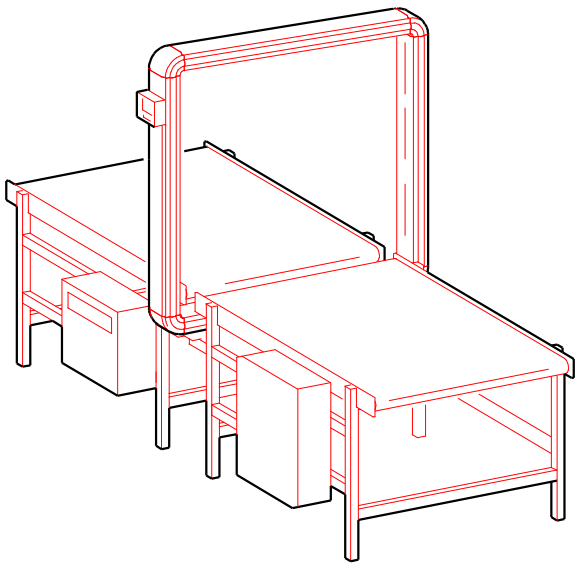
CS5000 FRAMES

Service and Installation Manual

Cargoscan A/S, January 1998



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Version 1.15 Part no. 790008

This manual covers CS5000 Frames with the following Serial numbers:

1146-1151
1162-1165
1182-1191
1193-1229
1234-1242
1244-1276
and
20001 ®

Federal Communications Commission
Radio Frequency Interference Statement

WARNING: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing device pursuant to Subpart J or Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

NOTE: In order to meet Class A emission limits, the I/O cables that interconnect between the device and any peripheral must be shielded.

Table of contents

1.0 Introduction

This document contains technical information needed to do installation and service on the Frame. For more detailed information on operation of the Frame, technical specifications etc., refer to the CS5000 and CS5000HS Operators Manual and CS5000 and CS5000HS Mechanical Designers Manual.

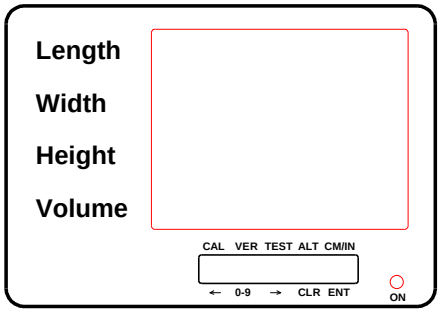
Appendix B contains a summary of points to be remembered when doing installation and service on the Frame. This will be useful for a serviceman that is familiar with the Frame. Appendix C contains a complete list of all existing status messages and error messages.

Chapter 2 to 7 should be read carefully before doing installation of the Frame. Chapter 8 contains a description of useful test functions for servicing the Frame

2.0 Use of the indicator unit

The indicator unit has four lines used for numerical output, and five keys.
Each key has two functions:

1: Select operation on CS5000
2: Numerical input.



Key	Select function	Numerical input
CAL/<--	Conv. cal.	Step back to previous digit
VER/0-9	Display versions	Increment numerical value
TEST/-->	Test function	Step to next digit
ALT/CLR	Show more data	Abort numerical input.
CM/INCH/ENT	Change units.	Execute function with numerical data.

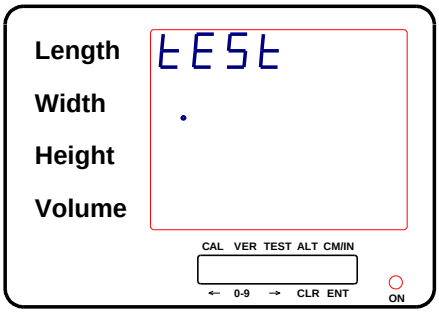
The selections CAL and TEST has numerical input. When these are pressed, a leading text will be displayed on the first line of the indicator unit, and a flashing cursor can be seen on the first position of the second line.

An example of use of the indicator unit is shown on the next page.

Example of use of test functions with numerical input on indicator unit:

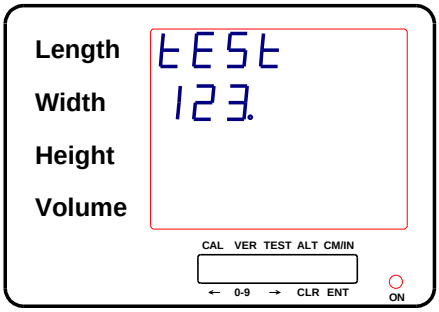
Press TEST

Display on indicator unit:



Cursor is flashing

Data may now be entered. Use 0-9 to increment digit pointed to by cursor (Counts around from 0 to 9 through space), and use the arrow keys to select the next digit:

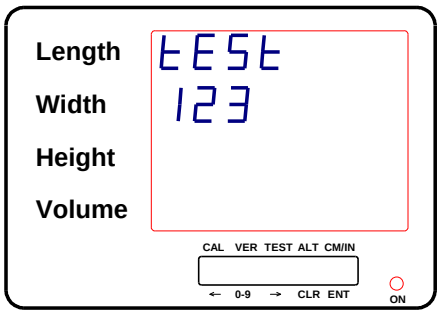


Value 123 is entered

Press ENT to execute the test function with this parameter. CLR will abort numerical input and allow for new selection of function.

Throughout this manual the example above will be denoted:
TEST123

Data displayed to indicator is written in the following format:



3.0 Communication protocol

Messages are transmitted to and from the Frame on HOST port as telegrams. Baud rate can be selected. Five different telegram formats are available.

Telegram format, number of start bits, number of stop bits and parity and timing for the telegrams depends on set-up of the Frame. This is described in chapter 5.

3.1 Baud rate

Baudrate is selected by two hardware jumpers on the M68EC000 CPU board. Switches ST1 & ST2 must be configured as following:

ST1	ST2	Baud rate
OUT	OUT	9600
IN	OUT	4800
OUT	IN	9600
IN	IN	19200

The CPU print in version 0012C has a printing error:
ST1=OUT, ST2=OUT baud rate is 9600 and not 2400

3.2 Telegram format

Selection of the optional sequence byte in the telegram formats are controlled by set-up. Refer to chapter 5.

The five different telegram formats are:

A: Standard telegram format

<STX>[<SEQ>]"Data"<ETX><CS><CR>

<STX> Start of text character (02 HEX).
<SEQ> Optional sequence byte. Controlled by set-up.
"Data" String with ASCII coded message.
<ETX> End of text character (03 HEX).
<CS> Checksum, computed so that the sum of all the characters in the message, including <STX>,<SEQ>, <ETX> and the checksum itself makes zero. The <CR> is not included in the checksum calculation.
<CR> Message terminator (0D HEX).

B: XOR checksum format #1

<STX>[<SEQ>]"Data"<CS1><ETX>

<STX> Start of text character (02 HEX).
<SEQ> Optional sequence byte. Controlled by set-up.
"Data" String with ASCII coded message.
<ETX> End of text character (03 HEX).
<CS1> Checksum, computed as exclusive or of all the bytes in the message including the SEQ byte, but not including the STX and ETX character.

C: XOR checksum format #2

<STX>[<SEQ>]"Data"<ETX><CS2>

<STX>	Start of text character (02 HEX).
<SEQ>	Optional sequence byte. Controlled by set-up.
"Data"	String with ASCII coded message.
<ETX>	End of text character (03 HEX).
<CS2>	Checksum, computed as exclusive or of all the bytes in the message including the SEQ byte, not including the STX and ETX character.

D: Telegram format D
For internal Cargoscan use only

E: Telegram format E
For internal Cargoscan use only

F: Telegram format F
For internal Cargoscan use only

3.3 Timing

In general all messages from the Frame represents events. Examples of such events are: An object enters the Frame; dimensions calculation are finished, e.t.c. There exists two different timing methods for transmission of messages from the Frame.

SEQUENTIAL timing: All events are reported in the sequence they occur.

TRUE timing. All events are reported on the moment when they occur.

The major impact from timing upon system behaviour is that for sequential timing reporting of events will be delayed when the Frame is busy calculating dimensions. This will be the case in a period of 10 to 200 msec after an object has left the Frame.

Example:

An “Object Start” message is transmitted when an object enters the frame. An “Object End” message is transmitted when it leaves the frame, and an “Object Data” message holding the dimensions is transmitted a few milliseconds later when the dimensions are calculated. In cases with high conveyor speed and short distance between objects, a new object may enter, and also possibly leave, the frame within the time window between the “Object Start” and “Object End” messages above. This new object generates new “Object Data” and “Object End” messages.

SEQUENTIAL timing:
The “Object Start”, and possibly the “Object End”, messages for the second object is delayed so that they are transmitted after the “Object Data” message for the first object. That is: All events are reported in the sequence they occur

TRUE timing:
The “Object Start”, and possibly the “Object End”, messages are transmitted immediately when the frame detects that the object enters/leaves the frame. “Object Start” and “Object End” messages may thus be transmitted in between the “Object End” and “Object Data” message of the previous object. That is: All events are reported on the moment when they occur.

4.0 Definition of messages on HOST port

This chapter does not apply when telegram formats D, E or F are selected.

All messages described here are ASCII coded. The telegram formats available are described in chapter 3.2. Parameters are encoded on fixed format with leading zeros after the message identity. All messages with parameters are defined below.

Optionally, some of the messages can be suppressed, so that they are not sent. This is controlled by set-up of the Frame. refer to chapter 5. the content of the telegrams can also be modified by set-up. We specially mention that a sequential parcel counter that may be used for parcel tracking may be selected.

4.1 Messages to Frame on HOST port.

VE Request for Frame to send a VE message with software version on HOST port.

ST Request for Frame to report status in a ST message on HOST port.

Refer to next chapter for documentation of VE and ST messages.

4.2 Messages from the Frame on HOST port.

Existing messages are:

CD Message transmitted continuously with 100 mm interval in conveyor movement. The message is enabled/disabled by a switch in the indicator unit.

MS General message with numerical code.

OA Measurement of object aborted. Reason for abortion given in numerical code.

OD Object is measured and dimensions calculated. The message holds object data as parameters.

OH Object has moved partly into the Frame. This optional message holds information about the highest height registered on the object until now.

OE Message that is transmitted immediately after the Frame detects that an object has passed out of it.

OS Message transmitted immediately after an object enters the Frame.

PU Message automatically transmitted from Frame when it is powered.

ST Response to a ST message (Status request) received on HOST port.

VE response to a VE message (Request for version) received on HOST port.

All messages are described in detail on the next pages:

CD Conveyor has moved 100 mm since the previous CD message received
The message is enabled/disabled by a switch inside the indicator unit.

MSppp General message

ppp Message parameter, ASCII-coded number (Described in appendix C)

OA[nn]aaa Measurement aborted.

nn Optional object counter, controlled by set-up.
aaa Abort reason (ASCII-coded number, described in appendix C)

The timing of this message is controlled by set-up parameter 3, Object Data delay, but slightly different for different abort codes:

Abort code	Explanation
120:	Transmitted immediately when small object detected.
121-127:	Transmitted when conveyor has reached specified position.
128:	Transmitted when conveyor has reached specified position. Indicates that dimension calculation was not finished.

OE[nn] Message transmitted from Frame when parcel leaves the Frame. The message is enabled/disabled by set-up.

nn Optional object counter, controlled by set-up.

The timing of this message is controlled by set-up.

OS[nn] Message transmitted from Frame when parcel enters Frame. The message is enabled/disabled by set-up.

nn Optional object counter, controlled by set-up.

The timing of this message is controlled by set-up.

OH[nn][hhhh] Optional message transmitted when object has moved partly into the Frame. The message is enabled/disabled by set-up. This parameter also controls when the message is transmitted.

nn Object counter, controlled by set-up.

hhhh The highest height measured on the object until the message is transmitted. The height is measured relative to the lowest sensor in the vertical bar.

This message is always transmitted with TRUE timing, independent on what set-up is set to.

OD[nn]u<measurement data>

Message holding data for parcel measured. The parameter u tells the units of the measurement data, and the format of the rest of the message depends on the units:

u: M = Metric units, 1 cm resolution
m = Metric units, 5 mm resolution
I = Imperial units, 0.1 inch resolution

Message format for Metric units, 1 cm resolution:

```
OD[nn]ulllwwwhhh[rrrr][VVVV][oooLLLPPPWWW]
```

nn:	Object counter, controlled by set-up.
u:	M for Metric units, 1 cm resolution
lll:	Parcel length [cm]
www:	Parcel width [cm]
hhh:	Parcel height [cm]
rrrr:	Irregularity measurement [0.1 cm]
VVVV	Parcel volume[0.1 dm^3], controlled by set-up.
ooo:	Parcel orientation [with sign], controlled by set-up.
LLL:	Overall length [cm], controlled by set-up.
PPP:	Transverse position [cm], controlled by set-up.
WWW:	Overall width [cm], controlled by set-up.

Message format for Metric units, 5 mm resolution:

```
OD[nn]ullllwwwwhhhh[rrrr][VVVV][oooLLLLPPPPWWWW]
```

nn:	Object counter, controlled by set-up.
u:	m for Metric units, 5 mm resolution
llll:	Parcel length [mm]
wwww:	Parcel width [mm]
hhhh:	Parcel height [mm]
rrrr:	Irregularity measurement [0.1 cm]
VVVV	Parcel volume[0.1 dm^3], controlled by set-up.
ooo:	Parcel orientation [with sign], controlled by set-up.
LLLL:	Overall length [mm], controlled by set-up.
PPPP:	Transverse position [mm], controlled by set-up.
WWWW:	Overall width [mm], controlled by set-up.

Message format for Imperial units, 0.1 inch resolution:

```
OD[nn]ulllwwwhhhooo[rrr][VVVV][LLLPPPWWW]
```

nn:	Object counter, controlled by set-up.
u:	I for imperial units, 0.1 inch resolution.
lll:	Parcel length [0.1 inch]
www:	Parcel width [0.1 inch]
hhh:	Parcel height [0.1 inch]
rrr:	Irregularity measurement [0.1 inch]
VVVV:	Parcel volume[0.01 ft^3], controlled by set-up.
ooo:	Parcel orientation [with sign], controlled by set-up.
LLL:	Overall length [0.1 inch], controlled by set-up.
PPP:	Transverse position [0.1 inch], controlled by set-up.
WWW:	Overall width [0.1 inch], controlled by set-up.

PUvvvv Power up message sent from Frame after power up.

vvvv Software version.

STppp Response to a ST message (Status request) received on HOST port.

ppp Message parameter (Described in appendix F)

VEvvvv Software version, sent form Frame after request from connected computer on HOST port.

vvvv Software version.

5.0 Set-up of Frame

A set of indirectly defined set-up parameters controls the behaviour of the Frame. These parameters are described in the chapter 5.1.1.

The values for the indirectly defined set-up-parameters are controlled by a set of directly defined set-up parameters described in chapter 5.1.2.

Displaying and changing values of the directly defined set-up parameters are described in chapters 5.2 and 5.3.

The set-up-parameters are protected by a switch in the indicator unit. Set-up parameters can not be changed when switch 1 in the display is in the protected position. Refer to appendix F. The purpose of this switch is to prevent unauthorised people from changing the set-up of the Frame.

5.1 Set-up parameters

The indirectly defined parameters I.1 through I.7 described first can not be selected directly. These parameters describes different features of the set-up, and parameter 2; Protocol number, described later allows selection between different sets of indirectly defined parameters.

5.1.1 Indirectly defined set-up parameters

Parameters defined indirectly by the directly defined set-up parameters.

I.1 Sequence byte (See chapter 3.2)
- 0: No sequence byte on telegrams
- 1: Sequence bytes on telegrams

I.2 Telegram format (See chapter 3.2)
- 0: Telegram format A
- 1: Telegram format B
- 2: Telegram format C
- 3: Telegram format D
- 4: Telegram format E
- 5: Telegram format F

I.3 Data bits and parity
- 7: 7 bits, even parity
- 8: 8 bits, no parity

I.4 Timing (See chapter 3.3)
- 0: SEQUENTIAL timing
- 1: TRUE timing

I.5 Object counter
- 0: No object counter
- 1: Use object counter

I.6 Object start
- 0: Do not send OBJECT START message
- 1: Send OBJECT START message

I.7 Object end
- 0: Do not send OBJECT END message
- 1: Send OBJECT END message

5.1.2 Directly defined set-up parameters

The directly defined set-up parameters are:

0 Tacho rate
Se description in standard documentation

1.1 Subtraction value length.
Value to be subtracted from length of all objects measured.
Minimum value: 0
Maximum value: 50

1.2 Subtraction value, width.
Value to be subtracted from width of all objects measured.
Minimum value: 0
Maximum value: 50

1.3 Subtraction value, height.
Value to be subtracted from length of all objects measured.
Minimum value: 0
Maximum value: 50

2. Protocol number.
Selection of protocol. The protocol number defines a subset of indirectly defined set-up parameters to be used, as shown in the table below.

Value	0	1	2	3	4	5	6	7	8
I.1 Sequence byte	0	0	1	0	0	0	0	0	0
I.2 Telegram format	A	A	D	E	B	C	A	A	F
I.2 Data bits and parity	7	7	8	-	7	8	7	7	-
I.4 Timing	0	1	1	0	0	0	1	0	0
I.5 Object counter	0	0	1	0	0	0	1	0	0
I.6 Object start	1	1	1	0	1	1	1	0	0
I.7 Object end	1	1	1	0	1	1	1	0	0

Minimum value: 0
Maximum value: 7

3. Object data delay
Specifies how many millimetres the conveyor belt shall move after the object has left the Frame before dimensions are transmitted. If set to zero, dimensions will be transmitted immediately after calculation is finished.

Minimum value: 0
maximum value: 2000

An OBJECT ABORT message with code 128 will be sent if dimension calculation is not finished when the conveyor reaches the specified position.

4. Object height delay
   Specifies how many millimetres the parcel shall move into the Frame before the OBJECT HEIGHT message is sent. If set to zero, no OBJECT HEIGHT message will be sent.

