control – motion – interface

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FS340 and FS641

High Performance Low Cost Controller for Flying Shears and Saws

- Precision controller for Flying Shears and Saws
- Easy parameter setting and immediately ready to work with minimum commissioning time
- High accuracy due to high feedback frequency range (300 kHz with TTL encoders and 200 kHz with HTL encoders)
- Extremely smooth motion by optimized S-shape profiles
- High dynamic response by means of short cycle time, therefore accurate cutting results also during change of line speed
- Most compact unit including operator panel for direct access and RS232 interface for remote access
- PROFIBUS DP interface available (option)

Operating Instructions

Safety Instructions

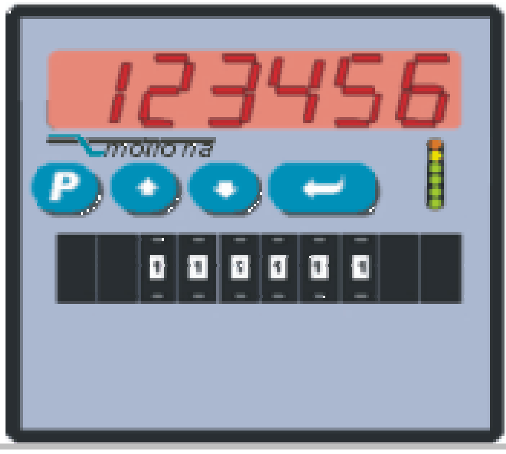
- This manual is an essential part of the unit and contains important hints about function, correct handling and commissioning. Non-observance can result in damage to the unit or the machine or even in injury to persons using the equipment!
- The unit must only be installed, connected and activated by 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:
FS34001a / June 12 / TJ	First edition

Table of Contents

1. Available Models

The two models as shown below are available. Both models are fully similar in terms of function and performance; however there is some difference with the size, the alert outputs and the speed ratio setting.

	FS340: ▪ Front size 96 x 48 mm (3.780'' x 1.890'') ▪ Cutting length setting by keypad ▪ Analogue output 14 bits ▪ 4 power transistor outputs (alert)
	FS641: ▪ Front size 96 x 96 mm (3.780'' x 3.780'') ▪ Cutting length setting by keypad or by front thumbwheel switches ▪ Analogue output 14 bits ▪ 4 power transistor outputs (alert) . and 4 relay outputs (alert)

Both models are suitable for front panel or operator desk mounting, by means of the included mounting clamps.

Where you desire to mount the units on DIN rails inside a cabinet, please refer to the mounting brackets type SM 300 and SM 600 available as accessories.

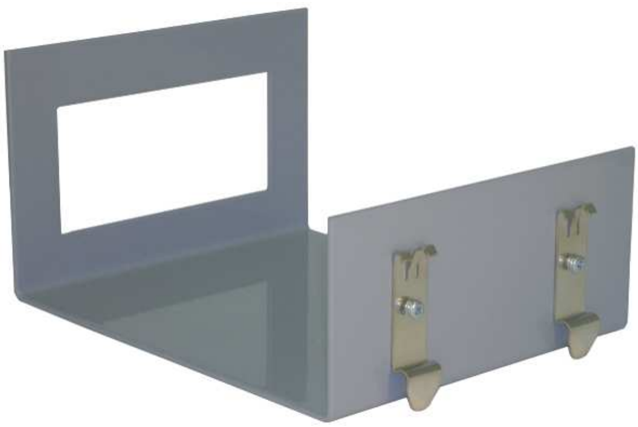


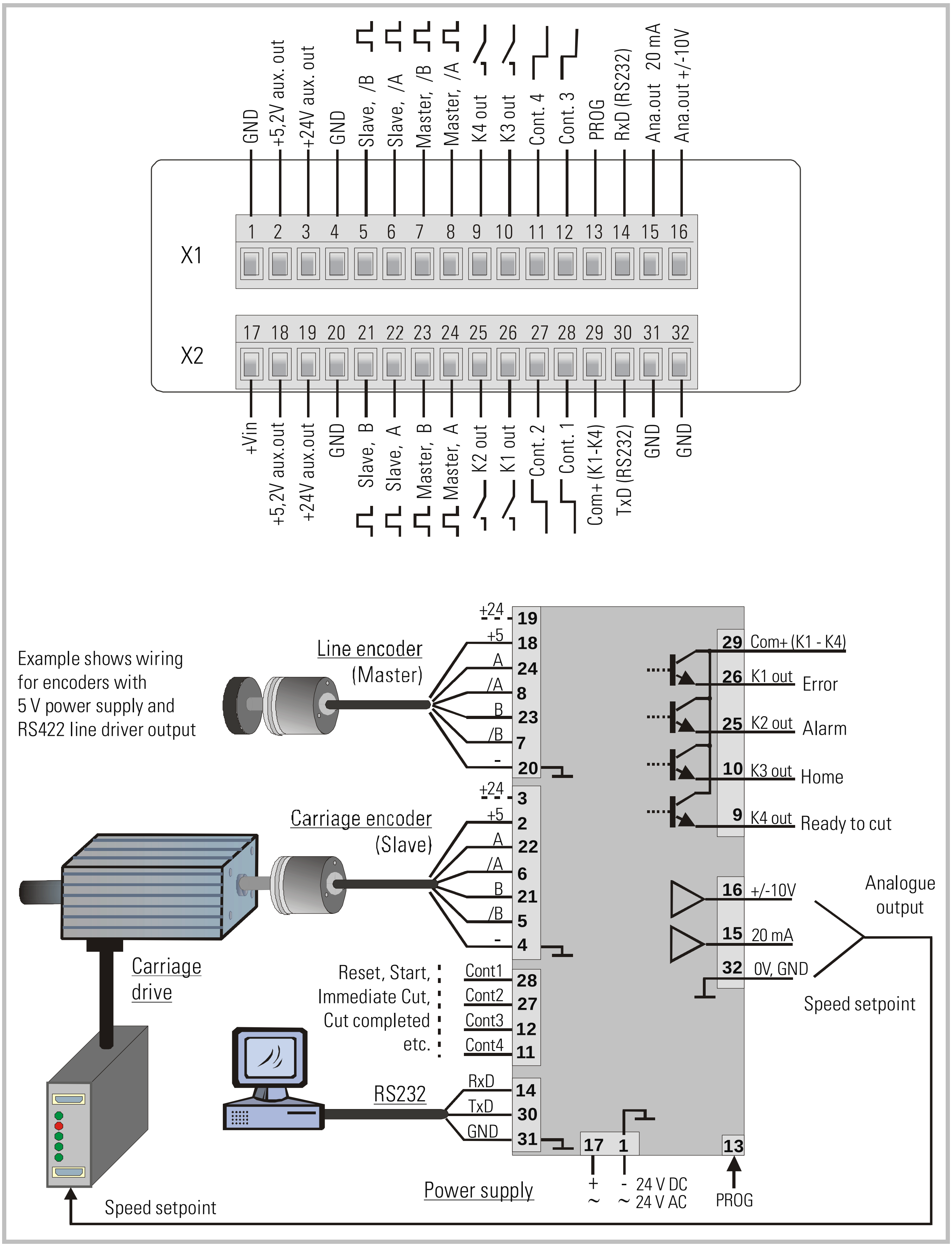
Figure: SM300 mounting bracket for DIN rail mounting of FS340 units

2. Introduction

The FS340 / FS641 units are suitable for control of "Flying Shears" and "Flying Saws", frequently used for cut-to-length applications with endless material, where the material is in continuous motion and cannot be stopped during the cutting process.
The mechanical construction provides a carriage with a cutting tool, following synchronously the material while the cut is in progress, and then returning to a home position, to wait for the next cut.
The FS340 / FS641 units have been designed for the special requirements of flying shear systems, under consideration of maximum efficiency and accuracy, with minimum stress for all mechanical parts. Very short control cycles together with intelligent motion profiles provide excellent performance under all operating conditions.
This unit is very easy to set up. All settings can be made either by keypad and display at the unit or by PC, with use of the motrona operator software OS3.2.
All relevant operational parameters and variables are accessible by RS232/RS485 interface. For PROFIBUS applications, our PB251 gateway is available. Therefore the user has multiple possibilities for remote control of all batch and cutting parameters via operator terminals, PC or PLC systems

- This manual first provides all basic instructions for operation of model FS340
- For operation of relays and thumbwheels with model FS 641 see appendix
- For PC setup our "OS32" software is available on the CD included to delivery, or on our homepage www.motrona.com
- For communication by PLC or IPC or by a remote operator terminal, please observe the serial protocol details described in our separate manual "Serpro".
- PROFIBUS communication is possible with use of our gateway PB251.

3. Electrical Connections



Terminal	Name	Function
01	GND	Common Ground Potential (0V)
02	+5,2V out	Aux. output 5.2V/150 mA for encoder supply
03	+24V out	Aux. output 24V/120 mA for encoder supply
04	GND	Common Ground Potential (0V)
05	Slave, /B	Carriage encoder, channel /B (B inverted)
06	Slave, /A	Carriage encoder, channel /A (A inverted)
07	Master, /B	Line encoder, channel /B (B inverted)
08	Master, /A	Line encoder, channel /A (A inverted)
09	K4 out	Digital output K4, transistor PNP 30 volts, 350 mA
10	K3 out	Digital output K3, transistor PNP 30 volts, 350 mA
11	Cont.4	Programmable control input
12	Cont.3	Programmable control input
13	(PROG)	(for download of new firmware only, not for general use)
14	RxD	Serial RS232 interface, input (Receive Data)
15	Ana.out 20 mA	Analogue output 0 – 20 mA (Slave speed reference) **)
16	Ana.out +/-10V	Analogue output -10V … 0 … +10V (Slave speed reference) **)
17	+Vin	Power supply input, +17 – 40 VDC or 24 VAC
18	+5,2V out	Aux. output 5,2V/150 mA for encoder supply
19	+24V out	Aux. output 24V/120 mA for encoder supply
20	GND	Common Ground Potential (0V)
21	Slave, B	Carriage encoder, channel B (non-inverted)
22	Slave, A	Carriage encoder, channel A (non-inverted)
23	Master, B	Line encoder, channel B (non-inverted)
24	Master, A	Line encoder, channel A (non-inverted)
25	K2 out	Digital output K2, transistor PNP 30 volts, 350 mA
26	K1 out	Digital output K1, transistor PNP 30 volts, 350 mA
27	Cont.2	Programmable control input
28	Cont.1	Programmable control input
29	Com+ (K1-K4)	Common positive input for transistor outputs K1-K4
30	TxD	Serial RS232 interface, output (Transmit Data)
31	GND	Common Ground Potential (0V)
32	GND	Common Ground Potential (0V) for DC or AC power supply

*) 120 mA and 150 mA are per encoder, i.e. total maximum currents are 240 mA and 300 mA

**) In general, the voltage output terminal 16 should be used for the slave speed signal

3.1. Power Supply

The FS340 synchronizer accepts both, a 17 – 40 volts DC power or a 24 volts AC power for supply via terminals 17 and 1. The current consumption depends on the level of the input voltage and some internal conditions; therefore it can vary in a range from 100 – 200 mA (auxiliary currents taken from the unit for encoder supply not included).

