

GSM modem for PGU connection, SMS and poll SMS

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Project history

Date	Author	Modification
2006	TCS / cd	Creation of documentation (version 1) and project for PG5 1.4.300
2007	TCS / cd	Updated with Q.G736-AS2 GSM terminal (version 2)
27/01/2010	TCS / cd	Updated project for PG5 2.0 Added "Read GSM Level" FBox (Version 3)

1. Summary

1.1 Functional description

This sample project is intended to show it is possible to

- establish an **online connection** between PG5 and a PCD using a GSM terminal
- send SMS messages
- receive SMS messages and interpret their content by the use of the DTMF driver

All those functionalities are programmed in Fupla by the use of the Modem library. The PCD has to be equipped with a GSM terminal Q.G736-AS2 in order to be able to receive SMS messages.

1.2 Possible application

The main advantage of a GSM terminal is that there is no need for a landline in order to access the PCD remotely.

This sample project may be used as base for every program where remote access to a PCD is required.

The possibility of sending SMS messages may be used for alarming e.g. the maintainer of a remote installation in case there is a problem detected. This way the maintainer will most likely know about the problem before the end user will recognise the problem.

1.3 Hardware and software used

Hardware

- PCD: PCD3.M5540 Firmware 1.10.16 or later
- GSM terminal¹: Q.G736-AS2 SIM card must support data service!
- A modem cable for connecting the PCD3 to the modem (straight D-SUB 9 pin cable)

Minimal software versions:

- SAIA PG5 2.0.110 with Fupla Modem library licensed (or at least in demo mode)
- HyperTerminal of Windows (optional)

¹ Since the reading of SMS messages from the SIM is realised by a special command set, there is no guarantee that this functionality is supported for all GSM terminals. Therefore the use of the GSM terminals Q.G736-AS2 provided by SAIA Burgess Controls AG is absolutely recommended.

2. Procedure before Fupla programming

2.1 Preparing the SIM card

SIM cards are protected by a PIN code by default. Therefore either the PIN code must be entered in the Initialisation string of the modem (configured in the hardware settings of the PCD) or the PIN code must be disabled.

In usual cases it is the easier way to enter the PIN code in the initialisation string of the modem. The initialisation string (init string) will be sent to the modem on start-up of the PCD and is used to configure the modem. One important setting initialized by the init string is e.g. the answer mode. This mode defines whether the modem shall answer an incoming call (which might be undesirable in some cases) or not.



In this document a virtual PIN code (1234) is used (configured in the Device Configurator). It is absolutely necessary to adjust this code to the code of your SIM!

2.1.1 Disabling the PIN code statically

The easiest way to disable the PIN code of a SIM card it using the HyperTerminal which is standard software delivered together with Windows.

