MC100
Pump Control Module

User's Manual
(DeviceNet)

CONTENTS:

1 Introduction

1.1 Abbreviations in this manual

Fieldbus	DeviceNet, Profibus, CANOpen etc.
Fieldbus interface module	Anybus Compact Com Module from HMS
Filling system	System consisting of an MC100 and from 1 to 16 pumps
Pumps	All Watson-Marlow Flexicon pumps types that communicates on Flexnet
WMF	Watson-Marlow Flexicon

1.2 Precautions

This manual should be read thoroughly before using the MC100.

It is strongly advised that

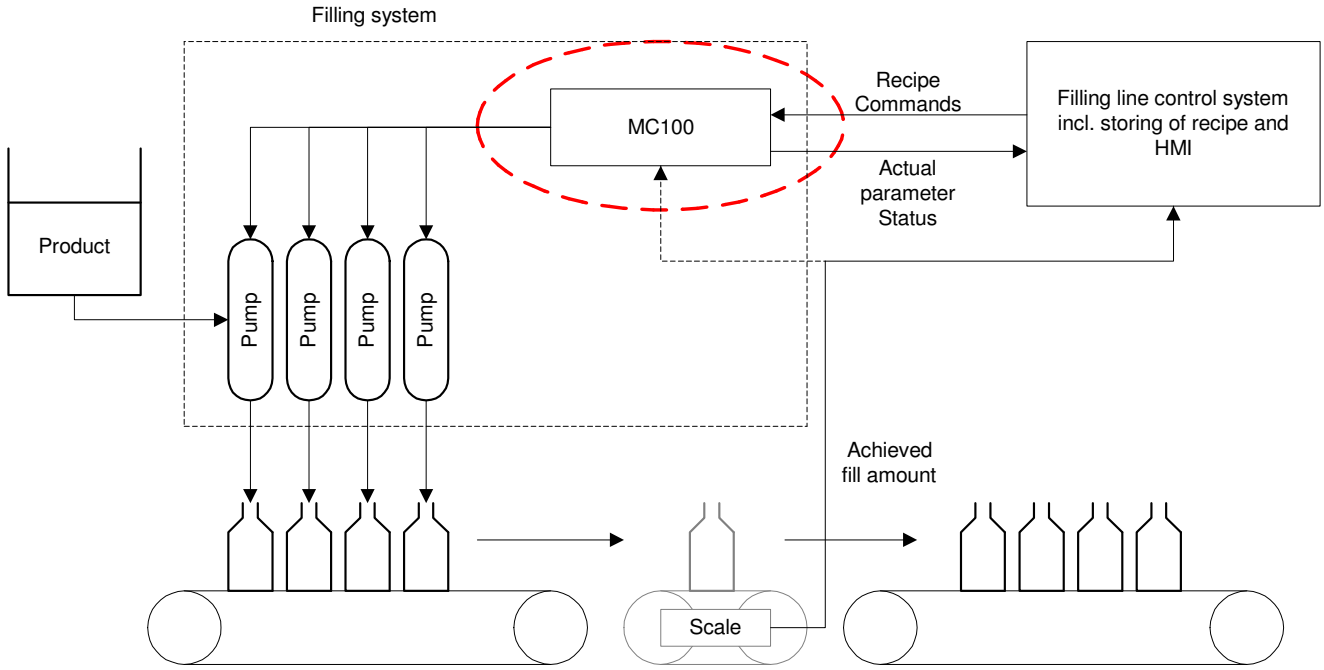
- No wiring is connect or disconnect on the MC100, while power supply is turned ON
- The MC100 must not to be used in explosion hazardous environments.

2 General description of MC100

2.1 Overview

MC100 is a Pump control module capable of controlling up to 16 WMF Pumps. The basic function is to receive filling data from the filling line control system through an industrial fieldbus and to calculate operating values for the pumps. Transmit/ Receive those values and status through the FlexNet protocol.

MC100 constitutes with WMF Pumps a filling system that is designed for incorporation into a larger facility as described below.



2.2 Introduction & design purpose

The MC100 is a small module for mounting inside the control cabinet of the filling line.
It is designed with the purpose of integrating Watson-Marlow Flexicon pumps into a filling line.

2.2.1 How it works / Technical description of operation

Via the fieldbus the MC100 receives operating data from and sending data to the control system for the filling line. The data are divided in three types:

- General data for the pump system
- Set-up data for each pump
- Operation data for each pump

The MC100 sets up the pump system according to the data received from the control system for the filling line.
All control and status signals for the individual pumps connected to the MC100 are sent to the MC100 via the fieldbus. The dispensing can also be controlled via hardwired signals. Please see the manual for the pumps for more details regarding the hardwired signals.

The MC100 cannot store data such as recipes and historical data. These data must be stores in the control system for the filling line and be transmitted to the pump system when needed.

2.3 Flexicon pumps used in multi-filling system, short description.

The Watson Marlow Flexicon multi filling system consists of up to 16 filling dispensers (pumps) connected via a fieldbus to a MC controller.
The dispensers can be peristaltic dispenser pumps (PD12 and PD22) and gear dispenser pumps (GD30).
The MC controller can be either a MC12 controller with integrated keyboard and display to enter data and control the dispensing or MC100 for integration in control systems.
This manual describes the MC100 controller.

The pumps are used for dispensing accurate doses of liquid into vials.
For this purpose there are a number of parameters, which are used to control the pump:

Speed:	The range for the dispensing speed is 30 to 600 rpm depending on the pump and the tube selected
Acceleration:	The range is 1 to 200 rpm/s depending on the pump and the tube selected.
Reverse (back sucking):	Is a figure between 1 and 10 defining a short reverse pumping to prevent dripping after the dispensing.
Tube:	The pumps hold a tube table of up to 10 tubes, which can be read from the pumps. The tubes are depending on the pump type. Thus the pump table can be down loaded from the pump software via the MC100.
Volume:	The volume the pump has to dispense at each filling. Please also see serial and parallel mode below.
Density:	The density [g/cm^3] for the product to be filled. Used when calculating the calibration value.
Calibration:	The net weight filled during dispensing. When a new volume is defined for a pump it will dispense approximately 70 – 80% of this volume until calibrated. The calibration is normally done by tare weighing a vial, filling it and weighing it again to calculate the net filling weight. The net weight filled is sent to the MC100. The MC 100 then calculates the dispensing data and sends it to the pump in question. Please see the manual for the pump for further details.

When more than 1 pump is connected to the MC100, it is possible to operate the filling system (MC 100 with pumps) in 3 different operating modes: Individual, parallel and serial mode.

Individual mode:	All the different types of WM-Flexicon pumps can be connected and run independently for all parameters.
Parallel mode:	This mode requires that all enabled pump are of the same type, i.e. all PD12; all PD22 or all GD30. Different pump types can be connected to the MC 100, but only pumps of the same type can be enabled and operated together in parallel mode. In parallel mode a virtual pump (pump no. 0) is be used to hold common parameters for all the enabled pumps. However, the pumps will still have to be calibrated individually.

Serial mode:

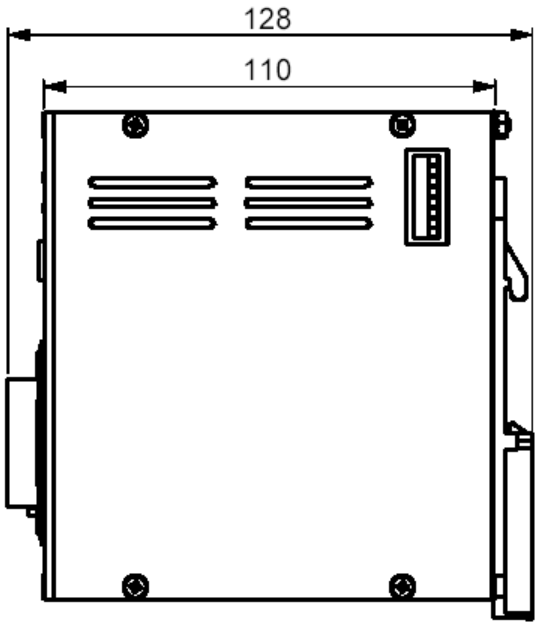
This mode requires that all enabled pump are of the same type, i.e. all PD12; all PD22 or all GD30.
Different pump type can be connected to the MC 100, but only pumps of the same type can be enabled and operated together in parallel mode.
All pump data, except tube sizes, are stored in the virtual pump (pump no. 0).
The filling volume is divided to the pumps based on the tube sizes.
Calibration for all the pumps is done by calibrating the virtual pump 0.

