

# DN-A244

## Quick Reference Guide

Document # 2509001

| Revision | Date    | Notes  |
|----------|---------|--|
| 1.00     |         | Original Release   |
| 1.01     |         | Minor Revisions  |
| 1.02     | 8/22/07 | <i>Final release for PCB Rev 1.00, Code Rev 3.02</i><br>Add names to the Digital and Analog I/O<br>Add the Serial Client Object<br>Add the Serial Protocol Description |
| 1.03     | 9/19/07 | VS Attribute 2 data type changed from Bool to USINT<br>VS Attribute 9 data type changed to UINT<br>VS Attributes 9, 10 changed to deferred                             |
| 1.04     | 9/24/07 | VS Attributes 8, 9 added Set access rule   |
| 1.05     | 11/2/07 | Corrected Serial Attr 13, not settable. Add serial data inputs to transport behavior. Changed baudrate to 19.2kb. Changed input assembly format.                       |
| 1.06     | 3/18/08 | Changed description of DeviceNet Status byte, page 6, to include bit 6.  |
| 2.00     | 3/20/08 | <i>Initial release for PCB Rev 2.00</i><br>Update hardware specification and pinout  |
| 2.01     | 4/03/08 | Added Rf Generator Object and attributes 12,13,&14 in Param Object. Changed GPI4 to AV.  |
| 2.02     | 4/14/08 | Fixed subscripts of AI1, AI2 in class 0x64   |

# 1. DN-A244 Quick Reference Guide

## 1.1 Objects Present

| Class Id |      | Object Name                           | Instances | Description   |
|----------|------|---------------------------------------|-----------|---|
| Dec      | Hex  |                                       |           |   |
| 1        | 0x01 | Identity                              | 1         | Identity information and RESET Service                                  |
| 2        | 0x02 | Message Router                        | 1         | Routes Explicit Messages to the appropriate object                      |
| 3        | 0x03 | DeviceNet                             | 1         | Network Parameters and Quick Connect                                    |
| 4        | 0x04 | Assembly                              | 2         | #108 Input Assembly<br>#126 Output Assembly                             |
| 5        | 0x05 | Connection                            | 3         | #1 Explicit Messaging<br>#2 Poll Connection<br>#4 COS/Cyclic Connection |
| 8        | 0x08 | Digital Input                         | 4         | GPI1..GPI4  |
| 9        | 0x09 | Digital Output                        | 4         | GPO1..GPO4  |
| 10       | 0x0A | Analog Input                          | 4         | AI1..AI4  |
| 11       | 0x0B | Analog Output                         | 2         | AO1..AO2  |
| 43       | 0x2B | Acknowledge Handler                   | 1         | COS/Cyclic Acknowledgements   |
| 106      | 0x6A | Serial Link Object                    | 1         | Serial Port Definitions   |
| 166      | 0xA6 | Virtual SPI                           | 1         | SPI Interface Diagnostics   |
| 170      | 0xAA | Non Volatile Test                     | 1         | Non-volatile Memory Test  |
| 176      | 0xB0 | Vendor Specific Parameter             | 1         | Build Date and Time   |
| 177      | 0xB1 | Vendor Specific Application Parameter | 1         | RF Generator Parameters   |

## 1.2 Assembly Data Mapping

### 1.2.1 Assembly #108 – Input Assembly

This assembly has nine(9) bytes of data.

| Byte |            | 7          | 6 | 5   | 4  | 3          | 2    | 1    | 0    |
|------|------------|------------|---|-----|----|------------|------|------|------|
| 0    | Analog     | AI1[7..0]  |   |     |    |            |      |      |      |
| 1    | In #1      | 0          | 0 | 0   | 0  | AI1[11..8] |      |      |      |
| 2    | Analog     | AI2[7..0]  |   |     |    |            |      |      |      |
| 3    | In #2      | 0          | 0 | 0   | 0  | AI2[11..8] |      |      |      |
| 4    | Analog     | AI3[7..0]  |   |     |    |            |      |      |      |
| 5    | In #3      | AI3[15..8] |   |     |    |            |      |      |      |
| 6    | Analog     | AI4[7..0]  |   |     |    |            |      |      |      |
| 7    | In #4      | 0          | 0 | 0   | 0  | AI4[11..8] |      |      |      |
| 8    | Digital In | 0          | 0 | SPE | AV | 0          | GPI3 | GPI2 | GPI1 |

