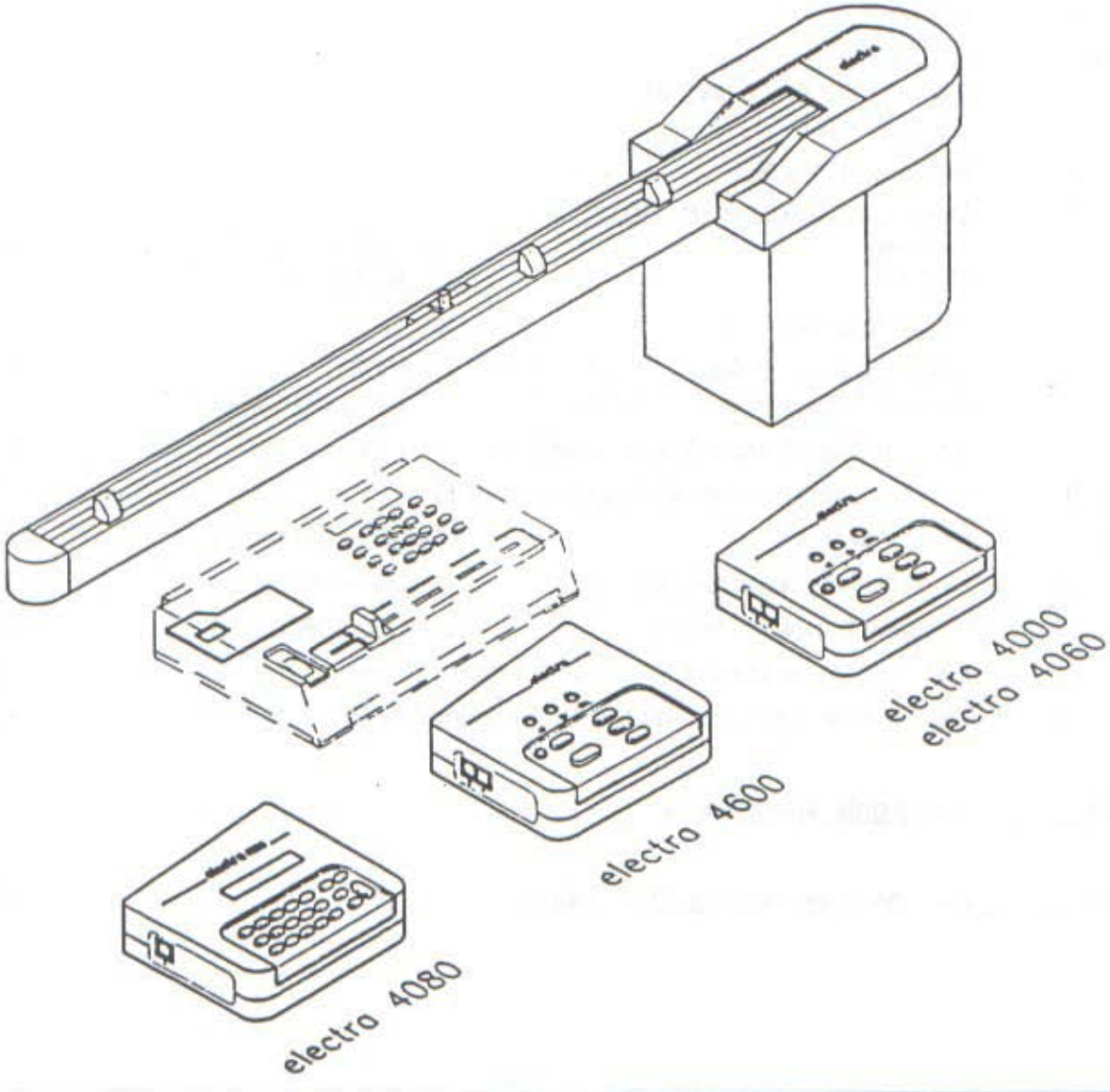
Service Instruction

for motor drives of the

electra 4

product line



Contents page

Safety advice

A **Unlock the motor drive from the cam boxes of the knitting machine**

During the test procedures it may occur that the motor drive starts to run suddenly.

To avoid any risk of accidents during repair and service works the mechanical connection between the VM-driver for cam box 12.514.12 (mounted to the rear cam box) and the belt union 10.652.02 must be lifted up.
The free movement of the cam boxes must be checked by moving them by hand across the knitting machine.

B **Unplug the mains cable from the socket.**

Before covers are removed and service works on mechanical or electrical components are started **the mains cable must be unplugged from the mains socket**.

Not following this rule may have serious consequences like insuries or death,
- when touching parts under electric tension,
- when the motor and the belt drive start to run on a sudden.

C **Mesuring procedures on electric parts when current is ON.**

Some tests of this instruction require mesurements while the motor is under current and switched on.
These tests must be executed by personnel with electrotechnical instruction.

Test steps marked with this sign require checks or measurements which include the danger to get in touch with the mains voltage. See item C above.

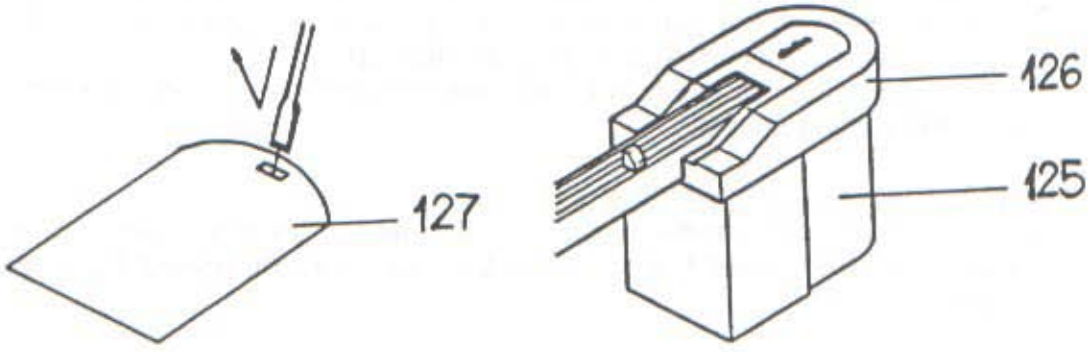
1.1 Replacing the tooth belt, article no. 10.650.02

Required tool:

- Screw driver TORX T15 article no. 03.690.02
- Allen key 4 mm article no. 05.609.02
- Pointed pliers article no. 03.683.02
- Screw driver (flat), aprox. 4mm

Procedure:

1.1.1 **Unplug the mains cable from the socket or the motor "electra 4...".**

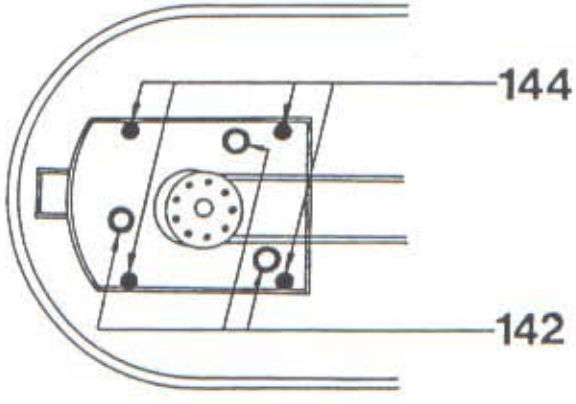


1.1.2 **Remove the cover (127)**
Make shure that all 4 screws M4x50mm (144) are removed. If not, remove them now, using a 3mm Allen key.
(When these 4 screws are still in place, the following steps cannot be executed)

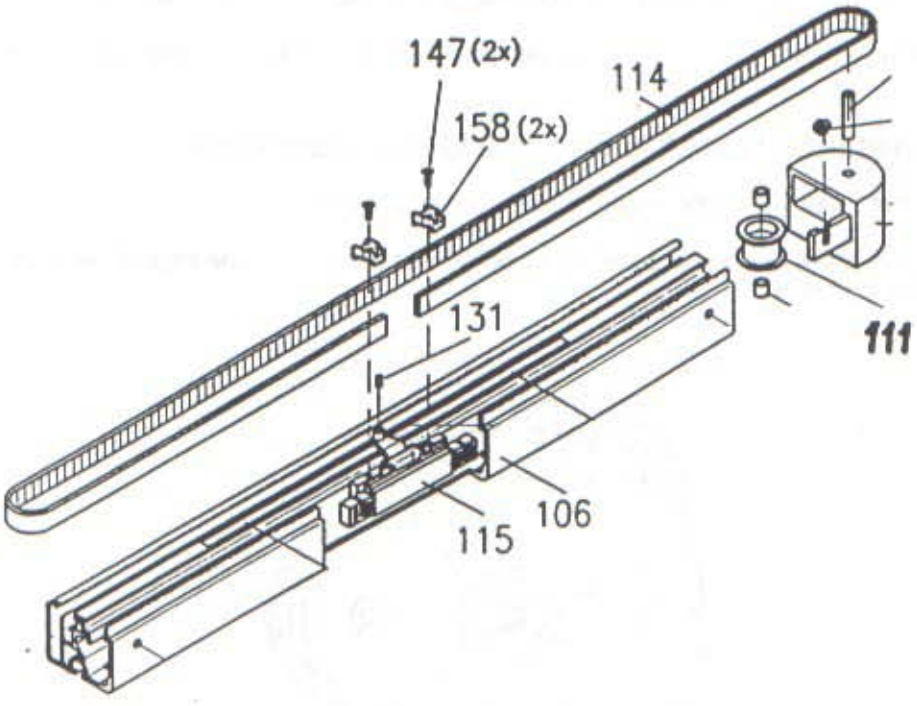
1.1.3 **Remove the top cover (126),** (2 screws, Torx T15)

1.1.4 **Remove the bottom cover (125),** (4 screws, Torx T15)

1.1.5 **Untight the 3 screws (142) for $^{3}/_{4}$ of a revolution,** using a 4mm Allen key.
Never remove them completely, the motor will drop to the floor !



1.1.6 **Insert the 4mm Allen key into one of the 3 screws (142) einstecken.**
Push the motor by hand towards the profile bar and tight the screw (142). The tooth belt is now untightend.



1.1.7 **Remove both screws TORX T15 (147) and the washers** (158) from the belt union (115).

1.1.8 **Remove both ends of the tooth belt from the belt union (115) by means of a pointed plier.**
Pull the tooth belt completely out of the profile bar (106).

1.1.9 **Insert the new tooth belt into the profile bar.**
It isn't necessary to remove the pulley housing assembly (110) !

1.1.10 **Lay the tooth belt around the pulley** (111) and insert both ends of the tooth belt into the belt union. Fix the ends with the screws (147) and with the clamps (158).

1.1.11 **Check the correct position of the tooth belt in both channels of the profile bar.**

1.1.12 **Untight the screw** (142), thereby, the pressure spring (108) pushes the motor against the tooth belt and gives the belt the correct tension.
Don't increase the belt tension by hand in addition to the spring tension!

1.1.13 **Tight the 3 screws** (142) and check the smooth run of the tooth belt in the profile bar, moving the belt union (115) by hand.

1.1.14 Put the **intermediate piece 10.649.02** in place. (see service information 33.642.53)

1.1.15 **Put the covers** (125), (126) and (127) back in place.

