Introduction
This application note describes how a communication is established between a local PC and a remote PROCESS-PLC over a phone line.

If you want to use the modem for the controller families NANO, DELTA and PASE-E, it is important that the serial interface supports the '8E1' data format (1 start bit, 8 data bits, even parity and 1 stop bit).

Important Notes
Due to the great variety of modem types available on the market, it is unfortunately not possible to specify a complete, universal initialization command because each manufacturer implements the modem’s command set in a different way.

We tried, however, to generate a documentation of the configuration steps that is as complete as possible. For more detailed information about modem commands and their syntax, please refer to the manual of the respective modem.

Note on Safety
No safety-critical works such as commissioning of axes may be carried out using the modem connection.

Operating Behavior and EMC
It is up to the user to select the most appropriate modem for the intended application, and above all to check electromagnetic compatibility (EMC). (Commercially available modem types usually do not meet the requirements for industrial use !)
Electrical Connections

Overview

Figure 1
Connecting Cable for Modem and PROCESS-PLC
A special cable is necessary to connect the modem with the PROCESS-PLC, i.e. a “null modem cable” which must be manufactured by yourself. Here, the transmitting and receiving wires are crossed. Both ends of the cable are equipped with a SUB-D male connector.

Wiring Diagram

```
<table>
<thead>
<tr>
<th>Modem</th>
<th>9 pin</th>
<th>25 pin</th>
<th>Controller</th>
<th>9 pin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>TXD</td>
<td>2</td>
<td>RXD</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RXD</td>
<td>3</td>
<td>TXD</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>GND</td>
<td>7</td>
<td>GND</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>RTS</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>CTS</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>DSR</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>DTR</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>DCD</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
```

- Connection to DSR - DTR - DCD only necessary when using a WESTERMO modem.
- Make DSR - DTR wire connection only when a telephone connection cannot be established in another way (applies e.g. for Austria).

Figure 2

Connecting Cable for Modem and PC
A commercially available modem cable as delivered with the modem can be used.

Wiring Diagram

```
<table>
<thead>
<tr>
<th>PC</th>
<th>9 pin</th>
<th>25 pin</th>
<th>Modem</th>
<th>9 pin</th>
<th>25 pin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>TXD</td>
<td>2</td>
<td>TXD</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>RXD</td>
<td>3</td>
<td>RXD</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>GND</td>
<td>7</td>
<td>GND</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>RTS</td>
<td>4</td>
<td>RTS</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>CTS</td>
<td>5</td>
<td>CTS</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>DSR</td>
<td>6</td>
<td>DSR</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>DTR</td>
<td>20</td>
<td>DTR</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>DCD</td>
<td>8</td>
<td>DCD</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>RI</td>
<td>22</td>
<td>RI</td>
<td>22</td>
</tr>
</tbody>
</table>
```

Figure 3
## Explanation of Terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Designation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>TxD</td>
<td>Transmit Data</td>
<td>Transmit data from the PC to the modem</td>
</tr>
<tr>
<td>RXD</td>
<td>Receive Data</td>
<td>Receive data from the modem to the PC</td>
</tr>
<tr>
<td>GND</td>
<td>Signal Ground</td>
<td>Signal ground</td>
</tr>
<tr>
<td>RTS</td>
<td>Request to Send</td>
<td>Command from the PC to the modem: Data will be transmitted on the serial interface.</td>
</tr>
<tr>
<td>CTS</td>
<td>Clear to Send</td>
<td>Message from the modem to the PC: Modem is ready to transmit data on the serial interface.</td>
</tr>
<tr>
<td>DSR</td>
<td>Data Set Ready</td>
<td>Message from the modem to the PC: Modem is ready</td>
</tr>
<tr>
<td>DTR</td>
<td>Data Terminal Ready</td>
<td>Message from the PC to the modem: PC is ready. (If this signal is inactive, the modem ignores other signals on the serial interface)</td>
</tr>
<tr>
<td>DCD</td>
<td>Data Carrier Detect</td>
<td>Message from the modem to the PC: The connection has been established</td>
</tr>
<tr>
<td>RI</td>
<td>Ring Indicator</td>
<td>Message from the modem to the PC: Incoming call</td>
</tr>
</tbody>
</table>
Configuring the Modem

Protocol Types
There are two different protocols that need to be taken into account when configuring the modems.

pcom3 Protocol: MIKRO, PASE-E Controllers (old protocol)
In this protocol, the communication between PROCESS-PLC and SYMPAS has the data format '8N1' (1 start bit, 8 data bits, no parity, 1 stop bit).
This data format is supported by any modem. Thus, configuration is reduced to the following points:

a) Deactivating the data flow control and modem result codes of both modems.
b) Ignoring the state of the DTR line (Data Terminal Ready) of the modem on the PLC side.
c) Entering the number of rings (modem register S0) of both modems.

