User´s guide

COIL WINDING MACHINE

ERN 100

Technology Products Company

TPC s.r.o.
Pálenica 53/79
033 01 Liptovský Hrádok
SLOVAKIA
Tel.: +421-44-5221633
Fax: +421-44-5222088
E-mail: tpc@tpc.sk

COIL WINDING MACHINE ERN 100

USER´S GUIDE

Contents:

1. INTRODUCTION

Universal coil winding machine ERN 100 is designed for winding the heavy coils, transformers, chokes, resistors, especially for distribution transformers.

Features:

- wide range of application for winding simple or complicated coils, multichamber coils, trapezoidal or asymetric windings

- the spindle is driven by a AC servo drive with a rareearth-based motor

- pitch control unit on ball bearings with a separate stepping motor and micro-stepping

- accurate reversible counting of turns and positioning of the spindle

- microprocessor-controlled winding cycle increases productivity

- serial interface RS 232

- manual winding regime

- UPS for back-up of power

TECHNICAL DATA:

Pitch range:	0,25 - 22,0 mm/rev.
Winding width:	0,10 - 799,9 mm (ERN 100K: 0,10 – 399,9)
Winding speed / Torque:	0 - 600 rpm / 75 Nm
	0 - 300 rpm / 150 Nm
Accuracy of spindle stop:	0,01 turn
Spindle position pre-set:	by 0,1 of a turn
Max. speed of wire guide:	shift max. 100 mm/s
	winding max. 75 mm/s
Acceleration/deceleration:	see Tab.
Max. coil diameter:	600 mm
Distance between centers:	230 - 1200 mm
Dimensions:	2300 x 730 mm
Weight:	cca 650 kg
Power supply:	3 x 400 V / 50...60 Hz
Power consumption:	max. 7 kVA

2. MACHINE DESCRIPTION

Coil winding machine consists of the following parts:

- control unit containing control electronics and programing elements

- drive unit containing AC servomotor with gears, power electronics and control elements

- UPS unit containing UPS for power back-up, transformer and power supply

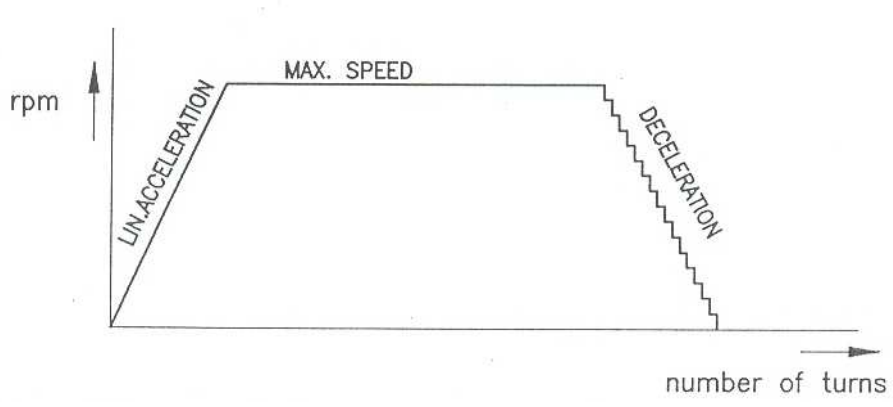
- base frame

- tailstock

- wire guide

- foot pedal

Coordination between spindle rotation and wire guide speed is controlled electronically with a separate stepping motor.
The winding cycle itself (linear acceleration, max.speed, linear deceleration, brake) is running automatically after pressing the START button.



Deceleration is microprocessor-controlled, which ensures an accurate stopping and positioning of the spindle at minimum winding time.

3. DESCRIPTION OF CONTROLS

1 - STAND BY switch

2 - EMERGENCY STOP - disconnects power in emergency

3 - POWER ON indicator

4 - MAIN SWITCH POWER

5 - UPS

6 - START button - starts winding cycle

7 - STOP button - breaks winding cycle

8 - Manual button - enables manually winding by the pedal

9 - BRAKE OFF - switches off the electromagnetic brake

10 - DISPLAY

11 - KEYBOARD with functions and numbers

12 - ENTER - enters data to the memory

13 - RESET - sets the initial stage

14 - CODE TABLE - choose the code of the wire diameter according to this table when you program the machine