3.2. Auxiliary Outputs for Encoder Supply

Terminals 2 and 18 provide an auxiliary output with approx. +5.2 volts DC (300 mA totally).
Terminals 3 and 19 provide an auxiliary output with approx. +24 volts DC (240 mA totally)

3.3. Impulse Inputs for Incremental Encoders

All input characteristics of the impulse inputs can be set by the parameter menu, for each of the encoders separately. The unit works with quadrature information (A / B, 90°) only. In theory, any of the following encoder characteristics would be applicable:

- Symmetric differential signals according to RS422 standard, however 1V min. as differential voltage.
- TTL inputs at a level of 3.0 to 5 volts (differential, with inverted signal)
- TTL inputs at a level of 3.0 to 5 volts (single-ended) *)
- HTL signals at a 10 – 30 volts level
  (alternatively differential A, /A, B, /B, or single-ended A, B only)
- Impulses from photocells or proximity switches etc. providing a HTL level (10 – 30 volts)
- Proximity switches according to NAMUR (2-wire) standard
  (may need additional remote resistor)

*) requires special settings of the threshold parameters, see "Special parameters F08"

- For trouble-free operation it is mandatory to use quadrature encoders with channels A and B or with channels A, /A, and B, /B (90° phase displacement).
- Where the impulse level is HTL (10 – 30 volts) you can use either single-ended signals (A and B only) or differential signals (A, /A, B, /B)
- Where the impulse level is TTL or RS422, it is strictly recommended to use symmetric differential signals (with inverted channels /A and /B).
  Under industrial environment conditions, single-ended TTL signals may cause serious problems due to insufficient EMC immunity of the signal lines
- All encoder input lines are internally terminated by pull-down resistors (8.5 k**Ω**). Where encoders with pure NPN outputs are used, corresponding pull-up resistors must be available inside the encoder or externally to ensure proper function (1 k**Ω** ... 3.3 k**Ω**).

3.4. Control Inputs Cont.1 – Cont.4

These inputs can be configured for remote functions like Reset, Start, Cut completed, Immediate cut or display selection purpose.
All control inputs require HTL level. They can be individually set to either NPN (switch to -) or PNP (switch to +) characteristics. For applications where edge-triggered action is needed, the menu allows to set the active edge (rising or falling). The Control inputs will also accept signals with Namur (2-wire) standard.

For reliable operation of the Control Inputs a minimum impulse duration of 50 µsec. must be ensured. Especially when using the Z marker pulse of a HTL encoder for index tracking, please verify that this minimum duration can be kept even with maximum speed of the machine

3.5. Switching Outputs K1 – K4

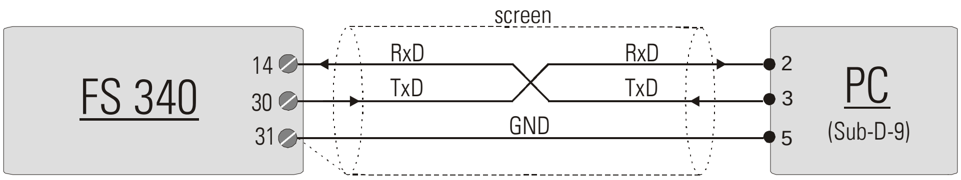
FS340 provides four digital outputs to signal control states like Ready to Cut, Alarm or Error. K1 – K4 are fast-switching and short-circuit-proof transistor outputs with a switching capability of 5 – 30 volts / 350 mA each. The switching voltage of the outputs must be applied remotely to the Com+ input (terminal 29)

3.6. Serial Interface

The serial RS232 interface can be used for the following purposes:

- Set-up of the unit by PC with use of the OS32 PC software
- Remote change of parameters during operation
- Remote readout of actual values by PLC or PC

The figure below explains the connection between the FS340 unit and a PC using the standard Sub-D-9 serial connector



For details of the serial communication protocol, please refer to the special "Serpro" manual.

3.7. Analogue Outputs

The unit provides a voltage output of +/- 10 volts (load = 3 mA), and a current output of 0 – 20 mA (load = 0 – 270 Ohms), both at a resolution of 14 bits (13 bits + sign).
With most standard applications the voltage output is used as a speed reference signal, connected to the speed input of the carriage drive.

4. Functional description

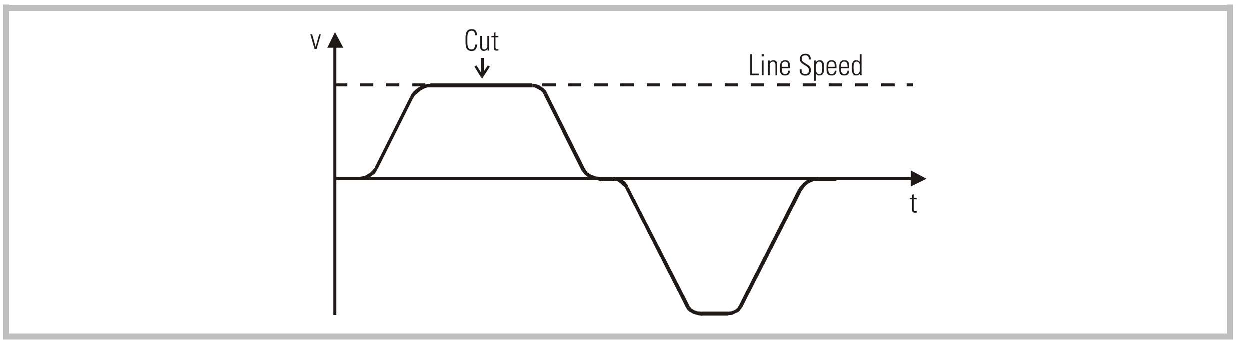
4.1. Principle of operation

The shear or saw blade is fixed on a carriage that can move in forward and reverse direction, under control of a +/- 10 volts speed reference signal, with a 4-quadrant DC or Servo or Vector drive.

Initially, the carriage keeps waiting in its rear home position, while the controller counts the current length of the passing material by means of encoder signals from a line roll or a measuring wheel.

As soon as the cutting point approaches an anticipated position, the carriage will accelerate and reach the line speed exactly where the cutting position matches the tool position. A "Ready-to-Cut" output will start the cutting procedure, while the carriage will exactly follow the material. When the cut is done, a remote "Cut completed" signal must tell the controller to decelerate and then return the carriage back to the home position again.

All speed transitions use self-optimizing S-shape profiles for minimum wear and tear of all mechanical parts, unless a linear ramp form has specifically been selected by corresponding parameter setting.



The FS340 or FS641 controller continuously measures the line speed and calculates an anticipation value to start the carriage before the cutting length is reached. Thus the shear will exactly match the cutting position of the material upon completion of the acceleration ramp and no overshoot or oscillation will take place prior to the cut. This saves time and increases the cutting efficiency of the shear system considerably.

4.2. System Configuration

As a master drive, either the motor of a feed roll or a measuring wheel equipped with an incremental encoder is used.

The encoder resolutions should be at least 5 times higher than the maximum acceptable cutting error.

At maximum line speed, the master encoder frequency should be at least about 1 kHz, for best resolution of the analogue output. Moreover, the input frequency must not exceed the maximum level of 300 kHz (RS422 and TTL differential encoder) or 200 KHz (HTL and TTL single-ended encoders).

It is best to choose the ppr numbers of line and carriage encoders in a way to produce frequencies in the same range. Acceptable ratios are in the range of

5:1 ... 1:1 ...1:5

Mismatching beyond 1:16 and 16:1 are not allowed. Where applicable, the (x1), (x2) or (x4) hardware multiplication of the Master channel or the Slave channel may be used to adapt the frequencies

The line encoder must be connected to input “Master” and the carriage encoder to input “Slave”.

For speed reference of the carriage drive, the analogue output is used.

At any time the controller needs a remote signal upon completion of the cut (“cut completed”) to commence the return motion of the carriage.

It is necessary to adjust the carriage drive to its maximum dynamic response (no internal ramps, no integral control loop, high proportional gain), because the FS340 and FS641 will generate the ramps which the drive has to follow with no additional delay

For safety reasons it is mandatory to limit the traveling range of the carriage by independent limit switches at both ends, in order to avoid damage with carriage overshoot upon failure of the electronic control system!

5. Keypad Operation

An overview of all parameters and explanations can be found under section 7.

The menu of the unit uses four keys, hereinafter named as follows:

PROG	UP	DOWN	ENTER

Key functions depend on the actual operating state of the unit. Essentially we have to describe three basic states:

- Normal operation
- General setup procedure
- Direct fast access to scaling factors

5.1. Normal Operation

In this mode the unit operates to the settings defined upon setup. All front keys may have customer-defined functions according to the specifications met in the keypad definition menu F06 (e.g. Display scroll, Immediate Cut or else)

5.2. General Setup Procedure

The unit changes over from normal operation to setup level when keeping the P key down for at least 2 seconds. Thereafter you can select one of the parameter groups F01 to F09.

Setup operation is disabled while the carriage is within a cutting cycle. I. e. the setup procedure cannot be started before the Start command has been released and the carriage has returned to its home position.