### 1.2.2 Assembly #108 – Data Mapping

| Data Item                       | Data Name         | Data Mapping |          |           |
|---------------------------------|-------------------|--------------|----------|-----------|
|                                 |                   | Class        | Instance | Attribute |
| GPI1<br>POS                     | Digital Input     | 0x08         | 0x01     | 3         |
| GPI2<br>FF                      | Digital Input     | 0x08         | 0x02     | 3         |
| GPI3<br>TS                      | Digital Input     | 0x08         | 0x03     | 3         |
| AV<br>Analog<br>Voltage         | Digital Input     | 0x08         | 0x04     | 3         |
| AI1<br>Forward<br>Power Sense   | Analog Input      | 0x0A         | 0x01     | 3         |
| AI2<br>Reflected<br>Power Sense | Analog Input      | 0x0A         | 0x02     | 3         |
| AI3<br>Frequency<br>Readback    | Analog Input      | 0x0A         | 0x03     | 3         |
| AI4<br>Not Used                 | Analog Input      | 0x0A         | 0x04     | 3         |
| SPE                             | Serial Port Error | 0x6A         | 0x01     | 14        |

### 1.2.3 Assembly #126 – Output Assembly

This assembly has five(5) bytes of data

| Byte |                | 7         | 6 | 5 | 4 | 3          | 2    | 1    | 0    |
|------|----------------|-----------|---|---|---|------------|------|------|------|
| 0    | Analog         | AO1[7..0] |   |   |   |            |      |      |      |
| 1    | Out #1         | 0         | 0 | 0 | 0 | AO1[11..8] |      |      |      |
| 2    | Analog         | AO2[7..0] |   |   |   |            |      |      |      |
| 3    | Out #2         | 0         | 0 | 0 | 0 | AO2[11..8] |      |      |      |
| 4    | Digital<br>Out | 0         | 0 | 0 | 0 | GPO4       | GPO3 | GPO2 | GPO1 |

### 1.2.4 Assembly #126 – Data Mapping

| Data Item                       | Data Name      | Data Mapping |          |           |
|---------------------------------|----------------|--------------|----------|-----------|
|                                 |                | Class        | Instance | Attribute |
| GPO1<br>Power On                | Digital Output | 0x09         | 0x01     | 3         |
| GPO2<br>Tuning Mode             | Digital Output | 0x09         | 0x02     | 3         |
| GPO3                            | Digital Output | 0x09         | 0x03     | 3         |
| GPO4                            | Digital Output | 0x09         | 0x04     | 3         |
| AO1<br>Power Output<br>Setpoint | Analog Output  | 0x0B         | 0x01     | 3         |
| AO2                             | Analog Output  | 0x0B         | 0x02     | 3         |

## **2. Connectors**

### **2.1 DeviceNet Micro Connector**

The five pin DeviceNet Micro connector is wired per the DeviceNet specifications.

### **2.2 Serial Port Connector**

The six pin JST connector is used to access the serial port on the processor; the serial port signals are also available on the Auxiliary I/O connector. The levels on this connector are TTL levels, and not RS-232 levels.

### **2.3 Auxiliary I/O Connector**

This connector is a sixteen pin dual row male header. Pin #1 is marked on the DN-A244 Pin Definition (Figure 2.3.1) below. The pin numbering is conventional for headers of this type. Pin #2 is horizontally adjacent to Pin #1, and Pin # 3 is below Pin #1 and adjacent to the edge of the board when the board is oriented in the same fashion as on the drawing.