Point a) causes the modems to suppress messages to SYMPAS or the controller which they do not understand.
Points b) and c) ensure that the modems accept a call via the phone line.

pcom5 Protocol: NANO, DELTA, PASE-E Controllers (new protocol)
In this protocol, the '8E1' data format (1 start bit, 8 data bits, even parity, 1 stop bit) is used to exchange data between PROCESS-PLC and SYMPAS. This protocol offers additional transmission reliability due to the parity check.
This data format has an overlength (11 bits instead of 10 bits are transmitted per character compared to the '8N1' data format) and must be preset in the modem separately. Additionally, the following configurations are necessary:

a) Deactivating the data flow control and modem result codes of both modems.
b) Ignoring the state of the DTR line (Data Terminal Ready) of the modem on the PLC side.
c) Entering the number of rings (modem register S0) of both modems.

Point a) causes the modems to suppress messages to SYMPAS or the controller, which they do not understand.
Points b) and c) ensure that the modems accept a call over the phone line.

SYMPAS
SYMPAS provides a terminal mode that serves to input all modem commands. To activate this mode, select Special / Terminal from the menu.

Settings in SYMPAS necessary to configure a modem
If a brand-new modem is connected to SYMPAS, the controller type must be set to "MIKRO" to allow that the modem can understand the configuration commands. To activate the respective dialog window, select Special / Settings... from the menu or press the key combination Ctrl-E.

The modem responds to all commands with "OK" until the configuration command "Disable modem result codes" is issued.

Working with SYMPAS via Modem
The SYMPAS editor can be used to edit programs. The connection is slightly slower than when using a direct RS232 connection but all SYMPAS options are available.
Communication with Controllers via Modem

When using slower modems (< 14440 bit/s), only quit the terminal mode when the DCD line is active or when the DCD-LED on the modem is lit (DCD = Data Carrier Detect). This signal indicates that a connection via phone line was established successfully and that a data carrier signal from the remote end is present. If the terminal mode is quit too early and setup mode is active, the telephone connection will be disconnected immediately. The reason is that the modem receives data from SYMPAS via the serial line while it is establishing the connection. During connection setup, any data received by the modem is a signal to disconnect the connection.

Terminating the Modem Connection

To terminate the telephone connection properly, it is necessary to change to terminal mode again. Type the line ‘+++ ATH’ and confirm by pressing the Enter key.

Another, though not recommended, possibility to terminate the connection is to simply switch off one of the two modems.

If the telephone connection is terminated by the “ATH” command in terminal mode and the mode changes to the SYMPAS setup mode, the phenomena might occur that SYMPAS continues to indicate “NANO B V…running” or something similar. The display changes to “No Sync” only after some time (even after some minutes) or when the mode is changed manually (e.g. to the editor and back). Trying to set or read registers, flags, inputs or outputs does not change this behavior but, of course, provides undefined results.

Saving the modem configuration permanently

Save the correct modem configuration in the non-volatile memory of the modem to ensure that it is retained also the next time the modem is turned on. To do this, issue e.g. the command AT&W or AT*W0.
Exemplary Configurations for Various Modem Types
The following exemplary configurations do not represent device recommendations by Jetter AG.

ELSA MicroLink 56k i
The ELSA MicroLink 56k i was specifically designed for industrial use and provides higher immunity to interference with respect to EMC than commercial office modems.

pcom3 Protocol
The following configuration is necessary:

<table>
<thead>
<tr>
<th>Modem Command</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT&amp;F</td>
<td>Load factory default settings</td>
</tr>
<tr>
<td>AT&amp;D0</td>
<td>Ignore DTR status change</td>
</tr>
<tr>
<td></td>
<td>(Note for Austria: This command is not possible, see Figure 2)</td>
</tr>
<tr>
<td>AT+IFC=0,0</td>
<td>No handshake on serial interface</td>
</tr>
<tr>
<td>ATS0=1</td>
<td>Accept call after 1 ring</td>
</tr>
<tr>
<td>ATX3</td>
<td>Ignore dial tone (for extensions)</td>
</tr>
<tr>
<td>ATQ1</td>
<td>Disable modem result codes</td>
</tr>
<tr>
<td>AT*W0</td>
<td>Save the current configuration in the non-volatile memory of the modem</td>
</tr>
</tbody>
</table>

pcom5 Protocol
This modem type supports a "Pseudo"11Bit mode, i.e. the ‘8E1’ data format is used on the serial interface to the PC/controller, and the ‘8N1’ data format is used on the interface on the telephone side. The data is exchanged across the telephone line independent of the serial interface. This allows to make use of all advantages the modem provides on the telephone line, such as transmission speed, handshake and error correction.

The entire configuration must be performed in the standard data format 8N1. Therefore, SYMPAS must be set to the controller type MIKRO (see section “SYMPAS”).

The following configuration is necessary:

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<tr>
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<td>AT*W0</td>
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</tr>
</tbody>
</table>

Operation
The following commands cause the modem to attempt a call or terminate a telephone connection:

<table>
<thead>
<tr>
<th>Modem Command</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATDTxxx</td>
<td>Call no. xxx by using tone dialing</td>
</tr>
<tr>
<td>+++ATH</td>
<td>Hang up</td>
</tr>
<tr>
<td>ATSV</td>
<td>Display firmware version (should be at least 1.15)</td>
</tr>
</tbody>
</table>
Industrial Modem WESTERMO TD-32
The WESTERMO company produces modems for installation on DIN-rails. The advantage of this kind of modem is that configuration is mainly performed via DIP switches. Please refer to the TD-32 manual for correct identification of the DIP switches.

Wiring
Refer to the section "Wiring Diagram" on page 3.

The following connections need to be made:
- SUB-D male connector between modem and PLC: TxD, RxD and GND
- Wire connection: RTS - CTS
- Wire connection: DSR - DTR - DCD

PCOM3 Protocol
DIP-Switch Setting
Remove the cover from the TD-32 and set the sliders as follows:

SW3: Set DIP-sliders 1 and 3 to ON
SW4: Set DIP-sliders 2, 3 and 8 to ON
SW5: Set DIP-slider 4 to ON

Set all other DIP-sliders to OFF

Software Configuration
The following configuration is necessary:

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<th>Modem Command</th>
<th>Explanation</th>
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</thead>
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<tr>
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<td>Load factory default settings</td>
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<td>ATSO=1</td>
<td>Accept call after 1 ring</td>
</tr>
<tr>
<td>ATX3</td>
<td>Ignore dial tone (for extensions)</td>
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<td>ATQ1</td>
<td>Disable modem result codes</td>
</tr>
<tr>
<td>AT*W0</td>
<td>Save the current configuration in the non-volatile memory of the modem</td>
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PCOM5 Protocol
DIP-Switch Setting
Remove the cover from the TD-32 and set the sliders as follows:

SW3: Set DIP-sliders 1 and 3 to ON
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Set all other DIP-sliders to OFF

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<tr>
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<td>Save the current configuration in the non-volatile memory of the modem</td>
</tr>
</tbody>
</table>
Some Important Modem Commands

Important Note
For configuration commands, please always consult the manual delivered with your modem since different types of modems might work with different commands.

General Commands
(These commands apply to most modem types)

Dialing from the main line

```
ATDP<Tel.#> Pulse dialing method
ATDT<Tel.#> Tone dialing method
```

Dialing from an extension in a private telephone system (private branch exchange, PBX)

```
ATDP0W<Tel.#> Pulse dialing method
ATDT0W<Tel.#> Tone dialing method
```

Connection to the central office by dialing 0. (The modem waits for the dial tone of the central office before dialing the telephone number.)

```
ATX3DP<0+Tel.#> Pulse dialing method
ATX3DT<0+Tel.#> Tone dialing method
```

The modem does not wait for the dial tone of the central office but dials the telephone number at once. When dialing from an extension, a '0' is prefixed to the telephone number.

Terminating a modem connection

```
ATH
```

Usually, the escape sequence `+++` (without Enter key) must be entered before the command is issued to trigger the modem to change from data mode to command mode.

Reseting the modem

```
ATZ
```

The configuration is loaded from the non-volatile memory. Any modem configuration that has been modified in the meantime is overwritten.