   Minimum value: 0
   Maximum value: 1000

5. Enable/disable additional data on HOST port
   0: Enable no additional data.
   1: Enable transmission of orientation, overall length, transverse position and overall width.
   2: Enable transmission of parcel volume.
   3: Combination of 1 and 2.
   4: Enable transmission of irregularity measurement.
   5: Combination of 1 and 4.
   6: Combination of 2 and 4.
   7: Combination of 1, 2 and 4.

Notice: Changing this parameter will influence on the format of the output on HOST port. In general the HOST port is connected to a computer that requires a specific output format from the CS5000 Frame to work properly. Thus, make sure that you insert the correct value for the actual installation in this parameter.

5.2 Displaying values of set-up parameters

In general a set-up parameter is displayed by pressing the CAL key and enter the number of the desired parameter. An exception for the tacho rate. Tacho rate is displayed by pressing the CAL key and pressing <ENTER>:

Display parameter 0, tacho rate:

Press CAL<ENTER>

Display output:

```
Tacho
35000
```

Display parameters 1.1 through 1.3, subtraction values:

Press: CAL1<ENTER>

Display output:

```
Sub         Leading text
   10       Parameter 1.1, subtraction value length
   10       Parameter 1.2, subtraction value width
   10       parameter 1.3, subtraction value height
```

Display parameter 2, protocol number:

Press CAL2<ENTER>

Display output:

```
Proto       Leading text
    0       Parameter 2, protocol number
```

Display parameter 3, object data delay

Press CAL3<ENTER>

Display output

```
DELOD       Leading text
  450       Parameter 3, Object data delay
```

Display parameter 4, Object height delay

Press CAL4<ENTER>

Display output

```
DELOH       Leading text
   50       Parameter 4, object height delay
```

Display parameter 5, Enable/disable additional data.

Press CAL5<ENTER>

Display output:

```
ALT         Leading text
    1       Parameter 5, enable/disable additional data.
```

5.3 Editing values of set-up parameters

NB: Error 148 indicates that one or more of the set-up parameters has illegal values, but it does not give information about which parameter(s) that holds invalid values. When getting error 148, carefully enter new values for ALL the set-up parameters.

NB: When finished changing set-up parameters: Always verify that set-up parameters are stored properly by reading them out as described in chapter 5.2 after switching the power off and on.

Make sure that switch 1 in the display is in the unprotected position before changing the set-up parameters. Set the switch in protected position when finished.

In general a set-up parameter is changed by pressing the CAL key and enter the number of the desired parameter. The new value to be inserted shall be entered after the parameter number, separated by space.

There are two exceptions: Parameter 0: Tacho rate. This is changed by entering the new value directly without the parameter number. (The new value must be minimum 100). Pressing CAL0<ENTER> will bring the Frame into automatic conveyor calibration.

Parameters 1.1 through 1.3 is changed by entering parameter number 1 and values for the three parameters separated by space in the same command.

Change parameter 0, tacho rate to 8460:

Press CAL8460<ENTER>

Display output:

```
Tacho
 8460
```

Change parameters 1.1 through 1.3, subtraction values to 10, 15 and 20 respectively:

Press: CAL 1 10 15 20<ENTER>

Display output.

```
Sub          Leading text
   10        Parameter 1.1, subtraction value length
   15        Parameter 1.2, subtraction value width
   20        parameter 1.3, subtraction value height
```

Change parameter 2, protocol number to 1:

Press CAL2 1<ENTER>

Display output.

```
Proto        Leading text
    1        Parameter 2, protocol number
```

Change parameter 3, object data delay to 0

Press CAL3 0<ENTER>

Display output

```
DELOD        Leading text
    0        Parameter 3, Object data delay
```

Change parameter 4, Object height delay to 80

Press CAL4 80 <ENTER>

Display output

```
DELOH        Leading text
   80        Parameter 4, object height delay
```

Display parameter 5, Enable/disable additional data to 0.

Press CAL5 0<ENTER>

Display output:

```
ALT          Leading text
    0        Parameter 5, enable/disable additional data.
```

6.0 Tacho calibration

To be able to measure correctly, the Frame must know the relationship between pulses from the tacho generator and movement of the conveyor. This relationship is called the TACHO RATE, and it is given in pulses/meter.

The Frame must be set in HIGH RESOLUTION MODE during tacho calibration and adjustment of skewing (chapter 7). The Frame is set in HIGH RESOLUTION MODE mode by pressing

TEST<SPACE><SPACE>1234

(without going into test mode) during parts of the tacho calibration and adjustment of skewing. When in HIGH RESOLUTION MODE, object dimensions are displayed with a resolution of .01 cm, and object orientation is shown on the 4. line of the display.

This mode also affects output on HOST port, and may cause errors on computers connected to the HOST port. Disconnect any computer connected to the HOST port if this is the case on the actual installation.

The Frame can be set back to NORMAL RESOLUTION MODE by pressing

TEST<SPACE><SPACE>4321

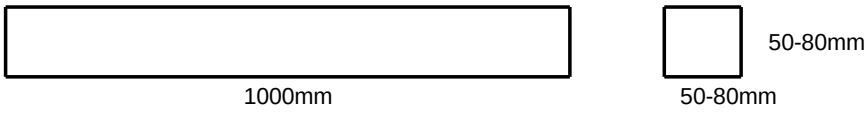
(without going into test mode) or by switching power off and on.

6.1 Definition of tacho rate

The tacho rate is defined as number of pulses that the tacho generator generates per 1000 mm movement of the conveyor.

The purpose of tacho calibration is to establish a correct value for the tacho rate. This is essential to achieve correct measurements.

A calibration object is needed to do conveyor calibration. This object should be a rod with a length of exactly 1000 mm (0.1 mm accuracy) and width and height of 50-80 mm to make sure it rests in a stable position on the conveyors.



Calibration object.

There are 3 functions to be used for tacho calibration:

1. Display current tacho rate

   Displays the current tacho rate on the indicator unit.

2. Automatic tacho calibration.
   The calibration object is brought through the Frame, and the Frame itself automatically computes and stores the tacho rate afterwards. Regrettably this function has a poor accuracy. Refer to 4.4 for procedure.

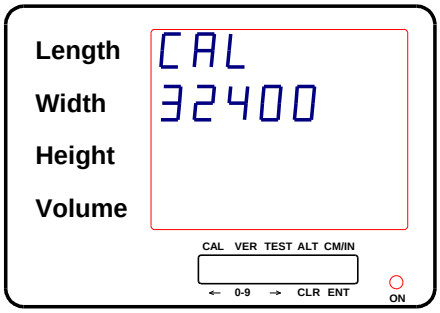
3. Manual tacho calibration
   The tacho rate to be used and stored is manually entered through the keys on the indicator unit. This method is used when the tacho rate is known in advance.

Automatic tacho calibration can not be used directly, as this function has too low accuracy. The value achieved here can only be used as a starting point. Refer to 4.4 for complete procedure.

6.2 Display current tacho rate

To review the current tacho rate, the following sequence should be performed on the CS2200 Indicator:

Push CAL + ENT and the value is displayed on the indicator.

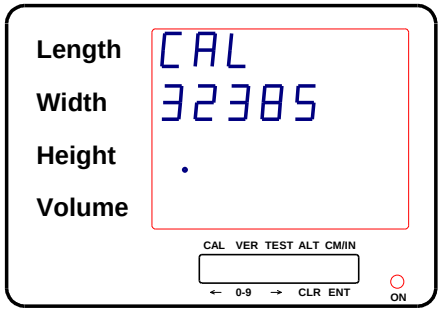


The tacho rate, here 32400 pulses/meter is displayed.

6.3 Manual tacho calibration

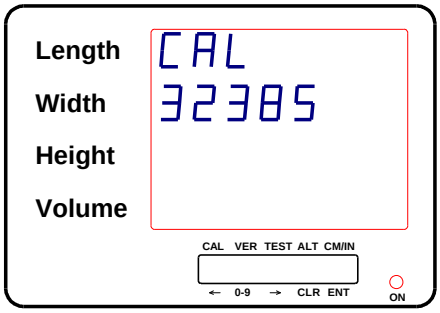
This function sets the value of the tacho rate from the keys on the CS2200 Indicator:

Push CAL and enter the numerical value desired as the tacho rate:



Value is entered manually
"." is flashing cursor.

Press ENT when the value is entered. The entered value will then be stored and displayed on indicator unit:

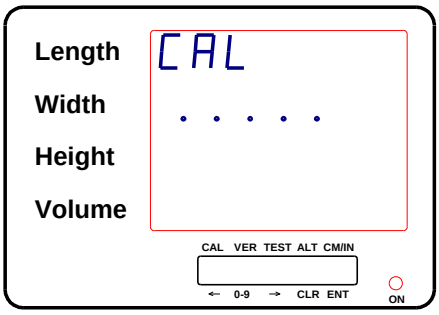


New calibration rate in
pulses/meter is displayed.

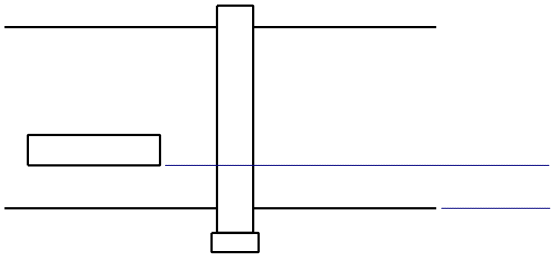
6.4 Automatic tacho calibration

Automatic tacho calibration means that the special calibration object is measured by the system, and based on that measurement, the system itself calculates the tacho rate. Proceed as follows:

Push CAL and enter the numerical value "0" before pushing ENT. This picture will then be shown on the indicator unit:

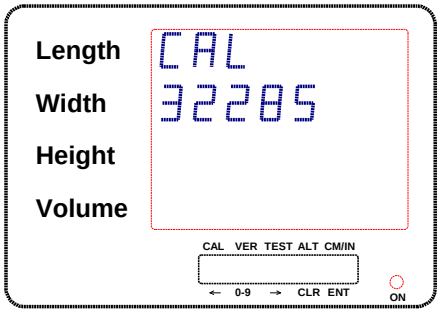


Start the conveyors and let the calibration object go through the Frame. The calibration object must be oriented along the transport direction as shown below:



Orientation of calibration object during automatic tacho calibration.

When finished, the tacho rate is stored in non-volatile memory and displayed:



Calibration can be terminated anytime by pushing CLR, "Abort" is then written on the indicator.

Due to the low accuracy of this function, the found value for the tacho rate can not be used directly. Refer to the next chapter for a procedure for tacho calibration.

6.5 Procedure for tacho calibration

Follow the procedure below:

1. Set switch 1 in the indicator unit in unprotected position to allow tacho calibration.

2. Do one series of 20 automatic tacho calibrations, using the calibration object with a length of exactly 1000 mm. Write down the tacho rate found in each calibration.

3. Calculate the average value from the 20 tacho calibrations done, and set this into the Frame using manual tacho calibration.

4. Verify that the Frame measures correctly, by repeated measurements of the calibration object with orientation as described in the figure in chapter 6.4. Set the Frame in HIG RESOLUTION MODE (see chapter 6.0) during measurements to achieve maximum resolution. Most readings of the 1000 mm calibration object should be near 1000 mm and on average have as many readings close to 1005 mm as close to 995 mm. If this is not fulfilled, adjust the value of the tacho rate by small steps to improve the measurement accuracy.

5. Set jumpers in indicator unit to prevent tacho calibration.

Remember adjustment of skewing after tacho calibration.

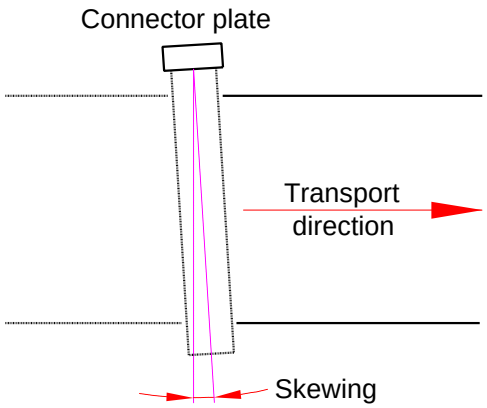
7.0 Adjustment of skewing

After tacho calibration, the skewing should be adjusted.

This is done by doing two measurement series of the test object. Each series should consist of minimum 15 measurements, and the orientation of the test object is different in the two measurement series. The skewing is adjusted until there is no systematically difference between the measuring result in the two measuring series. The Frame should be set in HIGH RESOLUTION MODE during these measurements.

7.1 Definition of Skewing

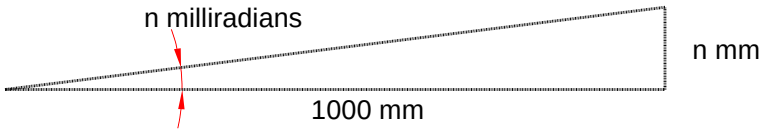
The skewing is defined as the angle between the bottom bar of the Frame and the transport direction. This is indicated on the figure below:



The skewing angle has its corner point on the connector plate side of the Frame, and it is defined as positive when the Frame is "pointing" in the same direction as the transport direction, as described in the figure above.

The optimal value for the skewing is 1-5 mRad. dependent on conveyor speed.

An angle of n milliradians has an opening of n mm when the arms of the angle is 1 meter long, as described in the figure below:



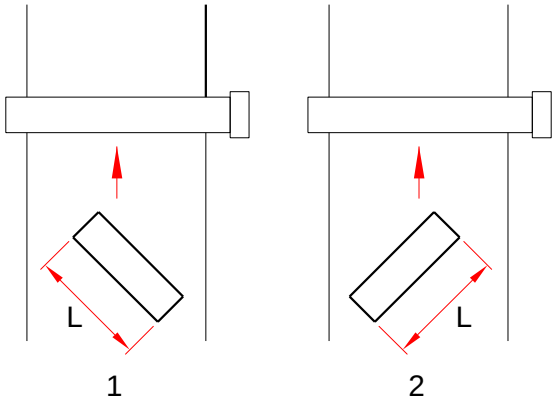
7.2 Definition of orientations during adjustment of skewing.

We define two orientations to be used for the test object during adjustment of the skewing:

Orientation 1: The test object is oriented 45 degrees to the transport direction, with the front end pointing away from the connector plate.

Orientation 2: The test object is oriented 45 degrees to the transport direction, with the front end closest to the connector plate.

Examples of these orientations are shown below:



Orientation 1 Orientation 2

Procedure for mechanical adjustment of the skewing is described on next page:

7.3 Procedure For Mechanical Adjustment Of The Skewing

Set the Frame in HIGH RESOLUTION MODE, as described in chapter 6.0 before adjustment of skewing, to achieve maximum measurement resolution during adjustment. Remember to set it back to NORMAL RESOLUTION MODE afterwards.

1. Do two measurement series with the object, one with orientation 1 and one with orientation 2. The angle need not be adjusted exactly to 45 degrees on each measurement. Each series should be minimum 15 measurements long.

   Write down the measured length of the test object for all the measurements in the two series.

2. The Frame is correctly mounted if there is no systematic difference between the length found in the two series.

   If the length in series 1 is systematically smaller than that of series 2, the skewing should be decreased.

   If the length in series 2 is the smallest one, the skewing should be increased.

Adjust the skewing with 0.5 milliradian in the wanted direction.

Repeat step 1. and 2. until there is no systematic difference between the length measured in series 1 and 2.

When finished, make sure that the Frame is mounted in a stable ways, so that the Frame will not move over time. Then set the Frame to the wanted resolution and unit.

8.0 Test procedures

8.1 Entering test mode.

To execute any tests, the CS5000 must be set in test mode by pressing:

TEST <SPACE> <SPACE>

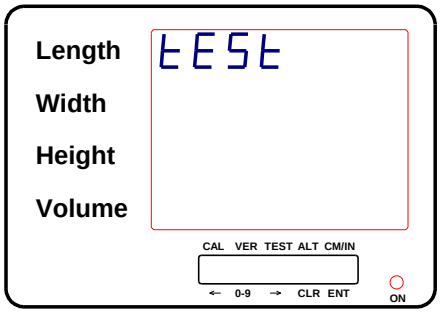
Press TEST, then --> twice to enter two spaces before pressing <ENT> to execute the command.

8.2 Operating in test mode

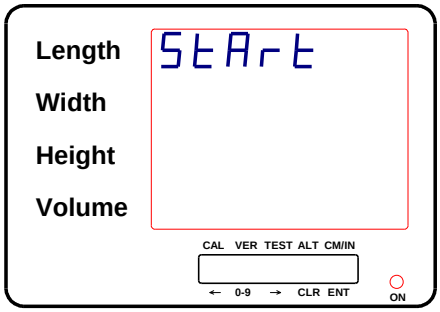
General selections of functions in test mode:

TEST123 <ENT>	Select test function indicated by string.
ALT	Show more test data
CM/IN	Stop current test.
TT<ENT>	Repeat last test.

While being in test mode, the text:



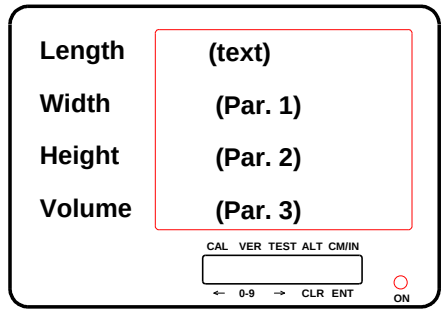
is shown on the indicator unit. While executing the tests, the text:

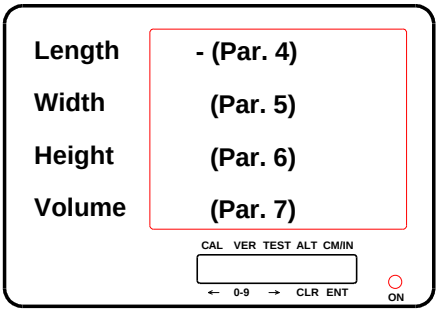


is displayed. This is overwritten by test data when the test is finished. In general the START text will be overwritten immediately.

