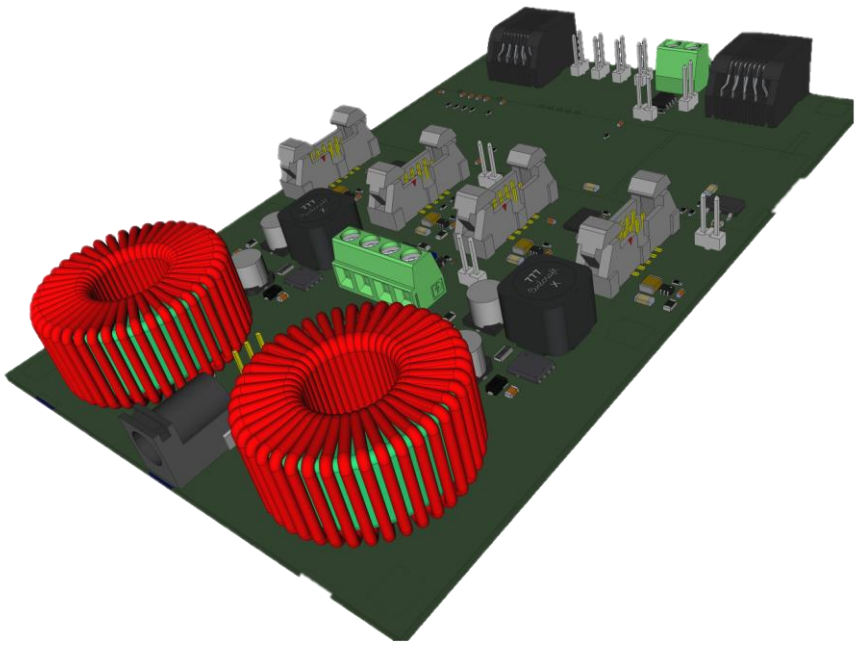

Lumineq® Bus Adapter

Controller Area Network Interface

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Date: September 19, 2019

Document number: ED001497A

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1 Overview

This document contains information about Lumineq Bus Adapter (LBA) programmed with Controller Area Network (CAN) interface software. Interface allows visualizing information transmitted in CAN 2.0 B compatible J1939 and NMEA2000 CAN buses on supported Lumineq displays. Information provided in this document is subject to change at any time without notice.

2 Power requirements

Supply voltage can be provided in two different ways, either using external +12 VDC supply or connecting 4-40 VDC to CAN-interface connector. Broad range of supply voltages enable easy implementation of Lumineq technologies is a wide variety of industries, from battery operated devices to heavy industrial machinery. LBA must be configured properly depending of DC input source. For detailed description of different power input options and their usage, see document *ED001502 - LBA Field Operations Manual*.

Input current is specific for each display glass, which mainly depends on the glass size and brightness. LBA driving a single EL40S display on default brightness level requires approximately 400mA at 12 VDC. Depending of the configuration and display(s) content required input current varies between 70mA – 2000mA with supply voltage of 12 VDC. Maximum input current is not limited by electronic design. High input current can occur with large segments and/or high brightness levels.

3 Network interface

Lumineq Bus Adapter monitors the network for certain predefined messages based on their parameter group numbers (PGNs). The assortment of supported parameter groups is fixed and predefined. When a message with supported PGN is detected the message is interpreted and the data is decoded according to corresponding Suspect Parameter Number (SPN) or similar network specific definition.

As PGN and SPN information is standardized this document contains only the necessary information to identify supported messages. Detailed information of each message is available at the standards listed in following Table 1.

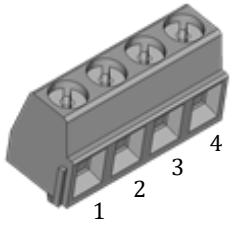
Table 1. Network standards.

Network	Standard
J1939	J1939DA (former J1939-71). Revision 201902.
NMEA2000	NMEA 2000® Network Message Database – PGNs (NMEA 2000 Appendix B) Full Database. Version 2.101.

