LORCH

Service Manual
V Series

909.0340.1-05

Contents

Document no. 909.0340.1-05
Issue date: 10.03.2021

Machine

Machine elements

1	torch	5	connector ground cable
2	front panel	6	connector external cooling unit
3	mains switch	7	mains cable
4	connections	8	gas hose

Safety precautions

Requirement

Use and maintenance of welding and cutting machines can be dangerous. Please draw user´s attention to follow the safety precautions to avoid injuries. Welding and cutting machines must be used appropriately and only by qualified/trained staff. Please follow safetyregulations and use safety precautions in order to prevent accident when working with these machines.

Only qualified workers who are knowledgeabel and have been trained to work safely with test instruments and equipment on energized circuits shall be permitted to perform testing work on electrical circuits or equipment were there is danger of injury from accidental contact with energized parts or improper use of the test instruments and equipment.

Use only original spare parts

Replace immediately any components that are not in perfect condition.

Norms

IEC 60974-4	In-service inspection and testing

Testing Lorch machines according to IEC 60974-4

- it is not necessary to disconnect any components of the power unit for the test
- it is recommended to disconnect the torch at water cooled machines
- the machine has to be cleaned properly before the test
- switch to MMA mode (stick electrode) if possible

Common Logic functions

component	function	cause
fan (power unit)	on	power modul temperature over 40°C
fan (power unit)	off	power modul temperature below 40°C
fan (cooling system)	on	after detection “arc established“
fan (cooling system)	off	after welding process, two minutes post-cooling time
pump	on	after detection “arc established“
pump	off	after welding process, two minutes post-cooling time

Pump test

- press the button “Acknowledge“ and the button gas test at the same time
- the pump is switched on for one minute
- the buttons “Acknowledge“ and gas test again to end the test manually

Reset settings

- press the button “Acknowledge“ and the button “TT Enter“ Enter at the same time
- all parameters are reset to their factory settings
- doing the reset in Tiptronic mode, only the settings of the actual Job are reset
- all settings in Menu Extras remain unchanged

Master Reset

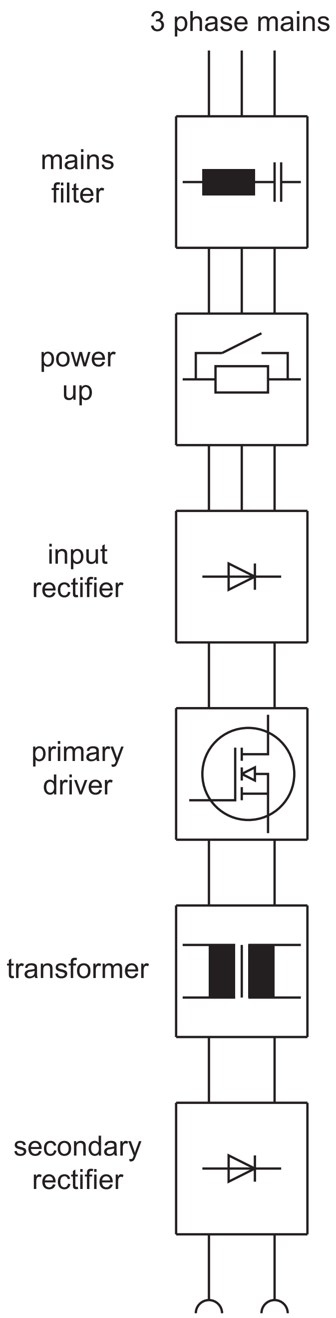
- press the button “Acknowledge“ and both arrow keys at the same time and keep them presses for about 5 seconds
- the display shows “Master Reset“
- release all buttons
- all settings and parameters are reset to their factory settings

!!! CAUTION !!!
all Tiptronic jobs are deleted after a Master reset !!!

Inverter Principle

A welding inverter is a electronically controlled welding power source. At conventional transformer based machines, the mains voltage with 50/60 Hz is directly switched to the welding transformer. At a welding inverter the mains voltage is rectified first and with electronic power switches (MOSFETs or IGBTs) chopped into a frequency of 80 kHz. This allows a very small construction of the welding transformer, because it‘s driven at this high frequency. The basic structure of a welding inverter is always the same at Lorch power sources:

- mains rectifier
- primary inverter
- transformer
- secondary rectifier



Pc-board DK-MAPRO

The pc-board DK-MAPRO is responsible for the welding sequence and is managing the process control of the V-Series
(MAPRO = **MA**ster-**PRO**cess)

Functions

- Logicfunctions of the welding process
- generating and monitoring supply voltages
- driving powerup-relais
- driving power unit/units
- driving ignition device
- monitoring control and operating elements (DK-ACI40/DK-DCI40, remote control, torch buttons)
- driving solenoid valve
- driving fans
- driving waterpump
- monitoring flowmeter
- monitoring mains- and output voltage
- generating signal „welding current on“
- managing communications between PC and machine
- managing and storage of all welding parameters
- CAN-bus

LEDs :

normal

LED	state	meaning
1 (green)	flashing (half freq. of LED5)	CPLD ok
2 (red)	off	Digital Signal Processor (DSP) ok
3 (green)	on	supply voltage 3.3V ok
4 (red)	off	Microcontroller ok
5 (green)	flashing	DSP is working
6 (green)	flashing	Microcontroller is working

malfunction

LED	state	meaning
1 (green)	never on	CPLD not working
2 (red)	on	DSP not working
3 (green)	off	supply voltage 3.3V missing : check 18V~ of control transformer X9/1 X9/2
4 (red)	on	Microcontroller not working
5 (green)	never on	DSP not working
6 (green)	never on	Microcontroller not working

If the LEDs are indicating a malfunction which can not be relieved by switching the machine off and on again, it is recommended that the pc-board DK-MAPRO is exchanged.

DIP switch

The DIP switches 1-3 are needed for programming the DSP (Process) via serial port. The DIP switch 4 is set due to the type of housing as V mobile or V driveable.

DIP switch	ON	OFF
1-3	serial program. mode	normal operation
4	config. V mobile	config. V (driveable)

Overview fuses

fuse	value [A]	safeguarding
Si 6	1	fans (power unit)
Si 7	2,5	cooling unit (pump)
Si 11	1	cooling unit (fans)

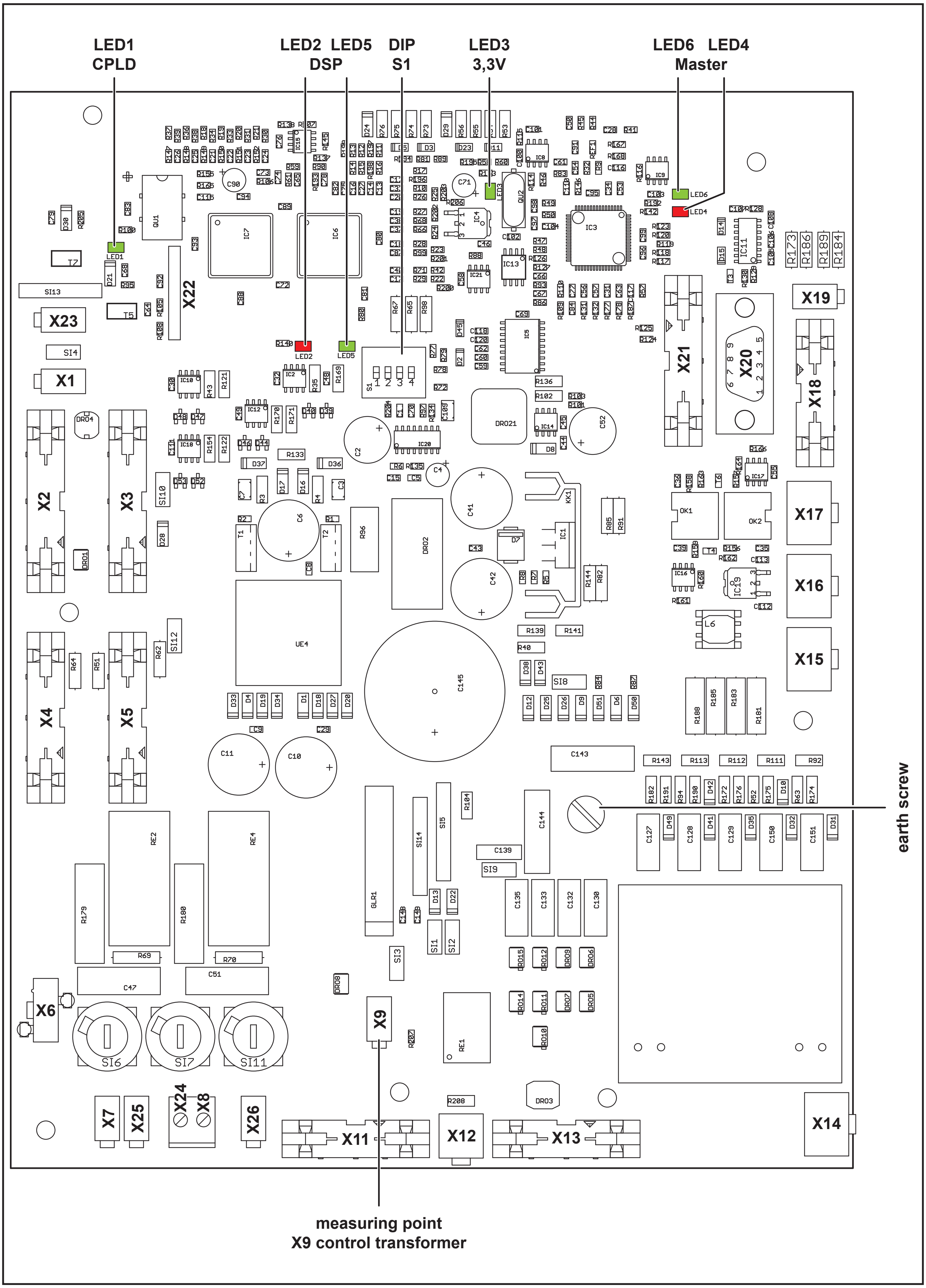
Measuring points

designation	measure point		result
gas valve	X1/1 X1/2	GND +	+24V DC
supply from control transformer	X6/1 X6/2	~ ~	230V AC
supply voltage fan group 1	X7/1 X7/2	~ ~	230V AC
supply voltage fan group 2	X25/1 X25/2	~ ~	230V AC
supply voltage fan (cooling unit)	X26/1 X26/2	~ ~	230V AC
supply voltage pump (cooling unit)	X8 X24	~ ~	230V AC
supply from control transformer	X9/1 X9/2	~ ~	18V AC
supply voltage flow meter	X12/1 X12/3	+ GND	+15V DC
supply voltage CAN interface	X15/1 X15/2	GND +	+15V DC
supply voltage CAN interface	X16/1 X16/2	GND +	+15V DC
supply voltage CAN interface	X17/1 X17/2	GND +	+15V DC

Overview connectors pc-board DK-MAPRO

connector	designation
X1	connector gas valve
X2	connector to power unit 1 (primary)
X3	connector to power unit 2 (primary)
X4	connector to power unit 1 (secondary)
X5	connector to power unit 2 (secondary)
X6	230V supply fans/cooling unit (from control transformer)
X7	connector fan group 1 (power unit)
X8	connector pump (with X24)
X9	connector control transformer (supply voltage for pc-board)
X11	interface for HF ignition unit
X12	connector flow meter
X13	connector remote control socket
X14	connector torch buttons
X15	CAN interface
X16	CAN interface
X17	CAN interface
X18	connector front panel
X19	connector output voltage (to pc-board DP-EMV)
X20	connector serial interface (RS232: internal programming connector)
X21	JTAG-Interface (internal programming connector)
X22	JTAG-Interface (internal programming connector)
X23	connector fan 24V DC (only used in V mobile machines)
X24	connector pump (with X8)
X25	connector fan group 2 (power unit)
X26	connector fan (cooling unit)

Picture pc-board DK-MAPRO



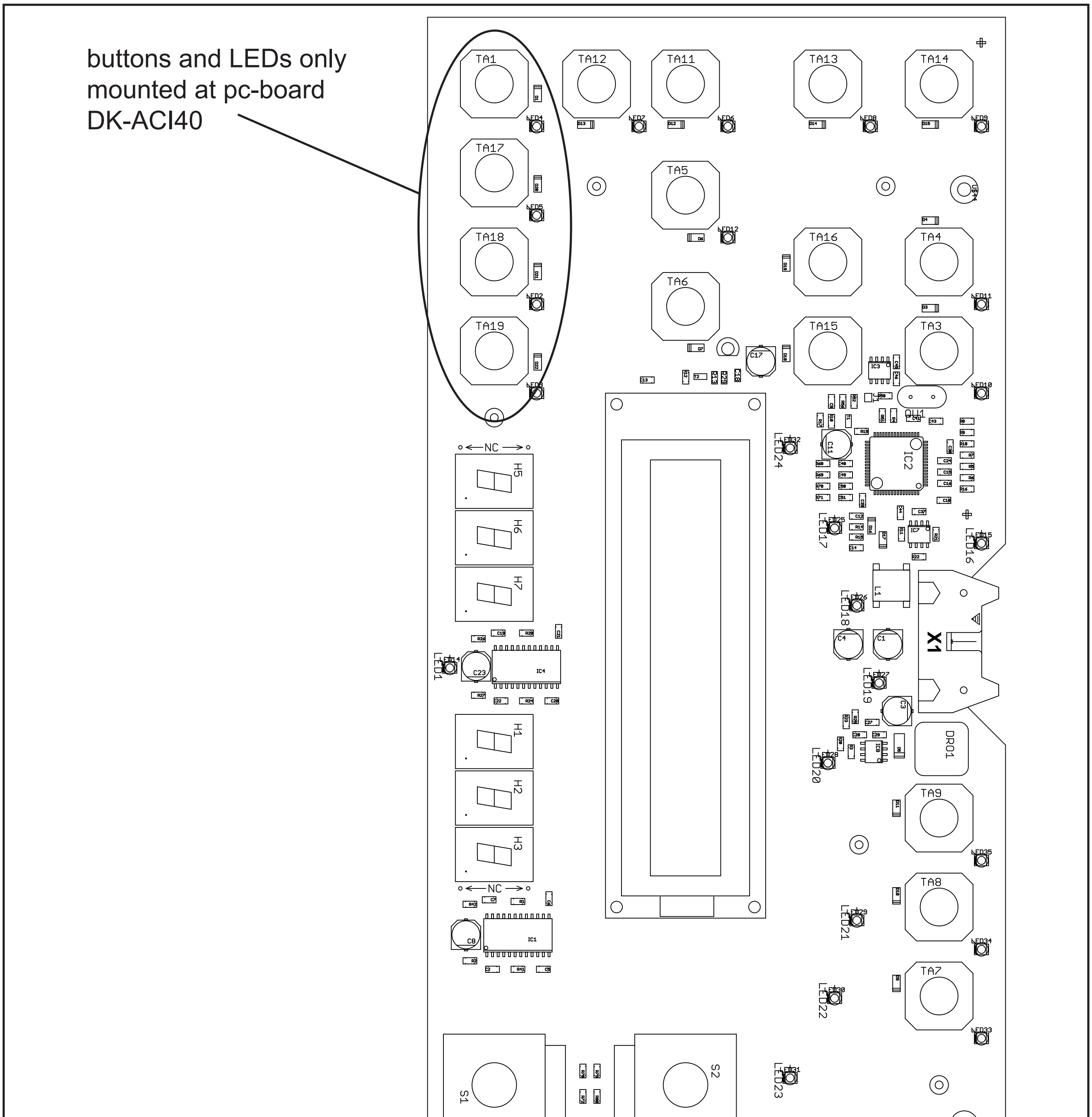
Pc-board DK-DCI40 / DK-ACI40

The pc-board DK-DCI40 (DC machines) and DK-ACI40 (AC machines) is the front panel with all buttons and optical displays.

Functions

- operating and handling of the machine
- display of operational parameters and error messages

Picture pc-board DK-DCI40 / DK-ACI40



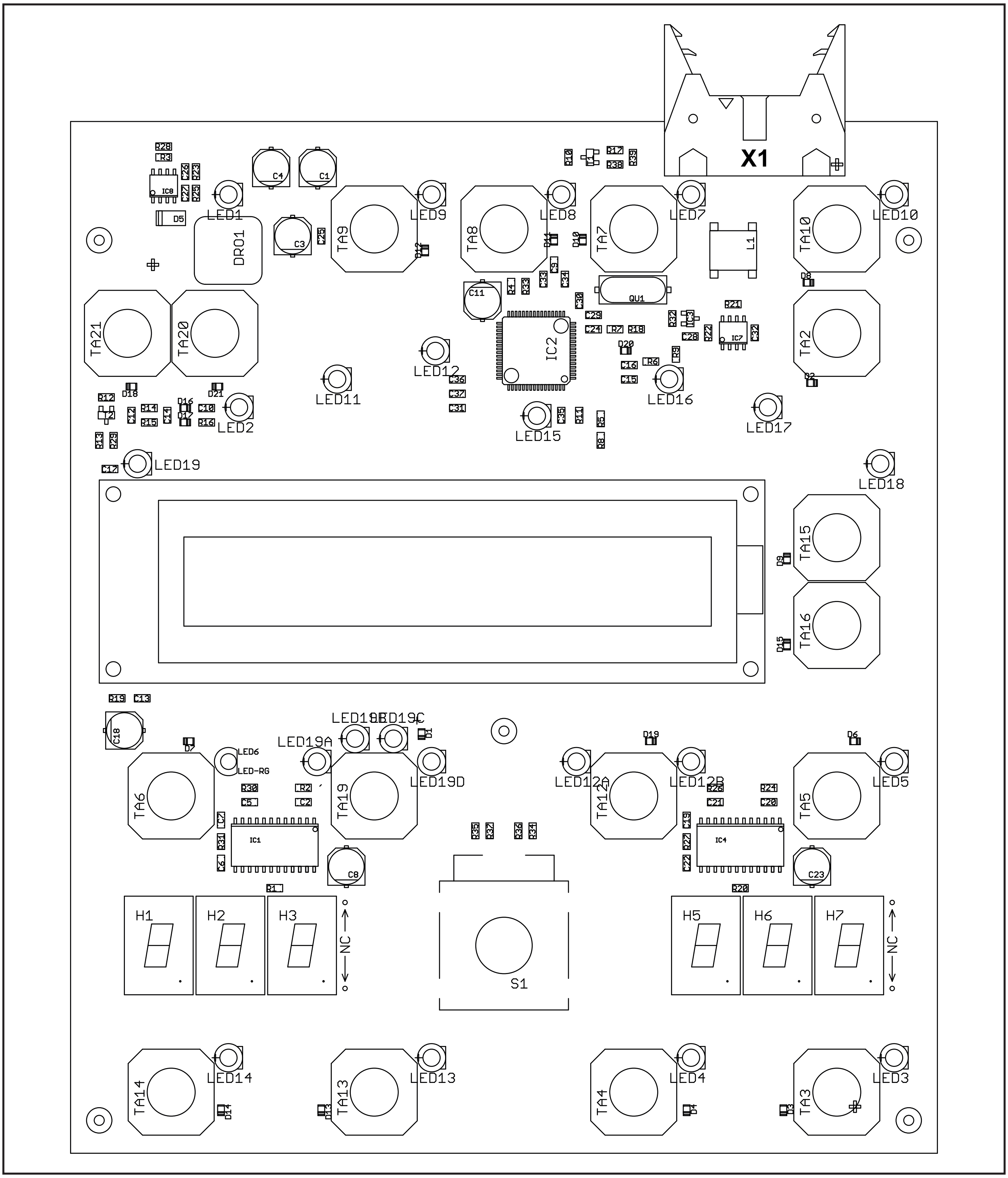
Pc-board DK-DCI45 / DK-ACI45

The pc-board DK-DCI45 and DK-ACI45 are the front panels with all buttons and optical displays of the V mobile machines.

