Eilersen
Industrial Sensors

Kokkedal Industripark 4
DK-2980 Kokkedal
Denmark
info@eilersen.com
Tel +45 49 180 100
Fax +45 49 180 200

4040C COMMUNICATION MODULE

BIN communication in a 4x40C system

Applies for:

Program no.: BIN_1LC.130307.1

Document no.: 0307mu4040CE-1

Date: 2022-09-23

Rev.: 1

1) CONTENTS

2) INTRODUCTION

2.1 Introduction

This document describes the use of a 4040C communication module from Eilersen Electric, when it is equipped with the program listed on the front page.

With the program specified on the front page, the 4040C communication module is capable of transferring weight data from a connected loadcell on an RS485 channel using a binary protocol.

By use of DIP switches it is possible to select the resolution (0,1 gram or 1 gram) by which the weight is represented.

By use of DIP switches it is possible to configure the averaging period to 2, 10, 50 or 100 ms.

By use of DIP switches it is possible to include one of 15 different FIR filters, that will be used to filter the loadcell signal.

By use of communication on the RS485 channel it will be possible to change the default power-up settings (determined by DIP switches) for communication mode, resolution, averaging period and filter number used.

The external device will typically be a PC, that is connected through a RS485 to USB converter.

3) DATA EXCHANGE

3.1 BIN Mode (Binary Mode)

The 4040C module will communicate with the following specifications:

Specification:	RS485 (2-wire)
Baudrate:	115200 bps
Data bits:	8
Parity:	None
Stop bits:	1
Protocol:	Master-Slave BIN protocol as described below

3.2 Polled/Continuous operation

The 4x40C system unit can be set to either Polled or Continuous operation. This is done using Sw2.8 as described later. This can be changed during operation by using a ***Set Mode*** request telegram (see protocol description).

In Polled operation the 4040C module operates as described in the next chapter; i.e. it only transmits its ***Read Weight*** response telegram when it receives a ***Read Weight*** request telegram from its RS485 master.

In Continuous operation the 4040C module automatically transmits its ***Read Weight*** response telegram upon completion of every averaging period; i.e. the 4040C module does NOT need to receive a ***Read Weight*** request telegram from its RS485 master.

NOTE: If the 4040C module is placed in Continuous operation the RS485 master should aim at performing transmissions in between transmissions made by the 4040C module. This is in order to avoid conflicts on the RS485 bus. If this is not possible retransmissions by the RS485 master are necessary until the telegram slips through to the 4040C module.

NOTE: If the 4040C module is placed in Continuous operation, the only request telegram allowed to be transmitted by the RS485 master, and which the 4040C module will respond to, is a ***Set Mode*** request telegram requesting the 4040C module to enter Polled operation. All other request telegrams send by the RS485 master will be ignored by the 4040C module.

3.3 Protocol description

The 4x40C system unit communicates with the external equipment using a master-slave binary protocol where the 4x40C system unit acts as a slave.

All valid request telegrams from the RS485 master will be acknowledge with a corresponding response telegram. All telegrams, request as well as response telegrams, are encapsulated by a start character (**<STX>** = ASCII 02h) and an end character (**<ETX>** = ASCII 03h). In addition all telegrams contain a checksum (**<BCC>**). Hence all telegrams have the following format:

<STX> <specific telegram contents> <BCC> <ETX>

The checksum is calculated by logical XOR of all preceding characters in the telegram including the **<STX>** character; i.e. the **<BCC>** itself and the **<ETX>** character are not included.

The following request telegrams are available:

Request Telegram	Telegram Format
Read Weight	**<STX> W <BCC> <ETX>**
Set Mode	**<STX> M <number> <BCC> <ETX>**
Set Resolution	**<STX> R <number> <BCC> <ETX>**
Set Average Period	**<STX> A <number> <BCC> <ETX>**
Set Filter Number	**<STX> F <number> <BCC> <ETX>**

The specific request and their corresponding response telegrams are described in detail in the following.

