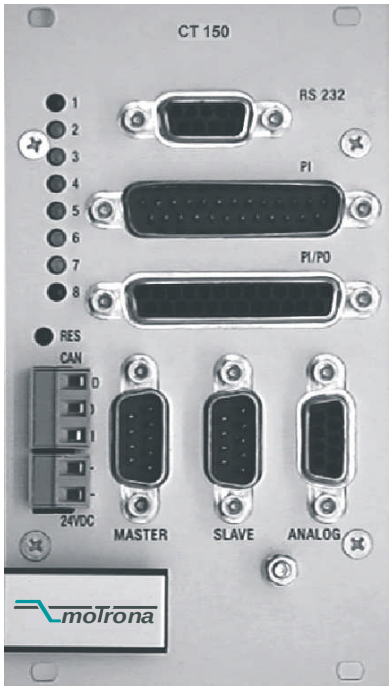
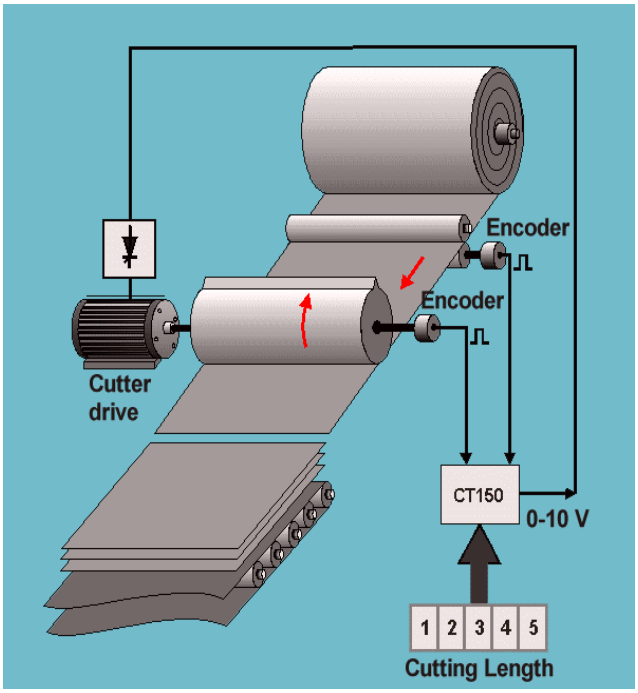
motrona GmbH
Zwischen den Wegen 32
78239 Rielasingen - Germany
Tel. +49 (0)7731-9332-0
Fax +49 (0)7731-9332-30
info@motrona.com
www.motrona.com

control – motion – interface

CT150

Precision Controller for Rotating Cutters, Rotary Punchers and Printing Screens





- Stand alone unit for full closed loop control of the cutter drive
- Fully synchronous motion while cut or print is in progress
- Variable cutting length or printing pitch by S-shape speed profile of the roll
- Index and print mark control included
- Easy setup and commissioning by Windows operator software
- Excellent accuracy and dynamics by only 150 µsec of response time
- Parallel and serial and CANopen interface for auxiliary PLC and PC control
- Includes batch counters, line speed control and more facilities

Operating Instructions

Safety Instructions

- This manual is an essential part of the unit and contains important hints about function, correct handling and commissioning. Non-observance can result in damage to the unit or the machine or even in injury to persons using the equipment!
- The unit must only be installed, connected and activated by a qualified electrician
- It is a must to observe all general and also all country-specific and application-specific safety standards
- When this unit is used with applications where failure or maloperation could cause damage to a machine or hazard to the operating staff, it is indispensable to meet effective precautions in order to avoid such consequences
- Regarding installation, wiring, environmental conditions, screening of cables and earthing, you must follow the general standards of industrial automation industry
- - Errors and omissions excepted –

Version:	Description:
CT15013B/TJ/Okt. 03/S.23/24/38	Steuerwort und Statuswort Geber-Eingänge, Grenzfrequenz
CT15014/TJ/Dez. 04/S.23	Schnittlängenfehler auslesbar
CT15014B_e/Bo/Jul-08	Anpassungen auf motrona-Format
CT15014C_e/pp/Nov-11	Chapter 19: replaced double by 8 times line speed

Table of Contents

1. Introduction

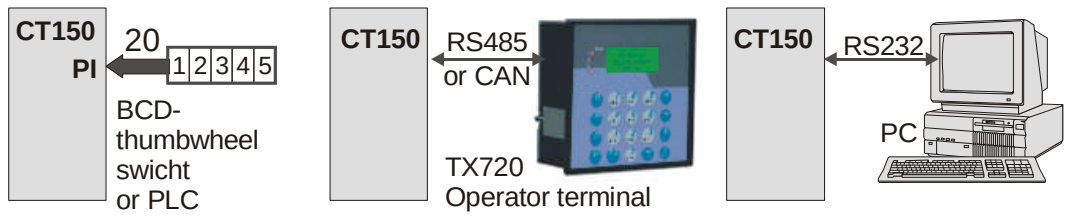
The CT150 cutting controller is technically based on the BY150 high performance synchro controls. The software however has been especially designed for rotating cutter systems and printing applications, with consideration of maximum cutting efficiency and accuracy at most careful treatment of all mechanical parts.

All parameters are set fully digital and no potentiometers must be adjusted. The unit provides a small keypad with LCD display for register settings. Also a windows operator software is included on disc, featuring easy setup by a PC / Laptop / Notebook computer. Some of the most important registers are accessible via parallel interface, allowing to preset cutting length and other variables by a simple BCD thumbwheel switch or a PLC parallel output. All internal registers are accessible by serial RS232 or 485 or CANopen communication.

The mechanical construction provides a fully closed 19" steel cassette with all connections on the front, guaranteeing excellent attributes with EMC immunity and emission. The cassette can be mounted into any standard rack. With use of option SM 150, also easy mounting on DIN rails is possible.

In some sections, this description uses expressions like „C02", „C03" which represent the serial access code to the corresponding registers.

The unit is suitable for control of cutting applications as well as for partial printing screens. This manual always says "cutting" or "cut" and the reader may replace this by "printing" when applicable.



Exampels how to operate the CT150 controller

Fig. 1

2. Principle of Operation

When a cutting process needs synchronous circumferential speed of the cutting tool with the line, the only length that can be cut is the one corresponding to the circumference of the roll (at constant rotational speed). Change of the cutting length needs exchange of the roll against another one with appropriate diameter.

The CT150 controller uses a two- speed principle featuring full synchronism while the cut is in progress, but taking a different roll speed when the tool is outside the cutting zone (where synchronism is not necessary). So, in terms of one revolution of the roll, we are talking about two speed zones: The „synchronous cutting zone" (which is register settable) and the „asynchronous zone" where the roll follows a speed profile calculated by the processor in order to get the desired cutting length. The CT150 calculates the speed profile of the „asynchronous zone" in a way that the physically possible minimum of acceleration and deceleration torque is applied to the drive with respect to actual line speed and preset cutting length.

With length settings smaller than the roll circumference, the „asynchronous zone" will take higher speeds than the „synchronous zone". With length settings longer than the circumference, the asynchronous speed will be lower and the drive can even go to a temporary standstill if necessary. Fig 1 shows two typical speed profiles.

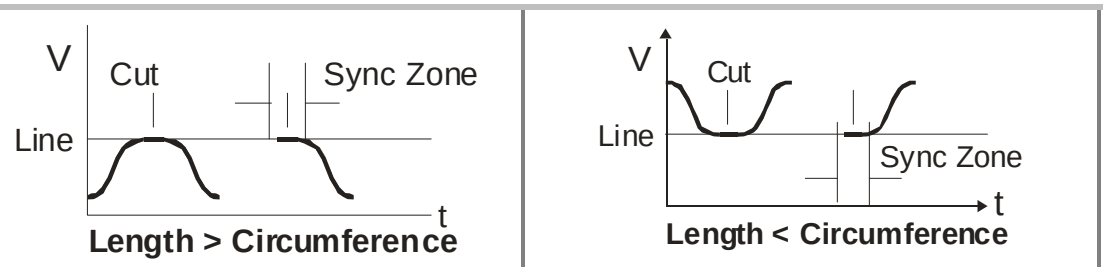


Fig. 2

Continuous closed loop control of the relative roll position with respect to the length progress of the line, combined with an update time as short as 150 µsec, provide best cutting accuracy and exceptional smooth motion of the cutting roll at any time.
It is a must to use a 4 quadrant drive or a servo drive for the cutting roll, because the CT150 must be able to accelerate and decelerate the roll under real closed loop conditions. However, no special requirements are necessary for the line drive, and also a simple measuring wheel on the material line is good for full performance.

3. Configuration of a Cutting System

In general, the Master drive will be the drive of a feed roll. With many applications, and with special regard to possible slip, a measuring wheel with encoder can be better.

CT150 version 10A or higher can operate with or without analogue feed forward signal. In general, for new applications, fully digital operation will be chosen (line speed taken from the master encoder only). But in order to be fully compatible to all former versions, the unit can also operate with an analogue input proportional to the line speed. Analogue feed forward signal must be used, when for reasons of poor master encoder resolution the master frequency does not reach at least 1 kHz with maximum line speed.
The CT150 controller uses encoders with RS422- TTL line driver outputs (5V, A, /A, B, /B). Where you must apply HTL encoders (10 - 30 V, A and B output), it is necessary to use our level converter PU210 which converts your HTL signals to the proper RS422 standard

Both, line encoder and roll encoder, should have at least 5 times the resolution of the maximum cutting error you can accept. Please note you can set the unit to multiple- edge- counting (Section 4.1) which can reduce the real number of ppr correspondingly. At any time you must be aware that the CT150 controller accepts cutting errors of + / - 5 encoder increments or edge counts, whatever this may be in terms of length tolerance. Please observe the maximum encoder frequency which is 300 kHz.
The unit must receive a „cutting pulse" with each revolution of the cutting roll. The rising edge of this cutting pulse must be physically located somewhere in the synchronous zone (i. e. around the position where the tool performs the cut). With respect to this rising edge, the user can set a „prior to cut" and an „after cut" zone where the tool must be synchronous to the line.

If applicable, a print mark sensor can be connected for fully automatic adjust of the cut with respect to a print mark. Two Trim inputs provide manual displacement of the cutting point on the material and also allow to jog the roll with the line in standstill. Fig. 2 shows the general block diagram of the CT150 controller.

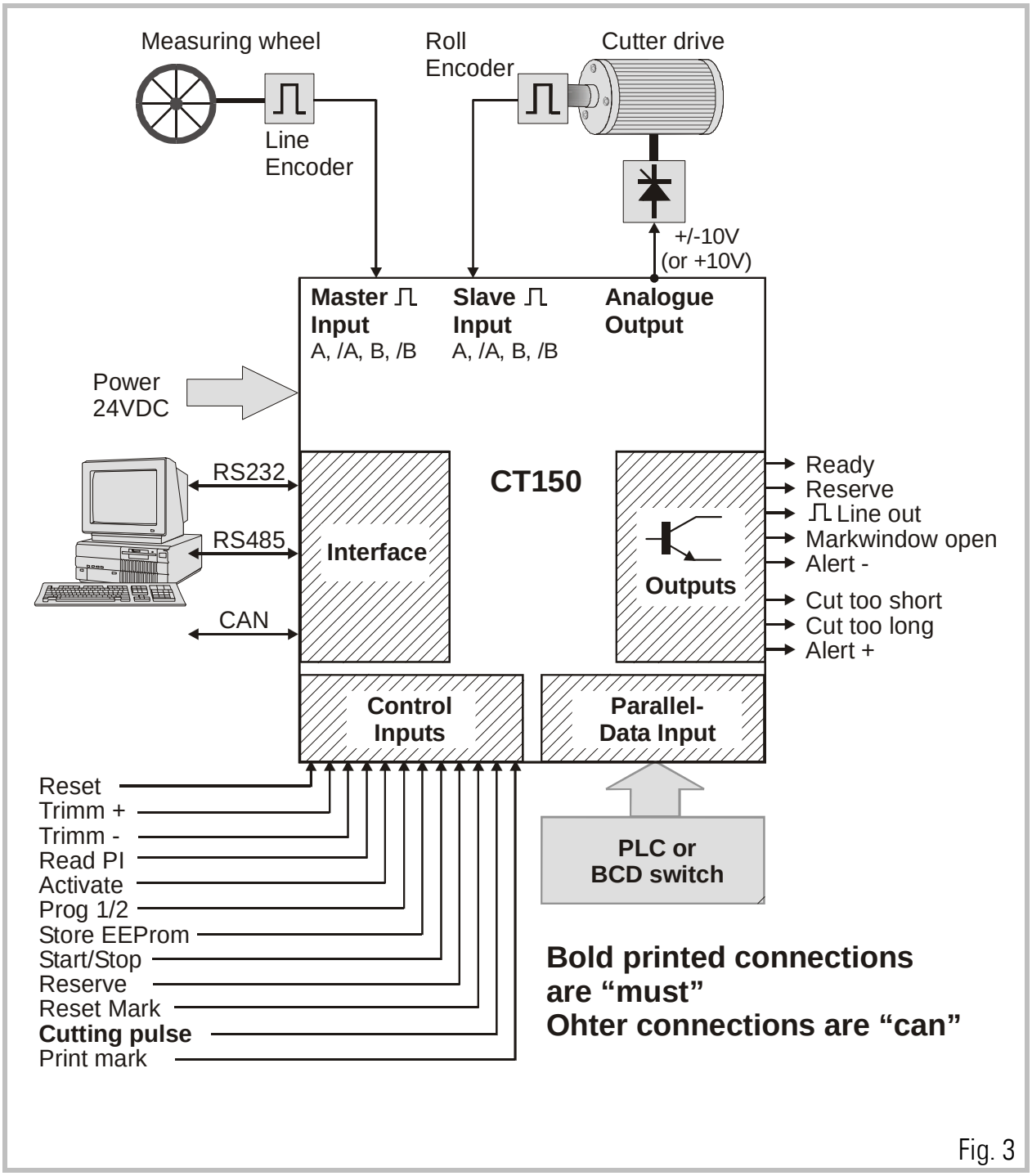

Measuring wheel
Line Encoder
Roll Encoder
Cutter drive
+/-10V (or +10V)
Master ⎍ Input
A, /A, B, /B
Slave ⎍ Input
A, /A, B, /B
Analogue Output
Power 24VDC
RS232
RS485
CAN
Interface
CT150
Outputs
Ready
Reserve
⎍ Line out
Markwindow open
Alert -
Cut too short
Cut too long
Alert +
Control Inputs
Parallel- Data Input
PLC or BCD switch
Reset
Trimm +
Trimm -
Read PI
Activate
Prog 1/2
Store EEProm
Start/Stop
Reserve
Reset Mark
Cutting pulse
Print mark
Bold printed connections are “must”
Ohter connections are “can”