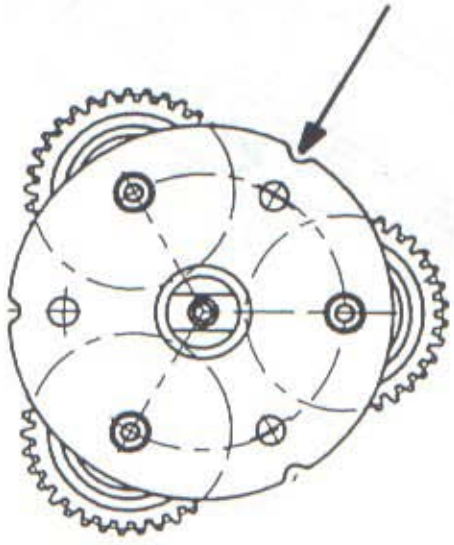
1.2 How to distinguish the parts of transmission (50 or 60 cycles/Hz)

See as well on pages 7 and 8 of the illustrated parts list 33.637.53, Such parts are marked with **50 Hz** or **60 Hz**.

VM-Sun wheel 10.592.01 and Sun wheel 10.605.03 for 50 cycles/Hertz

All plastic parts for 50 cycles are made of **white** material.

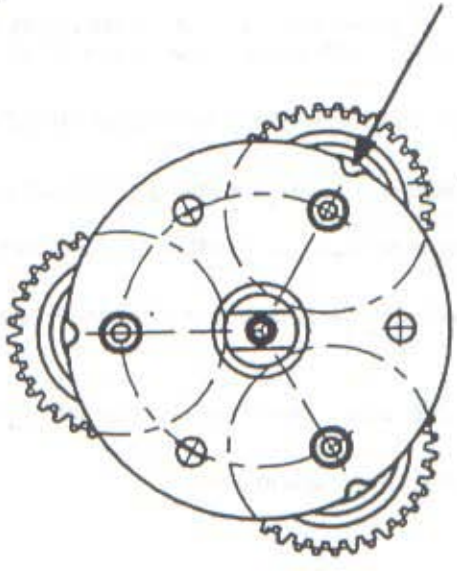
The sun wheel can be identified by the position of the score at the edge of the plate, as per illustration below.



VM-Sun wheel 10.593.01 and Sun wheel 10.606.03 for 60 cycles/Hertz

All plastic parts for 60 cycles are made of **green** material.

The sun wheel can be identified by the position of the **score** at the edge of the plate, as per illustration below.



2. Electrical issues

2.1 General advice

2.1.1 Eliminate potential causes of errors

In case of failure, all devices with auxiliary functions must be unplugged from the sockets BU5 .... BU9.

- Yarn break kontacts (BU5,BU6)
- AUTOCOLOR detection (BU9, evtl. BU7)
- Pedal switch (BU8)

If the error has disappeared now, one cable after one can be replugged, checking the motor functions immediately after each cable beeing plugged in.

If the error remains even when all cables are unplugged from the sockets BU5 ... BU9, proceed as follows

- 2.1.2 for E-4080, or
- 2.2.1 for E-4000 / E-4060 / E-4080, or
- 2.2.2 for E-4600

2.1.2 Temporary replacement of the M-Program box PG by a M-Control box SG

Trouble shooting on an E-4080 can be eased by the temporary use of an M-Control box SG 10.830.00 instead of the M-Program box PG 10.860.00.

- remove the M-Program box PG from BU1
- connect the M-Control box SG with two cables 10.910.03 to the sockets BU3 and BU4.

When the motor is performing correctly with the M-Control box SG, the failure can be supposed in one of the following components

- M-Program box PG	10.860.00		See 2.8
- Control circuit board II	10.760.03,	IC1 (92.906.57)	See 2.6.3

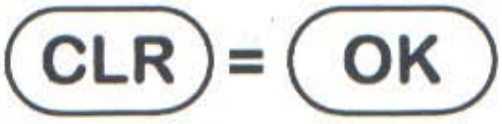
When the E-4080 motor isn't performing correctly even with the M-Control box SG nicht funktioniert, the failure can be supposed in one of the following components

- Control circuit board II	10.760.03,	IC2 10.762.03	See 2.6.4
		IC3 92.905.81	See 2.6.5

- or in one of the other parts of the E-4080, as per 2.2.1

2.1.3 OK key on M-Control box SG

Remark. On the M-control boxes SG of some earlyer series of Electr-4 motor drives the OK key was marked with CLR.
Therefore, when the OK key is named in this service instruction, on some motor drives the CLR key has to be pressed instead.



2.2.1 Checks of functions for E-4000 / 4060 / 4080

Important. **Before starting the tests, all cables must be removed from the sockets BU5 ... BU9.**

E-4080: **In addition to the M-Program box PG, a M-Control box SG must be connected to the sockets BU3 and BU4.**
All keys for the test have to be operated on the M-control box SG !

	operation	desired result	check or replace in case of failure	further advice
101	Switch ON the main switch of the motor	LED ▶ is ON LED **COL** is ON	Mains supply 230V / 120V	See 2.4.2
			Mains cable	
			Fuse **1A**/230V 92.050.61 **2A**/120V 92.051.11	The fuse is located underneath the main switch of the motor. (one fuse is spare)
			230VAC or 120VAC supply. check AC voltage at the drive circuit board 10.730.03	See 2.4.2
			Check +15VDC	See 2.4.2 and 2.6.2
			Check + 5VDC	See 2.6.2
			Check the connection of the 4 motor cables to the drive circuit board 10.730.03.	See 2.4.2
			Cable FCC 6/6 10.910.03 in socket **BU3**.	Replace by the cable from socket **BU4**.
			M-Control box SG	LEDs, socket BU3, See 2.3
			Control circuit board I or II	See 2.6
			Control cable 10.738.03	replace cable
102	Press the **COL** key	LED **COL** goes OFF	Cable FCC 6/6 10.910.03 in socket BU4	Test with another cable
			M-Control box SG	Key COL, contact no.4 in socket BU4, See 2.3
			Control circuit board I or II	replace IC2 10.762.03.

	operation	desired result	check or replace in case of failure	further advice
103	Press **GO/STOP** key	Motor starts to the right >>>>> and	Cable FCC 6/6 10.910.03 in socket BU4	Replace cable
			M-Control box SG	Key GO/STOP, Contact no.6 of socket BU4, See 2.3
			Control circuit board I or II	See 2.6
			Drive circuit board 10.730.03	See 2.4
			Connection of motor wires	White and black cables are crossed at the drive circuit board 10.730.03, See 2.4
		returns when reaching the **right** edge stop switch. The LED ◀ goes ON,	Edge stop PCB 10.695.03 at the right side	Check the edge stop PCB at pins 6 and 7 of the edge stop cable 10.698.03 with the Ohm-meter. See 2.5
			Edge stop cable10.698.03	Check cable, replace it.
			Control circuit board I or II	See 2.6
			Drive circuit board 10.730.03	See 2.4
		the motor goes on until reaching the **left** edge stop switch and returns then to the right side.	Left edge stop 10.695.03	Check the edge stop PCB at pins 2 and 3 of the edge stop cable 10.698.03 with an Ohm-meter. See 2.5
			Edge stop cable 10.698.03	Check, replace cable
			Control circuit board I or II	Replace IC2 10.762.03 See 2.6
104	Press ⏮ ⏭ key	The motor stops at the end of the row.	M-Control box SG	Key ⏮ ⏭, contact no.3 in socket BU4, See 2.3 Replace IC2 10.762.03.
105	Press **COL** key Press **GO/STOP** key	The LED **COL** is ON, the motor starts to the right and goes to the colour changer.	M-Control box SG Control circuit board I or II	Key COL, contact no.4 in socket BU4, See 2.3 Replace IC2 10.762.03.
		End of the test		

2.2.2 Checks of functions for E-4600

Important. The E-4600 must be mounted to a E-6000 and the cable 10.912.03 must be connected with the socket BU2 of the E-4600.
The M-Interface 05.970.00 is installed into the E-6000 console (see mounting instructions 33.637.03 for electra-4 motor drives)

The M-Control box SG is connected to the sockets BU3 and BU4.

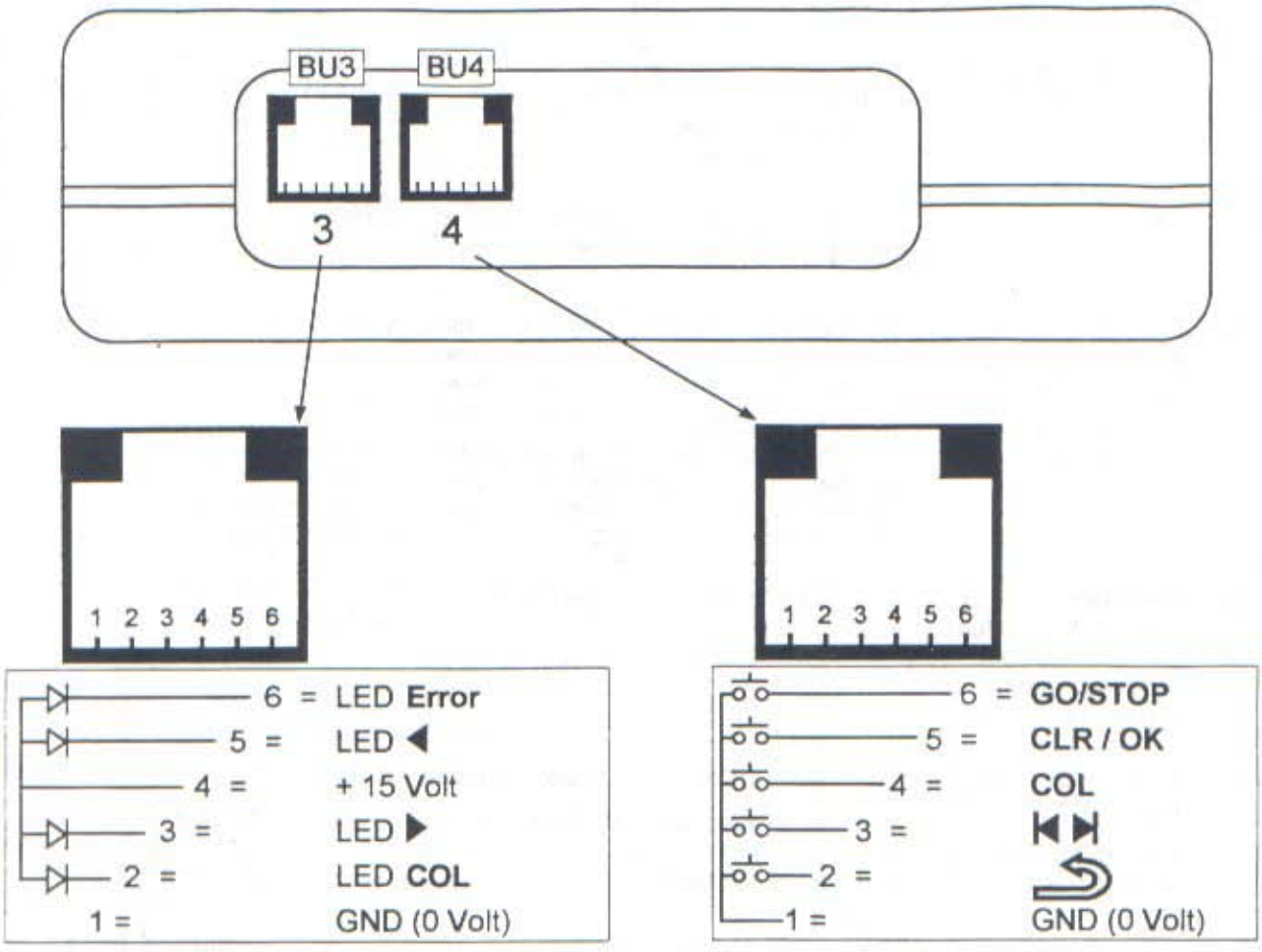
All other cables must be unplugged from the sockets BU5 ... BU9.

