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Installation & Operating Handbook for

P300 Series Satellite Modems (including P310 L-Band and Turbo FEC options)

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Covering software features up to and including V4.54/58

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IMPORTANT NOTE: THE INFORMATION AND SPECIFICATIONS CONTAINED IN THIS DOCUMENT SUPERSEDE ALL PREVIOUSLY PUBLISHED INFORMATION CONCERNING THIS PRODUCT

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1. EMC (ELECTROMAGNETIC COMPATIBILITY) AND SAFETY NOTICES

IMPORTANT - PLEASE READ THIS INFORMATION BEFORE INSTALLATION AND USE

1.1. EMC (ELECTROMAGNETIC COMPATIBILITY)

The P300 Modem Satellite Modems have been shown to comply with the following standards:

Emissions: EN 55022 Class B; Limits and methods of measurement of radio interference characteristics of Information Technology Equipment.

Immunity: EN 50024 Information technology equipment immunity characteristics

Extensive testing has been performed to ensure that the unit meets these specifications when configured with any or all of its available options, such as IF band, impedance, IF synthesiser step size, data rates, etc.

To ensure that the P300 Modems will maintain compliance with these standards please ensure that the following points are observed:

1) The equipment **MUST BE OPERATED WITH ITS COVER ON AT ALL TIMES**. If it is necessary to remove the cover for any reason, then you must ensure that the cover is correctly refitted before normal operation.

2) Damage to the front panel keyboard membrane or mechanical damage to the chassis could invalidate compliancy. Please contact the factory if damage occurs for advice on continued operation.

3) For the baseband data interfaces all 'D' type connectors must have grounding fingers on the plug shell to guarantee continuous shielding. The back-shells must comply to the requirements of VDE 0871 and FCC 20708, providing at least 40dB of attenuation from 30 MHz to 1 GHz. A good quality cable with a continuous outer shield, correctly grounded, ***must be used***.

4) Connections to the transmit and receive IF interfaces must be made with double screened coaxial cable - for example RG223/U.

Installations which ignore these requirements will invalidate the compliancy to EMC specifications.

1.2 SAFETY

To ensure operator safety the P300 Modems have been designed to comply with the following safety standard:

EN 60950 Safety of Information Technology Equipment, including electrical business machines.

Prior to installation and operation, please ensure that the following points are observed:

Environmental

The equipment is designed to operate in a static 19-inch rack system conforming to IEC 297-2. Operation of the equipment in transportable installations and vehicles equipped with the means of providing a stable environment is permissible. Operation of the equipment on vehicles, ships or aircraft without means of environmental conditioning may invalidate the safety compliancy. Please contact the factory for further advice. Operation of the equipment in an environment other than that stated in the specifications will also invalidate the safety compliancy.

The equipment must not be operated in an environment in which the unit is exposed to:

* Un-pressurised altitudes greater than 2000 metres
* Extremes of temperature outside the stated operating range
* Excessive dust
* Moisture or humid atmospheres above 95% RH
* Excessive vibration
* Flammable gases
* Corrosive or explosive atmospheres

Installation

The equipment is classified in EN 60950 as a pluggable equipment class A for connection to the mains supply. As such it is provided with a mains inlet cord suitable for use in the country of operation. In normal circumstances this will be of an adequate length for installation in the rack. If the mains cable proves to be too short then any replacement must have a similar type fuse (if fitted) and be manufactured to a similar specification. For example, look for HAR, BASEC or HOXXX-X ratings on the cable and the connector ends marked with BS1636A (UK free plug 13 amp); BSI, VDE, NF-USE, UL, CSA, OVE, CEBEC, NEMKO, DEMKO, SETI, IMQ, SEV and KEMA-KEUR for the IEC 6 amp free socket. Schuko and North American free plugs must have similar markings.

The installation of the equipment and the connection to the mains supply must be made in compliance to local or national wiring regulations for a category II impulse over-voltage installation. The positioning of the equipment must be such that the mains supply socket outlet for the equipment should be near the equipment and easily accessible or that there should be another suitable means of disconnection from the mains supply.

The equipment is designed to operate from a TN type power supply system as specified in EN 60950. This means a system that has separate earth, line and neutral conductors. The equipment is ***not*** designed to operate with an IT power system which has no direct connection to earth.

CAUTION: This unit has DOUBLE POLE / NEUTRAL FUSING.

2. INTRODUCTION

2.1 OVERVIEW

This handbook describes how to install and configure the P300 Series Satellite Modems. This includes the original P300, the P300 Turbo, P310 L-Band and P311 mixed L-Band/IF Modems. **Where ever reference is made to the P300 or P300 Series modem it applies to all products unless specifically noted**.

The P300 Series may be supplied equipped with different feature sets to suit different applications. This means that the mix of features available in any modem (such as Drop/Insert, IDR framing etc) may be tailored to suit any user requirement, however *typically* they are grouped into one of four standard configurations as follows:

P300 / P310-VSAT	Features for use in VSAT applications.
P300 / P310-IBS	Features for IBS/SMS use (or thin route IDR below T1) services.
P300 / P310-IDR	Features for IBS/SMS AND IDR services (IDR at T1 or greater).
P300 / P310-TCM	Features for use in TCM, TCM/IDR, IBS/SMS and standard IDR services.

The table on page 11 summarises the different features, and which features are available in the four standard configurations.

The P300 Series Modems are designed for operation in a typical ground station environment, providing a data link between geographically distant sites via satellite. Like its predecessors, it is physically small, light, and of rugged construction, allowing it also to be used in mobile and fly away terminals.

The P300 Series provides a data port on the terrestrial side which provides RS422, V.35, and RS232 software selectable interfaces on both 25 pin EIA 530 and 37 pin RS449 connectors. Optional G.703 interfaces provide either a T1 or E1 (1544kbps or 2048kbps) G.703 interface *in addition* to the standard three interfaces. The modem couples into the ground station up / down converter chains on the RF side at either 70MHz or, if the Wideband IF feature is available (standard on P300-IBS and above), 140MHz. The status of a unit is available externally on `form c` relay outputs designed to connect to station monitoring system. The modem also provides a complete remote Monitor & Control (M&C) port, allowing the status to be remotely monitored and the unit controlled or the configuration changed.

If Async ESC feature is available (standard on P300-IBS and above) the modem can provide an asynchronous Engineering Service Channel carried across the satellite link as an overhead added to the main data channel. The ESC channel can be internally linked to the remote M&C port, allowing any modem to be monitored or controlled from the distant end of the satellite link. In addition, external equipment (such as radio transceivers) if coupled into the remote M&C port may also be accessed remotely over the satellite link.

Higher specified P300 modems additionally feature many advanced functions including variable code rate Reed-Solomon, the ultimate in T1/E1 Drop/Insert functionality, separate ESC & Aux channels with independent electrical interface selection, a built in Bit Error Rate Tester (BERT) which can run continuously through the ESC or Aux channels logging results in the traffic log, plus a Closed Net Plus ESC (`minimum overhead`) mode in which the overhead varies from <0.5% to whatever is required to support virtually any async ESC channel requirements.

To provide as simple as possible software upgrade facility, the embedded monitor & control software can be changed without opening the product. Unlike other equipment which holds the embedded M&C software in EPROMs (requiring replacement EPROMs to be shipped, changed & returned), the P300 Modem M&C software is downloaded in to FLASH memory via a rear panel serial port from a PC. A process which requires no tools and is completed in 30 minutes. For operators requiring the latest features or upgrades, the most recent release of the internal M&C software is available on our Web site (http://www.paradisedata.com) for free download.

2.2 P300 SERIES FEATURES

As this handbook covers the full feature set of the P300 Modem, some of the text will not be applicable to modems equipped with only a subset of the possibly functionality. In the text where it describes features which are optional it uses phrases like:

Requires Drop/Insert feature (standard on P300 IBS and above)

Throughout the text the description of the feature ("Drop/Insert") is consistent, and wherever it is referenced it also states which of the four standard configurations this feature becomes available as standard. In the above example the Drop/Insert feature is standard on the P300-IBS configuration, and all models above, i.e. the P300-IBS, P300-IDR and the P300-TCM.

The P300 Series has been designed to make field upgrades as easy as possible, and many features may be added by front panel entry of a "Feature Code" which can be issued by Paradise Datacom. Some Options however may require extra hardware to be added (eg extra boards or just IC's) but this is easily performed by a competent technician. The table on the following page indicates which features may be added from the front panel, and which require the addition of extra hardware.

It might appear that the words `Feature` and `Option` are used interchangeably. In practice however we have attempted to use `Options` to refer to functions which always require hardware to be fitted, whereas we use `Features` to refer to functions which may be software enabled *without* extra hardware being fitted. For example we refer to both IDR and G.703 *Options* (as these each require an extra board to be fitted), whereas we refer to Drop/Insert and Reed-Solomon *Features* (as these are software enabled features within the basic modem hardware).

If you are new to the equipment it is worth confirming what features and options are available in the equipment you have. If it is one of the four standard configurations then a copy of the next page might be useful as you work through the manual to prevent you having to refer back to it. If it is a user defined feature set, then refer to Appendix C2, which explains how to determine the features available on any P300 Series modem.

When specifying the feature set of a modem, an Excel spreadsheet, which mimics the following table is available on request. The spreadsheet directly calculates the cost of the varying features you may specify, and when printed may be used to order modems. It also directly generates an order code for any user feature set you may specify and lists any warnings with the feature set you have specified.

2.3 FEATURE SUMMARY

Feature * means h/w option	P300 Series Configuration					Description
	VSAT	IBS	IDR	TCM	USER	
Base Modem	Y	Y	Y	Y		BPSK/QPSK/OQPSK, 4.8kbps to 512 kbps modem RS422 / V.35 / RS232 interface with 25 & 37 pin connectors 50MHz - 90MHz IF interface with 100Hz resolution
Viterbi FEC *	Y	Y	Y	Y		Viterbi FEC, rate 1/2,3/4,7/8 in BPSK, QPSK and OQPSK
Sequential FEC *						Sequential FEC, rate1/2,3/4,7/8 in BPSK, QPSK, OQPSK
Turbo FEC (TPC) *						Turbo FEC, various preset code rates (inc 1/2,3/4,7/8 & 0.789)
INTELSAT Reed-Solomon		Y	Y	Y		Reed-Solomon outer FEC, with n, k, t = 126, 112, 7 (switching to 225, 205, 10 or 219, 201, 9 with 4/8 deep interleaving as required for IDR & TCM/IDR)
Wideband IF		Y	Y	Y		Wideband 50MHz-180 MHz IF (instead of 50MHz - 90MHz)
High Data Rates		Y	Y	Y		Data rates 512kbps - 5Mbps in addition to Base Modem rates
Async ESC		Y	Y	Y		Variable rate ESC channel for Closed Net plus ESC operation High rate IBS/SMS ESC (with IBS/SMS feature) Async access to IDR 8k sync ESC channel (with IDR option)
IBS/SMS		Y	Y	Y		IBS/SMS framing (to IESS 309)
Drop/Insert		Y	Y	Y		Normal T1/E1 linear order Drop/Insert
IDR *			Y	Y		IDR operation (to IESS 308), P1348 Emulation & 32/64kbps Aux data in place of one/both IDR audio ESC
PRBS Tester			Y	Y		Internal Bit Error Rate Tester (BERT, overhead modes only)
8PSK/TCM				Y		8PSK with 2/3 rate Trellis Code Modulation (to IESS 310)
Extended D/I				Y		Independent timeslot re-ordering on Tx & Rx Signalling (CAS for E1 & RBS for T1) Rx Partial Insert for multi-destinational working Timeslot ID maintenance for N=1 to 31 with IBS/SMS or Closed Net plus ESC operation
Custom Features				Y		Arbitrary `n` & `k` for Reed-Solomon (with RS feature) Custom & Min O/H modes (with IBS/SMS or IDR options) Custom allocation of IBS o/h between ESC / Aux channels
Monitor/AGC *						Demod Rx carrier signal level monitor 0-10V Analog output of carrier signal level, Eb/No, or Rx offset frequency (in addition to normal AGC output) Constellation monitor port
AUPC						Automatic Uplink Power Control (requires Async ESC feature to operate)
1544kbps G.703 *						1544kbps G.703 interface *in addition* to RS422 / V.35 / RS232 interface (software selectable)
2048kbps G.703 *						2048kbps G.703 interface *in addition* to RS422 / V.35 / RS232 interface (software selectable)

Options marked with an asterisk will require boards or single IC's to be added to the unit in order to add the option at a later date. features without an asterisk can be added by entering a "Feature Code" into the front panel of the equipment.

2.4 FEATURE HIGHLIGHT

This list highlights some of the notable features about the P300 Series Modems:

All P300 Series Modems (ie base modem features)

- Variable data rate in 1 bps steps with fast acquisition even at low data rates
- BPSK, QPSK, and Offset QPSK (OQPSK)
- Viterbi FEC (to IESS 308/309), rate 1/2, 3/4 & 7/8 in BPSK, QPSK and OQPSK.
- 100Hz IF resolution
- RS422, V.35, and RS232 DCE interface on both EIA 530 25 pin and RS449 37 pin connectors.
- Can accommodate Viterbi & Sequential FEC simultaneously
- Built in 1-FOR-1 Redundancy Controller (requires only cables, passive IF splitter/combiner & second modem for complete 1:1 in just 2U)
- 0-99ms Doppler/plesiochronous buffer
- Full remote M&C
- 1000 event traffic log, with facility to continuously log circuit performance at regular intervals (logs average & worst case Eb/No and/or user BER)
- `In The Rack` upload of revised internal software
- 25dB Tx IF level control in 0.1dB steps
- Band limited IF input capable of operating with high composite power (ie IF input not `wide open` and affected by out of band signals)
- 1PPM internal frequency & clock reference, with external station clock input & options for higher stability internal references
- CCITT & INTELSAT V.35 scramblers for closed network operation, with additional two modes for compatibility with FDC and Linkabit proprietary patterns.
- Deferred alarm at user set service limits (individual Eb/No, BER & Buffer slip thresholds)
- *Frequency* locked clock loops (ie not phase locked) immune to clock hits caused by equipment such as routers
- Comprehensive monitoring and status display, with explicit fault descriptions of most significant fault for Tx & Rx paths
- P500 1-FOR-N Switch available ***allowing mixed interfaces within 1:N system***
- Supported by Alphawave CAM multi-product remote M&C system which can provide ***centralised log gathering on a PC*** (including logged circuit performance figures, eg Eb/No every 10 mins)
- Software includes two `User Variables` to accommodate custom user requirements (such as special alarm handling), allowing special user requested features to be added whilst still keeping common software
- Clear display, intuitive menus with `Normal` selections & efficient user interface with full keyboard
- Tx or Rx paths may be selected as `Off`, muting appropriate alarms in Tx or Rx only applications
- Three form `C` relays providing prompt Tx/Rx Traffic faults, as well as a prompt unit (equipment) fault and a deferred alarm.

P300 / P310 -IBS Additional Features

- **INTELSAT Reed-Solomon Feature**

  A fully INTELSAT compliant Reed-Solomon Codec providing

  * Automatic selection of appropriate INTELSAT values of `n, k & t` and interleaving depth for data rate & service selected (n, k, t = 126, 112, 7 by default, switching to 225, 205, 10 or 219, 201, 9 with 4/8 deep interleaving as required for IDR & TCM/IDR)
  * Provides improved low Eb/No performance in framed mode due to use of extended threshold frame sync algorithms
  * Enhanced capabilities with the `Custom Features` feature (see later)

- **Wideband IF Feature**

  The extension of the 50MHz - 90MHz IF range up to 50MHz - 180MHz

- **High Date Rate Feature**

  The extension of the data rate range to include rates above 512kbps up to 5.0Mbps (depending on modulation and FEC modes)

- **Async ESC Feature**

  The addition of a high rate async ESC channel, which may be internally linked to the M&C port to provide control of distant end equipment (in all overhead modes) without additional cabling. The Async ESC feature provides as follows:

  * Support for ***any*** async ESC rate in Closed Net Plus ESC mode, providing a scalable overhead which adds the minimum possible overhead to the satellite data to provide the baud rate selected (adding from <1% to 100% overhead). Closed Net Plus ESC mode also provides an optional backward alarm facility and above 32kbps a synchronous scrambler to replace the normal error multiplying V.35 self synchronising scrambler.
  * A high rate async ESC channel in IBS/SMS overhead, achieving 2400 Baud with a 64kbps carrier (requires IBS/SMS feature, standard on P300-IBS and above)
  * Async access to the IDR 8kbps synchronous ESC channel. (requires IDR option, standard on P300-IDR and above)
  * Software selectable RS232, RS485 or RS422 interface.

- **IBS/SMS Feature**

  Satellite Framing in accordance with IBS (to IESS 309) and SMS (EESS 501), including:

  * User assigned Tx, and corresponding Rx display of, Station ID, Channel ID & Spare ID within SMS overhead to aid carrier identification.
  * A high rate async ESC channel in IBS/SMS overhead (see Async ESC above)

- **Drop/Insert Feature**

  The most sophisticated Drop/Insert functions of any satellite modem whilst still maintaining simplicity of configuration and operation. The Drop/Insert feature provides:

  * 1544 kbps T1-D4 & T1-ESF and 2048 kbps G.732 operation
  * Arbitrary & independent timeslot selection for Drop & Insert
  * Full support for CRC-4 in G.732 mode and CRC-6 in T1-ESF mode
  * Terrestrial error monitoring based on Frame Alignment Words (FAW) or CRC
  * G.732 `E bit` processing, allowing the display of the *outbound* terrestrial error rate
  * Loopthrough or generation of local bearer onto which to insert the Rx data from any normal clock source (eg station clock, clock from satellite, internal clock)
  * Automatic generation of backup bearer so Rx traffic is not lost if Drop bearer into Tx fails and bearer is looped through to the Insert mux to pick up Rx data
  * Timeslot ID maintenance even with Closed Net Plus ESC carriers
  * Enhanced features with the Extended D/I Feature (see later)

P300 / P310 -IDR Additional Features

- **IDR Option**

  Satellite Framing in accordance with the IDR specification (to IESS 308), including:

  * Standard IDR framing with 2 x 32 kbps ADPCM audio ESC, a synchronous 8kbps ESC data channel, and four backward alarms
  * Enhanced features with the "Custom Features" feature (see later)
  * Independent ESC & Aux Ports to replace the shared ESC/Aux port of the base modem. The ESC and Aux ports are active in all framed modes. They provide the following features:
    - **ESC Port** provides a front panel selectable RS232, RS422, or RS485interface. In **IDR Mode** it provides either a synchronous interface to the 8kbps IDR ESC channel, **or** (if the Async ESC feature is available, standard on P300-IBS and above) an *async* interface supporting up to 4800 or 9600 Baud eg for distant end M&C via the IDR overhead. This same ESC port, although part of the IDR option, in **Closed net Plus ESC or IBS/SMS modes** provides a high rate asynchronous ESC interface (eg 2400 Baud at 64kbps in standard IBS/SMS mode, any Baud rate for Closed Net Plus ESC). Again typically used for distant end M&C via the overhead.
    - **Aux Port** provides a front panel selectable RS232 and RS422 interface. In **IDR Mode** it provides synchronous 32 or 64 kbps channel in place of one or both the 32kbps ADPCM ESC audio channels. In **IBS/SMS & Minimum Overhead modes** it provide a *synchronous* port which can be configured to use from 1/32 to 21/32 of the IBS/SMS overhead (eg for internal or external BER testing). When set to 1/32 and used asynchronously it provides the INTELSAT compliant Low Rate ESC channel.

- **PRBS tester feature**

  The internal Pseudo Random Binary Sequence (PRBS) Bit Error Rate Tester (BERT) offers the following features:

  * PRBS can pass through the main data channel, or the ESC or Aux channels of the overhead in parallel with the main data channel in any mode where overhead is added.
  * BERT results can be logged in the traffic log at user set intervals, providing continuous traffic quality monitoring and recording when operating through the overhead in parallel with the main data.
  * Compatible with patterns used by test equipment such as the Firebird etc.

P300 / P310 -TCM Additional Features

- **8PSK with 2/3 rate TCM** (50% bandwidth of QPSK 1/2 rate Viterbi)
- **Extended D/I Feature**

  The extended Drop/Insert provides significant extra features compared to the basic Drop/Insert feature set:

  * Arbitrary & independent timeslot *re-ordering* for Drop & Insert
  * Full support for G.732 Channel Associated Signalling (CAS) over IBS/SMS links
  * T1-D4 & T1-ESF Robbed Bit Signalling (RBS) maintenance over IBS/SMS links
  * Maintenance of timeslot ID for **N=1 to 31** inclusive when using ***any*** framing (normally only N=1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24 are maintained for IBS/SMS and there is no ID maintenance for IDR)
  * Insertion of only partial received data (for multi-destinational working)

- **`Custom Features` Feature**

  With respect to the **Reed-Solomon**, the Custom Features provides:

  * Codeword length (`n`) variable from 60 to 255
  * Error correct bytes (`t`) variable from 2 to 20 in steps of two
  * Selectable 4 and 8 depth interleaving

  With respect to the **Framing**, the Custom Features provides:

  * Custom IDR Modes including 16kbps ADPCM mode providing all normal IDR facilities in a 64kbps overhead, or all normal IDR facilities *plus* a 32kbps Aux channel in the normal 96kbps overhead (which allows an internal or external PRBS test to run in parallel with the traffic to monitor the service quality). The overhead can also be reduced to provide reduced IDR facilities with 64kbps or 32kbps overheads.
  * Custom IBS/SMS modes including facilities for multidestinational IBS carriers with 4 backward alarms, and Minimum Overhead modes (a more configurable version of Closed Net Plus ESC) where the overhead varies from the standard 16/15 (6.7%). In minimum overhead mode the user sets the required ESC Baud rate and the overhead is *scaled to the minimum value to provide the service required*. For example 2048kbps with 9600 Baud ESC in overhead of <1%, or 64kbps data with ESC rates up to 38.4kBaud

  With respect to the **ESC** Channels

  * Full user allocation of the overhead between ESC and Aux channels in IBS/SMS modes, providing user control over the relative rates of the async ESC channel and the sync Aux channel.

1st Generation Turbo Product Code Forward Error Correction (TPC FEC)

- Turbo codec for bandwidth *and* power efficiency
- Software can support up to 31 preset code rates (initial rates includes rate1/2, 3/4, 7/8 & 0.789)
- 3/4 Rate for compatibility with industry De-Facto Turbo.
- 1/2, 3/4, 7/8 Rate allow switch to Turbo & better margin / quality of service than Viterbi in same space segment (eg fixed capacity on long lease)
- 0.789 rate provides optimised performance near 3/4 rate for newer circuits.

2nd Generation Turbo Product Code Forward Error Correction (TPC FEC)

- **8PSK with rates of 3/4 and 7/8**
- 7/8 Rate for compatibility with industry De-Facto Turbo.

Monitor / AGC Option

- Monitor and display of Rx carrier level
- Rear panel PSK constellation monitor point
- An uncommitted 0-10V DC analogue output, set from the front panel to output AGC/Signal level (for antenna pointing / tracking), Eb/No, user BER or any other parameter available internally.

Auto Uplink Power Control (AUPC) Feature

- AUPC via async ESC channel on IBS/SMS, IDR and Closed Net Plus ESC carriers (ie overheads down to <1%).
- Automatically Interleaves AUPC with distant end remote M&C (if active) on ESC channel.
- Monitor only option for distant end Eb/No & BER monitoring without power control.
- Adds optional automatic regular logging of AUPC delta power and distant end Eb/No.
- Uni-directional, bi-directional and broadcast (Tx only / self monitor) modes.

3 DESCRIPTION

3.1 OPERATION

The P300 Series modems are fully software controlled and with the exception of the optional G.703 interface option there are no links or switches used to configure the unit. This enables all control and configuration to be performed either locally from the front panel, or by remote M&C. Local control is by front panel keyboard, and a large, easy to read, 80 character LCD display, with clear, intuitive menus for configuration and control. All the set-up parameters are stored in non-volatile memory which will retain data for a minimum of 3 years, with no power applied. The transmit and receive functions of the Modem are independent, so that they may be operated at a different data rates, IF frequencies, or different services if required.

Like all Paradise Datacom products, the P300 Series includes a traffic log, which stores the last 500 events, suitably time-stamped. It can automatically add several measured parameters to the log at operator set intervals, including average & worst case Eb/No, average & worst case estimated user BER, average & worst case estimated uncorrected BER, and the buffer fill state. The logged performance monitoring allows investigation into customer reports of poor link performance, and can provide a useful correlation against weather conditions, etc.

3.2 FAULT PHILOSOPHY

Faults are split into two categories:

a) **UNIT FAULTS**: Equipment failures (such as a synthesiser lock failure).
b) **TRAFFIC FAULTS**: Data path failures, (such as a lack of input clock).

A full description of every detected fault, its category (unit or traffic), and the corresponding action taken is provided in Appendix G - Fault Messages and Action Table. The response of the front panel LED indicators and external fault relays respond is described in the following sections.

3.3 ELECTRICAL DESCRIPTION

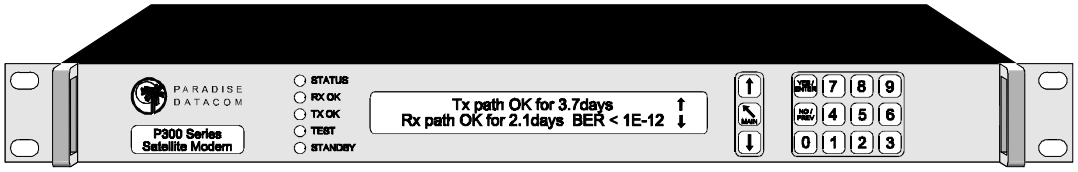
The P300 modem comprises of a single main modem Printed Circuit Board (PCB) with four optional additional boards:

- Optional G.703 interface (two different boards for T1 or E1 operation).
- Optional IDR ESC board, which provides for all the IDR ESC requirements
- Optional Monitor / AGC board which provides a user scalable AGC output and a constellation monitor point.
- Optional Turbo FEC daughtercard

For the P310, an L-Band daughterboard is also fitted internally above the main modem board, and further three internal options are possible:

- Reference oscillator options (several of varying stabilities)
- An internal 100W PSU to provide a DC feed to an external BUC
- An optional FSK communications board, to enable a modem and BUC to bo operated from the modem front panel (and to provide closed loop power control to the BUC flange).

3.4 FRONT PANEL FEATURES



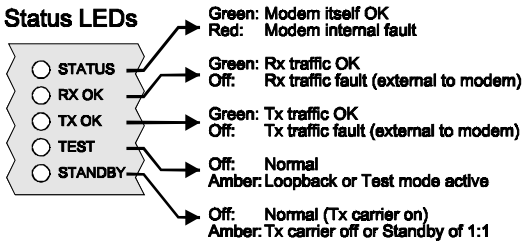
P300 Modem front panel view

Keyboard
The keyboard is of the membrane type (an integral part of the front panel), which provide a direct tactile feel. There are 15 keys in total - number keys in the range 0 to 9, an up arrow key (↑), down arrow key (↓), **MAIN** key, **YES/ENTER** key, and **NO/PREV** key.

LCD display
This backlit display provides 2 lines of 40 characters each and is highly legible even in conditions of high ambient light. The LCD provides detailed information about the status and configuration of the unit, and when appropriate, prompts the user to enter data via the keypad.

Monitor port
The circular monitor port available on the front panel of previous products has been moved to the rear panel and is now combined onto the Async ESC connector (a `D` type connector instead of the difficult to obtain 8 pin `din` audio type connector). See the description of the "Async ESC connector" under the rear panel description, which starts on the next page.

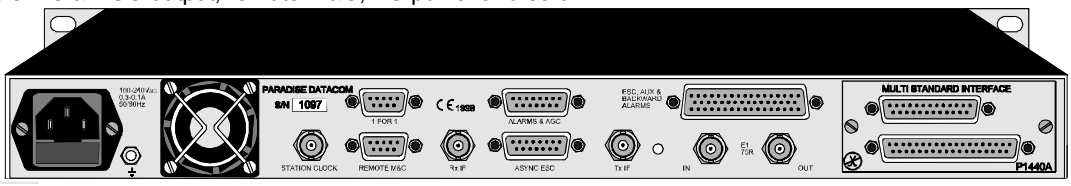
LED Indicators
Five LEDs on the front panel provide summary fault information, so that even when the LCD is unavailable for status display (such as when the operator is reconfiguring the unit, and a menu is displayed), the current status can always be assessed. If any of the LED's indicate a fault, press **MAIN**, then select *Status* to display the current fault condition.



- In **normal operation** there should be **three GREEN LED's** showing.
- If the **Status is RED, the unit has failed** due to internal *or possibly external* conditions. Refer to the text on the LCD Status screen and rectify if possible.
- If the **TX OK or RX OK LED's are off**, then the **Tx or Rx traffic has failed** due to an *external fault*, again refer to the text on the LCD Status screen and rectify if possible.
- If the **TEST LED is AMBER, a test mode or loopback is active**, press **MAIN**, and select *Test* to query or change the test settings.
- If the **STANDBY LED is Amber, the Tx carrier is off**. It may be intentionally switched off, or it may be muted due to either a fault, an external mute signal, or if in a 1-FOR-1 redundant pair it may be the standby unit.

3.5 REAR PANEL DESCRIPTION

At the rear of unit are all of the connectors necessary for the user to interface the Modem to the outside world; IF input and output to frequency conversion equipment, terrestrial data connection, station clock, alarms & AGC output, remote M&C, AC power and so on.



From left to right, the rear panel connectors are:

IEC mains power connector/voltage selector/fuse

The Modem is designed to operate from a mains AC supply of 100-240V (-15% + 10%, ie 85V to 264V at the connector). The IEC connector incorporates two fuses, independently fusing both live and neutral

P300 Modem rear panel view (IDR & G.703 options fitted)

lines. Access to the fuses is provided by a slide out tray. Both fuses are standard 20 mm type, rated 3.15A, of the slow-blow (time delay) type. **ALWAYS REPLACE THE FUSE WITH ONE OF THE SAME TYPE AND RATING.**

Chassis ground stud

This is an M4 stud for connecting a safety earth conductor directly to the chassis of the unit.

Fan

The fan may be selected to be temperature controlled or permanently active (ie the fact that it is not running does not indicate it has failed). Use the test menu to display the internal unit temperature if in doubt, the fan comes on at 26°C and off at 24°C.

Station Clock

This connector is a 75Ω BNC female which accepts a 1-10MHz signal, either a square wave of >1V p/p (eg a G.703 para 10 `synchronising clock`) or a sinusoid at a power level of 0dBm or greater. An alternative Station Clock signal at RS422 interface levels can be applied to the Async ESC connector. Either signal can be used by the modem as a reference for the receive output clock (the Station Clock **does not** have to be the same rate as the data as an internal PLL converts between rates). In addition if the Rx Clocking is set to use the 'Station Clock' and the Tx Clocking is set to 'Rx', then the Station Clock also sources the internally generated Tx Clock (Tx & Rx data rates are independent). Finally, if a 10MHz signal is applied, this signal may also be used in place of the internal reference for the Tx and Rx IF synthesisers.

1:1 Redundancy connector

The Modem has a built-in 1 for 1 redundancy controller which connects to the corresponding port of another Modem via this 9 pin male 'D' type connector. A complete 1:1 redundancy system requires only two modems, a 1:1 control cable (on this port), a data split (`Y`) cable, and passive splitters/combiners for the IF ports (or splitters/combiners already present in the system). Connection details are given in Appendix B, and an overview of 1 for 1 operation is provided in section 9 starting on page 177.

Remote M&C connector

This is a 9 pin female 'D' type connector whose pinout and interface levels are `SA-bus` compliant. The Modem can be set to operate with either Paradise/FDC or SA-bus protocols. The electrical interface can be selected between RS232 (for direct to PC applications) & RS485 (for multidrop applications). The Remote M&C port may be *internally* linked (ie no cables) to the Async ESC port for over the satellite distant end Remote M&C control. Pinout details are in Appendix B.

Rx IF input
This connector is a BNC female and can be used as either a 50Ω or 75Ω input. The allowable signal level of the desired carrier at the input of the modem is from -60dBm to -30dBm (P310: -70dBm to -20dBm). A level of -45dBm is recommended. The maximum composite power level that should be applied to this port is 30dB above the desired carrier, up to a maximum of 0dBm (P310: Composite +35dBc to max of -10dBm).

Alarms and AGC connector
This is a 15 pin male 'D' type connector that provides access to the three form `C' relay contacts that indicate alarm conditions. Also provided on this port if the Monitor/AGC option is fitted is an uncommitted analog output, which by default provides an AGC output, but which may be selected via the front panel to provide other user requested signals (eg Eb/No, Rx IF offset frequency, or other uses implemented as required). The alarm relays have the following definitions:

Unit Fault: A **unit fault** exists, i.e. an equipment failure.

Traffic Prompt: A Tx or Rx **traffic fault** exists.

Deferred alarm: One of the following conditions exists:
The receive BER is greater than the user defined threshold.
The receive Eb/No is lower than the user defined threshold.
Buffer slips are more frequent than the user set threshold.
A Backward alarm is being received from either the satellite or terrestrial ports.

Full pinout details are provided in Appendix B. The alarm relay functions can be changed, See `Relay Mode` in appendix E.

Async ESC connector
This 15 pin `D` female connector provides a superset of the features found previously on the front panel circular 8 pin `din` connector. It includes an RS232 serial port for the loading or revised internal software from a PC or the printing of the units traffic log to a serial printer / PC terminal emulator. If the Monitor/AGC option is fitted it provides I,Q, and symbol clock outputs to monitor the receive constellation (in order to view received signal quality on an oscilloscope). When the IDR option **IS NOT** fitted, it provides an RS232/RS422/RS485 asynchronous port for either the high rate Async ESC facility (for IBS/SMS or Closed Net Plus ESC services) or the IBS/SMS `low rate INTELSAT oversampled ESC facility` (which is configured as the Aux data channel on the modem). When the IDR option **IS** fitted, separate ports for the ESC and Aux channels on the IDR card are activated, and **ESC/Aux access on this async port is disabled**. Finally, this connector also provides the port for an RS422 compatible Station Clock (see the Station Clock paragraph on the previous page).

Tx IF output
This connector is a BNC female and can be used as either a 50Ω or 75Ω output. The output power level can be varied from 0dBm to -25dBm on 0.1dB steps from the front panel (P310: -5dBm to -30dBm).

ESC & Aux connector
This connector is fitted as part of the IDR option (Standard on P300-IDR & P300-TCM), it provides access to:

- Four backward alarm form `c` outputs, and the 4 backward alarm inputs, together with a Rx summary alarm signal for direct connection to the backward alarm inputs. Note that these can be used both in IDR modes, and (if the IBS and `Custom Features` features are available) a custom IBS mode, which allows four backward alarms for low rate IBS multidestinational carriers.

- Two Audio ESC ports (4 wire 600Ω, +7 to -16dBm). In addition to normal IDR ESC operation these ports may also be used in IBS modes to generate a 64kbps IBS carrier comprising just the two 32kbps ADPCM audio channels, or a 128kbps IBS carrier comprising 64kbps data (from the main data interface of the modem) plus the two 32kbps ADPCM audio channels. This is an emulation of the most popular modes of the P1348/P1448 voice/data mux card used often in SNG applications.
- An RS232/RS422/RS485 Port for sync/async ESC traffic, this port **replaces** the shared ESC/Aux access via the Async ESC connector on the main unit. Used to provide access to the 8kbps synchronous IDR ESC channel. If the Async ESC feature is available (standard on P300-IBS and above) then Async access to the 8kbps channel is also available. Again if the Async ESC feature is available this port also provides the high rate Async ESC on IBS/SMS or Closed Net Plus ESC services
- An RS232/RS422 port for sync/async Aux traffic, this port **replaces** the shared ESC/Aux access via the Async ESC connector on the main unit. The Aux port provides 32 or 64kbps access to the IDR overhead in place of one or both of the IDR 32kbps ADPCM Audio ESC channels. If the IBS/SMS feature is available then this port may be configured to provide either the IBS `low rate INTELSAT *oversampled* ESC facility`, or a higher rate *synchronous* channel within the IBS/SMS overhead.

Pinout details are provided in Appendix B.

Terrestrial Interface Connectors

The P300 provides as standard both 25 pin EIA530 and 37 pin RS449 female DCE connectors. NOTE that these are simply wired in parallel and you should not connect both simultaneously. The electrical interface is front panel selectable to be RS422, V.35, and RS232. Normally for RS232 operation the EIA530 connector would be used (which is standard 25 pin RS232 compatible) and for RS422 the 37 pin RS449 connector. The old style 34 pin `Winchester` connector favoured for V.35 interfaces has poor EMC performance and so could not be incorporated whilst maintaining CE compliance. If this style of connector is required then an external adaptor cable must be used.

If the **G.703 option** is fitted, then **in addition** to RS422/V.35/RS232, G.703 is also available as a software selectable interface standard. T1 (1544kbps) G.703 is a balanced 100Ω signal, and is provided on both `D` type connectors when G.703 is selected from the front panel. When the E1 (2048kbps) G.703 option is fitted then in addition to providing support for the balanced 120Ω signal on both `D` type connectors an additional pair of BNC connectors are provided to accept the unbalanced 75Ω interface standard. THE SELECTION BETWEEN 75Ω and 120Ω IS MADE BY A SWITCH ON THE E1 G.703 OPTION not by software. As with the 25/37 pin connectors, do not connect signals to both the BNC and `D` type connectors simultaneously.

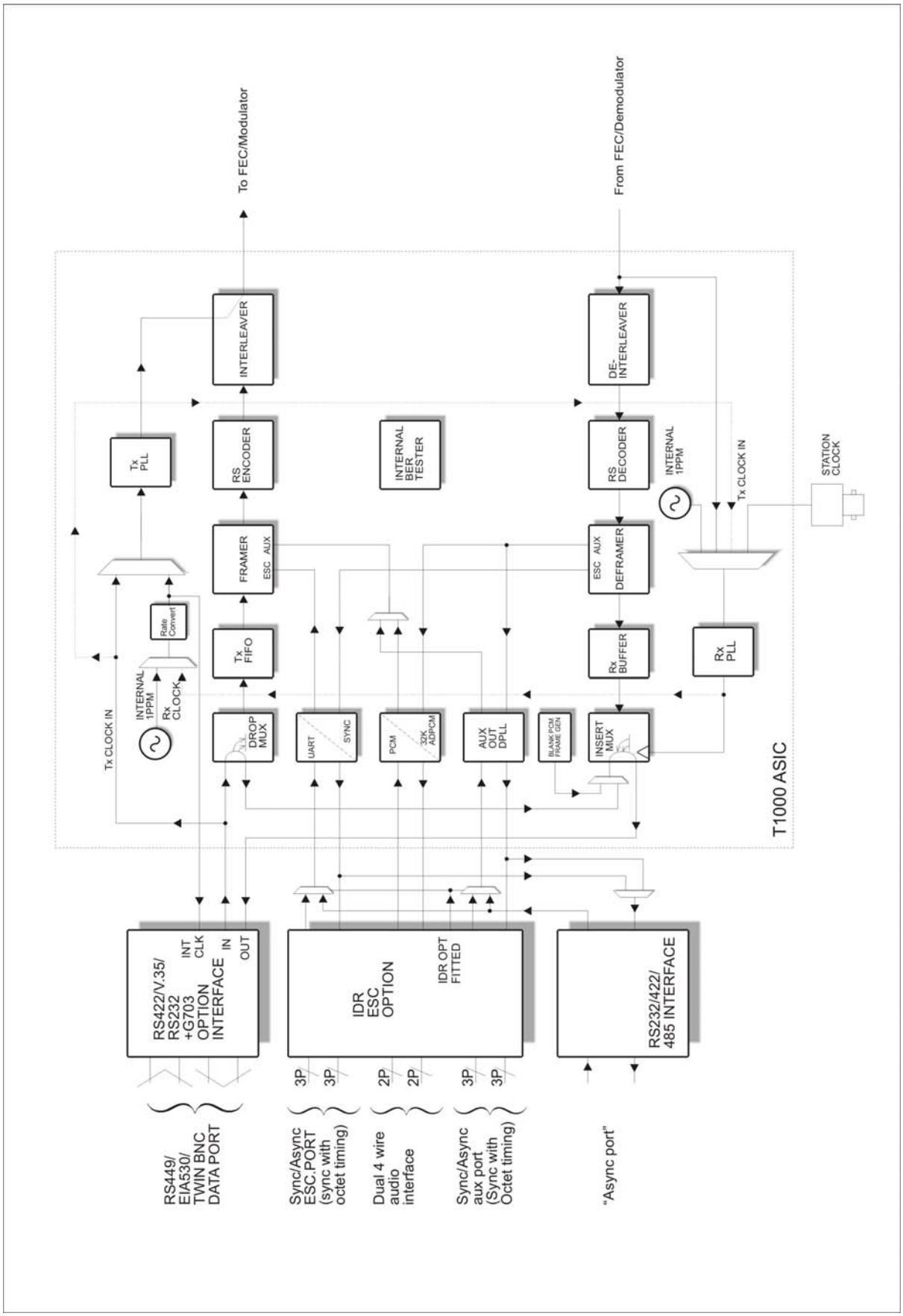
In addition a switch on both the T1 and E1 G.703 options controls **what happens to the G.703 port when power is removed**. Either the G.703 ports can be set to go high impedance (used in 1:1 redundancy operation) or it can be configured to loop the G.703 input back to the output (typically used when Drop/Insert is in operation and the same PCM bearer is cascaded through several modems). Again (as it affects what happens when power is removed) this is SET BY A SWITCH ON THE CARD not by software.

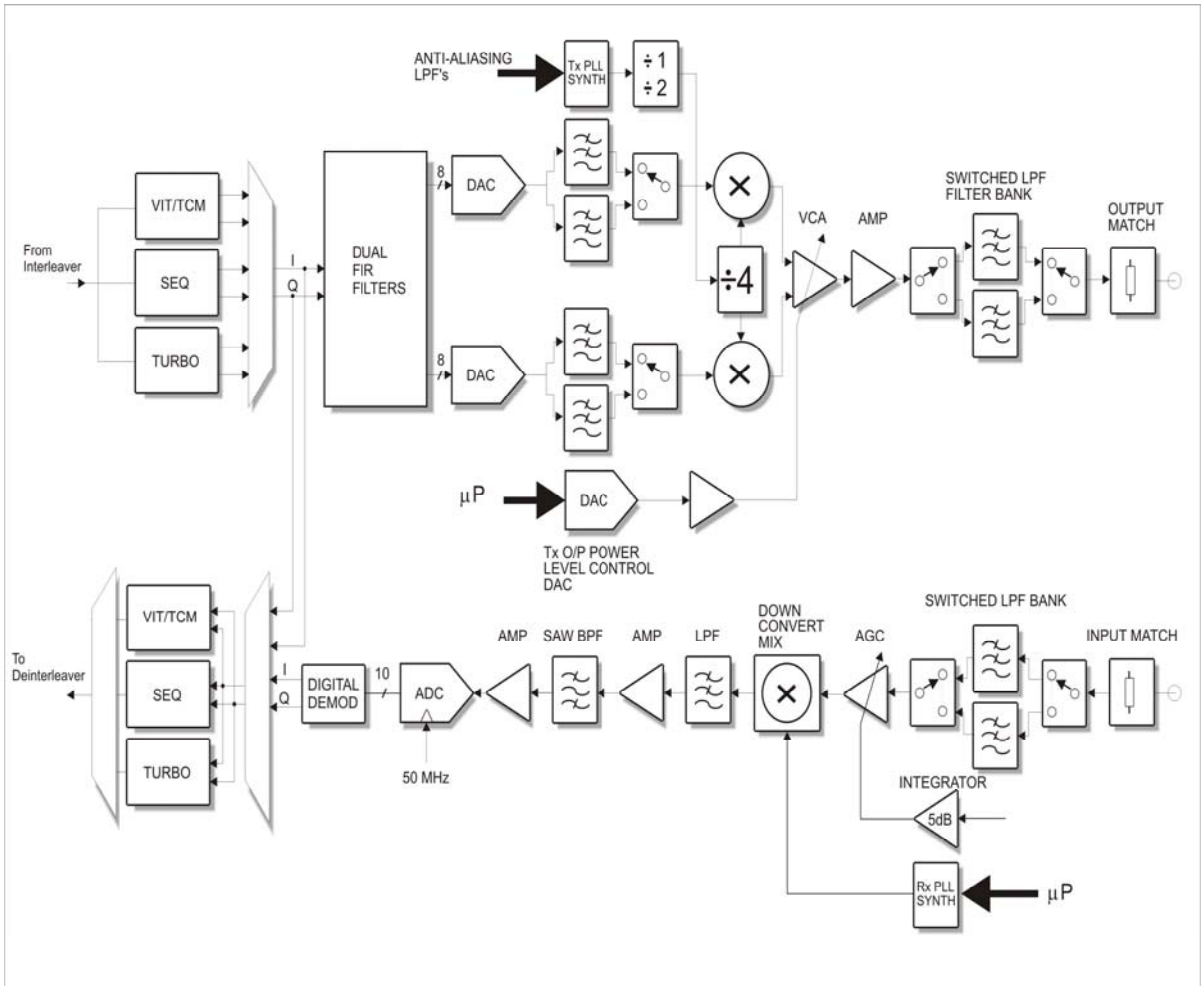
Finally, for special customer requirements it is possible to fit different interfaces to this port. Note that **UNLIKE PREVIOUS PRODUCTS the interface does NOT simply unplug**. Instead it is constructed as part of the main modem, and requires `snapping off` and a connector to be soldered in place before a replacement card can be fitted.

Standby LED

This LED mirrors the front panel standby LED, so that from the rear of the equipment the operator can tell if the carrier is off, or more importantly which unit of a 1:1 pair is the offline unit.

F. BLOCK DIAGRAM




ANTI-ALIASING LPF's
Tx PLL SYNTH
÷1
÷2
From Interleaver
VIT/TCM
SEQ
TURBO
I
Q
DUAL FIR FILTERS
8
DAC
÷4
VCA
AMP
SWITCHED LPF FILTER BANK
OUTPUT MATCH
µP
Tx O/P POWER LEVEL CONTROL DAC
To Deinterleaver
DIGITAL DEMOD
10
ADC
50 MHz
AMP
SAW BPF
LPF
DOWN CONVERT MIX
AGC
SWITCHED LPF BANK
INPUT MATCH
INTEGRATOR
5dB
Rx PLL SYNTH

4 SUMMARY OF SPECIFICATIONS

Common Main Specifications

Optional features are shown in **[square brackets]**

Modulation BPSK, QPSK, OQPSK, [8PSK]

Frequency/Resolution P300: 50 MHz - 90 MHz, 100Hz resolution.
[50 MHz - 180 MHz Wideband IF feature]

P310: 950MHz - 1750MHz 100Hz resolution
[950 MHz - 2150 MHz Wideband IF feature]

Traffic Interface

Electrical RS422, V.35 and RS232 software selectable (clocking can provide X.21 DCE or DTE mode)

Mechanical Both EIA530 DCE and RS449 DCE connectors (25 pin and 37 pin `D` female respectively).

Options T1 or E1 G.703 *in addition* to RS422, V.35, & RS232 (software selectable)
For special requirements a customer specific interface card may be fitted.

User Data Rates

Closed Network Resolution of 1 bps

		Rate 1/2	Rate 3/4	Rate 7/8	Uncoded	Rate 2/3
BPSK	min	4.8k	7.2k	8.4k	9.6k	
	max *	1250k	1875k	2187k	2500k	
QPSK / OQPSK	min	9.6k	14.4k	16.8k	19.2k	
	max *	2.5M	3.75M	4.375M	5.0M	
8PSK/TURBO	min		21.6k	25.2k		
	max *		5.0M	5.0M		
8PSK/TCM	min					19.2k
	max *					5.0M

[Closed Net plus ESC] As Closed Net above but limits include an overhead of approx 1.4 x ESC Baud rate. Resolution of 1 bps. ESC from 50Baud to 38.4kBaud

[IBS/SMS Mode] <9.6k to >2048k* (6.7% overhead added)
Resolution of 1 bps

[IDR Mode] <64k to >2048k* (96k overhead added)
Resolution of 8k (limitation of frame structure)

- Note: Maximum data rate is 512kbps in all modes before overheads unless the High Data Rate option is fitted.

Forward Error Correction	[1st & 2nd Gen Turbo Product Codec (TPC), Preset rates inc rate 1/2, 3/4,7/8 & 0.789] [TCM rate 2/3 to IESS 310] [Viterbi, rate 1/2, 3/4 or 7/8 k = 7 to IESS 308/309, 3 bit soft decision decoding] [Sequential rate 1/2, 3/4 or 7/8 to IESS 312, 2 bit soft decision decoding]
Reed-Solomon outer FEC	[Concatenated Reed Solomon outer codec to IESS 308/310] [Optional variable code rate]

Reed-Solomon, Turbo, TCM, Viterbi, & Sequential are independent FEC options.

Scrambling	
IBS/SMS	Synchronised to framing, per IESS 309
IDR & Closed Net	With RS Coding: synchronised to RS overhead. No RS Coding, non Turbo: V.35 self synchronising. No RS Coding, Turbo: Synchronous 2^{12}-1 (sync to TPC block alignment).
Closed Net plus ESC	32kbps or above, synchronised to ESC overhead. Less than 32kbps, as per Closed Network. V.35 scrambler has CCITT, INTELSAT, `FDC` & `Linkabit`modes
IF Ports	BNC female, 50Ω & 75Ω. Return loss 18dB typical.
External reference	Clocking only: 1kHz-10MHz in 1kHz steps (See Station Reference). Clocking & Frequency: 10MHz, 0dBm _ 1dB

Modulator Specifications

Output Power Level	P300: 0 to -25dBm continuously variable in 0.1dB steps from front panel or via remote control P310: -5 to -30dBm continuously variable in 0.1dB steps from front panel or via remote control
Output Level Stability	_ 0.5dB at 25°C _ 10 °C
Transmit Filtering	6th order Butterworth, aperture and group delay equalised, INTELSAT IESS compliant
Filter Implementation	257 tap FIR digital filter
Occupied Bandwidth	1.2 times symbol rate
Recommended Channel Spacing	1.4 times symbol rate
Phase and Amplitude Accuracy	+ 2 degrees, + 0.2dB, max
Carrier Suppression	-30dBc, min.
Output Phase Noise	<1.0 degrees RMS double sided, 100Hz to 100kHz

Output Frequency Stability	As per internal reference from 0°C to 50°C (See Internal Reference below)
Harmonics and Spurious	Better than - 55dBc/4 kHz.
Transmit On/Off Ratio	55dB minimum
External Transmit Inhibit	By external contact closure or by TTL signal applied to rear panel connector. Hardware function overrides processor control

Demodulator Specifications

IF Input Range	P300: -45dBm nominal, ±5dB (desired carrier) P310: -20 to -70dBm (desired carrier)
Maximum Composite Signal	P300: 30dB above level of desired input up to a maximum of 0dBm P310: 35dB above level of desired input up to a maximum of -10dBm
Frequency Acquisition Range	Selectable from ±1 kHz to ±32 kHz
Acquisition Threshold	< 5dB Eb/No
Acquisition Time (rate 1/2 FEC)	@ 9.6 kbps < 3 seconds at 6dB Eb/No @ 64 kbps < 2 seconds at 6dB Eb/No @ 2048 kbps < 500 ms at 6dB Eb/No
Clock Tracking Range	±100 ppm min
Receive Filtering	6th order Butterworth, group delay equalised (INTELSAT IESS compliant)

BER Performance

In all cases met in the presence of two adjacent carriers each 10dB higher than the desired carrier, with V.35 scrambling

These figures meet or exceed the relevant IESS performance specifications.

		Rate 1/2	Rate 3/4	Rate 7/8	Rate 2/3
Viterbi (all rates)	1×10^{-4}	4.7dB	6.1dB	7.1dB	
	1×10^{-8}	7.2dB	8.8dB	9.5dB	
Sequential (64kbps)	1×10^{-4}	4.3dB	5.4dB	6.4dB	
	1×10^{-8}	6.4dB	7.3dB	8.6dB	
Sequential (2048kbps)	1×10^{-4}	5.6dB	6.1dB	6.9dB	
	1×10^{-8}	7.5dB	8.1dB	8.4dB	
Turbo (TPC, QPSK) (all rates)	1×10^{-4}	2.2dB	2.7dB	3.5dB	
	1×10^{-8}	2.8dB	3.6dB	3.8dB	
8PSK Turbo (TPC)	1×10^{-4}		5.2dB	6.4dB	
	1×10^{-8}		6.4dB	6.8dB	
8PSK/TCM (all rates)	1×10^{-3}				6.3dB
	1×10^{-8}				10.4dB
8PSK/TCM + Reed-Solomon (all rates)	1×10^{-4}				6.1dB
	1×10^{-10}				7.3dB

BER performance with concatenated RS

BER improvement depends on n and k values chosen, but a typical increase in coding gain of 3dB is possible over basic Viterbi mode.

Monitor Functions	Measured FEC input BER (raw channel, not TCM) Estimated FEC output BER (not TCM) Measured Reed-Solomon input BER Estimated Reed-Solomon output BER Measured deframer FAW BER Measured Eb/No (*not* based on channel BER, range: 3.0-15.0dB, accuracy ±0.2dB). Measured frequency offset (± 100 Hz resolution)

Clocking and Buffering

Clock Loops	Frequency locked loops give phase hit immune operation even with poor clock sources such as routers etc.
Tx Clocking	Internal Reference (see Internal Reference below for stability) External - tracking range 100 ppm / min. Rx Timing - slaves Tx internally generated timing from Rx clocking whatever Rx clocking mode is selected eg with Rx=Satellite for loop timing (**with full asymmetric rate capability**), or with Rx=Station for both Tx & Rx clocking slaved to Station Clock (again with full asymmetric rate capability).
Rx Clocking	Clock from satellite (Buffer disable) Transmit input clock - (plesiochronous, includes full asymmetric rate operation) Internal Reference (see Internal Reference below for stability) DCE External timing clock (DTE interface only). Station reference (see below)
Internal Reference	P300: +/-1PPM P310: Default as per P300. Options: 7x10-7 per year (P313B), 1x10-7 per year (P313C), 7.5x10-8 per year (P313D).
Station References inputs	75Ω BNC female, transformer isolated 1MHz to 10MHz in 1kHz steps (accepts sinusoid >0dBm or squarewave eg G.703 para 10) 120Ω RS422 compatible input, 1kHz to 10MHz in 1kHz steps When set to 10MHz, the station reference may replace internal reference to all internal circuitry (eg IF synths). The unit automatically switches back to the internal reference if the station reference fails.
Buffer Size	Selectable in 1 ms increments from 0 to 99 ms. Automatically adjusted to slip an integer multiple of terrestrial multiframe length for framed rates (T1/E1). Buffer storage is 32kBytes, so above 2.6 Mbps max buffer size reduces linearly from 99 ms to 52ms at 5.0Mbps

Framing & Deframing

Formats	Closed Network (unframed)

Closed Net plus ESC [Async ESC Feature] provides variable rate async ESC, optional synchronous scrambler above 32kbps to replace error multiplying V.35 scrambler, optional backward alarm facility, and optional Timeslot ID Maintenance when used with Drop/Insert, all in minimum possible overhead down to <0.5%.

INTELSAT IBS & Eutelsat SMS [IBS/SMS Feature]. Framing to IESS 309 & IESS 310

INTELSAT IDR [IDR Option]. Framing to IESS 308 & IESS 310
Custom Framing [`Custom Features` feature]. Provides custom framing based on IBS or IDR formats. For example the use of 16 kbps ADPCM on the IDR audio ESC channels, providing an IDR carrier with all normal facilities but with 32kbps of overhead spare for continuous traffic quality BER monitoring (using built in PRBS tester with automatic results logging or external BERT)

Poor BER performance

Deframer includes extended threshold operation, which improves performance when used with Reed-Solomon in very poor BER conditions (where a single uncorrectable RS codeword can contain enough corrupt frame alignment words to knock an INTELSAT specified deframer out of frame sync).

[INTELSAT Reed Solomon Codec & Custom Features]

Format

Concatenated Reed Solomon outer codec to IESS 308/310

Code Rate

Default n, k, t = (126, 112, 7) depth 4, automatically switching to: (225, 205, 10) depth 4 for 1544 kbps IDR mode. (219, 201, 9) depth 4 for 2048 kbps IDR mode & TCM <=1544 kbps, and (219, 201, 9) depth 8 for TCM >1544 kbps

Processing Delay

Combined Encoder & Decoder: 8 x (2n - k + 60)
Combined Interleaver & De-interleaver: 8 x n x depth (Calculate delay time using data rate including RS overhead)

[Custom Features]

When available allows arbitrary selection of `n` & `k` to provide fully variable code rate.

`n` = 60-255
`k` = n-2 to n-20 step 2
Interleaving depth of four or eight

The `Custom Features` Feature allows use of shorter codewords to reduce interleaver / de-interleaver delay on low data rate circuits. For example switching from n, k, t = 126, 112, 7 to 64, 56, 4 provides approximately the same correction ability (7 in 126 = 5.5% and 4 in 64 = 6.25% respectively), with similar overheads (126/112=12.5%, 64/56=14.3%), but with interleaving & decoder delays reduced from 5632 to 3104 bits (156 ms to 85 ms at 32 kbps).

[Drop /Insert Feature]

Bearer Types T1-D4, T1-ESF, and G.732.

Timeslot Selection Independent selection of arbitrary timeslots for both Drop and Insert.

Bearer Generation The terrestrial bearer may be looped through the Drop mux then Insert mux, or terminated after the Drop mux and a new blank bearer generated by the Insert mux. The bearer generated within the Insert mux provides full multiframe and CRC support and may be generated from the Tx Clock, Station Reference, Satellite Clock or Internal reference.

Bearer Backup In the event that the Insert mux bearer clock is lost, or AIS is supplied, then the Insert mux will switch temporarily to bearer generation mode in order to preserve the receive traffic. The backup bearer may be generated from the Station Reference, Satellite Clock or Internal reference.

Terrestrial CRC Fully supported, with front panel display of terrestrial error rate based on CRC (T1-ESF and G.732) or Frame Alignment Word errors (all bearer types)

Timeslot ID Maintenance The IBS/SMS or Closed Net plus ESC overhead maintains the identity of individual D/I timeslots for N=1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, 30 (see Extended D/I Feature below).

[Extended Drop/ Insert Feature]

Timeslot Re-ordering Selected timeslots may be independently re-ordered on both Tx and Rx paths.

Timeslot ID Maintenance The IBS/SMS or Closed Net plus ESC overhead is extended to maintain the identity of individual D/I timeslots for *all values* of N from 1 to 31, including the previously unavailable values N=7, 9, 11, 13, 14, 17 - 19, 21 - 23, 25-29, and 31.

Multi-destinational working All or only a subset of the received data may be inserted into the terrestrial bearer on the receive path for multi-destinational working.

Signalling Both Channel Associated Signalling (CAS), and Robbed Bit Signalling (RBS) are fully supported:

For **E1** G.732 Drop/Insert, CAS signalling is extracted from terrestrial TS16 and carried over the satellite in IBS/SMS TS16 and TS48 before re-inserting into the distant terrestrial TS16

For **T1-D4** and **T1-ESF** RBS the IBS or Closed Net plus ESC overheads maintain the identity of the in band signalling, and it is re-inserted into the terrestrial multiframe in the correct positions to maintain the RBS.

[Async ESC Feature] & Aux Data Channel

ESC/Aux Port

A single port provides the interface for optional high rate async ESC (IBS/SMS or Closed Net plus ESC), or the INTELSAT low rate async IBS ESC channel.

Electrical Interface

RS232, RS422, or RS485 external interfaces or internal link to Remote M&C port (software selected). No external cabling required between the ESC and M&C ports for M&C via ESC channel within overhead. Other devices externally wired in parallel with M&C port can also be accessed remotely.

Aux Data Channel

IBS

INTELSAT low rate async ESC definition carried in bit 1 of TS32 providing a synchronous channel at 1/480th of the data rate, allowing up to one quarter of this rate for oversampled async data. Compliant with INTELSAT IESS 403 low rate ESC definition.

[Async ESC Feature]

Closed Net plus ESC

Overhead scales to provide any user specified async ESC Baud rate whatever the satellite data rate. ESC limit is approx 70% of main channel rate, overhead varies from <0.5% to >70%

IBS/SMS

High rate async data using from 1/32nd to 22/32nd of the IBS overhead, providing async baud rates from 0.2% to 5.1% of the terrestrial rate (eg up to >2400 Baud at 64 kbps). Includes modes compatible with the P400 Series, P230 & P1300/P1361 (using 20/32nd of the overhead).

[IDR Option]

IDR ESC Audio Interface

Two 32 kbps ADPCM channels, 4 wire 600Ω, +7dBm to -16dBm (software programmable in 0.1dB steps)

Backward Alarms

Outputs: Four `form C` relays
Inputs: Four protected inputs, short to 0 V to send alarm, with matching summary Rx fail output. Alarm inputs software configurable for:

a) All external patch
b) 1=Rx fail & 2-4=External Patch
c) 1=Rx Fail & 2-4=OK
d) 1-4=Rx Fail.

ESC/Aux Ports

When the IDR option is fitted, independent ESC & Aux ports on the IDR option replace the single shared ESC/Aux port of the base unit.

ESC Port

RS232, RS422, or RS485 external interfaces or internal link to Remote M&C port (software selected). No external cabling required between the ESC and M&C ports for M&C via ESC channel within overhead. Other devices externally wired in parallel with M&C port can also be

	accessed remotely. Provides Clock, Data, & Sync (Octet timing) lines.
IDR	Synchronous access to 8 kbps IDR ESC. With the Async ESC feature (standard on P300-IBS and above) async ESC access to the 8kbps IDR ESC is provided, giving up to a 9600 Baud async channel
Others	IBS & Closed Net plus ESC facilities as before installation of IDR option, but now on ESC port on IDR card not shared ESC/Aux port of base unit.
Aux Port	RS232 or RS422 (software selected). Provides Clock and Data lines.
IDR	Provides 32 or 64 kbps access in place of one or both Audio ESC channels.
IBS	INTELSAT low rate ESC mode as previously but now via Aux port on IDR card not shared ESC/Aux port of base unit. IDR option also adds sync IBS mode, configurable to use between 1/32nd and 21/32nd of the IBS overhead providing a full sync Aux port at between 0.2% and 4.3% of main data rate. Aux port provides satellite timing information for P1500 Slave Frequency Standard when not configured for Aux data access.
P1348 Emulation	The IDR Option includes the facility to emulate the more common modes of our popular P1348 / P1448 voice / data mux cards which are used extensively in SNG applications. It uses the IDR audio ESC ports for the audio interfaces and can generate a 64 kbps carrier consisting solely of two 32kbps ADPCM encoded audio channels, or a 128 kbps carrier comprising the two audio channels plus 64 kbps data from the main interface. This is compatible with a P400 Series modem fitted with P1448 card or a P230 Modem with a P1348 card, alternatively Drop/Insert can be used at the distant end to place the two 32kbps ADPCM audio channels in one timeslot and the 64 kbps data in another.

[PRBS Tester Feature]

BER Channel	PRBS tester may operate through either main traffic, ESC data, or AUX data channels (main traffic channel not available in Closed Net, ie no overhead mode). Use of ESC & AUX data channels allow continuous real traffic BER performance monitoring on links with overhead.
Test Patterns	2047, 2^{15}-1, 2^{20}-1, compatible with common stand alone BER testers.
Results	Display of error count & average BER
Autolog	Automatic logging of average and 1 minute worst case BER at user specified intervals (1 min - 24 hours)

[Monitor/AGC Option]

Facilities Provided	Demodulator Rx carrier signal monitoring & level display (±5dB) 0 -10 V Analog output (Signal level, Eb/No or Rx offset frequency) Buffered constellation monitor port Sounder for audible feedback from keyboard

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Traffic Log

Capacity	Total 500 entries
Entry Format	Fault message with time & date. Separate entry when fault clears/ changes
Automatic Entries (user defined interval)	Average & minimum Eb/No Average & minimum estimated user BER Buffer fill status Average & 1 minute minimum measured BER from PRBS tester (may run continuously through ESC or Aux channel for continuous traffic quality monitoring)
Interrogation method	View on front panel LCD, Print to rear panel serial port (`D` type) either all entries or just unprinted entries read over remote M&C bus

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[Auto Uplink Power Control] (AUPC)

Modes of operation:	Monitor of distant Eb/No & BER only, Full distant Eb/No maintenance, & Self monitor (broadcast) modes. Unidirectional or bidirectional operation.
Communication link:	Utilises async ESC channel on IBS/SMS, IDR and Closed Net Plus ESC carriers (ESC from 300Baud, ie overheads down to <1%).
User parameters:	Target Eb/No, Tolerance window, Max & Min delta powers, Slew rate limit, comms loss action (freeze, max or nominal power).
Ancillary features:	Automatic logging of distant Eb/No and local AUPC delta power at user controlled intervals in traffic log. Automatically interleaves AUPC messages with distant end remote M&C (if active) on ESC channel. Independent Max & *Min* delta powers (ie facility to *reduce* power & still maintain quality of service with good atmospherics) allows power balancing on transponders with traffic to varied destinations.

Common Specifications

Loopbacks	Interface Loop (local & remote) Drop/Insert Loop (local) Framer Loop (local)

	FEC Loop (local) RS Loop (local) Internal IF Loop (local, Rx IF automatically tuned to match Tx) Deframer/Framer Loop (remote)
Test Modes	Transmit CW (pure carrier) Transmit alternate 1,0 pattern (for carrier suppression test) Disable Reed-Solomon decoder corrections
Alarm Relays	3 independent changeover contacts: Prompt Unit fault Prompt Traffic fault (Tx or Rx) Deferred Alarm (backward alarm, BER or Eb/No below user threshold)
Controller	Intel 8032 micro controller provides all M&C functions
Embedded Software	Revised embedded software may be downloaded to FLASH memory with modem still in equipment racks. No EPROMs, no opening of the case.
Configuration Memories	Up to 10 different configurations can be stored & recalled from the front panel or remote M&C
User Interface	Clear & intuitive operator interface with plain English dialogue allows fast and efficient configuration of modem. 80 Character, backlit, high contrast, wide angle LCD 15 Key tactile full keyboard.
Remote M & C	For multi-drop applications, RS485 interface, for direct-to-PC applications RS232 interface (front panel selectable). M&C port may be directly internally linked to ESC port for distant end `over the satellite` M&C without cabling.
Redundancy Features	1:1 redundancy controller built in.`Y` cables passively split data, maintaining impedances. L Band inputs/outputs are passively split/combined outside the units. Offline unit tri-states data outputs & mutes Tx carrier.
BUC/LNB Support (P310)	
Reference to BUC/LNB	Stability: See Internal Reference / Station Reference (clocking section) Switchable from front panel / remote M&C. Tx: at rear N-Type to BUC +7dBm +/-2dB Rx : at rear N-Type to LNB 0dBm +/- 0.2dB
DC Supplies:	Switchable from front panel / remote M&C. Tx: 24V or 48V factory option (100W or 180W respectively) Rx: 15V or 24V at 500mA
FSK Communications	P310: Option for duplex FSK Communication with Paradise BUCs (P314). Provides control of BUC from modem front panel or by remote M&C via normal modem M&C ports. Includes control and monitoring of all BUC parameters available over FSK, and option to provide closed loop power control to BUC flange.

