DESCRIPTION

MC406 is a battery operated electronic converter designed to offer an high measure accuracy and stability in a compact size. The measured flowrate is displayed on the LCD screen together with one of the 4 available totalizers; other informations and some basic settings are directly accessible using the 4 pushbuttons interface. The complete instrument configuration and log access is possible using a provided PC-based software that access the infrared communication interface.
The two indipendent positive and negative passive pulse outputs allow the connection with any external counter.
Pressure and temperature probes are available on request (starting from 2016).

SENSOR COUPLING

The maximum full-bore sensor size is dn 600 mm; the built-in battery life is affected from the sensor size.
The flowmeter can be ordered both in compact or separate version, with a maximum cable length of 30mt.

MEASURING FEATURES

Flow velocity range: 0.05 m/s (error class to be defined) to 10 m/s +/- 0.5% or OIML R49 for MID version
Liquid conductivity >=20uS/cm
Sampling rate: awake unit 3.125Hz nominal (depends on the diameter); stand-by mode: from 1/5Hz to 1/60Hz (default 1/15Hz)
Digital filters: damping (number of avarages), cut-off, bypass and peak cut.

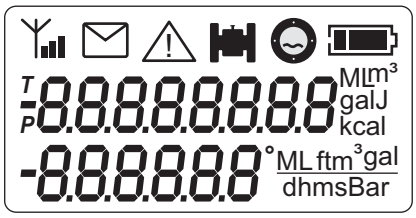
DATA STORAGE

All the parameters, totalizers and log are stored in a non-volatile memory. The datalogger offer a cyclic storage of over 100000 lines of data with a maximum resolution of 1 minute, recording the time stamp, flowrate, positive and negative totalizer and additional information as converter, any detected error condition and, if installed, the process pressure and temperature.

DISPLAY

The LCD can visualize an 8 and a 6 digit number plus several information icons, allowing the user to display several informations and set many parameters. On detalis, it is possible to show:

- live flowrate
- total positive totalizer (T+)
- total negative totalizer (T-)
- partial positive totalizer (P+)
- partial negative totalizer (P-)
- time & date
- converter temperature
- process pressure and temperature (if available)
- parameters corresponding code and value



CONVERTER OVERVIEW

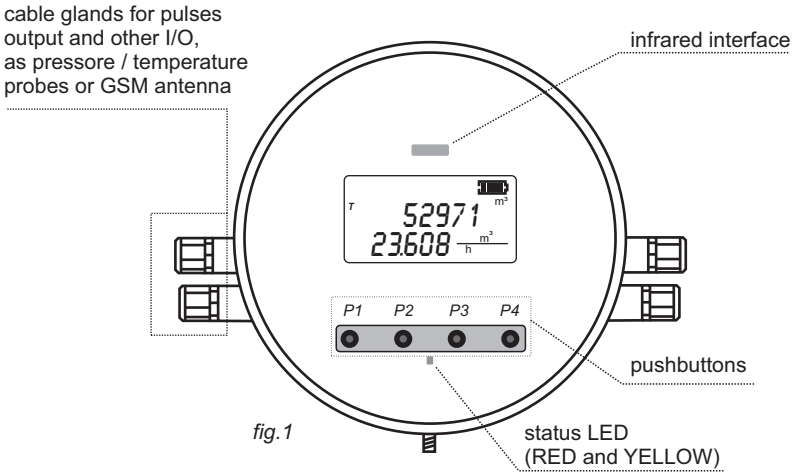


fig.1

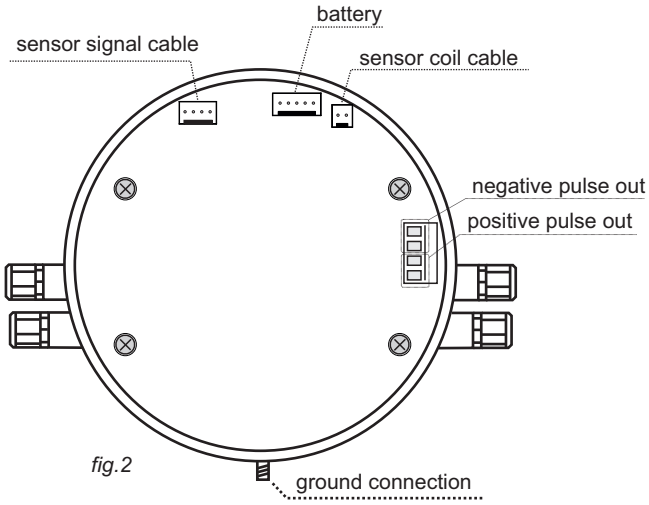
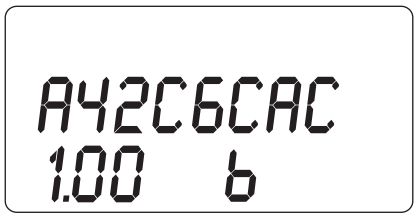


fig.2

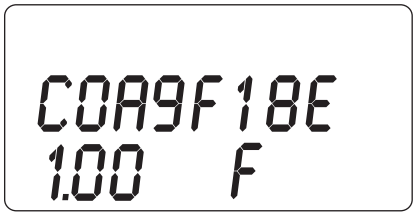
SYSTEM STARTUP

After the physical installation of the instrument has been completed, the electronic converter can be powered on by pluggin the battery pack to the proper connector (shown on fig.2). Several information are displayed to the user and a basinc setup is required.

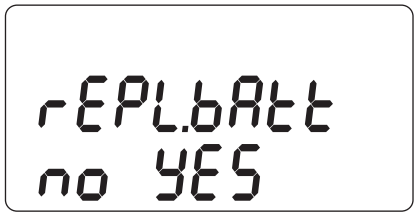
BOOTLOADER CHECKSUM AND VERSION
the bootloader is a separated software necessary to download a new firmware into the converter (see the proper section)



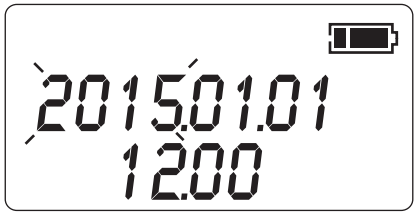
FIRMWARE CHECKSUM AND VERSION
this refers to the main firmware



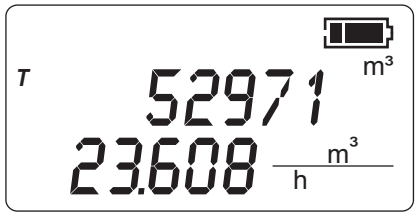
NEW BATTERY NOTIFICATION
if the unit is beeing powered with a new battery pack it is necessary to select «YES» by pressing P4 to reset the battery energy counter;
if the unit has just beeing disconnected and powered back with the same battery pack «NO» is the proper selection (P1)



DATE & TIME SETUP
check and eventually adjust the date and time
the flashing value is the one that can be adjusted using P3 / P4
P2 selects the next value in the sequence:
year>month>day>hour>minute.
After the last value has been selected, a further pression of P2 confirms the value and moves to the next screen;
P1 confirms the current settings and exits



MAIN VISUALIZATION SCREEN
the converter is now ready. The positive totalizer appears on the first row and the live flowrate on the second. The current technical unit is shown on the right side.