Figure 2.3.1 - DN-A244 Pin Definitions

**J1 Pin Definition**

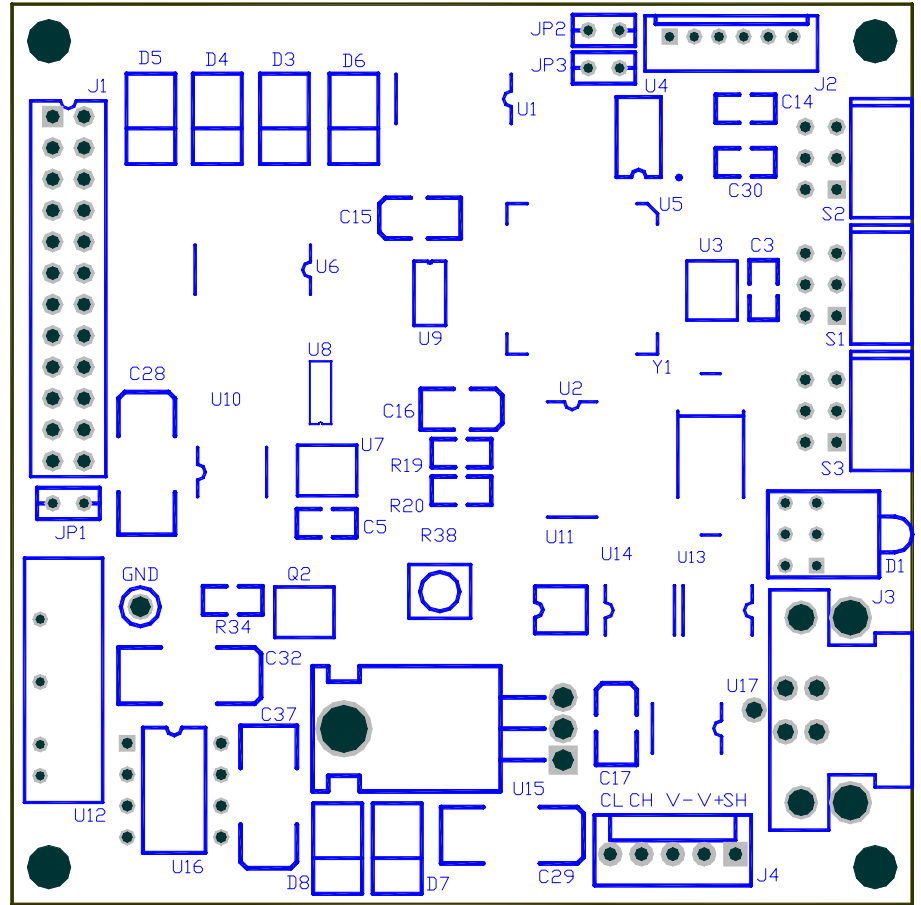
|      |    |    |      |
|------|----|----|------|
| GPO1 | 1  | 2  | GPO2 |
| GPO3 | 3  | 4  | GPO4 |
| GPI1 | 5  | 6  | GPI2 |
| GPI3 | 7  | 8  | GPI4 |
| GND  | 9  | 10 | AI1  |
| AI2  | 11 | 12 | AI3  |
| AI4  | 13 | 14 | AO1  |
| AO2  | 15 | 16 | +15V |
| Vcc  | 17 | 18 | NS-R |
| Rx   | 19 | 20 | MS-R |
| GND  | 21 | 22 | NS-G |
| Tx   | 23 | 24 | MS-G |

**J2 Pin Definition**

|                |   |
|----------------|---|
| NC Factory use | 1 |
| NC Factory use | 2 |
| Tx (DN-A244)   | 3 |
| GND            | 4 |
| Rx (DN-A244)   | 5 |
| GND            | 6 |

**J4 Pin Definition**

|        |   |
|--------|---|
| Shield | 1 |
| V+     | 2 |
| V-     | 3 |
| CAN_H  | 4 |
| CAN_L  | 5 |



### 3. Vendor Specific Objects

#### 3.1 RF Generator Object

Class Code: 0x64

##### 3.1.1 Class Attributes

| Attribute ID | Attribute Name         | Access Rule | Data Type | Description |
|--------------|------------------------|-------------|-----------|-------------|
| 1            | Revision               | Get         | UINT      | 1           |
| 2            | Max Object Instance    | Get         | UINT      | 1           |
| 6            | Max Class Identifier   | Get         | UINT      | 7           |
| 7            | Max Instance Attribute | Get         | UINT      | 25          |

##### 3.1.2 Instance Attributes

| Attribute ID | Attribute Name      | Access Rule | Data Type | Description              |
|--------------|---------------------|-------------|-----------|--------------------------|
| 1            | Forward Power       | Get         | UINT      | Returns AI1 (FWD power)  |
| 2            | Reflected Power     | Get         | UINT      | Returns AI2 (RFL power)  |
| 4            | Frequency           | Get         | UINT      | Returns AI3 Frequency    |
| 5            | Status              | Get         | USINT     | Byte 8 of assembly #108  |
| 6            | Max Power           | Get         | UINT      | Class 0xB1, Attribute 12 |
| 7            | Max Reflected Power | Get         | UINT      | Class 0xB1, Attribute 13 |
| 8            | Internal Status     | Get         | USINT     | Always 0                 |
| 12           | Regulation Mode     | Get         | USINT     | Always 0 (FWD mode)      |
| 25           | Power Index         | Get         | USINT     | Class 0xB1, Attribute 14 |