Alarms:	User set hi/low current monitor window on DC supply to BUC With FSK, all BUC alarms integrated into modem alarm handling.
Mechanical	P300: 1 U chassis - 355 mm deep P310: 1 U chassis - 440 mm deep
Weight	P300: 3 kg P310: 3.8Kg up to 4.35Kg with options
Power Supply	100-240 Volts AC +10% -15%, 47 - 63 Hz , P300: 40 watts maximum P310: 240W maximum (extra PSU for BUC) Rated maximum supply current 1A at 100V, 0.3A at 240V Fused IEC connector (Double pole / Neutral fused) Fuse rating T3.15AH 250V (3.15A fuse, time delay, high rupture current, for 250V supply) Maximum rating of fuse in supply plug or at the supply distribution board is 5A P310: Option (P324) for 48V DC primary input power.
Safety	EN 60555-2
EMC	EN 55022 Class B (emissions) EN 55024 Part 1 (immunity)
Environmental	Operating temperature range 0 to 50C

Supporting Products

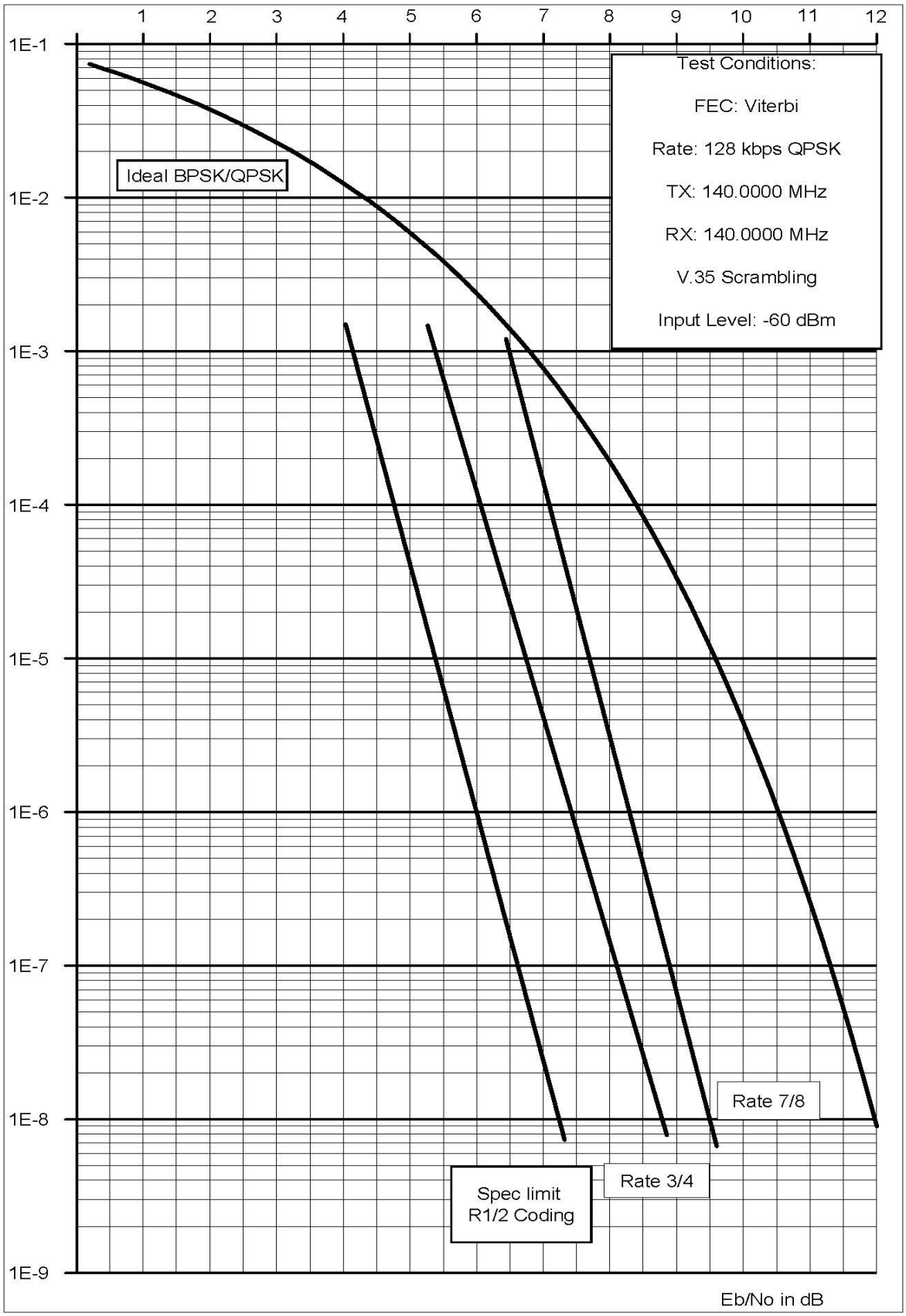
The P300 Series are supported by the following products:

P500 series 1:8 redundancy controller, which includes the facility to mix electrical interfaces within redundancy group

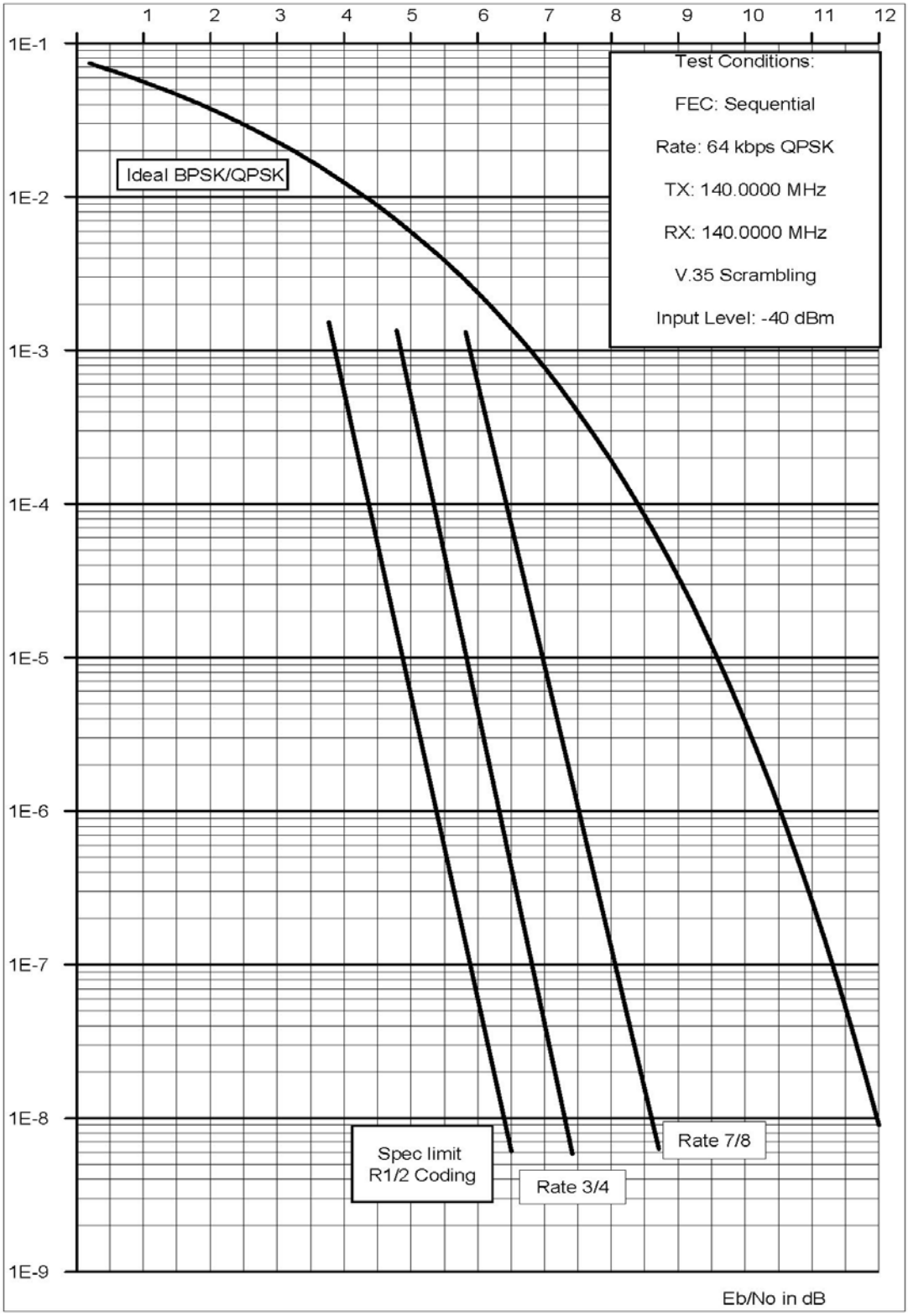
Alphawave CAM Monitor & Control software allows monitor and control of many different products (including non-Paradise products).

Specifications are subject to change without notice.

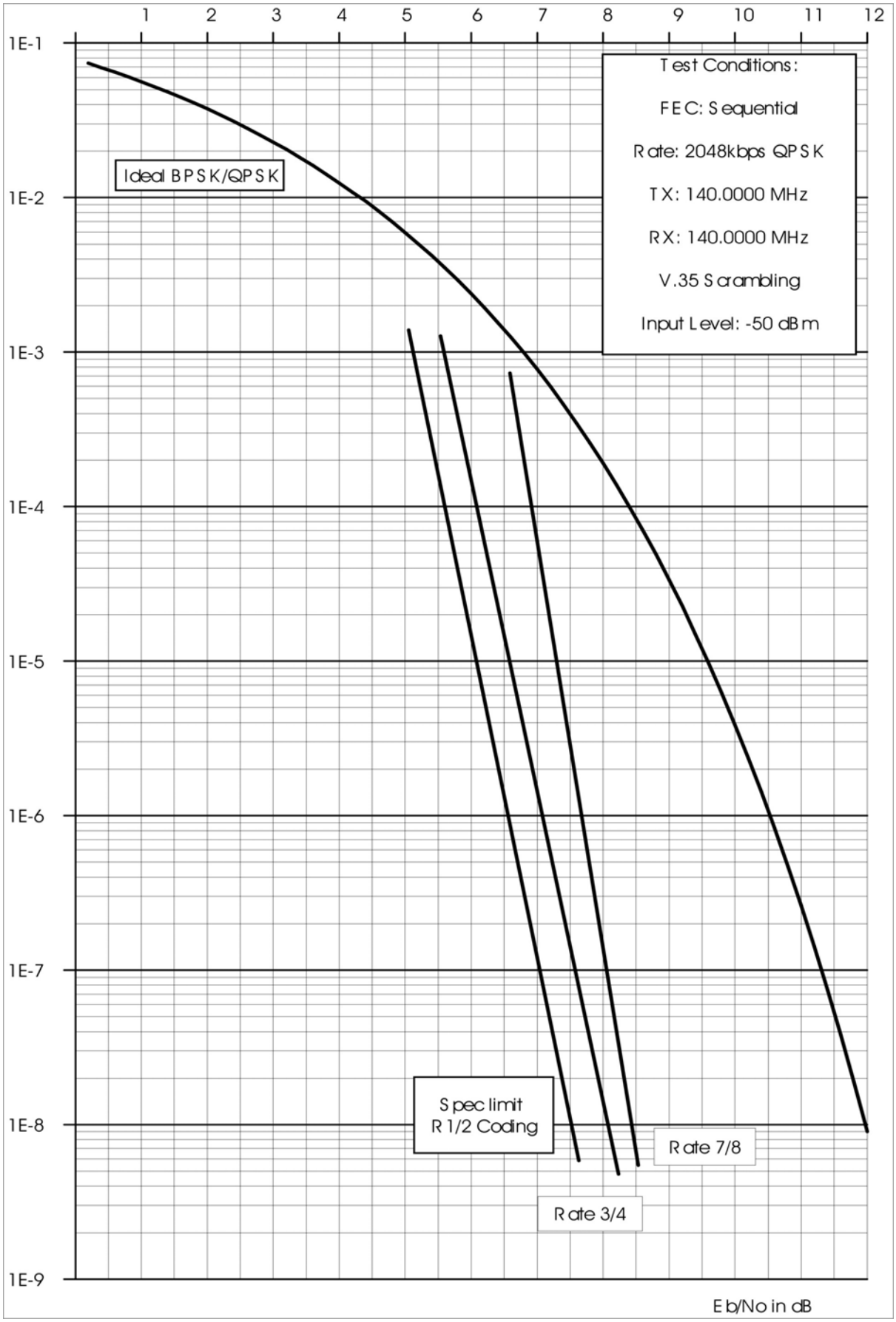
P300 Modem Series, Error Probability versus Eb/No - Viterbi Decoding.



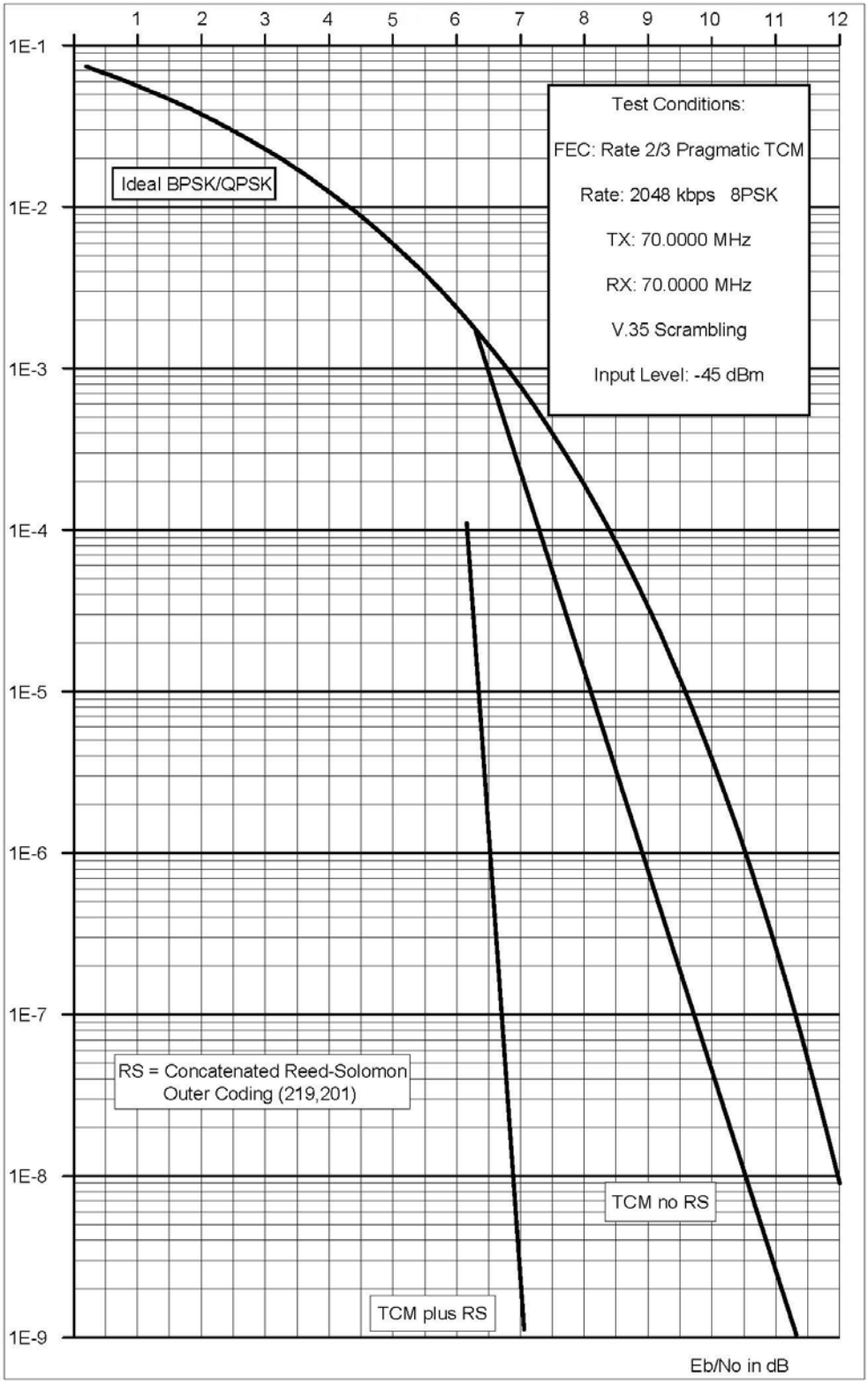
P300 Modem Series, Error Probability versus Eb/No - Sequential Decoding at 64kbps



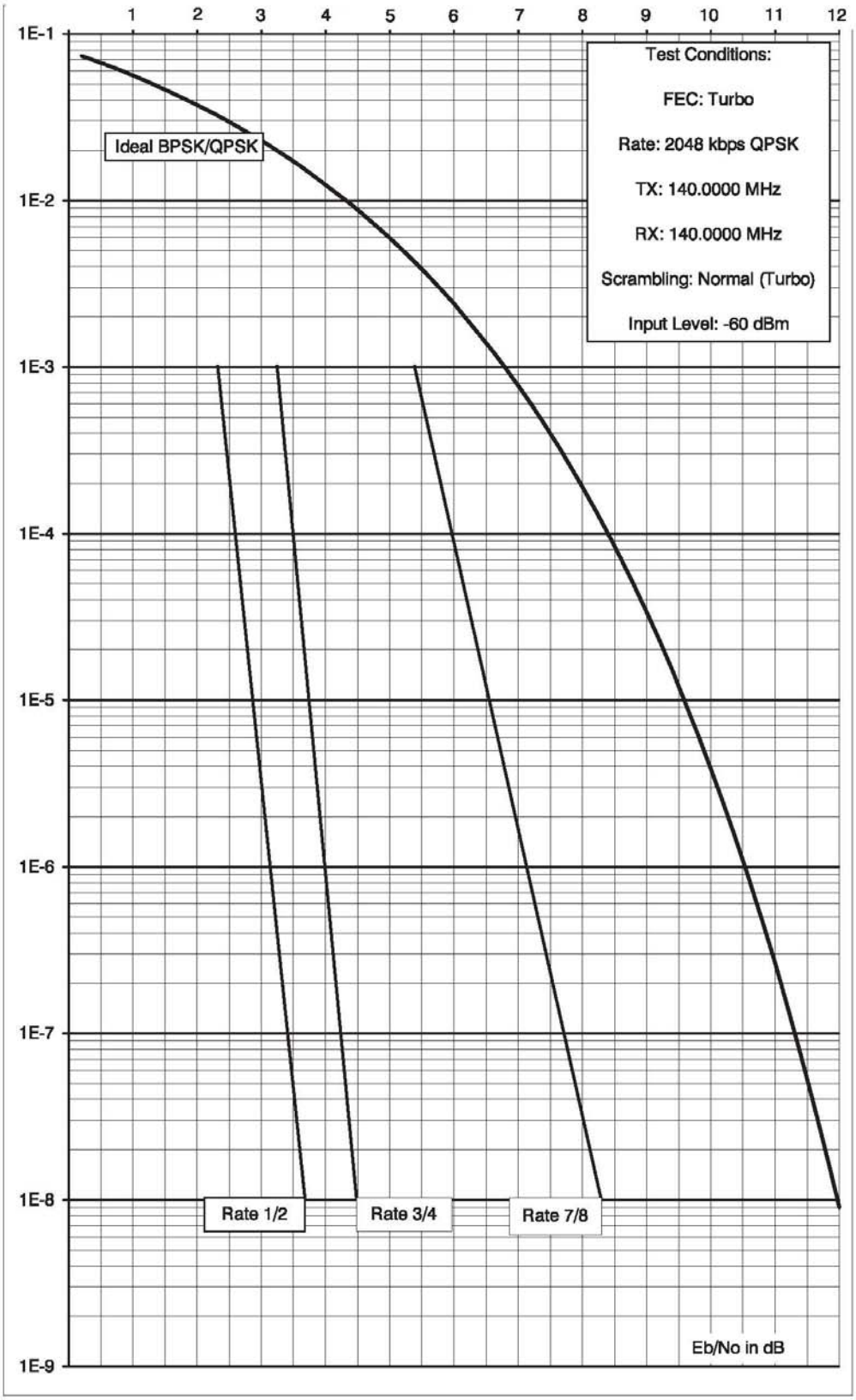
P300 Modem Series, Error Probability versus Eb/No - Sequential Decoding at 2048kbps.



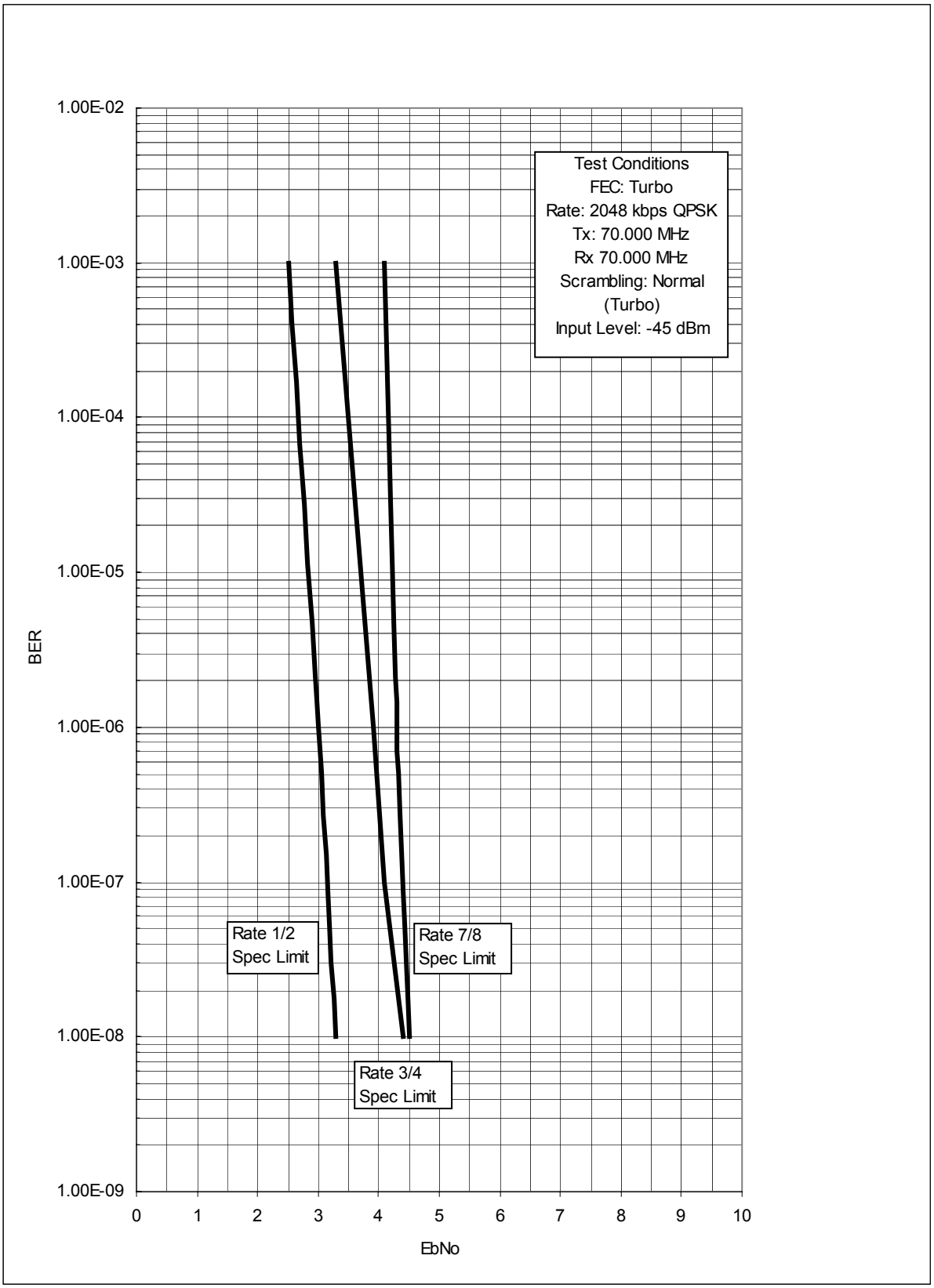
P300 Modem Series, Error Probability versus Eb/No - 8PSK/TCM with/without Reed-Solomon.



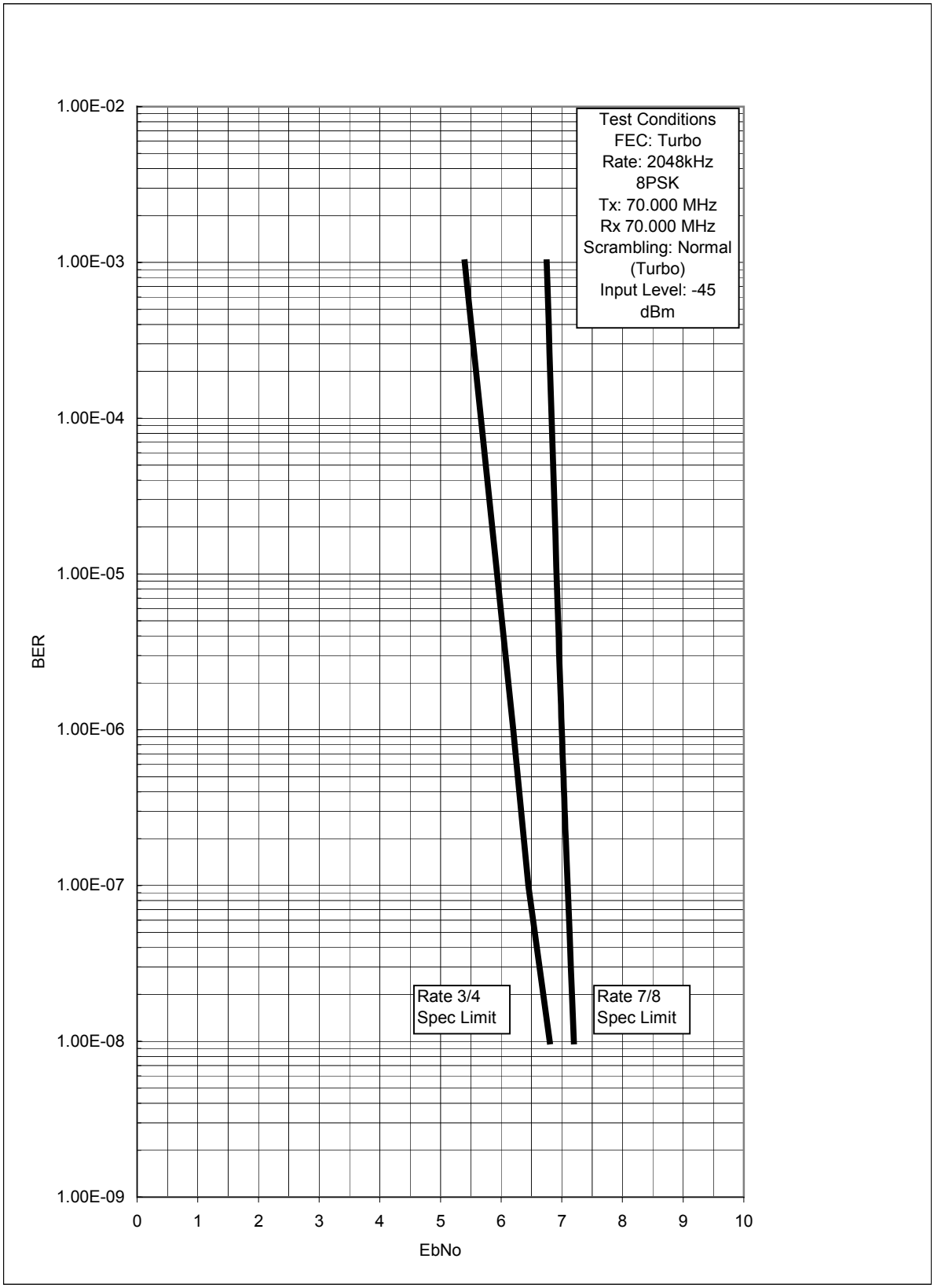
P300 Modem Series, Error Probability versus Eb/No – 1st Generation Turbo Codec.



P300 Modem Series, Error Probability versus Eb/No – 2nd Generation Turbo Codec.



P300 Modem Series, Error Probability versus Eb/No 8PSK Turbo.



5 INSTALLATION AND CONFIGURATION

5.1 UNPACKING

Prior to unpacking, inspect the exterior of the shipping container for evidence of damage during transit. If damage is evident, contact the Carrier immediately and submit a damage report. Carefully unpack all items, taking care not to discard packing materials, particularly the moulded foam inserts. Should the unit need to be returned to Paradise Datacom, USE THE ORIGINAL PACKING CARTON. This is the only approved shipping container that Paradise recognises.

5.2 VISUAL INSPECTION OF EQUIPMENT

Once unpacked, visually inspect the unit for damage. The shipping carton in which the Modem is shipped has been used by Paradise to ship our products worldwide for a number of years. It has shown, through experience, that it can withstand very rough handling. Therefore, if the equipment received is damaged, there can be no doubt that it has been subjected to abnormal or abusive treatment - please file a claim with the Carrier *immediately* and then contact Paradise Datacom. Assuming, however, that the equipment has been received in perfect condition, proceed with the installation of the equipment.

5.3 INTERFACE OPTIONS

Unlike previous Paradise products this unit is fitted as standard with an interface that is **AN INTEGRAL PART OF THE MODEM** main board, **DO NOT TRY TO REMOVE THE CARD**. Customer specific interface options are available, but these require the standard interface to be `snapped off` and a connector soldered to the board before the modem can accept other standard Paradise interface cards.

Note if fitting the additional G.703 options (T1 or E1) that there are links and switches on the card, and these should be set BEFORE the card is installed.

5.4 IF INTERFACE

Connect the appropriate cables to the Transmit IF and Receive IF connectors at the rear of the unit. Output power level can be controlled using the front-panel menus. The optimum input level for the demodulator is -45dBm ±15dB.

5.5 POWER UP

At power up the unit performs an initialisation procedure, which lasts approximately 3 seconds. If the unit was previously operational, it will enter operating mode. If the unit was previously non-operational, then the main menu will be displayed. During the power-up phase, the unit will display the product number P300 with a V & S suffix indicating the presence of the Viterbi and / or Sequential codec, plus the unit serial number.

The user should then select *SETUP, INITIAL CONFIG*, (to define every parameter prior to operation), later changes to the configuration are made with the *CHANGE* option. The Status screen cannot be selected unless *SETUP, INITIAL CONFIG* has been performed.

6 MENU SYSTEM

6.1 INTRODUCTION

All configuration & monitoring features are accessed from the front panel via the menu system. Provided an operator has an understanding of *how* the menu system works, there is no need to try and memorise the menu structure itself, as selecting a single option (*SETUP, INITIAL-CONFIG*, explained later) will make the unit prompt for all needed configuration parameters. The structure of the menu system is however shown on the next few pages for reference.

▶▶▶THE 1 MINUTE GUIDE TO FRONT PANEL OPERATION ◀◀◀

The main menu can be accessed from any display with the **MAIN** key. It is from this main menu that all functions are selected.

1:Status 2:Change 3:Monitor 4:Info
5:Log 6:Test 7:Setup 8:Action 9:Help

Main Menu

Whenever the '↑' or `↓' symbol appears it indicates that further information is available by pressing the **UP** or **DOWN** key. This information is usually worth looking at (otherwise we wouldn't have put it there !).

The **NO** key functions as a backstep/backspace key, both when entering numeric data, and when traversing the menus. The **YES** key doubles as an enter key for numeric entries. Where a numeric entry requires many digits (eg IF frequency), pressing **YES** after entering all *significant* digits fills the rest of the entry with zeroes, pressing **YES** again, enters this value.

When the user is requested to select a configuration parameter, the last setting is always displayed in [square brackets]. To select the same option again, just press the **YES** Key (ie you don't have to reselect the same option to get past the menu, just press **YES**)

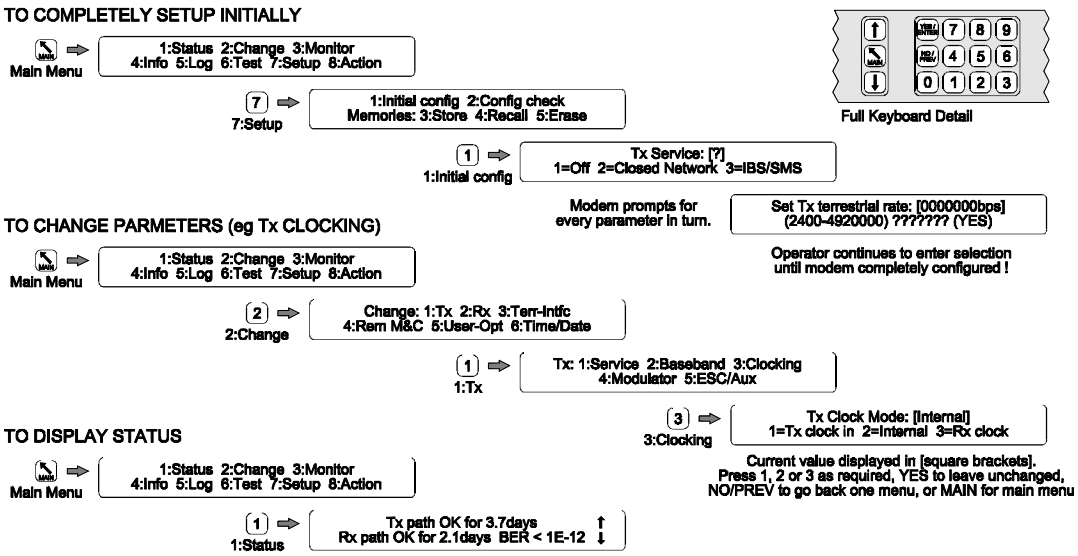
Options displayed with a colon eg "**1:Status**" switch to another screen or subsequent menu but do not affect operation. Options displayed with a equals sign eg "**1=Off**" change the configuration and may (if changing a relevant parameter) affect the traffic. Reselecting a current option (or pressing YES to select the current option) will never cause a traffic interruption.

When a unit is shipped (or if the non-volatile memory is cleared) it will have an blank configuration and require the operator to use *SETUP, INITIAL-CONFIG* prior to allowing *STATUS* to be selected. This prompts for all parameters required for a complete configuration.

Wherever possible menus state "(normal)" after the most common option. If in doubt, select the normal option if there is one, it works every time !

After *SETUP, INITIAL CONFIG* has been performed once, minor changes to the configuration may be made with the *CHANGE* option from the main menu. *CHANGE* allows parameters such as Tx & Rx service/data rates, clocking, IF frequencies, and miscellaneous parameters to be set without going through the entire *SETUP* process. If however you make a major change to the service (such as switching from Closed Net to IBS) you might decide a quick run through *SETUP, INITIAL CONFIG* again (accepting the current values with the **YES** key) will highlight any new parameters (with sensible defaults) that are relevant to this major change of service.

Make use of the Rx=Tx option, it's great, it cuts down configuration errors, and generally makes life easy. At least read the note on Rx=Tx in section 6.7 on page 89 so you know what you are missing !



When the configuration is complete, select *STATUS* from the main menu, check the LED status indicators, and read the message on the LCD. The messages are carefully worded to convey as much information as possible about any faults.

If you have configured the unit, but it will not operate as expected, try *SETUP, CHECK*, this takes approximately 10 seconds to run and checks the configuration for unusual settings (eg IBS with 7/8 rate FEC). If anything is found a warning is displayed and can be masked by pressing YES. These are only warnings, and after you mask each displayed warning you may continue to operate in that mode if required.

Use the *INFO, VIEW CONFIG, TX/RX/COMMON* screens to display the summarised configuration.

Then, if need be, read the rest of this handbook. If that fails, when you are sure you have the unit configured correctly and you have checked the status on the LCD, call us for technical support. We will do our best to remotely diagnose the problem.

6.2 MENU STRUCTURE DIAGRAMS

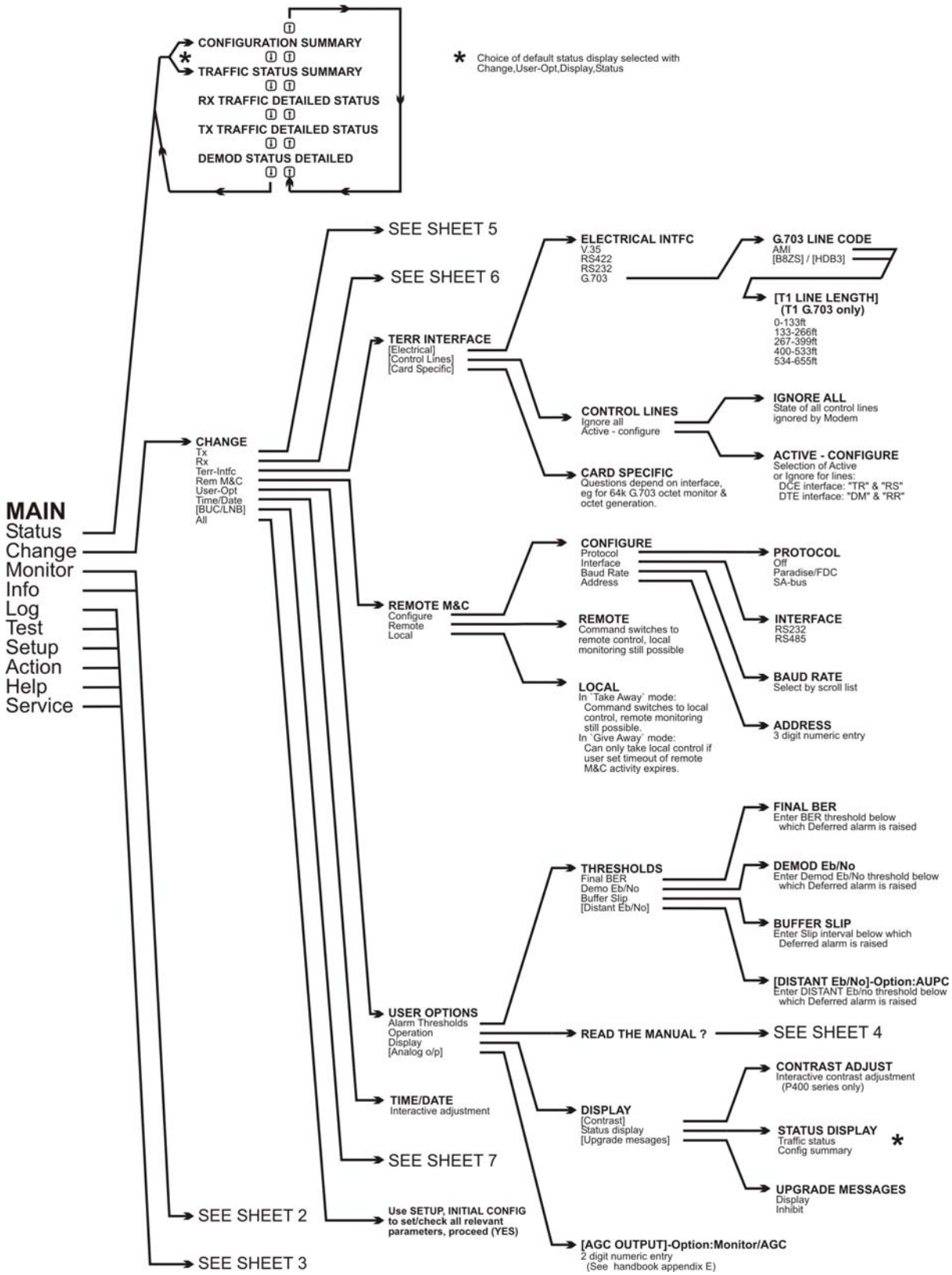
The full modem menu structure is presented on the following pages. In order to not over-complicate the menu screens for modems, which do not have the full feature set, some menu options only display if features are fitted and/or active.

Items in **[Square Braces]** are relevant only when the modem is configured in certain modes and are not displayed unless the modem is suitably configured. For example menu options relating to certain features of IBS or IDR framing only display if the Tx or Rx Service is set for IBS or IDR.

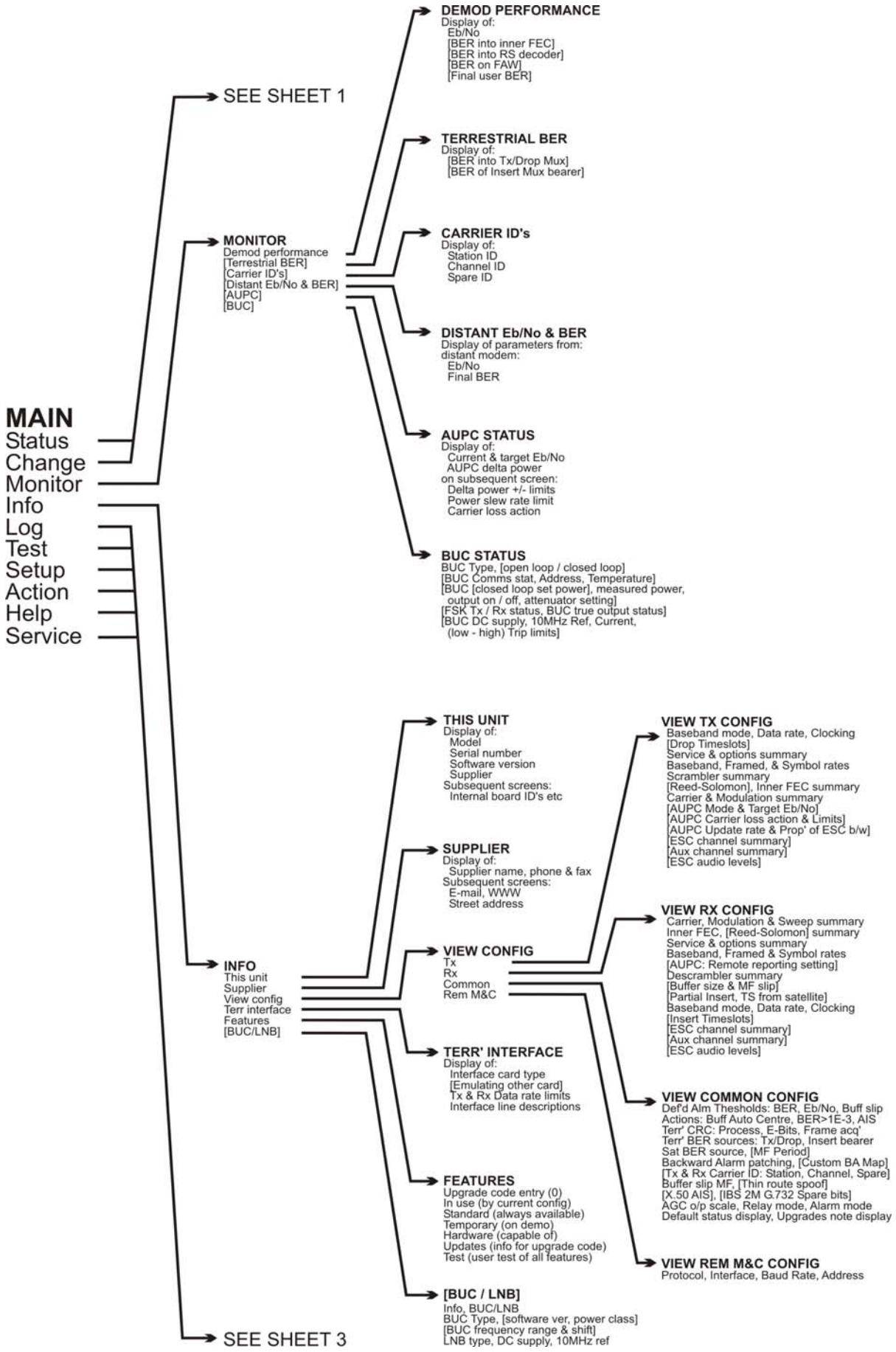
Items displayed with a "**-Option**" suffix such as **[AGC OUTPUT]-Option: Monitor/AGC** only appear on the menu's when the relevant feature is available on that modem. This may be a feature controlled by a front panel entered "Feature Code" or a feature requiring a hardware option (as per this example).

Some items require not only the feature to be available in the modem, but also the feature to be currently active before they are displayed. For example the option to raise a deferred alarm if the ***distant*** Eb/No falls below a certain level (shown on the diagrams as **[DISTANT Eb/No]-Option: AUPC**) requires the AUPC feature to be available <u>and</u> switched on before the menu option is shown.

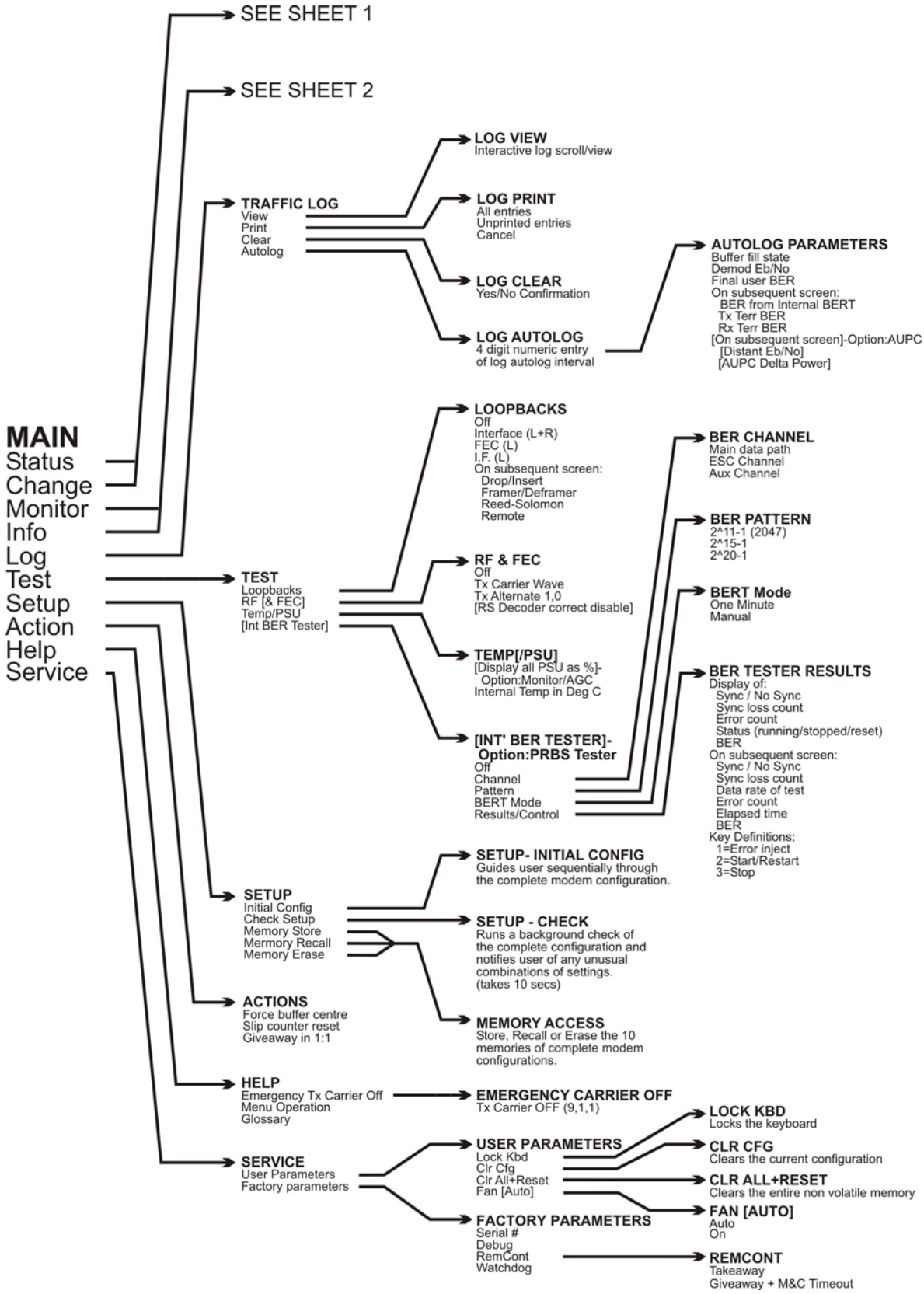
6.2.1 Menu Structure Sheet 1 / 7 (Main: Status, Change)



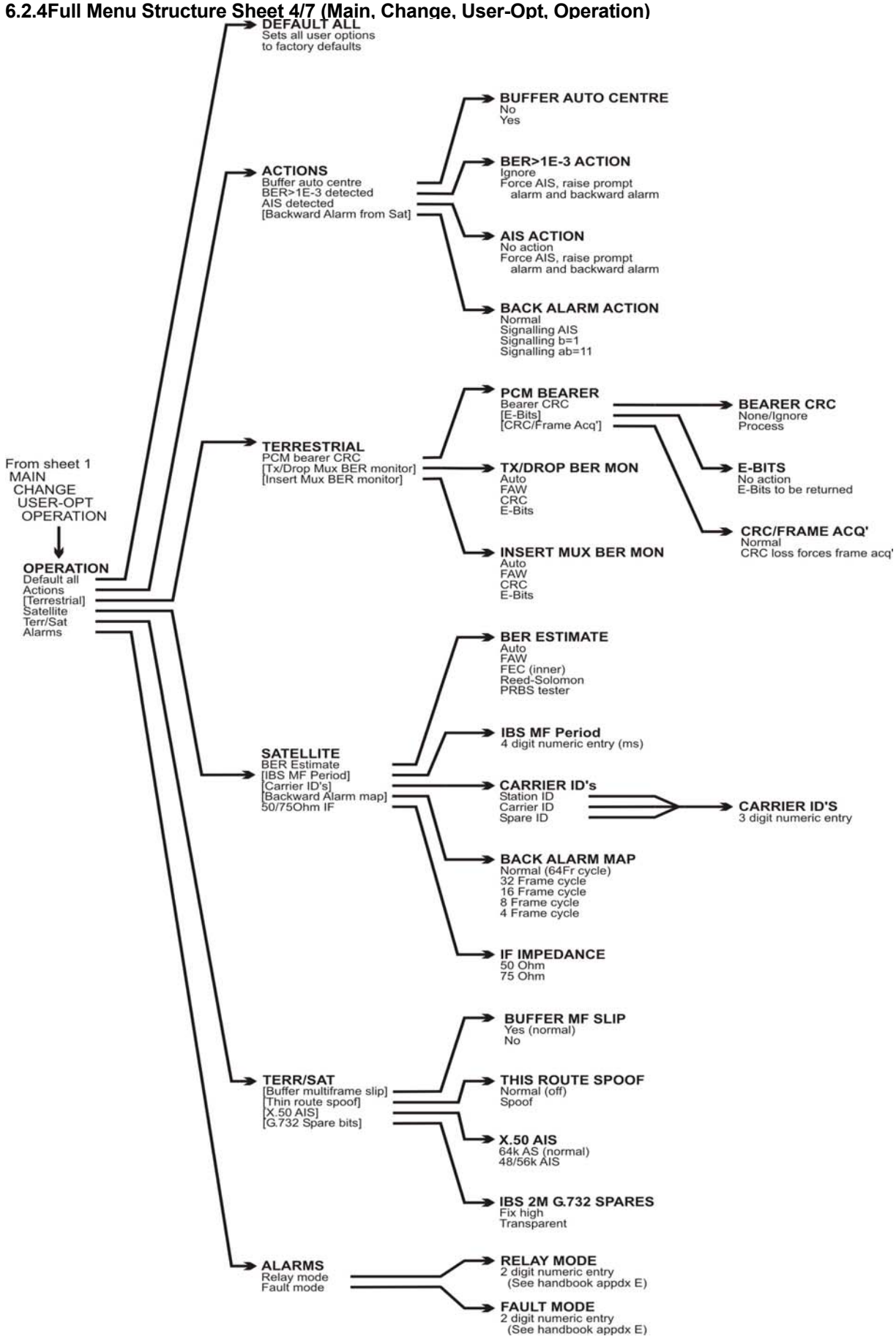
6.2.2 Full Menu Structure Sheet 2 / 7 (Main: Monitor, Info)



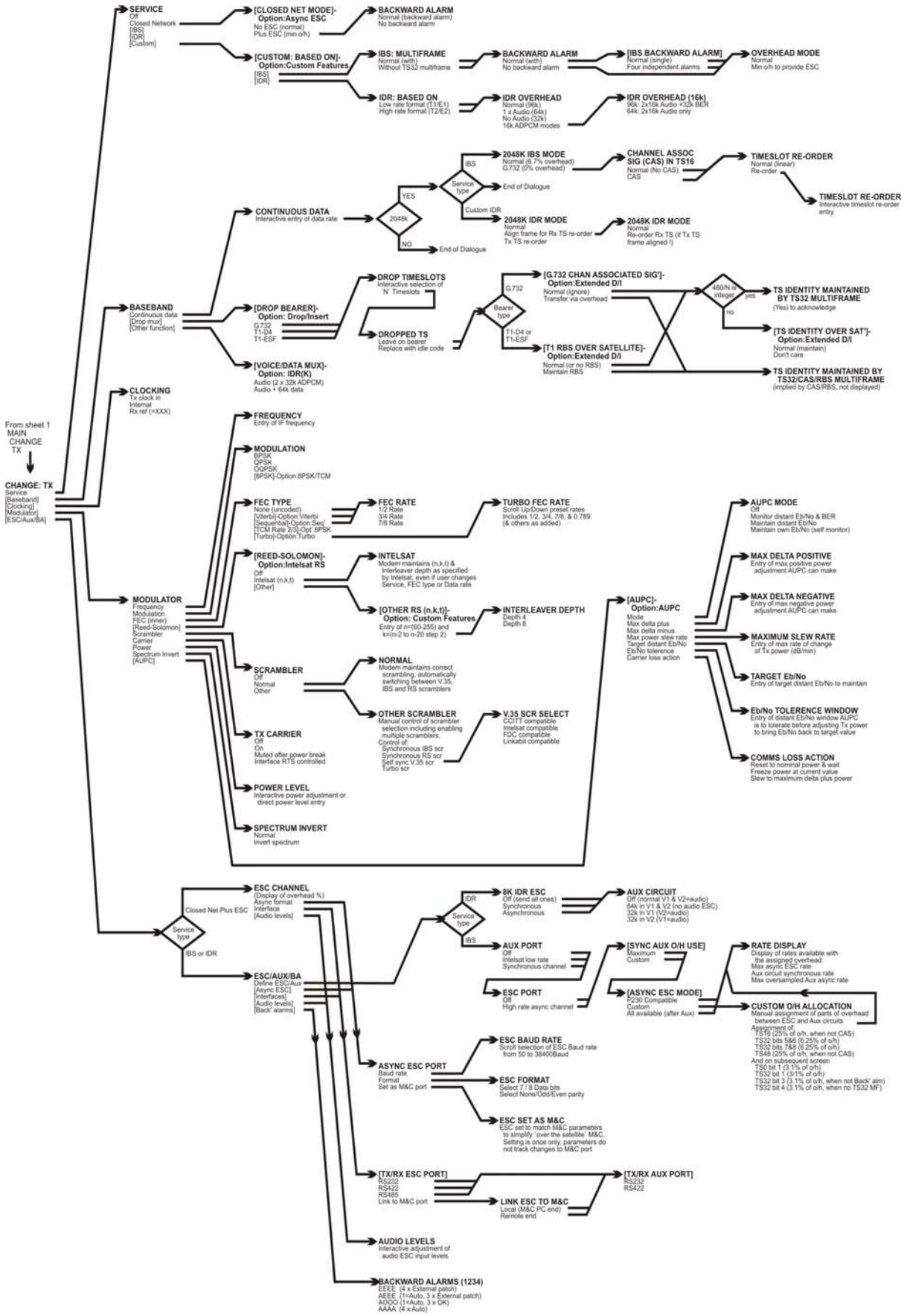
6.2.3 Full Menu Structure Sheet 3 / 7 (Main: Log, Test, Setup, Action, Help)



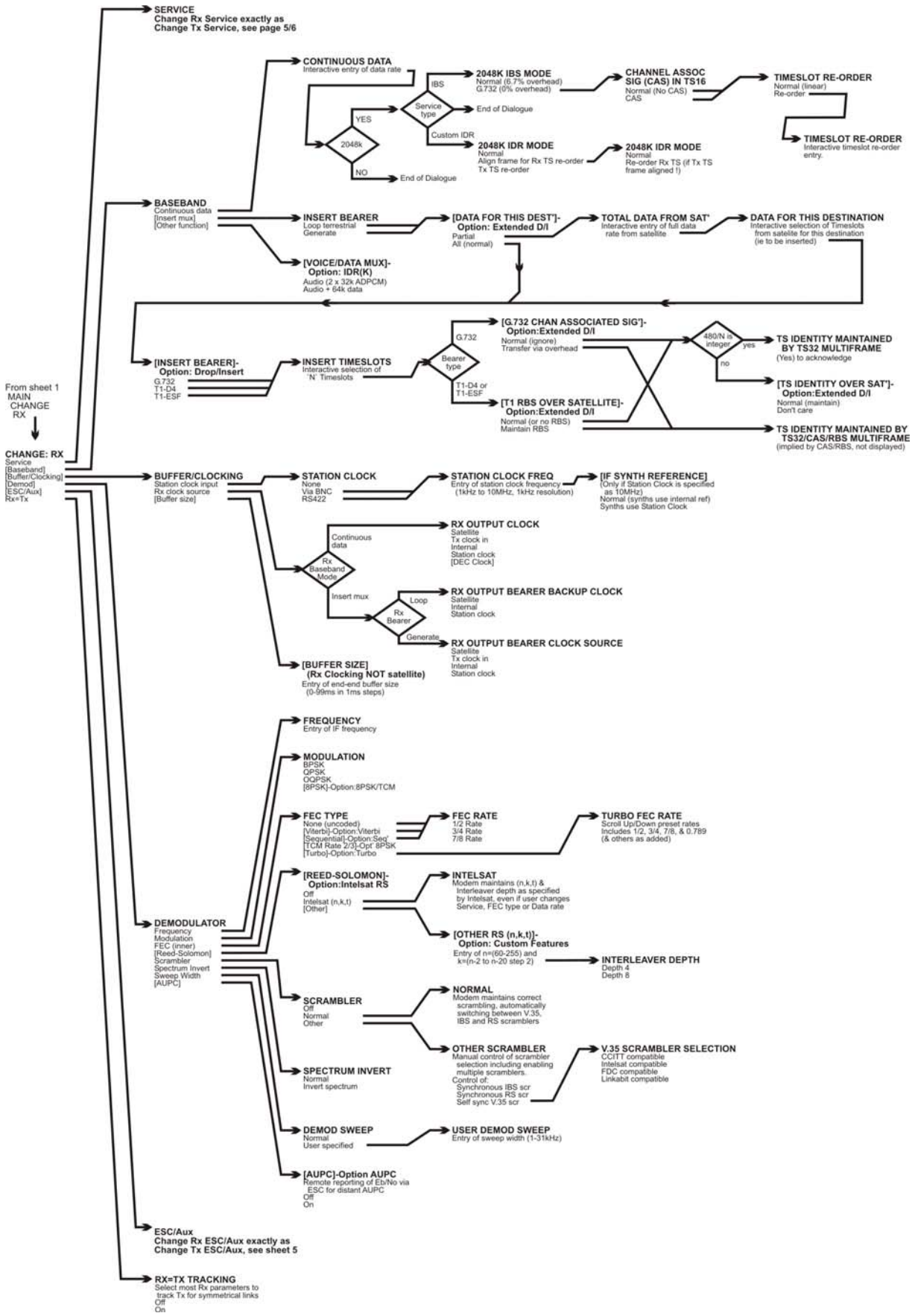
6.2.4Full Menu Structure Sheet 4/7 (Main, Change, User-Opt, Operation)



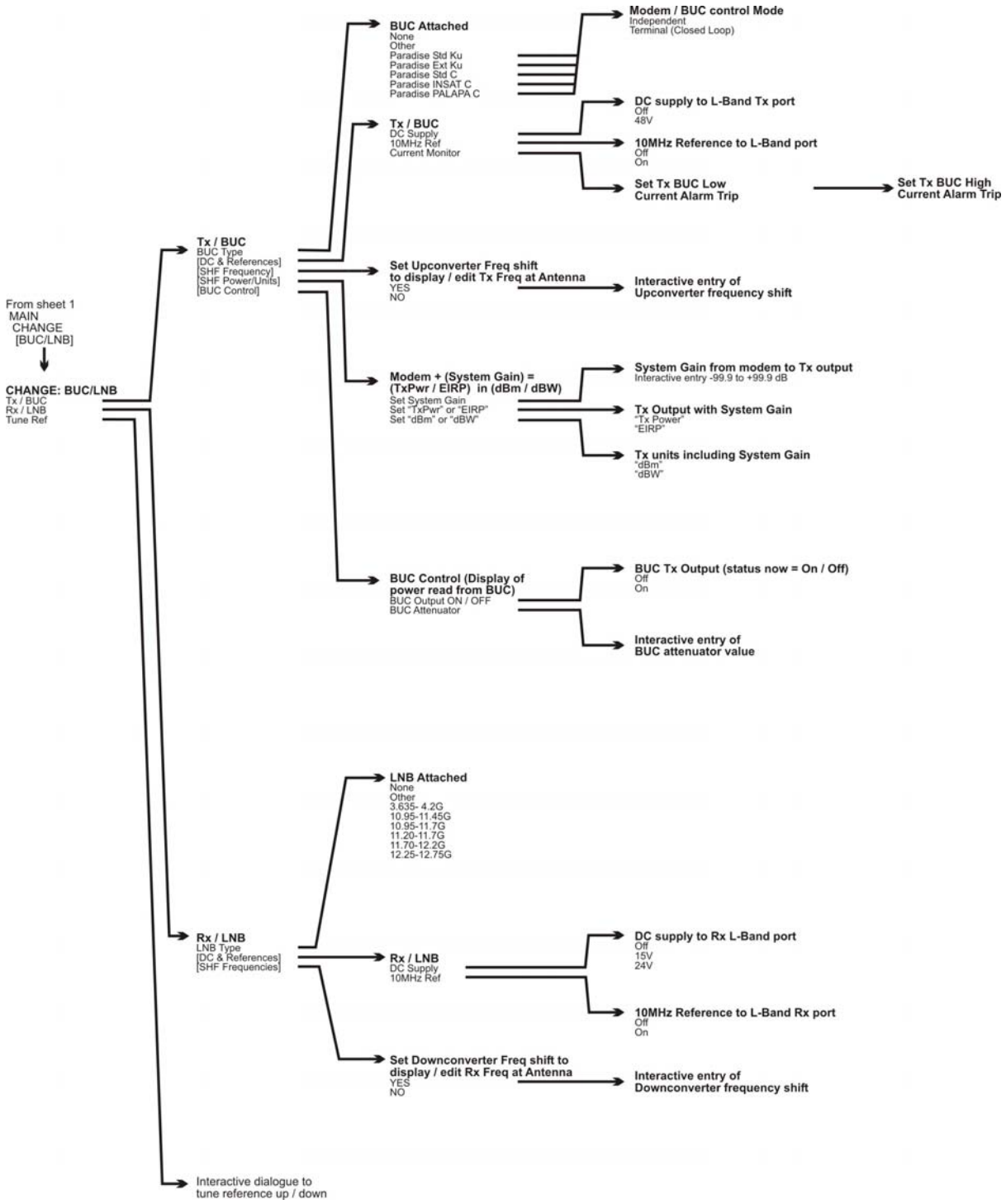
6.2.5 Full Menu Structure Sheet 5 / 7 (Change, Tx)



6.2.6 Full Menu Structure Sheet 6 / 6 (Change, Rx)

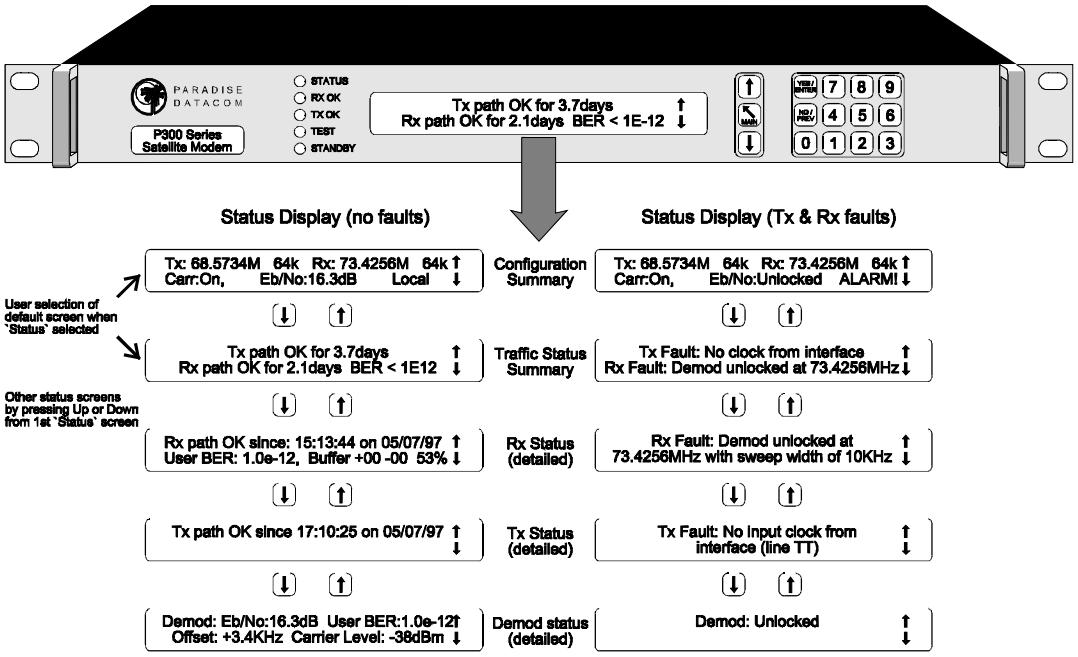


6.2.7 Full Menu Structure Sheet 7 / 7 (Change, BUC/LNB)



6.3 Status SCREEN DISPLAY

When *Status* is selected the LCD switches to a display of the current modem status. This is a series of screens which are accessible from each other with the **Up** and **Down** keys. The available status screens are summarised in the following diagram:



The operator has the option to display either the **Configuration Summary** Screen (shown first above) or the **Traffic Status Summary** Screen (shown second above) when Status is selected from the main menu. The selection between screens is made under *Change, User-Opt, Display*. These screens are now each discussed in turn:

CONFIGURATION SUMMARY

```
Tx:70.0000MHz 2048k  Rx:70.0000MHz 2048k
CARR:Normal  Eb/No>15.0dB  LOCAL  Info↓
```

Configuration Summary Screen

This screen displays a summary of the configuration on the top line. The lower line provides carrier **unit** and **traffic** messages such as "Carr:On", "Unit Fault" or "Traffic Warn", and the operator has to press the Down key to display the Tx & Rx Traffic Summary screen in order to determine what the fault is. The fields can take the following values:

Carrier Status:	**CARR: Normal**	Normal Tx status
	CARR: DISABLED	Carrier state set to `Off` (formerly **CARR :Mute-Off**)
	CARR: Mute-Brk	Carrier set to `Power Break Mute`, requires operator to confirm if carrier can be retransmitted as power outage has occurred.
	CARR: Mute-1:1	Muted by 1 for 1 logic
	CARR: Mute-Ext	Muted by external signal on alarms connector
	CARR: Mute-RTS	Carrier set to RTS controlled, and interface RTS line is off
	CARR: Mute-Flt	Muted, due to an internal fault (eg synthesiser lock)
	CARR: FAULT !!	There is a fault in the carrier on/off logic, disconnect the carrier from the satellite.
Demod status:	**Not Locked**	If the demodulator is unlocked
	Eb/No=xx.xdB9	When the demodulator is locked a valid Eb/No is displayed

Pressing the down arrow leads to further information

Unit Status (in order of priority):

Unit Fault	There is a Unit Fault
Cfg-Error	The Unit cannot perform as requested
Unit-Warn	There is a Unit Warning
Cfg-Warn	There is a configuration warning (from *Setup, Check*)
Cfg-Info	There is a Config Info message (from *Setup, Check*)
Traf-Fault	A Traffic Fault exists
Traf-Warn	A Traffic Warning exists
Remote	Remote M&C mode, no warnings or test modes active.
Local	Local mode, no warnings or test modes active.

TRAFFIC SUMMARY SCREEN

Tx Fault: Data input is all ones (AIS) **Rx path OK for 36.8 hrs, BER <1 E12 Info↓**

Traffic Summary Screen (Tx top line, Rx bottom line)

When there are no faults this screen shows how long since the last interruption for both paths (as for the lower line of the example shown), together with the carrier status for the transmit path and the Eb/No (discussed later) for the receive path. If either path has a traffic fault / warning active, then the status is replaced by an abbreviated 40 character fault message on the top or the bottom line for Tx & Rx respectively. A more descriptive message is available on the **"Info↓"** screens accessed with the Down Arrow key. These display a more descriptive 80-character messages for the **Detailed Rx Traffic status**, the **Detailed Tx Traffic Status**, and a **Detailed Demodulator Status**.

Any **Unit Faults** override **Tx & Rx Traffic Summary** and displays the fault message, such as

Unit Fault: Tx IF synth failure, **Tx carrier muted.**

Unit Fault (overrides Traffic or Configuration Summary screens)

When a unit fault is displayed, it takes over the whole of the Tx & Rx Traffic Summary screen (as it is important, and likely to relate to both Tx & Rx paths). The three detailed screens are however still available by pressing the **Down key from the Unit Fault Message**. On each successive press the screen cycles through the following three screens, until on the fourth press it returns to whichever of the two Status Screens has been selected as the default.

DETAILED RECEIVE TRAFFIC STATUS

Rx OK since 22:58 on 3/6/97 **BER >1E-7* Buffer +2 -0 53% Tx↓**

Detailed Receive Traffic Status

This screen normally shows the time of the last traffic interruption, the (estimated) user BER, along with the Doppler buffer overflow & underflow counts (reset by *ACTION, RESET SLIP COUNTS*), and the current buffer fill status. If the BER indication is followed by an asterisk, then there have been less than 100 errors, and the results are statistically weak. If there is a receive **traffic fault**, then a more detailed two line description of the fault/warning replaces the status information (as opposed to the one line message on the Status Traffic Summary Screen). Pressing down again selects the Transmit Detailed Traffic Status.