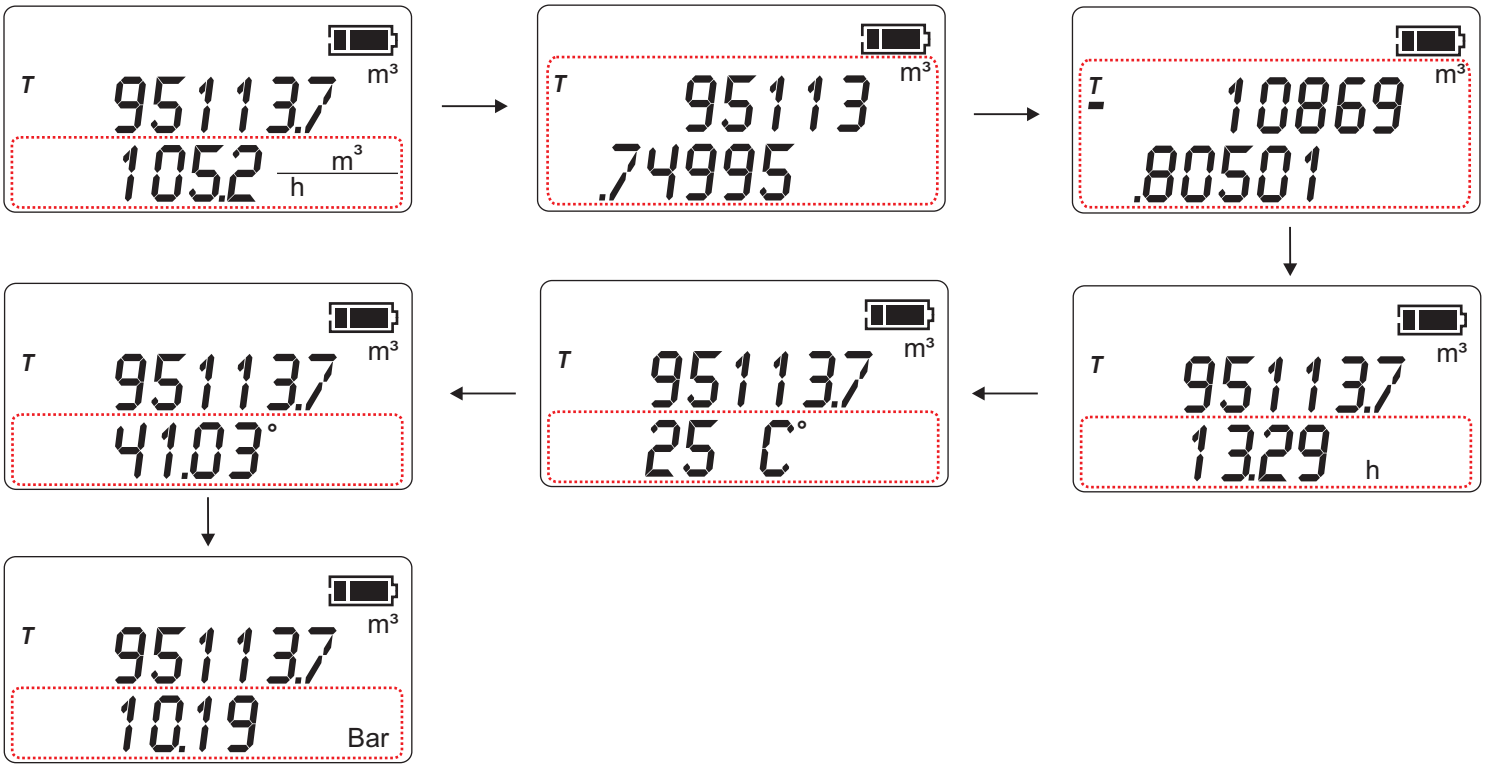


USER INTERFACE

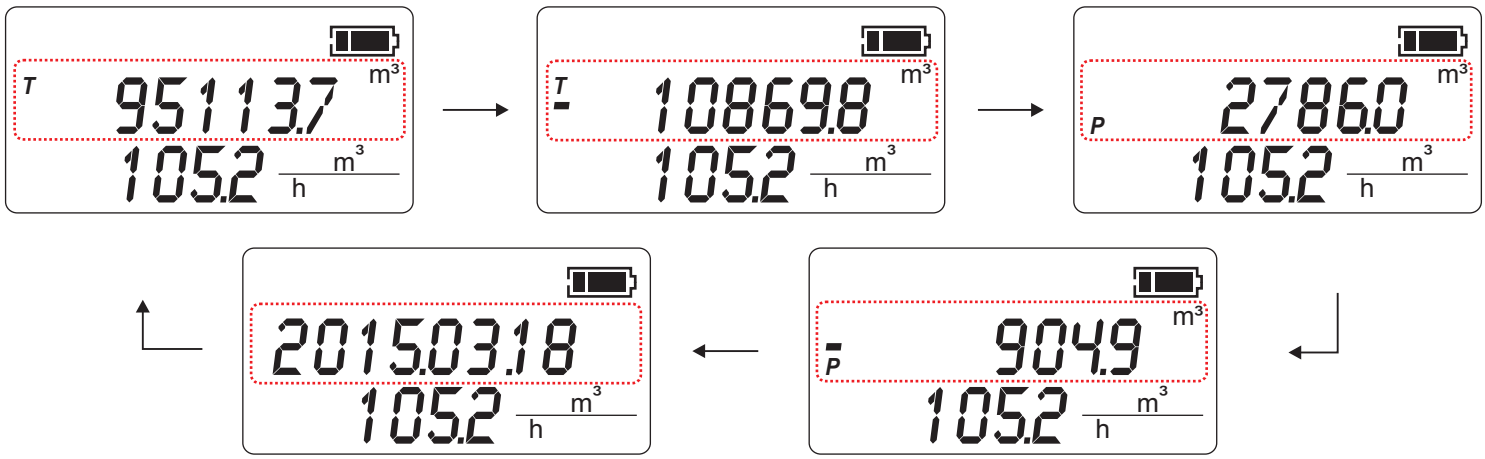
Starting from the main visualization screen (flowrate and total positive totalizaer), the 4 pushbuttons can be used to perform various operations. On details:

