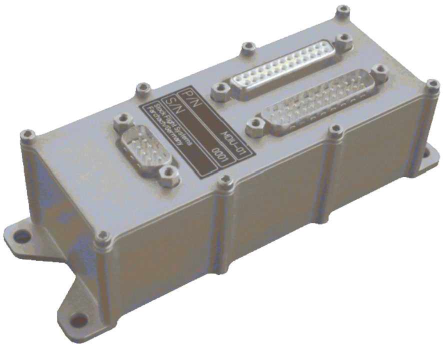
Micro Data Interface Unit (MDIU)
CANaerospace
Interface Control Document



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1 Introduction

This Interface Control Document describes, in hardware and software, the CANaerospace communication interface of the Micro Data Interface Unit (MDIU) with general purpose software. The MDIU is an integrated micro computer system with a number of analog, discrete an communication inputs/outputs that uses a CANaerospace network interface for communication with other systems. The MDIU signal interface characteristics may be configured using the CANaerospace Node Service Protocol.

2 Mechanical and Electrical Specification

The mechanical and electrical specification data of the MDIU are shown in Table 2.1.

Item	Specification Data
Mechanical Dimensions	115 mm x 49 mm x 31,5 mm (L x W x H) without flanges
Mass	0.23 kg
Electrical Power Supply	9 – 36 VDC
Power consumption	0.2A at 14 VDC supply
CANaerospace Interface	Isolated, according to ISO 11898
Operating Temperature Range	- 40° deg. C to + 85° deg. C
Operating Altitude	Up to 15000 m
Humidity	Less than 95%, non-condensing
Input Signals	• 4 analog inputs (+/- 10VDC) • 8 discrete inputs (5-28VDC) • 2 type K thermocouple inputs • 1 Variable Reluctance Speed (VRS) magnetic pickup transducer input • 1 Optically decoupled magnetic pickup transducer input • 2 ARINC 429 receivers • 1 RS-232 receiver • 1 RS-422 receiver
Output Signals	• 8 discrete outputs (28VDC/0.5A) • 1 ARINC 429 transmitter • 1 RS-232 transmitter • 1 RS-422 transmitter • 2 PWM/stepper motor drivers (28V/0.5A)

Table 2.1: MDIU System Specification Data

The three dimensional view with dimensions of the MDIU is shown in Figure 2.1. The enclosure is machined from aerospace grade aluminum and protected by Alodine 1200 surface treatment. The internal electronics is protected by conformal coating.

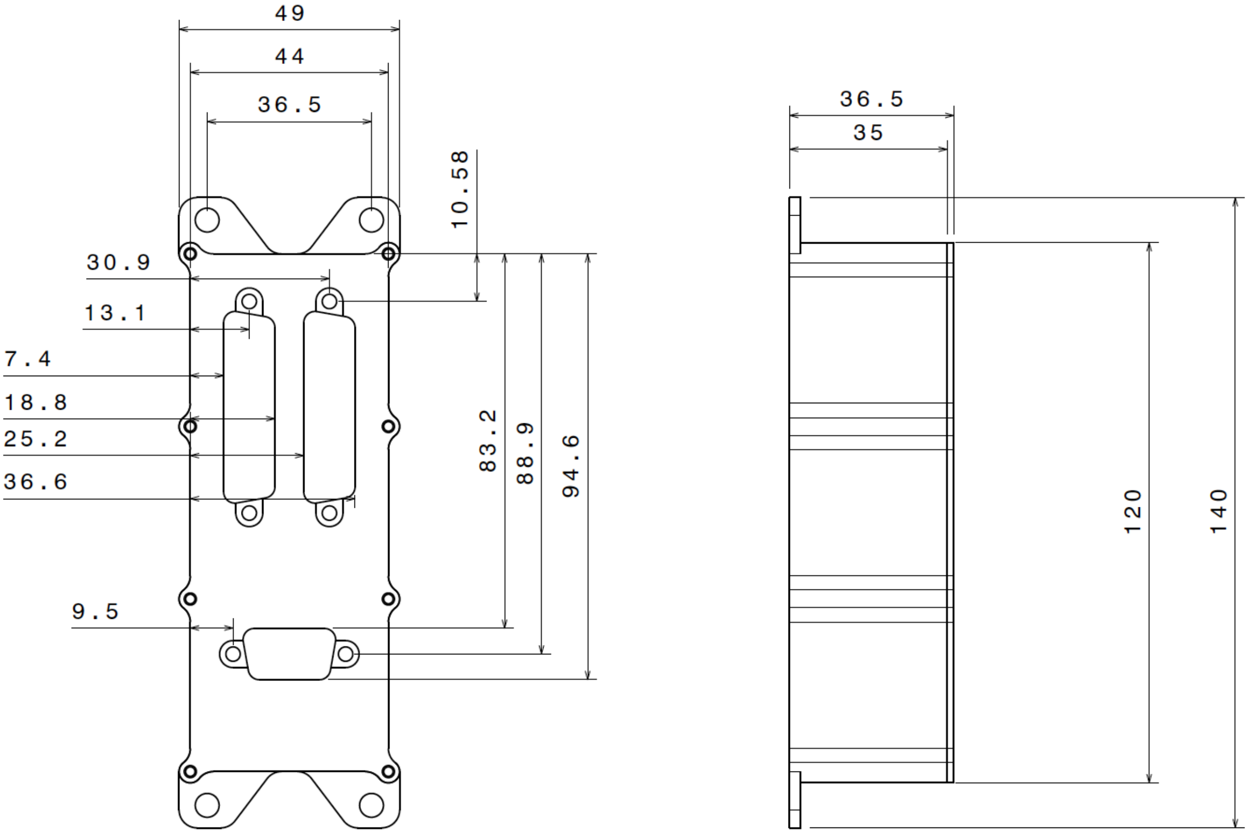

Figure 2.1: MDIU Dimensions

2.1 Power Supply and CANaerospace Interface

The MDIU is equipped with CANaerospace compatible DB9 interface connector which combines power supply lines with CAN signals as shown in Figure 2.2. The pinout description for this connector is shown in Table 2.2, the internal connections in Figure 2.3.

