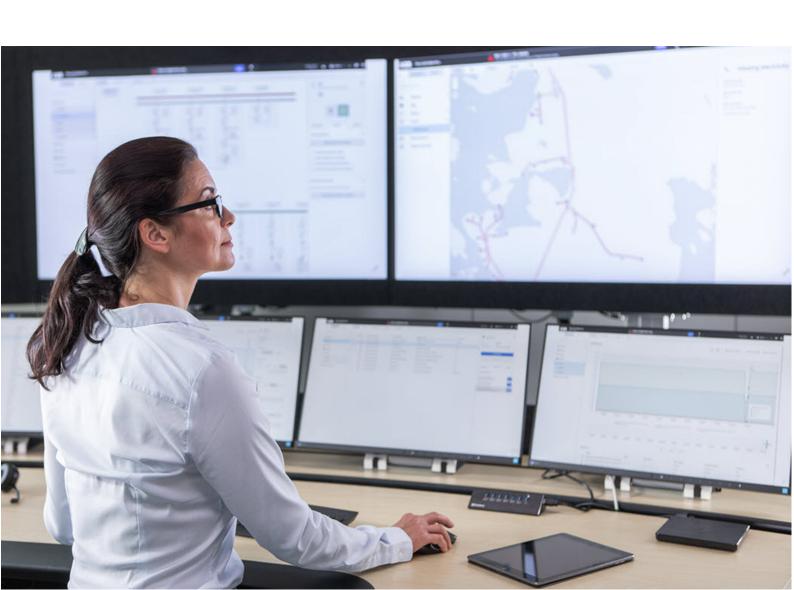ABB

MicroSCADA X SYS600 10.2
IEC 61107 Master Protocol

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Table of contents

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Section 2   Introduction

2.1   This manual

This manual provides thorough information on the IEC 61107 protocol and the necessary information related to it. It describes the implementation of the interface between SYS600 and the IEC 61107 device.

> ⚠️ Standard IEC 61107 has been replaced with standard IEC 62056-21. If the equipment to be connected supports standard IEC 62056-21 only, contact the nearest supplier.

Overview

The communication between SYS600 and an external device with IEC 61107 protocol is designed to be processed as a batch. This means that the SYS600 application program first downloads the batch of the IEC 61107 messages to PC-NET and then starts the communication between the external device and PC-NET (the communication unit of SYS600). During the communication phase, PC-NET sends downloaded messages to the external device. Replies to these messages are sent to SYS600 as spontaneous messages to the bit stream process object.

Interface

The interface between SYS600 and an external device is divided into two layers: the application layer and the link layer.

The application layer is mainly used to store downloaded messages before sending them to the external device. The station process of PC-NET executes the functions of the application layer. The station process type is ATR_DEVICE (code 27).

The link layer handles most of the functionalities of the interface. The link layer is called the process line. The type of the IEC 61107 protocol line is IE_PROTOCOL(code 26).

2.2   Use of symbols

This publication includes warning, caution and information symbols where appropriate to point out safety-related or other important information. It also includes tips to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:

> ⚠️ Warning icon indicates the presence of a hazard which could result in personal injury.

> ⚠️ Caution icon indicates important information or a warning related to the concept discussed in the text. It might indicate the presence of a hazard, which could result in corruption of software or damage to equipment/property.

> ⚠️ Information icon alerts the reader to relevant factors and conditions.

Tip icon indicates advice on, for example, how to design a project or how to use a certain function.

Although warning hazards are related to personal injury, and caution hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warnings and caution notices.

2.3 Related documents

The following MicroSCADA manuals should also be available for reference during the use of this manual:

Name of the manual	Document ID
SYS600 10.2 System Objects	1MRK 511 482-UEN

2.4 Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a dialog, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for file names.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the CTRL key. Although the Enter and Shift keys are not labeled they are written in capital letters, e.g. press ENTER.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the space bar, comma key and so on.
- Press CTRL+C indicates that the user must hold down the CTRL key while pressing the C key (in this case, to copy a selected object).
- Press ALT E C indicates that the user presses and releases each key in sequence (in this case, to copy a selected object).
- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.

  - The following convention is used for menu operations: **Menu Name /Menu Item / Cascaded Menu Item** . For example: select **File /Open /New Project** .
  - The **Start** menu name always refers to the **Start** menu on the Windows Task Bar.

