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V.23 Leased Line Modem

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Contents

Introduction

The MDU910LL V23 leased line (LL) modems are industrial grade modems for use on two and four wire private circuits with a bit rate of 1200 bps.

The modem has a robust aluminium enclosure along with an interfacing PCB which provides standard connectors for the power, DTE and line connections.

The modem is supplied with a 12 V AC supply and two line cables. One cable provides connection by an RJ45 plug meeting the requirements of TBR 15 and TBR 17 and the other is a UK only cable providing connection by a BT631A plug and meeting the requirements of BS 6328.

The modems provide either full duplex operation on a four wire private circuit or half duplex operation on a two wire private circuit. The line interfaces are link selectable for 600 ohm or high impedance.

Statutory Information

There are electro statically sensitive devices on the modem, so the usual precautions must be taken when opening the modem.

The Modem V23LL is CE marked in accordance with the following European directives and standards. Consideration must however be given to the points listed. If there is any doubt about the requirements listed below, seek advice from a competent engineer before using the modem.

TTE & SESE Directive 98/13/EC, standards TBR 15 : 1997 and TBR 17 : 1997

Notified body 186 (BABT), approval number 610125.

The 6 dB transmission level gain (LK10) should only be used set high when in high impedance mode.

Low Voltage Directive 73/23/EEC, standard BS EN 60950 : 1998

The modem is compliant with BS EN 60950. The interfaces to the private circuits are TNV-1 circuits as defined in BS EN 60950 clause 1.2.8.9.

The user shall ensure that the power drawn by the modem, together with the host and any auxiliary equipment drawing power from the host, is within the rating of the host power supply. The power requirements of the modem are: input voltage range 9.0 to 13.0 V AC, absolute maximum supply current 140 mA.

The analogue telecommunications interface is intended to be connected to TNV circuits, which may carry dangerous voltages. The telecommunication interface should be disconnected prior to opening the modem.

EMC Directive 89/336/EEC, standards BS EN 55022 : 1997 and BS EN 55024 : 1998

The modem is a class A product not designed for use in a domestic environment. The DTE cable must be shielded.

DTE Interface

The DTE interface speed is 1200 bps. Since the modem does not carry out any data framing or parity checking, any data format can be used. The following V24 interchange circuits are supported.

Signal Ground (circuit 102)
This signal is common with the 0 V power input.

Transmit Data (TxD, circuit 103, input).
The modulator in the modem directly follows TxD provided CTS is active. When CTS is inactive the modulator is clamped to the MARK condition.

Receive Data (RxD, circuit 104, output).
RxD follows the output of demodulator provided DCD is active. When DCD is inactive RxD is clamped to the MARK condition.

Request To Send (RTS, circuit 105, input).
In switched carrier operation the carrier is turned on when RTS is asserted, unless the modem is in two wire half duplex mode and DCD is active, in which case the modem waits for DCD to become inactive before turning the carrier on. The carrier is turned off 5 ms after RTS is negated. The antistreamer function operates on the RTS signal in switched carrier operation such that if RTS is active for more than two seconds the modem will turn the carrier off, and will not allow the carrier to be turned back on until RTS has first gone inactive and then active again. In constant carrier operation it is not necessary to assert RTS, as the carrier is always on.

Clear To Send (CTS, circuit 106, output).
In switched carrier operation, CTS is asserted either 20 or 30 ms (link selectable) after the carrier has been turned on, and is negated directly after RTS becomes inactive. CTS is also negated if the antistreamer times out. Because the line and DTE speeds are the same, CTS is not necessary for flow control. In constant carrier operation CTS is always active.

Data Set Ready (DSR, circuit 107, output).
DSR signifies that the modem is ready for operation. It follows the state of DTR and so the only time it is not active is directly after a reset.

Data Terminal Ready (DTR, circuit 108, input).
If sleep modem is enabled, DTR is required to enable the modem's voltage regulator. DTR is also required to enable the modem in firmware, unless DTR is forced (LK5).

Data Carrier Detect (DCD, circuit 109, output).
DCD signifies that the modem is receiving carrier and that the demodulator is locked on. In two wire half duplex operation DCD is clamped off when the transmit carrier is on, and is not released until 10 ms after the transmit carrier has been turned off.

Indicators

Listed below is the full description for each of the LEDs, which are located on the front panel of the modem.

RDY (Ready) On signifies that the power is on and the microprocessor is running. Flashing signifies an internal modem fault.

TXD Follows the state of the V24 TxD signal, on signifying a SPACE state, off signifying a MARK condition. The LED will pulse when data is being transmitted by the DTE.

