

Module for the remote GSM reading of the FLOMAG 3000 induction flowmeter

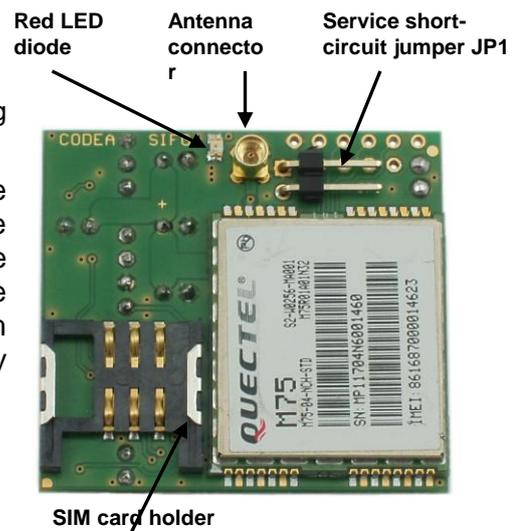
SAFETY INSTRUCTIONS

- Proceed carefully when handling the **GSM module G1** and respect the safety precautions against electrostatic discharge and do so with a disconnected power source.
- Before handling the module, touch the metal part of the meter first to discharge any dangerous electrostatic charge.
- If the module is powered, do not touch the conductive path on the module board with metal objects.
- Lead the external cable of the antenna through the relevant bushing.

1. Description

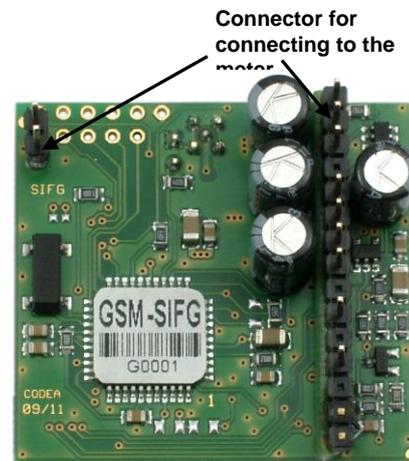
GSM module G1 is an additional module for Flomag induction meters.

The module is used for wireless data transfer (remote reading) in the form of SMS text messages via the GSM network. Messages are sent out in pre-set time intervals. When it is not sending SMS messages, the module is in standby mode and disconnected from the GSM network. The module is programmed by configuration SMS text messages.



A red LED diode located on the module board (see picture) indicates the status during the initiation, module operation mode and indicates failures.

The inserting service short-circuit jumper (JP1) is located next to the antenna connector and red LED diode and is used for service purposes. A permanently inserted jumper will set the module to idle mode. This jumper must be removed for operation.



The module is powered from the meter over the meter communication interface, to which it is connected using a connector. The module comes standardly with an external GSM antenna.

2. Installation and assembly

The **GSM module G1** set contains the following:

- **GSM module G1**
- external GSM antenna with connector cable terminated by coaxial connector (MMCX)
- shorting jumper



The FLOMAG 3000 induction flowmeter contains several positions for inserting plug-in modules. These positions are visible upon opening the cover of the meter. The GSM0SIFG communication module is inserted into positions 3 and 6 and covers the positions of modules 4 and 5 (see module assembly pictures further).

If impulse outputs on positions 4 and 5 are used, a special low-profile module is used.

