

# Telecommunications

## 2850B/BS 2851/S Digital Analyzers

**AEROFLEX**  
A passion for performance.



Desktop and rack-mountable digital testers for a wide range of PCM and data measurement applications up to 8 Mbit/s

- Combined data and PCM rate tester
- Framed and Unframed operation at 2048 and 8448 kbit/s with option of 1544 kbit/s (T1) or 704 kbit/s
- All data test interfaces as standard: RS-232, X.21 (X.24), V.35, RS-449 (V.36) (2851), codirectional, contra-directional with EUROCOM optional (2850B & 2851)
- 50 bit/s to 2.5 Mbit/s in 1 bit/s steps
- Data interface and analog channel access
- G.821, G.921, G.826, M.2100 and G.962 analysis
- Measurements include propagation delay, frequency deviation, frequency and level measurement, DTMF and CAS
- DC power and internal battery options
- Remote control via RS-232 or IEEE-488 with optional PC applications software

*The 2850B Digital Transmission Analyzer provides 64 kbit/s, 2 and 8 Mbit/s error performance analysis, and in addition other functionality such as DTMF and channel associated signaling capability, and propagation delay measurement.*

The 2851 Digital Communications Analyzer provides all of this plus data interface testing as standard for all commonly used interfaces. A structured data option enables detailed testing of X.50, 6+2 and reiterated data systems. With the addition of DC and battery power options, a full range of field and exchange digital and data measurement requirements can be met with a choice of desktop and rack-mountable packages. A choice of RS-232 or IEEE-488 remote control completes the picture, extending remote applications from unattended monitoring to laboratory and factory test requirements.

### PCM FRAMING SYSTEMS

2850B and 2851 are able to generate and receive all commonly used framing systems up to 8448 kbit/s, for both the European and North American digital hierarchies.

The instruments can be optioned as European or hybrid versions, and this includes an all bit rate version (European plus North American).

Thus 2850B and 2851 have the flexibility to address global applications, including operation in International Gateways where there is a requirement to test mixtures of European and North American traffic carried on satellite systems.

### 56 kbit/s and 64 kbit/s Channel Testing

Individual channels within T1, 704, 2048 and 8448 kbit/s (G.704/G.744) can be tested at 64 or 56 kbit/s, assisting in testing and fault location within digital data networks and cross-connect switches.

### n x 64 kbit/s Channel Testing

The expanding services at n x 64 kbit/s can be tested where they are carried within primary rate digital signals. All systems and n x 64 kbit/s cross-connect switches are catered for with the flexibility of contiguous and non-contiguous channel selection.

For the very latest specifications visit [www.aeroflex.com](http://www.aeroflex.com)

## Tributary Testing

Individual 2048 kbit/s tributaries within 8488 kbit/s signals can be tested to ensure correct functioning of multiplexes.

## Unstructured

Where the structures on digital links do not conform to the usual ITU-T Recommendations, for example inter-computer links, they can be tested using an unformatted format.

## DATA INTERFACE TESTING

All commonly used data interfaces are provided as standard to give a comprehensive data test capability together with primary and second order PCM rate testing. Thus PCM and data circuits and equipment can be tested with one compact, fully integrated test instrument. Data test interfaces provided are RS-232, X.21, RS-449 (V.36), V.35 (2851), codirectional and contradirectional (2850B and 2851). DTE is standard, DCE optional, EUROCOM D/1 is optionally available for European military network applications.

## Modes

Both synchronous and asynchronous modes are possible with a wide range of standard and user programmable data rates, so that traditional data interface testing can be addressed together with modern digital data services at 64 kbit/s,  $n \times 64$  kbit/s and other rates.

## REMOTE LOOPBACK

Remote loop activation and deactivation is provided for the RS-232 test interface according to ITU-T Recommendation V.54 by means of control lines. This facilitates testing of data circuits automatically without the need for manual intervention.

## STRUCTURED DATA OPTION

The Structured Data option for 2850B/S and 2851/S provides comprehensive X.50, 6+2 and reiterated structured data test capability through Co/Contradirectional, V.11 and TTL data interfaces, and within a 2048 kbit/s digital signal.

## Channel rates

As well as the standard sub-channel rates up to 19.2 kbit/s additional rates of 14.4, and 48 kbit/s are provided. It is also possible for the user to programme other rates for special applications.

## Out-of-service testing

Out-of-service testing can be used for error performance testing of structured data sub-channels out to subscribers' equipment as well as checking functionality of multiplex equipment. The equipment can be stressed by injecting errors into framing bits. Alarms and housekeeping bits can also be exercised to complete this flexible test capability.

Test access can be directly at 64 kbit/s or via a 64 kbit/s channel within a 2 Mbit/s signal.

Remote loop activation is provided according to national requirements to facilitate testing out to subscribers' equipment.

## In-service testing

Two types of in-service testing can be performed, in-service monitoring and drop and insert testing.

## In-service monitoring

An X.50 or reiterated data signal can be monitored directly at 64 kbit/s or via a 64 kbit/s channel of a 2 Mbit/s signal.

For 64 kbit/s signals via V.11 or Co/Contradirectional interfaces connection can be made across the line in high impedance mode (bridging). For 2 Mbit/s signals monitor and bridging modes are available.

Various parameters can be monitored during in-service testing including framing errors and housekeeping and alarm bits. Where test patterns are being carried within selected sub-channels these can also be monitored for errors.

## X.50 Drop and Insert Testing

Drop and insert testing can be performed directly at 64 kbit/s or on 64 kbit/s channels within 2 Mbit/s signals.

For 64 kbit/s signals via V.11 or Co/Contradirectional interfaces the X.50 signal is looped through and an X.50 sub-channel replaced by a test pattern. A second 64 kbit/s receiver is provided to enable monitoring of the return signal for test pattern errors.

For 2 Mbit/s signals an X.50 signal can be looped through on a selected channel and at the same time performing drop and insert on an X.50 sub-channel.

These are the normal drop and insert modes that will be used in-traffic for 64 kbit/s and 2 Mbit/s signals. Other configurations can be adopted for special applications for mixed 2 Mbit/s and 64 kbit/s connections.

## FLEXIBLE ERROR MEASUREMENTS

Where appropriate, 2850B and 2851 have the ability to detect, simultaneously, Code Errors, Framing Errors, Pattern Errors and CRC Errors. Further measurements are then made on a selected error type, including error distribution.

## Error Distribution/Histogram

The results are displayed in the form of a histogram with accumulation over 72 hours, and a maximum resolution of 1 minute. Other events such as sync loss are also stored on the histogram. All stored results are tagged with time and date, so that a comprehensive record of long term measurements is available to assist in fault localization. A permanent record of results can also be obtained by printing a text equivalent or a facsimile of the histogram subsequent to the test. In addition the instrument can be programmed to Autoprint selected parameters on event or at timed intervals.

## G.821 and G.921 Measurements with Histograms

Where availability measurements are being made on 64 kbit/s channels, results in G.821 format will be provided, while for higher rates Annex D of G.821 is applied. In addition up to 100 day histograms are provided for each of the G.821 parameters with automatic recognition of exceeding daily limits, defined by circuit grade and length for G.821, or circuit classification for G.921. Alternatively user defined limits can be entered directly. Where short tests are required histograms can be selected up to 25, 50 or 100 hours with a resolution of 15, 30 or 60 minutes.

## G.826 and M.2100 Measurements

G.826 extends measurements to 2 Mbit/s and above, while M.2100 adds other events such as alarms which contribute towards G.821 and G.826 measurements.

## RESIDUAL BIT ERROR RATE

Assessment of background error performance is useful in systems subject to periodic degraded performance, such as radio or satellite systems. This measurement is a long term error rate ignoring severe-

ly errored seconds.

### **BURST ERROR CAPABILITY**

Qualification of Burst Errors within Networks, and Network Performance under Burst Error conditions is difficult to achieve. 2850B and 2851 provide comprehensive facilities to stress network equipment with test patterns injected with programmable error bursts and burst rates, while on the receive side, different burst sizes can be detected and recorded. Thus, since the errors can be injected at both logic and code level, network performance under burst conditions can be determined.

### **HIGH TOLERANCE TO BURST ERRORS**

2850B and 2851 are particularly suited to measurements on systems subject to high error rates and burst errors, with the ability to ride through rapid fades as experienced on digital radio systems.

### **CRC BLOCK ERROR INJECTION TO G.962**

2048 kbit/s systems with CRC for ISDN applications can register G.821 parameter events when certain CRC block error rate thresholds are exceeded. The instrument is able to check the thresholds for Severely Errored Seconds, Degraded Minutes and Errored Seconds. The thresholds can be preset for each parameter, and multiplex and other equipment can be quickly and easily checked for conformance to the G.962 Recommendation.

### **ISDN ERROR REPORT BIT MONITORING TO G.962**

A further facility for the 2048 kbit/s systems with CRC is to carry information within the Not Frame Word bits 6, 7 and 8, on the occurrence of G.821 events (Severely Errored Seconds, Degraded Minutes and Errored Seconds), and where the events originated. The origin is determined by the position of these bits with respect to the CRC multiframe. The instrument decodes and displays this information in real time or latched mode, and can Autoprint it if required.

