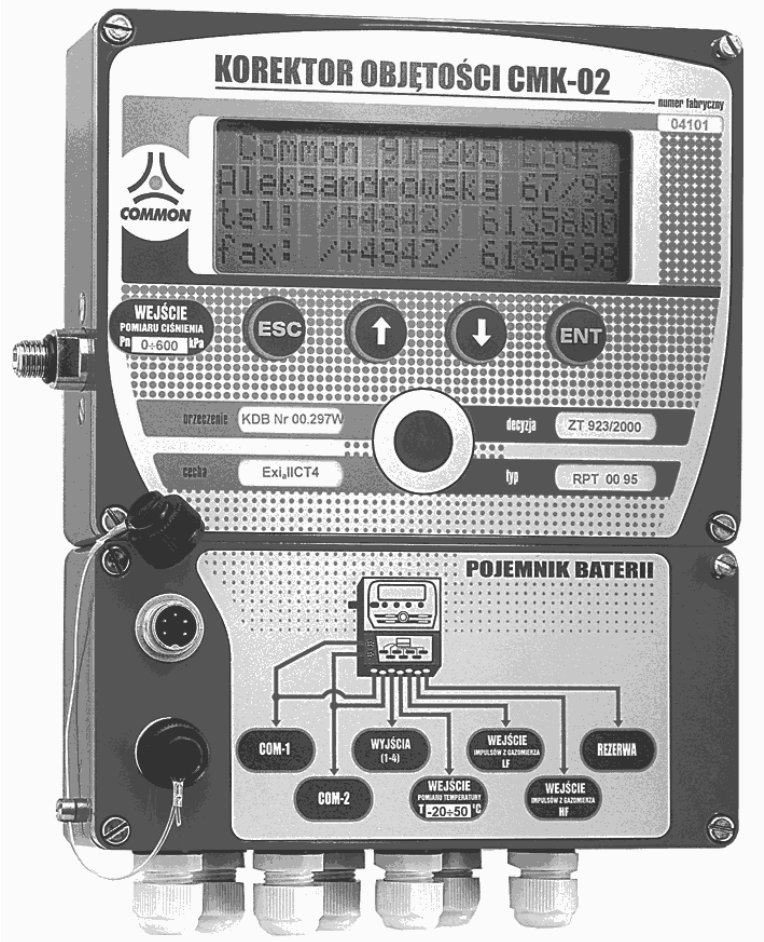
CMK-02 volume corrector



TECHNICAL DOCUMENTATION
AND
OPERATING INSTRUCTION

Contents

1 Introduction

CMK-02 Volume Corrector is designed to convert the measured gas volume and flow to basic conditions. It is assigned to be mounted in pressure reduction and measurement gas stations. It counts the uncorrected gas volume, on the basis of pulses which are generated by the reed relay transmitter, placed in the gas meter index head. Gas temperature and gas pressure measurements are performed, too. The corrector calculates the compressibility factor with the GERG-88 method, on the basis of the performed measurements and the declared gas composition, and it converts the uncorrected gas volume into standard conditions (for example: p=101.325 kPa; T=273.15 K).

The corrector also calculates and records:

- the correction coefficient,
- the real volume flux,
- the standard volume flux,
- the gas density in real conditions,
- the energy and mass fluxes that flow through the pipeline,
- the date, time and maximum number of pulses that were counted during one minute,
- the date, time and hour peaks' values between sharp hours,
- the date, time and hour peaks' values with the shift window.

This data, together with the values of gas temperature and pressure, uncorrected and standard volume values are remembered in the corrector non-volatile memory. They may be read on the four-line, twenty-dgits LCD, or perform distant-reading through the serial transmission links. The corrector is equipped with the transfer protocol that is compatible to the "GAZ-MODEM" protocol, as well as with the functional subset of the "MODBUS" protocol (RTU and ASCII versions).

The two channel signal converter with power supply CZAK-02 can work with CMK-02 corrector. One recommends it especially when frequent readouts are necessary.

2 Design

The CMK-02 corrector consists of two chambers. The main board with the processor, the serial links' circuits and the measuring transducers that change the signals from pressure transducers into digital ones is placed in the upper chamber. One can find also the absolute pressure gauge there. The manufacturer seals this chamber with lead; ***if the leaden seal is broken it is equivalent to the loss of the guarantee and to canceling the EX company certificate!***

The bottom chamber compounds the terminal strip, and the circuits of data transfer links are joined there, and also signal and measuring circuits. One can find the batteries there and a configuration switch. It is used during the manual configuration of the corrector operational parameters (discussed below). This chamber ***should*** be sealed with lead by the user (see the section: „Assembly & Installation").

The data transmission from the corrector can be made with the use of the RS-GAZ2/RS-232 signal converter, for instance: CZAK-02 or CAK-02 and through the 'OPTO-GAZ' link. When one touches the OPTO-GAZ head to the front panel of the corrector at the marked place, the automatic switch over of the COM1 line from the RS1 stationary link (which is connected to the terminal strip or to the TUCHEL socket) takes place. It makes it possible to read the corrector directly without the necessity to disconnect other RS1 and RS2 links (in case when both of them are being used). The OPTO-GAZ interface can be bought in COMMON S.A.

The service conditions of the CMK-02 volume corrector are introduced in chapters: „Basic Technical and Metrology Data" and „Assembly and Installation". We recommend to get to know in details these chapters before you start to install the device.

The CMK-02 volume corrector may work in two basic configurations:

a) Battery operation – the corrector works in the accounting mode, with the possibility to connect two inputs and two pulse outputs with a programmable function; there is the possibility to read data after joining any external signal converter of some admitted type; the calculations of Qn flux are performed on the base of LF low frequency impulses.

b) External supply operation – each function that is possible during the battery operation mode, and additionally the possibility to join the HF high frequency pulse transmitter of some admitted type with the option of its permanent monitoring.

The CMK-02 volume corrector can record up to 32768 samples of accounted data, and it assures the continuous recording by the device during 142 days when 10 minutes record interval is set. The memory for day and night data assures continuous recording during 5 years, and the memory for monthly recording – during the whole period of the corrector work, the list of events can contain up to 4000 records.

If one assumes the everyday 2-hours handling, without any external supply, and with LCD being switched on, the system of battery supplying assures 5 years of the corrector continuous work.

3 Basic Technical and Metrology Data

3.1 Basic Data of the microprocessor system.

- Processor: INTEL 386
- Memory: 256kB – Static RAM, 2MB or 4MB – FLASH ROM,
- A/C transducer: 24-bites sigma-delta
- Clock: RTC internal real time clock
- Communication: Two independent channels of serial transmission RS-GAZ2 (up to 115200 bps)
- Display: LCD – four lines, 20 characters per line; it keeps contrast in the full ambient temperature range ($-25^{O}C \div +55^{O}C$)
- Keyboard: Foil, 4 push-buttons
- Technology: 2.7-Volts
- Assembly: SMT two-side
- Supply: 2 lit batteries - SL-780 3.6V/13.5Ah (protected by resistors and insulating jacket)
- Protection class: IP54

3.2 Service conditions of the CMK-02 volume computer

- Ambient temperature: $-25^{O}C \div +55^{O}C$
- Relative humidity: max. 95% in temperature $55^{O}C$
- EMI interference: the interference type and level meet the requirements **OIML SP6 Sr9** on: „Electronic Devices for Volume Gas Meters" and the PGNiG company standard ZN-G-4007 dated on June 1995.

3.3 Basic Metrology Data

3.3.1 Pressure Measurement:

The absolute pressure transducer has been applied to measure pressure and it works in one of the following measuring ranges:

0.09÷0.7MPa, 0.25÷2MPa, 0.5÷4MPa, 1÷8MPa, 1.3÷10MPa.

The relative limiting error of the pressure measurement relating to the measured value equals to δ=0.3% in the whole range of working pressure and temperature. The pressure measuring range is programmable within the measuring range of the transducer. The transducer is mounted inside the CMK-02 volume computer housing.

3.3.2 Temperature Measurement:

The gas temperature measurement is performed by the PT1000 sensor, of A class and the measuring range of $-20^{O}C \div +50^{O}C$. The relative limiting error of the pressure measurement relating to the measured value equals to δ=0.2% in the whole range of ambient temperatures. The temperature measuring range is programmable within the measuring range of the PT1000 sensor. The sensor is mounted in the measurment section or in the gas meter directly.

Note:

*The P and T error values meets the **OIML SP6 Sr9** Recommendations on: „Electronic Devices For Volume Gas Meters" and the PGNiG company standard **ZN-G-40001** dated on June 1995.*

4 Assembly and Installation

The CMK-02 volume corrector is accommodated to direct assembling on the rotor gas meters directly, on the measurment pipe section or directly on, for example, a station wall of the gas station. The temperature sensor is fastened on the measurment section of the assembly kit in the stub pipe of temperature testing. Pressure is provided to the pressure transducers with the meter's tube.

One should make the electrical connections between the corrector and the other elements of the system using cables with wires made as multi-wire conductors. One should apply following wires:

a) to connect power supply and the channel of data transfer „RS-GAZ2" to the terminal strip or „Tuchel" link – four cables without shield, that meets the R_p<30Ω, L_p=500μH requirements, i.e.: LIYY 4x0.25mm^2 for CZAK to CMK distance not longerr than 150m or LIYY 4x1mm^2 for diastances up to 400m.

b) to connect the temperature sensor to the terminal strip – two wires in the common shield, for instance: LIYCY 2x0.25mm^2. ***The shield must be connected from the corrector side, only, to the housing earthing – the screw clamp in the bottom right corner of the board !***

c) to connect the pulse transmitter, a reed relay type to the terminal strip – two cables without shield, for example: LIYY 2x0.25mm^2

d) to connect the input signals to the terminal strip – four cables without shield, for example: LIYY 4x0.25mm^2

e) to connect the output signals to the terminal strip – four cables without shield, for example: LIYY 4x0.25mm^2

f) to connect the HF pulse transmitter to the terminal strip – two cables without shield, for instance: LIYY 2x0.25mm^2

NOTE:

- ***Because of the used seal wires, of PG9 type, the external diameter of the cable should be in the range from 5 to 8 mm.***
- ***The CMK-02 housing must be earthened electrostatically by the connection of R<1MΩ. One may utilize one of the six assembling holes, which are in the bottom of the housing to do the earthing!***
- ***Any shields of the connecting wires should be earthened from the corrector side, only. The resistance to earth must meet the subject standards!***