15 - PROGRAM BLOCK KEY

16 - Connector for a serial interface RS 232

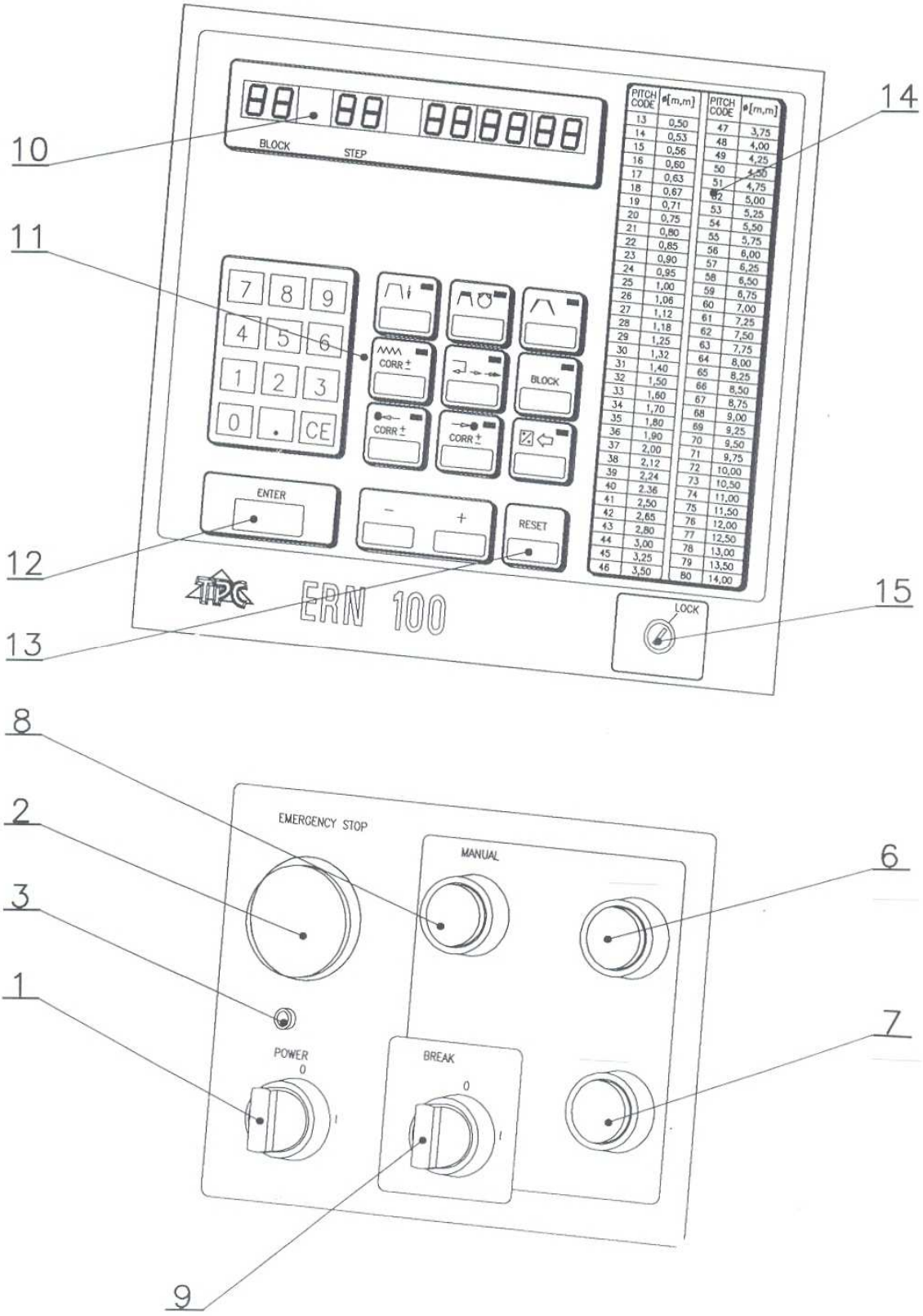
17 - Connector for multifunction footswitch