2.1 Installation procedure

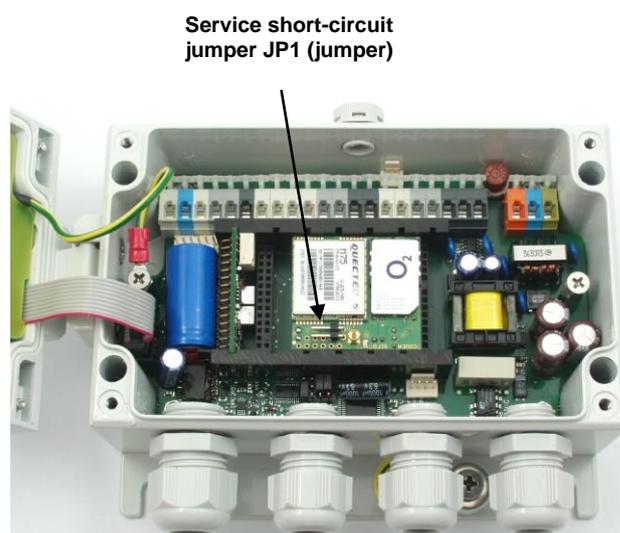
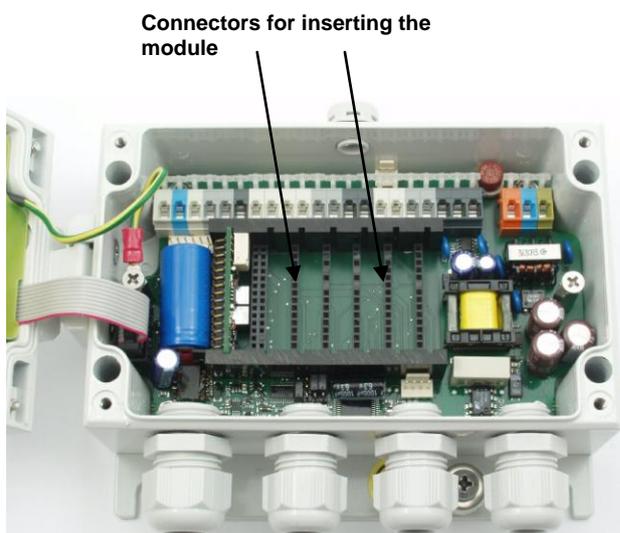
- pre-setting the SIM card (canceling the PIN, saving a phone number, ...), chap. 3.2
- disconnecting the power source of the meter
- inserting the pre-set SIM card into the module
- Inserting the module into the meter
- connecting the antenna cable to the module antenna connector
- connecting the power source of the meter
- starting the GSM module by inserting jumper JP1 (for 1-9 sec) see chap. 3.3 Starting the GSM module

2.2 SIM card preparation

Pre-set the SIM card according to chap. 3.2

2.3 Inserting the SIM card into the holder and communication module into the meter

- Prior to installing the communication module into the meter **disconnect the power source**,
- pay attention to the module orientation according to the attached pictures,
- insert the SIM card - as shown, insert the SIM card into the holder and carefully push into the pocket to the edge of the holder (module),
- install the module into the meter by inserting into connector positions specified for plug-in modules 3 and 5 on the bottom part of the electronics and gently pushing in the direction of the bottom of the meter.



2.4 Installing an external GSM antenna, connecting the antenna cable into the module

The **GSM module G1** is installed with an external GSM antenna.

- pull the connecting cable of the antenna through an unoccupied bushing available for the given meter,
- attach the coaxial connector (MMCX) on the end of the connecting cable of the antenna and with gentle force, click into the antenna connector on the GSM module G1,
- place the external antenna at a suitable location with sufficient GSM signal.

2.5 Finishing the installation and starting the GSM module

- connect the power source of the meter after carrying out the mechanical installation of the module,
- continue to start the module according to chap. 3.3 (inserting jumper JP1 for 1-9 sec, etc.).

3. GSM part of the module

3.1 Technical specifications

frequency	900, 1800 MHz
transmitting power	max. 2W for 900 MHz and max. 1W for 1800 MHz
range	according to GSM network availability
power source	from the meter interface

3.2 SIM card preparation

During a mechanical installation of the **GSM module G1**, a SIM card is also inserted into the meter along with the module. This SIM card must be prepared prior being inserted into the module, for example, using a common mobile phone.

Cancel the access PIN on the SIM card, it is also suitable to have your **voice mail blocked**. **As the first phone book entry, insert the phone number of the station** to which SMS text messages shall be sent. The phone number shall be entered in international format (+420123456789).

Save other numbers you will use to control the GSM module G1 to positions 2-10. The module only reacts to SMS messages from phone numbers stored in the phone book. SMS messages can also be sent to these phone numbers via JP1.