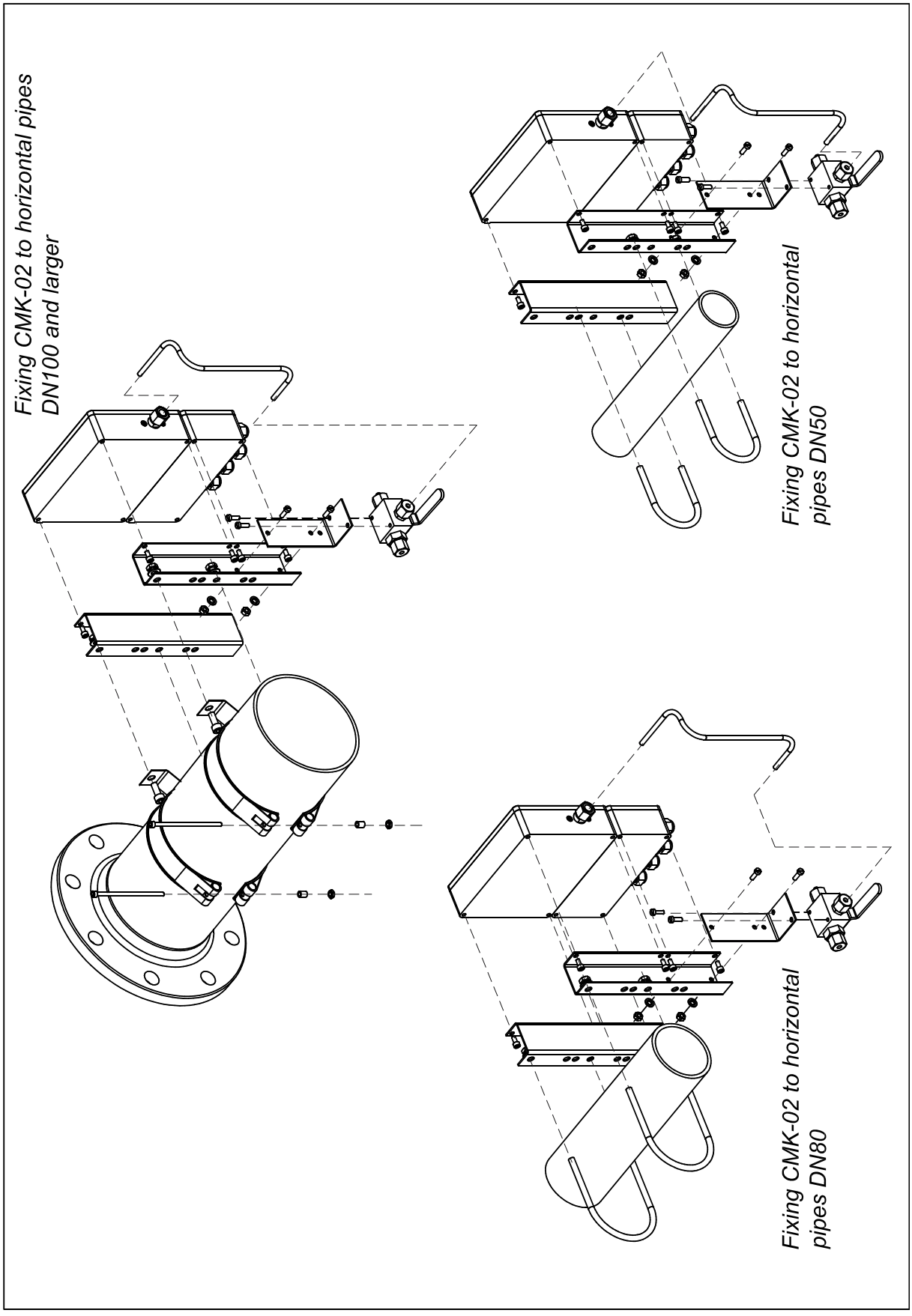


Fig. 1. Fixing the CMK-02 volume computer, version 1.

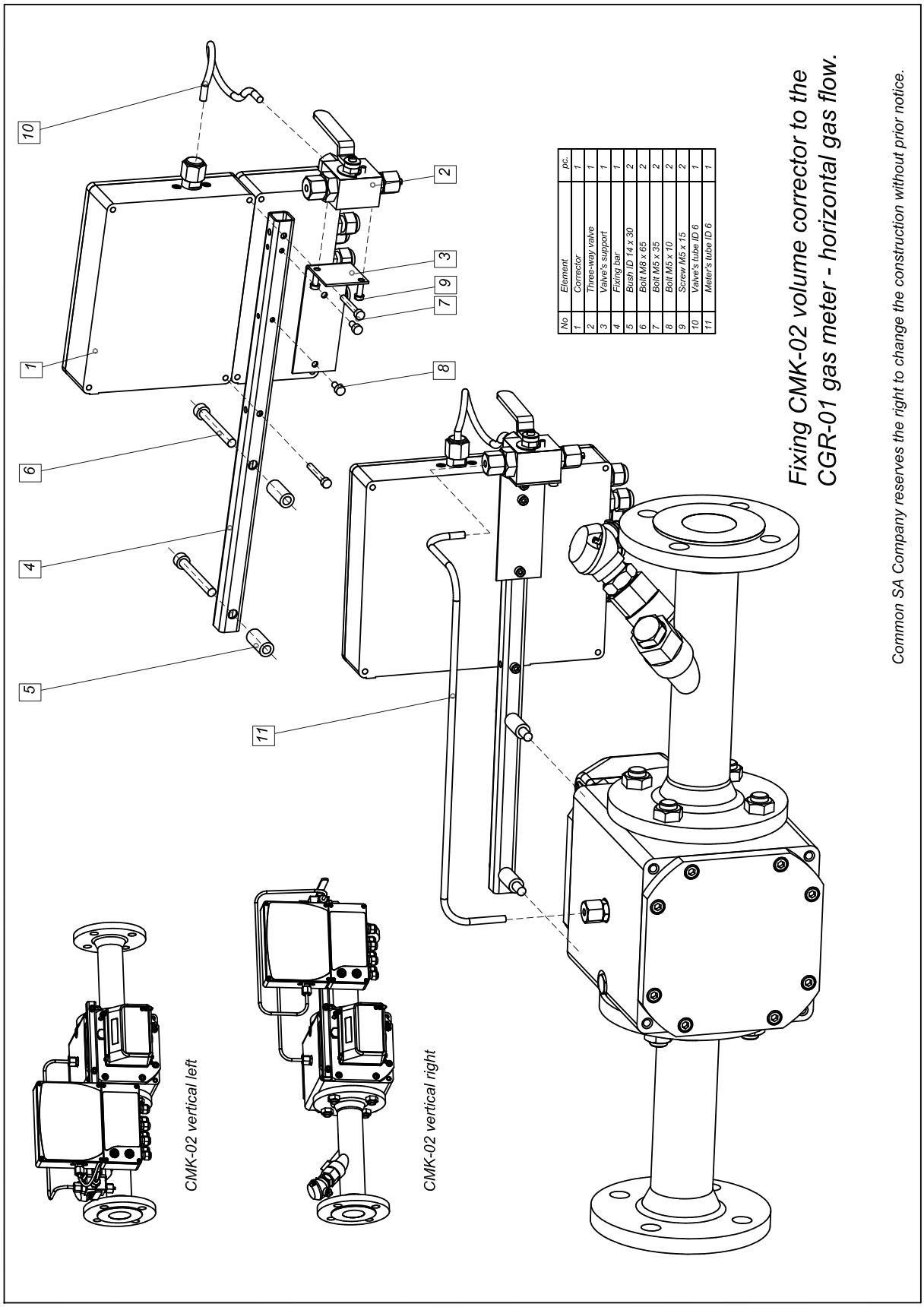


Fig. 2. Fixing the CMK-02 volume computer, version 2.

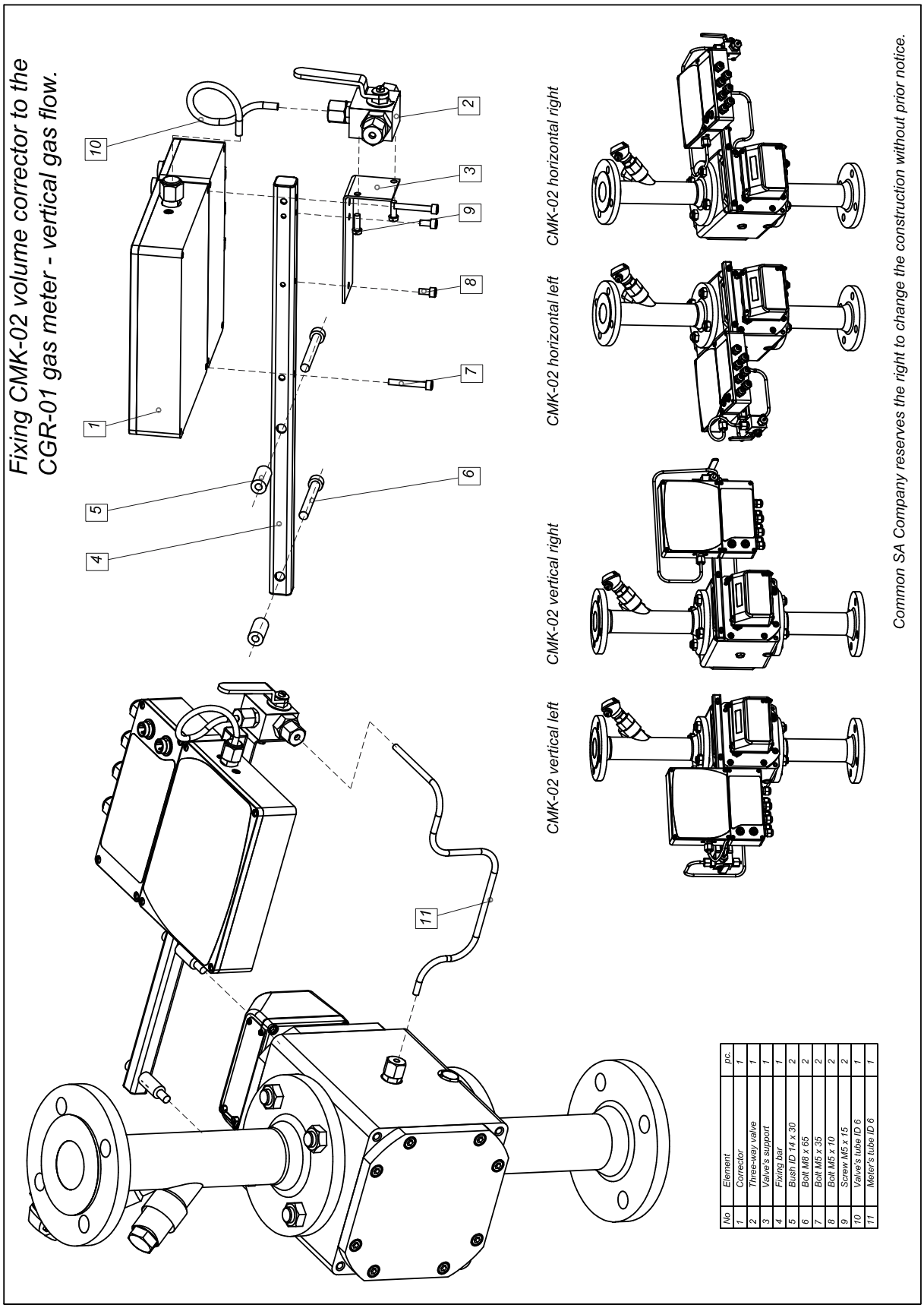
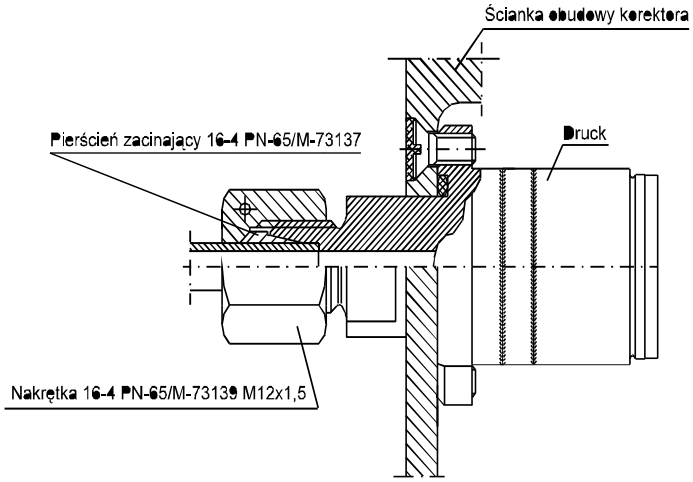


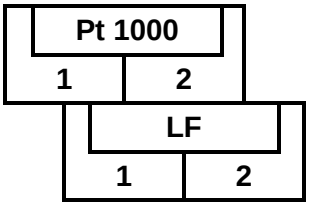
Fig. 3. Fixing the CMK-02 volume computer, version 3.

The installation of the CMK-02 volume corrector may be divided into several stages:

1. **To fix the corrector** close to the gas meter in any place that can be accessed by servicing personnel, easily. One should use the holder for this purpose, corresponding to the gas meter and to the construction conditions on the measurment station. There are several holders to fix the corrector either on the measurment sector either on the gas meter, in the offer of the COMMON S.A. When choosing the place for the corrector, one should remember that the pressure transducer must not be placed lower than the pressure pipe stub of the gas meter.
2. **To connect the pressure measurement.** The pressure pipe stub that is on the gas meter should be connected with the corrector pressure gauge by the meter's tube. One should also install a three-way valve to make easier further servicing or control pressure gauge connecting.