18 - Auxiliary output

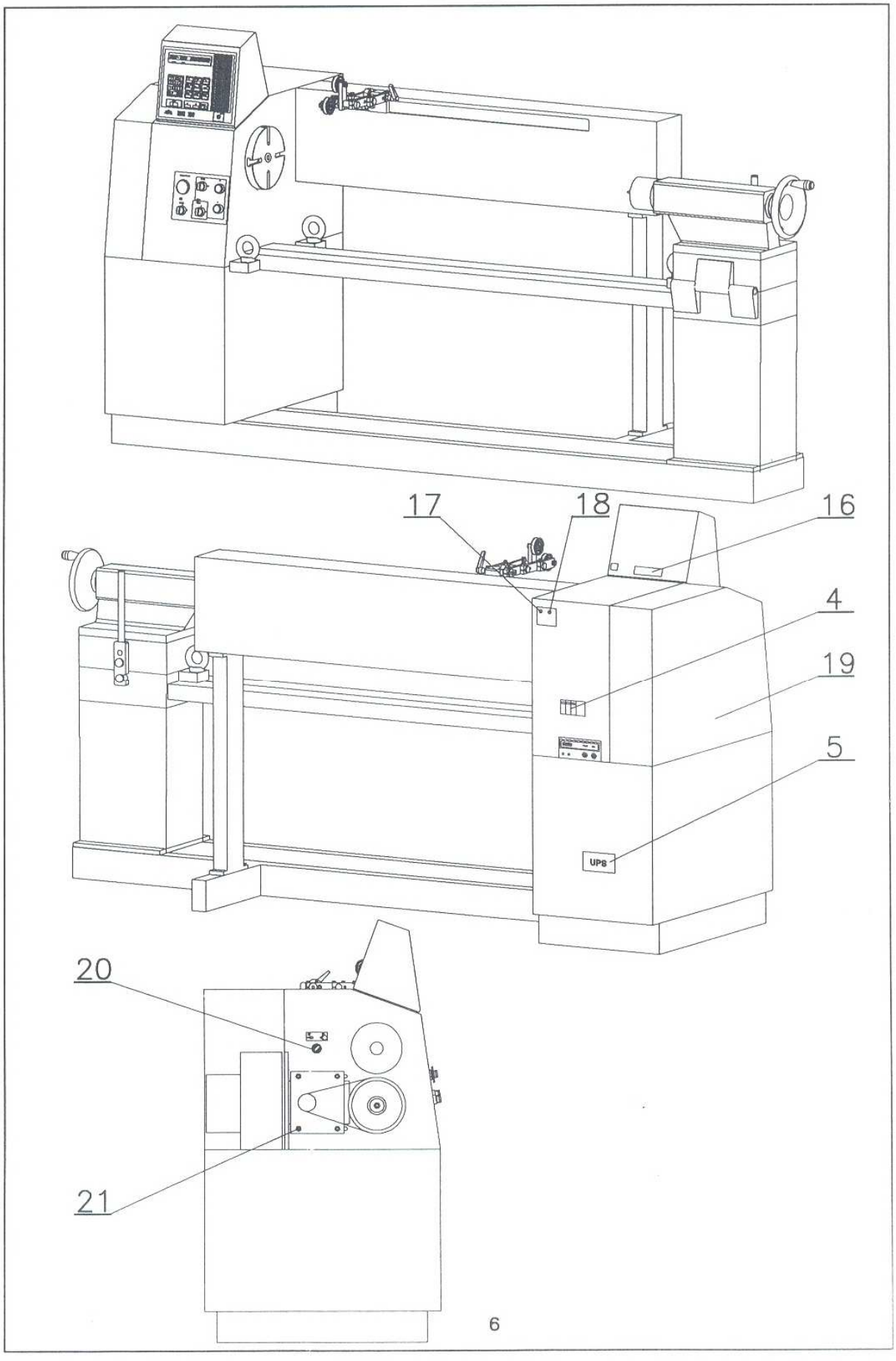
19 - Timing gear cover

20 - Gear switch

21 - Fixing screws



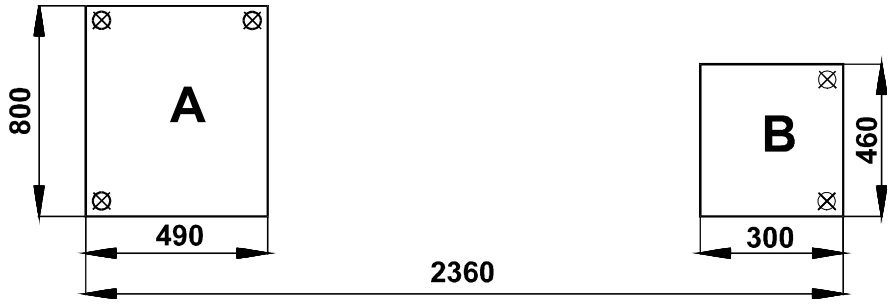
PITCH CODE	ø[m,m]	PITCH CODE	ø[m,m]
13	0,50	47	3,75
14	0,53	48	4,00
15	0,56	49	4,25
16	0,60	50	4,50
17	0,63	51	4,75
18	0,67	52	5,00
19	0,71	53	5,25
20	0,75	54	5,50
21	0,80	55	5,75
22	0,85	56	6,00
23	0,90	57	6,25
24	0,95	58	6,50
25	1,00	59	6,75
26	1,06	60	7,00
27	1,12	61	7,25
28	1,18	62	7,50
29	1,25	63	7,75
30	1,32	64	8,00
31	1,40	65	8,25
32	1,50	66	8,50
33	1,60	67	8,75
34	1,70	68	9,00
35	1,80	69	9,25
36	1,90	70	9,50
37	2,00	71	9,75
38	2,12	72	10,00
39	2,24	73	10,50
40	2,36	74	11,00
41	2,50	75	11,50
42	2,65	76	12,00
43	2,80	77	12,50
44	3,00	78	13,00
45	3,25	79	13,50
46	3,50	80	14,00


17
18
16
4
19
5
UPS
20
21

4. SETTING UP AND OPERATING

MECHANICAL INSTALLATION

The winding machine is fixed to the transport wooden pallet. It is necessary to prepare a level balanced surface according to the following picture for its final location.