Fig. 3

Fig. 3

4. Terminal Location and Grounding/Screening rules

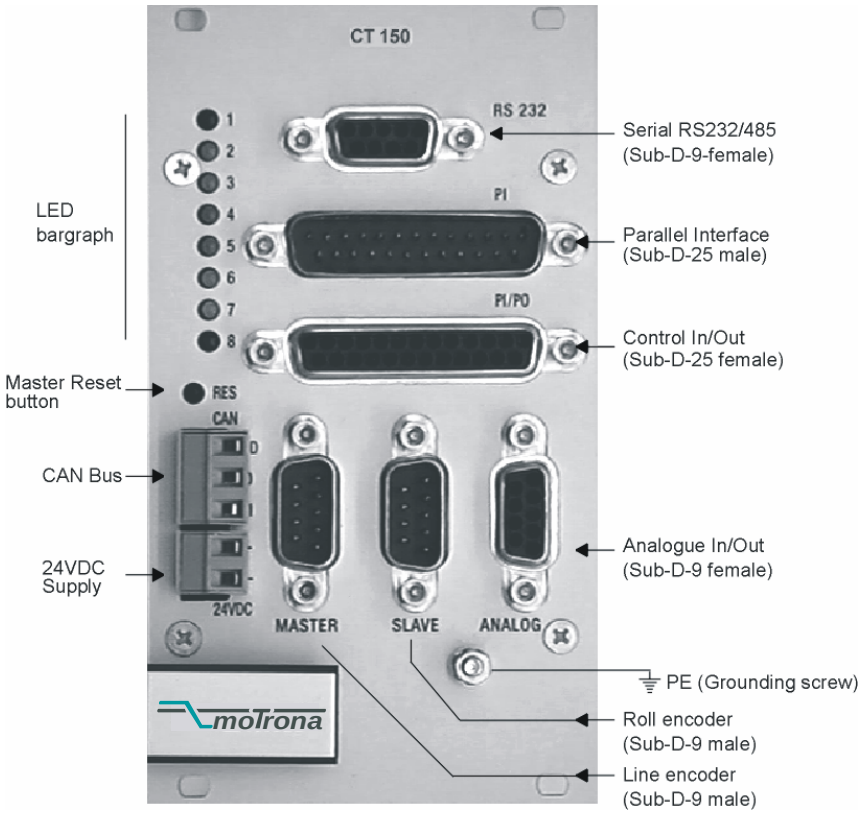


Fig. 4

For reasons of proper screening, it is a must to follow the subsequent instructions.

Where you don't exactly observe these grounding and screening rules, it is almost for sure that you will have problems later!

a. The minus wire of the power supply must be connected to the grounding screw on the front plate of the CT150 controller with a short wire of at least 0.75 mm².

   On site of the power supply, the minus output must be earthed.

   Where the wires between power unit and CT150 controller are longer than e.g. 1 meter, it is advisable to ground the front plate of the controller again by a separate wire, on the shortest way possible.

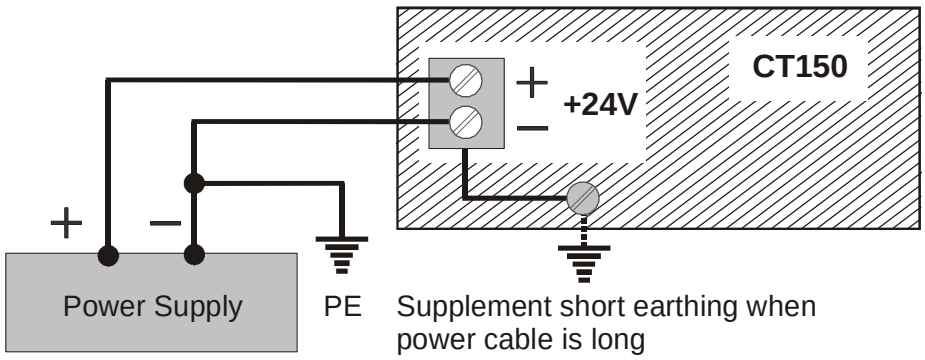


Fig. 5

b. All screens on the controller side must be connected to the housing of the corresponding Sub-D-connector. This is valid for encoder cables, analogue output and PI or PO lines. Where you use Sub-D-connectors with a plastic housing, you must solder the screen to the metallic frame of the connector. **At any time you must be sure the screen gets a proper contact to the front fascia of the unit when connected to the controller.**

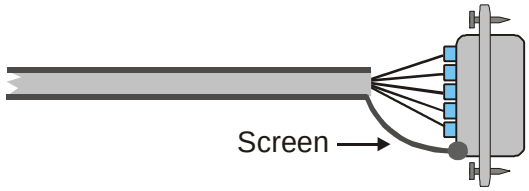
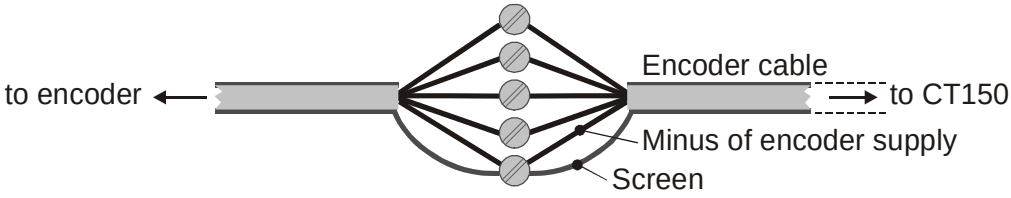


Fig. 6

c. When encoder cables are interrupted by terminal boxes or intermediate connectors on their way from the controller to the encoder, you must connect the screen to the Minus wire of the encoder supply there, but never to earth potential again!

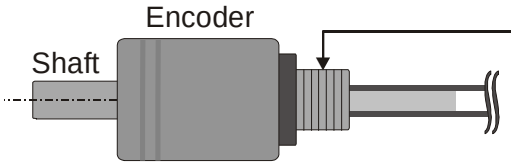


Tie Minus of encoder supply and screen together whereever you interrupt the encoder cable by terminal or connectors.
Make sure the screen can never get any earth potential here!

Fig. 7

d. When the cable arrives at the encoder site, the screen must again be connected to the Minus wire of the encoder supply, but not at all grounded to earth. In general, there are two types of encoder connections:

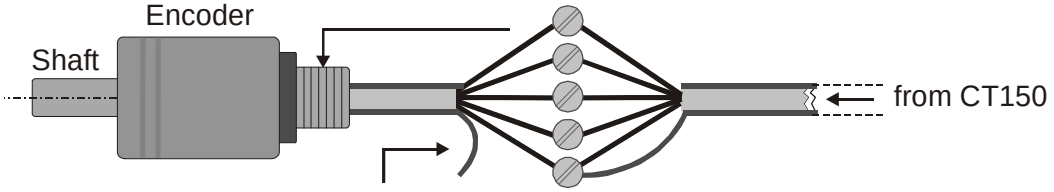
Encoder with plug connector



Make sure the screen of the cable is connected to the Minus supply of the encoder, but does not touch the metallic housing of the connector.

Fig. 8

Encoder with cable end



Leave this screen fully unconnected here to avoid illegal double earthing! (Screen is internally earthed to the encoder housing).

Connect screen to the Minus wire of the encoder supply here. Avoid any earth connection via contact to housings ect.

Fig.9

e. With all other cables like analogue output, control or parallel output, put the screen to the metal connector housing on the CT150 side and leave it unconnected on its peripheral side. Again avoid double earthing. The only place where the screen is earthed must be the front plate of the unit!

Example: Analogue speed reference signal

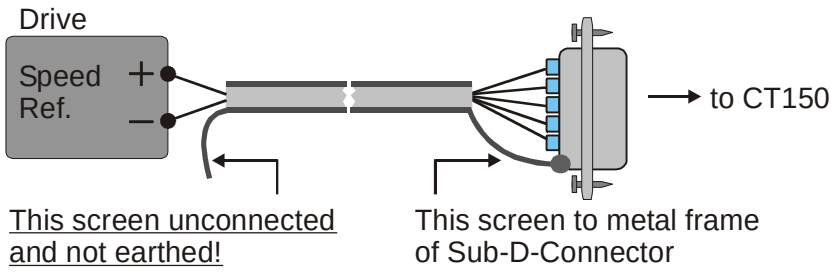


Fig10

4.1. Encoders

The unit only accepts TTL impulse signals (5V, RS422) or similar from an encoder simulation (resolver). It is essential to connect the channels A, /A, B, /B.

The index inputs Z and /Z of the slave can be used to generate the cutting pulse, but this needs the slave encoder to be directly mounted to the cutting roll, because only one cutting pulse per cut can be accepted. Also, in this case the encoder must mechanically be mounted in a way that the index pulse appears inside the synchronous cutting zone.
Under regular conditions it makes no sense to use the index inputs Z, /Z of the master channel. It is register selectable if you use the corresponding HTL inputs at the control in / out port with a photocell or proximity switch, or the TTL inputs with the encoder index.
See register "Index Mode"
Where you find you are working with existing 10 - 30 Volt encoder signals which feature only A, B, Z signals, the PU 210 converter should be used to gain full complementary signals in line with RS422 standards.

An auxiliary voltage of **5,2 V (max. 400 mA)** is available on the connector plugs **"Master"** and **"Slave",** for easy supply of the encoders. This voltage uses the same GND as the power supply, the digital inputs and the analogue output. Both encoder connectors on the unit are Sub - D - 9 pin, male.

Fig. 11 and Fig. 12 show the encoder connections and the principle of the input circuit. All impulse inputs are driven by high speed opto couplers.

When connecting the encoders it is not important to wire the A and B signals to produce the correct counting direction. The direction can be determined in the setup menu.

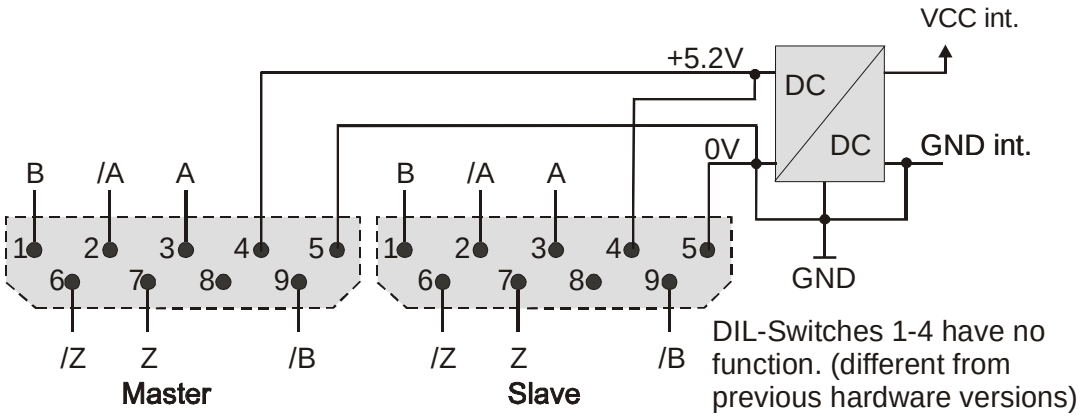


Fig. 11

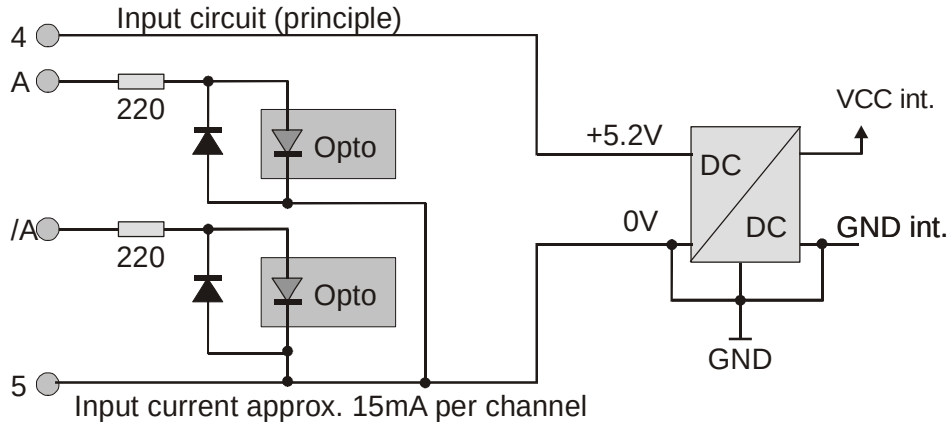


Fig. 12

Important

- With encoders, supplied by the CT150:

  Connector pins 4 and 5 provide the encoder supply.
- With encoders, supplied by an external source, or when an encoder simulation from the drive is used (Common GND operation)

  Use connector pin 5 as common zero Volt potential.
- For fully potential-free operation:

  Connect only A, /A and B, /B and leave terminal 5 (Common) unconnected.
  For reason of best noise immunity, we recommend to use potential free operation wherever you have line driver signals with remote supply.

Warnings:
Pin 4 of the Master and Slave encoder connectors is a supply output and you must never apply external voltage to this pin. Serious damage of the controller would be the result!

- Where you use one common encoder for feedback of the drive and feedback for the CT150 at the same time, there may come up interference problems. You can use a GV150 impulse splitter to eliminate any kind of problems. In most applications, the common encoder would also work fine when it is supplied by the drive and the CT150 operates in fully differential mode like shown.

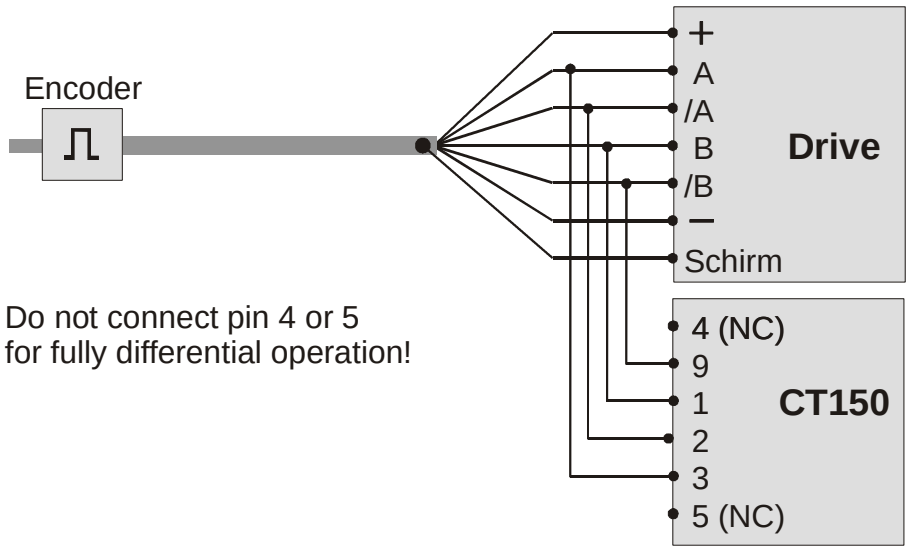


Fig. 13

DIL switches S1 / 5 - 8 provide the selection of the encoder edge counting. It is possible with complementary signals to count with times 1, 2, or 4 without any fear of miscounting. The selection always applies separately to the master **and** the slave input signals.