DETAILED TRANSMIT TRAFFIC STATUS

Tx OK since 08:25 4/6/97 **Carr:Normal Demod ↓**

Detailed Transmit Traffic Status

As with the Rx screen, this shows the date of the last interruption to the Transmit path, replaced with a more detailed two line description of any traffic fault/warning condition if it exists. Pressing down again selects the Demodulator Detailed Status.

DETAILED DEMODULATOR STATUS

Demod Stat: Eb/No: 8.5dB User BER: 4E-3 **Offset: 18kHz, Level: -48dBm Stat↓**

Detailed Demodulator Status

This screen shows the estimated **Eb/No**. This is the composite Eb/No including framing overheads (as used by INTELSAT when specifying modem performance figures). The **BER** is the final **USER BER,** which is being passed to the customer. The **Offset** is the measured error of the received carrier, relative to the nominal position expected which is useful for determining the frequency drift due to the satellite and frequency conversion equipment. The **Level** is the level of the desired carrier ***estimated*** by the demodulator and is only shown if the Monitor/AGC option is fitted. From this screen the Down Arrow leads back to the selected Status screen.

(Back to the selected Status Screen, `Config Summary` or `Tx & Rx Traffic Summary`)

6.4 SETUP - INITIAL CONFIGURATION MENU

When delivered, or if the non-volatile memory should ever be cleared, the unit must be completely configured using the *SETUP, INITIAL CONFIG* option. This takes the operator through all the sections of the *CHANGE* procedure described below to ensure all parameters are set. Only when '*SETUP, INITIAL-CONFIG*' has been performed once can *STATUS* be selected from the main menu. This ensures operation is not selected until all critical parameters are specified.

Setup: 1:Initial Config 2:Check
Memories: 3:Store 4:Recall 5:Erase

Setup Menu

Other options on the *SETUP* menu are:

CHECK: Which allow the setup to be checked, and looks for unusual combinations of configuration parameters (eg IBS with rate 7/8 FEC coding, multiple scramblers selected). Check does not prevent operation with any configuration; it is simply a convenience for the operator if there are configuration difficulties. The Setup Check takes several seconds to run and displays a message when the process is complete.

MEMORIES: *STORE, RECALL*, and *ERASE,* which allows access to the configuration memories of the Modem. The current configuration can be stored, another recalled, or an old stored configuration deleted. This provides a fast method of switching between multiple configurations when required.

6.5 CHANGE MENU

It is under the Change menu that individual parameters may be varied after an initial *SETUP, INITIAL-CONFIG* has been performed. If the unit is operating under Remote M&C, the options on the change screen are limited to only the remote M&C configuration & the time/date:

Change: 1:Tx 2:Rx 3:Terr-Intfc
4:Rem M&C 5:User-Opt 6:Time/Date 7:BUC/LNB

Change Menu (local control)

Normal Change Screen (local control):

(Option 7: BUC/LNB only on P310 L-Band modems).

Change Screen (Remote M&C):

Change limited as Remote M&C active !
Change: 1:Rem M&C 2:Time/Date

Change Menu (remote M&C)

Each of these options will be described in the following sections:

6.6 CHANGE, TX MENU

The Change, Tx menu is shown below. Note that options 2-5 are only displayed when the *SERVICE* option is set to something other than `Off`, and so initially, **the screen may *only* show the *SERVICE* option.**

```
Tx:  1:Service  2:Baseband
3:Clocking  4:Modulator  5:ESC/Aux/BA
```

Change, Tx Menu

Taking each of these possible selections in turn:

6.6.1 Change, Tx/Rx, SERVICE Menu

```
Tx Service: [IDR]  1=Off  2=Closed Network
3=IBS/SMS  4=IDR  5:Custom
```

Change, Tx/Rx, Service Menu

The options are:

OFF This disables the path completely for Tx or Rx only operation. All alarms for that path are muted, and traffic faults ignored. For the Tx path the Tx carrier is also muted.

CLOSED NET The Tx/Rx path operates in a `Closed Network` mode. If the Async ESC featureis available (standard P300-IBS and above) then a subsequent screen (described in the next section) asks if it is normal *Closed Network*, or whether *Closed Net Plus ESC* is required. Normal *Closed Network* adds no overhead to the data and is compatible with other closed network equipment such as the Paradise P200, and closed network equipment from other vendors.

Closed Net Plus ESC adds the lowest possible overhead to the satellite data to provide whatever ESC rate is selected. When this mode is selected there is also the option to provide a Backward Alarm facility. Closed Net Plus ESC also has the advantage that at rates above 32kbps a synchronous scrambler is used (in place of the error multiplying V.35 scrambler used on normal closed network links) and, if used with Drop/Insert, the `Timeslot Identity is maintained`. If you want the backward alarm, synchronous scrambler, or Timeslot ID Maintenance advantages of Closed Net Plus ESC, but don't want an ESC channel, simply select the ESC to the lowest Baud rate available (50 Baud), and the rest of the features will be provided within less than 0.5% overhead.

IBS/SMS The Tx/Rx path operates in IBS/SMS `Open Network` mode, where a 1/15th framing overhead is added to the data. In this mode the Modem is compatible with other `Open network` equipment such as the P230, P230D/I, OEM modems used with a P1300 framing unit, or other `Open Network` equipment from other vendors. Refer to the section "IBS/SMS Service Features" in Appendix F on page 212 for a full description of IBS/SMS features.

IDR The Tx path operates in IDR mode, where a 96kbps framing overhead is added

to the data. In this mode the equipment is compatible with OEM modems used with a P1300 framing unit, or other `IDR` equipment from other vendors. Refer to section "IDR Service Features" in Appendix F on page 219 for a full description of IDR features.

Custom This allows the operator to select a framing format based on the standard IBS/SMS or IDR definitions, but with non-standard or extra features such as Minimum overhead framing, or Multidestinational IBS. A description of the features and menus which follow this choice are in section 7 "Change, Tx/Rx, Service, Custom Menu" on page 135.

6.6.2 Change, Tx/Rx, Service, CLOSED NETWORK

These screens are only shown if the Async ESC feature is available, standard on the P300-IBS and above.

Note: Closed Net Plus ESC **is** available with the P400 series modems, refer to "Closed Network Plus ESC via the Custom Service menu" in section 8.7.2 on page 150.

When Closed Net is selected the following screen is shown to allow the selection of normal *Closed Network* operation, or *Closed Net Plus ESC*:

```
Closed Network mode [?]:
1=No ESC (normal)  2: Plus ESC (min o/h)↓
```

Change, Tx/Rx, Service, Closed Net, ESC Menu

NO ESC The modem operates without adding any overhead to the data, this is `normal` Closed Network mode. Normal *Closed Network* adds no overhead to the data and is compatible with other closed network equipment such as the Paradise P200, and closed network equipment from other vendors.

PLUS ESC The modem adds the minimum possible overhead to the satellite data (down to <1%) to support the async ESC rate you set. The **exact overhead used can be viewed on the Info, View Config, Tx/Rx screens**. It provides the following facilities:

- A variable rate ESC channel (up to approx 70% of main channel rate)
- An *optional* backward alarm facility.
- At rates of 32kbps and above it provides a synchronous scrambler to replace the error multiplying V.35 normally used on closed network links.
- If used with Drop/Insert (Yes, Closed Network with Drop/Insert), it provides Timeslot ID maintenance across the link.

See the first few paragraphs of Appendix F where *Backward Alarms*, *Synchronous Scrambling*, and *Timeslot ID Maintenance* are discussed (in relation to an IBS/SMS carrier).

Note: As the overhead affects the final composite framed data rate, and the ESC & backward alarm settings determine the required overhead, then **for two modems to interwork** the following parameters **must match** on both pieces of equipment:

- Main data rate.
- Async ESC Baud Rate, **Character length and Parity.**
- Backward Alarm option (ie both enabled or both disabled).

* Baseband modes (ie both Continuous Data or both Drop/Insert).

If *No ESC* is chosen then the dialogue ends here, otherwise it proceeds with the Backward alarm option as follows:

Backward Alarm facilitv:[?]
1=Normal (Back' Alm) 2=No Backward Alarm

Change, Tx/Rx, Service, Closed Net, Plus ESC, BA Menu

*NORMAL*A Backward alarm facility is provided causing a deferred alarm to be raised on this local equipment if the distant end Rx fails for any reason (eg local Tx failure, or distant Rx failure). The proportion of the overhead assigned to the ESC drops slightly (68% to 65%), so the overhead may increase marginally to provide the same async ESC rate.

NO BACK' ALM No Backward Alarm is sent (Tx) or received (Rx) and so slightly more of the overhead is available to the async ESC, lowering the total overhead marginally.

See "Overhead Rates" in section 8.7.1 on page 149 for details of the overhead percentage requirements for differing mixes of main data and async ESC data rates.

6.6.3 Change, Tx/Rx, BASEBAND Menu

This menu allows selection of the Baseband mode of the Modem

Tx BB: [?] 1=Continuous data **2=Drop Mux 3=Other function**

Change, Tx/Rx, Baseband Menu

Continuous Data Selects normal continuous data interface operation, the menu dialogue for this continues in the next section.

Drop/Insert Mux This option is only shown if the Drop/Insert feature is available, standard on the P300-IBS and above. It selects the Drop (Tx) / Insert (Rx) mode of baseband operation where a T1 or E1 PCM bearer is routed through the equipment, with Tx data being dropped from specific timeslots of the bearer, and Rx data being inserted back into the same or other timeslots. The menu dialogue for this continues in section 6.6.5 on page 61.

Other Function This option is only shown if the IDR option is fitted (as this includes the P1348/P1448 emulation mode, standard on P300-IDR and above) and the unit is set for ***IBS*** service. It selects the two special modes of baseband operation which use the Audio ports normally used for the IDR audio ESC circuit as the main traffic data. The unit can generate a 64kbps carrier comprising just the two 32kbps ADPCM audio channels, or a 128kbps carrier comprising 64kbps data (from the main data interface of the modem) plus the two 32kbps ADPCM audio channels. These modes are effectively an emulation of the popular P1348/P1448 voice/data mux card used often in SNG applications. The menu dialogue for this continues in section 6.6.6 on page 65.

6.6.4. Change, Tx/Rx, Baseband, CONTINUOUS Menu

Selecting *CONTINUOUS DATA* for the baseband interface leads to the following menu. Enter the data rate with any leading zeroes required, then press YES, if the field is incomplete the unit will add the trailing zeroes (to avoid having to enter three trailing zeroes when working with rates such as 64000, 128000 etc). When the field is full, pressing YES enters the new data rate.

Set Tx terrestrial data rate [2048000bps] **(2400-4920K) ???????bps (YES)**

Change, Tx/Rx, Baseband, Continuous Menu

If the **data rate is 2048000bps** and the Modem is set for **IBS/SMS service**, or a Custom service based on IBS framing, then this is a special condition. In this situation there are two modes of adding IBS framing, either normal (with 6.7% overhead) or G.732 mode (where the embedded framing in the G.732 is used, and no overhead is added). These modes are often referred to in the service definition specifications as **1920kbps or 1984kbps operation**. Refer to section 7.2.1 "Change, Tx/Rx, Baseband, Continuous, 2048k Menu (IBS)" on page 139 for the description of the dialogue in this case.

Similarly if the **data rate is 2048000bps** and the Modem is set for a **Custom service based on the IDR Low rate format** the Modem can provide additional features if the data is G.732 framed. In such a case it can either allow the transmit timeslots to be arbitrarily re-ordered, or frame align the Tx data within the satellite IDR frame, so that the distant receive equipment may arbitrarily re-order the timeslots. Refer to section 7.3.1 "Change, Tx/Rx, Baseband, Continuous, 2048k Menu (IDR)" on page 141 for the

description of the dialogue in this case.

Finally for data rate of **48kbps or 56 kbps**, in IBS modes the Modem automatically activates the X.50 `bit stuffing` to convert to/from 64kbps (as defined for IBS operation). However in **Custom IBS modes** the operator is offered the option of not using this facility. In Normal IBS modes then with 48 or 56kbps data the satellite rate is 64kbps x 16/15, but in custom modes this can be reduced to just 48 or 56 kbps x 16/15 (or less if Minimum overhead mode is selected).

6.6.5 Change, Tx/Rx, Baseband, DROP/INSERT Menu

These screens are only shown if the Drop/Insert feature is available, standard on the P300-IBS and above.

Drop/Insert selects the baseband mode where the Tx data is removed (dropped) from a T1 or E1 PCM bearer, and the Rx data is placed (inserted) into a similar bearer. The modem is capable of operating in Drop/Insert with any terrestrial interface, although in practise it is rarely used without a G.703 (DS1) interface.

The first step is to specify to the modem which format of PCM bearer it is working with:

Select bearer: [?]
1=G.732 2=T1-D4 3=T1-ESF

Change, Tx/Rx, Baseband, Drop/Insert, Bearer Menu

Following the bearer type selection, the timeslots from which the Tx data is to be Dropped (or in the Rx case where the Rx data is to be inserted) must be specified:

Drop TS: 1, 3-5, 17-15, 23
Toggle: ??-?? (YES) ßHelp

Change, Tx/Rx, Baseband, Drop/Insert, Timeslot Menu

The screen above shows groups of eight timeslots selected: 1, 3, 4, 5, **17, 16, 15**, 23, although any combination is possible. The selection system works by toggling timeslots or groups of timeslots into or out of the selection:

- In *G.732* mode timeslots are labelled **0 - 31**. In *T1-D4* and *T1-ESF* modes timeslots are labelled **1 - 24**.
- Timeslots already in the selection are toggled out from any position of the selection when the timeslot number is entered.
- Timeslots **not** already in the selection are toggled on, and placed on the end of the selection.
- Enter any single timeslot as a single or dual digit, eg 0, 5, 05, 23, 31
- Enter groups of timeslots as two pairs eg 02-5 (two through five), 11-17, 12-2
- For those familiar with other manufacturers equipment which use the term `mapping` (to relate the terrestrial timeslot selection to the order in the satellite frame). The terrestrial timeslots are `mapped` into the satellite frame *in the order listed on this timeslot selection screen*. If you want to revise the mapping, simply re-order the timeslots on this screen. For the example shown above the mapping would be as follows:

Terrestrial:	1	3	4	5	17	16	15	23
	↓	↓	-	↓	↓	-	↓	↓
to Satellite:	1st	2nd	3rd	4th	5th	6th	7th	8th

NOTE: If the Extended D/I feature is available (standard on P300-TCM) timeslots can be arbitrarily re-ordered, and so group selections may be down as well as up eg 11-17 means send in order

11,12,13...17, whereas 17-11 means send in order 17, 16, 15, ...11

NOTE: In G.732 mode whilst TS0 can be dropped, it must always be replaced in TS0 at the distant end (otherwise there is the possibility of frame alignment ambiguity).

The Modem hardware is capable of duplication and omission of timeslots, although the operator interface (described above) does not allow such selections. If this is a requirement, please contact the factory to discuss your needs.

After the timeslot selection the following prompt appears:

Dropped TS: [?]
1=Leave 2=Replace with idle code

Change, Tx/Rx, Baseband, Drop/Insert, Idle Menu

When data is `Dropped` from the bearer, there is the option to either leave the Tx data on the bearer, or to replace it with an idle code. If the Rx data is to be inserted into the same timeslots as the as the Tx data has been dropped from, then the Rx data will replace the Tx and it is of no consequence if it is first replaced by Idle code or not.

LEAVE The Tx data remains on the bearer, and will be accessible to downstream equipment (unless Rx data inserted over it)

REPLACE The Tx data is replaced as follows [MSB..LSB]:

G.732 Timeslots:	[01010101]
G.732 CAS in TS16:	[0101] (if CAS signalling mode active)
T1-ESF & T1-D4 Timeslots:	[10000000]

Note that in G.732 mode, TS0 is never replaced with idle code even if it is part of the Drop selection and Idle is selected.

If the modem is set for *CLOSED NETWORK* or standard *IDR* operation the dialogue finishes here.

If the modem is set for *CUSTOM IDR* (Low rate format) then skip to the ♦on page 65

If the Extended D/I feature is available (Standard on P300-TCM) and is set for *Closed Net Plus ESC*, *IBS* or *CUSTOM IBS*, then the following two prompts appear depending on the PCM bearer selected. Note that Channel Associated Signalling (CAS) & Robbed Bit Signalling (RBS) are described in Appendix F "Signalling Systems Introduction: CCS, CAS & RBS" on page 215 if required.

For *G.732* bearer operation (with the Extended D/I feature available):

G.732 Chan Assoc Sig in TS16: [?]
1=Normal (ignore) 2=Transfer via sat o/h

Change, Tx/Rx, Baseband, Drop/Insert, CAS Menu

NORMAL (IGNORE) TS16 does not contain CAS (ie a terrestrial CAS multiframe and `abcd` signalling nibbles for each timeslot). It is simply treated as a normal data timeslot and may be dropped / inserted as with any other timeslot.

TRANSFER TS16 contains CAS and by implication a terrestrial multiframe in order to carry the CAS. If selected, the terrestrial multiframe will be acquired, and CAS removed from/replaced into the Drop/Insert bearer. The CAS will be conveyed transparently from end to end of the link within IBS (or custom IBS) overheads.

For *T1-D4* & *T1-ESF* bearer operation (with the Extended D/I feature available):

T1 RBS over satellite: [?]
1=Normal (or no RBS) 2=Maintain RBS

Change, Tx/Rx, Baseband, Drop/Insert, RBS Menu

NORMAL (OR NO RBS) Robbed Bit Signalling (RBS) is not in operation, or can be ignored.

MAINTAIN RBS Robbed Bit Signalling (RBS) is in use with the least significant bit of each timeslot being used for signalling in frames 6 & 12 (D4) or 6, 12, 18, 24 (ESF) of the terrestrial multiframe. When this option is selected the Drop/Insert data is treated specially, and is placed into the bearer by the insert mux in the same frames from which it came. It is still possible to drop from and insert into different timeslots, it is simply that the frames of data containing the RBS are replaced into the *same relative positions within the terrestrial multiframe* by the insert mux, in order to preserve the RBS.

Following either of these selections, the Modem counts how many timeslots are being accessed and determines how to maintain the Timeslot identity. Refer to the section on "Timeslot Identity Maintenance" in Appendix F on page 214. Wherever possible the Modem resolves the issues itself, but where there might be a compatibility issue between different modem vendors the modem prompts the operator for input.

- If operating with a *G.732* bearer and *CAS* is selected, then the timeslot identity will be maintained by the satellite CAS Multiframe used to convey the CAS signalling. No user input is required
- If operating with a *T1-D4* or *T1-ESF* bearer and *RBS* is selected, then the modem will maintain the Timeslot (and RBS) identity using the normal TS32 Multiframe if possible, and if not it will activate a satellite CAS multiframe to support the RBS. No user input is required
- If no signalling (CAS or RBS) are active, then the Modem will maintain the timeslot identity by using the satellite TS32 multiframe where possible (unless N, the number of dropped/inserted timeslots falls into the category of `Odd values of N`). It will indicate as follows to which the operator just answers YES to accept the information:

TS identity will be maintained over
satellite by TS32 Multiframe (YES)

Change, Tx/Rx, Baseband, Drop/Insert, Ident Menu

- If no signalling (CAS or RBS) is active <u>and</u> the value of `N` of dropped and inserted timeslots falls into the category of `Odd values of N`, then it is not possible to maintain the timeslot identity using the satellite TS32 multiframe. The `Odd values of N` are

  N = **7, 9, 11, 13, 14, 17, 18, 19, 21, 22, 23, 25, 26, 27, 28, 29, 31**

  If this is the case and the Extended D/I feature is available (standard P300-TCM) then the modem prompts to see if timeslot ID maintenance is required:

TS identity over satellite: [?]
1=Normal (maintain) 2=Don=t care

Change, Tx/Rx, Baseband, Drop/Insert, Maint' Menu

NORMAL (MAINTAIN) The Modem will activate the satellite CAS multiframe in order to provide timeslot ID maintenance for the `Odd value of N` selected. Note that this mode may not be compatible with other manufacturers IBS/SMS equipment, as this is a special feature of the P300 and P400 series modems (which is why it asks you the question, instead of just getting on with it !).

DON'T CARE Timeslot ID will <u>not</u> be maintained and the Modem will be compatible with other manufacturers equipment for these `Odd values of N`.

This is the end of the Drop/Insert dialogue when in *Closed Net Plus ESC*, *IBS* or *CUSTOM IBS* modes

- If the Modem is in *CUSTOM IDR* mode (low rate format) then it is possible to maintain the Timeslot ID even with an IDR overhead structure. Refer to the section "Timeslot identity maintenance" in Appendix F on page 214 if a refresh is required. Note that this is only offered under Custom IDR to simplify normal IDR menu operation, but Custom IDR can be selected with all the possible custom features set to `Normal` to allow normal IDR operation, but **with timeslot ID maintenance**. Note that for low rate IDR carriers (<1544kbps) INTELSAT specify the IBS overhead structure, but the Modem can operate the IDR 96kbps overhead (and use Drop/Insert) even down to 64kbps.

If the Modem is in *CUSTOM IDR* mode (low rate format) then the following prompt is displayed:

TS identity over satellite: [?]
1=Maintain 2=Don't care (Normal)

Change, Tx/Rx, Baseband, Drop/Insert, IDR Maint' Menu

MAINTAIN The dropped/inserted timeslots will be aligned in the satellite IDR frame in order to maintain the timeslot identity.

DON'T The dropped/inserted data will be arbitrarily placed in the satellite IDR frame and the identity of the timeslots will not be maintained (as with normal IDR).

6.6.6 Change, Tx/Rx, Baseband, OTHER Menu

If the IDR option is fitted (standard on P300-IDR and above) then the modem can generate a 64kbps carrier comprising just of two 32kbps ADPCM audio channels, or a 128kbps carrier comprising 64kbps data (from the main data interface of the modem) plus two 32kbps ADPCM audio channels. These modes are effectively an emulation of and are compatible with the popular P1348/P1448 voice/data mux card used often in SNG applications. The choice between which mode is made on the following menu:

Voice/Data mux (P1348/P1448 emulation): [?]
1=Audio 2=Audio+64k Data

Change, Tx/Rx, Baseband, Other Menu

AUDIO A 64kbps data stream is generated from the two 32kbps ADPCM audio ports normally used for the IDR Audio ESC function. Closed Net Plus ESC, IBS or Custom IBS overhead is required in order to maintain the octet alignment (part of timeslot ID maintenance) in order for this to function.

On the Tx path the clock mode is forced to internal, and on the Rx mode the clock mode is forced to satellite (as the terrestrial interface is audio only there are no clocking issues).

AUDIO+DATA A 128kbps data stream is generated, 64kbps from the two 32kbps ADPCM audio ports normally used for the IDR Audio ESC function plus 64kbps from the main data port. Closed Net Plus ESC, IBS or Custom IBS overhead is required in order to maintain the timeslot ID and hence keep the channels separate in order for this to function. Normal clocking selections are available.

6.6.7 Change, Tx, CLOCKING Menu

Paradise Datacom products have always provided a `Data Marginal` warning where the incoming data phase is monitored with respect to the clock. The Modem shows a `Data Marginal` warning on the front panel if the data **changes** at the *instant* where it should be stable (and is sampled by the modem) which would otherwise cause data errors with no fault indication.

On the P300 this is taken a stage further and if the data phase is incorrect with respect to the normal clock edge, then the modem automatically switches to the other clock edge to sample the data. A Data Marginal warning is only issued momentarily as the phase switches. If regular Data Marginal warnings appear (for example in the traffic log) then the Tx data and clock phase are drifting (causing the modem to switch repeatedly) and you will be getting regular data errors. **This is not a modem fault, it is a warning of a situation causing data errors of which you would otherwise be unaware !** For this reason it is not possible to simply disable the Data Marginal alarm, instead you must investigate the external equipment to find why the Tx clock/data phase is changing.

The Tx clocking menu is as follows:

Tx clock mode: [?] **1=Tx Clock In 2=Internal 3=Rx ref(=Sat)**

Change, Tx, Clocking Menu

This selects the clock source used to generate the signal towards the satellite. The options are:

TX CLOCK — The external clock supplied on the interface `*Clock In*` line will be used (see interface card details in appendix A for line names). Should this clock input fail the Modem will switch to an internal backup clock (as used when *INTERNAL* is selected) to maintain the carrier, distant demodulator lock, and if a framing overhead is active, the Backward Alarm, Aux, and ESC channels.

INTERNAL — The Modem outputs a clock on the `*Int Tx clock out*` line (see interface card details in appendix A for line names) for use by the external equipment. Unlike the previous Paradise products, there is ***no requirement*** to loop this clock back into the `*Clock In*` line, on the P300 Modem it is routed internally.

The clock is normally generated from the internal frequency reference of ±1PPM. However if a Station Clock of 10MHz (only) is applied to the unit, then under the Rx Clocking screens it is possible to force the modem to replace the internal 1PPM reference with the 10MHz Station Clock as the reference for **all clocks and IF synthesizers** which normally use the internal reference. If this is the case then the *Internal Clock* would be generated from the 10MHz station clock.

RX REF(=???) — As *INTERNAL* except the Tx clock is generated from the Rx **output** clock. *Ref(=???)* shows the current Rx clock setting from which the Rx output clock is itself being generated. **This option is only of any practical use when the Rx Clocking is set to *Satellite* or *Station Clock***. When the Rx Clocking = *Satellite* this is commonly called `**Loop Timing**`.

Note: it uses the Rx **output** clock, **not *necessarily* the clock from the satellite**, ie the clock used depends on the Rx Clocking setting. This means for example that if the Rx Clocking = *Station Clock*, then setting Tx Clocking =*Rx ref(=Stn)* would slave the Tx Clock ultimately from the Station Clock (whatever

the Station Clock frequency). Similarly setting Tx Clocking = *Rx ref(Sat)* (ie with Rx Clocking = *Satellite*) would slave the Tx Clock to the incoming satellite clock (which is what most other modem manufacturers means by Tx=Rx). In all cases if the clock selected by the Rx Clocking fails, then the backup receive clocks (as defined in the Rx Clock section) also source the Tx Clock as it is slaved to the Rx clock whatever the source.

Note the P300 provides as standard the facility for **Asymmetric Loop Timing** (a $1000 option from some vendors). This means you can set Tx timing = *Rx ref(=Sat)* even if the Tx and Rx rates are different and it will generate the Tx Clock from the incoming satellite clock. This works for **any combination of rates**, it does not require the Rx rate to be higher than the Tx, or the rates to be in any way related.

Finally, **and only for those with inquisitive minds**, why does it state earlier "This option is only of any practical use when the Rx Clocking is set to *Satellite* or *Station Clock*" ? Because, with Rx=*Tx Clock In* it causes a clock loop as Rx=Tx AND Tx=Rx, with Rx=*Internal* it is the same as selecting Tx=*Internal*, ie the second Tx Clocking option, and with Rx=*DCE Clock* it does something entirely different for a reason even the inquisitive would find tedious, and uses the Station Clock again if there is one or the Internal 1PPM ref if not. So this option really is only of any practical use when the Rx Clocking is set to *Satellite* or *Station Clock*.

6.6.8 Change, Tx, MODULATOR Menu

```
Mod: 1:Freq 2:Mod'n 3:FEC 4:RS
5:Scr 6:Carr 7:Pwr 8:Spect Inv 9:AUPC
```

Change, Tx, Modulator Menu

Each option leads to the following menus:

6.6.9 Change, Tx/Rx, Modulator, IF FREQUENCY Menu

```
Set IF Frequency: [70.0000MHz]
50-180MHz (100Hz) ???????? (YES)
```

Change, Tx/Rx, Mod/Demod, IF Frequency Menu

The operator is prompted to enter the desired transmit frequency. In the 70 MHz band, the valid range is from 50MHz to 90MHz and in the 140 MHz band the valid range is from 100MHz to 180MHz. If both the 70MHz and 140MHz IF bands are available (standard P300-IBS and above) then the range is actually continuous from 50MHz to 180MHz (ie includes 90-100MHz). As the data entry field is 7 characters, entries for the 70MHz band require a leading zero to be entered. The operator may enter any frequency within either the IF band with up to 100Hz resolution. The unit will reject a frequency which falls outside the ranges stated, and will prompt the user to re-enter the value. Once complete, the user should press the **YES** key to accept the new value. Mistakes made when entering data can be corrected by using the **NO/PREV** key.

On later software, if the operator has set the SHF Frequency (*Change, BUC/LNB, Tx/BUC, SHF Frequency*) then the BUC / Upconverter chain frequency shift is added to the IF range of the modem, and the frequency on this edit screen is displayed and entered directly as the final SHF frequency at the antenna.

6.6.10 Change, Tx/Rx, Modulator, MODULATION Menu

```
Set modulation: [?]
1=BPSK 2=QPSK 3=OQPSK 4=8PSK
```

Change, Tx/Rx, Mod/Demod, Modulation Menu

The modulation may be selected from BPSK (Bi Phase Shift Keying), QPSK (Quadrature Phase Shift Keying), OQPSK (Offset QPSK), and if the 8PSK/TCM feature is available (standard P300-TCM) 8PSK (Eight Phase Shift Keying). Except for the very lowest of data rates where BPSK reduces the effects of system phase noise, QPSK or preferably 8PSK is virtually always used for bandwidth efficiency. When the demodulator is set to OQPSK, it will take approximately twice as long to acquire a carrier (for the same sweep width) as QPSK, due to the lack of power nulls in the OQPSK modulated carrier.

The allowable combinations of Modulation and FEC mode/Rate are:

BPSK / QPSK / OQPSK:	None, Viterbi or Sequential at rate 1/2, 3/4, or 7/8
8PSK:	TCM only at rate 2/3

See the OQPSK primer below, and also refer to Appendix E "Fault Mode 12" for interworking OQPSK between early and later P400 series modems.

OFFSET QPSK (OQPSK) PRIMER

When using Offset QPSK (OQPSK) modulation, the in phase and quadrature components of each symbol do not change together (as with QPSK), but instead one component is delayed by half a symbol compared to the other. Looking at a constellation (vector) diagram this effectively limits the *instantaneous* change of phase to either +/-90 degrees, excluding the 180 degree phase change which takes the vector transition through the zero amplitude point (equating to an instantaneous null in the RF envelope). By preventing the carrier phase change moving through the null power point, large amplitude variations of the output carrier are avoided. Consequently on links which exhibit some non-linearity (and therefore probably some AM to PM conversion), there is reduced amplitude modulation (AM) to get converted to Phase Modulation (PM) which would otherwise degrade the distant Eb/No as a phase noise effect.

6.6.11 Change, Tx/Rx, Modulator, FEC Menu

The operator is first prompted to select the Forward Error Correction (FEC) type, and the choices are between:

Select FEC Type: [?]
1=None 2=Viterbi 3=Sequential 4=TCM Rate 2/3 5=Turbo

Change, Tx/Rx, Mod/Demod, FEC Type Menu

NONE (uncoded)
VITERBI (if Viterbi FEC option fitted)
SEQUENTIAL (if Sequential FEC option fitted)
TCM (Trellis Code Modulation if the 8PSK/TCM feature is available, Rate 2/3 only)
Turbo (Turbo Product Code FEC, if the Turbo option is available)

Pressing **YES** accepts the current FEC type, and where there is a choice of FEC rates leads onto the FEC Code Rate selection screen. Note that 8PSK and TCM must be used together, and that for TCM only rate 2/3 is available.

For a review of the **processing delay associated with the Sequential decoder**, and how this is minimised, please refer to "FaultMode = 3" in Appendix E.

If interworking with other manufacturers equipment it is worth reading the notes in the section "Interworking different manufacturers equipment" on page 155 which covers primarily scrambling, but also the requirements for Spectrum Invert with Viterbi/Sequential in BPSK and QPSK. If specifically interworking with Comstream equipment with sequential FEC, see also Appendix E for "Fault Mode 11" (Comstream compatible sequential mode).

For *Viterbi* and *Sequential* FEC the FEC rate selection screen is as follows:

Select FEC Rate: [?]
1=1/2 Rate 2=3/4 Rate 3=7/8 Rate

Change, Tx/Rx, Mod/Demod, FEC Rate Menu (Vit/Seq)

The FEC code rate may be select as 1/2, 3/4, or 7/8 Rate, again pressing **YES** will accept the current FEC rate and return to the Change, Tx, Modulator menu. Most INTELSAT services use the more powerful 1/2 rate or 3/4 rate FEC (increasing the data rate by factors of 2 and 4/3 respectively).

The operator is warned of unusual combinations of Modulation and FEC type/code rate when *SETUP-CHECK* is requested.

For *Turbo* FEC the FEC rate selection screen is as follows:

Select Turbo Mode/Code rate, then (YES)
[0.750 Industry de-facto 3/4 rate] ↓↑

Change, Tx/Rx, Mod/Demod, FEC Rate Menu (Turbo)

The Turbo FEC code rate may be selected from the scroll list of preset rates displayed on the screen. pressing **YES** will accept the current FEC rate and return to the Change, Tx, Modulator menu. This list can contain up to 31 different rates, but currently only the following are defined:

Screen Description	**Exact code rate**	**Delay (bits) ***	**Modulation Schemes from**			
			BPSK	QPSK	OQPSK	8PSK
"0.3125 Industry de-facto 5/16 rate"	0.3125	2662	V3.57	V3.57	V3.57	n/a
"0.477 Industry de-facto 21/44 rate"	21/44	4056		V3.57		n/a
"0.493 Paradise 1/2 rate"	2028/4116	4056		V3.40		n/a
"0.666 Paradise 2/3 rate"	2499/3748	4998		V3.57		n/a
"0.750 Industry de-facto 3/4 rate"	0.750	4446		V3.40		n/a
"0.789 Paradise 3/4 rate"	3249/4116	6498		V3.40		n/a
"0.875 Paradise 7/8 rate" ** (Low Latency)	0.875	450 (yes 450)		V3.40		n/a

* Note on processing delay. Use the data rate *before* the FEC to determine the delay in milliseconds from the delay in bits. For example at 1Mbps using Rate 0.789 Turbo FEC, the FEC delay is (6498/1000000) seconds, which is 6.5ms.

** Note on Low Latency 7/8 Rate Turbo: As Turbo FEC schemes go this is a relatively poor performer. BUT it does provide about a 1dB performance improvement over 7/8 rate Viterbi, and for links where the transponder space is fixed to accommodate a 7/8 Viterbi coded link, switching from Viterbi to Turbo will give a useable 1dB improvement. It also provides significantly lower latency than subsequent Turbo schemes (which offer a better 7/8 rate performance at the cost of significant latency). If you`re stuck with a channel that can only accommodate 7/8 Rate FEC, then this will give you an extra dB over using Viterbi.

6.6.12 Change, Tx/Rx, Mod/Demod, REED-SOLOMON Menu

This option is only available if the INTELSAT Reed-Solomon feature is available (standard P300-IBS and above).

INTRODUCTION TO REED-SOLOMON

Reed-Solomon FEC is a powerful scheme `wrapped around` the normal inner FEC which may be used to correct the remaining errors from the normal Turbo, Viterbi, Sequential, or TCM inner FEC. The code rate is specified by three values `n`, `k`, and `t`. These have a fixed relationship of **n - k = 2t**, so `t` is simply half the difference between `n` and `k`. A typical code rate may be specified such as (n,k,t) = (126,112,7).

RS error correction works on codewords (blocks) of bytes, where `n` is the length of the block of which there are `k` bytes of original data, and 2t bytes of error correction information. The RS codec can correct any bytes in error up to a value of `t`, so in the above example with t=7, up to seven bytes within the 126 may be corrected no matter how many individual bits per byte are in error. However, when the error rate exceeds the correctable level, unlike other FEC schemes, which degrade gracefully Reed-Solomon fails dramatically. Once the error correction threshold is passed (eg 8 errors in our example block) the codec considers it uncorrectable and passes the block *uncorrected*, ie the error rate goes from 0 to *no error correction* in one step. There is a small transitional area where due to the distribution of the errors, the errors in some blocks are just below the threshold (and therefore fully correctable) and for some blocks just above (and therefore uncorrectable). In practice this effect gives a RS satellite circuit a transition from error free to unserviceable in about a 1dB change in Eb/No.

In addition to the (n,k,t) specification of the code rate, there is an additional parameter of *interleaving depth*. Interleaving is used to `mix up` the blocks so that a burst of errors affects a few bytes from several blocks, rather than a lot of bytes from a single block. Interleaving is usually of depth 4 or depth 8. The configuration menus are described in the following paragraphs.

See also the applications section, para 8.4 "Choosing *Optimum* Custom RS N&k Values" on page 146

The Reed-Solomon menu appears as follows:

Tx RS outer codec: [?]
1=Off 2=INTELSAT n,k,t & depth 3=Other

Change, Tx/Rx, Mod/Demod, Reed-Solomon Menu

The Reed-Solomon outer FEC codec may be configured as follows:

OFF The Reed-Solomon out FEC is disabled. Note that for testing the effectiveness of the RS codec, a test mode allows you to disable the RS decoder error corrections without removing the RS overhead (which changes the satellite data rate and therefore to a small extent the Rx Eb/No).

INTELSAT This switches the RS codec on using standard INTELSAT values, which are as follows:

<table>
<tr><th>FEC</th><th>Framing</th><th>Data Rate</th><th>(n,k,t)</th><th>Depth</th></tr>
<tr><td rowspan="2">TCM</td><td rowspan="2">Any</td><td>> 1544 kbps</td><td rowspan="3">(219,201,9)</td><td>8</td></tr>
<tr><td><= 1544 kbps</td><td rowspan="6">4</td></tr>
<tr><td rowspan="5">Non-TCM
eg Turbo, Viterbi, Sequential, or No FEC</td><td rowspan="4">IDR</td><td>2048 kbps</td></tr>
<tr><td>1544 kbps</td><td>(225,205,10)</td></tr>
<tr><td>Other rates</td><td rowspan="2">(126,112,7)</td></tr>
<tr><td>IBS or Closed Net</td><td>All rates</td></tr>
</table>

Note: When interworking with NEC modems in TCM mode (and IBS framing), NEC have chosen to use Interleaving depth 4 for all data rates. For rates >1544kbps then it will be necessary to select `Other`, and manually select the interleaving as depth 4.

OTHER This option is only available if the `Custom Features` feature is available (standard on P300-TCM). This feature allows the operator to specify the code rate outside of the normal INTELSAT parameters ***ie a fully variable code rate Reed-Solomon codec***. The limitations are as follows `n` = [60 - 255], `k` = [n - (2, 4, 6, 8, 10, 12, 14, 16, 18, or 20)] ie `t`=1 to 10.

See the applications section, para 8.4 "Choosing *Optimum* Custom RS N&k Values" on page 146

6.6.13 Change, Tx/Rx, Mod/Demod, SCRAMBLER Menu

Scrambler: [?]
1=Off 2=Normal 3:Other

Change, Tx/Rx, Mod/Demod, Scrambler Menu

The Scrambler selection is made from *OFF*, *NORMAL*, and *CUSTOM*.

OFF Turns off all scrambling, and whilst this may be used for testing or carrier line up, it is not normally used over satellite.

NORMAL Selects the appropriate scrambler based on the current configuration, and enables it (see table below).

FEC:	No Reed-Solomon		Reed-Solomon Active	
Service type:	Non Turbo	Turbo	Non Turbo	Turbo
Closed Net (No ESC), **Closed Net + ESC (<32kbps),** **IDR** (& Custom IDR) Custom IBS without TS32 MF	V.35 Scr	Turbo Scr	RS Scr	RS Scr
IBS/SMS, **Closed Net + ESC (>=32kbps),** Custom IBS with TS32 MF	IBS/SMS synchronous scrambler			

The rationale behind this "*NORMAL*" option is deceptively simple: Following Intelsats example of using Reed-Solomon with IBS or IDR, we have simply used the ***first*** *synchronous* scrambler in the transmit chain even when two or more are available. Also ***any*** synchronous scrambler is used in preference to the V.35 self synchronising scrambler, as this will multiply received errors degrading performance.

Other This allows non standard scrambler operation to match the configuration of other non standard equipment which leads onto the following menus:

Toggle Scramblers:
1=IBS (Off) 2=RS (N/A) 3=V.35 (On) 4=Turbo (N/A)

Change, Tx/Rx, Mod/Demod, Scrambler-Custom Menu

Pressing **1**, **2**, **3**, or **4** toggles each available scrambler between On and Off. Scramblers which are not available are shown as N/A (Not Available) as they are out of circuit (eg Reed-Solomon scrambler when RS is *Off*). This screen specifically allows you to enable more than one scrambler, in order that you might match the (mis)configuration of other equipment which allows the operator to accidentally switch multiple scramblers on. When the V.35 style scrambler is enabled a subsequent menu is displayed.

V.35 Style Scrambler [?]
1=CCITT 2=INTELSAT V.35 (Normal) 3=FDC 4=Linkabit

Change, Tx/Rx, Mod/Demod, Scrambler-Custom V.35 Menu

This screen then allows selection between CCITT V.35, INTELSAT V.35, FDC (Fairchild), and Linkabit types. These are all different interpretations of the poorly defined V.35 scrambler specified by the CCITT. Unless you are trying to inter-operate with another manufacturers equipment known to have an incorrect scrambler, select **INTELSAT** mode as this is the most common.

Refer also to section 8.9 on page 154 which describes in more detail the different scramblers, and interworking between manufacturers.

The operator is warned of unusual scrambler settings when *SETUP-CHECK* is requested.

6.6.14 Change, Tx, Modulator, CARRIER Menu

Carrier: [?] 1=Off 2=On
3=Muted after pwr brk 4=Intfc RTS Controlled

Change, Tx, Modulator, Carrier Menu

The state of the Transmit Carrier is selected as follows:

OFF — The carrier is off.

ON — The carrier will remain on, and after a power break it will automatically return to on.

POWER BREAK MUTE — The carrier is switched on **BUT** after a power cut the carrier will be switched off and a deferred alarm generated until either from the front panel or remotely the unit is instructed to return the carrier to the on state.

RTS CONTROLLED — The carrier will be dynamically controlled by the `*Sig Valid In*`, the RTS line on a V.35 DCE interface (see interface card details in appendix A for line names for other interfaces). No alarm is raised when the Tx carrier is muted by the RTS line going to the `off` state unless the RTS line itself is set to raise an alarm if it goes to the off state (*Change, Terr-Intfc, Control Lines*).

The operator is warned if the carrier is set to *POWER BREAK MUTE* when *SETUP-CHECK* is requested.

6.6.15 Change, Tx, Modulator, POWER LEVEL Menu

This is the normal menu for the P300 and P310 L-Band modem. An alternative menu is displayed when operating in `Terminal` mode with a Paradise BUC.

Set Tx Power [-15.3dBm]
enter value ??.? (YES), or ↑↓ to change

Change, Tx, Modulator, Power Menu (Normal)

This menu allows control of the Transmit output power. This may be varied from 0dBm to -25dBm (-5dBm to -30dBm for the P310) in 0.1dB steps, either by direct entry of the required power or by using the up/down keys to adjust the current value up or down in 0.1dB steps. Pressing the Up/Down keys rapidly causes the level to change in 0.5dB increments. If AUPC is active (refer to AUPC in section 8.11 on page 156) then the delta power added by the AUPC is also displayed on the top line.

When the P310 is operating in Terminal Mode (ie with a Paradise BUC and with the FSK option fitted to the modem, and the Modem / BUC mode set to *Terminal*), the power level at the BUC is under closed loop control. The operator now enters the desired power at the BUC directly, and the modem operates in conjunction with the BUC, varying the Tx Carrier level and BUC attenuator to provide the desired power.

Power from BUC (13-33), now [31]dBm
1:Set new power 2:Nudge up/down

Change, Tx, Modulator, Power Menu (Terminal with BUC)

If a Paradise BUC & FSK are fitted, but the modem / BUC are set in independent mode, then a third screen is displayed (similar to the 1st) from which the setting of the BUC attenuator may also be accessed by pressing the down key from the power level menu.

6.6.16 Change, Tx/Rx, Modulator, SPECTRUM INVERT Menu

Spectrum Invert [?] **1=Normal 2=Invert**

Change, Tx/Rx, Spectrum Invert Menu

This menu allows the Tx Spectrum to be inverted, to cope with satellites or frequency conversion equipment which also inverts the spectrum. Note that **apart from the fact that the modem will not lock onto an inverted spectrum**, on a spectrum analyser the carrier is to all appearances unchanged.

The operator is warned if *SPECTRUM INVERT* is active when *SETUP-CHECK* is requested.

NOTE ON BPSK SPECTRUM INVERSION
True spectrum inversion does not affect BPSK signals and so in BPSK mode there is no requirement for a true spectrum invert feature. Instead in BPSK mode (to be compatible with other manufacturers equipment), the Tx Spectrum Invert option reverses the ordering of the pairs of Tx data symbols from the FEC encoder to the modulator. The `Normal` option is compatible with other manufacturers BPSK equipment. The Invert option (ie reverse pairs of Tx symbols) is compatible with earlier Paradise products such as the P200 (which we consider to have the `correct` symbol pairing !). On the Rx path the symbol pairing is automatically determined, and so the Rx Spectrum Invert feature has no effect in BPSK.

If interworking with other manufacturers equipment it is worth reading the notes in the section ''Interworking different manufacturers equipment''on page 155 which covers primarily scrambling, but also the requirements for Spectrum Invert with Viterbi/Sequential in BPSK and QPSK.

6.6.17 Change, Tx, Modulator, AUPC (Software >=V2.12)
This menu is only displayed if the AUPC feature is available. It is advisable to refer to the introduction to AUPC in section 8.11 on page 156 before enabling this facility.

AUPC: 1:Mode 2:Max 3:Min 4:Slew rate **5:Target Eb/No 6:Tolerence 7:Loss act'**

Change, Tx, Modulator, AUPC Menu

Note that options 2 through 7 only display when the AUPC mode It is set to other than *Off* or *Monitor Distant*, so initially only ''AUPC: 1:Mode'' may be displayed.

6.6.18 Change, Tx, Modulator, AUPC, MODE Menu

Set AUPC Mode: [Off] **1=Off 2=Mon dist' 3=Maint' EbNo 4=Self mon**

Change, Tx, Modulator, AUPC Mode Menu

NOTE: You probably need permission from the satellite operators to use AUPC unless you have a blanket power budget which you may use as you see fit.

The modes are as follows:

OFF — The modem disables the Auto Uplink Power Control, the Tx power will not adjust dynamically. Any AUPC positive or negative delta power adjustment to the Tx output power It is removed instantaneously (ie a Tx power step). Any bandwidth within the ESC channel used by the AUPC It is released back for ESC usage.

MON DIST' — The local modem utilises the async ESC channel between the local and distant modems to regularly collect Eb/No and BER data from the distant modem. This can be displayed with *Monitor, Distant Eb/No & BER*. This It is not an `active` AUPC mode and the Tx power will not adjust dynamically, it simply allows local monitoring (and logging) of distant performance.

MAINT Eb/No — This It is full AUPC mode. As with *MON DIST'* above it uses the ESC channel to collect Eb/No information from the distant modem, but in addition it varies the Tx power within the constraints provided to maintain a specified distant Eb/No.

SELF MON — This It is ONLY used in Tx only applications (typically point to multipoint) to attempt to maintain the Eb/No at (multiple) Rx only stations. It requires the modem to be able to receive the its own carrier via satellite (not by any form of IF loop). In operation it monitors the *local* Rx Eb/No and adjusts the *local* Tx power to keep this local Eb/No constant. This means it can compensate for atmospheric changes which affect the Tx signal to the satellite, and LOCAL atmospheric changes affecting the Rx signal from the satellite. If however (as It is common) there are multiple Rx terminals over a wide geographical area, then different atmospheric conditions over each terminal will still cause a variation in the Eb/No for each terminal.

Note: See AUPC in section 8.11 on page 156 regarding the async ESC channel requirements in order for local modem to distant modem communications in order for modes `*Mon Dist*` and `*Maint Eb/No*` to operate. Note also that the distant modem must be set for remote reporting of Eb/No with *Change, Rx, Demod, AUPC*.

6.6.19 Change, Tx, Modulator, AUPC, MAX Menu

Set AUPC max positive delta power **[3.5dB] (0-25.0dB) ??.?dB (Yes)**

Change, Tx, Modulator, AUPC, Max Menu

This allows the maximum additional power that the AUPC can use to maintain the distant Eb/No to be set. Set this so that the total maximum power (ie the nominal power set with *Change, Tx, Mod, Power* PLUS the AUPC Max positive delta power) It is within the constraints put upon your carrier by the satellite operators.

6.6.20 Change, Tx, Modulator, AUPC, MIN Menu

Set AUPC max negative delta power
[1.0dB] (0-25.0dB) ??.?dB (Yes)

Change, Tx, Modulator, AUPC, Min Menu

This allows the minimum delta power that the AUPC can use to maintain the distant Eb/No to be set.

Normally the maximum delta power It is set to give the distant Eb/No a boost in *poor* atmospheric conditions, with any improvements in Eb/No caused by particularly *good* atmospheric conditions being considered a bonus. It is it not normally necessary to set the minimum delta power to any figure other than zero otherwise any beneficial gain in Eb/No caused by good atmospheric conditions will be negated by a decrease in Tx power.

This facility only exists so, if as a condition of being able to use AUPC, the satellite operator has asked you to provide a reduced power in particularly good atmospheric conditions at your geographic location. This may be in an attempt to `balance out` any increase in power required for other locations where there may be poor atmospheric conditions, with the AUPC in those locations requiring additional power from the satellite.

6.6.21 Change, Tx, Modulator, AUPC, SLEW RATE Menu

Set maximum power slew rate: [10]dB/min
(0.1-99.9dB/min, 0=no limit) ??.? (YES)

Change, Tx, Modulator, AUPC, Slew Rate Menu

This facility allows the changes in Tx power to occur at a controlled slew rate to prevent step changes in Tx power at the IF output. A value of zero indicates no limit and step power changes will occur. Whatever the slew rate limit the power changes will remain within the Max and Min power limits set on the previous two screens. Use caution when setting this parameter so that the slew rate you impose It is not too great to prevent the AUPC system responding to rapid fades (eg 10dB fade in 10 seconds).

6.6.22 Change, Tx, Modulator, AUPC, TARGET EB/NO Menu

Set target Eb/No to maintain: [8.5]dB
(0 to 25.0dB) ??.?dB (Yes)

Change, Tx, Modulator, AUPC, Target Eb/No Menu

This screen allows the target Eb/No to be set. This It is the distant Eb/No when the AUPC mode It is set to *Maint' Eb/No*, and the local Eb/No when set to *Self Mon*. This It is the target Eb/No the AUPC will adjust the Tx power within the Max, Min, and Slew rate limits (once the Eb/No goes outside the Tolerance window set below) to try and restore this figure.

6.6.23 Change, Tx, Modulator, AUPC, TOLERANCE Menu

Set Eb/No tolerance before AUPC action:
[±0.5dB] (0.1-25.0dB) ±??.?dB (Yes)

Change, Tx, Modulator, AUPC, Tolerance Menu

This sets a `tolerance window` on the monitored Eb/No. The AUPC will only attempt to restore the monitored Eb/No to the target Eb/No when the monitored Eb/No moves outside the tolerance window. This It is to prevent the AUPC continuously adjusting the power to compensate for minor normal Eb/No variations.

When the monitored Eb/No moves outside the tolerance window the AUPC will attempt to restore it back to the *target value* (ie not just back inside the tolerance window again).

6.6.24 Change, Tx, Modulator, AUPC, CARRIER LOST ACTION Menu

Set AUPC power on carrier lost: [Nominal]
1=Freeze 2=Nominal 3=Maximum

Change, Tx, Modulator, AUPC, Comms lost action Menu

This screen sets what action the AUPC It is to take locally if it looses communications with the distant modem (ie presumably there It is a significant fade and the distant demod has lost lock).

FREEZE	The carrier power It is frozen at its current value.
NOMINAL	The AUPC delta power It is reset to zero so the carrier returns to its nominal power.
MAXIMUM	The AUPC delta power increases to the maximum power limit as set on the AUPC Max positive delta power screen.

6.6.25 Change, Tx/Rx, ESC/AUX/BA Menu

This dialogue is not available when the service is set at Normal *Closed Network*, and differs between *Closed Net Plus ESC*, *IBS/SMS* and *IDR* services. The IBS/SMS and IDR menu appears below, but some options may not be displayed depending on how the modem Service is defined:

ESC/Aux: 1:Define 2:Async ESC
3:Interfaces 4:Audio levels 5:Back'alm

Change, Tx/Rx, ESC/Aux/BA Menu (IBS/SMS/IDR)

In *Closed Net Plus ESC* mode a slightly different screen is displayed including the overhead percentage required to support the ESC rate as set:

ESC Channel (overhead is 2.39%):
1:Async[2400,8,N] 2:Interface[RS485] 3:Audio

Change, Tx/Rx, ESC/Aux Menu (Closed Net Plus ESC)

DEFINE Enable & Disable the ESC & Aux ports, specify the port usage (eg IDR sync or async ESC), and allocate different parts of the overhead to each port. In *Closed Net Plus ESC* the ESC channel is already defined to use as much of the overhead as possible and the Aux channel is not available so the *Define* option is not required (and is not offered).

ASYNC ESC When the ESC port is set for async operation this selection configures the async character format and Baud rate.

INTERFACES Set the electrical interfaces for each port, for the ESC port control if it is directly internally linked to the M&C port for distant end M&C

AUDIO LEVELS Set the levels or the Audio port, both in when used for IDR ESC and when used directly to generate a 64kbps carrier (2 x Audio only) or 128 kbps carrier (2 x Audio + 64k data)

BACK' ALM Configure the four Tx backward alarms to map to the external input ports, or be directly connected to the Rx fault status of this modem (saves external patching in non-multidestinational carriers). This option is on the Tx menu only and again is not shown in *Closed Net Plus ESC* mode.

IDR MODE ESC & AUX PORT DEFINITIONS

6.6.26 Change, Tx/Rx, ESC/Aux/BA, DEFINE (IDR) Menu

When operating in IDR or Custom IDR modes, the Define selection is as follows:

IDR 8k ESC: [?]
1=Off 2=Sync 3=Async

Change, Tx/Rx, ESC/Aux/BA, Define (IDR), ESC Menu

OFF The ESC port is disabled (and all ones is sent in the 8k ESC channel)

SYNC Normal 8k synchronous access is provided on the ESC port.

ASYNC This option is only available of the Async ESC feature is available (standard on P300-IBS and above). The ESC interface is set to be asynchronous. The exact Baud rate it can support varies with the async character format set on the Async ESC menu. Typically with 8 bits per character (or 7 + parity) it will support 4800 Baud, but with 8 bits plus parity, it will operate to 9600 Baud.

The reason for this strange situation is as follows: The async data is carrier *synchronously* across the 8k ESC link at 9 **sync** bits per async character (start + 8 data bits, no stop or parity). At 9600 Baud with 8 bits/char there are a maximum of 960 async characters per second (9600 / 10 [start + 8 bits + stop]). 960 async characters per second requires 9 x 960 sync bits per second to convey, unfortunately 8.64kbps above the 8kbps channel capacity and so characters will be lost. At 9600 Baud with 9 bits/char (ie 8 *plus* parity) there are 872 async characters per second (9600 / 11 [start + 8 bits + parity + stop]). 872 async characters per second requires 9 x 872 sync bits per second to convey, 7.85kbps, and so no characters will be lost over the 8K ESC channel. So when set for [8 bits No Parity] or [7 bits with Parity] the maximum standard Baud rate is 4800 Baud. When set for [8 bits with Parity] the maximum standard Baud rate is 9600 Baud.

This is followed by the Aux port definition screen:

Tx Aux Circuit: [?]
1=Off (normal) 2=64K in V1&2 3=32K in V1 4=32K in V2

Change, Tx/Rx, ESC/Aux/BA, Define (IDR), Aux Menu

The Aux port can provide a 32kbps or 64kbps synchronous data circuit in place of one or both of the Audio ESC channels:

OFF (NORMAL) The Audio ESC channels operate as normal, the Aux port is disabled.

64K IN V1+V2 Both ESC Audio channels are disabled, and the Aux port operates at 64kbps.

32K IN V1 Audio ESC V2 operates as normal, and the Aux port provides a 32kbps channel in V1.

32K IN V2 Audio ESC V1 operates as normal, and the Aux port provides a 32kbps channel in V2.

IBS MODE ESC & AUX PORT DEFINITIONS

6.6.27 Change, Tx/Rx, ESC/Aux/BA, DEFINE (IBS) Menu

When operating in IBS or Custom IBS modes, the Define selection is as follows:

Tx Aux Port: [?] 1=Off **2=INTELSAT low rate channel 3=Sync Channel**

Change, Tx/Rx, ESC/Aux/BA, Define (IBS), Aux Menu

OFF The Aux port is disabled.

INTELSAT The Aux port provides the `low rate ESC` definition in IESS309 (which then refers back to IESS403). In this mode only TS32 bit 1 of the overhead is allocated to the Aux port, which provides an oversampled async interface at a maximum Baud rate of approx 1/2000th the main data rate. Note that even in this mode a clock is available, and the port may be used synchronously (at 1/480th the data rate) if required.

SYNC CHANNEL This option is only available if the *IDR* option is fitted (standard on P300-IDR and above) as it requires the `Clock/Data/Octet` Aux port on the IDR option to provide the synchronous Aux interface (the single `Data` line used for the oversampled INTELSAT ESC on the Async ESC connector cannot provide a synchronous interface). If selected the Aux port operates synchronously, and varying amounts of the IBS overhead may be allocated to the sync Aux channel. The sync channel may utilise at up to a total of 21/32nds of the overhead which with Standard IBS/SMS this allows the Aux port to operate up to 4.375% of the main data port rate. The selection of the overhead available to the Aux channel is made following the next menu (which specifies the ESC port), allowing the overhead to be allocated between the Aux port and ESC ports.

This menu is followed by

ESC Port [?]: **1=Off 2:High Rate async channel**

Change, Tx/Rx, ESC/Aux/BA Define (IBS), ESC Menu

OFF The ESC port is disabled

HIGH RATE ASYNC The **ESC Channel** provides the `Paradise High Rate ESC`, which in a later menu may be configured to be compatible with earlier products such as the P230, P230D/I, and P1300/P1361 combination. This provides an async channel with maximum Baud rate *approximately* the terrestrial rate / 23 (eg usable rates of 2400 Baud at 64 kbps and 9600 Baud at 256 kbps). One of the prime uses for this ESC channel is to link it to the M&C port of the Modem (software controlled internal link), and provide remote M&C of the *distant* equipment from the *local* end of the link.

The following menu's depend on the selections made for the Aux & ESC channels
If the **ESC port** is *OFF* and the **Aux port** is set to *Sync Channel* then the following menu selects the overhead assigned to the Aux port:

Sync Aux circuit o/h usage: [?] **1=Maximum 2:Custom**

Change, Tx/Rx, ESC/Aux/BA Define (IBS) Aux usage Menu

MAXIMUM The maximum 21/32nds of the overhead is allocated to the Aux channel. This comprises S16, TS32 bits 1, & 5-8, and TS48. Giving an Aux port synchronous data rate of 4.375% of the main data rate. If used asynchronously (ie oversampled as with the INTELSAT definition), the async rate may be up to 1% of the main data channel rate, ie approx 600 Baud at 64kbps.

CUSTOM This option is only available of the `Custom Features` feature is available (standard P300-TCM). The overhead can be operator assigned to the Aux port, varying the overhead as defined in the paragraph title "Custom Overhead Allocation" a few paragraphs further on. If the **ESC port** is defined as *Custom*, then this one screen allocates overhead between the Aux and ESC ports.

If the **ESC port** is set to *High Rate Async* and the **Aux port** is set to *Sync Channel* then the following menu allows the overhead assigned to the ESC port to be determined.

Asvnc ESC: [?] **1=P230 compatible 2=Custom 3=All avail o/h{ after Aux}**

Change, Tx/Rx, ESC/Aux/BA Define (IBS) ESC usage Menu

P230 COMP' The standard 20/32nds of the overhead is allocated to the ESC and this is compatible with earlier products such as the P230, P230D/I, and P1300/P1361 combination. The overhead allocated to the ESC is TS16, TS32 bits 5-8, and TS48. TS32 bit 1 is not used as this is reserved for the INTELSAT low rate ESC (on the Aux port if so configured). The ESC port provides an async channel with maximum Baud rate *approximately* the terrestrial rate / 23 (eg usable rates of 2400 Baud at 64 kbps and 9600 Baud at 256 kbps).

CUSTOM This option is only available of the `Custom Features` feature is available (standard P300-TCM). A subsequent screen allows the operator to assign the overhead to the ESC port, varying the overhead as defined in the paragraph title "Custom Overhead Allocation" which follows. If the **Aux port** is also set to *Sync Channel* then this one screen allocates the overhead between the Aux and ESC ports.

ALL AVAIL All the available overhead is assigned to the ESC channel. if the **Aux port** is defined as *Sync Channel* then the selection reads *All Avail after Aux*, and when the operator has defined the overhead allocated to the Aux port, <u>any Remaining</u> is allocated to the ESC port. If using the Custom, IBS, Minimum overhead mode, where the overhead rate varies to accommodate the ESC Baud rate defined, then setting the ESC to *All Avail* maximises the proportion of the overhead available to the ESC, and lowers the overhead addition to the minimum possible.

6.6.28 Custom IBS Overhead Allocation

Several of the above paths lead to the following screen where the available overhead can be allocated between the Aux port (if set to *Sync Channel*) and the ESC port (if set to *Custom*). This option is only available of the `Custom Features` feature is available (standard P300-TCM).

This sophisticated facility allows the operator for example to:

- On high rate links specify a *low proportion* of the overhead to be assigned to the ESC channel (still enough to provide the require async Baud rate) but then allocate the remaining overhead to the Aux port configured for a Sync Channel, allowing external access to the rest of the overhead for example other data or BER testing (internal or external).
- When using Custom, IBS, Min overhead, allocate the overhead between ESC & Aux ports. The overhead will scale to provide the ***set* ESC Baud rate** however much of the overhead is assigned to it, and increase / reduce the **total overhead** as appropriate. The remainder of the overhead can be allocated to the Aux channel, again for extra data of BER testing (internal or external). This effectively allows the ***sync channel rate to be varied*** (by changing the ESC rate & overhead ESC assignment, which the overhead then adjusts to provide).

The screens are as follows:

```
O/h use:  1=TS16=XXX  2=TS32b5&6=XXX  (YES)
3=TS32b7&8=XXX  4=TS48=XXX ↓More/Help
```

Change, Tx/Rx, ESC/Aux/BA Define (IBS) ESC/Aux Custom 1

↓ ↑

```
O/h use:  1=TS0b1=XXX  2=TS32b1=XXX
3=TS32b3=XXX  4=TS32b4=XXX ↑Back ↓Help
```

Change, Tx/Rx, ESC/Aux/BA Define (IBS) ESC/Aux Custom 2

Each of the `XXX` fields can display the following uses for that part of the overhead, and be toggled between the different uses by pressing the appropriate numbered key:

---	The overhead locations are unused
ESC	Defined for use by the ESC port
Aux	Defined for use by Aux port
CAS	In use for Channel Associated Signalling
B/A	In use for the Backward Alarm
MFW	In use for the TS32 Multi Frame Word.

TS16 and TS48 are both bytes of the overhead structure which are free when CAS is not in use, they are each equivalent to 8/32nd of the total overhead and can be allocated to ESC or Aux.

TS32 bits 5 and 6 (allocated together) and **bits 7 and 8** (allocated together) both correspond to 2/32nds of the overhead. These are normally spare, see note 1, and can be allocated to ESC or Aux.

TS0 bit 1 is 1/32nd of the overhead, and are normally spare again see note 1. This bit can only be allocated to the ESC.

TS32 bit 1 is 1/32nd of the overhead, and is the bit allocated by INTELSAT for the low rate oversampled ESC (available on the Aux port if so configured). Spare if the Aux port is not set to INTELSAT mode or Note 1, can be allocated to ESC or Aux.

TS32 bit 3 is 1/32nd of the overhead and is normally used for the backward alarm, but is spare if Custom IBS mode is selected, and the backward alarm facility has been disabled. This bit can only be allocated to the ESC.

TS32 bit 4 is 1/32nd of the overhead and is normally used for the Satellite TS32 Multiframe but is spare

if Custom IBS mode without a TS32 multiframe is selected. This bit can only be allocated to the ESC.

Note 1: Spare unless the unit is configured for 2048kbps, IBS G.732 mode, with spare bits of TS0 set to transparent (when these bits carry the spare bits).

To summarise:

In **standard IBS** modes up to (8+8+2+2+1+1) bits = 22/32nd of the overhead may be allocated to the ESC port, and up to (8+8+2+2+1) bits = 21/32nds of the overhead may be allocated to the Aux port. 21 of these bits are shared between ESC & Aux.

In **Custom IBS modes** (without backward alarm or TS32 multiframe) up to (8+8+2+2+1+1+1+1) bits = 24/32nd of the overhead may be allocated to the ESC port, the Aux port is as above for Standard IBS, and 21 of these bits remain shared between ESC & Aux.

When the overhead has been assigned as required, press the **YES** key which provides the following screen:

Max ESC rate=2650 Baud (YES) **Aux sync rate=1387bps, async=346 Baud**

Change, Tx/Rx, ESC/Aux/BA Define (IBS) ESC/Aux Custom 1

This summarises the ESC & Aux port rates based on the overhead assignments just made:

The **Max ESC Baud Rate** is the maximum continuous rate the ESC channel will support, the ESC channel must be set to a standard async Baud rate equal or below this figure using the Async ESC menu selection.

The **Aux Sync Rate** is the data rate of the Aux port. A DPLL generates this clock however obscure the rate !

The **Aux async Baud** is the maximum Baud rate that could be conveyed through this Aux channel, if the Aux clock is ignored and the Aux port is used in oversampled async mode (as defined by INTELSAT for the low rate IBS ESC).

The **Aux Sync Rate** and **Aux async Baud** information display is not available in early versions of the embedded M&C code.

6.6.29 Change, Tx/Rx, ESC/Aux/BA, ASYNC ESC Menu

This menu allows the async parameters for the **ESC** interface to be defined.

Async ESC port: **1:Baud rate [2400] 2:Format [8,N] 3=Set as M&C port [=]**

Change, Tx/Rx, ESC/Aux/BA, C.g., Async Menu

BAUD RATE Allows the ESC Baud rate to be set (see below), the current Baud rate setting is displayed.

FORMAT Allow the async character format for the ESC port to be set (see below), the current async character format is displayed.

SET AS M&C When selected this copies the remote M&C async settings to the ESC port, to simplify using the ESC port for remote M&C. This is a one time copy, and the ESC port configuration **will not track** changes to the remote M&C configuration. When the ESC port is configured as the remote M&C port, [=]

appears, when not equal [≠] appears.

6.6.30 Change, Tx/Rx, ESC/Aux/BA, Config Async, BAUD RATE Menu

ESC Baud rate: [2400]↓↑ (YES)
(Max continuous rate is 2962)

Change, Tx/Rx, ESC/Aux/BA, Cfg. Async, Baud Rate Menu

This menu allows the Baud rate for the external interface to the ESC channel to be set. Any rate can be set, although the maximum continuous rate supported is stated (calculated from the terrestrial rate, and async character format).

Refer to section 8.6 "Determining exact maximum ESC Baud rates" on page 148

6.6.31 Change, Tx/Rx, ESC/Aux/BA, Config Async, FORMAT Menu

Async Format: [7 bits, No parity]
1=7 bits, 2=8 bits, Parity: 3=None, 4=Even, 5=Odd (Yes)

Change, Tx/Rx, ESC/Aux/BA, Cfg. Async, Format Menu

The ESC async character format may be edited by pressing 1 or 2 to select 7 or 8 bits, and 3, 4, or 5 to select No parity, Even parity, or Odd parity respectively. Note that as described in the last paragraphs shortening the async character *reduces* the maximum continuous Baud rate, as the ESC channel is limited to a finite character rate per second, and the more bits in each async character, the higher the effective Baud rate allowed without exceeding the ESC channel character rate limit.

6.6.32 Change, Tx/Rx, ESC/Aux/BA, Config Async, SET AS REM M&C

This option sets the ESC channel async parameters to match the settings on the Remote M&C port. This is specifically intended to simplify remote M&C within the IBS/SMS overhead via the ESC channel. Note this is a `one time` setting, and if the remote M&C parameters are varied, **the ESC channel will not follow them**. If the remote M&C Baud rate exceeds the maximum continuous ESC rate, then the following warning will be issued, although the copying of the parameters will go ahead.