Functions

- operating and handling of the machine
- display of operational parameters and error messages

Picture pc-board DK-DCI45 / DK-ACI45



Function test of the front panel

The front panel has an internal function test. With this test, all LEDs and encoders can be checked. Switch between the single test forth and back with the arrow keys at any time.

Start test:

- press arrow key “left“ and “right“ (TA15 and TA16) at the same time
- the actual operating system version of the display is shown, e.g. : D 3 030204 (11)
- press right arrow key
- all LEDs are flashing and the LCD is toggeling between bright and dark
- press right arrow key
- the red LED at the key “electrode diameter“ is on
- press right arrow key
- all keys are tested, the key to be checked is indicated with a lit LED
- press right arrow key
- move the cursor (in LCD) with the encoder to the right and back to the left
- the display shows < End of tests... > and after 5 seconds the machine switches back to the normal display before the test was executed

Pc-board DK-DCDRV

The pc-board DK-DCDRV is managing the primary drive level of the power unit.

Functions

- encoding power unit
- connection of the thermal sensor (at heat sink)
- supply current sensor
- monitoring bus voltage and supply voltage
- safety shut-down of power unit
- passthrough signal power-up relay
- passthrough output of current sensor

Encoding power unit

The type of the power unit is set via the DIP switch.

DIP 1	DIP 2	setting	type
OFF	OFF	240 A	V24, V40
OFF	ON	270 A	V27
ON	OFF	300 A	V30, V50
ON	ON	reserviert	

LED displays

normal

LED	state	designation
1 (red)	off	primary overcurrent shut down
2 (green)	on	drive level of low-side is ok
4 (green)	on	bus voltage max is ok
5 (green)	on	drive level of high-side is ok
6 (green)	on	bus voltage min is ok

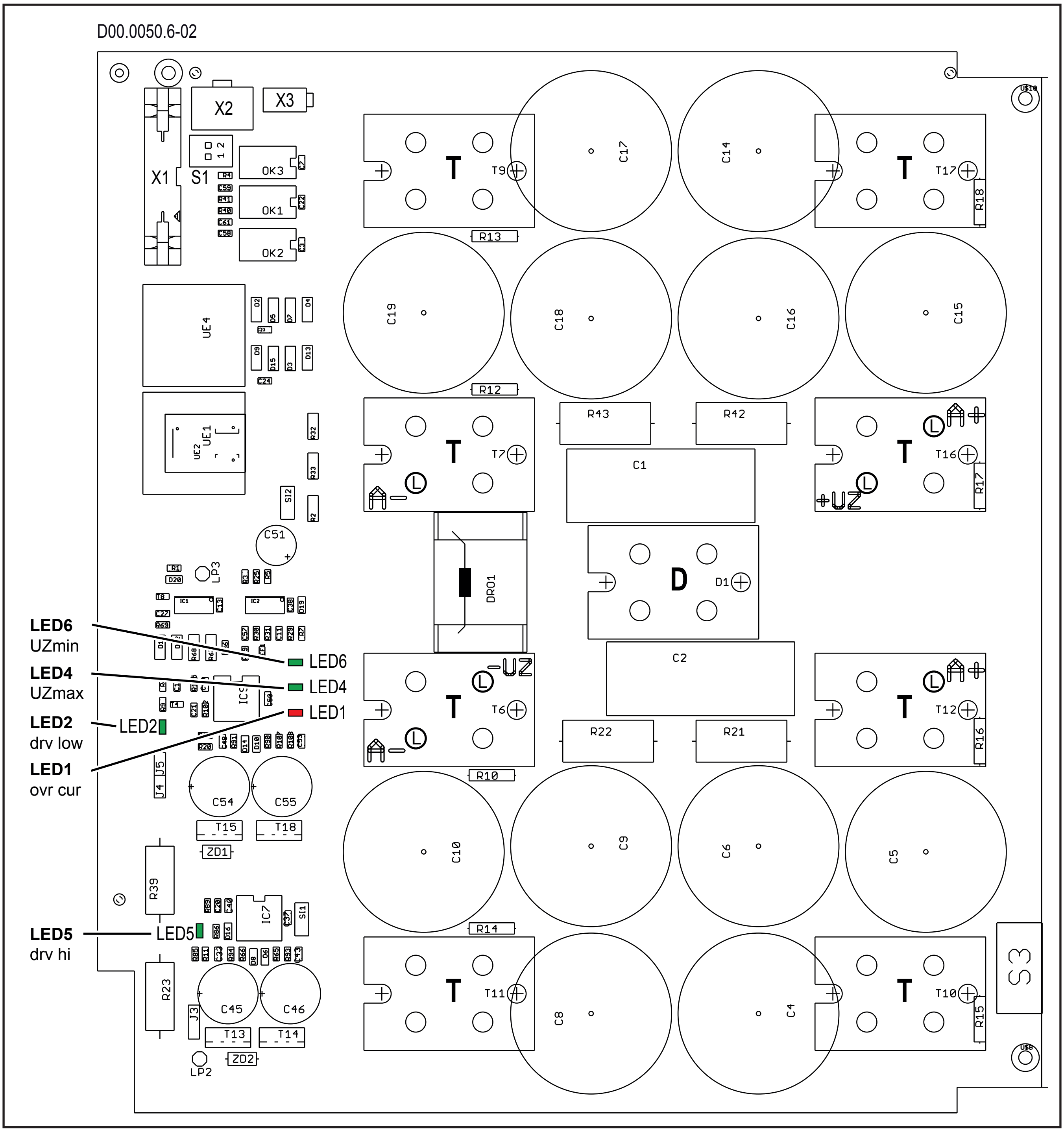
malfunction

LED	state	reason
1 (red)	on	primary current is too high, power unit has been switched off
2 (green)	never on	no drive level low-side
4 (green)	off	bus voltage is too high (e.g. mains overvoltage)
5 (green)	never on	no drive level high-side
6 (green)	off	bus voltage is too low (e.g. mains voltage too low)

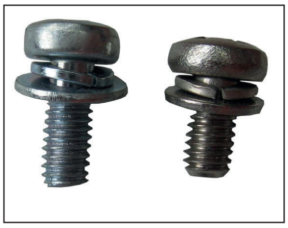
Measuring Points

designation	measure point		result
supply voltage current sensor	X2/1 X2/6	+ gnd	+15V DC
supply voltage current sensor	X2/3 X2/6	- gnd	-15V DC
temperature sensor	X3/1 X3/2	gnd +	10kΩ at 25°C (about +2V DC)

Picture pc-board DK-DCDRV / DK-S3DRV



T = MOSFET (power transistor)
D = diode



!!! CAUTION !!!

at all positions where cables are attached, the longer screws are used (A+ A- +UZ -UZ).
The rest of the ISOTOP screws are the short ones.

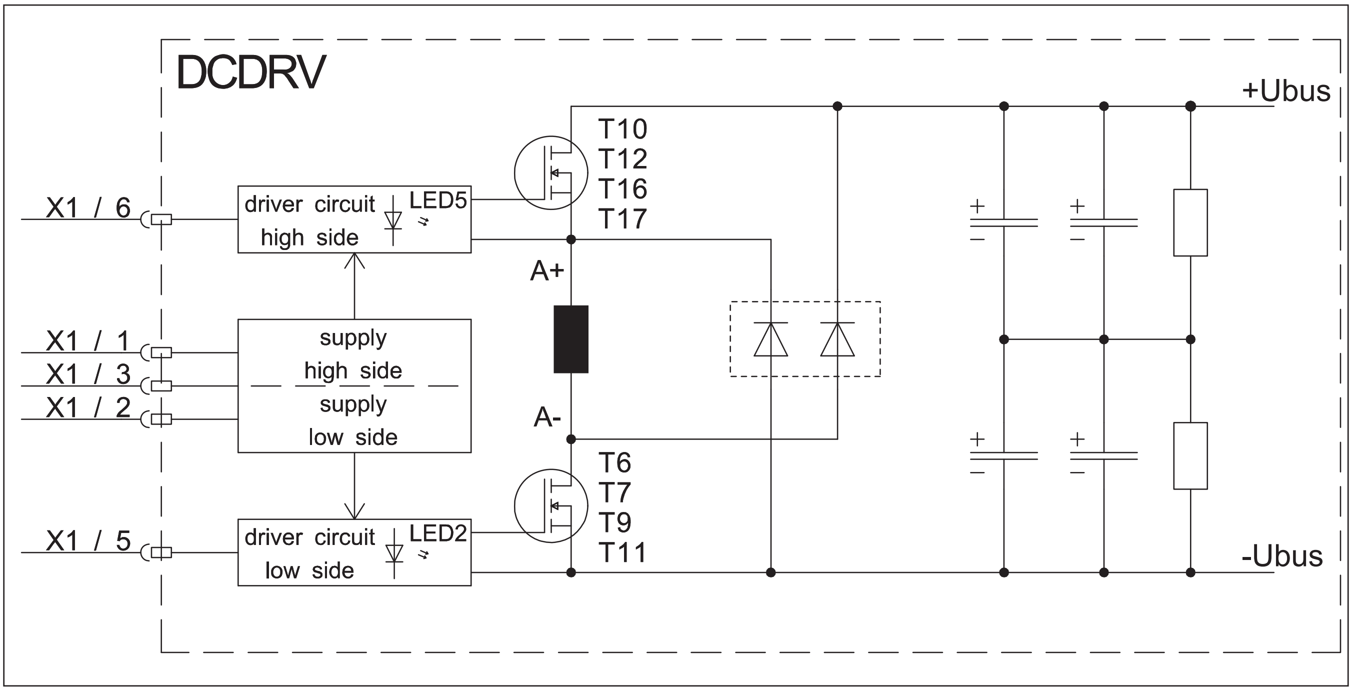
Overview connectors pc-board DCDRV

connector	designation
X1	connector to pc-board DP-MAPRO
X2	connector current sensor and pc-board PRWUP
X3	connector temperature sensor

Primary Driver

The pc-baord DCDRV is the primary driver board for the transformer. It is a classical half bridge design. The supply is provided via pins 1, 2 and 3 of the flat ribbon cable and the PWM signals (PWM = Pulse Width Modulation) for driving the MOSFETs are at pin 5 (low side) and pin 6 (high side).

Schematic



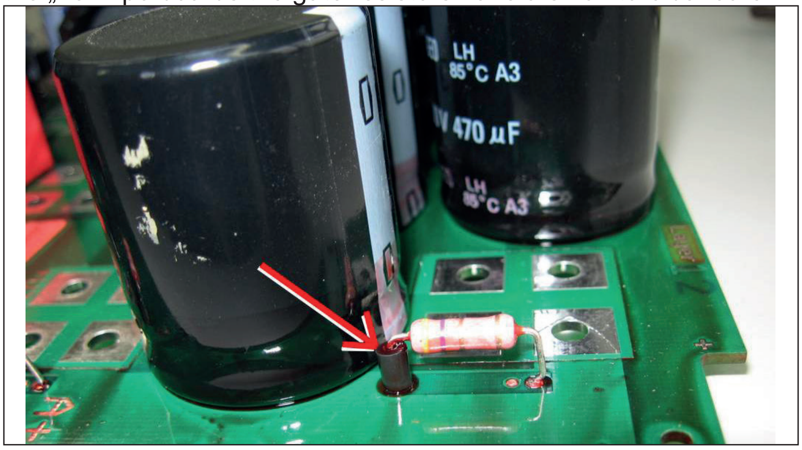
Changeover to new MOSFETs and new pc-board DK-DCDRV

Over the time there had been some changes at the power units. Important is to make sure, that the different versions are not mixed up (do not combine “old“ with “new“).

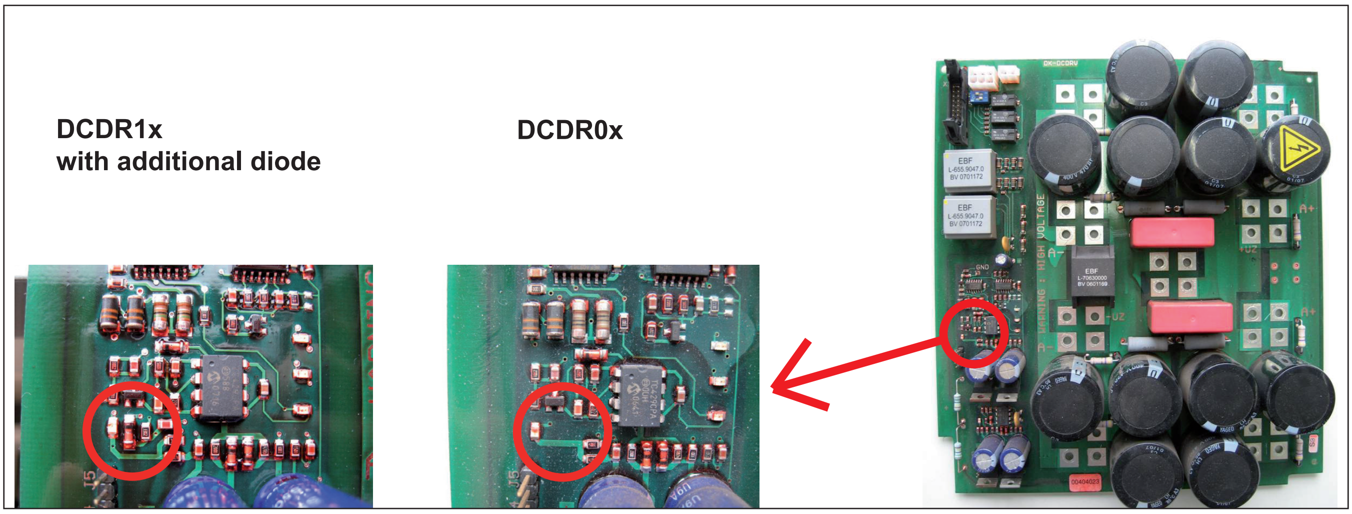
- Since september 2006 the MOSFET (711.2606.0) was replaced by a new type (711.2608.0). In this context the pc-boards DK-DCDRV/DK-S3DRV were replaced by DCDR-01 and DCDR-02.
- Since December 2007 additional diodes had been added to the pc-boards (change from DCDR0x to DCDR1x)
- Since April 2008 a new driver circuit was used (change from DCDR1x to DCDR2x)

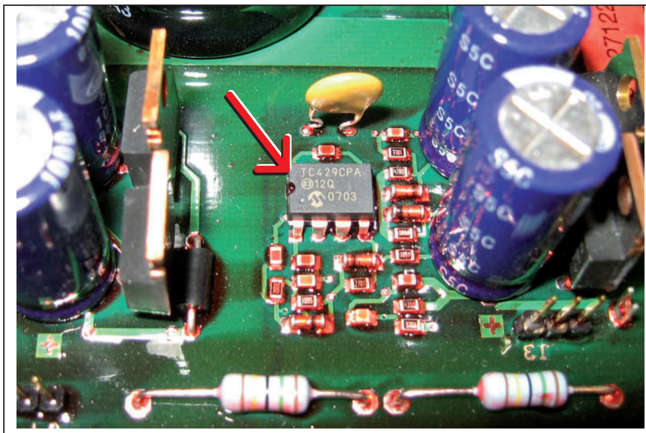
type	part. no.	designation	picture
„old“ MOSFET	711.2606.0	E26NA90	
„new“ MOSFET	711.2608.0	IXFN26N90	

The new pc-boards DCDR-01 and DCDR-02 can be easily distinguished from the „old“ pc-board DK-DCDRV. At the „new“ pc-boards the gate resistors have a small toroidal core:

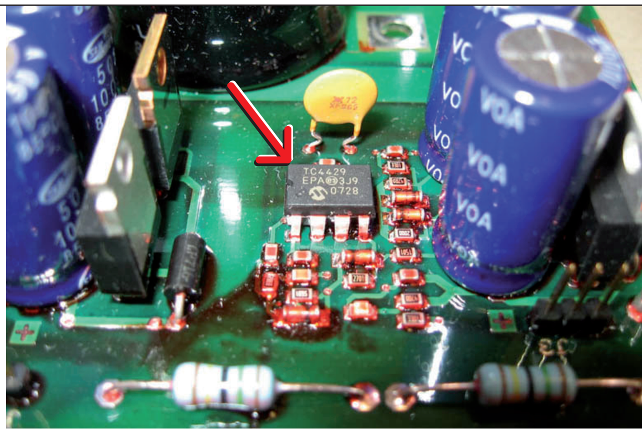


The main difference between the DCDR0x and DCDR1x is an additional diode:





old driver IC: JC429CPA



DCDR2x with new
driver IC: TC4429

V27, V30, V50:

pc-board	part no.	serial no.	date	identification			
				MOSFET	toroidal core	diode	driver ic
DK-DCDRV	650.5262.x			old	no	no	old
DCDR01	650.5258.x	7xx-1635-001	30.08.2006	new	yes	no	old
DCDR11	650.5364.x	7xx-1749-001	30.11.2007	new	yes	yes	old
DCDR21	650.5371.x	7xx-1812-001	12.03.2008	new	yes	yes	new

V24, V40:

pc-board	part no.	serial no.	date	identification			
				MOSFET	toroidal core	diode	driver ic
DK-DCDRV24	650.5259.x			old	no	no	old
DCDR02	650.5257.x	7xx-1635-001	30.08.2006	new	yes	no	old
DCDR12	650.5365.x	7xx-1749-001	30.11.2007	new	yes	yes	old
DCDR22	650.5372.x	7xx-1812-001	12.03.2008	new	yes	yes	new

!!! CAUTION !!! : the new MOSFETs are **not** compatible with the old type. The new MOSFETs must only be used with the new pc-boards DCDRxx. The new parts must not be mixed with the old parts, under no circumstances ! Especially at the machines with double power units (V40 and V50) it must be ensured, that both power units are equipped completely with only one version.