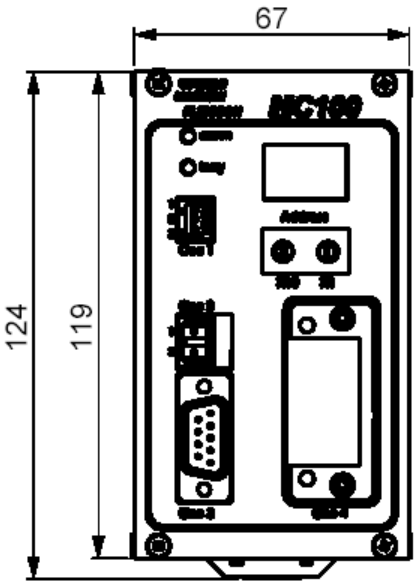
2.4 How to operate the dispenser pumps

Before a new filling is started the parameters for this filling is loaded to the pumps from the filling system.
The data are loaded to the pumps either individually or as common data depending on the operating mode – please see above.
Initially the pumps need to be primed – i.e. the product has to be filled into the tubes and nozzles of the filling system.
Hereafter the pumps must be calibrated.
For details of priming and calibrating please see the manual for the pumps attached.
During production a regularly re-calibration may be necessary – e.g. for each 1.000 filling depending on the product to be filled. This can be done “on the fly”.
For details on how to send and receive data from the MC100 please see section 7.

3 Technical specifications

3.1 Dimensions





3.2 Specifications

Fieldbus:
- DeviceNet

Pumps:
Max 16 pumps can be connected and controlled.
Pumps must be able communicate with MC100 via FlexNet protocol.

Material and surface treatment:
- Mounting box made from aluminium.
- All aluminium parts anodised (conductive).

Environmental:
- Ingress protection according to IP30.
- NEMA 1 enclosure.

Mounting:
- MC100 is to be mounted on DIN rail size 35.

Power supply:
- Supply 24 VDC ± 10%.
- Power consumption less than 10 VA.
- Fuse max. 1A

Weight:
- 0.5 kg.

3.3 Unpacking and inspection of MC100

With the shipment of MC100 you should receive:

- The MC100
- Declaration of Conformity
- CD-rom with documentation:
  - Manual for installation, programming and service of MC100
  - Documentation and support-files for Anybus CompactCom fieldbus module

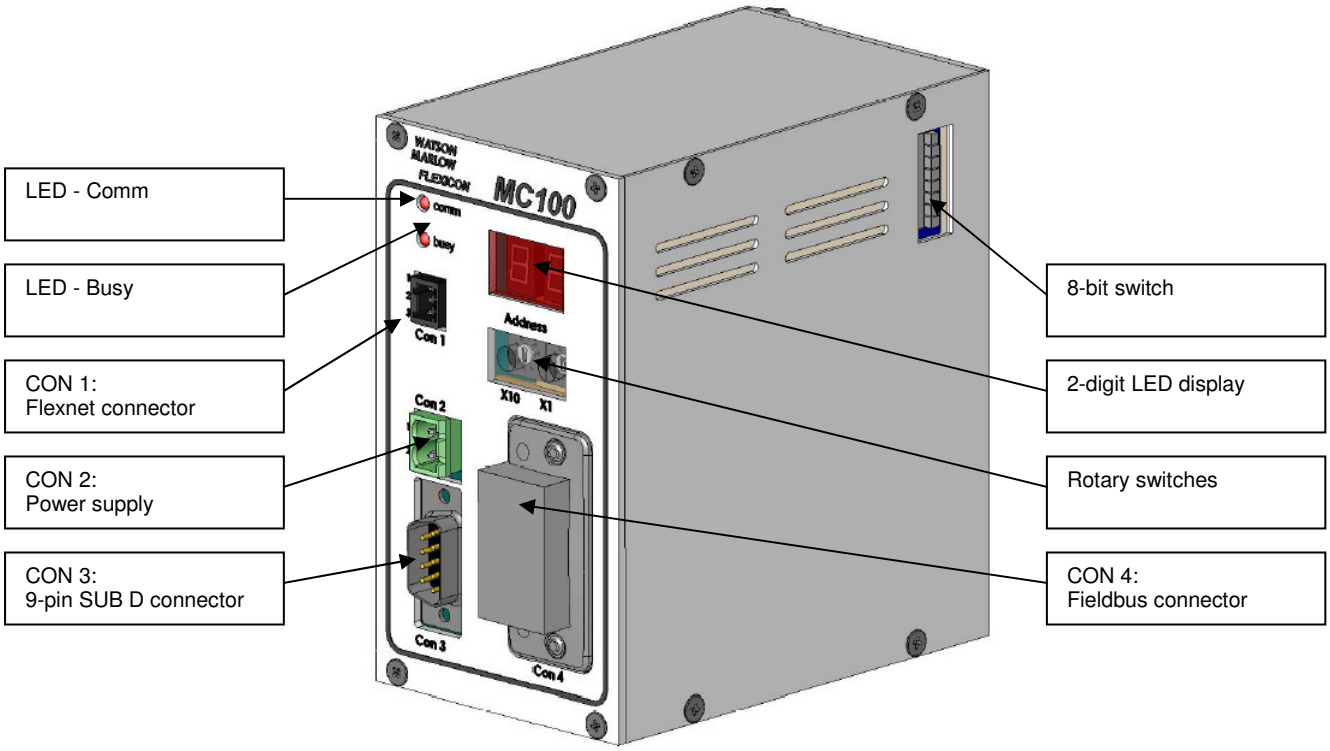
Please check that all ordered items have been received and that no items were damaged during transport. In case of any defects or omissions, please contact WMF or your supplier immediately.

Please verify that the model number stated on the nameplate and the installed fieldbus connector matches your purchase order.

Model number on nameplate	Fielbus connector
MC100 61-120-000	DeviceNet

3.3.1 Identifying the module

MC100 module:



3.3.2 Identifying the parts

- MC100 module.
- Connector for Flexnet.
- Connector for Power Supply.
- Connector for Fieldbus.

3.4 Mounting

3.4.1 Choosing a place to mount the MC100

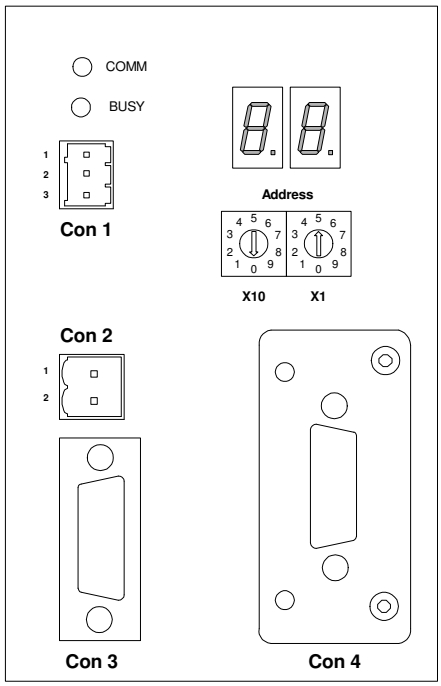
The MC100 must be mounted in an environment that adheres to the specifications in 3.2.

