

LIN to RS232 Gateway Communication Protocol Specification

MACH SYSTEMS s.r.o.



Changes

Date	Change	Changed by
11.3.2020	Device configuration bits changed! Transmission of LIN response timeouts is not sent to RS-232 Sniffing mode added	MM
26.11.2019	LIN channel autostart configuration bit added	MM
7.11.2018	Public Release	JJ, MM
2.11.2018	Changed error responses	JJ, MM
26.10.2018	Draft Release	MM, JJ
2.8.2018	Draft	MM

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1. Introduction

The LIN2RS232 Gateway with the Universal Firmware acts as a device which can make a bi-directional communication bridge between RS-232 and a LIN bus.

The gateway can act as:

- LIN Master
- LIN Slave
- LIN bus Sniffer (receives all LIN communication and forwards into onto the RS-232)

The gateway can be controlled by a binary protocol over RS-232. This allows the user to:

- Configure LIN channel (Master/Slave, Baud Rate)
- Transmit and Receive LIN frames
- Acts as a sniffer - all LIN communication is forwarded onto RS-232

The sniffing mode does not actively communicate over the LIN bus. Instead, it forwards all incoming LIN communication onto the RS-232 port.

The gateway configuration can be stored into an internal EEPROM. It would be automatically loaded on power-up.

LIN Frame Naming Convention

LIN frame consists of a header and a response.

Header =Synch. Break + Sync. Field + Id Field

Response = Data bytes + Checksum

Name	Meaning
Master Response	a complete LIN frame which contains both header and response
Master Request	a LIN header only e.g. Master transmits a header and expects a Slave to answer by a Slave response
Slave Response	a Slave Response only e.g. Databytes+Checksum

The following table summarizes TX/RX possibilities of the gateway for both LIN Master and Slave mode:

LIN Message Action	LIN Mode	
	Master	Slave
Transmit Master Response	yes	
Transmit Master Request	yes	
Transmit Slave Response		yes
Receive Slave Response	yes	
Receive LIN Frame	yes	yes

When the gateway is configured as LIN Master, an internal 1kOhm pull-up resistor between Vbat and LIN bus is automatically enabled.

2. Communication Protocol

The communication between the LIN Gateway Device and the control system is based upon a binary protocol over RS-232. The same message structure is used for both directions - to and from the device.

The protocol consists of Start, Message Id, DataLength, Data bytes, Checksum, and End.

RS-232 configuration is **fixed**: 115200 Baud, 8 data bits, no parity, 1 stop bit

STX (1B)	ID (1B)	DATALEN (1B)	DATA (X B)	CHECKSUM (1B)	ETX (1B)
0x02	Message Id	Number of data bytes	Data bytes Number of bytes = DATALEN	1-byte sum of ID, DATALEN and all DATA bytes	0x03

The rest of the documentation refers to **DATA** part only. The user is then responsible for encapsulating it with the rest of the protocol fields such as STX, Id, DataLen, Checksum and ETX.

2.1. Message Overview

The following tables describes message of the communication protocol over RS-232.

ID	Name	Request Data Length	Response Data Length	Comment
0x01	BOOT_UP		0	A notification that the gateway was powered up
0x11	READ_SN	0	4	Read gateway serial number
0x12	READ_HW_INFO	0	6	Read gateway HW info
0x13	READ_SW_INFO	0	2	Read gateway SW info
0x20	WRITE_CONFIGURATION	1	0	Configure LIN channel
0x21	READ_CONFIGURATION	0	1	Read LIN channel configuration
0x22	SAVE_CONFIGURATION	0	0	Save LIN configuration to EEPROM
0x23	LOAD_CONFIGURATION	0	0	Load LIN configuration from EEPROM
0x24	DEFAULT_CONFIGURATION	0	0	Load LIN default configuration
0x30	LIN_START	0	0	Start LIN channel
0x31	LIN_STOP	0	0	Stop LIN channel
0x40	MASTER_RESPONSE_TX	3 to 10	1 to 2	Transmit LIN Header+Response <i>Available when the device is configured as a Master</i>
0x41	MASTER_REQUEST_TX_RX	1	1 to 11	Transmit LIN Header+Receive Slave Response <i>Available when the device is configured as a Master</i>
0x50	SLAVE_RESPONSE_CONFIG	2 to 10	1	Configure Slave Response buffer
0x51	SLAVE_RESPONSE_TX_RX		2 to 11	A Slave response received or transmitted from/onto the bus.
0xFE	RESTART_BOOT	0		Restart gateway to bootloader
0xFF	GENERAL_ERROR		2	An error occurred

2.2. Error Codes

The following tables describes error codes

Error Code	Comment
0xE1	Checksum error
0xE2	Bus error
0xE3	Timeout overrun
0xE4	Unknown Message Id

3. Message Specification

3.1. LIN Channel Configuration

MessageId=0x20

Data section of a packet:

DATA 0
Configuration Register

Configuration Register:

bit 7							bit 0
-	CHECKSUM	AMLR	AUTOSTART	MODE1	MODE0	BAUD1	BAUD0

Bit 7	Reserved
Bit 6	Checksum Type 0 – Classical Checksum 1 – Enhanced Checksum (except for 0x3C and 0x3D identifiers)
Bit 5	AMLR - Automatic Message Length Recognition 0 – Message length is taken from LIN Id field (as defined in LIN v1.x) 1 – Message length is recognized automatically (variable datalength as defined in LIN v2.x)
Bit 4	AutoStart 0 – LIN channel is NOT automatically started on power-up 1 – LIN channel is automatically started on power-up
Bit 2..3	Mode 00 – Slave 01 – LIN Master 10 – Sniffing Mode 11 – Reserved
Bit 0..1	Baud Rate Selection 00 – Reserved 01 – 9600 10 – 19200 11 – Reserved

Type of response:

- 1) Gateway reconfigured

DATA 0 - status
0x01

- 2) Gateway cannot be reconfigured

DATA 0 - status
0x00

Possible reasons:

- Wrong baudrate type selected.

Default configuration of gateway

- Master
- Enhanced checksum
- 19200 Baud
- Auto-start disabled
- Automatic Message length Recognition
-

3.2. Read Configuration

MessageId=0x21

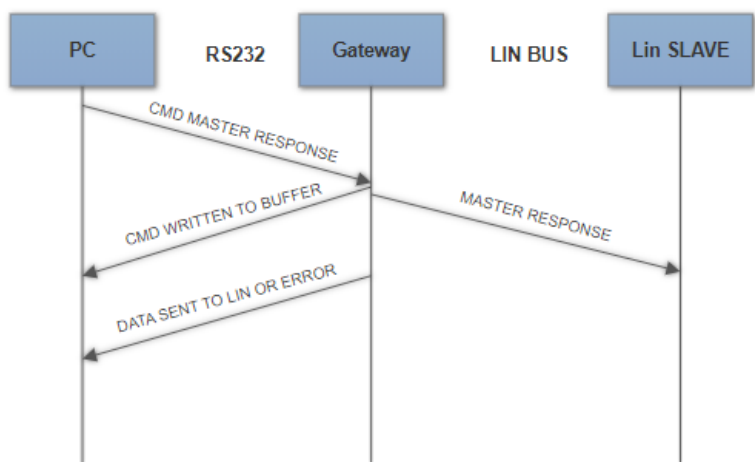
Type of response:

DATA 0
Configuration Register

3.3. Transmit Master Response

MessageId=0x40

The gateway will transmit a LIN frame (both LIN Header and Response) onto the LIN bus.



Data section of a packet:

DATA 0	DATA 1	DATA 2	DATA 3	DATA n
LIN ID	LIN DATALEN	LIN DATA1	LIN DATA 2	DATA n

Type of response:

1) Data written to LIN buffer

DATA 0 - status
0x01

2) Command cannot be processed (channel is in stop state or buffer is full)

DATA 0 - status
0x00

3) Data sent to bus

DATA 0 - status	DATA 1
0x02	LIN ID

4) Error

DATA 0	DATA 1
ERROR CODE	LIN ID

DATA1 (LIN ID) – error occurred while sending frame with this LIN ID

3.4. Transmit Master Request

MessageId=0x41

The gateway will transmit a LIN Header onto the LIN bus and will expect a Slave to send a response.

Data section of a packet:

DATA0
SLAVE LIN ID

DATA0 – LIN ID of slave device

Type of response:

1) Data written to LIN buffer

DATA 0 - status
0x01

2) Command cannot be processed (channel is in stop state or buffer is full)

DATA 0 - status
0x00

3) Received data from slave when gateway is MASTER

DATA 0 - status	DATA 1	DATA 2	DATA 3	DATAN
0x02	LIN slave ID	Length of received slave data	Data from slave byte1	Data from slave byte n

4) Error

DATA 0	DATA 1
ERROR CODE	LIN ID

DATA1 (LIN ID) – error occurred while receiving frame with this LIN ID

3.5. Slave Response Configuration

MessageId=0x50

When the gateway is configured as LIN Slave, it provides message buffers for Slave Responses. These message buffers can be used for both direction - transmission and reception of Slave Response.

The following describes how the message buffers can be set up.

DATA 0	DATA 1	DATA 2	DATA 3	DATAn
LIN ID of response	LIN DATALEN	LIN DATA1	LIN DATA 2	DATAn

- LIN ID has to be unique.
- Slave response buffers are empty after channel start.
- Max. LIN Datalen can be 8.

