LiGO | Protocol
capacitive fuel level sensor

SOJI
STABILITY

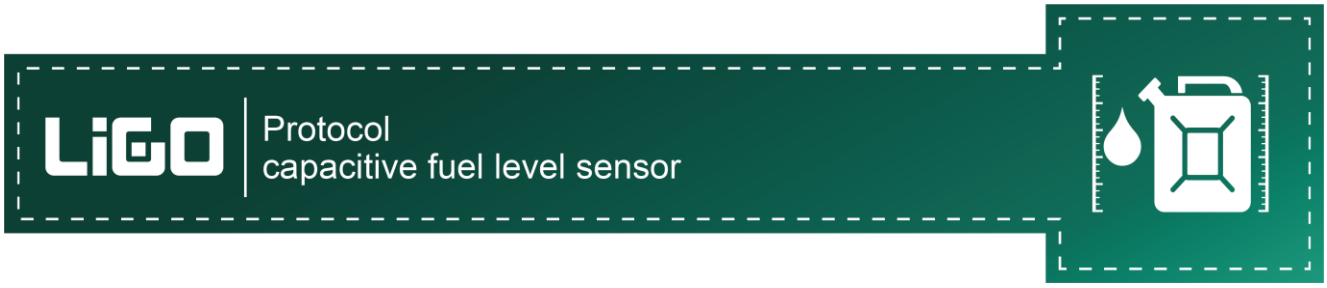
LIGO FUEL LEVEL SENSOR

LLS Protocol Integration

Version: V1.0

LIGO SP - RS232
LIGO SP - RS485

CONTENTS



I. GENERAL INTRODUCTION

LLS Protocol is used in LIGO RS232 / RS485 fuel level sensor with the following parameters:

- Baud rate: 2400,4800,9600,19200,38400,115200 (can be configured by software on PC)
- Data bits: 8
- Parity: None
- Stop bits: 1
- Flow control: None

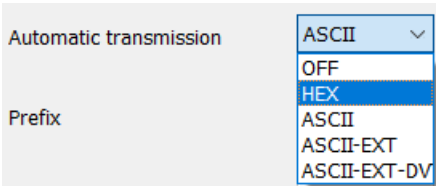
LIGO fuel level sensor has 2 working modes:

1. Slave mode: In this mode, the sensor will respond to all requests from the external device (master device). Each sensor in the network will be distinguished by different addresses configured with the LIGO Configurator software

2. Master mode: In this mode the sensor will automatically send data to the external device with a preset interval (message interval)

To enable this mode on the LIGO Configurator software , do the following:

- Automatic transmission: select HEX (binary) or ASCII or ASCII EXT



- Set the time of each transfer (Message interval)

II. EXCHANGE PROTOCOL DESCRIPTION

The LLS protocol supports two types of exchange protocols: binary (HEX) and character view (transmission of ASCII sequences). It is recommended to use binary exchange protocol.

1. Format of Binary Protocol Messages

All the commands of the binary communication protocol have the same standardized format which is given in the table:

Sequential number of the field	Field name	Field size, byte	Description
1	Prefix	1	The field is a marker of the message beginning shall have prefix 31h, and an outcoming messages shall be displayed with 3Eh prefix by the program.
2	Network address	1	For prefix 31h specify the network address of the recipient. For prefix 3Eh specify the network address of the sender.
3	Operation code	1	For prefix 31h specify the code of operation which the program shall perform For Eh prefix specify the code of operation to which the response is given
4	Data	It depends on the operation code	Data composition and format of the field depends on the operation code
5	Checksum	1	The field is used to control over data integrity

2. Single-Stage Data Reading (command 06h)

The command is designed for reading of the current data: relative level, temperature, frequency. The data are transmitted with a lower byte ahead.

2.1. Command format:

Offset, bytes	Field size, bytes	Value	Description
0	1	31h	Prefix
+1	1	00h..FFh	Network address of the recipient
+2	1	06h	Operation code
+3	1	00h..FFh	The checksum

2.2. Response format:

Offset, bytes	Field size, bytes	Value	Description
0	1	3Eh	Prefix
+1	1	00h..FFh	Network address of recipient
+2	1	06h	Operation code
+3	1	-128…127	Temperature in in degrees Celsius
+4	2	0000h…FFFFh	Relative level
+6	2	0000h…FFFFh	Frequency value
+8	1	00h..FFh	Checksum

3. Periodic Data Output (command 07h)

Command is designed to switch on periodic data output.

After the command is processed, the sensor starts sending data periodically — level, temperature, and frequency — with the time interval prescribed by the 13h command.

Turning off of the periodic data output is performed after receipt of any true command, reset of the processor or disconnection of power power supply (if the data output mode is not istalled by default).