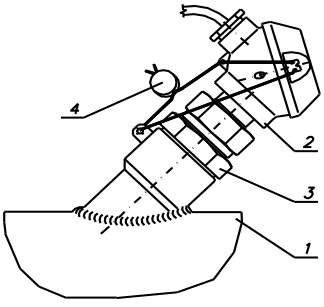


3. **To connect the basic measurements.** To perform the basic function: the accounting operation – it is necessary to connect the circuit of LF – low frequency transmitter from the gas meter counter head, and the circuit of the temperature sensor. One can find the description of the terminal strip below:



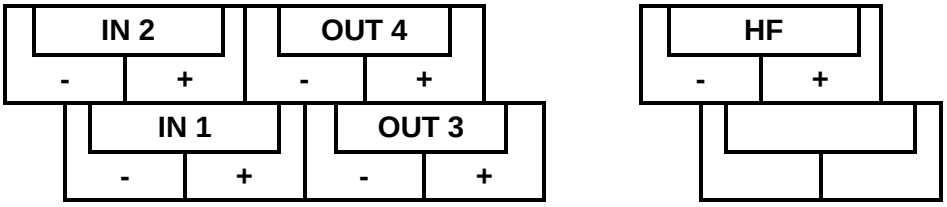
The corrector is adapted to service the reed relay LF transmitter, only (it is the standard of The COMMON Company, that every gas meter is equipped with it). There is no significance what is the polarity of the LF transmitter and the Pt 1000 sensor.

The example of the Pt 1000 temperature sensor assembling



1. the outflow section,
2. the Pt 1000 temperature sensor,
3. the thermometric sleeve
4. the leaden seal

4. **To connect auxiliary measurements.** One can find the description of terminal strips below. One should pay his attention to the polarity of the joined circuits (if the circuits of the connected systems are of the determined polarity). Becauss the corrector, as a whole is a intrinsically safe device, all its circuits must be connected to the circuits of intrinsicaly safe devices; in other cases one should apply explosion barriers.

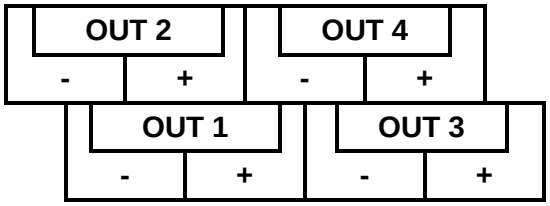


The input circuits that are marked: IN1 and IN2 may collaborate with intrinsically safe circuits of simple devices, and especially with the switching elements' contacts that have been admitted to operate in intrinsically safe circuits, with their maximum parameters: ***Uo=5V, Io<1mA, Po<5mW, Lo=any, Co=10uF***

The output circuits, marked as OUT3 and OUT4 may cooperate with intrinsically safe external circuits of i_a or i_b categories. The maximum input values are: ***U_i=5V, I_i=200mA, P_i=1.2W, C_i=470pF, L_i=0***. The maximum values of capacitance and inductance for this circuit should be accepted according to the criterion of the connected circuit, when internal parameters - C_i and L_i should be taken into account..

NOTE:

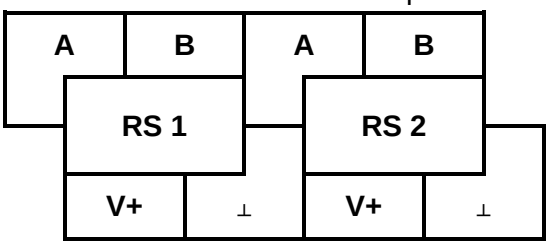
1. ***In case when the junction description meets the one below, all the ports are outputs; the electrical parameters are the same as for OUT3 OUT4 mentioned above.***



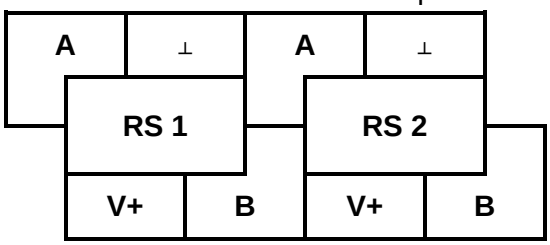
2. ***The software always gives the direction of the suitable port in the two-state outputs/inputs configuration menu.***

5. **To connect the CZAK-02 converter.** The CZAK-02 converter must be mounted beyond the explosion danger zone. The installation terms are described in the converter documentation. The suitable junctions of the CMK-02 volume computer terminal strip should be connected to the suitably marked junctions in the converter. One should pay attention to the description of the junctions, as their placing in the corrector and in the converter is not the same (see the figures below).

The CMK-02 terminal strip:



The CZAK-02 terminal strip:



The circuits that leave the explosion danger zone may be guided in one bunch.

5 The Corrector Maintenance

The user communicates with the corrector by the keyboard and the four-line alphanumerical display. The keyboard consists of four keys **Esc, Enter,** and arrows ↓, ↑.

The **Enter** key results in entering any submenu, changing the active item in the editor of values or storing the introduced number.

The **Esc** key results in returning to the master menu or exiting the mode of editing values.

The ↓ and ↑ keys result in changing the submenu, displaying continuing parts of the communicate that is too long for one screen and setting parameters when settings are changed.

If the corrector is in sleep mode (the display is inactive), one should activate it by pushing any key. The display switches off automatically when thirty seconds pass since the moment of last key operations (if there is external supplying the display is on all the time).

The following screens are displayed (one goes to the successive screen with pressing the ↓ key):

1) Main counters and volume fluxes:
   - uncorrected volume (V1),
   - standard volume (Vn),
   - real flux (Q1),
   - standard flux (Qn).

```
V1 =  0009543.0 m3
Vn =    18520.0 m3
Q1 =      171.5 m3/h
Qn =      188.9 m3/h
```

2) Gas parameters and correction values:
   - compressibility factor (K1),
   - correction coefficient (F),
   - instantaneous gas temperature (t1),
   - instantaneous gas pressure (p1).

```
K1 =   0.997546
F  =   2.386054
t1 =       19.8 °C
p1?=      258.7 kPa
```

Alarms:

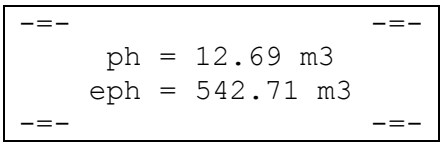
- *The sign '?' at the labels 't1' or 'p1' means that the corrector has not been able to perform the given data measurement correctly – there remains the value from the latest measurement on the screen still.*
- *The sign '!' means that the defined alarm limits have been exceeded, the blinking sign '!' signifies that the defined ranges of the transducers have been exceeded, too.*
- *The 'NAN' value means that the transducer has been damaged.*

The values p1, t1 are measured and the correction coefficient is calculated every 30 seconds during battery operation and every 2 seconds with the external supply.

The compressibility factor is calculated every 30 seconds on the base of temperature and pressure mean values for the latest 30 seconds.

3) Gas consumption

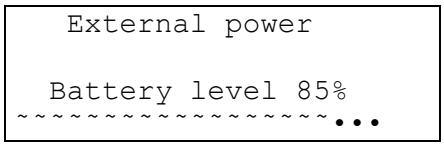
- the value since the beginning of the hour (ph),
- The expected consumption till the end of the hour (eph),

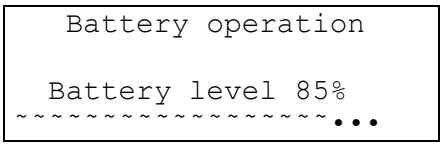


The expected hour consumption – the method of calculating

On the base of the current value of the standard flux, and assuming its stability, the quantity of gas is calculated, that will be taken till the hour end. Then the value is enlarged with the consumption that has been performed since the clock hour beginning.

4) The mode of the corrector supply and the battery capacity.

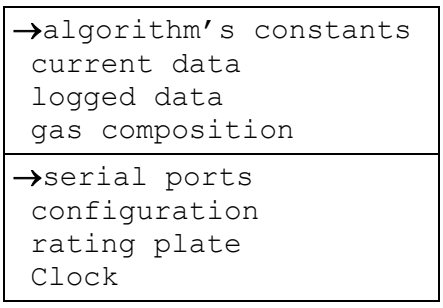




When the battery condition reaches 5% the corrector starts to record the alarm '*Low battery voltage*', and below 1% the corrector and recorder modules are switched off. Nevertheless one can still perform data transmition through, for instance, the OptoGAZ interface.

5.1 The Main Menu

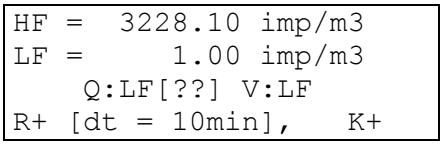
When **Enter** is pressed, the main menu is displayed. One performs his choice with the keys ↑ and ↓. The choice is to be confirmed by **Enter**.



5.1.1 Algorithm's constants

The given pieces of information are divided into the ones that concern the method to determine the volume and the others - the compressibility factor.

There are displayed: the pulse weight HF, LF, time of writing the recorded data and the current source of the signal Qr and Vr.



The information on the source of the signal used to determine the Q flux:
- Q : LF [LF] - the flux is counted from the low frequency LF reed relay transmitter,
- Q : HF [HF] - the flux is counted from the high frequency HF transmitter,

When a setting of ?? is in the square brackets (Q : LF [??]) the corrector matches the source of the signal on the flux itself, depending on its accessibility (for instance the corrector determines the flux from the HF transmitter, and in the moment when the external supply is broken, the corrector switches itself automatically to determine Q from the LF transmitter).

The signs +/- at the letters R and K determine the state of switching on/off the modules of the recorder (R) and the corrector (K).

If the change of the recording period of accounting data is to be made and the synchronization with the beginning of day and night has been chosen, the suitable information is displayed:

```
HF =  3228.10 imp/m3
LF =     1.00 imp/m3
    Q:LF[??] V:LF
R+ [dt=5→10min],   K+
```

When the key with the arrow is pressed, there are displayed:

- Standard temperature,
- Standard pressure,
- The applied method of calculations,
- The type of gas mixture.

```
tn =     273.15 K
pn =     101325 Pa
   K1 wg GERG-88
     natural gas
```

The method of calculations is matched automatically, to the chosen gas composition. As a standard, the corrector is equipped with the GERG-88 algorithm, other algorithms are also accessible:

Natural gas:

GERG-91, AGA-NX19

City gas /coke-oven gas:

Beattie-Bridgeman,

Other (H_2, CO_2, O_2, N_2, C_2H_2, air, propane-butane and others):

Peng-Robinson, Van der Waals, Redlich-Kwong, Soeve-Redlich-Kwong, Virial equation.

5.1.2 Current Data

The parameters that are determined by the CMK-02 volume computer currently are displayed in this menu. When one presses the ↓ key, he enters successive sets of parameters.

