COMBIVERT

GB **Instruction Manual Power Supply R5-C V1.1**

Mat.No.	Rev.
00R50EB-K001	1D

KEB

Preface

1.1 General

First we would like to welcome you as a customer of the company KEB Automation KG and congratulation to the purchase of this product. You have decided for a product on highest technical level.
The described hard- and software are developments of the KEB Automation KG. The enclosed documents correspond to conditions valid at printing. Misprint, mistakes and technical changes reserved.
The instruction manual must be made available to the user. Before working with the unit the user must become familiar with it. This especially applies to the knowledge and observance of the following safety and warning indications. The pictographs used in this instruction manual have following meaning:

	Danger Warning Caution	Is used, if life or health of the user is in danger or if substantial damage to property can occur.

	Attention observe at all costs	Is used, if a measure is necessary for safe and trouble-free operation.

	Information Aid Tip	Is used, if a measure simplifies the handling or operation of the unit.

Non-observance of the safety instructions leads to the loss of any liability claims. This list is not exhaustive.

1.2 Safety instructions

	Observe safety and operating instructions	Precondition for all further steps is the knowledge and observance of the safety and operating instructions. This is provided accompanied by the device or by the download site of www.keb.de.

Non-observance of the safety and operating instructions leads to the loss of any liability claims. The warnings and safety instructions in this manual work only supplementary. This list is not exhaustive.

1.3 Validity and liability

The use of our units in the target products is outside of our control and therefore lies exclusively in the area of responsibility of the machine manufacturer.
The information contained in the technical documentation, as well as any user-specific advice in spoken and written and through tests, are made to best of our knowledge and information about the application. However, they are considered for information only without responsibility. This also applies to any violation of industrial property rights of a third-party.
Selection of our units in view of their suitability for the intended use must be done generally by the user.
Tests can only be done within the application by the machine manufacturer. They must be repeated, even if only parts of hardware, software or the unit adjustment are modified.

Unauthorised opening and tampering may lead to bodily injury and property damage and may entail the loss of warranty rights. Original spare parts and authorized accessories by the manufacturer serve as security. The use of other parts excludes liability for the consequences arising out of.
The suspension of liability is especially valid also for operation interruption loss, loss of profit, data loss or other damages. This is also valid, if we referred first to the possibility of such damages.
If single regulations should be or become void, invalid or impracticable, the effectivity of all other regulations or agreements is not affected.

1.4 Copyright

2. Product description

With R5-C COMBIVERT you have acquired a DC supply unit with the highest demands on security and reliability.
This instruction manual describes the supply unit KEB COMBIVERT R5-C of the 400-V in a range of 30 kW...250 kW.

2.1 Specified application

The COMBIVERT R5-C serves exclusively for supply of frequency inverters with DC supply. The operation of other electric consumers is prohibited and can lead to the destruction of the unit!

2.2 Features of the COMBIVERT R5-C

- Degree of protection IP20
- Extensive protection against overcurrent, ground fault and temperature
- Short-circuit proof (with corresponding dimensioned mains fuses)

2.3 Unit identification

23.R5.C 1 R-9 0 R 0

Cooling	A: default	
Version	0: default	
free	0: default	
Voltage	9: 3ph; 400 V; AC	
Housing	R; U	
Options	0: without	3: precharging; DC-fuses
	1: precharging	4: GTR7; precharging; DC-fuses
	2: GTR7; precharging	
Control card	0: without	C: 2C.F5
Unit type	R5	
Size	19; 23; 25; 27; 28; 29	

2.4 Technical data

Rectifier size			19	23	25	27	28	29
Housing size			R	R	R	U	U	U
Chargeable inverter power	1)	[kW]	30	75	110	160	200	250
DC nominal output current		[A_{DC}]	90	180	270	380	470	610
Max. short time current	2)	[A_{AV}]	135	270	405	570	705	915
OL current		[A_{DC}]	153	306	459	646	799	1037
Input current	3)	[A_{RMS}]	79,8	147,5	221	312	386	500
Mains voltage		[V AC_{RMS}]	305…504 +/- 0%					
Phases			3					
Mains form			TN, TT					
Output voltage		[V DC]	430…713					
Maximal permissible mains fuse		[A]	100	200	350	500	710	710
I^2t mains fuse		[A^2s]	<19.100	<128.000	<231.200	<320.000	<845.000	<845.000
Supply line cross section (min)		[mm^2]	35	95	150	2x150	2x185	2x185
Supply line cross section (max)		[mm^2]	95	150	150	2x185	2x185	2x185
DC line cross section (min)		[mm^2]	50	120	150	2x150	2x150	4x95
DC line cross section (max)		[mm^2]	95	150	150	4x185	4x185	4x185
Storage temperature		[°C]	-25…70					
Operation temperature		[°C]	-10…45					
Climatic category (EN 60721-3-3)			3K3					
Protective system			IP20			IP00		
Power loss at nominal operating		[W]	ca. 220	ca. 400	ca. 600	ca. 1050	ca.1200	ca.1600
Max. heat sink temperature		[°C]	90					
Internal braking option			Option					
Max. braking current		[A]	133	133	200	250	250	250
Min. braking resistor		[Ohm]	6	6	4	3,2	3,2	3,2
Typ. braking resistor		[Ohm]	15	6,7	4,3	4,3	3,2	3,2
Line cross section braking resistor		[mm^2]	35…95			16…185		
Weight		[kg]	28			49	54	56

