IOM-DMCU900: MAY 2022: REV D

USER'S MANUAL

DMCU900 series

Hudson House, Albany Park Camberley Surrey, GU16 7PL, UK.
+44 (0) 1252 729140, fax +44 (0) 1252 729168
www.delta-mobrey.com, e-mail: sales@delta-mobrey.com

The Delta Mobrey Control Unit (DMCU) range represents the next evolution in Delta Mobrey's ultrasonic level measurement instrumentation.

APPROVALS:	
Ex	BKI ATEX, Certificate No.: BKI20ATEX0018

Table of Contents

Thank you for choosing a Delta Mobrey instrument.

1. INTRODUCTION

The **DMCU900** is a universal interface between Delta Mobrey's HART-capable level transmitters and other elements of the process control system such as PCs, PLCs, displays and actuators. Besides its role as an interface, the DMCU900 provides power for the 2-wire transmitters, and it is capable of handling complex control tasks. The **DMCU900** is capable of programming transmitters remotely and downloading parameters and measured data. The outputs such as 4 … 20 mA, relays, and digital outputs can be controlled using measured values and derived values calculated from them. Measured values (Primary Value and three additional values) can be logged. A large dot-matrix LCD panel provides a wide variety of functions, including tank content visualisation.

Certified explosion-proof versions of the **DMCU900** are available for hazardous environments.

THE HART SYSTEM

HART (**H**ighway **A**ddressable **R**emote **T**ransducer – bus addressable field devices) is a digital communication protocol developed for industrial measurement applications. A short amplitude digital signal is transmitted via the widely used standard 4…20mA output. Due to its symmetric sinusoidal nature and its short amplitude, it does not affect the output current's accuracy. Since HART modulates the sensor's signal, no extra cable is needed for HART signal transmission. Identifying, programming, and querying transmitters are done via HART.

COMMUNICATION

HART communication is a master-slave setup, which means that the transmitter – slave – only sends a response when the master (of which there can be only one in the system) sends a query. The master can be a Hand-held Communicator, a PC with a HART modem or a universal interface, or a DMCU900 (only one can be active). Communication uses standard commands (see *Properties of HART-Capable Devices*).

SYSTEM STRUCTURE

The system must contain a 230..1000 Ω resistor to guarantee that the short amplitude HART signal will not load the power supply with an unknown output impedance.

PROPERTIES OF HART-CAPABLE DEVICES

These parameters are programmed into the unit in the factory. Some of them can be edited by the user with a HART MASTER; the rest can only be edited by the manufacturer.

Short TAG	An editable 8-character device ID.
Short Address	Used to differentiate between up to 15 devices. The Short Address is unique for each device in the system. It is editable.
Message	An editable 32-character long arbitrary comment that can be assigned to the device and is operation-related.
Descriptor	An editable 16-character long arbitrary comment that can be assigned to the device and is material-related.
Date	Date. It serves as the current date of the device's real-time clock. It is editable.
Factory ID	Factory ID.
Device type ID	Device type ID, not editable.
Device ID	The manufacturer's electronic production number, not editable. The Factory ID, the Device Type ID and the Device ID together constitute the "Long Address."
SW version	Software version of the device (refer to device manual).
HW version	Hardware version of the device (refer to device manual).

An additional parameter contains the version number of the HART command set used by the device.

THE HART COMMAND SET

Using HART commands, we can decide what the devices should do. An ultrasonic transmitter needs different commands than a temperature transmitter or a valve, that would mean a lot of different commands. To avoid too much traffic, every command has a one-byte identifier that corresponds to a preprogrammed command specific to that particular device. Command 31 is the Extended ID, which makes the next 2 bytes a part of the command ID (0…65535). HART commands are divided in to 3 classes:

- universal commands 0..30
- general commands 32..121
- device-specific commands 128..253

All commands contain an address (short address, long address, or TAG), which determines the corresponding device.
All connected devices must have a unique address.

Universal Commands

These commands are understood by all devices, to which they give the same response.

0. *Read Unique Identifier*
The addressed device provides the followings in its response:

- Manufacturer's code (provided by the HART foundation, see *Appendix 1*)
- Product code (provided by the manufacturer, see *Preparing the Transmitters*)
- Universal command table code (HART 5)
- Device ID
- Software version
- Hardware version
- Device status

1. *Read Primary Variable*
This reads the digital value (Primary Value) that the transmitter sends to the 4…20 mA output.
The numeric value contains the unit as well.

2. *Read Output Current in mA and in Percent of Range*

3. *Read Output Current and Four Dynamic Variables*
The primary, secondary, tertiary and quaternary variables are transmitted.
The secondary, tertiary, and quaternary variables are specified in the manual of the particular devices.

6. *Modify (short) Polling Address (Write Polling Address)*
If there is more than one device in the loop (multidrop), each device must have a different address.
Addresses should be configured before connecting the devices to avoid errors caused by devices with the same addresses replying at the same time.

11. *Read Unique Device Identifier Associated with Tag*
Devices are queried by their short TAG, not their addresses.
Therefore, all short TAGs must be unique within the system.

12. *Read Device Message*
    This reads the 32 character message stored in the non-volatile memory of the device (e.g. T18 35% HCL TANK)
13. *Read the 8-Character "Short TAG", 16-Character Descriptor and Date*
14. *Read PV Sensor Information*
15. *Read Output Information*
16. *Read Final Assembly Number*
17. *Write 32-Character Message*
18. *Write 8-Character "Short TAG", 16-Character Descriptor and Date*
19. *Write Final Assembly Number*

General Commands

These commands do not have to be understood by all devices. If the device does not understand a command, it is ignored, however, if the command is understood, it must be interpreted according to the standard. There are numerous such commands; the most important ones are the following:

- 34: Damping (writing settling time)
- 35: Measurement range (writing upper and lower limits, and/or unit)
- 36: Upper limit now! (sets the upper limit – 20 mA)
- 37: Lower limit now! (sets the lower limit – 4 mA)
- 40: Setting constant current loop output (useful for testing)
- 41: Device self-test, sends back the result.
- 42: Master reset (restoring factory defaults)
- 50: Reading assignment status of the primary variable (PV), the secondary variable (SV), the tertiary variable (TV) and the quaternary variable (QV). This can not always be read unambiguously, in most cases it can be found in the manual of the device.
- 109: Switching „Burst" mode on and off.

Device-Specific Commands

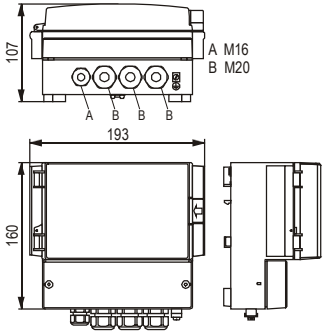
These commands are specified by the manufacturer. The commands are described in the device manual.

2. TECHNICAL DATA

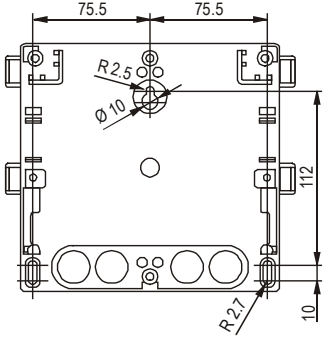
TYPE		DMCU900 SERIES
Outputs	Transmitter Power Supply	30 V DC / 60 mA (For Ex Version: 25 V DC / 22 mA)
	Display	128 x 64 dot-matrix
	Analogue	Max. 2 galvanically isolated 4 - 20 mA outputs, Max load: 500 Ω, with over-voltage protection
	Relay	Max. 5 SPDT, 250 V AC, AC1. 5 A
	RS 485 Interface	Galvanically isolated, HART / MODBUS protocol
	HART	Output signal level: 0.5 ±0.1 V_{pp} trapezoid 1200 / 2200 Hz Lowest input signal level: 50 mV_{pp} Built-in sensor's resistance: 250 Ω.
	Logger	Capacity: FLASH = 65000 entries; SD card (max 2 GB) = depends on the card

TYPE		DMCU900 SERIES
Connecting Cables	Power Supply, Relays, Analogue 4 … 20 mA	0.5 … 2.5 mm^2 wire cross-section
	RS 485 Interface	Shielded, twisted cable pair, cross section: 0.5 - 2.5 mm^2
	HART Line	Below 1500 m: shielded, twisted cable pair with a min. ∅0.5mm Above 1500 m: shielded, twisted cable pair, min. ∅0.8mm max. resistance : 75 Ω, max.capacitance : 200 nF
Number of Powered Transmitters		Max. 15 non-Ex (max. 4 Ex) transmitters
Power Supply / Power Consumption / Max. Power Supply		85 … 255 V AC 50 … 60 Hz / 12 VA / 255 V_{eff} 11.4 … 28 V AC 50 … 60 Hz / 12 VA / 28 V_{eff} 11.4 … 40 V DC / 11 W / 40 V DC
Fuse		85 … 255 V AC 50 … 60 Hz T400 mA 11.4 … 28 V AC 50 … 60 Hz and 11.4 … 40 V DC T1A
Housing Material		Polycarbonate (PC)
Mounting		Wall-mount and Panel mount
Ambient Temperature		-20 °C … +50 °C
Ingress Protection		IP 65
Ex Marking		Ⓔx II (1) G [Ex ia Ga] IIB, Ⓔx II (1) D [Ex ia Da] IIIC
Intrinsic Safety Data		U_o = 30 V I_o = 140 mA P_o = 1 W L_o = 4 mH C_o = 200 nF U_m = 253 V
Electrical Protection		Class I / III
Weight		0.9 kg

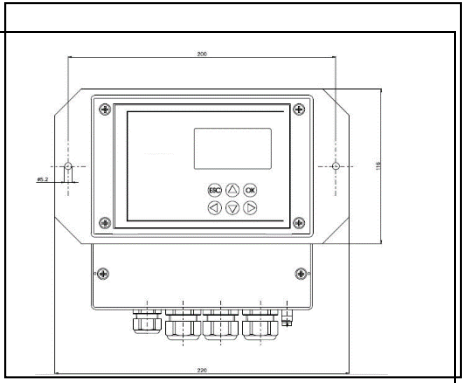
DIMENSIONS AND INSTALLATION



DMCU SERIES



HOLES FOR WALL MOUNTING



PANEL MOUNT

Wall Mount Instructions

Insert a single screw into the wall to suspend the controller.
Remove the lower terminal cover and insert two additional screws to secure the controller against the wall.

Panel Mount Instructions

Ensure there is adequate clearance behind the panel to allow for the depth of the controller and enough space below the cutout for the controller housing, including cable entries
Refer to the drawing above. The panel mount cut out size is 166mm x 107mm
Offer up the mounting plate to the controller and mark the positions of the two securing holes. Remove the plate and drill the two holes with 5mm diameter.
Take the control unit and remove the four fixing screws from the front cover.
Tilt the lid to access the ribbon cable and unplug this.
Place the mounting plate over the control unit.
Plug the ribbon cable back into the connector.
Replace the lid, insert and tightened the four screws which secure it.
The controller and front mounting plate can now be mounted from behind the panel.
Use two nuts and bolts (not supplied) to secure the mounting bracket in place.

Conditions for Ex Compliant Units

- Units should be mounted outside of the hazardous zone
- Devices must be protected from direct sunshine
- Power supply and ambient temperature values must not exceed the specified values
- Intrinsically safe (Ex) transmitters should be connected to the L+, L– terminals of the controller. These points are galvanically isolated from the rest of the electronics.
- The housing of the transmitters must be grounded
- Transmitters must be connected using shielded, twisted cables. The shielding between the transmitter and the controller should be grounded at one end, connected either to the internal or external part of the grounding screw.

3. ELECTRICAL CONNECTION

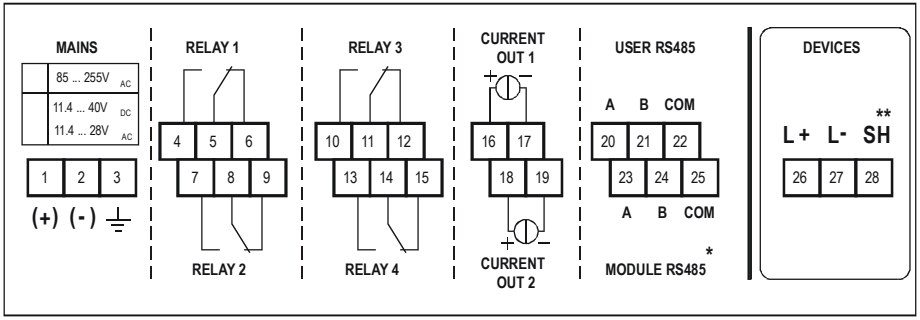
Cable Pinouts

After removing the screws of the cover, cables can be connected. Use the appropriate wires for AC, DC, SELV, and mains.
Use shielded and twisted cables (STP) to connect the transmitters. Wire length depends on the number of connected units and the electrical properties of the cable.

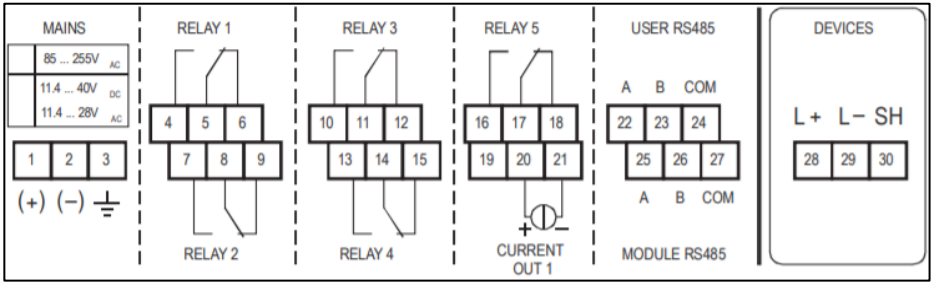
RS485 interface: **A:** TRD+
B: TRD–
COM: shielding

Number of Transmitters	Cable Capacitance (pF / m)			
	65	**95**	**160**	**225**
1	2800	2000	1300	1000
5	2500	1800	1100	900
10	2200	1600	1000	800
15	1850	1400	900	700

Four relay model



Five relay model



* Only DMCU types
** Non-Ex versions only

4. PROGRAMMING THE DMCU900

The following actions can be performed:

- Automatic detection of devices (transmitters) connected to the DMCU900 and adding them to the list of devices. Devices not on the list might be connencted to the system but are unable to communicate with the DMCU900 (see *Commissioning the DMCU900*, Main menu / DMCU900 config / DEV detect).
- Activating and deactivating devices (transmitters) (see *Commissioning the DMCU900*, Main menu / Devices). Theoretically, all devices in the system are working, whether they are listed or not. Devices in the list are automatically activated. Deactivation disables devices temporarily.
- Activating and deactivating relays and current loop outputs (see *Appendix 3* and *4*).
- Relays and current loop outputs of the DMCU900 are activated the same way devices are (see *Appendix 3* and *4*).
- Assigning DMCU900 outputs (relays, current loop outputs) to devices (transmitters).
- Formulating functional values (difference of 2 measured values, sum or average of 2 or more measured values).
- Remote programming of devices.
  (Parameters of the transmitters e.g. P01, P02, etc. are used in this manual the same way as described in the Installation and User's Manual)
- Programming of DMCU900 outputs. (Relay and current loop output parameters of the DMCU900 are identified as RP1, RP2, RP3 and CR1, CR2, CR3 respectively).

In-depth knowledge of HART standards and programming of the connected devices is required for configuring systems involving the DMCU900 universal interface.

Programming on the fly does not cause the polling of the devices, the relays, or current loop outputs to stop. Changes will be saved automatically upon returning to measurement mode.

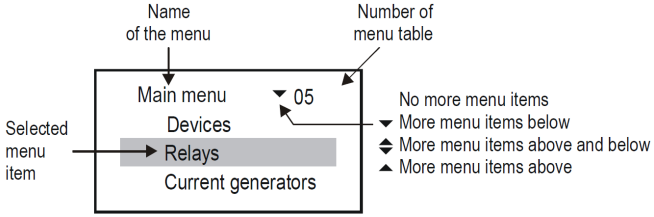
If the DMCU900 is left in Programming mode, it will automatically return to Measurement mode 5 minutes after the last key was pressed (modifications will be saved).

PROGRAMMING

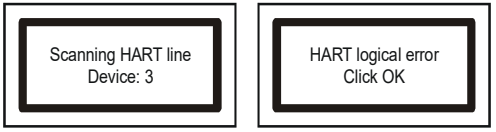
Programming is done via six buttons. There are three different kinds of screens on the display.

- **Measurement / Operation Screens**
  (marked with capital letters in the upper right corner, see *Appendix 5*):
  Measurement (see *Measurement Mode*)
  Bargraph (output range)
  User (see *DMCU900 Configuration*)
  Relay assignment table
  Current loop output assignment table
  Error list (see *6. Error Codes*)

- **Programming / Configuration Screens:**



- **Messages / Warnings** indicate what the unid does or what the user has to do



Below is a brief summary of programming; the complete menu system is detailed in **Appendix 2**. The current menu item and the editable value or character is highlighted at the cursor.

ESC ⇧ OK
⇦ ⇩ ⇨

Use ⇩ and ⇧ to navigate in the menu. Pressing and holding the buttons will cycle through the menu continuously.
To select a menu item, press OK and press ESC to exit.

The ⇦ and ⇨ buttons move the cursor in editable fields and cycle through values (numbers or text) when editing parameters. The ⇩ and ⇧ buttons scroll though characters when editing parameters (when held, these buttons move the cursor continuously, wrapped around). Use ESC to close error messages (it deletes them from the error list).

MENU NAVIGATION

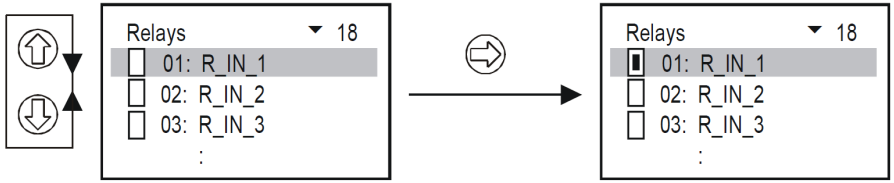
To cycle through various modes (M, B, U, R, C, E) use the ⇦ and ⇨ buttons.

Use the OK button to enter into the menu item at the cursor, and use the ESC button to exit.

Use the ⇩ and ⇧ buttons to navigate between items (when held, these buttons move the cursor continuously, wrapped around).

ACTIVATING / DEACTIVATING ITEMS

Devices on the list may be active (▮) or inactive (☐). Only active devices will be queried. Active relays and current loop outputs operate as they are configured, inactive relays are disengaged, and current loop outputs are 0 mA, while inactive.

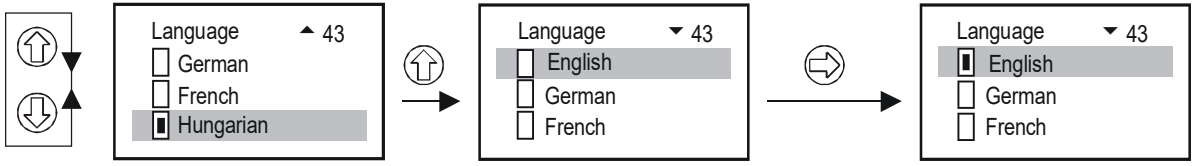


No active relays

R_IN_1 is active

Use ⇨ to activate / deactivate relays.

Selecting various modes (relay modes, current loop output modes, languages, etc.) is done in a similar fashion.



The selected language is activated immediately.

Assigning Outputs (Relay and Current Loop) to Devices

When setting up relays and outputs, they have to be assigned to devices and their variables (PV, SV, TV, QV):

- ⊞ Value is positive (add)
- ⊟ Value is negative (difference measurement)
- ⊡ Values marked this way are used for average calculation

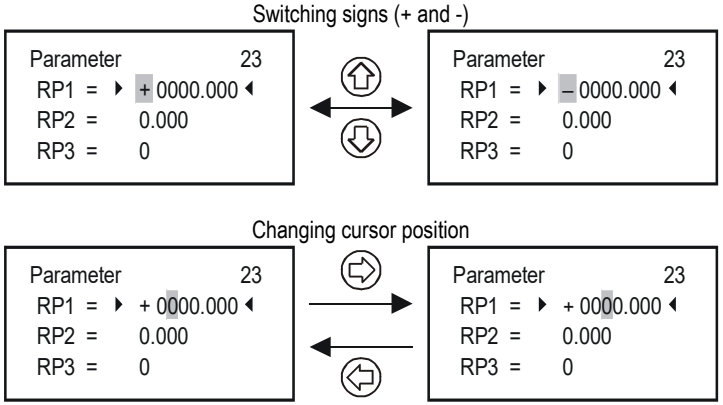
The above settings can be changed using ⇨.

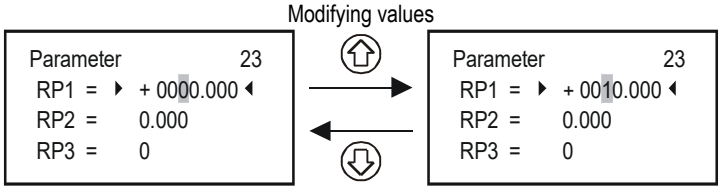
Note: If multiple devices (sources) are assigned (difference, average) to one relay, they must measure the same quantity (DIST, LEV, …) with the same unit of measurement (m, ft, inch, …).

Editing Parameter Values

Parameters have a sign and a value. Use the ⇦ and ⇨ buttons to move the cursor through the digits.

To change the values under the cursor, use the ⇧ and ⇩ buttons.





(ESC) quits without saving.

To save the parameters, press (OK) after RP3.

