SPI Lasers UK Limited

Serial Command Reference for the PRISM Laser Platform

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Introduction

The following document explains the command set and format of SPI's Red Fox OEM Fibre Laser platform serial protocol.

The physical layer has been implemented using the RS232 and RS485 hardware interfaces.

The data link layer conforms to the High Level Data Link Control (HDLC) definition (ISO03309) requirements.

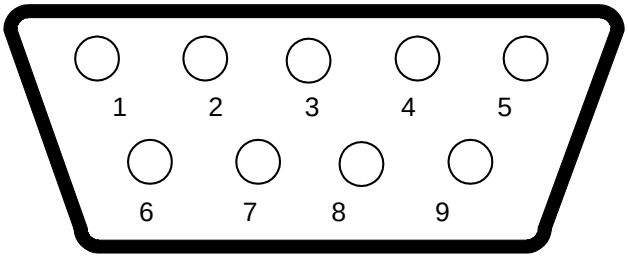
Conforming with the HDLC definition ensures that :

- Any data can be transmitted across the link (transparency).
- The beginning and ends of frames are unequivocally recognized.
- If an error occurs, the receiver will eventually resynchronise.
- The receiver can detect communications errors in each frame it receives.

Another important feature is that transmit and receive packets both have packet identification characters. This allows communications to run asynchronously.

Connecting to the OEM Fibre Laser

Connection is made using a standard 9Way D-plug (Male) operating with signal levels defined by the RS232 / RS485 specification



The pin-out is shown below:

Pin No	Connection Name	I/O	Description
1	Ground	-	Ground
2	RS-232 Rx	I	RS-232 receive
3	RS-232 Tx	O	RS-232 transmit
4	Not Connected	-	-
5	Ground	-	Ground
6	RS-485 Rx	I	RS-485 receive (differential)
7	RS-485 Rx	I	
8	RS-485 Tx	O	RS-485 transmit (differential)
9	RS-485 Tx	O	

When connecting with RS232 to a standard computer serial port, pins 2 and 3 should be crossed over at the computer end.

Communication settings:

- 1 Start bit
- 1 Stop bit
- 8 Data bits
- No Parity
- 2400 to 115200 baud rate settings (default 57600)

Data Link Layer

The philosophy of the protocol is that there can only be one master and up to 255 slaves. The master must send a message before the OEM Module generates a response (i.e. no unsolicited messages). The protocol contains an address byte to select and identify the OEM Modules. Any response from an OEM Module will always contain the current OEM Module Address byte setting to identify its address. The default laser address is 15.

Frame Structure

The protocol frame is based around the "High Level data link control" (HDLC) definition (ISO03309) with a framing byte at start and end, address byte, data bytes and 16-bit CRC checksum.

The frame byte is 0x7E and with the module address of 1, a typical frame will be:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	0x01	OEM Module Address
3	DATA	Command Data
4	Checksum LSB	Checksum Least Significant Byte
5	Checksum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

The "checksum" is a 16-bit CRC checksum utilizing the CRC16-ITU polynomial.
G(x) = x16 + x12 + x5 + 1, with an initialisation value of all '1's.

The checksum calculation is transmitted in each frame, LSB first, and is calculated from the address and the data.

The sequence below shows a typical command together with calculated checksum.

Byte no	Value	Function
1	0x7E	Start Framing Character
2	0x01	OEM Module Address
3	0x04	Command
4	0xBB	Checksum Least Significant Byte
5	0x50	Checksum Most Significant Byte
6	0x7E	End Framing Character

16-bit CRC Calculation

Following are two examples of generating the CRC algorithm.

C Code Example

```
// ----------------------------------------------------------------------
// Calculates CRC- returns calculated CRC
// ----------------------------------------------------------------------
// Note: returned calculated CRC (fcs) should be appended to the end of the command LSB first
// command_tx[] is string of characters on which checksum is to be calculated(including board address)
// command_length is number of characters in command

int calc_fcs(void)
{
   unsigned int j;                  // temporary variable
   unsigned int fcs = 0xFFFF;              // Calculated checksum
   unsigned int count;              // count of current

   for(count=0; count < command_length; count++)
   {
   j = (fcs ^ (unsigned int)command [count]) & 15;
          fcs = fcs >> 4;
          fcs = fcs ^ (j * 4225);
          j = (fcs ^ ((unsigned int)command [count] >> 4)) & 15;
          fcs = fcs >> 4;
          fcs = fcs ^ (j * 4225);
   }
   fcs = fcs ^ 0xFFFF;
   return fcs
}
```

VB Code Example

```
Public Function Checksum(sDataString As String) As Byte()

'INPUT  - Character string
'OUTPUT - 2 element byte array containing the LSB and MSB of the checksum

    Dim iCount As Integer
    Dim lTemp As Long
    Dim lTemp2 As Long
    Dim lCharValue As Long
    Dim lRunningResult As Long
    Dim bResult(1) As Byte

    lRunningResult = 65535
    For iCount = 1 To Len(sDataString)
        lCharValue = Abs(Asc(Mid$(sDataString, iCount, 1)))
        lTemp = (lRunningResult Xor lCharValue) And 15
        lRunningResult = lRunningResult \ 16
        lRunningResult = lRunningResult Xor (lTemp * 4225)
        lTemp = (lRunningResult Xor (lCharValue \ 16)) And 15
        lRunningResult = lRunningResult \ 16
        lRunningResult = lRunningResult Xor (lTemp * 4225)
    Next iCount
    lRunningResult = lRunningResult Xor 65535
    bResult(1) = lRunningResult \ 256        'MSB
    lTemp = bResult(1)
    lTemp2 = lTemp * 256
    bResult(0) = lRunningResult - lTemp2      'LSB
    Checksum = bResult
End Function
```

If the same calculation is performed on received data including the checksum, the calculated value should be 0xF47. If it is not, the checksum is invalid and the data should be discarded.

Data Element

The data element of the command comprises a command number and any number of Parameters as shown below.

Byte No	Value	Function
3	COMMAND NUMBER	Command number defining the following data structure
4	PARAM 1 MSB	First Parameter Most Significant Byte
5	PARAM 1 LSB	First Parameter Leas Significant Byte
6	PARAM 2	Second Parameter
6 + n	PARAM n	Last Parameter in the command structure

- *Not all commands have associated parameters.*
- *n is the number of data bytes to return the associated value.*
- *Multi byte values are returned MSB first.*

The “COMMAND NUMBER” is a single byte which selects the requested instruction.

The “PARAM”s is any number of single or multiple bytes containing any parameters required by the particular instruction.

If a value consists of multiple bytes, the data is transmitted Most Significant Byte (MSB) first.

The Transparency Algorithm

The protocol requires the existence of a transparency algorithm to overcome the likely event of data/checksum characters occurring with the same value as the frame character 0x7E. If this situation were allowed to exist it would produce errors in the frame structure and make it impossible for the slave devices to decipher the frame.

The transparency character is **0x7D**.

If a frame character is detected, the transparency character is inserted preceding it and the frame character has its sixth bit complemented. Similarly if a transparency character is detected the same process needs to be implemented.

Transparency Examples:

Byte No	Packet Data	Transmitted Data	Comments
1	0x7E	0x7E	
2	0x01	0x01	
3	0x6E	0x6E	
4	0x7E	0x7D	Inserted Transparency Byte to be detected and removed by the receiver.
5	0xAC	0x5E	Original byte with bit inverted. To be corrected by the receiver.
6	0xF9	0xAC	
7	0x7E	0xF9	
8		0x7E	

Byte No	Packet Data	Transmitted Data	Comments
1	0x7E	0x7E	
2	0x01	0x01	
3	0x12	0x6E	
4	0x7D	0x7D	Inserted Transparency Byte to be detected and removed by the receiver.
5	0x53	0x5D	Original byte with bit inverted. To be corrected by the receiver.
6	0x92	0x53	
7	0x7E	0x92	
8		0x7E	

The transparency algorithm is carried out in a serial fashion on the address, all data and checksum bytes before the frame is transmitted (i.e. Transparency algorithm is implemented after the checksum has been calculated).

On receiving data the reverse process is carried out. The data being checked for transparency bytes before any attempt is made to decode the data or checksum.