DATA0 - LIN ID of response:

bit 7			bit 0
---	BUFFER DIR	LIN ID	

Bit 7 Reserved

Bit 6 Buffer Direction

0 – RX, the gateway will receive data from LIN frame into this buffer. Length of received message depends on AMLR bit from configuration register. If AMLR bit is 0, message length is hardcoded in Lin ID, otherwise length of the message is recognized automatically. See Chapter **Slave Response** for notification about this event.

1 – TX, the gateway will transmit a Slave Response when the corresponding LIN Id is pooled by the Master. See Chapter **Slave Response** for notification about this event.

Bit 5..0 Lin ID (including message length coding if AMLR bit is 0)

DATA1 – LIN DATALEN:

Slave response buffer:

DATA0	DATA1	DATA2, DATA3, DATA4, DATAn	Comment:
<i>BUFFER DIR + ID</i>	<i>DataLen</i>	<i>Lin Data Array</i>	
1 0x01	4	0x01, 0x02, 0x03, 0x04	This data will be sent to LIN BUS if slave receives MASTER REQUEST with ID 0x01
0 0x02	0	-----	Slave will receive data from master and send them to PC.
1 0x05	2	0x22,0x23	This data will be sent to LIN BUS if slave receives MASTER REQUEST with ID 0x05

Type of response:

1) Data written to the Slave Response buffer

DATA 0 - status
0x01

2) Data cannot be written to the Slave Response buffer

DATA 0 - status
0x00

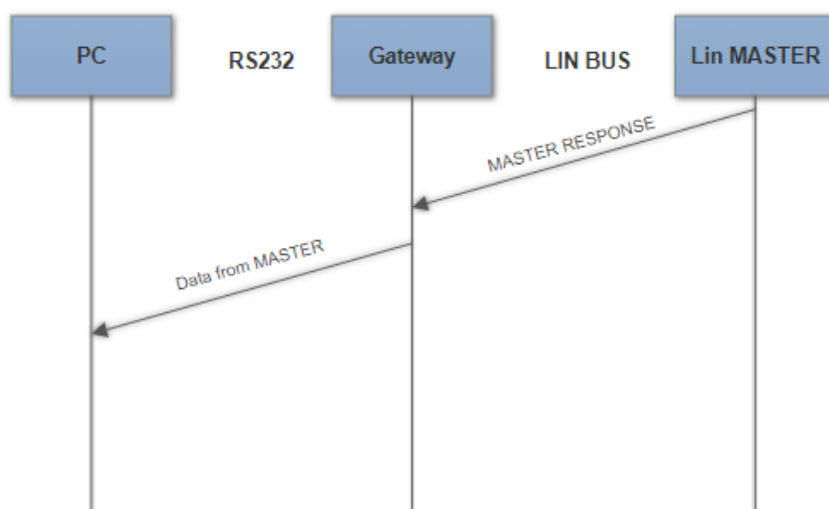
Possible reasons:

- A Slave response buffer with this LIN Id is already configured.
- Buffer Direction is 1 (TX) but the DataLen is 0.

3.6. Slave Response

MessageId=0x51

When the gateway is configured as a Slave and it receives or transmits a Slave Response from/onto the bus, it sends a notification to RS-232.



Type of responses:

- 1) Received data from Slave Response from the bus

DATA 0 - status	DATA 1	DATA 2	DATA 3	DATA n
0x01	LIN ID	Received slave data length	LIN DATA	LIN DATA n

- 2) Transmitted Slave Response onto the bus

Slave Response containing data from Message Buffer has been sent onto the bus.

DATA 0 - status	DATA 1
0x02	LIN ID

- 3) Error while receiving data from Slave Response

DATA 0 - status	DATA1
ERROR CODE	LIN ID

3.7. General Error Message

MessageId=0xFF

DATA 0	DATA 1
ERROR CODE	MSG ID

MSG ID – error occurred while processing command with this command ID

3.8. Device information response packet formats

Serial number – Message ID 0x11

Example S/N: 02030106

DATA 0	DATA 1	DATA 2	DATA 3
06	01	03	02

Hardware information – Message ID 0x12

Example HW Info: 000400030002

DATA 0	DATA 1	DATA 2	DATA 3	DATA 4	DATA 5
02	00	03	00	04	00

Software information – Message ID 0x13

DATA 0	DATA 1
VERSION MINOR	VERSION MAJOR

4. Message Examples

Command	Bytes [hex]
Configure LIN channel 19200, Master, Enhanced Checksum, Auto-Message Length	02 20 01 66 87 03 Gateway response: 02 20 01 01 22 03
Start LIN channel	02 30 00 30 03 Gateway response: 02 30 01 01 32 03
Transmit Master Response Frame LIN Id=0x21 with 3 data bytes:0x01 0x02 0x03	02 40 05 21 03 01 02 03 6F 03 Gateway response: 02 40 01 01 42 03 - Written to buffer 02 40 02 02 21 65 03 - LIN frame has been sent onto the LIN bus
Stop LIN channel	02 31 00 31 03 Gateway response: 02 31 01 01 33 03

5. Contact

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