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MCE2040 SERIEL COMMUNICATION MODULE

Transfer of status and weight for digital loadcells using simple PC/PLC protocol

Applies for:
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2) Introduction

2.1 Introduction

This document describes the use of the Eilersen Electric MCE2040 serial communication module, when equipped with program listed on the front page. With this program the MCE2040 communication module is capable of transmitting weight data of up to 4 loadcells using its PC/PLC protocol. Each loadcell is connected to the communication module through a MCE9610/MCE2010 loadcell interface module. The used protocol is a ’transmit only’ ASCII protocol. This means the MCE2040 module only transmits data. The MCE2040 module can be connected using RS232 or RS485/422.

With the implemented protocol either status and weight for each loadcell is transferred, or an ‘OR’ed status and summed weight for all loadcells is transferred. Functions as zeroing and calibration must be implemented on the PC/PLC.

By use of DIP-switches it is possible to include one of three different FIR filters, that will be used to filter the loadcell signals.

Exchange of data is performed as described in the following.

3) Data exchange

3.1 Parameters for serial communication

The serial transmission is made using the following specifications:

Specification:	RS232, RS485 or RS422
Baudrate:	9600 bps or 115200 bps depending on Sw1.8
Data bits:	7
Parity:	Even
Stop bits:	1
Protocol:	Simple ASCII ‘transmit only’ protocol

3.2 Protocol

The used protocol is a simple ASCII protocol. The protocol is a ’transmit only’ protocol, meaning that the MCE2040 module sends without being polled by telegrams from the PC/PLC.

The MCE2040 module can using Sw1.7 be configured to run in either **LC-mode** (**L**oad**C**ell) or **SUM-mode** (**SUM**med). In **LC-mode** status and weight for each individual loadcell is transferred. In **SUM-mode** a single OR’ed status and a single summed weight for the connected loadcells is transferred. The two modes are described in the following.

3.2.1 LC-mode

After each measurement period a new telegram is transmitted containing data for up to 4 loadcells. The transmitted telegram has the following format:

```
<LF>NN:SSSS,WWWWWWWWWW;SSSS,WWWWWWWWWW; ....  .... ;SSSS,WWWWWWWWWW<CR>
```

Each telegram contains a start character, detected number of loadcells, loadcell data for 1 to 4 loadcells depending on Sw1.1-Sw1.3 and a stop character. The length of the telegram therefore depends on the selected number of loadcells. Data for the individual loadcells are separated by a separator character. Data for the loadcells are transmitted in order depending on their loadcell address (from 0 and up). The telegram contains:

`<LF>`	Start character (ASCII 0Ah = LINEFEED). Indicates start of a new telegram.
`NN:`	Detected number of loadcells at power-up. A 2 digit ASCII **decimal** number followed by a colon (ASCII 3Ah). The number is transmitted with leading zeros so that it always fills 2 characters. If this number is different from the number indicated on Sw1.1-Sw1.3 the connection of loadcells, setting of loadcell addresses and loadcell communication should be checked.
`SSSS`	Status bits for the loadcell. A 4 digit ASCII **hex** number containing bits for error indication. Status is transferred with leading zeroes, so that it always fills 4 characters. This status **must** be 0 in order for the following weight value is valid. If the status is not 0 refer to the chapter '*STATUS CODES*'.
`WWWWWWWWWW`	Weight value for the loadcell in grams (1g resolution). A 10 digit ASCII **decimal** number containing loadcell signal from the loadcell. The weight is transferred with leading zeroes so that it always fills 10 characters. If the value is negative the first character will be a '-' (ASCII 2Dh).
`,`	Data separator (ASCII 2Ch). Separates status from weight for each individual loadcell.
`;`	Loadcell separator (ASCII 3Bh). Separates data for the individual loadcells from each other.
`<CR>`	Stop character (ASCII 0Dh = CARRIAGE RETURN). Indicates the end of a telegram.

As the transferred status and weight values are directly from the individual loadcells without zeroing etc., status handling, calculation of system weight(s), zeroing- and calibration functions **must** be implemented on the PC/PLC.