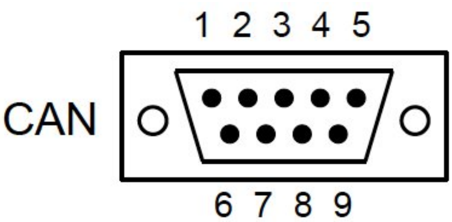

Figure 2.2: MDIU CANaerospace Connector

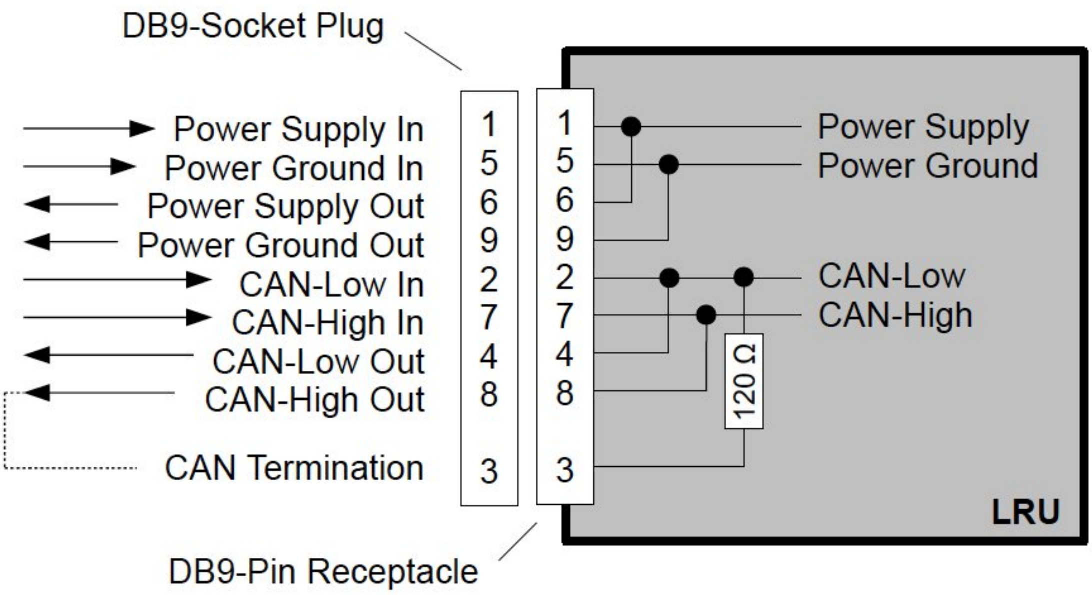

Figure 2.3: MDIU Internal Connections

Pin	Signal Name	Signal Description
1	PWR IN	DC Power Supply Input
2	CAN-L IN	CAN Low Input
3	CAN-TERM	CAN Termination Activation
4	CAN-L OUT	CAN Low Output
5	PWR GND IN	DC Power Ground Input
6	PWR OUT	DC Power Supply Output
7	CAN-H IN	CAN High Input
8	CAN-H OUT	CAN High Output
9	PWR GND OUT	DC Power Ground Input

Table 2.2: MDIU CANaerospace Connector Pinout

The MDIU CANaerospace interface connector pinout definition makes sure that no connector pin is used by more than one wire, so that the associated wire harness complies with international aerospace wiring standards without requiring external wire bundle or connector splices. The pinout definition also allows network termination using a simple bridge between pins 3 and 8, instead of a temination resistor installed within the connector backshell.

2.2 I/O Interface Connectors

The MDIU uses two DB25 I/O interface connectors at the top of the unit as shown in Figure 2.4. Tables 2.3 and 2.4 describe the I/O connector layout.

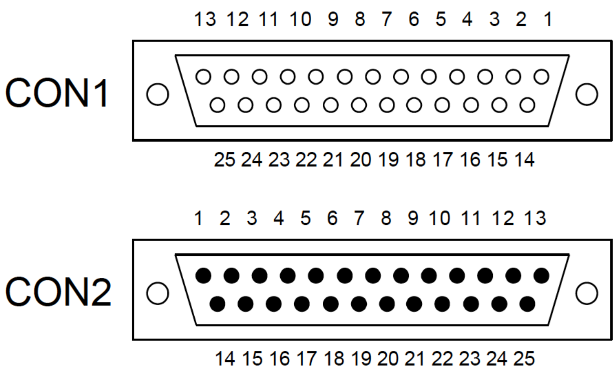

Figure 2.4: MDIU I/O Connectors

CON	Pin	Signal Name	Signal Description
1	1	ACPWR	9 to 36 VDC Aircraft Power Supply
1	2	RS232DBGTX	RS-232 Tx (Debug Interface)
1	3	RS232DBGRX	RS-232 Rx (Debug Interface)
1	4	RS422RXA	RS-422 Receiver A
1	5	RS422RXB	RS-422 Receiver B
1	6	RS422TXA	RS-422 Transmitter A
1	7	RS422TXB	RS-422 Transmitter B
1	8	A429RX0A	ARINC 429 Receiver #0 A
1	9	A429RX0B	ARINC 429 Receiver #0 B
1	10	A429RX1A	ARINC 429 Receiver #1 A
1	11	A429RX1B	ARINC 429 Receiver #1 B
1	12	A429TXA	ARINC 429 Transmitter A
1	13	A429TXB	ARINC 429 Transmitter B
1	14	DOUT0	Discrete Output #0
1	15	DOUT1	Discrete Output #1
1	16	DOUT2	Discrete Output #2
1	17	DOUT3	Discrete Output #3
1	18	DOUT4	Discrete Output #4
1	19	DOUT5	Discrete Output #5
1	20	DOUT6	Discrete Output #6
1	21	DOUT7	Discrete Output #7