- System prompts/messages and user responses/input are shown in the Courier font. For example, if the user enters a value that is out of range, the following message is displayed: `Entered value is not valid`.
  The user may be told to enter the string MIF349 in a field. The string is shown as follows in the procedure: `MIF349`
- Variables are shown using lowercase letters: sequence name

2.5 Document revisions

Version	Revision number	Date	History
A	10.2	31.03.2021	New document for SYS600 10.2

Section 3   Instructions

3.1   Communication session

One communication session contains a sequence of messages, which are sent to the external device by SYS600. These messages must be created by the application program of SYS600. PC-NET is transparent to IEC 61107 messages. PC-NET adds the block check character, BCC, to the end of an outgoing IEC 61107 message. PC-NET adds the serial number of the message to the beginning of the reply message sent by the external device. This is done to make the identification of the reply messages easier. The application program downloads messages of a session to PC-NET using the AM attribute.

The session must include messages to execute handshake and terminate the connection between SYS600 and the IEC 61107 external device.

The following is an example of a minimum session:

```
@S1 = "/ ? ! CR LF"                  handshaking
@S2 = "ACK 0Z1 CR LF"                selects the communication mode
@S3 = "SOH P1 STX (password) ETX
   " password check
```

(Data reading messages must be placed here.)

```
@S4 = "SOH B0 ETX"                   terminate connection
```

The PC-NET adds the BCC character to the end of messages. (Messages that begin with SOH- or STX-characters have BCC characters at the end.)

3.2   Autocaller

The Autocaller process (ACE) of SYS600 is used to connect PC-NET to the IEC 61107 device power meter with telephone lines. The ACE implementation of the IEC 61107 device interface works the same way as the ACE of the RTU and STA lines (see SYS600 System Objects).

If the AC attribute of an IEC line is active, the user (or the application program) can dial the IEC 61107 device by writing the phone number of the CN attribute. It is possible to call the IEC 61107 device before or after the downloading session and the starting session. The telephone connection to the IEC 61107 device breaks if the user writes an empty string to the CN attribute or if the connection time limit is exceeded. Notice that PC-NET does not break the telephone connection automatically.

Following ACE attributes are applicable with the IEC 61107 device line:

AC	Autocaller Enabled

The AC attribute states whether an Autocaller is connected to the line (value 1) or not (value 0).

Data type:	Integer
Value:	0 or 1
Default value:	0
Access:	No limitations

AS	Autocaller State

This attribute indicates the state of the Autocaller.

Data type:	Integer
value:	0 = IDLE, ready to make a call
	1 = CONNECTED, transmission is activated
	2 = BUSY , Autocaller is dialing
	3 = INITIAL, Autocaller is uninitialized
	4 = CONFIGURE, the IU attribute of the li is set to 0
Default value:	0
Access:	No limitations

CL	Connection time limited

This attribute determines whether a time limit has been set to the connection (value 1) or not (value 0). The maximum duration of the connection is determined by the CT attribute.

Data type:	Integer
Value:	0 = no time limit 1 = time limit
Default value:	1
Suggested value:	A time limit is necessary on certain radio telephone lines. Limiting the connection time may also be good practice in other cases, if there is a risk that the connection is not otherwise broken.
Access:	No limitations

CT	Connection time

The maximum time that a connection is allowed to last (in seconds). This attribute is significant only if time limiting is activated (CL = 1).

Data type:	Integer
Value:	0...600 seconds
Unit:	Seconds
Default value:	120
Access:	No limitations

CN	Connection

The CN attribute is used for dialing devices from the NET and for breaking telephone connections.
A call to a station or workplace is initiated by writing the phone number to the CN at-tribute. The NET unit then commands the autodialing modem to dial the number. The success of the dialing is reported as a system message. Writing an empty string to CN breaks the connection. When dialing a station, the link address of the station should be given at the end of the phone number string, preceded by the letter S. This option is normally used to increase the communication performance on multidrop lines. The station number is only significant in the unbalanced mode (several stations on one line).

Data type:	Text
Value:	Text string of maximum 25 characters
Default value:	Empty text string
Access:	No limitations

```
#SET NET1:SCN5 = "123456789S11"
```

CS	Connected station

Indicates which station the front-end is communicating with.

Data value:	Integer
Value:	0...65535 0 = Autocaller not defined or no communication
Default value:	0
Access:	Read-only

DD	Radio Disconnection Delay

Delay between the last data transfer and the line disconnection.