For most tests, there is not enough space for all parameters on the indicator unit. The parameters are written on more "pages", each page containing four lines that can be displayed on the indicator unit.

Example of test with two pages





Start of 2nd page.
Press ALT to see this page

New page is indicated by the '-' on the first line. The operator must press ALT to see the nest page. When all pages are shown, ALT will bring back the first page with test data.

8.3 Exit from test mode.

There is two ways to get “out of test mode”:

1. Execute test 0.
2. Power down the Frame and power up.

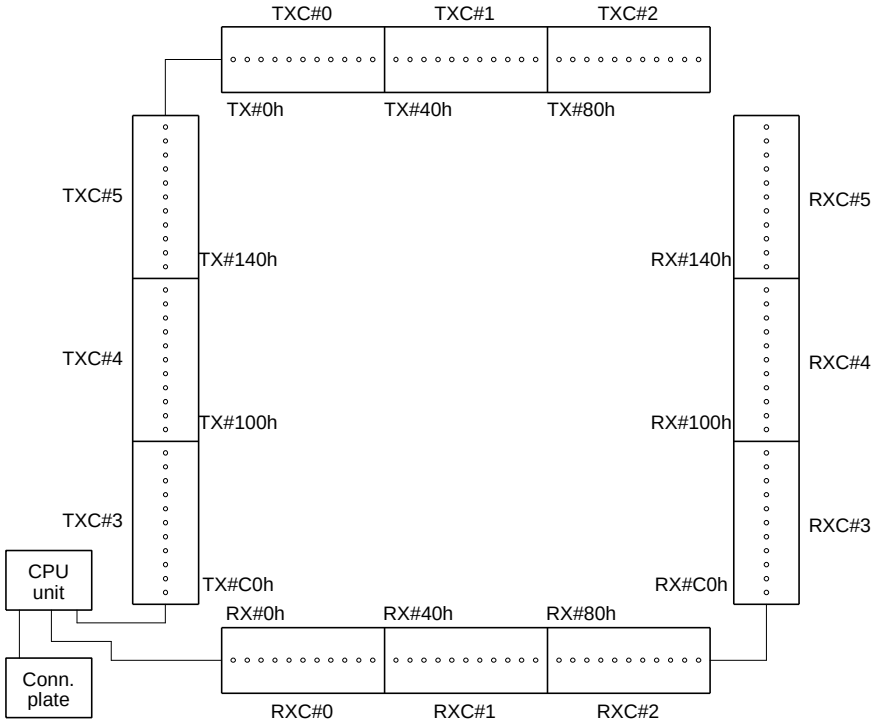
8.4 Available tests

Available tests are:

TEST	Repeat last test
TEST0	Hardware reset of Frame. The only way to exit test mode.
TEST11	TMS hardware test.
TEST13	Edge detection.
TEST15	Defective pixels.
TEST16	Defective pixels tested skewly.
TEST17	Exposure times.
TEST18	Continuos scanning, TMS mode.
TEST22	Calibration data for all boards
TEST3	Self-test CPU unit
TEST31	Show software revisions
TEST4	Test HOST port
TEST5	Tacho-test
TEST7	Continuos scanning, 68k mode
TEST7.1	Continuos edge detection
TEST81	Read parcel counter
TEST82	Set parcel counter
TEST9	Continuos edge detection test
TEST91	Defective light and dark pixels
TEST92	Defective light and dark pixels tested until defect occurs
TEST93	Repeated defective light and dark pixel counting errors.

Tests 91, 92 and 93 are available on software versions 5160 and newer for the 68k CPU board. These tests also require software version 9613 or newer on the I960 CPU board.

8.5 Pixel and board numbering



The figure shows how boards and pixels are numbered on a 96*96 cm Frame. On the figure we have:

TXC #n	Transmitter board n
RXC #n	Receiver board n
TX #n	Transmitter n
RX #n	Receiver n

Only the first transmitter/receiver on each board is indicated. These modules are numbered sequentially on the boards.

By pixel n, we interpret the pair of receiver n and transmitter n.

In general we have:

- Pixel zero is on the horizontal bar, nearest the connector plate.
- Pixels are numbered sequentially along the horizontal bar.
- When reaching the end of the horizontal bar, pixel numbering will continue on the lowest pixel of the vertical bar.
- The pixel number is often called the pixel address.
- Pixel numbers are in hexadecimal number system. In appendix I there is a table to translate hex numbers to decimal.
- Boards are numbered similarly.

Note that:

- Each board holds 40h pixels (64 decimally).
- One board covers 32 cm along its bar (5 mm per pixel).
- Both pixel and board numbering starts on zero.
- Throughout the tests pixel numbers and board numbers are coded hexadecimal.

A table that convert decimal to hexadecimal are found in appendix I.

To compute on which board a given pixel is found, use the table below:

Pixel no	Board no
00h to 3Fh	0
40h to 7Fh	1
80h to BFh	2
C0h to FFh	3
100h to 13Fh	4
140h to 17Fh	5
180h to 1BFh	6
1C0h to 1FFh	7
e.t.c.	

Example: Pixel BAh is found on board #2. The pixel number on the board is found by subtracting the pixel number from the number of the first pixel on the board. BAh - 80h makes 3Ah, which is 58 decimally. The pixel is thus pixel 58d on the board, and it is displaced 290 mm from the start of the board (5mm/pixel).

Remember that the first pixel on a board is pixel #0 on that board. Pixels are numbered on the silk print of the RX/TX boards.

HINT: The Windows calculator calculates hexadecimal numbers. Press the Hex button in scientific mode.

8.6 Description of tests and test data.

8.6.1 Repeat Last Test

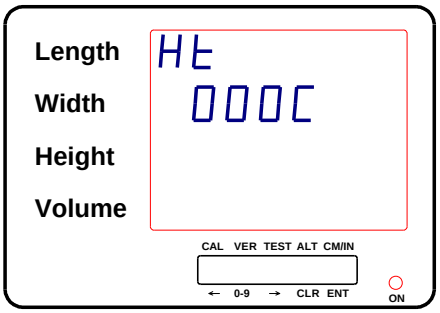
Syntax: TEST
Purpose: Simple way of repeating last test
Output: Se documentation of actual test

8.6.2 Hardware Reset

Syntax: TEST0
Purpose: Hardware reset of CS5000. Only way to bring CS5000 out of test mode.
Output:

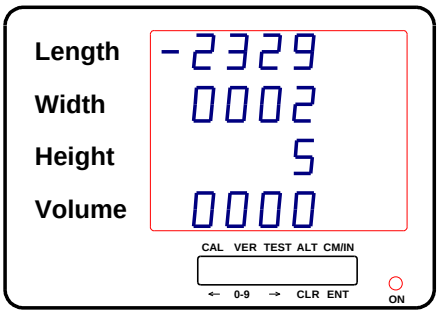
8.6.3 TMS Hardware Test

Syntax: TEST11
Purpose: Hardware test of TMS32010 and RX/TX boards.
Output: Example for 2*3 Frame listed and explained below.



HT Message identity

000C #parameters in message

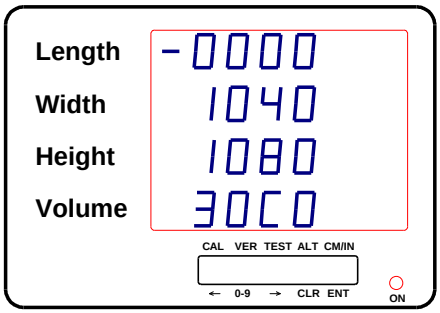


TMS software version (hexcoded)

Edge detection criterion

Calibration parameter

RAM test

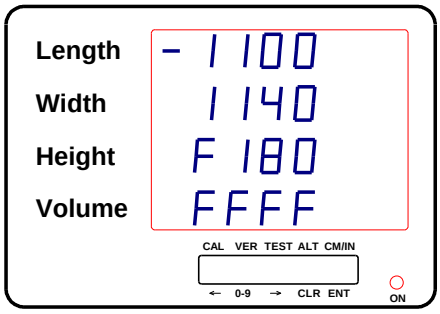


EPROM test

1. Status word

2. Status word

3. Status word



4. Status word

5. Status word

6. Status word

End of information

Number for status word should in general be the same as number of pairs of RX/TX boards in Frame. All parameters including status word are explained on the next page.

# parameters in message:	Number of parameters following after the first page.
TMS software version:	Version number in TMS computer, coded hexadecimal. Version 2329h is 9001 decimally
Edge detection criterion:	Internal filtering parameter for edge detection. Of no interest for service.
Calibration parameter:	Internal system parameter used to calculate exposure times for each individual pixel. Of no interest for service.
RAM test:	Read/write test of internal RAM on TMS CPU. 0 indicates RAM OK.
PROM test:	Checksum test of PROM on TMS computer. 0 indicates PROM OK.
Status words:	Each status word represents one pixel in the Frame. However the status word is only displayed for the first pixel on each board, and for other pixels where irregularities are detected.

The three least significant digits of the status word contains the pixel number, coded hexadecimal.

Example: 1100 is status word for pixel number 100h (256 decimally).

The most significant digit holds information about whether the pixel is the first pixel on a new board, on a new bar or if we have passed the last pixel in the Frame:

The Bits of the first status digit:

0: New board
1: New bar
2: Passed last module RX
3: Passed last module TX

This makes the following codes indicate the situations above:

1: New board
2: New bar
4: Passed last modules RX
8: Passed last module TX

These codes can occur in any combination. The most common combinations, and the only combinations that will appear in a correctly configured and working Frame are:

3: New board and new bar.
(First pixel on new board and new bar).

F: Passed last module RX
Passed last module TX
First pixel on new board.
First pixel on new bar.
(This is a correct indication of the first pixel "after the last pixel in the Frame". This non-existing pixel is logically located as the first pixel on a non-existing board on a non-existing bar.

Status is displayed for all pixels where at least one of the status bits is not zero.

Test 11 will in case of mismatch in number of RX and TX boards provide some additional info. The old output for a 3x3 Frame was like this:

0000
1040
1080
30c0
1100
1140
F180
FFFF

The output will look like this if all boards are present in the Frame. If there is more TX boards than RX boards or v.v the Frame status (last word) will be:

FFF0 more RX boards than TX boards
FFF1 more TX boards than RX boards

The question: is the error in the first or second bar, is answered by the codes

New bar detected on TX side, but not on RX side.
New bar detected on RX side but not on TX side.

This code is written before the end bar tag (3xxx).

Case: First bar contains 4 RX boards, but only 3 TX boards.

Frame data:

0000
1040
1080
0001 This code says: New bar detected on TX side, but not on RX side
30c0
...
FFF0 Total Frame code: more RX boards than TX boards

Case: The first bar is OK. The second has more TX boards than RX boards.
Frame data:
0000
1040
1080
30c0
1100
1140
F180
FFF1 Total Frame code there are more TX boards than RX boards

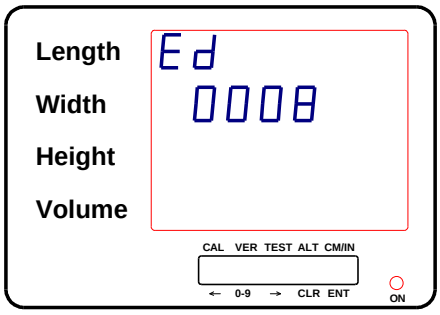
Since the code 0010 (New bar detected on RX-side, but not on TX-side) is missing, the error must be in bar 2.

Terminator:

FFFF No errors detected
FFFE Too many pixels stored
FFFD Too many pixels in Frame (or lack of last module signals).
FFF1 More TX boards than RX boards
FFF0 More RX boards than TX boards

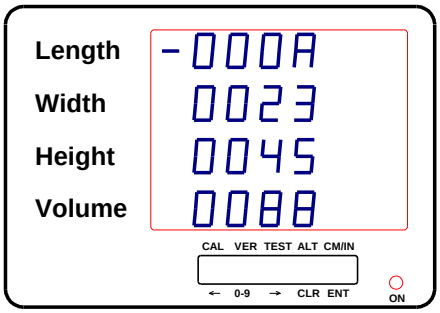
8.6.4 Edge Detection

Syntax: TEST13
Purpose: Edge detection on CS5000
Output:



Message identity

parameters in message

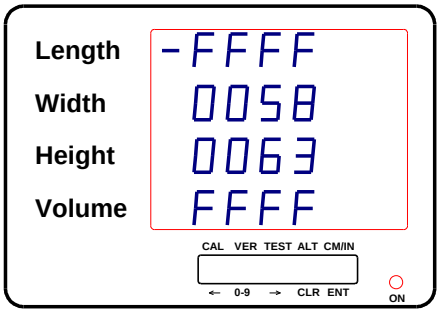


1. edge horizontal bar

2. edge horizontal bar

3. edge horizontal bar

4. edge horizontal bar



End horizontal bar

1. edge vertical bar

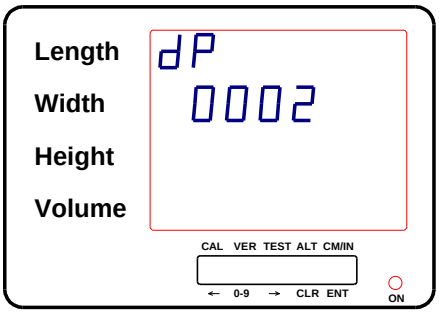
2. edge vertical bar

End vertical bar

All edges found in the two bars are reported. Number of edges depends on whatever is within the CS5000 when the test is executed.

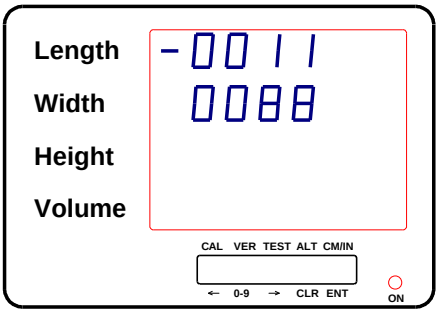
8.6.5 Defective Pixels.

Syntax: TEST15
Purpose: Spot defective pixels where there are no optical contact between receiver and corresponding transmitter.
Output:



Message identity

#defective pixels

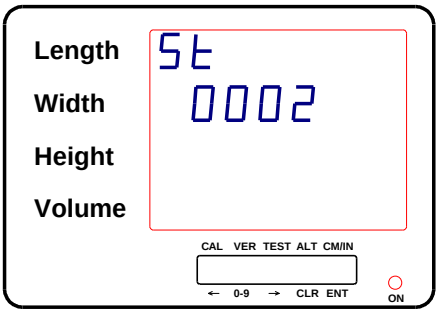


Addresses of defective pixels

Note: The test does not spot constant light pixels. Use test 91 to spot constant light pixels.

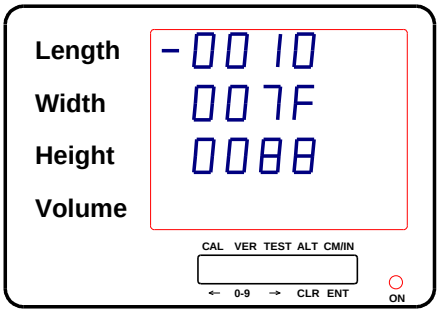
8.6.6 Defective Pixels Tested Skewly

Syntax: TEST16
Purpose: Tests pixels as in the previous test, except Transmitter 0 flashes when receiver 1 is tested, and in general receiver i+1 is activated when transmitter i is lightened when receiver i +1 is tested.
This test only spots defective dark pixels.
Output:



Message identity

defective pixels



Addresses of defective TX pixels

The test is not working properly for the last pixels on each bar. This test can be used in conjunction with the pixel test described above to tell whether a defective pixel is caused by a defective receiver or a defective transmitter.

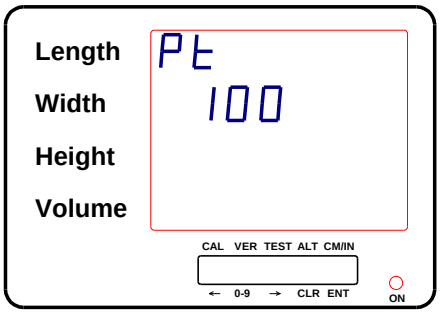
Defective transmitter: Address of defective pixel is the same in skew test and ordinary pixel test.
Defective receiver: Address of defective pixel is one lower in skew test than in ordinary pixel test.

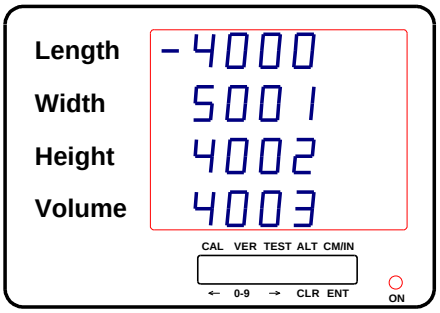
If we look at the results in the example above and the result from the defective pixel testing earlier together we notice that:

Pixel #11 has a defective receiver
Pixel #88 has a defective transmitter.
Pixel #7F is the last pixel in horizontal bar, not tested OK skewly.
(Neither is the last pixel in the vertical bar tested properly in this test).

8.6.7 Exposure Times For All Pixels

Syntax: TEST17
Purpose: Display exposure times for all pixels.
Output:

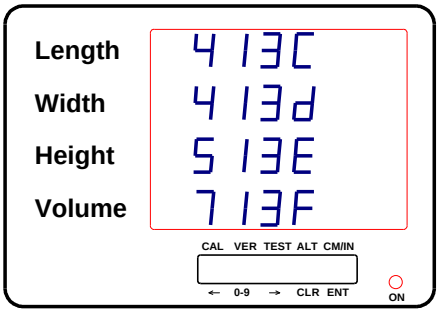




Exposure time pixel #0 is 4

Exposure time pixel #1 is 5

etc.



