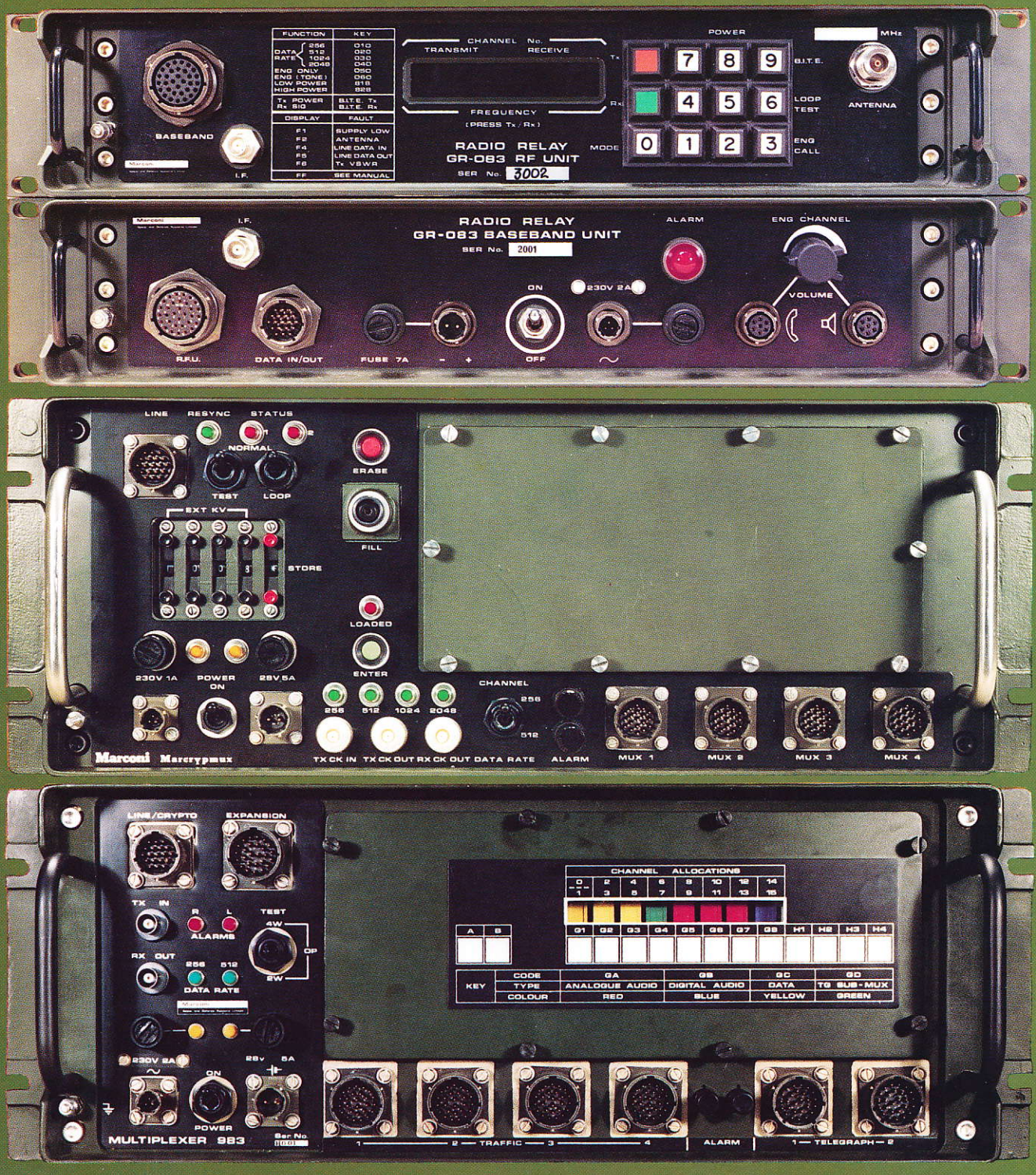
MUX 983
Signal Multiplexer

Marconi
Secure Radio Systems

MUX 983 - Flexible Signal &



Data Handling System for Mode

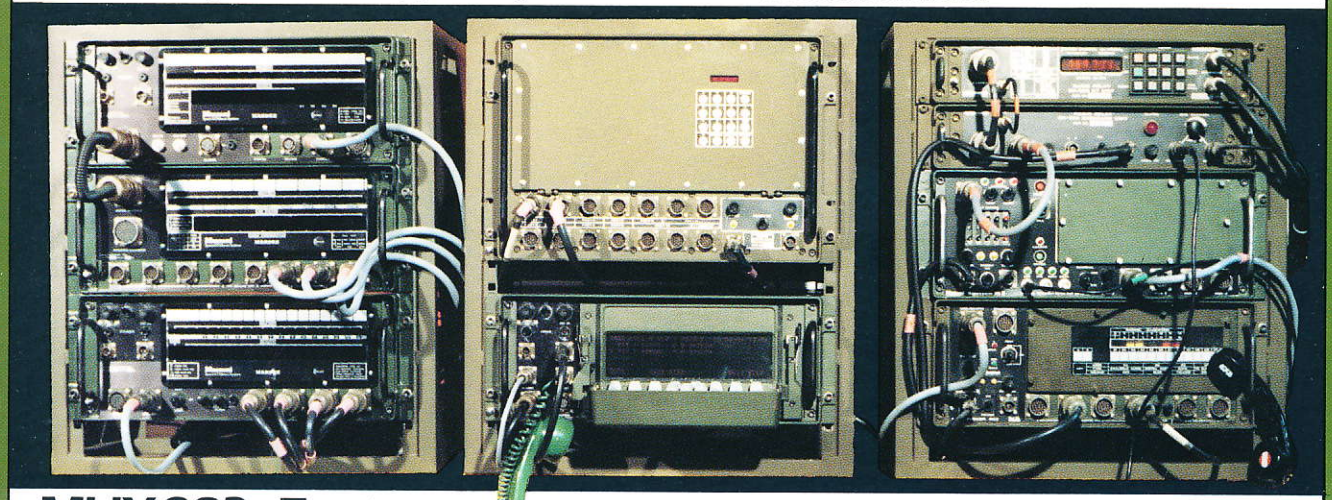
MUX 983 - System Modularity for greater flexibility

MULTIPLEXER 983 is a new versatile time-division multiplexer conforming to the EUROCOM standard specifying 15 Traffic channels, delta modulation at 16/32 kbit/s per channel, and a total output of 256/512 kbit/s. MUX 983 is designed as a 'second generation' EUROCOM multiplexer and offers:

- The high immunity to noise inherent in digital transmission.
- The opportunity to employ bulk encryption. (MARCRYP MUX developed by Marconi, is a bulk encryption equipment designed to be fully compatible, mechanically and electrically, with MUX 983 to provide economic high quality, bulk encryption.)