EDITING STRINGS (E. G. SHORT TAG)

The scrolling order of characters is as follows:

ABCDEFGHIJKLMNOPQRSTUVWXYZ [\ ] ^ _ ! ” # $ % & ’ () * + , - . / 0123456789 : ; < = > ? @

COMMISSIONING A DMCU900 NETWORK

To commission the network, follow the steps below:

- **Setting up transmitters.** Transmitters must be given a unique „Short address." If there are multiple transmitters in the network, addresses must not be zero.
- **Adding devices to the device list.** (See *Commissioning the DMCU900.*)
- **Configuring transmitter status.** When devices (transmitters) are added to device list, they are activated as soon as they are detected. The DMCU900 is polling them continuously, and stops only when the device is deactivated (see *Commissioning the DMCU900*).
- **Relay configuration.** Relays have to be assigned to one or more transmitters (sources), the operating mode (function) must be specified, switching points must be configured (parameters RP1…RP3), and they must be activated. (See *Relay Configuration*.)
- **Current loop output configuration.** It is similar to configuring relays. (See *Operation and Current Loop Output Parameters*.)

PREPARING THE TRANSMITTERS

The highest loop current of the base model of the DMCU900 is 60 mA, and 22 mA of the Ex certified version. If the loop current exceeds the specified values, the voltage at the terminals of the transmitters will drop below the minimum required for the devices to operate reliably. They may work, but HART signals will be distorted to the extent that communication will either be faulty or cease entirely. In networks with only one transmitter, the unit's short address can be set to 0, then its output will operate in the 4 - 20 mA range. If there are multiple transmitters in the loop, short addresses must be set between 1 and 15, and the output current of the transmitters will be automatically limited to 4mA. The fixed output current parameter can override this value (refer to transmitter manual). Loop current must not exceed the specified limit. Devices may not have the same "**Sort address**" or "**Long address**" to prevent errors.

Data for Delta Mobrey devices				
DEVICE TYPE	„SHORT ADDRESS" PARAMETER	CONSTANT CURRENT PARAMETER	DEVICE TYPE ID	DEFAULT „SHORT TAG"
DMSP400/500	P19	P08	3, 4	**XXXXXX** where xxxxxx is the order or type code of the transmitter e. g. DMCU400
DMSP900			2	

"**Short addresses**" can be modified in DMSPConf or via the DMCU900. Then transmitters must be connected and detected one by one, and their "**Short address**" must be set. The manufacturer determines the "Long address" of the devices, and it cannot be modified by the user.

WIRING

Wiring must be done following the instructions in *2. Technical Data* and *3. Electrical Connections.*

COMMISSIONING THE DMCU900

Switching on initiates a 40-second **test process**, in which the unit tests the integrity of the memory, where settings are stored (see *The Boot Process*).
If the test is successful, the following message appears on the screen, which means the device table still empty.

To **choose a Language** (English, German, French, Hungarian), go to **Main menu / DMCU900 config / Language** using the ↑ and ↓ buttons and confirm it by pressing the → button.

The device will switch to the selected language immediately.

Select **Main menu / DMCU900 config / DEV detect**, to detect devices in the loop.

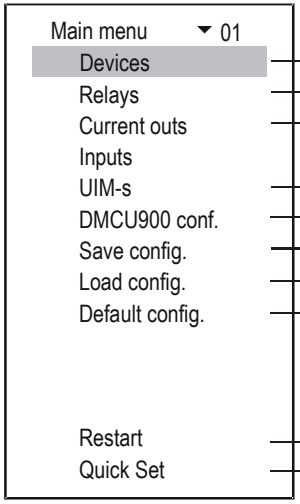
It is crucial not to confuse the *Short address* with the *List-tag* of the units. For the HART-capable devices to be discoverable and identifiable, it is necessary to assign a unique ***Short address*** to each of them, ranging from 1 to 15 when they are programmed. The DMCU900 registers devices based on their ***List-tags***, ranging from 1, … 8, 9, A, B, … F.

The next step is to configure the general settings of the system (display, backlight, etc.) in **Main menu / DMCU900 config**. (see *DMCU900 Configuration*), Relays (see *Relay Configuration*) and current loop outputs (see *Operation and Current Loop Output Parameters*) must be programmed according to the requirements of the application.

Settings can be protected by setting up a password in **Main Menu / DMCU900 config / Password** and by using the K1 switch (hardware protection) on the flip side of the front panel (see *6. Settings Protection*).

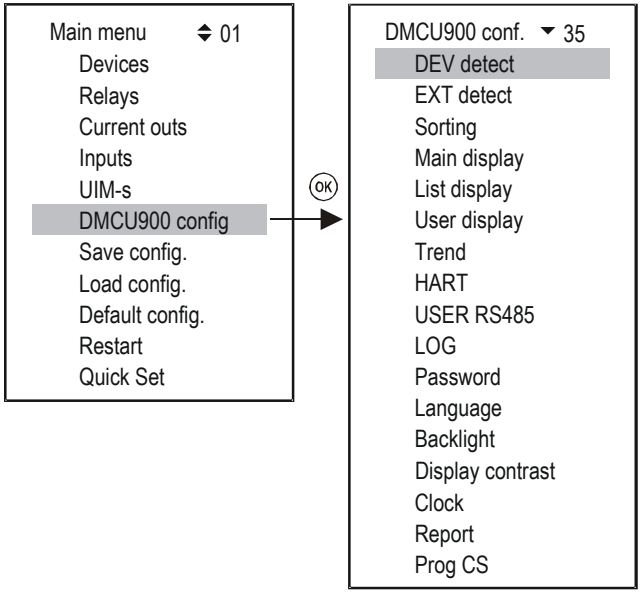
MAIN MENU

The **Main Menu** can always be accessed in measurement mode by pressing **OK**.



- Device settings (see *Device Programming*)
- Relay modes and parameters (see *Relay Configuration*)
- Current generator modes and parameters (see *Operation and Parameters of Current Loop Outputs*)
- UIM information, edit TAG
- General parameters (see *DMCU900 Configuration*)
- Save settings
- Load saved settings
- Load factory defaults. Clears device list, relay and current loop output settings, assignments and resets *DMCU900 conf.*
  It does not clear the number of switchings and total operating time.
  Repeat the steps described in *Commissioning the DMCU900*.
- Simulate restart (RESET)
- Quick Setup. Reverts the settings of the DMCU900 to default, initiates device detection, activates detected devices and logging (if the unit has a logging feature).

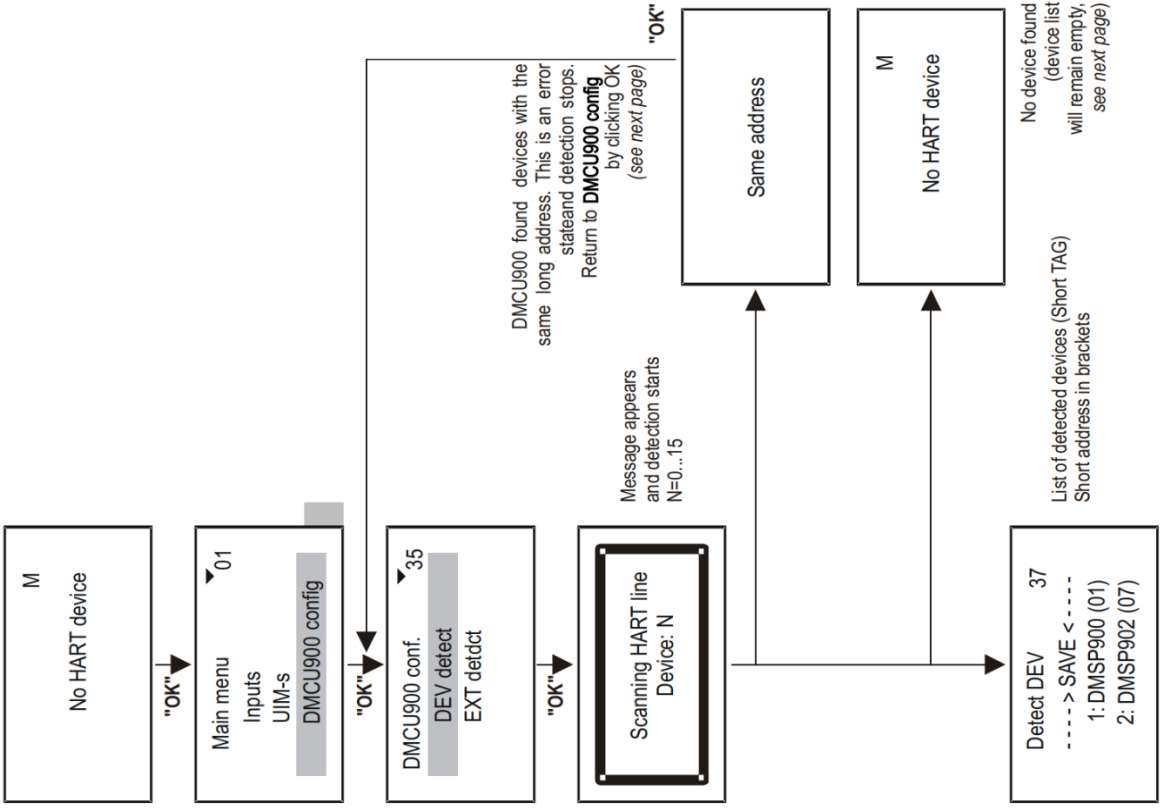
The current menu item is in a gray rectangle (cursor).



Navigate in the menu by using the ⇧ and ⇩ buttons, select items with the OK button.

DEV DETECT

The DMCU900 sends queries to the transmitters (from 0 to 15) via HART, assigns a hexadecimal tag (1 – F) to the devices, and populates the device list with them.



The DMCU900 detects devices by their **Short address** (that is why all short addresses must be unique within the system). However, it queries the devices by their **Long address**, which consists of the followings:

- **Manufacturer's ID:** (see *Appendix 1*)
- **Device Type ID:** device type identification number (see *Preparing the Transmitters*)
- **Device ID:** generated when the device is manufactured (0…16777215)

If detection stops with the "**Same Long Address"** error message, there are two ways to identify the devices that have the same long address.

- Devices must be removed one by one until **DEV detect** program completes successfully.
  One of the devices remaining in the loop has the same address as the removed unit.
  Reconnect the devices one by one, and after detection completes, the Factory ID, Device Type ID, and Device ID can be read in **Main Menu / Devices** (see *Device Programming*).
- The Long Address of HART compatible devices can be read using DMSPConf (by setting it to work with Short Addresses).

Users cannot modify **Long Addresses**; therefore, units with Long Address related problems must be sent back to the manufacturer. Call our Sales Department for help.

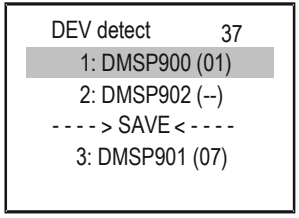
The following reasons are possible if the DMCU900 is unable to find all the devices:

1. One of the transmitters is not HART compatible. Check the label of the transmitters.
2. Faulty device. Dismount the unit and have it repaired or replaced.
3. Faulty wiring.
4. The voltage of the unit is too low, check the current loop output configuration of the transmitters (see *Preparing the Transmitters*)
5. If none of the devices respond:
   - If there is no voltage between L+ and SH, the output is faulty, or there is a short-circuit.
   - If voltage is present between L+ and SH, check for a short-circuit between L+ and L-, or a break in the circuit.

The next step is adding devices to the list and setting them up.

Search results may be the following:

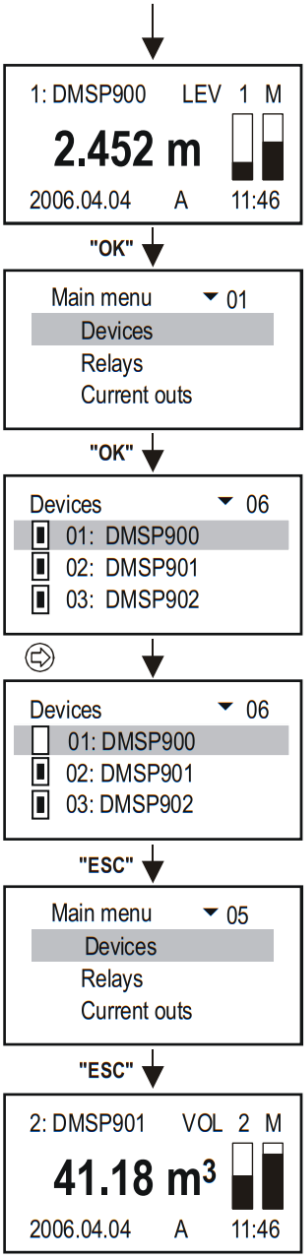
No HART device was found in the loop



Device is found in the loop:
The devices above →SAVE← are already on the list. This list is empty if the unit is either newly manufactured or if reset (**Main menu / Default**). Units under →SAVE← are not on the list but have responded to the query.
If a unit on the list responds, its "Short Address" will appear in brackets. Otherwise it is (--).

The Short TAG of responding units (either above or below →SAVE←) can be changed by selecting the device with "OK."
DMCU900 handles units only above →SAVE←.

Note:
If the number of devices in the loop is known and the DMCU900 detected them already, the detection process can be interrupted by pressing the ← button (the ← button must be held until the "DEV detection end" message appears).



Once back in measurment mode the measured values of the devices found during detection are displayed one after another on the display.
For the meanings of the captions on the display see 5.10 (Measurement mode)
If the measured data of a given device are not needed temporarily, no need to delete it from the list, it is enough to inactivate it in the following manner.

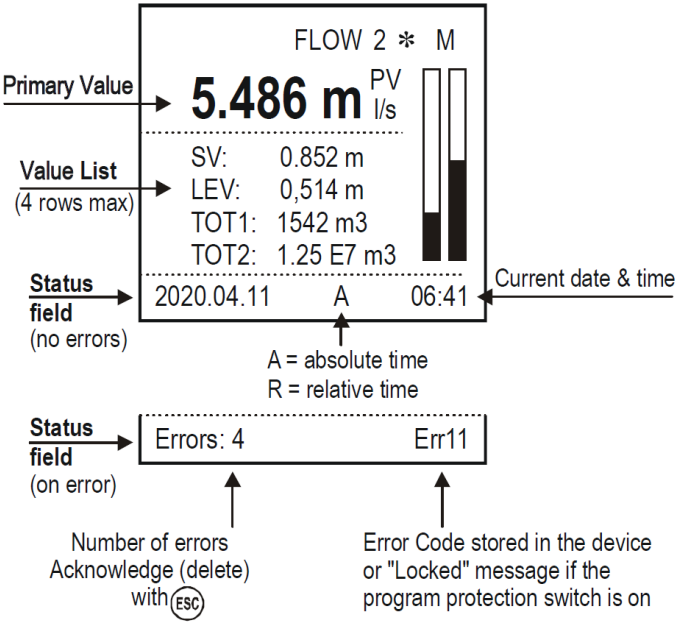
Device is active
Select the device with ⇧ and ⇩ and deactivate it by pressing ⇨

Inactive device
Active device

Upon re-entering measuring mode the measured values of the inactive device are not shown on the display and states of assigned relays and current outputs do not change.

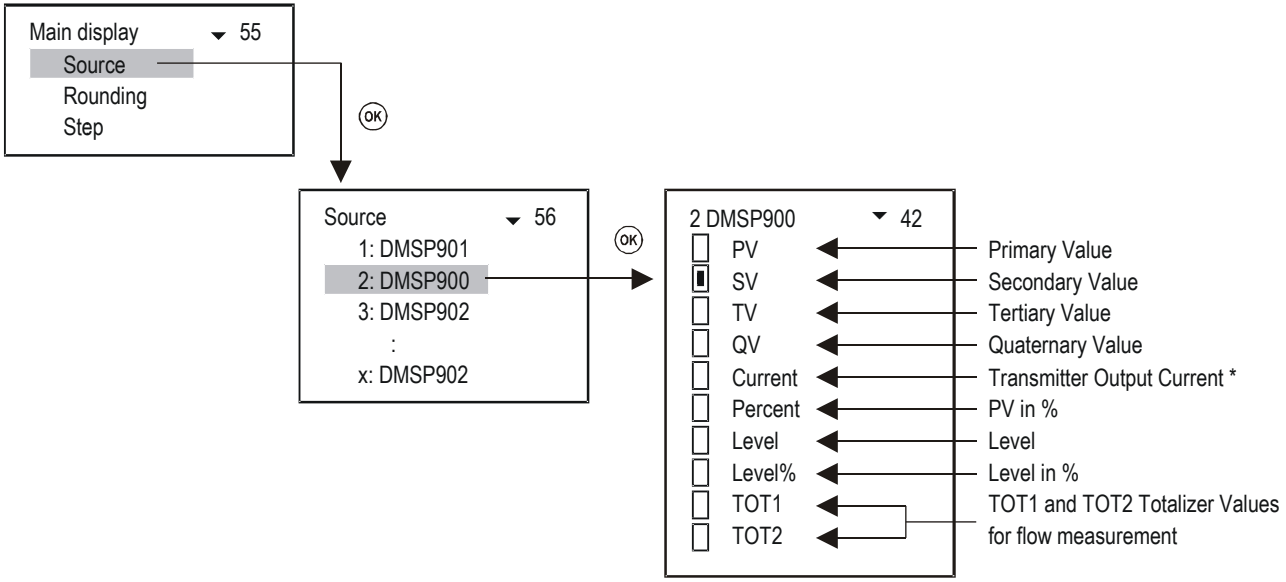
MAIN SCREEN

The main screen contains the ”Primary Value,” the ”Value List” and the ”Status Field” (see *Measurement Mode*).
The ”Primary Value” and the ”Value List” are user-selectable for each device.
The displayed value and rounding can be selected in “Main display.”
The display cycle time (stepping) is also configured there.



SOURCE

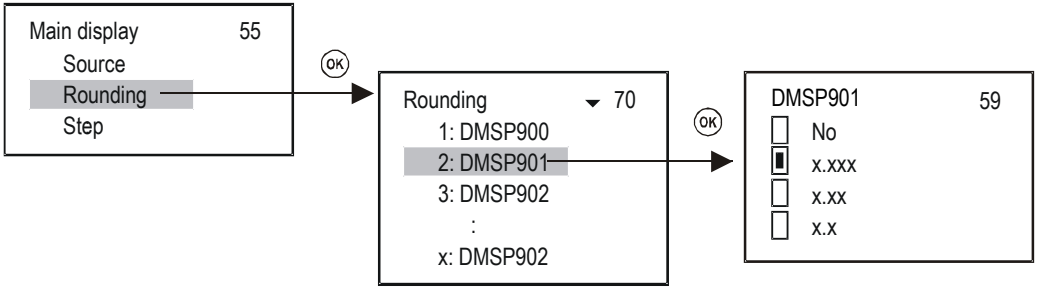
Primary Value can be selected independently for each transmitter.
Check your selection in **Main menu / DMCU900 config / HART / CommandSet**, to select the command for the appropriate value.



* Output current changes only if there is only one device in the system, and its "Short Address" must be zero; otherwise, the output current is constant.

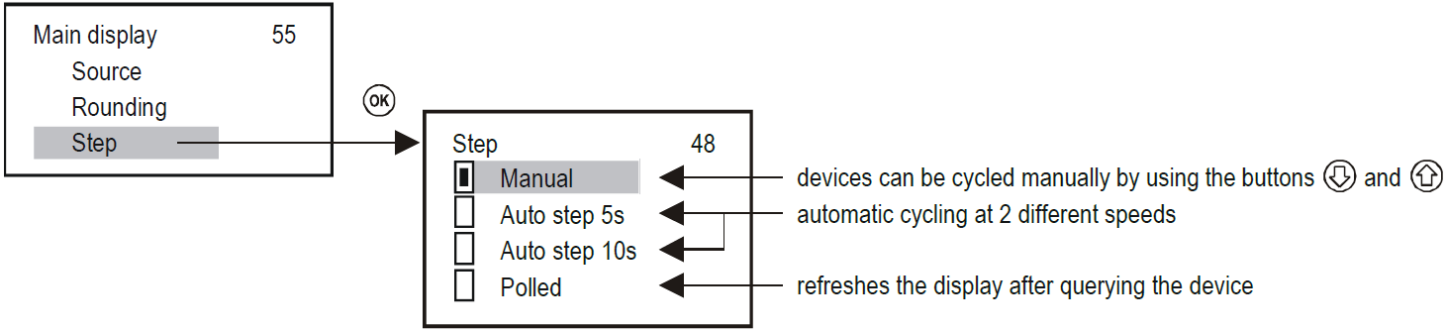
Rounding

The DMCU900 rounds values to 4 decimals by default; rounding is for the primary value only.