NOTE: ESC channel not
guaranteed above 2962 Baud (YES)

Change, Tx/Rx, ESC/Aux/BA, Set as Remote Warning Menu

6.6.33 Change, Tx/Rx, ESC/Aux/BA, INTERFACES Menu

This leads to the selection of the ESC and Aux interfaces. The interface selection screens are only shown for active ports, and so either or both may show in turn depending on how the ports are defined for use. If both are active then the ESC interface is selected first. NOTE that these are some of the few menus which appears on both Tx & Rx menu trees, but for which the setting is common to both !

ESC Interface

Tx & Rx ESC Interface: [Link-R]
1=RS232 2=RS422 3=RS485 4:Link to remote M&C

Change, Tx/Rx, ESC/Aux/BA, Cfg Interfaces, ESC Menu

All options except 4 are self explanatory, [Link-R] means Link-Remote and [Link-L] Link-Local. Option 4 leads onto the following menu:

Internal link to M&C Port: [Local]
1=Local M&C PC end 2=Remote end

Change, Tx/Rx, ESC/Aux/BA, Cfg Interfaces, ESC, Link to M&C

This instructs the Modem make an internal link between the ESC port and the remote M&C port. It must be set specifically for the end of the link the modem is located at. When either of these options are selected, the physical ESC port is disabled, as it is linked internally to the M&C port.

LOCAL Incoming messages (on this modems remote M&C port Rx lines from the M&C Master device) are routed directly to the Tx ESC channel and out over the satellite link. Messages from the incoming satellite link on the Rx ESC channel are routed onto the Tx output lines of the remote M&C port, to return the responses to the Master M&C device.

REMOTE Messages from the incoming satellite link on the Rx ESC channel are driven onto the remote M&C port Rx (*input*) lines, allowing any devices daisy chained to the remote M&C port to receive a message (including this modem). Messages present on the remote M&C port Tx (*output*) lines, which includes any response from this unit or any device daisy chained to the remote M&C port, are routed to the Tx ESC channel and back via the satellite link.

Aux Interface

Following the ESC interface selection the Aux port may be configured (self explanatory):

Aux Interface: [RS232]
1=RS232 2=RS422

Change, Tx/Rx, ESC/Aux/BA, Cfg Interfaces, Aux Menu

6.6.34 Change, Tx/Rx, ESC/Aux/BA, AUDIO LEVELS Menu

Audio levels: V1=-12.3dBm V2= 5.6dBm
Press 1 or 2 then level ↑↓, YES to fix

Change, Tx/Rx, ESC/Aux/BA, Audio Levels Menu

This screen is used to set the levels for the Audio ESC ports. These are typical used in IDR modes for the Audio ESC channels, but may also be used when generating a 64kbps IBS carrier (comprising of 2 x 32kbps ADPCM audio channels only), or a 128kbps (comprising of 2 x 32kbps ADPCM audio channels plus 64kbps from the main data port.

Press 1 or 2 to select, which channel, then use the **Up** and **Down** buttons to vary the level. Pressing the up/down keys slowly/rapidly causes the level to change in 0.1dB steps, rapidly in 0.5dB steps. **YES must be pressed to exit the screen otherwise the previous values will be restored**.

6.6.35 Change, Tx/Rx, ESC/Aux/BA, BACKWARD ALARMS Menu

This screen is used to configure the four backward alarm inputs used in multi-destinational IDR or for lower rate multi-destinational operation in some of the Custom IBS modes.

```
Back' Alm 1234: [?] E=Ext A=Auto O=OK
1=EEEE  2=AEEE  3=AOOO  4=AAAA
```

Change, Tx/Rx, ESC/Aux/BA, Backward Alarm Menu

This screen is at first difficult to understand, but is relatively simple. It allows the four backward alarm input to be mapped in certain ways, without any external backward alarm patching:

On the screen the letters mean as follows:

E=Ext: External patch, the state from the backward alarm connector on the rear panel connector will be sent (open circuit = OK, Ground = fail)

A=Auto: Auto, the alarm will be sourced internally from the summary Rx fail signal

O=OK: The alarm will always send the `OK` condition.

So the menu choices are as follows:

EEEE All four alarms report the state from the Backward Alarm connector on the rear of the equipment . Use when **transmitting a multidestinational carrier**, but where the carrier we are **receiving *does not*** correspond to the destination allocated backward alarm channel 1. The Rx fail signals from the modems receiving the carriers from all the other destinations (including this modems Rx fail signal) must be externally patched into the corresponding external backward alarm inputs.

AEEE Alarm 1 is *internally* connected to the Rx Fail signal, alarms 2-4 are available for external patching. Use when this station is **transmitting a multidestinational carrier**, where the carrier we are **receiving *corresponds*** to the destination allocated backward alarm channel 1. The Rx fail signals from the *other* modems receiving the carriers from all the other destinations must be externally patched into the corresponding external backward alarm inputs 2-4. If the external inputs 2-4 are open circuit, then this is the same as *AOOO* below.

AOOO Alarm 1 is internally connected to the Rx Fail signal, alarms 2-4 always send the OK state. Used in **non multidestinational working**, external backward alarm inputs are ignored.

AAAA All four alarms represent the internal Rx Fail signal. Used in **non multidestinational working**, external backward alarm inputs are ignored.

In non multidestinational operation, the choice between the third and fourth options is down to operator preference or station policy.

6.7 CHANGE, RX MENU

Many of the Change Rx Menus are identical to the Change Tx menus, and a reference is made back to the Change Tx description rather than repeat the text unnecessarily.

NOTE ON RX=TX FUNCTION

The Change, Rx Menu has an extra feature over the Change Tx, namely the ability for the Rx path to track the majority of the Tx configuration parameters (Rx=Tx) to simplify the configuration in symmetrical links (ie the majority). If Rx=Tx is activated then the following Rx parameters automatically ***track*** the Tx parameters:

Service:	All modes
Baseband:	Continuous: data rate. Drop/Insert: all selections *excluding* the timeslots.
Mod/demod:	Modulation, Inner FEC type & FEC Rate, Outer RS FEC, Scrambler, Spectral Invert
ESC/Aux/BA:	All parameters

Rx parameters which specifically remain independent are:

Baseband:	Insert timeslot selection (only if Drop/Insert active)
Buff/Clk:	Rx Buffer size & clocking mode
Demod:	IF Frequency & Sweep control

Note that setting Rx=Tx *even momentarily* copies the Rx parameters which track the Tx to the Rx configuration. Toggling this option on then off again provides a convenient way to copy the Tx config to the Rx (except the IF frequency) should this be required at any point.

The Change, Rx menu then will have different options showing depending on whether Rx=Tx mode is active:

Rx=Tx Disabled

```
Rx:  1:Service  2:Baseband  3:Buffer/Clocking
     4:Demod  5:ESC/Aux  6:Rx=Tx [Off]
```

Change, Rx Menu (Rx not set to follow Tx)

Note that options 2-5 on the top menu are only displayed when the *SERVICE* option is set to something other then *Off*, and so initially **the screen may *only* show the *SERVICE* and *Rx=Tx* options.**

Rx=Tx Enabled

```
Rx: 1:Baseband  2:Buffer/Clocking
    3:Demod  4:Rx=Tx [On]
```

Change, Rx Menu (Rx set to follow Tx)

In this mode:

The **Baseband** option is only shown if the Tx baseband mode is set to Drop Mux, and hence the Rx Insert Mux will be active and the operator needs access to the baseband menu in order to independently set the insert TS selection.

The **Buffer/Clocking** menu is always shown.

The **Demod** menu provides access to the independent selection of IF Frequency, and demod Sweep Width control

Note: If *Rx=Tx* is enabled, and the Tx Service is set to *Off*, then **only the Rx=Tx selection will be the only one displayed**.

6.7.1 Change, Rx, SERVICE Menu

See "Change, Tx/Rx, Service Menu" on page 57

6.7.2 Change, Rx, BASEBAND Menu

The *Continuous* & *Other* menu options are identical to the Tx selections, see "Change, Tx/Rx, Baseband Menu" on page 60

The *Insert Mux* selection is the same as the *Drop Mux* selection except the prior to the same dialogue as on the Tx path two other questions are asked: Bearer routing (*Loop Terr* or *Generate*) & Partial Insert (*All* or *Partial*). These are described as follows:

Bearer Routing

The bearer to the Insert Mux can either be looped from the Drop Mux, or generated internally. The following prompt is displayed:

Insert bearer : [?]
1=Loop Terr 2=Generate internally

Change, Rx, Baseband, Insert Mux, Bearer Route Menu

In most situations *Loop Terr* is selected, and the receive data is inserted onto the same bearer from which the Tx data was dropped. This however forces the receive data to be passed to the terrestrial using the terrestrial clock (which is already clocking the bearer) and hence is the `normal` plesiochronous mode. For other clock modes, such as where it is necessary to use the satellite clock or a station clock to drive the clock to the terrestrial equipment, use *Generate internally*.

LOOP TERR — The PCM bearer at the input to the Drop Mux is looped to the Insert Mux. If this bearer should fail (no clock or AIS) the modem will switch *temporarily* to *Generate Internally* so that the Rx traffic is not lost as a result of a Tx fault. When set for *Loop Terr* the Rx Clocking menu asks for the selection of the clock source for the *Backup bearer* (Satellite, Internal, or Station clock).

GENERATE — The modem generates a suitable formatted PCM bearer internally with multiframes (G.732 CAS) and CRC's (T1-ESF & G.732) as it is set to utilise (ie it will not generate a terrestrial TS16 CAS multiframe unless it is operating in a CAS mode and therefore expects one). When so configured the Rx Clocking menu asks for the selection of the clock from which to source the *Generated bearer* (Satellite, *Tx Clock In*, Internal, or Station clock).

Partial Insert

This option only available if the Extended D/I feature if available (standard on P300-TCM) and is provided to simplify Multidestinational working. It allows *some* of the incoming Rx data to be inserted onto the insert bearer, and the information for other destinations to be discarded. This screen is only displayed if Rx=Tx is *Off*, when Rx=Tx is *On* (ie a symmetrical link, which is by definition unlikely to be multi-destinational) Partial Insert makes no sense, and the option is not displayed.

Is all Rx data for this destination: [?]

1=All 2:Partial

Change, Rx, Baseband, Insert Mux, Partial Insert Menu

See the applications section, para 8.3 "Partial Insert and Multidestinational Working" on page 145 for a discussion of this facility.

If *All* is selected, the dialogue continues as with the Drop Mux on the Tx path.

If *Partial Insert* is selected the following screen is displayed:

Total data rate for ALL dest' from satellite:
[1152000] ??????? (YES)

Change, Rx, Baseband, Insert Mux, Partial, Total Rate Menu

Normally, when using Drop / Insert, the modem determines the expected data rate from the satellite from the number of timeslots specified. However when using partial insert the data rate from the satellite has to be specifically set (as there is more data coming from the satellite than will be inserted). It must be N x 64kbps, N=2 to 32 (minimum of 2 not 1, as you cannot have a multidestinational carrier with only 1 x 64kbps incoming !). The screen is then displayed:

Sat TS: 1-3, 10-12
Toggle:??-?? (YES)

Change, Rx, Baseband, Insert Mux, Partial, Data Select Menu

On this screen the data for this destination is selected from the total receive data. The incoming data from the satellite is labelled as timeslots 1 - N. NOTE this labelling bears NO RELATION to the terrestrial timeslots from which the data was dropped at the Tx site. **It should be read as *First* through *Nth* 64 kbps channel *of the total sent.*** For example in a 256kbps incoming carrier the Rx data is referred to as TS 1 - TS 4 (first, second, third and fourth 64kbps channel in the 256kbps) whether it was originally dropped from timeslots 1, 2, 3, & 4, or timeslots 13, 17, 19 & 23. **At the receive site** (whether partial insert is active or not) **there is *no concept of `Dropped timeslots`*, there is *only* first 64kbps, second 64kbps etc.**

When he selection of data for this destination is complete, the *Insert Mux* option on the Change, Rx, Baseband menu continues as with the *Drop Mux* option on the Change, Tx, Baseband menu. The total number of timeslots inserted must match the number of 64kbps channels selected for this destination on the `Sat TS` screen above.

6.7.3 Change, Rx, BUFFER / CLOCKING Menu

Refer also to the following applications sections for helpful notes:

8.1 "Doppler & Plesiochronous Buffering" on page 142
8.2 "Determining Clocking Schemes & Buffer Size" on page 143
and "P1440 in X.21 Mode" on page 176

Buffer/Clocking: 1:Station clock input
2:Rx clock source 3:Buffer Size

Change, Rx, Buffer/Clocking Menu

These three options lead onto the following three Menus

6.7.4 Change, Rx, Buffer / Clocking, STATION CLOCK Menu

Firstly the operator is asked to specify is a station clock is available

Station clock connection [?]:
1=None 2:Via BNC 3:RS422:

Change, Rx, Buffer / Clocking, Station Clock, Available Menu

Provided *None* is not selected, the display continues to the next question where the frequency of the clock is specified.

Station clock frequency: [0]kHz
(1-10MHz) ????? (YES)

Change, Rx, Buffer / Clocking, Station Clock, Frequency Menu

This screen allows the operator to set the frequency for the Station Clock if one is available. This may be any integer value of kHz (eg 1544k, 2048k, 5000k, 10000k, **or arbitrary values** such as 2500k or 4321k). Values down to 1kHz (**not** 1MHz) are accepted, a frequency of 0 indicates there is no station clock. When a Station Clock is present the Modem will use it *in preference to its internal frequency reference* for clock generation of any backup clocks required. See the notes in the Rx Clock section on the following page as to where the modem sources the Rx clock from under fault conditions.

The station clock frequency can be any integer multiple of 1kHz, and the 75Ω BNC will accept any sinusoid > 0dBm or a square wave > 1Vp/p (eg G.703 Para 10 synchronising clock). The operator should be aware that the losses associated with the coupling transformer on this BNC input increase below 1MHz, and at frequencies below this higher levels of input signal may be required. The RS422 input is located on the `Async ESC` connector and requires standard RS422 levels at any frequency.

If the station clock is specified as 10MHz, then a final screen is displayed as follows:

Use station clock as IF synth ref [No]:
1=No, use normal int' ref 2=Yes ↓READ

Change, Rx, Buffer / Clocking, Station Clock, Frequency Menu

This allows the IF synthesisers to be locked to the station clock instead of the internal 1PPM reference. This is normally not a requirement as the internal reference provides good enough phase noise performance for the lowest data rate the modem can support and at 1PPM results in a worst case IF error of 180Hz when the IF is tuned to 180MHz. However if this option is used please be aware that the transmit IF spectrum purity is entirely dependent upon the quality (phase noise performance) of the supplied reference.

If the external 10MHz reference fails totally then it will be automatically replaced with the internal reference. If however it degrades (level, frequency or phase noise), ***then until it fails totally the modem will continue to use it as the synthesiser reference***.

6.7.5 Change, Rx, Buffer / Clocking, RX CLOCK Menu

This screen varies depending on the configuration of the Rx path

Normal (non-Insert Mux operation)

This selects the source of the clock, which feeds the terrestrial output:

Rx output clock: [?]
1=Sat 2=Tx 3=Internal 4=Station 5=DCE

Change, Rx, Buffer / Clocking, Rx Clock (non-Insert) Menu

Insert Mux operation (generated bearer)

This selects the source of the clock for the **PCM BEARER** onto which the Rx data is inserted:

Rx output bearer clock source: [?]
1=Sat 2=Tx 3=Internal 4=Station

Change, Rx, Buffer / Clocking, Rx Clock (Insert-Loop) Menu

Insert Mux operation (looped bearer)

This selects the source of the clock for the ***BACKUP*** **PCM BEARER**, which is only used if the normal bearer looped from the Drop Mux fails and the unit auto generates a backup bearer onto which to insert the Rx data. Note that this screen does not display a *Tx* option, as it is the *failure* of the Tx bearer input which causes this backup clock to be used in the first place.

Rx o/p bearer backup clk : [?]
1=Sat 2=Internal 3=Station

Change, Rx, Buffer / Clocking, Rx Clock (Insert-Loop) Menu

All the options available on any of these menus for the **Rx output clock** are as follows:

SATELLITE — The clock from the satellite. This provides `Buffer Disable` operation, the buffer size is set to zero and the buffer size menu is no longer available. This is the same as `Rx=Rx` clock options found on some other equipment. The Rx PLL converts the satellite clock, which may include framing and or Reed-Solomon overheads back to the rate required at the terrestrial port. If the demodulator cannot lock onto a carrier (ie no clock from satellite), then the PLL switches to the internal frequency reference to provide a steady clock towards the terrestrial port.

TX CLK IN — The Tx path input clock is turned around to drive the Rx data back to the terrestrial. This is normal `Plesiochronous Mode`, and the buffer should be set large enough to accommodate both the difference in the clocks at each end of the link PLUS the Doppler shift, whilst providing the required interval between slips.

If the **Tx & Rx rates are equal** then the Tx clock is used directly to clock out the Rx data, should the Tx input clock fail the clock is switched to a PLL using as first backup the Station Clock if defined as available, or if the Station Clock is defined as *not* available then recovered Satellite Clock (while demodulator remains locked). Should this first backup fail it finally falls back to the internal 1PPM reference in order to maintain the Rx traffic. If the modem is operating with **asymmetric data rates**, then the Rx PLL converts the Tx clock to the correct rate for the Rx data. Should the Tx clock input fail the PLL switches to the internal reference as backup in order to maintain the Rx traffic.

INTERNAL The internal 1PPM frequency reference is used to source the clock towards the terrestrial. Again the buffer should be set large enough to accommodate the difference between the internal reference and the incoming satellite clock, PLUS the Doppler shift whilst providing the required interval between slips.

STATION If the **Station Clock is the same frequency as the Rx data rate**, then the Station Clock is used directly, switching to the Satellite Clock (whilst the demod is locked), and finally the internal reference for backups. If the **Station Clock is at a different frequency to the Rx Data rate** the Rx PLL converts the Station Clock to the correct rate to drive the Rx data towards the terrestrial. Should the Station Clock fail then the modem will switch to the internal frequency reference in order to maintain the Rx traffic. Again the buffer should be set large enough to accommodate the difference between the Station Clock and the incoming satellite clock, PLUS the Doppler shift, whilst providing the required interval between slips.

Note: If the Rx is set to *Station Clock* **AND** the Tx Clocking is set to *Rx ref(Stn)*, then it always operates as defined in the para above for the case where the "Station Clock is at a different frequency to the Rx Data rate" (even if the are the same rate).

DCE CLK This option is only available if a DTE card is fitted to the modem. The DTE card `*Ext Tx Clock In*`, ie the clock from the DCE (see interface card details in appendix A for line names for other interfaces) is used directly as the Rx output clock, should the `*Ext Tx Clock In*` fail the PLL sources the clock, locked first to the Station Clock (if available) or the recovered satellite clock (while the demodulator remains locked), and finally the internal frequency reference in order to maintain the Rx traffic.

6.7.6 Change, Rx, Buffer / Clocking, BUFFER SIZE Menu

This menu is only available of the Rx Clk is not set to Satellite (ie Buffer Disable) !

Refer also to the following applications sections for helpful notes:

8.1 "Doppler & Plesiochronous Buffering" on page 142
8.2 "Determining Clocking Schemes & Buffer Size" on page 143

Buffer size (end-end): [16]ms
(0-99ms) ??ms (YES)

Change, Rx, Buffer/Clocking, Buffer Size Menu

The operator enters the end to end buffer size in milliseconds (INTELSAT documents typically specify the buffer in terms of its end to end size). Should the capacity ever be exceeded and the buffer slip, then it will slip by exactly half its capacity, back to the mid position.

For rates of 1544 kbps and 2048 kbps where the data is framed, the buffer is usually made to slip integer multiples of the frame length (3ms and 2ms respectively). A user option sets if the buffer capacity should automatically be incremented to the nearest integer multiple of frame length at these rates. This option is available under *CHANGE, USER-OPT, OPERATION, TRANSFER, BUFFER MF SLIP*.

A second option is available to automatically force the buffer to its mid position whenever the receive traffic switches from failed to OK. This takes advantage of any outage, and ensures the buffer is centred every time normal operation begins. This option is available under *CHANGE, USER-OPT, OPERATION, ACTIONS, BUFFER AUTO CENTRE*. This option can be disabled, as for minor outages the errors or sync losses caused by centering the buffer may be larger than those caused by the outage.

In normal operation the buffer fill state can be viewed on the Received Detail Traffic Status screen accessible from the operate menu by pressing Down Arrow. This screen also shows a count of underflows and overflows (empty slips and full sips). Approximately equal counts indicate the buffer is too small to accommodate the incoming Doppler shift (2ms is usually sufficient). One count significantly higher than the other indicates that the buffer is slipping due to a large difference in the clock from the satellite and the buffer output clock. With *typical* earth station clock accuracies, buffers never need be larger than approximately 16ms.

The buffer can be manually centred by selecting *ACTIONS, BUFFER CENTRE*.

6.7.7 Change, Rx, DEMOD′ Menu

The options available on this menu change if the Rx=Tx function (on the Change, Rx Menu) is active.

Tx=Rx Not active

Demod: 1:Freq 2:Mod`n 3:FEC
4:RS 5:Scr 6:Spect Inv 7:Sweep 8:AUPC

Change, Rx, Demod Menu (Rx=Tx not active)

Rx=Tx Active

If the Rx=Tx function is active, only those parameters which vary between Rx & Tx are displayed, the screen appears as follows:

Demod: 1:Freq 2:Sweep 3:AUPC
(most of Rx follows Tx as Rx=Tx active)

Change, Rx, Demod Menu (Rx=Tx Active)

Each of this is now discussed in turn, referring back to the Tx path screens where operation is identical.

6.7.8 Change, Rx, Demod′, IF FREQUENCY Menu

See Change, Tx/Rx, Modulator, IF Frequency Menu on page 68

6.7.9 Change, Rx, Demod′, MODULATION Menu

See Change, Tx/Rx, Modulator, Modulation Menu on page 68

6.7.10 Change, Rx, Demod′ FEC Menu

See Change, Tx/Rx, Modulator, FEC Menu on page 69

6.7.11 Change, Rx, Demod′ REED-SOLOMON Menu

See Change, Tx/Rx, Modulator, RS Menu on page 71

6.7.12 Change, Rx, Demod′ SCRAMBLER Menu

See Change, Tx/Rx, Modulator, Scrambler Menu on page 72

6.7.13 Change, Rx, Demod′ SPECTRUM INVERT Menu

See Change, Tx/Rx, Modulator, Spectrum Invert Menu on page 75

6.7.14 Change, Rx, Demod' SWEEP Menu

Demod sweep range: [Normal=±25kHz]
1=Normal 2=User

Change, Rx, Demod' Sweep Menu

The operator has control of the sweep range of the Demodulator, but under normal circumstances `Normal` should be selected. Normal is defined as:

BPSK, QPSK & 8PSK

±80% of `the recommended carrier spacing` or ±25 kHz, whichever is the lower. The recommended carrier spacing is 1.4 times the symbol rate (ie data rate + framing + FEC + Modulation). See note later when operating *without* FEC AND *without* Framing.

OQPSK

±25% of the receive symbol rate (ie data rate + framing + FEC + Modulation) or ±25 kHz, whichever is the lower.

Assuming closed network, QPSK rate 1/2 coding, this means that for data rates down to 22 kbps the sweep will be ±25kHz, reducing linearly below this rate to 10.74kHz for 9.6kbps QPSK rate 1/2 FEC, or 4.8kbps BPSK. See note 2 in the following paragraph for an explanation of why the sweep width narrows at lower data rates.

If *USER* is selected, then the following menu is displayed:

Set user demod sweep: [±16kHz]
(1-31kHz, normal=±25kHz) ±??kHz (YES)

Change, Rx, Demod' Sweep, User Menu

The operator can configure the Demodulator to sweep up to ±32kHz to compensate for errors introduced in the Tx frequency conversion, satellite, and Rx frequency conversion equipment. Please note the following:

1. Increased sweep width proportionally increases the carrier acquisition time.
2. With low data rates, and wide sweep widths (ie wider than the recommended carrier spacing), it is perfectly feasible to acquire the **wrong carrier**. Typically low rate carriers are clustered together on a transponder, and the modem has no way of telling which carrier is which other than it has to be in the sweep range, and of the correct data rate.

Note

Applicable to operation *without* FEC AND *without* framing only

Part of the Rx carrier acquisition process when the Demod sweeps is for the Demod to temporarily lock onto `false locks`, these are detected as false because although the Demod has locked, the FEC will not lock correctly. This information is used to step the Demod directly onto the true carrier lock (this all happens in the background without the operator being aware of the process).

If the Demod is operated without FEC (ie uncoded), then frame alignment is used to determine if the lock is a false one and to push the Demod into acquiring the correct lock. HOWEVER, if the Demod is operated **without FEC AND without framing**, it cannot distinguish a between a true lock and false lock. False locks occur either side of the carrier at offsets of ±1/2, ±1/4, & ±1/8th the symbol rate for BPSK, QPSK, and 8PSK respectively. In such a case, the `Normal` sweep width is automatically narrowed to within these limits, to make the sweeping Demod avoid any false locks (assuming the Rx carrier is exactly on frequency).

When operating in this unusual situation *without* FEC AND *without* Framing, if the Rx carrier is not exactly on frequency, then it is possible for the Demod to lock onto a `false lock` (and not be able to detect it as false as there is no FEC or framing). In this situation you can either:

1. Use Custom Sweep to narrow the sweep range to avoid the false lock, but be careful not to narrow it too much so it avoids the true carrier lock as well. DO NOT increase the sweep range, as this will guarantee to bring false locks within the Demod sweep.

2. **Preferably**, adjust the Rx IF Frequency to account for the true Rx carrier frequency (including offsets), then adjust the sweep range to 50% of the `Normal` value. This will allow the Demod to re-acquire the carrier (even with further minor variations in Rx carrier frequency) without it sweeping into a false lock. If you are attempting to do this, when you have the Demod *correctly* locked you can read the current value of offset frequency from the `Demodulator Detailed Status` screen in order to adjust the Rx IF frequency.

6.7.15 Change, Rx, Demod' AUPC Menu

This screen provides the option to enable or disable the "Remote Reporting" facility used with AUPC to enable a distant end modem to report it's Eb/No and BER back to the other end of the satellite link. The facility can be either On or Off. See AUPC in section 8.11 on page 156.

6.7.16 Change, Rx, ESC/AUX/BA Menu

See Change, Tx/Rx, Modulator, ESC/Aux/BA Menu on page 79

6.7.17 Change, Rx, RX=TX Menu

This is described in detail under the initial note on the Rx=Tx function in para 6.7 on page 89

Set Rx=Tx, so most Rx parameters track Tx: [?] **1=Off 2=On**

Change, Rx, Rx=Tx Menu

OFF The receive path operates fully independently from the Tx path

ON Many of the Rx parameters follow the Tx, which greatly simplifies the configuration for duplex links. When enabled only the Insert Mux timeslot selection, Rx Clocking & Buffer Size, and IF Frequency & Sweep control require setting independently of the Tx path.

Note: Temporarily setting Rx=Tx is a convenient way of copying the Tx configuration to the Rx as when disabled again the Rx path keeps the Tx values, and does not return to the old Rx values.

6.8 CHANGE, TERR-INTFC MENU

The Change Terr-Interface Menu brings up one of two screens depending on the interface card fitted:

```
Terr interface: 1:Electrical
2:Control Lines  3:Card specific
```

Change, Terr-Intfc Menu

```
Terr-Interface: Nothing to configure
with card fitted (YES)
```

Change, Terr-Intfc, Alternate Menu

If there are parameters to configure with the interface card fitted, then the options are:

ELECTRICAL For interface cards, which support multiple electrical interfaces (eg currently P1440, P1441 and P1442 cards), this option allows the interface to be selected. For other cards the option may not be shown if the electrical interface cannot be changed.

CONTROL LINES This allows the interface control lines such as RTS and DTR to be configured. The operator has the option for each available control signal of ignoring the signal, or raising a Traffic Fault alarm if the interface control line goes `Off`.

CARD SPECIFIC Some interfaces such as 64 kbps G.703 have specific faults they can monitor (in the case of the 64 kbps G.703 interface it is the incoming octet timing), or options on the outgoing signal (supply outgoing octet timing or not). Control over such parameters is provided here.

6.8.1 Change, Terr-intfc, ELECTRICAL

With the standard P1440 (RS422, V.35, RS232, and optional G.703 interface) the following menu is shown (it may vary if other interfaces are used). The G.703 option on this screen is only shown if a T1 or E1 G.703 option is fitted.

```
Set electrical interface: [?]
1=V.35  2=RS422  3=RS232  4=G.703
```

Change, Terr-Intfc, Electrical Menu, Interface

The selection is self explanatory. Note that the 25 pin EIA 530 connector and 37 pin RS449 connectors on the rear of the equipment are connected in parallel, and both should not be used simultaneously. All electrical interfaces are available on both connectors, **including G.703** unless it is an E1 G.703 option where the switch on the option card is set for 75Ω in which case the interface is on the BNC connectors fitted as part of this option.
For the first three options the dialogue terminates here, for G.703 it proceeds to the line code selection:

```
Set G.703 line code: [?]
1=AMI  2=HDB3 (Normal)
```

Change, Terr-Intfc, Electrical Menu, Line Code (if G.703)

For E1 G.703 the line code selection is as shown above (AMI=Alternate Mark Inversion or HDB3=High Density Bipolar 3). For T1 G.703 the line code selection is between AMI and B8ZS (Binary 8 Zero Substitution). **In both cases the NON-AMI option is most common so select this if in any doubt**.

The NON-AMI options for T1 and E1 are both different means to achieve the same objective, which is to limit the number of contiguous zeros, which may be transmitted on the G.703 line. This is necessary with G.703 as with AMI a `mark` (logic one) is sent as a pulse on the line, and a `space` (logic zero) is set as the ***absence*** of a pulse on the line. If there are too many contiguous spaces the G.703 receiver fails to recover the clock properly (as there are no incoming pulses for a while) and it causes data errors. HDB3 and B8ZS are both methods of ensuring that no more than three or eight zeroes respectively occur on a G.703 line by substituting strings of more than this number of zeroes with another code, in turn this code is detected at the end of the G.703 line and replaced with the correct number of zeroes again.

If the line code is set incorrectly you will almost continuously see ***"Tx Warn: Tx line code violations detected"*** which indicates the modem is receiving line code violations and most probably set for AMI but receiving a B8ZS/HDB3 coded signal. **Intermittent** occurrences of the warning however are more likely to be caused by line noise corrupting the signal. Note that if the modem is incorrectly set for B8ZS/HDB3 and the other equipment expects AMI, then there will be no warning on the modem.

Finally, and only for T1 G.703 cards the following screen is shown:

```
Set T1 line length: [?]ft
1=<133'  2=<266'  3=<399'  4=<533'  5=<655'
```

Change, Terr-Intfc, Electrical Menu, Line Length (if T1 G.703)

This screen allows the signal to be pre-compensated to cope with differing lengths of standard `ABAM` cable. We would suggest you select option 1, less than 133 feet by default (no compensation).

6.8.2 Change, Terr-intfc, CONTROL LINES

This screen allows the operator to select whether the modem implements or ignores the interface handshake control lines:

```
Interface control lines:[?]
1=Ignore all  2:Active-configure
```

Change, Terr-Intfc, Control Lines Menu

IGNORE ALL All the control lines are ignored, the dialogue ends here

ACTIVE-CONFIGURE The three following screens are presented in turn allowing each line to be individually controlled. The line names change to match the interface type selected (examples here are for V.35).

Line "DTR" (DTE Ready In): [?]

1=Ignore 2=Active

Change, Terr-Intfc, Control Lines, Active Screen 1

Line "RTS" (Tx input signal valid): [?]

1=Ignore 2=Active

Change, Terr-Intfc, Control Lines, Active Screen 2

Note that if the carrier is set to *RTS-controlled* (under *CHANGE, TX, MODULATOR, CARRIER*, and the RTS line is set to `*IGNORE*`, then there will be no alarms should the RTS line go `off` inhibiting the carrier.

This final screen is only shown if the modem is fitted with a DTE interface.

Line "CTS" (Terr accepts Rx output): [?]

1=Ignore 2=Active

Change, Terr-Intfc, Control Lines, Active Screen 3

6.8.3 Change, Terr-intfc, CARD SPECIFIC

These screens are used for interfaces, which have interface specific requirements such as the 64kbps G.703 interface. With the standard P1440 interface this option is not shown on the Change, Terr-Intfc menu.

6.9 CHANGE, REM-M&C MENU

Remote M&C: [Local]
1:Configure 2=Remote 3=Local (Rem M&C timeout=120s)

Change, Rem-M&C Menu

This menu allows the remote M&C port to be configured, and control of the unit switched between local and remote. There are many different thoughts on how local / remote switching should be provided !

The text "(Rem M&C timeout=120s)" is only displayed if *Give Away* is selected on the menu described below, it indicates that the *Local* option is not available until the timeout (which counts down when no remote M&C messages are received) has expired. If *Take Away* is selected on the menu described below, then there is no timeout and the user may take local control at any time.

6.9.1 Local Control TAKE AWAY / GIVE AWAY Selection

Under *SERVICE (0), FACTORY PARAMETERS, REMOTE M&C* the following menu is provided:

Rem M&C philosophy: [?]
1=Takeaway 2:Giveaway+M&C Timeout

Service, Factory Parameters, Remote M&C Menu

TAKEAWAY When selected the operator can switch between Local and Remote control at will using the *Local* & *Remote* options on the Change, Rem M&C Menu.

GIVEAWAY When selected a subsequent screen is displayed which allows a timeout of up to 255 seconds to be specified. Normal switching between Local and Remote is then by Giveaway philosophy, ie once in Remote M&C, local control is only granted by a remote M&C command giving back local control. The timeout ensures that if the remote M&C fails the operator can take local control when the timeout expires if necessary. NOTE it **does not** automatically switch to local, it remains in remote mode unless the local operator specifically selects *Local* after the timeout has expired.

There is no option for Give Away *without* a timeout, otherwise the operator could find control of the modem locked out if this option was active without remote M&C operating.

The subsequent timeout menu is as follows, its function is described above:

Rem M&C timeout before user can take
local control: [120s] (1-255secs) ???s (YES)

Service, Factory Parameters, Remote M&C Timeout Menu

6.9.2 Change, Rem-M&C, CONFIGURE Menu

Remote M&C: 1:Protocol [Paradise]
2:Intfc [RS485] 3:Baud rate[2400] 4:Addr[123]

Change, Rem-M&C, Configure Menu

This menu configures the remote M&C port: The options are:

PROTOCOL This allows selection between *OFF*, *PARADISE/FDC*, and *SA-bus*. Full details of the remote M&C protocols and messages is provided in the Remote M&C section in Appendix D.

NOTE: Remote ***monitoring*** is possible with the selected protocol if the protocol is not set to *OFF*. Remote ***control*** is only possible if the protocol is not *Off* and control has been selected as *Remote* on the Change, Remote M&C menu.

INTERFACE The options available here are RS232 or RS485. RS232 is only usable for a direct connection between a single device and a PC. RS485 is required when more than one slave device is connected to the remote M&C bus. Again see the Remote M&C section for complete details of the electrical interface.

BAUD RATE The remote M&C Baud Rate is selectable, again see the Remote M&C section for complete details of suitable Baud Rates for each protocol.

ADDRESS The bus address must be specified. The valid range for the Paradise / FDC protocol is 1-255, for the SA-bus protocol the valid range of address is 49 to 111 (31H to 6FH).

6.10 CHANGE, USER-OPT MENU

User options: 1:Alarm thresholds
2:Operation 3:Display 4:Analog o/p

Change, User-Opt Menu

This screen allows access to all the user options, which are described in the following paragraphs.

6.10.1 Change, User-Opt, THRESHOLDS Menu

Thresholds: 1:Final BER [1.0E-5] 2:Demod Eb/No [6.0]dB
3:Buffer slip [24]hrs 4:DISTANT Eb/No[8.5]dB

Change, User-Opt, Thresholds Menu

This screen allows the operator to set thresholds at which a deferred alarm is raised, to allow action to be taken before the service degrades too far.

USER BER The operator may enter a BER at which the deferred alarm is raised should the estimated USER BER degrade below this threshold.

DEMOD Eb/No The operator may also or alternatively set a deferred alarm threshold for the Eb/No measured by the demodulator. This is the Eb/No as displayed on the screen whenever the demodulator status is displayed.

BUFFER SLIP The operator may also instruct the modem to raise the deferred alarm if the interval between buffer slips is less than a preset threshold. The threshold is set in hours, and may be for example set to 960 hours (40 days) or 1728 (72 days) to warn if the criteria for clock accuracies for a specific service are not being met.

DISTANT Eb/No If the AUPC feature is active in either `Maintain Eb/No` or `Monitor Distant` modes (refer to AUPC in section 8.11 on page 156) the operator has the facility to raise a deferred alarm if the DISTANT Eb/No falls below the user set threshold. This can be used in conjunction with the AUPC to indicate when the AUPC has reached the user set limit for maximum Tx power, but the distant Rx Eb/No has still fallen below the desired limit.

6.10.2 Change, User-Opt, OPERATION Menu

User options: 1:Default 2:Actions 3:Terr′
4:Sat′ 5:Terr/Sat 6:Alarms

Change, User-Opt, Operation Menu

The operator has control over many parameters, which are the subject of either personal or company preference. A single menu choice *DEFAULT ALL* resets these to the Paradise Defaults, which are listed in the following paragraphs along with each parameter.

6.10.3 Change, User-Opt, Operation, ACTIONS Menu

Actions: 1:Buffer auto centre **2:BER 3:AIS 4:Back' Alarm**

Change, User-Opt, Operation, Actions Menu

BUFFER AUTOCENTRE This selects if the receive buffer is automatically centred when the Rx traffic returns to OK from the fail state. This takes advantage of any outage, and ensures the buffer is centred every time normal operation begins. This option can be disabled, as for minor outages the errors or sync losses caused by centering the buffer may be larger than those caused by the outage itself. **Default:** ***ENABLED***

BER ACTION This option controls how a high BER indication is handled. INTELSAT specify that when the BER exceeds 1 x 10^{-3} the following actions are required: the Rx prompt alarm should be raised, AIS should be forced, and the backward alarm sent. This option can disable the forcing of AIS and the backward alarm to maintain the traffic as best as possible. **Note** the Rx Prompt alarm **is** still raised even if this option is set to *NO ACTION* to disable the AIS and Backward Alarm. **Default:** ***ACTION***

AIS ACTION This option is similar to BER action above, except it specifies how the modem is to handle the detection of AIS (the Alarm Indication Signal, all ones). INTELSAT specify the required actions as: the Prompt Traffic alarm should be raised, AIS should be regenerated (to prevent multiple noisy links building up enough errors to stop the all ones being detected), and the backward alarm should be sent. In continuous modes this option allows all three actions to be disabled. In Drop/Insert modes the Prompt Traffic alarm and the backward alarm are disabled, but AIS is still regenerated if it is detected. **Default:** ***ACTION***

BACK'ALARM This option is only displayed if the Insert mux is active and set for Channel Associated Signalling (CAS). It controls the forcing of the `abcd` signalling bits passed to the terrestrial port to certain values when an incoming backward alarm is received. **Default:** ***Normal***. The options are

- *Normal* A backward alarm is sent out of the insert mux to the terrestrial network (INTELSAT IESS 309).
- *Sig AIS* The `abcd` signalling nibbles for the *inserted timeslots* are forced to all ones.
- *b=1* The `b` bit of the `abcd` signalling nibbles for the *inserted timeslots* are forced to a one (Eutelsat EESS 501, SMS).
- *ab=11* The `a` and `b` bits of the `abcd` signalling nibbles for the *inserted timeslots* are forced to a one.

6.10.4 Change, User-Opt, Operation, TERRESTRIAL Menu

Terrestrial: 1:PCM Bearer CRC **BER monitors: 2:Tx/Drop mux 3:Insert mux**

Change, User-Opt, Operation, Terrestrial Menu

PCM BEARER CRC This option is only applicable when the unit is configured for Drop/Insert

operation with a PCM bearer which supports CRC (T1-ESF or G.732). When appropriate this accesses a sub menu which is discussed in the following section.

TX/DROP BER The source for the estimate of the terrestrial BER at the Drop Mux may be selected:

- *Auto* The selection is made automatically from the most appropriate source.
- *FAW* The *input* BER is estimated from the Frame Alignment Words (FAW) of the PCM bearer.
- *CRC* The *input* BER is estimated from the number of CRC errors (T1-ESF & G.732 only).
- *E-Bits* The ***output*** BER is determined by counting the E-Bits on the *incoming* G.732 signal. On a G.732 link an E-Bit is returned by the distant equipment when it receives an errored CRC, ie the incoming E-Bits represent the error rate at the far end of this modems outgoing G.732 link. ***Effectively the error rate on the outgoing link at the far end.***

Default: ***Auto***

RX/INSERT BER The source for the estimate of the BER *from* the terrestrial port at the input to the insert mux may be selected as described above for the Tx/Drop BER. **Default:** ***Auto***

6.10.5 Change, User-Opt, Operation, Terrestrial, PCM BEARER CRC Menu

PCM Bearer: 1:Bearer CRC **2:E-Bits 3:CRC/Frame Acq'**

Change, User-Opt, Operation, Terrestrial, PCM Bearer CRC Menu

BEARER CRC This option, only applicable to G.732 Drop/Insert bearers selects if the PCM bearer has a CRC, the options available are *None/Ignore* or *Process*.
Default: ***None/Ignore***.

E-BITS If a G.732 Bearer with CRC set to *Process* as above, then the additional option to process & return E-Bits is also available, options for what happens when incoming CRC errors are detected are *No Action* or *Return E-Bit*.
Default: ***No Action***.

CRC/FRAME ACQ' Again, if a G.732 Bearer with CRC set to *Process*, then the option exists to implement the strict letter of ITU G.704, and force a re-acquisition of the terrestrial Drop/Insert frame sync if CRC sync cannot be achieved within 8ms. Options available are *Normal* or *Reacquire frame if CRC sync lost*.
Default: ***Normal***.

6.10.6 Change, User-Opt, Operation, SATELLITE Menu

Satellite: 1:BER est' 2:IBS MF period **3:Carrier ID's 4:Back alm map 5:IF-50/75Ω**

Change, User-Opt, Operation, Satellite Menu

BER ESTIMATE This selects the source for the USER BER estimate displayed on the Receive Status Screens, and compared to both the Deferred USER BER alarm, and BER > 1 x 10^{-3} alarm thresholds. The selection is from:

AUTO The unit selects the most appropriate source. Note that **the INTELSAT mandatory method is FAW**, although *Auto* will select more accurate or more quickly updated methods if available. The list of priorities is as follows:

1. The PRBS tester (if in the main data channel)
2. The Reed-Solomon outer FEC Codec (if active)
3. The Turbo, Viterbi or Sequential inner FEC (if active)
4. The PRBS tester in ESC or Aux channels (if active)
5. The errors counted over one minute on the **FAW** (if framed)
6. No estimate of BER

FAW An estimate based on the count of errors on the Frame Alignment Words (FAW) received by the deframer over a 1 minute sliding window. Only available if operating in a framed mode.

FEC An estimate of the output error rate from the FEC decoder, based on the count of errors into the FEC and the FEC code rate. Note that if FEC is manually selected, but Reed-Solomon is active, the BER estimate will not include the significant error improvement of the RS codec.

RS An estimate of the output error rate of the RS Decoder based on the number of uncorrectable words passed by the decoder.

PRBS The real BER as measured by the PRBS tester, whether it be in the ESC or Aux channel, or the main data channel.

Default: ***AUTO***

IBS MF PERIOD This option is only applicable to Custom, IBS, Minimum overhead modes. In this mode the overhead is varied to accommodate any ESC requirements, and if the ESC and main data rate are very low the overhead multiframe structure might be very long. Whenever the Rx carrier is re-acquired the multiframe alignment also has to be re-acquired, and this option allows the *maximum* multiframe period to be specified in order to prevent excessively long multiframe periods affecting carrier re-acquisition times. By default it is 2000ms, approximately 4 times the normal IBS multiframe time of 512ms at 64kbps. This will only be an issue where very low data rates (<16kbps) and low ESC rates are in use, or Minimum overhead mode is active with **No** ESC requirement and the multiframe just provides timeslot ID maintenance and backward alarm facilities. Only consider adjusting from default if you see long periods where the status displays "TS32 Multiframe sync lost" or "CAS Multiframe sync lost" after the demod has lost and re-acquired the carrier. **Default:** ***2000ms***

Carrier ID'S The earlier versions of the Eutelsat SMS specification defined 3 eight bit identities which may be transmitted once per satellite TS32 multiframe to identify the carrier and the earth station. These were named *Station ID*, *Carrier ID* & *Spare ID*. More recent issues just say "reserved for uses such as.....". This options allows these three ID's to be set (0-255 for each), and also displays the corresponding ID's from the incoming Rx carrier. **Default: all** ***255***

BACK ALM MAP In Custom IBS Modes it is possible to operate an IBS style service, and allow the use of four independent backward alarms (as for IDR) for use on multidestinational services. This option allows the four alarms to be mapped in different ways onto the IBS TS32 multiframe, in the hope that should INTELSAT adopt such a standard, the P300 Modems could be set to be

compatible with however INTELSAT might define it. **Default: four alarms in a 64 frame cycle.**

IF-50/75Ω — The IF Impedance is selected on this menu. There are no electrical changes made when this option is changed as the IF ports are matched to both 50Ω and 75Ω operation, there is simply a slight adjustment of the internal power calibrations & readings to maintain accurate level control & indication.

6.10.7 Change, User-Opt, Operation, TERR/SAT Menu

Terr/Sat: 1:BufferMF slip **2:Thin Route Spoof 3:X.50 AIS 4:G.732 spares**

Change, User-Opt, Operation, Terr/Sat Menu

BUFFER MF SLIP — For data rates of 1544 kbps and 2048 kbps where the data is framed, the buffer is usually made to slip integer multiples of the frame length (3ms and 2ms respectively). This option sets if the buffer capacity should automatically be incremented to the nearest integer multiple of frame length at these specific rates. Options are *Adjust (Normal)* or *Don't Adjust*. **Default: ADJUST**

THIN ROUTE SPOOF — This interestingly named option is to allow full connectivity of a PCM bearer to be `spoofed` even if the link is connected over satellite via a `thin route` (ie less than the full PCM bearer using Drop/Insert). If enabled the following features of the PCM system appear transparent end to end:
AIS (all ones), Backward Alarm, CAS Backward alarm (G.732 only)
NOTE: When enabled **AIS is forced over the whole PCM bearer**, and so this option should not be used with cascaded Drop/Insert, where AIS from the second modem in a cascade would cause the inserted data from the first in the cascade to be lost. Options are *Spoof* or *Off*. **Default: *Off***

X.50 AIS — In standard IBS operation 48 & 56kbps are X.50 `bit stuffed` up to 64kbps prior to framing. It is not clear how AIS is intended to be transferred in these cases and so AIS can remain at 48 or 56kbps and still be X.50 stuffed, or AIS can be set at 64kbps. Options are *64k AIS (normal)* or *48/56k AIS*. **Default: 64k AIS (Normal)**

G.732 SPARES — When the terrestrial data rate is 2048kbps in IBS/SMS mode, the operator can select Normal or G.732 mode of operation (corresponding to INTELSATs confusing definition of 2048kbps and 1920/1984kbps operation). This option allows the spare bits of the TS0 of the terrestrial G.732 frame to be either transparent across the link, or forced to all ones. Refer to section 7.2 "Change, Tx/Rx, Baseband, Continuous, 2048k Menu (IBS)" on page 139 for further information on operation in this mode. Options are *Transparent* or *Fix High*. **Default: *Fix High*.**

6.10.8 Change, User-Opt, Operation, ALARMS Menu

Customer specific requirements:
1:Relay mode [0] 2:Fault mode [0]

Change, User-Opt, Operation, Alarms Menu

The two options under this menu are to enable Paradise to add customer specific features to the standard software and avoid having special versions of software for specific customers. As most special requests relate to either alarm handling or relay operation, we have defined two user variables which we can test in the main code, and if necessary perform special functions. This might include for example delaying the fault relays under specific alarm conditions, as requested on our previous modem products.

The specific functions available are listed in Appendix E on page 207.

RELAY MODE A value from 0-15, where 0 is `Normal`. **Default: 0**

FAULT MODE A value from 0-15, where 0 is `Normal`. **Default: 0**

6.10.9 Change, User-Opt, DISPLAY Menu

Display: 1:Status screen
2:Upgrade messages/notes

Change, User-Opt, Display Menu

The options are:

STATUS SCREEN This selection are covered in the section Status Screen Display on page 52. The options available are *Tx & RX TRAFFIC SUMMARY* or *CONFIGURATION SUMMARY*. **Default *Tx & Rx Traffic Summary***

UPGRADE MESSAGES The unit will by default display notes on the LCD (typically "**Note ↓**") when there is an upgrade option available to add extra facilities at this point in the menu structure. At such a point pressing the Down Arrow will explain what extra facilities are possible. The operator has the choice to either *ENABLE* or *DISABLE* the display of these messages. **Default: *Enable***.

6.10.10 Change, User-Opt, AGC Output Menu

Analog output: [0] (0-15) ?? (YES)
0 AGC, 1-15 refer to handbook appdx E

Change, User-Opt, AGC Output Menu

This option is only available if the Monitor/AGC option is fitted when the modem has an uncommitted 0-10V DC output on the alarms connector, sourced from a 10 bit DAC. This has been specifically provided to allow customer access to internal signals such as the AGC level or the Eb/No value. The exact signal output on this port is user controlled by entering a number from 0-15 at this menu. The full list of options available are described in Appendix E on page 207. **Default: 0** (standard AGC voltage).

6.11 CHANGE TIME/DATE MENU

Now: 11:29:35 on 12/06/97 - OK (yes) **1 Time adjust, 2 Date Adjust**

Change, Time/Date Menu

This menu is self explanatory, and allows the user to set the correct time and date so that events added to the traffic log are correctly time stamped.

6.12 CHANGE, BUC/LNB MENU

BUC/LNB: 1:Tx/BUC 2:Rx/LNB **3:Tune Ref**

Change, BUC/LNB Menu

This screen allows access to all the features relating to the BUC/LNB ***or RF chain*** that follows the modem. Although most of these facilities relate to the P310 L-Band version of the modem, certain options such as Tx/Rx Frequency Offsets (which allow the IF frequencies to be entered and displayed as final SHF frequencies) are also relevant and useful on the standard 70MHz/140MHz P300.

Each option is described in the following paragraphs.

6.12.1 Change, BUC/LNB, TX/BUC Menu

Tx/BUC: 1:BUC Type 2:DC & References **3:SHF Frequency 4:SHF Power/Units 5:BUC Control**

Change, BUC/LNB, Tx/BUC Menu (fewer option when not L-Band)

Options for *BUC Type*, *DC & References*, & *BUC Control* are only offered on L-Band modems. *BUC Control* is offered subject to the BUC Type and the Modem/BUC control mode selected.

Each option is defined in the following paragraphs.

6.12.2 Change, BUC/LNB, Tx/BUC, BUC TYPE Menu

This screen is only available on P310 L-Band modems.

BUC Attached:[?] 1=None 2=Other 3=Std Ku 4=Ext Ku **5=Std C 6=INSAT C 7=PALAPA C**

Change, BUC/LNB, Tx/BUC, BUC Type Menu 1

Options other than *None* or *Other* are only displayed if the FSK communications option is present within the P310, and refer to standard Paradise BUC's (with which the modem can communicate by FSK). If you are using a non Paradise BUC, then please select *Other* and manually configure the BUC parameters.

The table below specifies the parameters for the listed BUC types:

BUC Type	Lower Frequency Limit	Upper Frequency Limit	Frequency Shift
None	Modem IF +/- limits around user set SHF Frequency Shift		
Other	Modem IF +/- limits around user set SHF Frequency Shift		
Std Ku	14.000 GHz	14.500 GHz	13050 MHz
Ext Ku	13.750 GHz	14.250 GHz	12800 MHz
Std C	5.800 GHz	6.4250 GHz	4900 MHz
INSAT C	6.725 GHz	7.025 GHz	5775 MHz
PALAPA C	6.425 GHz	6.725 GHz	5475 MHz

The difference between *None* and *Other* is that with *Other* the operator can configure the modem to supply a 10MHz reference and a DC PSU to the BUC (if the internal BUC PSU option is fitted). With *None*, these options are not available.

If a Paradise BUC is fitted then the following screen is displayed:

Modem/BUC control mode: [?]1=Independent 2=Terminal (Closed Loop)

Change, BUC/LNB, Tx/BUC, BUC Type Menu 2

INDEPENDENT

The modem and BUC are both manually controlled from the modem front panel (the modem as normal, and the BUC with *Change*, *BUC/LNB*, *Tx/BUC*). The operator maintains control of the BUC Tx on/off status, and any BUC attenuator available. The modem does however automatically report the IF frequency to the BUC so the BUC may select the correct power calibration table for the monitored power reported back to the modem, viewable under *Monitor*, *BUC*.

It is advisable to keep the BUC attenuator at maximum attenuation to avoid overdriving the BUC input stages, unless there is considerable cross site cable loss. Fine (0.1dB power control is done with the modem (*Change*, *Tx*, *Mod*, *Power*), whereas the BUC attenuator provides 1dB adjustment steps. If the desired carrier power cannot be achieved with maximum BUC attenuation, then there must be considerable cross site loss and so it is safe to reduce the BUC attenuation. It is advisable to keep the modem carrier power several dB away from either the upper or lower modem power end stop, to provide future fine adjustment range.

Initial power adjustments must be made `off satellite`. The measured BUC power can be viewed using *Monitor*, *BUC*.

TERMINAL

The Modem takes control of the BUC to act as an integrated terminal, and the two together respond as follows:

- The modem IF output level screens are replaced by a screen allowing the operator to set the output power at the BUC flange.
- The Modem continuously reads the monitored power output from the BUC, and automatically varies the modem IF level and BUC attenuator to maintain the set power at the BUC flange (ie compensates for temperature changes in cable, equipment etc).
- The BUC Tx On/Off output is maintained as `On` (the Tx carrier can still be muted on Change, Tx, Modulator, Carrier menu).
- The modem automatically reads the frequency shift from the BUC, and configures the modem for display / entry of the final SHF frequencies instead of IF frequencies.

Terminal mode can only be used with a ***single carrier*** through the BUC, as the modem will try and compensate for the *combined* measured power by adjusting the *single* carrier from the modem controlling the BUC.

Terminal mode, where the Tx power is varied to maintain a steady level at the BUC flange, is NOT compatible with AUPC which requires the Tx power to vary to meet receive criteria.

6.12.3 Change, BUC/LNB, Tx/BUC, DC & REFERENCES Menu

This screen is only available on P310 L-Band modems where the BUC Type has been set to other than *None*

Tx/BUC: 1:DC Supply[On] 2:10M Ref[Off]
3:Current Monitor[2400 - 2800mA]

Change, BUC/LNB, Tx/BUC, DC & References Menu

DC SUPPLY If fitted with the P315 BUC DC supply option, then the modem may source 100W of 24V or 180W 48V (factory option) to the BUC `up the coax` or `line powered`. The only option available here is *On* or *Off*.

CAUTION: Needless to say severe damage may occur if a DC supply is fed to a BUC not configured for being `Line powered`.

10M REF The internal 10MHz reference may similarly be sourced from the modem `up the coax` to the BUC. The only option available here again is *On* or *Off*.

CURRENT MONITOR If the modem is sourcing the DC supply to the BUC, then it may be set to monitor the current drawn by the BUC, and to raise an alarm (Tx Fault) if it goes outside a user defined window. Two subsequent screens allow the user to independently set the low and high current alarm thresholds. The current being drawn by the BUC can be monitored from the *Monitor*, *BUC* menu's.

6.12.4 Change, BUC/LNB, Tx/BUC, SHF FREQUENCY Menu

This screen is available on both 70MHz/140MHz P300 modems and P310 L-Band modems, and allows the modem to be set to display and edit the final SHF frequencies instead of the IF frequencies. When the BUC Type has been set to a known Paradise BUC and the modem has the FSK communications option then this setting is done automatically and the menu option to manually set the frequency shift is not presented.

Set upconverter freq shift to display &
edit Tx freq at antenna:[Yes] 1=Yes 2=No

Change, BUC/LNB, Tx/BUC, SHF Frequency Menu 1

If *Yes* is selected then the following screen is displayed:

Freq shift of upconverter:[13050 MHz]
(0-65535MHz) ??.??? (YES)

Change, BUC/LNB, Tx/BUC, SHF Frequency Menu 2

Once set all Tx IF frequencies displayed or edited include the frequency shift of the BUC or upconverter chain.

6.12.5 Change, BUC/LNB, Tx/BUC, SHF POWER/UNITS Menu

This screen is available on both 70MHz/140MHz P300 modems and P310 L-Band modems, and allows the modem to be set to display and edit the final SHF power instead of the IF carrier level.

Modem +13.7[Gain]=SHF [EIRP] in [dBW]
1:System Gain 2=TxPwr/EIRP 3=dBm/dBW

Change, BUC/LNB, Tx/BUC, SHF Power/Units Menu

It allows the user to set the system Gain or Loss after the modem, so that the modem can then display and edit the Tx carrier level in terms of either the Tx Power or EIRP, measured in dBm or dBW. The system gain or loss can be set from -99.9dB to +99.9dB. Options for TxPwr/EIRP &dBm/dBW are only available once the System Gain has been set to other than zero. When zero the default units are TxPwr indBm.

This screen is not available on the L-Band modem with FSK when the Tx BUC Type has been set to a known Paradise BUC and the modem / BUC configured to operate as a Terminal, as here the modem / BUC work in a closed loop mode and compensate for whatever the system gain varies to be, in order to keep the power measured at the BUC constant.

6.12.6 Change, BUC/LNB, Tx/BUC, BUC CONTROL Menu

This screen is only available on the P310 L-Band modem if the BUC Type has been set to a known Paradise BUC, the modem has the FSK communications option, and the Modem/BUC are set in *Independent* mode. In the alternative *Terminal* mode (with Closed loop power control to the BUC flange) the BUC is kept *On* and the BUC attenuator automatically controlled.

1:BUC On/Off[On] 2:BUC Attenuator[7dB]
(Power at BUC reads: 32.7dBm)

Change, BUC/LNB, Tx/BUC, BUC Control Menu

BUC ON/OFF This switches the BUC Tx on and off independently of the modems Tx Carrier On/Off control. This may be useful where one BUC carries several carriers (passively combined but with one modem providing DC / 10MHz Ref / FSK) and you wish to mute all the carriers.

BUC ATTENUATOR This allows the user to vary the attenuator in the BUC. Typically this is used when there is a short run from the modem to the BUC made with reasonable quality cable, and where with such a low loss the minimum output from the modem could saturate the BUC input unless the attenuator (early in the BUC gain profile) is set suitably high.

IF IN DOUBT, always start with the MINIMUM modem Tx Carrier level and the MAXIMUM BUC attenuator setting.

The second line of this screen reports the actual power measured by the BUC.

6.12.7 Change, BUC/LNB, Rx/LNB Menu

Rx/LNB: 1:LNB Type 2:DC & References
3:SHF Frequencies

Change, BUC/LNB, Rx/LNB Menu

Options for *LNB Type*, and *DC & References* are only offered on L-Band modems.

Each option is defined in the following paragraphs.

6.12.8 Change, BUC/LNB, Rx/LNB, LNB Type Menu

LNB Attached[?] 1=None 2=Other 3=3.635-4.2G 4=10.95-11.45G
5=10.95-11.7G 6=11.2-11.7 7=11.7-12.2 8=12.25-12.75

Change, BUC/LNB, Rx/LNB, LNB Type Menu

The table below specifies the parameters for the listed LNB types:

Description	Low Frequency Limit	High Frequency Limit	Frequency Shift
None	Modem IF +/- limits around user set SHF Frequency Shift		
Other	Modem IF +/- limits around user set SHF Frequency Shift		
Std C	3.635 GHz	4.200 GHz	* 5150 MHz
Std Ku	10.950 GHz	11.450 GHz	10000 MHz
10.95-11.7G	10.950 GHz	11.700 GHz	10000 MHz
11.2-11.7G	11.200 GHz	11.700 GHz	10250 MHz
11.7-12.2G	11.700 GHz	12.200 GHz	10750 MHz
12.25-12.75G	12.250 GHz	12.750 GHz	11300 MHz

As with the BUC's, the difference between *None* and *Other* is that with *Other* the operator can configure the modem to supply a 10MHz reference and a DC PSU to the LNB. With *None*, these options are not available.

* Note the `Std C` LNB uses a high side Local Oscillator (LO), and the received SHF Frequency is LO - IF Frequency (not LO + IF as with most other bands). This is somewhat academic as from V3.85 onwards this is handled automatically and the modem displays the correct SHF frequency. Note however that with the LNB Type set to *None* or *Other*, there is no way to *manually* enter a SHF offset which uses a High Side LO.

6.12.9 Change, BUC/LNB, Rx/LNB, DC & REFERENCES Menu

Rx/LNB: **1:DC Supply[15V] 2:10M Ref[Off]**

Change, BUC/LNB, Rx/LNB, DC & References Menu

DC SUPPLY The P310 L-Band modem can supply either 15V or 24V at 500mA to the LNB `up the coax` or `line powered`. The option available here are *Off*, *15V* or *24V*.

CAUTION: Needless to say severe damage may occur if a DC supply (or the wrong voltage DC supply) is fed to a LNB not configured for being `Line powered`.

10M REF The internal 10MHz reference may similarly be sourced from the modem `up the coax` to the LNB. The only option available here is *On* or *Off*.

6.12.10 Change, BUC/LNB, Rx/LNB, SHF FREQUENCIES Menu

Similar to the BUC option, this screen is available on both 70MHz/140MHz P300 modems and P310 L-Band modems, and allows the modem to be set to display and edit the final SHF frequencies instead of the IF frequencies. When the LNB Type has been set to a predefined type (ie not *None* or *Other*) then this setting is done automatically and the menu option to manually set the frequency shift is not presented.

Set downconverter freq shift to display & **edit Rx freq at antenna:[Yes] 1=Yes 2=No**

Change, BUC/LNB, Rx/LNB, SHF Frequency Menu 1

If *Yes* is selected then the following screen is displayed:

Freq shift of downconverter:[13050 MHz] **(0-65535MHz) ??.??? (YES)**

Change, BUC/LNB, Rx/LNB, SHF Frequency Menu 2

Once set all Rx IF frequencies displayed or edited include the frequency shift of the LNB or downconverter chain.

Note this manual entry of SHF Frequency shift always assumes a low side Local Oscillator (LO) and therefore displays the SHF Frequency = LO + IF. There is *no means to enter* a High Side LO, where the SHF frequency received would be LO - IF Frequency (unlike the situation where the modem is told it has a Std C band LNB, and knows that a high side LO is used).

6.12.11 Change, BUC/LNB, Tune Ref Menu

This screen is only shown if a tuneable internal reference is fitted (ie something other than the default 1PPM reference).

Tune Reference:[50]% ↑↓ to nudge
YES to accept, NO to cancel

Change, BUC/LNB, Tune Ref Menu

This screen allows the internal reference oscillator to be calibrated up to about +/- 1PPM (the actual range depends on the exact oscillator option chosen) to compensate for ageing of the quartz crystal.

To calibrate the internal oscillator, either monitor the 10MHz reference if set to be output up the coax, OR, (OFF SATELLITE) set the Tx carrier to the highest possible frequency, engage *CW* (Carrier Wave) from the test menu, and measure the carrier centre frequency itself.

Needless to say. Ensure whatever you are measuring the frequency with is itself calibrated, warmed up, and significantly exceeds the stability of the reference option fitted to the modem (viewable under *Info*, *This Unit*)

6.13 MONITOR MENU

Monitor: 1:Demod performance 2:Terrestrial BER
3:Carrier IDs 4:Distant Eb/No & BER 5:AUPC 6:BUC

Monitor Menu

Each of these options is now discussed in turn.

6.13.1 Monitor, DEMOD PERFORMANCE Menu

Eb/No:10.3dB, To FEC:6.8E-4, To RS:7.8E-7
FAW BER:<1.0E-12, Final BER:<1.0E-12 (RS)

Monitor, Demod Performance Menu

This screen which is regularly updated provides the following information:

Demod Eb/No This is the effective `signal to noise ratio` the USER sees, (ie Ebi/No, the energy per information bit). This is also shown on several of the *Status* screens.

To FEC This is the measured uncorrected BER before any FEC. It is the raw uncorrected bit error rate ***into*** the FEC and it is not representative of the "User BER" after forward error correction. Displayed only if the inner FEC is active, ie not operating uncoded.

To RS This is the measured error rate into the Reed-Solomon decoder (from the FEC, unless operating uncoded). The difference between this and the **To FEC** figure shows the improvement due to the Inner FEC.

BER on FAW An estimate of the USER BER based on the count of errors on the Frame Alignment Words (FAW) received by the deframer over a 1 minute sliding window. Only available if operating in a framed mode. This is equivalent to the final user BER. The difference between this and the **To RS** figure shows the improvement due to the outer RS FEC.

Final BER This is the final BER figure the modem is using, the source is displayed in brackets after the BER, in this case (RS). It is based on this figure that the deferred alarm is raised if it exceeds the user BER threshold.

6.13.2 Monitor, TERRESTRIAL BER Menu

This screen is only available if the signal on the terrestrial ports is framed (ie T1/E1 PCM bearer) which allows the modem to determine the BER on those ports.

Terr: 1:BER at Drop Mux =1.6E-8 (FAW)

2:BER at Insert Mux=1.5E-8 (CRC)

Monitor, Terrestrial BER Menu

It displays the terrestrial BER at the input to the Drop and Insert multiplexers; these will be the same unless an interface card with separate Drop/Insert bearers is in use. The display shows BER (source), and the source may be changed by pressing 1 or 2. The dialogue is exactly the same as described in section 6.10.3 on page 105.

6.13.3 Monitor, CARRIER ID's Menu

This screen is only available if the receive service supports the transmission of the three identity bytes in the TS32 Multiframe. This includes IBS/SMS modes, Closed Net Plus ESC modes above 32kbps and Custom IBS modes with a TS32 multiframe.

Rx ID's carried in IBS MF word TS32bit4

Channel=173 Station=041 Spare=255

Monitor, Carrier ID's Menu

The earlier versions of the Eutelsat SMS specification defined these 3 eight bit identities to be transmitted once per satellite TS32 multiframe to identify the carrier and the earth station. These were named *Station ID*, *Carrier ID* & *Spare ID*. More recent issues just say "reserved for uses such as.....". If the demod is receiving a suitable carrier, then the ID's from the received carrier are displayed on this screen.

These may be manually set at the Tx end of the link by *Change, User-Opt, Operation, Satellite, Carrier ID's*.

6.13.4 Monitor, DISTANT Eb/No & BER Menu

This screen is only available when the AUPC feature is set to `Maintain Eb/No` or `Monitor Distant` (refer to AUPC in section 8.11 on page 156). In these modes the Eb/No and BER from the distant modem are brought across the satellite link by the AUPC, and are available for display on the local modem (and automatic timed entries to the traffic log if required).

Distant end Eb/No=9.7dB **Distant end final BER=<1.3E-7**

Monitor, Distant Eb/No & BER Menu

If the link is broken, or the AUPC cannot communicate with the distant end via the ESC channel, then both figures are replaced with `Unavail`.

6.13.5 Monitor, AUPC Menu

This screen is only available when the AUPC feature is set to `Maintain Eb/No` or `Self Monitor` (refer to AUPC in section 8.11 on page 156) when the AUPC is controlling the Tx power. The first line displays either `Distant Eb/No` or `Self monitor` respectively, the lower line shows the target Eb/No along with its tolerance window, and the current AUPC delta power. If the delta power reaches the preset limit either up or down, then it is prefixed with either a ↑ or ↓ arrow indicating that the power limit has been reached.

Distant Eb/No:9.7dB **Target:10.±0.5dB Delta power:+1.5dB ↓**

Monitor, AUPC Menu

The down arrow indicates that a subsequent screen (shown below) shows the limits the AUPC has been constrained to work under:

Limits: +3.5 -1.0dB Slew:10dB/min **Comms lost action:Nominal ↑**

Monitor, AUPC Limits Menu

Most of this is self explanatory except for the slew rate limit, which limits the rate of change of Tx power (it moves on 0.1dB steps at the appropriate rate to match the given slew rate). A slew rate limit of zero however indicates `no limit`, and step changes in power will be made on the Tx output.

6.13.6 Monitor, BUC Menu

This menu is only available on the P310 L-Band modem. It provides information on the current BUC connected.