Scroll the first and second line visualization options

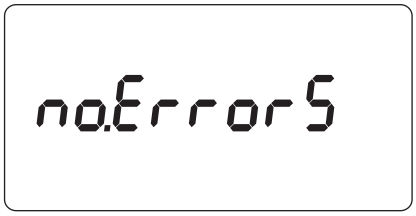
P3: scroll the live flowrate, time, board temperature and, if available, the process temperature and pressure



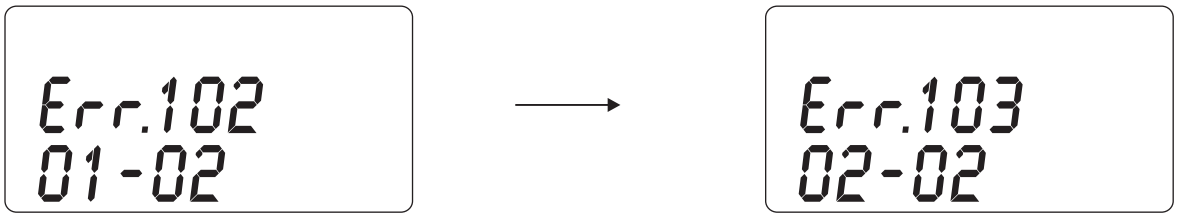
P4: scroll the totalizers and the date in this order: T+ > T- > P+ > P- > date



P2: scroll the the active alarms (first row) / alarms count (second row)
In a normal working condition no alams will be reported



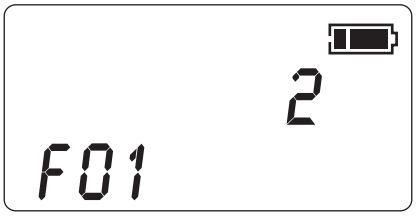
if one (or more) alarm condition is active, it will be scrolled



P1: enter the function selection passing through the password entry (if any value other than 0 is used, otherwise the password is not required)

to increase / decrease the current digit value use P4 / P3; move to the next digit with P2. When the last digit is entered, a further pression of P2 will unlock the access to the function selection if the entered password is correct, otherwise the digit will scroll back to the first one

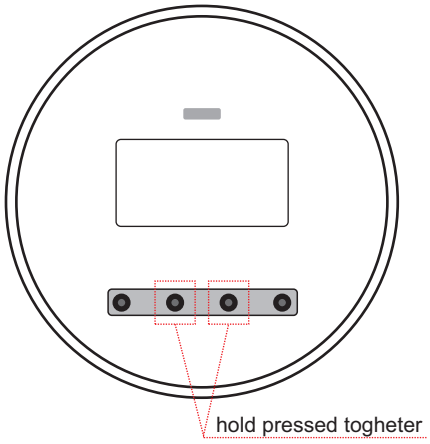
function selection code: every value corresponds to a parameter set menu or function (see *11. FUNCTIONS*); to select the function code use P4 / P3; to enter the selected code use P2. Pressing P1 returns to the main screen



inside a specific function, the pushbuttons functionality may differ (see *11. FUNCTIONS*); in this example, P4 / P3 increase and decreases the parameter value shown on the first row, P2 confirms the value and move back to the function selection, P1 abort the operation and goes back to the main screen.

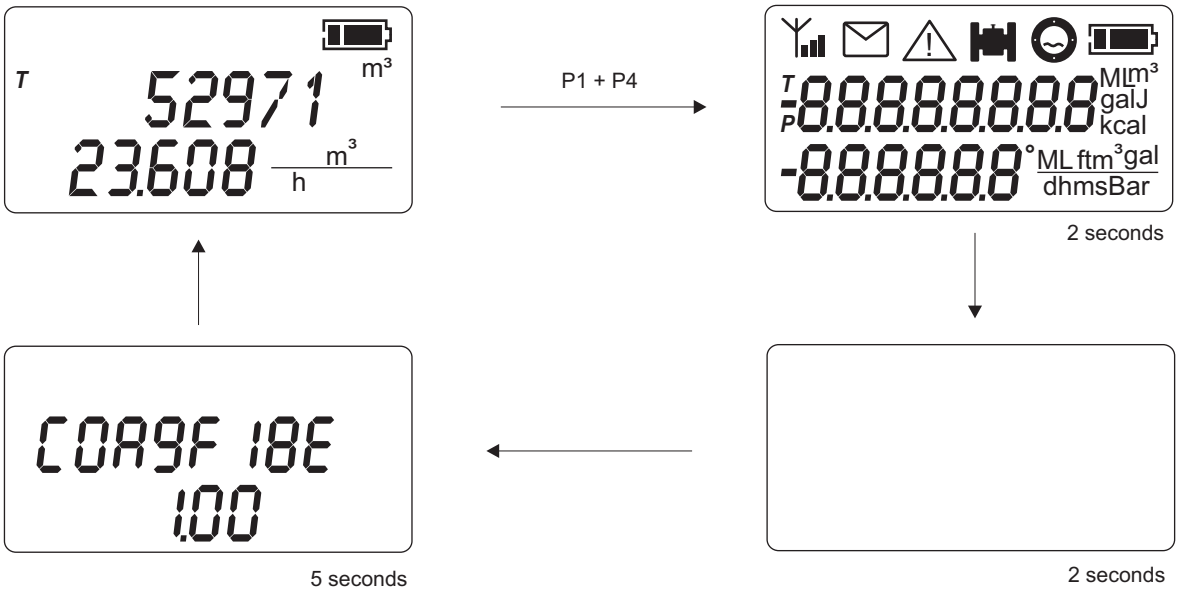
FIRST ACTIVATION

Depending on the instrument configuration, the converter can be shipped with the battery pack disconnected or already connected.
If disconnected: the unit is automatically operative once connected (see pag.11)
If already connected: the unit is hibernated and needs to be activated.
To activate an hibernated unit it is necessary to hold pressed P2 and P3 for 5 seconds



DISPLAY TEST

The LCD display integrity can be checked by pressing together P1 and P4 from the live measurement screen; all the display segments will be activated and cleared in sequence.Also, the firmware version.revision and its checksum are displayed. When completed, the previous measurement screen will be restored.



