FIELDBUS APPENDIX

DEVICENET

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Fieldbus Appendix: DeviceNet

1 Fieldbus Introduction

This section provides information about the DeviceNet organization and network.

1.1 Introduction to DeviceNet

DeviceNet is used for industrial automation, normally for the control of valves, sensors and I/O units and other automation equipment. The DeviceNet communication link is based on a broadcast-oriented, communications protocol, the Controller Area Network (CAN). This protocol has I/O response and high reliability even for demanding applications, e.g., control of brakes.

DeviceNet has a user organization, the Open DeviceNet Vendor Association (ODVA) that assists members of matters concerning DeviceNet.

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1.2 Network Overview

The media for the fieldbus is a shielded copper cable composed of one twisted pair and two cables for the external power supply. The baud rate can be changed between 125k, 250k and 500kbit/s, this can be done in three different ways. First is simply by the DIP switch, second via the fieldbus and third is auto baud rate setting.

Several different DeviceNet Scanners are available on the market, both for PLC-systems and PC computers.

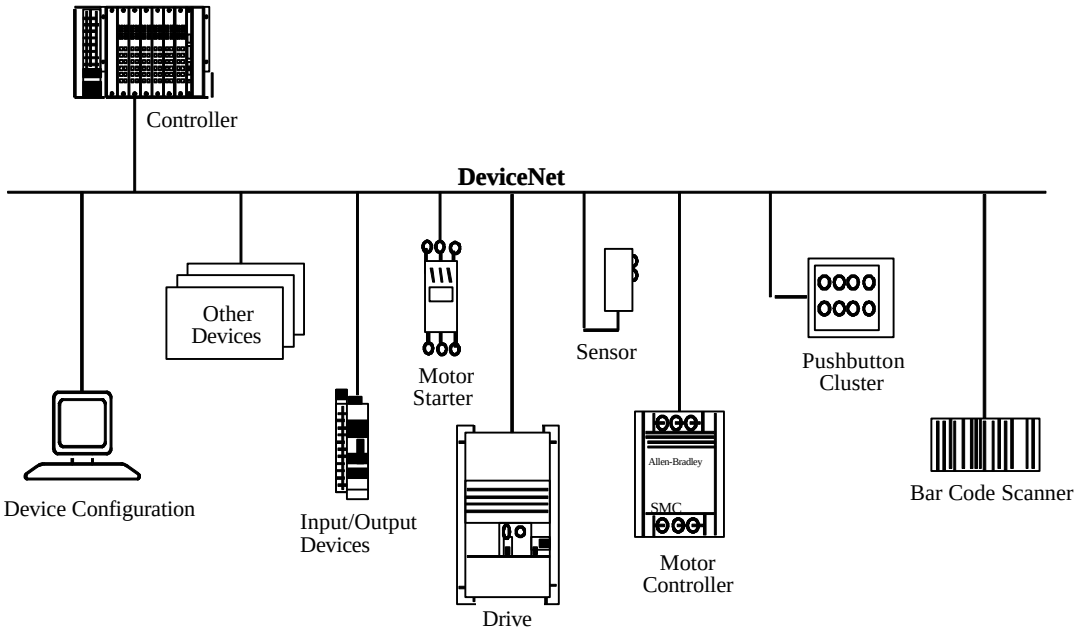
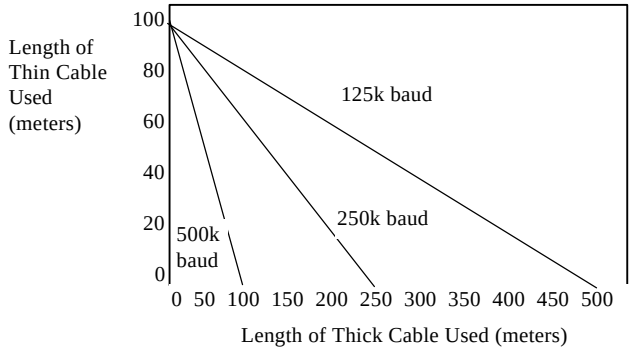


Figure 1: DeviceNet overview

1.3 Technical Features for DeviceNet



$L_{thick} + 5 \times L_{thin} = 500$ at 125Kbaud
$L_{thick} + 2.5 \times L_{thin} = 250$ at 250Kbaud
$L_{thick} + L_{thin} = 100$ at 500Kbaud

where L_{thick} is the length of thick cable and Lthin is the length of thin cable.

Figure 2: Maximum cable length for DeviceNet network

Summary Technical Features DeviceNet	
• DeviceNet specific cable (twisted pair) • Access to intelligence present in low-level devices -Master/Slave and Peer-to-Peer capabilities • Trunkline-dropline configuration • Support for up to 64 nodes • Node removal without severing the network • Simultaneous support for both network-powered (sensors) and self-powered (actuators) devices • Use of sealed or open-style connectors • Protection from wiring errors • Selectable data rates of 125k baud, 250k baud, and 500k baud. Max. Trunk distance 500 meters and Drop length 156 meters at 125k baud • Adjustable power configuration to meet individual application needs	• High current capability (up to 16 amps per supply) • Operation with off-the-shelf power supplies • Power taps that allow the connection of several power supplies from multiple vendor that comply with DeviceNet standards • Built-in overload protection • Power available along the bus: both signal and power lines contained in the trunkline • Provisions for the typical request/response oriented network communications • Provisions for the efficient movement of I/O data • Fragmentation for moving larger bodies of information • Duplicate MAC ID detection

Table 1: Technical features for DeviceNet

2 Module Overview

This section provides an overview over the DeviceNet Communications Adapter module.