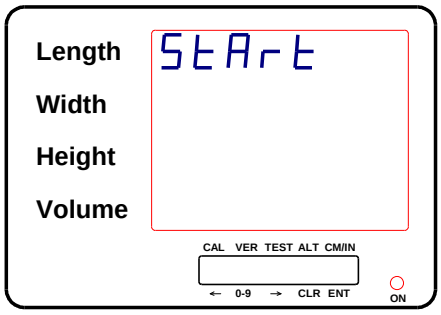
Exposure time pixel #13C is 4

etc.

Exposure time is coded into most significant nibble of the data word.
Pixel no. is coded into the three least significant nibbles.

8.6.8 Continuos Scanning TMS Mode

Syntax: TEST18.
Purpose: Starts continuos scanning of all pixels, controlled by the TMS computer
Output:



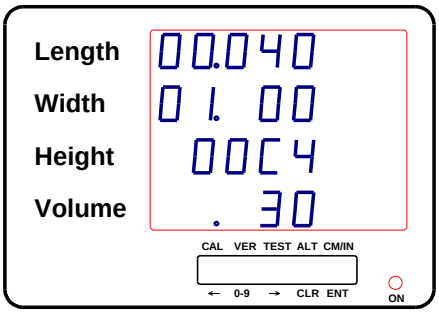
The purpose of this TEST is to allow hardware debugging using an oscilloscope on the boards. The output to the display has no significance.

Press CM/IN to return to test mode.

8.6.9 Calibration Data For All Boards In CS5000

NB: This test will not display correct test results if it is executed after test 17 (Pixel times). In that case, reset the Frame before executing the test.

Syntax: TEST22
Purpose: Show calibration data for all boards in the CS5000
Output: One page for each board, showing:
- Board number
- Number of pixels in board.
- Threshold for the board.
- Exposure time used on this board.
- Number of defective pixels on the board, separated in:
  - Defective dark pixels.
  - Defective light pixels.

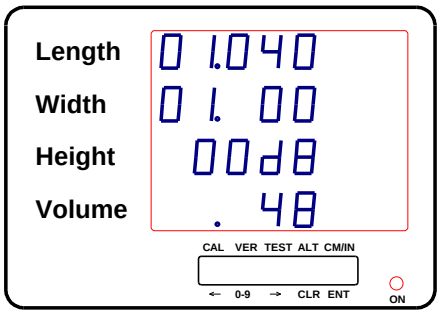


Board # #pixels on board

#dark defective #light defective

Exposure time on board

Threshold on board



Same data for next board

. Same data for all boards in the Frame.

All parameters are coded hexadecimal.

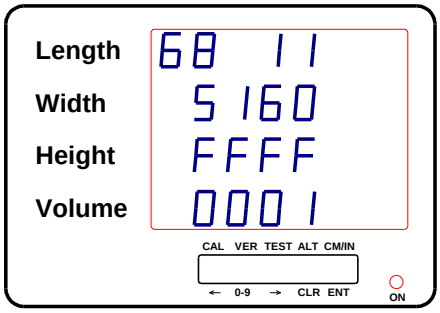
Board number is shown in the upper left corner of the indicator.
Number of pixels on each board should be 40h (64) for all boards.
A defective dark pixel is a pixel where light connection between RX and TX module is not detected during testing of the Frame.
A defective light pixel is a pixel where RX module detects light even when the corresponding TX module is not lightened.

In the example above, board # 1 has:
- 40h pixels
- 1 defective dark pixel
- 0 defective light pixel
- Exposure time of D8h*3.2 microseconds
- Threshold value of 48h

In general defective darks usually are caused by physical blocking of the length path or defective transmitters, defective lights are usually caused by defective receivers.

8.6.10 Self-test CPU Unit

Syntax: TEST3
Purpose: Execute self-test on CPU unit:
Output:



68 = ID, 11 = code

Software version

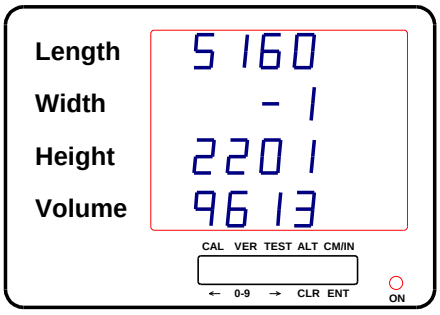
Prom checksum test (FFFF=OK)

RAM read/write test (1=OK)

ID		Test identity
Code:LSB	1	TMS CPU response on internal handshake line.
	0	No TMS CPU response on internal handshake line (replace CPU unit).
Code:MSB	1	Real time clock is inserted on 68k CPU board.
	0	Real time clock is not inserted on 68k CPU board. (Of no interest for service purpose; as this real time clock has no function)

8.6.11 Show software revision

Syntax: TEST31
Purpose: Show software revision
Output:



M68k Software version

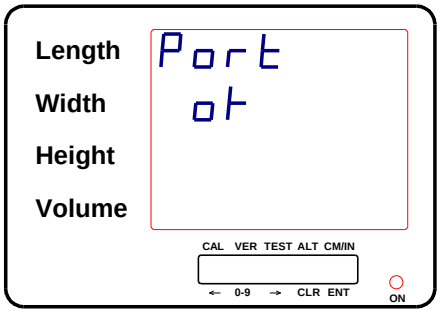
M68k revision number

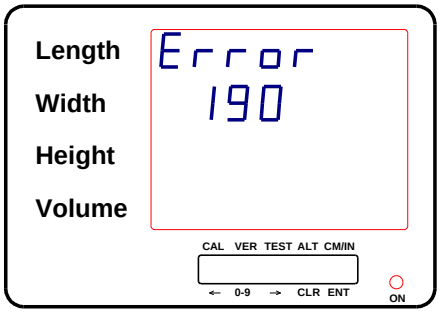
Indicator software version

Intel 960 software version

8.6.12 Test Host Port

Syntax: TEST4
Purpose: Test host port. Executed with host port looped (Pin 2-3, 5-20 are connected). Test is done by writing characters to host port and see if the same characters are received on the port.
Output:





Port is OK

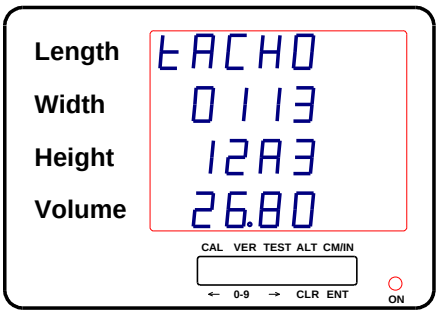
Port is not OK

Dependent on test result.

This test is modified when Telegram format D, E or F is selected, and does in that case not behave as described here.

8.6.13 Tacho-test

Syntax: TEST5
Purpose: Tests tacho interface. Counts tacho interrupts and tacho pulses received during 10 seconds. Also computes and displays average conveyor speed during this period.
Output: (After 10 seconds):



Test identity

Number of tacho interrupts

Number of tacho pulses (Hexadecimal)

Conveyor speed in m/minute

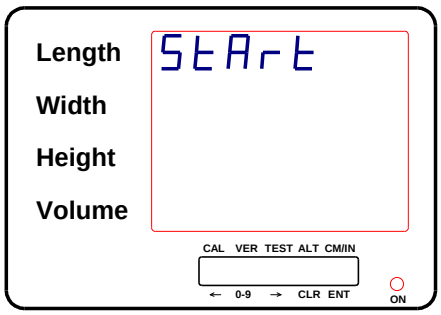
Conveyor speed will not be calculated correctly unless the Frame is correctly calibrated (tacho calibration). Conveyor speed is indicated as a decimal number.

Number of tacho pulses is a count of the pulses from the tacho generator. There will probably be overflow in this number so the value of the number has no direct significance. If number of tacho pulses is zero, however, no pulses are registered. This indicates a defective tacho, not tacho connected or tacho rotating in the wrong direction.

Number of tacho interrupts is incremented by one for each 5 mm conveyor movement during the test period.

8.6.14 Continuos Scanning 68k Mode

Syntax: TEST7
Purpose: Continuos scanning controlled by Motorola 68k CPU
Output:

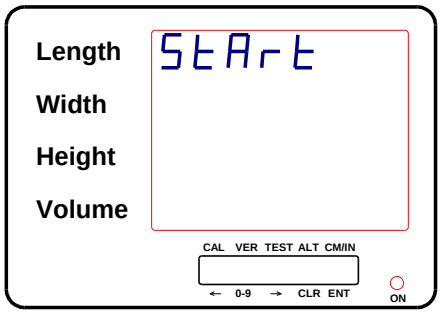


Aborted by pressing INC/CM

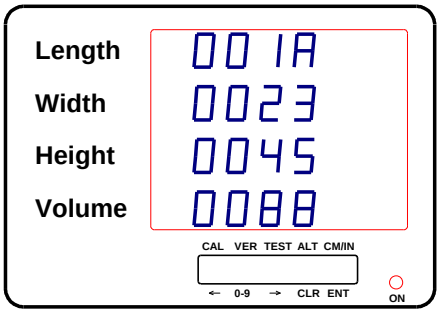
The purpose of test 7 is the same as the CONTINUOS SCANNING TMS MODE (TEST 18). It has special functions during Frame manufacturing.

8.6.15 Continuos edge detection

Syntax: TEST7<SPACE>1
Purpose: Continuos edge detection, displaying detected edges on the display.
Output:



When an object is intersecting the light curtains of the frame, the address of the first and last edge in horizontal end vertical bar is shown on in hexadecimal numbers on the display:



First edge horizontal bar

Last edge horizontal bar

First edge vertical bar

Last edge vertical bar

These edge addresses are updated when the intersecting object moves.

The test is aborted by pressing INC/CM

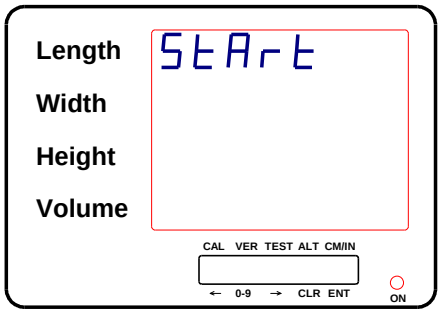
NB: This test does not work properly unless the switches on the TMS 960 CPU Board are set correctly. Refer to appendix E. With incorrect switch setting, the test works only when a part of the horizontal bar is blocked by the intersecting object.

Edges are not updated when the intersecting object is removed. The last edges detected will remain on the display after the object is removed.

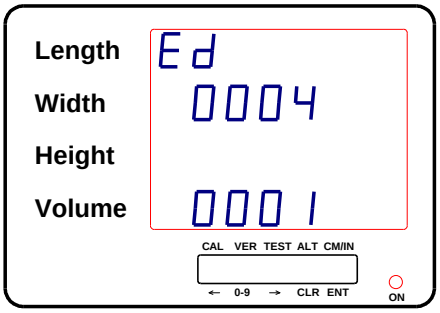
8.6.16 Edge detection Test

Syntax: TEST9
Purpose: Starts continuos edge detection, terminated on first scan where edges are detected. Then displays the edges found

Output when test is started:



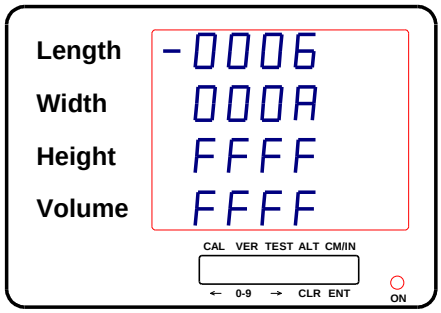
Then, when edges are detected:



Test identity

Number of data words in message

Internal CPU counter, not significant



Edges at pixel 6 and A

in horizontal bar

No edges in vertical bar

This test should be started with nothing inside the Frame. In theory edges should not be detected until something is placed inside the Frame. Then the pixel addresses where edges are detected will be displayed.

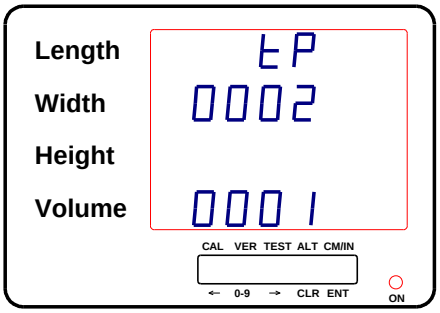
Edges detected when no object is within the Frame are called "false" edges. All Frames will detect false edges. These false edges are removed by filters during measuring. The false edges will occur more frequently on pixels with bad quality. This function is thus used for a quality control of the Frame:

- When starting this test on a good quality Frame, the average time between detection of false edges should be minutes.

- If false edges are detected immediately after the test is started, this probably is a pixel of poor quality. Read pixel address where the edges are detected to spot this pixel. The most probable reason for the bad pixel quality is that the light path of the pixel is partly broken. Look for dust, scratches in the glass cover, or a pixel that is partly blocked by the aluminium bridges in the profile cover. If this is not the case, bad quality on RX or TX module is the reason.

8.6.17 Defective light and dark pixels

Syntax: TEST91
Purpose: Spot defective pixels where there are no optical contact between receiver and corresponding transmitter.
Output: Pixel numbers for defective pixels
Reason for defective on defective pixels
Reason for defect is coded into the most significant digit:
0: Pixel is defective dark.
1: Pixel is defective light.
Pixel number is coded into the three least significant digits

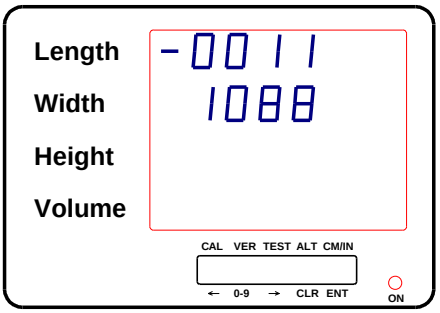


Test identity

Number of defective pixels

Internal CPU counter, not significant

Press ALT to see defective pixels



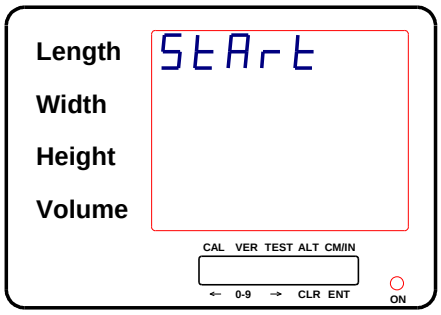
Addresses of defective pixels

In the example pixel 11h is defective dark, and pixel 88h is defective light.

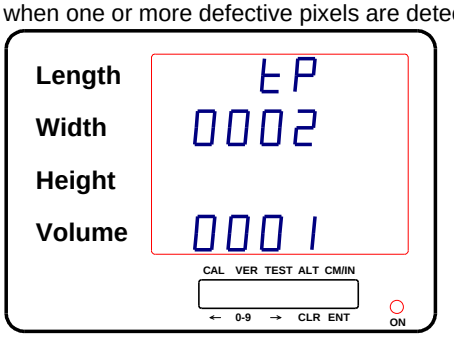
8.6.18 Defective light and dark pixels tested until defect occurs

SYNTAX: TEST92
Purpose: Spot defective pixels by repeating pixel test until a defective pixel is found. Does exactly the same testing as described during test 91. Testing is repeated over and over again until a defective pixel is encountered or CM/IN is pressed to return to test mode.

Output:



Then, when one or more defective pixels are detected:

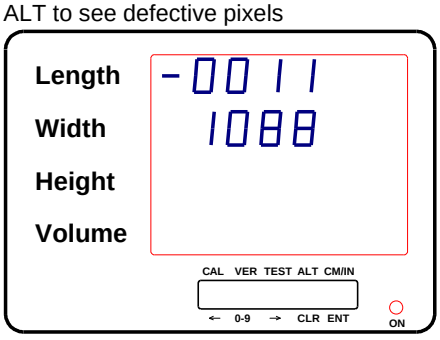


Test identity

Number of defective pixels detected

Internal CPU counter, not significant

Press ALT to see defective pixels

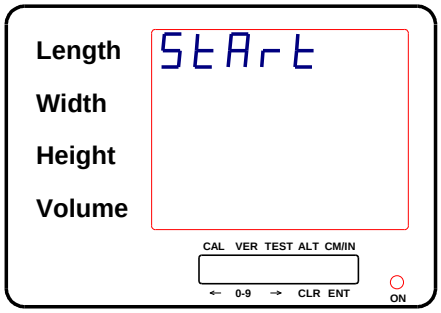


Addresses of defective pixels and reason for defect.

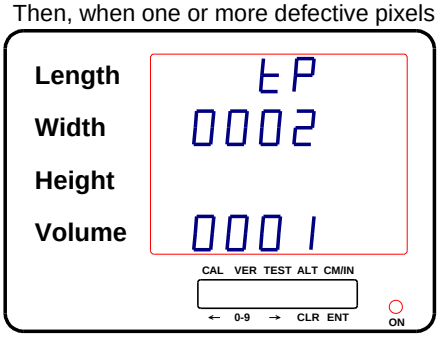
In the example pixel 11h is defective dark, and pixel 88h is defective light.

8.6.19 Repeated defective light and dark pixel test counting errors.

SYNTAX: TEST93
Purpose: Does exactly the same testing as described during test 91.
Testing is repeated over and over again and number of times defective pixels are detected is counted on the display. Test can be terminated by pressing CM/IN.
Output:



Then, when one or more defective pixels are detected:

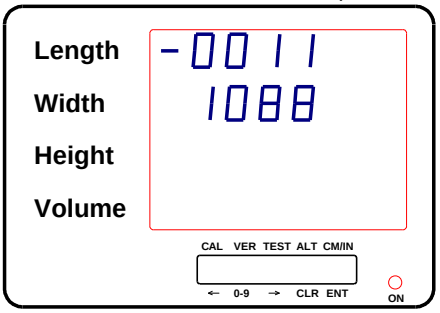


Test identity

Number of defective pixels detected

Counter for number of times defective pixels are detected.