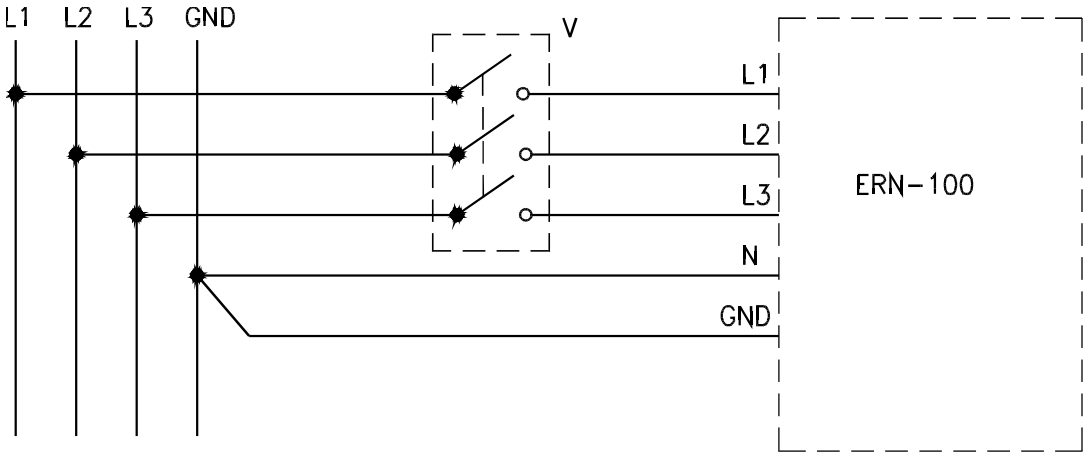
Surfaces A and B must be balanced horizontal in one surface. The winding machine is moved by lifting at 3 pendant eyes. At the winding of heavy coils there is recommended to fix the base frame with screws M 12 directly to flooring surface in marked points.

CONNECTING TO LINE

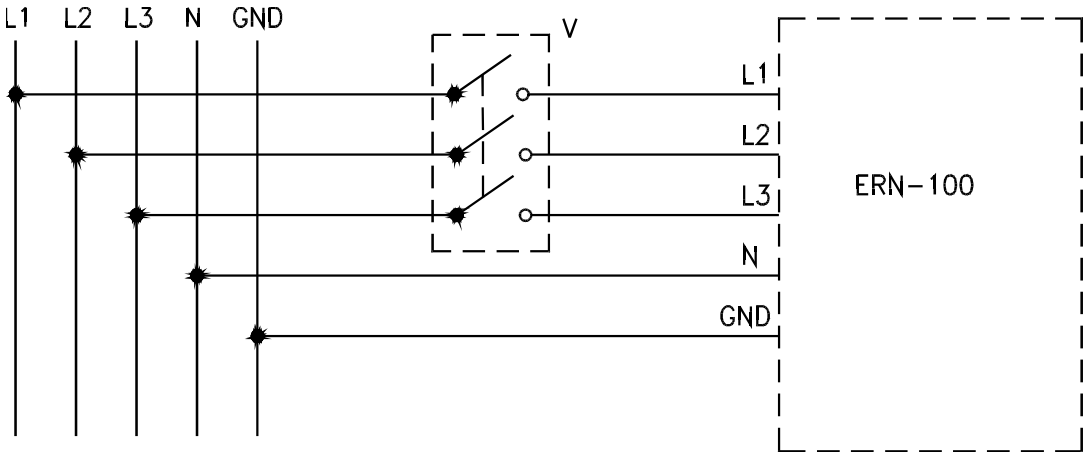
The winding machine must be connected to four- or five-wire system of the supply voltage 3 x 400V/50-60 Hz with the tolerance +- 5 %.
Electric connection must be sized for max.input of 7 kVA. Make sure before connecting the feeder cable, if the line corresponds with those requirements.

Note: The guarantee does not refer to the defects caused by connecting the winding machine to wrong supply voltage or to a off-tolerance supply voltage.

Four-wire system – recommended connecting



Five-wire system – recommended connecting



Note: An additional switch „V“ is recommended to use in case, if the lead-in cable is fixly connected to the line distribution. If the moving terminal is used for the installation, this switch will be not necessary.

UPS

The UPS is alive constantly, if the main switch (4) is in off-position, as well. In common running the UPS must be switched on constantly. In case of continual fall-out loss of the line voltage, f.e. electric distribution breakdown, repairs and re-designs or when the running is dead, it is necessary to set the UPS to off, that the useless discharge of storage batteries does not arise.
For this purpose we remove the supply cover (5) and press the button marked as
With a suitable tool (f.e. a pen). Repeated switch on is made by pressing the button .

The winding machine is switched over to the stand-by position by setting the switch POWER (1) to off. After ca. 8 sec. the display turns off and the light diode lights up itself on the control box. Actual winding data is recorded in the EEPROM.
We return to the initial regime by repeated switching on the switch POWER and can continue winding.
If the electric power supply was broken in the whole system – f.e. by setting the switch EMERGENCY STOP (2) to off, by the main switch (4) or the lenght of fall-out loss of the line voltage surpassed the battery capacity of the UPS (more than 90 minutes), the hard RESET will arise after renewing electric power supply. After pressing the button ENTER (12) the last remembered data from EEPROM will be set up.

If the electric power supply is broken while winding, the spindle will stop and the winding machine switch over to the stand-by after ca. 8 sec. After renewing electric power supply the winding machine returns to the initial regime, but in the position like after pressing the button STOP (7).

Keep always the following order at switching off and on the winding machine:

SWITCH ON: a) the UPS – if it was off
b) the main switch or EMERGENCY STOP (2)
c) the switch of stand-by POWER (1)

SWITCH OFF: a) the switch POWER, wait till the display (10) turns off (stand-by status)
b) the main switch (4)
c) the UPS only if it is necessary

MACHINE PREPARATION FOR RUNNING

The machine can be only operated by a person, properly trained for the working with the winding machine, familiarized with the service guide and safety rules, valid for mention workplace.