Communications Overview

The master packages the module address, command and parameters into a data string and calculates the crc-16 checksum. It converts any illegal characters using the transparency algorithm and then transmits the block starting and ending with a frame character.

The module receives the frame and reconstructs the original data and checksum by applying the transparency algorithm. The CRC check is then carried out and if it does not pass, the command is discarded and no response is returned because the integrity of the command can't be verified. If the address does not match the receiver then the command is discarded and no response is sent.

If the CRC proves the validity of the frame then the command is performed and the module transmits a response.

The response includes the module address in the address byte and enough information for the master to be able to determine the exact command it corresponds too. It also includes a response flag to indicate whether the command was successful. Some responses include a data length to inform the master how much data is in the response, which allows for future expansion if required.

Response Frame Format:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	Command Number	Command Data
4	Sub Command	Sub Command Identifier (Inclusion depends on the command response)
5	Response Flag	See Response Flag Definition table below
6	Data Length	Length of data to follow (Inclusion depends on the command response)
7	Data MSB	Response data value Most Significant Byte
8	Data LSB	Response data value Least Significant Byte
9	Checksum LSB	Checksum Least Significant Byte
10	Checksum MSB	Checksum Most Significant Byte
11	0x7E	End Framing Character

The master uses the same methodology to decode and validate the response frame before taking any notice of the data contained within it.

Module Address

The OEM Module Address Number refers to the module address byte used in all message packets. Default value is 0x0F. The address can be changed using Command 0xC2. A corresponding read command is not required. Any successful communications will verify the new address. However Command 0xC3 can be used to read the communication parameter if required.

In order to establish an unknown address of a module, 0x00 (zero) can be used. All modules will respond to a command containing a zero address with the corresponding response containing the modules address. Care must be taken when using address zero on an RS485 connection to make sure there is only one slave connected. Otherwise all slaves will try and respond causing bus contention.

Response Flags

All of the response messages from the Red Fox OEM modules contain a response flag to indicate the success or failure of any command, as defined in the following table:

Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully
0x01	Feature not available
0x02	Request out of range
0x03	Request over range
0x04	Request under range
0x05	Response value fault or Over range
0x06	Unable to Complete Command
0x07	Inadequate Access Level
0x08	Wait for timeout
0x09	Internal Communication Error
0xFF	Command failed

Undefined flag values are reserved for future use.

Relevant flag definitions are listed with the commands.

Command Set

Get Module Information – 0xB0

Overview:

Returns the model number, serial number, firmware version, maximum power level, and cooling type.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB0	Command – Get Module Information
4	CSum LSB	Checksum Least Significant Byte
5	CSum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB0	Command – Get Module Information
4	Response Flag	See Response Flag Definition table below
5	Data Length (0x39)	Number of data bytes to follow excluding checksum and framing character. Current data length is 57 bytes.
6 to 45	Model Number	40 bytes ASCII text - eg. SP-1500-M-W-00-014-10-PIQ-001
46 to 55	Serial Number	10 bytes ASCII text - eg. 345678
56 to 58	Firmware Ver	3 bytes (major, mid, minor – e.g. 3.1.5)
59 to 60	Max Power	Maximum Power Level in watts, MSB and LSB
61	Board Revision	Board Revision set in hardware to allow the microcontroller to recognise future updated boards
62	Cooling Type	Cooling Type (0 = water, 1 = air)
63	CSum LSB	Checksum Least Significant Byte
64	CSum MSB	Checksum Most Significant Byte
65	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Module information returned

0xFF	Command failed – Unable to return module information. This status will be returned whenever a Memory Error is present, indicating that the returned values may not be correct.

Get Status – 0xB1

Overview:

Provides a snapshot of the overall system state. Once executed another command may be required to provide the detail.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB1	Command – Get Status
4	CSum LSB	Checksum Least Significant Byte
5	CSum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB1	Command – Get Status
4	Response Flag	See Response Flag Definition table below
5	Data Length (0x02)	Number of data bytes to follow excluding checksum and framing character. Current data length is 2 bytes.
6	Data Byte 1	See Status Byte 1 Definition table below
7	Data Byte 2	See Status Byte 2 Definition table below
8	CSum LSB	Checksum Least Significant Byte
9	CSum MSB	Checksum Most Significant Byte
10	0x7E	End Framing Character

Status Byte 1 Definition:

Bit No	Meaning
0	HIGH = Emitting (Modulation is HIGH or bias is set, and there are no conditions preventing emission)
1	HIGH = Ready to Emit (Enable is HIGH, Diode power is present, no alarms, Modulation line is LOW)

2	HIGH = Alarm state present
3	HIGH = Warning state present
4	HIGH = Modulation line high
5	HIGH = Set point source is External
6	(reserved for future use)
7	(reserved for future use)

Status Byte 2 Definition:

Bit No	Meaning
0	Status bit 1 (same as on user port)
1	Status bit 2
2	Status bit 3
3	Status bit 4
4	Status bit 5
5	Access Level Status MSB – See Access Level Definition table below
6	Access Level Status LSB
7	Reduced Power Mode Enabled

Status Bit Value Meanings:

Value	Meaning
0	Emitting (Modulation and Enable HIGH, driver voltage present, no alarms)
1	Idle (Enable HIGH, driver voltage present, no alarms)
2	Not Armed (Enable LOW, no alarms)
3	Enable Line Cycle Required
4	Alarm: Thermistor
5	Alarm: Snap Switch
6	Alarm: Memory Corruption
7	Alarm: Aux Power Supply Voltage Low
8	Reserved for future use
9	Alarm: Fibre Failure Detected
10	Reserved for future use
11	Reserved for future use
12	Alarm: Humidity
13	Alarm: Internal Communication Failure
14	Alarm: Unexpected Emission Detected
15	Alarm: Driver Negative Power Supply Failure
16	Alarm: PLC Output Driver Fault
17-31	Reserved for future use

Access Level Definition:

Value	Meaning
0	User (No elevated permissions)

1	Customer Supervisor
2	SPI Service Engineer
3	SPI Factory

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Status returned
0xFF	Command failed – Unable to return status.

Get Digital I/O – 0xB2

Overview:

Returns the value of all digital inputs to and outputs from the system, both internal and external.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB2	Command – Get Digital I/O
4	CSum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB2	Command – Get Digital I/O
4	Response Flag	See Response Flag Definition table below
5	Data Length (0x05)	Number of data bytes to follow excluding checksum and framing character. Current data length is 4 bytes.
6	Data Byte 1	See Digital Byte 1 Definition below
7	Data Byte 2	See Digital Byte 2 Definition below
8	Data Byte 3	See Digital Byte 3 Definition below
9	Data Byte 4	See Digital Byte 4 Definition below
10	Data Byte 5	See Digital Byte 5 Definition below
11	Csum LSB	Checksum Least Significant Byte
12	Csum MSB	Checksum Most Significant Byte
13	0x7E	End Framing Character

Digital Byte 1 Definition:

Bit No	Meaning
0	PLC Port In: Modulation
1	PLC Port In: Enable
2	PLC Port In: Clear Alarm
3	PLC Port In: Spare 1
4	PLC Port In: Spare 2
5	PLC Port In: Low Power Mode
6	uC GPIO In: Aux Power Good
7	uC GPIO In: Driver Power Absent

Digital Byte 2 Definition:

Bit No	Meaning
0	uC GPIO In: Snap Switch
1	uC GPIO In: BDO Monitoring Select
2	uC GPIO In: High Side Driver Monitor
3	uC GPIO In: Address Switch 1
4	uC GPIO In: Address Switch 2
5	uC GPIO In: Address Switch 3
6	uC GPIO In: Address Switch 4
7	uC GPIO In: Test Mode (1 = normal operation, 0 = test mode)

Digital Byte 3 Definition:

Bit No	Meaning
0	uC GPIO In: PDOF 1 Light Level Above Threshold
1	uC GPIO In: PDOF 2 Light Level Above Threshold
2	uC GPIO In: PDOFs Different
3	uC GPIO In: Board Version 1
4	uC GPIO In: Board Version 2
5	uC GPIO In: Fan Monitor
6	uC GPIO In: Pilot Laser Requested
7	uC GPIO In: Negative Driver Supply Off