Data value:	Integer
Value:	0...32767
Unit:	Seconds
Default value:	0
Access:	No limitations

MC	Modem Command

Using this attribute, a modem can be controlled directly from SCIL with the A T/Hayes commands. When an A T command is written to the MC attribute, it is transmitted to the modem on the line. The response from the modem is read using the same attribute.

Data value:	Text
Value:	Text string, an A T/Hayes command
Default value:	0
Access:	No limitations

```
#SET NET1:SMC3 = ("AS0?")
```

PU	Pulse dialing

This attribute determines the dialing principle used.

Value:	0 = tone dialing 1 = pulse dialing
Default value:	0
Access:	No limitations

RC	Remote Calls Enabled

The RC attribute states whether remote calls are enabled on a line, meaning that the NET unit can be called from the stations connected to the line in question. This attribute applies to lines with autocaller (AC = 1).

Data value:	Integer
Value:	0 = remote calls not enabled 1 = remote calls enabled
Default value:	0
Access:	No limitations

RW	Radio Connection Wait Time

Normally, the DCD (Data Carrier Detect) signal is used to indicate an active connection. However, there are cases where this is not possible, for example, on radiotelephone lines using half-duplex links. The RW attribute defines the waiting time in seconds in such a situation from the finishing of the dialing until the transmission is started.

Data value:	Integer
Value:	0...32767
Unit:	Seconds
Default value:	0
Access:	No limitations

SR	Autocaller AT S registers

The S registers used by the Autocallers follow the A T (Hayes) de facto standard.
All the Autocallers that use the A T command set have a number of S registers. The number of registers used and the meaning of the individual registers varies slightly from one Autocaller model to another. The contents of the S registers are therefore not described in this document. Refer to the modem manuals.
Using the SR attribute, the S register number 2, 6, 7, 8, 9, 10, 11 and 12 are accessed. By using the MC attribute (see above), other S registers can also be accessed. The S registers 11 and 12 cannot be set.

Data type:	Integer
Value:	See the modem manual
Indexing:	Seconds
Access:	100 * line number + register number

The S register number 6 offline 2 in NET1 is set = 4:

```
#SET NET1:SSR206 = 4
```

3.3 The ATR station

The interface of an ATR station object provides attributes for sending IEC 61107 messages.

3.3.1 The attribute interface of the ATR station

Following attributes are used by the ATR station:

IU	In Use

Indicates whether the station is in use (value 1) or not in use (value 0).

Value:	0 or 1
Default value:	0
Access:	No limitations

When the station is taken out of use, the initialized station data and the FIFO message are cleared.

AL	Allocation

Indicates whether the ATR station is allocated to a certain application or not.

Value:	0, not allocated
	1, allocated
Access:	No limitations

AS	Allocating Application

The number of the application which has reserved the station.

Index range:	no indexes
Value range:	0..250
	0 = no application
Access	Read-only

MI	Message Identification

Indicates to which object address in the process database the station sends the system messages.

Value:	Integer, 1 .. 65535
Access:	No limitations

MS	Message Application

The number of the application that receives the systems messages.

Index range:	none
Value range:	1..250
Access:	Read, conditional write

AM	IEC 61107 Message

When the AM attribute is used, the application program downloads the command messages, which are sent from PC-NET to the IEC 61107 device during one communication session. The AM attribute has no indexes because messages are stored in the FIFO memory of the Alpha application layer. The FIFO memory has space for 16 messages.
Messages are written to the AM attribute as unsigned 8 bit vector. The reply of the AM attribute indicates the amount of messages in the FIFO queue. The FIFO memory can be cleared by taking the alpha protocol line temporarily out of use (IU=0).

> ⚠ The application layer does not convert the protocol of downloaded messages. Therefore, the application program of MicroSCADA is responsible for the correct syntax of the messages.

Value:	when writing:	vector
	when reading:	integer, number of messages in FIFO
Access:	No limitations	

vector = array (1..62) of unsigned 8

It is also possible to modify the application so that only one message is active throughout the session. Start the session by writing the first message to the AM attribute and then set the ST attribute. When the bitstream process objects have received and processed the reply, the next outgoing message is always written to the AM attribute until the end of the session. It may be easier to handle the replies using this method.