The GSM terminal has to be connected to the COM port of the PC with a non-crossed RS232 cable (modem cable).

```
at+cpin?                ;;Is the PIN code disabled?
+CPIN: SIM PIN          ;;NO
OK

at+cpin="1208"           ;;Entering PIN Code
OK

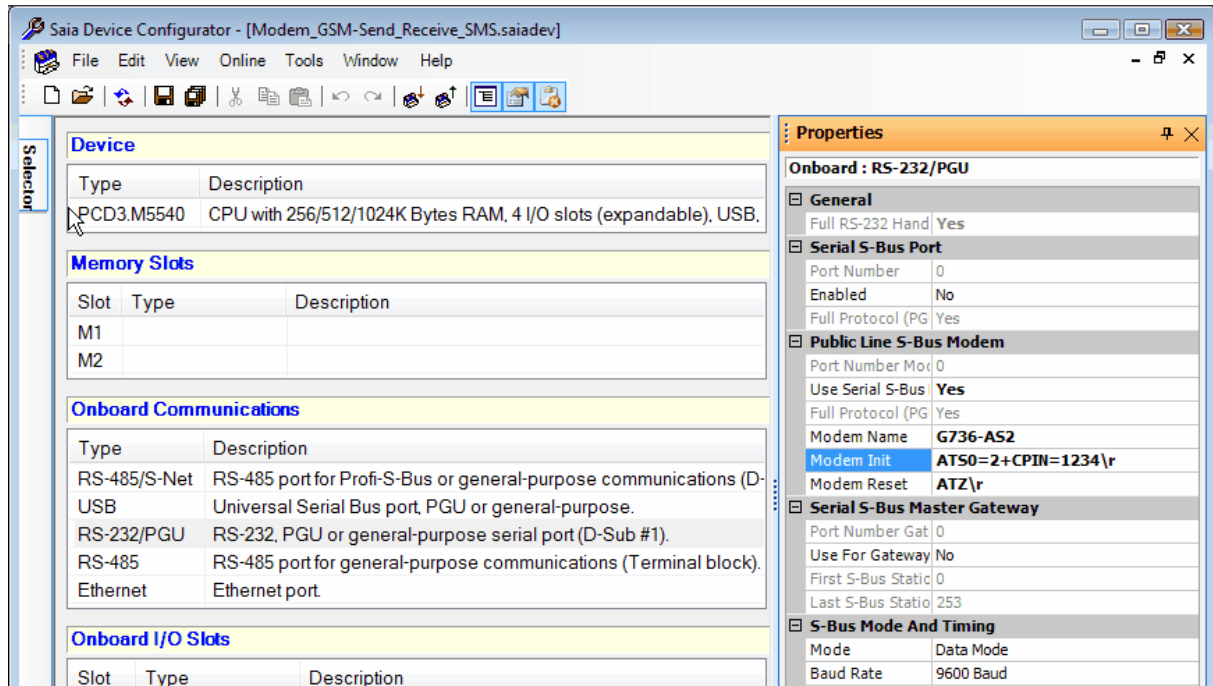
at+clck="SC",0,"1234"    ;;Disabling PIN Code of the SIM card
OK                       ;;OK, the PIN code is disabled
```

2.1.2 Configuring the PIN Code in the Init string

In order to disable the PIN code (only for the time until the next power down of the modem) it must be supplied in the init sting. The init string is configured using the Device Configurator in the RS232/PGU port properties. The Device Configurator can be opened from PG5 Project Manager *Project tree*).

ATS0=2+CPIN=1234\r

By default the init string: **ATS0=2+CPIN=nnnn\r** is entered in the corresponding field. So the nnnn has to be replaced by the PIN code of your SIM card.



Note that the configuration in the Device Configurator needs to be downloaded separately (and is not downloaded together with the PCD program).

2.1.3 Data Service

For transmitting the telegrams of the S-Bus protocol which is used for the communication between the PG5 and the PCD the SIM card must support the „data service“. Note that this is not the same as “WAP” service or „GPRS“. Please ask your provider to enable the data service on your SIM card.

However, sending and receiving SMS messages don't require data service.

Please consider that the GSM network doesn't cover every place. Therefore make sure the network is available at the site you'll install the PCD equipped with the GSM terminal (modem).

2.2 Configuring the PCD

In case the example project will be run on another type than the HW settings are configured for, please adjust the PCD type in the Device Configurator and adapt the port settings in the Device Configurator and in the Modem 18 FBox. Once this is done, rebuild the whole project before downloading the hardware configuration and code.

A GSM terminal must be connected to the PCD by a RS232 full connection in order to establish a S-Bus or PGU connection. This means that:

- on a PCD3.M5 or a PCD2.M5 controller it is also possible using the onboard port 0.
- on a PCD3 it is also possible using a PCD3.F121 or a PCD3.F2xx with RS232 interface
- on a PCD2.M5 it is also possible using a PCD2.F2xxx with a RS232 interface
- on a PCD1 or a PCD2.M1xx either a PCD7.F12x or a PCD7.F552 is required (it is not possible using the PGU port for a modem connection)
- on a PCS1 the internal modem option must be used (it is not possible using the PGU port or an additional PCD7.F12x for a modem connection on a PCS)

The lines (RX / TX etc.) are not to be crossed.

3. Functional description and settings in Fupla

3.1 Page 1: Standby mode for online connection

In order to establish an online connection from the PG5 to the PCD three preconditions must be fulfilled:

- The modem must be configured in the Device Configurator and this configuration must be loaded on the PCD
- The S-Bus mode in the hardware settings must be S-Bus Data (or Secure S-Bus Data mode, see FAQ 100713)
- If a “Modem 18” FBox is used, the “default standby mode” must be set to “S-Bus PGU”

If those three points are fulfilled, the PCD will answer an incoming call and tries establishing a connection to PG5. The master of this connection will be PG5.

