MCS-64

Multi-Channel-System for Process Industry

Technical Manual

CANopen

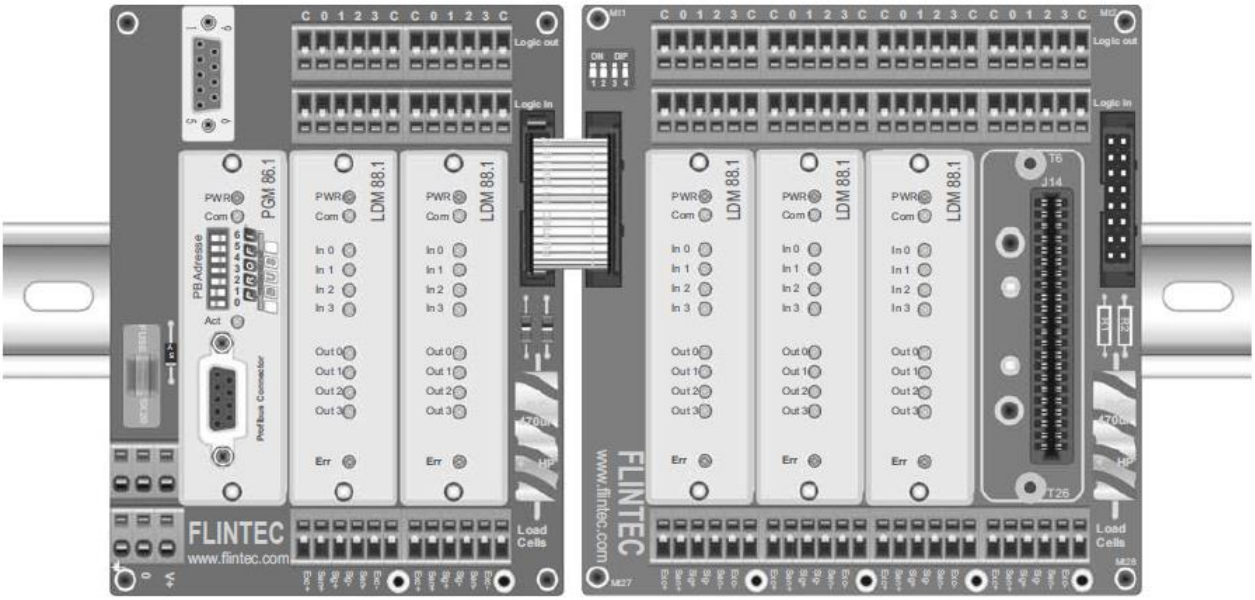

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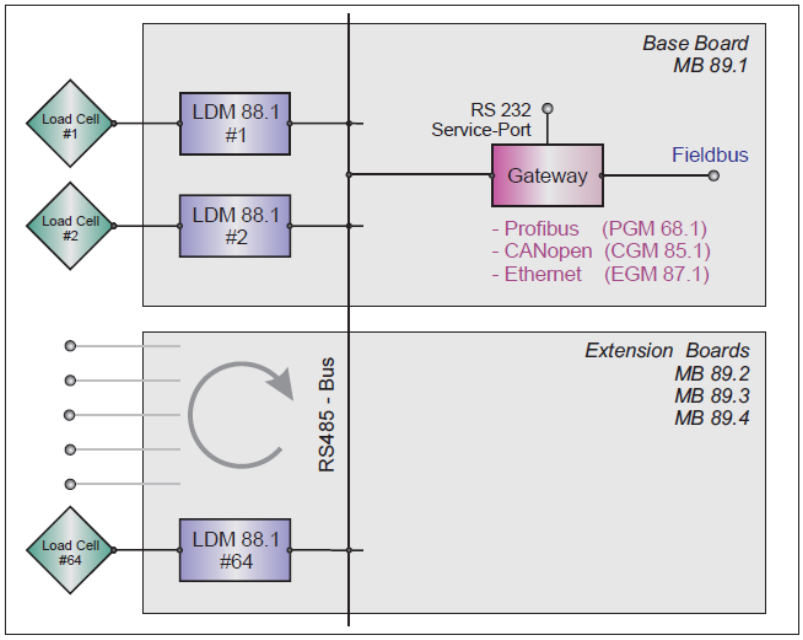
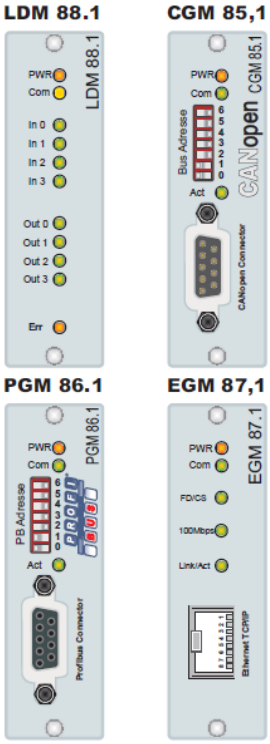
Table ofContents

1 Introduction

Components of MCS-64 in overview





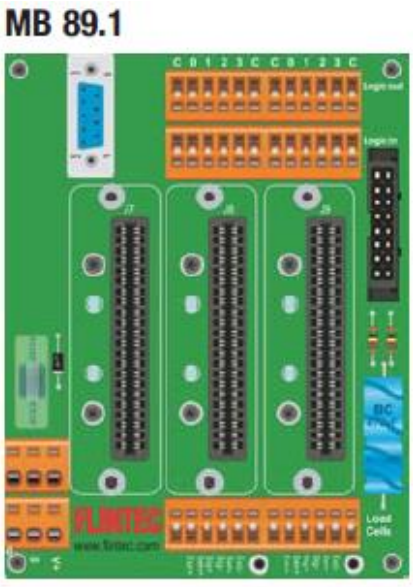
Components of MCS-64

All boards have the same technical features:

- Spring clips for load cell terminals in 6-wire-technique
- 4 DI's via spring clip terminal blocks
- 4 DO's via spring clip terminal blocks
- Header for ribbon cable to extension board

Base Board MB 89.1

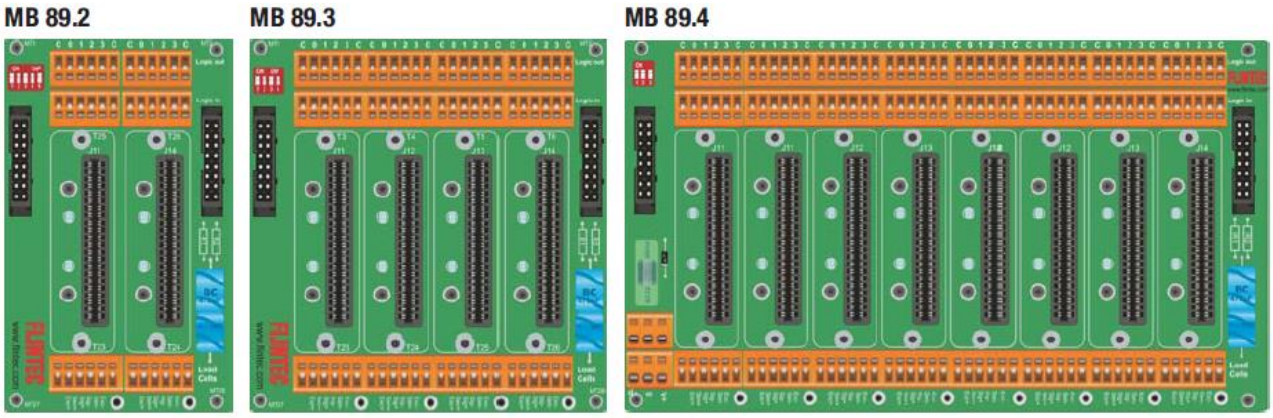
- Slot for one Gateway CGM 85.1 / PGM 86.1 / EGM 87.1
- 2 Slots for weighing processor LDM 88.1
- RS 232 Service port



Dim 104 x 135 mm

Extensions Board MB 89.2/ .3 / .4

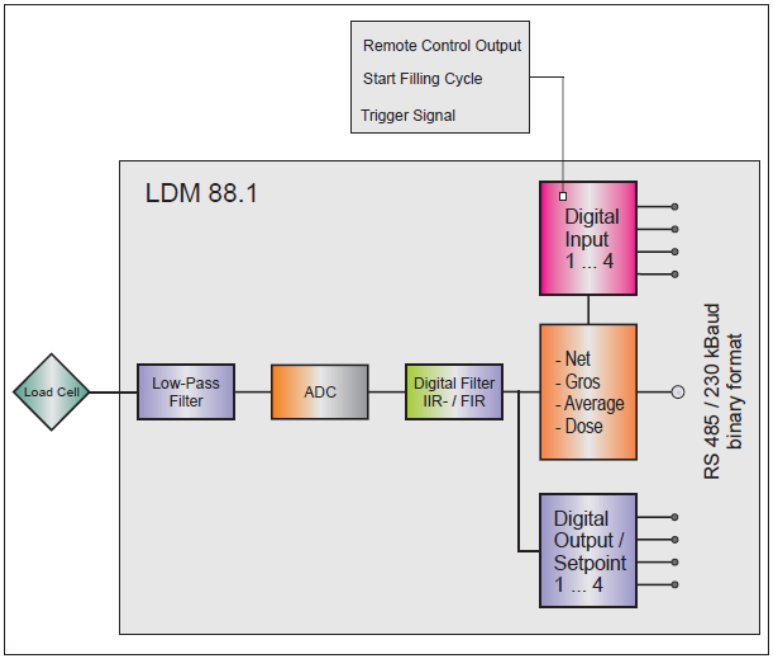
- 2/4/8 Slots for weighing processor LDM 88.1
-

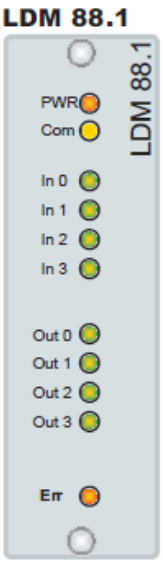


Weighing Processor LDM88.1

The digital weighing processor LDM 88.1 is a load cell digitizing unit for precise measuring of loads in motion.

- ± 18 bit resolution (±260 000d)
- Excitation 5 V DC / 50 mA
- 2 400 Measurements/s internal, 600 Measurements/s external
- mV/V calibration
- 4 DI's, / 4 DO's
- RS 485 bus, 115.2 kBaud
- Digital Filter (FIR and IIR) • for static or dynamic weighing processes
- 3 Firmware versions





LDM 88.1 Specifications

Linearity	< 0.002 % FS
Excitation	5 V DC, load cells 100-2 000 Ohm, 6 wire technique
Analogue input range	±2.2 mV/V (bipolar)
Minimum input per vsi	0.05 μV per interval non approved
Resolution	±260 000 counts , ±18-Bit-A/D convertor
Conversion rate	2400 measurements per second intern
Digital Filter	FIR Filter 2.5 ... 19.7 Hz or IIR Filter 0.25 ... 18 Hz; programmable in 8 steps each
Calibration	software calibration and set up
Computer interface intern	RS485/RS422, full duplex, 115 200 Baud, bus capability up to 64 devices
Weighing functions	zero, gross, tare, net, filter etc.
Inputs	4 opto-isolated inputs, 10 ... 30 V DC max. 3 mA
Outputs	4 OC outputs, < 35 V DC, 500 mA
Temperature effects	on zero 5 ppm/°K typ.; max. < 10 ppm/°K on span 4 ppm/°K typ.; max. < 8 ppm/°K
Temperature range	–10 °C to +50 °C (operating); –30 °C to +80 °C (storage)
Enclosure	Aluminium, protection IP40
Dimensions	80 x 23 x 100 mm, with two M3 fixing screws for mounting on boards MB89.1/2/3/4
Power supply	12 ... 24 V DC ±10 %, < 60 mA,(reversed voltage, burst and ESD protected)
Power consumption	1,5 W max.
EMC	CE 73/23/EEC; 93/98/EEC and 89/336/EEC
Computer interface via Service Port MB 89.1	RS232C, 115 200 Baud
Vibration	withstands 1.0 G operational; 2.5 G non-operational

1.1 Identification and Scope

This document describes the system design for a CANopen Gateway (CGM85) and up to 64 Load Cell Digitizing Module (LDM88.x) using the Flintec backplane system. It describes the functionality of the backplane, the protocol used on the backplane and the CANopen profile used to access the LDM88 modules via the CGM85 Gateway. It specifies the protocols and logical format of the messages between the CANopen and the local backplane system.

1.2 Purpose

The purpose of this document is to specify functionality and performance of the Gateway and the Load Cell Digitizing Modules (LDM88) with the available firmware versions (standard 88.183, filling 88.184, loss in weight 88.185).

1.3 Acronyms and Definitions

1.3.1 Acronyms

This section includes a list of all abbreviations and acronyms used throughout the document in alphabetical order.

CAN	Controller Area Network
CANopen	A higher layer protocol using the CAN.
FAT	Factory Acceptance Test – the preliminary test
Function	A software entity that encapsulates some computations and can be used without worrying about its implementation
PDO	Process Data Object
Process	A software entity that executes a computational entity, including modules and functions.
RPDO	Receive PDO
SAT	Site Acceptance Test – the final test on site.
SDO	Service Data Object
TPDO	Transmit PDO

2 System Detailed Design

2.1 General

This software connects a CANopen network to the local backplane modules. The Gateway transports commands and responses to and from the CANbus. It scans the LDM modules for their status and then transmits this status information continuously to the CAN controller.

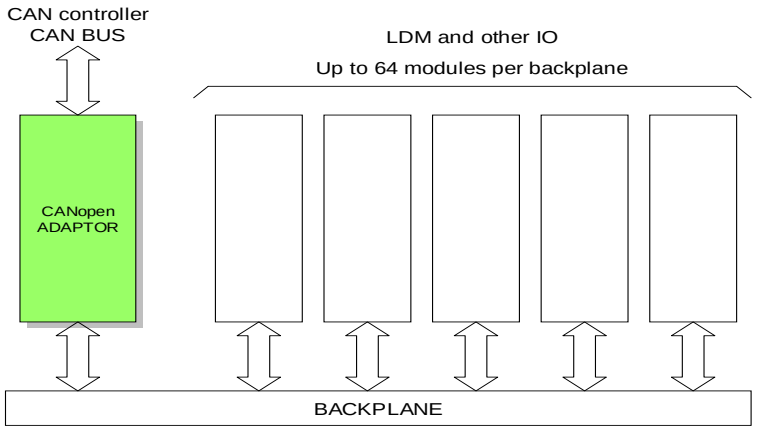


Figure 1- CANopen Gateway in context

2.2 Backplane handling

The Gateway must continuously scan the backplane modules. It keeps track of which modules are present and those that are not. The Gateway communicates with 4 levels of priority on the backplane.

The highest priority communication is initiated on direct commands from the CAN controller either by accessing a SDO or by using RPDO3.

The second highest priority is given to LDM modules in the final filling stage. The Gateway reports the end of filling for each module with a TPDO2 containing the module number, module status, and for example the dosed weight.

The third priority is the normal module scan. The Gateway continuously transmits TPDO1 with the status information for each module.