BUC Type: Std Ku **Modem/BUC Mode: Terminal ↓**

Monitor, BUC Menu

BUC Type This may be either: None, Other, Std Ku, Ext Ku, Std C, INSAT C, or PALAPA C

If the BUC is from Paradise Datacom and the modem is fitted with the FSK communication option, then significantly more information is available on this and subsequent screens. On this screen:

Modem/BUC Mode This may be either "Independent" where the BUC may be controlled from the

modem front panel or "Terminal", where the modem control the BUC and the modem RF output power to maintain a fixed power level at the BUC output (taking out temperature induced variations in the cable etc)

Subsequent screens (those marked * only visible when the BUC is FSK capable) include:

* The BUC communications status & Address, Temperature & PLL lock status
* The BUC Set power, the Measured power, set output status (on/off) and attenuator range & value
* The FSK generator/receiver status, true output status (on/off)
  The DC & 10MHz ref supply to the BUC on/off setting, measured current and current low/high trip limits

6.14 INFO MENU

Info: 1:This unit 2:Supplier 3:View Config
4:Terr-Intfc 5:Features 6:BUC/LNB

Info Menu

The options are as follows:

THIS UNIT This screen displays the modem number, serial number and software version. Pressing Down Arrow leads to further screens, which give the identity of the sub-boards and interfaces fitted to the equipment.

SUPPLIER This screen (together with screens accessed by the down arrow) give the manufacturer with contact fax and phone numbers, and e-mail addresses.

VIEW CONFIG This screen allows the configuration of the modem to be displayed. After selecting between Tx, Rx, Interface, Common and Remote M&C, subsequent presses of the down arrow display every parameter in that group.

TERR-INTFC This option displays information relating to the terrestrial interface card fitted into the modem. The information includes: Card type (and what card it is emulating when it is a multi-standard card), the data rate limits, and a list of every interface line the card provides along with a brief description of the function of that line (example follows)

Tx path input SD=Main Tx data input
Stable on rising edge of TT-B line ↓

Info, Terr-Intfc (sample interface line description)

FEATURES This option allows the current feature set of the modem to be checked and also further features added by entering a `Feature Code`. Refer to Appendix C for further details.

BUC/LNB This menu is only available on the P310 L-Band modem. It provides information on the current BUC & LNB connected.

BUC Type: Std Ku
Software ver: 2 Power Class: 2W = +33dBm

Info, BUC/LNB Menu

BUC Type This may be either: None, Other, Std Ku, Ext Ku, Std C, INSAT C, or PALAPA C

If the BUC is from Paradise Datacom and the modem is fitted with the FSK communication option, then more information is available on this and subsequent screens. On this screen:

Software Ver: The version of software in the BUC.
Power Class: The maximum power in Watts &dBm.

Subsequent screens (those marked * only visible when the BUC is FSK capable) include:

* BUC frequency range & shift (LO)

The **LNB** DC voltage (off, 15, 24V) & 10MHz ref (on/off) supply settings.

6.15 LOG MENU

Traffic Log: [43]entries
1:View 2:Print 3:Clear 4:Autolog

Log Menu

The Log menu allows the operator to view, print or clear the internal 1000 event traffic log. The *Autolog* option allows the operator to have certain parameters added to the traffic log at regular intervals. The traffic log is a circular store of 1000 locations, events not viewed or printed are lost after 1000 subsequent events. The options are as follows:

VIEW This allows the log to be viewed on the LCD. The Up Arrow and Down Arrow keys allow the operator to scroll through the list of logged events. Each entry is logged with it's time and date.

PRINT This allows the log entries to be printed to the rear panel serial port (on the Async ESC connector), either just the unprinted entries, or the whole log.

CLEAR The log is cleared.

AUTOLOG This is described below.

6.15.1 Log, AUTOLOG Menu

Auto log period: [60 mins]
(0=Off) ???? mins (Yes)

Log, Autolog Menu

This first screen sets the period between automatic log entries. Entering a figure of zero disables the automatic logging of any data.

When **YES** is pressed with a non-zero value for the Autolog period, the following screen is accessed:

Autolog(Y/N): 1 Buffer % (Y) 2 Eb/No (Y)
3 Rx User BER (N) ↓More

Log Autolog, Measurements Menu (1)

This screen allows the operator to toggle each of the first three loggable events on and off. (N) indicates No, the data will not be logged, (Y) indicates Yes the data will be logged. Pressing the key corresponding to each data type toggles between (Y) and (N). More options are available on subsequent screens:

Autolog (Y/N): 1:BERT BER (N) ↑ Back
2:Tx Terr BER (N) 3:Rx Terr BER (N) ↓More

Log Autolog, Measurements Menu (2)

Finally, if AUPC is active (see AUPC in section 8.11 on page 156), another subsequent screen is offered:

Autolog (Y/N): 1:AUPC Delta Power (Y)
2:Distant end Eb/No (N) ↑ Back

Log Autolog, Measurements Menu (3:AUPC)

Each option is as follows:

BUFFER % — The buffer fill state is logged every period this allows fill trends to be monitored

Eb/No — The ***average* AND *worst case*** Eb/No for the period are logged at the end of the period.

USER BER — The ***average* AND *worst case*** estimated USER BER are logged at the end of the period.

BERT BER — The BER as measured by the internal BER Tester (BERT). This can be measured either in the main data channel or when running in parallel with the main data in either the ESC or the Aux channels. The ***average* AND *1 second worst case*** BER measured by the BERT are logged at the end of the period.

TX TERR BER — This is the BER measured at the terrestrial input. This is only available if the terrestrial signal can be monitored for BER (ie it's framed and/or has a CRC). The actual method of measuring it is determined by *Change, User-Opt, Operation, Terrestrial, Tx/Drop BER*.

RX TERR BER — As above. This is only meaningful (ie different to the Tx/Drop BER above) if the modem is used with separate Drop/Insert bearers by the use of a twin G.703 terrestrial interface. The method of BER measurement can be selected by *Change, User-Opt, Operation, Terrestrial, Rx/Insert BER*.

AUPC DELTA POWER — This logs the power variation (delta power) the AUPC has used to maintain the target Eb/No. See AUPC in section 8.11 on page 156 for further details. This is useful in case the satellite operator requires you to determine the Tx power that was active at any time whilst AUPC was active.

DISTANT END EB/NO — This is the ***distant*** end Eb/No, available when AUPC is active (again see AUPC in section 8.11 on page 156 for further details). As with the local Eb/No the ***average* AND *worst case*** Eb/No for the period are logged at the end of the period.

The automatic logging of local/distant Eb/No and various BER's, coupled with a `centralised log accumulation` by an M&C package (eg Alphawave `CAM`) provides a very convenient way to be able to monitor the performance of any link (and have recorded data verifying the performance should anyone query if there was a `fade`).

Please note that each data type logged uses up one log entry every Autolog period (ie the log capacity can be consumed *quickly* with multiple events logged at very regular intervals).

6.16 TEST MENU

The test menu is as shown below, and leads on to the menu's described in the following few paragraphs. When either a loopback or test mode are active, the TEST LED on the front of the equipment illuminates.

Test: 1:Loopbacks [Off] 2:RF & FEC [Off]
3: PSU/Temp 4:Int BERT [ESC]

Test Menu

Each of these options is now discussed in turn:

6.16.1 Test, LOOPBACKS Menu

Loop (now Intfc): 1 Off, 2 Interface (L+R),
3 FEC (L), 4 I.F. (L) (↓ More)

Test, Loopbacks Menu

This screen shows the most common loopbacks, but by pressing the down arrow further options are provided. The loopback options are:

OFF Normal operation is selected.

INTERFACE (L+R) An interface loop (Local and Remote) is selected, providing both a terrestrial loop and a loop to the data from the remote end of the satellite link. The exact implementation of the loop is interface dependent. On G.703 cards it is a `copper loop`, on other cards the loopback is provided by a multiplexer at TTL levels. If an *INTERFACE LOOP* doesn't make the sync light on the firebird come on, your looking in the wrong place, its not the modem, try the cables!

For the remote loopback to function when this loopback is selected the clocking must be configured in a mode where it would work if the loop were made in the cables. Rx clocking must be set to something other than *Tx Clock* (switch to Satellite if this is the normal setting) and the Tx clocking must the set to *Tx Clock In*.

FEC (L) The data is looped back after the FEC just before it enters the modulator providing a local loop only. The Tx data continues to be transmitted, and the Rx data from the satellite is ignored. ESC & Aux channel data (which is present in the data stream at the FEC) is also looped.

I.F. (L) The Tx IF signal is looped back within the modem a IF. Tx data is transmitted as normal, and the Rx RF signal is ignored. The Rx IF Frequency is automatically adjusted to match the Tx IF Frequency (so the loop will function). ESC & Aux channel data (which is present in the data stream at the IF port) is also looped. When the loopback is switched off the RX IF Frequency is restored.

NOTE: The Tx IF Level needs to be set to above -10dBm for the loopback to function reliably. Do NOT change the Tx IF Level for a loopback if the modem is still on satellite!

Cont'd....

Options displayed on the second screen include all of the above, plus:

D/I (L) The data is looped back after the Drop mux, through the Doppler buffer, back into the Insert mux providing a local loop only. The Tx data continues to be transmitted and the Rx data from the satellite is ignored. If Drop/Insert baseband processing is not active, this loops the data at the output of the baseband block (ie it works even if Drop/Insert is not active). ESC & Aux channel data is NOT looped.

FRM (L) The data is looped after the Framer back into the Deframer providing a local loop only. The Tx data continues to be transmitted and the Rx data from the satellite is ignored. ESC & Aux channel data (which is present in the data stream at the Framer output) is also looped

RS (L) The data is looped after the Reed-Solomon Encoder / interleaver back into the RS Deinterleaver / decoder providing a local loop only. The Tx data continues to be transmitted and the Rx data from the satellite is ignored. ESC & Aux channel data (which is present in the data stream at the RS codec) is also looped

From the terrestrial port towards the IF ports the loopbacks in the following order test more and more circuitry: **Interface, Drop/Insert, Framer, Reed-Solomon, FEC, IF.**

REMOTE (R) This provides a loop of the Rx data after the deframer back into the framer. Tx input data is ignored, Rx traffic continues as normal. Incoming ESC & Aux channel data is not looped back to the remote site.

6.16.2 Test, RF & FEC Menu

Test modes: [Off] 1=Off 2:Tx CW
3:Tx Alt 1,0 4=RS corrections disable

Test, RF & FEC Menu

The test modes available are:

OFF All test modes are cancelled.

TX CW Selecting TX CW causes a pure carrier to be transmitted. This is useful for evaluating phase noise and spurious, but should not be used over a live satellite link.

TX ALT 1,0 Selecting TX alt 1,0 causes an alternating 1,0,1,0.... pattern to be fed to the modulator at the symbol rate. This produces two discrete frequencies to be generated, spaced at ± symbol rate about the (suppressed) carrier. This is useful for evaluating the carrier suppression of the modulator but should not be used over a live satellite link.

RS CORRECTIONS DISABLE This option allows the corrections being made by the RS decoder to be inhibited, without the removal of the RS overhead. This allows the true effect of the Reed-Solomon codec to be seen without data rate changes (which would affect Eb/No and therefore the error rate).

6.16.3 Test, PSU'S + TEMP Menu

PSU: +5V	**+15V**	**-15V**	**-5V**	**Temp**
Status: 97%	**98%**	**102%**	**98%**	**46C**

Test, PSU´s + Temp Menu

Power supply monitoring is only available if the Monitor/AGC option is fitted. If it is not the screen above displays only the temperature. When selected this displays all of the internal power supply lines & internal temperature as monitored by the processor with each PSU line is displayed as percentage of the nominal value. The temperature is monitored continuously and a Unit Warning /deferred alarm will be activated if ever the internal temperature reaches within 3 degrees Centigrade of the operating limits of 0C and 60C. Should the internal temperature exceed the limits of 0C and 60C, then a Unit Fault / Prompt Alarm is activated. **The Tx carrier is muted outside the operating temperature range.**

6.16.4 Test, INT' BERT Menu (Software>V2.34)

Internal BERT: 1=Off 2:Channel [ESC]
3:Pattern[2^15-1] 4:Mode[Manual] 5:Results

Test, Internal BERT Menu

The internal Bit Error Rate Tester (BERT) is only available if the `PRBS Tester` feature is available (standard on P300-IDR and above). It is a powerful feature capable of monitoring and Auto-Logging the BER of the receive satellite path, even while the main data channel of the link is carrying normal traffic. It allows a test pattern to be sent and received in either this main data channel, or in parallel with the main data channel in the ESC or Aux channels carried within all satellite overheads.

The BER tests can either be selected to be manually controlled (using Stop/Start/Reset, running for up to 27 hours), or to run continuously using a 1 minute sliding window. When Auto-Logging of the BER Tester results is enabled, the tester executes a test for the user set BER Auto-Log period (1-9999 minutes), and records both the average and 1 second worst case BER's in the traffic log of the modem at the end of the period. It then automatically re-starts a new test for the following period.

It may operate independently, or in conjunction with external BER equipment as the test patterns it uses are intentionally Firebird compatible. For example at one end of a link the internal BERT may be used to inject the PRBS and measure the Rx BER, while at the other end a Firebird is connected to the Main data port, or the ESC/Aux ports on the IDR Option (if fitted).

Each of the menu options is described in turn, with most other options appearing in a subsection below along with a description of the submenu they display:

OFF This disables the internal BER Tester, removing it from the channel in use, ie the Main, ESC, or Aux channel, restoring normal operation.

6.16.5 Test, Int' BERT, OFF/CHANNEL Menu

Channel for BER Test: [ESC]
1:Main data 2=ESC 3=Aux

Test, Internal BERT, Channel Menu

The test may run through the Main, ESC or Aux channels.

MAIN This first generates an `are you sure` screen before substituting the PRBS in place of the Tx main traffic channel and monitoring for errors on the Rx Main traffic channel. Note that for Closed Network mode only (ie no overhead at all) the BER Tester cannot currently inject a test pattern into the main traffic channel (a warning is issued on the screen). It can however receive and monitor a test pattern injected by equipment at the distant end of the link. On a link where it is necessary to use the BER Tester, switch to Closed Net *Plus ESC* mode, and if not using the ESC set it for the lowest possible Baud rate which will result in an overhead of <0.5%.

ESC / AUX *ESC* & *Aux* are defined below for the different service types. If either ESC or Aux are selected but the channel has not been defined, then the user is prompted to define the channel (and must then re-select the channel from this screen).

Closed Network **ESC** & **Aux** channels are not available in Closed Network mode (as there is no overhead in which to carry them).

Closed Net Plus ESC Closed Net Plus ESC mode is only available if the Async ESC feature is available (standard on P300-IBS and above). The **ESC** channel Baud rate is used to determine the overhead added to the main data, allowing the minimum possible overhead to be added (ie the minimum bandwidth to be used), to provide the Async ESC Baud rate required. When the ESC channel is used for BER testing the Async ESC is disabled and whatever bandwidth was assigned to the Async ESC channel is used synchronously for BER testing. The data rate to the satellite (main data + overhead) remains unchanged.

There is no **Aux** channel facility in Closed Net Plus ESC, as this mode is specifically designed to minimise the satellite bandwidth used, and hence all overhead is assigned to the ESC channel.

IBS/SMS IBS/SMS mode is only available if the IBS/SMS feature is available (standard on P300-IBS and above). The **ESC** channel is the channel, which is normally used to carry asynchronous data from earth station to earth station (typically used for distant end M&C). When selected as the BER test channel Async ESC data is not passed and the channel is used synchronously for BER testing. It is only possible to define an ESC channel in IBS/SMS mode for the BER test to run through if the Async ESC feature is available (standard on P300-IBS and above). The ESC channel may be configured to provide rates up to 4.6% of the main data rate for BER testing.

The **Aux** channel may be configured to provide the mandatory INTELSAT oversampled low rate ESC (yes `ESC` but on the Aux port of the modem). When used by the BER Tester it is used synchronously and provides a test channel of 0.2% the main data channel rate. If the IDR Option is fitted (standard on P300-IDR and above) which provide a synchronous external Aux port, then the Aux channel may be set for *sync channel* and to use all the available overhead not already in use by the ESC channel. This can provide a channel of up to 4.4% of the main data rate.

If the `Custom Features` feature is available (standard on P300-TCM), then the overhead may be user assigned between the **ESC** & **Aux** channels, allowing the desired Async ESC rate to be achieved for distant end M&C (but not massively exceeded), leaving any spare overhead to maximise the Aux channel data rate for BER testing.

IDR

IDR mode is only available if the IDR Option is fitted (standard on P300-IDR and above). The **ESC** channel is the 8kbps synchronous ESC channel standard on IDR Services (which may also be used for Asynchronous ESC data if the Async ESC feature is available).

The **Aux** channel may be selected to be either 32kbps (in place of one 32kbps ADPCM audio ESC channel) or 64kbps (in place of both audio ESC's). This provides a very useful channel rate for BER testing !

Custom Framing

Custom Framing mode is only available if the `Custom Features` feature is available (standard on P300-TCM). Custom framing is based on either IBS or IDR formats and custom framing provides the following advantages:

Based on **IBS**: A variable overhead may be added allowing both ESC & Aux channels to be scaled to virtually any rate. This is achieved by setting the ESC channel to the required Async ESC Baud rate, and changing the split of the allocation of the overhead between ESC & Aux channels. The total overhead then scales to provide the required ESC Baud rate in whatever part of the overhead you have assigned to it, with the rest of the scaled overhead for the Aux channel.

Based on **IDR**: As well as the features described above in standard IDR, it is possible to reduce the normal 96kbps overhead (two audio ESC's) to 64kbps (one audio ESC or 32kbps Aux data) or 32kbps (no audio ESC's & no Aux data). It may also be configured to use 16kbps ADPCM instead of 32kbps, allowing the full IDR features (two audio ESC) to be accommodated in 64kbps overhead. **More interestingly** using the normal IDR overhead of 96kbps together with 16kbps ADPCM for the audio ESC's, **it may provide all the normal IDR features, but with the second 32kbps audio slot free to configure as a 32kbps Aux channel for continuous BER testing.**

6.16.6 Test, Int' BERT, PATTERN Menu

BERT Pattern: [2^15-1]
1:2^11-1(2047) 2:2^15-1 3:2^20-1

Test, Internal BERT, Pattern Menu

The test pattern may be selected to be one of three standard patterns as 2^{11}-1(2047), 2^{15}-1, or 2^{20}-1.

6.16.7 Test, Int' BERT, MODE Menu

BER Test mode [1 Min]
1=One minute sliding window 2=Manual

Test, Internal BERT, Mode Menu

The test mode may be one of the following:

AUTOLOG The BERT mode is fixed in *Autolog* because the unit is configured to Autolog the results of the BER test at the user defined Autolog period. In Autolog mode the screen above is not shown, but rather a warning "Cannot select 1 Min/Manual mode while AUTOLOG of PRBS results is active (YES)" is displayed. To be able to manually select the BERT mode auto-logging of the BER result must be disabled by either setting the Autolog period to zero (Main, Log, Autolog) or by clearing the flag requesting it to log the BERT results on the subsequent Autolog screen.

ONE MINUTE One Minute sliding window mode displays the average BER over the last 1 minute. It does this by storing the error results second by second in a circular table 60 entries long and recalculating the average BER each second. For any seconds where the BERT is `out of sync` a zero entry is made in the table. The average BER over the one minute period is calculated based on only the non-zero entries (when sync is recovered).

MANUAL Manual mode allows the operator to manually start, stop & restart tests which may run for up to 27 hours (99,999 seconds), at which point the results are frozen.

6.16.8 Test, Int' BERT, RESULTS Menu

BERT:Sync OK Loss#:0 Rate:32000bps
Errors:328 Time:1.0min BER:1.7E-04 ↓

Test, Internal BERT, Results Menu

Note in this screen the following keys are active:

Press 1	Inject single error (buffered for up to 10 rapid key presses)
Press 2	Start a test / Restart the current test (manual mode only)
Press 3	Stop the current test (manual mode only)

The fields on this screen are as follows:

BERT:	"Sync OK"	The test is running and the tester is `in sync`
	"NO SYNC"	The test is running but the tester is `out of sync`
	"Reset"	No test has been run since the unit was (re)configured
	"Stopped"	The test has been manually stopped (results are frozen)

Loss#: A count to 99 sync losses and recoveries. When the display reaches ">99" the test is automatically stopped. The sync loss threshold is fixed at >25% errors over 1024 bits (equivalent to the Firebirds `Normal` threshold)

Rate: The test data rate. This accurately displays the rate at which the test is running whether it is in the Main, ESC or Aux channels.

Errors: The cumulative count of errors during the test. If the count reaches 999,999 then the test will stop and the results will be frozen. See Note 1 below.

Time: The cumulative test time, displayed as seconds to 1 minute, then decimal minutes to 1 hour, then decimal hours to a maximum of 27.7 hours.

BER: The calculated BER over the entire duration of the test (ie average over test period). It is displayed as follows:

When there are **more than 100 errors** the exact BER is displayed.

When there are **less than 100 errors** a ˙ symbol prefixes the BER display (approximately equal to, as the result is statistically poor).

When there have been **NO errors** the modem does not know if the BER is perfect, or simply if the test has not been running long enough to receive an error. In such a case it prefixes the display with a **<** symbol, and displays the BER that it would calculate if ONE error had been received. This means that as the test progresses without errors the displayed BER improves, but never assumes it is zero (as a Firebird does).

Note 1:

The BER displayed by the Internal BERT is 100% accurate. However if you use the Internal BERT and *in parallel* monitor the same received PRBS with an external Firebird, there will be a <0.1% discrepancy in the error count, but NOT the BER. For the purists amongst you, and so you do not question the accuracy of the Internal BERT, the briefest useful explanation possible is as follows:

When the processor reads the BER counters once per second (errors, number of bits etc), it has to freeze the counts in order to read the results accurately (in case the counters increment whilst being read). This reading of the counters takes less than 0.1% of the time, but does mean that the BERT is `blind` for a small proportion of the time and some individual errors may not be counted. However the BER is 100% accurate because as well as counting Errors, the BERT also counts PRBS bits received, and calculates the BER as <Errors> / <Count of bits received> (ie both are in proportion). This would *not* be the case if we did not count the bits received, and simply assumed that the error rate was <Errors> / (<Time> x <Rate>).

This may not sit comfortably on first reading, but you are probably happy with the concept that a PRBS multiplexed in with the main data channel at say 5% of the main data rate will provide the same BER reading as for the main data channel itself. You would probably agree that the result would be no different if the PRBS content was dropped to say 4% of the main data channel, implying that reducing the bits available to measure the BER by 20% will have no effect on the validity of the BER reading. The argument for the Internal BERT is no different, >99.9% of the bits available for BER measurement are used, with the other <0.1% lost as the processor reads the hardware registers.

6.17 SETUP MENU

See Setup - Initial Configuration Menu on page 56

6.18 ACTION MENU

Action: 1=Buffer Centre **2=Slip counter reset 3=1:1 Give away control**

Action Menu

The options on this menu are fairly self explanatory, however for completeness:

BUFFER CENTRE — Forces the Rx buffer to re-centre, and will cause a burst of errors. This is automatically performed when the Rx traffic goes from fail to OK if the option under *CHANGE, USER-OPT, OPERATION, ACTIONS, BUFFER AUTO CENTRE* is enabled.

SLIP COUNT RESET — This resets the counts of underflows and overflows on the *Status* status screens

1:1 GIVE AWAY — When two Modem's are configured as a 1:1 pair, this can be selected on the on-line unit, to handover control to the off-line unit.

6.19 HELP MENU

Help: 1:Emergency Tx Carrier Off
2:Menu operation 3:Glossary

Action Menu

The options on this menu are as follows:

EMERGENCY TX CARRIER OFF **This provides a short route to switch off the Tx carrier in an emergency.** It is operational even when under Remote M&C and normal access to the carrier on/off control is disabled (along with most other local control). A single further submenu provides the `are you sure` type check, pressing 1 at this next menu will switch off the Tx carrier. **Note the key sequence to switch off the carrier is therefore `911` from the main menu.** So the key sequence **Main, 9,1,1** will kill the Tx carrier whatever screen was left active on the display.

NOTE: This is an OFF only selection, to switch the carrier on again you must use the normal sequence, Change, Tx, Mod, Carrier, On. Although `911` is available in both local and remote M&C, access to the normal carrier on/off control is only available under local control. So if a unit is set for remote control, either the carrier must be switched on by remote M&C, or the unit must be returned to local control.

MENU OPERATION A short and simple guide to menu operation

GLOSSARY A sequential glossary of some of the standard telecomms abbreviations used during menu operation.

6.20 SERVICE MENU

The service menu is available by selecting 0 from the main menu. It provides options not normally required when configuring the Modem.

Service: 1:User Parameters
2:Factory parameters

Service Menu

6.20.1 Service, USER PARAMETERS Menu

User: 1:Lock Kbd 2:Clr Cfg
3:Clr All+Reset 4:Fan [Auto]

Service, User Parameters Menu

The options are:

LOCK KBD This locks the keyboard after displaying a screen showing the unlock code. As with all Paradise equipment the unlock code is simply the product number (eg 300). The unlock code is displayed before the keyboard is locked on the Modem, as we had quite a few calls to the technical support line which start off "I've just selected Lock Keyboard from the menu and ..... "

CLR CONFIG This clears the current configuration down to its default blank state.

CLR ALL+RESET This clears the entire non volatile memory, including current configuration, all configuration memories, and the traffic log, then resets the processor.

FAN Normally the fan is temperature controlled, switching on at 26C and off at 24C. The internal temperature can be monitored on the *TEST, PSU + TEMP* menu. A Unit Warning /deferred alarm will be activated if ever the internal temperature reaches within 3 degrees Centigrade of the operating limits of 0C and 60C. Should the internal temperature exceed the limits of 0C and 60C, then a Unit Fault / Prompt Alarm is activated. **The Tx carrier is muted outside the operating temperature range.**

6.20.2 Service, FACTORY PARAMETERS Menu

Factory: 1:Serial# [01564] 2:Debug [0]
3:RemCont [Giveaway-120s] 4:Watchdog

Service, Factory Parameters Menu

The options are:

SERIAL # This menu allows the serial number to be both viewed and edited.

DEBUG Used for Paradise internal procedures only. **Setting Debug to a value other than 0 is very likely to slow down the operation of the unit.**

REM M&C This option is used to set the timeout required before local control can be taken if the unit is in remote mode. This is covered extensively in section Change, Rem-M&C Menu on page 102

WATCHDOG This provides an option to test the watchdog timer. The watchdog timer is a timer, which is regularly reset by the processor. Should it ever reach its set time, then the processor has failed to reset it, and probably crashed. **Testing the Watchdog timer therefore will cause the unit to reset, and corrupt both Tx and Rx traffic for a few seconds.**

7 MENU SCREENS FOR SPECIALIST OPTIONS

The following sets of menu definitions are shown in this separate section in order not to complicate the earlier section dealing with basic menu operation.

7.1 CUSTOM FRAMING MENUS

These features are only available if the `Custom Features` feature is available together with the corresponding IBS or IDR options (standard on P300-TCM). Refer also to the section **Closed Network Plus ESC** via the Custom Service menu in section 8.7.2 on page 150.

7.1.1 Change, Tx/Rx, Service, CUSTOM Menu

If *Custom* is select from the Change, Tx/Rx, Service menu, this leads to the following dialogue:

Custom framing based on: [?] **1=IBS 2=IDR**

Change, Tx/Rx, Service, Custom Menu

IBS This leads to variants on standard IBS framing (all explained later) which allow for operation:

- Without a TS32 multiframe
- Without a backward alarm
- With four backward alarms for Multidestinational IBS
- **Minimum overhead mode**, where the overhead scales to provide any ESC requirement at any data rate.

IDR This leads to variants on standard IDR framing (again explained later) which allow for operation:

- With overheads of 96, 64, or only 32 kbps.
- With 16kbps ADPCM on the audio channels instead of 32kbps, allowing either all normal IDR features in a 64 kbps overhead, or (again utilising 16kbps ADPCM) **96 kbps overhead with all normal IDR features, but including a 32kbps spare channel for continuous BER traffic quality monitoring.**

The discussion of IDR this continues after the IBS section in para 7.1.3 on page 137.

7.1.2 Change, Tx/Rx, Service, Custom, IBS Menu

If *IBS* is select from the menu above this leads to the following question:

Multiframe: [?] **1=Normal 2=Without a TS 32 Multiframe**

Change, Tx/Rx, Service, Custom, IBS, Multiframe Menu

NORMAL A TS32 Multiframe is used as normal.

NO TS32 MF No TS32 Multiframe is sent (Tx) or acquired (Rx). This is primarily for operation at low rates where the TS32 multiframe becomes long enough to affect acquisition time. For example at 32kbps the multiframe lasts 1 second, and hence TS32 MF acquisition may take 1 second on top of demod lock time. This selection also frees up one additional bit of the overhead (TS32 bit 4) to carry ESC information.

The disadvantage of operating without a TS32 Multiframe is that the synchronous IBS scrambler cannot be used, and the `Normal` scrambler option selects INTELSAT V.35. This results in an increase in the error rate, as the V.35 scrambler multiplies any errors on the channel by a factor of three.

Both options lead on to the following question:

Backward Alarm:[?]

1=Normal 2=No Backward Alarm facility

Change, Tx/Rx, Service, Custom, IBS, Backward Alarm Menu

NORMAL A Backward Alarm is sent (Tx) or detected (Rx) as normal

NO BACK' ALM No Backward Alarm is sent (Tx) or received (Rx). This is a very useful facility to have to lose, but for maximum ESC operation this selection does free up one further bit of the overhead (TS32 bit 3) to carry ESC information.

If both the TS32 Multiframe and Backward Alarm options have been selected as *Normal*, then the following screen is displayed. If either the Backward Alarm facility or the TS32 Multiframe has been disabled, then this menu is skipped.

IBS Backward Alarm: [?]

1=Normal (single) 2=Four independent alarms

Change, Tx/Rx, Service, Custom, IBS, Back' Alm mode Menu

NORMAL A single backward alarm operates as normal

FOUR ALARMS The modem transmits or receives four independent backward alarms, using the form `c` outputs and backward alarm inputs normally used for IDR operation. This allows a single IBS Tx carrier feeding multiple Rx sites (each site receiving part of the data in the Tx carrier), to individually indicate to each site a failure of the return carriers from those sites. The sequence in which these four alarms are carried in the IBS overhead may be changed under *Change, User-Opt, Operation, Satellite, Back' Alm Map.*

Finally, all paths through these menus arrive at the following question:

Overhead Mode: [?]

1=Normal 2=Min o/h to provide set ESC

Change, Tx/Rx, Service, Custom, IBS, Overhead Mode Menu

This final option is the most powerful of the features in Custom IBS.

NORMAL The standard 16/15 (6.7%) IBS/SMS overhead is used. The ESC rate available is a fixed proportion of the main data rate (but may be manipulated within limits

by allocating more or less of the overhead to the ESC). When the ESC Baud rate is set too high, a warning will be displayed if the overhead cannot provide the requested ESC rate.

MIN O/H The ***overhead varies* to provide the ESC Baud rate** set on the ESC menus. The following two examples explain typical scenarios:

- At 2048 kbps with a 9600 Baud ESC channel the overhead can reduce to less than 1% whilst still maintaining the IBS/SMS benefits (namely a factor of three error rate improvement due to using the IBS/SMS scrambler instead of the V.35 scrambler, the ESC channel and the backward alarm facility).
- The operator can set the ESC channel Baud rate to 9600 Baud even at low data rates. For example at 64kbps the high rate ESC would normally provide a 2400 Baud channel, but if 9600 Baud is set in Minimum overhead mode, the overhead will scale to provide it. The practical ESC rate limit is 70% of the data rate, ie you can have a 9600 Baud ESC channel down to a data rate of 11kbps !

The final satellite data rate including overhead can be displayed on the *INFO*, *VIEW CONFIG*, *TX/RX* screens.

NOTE: This is obvious, but it is stated here as a reminder. As the exact overhead format is calculated based on your ESC requirement, for two Modems to calculate the same overhead usage and therefore interwork, the following parameters must be the same at both ends of the link:

- Main Data Rate.
- ESC async character format (bits / parity) & Baud rate.
- Proportion of overhead assigned to ESC.
- Baseband mode (ie continuous or Drop/Insert)

7.1.3 Change, Tx/Rx, Service, Custom, IDR Menu

If *IDR* is select from the menu Tx/Rx, Service, Custom screen this leads to the following question:

Framing based on: [?]
1=Low rate format (T1/E1) 2=High rate format (T2/E2)

Change, Tx/Rx, Service, Custom, IDR, Format Menu

The frame format definition for IDR operation varies with the data rate. For rates of 1544 or 2048 kbps (T1/E1) one format is defined, and for rates of 6312 and 8448kbps (T2/E2) another is defined (there is even a third definition for rates > 10Mbps). In *CUSTOM, IDR* mode, you have a free choice of format whatever the data rate and note that IDR operation is not limited to T1/E1 rates, but can be used at any data rate, (even down to 64kbps, although INTELSAT define that IBS framing should be used on IDR carriers below 1544kbps).

LOW The 12 bit overhead defined for T1/E1 operation in IESS 308 is used.

HIGH The 4 bit overhead on each of three subframes defined for T2/E2 operation is used.

Whichever format is selected, the following prompt appears:

IDR o/h: [?] 1=Normal:96k 2=1xAudio:64k

3=No Audio:32k 4=16k ADPCM modes

Change, Tx/Rx, Service, Custom, IDR, Overhead Menu

If *16k ADPCM MODES* are selected the following further prompt appears

IDR o/h: [?] 1=96k:2x16k-Audio+32k-BER

2=64k:2x16k-Audio only

Change, Tx/Rx, Service, Custom, IDR, O/H 16k Menu

The modes selected by these two menu's are as follows:

NORMAL:96K The normal IDR overhead is used

1XAUDIO:64K The overhead is reduced to 64kbps, the 32kbps defined for Audio ESC channel 2 is not transmitted. The 32kbps for [FAS + Back Alarms + 8K sync ESC channel], and Audio ESC channel 1 are still transmitted.

NO AUDIO:32K The overhead is reduced to 32kbps, both 32kbps channels defined for ESC audio are not transmitted. The 32kbps for [FAS + Back Alarms + 8K sync ESC channel] alone is transmitted.

16k Modes

96K Both Audio ESC channels operate in 16kbps ADPCM mode allowing both audio ESC's to fit into 32kbps. The 32kbps for [FAS + Back Alarms + 8K sync ESC channel] is transmitted first, followed by 32kbps defined for Audio ESC 1, **now containing both Audio ESCs 1 & 2 using 16kbps ADPCM**. These are followed by the **32kbps for Audio ESC channel 2, which is unused** and may be defined for use by the Aux port providing either a spare 32kbps for external BER testing, or for the use of the internal BER Tester (in both cases for possible traffic quality monitoring).

64K Both Audio ESC channels operate in 16kbps ADPCM mode allowing both Audio ESC's to fit into the 32kbps allocated to audio ESC channel 1. The overhead is 64kbps comprising 32kbps for [FAS + Back Alarms + 8K sync ESC channel] plus 32kbps containing the two 16kbps ADPCM audio channels. The final 32kbps defined for Audio ESC channel 2 is not transmitted.

7.2 IBS/SMS OPERATION WITH 2048KBPS CONTINUOUS DATA

7.2.1 Change, Tx/Rx, Baseband, Continuous, 2048k G.732 Menu (IBS)

2048kbps IBS/SMS operation is a special case, in which there are two modes of operation. These modes are confusingly referred to as 1920/1984kbps and 2048kbps mode in the IBS/SMS service definitions, but both operate with a 2048kbps terrestrial data rate !

2048K IBS mode: [?]

1=Normal (6.7% overhead) 2=G.732 (0% overhead)

Change, Tx/Rx, Baseband, Continuous, 2048k G.732 Menu

NORMAL The content of the 2048kbps data is ignored (ie it can be unframed), and the normal 6.7% overhead is added bringing the rate to 2184.53kbps. This is referred to as 2048kbps operation in the service definitions. If *NORMAL* is selected then the dialogue returns to that covered in the main section of the handbook.

G.732 The data is G.732 formatted data, ie it already contains a terrestrial G.732 frame comprising of 32 Timeslots, TS0 to TS31. Although the aggregate data is 2048kbps, as only 30 or 31 timeslots are available for data (TS0 is framing and TS16 may be signalling) the user data rate is 1920 or 1984kbps (30 or 31 x 64kbps). This is referred to as 1920kbps or 1984kbps operation in the service definitions, but the data rate at the terrestrial port is actually 2048kbps !

When selected instead of the unit inserting extra IBS/SMS framing on to the data (ie +6.7%), it uses the similar G.732 framing already present (+0%). Some locations in the G.732 framing *are* changed over satellite (such as TS0 Odd bit 4 which is used by the IBS/SMS TS32 multiframe word) and so it is not entirely transparent to all the overhead. Parts of the overhead unused for frame alignment, and also not `borrowed` by IBS/SMS features may be set to be either *Transparent* or *Fixed High*. This is controlled under *Change, User-Opt, Operation, Terr/Sat, G.732 Spares*.

If *G.732* mode is selected the operator is then prompted with:

Channel Assoc Sig (CAS) in TS16: [?]

1=Normal (No CAS) 2=CAS

Change, Tx/Rx, Baseband, Cont', 2048k IBS, G.732 CAS Menu

Channel Associated Signalling (CAS) is described in Appendix F "Signalling Systems Introduction: CCS, CAS & RBS" on page 215 if required.

NORMAL (NO CAS) TS16 does not contain CAS (ie a terrestrial CAS multiframe and `abcd` signalling nibbles for each timeslot). It is treated as a normal data timeslot, and this corresponds to modes defined as 1984kbps in the service definitions.

CAS This feature is only available if the Extended D/I feature is available (standard on P300-TCM). TS16 contains CAS and by implication a terrestrial multiframe

in order to carry the CAS (this corresponds to modes defined as 1920kbps in the service definitions). If selected, the terrestrial multiframe will be acquired, and CAS removed from/replaced into the Drop/Insert bearer. The CAS will be conveyed transparently from end to end of the link within IBS (or Custom IBS) overheads.

Whether *CAS* or *NO CAS* is selected, the following prompt appears:

Timeslot re-order option: [?]
1=Normal (linear) 2=Re-order

Change, Tx/Rx, Baseband, Cont', 2048k IBS, G.732, TS Menu

The Modem can re-order the timeslot data in the G.732 frame prior to transmission ***along with the CAS signalling*** if CAS was selected (although this feature is only available if the Extended D/I feature is available, standard on P300-TCM). This is for services where the equipment at the other end of the link may require subsets of data in particular timeslot groupings. In some applications this feature can remove the need for separate Digital Access Cross Connect (DACCs) equipment used simply to re-arrange timeslots. Typical applications might be with multiple LRE equipments (which may place data in alternate timeslots), or for multidestinational carriers where the receive equipment needs data for each location in contiguous timeslots.

If *Re-order* is selected a timeslot edit screen is displayed as follows:

TS order: 0, 17-31, 16, 15-1
Toggle: ??-?? (YES) ↑Help

Change, Tx/Rx, Baseband, Cont', 2048k IBS, G.732, Re-order Menu

This screen allows the operator to change the order of the transmitted timeslots. The screen above shows groups of timeslots 1-15 and 17-31 swopped in location with 1-15 also reversed (15-1) although any combination is possible. The selection system works by toggling timeslots or groups of timeslots into or out of the selection:

- Timeslots already in the selection are toggled out from any position of the selection when the timeslot number is entered.
- Timeslots **not** already in the selection are toggled on, and placed on the end of the selection.
- Enter any single timeslot as a single or dual digit, eg 0, 5, 05, 23, 31
- Enter groups of timeslots as two pairs eg 02-5 (two through five), 11-17, 12-2

NOTE Timeslots can be arbitrarily re-ordered, and so group selections may be down as well as up eg 11-17 means send in order 11,12,13...17, whereas 17-11 means send in order 17, 16, 15, ...11

Note that TS0 must remain the first selection in IBS G.732 modes, and for CAS, TS16 must also remain in position.

The Modem hardware is capable of duplication and omission of timeslots, although for simplicity the operator interface (described above) does not allow such selections. If this is a requirement, please contact the factory to discuss your needs.

7.3 CUSTOM IDR OPERATION WITH 2048KBPS CONTINUOUS DATA

7.3.1 Change, Tx/Rx, Baseband, Continuous, 2048k Menu (IDR)

If Custom IDR operation based on the Low (T1/E1) IDR format has been selected and the continuous data rate is 2048kbps, then the Modem can offer Timeslot Identity Maintenance and Timeslot Re-ordering features (see the section on "Timeslot Identity Maintenance" in Appendix F on page 212). These features are only available if the Extended D/I feature is available (standard on P300-TCM). Note that this is only offered under Custom IDR to simplify normal IDR menu operation, but Custom IDR can be selected with all the possible custom features set to `Normal` to allow normal IDR operation, but **with Timeslot ID Maintenance & Re-ordering**. The following screen is displayed when configuring the **Tx path**:

2048k IDR mode: [?] 1=Normal

2=Align frame for Rx TS re-order 3=Tx TS re-order

Change, **Tx**, Baseband, Continuous, 2048k IDR Menu

NORMAL Any format within the data is ignored, and data is randomly aligned within the IDR frame (as per normal IDR operation)

ALIGN FOR RX A terrestrial G.732 frame format is acquired, and is aligned within the IDR frame to allow the receive equipment to re-order the timeslots (if so set). Other than aligning the terrestrial frame within the satellite IDR frame the Tx data is unaffected.

TX TS RE-ORDER This selection leads onto a screen identical to that for IBS G.732 re-ordering (as described in the last `screen shot` and paragraphs of the previous section) which allows the timeslots to be arbitrarily re-ordered prior to transmission. The final re-ordered G.732 frame is frame aligned within the satellite IDR frame, allowing the receive path also to re-order on reception as well (although if both end re-order, it might get just a tad confusing !).

The corresponding following screen is displayed when configuring the **Rx path**:

2048k IDR mode: [?] 1=Normal

2=Re-order Rx TS (if Tx TS frame aligned !)

Change, **Rx**, Baseband, Continuous, 2048k IDR Menu

NORMAL The data formatting within the IDR frame is ignored and fed out as a 2048kbps stream as per normal IDR operation.

RE-ORDER RX This option only functions if the corresponding Tx path is set for `*ALIGN FOR RX*`. In this case the Modem relies on the incoming G.732 frame being aligned within the satellite IDR frame in order to locate and re-order the G.732 timeslots. This selection leads onto a screen identical to that for IBS G.732 re-ordering (as described in the previous section for IBS G.732 operation on page 140) which allows the timeslots to be arbitrarily re-ordered prior feeding to the terrestrial output.

8 APPLICATION NOTES

8.1 DOPPLER & PLESIOCHRONOUS BUFFERING

There are two terms commonly used when referring to the receive buffering, namely Doppler and Plesiochronous.

Doppler: Receive Doppler buffering is required because the incoming data from the satellite is subject to Doppler shift, which occurs in an approximately 24 hour cycle. The Doppler shift is due to the satellite movement relative to the earth and is directly proportional to its station keeping accuracy. Towards the end of a satellites life when its station keeping is degraded to save fuel, the Doppler shift on incoming signals increases and buffers may have to be increased in size. The receive buffer acts as a elastic store or FIFO (First In First Out memory) gradually emptying and filling to absorb the difference over the 24 hour period. If the clock signals within the system all originate from one source, then the buffer will never be exceeded, it will simply slowing filling and emptying over this 24 hour cycle.

Plesiochronous: This refers to buffering needed when there is more than one clock in the system and a buffer is required to absorb the difference between the two clocks. Typically data is placed into the buffer with one clock, and removed with another, thus causing a gradual *continuous* filling **or** emptying of the buffer, causing slips on a regular basis. The period between buffer slips (when it is totally full or empty) will be constant, and proportional to the difference between the two clocks.

A buffer will provide both functions, it simply depends on how the system clocking is arranged whether it provides Doppler buffering, or a combined Doppler and Plesiochronous buffering (if there are two clocks in the system). Typically a buffer used for a Plesiochronous system is set larger than a Doppler only buffer, as it has to accommodate a steady filling/emptying plus a superimposed daily cycle.

The slips, both underflows (-Ve) and Overflows (+ve) are displayed on the Detailed Rx Status screen. Approximately equal counts indicate the buffer is too small to accommodate the incoming Doppler shift (2ms is usually sufficient). One count significantly higher than the other indicates that the buffer is slipping due to a large difference in the clock from the satellite and the buffer output clock. With *typical* earth station clock accuracies, buffers never need be larger than approximately 16ms.

8.2 DETERMINING CLOCKING SCHEMES AND BUFFER SIZE

Please note that unless the clocking scheme has been discussed *and agreed* by both ends of the link, it is unlikely to work reliably!

You need to know the following things:

Incoming Rx carrier :
1. Is your Tx clock looped back to you at the distant end?
2. If not, what is the accuracy of the clock they are transmitting.

Outgoing Tx carrier:
1. Are you looping the incoming Rx clock (Tx Clock = Rx, or clock looped by the equipment or cables your end).
2. If not, what is the accuracy of your Tx clock

Follow these guidelines:

8.2.1 Clock Loop At One End:

The end ***with the clock loop*** requires **Buffer disable** (Rx Clock = *Satellite*). If there is either a cabled clock loop or the equipment loops the Rx clock back to the modem Tx input then set Tx clock = *Tx Clk In*. If there is no physical clock loop set the Tx clock = *Rx*.

The end ***without the loop*** requires the buffer active and set for 2 x Doppler shift only as there is no Plesiochronous effect with a clock loop. The Buffer size required depends on the satellite orbit (or rather the accuracy with which it's position is maintained), currently 2ms (end to end) buffering is enough for the Doppler shift from 1 satellite hop on current INTELSAT satellites. For 2 x Doppler shift 4ms is required.

Set the Tx & Rx Clock modes as follows to use the clock listed:

Clock from the interface / terrestrial network
Tx Clock = *Tx Clk In*, Rx Clock = *Tx Clk in*

Modem internal clock
Rx Clock = *Internal* and feeds the clock to the terrestrial equipment. If the Rx output clock is externally looped by equipment or in cable then set Tx Clock = *Tx Clk In*. If the Rx output clock is not returned to the modem Tx input by the equipment or the cable then set Tx Clock = *Rx Clk*.

Station clock
Rx Clock = *Station*, Tx Clock as for "Modem Internal Clock" above.

Satellite
Not possible, with clock loop at distant end, Rx satellite clock is *already* a copy of our Tx clock we cannot loop it again.

8.2.2 No Clock Loop

If there is no clock loop, then both ends need the Buffer active to cope with the normal Doppler effect, plus the plesiochronous effect (ie the difference between the clocks at each end). Apply the following rules to both ends:

Clock from the interface / terrestrial network

If the modem has a station clock (which also drives the network which the Rx output feeds), then select Rx Clock = *Station*. If there is no station clock then set Rx Clock = *Tx Clk In* (which as the Tx clock comes from the network, is presumably derived from the same master clock which clocks the network). Set the Tx Clock = *Tx Clk In*.

Other clock modes

These require careful consideration based on the exact situation. If you have questions relating to this subject, and are willing to at least draw a diagram of the system you are implementing then you are welcome to contact us by fax for advice for your exact application.

8.2.3 Determining Buffer Size

Use the following calculation to determine the buffer size required for *any* application:

If Lc is the local clock accuracy (e.g. $\pm 1 \times 10^{-9}$),
and Rc is the remote clock accuracy (e.g. $\pm 1 \times 10^{-11}$)
and Ms is the Minimum slip period in days (e.g. 40 days)

then the required Plesiochronous Buffer size (middle to end) in seconds is:

$$Bs = Ms \times 24 \times 60 \times 60 \times (Lc + Rc).$$

Simplifying, allowing a factor of two (end to end buffer, not middle to end) and allowing 2mS for the Doppler shift gives:

$$\mathbf{Bs = .002 + 172800 \times Ms \times (Lc + Rc)\ Seconds.}$$

So using the example figures above gives 0.00898 seconds, so 9ms is required to absorb the plesiochronous effects. To this you must add any Doppler requirement (ie 2ms for each satellite hop).

8.3 PARTIAL INSERT AND MULTIDESTINATIONAL WORKING

Partial Insert is only available if the Extended D/I feature is available (standard on P300-TCM). In a typical scenario, there may be a 2048kbps incoming carrier, containing say 8 timeslots (512kbps) for this destination. When set to *All* the full 2048kbps has to be received and passed to the terrestrial. When set to *Partial*, only the 8 timeslots for this destination are selected and inserted onto the insert mux bearer avoiding overwriting *all the data* on the bearer.

This technique can be applied to lower rate carriers also. Imagine four destinations, which require mesh connectivity for simplicity say at 384kbps (6 x 64kbps, although asymmetric operation up to any rate is possible). Each site has a modulator transmitting 1152kbps (3 x 384kbps), and three demodulators receiving the 384kbps from the other sites. The satellite bandwidth requirement is for four 1152kbps carriers, not twelve 384kbps carriers (ie the same aggregate rate, but possibly lower overall bandwidth when carrier spacing is taken into consideration):

- A single T1 or E1 bearer is looped through three modems, one operating as Tx/Rx, and two others in Rx only. In this example we will assume it is a T1 PCM bearer.
- The Tx data for all destinations arrives at the single Tx modem in each site on the T1 bearer in 18 timeslots. Note that the ability to re-order the Tx & Rx timeslots means the data can be in *any* timeslots and in any order.
- Each of the four sites transmits a 1152kbps (3 x 384kbps carrier) and all four destination sites receive the three carriers from the other destinations.
- At each site all three modems are configured for Rx Partial Insert, and the data for all but this site is discarded leaving a 384kbps to be inserted onto the looped T1 bearer by each Rx modem. In this way the data from each site for this destination can be re-inserted into the original timeslot from which the Tx data was dropped.

Without **Partial Insert** if each Rx modem inserts *all the received data* (18 timeslots) onto the T1 bearer, then the second Rx modem could just about insert its 18 timeslots without stamping on the 6 timeslots for this destination from the first Rx modem. However Rx modem 3, still has 18 timeslots to insert, but 12 of the timeslots on the T1 bearer now contain receive information from Rx modems 1 & 2, and so Rx modem 3 cannot insert all its data without losing data from another destination. The traditional alternative without **Partial Insert** is to use separate bearers for each Rx modem and a DACCS to sort our the data, but it's lower cost and less equipment to configure and maintain if the DACCS is not required at all !

Partial Insert becomes *mandatory* for multidestinational working when the total receive data at any one destination exceeds the capacity of the PCM bearers.

One final note: The P300 Series can provide multidestinational operation at aggregate carrier rates below 1544 kbps using the IBS overhead, but ***with four backward alarms.*** So multidestinational working down to 64kbps between nodes become practical (ie you don't have to use the 96kbps IDR overhead on the links to get multidestinational backward alarm facilities).

8.4 CHOOSING *OPTIMUM* CUSTOM VALUES OF RS N&K

Complete variable code rate Reed-Solomon is available if both the INTELSAT Reed-Solomon and `Custom Features` features are both available. Note that there **is nothing magic about the INTELSAT values,** except that they were approved by INTELSAT ! They were chosen because one modem manufacturer could not generate clocks which were not a multiple of 8kHz, and these non-optimum values make the satellite clock an 8kHz step.

Where maximum error correction capability is required chose `t` as high as possible (eg 10), and choose `n` as low as possible (eg 60) to maximise the number of bytes than can be corrected per codeword without adding too much overhead. In this extreme example it can correct one byte in six (t/n), but the overhead is 50% (overhead n/k, and k = n - 2t, so k = 40, gives overhead = 60/40). *Optimum* values may in certain applications mean **minimum delay** (particularly at low data rates), and the final paragraph of this section deals with this aspect.

Due to the synchronisation method used for the interleaver & de-interleaver (INTELSAT specified), on 2 codewords (blocks of `n` data bytes) out of 16 the error correction capability is slightly reduced by the equivalent of `t`=1. It is therefore best to avoid choosing a very low value of `t` so this intermittent reduction in error correcting capability is minimised. Note that in theory error correction codes (100,90,5) and (200,180,10) are equivalent (they can correct 5 bytes in 100 and 10 in 200 respectively), but the effect of the interleaver synchronisation words will be more noticeable (equivalent to a loss of `t`=1) when `t`=5 (20% loss) as opposed to `t`=10 (10% loss).

On the negative side the longer the codeword, the proportionally higher the delay through the encoder / decoder and interleaver / deinterleaver. The delay of the combined encoder and decoder is approximately 8 x (2 x `n` - `k` + 60) bits, and the interleaver & deinterleaver a further (8 x `n` x depth) bits (if calculating the delay, use the data rate inc framing and Reed-Solomon). INTELSAT recommend an interleaving depth of 4 for rates less than 1544kbps, and 8 for rates of 1544kbps and above.

Practical values for Reed-Solomon code rate will depend on the amount of overhead the circuit can tolerate. For overheads between 1.6% and 30% the table below gives **practical values of (n,k,t) with the error correction at its maximum**.

% o/h	Optimum (n,k,t)	% o/h	Optimum (n,k,t)	% o/h	Optimum (n,k,t)
1.6%	(254,250,2)	11%	(202,182,10)	21%	(115,95,10)
2%	(204,200,2)	12%	(187,167,10)	22%	(111,91,10)
3%	(206,200,3)	13%	(174,154,10)	23%	(107,87,10)
4%	(208,200,4)	14%	(163,143,10)	24%	(103,83,10)
5%	(210,200,5)	15%	(153,133,10)	25%	(100,80,10)
6%	(247,233,7)	16%	(145,125,10)	26%	(97,77,10)
7%	(245,229,8)	17%	(138,118,10)	27%	(94,74,10)
8%	(243,225,9)	18%	(131,111,10)	28%	(91,71,10)
9%	(242,222,10)	19%	(125,105,10)	29%	(89,69,10)
10%	(220,200,10)	20%	(120,100,10)	30%	(87,67,10)

For other values of overhead (o/h expressed as 1.xx), maximise `t` then:

n = Round((2 x o/h x t) / (o/h - 1))

k = n - 2t

If `n` is greater than 255, reduce `t`.

For some applications, particularly when operating with lower data rates, a reduction in the processing delay associated with Reed-Solomon FEC is the prime goal. In such circumstances use the `Custom Features` feature and select shorter codewords to reduce the encoder / decoder & interleaver / de-interleaver delay. For example switching from INTELSAT standard values of n, k, t = 126, 112, 7 to 64, 56, 4 provides approximately the same correction ability (7 in 126 = 5.5% and 4 in 64 = 6.25% respectively), with similar overheads (126/112=12.5%, 64/56=14.3%), but with interleaving & decoder delays reduced from 5632 to 3104 bits (156ms to 85ms at 32kbps). If using Sequential FEC, see also `Fault Mode = 3` in Appendix E.

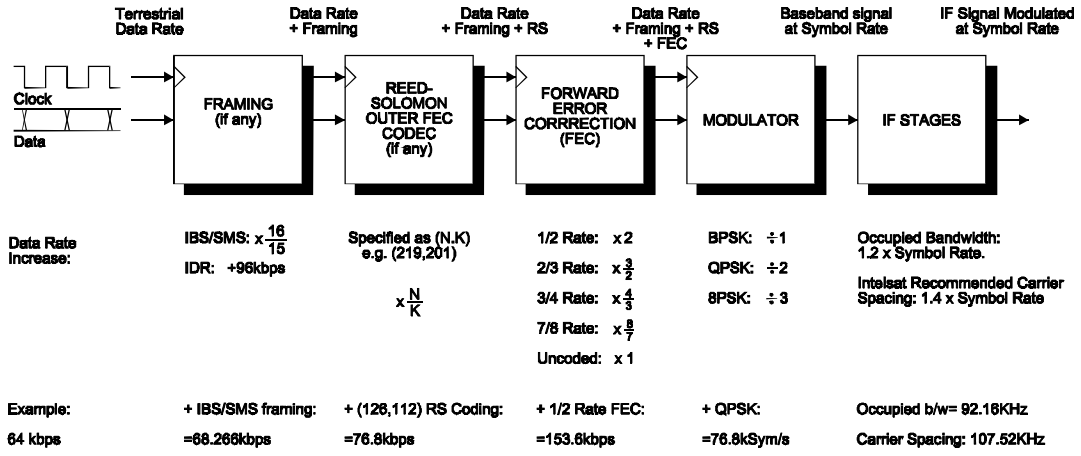
8.5 NOTES ON DATA RATES & SYMBOL RATES

The normal constraint for a modem is the range of *Symbol Rates* over which the modem can operate correctly. The Symbol Rate range however is not of initial interest to most modem users, as they first need to know if the modem can operate at the terrestrial *Data Rate* they require. This section briefly explains the relationship between Data Rates and Symbol Rates.

The **Data Rate** is normally the frequency of the clock used on the terrestrial port however if Drop/Insert is active the Data Rate is 64kbps times the number of timeslots dropped/Inserted.

As the P300 Series Modem use PSK (Phase Shift Keying) the **Symbol Rate** is the rate of *phase changes* on the I.F. signal. Each phase change represents a new symbol to the demodulator, and depending on the modulation scheme that symbol may convey one (BPSK), two (QPSK), or three (8PSK) bits of information.

The diagram below shows how the symbol rate is built up from the data rate.



You will see that with 1/2 rate FEC and QPSK (a common combination), the Symbol Rate is the same as the Data Rate (assuming no Framing or Reed-Solomon). This is a useful combination to check on any data sheet, as this will give you the Symbol Rate limits of the modem, from which the Data Rate limits in all other modes and combinations can normally be derived.

8.6 DETERMINING EXACT MAXIMUM ESC BAUD RATES

Should you wish to determine the exact maximum ESC Baud rates, in order to change the overhead allocation to achieve specific ESC rates with specific overheads, then the following section may be useful.

For **Standard IBS** the ***exact*** maximum continuous rate is:

Baud Rate = (Main data rate/15) x (O/H bits allocated/32) x (Bauds per Character/9)

Where:

Main data rate:	The main modem data rate, eg 64000bps (/15 gives total overhead)
O/H bits allocated:	The number of bits of the overhead allocated to the ESC, for example if the ESC is set in P230 mode, then 20 bits (TS16 bits 1-8, TS48 bits 1-8 & TS32 bits 4-8) are available (/32 give the proportion of the overhead allocated to the ESC)
Bauds per Character:	The number of Baud periods per character (eg for async character format 8,N there are 10 Baud periods per character: start + 8 data bits + stop (/9 as 9 *synchronous* bits are always used for each character).

Note that if the CAS Multiframe is active *to transfer G.732 CAS*, then TS16 and TS48 are not available. Note also that is the CAS Multiframe is active *without* CAS, ie to maintain the timeslot ID for an `Odd value of N` or if RBS signalling is active, then only 7 out of 8 of every TS16 are available for ESC, as TS16 has to carry the `CAS MF unique word` or `pack byte` every 8th frame. In this case simply consider TS16 as providing 7 bits of overhead not 8.

For **Custom IBS** modes this is unchanged unless Minimum Overhead mode is selected, in which case the overhead will **vary up or down from the standard 1/15th to accommodate whatever Baud rate is set on the ESC Rate screen.**

In all **IDR modes**, the ESC channel is an 8kbps synchronous channel, and if the ESC port is set to provide an async interface the ***exact*** maximum continuous async rate is:

Baud Rate = 8000 x (Bauds per Character/9)

Where "Bauds per Character" is the number of Baud periods per character (eg for async character format 8,N there are 10 Baud periods per character: start + 8 data bits + stop (/9 as 9 *synchronous* bits are always used for each character). This results in a maximum of 9777Baud with 11 Baud periods per character (eg start + 8 + parity + stop), and 8888 Baud with 10 Baud periods per character (eg start + 8 + stop), as used with Paradise & SA-bus M&C protocols (SA-bus is start + 7 + parity + stop = 10 Baud periods per character). So when set for [8 bits No Parity] or [7 bits with Parity] the maximum standard Baud rate is 4800 Baud. When set for [8 bits with Parity] the maximum standard Baud rate is 9600 Baud.

8.7 CLOSED NETWORK PLUS ESC

8.7.1 Overhead Rates

The following table shows example overhead rates for different async ESC Baud rates at a variety of main channel data rates. The table was generated (using a modem) with the async character format set for 8 bits no parity, the overhead percentages will vary slightly for async character formats different from this.

Figures: Overhead rate **with** backward alarm [/ Overhead rate **without** backward alarm, if different]

	Main data channel rates						
ESC rates	**9.6kbps**	**16kbps**	**64kbps**	**256kbps**	**512kbps**	**1024kbps**	**2048kbps**
2400 Baud	33.3%	20%	5% / 4.8%	1.25% / 1.19%	0.62% / 0.59%	0.39% *	0.39% *
4800 Baud	100%	50%	10%	2.5% / 2.38%	1.25% / 1.19%	0.62% / 0.59%	0.39% *
9600 Baud	n/a	100%	20%	5% / 4/76%	2.5% / 2.38%	1.25% / 1.19%	0.62% / 0.59%
19200 Baud	n/a	n/a	50%	10%	5% / 4.76%	2.5% / 2.38%	1.25% / 1.19%
38400 Baud	n/a	n/a	100%	20%	10%	5% / 4.76%	2.5% / 2.38%

* see notes on absolute minimum overhead in para 8.7.3 on page 150

The formula for deriving the overhead rate is moderately complex, and relies on many different parameters. For other mixes of data rate and async settings the simplest way to determine the overhead is to enter the parameters into a modem and then select Info, View Config, Tx. A screen such as the one shown below is displayed (as the second or third screen accessed by Down Arrow). This screen shows the exact overhead percentage as well as the Framed data rate ("Frm"), the data rate including any Reed-Solomon encoding ("RS"), and the final symbol rate including the effects of the `inner ` FEC and modulation ("Sym").

Rates: BB:2048000 Frm:2056031
(O/h=0.39%) RS:2056031 Sym:1370687

Info, View Config, Tx, (Down, Down)

There is of course a similar screen for the Rx path.

In addition a later screen summarises the ESC settings as show below

Tx ESC:All Intfc:RS485
(Async set:4800,8,N Avail:6413) ↓

Info, View Config, Tx, (Down, Down, Down, Down, Down etc)

Note that the displayed *available* ESC rate ("Avail") may well exceed the *set* ESC rate. This is because the hardware can only provide overhead in 1/Nth increments (eg 1/1=100%, 1/2=50%, 1/3=33%, 1/4=25% etc up to 1/256=0.39%) and so the modem must pick the appropriate value of N, which provides *at least* the required async ESC Baud rate.

8.7.2 Closed Network Plus ESC via the Custom Service menu

Early versions of the embedded code for the **P400 Series of satellite modems** did not *directly* provide a Closed Net Plus ESC option, although the feature is still available (under a different name) from the Custom Service menu dialogue.

If you wish to use Closed Net Plus ESC on a P400 series modem it is probably easier to load the modem with the latest embedded code (downloadable from our Web site) and use the Closed Net Plus ESC facility directly. This latest P400 software will also provide the facility on P420's and P440's which are fitted with an ASIC IFU ("IFU:2", see Appendix C1), which previously could not provide the facility as they had no "Custom" option on the service menu. The Custom Menu however has always been available on P460's and P480's.

If you do wish to use the Custom menus to define Closed Net Plus ESC operation, the table below specifies the parameters to enter at each menu, which follows the *Custom* option from the Tx/Rx Service selection screen.

Main Data Rate	Based On	TS32 MF	Backward Alarm	No. of Back' Alm	Overhead Mode
>= 32kbps	IBS	Normal	User choice	One	Min O/H
< 32kbps	IBS	No TS 32 MF	User choice	N/A (no TS32 MF)	Min O/H

In both cases under the *ESC*, *DEFINE* dialogue set the proportion of the overhead assigned to the async ESC as *Maximum (all remaining)* and set the Aux channel to *Off*, so that as much as possible of the overhead is used for the ESC reducing the total overhead added to the data. The final satellite data rate including overhead can be displayed on the *INFO*, *VIEW CONFIG*, *TX/RX* screens.

Note: As the overhead used relates directly to the data rate, ESC & backward alarm settings, then **for two modems to interwork** the following parameters **must match** on both modems:

- Main data rate.
- Async ESC Baud Rate and Character length / Parity.
- Backward Alarm option (ie both enabled or both disabled).
- Baseband modes (ie both Continuous Data or both Drop/Insert).

A Closed Net Plus ESC facility as described above (using the Custom Service options) is ***identical*** with the Closed Net Plus ESC facility which may be directly activated in software V1.50 or greater from the Service, Closed Net, ESC menu.

8.7.3 ESC channel with mis-match configurations at Absolute Minimum Overhead (0.39%)

Summary (fairly technical)

In Closed Net Plus ESC mode (or Custom IBS modes with minimum overhead selected) the modem adds the minimum possible overhead to accommodate the required ESC channel. The overhead is variable from 1/1 (100%) to 1/256 (0.39%) which covers a large range of requirements, however for very high bit rates with very low ESC requirements, 0.39% may still provide an ESC channel capable of more than the required Baud rate. For example with a 2048kbps closed network link with a 2400Baud ESC channel selected, the minimum 0.39% overhead could actually support an ESC of 6135Baud.

This is not normally an issue as the ESC UART is set to the 2400Baud the user has specified, and the fact that the channel could provide more is masked by the throughput limitation of the 2400Baud async link outside the modem. However under certain scenarios discovered recently (Nov 2002) it is possible in this absolute minimum overhead mode, to get the ESC channel operate strangely. Specifically it is possible to get the ESC channel to cause a delay in transmission of up to 3 characters (as if they were `stuck in the pipe`), which only appear out of the ESC channel when `pushed through` by subsequent

characters. This `Delayed Character Mode` is generally not a showstopper, but can cause issues with packet-based communications.

At Paradise we have only been able to make the ESC channel enter this `delayed character mode` by setting up a pair of modems in intentionally mis-matched configurations. However, now we have investigated and understood the mechanism, we feel it is feasible that under repeated changes of configuration the ESC channel might enter this `delayed character mode` (although we can't get it into this mode ourselves by this method). To avoid this possibility we have modified the modems embedded software from V3.56 or later to ensure that during normal reconfiguration the ESC channel should not get into this mode.

While we are confident that in general the ESC channel is not likely to get into this `delayed character mode` it is still possible to make it enter this mode if the modems are operated with intentionally mis-match configurations. For those that would like to understand why this happens the following text describes the operation in more detail. The following text is NOT mandatory reading!

ESC channel `delayed character mode` (very technical)
The Async ESC is carried in the satellite overhead by multiplexing it into the synchronous data of the satellite framing which is added to the main data. Each Async character is converted into a byte, buffered through a small FIFO, and then sent synchronously into the bits available in the frame for the ESC channel, using a leading 0 to indicate that the next 8 bits of overhead available to the ESC carry the 8 bits of a character. These 8 bits might be at one bit per satellite frame, or if a high proportion of the overhead is assigned to the ESC (such as in Closed Net Plus ESC mode) they could be successive bits (eg the whole 8 bits of satellite TS48).

This works fine, and ***normally*** if you mismatch the configuration of a pair of modems then the modems will not talk to each other as they calculate different overhead percentages to accommodate the Async ESC channel, the symbol rates do not match and hence they will not communicate.

However, once the overhead reaches the 0.39% minimum, changes to the ESC configuration do not change the overhead percentage (it is already at minimum), and the modems ***will*** communicate with mismatched ESC settings. For example if one modem is set to provide a ESC and a backward alarm facility and the other ESC only, then the modem without the backward alarm facility will route the parts of the overhead which carry the backward alarm from the distant end to the ESC channel decoding circuitry (because that is what it has been configured to do !). This can result in two problems:
When the configurations are mis-matched, there will be spurious characters output from the ESC channel, or the ESC channel will suffer significant character errors (as the backward alarm status is output as ESC data).
More significantly, the extra data routed to the ESC channel decoding circuitry from the overhead (in our example one bit per frame which carried the backward alarm from the distant modem) is NOT limited to 2400Baud by the sending modems physical Async ESC port, and may exceed the rate at which the UART in the receive modem can output these spurious ESC characters. Specifically, the small FIFO between the framing / overhead circuitry and the UART can get massively overrun, and after such an overrun this may lead to the ESC operating in `delayed character mode`. When in this mode, only a total modem reset will restore normal ESC channel operation.
In summary, it is possible by mis matching the configuration of a pair of modems to set them so that they continuously output spurious or errored characters from the ESC channel, or force the ESC channel into the `delayed character mode` where a major (power down) type reset is required to restore normal ESC operation. As the modems at each end of the link are simply operating as set, and don't know that the configurations are mis matched, it is ***not*** possible to automatically prevent or recover from such a configuration.