EUROMAG INTERNATIONAL

FUNCTIONS

read only
editable

A list of all the accessible functions from the user interface follows

FUNC	DESCRIPTION	ACTION P1	ACTION P2	ACTION P3	ACTION P4	MIN VALUE	MAX VALUE	NOTES
01	instant flowrate unit	back to main screen	confirm + return to function selection	value decrease	value increase	1	6	1=m;2=m3;3=L;4=ML;5 =ft3;6=gal;7=BBL. Setting 1(meters)the time base is autom. changed to 1 (second)
02	time base for instant flowrate	back to main screen	confirm + return to function selection	value decrease	value increase	1	4	1=s;2=m;3=h;4=d
03	counters unit	back to main screen	confirm + return to function selection	value decrease	value increase	1	4	1=m3;2=L;3=ML;4=gal; 5=BBL;6=Aft;7=Ain
04	zero finder	back to main screen	cancel operation; return to function selection	no action	zero finder start	-	-	display shows the countdown in seconds to complete the operation; when compleded the main screen is shown automatically
05	calibration factor	back to main screen	confirm + return to function selection	value decrease	value increase	-10.0	10.0	
06	sensor diameter	back to main screen	confirm + return to function selection	value decrease	value increase	1	4000	nominal sensor diameter [mm]
07	pulse volume	back to main screen	confirm + return to function selection	value decrease	value increase	1	10000	the parameter is electrically secured; read-only mode
08	pulse technical unit	back to main screen	confirm + return to function selection	value decrease	value increase	1	4	1=mL;2=L;3=m3;4=gal
09	pulse duration	back to main screen	confirm + return to function selection	value decrease	value increase	5	500	expressed in ms [seconds / 1000]
10	measurement frequency	back to main screen	confirm + return to function selection	value decrease	value increase	5	60	interval between two measures [s]
11	date and time	back to the previous field; if in years setting field, back to main screen	confirm + return to function selection	value decrease	value increase	5	60	interval between two measures [s]
12	damping	back to main screen	confirm + return to function selection	value decrease	value increase	2	100	number of samples averaged
13	bypass	back to main screen	confirm + return to function selection	value decrease	value increase	2	95	bypass filter threshold,full scale %
14	peak cut	back to main screen	confirm + return to function selection	value decrease	value increase	1	90	peak cut filter threshold,full scale %
15	cut off	back to main screen	confirm + return to function selection	value decrease	value increase	0.00	10.00	flow cut off expressed in m/s (finest adjustment +/-0.01m/s)
16	flowrate display digits	back to main screen	confirm + return to function selection	value decrease	value increase	0	4	number of decimal digits used to display the instantaneous flowrate
17	totalizers display digits	back to main screen	confirm + return to function selection	value decrease	value increase	0	3	number of decimal digits used to display the totalizers

FUNC	DESCRIPTION	ACTION P1	ACTION P2	ACTION P3	ACTION P4	MIN VALUE	MAX VALUE	NOTES
18	empty pipe threshold	back to main screen	confirm + return to function selection	value decrease	value increase	200	5000	the threshold value is a raw scaled value of the 24bit ADC conversion
19	full scale	back to main screen	confirm + return to function selection	value decrease	value increase	1.0	10.0	the full scale is expressed in m/s (not related to the diameter)
20	partial positive totalizer reset	back to main screen	confirm + return to function selection	no action	partial positive tot. reset (must be hold pressed for 5 sec.)	-	-	display shows the partial positive totalizer
21	partial negative totalizer reset	back to main screen	confirm + return to function selection	no action	partial negative tot. reset (must be hold pressed for 5 sec.)	-	-	display shows the partial negative totalizer
22	firmware version	back to main screen	return to function selection	no action	no action	-	-	shows the current firmware version.revision
23	firmware checksum	back to main screen	return to function selection	no action	no action	-	-	shows the current firmware checksum (CRC32)
24	empty pipe detection mode	back to main screen	confirm + return to function selection	value decrease	value increase	0	3	0:all empty pipe detections disabled; 1:enabled on the dedicated 4th electrode; 2:enabled on the measuring elecrodes; 3:enabled on both
25	password setup	back to main screen	on to next digit,confirm and return to function selection (must be input twice)	value decrease	value increase	0	999999	
26	bootloader version	back to main screen	return to function selection	no action	no action	-	-	shows the current bootloader version.revision
27	bootloader checksum	back to main screen	return to function selection	no action	no action	-	-	shows the current bootloader checksum (CRC32)
28	line frequency	back to main screen	confirm + return to function selection	value decrease	value increase	0	1	set the electrical line frequency to improve the interference rejection 0:50Hz; 1:60Hz
29	load user parameters	back to main screen	return to function selection	value decrease	(long press) load user parameters	-	-	replace the actual parameters with the stored user copy
30	lsave user parameters	back to main screen	return to function selection	value decrease	(long press) save user parameters	-	-	save the current parameters to the user copy memory
31	load factory parameters	back to main screen	return to function selection	value decrease	(long press) load factory parameters	-	-	replace the actual parameters with the factory data
32	damping in low power mode	back to main screen	confirm + return to function selection	value decrease	value increase	1	100	number of samples averaged when in low power mode

FUNC	DESCRIPTION	ACTION P1	ACTION P2	ACTION P3	ACTION P4	MIN VALUE	MAX VALUE	NOTES
33	auto power off	back to main screen	return to function selection	value decrease	value increase	0	7	power down timeout 0=20s;1=1 min;2=3 min; 3=15min;4=1h;5=6h;6= 12h;7=18h.
34	sensor offset	back to main screen	return to function selection	no action	no action	-99999999	99999999	shows the coupled sensor offet in RAW internal ADC value
35	firmware download attempt log	back to main screen	return to function selection	show previous record	show next record	oldest record (0)	latest available record	display the firmware download attempt log (see FIRMWARE UPDATE section)