RXD Follows the state of the V24 RxD signal, on signifying a SPACE state, off signifying a MARK condition. The LED will pulse when data is being received from the line.

RTS Follows the state of the V24 RTS signal, on signifying an active state.

CTS Follows the state of the V24 CTS signal, on signifying an active state.

DCD Follows the state of the V24 DCD signal, on signifying an active state.

DSR Under normal operating conditions, it follows the state of the V24 DSR signal, on signifying an active state. Flashing signifies that the antistreamer has timed out.

DTR Follows the state of the V24 DTR signal, on signifying an active state. With sleep mode enabled since DTR controls the modem's internal PSU, this indicator effectively signifies power on.

Installation

There are electrostatically sensitive devices on the modem, so the usual precautions must be taken when installing the modem. Installation should be carried out by a qualified person.

Please read the statutory information (page 6) prior to installation.

Circuit Types

The modem is appropriate for use on a number of circuit types. The drawings at the end of this manual illustrate them and also give the linking information.

Point to point circuits: a circuit that is dedicated for two modems only (two or four wire)

Multipoint circuits: a circuit that has an instation modem communicating with more than one outstation modems which do not communicate with each other, and where a distribution point is used to split and terminate the lines (two or four wire)

Multipoint hybrid circuits: a special type of multipoint circuit where the instation modem works four wire to the distribution point, but the outstation modems work two wire to the distribution point, so the distribution point contains hybrids

Omnibus circuits: a circuit that has more than two modems communicating with each other, and where a distribution point is used to split and terminate the lines (two wire only)

Multidrop circuits: a circuit where three or more modems use the same pair(s), ie no distribution point, and external line terminations terminate the circuits; a unbalanced configuration is where one of the modems acts as the instation modem and the outstation modems only communicate with the instation modem (two or four wire), whereas with a balanced circuit all the modems can communicate with each other (two wire only)

Omnibus multidrop circuits: an omnibus circuit but where the modems are multidropped on the same pairs and no separate unit is used as the distribution point (two wire only)

Connections

Signal	Connector	Pin

Power (not applicable if using the supplied PSU)		
12 V AC	2 way Molex	reversible

DTE (note: the DTE cable must be shielded)		
Shield	D-type	1
TXD	D-type	2
RXD	D-type	3
RTS	D-type	4
CTS	D-type	5
DSR	D-type	6
Signal Ground	D-type	7
DCD	D-type	8
DTR	D-type	20

Line (dependant on cable and I/F PCB LK1 position)		I/F LK1	Pins
2W	RJ45	A	4 & 5
	BT631A (UK use only)	A	1 & 6
4W TX	RJ45	B	3 & 6
	BT631A (UK use only)	A	1 & 6
4W RX	RJ45	B	4 & 5
	BT631A (UK use only)	A	2 & 5

The blade on the rear of the unit provides a connection point for earthing the enclosure. There is no requirement to do this.

Link Selection

The following links are on the modem PCB. The drawings at the end of this manual show the link positions for use on the various circuit types.

LK2 RTS-CTS delay: normal 20 ms, extended 30 ms

This is a function of the transmitter, but is determined by the capabilities of the receiving modem. If using this modem throughout the system then the link should be set to normal.

LK3 carrier control: constant or switched

LK4 extra line equalisation: in or out

When this link is out, the modem does perform limited line equalisation. It should be noted that TBR 15 and TBR 17 approvals are for use on open network provision (ONP) ordinary or special quality voice bandwidth analogue leased lines (A2O, A2S, A4O and A4S) as defined in ETS 300 448, ETS 300 449, ETS 300 451 and ETS 300 452, which are required to be of a certain quality that should not require the use of the extra line equalisation link.

LK5 DTR force: in (forced) or out (normal)

If DTR is not available at the DTR interface then it must be forced.

LK9 receive sensitivity: normal -34 dBm, high -44 dBm (600 ohms)
Recommended to be set high when in high impedance mode.
LK10 transmit level: normal -14 dBm, high -8 dBm (600 ohms)
Must only be used in high impedance mode.
LK11 two wire half duplex or four wire full duplex operation
LK12 termination: 600 ohm or high impedance
LK13 sleep mode: disabled or enabled
Disabled causes the modem to be powered at all times while enabled will cause the modem to only be powered in the presence of an active DTR signal. If the DTR signal is not available then disable. Enabled is recommended at all other times, particularly in equipment with battery backed power supplies.

The following links are on the stand alone interface PCB.