2.1 Mechanical Overview

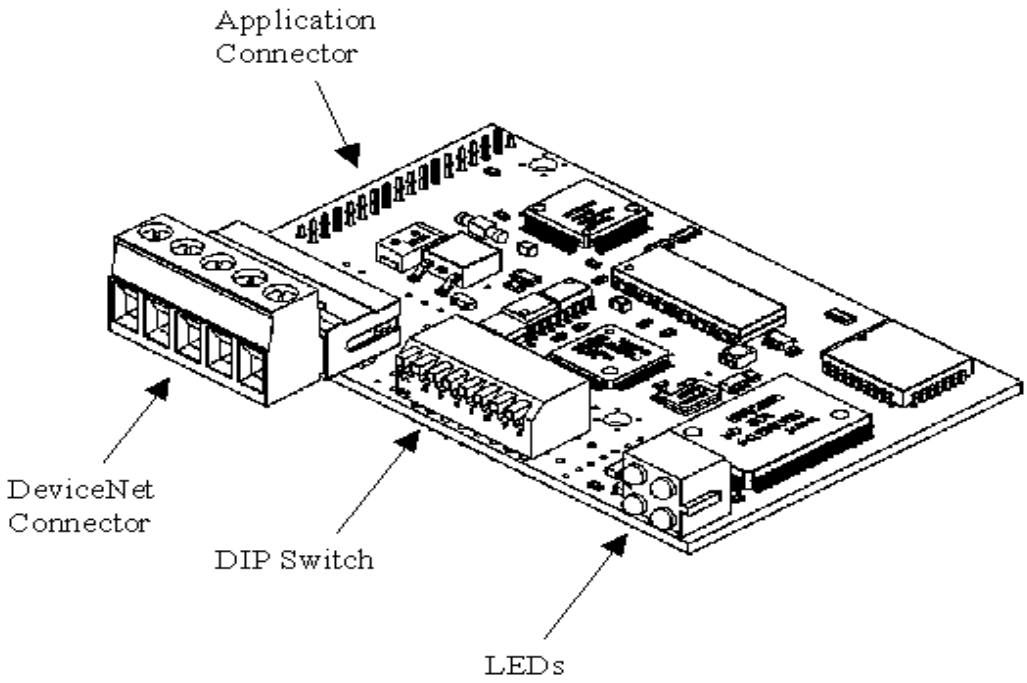


Figure 3. Mechanical overview

The DeviceNet Adapter is implemented according to the ODVA specification for a Communication adapter (profile no 12). It is acting as a “group two only server” on the DeviceNet network.

Connections supported:

1 Explicit

1 Polled I/O

1 Bit-Strobed I/O

1 Change of state/Cyclic I/O

Baud rate and Mac ID can be set either by a DipSwitch or via a mailbox command through the dual port RAM memory (DPRAM).

2.2 Data Exchange

Only compatible with other Profibus DP & DeviceNet Communications Adapter modules.

2.3 Application Interface

This section describes the two access methods available from the application side between the DeviceNet Adapter module and the application.

- Parallel: Through a Dual Port RAM memory (DPRAM).
- Serial: Through an asynchronous interface

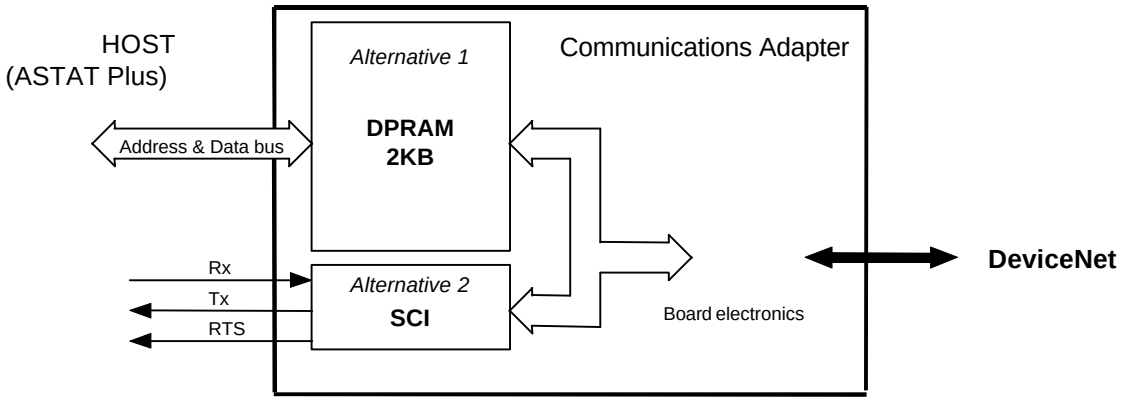


Figure 4. Communications board Access methods

3 Installation & Configuration

3.1 Fieldbus Connectors

The table below shows the pin function of the fieldbus connectors.

Pluggable connector	Screw Terminal	Description
1	1	V-
2	2	CAN_L
3	3	SHIELD
4	4	CAN_H
5	5	V+

Description of fieldbus connectors

3.2 Configuration

In a DeviceNet network, each node in the network has a Mac ID (the address in the network). The Mac ID is a number between 0 and 63. Each node's Mac ID has to be unique, since it is used to address the node. In a DeviceNet network it is also possible to configure the Baud rate, the following baud rates is possible to use in a network: 125, 250 and 500 kbit / sec. All nodes in the network have to communicate with the same baud rate.

On the DeviceNet Adapter module it is possible to set the Mac ID and the Baud rate with a physical DIP-switch mounted on the module. If the DeviceNet Communications Adapter module mounted inside a product it can be hard to reach the physical DIP-switch, in this case it can be useful to set the Mac ID and Baud rate with a mailbox message. Dip 1 and 2 are used to configure the Baud rate and dips 3 to 8 are used to configure the node address (Mac ID). Dip 1 is the most significant bit on the dipswitch.

If a customer wants to change the bit definitions of the DIP-switch to follow the DeviceNet specification that the high bit always should be at top. They can use the mailbox messages Get_Dipswitch and Set_Dipswitch to change the meaning of the value of the DIP-switch (e.g. if the module is mounted vertically in a product).