Calculation of system weight(s) is made by adding weight registers for the loadcells belonging together. Note that the result is only valid if all status registers for these loadcells does **not** indicate error. It is also up to the PC/PLC to ensure, that consistent loadcell data are used when calculating system weight(s); the used data should come from the same telegram.

3.2.2 SUM-mode

After each measurement period a new telegram is transmitted containing summed data for up to 4 loadcells. The transmitted telegram has the following format:

```
<LF>NN:SSSS,WWWWWWWWWW<CR>
```

Each telegram contains a start character, detected number of loadcells, summed loadcell data for 1 to 4 loadcells depending on Sw1.1-Sw1.3 and a stop character. The length of the telegram is therefore <u>independent</u> on the selected number of loadcells. The telegram contains:

<LF>	Start character (ASCII 0Ah = LINEFEED). Indicates start of a new telegram.
NN:	Detected number of loadcells during power-up. A 2 digit ASCII **decimal** number followed by a colon (ASCII 3Ah). The number is transferred with leading zeroes so that it always fills 2 characters. If this number is different from the number indicated on Sw1.1-Sw1.3 the connection of loadcells, setting of loadcell addresses and loadcell communication should be checked.
SSSS	Status bits for the connected loadcells achieved by logic OR'ing the status fields for the individual loadcells to a single value. A 4 digit ASCII **hex** number containing bits for error indication. Status is transferred with leading zeroes, so that it always fills 4 characters. This status **must** be 0 in order for the following weight value is valid. If the status is not 0 refer to the chapter '*STATUS CODES*'.
WWWWWWWWWW	Summed weight value for the connected loadcells in grams (1g resolution), achieved by adding the weight values for the individual loadcells to a single value. A 10 digit ASCII **decimal** number containing summed loadcell signal from the connected loadcells. The weight is transferred with leading zeroes so that it always fills 10 characters. If the value is negative the first character will be a '-' (ASCII 2Dh).
,	Data separator (ASCII 2Ch). Separates status from weight.
<CR>	Stop character (ASCII 0Dh = CARRIAGE RETURN). Indicates the end of a telegram.

As the transferred status and weight value is based directly on the loadcell values without zeroing etc., status handling, zeroing- and calibration functions **must** be implemented on the PC/PLC.

3.2.3 ASCII Hex

In both **LC-mode** and **SUM-mode**, the status codes are represented as a 4 digit ASCII hex number. This means, that each 4 bit nibble of the binary value is converted to the corresponding ASCII hex character '0' ..'F'.

3.3 Filtering

By use of DIP-switches it is possible to include one of three different FIR filters, that will be used to filter the loadcell signals. Thus it is possible, to send the unfiltered loadcell signals achieved over a 100 ms measurement period through one of the following FIR filters, before the results are transmitted to the RS232 and RS485/RS422 channel:

SW1.5	**SW1.6**	**FILTER**
OFF	OFF	No filter
ON	OFF	FIR filter – 14 taps
OFF	ON	FIR filter – 64 taps
ON	ON	FIR filter – 96 taps

4) Zeroing and calibration

4.1 Zeroing procedure

Zeroing of the system should be performed as follows:

1) The weighing arrangement should be empty and clean.
2) Read and store the actual weight values for the connected loadcells in corresponding zeroing registers.
3) After this the actual weight for loadcell **X** can be calculated as:

LcGross(**X**) = LcWeight(**X**) – LcZero(**X**)

and the system weight (uncalibrated) for the connected loadcells is calculated as:

SystemWeight = LcGross(0) + LcGross(1) + ….

Note that in **SUM-mode** it is only necessary to store the actual summed weight in one zeroing register and thereafter calculate the system weight as actual summed weight minus zero register.

4.2 Calibration procedure

Fine calibration of the system should be performed as follows:

1) Check that the weighing arrangement is empty, and that the gross weight is zero. Zero if necessary.
2) Place a known load (calibration weight) on the weighing arrangement.
3) Calculate the calibration factor that should be multiplied on the system weight in order to achieve correct showing as:

Calibration factor = (Calibration weight)/(Actual showing)

After this the determined calibration factor is used to calculate the calibrated weight as follows:

Sys.Weight(Calibrated) = Calibration factor * Sys.Weight(Uncalibrated)

If the determined calibration factor falls outside the interval 0.9 to 1.1 it is very likely that there is something wrong with the mechanical part of the system.