The machine is delivered partly disassembled for easier packing and transport. Before you switch the machine on for the first time, assemble it as follows:

a) Fasten the control unit on the drive unit. Connect the main power plug and the 25-pin connector on the back panel of the control box.

b) Check and fasten the fuse cartridges on the back panel of the drive unit.

c) Connect the multifunction footswitch to the socket (17) on the back panel.

d) The UPS cover (5) is removed and the UPS is switched on by pressing the button.

The machine is assembled and prepared to use.

SWITCH ON THE MACHINE

Switch on the MAIN SWITCH (4) on the back panel. Turn stand by switch to position ON. After pressing the ENTER button the machine is automatically reset to the initial stage (step „00“). The control system sets the last programmed block. The wire guide moves to initial (reference) position.
The machine is ready to work.

Pressing the START button starts the winding cycle. You can break the winding cycle by the STOP button.

FOLLOWING CORRECTIONS CAN BE MADE FOR WINDING PROCESS:

A) Spindle reference position setting

The spindle can be positioned within +- few degrees and the precise position is kept for any amount of windings.

You can set the spindle reference position as follows:

- Switch the brake-off by the switch (6)

- Turn the spindle manually to the desired position and return the switch (6) to the former position.

- Press RESET

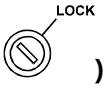
- Press ENTER

Note: When you switch the machine ON (by MAIN SWITCH POWER or EMERGENCY STOP button), RESET is realised automatically and the position of the spindle is taken as reference position.

B) Wire guide relative position

Relativ position enables to change all the coordinates already set in the block in range 0 - 798 mm by steps 0,1 mm. This means that the value of relative position is added from every coordinate in the block.

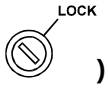
Holding the buttons + or – pressed (cca 0,5 s) moves the wire guide continuously.

C) Pitch correction (Key (12) in position )

Press  You can make correction of pitch by + or – (max.+- 9)

so that the pitch is corresponding to the wire diameter exactly.

When you program a new wire diametre code, the correction is automatically set to „0“

D) Left and right reversal point correction (Key (12) in position )

Press  or  You can set the left or right reversal point of the wire guide

by + or – with accuracy 0,1 mm.

E) Number of turns correction (Key (12) in position LOCK)

 After pressing this button - - - - - - is displayed and you can enter (change)

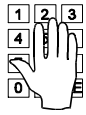
a new number of turns manually.

  write a new number of turns → ENTER

F) Pitch for the code „99“ (Key (12) in position LOCK)

 After pressing this button, the PITCH value valid for the code „99“ is

programmed. „ - „ is always displayed on the right.

  write the code and correction according to the table (range 0-96) → ENTER

The programmed value is valid for all the steps (windings) where in the key position WITHOUT MARKING,the value „99“ was entered. This means, that re-programming of this value can change the PITCH and correction.

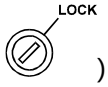
G) Correction of the wire guide position (Key (12) in position LOCK)

 After pressing this button, the current position of the wire guide is displayed.

Buttons + and − can adjust the wire guide position by steps of 0,1 mm.

Holding the buttons + or − pressed (cca 0,5 s) moves the wire guide continuously.

After finishing the correction, press ENTER again.

H) Return to the beginning of the step (Key (12) in position 

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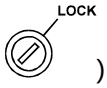
 Using this button you can return to the beginning of the step (winding). For example, if the wire breaks during the winding, just press STOP and the coil winding machine stops.

Then press  → CE and the task is returned to the beginning of the step, including the wire guide position and number of turns.

I) Back winding (Key (12) in position 

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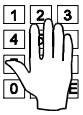
 After pressing this button „ 6A“ is displayed and you can wind back by the pedal. Number of turns is subtracted and wire guide moves in opposite direction.

After finishing the back winding, press 

J) Pedal control speed (MANUAL REGIME)

 Using this button you can set the top speed and the direction of rotation only for pedal control.

 → 

Enter the value 0 - 30 and direction (+/-) → 

This speed and direction of rotation is then valid for all the processes controlled by the pedal.

NOTE: In case a pedal speed „0“ is programmed, max.speed, acceleration, deceleration will be taken from actual step.

K) MANUAL REGIME

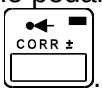
You can get to the manual regime in the following ways:

a) by pressing the button MANUAL (8), whereby the winding machine must be in the position REST or STOP
b) automatically after finishing the step at type of cycle 05, 15 or 06, 16.

The return from the manual regime is made by repeated pressing the button MANUAL.

The position of the manual regime is displayed - (by dash) instead of the block number.