Inside the group you can now select the desired parameter and set the value according to need. After this you can either set more parameters or return to the normal operation.
The adjoining sequence of key operations explains how to change
Parameter number 052 of group F06 from the original value of 0 to a new value of 8

Step	State	Key action		Display	Comment
00	Normal operation			Actual Error	
01		P	> 2 sec.	F01	Display of the Parameter group
02	Level: Parameter group	↑	5 x	F02 … F06	Select group # F06
03		↵		F06.050	Confirmation of F06. The first parameter of this group is F06.050
04	Level: Parameter numbers	↑	2 x	F06.051… F06.052	Select parameter 052
05		↵		0	Parameter 052 appears in display, actual setting is 0
06	Level: Parameter values	↑	8 x	1 …. 8	Setting has been modified from 0 to 8
07		P		F06.052	Save the new setting (8)
08	Level: Parameter numbers	P		F06	Return to level parameter groups
09	Level: Parameter groups	P		Actual Error	Return to normal operation
10	Normal operation				

During the general setup procedure all control activities remain disabled. New parameter settings become active after return to normal operation only.

5.3. Direct Fast Access to Cutting Length Setting

To get to the fast access routine, please press both

P and ↵ at the same time

This will access the parameter group F01 right away. To change the cutting length setting follow the same procedure as already described above.
Besides the advantage of direct access, the fundamental difference to general setup is the following:

- Direct fast access is enabled when the carriage is within a cutting cycle.
- During the fast access procedure all control functions remain fully active.
- Access is limited to cutting length settings; no other parameters can be changed.

5.4. Change of Parameter Values on the Numeric Level

The numeric range of the parameters is up to 6 digits. Some of the parameters may also include a sign. For fast and easy setting or these values the menu uses an algorithm as shown subsequently. During this operation the front keys have the following functions:

PROG	UP	DOWN	ENTER
Saves the actual value shown in the display and returns to the parameter selection level	Increments the highlighted (blinking) digit	Decrements the highlighted (blinking) digit	Shifts the cursor (blinking digit) one position to the left, or from utmost left to right

With signed parameters the left digit scrolls from **0 to 9** and then shows "**–**„ (negative) and "**-1**" (minus one). The example below shows how to change a parameter from the actual setting of 1024 to the new setting of 250 000.
This example assumes that you have already selected the parameter group and the parameter number, and that you actually read the parameter value in the display.
Highlighted digits appear on colored background.

Step	Display	Key action		Comment
00	001024			Display of actual parameter setting, last digit is highlighted
01			4 x	Scroll last digit down to 0
02	001020			Shift cursor to left
03	001020		2 x	Scroll highlighted digit down to 0
04	001000		2 x	Shift curser 2 positions left
05	001000			Scroll highlighted digit down to 0
06	000000			Shift cursor left
07	000000		5 x	Scroll highlighted digit up to 5
08	050000			Shift cursor left
09	050000		2 x	Scroll highlighted digit up to 2
10	250000			Save new setting and return to the parameter number level

5.5. Code Protection against Unauthorized Keypad Access

Parameter group F09 allows to define an own locking code for each of the parameter menus. This permits to limit access to certain parameter groups to specific persons only.

When accessing a protected parameter group, the display will first show "CODE" and wait for your entry. To continue keypad operations you must now enter the code which you have stored before, otherwise the unit will return to normal operation again.

After entering your code, press the ENTER key and keep it down until the unit responds. When your code was correct, the response will be "YES" and the menu will work normally. With incorrect code the response will be "NO" and the menu remains locked.

5.6. Return from the Programming Levels and Time-Out Function

At any time the PROG key sets the menu one level up and finally returns to normal operation. The same step occurs automatically via the time-out function, when during a period of 10 seconds no key has been touched.

Termination of the menu by automatic time-out will not store new settings, unless they have already been stored by the PROG key after editing.

5.7. Reset all Parameters to Factory Default Values

Upon special need it may be desirable to set all parameters back to their original factory settings (e.g. because you have forgotten your access code, or by too many change of settings you have achieved a complex parameter state). Default values are indicated in the parameter tables shown later.

To reset the unit to default, please take the following steps:

- Switch power off
- Press  and  simultaneously
- Switch power on while you keep down both keys

Where you decide to take this action, please note that all parameters and settings will be lost, and that you will need to run a new setup procedure again.

6. Menu Structure and Description of Parameters

All parameters are arranged in a reasonable order of functional groups (F01 to F09)
You must only set those parameters which are really relevant for your specific application.
Unused parameters can remain as they actually are.

6.1. Summary of the Menu

This section shows a summary of the parameter groups, with an assignment to the functional parts of the unit.

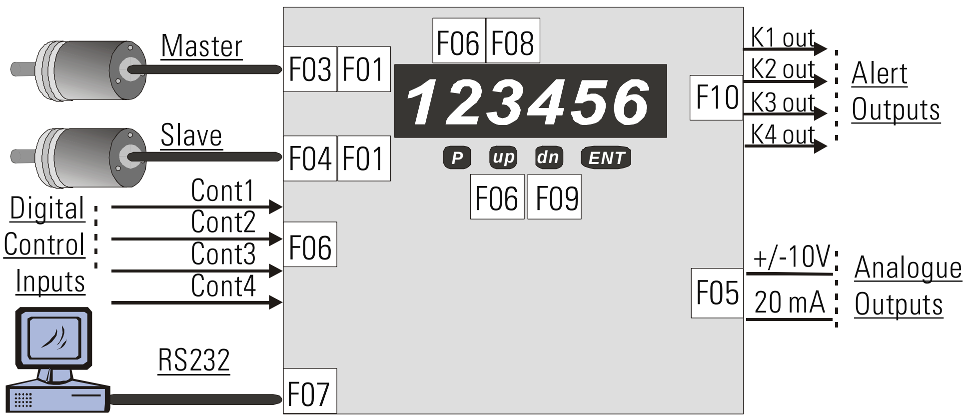
Group	Function
F01	Length Setting
000	Cutting Length
001	Reserved
F02	Operational Setting
002	Pulses Line / 1000
003	Pulses Cut / 1000
004	Acceleration 1
005	Acceleration 2
006	Integration Time
007	Correction Divider
008	Ramp Form
009	Synchron Time
01	Tool Width
011	Sampling Time
012	Wait Time
013	Max. Master Frequency
014	Cut Window
015	Sync. Samples
016	Home Window
017	Jog Speed
018	Jog Ramp
019	Min. Position
020	Max. Position
021	Alarm Position
022	Set Length Counter
023	Rel. Return Speed
024	Abs. Return Speed
025	Reserved

Group	Function
F03	Definitions for the Master Encoder
026	Encoder Properties
027	Edge Counting
028	Counting Direction
029	Reserved
030	Reserved
031	Reserved
F04	Definitions for the Slave Encoder
032	Encoder Properties
033	Edge Counting
034	Counting Direction
035	Reserved
036	Reserved
037	Reserved
F05	Analogue Output Settings
038	Analogue Format
039	Offset Correction
040	Gain Correction
041	Max. Correction
042	Offset Total
043	Gain Total
044	Reserved
045	Reserved

F06	Command Assignment
046	Key Up Function
047	Key Down Function
048	Key Enter Function
049	Input 1 Configuration
050	Input 1 Function
051	Input 2 Configuration
052	Input 2 Function
053	Input 3 Configuration
054	Input 3 Function
055	Input 4 Configuration
056	Input 4 Function
057	Reserved
F07	**Serial communication**
058	Unit Number
059	Serial Baud Rate
060	Serial Format
061	Reserved
062	Reserved
063	Reserved
F08	**Special functions**
064	Input Filter
065	Trigger Threshold 1
066	Trigger Threshold 2
067	Brightness
068	Frequency Control
069	Length Store Configuration
070	Display Time
071	Default Display

F09	Keypad protection codes
072	Protect Group F01
073	Protect Group F02
074	Protect Group F03
075	Protect Group F04
076	Protect Group F05
077	Protect Group F06
078	Protect Group F07
079	Protect Group F08
080	Protect Group F09
081	Reserved
082	Reserved
083	Reserved
084	Reserved
085	Reserved
086	Reserved
087	Reserved

The following schematics shows how in principle the parameter blocks are assigned to the various elements and functions of the controller.



6.2. Description of the Parameters

Prior to register setting you must decide which dimensions or length units (LU) you like to use for preset of the cutting length. This could be 0.1mm or 1mm or 0.001 inch or any other resolution you desire. All further settings refer to the Length Units you decided to use. E.g. when you chose to set the length with a 0.1 mm resolution, 1000 LUs will represent a length of 100.0 millimeters with all further entries.

6.2.1. Length Setting

F01		Range	Default
F01.000	Cutting Length: Preset of the desired cutting length scaled in length units.	1 … 999999	10000

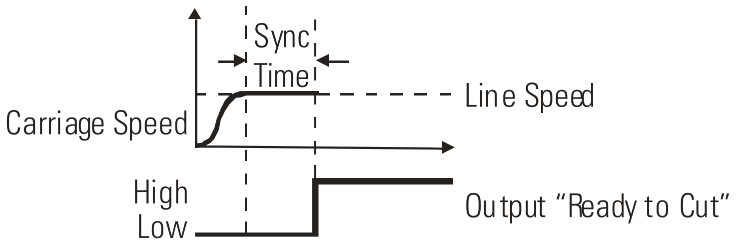
6.2.2. Operational Settings

F02		Range	Default
F02.002	Pulses Line / 1000: Scaling of the line encoder. Find out how many pulses you receive when the line moves 1000 length units (LU) forward and set the proper number of pulses here.	1 … 999999	1000
F02.003	Pulses Cut / 1000: Scaling of the carriage encoder. Find out how many pulses you receive when the carriage moves 1000 length units (LU) forward and set the proper number of pulses here.	1 … 999999	1000
F02.004	Acceleration 1: Acceleration rate of the carriage during forward motion. Scaled in Length units per second squared (LU/s^2).	1 … 99999	5000
F02.005	Acceleration 2: Acceleration rate of the carriage during reverse motion. Scaled in Length units per second squared (LU/s^2).	1 … 99999	5000

- The controller generates ramps of a constant gradient. Therefore, the ramp times depend on the acceleration settings and the actual line speed. When, for example, the unit is scaled to entire millimeters, an acceleration setting of 5000 mm/s^2 would mean that the carriage accelerates from zero to a speed of 5 m/s (= 300 m/min) within 1 second. Therefore it would need 100 ms when the real speed is 30 m/min only etc.
- You must only use acceleration settings that the drive is really able to follow. Settings outside of the physical capability of the drive will result in malfunction or even failure of the whole system.
- The acceleration settings refer to linear ramp forms. When you use S-ramps (see next parameter), the maximum acceleration at the steepest position of the S-profile will be by factor 1.25 higher.