3.1 Wiring

LBA is equipped with a universal screw terminal illustrated in Figure 1 allowing connectorless connection of LBA to target network. Location of the terminal on circuit board is shown in Figure 2. Typical wiring reference of J1939 and NMEA2000 wiring is shown in chapters 3.1.1 and 3.1.2.

Detailed description of different connection interfaces is available in separate document *ED001502 - LBA Field Operations Manual*.



Pin	Signal	Functional Description
1	CAN HI	CAN high level signal
2	CAN LO	CAN low level signal
3	VCC	Power supply for internal 4-40 VDC converters
4	GND	Signal/Power ground

Figure 1. LBA CAN terminal connector.

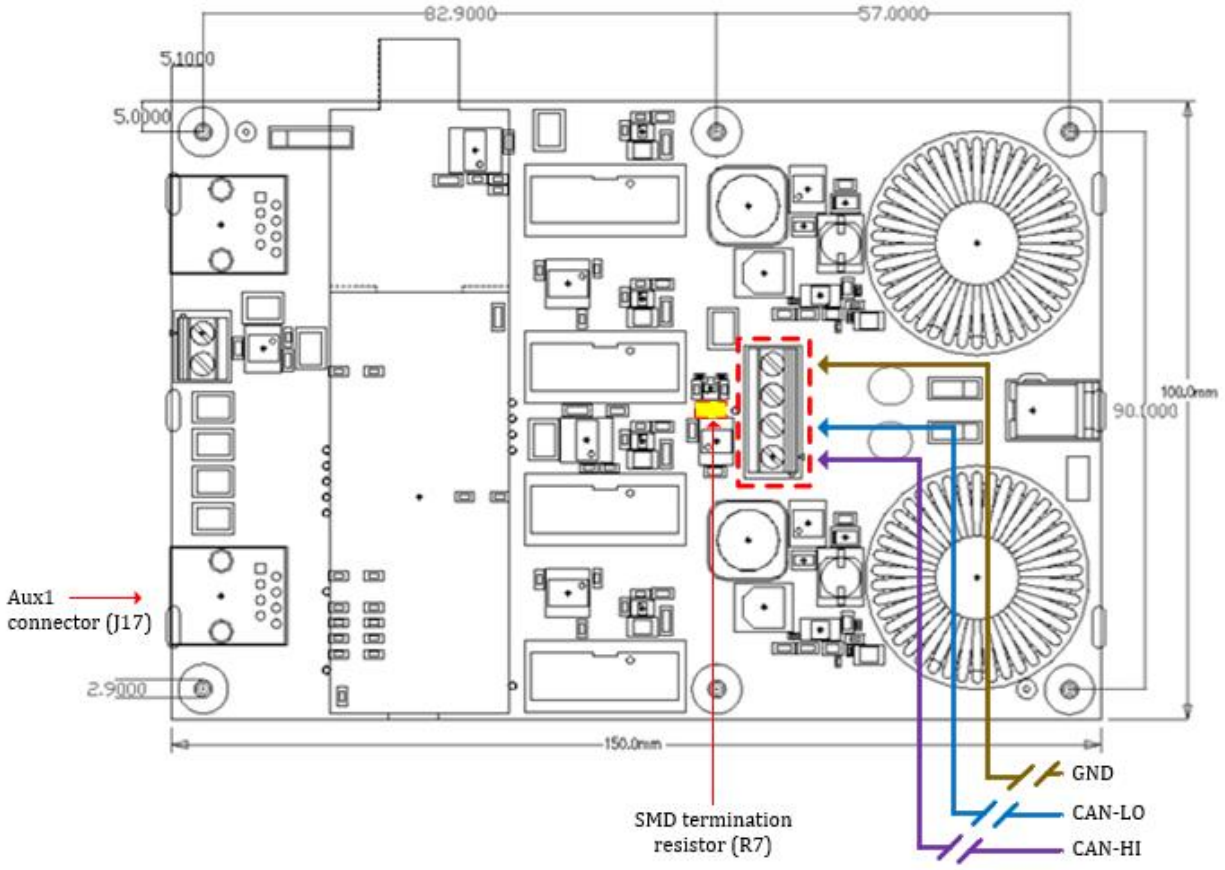
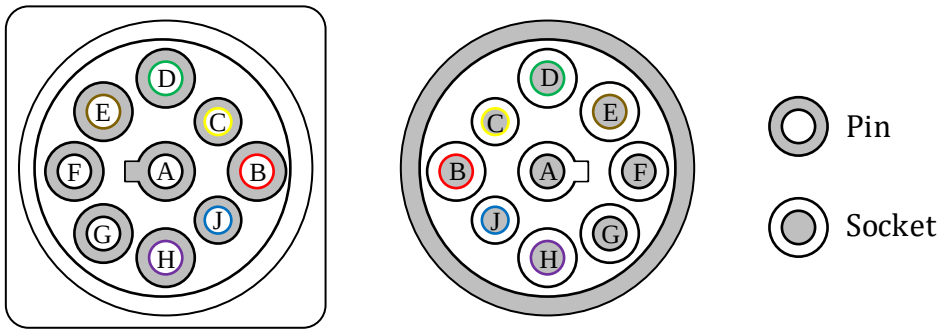