1) Main counters:

- gas volume in real conditions V1,
- gas volume in standard conditions Vn,
- energy meters for standard conditions E (the index signifies respectively: ‘s’ – energy counted with using heat of combustion, ‘i’ – heating value).
- mass for the standard conditions M.

```
V1 =  0010786.0 m3
Vn =       21139 m3
Es =      142842 MJ
M  =       15650 kg
```

2) Fluxes:

- gas flux in real conditions Q1,
- gas velocity in the pipeline U1 (one must point the cooperating gas meter, especially DN parameter to count this value correctly),
- normal energy flux,
- mass flow

```
Q1 =      171.75 m3/h
U1 =        2.18 m/s
Eq =     7555.62 MJ/h
Mq =      140.34 kg/h
```

3) Current correction values:

- the compressibility factor K1,
- the correction coefficient F,
- real temperature of gas,
- real pressure of gas.

```
K1 =    1.000179
F  =    1.105173
t1 =        19.8 °C
p1 =       119.9 kPa
```

3) Digital inputs / outputs:

- the HF pulse weight, measured by the corrector and related to1 m^3 - rHF,
- the calculated error of the HF constant relating to the programmed value - eHF,
- states of successive digital inputs/outputs, for instance:
  - I1 - - inactive input I1
  - I1+ - active input I1, the input signal below the filter threshold (described in the section: **algorithm constants | signalling**),
  - I1++ active input I1, the input signal above the filter threshold (described in the section: **algorithm constants | signalling**),
  - -O3 - inactive output O3,
  - +O3- active output O3, electric state of the output - opened,
  - +O3+ active output O3, electric state of the output - short-circuited
- day, time and maximal number of pulses counted during one minute.

```
rHF=    900.0 imp/m3
eHF=   0.0000 %
I1++ I2--  -O3- -O4-
Imax    1/12:15 = 7
```

4) Real parameters of the gas mixture:

- real density of gas ρ1,
- relative real density of gas d1,
- real heat of combustion Ho1,
- real heating value Hv1,

ρ1 =	0.8306 kg/m3
d1 =	0.6424 kg/m3
Ho1=	25.8587 MJ/m3
Hv1=	23.3273 MJ/m3

5) Maximum demand for standard values

- values calculated for every day and nigt,
- monthly values,

One can change the mode of displaying the maximum demand value with the **Enter** key. There will be displayed successively:

For day and night maximum demand:

- Value of the constant window (maximum consumption between sharp hours),
- Value of the shift window (maximum consumption for the period of 60 minutes),
- Instantaneous value (consumption during the latest 60 minutes).

For monthly maximum demand:

- Value of the constant window,
- Value of the shift window.

One can always find the date, starting time and the value of the given consumption.

Day and night consumption – the method of calculation

During every clock hour the increment of the standard volume of the gas flow is calculated. The highest one, counting since the beginning of the day and night (as a standard, one takes 10pm o'clock) is stored as the peak hour demand, together with the time signature of its occurring.

This cycle is repeated independently for every day and night.

Monthly consumption – the method of calculation

The biggest value from the period of one month is chosen among everyday determined maximum consumption values and stored as the monthly maximum demand.

This cycle is repeated independently for every month.

Daily peak flow constant window qh = 482.82 m3/h 06/01/2001 01:00
Daily peak flow shift window qh = 578.71 m3/h 06/01/2001 01:28

```
Daily peak flow
Current value
qh = 195.33 m3/h
06/01/2001 06:51
```

```
Monthly peak flow
constant window
qh = 2.75 m3/h
2/01/2000 5:00
```

```
Monthly peak flow
shift window
qh = 578.71 m3/h
06/01/2001 01:28
```

5.1.3 Recorded Values

The submenu is displayed that compounds four items:

```
→alarm list
 day data
 month data
 accounting data
```

or in the case of the corrector with hour data recording:

```
→alarm list
 hour data
 month data
 accounting data
```

When one selects the item, the message is displayed on the number of stored records; the percentage of the accessible memory for records is set in brackets.

```
 Amount of records
     629 (98%)
  ↑ newest data
  ↓ oldest data
```

The alarm list compounds:

- The date and time of the event start (P),
- The date and time of the event end (K) or the program and the user identifiers,
- The estimated growth of gas standard volume (if it was calculated),
- The brief description of the event.

The list may consist of 4000 records in maximum.

```
P:  6/01/01 00:33.35
K:  6/01/01 00:34.09
 dVn =      11.5 m3
  Exceeding limit P
```

The daily data compounds:

On every screen:

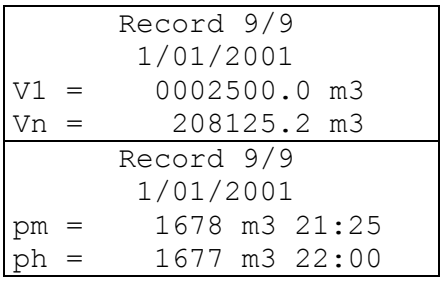
- The date of recording,

On the first screen:

- The indication of the real counter for the day and night end (V1),
- The indication of the main counter for the day and night end (Vn),
- On the second screen:
- The maximum hour demand time and value (with the shift window) – (pm),
- The maximum hour demand time and value (between sharp hours) – (ph),

The time of the maximum demand beginning is always introduced.

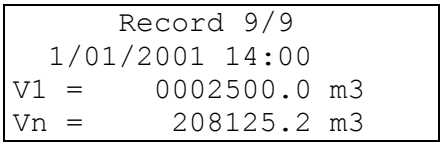
One can switch between the screens with pressing the **Enter** key. The data for the latest 60 months is stored.



The hour data compounds:

- The date and the hour of recording,
- The indication of the real counter at the hour end (V1),
- The indication of the main counter at the hour end (Vn).

The data for the latest 60 months is stored.



The month data compounds:

On every screen:

- The date of recording,

On the first screen:

- The indication of the real counter at the month end (V1),
- The indication of the main counter at the month end (Vn).

On the second screen:

- The maximum hour demand time and value (with the shift window) – (pm),
- The maximum hour demand time and value (between sharp hours) – (ph),

The time of the maximum demand beginning is always introduced.

One can switch between the screens with pressing the **Enter** key. The data since the beginning of the corrector operation is stored.

```
     Record 4/2
     January 2000
V1 =    0002500.0 m3
Vn =     208125.2 m3
```

```
     Record 4/2
     January 2000
pm =  1678m3 21:25/01
ph =  1677m3 22:00/01
```

The accounting data compounds:

On every screen:

- The date of recording,

On the first screen:

- The growth of gas real volume,
- The growth of gas standard volume,

On the second screen:

- The mean gas temperature for the recording period,
- The mean gas absolute pressure for the recording period,

On the third screen (in standard carrying out):

- reserve 1 – the temperature of the corrector housing,
- reserve 2 – the coefficient of gas compressibility.

One can switch between the screens with pressing the **Enter** key.

```
     Record 9/1029
   1/01/2000 07:00
dV1 =    0002500.0 m3
dVn =     208125.2 m3
```

```
    Record 9/1029
   1/01/2000 07:00
 t1 =        19.9 °C
 p1 =        99.8 kPa
```

```
    Record 9/1029
   1/01/2000 07:00
r1 =          23.6 °C
r2 =        1.0007
```

5.1.4 The Gas Compound

The submenu is displayed that compounds following items:

```
→gas parameters
 gas coefficients

 gas compound
```

The gas parameters are as follows (for the GERG-88 method of calculations):

- Molar heat of combustion (Hch),
- CH mole fraction
- N_2 mole fraction

Hch	916.64100
fraction CH	0.981822
fraction N2	0.015839

The gas coefficients are as follows (for the GERG-88 method of calculations):

standard compressibility factor (Zn),

- standard density (ρn),
- heat of combustion (Ho),
- heating value (Hv).

Zn	0.9975
ρn	0.7533
Ho	40.2542
Hv	36.3136

In the menu **gas compound** the percentage (volume or molar one) of all the gas components in the defined mixture is displayed.

Gas compound reach gas volume compound	
methane	95.520
ethane	01.880
propane	00.490
n-butane	00.150
....	
oxygene	00.000
carbon diox.	00.230
sulfur diox.	00.000
air	00.000

5.1.5 The Serial Links

The option **serial links** is discussed in details in the section **6. The Corrector Configuration**.

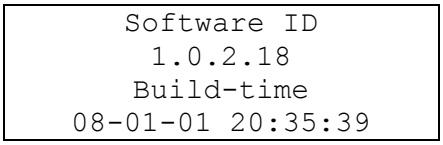
5.1.6 The Configuration

The option **configuration** is discussed in details in the section **6. The Corrector Configuration**.

5.1.7 The Rating plate

It displays the data on the product, the manufacturer and internal software version.

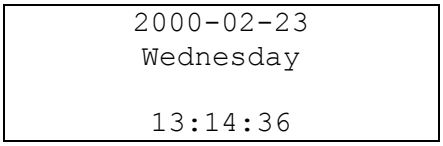
Serial No. 41059 Manufactured 2000 Software version 2102/1ar-301aE
Common 91-205 Łódź Aleksandrowska 67/93 tel: /+4842/ 6135600 fax: /+4842/ 6135698



5.1.8 The Clock

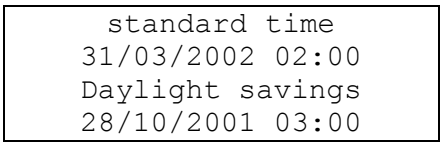
When this menu item is selected, the following data is displayed:

On the first screen: the current date, the day of the week and the time.

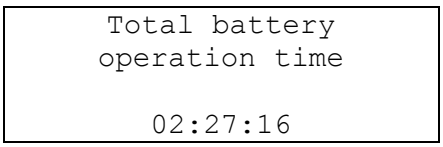


On the second screen: the date of seasonal time change into standard time and into daylight-savings one.

If the date has not been programmed either the corrector has changed its time, the communicate is displayed „not set”.

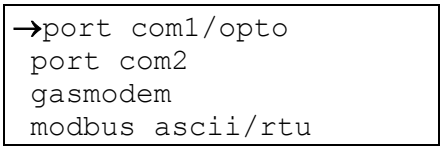


On the third screen: time of the corrector activation without external supply.

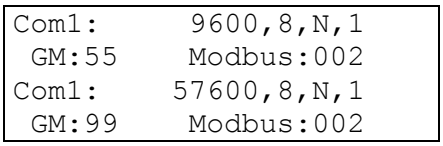


6 The Corrector Configuration

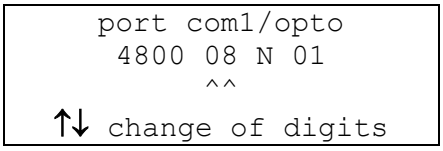
Before one performs the remote configuration of the corrector, he should settle the transmission links' parameters. To do this one should select the function: **serial links** in the main menu. The screen appears as follows:



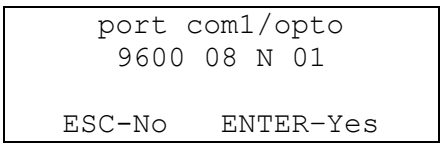
ATTENTION:
Since the software version 1.0.2.20b when this menu item is selected the following screen with gathered data on the serial links' parameters appears as below. When the ***Enter*** *key is pressed, one enters the configuration of the communication ports' parameters.*



The options **port com1/opto** and **port com2** provide setting the transmission parameters of the respectable ports COM1 and COM2. One can see the following parameters in the figure below (from left): the velocity of the transmission speed, data bits, parity, stop bits.

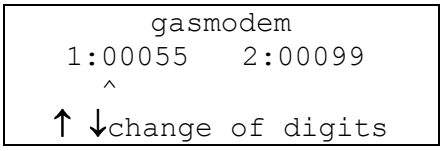


One changes the value of the selected parameter (marked with **^^^^^** signs) when presses the keys ↑ and ↓. After pressing the Enter key, he enters the next editing field. To finish the edition one should press the **Esc** key. If any changes have been introduced the screen appears asking to confirm them, for instance:



If one presses **Esc** the changes are cancelled; the **Enter** key confirms them – and the suitable port is re-configured.

In the option: **gasmodem** the protocol addresses of Gas – Modem are settled. The addresses should be programmed adequately for the COM1 and COM2.



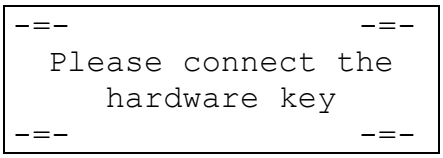
In the option **modbus ascii/rtu** the Modus protocol address is settled, common for the both communication links.