	operation	desired result	check or replace in case of failure	further advice
301	Switch on the manin switch of the E-6000 and of the E-4600.	E-6000 displays "START POS"	Mains supply 230V / 120V	See 2.4.2
			Mains cable	
		LED ◀ is ON	Fuse **1A**/230V 92.050.61 **2A**/120V 92.051.11	The fuse is located underneath the main switch of the motor. (one fuse is spare)
	Program the E-6000 with **cast on 97**, go on till the display shows **"START POS"**		Check 230VAC or 120VAC at the drive circuit board 10.730.03	See 2.4.2
	Connect the rear cam box of the E-6000 with the belt union of the motor.		Check +15VDC	See 2.4.2 and 2.6.2
			Check + 5VDC	See 2.6.2
	Set both cam boxes to **GX**.		Check the connection of the 4 motor cables to the drive circuit board 10.730.03.	See 2.4.2
	Move the cam boxes to START POSITION.		Cable FCC 6/6 10.910.03 in socket BU3.	Replace cable in socket BU3.
			M-Control box SG	LEDs, socket BU3, See 2.3
			Control circuit board I or II	See 2.6
			Control cable 10.738.03	replace cable
302	Press**ENT key on the** E-6000	Intermittent display on the E-6000 "CAST ON"	Interface PCB 05.963.01 Cable 10.912.03	See 2.7. Check functions of the interface PCB. see 2.3.
	Press **GO/STOP** key on the E-4600.	E-4600 must not start !	Control circ.board 10.760.03	See 2.6
303	Press **ENT** on the E-6000 till display shows **"1R EMPTY"**	Display on the E-6000 must show "1 R EMPTY"	Cable FCC 6/6 10.910.03 in the socket BU4	Replace cable in BU4
			M-Control box SG	Key GO/STOP, Contact no.6 in socket BU4,
	Press **GO/STOP** key on the E-4600.	E-4600 must run to the **left side** and it must stop at the **left** edge stop.	Drive circuit board 10.730.03 Interface PCB 05.963.01 Cable 10.912.03	See 2.4 See 2.3 See 2.7. Checks of the interface PCB

Goes on on next page, test no. 304

	operation	desired result	check or replace in case of failure		further advice
304	Press **ENT** key on the E-6000 till display **"1R EMPTY"** Press **GO/STOP** key on the E-4600.	Display on the E-6000 must show **"1R EMPTY"**. The E-4600 must start **to the right** side and it must stop at the right edge stop. LED **COL** is **ON** LED ▶ is **ON**	Drive circuit board Interface PCB Cable Control circ.board **M-Control box SG**	10.730.03 05.963.01 10.912.03 10.760.03	See 2.4 See 2.7. Checks of the interface PCB. See 2.6 See 2.3. LED, Socket BU3.
305	Press **ENT** key on the E-6000 till display "RC 0" (row counter) Press **GO/STOP** key on the E-4600.	The row counter on the E-6000 must show "RC 0" The E-4600 must run to the colour changer and then go on running between the left and the right edge stop.	When the motor runs into the colour changer and blocks there, the following components might be faulty Edge stop switch Edge stop cable Control circ.board IC2	 10.695.03 10.698.03 10.760.03 10.762.03	 see 2.5 see 2.5 see 2.6 see 2.6.4
306	Press **GO/STOP** key on the E-4600 when the cam boxes are travelling from **right to left**	**The E-4600 must stop immediately**	Steuerteil-Print IC2 M-Steuergerät SG	10.760.03, 10.762.03	See 2.6 Key GO/STOP, Contact no.6 of socket BU4, see 2.3
307	Press ➲ key on the E-4600. Press **GO/STOP** key on the E-4600.	LED ▶ is ON The E-4600 must run **to the right** and it must stop at the **right** edge stop. The E-6000 must show error **"206"**	Control circ.board M-Control box SG	10.760.03	See 2.6 Key ➲ , Contact no.2 of socket BU4, see 2.3 **Important. Don't cancel the error "206" on the E-6000 !**
308	Press **GO/STOP** key on the E-4600.	**The E-4600 must NOT start as long as error "206" stays on the E-6000 display.**	Interface PCB Control circ.board	05.963.01 10.760.03	See 2.7. Checks of the interface PCB See 2.6

2.3 M-CONTROL BOX SG



Signals for the LEDs

The signals on BU3 are exclusively controlling the LEDs in the control box.

The LED have no influence to the functions of the motor, they only indicate the actual state of the motor when it is in standby or in operation.
For test reasons, the cable in the sockets BU3 can be removed, the motor must work even when the sockets BU3 are not connected.

Control signals by the keys

The control signals from the keys are transmitted via the cable in BU4 to the motor.

The motor can work only if the sockets BU4 of the motor and the control box are connected by means of the cable 10.910.03.

2.4 Drive circuit board 10.730.03

2.4.1 Functions

The drive circuit board controls the AC voltage and it applies it to the motor's windings via the TRIACs TR1 or TR2, accordingly to the desired sense of drive.
The TRIACs are controlled by the optotriacs IC2 or IC3.
IC2 and IC3 are controlled by the IC3 (ULN2003) on the control circuit board I or II.

The zero status of the AC sinus is detected via the temperatur sensor (17-18) and it is transferred via the zener diode D1, the optocoupler IC1 and the control cable 10.738.03 to the IC2 on the control circuit board I or II.

2.4.2 Voltage supplies

AC voltage / mains

The AC voltage is on the pins L and N when the mains switch is ON.
Motors E-4000/4060/4080 have a DC-supply 10.724.03(230V) or 10.726.03(120V), connected to the pins L1 and N1.

DC voltages

In the motors E-4000/4060/4080 the 15V DC voltage from the DC-supply is connected to the pins "15V" and "GND". The control circuit board I or II is supplied via the socket ST10 and the control cable 10.738.03.
Important: For the correct polarity of the **15V DC voltage** the tagged cable must be plugged to the pins marked "15V".
(Since the E-4600 has no DC-supply integrated, the 15V DC voltage is transmitted from the E-6000 via the socket BU2 directly to the control circuit board II , see 2.7.1)

2.4.3 Cabling

See illustration below and on the following pages.

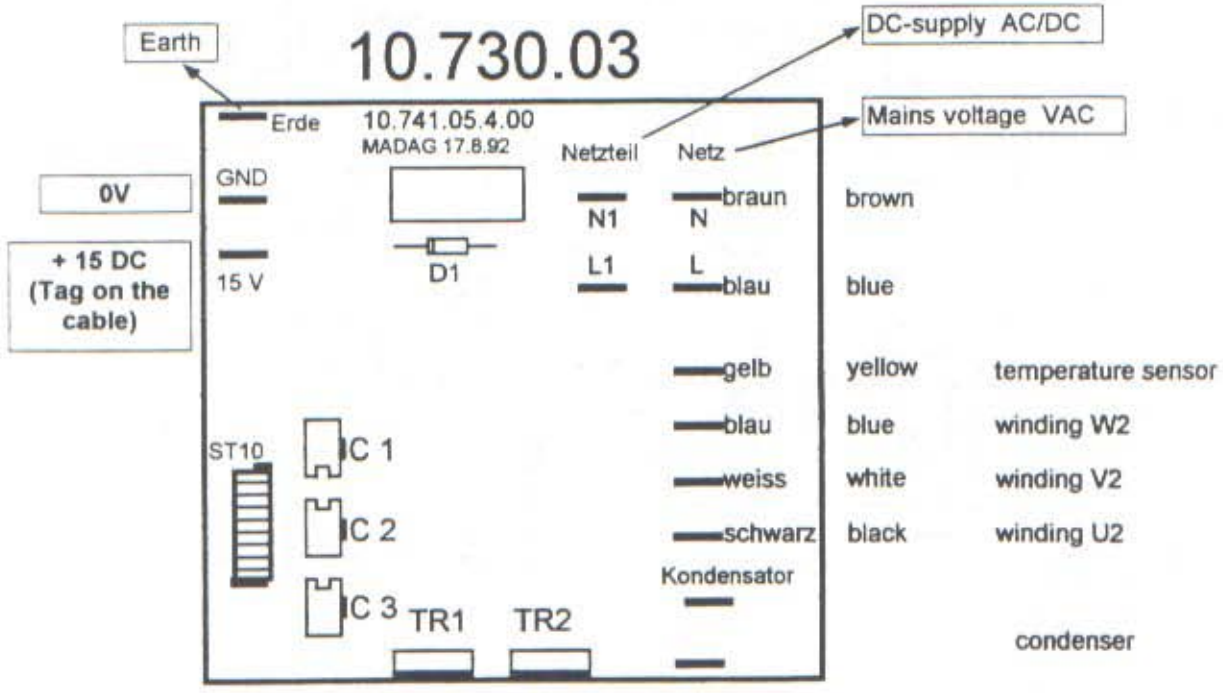
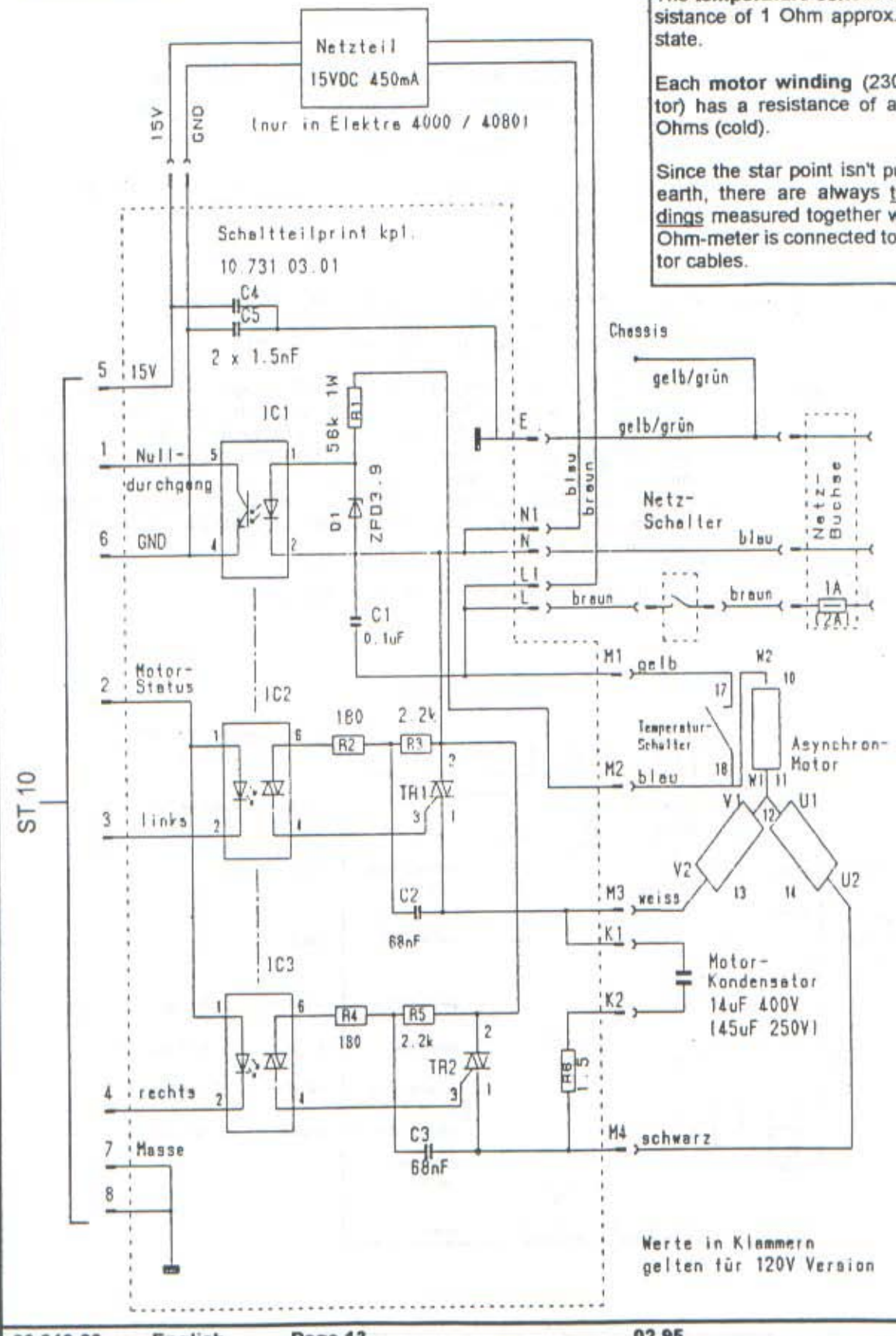


