2850B & 2850BS/2851 & 2851S
Digital Analyzers

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, 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, North American 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.

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.

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 unframed 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 x 64 kbit/s and other rates.

2850B/BS, 2851/S

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 severely 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 disruption of service to other in-traffic channels.

http://www.ifrinternational.com

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 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, 07
704 kbit/s - 10 Channel System.

02, 04, 05
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, 06, 07
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, 05
3152 kbit/s - DS1C mode 1 synchronous
3152 kbit/s - DS1C mode 2 asynchronous.

04, 05
6312 kbit/s - DS2 96 channels synchronous
6312 kbit/s - DS2 asynchronous
6312 kbit/s - 2048 kbit/s interworking to G.747.

01, 07
8448 kbit/s - G.742 asynchronous
8448 kbit/s - G.745 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 $Mx10^{-N}$, where M is 1-9 and N is 2-7.

CLOCK SOURCE
Internal, external or derived from the received signal.

INTERNAL

Accuracy
±5 ppm from 0°C to 55°C.
±3 ppm/year.

Small Offset
Steps of 5 and 25 ppm to maximum of ±150 ppm.

Large Offset
Up to 2.5 MHz
Steps of 2 kHz to maximum of ±96 kHz.
Over 2.5 MHz
Steps of 8 kHz to maximum of ±96 kHz.

External

Range
1 kHz to 11 MHz.

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

Impedance
1000 Ω.

Connector
BNC.

CLOCK OUTPUT
TTL via 50 Ω.

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

Insertion
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.
µ-Law for 1544 kbit/s.

Impedance
600 Ω 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 ±1 to 0 and 0 to ±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 3×10^{-1} to 1×10^{-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 ´ the number of errors in the burst eg. a burst length of 16 at a rate of 2×10^{-6} will measure 3.2×10^{-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

European versions
120 Ω.

North American versions
105 Ω.

Peak Voltage
3 V ±0.3 V.

Space Voltage
0 V ±0.3 V.

Unbalanced

Impedance
75 Ω.

Peak Voltage
2.37 V ±0.237 V.

Space Voltage
0 V ±0.237 V.

NRZ
TTL.

CABLE SIMULATOR

North American versions only
1000 ±100 feet of 22 gauge ABAM cable to Bell TA-TSY-000009.

SIGNALING BIT CONTROL
For framing systems with Channel Associated Signaling capability:
The signaling bits can be changed.
Dialled 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

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
±50 ppm.
1544 kbit/s
±130 ppm.
2048 kbit/s
±50 ppm.
3152 kbit/s
±30 ppm.
6312 kbit/s
±33 ppm.
8448 kbit/s
±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) or at 1544 kbit/s for option 05 (except when option 07 fitted).

BALANCED	Terminated	Bridging
Impedance		
European Versions	120 Ω	>1000 Ω
North American Versions	105 Ω	>1000 Ω
Level		
Normal European Versions	3 V + 2 -6 dB	3 V + 2 -6 dB
North American Versions	3 V +2 -6 dB	3 V +2 -6 dB

ALBO		
European Versions	3 V - 3 -30 dB	3 V - 3 -30 dB
North American Versions	3 V - 3 -30 dB	3 V - 3 -30 dB
UNBALANCED	**Terminated**	**Bridging**
Impedance	75 Ω	>1000 Ω
Level:		
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
BALANCED	**Monitor (-30 dB)**	**Monitor (-20 dB)**
Impedance		
European Versions	120 Ω (3000 Ω)	120 Ω (1000 Ω)
North American Versions		105 Ω (860 Ω)
Level:		
Normal		
European Versions	115 mV +2 -6 dB	300 mV + 2 -6 dB
North American Versions		325 mV +2 -6 dB
ALBO		
European Versions	115 mV - 3 -30 dB	300 mV - 3 -30 dB
North American Versions		325 mV - 3 -30 dB
UNBALANCED	**Monitor (-30 dB)**	**Monitor (-20 dB)**
Impedance	75 Ω (2400 Ω)	75 Ω (680 Ω)
Level		
Normal	75 mV + 2 -6 dB	237 mV + 2 -6 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.
μ-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 fame 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 1×10^{-9} to 9×10^{-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, RS-449 (V.36), V.35 and RS-232
2851 and 2851S only.