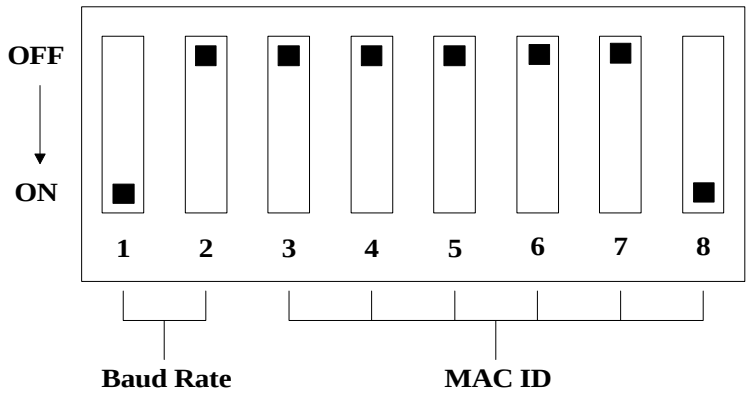


Figure 5. DIP-switch

3.2.1 Baud rate

There are three different Baud rates for DeviceNet 125k, 250k, 500kbit/s. Choose one of them by setting the DIP-switch as shown before starting configuring the module.

Baudrate bit/sec	DIP 1-2
125k	00
250k	01
500k	10
Reserved	11

Baudrate settings

3.2.2 Mac ID

To set the node address (Mac ID) use the DIP-switches 3 to 8 to configure the node address, dip 3 is the most significant bit and dip 8 is the least significant bit.

Address	DIP 3-8
0	000000
1	000001
2	000010
3	000011
...	...
62	111110
63	111111

Mac ID settings

3.3 Indications

The module is equipped with four LED's mounted at the front and one LED on the board, used for debugging purposes. The front LED's can be mounted in two ways, either top mounted or angle mounted. The functions of the LED's are described in the table and figure below.

1. Reserved
2. Network Status
3. Module Network Status
4. Reserved

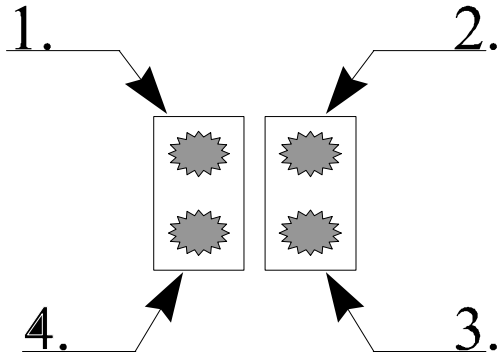


Figure 6. Adapter LED´s, angle mounted

There is also one additional Bicolor Watchdog LED on the Adapter module. The functionality of this LED is the same for all modules, and is specified in the Communications Adapter manual.

Of the four LED's at the front of the module, two of them are indicating net and module status, and the other two are reserved for future usage.

Module errors are indicated with the Module status LED and NetWork status LED.

LED's	Description
Module _Status, steady off:	No Power
Module _Status, steady red:	Unrecoverable fault
Module _Status, steady green:	Device Operational
Module _Status, flashing red:	Minor fault
NetWork _Status, steady off:	Not Powered/Not on line
NetWork _Status, steady green:	Link OK on line, Connected
NetWork _Status, steady red:	Critical Link failure
NetWork _Status, flashing green:	On line not connected
NetWork _Status, flashing red:	Connection Time Out

3.4 Termination

Termination of the fieldbus requires a terminating resistor at each end of the fieldbus. These resistors should have a value of 121 Ω.