Figure 2. CAN connector terminal location and bus termination resistor location on LBA.

3.1.1 J1939 and Deutsche 9 connector

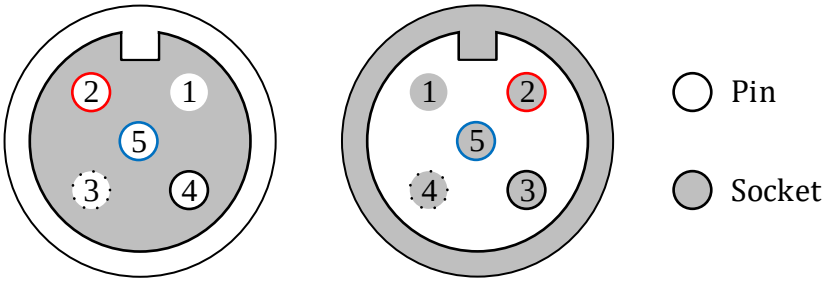
SAE-J1939 Deutsche 9 connector interface and wiring reference illustrated below.



Pin	Signal	Description	Typical Wire Color *
A	GND	Ground	Black
B	Battery	Battery	Red
C	CAN0-HI (+)	J1939 Channel 1	Yellow
D	CAN0-LO (-)	J1939 Channel 1	Green
E	CAN shield	CAN shield	Brown
F	J1708+	J1708+	White
G	J1708-	J1708-	Orange
H	CAN1-HI (+)	J1939 Channel 2	Violet
J	CAN1-LO (-)	J1939 Channel 2	Blue

3.1.2 NMEA2000 and Micro-C connector

NMEA2000 Micro-C connector interface and wiring reference illustrated below.



Male connector Female connector

Pin	Signal	Description	Typical Wire Color *
1	Shield	Shield	(Bare)
2	NET-S	VCC (V+)	Red
3	NET-C	GND (V-)	Black
4	NET-H	CAN-HI (CAN+)	White
5	NET-L	CAN-LO (CAN-)	Blue

*) May differ depending of target system implementation and target network. Always check wiring and pinout before connecting.

3.1.3 Bus termination

Termination resistor is not populated in default. Two different mounting options are provided. LBA has a dedicated place for 1206 size SMD resistor. Location of the resistor is shown in Figure 2. It is also possible to use axial-lead resistor by mounting it between the CAN HI and CAN LO screw terminals. Typical value for the termination resistor is 120 ohms.

3.2 Communication

CAN bus is monitored passively and no messages are sent actively or on request. LBA is not addressable and does not participate in address negotiation.

Supported baudrate is 250 kbit/s.

3.3 Message filtering

Compatible network is expected to use extended 29-bit CAN SAE J1939 compatible CAN 2.0 B identifier shown in Figure 3.