> ⚠ Always check the RT-attribute of the process object before processing.

ST	Start session

The ST attribute enables the communication between PC-NET and the IEC 61107 device. The communication starts when the connection between PC-NET and the IEC 61107 device is established (with modem lines). The communication starts immediately, when the interface is direct or the connection is already established.

Value:	when writing
	1, starts the session
	when reading
	0, session not active
	1, session active
Access:	No limitations

For more information, contact the nearest supplier for more information.

3.3.2 System messages generated by the ATR station

The ATR device sends the following system status messages to the base system:

13751	ATRP_SESSION_ENABLED

This message is the reply to the session start command (ST=1). The actual session begins when the connection between PC-NET and the IEC 61107 device is established.

13753	ATRP_SESSION_FINISHED

This message is sent by PC-NET when the session is ready (all session messages are successfully sent and they have all received a correct reply). The application program of SYS600 can use this system status message code to detect when the session is finished.

13755	ATRP_SESSION_STOPPED

The enabled session is stopped by user (IU=0).

13754	ATRP_SESSION_ABORTED

The session is not finished correctly. The IEC 61107 device has not sent replies to session messages, or the base system has not got the correct bitstream object to receive the IEC 61107 device messages.

Error status codes:

13752	ATRP_NOT_ALLOWED_WHILE_COMMUNICATING

The error status reply to the AM attribute writing while the session is still active.

13756	ATRC_UNKNOWN_ATTRIBUTE

The error reply status code to an unknown attribute.

13757	ATRC_SESSION_FIFO_FULL

The error status reply to the AM attribute writing when the FIFO session is full.

13758	ATRC_TOO_LONG_MESSAGE

The error status reply to the AM attribute writing when the message is too long to fit FIFO.

13759	ATRC_STATION_NOT_IN_USE

The error status reply to the starting session (ST=1), when the station is not in use.

13760	ATRC_LINE_NOT_IN_USE

The error status reply to the starting session (ST=1), when the line is not in use.

3.4 The IEC 61107 protocol process

Although the ABB Alphameter and the IEC 61107 device power meter use the same station process, they both have their own line processes that are dependent on the protocol. The line process of the IEC 61107 device interface performs the functions of IEC 61107 protocol.

3.4.1 The attributes of the IEC 61107 line process

IU	In Use

Indicates whether the line is in use (value 1) or not in use (value 0).

Data type:	Integer
Value:	0 or 1
Index range:	1...12 (NET line numbering)
Default value:	0
Access:	No limitations

SD	System Device Name

Associates the NET line numbers of PC-NET with the device names of the physical channels of serial ports. By default, the line number 1 is connected to the COM1, the line 2 to the COM2 and so on. By using the SD attribute, it is possible to override these default values. This may be necessary if the COM ports are used as NET lines or if, for example, a Rocket-Port card is used.

Data type:	Text
Value:	See above
Index range:	1...12 (NET line numbering)
Access:	Read, conditional write

MI	Message Identification

Indicates to which object address in the process database the line process sends the system messages.

Data type:	Integer
Value:	1...32760
Index range:	1...12 (NET line numbering)
Default value:	6000 + (100 * NET number) + line number
Access:	Read, conditional write

MS	Message Application

The number of the application that is the receiver of the system messages generated by the line.

Data value:	Integer
Value:	1..250
Index range:	1...12 (NET line numbering)
Default value:	1
Access:	Read, conditional write

AC	Autocaller

This attribute determines if the Autocaller is used.

PD	Poll Delay

Specifies the time between two command messages that are sent by PC-NET to the IEC 61107 device.

Data type:	Integer
Value:	0...65535
Unit:	Milliseconds
Index range:	1...12 (NET line numbering)
Default value:	1000
Access:	Read, conditional write

BR	Baud Rate

Transmission rate used on the line.

Data type:	Integer
Value:	Integer, 1...19200 (384 = 38400 bauds, 576 = 57600 bauds)
Unit:	Bits / s
Index range:	1...12 (NET line numbering)
Default value:	9600
Access:	Read, conditional write

EN	Enquiry Limit

The EN attribute specifies the maximum number of times that a telegram is retransmitted before PC-NET gives up, if the remote device does not respond.