Digital Byte 4 Definition:

Bit No	Meaning
0	PLC Port Out: Spare 1
1	PLC Port Out: Spare 2
2	uC GPIO Out: Enable Drivers (Positive)
3	uC GPIO Out: Enable Drivers (Negative)
4	uC GPIO Out: Internal/External Setpoint Select
5	uC GPIO Out: Microcontroller Enable
6	uC GPIO Out: High Power Enable
7	(reserved for future use)

Digital Byte 5 Definition:

Bit No	Meaning
0	uC GPIO Out: Green Status LED (Running)
1	uC GPIO Out: Red Status LED (Alarm)
2	uC GPIO Out: Amber Status LED (Emission)
3 to 7	(reserved for future use)

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Digital I/O returned
0xFF	Command failed – Unable to return Digital I/O

Get Laser Analogue Value(s) – 0xB3

Overview:

Returns the value of one or all analogue values associated with the laser side of the OEM laser module, specified by the sub command, after processing by the microcontroller if necessary.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB3	Command – Get Laser Analogue Value(s)
4	Analogue Select	Requested Analogue Value(s) – See table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB3	Command – Get Laser Analogue Value(s)
4	Analogue Select	Requested Analogue Value(s) – See Laser Analogue Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character: . Current data length is 2 bytes / requested channel.
7	Analogue Value MSB	Requested Analogue Value(s) – See Laser Analogue Definition table below Number of data bytes depends on number of channels requested.
8	Analogue Value LSB	
7 + n	Csum LSB	Checksum Least Significant Byte
8 + n	Csum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

Laser Analogue Definition:

Sub Command	Meaning	Scale	Data Length in Bytes
0	Return all Analogues listed below in a single message	See scaling below	Sum of below values
1	BDO Voltage	0-4096 (raw value)	2
2	External Pulse Set point	0.1% steps	2
3	Actual Driver Voltage	0-4096 (raw value)	2
4	PDOF Monitor 1	0-4096 (raw value)	2
5	PDOF Monitor 2	0-4096 (raw value)	2

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Requested analogue value(s) returned
0x01	Feature not available – This PDOF is not fitted
0x02	Request out of range – Unknown channel
0x05	Response value fault or Over range – Requested channel fault or out of range
0xFF	Command failed – Unable to return requested analogue value(s)

Get Environmental Analogue Value(s) – 0xB4

Overview:

Returns the value of one or all analogue values associated with the environmental side of the OEM laser module, specified by the sub command, after processing by the microcontroller if necessary.

A failed thermistor will respond with 0xFFFF, along with the “Out of range” response byte. If all channels are requested and one of the thermistors has failed, the “Out of range” response byte will be returned and the invalid thermistor value will be set to 0xFFFF.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB4	Command – Get Environmental Analogue Value(s)
4	Analogue Select	Requested Analogue Value(s) – See table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB4	Command – Get Environmental Analogue Value(s)
4	Analogue Select	Requested Analogue(s) – See Environmental Analogue Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is 2 bytes / requested channel.
7	Analogue Value MSB	Requested Analogue Value(s) – See Environmental Analogue Definition table below Number of data bytes depends on number of channels requested.
8	Analogue Value LSB	
7 + n	Csum LSB	Checksum Least Significant Byte
8 + n	Csum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

Environmental Analogue Definition:

Sub Command	Meaning	Scale	Data Length in Bytes
0	Return all Analogues listed below in a single message	See scaling below	Sum of below values
1	Humidity Sensor	1% steps	2
2	Dew Point (calculated from humidity and ambient temperature)	0.1ºC	2. Can be negative. Uses two's complement representation.
3	Fan speed %	rpm	2
4	Fan PWM Value	1% steps	2
5	Thermistor 1	0.1ºC	2
6	Thermistor 2	0.1ºC	2
7	Thermistor 3	0.1ºC	2
8	Thermistor 4	0.1ºC	2
9	Thermistor 5	0.1ºC	2
10	Thermistor 6	0.1ºC	2

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Requested analogue value(s) returned
0x01	Feature not available – Laser module is water cooled (for fan speed requests) or air cooled (for water temperature thermistor / dew point requests)
0x02	Request out of range – Unknown channel
0x05	Response value fault or Over range – Requested channel fault or out of range
0xFF	Command failed – Unable to return requested analogue value(s)

Get On and Emit Times – 0xB5

Overview:

Gets:

- The time that the laser has been powered on, regardless of its emission state
- The time that the laser has been in “Emission” mode.

Each value is a binary representation in seconds.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB5	Command – Get On and Emit Times
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB5	Command – Get On and Emit Times
4	Response Flag	See Response Flag Definition table below
5	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is 8 bytes. 4 bytes On Time. 4 bytes Emit Time.
6	On Time MSB	Module On Time data. 4 bytes MSB first.
7	On Time	
8	On Time	
9	On Time LSB	
10	Emit Time MSB	Module Emit Time data. 4 bytes MSB first.
11	Emit Time	
12	Emit Time	
13	Emit Time LSB	
6 + n	Csum LSB	Checksum Least Significant Byte
7 + n	Csum MSB	Checksum Most Significant Byte
8 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*

- *Multi byte values are returned MSB first.*

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Time data returned successfully
0xFF	Command failed – Unable to return time data. This status will be returned whenever a Memory Error is present, indicating that the returned values may not be correct.

Get Log Entry – 0xB6

Overview:

Returns a specific log entry. The laser use history is logged and stored by the controller. This allows any alarms to be logged which may help service engineering to solve customer problems. An Analogue Value associated with each log entry gives further detail.

Entry IDs start at 1.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB6	Command – Get Log Entry
4	Data Byte MSB	Log entry Identification
5	Data Byte LSB	
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB6	Command – Get Log Entry
4	Response Flag	See Response Flag Definition table below
5	Data Length (0x10)	Number of data bytes to follow excluding checksum and framing character. Current data length is 16 bytes.
6	Emit Time MSB	Laser Module Emit Time (seconds)
7	Emit Time	
8	Emit Time	
9	Emit Time LSB	
10	On Time MSB	Laser Module On Time (seconds)
11	On Time	
12	On Time	
13	On Time LSB	
14	Entry Type	See Entry Type Definition table below
15	Module State	See Module State Definition table below
16	Analogue MSB	Associated analogue value for record retrieved
17	Analogue LSB	
18	Log Entry MSB	Log entry Identification
19	Log Entry LSB	
20	Log Entry Count MSB	Number of log entries available.
21	Log Entry Count LSB	
22	Csum LSB	Checksum Least Significant Byte
23	Csum MSB	Checksum Most Significant Byte
24	0x7E	End Framing Character

Entry Type Definition:

Value	Meaning	Analogue Value Meaning
0	Alarm: Thermistor 1	Sensor Temperature in 0.1deg steps
1	Alarm: Thermistor 2	Sensor Temperature in 0.1deg steps
2	Alarm: Thermistor 3	Sensor Temperature in 0.1deg steps
3	Alarm: Thermistor 4	Sensor Temperature in 0.1deg steps
4	Alarm: Thermistor 5	Sensor Temperature in 0.1deg steps
5	Alarm: Thermistor 6	Sensor Temperature in 0.1deg steps
6	Alarm: Snap Switch	
7	Alarm: Memory Corruption	See “Memory State Definition” table
8	Alarm: Aux Power Supply Voltage Low	
9	Reserved for future use	
10	Alarm: Fibre Failure Detected	
11	Reserved for future use	
12	Reserved for future use	
13	Alarm: Humidity	Inlet Water Temperature in 0.1deg steps
14	Alarm: Internal Communication Failure	
15	Alarm: Unexpected Emission Detected	
16	Alarm: Driver Negative Power Supply Failure	
17	Alarm: PLC Port Output Driver Fault	
25	Internal Calibration Value Altered	New calibration value (0-255)
26	External Calibration Value Altered	New calibration value (0-255)
27	Humidity Monitoring Enabled or Disabled	1 = Enabled, 0 = Disabled

Module State Definition:

Value	Meaning
0	Emitting (Modulation and Enable HIGH, driver voltage present, no alarms)
1	Idle (Enable HIGH, driver voltage present, no alarms)
2	Not Armed (Enable LOW, no alarms)
3	Enable Line Cycle Required
4	Alarm Present

Memory State Definition:

Value	Meaning
0	No error
1	OEM Memory Checksum Failed
2	OEM Memory Read Failed
3	OSM Memory Checksum Failed
4	OSM Memory Read Failed
5	Internal Microcontroller Memory Error

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Record successfully retrieved
0x01	Feature not available – No record available
0x02	Request out of range – Requested record does not exist
0xFF	Command failed – Command not recognised

Get Alarms and Warnings – 0xB7

Overview:

Returns all alarms and warnings currently present in the laser.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB7	Command – Get Alarms and Warnings
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB7	Command – Get Alarms and Warnings
4	Response Flag	See Response Flag Definition table below
5	Data Length (0x05)	Number of data bytes to follow excluding checksum and framing character. Current data length is 5 bytes.
6	Data Byte 1	See Alarm Byte 1 Definition table below
7	Data Byte 2	See Alarm Byte 2 Definition table below
8	Data Byte 3	See Alarm Byte 3 Definition table below
9	Data Byte 4	See Warning Byte 1 Definition table below
10	Data Byte 5	See Warning Byte 2 Definition table below
11	Csum LSB	Checksum Least Significant Byte
12	Csum MSB	Checksum Most Significant Byte
13	0x7E	End Framing Character

Alarm Byte 1 Definition:

Bit No	Meaning when HIGH
0	Alarm(s) present
1	Alarm: Thermistor 1
2	Alarm: Thermistor 2
3	Alarm: Thermistor 3
4	Alarm: Thermistor 4
5	Alarm: Thermistor 5
6	Alarm: Thermistor 6

7	Alarm: Snap switch open

Alarm Byte 2 Definition:

Bit No	Meaning
0	Alarm: Memory Corruption
1	Alarm: Aux Power Supply Voltage Low
2	Reserved for future use
3	Alarm: Fibre Failure Detected
4	Reserved for future use
5	Reserved for future use
6	Alarm: Humidity
7	Alarm: Internal Comms Failure

Alarm Byte 3 Definition:

Bit No	Meaning
0	Alarm: Unexpected Emission
1	Alarm: Driver Negative Power Supply Failure
2	Alarm: PLC Output Driver Fault
3	Alarm: Future Use
4	Alarm: Future Use
5	Alarm: Future Use
6	Alarm: Future Use
7	Alarm: Future Use

Warning Byte 1 Definition:

Bit No	Meaning
0	Warning(s) present
1	Warning: Thermistor 1
2	Warning: Thermistor 2
3	Warning: Thermistor 3
4	Warning: Thermistor 4
5	Warning: Thermistor 5
6	Warning: Thermistor 6
7	Warning: Calibration Required

Warning Byte 2 Definition:

Bit No	Meaning
0	Warning: Thermistor Out of Range
1	Warning: Humidity
2	Warning: Calibration Failed
3	Warning: Fan Failed
4	(reserved for future use)
5	(reserved for future use)
6	(reserved for future use)
7	(reserved for future use)

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Alarms and warnings returned
0xFF	Command failed – Unable to return alarms and warnings

Clear Alarms – 0xB8

Overview:

Attempts to clear all present alarms. Some alarms require SPI Service Engineer login before they can be cleared.

Fibre Failure alarms cannot be cleared using this function.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB8	Command – Clear Alarms
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB8	Command – Clear Alarms
4	Response Flag	See Response Flag Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Alarms cleared successfully
0x06	Unable to Complete Command – Alarm condition persists; (some) alarm(s) could not be cleared
0x07	Inadequate Access Level – Could not clear all present alarms
0xFF	Command failed – Unable to clear alarm(s)

Clear Output Failure Alarm – 0xB9

Overview:

Attempts to reset a fibre alarm. This checks for the integrity of the fibre by applying a low signal level to ensure proper operation of the spool. This command can be run once by the user – if it fails, only an SPI engineer can run it a second time, to ensure that further damage does not occur.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB9	Command – Clear Output Failure Alarm
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xB9	Command – Clear Output Failure Alarm
4	Response Flag	See Response Flag Definition table below
5	Command Status	Further details on the command execution. See Clear Output Failure Status Definitions table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Clear Output Failure Status Definitions:

Value	Meaning
0	No Additional Status
1	No Alarm is Present
2	Clearance has failed once already – SPI Service Engineer must carry out command
3	Modulation signal not present / CW
4	Enable signal not present
5	Driver voltage not present
6	No signal detected at PDOF 1
7	No signal detected at PDOF 2
8	No signal detected at either PDOF
9	Other error clearing alarm

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Alarm cleared successfully
0x06	Unable to Complete Command – Command could not be completed. See Clear Output Failure Status Definitions table above
0x07	Inadequate Access Level
0xFF	Command failed – Unable

Set Alarm and Warning Limits – 0xBA

Overview:

Sets a specified internal configuration limit

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBA	Command – Set Alarm and Warning Limits
4	Configuration Select	Selects the configuration value to be updated – See Configuration Definition table below
5	Limit MSB	Associated data for the limit specified. For scaling see Configuration Definition table below
6	Limit LSB	
7	Csum LSB	Checksum Least Significant Byte
8	Csum MSB	Checksum Most Significant Byte
9	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBA	Command – Set Alarm and Warning Limits
4	Configuration Select	Identifies the updated configuration value – See Configuration Definition table below
5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Configuration Definition:

Value	Meaning	Scale
0	Thermistor 1 Alarm Limit	0.1ºC
1	Thermistor 2 Alarm Limit	0.1ºC
2	Thermistor 3 Alarm Limit	0.1ºC
3	Thermistor 4 Alarm Limit	0.1ºC
4	Thermistor 5 Alarm Limit (High)	0.1ºC
5	Thermistor 5 Alarm Limit (Low)	0.1ºC
6	Thermistor 6 Alarm Limit (High)	0.1ºC
7	Thermistor 6 Alarm Limit (Low)	0.1ºC
8	Thermistor 1 Warning Limit	0.1ºC
9	Thermistor 2 Warning Limit	0.1ºC
10	Thermistor 3 Warning Limit	0.1ºC
11	Thermistor 4 Warning Limit	0.1ºC
12	Thermistor 5 Warning Limit	0.1ºC
13	Thermistor 5 Warning Limit (Low)	0.1ºC
14	Thermistor 6 Warning Limit	0.1ºC
15	Thermistor 6 Warning Limit (Low)	0.1ºC
16	Dew Point Alarm Level	0.1ºC
17	Dew Point Warning Level	0.1ºC

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Configuration set successfully
0x02	Request out of range – Configuration select not recognised
0x03	Request over range – Configuration value over range
0x04	Request under range – Configuration value under range
0x07	Inadequate Access Level
0xFF	Command failed – Unable to set configuration value

Get Alarm and Warning Limits – 0xBB

Overview:

Gets a specified internal configuration limit

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBB	Command – Get Alarm and Warning Limits
4	Configuration Select	Selects the configuration value to read – See Configuration Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBB	Command – Get Alarm and Warning Limits
4	Configuration Select	Identifies the requested configuration value – See Configuration Definition table below
5	Response Flag	See Response Flag Definition table below
5	Limit MSB	Associated data for the limit specified. For scaling see Configuration Definition table below
8	Limit LSB	
9	Csum LSB	Checksum Least Significant Byte
10	Csum MSB	Checksum Most Significant Byte
11	0x7E	End Framing Character

Configuration Definition:

Value	Meaning	Scale
0	Thermistor 1 Alarm Limit	0.1ºC
1	Thermistor 2 Alarm Limit	0.1ºC
2	Thermistor 3 Alarm Limit	0.1ºC
3	Thermistor 4 Alarm Limit	0.1ºC
4	Thermistor 5 Alarm Limit (High)	0.1ºC
5	Thermistor 5 Alarm Limit (Low)	0.1ºC
6	Thermistor 6 Alarm Limit (High)	0.1ºC
7	Thermistor 6 Alarm Limit (Low)	0.1ºC
8	Thermistor 1 Warning Limit	0.1ºC
9	Thermistor 2 Warning Limit	0.1ºC
10	Thermistor 3 Warning Limit	0.1ºC
11	Thermistor 4 Warning Limit	0.1ºC
12	Thermistor 5 Warning Limit	0.1ºC
13	Thermistor 5 Warning Limit (Low)	0.1ºC
14	Thermistor 6 Warning Limit	0.1ºC

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Configuration returned successfully
0x02	Request out of range – Configuration select not recognised
0xFF	Command failed – Unable to return configuration value

Set Calibration Value – 0xBC

Overview:

Sets selected laser module calibration values.