At a very low priority the Gateway looks for backplane modules that aren't recorded as active, in order to re-establish communication with modules that may have been restarted to recover from failure.

The Gateway always informs the CAN controller when a module fails, or comes back online.

2.3 CANopen

The CANopen Gateway follows the CAN2.0B recommendations. It receives both 11-bit identifiers, and tolerates 29-bit identifiers. It only transmits 11-bit identifiers.
The Gateway is always quiet on the CANbus until the NMT Start command is received, except for the very first 'node guard' message.

When started, the TPDO1 is used to send status information. The backplane is scanned approx. 10 times per second. This gives 64 modules X 10 = 640 status messages per second if all 64 modules are installed. The TPDO1 holds the Gateway status, the module number, the module status and either net or gross weight, depending on the SDO selection. The default is the Gross value. When filling is in progress the Gateway transmits a TPDO2 every time a module changes state to 'wait for trigger'. This TDPO2 contains the module number, the module status, and the dosed weight. In Check Weigher applications the TPDO2 is used to send triggered measurements.

With RDPO1 frames you can send simple commands without an acknowledgement. The functions are: select Gross or Net value in TPDO1, Set or Clear System zero, Set or Clear Tare.

With RPDO2 frames you can send Triggers or Stop triggers. For the filling application the trigger can be used to start the Filling Cycle. On checkweigher applications the trigger can start measurements and a stop-trigger will stop further internal retriggers.

In case of an overrun, error or failure an EMERGENCY message is sent to the CAN controller indicating the nature of the error or failure.
EMERGENCY messages are transmitted when the CAN controller tries to set up a module not present, or not functioning, or when a module fails to answer the normal backplane scan or when a module comes back on-line.

RPDO3 and RPDO4 are ignored by the Gateway.
SDOs are handled according to profile and CANopen recommendation.

The NMT protocol will use the 'node guarding' method (no heartbeat), but are otherwise fully implemented

The "SDO **Block** Download Protocol" may be implemented later.

3 CANopen profile

3.1 The PDOs

The status is sent constantly to the CAN controller. The TPDO1 is sent up to 320 times per second. This has to cover all installed modules. With a 64 LDM installation this gives 5 measurement per second per LDM, a 32 LDM installation will give 10 measurements per second per LDM. Speed could be increased with a 16 LDM installation to 20 measurements per second per LDM (only possible with special firmware for Gateway).

The TPDO2 is sent every time a LDM finishes a filling cycle. It has the same format and fields as the TPDO1 except it contains the DOSED NET weight.

The format of the TPDO1 and TPDO2 is:

32 bit	16 Bit	8 bits	8 Bit
Weight	Module Status	Module number	Gateway State

- The first field is a single precision float value containing weight information, Gross or Net values if it is a TDPO1, and the Dosed NET weight if it is a TPDO2.
- The next 16 bit field contains the module status as described below:
  $0001 - Under range,
  $0002 - Over range,
  $0004 - Not within Zero range (not yet implemented, zero),
  $0008 - Exactly zero,
  $0010 - No motion, still stand, steady state,
  $0020 - Tare set,
  $0040 - Preset tare (0=tare is measured, 1=tare is set by user),
  $0080 - Invalid weighing (wire-break, A/D ref. out of range),
  $0100 - Set-point 0 (source>limit),
  $0200 - Set-point 1,
  $0400 - Set-point 2,
  $0800 - Set-point 3,
  $1000 - Filling in progress,
  $2000 - Filling has completed.
- $4000 - Average staus / ready.
- $8000 - Cold start.
- Module number is the module (LDM) from which the data originates (0..63).
- Gateway state is the state of the CANopen Gateway itself. This field is formatted as follows:

2 bit	2 Bit	4 Bit
cmd	resp	reserved

- "cmd" is a modulo-4 counter that increments every time a command is received i.e. every time a SDO is received by the Gateway. If the completion of the SDO setting requires communication with a LDM on the backplane the user can monitor the "resp" field to determine when the LDM has acknowledged the command.

- "resp" is a modulo-4 counter that increments when a command has been processed (and a result can be fetched). If a SDO has been received, it indicates when the Gateway has finished processing the SDO.

The CANopen SDOs is a confirmed service, and overrun does not occur if the CAN controller only communicates with the Gateway in the PRE-OPERATIONAL state. When a SDO has been received by the controller no further communication takes place until the service has been acknowledged (or a timeout occurs). However, other types of communication may fill the Gateways internal buffer storage. In this event, the Gateway will issue an Overrun Emergency message.

3.2 Communication Profile

The parameters which are critical for communication are determined in the communication profile.
This includes the data for manufacturer's product nomenclature, for identification, or the parameters for object mapping.

Abbreviations used in Tables:

ro	read only
rw	read / write
wo	write only (read will not be regarded as an error, but returns undefined results)
UI8	Unsigned8
UI16	Unsigned16
UI32	Unsigned32
I32	Signed32
REAL32	32 bit IEEE754 floating point
VS	Visible String

3.3 Object Directory

The object directory of the CAN communication module is described below:
Please look the following pages.

Communication Profile (Tables)

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
1000	0	Device Type	UI32	ro	00030191H	Device Type <TBD>
1001	0	Error Register	UI8	ro	0	0: No error Bit 0: General error in Gateway Module Bit 4: Error in CAN communication module Bit 7: Manufacturer-specific error
1005	0	COB-ID Sync messg.	UI32	rw	80H	COB-ID of the SYNC object
1006	0	Communication cycle Period	UI32	ro	3125	320 Hz TDPO1 rate (3125 uS)
100C	0	Guard Time	UI16	rw	320	Cycle time in ms, set by the NMT Master or the configuration tool. Index 100Ch and 100Dh are used if index 1017h is zero.
100D	0	Life Time Factor	UI8	rw	3	Wait time is set by the NMT Master or the configuration tool.
100E	0	Node guarding identifier	UI32	ro	0x700 + NodeID	Node guarding identifier
1010	0 1 2	Number of elements Save all. Save communication	UI8 UI32 UI32	ro rw rw	2 0 0	Number of Store parameters entries Save everything that can be saved same as sub 01 since only CAN com. params. can be saved
1014	0	COB-ID Emergency Message	UI32	ro	80H + NodeID	COB-ID of the Emergency Object
1017	0	Heartbeat Time	UI16	rw	0	Producer Heartbeat time in ms. If index 1017h is non-zero the Heartbeat protocol is used, otherwise the Node-guard protocol is used.
1018	0 1 2 3 4	Identity Object Vendor ID Product Code Revision Number Serial Number	UI8 UI32 UI32 UI32 UI32	ro ro ro ro ro	4	Number of entries Vendor ID Product Code Revision Number Serial Number

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
1400	0 1 2	Number of elements COB-ID Transmission type	UI8 UI32 UI8	ro ro ro	2 200H + NodeID FFH	Communication parameters of 1st Receive PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication.
1401	0 1 2	Number of elements COB-ID Transmission type	UI8 UI32 UI8	ro ro ro	2 300H + NodeID FFH	Communication parameters of 2nd Receive PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication.
1402	0 1 2	Number of elements COB-ID Transmission type	UI8 UI32 UI8	ro ro ro	2 80000400H + NodeID FFH	Communication parameters of 3rd Receive PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication.
1403	0 1 2	Number of elements COB-ID Transmission type	UI8 UI32 UI8	ro ro ro	2 80000500H + NodeID FFH	Communication parameters of 4th Receive PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication.
1600	0 1 2	Entries in Rx PDO 1 1st Object: LDM # 2nd Object Cmd. Byte.	UI8 UI32 UI32	ro ro ro	2 20060108 20060308	Mapping parameters of the 1st Receive-PDO Object is a bitwise command: Bit7 Bit6 Bit5 Bit4 Bit3 Bit2 Bit1 Bit0 Cmd: SnG SnN ST RT SZ RZ
1601	0 1 2	Entries in Rx PDO 2 1st Object: LDM # 2nd Object Cmd. Byte.	UI8 UI32 UI32	ro ro ro	2 20060108 20060408	Mapping parameters of the 2nd Receive-PDO Object is a bitwise command: Bit7 Bit6 Bit5 Bit4 Bit3 Bit2 Bit1 Bit0 Cmd: TR TS
1602	0	Number of mapped Entries in Rx PDO 3	UI8	ro	0	Mapping parameters of the 3rd Receive- PDO (disabled)
1603	0	Number of mapped Entries in Rx PDO 4	UI8	ro	0	Mapping parameters of the 4th Receive-PDO (disabled)

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
1800	0 1 2 3	Number of elements COB-ID Transmission type Inhibit Time	UI8 UI32 UI8 UI16	ro rw rw rw	3 180H + NodeID FFH 10	Communication parameters of 1st Transmit PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication. Transmit inhibit time of PDO in 100 µs steps. A repeated transmission of the PDO is prevented within the defined interval of the inhibit time. Cyclic sending of PDO value (default 640 times / sec.)
1801	0 1 2 3	Number of elements COB-ID Transmission type Inhibit Time	UI8 UI32 UI8 UI16	ro rw rw rw	3 280H + NodeID FFH 10	Communication parameters of 2nd Transmit PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication. Transmit inhibit time of PDO in 100 µs steps. A repeated transmission of the PDO is prevented within the defined interval of the inhibit time. Event based sending of PDO value (when a dosed value is present)
1802	0 1 2 3	Number of elements COB-ID Transmission type Inhibit Time	UI8 UI32 UI8 UI16	ro rw rw rw	3 380H + NodeID FFH 10	Communication parameters of 3rd Transmit PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication. Transmit inhibit time of PDO in 100 µs steps. A repeated transmission of the PDO is prevented within the defined interval of the inhibit time. Event based sending of PDO value (when Rx PDO 3 has been processed by the system)
1803	0 1 2 3	Number of elements COB-ID Transmission type Inhibit Time	UI8 UI32 UI8 UI16	ro ro ro ro	3 80000480H + NodeID FFH 10	Communication parameters of 4th Transmit PDO Determined using the CANopen minimum system ID assignment procedure. Asynchronous communication. Transmit inhibit time of PDO in 100 µs steps. (not used, will not be transmitted)

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
1A00	0	Number of mapped Entries in Tx PDO 1	UI8	ro	8	Mapping parameters of the 1st Transmit-PDO
	1	1st Object	UI32	ro	20000220H	32 bit IEEE754 floating point weight value.
	2	2nd Object	UI32	ro	20020110H	Module Status
	3	3rd Object	UI32	ro	20020208H	Module ID [0...63]. The current module scanned.
	4	4th Object	UI32	ro	20020308H	Gateway Status
1A01	0	Number of mapped Entries in Tx PDO 2	UI8	ro	8	Mapping parameters of the 2nd Transmit-PDO
	1	1st Object	UI32	ro	20010420H	32 bit IEEE754 floating point, default: dosed net value.
	2	2nd Object	UI32	ro	20020110H	Module Status
	3	3rd Object	UI32	ro	20020208H	Module ID [0..63]. The current module scanned.
	4	4th Object	UI32	ro	20020308H	Gateway Status
1A02	0	Number of mapped Entries in Tx PDO 3	UI8	ro	0	Mapping parameters of the 3rd Transmit- PDO (disabled)
1A03	0	Number of mapped Entries in Tx PDO 4	UI8	ro	0	Mapping parameters of the 4th Transmit-PDO (disabled)

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2000	0 1 2 3 4 5 6	Number of entries Gross weight Net Weight Tare Dosed weight Dosed tare Average weight	UI8 REAL32 REAL32 REAL32 REAL32 REAL32 REAL32	ro ro ro ro ro ro ro	6	Number of entries in command input array. Weight values as 32 bit IEEE754 floating point.
2001	0 1 2 3 4 5 6 7 8 9 10 11	Number of entries Gross weight Net Weight Tare Dosed weight Dosed tare Average weight A/D sample H&B Device ID H&B FW Version Device Status ADC Reference	UI8 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32	ro ro ro ro ro ro ro ro ro ro ro ro	11	Number of entries in info array. Weight and info values as 32 bit signed integer
2002	0 1 2 3	Number of entries 1st Object 2nd Object 3rd Object	UI8 UI16 UI8 UI8	ro ro ro ro	4	Number of objects in the dosed result. Module Status Module ID [0...63]. The module that finished a filling cycle. Gateway Status
2003	0 1..16	Number of entries Hardware ID bytes	UI8 UI8	ro ro	16	Number of bytes in hardware identification array.

<table>
<tr><th>Index</th><th>Sub-index</th><th>Name</th><th>Type</th><th>Attri-bute</th><th>Default-value</th><th>Meaning</th></tr>
<tr><td>2004</td><td>0</td><td>Number of entries.
Save:</td><td>UI8</td><td>ro</td><td>5</td><td>Number of parameters.
Save LDM settings (Valid LDM # is [0..63].)</td></tr>
<tr><td></td><td>1</td><td>Analog output</td><td>UI8</td><td>wo</td><td>LDM #</td><td>save analog output parameters,</td></tr>
<tr><td></td><td>2</td><td>Calibration</td><td>UI8</td><td>wo</td><td>LDM #</td><td>save calibration settings,</td></tr>
<tr><td></td><td>3</td><td>General set-up</td><td>UI8</td><td>wo</td><td>LDM #</td><td>save general set-up parameters,</td></tr>
<tr><td></td><td>4</td><td>Dosing parameters</td><td>UI8</td><td>wo</td><td>LDM #</td><td>save dosing setup parameters,</td></tr>
<tr><td></td><td>5</td><td>Set-points</td><td>UI8</td><td>wo</td><td>LDM #</td><td>save set-point parameters.</td></tr>
<tr><td></td><td>6</td><td>Loss in Weight</td><td>UI8</td><td>wo</td><td>LDM #</td><td>save loss in weight parameters</td></tr>
<tr><td>2005</td><td>0</td><td>Number of entries</td><td>UI8</td><td>ro</td><td>3</td><td></td></tr>
<tr><td></td><td>1</td><td>START filling process</td><td>UI8</td><td>wo</td><td>LDM #</td><td>START filling process</td></tr>
<tr><td></td><td>2</td><td>ABORT filling process</td><td>UI8</td><td>wo</td><td>LDM #</td><td>ABORT filling process</td></tr>
<tr><td></td><td>3</td><td>TRIG filling cycle</td><td>UI8</td><td>wo</td><td>LDM #</td><td>TRIG the next filling cycle</td></tr>
<tr><td>2006</td><td>0</td><td>Number of entries</td><td>UI8</td><td>ro</td><td>4</td><td>Number of system entries.</td></tr>
<tr><td></td><td>1</td><td>LDM select [0..63]</td><td>UI8</td><td>wo</td><td>LDM#</td><td>Restores the factory defaults, if the TAC is enabled.</td></tr>
<tr><td></td><td>2</td><td>Factory Default</td><td>UI8</td><td>wo</td><td>LDM#</td><td>Direct bitwise command byte 1 to LDM</td></tr>
<tr><td></td><td>3</td><td>Direct command 1</td><td>UI8</td><td>wo</td><td></td><td>Direct bitwise command byte 2 to LDM</td></tr>
<tr><td></td><td>4</td><td>Direct command 2</td><td>UI8</td><td>wo</td><td></td><td>Commands bits are:
<table>
<tr><th></th><th>Bit7</th><th>Bit6</th><th>Bit5</th><th>Bit4</th><th>Bit3</th><th>Bit2</th><th>Bit1</th><th>Bit0</th></tr>
<tr><td>Byte1</td><td>SnG</td><td>SnN</td><td></td><td></td><td>ST</td><td>RT</td><td>SZ</td><td>RZ</td></tr>
<tr><td>Byte2</td><td>TR</td><td></td><td></td><td></td><td></td><td></td><td></td><td>TS</td></tr>
</table>
Sng,SnN: select Gross or Net in PDO1(tx),
ST,RT: Set/Reset Tare,
SZ,RZ: Set/Reset Zero,
TR: Software trigger.
TS: Trigger Stop; stop triggered measurement(s).</td></tr>
<tr><td>2007</td><td>0</td><td>Number of entries</td><td>UI8</td><td>ro</td><td>1</td><td>CAN parameters (changes take effect after restart)</td></tr>
<tr><td></td><td>1</td><td>CAN speed</td><td>UI8</td><td>rw</td><td>2</td><td>1=1Mbit; 2=500Kbit; 3=250Kbit; 4=125Kbit; 5=50Kbit.</td></tr>
<tr><td></td><td>2</td><td>CAN address</td><td>UI8</td><td>ro</td><td>DIP-SW</td><td>The CANopen address. (DIP-SW on MCS-64)</td></tr>
<tr><td></td><td>3</td><td>LDM Scan end</td><td>UI8</td><td>rw</td><td>15</td><td>Last LDM module to include in the scan (default: 16 LDM modules).</td></tr>
</table>