Be sure that the MC100 is also protected from the following conditions
- Rain and moistures
- Corrosive gasses
- Dust or metallic particles in the air
- Physical shock or vibration
- Magnetic noise (Examples welding machines, power devices, etc.)

On the left side of the module is located a dipswitch (se 3.1), which should be accessible.

4 Wiring

MC100 Frontplate



Connectors / Indicators / Switches

Con1	Flexnet		Connector	Connect with
1	/DATA	I/O	PHOENIX MC 0,5/ 3 –G-2,5THT	PHOENIX FK MC 0,5/ 3 –ST 2,5
2	GND	-		
3	DATA	I/O		

The Flexnet connector should be connected to the corresponding terminals on all the pumps, establishing a multidrop network and the last pump should be terminated with a 120 ohm resistor between DATA and /DATA.
Use 0.25 – 0.35 mm2 wires twisted or screened. Terminal tubes must be minimum 8 mm long.

Con2	Power Supply		Connector	Connect with
1	+24V	IN	PHOENIX MC 0,5/ 4 –G-2,5THT	PHOENIX FK MC 0,5/ 3 –ST 2,5
2	0V	IN		

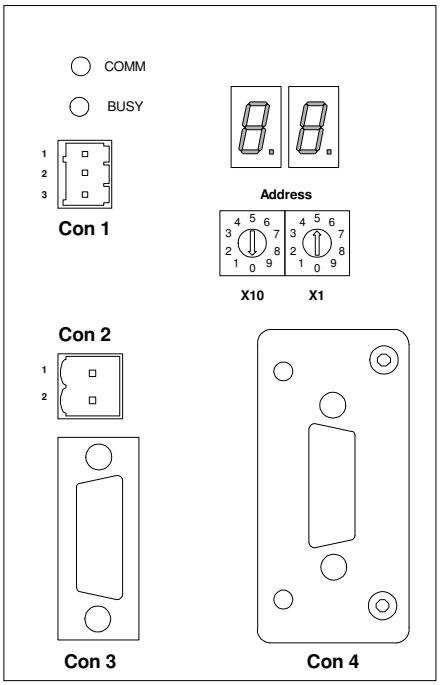
Use 0.5 mm2 wires, terminal tubes must be minimum 8 mm long.

Con3	Communication		Connector	Connect with
1	RS485 – A	I/O	9 pole SubD Male	Crossed cable to for example PC
2	TxD	OUT		
3	RxD	IN		
4	N.C.			
5	GND	-		
6	NC			
7	CTS	OUT		
8	RTS	IN		
9	RS485 – B	I/O		

X4	Fieldbus Interface		DeviceNet	Connect with for example
1	OV	Black	V-	PHOENIX Part number 28 62 57 6
2	Data	Blue	CAN_L	
3	Shield	-	SHIELD	
4	Data	White	CAN_H	
5	+24V	Red	V+	

5 Fieldbus network node address and front plate indicators

MC100 Frontplate



Connectors / Indicators / Switches

5.1 Network node address switches S1/S2:

The node address is setup on the 2 rotary switches S1 and S2.

Address-range 1 to 99

The address is normally set before powering up and connecting to the network for the first time, but if the address is change after power up, the new address will flash on P4/P5 display for 5 seconds, where it is possible to change back to the old address.
After 5 seconds the MC100 will do a total factory reset and start up using the new address.

5.2 P1/P2 LED indicators:

P1	Green	Continuously ON or flashing indication communication with the pumps
	Red	Flashing indicates Lost connection to at least 1 pump or internal error
P2	Green	Currently not used
	Red	ON indicates at least 1 pump is active
		Flashing together with P1 indicate fatal internal error in the module.

5.3 Display P4/P5

This display is used for general indication of the start up states in the MC100 and for various other purposes.

5.3.1 Start up states:

P4/P5	Description	Note
S U	Initial start up state	
S.U.	Internal communications started	
S.0.	Start initialisation of the fieldbus module	Short state if no errors
S.1.	Cyclic data now exchangeable with the network	Short state if no errors
S.2.	MC100 ready and waiting for connection	
S.3.	Intermediate state / special network state	Short state
S.4.	Connection to network established and working	Short state
S.5.	Internal error during initialization	Steady state (see trouble shooting)
S.7.	Internal error during initialization	Steady state (see trouble shooting)
S 8	Factory Reset to default – initiating from Dipswitch	
S 9	Factory Reset to default	

5.3.2 Network address

After initialization, the display is showing the network node address.

5.3.3 Alarm- and warning display

The node address is replaced by a flashing:

AL and the alarm number ***XX*****,** when and alarm is present (see **8.1.1** Alarms).
Er and the warning number ***XX***, when a warning (recoverable alarm) is present (see **8.1.2** warnings).

5.3.4 Dipswitch

The dipswitch on the right side of the MC100 module can used to do a factory-reset function.

Reset state	Dipswitch	Action	Description
0	All OFF	None	Normal runtime state
1	All OFF	Remove power to MC100	
2	SW 8 ON	Apply power to MC100	MC100 starts up and reaches init state 2 And the restart again initializing to factory defaults and starts up.
3	SW 8 ON	Remove power to MC100	
4	SW 8 OFF	Apply power to MC100	MC100 starts up normally

The factory reset can be necessary to do before trying to connect to fieldbus network.
During the factory reset initialization, the MC100 determines how many and what pump types are connected on the Flexnet. Based on this, the MC100 determines the number of cyclic data bytes to be exchanged on the fieldbus, which MUST be set to same number in the fieldbus network configuration (see 6.x.x).

6 Configuring the fieldbus network to the MC100

6.1 Connecting the MC100 and the pumps for the first time

Make sure all pumps have been giving a unique address and all the pumps have been powered up.
The Flexnet is connected with MC100 and to the pumps in a multidrop network.

Connect SubD connector X3 to a PC using a NULL-modem cable.
Start a terminal program on the PC for example HyperTerminal.
Set the communication-parameters to: 9600 baud, 8 bits, even parity and 1 stop-bit.

When applying power to the MC100, it will identify itself by printing the line:

" MC100 MFSC Ver. x.yy." (x.yy will be the current version)

The MC100 will then try to identify all connected pumps on the Flexnet; the LED indicator X1 will flicker and finally be steady green.

If for example 4 pumps are detected, the following line will be:

"Pumps: 1 2 3 4 1 4 4"

Stating that pumps numbered 1-4 are detected, lowest number is 1 and highest number is 4 totalling 4 pumps.

If the 2nd line is not printed and the MC12 has an Alarm indication: AL01 or AL02 flashing, it must be investigated if the Flexnet is correct wired.

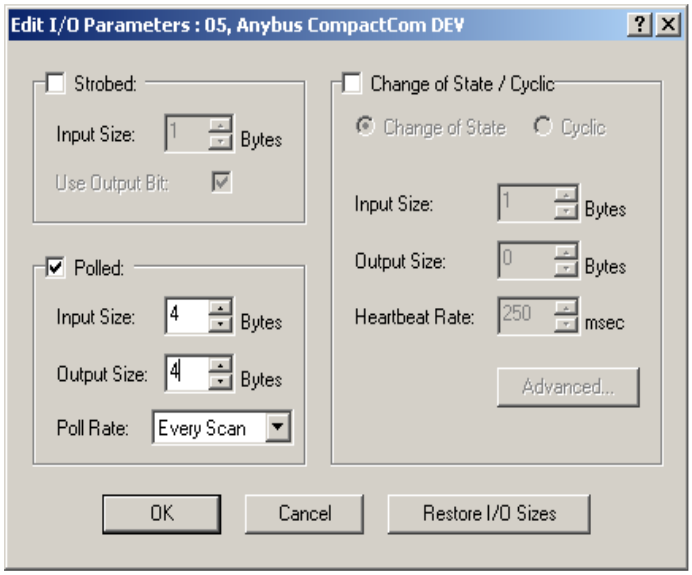
If all is OK, then continue to configure the DeviceNet scanner with RSNetWorx (see below).