CON	Pin	Signal Name	Signal Description
1	22	PWM0A	PWM/Motor Driver 0 A
1	23	PWM0B	PWM/Motor Driver 0 B
1	24	PWM1A	PWM/Motor Driver 1 A
1	25	PWM1B	PWM/Motor Driver 1 B

Table 2.3: CON1 Pin Assignment

CON	Pin	Signal Name	Signal Description
2	1	AINSUP	5V Analog Input Supply Voltage
2	2	REFGND	Analog Input Reference Ground
2	3	AIN0	Analog Input #0
2	4	AIN1	Analog Input #1
2	5	AIN2	Analog Input #2
2	6	AIN3	Analog Input #3
2	7	TC0A	Type K Thermocouple Input 0 A
2	8	TC0B	Type K Thermocouple Input 0 B
2	9	TC1A	Type K Thermocouple Input 1 A
2	10	TC1B	Type K Thermocouple Input 1 B
2	11	DIN0	Discrete Input #0
2	12	DIN1	Discrete Input #1
2	13	DIN2	Discrete Input #2
2	14	DIN3	Discrete Input #3
2	15	DIN4	Discrete Input #4
2	16	DIN5	Discrete Input #5
2	17	DIN6	Discrete Input #6
2	18	DIN7	Discrete Input #7
2	19	VRSIN	Variable Reluctance Speed Input
2	20	ODSIN	Optically Decoupled Speed Input
2	21	RS232RX	RS-232 Receiver
2	22	RS232TX	RS-232 Transmitter
2	23	RS232GND	RS-232 Ground
2	24	ACPWR	9 to 36 VDC Aircraft Power Supply
2	25	ACGND	Aircraft Supply Ground

Table 2.4: CON2 Pin Assignment

3 CAN Interface Characteristics

The CAN interface specified for the MDIU conforms to ISO-11898-1 and ISO-11898-2. It is galvanically isolated and uses exclusively the CAN-High and CAN-Low signals for communication on the network as shown in Figure 3.1. The CAN data rate is configurable between 125 kbit/s and 1 Mbit/s and has a default (factory setting) value of 1Mbit/s. The CAN transceivers provide dominant timeout protection.

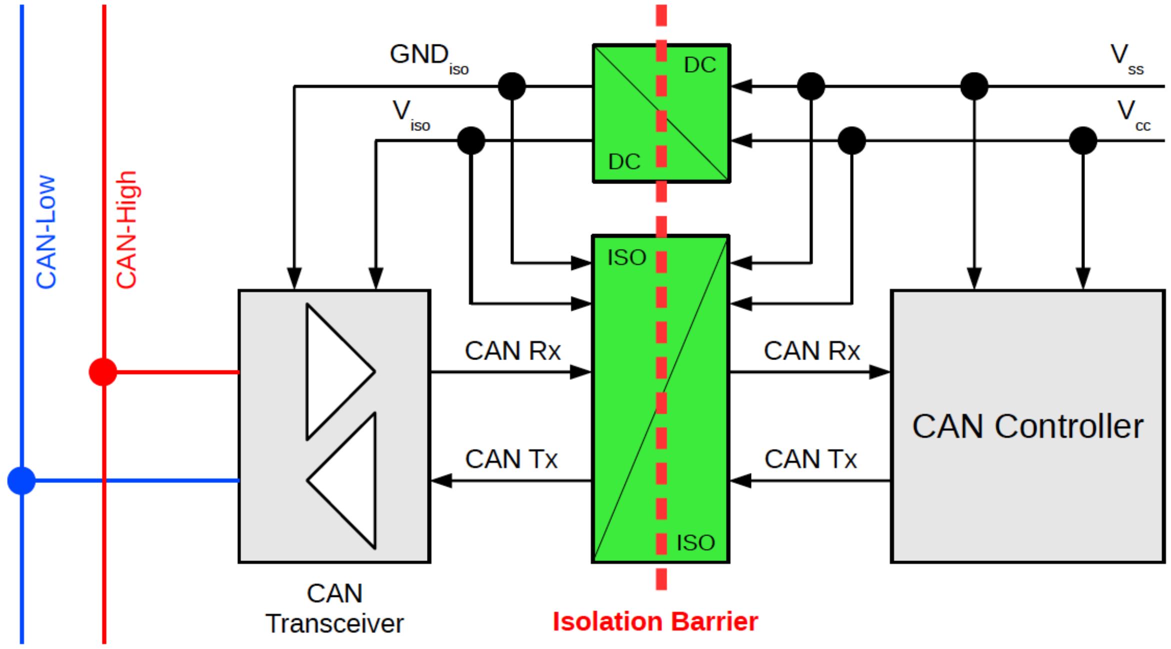

Figure 3.1: MDIU CAN Network Interface

MDIU units share information with other Line-Replaceable Units using a straight line CANaerospace network as shown in Figure 3.2. The network has to be terminated with a 120Ω resistor at each communication endpoint.