Diagram of the drive circuit board 10.730.03

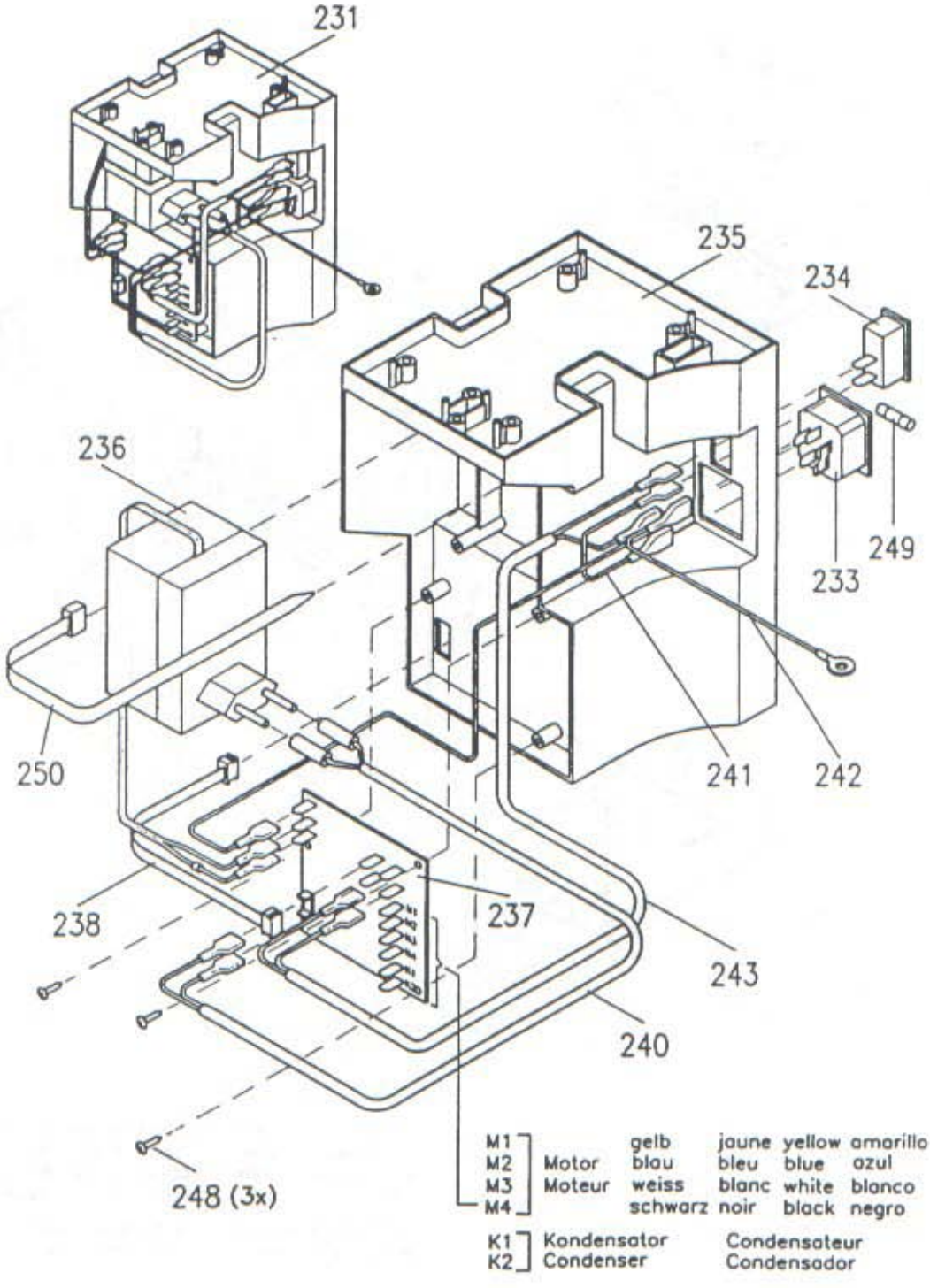
The **temperature sensor** has a resistance of 1 Ohm approx. in cold state.

Each **motor winding** (230 V motor) has a resistance of about 25 Ohms (cold).

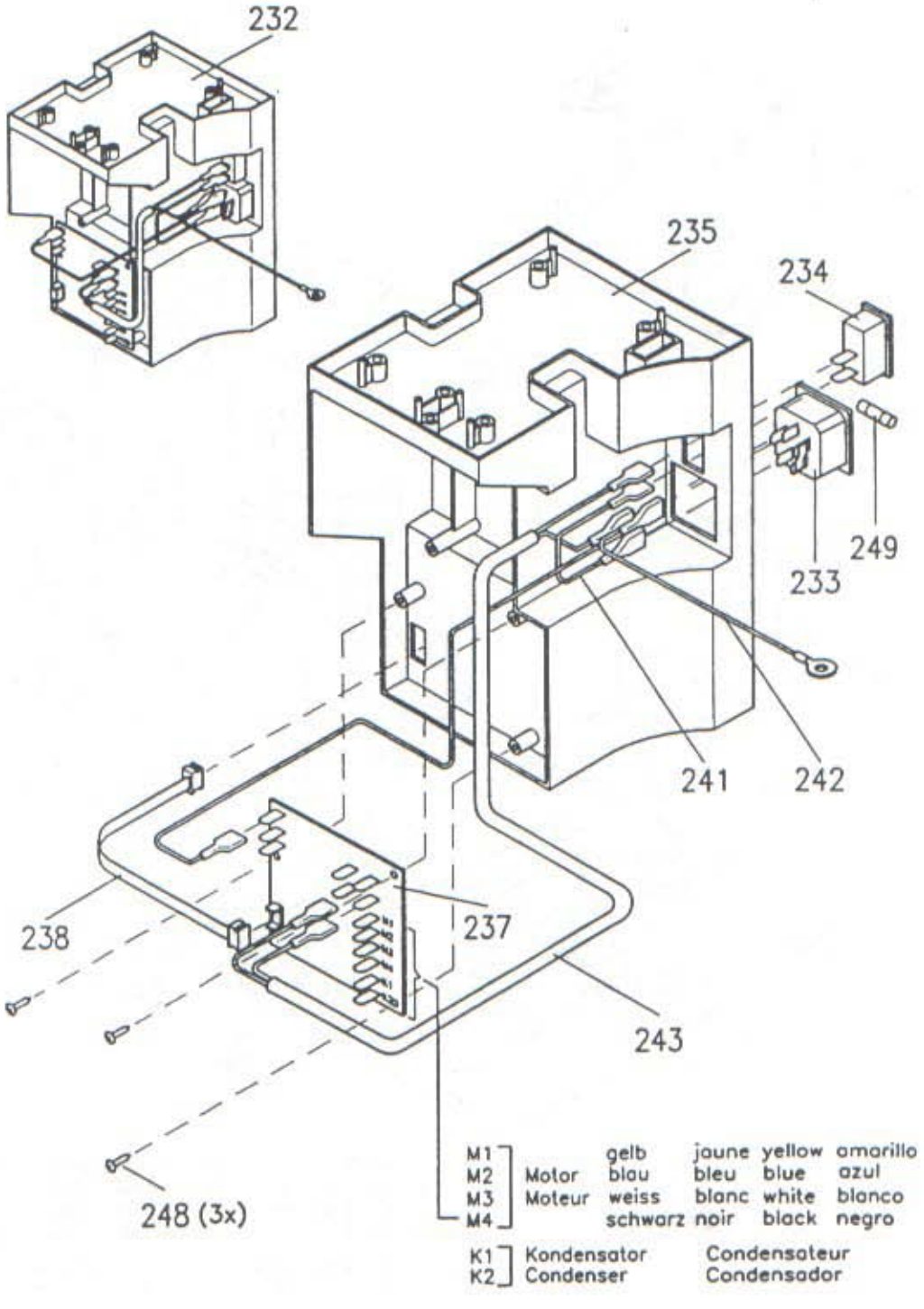
Since the star point isn't put to the earth, there are always <u>two windings</u> measured together when the Ohm-meter is connected to the motor cables.



E-4000 / 4060 / 4080



E-4600


232
235
234
249
233
241
242
238
237
243
248 (3x)
M1
M2
M3
M4
Motor
Moteur
gelb jaune yellow amarillo
blau bleu blue azul
weiss blanc white blanco
schwarz noir black negro
K1
K2
Kondensator Condensateur
Condenser Condensador

2.5 Edge stop switches

When the motor doesn't change direction at the end of the row or at the colour changer, one of the following components may be faulty.

2.5.1 Magnet 14.760.05 in the belt union

Check that the magnet is sitting in the fully bottom position in the belt union 10.652.02. If the magnet is looking out of the plastic belt union, the edge stop switches are not actuated properly.

2.5.2 Checking the function of the edge stop switches

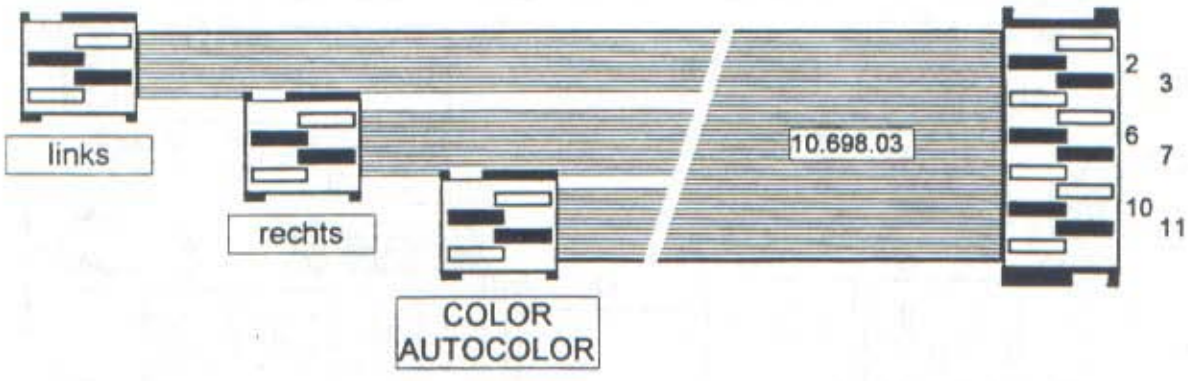
The following method allows to check the edge stop circuit boards 10.695.03 without removing the edge stop cable 10.698.03 nicht demontiert werden müssen.
Check that the white plugs are plugged firmly on all three edge stop circuit boards 10.695.03. This is possible from outside, without disassembling any parts.

- **Switch OFF the main switch of the motor and of the E-6000 (in case of E-4600).**
- Remove the ***VM-Control circuit board I or II*** at the back side of the motor.
- Unplug the edge stop cable 10.698.03 from the socket ST12. (see illustration at 2.6)
- Check the switching function of each edge stop switch with an Ohm-meter on the correesponding pins of the 12 pole plug as per the illustration below.

  Therefore, the belt union has to be moved **by hand** along the corresponding edge stop switch. The magnet is actuating the reed contact, the Ohm-meter shows a resistance of less than 5 Ohms.
- When higher Ohms are detected or no change is measured when the magnet is passing by the edge stop switch, the edge stop switch 10.695.03 in question has to be replaced firstly .
  Replace the edge stop cable 10.698.03 only after an unsuccessful exchange of the edge stop circuit board.