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2100 - 213F for LDM 0..63	0	Number of entries.	UI8	ro	19	Number of parameters.
	1	1st Parameter	I32	rw		Analog source
	2	2nd Parameter	I32	rw		Analog high
	3	3rd Parameter	I32	rw		Analog low
	4	4th Parameter	I32	rw		Filter setting
	5	5th Parameter	I32	rw		Filter Factor
	6	6th Parameter	I32	rw		Digital Outputs
	7	7th Parameter	I32	rw		Digital Inputs
	8	8th Parameter	I32	rw		Measuring Time
	9	9th Parameter	I32	rw		Filter mode
	10	10th Parameter	I32	rw		No-motion range
	11	11th Parameter	I32	rw		No-motion time
	12	12th Parameter	I32	rw		Digital outputs mask
	13	13th Parameter	I32	rw		Tare
	14	14th Parameter	I32	rw		Start Delay
	15	15th Parameter	I32	rw		Trigger Edge
	16	16th Parameter	I32	rw		Trigger Level
	17	17th Parameter	I32	rw		Update rate
	18	18th Parameter	I32	rw		Zero track (TAC protected)
	19	19th Parameter	I32	rw		Δ Time
21FF	0	Number of entries. As for 2100-2163	UI8	wo		Number of general parameters. As for 2100 – 213F, except this is WRITE ONLY and the settings are broadcasted to all LDMs.

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2200 - 223F for LDM 0..63	0	Number of entries.	UI8	ro	19	Number of filling parameters.
	1	1st Parameter	I32	rw		Pre-fill mode
	2	2nd Parameter	I32	rw		Correction factor for in-flight value in percent. Range: 0..50.
	3	3rd Parameter	I32	rw		Zero check average time (in milliseconds)
	4	4th Parameter	I32	rw		Tare delay (in milliseconds)
	5	5th Parameter	I32	rw		Tare average time (in milliseconds) 0= Tare off
	6	6th Parameter	I32	rw		Delay after pre-fill (in milliseconds).
	7	7th Parameter	I32	rw		Blanking time (in milliseconds) after coarse valve shuts OFF
	8	8th Parameter	I32	rw		In-flight delay time (in milliseconds)
	9	9th Parameter	I32	rw		Dosed weight average Time (in milliseconds)
	10	10th Parameter	I32	rw		Zero tolerance (in increments).
	11	11th Parameter	I32	rw		Tare reference (in increments).
	12	12th Parameter	I32	rw		Tare tolerance (in increments).
	13	13th Parameter	I32	rw		Pre-fill level (in increments). Set-point for 1st pre-filling.
	14	14th Parameter	I32	rw		Fine-fill weight (in increments)
	15	15th Parameter	I32	rw		Filling weight (in increments).
	16	16th Parameter	I32	rw		In-flight value (in increments).
	17	17th Parameter	I32	rw		Pre-fill level (in increments). Set-point for 2nd pre-filling.
	18	18th Parameter	I32	rw		Fill timeout value (in milliseconds)
	19	19th Parameter	I32	rw		Underweight post fill time
	20	20th Parameter	I32	rw		Tare interval – the number of fillings per tare measurements
	21	21st Parameter	I32	rw		Bad rupture blanking
22FF	0	Number of entries. As for 2200-2263	UI8	Ro wo	17	Number of filling parameters. As for 2200 – 223F, except this is WRITE ONLY and the settings are broadcasted to all LDMs.

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2300 - 233F for LDM 0..63	0 1 2 3 4 5 6 7 8 9 10 11 12	Number of entries. Absolute gain Absolute zero Calibrate enable Calibrate gain Set calibration point B Set calibration point A Calibrate max Calibrate min Calibrate save Calibrate zero Decimal point Display step size	UI8 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32	ro rw rw rw rw rw rw rw rw rw rw rw rw	12	Number of calibration parameters. Absolute gain calibrate (TAC protected) Absolute zero calibrate (TAC protected) Calibrate enable (enables TAC when the TAC is written) Calibrate gain (TAC protected) Set calibration point B Set calibration point A Calibrate max (TAC protected) Calibrate min (TAC protected) Calibrate save (TAC protected) Calibrate zero (TAC protected) Decimal point (TAC protected) Display step size (TAC protect)
23FF	0	Number of entries. As for 2300-233F	UI8	ro wo	12	Number of calibration parameters. As for 2300 – 233F, except this is WRITE ONLY and the settings are broadcasted to all LDMs.

<table>
<tr><th>Index</th><th>Sub-index</th><th>Name</th><th>Type</th><th>Attri-bute</th><th>Default-value</th><th>Meaning</th></tr>
<tr><td>2400 - 243F

for LDM 0..63</td><td>0
1</td><td>Number of entries
Dose Info</td><td>UI8
UI16</td><td>ro
ro</td><td>1</td><td>Read the dose info:

<table>
<tr><th>Bit value</th><th>Meaning</th></tr>
<tr><td>$0001</td><td>Coarse valve open</td></tr>
<tr><td>$0002</td><td>Fine valve open</td></tr>
<tr><td>$0004</td><td>Dose program running</td></tr>
<tr><td>$0008</td><td>Not used</td></tr>
<tr><td>$0010</td><td>Not used</td></tr>
<tr><td>$0020</td><td>Not used</td></tr>
<tr><td>$0040</td><td>Tare out of range – no filling in this cycle</td></tr>
<tr><td>$0080</td><td>Zero out of range</td></tr>
<tr><td>$FF00</td><td>The High byte has the following interpretation:

- 00= Idle
- 01= Waiting for trigger(2nd trigger)
- 02= Bottle on, calculating tare
- 03= Pre-fill
- 04= Main Filling
- 05= Fine Filling
- 06= In-flight delay
- 07= Post fill calculations
- 08= Post Filling</td></tr>
</table>
</td></tr>
</table>

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2500 - 253F for LDM 0..63	0 1 2 3 4 5 6 7 8 9 A B C	Number of entries. Trigger Level Trigger Egde ReTrigWindow ReTrigTime HoldTime TareWindow TareTime ReTrigStop Measuring Time Start Delay Δ Time Max Retriggers Count	UI8 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32	ro rw rw rw rw rw rw rw rw rw rw rw rw	12	Number of Check-Weigher parameters Trigger Level Trigger Egde ReTrigWindow ReTrigTime HoldTime TareWindow TareTime ReTrigStop Measuring Time Start Delay Delta time Max Retriggers Count
25FF		Number of entries. As for 2500-253F	UI8 I32	ro wo	8	Number of Check-Weigher parameters. As for 2500 – 253F, except this is WRITE ONLY and the settings are broadcasted to all LDMs.

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2600 - 263F for LDM 0..63	0 1 2 3 4	Number of entries. Set-point 1 Set-point 2 Set-point 3 Set-point 4	UI8 I32 I32 I32 I32	ro rw rw rw rw	4	Number of Set-point parameters. Set-point 1 value Set-point 2 value Set-point 3 value Set-point 4 value
26FF		Number of entries. As for 2600-263F	UI8 I32	ro wo	4	Number of Set-point parameters As for 2600 – 263F, except this is WRITE ONLY and the settings are broadcasted to all LDMs
2700 - 273F for LDM 0..63	0 1 2 3 4	Number of entries. Set-point 1 Set-point 2 Set-point 3 Set-point 4	UI8 I32 I32 I32 I32	ro rw rw rw rw	4	Number of Set-point parameters. Set-point 1 hysteresis Set-point 2 hysteresis Set-point 3 hysteresis Set-point 4 hysteresis
27FF		Number of entries. As for 2700-273F	UI8 I32	ro wo	4	Number of Set-point parameters As for 2700 – 273F, except this is WRITE ONLY and the settings are broadcasted to all LDMs
2800 - 283F for LDM 0..63	0 1 2 3 4	Number of entries. Set-point 1 Set-point 2 Set-point 3 Set-point 4	UI8 UI8 UI8 UI8 UI8	ro rw rw rw rw	4	Number of Set-point parameters. Set-point 1 source Set-point 2 source Set-point 3 source Set-point 4 source
28FF		Number of entries. As for 2800-283F	UI8 I32	ro wo	4	Number of Set-point parameters As for 2800 – 283F, except this is WRITE ONLY and the settings are broadcasted to all LDMs

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2900 - 293F for LDM 0..63	0 1 2 3 4 5 6 7 8 9 10 11	Number of entries Gross weight Net Weight Tare Dosed weight Dosed tare Average weight A/D sample H&B Device ID H&B FW Version Device Status ADC Reference	UI8 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32 I32	ro ro ro ro ro ro ro ro ro ro ro ro	11	Number of entries in info array. Weight and info values as 32 bit signed integer
2A00 - 2A3F for LDM 0..63	0 1 2 3	Number of entries. Mass Flow Value. Mass Flow Trend. Total Mass.	UI8 REAL32 REAL32 REAL32	ro ro ro ro	3	Number of entries in the mass flow data Mass Flow Value. Mass Flow Trend. Total Mass.
2B00 - 2B3F for LDM 0..63	0 1 2 3 4 5	Number of entries. Decimal Point. Scale. dTime. dWeight. Delay after refill	UI8 I32 I32 I32 I32 I32	ro rw rw rw rw rw	5	Number of entries in the mass flow parameters. The decimal point for the Flow value. The scale (see below). Delta Time measuring window. Delta Weight measuring window. Delay after refill. Scale: 0,1,2 : d/sec, d/min, d/hour, 3,4,5 : 1000 d/sec, 1000 d/min, 1000 d/hour, 6,7,8 : 1000000 d/sec, 1000000 d/min, 1000000 d/hour.
2BFF		Number of entries. As for 2B00-2B3F	UI8 I32	ro wo	5	Number of mass flow parameters. As for 2B00 – 2B3F, except this is WRITE ONLY and the settings are broadcasted to all LDMs.

Index	Sub-index	Name	Type	Attri-bute	Default-value	Meaning
2C00 - 2C3F for LDM 0..63	0 1 2 3 4 5	Number of entries. Mass Flow Control. Mass Flow Status.	UI8 UI8 UI8	ro rw ro	2	Number of entries in the mass flow control words. Mass Flow control word. Mass Flow status/info word
2CFF		Number of entries. As for 2C00-2C3F	UI8 I32	ro wo	2	Number of entries in the mass flow control words. As for 2C00 – 2C3F, except this is WRITE ONLY and the settings are broadcasted to all LDMs.
6401	0 1 2 3 4 5 6	Number of entries Gross weight Net Weight Tare Dosed weight Dosed tare Average weight	UI8 I16 I16 I16 I16 I16 I16	ro ro ro ro ro ro ro	6	Number of entries in the 16 bit analog input module (PC6D only) These entries are mandatory according to DS401. They are the same as for index 6402, but shifted 8 bits to the right (value/256).
6402	0 1 2 3 4 5 6 7	Number of entries Gross weight Net Weight Tare Dosed weight Dosed tare Average weight A/D sample	UI8 I32 I32 I32 I32 I32 I32 I32	ro ro ro ro ro ro ro ro	7	Number of entries in the 32 bit analog input module (PC6D only) These values are the internal long integer representation of the weight (the integer values are multiplied by 10^dp [2300sub0B]). Index 6402 is a sub-set of index 2001.
6403	0 1 2 3 4 5 6	Number of entries Gross weight Net Weight Tare Dosed weight Dosed tare Average weight	UI8 REAL32 REAL32 REAL32 REAL32 REAL32 REAL32	ro ro ro ro ro ro ro	6	Number of entries in the float analog input module (PC6D only) These values are the floating-point representation of the weight as they are transmitted in the PDO1(tx). Index 6403 is a replica of index 2000.

3.4 Quick Start Guide

3.4.1 Process data objects

TPDO1

- Weight values are available at all times (see page 9)
- The following table shows the information of TPDO1:

32 bit	16 Bit	8 bits	8 Bit
Weight	Module Status	Module number	Gateway State

- Default : net weight.
- Refresh time: every 10 ms per channel.
- Refresh cycle: starting from channel No. 1 through to channel No. X
- Format: Floating point single precision (IEEE 754)

TPDO2

The content TPDO2 is dependent of firmware version LDM 88.1

- Average Weight GA is available and refreshes when a new measurement is ready; only for firmware 88.183.

- Dosed Weight GD is available and refreshes when a new measurement is ready; only for firmware 88.184.

RPDO1

- The following commands can be executed direct (see Index 1600):

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Cmd:	SG	SN			ST	RT	SZ	RZ
	128	64			08	04	02	01

Examples:
- Setting tare for channel 2: transmit RPDO1 [01 08]
- Setting gross weight in TPDO1 for channel 1: transmit RPDO1 [00 128]

RPDO2

- The following commands can be executed direct (see Index 1601):

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Cmd:	TR							TS
	128							01

Example:
- Setting trigger start for channel 5: transmit RPDO1 [04 128]

3.4.2 Service data objects

SDO's

- Are only available on request

- See tables 3.3 Object Directory

- Can be used for complete setup of the System MCS-64 via CANbus master, e.g.:
  - Filter setting channel 1: Index 2100, Subindex 4
  - Filter Mode setting channel 3: Index 2102, Subindex 9

- Can be used to get information regarding all the commands available, e.g.:
  - Net weight channel 1: Index 2900, Subindex 2
  - AD sample channel 3: Index 2902, Subindex 7

Note: Index 2000 and 2001 refer to the CANbus standards (document DS 301, which is available on request). Using Index 2000 and 2001 you will only get the weight information (no channel info). Using Index 2900 – 293F you get the weight and channel information.