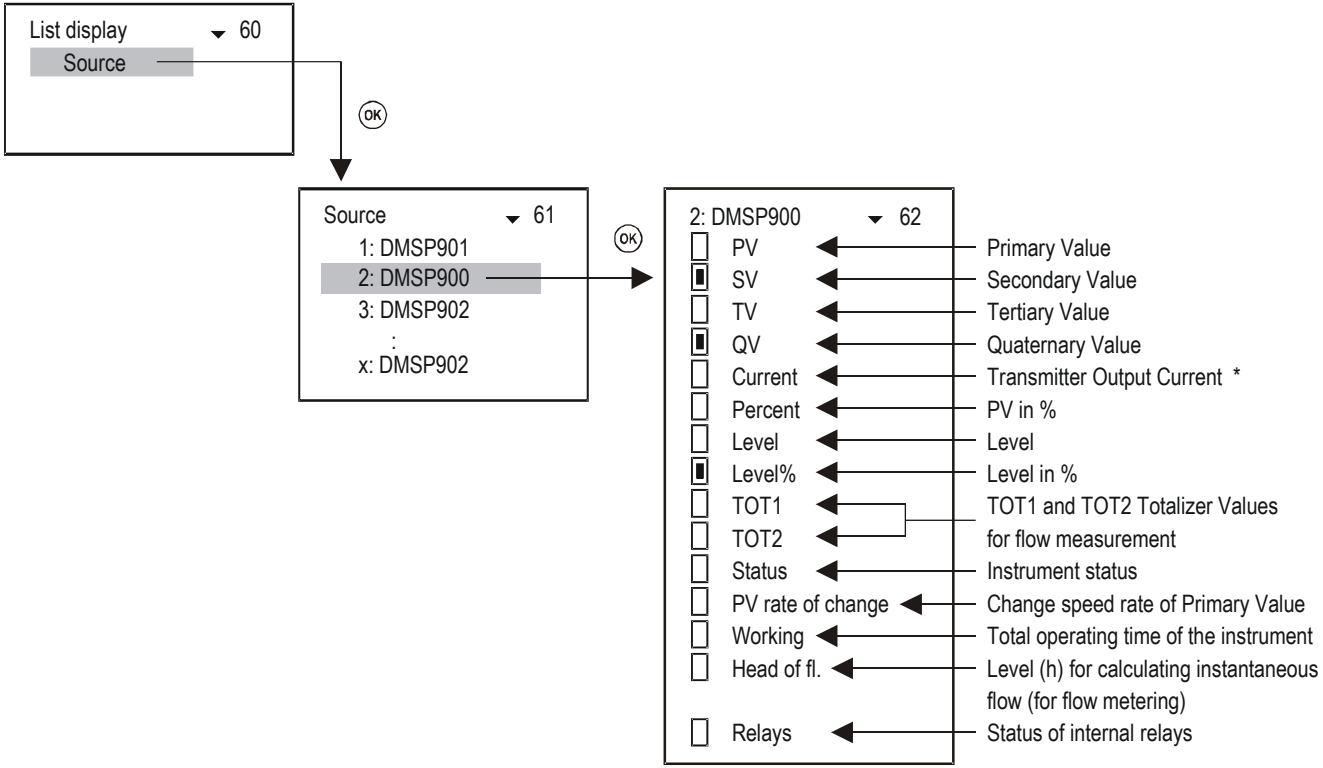
Stepping

Stepping is display-related only. Transmitter polling, relay and current loop output control operate continuously depending on the cycle time, set in **Main menu / DMCU900 config / HART / Cycle time**.



VALUE LIST

Four values can be selected altogether.



* Output current changes only if there is just one device in the system, and its "Short Address" must be zero; otherwise, the output current is constant.

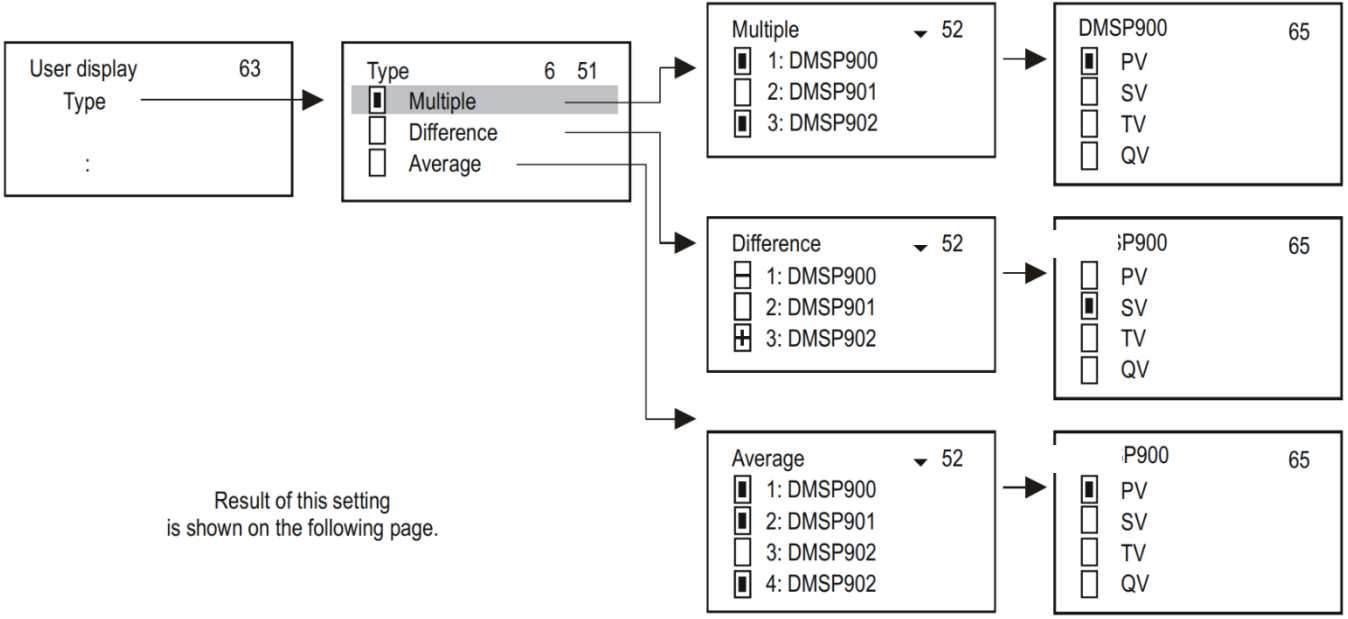
** The DMCU900 calculates the PV's rate of change every 5 seconds. If there are more transmitters in the loop and cycle time is longer than 5 seconds, the calculation of PV_Rate (t1 - t2 ≥ 5 sec) is performed every cycle.
Change speed rate of PV [PV / min] = $(PV_{t1} - PV_{t2}) \times 60 / (t1 - t2)$

USER DISPLAY

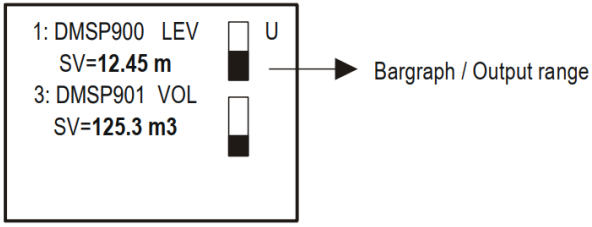
Users can choose the display format for the User Display in measurement mode (see *Measurement Mode*). User display will show an error message only if:

- Only one device is selected to display multiple, difference, or average.
- The corresponding units of the devices do not match while measuring difference or average.

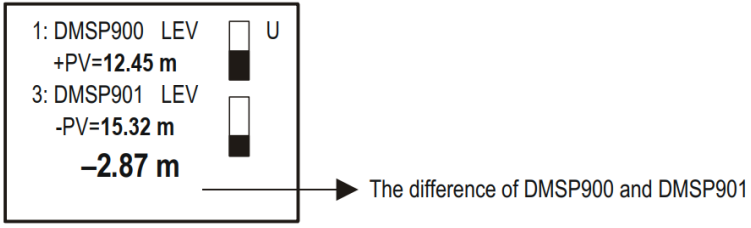
Editing the user display



- **Multiple**

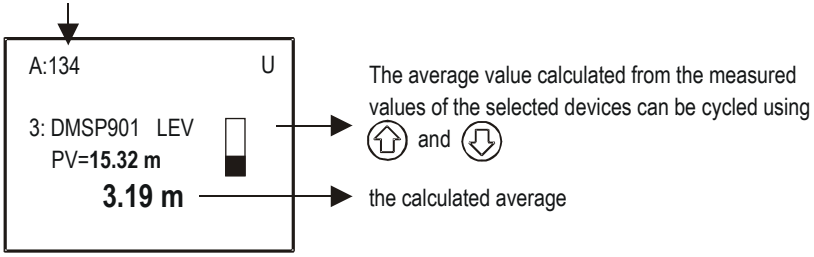


- **Difference**



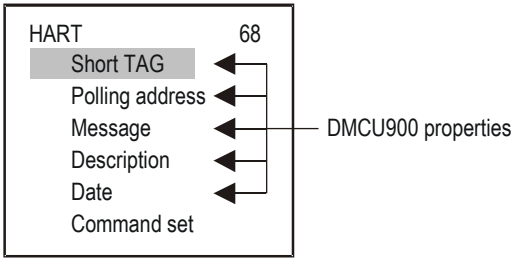
- **Average**

List ID of the devices whose average value is calculated by the DMCU900



HART

This menu is for configuring the properties of the DMCU900, the transmitter query settings, and selecting the particular HART commands, which the DMCU900 uses to communicate with the devices.

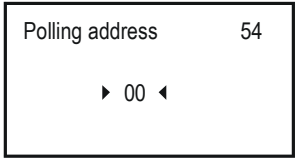


DMCU900 Short TAG

Arbitrary 8 characters long identifier

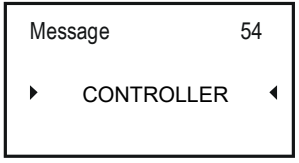
Polling Address

If multiple DMCU900s are connected to a system via RS485, they are distinguished by this address.



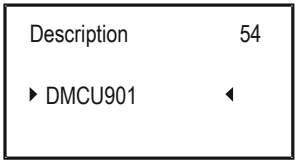
Message

A 32 characters long arbitrary, operation-related message. To change rows, use “OK” and “ESC”.



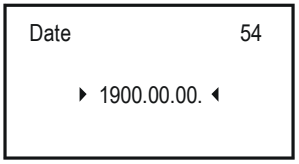
Description

An arbitrary 16 characters long text that describes the device.



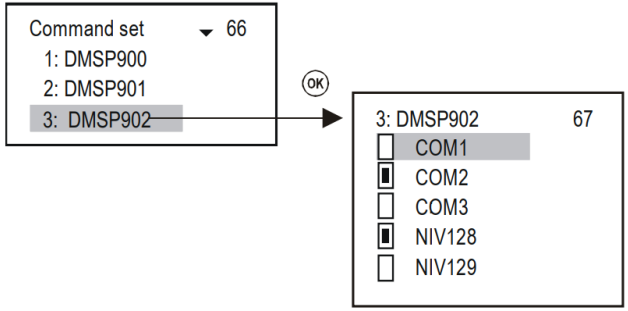
Date

The date set in the DMCU900.



Command Set

The DMCU900 and the devices communicate using various commands. The DMCU900 sends a command containing the address of the device, which sends a standard response. Some of the commands are universal, while others are device-specific. The appropriate commands are selected automatically based on the data required to control the display, relays, and current loop outputs.



If a operation-critical command is deactivated, a ”Program failure” message is generated on the relays and current loop outputs. The display flashes, and says that results are not refreshed because a HART command necessary for this operation is deactivated. **Therefore, modifying the commands is not recommended!** If multiple commands are selected, refresh time increases (display, relay, and output current modification).

The DMCU900 uses the following commands to communicate with the devices:

- COM1: query for primary value
- COM2: output current in mA and % (output range)
- COM3: primary, secondary, tertiary, and quaternary values

These commands are standard, they can be interpreted by any compatible third-party device.

The commands below can only be interpreted by Delta Mobrey products:

- NIV128: device specific command optimized for DIST, LEV, VOL measurements
- NIV129: device specific command optimized for DIST, LEV, FLOW, TOT1, TOT2 measurements

The table below shows the contents of the responses of Delta Mobrey devices to the commands as indicated:

COM3: 03 Universal HART command

	DMSP400/500			
	DMSP900			
P01	PV	SV	TV	QV
0	**DIST**	Temp	-	-
1	**LEV**	DIST	Temp	-
2	**LE%**	LEV	DIST	Temp
3	**VOL**	LEV	DIST	Temp
4	**VO%**	LEV	DIST	Temp
5	**FLO**	LEV	DIST	Temp

Refer to the User's & Programming Manual of the transmitter.

NIV128: Delta Mobrey device specific commands optimized for VOL measurement

	DMCU400/500			
	DMSP900			
P01	PV	Base	3. Pos.	4. Pos
0	**DIST**	LEV	SR	Curr.
1	**LEV**	LEV	SR	Curr.
2	**LE%**	LEV	SR	Curr.
3	**VOL**	LEV	SR	Curr.
4	**VO%**	LEV	SR	Curr.
5	**FLO**	LEV	SR	Curr.

***** SR (sensor range): Value of level difference between the „Maximum range" (H=P04) and the „Minimum range" (near dead zone blocking) in % (empty tank: DIST=H $\Rightarrow$ 0%, full tank: DIST="Minimum range" $\Rightarrow$ 100%). Necessary for displaying bargraphs.

NIV129: Delta Mobrey device specific commands optimized for FLOW measurement **(**TOT1 and TOT2 in float format)

	DMCU400/500			
	DMSP900			
P01	PV	Base	3. Pos.	4. Pos
0	**DIST**	LEV	TOT1	TOT2
1	**LEV**	LEV	TOT1	TOT2
2	**LE%**	LEV	TOT1	TOT2
3	**VOL**	LEV	TOT1	TOT2
4	**VO%**	LEV	TOT1	TOT2
5	**FLO**	LEV	TOT1	TOT2

USER RS485

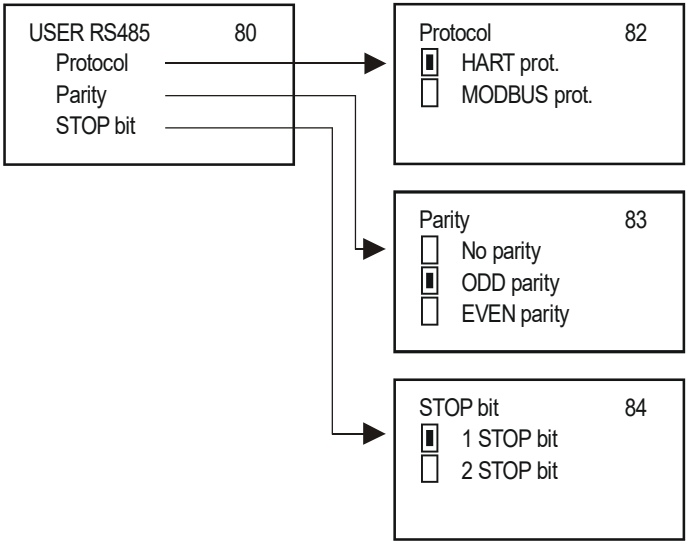
The **DMCU900**'s **User RS485** interface provides serial data transfer to the central process controller computer or a PLC. The following can be queried from DMCU900 through the communication line:

- system properties (DMCU900 configuration, relays, current loop outputs, transmitters, errors, etc.)
- error list
- relays and current loop outputs assigned to devices
- relays and current loop output configuration
- device output values

The DMCU900 units have separate addresses so they can be connected to a single system. (up to 30 DMCU900s).

There are two communication protocols:

- HART 5 (default)
- MODBUS RTU

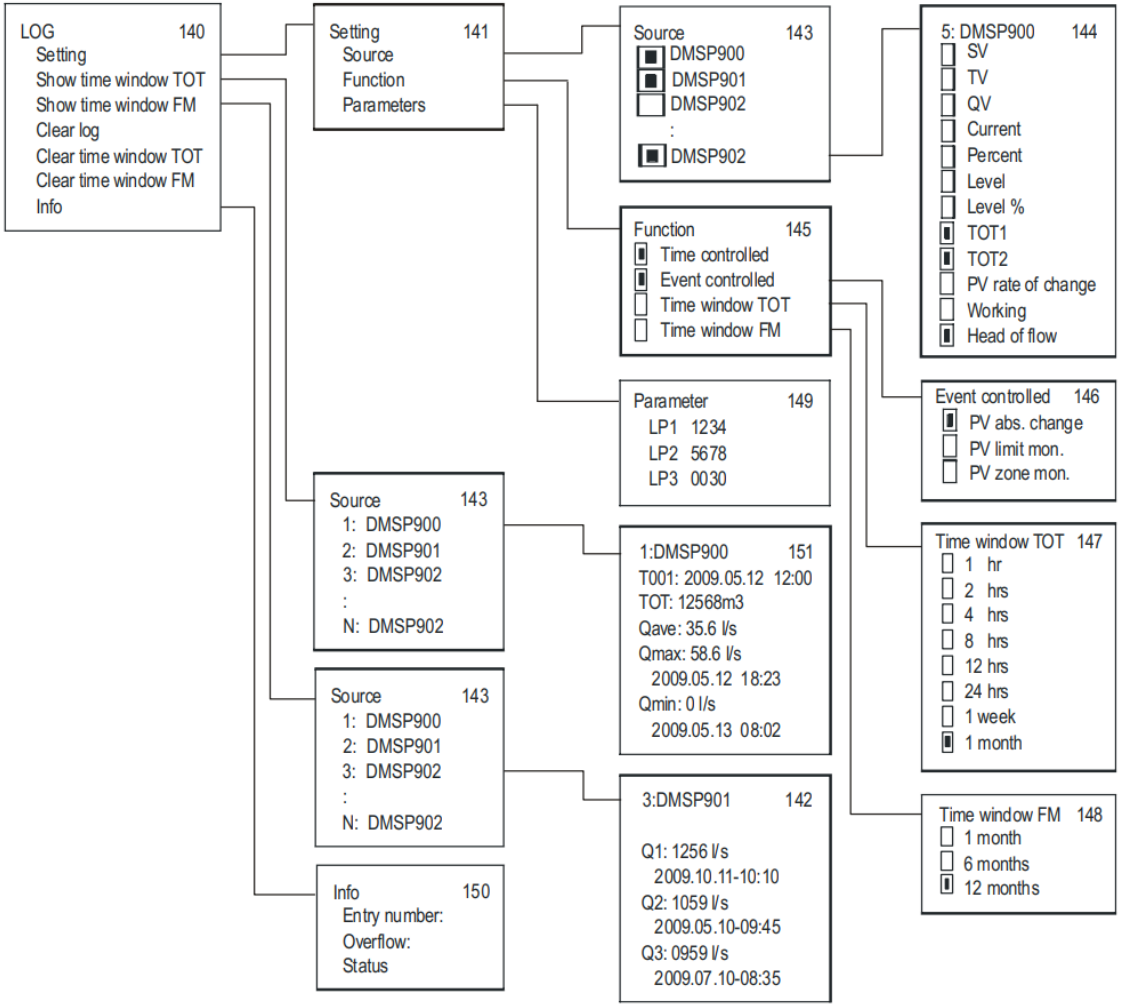


DATA LOGGER

The DMCU900's logger has two main parts:

- Trend logger: on a separate board, in MCU90F models. The accumulated data is stored on a FLASH card or an SD card. The unit logs the ID of the transmitters, the primary value, and three additionally selectable values.
  - Time-controlled logging, whereby entries are stored after a specified amount of time has passed
  - Event-controlled logging, whereby entries are stored when a predetermined condition is fulfilled.
- There are two types of time-window logging for flow-metering. The accumulated data is stored on a FLASH memory card.
  - *Time-window TOT*: TOT is calculated for a selected time interval, monitoring the average, minimum, and maximum values of the flow.
  - *Time-window FM*: the eight highest flow values during a pre-set period are stored with their timestamp.

The time-windows are independent from the trend logger and all four saving modes can operate at the same time (time/event-controlled, time-windows). The time-window logger function can be used only for Delta Mobrey transmitters in flow-metering mode.

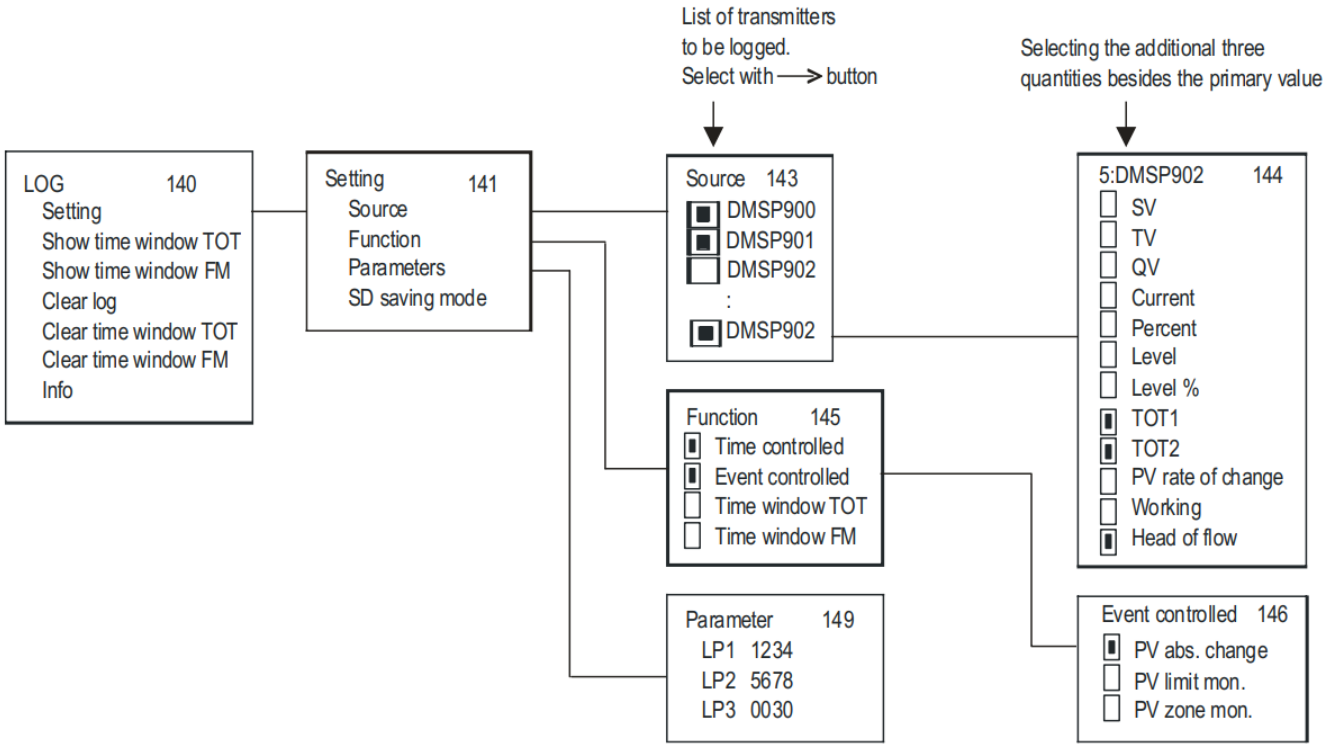

LOG 140
Setting
Show time window TOT
Show time window FM
Clear log
Clear time window TOT
Clear time window FM
Info
Setting 141
Source
Function
Parameters
Source 143
DMSP900
DMSP901
DMSP902
:
DMSP902
5: DMSP900 144
SV
TV
QV
Current
Percent
Level
Level %
TOT1
TOT2
PV rate of change
Working
Head of flow
Function 145
Time controlled
Event controlled
Time window TOT
Time window FM
Parameter 149
LP1 1234
LP2 5678
LP3 0030
Event controlled 146
PV abs. change
PV limit mon.
PV zone mon.
Source 143
1: DMSP900
2: DMSP901
3: DMSP902
:
N: DMSP902
1:DMSP900 151
T001: 2009.05.12 12:00
TOT: 12568m3
Qave: 35.6 l/s
Qmax: 58.6 l/s
2009.05.12 18:23
Qmin: 0 l/s
2009.05.13 08:02
Time window TOT 147
1 hr
2 hrs
4 hrs
8 hrs
12 hrs
24 hrs
1 week
1 month
Source 143
1: DMSP900
2: DMSP901
3: DMSP902
:
N: DMSP902
3:DMSP901 142
Q1: 1256 l/s
2009.10.11-10:10
Q2: 1059 l/s
2009.05.10-09:45
Q3: 0959 l/s
2009.07.10-08:35
Time window FM 148
1 month
6 months
12 months
Info 150
Entry number:
Overflow:
Status

Trend Logger

The trend logger function is only available on the DMCU90F model. Trend logging can be time-controlled (storing entries after a pre-programmed period) or event-controlled (logging when measured values change). These two modes can be working simultaneously; logging conditions can be set in the menu (programmed trend logging). Log entries contain transmitter identification, the timestamp of the entry, the transmitter's primary value, and three additional selectable values.