Check on these pairs of contacts with the Ohm-meter

2 - 3
6 - 7
10 - 11



2.6 Contol circuit board I 10.758.03 and II 10.760.03

2.6.1 Power supply

The control circuit board is supplied with +15V DC.
The motors E-4000, E-4060 and E-4080 have an integrated AC/DC supply with 15VDC output. The 15VDC voltage is connected to the drive circuit board 10.730.03 (ST10) and via the control cable 10.738.03 to pin no. 5 of the socket ST10 on the control circuit board I or II.
The E-4600 must be connected to an E-6000 with integrated Interface board. From there, the 15VDC voltage is brought via the cable 10.912.03 to the contact no. 5 in socket BU2.

The integrated circuits IC1 and IC2 are supplied with +5VDC voltage, produced by the voltage regulator REG1, 92.907.61.

2.6.2 Checking the DC voltages at the voltage regulator REG1

Switch ON the main switch of the motor (E-4000, E-4060, E-4080) or the main switch of the E-6000 console for a E-4600 motor.

Remove the VM-control circuit board out of the rear section of the motor without unplugging the flat cables from ST10 and ST12.
Check the DC voltages +15 V and +5 V with a DC voltmeter.(see illustration below)

2.6.3 IC1 (75176) 92.906.57

Transfers the signals from and to the program box PG.
This IC isn't in operation when the board is used in a E-4600 motor.

2.6.4 IC2 (EPROM) 10.762.03 (fitted in a plug-in socket)

This IC coordinates the functions of the internal and the external elements of the motor.
In case of failures which appearently have no relation with the parts named under 2.2, the IC2 has to be replaced. (e.g. when the error "motor overheated" is on)

2.6.5 IC3 (ULN2003), 92.905.81

The IC3 (supplied with +15V) has two main functions
- the control of the sense of revolution of the motor by amplifying the signals from IC2.
- the contro of the LEDs in the M-control box SG.

Parts location of the Control circuit board I 10.758.03 and II 10.760.03

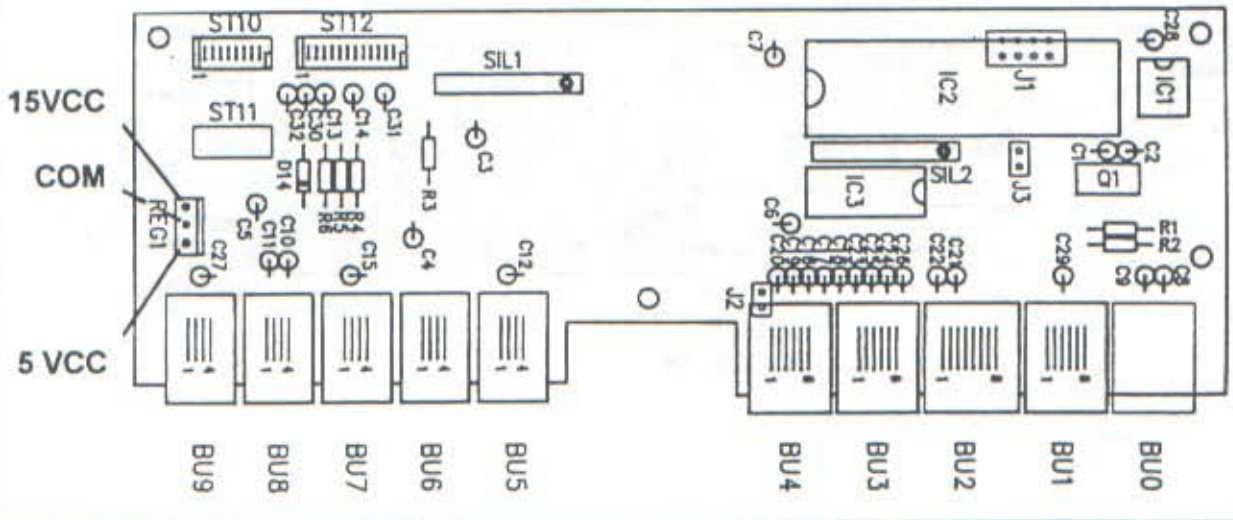
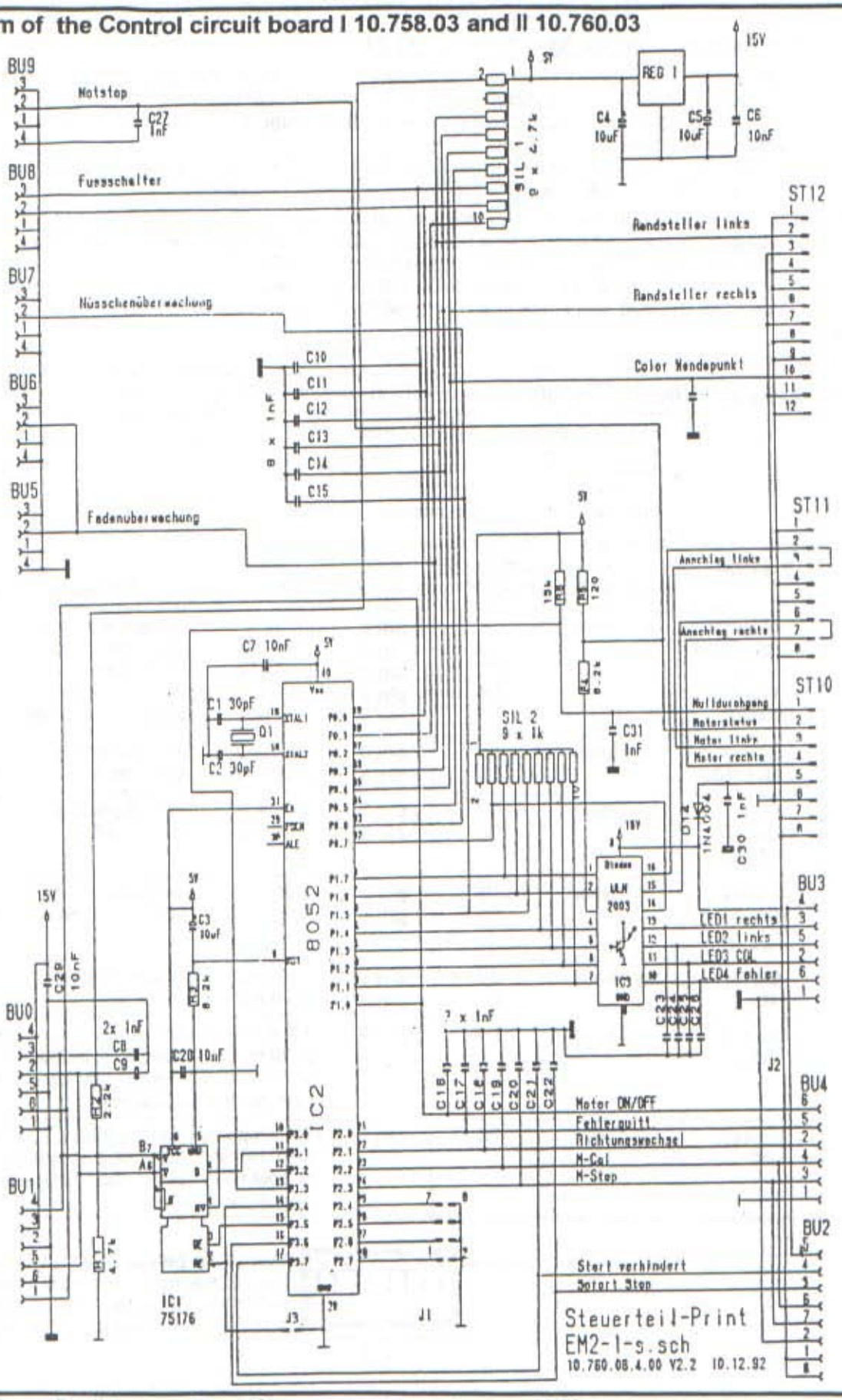


Diagram of the Control circuit board I 10.758.03 and II 10.760.03



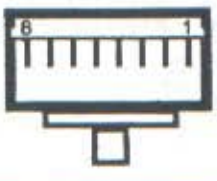
2.7 VM-Interface circuit board 05.963.01

2.7.1 The interface circuit board serves to connect the E-6000 with the E-4600 motor drive. It transmits the control signals from the E-6000 to the E-4600 in a one way sense.
Since the E-4600 has no AC/DC supply the 15VDC voltage is brought from the E-6000 via the interface circuit board to the motor.
The E-4600 only can be operated when it is connected to an E-6000 via the cable 10.912.03 in the socket BU2. The main switch of the E-6000 console must be switched ON.

2.7.2 **Checking the output signals on the socket BU1 of the interface circuit board in the E-6000.**
- Unplug the cable 10.912.03 from the socket BU2 of the E-4600, the other end is plugged into the socket BU1 of the interface circuit board in the E-6000.
- Program the E-6000. **Point 190** as PATTERN A, **Needles +70 / +90.**
- Move the E-6000 cam boxes slowly by hand to achieve the signals shown in the table below.

Output signals from the E-6000 to the E-4600, measured at the interface circuit board

Test no.	Action on the **E-6000**	Measuring points for the Volt-meter: **COM (-)** of the Volt-meter	Measuring points for the Volt-meter: **+** of the Volt-meter		Correct result VDC	Meaning of signals
		BU1 / pin 2 or anode of D5	05.960.03 kathode of Diode D...	**Cable/socket BU1/pin..**		
A	Main switch ON, go ahead till display shows **PROGR.**	as above	D1 D3 D2 D4 D5	**pin 5** **pin 3** **pin 4** **pin 6** **pin 7**	15 V 20 mV 20mV > 4 V > 4 V	DC power supply for E-4600 Immediate stop NO Motor start POSSIBLE Colour change NO Stop at end of row NO
B	display **START POS**	as above	D3 D2	**pin 3** **pin 4**	20 mV 20 mV	Immediate stop NO Motor start POSSIBLE
C	display **ERR 207**, + Beep	as above	D3 D2	**pin 3** **pin 4**	> 4 V 20 mV	Immediate stop YES Motor start POSSIBLE
D	display intermittent **_ _ _ SX**	as above	D3 D2	**pin 3** **pin 4**	20 mV > 4 V	Immediate stop NO Motor start NOT POSSIBLE
E	display **RC ..**	as above	D3 D2	**pin 3** **pin 4**	20 mV 20 mV	Immediate stop NO Motor start POSSIBLE
F	display **RC ..**	as above	D4	**pin 6**	>4V, dropping to 20 mV at the hole no. 8 (see illustr.)	The 20mV signal at hole no.8 produces a **colour change** at the end of the actual row.
G	display **RC ..**	as above	D5	**pin 7**	>4V, dropping to 20 mV at the hole no. 5 (see illustr.)	The 20mV signal at hole no.5 produces a **stop** at the end of the actual row.

BU1 / pin no. ... → 

Measuring points BU1/1...BU1/8
View to the free end of the cable 10.912.03, plugged into socket BU1 of the interface in the E-6000.

Illustration for test steps F and G

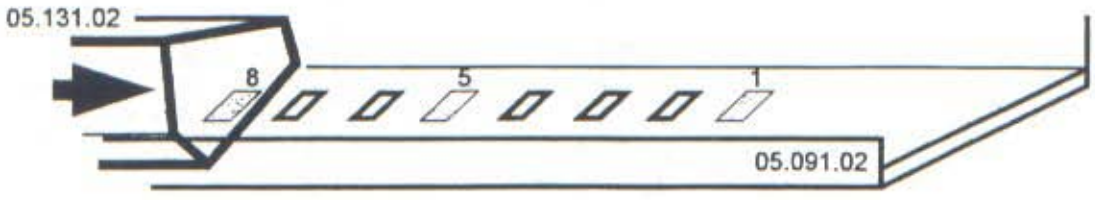
For the tests **F** and **G** the positon of the black cam box guide 05.131.02 of the front cam box must be in a specific relation to the guide rail 05.091.02.