The manual regime enables the winding by the pedal, whereby the direction of the wire guide can be changed by buttons 

or 

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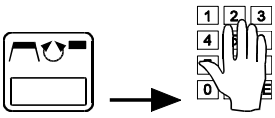
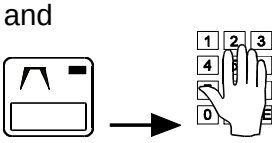
In the manual regime is also indicated:

1.) maximum speed, acceleration and deceleration ramp for the pedal



Max. speed of the pedal +- 0 - 30 → 

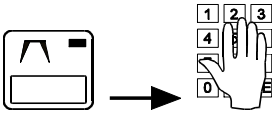
and



X Y → 

„X“ the acceleration and deceleration ramp of the pedal, the range 1- 8

2.) the deceleration ramp for the button STOP



X Y → 

„Y“ the decel.ramp of the button STOP, the range 1- 8

The regime set up for the pedal and the decel.ramp of the button STOP is valid for all the blocks.

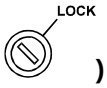
5. P R O G R A M M I N G

ENTERING THE DATA (GENERAL SCHEME)

PARAMETER → VALUE → ENTER

Note: You can not enter data in step „00“ - initial state, that follows after switching the machine on by POWER ON/OFF switch or after machine reset.

Use [+] button or a numeric button to get to the desired winding (STEP).

CHOOSING THE BLOCK (Key (12) in position 

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Note: Blocks 0 - 4 permit to program 99 steps (windings).
Blocks 5 - 9 permit to program 49 steps (windings).

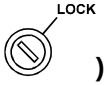
CHOOSING THE STEP

To choose the proper winding, you can use either of the following methods:

a) keyboard: Winding number → ENTER

b) buttons [+] or [–]

PROGRAMMING WINDINGS PARAMETERS

A. WINDING (Key (12) in position 

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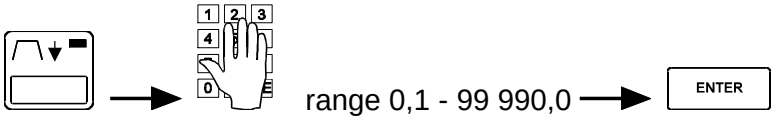
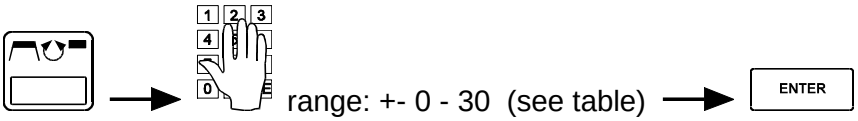
1. Number of turns

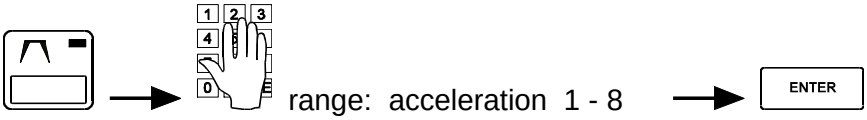


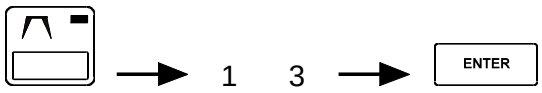
2. Max.speed and winding direction (Key (12) in position LOCK)



‘ + ‘ clockwise direction
‘ - ‘ anticlockwise direction

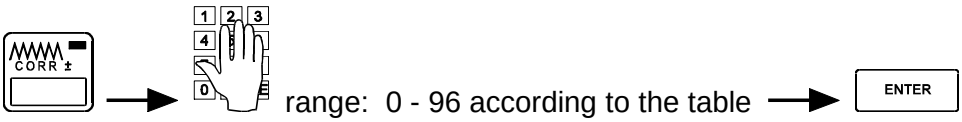
3. Acceleration and deceleration of the spindle (Key (12) in position LOCK)



Example: 

(acceleration 1,5 s) (deceleration 3 s)

4. Pitch and correction (Key (12) in position LOCK)



- correct the pitch within the range +- 9 by buttons + or − if necessary

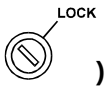
5. Type of cycle (Key (12) in position LOCK)

Set the type of cycle and choose, if number of turns in this step is canceled or not.

‘ 0X ‘ number of turns is set to zero (canceled)

‘ 1X ‘ number of turns is not canceled

where „X“ is the type of cycle (see appendix)

6. Left reversal point (Key (12) in position 

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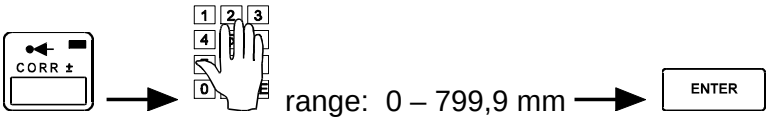
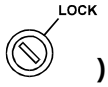


- correct by buttons [+] or [–] if necessary

7. Right reversal point (Key (12) in position 

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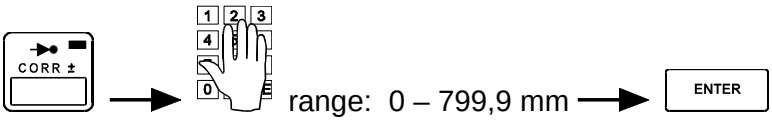
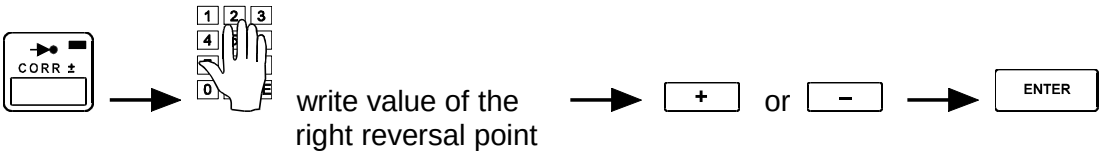
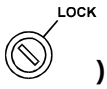