The laser includes the ability to apply an offset to the Requested Power signal, so that the mapping of 100% requested power – 100% rated optical output holds true as individual emitters dim or fail over the lifetime of the laser.

There are two calibration values present within the laser. The first is a hardware-based calibration, which affects the setpoint requested by a voltage applied to the PLC port. The second is a software-based calibration, which affects the setpoint requested using the "Set Current Output Power Setpoint Source and Level" command (0xC0).

The maximum possible calibration value is set internally. An error will be reported if this is exceeded.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBC	Command – Set Calibration Value
4	Calibration Parameter	Calibration value select – See Calibration Parameter Definition table below
5	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is a 1 byte value – See table(s) below
6	Data Byte	Associated data for the selected calibration value.
6 + n	Csum LSB	Checksum Least Significant Byte
7 + n	Csum MSB	Checksum Most Significant Byte
8 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to receive the associated value(s)*
- *If n = 0 no data is attached.*
- *Multi byte values are received MSB first.*

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBC	Command – Set Calibration Value
4	Communication Parameter	Calibration Value selected – See Calibration Parameter Definition table below

5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Calibration Parameter Definition:

Value	Meaning	Associated Data
0	External Calibration Value	1 byte – Range 0 – 255
1	Internal Calibration Value	1 byte – Range 0 – 255

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Calibration Value set successfully
0x02	Out of range – Invalid calibration parameter
0x03	Request over range – Calibration value too large
0x07	Inadequate Access Level
0xFF	Command failed – Unable to set calibration value

Get Calibration Value – 0xBD

Overview:

Gets selected laser module calibration values.

The laser includes the ability to apply an offset to the Requested Power signal, so that the mapping of 100% requested power – 100% rated optical output holds true as individual emitters dim or fail over the lifetime of the laser.

There are two calibration values present within the laser. The first is a hardware-based calibration, which affects the setpoint requested by a voltage applied to the PLC port. The second is a software-based calibration, which affects the setpoint requested using the "Set Current Output Power Setpoint Source and Level" command (0xC0).

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBD	Command – Get Calibration Value
4	Calibration Parameter	Calibration value select – See Calibration Parameter Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBD	Command – Get Calibration Value
4	Communication Parameter	Calibration Value selected – See Calibration Parameter Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is a 1 byte value – See table(s) below
7	Data	Associated data for the selected calibration value.
7 + n	Csum LSB	Checksum Least Significant Byte
8 + n	Csum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*

- *Multi byte values are returned MSB first.*

Calibration Parameter Definition:

Value	Meaning	Associated Data
0	External Calibration Value	1 byte – Range 0 – 255
1	Internal Calibration Value	1 byte – Range 0 – 255

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Calibration Value returned successfully
0x02	Request out of range – Calibration value not valid
0xFF	Command failed – Unable to return calibration value

Set Bias Level – 0xBE

Overview:

This command sets the bias level for the pump diodes. The bias level can be set in 1% increments from 0 to 100%. 100% bias represents a hard-coded fraction of the laser's maximum rated output power – this will be set to 25%

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBE	Command – Set Bias Level
4	Bias Level	Required Bias Level – 0 – 100% in 1% increments
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBE	Command – Set Bias Level
4	Response Flag	See Response Flag Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Bias setting successful
0x03	Request over range – Bias setting over range
0x04	Request under range – Bias setting under range
0xFF	Command failed – Unable to set bias

Get Bias Level – 0xBF

Overview:

This command reads the bias level for the pump diodes. The bias level can be set in 1% increments from 0 to 100%. 100% bias represents a hard-coded fraction of the laser's maximum rated output power – this will be set to 25%

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBF	Command – Get Bias Level
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xBF	Command – Get Bias Level
4	Response Flag	See Response Flag Definition table below
5	Bias Level	Bias Level – 0 – 100% in 1% increments
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Bias setting returned successfully
0xFF	Command failed – Unable to return bias setting

Set Current Output Power Setpoint Source and Level – 0xC0

Overview:

This command serves two purposes:

- To set whether the output power setpoint should be set using the communications interface (Internal Setpoint) or supplied as an external voltage to the PLC port (External Setpoint)
- If Internal setpoint is selected, to set the requested level.

The “Setpoint MSB” and “Setpoint LSB” values are ignored if the requested Setpoint Source is External.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC0	Command – Set Current Output Power Setpoint and Level
4	Setpoint Source	See Setpoint Source Definition table below
5	Setpoint MSB	Setpoint range 0 to 100%. Scaling 0.1% e.g. 36.9% MSB = 0x01, LSB = 0x71 (decimal 369)
6	Setpoint LSB	
7	Csum LSB	Checksum Least Significant Byte
8	Csum MSB	Checksum Most Significant Byte
9	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC0	Command – Set Current Output Power Setpoint and Level
4	Response Flag	See Response Flag Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Setpoint Source Definition:

Value	Meaning
0	Internal setpoint should be used
1	External setpoint should be used

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Level set successfully
0x02	Out of range – An invalid setpoint source was selected
0x03	Request over range – Power level higher than maximum
0x04	Request under range – Power level lower than minimum
0xFF	Command failed – Unable to set source or level

Get Current Output Power Setpoint Source and Level – 0xC1

Overview:

Returns the current requested output power setpoint as a percentage, along with which interface this level is being set by.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC1	Command – Get Current Output Power Setpoint and Level
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC1	Command – Get Current Output Power Setpoint and Level
4	Response Flag	See Response Flag Definition table below
5	Setpoint Source	See Setpoint Source Definition table below
6	Setpoint MSB	Setpoint range 0 to 100%. Scaling 0.1% e.g. 36.9% MSB = 0x01, LSB = 0x71 (decimal 369)
7	Setpoint LSB	
8	Csum LSB	Checksum Least Significant Byte
9	Csum MSB	Checksum Most Significant Byte
10	0x7E	End Framing Character

Setpoint Source Definition:

Value	Meaning
0	Internal setpoint should be used
1	External setpoint should be used

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Level returned successfully
0xFF	Command failed – Unable to return source and level

Set Communication Parameters – 0xC2

Overview:

Allows setting of the RS232/RS485 and CAN communications settings

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC2	Command – Set Communication Parameters
4	Communication Parameter	Communication parameter select – See Communication Parameter Definition table below
5	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is a 1 byte value – See table(s) below.
6	Data Byte	Associated data for the communication parameter – See definition below.
6 + n	Csum LSB	Checksum Least Significant Byte
7 + n	Csum MSB	Checksum Most Significant Byte
8 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to receive the associated value(s)*
- *If n = 0 no data is attached.*
- *Multi byte values are received MSB first.*

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC2	Command – Set Communication Parameters
4	Communication Parameter	Communication parameter changed – See Communication Parameter Definition table below
5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Communication Parameter Definition:

Value	Meaning	
0	RS232 Baud Rate	See Baud Rate Selection Definition table below
1	RS485 Baud Rate	
2	Module Address (Serial)	1 to 255 (Default 15)
3	Module address (CAN)	1 to 15 (Default 15)

Baud Rate Selection Definition:

Value	Meaning
0	Auto (set on reception of first command byte)
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	115200

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Communication Parameter set successfully
0x02	Request out of range – Communication parameter or associated data not valid
0xFF	Command failed – Unable to set communication parameter

Get Communication Parameters – 0xC3

Overview:

Returns the RS232/RS485 baud rate setting

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC3	Command – Get Communication Parameters
4	Communication Parameter	Communication parameter select – See Communication Parameter Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC3	Command – Get Communication Parameters
4	Communication Parameter	Communication parameter selected – See Communication Parameter Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is a 1 byte value – See table(s) below..
7	Data Byte	Associated data for the selected communication parameter – See definition below.
7 + n	Csum LSB	Checksum Least Significant Byte
8 + n	Csum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

Communication Parameter Definition:

Value	Meaning	Associated Data
0	RS232 Baud Rate	See Baud Rate Selection Definition table below
1	RS485 Baud Rate	
2	Module Address (Serial)	1 to 255 (Default 15)
3	Module address (CAN)	1 to 15 (Default 15)

Baud Rate Selection Definition:

Value	Meaning
0	Auto (set on reception of first command byte)
1	2400
2	4800
3	9600
4	19200
5	38400
6	57600
7	115200

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Communication Parameter set successfully
0x02	Request out of range – Communication parameter not valid
0xFF	Command failed – Unable to set communication parameter

Set Control Parameter – 0xC4

Overview:

This command contains functionality to set various Control Parameters.