- The bandwidth, speech quality, and immunity to link errors advantages of the SCALE (Syllabically Companded and Logically Encoded) system of delta modulation.
- Modular design.
- Great flexibility of channel allocation to speech, facsimile synchronous and asynchronous data telegraph and separate channel signalling traffic.
- Low speed telegraph/separate channel signalling via a telegraph sub-multiplexer giving 15 channels within one speech channel.

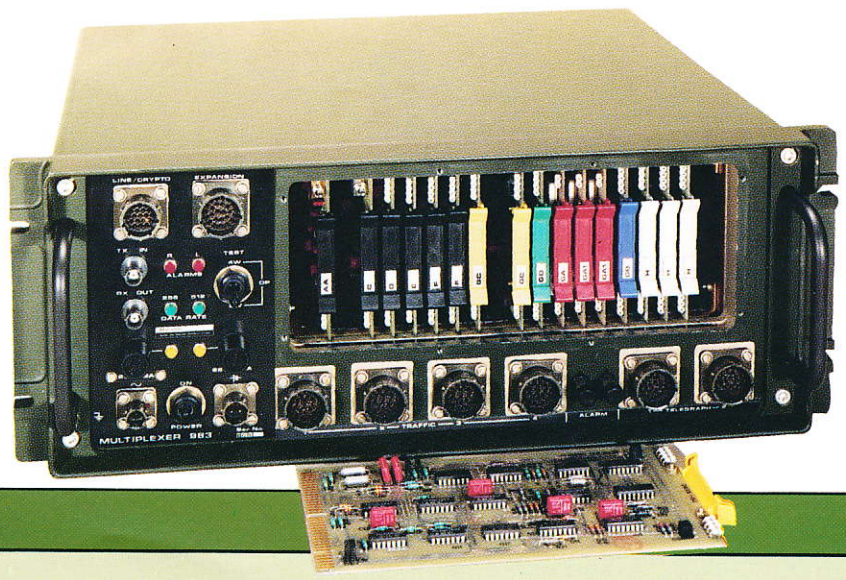
Additionally, MUX 983 incorporates interfaces for magneto signalling systems, existing standard 4 wire plus E and M facilities and 2 wire central battery to exchange.