3.3.1 *Read Weight* telegram

The 4x40C system unit is capable of receiving a ***Read Weight*** request telegram. The telegram is used to read the status and weight of the loadcell. The telegram is **ONLY** allowed when Polled operation is selected. The ***Read Weight*** request telegram has the following format:

<STX> W <BCC> <ETX>

Apart from the start, checksum and end characters the request telegram contains:

W is a 'W' character (ASCII 57h).

When the 4x40C system unit receives a ***Read Weight*** request telegram (or whenever the average period expires in Continuous operation), a ***Read Weight*** response telegram is transmitted from the 4x40C system unit as an acknowledge. The ***Read Weight*** response telegram has the following format:

<STX> <SS_1> <$WWWW_1$> <BCC> <ETX>

Apart from the start, checksum and end characters the response telegram contains:

SS_x Status value for loadcell(x). The value is a 2 byte (one word – 16 bit unsigned integer) binary number with MSB first indicating the status code of loadcell(x).

$WWWW_x$ Weight value for loadcell(x). The value is a 4 byte (one double word – 32 bit signed integer) binary number with MSB first indicating the current weight signal in the selected resolution for loadcell(x). The value is the result of the latest completed averaging.

3.3.2 *Set Mode* telegram

The 4x40C system unit is capable of receiving a ***Set Mode*** request telegram. The telegram is used to switch between Polled and Continuous operation overwriting the default power-on value set using Sw2.8. The telegram is used when Polled as well as when Continuous operation is selected. The ***Set Mode*** request telegram has the following format:

<STX> M <number> <BCC> <ETX>

Apart from the start, checksum and end characters the request telegram contains:

M	is a 'M' character (ASCII 4Dh).
<number>	is a 1 byte binary number (0-255) indicating the desired mode. A value of 0 corresponds to Polled operation, and a value of 1 corresponds to Continuous operation. All other values are invalid.

When the 4x40C system unit receives a ***Set Mode*** request telegram, a ***Set Mode*** response telegram is transmitted from the 4x40C system unit as an acknowledge. The ***Set Mode*** response telegram has the following format:

<STX> m <number> <BCC> <ETX>

Apart from the start, checksum and end characters the response telegram contains:

m	is a 'm' character (ASCII 6Dh).
<number>	is a 1 byte binary number (0-255) indicating the actual mode. A value of 0 corresponds to Polled operation, and a value of 1 corresponds to Continuous operation. All other values are invalid.

3.3.3 *Set Resolution* telegram

The 4x40C system unit is capable of receiving a ***Set Resolution*** request telegram. The telegram is used to set the desired resolution overwriting the default power-on value set using Sw2.6. The telegram is **ONLY** allowed when Polled operation is selected. The ***Set Resolution*** request telegram has the following format:

<STX> R <number> <BCC> <ETX>

Apart from the start, checksum and end characters the request telegram contains:

R	is a 'R' character (ASCII 52h).
<number>	is a 1 byte binary number (0-255) indicating the desired resolution. A value of 0 corresponds to 1 gram resolution, and a value of 1 corresponds to 0,1 gram resolution. All other values are invalid.

When the 4x40C system unit receives a ***Set Resolution*** request telegram, a ***Set Resolution*** response telegram is transmitted from the 4x40C system unit as an acknowledge. The ***Set Resolution*** response telegram has the following format:

<STX> r <number> <BCC> <ETX>

Apart from the start, checksum and end characters the response telegram contains:

r	is a 'r' character (ASCII 72h).
<number>	is a 1 byte binary number (0-255) indicating the actual resolution. A value of 0 corresponds to 1 gram resolution, and a value of 1 corresponds to 0,1 gram resolution. All other values are invalid.

