

MuLOGIC
LLM-336

**VOICE-BAND LEASED
LINE MODEM
(HARDWARE REVISION 2)**

User Guide
Issue 1.8
Feb. 2016

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MuLogic B.V.
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LLM-336 Leased Line Modem

Compliances

Public Leased line operation

- 2-wire operation (A2O, A2S): ES 203 021
- 4-wire operation (A4O, A4S): ES 203 021

CE Compliance

- EMC: Directive 2004/108/EC (EN 55022, EN55024)
- Safety: Directive 2006/95/EC (EN 60950)

The LLM-336 complies with EMC directive 2004/108/EC and is classified for use in Residential areas. Test standard: EN 55022 Class B

The LLM-336 also complies with the Immunity standard for ITE equipment EN 55024 with the applicable test levels increased to levels compatible with Industrial standards (ref. EN 61000-6-2).

About this user guide

Although this user guide was written with greatest possible care, omissions and errors cannot be precluded. MuLogic b.v. accepts no liability for any inaccuracies that may be found.

However, if you have comments or suggestions about this guide, please don't hesitate to contact us in order to help us to improve our product documentation.

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Important note:

This user guide applies to LLM-336 modems with hardware revision 2. Modems with hardware revision 2 are marked **H/W : rev.2** on the serial number label.

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Issue No 1.8 (Feb. 2016)

Declaration of Conformity

We, Mulogic b.v., Olivier van Noortstraat 4, 3124LA, Schiedam, the Netherlands,
herewith declare that the products:

Type of product	Model	Hardware Revision
Panel/DIN-Rail modem	LLM-336D	Rev. 2
Standalone modem	LLM-336S	Rev. 2
Rack mounted modem	LLM-336R	Rev. 2

are in conformity with the European Harmonised Standards as published in the Official Journal of the EC, Issue C225 (2007-09-25) following the provisions of the directives:

No.	Title
2004/108/EC	Electromagnetic Compatibility (EMC)
2006/95/EC	Electrical Safety (Low voltage directive)

The compliance of the product has been based on the following standards:

No.	Title	Issue
EN 55022	Emission limits in residential environments	2006
EN 55024	Immunity of IT equipment	1998+A1+A2
EN 60950	Electrical safety of IT equipment	2002
EN 61000-6-2	Immunity in Industrial environments	2001

The last two digits of the year in which the CE marking was affixed: 08

February 26, 2008



J.H.J Beck
Managing Director

This Declaration of Conformity is suitable to the European Standard EN 45014: *General Criteria for supplier's Declaration of Conformity*.

The basis for the criteria has been found in international documentation, particularly in ISO/IEC, Guide 22, 1982: *Information on manufacturer's Declaration of Conformity with standards or other technical specifications*.

1 Introduction



LLM-336

The MuLogic LLM-336 is a voice-band modem for reliable data communication over analogue leased lines, conditioned and unconditioned copper cable, or for operation in combination with radio equipment.

The LLM-336 is available in two versions of standalone modem or as rack card. The rack card conforms to the CEPT T/CD 01-14 type I specification, which enables easy integration in various hardware environments.

Up to 16 rack cards can be mounted in a MuLogic UCF-16.3 or MCF-16.3 card frame. The lower density UCF3.1 housing can house up to 3 modems.

The modem is designed to serve a vast majority of applications. It can be used on 2-wire and 4-wire lines, in point-to-point and multi-point configurations and complies with emissions/immunity standards for both industrial and residential use.

The LLM-336 offers synchronous data rates up to 33.6 kbit/s and supports asynchronous port rates of up to 115.2 kbit/s.

For asynchronous applications the LLM-336 modems are equipped with an RS232C and an RS485 interface port.

The LLM-336 is available in the following hardware versions:

- LLM-336D: Small plastic housing suited for panel or Din-rail mounting.
- LLM-336R: Modem card for MuLogic UCF and MCF card frames.
- LLM-336S: Modem card in metal housing for shelf or desktop use.

On the LLM-336D the RS485 port is standard. For LLM-336R and LLM-336S the RS485 port is available as an option.

Features

- **Supported modem standards**

- Full Duplex operation (ITU-T)

V.34	2400 up to 33600 bit/s
V.32bis	7200, 12000 and 14400 bit/s
V.32	4800 and 9600 bit/s
V.22bis	1200 and 2400 bit/s
V.22	1200 bit/s
V.21	300 bit/s

- Full Duplex operation (Bell)

212A	1200 bit/s
103	300 bit/s

- Switched carrier and multi-point operation (ITU-T)

V.33	12000 and 14400 bit/s (half-duplex only)
V.29	4800, 7200 and 9600 bit/s (half-duplex only)
V.27bis	2400 and 4800 bit/s (half-duplex only)
V.23	1200 bit/s (half-duplex only)

- **Operation over 2-wire and 4-wire leased lines or dry copper lines.**
- **Point-to-point and multi-point/multi-drop operation.**
- **Switched line impedance for multi-drop operation on dry copper wire.**
- **Operating modes selected by means of dipswitches.
Up to 40 modes are factory pre-programmed.**
- **Error Correction and Data Compression for reliable transmission and throughput improvement of asynchronous data. (ITU-T V.42bis and V.44)**
- **Automatic Carrier Control (controlled by transmitted data) for half duplex operation without RTS control.**
- **Programmable transmit level, ranging from –10 to – 30dBm @600Ω**
- **Programmable receive carrier detect thresholds.**
- **Both RS232C and RS485 interfaces supported on LLM-336D.**
- **RS485 optional for LLM-336R and LLM-336S.**
- **Data buffers for asynchronous port rates independent from line rate.**
- **Both 10-bit and 11-bit asynchronous data formats supported.**
- **Transparent asynchronous communication up to 9600 bit/s**

2

Hardware Details and Installation

Hardware versions

The LLM-336 is available in the following hardware versions:

- LLM-336D: Small plastic housing suited for panel or Din Rail mounting.
- LLM-336R: Modem card for MuLogic UCF and MCF card frames.
- LLM-336S: Modem card in metal housing for shelf or desktop use.



Fig. 1 LLM-336D

Front panel layout of LLM-336D

The front panel of the LLM-336D contains five LEDs that indicate the status of the most important interface signals and modem status.



Fig. 2 LLM-336R, LLM-336S

Front panel layout of LLM-336R and LLM-336S

The front panels of the LLM-336R and LLM-336S contain eight LEDs that indicate the status of the interface signals and modem status.

Front panel LED Indicators

The LED indicators of the LLM-336, display the real-time status of the modem and the key DTE interface signals. In case a communication problem occurs, these LEDs can help you determine the cause of the problem.

LED	ITU-T	DIN	Description
PWR	-	-	Indicates that the modem is powered on and functions correctly.
DSR	106	M1	(Not present on LLM-336D) DSR on, indicates that the modem is ready for operation. DSR is off when the modem is in configure mode.
DTR	108	S1	Follows the state of the DTR interface signal coming from the connected DTE. The DTE (attached device) activates the DTR to signal that its serial port is ready for communication.
TxD*	103	D1	Flashes when the modem receives data from the connected DTE.
RxD*	104	D2	Flashes when the modem receives data from the remote modem.
RTS	105	S2	(Not present on LLM-336D) Follows the state of the RTS interface signal coming from the connected DTE. At half-duplex operation, the DTE activates RTS to signal that it is ready to send data to the modem. At full-duplex operation, the DTE activates RTS to signal that it is ready for receiving data from the modem. (Circuit 133 mode).
CTS	106	M2	(Not present on LLM-336D) Follows the state of the modem CTS interface signal. The modem activates CTS to signal that it is ready to receive data from the DTE.
DCD	109	S5	Follows the state of the modem DCD interface signal. The modem activates DCD to signal that a valid carrier is received from the remote modem.

Notes:

At high data rates, short bursts of data may not be visible at the TxD and RxD LEDs

DTE stands for Data Terminal Equipment, a generic expression for computer, RTU or any terminal equipment connected to the modem via the serial port.

When the RS485 interface is used, only the TxD and RxD signals are controlled

Switches and jumpers

At the LLM-336D, the dipswitches are located at the side of the housing. For reaching the RS485 jumper inside the LLM-336D housing, release the 4 screws at the bottom of the housing.