4 COMMANDS

These pages describe the ASCII commands as they must be used by the DOP software.
For each command the equivalent CAN-index and sub-index are shown in brackets [...] for reference.

For better clarity, all commands are divided into groups as described on the following pages.

4.1 System diagnosis Commands – ID, IV, IS

Use these commands to get type, firmware version or device status of System MCS-64. These commands are sent without parameters.

ID Request of device identity [2900sub08]

Master (PC / PLC) sends	Devices responds
ID	D:8813

The response to this request gives the actual identity of the active device. This is particularly useful when trying to identify different device types on a bus.

IV Request of firmware version [2900sub09]

Master (PC / PLC) sends	Device responds
IV	V:0124

The response to this request gives the firmware version of the active device.

IS Request device status [2900sub0A]

Master (PC / PLC) sends	Device responds
IS	S:240000 (example)

The response to this request comprises of two 3-digit decimal values, which can be decoded according to the table below:

Leftmost 3-digit value:	Rightmost 3-digit value:
1 Signal stable	1 (not used)
2 Zero action performed	2 (not used)
4 Tare active	4 (not used)
8 (not used)	4 (not used)
16 Setpoint 0 active	4 (not used)
32 Setpoint 1 active	4 (not used)
64 Setpoint 2 active	4 (not used)
128 Setpoint 3 active	4 (not used)

The example decodes the result S:067000 as follows:

Signal stable (no-motion): 1
Zero action: 2
Setpoint 2 active: 64

Total 67

Note: the bits that are not used are set to zero.

4.2 Calibration Commands – CE, CM, CI, DS, DP, CZ, CG AZ, AG, ZT, FD, CS

Note: TAC represents Traceable Access Code (calibration counter).

CE TAC counter reading [2300sub03]

With this command you get the TAC counter reading or you can enable a calibration sequence.

Master (PC / PLC) sends	Device responds	Result
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active

This command must be issued PRIOR to any attempt to set the calibration parameters CZ, CG etc. In legal for trade applications the TAC counter can be used to check if critical parameters have been changed without re-verification. After each calibration the TAC counter increases by 1.

CM Set maximum output value [2300sub07]

This command is used for setup the maximum output value. Permitted values are between 1...99999.

Master (PC / PLC) sends	Device responds	Result
CM	M+30000	Request : CM = 30000
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
CM_50000	OK	Setting: CM = 50000

This value will determine the point at which the output will change to "oooooo", signifying over-range.

Note: The range, in which a scale can be set to zero (SZ) or automatic zero tracking (ZT) is active, is +/- 2% of CM value.

Factory default: CM = 199999.

CI Set minimum output value [2300sub08]

This command is used for setup minimum allowable output value. Permitted values are between -99999 ... 0.

Master (PC / PLC) sends	Device responds	Result
CI	I-300	Request : CI = -300
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
CI_-10000	OK	Setting: CI = -10000

This value will determine the point at which the output will change to "uuuuuu", signifying under-range.
Factory default setting: -9000.

DS Display step size [2300sub0C]

This command allows the output to step up or down by a unit other than 1. Permitted values are 1, 2, 5, 10, 20, 50, 100 and 200.

Master (PC / PLC) sends	Device responds	Result
DS	S+00002	Request : display step size 2
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
DS_50	OK	Setting: DS = 50

DP Set decimal point position [2300sub0B]

This command allows the decimal point to be positioned anywhere between leftmost and rightmost digits of the 5-digit output result. Position 0 means no decimal point.

Master (PC / PLC) sends	Device responds	Result
DP	P+00002	Request : position of dec. point
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
DP_0	OK	Setting: no decimal point

CZ Set calibration zero point [2300sub0A]

This is the reference point for all weight calculations, and is subject to TAC control.

Master (PC / PLC) sends	Device responds	Result
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
CZ	OK	Zero point set

Factory default: approx. 0 mV/V input signal

CG Set calibration gain (span) value [2300sub04]

This is the reference point for calibration under load, and is subject to TAC control.
Permitted values are 1...262143.

Master (PC / PLC) sends	Device responds	Result
CG	G+20000	Request : span 20000d
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
CG_50000	OK	Setting: span 50000d

For calibration an input signal near the display maximum (CM) will give the best system performance. The minimum calibration load of at least 20% is recommended.

Factory default: 200000 d = 2.000 mV/V input signal = 20 kg

AZ Absolute zero point calibration [2300sub02]

The command AZ is used as reference point for all weight calculations and will setup in mV/V. Permitted values are ± 32000 (= ± 3.2000 mV/V).

Master (PC / PLC) sends	Device responds	Result
AZ	Z+0.0005	Request : Zero point @ 0.0005mV/V
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
AZ_00500	OK	Setting: new: Zero point @ 0.0500 mV/V

Factory default: 00000 @ 0.0000 mV/V input signal.

AG Absolute gain calibration [2300sub01]

The command AG is used as absolute gain (or measuring range) for all weight calculations and will setup in mV/V. Permitted values are ± 32000 (= ± 3.2000 mV/V).

Master (PC / PLC) sends	Device responds	Result
AG	G+2.0000	Request : Meas. range 2.000 mV/V
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
AG_19998_90900	OK	new: Measuring range 1.9998 mV/V @ 90900 d

Factory default: 200000 @ 2.0000 mV/V input signal.

If the AG value has to be set at 2.0000 mV/V, but the load cell capacity is quoted at 2.2 mV/V, you will have to ratio the load cell capacity down.

Example : A 100kg load cell with an Output at Rated Load of 2.2 mV/V would be equivalent to 90.9 kg @ 2 mV/V (exact 1.9998 mV/V)

ZT Zero tracking [2100sub12]

This command enables or disables the zero tracking. Parameter = 0 disables the zero tracking and parameter = 1 enables the zero tracking. Issuing the command without any parameter returns the current ZT value.

Master (PC / PLC) sends	Device responds	Result
ZT	Z:001	Request : ZT status (ON)
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
ZT_0	OK	Setting: ZT = OFF

Zero tracking will be performed only on results less than +/-0.5 d at a rate of 0.4 d/sec, where d = display step size (see DS command). The zero can only be tracked to +/- 2% of maximum (see CM command).

In non legal for trade applications you can exceed the limit +/- 2%. If you require for example a zero tracking range of +/- 10 d then you have to set ZT to be 100 where d is the division size (which means d * 10).

Factory default: ZT=0

FD Factory default settings [2006sub02]

This command puts the LDM88.x back to a known state. The data will be written to the EEPROM and the TAC will be incremented by 1.

Note: All calibration and setup information will be lost by issuing this command!

Master (PC / PLC) sends	Device responds	Result
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
FD	OK	Factory default setting

CS Save the calibration values [2004sub02]

This command results in the calibration values being saved to EEPROM, and causes the TAC to be incremented by 1.

Master (PC / PLC) sends	Device responds	Result
CE	E+00017 (example)	Request: TAC-counter CE 17
CE_17	OK	Calibration sequence active
CS	OK	Calibration values saved

The CS command saves all of the calibration group values, as set by CZ, CG, CM, DS, DP and ZT. The command returns ERR and has no updating action unless it is preceded by the CE_XXXXX.

4.3 Motion detection Commands – NR, NT

The motion detection facility provides a means of disabling certain functions whenever a condition of instability, or "motion", is detected. The "no-motion", or "stable" condition is achieved whenever the signal is steady for the period set by NT, during which it cannot fluctuate by more than NR increments. The stable condition activates the relevant bit of responses to "Info Status" (IS).

The following functions are disabled if motion is detected: "Calibrate Zero" (CZ) "Calibrate Gain" (CG) "Set Zero" (SZ) and "Set Tare" (ST).

NR No Motion range [2100sub0A]

This is the range within which the weighing signal is allowed to fluctuate and still be considered as "stable". Permitted values are between 0 and 65535.

Master (PC / PLC) sends	Device responds	Result
NR	R+00010	Request: NR = 10 d
NR_2	OK	Setting: NR = 2
WP	OK	Setting saved

NR = 2 i.e. fluctuations within a maximum of ± 2 d, in the period NT, will be considered "stable".

Factory default: NR = 1.

NT Stabilisation time for in motion band [2100sub0B]

This sets the time (in milliseconds) over which the weight signal is checked to see if it is "stable" or has "no-motion". The weight signal has to vary by less than NR divisions over the time period NT to be considered 'stable'.
Permitted range 0-65535 milliseconds.

Master (PC / PLC) sends	Device responds	Result
NT	T+01000	Request: NT = 1000 ms
NT_500	OK	Setting: NT = 500 ms
WP	OK	Setting saved

If the value of NT =500 milliseconds, the output must not fluctuate more than NR increments within 500 milliseconds in order to be considered "stable".

Factory default: NT = 1000 [=1000 ms].

4.4 Filter setting Commands – FM, FL, UR

Using the commands FM and FL, a digital filter type and strength can be set which will eliminate most of the unwanted disturbances. The command UR is used for the average building. Please note that these filters are positioned immediately after the A/D Converter and therefore affect all aspects of the weighing operation.

FM Filter Mode FIR / IIR [2100sub09]

Choose filter mode, permitted values are "0" for IIR and "1" for FIR.

Master (PC / PLC) sends	Device responds	Result
FM	M+00001	Request: FM = 1 (FIR)
FM_0	OK	Setting: FM = 0 (IIR)
WP	OK	Setting saved

The digital IIR filter works as a low-pass filter of 2nd order with Gaussian characteristic, damping is 40 dB/decade; see table mode 0.

The digital FIR filter works as a low-pass filter with quick response; damping see table mode 1.

Factory default: 0

FL Setup filters [2100sub04]

Command for setup cut off frequency, permitted values are 0 ... 8.

Master (PC / PLC) sends	Device responds	Result
FL	F+00003	Request: FL = 3
FL_1	OK	Setting: FL = 1
WP	OK	Setting saved

Filter values can be chosen between 0 and 8, see table below.
FL= 0 means no filter in mode 0 or 1 (command FM).

Factory default: 3

Mode 0 Characteristic (IIR-Filter)

FL	Settling time to 0.1% (ms)	3dB Cut-off frequency (Hz)	Damping @300Hz (dB)	Output-rate* (samples/s)
0	no filtering	**		600
1	55	18	57	600
2	122	8	78	600
3	242	4	96	600
4	322	3	104	600
5	482	2	114	600
6	963	1	132	600
7	1923	0.5	149	600
8	3847	0.25	164	600

* Output-rate = $600/2^{UR}$ samples/s ** Antialiasing filter 17 Hz @ 60 dB/dec

Mode 1 Characteristic (FIR-Filter)

FL	Settling time to 0.1% (ms)	3 dB Cut-off (Hz)	20 dB damping at frequency (Hz)	40 dB damping at frequency (Hz)	Damping in the stopband (dB)	Stopband (Hz)	Output rate max. (samples/s)
0	no filtering	**					600
1	47	19.7	48	64	>90	>80	600
2	93	9.8	24	32	>90	>40	300
3	140	6.5	16	21	>90	>26	200
4	187	4.9	12	16	>90	>20	150
5	233	3.9	10	13	>90	>16	120
6	280	3.2	8	11	>90	>13	100
7	327	2.8	7	9	>90	>11	85.7
8	373	2.5	6	8	>90	>10	75

** Antialiasing filter 17 Hz @ 60 dB/decade

Attention: In mode 1 the output rate is dependant on the selected filter level (FL) and will be automatically adjusted by the LDM88.x.

UR Set the update rate (average building) [2100sub11]

This command will define over how many measurements, from the preceeding IIR or FIR filter, an average will be calculated. The average will be calculated over 2^{UR} samples. Permitted values 0...7 (see table below).

UR	0	1	2	3	4	5	6	7
No. of samples	1	2	4	8	16	32	64	128

Check / adjustment update rate:

Master (PC / PLC) sends	Device responds	Result
UR	U+0001	Request: average over 2 samples
UR_4	OK	Setting: average over 16 samples

Factory default: 0 [no average, = 600 samples/s]

Remark to Mode 1

Dependency Output Rate - averaging UR - Filter FL

UR	Output Rate samples/s								
	FL0	FL1 19.7 Hz	FL2 9.8 Hz	FL3 6.5 Hz	FL4 4.9 Hz	FL5 3.9 Hz	FL6 3.2 Hz	FL7 2.8 Hz	FL8 2.5 Hz
0	600	600	300	200	150	120	100	85.7	75
1	300	300	150	100	75	60	50	42.85	37.5
2	150	150	75	50	37,5	30	25	21.42	18.75
3	75	75	37.5	25	18.75	15	12.5	10.71	9.38
4	37.5	37.5	18.75	12.5	9.38	7.5	6.25	5.36	4.69
5	18.75	18.75	9.38	6.25	4.69	3.75	3.13	2.68	2.34
6	9.38	9.38	4.69	3.13	2.34	1.88	1.56	1.34	1.17
7	4.69	4.69	2.34	1.56	1.17	0.94	0.78	0.67	0.59

4.5 Set Zero/Tare and Reset Zero/Tare Commands – SZ, RZ, ST, RT

The following commands allow you to set and reset zero and tare values. The zero set during calibration remains the 'true zero' but new 'current zero' can be set using the SZ command. If the SZ command is issued and accepted then all weight values will then be based on the new 'current zero'. Please remember that zero value will be subject to the Zero tracking function if enabled.

If the weight signal is not stable (as defined by the No motion range NR and the No motion time NT) then both the set zero SZ and set tare ST commands will be disabled.

Also the Set Zero SZ command is not allowed if the new zero value required and the 'calibration zero' differ by more than 2 % of the CM value (maximum allowable value).

SZ Set Zero RPDO1 [00 02]

This command sets a new "current zero" which is then the basis of all weight values until further updated by the zero tracking function, another SZ command or the "reset zero" command RZ. The SZ command will fail (LDM responds with ERR) if the new "current zero" is more than 2% (of the CM value) higher or lower than the "true zero" set during calibration. The SZ command will also fail if the weight signal is not stable as defined by the No motion range (NR) and the No motion time (NT). If the weight signal is "stable", the response to the IS command (Device Status) will show the "signal stable" bit active and the SZ command will be accepted (OK). If the "signal stable" bit is not active, the SZ command will be rejected and the LDU will respond with ERR (error).

Master (PC / PLC) sends	Device responds	Result
SZ	OK	Set Zero performed

The SZ command is issued without any parameters and will return either the OK or ERR response. If the SZ command is accepted the LDM88.x responds with OK and the "zero action performed" bit of the device status (IS) response will be active.
Is the command acknowledged by the LDM88.x with OK, the status bit for Zero (request IS) is set to 1. A renewed SZ command or the reset zero command [RZ] changes the current zero point. The command is not implemented, if the current measured value is more than ±2% of the maximum display value [CM] of calibrated zero point [CZ]. LDM88.x response is ERR (error). [The 'signal stable' bit is also in the TPDO1 status, bit 4]

Note: The LDM allows 20% on the first SZ after power ON.