Over this connection it is possible to configure, reprogram and stop/start the PCD.

In this configuration the PCD will also answer if the PCD is in stop or halt mode.

Please make sure that in the Device Configurator of PG5 as well as in the “Modem 18” FBox the correct modem type is selected.



For going online with a PCD equipped with a Q.G736-AS2, the PCD is to be equipped with either an analogue or with another GSM modem. It is not possible to go online with an ISDN modem on the PC and a GSM modem on the PCD.

Due to the relatively long “Round Trip Delay” of GSM connections the performance of e.g. an online connection will be significantly lower than used from other communication methods such as USB or Ethernet connections. On a GSM network, around one S-Bus request will be transmitted per second (about 255 bytes).

3.1.1 Settings of the “Modem 18 FBox” that are not default values

The settings listed below aren’t default settings that are set as soon as the Modem 18 FBox is placed.

- Default S-Bus Mode (S-Bus PGU)
- Full Handshake
- Modem type (select the modem you use)
- Answer mode: Auto-answer
- Dial signal (GSM)

The FBox can be found in the family “Modem” in the “App” tab of the FBox selector. If the FBox selector isn’t shown on your Fupla window, select it from the menu “View”.

3.1.2 Reading the signal quality of the GSM network

The signal quality of the GSM network can be checked with the FBox “Read GSM Level”. The lower the output “Level”, the weaker is the signal quality (and thus the slower the connection will be). The experience shows that a value of 5 and lower is not suitable for a properly working online connection or for the transmission of SMS messages.

Every time the FBox reads the signal state, an initialisation of the Modem will be executed. Because of this fact, the FBox in the example program does not read the state cyclically (which could lead to unintended interruptions of online connections)

The level code is given according to the following table

<u>Level</u>	<u>Signal</u>	<u>Quality</u>
0	-113 dBm or less	Marginal
1..9	-111... -95 dBm	Marginal
10..14	-94... -85 dBm	Workable
15..19	-84... -75 dBm	Good
20..30	-74... -53 dBm	Excellent
31	-51 dBm or greather	Excellent
99	not known or not detectable	

Explanation of the quality

Marginal	At these sort of levels, it is very likely that you may suffer low throughput and disconnects due to cell loading/breathing even with an outdoor antenna. A properly working online connection or the transmission of SMS messages can not be guaranteed.
Workable	Probably worth considering an outdoor gain type antenna. Could suffer poor throughput and disconnects due to cell loading/breathing.
Good	Normally no problem holding a connection with this sort of level (even with cell breathing) without the use of an external antenna.
Excellent	Should not be affected by cell breathing/loading and should not require an external antenna.

3.2 Page 2: Sending SMS messages

On the second page of the Fupla file the FBoxes for sending SMS messages are placed. This task requires at least two FBoxes:

3.2.1 FBox “Call SMS”

The first FBox organises the communication between the SMS server and the PCD. Therefore the phone number of the SMS server (you’ll get this number from you provider; it is the same number as a mobile phone uses for sending SMS messages) is to be specified here.

Note that in case a country code is required, the “+” (indicating two zeros) sign is to be replaced by a “!”. The reason for this change lies in the different character set used by PG5 and the GSM modem.

Since the numbers entered in the parameter boxes of the FBox will be stored in a PCD register (32 bit) in “char format” (one character requires 4 bits), only 8 numbers (characters) may be hold by one register. Therefore the phone numbers will be divided in several registers.

Additionally, the destinations of the SMS messages are to be defined in this FBox. Note that the parameter “Service prefix” may only be used if all destinations do have an identical service prefix. In most cases this is not the case what causes the “service prefix” being not used at all and left empty.

The parameter “Originator” is only used if the SMS is sent by an analogue modem and has no effect if used with a GSM modem.

The input “En” of the FBox enables the FBox. SMS messages are only sent if this input has the state “1” (high).

3.2.2 Settings of the “Call SMS” FBox that are not default values

The settings listed below aren’t default settings that are set as soon as the “Call SMS” FBox is placed.