Master:		
DIL-Pos. 5	DIL-Pos. 6	Edge count
ON	ON	X1
OFF	ON	X2
ON	OFF	X4
OFF	OFF	Counter disabled
Slave:		
DIL-Pos. 7	DIL-Pos. 8	Edge count
ON	ON	X1
OFF	ON	X2
ON	OFF	X4
OFF	OFF	Counter disabled

Fig. 14

Please note, that

- The maximum frequency of the CT150 refers to the total **number of edges** counted, i.e. 300 kHz (x1) or 150 kHz (x2) or 75 kHz (x4).
- Impulse numbers, to be entered upon setup, also refer to the total **number of edges** counted, i. e. the entry data must be doubled with (x2) etc.

When possible, you should set the switches in a way to produce approximately similar impulse numbers on Master and Slave side to achieve best operation. i.e. 4096 impulses x 1 on the Master side and 1000 impulses x 4 on the Slave side.

4.2. Analogue Connections

All the analogue input and output signals can be found on the 9-Pin Sub-D connector (female) marked as "Analog" on the front plate. **The Analogue common GND is internally connected to the minus of the 24 VDC supply. All analogue levels are in range +/- 10 Volts.**

When you use the **digital feed- forward** mode, you must only connect **pin 7** which is the analogue output for the cutter drive speed reference.

When you use the **analogue feed- forward** mode, you must apply a 0 - 10 V analogue signal proportional to the line speed to **pin 6**.

Pin 4, 5, 8 and 9 are for special purpose and must normally remain unconnected.

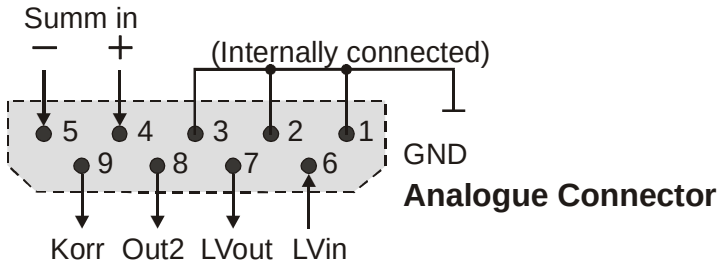


Fig. 15

4.3. Power Supply

The CT150 operates from an unstabilized 24 VDC supply (+/- 25%), however, the voltage including ripple should not exceed the following limits (18 V...30 V). The supply of the CT150 is both electrically and mechanically protected against wrong polarity misconnection by protection diodes and a special plug.

Warning:

At pin 1 of the "PI" connector and pin 1 of the "PI/PO" connector, a +24V output is available for easier wiring of input and output supplies. This voltage is taken from behind of a current limiting resistor. Short circuiting these outputs to GND can burn the resistor or internal printed lines.

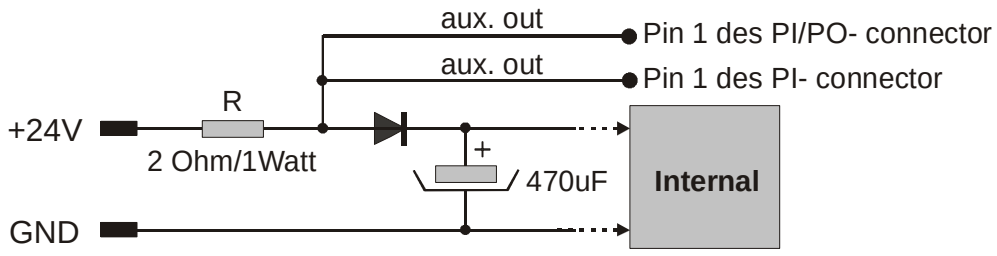


Fig. 16

4.4. Parallel Interface

The interface provides remote setting of operational and configuration registers. It receives BCD or binary data (selectable) from a remote thumbwheel switch or PLC control. There are four binary coded select lines which provide up to 16 addresses being accessible, via 20 data lines. The register parameters are stored in the following manner:

a. Store the parallel data upon a Read pulse. The data is then latched into the internal buffer, without affecting the control operation at this point.
b. Activate data upon an input pulse. All the data stored in the buffer is loaded and executed.

It is easy to see how 16 external registers may be easily loaded into the CT150.
The connection of the parallel interface is a 25 pin Sub-D connector (male) which is marked as "PI" on the front fascia.
All inputs are fully PLC compatible. All signals refer to GND and the minus potential of the supply.

Log. 0	(low)	=	0.....5 Volt
Log. 1	(high)	=	18...30 Volt

Important Advice
Upon power up, the unit loads the full register set stored in its EEProm. Data transmitted from the parallel and/or serial interface will overwrite the operational RAM-data, but not the corresponding EEProm registers. As a result, when powering up, any parallel or serial data will be replaced by EEProm data, until it is overwritten again.

The RAM data however can be restored to the EEProm at any time by parallel or serial command.
Parallel interface operations must keep the following timing conditions:

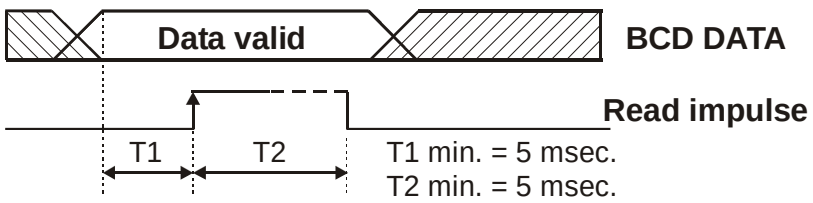
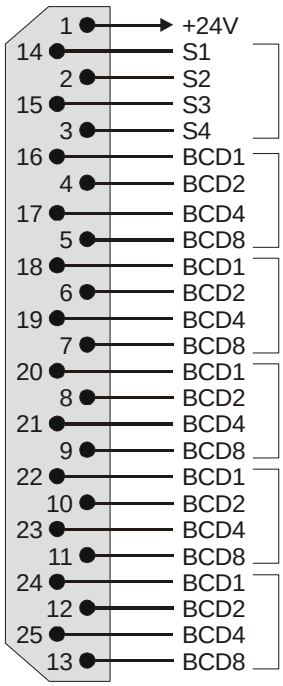


Fig. 17

Data latch occurs with the positive transition of the strobe pulse. Data lines must be in a valid state at least 5 msec. prior to the strobe, and remain present for an additional 5 msec. while the data is read. There is no upper limit for T1 and T2.



S4	S3	S2	S1		
0	0	0	0	Length	(C 05)
0	0	0	1	Pho-Offs.	(C 12)
0	0	1	0	Pho-Cut	(C 11)
0	0	1	1	P1 → Cut	(C 08)
0	1	0	0	Cut → P2	(C 07)
0	1	0	1	Circ 1	(C 00)
0	1	1	0	Circ 2	(C 02)
0	1	1	1	Trimm	(C 04)
1	0	0	0	Cut/Rev	(C 09)
1	0	0	1	Mark/Len	(C 10)
1	0	1	0	Mode	(C 40)
1	0	1	1	Ramptime	(C 17)
1	1	0	0	Gain - Cor	(C 46)
1	1	0	1	Gain - Tot	(C 48)
1	1	1	0	ppr1	(C 01)
1	1	1	1	ppr2	(C 03)

With signed parameters the most significant bit (pin 13) is used as sign bit (low=+).

When using binary format pin 16 is the LBS and pin 13 is the MSB.

Fig. 18

5. Control IN/OUT Port

There are 12 control input lines and 8 control output lines available on the 25 Pin Sub -D - Connector (female). This is marked on the fascia PI/PO. All the inputs are the same as the parallel inputs. All the outputs are opto-isolated transistor outputs which are PLC compatible.

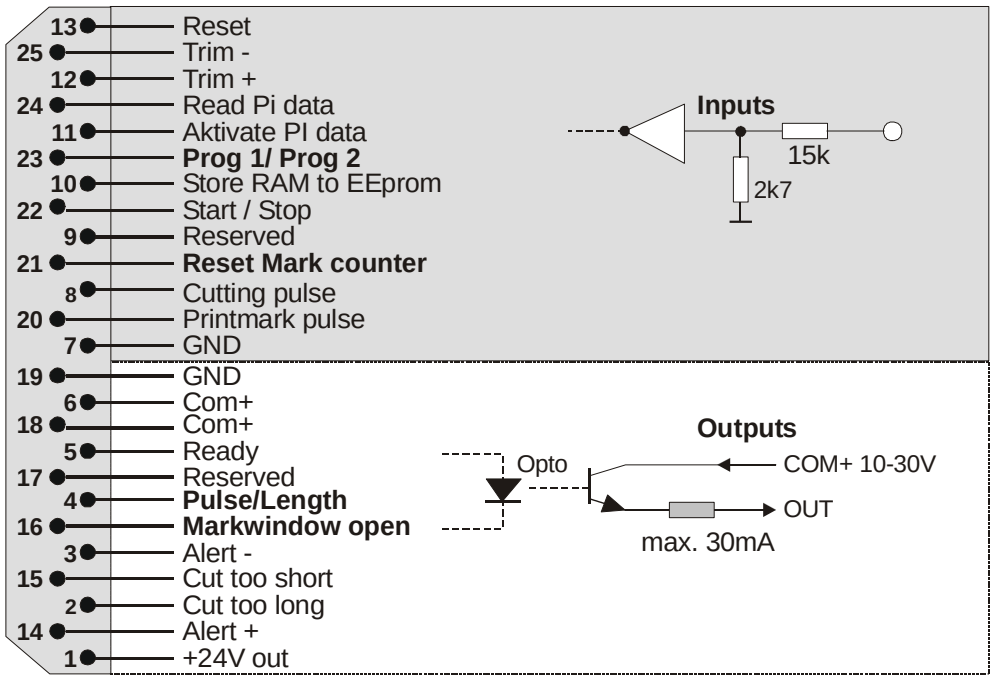


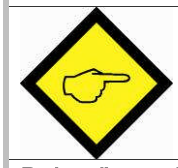
Fig. 19

Inputs	Description
Reset (13):	A High signal switches off the digital closed loop control and the unit only operates in an analogue open loop. When a Reset signal is applied with the Start / Stop input in High state, the unit also executes a new initial software startup cycle.
Trim + (25): Trim - (12):	Shifts the cutting position forward or reverse, i. e. the unit temporarily cuts longer or shorter pieces while one of the Trim inputs is High. With print mark registration, the Trim inputs can be used to adjust the cutting position with respect to the mark. Once it has been placed correctly, a „Store to EEprom" command will store the cutting position and the unit will find the correct position automatically again after power down. Trim inputs can also be used to jog the roll while the line stands still.
Read PI data (24)*:	Reads values of BCD or Binary code on parallel input. These values are stored in 16 separate buffer memories, as selected. This data is not activated until the following input is made.

Inputs	Description
Activate PI data (11)* :	A rising edge of this input transfers the data from the buffer memory to the operating memory.
PROG.1 / PROG.2 (23):	The unit can store two completely different sets of parameters and, depending of the production, use either parameter set 1 (Pin 23 low) or parameter set 2 (pin 23 high). Signal changes on this input will only become active when • either power is switched off and on again • or the start/stop input goes high and the cutting roll comes to standstill
Store RAM to EEprom (10) :	A rising edge at this input stores all actual operational data to the EEprom and the same data set will be loaded again after power down. It is recommended to use this command only at standstill or low speed, because it could affect the accuracy of the subsequent cut.
Start / Stop (22):	With Low state, the unit operates in a normal cutting cycle. When the input goes High, the subsequent cut is still executed normally and then the cutting roll decelerates to a closed loop stop position, following the ramp set to the "Ramptime" register.
Reset mark counter (21):	When using print mark operation, many times we find several marks on one size of the sheet to be cut, and only one of these marks is valid for registration. The unit can automatically blank out the other marks by defining the active mark as follows: Set this input to high when the valid print mark is close to the print mark sensor, but is not yet sensed. Move the line slowly until the sensor detects the mark and switches from low to high (rising edge required!). The Reset mark counter input must go back to low state before the sensor generates the next rising edge from the following mark. This stores the position of the valid print mark and the unit will not trigger to the other marks between. See also register Mark/Window.
Cutting Pulse (8) :	This input must receive one impulse per revolution of the cutting roll (unless the TTL index pulse of the slave encoder is used) and the rising edge of the impulse must be somewhere in the cutting zone, since it serves as reference for definition of the synchronous phase. When you have several tools on the roll (i. e. for several cuts per revolution), refer to register „Cuts / rev".

*) N.B It is permissible to activate both „Read" and „Activate" inputs at the same time. Thus for instance, a common input can be used to enter a new cutting length.

Inputs	Description
Print mark pulse (20) :	Connect the print mark sensor to this input if applicable. Otherwise leave it unconnected. Print mark registration refers again to the rising edge. The mechanical distance between mark sensor and cutter is register settable.
	Hint for print mark registration: With missing marks or those which were not detected correctly, the CT150 automatically places the cut to the position where the mark should have been. However, a sudden change of print mark distance which is not in multiples of the normal distance will result in a new searching process and the outputs „Cut out of tolerance“ will switch on until the mark position has been reached again.

Outputs	Description
Ready (5):	This announces that the unit is ready to run. On power up, this output is "Low" for about three seconds to allow the power supply to settle, and then switches to "High".
	Warning: When "High", the unit could not detect a system fault itself, therefore this is not a guarantee for fault-free operation!
Pulse/Length (4):	This output generates impulses proportional to the line motion, with scalable length units and a 1:1 duty cycle. As an example, the output can be used to count the total length in „meters“ by use of a remote counter or a PLC.
Mark window open (16):	This output goes high while the mark window is open. You have specified the position of the rising edge of a valid mark by the function „Reset mark counter“. You will also specify a window around the position where the valid mark must be expected, by the "Mark window" register. The output says that this window is open now and the next rising edge of the mark detector will trigger the print mark control.
Alert - (3) Alert + (14) :	These outputs signalize that the cutting roll is not in the exact angular position where it should be with respect to the line. Mechanical problems or drive overload could be the reason.
Cut too short (15) Cut too long (2) :	These outputs signalize that one or several cuts are out of the tolerance window set by register. Sudden change of print mark distance or insufficient drive response could be the reason.