F02		Range	Default
F02.006	Integration Time: Time constant for the phase integrator, which avoids positional errors. To be entered as number of cycles (1 cycle = 250 µsec) per increment	0 … 9999 0000 = Integrator off 0001 = fast 9999 = slow	500
F02.007	Correction Divider: Function to provide a digital attenuation of the phase correction signal that is produced, when the drive on mechanical grounds (dead band or backlash) cannot respond. In such a case, it is not desirable to make corrections immediately. The "Correction Divider" provides a window for the drive "backlash", within which the controller produces no correction and a division of the differential error count. 0 = No window, Reaction to 1 increment, no division 1 = Window +/- 1 increments, error division by 2 2 = Window +/- 2 increments, error division by 4 3 = Window +/- 4 increments, error division by 8 etc.	0 … 9	0
F02.008	Ramp Form: Selects the shape of the ramps of the carriage speed profile. Two types of ramps are available: linear and S-shaped ramps. The selection can be made independently for each of the four ramps of the speed profile by setting the corresponding bit of the parameter "Ramp Form" either to 0 or to 1: Bit 0: forward acceleration ramp Bit 1: forward deceleration ramp Bit 2: backward acceleration ramp Bit 3: backward deceleration ramp A ramp is S-shaped when the corresponding bit is 0 and it is linear when the corresponding bit is 1. Example: Ramp Form = 00 means that all ramps are S-shaped, Ramp Form = 01 means that only the forward acceleration ramp is linear, and Ramp Form = 15 means that all ramps are linear.	0 … 15	0

S-shaped ramps are recommended when using drives with high response (e.g. servo drives) whereas linear ramps are recommended for drives with lower response (e.g. big DC drives).

<table>
<tr><th>F02</th><th></th><th>Range</th><th>Default</th></tr>
<tr><td>F02.009</td><td>Synchron Time:
This is an adjustable delay time between reaching the synchronous speed and switching on the “Ready to cut” output.
Setting range 1-9999 milliseconds.
Under regular conditions the carriage will be in the correct cutting position immediately after completion of the acceleration ramp, and the Sync Time register can be set to its minimum value of 1 ms.
With mechanically unstable carriage constructions it may however be applicable to leave a short stabilization time before activating the cut.

</td><td>1 … 9999</td><td>1</td></tr>
<tr><td>F02.010</td><td>Tool Width:
Width of the saw blade or cutting tool, scaled in LU</td><td>0 …999</td><td>0</td></tr>
<tr><td>F02.011</td><td>Sampling Time:
Sets the internal digital feed forward control with respect to dynamics and resolution.
Lower set values result in faster response, but less accuracy of the feed forward signal. Higher set values result in better accuracy, but slower response with sudden speed changes.
Feed forward signals with lower accuracy do not at all affect speed accuracy of the synchronizing process, but only might cause slight angular errors.
Depending of the maximum Master encoder frequency, the subsequent setting can be recommended:
<table>
<tr><th>fmax</th><th>Sampling -Time</th></tr>
<tr><td>1 kHz</td><td>0.100 s</td></tr>
<tr><td>3 kHz</td><td>0.033 s</td></tr>
<tr><td>10 kHz</td><td>0.010 s</td></tr>
<tr><td>30 kHz</td><td>0.003 s</td></tr>
<tr><td>≥ 100 kHz</td><td>0.001 s</td></tr>
</table></td><td>0.001 … 9.980
(seconds)</td><td>0.001</td></tr>
<tr><td>F02.012</td><td>Wait Time:
Not applicable, leave at default setting.</td><td>0.01 … 9.99
(sec.)</td><td>9.99</td></tr>
</table>

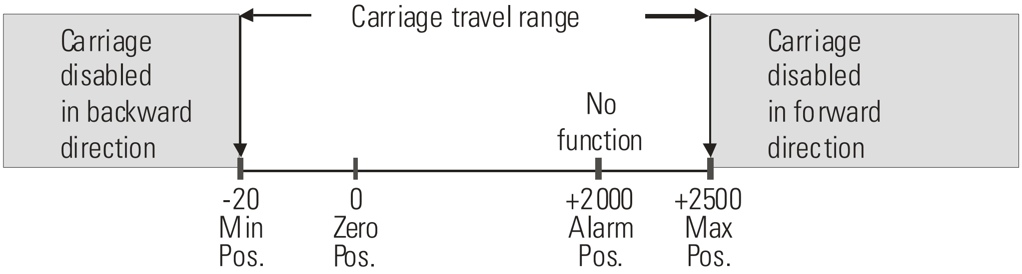
F02		Range	Default
F02.013	Max. Master Frequency: Sets the expected maximum input frequency on the Master encoder input, i. e. the line encoder frequency at maximum line speed. You should add a 10% reserve to the real maximum frequency. The unit will not process frequencies higher than this setting.	0.1 …300000.0 (Hz)	30000.0
F02.014	Cut Window: Sets a tolerance window scaled in length units around the cutting position where the carriage must be before the "Ready to cut" signal is switched on. We recommend setting this window not too small, because no cut will be activated when for any reasons we do not reach this window (carriage will then run to the front stop).	1 … 99	50
F02.015	Sync. Samples: Filter for the cut window. The purpose of this parameter is to ensure that the carriage has reached a stable position within the cut window and does not leave the window again right after the "ready to cut"-output has been switched on. Sync Samples = n means that during n consecutive control cycles the carriage must be inside the window, before the "ready to cut"-signal is switched on. This function should only be used for systems with poor dynamic performance. Please note that too high settings of this parameter may cause the controller to never set the "ready to cut"-signal. Recommended setting: 1	1 … 9999	1
F02.016	Home Window: Sets a window scaled in length units around the home position of the carriage. The output "Home" indicates by High state that the carriage position is inside this window. The unit will go to error state when a new cutting cycle would need to start before the carriage has returned to the home window from the previous cut.	1 … 999	100
F02.017	Jog Speed: Speed setpoint in Volt for Jog operations by use of input "Jog forward" or "Jog reverse".	0.01 … 10.00	1.00

F02.018	**Jog Ramp:** Ramp time in seconds for Jog operations with respect to speed changes between standstill and maximum speed (setpoint 10 V)	0 … 99	1
F02.019 F02.020	**Min. Position,** **Max. Position:** Programmable software limit switches scaled in length units for the extreme forward and rear carriage position. The settings refer to the “Zero” Position, which is set by the “Set Zero Position” input. In general (but this is not a “must”), the Zero position is also used as the “Home” Position. In this case, the Min Pos must always be set to negative and the Max Pos must always be set to positive values. When the Start command is off, these two software limit switches will limit the traveling range with Jog operations. With automatic operation (Start command set), only the rear “Min. Position” switch remains active and sets the unit to an Error state when touched during production. The front “Max. Position” switch however is out of operation. Instead, the “Alarm position” switch (see next parameter) is monitoring the forward carriage motion and sets an alarm output when touched during a cutting cycle.	-99999 … 0 0 … 999999	-99999 999999
F02.021	**Alarm Position:** Sets an alarm position scaled in length units for the forward motion of the carriage during automatic cutting operation. The “Alarm” output indicates that the actual carriage position is beyond the “Alarm Position” setting (See also parameters “Min.Position”, “Max.Position” and output “Alarm”).	0 … 999999	100000

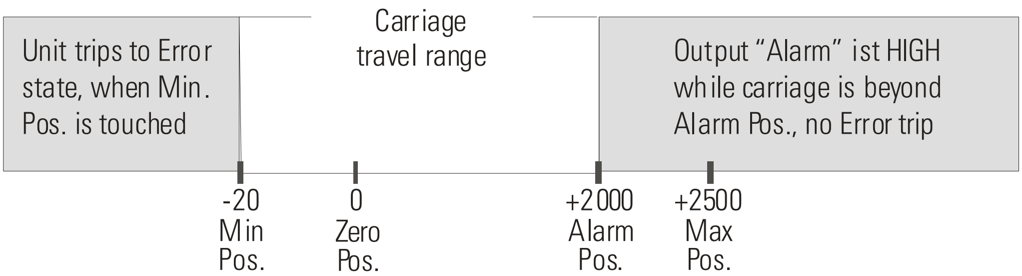
- The Home Position of the carriage for executing a cut is always the position where the carriage is located at the moment where the Start command is set.
- The Zero position however is the position where the carriage is located while the controller is powered up, or where it stands during the falling edge of the “Set Zero Position” command.
- Therefore “Home” must not necessarily be “Zero” at the same time!

The following drawings explain the function of the software limit switches, based on the following settings (example): “Min.Position” = -20 LU, “Max.Position” = +2500 LU, “Alarm Position” = 2000 LU:

Input Start/Stop = Low, Jog operation:



Input Start/Stop = High, automatic cutting cycle or immediate cut:



F02		Range	Default
F02.022	**Set Length Counter:** Set value for material length counter at start of automatic length operation, scaled in master encoder pulses. When command “Start” is set the material length counter is set to this value. Afterwards, the register “Set length Counter” is cleared to zero (set value only used one time).	0 … 999999	0
F02.023	**Rel. Return Speed:** Sets the ratio between the actual line speed and the maximum return speed. For example, setting 2.00 says that, if necessary, the return speed is permitted to be the double of the actual line speed. The controller will however use this maximum return speed only if really required from the cutting process. **Only active when register “Abs Return Speed” is set to 0!**	0.01 … 9.999	1.00
F02.024	**Abs. Return Speed:** Sets the return speed to an absolute value scaled in length units per minute independent of the line speed. **When set to 0, the register “Rel. Return Speed” (relative return speed according to actual line speed) is valid!**	0 … 9999999	0

6.2.3. Definitions for the Master Encoder

F03			Range	Default
F03.026	**Encoder properties**		0 … 3	1
	0=	Differential Impulses A, /A, B, /B (2 x 90°) incl. inv.		
	1=	Single-ended Impulses A, B (2 x 90°) without inv.		
F03.027	**Edge counting**		0 … 2	0
	0=	Simple edge evaluation (x1)		
	1=	Double edge evaluation (x2)		
	2=	Full quadrature edge evaluation (x4)		
F03.028	**Counting direction**		0 … 1	0
	0=	Up when A leads B		
	1=	Down when A leads B		
F03.029	n.a.		n.a.	

