

**Compatibility Notes for**  
**P300 & P400 Series Satellite Modems**

(Including Viterbi and Sequential  
FEC options)

Issue 4

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## 1 INTRODUCTION

This document was originally written for the P400 Series of Satellite Modems, but is equally applicable to the P300 series. Wherever "P400 Series" is mentioned in the text it applies equally to the P300 Series.

The document summarises the results of inter-compatibility tests we have performed between the our products and equipment from other manufacturers. These are tests we have performed in ideal conditions in our development laboratory, to save operators having to perform similar tests over satellite with the language & test equipment difficulties this can often involve.

It is our intent that the P400 Series (and P300 Series) should interwork with modems from all manufacturers, in as many of the modes these other products offer as possible. Some specific proprietary modes of other equipment are not provide by the P400/P300 series, but for all products listed there are at least *some modes* in which both equipments will inter-operate.

This document and the tests performed are as accurate as we can achieve, but there may be special cases where equipment has been modified from its standard condition by the manufacturer, and is no longer compatible with the standard equipment (and therefore not with the P400 series either). Where we are aware that non standard equipment, or equipment with many different variations in the field exists, we have made a comment in the test results.

If you find any inaccuracies in this document, or are aware of any other equipment which should be included, then we will be very pleased to hear from you. Please contact our normal technical support staff with any extra information you might have available.

## 2 E.F. DATA SDM-650B

These tests were performed in our US facility by Paradise Staff with SDM-650B fitted with software version 2.66.

### 2.1 Description

The SDM-650B is an older design of which thousands are deployed throughout the world. The basic modem is closed network only and has a **sequential only FEC scheme** with a limited choice of data rates. Scrambling is specified as CCITT V.35 only and may be disabled.

It appears there have been numerous versions of the SDM-650B shipped over the years and it is not easy to determine what the specific facilities of the unit might be. Configuration is by a mix of software and links or switches on various PCB's.

Different revision of hardware have different mixes of links & switches to configure the unit. This is important as it is very useful to have a manual which matches the hardware release and software revision level of the equipment you are *actually using* where possible.

"Compatibility Kits" for the SDM-650B exist according to the manual and it is apparent from one customers feedback that they can significantly affect inter-operation with other modems (as they would be intended to do).

### 2.2 Interworking Configuration

These tests were performed using QPSK at 70MHz IF, with ½ rate Sequential FEC. Apart from the normal matching of configuration, the following is also required:

**Differential encoding/decoding must be on**, this is user controlled on the SDM-650B, but always on in the P400 series.

**Spectrum Invert** must be active in **both directions**, without this the P400 series will show either "Demod Unlocked" or "FEC Sync Loss (Spect Inv ?)", the SDM-650B will also fail to lock. Spectrum Invert can be provided as follows:

On the P400 series (from the front panel)

On the SDM-650B by "compatibility kit"

**Both directions, but at either site. NOT both sites (which then cancels !)**

**Data Invert** in both directions. This can be provided in several ways:

Use links or switches on the SDM-650B to invert the input & output data on the interface (some models).

Swop the A&B pairs of the input & output data at *one* end of the link.

Use a scrambler / descrambler at one end which uses the same scrambling pattern but inverts the data. Selecting a V.35 style Linkabit scrambler on the P400 series provides the inverse of the Intelsat V.35 scrambler, which is very similar to the CCITT scrambler the SDM-650B is specified to have. At worst this will result in a  $1 \times 10^{-12}$  background error rate due to scrambler incompatibility.

### 2.3 Notes

**Demod Lock Time:** The SDM-650B is a very old modem with a purely swept carrier detection scheme, and as such it can take a long time to acquire the carrier and for the demod to lock. In the tests we performed using a modem limited to 56kbps & 112kbps, the demod might take up to two minutes to lock (at 56kbps). This is long enough for most people to determine it doesn't work, and be tempted to change the configuration !

### 2.4 Recommendations

1. Have the right version of the manual for the hardware / software on the SDM-650B you are using.
2. Because of the variation in links & switches between SDM-650B models, you are likely to require test equipment (eg Firebirds) to get the link operating initially.

### 3 E.F. DATA SDM-300

These tests were performed at our UK facility by Paradise staff with an SDM300.

#### 3.1 Description

#### 3.2 Interworking Configuration

These tests were performed with the modem type set to CUSTOM, Intelsat Open. The data rate was 1024kbps Closed Network with BPSK and QPSK at 70MHz IF, with  $\frac{1}{2}$ ,  $\frac{3}{4}$  and  $\frac{7}{8}$  rate Sequential and Viterbi FEC. Apart from the normal matching of configuration, the following is also required:

**Scrambling:** set the P400 series modem to V35, CCITT.

##### Viterbi FEC

Note the SDM 300 does not provide  $\frac{3}{4}$  or  $\frac{7}{8}$  rate FEC in BPSK

**Tx and Rx data phase** (ie data inversion control) must be set to **normal** on the SDM 300

Note: Spectrum Inversion may be necessary on SDM300 Modems for some FEC rates (e.g. Rate 3/4).