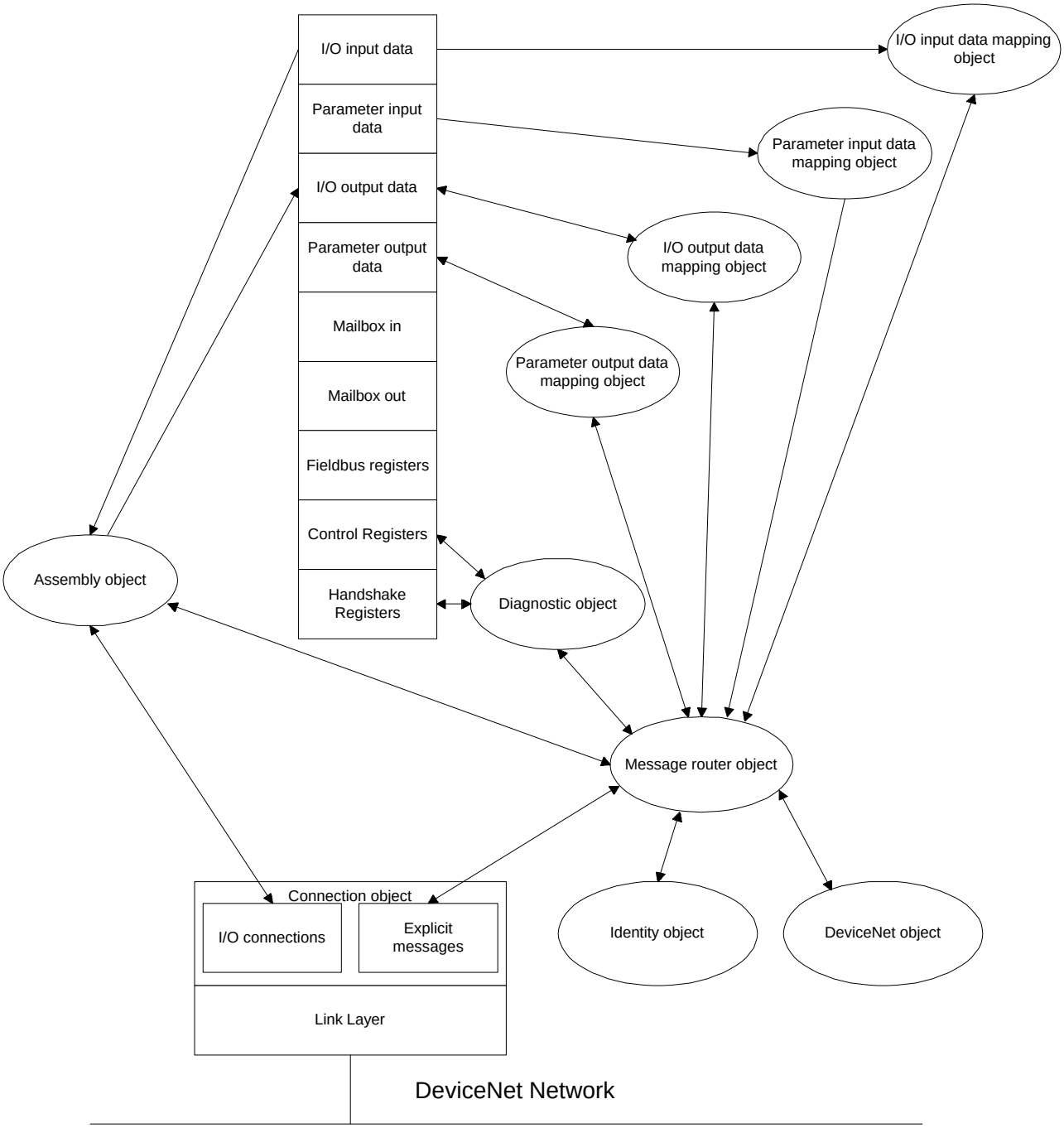
3.5 EDS file

Each device in a DeviceNet network is associated with an EDS file, containing all necessary information about the device. The network configuration program uses this file during configuration of the network.

4 Functions & Operation

4.1 DPRAM Structure of the DeviceNet Module

The interface from the fieldbus against the module is based on the standard DeviceNet objects and five vendor specific objects. Most applications do not require the usage of the vendor specific objects. The vendor specific objects can be used to access different areas in the DPRAM and for diagnostic during development.



4.2 IN/OUT area

The I/O in/out data is read/written through I/O connections or Explicit messages from the assembly object.

4.2.1 Fieldbus Specific Area

The fieldbus specific area in the module DeviceNet is read only from the application and is located from address 0x640 in the DPRAM. The information that can be read from the area is specified below.

Address	*Memory Area*	*Description*
640h - 645h, 647h	Fieldbus specific OUT	Fieldbus specific output data Application ⇐ Adapter module
646h, 648h - 7BFh	Reserved	Reserved for future use

4.2.2 Identity status attribute

The net mode byte gives information about in which state the module is, after initialization.

Address:	0x640
Size:	2 byte
Type:	Byte
Range:	0-16 bit information
Scaling:	-
Unit:	-
Initial value:	-

4.2.3 Connection status

This is the actual status of each connection in the module.

Address:	0x642-0x645
Size:	1 byte
Type:	Byte
Range:	{00, 01, 03, 04, 05}
Scaling:	-
Unit:	-
Initial value:	-

Explicit Connection 0x642

Polled I/O Connection 0x643

Bitstrobed Connection 0x644

Change of state/Cyclic Connection 0x645

Possible values of the different connection registers are:

00 = Nonexistent

01 = Configuring

03 = Established

04 = Timed out

05 = Defferred delete

4.2.4 Master Status

This is the status of the master in the network.

Address:	0x647
Size:	1 byte
Type:	Byte
Range:	{01, 02}
Scaling:	-
Unit:	-
Initial value:	00

Possible values are:

01 = Master is Running

02 = Master is Idle

4.3 Control Registers

Address	Size (words)	Name	Description
21E0h	1	Bootloader version	The version of the bootloader in the module
21E1h-21E2h	3	-	Not used
21E3h-21E4h	2	Module serial number	Unique module serial number
21E5h	1	Vendor ID	Manufacturer ID number (HMS, other)
21E6h	1	Fieldbus type	Fieldbus type identifier
21E7h	1	Module software version	Software version
21E8h	1	ComMode	The bitrate and timeout time used by the serial interface.
21E9h	1	Slow data priority	The priority level for Parameter data and Mailbox messages.
21Eah	1	Heartbeat min. time	The minimum time between two heartbeat messages.
21EBh-21EFh	5	-	Not used
21F0h	1	Module type	Module type (Adapter, Master, other)
21F1h	1	Module status	Bit information, Freeze, clear, etc.
21F2h-21F7h	6	-	Not used
21F8h	1	IN I/O length	Size of I/O IN data (bytes)
21F9h	1	-	Not used
21FAh	1	IN total length	Total number of IN bytes supported
21FBh	1	OUT I/O length	Size of I/O OUT data (bytes)
21FCh	1	-	Not used
21FDh	1	OUT total length	Total number of OUT bytes supported
21FEh	1	Reserved	Reserved for future 16-bit compatibility

Table: Control register area memory map, 62 bytes

5 Fieldbus Specific Object List

The following objects are included in the module:

DeviceNet objects

- Identity object Class 0x01
- Message router Class 0x02
- DeviceNet object Class 0x03
- Assembly object Class 0x04
- Connection object Class 0x05
- Acknowledge Handler Object Class 0x43

Vendor specific objects

- I/O data Input Mapping Object Class 0xA0
- I/O data Output Mapping Object Class 0xA1
- Diagnostic Object Class 0xAA
- Parameter data Input Mapping Object Class 0xB0
- Parameter data Output Mapping Object Class 0xB1

5.1 Identity Object, Class 0x01

Class Attributes

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Revision	Get_Attribute_Single	Revision of the Identity Object.	The Revision attribute, which consists of Major and Minor.	1, 1, 1	UINT