LK1 line connector pin assignment
This sets the pin assignment of the line connector and is dependant on both the line cable and 2 or 4 wire. See the table is section 6.3.
LK2 0 V earth: connects the enclosure and pin 1 of the D-type to the internal 0 V rail

Troubleshooting

Below is a list of potential problems that may occur when trying to use this modem.

(1) Modem will not power up, or powers up but does not function
Power is not applied, DTR is inactive with sleep mode enabled or DTR is inactive when the DTR force link is out.

(2) READY LED off or flashing
If the READY LED is not continuously on then the modem is detecting a fault condition, which either means the microprocessor has developed a fault or the internal PSU has moved out of spec. In the case of a fault the modem should be returned for repair.

(3) Modem will not detect carrier
Check that the line connections are correct and that the incoming level is high enough to be detected. Check that the 2W/4W links are correctly set and the line connector wiring. In high impedance mode the receiver is less sensitive.

(4) Modem does not transmit carrier
Check that the line corrections are correct. Check that the line is not short circuited. Check that the 2W/4W links are correctly set: the transmitter is locked out when DCD is active in two wire operation. If the DSR LED is flashing then the antistreamer has timed out and disabled the transmitter, which either means that the DTE is at fault or the modem is set for switched carrier when it should be constant carrier.

(5) Transmit carrier is too high / low
Line impedance may be wrong, or the TX LEVEL link is set incorrectly. In high impedance operation the modem's normal transmit level is -20 dBm. Remember that it is an approval requirement that the transmit level does not exceed -9 dBm in two wire operation or -13 dBm in four wire operation.

(6) Local / remote modem does not receive the beginning of messages
RTS-CTS delay may be set too short on the transmitting modem, or carrier detect time may be too long on the receiving modem.

(7) Local / remote modem does not receive the end of messages
RTS may be being turned off too soon by the transmitting DTE. The DTE must keep RTS active until the last bit of data has been transmitted on the TxD line. With some types of modem it may be necessary to delay RTS for several bit periods after the last bit of data to allow for delays through modulators and filters. On this modem there is a built in 5 ms delay.

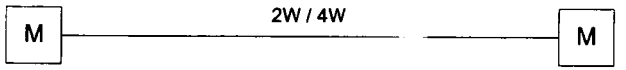
(8) Local / remote modem experiences data corruption
Line may have high noise level. On long or poor quality lines extra phase equalisation may be added (by link).

(9) High impedance operation
High impedance operation should only be used on multidrop lines where more than two modems are connected across the same copper pair. The ends of the telephone line(s) must be terminated: a high impedance modem transmitting into a high impedance line can produce transmission levels in excess of 0 dBm. When correctly terminated the transmission level and receiver sensitivity both reduce so it is recommended that their associated links be set to high.

Specification

Line modulation:	V23 forward channel 1200 bps FSK
Transmission frequencies:	mark 1300 Hz, space 2100 Hz
Line interface:	two wire or four wire, 600 ohms or high impedance, all by link selection
Transmission level - 600 ohm impedance:	-14 or -8 dBm into 600 ohms by link selection
Transmission level - high impedance:	-20 or -14 dBm into 600 ohms by link selection
Carrier detect level - 600 ohm impedance:	-34 or -44 dBm by link selection
Carrier detect level - high impedance:	-23 or -33 dBm by link selection
Carrier loss hysteresis:	3 dB
Receiver dynamic range:	43 dB
Carrier detect time:	15 ms max (dependant on received signal level)
Carrier loss time:	10 ms max (dependant on received signal level)
RTS to CTS delay:	20 or 30 ms, by link selection
Performance:	BER less than 10^{-5}, with SNR of 12 dB, Rx Sense normal, Rx level -30 dBm
DTE interface:	V28 and EIA-232 compliant (see section 4 for V24 signals supported)
DTE speed:	1200 bps
Operating temperature range:	-15 to +60 °C
Supply voltage:	100-240VAC 50/60 Hz external. 9.0 to 13.0 V AC Secondary.
Supply current operating:	100 mA normal at 12.0 V AC, 140 mA maximum
Supply current sleep:	less than 2 mA
Supply protection:	PTC thermistor
Dimensions (H x W x D):	35 mm x 110 mm x 220 mm
Weight:	400g