3.3.4 *Set Average Period* telegram

The 4x40C system unit is capable of receiving a ***Set Average Period*** request telegram. The telegram is used to set the desired average period overwriting the default power-on value set using Sw2.4-Sw2.5. The telegram is **ONLY** allowed when Polled operation is selected. The ***Set Average Period*** request telegram has the following format:

<STX> A <number> <BCC> <ETX>

Apart from the start, checksum and end characters the request telegram contains:

A	is a 'A' character (ASCII 41h).
<number>	is a 1 byte binary number (0-255) indicating the desired average period. A value of 0 corresponds to 2 ms, a value of 1 corresponds to 10 ms, a value of 2 corresponds to 50 ms and a value of 3 corresponds to 100ms. All other values are invalid.

When the 4x40C system unit receives a ***Set Average Period*** request telegram, a ***Set Average Period*** response telegram is transmitted from the 4x40C system unit as an acknowledge. The ***Set Average Period*** response telegram has the following format:

<STX> a <number> <BCC> <ETX>

Apart from the start, checksum and end characters the response telegram contains:

a	is a 'a' character (ASCII 61h).
<number>	is a 1 byte binary number (0-255) indicating the actual average period. A value of 0 corresponds to 2 ms, a value of 1 corresponds to 10 ms, a value of 2 corresponds to 50 ms and a value of 3 corresponds to 100ms. All other values are invalid.

3.3.5 *Set Filter Number* telegram

The 4x40C system unit is capable of receiving a ***Set Filter Number*** request telegram. The telegram is used to set the desired filter number overwriting the default power-on value set using Sw1.1-Sw1.4. The telegram is **ONLY** allowed when Polled operation is selected. The ***Set Filter Number*** request telegram has the following format:

<STX> F <number> <BCC> <ETX>

Apart from the start, checksum and end characters the request telegram contains:

F	is a 'F' character (ASCII 46h).
<number>	is a 1 byte binary number (0-255) indicating the desired filter number. The number can have a value of 0-15 corresponding to the 15 different filters (and 0 for no filtering). All other values are invalid.

When the 4x40C system unit receives a ***Set Filter Number*** request telegram, a ***Set Filter Number*** response telegram is transmitted from the 4x40C system unit as an acknowledge. The ***Set Filter Number*** response telegram has the following format:

<STX> f <number> <BCC> <ETX>

Apart from the start, checksum and end characters the response telegram contains:

f	is a 'f' character (ASCII 66h).
<number>	is a 1 byte binary number (0-255) indicating the actual filter number. The number can have a value of 0-15 corresponding to the 15 different filters (and 0 for no filtering). All other values are invalid.

3.3.6 *Telegram examples*

The following is a list of telegram examples (i.e. requests with corresponding responses):

Telegram type	Request	Response
Read Weight	<02h> <57h> <55h> <03h>	<02h> <00h> <00h> <00h> <00h> <00h> <81h> <83h> <03h>
Set Mode	<02h> <4Dh> <00h> <4Fh> <03h>	<02h> <6Dh> <00h> <6Fh> <03h>
Set Resolution	<02h> <52h> <00h> <50h> <03h>	<02h> <72h> <00h> <70h> <03h>
Set Average Period	<02h> <41h> <00h> <43h> <03h>	<02h> <61h> <00h> <63h> <03h>
Set Filter Number	<02h> <46h> <00h> <44h> <03h>	<02h> <66h> <00h> <64h> <03h>

3.4 Loadcell status codes

The following loadcell status codes are possible. If more than one error condition is present the status codes are OR'ed together.

CODE (Hex)	CAUSE
0001	*Reserved for future use*
0002	*Reserved for future use*
0004	*Reserved for future use*
0008	*Reserved for future use*
0010	*Reserved for future use*
0020	*Reserved for future use*
0040	**No answer from loadcell** Bad connection between loadcell and 4040C?
0080	*Reserved for future use*
0100	*Reserved for future use*
0200	*Reserved for future use*
0400	*Reserved for future use*
0800	**No loadcell answer** Bad connection between loadcell and 4040C?
1000	*Reserved for future use*
2000	*Reserved for future use*
4000	*Reserved for future use*
8000	*Reserved for future use*