Data type:	Integer
Value:	1 .. 255
Index range:	1...12 (NET line numbering)
Default value:	10
Access:	Read, conditional write

HT	Header Timeout

Specifies the maximum waiting time in milliseconds within which the first byte of a line layer response from the IEC slave should have been received after the transmission of a message. If no response has been received within this time, new attempts are per-formed the number of times specified by the Enquiry limit. If a response is still not obtained, the station is suspended.

Data type:	Integer
Value:	0...65535
Unit:	Milliseconds
Index range:	1...12 (NET line numbering)
Default value:	3000
Access:	Read, conditional write

TI	Response Timeout

The time in seconds that the IEClink waits for the end of the line layer response.

Data type:	Integer
Value:	1...65
Unit:	Seconds

TI	Response Timeout
Index range:	1...12 (NET line numbering)
Default value:	2
Access:	No limitations

RI	Receiver Enable Delay

Defines the delay in milliseconds after which the receiver of a NET line is enabled after a message has been issued.

Data value:	Integer
Value:	0.. 255
	0 = Receiver always enabled 1...9 = Receiver enabled right after transmission 10...65535 = Receiver enabled as stated by the value
Unit:	milliseconds
Index range:	1...12 (NET line numbering)
Default value:	50
Access:	No limitations

PY	Parity

Specifies the parity check (if any) used for the characters transferred on the line.

Data value:	Integer
Value:	0 = no parity check
	1 = odd parity
	2 = even parity
Index range:	1...12 (NET line numbering)
Default value:	0
Access:	Read, conditional write

RD	Receiver Data Bit Count

Specifies the number of data bits in each received character.

Data value:	Integer
Value:	5, 6, 7 and 8
Unit:	Data bits
Index range:	1...12 (NET line numbering)
Default value:	8
Access:	Read, conditional write

SB	Stop Bits

Specifies the number of stop bits attached to each transmitted character.

Data value:	Integer
Value:	1 or 2
Unit:	Stop bits
Index range:	1...12 (NET line numbering)
Default value:	1
Access:	Read, conditional write

TD	Transmitter Data Bit Count

Specifies the number of data bits in each transmitted character.

Data value:	Integer
Value:	5, 6, 7 or 8
Unit:	Data bits
Index range:	1...12 (NET line numbering)
Default value:	0
Access:	read/write

DC	Diagnostic Counter

PC-NET line has a set of 16 diagnostic counters. The IEC 61107 line uses the counter set as described below:

1	TRANSMITTED TELEGRAMS - Incremented each time a message is successfully transmitted.
2	FAILED TRANSMISSIONS - Incremented each time a CTS or DCD signal prevents a transmission.
3	Not used
4	Not used
5	Not used
6	MESSAGE BUFFER OVERFLOWS - Incremented each time a message longer than 230 characters has been received.
7	Not used
8	Not used
9	MESSAGE TIMEOUTS - Incremented each time a transmitted message has not received a reply.
10	Not used
11	RECEIVED MESSAGES - Incremented each time a message has been received from the IEC 61107 device without errors.
12	PARITY ERRORS - Incremented each time a message has been rejected because of a parity error.
13	OVERRUN ERRORS - Incremented each time a message has been rejected because of a receiver overrun.
14	BCC ERRORS - Incremented each time a message has been rejected because of the checksum.
15	FRAMING ERRORS - Incremented each time a message has been rejected because of the character format.
16	SCC BUFFER OVERFLOW ERRORS - Incremented each time a message has been rejected because of the checksum.
values:	integer, 0..65535
access:	read/write

3.4.2 System status messages of IEC 61107 line process

The following system status messages are defined for the IEC 61107 line process.

17452	IECP_LINE_PASSIVATED

Line is passivated by the Autocaller, the user has disconnected the connection.

17458	IECP_CONNECTION_ESTABLISHED

The IEC 61107 device has responded to the first session message.

17456	IECP_SESSION_STOPPED

The line is set out of use when the session is not yet finished.

17451	IECP_SESSION_ABORTED

The session has failed because of the IEC 61107 device. The PC-NET has not received correct replies from the IEC 61107 device.

17450	IECP_SESSION_READY

All messages from the FIFO session have been sent correctly to the IEC 61107 device.

> ⚠️ It is not recommended to use the IECP_SESSION_READY (17450) system status message when searching for the correct ending of the session. The IEC 61107 device replies are sent to the base system via the station process. Therefore, it is possible that the SESSION_READY status messages reach the base system before the last IEC 61107 device reply.