### **PROGRAMMABLE ERROR GATING**

In addition to long term mean error ratio, a current error ratio measurement is available with fixed gating periods of 1, 2, 5 or 10 seconds, as well as automatic gating adjustment. Flexibility of application is thus assured, for example fade margin adjustment on digital radios.

### **IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS**

2850B and 2851 are equally suited to both installation and in-service maintenance measurements. Interfaces are provided to enable the receiver to be connected to a number of network points at varying impedances and signal sensitivities, including the provision of automatic equalization (automatic line build out, ALBO) at 2048 kbit/s (1544 kbit/s for North American versions).

### **CHANNEL ACCESS**

Flexible access is provided to transmit and receive timeslots in appropriate frame structures at 704, 2048, 1544 and 8448 kbit/s. Note that analog access is possible only at 1544 and 2048 kbit/s.

### **Drop and Insert**

In addition to checking error performance of selected 64 kbit/s and n x 64 kbit/s channels with transmitter and receiver operating independently, a Drop and Insert configuration can be adopted so that 64 kbit/s and n x 64 kbit/s channels can be tested with minimum dis-

ruption of service to other in-traffic channels.

### **External Access**

Access is provided to selected transmit and receive channels, at both analog and digital levels. Thus, if required, external analog or digital test equipment can be connected to make specific channel measurements beyond the capability of 2850B and 2851.

### **TERMINAL EQUIPMENT TESTING**

2850B and 2851 are able to simulate and detect alarm conditions associated with the various framing systems, so that terminal equipment can be tested for correct operation. This includes the ability to generate programmable Frame or Code Errors to check equipment thresholds.

In addition, there are automatic test sequences for checking Frame and Multiframe Alignment Strategy, and access is allowed to control and display the condition of all unassigned frame bits.

### **PROPAGATION DELAY MEASUREMENT**

Delay measurements on data and PCM rate circuits are accomplished to a high level of accuracy. This is particularly important on satellite links where high values of delay are experienced and need to be measured, and for characterizing networks to assist in finding unwanted loopbacks.

### **CHANNEL ASSOCIATED SIGNALING**

The four-bit word associated with a selected transmit channel can be controlled. In addition dialled numbers can be generated to simulate call set up.

On the receive side, the selected channel can be monitored, and dialling information displayed. The parameters associated with the dial pulses are user programmable as a mask, so that deviations will be displayed as errors.

All 30 channels of a 2048 kbit/s signal or 24 channels of a 1544 kbit/s signal can also be monitored simultaneously, for example when searching for an idle channel.

### **DTMF SIGNALING**

DTMF supplements channel associated signaling capability to provide a more comprehensive signaling test capability. Tone and dialling generation and monitoring facilities are provided.

### **DIGITAL SIGNAL LEVEL AND FREQUENCY MEASUREMENT**

The frequency and amplitude of the incoming digital signal is displayed which enables early warning of degradation of the signal.

### **2 CHANNEL SYNCHRONIZATION MEASUREMENT**

2 primary rate digital signals can be compared for frequency synchronization, thereby assisting in isolating network clocking problems.

### **OCTET SLIP DETECTION**

Octet slips can be detected at the channel level of a primary rate signal, which allows the effects of frame slips introduced by network buffers to be assessed.

### **EASE OF USE**

2850B and 2851 are set up using a combination of menus, key pad and soft keys. Eighteen complete set up conditions can be stored in non-volatile memory, thus ensuring ease of use.

## RS-232 REMOTE OPERATION

Remote unattended operation can be accomplished via an RS-232 port, which can also be used for local printing. Keyboard functions can be duplicated via RS-232 enabling complete remote reconfiguration and reporting of results.

## IEEE-488

For 2850BS and 2851S IEEE-488 can be specified as an option in addition to the standard RS-232 for factory test and laboratory applications or where IEEE-488 is preferred.

## ALTERNATIVE PACKAGES

Alternative packages are offered for field portable (2850B and 2851), and rackmount (2850BS and 2851S) applications.

## REMOTE APPLICATIONS SOFTWARE

This optional PC based software runs on Windows 95, 98 and NT platforms. It provides full remote control, storage of results, and a comprehensive results display capability.

## END-TO-END VOICE COMMUNICATION

The instrument has a loudspeaker to which can be connected a selected voice channel, via an internal Codec, from frame structures at 1544 and 2048 kbit/s. It is also possible to connect an external microphone to a selected transmit channel, thereby enabling end-to-end voice communication to be established between two 2851 instruments to assist in setting up tests.

## POWER OPTIONS

In addition to mains power, options are provided for battery and DC power to cater for all operational requirements including factory, exchange and field.

# SPECIFICATION

## PCM TRANSMIT INTERFACE

### Framing and Bit Rates

Signals can be transmitted unframed or with the frame structure indicated.

### Enabling option

See table at end of specification.

### 03, 04

704 kbit/s - 10 Channel System.

### 02, 04

1544 kbit/s - T1  
1544 kbit/s - T1 no signaling  
1544 kbit/s - T1ESF  
1544 kbit/s - T1ESF no signaling  
1544 kbit/s - T1DM, DDS Data Mux.

### 01

2048 kbit/s - G.704  
2048 kbit/s - G.704 no multiframe  
2048 kbit/s - G.704 with CRC  
2048 kbit/s - G.704 with CRC, no multiframe  
2048 kbit/s - 32 frame multiframe.

### 04

3152 kbit/s - DS1C mode 1 synchronous  
3152 kbit/s - DS1C mode 2 asynchronous.

### 04

6312 kbit/s - DS2 96 channels synchronous  
6312 kbit/s - DS2 asynchronous  
6312 kbit/s - 2048 kbit/s interworking to G.747.

### 01

8448 kbit/s - G.742 asynchronous  
8448 kbit/s - G.704/741 synchronous  
8448 kbit/s - G.704/744, 120 channels, synchronous.

### 01, 25

256 kbit/s - EUROCOM D/1 IB5  
512 Kbit/s - EUROCOM D/1 IB5  
1024 kbit/s - EUROCOM D/1 IB5.

### Permitted combinations of bit rates

2048 & 8448 kbit/s or  
704 & 2048 & 8448 kbit/s or  
1544 & 2048 & 8448 kbit/s or  
1544 & 3153 & 6312 kbit/s or  
704 & 2048 & 8448 & 1544 & 3152 & 6312 kbit/s  
256 & 512 & 704 & 1024 & 2048 & 8448 kbit/s.

### AIS

All ones signal with zeros programmable at a rate of  $M \times 10^N$ , where  $M$  is 1-9 and  $N$  is 2-7.

### CLOCK SOURCE

Internal, external or derived from the received signal.

### INTERNAL

#### Accuracy

$\pm 5$  ppm from 0°C to 55°C.  
 $\pm 3$  ppm/year.

#### Small Offset

Steps of 5 and 25 ppm to maximum of  $\pm 150$  ppm.

#### Large Offset

Up to 2.5 MHz - Steps of 2 kHz to maximum of  $\pm 96$  kHz.  
Over 2.5 MHz - Steps of 8 kHz to maximum of  $\pm 96$  kHz.

### EXTERNAL

#### Range

1 kHz to 11 MHz.

#### Level

TTL square wave. In accordance with G.703, Figure 21.

#### Impedance

1000  $\Omega$ .

#### Connector

BNC.

### CLOCK OUTPUT

TTL via 50  $\Omega$ .

### LINE CODES

AMI (50% duty cycle), HDB3, B8ZS, B6ZS, NRZ (TTL level).

### NON STANDARD

Unframed only.

### Clock

Internal, External

**Range**

1 kbit/s to 9 Mbit/s

**Steps**

1 bit/s

**Line Code**

NRZ

**Level (data and clock)**

TTL

**Connector**

Auxiliary connector, 25 way D-Type (for pinout see end of specification)

**TEST PATTERNS****Single Channel**

Selected 64 kbit/s channel of framed signal.

**n x 64 kbit/s Channel**

Selected n x 64 kbit/s channel of framed signal.  
Channel distribution can be contiguous or non-contiguous.

**Framed**

All channels of framed signal.

**Unframed**

Unframed signal.

**PRBS**

$2^9-1$ ,  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$

Optional maximum 14 or 7 successive 0 limitation for 1544 and 3152 kbit/s systems.

**Sense**

True or inverted.

**Mode (framed only)****8 bit**

PRBS data fills all 8 bits in an octet.

**7 + 1 bit**

First 7 bits are PRBS and last bit is a 1.

**All zeros**

Continuous sequence of 0000.

**All ones**

Continuous sequence of 1111.

**Alternating**

Alternating sequence of 1010.

**16 bit word**

User programmable sequence of 16 bits.

**8 + 8 word**

Two user programmable 8 bit sequences are alternated by an external TTL input. The changeover occurs at the end of 8 bits.

**1 kHz 0 dBm0 sine wave**

Digital representation of a sinusoidal signal of 1 kHz at a nominal level of 0 dBm0, coded according to A-Law, inserted into single channel. This facility is not available for 1544 kbit/s systems.

**FILL PATTERNS**

In single channel framed operation the following patterns are used to fill all other channels.

**PRBS**

$2^{15}-1$

**8 bit word**

User programmable sequence of 8 bits.