One can configure the CMK-02 volume corrector in three ways:

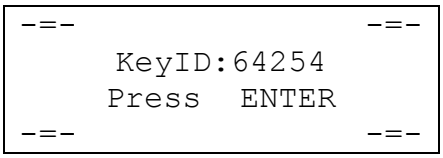
1. **If the computer and suitable servicing software are used.** Considering the fact, that the CMK-02 volume corrector has been the functional widening of the CMK-01 corrector, the same software to configure the both devices can be used. But one should remember that older software versions may not make possible configure some work parameters. As the CMK-02 corrector stores its work parameters in the nonvolatile memory, one should remember to authorize the configuration, i.e. to rewrite the newly set parameters to the FLASHROM. The program SERVICE.EXE in the version for MS-DOS system, and also older versions WService.exe program for the systems of MS-Windows group have no such an option, so the parameters that will be settled by them will be stored in RAM, only. It will cause that if the corrector is interfered strongly, after its re-starting by the „Watch Dog" function, it will return to the configuration that has been stored in the FLASHROM.
2. **If the hardware key is used.** One should join the key to any COM junction to start the internal service menu.
3. **If the configuration switch is used.** If the hardware key is lacking, one should shift the configuration switch, that is placed between the terminal strips in the battery chamber into the **ON** position, and then choose the option: **configuration** in the menu.

6.1 The Configuration of The Corrector Work Parameters

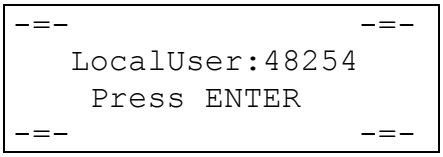
When one selects the option: **configuration** in the main menu the following screen is displayed, with the communicate:



When the external hardware key is connected, it is detected automatically, and the message with its read identifier is displayed:

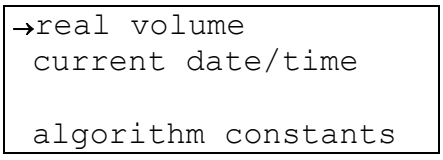


As an alternative one can switch the configuration switch that is placed in the battery chamber into the **ON** position. The software will recognize the switch condition automatically and display the following screen:



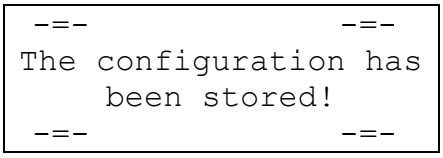
ATTENTION:
The correctors, which are equipped with the software with the number lower than 1.0.2.18 require the additional access password (this password is: ***Enter, ↓, ↑, Esc***). *Only four successive key pushing is read, each next one will be ignored and will result in returning to the main menu.*

When one presses the **Enter** key, the submenu is displayed that covers the following items.



Two first options are used to synchronize the counter and to set the corrector clock. Any changes in these settings cause automatic upgrading the suitable variables in the corrector.

All the modifications in the **algorithm constants** menu are buffered and will be stored in the FLASH ROM when one goes out of this menu, only, and the following screen appears.



6.2 Programming The Algorithm Constants

The whole configuration menu can be introduced as follows (the options, which are necessary for the minimum configuration of the corrector, have been distinguished):

```
real volume
current date/time
algorithm constants
 gas-meter
 counter
  format of counter
  LF pulse weigh
  HF coefficient
  test window Qr
  error range HF/LF
 alarm limits
  p alarm limits
  t alarm limits
  Q1 alarm limits
  Qn alarm limits
 Gas composition
  standard
   high-methaned N9
   high-methaned N43
   nitrided N48
   nitrided
   high-methaned
    molar composition
    volumetric composition
    partial analysis
     standard density
     heat of combustion
     CO2 mole fraction
     H2 mole fraction
  method of calculations
   GERG-88
   GERG-91
   NX-19
   AGA8-DC92
   Peng-Robinson
   Van der Waals
   Redlich-Kwong (RK)
   Redlich-Kwong (SRK)
  standard conditions
clock
  gas day and night
recording period
summer time
  date of change
  automatic
  unset
 winter time
  date of change
  automatic
  unset
serial links
 port com1/opto
 port com2
 addressing
  set 1
  ...
  set 4
   gas-modem
   modbus ascii/rtu
signalling
 line I1
 line I2
 line O1
  working mode
  configuration
 line O2
  working mode
  configuration
transducers
  K1 value
 input Q1
  work range
  unit
  simulation
 input t
  work range
  unit
  simulation
 input p
  work range
  unit
  simulation
```

The menu of the serial ports configuration, as it does not need to be authorized by the operator, has been placed additionally in the corrector main menu.

6.3 The Change of The Parameter Value.

The change of the selected parameter value (the whole value is underlined with **^^^^** signs) or any given digit (marked with the **^** sign) is performed by the keys ↓ and ↑. When one presses the **Enter** key, he comes to the next field of the edition, and if the **Esc** key – he completes editing**.**

When editing is completed, the screen is displayed with the newly set values, recognized as permitted ones, (for example the date that does not exist: 31/02/2001 will be changed automatically into: 28/02/2001) with the question to confirm or to cancel the new settings.

Pressing the **Esc** key causes canceling the changes; the **Enter** key confirms them. This scheme is effective during setting all the work parameters of the corrector.

ATTENTION:
The correctors equipped with the software of 1.0.2.16 number or higher one, do not display the accepting screen if no changes of parameters' settings have been made.

6.4 Setting The Work Parameters.

The best way to start the corrector configuration is to set the algorithm constants, and the date, the time and the real volume counter should be set at the end. The most important parameters, which are responsible for the accounting operation are described below.

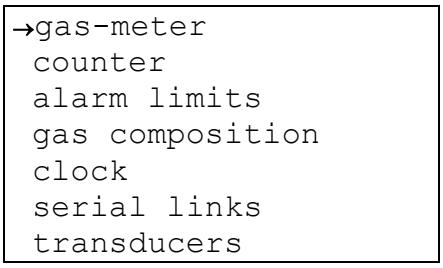
real volume – setting the counter of real volume
current date/time – setting date and hour
algorithm constans:

gas-meter – one should set the gas-meter parameters (from the rating plate)
counter – compounds options to configure the counter

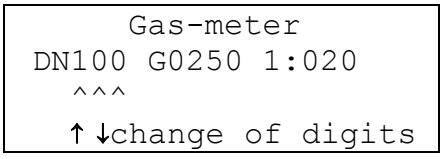
- **format of counter** – one should set the total number of digits for the counter (the quantity of drums) and the quantity of digits after the decimal point
- **LF pulse weight** – expressed in m^3 per pulse.

alarm limits – one should set the alarm limits for tested values
gas composition – one should introduce the suitable gas composition. There are several ways to introduce the gas composition. The details of them can be found further in this manual.
clock – one should set the automatic change of satndard and dayligt savings time. All the dates of time changes have been implemented in the corrector.

The **configuration** menu covers the following options:



6.4.1 algorithm constants | the gas-meter



One should set the cooperating gas-meter parameters: DN, G and rangeability, that can be read from the rating plate ('rangeability means the Q_{min} value that is read from the rating

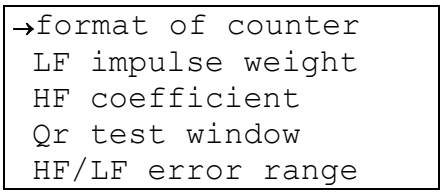
plate, divided by Q_{max} for instance: for the gas-meter DN100 G250 Q_{min}=20m^3/h, Q_{max}=400m^3/h so 'ranges' value equals to 1:20).

The change of settings in this menu will cause the automatic change of the Q1 transducer range. If the corrector should be connected to the gas-meter, which is absent in the data base, the Q1 transducer range should be changed manually.

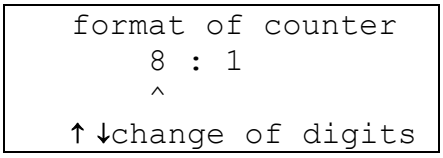
Any incorrect setting may result in improper work of the circuits of controlling the standard flux value and calculating the module of the HF coefficient error, as well as incorrect calculating of the gas velocity value.

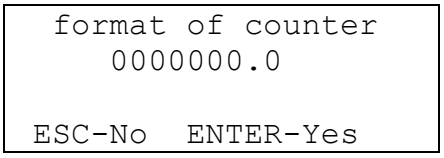
6.4.2 algorithm constants | counter

The submenu is displayed that covers the functions:



6.4.2.1 algorithm constants | counter | format of counter



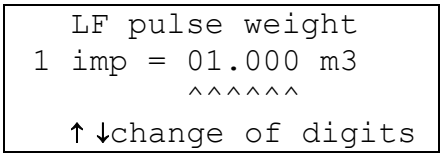


One sets two numbers: the first one is the total number of digits (drums) of the mechanical gas-meter counter. The second number determines the number of digits after the decimal point. The correctness of these parameters setting influences synchronizing of the V1 counter clearing according to the gas-meter counter.

The format of the set counter is displayed at confirming in such a form that will be used to display the current value of the counter.

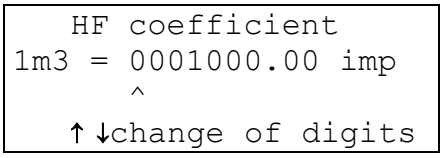
The format of the counter is not used to set the LF pulse weight in the same time. It means that even if the LF weight is set for instance to 0.01m3, the corrector might not display fractional digits.

6.4.2.2 algorithm constants | counter | LF pulse weight



The LF pulse weight is set in m^3 per 1 input impulse. The following values are accessible: 10, 1, 0.5, 0.1, 0.05, 0.01, 0.005, 0.001 m^3/imp.

6.4.2.3 algorithm constants | counter | HF coefficient



If the HF transmitter is connected to the corrector, one recommends to set this input pulse weight, independently whether the corrector is supplied permanently from the external supplier, whether not. The weight should be set as the number of pulses per 1m^3.

Each digit of the coefficient must be set separately. One can access the digits and the decimal point in the edition.

6.4.2.4 algorithm constants | counter | HF coefficient | Qr test window

```
 Qr test window
Q/LF=10 min HF=15 s
     ^^
  ↑↓change of digits
```

This parameter defines the time periods when the mean value of the volume flux is calculated. In the example above, the flux, which is calculated from the LF input will be averaged for the latest 10 minutes, and from the HF input – for the latest15 seconds.

When the external supply fades, the corrector switches the flux calculations automatically from the HF input into the LF one.

6.4.2.5 algorithm constants | counter | HF coefficient | HF/LF error range

```
HF/LF error range
 -3.00 ÷ +3.00 %
 ^
  ↑↓change of digits
```

During the corrector work it calculates the HF measuring error relating to the LF and averages it taking into account the latest 10 LF pulses. This parameter defines when the information on the error is to be recorded in the list of events. Such errors may appear in the moments of fading or appearing the external supply or in the case of gas pulse flow in both directions.

6.4.3 algorithm constants | alarm limits

```
→p alarm limits
 t alarm limits
 Q1 alarm limits
 Qn alarm limits
```

The alarm limits provide signals that the expected values have been exceeded. They are not the measuring ranges of the transducers, but the values, which exceeding means the improper measuring system operation. If the ranges have been exceeded, the suitable alarms in the list of events are generated.

Hint:

- One sets the pressure alarm limits for the reducing valve with some margin. In the case of the reducer failure we will be able to get additional information.
- The temperature alarm limits are set in standard at –10÷30°C. This is the range of the highest accuracy of the GERG-88 method.
- The minimum Q1 alarm limit should be commonly set to 0, and the maximum one – from the rating plate of the gas-meter.
- If one is interested in exceeding the ordered power, then the Qn limits should be set as 0÷the ordered power.
- The reserve alarm limits are set in standard as 0 ÷ 0. One may change them with the external service program.

6.4.4 algorithm constants | gas composition

The submenu is displayed that covers the following functions:

```
→standard
 molar composition
 volumetric composition
 partial analysis
```

6.4.5 algorithm constants | gas composition | standard

```
→N9
 N43
 N48
 nitrided natural
 high-methane natural
```

The list is displayed that covers the names of gas compositions that have been fixed in the corrector memory. One selects the mixture when puts the arrow onto any requested composition and presses the **Enter** key.

The following mixtures are accessible in standard: N9, N43, N48, averaging nitrided gas, and averaging high-methane gas.