##### Sequential FEC

Note the SDM 300 does not provide  $\frac{3}{4}$  or  $\frac{7}{8}$  rate FEC in BPSK

**In BPSK and QPSK** modes the **data must be inverted** at one end of the link in both directions.

This is best achieved by setting the **Tx and Rx data phase to invert on the SDM 300**.

Additionally in **QPSK** mode requires **spectrum invert** at one end of the link in **both directions**.

**Both directions, but at either site. NOT both sites (which then cancels !)**

#### 3.3 Notes

The SDM 300 has several manufacturer compatible modes accessible only when the modem type is set to CUSTOM, these are:

FDC closed, EFD closed, Intelsat Op, CSC closed, SDM 51 compliant

Changing the manufacturer mode appears to change a variety of data invert, spectrum invert, scrambler, FEC and filter shape settings.

#### 3.4 Recommendations

For closed network, used the Intelsat Open setting which means that filter settings etc will be compatible with the P400 series.

For Open Network (IBS) and IDR operation, use the IDR (SDM 308) and IBS (SDM 309) settings available.

### 3.5 Additional Tests

These tests were performed at our US facility by Paradise staff with an SDM300.

### 3.6 Description

#### 3.7 Interworking Reed-Solomon

**Reed Solomon** WILL NOT INTER-OPERATE in "Closed Network", or "IDR" service modes, due to the incompatibility of the two modem's RS scramblers. While Paradise equipment has many scramblers to choose from, none were found to work with the SDM-300's RS scrambler under any circumstances.

**Reed Solomon** WILL INTER-OPERATE in IBS service mode. However, please note that in some cases the RS n,k,t,d values need to be manually selected in the Paradise modem under the menu selection RS - "Other", due to the non-standard RS parameters implemented in the SDM300. These specific cases are: >1544kbps - Paradise must use RS - "Other" set to 219,201,9,4, since the SDM-300 uses these n,k,t,d values (normally the Paradise "Intelsat" default values above 1544kbps are 219,201,9,8).

Otherwise, the standard "Intelsat" values are the default settings in both modems.

#### 3.8 Closed Network Compatibility

Paradise "**Closed Network**" Service mode is only compatible with the SDM-300 set to either "Intelsat Open" or "EFD Closed" Modem type. RS is not compatible (see Reed Solomon Compatibility section above).

"Closed + ESC" mode on the SDM-300 is not compatible with Paradise or other Modems.

#### 3.9 IBS Compatibility

"**IBS**" service mode is fully compatible with the SDM-300, including RS (see Reed Solomon Compatibility section above).

#### 3.10 IDR Compatibility

"**IDR**" service mode is compatible with the SDM-300, with some qualifications:

- a. RS is not compatible (see Reed Solomon Compatibility section above).
- b. The SDM-300 only supports T1 & E1 (1544 & 2048 kbps) data rates in IDR mode.

#### 3.11 Other SDM-300 Notes

##### **Viterbi FEC:**

Any SDM-300 firmware version less than 6.1.1 requires the Tx spectrum to be inverted when, and only when, Viterbi 3/4 Rate FEC is used.

##### **Sequential FEC:**

- a. In BPSK & QPSK modulation modes, the SDM-300's "Data Invert" must be set for "Invert" on both Tx and Rx.
- b. In QPSK mode the spectrum must be set to "Invert" on the SDM-300's for both Tx & Rx.

## 4 COMSTREAM CM701

These tests were performed at our UK facility by Paradise and Comstream Staff with a CM701 fitted with: M&C s/w v5.0, Demod s/w v4.3, Mod s/w V4.4, Mod gate array v4.4.

### 4.1 Description

The CM701 is getting rather `long in the tooth` now days, but there is a large installed base.

### 4.2 Interworking Configuration

These tests were performed at 1024kbps using BPSK and QPSK at 70MHz IF, with  $\frac{1}{2}$ ,  $\frac{3}{4}$  and  $\frac{7}{8}$  rate Sequential and Viterbi FEC. Apart from the normal matching of configuration, the following is also required:

**Differential encoding/decoding must be on**, this is user controlled on the CM701, but always on in the P400 series.

**Tx and Rx data invert** set to normal

#### **Spectrum Invert with Viterbi FEC**

Most modem manufacturers use this parameter to control the PQ symbol pairing when in BPSK mode. However the CM701 does not have such functionality, hence when in BPSK mode the P400 series modems need to have the Tx spectrum Invert set to `invert` (in order to match the CM701 symbol pairing). The P400 Rx does not matter as the P400 series auto detects the symbol pairing and adjusts to match. In QPSK modes however the setting at both ends needs to be normal.