Press ALT to see the defective pixels found the last time.



Addresses of defective pixels

In the example pixel 11h is defective dark, and pixel 88h is defective light.
Testing pauses for approximately two seconds when a defective pixel is detected.

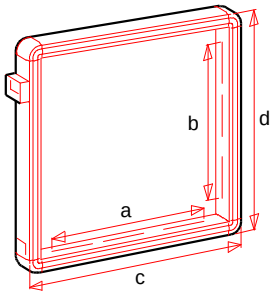
APPENDICES

A: Specifications Frame CS5000

The Frames exists in two versions:

Standard Frame	CS5000
High speed Frame	CS5000HS

The Frames are also manufactured in two sizes, Size 1 and Size 2, defined below



Models and part numbers:

DESCRIPTION	SUPPLY VOLTAGE	HOST INTERFACE	ORDER NO	PART NO
Standard Frame, Size 1, CS2200 Display, Host Cable, and Power cable	120VAC	RS-232	CS5000 0001	550333
		RS-422	CS5000 0011	550337
	220VAC	RS-232	CS5000 0002	550332
		RS-422	CS5000 0012	550334
Standard Frame, Size 2, CS2200 Display, Host Cable, and Power Cable	120VAC	RS-232	CS5000 0101	550443
		RS-422	CS5000 0111	550447
	220VAC	RS-232	CS5000 0102	550442
		RS-422	CS5000 0112	550444
High Speed Frame, Size 1, CS2200 Display, Host Cable, and Power Cable	120VAC	RS-232	CS5000 1001	550336
		RS-422	CS5000 1011	550339
	220VAC	RS-232	CS5000 1002	550335
		RS-422	CS5000 1012	550338
High Speed Frame, Size 2, CS2200 Display, Host Cable and Power Cable	120VAC	RS-232	CS5000 1101	550446
		RS-422	CS5000 1111	550449
	220VAC	RS-232	CS5000 1102	550445
		RS-422	CS5000 1112	550448

Specifications

	CS5000 x0xx (Size 1)	CS5000 x1xx (Size 2)
Weight	61 kg	77 kg
Outside dimensions (cxd)	1340x1340 mm	1660x1660 mm
Measuring field(axb)	960x960 mm	1280x1280 mm
Maximum object size	94x94x200 cm	126x126x200 cm
Minimum object size	100x50x2 mm	
Object spacing	50 mm	
Calculation time:	Time from object leaves frame until dimensions are present: Typical 40 msec Worst case 200 msec	
Object orientation	Place object with the most stable side down. No other orientation requirements.	
Operating temperature	-10° to +40°C.	
Voltage	230/115 AC ± 10% volts, 50/60 Hz.	
Humidity	10-80% non condensing	
Power requirement	Max. 100W	

Precision/Conveyor speed

Precision	Standard Frame		High speed Frame	
	Size 1 CS5000 00xx	Size 2 CS5000 01xx	Size 1 CS5000 10xx	Size 2 CS5000 11xx
±5 mm	0-100 m/min	0-100 m/min	0-180 m/min	0-150 m/min
±10 mm	100-150 m/min	100-150 m/min	180-200 m/min	150-200 m/min
±20 mm	150-200 m/min	150-200 m/min	-	-

B: Checklist for installation and service

Things to be checked during installation:

- Conveyors must be mounted in the same plane
- Bottom bar must be parallel to conveyor plane.
- Frame must be mounted vertically to conveyor plane.
- Conveyor calibration must be correctly done.
- Skewing must be correctly adjusted.
- Conveyors must not move into Frame.

Things to be checked during error search:

- All pixels (RX/TX pairs) should be OK.
- Power supply levels should be measured. These can usually be measured on HOST plug. Indicator and tacho should be connected for maximum load when measuring. For some interface version, power is not available on HOST plug, in that case a special cord between indicator and Frame, allowing power to be measured with indicator connected is needed.
  +5V supply is for CPU and tacho
  +5V supply is for indicator unit.
  +12V and -12V supply is for RX- and TX-boards.
  When adjusting 5V power, adjust to 5.1 Volts with only CPU unit connected to power supply.
- Check internal cables carefully, specially in the connector plate corner.
- Tachometer
  Good mechanical contact to conveyor.
  Must rotate in right direction
- Correct setting of Jumpers on TX boards.
  Self-test error if not mounted correctly.

Self-test done after power up:

The Frame goes through an intensive self-test after power up. This self-test includes:

- Read/write test of all RAM
- Checksum test of all PROM
- Function test of all RX/TX boards
- Test of all pixels in the Frame.

A successful self-test after power up nearly guarantees a well functioning Frame, however the following functions are not tested:

- Host port
- Tachometer and tachometer-interface.
- Key input from indicator unit

Most important test functions to be used:

- Tests to spot defective pixels.
- Find whether defect is on RX or TX side.
- Spot weak pixels (pixels with long exposure time).
- Tacho-test.
- Continuos edge detection.
  Should not indicate edges immediately
  (can be caused by conveyor partly into Frame).

Hints for troubleshooting:

The most common error situations are listed below.

Error code	Action
102	Light path between sensors are blocked. One or more sensors are defective. -use pixel test to spot defective pixels If all pixels are defective, check +/- 12 V power supply. If there are one, or a few, defective pixels at the end of a bar, the internal electronics inside the bar probably has slipped out of position.
151	Wrong number of TX or RX board connected. RX or TX boards are not strapped correctly. Corner cables are not connected. Not all cables are connected to RX/TX bars.

Other error situations.

Parcels are passing through the Frame without being measured.

- The tacho wheel is not in contact with the conveyor belt.
- The Tacho wheel is rotating in wrong direction.
- Tacho generator is defective or not connected.
  use tacho-test.

Parcels are measured with much to small dimensions.

- The tacho wheel does not have good contact with the conveyor.
- Tacho calibration is not done correctly.

System resets, does not measure properly, malfunctions.

- Check power supply for 5V and +/- 12V.

Indicator unit is blanking without reason.

- Conveyor belt is moving in and out of Frame when conveyor is moving.

Loose connectors around the connector plate may be the reason for communication problems e.t.c.

C: List of status messages and error messages

This is a complete list of all status codes displayed on the indicator unit and transmitted on the host port. In general the codes are transmitted to the host as a message with an identity and the code as a three digit parameter to the message. A message identity is listed along with each code. The messages are displayed as an error message with the code on the indicator unit.

Message identities are:

MS General message identity for messages from Frame to host computer.

OA Object abort, measurement of an object is terminated due to an error in measurement. Codes are described below.

ST Status message. These messages are an immediate response to a "status request" (ST message) received on the host port.

Some codes has both MS and ST listed as identity. The MS identity is used when the Frame is reporting an event that has happened (error detected in Frame e.t.c.), while the ST identity is used when the message is response to a status request on the host port.

Some codes has no identity (-), these messages indicate errors in operator entry on the keys on the indicator unit, and they are reported on the indicator only.

Message codes:

Code	Id.	Explanation	Action
3	MS ST	Internal error: Contact problems between neighbour RX boards or TX boards, corner cables or connections between RX/TX boards and CPU unit.	Check internal wiring.
4	MS ST	Internal hardware error on CPU unit	Check internal wiring.
50	MS	The Frame has received an unknown message. This message is received on one of the two serial lines, or it is generated internally by software. This error may sometimes occur during test procedures.	Check that the data host sends to Frame on host port is valid. Try to replace indicator unit or CPU unit if error is permanent.
51	MS	General ASCII decoding error on message received on serial line.	Check that the data host sends to Frame on host port is valid.

100	MS ST	Sensors OK. Transmitted when the Frame detects that the sensors are OK. This message cancels the error message with error code 102 indicating bad sensors. This message is not displayed on the indicator unit. The error message with code 102 is removed when the situation occurs. This is the response to a status request when the Frame is working normally.	
102	MS ST	Sensor error. One or more sensors are defective. The light path between one or several transmitters and their corresponding receiver may be blocked, or defective electronics may be the reason. It is also possible that the boards has moved physically inside the aluminium, so that the light path is blocked by the aluminium covers of the Frame.	Check that the light path across the Frame is not blocked by dust e.t.c. Refer to test procedures.
110 to 119	OA	Internal software error during volume calculations.	
120	OA	Object was to small to be measured. This message is not displayed on the indicator unit. The indicator unit will be blanked when this situation occurs.	Ignore object. It was so small that it should be regarded as noise.
121	OA	Object was outside measuring field on top or bottom of Frame.	Measure object over again
122	OA	Object was outside measuring field on one of the sides.	Measure object over again
123	OA	Combination of 121 and 122	Measure object over again
124	OA	Object was too long to be measured. (>3000 mm)	Measure object over again
125	OA	Combination of 124 and 121	Measure object over again
126	OA	Combination of 124 and 122	Measure object over again
127	OA	Combination of 121, 122 and 124	Measure object over again
128	OA	The object dimensioning was calculated too late. (Possible when set-up parameter 3 has a non zero value	
129	ST	Status was requested while Frame is executing the self-test functions after power up.	

130	MS	Measuring started. Transmitted after power up when the Frame has successfully finished self-testing and started measuring. This message is not displayed on the indicator unit. A picture with zero value for all dimensions and volume are displayed on the indicator when measuring starts.	
138		Illegal parameter during set-up	
140	MS ST	No indicator connected. The Frame is not able to get contact with the indicator unit.	Check serial line to indicator unit. Check cable to indicator unit. Check internal wiring and connector plate. Check RS-module on connector plate. Replace this RS-module. Replace indicator unit. Replace CPU unit.
141	MS	ASCII decode error when receiving tacho rate from indicator unit.	Check serial line between Frame and indicator unit. Check handshake lines specially. Check RS module. Replace this if necessary.
142	MS	Indicator has failed to store tacho rate in its non-volatile memory.	Replace indicator unit.
143	MS	An attempt has been done to do tacho calibration when the jumper in the indicator does not allow this.	Change jumper in indicator unit.
144	MS	General ASCII decode error on serial line from indicator unit.	Reset Frame. Check cable to indicator and internal cables in Frame. Try to replace indicator unit or CPU unit if error is permanent.
145	MS	Indicator has received a message from Frame with data errors in it.	Check cable to indicator and internal cables in Frame. Try to replace indicator unit or CPU unit if error is permanent.
146	MS	Indicator has received a message with checksum error from Frame.	Check cable to indicator and internal cables in Frame. Try to replace indicator unit or CPU unit if error is permanent.
147	MS	Indicator has received characters with parity error from Frame.	Check cable to indicator and internal cables in Frame. Try to replace indicator unit or CPU unit if error is permanent.

148	MS ST	Tacho rate stored in indicator or attempted to store during tacho calibration has a value that is to small to be accepted. Values of the tacho rate less than 100 pulses/meter is not accepted.	Do tacho calibration. Replace indicator unit if error is permanent.
149	MS ST	Checksum error in non-volatile memory in indicator unit. This memory is used for holding the tacho rate. Thus we have no valid value for the tacho rate.	Do tacho calibration.
150	MS ST	Self-test error on CPU unit. Error detected on Motorola 68000 CPU board.	Replace CPU unit. You can press ALT to see more data on the error. Refer to test procedures, TEST 3, for explanation of the data.
151	MS ST	Self-test error on TMS part of CPU unit or on RX/TX boards.	Press ALT to see test data. Refer to test procedures, TEST 11, for explanation of the data. Possible reasons for the error are: Wrong number of RX/TX boards connected; RX/TX boards not connected properly; Corner cables has fallen out; Errors on internal cabling of CPU; Jumpers ST5 and ST6 on RX and TX boards are not set correctly. refer to appendix E.
152	MS ST	Self-test error on CPU unit indicating no communication between the two parts of the CPU unit.	Replace CPU unit.
154	MS ST	Self-test error in read/write test of RAM in CPU unit during operation.	Reset system. Replace CPU unit if error is permanent.
155	MS ST	Checksum error in PROM in CPU unit detected during operation of Frame.	Reset system. Replace CPU unit if error is permanent.
156	MS ST	Checksum error in PROM in indicator unit. Detected during operation.	Reset system. Replace indicator unit if error is permanent.
157	MS ST	Error in RAM detected on indicator unit during operation.	Reset system. Replace indicator unit if error is permanent.
190	-	This errors is an immediate response to the test function for testing the host port when this test indicates that the port is not OK.	Refer to test procedures.

191	-	Error message given when operator enters an unknown test-code in test mode.	Enter test over again. Refer to test procedures.
192	-	An attempt to set the parcel counter using test function 83 is done. However, the new value for the counter was not entered properly.	Refer to test procedures for syntax to be used when entering the value.
193	-	The parcel counter in the Frame is checksum controlled. There is checksum error on this counter, so it does not hold a valid value.	Set the parcel counter to wanted value.
198	ST	Status was requested while Frame in test mode. Frame is set in test mode by operator during error searching, maintenance etc.	
199	ST	Status was requested while calibration of the pulse generator is done on the Frame.	

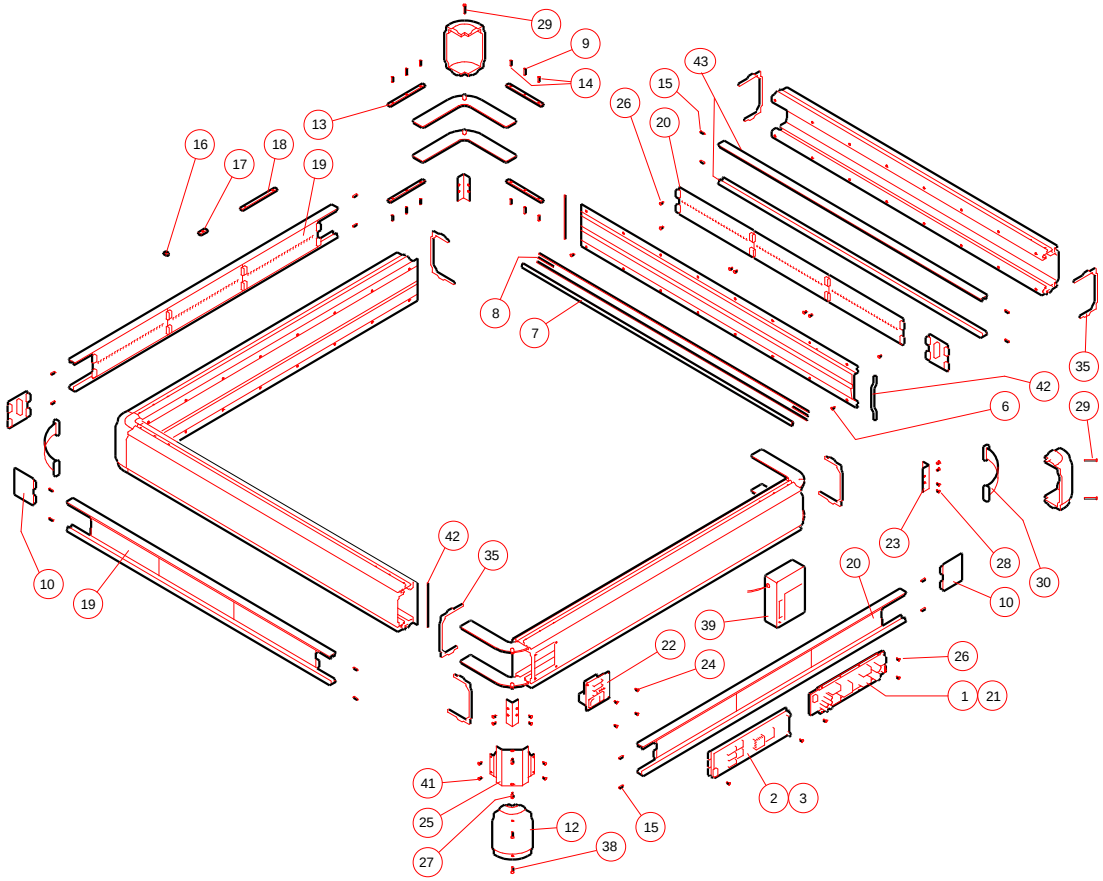
D: Spare part description list and drawings

Parts referred to in drawings:

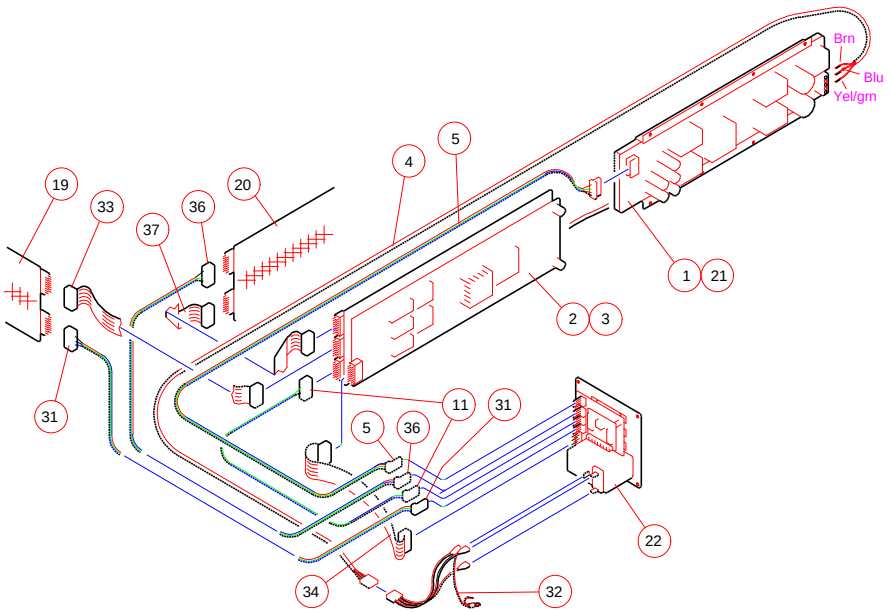
Index no.	Part no.	Description
1	300081	115V PSU
1	300079	220V PSU
2	650297	CPU LS Module CS5000
3	650293	CPU HS Module CS5000HS
4	653000	Cable AC-Mains
5	653001	Cable DC-Power
6	260140	Screw tapt M4x12 Din 7500D
7	220002	Acrylic glass 14, 7x1160mm
8	150003	Tape double-sided 5mm
9	260141	Screw set M6x10 Din 916
10	650283	Board HSMF Corner
11	653002	Cable TMS-Power
12	220061	Cover Corner
13	260013	Lock Rail
14	260017	Screw set M6x12 Din 916
15	260019	Screw set M5x15 Din 916
16	260006	Nut Spring M5 Knurr
17	260074	Nut Slide Short
18	260075	Nut Slide Long
19	650252	Board HSMF RX
20	650253	Board HSMF TX
21	300079	PSU module 687A 220VAC
22	650067	Connector Module ver.3B
23	220165	EMC Shield Inner Corner
24	260024	Screw M3x10 Din 912
25	220167	EMC Shield Outer Corner
26	260038	Screw Ø2, 9 x 6,5 Din 7981BZ
27	240100	Spacer SPA-02-SS-M4x10
28	260156	Screw Tapt M4 x 8 Din 7500D
29	260154	Screw M4x35 Din 7985
30	653009	Cable Corner 40L
31	653007	Cable RX-Power
32	653008	Cable AC-Input
33	653006	Cable RX-TMS
34	653003	Cable CPU-Peripherals
35	220137	Sealing Corner CS5000
36	653005	Cable TX-Power
37	653004	Cable TX-TMS
38	260158	Screw M4x20 Din 7985
39	650294	CS2200 MF Display
40	650017	Cable Host RS232
41		Screw
42		Sealing corner inner
43	220054	Rail for PCB (1130mm)
44	650038	RS232 module rev.3A