The multiplexer can also be used in fixed digital communications networks.



MUX 983 - Features

- EUROCOM compatible
- Compact, reliable, ruggedised construction
- Modular design for greater flexibility
- 15 quality Traffic channels per unit
- 15 submux telegraph/separate channel signalling channels on one traffic channel
- Direct data access
- Eurocom Delta Modulation
- Digital Time Division Multiplexing
- Rapid channel reconfiguration via front panel access
- AC and DC power supplies with automatic changeover
- Low power consumption
- Easy to use
- Standard 19 inch rack mounting
- Comprehensive, built-in test facilities



rn Military Communications...

MUX 983 - The System in detail

The flexibility of MUX 983 is illustrated overleaf. The multiplexer channels are accessed in pairs by interchangeable plug-in boards of four different kinds (described later). Channel 0 is always allocated to multiplexer framing and so is not accessed by whatever board is fitted in the first position. The boards may be selected in any combination up to a total of eight boards with the single restriction that not more than one telegraph sub-multiplexer board can be fitted. Channels may be left unused with no effect on the other channels.

The link capacity can be increased by working two multiplexers in parallel, then channels 0 to 15 of the slave multiplexer become channels 16 to 31 of the combination and, in this case, channel 16 is accessible. Using Marcryp mux up to 4 such pairs can be arranged to provide up to 124 Traffic channels.

Allocation of channels to traffic types is made by fitting the selected combination of boards. A removable cover on the equipment front panel allows very simple fitting of the boards with the equipment in situ. A 'wipe-clean' label in the front panel facilitates recording the board fit for various roles.

TRAFFIC BOARDS

Analogue Audio Boards each code/decode two speech channels using SCALE delta modulation. The circuits are implemented by thick film hybrid techniques resulting in excellent reliability and high component packaging density. The excellent speech quality obtained with SCALE delta modulation working at the multiplexer frame rate of 32,000 samples/second is suitable for multi-hop communication previously achieved with 6-bit p.c.m. at 48,000bit/s. SCALE delta modulation has a dynamic range of 34dB and so can accommodate wide variations in speech level.

Two types of Analogue Audio Boards are available:

GA Board which provides for 2-wire or 4-wire operation with either ring-down magneto or E and M signalling.

GG Board which provides for 2-wire operation only with either ring-down magneto or CB auto extension signalling.

Asynchronous Data Boards each process two channels of asynchronous data at rates up to 4800bit/s for access to the multiplexer channels. Link error rates of 1% are reduced by the system to data error rate of 0.01%.

Telegraph Sub-Multiplexer Board multiplexes up to 15 telegraph channels to the selected multiplexer channel. Separate boards, which may be fitted in up to four specific positions in the equipment, each interface up to four CCITT V24 telegraph channels to the sub-multiplexer. The 16th interface is not available. Each telegraph interface will process signals at up to 100bit/s. Link error rates of 1% are reduced by the system to telegraph error rates of 0.01%. HA interface boards each provide up to 4 separate channel signalling – E and M – over the Telegraph sub– multiplexer facility.

Synchronous Data Digital Audio Boards each provide digital access to two multiplexer channels at the channel bit rate. These also allow any channels to be patched through from one multiplexer to another within the node without digital-analogue-digital conversion thus avoiding the degradation implicit in such conversions. They are recommended for use particularly where such patching is required for 16kbit/s speech channels (32kbit/s channels are more tolerant of conversions).