**EXTERNAL VOICE/DATA**

For framed operation, an externally input 64 kbit/s data stream or a voice frequency signal can be inserted into one of the channels in the transmitted signal instead of a test pattern.

**DATA INPUT**

Applies only to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).

**Data Input Interface**

Codirectional to G.703.  
Contradirectional to G.703 (AMI 100% or Bipolar NRZ).  
X.21, RS-449 (V.36), V.35 (using DCE cable adapter accessory).  
NRZ (TTL level).

**VOICE FREQUENCY INPUT**

Applies only to 1544 and 2048 kbit/s systems.

**Range**

0.3 to 3.4 kHz.

**Encoding**

A-Law for 2048 kbit/s.  
 $\mu$ -Law for 1544 kbit/s.

**Impedance**

600  $\Omega$  balanced.

**Max Input Level**

+3 dbm0.

**DROP & INSERT**

For framed operation the received signal is looped to the transmitter.

Note that for CRC frame structures the CRC is re-calculated before re-transmission.

**64 kbit/s**

A selected 64 kbit/s channel is replaced by a test pattern or by an externally input digital signal.

**Audio**

A selected 64 kbit/s channel is replaced by an externally input voice frequency signal (as above).

**n x 64 kbit/s**

A selected n x 64 kbit/s channel is replaced by a test pattern. The channel selection can be contiguous or non-contiguous.

**ERROR INJECTION****Target**

Test Pattern Only, Framing Only, CRC Only.  
Traffic (Drop and Insert Mode).

**Error Type****Binary**

Bits are inverted before coding.

## Code

Code errors are injected by changing  $\pm 1$  to 0 and 0 to  $\pm 1$  where the polarity of the inserted mark is the same as the polarity of the last mark transmitted.

## Injection Mode

### Singly

By keypress.

### Fixed rate

Rate  $3 \times 10^{-1}$  to  $1 \times 10^{-7}$ .

### In bursts

Pseudo Random Burst with user selectable burst length of 8, 16, 32, 64, 128, 256 errors. The actual transmitted error ratio with bursts at a fixed rate is fixed rate  $\times$  the number of errors in the burst eg. a burst length of 16 at a rate of  $2 \times 10^{-6}$  will measure  $3.2 \times 10^{-5}$ .

Bursts may not stay confined to the designated target type.

## CRC Block Errors

To ITU-T Recommendation G.962.

## Range

1-999 errored blocks in 1,000 or 60,000 blocks.

## Threshold Presets

Programmable presets for Severely Errored Seconds, Degraded Minutes and Errored Seconds thresholds.

## MAIN OUTPUTS

Balanced

### Impedance

120  $\Omega$ .

### Peak Voltage

3 V  $\pm 0.3$  V.

### Space Voltage

0 V  $\pm 0.3$  V.

### Unbalanced

### Impedance

75  $\Omega$ .

### Peak Voltage

2.37 V  $\pm 0.237$  V.

### Space Voltage

0 V  $\pm 0.237$  V.

## NRZ

TTL.

## SIGNALING BIT CONTROL

For framing systems with Channel Associated Signaling capability:  
The signaling bits can be changed.  
Dialed numbers up to 20 digits can be generated.

## DTMF SIGNALING

See Measurements Section.

## C-BIT FRAMING

Generation of C-Bit Frame for French TRANSMIC-2G System.  
Control of C-Bit Frame message bits.

## ACCESS TO STRUCTURE BITS

The following tests are available, depending on the framing system selected:

Frame alignment strategy.

Multiframe alignment strategy.

Change unassigned, distant, distant multiframe and alarm bits.

Change Auxiliary Data Bits (T1 systems).

Send BELL Yellow Alarm:

Bit 2 Suppression (T1SF).

Facility Data Link message (T1ESF)

## LOOPBACK (T1 SYSTEMS ONLY)

Activates and deactivates automatic remote loop equipment.

4 loopback codes, each of 3-16 bits (2 loopup and 2 loopdown) can be user programmed and stored in non-volatile memory for subsequent use.

## SYNC OUTPUTS

PRBS

Polarity - Negative pulse

Interface - TTL

## PCM RECEIVE INTERFACE

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### FRAMING AND BIT RATES

**Signals can be received unframed or with the frame structure indicated.**

As Transmitter plus 1544 kbit/s - T1SLC96 (synchronization and channel access).

### Permitted combinations of bit rates

As Transmitter.

### Frequency Tolerance

704 kbit/s  $\pm 50$  ppm

1544 kbit/s  $\pm 130$  ppm

2048 kbit/s  $\pm 50$  ppm

3152 kbit/s  $\pm 30$  ppm

6312 kbit/s  $\pm 33$  ppm

8448 kbit/s  $\pm 30$  ppm

## LINE CODES

As Transmitter

## NON STANDARD

Unframed only

## Clock

External

## Range

1 kbit/s to 11 Mbit/s

## Line Code

NRZ

## Level (data and clock)

TTL

## Connector

Auxiliary connector, 25 way D-Type (see end of specification for pinout)

## INPUT MODES AND SENSITIVITY

### Modes

#### Terminated

Terminates the line

#### Bridging

Taps onto a terminated line or unprotected monitor point.

#### Monitoring

Connects to a protected monitor point.

## Automatic Line Equalization

Automatic Line Equalization (Automatic Line Buildout, ALBO) is provided at 2048 kbit/s for Option 01 (except when option 04 fitted)

<b>BALANCED</b>	<b>Terminated</b>	<b>Bridging</b>
<b>Impedance</b>	120 Ω	>1000 Ω
<b>Level</b>		
Normal	3 V + 2 -6 dB	3 V + 2 -6 dB
ALBO	3 V - 3 -30 dB	3 V - 3 -30 dB
<b>UNBALANCED</b>	<b>Terminated</b>	<b>Bridging</b>
<b>Impedance</b>	75 Ω	>1000 Ω
<b>Level</b>		
Normal	2.37 V + 2 -6 dB	2.37 V + 2 -6 dB
ALBO	2.37 V - 3 -30 dB	2.37 V -30 dB
<b>BALANCED</b>	<b>Monitor</b>	<b>Monitor</b>
	<b>(-30 dB)</b>	<b>(-20 dB)</b>
<b>Impedance</b>	120 Ω (3000 Ω)	120 Ω (1000 Ω)
<b>Level</b>		
Normal	115 mV +2 -6 dB	300 mV + 2 -6 dB
ALBO	115 mV - 3 -30 dB	300 mV - 3 -30 dB
<b>UNBALANCED</b>	<b>Monitor</b>	<b>Monitor</b>
	<b>(-30 dB)</b>	<b>(-20 dB)</b>
<b>Impedance</b>	75 Ω (2400 Ω)	75 Ω (680 Ω)
<b>Level</b>		
Normal	75 mV + 2 -6 dB	237 mV + 2 -6 dB
ALBO	75 mV - 3 -30 dB	237 mV - 3 -30 dB

## TEST PATTERNS

### Source

Selected channel of framed signal.  
All channels of framed signal.  
Unframed signal.

### PRBS

$2^9-1$ ,  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$

Optional max 14 or 7 successive 0 limitation for 1544 and 3152 kbit/s systems.

### Sense

True or Inverted.

### Mode (framed only).

#### 8 bit

PRBS data fills all 8 bits in an octet.

#### 7 + 1 bit

First 7 bits are PRBS and last bit is a 1.

### Repetitive Word

Any word which repeats over a 16 bit sequence.

## PATTERN SYNCHRONIZATION

### Loss Criterion

#### PRBS

Error rate greater than 1 in 5 for each of 10 consecutive deciseconds (1 in 10 above 5 Mbit/s).

#### 16-bit word

Error rate greater than 1 in 20 for each of 10 consecutive deciseconds.

### Async Message

Error rate greater than 1 in 20 for each of 10 consecutive deciseconds.

## CHANNEL EXTRACT

For framed single channel operation a selected 64 kbit/s channel is extracted from the received signal and output as a data signal or voice frequency signal. The audio output is also available on the internal loudspeaker.

### Data Output

Applies only to frame structures at 704, 1544, 2048 and 8448 kbit/s (G.704/G.744).

### Data Output Interface

Codirectional to G.703.  
Contradirectional to G.703 (100% AMI or Bipolar NRZ).  
X.21, RS-449 (V.36), V.35 (using DCE cable adapter accessory)  
NRZ (TTL level).

### Frame or AIS alarm detected

All 1's transmitted.

### Signal loss detected

Outputs are off.

### Clock output

64 kHz NRZ (TTL).

### Voice Frequency Output

1544 and 2048 kbit/s systems only.

### Range

0.3 to 3.4 kHz.

### Decoding

A-Law for 2048 kbit/s.  
 $\mu$ -Law for 1544 kbit/s.

### Impedance

600 Ω balanced.

## STATUS INDICATORS

LEDs indicate frame structure alarm conditions.

### Display modes

#### AUTORESET

LEDs show current condition and extinguish when the alarm condition clears. LEDs are ON for the length of time an alarm condition exists with a minimum of 1 sec.

#### LAMP LOCK

LEDs remain on after alarm clears.

#### LINE

ON indicates signal loss.

## **AIS**

ON indicates signal is all 1's. All 1's is defined as signal with less than three zeros in two frame periods.

## **FRAME**

ON indicates a loss of frame alignment.