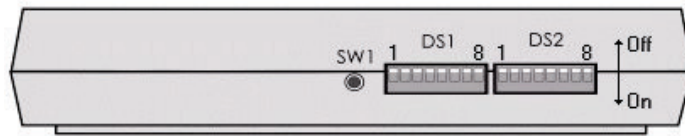


Fig. 3 Switches of the LLM-336D

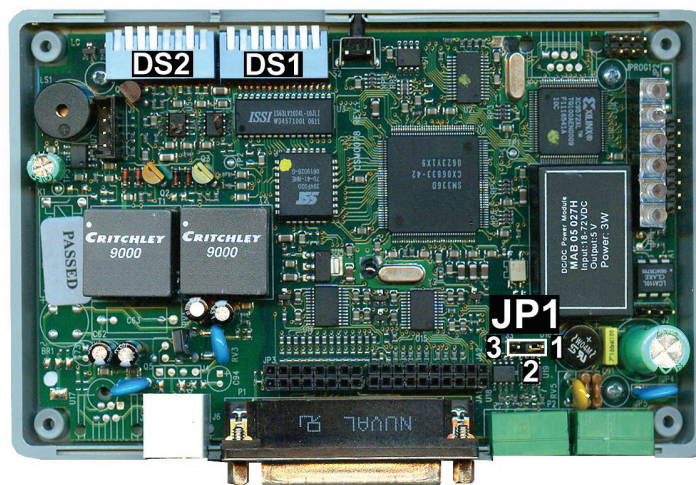


Fig. 4 Switches and RS485 jumper of LLM-336D

For reaching the dipswitches and RS485 jumper of the LLM-336R or LLM-336S, the modem card must first be removed from the card frame or desktop housing by releasing the front panel screws.

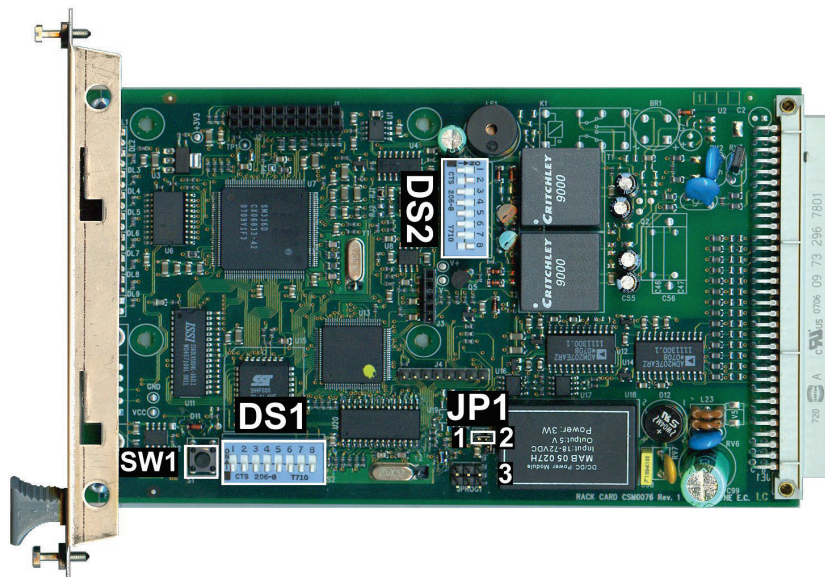


Fig. 5 Switches and RS485 jumper of LLM-336S and LLM-336R

SW1, Reset Switch

This switch can be used to reset or restart the modem.

JP1, RS485 mode

This jumper is used to select 2-wire RS485 or 4-wire RS485/422.

When the jumper is in position 1-2, both 2-wire and 4-wire Rx terminals can receive RS485 data. When the jumper is in position 2-3 only the 4-wire Rx terminals can receive data.

JP1	Pos 1-2*	Pos 2-3
	2-wire RS485	4-wire RS485/RS422

Note: JP1 Position 1-2 can be used for both 2-wire and 4-wire RS485

DS1, Dip-switch 1

Switch	ON	OFF
DS1.1-DS1.6	See table 3, operating modes	
DS1.7	Configure mode	Modem mode
DS1.8	S92 Tx Level*	S91 Tx Level*

Note: See page 3-12

DS2, Dip-switch 2

Switch	ON	OFF
DS2.1	4-wire operation	2-wire operation
DS2.2	2-wire operation	4-wire operation
DS2.3	4-wire Rx line terminated with 600 Ω	4-wire Rx line terminated with 5000 Ω
DS2.4	4-wire operation	2-wire operation
DS2.5	Controlled impedance (note 1)	Fixed impedance
DS2.6	<i>Reserved</i>	<i>Reserved (keep Off)</i>
DS2.7	Originate mode (note 2)	Answer mode
DS2.8	Monitor speaker always on (note 3,4)	Monitor speaker off

Line type	DS2.1	DS2.2	DS2.3	DS2.4	DS2.5	DS2.6
2-wire, fixed 600Ω	Off	On	Off	Off	Off	Off
4-wire, fixed 600Ω	On	Off	On	On	Off	Off
2-wire, controlled impedance	Off	On	Off	Off	On	Off
4-wire, controlled Tx impedance	On	Off	Off	On	On	Off

Table 2. Line connection modes

Note 1. Controlled impedance is used for multi-drop operation on a non-conditioned copper cable. In 2-wire controlled impedance mode, when transmitting (RTS on), the impedance is 600Ω. When receiving (RTS off), the impedance is 5000Ω. In 4-wire controlled Tx impedance mode only the impedance of the TX pair is switched. The RX impedance shall be set to "high" by setting DS2.3 to OFF.

Note 2. For V.34, V.32(bis), V22(bis and V.21) operation one modem must be set to **originate** mode and the other to **answer** mode.

Note 3. The monitor speaker can be switched On or Off during operation.

Note 4. In 4-wire line connection mode, the monitor speaker only makes the receive signal audible.

Operating modes

Note: Profiles 2..40 are factory pre-set. (see notes on page 2-6)
Consult chapter 3 if none of these operating modes suit your application.

Operating modes		DS1.1	DS1.2	DS1.3	DS1.4	DS1.5	DS1.6
0	User Profile 0	Off	Off	Off	Off	Off	Off
1	User Profile 1	On	Off	Off	Off	Off	Off
2	V.34 33.6 kbit/s sync. - Up to 9.6 kbit/s async.	Off	On	Off	Off	Off	Off
3	V.34 31.2 kbit/s sync. - Up to 9.6 kbit/s async.	On	On	Off	Off	Off	Off
4	V.34 28.8 kbit/s sync. - Up to 7.2 kbit/s async.	Off	Off	On	Off	Off	Off
5	V.34 26.4 kbit/s sync. - Up to 7.2 kbit/s async.	On	Off	On	Off	Off	Off
6	V.34 24.0 kbit/s sync. - Up to 4.8 kbit/s async.	Off	On	On	Off	Off	Off
7	V.34 21.6 kbit/s sync. - Up to 4.8 kbit/s async.	On	On	On	Off	Off	Off
8	V.34 19.2 kbit/s sync. - Up to 4.8 kbit/s async.	Off	Off	Off	On	Off	Off
9	V.34 16.8 kbit/s sync. - Up to 2.4 kbit/s async.	On	Off	Off	On	Off	Off
10	V.34 14.4 kbit/s sync. - Up to 2.4 kbit/s async.	Off	On	Off	On	Off	Off
11	V.34 12.0 kbit/s sync. - Up to 2.4 kbit/s async.	On	On	Off	On	Off	Off
12	V.34 9.6 kbit/s sync. - Up to 2.4 kbit/s async.	Off	Off	On	On	Off	Off
13	V.34 9.6 kbit/s asynchronous	On	Off	On	On	Off	Off
14	V.34 38.4 kbit/s async. with ErrCorr/Dcompr.	Off	On	On	On	Off	Off
15	V.34 19.2 kbit/s async. with ErrCorr/Dcompr.	On	On	On	On	Off	Off
16	V.34 9.6 kbit/s async. with ErrCorr/Dcompr.	Off	Off	Off	Off	On	Off
17	V32bis 14.4 kbit/s sync. Up to 2.4kbit/s async.	On	Off	Off	Off	On	Off
18	V32 9.6 kbit/s sync. Up to 2.4 kbit/s async.	Off	On	Off	Off	On	Off
19	V32 9.6 kbit/s asynchronous	On	On	Off	Off	On	Off
20	V.22bis 2.4 kbit/s asynchronous	Off	Off	On	Off	On	Off
21	V.22 1.2 kbit/s asynchronous	On	Off	On	Off	On	Off
22	V.21 300 bit/s asynchronous	Off	On	On	Off	On	Off
23	V.23 1.2 kbit/s async. Half Duplex RTS contr.	On	On	On	Off	On	Off
24	V.23 1.2 kbit/s async. Half Duplex ACC.	Off	Off	Off	On	On	Off
25	Reserved	On	Off	Off	On	On	Off
26	Reserved	Off	On	Off	On	On	Off
27	Reserved	On	On	Off	On	On	Off
28	V.27 4.8 kbit/s sync. Half Duplex RTS contr.	Off	Off	On	On	On	Off
29	V.27 2.4 kbit/s sync. Half Duplex RTS contr.	On	Off	On	On	On	Off
30	V.27 4.8 kbit/s async. Half Duplex RTS contr.	Off	On	On	On	On	Off
31	V.27 2.4 kbit/s async. Half Duplex RTS contr.	On	On	On	On	On	Off
32	V.29 9.6 kbit/s sync. Half Duplex RTS contr.	Off	Off	Off	Off	Off	On
33	V.29 7.2 kbit/s sync. Half Duplex RTS contr.	On	Off	Off	Off	Off	On
34	V.29 4.8 kbit/s sync. Half Duplex RTS contr.	Off	On	Off	Off	Off	On
35	V.29 9.6 kbit/s async. Half Duplex RTS contr.	On	On	Off	Off	Off	On
36	V.29 7.2 kbit/s async. Half Duplex RTS contr.	Off	Off	On	Off	Off	On
37	V.29 4.8 kbit/s async. Half Duplex RTS contr.	On	Off	On	Off	Off	On
38	V.29 9.6 kbit/s async. Half Duplex ACC	Off	On	On	Off	Off	On
39	V.29 4.8 kbit/s async. Half Duplex ACC	On	On	On	Off	Off	On
40	Reserved	Off	Off	Off	On	Off	On