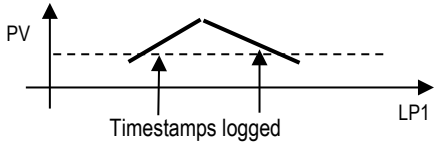
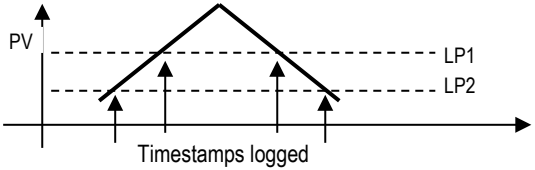
Date:2015.06.29 13:14																									
Hea	Date	Time	Type	Dev	Addr	Tag	Err.	Status	Curr0	Value0	Unit0	Curr1	Value1	Unit1	Curr2	Value2	Unit2	Curr3	Value3	Unit3					
LT	2015.06.29	13:11:00	2	1	151.18.15978248	TMH-500	0	320	15	degC	26.4	26.2	25.8	26.2	26.1	26	25.7	26.1	26.1	25.9	25.7	25.6	25.6	25.7	25.6
LG	2015.06.29	13:11:02	2	1	151.18.15978248	TMH-500	0	320	TEMP	26.399999	degC	?	NaN	(null)	?	NaN	(null)	?	NaN	(null)					
LT	2015.06.29	13:11:02	2	1	151.18.15978248	TMH-500	0	320	15	degC	26.4	26.2	25.8	26.2	26.1	26	25.7	26.1	26.1	25.9	25.7	25.6	25.6	25.7	25.6
LG	2015.06.29	13:11:04	2	1	151.18.15978248	TMH-500	0	320	TEMP	26.399999	degC	?	NaN	(null)	?	NaN	(null)	?	NaN	(null)					

At first, data is written only into the FLASH memory, which can store 65000 entries. When the data is copied onto an SD (Secure Digital) card, the maximum number of stored entries depends on the SD card's size. Reading the on-board memory can be performed via the USB port via an ordinary commercial USB cable (USB A-B cable). SD card usage is detailed in *Data Logger*.



Follow the steps below to set up trend logging:

- Logged transmitters, whose primary value and three additional values will be logged, can be selected in “Source.”
- Logging mode (time-controlled, event-controlled or both) can be selected in “Mode.”
- For time-controlled logging mode, logging interval is entered into LP3 in minutes in “Parameters.”
- For event-controlled logging mode in “Parameters” menu point LP1 and LP2 parameters should be set, according to the table below:

Event-Controlled Trend Logging		
Mode	**Operation**	**Parameters**
PV absolute change	Logging when (absolute) change of Primary value (PV) reaches the threshold value (LP1).	**LP1**
PV threshold value monitoring	Timestamp of Primary Value (PV) crossing the threshold value (LP1) is logged. 	**LP1**
PV zone monitoring	Timestamp of Primary Value (PV) exiting and entering the zone defined by LP1 and LP2. 	**LP1** **LP2**

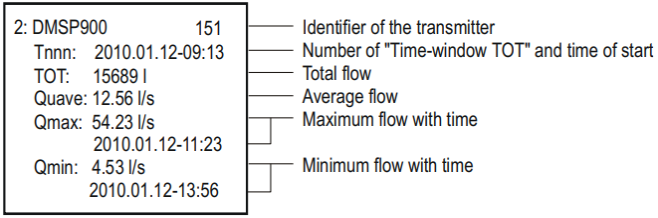
Time-controlled trend logging stores the average of the selected value calculated for the period set in LP3.
Logging mode and parameters are the same for all transmitters. Logging starts upon exiting LOG / Settings.

Many events that affect the entire system's operation are logged besides transmitter values (see *Data Logger*).

Time-Window TOT (Total Flow Logging)

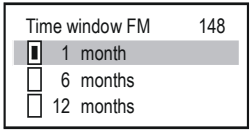
This function is only available with Delta Mobrey transmitters operating in flow measurement mode (selected NIV129 in Main menu / DMCU900 conf. / HART / Command set). Within the selected time interval, the DMCU900 calculates the total flow (TOT), the average flow (Qave), and monitors the maximal and the minimal flow. Period length can be adjusted in the menu. Up to 256 time-windows can be stored.

To read the log, go to Main menu / DMCU900 conf. / LOG / Show time window TOT. ↑, ↓, OK and → buttons are used for navigating in the list (OK moves down 10 lines, → moves up 10 lines in the list).
T000 is the unfinished "Time-window 1." T001 is the last finished time-window. Time can be adjusted by increasing or decreasing "nnn" (0-255).

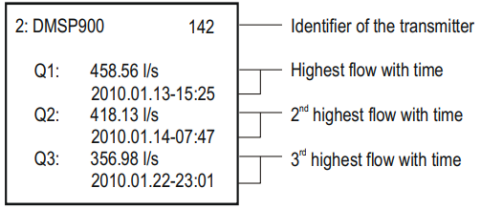


Time-Window FM (Flow Maximum Logging)

This function is only available for Delta Mobrey transmitters operating in flow measurement mode (use NIV129 in Main menu / DMCU900 conf. / HART / Command set). The eight highest flow values are stored with timestamps within the time interval selected in the menu.

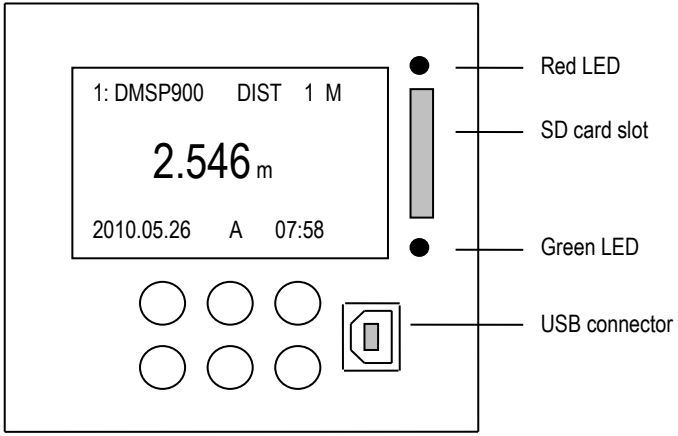


To read logged data, go to "Main menu / DMCU900 conf. / LOG / Show time window FM" and use the ↑ and ↓ buttons to navigate in the list.

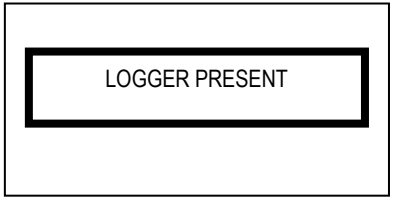


Using a Memory Card for Logging

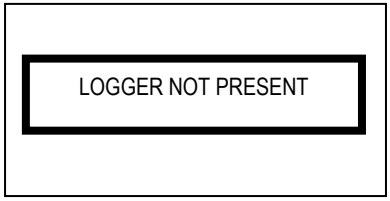
Trend logging is performed by a logger unit connected to the front panel. It contains a FLASH memory chip and an SD (Secure Digital) card slot. Two LEDs indicate communication between the central unit of the DMCU900 and the logger on the front panel. The green LED (read) flashes when a new logging entry is created, the red LED (write) indicates when data is written on the SD card. To store data on SD card, a maximum of 2 GB capacity is recommended.



The DMCU90F's logger performs a self-check when the unit is turned on. Depending on the result, the procedure displays one of the following messages:



Everything is in order.
The red and green LED-s are flashing until this message appears.



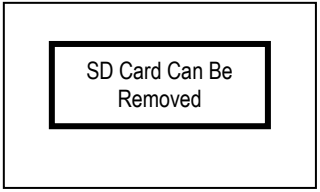
The logger is not working properly.
A **P-200: LOG IP** entry is created in the error-list.

This procedure is repeated every time the unit is turned on or restarted.

Measurement data is sent continuously to the logger unit (indicated by the green LED), and if the conditions are met (see *Data Logger*), they are logged, which is indicated by the red LED.

The capacity of the onboard FLASH memory is 65000 entries. When the FLASH memory is full, and there is no SD card in the card-reader, old entries will be overwritten for the sake of continuity. The number of overflows is stored in “LOG / Info.” When there is an SD card in the slot, reading and writing is performed with the frequency set in “LOG / Settings / SD saving mode.”

The logger unit of the DMCU90F automatically senses when an SD card is inserted and automatically starts copying the contents of the FLASH memory onto the SD card. The status of this process can be followed in the trend bar graph. Wait for writing to finish (red LED stops blinking) before removing the memory card. To avoid removing the card while writing, push ESC and ↑ at the same time. The following message will be displayed:



The DMCU90F will not send any data to the logger for 10 seconds, and the SD card can be safely removed.

File System and Log Entries

When an SD card is inserted into the DMCU90F the contents of the onboard FLASH memory are automatically copied onto the SD card (red LED flashes continuously). The logger finds the directory with the most recent date and checks if there are more than 200 files in the directory. If not, DMCU900 continues writing. If there are more than 200 files in it, a new directory is created. A single log file can contain up to 1000 entries, but every time the unit is turned on, restarted, or the LOG menu is accessed a new log file is created.

After saving to the SD card is completed, the data is ready to be accessed on a PC. The log file contains raw text, the separator character is TAB.

Name of the directories on the card:	**PR**ddd	where ddd=001…999
File names in the directories:	**PR**ffffff**.TXT**	where ffffff=000001…999999

The created file structure is as follows:

```
PR001                          1st directory
  PR000001.TXT
  PR000002.TXT
  PR000003.TXT
       :
  PR000200.TXT
PR002                          2nd directory
  PR000201.TXT
  PR000202.TXT
       :
  PR000252.TXT
PR003                          3rd directory
  PR000253.TXT
  PR000254.TXT
       :
```

Log files have two main parts: header and data. The header contains the following information:

```
DELTA MOBREY DataLogger Ver.:1.08 DMCU900 Ver.:01.02.02      << DataLogger and DMCU90F version
Date:2020.01.01 01:02                                        << Date of file creation
```

Data field contains the following data rows:

Title	Description	Example
Head	Log entry code	(LG = logger, ST = status, SD = mem. card operation, ER = error message, VO = time of switching OFF)
Date	Log entry date	2020.05.07
Time	Log entry time	13:01:40
Type	Log entry type (see *Type Codes*)	2
Dev	List-tag of the source device	3
Addr	HART Long address of the transmitter	151.30.2555904
Tag	Short tag	DMSP900
Err.	Error	0
Status	Status	0
Curr1	Primary Value	FLOW
Value1		125.67
Unit1		m^3/h
Curr2	2nd selected additional value	LEV
Value2		0.567
Unit2		m
Curr3	3rd selected additional value	TOT2
Value3		12345678
Unit3		m^3
Curr4	4th selected additional value	Work
Value4		1548
Unit4		h

Comments:

- If the type of the log entry is not 2, the DMCU90F is the source (DEV=255, TAG=P-200, Error=0, Status=0), and the PV and the three additional values are NAN (no data).
- SD card is inserted: `SD 2010.05.07 13:01:40 SD pushed`
- SD card is removed: `SD 2010.05.07 13:01:40 SD pulled`
- Value1, Value2, and Value3 of ST entries contain LP1, LP2 and LP3 parameters respectively.
- ST entries contain the following codes in the Type and Dev columns:

Type:

B7	B6	B5	B4	B3	B2	B1	B0
				00=absolute value change 01=limit value monitoring 10=zone monitoring		1=event-controlled ON	1=time-controlled ON

Dev:

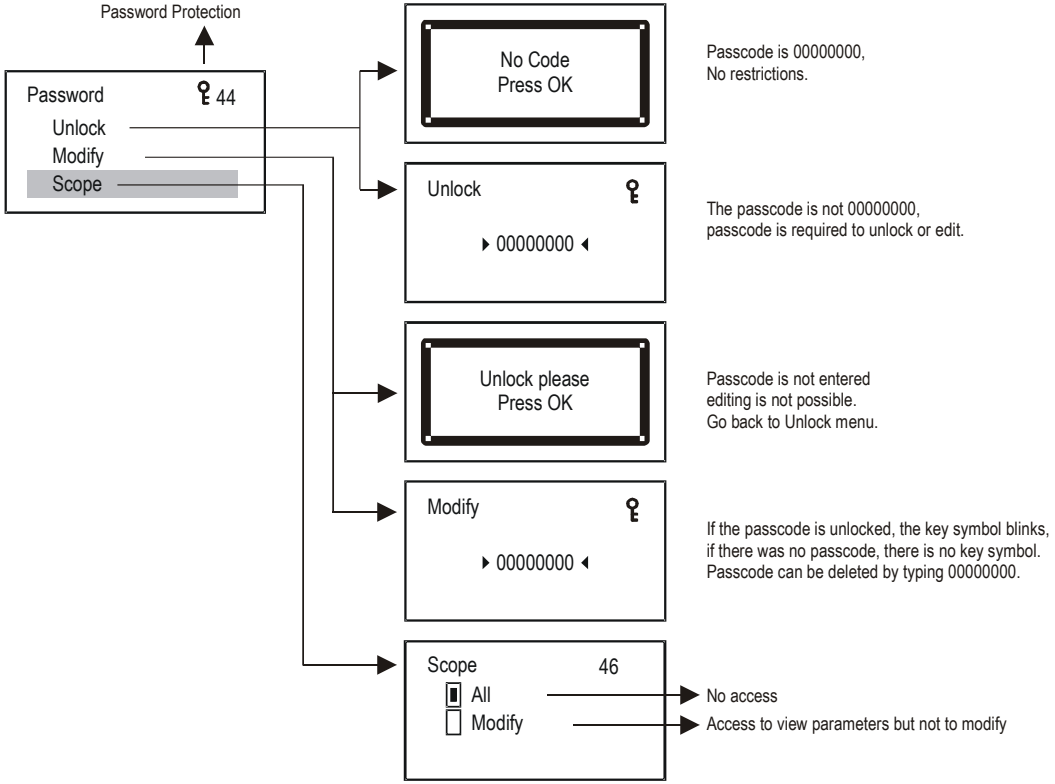
B7	B6	B5	B4	B3	B2	B1	B0
	SD saving mode 000= 1 row 001= 8 rows 010= 16 rows 011= 32 rows 100= 64 rows 101= 128 rows			Number of transmitters to be logged (LOG/Settings/Source)			

- The type code column may contain the following codes:

Type code	Description	Comments
0	Hardware reset	Turning ON
1	Software reset	Device was restarted from menu
2	Entry of measured value	Programmed TREND log entry
3	DMCU900 CRC altered	DMCU900 settings have changed. CRC calculated upon entering Main Menu and the one upon leaving do not match.
4	TOT1 clear	TOT1 was cleared (flow-metering).
5	TOT2 clear	TOT2 was cleared (flow-metering).
6	DMCU900 clock set	
7	Transmitter (DEVICE) default load	Loading default settings for the transmitter from the menu.
8	DMCU900 default load	
9	Logger delete from menu	
10	DMCU900 error-list clear	
11	Transmitter program CRC altered	DMCU900 checks CRCs upon entering and leaving remote programming mode. Log entries are created when the two CRCs do not match.
12	New list saved after (DEVICE) detection	
253	Instrument respond error	Transmitters not responding to commands are logged in the error list as well.
254	Instrument inactive	The transmitter selected for logging is inactive.

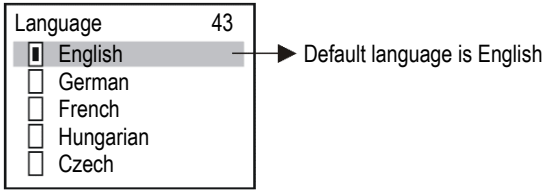
PASSCODE

Viewing and editing DMCU900 settings can be protected with a passcode (must be other than 00000000).
If the password is set, the symbol appears in the top right corner, and flashes after being unlocked.
The password remains temporarily unlocked until returning into measurement mode.



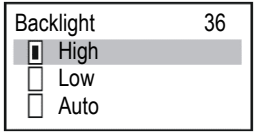
LANGUAGE

Select system language used by the unit.
The selected language will be switched to immediately.



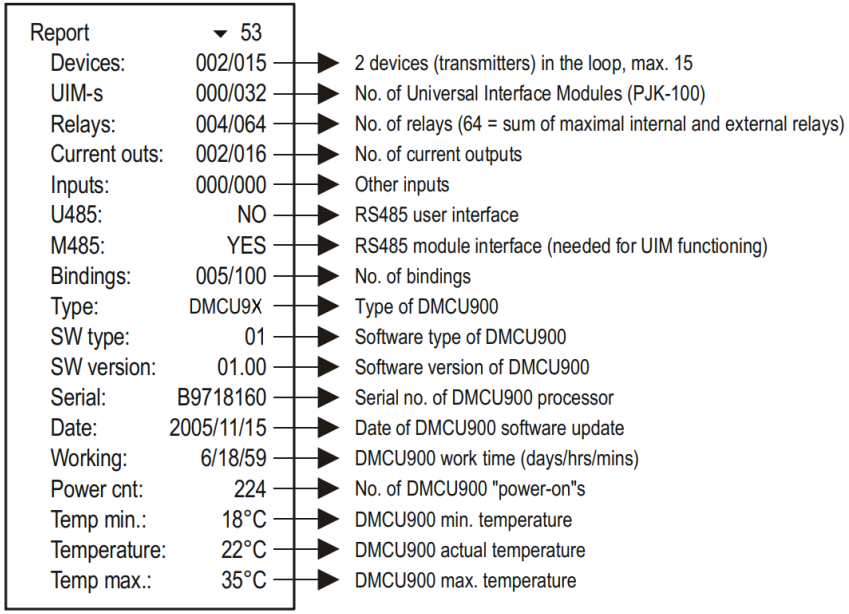
BACKLIGHT

Edit display backlight settings here. In “Auto” mode, pressing a button sets the backlight to “high.”
Ten seconds after the last keystroke, the backlight turns off.



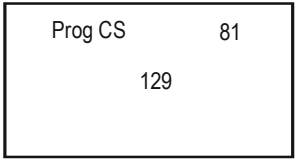
REPORT

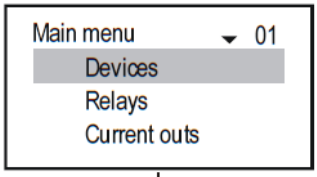
This section provides information about the system's structure, the number of devices (transmitters), relays, current loop outputs, and modules connected to the system. Binding is when a relay or current loop output is assigned to a device.



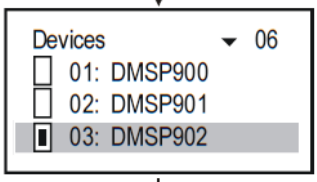
PROG CS

When leaving the menu, the device generates a Frame Check Sequence from the settings (XOR byte relation).





"OK"

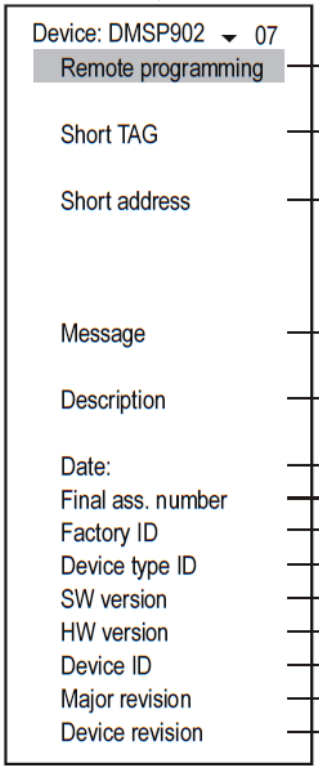


Navigate using the ⇧ and ⇩ buttons, and press OK to edit settings.

■ Device is active

□ Device is inactive, but can be programmed as if it were active

"OK"



Device programming and reading parameters

To read or modify the Short TAG use ⇦ ⇨ ⇧ ⇩ then press OK

Short address** (1 - 15), the device is detected by this address. It can be edited without entering Secret code*. Edit it with caution.

