CARMA CANbus API No. 224

Antenna IF Module

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Version: D

Issued By: UC Berkeley

Approved by: <Name> <Institution> <Date>
## Revision History

<table>
<thead>
<tr>
<th>VERSION</th>
<th>DATE</th>
<th>SECTIONS AFFECTED</th>
<th>REASONS / REMARKS</th>
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<tbody>
<tr>
<td>A</td>
<td>9 May 2004</td>
<td>All</td>
<td>Original</td>
</tr>
<tr>
<td>B</td>
<td>5 Oct 2004</td>
<td>5.2, 5.8</td>
<td>Units changed in blanking frame packet #2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Upload detector calibration table commands</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x3f9, 0x3fa added in 5.8</td>
</tr>
<tr>
<td>C</td>
<td>5 Oct 2004</td>
<td>5.1, 5.5, 5.7</td>
<td>Calibrated attenuation vs. frequency command</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0x104 removed from 5.1</td>
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<td></td>
<td></td>
<td>Responses to command 0x104 (packets 0x140, 0x141) removed from 5.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Added current attenuation on PAM status broadcast (0x130) packet in 5.7</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Added “Go to preset IF level” command 0x106 in 5.1</td>
</tr>
<tr>
<td>D</td>
<td>20 Jun 2005</td>
<td>All</td>
<td>Revised numbering scheme</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Added select debug output command</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Added System monitor packet 5</td>
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1 CAN Node Overview
This CANbus node controls the antenna IF switch, the preamplifier module (PAM), and the laser transmitter module. Its functions are to select the receiver, control the IF level, and monitor the correct functioning of the laser transmitter.

2 Related Documents
Description of the CAN ID standard for CARMA

3 Messaging Format
Only CANbus communication is covered in this document. Other communications to a node, for example through an RS-232 port, are intended only for engineering use and therefore not part of the API. The Host is the Linux crate that controls the CANbus.

All messages follow the Extended ID CAN address standards in the document referenced in Sec. 2. Bit values and positions are as follows:

Bit 28: Host Process (1 bit)
0: Host should ignore this message; message is meant to go from Node to Node or from Host to Node
1: Host needs to process this message.

Bit 27: Address Mode (1 bit)
0: Address by API ID and API Instance
1: Address by Module Type and Module Serial Number

Bits 26-17: Message Type (10 bits)
Message Type. Valid range: 0x000–0x3FF

Bits 16-09: API ID or Module Type (8 bits)
API ID. Valid range: 1–255. 0 from host means any API; 0 from module is an error.
Module Type. Stored in module 1-Wire ID. Valid range: 0–255. 0 from host means any Module type; 0 from module is an error.

Bits 08-00: Node Location Code (API Instance) or Module Serial Number (9 bits)
Node Location Code: Stored in 1-Wire Location ID Dongle (if no dongle, module returns 1)
Valid range 0–511. 0 from host means any location; 0 from module is an error
Module Serial Number: Stored in module 1-Wire ID.
Valid range 0–511. 0 from host means any s/n; 0 from module is an error.

4 API and Module Numbers

4.1 API Number
CARMA CANbus API No. 224

4.2 Module Number(s)
This API has been implemented on Module ID number(s): 224
4.3 Node Location ID

The node location ID identifies the receiver polarization that the module is connected to. Currently the polarization assignments are not defined.

1 – Polarization 1
2 – Polarization 2

5 Commands and Messages

In the following the CAN message is given in hex. Each message has up to 8 bytes of data following the CAN Message ID starting with Byte 0. Bytes may be combined to form different data types. Multi-byte data types will be sent in network byte order with the most significant byte preceding the least significant.

Table 1: Data types used in CANbus messages

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Bytes</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>UB</td>
<td>Unsigned byte</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>UI</td>
<td>Unsigned integer</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>UL</td>
<td>Unsigned long integer</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>SI</td>
<td>Signed integer</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>SL</td>
<td>Signed long integer</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>FL</td>
<td>IEEE 754-1990 float</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>DBL</td>
<td>IEEE 754-1990 double float</td>
<td>8</td>
<td>7</td>
</tr>
</tbody>
</table>

*The code is used when a message needs to indicate a data type.