8.8 CROSS REFERENCE TO SDM300 D/I & FRAMING MODES.

The P300 Series Modems are equipped with the Drop/Insert and possibly the Extended Drop/Insert features can provide all the Drop/Insert functions of competing equipment such as the SDM300. If you are familiar with the modes the SDM300 offers then here is a cross reference, along with the menu entries to configure the P300 similarly (unlike the SDM300 however, you don't have learn what the cryptic abbreviations mean, you just answer the questions!)

E1_CCS: 2048kbps G.732 with common Channel Signalling

1. Select *Change, Tx, Service, IBS/SMS*
2. Select *Change, Tx, Baseband, Drop Mux, G.732*.
3. Select the number of timeslots to drop, and include the Common Channel Signalling (CCS) timeslot (probably TS16).
4. Select *Leave* or *Replace* with Idle code as required.
5. When "G.732 Channel Associated Signalling, 1=Normal (ignore), 2=Transfer" is asked, select *Normal (ignore)*.
6. If the number of timeslots chosen is **not an `Odd values of N`** (eg N=7 or 9), then the unit will prompt "TS Identity will be maintained by TS32 multiframe (YES)" and the setup is complete.
7. If you have selected **an `Odd value of N`** the unit will prompt "TS Identity over satellite, 1=Normal (maintain), 2=Don't maintain". If you select *Normal (maintain)* the unit will provide TS identity maintenance ***for any value of N*** by using a CAS multiframe (Paradise proprietary). If you select *Don't Maintain* then the Modem will not use a CAS multiframe, and will be compatible with other manufacturer equipment with the same number of timeslots selected.
8. Configure the receive path similarly, if *Rx=Tx* is active, then only the timeslots need selecting.

Note the P300 Modem equipped with the Extended D/I feature (standard on P300-TCM) can support ***any value of N***, not just N = 1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 16, 20, 24, 30 as listed for the SDM300.

E1_CAS: 2048kbps G.732 with Channel Associated Signalling

As above, but there is no CCS timeslot to select in step 3, and at step 5 when "G.732 Channel Associated Signalling? " is asked, select *CAS* whereupon the dialogue terminates.

Note the P300 Modem equipped with the Extended D/I feature (standard on P300-TCM) can support ***any value of N***, not just those listed for the SDM 300.

E1_IBS: 2048kbps with no assumed G.732 frame format

1. Select *Change, Tx, Service, IBS/SMS*
2. Select *Change, Tx, Baseband, Continuous, 2048000bps*
3. When asked the question "2048k IBS Mode: 1=Normal 2=G.732" answer *Normal*

E1_31_TS: 2048kbps G.732 with no CAS, 31 timeslots used for data

Assuming the intent of this mode is to provide a carrier with a satellite framed rate of 2048kbps...

1. Select *Change, Tx, Service, IBS/SMS*
2. Select *Change, Tx, Baseband, Continuous, 2048000bps*
3. When asked the question "2048k IBS Mode: 1=Normal 2=G.732" answer *G.732*
4. When asked the question "Channel Assoc Sig in TS16 1=Normal(No CAS) 2=CAS" select *Normal*
5. When asked the question "Timeslot re-order option 1=Normal (linear) 2=Re-order" select *Normal*

Unlike the SDM300, this mode passes 31 data timeslots transparently, not just the 30 implied in the SDM300 handbook. The P300 Modem can also provide 30-timeslot operation where TS16 contains

CAS, at step 3 simply select *CAS*.

T1_ESF & T1_ESF_S: 1544kbps Extended Super Frame (_S Special)

The P300 Modems do not require the _S `Special` mode to support N=9 and N=18, ***as the P300 Modem* equipped with the Extended D/I feature (standard on P300-TCM) *can support any value of N.*** Simply configure as follows:

1. Select *Change, Tx, Service, IBS/SMS*
2. Select *Change, Tx, Baseband, Drop Mux, T1-ESF*.
3. Select the number of timeslots to drop
4. Select *Leave* or *Replace* with Idle code as required.
5. When "T1-RBS Over Satellite, 1=Normal (or no RBS) 2=Maintain RBS" is asked, select as appropriate. If *RBS* is selected the dialogue ends here.
6. For *No RBS,* if the number of timeslots chosen is **not an `Odd values of N`** (eg N=7 or 9), then the unit will prompt, "TS Identity will be maintained by TS32 multiframe (YES)" and the setup is complete.
7. If you have selected **an `Odd value of N`** the unit will prompt "TS Identity over satellite, 1=Normal (maintain), 2=Don't maintain". If you select *Normal (maintain)* the unit will provide TS identity maintenance ***for any value of N*** by using a CAS multiframe. If you select *Don't Maintain* then the Modem will not use a CAS multiframe, and will be compatible with the same number of timeslots selected.
8. Configure the receive path similarly, if *Rx=Tx* is active, then only the timeslots need selecting.

T1 & T1_S 1544kbps D4 Framed (_S Special)

The P300 Modem do not require the _S `Special` mode to support N=9 and N=18, ***as the P300 Modem* equipped with the Extended D/I feature (standard on P300-TCM) *can support any value of N.*** Simply configure as for T1_ESF & T1_ESF_S as above, but select T1-D4 not T1-ESF in step 2

T1_IBS: 1544kbps in the same bandwidth as Normal 1536kbps IBS

This is the standard INTELSAT definition for non Drop/Insert 1544kbps over IBS.

1. Select *Change, Tx, Service, IBS/SMS*
2. Select *Change, Tx, Baseband, Continuous, 1544000bps*

8.9 V.35 SCRAMBLERS

In all cases, setting the P300 Modem scramblers to Normal will implement the correct scrambling to match the configuration you have the modem in (ie Closed network, IBS, or IDR, with or without Reed-Solomon). Only read this section if you are having trouble interworking two manufacturers equipment which you think is scrambler related (or just for interest!).

Note that there are no known incompatibilities between any manufacturers synchronous IBS or synchronous Reed-Solomon scrambling. The issues relate only to V.35 scrambling, used typically on closed network or IDR links without Reed-Solomon.

History

Note: This is the author's understanding from 15 years working in the industry.

There was only intended to be one V.35 scrambler, but the CCITT who made the original specification were the first of many organisations to get it wrong. To ensure there was no ambiguity they printed a written description together with an example schematic. However the schematic they supplied behaved differently from the written description (well done boys), and there immediately grew two opposing camps, those who had worked to the schematic and those who had worked to the written description!

The difference between the two implementations was only in the action to take when the `adverse state` is detected, ie what to do if a long string of zeroes has been output. In such a case a counter injected an opposing bit to generate a transition (and break the cycle of all zeroes) with a counter in the corresponding descrambler cancelling out this injected opposing bit. The difference between the two implementations is in the count length of this adverse state detector counter; one is 30 counts and the other 31.

The net result of inter-operating equipment from the two differing V.35 camps (schematic / written description) was a background pattern dependent error rate in the order of 1×10^{-8}. Note that as the background error rate is *pattern dependent*, there is no guarantee you will see it with regular test equipment such as Firebirds etc, which generate repeated fixed patterns. In most satellite communications such a background error rate might be masked by the channel noise, but in some carrier line up procedures a circuit may be required to operate error free for 12/24 hours. For higher data rate circuits this proved impossible to achieve with the differing scramblers, and so tests were performed `on the bench`.

INTELSAT were called in to adjudicate the argument, and as both camps were technically correct someone was going to be upset. INTELSAT decided in favour of the larger camp, with a Japanese company being the only member in the opposing camp. This was unfortunate as it happened that the losers were the only company to have the V.35 scrambler buried deep within as ASIC at the time (and therefore a nightmare to change), whereas every other manufacturer had it implemented in hardware, and could have made cuts / straps to resolve the issue!

The definition finally approved by INTELSAT became known as "**INTELSAT V.35 scrambling**", with the other definition derived from the original CCITT spec as "**CCITT V.35 scrambling**". INTELSAT of course approve only INTELSAT V.35 scrambling!

Other Derivatives

As mentioned earlier, the CCITT were only the first of many companies to mess up the V.35 scrambling. At least two other companies also implemented a V.35 scrambler, which was accidentally different to the CCITT definition (ie didn't match the schematic **or** the written description). These companies now offer corrected INTELSAT V.35 implementations, but in order to maintain backwards compatibility they support their original V.35 attempts as well. To maximise compatibility with other manufactures equipment, in addition to both INTELSAT and CCITT, Paradise modems implement two of these other

V.35 schemes, these modes are referred to as "FDC" and "Linkabit".

The following table defines what happens when differing scramblers are interworked

Scrambler / Descrambler	CCITT	INTELSAT	FDC	Linkabit
CCITT	**OK**	$1x10^{-8}$ error rate*	Hopeless	Data invert and $1x10^{-8}$ error rate*
INTELSAT	$1x10^{-8}$ error rate*	**OK**	Hopeless	Data invert
FDC	Hopeless	Hopeless	**OK**	Hopeless
Linkabit	Data invert and $1x10^{-8}$ error rate*	Data Invert	Hopeless	**OK**

* Pattern Dependent.

8.10 INTERWORKING DIFFERENT MANUFACTURERS EQUIPMENT

Unfortunately not all manufacturers use the same terminology, and so this complicates circuit set up. To the best of our ability the following table shows the equivalence between manufacturers. This table will be extended, as information on other products is forthcoming.

Equipment	Scramblers in the **columns** below are determined to be equivalent			
Paradise P300 Series Modem	**CCITT**	**INTELSAT**	**FDC**	**Linkabit**
Paradise P200 series (closed net) BPSK requires P300 Tx Spectrum invert		"Scrambler on"		
Paradise P230 IBS/SMS	Uses synchronous IBS scrambling, so V.35 type not an issue			
FDC SM290 / SM2900 (Viterbi)		"V.35"	"FDC"	"Link"
FDC SM290 / SM2900 (Sequential)		"Link"	"FDC"	"V.35"
SSE SM3000/4000 (Viterbi)		"V.35"	"FDC"	"308"
SSE SM3000/4000 (Sequential)		"308"	"FDC"	"V.35"
EF SDM 300 / 300A (Viterbi)		"IESS 308(V.35)"		
EF SDM 300 / 300A (Sequential) (Requires Tx & Rx Spectrum invert on P300 Modem)		"IESS 308(V.35)" (300/A set for data invert)		"IESS 308(V.35)" (300/A set for true data)
EF SDM 650B (Requires Tx & Rx Spectrum invert on P300 Modem)		"V.35" (650B set for data invert)		"V.35" (650B set for true data)
Comstream CM701 **Viterbi**: BPSK requires P300 Tx/Rx spectrum invert, QPSK is OK **Sequential** requires P300 Rx spectrum invert in BPSK and both Tx & Rx spectrum invert in QPSK. **See Appendix E: FaultMode=11**	"Comstream" (701 set for data invert)	"IDR MAN"		"Comstream" (true data but poss 10^{-8} error rate)

A `compatibility document` which, describes interworking tests between the Paradise P300/P400 Modems and other manufacturers modems, is available on request.

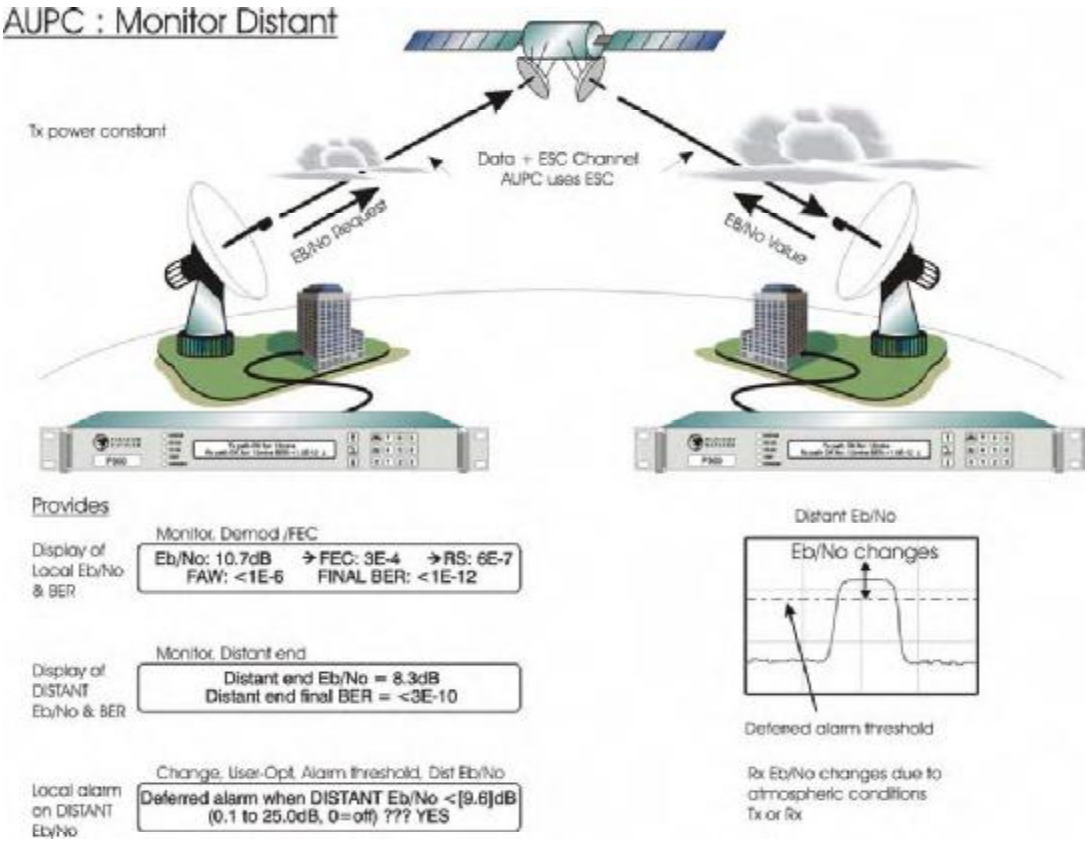
8.11 INTRODUCTION TO AUPC (AUTOMATIC UPLINK POWER CONTROL)

Note: Authorisation from the satellite operator is probably required before AUPC is activated.

8.11.1 Introduction

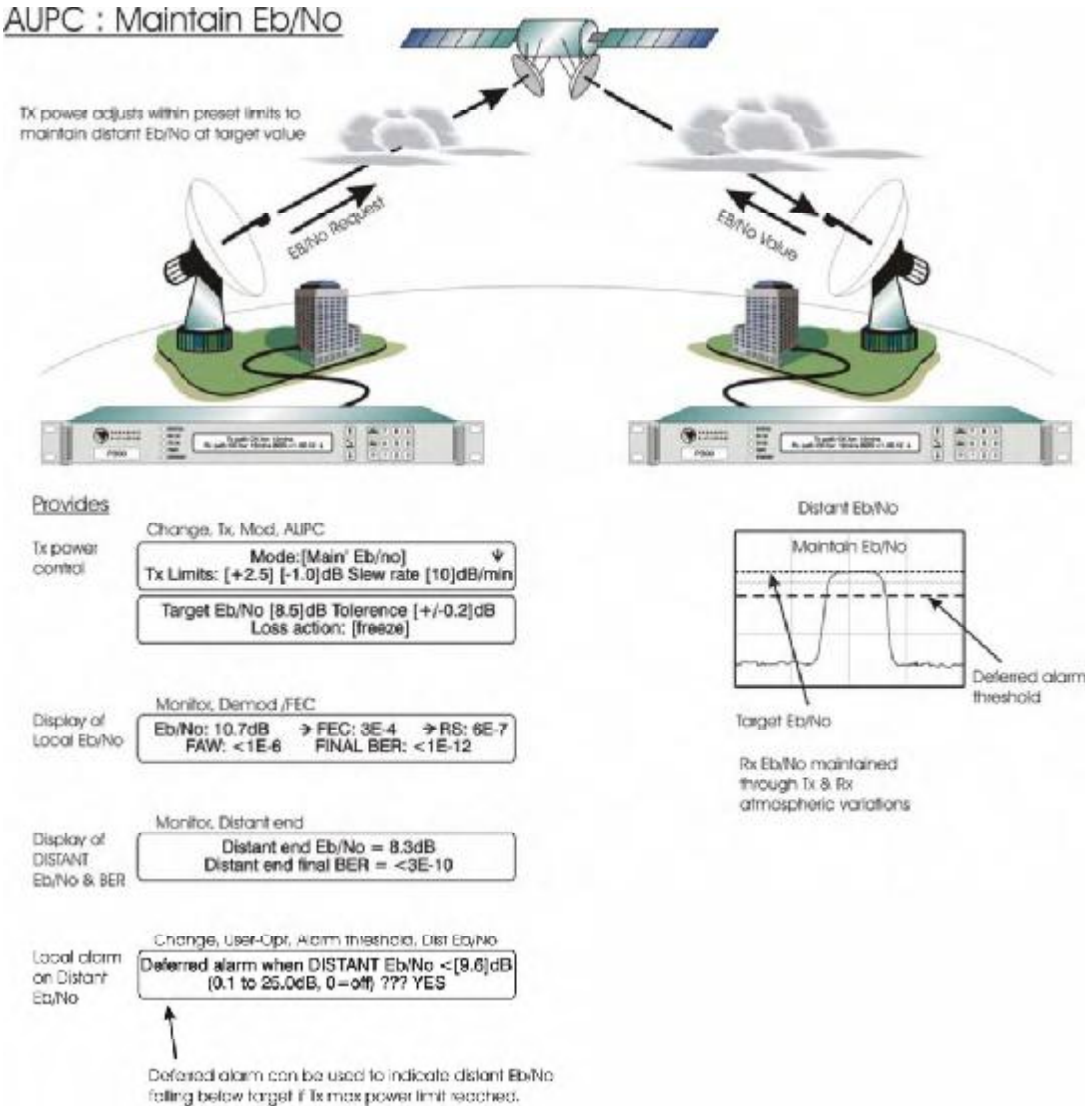
AUPC provides a mechanism to counteract changes in atmospheric conditions (eg rain), which in turn affects the attenuation of the atmosphere and can degrade the performance of a satellite link. It does this by monitoring the *distant* end Eb/No and automatically adjusting the local Tx power of a satellite link to try and maintain the specified distant end Eb/No figure.

To be able to monitor the *distant* Eb/No the local modem needs to be able to interrogate the distant modem and request the current Eb/No value. It does this by sending messages through the asynchronous ESC channel (which is carried over the satellite multiplexed with the main data channel). For AUPC to operate an async ESC channel must be defined, and on the P300 Series this is available in Closed Network (Closed Net Plus ESC), IBS/SMS and IDR modes.



The AUPC may be set to ***monitor*** the distant Eb/No (*Mon Dist*, shown above) or in its normal mode to ***maintain*** a distant Eb/No (*Maint' Eb/No*, shown overleaf). In both modes the *distant* Eb/No and BER estimate can be displayed on the *local* end LCD (**Monitor, Dist end**), a deferred alarm can be set to activate if the distant Eb/No falls below a user set threshold (**Change, User-Opt, Alarm Thresholds, Distant Eb/No**), and the distant end Eb/No can be recorded regularly in the local end traffic log using the Autolog feature (**Change, Log, Autolog**). The distant Eb/No can also be output on the uncommitted analog DAC output if the Monitor / AGC option is fitted (see "uncommitted analog

DAC output", value = 4 in Appendix E starting on page 207)



In *Maint' Eb/No* mode the Target Eb/No has to be set as well as a *Tolerance window.* Only when the target Eb/No tolerance is exceeded is the Tx power adjusted to bring the distant Eb/No back to the target value. The Tx power will only continue to be adjusted automatically until the Eb/No settles on the target value. This prevents continual Tx power variations under normal minor thermal noise variations. Once settled on the target Eb/No the Tx power adjustment will only be automatically reactivated when the Eb/No tolerance is again exceeded.

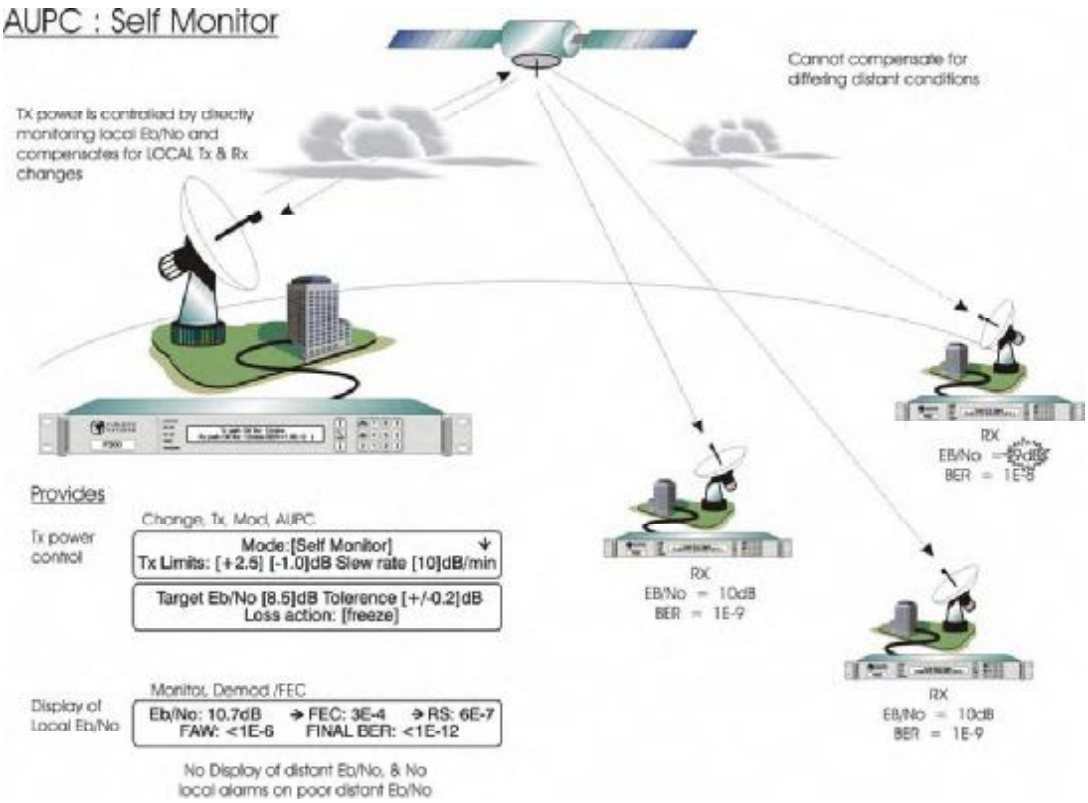
Separate upper and lower Tx power limits are set along with a slew rate limit (if it is felt that additional limits to prevent rapid power variations are required). By manipulating the upper and lower power limits one of three scenarios can be achieved:

+/- Limits: **Constant performance**: Always uses the power required to maintain the Eb/No. Provided the limits are not reached the link performance will stay as it is (subject to the tolerance window).

+ Limit only: **Best performance**: The power will increase when required by a fade bit it will not reduce. Any especially good atmospheric conditions will improve the Eb/No

beyond the current level.

- Limit only: **Power economy**: The power will not increase, but it will reduce if there are any especially good atmospheric conditions that allow less power to achieve the target Eb/No.



The AUPC can also be set in ***self monitor*** mode (*Self Mon*). This is used when a single Tx carrier is used to broadcast information to multiple Rx sites. Provided the local modem Rx path is locked to this *broadcast* carrier then the local Eb/No indicates any atmospheric changes on the local end satellite uplink and down link. In this mode the AUPC controls the local Tx power by directly monitoring the *local* Eb/No. This is an imperfect system as it changes the local Tx power to compensate for local atmospheric changes which affect the local uplink and downlink, it cannot however compensate for distant atmospheric changes affecting the multiple distant downlinks. *Self Mon* mode requires no ESC channel as the AUPC software can directly read the local Eb/No as well as control the local Tx power.

If AUPC is active in normal (*Maint' Eb/No*) or self monitor (*Self Mon*) modes then the status of the AUPC can be displayed (**Monitor, AUPC**), also the AUPC delta power can be recorded regularly in the traffic log using the Autolog feature (**Change, Log, Autolog**). The AUPC delta power can also be output on the uncommitted analog DAC output if the Monitor / AGC option is fitted (again see "uncommitted analog DAC output", value = 5 in Appendix E starting on page 207)

The speed of reaction of the AUPC depends primarily on two factors: The user specified slew rate (specifically to limit the rate of change of Tx power when a power adjustment is deemed necessary), and the ESC channel Baud rate (which affects how regularly the distant Eb/No is read by the local modem in order to determine if any adjustment is necessary).

The AUPC will use a different proportion of the available ESC bandwidth depending on the ESC interface selected.

If the ESC interface is set to **Link to M&C** (*Link-L* or *Link-R*) then it assumes the ESC channel is *also* being used for network M&C (as this is the setting used to provide the connectivity for distant end M&C). In this case the AUPC will use up to 33% of the ESC channel bandwidth in order to achieve an Eb/No reporting rate of once per second. If the ESC Baud rate is such (ie so high) that the AUPC can achieve this update rate using less than 33% of the ESC channel bandwidth, then it uses only the proportion of bandwidth required for a 1Hz update rate. The 33% bandwidth is used by interleaving the requests for the distant Eb/No and distant end Eb/No responses between M&C messages using the ESC channel.

If the ESC interface is set to RS485, then the external RS485 interface will be disabled and the AUPC will use 100% of the ESC channel bandwidth to achieve as high an Eb/No reporting rate as possible.

If the ESC interface is set to RS232 or RS422, AUPC cannot be used.

The Eb/No update rate and percentage of ESC channel bandwidth used is displayed on one screen of the **Info, View Config, TX** sequence of screen displays.

8.11.2 Configuring AUPC for operation

DO NOT switch on the AUPC immediately, it is much simpler to get the circuit working first, determine the normal levels, AND THEN activate the AUPC.

- Configure the modems at both ends of the link and ensure the basic satellite link is operating correctly. Set the Tx power to achieve the distant Eb/No expected under clear sky conditions.
  - For IBS/SMS and IDR carriers the ESC can be switched on later within the overhead without changing the carrier power or bandwidth.
  - For Closed Net Plus ESC carriers, the overhead is added *as required* for the ESC channel. Adding an ESC channel later will change the bandwidth of the signal and may slightly affect the Eb/No. In this case configure the ESC at least to a nominal Baud rate. If the ESC is not used for any other M&C purposes then 300 Baud may be sufficient for AUPC alone.

- Configure an ESC channel for 8 bits no parity, Baud rate as described below.
  - For IBS/SMS and IDR configure as higher rate ESC channel as the modem can provide. This will give the fastest possible reporting rate.
  - For Closed Net Plus ESC our suggestion would be to include the optional Backward Alarm (as this is a very useful feature), and set the Baud rates as high as possible without either exceeding the allotted satellite bandwidth or using an overhead over 10%.

  The ESC channel for the AUPC must have symmetrical Baud rates.

- Set the ESC interface:
  - If the ESC channel is to be used for AUPC only, set the ESC interface to *RS485*. The external RS485 port will be disabled and the AUPC will use 100% of the ESC channel capacity at whatever Baud rate you have defined the ESC channel.
  - If the ESC channel is to be used for AUPC ***and*** distant end remote M&C, set the ESC interface to either Link-Local or Link-Remote (Local at the controlling PC end, remote at the end farthest away from the PC).

    Note: ***This is contrary to expectations!*** When using AUPC with either Link-Local and Link-Remote selected as the ESC interface (to internally connect the Remote M&C port to the ESC channel) it is **not required** to have the ESC channel at the same Baud rate as the M&C system.

    For example the station M&C could be running at 9600 Baud, and the ESC channel set for 2400 Baud. The AUPC software will buffer and rate convert the M&C

messages whilst interleaving the AUPC data. M&C messages will of course take longer to get across a 2400 Baud ESC than a 9600 Baud ESC, but if the bandwidth has to be paid for (ie it's not withing the IBS/SMS or IDR overheads) then it's worth the saving.

Alternatively if the station M&C is at say 2400 Baud, but the station is transmitting a 512kbps IBS/SMS link that would support a 19200 Baud ESC within the IBS/SMS overhead. Setting the ESC for 19200 Baud will provide a very high update rate for the Eb/No monitoring, by having enough bandwidth so that the maximum 33% it uses in this mode can provide at least a 1Hz update rate.

- Start the AUPC in a passive mode (distant end monitoring only mode) to ensure the system is working:
  - Switch on REMOTE REPORTING (**Change, Rx, Demod, AUPC**) to respond to the Eb/No requests at the ***distant modem***.
  - Set the local AUPC for *Mon Dist*, to determine if it is working correctly. If it is then the distant Eb/No should be available on the *Monitor, Distant* screens. If the Eb/No or BER figures say "Unavail" then the ESC is not correctly configured. If it does not work in this mode don't start changing the AUPC, sort out the ESC channel!
  - When the distant Eb/No is displayed, record the distant Eb/No under clear sky conditions. Then change the AUPC mode to **Maint Eb/No** in order to get access to the other AUPC settings.
  - Review the proportion of ESC bandwidth and more importantly the distant Eb/No update rate using *Info, View Config, Tx, (down, down etc)*.

- Determine the parameters for the AUPC:
  - Determine the way the AUPC will operate, will it try to:
    1. **Maintain a minimum Eb/No**, but take advantage of a better Eb/No when atmospheric conditions are favourable (normal)
    2. **Maintain a fixed Eb/No**, reducing Tx power when atmospheric conditions are favourable (unlikely).
  - **To maintain a minimum Eb/No**, set this as the *Target Eb/No*, set the *Max power* to the maximum increase you are allowed, and set *Min power* to ***Zero***. This will prevent the Tx power *decreasing* if the Eb/No is better than the target, but will increase the power if the Eb/No falls below target.
  - **To maintain a fixed Eb/No** set this as the *Target Eb/No*, set the *Max power* to the maximum increase you are allowed, and set *Min power* to the limit of the power decrease you will accept. The Tx power will increase and decrease within the limits to try and maintain a constant Eb/No.
  - Set the *Tolerance Window* size to something practical, say 0.2 to 0.5dB (depending on how accurately you wish to try and maintain the Eb/No).
  - Set the *Slew Rate* to something which can respond to a fast fade. We suggest no less than 15dB/min (ie 0.25dB/sec) If there is no reason to set a particular slew rate then leave it set to zero (no slew rate limit).
  - Set the *Comms Loss Action* after careful consideration. The most advantageous setting is *Maximum*, but note that anything, which interrupts the link, will cause the Tx carrier to increase to the maximum delta Tx power. *Freeze* is probably the most sensible choice, causing the carrier to remain at the current value until the link is restored. Finally *Nominal* is the safest option, with the AUPC returning the carrier to it=s nominal power if the link is broken.
- Optionally log the parameters:
  - Use the Autolog feature to optionally record the distant Eb/No and/or the AUPC delta power. This may prove useful in determining how often the AUPC is required, and if it manages to

maintain the Eb/No within the parameters you have set. Logging the AUPC delta power allow you to, if questioned, be able to specify to the satellite operator the exact power you were transmitting throughout the day (or at a specific time in question).

8.12 TUTORIAL ON CARRIER/NOISE & Eb/No MEASUREMENTS

8.12.1 Introduction

This is the source of much confusion and `Specmanship`. This brief tutorial explains what the terms mean and how to measure and interpret the figures you see. The diagram on the following page attempts to summarise this as clearly as possible visually with the text below adding detail for which there is no room on the diagram. Finally a table provides a quick look up reference to convert values measured on a spectrum analyser to a real Eb/No.

8.12.2 Derivation of Eb/No from (C+N)/N

It is possible to describe the **Carrier / Noise** ratio within the Rx system at an arbitrary reference point, eg at the input to the demodulator, at the input to the Forward Error Correction decoder (FEC), at the input outer Reed-Solomon FEC decoder, or even at the terrestrial data interface. Many of the terms you come across represent this Rx Carrier / Noise ratio at these different reference points.

It is common to measure **(Carrier + Noise) / Noise** at the demodulator input on a spectrum analyser. Ideally we are after the Carrier / Noise ratio, but as we cannot turn off the atmospheric noise (!) we have to make the measurement with the noise on, and then convert back to simply Carrier / Noise. In the equation below the term (C+N)/N is the (Carrier+Noise) / Noise ratio read from the spectrum analyser.

$$\frac{Carrier}{Noise} = \frac{C}{N} = 10\log_{10}(10^{(\frac{(C+N)/N}{10})} - 1) = \frac{E_s}{N_0}$$

We can express this same Carrier / Noise ratio at the input of the demod in terms of the Energy per *Symbol* / Noise power density, which is written as $\mathbf{E_s / N_o}$. Because `Carrier / Noise` is a ratio of two powers measured in the same bandwidth (the resolution bandwidth of the analyser), this is the same as E_s / N_o.

Within the demodulator, each *Symbol* is converted back into the *Transmitted Bits*. For BPSK each Symbol represents only 1 Transmitted Bit, for QPSK or OQPSK each Symbol represents 2 Transmitted Bits, and for 8PSK each Symbol represents 3 Transmitted Bits. The expression $\mathbf{E_t / N_o}$ (or $\mathbf{E_{bt} / N_o}$) represents the Carrier to Noise ratio referenced to this *Transmitted* Bit rate. For QPSK and 8PSK the *Transmitted* Bit rate is higher than the *Symbol* rate, and so E_t / N_o (ie the Carrier / Noise referenced to Transmitted Bit rate) is lower than the E_s / N_o (the Carrier / Noise referenced to the Symbol rate), as this same power is referenced to a higher bit rate. Allowing for the change in bit

$$\frac{E_t}{N_0} = \frac{E_s}{N_0} - 10\log_{10}(No\ of\ Bits\ /\ Symbol)$$

rate in the demod gives:

Next in the demod chain comes the FEC Decoder. The receive Carrier / Noise referenced to this point is referred to as $\mathbf{E_{Dec} / N_o}$. In the FEC Decoder the bit rate is reduced, as the data is decoded to provide corrected data at a lower rate. Because the data rate reduces through the FEC Decoder E_{Dec} / N_o is higher than E_t / N_o as the same power is referenced to a lower bit rate. Allowing for the change in bit rate in the FEC decoder gives:

$$\frac{E_{Dec}}{N_0} = \frac{E_t}{N_0} - 10\log_{10}(FEC\ Code\ Rate)$$

Following the FEC Decoder (the `inner FEC`, ie Turbo, Viterbi, Sequential or TCM) comes the Reed-Solomon `Outer FEC` Decoder (if active). This `Outer FEC` RS Decoder operates similarly to the `Inner FEC` Decoder, reducing the bit rate as it corrects errors and finally generating the Composite Information Bit Rate at its output. The Carrier / Noise expressed at this Composite Information Bit Rate is referred to as the $\mathbf{E_b / N_o}$ (or $\mathbf{E_{bi} / N_o}$ or $\mathbf{E_i / N_o}$ with `I` and `b`referring to *Information* and *Bit* respectively). Again because the data rate reduces through the RS Decoder E_b / N_o is higher than E_{Dec} / N_o as the same power is referenced to a lower bit rate. Allowing for the change in bit rate in the RS Decoder gives:

$$\frac{E_b}{N_0} = \frac{E_{Dec}}{N_0} - 10\log_{10}(RS\ Code\ Rate = (\frac{k}{n}))$$

It is this $\mathbf{E_b / N_o}$ that is typically displayed on the front panel of Modem equipment.

Finally, after the RS Decoder comes Deframing and baseband processing such as Drop/Insert. IBS/SMS or IDR deframing does decrease the bandwidth, but the bandwidth reduction effects of deframing are ignored as INTELSAT chose to define the mandatory modem performance in terms of E_b / N_o, specifying that this relates to the *Composite* Information Bit Rate (ie it includes framing). Baseband processing has no effect on bandwidth and is totally ignored.

8.12.3 Practical Implications of Displayed Eb/No

Practically this means the following:

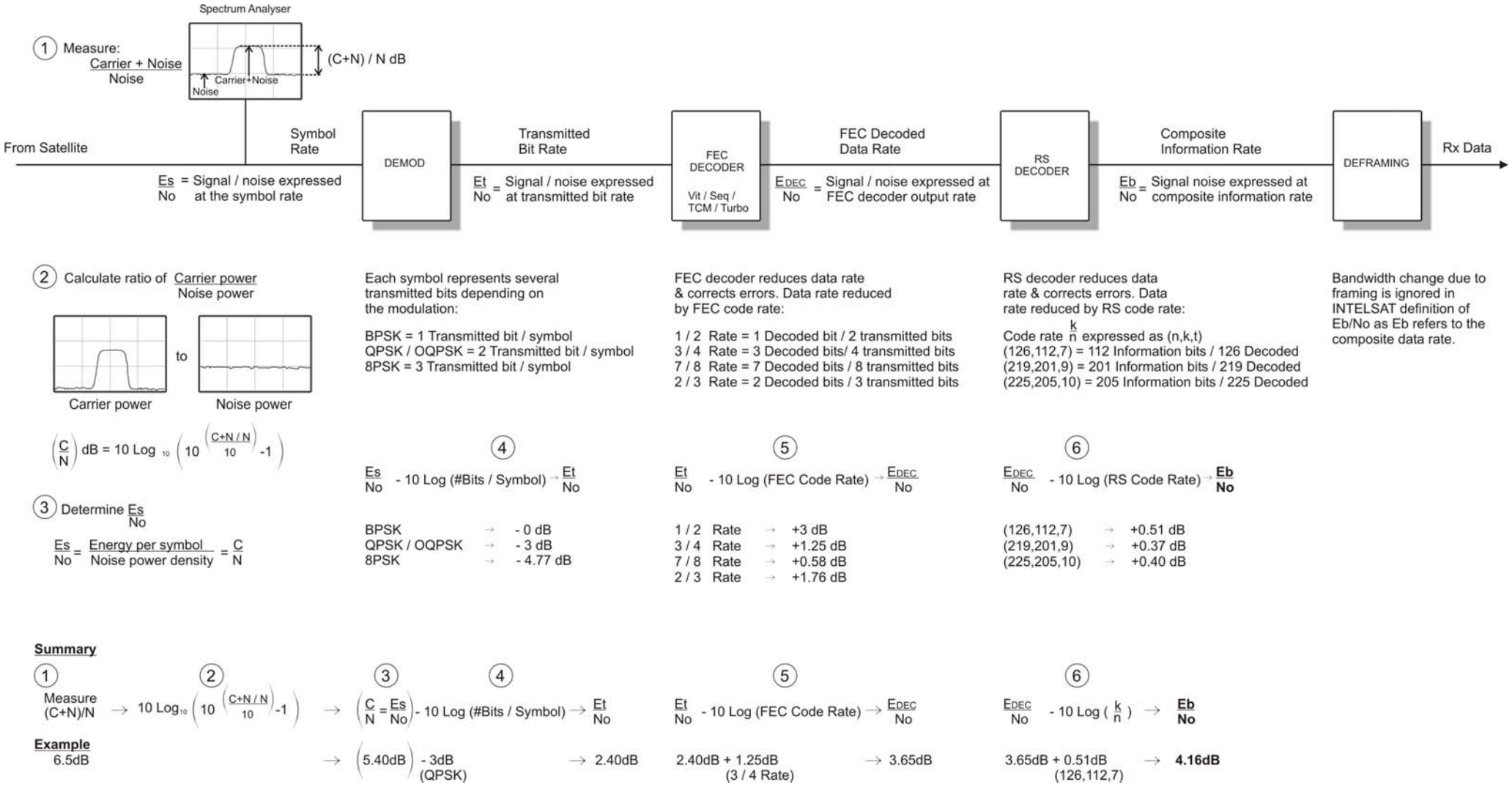
For a constant Tx Power, you will get the same displayed E_b / N_o whatever the settings of Modulation Inner FEC, and Outer (RS) FEC, as the E_b / N_o display compensates for these parameters. The bandwidth will vary and so will the Carrier / Noise at the input of the demod, but the displayed E_b / N_o will be steady as it compensates for these parameter changes.

When comparing BER performance for different Modulation / FEC schemes against E_b / N_o, the plotted E_b / N_o already accounts for the changes in Carrier / Noise caused by the different Modulation and FEC settings. **Any BER difference you see with different schemes is a real difference, you don't have to further compensate for the changes in Carrier / Noise this change induces**.

You do however have to be aware of Bandwidth considerations. You might find a Modulation / FEC scheme which gives an exceptional BER for a given E_b / N_o, but it will of little practical value if the bandwidth it requires occupies a whole transponder.

When you look at BER performance figures **at a *specified* E_b / N_o you get the same BER performance whether the data is framed or not**. Adding framing to a Closed Network link would increase the bandwidth, decrease the Carrier / Noise, decrease the displayed E_b / N_o (as it does not compensate for framing) and therefore degrade the BER. However when brought back to the same E_b / N_o you do of course recover the same BER. Framing therefore does not degrade the BER for a stated E_b / N_o, but it does require more power (and bandwidth) to achieve the same E_b / N_o.

8.12.4 Eb/No Explanatory Diagram



8.12.5 Tables to Convert (C+N)/N to Eb/No

$\frac{C+N}{N}_0$	$\frac{C}{N}=\frac{E_S}{N_0}_0$	$\frac{E_t}{N_0}_0$	$\frac{E_{Dec}}{N_0}_0$	$\frac{E_b}{N_0}_0$
4.6	2.75			
4.8	3.05			
5.0	3.35			
5.2	3.64			
5.4	3.92			
5.6	4.20			
5.8	4.47			
6.0	4.74			
6.2	5.01			
6.4	5.27			
6.6	5.53			
6.8	5.78			
7.0	6.03			
7.2	6.28			
7.4	6.53			
7.6	6.77			
7.8	7.01			
8.0	7.25			
8.2	7.49			
8.4	7.72			
8.6	7.95			
8.8	8.19			
9.0	8.42			
9.2	8.64			
9.4	8.87			
9.6	9.10			
9.8	9.32			
10.0	9.54	**Adjust for**	**Adjust for**	**Adjust for**
10.5	10.09	**modulation:**	**FEC Rate:**	**RS Codec:**
11.0	10.64	BPSK: -0dB	1/2 Rate: +3.0dB	(n,k,t)=
11.5	11.18	QPSK: -3.0dB	3/4 Rate: +1.25dB	(126,112,7): +0.51dB
12.0	11.72	OQPSK: -3.0dB	7/8 Rate: +0.58dB	(219,201,9): +0.37dB
12.5	12.25	8PSK: -4.77dB	2/3 Rate: +1.76dB	(225,205,10): +0.40dB
13.0	12.78			
13.5	13.30			
14.0	13.82			
14.5	14.34			
15.0	14.86			
15.5	15.38			
16.0	15.89			
16.5	16.40			
17.0	16.91			
17.5	17.42			
18.0	17.93			
18.5	18.44			
19.0	18.94			
19.5	19.45			
>20	=(C+N) / N (error <0 .04dB)			

Example: 8SPK with 2/3 Rate TCM FEC, & RS=(219,201,9)

$\frac{C+N}{N}_0$	$\frac{C}{N}=\frac{E_S}{N_0}_0$	$\frac{E_t}{N_0}_0$	$\frac{E_{Dec}}{N_0}_0$	$\frac{E_b}{N_0}_0$
(C+N)/N= 8.4dB	C/N= 7.72dB	8PSK so subtract 4.77dB	2/3 Rate FEC, so add 1.76dB	RS Code (219,201,9) so add 0.37dB
Measure	**Look up**	**Calculate Eb/No = C/N - 2.64dB**		

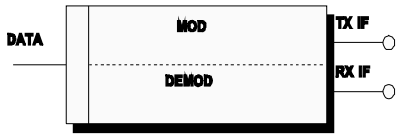
9 1 FOR 1 OPERATION

9.1 THEORY

Any two Modems' will operate as a 1 FOR 1 redundant pair, with no other equipment except for a single interconnecting lead, two power splitter/combiners and cable forms to parallel up the interfaces of both units.

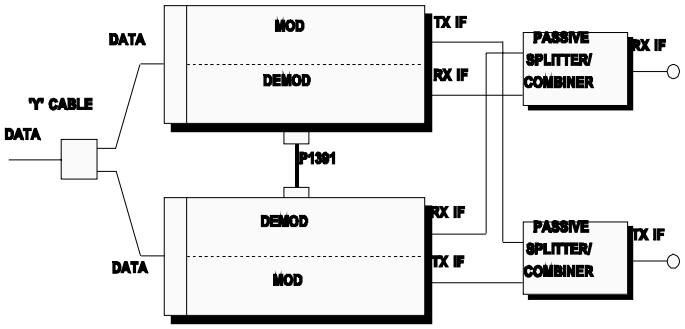
Both Modem's of the pair operate continuously, performing their function on the incoming data and IF signals, but only one Modem enables its output, and drives the signals towards the terrestrial device and towards the satellite. For P310 L-Band modems, by default the standby modem also disables and DC & 10MHz reference it might be feeding to a BUC/LNB `up the coax` (this can be changed, See ‚Relay Mode 4-‚ in Appendix E: Customer Specific Features on page 207 for a description)

The diagram on the right illustrates the equivalence of a standard Modem and a 1 FOR 1 redundant pair. The pair of units, with suitable cables, may be used as a direct replacement for a single unit, with all connectors and pin assignments remaining the same. A particular advantage of this arrangement is that one unit of the pair may be replaced without interrupting traffic.



SINGLE P300 SERIES MODEM

PAIR OF P300 SERIES MODEMS



EQUIVALENT 1:1 PAIR

To enable the parallelling of all the interfaces the off line unit provides no terminating load so the correct impedance is maintained even when two are connected in parallel. All interfaces also have the facility to disable the outputs (either by making the outputs high impedance, or by relay switching), enabling one of a parallelled pair to drive the outputs without line contention.

In the event of a catastrophic failure, such as a power supply etc, the switching circuitry (which is distributed between the two units) will switch over to the operational unit. All interface cards guarantee not to increase the load on signal lines in the powered down condition, i.e. the pair will work (and switch over) successfully even if one unit fails totally.

9.2 SWITCHING PHILOSOPHY

Both Modem's operate continuously, with each providing a regularly updated status to their half of the 1 FOR 1 control logic. There is no pre-assigned master and slave unit.

Changeovers are minimised, i.e. a unit taken off line due to a reported failure, will remain off line even if it returns to the OK state. If it does return to the OK state then it will act as the standby unit. The software provides the necessary delays of status to the control logic, to prevent unnecessary switching. There is no delay in the case of catastrophic failures, when the hardware performs the switching regardless of the software, and its associated built in delays. The 1 FOR 1 system has no `memory', i.e. a unit taken off line because of an indicated failure, will be put on line again if it now indicates OK, (but only if the on-line unit has now failed, otherwise it would be an unnecessary changeover).

Detected failures

A failure is defined as either a detected failure of the unit, or a catastrophic (power) failure. The Modems will changeover if one fails, and if the other unit indicates that it is still operational. If both units fail simultaneously (which is likely to be caused by external circumstances), then no changeover takes place.
Both unit *and* traffic faults can cause a 1:1 switch over. However, traffic faults caused externally to the equipment, which would affect both units simultaneously, do not force a spurious changeover, due to the design of the 1:1 switching logic.

Manual changeovers
The Modem is able to `give away' operation to the other unit of the pair, if instructed to do so from the front panel, as described earlier. The switch over will only occur if the other unit indicates that it is OK, and is performed by momentarily simulating a failure in the on-line equipment.

9.3 PRACTICAL 1 FOR 1 IMPLEMENTATION

To implement 1 FOR 1 switching between any two Modems', the following steps need to be performed:

1. Check that both Modems' have the same software issue.

2. Connect a 4 way screened cable, between the 9 pin 1 FOR 1 connectors on the two Modem's to be used, refer to Appendix B for details of the connector, as well as the lead required.

3. If the modem has the G.703 option fitted, ensure the switches on the G.703 options are set for 1:1 operation.

4. Plug in the 9 pin 1:1 control lead first, this should force one of the Modem's to indicate that its outputs are tri-state (the standby LED on the front and the Hi-Z LED on the rear should illuminate on one modem).

5. Connect the data interfaces in parallel, and configure the two units alike. Suitable adapter cables are available from Paradise for all the standard interfaces.

6. Connect the two transmit IF ports to the input ports of a suitable power splitter/combiner, of the correct impedance (50Ω or 75Ω) and the appropriate frequency range. The combined output is then fed to the up-conversion equipment. Note that only one output is active at a time, and because of the loss of most splitter/combiners the power level at the output of each modem needs to be increased by approximately 3.5dB.

7. Connect the two receive IF ports to the two output ports of a suitable power splitter/combiner, of the correct impedance (50Ω or 75Ω) and the appropriate frequency range. The output of the down-conversion equipment then feeds the input of the splitter/combiner, so that both demodulators are fed with an identical signal. Because of the wide dynamic range of the Modem AGC circuits, there should be no need to modify the signal levels.

8. Switch between units by using the menu option *Main, Actions, Giveaway in 1:1*. The pair will not switch over unless the partner unit is operational (ie indicates no faults).

Note: Testing a 1:1 pair in loopback requires the IF's to be split/combined and ***then*** looped. Placing an external individual loopback on each modem will *not work* as the off-line one who's output is muted sees a Rx fault as there is no carrier. When split/combined and looped testing will work, but it can still be difficult to `get your head round it`. It is much easier with no loopback and the 1:1 pair talking to a third modem.

10 BOOT CODE OPERATION

10.1 FLASH SOFTWARE UPDATE

The Modem software is contained in a FLASH EPROM, and can be updated without opening the equipment through the serial port on the Async ESC connector. It is not even necessary to remove the equipment from the rack BUT it is necessary to route the traffic via another modem, as loading the software requires a processor reset and will affect the traffic.

To access the `Boot Menu`, power the unit up whilst holding in the `**MAIN**` key, and the following menu will be displayed:

Serial Flash Update **1 Start Process 2 Reboot**

Boot Menu

Option 2 allows the unit to continue as normal. Option 1 leads onto the following menu:

Connect PC to serial port **Press YES/ENTER when connected**

Boot, Start Process Menu

At this point the serial cable supplied with the equipment should be connected between the PC ands the modems `Async ESC` connector, then the **YES** key pressed. This leads onto the following menu:

Waiting for communications with PC... ** **Press YES/ENTER key to abandon

Boot, Comms Start screen

The bar in the top right hand corner spins whilst it waits for serial communications to begin.

On the PC (under Windows) start the download program (winflash.exe) and select the serial port in use and the new firmware (p300_s.rec). Both the PC and the modem will display the status of the download as it progresses.

The display should first indicate:

Waiting for PC to start erase cycle /

Boot, Process Wait screen

and will then proceed to:

Waiting for flash memory to Erase /

Boot, Erase Wait screen

When the Flash has erased (which takes approximately 30 seconds) the screen changes to:

Programming Flash memory in progress /
Banks: FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF

Boot, Flash Program screen

Each "FF" represents a blank 32k bank of memory. The bar in the top right hand corner spins to show communications are continuing, and the bar on each bank in turn spins first clockwise as information is loaded from the PC, then anticlockwise as the bank is programmed. When each bank is complete it shows either a tick "√" when complete, a "-" if it is intentionally left empty, or an "X" if it fails to program. Any failure to program is automatically retried, and an "X" should never reman on the screen.

Whilst the programming continues the PC report the status as messages are transferred, and displays the percentage of the file that has been transferred. When the programming is complete, the unit prompts the operator as follows, and the PC returns to the DOS prompt:

Programming complete
Press YES/ENTER to continue

Boot, Programming Complete screen

At this point the processor re-boots. The first reboot with a new main code the unit performs a checksum test on each bank, displaying the results as follows:

Checksumming main code....
Banks: √- √√- √- √■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■■

Boot, Flash Checksum screen

Finally, when the checksums are verified, the processor jumps into the new Flash code, and begins execution of the latest version of the embedded M&C code. Should the code fail to execute properly, hold down the **No/Prev** key to clear the memory.

Should the program ever crash, or be otherwise reset (other than from power up), it will automatically do an extensive checksum test as above. However from a normal power up, where it may be critical to restore the service as quickly as possible only an abbreviated test is performed, and the screen above will not be displayed.

10.2 OTHER BOOT CODE OPTIONS

The other options available from power up, by holding in a key on the keypad are:

MAIN Stay in boot code for serial download
NO/PREV Clear the non-volatile memory
0 Set the LCD contrast to mid scale
1 Display Boot Code software version

The following options allow a fully equipped P300 to act as a model with fewer options to enable testing of a lower specified product to see if it provides the facilities required.

4 ***Reduce*** the functionality to P300-VSAT level (from a higher level only)
5 ***Reduce*** the functionality to P300-IBS level (from a higher level only)
6 ***Reduce*** the functionality to P300-IDR level (from a higher level only)

APPENDIX A: DATA INTERFACE INFORMATION

GENERAL

Unlike previous Paradise Datacom products, the standard interface of the P300 Series Modem **DOES NOT SIMPLY UNPLUG**. Instead to reduce the cost of the modem the interface is built as a standard part of the main PCB and includes RS422, V.35, and RS232 modes. An ***additional*** G.703 interface may be fitted internally to provide front panel selection between RS422, V.35, RS232 and G.703.

IT IS POSSIBLE TO FIT OTHER INTERFACES, and in fact the whole Paradise P14xx range can be utilised in the P300 series modem. **However**, prior to fitting another interface the case must be opened, the standard interface `snapped off` from the main PCB, and a 48 pin connector fitted to the main PCB to accept the plug in cards. It is advisable to return the equipment to the factory for this to be done, although it is perfectly possible in the field.

1:1 OPERATION

The standard RS422, V.35, and RS232 interface does not require any resistor packs to be unplugged for 1:1 redundancy operation. HOWEVER the G.703 option has a switch to set the mode (Normal or 1:1) and the E1 G.703 card a second switch to select 120Ω/75Ω operation. The Normal/1:1 switch on the G.703 option doubles the impedance (so you can connect the two in parallel) and also selects what happens when power is removed. If the power is lost in "Normal" mode the G.703 input and output are joined so that if in Drop/Insert operation the G.703 signal is looped through multiple equipments, the other traffic is not affected by a break in the G.703 line. If the power is lost in "1:1" mode the G.703 output goes high impedance if power is lost, allowing its 1:1 partner to carry the traffic.

Unlike previous interfaces, the standard P300 Series interface does not provide a pin on the connector, which can make the interface go high impedance.

HANDSHAKE LINES

Many interfaces provide optional control lines (such as RTS/CTS etc). It is generally better to implement these between equipments if possible.

P1440 IN RS422 MODE

The P1440 is the standard interface supplied with the P300 Series Modem. If **RS422** is selected under *Change*, *Terr-Intfc*, *Electrical* then the following interface description applies.

Min Req	Signal Description	RS422 Name	Circuit Number	25 pin		37 pin		Electrical Levels
				A	B	A	B	
DATA CIRCUIT TOWARDS MODEM (TX)								
✓	**Clock In**	TT	113	24	11	17	35	RS422
✓	**Data In**	SD	103	2	14	4	22	RS422
	Sig` Valid In	RS	105	4	19	7	25	RS422
	Sig Accpt`d Out	CS	106	5	13	9	27	RS422
	Int` Tx Clock Out	ST	114	15	12	5	23	RS422
DATA CIRCUIT FROM MODEM (RX)								
✓	**Clock Out**	RT	115	17	9	8	26	RS422
✓	**Data Out**	RD	104	3	16	6	24	RS422
	Sig` Valid Out	RR	109	8	10	13	31	RS422
COMMON LINES								
✓	**Signal Ground**	SG	102	7		19, 20, 21		Ground
✓	**Shield/Protective ground**	PG	101	1		1		Screen
	Device (DTE) Ready In	TR	108	20	23	12	30	RS422
	Device (DCE) Ready Out	DM	107	6	22	11	29	RS422
	Local Loop In	LL	141	18		10		RS232
	Remote Loop In	RL	140	21		14		RS232

The **maximum data rate** is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The **input clock/data phase** is selected automatically, reporting a `**Data Marginal**` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the `Data In` signal is checked against the `Clock In` signal. With the Tx Clocking Set to *Internal* or *Rx* the `Data In` signal is checked against the `Int` Tx Clk Out` signal.

Note that although there are both 25-pin EIA530 pinout and 37 pin RS449 pinout connectors on the rear panel, these are simply connected in parallel. **Do not use both connectors** at the same time.

By selecting *Change*, *Terr-Intfc*, *Control Lines* it is possible to configure the modem to raise an alarm if either the `Sig= Valid In` line (RS) or `Device (DTE) Ready In` line (TR) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the `Sig` Valid In` line (RS) by selecting *Change*, *Tx*, *Modulator*, *Carrier*, *RTS-Controlled*.

P1440 IN V.35 MODE

The P1440 is the standard interface supplied with the P300 Series Modem. If **V.35** is selected under *Change, Terr-Intfc, Electrical* then the following interface description applies.

Min Req	Signal Description	V.35 Name	Circuit Number	25 pin		37 pin		Electrical Levels	Old Style Winchester
				A	B	A	B		
DATA CIRCUIT TOWARDS MODEM (TX)									
✓	**Clock In**	SCTE	113	24	11	17	35	V.35	U & W
✓	**Data In**	SD	103	2	14	4	22	V.35	P & S
	Sig` Valid In	RTS	105	4		7		RS232	C
	Sig Accpt`d Out	CTS	106	5		9		RS232	D
	Int` Tx Clock Out	SCT	114	15	12	5	23	V.35	Y & aa
DATA CIRCUIT FROM MODEM (RX)									
✓	**Clock Out**	SCR	115	17	9	8	26	V.35	V & X
✓	**Data Out**	RD	104	3	16	6	24	V.35	R & T
	Sig` Valid Out	RLSD	109	8		13		RS232	F
COMMON LINES									
✓	**Signal Ground**	SG	102	7		19, 20, 21		Ground	B
✓	**Shield/Protective ground**	FG	101	1		1		Screen	A
	Device (DTE) Ready In	DTR	108	20		12		RS232	H
	Device (DCE) Ready Out	DSR	107	6		11		RS232	E
	Local Loop In	LL	141	18		10		RS232	-
	Remote Loop In	RL	140	21		14		RS232	-

The **maximum data rate** is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The **input clock/data phase** is selected automatically, reporting a `**Data Marginal**` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the `Data In` signal is checked against the `Clock In` signal. With the Tx Clocking Set to *Internal* or *Rx* the `Data In` signal is checked against the `Int` Tx Clk Out` signal.

Note that although there are both 25-pin EIA530 pinout and 37 pin RS449 pinout connectors on the rear panel, these are simply connected in parallel. **Do not use both connectors** at the same time. If you require the older 34-pin `Winchester` connector then an adaptor lead is required, please contact the factory for details.

By selecting *Change, Terr-Intfc, Control Lines* it is possible to configure the modem to raise an alarm if either the `Sig' Valid In` line (RTS) or `Device (DTE) Ready In` line (DTR) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the `Sig' Valid In` line (RTS) by selecting *Change, Tx, Modulator, Carrier, RTS-Controlled*.

P1440 IN RS232 MODE

The P1440 is the standard interface supplied with the P300 Series Modem. If **RS232** is selected under *Change*, *Terr-Intfc*, *Electrical* then the following interface description applies.

Min Req	Signal Description	RS232 Name	Circuit Number	25 pin		37 pin		Electrical Levels
				A	B	A	B	
DATA CIRCUIT TOWARDS MODEM (TX)								
✓	**Clock In**	DA	113	24		17		RS232
✓	**Data In**	BA	103	2		4		RS232
	Sig` Valid In	CA	105	4		7		RS232
	Sig Accpt`d Out	CB	106	5		9		RS232
	Int` Tx Clock Out	DB	114	15		5		RS232
DATA CIRCUIT FROM MODEM (RX)								
✓	**Clock Out**	DD	115	17		8		RS232
✓	**Data Out**	BB	104	3		6		RS232
	Sig` Valid Out	CF	109	8		13		RS232
COMMON LINES								
✓	**Signal Ground**	AB	102	7		19, 20, 21		Ground
✓	**Shield/Protective ground**	SHIELD	101	1		1		Screen
	Device (DTE) Ready In	CD	108	20		12		RS232
	Device (DCE) Ready Out	CC	107	6		11		RS232
	Local Loop In	LL	141	18		10		RS232
	Remote Loop In	RL	140	21		14		RS232

The **maximum data rate** is 100kbps (over good quality screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 50kbps to 20m, 25kbps to 40m etc). NOTE this is a synchronous RS232 interface if you need an asynchronous interface please contact the factory.

The **input clock/data phase** is selected automatically, reporting a `**Data Marginal**` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). With the Tx Clocking Set to *Tx Clock In* the `Data In` signal is checked against the `Clock In` signal. With the Tx Clocking Set to *Internal* or *Rx* the `Data In` signal is checked against the `In` Tx Clk Out` signal.

Note that although there are both 25-pin EIA530 pinout and 37 pin RS449 pinout connectors on the rear panel, these are simply connected in parallel. **Do not use both connectors** at the same time. The EIA530 connector is pin compatible with the standard 25-pin RS232 interface.

By selecting *Change*, *Terr-Intfc*, *Control Lines* it is possible to configure the modem to raise an alarm if either the `Sig Valid In` line (CA) or `Device (DTE) Ready In` line (CD) switch to the inactive state. It is also possible to configure the Tx carrier to be switched on and off by the `Sig Valid In` line (CA) by selecting *Change*, *Tx*, *Modulator*, *Carrier*, *RTS-Controlled*.

P1440 IN G.703 MODE

If the G.703 option is fitted to the P300 Series modem, then G.703 becomes a front panel / software selectable interface in addition to the standard RS422, V.35 and RS232 interfaces. If **G.703** is selected under *Change, Terr-Intfc, Electrical* then the following interface description applies.

Note on E1 G.703 cards you must set switch 2 on the G.703 option to select either 75Ω G.703 (on the BNC connectors) or 120Ω G.703 (on the D type connectors). For the T1 card, or for the E1 card if the impedance switch is set for 120Ω, then the following pinout applies. Note that although there are both 25-pin EIA530 pinout and 37-pin RS449 pinout connectors on the rear panel, these are simply connected in parallel. **Do not use both connectors** at the same time.

Min Req	Signal Description	25 pin		37 pin		Electrical Levels
		A `Tip`	B `Ring`	A `Tip`	B `Ring`	
DATA CIRCUIT TOWARDS MODEM (TX)						
Y	**Data In**	2	14	4	22	G.703
DATA CIRCUIT FROM MODEM (RX)						
Y	**Data Out**	3	16	6	24	G.703
COMMON LINES						
	Signal Ground	7		19, 20, 21		Ground
Y	**Shield/Protective ground**	1		1		Screen

Line Code / Line Length
For both T1 and E1 G.703 cards the line code is set from the front panel after the electrical interface is selected. For T1 either AMI or B8ZS is available, for E1 cards AMI or HDB3. In coded (ie non AMI modes) the modem will display a `Data Marginal` warning whenever a line code violation is detected. For T1 cards a choice of line lengths is also given to allow the card to pre-compensate the T1 signal for line losses. If you are in doubt, select the <133 feet option (no pre-compensation).

Switch/Link Settings
For T1 G.703 cards set **SW2** to Position 2.
For E1 G.703 cards, **SW2** selects either 75Ω G.703 on the BNC connectors or 120Ω G.703 on the D type connectors

Sw2 **position 1** **75Ω** (via BNC connectors)
Sw2 **position 2** **120Ω** (via either D type connector) or T1 G.703 operation.

NOTE: **With 120Ω selected** the EMC suppression capacitors soldered to the 75Ω BNC connectors may degrade operation with low amplitude G.703 signals. If you are in a 120Ω only environment, simply unplug the twisted pairs connecting the BNC connectors to the G.703 interface card.

When the 75Ω BNC interface is selected, the screen of the output connector is always connected to ground. The screen of the input connector may be selected as follows:

LK1 pos **1-2** **Input screen grounded** (recommended)
LK1 pos **2-3** **Input screen floating**

LK1 has no effect on T1 G.703 cards if SW2 is correctly set in position 2

Finally, for both T1 and E1 options, **SW1** selects what action to take if the power is removed:

Sw1 **position 1** **Normal**, the G.703 input is looped to the output by a relay if power is removed. This is so any other traffic on the G.703 PCM bearer is not lost by a break in the bearer.

Sw1 **position 2**	**1:1 Operation**, the G.703 output goes high impedance if power is removed allowing the units 1:1 partner to carry the traffic. The normal input impedance switches to whichever one is on-line (with the standby input at high impedance)

Installation note: If installing the G.703 card, the BNC labelled `IN` connects to J3 on the card, and the BNC labelled `OUT` to J2 on the card.

Q323 G.703 (Special) option PCB

The Q323 is a modified version of Q302 G703 card. The "Q302" switches are configured as normal. (Please see P300 Installation and Operating handbook)

The additional logic allows the E1 frame data to be modified to solve interaction problems with AIS data.

The logic does not support modified T1 data.

If the switches are all off, then the data path is just delayed by one bit in both directions.

The new functions are controlled by SW3 on the PCB.

Option	**OFF**	**ON**
SW3-1	Normal Operation	TS1-31 Modified
SW3-2	TS0 transparent	TS0 Bit 1 overwritten with CRC4
SW3-3	TS16 modified	TS16 transparent
SW3-4	TS1-31data inversion	TS1-31 bit mask inversion

SW3-3 and SW3-4 have no effect if SW3-1 is OFF.

The card supports the following modes.

SW3:

1 2 3 4	**Mode**	**Description**
0 0 0 0	Transparent	Card functions as standard Q302
0 1 0 0	Transparent + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 0 0	TS1-31 Invert	Data through the modem is inverted
1 1 0 0	TS1-31 Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 0 1	TS1-31 Bit Invert	Data bits 1, 2, 5 and 6 are inverted
1 1 0 1	TS1-31 Bit Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 1 0	TS1-15, 17-31 Invert	Data through the modem is invertedTS16 - Channel Associated Signaling support
1 1 1 0	TS1-31 Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1
1 0 1 1	TS1-15, 17-31 Bit Invert	Data bits 1, 2, 5 and 6 are inverted TS16 - Channel Associated Signaling support
1 1 1 1	TS1-15, 17-31 Invert + CRC4	As above with CRC4 multi-frame in TS0 bit 1

1 = switch on, 0 = switch off

When transparent TS16 options are selected and the P300 is in drop and inset mode, the P300 modem must be set to maintain timeslot identities if TS16 is part of the drop and insert group.

P1440 IN X.21 MODE

The P300 Series along with its standard P1440 RS422/V.35/RS232 interface can provide both X.21 DCE and X.21 DTE operation. For X.21 operation the card must be set to RS422 mode, and the Tx & Rx Clocking modes must be set correctly. With the use of the appropriate adaptor lead (to convert to the X.21 standard 15 pin D connector), a full X.21 DCE or DTE interface is available.

X.21 DCE OPERATION

This only has a **clock *from* the modem** to the terrestrial equipment. Configure a cable with a 15 pin `D` female at one end (X.21 DCE) and either a 25 pin or 37 pin `D` male (not both) at the other end as follows:

Min Req	X.21 DCE (15 pin D female)			Signal Description	RS422 Name	Circuit Number	25 pin		37 pin		Electrical Levels
	Name	A	B				A	B	A	B	
DATA CIRCUIT TOWARDS MODEM (TX)											
Y	T	2	9	**Data In**	SD	103	2	14	4	22	RS422
	C	3	10	Sig` Valid In	RS	105	4	19	7	25	RS422
DATA CIRCUIT FROM MODEM (RX)											
Y	S	6	13	**Clock Out**	RT	115	17	9	8	26	RS422
Y	R	4	11	**Data Out**	RD	104	3	16	6	24	RS422
	I	5	12	Sig`Valid Out	RR	109	8	10	13	31	RS422
COMMON LINES											
Y	Sig gnd	8		**Signal Ground**	SG	102	7		19, 20, 21		Ground
Y	Prot gnd	1		**Shield / prot` ground**	PG	101	1		1		Screen

Clocking: IMPORTANT

The interface will not work as X.21 unless you set the clocking correctly! The **Rx Clock Menu** is used to set the source of the single clock from the modem as *Satellite*, *Internal*, or *Station Clock*. Do not select *Tx Clk In,* as this does not exist in X.21. The **Tx Clocking** should simply be set to *Rx* as the Tx data is clocked by the same clock as the Rx data.

The **maximum data rate** is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The **input clock/data phase** is selected automatically, reporting a `**Data Marginal**` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). Check the phase of the Data In with respect to the Clock Out line.

By selecting *Change*, *Terr-Intfc*, *Control Lines* it is possible to configure the modem to raise an alarm if either the `Sig` Valid In` line (C) switches to the inactive state. As there is no X.21 equivalent of the RS422 `Device (DTE) Ready In` line (TR), set this to *Ignore*. It is also possible to configure the Tx carrier to be switched on and off by the `Sig` Valid In` line (C) by selecting *Change*, *Tx*, *Modulator*, *Carrier*, *RTS-Controlled*.