6. The Serial Port

The RS232 serial link can be used for two purposes:
The unit includes a serial RS232 and a RS485 interface, both accessible by the Sub-D-9 connector marked „RS232".

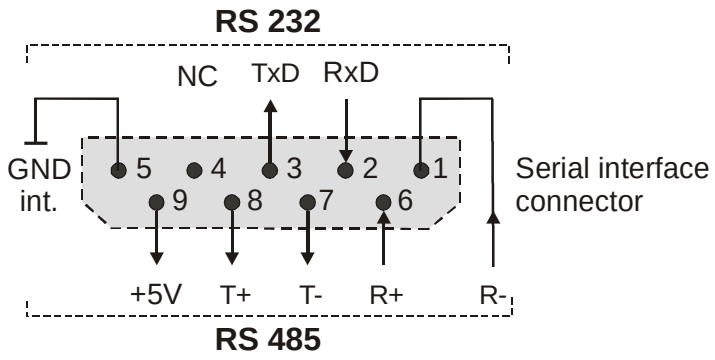
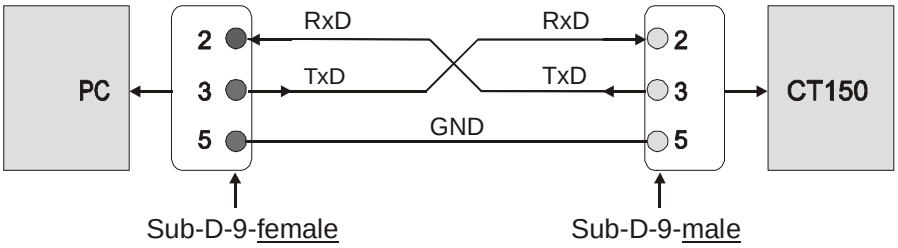


Fig. 20

To run the OS 3.2 operator software with your PC by RS232, your PC must be connected to the CT150 unit like shown:



Only pins 2,3 and 5 must be wired and pins 2 and 3 must be crossed over

Fig. 21

Please make sure your PC serial cable uses only the three pins shown. When also other pins are connected, this will cause interference with the RS485 pins and the PC communication will not work.

When using the RS485 interface, you can serve up to 32 different bus participants in either 2-wire or 4-wire transmissions mode. The subsequent figures show, as an example, how to run a TX720 operator terminal with a CT150 unit and other controllers.

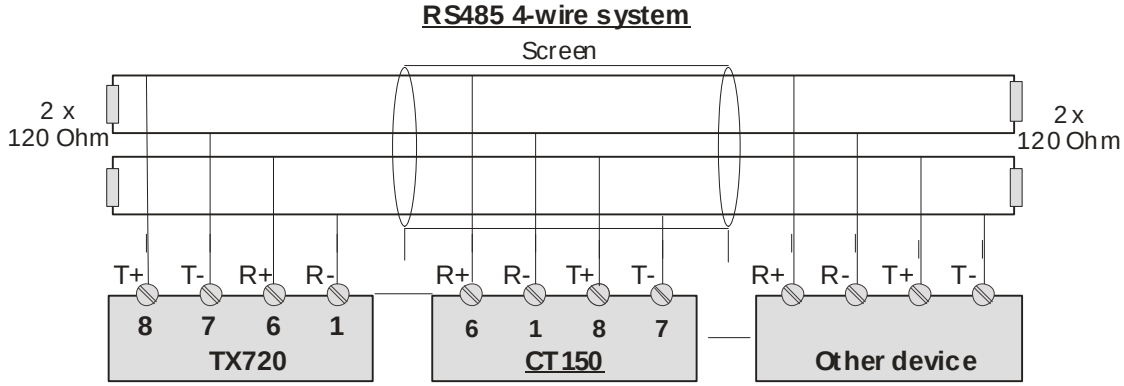


Fig. 22

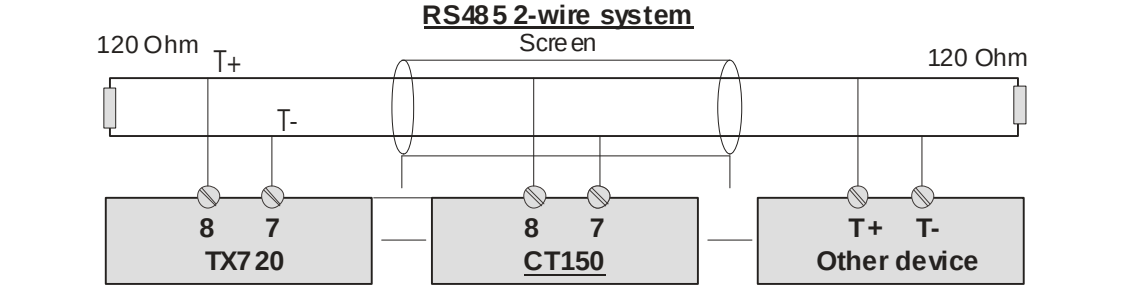


Fig. 23

A detailed **description of the serial protocol** is available upon request or can be downloaded from the Download site of the motrona homepage www.motrona.de
document name: „Serpro"

7. Register settings

Registers can be set by keypad under LCD control or by PC, using the OS3.2 operator software. This section describes the registers and their meanings and the next section shows how to program the registers.

The unit provides 4 Sub-Menus.

Data In Contains operational registers.

Setup Contains registers that need to be set only once upon commissioning.

Adjust provides easy setting of the analogue gains upon commissioning.

Testprog executes various testing functions for internal and external signals.

Expressions like C00 indicate the serial register access codes.

8. How to operate the Keypad (not needed with PC setup)

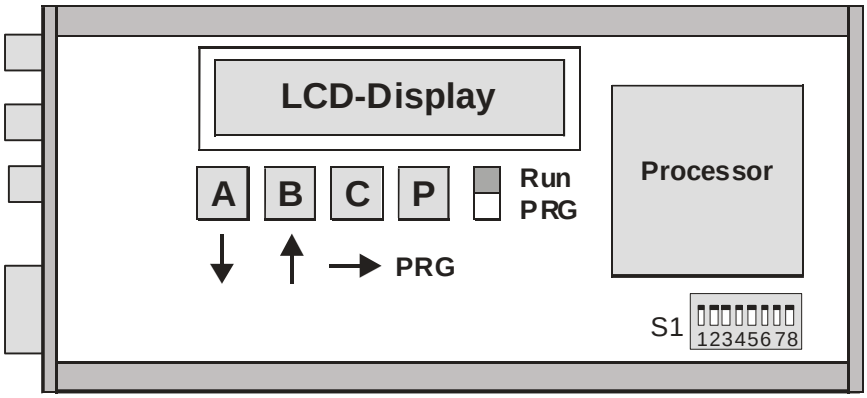


Fig. 24

To access the operator PCB, remove right hand side plate.

The on board setting controls comprise an LCD display, 4 small buttons and a sliding switch. When the switch is selected to "Run", the LCD permanently displays the software version of the program and the buttons A, B, C and P have no function.
Programming by the on board setting controls requires the sliding switch to be slid to "PRG". For external PC setting it must however be in the „Run“ position.
The buttons have the following control functions (Cursor highlights the register):

Button A: Scrolls register down; scrolls menu forward and also increments the highlighted digit.

Button B: Scrolls registers up; scrolls menu backward and also decrements the highlighted digit.

Button C: Returns from register to menu titles; increments highlighted digits to the right, (or from full right to full left).

Button P: Enters from menu to registers; changes register from text to value and back to text again. Stores actual data to the EEprom.

The following example shows how to set the “Trim“ register of the Data In menu (see register table).

Aktion	LCD
• Slide the switch to “PRG	DATA IN
• Select the Data IN Menu by pressing “P“	Circ. 1
• Press “A“ several times until the LCD shows “Trim“	Trim
• Select the Trim register by P and read the actual setting (i.e.100)	1 0 0
Change setting to i.e. 050 msec. like shown:	
• Key B decrements digit highlighted by cursor	0 0 0
• Key C shifts cursor right	0 0 0
• Key A increments highlighted digit. Press A 5 times	0 5 0
• Press P to store the new value	Lenght

When you slide the switch back to “RUN“, you read again “CT15010A“ and the unit is ready to operate.

When you press “C“ instead, you come back to “DATA IN“ etc.

Please note:
The unit is unable to operate or to make serial communication while the slide switch is in the “PRG“ position!

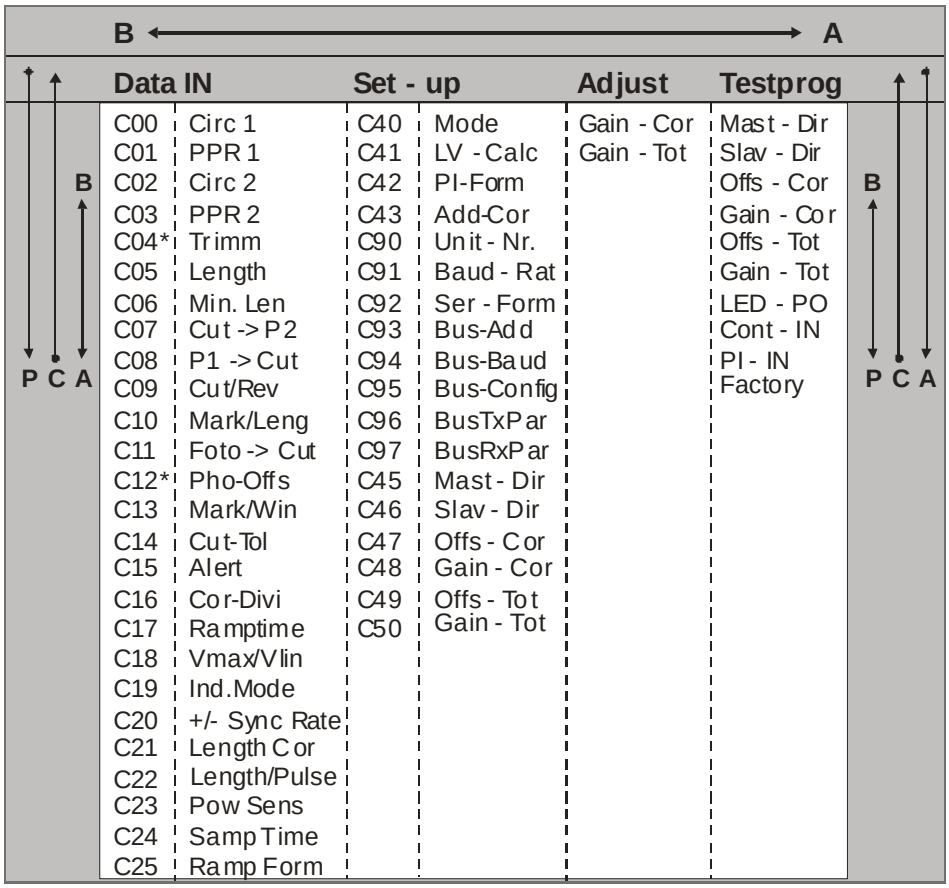
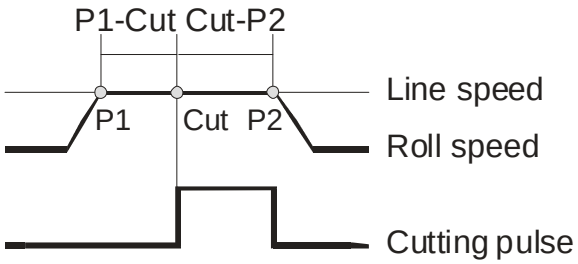
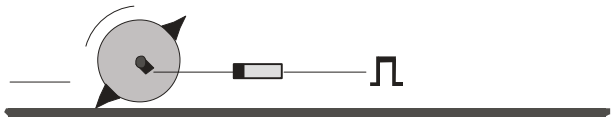
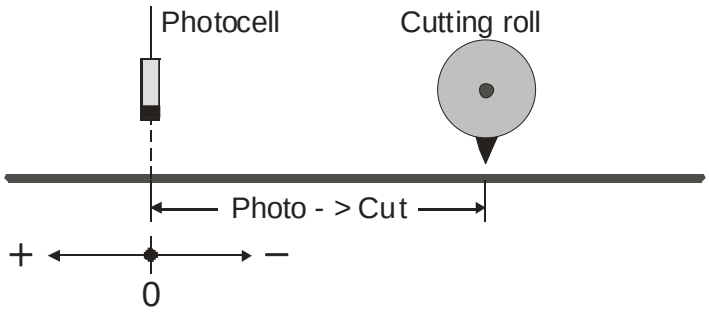

B
A
Data IN
Set - up
Adjust
Testprog
P C A
B
C00 Circ 1
C01 PPR 1
C02 Circ 2
C03 PPR 2
C04* Trimm
C05 Length
C06 Min. Len
C07 Cut -> P2
C08 P1 -> Cut
C09 Cut/Rev
C10 Mark/Leng
C11 Foto -> Cut
C12* Pho-Offs
C13 Mark/Win
C14 Cut-Tol
C15 Alert
C16 Cor-Divi
C17 Ramptime
C18 Vmax/Vlin
C19 Ind.Mode
C20 +/- Sync Rate
C21 Length Cor
C22 Length/Pulse
C23 Pow Sens
C24 Samp Time
C25 Ramp Form
C40 Mode
C41 LV - Calc
C42 PI-Form
C43 Add-Cor
C90 Unit - Nr.
C91 Baud - Rat
C92 Ser - Form
C93 Bus-Add
C94 Bus-Baud
C95 Bus-Config
C96 BusTxPar
C97 BusRxPar
C45 Mast - Dir
C46 Slav - Dir
C47 Offs - Cor
C48 Gain - Cor
C49 Offs - Tot
C50 Gain - Tot
Gain - Cor
Gain - Tot
Mast - Dir
Slav - Dir
Offs - Cor
Gain - Cor
Offs - Tot
Gain - Tot
LED - PO
Cont - IN
PI - IN
Factory
B
P C A