SYNCHRONIZATION

The frame synchronization pattern conforms to EUROCOM standards and occupies channel 0. The synchronization process is optimized to work in high error-rate conditions to match the capability of the speech channels. Polarity of the framing pattern is used to indicate synchronization, or the lack of it, to the remote multiplexer. A Housekeeping signal is provided to control the synchronization of the MARCRYP MUX bulk encrypter. Local and remote frame synchronization states are displayed by front panel indicators.

SIGNALLING

Various forms of signalling are available on the speech circuits. The multiplexer speech channel interfaces are compatible with 2-wire magneto systems, existing standard 4-wire plus E and M facilities and 2-wire CB auto extension signalling.

INCREASED CAPACITY

Link capacity can be increased by interconnecting multiplexers in various configurations as shown overleaf. Further expansion is possible using MARCRYP MUX in a super-multiplex configuration.

DELTA MODULATION

Delta modulation has been chosen by EUROCOM in preference to pulse code modulation (p.c.m.) as it enables up to four times the number of audio channels to be transmitted in the same bandwidth. Each sample of the analogue signal is converted to a single digital bit, either '1' or '0', to indicate that the new sample is higher or lower than the level represented at the previous sample. When decoded and smoothed the original analogue signal is reproduced. Delta modulation also has the advantage over p.c.m. in that it is less susceptible to link transmission errors as all bits in a delta coded signal have equal significance. The dynamic range is enhanced by a digital method of companding, invented by Marconi and since adopted as a EUROCOM standard. The method is SCALE (Syllabically Companded and Logically Encoded) delta modulation.

POWER SUPPLIES

MUX 983 will operate from either 24V d.c. vehicle supplies or from 115V/220V a.c. supplies. In the event of a.c. mains failure there is automatic switch over to 24V d.c. battery supply, providing 'no break' operation.

TEST FACILITIES

Built-in test facilities provide for two forms of loop test. In one of these the composite data is linked internally from multiplexer to demultiplexer so that each channel is routed back to itself thus checking 4-wire speech and telegraph paths. For 2-wire loop testing, the receive sections of a channel pair on one board are electrically interchanged so that communication between associated channel pairs may take place. All plug-in boards, not only the interchangeable traffic type boards, are accessible via the cover on the front panel.