Instance Attributes

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Vendor Id	Get_Attribute_Single	Identification of each vender by number	Vender IDs are managed by ODVA. The value zero is not valid	90, 90, 90	UINT
2	Device Type	Get_Attribute_Single	Indication of the general type of product	The list of device types is managed by ODVA. It is used to identify the device profile that a particular product is using. Device profiles define minimum requirements a device must implement as well as common options.	12, 12, 12	UINT
3	Product Code	Get_Attribute_Single	This is a code assigned by the vendor to describe the device	The vendor assigned Product Code identifies a particular product within a device type. Each vendor assigns this code to each of its products. The Product Code typically maps to one or more catalog/model numbers. Products shall have different codes if their configuration and/or runtime options are different. Such devices present a different logical view to the network.	12, 12, 12	UINT
4	Revision	Get_Attribute_Single	Revision of the item the Identity Object represents	The Revision attribute, which consists of Major and Minor Revisions, identifies the Revision of the item the Identity Object is representing. The value zero is not valid for either the Major and Minor Revision fields. The Major and Minor Revision are typically displayed as major.minor. Minor revisions shall be displayed as three digits with leading zeros as necessary. The Major Revision attribute is limited to 7 bits. The eighth bit is reserved by DeviceNet and must have a default value of zero.	{1,1}, {1,1}, {1,1}	Array of: USINT USINT
5	Status	Get_Attribute_Single	Summary Status of the Device	This attribute represents the current status of the entire device. Its value changes as the state of the device changes.	0, 0, 255	WORD
6	Serial Number	Get_Attribute_Single	Serial Number of the device	This attribute is a number used in conjunction with the Vendor ID to form a unique identifier for each device on DeviceNet. Each vendor is responsible for guaranteeing the uniqueness of the serial number across all of its devices.	N/A, N/A, N/A	UDINT
7	Product Name	Get_Attribute_Single	Human readable identification	This text string should represent a short description of the product/product family represented by the product code in attribute 3.	" ANYBUS-S DNET ", " ANYBUS-S DNET ", "ANYBUS-S DNET"	SHORT_STRING
9	Config.Consist. Value	Get_Attribute_Single	Contents identify configuration of device	A product may automatically modify the Configuration Consistency Value whenever any non-volatile attribute is altered. The client node's behaviour, upon detection of a mismatch, is vendor specific.	N/A, N/A, N/A	UINT

5.2 Message router, Class 0x02

Class Attributes (0)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Revision	Get_Attribute_Single	Revision of the Identity Object.	The Revision attribute, which consists of Major and Minor.	1, 1, 1	UINT

5.3 DeviceNet Object, Class 0x03

Class Attributes(0)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Revision	Get_Attribute_Single	Revision of the DeviceNet Object Class Definition upon which the implementation is based	The current value assigned to this attribute is two (2). If updates which require an increase in this value are made, then the value will be increased. Support of this attribute is required.	2, 2, 2	UINT

Instance Attributes (1)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	MAC ID	Get_Attribute_Single	Node Address.	This attribute contains the MAC ID of this device. The range of values is 0 to 63 decimal. A device that uses switches to set the MAC ID must return an Error Response whose General Error Code is set to 0E (Attribute not settable) in response to a Set_Attribute_Single Request specifying the MAC ID attribute. The exception to this rule is that if the MAC ID switches are not user accessible when the product is installed, then the switch settings can be overridden via a Set_Attribute_Single. The MAC ID attribute is considered non–volatile in that once configured the attribute must be remembered after a power cycle or device reset. If a device does not know what its MAC ID is it should default to 63. The modification of the MAC ID requires a device to delete all Connection Objects and re-execute the Network Access State Machine defined in Chapter 6.	DIPSWITCH, 0, 63	USINT
2	Baud Rate	Get_Attribute_Single	The baud rate of the device	The Baud Rate attribute indicates the selected baud rate. Values are 00 - 125K 01 - 250K 02 - 500K	DIPSWITCH, 0, 2	USINT
5	Allocation Information	Get_Attribute_Single	Allocation Choice Master's Mac ID	Struct of: BYTE: Allocation Choice USINT: Master's Mac ID	N/A, N/A, N/A	Struct of: BYTE USINT

5.4 Assembly Object, Class 0x04

Class Attributes

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Revision	Get_Attribute_All	Revision of the Assembly Object.	The revision attribute, which contains the object revision.	1, 1, 1	UINT

DPRAM INPUT AREA, Instance 0x64

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x03	Data	Get_Attribute_Single	The data is produced from I/O I/O data input object, attribute 1. Default is the data configured as I/O input data in the init command of the module. This can be overwritten by mailbox telegrams during initialisation.		N/A,N/A, N/A	Array of USINT

*Note: If the I/O input data size is set to 0 this instance will NOT be initialised.

DPRAM INPUT AREA, Instance 0x65-0x69

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x03	Data	Get_Attribute_Single	The data is produced from I/O I/O data input object, attribute 2-5. Those instances can only be configured by mailbox telegrams during initialisation.		N/A,N/A, N/A	Array of USINT

*Note: If the I/O input data size is set to 0 the instance will NOT be initialised.

DPRAM OUTPUT AREA, Instance 0x96

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x03	Data	Get_Attribute_Single Set_Attribute_Single	The data is produced from I/O data output object, attribute 1.Default is the data configured as I/O output data in the init command of the module. This can be overwritten by mailbox telegrams during initialisation.		N/A,N/A, N/A	Array of USINT

*Note: If the I/O output data size is set to 0 this instance will NOT be initialised.

DPRAM INPUT AREA, Instance 0x97-0x9A

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x03	Data	Get_Attribute_Single	The data is produced from I/O data output object, attribute 2-4.Those instances can only be configured by mailbox telegrams during initialisation.		N/A,N/A, N/A	Array of USINT

*Note: If the I/O input data size is set to 0 the instance will NOT be initialised.