There are several categories of CAN message. These are discussed in detail in the document referenced in Sec. Error! Reference source not found..

5.1 Commands From Host

5.1.1 System, Highest Priority (host process bit = 0): 0x000–0x03F

0x000: Reset

Resets the microcontroller module with a key sequence for protection against accidental triggering.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>0xE1</td>
<td>0x1E</td>
<td>0xA5</td>
<td>0x5A</td>
<td>0xC3</td>
<td>0x3C</td>
<td>0x96</td>
<td>0x69</td>
</tr>
</tbody>
</table>

0x001: Set Time

Synchronize node internal time to host system Modified Julian Day (MJD). The MJD has an accuracy of 86.4 μs.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>MJD</td>
<td>MJTIME</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MJD (UI)
Modified Julian Day number
MJTIME (UL)
Time of Day in billionths of a day

0x002: Stop Channel 1 Fast Sampling

Stop sending any fast sampling data in channel 1.

0x003: Stop Channel 2 Fast Sampling

Stop sending any fast sampling data in channel 2.
0x004: Start Channel 1 Fast Sampling
Start sending data in channel 1 at the highest speed possible (See Sec. 5.2.3 for response packets).

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>FASTITEM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**FASTITEM (UI)**
Value to sample at high data rate:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item Name</th>
<th>Data Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Laser temperature</td>
<td>FL</td>
</tr>
<tr>
<td>2</td>
<td>Laser optical power</td>
<td>FL</td>
</tr>
<tr>
<td>3</td>
<td>IF total power</td>
<td>FL</td>
</tr>
</tbody>
</table>

0x005: Start Channel 2 Fast Sampling
Start sending data in channel 2 at the highest speed possible (See Sec. 5.2.3 for response packets). Same items as for Channel 1.

5.1.2 Application, High Priority (host process bit = 0): 0x040–0x07F

0x040: Application Message To Node
None.

0x080: Select band number
Select a particular band as input to the PAM, by setting the position of the IF switch.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>IFSWIPOS</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**IFSWIPOS(UB)**
IF switch position 1, 2, 3, 4.

5.1.3 Application, Normal Priority (host process bit = 0): 0x080–0xDF

0x081: Set IF total attenuation
Set the IF attenuator to a nominal value.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>ATTENSET</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**ATTENSET (FL)**
Attenuator setting, 0-63 dB in steps of 0.5 dB.

0x082: Set IF level
Set the IF attenuator so that the IF total power detector returns the closest value to the input parameter.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>IFTOTPOW</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

**IFTOTPOW (FL)**
Target IF total power, in mW. Current PAM will only be able to produce about +8 dBm.

0x083: Set input attenuator
Set the input and output IF attenuators to a nominal value.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>ATTENSETINPUT</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

GENERATED FROM TEMPLATE VERSION G
ATTENSETINPUT (FL)  
Input attenuator setting, 0-31.5 dB in steps of 0.5 dB.

0x084: Set output attenuator  
Set the input and output IF attenuators to a nominal value.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>ATTENSETOUTPUT</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

ATTENSETOUTPUT (FL)  
Input attenuator setting, 0-31.5 dB in steps of 0.5 dB.

0x085: Query total power detector  
Query value read from total power detector in PAM (see Sec. 5.6 for response packets).

0x086: Go to output power preset  
Go to preset IF level. Current preset IF level is 0 dBm. Thus, it is functionally equivalent to “Set IF level” command with IFTOTPOW=1.0 mW (see Sec. 5.7 for response packets).

5.1.4 System, Low Priority (host process = 0): 0x3E0–0x3FF

0x3F0: Retrieve Error Log Entry  
Request the node to return one of up to 64 error records maintained in the module’s RAM. Records are returned in two messages, 0x1F0 and 0x1F1 (see Sec. 5.3.2 for format)

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Record Number</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Record Number (UB)  
One of 64 possible error records stored in the module memory.