5) Status codes

Status codes are shown as a 4 digit hex number. If more than one error condition is present the error codes are OR'ed together.

CODE (Hex)	**CAUSE**
0001	**Invalid/missing 'sample' ID** Bad connection between communication module and loadcell module. Not all telegrams from communication module are received in loadcell module.
0002	**Loadcell timeout** Check that the loadcell is connected to the loadcell module.
0004	**Loadcell not synchronised** Bad connection between loadcell and loadcell module, or very powerful under- or overload.
0008	**Hardware synchronisation error** Loadcell samples are not synchronized. Cable between loadcell modules shorted or disconnected.
0010	**Power failure** Supply voltage to loadcells is to low.
0020	*Reserved for future use*
0040	**Invalid/missing 'latch' ID** Bad connection between communication module and loadcell module. Not all telegrams from communication module is received in loadcell module.
0080	**No answer from loadcell module** No data is received from this loadcell module. This can be caused by the removal of the loadcell module, no power to the module or that the connection between loadcell module and communication module is broken.
0100	*Reserved for future use*
0200	*Reserved for future use*
0400	*Reserved for future use*
0800	**No loadcell modules answer** Bad connection between communication module and loadcell module. Not all telegrams from communication module are received in loadcell module.
1000	*Reserved for future use*
2000	*Reserved for future use*
4000	*Reserved for future use*
8000	**Wrong number of loadcells** The number of detected loadcells at power-up does not match the number indicated on Sw1.1-Sw1.3.

6) Installation of the system

6.1 Checklist during installation

During installation of the system the following should be checked:

1) The loadcells are mounted mechanically and connected to the MCE2040 module using their corresponding loadcell interface module (MCE9610/MCE2010). The loadcell addresses are set using the DIP-switches (Sw1.5-Sw1.8) on the MCE9610/MCE2010 modules, so that they forth running from address 0 (0-5).

2) The MCE2040 module is connected to the communication network.

3) The expected number of loadcells, data format for serial transmission and baudrate for serial communication is set using the MCE2040 module switches; Sw1.1-Sw1.3, Sw1.7 and Sw1.8 respectively. Power is applied.

4) Verify that the TXBB LED on the MCE2040 module is lit and that the TXBB LED's on the loadcell modules (MCE9610/MCE2010) are also lit (can flash slightly).

5) Verify that the TxExt LED on the MCE2040 module flashes each time a telegram is sent at the expiration of each measurement period.

6) Verify that the MCE2040 module has found the correct loadcells as no error codes should be indicated for these.

7) Verify that every loadcell gives a signal by placing a load directly above each loadcell one after the other (possibly with a known load).

The system is now installed and a possible zero and fine calibration is made as described earlier. Finally verify that the weighing system(s) returns a value corresponding to a known actual load.

Note that in the above checklist no consideration has been made on which functions are implemented on the PC/PLC.

7) Hardware description

7.1 DIP-switch settings

The MCE2040 module is equipped with one DIP-switch block. DIP-switch block 1 has the following function:

SWITCH	FUNCTION
Sw1.1-Sw1.3	**Expected number of loadcells** The expected number of loadcells is set as indicated below. **Note** that these switches are only read at power-up.
Sw1.4	*Reserved for future use*
Sw1.5-Sw1.6	**Filtering** Used to select the desired filter as described in an earlier chapter. Note that these switches are only read during power on.
Sw1.7	**Data format for seriel transmission** OFF: **LC-mode** (loadcell signals) ON: **SUM-mode** (summed signal) **Note** that this switch is only read at power-up.
Sw1.8	**Baudrate for serial communication** OFF: 9600 baud ON: 115200 baud **Note** that this switch is only read at power-up.