X.21, 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	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).

2850B/BS, 2851/S

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	NRZ.
(V.10, V11)	Biphase Mark.
	Biphase Space.

Input Impedance

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

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	
A.sync.	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.

X.21 -DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
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.

RS-449 (V.36) - DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
4, 22	SD Send Data	103	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.

V.35 - DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
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.

RS-232 - DTE/DCE

Pins	From DTE (To DCE)	Circuit	Pins	To DTE (From DCE)	Circuit
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 ready	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	109
7, 1	Ground		25	Test mode	142

Control Lines

X.21

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

RS-449 (V.36)

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

V.35

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

RS-232

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 signal 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 ready)	DSR (data set ready)	(normally ON when Transmitter On and OFF when Transmitter OFF).
	RLSD (receive line signal detect)	Settable to ON or OFF.
	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

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 $3x10^{-1}$ to $1x10^{-7}$ (sync only)

http://www.ifrinternational.com

ALARMS
Line.
Errors.
Pattern.

SYNC OUTPUTS
PRBS transmit and receive.

Polarity
Negative pulse.

Interface
TTL

Pulse width
50% of bit interval.

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.
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.

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

	Codirectional	Contradirectional	EUROCOM D/1
Line Signal Coding Level	To ITU-T Rec. G.703	To Rec.ITU-T G.703	TO EUROCOM D/1, IB6
Bit Rate	64 kbit/s	64 kbit/s	32, 64, 128, 256, 512, 1024, 2048 kbit/s
Format	Unstructured	Unstructured	Unstructured
Transmit Timing	Internal Receiver External 2048 kbit/s	Contradirectional Input Receiver Internal External 2048 kbit/s	Internal Receiver External (EUROCOM)
Transmit Timing Output	TTL at 64 kHz	TTL at 64 kHz	TTL at bit rate
Receive Timing			
Connector	15 way D-Type, ISO 4903	15 way D-Type, ISO 4903	15 way D-Type, ISO 4903

Pinouts	Codirectional	Contradirectional	EUROCOM D/1
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

2850B/BS, 2851/S

ERROR INJECTION

Singly
by keypress.

Fixed rate
1×10^{-2} to 1×10^{-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 Radio (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 1250 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 activation 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 (SESR).
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
SESR	X.XE-Y	SESR > 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 ±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
±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.
 ±1.5 dB
-10 to -20 dB.
 ±2 dB
-20 to -30 dB.
 ±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 $Xx10^y$ 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 $1x10^{-3}$ (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 $1x10^{-3}$ 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 $1x10^{-3}$.
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 $1x10^{-3}$.

Degraded Minute
A one minute interval during which the error ratio is worse than $1x10^{-6}$. 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 $1x10^{-6}$.

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

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.

2850B/BS, 2851/S

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
±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℃.

Safety
Complies with IEC 348, HD401 for class 1 portable equipment and is for use in a pollution degree 2 environment. The instrument is designed to operate from an installation category 1 or 2 supply.

CONDITIONS OF STORAGE AND TRANSPORT

Temperature
-40 to +70℃

Humidity
Up to 90% relative humidity (non condensing).

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

ELECTROMAGNETIC COMPATIBILITY
Conforms to the protection requirement of Council Directive 89/336/EEC.
Complies with the limits specified in the following standards:
BS EN 55011 Class B CISPR 11.
BS EN 50082-1 IEC 801-2, 3, 4.
BS EN 60555-2 IEC 555-2

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.

48V 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℃.

Charge time
15 hours.

Temperature range for full nominal charge
10 to 30℃.

Temperature range for full nominal discharge
0 to 50℃.

Limit range of operation

Charge
0 to 35℃.