## **ERRORS**

ON indicates that the error rate of the major error type is greater than a threshold set by the user. Threshold is  $1 \times 10^{-9}$  to  $9 \times 10^{-3}$ .

## **MF/ZEROS**

ON indicates:  
Loss of multiframe alignment (2048 kbit/s)  
More than 31 consecutive zeros have been received (1544 kbit/s).

## **DIST/YELLOW**

ON indicates:  
Distant alarm (2048 kbit/s)  
Yellow alarm (1544 kbit/s)

## **DMF/**

ON indicates:  
Distant multiframe alarm (2048 kbit/s)  
ISDN error report alarm (2048 kbit/s systems for ISDN applications).

## **PATTERN**

ON indicates loss of pattern synchronization.

## **REMOTE**

ON indicates the instrument is under remote control and the keyboard is inoperative.

## **RX: CRC UNSYNC**

The loss of CRC synchronization is indicated by a message on the display.

## **C-BIT: UNSYNC**

Loss of C-Bit framing sequence synchronization.

## **ALARM EXTENSION**

An output is provided corresponding to an alarm condition.

### **Polarity**

Positive for alarm.

### **Interface**

TTL.

## **ERRORS OUTPUT**

An output pulse is provided for each code error, pattern error, frame error, or CRC error (as selected to be the major measurement - see measurements section). (Pin 16 of auxiliary connector).

### **Interface**

TTL.

### **Pulse Width**

50% of bit interval.

## **UNASSIGNED FRAMING BITS**

The state of the unassigned bits is displayed.

Applies to 704, 2048 and 8448 kbit/s systems.

## **ISDN ERROR REPORT BITS**

(to ITU-T Rec. G.962)

Applies to 2048 kbit/s CRC system with no signaling multiframe, to G.704.

## **Bits monitored**

Bits 4, 5, 6, 7 and 8 in Not Frame Word.

## **Function**

Detects, displays and Autoprints occurrence of valid error alarm pulses within bits 6, 7 and 8 corresponding to Severely Errored Seconds, Degraded Minutes and Errored Seconds, and their relation to the CRC multiframe, in frame pairs.

Alarm pulses can be latched.  
Bits 4 and 5 are displayed.  
Changes in the state of bit 5 are Autoprinted.

## **ISDN ERROR REPORT BITS**

Applies to 2048 kbit/s system with no signaling multiframe, to G.704.

## **Bits monitored**

Bits 4, 5, 6, 7 and 8 in Not Frame Word.

## **Function**

Detects, displays and Autoprints occurrence of valid error alarm pulses within bits 6, 7 and 8 corresponding to Severely Errored Seconds, Degraded Minutes and Errored Seconds. Four sets of bits 6, 7 and 8 are displayed corresponding to the four combinations of bits 4 and 5 (00, 01, 10 and 11, each of which exists for 250 ms each second).

## **SYNC OUTPUTS**

PRBS.

### **Polarity**

Negative pulse.

### **Interface**

TTL

## **DATA TEST INTERFACES**

---

### **X.21 (X.24), RS-449 (V.36), V.35 and RS-232**

2851 and 2851S only.

### **X.21 (X.24), RS-449 (V.36), V.35**

X.21 (V.11), RS-449 (V.11) and V.35 circuits are presented to a common connector. DTE interfaces are provided by supplied cables which provide the appropriate connector and electrical interface. A series of optional cables provide alternative combinations of V.10, DTE and DCE.

### **Connector (instrument)**

50 way type 57 female.

### **Cable Connectors**

#### **X.21**

15 way D-Type, ISO 4903 female.

#### **RS-449 (V.36)**

37 way D-Type, ISO 4902 female.

#### **V.35**

34 way MRAC, ISO 2593 female.

### **Cable recognition**

Automatic recognition of the cable type plugged in.  
Dedicated interface, DTE, DCE provided by means of optional cable.

## RS-232

25 way D-Type female, ISO 2110.

### Mode

X.21 (X.24)	Synchronous.
RS-449 (V.36)	Synchronous. Asynchronous.
V.35	Synchronous.
RS-232	Synchronous. Asynchronous.
Implementation	DTE. DCE (Option).

### Electrical

X.21	V.11 (Balanced). V.10 (Unbalanced) (Option).
RS-449 (V.36)	V.11 (Balanced). V.10 (Unbalanced) (Option).
V.35	V.35 (data and timing). V.28 (control lines).
RS-232	V.28.

### Line Code

RS-232, V.35	NRZ.
X.21, RS-449 (V.10, V11)	NRZ. Biphase Mark. Biphase Space.

### Input Impedance

X.21, RS-449 (V.36)	
V.11 Terminated	120 $\Omega$
V.11 Unterminated	>3000 $\Omega$
V.10	>3000 $\Omega$
V.35	100 $\Omega$

### Data Rate

V.11	50 bit/s to 2.5 Mbit/s
V.11	50 bit/s to 9 Mbit/s (option 26)
V.10	50 bit/s to 100 kbit/s.
V.35	50 bit/s to 2.5 Mbit/s.
RS-232	
Async.	50 bit/s to 38.4 kbit/s
Sync.	50 bit/s to 80 kbit/s

### Timing

Synchronous	
Transmitter	External, From DCE, Internal
Receiver	External, From TX, From DTE, From DCE.
Asynchronous	
Transmit	50, 75, 100, 110, 134.5, 200, 300, 600, 1200, 1800, 2000, 2400, 3600, 4800, 9600, 19200, 38400 bit/s.
Receive	Receive signal.

### Polarity

The polarity of the transmitter incoming and outgoing clocks and the receiver incoming clock can be selected.

### Async coding

Data bits	5, 6, 7, 8
Stop bits	1, 1.5, 2
Parity	Odd, even, none

### Async character rate

Transmitter	Selectable: low, medium, high
Receiver	Up to 1000 characters/sec.

## Receiver Clock Recovery

The receiver clock can be recovered from the data.

### TEST PATTERNS

Sync and async.

### PRBS

$2^9-1$ ,  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$

### Sense

True or inverted.

### All Ones

Continuous sequence of 1111.

### All Zeros

Continuous sequence of 0000.

### Alternating

Alternating sequence of 1010.

### Sync.

### 16 bit word

User programmable sequence of 16 bits.

### 8 + 8 word

Two user programmable 8 bit sequences are alternated by an external TTL input. The changeover occurs at the end of 8 bits.

### Async.

### Fox Message

3 messages to ITU-T Recommendation R.52.

### Fox 1

International alphabet 2.

### Fox 2

International alphabet 5, 96 character set.

### Fox 3

International Alphabet 5, 64 character set.

### User message

1-19 characters.

### ERROR INJECTION

### Singly

By key press.

### Fixed rate

Rate  $3 \times 10^{-1}$  to  $1 \times 10^{-7}$  (sync only)

### ALARMS

Line, Errors, Pattern.

### SYNC OUTPUTS

PRBS transmit and receive.

### Polarity

Negative pulse.

### Interface

TTL

### Pulse width

50% of bit interval.

<b>X.21 (X.24) - DTE/DCE</b>					
<b>Pins</b>	<b>From DTE (To DCE)</b>	<b>Circuit</b>	<b>Pins</b>	<b>To DTE (From DCE)</b>	<b>Circuit</b>
2, 9	Transmit	T	4, 11	Receive	R
3, 10	Control	C	6, 13	Timing	S
8	Ground		5, 12	Indication	I
- For unbalanced operation the second pin of each pair is earth.					
<b>RS-449 (V.36) - DTE/DCE</b>					
<b>Pins</b>	<b>From DTE (To DCE)</b>	<b>Circuit</b>	<b>Pins</b>	<b>To DTE (From DCE)</b>	<b>Circuit</b>
4, 22	SD Send Data	03	6,24	RD Receive Data	104
17, 35	TT Tx Timing	113	8,26	RT Rx Timing	115
19	Signal Ground		5, 23	ST Send Timing	114
7, 25	RS (RTS)	105	9, 27	CS (CTS)	106
12, 30	DTR	108/2	11, 29	DSR	107
- For unbalanced operation the second pin of each pair is earth.					
- DTR present on DTE cable option but not monitored on DCE cable option.					
- DSR present on DCE cable option but not monitored on DTE cable option.					
<b>V.35 - DTE/DCE</b>					
<b>Pins</b>	<b>From DTE (To DCE)</b>	<b>Circuit</b>	<b>Pins</b>	<b>To DTE (From DCE)</b>	<b>Circuit</b>
P, S	Transmit Data	103	R, T	Receive data	104
U, W	Transmit Timing	113	V, X	Receive timing	115
B	Signal Ground		Y, AA	Transmit timing	114
C	Request to send	105	D	Clear to send	106
H	DTR	R, T108/2	E	DSR	107
- DTR present on DTE cable option but not monitored on DCE cable option.					
- DSR present on DCE cable option but not monitored on DTE cable option.					
<b>RS-232 - DTE/DCE</b>					
<b>Pins</b>	<b>From DTE (To DCE)</b>	<b>Circuit</b>	<b>Pins</b>	<b>To DTE (From DCE)</b>	<b>Circuit</b>
2	Transmit data	103	3	Receive data	104
24	Transmit timing	113	17	Receive timing	115
4	Request to send	105	15	Transmit timing	114
20	Data terminal	108	5	Clear to send	106
18	Local loop	141	6	Data set to ready	107
21	Remote loop	140	8	Receive line signal detect	10
7, 1	Ground		25	Test mode	142