#### **Spectrum Invert with Sequential FEC**

With sequential FEC in QPSK mode it is necessary to have Spectrum Invert active at one end of the link in **both directions**. For BPSK, the spectrum invert has to be at the P440 end (in both directions) to make the BPSK symbol pairings match the CM701. **Both directions, but at one end. NOT both ends (which then cancels !)**

**Scramblers** The Comstream CM701 provides two V35 scramblers `IDR MAN` and `Comstream`. IDR MAN will interwork with Intelsat V35. However Comstream (apparently CCITT V35) causes a data inversion when interworking with CCITT V35. If you are forced to interwork with a CM701 with scrambling set to Comstream do one of the following:

1. On the CM701 enable the Data Invert parameter on same path that has the Comstream Scrambler active
2. On the P400 series modems use the Linkabit Scrambler/Descrambler, which will have the effect of inverting the sense of the data, and hence correcting the overall sense. However Linkabit is an inversion of *Intelsat* V35 scrambling which is very similar to the CCITT scrambler, but will cause a  $1 \times 10^{-12}$  background error rate.

### 4.3 Notes

**Sequential FEC:** The CM701 rate  $\frac{3}{4}$  sequential is not Intelsat compliant and will not interwork with the P400 (in  $\frac{3}{4}$  Rate sequential mode). The P300 however has a special Comstream compatible mode (see Handbook appendix E) and will interwork correctly.

### 4.4 Recommendations

1. The CM701 an Tx and Rx energy dispersal setting was always set to x1 (although it's not too descriptive about what that actually means)
2. The CM701 has two Tx and Rx filter selections `SMS Filtering` and `Comstream Filtering`. Select SMS filtering to match the P400 series modem filters. Interworking is possible with the CM701 set to Comstream filtering, but there will be a slight BER degradation.

## 5 RADYNE-COMSTREAM 2401L, 2401LS, 2401LB/ST

These test were conducted in our US facility by Paradise staff with a 2401L fitted with software version 8.9.

### 5.1 Description

This section applies to all three models of Comstream-Radyne equipment listed, since Modem functions are functionally the same, except where noted.

The Radyne-Comstream 2401 modem comes in several models, such as 2401L (L-band Tx & Rx), 2401LB/ST (L-Band with ODU Driver), and 2401LS (L-Band Low Speed). The 2401L has a maximum data rate of 2048kbps in QPSK and OQPSK, and 1024kbps in BPSK modulation modes. The 2401LS is the same except for it's maximum data rate is 1024kbps in QPSK and OQPSK, and 512kbps in BPSK modulation mode. The 2401LB/ST has the features of the 2401L, plus a high-stability 10MHz reference and power supply for a BUC or SSPA. It also has a power supply for a LNB. This last model would be equivalent to the Paradise P310 Modem.

### 5.2 Interworking Configuration

These test were conducted using a variety of modulation settings (BPSK, QPSK, OQPSK), the different maximum data rates, (1024 - BPSK, 2048 - QPSK & OQPSK), different Viterbi FEC rates (1/2, 3/4, 7/8), Scrambling (Intelsat V.35), and other possible configuration settings. Apart from the normal matching of configurations, the following is also required:

**Differential Encoding/Decoding** must be "ON" on the 2401 (it is always on in the P300/P310).

**Service** type (P300/P310) must be **Closed Network** only, no other service mode was found to be compatible with the 2401, including Closed+ESC, IBS/SMS, and IDR.

**Scrambling** Note: the 2401 uses "V.35-IESS" which is the same as the P300/P310 "V.35 Intelsat", and is automatically set in the P300/P310 modem when the P300/P310 scrambling is set to "Normal" for both Tx & Rx. It is necessary to set all parameters in the 2401, including setting the desired scrambler on one menu, then "Enable" it on another menu for both Tx & Rx.

**Reed-Solomon** is compatible with a P300/P310, however, on the 2401 you must go to the "Mod/ReedSolomon" menu then "Enable" RS, then go to the "Mod/Data/Scrmbl Set" menu and set the scrambling to "RS Scrmblr" . Then go to the "Mod/Data/Scrmbl Ctrl" and "Enable" it.

Then repeat for the Demod menu.

### 5.3 Other Notes

The 2401 **Spectrum Invert** for Tx & Rx, as well as **Data Invert** for Tx & Rx should be set to "Normal". The units tested did not have the optional Sequential FEC, and so were not tested, although we think they should be compatible at all rates.