The number of loadcells is indicated using Sw1.1-Sw1.3 as follows:

Sw1.1	Sw1.2	Sw1.3	Number of loadcells
OFF	OFF	OFF	4
ON	OFF	OFF	1
OFF	ON	OFF	2
ON	ON	OFF	3
OFF	OFF	ON	4
ON	OFF	ON	4
OFF	ON	ON	4
ON	ON	ON	4

7.2 Light emitting diodes

The MCE2040 module is equipped with 2 light emitting diodes (LED's). These LED's have the following function:

LED	FUNCTION
TxBB (Green LED)	**Communication with loadcells** The MCE2040 communicates with the loadcells
TxExt (Green LED)	**Extern bus TxD (Transmit Data)** The MCE2040 module transmits data across the Extern bus.

7.3 Jumpers

The MCE2040 module is equipped with 2 jumpers. These jumpers have the following function:

JUMPER	FUNCTION
S1	**Selection of RS422 or RS485** This jumper is placed depending on whether the module should use RS422 or RS485 communication on the external bus: RS422 (4 wire): **OFF** RS485 (2 wire): **ON (shorts R- to T-)**
S2	**Selection of RS422 or RS485** This jumper is placed depending on whether the module should use RS422 or RS485 communication on the external bus: RS422 (4 wire): **OFF** RS485 (2 wire): **ON (shorts R+ to T+)**

7.4 EE-bus connector

The MCE2040 module is equipped with a 10 pole connector for connection to the Eilersen Electric EE-bus. Hereby connection to the individual MCE9610/MCE2010 loadcell modules as well as to the power supply for the MCE2040 module is achieved. The connection is made using a ribbon cable with mounted connectors for the individual modules. The 10 pole connector (J1) has the following connections:

J1 Connector	Function
J1.1-J1.2	RS485-B (**negative** line)
J1.3-J1.4	RS485-A (**positive** line)
J1.5-J1.6	0VDC (Gnd1)
J1.7-J1.8	+24VDC (Vin1)
J1.9-J1.10	Not used

7.5 MCE9601 connection module

The MCE2040 module is normally connected to loadcells and power supply through a ribbon cable and a MCE9601 connection module. The MCE9601 module has the following connections:

MCE9601	Supply	Terminal
24V	+24VDC	(+24VDC)
A		A (R+/T+)
B		B (R-/T-)
Gnd	0VDC	Gnd

7.6 RS232/RS422/RS485 external communication connector

The MCE2040 module is equipped with a 9 pole sub-D connector (female) for connection to the external communication network. The connector (J2) has the following connections:

Pin	Designation	Connection
J2.1	RS422.R- (RS485.B)	PC/PLC.T-
J2.2	RS232.RX	PC/PLC.RS232-TX
J2.3	RS232.TX	PC/PLC.RS232-RX
J2.4	RS422.T+ (RS485.A)	PC/PLC.R+
J2.5	GND	PC/PLC.GND
J2.6	RS422.R+ (RS485.A)	PC/PLC.T+
J2.7	-	Not used
J2.8	-	Not used
J2.9	RS422.T- (RS485.B)	PC/PLC.R-

7.7 Digital I/O connector

The MCE2040 module is equipped with a digital I/O connector (J3) for possible connection of 2 digital inputs and 2 digital outputs. With the installed program the following functions are implemented on the I/O signals:

Pin	Designation	Connection
J3.1	IN1	Not used
J3.2	GND	
J3.3	IN2	Not used
J3.4	24VDC OUT	
J3.5	OUT1	Not used
J3.6	GND	
J3.7	OUT2	Not used

Note that J3.1 is placed next to the **TxExt** light emitting diode.

7.8 Internal JTAG connector

The MCE2040 module is equipped with an internal JTAG connector. The connector (J5) is used exclusively by Eilersen Electric A/S during download of software to the Cygnal processor.

7.9 MCE2040 Update time

All loadcells are sampled over a period of 100 mS, after which the transmission of a telegram is started, and a new sample period is started. The transmission time depends on the selected baudrate, the selected mode, and in **LC-mode** the connected number of loadcells.