RZ Reset Zero Point RPDO1 [00 01]

This command cancels the SZ command and the zero reading reverts to that set by the CZ command during calibration.

Master (PC / PLC) sends	Device responds	Result
RZ	OK	Zero point CZ active again

The LDM88.x responds to the RZ command with either OK or ERR. If OK is returned then the "zero action performed" bit in the Device Status (IS) response will be set to "0".

ST Set Tare RPDO1 [00 08]

This command will activate the net weighing function by storing the current weight value as a tare.

The weight signal must be "stable" within the limits set by NR (No Motion Range) and NT (No Motion Time) commands for the "signal stable" bit to be active and set tare command to be accepted.

Master (PC / PLC) sends	Device responds	Result
ST	OK	Tare performed

If the weight signal is "stable", the response to the IS command (Device Status) will show the "signal stable" bit active and the ST command will be accepted (OK). If the "signal stable" bit is not active, the ST command will be rejected and the LDU will respond with ERR (error).

RT Reset Tare RPDO1 [00 04]

The weighing signal returns to gross mode.

Master (PC / PLC) sends	Device responds	Result
RT	OK	Tare deactivated

The LDM88.x responds to the RT command with either OK or ERR. If OK is returned then the "tare active" bit in the Device Status (IS) response will be set to "0".

4.6 Output Commands – GG, GN, GT, GS

The following commands "Get" the Gross, Net, Tare and ADC (Sample) values from the LDM88.x are available on the CAN profile index 2000 and 2001 in floating point and integer respectively.

GG Get Gross value [2000/2001sub01]

Normally sent in TPDO1, if selected by index 1A00sub01.

Master (PC / PLC) sends	Device responds	Result
GG	G+01.100	Gros weight 1.100 d

GN Get Net value [2000/2001sub02]

Normally sent in TPDO1, if selected by index 1A00sub01.

Master (PC / PLC) sends	Device responds	Result
GN	G+01.000	Net weight 1.000 d

GT Get Tare value [2000/2001sub03]

Master (PC / PLC) sends	Device responds	Result
GT	T+00.100	Tare weight 100 d

GS Get ADC Sample value [2900sub07]

This command gets the actual Analogue to Digital Converter (ADC) value. This can be useful during development or when calibrating to see how much of the ADC range is being used.

Master (PC / PLC) sends	Device responds	Result
GS	S+125785	AD-value = 125.785 d

For service applications, it is helpful to note the GS values for the "no-load" or "zero" output and when the "calibration load" is applied.

4.7 Setpoint Commands - Sn, Hn, An

The LDM88.x has 4 setpoints where the status is dependent on the weight value. Each of them can be assigned as an independent setpoint value (Sn) with a corresponding hysteresis/switch action (Hn) and base (An – switch on the gross or the net weight).

S1 Setpoint 1 [2600sub01]

Request / Setting

Master (PC / PLC) sends	Device responds	Result
S1	1+01500	Setpoint S1 = 1500 d
S1_03000	OK	Setting: Setpoint S1 = 3000 d

Similarly to read or set setpoint 2, use S2 instead of S1, etc. (2600sub02).

H1 Hysteresis setpoint 1 [2700sub01]

Using the H1 command, the hysteresis on the setpoint value is set by the numeric value and the polarity of this numeric value defines whether the setpoint switches on or off when the setpoint value is reached.

Example

Setpoint	Hysteresis	Load	OFF	ON
S1 = 20.00 kg	H1 = -1.00 kg	increasing	≥ 21.01 kg	0 ... 21.00 kg
S1 = 20.00 kg	H1 = -1.00 kg	decreasing	≥ 20.00 kg	19.99 ... 0 kg
S1 = 20.00 kg	H1 = 1.00 kg	increasing	0... 19.99 kg	≥ 20.00 kg
S1 = 20.00 kg	H1 = 1.00 kg	decreasing	19.00. ..0 kg	≥ 19.01 kg

Example of negative hysteresis of 1.00 kg (H1 = -100) on a setpoint (S1) of 20.00 kg (lines 1 & 2 of table above):

When the weight is increasing between 0 kg and 21.00 kg the setpoint is “ON”. Once the weight increases above 21.00 kg then the logic output is “OFF”. The setpoint will come “ON” again when the weight value drops below 20.00 kg.

Example of positive hysteresis of 100 kg (H1 = +1.00) on a setpoint of 20.00 kg (lines 3 & 4 of table above):

When the weight is increasing between 0 kg and 19.99 kg the setpoint is “OFF”. Once the weight increases above 19.99 kg then the setpoint is “ON”. The setpoint will switch “OFF” again when the weight value drops below 19.00 kg.

Request / Set Hysteresis value for setpoint 1

Master (PC / PLC) sends	Device responds	Result
H1	1-00100	Request: neg. Hysteresis
H1_100	OK	Setting: pos. Hysteresis
H1_-100	OK	Setting: neg. Hysteresis

Setpoint range between ± 1 (minimum) and ± 199999 (maximum).

Similarly to read or set the setpoint 1 hysteresis, use H2 instead of H1 etc. (2700sub02).

A1 Request / Set the base for setpoint 1 [2800sub01]

The A1 command defines the base on which the setpoint value acts. If A1 is set to "0" then setpoint 1 acts on the unfiltered gross weight. If A1 is set to "1" then setpoint 1 acts on the unfiltered net weight.

A1 = 0	Not filtered gross weight
A1 = 1	Not filtered net weight

Request / Set base for setpoint 1

Master (PC / PLC) sends	Device responds	Result
A1	1+00000	Allocation gros weight
A1_1	OK	Allocation net weight

Similarly to read or set the setpoint 1 base, use A2 instead of A1 etc. (2800sub02).

The MCS-64 transmits one TPDO2 every time a setpoint changes state. The weight sent in the TPDO2 is the weight that caused the TPDO2 to be transmitted, Net or Gross as selected for the actual setpoint. The TPDO2 also holds the Weighing status flags and the setpoint Number.
If two (or more) setpoints have exactly the same settings the setpoint with the higher number will be "hidden".

NOTE: All changes to the setpoint settings have to be stored in EEPROM using the SS command. See section 4.11 page 47.

4.8 Trigger Commands – SD, MT, GA, TE, TR, TL

Remark: These commands are only available in firmware 88.183 (see time diagram page 44); the TR command is also available in the 88.184 firmware.

Note: All setups should be stored with the WP command before power off.

SD Start Delay 0 ... 500 ms [2500sub0A]

Set the delay between falling/rising edge of trigger pulse and start of measurement. Permitted values are 0 ... 500 ms.

Master (PC / PLC) sends	Device responds	Result
SD	S+00100	Request: SD=100 ms
SD_200	OK	Setting: SD=200 ms

Factory default: 0 [= 0 ms]

MT Measuring Time. Range 0...500 milliseconds [2500sub09]

Set the time over which the average value will be built. Permitted values are 0 ... 500 ms.

Master (PC / PLC) sends	Device responds	Result
MT	M+00100	Request: MT=100 ms
MT_500	OK	Setting: MT=500 ms

Note: MT = 0 means disabled trigger and average function.

Factory default: 0

GA Get Average [2900sub06]

Issuing the GA command the LDM 88.1 returns the latest average weight value by using the MT setup. On System80 it is not necessary to ask for this. The average result is sent in a TPDO2 when ready, or retriggered.

Master (PC / PLC) sends	Device responds	Result
GA	A+01.100	Answer: GA=1.100 g

Note: During the time between the trigger condition being accepted and the average value being updated, the GA command will return the value 99999 when it has been triggered or 88888 when it has been retriggered or 99996 when the system tried to change Tare or Zero before end of measurement.

[**Remark:** When started this function, the latest average weight is availabe in TPDO2.]

TL Trigger Level [2500sub01]

Set the trigger level for rising edge start of measurement. Permitted values are in the range 0...262143.

Master (PC / PLC) sends	Device responds	Result
TL	T+99999	Request: TL=99999
TL_1000	OK	Setting: TL=1000

With regard to the trigger commands SD and MT, a check weighing will automatically start when the weight overshoots by e.g. 1.000d (increments), e.g. 100,0 g.

Factory default: 199999

TE Trigger Edge [2500sub02]

Issuing the TE command selects rising or falling edge trigger. Parameter = 0 select falling edge and parameter = 1 select rising edge.

Master (PC / PLC) sends	Device responds	Result
TE	E:001	Request: TE=1
TE_0	OK	Setting: TE=0

Factory default: 0 [falling edge]

Note: This command cannot be used together with the TL command.

TR Trigger RPDO2 [00 80]

[This command will start the measuring cycle in the same way as the hardware trigger input. The result is sent as a TPDO2 with source=LDM#.]

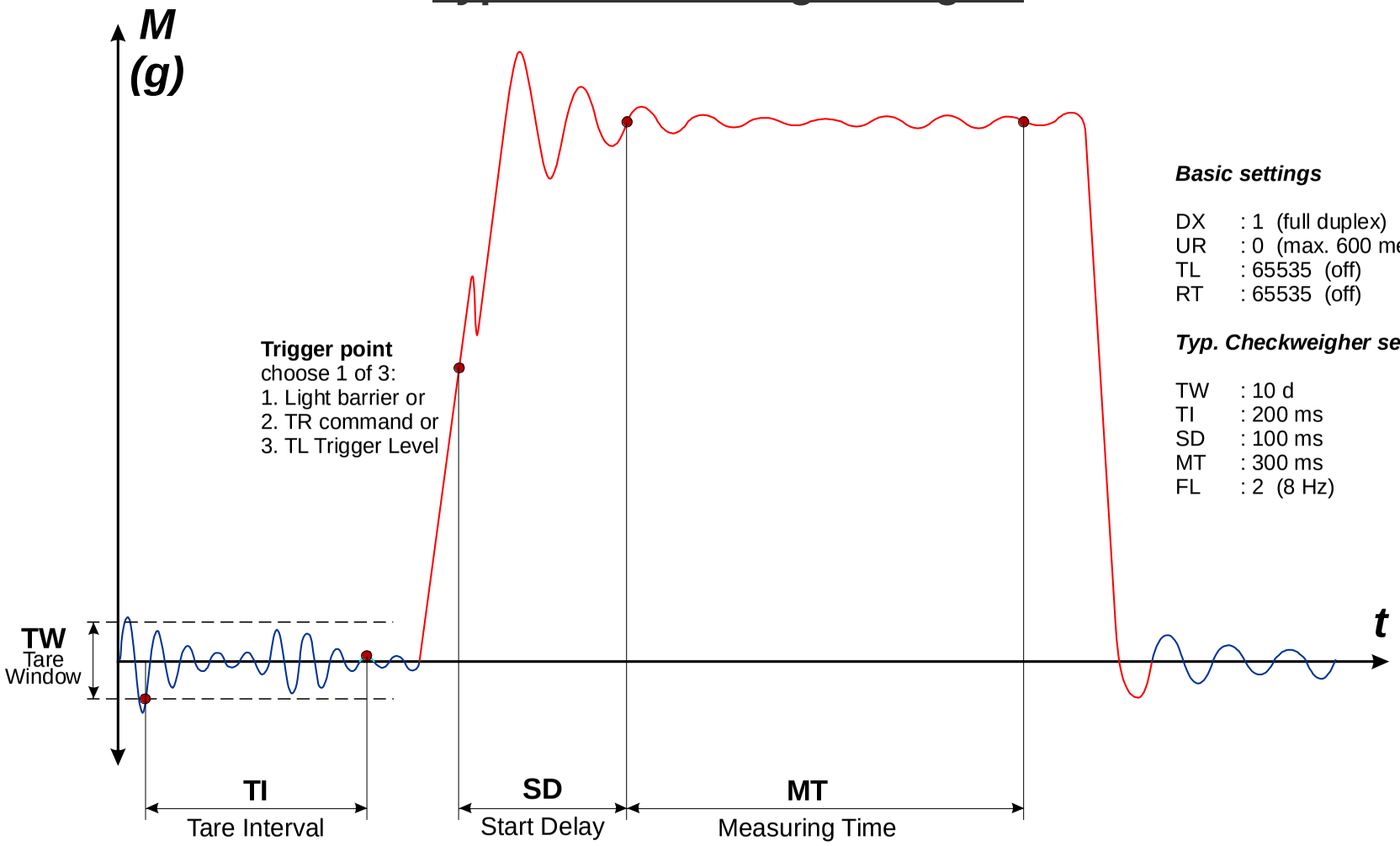
Master (PC / PLC) sends	Device responds	Result
TR	OK	Trigger started

Note: This function can be used as a soft trigger in a check weigher application (firmware 88.183) or to start a filling process (firmware 88.184)

[Special returned values are:
- 99999 = trigged measurement in progress
- 88888 = Re-Trigger in progress
- 99996 = Tried to change Tare or Zero before end of measurement]

[The Trigger function can also be stopped by sending 01 instead of 80 with RPDO2 [00 01] for LDM #1, RPDO2 [01 01] for LDM #2, RPDO2 [02 01] for LDM #3 etc..]

Typical Checkweigher Signal



Basic settings

DX : 1 (full duplex)
UR : 0 (max. 600 meas./s)
TL : 65535 (off)
RT : 65535 (off)

Typ. Checkweigher settings

TW : 10 d
TI : 200 ms
SD : 100 ms
MT : 300 ms
FL : 2 (8 Hz)

4.9 Trigger Special Commands– RW, TT, TS, DT, TW, TI, HT

Remark: These commands are only available in **firmware 88.183** (see time diagram page 47).

Note: All setups should be stored with the **WP** command before power off.

RW Re-Trigger Window [2500sub03]

Set the re-trigger window in counts (digits) without decimal point. If the weight relative to the current average value changes by more than the RW value the average cycle will be restarted using TT as measure time.To automatically issue the re-trigger command, the time period over which an increase of weight average is measured has to be defined by using the command DT.

Master (PC / PLC) sends	Device responds	Result
RW	R+65535	Request: RW=65535
RW_500	OK	Setting: RW=500d

Factory default: 65535

TT Re-Trigger Time [2500sub04]

Set the re-trigger time in milliseconds [ms]. Re-trigger time is the average time used by the re-trigger function. If set to zero the re-trigger function is disabled.

Master (PC / PLC) sends	Device responds	Result
TT	T+65535	Request: TT=65535
TT_300	OK	Setting: TT=300ms

Factory default: 65535

TS Re-Trigger Stop [2500sub08]

Set the re-trigger stop in counts (digits) without decimal point. In case of a (TS) decrease in weight relative to the current average value the re-trigger function is stopped.

Master (PC / PLC) sends	Device responds	Result
TS	T+00000	Request: TS=00000
TS_480	OK	Setting: TT=480d

Factory default: 00000

[The Re-Trigger can also be stopped with RPDO2 [00 01] for LDM #1, RPDO2 [01 01] for LDM #2, RPDO2 [02 01] for LDM #3 etc..]

DT Delta Time [2500sub0B]

Set the Delta Time in milliseconds [ms]. During MT and TT timeframes "sub-averages" will be calculated by the system over the time DT. If a sub-average is outside the re-trigger window, the re-trigger function is automatic started.