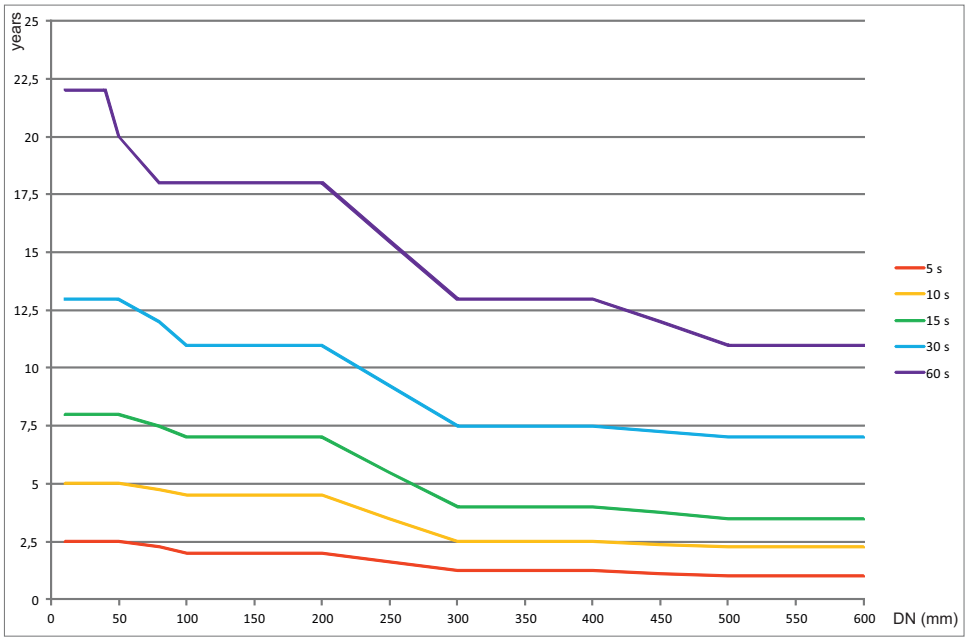
BATTERY

The converter is powered with a lithium battery pack, offering over 10 years of service (depending on the configuration and the working conditions).The residual life is estimated by calculating the energy usage all over the instrument life, so when the battery pack is replaced it is necessary to reset the battery usage counter. Powering up the unit automatically takes the user to a selection screen (see *SYSTEM STARTUP*).

NOTE: waking-up the unit frequently or entering very long power down timeouts (funcion 33) can reduce the expected battery life.

	battery good
	25% or less
	10% or less

Expected battery life (years) VS sensor diameter and sampling time



SELF DIAGNOSTIC

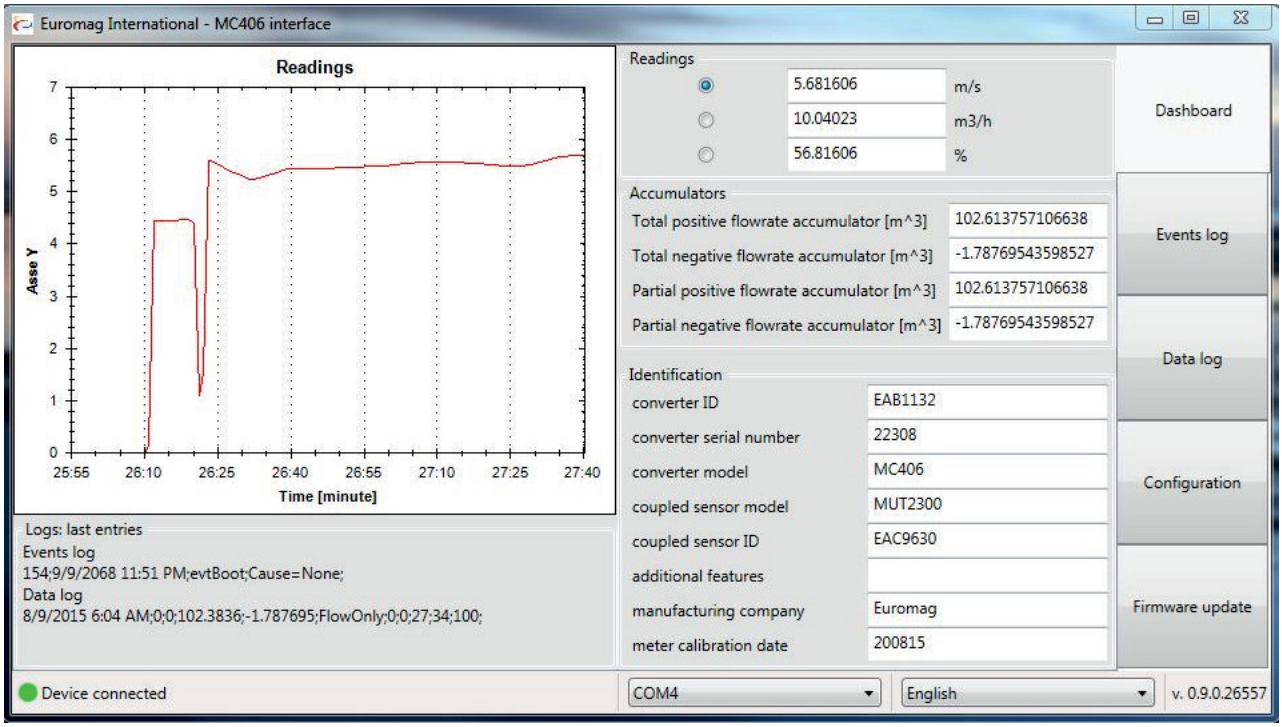
During the measuring process MC406 detects automatically if a fault condition occours and eventually stops the measurement reporting an alarm indication on the display. The following table decribes the various alarm condition and the behaviour of the converter.

ANOMALY DETECTED	POSSIBLE CAUSES	CONVERTER BEHAVIOUR	DISPLAYED ICONS & CORRESPONDING ERROR CODE
excitation failure	sensor disconnecteted; sensor cables damaged; sensor coils damaged	the measure is forced to 0 and the error condition is displayed and logged	 101
empty pipe detected on the 4th electrode	the sensor is not completely full of liquid; air is injected and causes turbolence; sensor disconnected; sensor cables damaged; liquid conductivity too low	the measure is forced to 0 and the error condition is displayed and logged; to save battery energy the coil excitation is stopped until the error condition recovers	 102
empty pipe detected / invalid measure on the measuring electrodes	the sensor is at least half empty; air is injected and causes turbolence; sensor disconnected; sensor cables damaged; liquid conductivity too low; an electric dispersion on the process is affecting the measure; an high source of electromagnetic interference is affecting the measurement	the measure is forced to 0 and the error condition is displayed and logged; to save battery energy the coil excitation is stopped until the error condition recovers	 103
temperature exceed the nominal converter working range	the enviornment temperature is over the working range; the converter is installed exposed to direct sunlight	the error condition is displayed	 201
wet electronic board	the cap or a cable gland was not properly closed causing a water intake or a humidity condensation inside the converter case	the error condition is displayed	 202
supply voltage out of range	the battery pack is dameged or empty; a wrong power source is connected to the converter	the error condition is displayed	 301
pulses overlapped	the pulse settings are not compatible with the measured process	the error condition is displayed	 401
firmware checksum differs from the attended value	the internal program memory has changed	the error condition is displayed and the program execution stopped	 801
parameters checksum differs from the attended value	the parameters data is corrupted	the error condition is displayed and the program execution stopped	 802
a watchdog reset was performed	a disturbance caused an unhandled behaviour in the regular software execution	the instrument was reset to restore the functionality; the alarm is cleared after it has been displayed	 901