To produce the desired signals in the E-6000 console, the front cam box must be approached slowly from the left side to the corresponding hole in the guide rail 05.091.02. (no. 8 for test step F, or no. 5 for test step G)

The signals are produced by the E-6000 in an area of about 0.5cm before the edge of the cam box guide reaches the corresponding hole.

Important. The correct signals are procuced at the right end of each row when the E-6000 is in the PATTERN A knitting mode (Knitting technique **190**, needles **+70/+90**) and the row counter RC .. is shown at the end of each row.

The EPROMs in the E-6000 must be of version __.___.**33** or above.



Layout of the interface circuit board 05.963.01

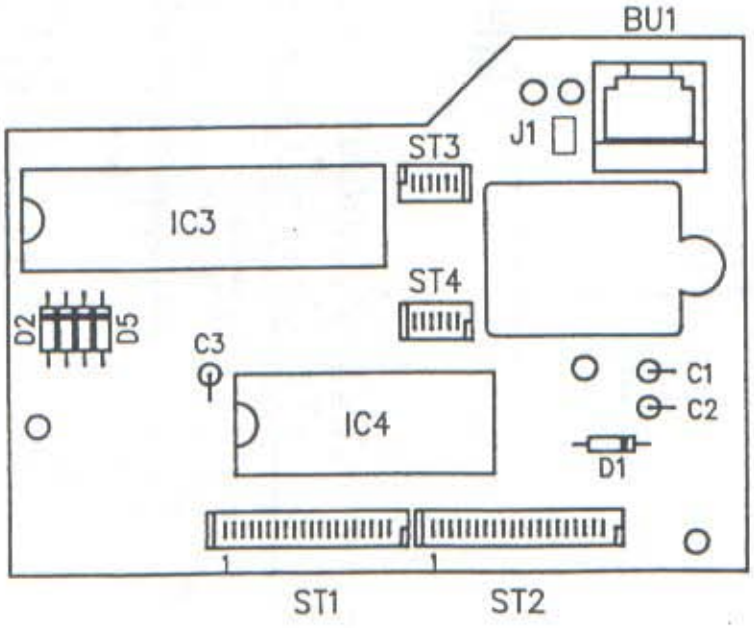
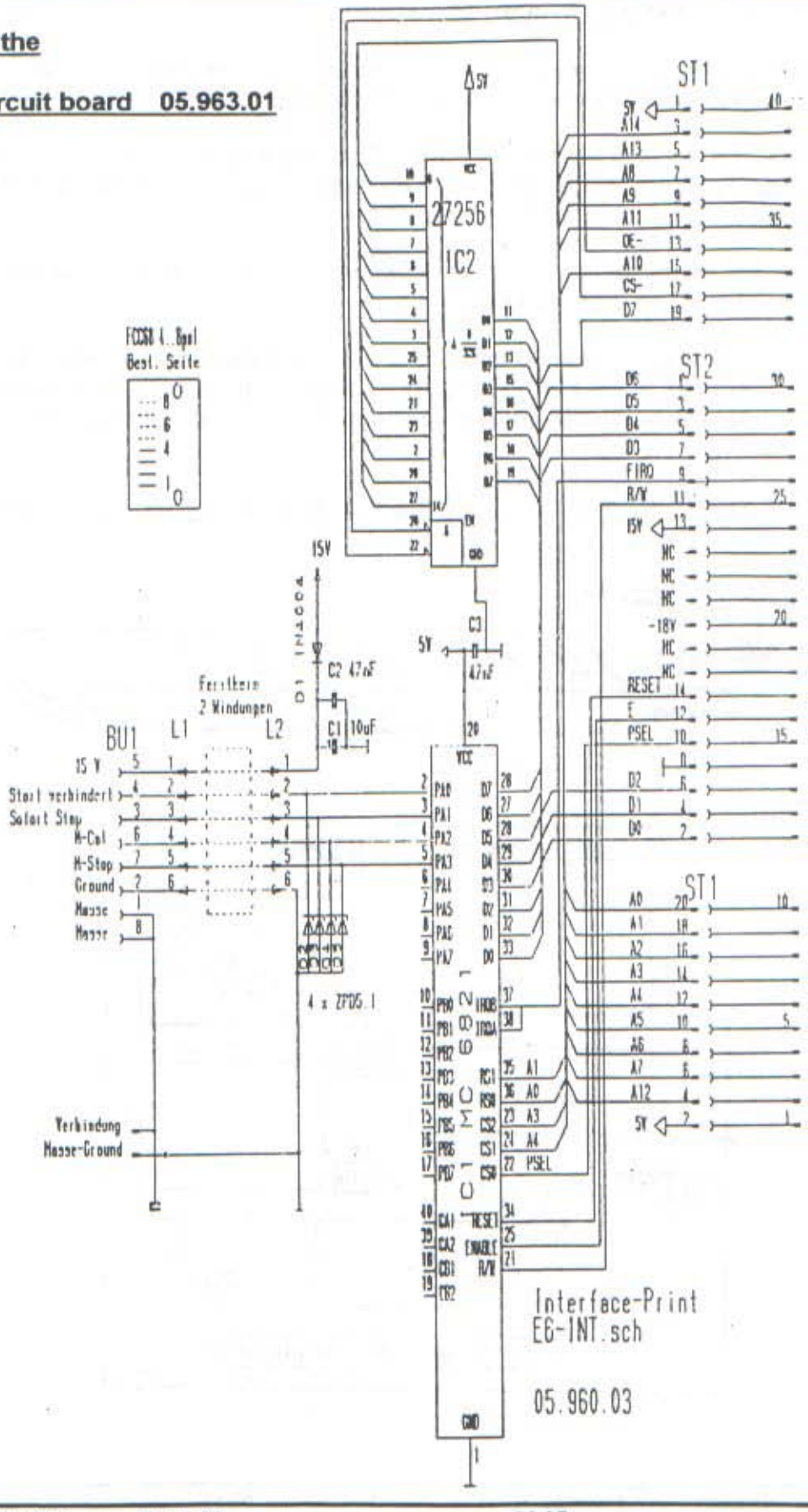


Diagram of the

interface circuit board 05.963.01



2.8 Test of the program box PG 10.860.00

Test A: is automatically executed when the program box is swichted on.
Test B: serves for trouble shooting by a service technician.

Display shows **"*abb E xxx yyyyy"** when a failure is detected.

a = Test mode (A,B or C)
bb = Test number 1..99
E xxx = Failure number
yyyyy = Additional information regarding the failure

Test steps which need input on the keys, show **"*abb TASTE yyyyy"** (TASTE = KEY)
yyyyy = indicates the key to be pressed next.

Test procedure A: (when switching on)

Test A is automatically executed each time the E-4080 is switched on.

During the test no keys must be pressed. The entire hardware or the program box is checked without any need of pressing keys.

When a failure is detected, normal operation of the motor isn't possible.
Therefore, test B must be executed to get further information about the type of failure.

Test conditions
The program box is completely assembled.
The program box is connected to a motor drive which supplies it with +15VDC.

Test A0. Display check

Failure number 110

After switching on the main switch, the display must show the running word "WARTEN" (WAIT) for about 3 seconds, then the next display must show up.

display = **"WARTEN"** when no failure occured after switching on.
= **"TEST B OK"** when switching on after test B has been executed successfully. **If the motor shall be operated normally now, the main switch must be switched off and on again.**
= **"TEST B FAIL"** when the main switch is switched on after a failing test B.

Check of the LCD display.
The text must be displayed without missing pixels.

Adjust the contrast of the LCD display.
Adjust the best contrast of the display through the hole at the left side of the program box PG,using a small 1mm screwdriver .

Trouble shooting

No display at all	Cable	10.910.03	check/replace
	Display	10.876.03	check/replace
	Logic circuit board	10.880.03	check/replace
	Program box PG	10.860.00	check/replace
TEST B FAIL "	IC5, C1, D1, R1 auf	(10.880.03)	check/replace
	Logic circuit board	10.880.03	replace
"*A0 E 110 "	Display	10.876.03	replace

Test procedure for Test B (for trouble shooting by a service technician)

Test B is iniciated by simoultaneous pressing the **keys 0 (zero) and 1** during the main switch of the E-4080 is pressed. The display "TEST B BEGIN" must show up.
Important. The keys **0** and **1** must be pressed for about 3 seconds after switching on the main switch.

When "*A5 E 109": Keys have not been detected correctly, restart the test.

At the following test procedure, each key contact is checked. Additionally, test data are strored into the EEPROM. These data are read when the E-4080 is switched on next time.

Test B1. Check of the key contacts

Failure number 109

Each contact is checked individually. On the display, the instruction for the next key to be pressed is given "*B1 TASTE yyyyy" (yyyyy = next key to be pressed).

Trouble shooting in case of error display.

"*B1 E 109 yyyyy"	Repeat test, eventually wrong handling?		
	ST1 (on both PCBs)	92.263.61	check/replace
	Key pad cable	10.887.03	check/replace
	Key pad	10.875.02	check/replace
	IO-circuit board	10.885.03	check/replace
	IC7, IC8, SIL2 on	(10.880.03)	check/replace
	logic circuit board	10.880.03	replace.

Test B2. Writing test data into the EEPROM

Failure number 107

Test B2 is executed automatically after test B1 has been finished. Test data are written into the EEPROM. They will be read from the EEPROM when the main switch is switched on the next time.

"*B2 E 107 yyyyy"	IC1, IC6 on	(10.880.03)	check/replace
	logic circuit board	10.880.03	replace

After test B2 has been fininshed correctly, the display must show **"TEST B END"**

Test B End of the test

After finishing test B2, the main switch must be switched off and on again. Firstly, test A is made automatically, then the display must show **"TEST B OK"**.

Caution **the motor drive can be started and stopped by the GO/STOP key. All other keys are out of function, the motor doesn't respond to them.**

Trouble shooting in case of failure

"TEST B FAIL "	R1, IC1, IC6 on	(10.880.03)	check/replace
	D1 on	(10.885.03)	check/replace
	logic circuit board	10.880.03	replace.

Normal operation

For normal operation, the main switch must be switched off and on again once more. Then, the standard display "WARTEN" shows up, followed by " COL >>>"

The program box PG is now ready for normal operation.

These items are not checked with the above tests

- Serial interface components (To be tested with motor drive)
- Radio shielding components
- Values of resistors, potentiometer and similar.
- Tolerance of the 5VDC regulator REG1 92.907.61 (I/O-circuit board 10.885.03
- Temporary failures, ,like bad contacts, bad soldering points, thermally sensitive components.

2.9 End test for E-4060/4080/4600

Required auxiliary devices

1 pcs. test plug Nr.1 (for test 211)
1 pcs. test plug Nr.2 (for test 212)
1 pcs. test plug Nr.3 (for the pedal switch)
1 pcs. test plug Nr.4 (for the yarn break control or the AUTOCOLOR detection.
1 pcs. 15V DC-supply 10.724.03(230V) or 10.726.03(120V) for testing the E-4600
1 pcs. **M-Control box SG 10.830.00 for the end test of an E-4080.**

All keys in the following test must be touched on the M-Control box SG 10.830.00

Test conditions

- The motor drive is complete and the cables are connected, with exception of the auxiliary functions in the sockets BU5 ... BU9. These sockets must remain free.
- The M-program box PG is tested (as per 2.8) and connected to socket BU1.
  (For the end test of an E-4600, an M-program box PG can be connected to BU1, in addition to the M-control box SG 10.830.00.
  The M-program box PG shows then the corresponding failure code for the following test step. The actual state can be called by the ENT key on the M-program box.
- The 15VDC-supply (10.724.03/230V or 10.726.03/120V) must be fitted to the motor drive.
  (For an **E-4600**, a 15VDC-supply must be installed temporarily for this test procedure. The cable 10.912.03 from the E-6000 must be removed from the socket BU2)
- The sockets BU2, BU5 ... BU8 are checked by means of the test plugs no. 1 ... 4.
- The mechanical parts of the motor drive are functional.