6.2 Configuring the DeviceNet network

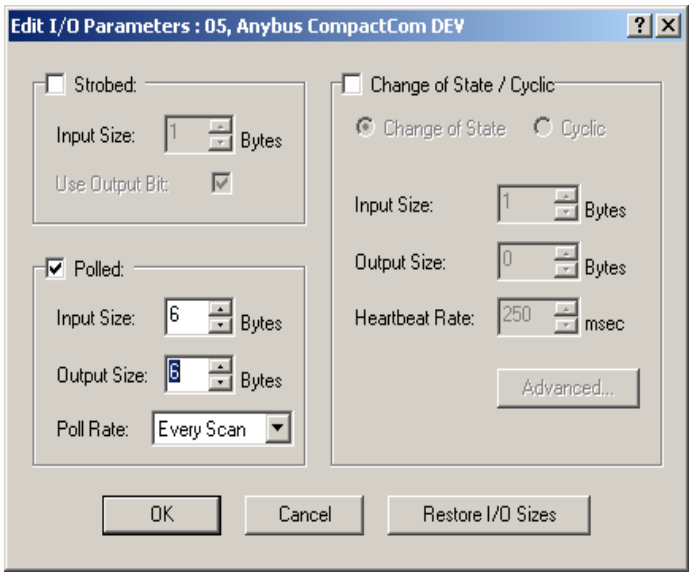
The description is on how to configure the MC100 for DeviceNet using RSNetWorx is described in the HMS document DeviceNet RSNetWorx 1 03.pdf, the newest verison can be downloaded from http://www.hms.se/support/support.asp?PID=324&ProductType=Anybus-CompactCom.

In section **4.4 Configuring the I/O size and Mapping** in the document please use the examples below in stead for configuration:

Example 1: This will configure for MC100 with 1-2 pumps (Minimum configuration)



Example 2: This will configure for MC100 with 3-4 pumps



Always add 2 bytes when increasing from for example 4 to 5 pumps to keep the structure of always increasing the cyclic bytes with min 2 bytes (see 7.1 Process Data Exchange (Cyclic data) below)

7 Operating the MC100

7.1 Process Data Exchange (Cyclic data)

The cyclic data consists of control bits and status bits.

There is a distinction between MC100 control/status bits and pumps control/status bits.
When connected to the Fieldbus network the MC100 will always transmit and receive 1 word for the MC100 function and minimum 1 word for the pumps (even if only 1 pump is connected there will still be allocated 1 word, where the highest 8 bits will be empty).

7.1.1 Process control bits for MC100

There is allocated one word (2 bytes) for MC100 control bits as shown below.

Word 0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
B1.7	B1.6	B1.5	B1.4	B1.3	B1.2	B1.1	B1.0	B0.7	B0.6	B0.5	B0.4	B0.3	B0.2	B0.1	B0.0

B0.0-4: Sets the active pump number
B0.4-7 Reserved for future use
B1.0: Mode bit 0
B1.1: Mode bit 1

MC100 working modes: [1]	Mode bit 0	Mode bit 1
Individuel	“1”	“0”
Parallel	“0”	“1”
Seriel	“1”	“1”

B1.2-4 Reserved for future use
B1.5 Alarm reset: will reset lowest number alarm or warning
B1.6 Rescan for pumps: resulting in new values for connected pumps (See ADI 12)
B1.7 Total reset of MC100 including loading the default values to connected pumps.

7.1.2 Modes:

Individual mode

When selected the attached pumps are operated individually. I.e. volumes; dispense signals; calibration values etc. has to be sent to each pump.

Parallel mode

Parallel mode requires that all pumps not disabled are of the same type, i.e. PD12 or PD22 or GD30.
In parallel mode the virtual pump 0 is used to hold common parameters for all the enabled pumps.
In parallel mode the common data are:

- Volume
- Pump speed
- Acceleration
- Tube size
- Density

[1] See Appendix 1 for description of the working modes

If parameters are sent to a pump different from pump 0, there is generated a warning 10 and the parameters are discarded.
Please note that in parallel mode the calibration is NOT a common data. The pumps will still have to be calibrated individually to cope with differences in the tubes, positioning of the tubes in the pump head – etc. The MC100 will take care of sending the parameters from pump 0 to all the connected enabled pumps.
If pumps of different types are not disabled in parallel/serial mode before changing to serial mode Alarm 08 is generated.

Serial mode

Serial mode requires that all pumps not disabled are of the same type, i.e. PD12 or PD22 or GD30.
In serial mode the virtual pump 0 is used to hold common parameters for all the enabled pumps.
In serial mode the common data are:

- Volume
- Pump speed
- Acceleration
- Density
- Calibration

Please note that in serial mode the tube size is NOT a common data.
When parameters are sent to the MC100 in serial mode the MC100 takes all parameters EXCEPT tube-size when sent to pump 0 and ONLY the tube size when sent to a pump number different from 0.

In serial mode the filling volume is divided to the enabled pumps based on the individual tube sizes. The MC100 do a calculation, so the distance the pumps runs are the same independent of the tube size. I.e. if the tube sizes are different in the enabled pumps the filling volumes from these pumps will also be different.
If the enabled pumps are using the same tube size the filling volume will be divided equally between the pumps. Calibrations for all the pumps are carried out by calibrating pump 0.
If pumps of different types are not disabled in parallel/serial mode before changing to serial mode Alarm 08 is generated.

Na

If operation mode 0 is selected nothing will be changed in the setup.

7.1.3 Process status bits from MC100

Status bits cyclic process data
For MC100 status one word (2 bytes) is dedicated as scheduled below.

Word 0

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
B1.7	B1.6	B1.5	B1.4	B1.3	B1.2	B1.1	B1.0	B0.7	B0.6	B0.5	B0.4	B0.3	B0.2	B0.1	B0.0

B0.0-4 Active pump number
B0.4-7 Reserved for future use
B1.0 Mode status bit 0
B1.1 Mode status bit 1

MC100 mode status:	Mode status bit 0	Mode status bit 1
Individuel	“1”	“0”
Parallel	“0”	“1”
Seriel	“1”	“1”

B1.2-3 Reserved for future use
B1.4 Ready to receive acyclic ADI parameters (explicit messages)
B1.5 Parameter error – is reset when new parameter is accepted.
B1.6 Ready
B1.7 Alarm

Note **B1.4** in the MC100 control bits is used as a **READY-** /**BUSY** bit for explicit parameter transfers, the bit will go low when accepting an explicit parameter transfer and will go high again when the data is processed, thereby enabling a new transfer, this handshake mechanism **MUST** be respected otherwise data will be lost.

7.1.4 Process control bits for the pumps

To control each pump one byte (8 bits) is dedicated as described below.

Minimum one word is transmitted for pump control. The number of pumps connected is a parameter, which is part of the configuration of the number of cyclic bytes of the network.

Word 8		Word 7		Word 6		Word 5		Word 4		Word 3		Word 2		Word 1	
P16	P15	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1

Bit mapping in each command byte:

7	6	5	4	3	2	1	0
	Direction	Disable in Par./Serial	RESET		PUMP	DISP	START

Bit 0: START Starts a single Dispense cycle, when the Pump is set in Dispense mode (Bit. 1) This bit must be cleared upon receiving the BUSY bit in the status byte for the pump, see below.
Bit 1: DISP Sets the pump in dispense mode and thereby enables the START bit to start dispenses. If removed during a dispense, the pump stops immediately.
Bit 2: PUMP[2] Starts pump running continuously with the speed set in ADI 3.
Bit 3: Reserved for future use
Bit 4: RESET To be used with future pumps
Bit 5: Disable pump in parallel and serial mode.
Bit 6: Direction[3] [1/0] [Backwards/Normal] pump and dispense direction.
Bit 7 Reserved for future use

[2] The DISP bit has higher priority and must be cleared before setting the PUMP bit.
[3] Available for pumps able to handle this function (GD30).