Pc-board DK-ACDRV

The pc-board DK-ACDRV is managing the drive level for the secondary inverter (AC power module with IGBT full-bridge)

Functions

- encoding AC power unit
- drive level IGBTs
- connection of temperature sensor

Encoding power unit

J1	setting	machine type
0	2 IGBT	V24, V40
1	4 IGBT	V27, V30, V50

(0 = contact open ; 1 = contact closed)

LEDs

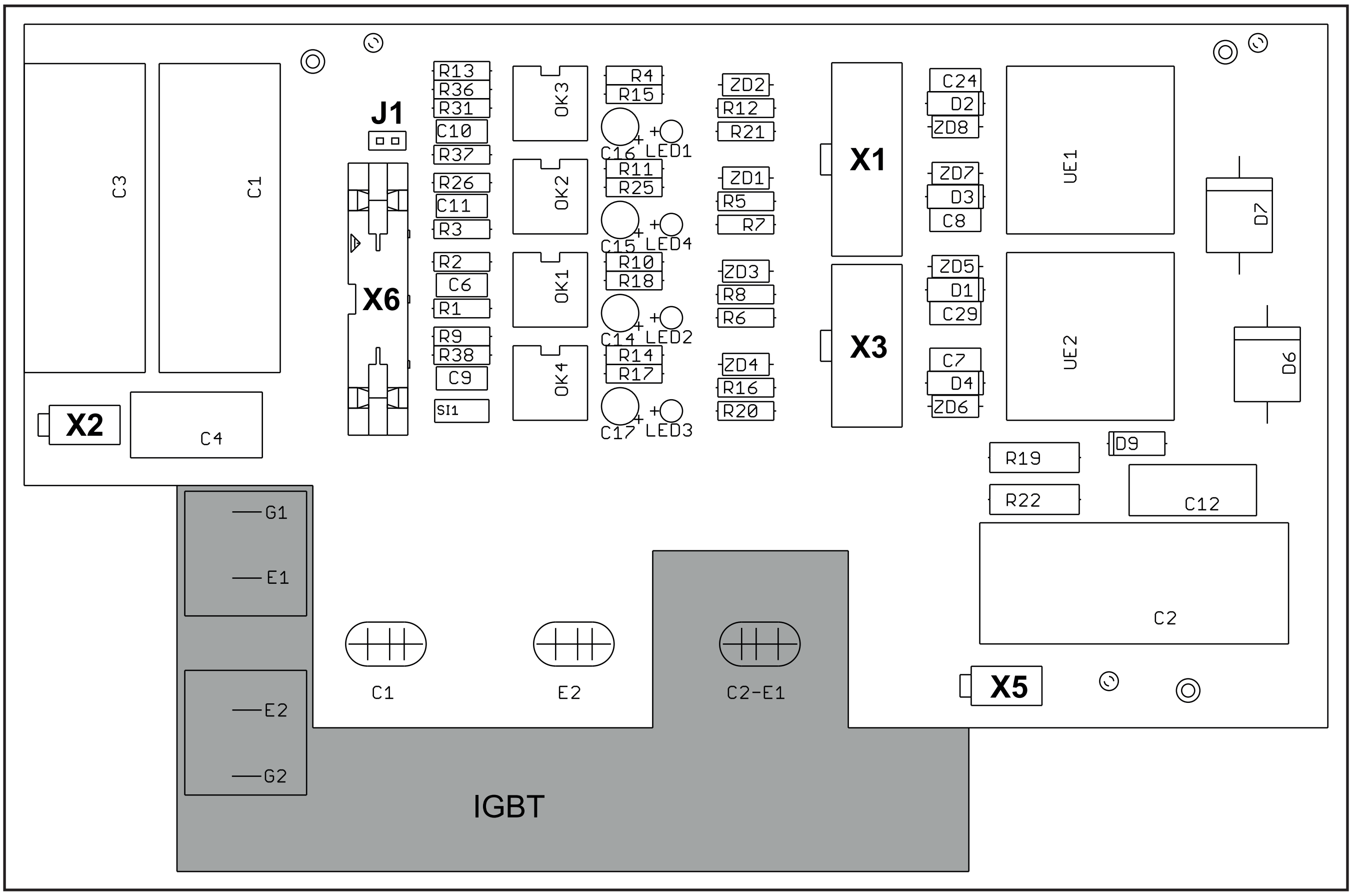
The LEDs on the pc-board DK-ACDRV are showing the drive level state of the IGBT.

LED on	IGBT not driven
LED off	IGBT driven

Measuring points

designation	measure point		result
temperature sensor	X5/1 X5/2	+ GND	10kΩ at 25°C (about +2V DC)

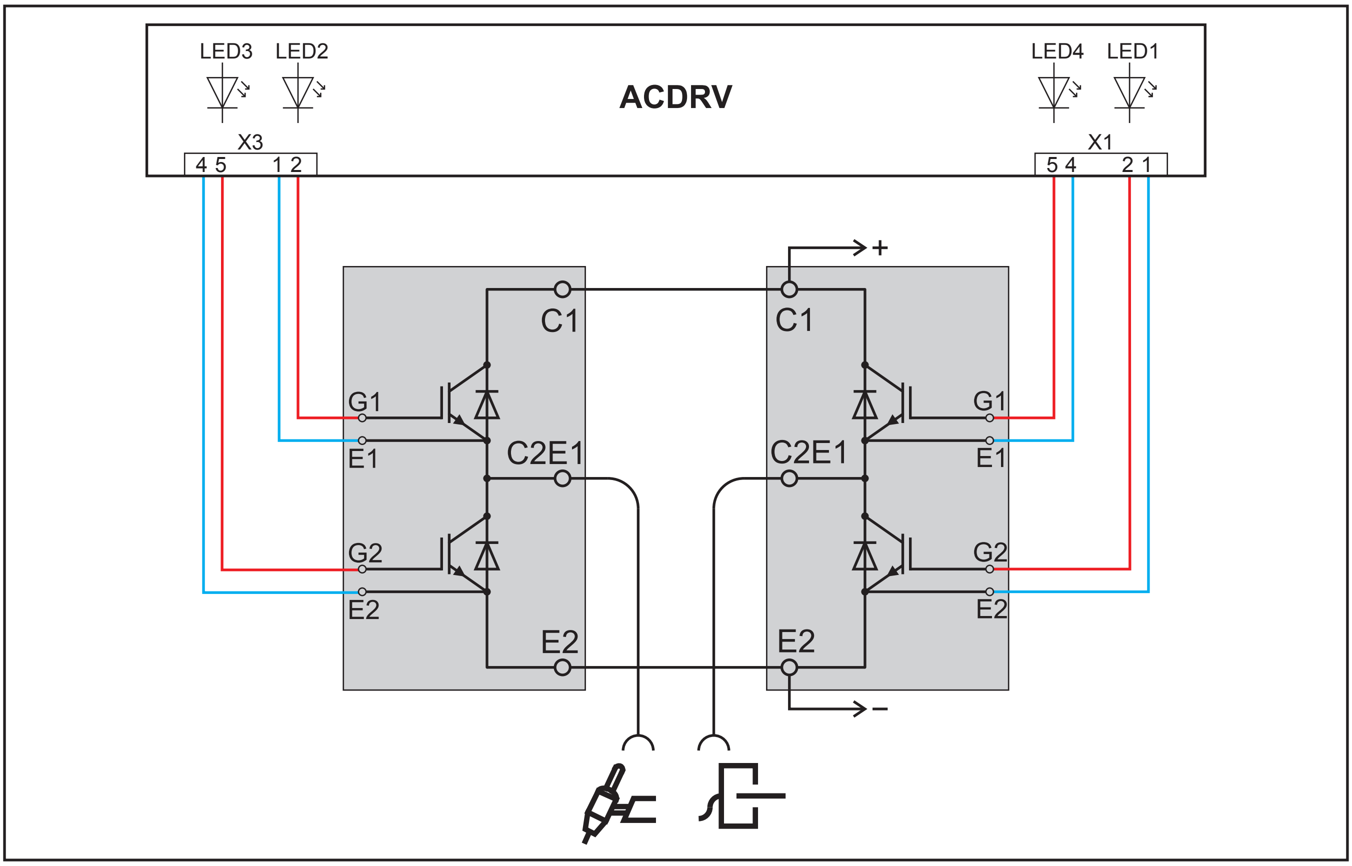
Picture pc-board DK-ACDRV



Overview connectors pc-board DK-ACDRV

connector	designation
X1	connector to IGBT
X2	output voltage of secondary rectifier
X3	connector to IGBT
X5	connector temperature sensor
X6	interface to pc-board DK-MAPRO

Schematic AC inverter



Pc-board DK-PWRUP

The pc-board DK-PWRUP is the power-up circuit of the machine.

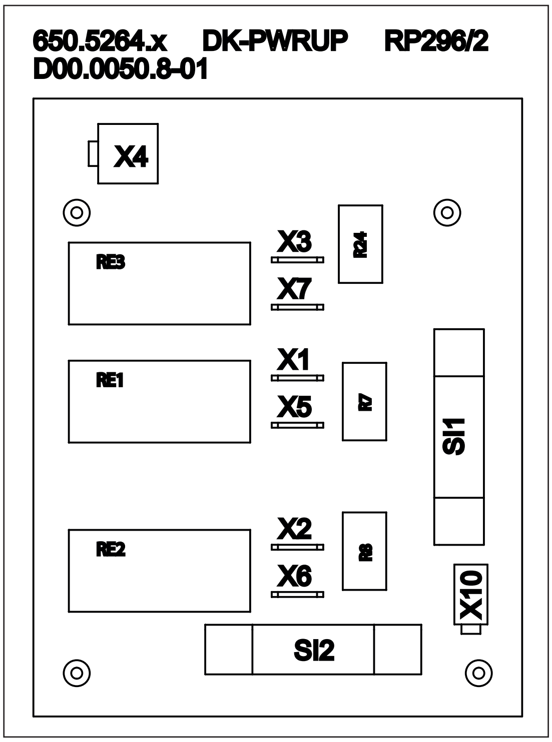
Functions

- reducing start-up peak current for capacitors
- supply and safeguarding of control transformer

Measuring Points

designation	measure point		result
mains input L1	X5	~	400V AC
mains input L2	X6	~	
mains input L3	X7	~	
mains output L1	X1	~	400V AC
mains output L2	X2	~	
mains output L3	X3	~	
supply voltage control transformer	X10/1 X10/2	~ ~	400V AC
drive level relay	X4/1 and 3 X4/2 and 4	+ -	+24V DC

Picture Pc-board DK-PWRUP



Fuses

Safeguarding the control transformer via Si1, Si2 : each 4A, 400V (slow)

Pc-board DP-S3NEFI

The pc-board DP-S3NEFI is mains filter and power-up circuit in one for the V24 mobile.

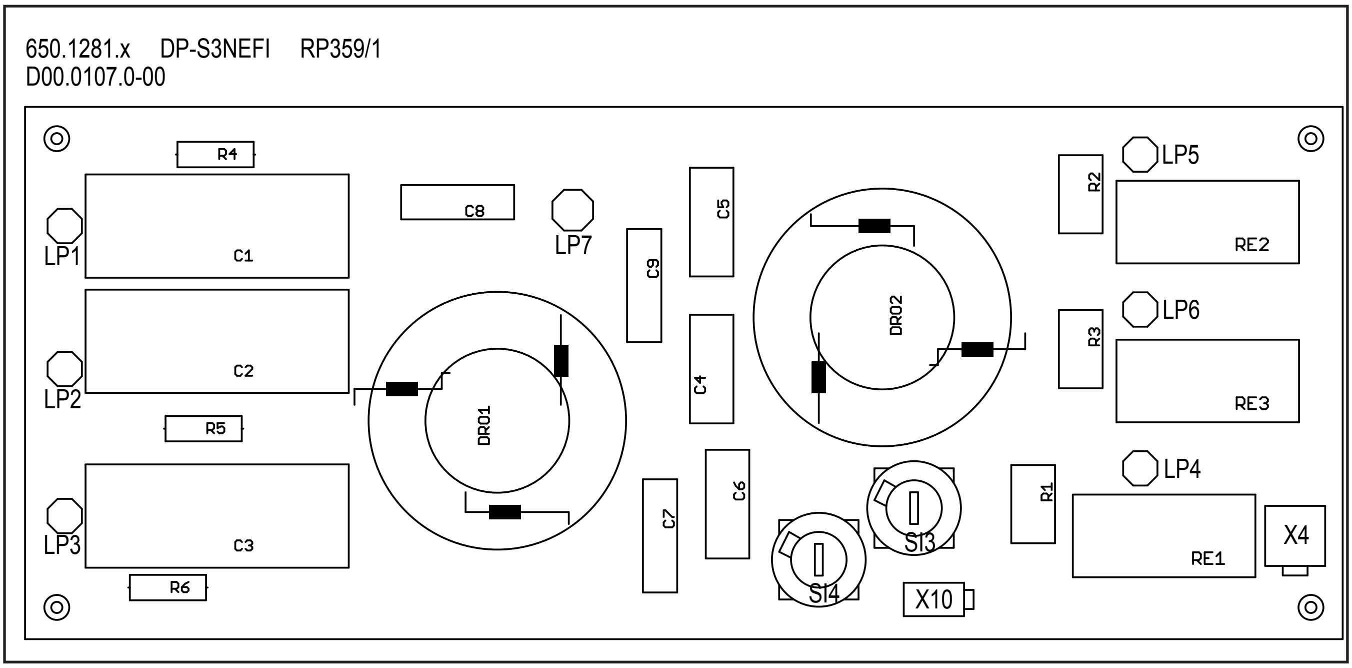
Functions

- mains filter
- reducing start-up peak current for capacitors
- supply and safeguarding of control transformer

Measuring points

designation	measure point		result
mains input L1	LP1		
mains input L2	LP2	~	400V AC
mains input L3	LP3		
mains output L1	LP4		
mains output L2	LP5	~	400V AC
mains output L3	LP6		
supply voltage control transformer	X10/1 X10/2	~ ~	400V AC
drive level relay	X4/1, 3 X4/2, 4	+ -	24V DC

Picture pc-board DP-S3NEFI



Fuses

Safeguarding the control transformer via Si1, Si2 : each 4A, 400V (slow)

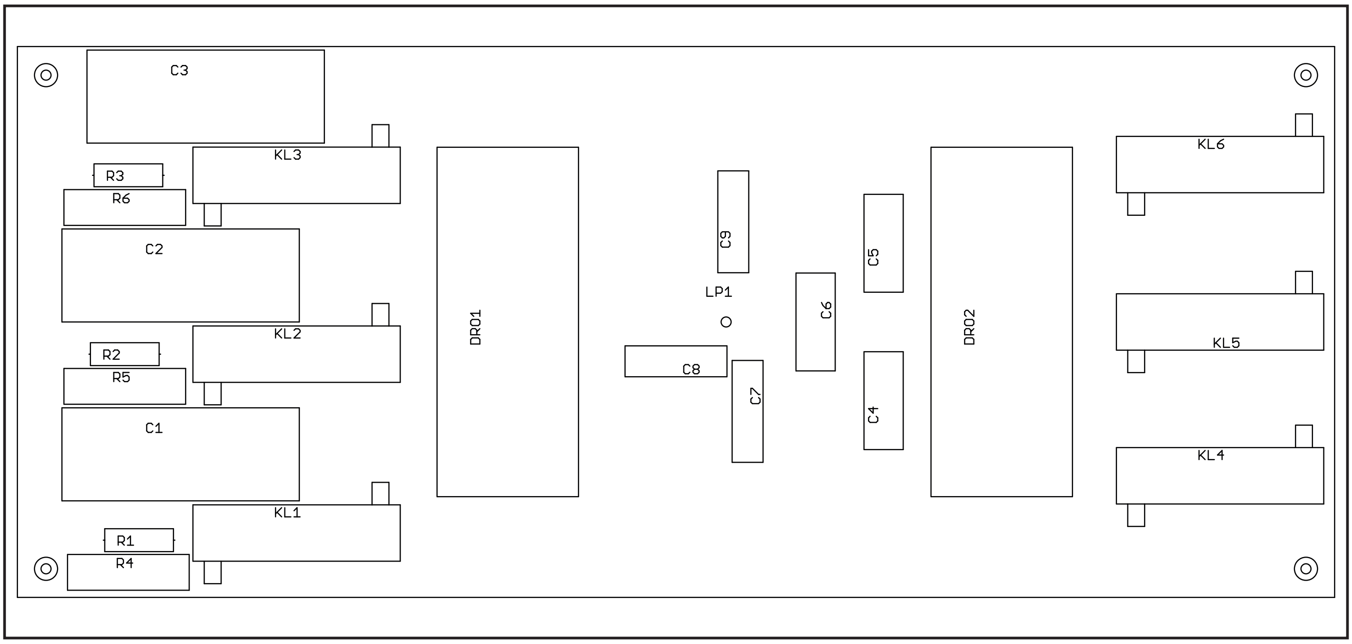
Pc-board NEFI3x32

The pc-board NEFI3x32 is the mains filter for the V30 mobile.

Functions

- mains filter

Picture pc-board NEFI3x32



connector	designation
KL1 KL2 KL2	mains input L1 mains input L2 mains input L3
KL4 KL5 KL6	mains output L1 mains output L2 mains output L3

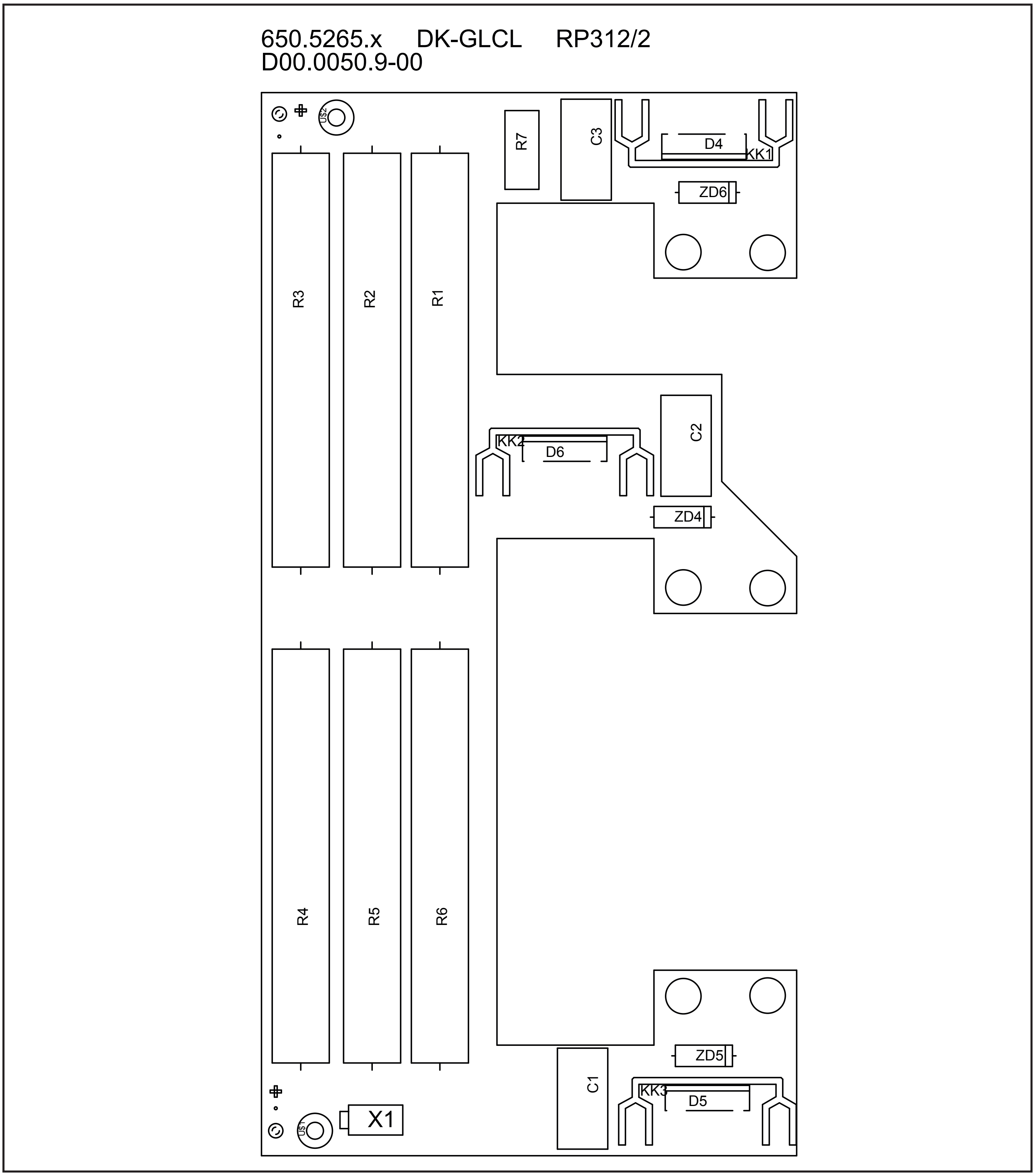
Pc-board DK-GLCL

The pc-board DK-GLCL is for wiring the secondary rectifier diodes.