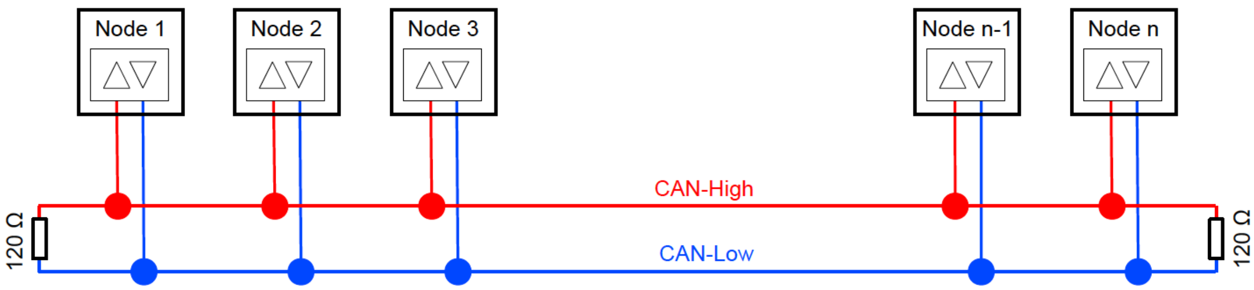

Figure 3.2: CANaerospace Network Topology

Depending on the CANaerospace network length, a degradation of the communication data rate according to the graph in Figure 3.3 should be applied.

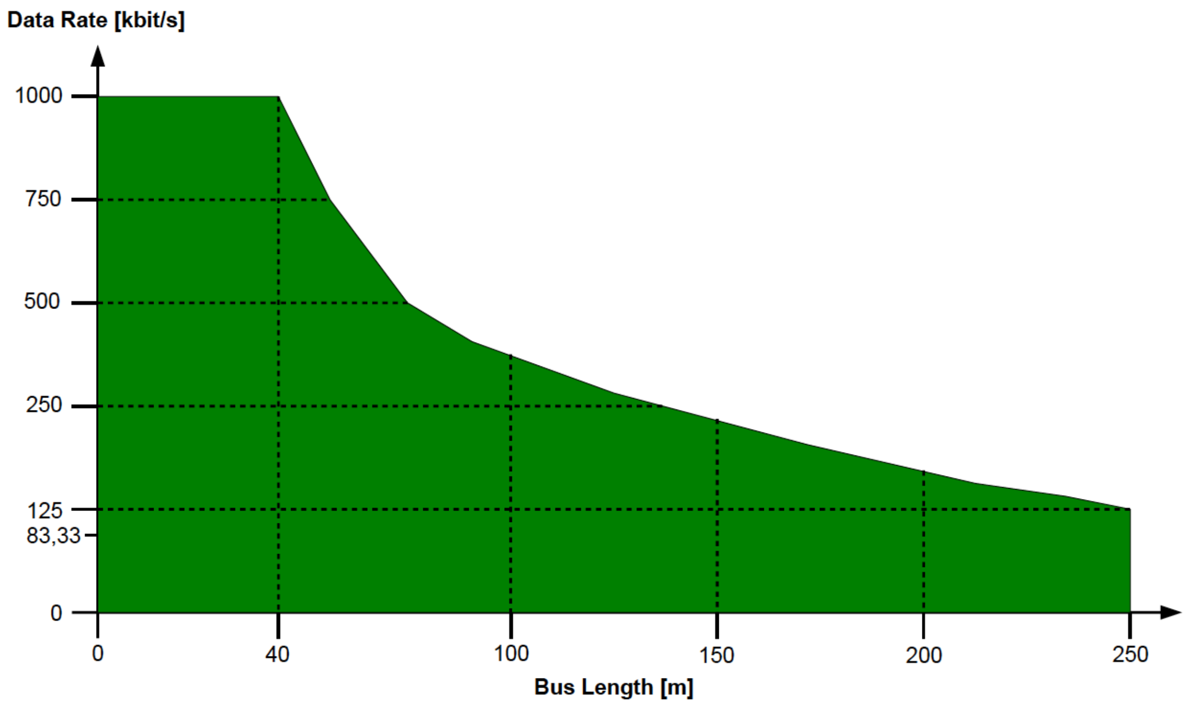

Figure 3.3: CAN Data Rate vs. Network Length

4 Power Supply Interface Characteristics

The MDIU operates between 9VDC and 36VDC without adverse effects on performance and network interface characteristics.

5 CANaerospace SysNodeID and Identifier Distribution

The MDIU General Purpose Software uses the CANaerospace standard identifier distribution which is signaled through the Identification Node Service (refer also to section 8.1of this document). To allow the use of MDIU in systems with differing identifier distribution, the identifier distribution code may also be modified using the CANaerospace Identifier Distribution Setting Node Service (refer also to section 8.8of this document).

6 Normal Operation Data

The MDIU with General Purpose Software continuously transmits and receives Normal Operation Data CANaerospace messages as described in Tables 6.2 and 6.2. The CANaerospace Identifiers, SysNodeID, Identifier Distribution Code and the rate at which transmitted messages are emitted by the MDIU are configurable through the Node Service Interface as described in section of this document. The default CANaerospace Identifiers given in Tables 6.2 and 6.3 are compatible with CANaerospace revision 2.0. The parameter lists are subject to future amendments which will be reflected through the MDIU software revision returned by the CANaerospace Identification Service (IDS). The default SysNodeID and CANaerospace Identifier base (factory setting) of the MDIU with General Purpose Software is shown in Table 6.1.