0x3F1: Clear Error Counters  
Selectively clear error counter groups

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Group</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Group (UB)  
Defines error counter group to clear
0: Clear ALL Counters
1: Clear Communications Error Counters
2: Clear Operating System Error Counters
3: Clear Hardware Error Counters
4: Clear Process Error Counters
5–255: Not used

0x3F3: Downloader Code Data  
This message is used by the CAN downloader to download a HEX file into the module.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Ch1</td>
<td>Ch 2</td>
<td>Ch 3</td>
<td>Ch 4</td>
<td>Ch 5</td>
<td>Ch 6</td>
<td>Ch 7</td>
<td>Ch 8</td>
</tr>
</tbody>
</table>

Ch 1 – Ch 8 (8 × UB)  
ASCII characters from Intel HEX format file for code image.
0x3F4: Error Log Clear
Clear all errors in the module’s error table. The data payload is a key for security.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>0xE1</td>
<td>0x3C</td>
<td>0xA5</td>
<td>0x69</td>
<td>0x96</td>
<td>0x5A</td>
<td>0xC3</td>
<td>0x1E</td>
</tr>
</tbody>
</table>

0x3FB: Enable/Disable Monitor Packets
Start or stop sending blanking and system monitor packets. If the module receives any time stamps the blanking and system monitor packet sending will be automatically enabled.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>0xE1</td>
<td>0x1E</td>
<td>0xA5</td>
<td>0x5A</td>
<td>0xC3</td>
<td>NA</td>
<td>Blanking Frame Enable</td>
<td>System Monitor Enable</td>
</tr>
</tbody>
</table>

  **Blanking Frame Enable (UB)**
  0: Off
  1: On
  3–255: Not used

  **System Monitor Enable (UB)**
  0: Off
  1: On
  3–255: Not used

0x3FC: ID Request
Requests Module ID number to be sent back through message 0x3FC (See Sec. 5.3.2).

0x3FD: Start Download
Starts downloading a new program into the embedded microprocessor. The data payload is a key for security. The download is sent using message 0x3F3.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>0x1E</td>
<td>0xA5</td>
<td>0x69</td>
<td>0xC3</td>
<td>0x96</td>
<td>0x5A</td>
<td>0x1E</td>
<td></td>
</tr>
</tbody>
</table>

  **Security Code (8×UB)**

0x3FE: Assign Dongle ID Number
Change the Module ID number. This is used for engineering tests only–the hardware ID will overwrite this value when the module is reset.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>0xE1</td>
<td>0x1E</td>
<td>0xA5</td>
<td>0x5A</td>
<td>0xC3</td>
<td>0x3C</td>
<td>New ID</td>
<td></td>
</tr>
</tbody>
</table>

  **Security Code (6×UB)**
  **New ID (UI)**
  New Module ID number. Range: 0–511

0x3FF: ASCII Character Packet
Send a string of 1 to 8 characters.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Char 0</td>
<td>Char 1</td>
<td>Char 2</td>
<td>Char3</td>
<td>Char4</td>
<td>Char5</td>
<td>Char6</td>
<td>Char7</td>
</tr>
</tbody>
</table>
5.1.5 System, Low Priority (host process = 0): 0x3E0–0x3FF
None.

5.2 Monitoring

5.2.1 Blanking Frame Monitor Packets (host process bit = 1): 0x0E0–0x10F

0x0E0: Blanking Frame Monitor Packet #1
Blanking frame monitor packets are sent asynchronously every 500 ms.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>IFTOTPOW</td>
<td>PAMTEMP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IFTOTPOW (FL)
IF total power monitor output, in mW, averaged over the last 0.5 s

PAMTEMP (FL)
Preamplifier module physical temperature, in ºC.