X.21 DTE OPERATION

This only has a **clock *to* the modem** from the terrestrial equipment. Configure a cable with a 15 pin `D` male at one end (X.21 DTE) and either a 25 pin or 37 pin `D` male (not both) at the other end as follows:

Min Req	X.21 DTE (15 pin D male)			Signal Description	RS422 Name	Circuit Number	25 pin		37 pin		Electrical Levels
	Name	A	B				A	B	A	B	
DATA CIRCUIT TOWARDS MODEM (TX)											
✓	S	6	13	**Clock In**	TT	113	24	11	17	35	RS422
✓	R	4	11	**Data In**	SD	103	2	14	4	22	RS422
	I	5	12	Sig` Valid In	RS	105	4	19	7	25	RS422
DATA CIRCUIT FROM MODEM (RX)											
✓	T	2	9	**Data Out**	RD	104	3	16	6	24	RS422
	C	3	10	Sig` Valid Out	RR	109	8	10	13	31	RS422
COMMON LINES											
✓	Sig gnd	8		**Signal Ground**	SG	102	7		19, 20, 21		Ground
✓	Prot gnd	1		**Shield / Prot` ground**	PG	101	1		1		Screen

Clocking: IMPORTANT

The interface will not work as X.21 unless you set the clocking correctly! The **Tx Clocking** menu should be set take the single clock from the terrestrial by selecting *Tx Clock In.* The Rx Clock menu should also be set to return Rx data in time with the single Tx Clock by also selecting *Tx Clock In*. NO OTHER COMBINATIONS WILL WORK.

The **maximum data rate** is 10Mbps (over good quality twisted pair screened cable), but this rate is reduced as the connecting cables extend beyond 10m. As an estimate, assume the maximum rate halves as the distance doubles (ie 5Mbps to 20m, 2.5Mbps to 40m etc).

The **input clock/data phase** is selected automatically, reporting a `**Data Marginal**` warning whenever it has to switch phase. If the modem reports Data Marginal frequently then this is not a modem fault but an indication that you have a clocking problem external to the modem (ie changing clock/data phase, a problem which would otherwise have caused untraceable data errors). Check the phase of the Data In with respect to the Clock In line.

By selecting *Change*, *Terr-Intfc*, *Control Lines* it is possible to configure the modem to raise an alarm if either the `Sig` Valid In` line (I) switches to the inactive state. As there is no X.21 equivalent of the RS422 `Device (DTE) Ready In` line (TR), set this to *Ignore*. It is also possible to configure the Tx carrier to be switched on and off by the `Sig` Valid In` line (I) by selecting *Change*, *Tx*, *Modulator*, *Carrier*, *RTS-Controlled*.

MIL-STD-188-114A INTERFACE

The P300 Series terrestrial interface is compliant with the interfaces defined in MIL-STD-188-114A when set in RS422 mode.

This MIL-STD document specifies three types of `balanced generators`

Type 1	Low offset voltage, for <100kbps. Defined in this ***1985*** document for compatibility with ***"older equipment".***
Type 2:	3V offset maximum, for 100kbps to 10Mbps. MIL-STD-188-114A actually specifies this "corresponds to the EIA RS-422A balanced generators"
Type 3:	New terminated voltage generator for >10Mbps

Strictly the P300 Series is compliant with the Type 2 interface, defined for use from 100kbps to 10Mbps, however in the P300 Series this interface will also operate down to 4800bps. The low offset voltage Type 1 generator is not supported, but as specified for use with "older equipment" in 1985, should not be an issue today. The Type 3 is for data rates beyond the P300 Series operating range, and also is not supported.

A few notes from MIL-STD-188-114A

"Connectors, pin assignments and communication protocols are not standardised in this MIL-STD document"

FED-STD-1030A may be considered equivalent to EIA RS423A and CCITT V.10

FED-STD-1020A may be considered equivalent to EIA RS422A and CCITT V.11

P1451 EUROCOM D/1 `D` & `G` PLUS MULTI-STANDARD INTERFACE

The P1451 interface provides support for the Eurocom D/1 interface often used in military or government applications, it includes both the Eurocom `D` and `G` interfaces as defined for the Eurocom Tactical Communications systems.

In addition to the Eurocom modes, it also provides all the features of the standard P1440 interface including RS422, V.35, RS232 and optional G.703 operation. The single exception to this is that the P1451 omits the RS449 pinout 37 pin `D` type female connector (leaving only the EIA 530 pin out 25 pin connector of the P1440 card), and adds instead a second 25 pin connector (a male) for the Eurocom interface.

Note that although the RS422/V.35/RS232 and G.703 modes are still compatible with 1:1 redundant operation (as with the P1440), **the Eurocom interfaces ARE NOT 1:1 compatible**.

IMPORTANT: The Eurocom modes are activated by grounding certain pin combinations on the Eurocom connector. **With no pins grounded (or the Eurocom lead unplugged), the card operates just as the standard P1440**, allowing software selection of the interface (RS422/V.35/RS232/G.703), control lines in non-G.703 modes (RTS etc in), and line code and length (in G.703 modes). **With the appropriate pins grounded the modem recognises it as a Eurocom D or G card**, and the software selections relating to the other interfaces are not available.

NOTE ESPECIALLY: That when switching between Normal, Eurocom D and Eurocom G modes (ie exchanging connectors if the links to enable the Eurocom modes are in the cables), that the modem must be RESET in order to recognise and correctly operate with the new card type. This is achieved simply by removing the power cord for a few seconds, and then re-powering the unit.

To verify if the card is in a Eurocom mode select Main, Info and Terr-Intfc from the menu and read the card description.

To use this interface in RS422/V.35/RS232 or G.703 modes, please disconnect any connectors from the Eurocom interface, and treat the card exactly as the P1440 card described earlier. For operation in Eurocom modes, please continue reading.

Note: For non-Eurocom operation without a G.703 option fitted, a small 2 x 4 header is required plugged into J4 (exactly as per the P1440) in order for RS422, V.35 and RS232 modes to work. Equipment is supplied with the header fitted, but be aware of this if ever removing a G.703 option card.

Eurocom D/1 interface `D` operation

The Eurocom `D` interface uses transformer coupled differential clock and data signals. The data signal is AMI coded, and the amplitude of both clock and data signals are ±0.5V (ie 1.0 V peak to peak). The differential lines are of 130Ω impedance, and the centre tap of the line coupling transformers may either be grounded, or left floating.

The Eurocom `D` interface will operate from <16kbps to >2048kbps, although the Eurocom specification calls for only 256, 512, and 1024kbps. In addition to the clock and data lines in and out (four lines), a fifth line is implemented over and above the Eurocom specification which carries the modems internal clock out when the Tx clock is set to internal.

Min Req	Signal Description	RS422 Name	Circuit Number	25 pin		Link to ground centre tap of transformer
				A	B	
DATA CIRCUIT TOWARDS MODEM (TX)						
Y	**Clock In**	TT	113	19	6	LK 1 *
Y	**Data In**	SD	103	18	5	LK 2 *
	Int` Tx Clock Out	ST	114	21	8	LK 7 *
DATA CIRCUIT FROM MODEM (RX)						
Y	**Clock Out**	RT	115	4	17	LK 4 *
Y	**Data Out**	RD	104	16	3	LK 5 *
COMMON LINES						
Y	**Ground to Activate Eurocom `D`**			14		n/a
	Do Not Connect			12, 20		n/a
Y	**Signal Ground**	SG	102	2, 7, 13, 15, 22, 25		n/a
Y	**Shield/Protective ground**	PG	101	1		n/a

*** Links**

All links settings are:

Centre tap-grounded: 1-2 (link `up` with the PCB legend the right way up)

Centre tap-floating 2-3 (link `down` with the PCB legend the right way up)

The typical configuration would normally be to ground the outputs, and leave the inputs floating ie:

Links 4, 5, and 7 in pos 1-2 (up), and links 1 and 2 in pos 2-3 (down)

This provides protection by ensuring the signal levels remain close to ground potential (as might happen if both inputs and outputs were floating), but avoid any ground currents between distant locations (as might happen if both inputs and outputs were grounded).

The modem will detect and display the `Data Marginal` warning if the Tx input clock and data phase is incorrect, and will automatically flip the clock phase to correct this. If repeated `Data Marginal` alarms occur then it is likely the Tx clock and data are not from the same clock course and are `slipping past` each other.

Eurocom D/1 interface `G` operation

The Eurocom `G` interface uses transformer coupled differential combined clock and data signal, which is diphase coded. The amplitude is ±1.0V (ie 2.0 V peak to peak). The lines are of 130Ω impedance, and the centre tap of the line coupling transformers may either be grounded, or left floating.

The Eurocom `G` interface will operate at either 16kbps of 32kbps only; NO OTHER DATA RATES are supported. The modem will generate a configuration error if configured for data rates outside the range 16-32kbps, but note that ***only*** 16kbps & 32kbps are valid rates for operation of the Eurocom interface. For example configuring the modem for 20kbps will NOT cause an error, but the Eurocom interface will not function correctly at this rate.

Min Req	Signal Description	25 pin		Link to ground centre tap of transformer
		A	B	
DATA CIRCUIT TOWARDS MODEM (TX)				
Y	**Clock/Data In**	24	11	LK 3 *
DATA CIRCUIT FROM MODEM (RX)				
Y	**Clock/Data Out**	23	10	LK 6 *
COMMON LINES				
Y	**Ground to Activate Eurocom `G` at 16kbps**	20		n/a
Y	**Ground to Activate Eurocom `G` at 32kbps**	14 AND 20		n/a
	Do Not Connect	12		n/a
Y	**Signal Ground**	2, 7, 13, 15, 22, 25		n/a
Y	**Shield/Protective ground**	1		n/a

*** Links**

All links settings are:

Centre tap-grounded: 1-2 (link `up` with the PCB legend the right way up)

Centre tap-floating 2-3 (link `down` with the PCB legend the right way up)

The typical configuration would normally be to ground the outputs, and leave the inputs floating ie:

Link 6 in pos 1-2 (up), and link 3 in pos 2-3 (down)

This provides protection by ensuring the signal levels remain close to ground potential (as might happen if both inputs and outputs were floating), but avoid any ground currents between distant locations (as might happen if both inputs and outputs were grounded).

APPENDIX B: MODEM CONNECTOR PINOUTS

REMOTE M&C (RS485/RS232) CONNECTOR

The selection of RS232 or RS485 must be made via the front panel. Refer to Appendix D for an overview of the Remote M&C protocol.

Connector type: 9 Pin `D' Female, pin compatible with `SA-bus`

Pin	Signal name	Direction	Name-RS485		Name-RS232
			SA Bus	Paradise	
1	Shield/Gnd *		Shield	Shield/Gnd	Shield/Gnd
2			SRR	-	-
3	Master-B	+ to modem	SSD	RX-B	-
4	Slave-B	+ from modem	SRD	TX-B	-
5	Shield/Gnd *		SG	Shield/Gnd	Shield/Gnd
6	Slave-A	- from modem	RC	TX-A	Tx. data
7			SRS	-	-
8			SCS	-	-
9	Master-A	- to modem	SC	RX-A	Rx. data

***** Pins 1 & 5 are both grounded on the modem (ie Shield and Ground are interchangeable).

See also the `M&C Appnote` available from www.paradisedata.com.

Interconnecting Devices Using RS485

This page summarises the RS485 M&C ports of many different equipments from multiple vendors and explains how to interconnect them all for M&C operation. Connect any of the following devices in parallel on a daisy chain cable for multi-device operation:

Product: / **Signal 9**	**Paradise P300 / P400**		**Paradise P300**	**Paradise P500**		**Paradise P200 / P230 / P230DI**		**Paradise P1300 / P1301**		**Codan C57/5900**	**Anancom AnaSat-C**	**Gilat SkyWay**
Port Name:	Remote M&C	ESC/Aux/ Back' Alm	Async ESC	RS485 In	RS485 Out	RS485/ RS232	ESC Async	Rem Cont	Async 2 on P1361	Monitor/ Control	M & C	Maint
Connector: (on cable)	9 pin `D` Male	50 pin `D` Male	15 pin `D` Male	9 pin `D` Male	9 pin `D` Female	15 pin `D` Male	9 pin `D` Male	15 pin `D` Male	9 pin `D` Male	9 pin `D` Male	18p Circ' Female	9 pin `D` Male
Shield	1	1	1	5	5	14	9	12	3	5	12 and 18	1
Master-A (to product `-`)	9	13[1] / (15)	2[1] / (3)	1	1	1	2[1] / (7)	1	9[1] / (5)	7	11	5
Master-B (to product `+`)	3	14[1] / (16)	9[1] / (10)	6	6	9	3[1] / (5)	9	2[1] / (8)	3	10	9
Slave-A[2] (from product `-`)	6	15[1] / (13)	3[1] / (2)	2	2	2	7[1] / (2)	2	5[1] / (9)	8	9	3
Slave-B[2] (from product `+`)	4	16[1] / (14)	10[1] / (9)	7	7	10	5[1] / (3)	10	8[1] / (2)	2	8	7
Conn' Ref[3]	A	P[1] / (Q)	R[1] / (S)	D	E	F	G[1] / (H)	I	J[1] / (K)	L	N	T

Notes

1: For all Async ESC channels carrying M&C data (for distant end M&C via the satellite) the cabling depends on ***which end of each separate M&C link*** the device is. Devices **routing M&C data *to* the satellite** are considered to be at the ***Local end*** of the M&C link, and devices **bringing M&C into a site *from* the satellite** are considered the ***Remote end*** of the link. For example at a Hub co-located with the system M&C computer every device would be considered the `Local end` of any M&C links via satellite. However at a node the device providing the incoming M&C link from the satellite would be considered the `Remote end` of the link, **but *any additional devices*** taking the M&C *back* to the satellite on a second hop to a more distant station would be the `Local end` again (*local* because they are the *end of that specific link nearest the M&C computer*). Pin numbers for Async ESC ports in the table above are shown as: **"local end pin[1] / (remote end pin)"**, and the cable must be made accordingly taking into account *which end of each M&C link* the particular ESC connector is. For user convenience the P300 & P400 can provide an internal link from the M&C port to ESC port, avoiding having to cable M&C to both the M&C connector and then the ESC connector (if distant end control via satellite is to be used). When using this internal link you set the ESC interface to `Link to M&C` on the modem, and specify whether it is `Local end` or `Remote end` and the device internally routes it correctly (without any pin number changes on the Remote M&C port).

2. For reliable operation ensure that when no slave devices are talking the Slave-B line floats at least 200-300mV **higher** than the Slave-A line. If necessary provide 1k, 470Ω, or even 220Ω pullups (Slave-B to RS232/485 converter DC+) and pulldowns (Slave-A to Gnd) to ensure lines float as specified. This ensures idle state of slave lines when not driven is a `mark` as an idle state of `space`

will cause the first and possibly subsequent characters of slave responses to be lost. Due to the low speeds & short cables it is not normally required to *terminate* RS485 async M&C cables. If it does prove necessary use 120Ω between Master-A and Master-B at the end of the cable (furthest from bus controller). Between Slave-A and Slave-B try 470Ω first farthest away from the controller, then add 470Ω at the controller end too. If necessary reduce both to 240Ω or even 120Ω.

3. Conn' Ref' is used for specifying cables. For example a cable to connect a P300 at the distant end of a link with a Codan C5700 transceiver could be specified as: "A + 500cm + L" (ie connector `A`, 5 metres of cable, then connector `L`). The 10 connector `local RS485 bus` daisy-chain cable used in a 1:N switch to connect a backup P300, the P500 `RS485 Out` port, and a further 8 P300's could be specified as: "A + 50cm + E + 8 x (30cm + A)".

1 FOR 1 INTERFACE

Connector type: 9 Pin `D' male

1:1 CONNECTOR	
1	Ground
2	Line in
3	Line out
6	Fail in
7	Fail out
4	Serial in (unused)
8	Serial out (unused)
5	Not used
9	Not used

Serial In/Out
This is an uncommitted and currently unused RS232 serial port.

Line In/Out & Fail In/Out
A suitable four way lead (4 + Screen) 1:1 redundancy lead is as follows:

Unit 1	Unit 2	
Pin 1 ...Screen...	Pin 1	(circuit ground)
Pin 2	Pin 3	(On-Line signal 2-1)
Pin 3	Pin 2	(On-Line signal 1-2)
Pin 6	Pin 7	(Fail signal 2-1)
Pin 7	Pin 6	(Fail signal 1-2)

Keep this lead as short as practical, and ensure it is screened to prevent spurious changeovers by noise induced in these high impedance signal leads.

Refer to the earlier section on 1 FOR 1 switching for details of 1 FOR 1 operation.

A standard 1 FOR 1 lead is available from Paradise Datacom, part number P1391. The lead is 10cm long, and is designed for use when two Modems are mounted vertically adjacent to each other in the rack.

ALARMS & AGC CONNECTOR
Connector type: 15 pin `D' male

ALARMS CONNECTOR	
2, 12	Fault Relay - Common
4	Prompt Unit fault - N/O
11	Prompt Unit fault - N/C
3	Prompt Traffic fault (prompt) - N/O (c/o pair a)
10	Prompt Traffic fault (prompt) - N/C (c/o pair a)
5	Prompt Traffic fault (prompt) - N/O (c/o pair b)
13	Prompt Traffic fault (prompt) - N/C (c/o pair b)
1	Deferred alarm - N/O
9	Deferred alarm - N/C
6	Uncommitted analog output from processor (If Monitor/AGC option fitted). Selectable Rx signal level, Eb/No, IF offset freq etc, see Appendix E
7	Transmit inhibit
8	Buffered direct AGC voltage. This may be used as an antenna-pointing signal when the demod is unlocked. It responds to composite power in approximately a 2MHz bandwidth around the nominal Rx carrier frequency.
14	Not connected
15	Ground

To externally inhibit the Transmit carrier, either apply a TTL/CMOS 'low' signal to pin 7, or short pin 7 to ground (for example with an external relay closure).

All relay contacts rated 30V DC 2A, or 125VAC 0.4A. The functions are as defined below:

Prompt Unit: A **unit fault** exists, i.e. an equipment failure.

Prompt Traffic: A Tx or Rx **traffic fault** exists.

Deferred alarm: One of the following conditions exists:
The receive BER is greater than the user defined threshold.
The receive Eb/No is lower than the user defined threshold.
Buffer slips are more frequent than the user set threshold.
A Backward alarm is being received from either the satellite or terrestrial ports.

Note: N/O means 'normally open' *in the non-fail state of the modem* (relays energised), when power is removed the relays fall back to the non-normal (ie non-energised) alarm state.
Note: The function of these relays can be changed. See "Relay Mode" in Appendix E: Customer Specific Features on page 207 for a description.

ASYNC ESC CONNECTOR

This connector carries:

An RS232/RS422/RS485 async port for use on either the ESC or Aux channels
An RS232 serial port for log printing & embedded M&C update
An RS422 Station Clock input
The Receive constellation monitor points (if the Monitor/AGC option is fitted)

ASYNC ESC CONNECTOR		
RS232	**RS422/ RS485**	**Async port for ESC or Aux channel**
2	2 (a)	Async ESC/Aux Input (to satellite)
-	9 (b)	Async ESC/Aux Input (to satellite)
3	3 (a)	Async ESC/Aux Output (from satellite)
-	10 (b)	Async ESC/Aux Output (from satellite)
1	1	Ground
RS232		**Serial port for Log printing or embedded M&C update**
12		Serial Input (RS232 port)
5		Serial Output (RS232 port)
13		Ground
Analog		**Rx constellation monitor (Rx signal quality)**
14		Rx I channel eye
7		Rx Q channel eye
15		Rx symbol clock
13		Ground
RS422		**Differential Station Clock Input**
4		Station Clock (a)
11		Station Clock (b)
13		Ground

RX CONSTELLATION MONITOR PORT.

If the Monitor/AGC option is fitted it is possible to view a receive constellation (but not the more traditional `eye pattern`). To display the receive constellation on an oscilloscope, connect the I and Q signals to the main X/Y inputs, and apply the receive symbol clock to the external trigger input of the 'scope. The main 'scope inputs should be set to X/Y display, AC coupled, both channels on 200 mV/div, with the trigger from the external trigger input. See `STANDARD LEAD` on the following page.

DIFFERENTIAL STATION CLOCK

This provides a RS422 compatible station clock in addition to the unbalanced 75Ω station clock BNC connector. See the menu dialogue in section 6.7.4 on page 92 for a full description of this port.

ASYNC PORT FOR ESC OR AUX CHANNELS

The modem has two fully independent data channels, which may be carried over the satellite within any overhead that is added, these are referred to as the ESC and Aux channels. The shared interface on this connector allows the use of only one of these channels at a time, and then only in an Async mode (there is no clock signal on this port). If both ESC and Aux channels are to be used together or either channel used in a synchronous mode, then the IDR option must be fitted which provides separate ESC & Aux ports both with clock, data, and octet lines. **When the IDR option is fitted the shared ESC/Aux port on this connector IS DISABLED.** The screen dialogue to configure these channels is described in section 6.6.25 "Change, Tx/Rx, ESC/AUX/BA Menu" on page 79.

When configured for different services the ESC and Aux channels provide as follows:

In **Closed Net Plus ESC** mode the ESC channel provides the variable rate async ESC facility, the Aux channel is not used.

In **IBS/SMS** modes the ESC channel provides the High Rate Async ESC facility (2400 Baud at 64kbps) and the Aux channel either the INTELSAT low rate ESC facility (50 Baud at 64kbps) or a variable rate synchronous Aux circuit. However to use the Aux channel in a synchronous mode the IDR option must be fitted. Without the IDR option, which has separate ports for ESC & Aux channels, both ESC and Aux channels (ie high rate async ESC & INTELSAT low rate ESC) cannot be used simultaneously.

In **IDR** Mode this port is not used, as when the IDR option is fitted separate ESC and Aux ports on the IDR card replace this shared ESC/Aux port. Refer to the definitions of the ESC & Aux ports on the 50 way IDR ESC/Aux/Backward Alarm connector on the following few pages.

SERIAL PORT FOR LOG PRINTING OR EMBEDDED M&C UPDATE

Update the embedded M&C software

See section 10 "Boot Code Operation" on page 168 for a description of updating the modems embedded M&C software. The lead described under "PC connection" below will be required to connect the modem to the PC.

Log Printing

When the async port is used to print the traffic log, it is set for 9600 Baud, RS232 levels, 8 data bits, no parity, one stop bit. There are no serial configuration options, although unlike previous products this port does now support XON/XOFF flow control. The printer carriage is assumed to be 80 columns wide.

PC Connection

To connect the serial printer port to a standard PC serial port 25 pin D type female [pins for the 9 pin `AT` serial port are in square brackets], the following connections are required. Modem pin 12 to PC pin 2 [3], Modem pin 5 to PC pin 3 [2], and Modem pin 13 to PC pin 7 [5]. See `STANDARD LEAD` below.

STANDARD LEAD

A constellation monitor / serial lead is available from Paradise Datacom, part number M1479. This lead provides the required connections to a 25 pin D type for a PC connection (for printing/capturing a log or updating the modems embedded software), and three BNC's for connecting to a scope for the constellation monitor.

ESC/AUX & BACKWARD ALARMS CONNECTOR

This connector is fitted as part of the IDR option (standard on P300-IDR and above). Note that when this option is fitted **the ESC and Aux ports on this connector replace the shared ESC/Aux port on the Async ESC connector**.

Connector type: 50 pin `D' female

ESC Port

Pin Number	Sync	Async	RS 485 / RS422 usage	RS 232 usage
30	Y		Tx ESC Clock out A	Tx ESC Clock out
31	Y		Tx ESC Clock out B	n/c
13	Y	Y	Tx ESC Data in A	Tx ESC Data in
14	Y	Y	Tx ESC Data in B	n/c
32	Y		Rx ESC Clock out A	Rx ESC Clock out
33	Y		Rx ESC Clock out B	n/c
15	Y	Y	Rx ESC Data out A	Rx ESC Data out
16	Y	Y	Rx ESC Data out B	n/c
46	(Y)		Tx ESC Octet out A	Tx ESC Octet out
47	(Y)		Tx ESC Octet out B	n/c
48	(Y)		Rx ESC Octet out A	Rx ESC Octet out
49	(Y)		Rx ESC Octet out B	n/c
17	Y	Y	Ground	Ground

(Y) indicates lines are optional

In **Closed Net Plus ESC** mode the variable rate ***async*** ESC is available on this port.

In **IBS** modes high rate ***async*** ESC is available on this port.

In **IDR** modes this port provides access to the 8kbps IDR ESC channel. This can either by ***synchronous*** at 8kbps, or (if the Async ESC feature is available) ***asynchronous*** at up to 4800 or 9600 Baud.

Aux Port

Pin Number	Sync	Async	RS422 usage	RS 232 usage
26	Y		Tx Aux Clock out A	Tx Aux Clock out
27	Y		Tx Aux Clock out B	n/c
9	Y	Y	Tx Aux Data in A	Tx Aux Data in
10	Y	Y	Tx Aux Data in B	n/c
28	Y		Rx Aux Clock out A	Rx Aux Clock out
29	Y		Rx Aux Clock out B	n/c
11	Y	Y	Rx Aux Data out A	Rx Aux Data out
12	Y	Y	Rx Aux Data out B	n/c
42	(Y)		Tx Aux Octet out A	Tx Aux Octet out
43	(Y)		Tx Aux Octet out B	n/c
44	(Y)		Rx Aux Octet out A	Rx Aux Octet out
45	(Y)		Rx Aux Octet out B	n/c
50	Y	Y	Ground	Ground

(Y) indicates lines are optional

In **Closed Net Plus ESC** mode the aux port is not used.

In **IBS** modes the Aux port can be set to both `INTELSAT` (using TS32 bit 1) and `Sync` modes (selectable to use any of TS16, TS32 bits 1& 5-8, & TS48). In both modes a clock is provided and the port can be used synchronously (with the clock), or asynchronously (allowing the async data to be oversampled by the higher rate clock). In this oversampled mode (as specified by INTELSAT), the Baud rate is limited to approximately 25-33% of the synchronous clock rate.

In **IDR** modes the Aux port provides either 32 or 64kbps data access in place of either one or both of the 32kbps ADPCM audio channels. Typically this would be used synchronously, but if required it could be used asynchronously & oversampled giving maximum baud rates of approx 9600 Baud (in place of one audio channel) or 19200 Baud (in place of both Audio channels).

Audio Ports

Pin Number	Description
38	Tx Audio Channel 1 in A
39	Tx Audio Channel 1 in B
40	Tx Audio Channel 2 in A
41	Tx Audio Channel 2 in B
34	Rx Audio Channel 1 out A
35	Rx Audio Channel 1 out B
36	Rx Audio Channel 2 out A
37	Rx Audio Channel 2 out B
50	Ground

All ports are 600Ω, with levels set independently from the front panel of +7dBm to -16dBm. Audio is encoded as 32kbps ADPCM (or 16kbps ADPCM in some custom modes)

The Audio ports may be used in two applications:

In **IBS** modes if set to *emulate* a P1348/P1448 Audio/Data mux card, the ESC ports provide the equivalent of the two audio ports on the P1348/P1448 (ie can transmit 64kbps=2 audio channels, or 128kbps=2 audio channels plus 64 kbps data from main data port).

In **IDR** modes these are used to access the IDR Audio ESC channels. One or both Audio ESC's may be dropped in favour of 32 or 64kbps access to the channel by the Aux port.

Backward Alarms

Pin Number	Description
1	BA 1-4 Common
2	BA1 N/O
18	BA1 N/C
3	BA2 N/O
19	BA2 N/C
4	BA3 N/O
20	BA3 N/C
5	BA4 N/O
21	BA4 N/C
22	BA1 Input
23	BA2 Input
24	BA3 Input
25	BA4 Input
7	Rx Summary fault output (link to BA in)
6	Ground

N/O indicates **normal open in the normal, non-alarm state** & N/C normally closed in the non-alarm state. Unlike the modem fault relays, the backward alarms are not normally energised, and fall back to the `Normal` state when modem power is removed. The modem deferred alarm acts as a summary backward alarm and activates when any backward alarm is received (this does fall back to the `Fail` state when power is removed).

Backward alarm inputs float to the **`Good`** state (high =+5V) and indicate **`Fail`** when connected to 0V. The Rx summary fault is an open collector output, 0V = Fail, open collector=OK. From the front panel the backward alarm inputs (**BA x**) can be set as follows (E=Ext, A=Auto-Rx fail, O=OK):

	Menu Opt	**BA 1**	**BA 2**	**BA 3**	**BA 4**
Mode 1	EEEE	Ext patch	Ext patch	Ext patch	Ext patch
Mode 2	AEEE	Rx Fail	Ext patch	Ext patch	Ext patch
Mode 3	AOOO	Rx Fail	Good	Good	Good
Mode 4	AAAA	Rx Fail	Rx Fail	Rx Fail	Rx Fail

If external patching is required, connect the Rx summary fault to the required BA input and any other modem fail outputs to the appropriate other BA inputs. Leave unused inputs floating.

In **IDR** modes these are used for the 4 standard IDR backward alarms.

In **IBS** modes BA 1 indicates the normal single IBS backward alarm status (mirrored by the unit deferred alarm). For **multidestinational *IBS*** carriers it is possible to operate the P300 in IBS mode, but use 4 separate backward alarms as per IDR. From the front panel select Service as `Other`, based on `IBS`, and follow the screen prompts.

APPENDIX C: UPGRADE INFORMATION

INTRODUCTION

To first explain the terms "Software Upgrades", "Hardware Upgrades", and "Feature Code" upgrades.

Software Upgrades normally involve a visit to our web site (http://www.paradisedata.com) to download the latest version of the modems embedded software. This is then loaded into the modem from a PC through the modems serial port (on the Async ESC connector) and the PC COM port. Software upgrades can always be performed in the field.

Hardware Upgrades involve the replacement of printed circuit boards (PCB's), firmware (such as the "Boot Code"), or cuts/straps to the PCB's to implement hardware changes. Some hardware upgrades can be performed in the field, and some require a return to the factory.

Feature Code upgrades require the user to enter a feature code into the front panel of the modem, which then allows the modem to provides additional facilities. Feature Codes can only be issued by Paradise Datacom, but the upgrade itself is performed in the field.

THE P300 SERIES MODEM HARDWARE

The P300 Series is a massively redesigned and cost engineered version of our previous P480 modem. It can provide every feature of the P480 (except it has a lowest data rate of 4.8kbps not 2.4kbps) but yet has only approximately one third the number of components. It relies on the Paradise Datacom T1000 Baseband processing ASIC to provide many of its features.

To provide the cost reduction on the base unit (ie the P300-VSAT), wherever a feature required significant hardware the hardware has been made optional. However as most of the processing is provided by the T1000 ASIC, the optional hardware is limited to:

- The Sequential FEC (a plug in Xilinx chip or module)
- The Turbo codec (a plug in module)
- The Viterbi/TCM FEC (a plug in chip, normally fitted but can be removed for Sequential only operation)
- The G.703 option card (T1 or E1 variants)
- The IDR ESC interface (audio transformers, PCM codecs, full ESC & Aux interfaces)
- The Monitor / AGC option (Rx carrier level monitoring, a constellation monitor point, and a used defied analog output signal)

Although these are the only hardware options, many of the features are considered options and are controlled by `Feature Codes`. Basically this means the features can be turned on and off by a feature code entered into the front panel.

It may be difficult at first to understand the logic in providing the features within the ASIC, but not having them enabled on every modem. Quite simply the ASIC, which allows us to provide these features was very expensive to develop and this is a cost we have carried in order to provide the competitive product we offer. When we are paid extra to enable a feature (which may already be in the ASIC in the modem you already have) it is not `money for old rope`, it is simply helping us to recover the very large up front costs of developing the ASIC in the first place. Without the prospect of recovering the ASIC development cost by charging for the additional features it provides, the ASIC would not have been developed and the modem would be only half the product it is today.

Upgrading a P300 Series modem may then involve the entering of a `Feature Code` into the front panel, or the addition of one of more of the optional hardware items listed above in addition to entering of a `Feature Code` into the front panel.

APPENDIX C1: MODEM CAPABILITIES & UPGRADES

DETERMINING THE HARDWARE CAPABILITY OF A MODEM

Normally where a Feature Code upgrade is available (ie one that does not require a physical hardware upgrade) then the screens show "↓*Note*" at locations where extra features would appear. These notes can however be turned on and off by selecting *Change*, *User-Opt*, *Display*, *Upgrade Messages*, *Display* or *Inhibit* on recent software, so if no message is shown do not assume an upgrade is not available.

To determine the ***hardware capability*** of any P300 Series Modem see ‘’Features: Hardware’’ in Appendix C2 which follows immediately. Any feature for which the modem Hardware is already present can be added by a simple `Feature Code` upgrade from the front panel.

APPENDIX C2: FEATURE SCREENS

Under *Info* the modem shows a *Features* option. This details features by **assigning each feature a letter**, and then displaying the letters for which features are available, or which may be added by entering a `Feature Code`.

The available features are controlled by the following hardware and software mechanism. Needless to say for any specific feature to be used, the equipment needs both the hardware to be fitted and the software to have that feature enabled:

Hardware
The equipment determines what boards and assemblies are fitted when it powers up, and generates an internal list of its hardware capabilities. This can be displayed, see `Features: Hardware` below.

Software
Some features are permanently software enabled (***Standard*** features). This list can be displayed (see `Features: Standard` below) and can be changed by entering a feature code issued by Paradise.

Some features are enabled for a temporary period only (***Temporary*** features). Again the temporary feature list and its duration can be displayed (see `Features: Temporary` below) and changed by entering a feature code issued by Paradise. The `Temporary features` facility is usually used to provide extended customer evaluation (30+ days) of specific features.

All available features can be *user enabled* for evaluation (***Test*** features). A user activated feature test enables *every feature the modem hardware can provide* for a period of 5 days. Each modem provides 3 such user test periods after which the facility is no longer available (unless reset by the entry of a valid feature code issued by Paradise). Again, features on test can be displayed (see `Features: Test` below).

The feature menu is as follows:

```
Features: 1:In use  2:Standard  3:Temp'
4:Hardware  5:Upgrades  6:Test  ↓Help
```

Info, Features

FEATURES: IN USE
The letters shown represent the features that are actually ***in use with the current configuration*** (see following table for a description of what each letter means). This is the minimum feature set you need to operate as currently configured. An example screen follows:

Features in use by current config **A B C - E - - - - - - L - N - P - - S - - - W X - - ↓READ**

Info, Features, In Use

In the example above you can see (by checking against the following table) that the Tx & Rx paths, Drop/Insert, IBS framing, INTELSAT Reed-Solomon, Viterbi FEC, Variable data rate, and the 70MHz IF are in use. Letters W and X are for features not yet defined.

Pressing down arrow from this screen (↓ shown only if relevant) shows features, which are in use with the current configuration, but which are only temporarily enabled and expire in the period shown (***Temporary*** features). The modem will cease to be able to provide these features when the period expires unless a Feature Code issued by Paradise Datacom is entered. If you have no means to get a feature code from Paradise Datacom (eg lack of comms, public holiday etc), use one of the 5-day user activated Feature Test periods to provide cover until you can contact us.

Pressing down arrow a further time shows features which are in use with the current configuration, but which have been enabled as a result of a user option to test all the features of the equipment and which expires in the period shown (***Test*** features). Again the modem will cease to be able to provide these features when the period expires unless a Feature Code issued by Paradise Datacom is entered, or another 5 day feature test is activated by the user (if available).

FEATURES: STANDARD
The letters shown represent the features that are permanently enabled in the equipment (***Standard*** features), even if not required by the current configuration. To determine if any of the features are in fact required for the current configuration see `FEATURES: IN USE` above.

Pressing down arrow shows two data rates "Low Rate" and "High Rate" (also controlled by feature codes issued by Paradise). Refer to the alphabetic feature list in the table that follows to determine how these two data rates are used.

FEATURES: TEMPORARY
The letters shown represent the features that are temporarily enabled (***Temporary*** features), along with how long the temporary features will remain enabled (even if not required by the current configuration). To determine if any of the features are in fact required for current configuration, see `FEATURES: IN USE` above.

FEATURES: HARDWARE
The letters shown represent the features that the hardware can support, ie the capabilities of the hardware (not all of which might be enabled in the software). Features, which the hardware is capable of but which are not software enabled are listed under upgrades (below). Note this list excludes features, which require optional plug in boards or chips (eg IDR or Sequential), which are only available if the options are fitted.

FEATURES: UPGRADES
The first screen shows all the information required about this unit to enable a `Feature Code` to be supplied. Record the information on this screen (model, serial number, software, and IDENT#) and contact the supplier (or Paradise Datacom directly). A subsequent screen shows letters representing the

features that the hardware can support but which are not enabled in the software. These are therefore features that can be gained without hardware changes by entering a `Feature Code` issued by Paradise. Other features are available but may require a hardware upgrade (ie a chip to be plugged in or a PCB to be added)

If you contact Paradise Datacom directly we will supply within a few minutes by fax a Feature Code to provide the extra features you require (eg addition of Reed-Solomon etc). This will be a temporary code valid for probably 30 days to enable you to raise and place a purchase order on your supplier. When you place a formal order on the supplier for the features, a Feature Code will be provided to make the features permanent. If you are unable to contact Paradise Datacom for some reason use one of the 5 day `Feature Tests` to give you *all the features* for 5 days while you contact us. Each modem has only 3 `Feature Tests` of 5 days each, but when you enter a valid Feature Code the number of `Feature Tests` will be reset to 3 again.

FEATURES: TEST

These screens give the user access to start and monitor the user enabled ***Test*** features facility. ***This enables the user to test all the features the modem can provide***, for a period of 5 days, up to three times on each modem.

ALPHABETIC FEATURE LIST

Feature	P300 VSAT	P300 IBS	P300 IDR	P300 TCM	Letter	Description of Feature	P300 User
	Included as standard						
Base Modem	Y	Y	Y	Y	A	Tx path: without this the modem can be Rx only	
					B	Rx path: without this the modem can be Tx only	
					P	Variable rate: ***Variable*** data rate if enabled (see `R`), ***fixed*** if not (See `Q`)	
					S	70MHz IF interface: IF frequencies in the range 50 - 90MHz (Provides 50-180MHz if feature `T` also)	
					U	100Hz IF synth steps: 2.5KHz if not enabled	
					V	Misc ASIC functions: Terrestrial CRC support & BER monitoring	
Viterbi FEC	Y	Y	Y	Y	N *	Viterbi FEC (to IESS 308/309), rate 1/2, 3/4, 7/8 in BPSK, QPSK and OQPSK.	
Sequential FEC					M *	Sequential FEC (to IESS 312) , rate 1/2, 3/4, 7/8 in BPSK, QPSK, OQPSK	
INTELSAT Reed-Solomon		Y	Y	Y	L	Reed-Solomon outer FEC (to IESS 308/310), with n, k, t = 126, 112, 7 (Switches to 225, 205, 10 or 219, 201, 9 with 4/8 deep interleaving as required for IDR & TCM/IDR if options are available)	
Wideband IF		Y	Y	Y	T	140MHz IF interface: IF frequencies in the range 100 - 180 MHz (Provides 50-180MHz if feature S also available)	
High Data rates		Y	Y	Y	R	If data rate is ***Variable*** by feature `P`, then data rate range is 4.8kbps to 5.0Mbps if this feature enabled otherwise limited to rates between ***Low_Rate*** and ***High_Rate*** (see bottom of table). No effect if feature `P` disables variable rate	
Async ESC		Y	Y	Y	G	Variable rate ESC channel for Closed Net plus ESC operation High rate IBS/SMS ESC (with IBS/SMS feature) Async ESC access to IDR 8k sync ESC channel (with IDR option).	
IBS/SMS		Y	Y	Y	E	IBS/SMS framing (to IESS 309) with low rate INTELSAT ESC (to IESS 403).	
Drop/Insert		Y	Y	Y	C	Normal T1/E1 linear order Drop/Insert, excludes `Odd values of N` such as N=7, 9 etc (see feature D)	
IDR			Y	Y	F *	IDR operation (to IESS 308): Two audio ESC channels Sync 8kbps ESC; Four form `C` backward alarms.	
					H	Aux: IBS variable rate synchronous Aux channel, IDR 32/64kbps in place of one/both audio ADPCM ESC channels	
					J	P1348 emulation: Emulation of P1348 / P1448 cards popular in SNG applications. Includes generation of 64kbps carrier from 2 x 32k ADPCM audio (using IDR Audio ESC ports), or 128kbps from 2 x Audio + 64kbps data.	
PRBS Tester			Y	Y	K	PRBS tester: Internal BERT (can run through Main, ESC and Aux channels in any o/h modes)	
8PSK/TCM				Y	O	8PSK with 2/3 rate Trellis Code Modulation (TCM, to IESS 310).	
Extended D/I				Y	D	Arbitrary Timeslot re-ordering on Tx & Rx paths. Timeslot ID maintenance for the `Odd values of N` giving N=1 to 31 with IBS/SMS or Closed Net plus ESC operation. E1 CAS & T1 RBS signalling support. Rx Partial Insert (for multi-destinational working)	
Custom Features				Y	I	Arbitrary `n` & `k` when using Reed-Solomon, Custom and Minimum Overhead framing modes, Custom allocation of IBS o/h between Async ESC & Sync Aux ports.	
Dual Rate					Q	Dual rate: If data rate is ***fixed*** by feature `P`, then fixed at ***Low_Rate*** unless this feature enabled when choice of ***Low_Rate*** or ***High_Rate*** is available (see below). No effect if feature `P` enables Variable rate	

Turbo Codec					W *	Turbo Codec inc rates 1/2, 3/4, 7/8 & 0.789. Later model P300 only (previously letter `W` was spare = active).	
Spare	Y	Y	Y	Y	X	Spare (active)	
Spare					Y	Spare (inactive)	
AUPC					Z	Auto Uplink Power Control (requires Async ESC feature also to function)	
Low_Rate	4.8k	4.8k				See features `Q` and `R` above	
High_Rate	512k	512k				See features `Q` and `R` above	
Monitor / AGC					*	Demod Rx carrier signal level monitor. 0-10V Analog output of carrier signal level, Eb/No, or Rx offset frequency (in addition to normal AGC output). Constellation monitor port	
1544kbps G.703					*	1544kbps G.703 interface *in addition* to RS422 / V.35 / RS232 interface (software selectable).	
2048kbps G.703					*	2048kbps G.703 interface *in addition* to RS422 / V.35 / RS232 interface (software selectable).	

A * in the `Letter` column indicates these features require additional hardware to be fitted (eg small PCB or `Chip`). All Other features may be added simply by entering a `Feature Code`.

APPENDIX C3: FEATURES ON DEMO EXPIRE SOON

** IF YOU HAVE BEEN REFERRED TO THIS SECTION BY A MESSAGE ** ** ON THE EQUIPMENT DISPLAY, THEN THIS IS VERY IMPORTANT **

The modem is warning you that at least one of the features the modem is using in order to operate as configured is due to expire soon. This means that after expiry, it will cease to function as configured, and one or several of the features required for how it is currently configured will no longer be available.

This ***Temporary*** Features mode is usually used to allow customers to evaluate features (eg Drop/Insert, Reed-Solomon) for a finite duration after which the modem reverts back to its standard feature set. Please refer to section C2 to further explain this topic and a description of how to determine which features are required in order to continue operation.

!! DO NOT IGNORE THIS MESSAGE!!

If the features are still in use when the time limit expires then the modem will change it's configuration so it does not require the features which have timed out, and if this in turn causes a change to the transmitted carrier then the carrier will be muted. A message stating ‘'Features not available'’ will then be displayed showing the letters corresponding to the features, which are no longer available. If for any reason you need to keep a modem configuration after timeout (eg to re-use it), then use the configuration memories to store the current configuration before it times out and is changed, and recall it after the features are available again (eg if you instigate a feature test or have a feature code upgrade).

APPENDIX C4: ASYMMETRIC LOOP TIMING

All P300 Series modems **have this asymmetric loop timing facility.**

APPENDIX C5: UPGRADE AVAILABLE

Again this section is not applicable to the P300 series modems.

APPENDIX C6: FEATURES NOT AVAILABLE

You have been directed to this appendix by a message on the equipment display, as the unit has detected it has been configured to use features, which it cannot provide. This is as a result of one of the following:

1) It has been programmed over the remote M&C to use features, which it cannot provide. This cannot happen with local control, as locally the configuration screens do not show features, which are not available.
2) It was configured to use a certain feature, which is no longer available (see ***Temporary*** Features or ***Test*** Features in Appendix C2)

Please refer to Appendix C2 (previous page) for a description of the feature list (shown as a series of letters) on the equipment display.

APPENDIX D: REMOTE M&C

REMOTE M&C PROTOCOL

Summary

The P300 Series Modems support two separate remote M&C protocols, these are:

1. Paradise / FDC protocol, compatible with all previous Paradise equipment.

2. SA-bus protocol (as defined by Scientific Atlanta).

The protocols should co-exist without adverse effect on the same M&C bus (provided the unit addresses are unique!). Both protocols assume one `Master device` and multiple `Slave devices`. The Master device initiates all communications and Slave devices only ever send a message in response to a request from the Master.

Character Format / Baud Rate

The character format & Baud Rates are as follows:

Paradise / FDC: 8 bits, no parity, 1 stop bit, selectable 300-19200 Baud,
SA-bus: 7 bits, even parity, 1 stop bit, specified only at 1200 & 9600 Baud.

The SA-bus protocol definition specifies that the characters in the `Body` of the message should, as far as possible, be limited to the printable ASCII characters. Whilst this is not specified for the Paradise / FDC protocol, Paradise Datacom have attempted to achieve this wherever possible. For this reason, only 6 bits of each character of the `Body` are utilised (bits 0 to 5). Bit 6 is fixed at a one for both protocols, and for the Paradise / FDC protocol (where the character has 8 bits, 0-7), bit 7 is fixed at a zero. Note that this applies only to `Body` characters; there are no such constraints on the other characters in the message.

Electrical Interface

Both protocols require a 4 wire plus ground interconnection between equipments. Signals are at RS485 levels (effectively a tri-statable RS422) with Tx & Rx data being transmitted as a series of async characters over a differential pair (labelled `A` and `B`). Lines referred to as Tx-A and Tx-B are outputs, and Rx-A and Rx-B are inputs. The Paradise convention (as specified by RS422) is that the `B` lines represent true data (ie the inactive state is `mark`, which is high), and the `A` lines inverse data (ie the inactive state is `space`, which is low).

An async character then appears as:

RS 485 `B` Line	mark	space									mark	mark
(Paradise / FDC)	idle	start	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	stop	idle
(SA bus)	idle	start	bit 0	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	parity	stop	idle
RS 485 `A` Line	mark	space									mark	mark

The differential pair from Master to Slaves is typically driven all the time by the Master device (ie never goes high impedance). The return pair (from Slaves to Master) is driven by a Slave device when sending a message. All devices hold their output drivers at a high impedance unless actually transmitting a

message, to allow other Slave devices on the bus access to the `return pair`.

It is possible to operate a link to a single device using an RS232 interface instead of RS485. However as RS232 cannot go high impedance, only one Slave device can be on the bus otherwise there is permanent bus contention. Note that on RS232 systems, a `mark` (high) is defined as ` negative voltage and a space (low) is defined as a positive voltage. This means that a RS232 character will appear as the **RS485 `A` line** shown previously, except it will transition from <-3V to >+3V as opposed to 0V & 5V.

Message Structure

All messages are transmitted in a defined message format. The formats are as follows:

Paradise / FDC

The same format is used for message from Master to Slaves, and Slaves to Master. Messages from Master to Slaves carry the address of the destination Slave device; return messages from Slave to Master **ALSO** carry the address of the Slave (ie the source of the message NOT the destination on the return, as all returned message are for the Master device).

idle	STX (02H)	Char Count (06H-FFH)	Address (1-255)	Instruction (0-3FH)	`Body` (1st char)	`Body` (other chars)	`Body` (last char)	Asterisk (if Body)	Checksum	ETX (03H)	idle

STX:	The fixed character 02H
Char Count:	The message length including STX and ETX characters (06H for zero `Body` length)
Address:	Slave address, range 1-255. Zero is reserved for the `Global` address to which all devices respond.
Instruction:	Range 0-3FH. Add 40H (64_{10}) to request a standard `ACK`, add 80H (128_{10}) to request an `extended ACK` to this message.
Body:	From 0 to 248 characters (resulting in a maximum message length of 255 characters).
Asterisk:	An ASCII `*` character if there is a body (ie if the length of the body of the message <>0)
Checksum:	The Modulo 256 sum of all the characters inclusive from the `Address` to the end of the `Body`, up to and including the asterisk.
ETX:	The fixed character 03H

The Paradise / FDC protocol supported by the P4xx series of Modems is a *slightly enhanced* version, which is backwards compatible with the previous version. The enhancement is to add an `extended ACK` message (which the Master *specifically* requests instead of the original `ACK`) that includes the instruction code of the message it is ACKing. This allows multiple messages to be in transit to the same Slave on the M&C bus, with the returned ACK's identifying which messages were received correctly (and more importantly which are unACKed and need resending). This allows multiple messages to be sent without having to wait for each to be ACK'd individually (which is useful in very distributed systems with long message transit times).

Slave devices will respond with the original format ACK when requested originally defined, allowing common code in the slave devices to support both variants.

SA-bus

The SA-bus message structure has a different format for messages from Master to Slaves, and from Slaves to Master.

Master to Slave

The message format is:

idle	STX (02H)	Address (31H-61H)	Instruction (30H-7FH)	`Body` (1st char)	`Body` (other chars)	`Body` (last char)	ETX (03H)	Checksum

STX: The fixed character 02H

Address: Slave Address, range 31H to 6FH (49-111_{10}, ie 63 usable addresses).

Instruction: Range 30H to 7FH. An ACK or NAK is automatically returned if the instruction is received (or there is no response if the message is not received !).

Body: From zero to 128 characters (resulting in a maximum message length of 132 characters).

ETX: The fixed character 03H

Checksum: The Exclusive OR of the chars from the `STX` to `ETX` inclusive.

Slave to Master

The message format is:

idle	ACK / NAK (06H/15H)	Address (31H-61H)	Instruction (30H-7FH)	`Body` (1st char)	`Body` (other chars)	`Body` (last char)	ETX (03H)	Checksum

ACK/NAK: The fixed character 06H or 15H

Address: As Master to Slave

Instruction: Echo of the instruction to the Slave

Body: NAK: One character, an echo of the instruction sent.
ACK: Where no response is expected (ie a `write` message), one character, an echo of the instruction sent. Where a response is called for (ie a `query` message resulting in a `read` response), the body is as defined for that response.

ETX: As Master to Slave

Checksum: As Master to Slave

Message Categories

The remote M&C messages break down into the following categories:

1. Messages to read the configuration & reconfigure the unit
2. Messages to read the fault / operating status / performance of the equipment
3. Messages to read the current test mode & change the test status
4. Messages to request internally calculated values (eg data rates including overhead etc)
5. Messages relating to the remote M&C status
6. Messages relating to queries on the device itself, or option / cards fitted
7. Messages relating to the capabilities of the devices, and remote upgrading.
8. Message to perform an action (eg buffer centre)
9. Messages to change Tx power / carrier in an abbreviated form
10. Messages to read the traffic log
11. Administrative messages

The following table summarises all messages, including the message categories listed above. A detailed list of the content of each message is available on request from Paradise Datacom.

List of All Remote M&C Messages

Cat'	Message Mnemonic	First Avail'	Direction	Instr' Code	Body Length	Partner (optional)	Function	
1	RxBBQry	V0.61	to unit	16	1	→ RxBBRd	Query	Configuration of the Rx Baseband section, ie Insert Mux, Deframer, Clocking, Buffer, ESC functions, Descramblers, Station clock (current config or config memories)
1	RxBBRd	V0.61	from unit		70	RxBBQry	Config	
1	RxBBWr	V0.61	to unit	17	70	→ (ack)	Change	
1	RxModQry	V0.61	to unit	20	1	→RxModRd	Query	Configuration of the Rx demodulator functions, ie modulation, IF frequency, Reed Solomon parameters, FEC coding & FEC rate, Spectrum inversion, Sweep width (current config or config memories).
1	RxModRd	V0.61	from unit		14	RdModQry	Config	
1	RxModWr	V0.61	to unit	21	14	→ (ack)	Change	
1	TxBBQry	V0.61	to unit	18	1	→ TxBBRd	Query	Configuration of the Tx Baseband section, ie Drop Mux, Framer, Clocking, ESC functions, Scramblers (current config or config memories).
1	TxBBRd	V0.61	from unit		58	TxBBQry	Config	
1	TxBBWr	V0.61	to unit	19	58	→ (ack)	Change	
1	TxModQry	V0.61	to unit	22	1	→ TxModRd	Query	Configuration of the Tx modulator functions, ie modulation, IF frequency, Reed Solomon parameters, FEC coding & FEC rate, Spectrum inversion (current config or config memories).
1	TxModRd	V0.61	from unit		14	RdModQry	Config	
1	TxModWr	V0.61	to unit	23	14	→ (ack)	Change	
1	UnitCfgQry	V0.61	to unit	24	1	→ UnitCfgRd	Query	The parameters which affect both Tx & Rx paths, including user alarm thresholds, and all `user settings` etc (current config or config memories).
1	UnitCfgRd	V0.61	from unit		26	UnitCfgQry	Config	
1	UnitCfgWr	V0.61	to unit	25	26	→ (ack)	Change	
1	AUPCQry	V2.09*	to unit	44	1	→ AUPCRd	Query	Settings related to Auto Uplink Power Control (AUPC), contains parameters for both Tx and Rx paths, including performance figures for the distant end of the link.
1	AUPCRd	V2.09*	from unit		16	AUPCQry	Config	
1	AUPCWr	V2.09*	to unit	45	16	→ (ack)	Change	
2	TestResQry	V1.37*	to unit	38	0	→ TestResRd	Query	Test results from the internal PRBS tester

Cat'	Message Mnemonic	First Avail'	Direction	Instr' Code	Body Length	Partner (optional)	Function	
2	TestResRd	V1.37*	from unit		12	TestResQry	Status	
2	UnitResQry	V0.61	to unit	39	0	→ UnitResRd	Query	The results of internal BER measurments & the source for those when the source is variable.
2	UnitResRd	V0.61	from unit		22	UnitResQry	Status	
2	UnitStatQry	V0.61	to unit	42	0	→ UnitStatRd	Query	The alarm status of the unit. Separate Unit, Tx traffic, & Rx traffic faults & warnings, as well as Errors, Warnings or Info relating to the (pending) configuration.
2	UnitStatRd	V0.61	from unit		46	UnitStatQry	Status	
2	QFaultQry	V0.61	to unit	1	0	→ QFaultRd	Query	Summary status in one bit per subject format
2	QFaultRd	V0.61	from unit		4	QFaultQry	Status	
3	UnitTestQry	V0.61	to unit	40	0	→ UnitTestRd	Query	The test configuration of the unit, loopbacks, PRBS tester configuration, test functions (CW, alt 1,0, RS decoder disable)
3	UnitTestRd	V0.61	from unit		3	UnitTestQry	Status	
3	UnitTestWr	V0.61	to unit	41	3	→ (ack)	Change	
4	RxCalcQry	V1.49*	to unit	28	0	→ RxCalcRd	Query	Calculated Rx parameters, eg intermediate data rates (ie with each overhead as added), Min overhead frame lengths, ESC rates available (current config only)
4	RxCalcRd	V1.49*	from unit		26	RxCalcQry	Config	
4	TxCalcQry	V1.49*	to unit	29	0	→ TxCalcRd	Query	Calculated Tx parameters eg intermediate data rates (ie with each overhead as added), Min overhead frame lengths, ESC rates available (current config only).
4	TxCalcRd	V1.49*	from unit		30	TxCalcQry	Config	
5	GoLocal	V1.37	to unit	8	0	(ack)	Command	
5	ContModeQry	V1.37	to Unit	32	0	→ ContModeRd	Query	Local / remote config parameters
5	ContModeRd	V1.37	from unit		2	ContModeQry	Config	
5	ContModeWr	V1.37	to unit	33	2	→ (ack)	Change	
6	ShortDeviceQry	V1.49	to unit	0	0	→ ShortDeviceRd	Query	The device model number & software version (two most significant digits only)
6	ShortDeviceRd	V1.37	from unit		6	ShortDeviceQry	Status	
6	UnitInfoQry	V0.61	to unit	37	0	→ UnitInfoRd	Query	The model number, version numbers & ID's of the internal cards & software
6	UnitInfoRd	V0.61	from unit		18	UnitInfoQry	Status	

Cat'	Message Mnemonic	First Avail'	Direction	Instr' Code	Body Length	Partner (optional)	Function	
7	SAFChgWr	V1.76*	to unit	51	14	→ (ack)	Change	Enter an unpgrade code, there is no direct corresponding read other than SAFStat
7	SAFStatQry	V1.49*	to unit	50	0	→ SAFStatRd	Query	Query the hardware & software feature capability
7	SAFStatRd	V1.49*	from unit		58	SAFStatQQry	Config	
8	ActionWr	V1.18	to unit	43	4	→ (ack)	Action	Front panel `actions`, eg buffer centre, clear slip counters, etc.
9	TxPwrQry	V0.61	to unit	26	0	→ TxPwrRd	Query	Short message for Tx power or carrier on/off without rest of Txmod. To allow changes to Tx power without risk of anything else being reconfigured & hence traffic disturbed (current config only).
9	TxPwrRd	V0.61	from unit		2	TxPwrQry	Config	
9	TxPwrWr	V0.61	to unit	27	2	→ (ack)	Change	
10	Log16EventQry	V0.71*	to unit	34	1	→ Log16EventRd	Query log	To read the traffic log.
10	Log16EventRd	V0.71*	from unit		178	Log16EventQry	Log events	
10	Log4EventQry	V0.71	to unit	35	1	→ Log4EventRd	Query log	
10	Log4EventRd	V0.71	from unit		46	Log4EventQry	Log events	
10	LogDoneMsgWr	V0.71	to unit	36	2	→ (ack)	End log query	
11	RemoteKbdWr	TBD	to unit	9	6	→ RemoteLCDRd	Keyboard	Remote operation of unit as if from keyboard. Initial RemoteKbdWr message with either all no key presses or single `Main` keypress initiates first RemoteLCDRd.
11	RemoteLCDRd	TBD	from unit		110	RemoteKbdWr	Display	
11	Reset	V0.61	to unit	4	0	(ack)	Command	
11	TimeDateQry	V0.88	to unit	10	0	→ TimeDateRd	Query	The time & date of the internal real time clock. The timeDateWr will probably be used in broadcast mode (address 0), and the TimeDateRd probably used on status screens to display the current unit time to compare log entries to etc.
11	TimeDateRd	V0.88	from unit		6	TimeDateQry	Status	
11	TimeDateWr	V0.88	to unit	11	6	(ack)	Change	
11	CommsPing	V1.37	to unit	63	0	→ (ack)	Query	Used to test comms integrity, and general acknowledge for many commands which do not directly request a response
11	Ack (original)	V0.61	from unit		0	General Ack to many messages	Acknowledge	
11	Ack (extended)	V0.61	from unit		1			

Note: Instruction codes used for SA-bus messages are as specified above + 30H. SA-bus instructions 70-7F are not used

*** Note on `First Available` column**

Items marked have been available since the version specified, but only in specific builds, there are different builds of the code as follows:

Build Name	Filename	Marked message available?	Comments
P440 build	P440Vxxx	**No**	Build applicable only to Q460 board (ID_Dig=0) with Xilinx IFU (ID_IFU=0) and 4M code storage (Boot_Code will be V1.x for 4M)
P460 build	P460Vxxx	**No**	Build applicable only to Q460 board (ID_Dig=0) with ASIC IFU (ID_IFU=1 or 2) and 4M code storage (Boot_Code will be V1.x for 4M)
P480 build	P480Vxxx	**Yes**	Build applicable to all Q480 boards (ID_Dig=1, all of which have 8M code storage) with any IFU, **OR** a Q460 board (ID_Dig=0) modified to have 8M code storage (Boot_Code will be V2.x for 8M) fitted with any IFU
P300 build	P300vxxx	**Yes**	Build applicable to all P300's

APPENDIX E: CUSTOMER SPECIFIC FEATURES

This appendix lists the customer specific options available on the P300 Series Modems:
Refer to the Change, User-Opt, Operation menu, section 6.10.7 on page 109 for explanations of how to use these parameters:

RELAY MODE SETTING

0 Default (normal) relay operation.

1 **Cable & Wireless (Alarms Summarise)**

This feature remaps the external alarm relays to summarise the Traffic & Unit faults. Normally these are separated as Traffic faults relate to faults external to the equipment (Prompt Traffic) and Unit faults relate to faults within the equipment itself (Prompt Unit Fault). When this option is selected the three fault relays map as follows:

Prompt Unit Fault:	Any unit fault or Tx traffic fault (ie Tx summary alarm)
Prompt Traffic Fault:	Any unit fault or Rx traffic fault (ie Rx summary alarm)
Deferred Fault:	Function unchanged from normal

2 **Tx Carrier On/Off indication (Software >=V2.12)**

This feature provides a form C relay contact to indicate the Tx carrier On/Off state. It may be used to indicate which one of a 1:1 pair is on-line and which off-line. When active the "Deferred Alarm" output becomes instead a Tx carrier On/Off indication, mimicking the operation of the Standby LED on the front panel. `Carrier On` corresponds to the no alarm condition, and `Carrier Off` corresponds to the alarm condition. When used to indicate which one of a 1:1 pair is on-line, should both Tx carriers mute (eg an external inhibit applied to both modems in a 1:1 pair) then the deferred relays of both units would indicate the off condition.

3 **P300 Clock mode selection (P300i/P310i modem/router only, Software >=3.41)**

Normally the P300i/P310i data input is internally coupled directly to the output of the internal Linux router. In this mode the Tx & Rx clocking modes for the modem are fixed (as the Ethernet port or the router has no concept of clock direction). However under certain circumstances the internal link from modem to router is broken and routed through a new rear connector (eg to insert a Crypto). In such modes it is again useful to have manual selection of the clocking modes for the modem, and activating Relay Mode 3, re-instates the clock mode questions on the modem front panel dialogue.

4 **L-Band 1:1 Switching - DC & References. (P310 L-Band modem only, Software >=3.62)**

In a 1:1 L-Band system, if the modems are configured to supply DC and/or the 10MHz reference `up the coax` to a BUC or LNB, then when a 1:1 changeover occurs, the modem which becomes the standby switches off the DC & Reference feeds and these are now supplied by the new On-Line modem (which switches them on). This is the ***NORMAL*** state, ***without*** this relay mode active. This assumes the L-Band feeds are split/combined through an L-Band splitter/combiner which passes the DC and reference out of the common port from either split port.

When this **relay mode is active**, the modems **DO NOT SWITCH OFF** the DC & Reference when in standby, to accommodate 1:1 systems where each modem is coupled to one of a redundant pair of BUC's or LNB's. This means that both BUC/LNB's continue working whichever modem is on-line (however the standby modem does of course inhibit the Tx carrier). Obviously if a splitter / combiner as described above is used with this Relay Mode active, then the two slightly different frequency 10MHz references will beat together, and cause the common BUC/LNB to fail.

5-15 Undefined at present

FAULT MODE SETTING

0 Default (normal) fault detection

1 **ISDN Backup (<V2.14) / ISDN backup AND OQPSK Compatibility (>=V2.14)**

Software <V2.14: Exactly as defined for Fault Mode 13 (but available in earlier versions).

Software >=V2.14: A combination of Fault Mode 13 (ISDN backup) AND Fault Mode 12 (OQPSK Compatibility).

2 **Telenor (Receive fail Transmit Inhibit, RTI)**

This additional feature allows the guaranteed shutdown of transmission from a remote unmanned site even in the event that all M&C is lost. When enabled this remote shutdown is accomplished by muting the signal *to* the remote destination, which will then mute its transmit carrier whenever the `receive input signal is lost` for more than 10 seconds continuously. Specifically:

The definition of `receive input signal is lost` includes demod unlocked, FEC sync lost, RS sync lost, frame sync lost (if applicable), and Multiframe sync lost (if applicable).

The remote transmit will unmute when all the above alarms have been clear for 5 seconds.

3 **Max Sequential decoder gain**

In normal operation at data rates of 128kbps and below, to reduce the delay through the sequential decoder (if selected as the FEC in operation), the decoder processing memory is shortened at the cost of slightly reduced decoder gain. This option *disables* the shortening of the memory, and leaves the maximum memory in circuit maximising the Sequential decoder gain (at the cost of increased processing delay). In the normal mode (when this function is not active) the decoder memory is 4096 bits, but at receive rates of 128kbps and below this is reduced to 2048 bits, 64kbps and below 1024 bits, and 32kbps and below 512bits. This means the maximum delay is 32ms at 128.001kbps, and stays between 32ms and 16ms right down to 16kbps, (below which, with the minimum 512bits of processing memory the delay increases again above 32ms). The data rate used to determine the processing memory size is the receive rate ***including*** any framing and Reed-Solomon overheads (as this is the output rate of the sequential decoder). See the separate note in section 8.4 on page 146 regarding minimising the Reed-Solomon delay.

4 **Slow Sweep / Poor Eb/No Acquisition**

Satellite modems are one large compromise, and part of this compromise is a trade off between poor Eb/No acquisition performance and normal Eb/No acquisition speed. The modem is optimised for reasonably fast acquisition down to an Eb/No of 5dB, and the sweep speed is set to match goal. This option reduces the sweep speed (and hence increases the acquisition time) by a factor of ten, but improves the low Eb/No acquisition by approx 0.5dB. It is advisable when using this setting to narrow the Rx sweep width (if you know the frequency of the Rx carrier to be fairly accurate) to help speed up the acquisition while sweeping at this very slow rate.

5 **Post Reed-Solomon V35 Scrambling**

Not available on the P300.

6 **Fast Eb/No monitoring**

The raw Eb/No information the M&C reads varies significantly and so the Eb/No displayed by the equipment is a heavily averaged to provide a steady result to display. In some circumstances it is desirable to have a faster display of Eb/No (eg to track short duration interruptions such as a helicopter crossing the beam), and this option disables the Eb/No averaging providing a faster responding, but rather jittery Eb/No display.

7 **Severely Degraded Phase noise mode**

In response to a customer request, to provide operation with a severely degraded receive phase noise in QPSK, this mode can be enabled. It allows operation with up to **20dB worse phase noise** than the INTELSAT mask (DC - 1kHz), although at the cost of a degraded BER in normal operating conditions (BER is degraded by up to 1dB compared to `Normal` mode).

8 **Disable the Upper Temperature Limit**

The specified upper internal temperature limit of the modem is 60C. Within three degrees of this the unit will raise a Unit Warning (& deferred alarm relay) ‘’Warning: Int' temp 57C, Tx CARRIER WILL MUTE outside operating range 0-60C’’. Above an internal temperature of 60C the carrier mutes and a Unit Fault is raised (& Prompt Unit alarm relay), ’’Unit Fault: Tx carrier muted, unit temp 61C outside operating range 0-60C’’. Setting Fault Mode to 8 disables both the carrier muting and the Unit Fault / Prompt alarm above 60C, however the warning/deferred alarm above 57C is still activated. **Modem operation outside the specified internal temperature range is not guaranteed, and so this option should not be used on satellite.**

9 **Internal Test Mode** (Disable Differential Encoder and Decoder)

10 **Extended 1 for 1 for Antenna Diversity, Initially On Ships (Software >=V2.05)**

The normal 1 for 1 redundancy system will cope well with each modem in the 1 for 1 pair being connected to a different antenna (eg at opposite ends of a ship on stabilised platforms). The modems will automatically switch traffic to whichever one remains operational. Should one of the antennas loose its line of sight to the satellite it will cause the on-line modem receive to fail and the modems 1 for 1 partner to come on line, conveniently also switching the Tx to the other antenna. However one specific customer wished to integrate a `block` signal from the Antenna Control Unit (ACU) into the 1 for 1 system, to guarantee the Tx on either antenna would be muted when the corresponding ACU indicated `block` (ie when the antenna movement limits set on the ACU indicated the antenna was starting to point at the ship itself, or more importantly the crew!).

The solution is to link the `block` signal from the antenna directly to the modems external Tx Inhibit signal on pin 7 of the alarms connector (grounded when blocked, also connect a ground on pin 15) **AND to set Fault Mode to 10**. With the connection made but **without the Fault Mode set to 10** the Tx to either antenna ***will*** be muted when the corresponding ACU `block` signal is active. It ***will not*** however immediately switch the traffic over to the other modem in the 1 for 1 pair (ie not switch the traffic to the other antenna, as the external Tx inhibit is not considered a fault by the 1 for 1 logic). Without Fault Mode set to 10 then it would be possible for the ACU to indicate `block`, muting the Tx carrier (because the antenna has just passed the ACU movement limit where the beam is approaching the ship) ***and*** for the Rx carrier to remain OK until the receive signal is fully obstructed by the ship. If this happens there will be a break in transmission from the ship until the receive totally fails, finally causing a Rx fault which will make the modems 1 for 1 partner take over, switching both Tx and Rx to the other antenna.