Note: The serial interfaces (RS-232, RS-422, ARINC 429) are not served by the General Purpose Software and need customized application software. Contact info@stockflightsystems.com for details.

LRU	Default SysNodeID	Default CANaerospace Identifier Base (CIB)	Default Identifiers
MDIU	50	1500	1500 - 1511

Table 6.1: Default SysNodeID and CANaerospace Identifier Assignment (factory settings)

By default, the MDIU transmits the parameters shown in Table 6.2 at a rate of 50/s (every 20ms). The transmission rate may be changed individually for each signal using the Transmission Interval Service (refer to section 8.2of this document). The data in Table should be transmitted by commanding nodes only in case of changes in the data content, at a rate of 50/s (every 20ms) per parameter as a maximum. The default CAN baud rate (factory setting) of MDIU units is 1Mbit/s.

Parameter Name	Parameter Description	Node-ID	Direction (from MDIU)	CANaerospace Identifier	Data Type	Service Code
AIN0	Analog Input #0	SysNodeID	Transmitted	CIB + 0 (see Table 6.1)	FLOAT	Figure 6.1
AIN1	Analog Input #1	SysNodeID	Transmitted	CIB + 1 (see Table 6.1)	FLOAT	Figure 6.1
AIN2	Analog Input #2	SysNodeID	Transmitted	CIB + 2 (see Table 6.1)	FLOAT	Figure 6.1
AIN3	Analog Input #3	SysNodeID	Transmitted	CIB + 3 (see Table 6.1)	FLOAT	Figure 6.1
DIN	Discrete Inputs	SysNodeID	Transmitted	CIB + 4 (see Table 6.1)	BLONG	Figure 6.1
TC0	Thermocouple #0 Input	SysNodeID	Transmitted	CIB + 5 (see Table 6.1)	FLOAT	Figure 6.1
TC1	Thermocouple #1 Input	SysNodeID	Transmitted	CIB + 6 (see Table 6.1)	FLOAT	Figure 6.1
VRSIN	VRS Pulse Input Frequency	SysNodeID	Transmitted	CIB + 7 (see Table 6.1)	FLOAT	Figure 6.1
ODSIN	OD Pulse Input Frequency	SysNodeID	Transmitted	CIB + 8 (see Table 6.1)	FLOAT	Figure 6.1

Table 6.2: MDIU Transmitted Normal Operation Data

Parameter Name	Parameter Description	Node-ID	Direction (from µNECS)	CANaerospace Identifier	Data Type	Service Code
DOUT	Discrete Outputs	Any	Received	CIB + 9 (see Table 6.1)	BLONG	0
PWMOUT0	PWM/Motor Output #0	Any	Received	CIB + 10 (see Table 6.1)	USHORT2	0
PWMOUT1	PWM/Motor Output #1	Any	Received	CIB + 11 (see Table 6.1)	USHORT2	0

Table 6.3: MDIU Received Normal Operation Data

The parameter lists are subject to future amendments which will be reflected through the software revision returned by the CANaerospace Identification Service (IDS).

6.1 Normal Operation Data Format (MDIU Transmitted Messages)

Figure 6.1 shows the format of Normal Operation Data messages transmitted by the MDIU. The Service Code of these messages contains sensor and computation status information which may be used by receiving stations to act correspondingly. The message code is incremented for each transmission. Each parameter uses its own message code for this purpose.

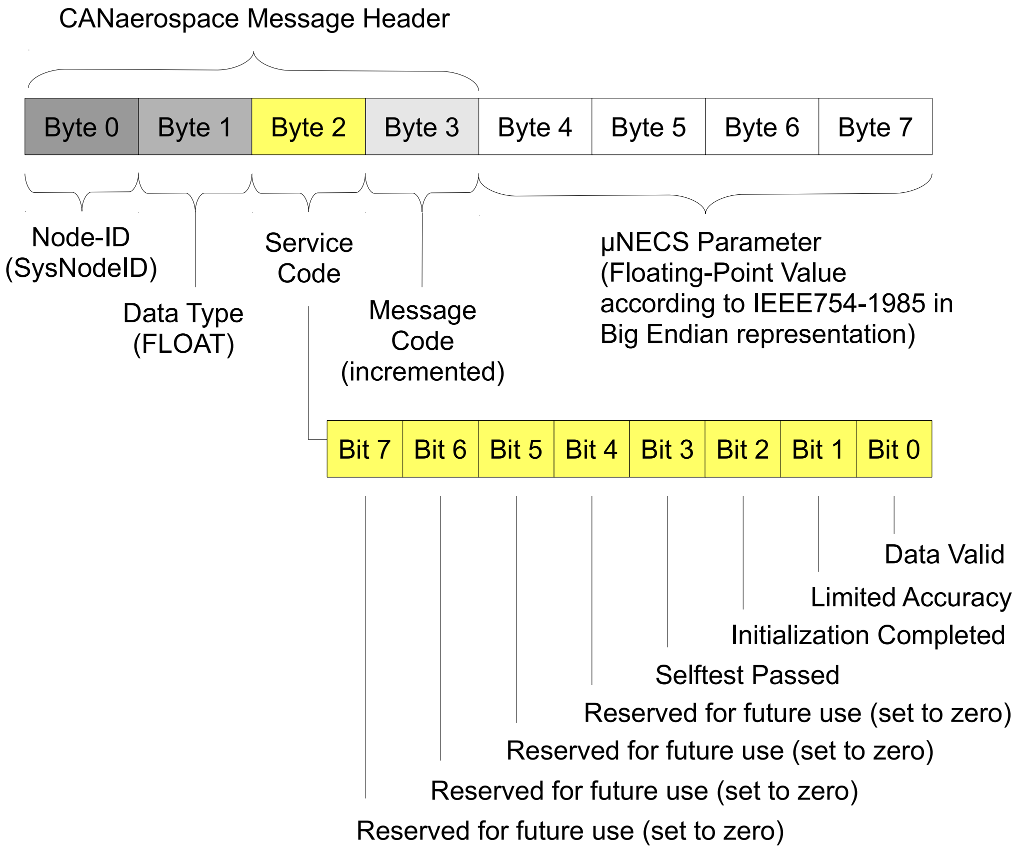

Figure 6.1: Normal Operation Data Format (MDIU Transmitted Messages)