Master (PC / PLC) sends	Device responds	Result
DT	T+00000	Request: DT=00000
DT_50	OK	Setting: TT=50ms

Factory default: 00000

TW Tare Window [2500sub06]

Set the Tare Window in in counts (digits) without decimal point. Tare window (TW) allows an automatic Tare update. If TW = 0 this function is not active. If TW = 100, this means a new tare value will be taken when the net average weight of an empty scale is within 100 counts or division of zero. The new average tare value is calculated over the average tare time defined by TI. If the tare average is outside tare window, the tare will not be updated.

Master (PC / PLC) sends	Device responds	Result
TW	T+00000	Request: TW=00000
TW_100	OK	Setting: TW=100d

Factory default: 00000

TI Tare Time [2500sub07]

Set the Tare Time in milliseconds [ms]. During the Tare Time a “tare-average” will be calculated by the system.

Master (PC / PLC) sends	Device responds	Result
TI	T+00000	Request: TI=00000
TI_200	OK	Setting: TI=200ms

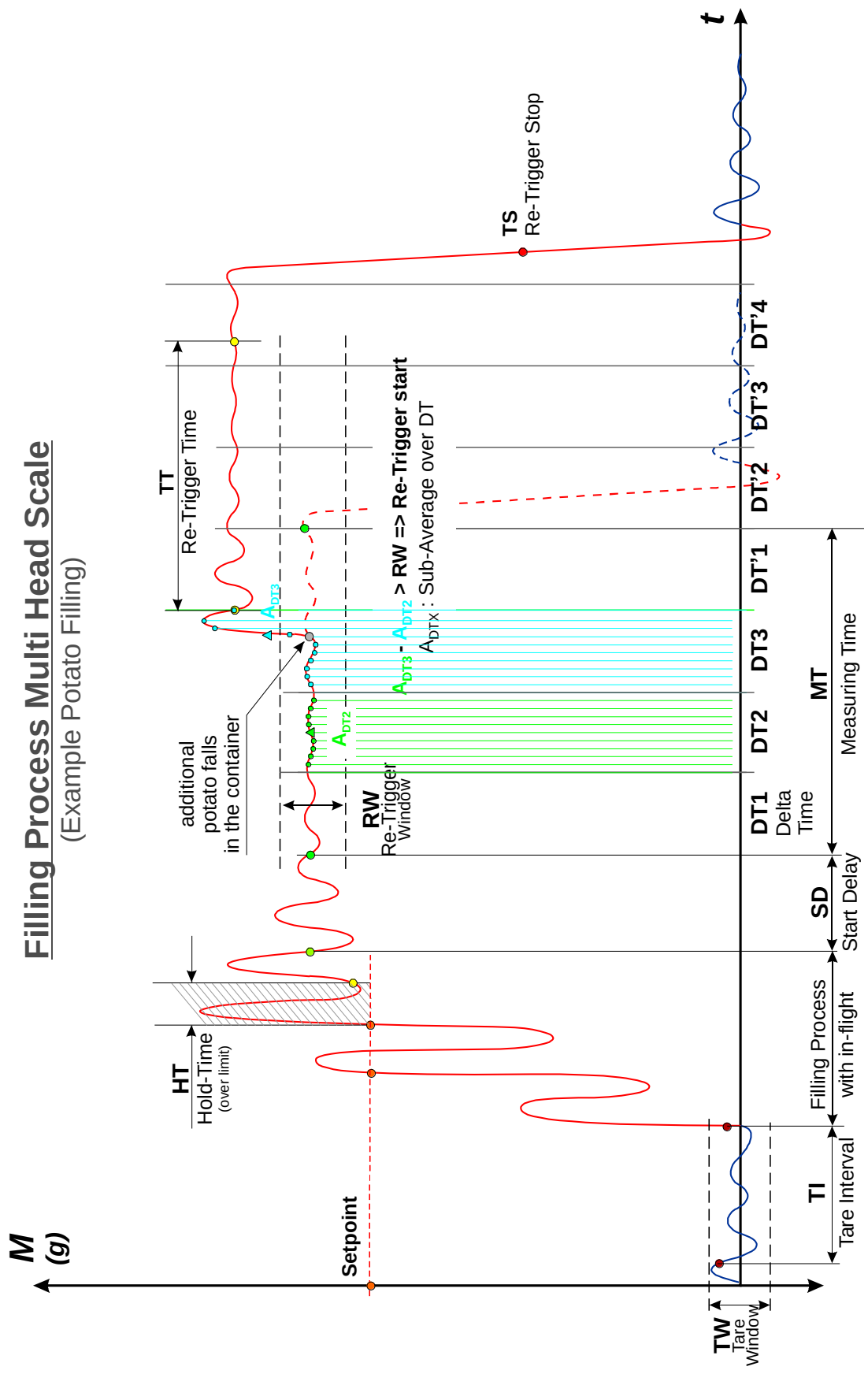
Factory default: 00000

HT Hold Time [2500sub05]

Set the Hold Time in milliseconds [ms]. During the Hold Time the weight value must be over setpoint that a digital output can be switched. This means that a short signal peak will not lead to the switching of a digital output.

Master (PC / PLC) sends	Device responds	Result
HT	T+00000	Request: HT=00000
HT_200	OK	Setting: HT=200ms

Factory default: 00000


Filling Process Multi Head Scale
(Example Potato Filling)
M
(g)
t
TS
Re-Trigger Stop
TT
Re-Trigger Time
HT
Hold-Time
(over limit)
Setpoint
additional
potato falls
in the container
RW
Re-Trigger
Window
ADT3 - ADT2 > RW => Re-Trigger start
ADTX : Sub-Average over DT
ADT3
ADT2
DT1
Delta
Time
DT2
DT3
DT'1
DT'2
DT'3
DT'4
MT
Measuring Time
SD
Start Delay
Filling Process
with in-flight
TI
Tare Interval
TW
Tare
Window

4.10 Communication setup Commands – AD & BR

NOTE: These settings will only take effect after a power on reset (remember to store the settings using the WP command [2004sub03] before turning the power off.)

AD Device address setup / request [2007sub02]

It is possible to set the network address of the device using the AD command. (Address range between 1 and 126).

Note: Setting the device address to 0 or 127 are not allowed. Address 0 is used by the Network Management Protocol (NMT).

Request

Master (PC / PLC) sends	Device responds	Result
AD	A:001	Request: Address 1
AD_49	OK	Setting: Address 49

Factory default: Address 1

BR Request / Setup CAN Speed [2007sub01]

With this command the following bits/second rates can be setup:

- 1 = Mbit
- 2 = 500 kbit/s
- 3 = 250 kbit/s
- 4 = 125 kbit/s
- 5 = 50 kbit/s

Master (PC / PLC) sends	Device responds	Result
BR	B:001	Request: CAN speed 1 Mbit /s
BR_2	OK	Setting: CAN speed 500 kbit/s

Factory default: 500 kbit/s.

4.11 Save calibration, setup and setpoint parameters Commands – CS, WP, SS

The setup and calibration parameters can be divided into 3 groups:

- Calibration parameter: CZ, CG, DS, DP & ZT are saved by the CS command.
- Setup parameters (other than setpoint): FL, FM, NR, NT, BR, AD, etc. are saved by the WP command.
- Setpoint parameters: Sn, Hn and An are saved by the SS command.

CS Save the calibration parameters [2004sub02]

Note: Calibration parameters can only be saved if the TAC code is known and precedes the CS command. See the CE and CS commands on page 26.

Both the setup parameters and the setpoint parameters are stored in EEPROM using the WP and SS commands respectively.

WP Save the setup parameters [2004sub03]

With this command the settings of the "Filter" (FL, FM) , the "No-Motion" (NR, NT) and the communication (AD, BR) will be saved in the EEPROM.

Master (PC / PLC) sends	Device responds	Result
WP	OK	Parameter saved
WP	ERR	Error

SS Save the "setpoint" set-up parameters [2004sub05]

With this command the settings of the setpoints (Sn), the "setpoint hysteresis" (Hn) and the "setpoint action" (An) will be saved in the EEPROM.

Master (PC / PLC) sends	Device responds	Result
SS	OK	Parameter saved
SS	ERR	Error

4.12 Filling Commands – PD1 to PD21, DI, SC, AC, GD, DT, SD

Remark: These commands are only available in **firmware 88.184**.

Note: All setups should be stored with the SD command before power off.

A separate description of these commands is availble as pdf-file. Please contact germany@flintec.net.

4.13 Loss in Weight Commands – PL1 to PL5, LC, LI, GF, GR, GM, SL

Remark: These commands are only available in **firmware 88.185**.

Note: All setups should be stored with the SL command before power off.

A separate description of these commands is availble as pdf-file. Please contact germany@flintec.net.

4.14 Speed Estimation Multi-Channel System MCS-64

Gateway CANopen CGM 85.1

No. of Channels	Transfer Rate per Channel	Remark
8	40 Measurements/sec *	* new firmware in gateway required
16	20 Measurements/sec *	* new firmware in gateway required
32	10 Measurements/sec	
64	5 Measurements/sec	

This speed estimation is for example valid for gross / net weight.

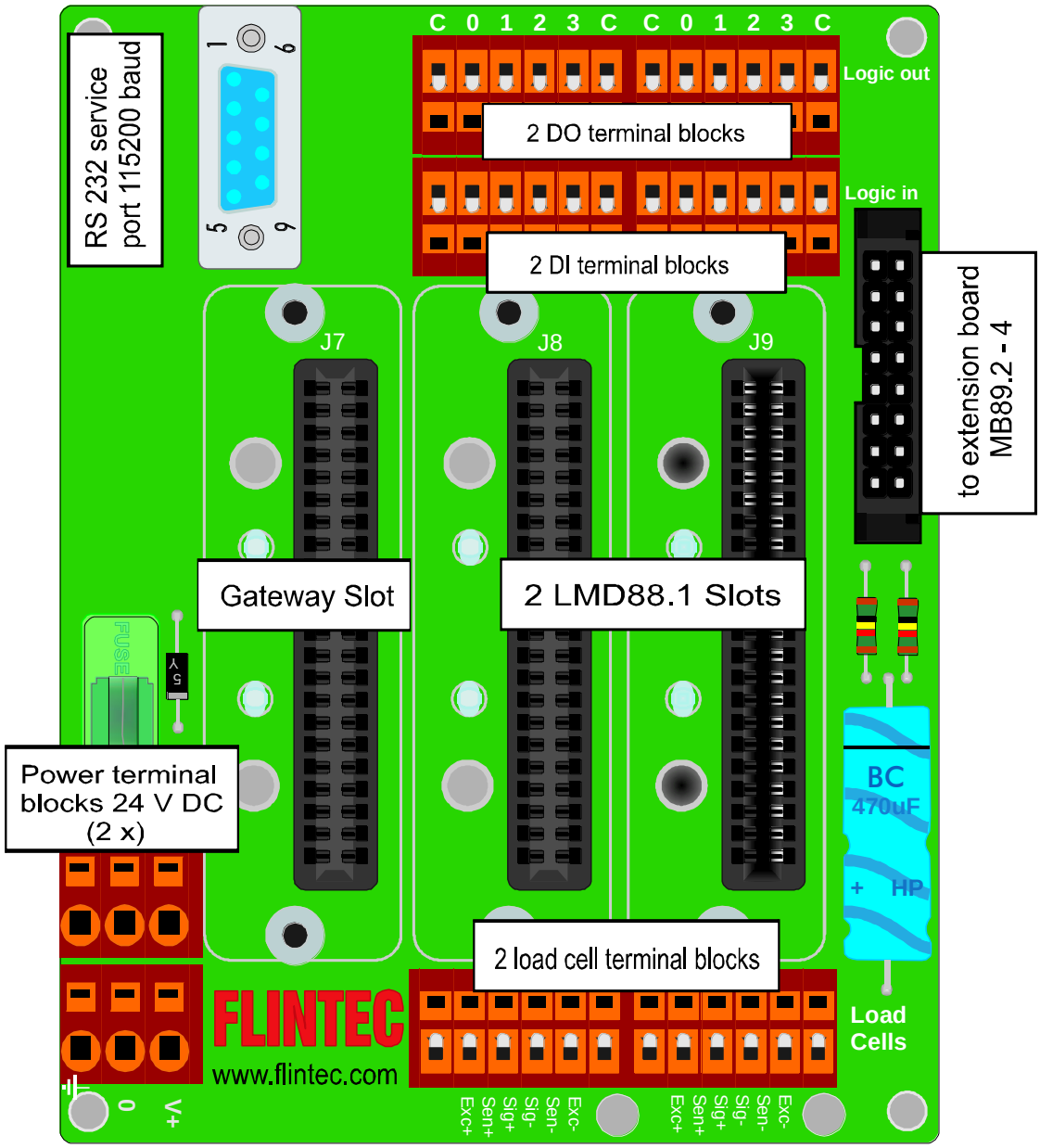
For applications like check weighers, filling, loss in weight etc. each LDM 88.1 calculates the valid result. This means that no “data stream” will overload the CANopen traffic.

For a single channel, the data output via service port can be used for high speed measurements, e.g. with the DOP software. The measuring rate is up to 600 meas./s.