3.5 Filtering

By use of DIP-switches it is possible to include one of 15 different FIR filters, that will be used to filter the loadcell signals. Thus it is possible, to send the unfiltered loadcell signals achieved over each averaging/sample period (Tavg) through one of the following FIR filters, before the results are transmitted on the RS485 channel:

SW1.1	SW1.2	SW1.3	SW1.4	No.	Taps	Frequency				Damping
						Tavg 2ms	Tavg 10ms	Tavg 50ms	Tavg 100ms	
OFF	OFF	OFF	OFF	0	-	-	-	-	-	-
ON	OFF	OFF	OFF	1	7	120 Hz	24 Hz	4.8 Hz	2.4 Hz	-60dB
OFF	ON	OFF	OFF	2	9	100 Hz	20 Hz	4.0 Hz	2.0 Hz	-60dB
ON	ON	OFF	OFF	3	9	120 Hz	24 Hz	4.8 Hz	2.4 Hz	-80dB
OFF	OFF	ON	OFF	4	12	80 Hz	16 Hz	3.2 Hz	1.6 Hz	-60dB
ON	OFF	ON	OFF	5	12	100 Hz	20 Hz	4.0 Hz	2.0 Hz	-80dB
OFF	ON	ON	OFF	6	15	80 Hz	16 Hz	3.2 Hz	1.6 Hz	-80dB
ON	ON	ON	OFF	7	17	60 Hz	12 Hz	2.4 Hz	1.2 Hz	-60dB
OFF	OFF	OFF	ON	8	21	60 Hz	12 Hz	2.4 Hz	1.2 Hz	-80dB
ON	OFF	OFF	ON	9	25	40 Hz	8 Hz	1.6 Hz	0.8 Hz	-60dB
OFF	ON	OFF	ON	10	32	40 Hz	8 Hz	1.6 Hz	0.8 Hz	-80dB
ON	ON	OFF	ON	11	50	20 Hz	4 Hz	0.8 Hz	0.4 Hz	-60dB
OFF	OFF	ON	ON	12	64	20 Hz	4 Hz	0.8 Hz	0.4 Hz	-80dB
ON	OFF	ON	ON	13	67	15 Hz	3 Hz	0.6 Hz	0.3 Hz	-60dB
OFF	ON	ON	ON	14	85	15 Hz	3 Hz	0.6 Hz	0.3 Hz	-80dB
ON	ON	ON	ON	15	100	10 Hz	2 Hz	0.4 Hz	0.2 Hz	-60dB

NOTE: With all four switches OFF, no filtering is performed.

NOTE: The default power-on filter number (0-15) selected using DIP switches can be changed during operation by using a ***Set Filter Number*** request telegram (see protocol description).

NOTE: When configured so that Tavg is 2ms, a filter with more than 85 taps (corresponding to filter no. 14 with frequency of 15Hz and damping of -80db) must **NOT** be selected/used.

4) HARDWARE DESCRIPTION

4.1 4x40C front panel

This chapter describes the connections, DIP-switch settings and lamp indications that are available on the 4x40C front panel.

4.1.1 Connection of power

The 4x40C system unit is powered by applying +24VDC on a two pole connector as specified on the front panel of the 4x40C system unit. This powers the 4040C communication module as well as the loadcells.

4.1.2 Connection of loadcells

The loadcells must be connected to the available BNC connectors in the front panel of the 4x40C system unit. The loadcells are connected starting with the connector marked 1 and continuing onwards in rising order. Thus if three loadcells are to be connected, they should be connected to the BNC connectors marked 1, 2 and 3.

4.1.3 Connection of external units with J2 connector

The 4040C module is connected to an external unit with the J2 connector with these connections:

J2 pin.	Function	Connected to
1	B (-)	RS485-B (-) please see below
2	A (+)	RS485-A (+) please see below
3	I/O	Not connected
4	GND	Gnd

Please notice that in some external systems (especially German) the use of A and B is switched. The use of + and – markings are always the same

4.1.4 SW1 settings

The front panel of the 4x40C system unit is equipped with a 4 pole DIP switch block named SW1. Please note that unless stated otherwise, these switches are **ONLY** read during power-on. These switches are mounted on the 4040C communication module.