7.1.5 Process status bits from the pumps

To retrieve status from each pump, one byte (8 bits) is dedicated as described below.

Minimum one word is received with status from the pumps. The number of pumps connected is a parameter, which is part of the configuration of the number of cyclic bytes of the network.
The MC100 will always automatically send the number of bytes for the connected pumps, after a factory reset to defaults.

Word 8		Word 7		Word 6		Word 5		Word 4		Word 3		Word 2		Word 1	
P16	P15	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1

Bit mapping in the status byte:

7	6	5	4	3	2	1	0
ALARM	Direction	DONE	Pump	Dispense	Tube Br.	BUSY	READY

Bit 0:	READY	Pump is ready (self check is OK).	
Bit 1:	BUSY	“1” Indicate that the pump is active, either dispensing or pumping “0” pump is idle	
Bit 2:	Tube Br.	Tube bridge bit:	”1” = tube bridge on, “0” = tube bridge off.
Bit 3:	Dispense	Dispense bit:	“1” = dispense mode
Bit 4:	Pump	Pump bit:	“1” = pump mode
Bit 5:	DONE [4]	Set, when pump goes from dispensing to idle / reset by a new START bit.	
Bit 6:	Direction	Handshake for bit B5 from command byte (0=normal / 1=reverse direction.)	
Bit 7:	ALARM	See Chapter 8 for further information	

[4] The DONE bit can be necessary to use if there is very short filling times, where the BUSY signal is not detected because of transmission times on the fieldbus network.

7.2 Operation Parameters / Parameter specifications

The parameters for the MC100 can be accessed using explicit messages on the DeviceNet Network.

The following specification based on the HMS Anybus CompactCom software specification for DeviceNet

The parameters are in the Application Data Object.

The object can be accessed using **Class A2 (162 decimal)** object.

The basic parameters in then MC100 are in so called Data Application Instances (ADI's) and each ADI has attributes described in the tables below, where the data types are described.

7.2.1 List of basic ADI's

The list shows the basic ADI's which must be accessed, when controlling the pumps via the MC100.

ADI No.	Description	Data type	Range	Default
1	Volume	Double integer	1000-999990000	10000000
2	Tube	Integer	1-10	6
3	Speed	Integer	30-600	100
4	Acceleration	Integer	1-200	10
5	Reverse	Integer	0-5	0
6	Density	Double integer	50000 - 200000	100000
7	Calibration value	Double integer	50 –200 % of Volume	- - -

The data types for ADI1, 6 and 7 are special in that this data format has been chosen in stead of floating point, to be able to use the MC100 with PLC's without floating point capability.

The data type is a double word type where there is a hidden fixed decimal point position with 5 decimals.
Examples: Floating point value 123.45678 must be send to the MC100 as 12345678 or
Floating point value 1.2 must be send to the MC100 as 120000

In the PLC or HMI there must be a conversion to this format (i.e. multiply with 100000), if the input is in floating point format. Likewise, if reading for example volume from the MC100, then divide the value with 100000 to display it as a floating point.

The tube in ADI 2 is a number from 1-10, as the maximum number of tubes in a pump is 10, the actual tubes sizes available for the pump, can be retrieved via ADI 13 or ADI 16.

The format is 10*inner tube diameter. Example: 48 equal tube size 4.8 mm

It's possible for to read minimum and maximum values from the ADI's to be used as limitations for inputs, but the MC100 will also handle these ranges and discard the input and set a warning if out of range, the warning will automatically be cleared if a value within the range is sent, but can also be cleared using B1.5 Alarm reset bit in MC100 control bits.

IMPORTANT: When reading or writing to ADI's a pump, it **MUST FIRST** be selected using the cyclic bits B0.0-4 in the MC100 control bits, because the parameters will **ALWAYS** be for this pump.

The parameters above are:

Volume	The volume to be dispensed at each filling. Please note that to avoid overfilling the first dispense (before calibrating) will be approximately 80% of the requested filling.
Tube	The tube number (1 to 10) used selected from the tube table. The tube table is specific for the pump type and can be downloaded from the pump controller (please see next section). The tube table for each pump type is found in appendix 2 in this manual.
Speed	The revolutions per minute of the pump. If the product is foaming the revolutions may have to be lowered. The speed range is 30 to 600; however, the upper value is dependent on the pump type and the selected tube size. Please see the details in appendix 2.
Acceleration	A number indicating the ramp up and down when starting/stopping the dispensing. The range is 1 to 200 rpm/s. The upper value is dependent on the pump type and the selected tube size.
Reverse	A number indicating the reversing of the pump after dispensing to avoid dripping of the product between dispensing. The reverse is a number in the range 0 to 10. The physical reversing is dependent on the pump type. For a PD12 the value 10 gives ¼ reverse rotation where for a PD22 the value 10 gives a full reverse rotation.
Density	The density of the product to use when calibrating. When calibrating the weight of the filled amount of the product is entered. If the product has a density other than 1 the MC100 has to take that into the calculation of the pump data for filling to convert to volume. The density must be in the range 0,5 to 2,0 g/cm^3. Please note the conversion to integer as described above.
Calibration value	The weight of the product in g filled (found by subtracting the weight of the vial from the total weight of the filled vial). When receiving the weight MC100 calculates new pump parameters for the actual pump and send it to the pump controller. The pump will use the new setting from the first dispensing after having received the new data. If the volume is changed the calibration is reset. To avoid overfilling the fillings after entering a new volume will be approximately 70 – 80% of the requested filling volume. Hereafter a new calibration must be made. Please note that if the calibration value is outside the limits (below 50% or above 200% of the volume) a warning is generated and the calibration value is ignored. When transmitting and receiving the value for calibration please note the conversion to integer as described above.

Please consult the manual for the actual pump type for a more detailed description of the parameters.

7.2.2 List of additional ADI's

ADI No.	Description	Data type	Range	Default
8	Packed data ADI 1-6	Double integer	6 elements	See ADI
9	Versions	Char	Max.39 chars	See ADI
	Alarm texts strings			See 8.2.1
	Warning text strings			See 8.2.2
10	Alarm number	Integer	0-17	0 - See 8.2.1
11	Warning number	Integer	0-9	0 - See 8.2.2
12	Versions / Builds	Integer	-	See ADI
13	Tubes sizes	Integer	10 elements	80
14	Tubes steps/ml	Integer	10 elements	127
15	Packed data ADI 1-6	Double integer	6 elements	See ADI
16	Tubes sizes	Double integer	10 elements	80
17	Tubes steps/ml	Double integer	10 elements	127
18	Misc. Status bits	Integer	1 element	Not described
19	Misc. Diagnostics	Integer	8 elements	Not described
20	Reserved for Balance	Float	1 element	-
21	Reserved for Balance	Double integer	1 element	-
22	Reserved for Balance	Float	1 element	-
23	Reserved for Balance	Integer	1 element	-
24	Reserved for Balance	Integer	1 element	-
25	Packed status	Misc	14 elements	-
26	Distance in steps for active pump	Double integer	1 element	

Common for all these ADI's are, that they are not necessary for the parameterization of the pumps, but it is recommended, that at least ADI 9 or ADI 10/11 and ADI 13 is implemented.

ADI 18 and 19 is only used by technicians for service purposes

ADI 8, 15 and ADI 13, 16 and ADI 14, 17 are equal except for the data types, where ADI15,16,17 are available to make things more easy in Allan Bradley PLC's.