Table 3. Operating modes. See notes on following page.

For the AT commands settings used for these profiles, refer to Appendix 1

Originate-Answer mode selection

For full-duplex operating modes 0 to 22, one modem must be set to Originate mode and the other to Answer mode. See DS2.7 (page 2.4).

Asynchronous 10 or 11 bit Characters

The default asynchronous format is 10-bit, which can be used for formats with 8 data bits-No parity (8-N-1) and 7 data bits plus parity (7-E-1 or 7-O-1).

For operation with 11-bit characters (8-E-1 or 8-O-1) consult pages 3-2 and 3-5.

Transparent asynchronous operation can be achieved by using synchronous modes (e.g. modes 2 to 12).

In transparent asynchronous operation, the modem will accept all data formats and rates up to the maximum reliable rate which is approx. $\frac{1}{4}$ of the line rate.

Consult page 3-6 for further information.

Error correction Data compression

In modes 14, 15 and 16, Error Correction and Data Compression for asynchronous data is enabled. Consult page 3-6 for further information.

Synchronous modes

The default synchronous clock mode is: Tx clocks generated by the modem. For external or slave clocking consult page 3-7.

Half-duplex operation

For RTS-CTS delay times, ACC and multi-drop operation, refer to pages 3-8, to 3-11.

In ACC modes, the duration of a transmission is limited to 10 seconds. This is set by register S30. See page 3-10.

Multi-drop operation

For Multi-drop operation refer to page 3-11

Data rates

In operating modes 2 and 14, the modem will attempt to make a line connection of 33.6kbit/s, or a lower rate when the signal quality is insufficient. For the other operating modes, the data rate is fixed.

On-line Command Mode

For diagnostics purposes, the modem can be switched to on-line command mode. See chapter 4. The escape code and commands should be issued in 8-N-1 format. The data rate in asynchronous modes is equal to the speed of the serial port. For synchronous modes, the command port rate is always 9600 bit/s.

Connectors

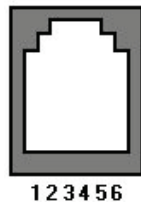


Fig. 5 LLM-336D



Fig. 6 LLM-336S, LLM-336R (IOC-PSV board)

Line Connector



- 1 = Not connected
- 2 = 4-wire transmit signal a (output)
- 3 = 4-wire receive signal a (input) / 2-wire receive-transmit a
- 4 = 4-wire receive signal b (input) / 2-wire receive-transmit b
- 5 = 4-wire transmit signal b (output)
- 6 = Not connected

Note: For the LLM-336R, the connector pin-out applies to the line connector of the IOC-PSV interface board or the MCF-16.3 back plane.

RS232 Connector

PIN	V.24	Description	Data		Control		Clock	
			DTE	DCE	DTE	DCE	DTE	DCE
2	103	TxD – Transmitted data	•					
3	104	RxD – Received data		•				
4	105	RTS – Request to send			•			
5	106	CTS – Ready for sending				•		
6	107	DSR – Modem ready				•		
7	102	Signal ground						
8	109	DCD – Data Carrier Detect				•		
15	114	INTCK – Internal transmit clock						•
17	115	RXCK – Receive clock						•
20	108.2	DTR – Data Terminal Ready			•			
24	113	EXTCK – External transmit clock					•	
25	142	TI -Test/Busy indicator				•		

Table 4 V.24 interface signals

Power pins (LLM-336D)

The operating power of the LLM-336D is supplied at pins 1 and 2 of the PWR/CI screw terminal connector (see fig. 5). The voltage range depends on the model.

LLM-336D/VR1: 9-36Vdc, 11-28 Vac

LLM-336D/VR2: 18-60Vdc, 18-30Vac

Note: The power input of the LLM-336D is not polarised. You can connect DC power in either direction.

CI pins (LLM-336D)

Pins 3 and 4 of the screw terminal connector are reserved for future use and customer-specific applications.

RS485 connector (LLM-336D)

Pins 1 and 4 are RS485 “Rx” inputs used in 4-wire RS485 or RS422 mode. Pins 2 and 3 are used for 2-wire RS485 or as “Tx” outputs in 4-wire RS485 or RS422 mode.

Note 1: The RS485 output/inputs are not terminated. When RS485 termination is needed, this should be applied externally.
Note 2: Jumper JP1 can be used to disable the receiver on pins 2 and 3.
Note 3: RS485Rx is for the modem’s TxData input. RS485 Tx is for RxData.

Power connector (LLM-336S/R)

The operating power of the LLM-336S and LLM-336R (when used in UCF-16.3 or UCF-3.1) is supplied at either of the 2 screw terminal connectors (see fig. 6). The remaining power connector can be used for linking the power to another device. The operating voltage range depends on the model.

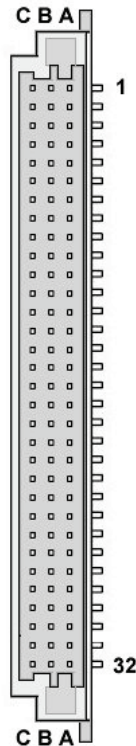
LLM-336S/VR1: 9-36Vdc, 19-26 Vac

LLM-336S/VR2: 18-60Vdc, 18-42Vac

Note: The power input of the LLM-336S is not polarised. You can connect DC power in either direction.

LLM-336R Connector pin-out

The LLM-336R card has a female 96pin ABC-row DIN 41612 connector. Interface circuits printed **bold** are compliant with ITU-T V.24/V.28 or RS232C.



PIN	Row A	Row B	Row C
1	PGND	PGND	PGND
2			
3			
4		4-wire-Tx-A	
5			
6		4-wire-Tx-B	
7	2-wire-TxRx-B		2-wire-TxRx-A
8			
9			
10			
11	TxCLK (O)		TxD (I)
12			RxD (O)
13	RxCLK (O)		RTS (I)
14			CTS (O)
15			DSR (O)
16	DTR (I)	Reset (I, low active)	SGND
17		Com RxD (O) N/A	
18		Com TxD (I) N/A	DCD (O)
19	RI (O) N/A	NMS TxD (I)	
20		NMS RxD (O)	OH (O, low active)
21	EXCLK (I)	RS485 Rx +	
22	TST (O)	RS485 TxRx +	
23	Pwr (O, low active)	RS485 TxRx -	
24	Address sel. A0	RS485 Rx -	Address sel. A2
25	Address sel. A1		Address sel. A3
26			
27	~PSU-A-in	~PSU-A-in	~PSU-A-in
28	~PSU-B-in	~PSU-B-in	~PSU-B-in
29	+5Vdc-out	+5Vdc-out	+5Vdc-out
30	+5Vdc-out	+5Vdc-out	+5Vdc-out
31	DGND	DGND	DGND
32	DGND	DGND	DGND

LLM-336R Connector use

Power

Connect operating power to pins 27 and 28 (rows a, b, c are interconnected).

Note: When power is applied to pins 27 and 28, a 5Vdc power output is available for powering external devices. The 5Vdc is present between pins 29/30 and 31/32 (rows a, b, c are interconnected). The maximum 5Vdc output current is 200mA. When no power is applied to pins 27 and 28, pins 29/30 and 31/32 can be used for powering the device from 5Vdc. The maximum current is 340mA.

Line

Connect the 2-wire leased line to pins A7 and C7. In 4-wire mode, pins A7 and C7 are the input of the receive pair, pins B4 and B6 connect to the transmit pair.