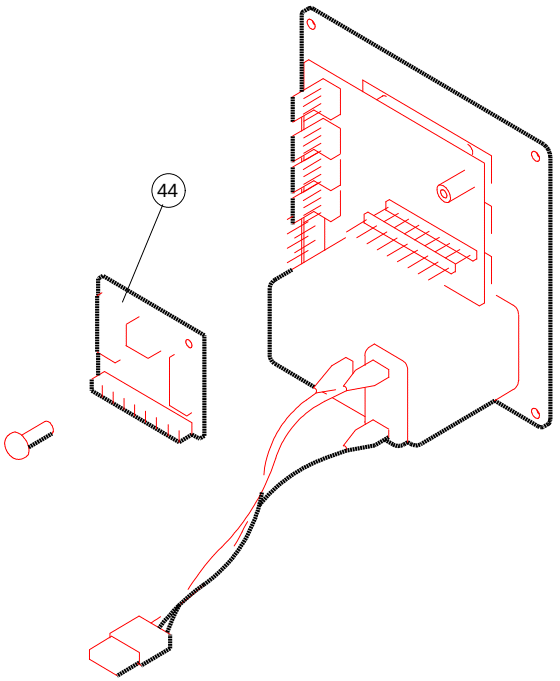
Please refer to enclosed drawings on page 57 and 58 of parts in Frame for location of spare parts.

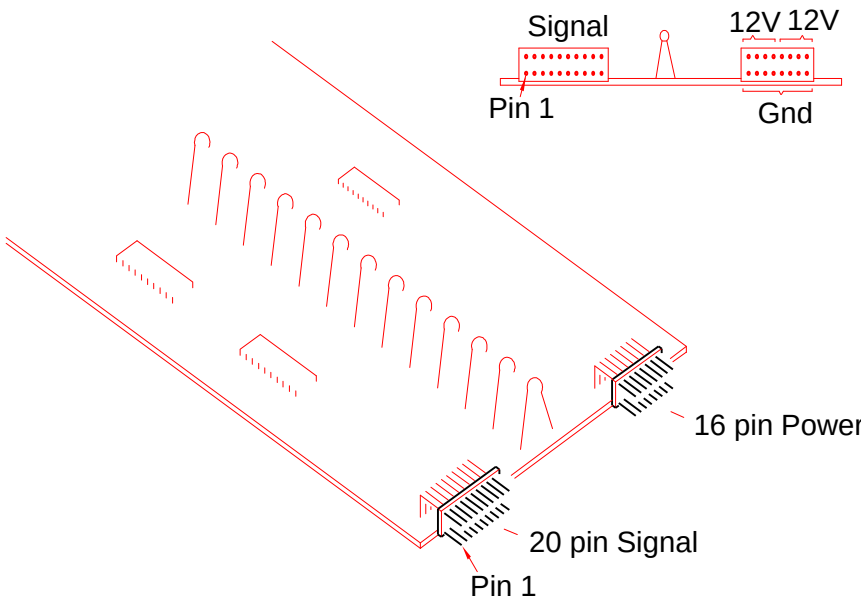
Drawing of Frame with spare parts number.



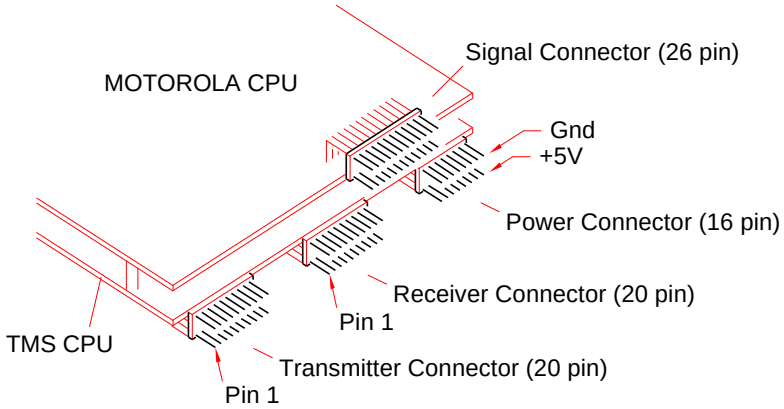
Drawing of internal wiring in CS500. No. on drawing refers to part list.







Transmitter/Receiver Board



CPU-Assembly Connectors

COMMENTS :

CABLE TYPE : PFSK 6x 0.22 W/SHIELD

CONNECTOR TYPE : END A :
END B :25PIN MALE D-SUB

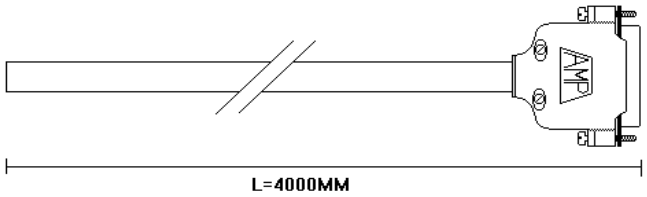
CABLE HOST RS232		CGS 045
DRAW NO. 40	ORDER NO. 650017	PAGE 1 OF 1

END A

NOTE!
SHIELDING TERMINATED
TO HOUSING

END B

NOTE!
SHIELDING TERMINATED
TO HOUSING



NOTE!
PIN 5 CONNECTED TO PIN 20.

END B

PIN 2 RED
PIN 3 BLUE
PIN 7 GREEN

CARGOSCAN A/S

REV. A95	
DATE 22.08.95	SIGN. A.J.S

COMMENTS :

CABLE AC-MAINS		CGS 047
DRAW NO. 5	ORDER NO. 653000	PAGE 1 OF 1

CABLE TYPE : PMH 2X 0,75 MM2 + J

CONNECTOR TYPE :

SIDE A: MATE`N LOCK 3 P FEM

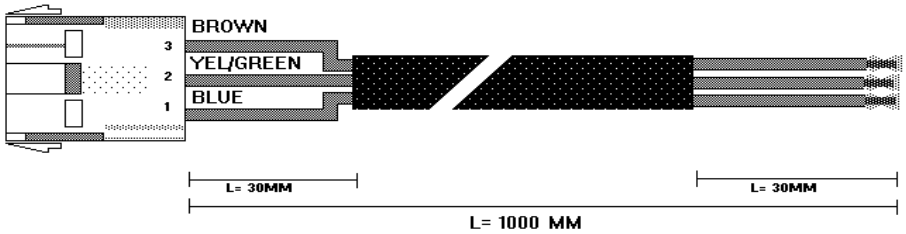
SIDE B: SPLICE 1015616 BC

END A

FEMALE CONNECTOR

MALE CRIMP TERMINAL

END B



CARGOSCAN A/S

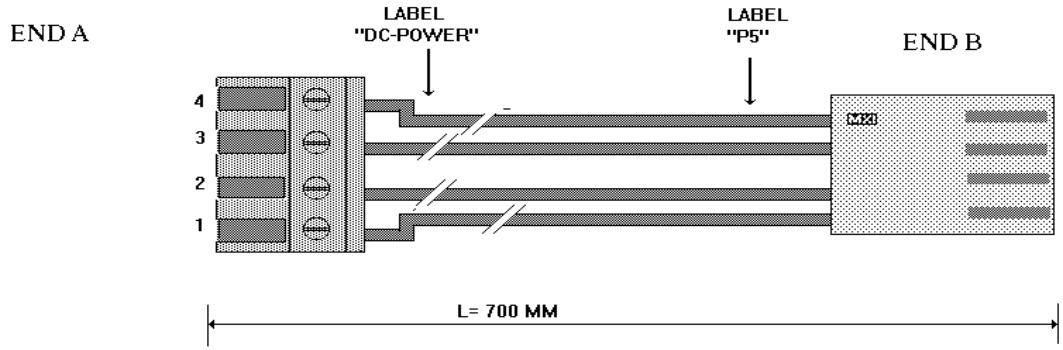
REV. A95	
DATE 20.07.95	SIGN. A.J.S

COMMENTS :

CABLE TYPE : 4X0.50MM2

CONNECTOR TYPE : END A : PHOENIX MSTB 2.5-ST-5.08
END B : CONN MOLEX 6471-041

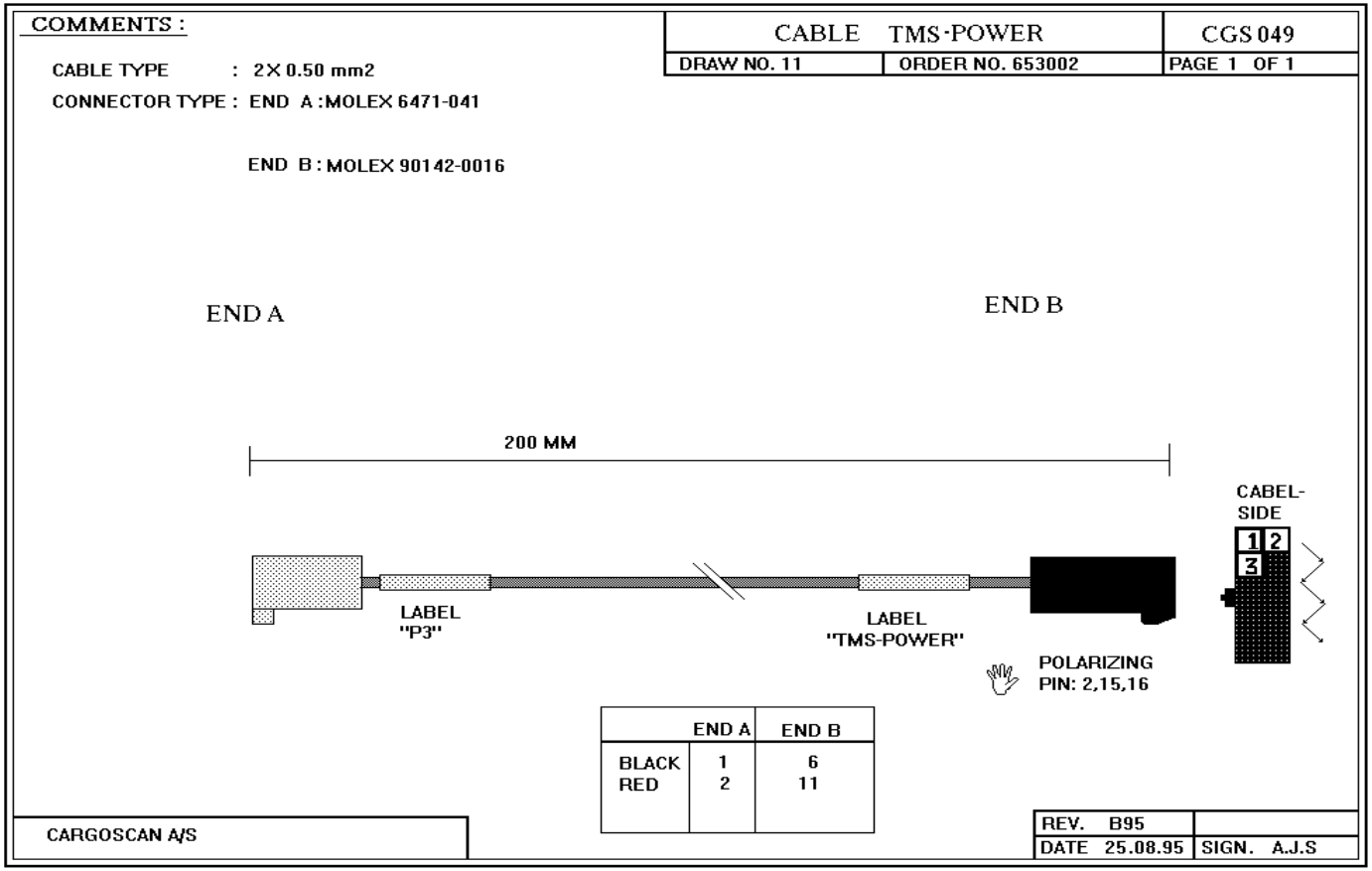
CABLE DC-POWER		CGS 048
DRAW NO. 4	ORDER NO. 653001	PAGE 1 OF 1



	END A	END B
BLACK	1	1
BROWN	2	4
RED	3	2
BLUE	4	3

CARGOSCAN A/S

REV. A95	
DATE 28.08.95	SIGN. A.J.S



COMMENTS :

CABLE CPU-PERIPHERALS | CGS 050

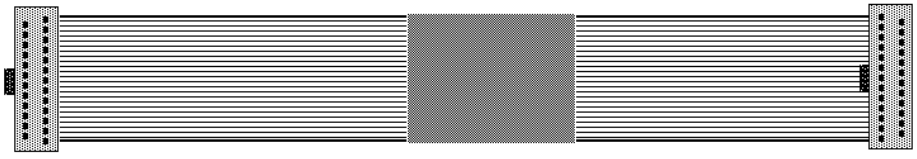
DRAW NO. 34 ORDER NO. 653003 | PAGE 1 OF 1

CABLE TYPE : RIBBON CABLE 26-LEADER

CONNECTOR TYPE : END A : CONN AMP RC 26P
END B : CONN AMP RC 26P

END A END B

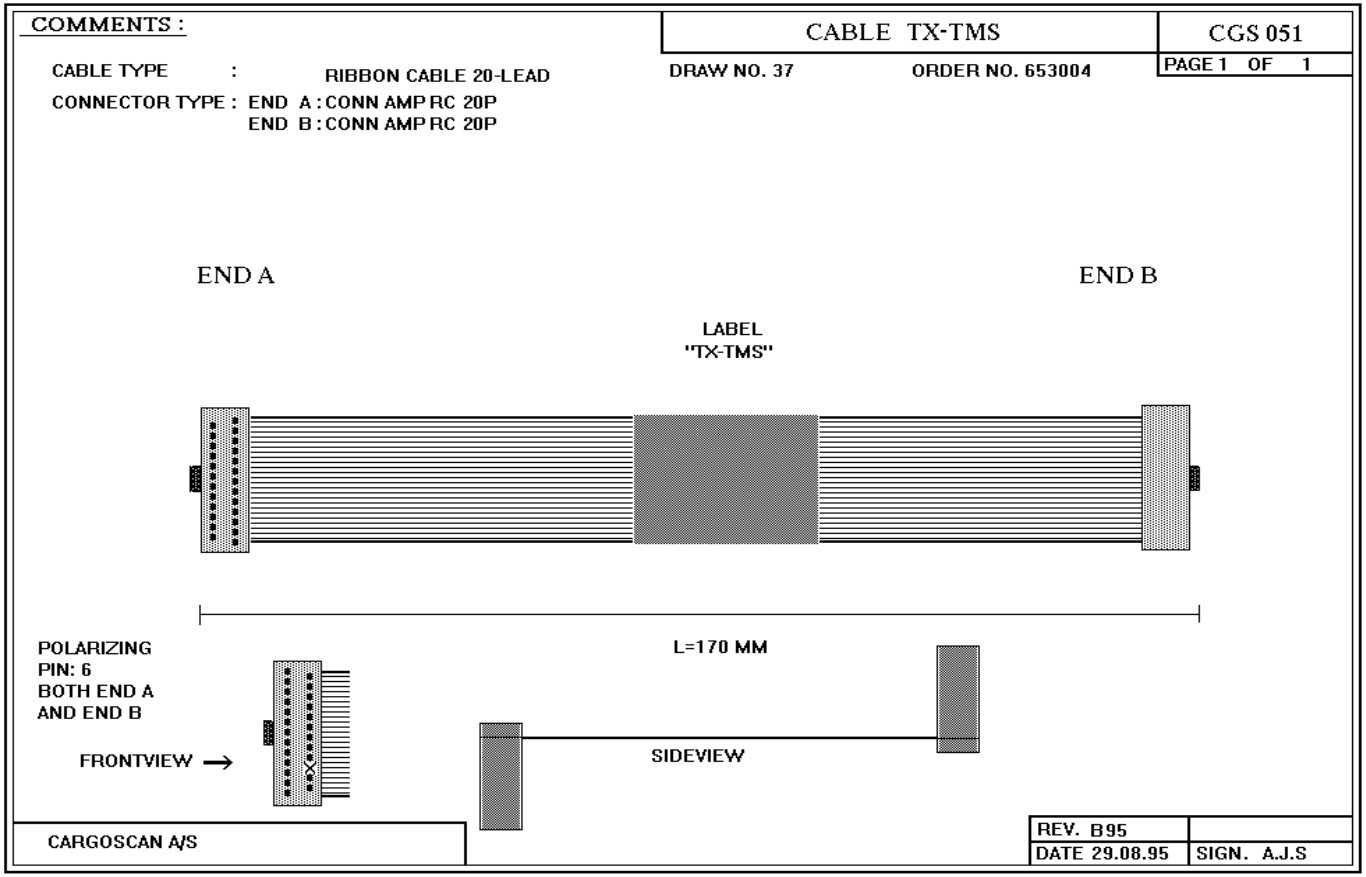
LABEL
"CPU-PERIPHERALS"