##### 3.1.3 Instance Services

One instance service is supported.

| Service ID | Service Name         | Description                      |
|------------|----------------------|----------------------------------|
| 0x0E       | Get Attribute Single | Return the value of an attribute |

## 3.2 Application Parameter Object

Class Code: 0xB1

### 3.2.1 Class Attributes

There are no required class attributes for this object.

### 3.2.2 Instance Attributes

| Attribute ID | Attribute Name   | Access Rule | Data Type    | Description  |
|--------------|------------------|-------------|--------------|--|
| 1            | Start Frequency  | Get/Set     | UINT         | Range [0..65535]   |
| 2            | Direction        | Get/Set     | USINT        | Range [0..255]   |
| 3            | Band             | Get/Set     | USINT        | Range [0..255]   |
| 4            | Gain             | Get/Set     | UINT         | Range [0..65535]   |
| 5            | Lock             | Get/Set     | USINT        | Range [0..255]   |
| 6            | Up-ramp          | Get/Set     | USINT        | Range [0..25.5] seconds  |
| 7            | Down-ramp        | Get/Set     | USINT        | Range [0..25.5] seconds  |
| 8            | Generator Part # | Get/Set     | Short String | 8,[A-Z,a-z,0-9,' ','\0]*   |
| 9            | Generator S/N    | Get/Set     | UINT         | Range [0..65535]   |
| 10           | Generator FW     | Get         | USINT        | Range [0..255]   |
| 11           | DeviceNet Status | Get         | USINT        | Bit 7 = 0, normal<br>Bit 7 = 1, Bus Off<br>Bit 6 = 0, no connections<br>Bit 6 = 1, connected<br>Bits 0 to 5 not used |

Attribute 8 will be maintained as a local copy on the DN-A244. The values will be read over the serial port at reset, and when SPE transitions out of error condition. Attribute 11 is determined by the DN-A244 and will be written over the serial port regularly.

### 3.2.3 Instance Services

Two instance services are supported.

| Service ID | Service Name         | Description                      |
|------------|----------------------|----------------------------------|
| 0x0E       | Get Attribute Single | Return the value of an attribute |
| 0x10       | Set Attribute Single | Set the value of an attribute    |

### 3.2.4 Data Transport Behavior

There are five distinct data transport behaviors:

#### 1 – DeviceNet I/O access to hardware I/O

This is the movement of DeviceNet data by I/O messaging, such as Polled I/O, to or from actual digital or analog hardware I/O.

#### 2 – DeviceNet Explicit Message access to local data

This is conventional DeviceNet messaging performing 'get', 'set', or other services to obtain data or parameters that are stored locally on the DN-A244. This is how most DeviceNet attributes are read or written. It is also how the local copy of the parameters in Application Parameter Object (Class 0xB1) attribute 8 will be accessed over DeviceNet.

#### 3 – DeviceNet Explicit Message with Deferred Response

This is DeviceNet messaging access to remote data. Upon receipt, a serial port command will be sent to move the necessary data over the serial port, then the necessary DeviceNet reply is sent. This is how attributes 1 through 7 and 9 & 10 of the Application Parameter Object will be accessed

#### 4 – Independent Serial Port Transport

These will be exchanges of data over the serial port that are not dependent upon DeviceNet messaging. The parameter values used for attribute 8 of the Application Parameter Object will be obtained (copied) over the serial port at times not related to DeviceNet messages. Attribute 11 of the Application Parameter Object will also be sent over the serial port regularly, independent of DeviceNet messages.

#### 5 – Serial Input Data

Some Input data will be sourced from data transferred over the serial port. Specifically Analog Input #3 (16 bits), and GPI (8 bits) will be updated in response to the periodic status message, S11, described in the next section. The response will be formatted in hex characters as follows: "P11ABCDEF\n". AB = High order 8 bits analog, CD = low order 8 bits analog, EF = 8 bits digital. '\n' is a single new-line character.