3.4.3 Error status codes of the IEC-61107 line process

17453	IECP_BUFFER_NOT_READY

Internal buffer handling problem.

17454	IECP_ERR_REPLY_FROM_DEVICE

The reply from IED has not been accepted because of a BCC or character format error (after retrying).

17455	IECP_NO_REPLY_FROM_DEVICE

The IEC 61107 device has not replied to the command message.

17457	IECP_SESSION_ENDS_TO_CTS_ERROR

The session is aborted because of a CTS error.

3.5 Messages from the IEC 61107 Device to SYS600

The replies to session messages are sent from PC-NET to the base system with bitstream messages. The application program of SYS600 must be used to move the necessary data from reply messages to the corresponding process objects.

Notice that the SCIL program that does the translation must be started by the event channel (when the bitstream process object has been updated), because PC-NET writes successive reply messages to the same process object.

PC-NET adds the serial number of the message (within one session) to the beginning of the IEC 61107 device reply to make the identification of the messages easier. The user cannot change the address of the bitstream object, which is OA= 1. If the reply is longer than 224 bytes, the next block is written to another bitstream process object, OA=2. The maximum length of a reply is 16384 bytes, which means that the process objects with OA=1..74 are updated with the longest possible reply.

3.5.1   Program example

The base system station object of ATR type must be created. The common way to do this is to add the following lines to the end of the SYS_BASCON.COM file:

```
#CREATE STA:V = LIST(-
          TT = "EXTERNAL",-
          ST = "ATR",-
          ND = 2,-
          TN = 1)
#CREATE STA1:B = %STA

@NET=2
@STA=1
@LINE=1
```

The following SCIL script can be used to create an IEC 61107 line and a station object to PC-NET 2.

```
#SET NET'NET':SPO'LINE'=26
#SET NET'NET':SDV(27)=(1,1)
#SET NET'NET':SIU'LINE'=0
#SET NET'NET':SBR'LINE'=300
#SET NET'NET':STI'LINE'=25
#SET NET'NET':SPD'LINE'=1000
#SET NET'NET':SRI'LINE'=50
#SET NET'NET':SEN'LINE'=10
#SET NET'NET':SSD'LINE'="COM7" ;uses COM7
#SET STA'STA':SIU=0
#SET STA'STA':SAL=1
#SET STA'STA':SAS='NET'
#SET STA'STA':SIU=1
#SET STA'STA':SHM=2

#SET NET'NET':SIU'LINE'=1
```

The reading of general registers:

```
#SET STA1:SAM = (47,63,33,13,10) /* /?!'cr''lf' */ #SET STA1:SAM =
(6,48,48,49,13,10) /* 'ack'001'cr''lf' */ #SET STA1:SAM =
(1,80,49,2,40,74,74,74,41,3) /* 'soh'P1'stx'(JJJ)'etx' */ #SET STA1:SAM =
(1,82,49,2,71,82,82,40,49,44,50,44,50,41,3) /*
'soh'R1'stx'GRR(1,2,2)'etx' */ #SET STA1:SAM = (1,66,48,3,11 /*
'soh'B0'etx'*/ #SET STA1:SST = 1 /* enable session */ #SET
NET1:SCN1="123456" /* dialing to the IEC 61107 device power meter */
```

Replies:

```
bitstream =(1,/EMO0MT30v2.20'cr''lf')
bitstream = (2,'soh'P0'stx'()'etx''bcc')
bitstream = (3,'ack')
bitstream = (4,'stx'(0*kwh)'cr''lf'(0*kvarh)'etx''bcc')
bitstream = (5,'ack')
```

The following example shows the unpacking of bitstream to bytes:

```
@VEC = UNPACK_STR(BITS:P1,1)
@LEN = LENGTH(%VEC)
@BIT_NO = 1
@I = 0

#LOOP %I < (%LEN DIV 8)
    @VAL = 1
    @BTY = 0
    #LOOP_WITH X = 1 .. 8
        IF %VEC(%BIT_NO) == 1 #THEN #BLOCK
```

```
                @BTY = %BTY + %VAL
                #BLOCK_END
                @VAL = %VAL*2
            @BIT_NO = %BIT_NO + 1
        #LOOP_END
        #SET BITS:P(%I) = %VAL
        @BTY = 0
        @I = %I+1
    #LOOP_END
```

Index

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