Test procedure for E-4060/4080/4600

Set the belt union 10.652.02 fully to the left side and separate the back cam box from the belt union.

Operation	desired result	failure no.	check or replace in case of failure	further advice
201. Press the keys **OK** and ➲ on the M-control box SG simultaneously and switch ON the main switch. **Important. release the keys while the word "WARTEN" runs over the display.**	LED "FAILURE" is ON	4120	Mains voltage230V (or 120V)	see 2.4.2
			Mains cable	check continuity
			Mains fuse 92.050.61 (1A/230V) 92.051.11 (2A/120V)	located underneath the mains cable socket. (one spare fuse is available in the same containment)
			Check the mains voltage at the drive circuit board 10.730.03	see 2.4.2
			Check +15VDC voltage	see 2.4.2
			Check + 5VDC voltage	see 2.6.2
			Check the correct cabling of the motor cables connected to the drive circuit board 10.730.03	see 2.4.3
			Cable FCC6/6 10.910.03 in socket BU3	replace testwise by the cable in socket BU4)
			M-Control box SG 10.830.00	LEDs, BU3, see 2.3
			Control circ.board II 10.760.03	see 2.6
			Control cable 10.738.03	replace cable

Operation	desired result	failure no.	check or replace in case of failure		further advice
202. Put test plug no.3 into socket BU8 (Pedal)	LED "FAILURE" goes OFF	4120	Control circ. board II	10.760.03	see 2.6
			Cable 10.910.03 in BU3		replace testwise
Remove test plug	LED ◀ is ON		M-control box SG	10.880.00	see 2.3
203. Put test plug no.4 into socket BU5	LED ◀ goes OFF	4122	Control circ. board II	10.760.03	see 2.6
			Cable in BU3	10.910.03	replace testwise
Remove test plug	LED ▶ is ON		M-control box SG	10.830.00	see 2.3
204. Press key **GO/STOP** on SG	LED ▶ goes OFF	4123	M-control box SG	10.830.00	contact GO/STOP see 2.3
Release key **GO/STOP**	LED "FAILURE" is ON		Control circ. board II	10.760.03	see 2.6
205. Move belt union to the **right**, along the **left** edge stop	LED "FAILURE" goes OFF	4124	Edge stop **left**	10.695.03	see 2.5
			Edge stop cable	10.698.03	see 2.5
			Control circ. board II	10.760.03	see 2.6
	LED **COL** is ON		Cable in BU3	10.910.03	replace testwise
			M-control box SG	10.880.00	see 2.3
Move belt union to the **right**, along the **right** edge stop	LED **COL** goes OFF	4125	Edge stop **right**	10.695.03	see 2.5
			Edge stop cable	10.698.03	see 2.5
	LED ◀ is ON		Control circ. board II	10.760.03	see 2.6
Move belt union to the **right**, along the **COLOR** edge stop	LED ◀ goes OFF	4126	Edge stop **COLOR**	10.695.03	see 2.5
			Edge stop cable	10.698.03	see 2.5
	LED "FAILURE" is ON		Control circ. board II	10.760.03	see 2.6
206. Put test plug no.4 into BU7 (Autocolor)	LED "FAILURE" goes OFF	4128	Control circ. board II	10.760.03	see 2.6
Remove test plug	LED "FAILURE" is ON				
207. Press key **OK** on SG	LED "FAILURE" goes OFF	4129	Cable in BU4	10.910.03	replace testwise
			M-control box SG	10.830.00	contact **OK** in SG, see 2.3
Release key **OK**	LED **COL** is ON		Control circ. board II	10.760.03	see 2.6
208. Press key ⮕ on SG	LED **COL** goes OFF	4130	Cable in BU4	10.910.03	replace testwise
			M-control box SG	10.830.00	contact ⮕ in SG, see 2.3
Release key ⮕	LED ◀ is ON		Control circ. board II	10.760.03	see 2.6

Go on at test step 209, next page

Operation	desired result	failure no.	check or replace in case of failure		further advice
209. Press key **COL** on SG	LED ◀ goes OFF	4131	Cable in BU4	10.910.03	replace testwise
			M-control box SG	10.830.00	Contact COL in SG, see 2.3
Release key **COL**	LED ▶ is ON		Control circ.board II	10.760.03	see 2.6
210. Press key ⏮ ⏭ on SG	LED ▶ goes OFF	4132	Cable in BU4	10.910.03	testweise ersetzen
			M-control box SG	10.830.00	Contact ⏮ ⏭ in SG, see 2.3
Release key	LED ◀ is ON		Control circ.board II	10.760.03	see 2.6
211. Put test plug no.1 into BU2	LED ◀ goes OFF	4133	Control circ.board II	10.760.03	see 2.6
Remove test plug	LED ▶ is ON				
212. Put test plug no.2 into BU2	LED ▶ goes OFF	4134			see 2.6
Remove test plug	LED ◀ flashing				
213. Press key **ENT** on program box **PG**	" FEHLER 4xxx " (when a failure showed up during the test)	4xxx	Control circ.board II	10.760.03	see 2.6
	" **COL >>**" (after finishing the test successfully)		further advice as per the failure number on the display.		see failure lists 2.12/2.13

Establish normal operation

E-4060 Switch OFF the main switch and ON again.
On the M-control box SG, the LEDs ▶ and **COL** must be ON.

E-4080 Switch OFF the main switch. Remove the M-control box SG from sockets BU3/BU4.
Switch ON the main switch. The LCD display must show the word "WARTEN", followed by " COL >>".

E-4600 Switch OFF the main switch.
Remove the 15VDC supply 10.724.03 and the supply cable 10.740.03 entfernen.
Establish the cable connection between E-6000 and E-4600 (BU2).
Switch ON the main switches of the E-6000 and the E-4600.
The LED ◀ must be ON.

AUTOCOLOR detection via socket BU9

- With the above test, the socket BU9 is not checked.
- To check the socket BU9 for the use of the AUTOCOLOR detection the test plug no. 4 is plugged into BU9 when the motor drive is running. An immediate stop must result.
- In case of failure, the control circuit board II 10.760.03 must be replaced or checked.

2.10 General hardware test for E-4060/4080/4600

The general hardware test is executed automatically each time the motor drive is switched on.

Indication of failures is on the LEDs of the M-control box SG (or on the LCD display of the M-program box of an E-4080).

The port numbers (at IC2 10.762.03) and the failure numbers help to identify the failing components.

In case of failure, the LED "FAILURE" is **flashing fast.** By means of the LEDs for the sense of travelling and for the colour change function, the kind of failure is indicated as per the code in the following table.

A failure cannot be cancelled.

When a failure occures, the failing component must be replaced firstly. See 2.11, detailed electronic test.

Globale hardware test for E-4060/4080/4600

\- = LED is OFF
X = LED is ON
* = LED is flashing fast

Source of failure, reason	Port no. of IC2	LED code on M-control box SG FAILURE	◀	▶	COL	Failure no. on PG	see also
RAM of IC2 (Microprocessor)		*	X	X	-	4101	IC2 10.762.03
ROM of IC2 (Microprocessor)		*	-		X	4102	IC2 10.762.03
Motor test	P 1.6...P 1.7	*	-	X	-	4106	IC3/ST10 on 10.758.03 on 10.760.03 Cable 10.738.03 ST10 on 10.730.03 IC2/IC3 on 10.730.03
Serial interface (for BU1 / Progr.box PG)	P 3.0...P 3.1	*	X	-	-	4103 to 4105	IC1 92.906.51 IC2 10.762.03
Port 0 of IC2 (Microprocessor)	P 0.0...P 0.5	*	-	X	X	4110	Details about ports, see table 2.11 and diagram 10.760.03
Port 3 of IC2 (Microprocessor)	P 3.6...P 3.7	*	-	X	X	4113	Details about ports, see table 2.11 and diagram 10.760.03
Port 1 of IC2 (Microprocessor)	P 1.0...P 1.5	*	X	-	X	4111	Details about ports, see table 2.11 and diagram 10.760.03
Port 2 of IC2 (Microprocessor)	P 2.0...P 2.7	*	X	X	X	4112	Details about ports, see table 2.11 and diagram 10.760.03

2.11 Detailed hardware test for E-4060/4080/4600

Conditionds for the test. Same as for end test 2.9

The detailed hardware test is started by pressing the keys OK and ↵ on the M-control box SG when switching on the main switch.

Then, each function is tested as per the sequence shown in the table below, either by pressing a key or by plugging the corresponding test plug into the indicated socket BU...

When a failure occurs in the test procedure, the test can't be carried on further. On the M-control box SG the kind of failure is indicated by means of the four LEDs with the following code.

\- = LED is OFF
X = LED is ON

The failure can't be cancelled, in case of doubts about the correct sequence it is recommended to restart the test from the beginning.

Set the belt union 10.652.02 fully to the left side and separate the back cam box from the belt union.

Source of failure, reason	Operation K = press key P = test plug	LED code on SG Failure OK	◀	▶	COL	Failure number on PG	Check port number of IC2
Pedal switch	P no. 3 BU8	X	-	-	-	4120	port 0.0
Yarn break detection	P no.4 BU5	-	X	-	-	4122	port 0.2
Key **GO/STOP**	K	-	-	X	-	4123	port 1.0
Edge stop **left**	move belt union	X	-	-	-	4124	port 0.3
Edge stop **right**	move belt union	-	-	-	X	4125	port 0.4
Edge stop **COLOR**	move belt union	-	X	-	-	4126	port 0.5
Detection **AUTOCOLOR**	P no.4 BU7	X	-	-	-	4128	port 1.5
Key **OK**	K	X	-	-	-	4129	port 2.0
Key ↵	K	-	-	-	X	4130	port 2.1
Key **COL**	K	-	X	-	-	4131	port 2.2
Key ⏮ ⏭	K	-	-	X	-	4132	port 2.3
E6000/ 1 Test plug no.1	P no.1 BU2	-	X	-	-	4133	port 3.6
E6000/ 2 Test plug no.2	P no.2 BU2	-	-	X	-	4134	port 3.7
When the test is finished successfully, the LED ◀ is flashing.							
AUTOCOLOR detection in BU9, see indication under 2.9							

2.12 List of failure numbers for Electra-4 motor drives

4101 .. 4149 for hardware test failures

4101	Processor ROM		
4102	Processor RAM		
4103..4105	Serial interface		
4106	Motor test	IC3/ST10	at 10.758.03
			at 10.760.03
		Cable	10.738.03
		ST10	at 10.730.03
		IC2/IC3	at 10.730.03
4110	Port 0 of the processor	(p0.0 .. p0.5)	
4111	Port 1 of the processor	(p1.0 .. p1.5)	
4112	Port 2 of the processor	(p2.0 .. p2.7)	
4113	Port 3 of the processor	(p3.6 .. p3.7)	
4120	Pedal switch	(port0.0)	
4122	Yarn break control	(port0.2)	
4123	Key GO / STOP	(port1.0)	
4124	Left edge stop	(port0.3)	
4125	Right edge stop	(port0.4)	
4126	Color edge stop	(port0.5)	
4128	Autocolor detection	(port1.5)	
4129	Key OK	(port2.0)	
4130	Key Change sense of travelling	(port2.1)	
4131	Key COL	(port2.2)	
4132	Key Stop at the end of row	(port2.3)	
4133	E6000/1 (immediate stop)	(port3.6)	
4134	E6000/2 (start not possible)	(port3.7)	
4135	Mains frequency	Temperature switch in the motor	
		D1 (Zener-diode 3.9V)	on PCB 10.730.03
		IC1 (92.404.01)	on PCB 10.730.03
		IC2 (10.762.03), port 3.3	

4150 .. 4159 for interface failures

ERR_KOMMUNIKATION	4150	Interface not ready after MAX no. of intempts (BUSY)
ERR_DATENEMPFANG	4151	No. of receiving collisions > MAX no. of intempts
ERR_BUFFERUEBERLAUF	4152	Buffer overflow
ERR_PARITY	4153	No. of parity errors > MAX no. of intempts
ERR_STATUSANTWORT	4154	No status answer after MAX no. of intempts
ERR_BEFEHL_UNBEKANNT	4160	received unknown order
ERR_BEFEHL_UNGUELTIG	4161	received unvalid order
ERR_REIHENZAEHLER	4170	Row counter error
ERR_FARBWAHL	4171	selection of an unvalid colour

Interface failures may be caused by a failure in the M-program box PG 10.860.00, in the IC1 of the PCB 10.762.03, in the IC2 of PCB 10.760.03, or by a problem in the cabling in BU1.