SWITCH	FUNCTION
Sw1.1-Sw1.4	**Filtering** Used to select the desired filter as described in an earlier chapter. Note that these switches are read during power-on **ONLY**.

NOTE: The default power-on filter number (0-15) selected using DIP switches can be changed during operation by using a ***Set Filter Number*** request telegram (see protocol description).

4.1.5 Light Emitting Diodes (LEDs)

The front panel of the 4x40C system unit is equipped with a number of status lamps (light emitting diodes). The lamps that are mounted on the 4040C communication module have the following functionality:

LED	FUNCTION
TxLC (Yellow)	**4040 communication with loadcells** Lit when communicating with the connected loadcells.
TxBB (Right - Green)	**4040 communication** Lit when communicating externally.
LC1 (Red)	**Status for loadcell #1** Lit if the connection to loadcell #1 is broken.
LC2 (Red)	**Status for loadcell #2** Lit if the connection to loadcell #2 is broken.
LC3 (Red)	**Status for loadcell #3** Lit if the connection to loadcell #3 is broken.
LC4 (Red)	**Status for loadcell #4** Lit if the connection to loadcell #4 is broken.

4.2 4040C communication module

This chapter describes the connections, DIP-switch settings and status lamps (LEDs) that are available internally on the 4040C communication module.

4.2.1 SW2 settings

The 4040C communication module is internally equipped with a 8 pole DIP switch block named SW2. Please note that these switches are **ONLY** read during power-on. This DIP switch block has the following function:

Sw2.1	Sw2.2	Sw2.3	Number of loadcells
OFF	OFF	OFF	1
ON	OFF	OFF	1
OFF	ON	OFF	1
ON	ON	OFF	1
OFF	OFF	ON	1
ON	OFF	ON	1
OFF	ON	ON	1
ON	ON	ON	1

Sw2.4	Sw2.5	Averaging period (Tavg)
OFF	OFF	2 ms
ON	OFF	10 ms
OFF	ON	50 ms
ON	ON	100 ms

NOTE: The default power-on value for averaging period selected using DIP switches can be changed during operation by using a ***Set Average Period*** request telegram (see protocol description).

Sw2.6	Resolution
OFF	1 gram (i.e. 1 equals 1 gram)
ON	0,1 gram (i.e. 1 equals 0,1 gram)

NOTE: The default power-on value for resolution selected using DIP switches can be changed during operation by using a ***Set Resolution*** request telegram (see protocol description).

SWITCH	FUNCTION
Sw2.7	*Reserved for future use*

SWITCH	FUNCTION
Sw2.8	**Polled/Continuous operation** OFF: Polled operation (see protocol description) ON: Continuous operation (see protocol description)

NOTE: The default power-on value for mode selected using DIP switches can be changed during operation by using a ***Set Mode*** request telegram (see protocol description).

4.2.2 Jumper settings

The 4040C communication module is internally equipped with 4 jumpers named P2, P3, P4 and P5. In this system these jumpers must be set as follows:

JUMPER	POSITION
P2	OFF (Loadcell connected to 4040C **NOT** accessible using SEL1)
P3	OFF (Loadcell connected to 4040C **NOT** accessible using SEL6)
P4	OFF (Loadcell connected to 4040C **NOT** accessible using SEL1)
P5	OFF (Loadcell connected to 4040C **NOT** accessible using SEL6)

4.2.3 Light Emitting Diodes (LEDs)

The 4040C communication module is internally equipped with a number of status lamps (light emitting diodes). The lamps have the following functionality:

LED	FUNCTION
D11 (Red)	*Reserved for future use*
D12 (Red)	*Reserved for future use*
D13 (Yellow)	*Reserved for future use*
D14 (Yellow)	*Reserved for future use*

4.2.4 JTAG connector

The 4040C communication module is internally equipped with a JTAG connector. The connector (J4) is used exclusively by Eilersen Electric A/S for download of software to the Cygnal processor.