Functions

- wiring secondary diodes
- pulse smoothing

Picture pc-board DK-GLCL



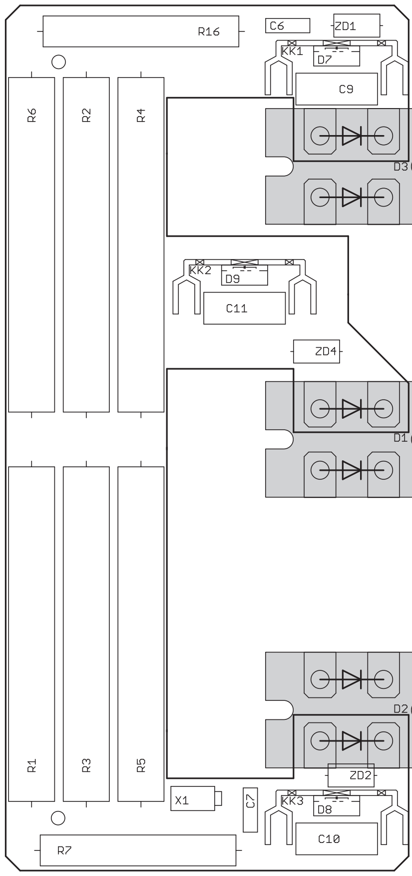
Pc-board DK-GLCL3

Since 02.12.2011 the pc-board DK-GLCL was replaced by the pc-board DK-GLCL3.
Since 09.03.2012 the secondary diodes 713.0298.0 were replaced by a new diode tyoe 713.0301.0.
The new diode types are NOT compatible with the “old” pc-board DK-GLCL.

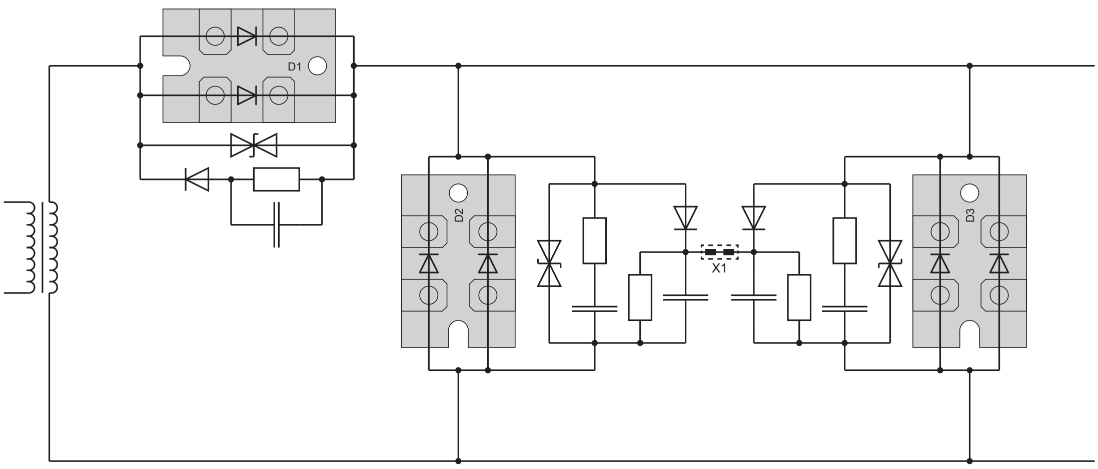
Compatibility

diode type	DK-GLCL	DK-GLCL3
713.0298.0	ok	ok
713.0301.0	X	ok

Picture pc-board DK-GLCL3



Schematic



Pc-board DK-KSDC / DK-KSDCD / DK-KSDCN

The pc-board DK-KSDC is an additional support for the HF ignition.

Functions

- electronic short-circuit switch for HF ignition support

LEDs

normal

LED	state	designation
1 (green)	on	supply voltage +15V DC ok

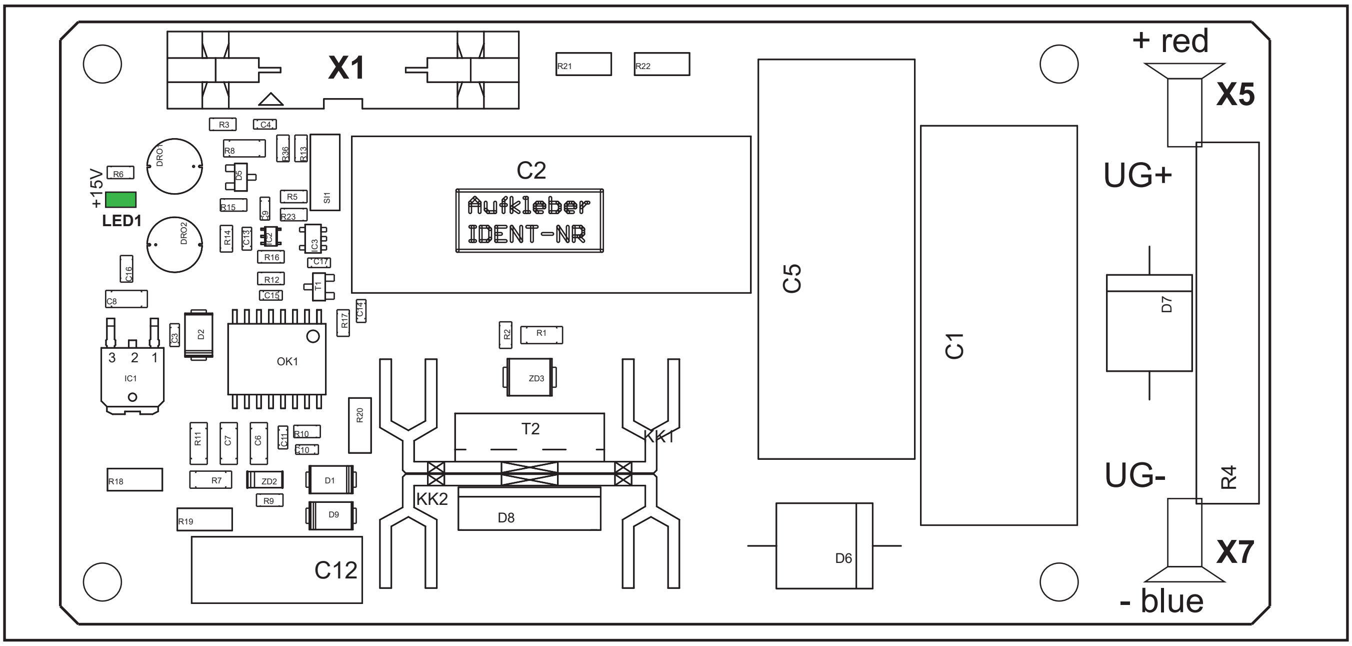
malfunction

LED	state	cause
1 (green)	off	supply voltage +15V DC of pc-board DK-MAPRO is missing

Measuring points

designation	measuring point		result
secondary output voltage (in stick electrode mode)	X5 X7	+ GND	about 58V DC

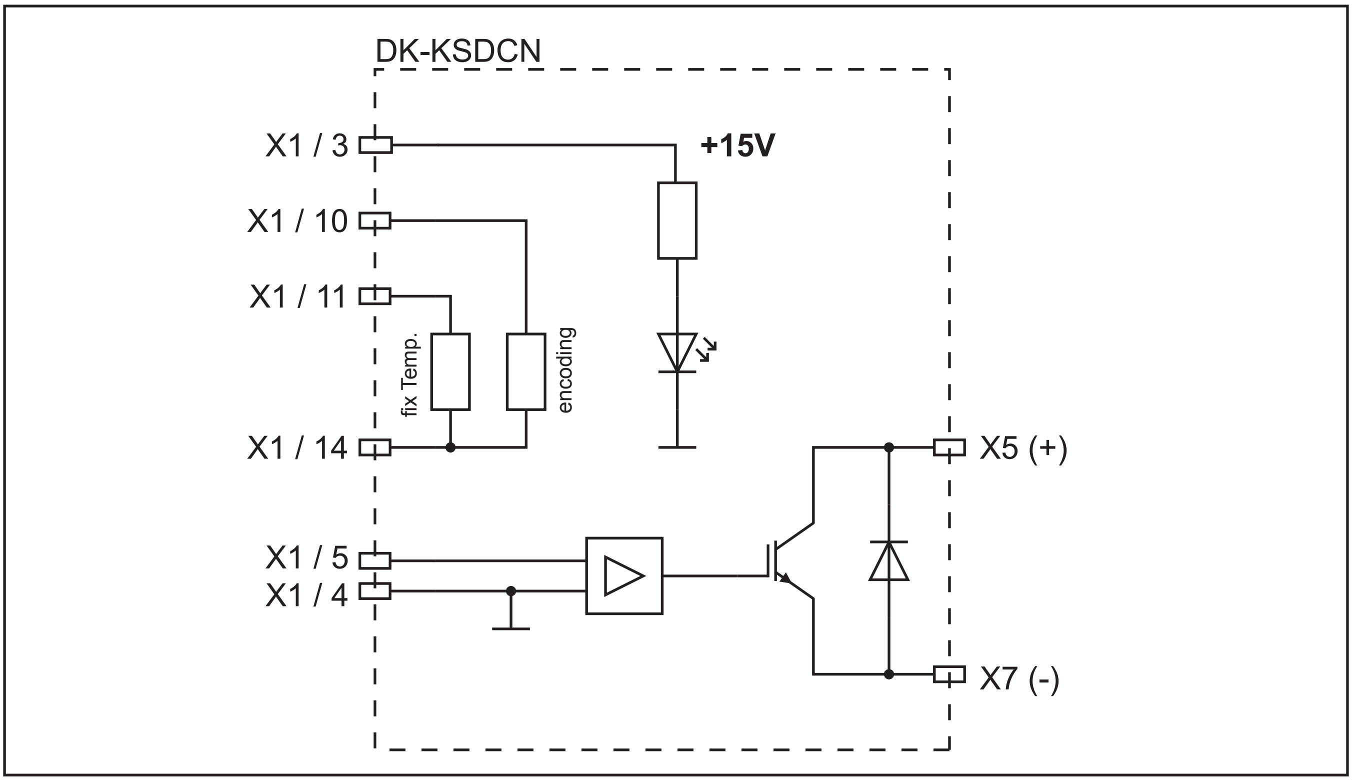
Picture pc-board DK-KSDCN



Overview connectors pc-board DK-KSDCN

connector	designation
X1	interface to pc-board DK-MAPRO
X5	connector to output socket (+)
X7	connector to output socket (-)

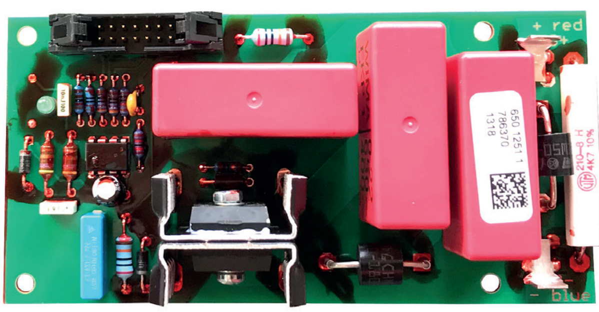
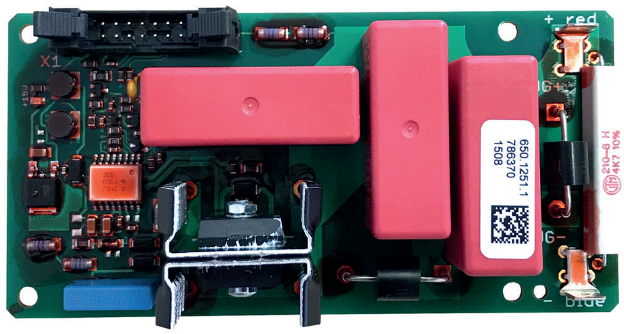
Schematic DK-KSDCN



The DK-KSDCN produces an additional voltage spike of about 350V for the support of the HF ignition.
At the output of the power unit a short circuit is made by a MOSFET, then the output current is increased step wise. Until a certain current is reached, the MOSFET opens up and produces the voltage spike.

Changes pc-board DK-KSDCN

Since February 2021 from serial number 0709-3105-0001-8 a new version of the KSDCN is used in the series.

	
old KSDCN	new KSDCN

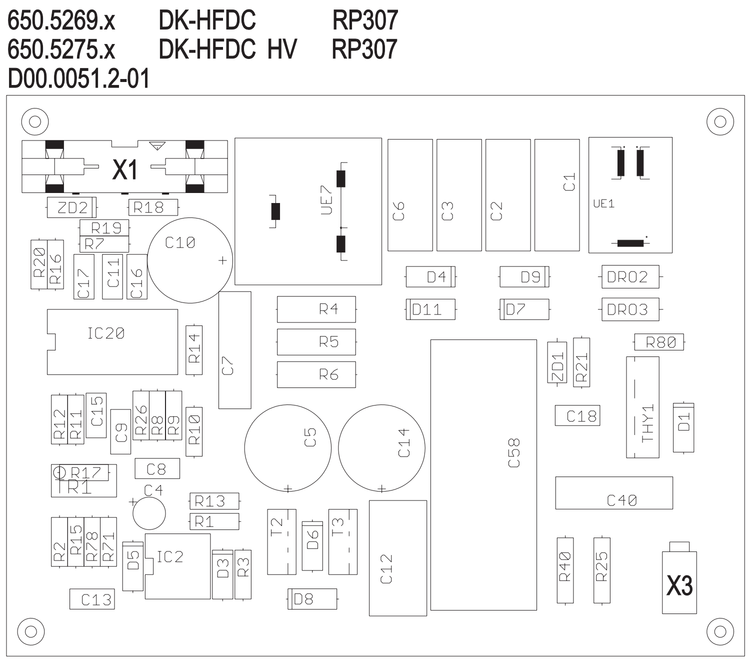
Pc-board DK-HFDC / DK-HFDC HV

The pc-board DK-HFDC is the ignition device of the welding machine.
In the machines V40 and V50 the pc-board DK-HFDC HV is used. All other machines are equipped with the pc-board DK-HFDC.

Functions

- generating high voltage pulses

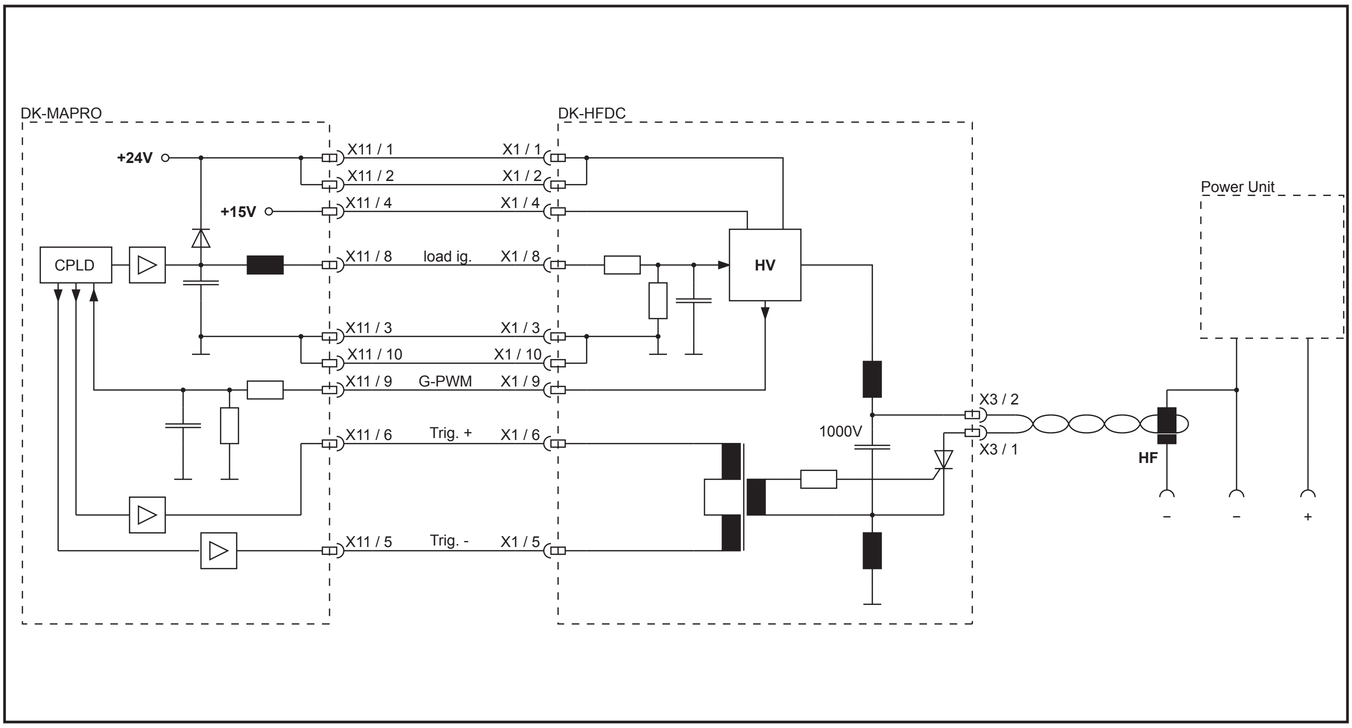
Picture pc-board DK-HFDC



Overview connections pc-board DK-HFDC

connector	designation
X1	interface to pc-board DK-MAPRO
X3	connector for HF-inductor

Schematic DK-HFDC



Ignition Sequence

The pc-board DK-MAPRO activates +24V DC on pin 8. This causes the pc-board DK-HFDC to charge the ignition capacitor up to 1000V. The charging process is monitored by the CPLD. As soon as the 1000V are reached, the ignition impulse is triggered with a thyristor (trigger impulse via pins 5 and 6).