Before inserting the SIM card into the GSM module, you can (for example again by using a common mobile phone) also **save a configuration SMS** message on it (with parameters see chap. 3.6). Another option is then **sending a configuration SMS** message from a common mobile phone (however, from a phone number saved in the phone book on the SIM card in the module) to the phone number of the SIM card inserted in the GSM module prior to starting the module.

If the GSM module was already configured before and there is no request for changing the configuration, the last known configuration is maintained, therefore it is not necessary to store or send a new configuration SMS message.

3.3 Starting the GSM module

In order for the GSM module to be properly configured, a **configuration SMS** message shall be sent (or saved on the SIM card) prior to initiating the module start (you can also have multiple SMS messages, with parameters see chap. 3.6).

If receiving SMS messages is initialized via JP1, the sender of this configuration SMS is not checked in the module, based on the phone number saved on the SIM card, and the request stated in the configuration messages **will be carried out**.

If the module was assembled mechanically, including antenna, inserted SIM card and connected to the power source of the meter, you can continue to the module start.

Start the module by requesting to accept, process and send an SMS message by inserting the service shorting jumper (according to 3.4. GSM module function).

To achieve proper functionality, this start-up process must be repeated after each insertion of the module.

3.4 GSM module function

The **GSM module G1** is powered from the meter interface.

Communication module **GSM module G1** data for the measured volume into the archive at regular intervals and after the archive is full, archive data SMS messages are sent automatically.

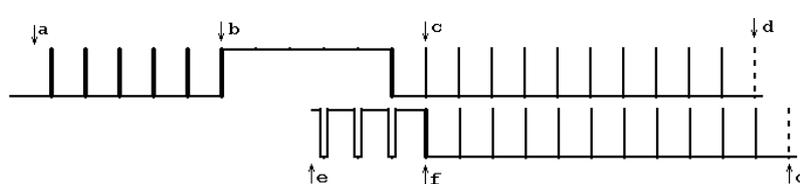
The GSM module has three action modes: inactive, standby and active.

In **inactive mode**, the module has all actions deactivated and it monitors the status of configuration jumper JP1.

To save energy, the GSM part of the module is completely turned off if configuration jumper JP1 is removed (aside from active mode). Only the module processor runs in **standby mode** with a micro power input. The processor only checks the time and the module operation initiates for planned times or after inserting service shorting jumper JP1 (active mode).

Inserting shorting jumper JP1 starts operation - **active mode**.

Flashing LED after the insertion of JP1



- the interval between individual flashes is 1 second. The course of flashing/illumination is shown in the picture:

- a) connecting jumper JP1 - start process
this is followed by 5 LED flashes
 - if JP1 is disconnected after flash 1 to 5, the module will send **data (archive binary) SMS** to the phone number which is at position 1 in the phone book
- b) LED diode lit for 5 seconds - if JP1 is disconnected during this interval, it will go to phase e)
- c) up to 10 short LED flashes - disconnecting JP1 after n flashes will send a **data SMS** message to the phone number listed as entry n in the phone book
- d) if JP1 remains connected, the module reaches the phase where **inactive mode** is enabled
- e) JP1 disconnected - module flashes 3 times inversely
- f) JP1 status
 - if JP1 remains disconnected - a **service SMS** is sent to the phone number listed as entry number 1 in the phone book
 - if the jumper was connected again during the course of phase e), up to 10 short flashes will be executed - disconnecting JP1 after n flashes will send a **service SMS** message to the phone number listed as entry n in the phone book
- g) returns back to phase a) - if JP1 remains short-circuited for another 20s (phase a)b)c) goes to phase d) and enables inactive mode

To send a service SMS, the jumper must be disconnected within 5 seconds (phase b) of continuous red LED diode illumination!

Accessing the GSM network and sending SMS

Communication is established with the meter first (about 2-5 sec). A flashing red LED (1 sec) indicates the proper reading of data and the process continues with the activation of GSM and sending an SMS message. The internal real time is synchronized with the time read from the meter during each communication.