6.2.4. Definitions for the Slave Encoder

F04			Range	Default
F04.032	**Encoder properties**		0 … 3	1
	0=	Impulses A, /A, B, /B (2 x 90°) incl. inv.		
	1=	Impulses A, B (2 x 90°) without inv.		
F04.033	**Edge counting**		0 … 2	0
	0=	Simple (x1)		
	1=	Double (x2)		
	2=	Full quadrature (x4)		
F04.034	**Counting direction**		0 … 1	0
	0=	Up when A leads B		
	1=	Down when A leads B		
F04.035	n.a.			

n.a. = not applicable

6.2.5. Analogue output definitions

F05			Range	Default
F05.038	Control characteristics and analogue format		0 … 3	0
	0=	Output scaled for a -10 volts … +10 volts signal		
	1=	Output scaled for a -10 volts … +10 volts signal		
	2=	Output scaled for a -20 mA … +20 mA signal		
	3=	Output scaled for a -20 mA … +20 mA signal		
F05.039	Offset Correction: Digital setting of analogue offset on correction signal.		-10.000 … +10.000 (volts)	0.000
F05.040	Gain Correction: Digital setting of the proportional gain of the control loop. Setting to 2.048 results in a response of 1 mV per error bit. Recommended setting: 0.500...5.000 (Gain Correction / 2048 = x.xxx volts per error bit).		0 … 51.200	2.000
F05.041	Max. Correction: Limitation of the output voltage of the correction signal (correction will not exceed this setting)		0 … 10.000 (volts)	2.000
F05.042	Offset Total: Digital setting of analogue offset of the overall analogue output signal.		-10.000 … +10.000 (volts)	0.000
F05.043	Gain Total: Sets the full-scale output voltage at maximum master frequency, i.e. 9,000 means 9 volts at max. frequency		0 … 11.000 (volts)	10.000

n.a. = not applicable

6.2.6. Key command assignments

F06			Range	Default
F06.046	Function assignment to key „UP“		0 … 16	0
	0=	No function		
	1=	Reset		
	2=	Start		
	3=	Immediate Cut		
	4=	n.a.		
	5=	n.a.		
	6=	Set Zero position	For more details about these functions see section 7.1	
	7=	Store to EEPROM		
	8=	Scroll Display		
	9=	n.a.		
	10=	Jog forward		
	11=	Jog backward		
	12=	Clear Batch Counter		
	13=	n.a.		
	14=	Read front thumbwheels (model FS 641 only)		
	15=	Clear Error		
	16=	n.a.		
F06.047	Function assignment to key „DOWN“		0 … 16	0
		See key „UP“		
F06.048	Function assignment to key „ENTER“		0 … 16	0
		See key „UP“		

n.a. = not applicable

6.2.7. Characteristics and functions of the Control Inputs

F06			Range	Default
F06.049	**Switching characteristics of input „Cont.1“**		0 … 7	0
	0=	NPN (switch to -), function active LOW		
	1=	NPN (switch to -), function active HIGH		
	2=	NPN (switch to -), rising edge		
	3=	NPN (switch to -), falling edge		
	4=	PNP (switch to +), function active LOW		
	5=	PNP (switch to +), function active HIGH		
	6=	PNP (switch to +), rising edge		
	7=	PNP (switch to +), falling edge		
F06.050	**Function assignment to input „Cont.1“**		0 … 16	6
	0=	No function		
	1=	Reset		
	2=	Start		
	3=	Immediate Cut		
	4=	Cut Completed		
	5=	n.a.		
	6=	Set Zero position		
	7=	Store to EEPROM	For more details about these functions see section 7.1	
	8=	Scroll Display		
	9=	Parameter Input Disable		
	10=	Jog forward		
	11=	Jog backward		
	12=	Clear Batch Counter		
	13=	n.a.		
	14=	Read front thumbwheels (model FS 641 only)		
	15=	Clear Error		
	16=	n.a.		
F06.051	**Switching characteristics of input „Cont.2“**		See „Cont.1“ (F06.049)	
F06.052	**Function assignment to input „Cont.2“**		See „Cont.1“ (F06.050)	
F06.053	**Switching characteristics of input „Cont.3“**		See „Cont.1“ (F06.049)	
F06.054	**Function assignment to input „Cont.3“**		See „Cont.1“ (F06.050)	
F06.055	**Switching characteristics of input „Cont.4“**		0 – 3	
	0=	NPN (switch to -) function active LOW		
	1=	NPN (switch to -) function active HIGH		
	2=	PNP (switch to +), function active LOW		
	3=	PNP (switch to +), function active HIGH	no edge-triggered functions are possible with Cont.4	
F06.056	**Function assignment to input „Cont.4“**		See „Cont.1“ (F06.050)	

n.a. = not applicable

- Unconnected NPN inputs are always HIGH (internal pull-up resistor)
- Unconnected PNP inputs are always LOW (internal pull-down resistor)

6.2.8. Serial communication parameters

F07			Range	Default
F07.058	**Serial device address** (unit number)		11 … 99	11
F07.059	**Serial baud rate**		0 … 6	0
	0=	9600 Baud		
	1=	4800 Baud		
	2=	2400 Baud		
	3=	1200 Baud		
	4=	600 Baud		
	5=	19200 Baud		
	6=	38400 Baud		
F07.060	**Serial data format**		0 … 9	0
	0=	7 Data, Parity even, 1 Stop		
	1=	7 Data, Parity even, 2 Stop		
	2=	7 Data, Parity odd, 1 Stop		
	3=	7 Data, Parity odd, 2 Stop		
	4=	7 Data, no Parity, 1 Stop		
	5=	7 Data, no Parity, 2 Stop		
	6=	8 Data, Parity even, 1 Stop		
	7=	8 Data, Parity odd, 1 Stop		
	8=	8 Data, no Parity, 1 Stop		
	9=	8 Data, no Parity, 2 Stop		

6.2.9. Special functions

F08			Range	Default
F08.064	**Digital input filter**: must be set to "0".		0 … 3	0
F08.065	**Trigger threshold** for encoder1 inputs *)		30 … 250	166
F08.066	**Trigger threshold** for encoder2 inputs *)		30 … 250	166
F08.067	**Brightness** of the 7-segment LED display		0 … 4	0
	0=	100% of maximum brightness		
	1=	80% of maximum brightness		
	2=	60% of maximum brightness		
	3=	40% of maximum brightness		
	4=	20% of maximum brightness		
F08.068	**Frequency Control**: must be set to "0"		0 … 1	0
F08.069	**Length Storage**		0 … 1	0
	0=	Cutting length set by the "Direct Fast Access" menu (see chapter 5.3) is only temporary active until next power-down.		
	1=	Cutting length set by the "Direct Fast Access" menu (see chapter 5.3) is stored to EEPROM for enduring use.		
F08.070	**Display Time**: Update time (sec.) for display only		0.005 … 9.999	0.050
F08.071	**Default Display**: Number of actual value displayed by the unit after power up (see table in chapter 7.1 at description of Scroll Display command)		0 … 8	0

***)** Must be set to the default value (166) for any kind of input signals, except for single-ended TTL signals which require a setting of 35.

6.2.10. Keypad protection codes

F09		Range	Default
F09.071	**Protected group F01**	0 = no protection 1 – 999 999 = Protection code for the actual parameter group	0
F09.072	**Protected group F02**		
F09.073	**Protected group F03**		
F09.074	**Protected group F04**		
F09.075	**Protected group F05**		
F09.076	**Protected group F06**		
F09.077	**Protected group F07**		
F09.078	**Protected group F08**		
F09.079	**Protected group F09**		

7. Description of Commands and Outputs

7.1. Commands

No.	Command	Description	Assignment to	
			Keypad	Input
1	**Reset**	Sets the internal differential counter and the analogue correction signal to zero. Both drives run solely in analogue synchronization (open loop) whilst activated	yes	yes
2	**Start**	Start of the automatic cutting procedure. The unit cuts automatically to preset cutting length. When this command is not set, the carriage is held in its home position (closed loop position control). The carriage can be moved into forward and reverse direction by use of the inputs "Jog forw" and "Jog rev".	yes	yes
3	**Immediate Cut**	A positive edge at this input will immediately start the shear for a cutting cycle, independent on what the actual length is. The subsequent cut will correspond to the preset length again, unless another Flying Cut will be triggered again. This function e.g. allows the operator to cut out bad parts of the material. An immediate cut can also be performed when the material is in standstill or when Start command is reset.	yes	yes
4	**Cut completed**	This input must receive a signal when mechanically a cut has been fully completed. With the rising edge of this signal, the controller will start deceleration and reversal in order to put the carriage back to its rear home position. With this signal missing, the carriage will continue to follow the material synchronously. When the carriage reaches the "Alarm position", the "Alarm" output will be set, but the carriage will not automatically stop!	no	yes
5	**n.a.**		no	no
6	**Set Zero Position**	This command allows defining the "Zero" position of the carriage. The internal carriage position counter is reset and held to Zero while this command is set. All limitation settings and alarms refer to this zero position. Please note that upon power up the carriage position counter will be cleared also and the unit would take any actual position as a Zero position. Where you power the controller down while the carriage is not in at Zero, or where you move the carriage with the controller in powerless state, it is always necessary to redefine "Zero" after power up by a positive signal to this input.	yes	yes