If the CPLD can not read the PWM signals of the ignition board, the complete process is stopped and the error meassage **E19** (error ignition device) is shown in the display of the machine.
Possible reasons could be:
- the 24V at pin 8 are missing
- loose contact of the flat ribbon cable between MAPRO board and HFDC board
- faulty HFDC board

Pc-board DK-UFI

The pc-board DK-UFI is for wiring the welding sockets.

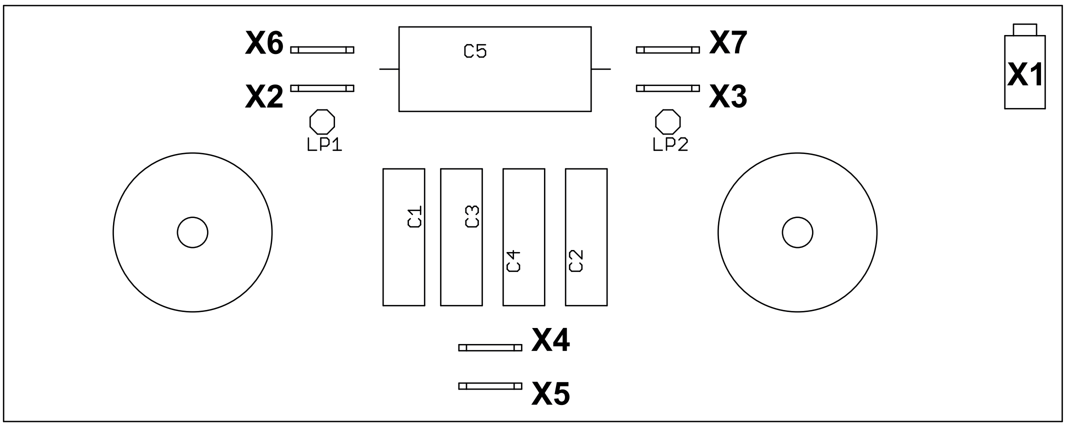
Functions

- wiring welding sockets
- providing output voltage

Measuring points

designation	measuring point		result
secondary output voltage in MMA (stick electrode) mode	X2 x3	+ GND	ca. 58V DC
	X6 X7	+ GND	ca. 58V DC
	X1/1 X1/2	+ GND	ca. 58V DC

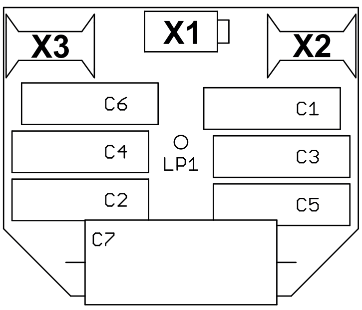
Picture pc-board DK-UFI



Pc-board DK-EMV

The pc-board DK-UFI was replaced by the pc-board DK-EMV.
Since serial no. xxx-1602-001 from the 9th Jan. 2006, the pc-board DK-EMV is used:

Picture pc-board DK-EMV



Pc-board LSW

The pc-board LSW is the current sensor of the machine (potential free).

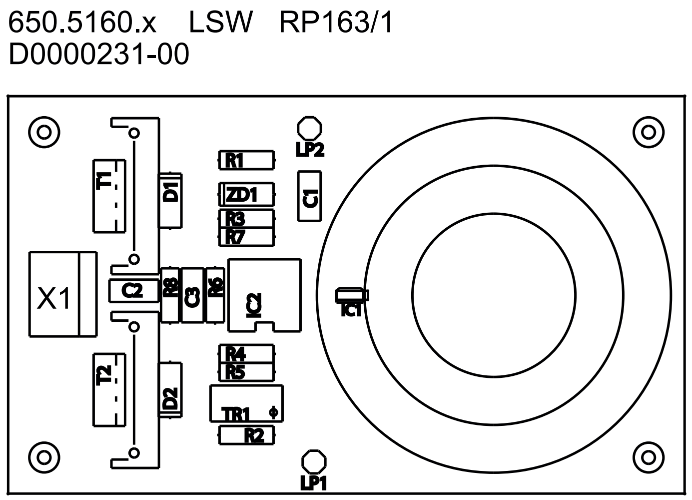
Functions

- measuring the welding current

Measuring points

designation	measure point		result
supply voltage	X1/1 X1/3	- +	 +30V DC

Picture pc-board LSW



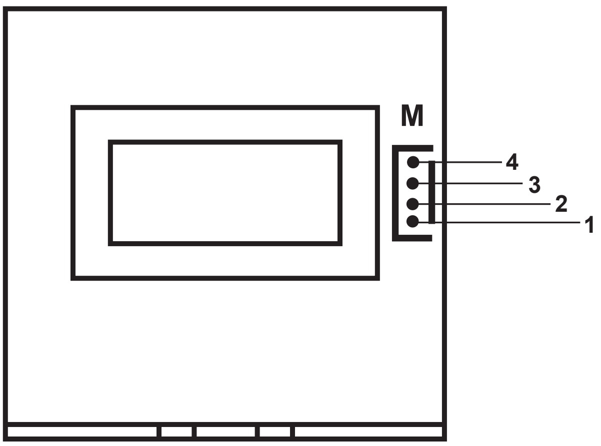
Current sensor VAC

Since serial no. xxx-1724-001 from the 13th of June 2007, a new current sensor (VAC) is used instead of the LSW.

Measuring points

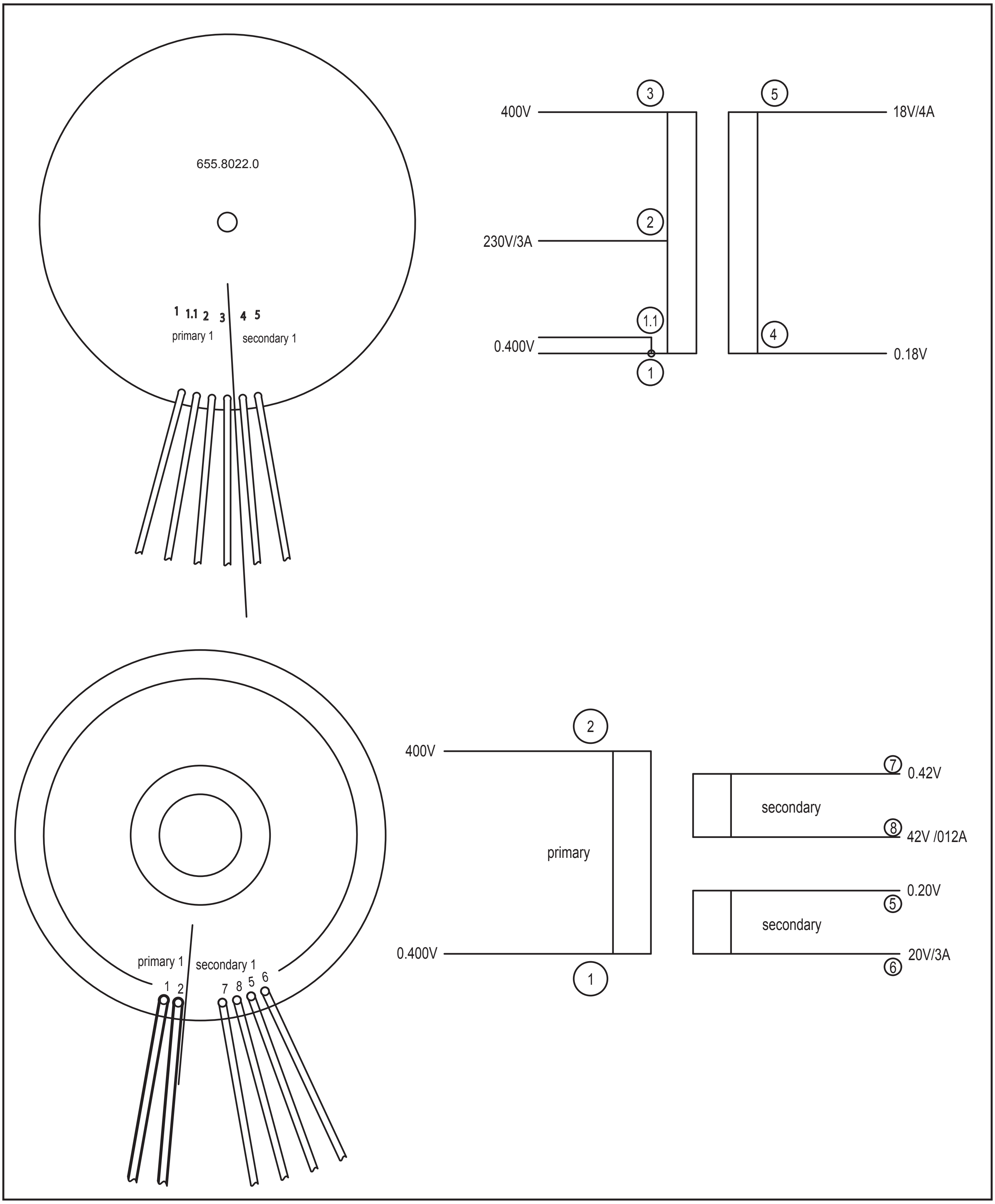
designation	measure point		result
supply voltage	X1/1 X1/2 X1/4	+ - GND	+15V DC -15V DC GND
sensor output	X1/3		(2000:1)

Picture current sensor VAC:



Control transformer

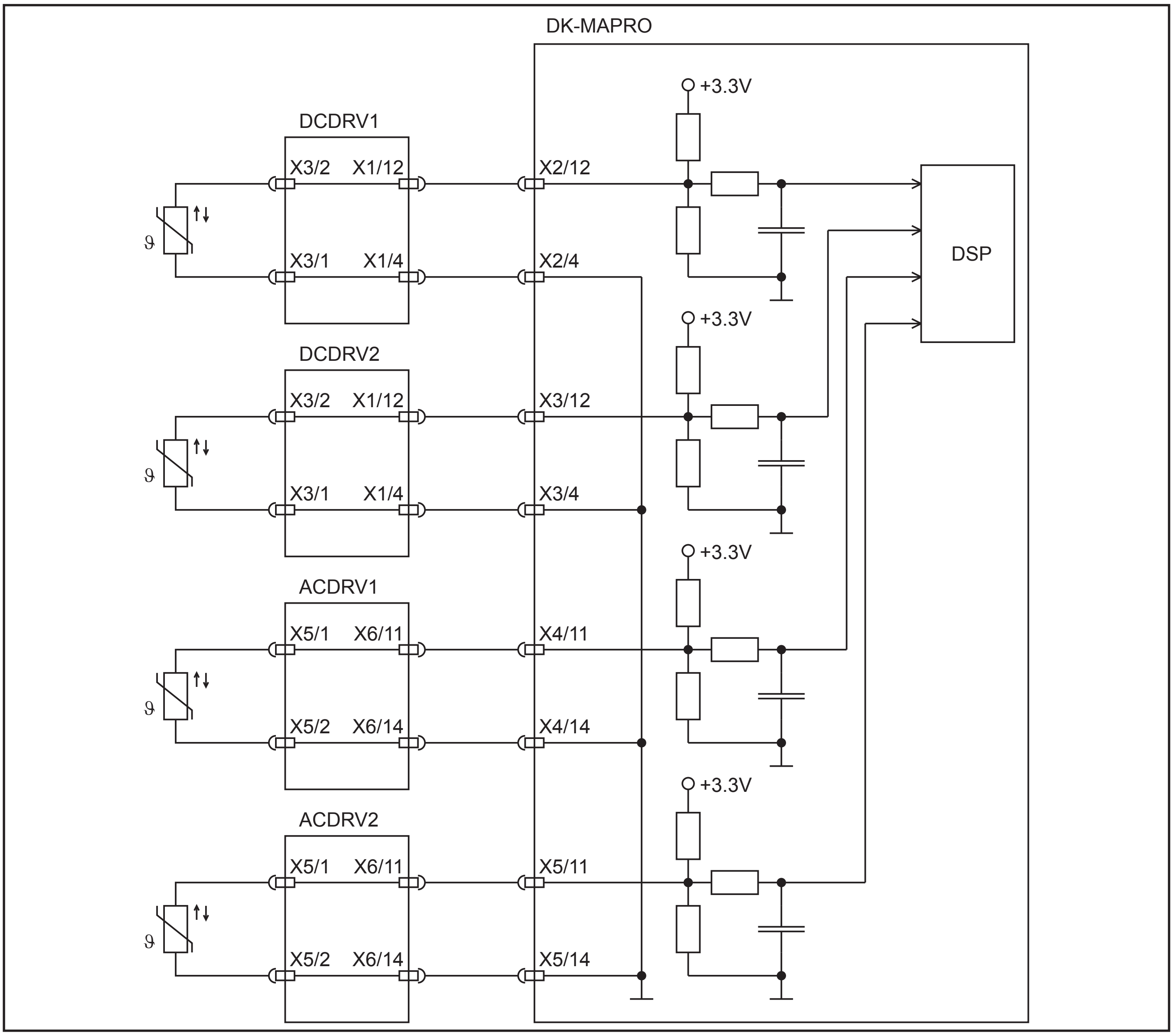
The control transformer 655.8022.0 is used in all “driveable“ machines of the V series.
The control transformer 655.8025.0 is used in the V mobile machines.



Temperature monitoring

The temperature of the heat sink is constantly monitored via a temperaure sensor. This sensor is a temperature dependent resistor (NTC = negative temperature coefficient). The higher the temperature, the lower the resistance value of the sensor.

Schematic



The DSP is monitoring the temperature of the heatsink and as soon as the temperature reaches the programmed maximum value, the machine will stop and displays **E01** (thermal overload).
The actual value of the temperature can be displayed at the front panel in menu Extras, Diagnosis, Module Temperatures.
If one of the temperature sensors are faulty itself, then the machine will stop and **E13** (Temp.sensor error) is displayed.

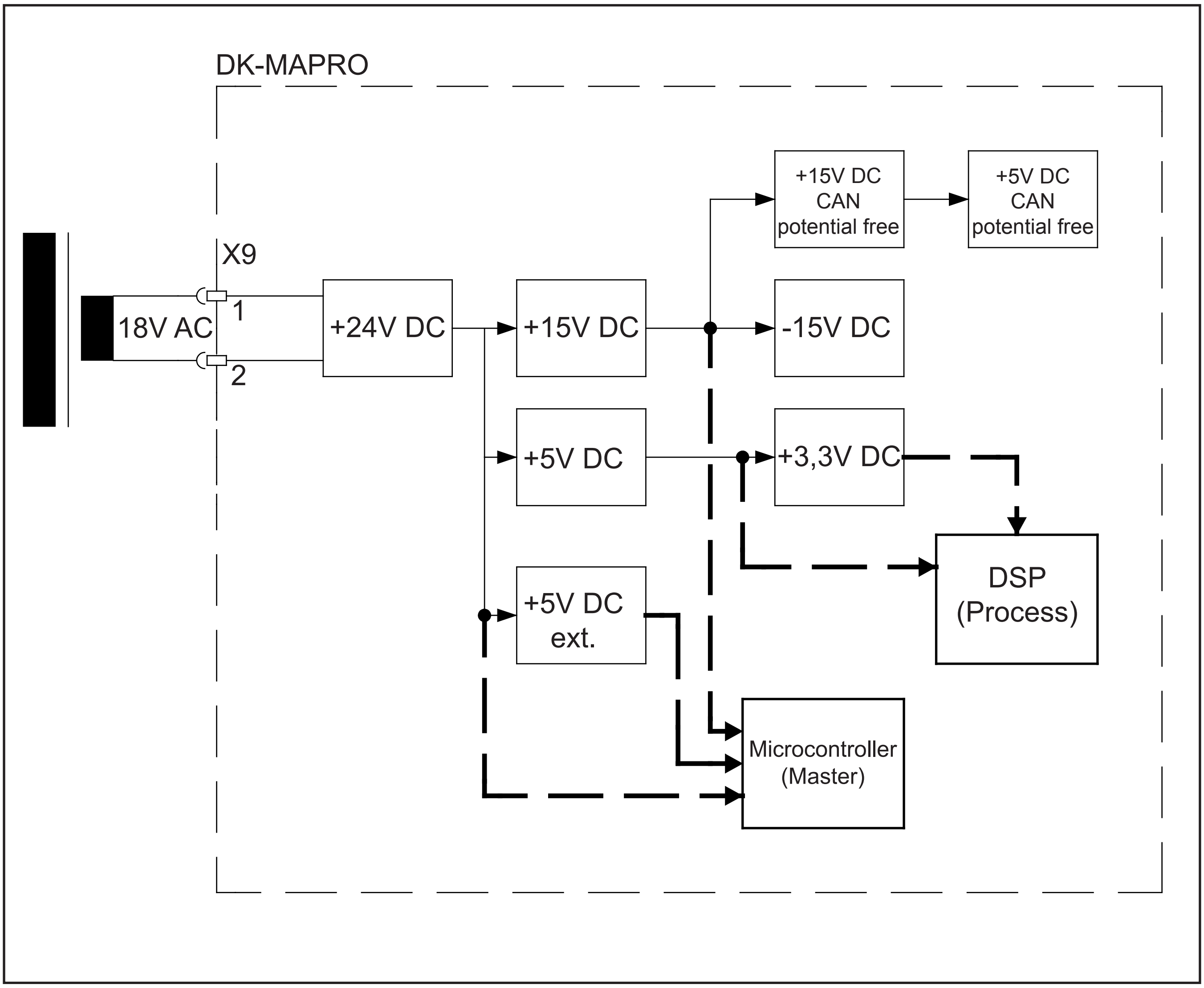
Maximum temperatures

machine type	temp. primary	temp. secondary
V24	90 °C	87 °C
V27	91 °C	100 °C
V30, V40	93 °C	100 °C
V50	94 °C	100 °C

Supply voltages

On the MAPRO pcb, all internal supply voltages are generated from the output of the control transformer.

Schematic



Different supply voltages are monitored by the Microcontroller (Master) and the DSP (Process).
If the 24V drops below 17V the machine will stop and displays **E14** (Op. voltages error).
If the 24V are higher than 36V the machine will stop and displays **E02** (mains overvoltage).