System Introduction

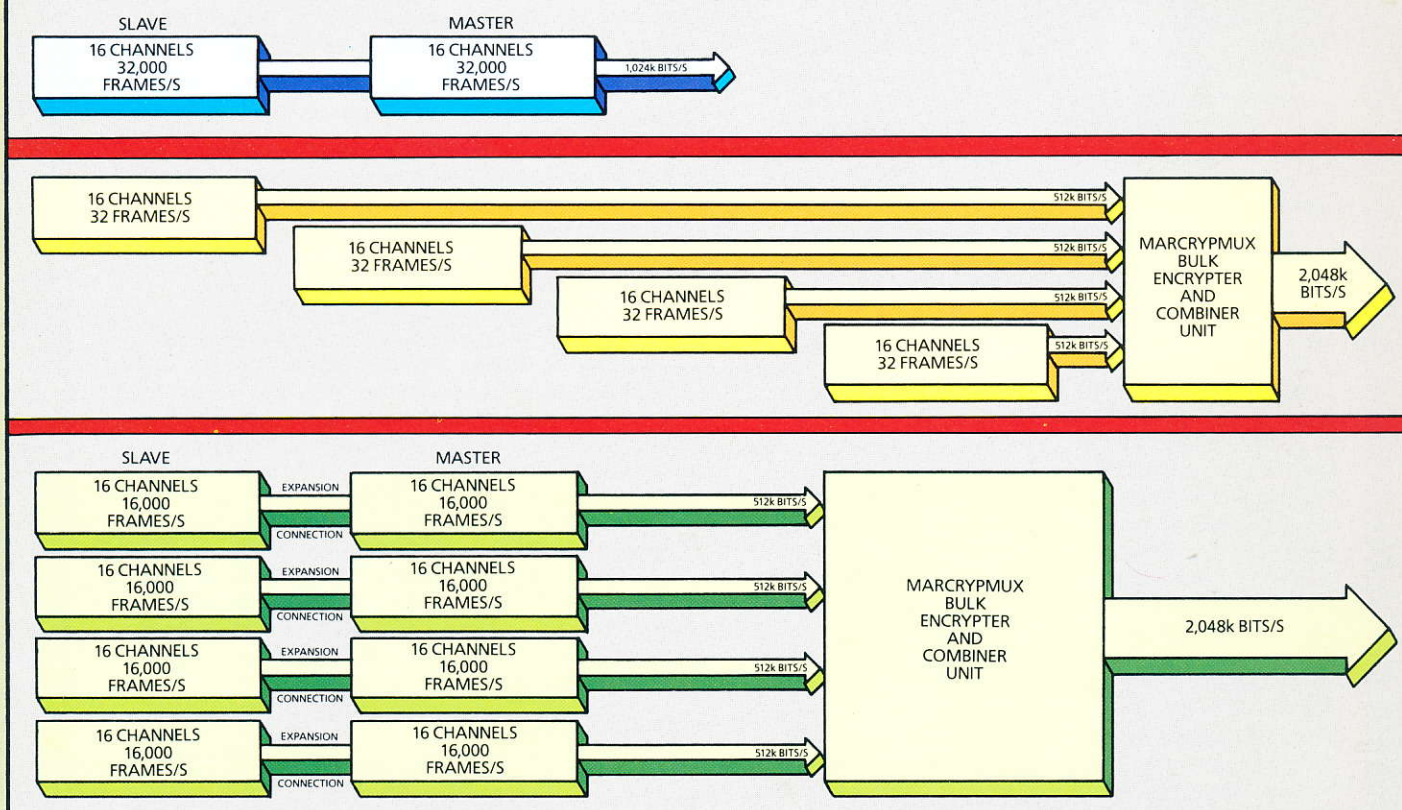
In order to maintain its effectiveness against an enemy possessing a high degree of mobility, the Army of Today, whatever its size, requires comprehensive communications networks stretching from General Headquarters down to at least Brigade and in some cases to Battalion level.

In a modern digital radio relay system, these communications will require that groups of signals be transmitted simultaneously from a number of varying sources and in different formats – both digital and analogue. The advantages of such a system are obvious, and together with the opportunity to employ efficient bulk encryption, signal multiplexing is an essential part of a modern tactical communication network.

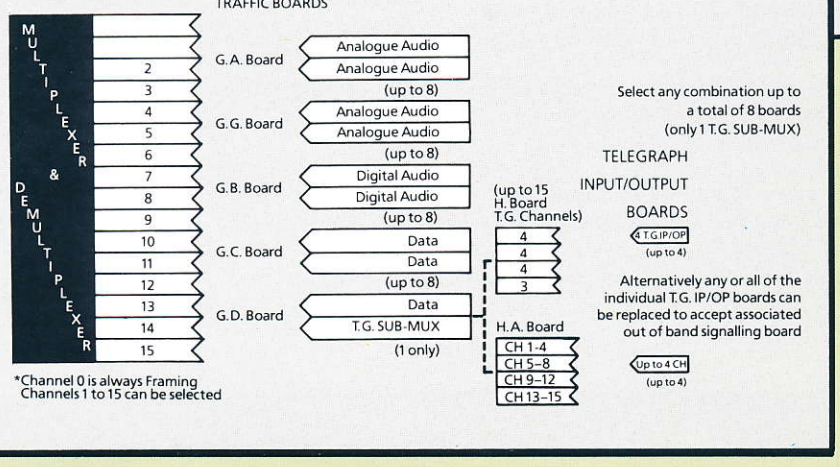
MUX 983, Marconi's advanced Time Division Multiplexer, is part of a comprehensive Military Radio Relay System CLAYMORE designed to meet modern military requirements. MUX 983 will interface with all other components in this system which includes a bulk encryption device (MARCRYP MUX) and, indeed, with other existing systems. Its modular design makes it flexible for tailoring to customer's requirements and for ease of future expansion.

MUX 983 employs highly sophisticated multiplexing techniques, the result of years of Marconi experience and expertise in digital signal technology.