7.2.3 Detailed description of the ADI's

Default values are values in the MC100 after a factory default reset, the values depends on the pump types and the examples below are for PD12B pump types

Instance	1	Volume		
	Attribute ID	**Description**	**Type**	**Value**
Read	1	Name	Byte-String	"Volume"
	2	Data-type	-	double integer
	3	Elements	-	1
	4	Access	-	Read/Write
	5	Data value	Double Integer	Last Write value
	6	Max. value	Double Integer	9999,00000
	7	Min. value	Double Integer	0,01000
	8	Default value	Double Integer	100,00000
Write	5	Data value	Double Integer	>= Min and <= max value

Instance	2	Tube		
	Attribute ID	**Description**	**Type**	**Value**
Read	1	Name	Byte-String	"Tube"
	2	Data-type	-	Integer
	3	Elements	-	1
	4	Access	-	Read/Write
	5	Data value	Integer	Last Write value
	6	Max. value	Integer	10
	7	Min. value	Integer	1
	8	Default value	Integer	Dependant on pump
Write	5	Data value	Integer	>= Min and <= max value

Instance	3	Speed		
	Attribute ID	**Description**	**Type**	**Value**
Read	1	Name	Byte-String	"Speed"
	2	Data-type	-	Integer
	3	Elements	-	1
	4	Access	-	Get/Write
	5	Data value	Integer	Last Write value
	6	Max. value	Integer	600 (tube dependant)
	7	Min. value	Integer	30
	8	Default value	Integer	200
Write	5	Data value	Integer	>= Min and <= max value

Instance	4	Acceleration		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	“Acceleration”
	2	Data-type	-	Integer
	3	Elements	-	1
	4	Access	-	Read/Write
	5	Data value	Integer	Last Write value
	6	Max. value	Integer	200 (tube dependant)
	7	Min. value	Integer	1
	8	Default value	Integer	10
Write	5	Data value	Integer	>= Min and <= max value

Instance	5	Reverse		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	“Reverse”
	2	Data-type	-	double integer
	3	Elements	-	1
	4	Access	-	Read/Write
	5	Data value	Double Integer	Last Write value
	6	Max. value	Double Integer	10
	7	Min. value	Double Integer	0
	8	Default value	Double Integer	0
Write	5	Data value	Double Integer	>= Min and <= max value

Instance	6	Density		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	“ Density”
	2	Data-type	-	double integer
	3	Elements	-	1
	4	Access	-	Read/Write
	5	Data value	Double Integer	Last Write value
	6	Max. value	Double Integer	2,00000
	7	Min. value	Double Integer	0,50000
	8	Default value	Double Integer	1000000
Write	5	Data value	Double Integer	>= Min and <= max value

Instance	7	Calibration		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	“Calibration”
	2	Data-type	-	double integer
	3	Elements	-	1
	4	Access	-	Read/Write
	5	Data value	Double Integer	Last Write value
	6	Max. value	Double Integer	2 * the value In instance 1
	7	Min. value	Double Integer	0,5 * the value In instance 1
	8	Default value	Double Integer	Value from instance 1 (no calibration done)
Write	5	Data value	Double Integer	>= Min and <= max value

Instance ID	8	Packed parameters from Instance ID 1-7		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	"Packed Parameters"
	2	Data-type	-	double integer
	3	Elements	-	6
	4	Access	-	Read/Write
	5	Data values	Double Integers	Last Write values
	6	Max. values	Double Integers	Max. values
	7	Min. values	Double Integers	Min. values
	8	Default values	Double Integers	Default values
Write	5	Data values	Double Integers	>= Min and <= max values

Data structure for Instance 8:

Double Integer		
1	Volume	
2	Tube	Speed
3	Acceleration	Reverse
4	Density	
5	Reserved	
6	Reserved	Reserved

Instance	9	Versions- and Alarm strings		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	"Versions / Alarms / Warnings"
	2	Data-type	-	4 (char) String of (1-39) (char)
	3	Elements	-	39
	4	Access	-	Read Only
	5	MC100 Version	char	MC100 Version
	6	Pump version	Char	Pump version
	7	Alarm Type	Char	Alarm-string (Read at alarm)
	8	Warning Type	char	Warning-string (Read at warning)

Instance	10	Alarm number		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	"Alarm number"
	2	Data-type	-	Integer
	3	Elements	-	1
	4	Access	-	Read Only
	5	Data value	Integer	Alarm number [5]
	6	N.A.	Integer	
	7	N.A.	Integer	
	8	N.A.	Integer	

[5] Alarm – number is a reference to the Alarm list (Chapter 8).The text-string can also be read from Instance **9**, Attribute **7**.The number is also flashing on the 2-digit display [AL][number]

Instance	11	Warning number		
Read	**Attribute ID**	**Description**	**Type**	**Value**
	1	Name	Byte-String	"Warning number"
	2	Data-type	-	Integer
	3	Elements	-	1
	4	Access	-	Read Only
	5	Data value	Integer	Warning number [6]
	6	N.A.	Integer	
	7	N.A.	Integer	
	8	N.A.	Integer	

Instance	12	Firmware Version		
Read	**Attribute ID**	**Description**	**Type**	**Value**
	1	Name	Byte-String	"Firmware Version"
	2	Data-type	-	Integer
	3	Elements	-	1
	4	Access	-	Read Only
	5	Data value	Integer	MC100 Firmware version
	6	Data value	Integer	MC100 Firmware build no.
	7	Data value	Integer	Pump HW and SW
	8	N.A.	Integer	

The data value for attribute 5 is 4 BCD digits

3 (MSB)	2	1	0 (LSB)
Version(x10)	Version(x1)	Major	Minor

Example Version 1, revision 3.7

0	1	3	7

The data value for attribute 6 is build number [integer]

The data value for attribute 7 is 2 bytes

3 (MSB)	2	1	0 (LSB)
TBD	TBD	Pump software	Pump hardware

Pump hardware: BCD1, BCD0.
Pump software: Version = byte/10.

[6] Warning – number is a reference to the Warning list The text-string can also be read from Instance **9**, Attribute **8**. The number is also flashing on the 2-digit display [ER][number]

Instance	13	Tube table – diameters		
Read	**Attribute ID**	**Description**	**Type**	**Value**
	1	Name	Byte-String	“Tube Sizes”
	2	Data-type	Integer	Integer
	3	Elements	-	5
	4	Access	-	Read Only
	5	Data value	-	See. Table below
	6	N.A.	Integer	
	7	N.A.	Integer	
	8	N.A.	Integer	

Data structure for Instance 13:

Integer	lsb Byte	msb Byte
1	Tube 1	Tube 2
2	Tube 3	Tube 4
3	Tube 5	Tube 6
4	Tube 7	Tube 8
5	Tube 9	Tube 10

The values in the table are the inner diameter of the tube multiplied by 10.
Example Tube 3 = 32, equals an inner diameter of 3.2 mm.
NB! Tube diameter = 0 denotes no tube in that entry.

Instance	14	Tube table – steps/ml		
Read	**Attribute ID**	**Description**	**Type**	**Value**
	1	Name	Byte-String	“Tubes Steps/ml”
	2	Data-type	Integer	Integer
	3	Elements	-	10
	4	Access	-	Read Only
	5	Data value	-	See. Table below
	6	N.A.	Integer	
	7	N.A.	Integer	
	8	N.A.	Integer	

Data structure for Instance 14:

Integer	Steps/ml
1	Tube 1
2	Tube 2
3	Tube 3
4	Tube 4
5	Tube 5
6	Tube 6
7	Tube 7
8	Tube 8
9	Tube 9
10	Tube 10

NB! Tube steps/ml = 0 denotes no tube in that entry.