Voltage limits

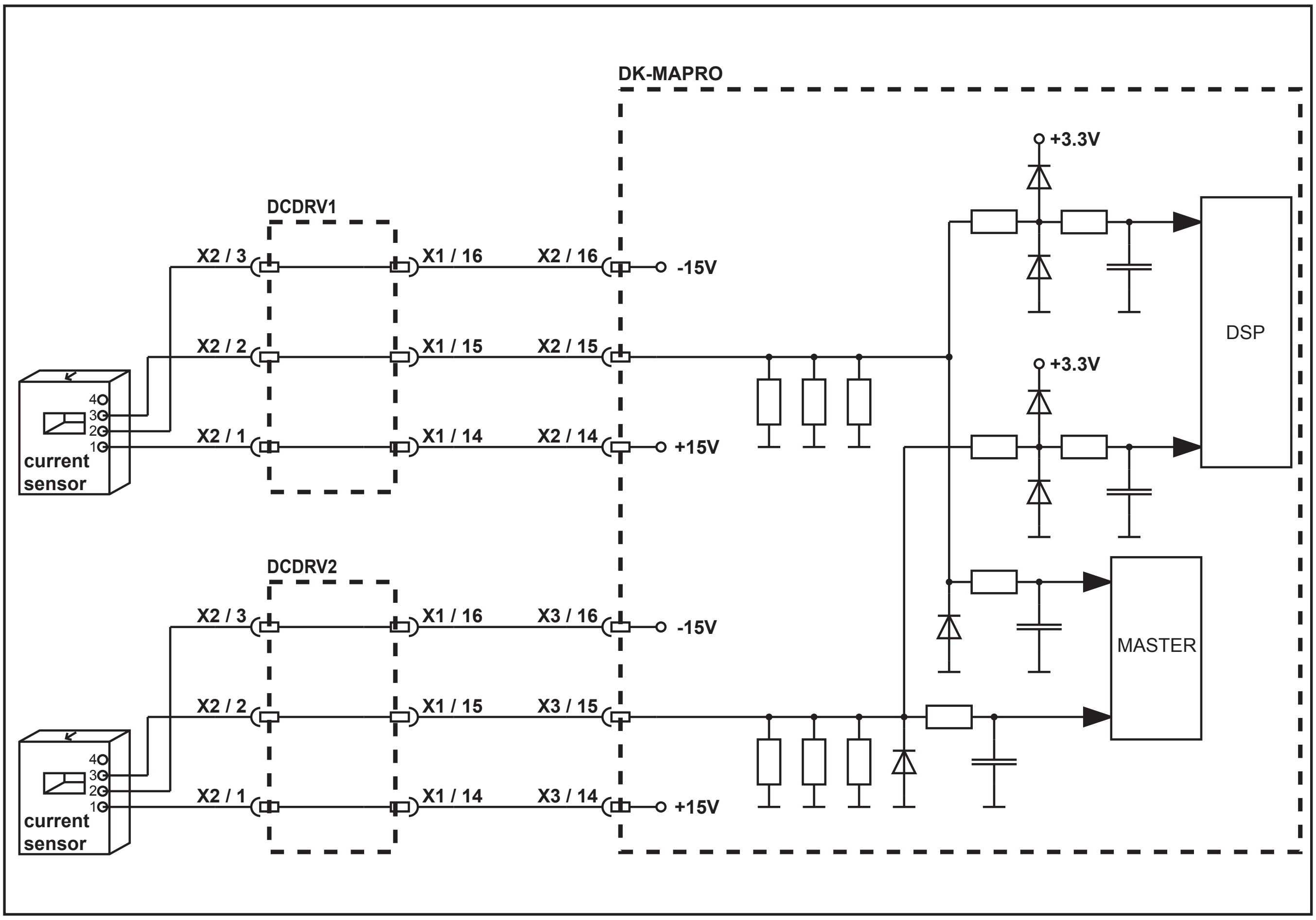
supply voltage	limit	result
+24V	< 17V	shutdown with **E14**
+24V	> 36V	shutdown with **E02**

The actual values of the 24V and 15V can be checked via the front panel in menu Extras, Diagnosis, Op. Voltages.

Monitoring welding current

The welding current is measured via a separate current sensor (VAC or LSW pcb at older machine versions). The current is monitored by the Microcontroller (Master) and the DSP (Process) at the same time.

Schematic



The output of the current sensor is a current with a ratio of 1:2000, meaning at a welding current of 300A the sensor output is 150mA. The output current is measured via an internal shunt resistor by the Master and Process.
If the Master measures a current >120% of the maximum value, the machine will stop and displays **E03** (secondary overcurrent).
If the Master measures a voltage >3.5V at the shunt resistor (that would mean a welding current >988A), the machine will stop and displays **E09** (error v/a measuring).

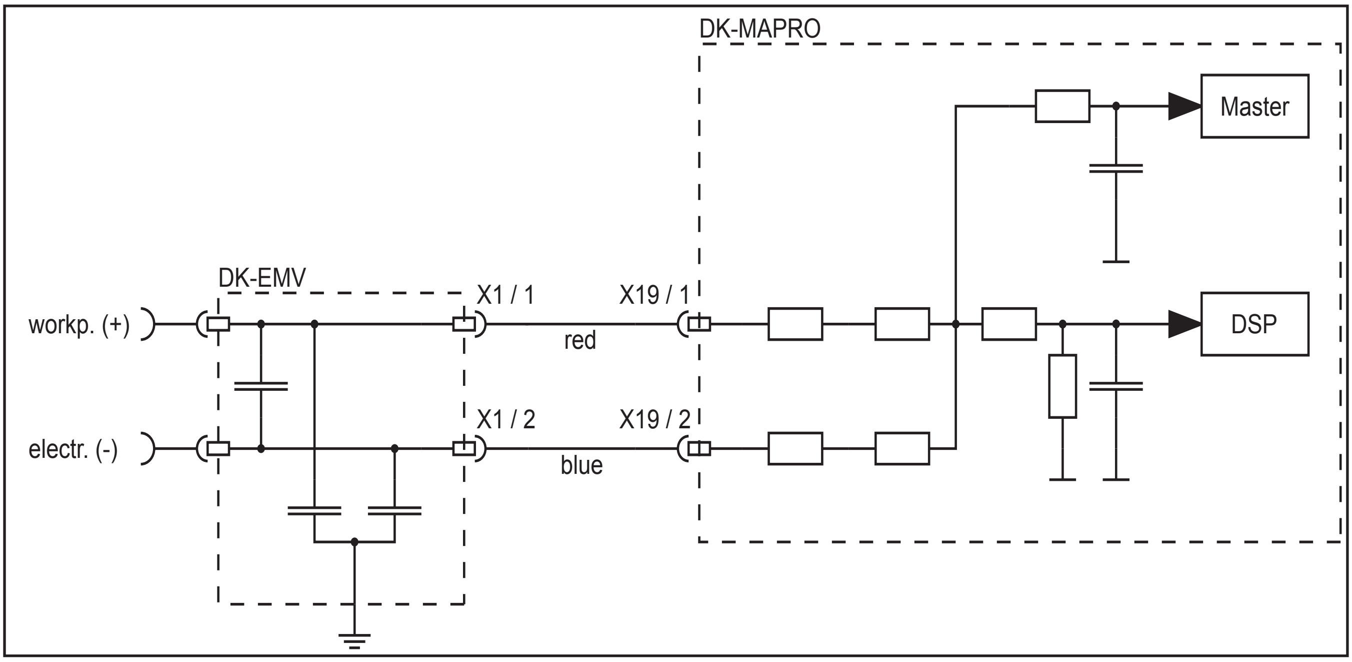
If the Process is measuring a welding current >20A although the machine is not welding (standby), the machine will stop and displays **E21** (Output voltage/current).

At V40 or V50 (machines with double power units), both power units are working parallel. For example: the machine is set for 200A welding current, then 100A are generated from power unit 1 and the other 100A are generated from power unit 2. The outputs of both power units must be the same.
If for some reason one power unit generates less than the other power unit and the difference between the power units are >40A, then the machine will stop and displays **E17** (error current symmetry).
The actual current values of each power unit can be displayed in Menu Extras, Diagnosis, Current module 1/2.
To check which power unit is faulty, it is possible to use the power units independently by converting the V40 into a V24 (using only one power unit) or converting a V50 into a V30.
This conversion can easily be made by just disconnecting the flat ribbon cables of the second power unit from the DK-MAPRO (X3 and X5) and changing the DIP switch settings of the DCDRV board.

Monitoring welding voltage

The output voltage is measured via X19 of the pc-board DK-MAPRO. As well as the Master and the Process (DSP) are measuring the output voltage independently.

Schematic



If the Master is measuring a voltage higher than 100V, the machine will stop and displays **E06** (secondary overvoltage). If the Process should detect a voltage higher than 100V, the machine will stop and displays **E20** (Overvoltage secondary).
If no voltage can be measured at all, then machine will stop and displays also **E20**.
Possible reasons could be:
- disconnected measuring wires (red and blue)
- loose connection of the connectors
- interchanged wires (red with blue)

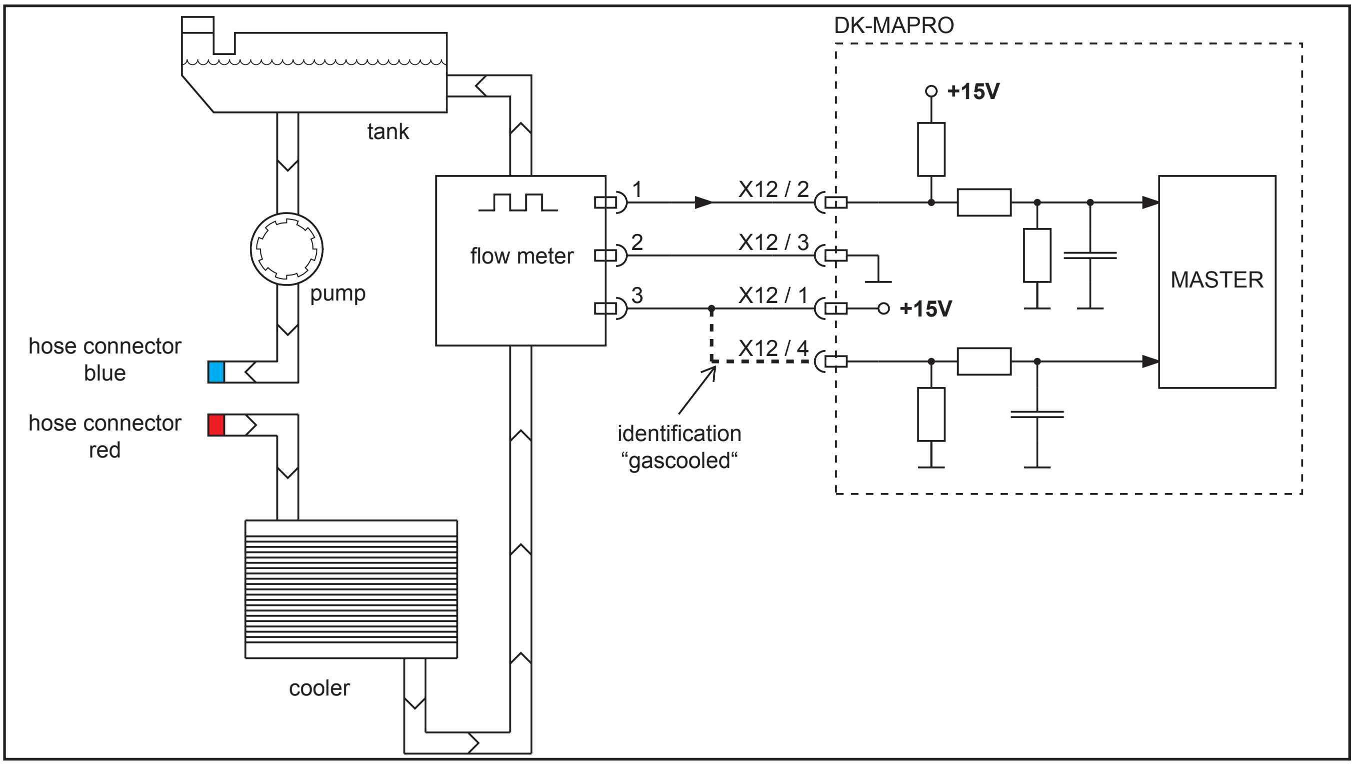
If the Master is measuring another voltage than the DSP, the machine will stop and displays **E09** (V/A measuring error).

If the Process is measuring an output voltage >60V when the machine is not welding (standby), the machine displays the error message **E21** (Output voltage/current).

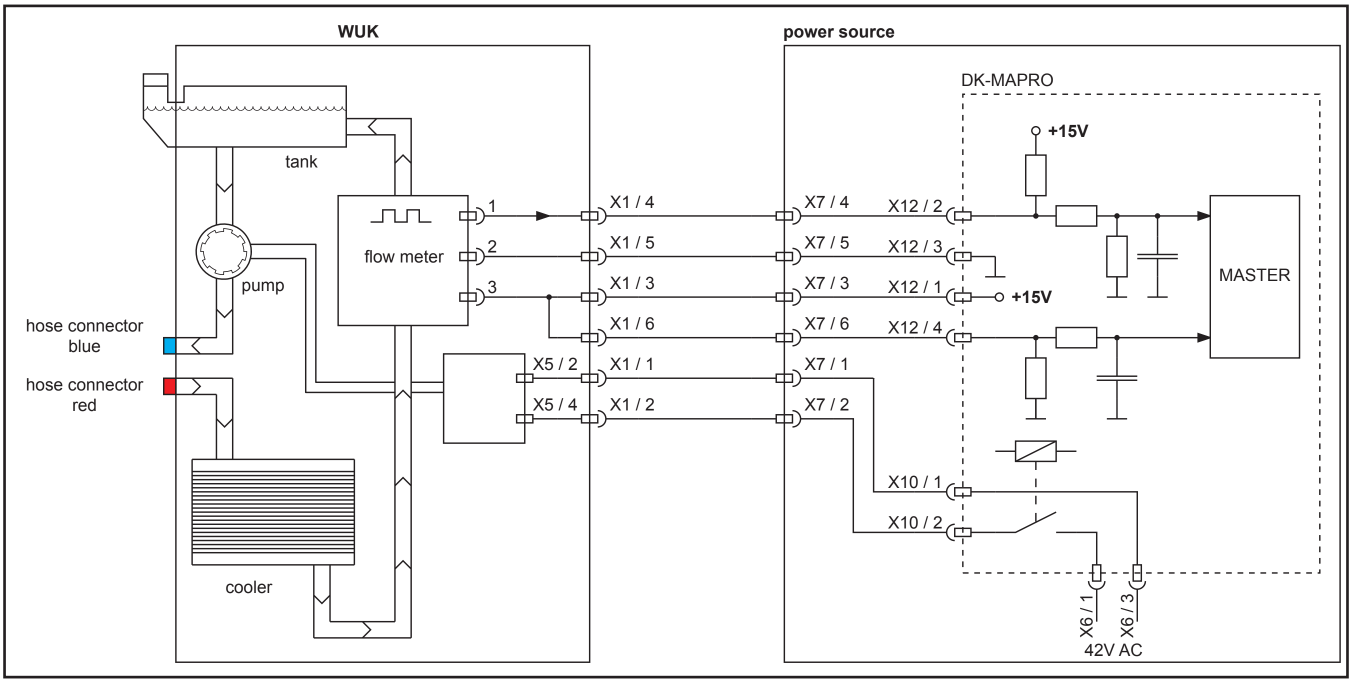
Cooling unit

At watercooled machines, the flowrate of the cooling liquid is measured in the return flow. The flowmeter output is a digital signal where it's frequency is proportional to the flowrate. The higher the flowrate, the higher the frequency. If the flowrate is below 0.3 liter per minute, the machines will stop and dislays **E05** (cooling system error).

Schematic (internal cooling unit)

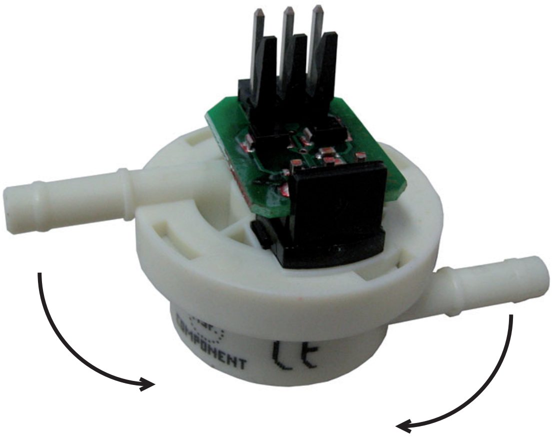
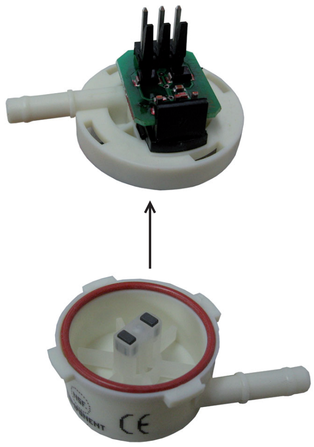
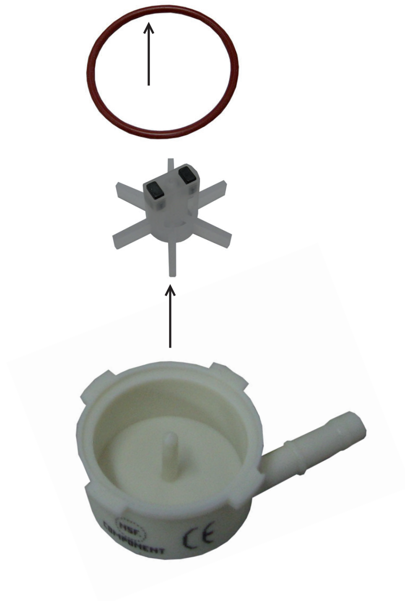


Schematic (external cooling unit "WUK")



At gas cooled machines, a small cable bridge is shorting pins 1 and 4 at connector X12, instead of a flow meter. This is the identification to deactivate the monitoring of the flow meter.
At the V mobile machines, this identification is used to detect if an external water cooling unit is attached or not. In this case the cable bridge has the opposite meaning: "water cooled". This is the reason for setting the DIP switch 4 on the DK-MAPRO board:
OFF = internal cooling system ("driveable machines")
ON = external cooling system ("mobile machines")