<table>
<tr><td colspan="5">CAN identifier
29 bits</td></tr>
<tr><td rowspan="2">Priority
3 bits</td><td colspan="3">PGN – Parameter Group No.
18 bits</td><td rowspan="2">SA
8 bits</td></tr>
<tr><td>EDP
1 bit</td><td>DP
1 bit</td><td>PDUF
8 bits</td><td>PDUS
8 bits</td></tr>
</table>

Figure 3. CAN identifier structure.

Message filtering is based on PGN matching. Priority and Source Address (SA) fields are not examined during message monitoring. Thus message with supported PGN value is always received despite its priority and sender's source address. Both peer-to-peer targeted and broadcast messages are monitored. Identifier specific fields are described in Table 2.

Table 2. CAN identifier field breakdown.

Priority	*Message specific. LBA accepts all values.*
PGN	*Message specific.*
Source address (SA)	*Message specific. LBA accepts all values.*
Extended Data Page Bit (EDP)	0
Data Page Bit (DP)	J1939: 0 NMEA2000: 1
PDU format (PDUF)	PF < 240 (0xF0): peer-to-peer (PDU1) message PF >= 240 (0xF0): broadcast (PDU2) message
PDU specific (PDUS)	PF < 240 (0xF0): destination address PF >= 240 (0xF0): group extension

4 Supported messages

LBA CAN interface is intended and designed to allow connecting display to CAN bus for demonstrating and experimenting the display with live data. Supported message set contains a selection of the most common and generic vehicle messages. It is unlikely that all supported messages are available at the target network.

Unit of the active value is defined by corresponding network standard in default. The value may be rounded, truncated or converted to other format or unit depending of the data and display type.

Method of changing active information is display specific. During normal operation LBA uses a limited sub-set of messages defined by active display and network configuration. See chapter 7 for display specific details.

4.1 J1939

Table 3. Supported J1939 messages.

Information	PGN	SPN	Description
Illumination Brightness Percent (%)	53248 D000h	1487	Commanded backlight brightness level for all cabin displays. Note that this message actually controls the display brightness instead of indicating the value.
Vehicle Speed (kmph)	65265 FEF1h	84	Speed of the vehicle.
Engine Speed (rpm)	61444 F004H	190	Actual engine speed.
Engine Coolant Temperature (°C)	65262 FEEEh	110	Temperature of liquid found in engine cooling system.
Fuel Level (%)	65276 FEFCh	96	Ratio of volume to the total volume of storage container.
Battery Potential (V)	65271 FEF7h	158	Electrical potential at the input of the ECU.
Payload Percentage (%)	64996 FDE4h	2600	The current payload of the equipment, reported as a percentage of the equipment's rated payload limit.

4.2 NMEA2000

Table 4. Supported NMEA2000-messages.

Information	PGN	Description
Depth (m)	128267 1F50Bh	Depth relative to the transducer location.
Course Over Ground (°)	129026 1F802h	The direction of the path over ground actually followed by a vessel.
Speed Over Ground (kt)	129026 1F802h	1 knot (kt) = 0.5144 m/s
Time (24h format)	126992 1F010h	UTC time.
Fuel level (%)	127505 1F211h	Fuel level in the tank.
Engine Speed (rpm)	127488 1F200h	Engine speed of engine instance 0, corresponding the Port side motor in multi-engine vessel.

5 Configuration

Before usage LBA hast to be configured according to target environment. Configuration is carried out during production based on information provided at order. Reconfiguration is possible by using Lumineq Loader application with a text-file based configuration file. This chapter briefly describes the required steps of LBA CAN configuration. See document *ED001499 -Lumineq Bus Adapter Script Manual* for detailed instructions of Lumineq Loader application usage and command syntax.

Figure 4. Lumineq Loader PC application.

5.1 Sample configuration file

Configuration file consists of semicolon separated commands as seen in figure below. File can be created using Microsoft Windows Notepad, or similar, text editor. Finished configuration file is then transmitted to LBA using the Lumineq Loader Script Wizard functionality.