6.4.5.1 algorithm constants | gas composition | molar composition algorithm constants | gas composition | volumetric composition

If one of the options has been selected, the screen is displayed that is introduced below. One can see the inscription **molar composition** or **volumetric composition** in the first line, depending on what option has been chosen. One can find one of the components and the total sum of all the components below. With the arrow keys one chooses the component he is going to modify.

```
   molar composition
methane       95.519
total 100.000
 ↑↓ component change
```

One can find the name of the component, its percentage in the mixture, and the total sum of all the mixture components below.

With the ↑ ↓ arrows, one selects the component he is going to modify. To make this modification one presses the **Enter** key and the **^** sign appears under the first digit of the component number. One can perform modification of each digit then, and when the number has been set, he presses the **Esc** key and returns to the component selection.

```
  molar composition
methane       95.519
total 100.000
 ↑↓ component change
```

When all the components have been set, one presses the **Esc** key. The screen is displayed with the question whether to confirm or to cancel the introduced changes. The user may be learnt respectively, if the total sum of the mixture components differs from 100%.

6.4.5.2 algorithm constants | gas composition | partial analysis

The list is displayed that covers the names of the input parameters of the calculating method. For the GERG methods there are introduced: standard density, heat of combustion and molar fractions of CO_2 and H_2.

```
→ρn              0.7366
 Hs             39.8734
 xCO2            0.0007
 xH2             0.0000
```

One can set each of the parameters in the way that is introduced in the example below:

6.4.5.2.1 algorithm constants | gas composition | standard density

```
          ρn
   0.736572e+00
   ^
  ↑↓ digit change
```

6.4.6 algorithm constants | clock

The submenu is displayed that covers the functions:

```
→gas day and night
 recording period
 summer time
 winter time
```

6.4.6.1 algorithm constants | clock | gas day and night

```
   Gas day and night
  Starting at 22:00
              ^^
  ↑↓ digit change
```

One sets the start of the clearing 24 hours (sharp hours only). As a standard, the clearing 24 hours are set at 22:00.

6.4.6.2 algorithm constants | clock | recording period

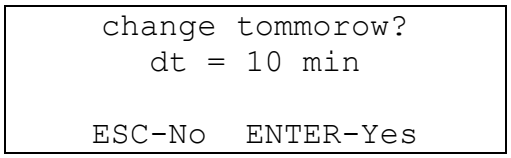
```
  Recording period
    dt = 10 min
         ^^
  ↑↓ digit change
```

One sets the recording period of the accounting data. One may set the values that can be found in the table below, only. The table below introduces the relationship between the recording period and the one, when the oldest data stored in the corrector memory are replaced with the newest ones.

Recording period	1	2	3	4	5	6	10	12	15	20	30	60
Memory cap.(days)	23	46	68	91	114	137	228	273	341	455	683	1365

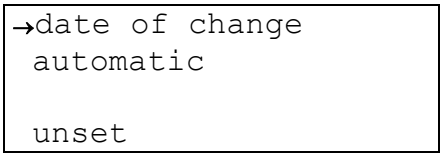
When the recording period has been set, the screen appears with the question, whether to change the recording period together with gas day and night. To perform the immediate

change of the recording period, without waiting to the end of the gas day and night, one should press any arrow to replace the question „**change tommorow?"** into „**change immediately?"**.



6.4.6.3 algorithm constants | clock | standard time
algorithm constants | clock | daylight savings time

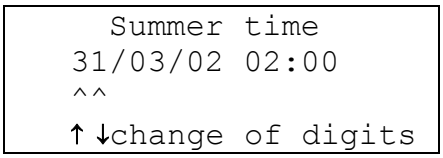
When one of the functions has been selected, the submenu is displayed:



One can program the date of the time change in the corrector by three ways:

1) date of change – to set one given date and to cancel the setting when the time change is performed,
2) automatic – to switch on the automatic time change,
3) unset – lack of clock modification.

6.4.6.3.1 algorithm constants | clock | summer time | date of change
algorithm constants | clock | winter time | date of change



If it is necessary to make the time change at the deadlines other than the standard ones, then one should select the function **date of change** for summer time and for winter time, and set the dates of change manually.

One should remember that in the function **summer time** the clock is shifted one hour forward, and in the function **winter time** – back.

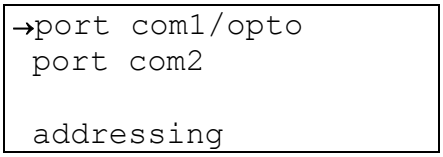
When the corrector performs the change, it sets the settings to zero and one should set the next date of the time change.

6.4.6.4 algorithm constants | clock | summer time | automatic
algorithm constants | clock | winter time | automatic

In the automatic mode the corrector determines the dates of change itself. For the summer time it is the last Sunday of March, from 2:00 a.m. to 3:00 a.m.; and for the winter time – the last Sunday of October from 3:00 a.m. to 2:00 a.m..

6.4.7 algorithm constants | serial links

When this option has been selected, the submenu is displayed:



The options **port com1/opto** and **port com2** work in the same way as one has described in the previous chapter.

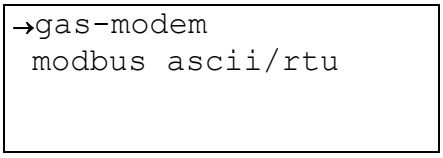
6.4.7.1 algorithm constants | serial links | addressing

The submenu is covered by this option:

The four sets of addressing make possible set four different addresses for each port for one protocol. If there is a question in the broadcasting mode, the corrector answers with the address from the first set.

6.4.7.1.1 algorithm constants | serial links | addressing | set 1÷4

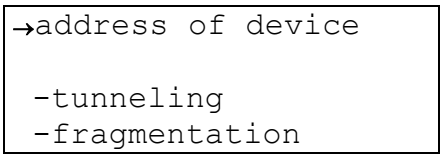
The option compounds the submenu:



One selects the protocol, for which he sets addresses in the set that has been chosen before.

6.4.7.1.1.1 algorithm constants | serial links | addressing | set 1÷4| gas-modem

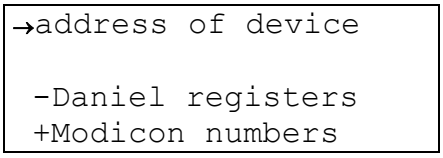
The option compounds the submenu:



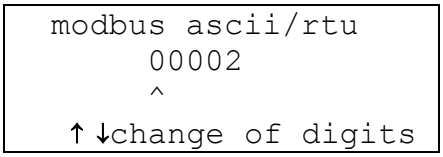
In the function **address of device** one sets the address as it has been described in the beginning of the chapter. The functions **tunneling** and **fragmentation** are used for cooperating with digital transducers.

6.4.7.1.1.2 algorithm constants | serial links | addressing | set 1÷4 | modbus ascii/rtu

It covers the submenu:



In the function **address of device** one sets one address for the both COM links for a selected set.



The parameter **Daniel registers** is used to configure the method of registers' addressing:

„+" –32 bits registers,

„-" –16 bits registers

The parameter **Modicon numbers** is used to configure the way to transfer fixed-point values:

„+" – numbers transferred in a format 3,4,1,2,

„-" – numbers transferred in a format 1,2,3,4

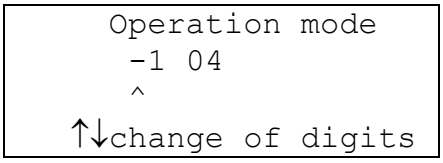
To change the parameter condition, one presses the **Enter** key, when earlier has placed the arrow on the selected parameter.

6.4.8 algorithm constants | signaling

Four entries are displayed in this menu, respectably to the devices' settings. One configures only link parameters for the inputs, and for the two-state outputs he may assign a function additionally.

6.4.8.1 algorithm constants | signaling | line IN1(I1)
algorithm constants | signaling | line IN2(I2)

Programming the operation mode for the input is as follows:



The successive values are as follows:

- the state of switching the line servicing on (- inactive line, + active),
- the level of activity (1: high/shorted, 0: low/opened),
- the value of the signal hysteresis (of filtering time) (0-30).

Switching the input line on will cause recording an alarm during active state on the input.

Independently on switching on there is always a possibility to monitor the input state by the remote computer.

Hint

- With external supply the signals are filtered with 1 second resolution.
- One does not recommend to set hystereses with the battery operation, because of reducing the frequency of scanning the inputs and calculating the outputs' values.
- With the external supply the input signal hysteresis means time, after which the input value is recognized as a stable one, for instance: setting 25 means, that the input state should be steady during 25 seconds to be recognized by the corrector as the constant value.
- One does not recommend to set any hysteresis time for the output signals when the threshold of the signal switching has been programmed to 0.5Hz.

6.4.8.2 algorithm constants | signaling | line OUT1(O1)
algorithm constants | signaling | line OUT2(O2)
algorithm constants | signaling | line OUT3(O3)
algorithm constants | signaling | line OUT4(O4)

The procedure to program the output operation mode is the same as the input one.

The configuration of the function looks as follows:

```
     configuration
1,04,000,00 000000.00
^
   ↑↓change of digits
```

The description of the function has been introduced in a simplified way; signs `---` mean the digits, which have no significance for the successive functions.

The following functions are accessible:

6.4.8.2.1 Input propagation:

In this mode, the output is set depending on the function of the input lines states.

```
0,AB,FFF,-- ----.----
```

A: input 1
- 0 – always '*false'* value
- 1 – always '*true'* value
- 2 – direct input value
- 3 – direct, negated input value
- 4 – filtered input value
- 5 – filtred, negated input value

B: input 2
As in item: A

FFF: performed function
- 1 – logical sum OR
- 2 – logical product AND
- 3 – symmetric difference XOR
- 4 – negated logical sum NOR
- 5 – negated logical product NAND
- 6 – negated symmetric difference NOT XOR

A	B	OR	AND	XOR	NOR	NAND	NXOR
0	0	0	0	0	1	1	1
0	1	1	0	1	0	1	0
1	0	1	0	1	0	1	0
1	1	1	1	0	0	0	1

Example:

```
0,23,001,00 0000.0000
```

The performed function is as follows: Output = *NOT (Input1 OR (NOT Input2))* and it means that the output will be set only in the case when Input 1 is inactive and Input 2 is active.

6.4.8.2.2 System alarm

The output is always active, when at least one system alarm is active.

```
1,--,---,-- ----.----
```

6.4.8.2.3 Process alarm

The output is always active, when at least one process alarm is active.

.

```
2,--,---,-- ----.----
```

6.4.8.2.4 Alarm

The output line state will mirror the condition of the programmed process alarm or the system one.

```
3,--,NNN,-- ----.----
```

NNN: the alarm number (The Table with alarm numbers is introduced in Annex B to this Manual)

6.4.8.2.5 Change of register value of the corrector parameters' table

The output line condition will mirror the result of the control condition of the register value of the internal table of accessible parameters (DP).

```
4,XX,ZZZ,TT VVVVVVVVV
```

XX: relation
- 0 – inequality (<>)
- 1 – equality (=)
- 2 – majority (>)
- 3 – minority (<)
- 4 – not less (>=)
- 5 – not bigger (<=)

ZZZ: the register number in the table of current data (The table of the accessible parameters are compatible to the DP table of the GasModem2 protocol and it is possible to take it from the manufacturer and is introduced in Annex A to this Manual)

TT: percentage threshold of switching the signal 0.5 Hz modulation on

V: comparable value

Example:

```
4,03,117,00 0093.5000
```

The output will be active if the percentage of methane (DP117) is less than 93.5%. It is obvious, that monitoring set so makes sense if the corrector is connected with the chromatograph.

6.4.8.2.6 Exceeding ordered power

The output will be activated when the programmed threshold of gas consumption is exceeded.

For the real values (pm1):

```
5,XX,---,TT VVVVVVVVV
```

For the standard values (pmn)

```
6,XX,---,TT VVVVVVVVV
```

X: detection mode of exceeding the consumption

0 – fix window, counter operation

In this mode the corrector will set the active condition at the output, if the value of the programmed threshold of gas consumption (V) is exceeded, counting since the beginning of the full hour. If (T) – percentage of value (V) is exceeded, the modulated signal appears at the output, with the frequency of 0.5Hz.