No.	Command	Description	Assignment to	
			Keypad	Input
7	Store to EEPROM	Stores actual operational settings to the EEPROM, so they remain available also after power down.	yes	yes
8	Scroll Display	Selects the source of the digital display. See chapter 7.3 Display for details.	yes	yes
9	Parameter Disable	Disables the keypad for any parameter access. Only commands assigned to the keypads will be accessible	no	yes
10	Jog Forward	Moves the carriage in one or the other direction (Jog speed register settable). The carriage automatically stops when it reaches one of the software limit switches (Minimum or Maximum position). After termination of a Jog command, the carriage will be held again in its new position under closed-loop control. From this new home position the carriage will also start to execute the next cut, no matter where it is. The Jog inputs are only active when the Start command is not set. The limitation of the traveling range by the software limit switches will be disabled while you set the “Set Zero Position” command.	yes	yes
11	Jog Backward		yes	yes
12	Clear Batch Counter	Resets the internal batch counter to zero.	yes	yes
13	n.a.		no	no
14	Read Thumbwheels	Reads and activates the cutting length setting from the front thumbwheel switches (model FS641 only)	yes	yes
15	Clear Error	Resets error states and clears the corresponding error messages (see also chapter 7.4 Error Messages)	yes	yes
16	n.a.		no	no

n.a. = not applicable

7.2. Outputs

No.	Output	Terminal
K1	Error: This output goes high when an error is detected during operation (see section 7.4 "Error Messages").	X2 / 26
K2	Alert: This output is set when during forward motion the carriage reaches the "Alarm Position". It can be used to limit the traveling range of the carriage into forward direction during production. If, e.g. for mechanical or other reasons, the carriage could not synchronize with the line, the controller would never generate the "Ready to cut" signal and the carriage would run to the front stop. The output switches high to indicate that the carriage will run out of range if the cut will not be aborted immediately.	X2 / 25
K3	Home: Indicates that the carriage is in its home position like defined by register "Home Window".	X1 / 10
K4	Ready to Cut: This output goes high when the shear has reached its cutting position with respect to the material and moves fully synchronous with the line. It is reset to low after the controller has received the "Cut completed" signal.	X1 / 9

7.3. Display of Actual Values

During normal operation it is possible to display an actual value. Two LEDs at the front panel indicate the actual value displayed. You can scroll the actual value on the display by Scroll Display command, which can be assigned either to a key or to an input. Parameter F08.071 "Default Display" selects the actual value to be displayed after power up of the unit.

Nr.	Display	L1 (red)	L2 (yellow)
0	Display OFF (only two decimal points are lit to indicate operation state)	OFF	OFF
1	Position error (differential counter)	OFF	OFF
2	Position error (bar graph display, see diagram below)	OFF	OFF
3	Actual Master frequency (Hz)	ON	OFF
4	Recorded Minimum Position Error during last cut	OFF	ON
5	Recorded Maximum Position Error during last cut	ON	ON
6	Actual cutting length scaled in length units	Flashing	OFF
7	Carriage Position scaled in encoder increments	OFF	Flashing
8	Batch counter	Flashing	Flashing

Bar graph display with reference to the actual synchronization error

The diagram shows positive errors only (Slave lags Master). Negative errors are mirror-inverted.

7.4. Error Messages

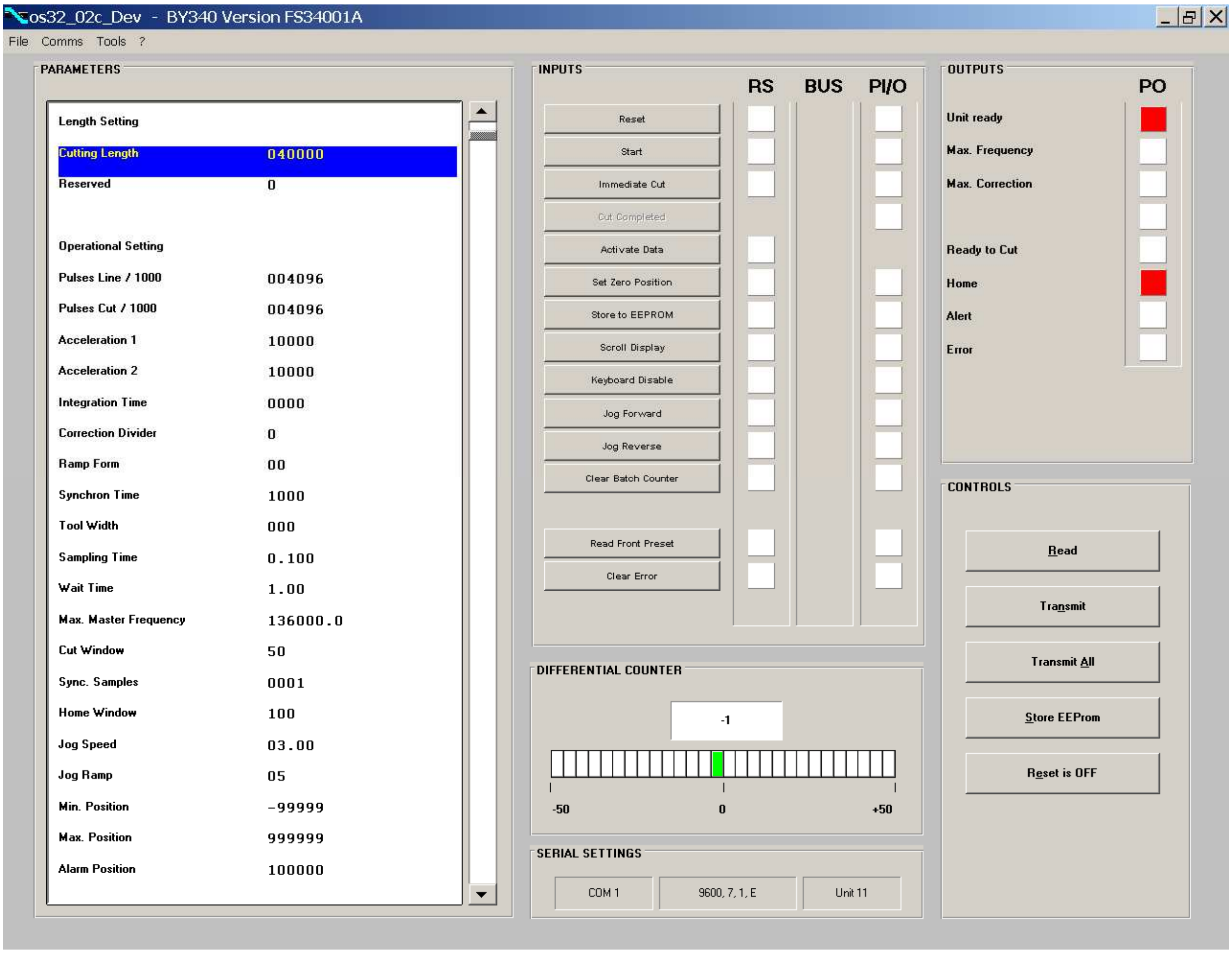
Upon detection of an error, the carriage remains in a closed-loop standstill at home position after termination of the current cut. Output "Error" switches to high and the unit displays a flashing error message "Error…" indicating the error number.
To clear an error state either set "Clear Error" command or cycle the power supply of the unit. Please note that the unit will immediately return to the error state if the cause for the error has not been eliminated.

Error No.	Error Description
Error 0	The reason for the error has been rectified (e. g. power supply voltage recovered above minimum level) but the error has not yet been cleared by input "Clear Error".
Error 1	Cut not possible: A cut is declared as "not possible" when the carriage already should start into forward direction before it has fully returned to Home position from the previous cut. This, in general, will happen with too short cutting lengths at too high line speed.
Error 2	Limit Switch: This error indicates that during automatic cutting operation the rear software limit switch has been touched (See drawing at parameter "Minimum Position")
Error 3	Power Low: The power supply voltage is too low. This error is reset automatically when the power supply voltage recovers and exceeds the minimum power supply voltage level.
Error 4	Val. Range exceed: The ratio between the number of line encoder pulses and the number of carriage encoder pulses is outside the permitted range (see section 4.3 System Configuration)

8. Steps for Commissioning

For easy and uncomplicated commissioning of the FS340 / 641 controllers you need a PC with the actual operator software OS3.x. You can download this software and full instructions, free of charge, from our homepage www.motrona.com.

Connect your PC to the synchronizer as shown in section 3.6 and start the OS3.x software. The following screen will appear:



Where instead you find the mask blank with the indication „OFFLINE“ in the top bar, please click to the „Comms“ menu and check the serial settings of your PC.