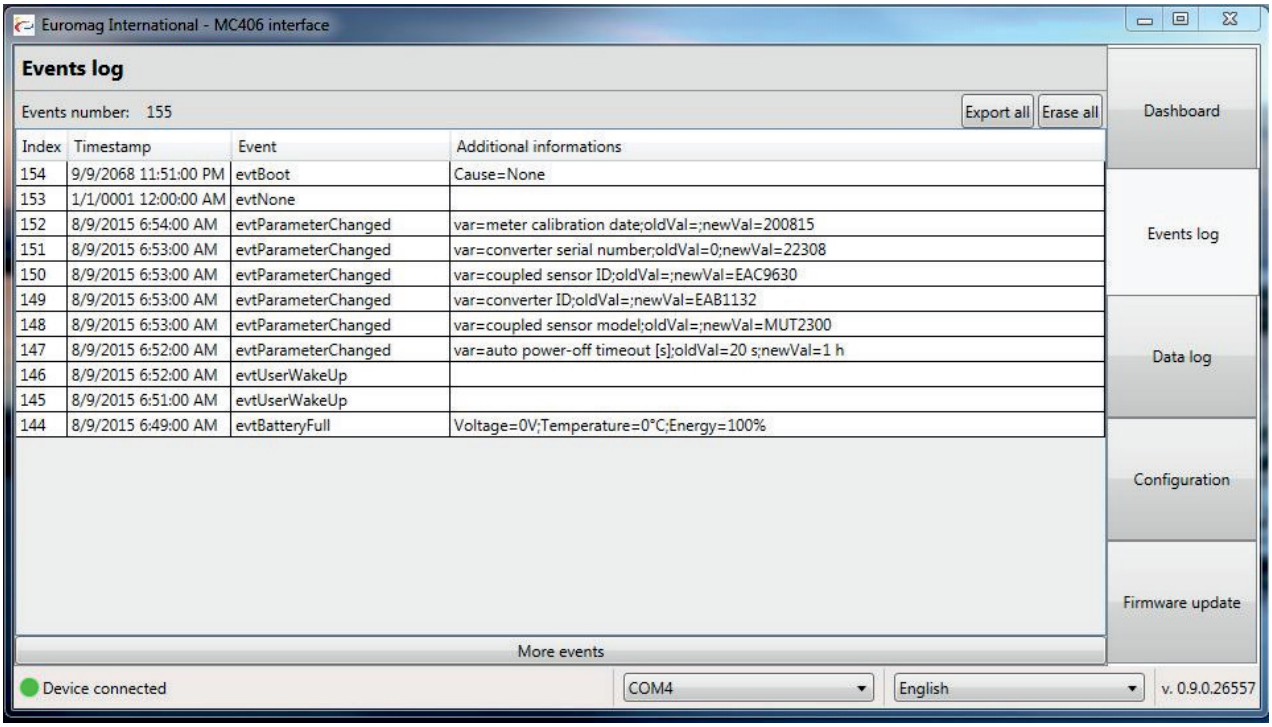
PC CONNECTION SOFTWARE

With the provided PC-based connection software and the Euromag infrared USB adapter is possible to perform several actions, on detalis:

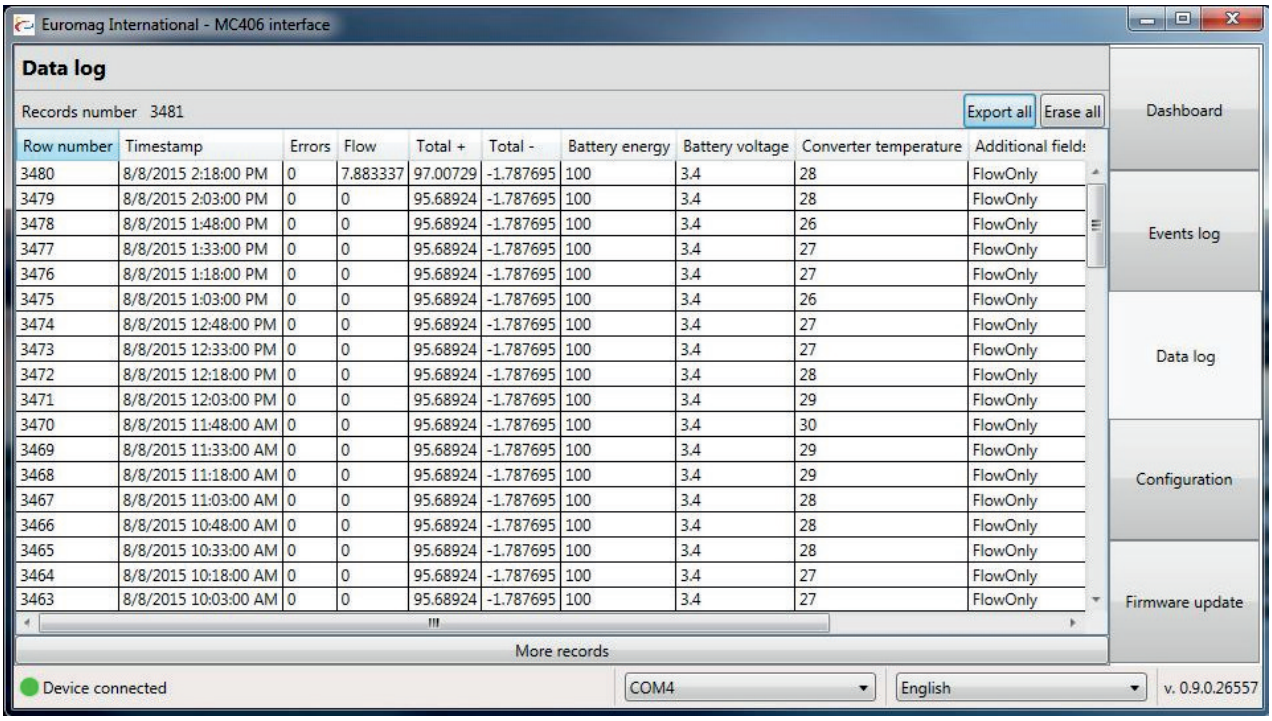
- view the live measurements in real time
- read and write all the non-volatile parameters
- download the internal datalogger
- view the instrument event logger