Discharge
0 to 50℃.

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	Recevie 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	Tranmit 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 order 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	Common
54311-126	X.21 Adaptor lead-V.10, DTE, female	Common
54311-140	X.21 Adaptor lead-V.11, DCE, female	Common
54311-141	X.21 Adaptor lead-V.10, DCE, female	Common
54311-128	RS-449 Adaptor lead-V.10, DTE female	Common
54311-142	RS-449 Adaptor lead-V.10, DCE female	Common
54311-143	RS-449 Adaptor lead-V.10, DCE female	Common
54311-144	V.35 Adaptor lead-DCE, female	Common
54311-152	RS-232 Adaptor lead-DCE, female	Common
54311-121	RS-232 lead-male to male-25 way D type - 1.5 m	Common
54311-122	X.21 lead-male to male-15 way D type 1.5 m	Common
54311-147	RS-449 lead-male to male-37 way D type 1.5 m	Common
54311-148	V.35 lead-male to male- 34 way MRAC 1.5 m	Common
54311-130	Co/contradirectional test lead-15 way D type to free end	Common
43129-189	IEEE-448 lead (2851S)	Common
46662-387	RS-232 null modem female to male	Common
54717-039	Scriptos printer	Common
54311-216	RS-232 special lead Scriptos to 2850B/2851	Common
46662-260	Scriptos paper 10 pack	Common
46662-383	Bantam/310 adaptor	N American
46662-491	Signal lead Bantam/Bantam	N American
46662-384	Signal lead 310/Bantam	N American
46662-382	Bantam plug	N American
46883-805	Signal lead balanced (CF-CF)	European
54311-210	Signal lead unbalanced - (BNC-BNC)	European
46662-388	BNC to 1.6/5.6 adaptor	European
46884-402	D-type connector 25 way	Common
46662-490	Hard carrying case (2850B/2851)	Common
46662-493	Soft carrying case (2850B and 2851)	Common
46662-192	Transit case (2850BS/2851S)	Common
46662-499	Soft carrying case (2850BS/2851S)	Common
44991-035	Remote applications software: single licence version	Common
44991-039	Remote applications software: site licence version	Common
46883-852	Null modem (female to female)	Common
46883-824	Gender changer (female to female)	Common
54127-309	Rack mount kit (2850BS to 2851S only)	Common
46662-607	Codirectional test lead 15 way D-type to RTG16 - 2 m	European
49000-002	Remote Applications Software single user licence	Common
49000-003	Remote Applications Software 20 user licence	Common

Option	Allowed Combinations							Description
01	★	★	★	★				European - 2048 & 8448 kbit/s
02		★						European - Add 1544 kbits
03			★					European - Add 704 kbit/s.
04				★				European - Add 704 kbit/s, T1, T1C, T2 (No ALBO)
05					★	★	★	North American - T1, T1C, T2
06						★		North American - 2048 kbit/s instead of T2
07							★	North American - Add 704, 2048, 8448 kbit/s (No ALBO)
08	†	†	†	†				French key panel.
09	†	†	†	†				1.6/5.6 Connectors
12	†	†	†	†	†	†	†	Battery
13	†	†	†	†	†	†	†	IEEE-488 (2852S and 2853S).
15	†	†	†	†	†	†	†	DC Input - ±36 V to ±60 V (includes cable)
16	†	†	†	†	†	†	†	DC Input - ±20 V to ±36 V (includes cable)
17	†	†	†	†	†	†	†	DC Input - ±10 V to ±18 V (includes cable)
22	†	†	†	†	†	†	†	EUROCOM D/1 IB6
23	†	†	†	†	†	†	†	Interface switching unit (2850S)
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

★ Basic options
† Additional options
Options 15, 16 and 17 are mutually exclusive

Option 12 is available only on 2850BS and 2851S
Option 15, 16, 17 and 24 are mutually exclusive on 2850B and 2851
For Option 24, the TTL interface is not available on 2850B and 2851