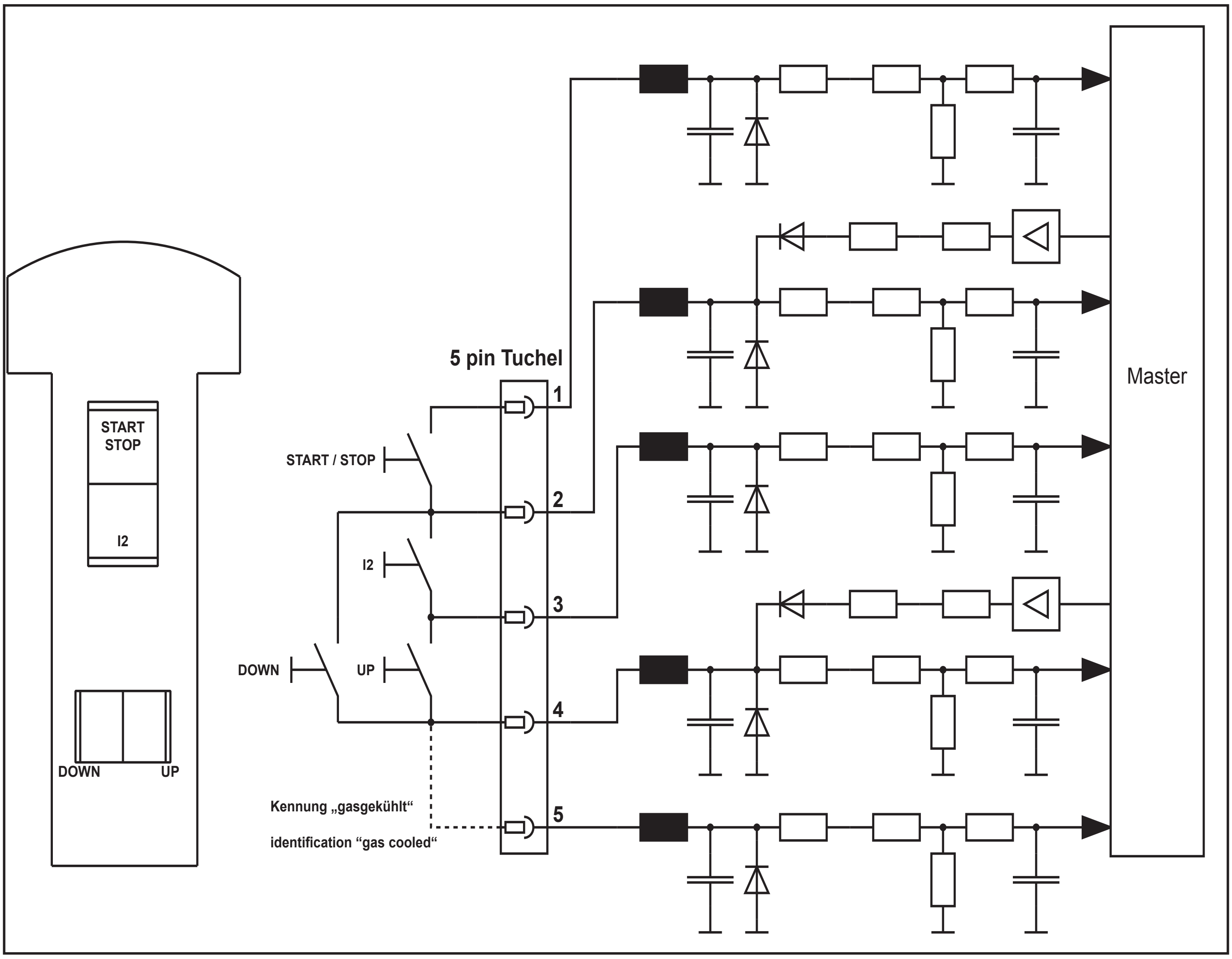
Flow meter

To open the flow meter, turn the housing halves against each other (bayonet assembly)	
take off the top halve	
take out sealing ring and the turbine **<u>!!! CAUTION !!!</u>** **mind the right flow direction, do not reverse in- and output when mounting the flow meter back into the machine**	

Torch control

The buttons of the torch are monitored by the Master of the DK-MAPRO board.

Schematic

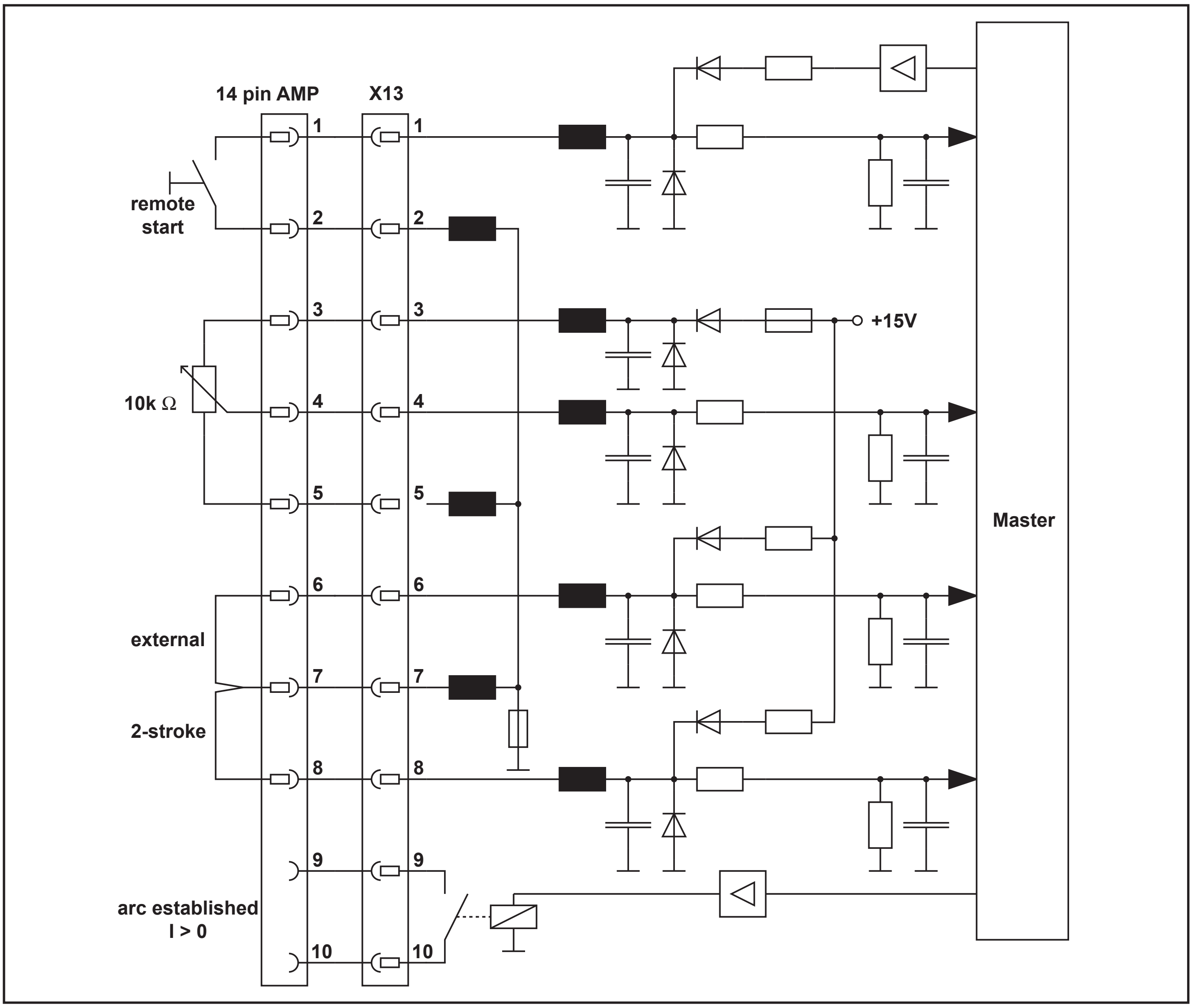


In case of short circuits between the connecting pins, the machine will stop and displays **E10** (error torch connection).
All gas cooled torches must have an internal cable bridge between pins 4 and 5. This is the identification for the machine to detect if the water cooling unit should be activated or not.
If there is no connection between pins 4 and 5, the machines will activate the pump as soon as it detects that an arc is ignited.
If the start contact is already closed when the machine is switched on, the machine displays also **E10**.

Remote control interface

The remote control interface is for connecting a hand or foot remote control. It is also possible to use the interface for a small automation application.
In case of “inpermissible“ short circuits between the connector pins of the interface, the machine will stop and displays **E11** (remote control conn.).
If the start contact is already closed when the machine is switched on, the machine displays also **E11**.

Schematic



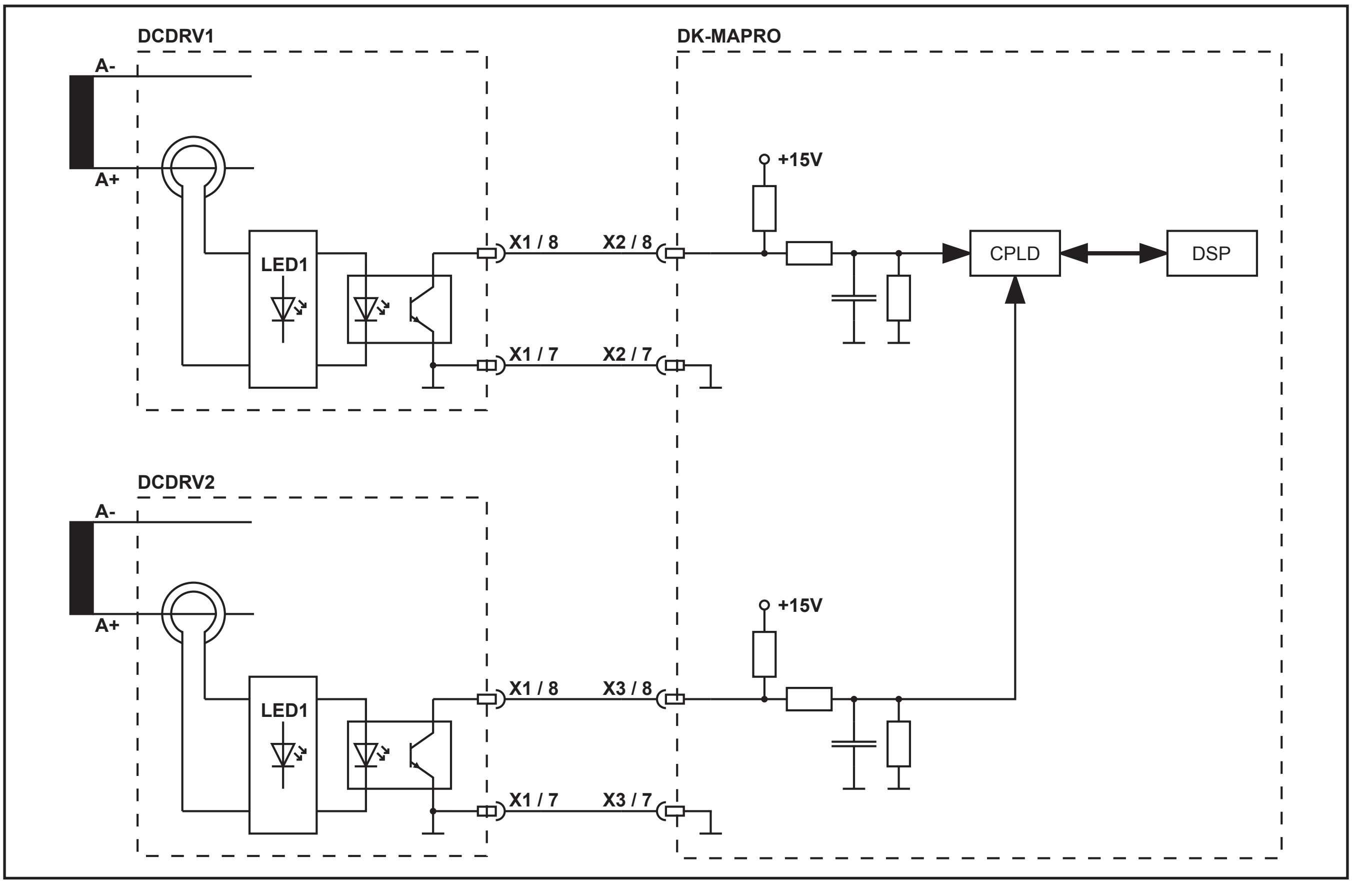
Signal overview

Signal	pin	designation
weld start	1 and 2	as soon as pin 1 and 2 are connected, the machine starts (same function as pressing the torch trigger switch)
weld energy	4	analog input for setting the weld energy (e.g. with an potentiometer) 0V = minimum setting of the actual welding program 15V = maximum setting of the actual welding program **<u>! CAUTION !</u>** this analog input is only valid if the identification “external“ on pin 6 and 7 is active
identification “external“	6	as soon as pin 6 is connected to pin 7, the analog input on pin 4 is valid
ground	7	gnd for the identification signals on pins 6 and 8
identification “2 stroke“	8	as soon as pin 8 is connected to pin 7, the machine operates in 2-stroke mode at “weld start“
arc established	9 and 10	potential free relay contact (closing contact) as soon as welding current is flowing, this relay contact is connecting pin 9 to 10 maximum contact load: 1A

Monitoring primary current

The input current of the power units is monitored at the DCDRV pcb. The current is measured with an internal current sensor, located on the pcb. As soon as the current is exceeding the maximum value, the CPLD (= Complex Programmable Logic Device) shuts down the power unit immediately.
The welding current of the V40 and V50 is generated by two power units parallel. The V24 to V30 only have one power unit.

Schematic



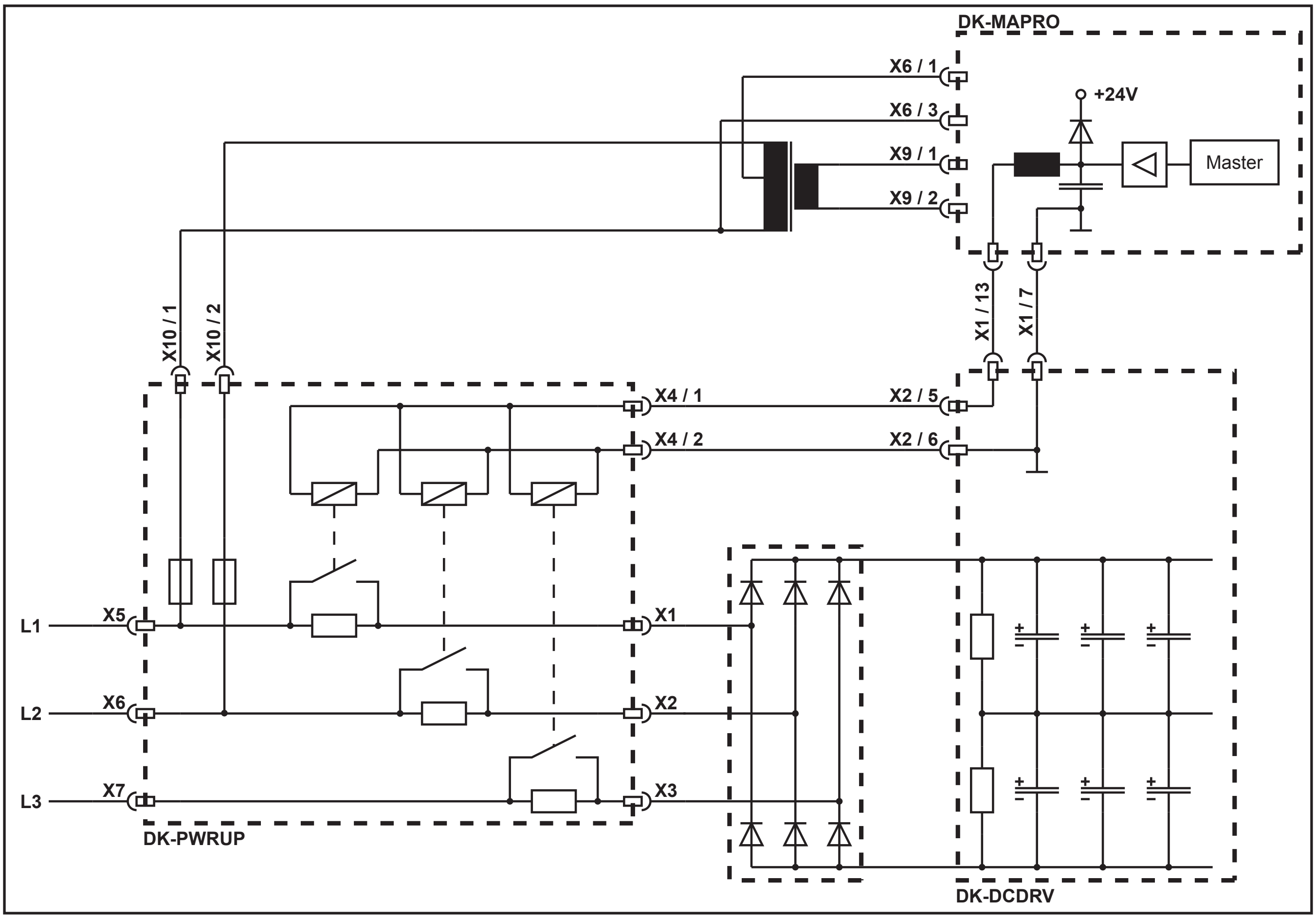
If power unit 1 draws too much current, the machine will stop and displays **E16** (primary overcurrent protection1).
If power unit 2 draws too much current, the machine will stop and displays **E24** (primary overcurrent protection2).

For example: **E16** (primary overcurrent protection1)
possible reasons could be:
- power unit 1 is broken (hardware defect, like broken MOSFET)
- power unit 2 is not active (if driver signals for the second power unit are missing or the DCDRV pcb of power unit 2 is malfunctioning)
  In this case power unit 1 has to generate all the weld energy by itself. Which is possible to a certain amount of power (200A to 250A) but beyond that, the unit will stop with **E16**
- malfunction at DCDRV pcb of power unit 1 (e.g. optocoupler output malfunction)
- bad flat ribbon cables between MAPRO pcb and power units

Power-up cycle

After switching on the machine with the mains switch, the capacitors on the DCDRV pcb are charged up first. These capacitors are buffering the bus voltage (rectified mains voltage). The input current during charge up can be very high and must be limited to prevent the mains fuses to break. The current limitation is made by the PWRUP pcb, where each phase is conducted via resistors to the mains rectifier. After the bus voltage reached a certain voltage (>250V DC), the resistors on the PWRUP pcb are short circuit with relays, so the the full mains input is present and the bus voltage is at maximum (560V DC to 580V DC).
The bus voltage is monitored by the DSP (Process) and the relays on the PWRUP board are switched by the microcontroller (Master).