<b>Control Lines</b>		
<b>X.21</b>		
DTE	DCE	
I (Indication)	C (Control)	Displayed as ON or OFF
C (Control)	I (Indication)	Settable to ON or OFF (Normally ON when transmitter ON and OFF when transmitter OFF)
<b>RS-449 (V.36)</b>		
DTE	DCE	
CS (Clear to send)	RS (Request to send)	Displayed as ON or OFF
RS (Request to send)	CS (Clear to send)	Settable to ON or OFF (Normally ON when transmitter ON and OFF when transmitter OFF)
DTR (Data terminal ready)	DSR (Data set ready)	Set to on
<b>V.35</b>		
DTE	DCE	
CS (Clear to send)	RS (Request to send)	Displayed as ON or OFF
RS (Request to send)	CS (Clear to send)	Settable as ON or OFF (normally ON when transmitter ON and OFF when transmitter OFF)
DTR		DSR Set to ON
<b>RS-232</b>		
DTE	DCE	
CTS (Clear to send)	RTS (request to send)	Displayed as ON or OFF.
DSR (data set ready)	DTR (data terminal ready)	Displayed as ON or OFF.
RLSD (receive line detect)	LL (local loop)	Displayed as ON or OFF.
	RL (remote loop)	Displayed as ON or OFF.
TM (Test Mode)		Displayed as ON or OFF.
RTS (request to send)	CTS (clear to send)	Settable to ON or OFF.
DTR (data terminal)	DSR (data set ready)	(normally ON when ready) Transmitter On and OFF when Transmitter OFF). Settable to ON or OFF.
	RLSD (receive line signal detect)	
	TM (Test Mode)	Settable to ON or OFF.
LL (local loop)		Set to ON for V.54 loop 3 selected
		Set to OFF for V.54 loop 3 deselected
RL (remote loop)		Set to ON for V.54 loop 2 selected
		Set to OFF for V.54 loop 2 deselected

## STRUCTURED DATA (OPTION 24)

### X.50

#### Framing

Division 2, 80 channel  
Division 3, 20 channel

#### Status Bit Mode

##### Unframed

The S bit can be set to 1 or 0, and monitored

##### Framed (France)

The S bit is  $F + 7D$  where  $F$  is the status bit framing and is alternating 1 and 0, and  $D$  are data bits. The  $D$  bits can be set to 1 or 0, and monitored.

##### Distant End Alarm Bit (A)

The A bit can be controlled and monitored.

##### Housekeeping Bits (B to H)

The B to H bits can be controlled and monitored.

### X.50 channel rate

#### Division 2, 80 channel

600, 1200, 2400, 4800, 9600 bit/s.

#### Division 3, 20 channel

2400, 4800, 9600 bit/s.

#### Additional rates

14.4, 19.2, 48 kbit/s and programmable X.50 bit rate

#### X.50 bit rate

64 kbit/s.

### 6+2 and REITERATED DATA

#### Framing

8 bit envelope with first bit framing, last bit status and 6 data bits.

#### Framing Bit

The framing bit alternates 1,0.

#### Status Bit

Set to 1 or 0 on transmitter and displayed on receiver.

**Channel Rate**

600, 1200, 2400, 4800, 9600, 19200 and 48000 bit/s.

**Bit Rate****Reiterated**

64 kbit/s.

**6+2 (non-reiterated)**

800, 1600, 3200, 6400, 12800, 25600, 64000, User.

**Reiteration**

7 bit and 8 bit.

**REMOTE LOOP ACTIVATION**

UK - Fixed word

Italy- Unstructured - Programmable 8 bit word.

Structured - Programmable 6 bit word.

DER Multipoint - Programmable tributary sequence number.

**INTERFACE****Codirectional, Contradirectional, V.11, TTL, 2048 kbit/s channel.****CODIRECTIONAL**

Line Signal Coding and Level to ITU-T Recommendation G.703.

**Transmit Timing**

Internal, Recovered 64 kbit/s clock, External 2048 kbit/s clock.

**Receive Timing**

Recovered 64 kbit/s clock.

**CONTRADIRECTIONAL**

Line Signal Coding and Level to ITU-T Recommendation G.703

**Transmit Timing**

Contradirectional, Internal, Recovered 64 kbit/s clock, External 2048 kbit/s clock.

**Receive Timing**

Contradirectional

**Connector (Co/Contra)**

15 way D-Type, ISO4903.

**Pinouts**

1,9	Transmit Data Out.
2,10	Transmit D&I Data In.
3,11	Receive Data In.
4,12	Transmit Clock Out.
5,13	Transmit Clock In.
6,14	Receive Clock Out.
7,15	Receive Clock In.
8	Earth.

Receiver Termination - Terminated, Bridging

**V.11****Transmit Timing**

V.11 input, Internal, Recovered 64 kbit/s clock, External 2048 kbit/s clock.

**Receive Timing**

V.11 input, Recovered 64 kbit/s clock.

**Codirectional, Contradirectional and EUROCOM D/1 (2850B, 2850BS, 2851 and 2851S)**

	<b>Codirectional</b>	<b>Contradirectional</b>	<b>EUROCOM D/1</b>
<b>Line Signal Coding Level</b>	To ITU-T Rec. G.703	To Rec.ITU-T G.703	TO EUROCOM D/1, IB6
<b>Bit Rate</b>	64 kbit/s	64 kbit/s	32, 64, 128, 256, 512, 1024, 2048 kbit/s
<b>Format</b>	Unstructured	Unstructured	Unstructured
<b>Transmit Timing</b>	Internal Receiver External 2048 kbit/s	Contradirectional Input Receiver Internal External 2048 kbit/s	Internal Receiver External (EUROCOM)
<b>Transmit Timing Output</b>	TTL at 64 kHz	TTL at 64 kHz	TTL at bit rate
<b>Receive Timing</b>	Receiver	Receiver	Receiver
<b>Connector</b>	15 way D-Type, ISO 4903	Contradirectional Input 15 way D-Type, ISO 4903	EUROCOM 15 way D-Type, ISO 4903
<b>Pinouts</b>	<b>Codirectional</b>	<b>Contradirectional</b>	<b>EUROCOM D/1</b>
1,9	Transmit Data Out (test interface) Transmit Data Out (receiver time slot access)	Transmit Data Out (test interface) Transmit Data Out (receiver time slot access)	Transmit Data Out
3,11	Receive Data In (test interface) Receive Data In (transmitter time slot access)	Receive Data In (test interface) Receive Data In (transmitter time slot access)	Receive Data In
5,13		Transmit Clock In (test interface)	Transmit Clock In (External)
7,15		Receive Clock In (test interface)	Receive Clock In
4,12		Transmit Clock Out (receiver time slot access and test interface)	Transmit Clock Out
2,6,8,14	Earth	Earth	Earth

**Connector**

15 way D-Type, ISO4903.

**Pinouts**

1,9	Transmit Data Out.
2,10	Transmit D&I Data In.
3,11	Receive Data In.
4,12	Transmit Clock Out.
5,13	Transmit Clock In.
6,14	Receive Clock Out.
7,15	Receive Clock In.
8	Earth.

Receiver Termination - Terminated, Bridging

**Via 2048 kbit/s channel**

64 kbit/s X.50 encoded signals can be inserted into a transmit 2048 kbit/s signal, and extracted from a receive 2048 kbit/s signal.

**Transmit and Receive Timing**

2048 kbit/s channel.

**TTL**

Transmit Timing, Internal TTL input, Recovered 64 kbit/s clock, External 1024 kbit/s clock.

**Receive Timing**

TTL input, Recovered 64 kbit/s clock.

**Level**

NRZ, Biphase (M), Biphase (S).

## Connector

15 way D-Type, ISO4903.

### Pinouts

1	Transmit Data Out.
2	Transmit D&I Data In.
3	Receive Data In.
4	Transmit Clock Out.
5	Transmit Clock In.
6	Receive Clock Out.
7	Receive Clock In.
8, 9, 11, 13	Earth.

## MODE

Transmit and receive are independent.

### Transmit

Test pattern inserted within selected sub-channel.

### Receive

Test pattern extracted from selected sub-channel and monitored for errors.

### Drop and Insert

64 kbit/s or 2048 kbit/s signal looped through and a test pattern inserted in a selected sub-channel of an X.50 signal.

For Receive and Drop and Insert the same or different sub-channel can be monitored for pattern errors on the receiver.

## TEST PATTERNS

### PRBS

$2^9-1$ ,  $2^{11}-1$ ,  $2^{15}-1$ ,  $2^{20}-1$ ,  $2^{23}-1$ .

### Programmable Word

12 bit word.

### FILL PATTERN

$2^7-1$  PRBS, Programmable 6 bit word.

## ERROR INJECTION

### Singly

by keypress.

### Fixed rate

$1 \times 10^{-2}$  to  $1 \times 10^{-8}$  in decade steps.

### Target

Framing bits, Data bits.

## AIS INJECTION

AIS can be injected into transmit data in programmable bursts.