Data Interface RS232C

The interface pins A11..22 and C11..18 allow for direct connection to a V.24/V.28 or RS232C interface.

Data Interface RS485

The interface pins B21 and B24 are RS485 Rx inputs used in 4-wire RS485 or RS422 mode. Pins B22 and B23 are used for 2-wire RS485 or Tx outputs in 4-wire RS485 or RS422 mode. Refer to the use of JP1 on page 2-3.

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3 Configuration

Introduction

If none of the pre-configured operating modes as presented on page 2-7 suit your application, the modem can be reconfigured by means of AT commands. To accept AT commands, the modem must be switched to configuration mode.

Configuration mode

The command/configuration mode is selected by means of putting dip switch DS1.7 in the ON position and DS1.8 OFF, before power-up or reset. (see pages 2-3 and 2-4).

AT commands can be issued at common asynchronous data rates from 300 bit/s to 115.200 bit/s in both 10 bit and 11 bit formats.

New configurations can be stored in user profiles 0 and 1 (see page 2-7).

Configurations of the stored profiles can be retrieved by means of the **ATZ** command, modified, and then stored in user profiles 0 or 1 by means of the **AT&W** and **AT&W1** commands.

Configuration Profiles

The modem knows 3 types of configuration profiles:

Active profile: This the default setting of the modem after it is powered-on in Configuration Mode (see above). All changes to the configuration are made in the active profile and then stored to one of the stored user profiles.

Stored user profiles: These are profiles 0 and 1 as selected with switch DS1. Changes made in the active profile can be stored in user profile 0 and 1 by means of the **AT&W** and **AT&W1** command.

Stored factory profiles: These are profiles 2 to 40 as selected with DS1. They are stored in the factory and can be used as they are or changed and stored on profile 0 or 1. Factory profiles can be custom made on request. Contact MuLogic support for further information.

AT command conventions

Unless specified otherwise, all command lines must begin with the AT attention code. This code can be either entered as upper case (AT) or lower case (at) ASCII characters. (But not as 'At' or 'aT') The command line is terminated with the **enter key <cr>**. The AT code is used to determine the data rate and format of the command. After a correct command string is received, the modem will respond with 'OK' and the modem's serial port will be set to the speed and format in which the command was issued. If a syntax error is made, the modem will return with 'ERROR'.

Using settings of factory profiles for 11bit async. mode

For example, factory profile 13 (9600 bit/s V.34 asynchronous) is configured for 10 bit data format operation. This can be used for asynchronous data formats like 9600-8-N-1, 9600-7-E-1 and 9600-7-O-1.

To configure the modem for operation in 11bit mode, like 9600-8-E-1 or 9600-8-O-1, use a terminal emulator program such as e.g. Hyperterm and configure the serial port to the required data format.

Note: when set to the format 8-E-1 (8 data bits, Even parity), the modem will only work with devices set to this 8-E-1 format.
When set to the format 8-O-1 (8 data bits, Odd parity), the modem will only work with devices set to this 8-O-1 format.

Power-on the modem with DS1.7 set to ON and DS1.8 set to OFF.

Enter:

- **ATZ13<cr>** (This will copy the settings of profile 13 into the active profile and will set the port of the speed and data format in which the command was given)
- **AT&W<cr>** (This will store the settings of the active profile (i.e. the setting of profile 13 along with the new entered data format) in user profile 0).

Note: To verify that the terminal is set to the correct speed and format, use the **AT&VFA** command. The modem will return the used speed and format.

Power-off the modem and power-on with DS1.1 to DS1.8 set to OFF (this will select user profile 0)

The escape code

The escape code can be used to switch the modem into command/configuration mode while the modem is connected with the remote modem.

See chapter 4, Diagnostics.

The escape sequence is issued by sending the “escape character” for three consecutive times. The escape character is selectable as any ASCII character. Its value is stored in register S2.

The default value for S2 is 43 (“+”). See chapter 4.

To disable the escape code detection, set S2 to 0 by entering **ATS2=0 <cr>**.

To prevent the modem from accidentally entering command mode, the escape sequence is protected by means of a “guard time”: data must be absent for at least 1 second before and after the escape sequence is issued. In this way escape characters sent within a string of characters are not recognised as an escape code.

AT Commands

AT&V Display configuration settings

The AT&V commands are used to give information on the current and stored settings of the modem.

AT&V Using the AT&V command, the settings of the active profile and the stored user profiles are displayed.
For displaying the settings of the factory profiles, use the ATZ commands (ATZ2 .. ATZ40) to copy the settings into the active profile.
Example: ATZ15<cr> AT&V<cr> shows the setting of profile 15.

Note: The setting of the +MS command is only displayed in the active profile and only when ATF is 0.

AT&V1 This command is used in on-line command mode for displaying the status of the connection. See chapter 4, Diagnostics.

AT&VFn Displays the speed and format stored in profiles 0 to 40 (n = 0..40)

AT&VFA Displays the actual speed and data format of the terminal.

AT&F Restore initial settings

The AT&F command resets the configuration to the default power-on settings. (V.34 operation with error correction and data compression).

ATZ Retrieve settings from stored profiles

The ATZ command is used to retrieve the settings from a stored profile. It is used for simple changes to the factory pre-set stored profiles.

ATZn Copy configuration of stored profile n (n = 0..40) into the active profile.

For example:

ATZ Copy configuration of stored profile 0 into the active profile.

ATZ1 Copy configuration of stored profile 1 into the active profile.

ATZ2 Copy configuration of stored profile 2 into the active profile, etc.

AT&W Write configuration in stored profiles 0 or 1

The AT&W command writes the current configuration in profiles 0 or 1.

AT&W0 Write configuration into stored profile 0

AT&W1 Write configuration into stored profile 1

Note: The profile used on power-up is determined by switches DS1.1 to DS1.6

ATSn Read/Write S-registers

ATSn=x Writes value x in S-register n.

ATSn? Reads and displays the value of S-register n.

Modulation modes

The modem modulation modes of the LLM-336 are set by means of the AT+MS command for full duplex modes, and the ATF command for half duplex modes.

ATF Half duplex modulation modes

- ATF0** (Automatically set when AT+MS settings are used)
- ATF2 V.23 1200 bit/s (Asynchronous buffered mode (&Q6) only)
- ATF3 V.27 2400 bit/s
- ATF4 V.27 4800 bit/s
- ATF5 V.29 4800 bit/s
- ATF6 V.29 7200 bit/s
- ATF7 V.29 9600 bit/s
- ATF8 V.33 12000 bit/s
- ATF9 V.33 14400 bit/s

AT+MS Full duplex modulation modes

The syntax for entering the AT+MS command is as follows:
AT+MS=<mod>,[<automode>,<min_rate>,<max_rate>]<cr>
 Where "mod", "automode", "min_rate" and "max_rate" are numerical parameters.

Note: the <mod> parameter is mandatory. The parameters between the brackets are optional.

- mod:** Modulation mode
- automode:** Select automode (always leave at 0)
- min_rate:** Lowest allowable data rate
- max_rate:** Highest allowable data rate.

<mod>	Modulation	Speed range (min_rate, max_rate)
0	V.21	300 bit/s (Asynchronous buffered mode (&Q6) only)
1	V.22	1200 bit/s
2	V.22bis	2400, 1200 bit/s
9	V.32	9600, 4800 bit/s
10	V.32bis	14400, 12000, 9600, 7200, 4800 bit/s
11	V.34	33600, 31200, 28800, 26400, 24000, 21600, 19200, 16800, 14400, 12000, 9600, 7200, 4800, 2400 bit/s
64	Bell 103	300 bit/s (Asynchronous buffered mode (&Q6) only)
69	Bell 212A	1200 bit/s

<automode> (not used for leased line operation, leave at 0)

Note: Using the AT&V command, the setting of the +MS command is only displayed in the active profile and only when ATF is 0.
 The command AT+MS? can be used for displaying the current +MS setting.

Examples

- V.22 mode: AT+MS=1,0<cr>
- V.34 all rates enabled: AT+MS=11,0
- V.34 9600..24000 bit/s: AT+MS=11,0,9600,24000<cr>
- V.34 19200 only: AT+MS=11,0,19200,19200<cr>

Example: Setting V.32bis synchronous with data rate of 7200 bit/s:

- ATZ18<cr> retrieve configuration of stored profile 18 (V.32bis, 9600bit/s)
- AT+MS=10,0,7200,7200<cr> Set V.32bis, 7200 bit/s.
- AT&W<cr> Store in profile 0
- Power-on or reset with DS1.1 to DS1.8 all set to OFF (user profile 0)

Asynchronous operation

For asynchronous operation, it is important that the configuration commands are entered in the speed and data format at which the modem must operate. So, if the modem must work at an asynchronous data format of 8 data bits and Even parity, the configuration commands must be given in this format. For error correction and buffered modes, also the speed is stored.