1) The typical inverter ratings are only assignment references for the components. The drive powers are dependent on the connected motors and must be designed accordingly.

2) The max. short time current limit is specified for 1 minute. The overload cycle is 300 seconds. This corresponds to duty class 2 EN 60146-1-1.

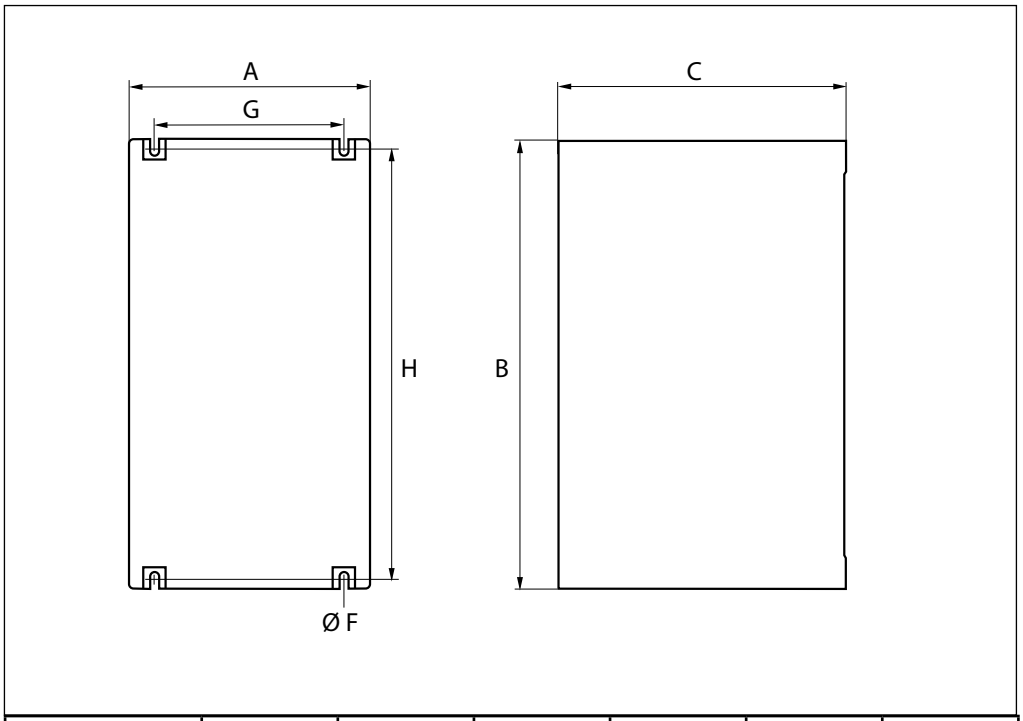
3) The current data are based on a fundamental frequency component of g=0,75. The fundamental frequency component or the effective value of the input current is dependent on load and line supply conditions. At uncontrolled B6 converters the phase angle cosφ1 can be set to one, so the value of the fundamental frequency components is equal to the value of the power factor.

The units are not short-circuit proof without corresponding dimensioned fuses.The max. loadable DC link capacity is 100000 µF. Exceeding the capacity triggers the error "charge time out" (E.cto). Do not charge the DC link during the load cycle.

3. Installation

3.1 Unit Installation

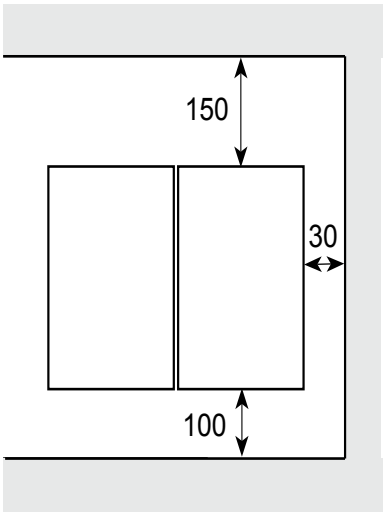
3.1.1 Dimensions



Housing	A	B	C	F	G	H
R	340	545	355	10	300	515
U	340	800	408	11	300	774

3.1.2 Installation Instructions

The COMBIVERT R5 is provided for vertical installation. The following minimum distances must be observed:



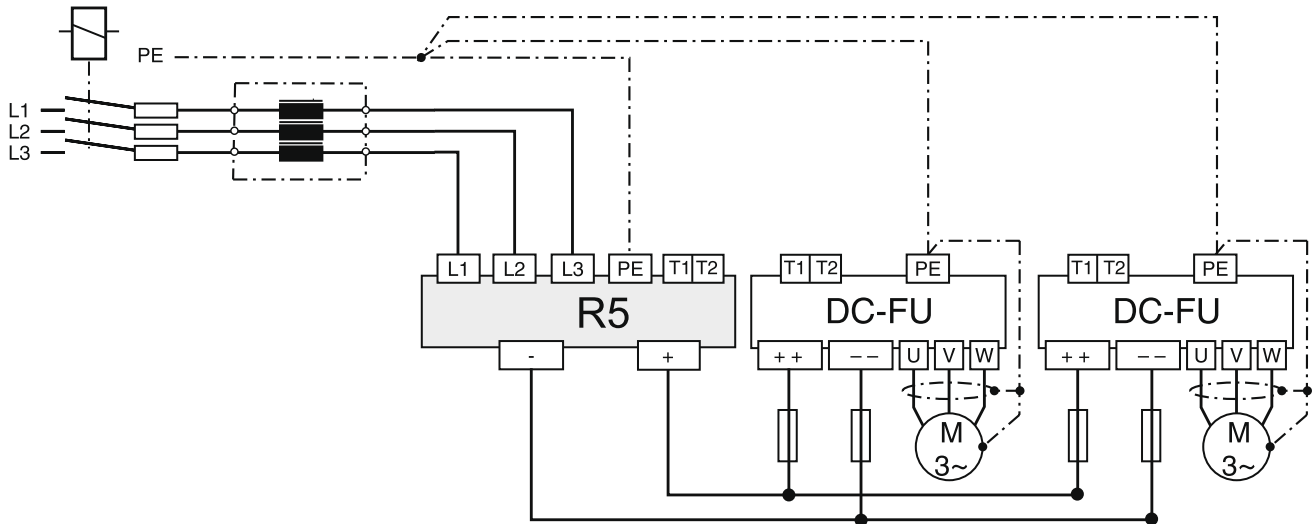
3.2 Connection of the Power Unit

3.2.1 Mains Connection of the Supply Unit

- absolutely use a line reactor
- in case of interconnected operation with several supply units consider information sheet 00.R5.0DM-I000!

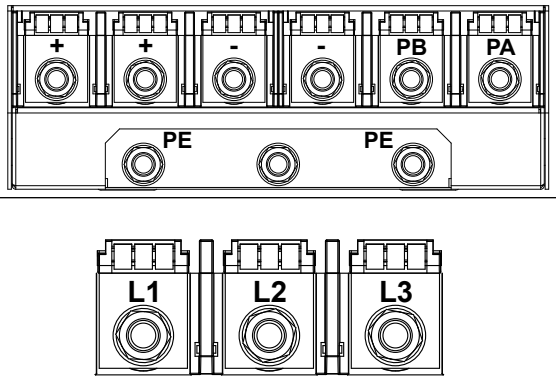
Switching at the input without waiting of an under-potential error (E.UP) causes high wear of the switching contacts. Fuses and overcurrent protection units can release furthermore. See publication ENG 000 0001.

Connection of the supply unit



3.2.2 Terminal strips of the power circuit

	All terminal strips following the requirements of the EN 60947-7-1 (IEC 60947-7-1)

Connection terminals	Terminal in acc. with table 3.2.2.1		
	**Name**	**Function**	**No.**
	L1, L2, L3	3-phase mains connection	4
	PA, PB	Connection for braking resistor	
	+, –	DC link output	
	PE	Connection for shielding /earthing	
	T1, T2	Connection for temperature sensor	3

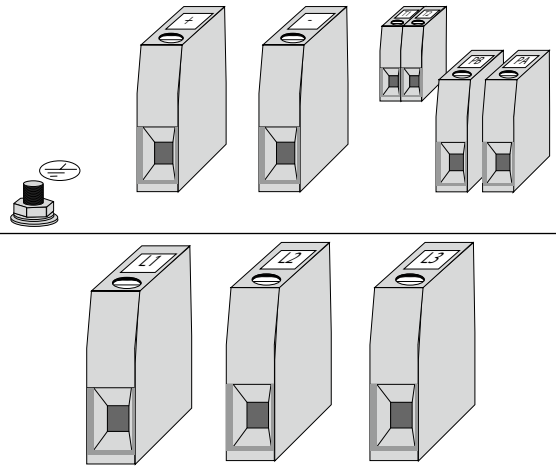
	Terminal in acc. with table 3.2.2.1		
	**Name**	**Function**	**No.**
	L1, L2, L3	3-phase mains connection	1
	+, -	DC link output	
	PA, PB	Connection for braking resistor	2
	T1, T2	Connection for temperature sensor	3
	⏚	Connection for shielding /earthing	4