Instance ID	15	Packed parameters from Instance ID 1-7		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	"Packed Parameters"
	2	Data-type	-	double integer
	3	Elements	-	6
	4	Access	-	Read/Write
	5	Data values	Double Integers	Last Write values
	6	Max. values	Double Integers	Max. values [17]
	7	Min. values	Double Integers	Min. values [17]
	8	Default values	Double Integers	Default values
Write	5	Data values	Double Integers	>= Min and <= max values

Data structure for Instance 15:

Double Integer	
1	Volume
2	Tube
3	Speed
4	Acceleration
5	Reverse
6	Density

Instance	16	Tube table – diameters		
	Attribute ID	Description	Type	Value
Read	1	Name	Byte-String	"Tube Sizes"
	2	Data-type	-	Double Integer
	3	Elements	-	5
	4	Access	-	Read Only
	5	Data value	Double integer	See. Table below
	6	N.A.	Integer	
	7	N.A.	Integer	
	8	N.A.	Integer	

Data structure for Instance 16:

Double Integer	
1	Tube 1
2	Tube 2
3	Tube 3
4	Tube 4
5	Tube 5
6	Tube 6
7	Tube 7
8	Tube 8
9	Tube 9
10	Tube 10

The values in the table are the inner diameter of the tube multiplied by 10.
Example Tube 3 = 32, equals an inner diameter of 3.2 mm.
NB! Tube diameter = 0 denotes no tube in that entry.

Instance	17	Tube table – steps/ml		
Read	**Attribute ID**	**Description**	**Type**	**Value**
	1	Name	Byte-String	“Tubes Steps/ml”
	2	Data-type	Integer	Integer
	3	Elements	-	10
	4	Access	-	Read Only
	5	Data value	-	See. Table below
	6	N.A.	Integer	
	7	N.A.	Integer	
	8	N.A.	Integer	

Data structure for Instance 17:

Double Integer	
1	Tube 1
2	Tube 2
3	Tube 3
4	Tube 4
5	Tube 5
6	Tube 6
7	Tube 7
8	Tube 8
9	Tube 9
10	Tube 10

NB! Tube steps/ml = 0 denotes no tube in that entry.

Instance	25	Packed status		
	Attribute ID	Description	Type	Value
Read	1	Name	Bytes	"Packed status"
	2	Data-type	-	Byte
	3	Elements	-	80
	4	Access	-	Read Only
	5	Data values	Bytes	
	6	Max. values[7]	Bytes	
	7	Min. Values	Bytes	
	8	Default values	Bytes	

Data structures:

Attribute 5	Byte No	Type	Description
Read	0-39	Text-string	MC100 version
	40	Byte	Alarm number
	41	Byte	Warning number
	42	BCD	MC100 FBM Version – Major
	43	BCD	MC100 FBM Version - Minor
	44-53	Byte	Tube table (Inner diameter * 10)
	54-73	Word	Tube table – steps/ml
	74-77	Dword	Volume
	78	Byte	Tube number / 10*Tube inner diameter[8]
	79-80	Word	Speed
	81	Byte	Acceleration
	82	Byte	Reverse
	83-86	Dword	Density
	87-99	Bytes	Reserved

Attribute 6	Byte No	Type	Description
Read	0-39	Text-string	Pump Name and version
	40-41	Word	Firmware build
	42-73	Bytes	N.A.
	74-77	Dword	Max. Volume
	78	Byte	Number of tubes
	79-80	Word	Max. Speed
	81	Byte	Max. Acceleration
	82	Byte	Max. Reverse
	83-86	Dword	Max. Density
	87-99	Bytes	Reserved

[7] Where possible , see structure description

[8] Depending on tube dimension setting

Attribute 7	Byte No	Type	Description
Read	0-39	Text-string	Alarm text
	40	Byte	Active pump hardware ID
	41	Byte	Active pump software ID
	42-73	Bytes	N.A.
	74-77	Dword	Min. Volume
	78	Byte	1 (Lowest tube number)
	79-80	Word	Min. Speed
	81	Byte	Min. Acceleration
	82	Byte	Min. Reverse
	83-86	Dword	Min. Density
	87-99	Bytes	Reserved

Attribute 8	Byte No	Type	Description
Read	0-39	Text-string	Warning text
	40	Byte	Active pump alarm-bits
	41	Byte	N.A.
	42-73	Bytes	N.A.
	74-77	Dword	Default Volume
	78	Byte	Default tube number (pump dependant)
	79-80	Word	Default Speed
	81	Byte	Default Acceleration
	82	Byte	Default Reverse
	83-86	Dword	Default Density
	87-99	Bytes	Reserved

Instance	26	Distance		
Read	**Attribute ID**	**Description**	**Type**	**Value**
	1	Name	Byte-String	“Distance [steps]”
	2	Data-type	-	Double Integer
	3	Elements	-	1
	4	Access	-	Read
	5	Data value	Integer	Distance in steps
	6	Max. value	Integer	32767
	7	Min. value	Integer	5
	8	Default value	Integer	N.A.

8 Alarm and warnings

8.1 Alarms handling

When MC100 is in Alarm state, the only possible action is to reset the alarm. Only applies if the alarm causes are removed, otherwise the alarm will re-appear at the next attempt.

Alarms are cleared one-by-one, starting top down – meaning lowest number first.

8.1.1 Module Alarms

Alarm no.	Alarm description	Action
0	No pending alarms	
1	No pumps connected during power up	Check connections /power to pumps
2	Connection to one or more pumps lost	Check connections /power to missing pump
3	Connected pumps not equal to last time	Configuration changed – Investigation or new initialization must be done
4	Attempt to access not connected pump	
5	Reverse direction not available	Pump command Bit 5: Direction set for one direction pump
6	Unstable FlexNet: Check pumps [9]	Difficult to trigger, but observe flashing ONLINE indicator, which indicate the same fault.
7	FRAM storage failure: Restart or Reset	
8	Mode change not completed: check pumps	Changing mode was not possible, check pump versions, if change was to parallel or serial mode
9	Missing or defect Anybus CompactCom Module	No Alarm string available, because module not working
10	Reserved	
11	Run length limit	Run length less than 5 or more than 16777215 steps
12	Parameter process error	Failed to transfer parameters from PLC to pumps/FRAM
13-16	Reserved	
NN	FB module not Ready [10]	Internal MC100 module check, possible replacement of module.

Pump alarms

20	Dispense not finished	Dispensing has stopped before finishing.
21	Tube bridge off at dispense start	Dispensing or pumping cannot start
22	Tube bridge off while dispensing	Dispense not finished
23	Tube bridge off at pumping start	Trying to start pumping with tube bridge off
24	Tube bridge off while pumping	Removing tube bridge while pumping

[9] Expected to be implemented in a later version

[10] Alarm is only displayed with the 2 LED's on MFSC module – both flashes RED/ORANGE.

8.2 Warnings handling

All warnings are cleared automatically, when data within limits are received via FB, or with clear-bit: MC100 command B1.4

In warning 08-13 by the phrase **individual** pumps, means “real” connected pumps and pump 0 means the pseudo pump, which holds common parameters in parallel and serial mode

8.2.1 Warnings

Warning no.	Warning description	Action
0	No pending warnings	
1	Fill volume out of range	Attempt to set parameter that is outside limits. Set new parameter.
2	Tube number is not in table	
3	Speed setting is out of range	
4	Acceleration setting is out of range	
5	Reverse setting is out of range	
6	Density setting is out of range	
7	Calibration is out of range	
8	Common calibration in parallel	Calibration attempt for individual pump, calibrate pump 0 only.
9	Individual calibration in serial	Calibration attempt for Pump 0, calibrate pumps individually
10	Attempt to setting common parameters to individual pump in serial mode	Use pump 0 or clear warning
11	Attempt to calibrate common pump in Individual mode	Clear by calibrating physical connected pumps

9 Trouble shooting

9.1 Trouble-shooting

Different kind of problems can cause machine stop, errors etc. Most trouble-shooting will be based on the information from the front plate indicators and display and the Alarm list information (see 8.1.1)

Examples:

Problem: Display is flashing AL / 01 when applying power to the module, indication that the MC100 cannot find any pumps connected.

Solution: First check if power is applied to the pump(s) and they are ON, then check cabling and connectors for faults.
To check if problem has been solved, it's necessary to turn power OFF and ON again

Problem: Display is flashing AL / 03 when applying power to the module.