For asynchronous operation the following commands apply:

ATF Half duplex modulation modes

See page 3-4.

AT+MS Full duplex modulation modes

See page 3-4.

AT&Q Data modes

- AT&Q0 Asynchronous direct mode *1
- AT&Q5** Asynchronous error correction/data compression mode (V.42bis)*2
- AT&Q6 Asynchronous buffered mode *2

Note *1: port speed according to modem standard. Data format according to format of AT&W command

Note *2: port speed and data format according to speed and format of AT&W command. Error correction/data compression can only be used with full duplex modes as set with the AT+MS commands.

AT&K Flow control options (&Q5 and &Q6 settings only)

- AT&K0 Flow control disabled
- AT&K3 RTS/CTS flow control enabled
- AT&K4 Xon/Xoff flow control enabled
- AT&K11 CTS flow control enabled (RTS is ignored)**

Note: Flow control is needed when, in &Q5 and &Q6 modes, the speed of the attached device is different from the speed of the modem. When AT&K11 or AT&K3 is selected, the modem will turn off the RS232 CTS signal before the buffers will overflow. The attached device must stop sending data when the CTS signal is off. In the same manner the attached device can turn off the RTS signal to tell the modem to stop sending data. (Full duplex modes only)

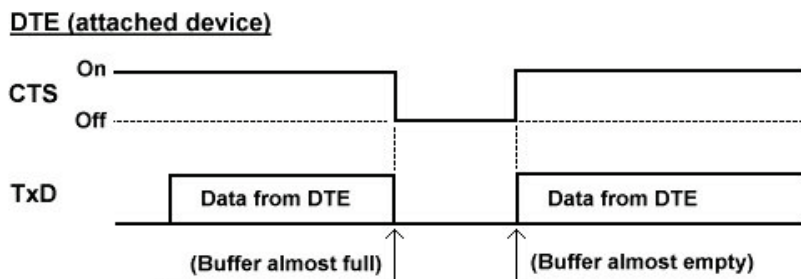


Figure 7. CTS flow control (&K11 and &K3 modes)

Applications with Asynchronous data

When using buffered interfaces with certain communication protocols, care must be taken that the rules of such protocols are not violated. Some protocols do not allow for long inter-character delay times and require the data packet to be received without interruptions.

A good example is the Modbus RTU protocol which does not allow for an inter-character time (the delay between each asynchronous character) of more than 1.5 character times. This means that, when using Modbus RTU, the port speed of the modem cannot be more than 2 times the line speed.

Thus, for example for 1200 bit/s modulation modes (like V.23 and V.22) this allows for a maximum port speed of 2400 bit/s.

Asynchronous buffered mode

The LLM-336 supports a buffered interface for asynchronous data in all modem modulation modes.

This allows for the attached device to run at a serial port rate other than the line speed of the modem. It also enables devices at both point-to-point modems (or the different modems in a multi-drop network) to run at different port speeds.

Setting the modem's serial port to a higher rate however will not result in a higher throughput. Although each character leaves the modem at a higher rate, the delay between each character increases, so the total time for sending multiple characters remains the same.

When the port speed is higher than the line speed of the modem, CTS flow control must be used.

Note: *not all asynchronous data protocols tolerate long delays between each received character (See example on Modbus RTU above)*

Asynchronous error correction and data compression mode

The LLM-336 supports error correction and data compression modes for all (except V.21 and Bell 103) full-duplex modem modulation modes as set with the AT+MS commands.

Error correction ensures that all errors that are introduced during the transmission over the line are automatically corrected.

Data over the line is sent in data packets with a CRC check and each packet is automatically retransmitted when it appears to contain errors.

Data compression can improve the data throughput by compressing redundant data. Note that, in order to benefit from data compression, the port speed must be set to a higher rate than the line speed of the modem. Also CTS flow control must be used.

For use with SCADA protocols it is advised to set the line speed slightly higher than the port speed to prevent inter-character delay.

Asynchronous transparent mode

In certain circumstances it can be useful to create a modem connection that is transparent for each asynchronous speed and data format.

The LLM-336 supports transparent asynchronous communication up to 9600bit/s. This is achieved by setting the modem to V.34 synchronous operation at 33600 bit/s or 31200 bit/s line rate (operating modes 2 and 3). Also lower synchronous line rates can be used as long as the asynchronous data rate is less than $\frac{1}{4}$ of the line rate of the modem. For example, V.29, 9600 bit/s synchronous can be used for transparent asynchronous communication up to 2400 bit/s.

Applications with Synchronous data

The data rate at which the commands are given is not relevant as the DTE port rate is determined by the modem. However, for using the escape code for line diagnostics (see chapter 4) the asynchronous speed and data format must match the speed and data format at which the configuration commands were issued.

Use the AT&VFn commands to verify rate and format. (see page 3-3).

For synchronous operation the following commands apply:

AT&Q Data modes

AT&Q1 Synchronous direct mode

&R RTS-CTS control (full duplex modes)

AT&R0 CTS follows RTS, the delay [ms] is determined by register S26.

AT&R1 RTS is ignored, CTS active when modem link is up.

ATS26 RTS to CTS Delay Interval

Range : 0-255 (units of 10ms)

Default : 0

Refer to page 3-10

&X Transmit clock source

AT&X0 Selects internal transmit clock (generated by the modem).

AT&X1 Selects external transmit clock. (**note 1**)

AT&X2 Slaves transmit clock to receive clock. (**note 2**)

Note 1: This feature may not be supported on all hardware variants.

The rate of the external clock must match the rate at which the modems will connect. So, if the modem is configured for 19.200 bit/s operation, the external clock signal must be for 19.200 bit/s.

When set to AT&X1 mode, a clock signal **must** be present at the interface.

Note 2: Slave clock should only be selected on one of the two connected modems.

Note 3: In V.34 mode, after power-up the clock rate at the interface is 33600. (14400 for V.32bis). After the modem handshake is finished, the actual clock rate matching the line rate will be present at the interface.

Example: Changing profile 4 for external transmit clock source

- ATZ4<cr>: retrieve configuration of stored profile 4 (V.34, 28.800 bit/s)
- AT&X1<cr>: select external clock source.
- AT&W<cr>: store in profile 0

Power-on or reset with DS1.1 to DS1.8 set to OFF (this will select user profile 0)

Half duplex operation

For half duplex and multi-point operation with short data packets, the V.23 or V.29 modulation modes shall be selected. See %H commands, page 3-10. V.27bis and V.33 are less effective for half-duplex use with short messages as in these modes the RTS-CTS times are quite long.

Note: the V.23, V.27, V.29 and V.33 modes in the LLM-336 modem can only operate in half-duplex, regardless if 2-wire or 4-wire operation is selected. Full-duplex switched carrier operation of these modes on 4-wire lines is supported by the **LLM-336FX** modems.

The half-duplex procedure with RTS control is as follows: the DTE raises RTS to signal that it wants to transmit data. Upon RTS active, the modem will start sending a carrier signal over the line. After certain time, (the RTS-CTS delay, see table 5) the modem raises CTS to signal that the remote receiver is ready and data can be sent. When RTS is dropped, the modem stops sending. When a signal is received from the remote modem, the modem raises DCD. After a certain time (depending on the RTS-CTS delay time of the remote modem) data is received. Half-duplex operation without using RTS control is possible by using the AT%H3 command (ACC mode). In this mode the carrier is controlled by the data sent to the RS232 or RS485 port.

Note: As long as the modem receives a carrier signal from another modem (DCD on) raising RTS (%H1, %H2) or sending data (%H3) will not activate the carrier. When DCD goes Off, data present in the buffer (%H3) will be sent.