### Burst Range

0.01 to 99.9s

### Burst resolution

0.01s

## ALARMS

### Transmitter

Tx no clock, D&I no clock, D&I no sync

### Receiver

Line, Frame, Framed Status Unsync, Errors, Distant, Pattern.

## MEASUREMENTS

### ERROR TYPES

#### PCM Interfaces

Line Code Errors (Bipolar violations).  
Pattern Errors.  
Framing Errors.  
CRC Errors.

#### Data Interfaces

Pattern Errors.

#### Structured Data

Pattern Errors, Framing Errors.

## MAIN PARAMETERS

Number of Errors.

Depends on PCM or Data Interface, Framing System and Test Mode

Long Term Mean Error Ratio (LTMER).  
Total Test Time.  
Number of Loss of Signal (LOS) seconds.  
Number of AIS seconds.  
Number of No Frame Alignment seconds.  
Number of No Pattern Sync seconds.  
Number of No CRC Sync seconds.

Octet Slips (Primary Rate PCM and 8448 kbit/s G.744 Systems only)

Octet slips are detected for single channel pattern measurements.

Number of positive and negative slips.  
Time since last slip.  
Time between last two slips.

Further measurements

One of the four error types is selected to be the basis for further measurements. The selection also controls the type of measurement presented as an error distribution with time and the source of errors routed to the rear panel ERRORS socket.

## ADDITIONAL PARAMETERS

### Current Error Ratio

#### Automatic

Error ratio measured using short term algorithm.

#### Fixed Gating

1, 2, 5 or 10 seconds.

### Burst Measurements

Number of bursts, Time between last two bursts, Time since last burst.

### Residual Bit Error Rate (Background Error Rate)

Long Term Mean Error Ratio excluding Severely Errored Seconds.

## G.821 ERROR PERFORMANCE

### Measurements

64 kbit/s channel availability measurements are made to ITU-T Recommendation G.821, while for higher rates a channel performance to G.821 Annex D is applied.

### Parameters

% Available Time  
Number of Errored Seconds  
% Error Free Seconds  
Number of Severely Errored Seconds (SES).  
% Non SES.  
Number of Degraded Minutes (DM).  
% Non DM.  
Number of Breaks.

## G.821/G.921 HISTOGRAMS

### Parameters

Errored Seconds (ES).  
Severely Errored Seconds (SES).  
Degraded Minutes (DM).  
Breaks.

### Test Length

Up to: 100 days, 100 hours, 50 hours, 25 hours.

### Resolution

100 days - 1 day.  
100 hours - 60 minutes.  
50 hours - 30 minutes.  
25 hours - 15 minutes.

### Parameter Limits

Limits calculated from user entered data and applied to selected resolution of 1 day, 60, 30 or 15 minutes. Histogram bar highlighted when limit exceeded.

### G.821 limits

User enters:

length in km for High Grade section of line.  
length in km for Medium Grade section of line.  
length in km for Local Grade section of line.  
The line can be a combination of grades.  
The limits for each are calculated and added.  
For a Local or Medium grade block allocation user enter 1.250 km.

### G.821 Limits (Radio)

As for G.821 except limits are degraded for adverse propagation conditions.

### G.921 limits

User enters:

length in km for Classification 1 section of line.  
length in km for Classification 2 section of line.  
length in km for Classification 3 section of line.  
length in km for Classification 4 section of line.

The line can be a combination of all Classifications. The block allocations are calculated for each and the overall limits totalized.

### G.921 Limits (Radio)

As for G.921 except limits are degraded for adverse propagation conditions.

### User defined limits

User enters the day, 15, 30 or 60 minute limit directly for each parameter. The period limits are then calculated.

### Display

Histogram page for each of four parameters.

### Printing Results

PRINT DISPLAY prints histogram plus text equivalent of results and setup.

SHIFT PRINT DISPLAY prints results for all four parameters for complete test.

## M.2100

Implementation of Interpretation for the Receive and Send Direction columns in Table B2/M.2100 for 2 Mbit/s signal (non CRC4) and 2 Mbit/s (CRC4).

User programmable thresholds S1 and S2 for ES (Errored Seconds), SES (Severely Errored Seconds) and US (Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold acti-

vation settable for each parameter YES/NO.

Parameter	S1 Limit	S2 Limit	Message
ES	XXXX	XXXX	ES > S1 limit or ES > S2 limit
SES	XXXX	XXXX	SES > S1 limit or SES > S2 limit
US	XXXX	XXXX	US > S1 limit or US > S2 limit

X=1 to 9

## G.826

Parameters

Number of Errored Blocks (EB).  
Number of Errored Seconds (ES).  
Number of Severely Errored Seconds (SES).  
Number of Background Block Errors (BBE).  
Errored Second Ratio (ESR).  
Severely Errored Second Ratio (SESER).  
Background Block Error Ratio (BBER).  
Unavailable Seconds (US).  
% Unavailable Seconds (%US)  
% Available Seconds (%AS)  
Number of Breaks.

User programmable thresholds for ESR (Errored Second Ratio), SESR (Severely Errored Second Ratio), BBER (Background Block Error Ratio) and %US (%Unavailable Seconds). Exceeding the threshold during a test causes message. Threshold activation settable for each parameter YES/NO.

Parameter	Limit	Message
ESR	X.XE-Y	ESR > limit
SESER	X.XE-Y	SESER > limit
BBER	X.XE-Y	BBER > limit
%US	X.XXXX	%US > limit

X=1 to 9, Y=2 to 8.

## STORED RESULTS

### Error Distribution and Histograms

The errors associated with the selected error type are stored, minute by minute, for later analysis.

### Accumulation Time

72 hours.

### Histogram

Page width

20 hours with a resolution of 1 hour.  
20 minutes with a resolution of 1 minute.  
The display is selectable from anywhere within the 72 hours.

### Display

The stored results are displayed as a histogram of errors. A cursor is moved to point at any hour or any minute. The number of errors, the number of errored seconds (ES) and the number of severely errored seconds (SES) for that interval are then displayed, together with the date and time.

Intervals of loss of synchronization and power loss are displayed on the baseline.

## TEST DURATION

When a test is started all previous results are cleared.

### Duration

Indefinite, Timed, Range - Programmable in the range 1 minute to 100 hours. Tests may be stopped at any time.

## PROPAGATION DELAY

Measured using a PRBS unframed test pattern to allow operation under high error rate conditions.

### Range

Up to 2 seconds.

### Resolution

1 bit period  $\pm 2$  microseconds.

### Update rate

Typically 2 seconds. Can be longer at low data rates.

## CHANNEL ASSOCIATED SIGNALING

Selected channel signaling analysis for systems incorporating channel associated signaling.

Display: Signaling Code

### 2048 kbit/s

Decimal and binary equivalent of current and previous signaling code Signaling code for all 30 channels simultaneously

### T1

Current and previous state of A and B bits  
Signaling code for all 24 channels simultaneously

### T1 ESF

Current and previous state A, B, C and D bits  
Signaling code for all 24 channels simultaneously

### Analysis

From a set of user entered values (signaling codes and mask limits), the last 20 dialled digits are displayed. An error indication is given if the mask limits are exceeded.

### Errors

Wrong signaling code.  
Dial break pulse too wide.  
Dial break pulse too narrow.  
Inter Dial break pulse too wide or inter digit pulse too narrow.  
Inter Dial break pulse too narrow.  
11 or more dial break pulses.

## C-BIT FRAMING

Monitoring of C-Bit Frame for French TRANSMIC-2G system.  
Display of C-Bit Frame message bits.

## DTMF SIGNALING

### (Dual tone multifrequency)

DTMF tones are generated and detected within  
64 kbit/s channels on 2048 kbit/s and 1544 kbit/s (T1) systems.

### Tone pairs (one from each group)

Low group - 697, 770, 852, 941 Hz.  
High group - 1209, 1336, 1477, 1633 Hz.

### Generator

Generation of tone digits by keyboard entry.

### Modes

Tone burst to preset length.  
Sequence preset up to 19 digits.  
Tone generated sent to loudspeaker if switched on.

### Receiver

Receipt and display of valid tone digits.  
No detection of short tones or other errors is provided.

## BIT RATE MEASUREMENT

The bit rate is measured every second displayed to nearest 1 Hz.

### Accuracy

$\pm 5$  ppm.

## DIGITAL SIGNAL LEVEL MEASUREMENT

The amplitude of the incoming digital signal is measured and displayed in Volts peak and dB relative to nominal.

### Range

+3 to -35 dB.

### Accuracy

+3 to -10 dB	$\pm 1.5$ dB
-10 to -20 dB	$\pm 2$ dB
-20 to -30 dB	$\pm 3$ dB.

## 2 CHANNEL SYNCHRONIZATION MEASUREMENT

The clocks are extracted from two primary rate digital signals and compared for synchronization.

One of the inputs is used as a reference.

A sync slip is registered for each bit of relative phase shift.

### Measurement

Number of slips in current second. Total slips since start of test.

### Timing measurement (DTE only)

Time intervals between changes of control lines.

### X.21

C and I.

### RS-449 (V.36)

RS and CS.

### V.35

RTS and CTS.

### RS-232

RTS and CTS.

### Range

0-10 s.

### Resolution

1 ms.

## PARAMETER RULES

### Loss of signal (LOS)

Errors in a loss of signal (LOS) second are discarded.