Arbitrary text message assigned to the device (usually operation-related, max 32 char. long)

Arbitrary text assigned to the device (usually material-related, max 16 char. long)

Date

Factory default setting is 0

Factory ID, for Delta Mobrey devices it is 151

Device type ID

Software version of the transmitter (see manual)

Hardware version of the transmitter (see manual)

Manufacturer's electronic serial number

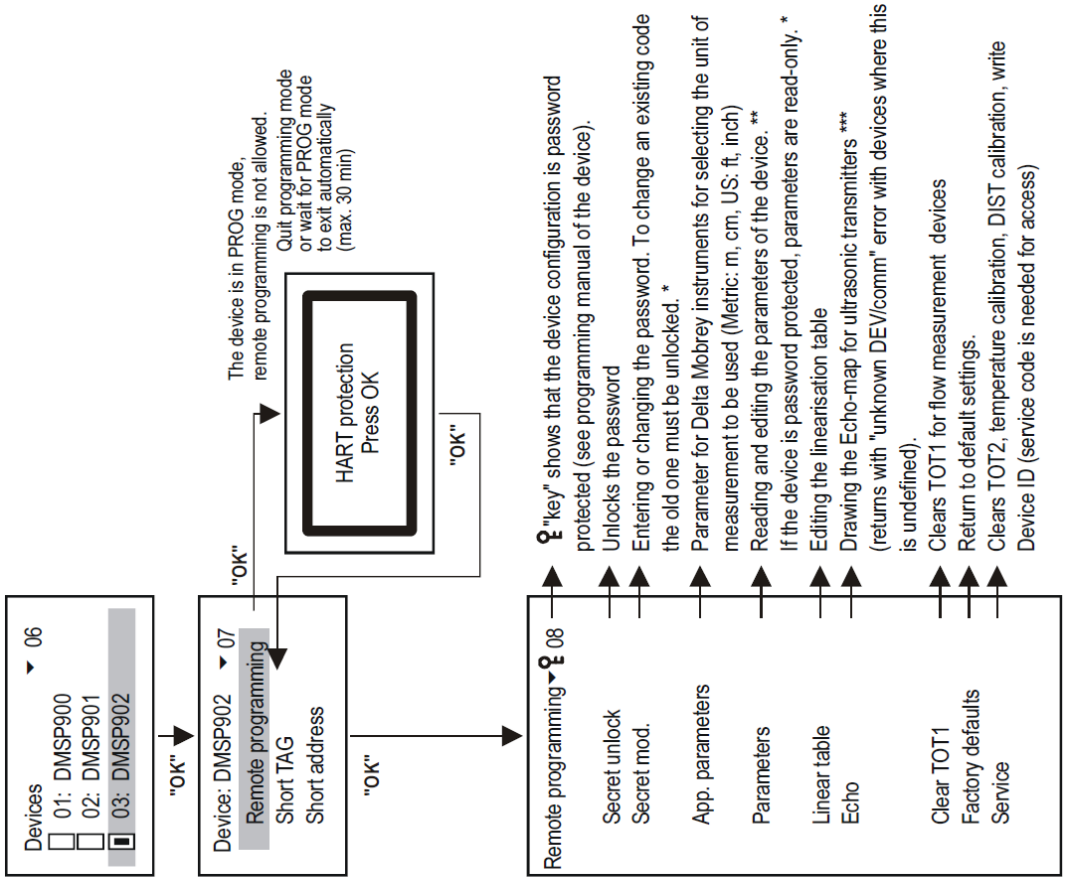
HART revision

0

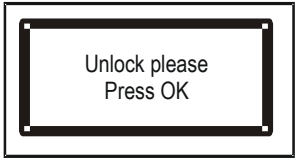
* For devices that are not DELTA MOBREY compatible, only the values assigned the 4-20 mA connection and damping time are programmable.

** Press OK to view the short address of the device . Since the short address is stored only in the operative memory, it is lost every time the device is turned off. If it is lost and read it will appear as "??." It bears no effect on operation, because after detection, communication is conducted using the Long Address, which cannot be modified. The transmitter will have a new address as soon as it is detected again.

Select the device to be programmed as described above.

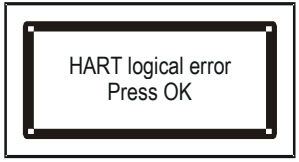


* If access is denied, the following message appears.



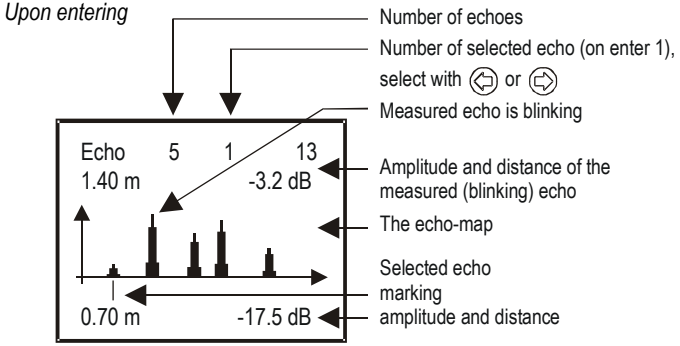
After entering a valid code, press **OK**.

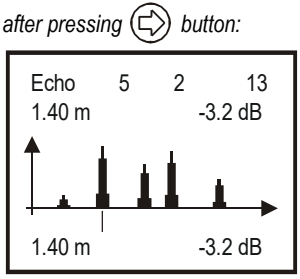
** The DMCU900 does not validate parameters entered in remote programming. They are only validated by the devices after receiving them. If the parameter is invalid, or if it is not defined in the device, the following message appears:



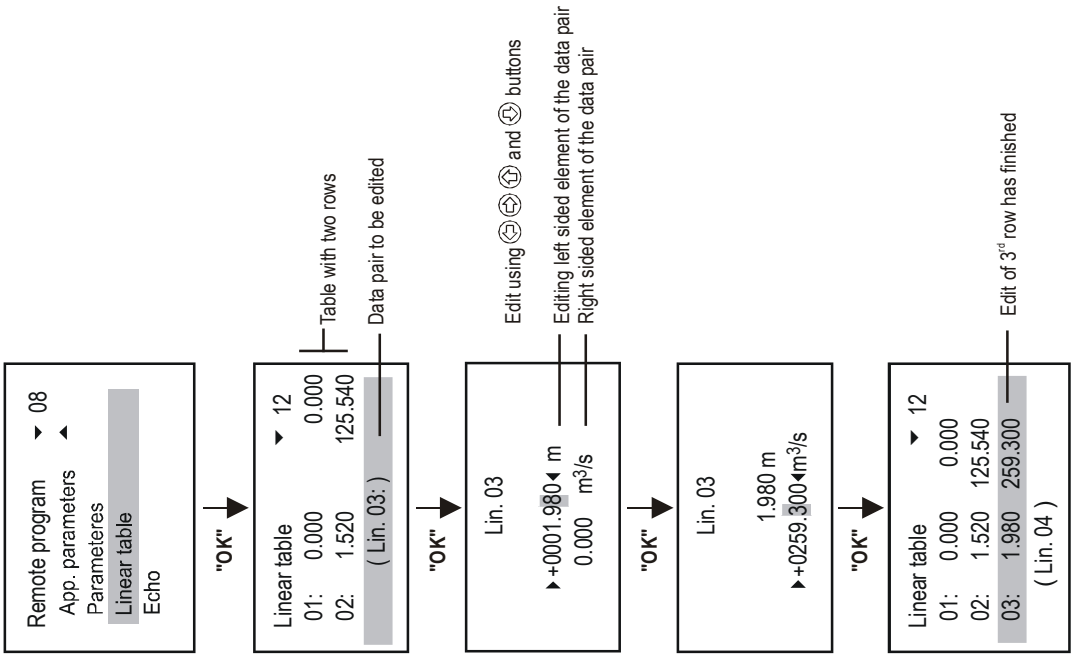
Refer to the User Manual of the transmitter to solve the problem.

*** The Echo Map of ultrasonic transmitters





Note: The displayed data reflects the moment of entering into the menu.
The flashing echo is the one used by the transmitter to measure distance. To refresh the display press **ESC** then **OK**.



Warning! For the transmitter to compute the measurement results using the linearisation table, linearisation must be enabled with parameter P47. (Refer to the transmitter's User's & Programming Manual.)

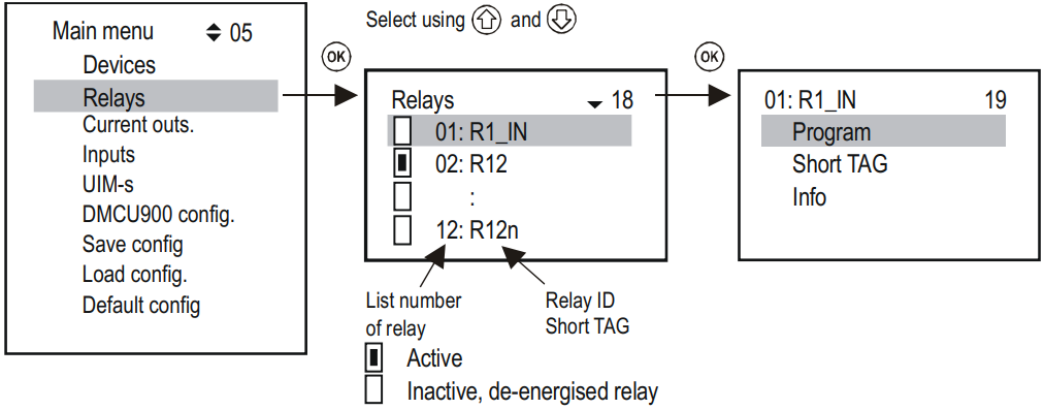
RELAY CONFIGURATION

It is recommended to make a device-relay and value (PV=primary value, SV=secondary value, ….) assignement plan in advance. Relays can be assigned to multiple sources (difference, average). Relay functions must be selected in **Main Menu / Relays / Program / Function**. Finally, the parameters have to be specified in **Main Menu / Relays / Program / Parameter** so that the units of RP1 and RP2 are determined by the devices assigned to them. So if the selected value is LEVEL[m], the RPx parameters also have to be entered in LEVEL[m].

SELECTING RELAYS

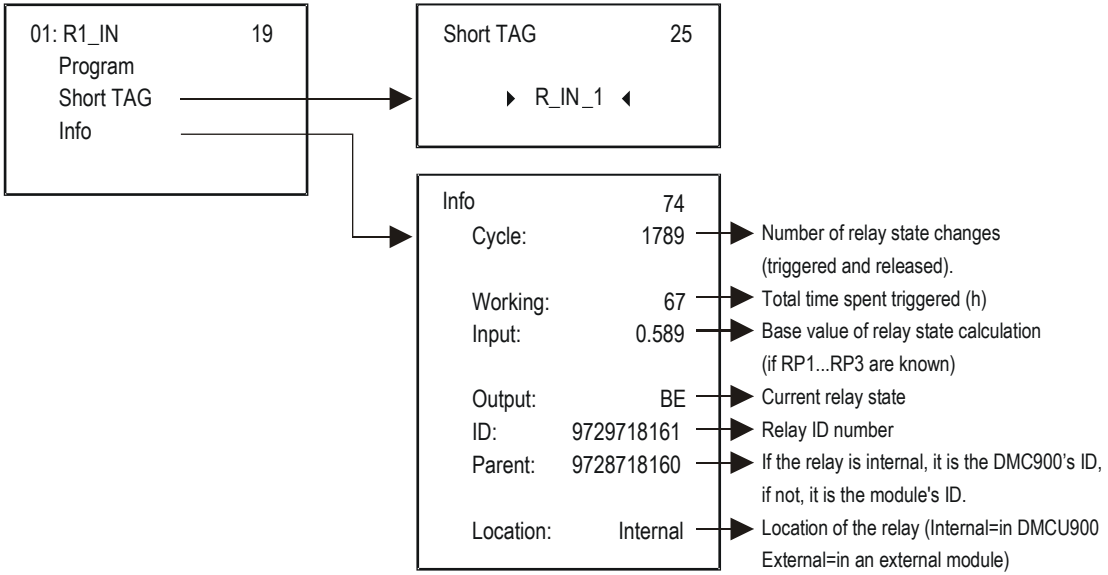
The relay menu cannot be accessed if the system does not contain at least one relay.

The number of relays in the system can be viewed under **Main menu / DMCU900 config / Report**. (see *Report*).



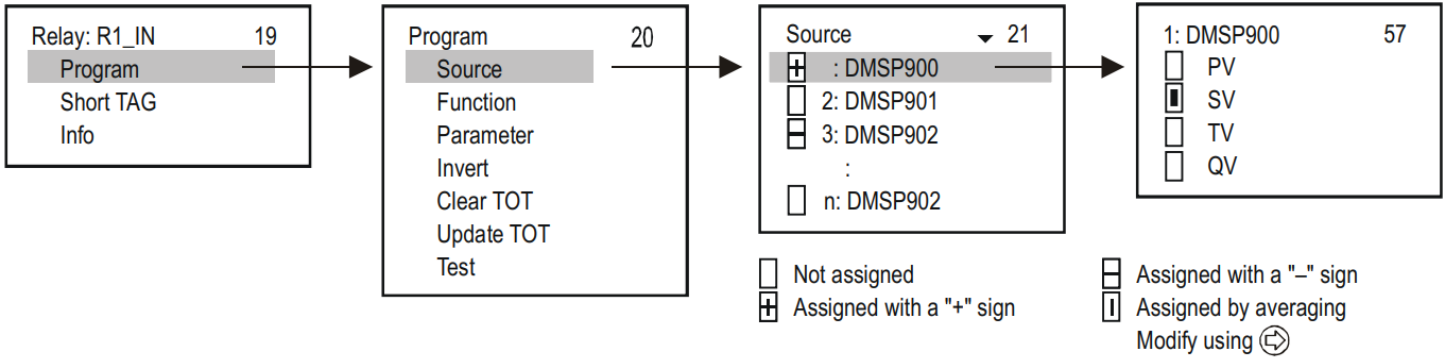
RELAY PROPERTIES

"Cycle," "Working," "Input," and "Output" of internal relays are continuously refreshed.

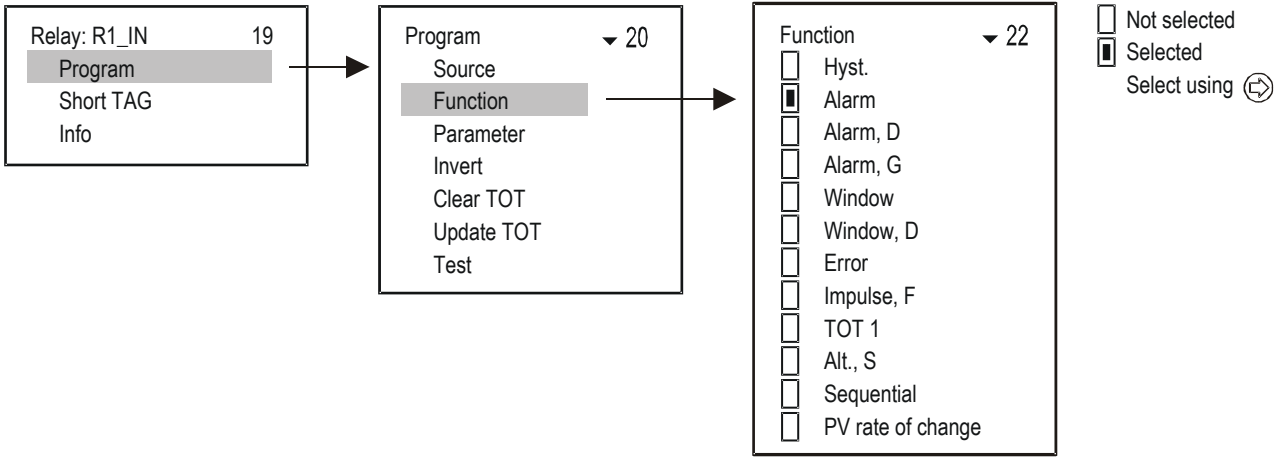


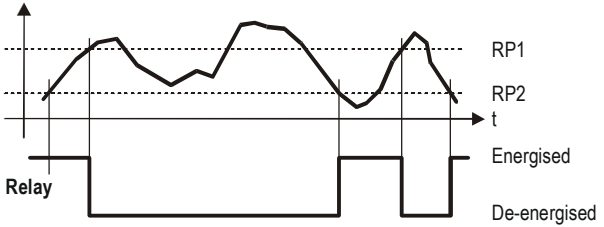
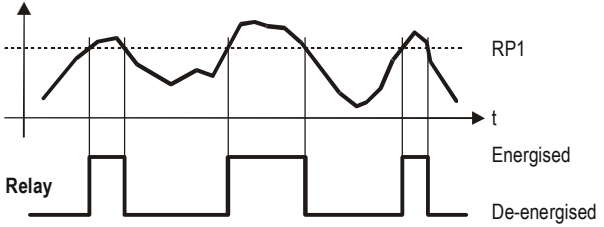
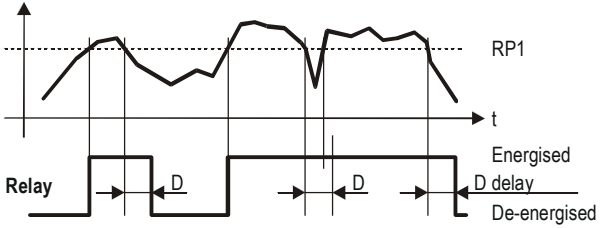
Source Selection

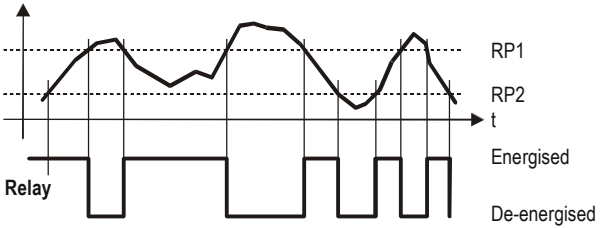
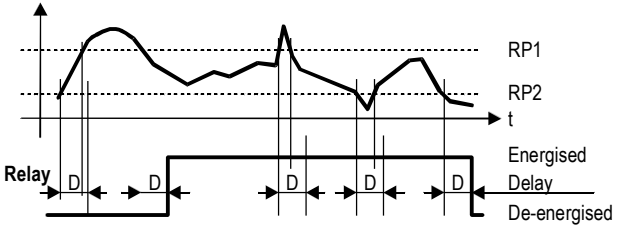
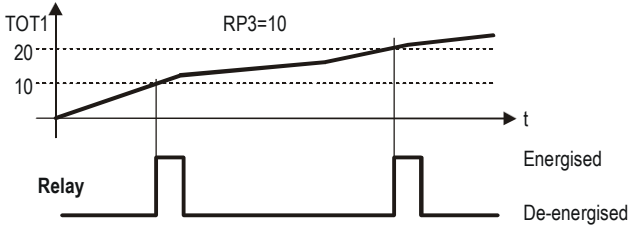
One or more devices can be assigned to one relay.

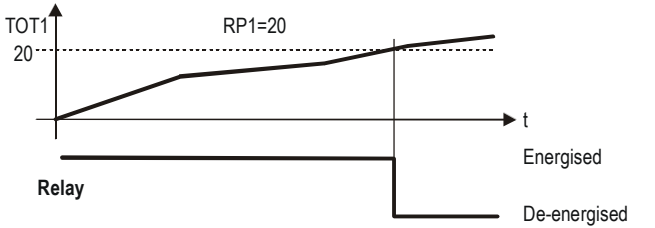
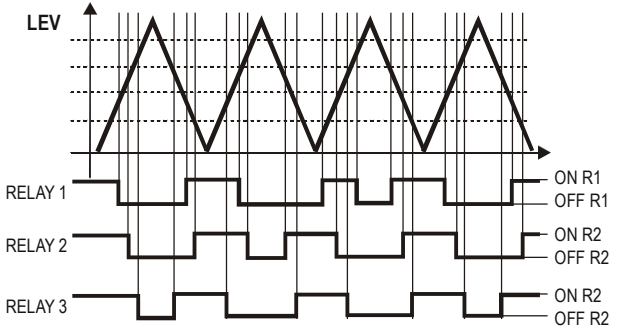


In the above example, Relay R1_IN is controlled by the difference between the secondary values of DMSP900 and DMSP901. In case it is a single unit, the sign is irrelevant, even “average” can be selected. If multiple devices are selected, the system uses the mathematical sum as the basis of calculation. With multiple selected devices, if the units of the values do not match, the unit will display an error message. Make sure the appropriate HART command is selected for the device (**Main Menu / DMCU900 Config / HART / Command Set**, see *HART*).