If no data is received from the meter, a red LED will quickly flash twice (lit about 0.2 sec with a delay of about 0.5 sec) and if incomplete data is read, the red LED will begin shortly flashing three times. If communicating with the meter fails, the process is repeated after about 30 sec 6 times and LED indication as well. If no data was read, the module will send an SMS message with zero data.

The power activation for the GSM part of the module continues. The red LED will continue to indicate this with a less intensive light. The GSM part is then registered into the GSM operator's network (approx. 20 sec).

The module determines whether the configuration SMS messages were received, this takes about 120 sec. If the configuration SMS messages are received, the status of their processing is indicated with **two longer flashes** (approx. 2x 1 sec with a delay of 0.5 sec). The maximum number of received SMS messages is 5.

If a request to send an SMS message (from JP1, PER1, Dx Hx accordance) was given at the beginning of the login process, an SMS message is sent containing the data read from meters. The successful sending of an SMS message is followed by **one longer LED flash** (about 1 sec).

If the configuration SMS message contained a request to send a data or service SMS, the module will read new data from the meters (without LED indication) and the SMS is sent.

The GSM part of the module then logs off from the operator network, deactivates the power source and the less intensive red LED light will be disabled. If everything is in order, the entire process of sending an SMS takes about 120 to 180 sec. This period can also be affected by the status of the GSM network, operator, number of configuration SMS messages received or the SIM card used.

If problems are encountered with sending an SMS (GSM part), the red LED will shortly flash several times (0.2 sec with a delay of 0.5 sec) in three identical clusters (e.g. loss of communication with GSM is indicated as follows: 2 flashes, 1 sec pause, 2 flashes, 1 sec pause, 2 flashes). The number of flashes for one cluster expresses the type of problem:

Indication of an issue	Possible cause	Elimination
2 flashes	communication lost with GSM module usually indicates a problem with the power segment of the module	reduce the overheating of the meter and module
3 flashes	cannot login to operator	weak signal, or incorrectly attached antenna, SIM card error, etc.
4 flashes	cannot determine phone number of recipient	phone number entered incorrectly or missing number at position one on the SIM card
5 flashes	GSM module rejected or did not confirm the sending of an SMS	weak signal, or incorrectly attached antenna, SIM card error, etc.

After indicating an error by flashing, the module will attempt to send an SMS message again. The module is programmed for a total of 3 attempts to send an SMS message. After carrying out these attempts, the module will switch off.

If any of the above stated problems occur, the SIM card shall be checked along with the antenna connection or inserted connector into the meter.

Data form (*archive binary*) of SMS message:

- multiple byte variable byte order is always from lowest to highest in the direction of the end of the SMS.

Length [1byte]	- SMS heading
Length [4byte]	- serial number of meter
Length [1byte]	- year archive SMS was saved
Length [1byte]	- month archive SMS was saved
Length [1byte]	- day archive SMS was saved
Length [1byte]	- hour archive SMS was saved
Length [1byte]	- minute archive SMS was saved
Length [1byte]	- interval for storing values to archive 1-60 in [min] and 61 and more in [hours], i.e. 61 = 1 hour, 62 = 2hours, 63 = 3hours ...
Length [1byte]	- rotation – the number of times a value in [ml] is divided by 2 – all values for start and increment
Length [6byte]	- start value in value archive in [ml]
Length [60x2byte]	- increments in value archive in [ml]

Service SMS message format:

*xyzW12	- information on SMS, meter and SW * = SMS type (* = data, # = service, ! = beyond plan, e.g. with fault), x = meter type 1symbol ('A'..'Z', 'O'=Flomag..), y = SW version for SIFG module, 1symbol (0,'A'..'Z'), z = SW version of meter, 1symbol ('A'..'Z') W=identifies the phone book used on SIM ('S'=SM standard, 'F'=FD fixed option, 'E'- reading error), 12=signal level in [-dBm] (20..99) – see. AT+CSQ, see also SF and SQ data
V=12345m3	- overall volume
01/02/03 12:34	- time stamp dd/mm/yy hh:mm, module time read from meter
ST=ABcdEF, PER1, stavPER1, PERA	- planning status, coded per symbol A =DEN1, B =HOD1, c =DEN2, d =HOD2, E =DEN3, F =HOD3 coding per symbol ('0','A'..'Z','1'..'5' = 0,1..26,27..31 and negative 'a'..'z','6'..'9','!' = -1..-26, -27..-30,-31).
PER1 = period in [min], stavPER1 =remaining time until end of period in [min], PERA = 0..10	
SA=2	- interval status in [min] storing to archive

Example of **service** SMS message format:

#00AS67 V=3m3 10/10/11 09:07 ST=aBJBTB,28800,27704,1 SA=2

3.5 GSM module deactivation (inactive mode)

Prior to removing the GSM module from the meter, it is recommended to perform the deactivation process - enabling inactive mode on the module. **Before mechanically removing the module, disconnect the power source of the meter!**

The module can be deactivated by inserting shorting jumper JP1 according to 3.4.

The module can again be started by removing jumper JP1 for 2 or more seconds and re-inserting it according to 3.4.

3.6 Setting GSM module parameters via a configuration SMS message

GSM module parameters are configured by sending a configuration SMS message via a GSM modem from the control room or a common mobile phone to the phone number of the SIM card inserted in the module (or also by saving this configuration SMS message directly on the SIM card before inserting it into the module).

The format of this message and meaning of keywords contained within the message are described in detail in the following chapter.

The communication module then sends SMS messages with data obtained from meter when at least one of the following conditions is satisfied:

- 1) service jumper (JP1) was inserted according to 3.4,
- 2) the parameters set for **D1(day)** and **H1(hour)** or **D2** and **H2** or **D3** and **H3** are identical with the real time values (according to the internal time of the meter),
- 3) lapsed time **PER1** minutes from the previous periodical login to the GSM network and parameter **PERA:1** is set.

Note: If another request to send an SMS message is given during a period shorter than 5 minutes from the previous request, only the first of these SMS messages will be sent. For activations carried out by a short insertion of the shorting jumper (JP1), the SMS message is sent without this restriction.

3.6.1 Definition of keywords and parameter ranges

Parameters **Dx**, **Hx**, **PER1**, **PERA**, **WRTNx**, **SMSD:**, **SMSS:**, **AR:** can be set by sending an SMS message to the phone number of the SIM card used in the GSM module G1. The message sent consists of text strings (keywords with number data) for setting individual parameters (only the ones contained in the sent message are changed, others remain unchanged) and a space serves as a separator. Setting each parameter consists of a keyword and several numbers or symbols. The first separator between data is “:”, others are “,”. It is necessary to respect the below given format - i.e. use capital letters and insert a space between each parameter.

Dx:y...sequence number of the day of the month on which the service SMS message will be sent.

whereby **x** ranges from **1 to 3** and **y** ranges from **-31 to -1, 1 to 31** (a negative number represents the sequence from the end of the month, 0 or a number beyond the specified ranges (two-digit maximum) deactivates the sending of the SMS according to this parameter)

*The default setting is **D1:-1 D2:10 D3:20***

Hx:y ...hour (relevant to parameter Dx) at the beginning of which a service SMS is sent.

whereby **x** ranges from **1 to 3** and **y** ranges from **0 to 23** (number beyond the specified range deactivates the sending of the SMS according to this parameter).

*The default setting is **H1:2 H2:2 H3:2***

PER1:ythis parameter defines the period for the automatic GSM network login (configuration SMS messages are received concurrently). The period commences the moment a configuration SMS message is received.

whereby **y** ranges from **6 to 65 535** minutes (about 45 days). If a value of **0** is entered, the periodical login will be deactivated.

If the below described parameter is set to **PERA:1**, a service SMS message including data will be sent during the GSM network login.