- correct by buttons [+] or [–] if necessary

If the wire guide occurs inside of the winding window (between left and right reversal point), its direction can be programmed as follows



Left reversal point | position of the wire guide | right reversal point

8. Auxiliary functions (Key (12) in position 

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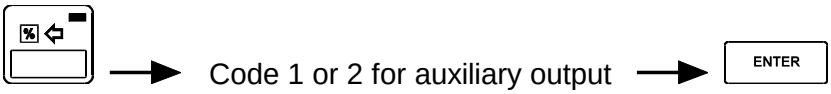
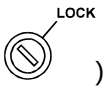


Code 1: auxiliary output switch off
Code 2: auxiliary output switch on

Auxiliary connector (18):

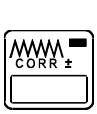
Notice:
Power supply + 24 V DC -
max. load current 150 mA !

B. SHIFT (Key (12) in position 

)

If you enter „0“ to the number of turns, wire guide moves to the position of the right reversal point. In this case only the following parameters are programmed:

1)  → set 0 → ENTER

2)  →  wire guide speed, set one of these values:
10,20,30,40,50,60,70,80,90

3)  →  set the value of the coordinate you want to shift to

4)  set the type of cycle and choose, if number of turns in this step is canceled or not.

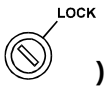
‘ 0X ‘ number of turns is set to zero (canceled)
‘ 1X ‘ number of turns is not canceled

where „X“ is the type of cycle (see appendix)

5)  → auxiliary output → ENTER

Code 1: auxiliary output switch off
Code 2: auxiliary output switch on

Other parameters are not important.

C. JUMP (Key (12) in position 

)

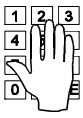
If a wire guide shift (number of turns „0“) is programmed with the pitch „0“, this step is not regarded as a shift, but as a jump by the value stored in the right reversal point.

1)  → set 0 → ENTER

2) 

→ set 0 → ENTER

3) 

→ 

set the value of the jump

4)  set the type of cycle and choose, if number of turns in this step is canceled or not.

‘ 0X ‘ number of turns is set to zero (canceled)
‘ 1X ‘ number of turns is not canceled

where „X“ is the type of cycle (see appendix)

5) 

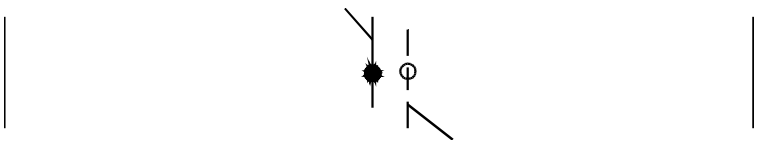
→ auxiliary output → ENTER

Code 1: auxiliary output switch off
Code 2: auxiliary output switch on

Other parameters are not important.

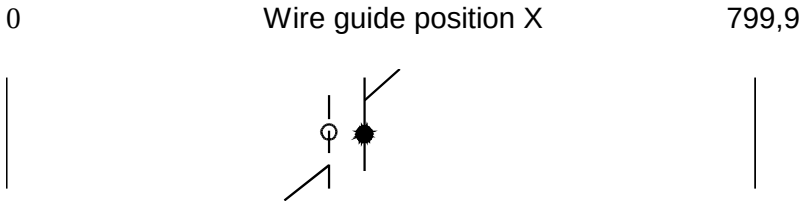
EXAMPLE 1: Number of turns: 0
Pitch: 0
Right reversal point value: 5,2

0 Wire guide position X 799,9



new position after jump: X + 5.2 mm

EXAMPLE 2: Number of turns: 0
Pitch: : 0
Right reversal point value: -5,2



new position after jump: X - 5.2 mm

NOTE: When the minus value (e.g. -5,2 mm) is to be programmed, first write the value and then the minus sign.

ERROR CODES

Microprocessor control with powerful software enable wide range of programmable parameters. Mistakes in program are displayed by writing Error or Error code.

ERROR 1 Mechanical displace of the wire guide.
This code appears in case that the lateral power on the wire guide overcomes the torque of the step motor.
Next procedure: press RESET

ERROR 4 Pitch or spindle speed is too high (exceeds the max.speed 75 mm/s of the wire guide).
Next procedure: press ENTER and correct either spindle speed or pitch

ERROR 5 Winding width is out of range.
Next procedure: press ENTER and correct either relative position or reversal points

ERROR 6 Program is not logic in the case type of cycle „3“, following step can not be the shift, jump or winding with the opposite speed direction.

6. GEAR CHANGE

Timing belt drive is under the cover (19). The machine is delivered with the reduction gear „300“.