Relay: R1_IN 19
Program
Short TAG
Info
Program 20
Source
Function
Parameter
Invert
Clear TOT
Update TOT
Test
Function 22
Hyst.
Alarm
Alarm, D
Alarm, G
Window
Window, D
Error
Impulse, F
TOT 1
Alt., S
Sequential
PV rate of change
Not selected
Selected
Select using

OPERATING MODE	FUNCTION	PROG. PAR
Hysteresis. (2-point control) Default: filling with triggered relay: Invert = OFF, the relay will release above RP1, below RP2 it is triggered Reverse operation: by flipping RP1 and RP2 or by selecting Invert = ON Main Menu / Relays / Program / Invert "Alert Above" is enabled if RP1 = RP2.		**RP1,** **RP2**
Alarm Default: Invert = OFF Below RP1 relay will be de-energized Reverse operation (relay will be triggered below RP1) by selecting Invert = ON Hysterisis = 2.5% of RP1 If RP1 = 0 the relay will be constantly triggered		**RP1**
Alarm D (delayed switching) Default: Invert = OFF below RP1 relay will be released using delay in RP3 (Factory default t = 0 sec) RP3 is in seconds		**RP1,** **RP3**
Alarm G (group ALARM) Default: Invert = OFF	If the condition (measured value < RP1) is met in any of the assigned transmitters, the relay releases. Hysteresis: 2.5% of RP1 Operation can be inverted with Invert =ON (Relay releases when the measured value exceeds RP1)	**RP1**

Window (Window Comparator) Default: Invert = OFF Between RP1 and RP2 relay will be triggered Reverse operation (Between RP1 and RP2 relay releases) by selecting Invert = ON		**RP1, RP2**
Window D (Comparator with Switching Differential) Default: Invert = OFF Between RP1and RP2 relay will be triggered using delay in RP3 (Factory default t= 0 sec) Reverse operation (Between RP1 and RP2 relay releases) by selecting Invert = ON		**RP1, RP2, RP3**
Error Default: Invert = OFF In case of an error, the relay will be de-energized. RP3 = 0 for any error; RP3 = n for error of code **n** Inverted operation (in case of error relay will be triggered) by selecting Invert = ON		**RP3**
Impulse F Default: Invert = OFF Relay will be triggered for appr. 200ms for each volume unit (integer) set in RP3. Operation can be reversed by selecting Invert = ON. Programming error will be displayed if: • more than one device (transmitter) is marked as source • RP3 = 0		**RP3**

TOT1 Default: Invert = OFF relay will release when TOT1 reaches value in RP1. Operation can be reversed by selecting Invert = ON (relay will be triggered).		**RP1**
Alt (optimized pump control) Default: Invert = OFF Multiple relays (up to 8) can be assigned to one source (transmitter), and they are controlled so that the switching number will be the same for all of them. All the connected relays will be triggered and released one after another, regardless of which relay's conditions are met. The programmed relay operation is shown in the following diagram.		**RP1,** **RP2**

PV Rate of Change
Default: “Invert = OFF”

The DMCU900 calculates the PV rate of change every 5 seconds. When there are multiple transmitters in the loop, and cycle time is more than 5 seconds, the PV Rate is calculated once every cycle.

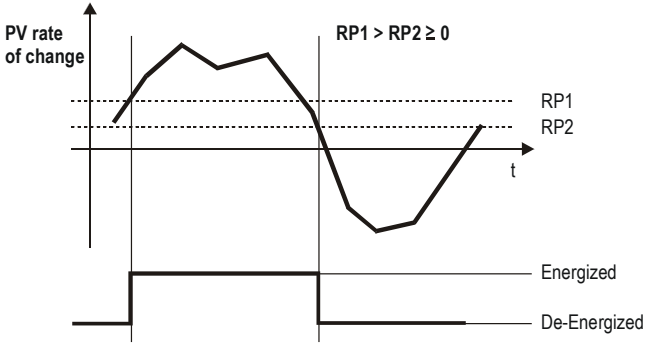
$$(t1 - t2 \geq 5 \text{ sec})$$

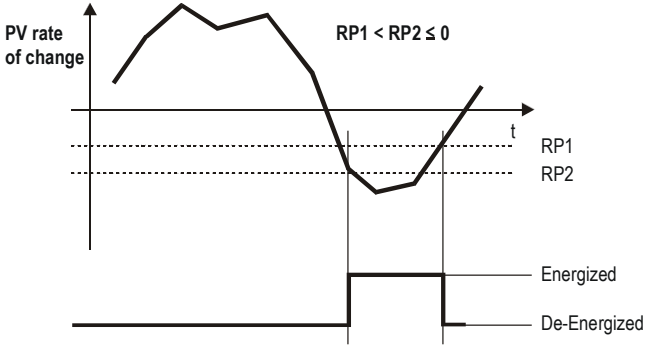
PV rate of change is [PV / min] = $(PV_{t1} - PV_{t2}) * 60 / (t1 - t2)$

There are two operating modes depending on the value of the parameters:

1. **RP1 > RP2 ≥ 0**
   For example: Relay is triggered when level is increasing too fast in the tank.
2. **RP1 < RP2 ≤ 0**
   For example: Relay is triggered when level is decreasing too fast in the tank.

Set Invert = ON to reverse the operation





RP1
RP2

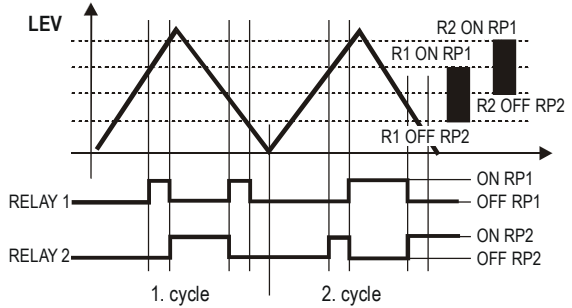
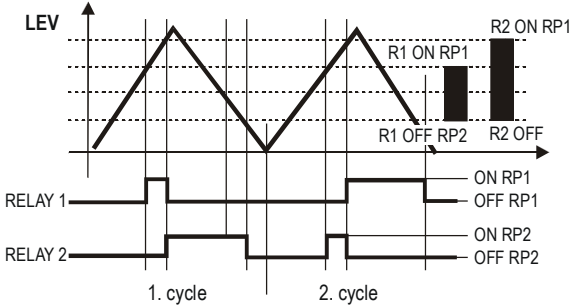
Sequential

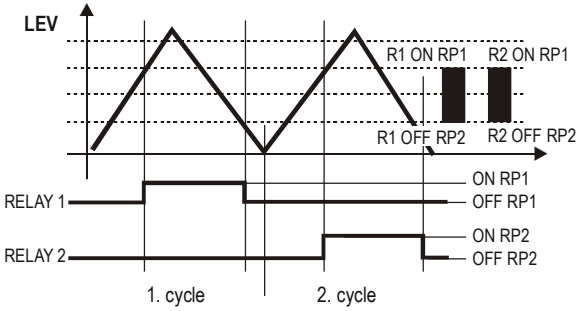
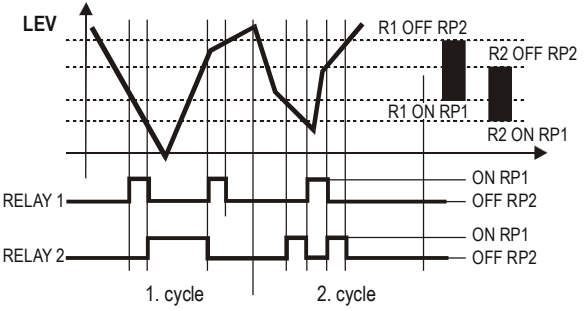
Default: Invert = OFF

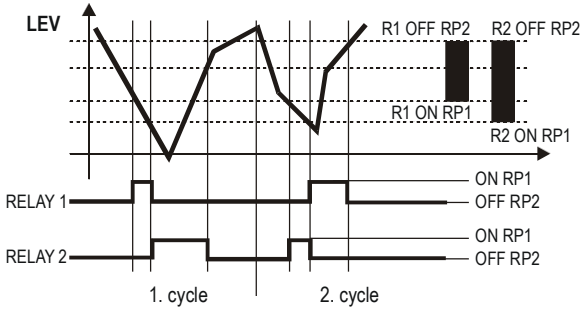
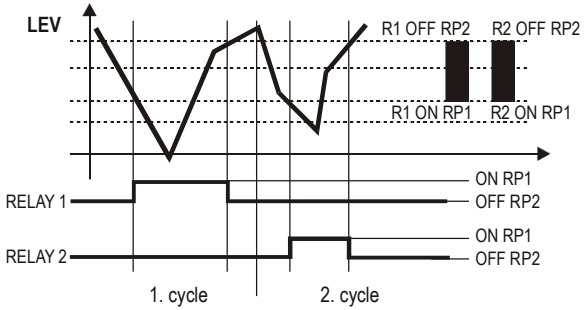
Parameter values determine operational behaviour.

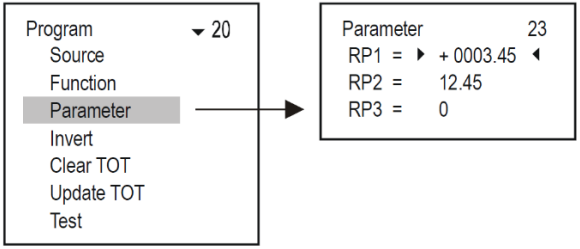
There is only one triggered relay at a time. When all relays are released, a new cycle starts and relay order is reversed.

The example below shows two relays in operation (max. 8 relays can operate in a group)

Sequential **1. Relay switching points differ** **Rx – RP1 > Rx – RP2** Relay is triggered for emptying.		**RP1** **RP2**
Sequential **2. Triggering (ON) points differ** **Releasing points are the same** **Rx – RP1 > Rx – RP2** Relay is triggered for emptying.		**RP1** **RP2**

Sequential **3. Relay switching points are the same for both relays** **Rx – RP1 > Rx – RP2** Relay is triggered for emptying. If there are multiple relays in the system (2 - 8), they operate in an alternating fashion.		**RP1** **RP2**
Sequential **4. Different ON/OFF switching points** **Rx – RP1 < RX – RP2** Relay is triggered for filling.		**RP1** **RP2**

Sequential **5. Different switching points for turning ON and same switching points for turning OFF** **Rx – RP1 < RX – RP2** Relay is triggered for filling.		
Sequential **6. Different switching points for turning ON and same switching points for turning OFF for the relays** **Rx-RP1 < RX-RP2** Relay is triggered for filling. If there are multiple relays in the system (2 - 8), they operate in an alternating fashion.		**RP1** **RP2**

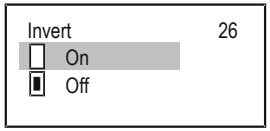


Cursor
Select place value
Modifies numbers and signs
RP1: back to “Program” menu
RP2 and RP3: back to previous parameter
Confirm parameter and proceed to next one
In RP3: RP1 … RP3 are entered into memory
and navigates back to “Program” men

Inversion

Relay operation can be reversed by turning “Invert” on.

Default: Off



☐ Not selected
▮ Selected
Select using ⇨
Selected choice gets applied immediately

Clearing TOT

Transmitters that measure flow the add the corresponding **TOT1 and TOT2** quantities together. The DMCU900 can transmit **TOT2** as relay impulses (pre-set units). The relay has to be in **Impulse F** mode to enable this function. The relay’s **RP3** parameter specifies the volume that triggers each impulse (200 ms long). Each relay programmed to work in **Impulse F** mode has a **PULSE** and a **TOTAL** variable. The **TOTAL** variable of the relay follows the transmitter’s **TOT2** variable. The volume difference between the two variables divided by the value of **RP3** is entered into the relay’s **PULSE** variable. The value of **PULSE** is transmitted to the relay’s output. The **TOTAL** and **PULSE** relay variables are automatically saved in memory every 6 minutes (stored even when the system is powered down). Relay impulses occurring while the unit is powered down are stored in the transmitter and recalculated from the last saved state when power is restored. Use a UPS to avoid recalculation.

Example: Make the TOT2 value of the transmitter 1000 m^3 and the relay TOTAL value 1000 m^3. Make the PULSE value of the relay 0 and set the RP3 parameter of the relay at 10 m^3. As long as the transmitter’s TOT2 value and the relay’s TOTAL are equal, no impulses are generated on the relay output.

When the transmitter’s TOT2 changes from 1000 m^3 to 1050 m^3, the difference is 50 m^3; since **RP3** is set to 10 m^3, the value of PULSE will increase by 5 (50 m^3 / 10 m^3) and the relay lets out 5 impulses. Afterwards, the relay’s PULSE value becomes 0, while TOTAL becomes 1050 m^3.

Pressing OK resets the values of relay **TOTAL** and **PULSE**. Then the **TOT2** in the transmitter is divided by **RP3** and the result is sent to the relay’s output.

Clearing TOT brings up the following message.

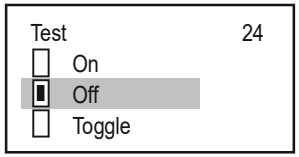
Refreshing TOT

Pressing **OK** copies the transmitter's **TOT2** value into the relay's **TOTAL** variable and deletes the contents of the relay's **PULSE**. The transmitter and the DMCU900 become synchronised.

Updating brings up the following message.

Testing

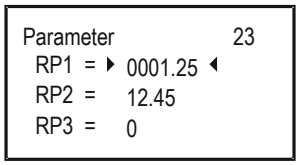
Relay operation is tested as seen below.



☐ Not selected
▮ Selected
Select using ⇨
Changing the selection will change the state of relay immediately

Pressing ⇨ in toggle mode makes the relays switch.

Note:

1. 

To edit the parameter in **Main Menu / Relays / Relay / Program / Parameter,** use the ⇧ ⇩ buttons, to accept the entered value, press (OK). Editing can only be concluded by pressing (OK) after setting RP3 (even if it is zero or not applicable in the function).
2. Inactive relays are disengaged/released (see **Main Menu / Relays**).
3. Relays can be assigned to multiple devices (**Main Menu / Relays / Program / Source**)
   The result is the sum of the sources.
   If the measurement mode or units of devices do not match, the DMCU900 sends an error message (see **Error Messages**)
   The values of transmitters marked ⊞ are added to the result.
   The values of transmitters marked ⊟ are subtracted from the result of the transmitters marked ⊞.
   The values of the transmitters marked | are averaged.
4. If the **Error** function is selected, no source assignment is required since only the errors of active devices are monitored.
5. If the assigned source does not respond, current relay state is held.
6. The device throws an error if:
   - there are multiple sources with different units,
   - **Impulse F** function is selected, and there are multiple sources or RP3 is 0,
   - **Alt S** or Sequential function is selected, and more than 8 relays are assigned to one device, or the sources are different (e. g. PV for one relay, and SV for another),
   - the sources are SV, TV, and QV but the COM3 command is not selected,
   - **ALARM** or G function is selected and the transmitter units do not match.

For a detailed programming overview see *Appendix 3.*

OPERATION AND CURRENT LOOP OUTPUT PARAMETERS

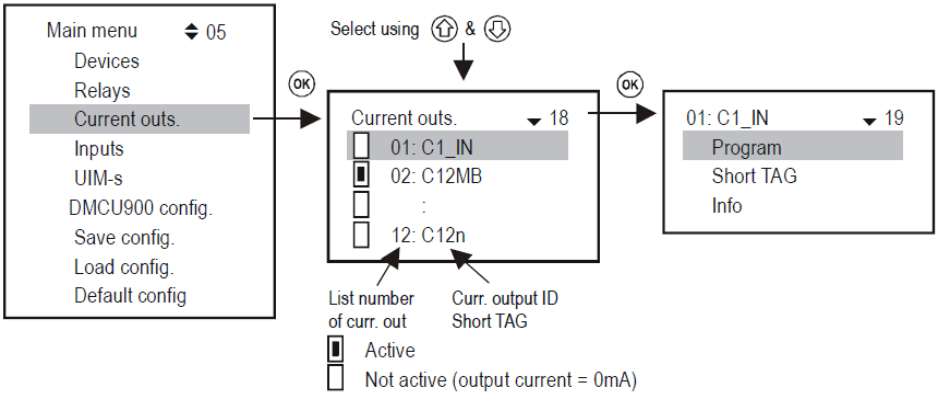
Current loop outputs must have at least one device assigned to them (Main menu / Current outputs / Program / Source).

- The results of the transmitters marked [+] are added.
- The results of the transmitters marked [−] are subtracted from the sum of the result of the transmitters marked with [+] (**difference measurement**).
- The results of the transmitters marked [|] are averaged.

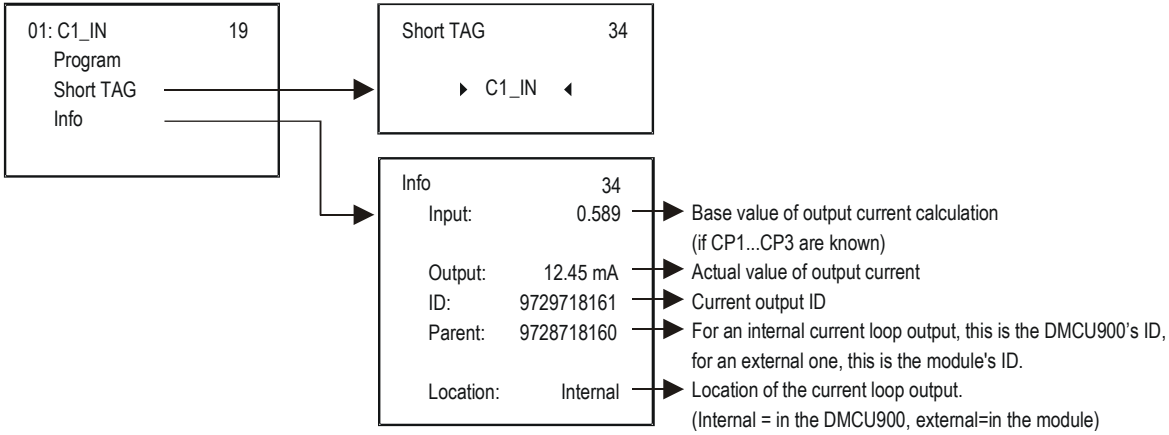
Functions must be configured in **Main Menu / Current Outputs / Program / Function**, and parameters have to be set, so that the units of CP1 and CP2 be determined by the transmitter(s). Thus, if LEVEL [m] (e. g. for DMSP900 P01=x1 P00=00x) mode is selected, programming must be in LEVEL [m] as well (**Main menu / Current outputs / Program / Parameter**).
For a programming details refer to ***Appendix 4***.

SELECTING CURRENT LOOP OUTPUTS

The system must contain at least one current loop output to access the current loop output menu. The number of current loop outputs in the system can be checked in **Main menu / DMCU900 config / Report** (see *Data Logger*).



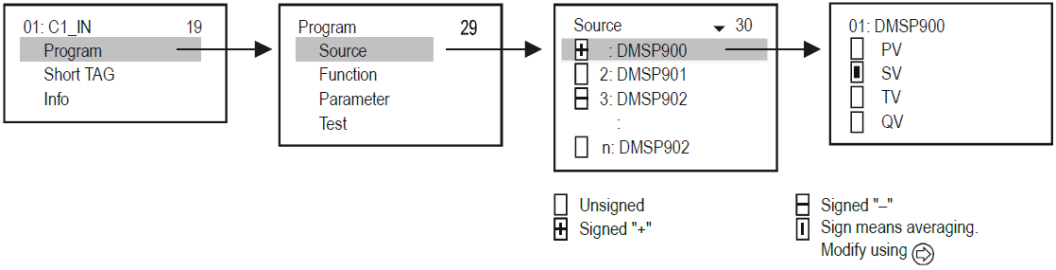
CURRENT LOOP OUTPUT PROPERTIES



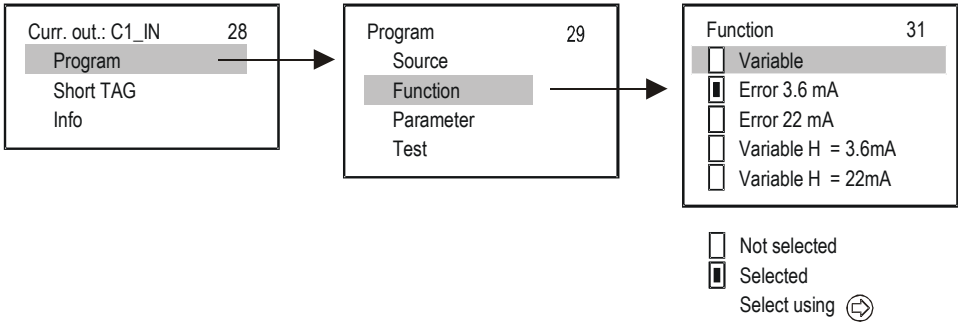
CURRENT LOOP OUTPUT PROGRAMMING

Selecting a Source

Multiple devices can be assigned to a single current loop output.



In the above example, output C1_IN is controlled by the difference between the secondary values of DMSP900 and DMSP902. In there is only one device in the system, the sign is irrelevant, even average mode can be selected. If multiple devices are selected, the system uses the mathematical sum as the basis of calculation. With multiple selected devices, if the units of the values do not match, the unit will display an error message. When selecting the value, make sure the appropriate HART command is selected for the device (**Main Menu / DMCU900 Config / HART / Command Set**, see *HART*).



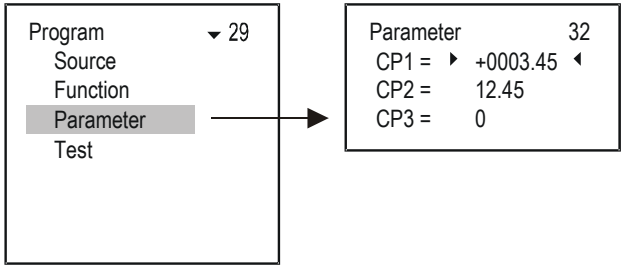
Function

FUNCTION	DESCRIPTION	PROG. PAR.
Variable	Defined by the selected "Source" value (PV, SV, TV, QV). The value of CP1 is assigned to 4mA, the value of CP2 is assigned to 20mA.	**CP1** **CP2**
Error 3.6 mA Error 22 mA	CP3 = 0 stands for an error in all cases CP3 = N stands for "Error Code N" See *5. Error Codes* If there is no error, the value of the current loop output is 4mA.	**CP3**
Variable H = 3.6 mA Variable H = 22 mA	Unifies the previous two functions: As long as there is no error, its operation is defined by the values (PV, SV, TV, QV) selected in "Source." The value of CP1 is assigned to 4mA; the value of CP2 is assigned to 20mA. In case of an error, the current corresponding to the error code will be generated.	**CP1** **CP2** **CP3**

Note:

1. If the selected mode is “Variable” and CP1=CP2, the device displays an error message.
2. If the assigned device does not respond or responds with an “Err xx” error, the value of the output loop current will not change (HOLD).
3. The current on inactive outputs is 0 mA.
4. If the **Error** function is selected, only errors of the active devices are monitored, and no **Source** assignment is required.
5. Modified parameters will be saved only when the cursor is on CP3 and (OK) is pressed.