Currently the only Control Parameter is Low Power Mode. The pin on the PLC port "Low Power Mode Enable" overrides any setting made by this command. If the user attempts to set the Low Power Mode setting using this command when the Low Power Mode Enable pin is high, the command will return "Unable to complete".

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC4	Command – Set Control Parameter
4	Control Parameter Select	See Control Parameter Definition table below
5	Control Parameter Data Length	Length of the Control Parameter associated data. See Control Parameter Definition table below
6	Data	Associated data for requested control parameter. See Control Parameter Definition table to find the applicable data.
6+n	Csum LSB	Checksum Least Significant Byte
7+n	Csum MSB	Checksum Most Significant Byte
8+n	0x7E	End Framing Character

- *n is the number defined in Data Length to receive the associated value(s)*
- *If n = 0 no data is attached.*
- *Multi byte values are received MSB first.*

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC4	Command – Set Control Parameter
4	Control Parameter Select	Requested Control Parameter – See Control Parameter Definition table below
5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte

8	0x7E	End Framing Character

Control Parameter Definition:

Value	Meaning	Control Data Length
0	Set Reduced Power Mode 1 = Enable 0 = Disable	1

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Control Parameter set successfully
0x02	Request out of range – Invalid control parameter value
0x06	Unable to complete – PLC port is overriding
0x07	Inadequate Access Level – Unable to execute command
0xFF	Command failed – Invalid Command

Get Control Parameter – 0xC5

Overview:

This command contains functionality to get various Control Parameters.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC5	Command – Get Control Parameter
4	Control Parameter Select	See Control Parameter Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xC5	Command – Get Control Parameter
4	Control Parameter Select	Requested Control Parameter – See Control Parameter Definition table below
5	Response Flag	See Response Flag Definition table below
6	Control Parameter Data Length	Length of the Control Parameter associated data. See Control Parameter Definition table below
7	Data	Associated data for requested control parameter. See Control Parameter Definition table to find the applicable data.
8	Csum LSB	Checksum Least Significant Byte
9	Csum MSB	Checksum Most Significant Byte
10	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

Control Parameter Definition:

Value	Meaning	Control Data Length
0	Set Reduced Power Mode 1 = Enable 0 = Disable	1

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Control Parameter set successfully
0x02	Request out of range – Invalid control parameter value
0xFF	Command failed – Invalid Command

Set Access Level – 0xCB

Overview:

Set the access level by entering a passcode, allowing access to greater numbers of commands. The access levels are hierarchical so if the user has entered the highest level pass code then they will have access to all commands. The access level is time limited and varies depending upon the access level.

If the user enters a bad passcode, a timeout of 10 seconds begins before another can be entered. This is to prevent the customer sending repeated login attempts until the correct passcode is entered.

The password "####" can be entered to set the user level to User, and "****" can be entered to get the current access level.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCB	Command – Set Access Level
4	Data Byte 1	MSB of Passcode
5	Data Byte 2	Passcode Data
6	Data Byte 3	Passcode Data
7	Data Byte 4	LSB of Passcode
8	Csum LSB	Checksum Least Significant Byte
9	Csum MSB	Checksum Most Significant Byte
10	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCB	Command – Set Access Level
4	Response Flag	See Response Flag Definition table below
5	Access Level	Current Access Level – See Access Level Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Access Level Definition:

Value	Meaning
0	User (No elevated permissions)
1	Customer Supervisor
2	SPI Service Engineer
3	SPI Factory

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Access level successfully set
0x06	Unable to complete command – Wrong password
0x08	Wait for timeout – Command disabled until timeout expires
0xFF	Command failed – Unable to set access level

Program Control – 0xCC

Overview:

Controls functionality associated with updating the application code.

Please note that this command will not always produce a response – a request to reset program execution or enter/exit boot mode will be actioned immediately, and no response will be sent unless the command failed.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCC	Command – Program Control
4	0xAA	4 byte code to stop accidental command execution
5	0xBB	
6	0xCC	
7	0xDD	
8	Function	See Program Control Function Definition table below
9	Csum LSB	Checksum Least Significant Byte
10	Csum MSB	Checksum Most Significant Byte
11	0x7E	End Framing Character

Laser Module Transmits

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCC	Command – Program Control
4	Function	Requested Function – See Program Control Function Definition table below
5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Program Control Function Definition:

Value	Meaning	Notes
0	Stop Program and Enter Boot Mode	Only valid in main program (not in bootloader). Does not respond if successful
1	Start Program and Exit Boot Mode	Only valid in bootloader. Does not respond if successful
2	Reset Program Execution	Does not respond if successful
3	Check whether system is in bootloader	Responds 0x00 if in bootloader, 0x01 if in main program

Relevant Response Flag Definition

Response Flag Value	Description
0x00	Success - System is in bootloader
0x01	System is not in bootloader (system is executing)
0x02	Out of range – Invalid Program Control Function
0x06	Unable to complete command – Wrong 4-byte code
0x09	Internal communication error - System is in bootloader, and cannot ascertain whether an upgrade is requested
0xFF	Command failed – Could not enter/exit boot mode, or failed to reset

Memory Page Erase – 0xCD

Overview:

Erases a specified memory page. Pages in this microcontroller are 2kB in size.

Be aware that this command can take some time to execute (several seconds) if many pages are being erased.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCD	Command – Memory Block Erase
4	Device	See Memory Device Definition table below
5	Address MSB	32 bit address to the start of the memory block to be erased
6	Address	
7	Address	
8	Address LSB	
9	Number of Pages to Erase	Number of 2kB pages to erase. Ensure that sufficient pages are erased to contain the program.
10	Csum LSB	Checksum Least Significant Byte
11	Csum MSB	Checksum Most Significant Byte
12	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCD	Command – Memory Block Erase
4	Device	Requested Memory Device – See Memory Device Definition table below
5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Memory Device Definition:

Value	Meaning
0	Main Program Flash

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully
0x01	Feature not available – This command can only be run from the bootloader
0x02	Out of range – Invalid memory device
0x04	Under range – The specified address is not part of program memory space
0xFF	Command failed

Memory Block Write – 0xCE

Overview:

Writes a specified memory block either two, four or eight bytes at a time.

The data is transmitted in increasing memory address order. For example, if the two bytes “AA 55” are to be transmitted to memory address “10 00 00 00”, then AA will be written to 10 00 00 00 and 55 will be written to 10 00 00 01.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCE	Command – Memory Block Write
4	Device	See Memory Device Definition table below
5	Address MSB	32 bit address to the start of the memory block to be written
6	Address	
7	Address	
8	Address LSB	
9	Data Length (n)	Data Length to specify the size of the data block to be written. Must be 2, 4 or 8 bytes.
10…	Data	Data to be written to the flash memory. Data must be either two, four or eight bytes. Data must be transmitted in memory address order, the lowest address first.
9+n	Csum LSB	Checksum Least Significant Byte
10+n	Csum MSB	Checksum Most Significant Byte
11+n	0x7E	End Framing Character

- *n is the number defined in Data Length to receive the associated data*
- *If n = 0 no data is attached.*

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCE	Command – Memory Block Write
4	Device	Requested Memory Device – See Memory Device Definition table below
5	Response Flag	See Response Flag Definition table below
6	Csum LSB	Checksum Least Significant Byte
7	Csum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Memory Device Definition:

Value	Meaning
0	Main Program Flash

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully
0x01	Feature not available – This command can only be run from the bootloader
0x02	Out of range: Invalid memory device
0x04	Under range – The specified address is not part of program memory space
0x05	Value fault – The data length is not 2, 4 or 8 bytes
0xFF	Command failed

Memory Byte Read – 0xCF

Overview:

Reads a specified number of bytes from memory.