- SMS server number (Tf number1..3); enter the SMS server of your provider
- Protocol option; select “GSM-text”
- Destinations; enter the cell phone number(s) where the SMS messages are to be sent

3.2.3 FBox „Send SMS“

The second FBox on this page is used to trigger the single SMS messages to be sent. Further on destination of the SMS as well as the content of the message is specified (by providing the text address to be sent).

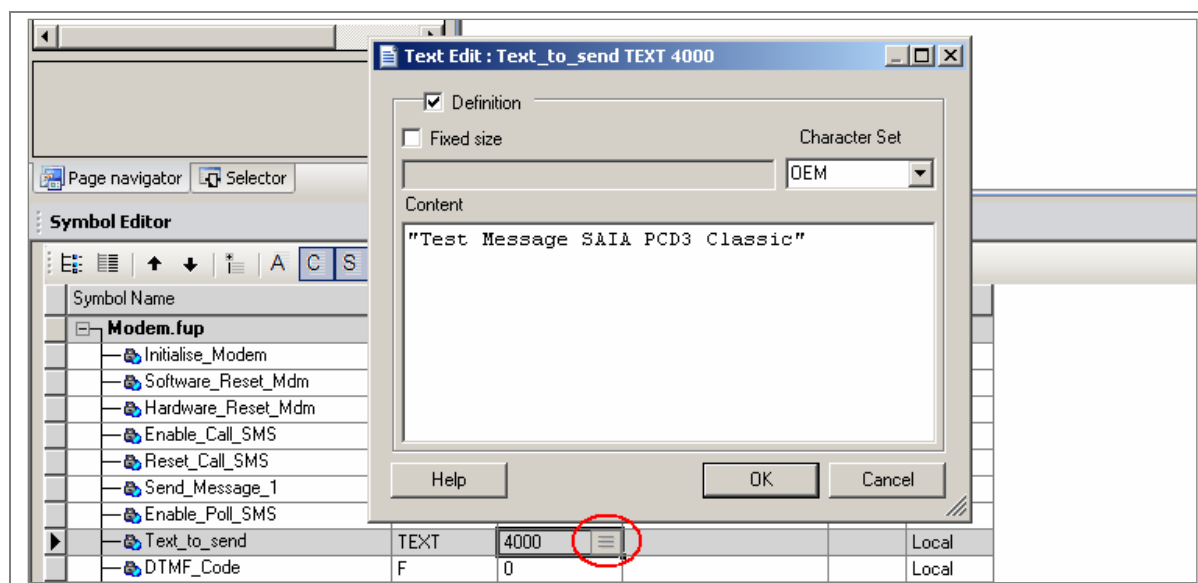
For every combination of recipient and message one “Send SMS” FBox is required.

Every time the state of the input “Cal” rises from 0 to 1, the specified message is sent to the according recipient (“1” means to “Destination 1” of the Call SMS FBox and not the phone number “1”; in this example it is the number 079 000 00 00). If the first attempt of sending the SMS message fails, it will be repeated according the maximal retry count which is specified in the FBox “Call SMS”).

A message will be regarded as sent if the SMS server responds with an “OK” at the end of the transmission. This doesn’t mean that the message was received by the recipient.

The content of the text address entered on the face of the FBox will be sent. In the example the text does have the symbolic name “Text_to_send”. This text contains “Text Message Saia PCD3 Classic”. The definition for this text is done in the Edit Text window (see below) that is opened by double-clicking the small box (marked red in the screenshot below) behind the text address in the Symbol editor.

Select “GSM” as Character set in the text definition window (this setting only takes effect if special character are sent).



3.2.4 Settings of the “Send SMS” FBox that are not default values

The settings listed below aren’t default values that are set as soon as the “Call SMS” FBox is placed.

- The destination is depending on the recipient to whom the message is to be sent.
- The Text to be sent in the message has to be defined in the Symbol Editor; its symbol name is to be entered on the face of the FBox

In case the option “Convert \$ commands in texts” is configured to “Yes”, it is possible transmitting Register contents or the current time/date of the PCD in a message (enter e.g. \$R0010 for the content or \$H \$D for time and date).

Note that the maximum length of an SMS message is around 160 characters.