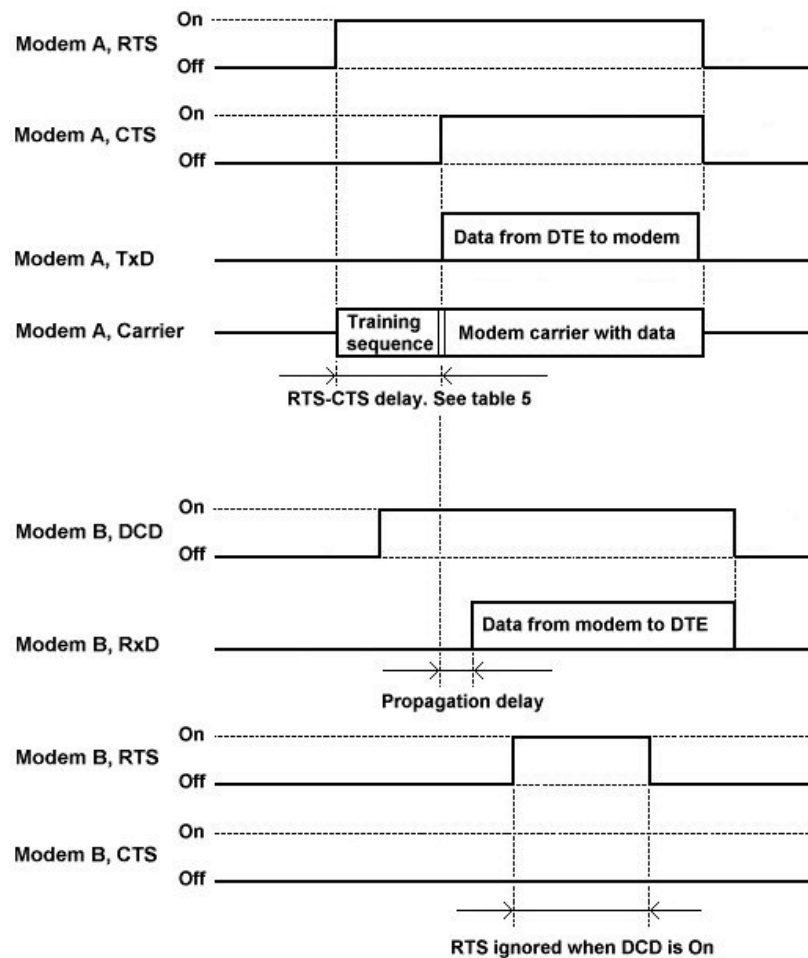


Figure 8. RTS controlled half-duplex operation

Automatic Carrier Control

The Automatic Carrier Control feature (ACC) enables half duplex and multi-point operation without the need for the DTE to control and monitor the RTS and CTS interface signals. It can be used for asynchronous data formats only. See %H commands on page 3-10.

In ACC mode only the RxD and TxD signals are used, which allows for easy connection of RS232C devices and the use of the RS485/422 interface for half duplex operation.

Instead of using the RTS signal to control the carrier, in ACC mode the transmitter carrier is automatically started when data is sent to the modem via the TxD data input. As soon as the block of data has left the transmit data buffer, the transmitter will stop sending and the receiver will be enabled.

In ACC mode, the LLM-336 has a feature to suppress the spurious or garbage characters that occur at the RxD output when the remote modem's carrier is dropped. This is an important feature, especially when 2-wire RS485 is used. Each transmission is ended with a spurious suppression sequence.

The duration of the suppression sequence is set in register S8. When receiving the suppression sequence, the modem will block (clamp) all data to the RxD output after a time-out as set in register S13. The time set by S13 must be shorter than the time for S8. This allows the receiver to block the data before the carrier of the other modem is turned off.

Note: Contact MuLogic support for additional information on ACC operation and the setting of registers S8 and S13.

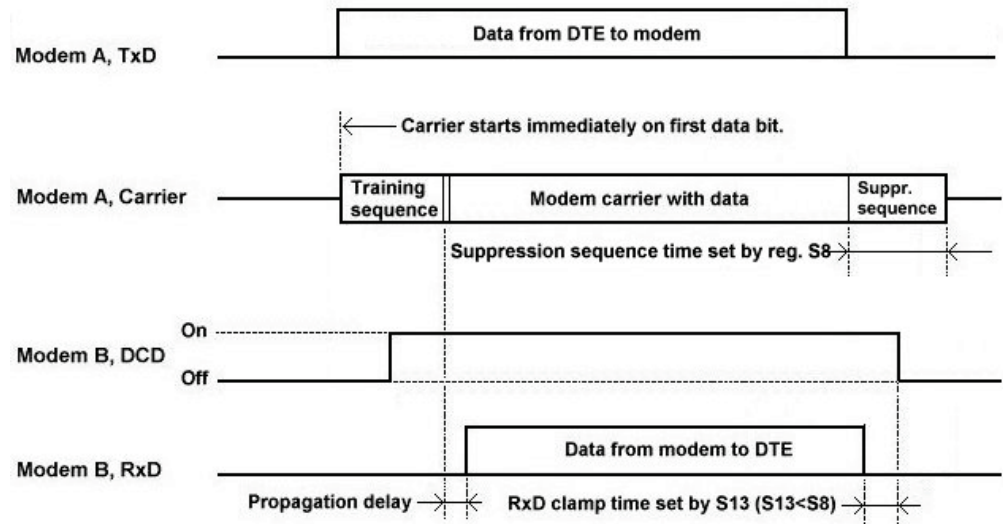


Fig. 9. Automatic Carrier Control (ACC) operation

Note: the behaviour of the CTS signal is determined by the AT&R command. In ACC mode the RTS does not control the carrier. When AT&R0 is set, the RTS controls the CTS. This allows for use of ACC mode, also when the DTE supports RTS-CTS control.

For half-duplex operation the following commands apply:

ATF Half duplex modulation modes

See page 3-4

AT%H Half duplex carrier control modes

- AT%H0 Half duplex operation disabled (Set in +MS full-duplex modes)
- AT%H1 Half duplex operation with RTS carrier control
- AT%H2 Half duplex operation with RTS control. Carrier off when buffer empty.
- AT%H3 Half duplex operation with Automatic Carrier Control (ACC).

&R RTS-CTS control (ACC mode)

- AT&R0 CTS follows RTS, the delay [ms] is determined by register S26.
- AT&R1 RTS is ignored, CTS always active.

ATS26 RTS to CTS Delay Interval

- Range : 0-255 (units of 10ms)
- Default : 0

S26 is used to increase the standard delay between RTS-On and CTS-On to values higher than the delay times as given in table 5 . This delay is needed to allow the remote receiver to adapt (train) to the transmitted carrier.

Note: Values shorter than the delay as presented in Table 5 are ignored.

Example: `ATS26=40<cr>` sets the RTS-CTS delay to 400ms.

Mode	RTS-CTS delay
V.23, 1200 bit/s	60 ms
V.27, 2400 bit/s	943 ms
V.27, 4800 bit/s	708 ms
V.29, 9600, 7200, 4800 bit/s	253 ms
V.33, 12 and 14.4 kbit/s	1393 ms

Table 5. Default RTS-CTS delay times

ATS8 %H3 ACC carrier hold-on time

- Range : 0-255 (units of 1ms)
- Default : 50 (for V.29) (S8=120 for V.23 operation)

ATS13 %H3 ACC RxD clamp time-out

- Range : 0-255 (units of 1ms)
- Default : 5 (for V.29) (S13=30 for V.23 operation)

ATS30 Anti streaming time-out

- Range : 0-255 (units of 1s)
- Default : 0

S30 sets the maximum time duration of the transmitted carrier signal. This is used in multi-drop applications for preventing devices from accidentally keeping the carrier On continuously by holding the RTS signal high (%H1, %H2 modes) or sending data continuously (%H3 mode).

Multi-point operation

In half-duplex modes the LLM-336 can be used for multi-point or multi-drop operation.

A common multi-point configuration is made of:

- one “master” modem that sends the poll requests
- multiple “slave” modem the receive the poll requests and return the poll responses.

Note: The LLM-336 can be used on 2-wire and 4-wire lines. However, on both 2-wire and 4-wire lines, the communication is half duplex, which means that the modem is either transmitting or receiving. For constant carrier transmitting and switched carrier receiving on 4-wire lines, the LLM-336FX modems shall be used.

Multi-point operation on conditioned lines

On conditioned multi-point lines, the Telecom provider takes care of sufficient line gain and impedance matching.

All modems can be set to fixed 600Ω impedance. See table 2, page 2-4.

Multi-drop operation on non conditioned lines

Multiple LLM-336 modems can be connected to one single pair of wires. See figure 10.

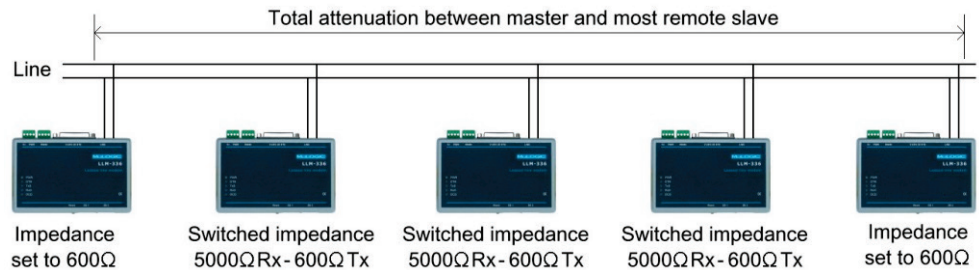


Figure 10. Multi-drop on a single pair of wires

Each modem connected to the line will add extra attenuation. This will reduce the maximum cable distance between master and most remote slave modem. To reduce this attenuation and to offer a better impedance matching, the modems that are not at the ends of the line can be set to switched impedance. See figure 10 above and table 2 on page 2-6.