5.5 DeviceNet Connection Object (5)

Class Attributes (0)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Revision	Get_Attribute_Single	Revision of the DeviceNet Object		2, 2, 2	UINT

Explicit Connection Instance (1)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	State	Get_Attribute_Single	State of the object	0=Nonexistent 1=Configuring 3=Established 4=Timed out 5=Defferred delete	1, 0, 5	USINT
2	Instance Type	Get_Attribute_Single	Indicates either IO or messaging connection		0, 0, 0	USINT
3	Transport Class Trigger	Get_Attribute_Single, Set_Attribute_Single	Defines Behaviour of the connection		0x83, 0x83, 0x83	BYTE
4	Produced Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	Placed in CAN Identifier Field when the Connection Transmits		N/A, N/A, N/A	UINT
5	Consumed Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	CAN Identifier Field value that denotes message to be received		N/A, N/A, N/A	UINT
6	Inital Comm Characteristics	Get_Attribute_Single, Set_Attribute_Single	Defines the Message Group(s) across which productions and consumptions associated with this		N/A, N/A, N/A	BYTE
7	Produced Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes transmitted across this Connection	512	512, 512, 512	UINT
8	Consumed Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes received across this Connection	512	512, 512, 512	UINT
9	Expected Packet Rate	Get_Attribute_Single, Set_Attribute_Single	Defines timing associated with this Connection	Resolution is 10 ms	N/A, N/A, N/A	UINT
12	Watchdog Timeout Action	Get_Attribute_Single, Set_Attribute_Single	Defines how to handle Inactivity/Watchdog timeouts	0-Transition to time out 1-Auto Delete 2-Auto Reset 3-Defered Delete	N/A, N/A, N/A	USINT
13	Produced Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the produced_connection_path length attribute		0, 0, 0	UINT
14	Produced Connection Path	Get_Attribute_Single, Set_Attribute_Single	Application Obj. producing data on this connection		0, 0, 0	ARRAY OF: USINT
15	Consumed Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the consumed_connection_path length attribute		0, 0, 0	UINT
16	Consumed Connection Path	Get_Attribute_Single, Set_Attribute_Single	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object		N/A, N/A, N/A	ARRAY OF: 01 UINT

Polled IO Connection Instance (2)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	State	Get_Attribute_Single	State of the object	0=Nonexistent 1=Configuring 3=Established 4=Timed out	1,0, 4	USINT
2	Instance Type	Get_Attribute_Single	Indicates either IO or messaging connection		0, 0, 1	USINT
3	Transport Class Trigger	Get_Attribute_Single, Set_Attribute_Single	Defines Behavior of the connection		N/A, N/A, N/A	BYTE
4	Produced Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	Placed in CAN Identifier Field when the Connection Transmits		N/A, N/A, N/A	UINT
5	Consumed Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	CAN Identifier Field value that denotes message to be received		N/A, N/A, N/A	UINT
6	Initial Comm Characteristics	Get_Attribute_Single, Set_Attribute_Single	Defines the Message Group(s) across which productions and consumptions associated with this		N/A, N/A, N/A	BYTE
7	Produced Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes transmitted across this Connection		I/O in length, 0, I/O in length	UINT
8	Consumed Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes received across this Connection		I/O out length, 0, I/O out length	UINT
9	Expected Packet Rate	Get_Attribute_Single, Set_Attribute_Single	Defines timing associated with this Connection		N/A, N/A, N/A	UINT
12	Watchdog Timeout Action	Get_Attribute_Single, Set_Attribute_Single	Defines how to handle Inactivity/Watchdog timeouts	0-Transition to time out 1-Auto Delete 2-Auto Reset 3-Defered Delete	N/A, N/A, N/A	USINT
13	Produced Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the produced_connection_path length attribute		6, 6, 6	UINT
14	Produced Connection Path	Get_Attribute_Single, Set_Attribute_Single	Application Obj. producing data on this connection		20 04 24 64 30 03, N/A, N/A	ARRAY OF: USINT
15	Consumed Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the consumed_connection_path length attribute		6, 6, 6	UINT
16	Consumed Connection Path	Get_Attribute_Single, Set_Attribute_Single	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object		20 04 24 96 30 03, N/A, N/A	ARRAY OF: UINT

Bit-Strobe Connection Instance (3)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	State	Get_Attribute_Single	State of the object	0=Nonexistent 1=Configuring 3=Established 4=Timed out	1, N/A, N/A	USINT
2	Instance Type	Get_Attribute_Single	Indicates either IO or messaging connection		1, 0, 1	USINT
3	Transport Class Trigger	Get_Attribute_Single, Set_Attribute_Single	Defines Behaviour of the connection		N/A, N/A, N/A	BYTE
4	Produced Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	Placed in CAN Identifier Field when the Connection Transmits		N/A, N/A, N/A	UINT
5	Consumed Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	CAN Identifier Field value that denotes message to be received		N/A, N/A, N/A	UINT
6	Initial Comm Characteristics	Get_Attribute_Single, Set_Attribute_Single	Defines the Message Group(s) across which productions and consumptions associated with this		N/A, N/A, N/A	BYTE
7	Produced Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes transmitted across this Connection		N/A, N/A, N/A	UINT
8	Consumed Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes received across this Connection		8, 8, 8	UINT
9	Expected Packet Rate	Get_Attribute_Single, Set_Attribute_Single	Defines timing associated with this Connection		0, 0, 0xffff	UINT
12	Watchdog Timeout Action	Get_Attribute_Single, Set_Attribute_Single	Defines how to handle Inactivity/Watchdog timeouts	0-Transition to time out 1-Auto Delete 2-Auto Reset 3-Defered Delete	N/A, N/A, N/A	USINT
13	Produced Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the produced_connection_path length attribute		6, 6, 6	UINT
14	Produced Connection Path	Get_Attribute_Single, Set_Attribute_Single	Application Obj. producing data on this connection		20 04 24 65 30 03, N/A, N/A	ARRAY OF: USINT
15	Consumed Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the consumed_connection_path length attribute		6, 6, 6	UINT
16	Consumed Connection Path	Get_Attribute_Single, Set_Attribute_Single	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object		20 04 24 97 30 03, N/A, N/A	ARRAY OF: UINT