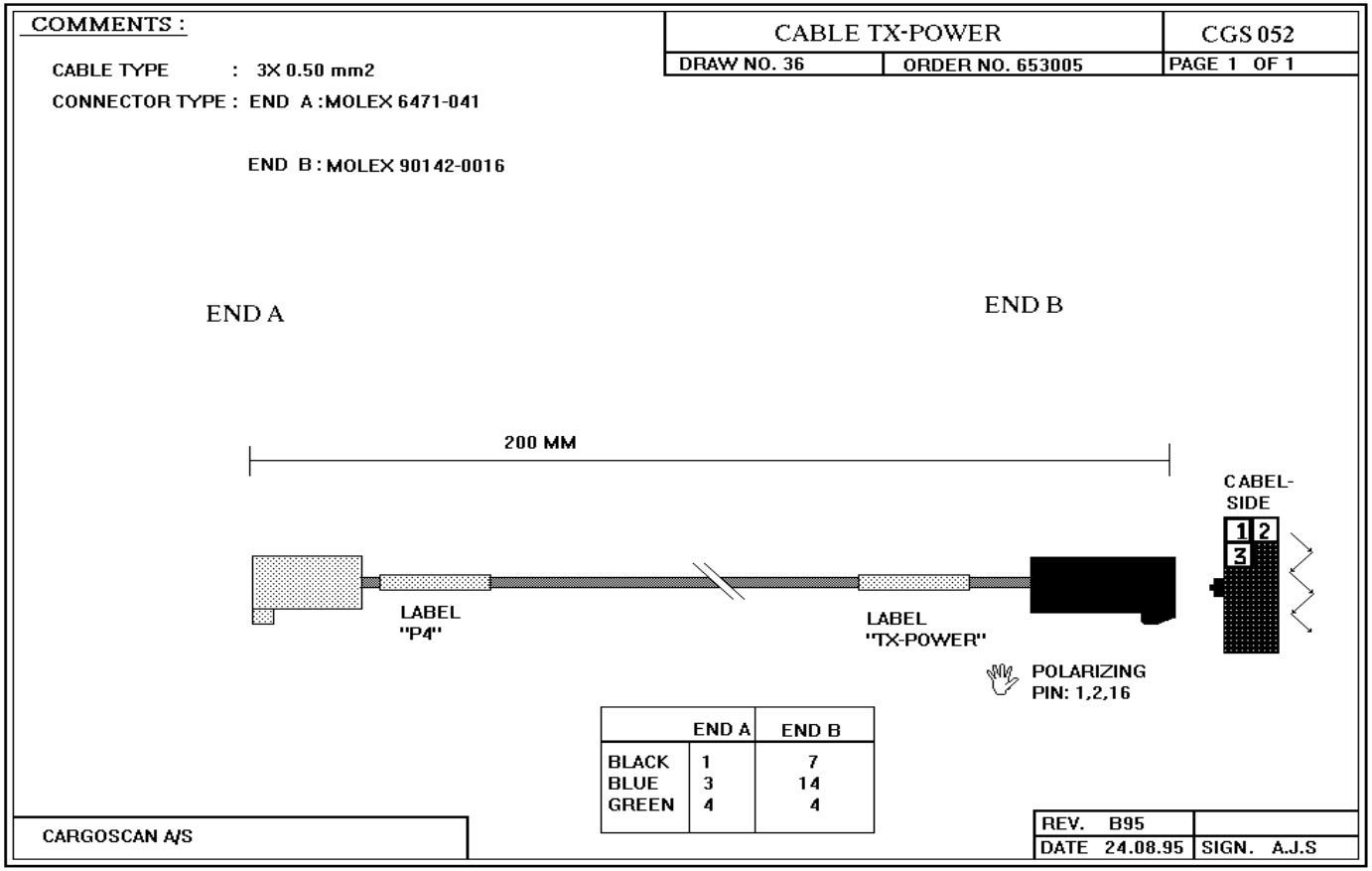


L=170 MM

CARGOSCAN A/S

REV. B95
DATE 29.08.95 SIGN. A.J.S





COMMENTS :

CABLE TYPE : RIBBON CABLE 20-LEAD

CONNECTOR TYPE : END A : CONN RC LATCH 20P
END B : CONN RC LATCH 20P

CABLE RX-TMS

CGS 053

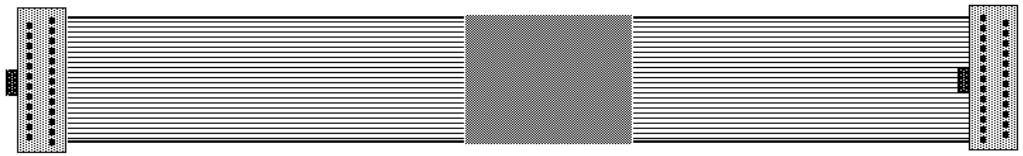
DRAW NO. 33 ORDER NO. 653006

PAGE 1 OF 1

END A

END B

LABEL
"RX-TMS"



L= 360MM

CARGOSCAN A/S

REV. B95

DATE 29.08.95 SIGN. A.J.S

COMMENTS :

CABLE TYPE : 3 X 0.50 mm2

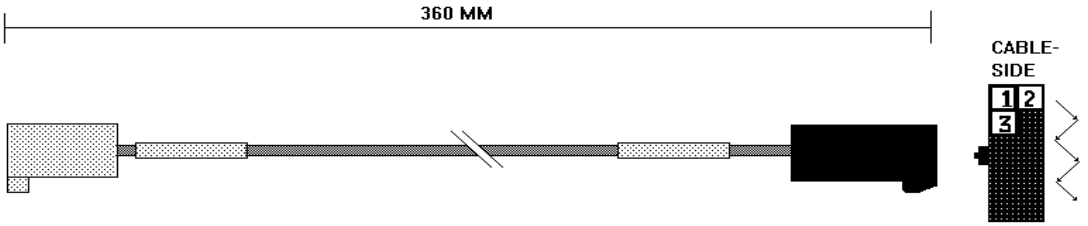
CONNECTOR TYPE : END A : MOLEX 6471-041

END B : MOLEX 90142-0016

CABLE RX-POWER	CGS 054
DRAW NO. 31	ORDER NO. 653007
PAGE 1 OF 1	

END A

END B

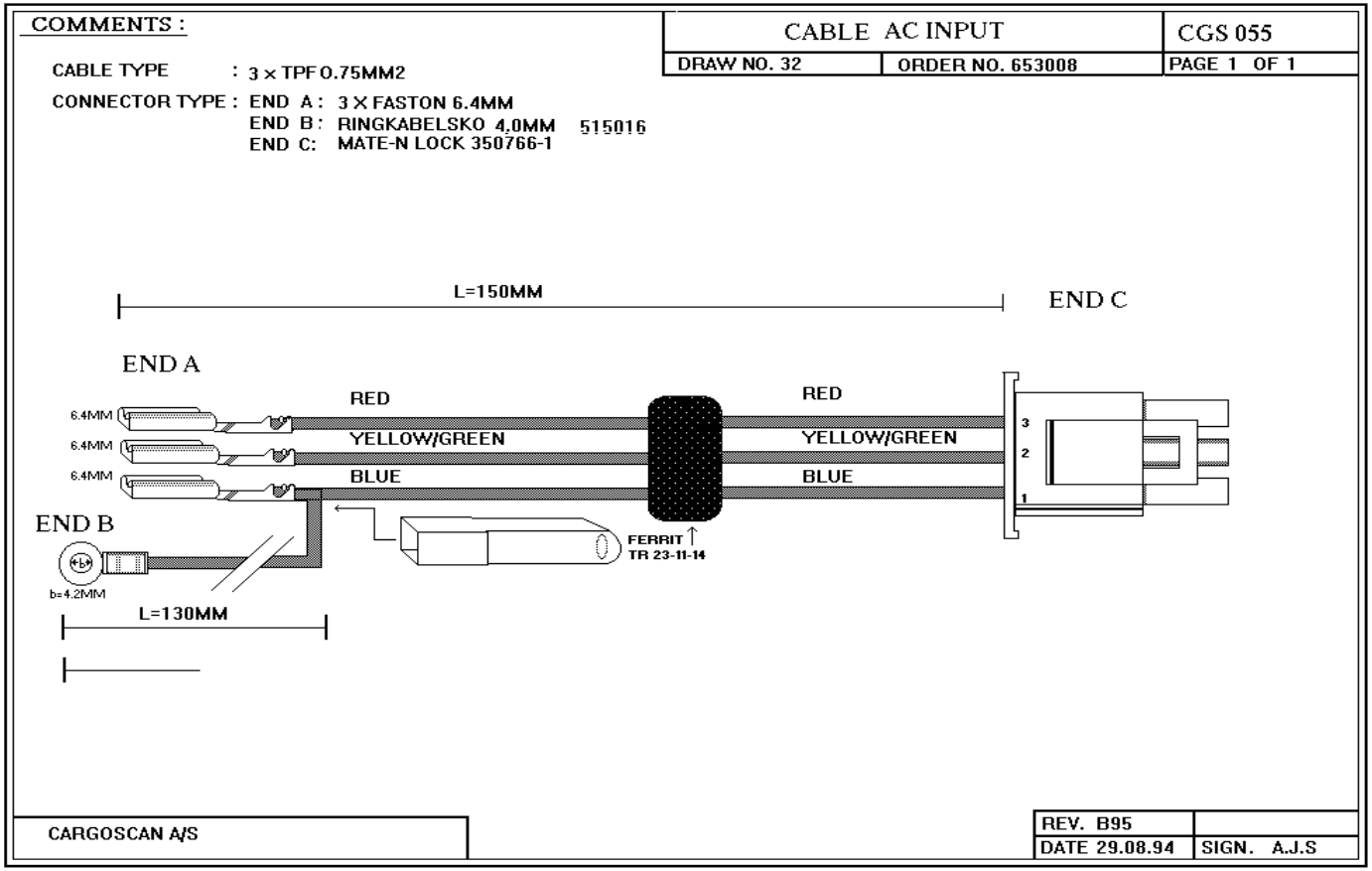


POLARIZING
PIN: 1,2,16

	END A	END B
BLACK	1	7
BLUE	3	14
YELLOW	4	4

CARGOSCAN A/S

REV. B95	
DATE 24.08.95	SIGN. A.J.S



COMMENTS :

CABLE TACO/PULS ENCODER		CGS 056
DRAW NR.	ART NR.	PAGE 1 OF 1

CABLE TYPE : PFSK 6x 0.22 W/SHIELD

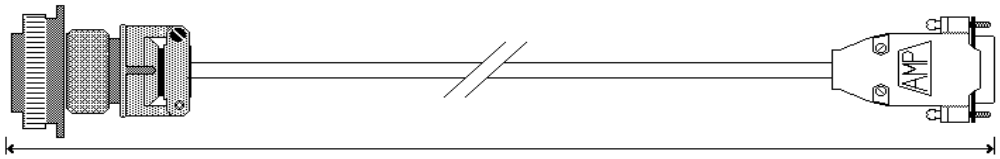
CONNECTOR TYPE : END A : CONN MIL 7P FEM CIRK
END B : 9 PIN MALE D-SUB

END A

NOTE!
SHIELDING TERMINATED
TO HOUSING

END B

NOTE!
SHIELDING TERMINATED
TO HOUSING



1700 MM

	CONN MIL	D SUB 9P MALE
RED	F	1
BLUE	A	2
GREEN	C	3
YELLOW	D	8

CARGOSCAN A/S

REV. B95	
DATE 24.08.95	SIGN. A.J.S

E: Fuses, switches and jumper information

FUSES:
There are 3 different fuse positions in the Frame:

- Mains power plug contains two fuses 5x20:
  - 220VAC - 1.0A T
  - 115VAC - 2.0A T

- Power supply contains one fuse 5x20
  - 220VAC - 1.5A T
  - 115VAC - 2.5A T

- Connector panel contains two fuses of solder type:

  - F1 - 5V 1A
  - F2 - 12V 1A

  These fuses protects DC voltages on connectors.
  They do not show on voltage LED's.

JUMPERS:

0014B RX-board - receiver diodes.

Jumper END1 - Termination of Shclk signal - TO BE LEFT OPEN.
Jumper END2 - Termination of Modclk signal - TO BE LEFT OPEN.

Jumper ST5 - Mounted on last board on a bar - otherwise left open.
Jumper ST6 - Leave open on last board on a bar - otherwise shorted.

Failure to mount ST5 & ST6 correctly will produce the "ERROR 151" message.

0015B TX-board - Transmitter diodes.

Jumper END1 - Termination of Shclk signal - TO BE LEFT OPEN.
Jumper END2 - Termination of Modclk signal - TO BE LEFT OPEN.

Jumper ST5 - Mounted on last board on a bar - otherwise left open.
Jumper ST6 - Leave open on last board on a bar - otherwise shorted.

Failure to mount ST5 & ST6 correctly will produce the "ERROR 151" message.

0012C M68EC040 CPU BOARD

Baudrate must be manually jumped according to the following table:

ST1 IN & ST2 IN = 19200
ST1 OUT & ST2 IN = 9600
ST1 IN & ST2 OUT = 4800
ST1 OUT & ST2 OUT = 9600 (NB! Error on silk print)

ST3 TEST - Should be left open.
ST100 DISABLE CACHE - Should be left openSWITCHES

0013C TMS 960 CPU Board

DIP switch row located on position A5 on the board must be set as follows:

Switch no:	1	2	3	4	5	6	7	8
Set to:	OFF	ON	ON	ON	ON	ON	ON	ON

F: Indicator Unit CS2200

Internal switches:

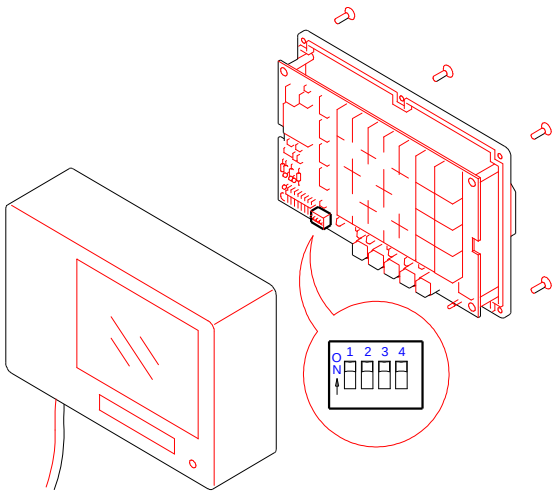


Figure B.2. Assembly of indicator unit

Figure B.2 shows the location of the switches within the indicator unit.

The functions of the switches are described below. Open switches are denoted by 0, closed swathes denoted by 1:

Switch no. 1	OFF	Set-up parameters protected.
	ON	Set-up parameters unprotected.
Switch no. 2	OFF	Position signals are transmitted.
	ON	Position signals are not transmitted.
Switch no. 3-4		
	OFF-OFF	Metric units, 1 cm resolution
	OFF-ON	Metric units, 5 mm resolution
	ON-OFF	Imperial units, 0.1 inch resolution.
	ON-ON	Not in use.

As seen on the figure above, switch no. 1 is the leftmost switch.

G: Plug pin-out

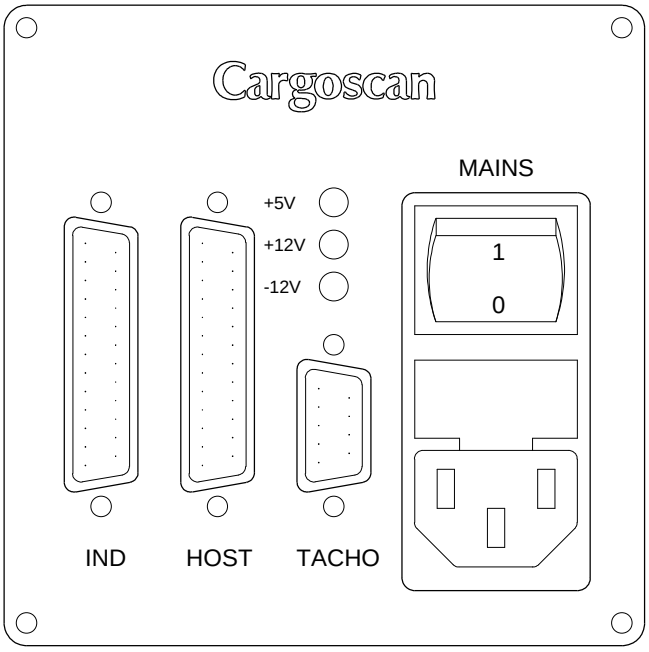


Figure Connector plate

PLUG	TYPE	CONNECTION/USE
IND	Subminiature D25 Female	RS232 interface to indicator CS2200
HOST	Subminiature D25 Female	Serial interface to controlling computer RS232 and RS422 available
TACHO	Subminiature D Female	Tacho signals from tacho unit on conveyor
220VAC	Schaffner FN 285-2-06 220 volts, 50/60 Hz	Mains power with power switch and fuse. (2*1.6 A).