Saving the modem configuration

```
AT&W First memory bank
AT*W0 First memory bank
AT*W1 Second memory bank
```

The current modem configuration is saved in the non-volatile memory. Therefore, this configuration is retained when the modem is switched off and is automatically recalled the next time the modem is switched on. For this purpose, most modems offer two independent memory banks to allow that two modem configurations can be saved.

Querying the value of a modem register

```
ATS<Reg.#>? Displays the content of the specified modem register.
```

Write a value to a modem register

```
ATS<Reg.#>=<value> Writes the value to the modem register.
```
Disable modem result codes

ATQ1
All messages sent by the modem to the PC are suppressed.

Enable modem result codes

ATQ0
Exemplary Program

The function in this programming example triggers the connected modem to dial a telephone number over the user-programmable serial interface, and then enables the serial interface for the communication with SYMPAS.

The exemplary program was developed and tested for a PROCESS-PLC NANO-B or NANO-C. For other controller families, the register numbers must be adapted accordingly.

Program Listing

```
0: DEF_FUNCTION [TelephoneDial, TD]
   Par: TelNumberPtr
   Var: help, Digit, ByteCounter
1:   ; This function dials a telephone number
2:   ; over the user-programmable RS232 of the
3:   ; Nano-B and returns to the
4:   ; pcom-5 mode. The TelNo. must be
5:   ; present in a text register and is
6:   ; passed along as parameter.
7:   ;
8:   ;
9:   REGISTER_LOAD [10000 with 1]   ;PC-IO PRIM-protocol
10:  REGISTER_LOAD [10001 with 6]   ;Baud rate 9600
11:  REGISTER_LOAD [10002 with 2]          ;8 bits even, 1 stop
12: DISPLAY_TEXT [#9, cp=0, "atdt"]
13: REGISTER_LOAD [help with RR(TelNumberPtr)]
14: REG help
15: =
16: REG help
17: WAND
18: b000000000000000011111111
19: REGISTER_LOAD [Digit with R(help)]   ;length of TelNo.
20: REGISTER_LOAD [ByteCounter with 3]
21: IF
22: REG Digit
23: =
24: 0
25: THEN
26: REG TelephoneDial
27: =
28: -1
29: RETURN
30: ELSE
31: LABEL Loop
32: REGISTER_LOAD [help with RR(TelNumberPtr)]
33: IF
34: REG ByteCounter
35: =
36: 1
37: THEN
38: REG help
39: =
40: REG help
41: WAND
42: b000000000000000011111111
43: IF
44: REG ByteCounter
```

45: = ; of the register
46: 2
47: THEN
48: REG help
49: =
50: REG help
51: WAND
52: b000000001111111100000000
53: REG help ; and shift to the right
54: =
55: REG help
56: /
57: 256
58: IF
59: REG ByteCounter ; Extract upper digit
60: =
61: 3
62: THEN
63: REG help
64: =
65: REG help
66: WAND
67: b111111110000000000000000
68: REG help ; and shift to the right
69: =
70: REG help
71: /
72: 65536
73: THEN
74: REGISTER_LOAD [10003 with R(help)] ; Output digit
75: REG ByteCounter ; next byte
76: =
77: REG ByteCounter
78: +
79: 1
80: REG Digit ; and one digit less
81: =
82: REG Digit
83: -
84: 1
85: IF
86: REG Digit ; no digit available anymore?
87: =
88: 0
89: THEN
90: GOTO Exit ; then dialing completed
91: ELSE
92: IF
93: REG ByteCounter ; if ByteCounter too large
94: =
95: 4
96: THEN
97: REG ByteCounter ; then adapt ByteCounter
98: =
99: 1
100: REG TelNumberPtr ; and fetch new
101: =
102: REG TelNumberPtr ; text register
103: +
104:       1
105:     THEN
106:       GOTO Loop
107: Label Exit
108:       REGISTER_LOAD [10003 with 13] ; end dialing
109:     WHEN
110:       REGZERO 10004
111:     THEN
112:       REGISTER_LOAD [10000 with 0] ; then PC-IO pcocm-5
113:       REG TelephoneDial ; and end of function
114:       =
115:       0
116:     RETURN
117: END_DEF
118: ;
119: ;
120: Task 0 -----------------------------------
121: WHEN
122:     E 101
123: THEN
124:     TelephoneDial [TelNumberPtr=telno]
125:     DELAY 50
126:     GOTO 0
End of program

Symbol file

telno       100 = "92"
Loop        !
Exit        !