CHANGING TO THE GEAR „600“

- remove the cover (19), attached by 5 screws
- loosen four screws (21) and remove the timing belt

- remove the timing gear signed „300“ and put the one signed „600“ (delivered with the machine) instead
- use the shorter timing belt, put on, tension and attach with the screws (21)
- turn the switch (20) to position „600“ rpm

Note:

After each gear change and turning the switch (15) it is necessary to inform the control unit by pressing RESET or switching the machine OFF and ON.

7. S E R I A L I N T E R F A C E

The machine is equipped with a socket (13) for communication with a PC - interface RS 232.

Optional accessories offered by the producer comprise a connecting cable and a floppy disk with the program for creating the winding program on a PC.

Connector (13):

8. COMPLETENESS AND ENCLOSURE

Documents delivered with the machine:

1 pc certificate of quality and completeness

1 pc user´s guide

1 pc AC servo drive user´s guide

1 pc APC Smart-UPS user´s guide

ENCLOSURE:

2 pcs fuse T 630 mA/250V

2 pcs fuse T 1 A/250V

1 pc microswitch WN 559 00

1 pc timing gear „600“ (122 teeth) TA 017 23

1 pc timing belt 40 T5 610

3 pcs allen key No 4,5,6

9. FUSE CHANGE

Change the wrong fuses at the POWER switch OFF and the main power plug disconnected. The fuses are on the back panel of the drive box. Be sure to use only the types of fuses specified by the producer.

10. MAINTENANCE

As the machine contains a minimum number of mechanical gears, the maintenance is simple. To ensure trouble-free work, following operations are recommended:

- clean regulary the winding space of dust, dirt and wire ends

- check tension of the timing belt

- the ball bearings have permanent grease filling, no lubrication is needed

11. WARRANTY PERIOD AND SERVICE

Warranty period is 12 months from the date of delivery.

Warranty and after warranty repairs are provided by TPC s.r.o. Liptovský Hrádok

12. APPENDICES

1. CODE TABLE OF SPINDLE SPEED

2. CODE TABLE OF ACCELERATION-DECELERATIONS TIMES

3. PITCH CODE TABLE

4. TYPE OF CYCLE

5. SPARE PARTS

CODE TABLE OF SPINDLE SPEED

CÓDE (0-30)	GEAR „600“ (rpm)	GEAR „300“ (rpm)
0	0	0
1	2	1
2	4	2
3	6	3
4	8	4
5	10	5
6	15	7,5
7	20	10
8	25	12,5
9	30	15
10	40	20
11	50	25
12	60	30
13	70	35
14	80	40
15	100	50
16	120	60
17	140	70
18	160	80
19	180	90
20	200	100
21	240	120
22	280	140
23	320	160
24	360	180
25	400	200
26	440	220
27	480	240
28	520	260
29	560	280
30	600	300

CODE TABLE OF ACCELERATION - DECELERATION TIMES

(Valid for all gears)

CODE	ACCEL.TIME TO MAX.SPEED (S)	DEC.TIME FROM MAX.SPEED (S)
1	1,5	1,5
2	2,2	2,2
3	3	3
4	4,5	4,5
5	6	6
6	9	9
7	12	12
8	16	16

PITCH CODE

CODE	WIRE DIAM. (mm)	PITCH (mm)	CODE	WIRE DIAM. (mm)	PITCH (mm)
1	0,250	0,285	49		4,250
2	0,256	0,300	50		4,500
3	0,280	0,316	51		4,750
4	0,300	0,335	52		5,000
5	0,315	0,355	53		5,250
6	0,335	0,377	54		5,500
7	0,355	0,396	55		5,750
8	0,375	0,417	56		6,000
9	0,400	0,446	57		6,250
10	0,425	0,473	58		6,500
11	0,450	0,496	59		6,750
12	0,475	0,521	60		7,000
13	0,500	0,548	61		7,250
14	0,530	0,590	62		7,500
15	0,560	0,620	63		7,750
16	0,600	0,660	64		8,000
17	0,630	0,690	65		8,250
18	0,670	0,725	66		8,500
19	0,710	0,775	67		8,750
20	0,750	0,825	68		9,000
21	0,800	0,875	69		9,250
22	0,850	0,925	70		9,500
23	0,900	0,975	71		9,750
24	0,950	1,025	72		10,000
25	1,000	1,075	73		10,500
26	1,060	1,155	74		11,000
27	1,120	1,215	75		11,500
28	1,180	1,275	76		12,000
29	1,250	1,345	77		12,500
30	1,320	1,451	78		13,000
31	1,400	1,495	79		13,500
32	1,500	1,595	80		14,000
33	1,600	1,695	81		14,500
34	1,700	1,800	82		15,000
35	1,800	1,900	83		15,500
36	1,900	2,000	84		16,000
37	2,000	2,100	85		16,500
38	2,120	2,250	86		17,000
39	2,240	2,380	87		17,500
40	2,360	2,500	88		18,000
41	2,500	2,650	89		18,500
42	2,650	2,800	90		19,000
43	2,800	2,950	91		19,500
44	3,000	3,150	92		20,000
45		3,250	93		20,500
46		3,500	94		21,000
47		3,750	95		21,500
48		4,000	96		22,000

TYPE OF CYCLE