POINT TO POINT - 2W OR 4W

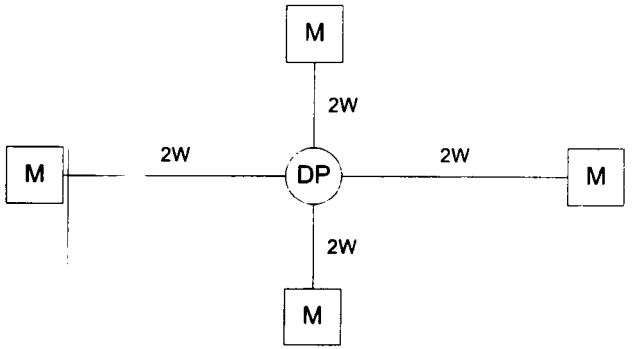


M = Modem

2W	LK3	LK9	LK10	LK11	LK12
M	SW	NORM	NORM	2W	600

4W	LK3	LK9	LK10	LK11	LK12
M	CONST	NORM	NORM	4W	600

OMNIBUS - 2W ONLY



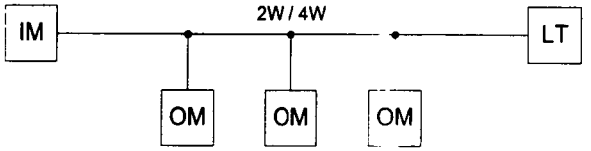
M = Modem

DP = Distribution Point

	LK3	LK9	LK10	LK11	LK12
M	SW	NORM	NORM	2W	NORM

SALES: 0118 965 5100

MULTIDROP - 2W OR 4W



IM = Instation Modem

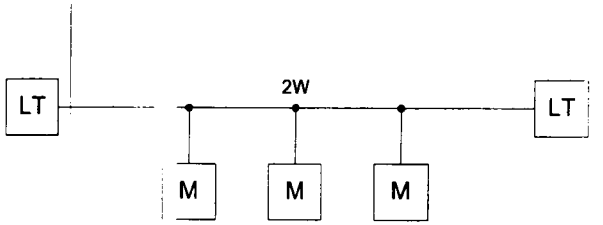
OM = Outstation Modem

LT = LINE TERMINATION

2W	LK3	LK9	LK10	LK11	LK12
IM	SW	NORM	NORM	2W	600
OM	SW	HI	HI	2W	HI

4W	LK3	LK9	LK10	LK11	LK12
IM	CONST	NORM	NORM	4W	600
OM	SW	HI	HI	4W	HI

OMNIBUS MULTIDROP - 2W ONLY

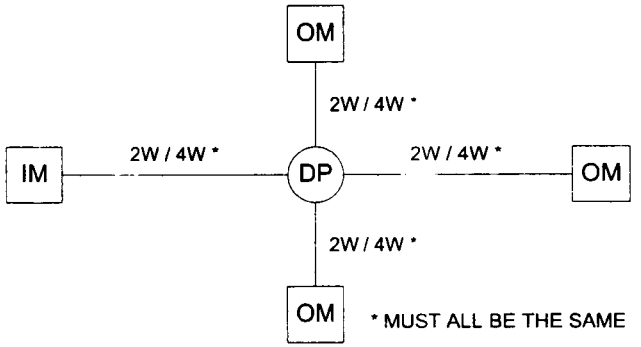


M = Modem

LT = Line Termination

	LK3	LK9	LK10	LK11	LK12
M	SW	HI	HI	2W	HI

MULTIPOINT - 2W OR 4W



IM = Instation Modem

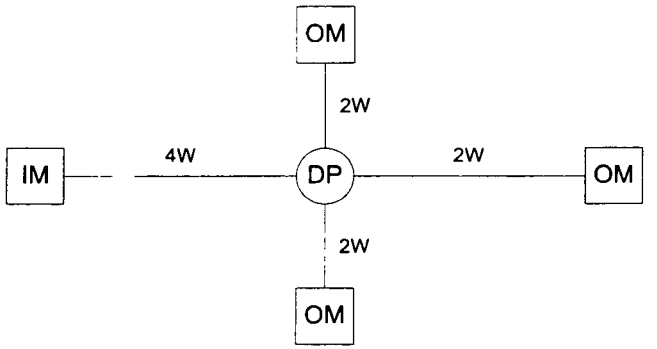
OM = Outstation Modem

DP = Distribution Point

2W	LK3	LK9	LK10	LK11	LK12
IM / OM	SW	NORM	NORM	2W	600

4W	LK3	LK9	LK10	LK11	LK12
IM	CONST	NORM	NORM	4W	600
OM	SW	NORM	NORM	4W	600

MULTIPOINT HYBRID - 2W AND 4W



IM = Instation Modem

OM = Outstation Modem

DP = Distribution Point

	LK3	LK9	LK10	LK11	LK12
IM	CONST	NORM	NORM	4W	600
OM	SW	NORM	NORM	2W	600