Solution: First check if all the pump(s) has power applied and are indicating power ON.
If this is OK, then the MC100 has stored a different configuration and must be reconfigured using the factory default configuration.
Make a factory reset to default by following the steps below:

1. Locate the dipswitches on the right side of the cabinet, turn dipswitch 8 ON.
2. Turn power ON to the module, which now starts up with the Alarm, but shortly after starts the reset sequence and starts up again without the alarm 03.
3. Turn power OFF and turn dipswitch 8 back to OFF.
4. Turn power ON again and confirm that the alarm is still removed.

Alternative:
Use the Node address switch to do a factory reset. see section 5.1

Important: The cyclic bytes exchanged with fieldbus master/scanner will now reflect the current configuration. If this configuration is different from setting in the Master/scanner it will not be possible to connect to the scanner.

Problem: Display is shoving "**S.2.**". As a follow up on the configuration problem above, this will be the display, when the master/scanner has a different configuration of the number of cyclic bytes.

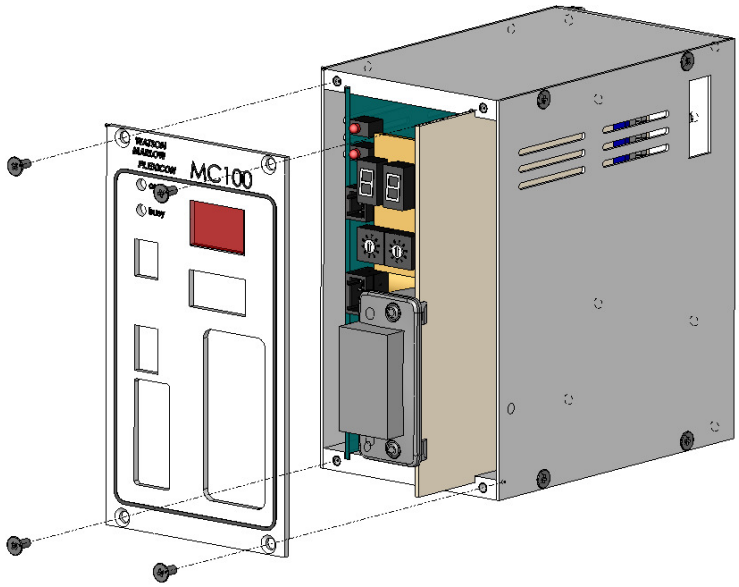
Solution:
1. If this is the initial configuration, please use section **6. Configuring the fieldbus network to the MC100** and the supplied documentation and files on the CD-rom to setup the network.
2. If this situation occurs after the system has been running normally, but after a factory reset, focus must be moved to the pumps, where probably one or more pumps is not communicating on the Flexnet.
   Use the description in **6.1 Connecting the MC100 and the pumps for the first time**, to control the number of pumps that are detected on the Flexnet. When the problem is solved and the correct pumps corresponding to the correct configuration is verified, it will be necessary to do a factory reset again.

9.2 Opening the MC100 for service/replacement of PCB's

1 Power OFF for the 24V to the Module

2 Remove all cables attached the MC100.

3 To access the 2 circuit boards, remove the front cover by removing the 4 countersunk pozidrive screws and the front cover will come off. The 2 PCB's are connected with a ribboncable and has to be pulled out together for service on either one.



10 Decommissioning

10.1 Advice about dismantling / removal / disposal

Disconnect all services prior to dismantling the MC100
Disconnect all connections to other equipment.

10.2 Environmental conditions / -regulations

A MC100 is subject to the WEEE-system and may not be disposed using normal refuse collection.

The machine must be collected and disposed separately as it contains electrical components such as batteries, electrolytic capacitors and printed circuit boards. ?

Further information is available on our web-site www.flexicon.dk.

10.3 The WEEE system

WEEE stands for: ”Waste Electrical and Electronic Equipment” and the term is used commonly throughout the EU for waste from electrical and electronic equipment (EEE).

The WEEE Directive stipulates common EU regulations on treatment of WEEE. The rules are based on consideration for the environment, and they aim at limiting the amount of WEEE we have to dispose of. The objective is, on the one hand, to encourage producers to manufacture environmentally friendly products, and, on the other, to increase reuse, recycling and other forms of recovery.

The WEEE rules provide for producer responsibility, which means that producers and importers of electrical products must organise and finance take-back and treatment of WEEE, and report information to a producer register.

WEEE pictogram:

11 Appendix 1

Operating modes for MC100

(1) Individual
Individual filling means that each Pump has its own operating parameters and that fills, calibration and pumping will not be synchronized with any other connected Pump. In theory, this means that the MC12 can control up to 16 Pumps concurrently.
Calibration is carried out by first selecting the pump number via MC100 control bits as in Individual Mode and then sending the calibration value through the use of ADI 7.

The parameters are sent to the individual Pump number after setting the pump number by the MC100 control bits.

(2) Parallel
Parallel filling is used in a multi-head filling system in which a number of bottles are changed in each cycle and filled at the same time. This gives a very high capacity. The number of Pumps and the number of bottles changed at each cycle should be identical.

If more Pumps are connected to the MC100, they can, if they are of the same type, work synchronously with the same set of parameters. In parallel mode, only parameters in Pump 0 will be used i.e. all Pumps use same volume, tube size, speed, etc.
Calibration must be carried out for the individual Pumps, by first selecting the pump number via MC100 control bits as in Individual Mode and then sending the calibration value through the use of ADI 7.

(3) Serial
Serial filling is used to boost the overall capacity in a semi or fully automated system by using each Pump to fill part of the total volume.

Similar to parallel filling, Pump 0 is used for setting parameters for all connected pumps, with the exception of Function 2 for tube diameter.

For setting tube diameter, select the Pump number by the MC100 control bits as in Individual Mode and then send the tube number using ADI 2. In this way, the last Pump may for instance fill a smaller part of the total volume than the other Pumps in the system. This is done by applying a smaller tube in the last Pump.

When all Pumps have been programmed, the MC100 will automatically calculate which part of the total volume the individual Pumps should fill, so that they are completed simultaneously. This gives the best capacity.

Calibration is also carried out in Pump 0, as the system perceives the whole system as one single Pump. I.e. selecting pump number 0 via MC100 control bits as in Individual Mode and then sending the calibration value through the use of ADI 7.

12 Appendix 2

12.1 Tube tables

12.1.1.1 PD12

Tube Number	Inner Diameter [mm]
1	0.8
2	1.6
3	3.2
4	4.8
5	6.0
6	8.0
7	1.2
8	0.5

12.1.1.2 PD22

Tube Number	Inner Diameter [mm]
1	3.0
2	5.0
3	6.5
4	8.0
5	10.0
6	12.5

12.1.1.3 GD30

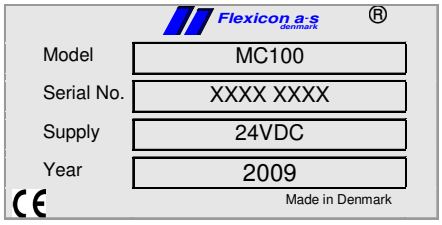
Tube Number	Inner Diameter [mm]
1	1.0 (pseudo number)

13 Declaration of Conformity

We Watson-Marlow Flexicon
Frejasvej 2-6
DK-4100 Ringsted

Declare on our sole responsibility that the product:

Pump control module: **MC100**
Model: **91-120-000** / **91-121-000**



To which this declaration relates is in conformity with the following standard(s):

EN55022	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
EN61000-6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments
EN61000-6-3	Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential, commercial and light-industrial environments

According to the provisions in the Directives:

2004/108/EC	On the approximation of the laws of the Member States relating to electromagnetic compatibility

Signature:

April 2009

Ringsted, Denmark

Jørn Jeppesen, Development Manager