*The default setting is **PER1:28800***

PERA:ythis parameter specifies whether a service SMS message will be sent during the GSM network login.

whereby **y** is **0, 1 or 2**.

A value of **0**, for an interval defined by parameter **PER1**, represents only logging into the GSM network, without sending an SMS message (only receives and processes the incoming configuration SMS).

A value of **1** sets the sending SMS including data within the **PER1** interval.

A value of **2** sets the sending of SMS including data within every other **PER1** interval.

*The default setting is **PER:1***

WRTNx:y this parameter is used to configure (change) the phone number stored on the SIM card in the module,

whereby **x** ranges from **1 to 9** and represents the order of phone numbers stored on the SIM card in the module,

y is the newly requested phone number for saving to SIM card in international format, i.e. **+420123456789**

SMSD:this parameter defines the request to send the current data archive (binary) SMS messages that are in progress.

This parameter can be used in situations when a request to send a data SMS message is given, e.g. beyond the scheduled term, or when a data SMS is requested to be sent within the scope of periodical login to the operator's network, in spite of this parameter being set to PERA=0.

SMSD:YYMMDDHH,Xthis parameter defines a send request and number of data archive (binary) SMS messages for the required date and time,

whereby **YYMMDDHH** represents the date in two-digit format year, month, day, hour and **X** represents the number of SMS messages required. The maximum number of SMS messages sent is **8**.

SMSD:-1 ...this parameter defines the request to send the last complete (already sent) data archive (binary) SMS messages.

SMSS:this parameter defines the request to send a service symbol SMS message (readable on a common mobile phone). The Service SMS format is pre-set, individual items are separated in the SMS with a space.

AR:xthis parameter configures the interval for storing into the archive and, at the same time, the sending of data archive (binary) SMS messages,

whereby **x** ranges from **1 to 1440** and represents a time interval in minutes for saving to the archive. Available values are 1,2,5,10,15,20,30,60,120,180,240,360,480,720 a 1440.

The interval for sending a data archive SMS is 61 times the interval for saving. The data SMS contains the initial state of the register of the quantity passed and 60 increments within the specified time interval.

The data archive SMS message is automatically sent when the archive is filled, i.e. for interval 62, where a new initial value for the next archived SMS is saved.

The default setting is AR:15

3.6.2 Example of configuration SMS message format:

1) D1:15 H1:3

- a service SMS will be sent out every 15th day of the month at 3:00 AM.
- periodical login and sending of messages and other parameters (D2, H2, D3, H3, ...) remain unchanged

2) D1:0 PER1:10080 PERA:1

- sequence number for day 0 will not permit sending a service SMS for parameters D1, H1 identical with real time, other parameters (D2, H2, D3, H3, ...) remain unchanged
- periodical login and sending service SMS messages every 10080 minutes (7 days)

3) PER1:0

- prohibits sending service SMS messages during periodical login to GSM network
- the sending of service SMS messages when parameters Dx and Hx are identical with real time remains unchanged

4) D3:1 H3:5 PER1:20160 PERA:0

- a service SMS message will be sent on the first day of the month at 5:00 AM, the sending of service SMS messages according to parameters D1, H1, D2, H2 remains unchanged
- the module will periodically login to the GSM network every 20160 minutes (14 days) from the moment the configuration SMS message is received, a service SMS message with data will not be sent out during the periodical login (within interval PER1)

5) WRTN1:+420987123456

- changes (enters) phone number +420987123456 to position 1 in the phone book of the SIM card in the GSM module

6) SMSD:

- a current data archive (binary) SMS message in progress will be sent

7) SMSS:

- a service SMS message in the pre-set format (from the manufacturer) will be sent

8) AR:15

- the interval for saving to the archive will be 15 minutes and the interval for sending data SMS messages will be 915 minutes (i.e. 15h and 15min.).

9) SMSD:11090412,8

- a data archive (binary) SMS message, which will be found as of September 4, 2011 at 12PM, will be sent. The following 7 archive SMS messages will also be sent in the sequence towards the current date. I.e. a total of 8 archive SMS messages will be sent.