0x0E1: Blanking Frame Monitor Packet #2
Second part of blanking frame monitor stream sent asynchronously every 500 ms.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>ATTENSET</td>
<td>PAM Status</td>
<td>IF Switch Stat</td>
<td>LASER Stat</td>
<td>ECOUNT</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ATTENSET (FL)
Calibrated total attenuator setting at the time of sending the frame, in dB

PAM Status (UB)
0 – Valid operating state
1 – PAM temperature in range, attenuation changed during last blanking period (data should be blanked)
2 – PAM temperature in range, IF level too high
3 – PAM temperature in range, IF level too low
4 – PAM temperature out of range
5 – PAM temperature out of range, attenuation changed during last blanking period (data should be blanked)
6 – PAM temperature out of range, IF level too high
7 – PAM temperature out of range, IF level too low

IF Switch Status (UB)
0 – Changed position during last blanking period (data should be blanked)
1 – Receiver 1
2 – Receiver 2
3 – Receiver 3
4 – Receiver 4
5 – Stuck (position read is different from commanded)

Laser Status (UB)
0 – Valid operating state
1 – Optical power out of range
2 – Laser out of temperature regulation
3 – Laser out of temperature regulation, optical power out of range

ECOUNT (UB)
Count of errors logged during last blanking period

0x0E2: Blanking Frame Monitor Packet #3
Third part of blanking frame monitor stream sent asynchronously every 500 ms.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>LASOPTPOW</td>
<td>LASERRTEMP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
LASOPTPOW (FL)
Laser optical power monitor output according to laser diode driver, in V.

LASERTEMP (FL)
Laser regulation error, in V. Very small when laser temperature is being successfully regulated.

**0x0E3: Blanking Frame Monitor Packet #4**
Fourth part of blanking frame monitor stream sent asynchronously every 500 ms.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>ATTENSETINPUT</td>
<td>ATTENSETOUTPUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ATTENSETINPUT (FL)
Current calibrated input attenuator setting, in dB

ATTENSETOUTPUT (FL)
Current calibrated input attenuator setting, in dB

**0x0E4: Blanking Frame Monitor Packet #5**
Fifth part of blanking frame monitor stream sent asynchronously every 500 ms.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>LASERID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LASERID (8xUB)
Eight byte laser ID obtained from attached silicon serial number (Dallas DS2401)

### 5.2.2 System Monitor Packets (host process bit = 1): 0x0120–0x12F

**0x120: System Monitor Packet #1**
System monitor packets are standardized packets with information on the health and status of the module. They are sent at 5-second intervals.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>MODSN</td>
<td>MODTYPE</td>
<td>INITREQ</td>
<td>CAN Rx Errors</td>
<td>CAN Tx Errors</td>
<td>MEMERR Count</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MODSN (UI)
Module serial number for transmitting node. Range: 1 to 511 (0 is an error condition)

MODTYPE (UB)
Module type for the transmitting node. Range: 1 to 255 (0 is an error condition)

INITREQ (UB)
Initialization Request.
0: Initialization not required
1: Module needs to be initialized
2–255: Not used

CAN Rx Errors (UB)
CANbus controller receive error count

CAN Tx Errors (UB)
CANbus controller transmit error count

MEMERR Count (UI)
Cumulative count of memory errors detected in the module RAM (reset by message 0x3F1)

**0x121: System Monitor Packet #2**
Sent on every 5-second time boundary.
### Byte #

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>SOCNT</td>
<td>TSOCNT</td>
<td>SWVERMAJ</td>
<td>SWVERMIN</td>
<td>SWVERTST</td>
<td>TESTMODE</td>
<td></td>
</tr>
</tbody>
</table>

**SOCNT (UI)**
Scheduler overflow count. Range: 0x0000 to 0xFFFF. (Cumulative, reset by message 0x3F1)

**TSOCNT (UI)**
Timed scheduler overflow count. Range: 0x0000 to 0xFFFF. (Cumulative, reset by message 0x3F1)

**SWVERMAJ (UB)**
Software version (major)

**SWVERMIN (UB)**
Software version (minor)

**SWVERTST (UB)**
Software version (test)

**TESTMODE (UB)**
0: Normal operating mode
1–255: No test modes

### 0x122: System Monitor Packet #3
Sent on every 5-second time boundary.

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>COMMERR</td>
<td>TIME_ERR</td>
<td>SWERR</td>
<td>HWERR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMERR (UI)**
Count of all communication errors (cumulative, reset by message 0x3F1)