Fig. 25

9. The Data IN – Menu

Register	Description
Circ 1:	This register must be set to the circumference of the line feed roll or the measuring wheel. **You are free to set it in any dimensions** (i. e. inch, millimeters or 0.1 millimeters), but herewith you fix up all other length dimensions (for other registers, length preset, photocell distance etc.) If you enter Circ 1 with 0.1 mm resolution, all following presets will be scaled with 0.1 mm steps. Range 1 - 65535
PPR 1:	Pulses per revolution of the feed roll. Enter the number of pulses from the master encoder for one revolution of the roll, or measuring wheel. Range 1 - 999 999. Observe count setting (x1, x2, x4).
Circ 2:	Circumference of the cutting roll. Range 1 - 65535 length units
PPR 2:	Pulses per revolution of the cutting roll. Range 1 - 999 999
Trim:	Speed for positional displacement of the cutting position, when using the Trim inputs. Entry is in software cycles (1 cycle = 100 μsec) necessary to displace the cutting roll by one slave encoder increment. With setting 001, the unit changes the position by 1 encoder increment every 100 μsec. With setting 999 we need 999 x 100 μsec to change the position by one increment.
Length:	This is a default length which the cutter will cut upon missing remote length preset. It will also cut the default length whenever the slide switch is returned from PRG to its RUN position. Range 1 - 999 999 length units. **We recommend to set always this register similar to the Circ 2 register (continuously synchronous roll speed).**
min. Length:	Minimum cutting length. Limits the length setting range in order to avoid operator mistakes
Cut → P2:	This register defines, how long after the rising edge of the cutting pulse the roll must remain synchronous before the speed profile starts to change speed. Entry in length units. Range 1 - 9999
P1 → Cut:	Similar to above, but distance **prior to** the rising edge of the cutting pulse. Range 1-9999
	 Fig. 26

Register	Description
Cuts/Rev:	Set this register to 1 when your roll uses only one tool at it's circumference to perform one only cut per revolution. There are two ways of setting when you have mounted two or more tools around the roll and one revolution performs two or more cuts. a) You have one only cutting pulse per revolution of the roll (where i. e. two cuts are executed). Then set this register to the number of cuts the roll performs with each revolution. The CT 150 then will generate the missing cutting pulses internally.  **Example:** Two cuts per revolution, but only one cutting pulse: Set "Cur / rev." to "2" Fig 27 b) You use several cuts per revolution, but each cut will also generate a cutting pulse. Then proceed like follows: • Set register „Cut rev" to 1 • Do not set the real circumference to the register „circ 2", but set it only to the part of the circumference between two cuts. • Set also the ppr2 register to the number of pulses for one cut.  **Example:** Two cuts per revolution, but also two cutting pulses per revolution: Set "Cut / rev" to "1". Set "circ2" to half of the real roll circumference. Set "ppr2" to half of the ppr. Fig. 28
Marks/Length:	For print mark registration only: Set this register to „1", when you have only one print mark with each cut. Set it to the number of print marks between two cuts, when you find several marks, but the cut should only be executed with one specific mark.
Pho → Cut:	With print mark registration only. Preset of the mechanical distance between photocell and cutting position. Range 0 - 999 999 length units.

Register	Description
Pho- Offset:	With print mark registration only. Fine adjustment of the desired cutting position with respect to the print mark. Setting to „0“ results in placement of the cut to the edge of the print mark (rising edge of the photocell). This register is also accessible remotely by parallel input. Range +/- 9999 length units.  Fig:29
Mark/Win:	With print mark registration only. Defines a symmetric window around the rising edge of the print mark sensor. The print mark is supposed to appear inside this window and signals outside the window will not trigger the print mark registration. See also input „Reset mark counter“. Range 0-999 length units. You must set this register to 00 if not used.
Cut Tolerance:	Defines the switching level of the outputs „Cut too short“ and „Cut too long“. Range 0-99 length units. Increments the waste counter and the cycle counter for automatic length overwrite (with print mark mode) every time when exceeded.
Alert:	Defines the switching level of the alarm outputs when the system is forced out of synchronization due to external events (drive fault or mechanical problem). Setting occurs in „error encoder increments“ and the alarm outputs switch on when the positional error of the roll in respect to the scheduled position overpasses the number of encoder bits set. Range 1 - 9999.
Cor-Divi:	Correction divider. Setting range 1-9. This provides a digital attenuation of the phase correction signal that is produced, when the drive on mechanical grounds (deadband or backlash) cannot respond. In such a case, it is not desirable to make corrections immediately. The "Cor-Divi" provides a window for the drive "backlash", within which the controller produces no correction. Value 1 = No window, Reaction to 1 error increment. Value 2 = Window +/- 1 Encoder increment. Value 3 = Window +/- 2 Encoder increments. Value 4 = Window +/- 4 Encoder increments. Value 5 = Window +/- 8 Encoder increments. etc.

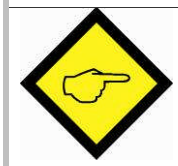
<table>
<tr><th>Register</th><th>Description</th></tr>
<tr><td>Ramp time:</td><td>Ramp time to stop the cutter drive.
Range 0.01 – 9.99 sec.
This ramp has absolutely nothing to do with the ramps the unit uses in normal operation, because it automatically calculates the softest speed transition possible. The ramp register only stops the drive when you slide the keypad enable switch from „Run“ to „PRG“ while the drive is running, or when you use the Start/Stop input to stop the drive.</td></tr>
<tr><td>Vmax/Vlin:</td><td>This setting is important only when the range of cutting lengths includes lengths shorter than the roll circumference, so the roll must accelerate between two cuts. The register sets the maximum speed ratio between the circumferential roll speed and the line speed that the drive will take when required.
This means, whenever you cut shorter length, it is necessary the slave drive can at least run double line speed. The higher the ratio, the shorter the minimum length you can cut. It is important to know that this ratio setting does not refer to the maximum line speed, but to the real line speed you use when cutting short length. You are free to reduce your line speed with shorter length preset and i. e. set this register to 8. But then you must be sure that the cutter drive can really run 8 times the line speed you actually use for your shortest length. In general, setting „8“ can be recommended.</td></tr>
<tr><td>Index Mode:</td><td>This register selects the index source (i. e. the cutting pulse and the print mark pulse). You are free to use either the TTL inputs on the encoder connectors, or the HTL inputs at the control IN / OUT port PI / PO.
<table>
<tr><th>Index Mode</th><th>Cutting pulse source</th><th>Print mark source</th></tr>
<tr><td>0</td><td>HTL, Pin 8
on PI/PO</td><td>HLT, Pin 20
on PI/PO</td></tr>
<tr><td>1</td><td>TTL Index Pins
6 and 7 at Slave input</td><td>HLT, Pin 20
On PI/PO</td></tr>
<tr><td>2</td><td>HTL, Pin 8
On PI/PO</td><td>TTL Index Pins
6 and 7 at Master input</td></tr>
<tr><td>3</td><td>TTL Index Pins
6 nnd 7 at Slave input</td><td>TTL Index Pins
6 and 7 at Master input</td></tr>
<tr><td></td><td></td><td>Fig. 30</td></tr>
</table></td></tr>
<tr><td>+/- Sync Rate:</td><td>Percent adaptation of the circumferential roll speed to the line speed during the synchronous cutting phase. Setting range +/- 99.9%. When set to 00.0% (normal setting), the tool will be fully synchronous with the line upon the cut. Some applications may require slightly higher or lower speed due to the shape of the cutting tool, which can be set by this register.</td></tr>
</table>

Register	Description
Length Correction:	With print mark registration only. Automatic overwrite of the length setting by the print mark distance found by measurement. Setting range 0 – 9 0 = overwrite switched off 1 = overwrite after 1 cycle 2 = overwrite after 2 cycles 3 = overwrite after 4 cycles 4 = overwrite after 8 cycles
	Clarification: When cutting or printing paper or foils with print marks, the material can shrink or stretch for reasons of tension, ambient temperature, humidity etc. As a result, the distance between two print marks (i. e. also the cutting length) will change and no more exactly match the preset length. Due to the proportional control feature of the CT150 unit, this would also cause a slight displacement of the real cutting position with respect to the print mark. The „Length Correction" register sets a number of cutting cycles where the cut must be out of tolerance (register Cut-Tolerance) in always the same direction and consecutively. When reached, the length preset is automatically overwritten by the real length measured between the print marks and proportional position errors are eliminated.
Length/Pulse:	Scaling factor for the auxiliary impulse output. Setting range 1 – 99 999 length units per impulse. If the whole system is calibrated in „Millimeters" and the output should be used to count and totalize the line with integer meters, set this register to 1000 to receive one impulse every meter
Power Sense:	0 = batch counters not stored in the EEprom upon power down 1 = batch counters stored in the EEprom
Sampling Time:	Provides digital filtering of the feed forward signal generated from the line encoder. Range 0001 - 1000 msec. Normal setting **1 msec.** recommended. In applications where the line speed is very unsteady, settings like 10 or even 100 msec. can be advantageous for smoother motion of the rotating knife. Please note that higher setting results in lower response with changes of the line speed.
Ramp Form:	1 = speed profile with S-shaped polynomial ramps (suitable best for nearby all servo drives) 2 = speed profile with straight linear ramps (sometimes preferable with big DC drives)

10. Setup Menu

Register	Description
Mode:	Mode 1: Operation **without** print mark Mode 2: Operation **with** print mark
	**Important hint:** When you use <u>never</u> print mark operation, set Mode to "1". When you use <u>always</u> print mark operation, set Mode to "2". Where you run <u>mixed</u> production (sometimes with and other times without print mark): Set Mode to "2" and install a select switch to apply or remove the print mark impulse to pin 20 of the Control IN/OUT port, according to actual need.
LV - Cal:	Selects analogue or digital Feed Forward mode 1 = Analogue Feed Forward. Apply a 0 - 10 V signal proportional to line speed to pin 6 of the analogue connector. 2 = Digital Feed Forward. Leave pin 6 of the analogue connector open. Unit generates Feed Forward signal from master encoder. Use always setting „2", except you need analogue feed forward for special reasons.
PI - Form:	Selects the input code of the parallel interface (PI): 0 = data entry with BCD code 1 = data entry with binary or hexadecimal code
Add - Cor:	Switches the internal summation of the analogue correction signal on / off. 0 = off, open loop mode with no correction 1 = on, closed loop mode with correction superimposed Must always be set to "1" with regular operation!
Unit-Nr:	**For serial operation only.** Allows entry of a device address between 11 and 99. It is not allowed to use addresses containing a "0" (i. e. 20, 30, 40 etc.) as these are reserved for collective addressing of several units. **Factory setting "11".**

<table>
<tr><th>Register</th><th>Description</th></tr>
<tr><td>Baud Rate</td><td>For serial operation only.
The following transmission rates can be selected:
<table>
<tr><th>Baud Rate</th><th>Setting</th></tr>
<tr><td>0</td><td>9600 Baud</td></tr>
<tr><td>1</td><td>4800 Baud</td></tr>
<tr><td>2</td><td>2400 Baud</td></tr>
<tr><td>3</td><td>1200 Baud</td></tr>
<tr><td>4</td><td>600 Baud</td></tr>
<tr><td>5</td><td>19200 Baud</td></tr>
<tr><td>6</td><td>38400 Baud</td></tr>
<tr><td colspan="2">Factory setting : = 0 Fig. 31</td></tr>
</table></td></tr>
<tr><td>Ser- Form</td><td>Ser-Form: For serial operation only.
The following formats of serial data can be selected:
<table>
<tr><th>Ser-Form</th><th>Data bits</th><th>Parity</th><th>Stop bits</th></tr>
<tr><td>0</td><td>7</td><td>Even</td><td>1</td></tr>
<tr><td>1</td><td>7</td><td>Even</td><td>2</td></tr>
<tr><td>2</td><td>7</td><td>Odd</td><td>1</td></tr>
<tr><td>3</td><td>7</td><td>Odd</td><td>2</td></tr>
<tr><td>4</td><td>7</td><td>None</td><td>1</td></tr>
<tr><td>5</td><td>7</td><td>None</td><td>2</td></tr>
<tr><td>6</td><td>8</td><td>Even</td><td>1</td></tr>
<tr><td>7</td><td>8</td><td>Odd</td><td>1</td></tr>
<tr><td>8</td><td>8</td><td>None</td><td>1</td></tr>
<tr><td>9</td><td>8</td><td>None</td><td>2</td></tr>
<tr><td colspan="4">Factory setting: 0 Fig. 32</td></tr>
</table></td></tr>
<tr><td>Bus-Add,
Bus-Baud,
Bus-Config,
BusTxPar,
BusRxPar:</td><td>Only relevant for units with option “field bus interface” (CAN-Bus or PROFI-Bus DP). See supplementary instructions for further information.</td></tr>
<tr><td>Mast Dir:</td><td>Direction of phase of the master encoder. Settings can be changed from „0“ to „1“ in order to change the direction of internal counting. Changing this bit does the same as interchange of the A / B encoder channels. For correct setting see „Steps for commissioning“.</td></tr>
<tr><td>Slave Dir:</td><td>Similar to above, but for slave encoder.</td></tr>
<tr><td>Off-Cor:</td><td>Digital setting of analogue offset on correction signal.
Setting range +/- 99. Normal setting "0"*)</td></tr>
<tr><td>Gain-Cor:</td><td>Digital setting of gain control (proportional control)
Range 0 - 9999. Setting to 9999 results in a response of 100 mV per error bit.
Recommended setting: 200....2000 (i. e. 2 mV....20 mV per error bit).</td></tr>
</table>

Register	Description
Offs-Tot:	Digital setting of the offset on the slave speed reference output. Range +/- 99. Normal setting "0" ***)**
Gain-Tot:	Digital setting of the feed forward analogue output gain. Setting range 0 – 999999.
	***) Remark:** CT150 uses precision instrumental amplifiers which do not need an offset adjustment. In larger drive plants however, by balance currents between several devices, an external offset can build up, which can be compensated by the offset adjust.

11. Adjust Menu

There are only the parameters Gain-Cor and Gain-Tot accessible (the same as described above), but in this menu they can be changed continuously with the motors running. This allows easy adjustment of the analogue synchronization and the intensity of correction while observing the LED bar graph and the drives. Keeping down key A continuously increments the values and key B decrements, while the LCD displays the current state. The PRG key stores the setting to the EEProm and key C resets the LED bar graph to its green centre position.

12. Testprog – Menu

This menu contains a couple of useful tests for the controller itself and its peripheral devices (encoders, remote lines etc.)

Register	Description
Mast-Dir:	This is the same register as in the setup menu, but the LCD display operates as an up/down counter for the master encoder pulses, permitting full check of the encoder functions. When the encoder is rotated "forward", the counter counts up. If incorrect, press "A" to change the counting direction. Key "B" operates as a counter reset button. Key "PRG" automatically stores the direction in the “Mast-Dir” register.
Slave-Dir:	Similar to Mast-Dir, but for slave encoder. Counter must also count up with forward rotation.
Off-Cor:	Similar to the setup menu, but continuous scroll up/down by keys "A" and "B" and 100x increased resolution (100 mV output correspond to 1 mV in reality) for better measuring.
Gain-Cor:	Similar to the setup menu, but continuous scroll up/down by "A" and "B" and full scale correction output (1024 error bits are simulated).
Offs-Tot:	Similar to setup menu, but scroll function with "A" and "B"
Gain-Tot:	Similar to setup menu, but scroll function with "A" and "B"
LED + PO:	Test for front Led’s and Control outputs PI/PO. Switches on and off all Led’s and outputs, one after the other.
Cont-IN:	Checks and displays the state of the PI/PO control inputs. The LCD display shows the inputs in hexadecimal code (0...9, A, B, C, D, E, F). Touching key "A" changes the code to "1 of 12" and the high state pin numbers of the connector appear in the display. In this code, only one pin can be displayed.
PI-IN:	Displays the state of all data and select lines in a BCD or hexadecimal code. Suited best to check data transmission from a remote switch or a PLC.
Factory:	Hidden registers, factory accessible only.