6.2 Normal Operation Data Format (MDIU Received Messages)

Figure 6.2 shows the format of Normal Operation Data messages received by the MDIU. The data format and Service Code of these messages is described in section of this document. The message code is incremented for each transmission. Each parameter uses its own message code for this purpose.

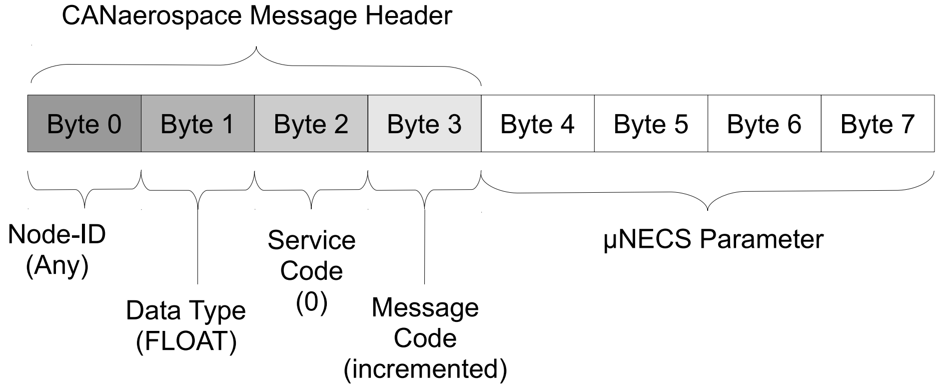

Figure 6.2: Normal Operation Data Format (MDIU Received Messages)

7 CANaerospace Periodic Node Health Status Message

Each MDIU transmits a CANaerospace Periodic Node Health Status Message (PHSM) once per second. This message allows to continuously determine the CANaerospace network health and performance, through processing of these messages from all nodes of a given network segment. The format of the PHSM is shown in Figure 7.1. The CANaerospace identifier on used for the transmission of the PHSM by a particular MDIU is based on the MDIU SysNodeID and calculated using the following equation:

PHSM CANaerospace Identifier = SysNodeID + 1900

Table 7.1 describes the message content of the PHSM.

Message Byte	Explanation
Service Code	CAN controller status bits as described in the Bosch CAN specification.
Byte 4/5	Unsigned 16-bit integer containing the accumulated CAN transmission errors of the node since the last power-on event.
Byte 6/7	Unsigned 16-bit integer containing the accumulated CAN receive errors of the node since the last power-on event.

Table 7.1: Periodic Health Status Message Content

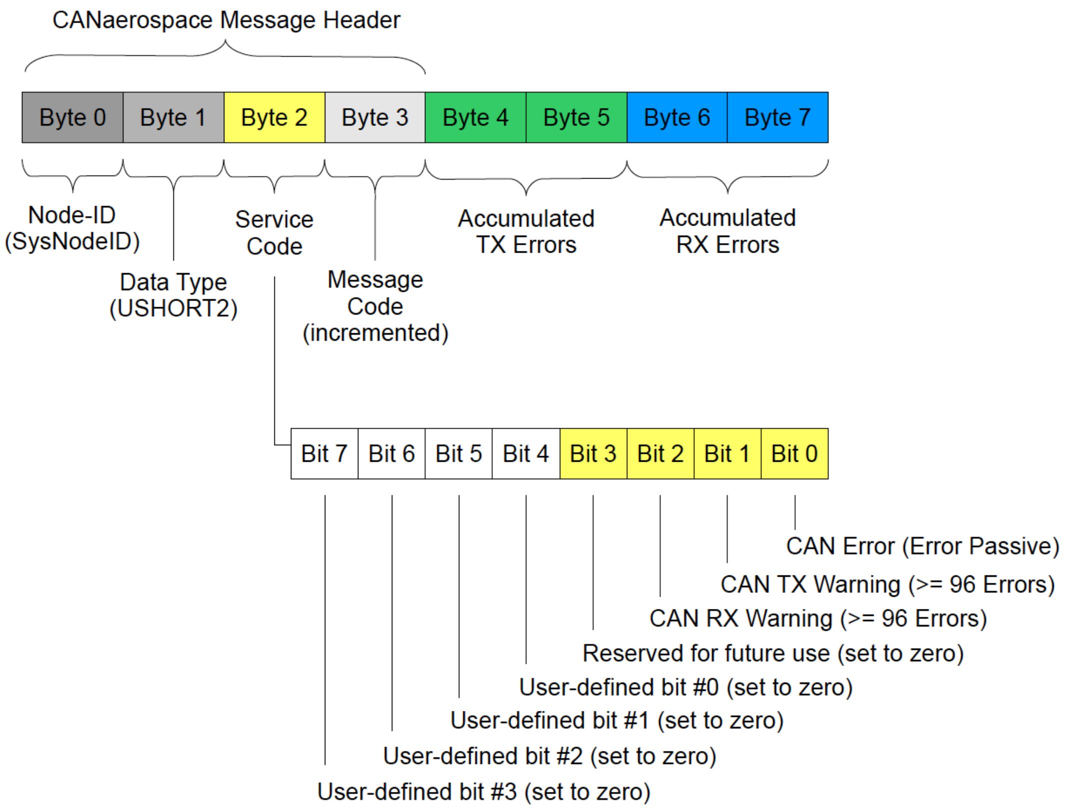

Figure 7.1: Periodic Node Health Status Message Format

Figure 7.2 shows the behavior of the CAN transmit/receive error counters.