Calculation example: The attenuation between the two outer modems shall be no more than 30dB. When set to “switched impedance” each modem will add approximately 1.2dB of attenuation. If, for example, the attenuation between the two outer modems (without intermediate modems connected) is 20dB then there is an attenuation margin of maximum 10dB. This means that, in this example, a maximum of 8 intermediate modems (8 x 1.2 dB = 9.6 dB) can be placed between master and most remote slave.

Note: These figures serve as an example only. The attenuation of a line depends on the wire gauge (diameter) and the length of the cable.

For testing the line attenuation, consult chapter 4.

Transmit level

The default value of the transmit level is –11dBm (at 600Ω). This value is suitable for nearly all applications. The transmit level can be changed by means of registers S91 and S92. Note that transmit levels higher than –11dBm may be in violation with the rules for operation on public leased lines.

DS1.8 Operation

Using DS1.8, two different transmit levels can be selected:

- **DS1.8 OFF** selects the level programmed with the ATS91 command.
- **DS1.8 ON** selects the level programmed with the ATS92 command.

ATS91/ATS92 Transmit levels

Range : 10-30 (units of -dBm) ***Note 2**

Default : S91=11 (i.e. –11dBm) S92=21 (i.e. –21dBm) ***Note 3**.

The values of S91 and S92 are global. This means that they apply to **all** selected operating profiles. ***Note 1**

Example: ATS91=15 <cr> (set Tx level selected with DS1.8=OFF to –15dBm)

Note 1: The Tx level is stored in NVRAM automatically and immediately after the command.

Note 2: Should higher Transmit levels than –10dBm be needed, please contact MuLogic support.

Note 3: The transmit level is expressed in dBm in a 600Ω resistive impedance. The transmit level in the ETSI complex reference impedance Z_R (expressed in dBV) is approx. 2dB below the level set in dBm. That is, a level of –10 dBm into 600Ω equals –12dBV into the ETSI reference impedance Z_R .

Receive threshold

The levels at which the modem’s DCD will turn on or off can be changed by means of the AT*T commands. The AT*T commands will **not** influence the sensitivity of the receiver.

AT*T Received carrier detect threshold

AT*T0 Threshold -43dBm on/-48dBm off

AT*T1 Threshold -33dBm on/-38dBm off

AT*T2 Threshold -26dBm on/-31dBm off

AT*T3 Threshold -16dBm on/-21dBm off

The AT*T setting is global. This means that it applies to **all** selected operating profiles.

Example: AT*T2 <cr> (set -26dBm on/-31dBm off)

Note: The Rx threshold is stored in NVRAM automatically and immediately after the command.

4

Diagnostics

Line diagnostics

For testing purposes, the LLM-336 can report the quality and attenuation of the line and the actual data rate of the modem connection.

To collect this information, an asynchronous terminal or PC with terminal emulation software such as Hyperterm can be used.

The line diagnostics are only available when the modem is in a full-duplex mode and in connection with another modem (DCD On).

To put the modem in online command mode, the Escape code is used. The escape code must be issued at the speed and format used for storing the specific operating profile.

Note: For the asynchronous operating modes this is equal to the speed and format of the serial port.

For the stored factory profiles used for synchronous operation, the speed and data format is **19200bit/s, 8bit, no parity. (19200-8-N-1)**

Entering the escape code

The default escape code character is “+” (ASCII code 43)

Before entering the escape characters wait at least one second, then enter **+++** and wait for another second. As response the modem will return “OK”.

To return to normal modem operation type **ATO<cr>**.

AT%L Check Received carrier level

The AT%L command displays the level of the signal received from the remote modem. The result is expressed in dBm. Note that the presented level is an indication of how the modem perceives the signal. It is not an absolute value of the line attenuation. Depending on the attenuation of the line and the transmit level of the remote modem, the values may vary from 8 to 43 (-8 to -43 dBm) where higher values indicate a lower signal level.

If the transmit level of the remote modem is known then the line attenuation can be calculated by subtracting the transmit level of the remote modem (S91 or S92) from the received carrier level.

For example, when the remote modem has a transmit level of -11dBm (S91 set to 11) and the AT%L command reports 33, then the line attenuation is 22dB.

AT%Q Check Line signal quality

The AT%Q command displays the quality of the line signal as perceived by the modem. The value increases with the amount of noise or other disturbances on the line, i.e. higher values indicate a lower signal-to-noise ratio (SNR).

Values between 0 and 10 are an indication for a good quality. Values from 11 to 127 are an indication for a lesser to low quality.

AT&V1 Report line status

The AT&V1 command displays the current connection status.

For example:

```

LAST TX rate..... 26400 BPS
HIGHEST TX rate..... 28800 BPS
LAST RX rate..... 26400 BPS
HIGHEST RX rate..... 28800 BPS
PROTOCOL..... LAPM
COMPRESSION..... V44
Line QUALITY..... 015
Rx LEVEL..... 033
Highest Rx State..... 67
Highest TX State..... 67
EQM Sum..... 008A
RBS Pattern..... FF
Rate Drop..... FF
Digital Loss..... None
Local Rtrn Count..... 01
Remote Rtrn Count..... 00
    
```

In this example the modem was configured for V.34 operation. After the initial handshake, the line rate was 28.800 bit/s. The local modem invoked 1 retrain after which the line rate was dropped to 26400 bit/s.

LAST TX rate:	Current transmit speed in bit/s.
HIGHEST TX rate:	Highest transmit speed achieved.
LAST RX rate:	Current receive speed in bit/s.
HIGHEST RX rate:	Highest receive rate achieved.
PROTOCOL:	Error correction protocol.
COMPRESSION:	Data compression protocol.
Line QUALITY:	Line signal quality (see AT%Q).
Rx LEVEL:	Receive level in -dBm. (see AT%L).
Highest Rx State:	Highest handshake receiver state.
Highest TX State:	Highest handshake transmitter state.
EQM Sum:	Eye Quality Monitor Sum.
RBS Pattern:	Indicates the robbed bit pattern.
Rate Drop:	Indicates speed rate drops.
Digital Loss:	Indicates loss caused by digital pads.
Local Rtrn Count:	Number of retrains initiated by this modem.
Remote Rtrn Count:	No. of retrains initiated by the remote modem.

5

Technical Specifications

Full duplex modulation modes

- **ITU-T V.34** - 33k6, 28k8, 26k4, 21k6, 19k2, 14k4, 12, 9.6, 7.2, 4.8, and 2.4 kbit/s async/sync.
- **ITU-T V.32bis** - 14k4, 12k and 7200 bit/s async/sync.
- **ITU-T V.32** - 9600 and 4800 bit/s async/sync.
- **ITU-T V.22bis** - 2400 and 1200 bit/s async/sync.
- **ITU-T V.22** - 1200 bit/s async/sync.
- **ITU-T V.21** - 300 bit/s asynchronous.
- **Bell 212A** - 1200 bit/s async/sync.
- **Bell 103** - 300 bit/s asynchronous.

Half duplex and multi-point modulation modes

- **ITU-T V.33** - 14400, 12000 bit/s async/sync.
- **ITU-T V.29** - 9600, 7200, 4800 bit/s async/sync.
- **ITU-T V.27bis** - 4800, 2400 bit/s async/sync.
- **ITU-T V.23** - 1200 bit/s asynchronous.

Note: *these modes support half-duplex operation only*

Error correction and data compression

- **ITU-T V.42** - LAPM error correction
- **ITU-T V.42bis** and **V.44** data compression

Supported DTE (serial port) data rates and formats

- **Asynchronous data rates:** 300, 600, 1200, 2400, 4800, 7200, 9600, 12k, 14k4, 19k2, 28k8, 38k4, 57k6, 115k2 bit/s
- **Async formats:** 10bit: 8-N-1, 7-E-1, 7-O-1 or 11bit: 8-E-1, 8-O-1.
- **Synchronous data rates:** 1200, 2400, 4800, 7200, 9600, 12k, 14k4, 16k8, 19k2, 21k6, 26k4, 28k8, 33k6 bit/s
- **Sync Tx clock modes:** Internal or slaved to RxClk.

Supported DTE (serial ports) interface signals

- **RS232C – V.24/V.28:** TxD, RxD, RTS, CTS, DSR, DCD, DTR, RxClk, TxClk, TST.
- **RS485 2-wire:** TR+, TR-
- **RS422 - RS485 4-wire:** TxD+, TxD-, RxD+, RxD-

RTS-CTS delay

The RTS-CTS delay in half duplex switched carrier mode is measured between the RTS input and the CTS output of the sending modem. The RTS-CTS times given are the minimal values.