Change of state/Cyclic (4) (Acknowledged)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	State	Get_Attribute_Single	State of the object	0=Nonexistent 1=Configuring 3=Established 4=Timed out	1, N/A, N/A	USINT
2	Instance Type	Get_Attribute_Single	Indicates either IO or messaging connection		1, 0, 1	USINT
3	Transport Class Trigger	Get_Attribute_Single, Set_Attribute_Single	Defines Behaviour of the connection		N/A, N/A, N/A	BYTE
4	Produced Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	Placed in CAN Identifier Field when the Connection Transmits		N/A, N/A, N/A	UINT
5	Consumed Cnxn Id	Get_Attribute_Single, Set_Attribute_Single	CAN Identifier Field value that denotes message to be received		N/A, N/A, N/A	UINT
6	Initial Comm Characteristics	Get_Attribute_Single, Set_Attribute_Single	Defines the Message Group(s) across which productions and consumptions associated with this		N/A, N/A, N/A	BYTE
7	Produced Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes transmitted across this Connection		0, 0, N/A	UINT
8	Consumed Connection Size	Get_Attribute_Single, Set_Attribute_Single	Maximum number of bytes received across this Connection		0, 0, N/A	UINT
9	Expected Packet Rate	Get_Attribute_Single, Set_Attribute_Single	Defines timing associated with this Connection		0, 0, 0xffff	UINT
12	Watchdog Timeout Action	Get_Attribute_Single, Set_Attribute_Single	Defines how to handle Inactivity/Watchdog timeouts	0-Transition to time out 1-Auto Delete 2-Auto Reset 3-Defered Delete	N/A, N/A, N/A	USINT
13	Produced Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the produced_connection_path length attribute		0, 0, 6	UINT
14	Produced Connection Path	Get_Attribute_Single, Set_Attribute_Single	Application Obj. producing data on this connection		20 66 24 01 30 03, 0, N/A	ARRAY OF: USINT
15	Consumed Connection Path Length	Get_Attribute_Single, Set_Attribute_Single	Number of bytes in the consumed_connection_path length attribute		4, 4, 4	UINT
16	Consumed Connection Path	Get_Attribute_Single, Set_Attribute_Single	Specifies the Application Object(s) that are to receive the data consumed by this Connection Object		20 2B 24 01, 20 2B 24 01, 20 2B 24 01	ARRAY OF: UINT

5.6 Acknowledge Handler Object (0x43)

Class Attributes (0)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Revision	Get_Attribute_Single	Revision of the DeviceNet Object Class Definition upon which the implementation is based	The current value assigned to this attribute is two (2). If updates, which require an increase in this value, are made, then the value will be increased. Support of this attribute is required.	1, 1, 1	UINT
2	Max Instance	Get_Attribute_Single	Maximum instance number of an object currently created in this class level of the device.	The largest instance number of a created object at this class hierarchy level.		UINT

Instance Attributes (1)

#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
1	Acknowledge Timer	Get_Attribute_Single, Set_Attribute_Single	Time to wait for acknowledge before resending	Range 1-65535 ms(0 invalid) default=16	16,1,65535	UINT
2	Retry Limit	Get_Attribute_Single, Set_Attribute_Single	Number of Ack Timeouts to wait before informing the producing application of a Retry-Limit_Reached event.	Range 0-255 default.	1,0,255	USINT
3	COS Producing Connection Instance	Get_Attribute_Single, Set_Attribute_Single	Connection Instance which contains the path of the producing I/O application object a which will be notified of Ack Handler events.	Connection instance Id	N/A	UINT
4	Ack List Size	Get_Attribute_Single	Maximum number of members in Ack List	0=Dynamic >0 Max number of members	N/A	BYTE
5	Ack List	Get_Attribute_Single	List of active connection instances, which are receiving Acks.	Number of members followed by list of: Connection Instance ID	N/A	BYTE Array of USINT
6	Data with Ack Path List Size	Get_Attribute_Single	Maximum number of members in Data with Ack Path List.	0=Dynamic >0 Max number of members	N/A	BYTE
7	Data with Ack Path List	Get_Attribute_Single	List of connection instance/consuming application object pairs. This attribute is used to forward data received with acknowledgment.	List of connection instance/consuming application object pairs. This attribute is used to forward data received with acknowledgments	N/A	BYTE Array of UINT USINT Array of USINT

5.7 I/O data Input Mapping Object, Class 0xA0

Class Attributes

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Revision	Get_Attribute_All	Revision of the Parameter data input object.	The revision attribute, which contains the object revision.	1, 1, 1	UINT

Instance Attributes, Instance 0x01

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Data	Get_Attribute_Single	Data that is read	In bytes	N/A	Array of USINT
0x02	Data	Get_Attribute_Single	Data that is read	In bytes	N/A	Array of USINT
…	…	…	…	…	…	…
0x5	Data	Get_Attribute_Single	Data that is read	In bytes	N/A	Array of USINT

Please note: Which attributes that exist are depending on which attributes that are initialised from the DPRAM during initialisation.

5.8 I/O data Output Mapping Object, Class 0xA1

Class Attributes

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Revision	Get_Attribute_All	Revision of the Parameter data output object.	The revision attribute, which contains the object revision.	1, 1, 1	UINT

Instance Attributes, Instance 0x01

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Data	Get_Attribute_Single, Set_Attribute_Single	Data that is read or written	In bytes	N/A	Array of USINT
0x02	Data	Get_Attribute_Single, Set_Attribute_Single	Data that is read or written	In bytes	N/A	Array of USINT
…	…	…	…	…	…	…
0x05	Data	Get_Attribute_Single, Set_Attribute_Single	Data that is read or written	In bytes	N/A	Array of USINT

Please note: Which attributes that exist are depending on which attributes that are initialised from the DPRAM during initialisation.