3.1. Command format

Offset, bytes	Field size, bytes	Value	Description
0	1	31h	Prefix
+1	1	00h..FFh	The Network address of the sender
+2	1	07h	Operation code
+3	1	00h..FFh	Checksum

3.2. Response format

Offset, bytes	Field size, bytes	Value	Description
0	1	3Eh	Prefix
+1	1	00h..FFh	Network address of recipient
+2	1	07h	Operation code
+3	1	00h	The command has been executed successfully
		01h	The command cannot be executed
+4	1	00h..FFh	Checksum

3.3. Periodic data output format

Offset, bytes	Field size, bytes	Value	Description
0	1	3Eh	Prefix
+1	1	00h..FFh	The Network address of the sender
+2	1	07h	Operation code
+3	1	-128…127	Temperature in in degrees Celsius
+4	2	0000h…FFFFh	Relative level
+6	2	0000h…FFFFh	Frequency value
+8	1	00h..FFh	Checksum

4. Periodic Data Output Interval Adjustment (13h command)

Command is designed to set up interval of periodic data output.

4.1. Command format

Offset, bytes	Field size, bytes	Value	Description
0	1	31h	Prefix
+1	1	00h..FFh	Network address of the recipient
+2	1	13h	Operation code
+3	1	0…255	Interval of the data output in seconds
+4	1	00h..FFh	Checksum

4.2. Response format

Offset, bytes	Field size, bytes	Value	Description
0	1	3Eh	Prefix
+1	1	00h..FFh	The Network address of the sender
+2	1	13h	Operation code
+3	1	00h	The command has been executed successfully
		01h	The command cannot be executed
+4	1	00h..FFh	Checksum

5. Default Data Output Mode (command 17h)

This command determines the order of data output after the sensor is powered on or the processor is reset. After the power is on or the processor is reset, the program will send data periodically via the interface at the time interval prescribed by the 13h command.

5.1. Command format

Offset, bytes	Field size, bytes	Value	Description
0	1	31h	Prefix
+1	1	00h..FFh	Network address of the recipient
+2	1	17h	Operation code
+3	1	00h	The command has been executed successfully
+3	1	01h	The data are output in binary form
+3	1	02h	The data are output in character-coded form (ASCII mode)
+3	1	03h	The data are output in character-coded form (ASCII EXT mode)
+4	1	00h..FFh	Checksum

5.2. Response format

Offset, bytes	Field size, bytes	Value	Description
0	1	31h	Prefix
+1	1	00h..FFh	Network address of the recipient
+2	1	17h	Operation code
+3	1	00h	The command has been executed successfully
+3	1	01h	The command cannot be executed
+4	1	00h…FFh	Checksum

Description of Commands for the Text-Based Protocol

Data exchange via the text-based protocol includes receipt and sending of ASCII symbols sequence interpreted and the request and response commands.

Reading the Data

The command is designed for reading of the current data: relative level, temperature, frequency. The command is a sequence of symbols ASCII “D” and “O”. After receipt of the “DO” command the program will response in the form of ASCII symbols sequence.

For example, F=0AF9 t=1A N=03FF.0 <CR><LF>, where F is the current frequency value, t is the current value of temperature in Celcius degrees, N is the level value. All values are in hexadecimal form.

In case the frequency value exceeds FFFh, the data are considered invalid.

Periodic Data Output

The command is designed to switch on periodic data output. After processing the command, the sensor performs periodic data output in the text-based form (ASCII codes) of the following data: relative level, temperature, frequency.

The data are being output periodically with an interval set up when cofiguring the sensor (LIGO Configurator software). In case the data output interval is set to zero, the data output won't be performed.

Switching on of the periodic data output is done by sending of the “DP” symbols in line. After processing of the command, the symbols line will be received. For example, F=0AF9 t=1A N=03FF.0 <CR><LF>, where F is the current frequency value, t is the current value of temperature in Celcius degrees, N is the level value. Turning off of the periodic data output is performed after receipt of any true command, reset of the processor or disconnection of power supply.

Checksum Calculation Algorithm

The checksum is calculated using Dallas APPLICATION NOTE 27 table method: Understanding and Using Cyclic Redundancy Checks with Dallas Semiconductor iButton Products. One can use the following algorithms to calculate the checksum with a polynom ^8 + a^5 + a^4 + 1 (C language):

```
U8 CRC8(U8 data, U8 crc)
{
U8 i = data ^ crc;
crc = 0;
if(i & 0x01) crc ^= 0x5e;
if(i & 0x02) crc ^= 0xbc;
if(i & 0x04) crc ^= 0x61;
if(i & 0x08) crc ^= 0xc2;
if(i & 0x10) crc ^= 0x9d;
if(i & 0x20) crc ^= 0x23;
if(i & 0x40) crc ^= 0x46;
if(i & 0x80) crc ^= 0x8c;
return crc;
}
```