13. The LED Display

The 8 Led's mounted on front of the module indicate the instantaneous angular error between the real roll position and the position where it should be with respect to the actual line position. The display provides information for commissioning and fault monitoring, in a very simple but efficient form.

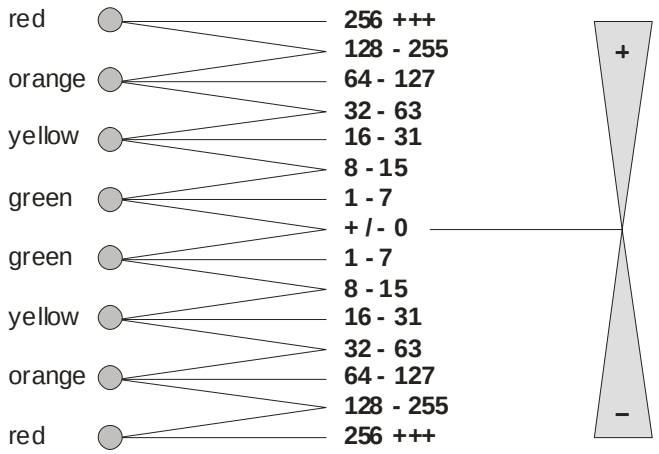


Fig. 33

When both green Led's in the centre are lit, the phase error is absolutely zero.

When either of the green Led's is lit alone, the error lies between 1 to 7 bits. When one green and one yellow LED is lit, the phase error lies between 8 to 15 bits, etc.

When the lights are up, this indicated positive correction (Master is ahead)
When the lights are down, this indicated negative correction (Slave ahead)

The above notes hold for positive reference giving forward rotation. Everything is reversed for negative reference giving forward rotation.

14. Remarks about Drives, Encoders, Cables, Installation

14.1.

The drives in use must be dimensioned correctly in respect to power and dynamics required. The CT150 can never provide good operation outside the physical limits of the drives. Prior to connecting the master and the slave to the controller, both drives must be adjusted for a proper stand-alone operation with no oscillation, by means of a remote speed reference voltage. The reference inputs must be potential free.

14.2.

The resolution of the TTL-encoders, in principle, should be as high as possible, in order to keep the mechanical phase error as small as possible when the controller "plays" a few encoder increments around the zero error position. However it would be nonsense to choose the number of ppr much higher than needed or reasonable. If, for example, a gear box with several 0.1 mm of clearance is installed, a 0.01 mm resolution of the encoder could cause slight stability problems, which needed to be removed by the "Corr-Div" error divider again.

The CT150 loads each encoder channel with a current of 15 mA. For this reason, one encoder is unable to supply the impulse input of several target units at a time, as needed with some multi drive systems. In such applications, our impulse distributor type GV150 must be used to feed several controllers from one encoder.

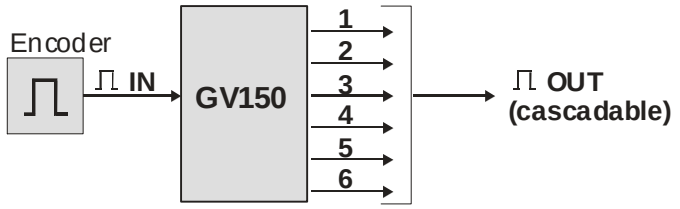


Fig. 34

14.3.

Please note, that not all types of cables are suited to transmit frequencies as high as 300 kHz! However, with proper installation and screening, the RS 422 lines provide perfect transmission even over long distances.

The cross section of encoder cables must be chosen with consideration of voltage drop on the line. The CT150 provides a 5.2 V encoder supply and at the other end the encoder must at least receive it's minimum supply voltage! (See encoder specifications).
Please observe the unit accepts at maximum 300 kHz of encoder frequency.

14.4.

You must strictly observe all rules and specifications given in the drive manual and all **general safety and installation standards**. Use shielded power cables for the motors. Keep distance between power cables and electronic cables. Put filters to all inductive equipment installed in the same cabinet (i.e. RC filters in parallel to coils of AC contactors, diodes in parallel to electromagnetic DC values etc.) Make sure your cabinet and your machine have a solid earthing/grounding system. CT150 possesses excellent features with EMC immunity, but it can fail under poor electrical environment conditions.
Keep strictly to the instructions for screening given in section 4)!

14.5.

If you need to switch electronic signals by relay contacts, it is **necessary** to use relays with **gold contacts**. For impulse or analogue switching, we recommend the use of our electronic matrix switch type **GV155**.

15. Steps for commissioning

In principle, all commissioning could happen without a PC, just by use of LCD and keypad. Since, however, things go much easier and faster, we recommend you to use the OS3.2 operator software and follow the subsequent steps.

15.1.

At this time you must be sure your cutting roll drive is adjusted for proper operation and maximum dynamics. **Remove any ramps** and delays from the drive because the CT150 controller will produce the ramps. Make sure the drive can run the maximum speed with a speed reference of 9 Volts already (We must leave 1 Volt of output swing for the CT150 to make corrections).

15.2.

Make sure all connections are correct and DIL switch S1 is set according to need.

You must be sure your cutter drive runs forward (direction of the line) when is receives a positive voltage. If not, you must change this on your drive now.

15.3.

Power the unit up, connect the serial cable to the PC and start the OS3.2 software.

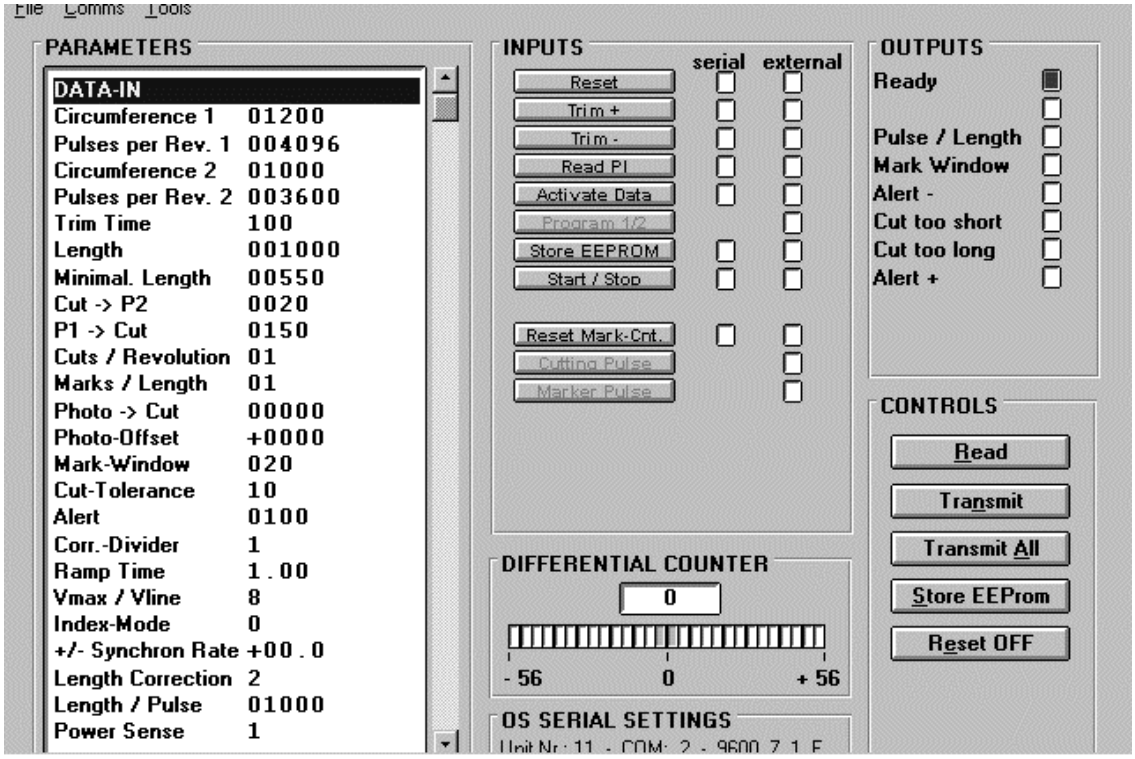


Fig. 35

15.4.

Set all registers according to need.
The following registers must be set to initial values like shown:

Length	:	= Circ 2	Mode	:	1	
Corr-Divider	:	1	Add Cor	:	1	
Vmax	:	8	Gain Cor	:	200	
+/- Sync	:	00.0	Gain Tot	:	see table	
			Unit NR.	:	11	
			Baud Rate	:	0	
			Ser Form	:	0	Fig. 36

The initial Gain Tot setting depends on the expected maximum frequency of the line encoder (frequency in KHz at **maximum line speed**)

fmax	Gain Total	
1 kHz	200 000	
3 kHz	66 000	
10 kHz	20 000	
30 kHz	6 600	
100 kHz	2 000	
For frequencies between use interpolated values. Initial setting can be approximately.		Fig. 37

Setting of registers "Mast-Dir" and "Slave-Dir" is not important at this time.
Click "Transmit All" and then to "Store EEProm" to store your settings to the CT150 controller.

15.5.

We must first set the counting direction of the encoders. Select the **"Test"** function in the **"Tools"** menu.

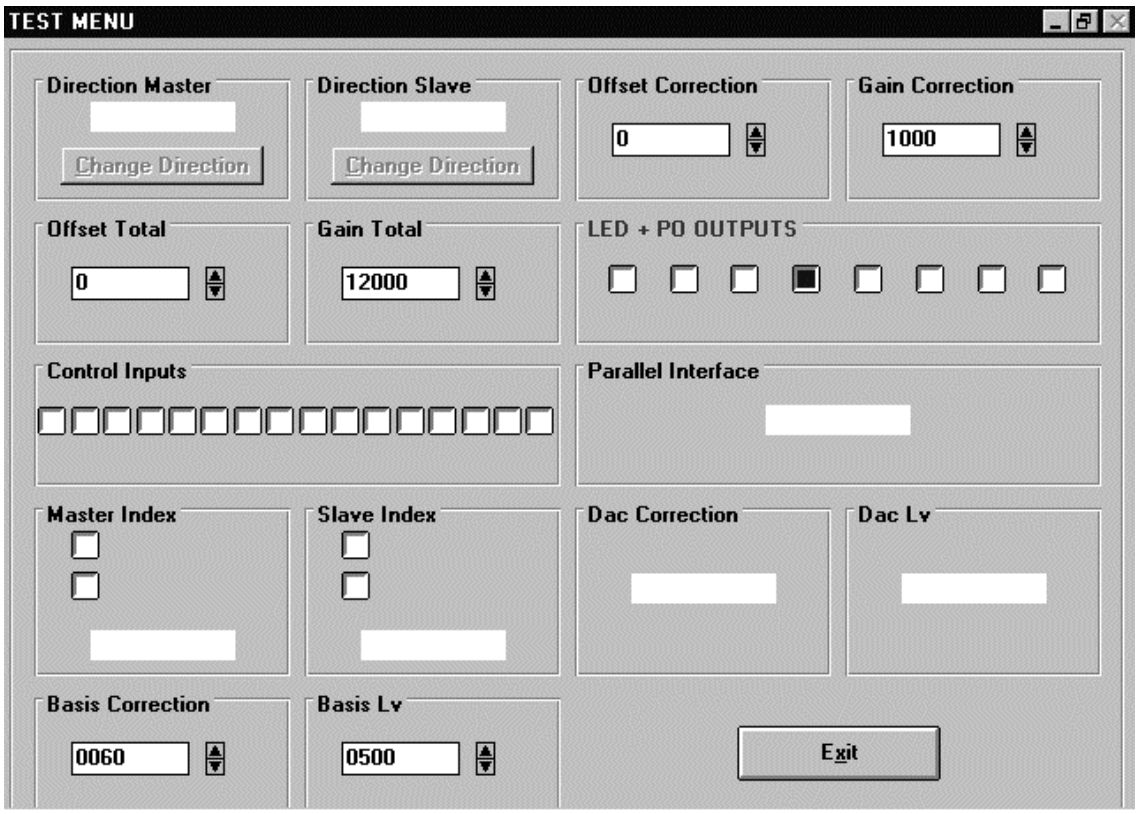


Fig. 38

Click to the **"Master Direction"** field. Rotate the Master encoder in forward direction, e.g. the direction it will rotate later with the material. The counter in the Master Direction field must count up. Where you find we count down, click "Change direction".

When we count up, click to the **"Direction Slave"** field.

Warning:

Your cutter drive will get a speed reference of 2 Volts via ramp while you click. **It will start immediately when the drive is enabled!** This test speed depends on the Gain-Correction setting (200=2Volts) and you can reduce it if required for this test. However, for further steps it is necessary to set Gain-Correction to 200 again.

Also the "Direction Slave" counter must count up. Where you find we count down, click "change direction". When we count up, click to any other field to stop the carriage drive again.

15.6.

Where you use the parallel interface for length preset (e.g. with a remote BCD switch or a PLC data output), please click to the **"Parallel Interface"** field and verify the parallel data arrive correctly.

15.7.

Click "Exit" now to return to the normal screen. This will save the settings in the controller. Next, you should check if the **control inputs** you use operate correctly. Apply all signals like "Reset" or "Start/Stop" and see if the signal change is visible in the "external" column of the Inputs field of your screen. Especially it is important to check the "Cutting Pulse". The corresponding indication box in the external field must go either ON or OFF while your tool is approximately in it's cutting position. Please remind the Cut-P2 and P1-Cut settings refer to the rising edge of the cutting pulse (when indicator switches from "OFF" to "ON").

15.8.

As a next step, we must set the **Gain Total** value for the analogue feed forward signal. Make sure the cutter drive is enabled to run, then select the **"Adjust"** function in the **"Tools"** menu. Please run the Master encoder at low speed and see how the cutter roll follows.