**TIME_ERR (UI)**
Count of all time or synchronization errors (cumulative, reset by message 0x3F1)

**SWERR (UI)**
Count of all software errors (cumulative, reset by message 0x3F1)

**HWERR (UI)**
Count of all hardware errors (cumulative, reset by message 0x3F1)

### 0x123: System Monitor Packet #4
Sent on every 5-second time boundary.

<table>
<thead>
<tr>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>TIME JITTER</td>
<td>SINCE LAST TS</td>
<td>TS DELTA</td>
<td>API Ver</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TIME JITTER (SI)**
Average time jitter (\(|t_{\text{internal}} - t_{\text{system}}|\)). \(t_{\text{internal}}\) is the module’s time and \(t_{\text{system}}\) is the time from the host. Average is over last 32 time stamps. Units: ms.

**SINCE LAST TS (UI)**
Time since receiving last time stamp. Units: s.

**TS DELTA (SI)**
Last time difference (\(t_{\text{internal}} - t_{\text{system}}\)). Units: ms

**API Ver (UB)**
Version letter of this API document used (one character).
### 0x124: System Monitor Packet #5
Sent on every 5-second time boundary.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>UPTIME</td>
<td>Bootloader</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **UPTIME (UL)**
  - Time since module was last reset. Units: s
- **Bootloader (UB)**
  - Indicates whether or not the CAN boot loader is present in the module:
    - 0: Boot loader absent
    - 1: Boot loader present
    - 2–255: Not used

#### 5.2.3 Fast Sampling Packets (host process bit = 1): 0x110–0x113
These are generated in response to messages 0x004 and 0x005 and halted in response to messages 0x002 and 0x003 (See Sec. 5.1).

### 0x110: Channel 1 Fast Sample Size
This packet is sent once, when fast sampling in channel 1 is initiated.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>DATATYPE1</td>
<td>NFAST1</td>
<td>TOTALNFAST1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

- **DATATYPE1 (UB)**
  - Data type for sampled variables (See Table 1).
- **NFAST1 (UB)**
  - Number of message type 0x112 fast sample packets per 0.5 s set.
- **TOTALNFAST1 (UB)**
  - Total number of samples in 0.5 s.

### 0x111: Channel 2 Fast Sample Size
This packet is sent once, when fast sampling in channel 2 is initiated.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>DATATYPE2</td>
<td>NFAST2</td>
<td>TOTALNFAST2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

- **DATATYPE2 (UB)**
  - Data type for sampled variables (See Table 1).
- **NFAST2 (UB)**
  - Number of message 0x113 fast sample packets per 0.5 s set.
- **TOTALNFAST2 (UB)**
  - Total number of samples in 0.5 s.

### 0x112: Channel 1 Fast Sample Packet
Items and their data types are given in Table 2. They are packed into the eight data bytes as densely as possible.

### 0x113: Channel 2 Fast Sample Packet
Same as for Channel 1.
5.3 Node Responses

5.3.1 Responses To Host (host process bit = 1): 0x170–0x1AF

0x170: Total Power
Readout from the total power detector on the PAM (see Sec. 5.1 for query packets).

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Name</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IFTOTPOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTPOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- IFTOTPOW (FL)
  Calibrated total power detector readout, in mW.
- TOTPOW (FL)
  Actual total power detector readout, in V.

5.3.2 System Responses (host process bit = 1): 0x1F0–0x1FF

0x1F0: Error Record Return Data Packet #1
Contains the Time Stamp for the Error Record sent in response to message 0x3F0: Retrieve Error Log Entry Message (see Sec. 5.3.3).

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Name</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ERRLOG #</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MJD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MJTIME</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ERRLOG # (UB)
  Error log entry number (1–64).
- MJD (UI)
  Date of the Log Entry in MJD
- MJTIME (UL)
  Time of Day. Units: 10^9 day, 0.0864 ms

0x1F1: Error Record Return Data Packet #2
Contains error codes and other optional information.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Name</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ERRCODE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ERRDATA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- ERRCODE (UI)
  Error code value.
- ERRDATA (UL)
  Interpreted as 4 x UB or 2 x UI or 2 x SI or UL or SL as required for engineering diagnostics.