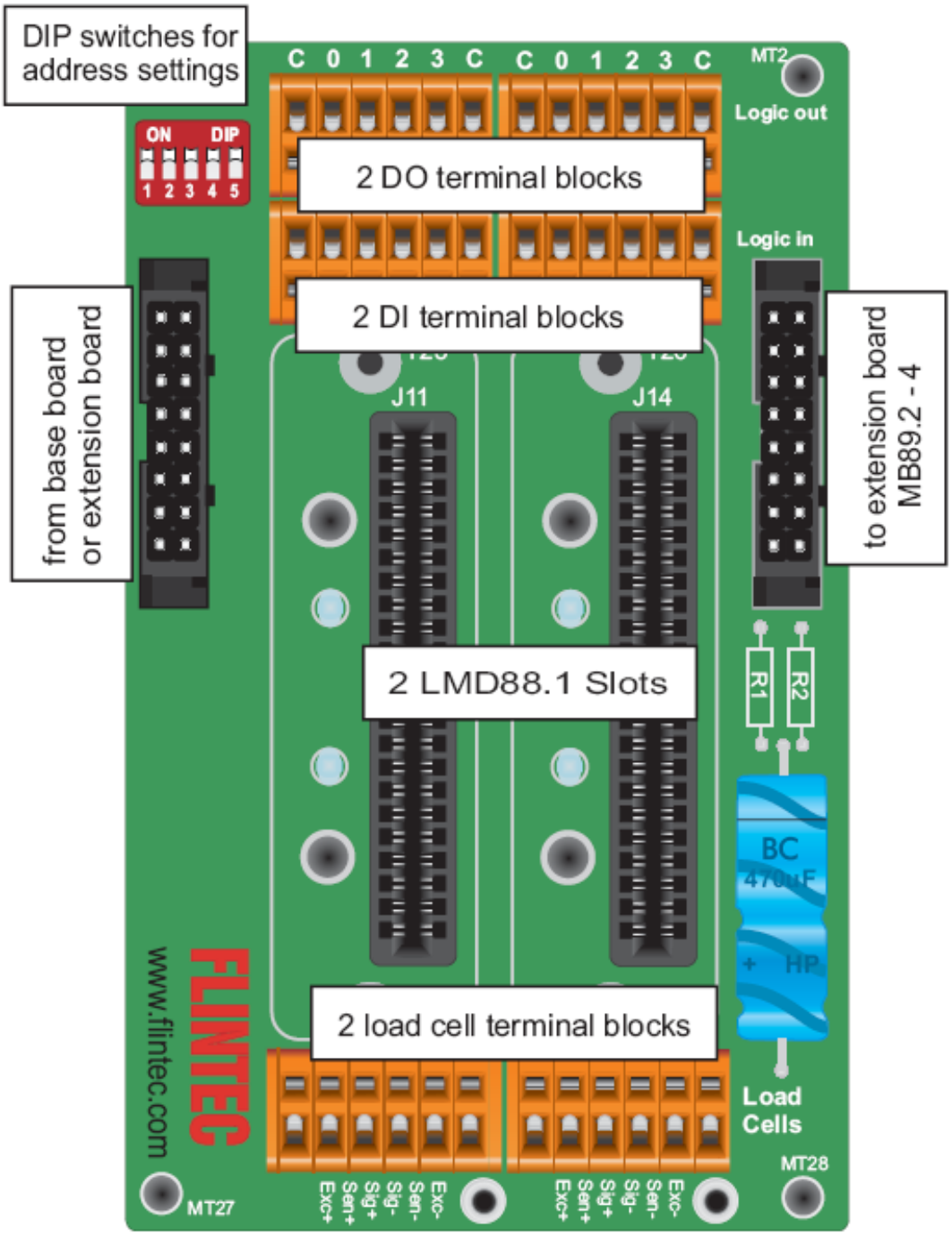
5 MCS-64 Components and Configuration

These pages describe the MCS-64 pcbs and the address setups for the expansion boards.

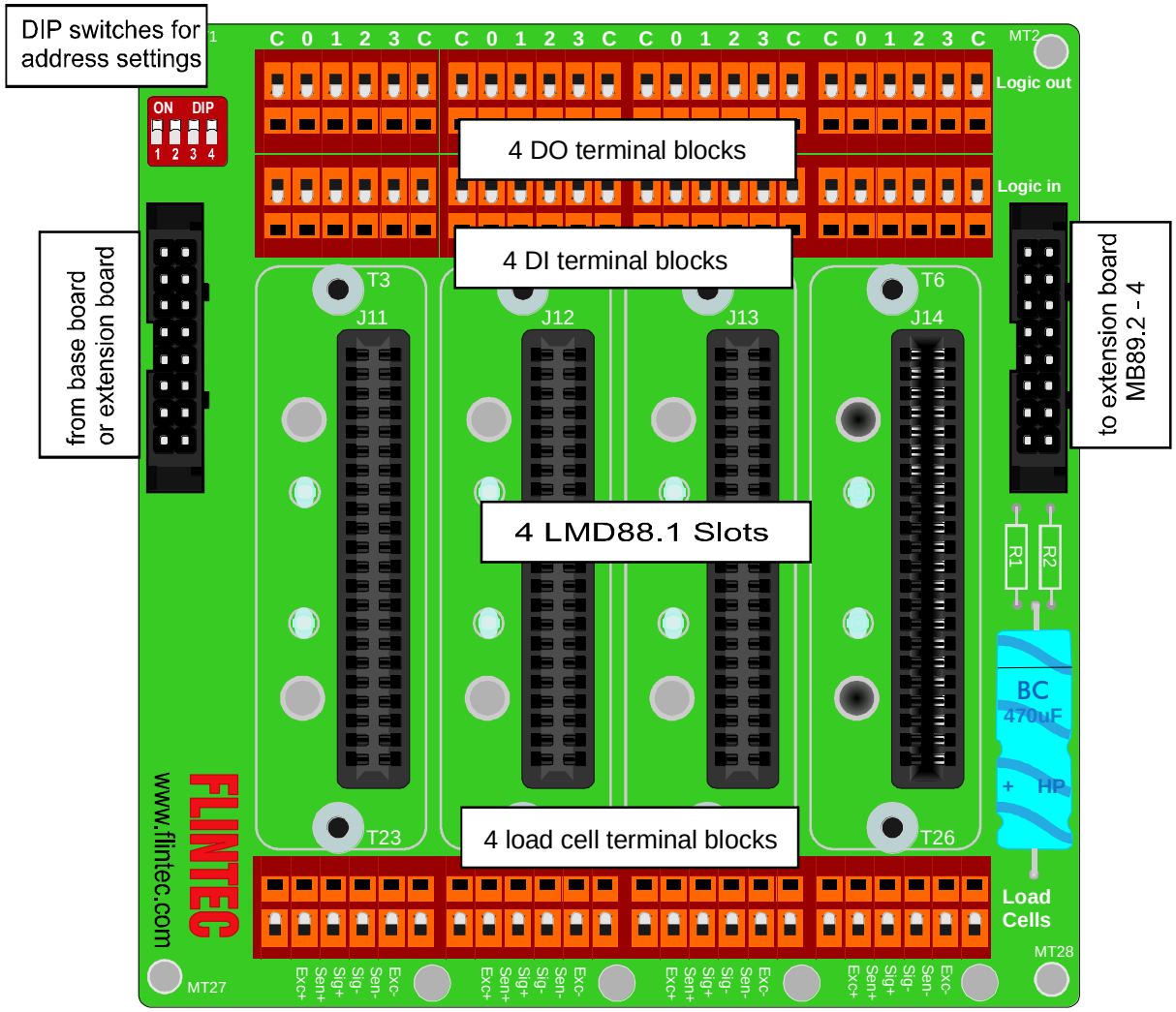
5.1 Base Board MB 89.1 for 1 Gateway and 2 LDM 88.x



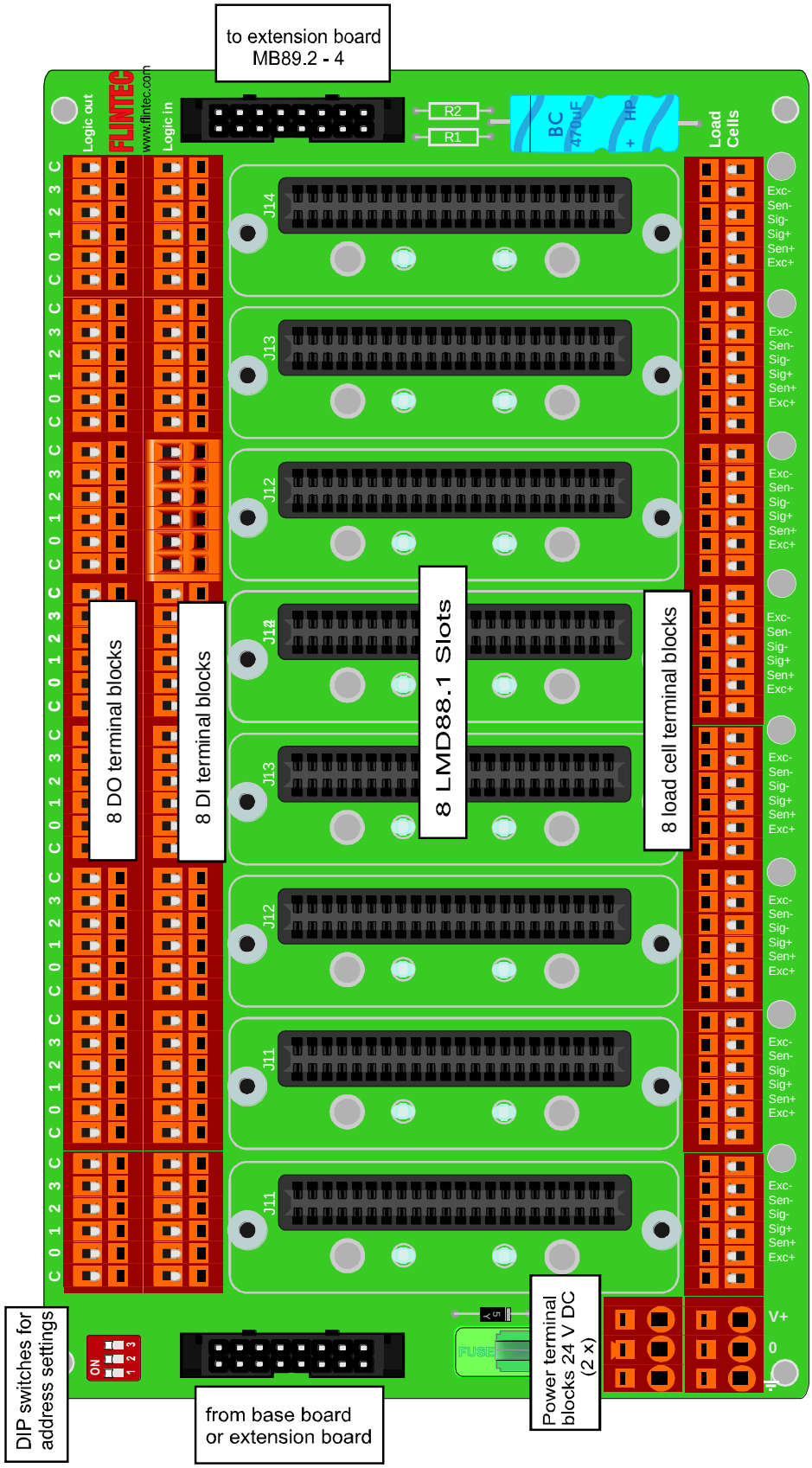
5.2 Extension Board MB 89.2 for 2 LDM 88.x