Plug types on the plug plate:

TACHO plug:	Pin	Signal	Comments
	1	GND	Ground
	2	f1	Pulses, positive phase
	3	f2	Pulses, negative phase
	7	+12V	Power out
	8	+5V	Power out
	9	GND	Ground

220VAC plug:

Pin	Signal	Comments
N	VAC	220 VAC 50/60 Hz
E	GND	Ground
P	VAC	220 VAC 50/60 Hz

HOST plug:

RS232 and RS232 Isolated 1500V:

Pin	Signal	Comments
1		Chassis ground
2	/RXD	Receive data
3	/TXD	Transmit data
5	RTS	Handshake out (Not on Isolated 1500 V)
7	GND	Signal ground
20	DTR	Handshake in (Not on Isolated 1500 V)

If no handshake is connected to pin 20, short this pin to pin 5.

RS422:

Pin	Signal	Comments
1		Chassis ground
2	/RX	Receive data inverted
3	/TX	Transmit data inverted
5	TX	Transmit data non inverted
7	GND	Signal ground
20	RX	Receive data non inverted

Receiver is terminated with 120 ohm between /RX and RX.

RS485:

Pin	Signal	Comments
1		Chassis ground
2	/DATA	Transmit/receive data, negative
3		
5		
7	GND	Signal ground
20	DATA	Transmit/receive data, none inverted

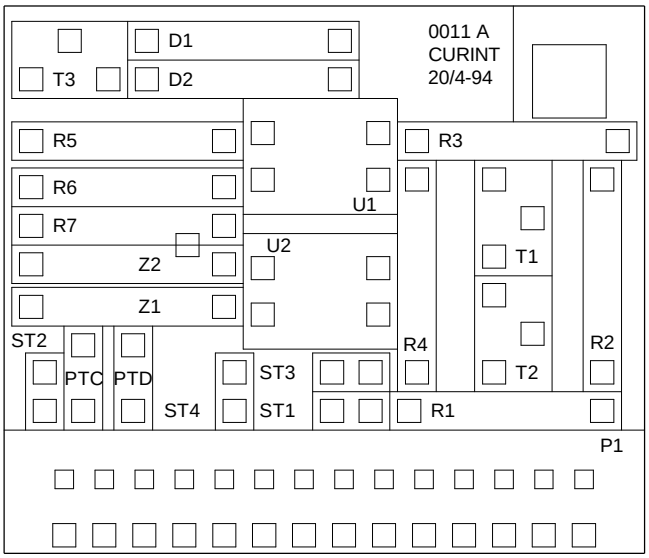
Termination selectable 120 ohm with jumper on interface board.

Current loop: RX can be configured as active or passive selected by jumper on interface board.

TX can be configured as active or passive selected by jumper on interface board.

Pin-out:

1	Chassis ground
2	CL-RXB
3	CL-TXA
5	CLTXB
7	CL-Return
20	CL RX-A



Connector:
- Passive Isolated TX
  Mount jumper ST2
  Dismount jumper ST1
  Connect to CL-TXA(in) and CL-TXB(out)

- Active non isolated TX
  Dismount jumper ST2
  Mount jumper ST1
  Connect to CL-TXB(out) and CL-return(in)

- Passive isolated RX
  Mount jumper ST4
  Dismount jumper ST3
  Connect to CL-RXA(in) and CL-RXB(out)

- Active non isolated RX
  Dismount jumper ST4
  Mount jumper ST3
  Connect to CL-RXB(out) and CL-Return(in)

Also see drawing in appendix J.

IND plug:

Pin	Signal	Comments
1		Chassis ground
2	/RXD	Receive data
3	/TXD	Transmit data
5	RTS	Out
7	GND	Signal ground
11	+12V	Power out
12	+5V	Power out
13		Power ground
14		Power ground
20	DTR	In
23	+12V	Power out
24	+5V	Power out
25		Power ground

H: Definition of messages on IND port.

All messages are ASCII coded. The communication protocol is described in appendix C. In general the two first bytes holds the message identity. Parameters, if any, are encoded on fixed format with leading zero after the message identity.

Messages from the Frame to the indicator unit:

Message with parameters	Explanation
BL	Erase digit area of indicator.
Li"STRING"	Write the string following the "Li" identity to line "i" on the indicator unit. "i" must take a value between 1 and four.
EA	Request for content of non-volatile memory in CS2200.
EW<hex1><hex2>..<hex16>	Write data in non-volatile memory. 16 words of data is coded as four digits hexadecimal numbers with leading zeros. No separator.
LEiiiiiiii	Back lightening of unit field. i = 0: Corresponding field is not lightened i = 1: Corresponding filed is lightened First character in field represents unit field zero etc.

Numbering of units fields:

field no	unit	unit	field no
0	cm	inch	4
1	cm	inch	5
2	cm	inch	6
3	dm3	ft3	7

Messages to indicator unit, continued.

S?	Request for switch setting
L1	Lighten OBJECT led
L0	Switch OBJECT led off.
VE	Request for software version

Messages from the indicator unit.

K1dddd
K2
K3dddd
K4
K5 Function key is pressed. Key number, counted from left is indicated in the command identity. The keys are, in sequence: VER, TST, ALT, I/C. CAL and TST are the only ones that may have a parameter input string.

DD<hex1><hex2>..<hex16>
Content of non-volatile memory sent as 16 hex numbers. Each number is coded as 4 ASCII coded digits without separator.

SWiiii Setting of the four switches.

i = 0 switch open
i = 1 switch closed

First character in string represents switch 1, e.t.c.

VEvvvv Software version in Indicator CS2200

I: Decimal to hexadecimal number conversion

Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex
0	000	1	001	2	002	3	003	4	004	5	005	6	006	7	007
8	008	9	009	10	00a	11	00b	12	00c	13	00d	14	00e	15	00f
16	010	17	011	18	012	19	013	20	014	21	015	22	016	23	017
24	018	25	019	26	01a	27	01b	28	01c	29	01d	30	01e	31	01f
32	020	33	021	34	022	35	023	36	024	37	025	38	026	39	027
40	028	41	029	42	02a	43	02b	44	02c	45	02d	46	02e	47	02f
48	030	49	031	50	032	51	033	52	034	53	035	54	036	55	037
56	038	57	039	58	03a	59	03b	60	03c	61	03d	62	03e	63	03f
64	040	65	041	66	042	67	043	68	044	69	045	70	046	71	047
72	048	73	049	74	04a	75	04b	76	04c	77	04d	78	04e	79	04f
80	050	81	051	82	052	83	053	84	054	85	055	86	056	87	057
88	058	89	059	90	05a	91	05b	92	05c	93	05d	94	05e	95	05f
96	060	97	061	98	062	99	063	100	064	101	065	102	066	103	067
104	068	105	069	106	06a	107	06b	108	06c	109	06d	110	06e	111	06f
112	070	113	071	114	072	115	073	116	074	117	075	118	076	119	077
120	078	121	079	122	07a	123	07b	124	07c	125	07d	126	07e	127	07f
128	080	129	081	130	082	131	083	132	084	133	085	134	086	135	087
136	088	137	089	138	08a	139	08b	140	08c	141	08d	142	08e	143	08f
144	090	145	091	146	092	147	093	148	094	149	095	150	096	151	097
152	098	153	099	154	09a	155	09b	156	09c	157	09d	158	09e	159	09f
160	0a0	161	0a1	162	0a2	163	0a3	164	0a4	165	0a5	166	0a6	167	0a7
168	0a8	169	0a9	170	0aa	171	0ab	172	0ac	173	0ad	174	0ae	175	0af
176	0b0	177	0b1	178	0b2	179	0b3	180	0b4	181	0b5	182	0b6	183	0b7
184	0b8	185	0b9	186	0ba	187	0bb	188	0bc	189	0bd	190	0be	191	0bf
192	0c0	193	0c1	194	0c2	195	0c3	196	0c4	197	0c5	198	0c6	199	0c7
200	0c8	201	0c9	202	0ca	203	0cb	204	0cc	205	0cd	206	0ce	207	0cf
208	0d0	209	0d1	210	0d2	211	0d3	212	0d4	213	0d5	214	0d6	215	0d7
216	0d8	217	0d9	218	0da	219	0db	220	0dc	221	0dd	222	0de	223	0df
224	0e0	225	0e1	226	0e2	227	0e3	228	0e4	229	0e5	230	0e6	231	0e7
232	0e8	233	0e9	234	0ea	235	0eb	236	0ec	237	0ed	238	0ee	239	0ef
240	0f0	241	0f1	242	0f2	243	0f3	244	0f4	245	0f5	246	0f6	247	0f7
248	0f8	249	0f9	250	0fa	251	0fb	252	0fc	253	0fd	254	0fe	255	0ff
256	100	257	101	258	102	259	103	260	104	261	105	262	106	263	107
264	108	265	109	266	10a	267	10b	268	10c	269	10d	270	10e	271	10f
272	110	273	111	274	112	275	113	276	114	277	115	278	116	279	117
280	118	281	119	282	11a	283	11b	284	11c	285	11d	286	11e	287	11f
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296	128	297	129	298	12a	299	12b	300	12c	301	12d	302	12e	303	12f
304	130	305	131	306	132	307	133	308	134	309	135	310	136	311	137
312	138	313	139	314	13a	315	13b	316	13c	317	13d	318	13e	319	13f
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328	148	329	149	330	14a	331	14b	332	14c	333	14d	334	14e	335	14f
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344	158	345	159	346	15a	347	15b	348	15c	349	15d	350	15e	351	15f
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376	178	377	179	378	17a	379	17b	380	17c	381	17d	382	17e	383	17f
384	180	385	181	386	182	387	183	388	184	389	185	390	186	391	187
392	188	393	189	394	18a	395	18b	396	18c	397	18d	398	18e	399	18f
400	190	401	191	402	192	403	193	404	194	405	195	406	196	407	197
408	198	409	199	410	19a	411	19b	412	19c	413	19d	414	19e	415	19f
416	1a0	417	1a1	418	1a2	419	1a3	420	1a4	421	1a5	422	1a6	423	1a7
424	1a8	425	1a9	426	1aa	427	1ab	428	1ac	429	1ad	430	1ae	431	1af
432	1b0	433	1b1	434	1b2	435	1b3	436	1b4	437	1b5	438	1b6	439	1b7
440	1b8	441	1b9	442	1ba	443	1bb	444	1bc	445	1bd	446	1be	447	1bf
448	1c0	449	1c1	450	1c2	451	1c3	452	1c4	453	1c5	454	1c6	455	1c7
456	1c8	457	1c9	458	1ca	459	1cb	460	1cc	461	1cd	462	1ce	463	1cf
464	1d0	465	1d1	466	1d2	467	1d3	468	1d4	469	1d5	470	1d6	471	1d7
472	1d8	473	1d9	474	1da	475	1db	476	1dc	477	1dd	478	1de	479	1df
480	1e0	481	1e1	482	1e2	483	1e3	484	1e4	485	1e5	486	1e6	487	1e7
488	1e8	489	1e9	490	1ea	491	1eb	492	1ec	493	1ed	494	1ee	495	1ef
496	1f0	497	1f1	498	1f2	499	1f3	500	1f4	501	1f5	502	1f6	503	1f7
504	1f8	505	1f9	506	1fa	507	1fb	508	1fc	509	1fd	510	1fe	511	1ff
512	200	513	201	514	202	515	203	516	204	517	205	518	206	519	207
520	208	521	209	522	20a	523	20b	524	20c	525	20d	526	20e	527	20f
528	210	529	211	530	212	531	213	532	214	533	215	534	216	535	217
536	218	537	219	538	21a	539	21b	540	21c	541	21d	542	21e	543	21f
544	220	545	221	546	222	547	223	548	224	549	225	550	226	551	227
552	228	553	229	554	22a	555	22b	556	22c	557	22d	558	22e	559	22f
560	230	561	231	562	232	563	233	564	234	565	235	566	236	567	237
568	238	569	239	570	23a	571	23b	572	23c	573	23d	574	23e	575	23f
576	240	577	241	578	242	579	243	580	244	581	245	582	246	583	247
584	248	585	249	586	24a	587	24b	588	24c	589	24d	590	24e	591	24f
592	250	593	251	594	252	595	253	596	254	597	255	598	256	599	257

Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex	Dec	Hex
600	258	601	259	602	25a	603	25b	604	25c	605	25d	606	25e	607	25f
608	260	609	261	610	262	611	263	612	264	613	265	614	266	615	267
616	268	617	269	618	26a	619	26b	620	26c	621	26d	622	26e	623	26f
624	270	625	271	626	272	627	273	628	274	629	275	630	276	631	277
632	278	633	279	634	27a	635	27b	636	27c	637	27d	638	27e	639	27f
640	280	641	281	642	282	643	283	644	284	645	285	646	286	647	287
648	288	649	289	650	28a	651	28b	652	28c	653	28d	654	28e	655	28f
656	290	657	291	658	292	659	293	660	294	661	295	662	296	663	297
664	298	665	299	666	29a	667	29b	668	29c	669	29d	670	29e	671	29f
672	2a0	673	2a1	674	2a2	675	2a3	676	2a4	677	2a5	678	2a6	679	2a7
680	2a8	681	2a9	682	2aa	683	2ab	684	2ac	685	2ad	686	2ae	687	2af
688	2b0	689	2b1	690	2b2	691	2b3	692	2b4	693	2b5	694	2b6	695	2b7
696	2b8	697	2b9	698	2ba	699	2bb	700	2bc	701	2bd	702	2be	703	2bf
704	2c0	705	2c1	706	2c2	707	2c3	708	2c4	709	2c5	710	2c6	711	2c7
712	2c8	713	2c9	714	2ca	715	2cb	716	2cc	717	2cd	718	2ce	719	2cf
720	2d0	721	2d1	722	2d2	723	2d3	724	2d4	725	2d5	726	2d6	727	2d7
728	2d8	729	2d9	730	2da	731	2db	732	2dc	733	2dd	734	2de	735	2df
736	2e0	737	2e1	738	2e2	739	2e3	740	2e4	741	2e5	742	2e6	743	2e7
744	2e8	745	2e9	746	2ea	747	2eb	748	2ec	749	2ed	750	2ee	751	2ef
752	2f0	753	2f1	754	2f2	755	2f3	756	2f4	757	2f5	758	2f6	759	2f7
760	2f8	761	2f9	762	2fa	763	2fb	764	2fc	765	2fd	766	2fe	767	2ff
768	300	769	301	770	302	771	303	772	304	773	305	774	306	775	307
776	308	777	309	778	30a	779	30b	780	30c	781	30d	782	30e	783	30f
784	310	785	311	786	312	787	313	788	314	789	315	790	316	791	317
792	318	793	319	794	31a	795	31b	796	31c	797	31d	798	31e	799	31f
800	320	801	321	802	322	803	323	804	324	805	325	806	326	807	327
808	328	809	329	810	32a	811	32b	812	32c	813	32d	814	32e	815	32f
816	330	817	331	818	332	819	333	820	334	821	335	822	336	823	337
824	338	825	339	826	33a	827	33b	828	33c	829	33d	830	33e	831	33f
832	340	833	341	834	342	835	343	836	344	837	345	838	346	839	347
840	348	841	349	842	34a	843	34b	844	34c	845	34d	846	34e	847	34f
848	350	849	351	850	352	851	353	852	354	853	355	854	356	855	357
856	358	857	359	858	35a	859	35b	860	35c	861	35d	862	35e	863	35f
864	360	865	361	866	362	867	363	868	364	869	365	870	366	871	367
872	368	873	369	874	36a	875	36b	876	36c	877	36d	878	36e	879	36f
880	370	881	371	882	372	883	373	884	374	885	375	886	376	887	377
888	378	889	379	890	37a	891	37b	892	37c	893	37d	894	37e	895	37f
896	380	897	381	898	382	899	383	900	384	901	385	902	386	903	387
904	388	905	389	906	38a	907	38b	908	38c	909	38d	910	38e	911	38f
912	390	913	391	914	392	915	393	916	394	917	395	918	396	919	397
920	398	921	399	922	39a	923	39b	924	39c	925	39d	926	39e	927	39f
928	3a0	929	3a1	930	3a2	931	3a3	932	3a4	933	3a5	934	3a6	935	3a7
936	3a8	937	3a9	938	3aa	939	3ab	940	3ac	941	3ad	942	3ae	943	3af
944	3b0	945	3b1	946	3b2	947	3b3	948	3b4	949	3b5	950	3b6	951	3b7
952	3b8	953	3b9	954	3ba	955	3bb	956	3bc	957	3bd	958	3be	959	3bf
960	3c0	961	3c1	962	3c2	963	3c3	964	3c4	965	3c5	966	3c6	967	3c7
968	3c8	969	3c9	970	3ca	971	3cb	972	3cc	973	3cd	974	3ce	975	3cf
976	3d0	977	3d1	978	3d2	979	3d3	980	3d4	981	3d5	982	3d6	983	3d7
984	3d8	985	3d9	986	3da	987	3db	988	3dc	989	3dd	990	3de	991	3df
992	3e0	993	3e1	994	3e2	995	3e3	996	3e4	997	3e5	998	3e6	999	3e7
1000	3e8	1001	3e9	1002	3ea	1003	3eb	1004	3ec	1005	3ed	1006	3ee	1007	3ef
1008	3f0	1009	3f1	1010	3f2	1011	3f3	1012	3f4	1013	3f5	1014	3f6	1015	3f7
1016	3f8	1017	3f9	1018	3fa	1019	3fb	1020	3fc	1021	3fd	1022	3fe	1023	3ff

J: Mech. drawings/Component placement, Product revision CS5000 and Keying of Boards

Please find enclosed drawings showing component placement for:

MC68EC040 CPU Board
TMS 960 CPU Board
RX ARRAY Board
TX ARRAY Board
DISPLAY

Please find enclosed drawings for:

CURRENT LOOP MODULE
RS485 INTERFACE
RS422 INTERFACE
RS232 MODULE
RS232 MODULE ISOLATED
CS5000 CONNECTOR PLATE

...and the following documents:

* "Product Revision CS5000 Measuring Frame", that describes compatibility between the outdated and redesigned CS5000 Frames.

* “Keying of boards and cables CS5000 Frames”.