0x3FC: ID Request (Response)
Returns information about Module ID in response to a 0x3FC request. Note: the request and response messages are both 0x3FC, but the request has host process bit = 0. The node will not respond if host process bit = 1.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Name</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Module Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ser No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>API No</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dongle ID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Module Type (UI)
  Module type number
- Ser No (UI)
  Serial number of the hardware. Range: 1–511 (0 is an error condition)
- API No. (UI)
  Current API number in module (API 224)
Dongle ID (UI)
Location ID. See Error! Reference source not found.

0x3FF: ASCII Character Packet
Send a string of 1 to 8 characters.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Char 0</th>
<th>Char 1</th>
<th>Char 2</th>
<th>Char3</th>
<th>Char4</th>
<th>Char5</th>
<th>Char6</th>
<th>Char7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>PAM Status</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>ATTENSET</td>
<td>ATTENSET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAM Status (UB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – Valid operating state</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – Attenuation changing (used during set level command)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – IF level too high</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 – IF level too low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATTENSET (FL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current attenuation setting, 0-63.0 dB in steps of 0.5 dB.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

5.3.3 Global Variables Node Broadcast (host process bit = 0): 0x130–0x16F

0x130: Message From Node
None.

5.3.4 Global Variables Host Broadcast (host process bit = 1): 0x130–0x16F
Messages are broadcast immediately on change of state.

0x130: PAM Status
Broadcasts the status of the PAM immediately on a change of state.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>PAM Status</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>ATTENSET</td>
<td>ATTENSET</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAM Status (UB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – Valid operating state</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – Attenuation changing (used during set level command)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – IF level too high</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 – IF level too low</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATTENSET (FL)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current attenuation setting, 0-63.0 dB in steps of 0.5 dB.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

0x131: Switch Status
Broadcasts the status of the IF switch immediately on a change of state.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>PAM Status</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>IF Switch Status (UB)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 – Switch moving (not used, switch changes status in &lt;20 ms)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 – Receiver 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 – Receiver 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 – Receiver 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 – Receiver 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 – Stuck</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

5.4 Engineering Messages

5.4.1 Engineering Commands (host process bit = 0): 0x300–0x36F
These messages may be sent through the host, but will not be generated by it.

0x300: Set Debug Output
Determines the output for the runtime debug messages
### 0x301: Start Calibration Table Upload
Start upload of IF power detector calibration table. The data payload is a key for security, plus a byte for the length of the table (in voltage-power pairs).

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>0xA1</td>
<td>0x1A</td>
<td>0x5C</td>
<td>0xC5</td>
<td>0xE3</td>
<td>0x3E</td>
<td>0x77</td>
<td>TABLEN</td>
</tr>
</tbody>
</table>

### TABLEN (UB)
Number of voltage-power pairs in detector calibration table.

### 0x302: Upload Calibration Table Element
Upload a voltage-power pair of the IF power detector calibration table (upload was started by a 0x3f9 command, otherwise this packet is ignored). When a number of pairs equal to that specified by command 0x3f9 have been uploaded, the table will be automatically burned in the onboard EEPROM.

<table>
<thead>
<tr>
<th>Byte #</th>
<th>Byte 0</th>
<th>Byte 1</th>
<th>Byte 2</th>
<th>Byte 3</th>
<th>Byte 4</th>
<th>Byte 5</th>
<th>Byte 6</th>
<th>Byte 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>DETVOL</td>
<td>TOTPOW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### DETVOL (FL)
Detector voltage, in V.

### TOTPOW (FL)
Total RF power at module output, in mW.

#### 5.4.2 Engineering Responses (host process bit = 1): 0x200–0x24F
These messages are not interpreted by the host but can be passed back in response to an engineering message.

None.

#### 5.4.3 Engineering Private Responses (host process bit = 0): 0x250–0x26F
These messages are ignored by the host but can be read by an engineering host (e.g., Windows notebook) plugged into the CANbus.

None.

#### 5.5 Node-to-Node

#### 5.5.1 Node-to-Node (host process bit = 0): 0x1B0–0x1EF
None.