Schematic

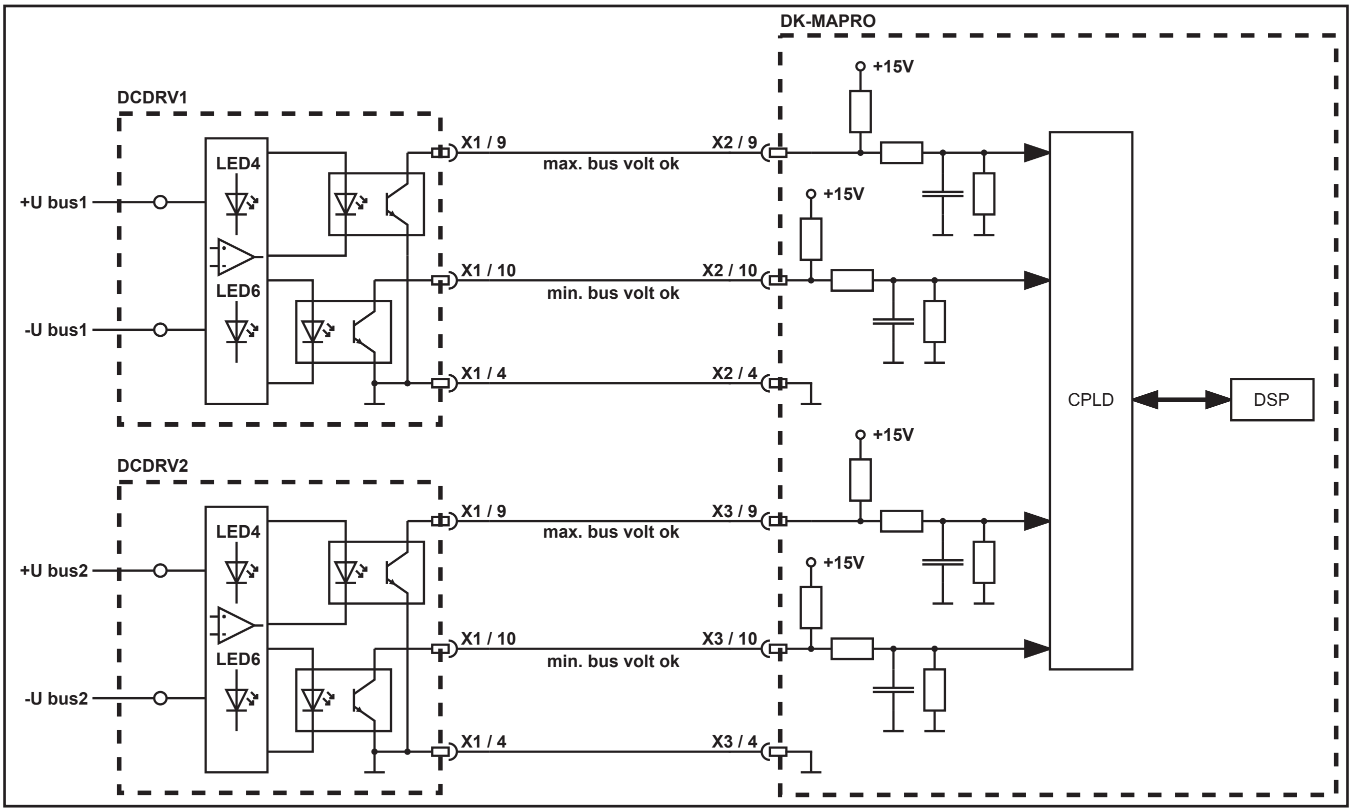


Monitoring bus voltage

The bus voltage is monitored by the DSP (Process) directly. As soon as the bus voltage is too low or too high, the machine will stop and displays the corresponding error message:
E22 : Mains undervoltage 1
E23 : Mains overvoltage
E30 : Mains undervoltage 2

Should the mains voltage be too low at both power units (only at V40 or V50), only the error message with the highest number is displayed (**E30**).

Schematic



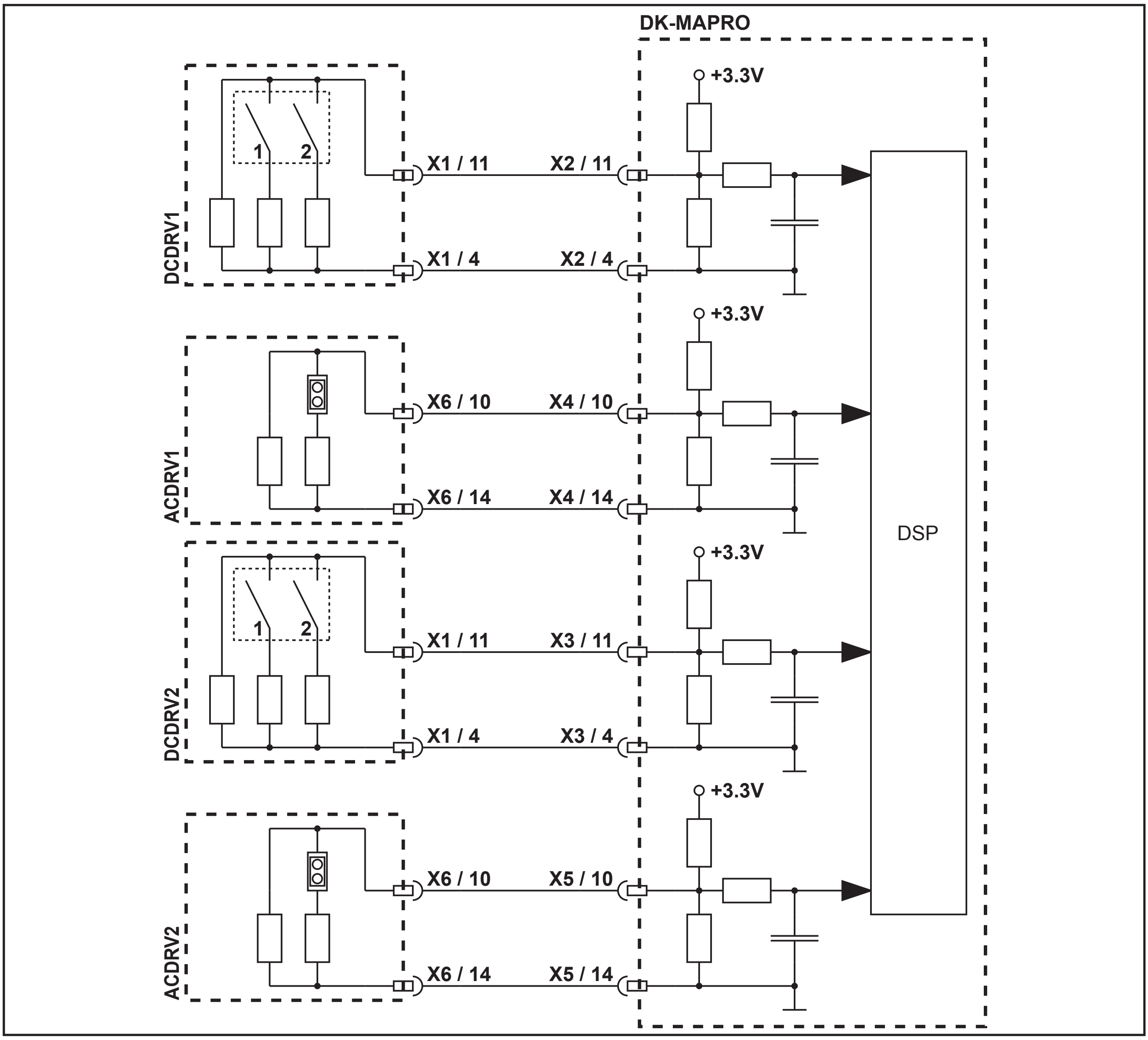
Voltage limits

bus voltage	LED4	LED6	optocoupler output min. bus volt. ok (pin 10)	optocoupler output max. bus volt. ok (pin 9)	error message
0 - 250V	on	off	high	low	E22, E30
255V - 700V	on	on	low	low	-
705V - ∞	off	on	low	high	E23

Identification power units

The pc-board DK-MAPRO is reading the configuration of the power units during the initialisation. On the primary sides (pc-board DCDRV) the configuration is set by a DIP switch. On the secondary sides at AC/DC machines (pc-board ACDRV) the configuration is set by a small jumper. The secondary side of the DC machines are the pc-board KSDCN, which have a fixed (not setable) configuration.
If the DK-MAPRO detects a non valid configuration, it will display the error code **E25** (Powermodul detection).

Schematic



primary side (on DCDRV boards)

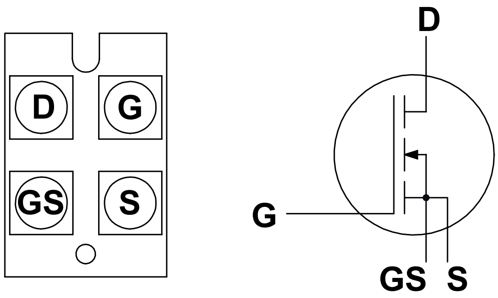
DIP 1	DIP 2	setting	type
OFF	OFF	240 A	V24, V40
OFF	ON	270 A	V27
ON	OFF	300 A	V30, V50
ON	ON	reserved	

secondary side (on ACDRV boards)

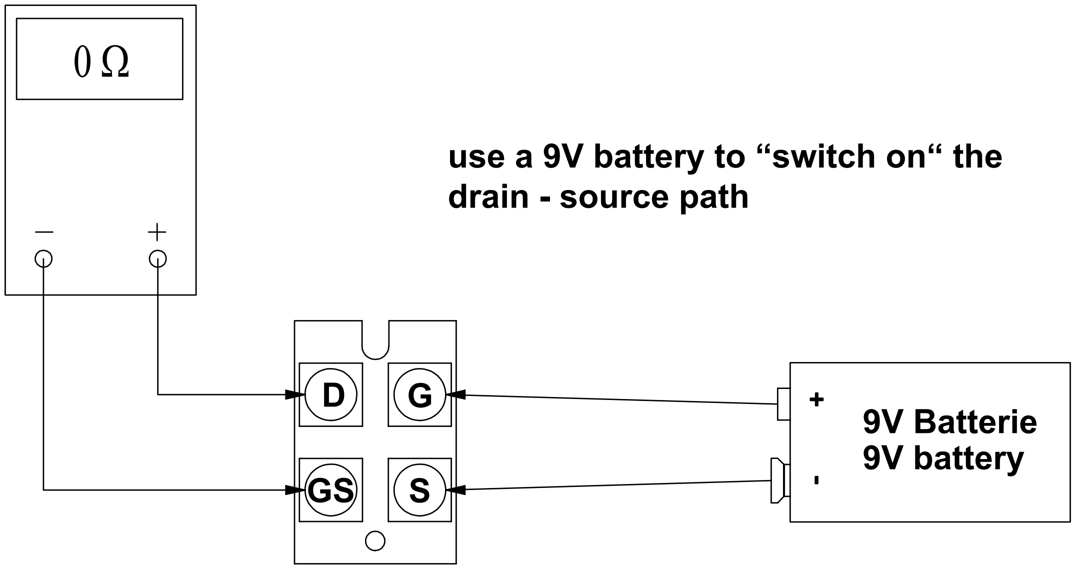
J1	setting	type
0 (jumper not set)	2 IGBT	V24, V40
1 (jumper set)	4 IGBT	V27, V30, V50

Checking MOSFETs

MOSFET - Test

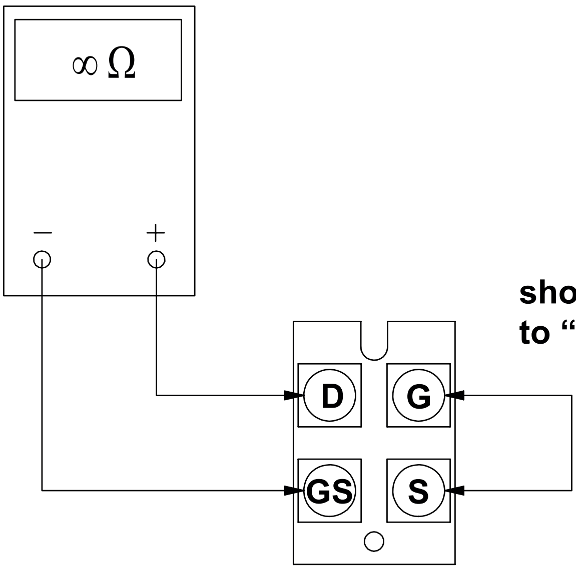


use a 9V battery to “switch on“ the drain - source path



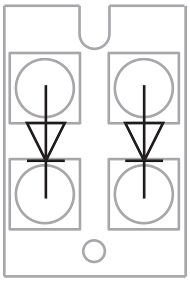
drain - source path is low resistant

short circuit between gate and source to “switch off“ the drain - source path



drain - source path is high resistant

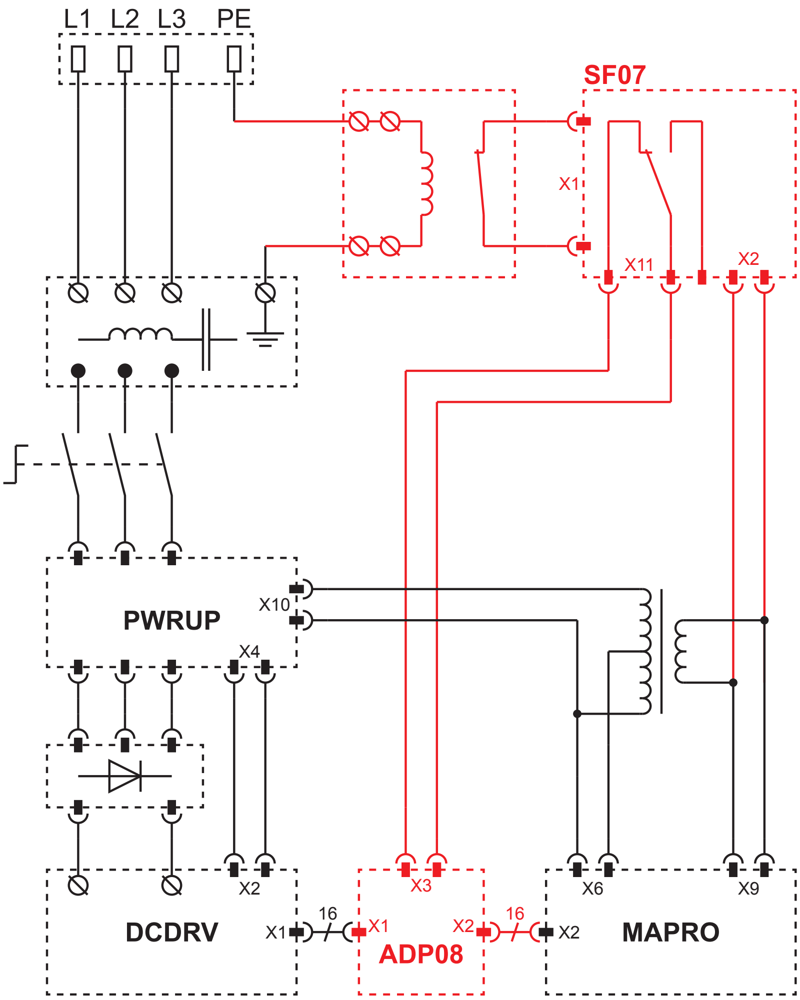
Inside diagram diodes



PE protection (optional)

The PE protection is an optional feature. As sson as a current >15A is flowing via the protective earth wire of the mains cable, the machine stops immediately and the error code E16 “primary overcurrent protection 1” is displayed.

Schematic



List of error codes

Code	designation	cause	remedy
E 00	no program	operating system and welding program doesn't match to each other	store welding programs matching to the operating system version, into the machine
E 01	thermal overload	temperature of power units are too high	let machine cool down in standby (*1) see page 32
E 02	mains overvoltage	mains voltage too high (24V supply > 36V)	check mains voltage and control transformer (*2) see page 33
E 03	secondary overcurrent	welding current is too high	check current sensor and its wiring see page 34
E 05	cooling system error	flowrate of the cooling liquid is too low (< 0.3 l/min)"	check connectors of flow-meter, level of cooling liquid and flowrate (*3). See page 36
E 06	secondary overvoltage	Master detects output voltage is too high	- check power unit - check ground connection see page 35
E 07	EEProm checksum error	no welding program stored or error during reading from memory	transfer welding programs to machine again
E 09	V/A measuring error	external current/voltage or measure-difference between Master and Process	check wiring of current sensor and pc-board DK-UFI DC machines: check DK-KSDCN AC machines: check IGBTs see page 34 and page 35
E 10	torch connection	short circuit of torch control cables or between torch switch wires and welding potential	check torch control cables and torch interface see page 38
E 11	remote-control conn.	short circuit between remote control cables	check remote control and wiring of remote control socket, see page 39
E 12	Communication Process	Process is not responding to Master	switch the machine off and on again optionally exchange pc-board DK-MAPRO
E 13	Temp. sensor error	Temp. sensor is defective	check resistor value and wiring of the sensor see page 32
E 14	Op. voltages error	supply voltage is too low (24V < 17V)	check mains voltage and control transformer (*2) see page 33
E 16	primary overcurrent protection1	- power consumption of power unti 1 is too high - PE protection became active	- check DK-DCDRV and MOSFETs of power unit1 - check ground cable and wiring of power unit see page 40 and page 45
E 17	Error current symmetry	output difference between power units	check power units (*4), see page 34
E 19	Ignition unit error	no response of ignition unit to pc-board DK-MAPRO	check/exchange pc-board DK-HFDC see page 28
E 20	Overvoltage sec.	Process is measuring a too high output voltage or no voltage at all	check wiring of the output sockets to DK-MAPRO check power unit see page 35
E 21	Output voltage/current	external current/voltage or measure-difference between Master and Process	check wiring of current sensor and pc-board DK-UFI, see page 34 and page 35
E 22	Mains undervoltage 1	power unit 1 reports mains voltage too low	check mains voltage and mains rectifier see page 42
E 23	Mains overvoltage	power unit reports mains voltage too high	check mains voltage, see page 42
E 24	Overcurrent protection2	power consumption of power unti 2 is too high	check DK-DCDRV and MOSFETs of power unit 2 see page 40
E 25	Power module detection	Jumper on pc-board DK-DCDRV or pc-board DK-ACDRV have been set wrong	check Jumper J1, J2 on pc-board DK-DCDRV (by AC machines check also Jumper 1 on pc-board DK-ACDRV), see page 43
E26	Synchronisation error	communication between the machines is not working properly	check optical cable between both machines and settings of each machine (Synchro Master-Slave setting)
E 29	AC Overvoltage	ignition voltage in zero-crossing is too high	check IGBTs
E 30	Mains undervoltage 2	power unit 2 reports mains voltage too low	check mains voltage and mains rectifier see page 42
E 31	Communication error	Master is not responding to Process	switch the machine off and on again optionally exchange pc-board DK-MAPRO

(*1) display the module temperatures in menu Extras > Diagnosis > Module temperatures
(*2) display the supply voltages in menu Extras > Diagnosis > Op. voltages 15V / 24V
(*3) display the flow rate in menu Extras > Diagnosis > Flow rate cooling system
(*4) display the welding current of the mudules in menu Extras > Diagnosis > Current module 1 / 2

LORCH

Lorch Schweißtechnik GmbH   Postfach 1160   D-71547 Auenwald   Germany
Tel. +49 (0)7191 503-0   Fax +49 (0)7191 503-199   info@lorch.biz   www.lorch.biz