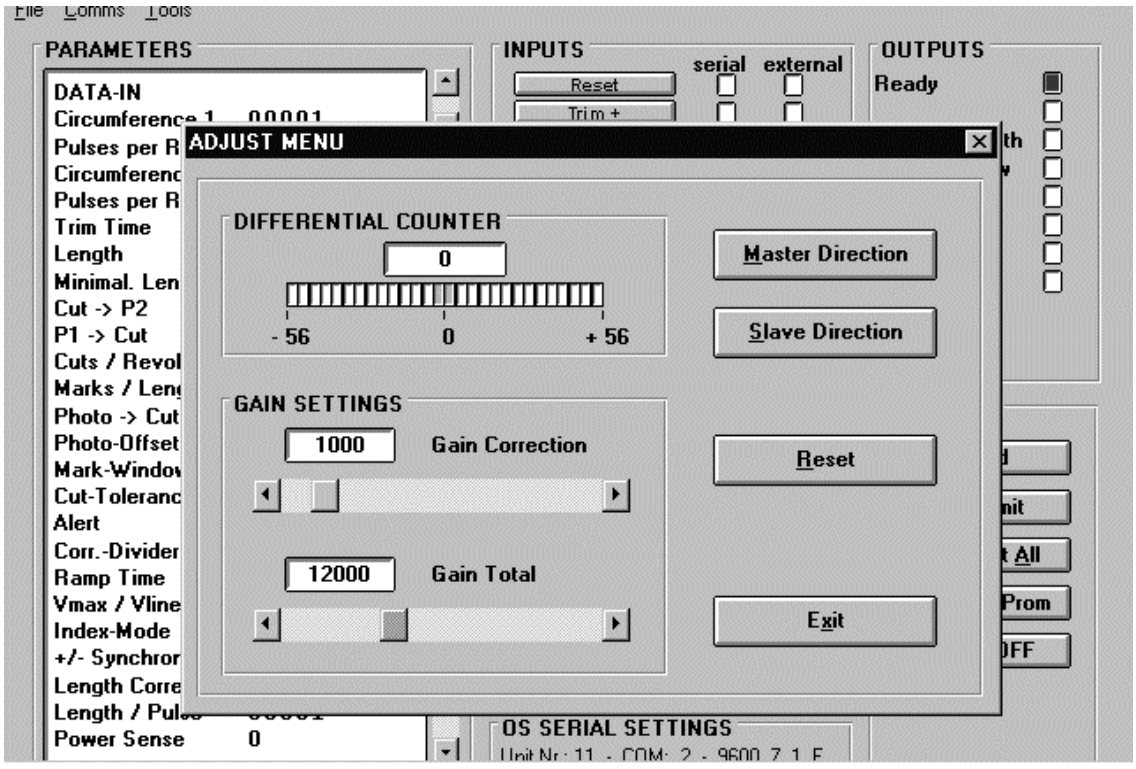


Fig. 39

We must observe the color bar graph and the differential counter now while we adjust the "Gain Total". Gain Correction should always be set to 200 during this procedure.
When we click the Reset to "ON", our differential counter will show zero and the bar graph will be in its green center position.
When we click the Reset to "OFF", our differential counter will run away and the bar graph will move to one or the other direction.
We must find now a setting for Gain Total that keeps our counter close around zero
(i. e. -5....0....+5) and the bar graph in its green/yellow center position.

- When the counter counts to positive (bar graph moves to right):
  Gain Total is too low and must be increased.
- When the counter counts to negative (bar graph moves to left):
  Gain Total is too high and must be reduced.
- For important changes of Gain Total use the slide button in the Gain Total field.
  For fine tuning, use the ▶ and ◀ buttons.

15.9.

When Gain-Total has been set correctly, we must now adjust Gain-Correction.
The rule is to have Gain Correction as high as possible. Typical values are from 300 to 1000, sometimes even 2000. Where you find your drive starts oscillating or running roughly, reduce Gain Correction again until we have stable operation. To change Gain-Correction, use the slide button or the ◀ and ▶ keys of the corresponding field.

15.10.

We now can exit the Adjust Menu and return to the main menu. The machine is ready to cut and we can simulate automatic cutting cycles.
It is important you start your first trials with a length setting equal to the circumference 2 - setting. This ensures your cutting roll rotates at constant speed with the circumferential tool speed always synchronous to the line. Then try to change the length setting. The more your settings moves away from the „"circ2" value in one or the other direction, the more distinct you will see the speed profile of the cutter roll. All the time, the front LED's on the unit and the color bar on the PC screen should move around the green/yellow center range.

15.11.

It is recommendable to observe the cutting cycle by the oscilloscope function of the operator software. Select "Oscilloscope" in the Tools menu. Set the serial code of channel 1 to :1 to see the cutting error. Set the serial code of channel 2 to :2 to see the speed profile.

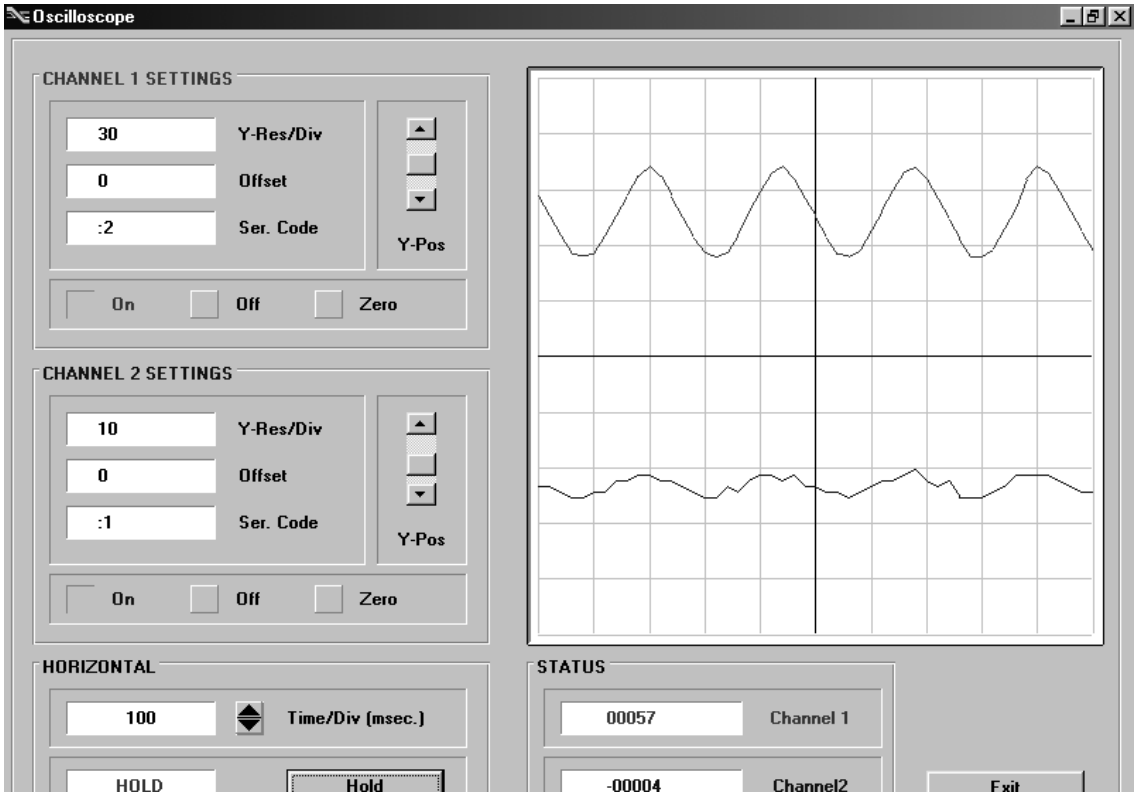


Fig. 40

16. Hints to improve performance

The performance of the electronic control system is clearly indicated by the front LED's and the color bar with differential counter on your PC screen. When you have achieved settings to keep the LED's at the green/yellow center position at all line speeds and with all length presets, there is nothing to improve.
If, despite of this, your cutting results should not satisfy you in terms of accuracy or synchronism, there are definitely mechanical or other reasons outside of the control loop.
The following hints refer to improvements you can make when LED and differential counter indicate unusual characteristics:

16.1.

Many of the front LED's are lit at the same time and the differential counter shows very unstable values:

- The resolution (ppr per length unit) of one of the encoders could be much higher than the mechanical clearance of your gears / tooth wheels etc.
- reduce edge count setting from (x4) to (x2) or (x1)
- See register "Correction Divider"
- Reduce ""Gain Correction" setting if this eliminates the problem.

Remark:
Even though your LED's can indicate a very unstable characteristics, your cutting accuracy and performance may be good. Then just accept this visual flaw.

16.2.

The LED's and the differential counter move up and down with the speed cycle of the cutter.

- Try to increase the "Gain-Correction" setting
- Check for avoidable ramps and delays in your drive
- The cutter drive is not strong and dynamic enough to follow the speed profile or to bring enough torque at the time the tool penetrates the material
- Reduce line speed for length settings where you observe this.

Remark:
This must not really affect your cutting performance. When the accuracy is good, you can accept this visual flaw.

17. Auxiliary Register and Command Codes

The following auxiliary registers are accessible by serial link, with the access codes shown (R = Read only, R/W = Read and write)

Code	Name		Function
:1	Error Count	(R)	Shows the differential number of encoder increments between the scheduled roll position and the real roll position at any time
:2	LV Value	(R)	Represents the actual feed forward signal (speed profile) of the cutting roll drive. 0 = Standstill 4095 = maximum speed.
:6	Print mark Error	(R)	Difference between actual and desired position of the cut with respect to the print mark. Unit: master encoder increments. (Only available when Mode = 2)
:7	Batch Counter	(R/W)	Increments with every cut executed. Can be preset to zero or datum.
:8	Waste Counter	(R/W)	Increments with every "Out of tolerance" cut. Can be preset to zero or datum.
:9	Line Speed	(R)	Represents the encoder frequency of the measuring wheel. 1 bit = 5Hz.
<4	Actual Cutting Length	(R)	Actual cutting length, scaled in master encoder increments
<7	Actual Cutting Error	(R)	Actual cutting length minus preset cutting length, scaled in master encoder increments
<8	Actual Cutting Error	(R)	Actual cutting length minus preset cutting length, scaled in length units

Beside the serial access codes shown in this manual, the subsequent codes are available to execute the same commands that can be activated by the hardware inputs also:

Ser.Code	Bit of control word (86)	Function	Type
55	14	Reset mark counter	S
56	4	Read PI data	D
58	0	Start / Stop	S
60	7	Reset	S
65	6	Trim +	S
66	5	Trim -	S
67	3	Activate data	D
68	1	Store EEprom	D

S = Static command, must be set to 1 to activate command and must be reset to 0 to deactivate command.

D = Dynamic command, must be set to 1 to activate command. Is automatically reset to 0 after execution.

Fig. 41

All commands can be activated either by its serial access code or by setting the corresponding bit of the control word **(Ser. Access code 86).**

Please note that all serial commands are “logical OR” to hardware commands (control inputs) and hence a command is ON whenever set by serial command or hardware input or both at a time.
The state of the control outputs can be read out by the status word (Ser. Access code 85) via serial interface. Bit 7, 6, 5, …, 1, 0 of the status word correspond to control outputs PI/PO pin 5, 17, 4, 16, 3, 15, 2, 14.

18. General Master Reset and Erase of EEProm

The unit carefully checks all entry data for validity and correctness within their permitted numeric range. If, as an extreme exception, invalid data should intrude into the register range, bad function or even a full hang-up could be the result. If this should ever happen

- push the Reset button on the unit's front (accessible by a small screw driver only)

  or
- power down the unit and power up again after a few seconds.

  Both measures result in a complete reconfiguration of all ports and registers. RAM and buffer data will be lost and the unit restores all data from the EEProm.

  If, however, invalid data should have penetrated to the EEProm, even the previous steps will not help. In this case:

- switch off the unit
- set the slide switch PRG/RUN to the PRG position
- keep key A down while powering on the unit and keep it down for at least another 5 sec.

This will clear up all the EEProm to its factory default values, and all registers need to be setup once more.

Above steps represent an emergency procedure that you will never have to apply under regular conditions.
In an extreme case however (i. e. lightening-strike in the factory etc.) they could help to get the unit working again.

It is mandatory erase the EEprom when the processor has been changed for reasons of software upgrade.

19. Physical Range of Cutting Lengths

The possible range of cutting lengths depends on several mechanical and electrical parameters like roll diameter, line speed, synchronous zone and dynamics of the drive. There is no limitation from the CT 150 controller. This unit calculates at any time the longest ramps possible to achieve the desired cutting result. As soon as these ramps become so short that the drive is unable to follow, we run to the physical limit.
The subsequent formulae should help you to optimize the layout of your cutting machine or to calculate what is possible or impossible. It is assumed that the cutter drive could run 8 times of maximum line speed (Vmax / VIin = 8). In situations where the cutter can take higher speeds, or where we can reduce line speed at extremely short cutting lengths, it is possible to cut shorter pieces than given by the formulae.

The following abbreviations are used:		
U	=	Circumference of the cutting roll (mm).
v_0	=	Max. line speed in mm per second.
ℓ_{sync}	=	length of the synchronous phase (mm)
t_H	=	Shortest time the drive needs to accelerate the roll from line speed to double line speed (sec.).
t_L	=	Shortest time the drive needs to decelerate the roll from synchronous speed to standstill (sec.).
ℓ	=	Actual cutting length (mm).
L1, L2, T1, T2	=	Reference values for calculation.

19.1. The shortest length possible

First we must calculate the reference time T1:

$$T1\ (sec) = \frac{U - \ell_{sync}}{9\, v_0}$$

When t_H is lower or equal T1:

$$\ell_{min} = \frac{7\left(l_{sync} + v_0\, t_H\right) + U}{8} \quad (mm)$$

When t_H is higher than T1:

$$\ell_{min} = \ell_{sync} - \tfrac{2}{7} v_0\, t_H + \tfrac{2}{7} \sqrt{v_0^2 t_H^2 + 7\left(U - \ell_{sync}\right) v_0\, t_H}\ (mm)$$

19.2. The longest length possible

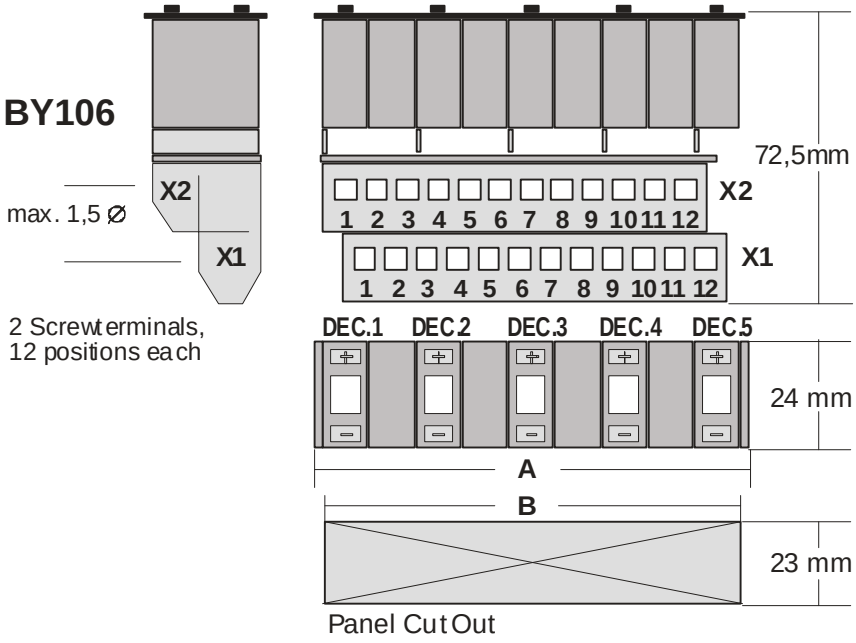
First we must calculate the reference time T2:
$$T2 = \frac{U - \ell_{sync}}{v_0}$$
When t_L is lower or equal T2, there is **no limitation** for long lengths.
When t_L is higher than T2, the longest length is:
$$\ell_{max} = \ell_{sync} + 2\, v_0\, t_L - 2\, \sqrt{v_0^2\, t_L^2 - (U - \ell_{sync})\, v_0\, t_L}\ (mm)$$

19.3. Dynamic requirements for the roll drive

The subsequent formulae show what the drive must be able to execute in terms of acceleration / deceleration, when the cutting parameters are specified.