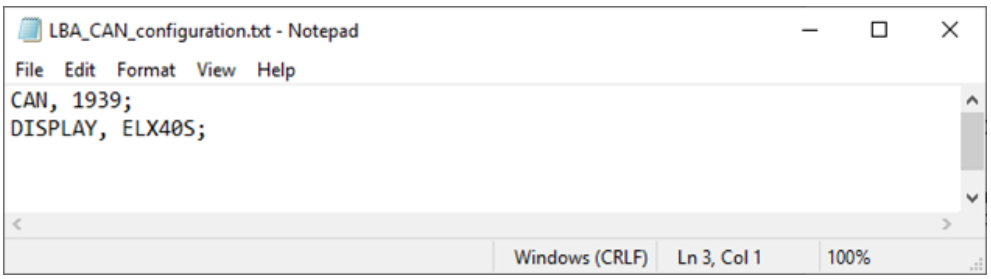


Figure 5. Lumineq Loader configuration file with content to configure LBA to drive ELT40S display in J1939 CAN network.

5.2 Network

Target network is set using command CAN. Following table contains possible configuration options.

Network	Configuration file entry
J1939	CAN, 1939;
NMEA2000	CAN, 2000;

Depending of display, the device may inform user of current operating mode during startup. With displays having 4x7segment area 1939 is shown for J1939 mode and 2000 for NMEA2000 mode.

5.3 Display

Target display is set using command DISPLAY. To configure LBA to use ELT40S multipurpose display add following line to the configuration file:

```
DISPLAY, ELX40S;
```

See chapter 7 for a list of supported displays and their configuration file entries.

6 Local user interface

Certain LBA functionalities can be controlled using the Auxiliary 1 (Aux1) control board. Depending of active display Aux1 knob can be used to change active parameter and/or adjust display brightness. Aux1 is connected to port J17 on LBA using standard RJ45 network cable.

Figure 6. Auxiliary 1 control board

Display brightness may also be controller remotely over the Cabin Illumination CAN message. In such case it is possible to overdrive the remote brightness setpoint by manually adjusting the brightness.

Display specific chapters contain more information about the Aux1 behavior with each support display. Refer to LBA Specification document for detailed description of Aux1 board connectivity and functionality.

7 Displays

This chapter contains display specific information for each supported display. Note that supported messages vary between different displays according to display capabilities. Value received from CAN bus will be converted and scaled to feasible level and unit if necessary.

7.1 ELT40S and EL40S

Default display type for LBA CAN interface is multipurpose segment display available as transparent ELT40S and non-transparent EL40S version. Single value per view is visible. Active view may be changed using Aux1 interface board. EL(T)40S displays exists with two different segment mappings.

Figure 7. Lumineq EL40S segment TFEL display.

Table 5. ELT40S and EL40S display configuration values to be used in configuration file.

Display	Command value	Comments
EL40S	EL40S	To be used only with early prototype displays
ELT40S	ELX40S	Use with EL40S and Transparent ELT40S

Upon startup the display will scroll through different views by changing the active view every 2 seconds. Automatic view cycling can be halted by rotating the knob on Aux1 board. This takes the display into manual mode where user can select the active view by rotating the knob. Display will indicate current parameter number when automatic view cycling mode is exited.

When active view is manually changed the display indicates which view was activated by displaying the View ID for 1 second. View ID consists of constant part and changing part. Syntax follows notation PA.XX where XX stands for the active parameter number.

To enter manual brightness adjusting mode press knob down until "br" is shown on display to indicate proper entry to brightness adjusting mode. Press knob down until "PA" is shown to enable remote brightness control or rotate the knob to manually adjust brightness level. Exit manual adjusting mode by pressing knob down until "PA" is shown.