3.3 Page 3: receiving SMS messages

The reception of SMS messages is realised through the FBox „Poll SMS“. This FBox polls the GSM terminal in intervals. If the modem states to have received a message, this message will be read and passed to the DTMF driver (Dual Tone Multi-Frequency; in fact we don't have a frequency in this case, but the driver interprets the characters received in the SMS as if he got them from a modem supporting DTMF). The DTMF driver will then set the according flags of registers.

The DTMF driver features a functionality to respond to the sender according to the actions he has done (whether all commands were executed or not)

3.3.1 The “Poll SMS” FBox

In the adjust window of the „Poll SMS“ FBox the SMS protocol is to be set to DTMF. The other parameters may be set to default values.

Optionally the address of the confirmation message may be set to either the originator of the message or to a static number.

The interval, in which the modem is polled, may also be adjusted. In this relation it is important to keep in mind that while the modem is polled, it can't answer to incoming calls.

As soon as a message is read from the SIM card, it will be deleted.



The FBox needs some specific data that it receives every time a message is sent. Therefore at least one message has been sent before the polling mechanism works!



Please make sure that the SMS memory of the SIM card is empty. The PCD will read one message per polling cycle. If there memory of the SIM is full before inserted to the modem, it will take a long time until all messages are read (and interpreted as invalid).

3.3.2 The DTMF FBoxes

The content of a message has to have the common DTMF syntax (see example below).

The access code in this example is 1234. It is the first command to be given.

1*1234#500*1*1#600*0*5678#.

Description of the DTMF code:

1*1234#	Entering the access code.
500*1*1#	Setting the second output of the FBox “DTMF USet” with the function code 500. The function code is specified in the adjust window of the according FBox.
600*0*5678#	Setting the first output value of the FBox “DTMF UPar” (Function code 600) to 5678.

The access code is to be entered as first command in every message!

4. Errors and debugging

4.1 Common errors

The list below describes some of the common problems and their reasons related with the in this document described features.

Error	Cause and resolution of error
The GSM modem is not reachable	Please check whether the modem accepts the PIN code configured. The best way to do this is with the HyperTerminal (see chapter 2.1) Make sure the GSM modem is placed in a site where the GSM network is available (check e.g. with a normal mobile phone)
No online connection to the PG5 is possible	Check whether data mode is supported by your SIM card (see chapter 2.1.3). Note that some providers sell SIM cards with several numbers; one supporting data service and one not supporting it (but e.g. Voice calls).
No SMS messages are sent	Check the number of the SMS servers and make sure you haven't used the „+“ as prefix for a country code for the SMS server but a „!“.
SMS messages are empty	Maybe the memory for preparing the message is read-only (e.g. flash). Make sure the „Build options“ are correct (or default).
	Maybe the PCD firmware does not support the „CopyText“ function (see FAQ 100886) and it is required because the „Call SMS“ parameter „Use \$-commands in texts“ is set to „Yes“ or „use Text delimiter“ is set to „No“. Update the firmware of the PCD or disable the option „Use \$-commands in texts“ and enable „use Text delimiter“.
The FBox „Modem 18“ shows a „Fatal Error“ in the diagnostics	Make sure the connection from PCD to the modem is done properly. The lines mustn't be crossed!
	Check whether the hardware settings do fit the settings in the Modem 18 FBox.

4.2 Troubleshooting / debugging

When troubleshooting, it is advisable to start with an underlying function and test further functions one by one. It makes sense to start e.g. by checking whether an online connection is possible without programming the PCD (only downloading the hardware settings with the modem configuration).

The next step would be sending SMS messages, and finally the reception of the SMS messages.

The adjust window of the "Modem 18" FBox is a very helpful tool since in this window the error will be listed. Together with the online help most error code values shown on this page may be interpreted.

If in this window an error code with a value higher than 3000 is displayed, it indicates a problem with the text to be sent. In this case, have a look at the text; it probably doesn't exist at all.

4.3 Restrictions

The functionality „PGU and DTMF“ as default standby mode (see FBox „Modem 18“) is not possible because DTMF is not supported by the GSM networks.

4.4 Sources

(Nearly) all the information found in this document can be found in the online help of PG5.