First we need to calculate two reference length values:
$$L1 = \frac{2U + 7\ell_{sync}}{9}\ (mm) \quad L2 = 2U - \ell_{sync}\ (mm)$$
For all cutting lengths smaller or equal L1:
$$t_H = \frac{81 - 71_{sync} - U}{7\, v_0}\ (sec)$$
For all cutting lengths longer or equal L2:
$$t_L = \frac{U - \ell_{sync}}{v_0}\ (sec)$$
For lengths between L1 and L2 we get:
$$t_L = \frac{1}{4v_0} \bullet \frac{(\ell - \ell_{sync})^2}{\lvert U - \ell \rvert}$$
$$t_H = \frac{7}{4v_0} \bullet \frac{(\ell - \ell_{sync})^2}{\lvert U - \ell \rvert}$$

20. The BY 106-X Remote Thumbwheel Switch



Switch Type	No. Decades	A (mm)	B (mm)
BY 106-3	3	59,5	57
BY 106-4	4	59,5	57
BY 106-5	5	74,5	72

Fig. 42

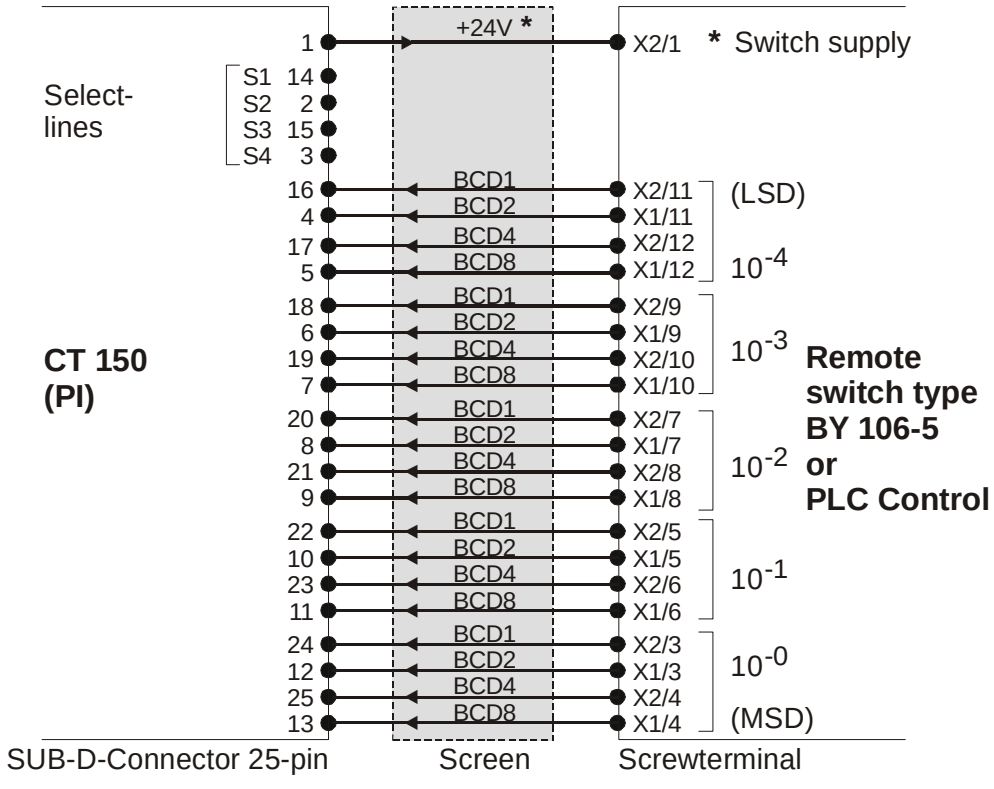
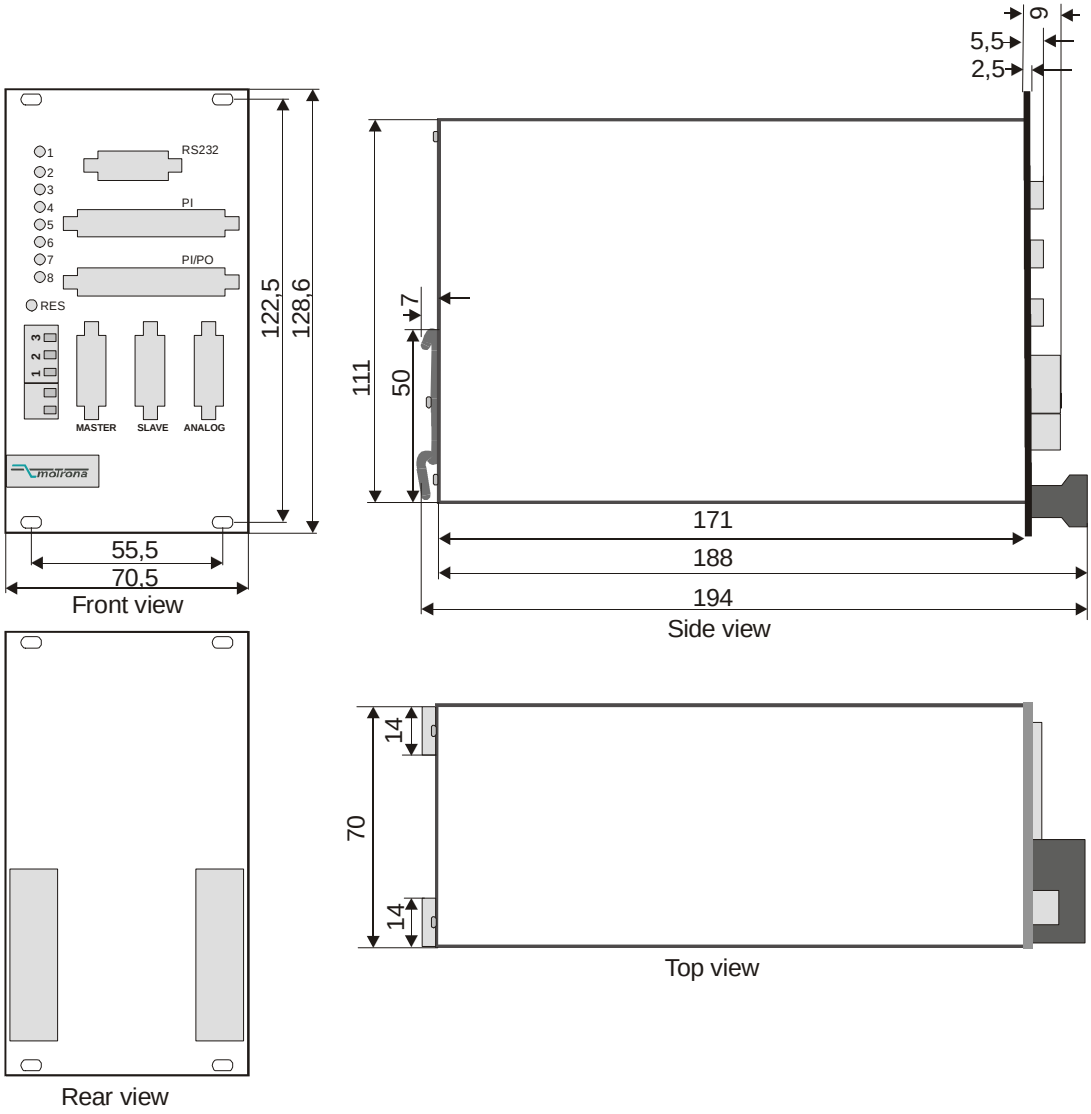


Fig. 43

21. Dimensions and Specifications



Power supply	:	18...30 V unstabilized
Consumption	:	approx. 300 mA (plus 25% of the encoder supply currents, if internal encoder supply used)
Encoder Supply	:	Aux. voltage 5.2 V, max. 400 mA installed
Processor	:	H8/532 with 20 MHz clock frequency
PCB and Technology	:	SMD, Multiplayer PCB`s, High speed logic 74 HCT
Encoder Inputs	:	Two A, /A, B, /B, Z, /Z (5 V TTL opto-isolated) Low < 0.8 V, High >3.0 V (4.0 V differential input signals)
Other Inputs	:	1 parallel port PI (24 lines) 1 control port (12 lines) all PNP with 10 - 30 V level.
Serial link	:	RS 232 and RS485, CAN optional, Profibus u. d.
Absolute max. frequency	:	310 kHz
Response time	:	approx. 150 µsec
Analogue In/Out	:	3 inputs +/- 10 V (Ri = 100 kOhms) 3 outputs +/- 10 V (Imax = 5 mA) Resolution: 12 Bit (= 4096 steps)
Analogue Correction	:	10 Bit = 1024 error increments
Error memory	:	32 000 error increments
Control Outputs	:	8 transistor outputs (opto-coupler 30 V / 30 mA max.)
Cutting accuracy	:	ca. +/- 5 encoder increments
Ambient temperature	:	Operation: 0 - 45°C (32 – 113°F) Storage: -25 - +70°C (-13 – 158°F)
Dimensions	:	see drawing
Weight	:	Approx. 850 g
Conformity and standards	:	EMC 89/336/EEC: EN 61000-6-2 EN 61000-6-3 NS73/23/EEC: EN 61010-1

22. Serial code list

22.1. Parameters

#	Menu	Name	Code	Min	Max	Default
0	DATA-IN	Circumference 1	00	1	65535	1000
1		Pulses per Rev. 1	01	1	999999	10000
2		Circumference 2	02	1	65535	1000
3		Pulses per Rev. 2	03	1	999999	10000
4		Trim Time	04	0	999	100
5		Length	05	1	999999	1000
6		Minimal Length	06	1	50000	500
7		Cut -> P2	07	1	9999	10
8		P1 -> Cut	08	1	9999	10
9		Cuts / Revolution	09	1	99	1
10		Marks / Length	10	1	99	1
11		Photo -> Cut	11	0	99999	0
12		Photo-Offset	12	-9999	9999	0
13		Mark-Window	13	0	999	0
14		Cut-Tolerance	14	0	99	10
15		Alert	15	0	9999	100
16		Corr.-Divider	16	1	9	1
17		Ramp Time	17	0	999	0
18		Vmax / Vline	18	2	8	8
19		Index-Mode	19	0	3	0
20		+/- Synchron Rate	20	-999	999	0
21		Length Correction	21	0	9	0
22		Length / Pulse	22	1	65535	100
23		Power Sense	23	0	1	0
24		Sampling Time	24	1	1000	1
25		Ramp Form	25	1	2	1

#	Menu	Name	Code	Min	Max	Default
26	SET-UP	Mode	40	1	2	1
27		LV-Calculation	41	1	2	1
28		PI-Format	42	0	1	0
29		Add-Correction	43	0	1	1
30		Ser. Unit Number	90	11	99	11
31		Ser. Baud Rate	91	0	6	0
32		Ser. Data Format	92	0	9	0
33		Bus Address	93	1	127	1
34		Bus Baud Rate	94	0	7	1
35		Bus Config.	95	0	255	1
36		Bus Tx Parameter	96	0	255	0
37		Bus Rx Parameter	97	0	255	0
38		Master Direction	45	0	1	0
39		Slave Direction	46	0	1	0
40		Offset Correction	47	-99	99	0
41		Gain Correction	48	0	9999	100
42		Offset Total	49	-99	99	0
43		Gain Total	50	0	999999	2000

22.2. Inputs

#	Name	Code	Cmd Bit	SerStatus	BusStatus	ExtStatus
0	Reset	60	0080	Yes	Yes	Yes
1	Trim +	65	0040	Yes	Yes	Yes
2	Trim -	66	0020	Yes	Yes	Yes
3	Read PI	56	0010	Yes	Yes	Yes
4	Activate Data	67	0008	Yes	Yes	Yes
5	Program 1/2		0004	No	Yes	Yes
6	Store EEPROM	68	0002	Yes	Yes	Yes
7	Start / Stop	58	0001	Yes	Yes	Yes
8	Reset Mark-Cnt.	55	4000	Yes	Yes	Yes
9	Cutting Pulse		2000	No	Yes	Yes
10	Marker Pulse		1000	No	Yes	Yes

22.3. Variables

#	Name	Code	Notes
0	tstcou	":0"	Internal Using
1	Error Count	":1"	R(*)
2	LV Value	":2"	R
3	Marpufh	":3"	Internal Using
4	len_imh	":4"	
5	Facdelh	":5"	
6	Printmark Error	":6"	R
7	Batch Counter	":7"	R/W(**)
8	Waste Counter	":8"	R/W
9	Line Speed	":9"	R
10	mar_onh	";0"	Internal Using
11	Cystah	";1"	
12	Marcouh	";2"	
13	Cutcouh	";3"	
14	m_averh	";4"	
15	Marmaxh	";5"	
16	Marminh	";6"	
17	mark_1h	";7"	
18	mark_2h	";8"	
19	mark_3h	";9"	
20	mark_4h	"<0"	
21	mark_5h	"<1"	
22	Speed	"<2"	
23	mar_err	"<3"	
24	Actual Cutting Lenght	"<4"	R
25	mar_ofh	"<5"	Internal Using
26	Lenpufh	"<6"	
27	Actual Cutting Error (Scaling: Master encoder increments)	"<7"	R
28	Actual Cutting Error (Scaling: length units)	"<8"	R
29	h'0000	"<9"	Internal Using
30	varaddh	"=0"	
31	h'0000	"=1"	

(*) Read only
(**) readable and writable