Table 6. ELT40S/EL40S J1939 network parameters

Parameter	Information	Unit on display	Range on display	Resolution on display	Resolution on network
PA. 0	Fuel level	%	0 to 100	1	0.4 % / bit
PA. 1	Engine Coolant Temp	°C	-40 to 210	1	1 °C / bit
PA. 2	Vehicle Speed	km/h	0 to 250	1	1/256 km/h / bit
PA. 3	Engine Speed	rpm/min	0 to 8030	10	0.125 rpm / bit
PA. 4	Battery Potential	V	0 to 999.9	0.1	0.05 V / bit
PA. 5	Payload	%	0 to 250	1	1 % / bit

Table 7. NMEA2000 network parameters

Parameter	Information	Unit on display	Range on display	Resolution on display	Resolution on network
PA. 0	Time	24 H	-	1 min	-
PA. 1	Speed Over Ground	m/s	0 to 655	1	1x10E-2
PA. 2	Course Over Ground	deg	1 to 359	1 deg	1x10E-4 rad
PA. 3	Depth	m	0 to 9999	1	1x10E-2 m
PA. 4	Engine #0 Speed	RPM	0 to 16383	1	1/4
PA. 5	Fuel level	%	0 to 100	1	4x10E-3

7.2 ELT120S-MultiGauge

Display visualizes typical road vehicle dashboard content such as engine parameters and coolant liquid temperature and fuel level. ELT120S-MultiGauge display can only be used in J1939 network.

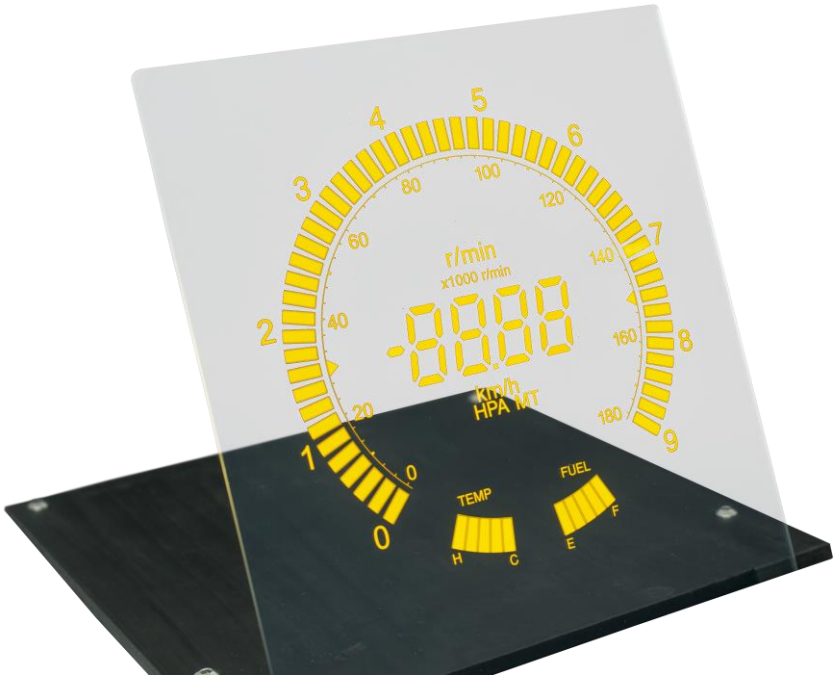


Figure 8. ELT120S-MultiGauge segment display.

Table 8. ELT120S-MultiGauge display configuration to be used in configuration file.

Display	Command value
ELT120S-MultiGauge	ELT120S-MULTIGAUGE

Manual brightness adjusting mode can be accessed by rotating knob on Aux1 board. To exit manual adjusting mode press down the knob until "br" is shown.

Table 9. ELT120S-MultiGauge J1939 network parameters

Information	Unit on display	Range on display	Resolution on display	Resolution on network
Fuel level	%	0 to 100	20	0.4% / bit
Engine Coolant Temp	-	-40 to 115	-	1 °C / bit
Engine Speed	RPM	0 to 8030	167	0.125 rpm / bit
Vehicle Speed	km/h	0 to 250	1	1/256 km/h / bit

8 Related documents

Number	Name
ED001499	Lumineq® Bus Adapter Script Manual
ED001502	LBA Field Operations Manual

9 Document version history

Version	Date	Change list
1.0	7.8.2019	Released