### Framing errors

Errors in a loss of frame (LOF) second are discarded.

### Pattern errors

Pattern errors are counted up to the point when pattern synchronization is lost. The count is suspended until synchronization is regained.

### CRC errors

Errors in any second with loss of CRC multiframe sync are discarded.

### Allowed Seconds

Seconds in which errors are not discarded.

### Error counts

Count displays reach 999,999,999 and then stop.

### **Errors ratios**

Displayed in the form  $X \times 10^Y$  where X is 1 to 9 and Y is 2 to 11.

### **Percentages**

Calculated to 6 decimal places and displayed rounded to 5.

### **Update rate**

Results and displays are updated every second.

### **Unavailable Time**

A period of unavailable time begins when the error ratio in each second is worse than  $1 \times 10^{-3}$  (or otherwise severely errored) for ten consecutive seconds. These ten seconds are considered part of the unavailable time. The period of unavailable time terminates when the error ratio in each second is better than  $1 \times 10^{-3}$  for ten consecutive seconds. These ten seconds are considered part of the available time.

### **Break**

A period of unavailable time.

### **Errored Seconds**

A second of available time in which one or more errors are detected.

### **Error Free Second**

A second of available time in which no errors are detected.

### **Severely Errored Seconds**

A second of available time in which the error ratio is worse than  $1 \times 10^{-3}$ .

A second of available time in which the CRC block error rate is greater than:

830 errored CRC blocks in 1 second for 2048 kbit/s systems (M.2100).

320 errored CRC blocks in 1 second for 1544 kbit/s system (M.2100).

Note that a one second interval containing loss of signal or loss of synchronization is considered to be a severely errored second.

### **Non Severely Errored Second**

A second of available time in which the error ratio is equal to or better than  $1 \times 10^{-3}$ .

### **Degraded Minute**

A one minute interval during which the error ratio is worse than  $1 \times 10^{-6}$ . The one minute intervals are obtained by ignoring unavailable time and severely errored seconds and consecutively grouping the remaining seconds.

### **Non Degraded Minute**

A one minute interval (as defined above) during which the error ratio is equal to or better than  $1 \times 10^{-6}$ .

## **MEASUREMENTS**

### **Total Test Time**

A count incremented once every second that the test is in progress. Displayed as days, hours, mins, seconds.

### **Number of Errors**

The total number of errors (to date or to end of test) in the allowed seconds.

### **Long Term Mean Error Ratio (LTMER)**

The ratio of Number of Errors to the Total Number of relevant bits.

### **Number of Loss of Signal (LOS) seconds**

The total number of seconds in which there was no input signal.

### **Loss of Signal events**

The number of blocks of consecutive Loss of Signal seconds.

### **Number of AIS seconds**

The total number of seconds in which an AIS is detected.

### **AIS events**

The number of blocks of consecutive AIS seconds. LOS seconds are not included.

### **Number of Loss of Frame Alignment (LOF) seconds**

The total number of seconds in which a Frame Alarm is detected.

### **Loss of Frame events**

The number of blocks of consecutive Loss of Frame seconds. LOS and AIS seconds are not included.

### **Number of Loss of Pattern Sync (LOP) seconds**

The total number of seconds during which there was no Pattern Sync.

### **Loss of Pattern Sync events**

The number of blocks of consecutive Loss of Pattern Sync seconds. LOS, AIS and LOF seconds are not included.

### **Number of Loss of CRC Sync (LOC) seconds**

The total number of seconds during which Loss of CRC Alignment (LOC) was detected.

### **Loss of CRC Sync events**

The number of blocks of consecutive Loss of CRC Sync seconds. LOS, AIS and LOF seconds are not included.

### **Short Term (Current) Error Ratio**

The Auto algorithm used results in a fast attack/slow decay response which responds quickly to a rise in error ratio but falls slowly when the error ratio decreases. Also 1, 2, 5, 10 seconds gating.

### **Number of Bursts**

The total number of bursts in the allowed seconds. A burst is defined as the detection of more than X errors in a multiframe where X may be set between 8 and 256.

### **Time Between Last Two Bursts**

The time between the last two bursts is displayed in hours, mins, sec, millisecs.

### **Time Since Last Burst**

The time since the last burst is displayed in hours, mins, sec, millisecs.

### **% Available Time**

The ratio of available time to total test time.

### **% Unavailable Time**

The ratio of unavailable time to total test time.

### **Number of Errored Seconds**

The total number of available seconds in which one or more errors were detected.

### **% Errored Seconds**

The ratio of errored seconds to available time.

### **% Error Free Seconds**

The ratio of errored seconds to available time.

### **Number of Severely Errored Seconds (SES)**

Total number of SES.

### **% Severely Errored Seconds**

The ratio of SES to available time.

### **% Non Severely Errored Seconds**

The ratio of non SES to available time.

### **Number of Degraded Minutes (DM)**

Total number of DM.

### **% Degraded Minutes**

The ratio of DM to available time.

### **% Non Degraded Minutes**

The ratio of non DM to available time.

### **Number of Breaks**

Total number of Breaks.

## **GENERAL CHARACTERISTICS**

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### **OPERATOR INTERFACE**

The instrument is controlled via a keyboard containing a data entry keypad, dedicated keys and five soft-keys used in conjunction with a Cold Cathode Backlit Liquid Crystal Display. The 8 line by 40 character (plus graphics capability) LCD and keyboard are fully interactive providing menu and soft-key operation.

### **DISPLAYS**

Transmit parameters.  
Receive parameters.  
Measurement Results including Stored Results.  
RS-232C Port parameters.  
Printer Type selection.  
Measurement definition.  
Autoprint definition.  
Setup Conditions (Stored Parameters).  
Current Status.

### **DISPLAY LANGUAGE**

English, French, Italian, Spanish. User Selectable.

### **AUDIBLE ALARM**

#### **Mode**

ON, OFF.

#### **ON**

Alarm sounds on detection of:

Loss of any sync/signal.  
Any errored second.

### **LOUDSPEAKER**

Selected 64 kbit/s channels can be routed to the loudspeaker. There is a volume control.

### **SETUP CONDITIONS (STORAGE FACILITY)**

A variety of information can be stored in non-volatile memory (battery backed-up).

#### **Last Operation**

The instrument retains all setup parameters when powered down. These are reinstated when the instrument is powered up.

#### **Configuration Stores**

18 sets of transmitter/receiver/test definition parameters can be selected for storage. Each set can be recalled whenever required, and can be identified with a 12 character label.

### **REAL TIME CLOCK**

Displays date and time.

### **Resolution**

One second.

### **Accuracy**

$\pm 1$  minute per week.

### **POWER FAIL/TEST CONTINUE**

If mains power is lost during a test, the test is resumed when power returns.

### **Indications**

Power Fail page, Autoprint output.

### **MULTIPLE TESTS STORAGE**

6 full sets of test results can be stored for later analysis and/or printing.

### **PRINT TO RAM**

Up to 8,000 print lines can be stored in memory for subsequent scrolling on screen with full or partial print capability. Where required Print to RAM results can be stored with associated test results.

### **KEYBOARD LOCKOUT**

The keyboard can be disabled whilst a test is running.

### **PRINTER FACILITIES**

#### **Page print or Autoprint printers**

40 column minimum.

#### **Page printing**

Page printouts are initiated by the PRINT key and cause the whole of the current page to be printed. Graphics display pages can be printed in a text equivalent or a facsimile to a suitable printer.

#### **Autoprinting**

The printer can be set automatically to print on the occurrence of any of the following (where applicable), each event printed with its date and time and two digit identity number. A twelve character label is also printed where appropriate:

Test start and stop.  
Loss and restoration of signal.  
Loss and restoration of alignment.  
Loss and restoration of pattern sync.  
Detection of errors (ES).  
Detection of burst errors.  
Detection of ISDN error report alarm pulse (2048 kbit/s ISDN system).  
Detection of change of state of bit 5 in Not Frame Word (2048 kbit/s ISDN system).  
Detection of alarms.  
Detection of octet slips.  
Detection of a short term (current) error ratio, for the selected major error type, crossing a user set threshold.  
Detection of change of signaling code.  
Cumulative printout at preselectable intervals of 15 mins, 30 mins, 1 hour, 6 hours, 12 hours or 24 hours.  
Stored results, G.821 results, and two channel synchronization slips may be included in interval print.  
Loss and restoration of power.

#### **Printer Operation**

Page printing, Long term collection of information via the Autoprint facility.

#### **Remote Control**

Remote commands are made up from a mixture of text and data.

Commands are grouped into logical sets and allow for ease of use and self-documenting control programs.

Most controls are remotely programmable.

#### **RS-232 PORT**

The RS-232 port is used for printer operations, remote control, or for duplication of the display onto a terminal.

#### **Type**

Asynchronous, DTE, Full Duplex.

#### **Bit Rates**

300, 600, 1200, 2400, 4800, 9600, 19200 and 38400 bit/s.

#### **Code**

ASCII

#### **Code bits/Parity/Stop bits**

7/Odd/1, 7/Even/1, 7/Odd/2, 7/Even/2, 8/None/1, 8/None/2.