The data is returned in increasing memory address order. For example, if a read of two bytes is requested from memory address “10 00 00 00”, then the first byte in the response will be the contents of 10 00 00 00, and the second byte will be the contents of 10 00 00 01.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCF	Command – Memory Block Read
4	Device	See Memory Device Definition table below
5	Address MSB	32 bit address to the start of the memory block to be read
6	Address	
7	Address	
8	Address LSB	
9	Data Length	Data Length to specify the size of the data block to be read, in bytes.
11	Csum LSB	Checksum Least Significant Byte
12	Csum MSB	Checksum Most Significant Byte
13	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xCF	Command – Memory Block Read
4	Device	Requested Memory Device – See Memory Device Definition table below
5	Address MSB	32 bit address to the start of the memory block being returned
6	Address	
7	Address	
8	Address LSB	
9	Data Length	Length of data being returned, in bytes.
10	Response Flag	See Response Flag Definition table below
11	Data	Data being returned
11+n	Csum LSB	Checksum Least Significant Byte
12+n	Csum MSB	Checksum Most Significant Byte
13+n	0x7E	End Framing Character

- *n is the number defined in Data Length to receive the associated data*
- *If n = 0 no data is attached.*

Memory Device Definition:

Value	Meaning
0	Main Program Flash

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully
0x01	Feature not available – This command can only be run from the bootloader
0x02	Out of range: Invalid memory device
0x04	Under range – The specified address is not part of program memory space
0x05	Value fault – Zero bytes requested
0xFF	Command failed

Engineering / Service / Diagnostic Commands

Get ADC Readings – 0xD0

Overview:

Returns the raw values from requested ADC channels. Useful during setup and diagnostics.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD0	Command – Get ADC Reading(s)
4	ADC Select	Requested ADC Value(s) – See table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD0	Command – Get ADC Reading(s)
4	Analogue Select	Requested ADC Value(s) – See Laser ADC Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is 2 bytes / requested channel.
7	ADC Value MSB	Requested ADC Value(s) – See Laser ADC Definition table below Number of data bytes depends on number of channels requested.
8	ADC Value LSB	
7 + n	Csum LSB	Checksum Least Significant Byte
8 + n	Csum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

Laser ADC Definition:

Sub Command	Meaning	Data Length in Bytes
0	Return all ADC values listed below in a single message	Sum of below values
1	BDO Voltage	2
2	External Pulse Setpoint	2
3	Actual Driver Voltage	2
4	PDOF Monitor 1	2
5	PDOF Monitor 2	2

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Requested ADC value(s) returned
0x01	Feature not available – This PDOF is not fitted
0x02	Request out of range – Unknown ADC value
0xFF	Command failed – Unable to return requested ADC value(s)

Clear All Log Entries – 0xD1

Overview:

Clears the log. Requires factory permission.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD1	Command – Clear Log Entry
4	Csum LSB	Checksum Least Significant Byte
5	Csum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD1	Command – Clear Log Entry
4	Response Flag	See Response Flag Definition table below
5	Csum LSB	Checksum Least Significant Byte
6	Csum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Log successfully cleared
0x07	Inadequate Access Level – Unable to clear logs
0xFF	Command failed – Unable to clear logs

Engineering Functions – 0xD2

Overview:

This command contains various engineering functions.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD2	Command – Engineering Functions
4	Function Select	See Function Select Definition table below
5	Function Parameter MSB	Associate data for selected function. See Function Select Definition table to find the applicable data. Four bytes of Function Parameter data must always be present in the command, but their value will be ignored if the selected function does not require parameter data.
6	Function Parameter	
7	Function Parameter	
8	Function Parameter LSB	
9	Csum LSB	Checksum Least Significant Byte
10	Csum MSB	Checksum Most Significant Byte
11	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD2	Command – Engineering Functions
4	Function Select	Requested Function Select – See Function Select Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is 0 bytes.
7	Function Data	Optional associated function response data.
7 + n	Csum LSB	Checksum Least Significant Byte
8 + n	Csum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

Function Select Definition:

Value	Meaning	
0	Set Defaults – No associated Function Parameter Data	
1	Trigger Watchdog (for engineering use only) – No associated Function Parameter Data	
2	Set Alarm for test purposes – See Set Alarm Definition table below	
3	Manual Set Fan Speed	Range 0 to 100% in 1% increments. Set to 255 to return to automatic operation.
4	Manual Override PLC Output	Desired override value for PLC outputs (see table for bit definitions). This function is intended for manufacturing test purposes. Send 0xFFFFFFFF to return to normal operation.
5	Disable Humidity Monitoring	1 - Disable, 0 - Enable
6	Manual Set User Analogue Output	0 to 4095 – Requested value from user output DAC

Set Alarm Definition:

Value	Meaning
0	Clear all alarms unconditionally
1	Alarm: Thermistor 1
2	Alarm: Thermistor 2
3	Alarm: Thermistor 3
4	Alarm: Thermistor 4
5	Alarm: Thermistor 5
6	Alarm: Thermistor 6
7	Alarm: Snap Switch
8	Alarm: Memory Corruption
9	Alarm: Aux Power Supply Voltage Low
10	Reserved for future use
11	Alarm: Fibre Failure Detected
12	Reserved for future use
13	Reserved for future use
14	Alarm: Humidity
15	Alarm: Internal Communication Failure
16	Alarm: Unexpected Emission Detected
17	Alarm: Driver Negative Power Supply Failure
18	Alarm: PLC Port Output Driver Fault
19	Clear all warnings unconditionally

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Function executed successfully

0x01	Feature not available – Laser is water cooled
0x02	Request out of range – Invalid parameter value
0x03	Request over range – Value too large
0x07	Inadequate Access Level – Unable to execute command
0xFF	Command failed

PLC Output Manual Override Definition:

Bit No (LSB first)	Description
1	Ready to Emit
2	Emitting
3	Alarm
4	Warning
5	Status 1
6	Status 2
7	Status 3
8	Status 4
9	Status 5
10	Spare 1
11	Spare 2

Set Model and Serial Number – 0xD3

Overview:

Sets the model and serial number, for use during initial setup or after Set Defaults is executed.

Only alphanumeric characters and dashes are allowed. The model and serial number must be padded with trailing null characters (0x00) to the lengths below.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD3	Command – Set model and Serial Number
4	Data Length (0x32)	Number of data bytes to follow excluding checksum and framing character. Current data length is 50 bytes.
5 to 44	Model Number	40 bytes ASCII text - eg. SP-1500-M-W-00-014-10-PIQ-001
45 to 54	Serial Number	10 bytes ASCII text - eg. 345678
55	CSum LSB	Checksum Least Significant Byte
56	CSum MSB	Checksum Most Significant Byte
57	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD3	Command – Set model and Serial Number
4	Response Flag	See Response Flag Definition table below
5	CSum LSB	Checksum Least Significant Byte
6	CSum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Module information updated successfully
0x02	Request out of range – Invalid characters present
0x07	Inadequate Access Level – Unable to set information
0xFF	Command failed – Unable to set module information

Raw I2C Write – 0xD4

Overview:

Writes directly to an I2C device present within the laser.