3200 .. 3209 for errors occuring under operation

ERR_FADEN	3200	Yarn break on BU5 or BU6
ERR_ANSCHLAG_L	3201	Motor arrived to left end of travel
ERR_ANSCHLAG_R	3202	Motor arrived to right end of travel
ERR_TEMPERATUR	3203	Motor overheated
ERR_EXTERN	3204	AUTOCOLOR on BU9 (more than one eyelet is up)
ERR_MBLOCK	3205	Motor is blocked
ERR_RICHTUNG	3206	Wrong sense of travelling
ERR_NUESSCHEN	3207	AUTOCOLOR on BU7 (more than one eyelet is up)
ERR_SYSTEM_1	3241	Sending status = MESSAGE SENT
ERR_SYSTEM_2	3242	Sending status = S_COLLISION
ERR_SYSTEM_3	3243	Sending status = NO STATUS
ERR_SYSTEM_4	3244	Sending status = PARITY FAILURE

Errors occuring under operation

These failures may occure when the motor is started or after receiving a SET_ROW signal from the M-program box PG.

The failure is indicated on the LEDs of the M-control box SG (or on the LCD display of the M-program box PG).

In case of failure, the motor is stopped immediately and the **LED "FAILURE" is flashing slowly**. The other LEDs show the specific type of failure, as per the table below.

The failure can be reset by the OK key (or by the ENT key on the M-program box).

Exception
The failure motor overheated disappears automatically after the motor has cooled down and reached it's normal operating temperature.

Failure codes (indicated by the LEDs on the M-control box SG)

Type of failure	LED				Failure number
	"FAILURE"	◀	▶	COL	LCD display on PG
Yarn break detection	*	-	-	-	3200
Left end of travel is reached	*	-	X	-	3201
Right end of travel is reached	*	X	-	-	3202
Motor overheated	*	X	X	-	3203
AUTOCOLOR (on BU9)	*	-	-	X	3204
Motor blocked	*	-	X	X	3205
Wrong sense of travel	*	X	-	X	3206
AUTOCOLOR (on BU7)	*	X	X	X	3207

States of the LEDs

-	=	LED is OFF
X	=	LED is ON
*	=	LED **flashing slowly**

2.13 Listing of error messages on the M-program box PG

2.13.1. Error messages during programming (nos. 2001 ... 2050)

These errors stop the programming procedure. They can be reset by the ENT key.
For explanation of these error messages, see the user's manual of E-4080.

2.13.2 Error messages during the motor's operation

These errors produce an immediate stop of the motor
They can be reset by the ENT key.
(Exception. the motor is overheated, it is automatically operational after cooling down)

	Number	Explanations
	3010	Warning: serial data are not available
	3011	Invalid motor status. -Data transfer)
+	3012	Row counter difference, due to wrong signals from edge stops (same as 3170: check row counter)
+	3013	Row counter max. overflow on various parts
	3150	Interface not ready after MAX intempts (BUSY)
	3151	Number of receiving collisions > MAX intempts
	3152	Buffer overflow
	3153	No. of parity errors > MAX intempts (Data transfer)
	3154	No status answer after MAX intempts
	3160	Received unknown order
	3161	Received invalid order
+	3170	wrong row counter signal from the M-program box to 10.760.03 (same as 3012: check row counter)
	3171	invalid colour selected
+	3200	Yarn break
	3201	Reached the left end of travel
	3202	Reached the right end of travel
+	3203	Motor overheated
+	3204	Emergency stop (When AUTOCOLOR plugged in BU9 and 2 eyelets are up)
+	3205	Motor blocked
+	3206	Wrong sense of travel
+	3207	When AUTOCOLOR plugged in BU7 **and** 2 eyelets are up

2.13.3 Error messages, produced by the tests 2.10 and 2.11

The following error messages indicate to a failure in the control electronic of the motor.
They can't be reset.
The motor can't be started.

Number	Explanations
4101	Processor ROM
4102	Processor RAM
4103	Serial interface (Data transfer from PG is incorrect, see 2.10)
4104	Serial interface (Data transfer from PG is incorrect, see 2.10)
4105	Serial interface (Data transfer from PG is incorrect, see 2.10)
4106	Motor test (see 2.10)
4110	Port 0 of the processor (P0.0 .. P0.5)
4111	Port 1 of the processor (P1.0 .. P1.5) (STOP/GO key or two other keys have been pressed during switching on the main switch) Exception. the keys for starting the tests 2.9 and 2.11.
4112	Port 2 of the processor (P2.0 .. P2.7)
4113	Port 3 of the processor (P3.6 .. P3.7)

4120..4134: See 2.11

+	4150	Data transfer not possible (Power supply of motor and program box PG were not switched on at the same time)
+	4151	Data transfer not possible (Power supply of motor and program box PG were not switched on at the same time)
	4160	Received unknown order
	4161	Received invalid order

2.13.4 Error messages on testing the M-program box PG (see 2.8)

These error messages only can show up at switching on the main switch. They indicate to a failurer in the M-program box PG. They can't be reset.

Number	Explanations
***A0 E 110**	LCD display faulty
***A1 E 103..105**	Serial interface faulty (see 2.10)
***A2 E 101**	Data memory of the processor faulty
***A21 E 106**	external data memory faulty (not equipped in actual hardware configuration)
***A3 E 107**	EEPROM faulty (permanent memory)
***A4 E 108**	EPROM faulty (Program memory)
***A5 E 109**	Key pad faulty, or a key is pressed when switching on
***Bx xxxxx**	shows up when test B is started, to be used by service technicians. See 2.8 Test procedure test B.

3. Electronic spare parts for Electra-4 motors

Article no.	Part name	Qty per packing unit	Part is used in circuit board	as
05.364.43	EPROM "Muster A"	1	05.960.03	IC2
05.383.02	Resistor bank 5x22k	1	10.880.03	SIL2
10.762.03	Microprocessor	1	10.758.02	IC2
92.263.41	Multi pin socket, 6 pins	1	05.960.03	ST3,ST4
			10.880.03	ST2
			10.885.03	ST2
92.263.51	Multi pin socket, 8 pins	1	10.730.03	ST10
			10.758.03	ST10
			10.760.03	ST10
92.263.61	Multi pin socket, 10 pins	1	10.880.03	ST1
			10.885.03	ST1
92.263.71	Multi pin socket, 12 pins	1	10.758.03	ST12
			10.760.03	ST12
92.263.81	Multi pin socket, 16 pins	1	10.880.03	ST3
92.263.91	Multi pin socket, 20 pins	1	05.960.03	ST1,ST2
92.305.01	Capacitor 47nF	1	05.960.03	C2,C3
92.305.11	Elko 10mF/25V	1	05.960.03	C1
			10.758.03	C3..C5
			10.760.03	C3..C5
			10.880.03	C1,C8
92.307.01	Resonator 11.059M	1	10.880.03	Q1
			10.758.03	Q1
			10.760.03	Q1
92.404.01	Opto-coupler	3	10.730.03	IC1
92.404.11	Opto-triac	3	10.730.03	IC2/IC3
92.683.01	Socket FCC68 4/4	1	10.760.03	BU5..BU9
92.683.11	Socket FCC68 6/6	1	10.758.03	BU3,BU4
			10.760.03	BU1,BU3,BU4
			10.885.03	BU1
92.683.21	Socket FCC68 8/8	1	10.760.03	BU2
92.683.31	Socket FCC68 8/8	1	05.960.03	BU1
92.866.01	Plug socket 28pins	1	10.880.03	(IC3)
		1	05.960.03	(IC2)
92.866.11	Plug socket 40pins	1	10.758.03	(IC2)
			10.760.03	(IC2)
92.901.01	EEPROM 93c46	1	10.880.03	IC5
92.904.61	Microprocessor 8032	1	10.880.03	IC1
92.904.81	PIA 6821P	1	05.960.03	IC1
92.905.61	Inverter OC 74LS05	1	10.880.03	IC8
92.905.81	Driver ULN2003A	1	10.758.03	IC3
			10.760.03	IC3
92.906.11	NOR 74LS02	1	10.880.03	IC9
92.906.21	74LS373	1	10.880.03	IC2
92.906.31	Buffer 3S74LS541	1	10.880.03	IC7
92.906.51	Transceiver SN75176	1	10.760.03	IC1
			10.880.03	IC6
92.907.61	V-Regulator 5V	1	10.758.03	REG1
			10.760.03	REG1
			10.885.03	REG1
92.951.01	Potentiom. 10k	1	10.880.03	POT1
92.960.41	Triac	4	10.730.03	TR1/TR2
92.960.61	Diode 1N4007	3	10.758.03	D14
			10.760.03	D14
			05.960.03	D1
92.961.21	Zener diode 5.1V	5	05.960.03	D2-D5
92.961.51	Zener diode 10V	5	10.885.03	D2
92.961.61	Zener diode 3.9V	1	10.730.03	D1
92.962.51	LED red	5	10.850.03	LED1..4

4. Accessories for testing

DC-supply and Supply cableE-4600: Since the socket BU2 must be free for the use of the test plugs no. 1 and 2 at the **test 2.9** and for the **detailed hardware test 2.11**, the motor isn't supplied with 15VDC from the E-6000.

Therefore, the following parts are temporarily required for testing the E-4600.

230V motor.	**DC-supply**	**230/15V**	**10.724.03**	and	**Supply cable**	**10.740.03**
120V motor.	**DC-supply**	**120/15V**	**10.726.03**	and	**Supply cable**	**10.741.03**

M-Control box SG and Cables FCC68

For the test procedures 2.2.1, 2.9, and 2.11 of an **E-4080** the following parts are required temporatily in addition to the M-program box PG .

1 pc. **M-Control box SG 10.830.00** and 2 pcs. **Cable FCC68 10.910.03**.

Multi range meter 03.711.02 (if not available on local markets)

For several tests and measurements a tester is required with the following modes and ranges.

- AC voltages (up to 250 Volts)
- DC voltages (up to 25 Volts)
- Resistor/continuity tests (Ohms)

The Digital Multimeter 03.711.02 fulfills all requirements for testing Electra-4 motor drives.

SET Test plugs (illustration below)

The test plugs no.1 ... no.4 are required for the tests **2.9** and **2.11**.
The complete set is available as under article no. **03.380.01.** (Single test plugs are not available)