1 – shift window, counter operation

In this mode the corrector will set the active condition at the output, if the value of the programmed threshold of gas consumption (V) is exceeded, in the period of the latest 60 minutes. If (T) – percentage of value (V) is exceeded, the modulated signal appears at the output, with the frequency of 0.5Hz

2 – fix window, time work

In this mode the corrector will set the active condition at the output, if during the programmed time period of (T) minutes and assuming the stability of the current flux value, the programmed threshold of gas consumption (V) is exceeded, counting since the beginning of the full hour.

3 – shift window, time work

In this mode the corrector will set the active condition at the output, if during the programmed time period of (T) minutes and assuming the stability of the current flux value, the programmed threshold of gas consumption (V) is exceeded, counting in the period of the latest 60 minutes.

T: counter operation: the percentage threshold to switch on the signal 0.5 Hz,
time work: prediction time of the consumption value

V: threshold value of gas consumption

Example #1:

```
6,00,000,75 0350.0000
```

The output is active when the gas consumption exceeds the value of 350nm^3 – counting since the beginning of the full hour. In case when 75% of this value has been exceeded, i.e. the value of 262.5nm^3 the output will be modulated by the signal of 0.5Hz.

Example #2:

```
5,02,000,15 0150.0000
```

The output is active when the gas consumption exceeds the value of 150m^3.

The value is estimated on the base of calculating the gas consumption since the beginning of the full hour, increased by the gas quantity that will flow during successive 15 minutes, if one assumes the invariability of the current value of the gas flux

6.4.8.2.7 Output proportional to Vn

This function is realized by the output 2, only (port OUT4). This output will be activated/inactivated proportionally to the growth of the Vn counter value.

```
7,--,---,-- VVVVVVV
```

V: weight of generated pulse

Hint

The generated signal is always of not bigger than 0.5Hz frequency and of pulse-width modulation close to 50%. If the correction conditions cause the attempt to exceed the limit frequency, the suitable alarm is recorded.

Example:

```
7,00,000,00 0010.0000
```

Every 10nm3 the impulse will appear at the output.

6.4.8.3 algorithm constants | transducers

This function covers the submenu:

```
→K1 value
 Q1 input
 t input
 p input
```

6.4.8.3.1 algorithm constants | transducers | K1 value

```
    simulation
 - value:1.0000
 ^
  ↑↓change of digits
```

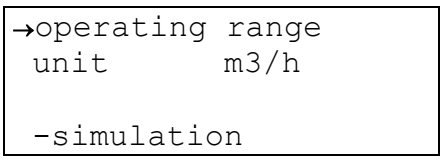
One may settle here the simulation of the compressibility factor value. He sets activity:

- switched off
+ simulation switched on.

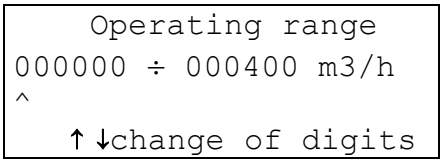
When the simulation is set, the value of the compressibility factor will be constant; the correction will be performed on the base of pressure and temperature measurements, only.

6.4.8.3.2 algorithm constants | transducers | Q1 input
algorithm constants | transducers | t input
algorithm constants | transducers | p input

They cover the submenu:



6.4.8.3.2.1 algorithm constants | transducers | Q1/t/p input | operating range



Operating range

One sets the operating range of the transducer. It does not cause any changes of the measured values, only exceeding of these values will result in generating suitable entries in the alarm list.

Usually there is no need to change the ranges, the Q1 range is set automatically when the gas-meter size is selected in „**algorithm constants | gas-meter"**, the pressure range depends on the sensor type and is set by the manufacturer, the temperature pressure for the Pt 1000 transducer amounts to –50÷+70 and also is set by the manufacturer.

The range values are always set in the following units:

for the volume flux:

m^3/h,

for temperature:

ºC,

for pressure:

kPa.

6.4.8.3.2.2 Unit

One sets the unit when moves the arrow onto the function: unit and presses **Enter**. The accessible units are as follows:

for the volume flux:

m^3/h, l/h,

for temperature:

ºC, ºF, ºR, K,

for pressure:

Pa, hPa, kPa, MPa, mbar, bar, atm, mmHg, psi

6.4.8.3.2.3 algorithm constants | transducers | Q1/t/p input | simulation

```
     simulation
- value:2.5000e+02
^
   ↑↓change of digits
```

The value is set in the engineering notation, i.e.:

2,5e+2 equals mathematically to $2,5 * 10^2 = 250$

The simulation value for every measured quantity may be set in the same way as one can find above.

The simulation values are always introduced in SI units, i.e.:

for the volume flux:

m^3/h,

for temperature:

K,

for pressure:

Pa.

6.5 Activating The Configuration

All the modifications in the menu of: **algorithm constants** are buffered and stored in FLASHROM only when one leaves this menu and the following message appears:

```
  -=-             -=-
Configuration storage
     completed!
  -=-             -=-
```

If this message does not appear, it means that the corrector has found no change of any configuration parameter.

The last activity is to synchronize the main counter and time control.

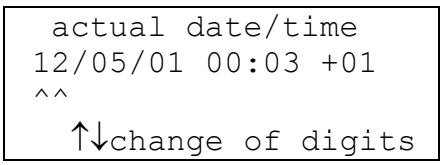
6.5.1 real volume

```
  Real volume
 V1 = 0000056.0 m3
      ^
   ↑↓change of digits
```

The edition of the parameter always meets the actually set format of the counter.

COMMENT:
The correctors with software of the number 1.0.2.16 or higher, are equipped with the function of blocking the modification of the last digit of the counter.

6.5.2 actual date / time



One programs in this window successively: day, month, year, hour, minute and time zone shift, where the corrector is placed (the value of second always equals to 0; the time zone for Poland is +01).

In spite of editor's permitting to introduce incorrect dates, for instance: 31/02/2001, when the edition is completed, such a date will be introduced that the corrector has recognized as the proper and closest one to the introduced date.

7 Communication Between The Corrector and The Computer

The corrector is equipped with two serial links that work independently one on the other. The asynchronous transmission is applied, with one bit of stop and eight data bits. The user may determine the way to check the parity and the transmission baud rate.

The protocol of data reading meets the protocol GAS - MODEM. It is based on the principle of asking the corrector by the computer. The computer sends the demands to send the determined type of information. The data exchange takes place through blocks.

The program Gas-service is used for the communication between the station operator and the corrector. This program allows, among others:

- to set the gas composition, the temperature ranges, Qmin, Qmax pressure values
- to set the current setting of the counter, and sampling time
- to set the day and the hour, to change the standard and dayligh savings time
- to change the internal password of the corrector etc.

The program is provided to the installer of the station, gas departments, and in case where the CMK-02 volume corrector (the system to perform correction and recording of gas volume) is applied – to the owner of the system for technological purposes.

The configuring parameters of the corrector can be set (with exception of serial link parameters) with the use of any external computer (a notebook or any similarly working device) connected to the corrector through serial links.
Also the remote access through telephone links is possible: commutative and separated ones.

The password that allows to perform and change the parameters in the corrector may be known by the authorized user, only and only he/she may change it. Every change of the corrector parameters leaves the trace as the entries in the list of alarms, with the date, the user's number and the program's number.

8 Package, Storing And Transport

The picking list of the system of correction and recording gas volume (gas volume corrector) CMK-02:

1. The corrector CMK-02
2. The temperature sensor with the wire
3. The wire to the CLFK pulse transmitter
4. The technical documentation
5. The standard chart for the measuring inputs of The CMK-02 Gas Volume Computer
6. The guarantee certificate
7. The company certificate

The components of the CMK-02 gas volume corrector should be packed for the period of transport from the manufacturer to the user, according to the company documentation. One permits installing some system subassemblies directly on the gas pipe-lines' parts and packing them jointly for the transport period according to the documentation. The system components should be stored in the transport packing or without it on the storing rack in a room with the temperature within the range of $-5^{O}C \div +60^{O}C$ and the humidity not bigger than 80% without any vapors of chemically active compounds.

The transport should be performed in accessible means of transport in the conditions that protect against mechanical damages. The charge should be protected against moving during transportation.

9 Annex A – Table of accessible parameters

Parameter ID	Design.	Register name
1	dVn	Growth of real volume for recording period
2	dV1	Growth of standard volume for recording period
3	p1	Average gas presure
4	t1	Average gas temperature
5	tob	Value res1
6	K1	Value res2
17	Vn	Counter of standard volume
18	V1	Counter of real volume
19	CFG	Identifier of configuration version
20		Identifier of calculating method for compressibility
21		Identifier of measuring method for volume
22	DN	DN of cooperating gas-meter
23	G	G of cooperating gas-meter
24	Qmax/Qmin	Ranges of cooperating gas-meter
25	[LF] Q/imp	Low frequency pulse weight (LF)
26	D	Diameter of pipe-line
27	d	Diameter of orifice
28	alfatr	Coefficient of pipeline expansion
29	alfatk	Coefficient of orifice expansion
30	wc	Roughness coefficient
31		Method to take pressure from orifice
32	Ah	Standard capacitance of battery
33	Esrc	Source to calculate energy value
34		Date shift for 24 hours recording entries
35	dateoff	Starting hour of gas day and night
36	tmzone	Time zone relating to GMT
37	V1digits	Number of all digits of counter
38	V1prec	Number of decimal digits of counter
39	Tn	Standard temperature
40	pn	Standard pressure
41	to1r min	Lower measuring range of case temperature
42	to1r max	Upper measuring range of case temperature
43		Lower measuring range of coef. HF/LF
44		Upper measuring range of coef. HF/LF
45		Lower measuring range of dPL
46		Upper measuring range of dPL
47		Lower measuring range of dPH
48		Upper measuring range of dPH
49	p1r min	Lower measuring range of P1
50	p1r max	Upper measuring range of P1
51	t1r min	Lower measuring range of T1
52	t1r max	Upper measuring range of T1
53	q1r min	Lower measuring range of Q1
54	q1r max	Upper measuring range of Q1
55		Lower measuring range of R1
56		Upper measuring range of R1
57		Lower measuring range of R2
58		Upper measuring range of R2
59		Source of signal to calculate volume
60		Source of signal to calculate flux

Parameter	Design.	Register name
61		Window size for averaging time for QLF value
62		Window size for averaging time for QHF value
63	[HF] Q/imp	Pulse weight HF
64	dP min	Bottom measuring limit dP
65	dP max	Top measuring limit dP
66	p1 min	Bottom measuring limit p1
67	p1 max	Top measuring limit p1
68	t1 min	Bottom measuring limit T1
69	t1 max	Top measuring limit T1
70	q1 min	Bottom measuring limit Q1
71	q1 max	Top measuring limit Q1
72	qn min	Bottom measuring limit Qn
73	qn max	Top measuring limit Qn
74	r1 min	Bottom measuring limit R1
75	r1 max	Top measuring limit R1
76	r2 min	Bottom measuring limit R2
77	r2 max	Top measuring limit R2
78		Date of time change S->W
79		Date of time change W->S
116	%|x	Identifier of gas composition type (molar/volume)
117	ch4	Percentage of methane
118	c2h6	Percentage of ethane
119	c3h8	Percentage of propane
120	c4h10	Percentage of butane
121	i-c4h10	Percentage of i-butane
122	c5h12	Percentage of pentane
123	i-c5h12	Percentage of i-pentane
124	c6h14	Percentage of hexane
125	c7h16	Percentage of heptane
126	c8h18	Percentage of octane
127	c9h20	Percentage of nonane
128	c10h22	Percentage of decane
129	c2h4	Percentage of ethylene
130	c3h6	Percentage of propane
131	i-c4h8	Percentage of i-butene
132	cis-c4h8	Percentage of cis-2-butene
133	izo-c4h8	Percentage of isobutene
134	1,2-c4h6	Percentage of 1,2-butadiene
135	1,3-c4h6	Percentage of 1,3-butadiene
136	1-c5h10	Percentage of 1-pentene
137	c5h10	Percentage of cyclopentane
138	c6h6	Percentage of benzene
139	c7h8	Percentage of toluene
140	ch9oh	Percentage of methanol
141	h2	Percentage of hydrogen
142	h2o	Percentage of water vapor
143	h2s	Percentage of hydrogen sulphide
144	co	Percentage of carbon monoxide
145	he	Percentage of helium
146	ne	Percentage of neon
147	ar	Percentage of argon
148	n2	Percentage of nitrogen
149	o2	Percentage of oxygen
150	co2	Percentage of carbon dioxide