### 5.4 Recommendations

P300/P310: Use Closed Network, any modulation, any Viterbi FEC rate, use RS if desired, "Normal" scrambler in the P300/P310. DO NOT use any other service mode.

2401: Use any modulation, any Viterbi FEC rate, "V.35-IESS" scrambler, and use RS if desired.

P300/P310: Use Closed Network, any modulation, any Viterbi FEC rate, use RS if desired , "Normal" scrambler in the P300/P310. DO NOT use any other service mode.

2401: Use any modulation, any Viterbi FEC rate, "V.35-IESS" scrambler, and use RS if desired.



## 6 FAIRCHILD SM2900 & SM290

These tests were performed at our UK facility by Paradise Staff with a FAIRCHILD SM2900 fitted with S/W V6.7, and a SM290 fitted with S/W V0.1L

### 6.1 Description

For `Open Network` IBS, or IDR, the SM290 uses an external framing unit (the Paradise P1300, but often badged as a Fairchild product). The SM2900 uses an internal framing unit (Paradise design).

### 6.2 Interworking Configuration

These tests were performed at 1024kbps QPSK, 70MHz IF, with  $\frac{1}{2}$  and  $\frac{3}{4}$  rate Viterbi FEC and  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and  $\frac{7}{8}$  rate Sequential FEC. Apart from the normal matching of configuration, the following is also required:

**Differential encoding/decoding must be on**, this is user controlled on the SM2900, but always on in the P400 series.

**Scrambling** The SM2900 & SM290 has a matching scrambler / descrambler for all but CCITT V35. Note the 'V35' setting on the SM2900 & SM290 corresponds to INTELSAT V35 on the P400 series when in Viterbi mode, but in Sequential mode the SM2900&SM290 introduce an extra data inversion before the scrambler, and after the descrambler. Therefore it is necessary to change scrambler settings when in sequential mode if the SM2900 & SM290 is set to 'V35'. In this case set the P400 series modem to Linkabit, which is an inverse of INTELSAT V35 (to compensate for this extra inversion).

### 6.3 Notes

With the SM290 and external framing unit it is possible to set multiple scramblers active (ie on the framing unit and on the modem). The SM2900 attempted to provide all the functionality of the SM290 and P1300 combination but with an internal framing unit, right down to dumb things like being able to activate multiple scramblers. When a Reed-Solomon Internal Framing Board is fitted to the SM2900 modem it gets worse, and the operator has three independent (& diverse) screens with which to control the three scramblers (V.35, IBS, and Reed-Solomon).

If you have to interwork with a SM290/P1300 or a SM2900 with multiple scramblers active, then use the `Custom` option on the P400 series which allows you to activate multiple scramblers specifically to work with equipment such as this.

### 6.4 Recommendations

Leave the P400 scrambling set to `Normal`, and get the configuration of the other equipment right !

## 7 SSE DATACOM SM3000

These tests were performed at our UK facility by Paradise staff using a SSE SM3000 with S/W V2.6

### 7.1 Description

The SM3000 & SM4000 are Fairchild / SSE's 1U high replacements for the 2U SM2900. The SM4000 is a higher data rate version of the SM3000.

### 7.2 Interworking Configuration

These tests were performed at 1024kbps using BPSK and QPSK at 70MHz IF, with  $\frac{1}{2}$ ,  $\frac{3}{4}$ , &  $\frac{7}{8}$  rate Viterbi and  $\frac{1}{2}$ ,  $\frac{3}{4}$ , &  $\frac{7}{8}$  rate Sequential FEC. Apart from the normal matching of configuration, the following is also required:

**Differential encoding/decoding must be on**, this is user controlled on the SM3000, but always on in the P400 series.

#### Scrambling

On the SM3000 the `308` scrambler option is actually **inverted** Intelsat V35 (corresponding to the `Linkabit` definition on the P400 series)

The `V.35` option is **non-inverted** Intelsat V.35 (`Intelsat` on the P400 series).

There appears to be no CCITT V.35 mode on the SM3000.

In **Viterbi FEC** mode this all works as expected (assuming you set the modes as they are shown to correspond above). For some reason in **Sequential FEC mode** the SM3000 adds an extra inversion, resulting in the inverse of the Viterbi scrambling modes. ie in Sequential mode SM3000-`308` = P400-Intelsat, and SM3000-`V.35` = P400-Linkabit, and

### 7.3 Notes

As described for the SM290 and SM2900 previously, multiple scramblers can be activated. If you have to interwork with a SM3000 with multiple scramblers active, then use the `Custom` option on the P400 series which allows you to activate multiple scramblers specifically to work with equipment such as this.

### 7.4 Recommendations

Leave the P400 scrambling set to `Normal`, and get the configuration of the other equipment right !