### 3.2.5 Serial Port Activity

At power up Serial port will transmit G08 to obtain an initial value. A response transitions the port to online. A periodic S11 will be sent at a rate set by the link timer (Class 6A, Inst. 1 Attr 9). As long as it is acknowledged, the port will stay online. If it transitions to offline, the periodic message will change back to G08. Any activity will keep the connection online. The P11 ack response will contain serial input data, as described in section 3.1.4.

DeviceNet Get commands will be put into the serial message queue. If there is no response, a Vendor specific Data Not Available error will be generated. If, for instance, a G05 was answered with a "P04", the port would stay on line but the Data Not Available error would be generated.

If a Get command is received while one is still waiting for response, a Vendor Specific Data Pending error will be generated and the second Get command will be dropped.

On a Get 08, the local copy will be returned and a new G08 will be sent on the serial port.

An "E" response is intended to indicate Error. It will increment an internal count of errors that is kept for debug purposes. The count is not available externally. Otherwise an "E" will be treated the same as a "P".

### 3.3 Serial Link Object

Class Code: 0x6A

#### 3.3.1 Class Attributes

| Attribute ID | Need in Implementation | Access Rule   | Name         | DeviceNet Data Type | Description of Attribute                          |
|--------------|------------------------|---|--------------|---------------------|---|
| 1            | Conditional            | Get   | Revision     | UINT                | Revision of this object<br>Current Value = 0x0003 |
| 2            | Conditional            | Get   | Max Instance | UINT                | Maximum instance number                           |
| 3-7          | Optional               | These attributes are optional and described in Volume II chapter 5 of the DeviceNet Specification |              |                     |   |

#### 3.3.2 Instance Attributes

| Attribute ID | Attribute Name          | Access Rule | Data Type | Description  |
|--------------|-------------------------|-------------|-----------|--|
| 1            | Baudrate                | Get         | UINT      | 19397 = 0x4BC5   |
| 2            | Mode                    | Get         | USINT     | 'A' = Asynchronous   |
| 3            | Parity                  | Get         | USINT     | 'N' = None   |
| 4            | Data Bits               | Get         | USINT     | '8' = Eight Data Bits  |
| 5            | Stop Bits               | Get         | USINT     | '1' = One Stop Bit   |
| 6            | Checksum                | Get         | USINT     | 'N' = No Checksum  |
| 7            | Diagnostic Action       | Get/Set     | USINT     | '0' = Normal Operation<br>'1' = Echo<br>'2' = Transmit Continuous<br>'3' = Transmit Sequential                                     |
| 8            | Diagnostic Character    | Get/Set     | USINT     | Range [0..255]<br>Default:'U' = 0x55   |
| 9            | Link Timer              | Get/Set     | UINT      | Any value in the range [0..65535] in milliseconds<br>Default = 2000  |
| 10           | Framing Errors          | Get/Set     | UINT      | Range [0..255]   |
| 11           | Data Overrun            | Get/Set     | UINT      | Range [0..255]   |
| 12           | Serial Transactions     | Get/Set     | UINT      | Range [0..65536]   |
| 13           | Serial Status Register  | Get         | USINT     | Get returns and clears the Serial Status Register:<br>SSR.7 = Invalid Level<br>SSR.1 = Framing/Data Error<br>SSR.0 = Timeout Error |
| 14           | Serial Port Error (SPE) | Get         | BOOL      | SSR (Attribute 13) != 0  |
| 14           | Serial Port Error (SPE) | Set         | BOOL      | Set = 1 enables flashing Module Status LED behavior.<br>This does not effect the Get value. Default is not enabled.                |

### 3.3.3 Instance Services

Two instance services are supported.

| Service ID | Service Name         | Description                      |
|------------|----------------------|----------------------------------|
| 0x0E       | Get Attribute Single | Return the value of an attribute |
| 0x10       | Set Attribute Single | Set the value of an attribute    |

### 3.3.4 Serial Port Behavior

The serial link timer is started when a message is transmitted. If no response is received before the timer expires, the link is considered timed out. This will be reflected in the Serial Link Status Attribute and the Serial Port Error Attribute. Upon expiration the next queued message will be transmitted, and the timer restarted. The timed out indications are discontinued once a proper response message is received within the timer interval. The serial link timer will also be used to generate the periodic message to set the value of the DeviceNet Status Attribute of the Application Parameter Object (Class 0xB1).