Typical MUX 983 Configurations



Flexibility of Channel Allocation



MUX 983

Optional Equipment

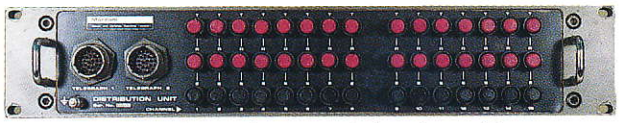
Access to the multiplexer can be provided by the following optional equipment.

AUDIO DISTRIBUTION UNIT

A single Audio Distribution Unit (ADU) provides access for up to 8 traffic channels. These channels are accessed by open ended cables by means of individual spring loaded terminal posts. Each channel has six wires associated with it to include 2 or 4 wire working with either E and M signalling or data timing. In additon, terminals are provided for common earths. Alternatively access may be direct from a vehicle input panel.

MUX 983 has been developed with the next generation of military systems peripherals and capabilities in mind.

TELEGRAPH DISTRIBUTION UNIT



A single Telegraph Distribution Unit (TDU) provides access for the direct connection of up to fifteen teleprinters having the CCITT V24 interface. The channels are accessed by open ended cables by means of individual spring loaded terminal ports and each channel has three wires associated with it to include Transmit, Receive and Common Return. However, as teleprinters already deployed in the field may not have the V24/V28 interface, a Marconi high level Telegraph Converter Unit (TCU) is available. This unit provides conversion between the V24/V28 (6 volt) standard of the multiplexer and the drive levels associated with double and single current in-service teleprinters. Full or half duplex operation per channel, in conjunction with the associated front panel Local Record control, is available and a further preset control allows the individual adjustment of the receive loop current; current is also supplied in the transmit contact loop to drive peripheral equipment such as tape transmitters.

LINE TERMINATION UNIT

Data Summary

SUBSCRIBER CAPACITY

Max. No of Speech Channels	Single Multiplexer	Two Multiplexers in parallel
Without telegraph sub-mux	15	31
With one telegraph sub-mux	14	30
With two telegraph sub-mux	N/A	29
Max. No of Telegraph Channels		
With one telegraph sub-mux	15	15
With two telegraph sub-mux	N/A	30
Data Rate for Speech Channels	16/32 kbit/s	16/32 k/bit/s
Composite Output Rate	256/512 kbit/s	512/1024 k/bit/s

SUBSCRIBER INTERFACE

Audio	
Frequency response	+2, −6dB, 300Hz–600Hz ±2dB, 600Hz–3000Hz +2, −6dB, 3000Hz–3400Hz
Input/output impedance	600 nominal balanced
Input level, 4-wire	−4dBm
2-wire	0dBm
Output level	−4dBm
A–D conversion	Delta modulation with 3-bit syllabic companding to give dynamic range of 34dB and return loss >16dB (300Hz to 3000Hz)
Signalling (1)	Magneto
(2)	Standard E and M
(3)	CB Auto Extension
Telegraph	To CCITT V24 (6-0-6 unbalanced, V28 levels) Up to 100 bauds.
Error rate	Better than 1 in 10^4 for trunk error rate of 1 in 100
Asynchronous Data	To CCITT V24 (unbalanced). Up to 4800 bauds
Synchronous Data/ Digital Audio	To CCITT V24 (unbalanced) 16/32 kbit/s

LINE INTERFACE AS EUROCOM

Data rate	256/512/1024 kbit/s ± 15 × 10^{-6}
Impedance	130 balanced and not referred to ground
Signals at interface	Go data, Go clock, Return data, return clock, Synchronization state (Housekeeping)
Information format options	AM1
Clock format	NRZ

MULTIPLEX SYSTEM

	16-channel t.d.m.
Framing pattern	000011101100101, in channel 0
Signalling	In-band digital or separate channel..

GENERAL

Power supply	24/28V d.c. nominal to FVRDE Spec 2070 or 115V/220V a.c. 50/60Hz with auto changeover
Power consumption	35W (max)
Size	483mm (19in.) wide by 177mm (7in.) high by 300mm (12in.) deep 257mm(10.125in.) behind front panel
Weight	18kg (40lb) (max)
Environmental capability	
– Ambient operating temperature	−40°C to +55°C
– Mechanical	DEF STAN 07–55
Finish	Olive drab to BSS 381C or to order

Marconi
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