See the Device Definition table for the allowable actions which can be made.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD4	Command – Raw I2C Write
4	Device Number	See Device Definition table below
5	Data Byte 0	See Device Definition table below
6	Data Byte 1	
7	Data Byte 2	
8	CSum LSB	Checksum Least Significant Byte
9	CSum MSB	Checksum Most Significant Byte
10	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD4	Command – Raw I2C Write
4	Response Flag	See Response Flag Definition table below
5	CSum LSB	Checksum Least Significant Byte
6	CSum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Device Definition:

Value	Meaning	Data Byte 0	Data Byte 1	Data Byte 2
0	OEM Memory IC – Page 1	Address MSB	Address LSB	New Data
1	OEM Memory IC – Page 2	Address MSB	Address LSB	New Data
2	OSM Memory IC	*(not used)*	Address LSB	New Data
3	Pilot Laser Digi-Pot 1 – Write Value to Volatile Memory	*(not used)*	*(not used)*	New Data
4	Pilot Laser Digi-Pot 1 – Fix Value (Copy to Non Volatile Memory)	*(not used)*	*(not used)*	*(not used)*
5	Pilot Laser Digi-Pot 2 – Write Value to Volatile Memory	*(not used)*	*(not used)*	New Data
6	Pilot Laser Digi-Pot 2 – Fix Value (Copy to Non Volatile Memory)	*(not used)*	*(not used)*	*(not used)*
7	External Calibration Digi-Pot – Write Value to Volatile Memory	*(not used)*	*(not used)*	New Data
8	External Calibration Digi-Pot – Fix Value (Copy to Non Volatile Memory)	*(not used)*	*(not used)*	*(not used)*
9	PDOF 1 Digi-Pot – Write Value to Volatile Memory	*(not used)*	*(not used)*	New Data
10	PDOF 1 Digi-Pot – Write Value to Non-Volatile Memory	*(not used)*	*(not used)*	New Data
11	PDOF 1 IO Expander – Initialise	*(not used)*	*(not used)*	*(not used)*
12	PDOF 1 IO Expander – Write Value	*(not used)*	*(not used)*	New Data
13	PDOF 2 Digi-Pot – Write Value to Volatile Memory	*(not used)*	*(not used)*	New Data
14	PDOF 2 Digi-Pot – Write Value to Non-Volatile Memory	*(not used)*	*(not used)*	New Data
15	PDOF 2 IO Expander – Initialise	*(not used)*	*(not used)*	*(not used)*
16	PDOF 2 IO Expander – Write Value	*(not used)*	*(not used)*	New Data

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Write successful
0x01	Feature not available – Device not fitted
0x02	Request out of range – Device number invalid
0x03	Over range – Address too large
0x07	Inadequate Access Level – Unable to set information
0x09	Internal Communication Error – Bus Error
0xFF	Command failed – Unable to set I2C

Raw I2C Read – 0xD5

Overview:

Reads directly from an I2C device present within the laser.

See the Device Definition table for the allowable actions which can be made. Not all actions will return a result, as not all components have all registers/memory locations readable.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD5	Command – Raw I2C Read
4	Device Number	See Device Definition table below
5	Address MSB	Internal address. One or both bytes are ignored for some components (see Device Definition table)
6	Address LSB	
7	CSum LSB	Checksum Least Significant Byte
8	CSum MSB	Checksum Most Significant Byte
9	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD5	Command – Raw I2C Read
4	Device Number	See Device Definition table below
5	Response Flag	See Response Flag Definition table below
6	Address MSB	Device address to be updated
7	Address LSB	
8	Data	New Data
9	CSum LSB	Checksum Least Significant Byte
10	CSum MSB	Checksum Most Significant Byte
11	0x7E	End Framing Character

Device Definition:

Value	Meaning	Address Length (bytes)
0	OEM Memory IC – Page 1	2
1	OEM Memory IC – Page 2	2
2	OSM Memory IC	1
3	Pilot Laser Digi-Pot 1 – Wiper Value	0
4	Pilot Laser Digi-Pot 2 – Wiper Value	0
5	Calibration Pot – Wiper Value	0
6	PDOF 1 Digi-Pot – Wiper Value	0
7	PDOF 2 Digi-Pot – Wiper Value	0
8	PDOF 1 IO Expander – Output Value	0
9	PDOF 2 IO Expander – Output Value	0

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Write successful
0x01	Feature not available – Device not fitted
0x02	Request out of range – Device number invalid
0x07	Inadequate Access Level – Unable to set information
0x09	Internal Communication Error – Bus Error
0xFF	Command failed – Unable to read I2C

Set PDOF Offset – 0xD6

Overview:

Sets the PDOF offset DAC.

Note: This only writes to the DAC itself; it does not update the offset value stored in the OSM memory. This value was written at system setup and should only be overwritten in exceptional circumstances.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD6	Command – Set PDOF Offset
4	PDOF Select	See PDOF Definition table below
5	Offset MSB	Associated Offset value
8	Offset LSB	
9	CSum LSB	Checksum Least Significant Byte
10	CSum MSB	Checksum Most Significant Byte
11	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD6	Command – Set PDOF Offset
4	PDOF Select	See PDOF Definition table below
5	Response Flag	See Response Flag Definition table below
6	CSum LSB	Checksum Least Significant Byte
7	CSum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

PDOF Definition:

Value	Meaning
1	PDOF 1 Select
2	PDOF 2 Select

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Write successful
0x01	Feature not available – PDOF not fitted
0x02	Request out of range – PDOF number invalid
0x03	Request too large – Offset value >4095
0x07	Inadequate Access Level – Unable to set PDOF offset
0xFF	Command failed – Unable to set PDOF offset

Get PDOF Offset – 0xD7

Overview:

Gets the current value of the PDOF offset, raw DAC value.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD7	Command – Get PDOF Offset(s)
4	PDOF Select	See PDOF Definition table below
5	CSum LSB	Checksum Least Significant Byte
6	CSum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD7	Command – Get PDOF Offset(s)
4	PDOF Select	See PDOF Definition table below
5	Response Flag	See Response Flag Definition table below
6	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is 2 bytes / PDOF channel.
7	Offset MSB	Requested Offset value
8	Offset LSB	
7 + n	CSum LSB	Checksum Least Significant Byte
8 + n	CSum MSB	Checksum Most Significant Byte
9 + n	0x7E	End Framing Character

- *n is the number defined in Data Length to return the associated value(s)*
- *If n = 0 no data is returned.*
- *Multi byte values are returned MSB first.*

PDOF Definition:

Value	Meaning
0	Request all PDOF offset values. 4 bytes each.
1	PDOF 1 Select
2	PDOF 2 Select

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Read successful
0x01	Feature not available – PDOF not fitted
0x02	Request out of range – PDOF number invalid
0xFF	Command failed – Unable to read PDOF offset

Set OPFA Threshold DAC Value– 0xD8

Overview:

Sets the OPFA threshold DAC value. This sets the setpoint level above which hardware output failure monitoring is active.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD8	Command – Set OPFA Threshold DAC Value
4	Offset MSB	Associated Offset value
5	Offset LSB	
6	CSum LSB	Checksum Least Significant Byte
7	CSum MSB	Checksum Most Significant Byte
8	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD8	Command – Set OPFA Threshold DAC Value
4	Response Flag	See Response Flag Definition table below
5	CSum LSB	Checksum Least Significant Byte
6	CSum MSB	Checksum Most Significant Byte
7	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Write successful
0x01	Feature not available
0x03	Over range – Requested value > 4095
0x07	Inadequate Access Level – Unable to set threshold DAC
0xFF	Command failed – Unable to set threshold DAC

Get OPFA Threshold DAC Value - 0xD9

Overview:

Gets the current value of the PDOF offset, raw DAC value.

Laser Module Receives:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD9	Command – Get OPFA Threshold DAC Value
4	CSum LSB	Checksum Least Significant Byte
5	CSum MSB	Checksum Most Significant Byte
6	0x7E	End Framing Character

Laser Module Transmits:

Byte No	Value	Function
1	0x7E	Start Framing Character
2	Module Address	OEM Module Address
3	0xD9	Command – Get OPFA Threshold DAC Value
4	Response Flag	See Response Flag Definition table below
5	Data Length	Number of data bytes to follow excluding checksum and framing character. Current data length is 4 bytes / PDOF channel.
6	Value MSB	Requested value
7	Value LSB	
8	CSum LSB	Checksum Least Significant Byte
9	CSum MSB	Checksum Most Significant Byte
10	0x7E	End Framing Character

Relevant Response Flag Definition:

Response Flag Value	Description
0x00	Command executed successfully – Read successful
0x01	Feature not available
0x07	Inadequate Access Level – Unable to set threshold DAC
0xFF	Command failed – Unable to read threshold DAC value