5.9 Diagnostic Object, Class 0xAA

Class Attributes

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Revision	Get_Attribute_All	Revision of the Diagnostic Object.	The revision attribute, which contains the object revision.	1, 1, 1	UINT

Diagnostic Instance 0x01

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data type	DPM	SCI
0x01	Module serial number	Get_Attribute_Single	Serial number			UDINT	✓	✓
0x02	Vendor ID	Get_Attribute_Single	Manufacture ID			UINT	✓	✓
0x03	Fieldbus type	Get_Attribute_Single	Fieldbus type			UINT	✓	✓
0x04	Module software version	Get_Attribute_Single	Software version			UINT	✓	✓
0x05	Interrupt count	Get_Attribute_Single	Counter incremented each handshake interrupt			UINT		
0x06	Watchdog counter in	Get_Attribute_Single	Not implemented			UINT		
0x07	Watchdog counter out	Get_Attribute_Single	Counter incremented each 1ms			UINT		
0x08	Access method status	Get_Attribute_Single	Access method state for areas IN, OUT, FB spec/Control			STRUCT of {USINT, USINT, USINT, USINT}		
0x09	LED status	Get_Attribute_Single	LED indication status 1byte / LED			STRUCT of {USINT, USINT, USINT, USINT, USINT, USINT}	✓	✓
0x0A	Module type	Get_Attribute_Single	Module type			UINT	✓	✓
0x0B	Module status	Get_Attribute_Single	Bit information, Freeze, clear, etc.			WORD	✓	✓
0x0C	New data field	Get_Attribute_Single	Array of new data flags for 8 bytes area			LWORD		
0x0D	Interrupt cause	Get_Attribute_Single	Interrupt cause register			WORD		
0x0E	Interrupt notification	Get_Attribute_Single	Interrupt notification setting register			WORD		
0x0F	IN cyclic I/O length	Get_Attribute_Single	Size of I/O IN data (bytes)			UINT	✓	✓
0x10	IN DPRAM length	Get_Attribute_Single	Number of valid IN bytes in DPRAM			UINT		
0x11	IN total length	Get_Attribute_Single	Total number of IN bytes supported			UINT	✓	✓
0x12	OUT cyclic I/O length	Get_Attribute_Single	Size of I/O OUT (bytes) data			UINT	✓	✓
0x13	OUT DPRAM length	Get_Attribute_Single	Number of valid OUT bytes in DPRAM			UINT		
0x14	OUT total length	Get_Attribute_Single	Total number of OUT bytes supported			UINT	✓	✓
0x15	Reserved	Get_Attribute_All	Reserved for future 16-bit compatibility			UINT	✓	✓
0x16	Application indication	Get_Attribute_Single	Application indication register			USINT	✓	
0x17	AnyBus indication	Get_Attribute_Single	AnyBus indication register			USINT	✓	

5.10 Parameter data Input Mapping Object, Class 0xB0

Class Attributes

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Revision	Get_Attribute_All	Revision of the Parameter data input object.	The revision attribute, which contains the object revision.	1, 1, 1	UINT

Instance Attributes, Instance 0x01

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Data	Get_Attribute_Single	Data that is read	In bytes	N/A	Array of USINT
0x02	Data	Get_Attribute_Single	Data that is read	In bytes	N/A	Array of USINT
…	…	…	…	…	…	…
0x32	Data	Get_Attribute_Single	Data that is read	In bytes	N/A	Array of USINT

Please note: Which attributes that exist are depending on which attributes that are initialised from the DPRAM during initialisation.

5.11 Parameter data Output Mapping Object, Class 0xB1

Class Attributes

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Revision	Get_Attribute_All	Revision of the Parameter data output object.	The revision attribute, which contains the object revision.	1, 1, 1	UINT

Instance Attributes, Instance 0x01

ID#	Attribute Name	Services	Description	Semantics	Default, Minimum, Maximum	Data Type
0x01	Data	Get_Attribute_Single, Set_Attribute_Single	Data that is read or written	In bytes	N/A	Array of USINT
0x02	Data	Get_Attribute_Single, Set_Attribute_Single	Data that is read or written	In bytes	N/A	Array of USINT
…	…	…	…	…	…	…
0x32	Data	Get_Attribute_Single, Set_Attribute_Single	Data that is read or written	In bytes	N/A	Array of USINT

Please note: Which attributes that exist are depending on which attributes that are initialised from the DPRAM during initialisation.

6 Electrical specifications

Preliminary current consumption:
Current consumption general electronics I_{AVG} = 100 mA, Bus electronics I_{AVG} = 30 mA in stand by and 100mA inrush current.

The table below describes the general pin configuration for the ASTAT Plus interface

Contact Pin	Description	Symbol	Min	Typ	Max	Unit
2	GNDBUS Ground					
3-4	No Connection					
5	+5V Power Electronic	V_{CC} I_{IN}	4.5 -	5.0 250	5.5 300	V mA
6	GND Ground					
7-31 33-34	Depending on Interface					
32	RES IN Reset (pulse duration)	V_{IH} V_{IL} t_W	0.7 Vcc 1.0		 0.3 Vcc 	V V µS

Description of the Host connector characteristics:

- ***If an optical transceiver is connected to the bus interface, the current consumption may be even higher. Please consult the data sheets of the optical transceiver for correct information.***

Parallel Pin	Description
7-8	Not Used (asynchronous data)
9-18	Address pins
19-26	Data pins
27	BUSY
28	IRQ
29	RD
30	WR
31	CE
33	Address pin
34	Not Connected

Alternative 1. Interface with DPRAM

SCI Pin	Description
7	TX
8	RX
9-12	Not Connected
13	RTS
14-31	Not Connected
33-34	Not Connected

Alternative 2. Asynchronous Serial Interface

For more information about timing and Electrical Characteristics of the DUAL PORT Memory see appendix DPRAM or Cypress Data book. Type CY7C136