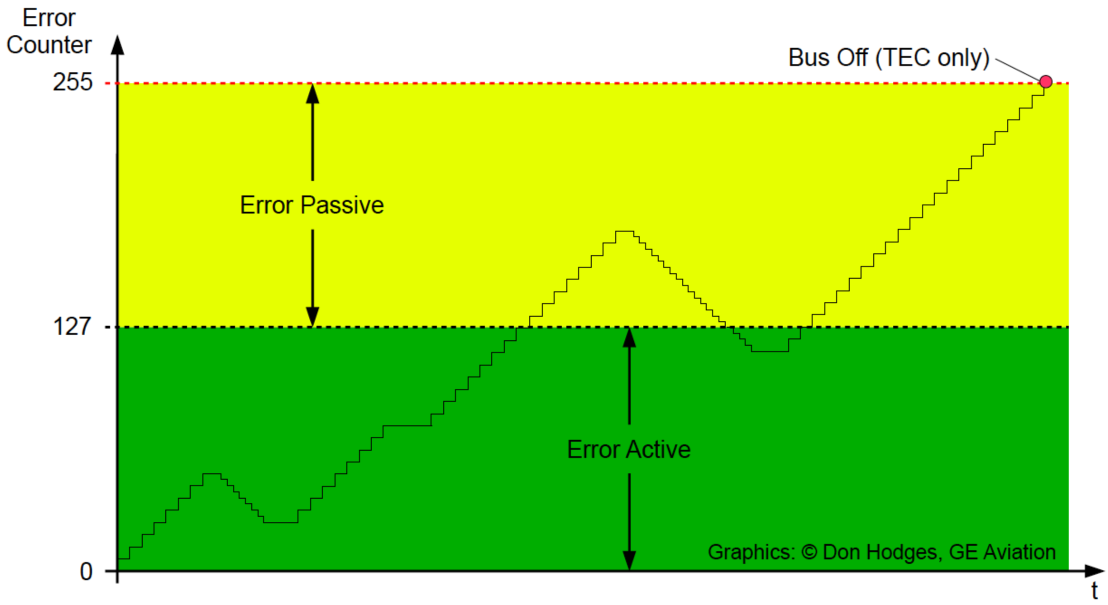

Figure 7.2: CAN Transmit/Receive Error Counters

8 Node Service Interface

Table 8.1 lists the CANaerospace Node Services supported by the µNECS. If a MDIU receives a service request with a node service code not listed in Table 8.1 or if it does not support a particular service for other reasons, it responds with the NS_UNKNOWN_SERVICE (-1) return code. The list of supported services is subject to future amendments which will be reflected through the software revision returned by IDS.

All Node Services are implemented on Node Service Channel 0 (Node Service Request CANaerospace identifier = 128, Node Service Response CANaerospace identifier = 129). The SysNodeID factory setting is 50. Node Services become effective immediately if the Node Service Response is NS_OK (0). The µNECS General Purpose Software responds to all Node Service Requests within 100ms after they have been received.

CANaerospace Node Service	Node Service Acronym	Node Service Code	Node Service Description
Identification Service	IDS	0	Returns the hardware/software revision, the CANaerospace identifier distribution scheme and the message header type of the addressed node.
Transmission Interval Service	TIS	5	Controls the transmission time interval of individual normal operation data messages in multiples of milliseconds. Using this service, the transmission of individual messages may also be turned off entirely by specifying a transmission interval of “0”.
FLASH Programming Service	FPS	6	Stores the settings made through the NIS, BSS, CSS and DSS services permanently into internal non-volatile memory.
State Transmission Service	STS	7	Causes those parameters of the addressed node which are normally transmitted on state change only to be transmitted once, for node synchronization purposes.
Baudrate Setting Service	BSS	10	Sets the CAN baud rate of the addressed node. Note that a baud rate change becomes effective only after the request has been received and processed by the addressed node and the corresponding node response has been transmitted.
Node-ID Setting Service	NIS	11	Changes the number used as the “own” SysNodeID of the addressed node for future node service requests. The SysNodeID is also transmitted in the corresponding byte of each normal operation data message for source identification.

CANaerospace Node Service	Node Service Acronym	Node Service Code	Node Service Description
CANaerospace Identifier Distribution Setting Service	DSS	15	Changes the CANaerospace identifier distribution code which is returned by the addressed node through IDS. The identifier distribution code allows interrogating nodes to determine if the normal operation data messages transmitted by the addressed node are compliant with the CANaerospace standard identifier distribution or if a modified identifier distribution is used.
CANaerospace Signal Identifier Setting Service	SIS	17	Changes the CANaerospace identifier for the normal operation data message associated with the specified signal of the addressed node. The signal number assignment and the default identifiers are listed in the LRU specific Interface Control Document.

Table 8.1: Supported CANaerospace Node Services

For those Node Services addressing a specific CANaerospace message (or signal) like TIS or CSS, Table 8.2 describes the signal number assignment for signal identification.