When Fault Mode is set to 10, the External Tx Inhibit ***is additionally considered*** as a fault by the 1 for 1 logic (although it has no effect on the normal LCD display of modem faults). Now, apart from the ACU `block` signal immediately muting the Tx carrier, the 1 for 1 modem pair will also change over to the standby modem causing the traffic to be immediately routed to the other antenna (provided the standby modem has no faults and the ACU of the other antenna is not itself indicating `block` causing the standby modem External Tx Inhibit to be active). Only when the ACU indicates `not blocked` can the traffic switch back to the first antenna. Should both ACU's indicate `block` *then Tx from both antenna will be muted*, with the last one to indicate `not blocked` remaining on-line (as far as the 1 for 1 is concerned) providing receive data. Full traffic will switch back to the first modem, which has no faults, ie where the modem has a good receive

signal and the ACU indicates `not blocked`. When both ACU's indicate `not blocked` (ie most of the time) the normal modem 1 for 1 redundancy operates.

This might take a few reads to fully understand, but it is an elegant solution to the problem requiring nothing other than a data `Y` cable, a standard 1 for 1 cable and a two wire link (ground & `blocked`) from each ACU to the corresponding modem!

A word of advice on installation. DO NOT put the modems at opposite end of the ship and run the 1 for 1 and data `Y` cables along the entire ships length. Instead co-locate the modems, keep the 1 for 1 cable and data `Y` cable short, and run the modem IF along the length of the ship. If the ACU's are located at the ends of the ship with the antennas, use coax cable to connect the `blocked` signal from the ACU to the modem along the ships length (screen=ground, centre=`block`).

11 **Comstream Sequential Mode (Software >=V2.12)**

This switches the Sequential encoder and decoder to be "Comstream compatible" at Rate 3/4 (in Rate 1/2 it is already compatible and this flag has no effect, plus there is no Rate 7/8 on the CM701). Note that when interworking with Comstream equipment with **Viterbi FEC**: BPSK requires P300 Tx & Rx spectrum invert, QPSK is OK without. With **Sequential FEC**: BPSK requires P300 Rx spectrum invert and both Tx & Rx spectrum invert in QPSK.

12 **OQPSK Compatibility Mode (Software >=V2.12)**

Refer to the OQPSK Primer on page 69 before reading this section.

When using Offset QPSK (OQPSK) modulation, the in phase and quadrature components of each symbol do not change together (as with QPSK), but instead *one component* is delayed by half a symbol compared to the other. In order to be in accordance with general industry practises Paradise Datacom has changed which of the two components is delayed with respect to the other between the earliest of the P400 series modems and ongoing P400/P300 production. If you experience difficulty interworking in OQPSK mode between equipments, switch on this mode at the transmit end of the link which fails.

13 **Inmarsat (ISDN Backup) (Software >=V2.14)**

This additional feature allows an external equipment to provide an ISDN backup of the satellite circuit should the link fail, or degrade beyond user set Eb/No or BER parameters. The ISDN backup being initiated from one end of the link only (in response to a failure in either direction) by the Receiver Ready line of the interface card being dropped. Exact additions are:

A backward alarm is transmitted if the user Rx BER or Rx Eb/No pass the user set thresholds (normally these only activate the deferred alarm). This signals the remote end that the circuit has degraded beyond the *user thresholds* (although it is already mandatory to send a backward alarm in IBS/SMS when the user BER degrades below the fixed threshold of 1×10^{-3}).

When the user Rx BER or Rx Eb/No pass the user set thresholds OR a backward alarm is received, the interface card *Sig' Valid Out* line is deactivated (normally this line deactivates only in response to a prompt Rx alarm, eg carrier loss). This line can be used with certain ISDN equipment to initiate an ISDN call.

14-15 Used for internal Paradise testing of enhanced modes we are evaluating. Not suggested for customer selection.

UNCOMMITTED DAC OUTPUT CONTROL

The output controlled by this selection in only available of the Monitor/AGC option is fitted. Refer to the Change, User-Opt, AGC Output menu, section 6.10.10 on page 109 for an explanation of this parameter. This output is updated 10 times per second.

Note: For antenna pointing AGC whilst demod unlocked, see definition of pin 8 on alarms and AGC connector.

0 **Coarse AGC voltage (Rx Signal level)**, default

Scaled at 1V per 10dB, with extremes of 0V=-100dBm and 10V=0dBm and a 1.0dB resolution. This signal is forced to 0V when the demod is unlocked. Note that although the scaling extends from 0 to -100dBm, the actual output range is limited to the range measurable by the software, which is -21dBm to -83dBm (except for when it is forced to 0V if the demod is unlocked).

Note the absolute accuracy of this measured parameter and the unit-to-unit repeatability is relatively poor (±4dB), but on any one unit it will be consistent and so show trends accurately.

1 **Rx Eb/No Level**

Scaled at 1V per 2dB, with extremes of 0V=0dB and 10V=+20dB and a 0.1dB resolution. This signal is forced to 0V when the demod is unlocked. Note that although the scaling extends from 0 to 20dB, the actual output range is limited to the range measurable by the software, which is approx from a lower limit of 3.0dB (demod unlock threshold) to an upper limit of 13-19dB (dependent on Modulation scheme, FEC Rate & Data Rate). To Determine the upper limit at any mix of modulation, FEC, and data rate simply set the modem in IF loopback.

2 **Rx IF Offset Frequency**

Scaled at 1V per 10KHz, with extremes of 0V=-50KHz and 10V=+50KHz and a 25Hz resolution. This signal sweeps when the demod is unlocked. The default demod sweep is ±25KHz, with a maximum of ±32KHz.

3 **Fine AGC voltage (Rx Signal level)**

In response to customer requests for a finer resolution signal level indicator. Scaled at 3.33V per 10dB, with extremes of 0V=--60dBm and 10V=-30dBm and a 0.1dB resolution. This signal is forced to 0V when the demod is unlocked.

4 **Distant end Eb/No (Software versions >=2.12)**

Valid only when the AUPC feature is active, this provides an output of the *distant* end Eb/No. Scaling is as for option 1 (Local Rx Eb/No).

5 **AUPC Delta Power (Software versions >=2.12)**

Valid only when the AUPC feature is active, this provides an output of the local power adjustments in made in order to maintain the distant Eb/No. Scaling is 0V=-25dB, 10V=+25dB, with 0.1dB resolution. Practically it limits to between the upper and lower AUPC delta limits set by the operator (ie although scaled to ±25dB, it may practically vary only to +3 -1dB if those are the upper and lower AUPC delta limits set).

6-15 Undefined at present

APPENDIX F: FRAMING AND DROP/INSERT OVERVIEW

IBS/SMS FRAMING

IBS/SMS Service Features

The INTELSAT definition of IBS framing (IESS 309) is intentionally very similar to Eutelsats SMS framing (EESS 501 "SMS QPSK/FDMA System Specification"), as they are both designed to allow common equipment to provide for both services. From here on we will refer to IBS framing, but the text applies equally to SMS framing

Standard Features (specified in IBS/SMS definitions)

The addition of standard IBS framing increases the data rate by exactly 1/15th (approx 6.7%). IBS framing is added to provide the following extra features compared to `closed network` links:

- A **Synchronous Scrambler**, which replaces the self-synchronising (V.35) scrambler used in most closed network links. The closed network V.35 scrambler outputs 3 errors for every error received and so increases the error rate by a factor of 3. The IBS/SMS synchronous scrambler does not multiply errors, and so give a factor of three BER performance increase over the V.35 scrambler.
- A **Backward Alarm** facility, which raises a local deferred alarm if the distant end modem cannot receive data, transmitted from this station (ie a possible Tx problem this end).
- A ***Low Rate* Oversampled async ESC Channel** (1/2000th the data rate), this is available on the Aux port of the modem. This results in async rates of <50 Baud at 64kbps and 110 Baud at >256kbps.
- A **TS32 Multiframe Sequence** to allow the transmission of satellite encryption control vectors, and three 8 bit carrier ID's (referred to as Station, Channel, and Spare ID).
- Overhead channels to convey **Channel Associated Signalling** (CAS) corresponding to an extra 2kbps per 64kbps transmitted by use of a separate CAS Multiframe sequence (in TS16/48).
- **Timeslot ID Maintenance**: which is the facility to maintain the identity of individual data streams when multiplexed together into one aggregate rate carrier (eg two independent 64kbps circuits in one 128kbps carrier).

Additional Features (Paradise products)

In addition to the basic INTELSAT definition above, the P300 Modems provide the following additional features in IBS/SMS mode:

- A **high rate ESC channel** carried in spare parts of the overhead. This allows up to 68% (22/32nd) of the overhead to be used for ESC providing a **2400 Baud ESC with a 64kbps carrier**, and proportionally higher ESC rates with higher data rate carriers.
- In addition to the INTELSAT low rate oversampled async ESC Channel (on the shared ESC/Aux port), The P300 when fitted with the IDR option (standard on P300-IDR and above) also provides a clock so the port may be used as a **synchronous Aux channel**. In addition the overhead usage can be varied from the one bit per frame (TS32 bit 1) defined by INTELSAT, up to 21 bits per frame, providing a synchronous Aux channel at up to 4.3% of the main data rate. This may be used for example with external or internal BER testers to provide a continuous measurement of the live BER.

IBS/SMS Definition

Frame Format

IBS framing is a derivative of the framing used on 2048kbps PCM bearers within Europe specified in ITU-G.732. G.732 specifies a frame of 32 timeslots (each timeslot is 8 bits of data) and the timeslots are labelled TS0 - TS31. TS0 and TS16 are reserved for special functions, leaving the remaining 30 timeslots available for data, ie 30 data timeslots with 2 overhead timeslots, a ratio of 32/30 or an increase of 1/15th. G.732 uses an awkward definition of having even & odd numbered frames with TS0 having different functions in even & odd frames. Thankfully the IBS specification parted from the G.732 definition at this point and instead of having even & odd frames of 32 timeslots, it defined one longer

frame equivalent to an even then an odd G.732 frame. An IBS frame therefore has 64 timeslots, with special functions for TS0, TS16, TS32 (same as G.732 TS0 odd), and TS48 (same as G.732 TS16 odd), which leaves 60 timeslots available for normal data.

An IBS Frame is constructed as follows:

TS0 consists of a spare bit (X), followed by a 7-bit frame alignment word ie [X0011011].

TS16 & TS48 are defined to convey Channel Associated Signalling (CAS, when required), and are normally forced to all ones [11111111] when CAS is not being transmitted. CAS is covered separately later.

TS32 conveys the Low rate ESC (E), the Backward Alarm (B), and the TS32 Multiframe sequence (M). If IBS satellite link encryption is in use (very, very rare) then it also conveys the encryption control vectors otherwise these bits are spare (X as shown). One bit is also forced to a logic 1 for frame alignment, resulting in a content of [E1BMXXXX]

A standard IBS frame then is 64 x 8 (ie 512) bits long.

TS32 Multiframe

A 64 bit multiframe pattern is placed one bit at a time into the `M` bit of TS32.When the 64 bits have been sent (one bit at a time over 64 frames) the sequence restarts indicating the end of one multiframe and the beginning of the next. The 64 bit TS32 multiframe sequence also contains 3 eight bit user fields nominated names of Station ID, Channel ID & Spare ID. The TS32 multiframe then is 64 x 512 (ie 32768) bits long.

Synchronous IBS Scrambler

The synchronous IBS scrambler is restarted at the beginning of every multiframe. Note this is not every frame, as it requires a reasonable length of the scrambling pattern to be used to ensure the final data appears random. The scrambling pattern itself is 2^{15}-1 (32767) bits long and runs throughout the frame. Scrambling is however disabled for TS0 & TS32 (otherwise the distant end could never find the frame sync, then TS32 multiframe sync, in order to find out where the scrambler starts!).

Backward Alarm

The backward alarm is a single bit of TS32 which is connected to a summary `Rx Fail` signal from the demodulator / deframer. If at either end of the link the Rx path fails for any reason, then this backward alarm bit of TS32 is raised on the outgoing Tx signal, indicating to the distant end that there is an Rx failure this end. This could be caused by any manner of Rx fault (LNA, downconverter, demod) at this end, but it is a warning that the fault might equally exist at the Tx end (modulator, upconverter, HPA etc). The backward alarm is normally a `deferred alarm`, meaning it should be checked but it is not necessarily a failure of the traffic path at this end.

Low Rate ESC Channel

The low rate ESC channel is a *very* low rate. One bit of TS32 is allocated to carry the ESC information, and so the rate is one bit per frame (ie 1/64x8), one 512th the framed data rate or 1/480th the unframed rate. For example at 64kbps the ESC channel is a ***synchronous rate*** of 133bps. However, INTELSAT did not define a synchronous interface to the channel, only an oversampled asynchronous interface (ie a data line without a clock line). This means that the Baud rate of the async channel must be one third to one quarter of the synchronous rate to ensure each Baud period of the async word is sampled 3 or 4 times (necessary otherwise the reconstructed async character cannot be read at the far end). This is a very poor use of the bandwidth, but the definition was made to allow the facility to be added to then current equipment with minimal hardware implications. The INTELSAT defined limit is 1/2000th of the data rate, but in practice this can be pushed to about 1/1500th of the data rate (not quite enough to get a reliable 50 Baud with a 64kbps carrier!).

Timeslot ID Maintenance

Timeslot identity maintenance is the facility to maintain the identity of individual data streams when multiplexed together into one aggregate rate carrier (eg in its simplest form two independent 64kbps circuits in one 128kbps carrier). Typically such individual data streams comprise of 64kbps data channels from `N` timeslots of terrestrial PCM bearers, interfaced to the IBS/SMS framing via the Drop/Insert multiplexer.

Operating over satellite ***without*** TS ID maintenance is comparable to using an external Drop/Insert mux interfaced in our 2 x 64kbps example to the modem at 128kbps. Once demultiplexed to 128kbps the start and end boundaries of each timeslot are lost in the continuous 128kbps data stream. Without the TS ID maintenance there would be 16 different ways (2 x 8 bits per TS) that the two data streams could be inserted back into the terrestrial PCM bearer timeslots at the receive end. One correct way, one with channels reversed (8 bits shifted), and 14 ways (shifts of 1-7, 8-15 bits) in which parts of each channel appeared in the channel. **Without TS ID maintenance then, Drop/Insert can only useful if all the data dropped / inserted comprises one single data stream of N x 64kbps from a single source.**

Note: Typically D/I is tested with a PRBS from a Firebird in all relevant timeslots, this is a guaranteed way to **NOT TEST** TS ID Maintenance, as it is not required for such a test (because all the data comprises one single data stream from a single source, the PRBS generator). Instead to verify TS ID maintenance insert the PRBS into any *subset* of the dropped timeslots (eg just one). If the Timeslot ID is **not maintained**, you are likely to get something else back in the equivalent receive timeslot instead of the PRBS (probably the idle code from one of the other dropped timeslots). If the Timeslot ID **is maintained**, you should *consistently* get the PRBS back in this *same* subset or single timeslot. Bear in mind that without TS ID maintenance, when dropping N timeslots, statistically it will still work one time in 8xN, when the random timeslot alignment happens to be correct!

Implementation of Timeslot ID Maintenance

The requirement is to provide:

1) Timeslot boundary maintenance (start/end of each timeslots 8 bits) within the data stream.
2) Timeslot identity (ID) maintenance, ie which 8 bits relate to which timeslot (first, second, third etc) within the data stream.

The data from each timeslot appears as a set of 8 bits from each terrestrial frame. *Timeslot boundary maintenance* is provided by placing the data into the IBS frame, timeslot aligned after TS0. When TS0 is located, the next 8 bits represent 8 bits from one terrestrial timeslot, the following 8 from the next etc.

Timeslot Identity Maintenance again relies on relative position to TS0. Data from the first timeslot of the group of timeslots is always placed in the first timeslot after TS0, the second of the group in the second TS, and so forth. Once the 8 bits of data from every timeslot have been placed in the frame, the process repeats until the frame is full. For the *following* frame to be similarly formatted the timeslot data must fit into the 60 available data timeslots of the satellite frame exactly (so that the next data is from the first TS again). This brings in a complication.....

Each IBS frame has 60 timeslots available for data, and so in order to provide timeslot ID maintenance, the number of timeslots `N` must fit into 60. This limits the values of N to:

1 Frame (ie 60 available data timeslots): N = **1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30**

This is less than ideal, and so a few further values are accommodated by mapping them into two frames:

2 Frames (ie 120 available data timeslots): N = **8, 24**

Finally, to support one further rate, four frame are used:

4 Frames (ie 240 available data timeslots): N = **16**

The remaining values of N cannot have Timeslot ID Maintained by groups of 1, 2, or 4 frames, these are collectively know as the `Odd values of N`:

`Odd values of N`: N = **7, 9, 11, 13, 14, 17, 18, 19, 21, 22, 23, 25, 26, 27, 28, 29, 31**

Most previous equipment could not provide timeslot ID maintenance for these `odd values of N`, however the P300 when equipped with the Extended D/I feature uses a derivative of the IBS CAS Multiframe (see later section "CAS Multiframe") to provide timeslot ID maintenance for even these remaining values of N.

Signalling Systems Introduction: CCS, CAS & RBS
Signalling systems are used to convey call status on PCM systems, call status is information such as Busy, Idle, Ring tone, Dialling etc.

Common Channel Signalling (CCS)
Some PCM systems us a`Common Channel Signalling` (CCS), where a whole timeslot is allocated to carry the signalling function between the ends of the link (with protocols such as `Signalling system No 7` etc running within that 64kbps channel). Common Channel Signalling is used on both 1544kbps (T1) and 2048kbps (E1) systems, although different signalling systems run on the common channel (of course!)

Channel Associated Signalling
Some E1 PCM systems use Channel Associated Signalling (CAS), where a low rate data signalling channel is provided uniquely for each timeslot. ITU-G.704 defines these signalling channels as comprising of four bits (named `abcd`), which are sent every 16th frame, resulting in a channel of 2kbps. There is an individual 2kbps signalling channel for each of the 30 PCM channels (timeslots 1-15 and 16-31) and these are carried sequentially in pairs in TS16 (there is no signalling channel for TS0 nor TS16, as TS0 is reserved for the Frame Alignment Word, and TS16 carries the signalling for the other timeslots).

Robbed Bit Signalling (RBS)
Robbed bit signalling is a technique used on T1 PCM bearers whereby signalling is conveyed by stealing the signalling bandwidth from the 64kbps timeslot to which it relates. Once every 6 frames one bit (the least significant bit) of the 8 bits per timeslot is `stolen` and used to convey signalling. In T1-D4 (which has a 12 frame terrestrial multiframe) this gives two signalling bits `ab`, and in T1-ESF (which has a 24 frame terrestrial multiframe) this gives four signalling bits `abcd`. The frames in which the bit is robbed are synchronised to the terrestrial multiframe as follows: T1-D4: 6th & 12th, T1-ESF 6th, 12th, 18th, 24th.

Stealing the LSB every sixth frame was acceptable when PCM signals conveyed primarily PCM audio as it made a negligible difference to the audio quality. However when the PCM network was later used to convey data not just PCM encoded voice, only 56kbps of data could be conveyed (using 7 bits per timeslot), as it was difficult to guarantee the signal would not pass through a link using Robbed Bit Signalling where the 8th bit would be overwritten every 6th frame, causing errors on the 64kbps data.

Signalling Over Satellite

Common Channel Signalling (CCS)
With Common Channel Signalling, the whole 64kbps signalling channel (timeslot) must be conveyed from one end of the link to the other and typically this is done on sub primary order satellite circuits (thin routes) by selecting the timeslot carrying the CCS for Drop/Insert as with other data timeslots. Special action is required with CCS, as the equipment at both ends of the link needs to be configured for the ` thin route` over the satellite so it does not dynamically allocate traffic to a timeslot, which is not passed over satellite link!

Channel Associated Signalling
The IBS specification includes an option for equipment to support CAS, and defines a mechanism whereby the CAS (the 2kbps signalling channel per timeslot) can be carried within the 6.7% IBS satellite overhead. This option is fully implemented within the P300 equipped with the Extended D/I feature (standard on P300 TCM), and is further explained in the following section on "CAS Multiframe".

Robbed Bit Signalling (RBS)
Historically PCM bearers using Robbed Bit Signalling could not be used with Drop/Insert, as over standard IBS links the location of the signalling information (ie which timeslots have a bit overwritten with signalling) was lost. Even with Timeslot ID Maintenance (which preserved timeslot sequence and timeslot start / end boundaries) RBS was still lost. To preserve RBS not only is TS ID maintenance required, but also the timeslots required placing back into the correct frames within the terrestrial multiframe (so in T1-D4 for example the timeslots containing the RBS are placed in frames 6 & 12 of the terrestrial multiframe).

INTELSAT's IBS definition does not specify a mechanism to achieve this, so the P300 equipped with the Extended D/I feature (standard on P300 TCM) uses an extension of the Timeslot ID Maintenance scheme to provide RBS support with Drop/Insert over `thin route` satellite links. It does this by treating not just the timeslots from one frame as a group of `N` timeslots, but the group from the whole terrestrial multiframe as a block within which timeslot identity has to be maintained. In effect if two timeslots were dropped from T1-D4 and T1-ESF bearers with RBS support enabled, although the aggregate data rate would be only 128kbps plus 6.7% overhead, the frame and multiframe structure would be as to support N=24 and N=48 respectively (N x 12 for D4, and N x 24 for ESF as D4/ESF have 12/24 frames per multiframe, relative to which RBS is placed). As with the support for `Odd values of N`, the CAS Multiframe is again used to provide support for these extended timeslot sets, and hence support the Robbed Bit Signalling.

CAS Multiframe
INTELSAT have defined a satellite CAS Multiframe to allow Channel Associated Signalling to be transferred across the satellite link between E1 PCM bearers within the IBS satellite overhead. The P300 equipped with the Extended D/I feature (standard on P300 TCM) uses the CAS Multiframe definition to support CAS, **and also** to provide Timeslot ID Maintenance for `Odd values of N` (N = 7, 9, 11, 13, etc), which in turn allows the Modem to also support Robbed Bit Signalling (RBS). The CAS multiframe is **entirely independent** of the TS32 Multiframe, which has already been described.

The CAS Multiframe consists of data & frame alignment words in TS16 and TS48 of the IBS frame. A CAS multiframe starts off as a unique word of [00001y11] in TS16, and comprises a further 15 signalling data timeslots in TS48 & TS16 stretching over 8 frames. When carrying CAS, the 15 signalling data timeslots carry pairs of the `abcd` signalling nibbles from the terrestrial TS16. When not carrying CAS but where the CAS Multiframe format is being used for solely for timeslot ID maintenance for `Odd values of N`, these 15 signalling data timeslots are available for the high rate ESC.

Similar to the `fitting` of the main data into the 60 timeslots available for data per IBS frame, the `abcd` signalling information has to be `fitted` into the 30 available nibbles in the 15 signalling data timeslots in TS16 / TS48 following the CAS MF unique word in TS16. There are certain values of `N` for which this will work, ie where 30/N gives an integer. These include N = **1, 2, 3, 5, 6, 10, 15, 30**. In these cases then the CAS multiframe is 8 frames in duration with the first frame containing CAS-MF unique word in TS16 and pairs of `abcd` signalling nibbles in TS48, and the following seven frames contain pairs of `abcd` signalling nibbles in TS16 and TS48.

For values of N which are not supported by an 8 frame CAS multiframe (with room for 30 nibbles of signalling), the multiframe is simply extended in length by multiples of 8 frames until it reaches a value where it can accommodate an integer multiple of the signalling information in one multiframe. Although the multiframe is extended in multiples of 8 frames giving a further 30 locations to carry signalling each 8 frames, the CAS-MF unique word is not repeated but is instead replaced by a [00000000] pack byte in TS16 of every eighth frame after the original CAS-MF unique word. This keeps the same ratio of 30 signalling nibbles every 8 frames, no matter how long the CAS multiframe actually is.

The CAS Multiframe structure is of variable length (in multiples of 8 frames), and this feature lends itself to providing timeslot ID Maintenance for `Odd value of N`, ie values which the fixed length TS32 multiframe cannot accommodate. This is an efficient use of the overhead as when not sending signalling information 15 out of every 16 TS16/TS48 locations are still available for high rate ESC, even when the CAS multiframe is required to support `Odd values of N` or Robbed Bit Signalling.

CAS MULTIFRAME SUMMARY

	TS Identity Maintenance Method & Length of CAS Multiframe (in frames)			
`N`	Any Drop/Insert mode without signalling	G.732 Drop/Insert with CAS	T1-D4 RBS mode	T1-ESF RBS Mode
1	TS 32	CAS = 8	TS 32	TS 32
2	TS 32	CAS = 8	TS 32	TS 32
3	TS 32	CAS = 8	CAS = 24	CAS = 24
4	TS 32	CAS = 16	TS 32	CAS = 8
5	TS 32	CAS = 8	TS 32	TS 32
6	TS 32	CAS = 8	CAS = 24	CAS = 24
7*	CAS = 56	CAS = 56	CAS = 56	CAS = 56
8	TS 32	CAS = 32	CAS = 8	CAS = 16
9*	CAS = 24	CAS = 24	CAS = 72	CAS = 72
10	TS 32	CAS = 8	TS 32	TS 32
11*	CAS = 88	CAS = 88	CAS = 88	CAS = 88
12	TS 32	CAS = 16	CAS = 24	CAS = 24
13*	CAS = 104	CAS = 104	CAS = 104	CAS = 104
14*	CAS = 56	CAS = 56	CAS = 56	CAS = 56
15	TS 32	CAS = 8	CAS = 24	CAS = 24
16	TS 32	CAS = 64	CAS = 16	CAS = 32
17*	CAS = 136	CAS = 136	CAS = 136	CAS = 136
18*	CAS = 24	CAS = 24	CAS = 72	CAS = 72
19*	CAS = 152	CAS = 152	CAS = 152	CAS = 152
20	TS 32	CAS = 16	TS 32	CAS = 8
21*	CAS = 56	CAS = 56	CAS = 168	CAS = 168
22*	CAS = 88	CAS = 88	CAS = 88	CAS = 88
23*	CAS = 184	CAS = 184	CAS = 184	CAS = 184
24	TS 32	CAS = 32	CAS = 24	CAS = 48
25*	CAS = 40	CAS = 40	T1 only provides a maximum of 24 timeslots to Drop/Insert	
26*	CAS = 104	CAS = 104		
27*	CAS = 72	CAS = 72		
28*	CAS = 56	CAS = 112		
29*	CAS = 232	CAS = 232		
30	TS 328	CAS = 8		

31*	CAS = 248	CAS = 248
32+	CAS = 8	CAS = 128

* These are the `Odd values of N` for which the Timeslot ID cannot be maintained by the TS 32 Multiframe.

+ N=32 is a special case normally handled as unframed 2048kbps (ie no Drop/Insert) or 1920/1984kbps (D/I with N=30/31)

IDR FRAMING

IDR Service Features

The INTELSAT definition of IDR framing is in IESS 308. Eutelsat have a similar system defined in EESS 203 "Intermediate Rate Digital Carriers (IDC), Earth Station Standard" which simply cross refers back to the INTELSAT IESS 308 standard for the Channel Unit Characteristics, and so the Modem equipment required for these services is identical. From here on we will refer to IDR framing, but the text applies equally to Eutelsats IDC framing.

Standard Features (specified in IDR definitions)

The addition of standard IDR framing increases the data rate by exactly 96kbps. IDR framing is added to provide the following extra features compared to `closed network` links:

- Two Audio ESC channels, encoded as 32kbps ADPCM. As IDR is intended to replace all FDM links, these Audio ESCs replace the analog audio engineering service circuits of the FDM service.
- An 8kbps digital ESC circuit.
- Four independent backward alarms, to signal to up to four sites receiving a multidestinational carrier, that there is trouble with the link in the other direction.

Additional Features (Paradise products)

- Where many IDR carriers exist between sites, the Audio ESC on the second and subsequent carriers are not required (as the mandatory station to station ESC is met with the first carrier). The P300 equipped with the IDR option (standard on P300-IDR and above) allows 32 or 64kbps access to the bandwidth occupied by these audio channels on the Aux port. Allowing either one or both of the ESC channels to be replaced with either revenue bearing data, or possibly a PRBS for on-line BER measurement (with either the internal or an external BERT).
- A far more useful *asynchronous* interface to the synchronous 8kbps digital ESC circuit, allowing for example M&C information to be conveyed providing the possibility to provide distant end control via the satellite channel.
- The use of 16kbps ADPCM instead of 32kbps, allowing both audio ESC's to be compressed into 32kbps not 64kbps. This allows either:
    - All normal IDR facilities in a 64kbps overhead
    - All normal IDR facilities *plus* a 32kbps Aux channel in the normal 96kbps overhead (which allows an internal or external PRBS test to run in parallel with the traffic to monitor the service quality)
- Reduced IDR facilities with 64kbps or 32kbps overhead.

APPENDIX G: FAULT MESSAGES AND ACTION TABLE

The table on the following pages lists the faults, which can be shown on the modem display, along with a description of what the fault means, and the actions the modem will take if such a fault occurs. It also shows relevant checks the operator might make to try to eliminate the fault condition.

To find a displayed fault in this large table, check only the relevant section depending on the first few words of the displayed message:

For "Unit Fault..."	Check UNIT FAULTS section
For "Warning...."	Check UNIT WARNINGS section
For "Tx Fault...."	Check TX TRAFFIC FAULTS section
For "Tx Warn...."	Check TX TRAFFIC WARNINGS section
For "Rx Fault...."	Check RX TRAFFIC FAULTS section
For "Rx Warn...."	Check RX TRAFFIC WARNINGS section

There are also other screens relating to configuration errors and warnings, and screens, which are displayed simply for user information. Most of these are self-explanatory, however if you find you need help understanding a message not described here, please WRITE DOWN the EXACT TEXT and call us for support.

Finally, many messages, also show "↓READ" or "↓Note" and display further information if the down arrow is pressed, this is usually worth reading!

Text on Display	Description / Cause / Notes
UNIT FAULTS (Top+Bottom lines of display)	**Unit Faults: Status LED=Red, & Unit Fault (prompt) relay**
Software Initialising please wait	Unit executing power up sequence (<5 secs)
Unit Fault: Tx carrier muted, unit temp <nn>C outside operating range 0-60C	This message refers to the internal unit temperature, **Check** the modem vent slots are clear and the rear fan has not failed. This may be disabled, see Fault Mode = 8 in Appendix E
Unit Fault: PSU fault on <line>, now <nnn>%	The failed PSU line is shown together with its current value in % of nominal. The unit has a linear supply and will fail if the mains input is below the specified minimum level. **Check** the mains voltage. **Check** the internal PCB mounted Low Voltage fuses.
Unit Fault: Internal LCA programming error (cycle power supply)	Internal hardware has failed to initialise, disconnect the mains, wait 5 seconds and then connect it again. If the fault persists see note 8.
Unit Fault: Internal fault, consult factory	See note 8
Unit Fault: Tx IF synth failure, Tx carrier muted	The synthesiser, which generates the Tx IF carrier has failed. The unit has muted the Tx IF output to prevent transmitting an incorrect signal. An external 10MHz station reference may be used as the synthesizer reference, so if the station reference is in use **check** it is present and has clean enough phase noise for its intended use.
Unit Fault: Tx carrier generation failure, Tx carrier muted	The power detector on the generated Tx carrier indicates a carrier generation failure. The unit has muted the Tx IF output to prevent transmitting an incorrect signal. See note 8.
Unit Fault: Rx IF synth failure	The synthesiser which generates the LO to receive the Rx carrier has failed. An external 10MHz station reference may be used as the synthesizer reference, so if the station reference is in use **check** it is present and has clean enough phase noise for its intended use.
Unit Fault: Rx PLL internal backup reference has failed	The internal backup reference to the Rx PLL has itself failed. This is only actually *used* when the external reference sources have failed, however it's failure is very significant as the same signal is used in many places within the modem. See note 8.
Unit Fault: Rx PLL Clock generation failure (<source>/int)	The internal backup clock, generated by the Rx PLL has itself failed. This is only actually *used* when the external primary clocks sources have failed, however it's failure is very significant, as it should never fail as it is internally generated. See note 8.
Modem/BUC Fault: FSK Comms with BUC failed (searching BUC address: xx)	The Modem is configured to operate with a Paradise BUC, and FSK communications between the modem and BUC have failed. The modem will sequentially search the available range of BUC addresses in case a replacement BUC set for a different address has been installed
BUC Fault: Outside operating temperature range (now xx)	The Modem is configured to operate with a Paradise BUC. When the Modem reads the BUC temperature by FSK and the BUC is outside it's operating temperature.
BUC Fault: PLL in Block UpConverter lock fail (10M ref' to BUC: On)	The Modem is configured to operate with a Paradise BUCand the PLL generating the SHFcarrier in the BUC has failed. The state of the reference feed to the BUC is also reported.

UNIT WARNINGS (Top+Bottom lines of disp=)	**Unit Warnings: Deferred alarm relay only**
Warning: TX CARRIER IS MUTED as power outage, CARRIER: 1=Restore 2=Mute	The Tx carrier is set to mute after a power fail. The power has failed and returned and the operator is offered the option to restore the Tx carrier status to ON. The Tx carrier is set under Change, Tx, Mod, Carrier
Warning: Int' temp <nn>C, Tx CARRIER WILL MUTE outside operating range 0-60C	This message refers to the internal unit temperature, **Check** the modem vent slots are clear and the rear fan has not failed. This Tx Mute may be disabled, see Fault Mode = 8 in Appendix E
Warning: 10MHz Reference clk in failed, IF & Clocks switched to int' 1PPM ref.	The station clock, set to 10MHz, has been selected as the reference the Tx & Rx synthesisers, but it has failed. **Check** the signal applied to the station clock port.
Unit Warn: Turbo codec DLL fail (<error code>)	This is an internal failure; consult the factory with the error code. Typically though it is caused by poor seating of the Turbo option board on the mating connectors.

TX TRAFFIC FAULTS (Top line of display)	**Tx Traffic Faults: Tx OK LED Off and Tx Traffic (prompt) relay.**
Tx Warn: Reconfiguring Tx path	The modem is reconfiguring the Tx path (after a user parameter change).
Tx Fault: <line> off, terr <DTE/DCE> not ready	<line> depends on the interface in use (eg RS422 DCE="TR", V.35="DTR"). This is a DC control line, which is used to indicate the terrestrial equipment is functioning properly. The <line> switching off may be user set to cause this fault or be ignored (Change, Terr-Int, Control Lines).See note 5.
Tx Fault: <line> off, nothing to send	<line> depends on the interface in use (eg RS422 DCE="RS", V.35="RTS"). This is a handshake line, which is used to indicate the terrestrial equipment has data to send. The <line> switching off may be user set to cause this fault or be ignored (Change, Terr-Int, Control Lines). The Modem can be set to mute the Tx carrier if this line is off (Change, Tx, Mod, Carrier). If carrier is set to mute when this line is off but this line is set to ignore, then there is no alarm when this line mutes the carrier. See note 5
Tx Fault: No clock from interface	The modem is set to use the "Tx Clock In" (Change, Tx, Clocking), but no clock is being provided. The clock generation will use the internal clock as a backup to maintain the carrier and any framing/ESC integrity. **Check** the data connector is attached and for activity on the clock input lines
Tx Fault: Data input is all ones (AIS)	The data supplied to the modem is all ones (AIS). This is normally used to indicate an upstream equipment fault, **it is not a modem fault**. See note 4
Tx Fault: No Incoming Octet Timing	This message is only displayed if a 64kbps G.703 card is fitted. It indicates the card has detected that there is no incoming octet timing on the G.703 signal. The monitoring of this octet timing may be enabled and disabled with Change, Terr-Int, Card Specific.
Tx Fault: Frame sync lost on Tx input	The modem only detects frame sync when the Drop mux is active (or 2048k IBS G.732 0% overhead mode is enabled). **Check** the bearer type is specified correctly (Change, Tx, Baseband, Drop). This normally only occurs if either there are significant errors on the terrestrial link, or if it is supplied with AIS and the modem is set to ignore AIS. **Check** that the AIS detector is not disabled with Change, User-Opt, Operation, Actions, AIS. **ALSO** there is an option to make the modem re-seek frame sync if CRC sync is lost (Change, User-Opt, Operation, Terrestrial, PCM Bearer CRC, CRC/Frame Acq'). **Check** the modem is not set to expect a CRC and forcing frame re-acquisition if CRC is lost, but there is no CRC on the PCM signal.
Tx Fault: TS16 MF sync lost on Tx input	The modem only seeks TS16 Multiframe sync when the Tx baseband is set to use the Drop mux in a G.732 mode and CAS signalling has been selected (or 2048k IBS G.732 0% overhead mode with CAS is enabled). **Check** that a CAS multiframe is present on the PCM signal applied to the modem (ie terrestrial TS16 contains the 16 frame multiframe sequence).
Tx Fault: CRC sync lost on Tx input	The modem only seeks Cyclic Redundancy Code (CRC) sync when the Tx baseband is set to use the Drop mux in G.732 mode (or 2048k IBS G.732 0% overhead mode) and when set by the user to process CRC's (Change, User-Opt, Operation, Terrestrial, PCM Bearer CRC, Process). If CRC sync is permanently lost, **check** if a CRC is present on the PCM signal.
Tx Fault: Dropped data is all ones (AIS)	The specific timeslots dropped by the Drop Mux contain all ones (AIS). This is different to the "Tx Fault: Data input is all ones (AIS)" message described earlier which refers to the whole PCM bearer being AIS. In the case it is only the specific timeslots, which contain AIS. This is normally used to indicate an upstream equipment fault, **it is not a modem fault**. See note 4
Tx Fault: Input BER > 1E-3, [AIS forced]	The Bit Error Rate at the Tx input (measured on the PCM Frame Alignment Words) is worse than $1x10^{-3}$. This can only be due to a very poor error rate on the PCM input signal. "[AIS Forced]" is only shown if the user option of what action to take when the BER is bad is not set to Ignore (Change, User-Opt, Operation, Actions, BER Action). The fault is always displayed, although the actions can be cancelled by selecting Ignore. **Check** the line code setting (AMI/B8ZS/HDB3) matches the input

	signal on any G.703 cards in use (see note 3).
Tx Fault: Clock loop fail, Tx muted	The Tx clock generation loop, which generates the timing over the satellite link has failed and the Tx carrier is muted as a result. If the Tx Clocking (Change, Tx, Clocking) is set to "Tx Clock In", then **check** the Tx Clock frequency matches the data rate (Change, Tx, Baseband, Continuous).
Tx Fault: BUC DC current outside limits	The Modem is configured to operate with a BUC and the operator has activated the BUC current monitor, but the current drawn by the BUC is outside the low/high window set. View the current drawn and alarm settings with *Monitor, BUC*, change with *Change, BUC/LNB, Tx/BUC, Current Monitor*
Tx Fault: BUC current/connection fault	The Modem is configured to operate with a BUC and the modems DC supply to the BUC has been activated, but the DC switch indicates either an open or short circuit.

TX WARNINGS (Top line of display)	**Tx Traffic warnings: Deferred alarm relay only**
Tx Warn: Reconfiguring Tx path	The modem is reconfiguring the Tx path (after a user parameter change).
Tx Warn: Data marginal, clock inv ?	The phase of the input Clock and Data is checked to ensure the data is stable when it is actually latched into the modem. This message means that the data is changing at this critical time, and it WILL CAUSE DATA ERRORS. **Check** the A & B clock lines are not reversed. (Data A & B should be stable on the rising edge of Clock B, the falling edge of Clock A)
Tx Warn: Line code violations det…	G.703 interfaces have several different line codes. For 1544kbps they are typically AMI and B8ZS, and for 2048kbps they are AMI and HDB3. Normally the LATTER is the one, which is used. The interface must be configured to match the line code of the other equipment; otherwise line code violations (ie terrestrial data errors) will occur. See Note 3
Tx Warn: Transmit FIFO slip	The FIFO, which interfaces the Drop Mux to the Framer has slipped (full or empty). This should never occur in operation (contact factory).
Tx Warn: Backward alarm at Tx input	A Frame Backward Alarm is detected at the Tx Input. This indicates that equipment downstream of the RECEIVE path has failed and is returning an alarm. This may be due to **any** receive downstream equipment, but *could* be due to the modem Rx output failing. **Check** the modem Rx path indicates OK, **Check** the Rx data output from the modem is connected to the downstream equipment.
Tx Warn: TS16 MF Back' alarm at Tx input	A Multiframe Backward Alarm is detected at the Tx Input, this indicates that equipment downstream of the RECEIVE path has failed to find multiframe sync and is returning an alarm. The Modem only detects this alarm when the Tx baseband is set to use the Drop mux in a G.732 mode and CAS signalling has been selected (or 2048k IBS G.732 0% overhead mode with CAS is enabled). On the Rx path, if the Insert Mux bearer is set to Generate, then **check** the Rx path is also utilising CAS, otherwise it will generate a bearer without a TS16 Multiframe.
Tx Warn: Tx input BER > User threshold	The Bit Error Rate at the Tx input (measured on the PCM Frame Alignment Words) is worse than the user set threshold for a deferred alarm (Change, User-Opt, Thresholds, User BER). This warning will be replaced with a Fault message at $1x10^{-3}$. **Check** the line code setting (AMI/B8ZS/HDB3) matches the input signal on any G.703 cards in use. See note 3
Tx Warn: Framer slipping data to sync	After a break in the Tx input data, the framer is `bit slipping` data in the Transmit FIFO to bring the data taken out of the FIFO by the framer into step with the satellite frame timing. It bit slips (rather than force the frame timing into step with the data) to prevent causing a frame sync loss in the distant end equipment.
Tx Warn: Framer slipping sig' to sync	See above text, but this time with regard to CAS signalling data not the main data path.
Tx Warn: Framer Sig' FIFO slip	The FIFO, which carries the CAS signalling from the Drop Mux to the Framer, has slipped (full or

	empty). This should never occur in operation (contact factory).
Tx Warn: RS Encoder FIFO slip	The FIFO, which interfaces the Framer to the Reed-Solomon encoder, has slipped (full or empty). This should never occur in operation (contact factory).
Tx Warn: Turbo encoder status	This is a warning used in the engineering debugging process it should not occur in the field. If it does, please consult the factory.
Tx Warn: Carrier muted as Ref settles	This is displayed for 30 seconds from a cold start as the Tx carrier is muted while the frequency reference temperature stabilises. If a power outage is less than 30 seconds, then the mute is for the same period as the power outage.
Tx Warn: BUC Mute as Ref settles <2Min	The Modem is configured to operate with a Paradise BUC and to supply a 10MHz reference `up the coax`. From a cold start the modem will switch of the BUC Tx output for 2 minutes until the internal reference has settled to avoid bringing up carriers off frequency. After 2 minutes the BUC On/Off status is returned to it's previous setting. If a power outage is less than 2 minutes, then the mute if for the same period as the power outage. This is different to the *Tx Carrier mute* above as it mutes the *BUC itself* and will therefor mute any number of carriers transmitted through a single BUC.
Tx Warn: BUC Power exceeds P1dB point	The Modem is configured to operate with a Paradise BUC and communicate by FSK. The modem has read the measured power at the BUC output and it exceeds its P1dB point of this BUC. This means the BUC is approaching or is into compression, and as such may be degrading the transmitted spectrum. Either back off the power or monitor the Tx spectrum very carefully.
Tx Warn: Cannot hold power set at BUC	The Modem is configured to operate with a Paradise BUC, communicate with the BUC by FSK, and the Modem / BUC are set in `Terminal` mode where the modem maintains the power at the BUC flange by adjusting both the Tx Carrier Level and where available the BUC attenuator. Currently both of these adjustments are at an end stop, and the modem cannot adjust the levels any further in order to try and maintain the set flange power.

RX TRAFFIC FAULTS (Bottom line of disp	**Rx Traffic Faults: Rx OK LED Off and Rx Traffic (prompt) relay.**
Rx Fault: Demod unlocked at <nn.nnnn>MHz	The Demod cannot find a carrier to lock to at the specified frequency. **Check** the frequency; **check** the Data rate and FEC settings (use Info, View Config, Rx). Perhaps check the demod itself by enabling a IF Loopback (Test, Loopback, IF).
Rx Fault: FEC sync lost (demod locked)	The Demod can lock to the carrier, but the inner FEC decoder (Turbo, Vit or Seq) cannot lock to the demodulated data. **Check** you have the correct FEC settings (ie Turbo, Vit or Seq as appropriate, use Info, View Config, Rx). The most common other cause is Spectrum Inversion; you can check this by temporarily turning on the Rx Spectrum Inversion (Change, Rx, Demod Spect Inv).
Rx Fault: De-interleaver sync lost	The Demod can lock to the carrier, and the inner FEC decoder to the demodulated data. However the Reed-Solomon De-interleaver cannot find sync with the decoded data. **Check** the RS de-interleaving depth, then the values of `n` and `k`(use Info, View Config, Rx). On Non-Paradise Tx modems, **check** the V.35 scrambler is not enabled in addition to the Reed-Solomon scrambler.
Rx Fault: Frame sync lost	The modem cannot find the IBS or IDR frame sync on the receive data. **Check** the Rx Service settings (Change, Rx, Service), although as the service type affects the composite data rate over satellite, it is more likely the demod will fail to lock rather than this message appears if the wrong service type is selected. On Non-Paradise Tx modems, for IBS, check the V.35 scrambler is not enabled in addition to the IBS/SMS scrambler.
Rx Fault: TS32 Multiframe sync lost	The modem cannot find the IBS TS32 Multiframe sync on the receive data although it has found Frame sync (otherwise the message above would display). This is only likely in Custom IBS modes where the operator has the option of sending a TS32 Multiframe or not. Note that for low data rates

	the standard IBS/SMS multiframe period can be long (1 sec at 32kbps) and it may be best to use Custom IBS without a TS32 MF for rates of below 32kbps to improve the acquisition time if the carrier is momentarily lost.
Rx Fault: CAS Multiframe sync lost	The modem cannot find the IBS CAS Multiframe sync on the receive data although it has found Frame sync and TS32 Multiframe sync (otherwise the Frame/Multiframe sync messages above would display). CAS Multiframe sync used to convey either 1) Channel Associated Signalling (CAS) in G.732 Drop/Insert modes using CAS, 2) To maintain the identity of a group of timeslots (for the `Odd values of N` such as N=7 etc). 3) To maintain Robbed Bit Signalling (RBS) in selected in T1-D4 or T1-ESC Drop/Insert modes. Be aware that most competing modems do not support the use of a CAS Multiframe to provide any of these three functions. **Check** as follows for each use: 1) The Tx modem is set to operate in CAS mode if CAS signalling is to be conveyed within the IBS/SMS overhead (one of the questions in the Change, Tx, Baseband, Drop menu dialogue) 2) If the Tx modem cannot use a CAS Multiframe to maintain the TS identity for the `Odd values of N`, then to prevent this modem seeking a CAS multiframe for one of these `Odd value of N`, in the Change, Rx, Baseband, Insert menu dialogue, when prompted "TS identity over satellite: [?] 1=Maintain (normal) 2=Don't care, select "Don't Care" 3) If the Tx modem cannot use a CAS Multiframe to maintain RBS over satellite, in the Change, Rx, Baseband, Insert menu dialogue, when prompted "T1 RBS over satellite: [?] 1=Normal (or no RBS) 2=Maintain RBS, select "Normal (or no RBS)".
Rx Fault: Final data is all ones (AIS)	The final customer data after demodulation, error correction, deframing and descrambling is all ones. This is normally used to indicate an upstream equipment fault (such as a lack of input clock at the Tx end), **it is not a modem fault**. See note 4.
Rx Fault: X.50 de-stuff sync lost	In IBS modes at 48kbps or 56kbps the IBS specification (IESS 309) specifies that the 48/56kbps data is `bit stuffed` up to 64kbps according to X.50 prior to IBS framing. The bit stuffing adds an 80 bit-repeating pattern which is detected at the Rx end then removed to return the data to 48/56kbps. This message indicates the modem cannot find the 80-bit pattern in order to remove it. **Check** the data is intended to be 48/56kbps X.50 stuffed to 64kbps, not raw 64kbps data. Refer **also** to the Change, User, Operation, Terr/Sat, and X.50 AIS dialogue description for a discussion about AIS in X.50 modes.
Rx Fault: Final BER > 1E-3 [AIS Forced]	The User (final) Bit Error Rate is worse than $1x10^{-3}$. "[AIS Forced]" is only shown if the user option of what action to take when the BER is bad is not set to Ignore (Change, User-Opt, Operation, Actions, BER Action). The fault is always displayed, although the actions can be cancelled by selecting Ignore. The source for the BER measurement is user defined (Change, User-Opt, Operation, Satellite, BER est'). Normally this should be set to "Auto", however it may be user set to other BER sources if required. It is possible to manually set the source to the inner FEC (Turbo/Vit/Seq), even when the outer FEC (RS) is active, thereby not including the effects of the RS error correction in the displayed user BER. **Check** this remains set to "Auto"unless there is good reason.
Rx Fault: <line> off, <DTE/DCE> not ready	<Line> depends on the interface in use (eg RS422 DCE="TR", V.35="DTR"). This is a DC control line, which is used to indicate the terrestrial equipment is functioning properly. The <line> switching off may be user set to cause this fault or be ignored (Change, Terr-Int, Control Lines). See note 5.
Rx Fault: <line> off, DCE not accp't Rx data	<Line> depends on the interface in use and is only available if the modem is fitted with a DTE interface card (eg RS422 DTE="CS", V.35="CTS"). This is a handshake line, which is raised in response to our RS/RTS line (if the modem interface is a DTE), which in turn indicates the output data is valid (ie demod locked and FEC/deframing OK). Its status can be used to determine if the terrestrial device is accepting the modems output data. The <line> switching off may be user set to cause this fault or be ignored (Change, Terr-Int, Control Lines). See note 5

Rx Fault: No insert bearer, generating	If the Rx Baseband is set to Insert Mux, with the bearer Looped through from the Drop Mux (dialogue under Change, Rx, Baseband, Insert) then if the Tx input signal fails (no bearer or AIS) then this looped bearer onto which the Rx traffic is to be inserted is not available and the Rx data would therefore be lost as a result of a Tx fault. In such a circumstance the modem temporarily generates a PCM bearer onto which the Rx data can be inserted to preserve the Rx traffic. See notes 6 & 9
Rx Fault: Insert bearer AIS, generating	See above, see notes 6 & 9.
Rx Fault: Ins mux bearer frame sync lost	The modem only detects frame sync when the Insert Mux is active. **Check** the bearer type is specified correctly (Change, Rx, Baseband, Insert). This normally only occurs if either there are significant errors on the terrestrial link, or if it is supplied with AIS and the modem is set to ignore AIS. **Check** that the AIS detector is not disabled with Change, User-Opt, Operation, Actions, AIS. **ALSO** there is an option to make the modem re-seek frame sync if CRC sync is lost (Change, User-Opt, Operation, Terrestrial, PCM Bearer CRC, CRC/Frame Acq"). **Check** the modem is not set to expect a CRC and forcing frame re-acquisition if CRC is lost, but there is no CRC on the PCM signal. See notes 6 & 9
Rx Fault: Ins mux bearer MF sync lost	The modem only seeks TS16 Multiframe sync when the Rx baseband is set to use the Insert mux in a G.732 mode and CAS signalling has been selected. **Check** that a CAS multiframe is present on the PCM signal applied to the modem (ie terrestrial TS16 contains the 16 frame Multiframe sequence). See note 9.
Rx Fault: Ins mux bearer CRC sync lost	The modem only seeks Cyclic Redundancy Code (CRC) sync when the Rx baseband is set to use the Insert mux in G.732 mode and when set by the user to process CRC's (Change, User-Opt, Operation, Terrestrial, PCM Bearer CRC, Process). If CRC sync is permanently lost, **check** if a CRC is present on the PCM signal.
Rx Fault: Clk PLL lock fail to <source>	The PLL, which generates the Rx output clock, (or backup Rx clock) has failed to lock to the specified reference. **Check** the reference specified as <source> is the correct frequency. If a station clock is specified as available the modem will use this to generate the *backup* Rx output clock even if "Station" not specified as the *primary* source on the Rx Clock Mode screens. **Check** that the Station clock is still connected as it is a common mistake to change the Rx Clock Mode to something other than "Station", then disconnect the station clock assuming the modem will not use it, whereas the modem will *always* use it to generate the backup clock in preference to the internal 1PPM clock, if it is has been told a station clock is available. (Change, Rx, Clock/Buff, Station Clock Input).
Rx Fault: LNB connection/current fault	The Modem is configured to feed a DC supply `up the coax` to an LNB, but it detects there is either an open or short circuit.

RX WARNINGS (Bottom line of display)	**Rx Traffic warnings: Deferred alarm relay only**
Rx Warn: Reconfiguring Rx path	The modem is reconfiguring the Rx path (after a user parameter change).
Rx Warn: Backward alarm from satellite	A Backward Alarm is detected at the Rx Input. This indicates that equipment downstream of the TRANSMIT path (ie from our modem Tx output, though the Tx chain, through the satellite and then through the whole distant end Rx path or even further downstream) has failed and is returning an alarm. This may be due to a receive downstream equipment failure, this Tx chain failing, the satellite itself, but also *possibly* the modem Tx output failing. **Check** the modem Tx path indicates OK, **Check** the Tx IF output from the modem is connected to the upconverter equipment and onwards; monitor the Tx carrier (or distant Rx if possible) with a spectrum analyser.
Rx Warn: CAS MF Back' alm from sat	A Multiframe Backward Alarm is detected at the Rx Input, this indicates that equipment downstream of the TRANSMIT path has failed to find CAS Multiframe sync and is returning an alarm. Realistically while this could be caused by any equipment from the Tx modulator onwards, it is unlikely to be other than the Tx mod, the Rx demod, or further down the Rx path as other failures would result in a more

	catastrophic failure (and the correspondingly more significant backward Alarm above). The Modem only detects this alarm when the Rx baseband is set to use the Insert mux in a G.732 mode and CAS signalling has been selected (or 2048k IBS G.732 0% overhead mode with CAS is enabled). Read the text corresponding to "Rx Fault: CAS Multiframe sync los" to determine why a CAS multiframe is in use over satellite and Check the three items listed against this message on the Tx path of this modem.
Rx Warn: Back' alm 1234 from satellite	The display may show numbers or dashes (eg "-2-4") corresponding to which of the four backward alarms are active at the Rx Input. This indicates that equipment downstream of the TRANSMIT path (ie the distant end Rx path or further downstream) has failed and is returning an alarm. In Multidestinational circuits this may NOT correspond to the Tx path of THIS MODEM. The fault may be due to **any** receive downstream equipment, but *could* be due to the relevant modem Tx output failing. **Check** the relevant modem Tx path indicates OK, **Check** the Tx IF output from the modem is connected to the upconverter equipment and onwards, monitor the Tx carrier (or distant Rx if possible) with a spectrum analyser.
Rx Warn: O/p clk fail=<source>, now PLL	The clock selected as the Receive data output clock, (where <Source> shows the specified clock) has failed. The modem has switched to using a backup clock generated by the Rx PLL to preserve the receive traffic. This fault only occurs if the <source> is the same frequency as the Rx data rate, otherwise the clock is not used directly instead it is rate converted by the Rx PLL, and it's failure results in the fault described immediately below instead. Refer also to the description of the dialogue under (Change, Rx, Buff/Clk, Rx Clock) to determine which signal the PLL uses as a backup clock.
Rx Warn: No clk ref=<source> , now int'	The reference specified for the PLL, which generates the Rx output clock (or backup Rx clock) has failed; the modem has switched to using the internal 1PPM reference to keep the clock available. **Check** the clock <source> specified is present. If a station clock is specified as available the modem will use this as the <source> to generate the *backup* Rx output clock even if "Station" not specified as the *primary* source on the Rx Clock Mode screens. **Check** that the Station clock is still connected as it is a common mistake to change the Rx Clock Mode to something other than "Station" , then disconnect the station clock assuming the modem will not use it, whereas the modem will always use it in preference to the internal 1PPM clock if it is has been told a station clock is available. (Change, Rx, Clock/Buff, Station Clock Input).
Rx Warn: Back' alm received at ins' mux	This fault will only be displayed if the modem if fitted with an interface which provides four ports for separate input and output of separate Tx/Drop and Rx/Insert PCM bearers. It indicates a Backward Alarm is detected at the Rx bearer Input. This indicates that equipment downstream of the RECEIVE path has failed and is returning an alarm. This may be due to **any** receive downstream equipment, but *could* be due to the modem Rx output failing. **Check** the modem Rx path indicates OK, **Check** the Rx data output from the modem is connected to the downstream equipment.
Rx Warn: MF Back' alm Rx'd at ins' mux	This fault will only be displayed if the modem if fitted with an interface, which provides four ports for separate input and output of separate Tx/Drop and Rx/Insert PCM bearers. It indicates a Multiframe Backward Alarm is detected at the Rx bearer Input, this indicates that equipment downstream of the RECEIVE path has failed to find Multiframe sync and is returning an alarm. The Modem only detects this alarm when the Rx baseband is set to use the Insert mux in a G.732 mode and CAS signalling has been selected. On the Rx path, if the Insert Mux bearer is set to Generate, then **check** the Rx path is also utilising CAS, otherwise it will generate a bearer without a TS16 Multiframe.
Rx Warn: X.50 Back' alm from satellite	This indicates the distant end equipment has an X.50 fault and is returning an X.50 backward alarm. See the description for the message "Rx Fault: X.50 de-stuff sync lost" for a further description.
Rx Warn: RF sig too low, now <-71dbm>	The Receive RF signal level is below the range specified for this equipment. Increase the level to ensure specified performance is met.
Rx Warn: RF Sig too high, now <-19dBm>	The Receive RF signal level is above the range specified for this equipment. Decrease the level to

	ensure specified performance is met.
Rx Warn: Eb/No below user threshold	The Receive Eb/No (derived from the Carrier to noise ratio) is worse than the user threshold set for a deferred alarm (Change, User-Opt, Thresholds, Eb/No). This may be used as an advance warning of service degradation.
Rx Warn: Rx BER below user threshold	The final Bit Error Rate is worse than the user threshold set for a deferred alarm (Change, User-Opt, Thresholds, User BER). This may be used as an advance warning of service degradation. The source for the BER measurement is user defined (Change, User-Opt, Operation, Satellite, BER est"). Normally this should be set to "Auto", however it may be user set to other BER sources if required. It is possible to manually set the source to the inner FEC (Turbo/Vit/Seq), even when the outer FEC (RS) is active, thereby not including the effects of the RS error correction in the displayed user BER. **Check** this remains set to "Auto" unless there is good reason.
Rx Warn: Buffer slips too frequent (YES)	The minimum period between buffer slips is less than the user threshold set for a deferred alarm (Change, User-Opt, Thresholds, Buffer Slip). This is used as an advance warning that the clock accuracy is less than expected causing the buffer to slip more frequently in turn causing data errors. The alarm may be muted by pressing YES. **Check** the system clocking to see if a clock has degraded. If the clocks are correct but the buffer is slipping too frequently increasing the buffer size will increase the period between buffer slips (but at the cost of increased delay).
Rx Warn: Ins' bearer BER>user threshold	This fault will only be displayed if the modem if fitted with an interface, which provides four ports for separate input and output of separate Tx/Drop and Rx/Insert PCM bearers. The Bit Error Rate at the Rx bearer input (measured on the PCM Frame Alignment Words) is worse than the user set threshold for a deferred alarm (Change, User-Opt, Thresholds, User BER). See note 3
Rx Warn: Buffer overflow & recentre	The Doppler / Plesiochronous buffer has filled, and automatically slipped to position itself back in mid position. Half the buffer capacity will have been discarded, but for framed data (eg T1/E1 only) frame sync will not be lost if the user option (Change, User-Opt, Operation, Terr/Sat, Buffer MF Slip) is set to "Adjust", to ensure buffer slips are an integer multiple of the multiframe length.
Rx Warn: Buffer underflow & recentre	The Doppler / Plesiochronous buffer has emptied, and automatically slipped to position itself back in mid position. Half the buffer capacity will have been repeated, but for framed data (eg T1/E1 only) frame sync will not be lost if the user option (Change, User-Opt, Operation, Terr/Sat, Buffer MF Slip) is set to "Adjust", to ensure buffer slips are an integer multiple of the multiframe length.
Rx Warn: Ins' mux slipping data to sync	After a break in the Rx signal, the Insert Mux is `bit slipping` data in the Doppler Buffer to bring the data taken out of the Buffer by the Insert Mux into step with the terrestrial (bearer) frame timing.
Rx Warn: Ins' mux slipping sig' to sync	See above text, but this time with regard to CAS signalling data not the main data path.
Rx Warn: RS Decoder FIFO slip	The FIFO, which interfaces the RS Decoder to the Deframer has slipped (full or empty). This should never occur in operation (contact factory).
Rx Warn: Insert mux sig' FIFO slip	The FIFO, which carries the CAS signalling from the Doppler Buffer to the Insert Mux has slipped (full or empty). This should never occur in operation (contact factory).
Rx Warn: DISTANT Eb/No below threshold	The DISTANT modems Receive Eb/No (ie this local modems TX CARRIER) is worse than the user threshold set for a deferred alarm (Change, User-Opt, Thresholds, Distant Eb/No). This may be used as an advance warning of service degradation. This function is only available if AUPC is active, where the local modem continuously reads the distant modems Eb/No.
Rx Warn: Turbo Decoder status	This is a warning used in the engineeering debuging process it should not occur in the field. If it does, please consult the factory.

Actions: Relays

U = Prompt Unit Fault relay. [Equivalent to SMS/IBS/IDR AE/AS1/AS1]

T = Prompt Traffic Fault relay. [Equivalent to SMS/IBS/IDR AE/AS1/AS1]

D = Deferred Alarm relay. [Equivalent to SMS/IBS/IDR none/AS2/AS2]

Actions: To Terrestrial

TA = AIS (all ones) in selected TS if the Insert mux is active, AIS over all data if not in Insert mode. If Insert mode is active and the user control "Thin Route Spoof" (Change, User opt, Operation, Terr/Sat, Thin Route Spoof) is set to "On", then AIS is forced over the whole PCM bearer, not just the selected timeslots to "spoof" full bearer connectivity when passed over a "Thin Route" satellite circuit (ie not the whole bearer data rate). [Equivalent to SMS/IBS/IDR AH1&AH3/AH1/AH1]

TB = Frame Backward Alarm (in PCM Multiplex, eg G.732 TS0-NFAS bit 3). [Equivalent to SMS/IBS/IDR AH2/AH2/none]

TC = AIS (all ones) forced in the G.732 CAS `abcd` signalling nibble. Equivalent to SMS/IBS/IDR AH4/AH3/none]

TD = Force a fixed value in the G.732 CAS `abcd` signalling nibble. The fixed value is set by user control (Change, User Opt, Operation, Actions, Back Alarm) to be either No-Action, b=1, a=b=1, a=b=c=d=1. [Equivalent to SMS/IBS/IDR AH5/none/none]

TE = Multiframe Backward Alarm (in PCM Multiplex, eg G.732 TS16 frame 0 of multiframe = 0000 1111). [Equivalent to SMS/IBS/IDR AH6/none/none]

Actions: To Satellite

SA = AIS (all ones), framed and scrambled ad subject to RS coding if active. [Equivalent to SMS/IBS/IDR AK1/AD1/AD1]

SB = Frame Backward Alarm (in IBS/SMS this is direct, in IDR or when multiple backward alarms are active it corresponds to the "Rx Summary Fault Output" which is externally patched back into the Backward Alarm inputs). [Equivalent to SMS/IBS/IDR AK2/AD2/AD2]

SC = AIS in CAS signalling carried in IBS/SMS TS16/TS48 over satellite. [Equivalent to SMS/IBS/IDR AK3/AD3/none]

SD = Multiframe Backward Alarm in IBS/SMS TS16/TS48 over satellite (TS16 frame 0 of CAS multiframe = 0000 1111). [Equivalent to SMS/IBS/IDR none/none/none]

Actions: Other

BM= BUC Mutes (not a modem function)

CM = Carrier Mute, Tx carrier is switched off

TF = Tx Flow control, the `CTS` (Clear To Send) line is switched off

RF = Rx Flow control, the `RR` (Receiver Ready) line is switched off

Notes

1: In response to a CAS multiframe sync loss from the terrestrial port, the appropriate alarm to raise would appear to be the CAS-MF backward alarm. However as the bearer is normally looped there is no point in raising this alarm, as a CAS multiframe is required to convey it (ie the presence of the fault prevents the return alarm being sent). There are only two circumstances where the return bearer is not dependent upon the bearer into the Insert Mux, either when the Insert Mux is generating the bearer, or when the Rx path is receiving an independent 2M stream, which contain a CAS multiframe. In these two circumstances the CAS-MF backward alarm is sent (TE), in all other circumstance the TS0 backward alarm is sent (TB).

2: Normally, an incoming TS16 Multiframe backward alarm causes the modem to transmit a Satellite Frame Backward Alarm (SB) to be sent. However if the user control "Thin Route Spoof" (Change, User opt, Operation, Terr/Sat, Thin Route Spoof) is set to "On" to "spoof" full bearer connectivity when passed over a "Thin Route" satellite circuit (ie not the whole bearer data rate), then an incoming TS16 Multiframe backward alarm causes the modem to transmit a Satellite Multiframe Backward Alarm (SD, instead of SB) to keep the Frame and Multiframe backward alarm functions separate.

3: Line code setting: For P1431/32 cards **check** the switch on the card itself. For P1440/41/42 cards, which are configured from the front panel **check** with Change, Terr-Int, Electrical, then reselect G.703, which is followed by the line code configuration.

4: All ones (the Alarm Indication Signal, AIS) is a means of signalling to downstream equipment that the data being sent is not valid. It is advised to leave AIS detection enabled so the modem can inform you when there is a fault with the traffic. If

necessary (eg if the data itself contains long strings one ones) you can disable the detection of AIS and resulting actions using Change, User-Opt, Operation, Actions, AIS.

5: **Check** if this line is connected in the cable and supported by the connected device. If the line is floating (no cable/not supported) then it might `float` to the off state and intermittently raise this alarm.

6: The modem generates a temporary backup bearer for the Insert mux when set to "Loopthrough" *only* if there is no bearer available. Should the operator *assume* the modem is set to "Generate" not "Loopthrough", and feed the Rx bearer output back to the Tx bearer input (including via other equipment), **then it will oscillate**. Temporarily generating a backup bearer when there is no bearer incoming, then as this temporary bearer is detected at the Tx input when fed back to the modem, it will switch off this temporary bearer and return to "Loopthrough" mode whereupon as there is now no source for the bearer (it's a compete loop), it will fail again and switch back temporarily to generating a backup bearer. If you see the modem displaying a bearer status switching between "Rx Fault: Ins mux bearer frame sync lost", "Rx Fault: Insert bearer AIS, generating", and / or "Rx Fault: No insert bearer, generating", then **check** that the bearer is not set to "Loopthrough" AND at the same time looped back to the modem Tx input, even if via other equipment.

7: If the user control "Thin Route Spoof" (Change, User opt, Operation, Terr/Sat, Thin Route Spoof) is set to "On" to "spoof" full bearer connectivity when passed over a "Thin Route" satellite circuit (ie not the whole bearer data rate), then a CAS backward alarm incoming on the Rx Input is passed to the terrestrial as a terrestrial Multiframe backward Alarm (SD). If "Thin Route Spoof" is not active, the warning is still displayed but no actions are taken (ie SD is not generated).

8: You might try to clear the unit's non-volatile memory and then reconfigure the unit from scratch. From the main menu select 0, then User Parameters, Clr All + Reset. If this fails contact the factory for an RMA number then return the unit for repair. If the unit will not boot to allow you to select from the screens, you can also clear the memory by powering up the unit while holding in the `NO` key (but you have to hold the key in until the unit gives its normal three beeps).

9: If you wish to use Drop/Insert, and pass the incoming satellite timing to the downstream network, this is only possible by setting the Rx Insert bearer to "Generate" not "Loopthrough" (Change, Rx, Baseband, Insert dialogue), and selecting Rx Clock as "Satellite" (Change, Rx, Buff/Clock, Gen' Bearer Clock). If the downstream equipment requires a terrestrial TS16 Multiframe, you must configure the modem to use CAS, so the generated bearer has a TS16 multiframe.