In addition, if the SPE bit is set, the Module Status LED will flash red when the link is timed out. This may be useful for debugging and is not the default behavior.

## **3.4 Generic Serial Parameter Protocol**

### **3.4.1 General Requirements**

This serial protocol allows a DeviceNet node and a connected product to exchange information about the values of parameters. It is helpful, when monitoring the serial link, for the exchange to consist of printable ASCII characters and simple line formatting characters. A message can be either a request or a response, and contains at least a service identifier, and a parameter number. Depending on the service identifier there may be a separator character to improve readability and a numeric value or a string value. Finally there should be an end delimiter that indicates the end of a message. This end delimiter should also signal the receiver that it may process the current message and prepare for the next one. In order to improve readability on a monitoring device certain characters may be included in the message which can be ignored by the receiver and have no semantic meaning.

The serial connection is point to point, so there is no need for the concept of node address on either end. A connection is assumed to exist, and mechanisms may be implemented to determine the absence of a cable or valid signal levels at the receiver. One end of the serial connection will be the client endpoint. The client will produce requests and it will consume responses. The DeviceNet unit will be the client. The other endpoint of the connection will be the server endpoint. The server endpoint will consume requests and generate responses.

## 3.5 Semantic Units

### 3.5.1 Service Identifiers

A service identifier consists of a single printable ASCII character.

| Service ID | Service Name    | Used By |
|------------|-----------------|---------|
| G          | Get Parameter   | Client  |
| S          | Set Parameter   | Client  |
| P          | Parameter Value | Server  |
| E          | Error Service   | Server  |

### 3.5.2 Parameter Address

Parameters are arranged in a flat structure and numbered sequentially from 01 to 99. There is no parameter number 00. A parameter address must be represented by two decimal digits.

### 3.5.3 Parameter Values

A numeric parameter can be represented by a string of decimal digits. Leading zeros are allowed, but are not required.

A string parameter can be represented by a string of printable ASCII characters.

Parameters that are determined to be too long, or that prevent determination of a valid value, such as numeric parameters that cause an overflow, will be ignored. The parameter will be considered invalid and an appropriate DeviceNet Error Response will be sent. This GSPP policy on length checks is preliminary and may not become fully implemented, or may change in the future.

### 3.5.4 End Delimiter

The end delimiter is a newline character. It is also called a line feed and has the hexadecimal value of 0x0A. Multiple end delimiters are treated as if only the last one was present in the data stream.

### 3.5.5 Ignored Characters

The following characters may be optionally inserted in the body of a message to improve the readability on debugging or monitoring devices. They contain no semantic or syntactic information and should be ignored by the receivers at both connection endpoints.

| Character | Name            | Reason   |
|-----------|-----------------|--|
| ' '       | Blank           | Separate fields of a message (note 1)                |
| HT        | Tab             | Separate fields of a message                         |
| ','       | Comma           | Separate fields of a message                         |
| '='       | Equals          | Insert between Parameter Address and Parameter Value |
| CR        | Carriage Return | Used with newline for some devices that require it   |

Note 1 – blanks are not ignored if they occur within a string parameter

### 3.5.6 Examples

The following examples will use the C language escape sequences to represent non-printable ASCII control characters.

| Request Messages  | Description   |
|-------------------|---|
| "G02\r\n"         | Get the value of Parameter 2. The \r is ignored   |
| "G 02\n"          | Get the value of Parameter 2. The blank is ignored  |
| "S 02 = 44\n"     | Set the value of Parameter 2 to the value 44 decimal.   |
| "S 06 = ABC123\n" | Set the value of Parameter 6 to "ABC123". The equals sign and the spaces and the newline are not part of the string |
| "S06ABC123\n"     | Set the value of Parameter 6 to "ABC123". All extra characters have been removed.                                   |

| Response Messages | Description   |
|-------------------|---|
| "P02117\r\n"      | The value of Parameter 2 is 117 decimal   |
| "P 02 = 117\r\n"  | The value of Parameter 2 is 117 decimal. Spaces and an equals sign added for readability.   |
| "E 11,03\r\n"     | The last request resulted in an error. An error message will always contain four decimal digits. A comma has been inserted for readability. |
| "P\r\n"           | Standard Success Response to a Set ("S") Service. Including address or value is allowed, but not required.                                  |
| "P11ABCDEF\n"     | Serial Input Data, Response to periodic S11, see 3.1.4  |