Parameter Name	Signal Number	Direction (seen from MDIU)
AIN0 (Analog Input #0)	0	Transmitted
AIN1 (Analog Input #1)	1	Transmitted
AIN2 (Analog Input #2)	2	Transmitted
AIN3 (Analog Input #3)	3	Transmitted
DIN (Discrete Inputs)	4	Transmitted
TCIN0 (Thermocouple Input #0)	5	Transmitted
TCIN1 (Thermocouple Input #1)	6	Transmitted
VRSIN (Variable Reluctance Speed Sensor Input)	7	Transmitted
ODSIN (Optically Decoupled Speed Sensor Input)	8	Transmitted
DOUT (Discrete Outputs)	9	Received
PWMOUT0 (PWM Output #0)	10	Received
PWMOUT1 (PWM Output #1)	11	Received

Table 8.2: MDIU Signal Number Assignment

8.1 Node Identification Service (IDS)

Message Data Byte	**Data Field Description**	**Node Service Request**	**Node Service Response**
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	NODATA (0)	UCHAR4 (16)
2	Service Code	IDS (0)	IDS (0)
3	Message Code	Standard Info (0)	NS_OK (0) NS_INVALID_MODE (-3) if request is not Standard Info
4-7	Message Data	n.a.	Standard Info: Byte 0 = Header Type (Standard = 0) Byte 1 = Identifier Distribution (Standard = 0) Byte 2 = 0 Byte 3 = 0

Table 8.3: Node Identification Service Format

8.2 Transmission Interval Service (TIS)

Message Data Byte	**Data Field Description**	**Node Service Request**	**Node Service Response**
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	USHORT (7)	NODATA (0)
2	Service Code	TIS (5)	TIS (5)
3	Message Code	Signal Number from LRU specific Interface Control Document.	NS_OK (0) NS_OUT_OF_RANGE (-6) if the requested transmission interval is not 0 (zero) or between 20 and 10000.
4-7	Message Data	Transmission Interval in milliseconds. Valid range: 50 to 10000. A value of 0 (zero) inhibits the transmission of the specified parameter.	n.a.

Table 8.4: Transmission Interval Service Format

8.3 FLASH Programming Service (FPS)

Message Data Byte	Data Field Description	Node Service Request	Node Service Response
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	NODATA (0)	NODATA (0)
2	Service Code	FPS (6)	FPS (6)
3	Message Code	Magic Number (123)	NS_OK (0) NS_INVALID_MODE (-3) if Magic Number is not 123.
4-7	Message Data	n.a.	n.a.

Table 8.5: FLASH Programming Service Format

8.4 State Transmission Service (STS)

Message Data Byte	Data Field Description	Node Service Request	Node Service Response
0	Node-ID	SysNodeID (1-199)	n.a.
1	Data Type	NODATA (0)	n.a.
2	Service Code	STS (7)	n.a.
3	Message Code	0	n.a.
4-7	Message Data	n.a.	n.a.

Table 8.6: State Transmission Service Format

8.5 Baudrate Setting Service (BSS)

Message Data Byte	Data Field Description	Node Service Request	Node Service Response
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	NODATA (0)	NODATA (0)
2	Service Code	BSS (10)	BSS (10)
3	Message Code	0 = 1 Mbit/s 1 = 500 kbit/s 2 = 250 kbit/s 3 = 125 kbit/s	NS_OK (0) NS_OUT_OF_RANGE (-6) if the CAN baud rate is not in the range of 0 to 3. Note that the response to this service will use the “old” Baudrate.
4-7	Message Data	n.a.	n.a.

Table 8.7: Baudrate Setting Service Format

8.6 Node-ID Setting Service (NIS)

Message Data Byte	Data Field Description	Node Service Request	Node Service Response
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	NODATA (0)	NODATA (0)
2	Service Code	NIS (11)	NIS (11)
3	Message Code	New SysNodeID, where: 0 < New SysNodeID < 200	NS_OK (0) NS_OUT_OF_RANGE (-6) if the new SysNodeID is out of the range of 1 to 199. NS_OVERLAPPING (-11) if the specified SysNodeID is already in use by one of the other CLS nodes. Note that the response to this service will use the “old” SysNodeID.
4-7	Message Data	n.a.	n.a.

Table 8.8: Node-ID Setting Service Format

8.7 CANaerospace Signal Identifier Setting Service (SIS)

Message Data Byte	Data Field Description	Node Service Request	Node Service Response
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	ULONG (4)	NODATA (0)
2	Service Code	CSS (14)	CSS (14)
3	Message Code	Signal Number from LRU specific Interface Control Document	NS_OK (0) NS_OUT_OF_RANGE (-6) if the specified CANaerospace Identifier is out of the range of 200 to 1899.
4-7	Message Data	CANaerospace Identifier (32bit unsigned integer value)	n.a.

Table 8.9: CANaerospace Signal Identifier Setting Service Format

8.8 CANaerospace Identifier Distribution Setting Service (DSS)

Message Data Byte	Data Field Description	Node Service Request	Node Service Response
0	Node-ID	SysNodeID (1-199)	SysNodeID (1-199)
1	Data Type	NODATA (0)	NODATA (0)
2	Service Code	DSS (15)	DSS (15)
3	Message Code	0 = Default CANaerospace Identifier Distribution Code 1 -240: User-defined CANaerospace Identifier Distribution Codes	NS_OK (0) NS_OUT_OF_RANGE (-6) if the specified Identifier Distribution Code is out of the range of 0 to 240.
4-7	Message Data	n.a.	n.a.

Table 8.10: CANaerospace Identifier Distribution Setting Service Format