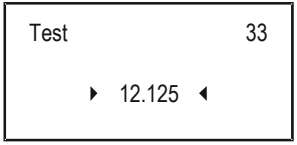
Parameter Configuration



◂ ▸ Cursor
(⇦)(⇨) Select place value
(⇧)(⇩) Modifies numbers and signs
(ESC) RP1: back to “Program” menu
RP2 and RP3: back to previous parameter
(OK) Confirm parameter and proceed to next one
In RP3: RP1 … RP3 are entered into memory
and navigates back to “Program” menu

Testing

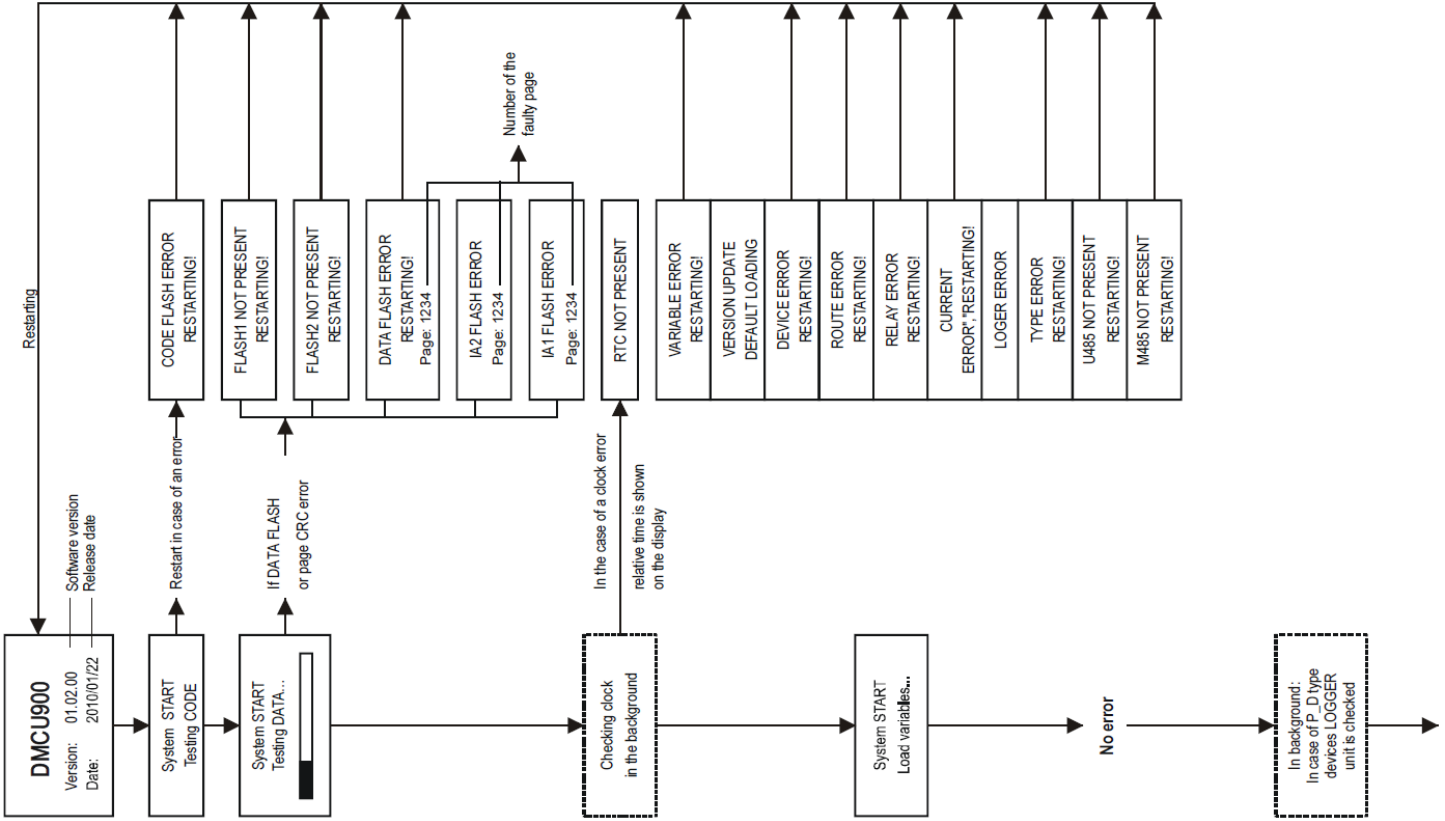
The current loop output can be tested in 1µA steps. Changing the numbers changes the output immediately, it is not necessary to press **OK**.

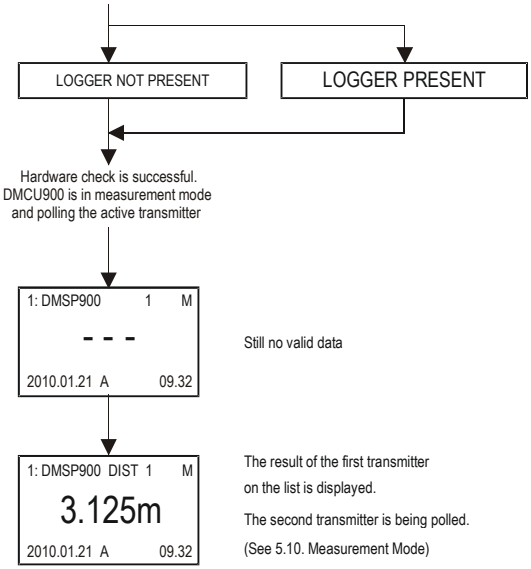


(⇦)(⇨) Select place value
(⇧)(⇩) Edit sign and numbers

THE BOOT PROCESS

Every time the unit is powered on, it runs a self-test. The steps of the process are indicated on the display in English. The procedure takes about 40 seconds.

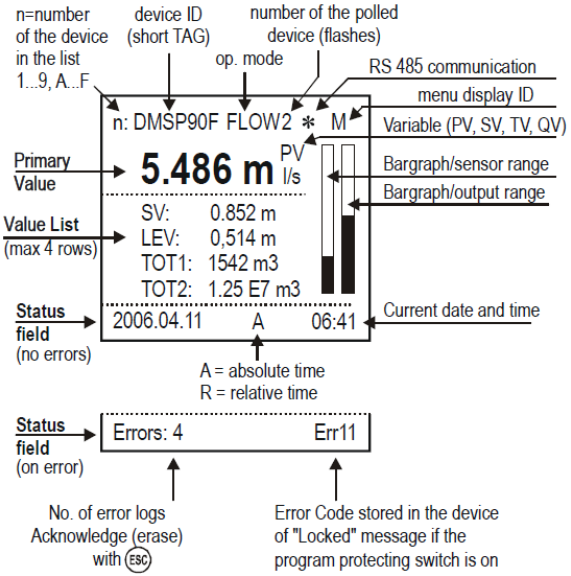



LOGGER NOT PRESENT
LOGGER PRESENT
Hardware check is successful.
DMCU900 is in measurement mode
and polling the active transmitter
1: DMSP900 1 M
- - -
2010.01.21 A 09.32
Still no valid data
1: DMSP900 DIST 1 M
3.125m
2010.01.21 A 09.32
The result of the first transmitter
on the list is displayed.
The second transmitter is being polled.
(See 5.10. Measurement Mode)

MEASUREMENT MODE

After the boot test, the DMCU900 will automatically enter the **Measurement Mode / standard display screen**. Measured values are continuously polled and displayed corresponding to the device list's contents and the settings in **Main Menu / DMCU900 config / Main Display / Step**. Up to 5 value per device can be displayed simultaneously on the display (1 primary value – see *Main Screen* - and 4 on the value list – see *Value List*) along with their units and abbreviations (DIST, LEV, VOL, FLOW, PV, SV, TV, QV, TOT1, TOT2, E). The upper row contains the device identifier (Short TAG), List Tag (1, … 9, A, ...F), and the device currently communicating with the DMCU900.

When the device communicates via RS485, the "*" is blinking. There are two bar graphs on the display. One is the "sensor range" (only for Delta Mobrey transmitters), this indicates the transmitter's measuring range (the tank level between the maximum and minimum measuring distance). The other is the "output range" that indicates the 4 – 20 mA range of the transmitter.



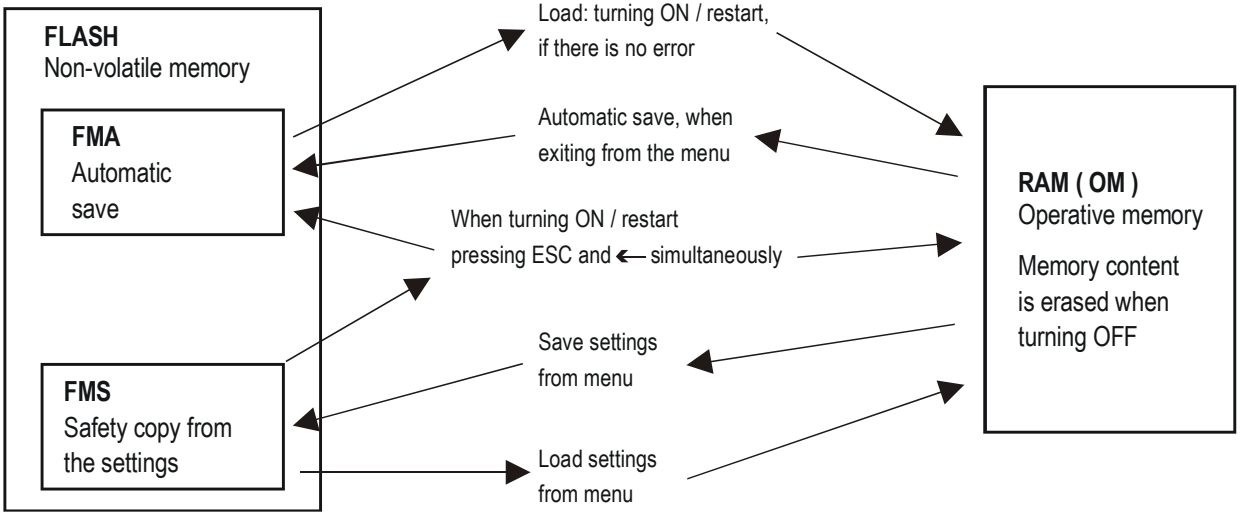
Bargraph Screen, User Display (**Range**, **Double**, **Difference**, **Average,** see **Main menu / DMCU900 config / User display** – *DMCU900 Configuration*), relay–device and current loop output–device assignments, and the error list, can be viewed in this mode, using the ⇦ and ⇨ buttons.

See Appendix 5

After an error is corrected, it remains displayed until it is acknowledged by pressing the **ESC** button. Programming does not halt device polling, relay and current loop output control, or RS485 service. The DMCU900 automatically returns to measurement mode 5 minutes after the last keystroke. It also saves the number of switchings and the total operating time of the relays every 6 minutes (automatic exit triggers the timer).

SAVING AND LOADING SETTINGS

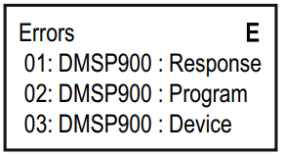
Settings are stored in non-volatile FLASH memory (**FMA**). The contents of the FLASH memory are copied into the operative memory (**OM**) when DMCU900 is turned ON or restarted. Settings are automatically saved when exiting from the Menu.
Additionally, relay operating time and the number of switchings are saved every 6 minutes in the FLASH memory. A backup copy of the automatically saved settings (**FMS**) can be made in **Main menu / Save config**.
Backups can be loaded in the **Main menu / Load config**. If there is a backup copy from the settings, the contents (**FMS)** are copied into the operative memory (**OM**) and the automatic saving storage (**FMA**) FLASH memory when ESC and ← buttons are pressed simultaneously.



5. ERROR CODES

In the event of an error, the message “errors” (see *Appendix 5 – Measurement Mode*) appears immediately.

Errors that occur during operation are collected in the E (Error) table where the error identification message is displayed.



Sensor and **Reply** error messages are automatically erased from the list upon correcting the corresponding error.

Other error entries will remain in the table until they are acknowledged by pressing **ESC**. For instance, if a relay or current loop output is set to “Error,” the error will remain indicated even after correcting it, up until it is acknowledged.

ERROR CODE	MESSAGE	DESCRIPTION	CORRECTION
1	Init	Device does not respond after switching-on*	Check device wiring
2	Reply	Normally operating device does not respond **	Check device wiring
3	Sensor	Device sensor failure ***	Check device (transmitter)
4	Device	Other device error (see chart on next page)	Check programming of device (refer to the transmitter’s User’s & Programming Manual), and working conditions
5	Program	Error occurred while programming relay or current loop output ****	Check programming
6	Save	Error occurred while saving to memory	If this happens repeatedly, send the device back to the manufacturer.
7	Log	Logging does not respond, or a failure may have happened while saving	Please check the SD card, if necessary, try another one.

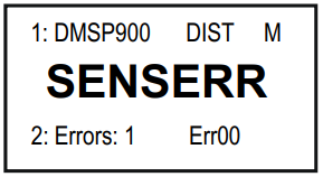
* Possible reasons for active devices on the list not responding after switching on:

- the system was altered before turning on (device was disconnected, wiring was changed, etc.)
- device failed to reach operating condition while booting (and is not yet able to measure).

** A device that was working perfectly suddenly stops responding. Possible reasons:

- device is faulty
- broken cable
- noisy HART line (see Main Menu/DMCU900 Config/HART Test)

*** Sensor errors have a different error message. It pops up if an ultrasonic transmitter has a broken or dusty transducer. If there is a display connected, the error message will say **NoEcho**. With magnetostrictive transmitters, this error may indicate a cracked magnetic disc or a broken magnetostrictive wire.

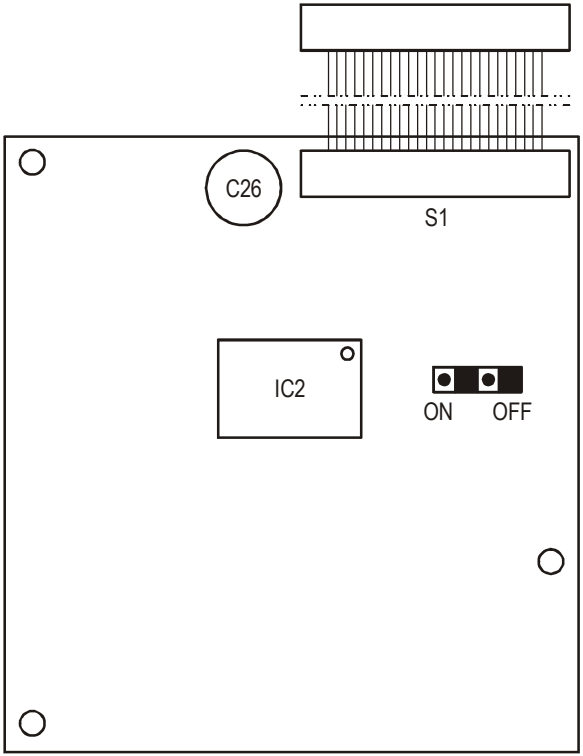


The device responds, but there is no valid result because of a sensor error.

**** The following conditions cause a programming error:

- assigning sources with unmatching units of measurement to a relay or current loop output,
- a variable (PV, SV, etc.) is assigned to a current loop output, and CP1=CP2 (see *Operation and Parameters of Current Loop Outputs*),
- a relay is assigned to a flow value (Impulse F) and there is more than one source (see *Relay Configuration*),
- a relay is assigned to a flow value (Impulse F) and RP3=0 (see *Relay Configuration*),
- more than 8 relays with „Alt S" or Sequential function are assigned to a transmitter,
- variables selected for a relay with „Alt R" function do not match,
- COM3 HART command is not selected for an SV, TV or QV source,
- ALARM, G function is selected, but the units of the measured values do not match.

6. SETTINGS PROTECTION



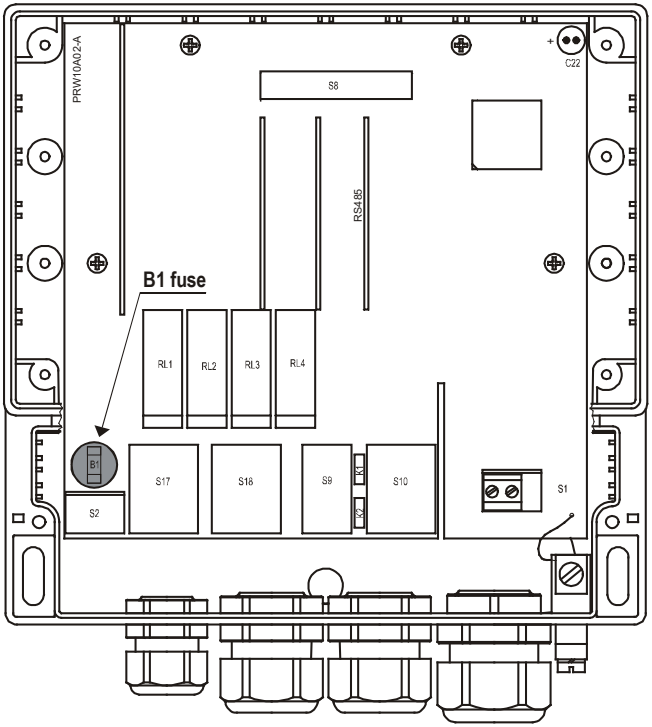
To access the switch, loosen the nuts of the front panel.

When the program protection switch is in the **ON** position, it will prevent the modification of parameters that affect the following properties:

- relay parameters
- current loop output parameters
- device activation
- remote programming
- editing the Service menu
- DEV detect, EXT detect in DMCU900 config

The switch does not prevent any modification that does not influence the measuring functionality of the DMCU900 (such as language, backlight, user image, sorting, restart, etc.).

7. FUSE REPLACEMENT



To access the fuses, loosen four nuts of the front panel, tilt the front panel forward carefully, avoid any tension put on the ribbon cable, and replace the fuse.

Warning! Only use fuses specified in the table below:

POWER SUPPLY	FUSE B1
85…255 V AC 50…60Hz	T400mA
11.4…28 V AC 50…60Hz 11.4…40 V DC	T1A

The device contains one network fuse. Its value depends on the power supply.

8. SERVICING

BOX MESSAGES

No.	Box Message	Explanation
1	No CODE!	Secret code is not set
2	In manual prg!	The transmitter is in manual programming
4	Already unlocked!	No code in the transmitter (i.e. 00000000)
5	Unlock, please!	Secret code needed for modification (see *Main Menu / DMCU900 config. / password*)
6	HART error!	Communication error
7	TOT1 cleared!	Value in TOT1 deleted
8	TOT2 cleared!	Value in TOT2 deleted
9	HART no reply	Device does not respond during programming, or bad data
10*	HART comm. error	Error in HART message (parity, framing, overflow, etc.)
11*	HART logical error	Other logical error in HART message
12*	HART write protect	Parameter cannot be written
13	Unknown dev/comm	Address (long address) in HART message is not found in the list
14	Parameter saved	Parameter was saved successfully
15	Save error	Error writing to FLASH memory
16	Device added	Device selected in “Device detect” has been added to the list.
18	Unknown param.	Unknown parameter encountered while detecting devices
19	Default loaded	Loading factory defaults (depending on type) was completed successfully.
20	PSW cleared	Secret code was cleared
23	FLASH error	FLASH error on boot
24	Same address!	Multiple matching Long Addresses found while detecting devices
25	No HART device	Detection (DEV detect) ended without finding any devices with a Short Address between 0 and 15.
26	Load error	Error reading FLASH memory.
28	No comp. Device	Device is not Delta Mobrey compatible.
30	HART:Parse error	Received data could not be parsed.
31	HART:Invalid sel.	The received HART command is unknown to the DMCU900.
32	HART:Too large	The received HART command is longer than standard.

No.	Box Message	Explanation
33	HART:Too small	The received HART command is shorter than standard.
34	HART:Few data	
35	HART:Device spec.	Bad parameter sent in remote programming.
36	HART:Access restr.	
37	HART:Busy	
38	HART:Comm. not. imp.	Received HART command could not be parsed by the DMCU900.
39	Please wait!	DEV detect cannot run due to periodic disturbance on the HART line, which causes a persistent error.
40	TOT cleared	TOT deleted while programming relays (Impulse F).
41	TOT updated	TOT updated while programming relays (Impulse F).
42	No in RP mode	Device could not run “Remote programming” (RP) while programming.
43	Stick in RP mode	Could not exit after programming device remotely.

OTHER MESSAGES

No.	Message	Explanation
1	Scanning HART line	Displayed while detecting devices
2	Logical error	• **Difference** or **average** is selected, but there is only one active device (displayed instead of User Screen). • Units of the selected devices do not match.
3	No user screen	“None” is selected in Main menu / DMCU900 config. / User display.
4	No active device	Displayed during measurement or instead of User Screen when there is no active device.
5	No HART device	The unit’s device list is empty. Run DEV detect.
6	Locked	Program protection switch is on (settings cannot be modified).
7	No current loop output	Displayed in Current Loop Output Assignment, if there are no current loop outputs in the system.
8	No relay output	Displayed in Relay Assignment, if there are no relays in the system.

7

TROUBLESHOOTING

Main Menu / Relays or Main menu / Current Outputs cannot be accessed:

There are no relays or current loop outputs connected to the unit. Check the relays and/or current loop outputs in **Main Menu / DMCU900 config. / report**.

Main Menu / Devices cannot be accessed:

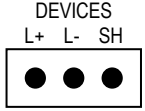
The device list is empty. There are no active or inactive devices in the system. A "No HART Device" message appears on the screen in measurement mode.

"Please wait" message appears when running DEV detect

Noise on the HART line reached a level where communication is impossible. To remedy the situation, switch the unit off and back on again. Check cable shielding and route.

DEV detect says "No device.."

The DMCU900 could not detect any responding devices.