Parameter	Design.	Register name
151	so2	Percentage of sulphur dioxide
152	air	Percentage of air
153	Zn	Compressibility factor in standard conditions
154	Mm	Molar mass of mixture
155	Ron	Real density in standard conditions
156	dn	Relative density in standard conditions
157	Hsn	Heat of combustion in standard conditions
158	Hin	Heating value in standard conditions
159		Absolute viscosity in standard conditions
160		Isentropic exponent in standard conditions
161		Source of supplying the corrector
162		Date and time of the latest recording
163	LF	LF pulse counter
164		Counter of corrector work time
165		Counter of corrector activating time
166		Meter of used battery power
167	dV1	Growth of real value
168	V1	Counter of real volume
169	dVn	Growth of standard volume
170	Vn	Counter of standard volume
171	V1 [A]	Counter of real volume for alarm conditions
172	Vn [A]	Counter of standard volume for alarm conditions
173	E	Energy meter
174	M	Mass meter
175	Qr	Real flux
176	Q1	Corrected real flux
177	Qn	Standard flux
178	Qe	Energy flux
179	Qm	Mass flux
180	Tob	Temperature of housing
181	T1	Gas temperature
182	P1	Gas pressure
183	[L] dP1	Differential pressure (L)
184	[H] dP1	Differential pressure (H)
185	dP1	Differential pressure
186	F1	Gas humidity
187	Pa1	Barometric pressure
188	K1	Compressibility factor
189	Fi1	Correction volume coefficient
190	Wi	Wobbe index (lower)
191	Ws	Wobbe index
192	Hs1	Real combustion heat
193	Hi1	Real heating value
194	ro1	Relative real density
195	d1	Real density
196	wiz1	Isentropic exponent in real conditions
197	lpd1	Absolute viscosity in real conditions
200		Flow ratio C
201		Expansion number
202	Re	Reynolds number
203	HF real	Measured pulse weight HF
204	HF / LF	Counter of HF pulses that relate to LF
205	HF err	Weight error of HF
206	pm1	Current value of hour consumption (m3)

Parameter	Design.	Register name
207	pmn	Current value of hour consumption (nm3)
208	Imax	Maximum quantity of LF pulses during 1 minute
209		State of switching corrector on
210		State of switching recorder on
211	dtau	Interval of writing recorded data
212	IO in	Bi-state input condition
213	IO out	Bi-state output condition
214	Q1src	Source of Q1 value
215	[LF] Q1	Flux value counted from LF
216	[HF] Q1	Flux value counted from HF
217	OP id	Operator's number
218	PRG id	Number of service program
219	[GPF] seg	Location of error – Program Segment
220	[GPF] off	Location of error – Shift in segment
221	[GPF] id	Location of error – Identification of exception
222	r1	Value of external transducer
223	r2	Value of external transducer
224	r3	Value of external transducer
225	r4	Value of external transducer
226	r5	Value of external transducer
227	r6	Value of external transducer
228	r7	Value of external transducer
229	r8	Value of external transducer
230	r9	Value of external transducer
231	r10	Value of external transducer
232	r11	Value of external transducer
233	r12	Value of external transducer
234	r13	Value of external transducer
235	r14	Value of external transducer
236	r15	Value of external transducer
237	r16	Value of external transducer

10 Annex B – Table of alarms

Number	Description
0	Scaler start
6	Change of time more than 10min
7	Exceeding scaler temperature
11	Exceeding p transducer range
12	Exceeding T transducer range
14	Exceeding Qn limit value
15	Exceeding Q1 limit value
17	Exceeding p limit value
18	Exceeding T limit value
20	Exceeding Q1 transducer range
21	Change of time below 10min
22	Change of V1 counter value
28	Exceeding rez1 transducer range
29	Exceeding rez2 transducer range
30	Exceeding rez1 limit value
31	Exceeding rez2 limit value
32	Error of HF/LF coefficient
33	Active 1 signaling
34	Active 2 signaling
35	Active 3 signaling
36	Active 4 signaling
40	Scaler stop
42	Setting scaler working
46	Change of access password
47	Low battery voltage
48	Change of configuration constants
49	Change of gas composition
50	Transition through 0 of V1 counter
51	Transition through 0 of Vn counter
55	Reading gas composition from chromatograph
63	Change of recording period
104	Unknown reset
244	Exceeding limit frequency of Vn pulse output
245	Error of gas composition
246	Change of configuration
247	Calculating error K1
248	Recovery of counters Vr/Vn
249	Damage of P transducer
250	Damage of T transducer
251	Unknown communication protocol
252	Error of program executing
253	"Watch-dog" System
254	"Watch-dog" Process
255	Error CRC – control of operational memory integrity

11 Annex C -
Access to parameters in communication protocols

Parameter item	Gas Modem II				MODBUS Record number			
	Index	Readout	Entry	Recording	short	dword	float	double
1	0			x				
2	1			x				
3	2			x				
4	3			x				
5	4			x				
6	5			x				
17	16			x				
18	17			x				
19	18	x				D43001		
20	19	x	x			D43003		
21	20	x	x			D43005		
22	21	x	x		S41004	D43007		
23	22	x	x		S41005	D43009		
24	23	x	x		S41006	D43011		
25	24	x	x				F45013	47025
26	25	x	x				F45015	47029
27	26	x	x				F45017	47033
28	27	x	x				F45019	47037
29	28	x	x				F45021	47041
30	29	x	x				F45023	47045
31	30	x	x		S41013			
32	31	x	x		S41014			
33	32	x	x		S41015			
34	33	x	x		S41016			
35	34	x	x		S41017			
36	35	x	x		S41018			
37	36	x	x		S41019			
38	37	x	x		S41020			
39	38	x	x				F45041	47081
40	39	x	x				F45043	47085
41	40	x	x				F45045	47089
42	41	x	x				F45047	47093
43	42	x	x				F45049	47097
44	43	x	x				F45051	47101
45	44	x	x				F45053	47105
46	45	x	x				F45055	47109
47	46	x	x				F45057	47113
48	47	x	x				F45059	47117
49	48	x	x				F45061	47121
50	49	x	x				F45063	47125
51	50	x	x				F45065	47129
52	51	x	x				F45067	47133
53	52	x	x				F45069	47137
54	53	x	x				F45071	47141
55	54	x	x				F45073	47145
56	55	x	x				F45075	47149
57	56	x	x				F45077	47153

58	57	x	x				F45079	47157
59	58	x	x		S41041			
60	59	x	x		S41042			
61	60	x	x		S41043			
62	61	x	x		S41044			
63	62	x	x				F45089	47177
64	63	x	x				F45091	47181
65	64	x	x				F45093	47185
66	65	x	x				F45095	47189
67	66	x	x				F45097	47193
68	67	x	x				F45099	47197
69	68	x	x				F45101	47201
70	69	x	x				F45103	47205
71	70	x	x				F45105	47209
72	71	x	x				F45107	47213
73	72	x	x				F45109	47217
74	73	x	x				F45111	47221
75	74	x	x				F45113	47225
76	75	x	x				F45115	47229
77	76	x	x				F45117	47233
78	77	x	x			D43119		
79	78	x	x			D43121		
116	115	x	x		S41098			
117	116	x	x				F45197	47393
118	117	x	x				F45199	47397
119	118	x	x				F45201	47401
120	119	x	x				F45203	47405
121	120	x	x				F45205	47409
122	121	x	x				F45207	47413
123	122	x	x				F45209	47417
124	123	x	x				F45211	47421
125	124	x	x				F45213	47425
126	125	x	x				F45215	47429
127	126	x	x				F45217	47433
128	127	x	x				F45219	47437
129	128	x	x				F45221	47441
130	129	x	x				F45223	47445
131	130	x	x				F45225	47449
132	131	x	x				F45227	47453
133	132	x	x				F45229	47457
134	133	x	x				F45231	47461
135	134	x	x				F45233	47465
136	135	x	x				F45235	47469
137	136	x	x				F45237	47473
138	137	x	x				F45239	47477
139	138	x	x				F45241	47481
140	139	x	x				F45243	47485
141	140	x	x				F45245	47489
142	141	x	x				F45247	47493
143	142	x	x				F45249	47497
144	143	x	x				F45251	47501
145	144	x	x				F45253	47505
146	145	x	x				F45255	47509

147	146	x	x				F45257	47513
148	147	x	x				F45259	47517
149	148	x	x				F45261	47521
150	149	x	x				F45263	47525
151	150	x	x				F45265	47529
152	151	x	x				F45267	47533
153	152	x	x				F45269	47537
154	153	x	x				F45271	47541
155	154	x	x				F45273	47545
156	155	x	x				F45275	47549
157	156	x	x				F45277	47553
158	157	x	x				F45279	47557
159	158	x	x				F45281	47561
160	159	x	x				F45283	47565
161	160	x			S41143			
162	161	x				D43287		
163	162	x				D43289		
164	163	x				D43291		
165	164	x				D43293		
166	165	x					F45295	47589
167	166	x					F45297	47593
168	167	x					F45299	47597
169	168	x					F45301	47601
170	169	x					F45303	47605
171	170	x					F45305	47609
172	171	x					F45307	47613
173	172	x					F45309	47617
174	173	x					F45311	47621
175	174	x					F45313	47625
176	175	x					F45315	47629
177	176	x					F45317	47633
178	177	x					F45319	47637
179	178	x					F45321	47641
180	179	x					F45323	47645
181	180	x					F45325	47649
182	181	x					F45327	47653
183	182	x					F45329	47657
184	183	x					F45331	47661
185	184	x					F45333	47665
186	185	x					F45335	47669
187	186	x					F45337	47673
188	187	x					F45339	47677
189	188	x					F45341	47681
190	189	x					F45343	47685
191	190	x					F45345	47689
192	191	x					F45347	47693
193	192	x					F45349	47697
194	193	x					F45351	47701
195	194	x					F45353	47705
196	195	x					F45355	47709
197	196	x					F45357	47713
200	199	x					F45363	47725
201	200	x					F45365	47729

202	201	x					F45367	47733
203	202	x					F45369	47737
204	203	x					F45371	47741
205	204	x					F45373	47745
206	205	x					F45375	47749
207	206	x					F45377	47753
208	207	x			S41190	D43379		
209	208	x			S41191			
210	209	x			S41192			
211	210	x			S41193			
212	211	x				D43387		
213	212	x				D43389		
214	213	x			S41196			
215	214	x					F45393	47785
216	215	x					F45395	47789
217	216	x			S41199			
218	217	x			S41200			
219	218	x						
220	219	x						
221	220	x						
222	221	x			S41204	D43407	F45407	47813
223	222	x			S41205	D43409	F45409	47817
224	223	x	x		S41206	D43411	F45411	47821
225	224	x	x		S41207	D43413	F45413	47825
226	225	x	x		S41208	D43415	F45415	47829
227	226	x	x		S41209	D43417	F45417	47833
228	227	x	x		S41210	D43419	F45419	47837
229	228	x	x		S41211	D43421	F45421	47841
230	229	x	x		S41212	D43423	F45423	47845
231	230	x	x		S41213	D43425	F45425	47849
232	231	x	x		S41214	D43427	F45427	47853
233	232	x	x		S41215	D43429	F45429	47857
234	233	x	x		S41216	D43431	F45431	47861
235	234	x	x		S41217	D43433	F45433	47865
236	235	x	x		S41218	D43435	F45435	47869
237	236	x	x		S41219	D43437	F45437	47873