DASHBOARD - live values and basic informations

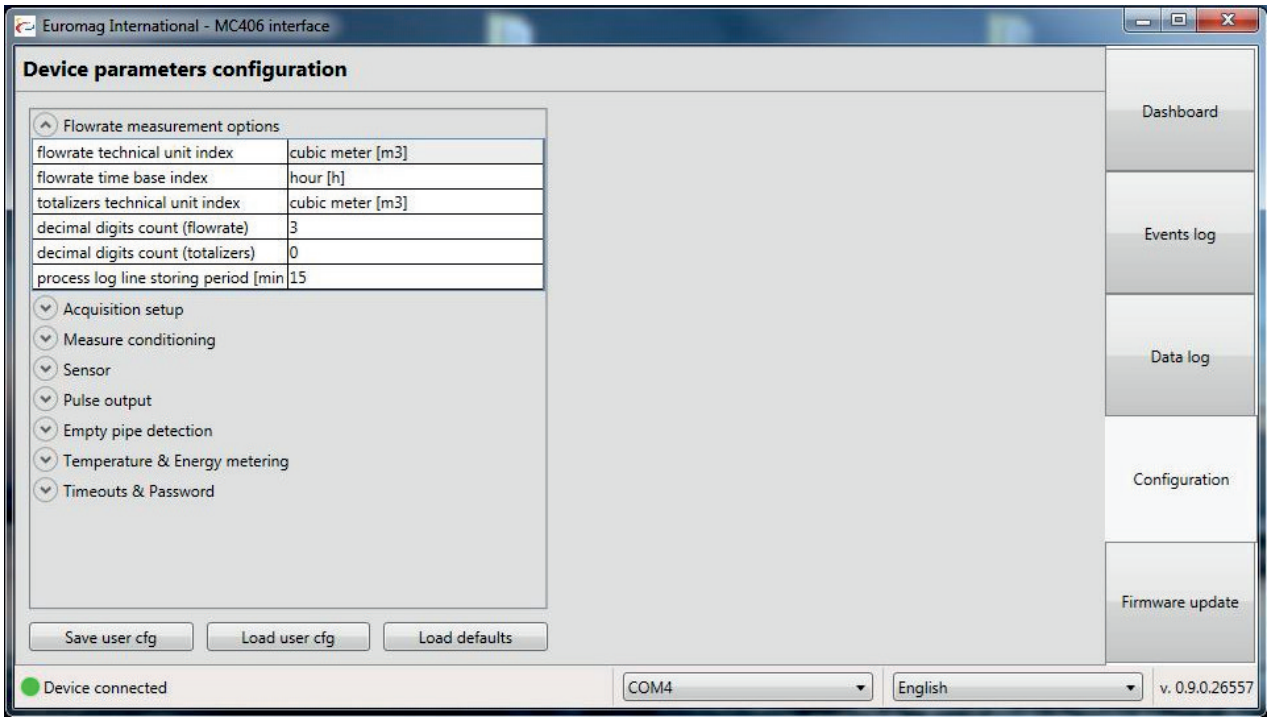


EVENTS LOG - internal events such as battery replacement, parameters modification etc.



Row number	Timestamp	Errors	Flow	Total +	Total -	Battery energy	Battery voltage	Converter temperature	Additional field
3480	8/8/2015 2:18:00 PM	0	7.883337	97.00729	-1.787695	100	3.4	28	FlowOnly
3479	8/8/2015 2:03:00 PM	0	0	95.68924	-1.787695	100	3.4	28	FlowOnly
3478	8/8/2015 1:48:00 PM	0	0	95.68924	-1.787695	100	3.4	26	FlowOnly
3477	8/8/2015 1:33:00 PM	0	0	95.68924	-1.787695	100	3.4	27	FlowOnly
3476	8/8/2015 1:18:00 PM	0	0	95.68924	-1.787695	100	3.4	27	FlowOnly
3475	8/8/2015 1:03:00 PM	0	0	95.68924	-1.787695	100	3.4	26	FlowOnly
3474	8/8/2015 12:48:00 PM	0	0	95.68924	-1.787695	100	3.4	27	FlowOnly
3473	8/8/2015 12:33:00 PM	0	0	95.68924	-1.787695	100	3.4	27	FlowOnly
3472	8/8/2015 12:18:00 PM	0	0	95.68924	-1.787695	100	3.4	28	FlowOnly
3471	8/8/2015 12:03:00 PM	0	0	95.68924	-1.787695	100	3.4	29	FlowOnly
3470	8/8/2015 11:48:00 AM	0	0	95.68924	-1.787695	100	3.4	30	FlowOnly
3469	8/8/2015 11:33:00 AM	0	0	95.68924	-1.787695	100	3.4	29	FlowOnly
3468	8/8/2015 11:18:00 AM	0	0	95.68924	-1.787695	100	3.4	29	FlowOnly
3467	8/8/2015 11:03:00 AM	0	0	95.68924	-1.787695	100	3.4	28	FlowOnly
3466	8/8/2015 10:48:00 AM	0	0	95.68924	-1.787695	100	3.4	28	FlowOnly
3465	8/8/2015 10:33:00 AM	0	0	95.68924	-1.787695	100	3.4	28	FlowOnly
3464	8/8/2015 10:18:00 AM	0	0	95.68924	-1.787695	100	3.4	27	FlowOnly
3463	8/8/2015 10:03:00 AM	0	0	95.68924	-1.787695	100	3.4	27	FlowOnly

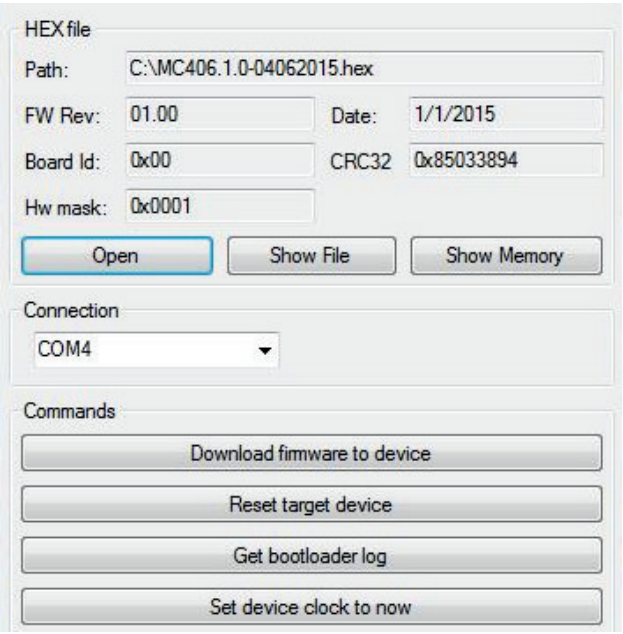
DATA LOG - internal process log download and CSV exportation



CONFIGURATION - parameters setup, including user coppy handling and factory recover

FIRMWARE UPDATE

Using the provided software utility and the infrared communication interface is possible to update the converter firmware with a newer release.