- Check for short-circuits or breaks.
  If there is voltage between L+ and SH, but between L+ and L- the voltage is 0V, it indicates a short circuit.
- There is a break in the circuit. If there is no voltage between L- and SH, it is because there is no voltage drop on the sensing resistor (R_{fi}=255Ω) connected between these 2 points, even though the loop current can never be 0 mA.
- Check the voltage on the contacts of the transmitters. Low voltage might indicate bad wiring (high transient resistance) or high loop current, which results in a sizeable voltage drop on the sensing resistor. Connect the devices to the loop one by one, check their Short Address, and constant current parameter (see *Preparing Transmitters*).
- Check if the device is HART compatible (device label).

The unit does not start up when it is switched on.

It is in a reboot loop (see *The Boot Process*).

- Faulty FLASH (the non-volatile memory in the unit).
- Faulty RS485 card (types P__-1_A and P__-1_B). The RS485 card is tested on boot, and it may hang the system if it is faulty. Contact our Export Sales department for help.

Frequent "Response" error entries.

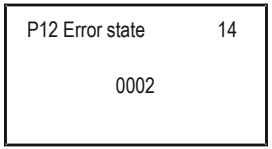
The line is noisy, check the grounding of the cable shielding. If the cable is not shielded, replace it with a shielded one.

ADDITIONAL INFORMATION

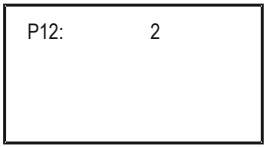
Problems that may occur in remote programming:

The DMCU900 displays four digits for all parameters, even if the parameter takes only one integer. For example:

PRW:



DMSP900:



The DMSP900 tests only the fourth place value and does not display an error if 1002 is entered. It even stores the four-digit value and does not indicate an error, but upon reading this parameter from the DMSP900, the value will be 1002, which cannot be parsed.

The DMCU900 sends the parameters without checking them, which is done by the transmitters.

In the event of an error, if the device does not accept the value, then a "**HART logical error**" message box appears on the screen.

Using a second HART Master (Hand-Held or HART modem + DMSPconf configuration software).

Generally, there can only be one master in a HART system. Since the DMCU900 is the master, other masters can only be used if the status of every device is set to inactive, i. e. the DMCU900 is in listen mode. (see *Main Menu / Devices*) After this, the other master can be connected to the L- and SH terminals (with a 255 Ω sensing resistor in the DMCU900).

Upon leaving remote programming, the unit tests if the transmitter really left remote programming mode.

In remote programming, "RP" appears on the display of the transmitter. If it fails, the "Stuck in RP mode" message pops up, which indicates that programming mode cannot be accessed manually.

When a transmitter does not respond, a "Response" error is entered into the table, but when the error is eliminated (the device responds), the entry is automatically cleared from the table (and does not need to be acknowledged).

This is true for "Sensor" error (noEcho, etc.) as well. Relay and current loop output states are not refreshed in this process.

The DMCU900 immediately saves modified settings when leaving the menu.

However, there are events that need to be recorded, which is done only every 6 minutes. The events include:

- Operating time and number of switchings of relays
- The number of times the DMCU900 was turned on (see *Main Menu / DMCU900 config. / Report / Power count*)
- If the function of any relay is "Impulse F," i. e. it sends a pulse (considering RP3) to the output; the relating variables are TOTAL and PULSE (see *Main Menu / Relays / Programming / Deleting TOT*).

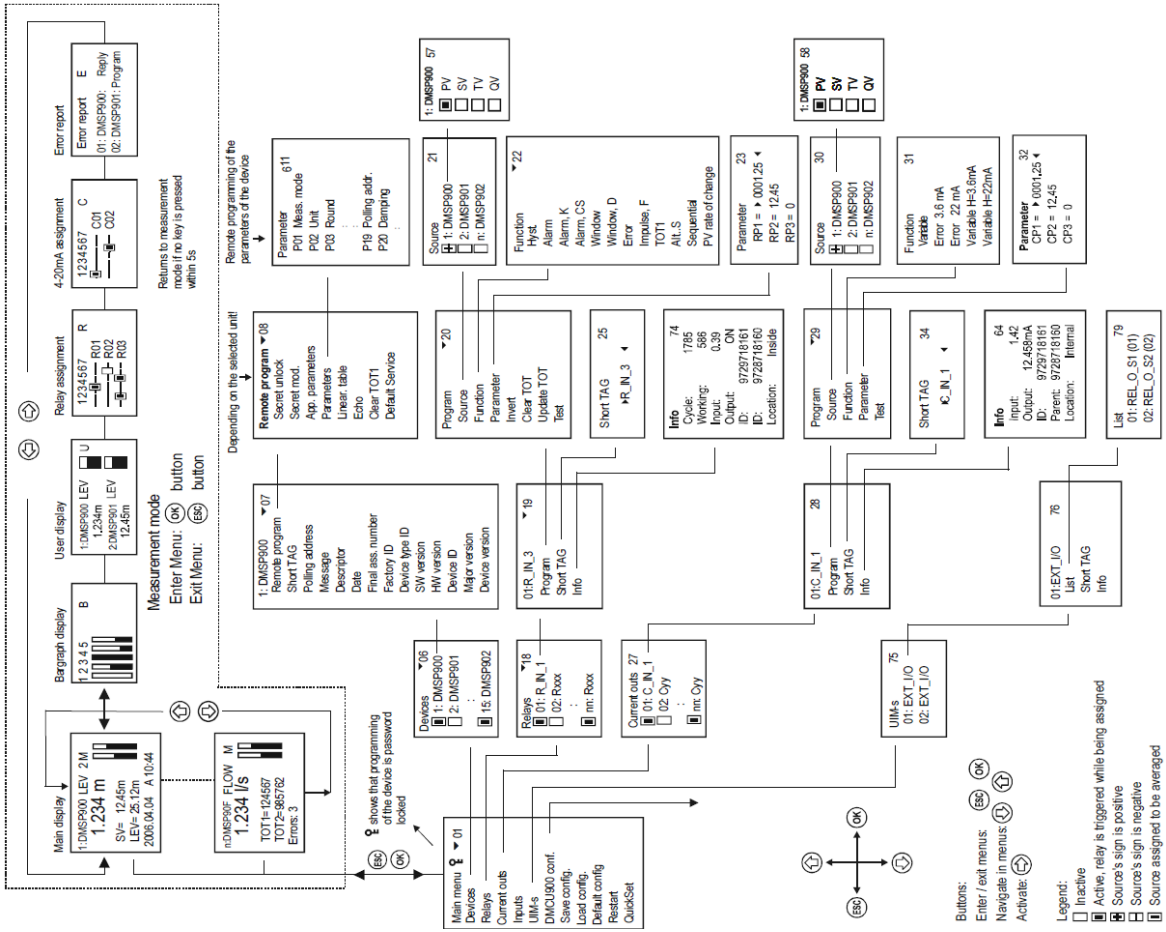
The error list is cleared when the device is switched off.

9. APPENDIX 1 – MANUFACTURER CODES OF HART COMPATIBLE DEVICES

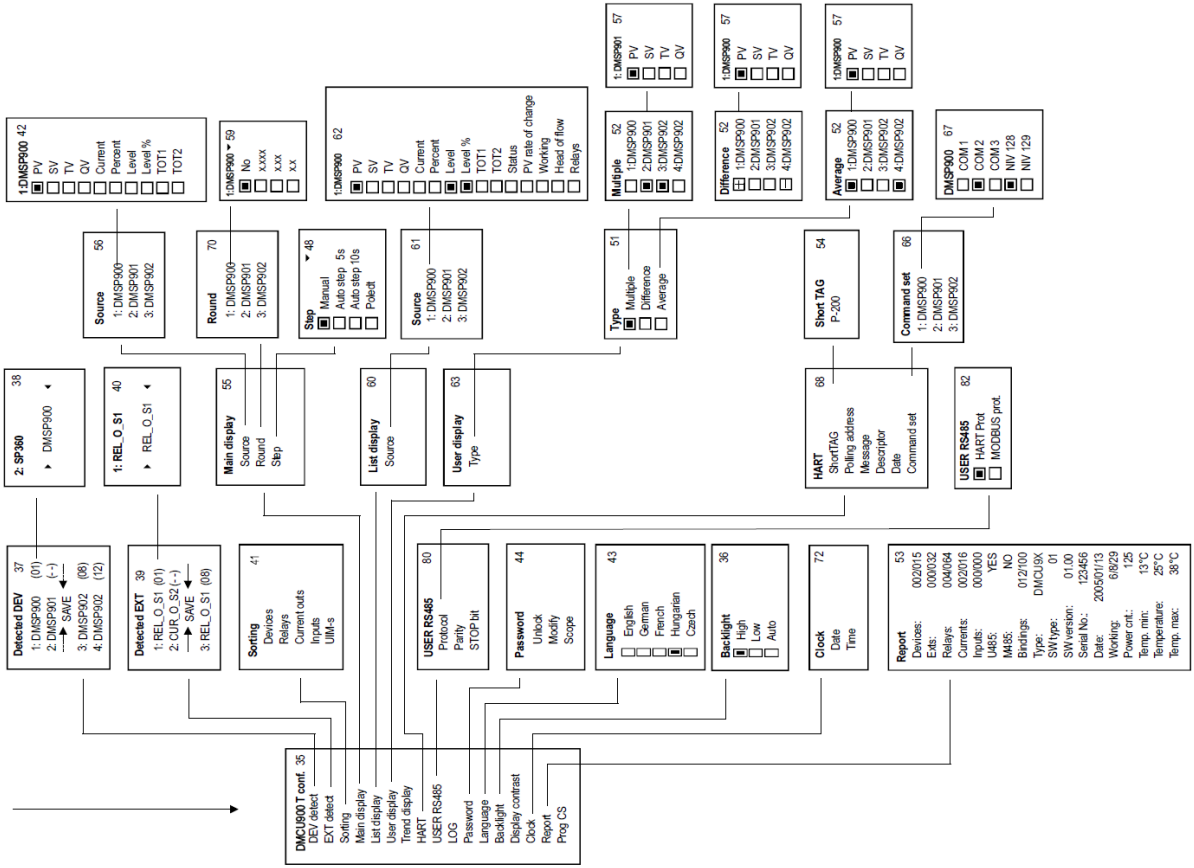
1 Acromag
2 Allen Bradley
3 Ametek
4 Analog Devices
5 Elsag Bailey
6 Beckman
7 Bell Microsensor
8 Bourns
9 Bristol Babcock
10 Brooks Instrument
11 Chessel
12 Combustion Engineering
13 Daniel Industries
14 Delta
15 Dieterich Standard
16 Dohrmann
17 Endress & Hauser
18 Elsag Bailey
19 Fisher Controls
20 Foxboro
21 Fuji
22 ABB Automation
23 Honeywell
24 ITT Barton
25 Kay Ray/Sensall
26 ABB Automation
27 Leeds & Northrup
28 Leslie
29 M-System Co.
30 Measurex
31 Micro Motion
32 Moore Industries
33 Moore Products
34 Ohkura Electric
35 Paine
36 Rochester Instrument Systems
37 Ronan
38 Rosemount
39 Peek Measurement
40 Schlumberger
41 Sensall
42 Siemens
43 Weed
44 Toshiba
45 Transmation
46 Rosemount Analytic
47 Metso Automation
48 Flowserve
49 Varec
50 Viatran
51 Delta/Weed
52 Westinghouse
53 Xomox
54 Yamatake
55 Yokogawa
56 Nuovo Pignone
57 Promac
58 Exac Corporation
59 Delta Mobrey
60 Arcom Control System
61 Princo
62 Smar
63 Foxboro Eckardt
64 Measurement Technology
65 Applied System Technologies
66 Samson
67 Sparling Instrumnets
68 Fireye
69 Krohne
70 Betz
71 Druck
72 SOR
73 Elcon Instruments
74 EMCO
75 Termiflex Corporation
76 VAF Instruments
77 Westlock Controls
78 Dexelbrook
79 Saab Tank Control
80 K-TEK
81 Flowdata
82 Draeger
83 Raytek
84 Siemens Milltronics PI
85 BTG
86 Magnetrol
87 Metso Automation
88 Milltronics
89 HELIOS
90 Anderson Instrument Company
91 INOR
92 ROBERTSHAW
93 PEPPERL+FUCHS
94 ACCUTECH
95 Flow Measurement
96 KAMSTRUP
97 Knick
98 VEGA
99 MTS Systems Corp.
100 Oval
101 Masoneilan-Dresser"
102 BESTA
103 Ohmart
104 Harold Beck and Sons
105 Rittmeyer Instrumentation
106 Rossel Messtechnik
107 WIKA
108 Bopp & Reuther Heinrichs
109 PR Electronics
110 Jordan Controls
111 Valcom s.r.l.
112 US ELECTRIC MOTORS
113 Apparatebau Hundsbach
114 Dynisco
115 Spriano
116 Direct Measurement
117 Klay Instruments
118 Action Instruments
119 MMG Automatiky DTR
120 Buerkert Fluid Control Systems
121 AALIANT Process Mgt
122 POUNDS INSTRUMENT
123 ZAP S.A. Ostrow Wielkopolski
124 GLI
125 Fisher-Rosemount Performance Technologies
126 Paper Machine Components
127 LABOM
128 Danfoss
129 Turbo
130 TOKYO KEISO
131 SMC
132 Status Instruments
133 Huakong
134 Duon Systems
135 Vortek Instruments, LLC
136 AG Crosby
137 Action Instruments
138 Keystone Controls
139 Thermo Electric Co.
140 ISE-Magtech
141 Rueger
142 Mettler Toledo
143 Det-Tronics
144 TN Technologies
145 DeZURIK
146 Phase Dynamics
147 WELLTECH SHANGHAI
148 ENRAF
149 4tech ASA
150 Brand Instruments
151 NIVELCO
152 Camille Bauer
153 Metran
154 Milton Roy Co.
155 PMV
156 Turck
157 Panametrics
158 Stahl
159 Analytical Technology Inc.
160 Fieldbus International
161 BERTHOLD
162 InterCorr
163 China BRICONTE Co Ltd
164 Electron Machine
165 Sierra Instruments
166 Fluid Components Intl

Delta Mobrey reserves the right to change technical specifications without notice.

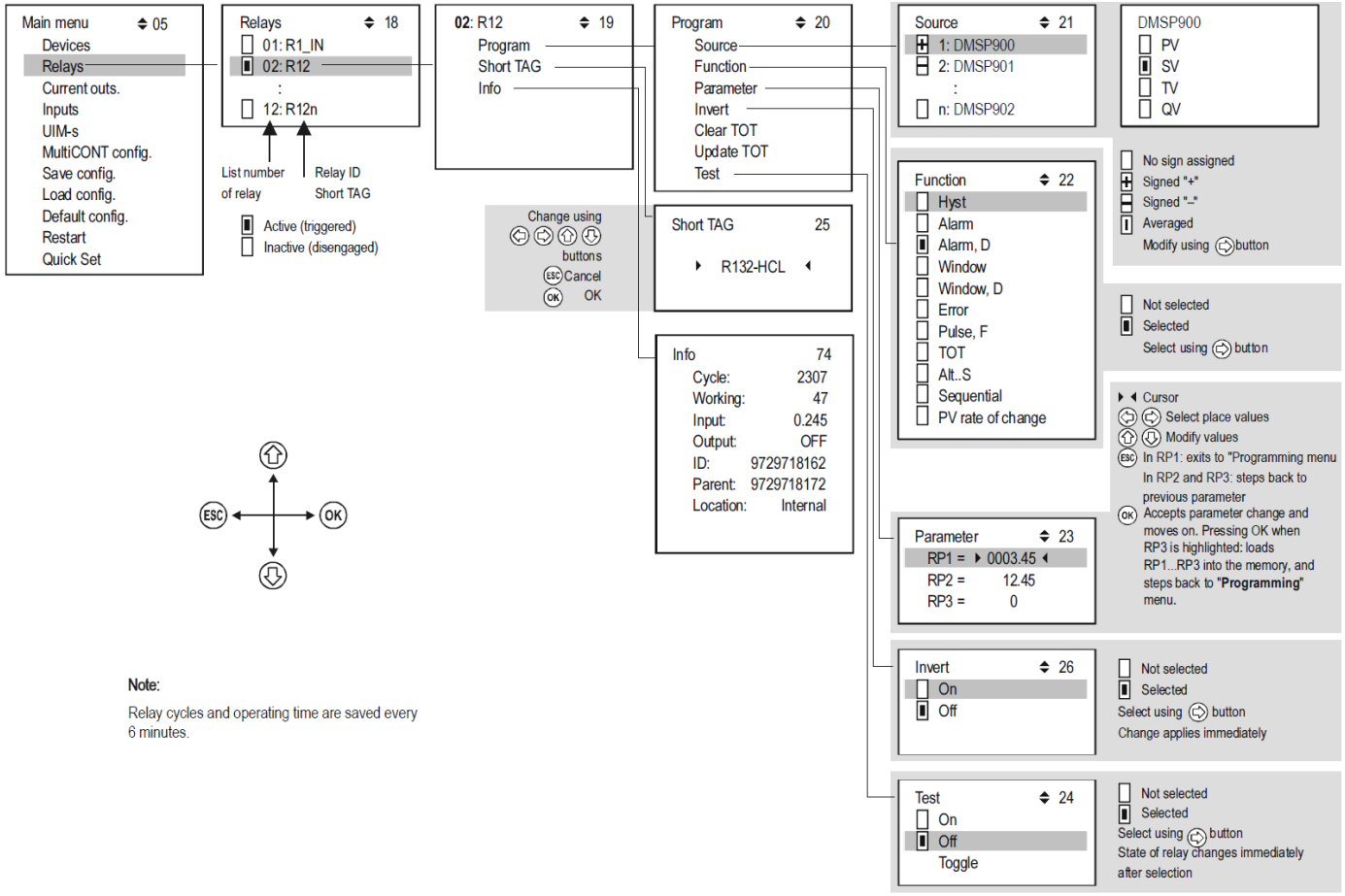
10. APPENDIX 2 - THE MENU SYSTEM



11. APPENDIX 2 - THE MENU SYSTEM (CONTINUED)



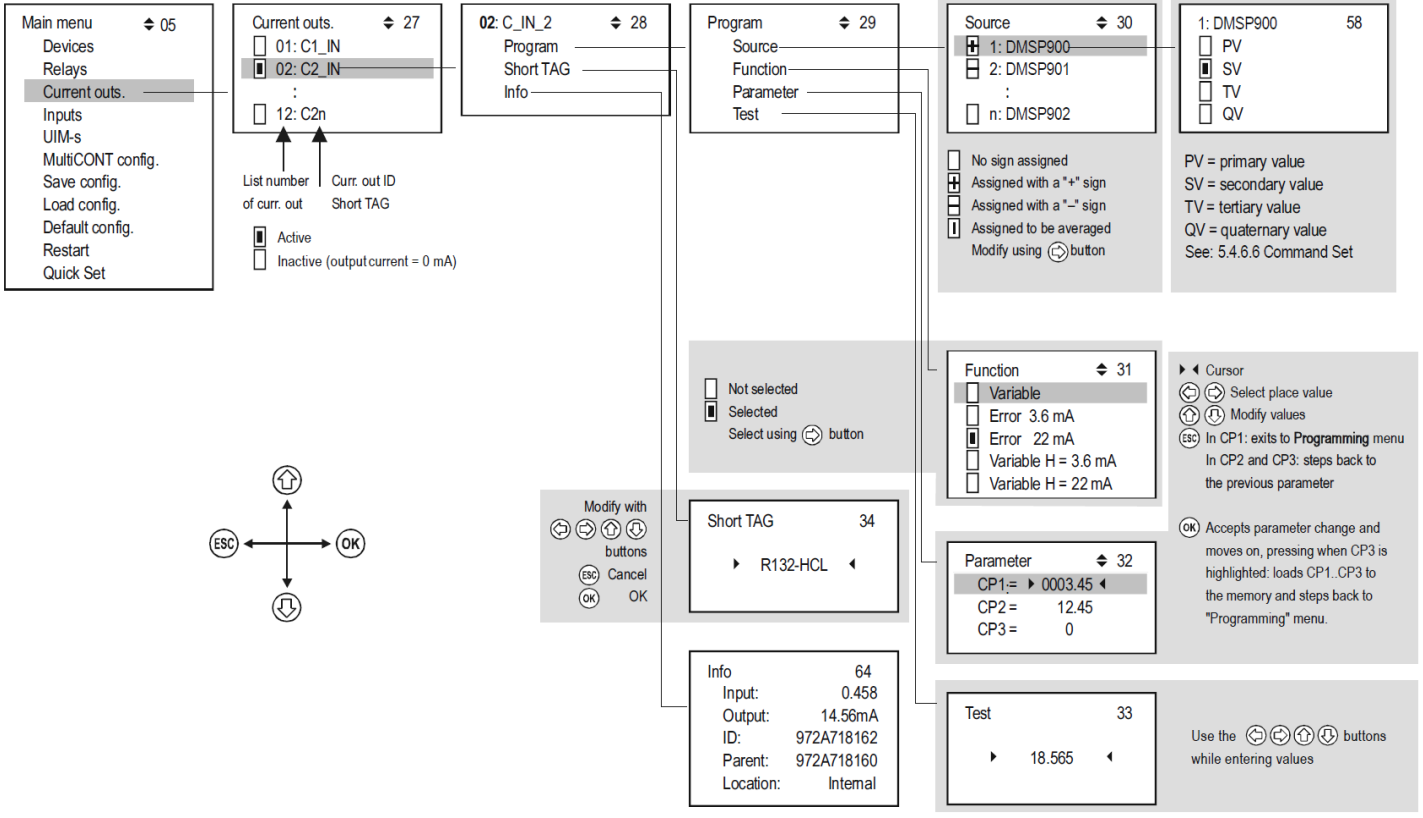
12. APPENDIX 3 – RELAY PROGRAMMING



Note:

Relay cycles and operating time are saved every 6 minutes.

13. APPENDIX 4 – CURRENT LOOP OUTPUT SETUP



14. APPENDIX 5 – MEASUREMENT MODE