Set all parameters in the Edit filed according to your needs, following the hints given in this manual. The following parameters should initially be set to the values as shown:

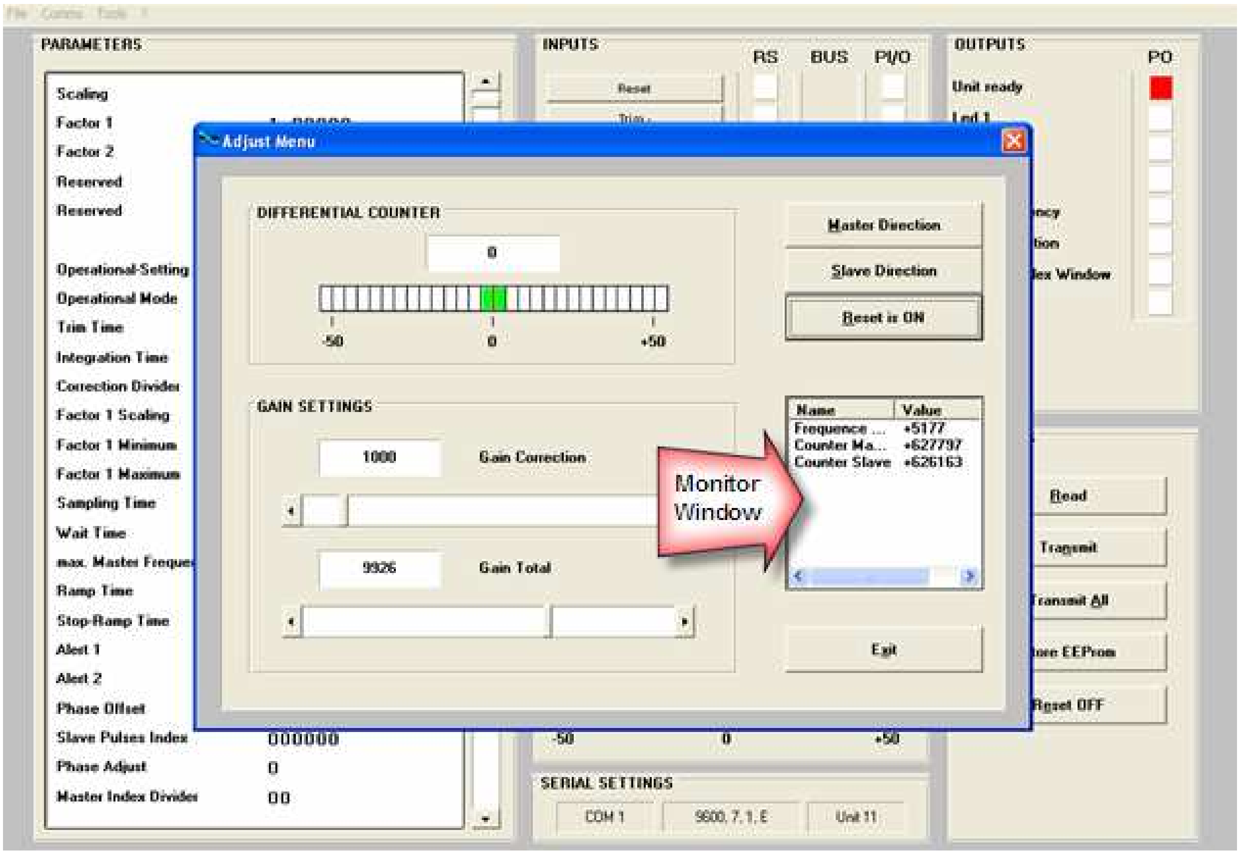
Number	Register	Initial Setting
F02.006	Integration Time	0000
F02.007	Correction Divider	0
F05.040	Correction Gain	1.000
F05.041	Max. Correction	10.000

After entry of all parameters click to “Transmit All” followed by “Store EEPROM” to store all parameters to the FS340 or FS641 controller.

- At this time, both drives (line and carriage) must be adjusted to proper and stable operation over the full speed range. Carriage drive settings must provide a maximum of dynamics and response (set ramps to zero, switch off any integral or differential component of the internal speed control loop, i.e. operate the drive with proportional speed control only, with the proportional Gain set as high as possible).
- For the set-up procedure it is recommended to mechanically disconnect the motor shaft from the carriage, so you can run the motor continuously and need not to observe the mechanical limitations of the carriage

8.1. Running the Adjust menu

For adjustments of directions and control gains of the slave drive, you need to open the „Adjust“ menu available under „Tools“ in the main menu of the screen. To start the Adjust menu the first time, the Slave drive should be disabled for reasons of safety.



While the adjust menu is running the software limit switches are disabled! The carriage drive ramps up to line speed (ramp time selectable by parameter “Jog Ramp”)and runs synchronous to the material line.

8.2. Set Directions of Rotation

The direction of rotation must be defined for both, master and slave encoder. Make sure the Reset is switched on when you do this (the softkey must show "Reset is ON")

- Move the Master encoder into **forward** direction (manually or by means of a remote speed signal to the Master drive). Observe the "Counter Master" value shown in the monitor window on the right. It must count up to positive values. Where you find it counts down or to negative, please click to button "Master Direction" to change the counting direction.
- Move the Slave encoder into forward direction (manually or by enabling the Slave drive while the Master is moving forward). Observe the "Counter Slave" value. It must again count up to positive values. Where you find it counts down or to negative, please click to button "Slave Direction" to change the counting direction.

8.3. Tuning the Analogue Output

- Switch Reset to ON by clicking to the corresponding softkey on the screen.
- Enable both, Master and Slave drive. Turn the speed signal for the Master to approximate 25% of the maximum speed. The Slave should now move, too. As a next step, switch the Reset to OFF by clicking to the Reset button (showing actually "Reset On"). This will activate the closed loop control.
- Observe the color bar and the value of the differential counter. There are the following two possibilities:

a. The bar graph moves to the right and the differential counter shows positive values. This indicates that the analogue output is too low. Please increase the setting of "Gain Total" by scrolling up with the arrow key on the right, or by shifting the slider into a more right position.

b. The bar graph moves to the left and the differential counter shows negative values. This indicates that the analogue output is too high. Please decrease the setting of "Gain Total" by scrolling down with the arrow key on the left, or by shifting the slider into a more left position.

"Gain Total" is set correctly when the bar graph remains in its centre position and the differential counter swings around zero (e.g. +/-8 counts)

- Turn speed signal for the master to approximately 80% of maximum speed. Continue to observe the color bar and the value of the differential counter and adjust "Gain Total" again if necessary.

You can reset the differential counter to zero at any time between, by cycling the "Reset" command.

8.4. Setting of the Proportional Gain

The register "Gain Correction" determines how strong the controller responds to position and speed errors of the drive. In principle, this setting therefore should be as high as possible. However, depending on dynamics and inertia of the whole system, too high gain values will produce stability problems.

Please try to increase the setting of Correction Gain from 0.500 to 1.000, 1500, 2.000, 2.500, 3.000 etc. However, as soon as you find unsteady operation, noise or oscillation, you must reduce the setting again correspondingly.

We also recommend to ramp up and down the master while checking the color bar and the differential counter for stable operation.

Once you have successfully concluded these steps, you can exit the Adjust menu.
Now your machine is ready for operation and you can run initial test cuts without material (see next chapter).

8.5. Tuning the controller

When during commissioning you cannot get the "Cut completed" signal because the carriage drive is mechanically disconnected to the machine, it is legal to link the "Ready to cut" output directly to the "Cut completed" input.
<u>This however is allowed for testing purpose without material only!</u>
To do this, set parameter "Sync Time" to the desired synchronous time. The carriage will then start the return cycle after lapse of this synchronous time, regardless of the tool position.

- Use the Jog function to put the carriage to the desired Home position. Where your software limit switches should bar you from reaching the position, keep input "Set Zero Pos." set during jog. This will prevent limitation by the software switches because the counter for the carriage position is kept to zero.
- Make sure that – with respect to your definition of the zero position – your software limit switches are set correctly, so that the carriage can move inside the designated traveling range, but cannot leave it.
- For the very first trials you should use a long length setting ("Cutting Length") and a slow line speed.
- Start the line drive or move the measuring wheel at the line encoder to simulate the moving material.
- Set "Immediate Cut" command and see how the controller executes a first cutting cycle.
- Set the "Start" command. The carriage will wait for expiration of the preset cutting length and then execute a cutting cycle
- Observe the position error at the differential counter or the bar graph display. During the whole cycle the position error should not exceed values like 30 and the bar graph should remain in the centre area all the time. Increase the line speed step by step and continue the observations.

- If during forward acceleration the position error takes high positive values and the bar graph moves to the extreme right position, this indicates that the carriage drive cannot follow the acceleration ramp and you should decrease the "Acceleration 1" setting. The same is valid for "Acceleration 2", when during reverse acceleration you observe high negative errors and the bar graph moves to the extreme left.
- Where you find your position error remains small enough all the time, you are free to increase the Acceleration settings. This will cause steeper ramps and therefore increase your total cutting output.

<u>All this assumes that you have properly adjusted your analogue output by parameter "Gain Total" in a way that the bar graph remains in centre position when the carriage moves at constant speed.</u>

<u>Remark:</u> Position errors will not affect the cutting accuracy, unless they occur directly during the cut and are different with each cut.

At this time you can try to optimize also other settings:

- **Using and Adjusting the Integrator:**
  When, for stability reasons, you needed to keep your " Gain Correction" value low, any important non linearity in your drive system could cause remaining position errors during the synchronous phase. In this case set "Integration Time" to 100 …10 or even lower. The Integrator will reduce the position error always into a +/-6 increments error window. The lower the Integration Time setting, the faster it will catch up with the correct position. Too low settings (= too high integration speeds) will however result in oscillation problems. Wherever your differential counter remains in an acceptable range around zero (e.g. -8 … +8), there is no need to use the integrator and you should leave "Integration Time" set to 0.
- **Adjusting the Correction Divider**:
  Where you find the bar graph oscillates quickly around zero over several fields during the synchronous phase, this indicates your encoder resolution is too high with respect to mechanical clearance, backlash of tooth belts or other tolerances. To eliminate this, set Correction Divider to 1 or 2 or higher until you observe more stable operation.
- Increase the setting of "Return Speed" to save time with the fly back of the carriage. If necessary, the carriage then will take higher return speed, which increases again the total cutting output.
- Increase the "Acceleration" settings as far as more dynamic motion is desirable and the drive can follow.
- Keep the cutting time (penetration time of the tool or saw blade) as short as possible to achieve maximum efficiency

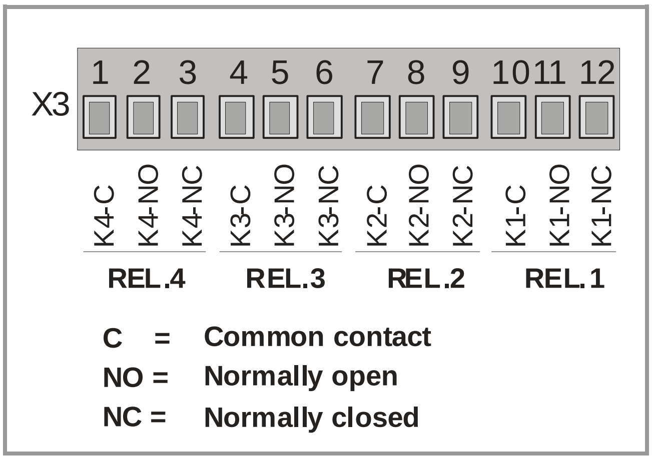
This concludes the procedure of commissioning of your Flying shear system. We recommend saving all parameter settings on hard disc or disc. In case of repeat applications (machine with similar specifications), or after exchange of the controller, you just need to download the settings and are immediately ready to go.