5.3 Extension Board MB 89.3 for 4 LDM 88.x

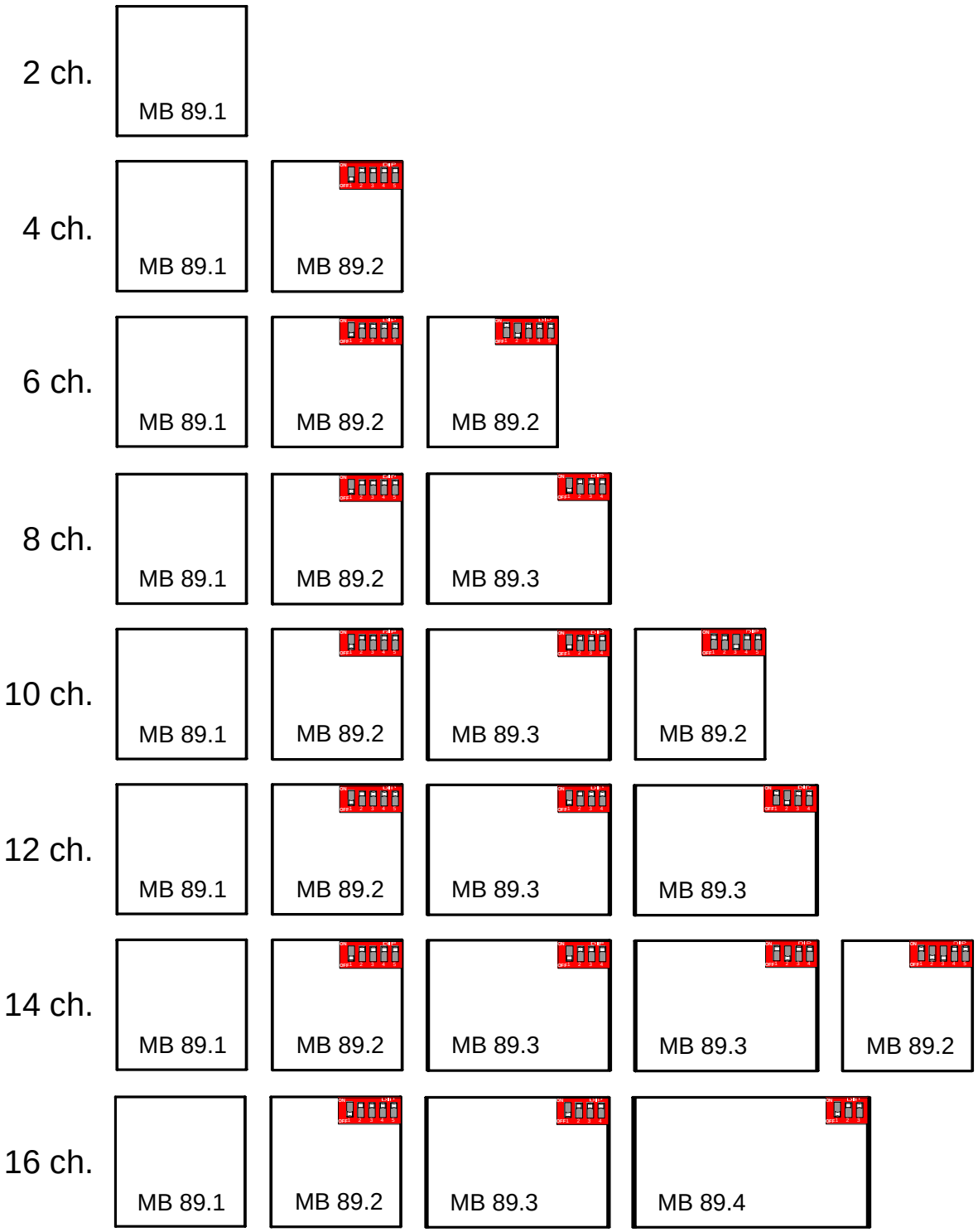


5.4 Extension Board MB 89.4 for 8 LDM 88.x



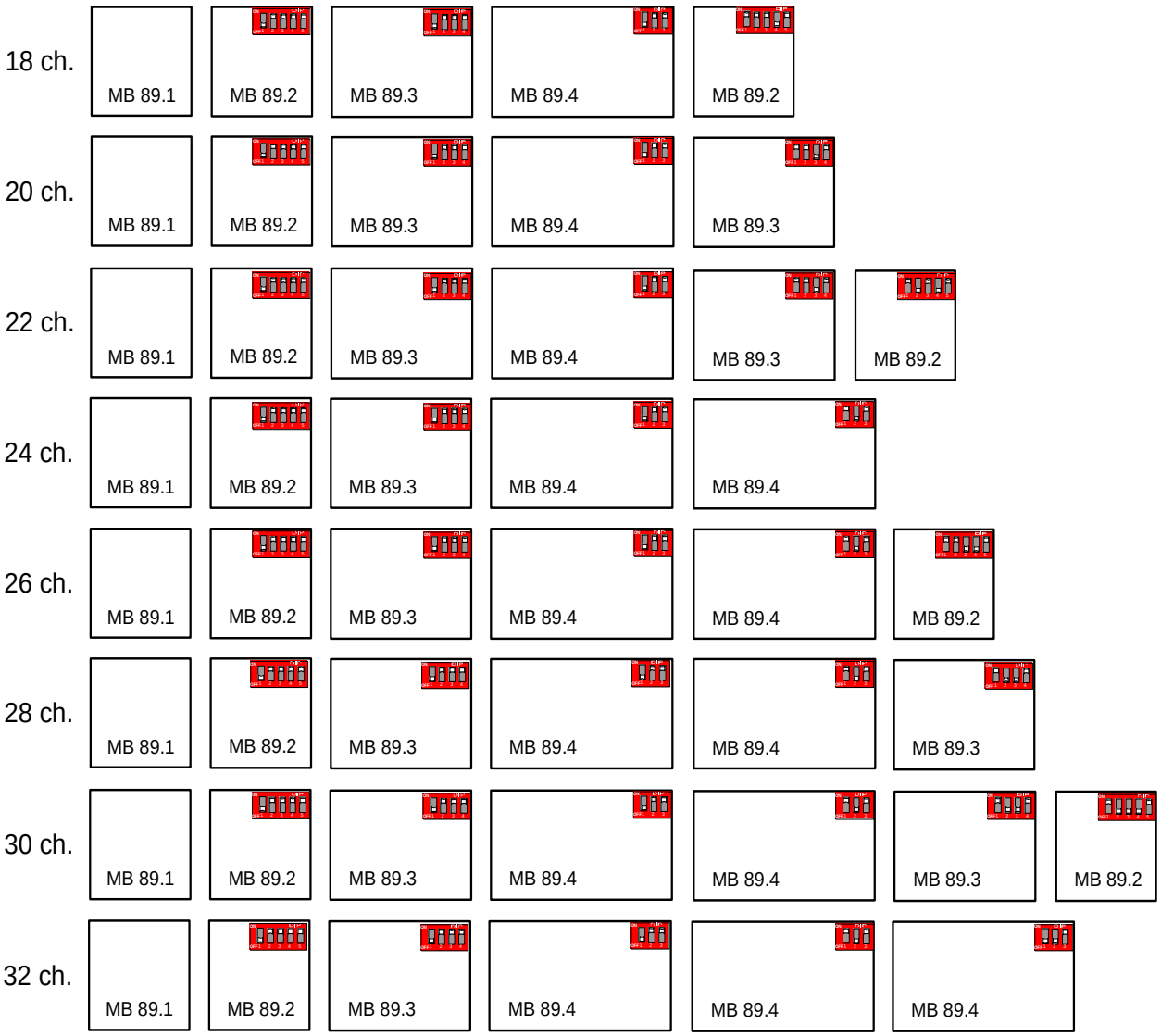
5.5 Address setup guide extension boards for 1 – 16 channels

DIP switch setting see table below



5.6 Address setup guide extension boards for up to 32 channels

DIP switch setting see table below



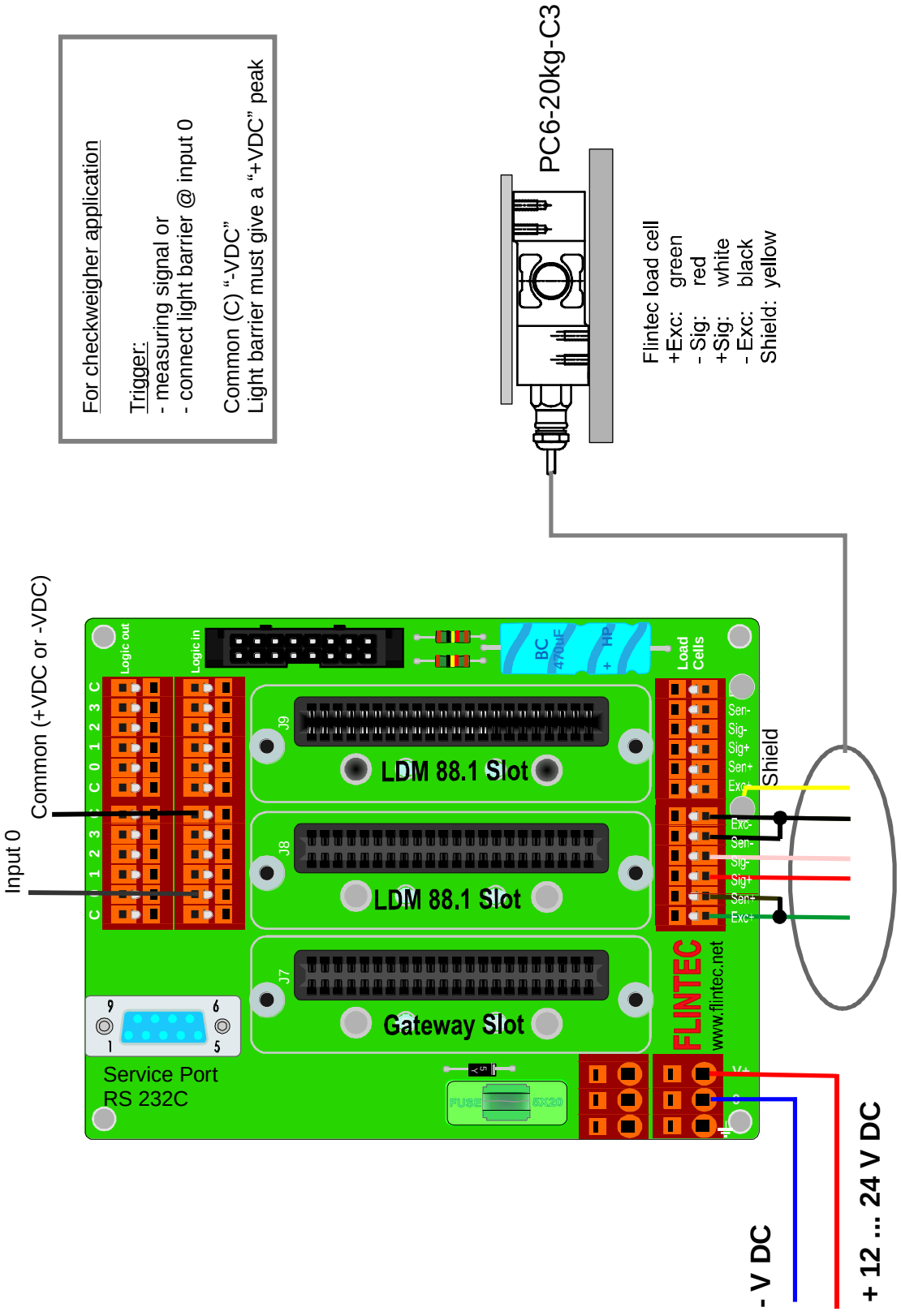
5.7 Board Combinations

	0	2	4	8	12 /16	20 / 24	28 / 32	36 / 40	44 / 48	52 / 56	60 /
02	MB89.1										
04	MB89.1	MB89.2									
06	MB89.1	MB89.2	MB89.2								
08	MB89.1	MB89.2	MB89.3								
10	MB89.1	MB89.2	MB89.3	MB89.2							
12	MB89.1	MB89.2	MB89.3	MB89.3							
14	MB89.1	MB89.2	MB89.3	MB89.3	*MB89.2*						
16	MB89.1	MB89.2	MB89.3	MB89.4							
18	MB89.1	MB89.2	MB89.3	MB89.4	MB89.2						
20	MB89.1	MB89.2	MB89.3	MB89.4	MB89.3						
22	MB89.1	MB89.2	MB89.3	MB89.4	MB89.3	*MB89.2*					
24	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4						
26	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.2					
28	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.3					
30	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.3	*MB89.2*				
32	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4					
34	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.2				
36	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.3				
38	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.3	*MB89.2*			
40	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4				
42	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.2			
44	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.3			
46	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.3	*MB89.2*		
48	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4			
50	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.2		
52	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.3		
54	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.3	*MB89.2*	
56	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4		
58	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.2	
60	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.3	
62	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.3	*MB89.2*
64	MB89.1	MB89.2	MB89.3	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	MB89.4	

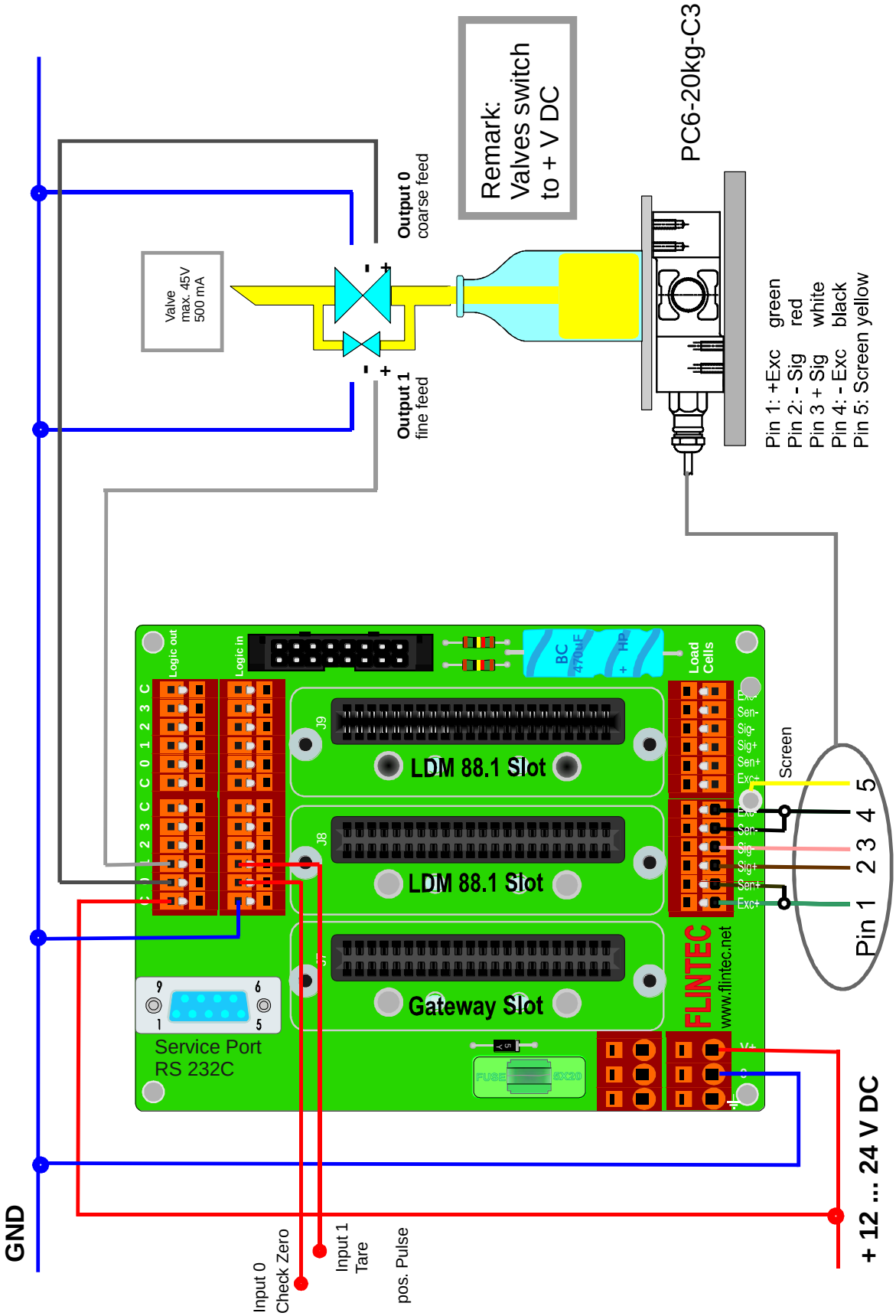
Switch Settings: SWn – SW1:

MB89.2					00110	01010	01110	10010	10110	11010	11110
MB89.2		00001	00010	00100	01000	01100	10000	10100	11000	11100	
MB89.3			0001	0010	0100	0110	1000	1010	1100	1110	
MB89.4				001	010	011	100	101	110	111	

5.8 Example Check Weigher Wiring



5.9 Example Liquid Filling Wiring

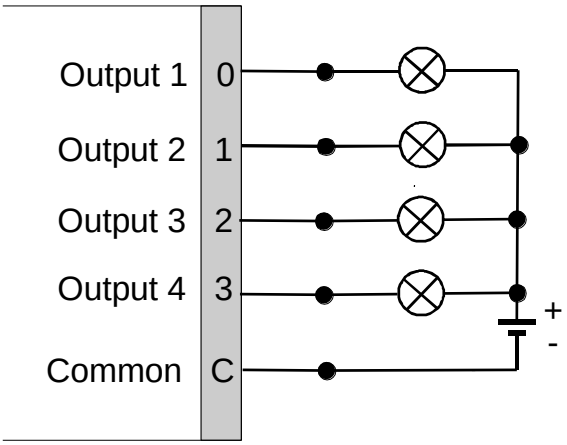


5.10 LDM 88.1 - digital Input / digital Output -

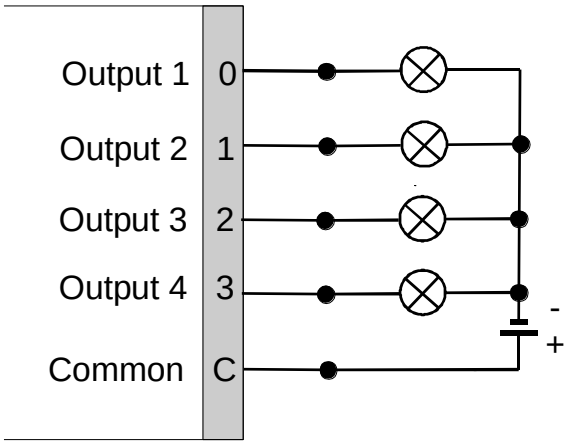
Outputs LDM 88.1

< 35 V DC / 500 mA or < 25 V AC / 500 mA (50/60 Hz)

Common is "**-**" V DC

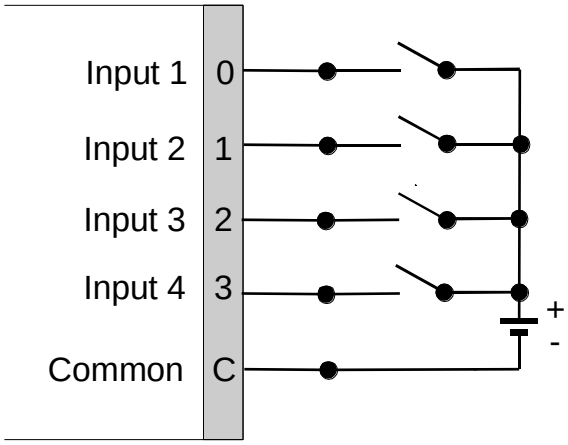


Common is "**+**" V DC



Inputs LDM 88.1

opto-isolated 10 ... 30 V DC, max. 3 mA



5.11 Firmware Versions

- **LDM 88.183** for check weighing and dosing/filling of non fluid products
- **LDM 88.184** for dosing/filling of fluids
- **LDM 88.185** for mass flow, trend and totalizing of fluids/powder

5.12 Appendix

For CANbus communication via PC (Windows OS) with USB-port you can use:

PCAN-USB-Adapter

Supplier: PEAK-System Technik GmbH, D-64293 Darmstadt

article no. IPEH-002021

www.peak-system.com / info@peak-system.com