Mode	RTS-CTS delay
V.23, 1200 bit/s	60ms
V.27, 4800 bit/s	708ms
V.27, 2400 bit/s	943ms
V.29, 9600, 7200, 4800 bit/s	253ms
V.33, 12000, 14400 bit/s	1393ms

Throughput delay

The throughput delay is measured between the TxD input of the sending modem and the RxD output of the receiving modem.

Mode	Throughput Delay (TxD to RxD)
V.34 sync/async. direct and buffered	30-34ms
V.32bis sync/async. direct and buffered	29-30ms
V.32 sync/async. direct and buffered	29-30ms
V.22bis sync/async. direct and buffered	48ms
V.22 sync/async. direct and buffered	68ms
V.23 async. direct and buffered	28ms
V.23 async ACC mode	84ms (note*)
V.27 sync/async. direct and buffered	26-43ms
V.29 sync/async. direct and buffered	21-26ms
V.29 async. ACC mode	275ms (note*)
V.33 sync/async. direct and buffered	25-26ms

Note*: carrier switch-on time included

Line connection

- 2-wire or 4-wire leased lines, cable or voiceband port.
- Line connector type
 - LLM-336D: 6P4C modular jack.
 - LLM-336S: 6P4C modular jack.
 - LLM-336R: on DIN 41612M connector.
- Line impedance: 600Ω
- High Rx impedance: 5000Ω for multi-drop operation.
- Controlled Transmit impedance: 600/5000Ω for multi-drop operation.
- Transmit level
 - 10 to -30 dBm @ 600Ω. Default value: -11dBm @ 600Ω
 - 12 to -32 dBV @ Z_R. Default value: -13dBV @ Z_R (ES 203 021)
- Receive threshold selectable
 - 43 dBm on, -48 dBm off.
 - 26 dBm on, -31dBm off.
 - 16 dBm on, -21dBm off.

Power supply

The power supply input of the LLM-336D accepts both DC and AC voltages.
The DC input is not polarised.

LLM-336x/Vr1 versions	LLM-336x/Vr2 versions
<ul style="list-style-type: none"> • 9-36 Vdc (11-26 Vac) • Power consumption: 2.2W max. • In-rush current: 320mA. 	<ul style="list-style-type: none"> • 18-60 Vdc (18-42 Vac) • Power consumption: 2.2W max. • In-rush current: 160mA.

General

Dimensions and weight

- LLM-336D: 95x145x30 mm LxWxH, Weight: 210 gr.
- LLM-336S: 245x130x30 mm LxWxH, Weight: 984 gr.
- LLM-336R: 3U (HE) high, 5HP (TE) wide Eurocard, 100x160mm.

Temperature range

- -20 ..+70°C, Humidity: 5..95%

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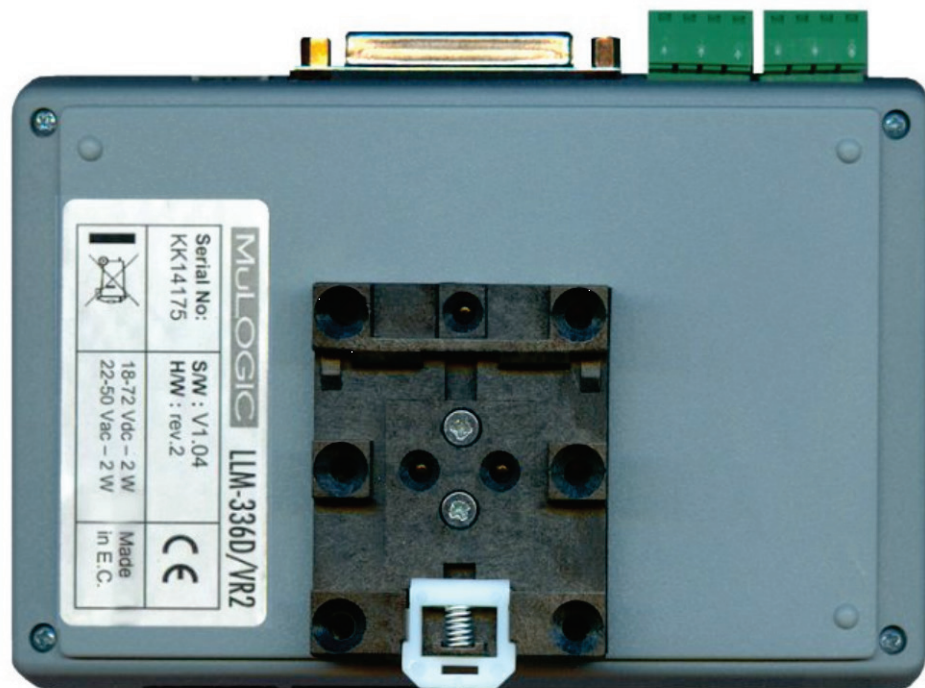
Din Rail Mounting Bracket

The LLM-336D is supplied with a mounting bracket for symmetrical rails of 35 mm according to DIN 46277-3, BS5584:1978 or EN 50-022.

The bracket is mounted to the bottom of the housing by means of an adhesive strip and two screws.

Mounting instructions of LLM-336D

Remove the yellow cover of the adhesive strip and mount the bracket. The bracket should be aligned with the two mounting holes in the bottom of the housing. Then place the screws.



LLM-336D with DIN rail mounting bracket

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Appendix A

Settings of Operating profiles

Fore reference the settings of the various operating profiles are given.

Profile	Port rate	AT commands
0 (default)	115200,8,N,1	AT&F +MS=11,0
1 (default)	19200,8,N,1	AT&F &M +MS=11,0,19200,19200
2	9600,8,N,1	AT&F &Q1 +MS=11,0
3	9600,8,N,1	AT&F &Q1 +MS=11,0,31200,31200
4	9600,8,N,1	AT&F &Q1 +MS=11,0,28800,28800
5	9600,8,N,1	AT&F &Q1 +MS=11,0,26400,26400
6	9600,8,N,1	AT&F &Q1 +MS=11,0,24000,24000
7	9600,8,N,1	AT&F &Q1 +MS=11,0,21600,21600
8	9600,8,N,1	AT&F &Q1 +MS=11,0,19200,19200
9	9600,8,N,1	AT&F &Q1 +MS=11,0,16800,16800
10	9600,8,N,1	AT&F &Q1 +MS=11,0,14400,14400
11	9600,8,N,1	AT&F &Q1 +MS=11,0,12000,12000
12	9600,8,N,1	AT&F &Q1 +MS=11,0,9600,9600
13	9600,8,N,1	AT&F &Q +MS=11,0,9600,9600
14	38400,8,N,1	AT&F +MS=11,0
15	19200,8,N,1	AT&F +MS=11,0,19200,21600
16	9600,8,N,1	AT&F +MS=11,0,9600,14400
17	9600,8,N,1	AT&F &Q1 +MS=10,0
18	9600,8,N,1	AT&F &Q1 +MS=9,0
19	9600,8,N,1	AT&F &Q +MS=9,0,9600,9600
20	2400,8,N,1	AT&F &Q +MS=2,0,2400,2400
21	1200,8,N,1	AT&F &Q +MS=1,0
22	300,8,N,1	AT&F &Q6 +MS=0,0
23	1200,8,N,1	AT&F &Q6 F2%H1
24	1200,8,N,1	AT&F F2%H3 S8=140S13=30S30=10
25	1200,8,N,1	AT&F F2%H3 S8=50S13=20S30=10
26	2400,8,N,1	AT&F F2%H3 S8=140S13=20S30=10
27	9600,8,N,1	AT&F
28	9600,8,N,1	AT&F &Q1 F4%H1&Q1
29	9600,8,N,1	AT&F &Q1 F3%H1&Q1
30	4800,8,N,1	AT&F &Q F4%H1&Q
31	2400,8,N,1	AT&F &Q F3%H1&Q
32	9600,8,N,1	AT&F &Q1 F7%H1&Q1
33	9600,8,N,1	AT&F &Q1 F6%H1&Q1
34	9600,8,N,1	AT&F &Q1 F5%H1&Q1
35	9600,8,N,1	AT&F &Q F7%H1&Q
36	7200,8,N,1	AT&F &Q F6%H1&Q
37	4800,8,N,1	AT&F &Q F5%H1&Q
38	9600,8,N,1	AT&F F7%H3 S30=10
39	4800,8,N,1	AT&F F5%H3 S30=10
40	9600,8,N,1	AT&F

Note: Settings may be subject to change without notice

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