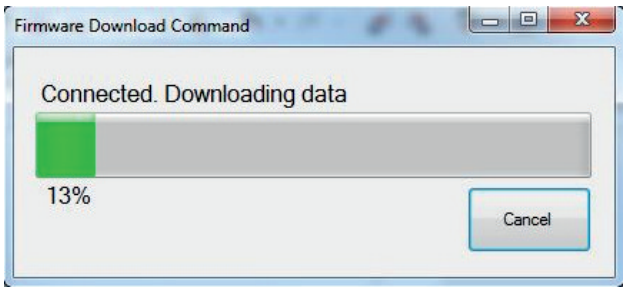


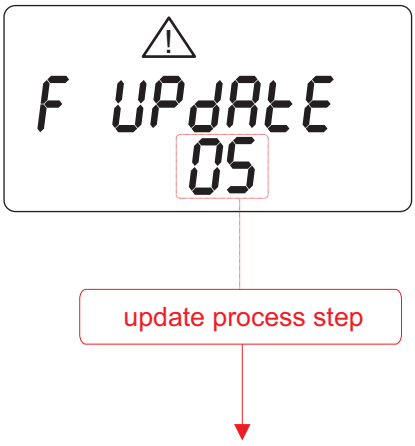
After selecting the firmware file and the proper COM port the converter must enter in boot mode; this can be done by cycling the power or by pressing the “Reset target device” button; the LCD will show the bootloader CRC32 and version.

When the yellow LED is lit on the serial infrared port is ready and selecting “Download firmware to device” will start the download. A progress bar will show the firmware download progress, while the instrument will display the internal operations sequence.

The actual working firmware is backup on a dedicated memory area, so in case of failure the converter will automatically recover the normal functionality. During the operation the red LED is lit on when the FLASH memory is being erased or written.

At the end of the update process the unit will automatically reboot.



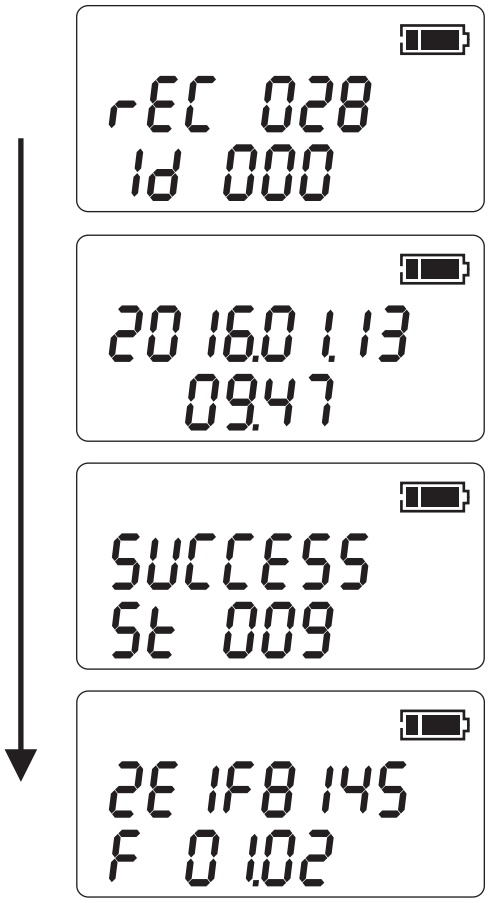


0	Working firmware check	6	Working firmware backup
1	Waiting for the download request	7	Working firmware update
2	Download request received	8	New working firmware backup
3	Erasing download memory	9	Update OK
4	Firmware downloading	10	Restore working firmware (during start-up only)
5	Checking the downloaded firmware	11	Restore working firmware (after update failure)

Every firmware download attempt is logged in the internal memory. Selecting “get bootloader log” after the reset with the yellow LED on will show the download attempt log. The log can store over 500 records: once is full no more downloads are allowed.

Date	Time	ID	Step	Success	Fw Rev.	crc32
01/01/2015	14:27	0	Update Ok	True	01.00	000FB47E
01/01/2015	14:29	0	Downloaded Fw ...	False	01.00	FFFFFFFF
01/01/2015	14:30	0	Update Ok	True	01.00	000FB47E

The download attempt log can also be visualized on the converter display accessing function 35; each record information is scrolled in 4 screens automatically. P3 and P4 can be pressed in any moment to move to the previous or next stored record.



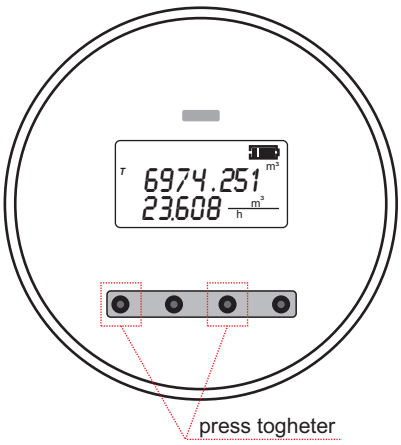
Screen 1: the number of record and the downloading party corresponding ID

Screen 2: date (YYYY.MM.DD) and time when the attempt was performed

Screen 3: show if the attempt was succesful (SUCCESS) or not (FAIL); also the last completed step is reported (see previous page)

Screen 4: show the checksum and version of the downloaded firmware; if the operation was not succesful FFFFFFFF may be shown as checksum

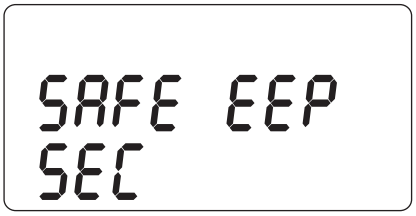
Accessing the download attempt log from the main visualization screen



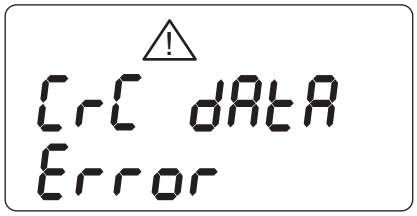
ADDITIONAL DISPLAYED INFORMATION

Apart from the regular user interface screens, some extra information can be displayed.

Safe EEPROM secured: the calibration and measurment related parameters EEPROM memory is protected against write attempts.



The firmware or the EEPROM data checksum (parameters and/or totalizers) has failed the last intergrity check; no further measurement will be performed.



CONVERTER INSTALLATION

Once the flowmeter is unboxed and installed, the pulses outputs can be wired (if required); the maximum allowed voltage is 30V ac or dc (no attention to the polarity is required). The electronic clean contacts can handle up to 100mA current.
The last step is the connection of the battery pack to the main board: pull out the battery pack, insert the connector and pull it back in place. Observe the pack orientation as indicated (look at the image below).
At this point (if necessary) the allowed parameters can be visualized and adjusted.