#### **Handshake Hardware**

DTR, RTS, CTS and DSR

#### **Software**

XON and XOFF

#### **Lines Used**

#### **Tx DATA**

Pin 2

#### **RTS**

Pin 4

#### **DTR**

Pin 20

#### **Rx DATA**

Pin 3

#### **CTS**

Pin 5

#### **DSR**

Pin 6

#### **Connector**

25 way female D-type.

#### **Electrical**

To RS-232C/V.28.

#### **IEEE-488 (Option) (2850BS and 2851S only)**

#### **Remote Control**

Used for remote control or printer operations.

#### **LIMIT RANGE OF OPERATION**

#### **Temperature**

0 to 55°C.

#### **CONDITIONS OF STORAGE AND TRANSPORT**

#### **Temperature**

-40 to +70°C

#### **Humidity**

Up to 90% relative humidity (non condensing).

#### **Altitude**

Up to 2500 m (pressurized freight at 27 kPa differential).

#### **ELECTROMAGNETIC COMPATIBILITY**

Conforms with the protection requirements of the EEC Council Directive 89/336/EEC. Conforms with the limits specified in the following standards:

IEC/EN61326-1 : 1997, RF Emission Class B, Immunity Table 1, Performance Criteria B

#### **SAFETY**

Conforms with the requirements of EEC Council Directive 73/23/EEC (as amended) and the product safety standard IEC/EN 61010-1 : 2001 + C1 : 2002 + C2 : 2003 for Class 1 portable equipment, for use in a Pollution Degree 2 environment. The instrument is designed to be operated from an Installation Category 1 or 2 supply.

#### **POWER REQUIREMENTS**

#### **AC Operation**

#### **AC Voltage**

230 V nominal. 190 to 264 V.  
115 V nominal. 90 to 120 V.

#### **Frequency**

45 to 66 Hz.

#### **Consumption**

20 VA maximum.

#### **DC operation (Option)**

One of three options can be specified.

#### **48 V Range**

±36 to ±60 V.

#### **24 V Range**

±20 to ±60 V.

#### **12 V Range**

±10 to ±18 V.

#### **Battery operation (Option)**

#### **Operating time**

7 hours with backlight timeout of 5 minutes for temperature range of 17 to 27°C.

#### **Charge time**

15 hours.

#### **Temperature range for full nominal charge**

10 to 30°C.

#### **Temperature range for full nominal discharge**

0 to 50°C.

#### **Limit range of operation**

#### **Charge**

0 to 35°C.

#### **Discharge**

0 to 50°C.

#### **2850B and 2851**

Mounts under 2851.

## 2850BS and 2851S

Mounts inside 2851S.

### Weight

2.7 kg

### DIMENSIONS AND WEIGHT

	Height	Width	Depth	Weight
2850B/2851	110 mm max	353 mm	297 mm	4 kg
2850BS/2851S	197 mm	345 mm	477 mm	7.5 kg

### Auxiliary Connector 25 Way D-Type

Pin	Function
1-2	Earth
3	Transmit external TTL clock input
4	Alarm extension output
5	Transmit PRBS sync output
6	Receive PRBS sync output
7	+5 V
8	Pattern alternate input
9-13	Earth
14	Receive NRZ line data input
15	Receive NRZ clock data input
16	Errors input
17	Spare
18	Transmit TTL data output
19	Transmit NRZ 64 kbit/s data input/receive TTL data input
20	Receive NRZ 64 kbit/s clock output
21	Receive NRZ 64 kbit/s data output
22	Transmit NRZ line data output
23	Transmit NRZ line clock output/transmit TTL clock output
24	Receive demultiplex clock output
25	Receive demultiplex data output

## VERSIONS AND ACCESSORIES

When ordering please quote the full ordering number information.

### Ordering Numbers

#### Versions

2850B	Desktop version
2850BS	Metal case version
2851	Desktop version
2851S	Metal case version

#### Supplied Accessories

43123/076	Supply Lead
41690/485	Stowage Cover (2851S only)
46884/604	Audio jacks plus (Qty 2)
46884/403	15 Way D-Type Connector
54311/125	X.21 Adaptor Lead - V.11, DTE
54311/127	RS-449 Adaptor Lead - V.11, DTE
54311/131	V.35 Adaptor lead - DTE
46882/128	Operating Manual
46882/127	Introductory guide

#### Optional Accessories

46880/004	Service manual
54311/126	X.21 Adaptor lead-V.10, DTE, female
54311/140	X.21 Adaptor lead-V.11, DCE, female
54311/141	X.21 Adaptor lead-V.10, DCE, female
54311/128	RS-449 Adaptor lead-V.10, DTE female
54311/142	RS-449 Adaptor lead-V.11, DCE female
54311/143	RS-449 Adaptor lead-V.10, DCE female
54311/144	V.35 Adaptor lead-DCE, female
54311/152	RS-232 Adaptor lead-DCE, female
54311/121	RS-232 lead-male to male-25 way D type - 1.5 m
54311/122	X.21 lead-male to male-15 way D type 1.5 m
54311/147	RS-449 lead-male to male-37 way D type 1.5 m
82520	RS-449 to RS-530 adapter lead, 1.5 m male to male
54311/148	V.35 lead-male to male- 34 way MRAC 1.5 m
54311/130	Co/contradirectional test lead-15 way D type to free end
43129/189	IEEE-448 lead (2851S)
46662/387	RS-232 null modem female to male
54717/040	Kyosha printer including power supply and data lead
54311/216	RS-232 special lead Scriptos to 2850B/2851
46662/260	Scriptos paper 10 pack

46883/805	Signal lead balanced (CF-CF)
54311/210	Signal lead unbalanced - (BNC-BNC)
46662/388	BNC to 1.6/5.6 adaptor
46884/402	D-type connector 25 way
46662/490	Hard carrying case (2850B/2851)
46662/493	Soft carrying case (2850B and 2851)
46662/192	Transit case (2850BS/2851S)
54112/157	Soft carrying case (2850BS/2851S)
44991/035	Remote applications software: single licence version
44991/039	Remote applications software: site licence version
46883/852	Null modem (female to female)
46883/824	Gender changer (female to female)
54127/309	Rack mount kit (2850BS to 2851S only)
46662/607	Codirectional test lead 15 way D-type to RTG16 - 2 m
49000/002	Remote Applications Software single user licence
49000/003	Remote Applications Software 20 user licence

Option	Allowed Combinations				Description
01	★	★	★	★	2048 & 8448 kbit/s
02		★			Add 1544 kbits
03			★		Add 704 kbit/s.
04				★	Add 704 kbit/s, T1, T1C, T2 (No ALBO)
08	†	†	†	†	French key panel.
09	†	†	†	†	1.6/5.6 Connectors
12	†	†	†	†	Battery
13	†	†	†	†	IEEE-488 (2850BS and 2851S).
15	†	†	†	†	DC Input - $\pm 36$ V to $\pm 60$ V (includes cable)
16	†	†	†	†	DC Input - $\pm 20$ V to $\pm 36$ V (includes cable)
17	†	†	†	†	DC Input - $\pm 10$ V to $\pm 18$ V (includes cable)
22	†	†	†	†	EUROCOM D/1 IB6
23	†	†	†	†	Interface switching unit (2851S)
24	†	†	†	†	Structured data (X.50, 6+2, reiterated data)
25	†				EUROCOM D/1 IB5 and IB6
26	†	†	†	†	V.11 data rate to 9 Mbit/s
<p>★ Basic options      Option 13 is available only on 2850BS and 2851S</p> <p>† Additional options    Option 15, 16, 17 and 24 are mutually exclusive on 2850B and 2851</p> <p>Options 15, 16 and 17 are mutually exclusive</p> <p>For Option 24, the TTL interface is not available on 2850B and 2851</p>					

**CHINA Beijing**

Tel: [+86] (10) 6467 2761 2716  
Fax: [+86] (10) 6467 2821

**CHINA Shanghai**

Tel: [+86] (21) 6282 8001  
Fax: [+86] (21) 62828 8002

**FINLAND**

Tel: [+358] (9) 2709 5541  
Fax: [+358] (9) 804 2441

**FRANCE**

Tel: [+33] 1 60 79 96 00  
Fax: [+33] 1 60 77 69 22

**GERMANY**

Tel: [+49] 8131 2926-0  
Fax: [+49] 8131 2926-130

**HONG KONG**

Tel: [+852] 2832 7988  
Fax: [+852] 2834 5364

**INDIA**

Tel: [+91] 80 5115 4501  
Fax: [+91] 80 5115 4502

**KOREA**

Tel: [+82] (2) 3424 2719  
Fax: [+82] (2) 3424 8620

**SCANDINAVIA**

Tel: [+45] 9614 0045  
Fax: [+45] 9614 0047

**SPAIN**

Tel: [+34] (91) 640 11 34  
Fax: [+34] (91) 640 06 40

**UK Burnham**

Tel: [+44] (0) 1682 604455  
Fax: [+44] (0) 1682 662017

**UK Stevenage**

Tel: [+44] (0) 1438 742200  
Fax: [+44] (0) 1438 727601  
Freephone: 0800 282388

**USA**

Tel: [+1] (316) 522 4981  
Fax: [+1] (316) 522 1360  
Toll Free: 800 835 2352

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[www.aeroflex.com](http://www.aeroflex.com)  
[info-test@eroflex.com](mailto:info-test@eroflex.com)



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