9. Appendix for model FS 641

9.1. Relay Outputs

While model FS340 provides high-speed transistor outputs only, model FS641 provides four additional relay outputs, operating in parallel to the high-speed transistor outputs K1 – K4.

All electrical connections of FS 641 are fully similar to FS 340, except that with FS 641 models the back plane is equipped with an additional terminal strip X3 providing the relay connector:



9.2. Front Thumbwheel Switches

Moreover, the FS 641 models provide thumbwheel switches on the front panel, for simple and easy setting of the cutting length.
This is how the front switches work:

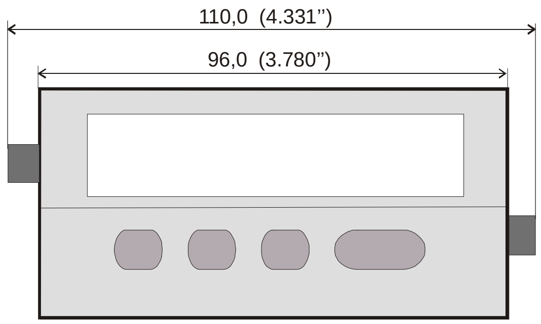
- Upon power-up the unit will read the thumbwheel settings and overwrite the internal cutting length setting correspondingly, i.e. the system cuts the length set by the front thumbwheels.
- When during operation you change the thumbwheel setting, this will not affect the cutting length until you apply a "Read Thumbwheel" command to the unit. You can assign this command to either one of the front keys or to one of the Control Inputs, as shown under sections 6.2.6 and 6.2.7
- When the front thumbwheels are all set to zero, the controller will automatically use the internal cutting length as entered by menu.

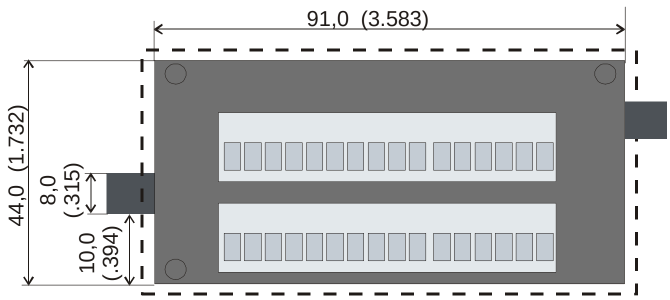
10. Specifications and Dimensions

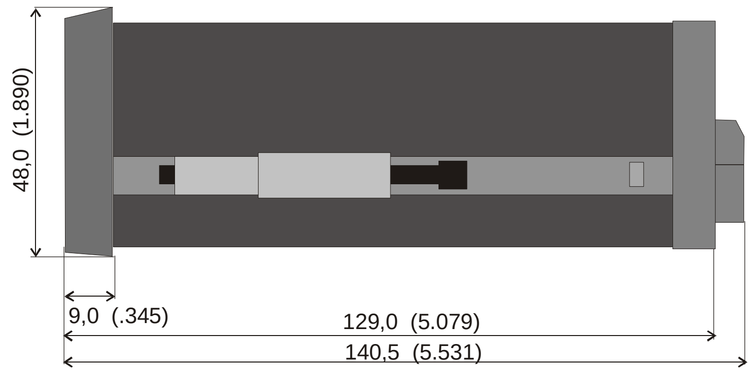
AC power supply	:	24 V~ +/-10%, 15 VA
DC power supply	:	24V- (17 – 40V), approx. 100 mA (+ encoders)
Aux. encoder supply outputs:		2 x 5,2 VDC, 150 mA each 2 x 24V DC, 120 mA each
Inputs	:	2 universal encoder inputs 4 digital control inputs HTL (Ri = 3.3 kΩ) Low < 2.5 V, High > 10 V, min. pulse width 50 µsec.
Counting frequency (per encoder)	:	RS422 and TTL differential: 300 kHz HTL single ended: 200 kHz TTL single-ended: 200 kHz
Switching outputs (all models)	:	4 fast power transistors 5 - 30V, 350 mA (b) Response time < 1 ms (a),
Relay outputs (models FS641 only)	:	4 relays (dry changeover contacts) (b) AC switching capability max. 250 V/ 1 A/ 250 VA DC switching capability max. 100 V/ 1A/ 100 W
Serial link	:	RS232, 2400 – 38400 Bauds
Analogue outputs	:	0…+/- 10V (load max. 2 mA) 0...20mA (load max.270 Ohm) Resolution 14 bits, Accuracy 0.1% Overall response time < 1 ms (a)
Ambient temperature	:	Operation: 0 - 45°C (32 – 113°F) Storage: -25 - +70°C (-13 – 158°F)
Housing	:	Norly UL94 – V-0
Display	:	6 Digit, LED, high- efficiency red, 15mm
Protection class (front side only)	:	FS 340: IP65 FS 641: IP20 (with use of the plexiglass cover part # 64026 also IP65)
Protection class rear side	:	IP20
Screw terminals	:	Cross section max. 1.5 mm²,
Conformity and standards:		EMC 89/336/EEC: EN 61000-6-2 EN 61000-6-3 LV73/23/EEC: EN 61010-1

(a) Continuous serial communication may temporary increase response times
(b) Diode or RC filtering is mandatory when switching inductive loads

Dimensions of model FS340:

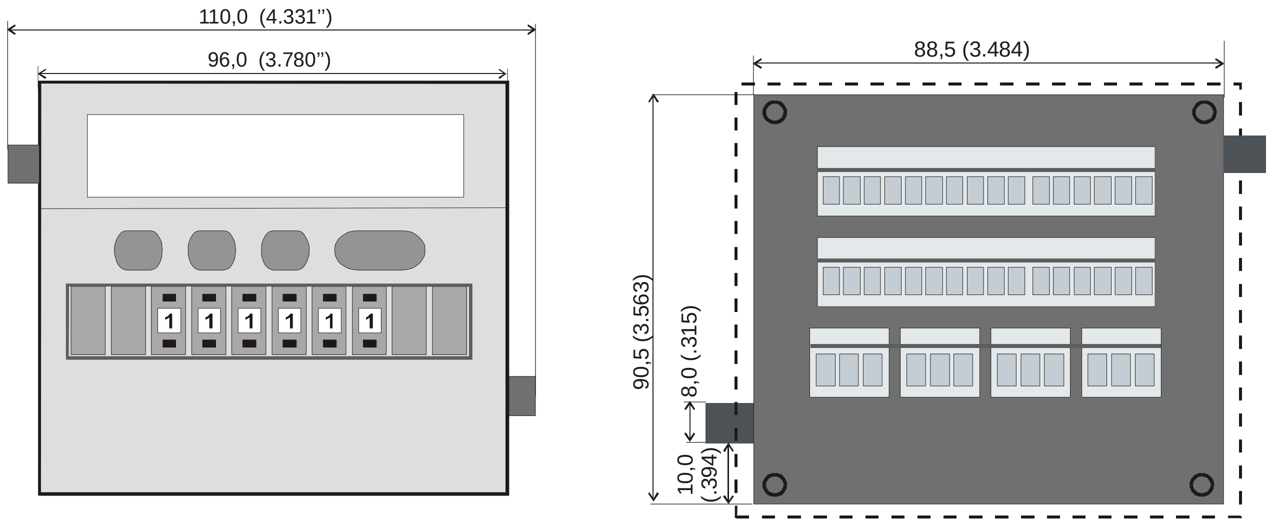


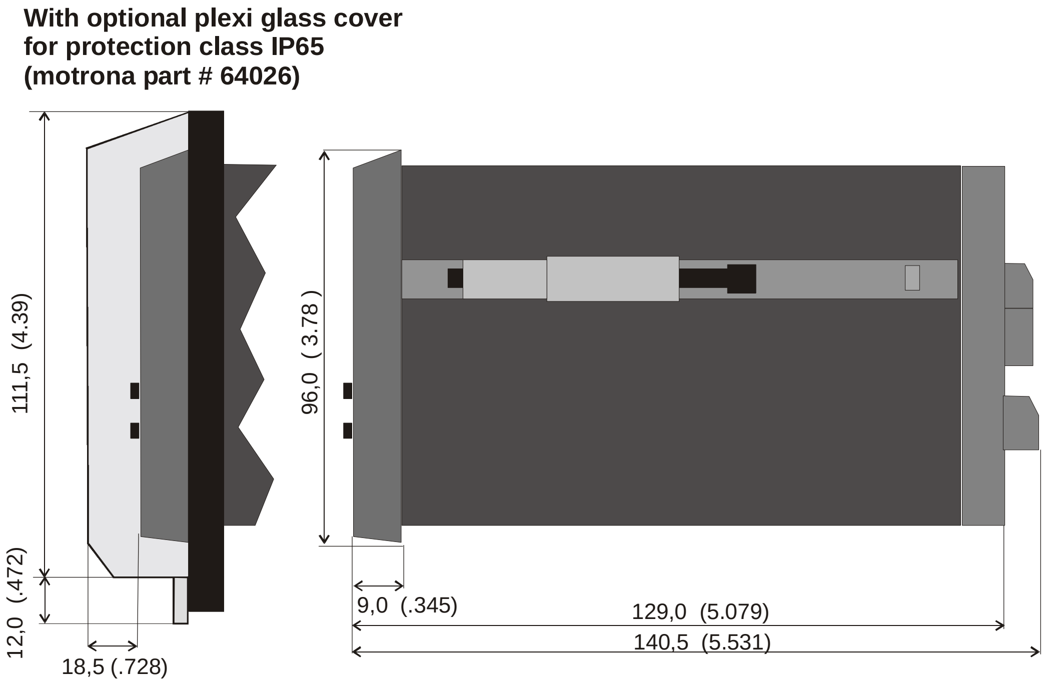




Panel cut out: 91 x 44 mm (3.583 x 1.732'')

Dimensions of model FS641:





Panel cut out (b x h): 89 x 91 mm (3.504'' wide x 3.583'' high)