Table3.2.2.1 Permissible cable cross-sections and tightening torques of the terminals

No.	permissible cross-section flexible with wire-end ferrule				Max. tightening torque	
	mm²		AWG/MCM		Nm	lb inch
	min	max	min	max		
1	50	150	6 AWG	0 MCM	25…30	220
2	35	95	4 AWG6	000 MCM	15…20	150
3	0.2	4	24 AWG	10 AWG	0.6	5.3
4	10 mm stay bolt for ring thimble				25	220

3.2.3 Connection of the Braking Resistor

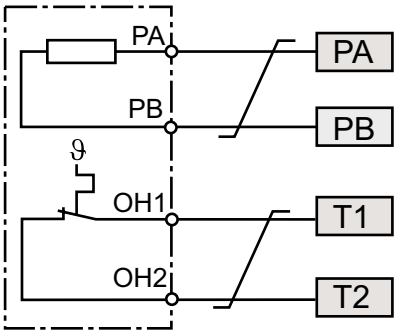
It is absolutely necessary to monitor the braking resistance temperature switch to record a braking resistance overheat. The overheat may be caused by:
- incorrect dimensioning of the braking resistance
- the input voltage being too high

The current of the brake transistor is monitored additionally. The input thyristors are switched off in case of a short circuit.

Braking resistors can develop a very high surface temperatures, therefore install as safe-to-touch as possible!

Connection of a braking resistor

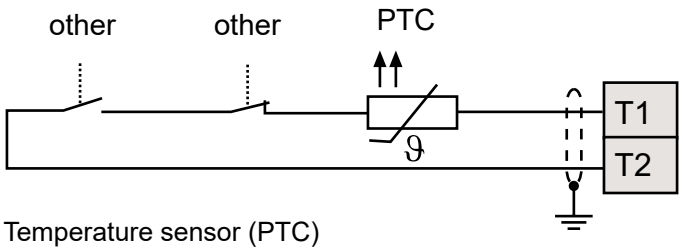
As standard the evaluation at terminals T1 and T2 is switched off and must be activated if necessary (application mode Pn.12=“7“).



3.2.4 Connection of a Temperature Detection

An external temperature sensor/switch can be connected to the terminals T1, T2 . The supply unit switches off with the error message E.OH during tripping.

As standard the evaluation at terminals T1 and T2 is switched off and must be activated if necessary (application mode Pn.12=“7“).



Temperature sensor (PTC)
Tripping resistance 1650 Ω…4 kΩ
Reset resistance 750 Ω…1650 Ω
(acc. VDE 0660 Teil 302)

3.3 Instructions of an EMC-conform Installation

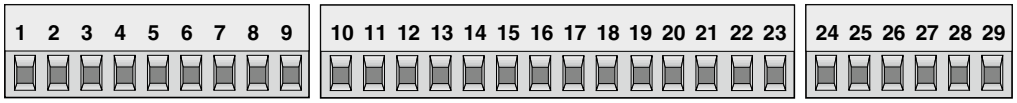
- To avoid coupled-in noise, separate
  a) Line-supply cables,
  b) Motor lines of frequency inverters/servo power controller,
  c) Lay control and data lines (low-voltage level <48 V), with a distance of at least 15 cm.
- In order to maintain low-resistance high frequency connections, earthing and shielding, as well as other metallic connections (e.g. mounting plate, installed units) must be in metal-to-metal contact with the mounting plate, over as large an area as possible. Use earthing and equipotential lines with a section as large as possible (min. 10 mm^2) or use thick earthing strips.
- If external interference suppression filters are used, then these must be installed as close as possible to (<30 cm from) the interference source and in metal-to-metal contact with the mounting plate, over as large an area as possible.
- Always equip inductive control elements (contactors, relays etc.) with suppressors such as varistors, RC-elements or damping diodes.
- All connections must be kept as short as possible and as close as possible to the earth, as free floating lines work as active and passive aerials.
- Keep connection cables straight (do not bundle). Install a non-assigned wire on both sides of the protective conductor.
- The flow and return circuit must be twisted when the lines are not shielded, in order to dampen common-mode noise.
- As a general principle use metal cable glands with shield connection.

4. Installation and connection

4.1 Control Card Version C

4.1.1 Assignment of the Terminal Strip X2A

X2A



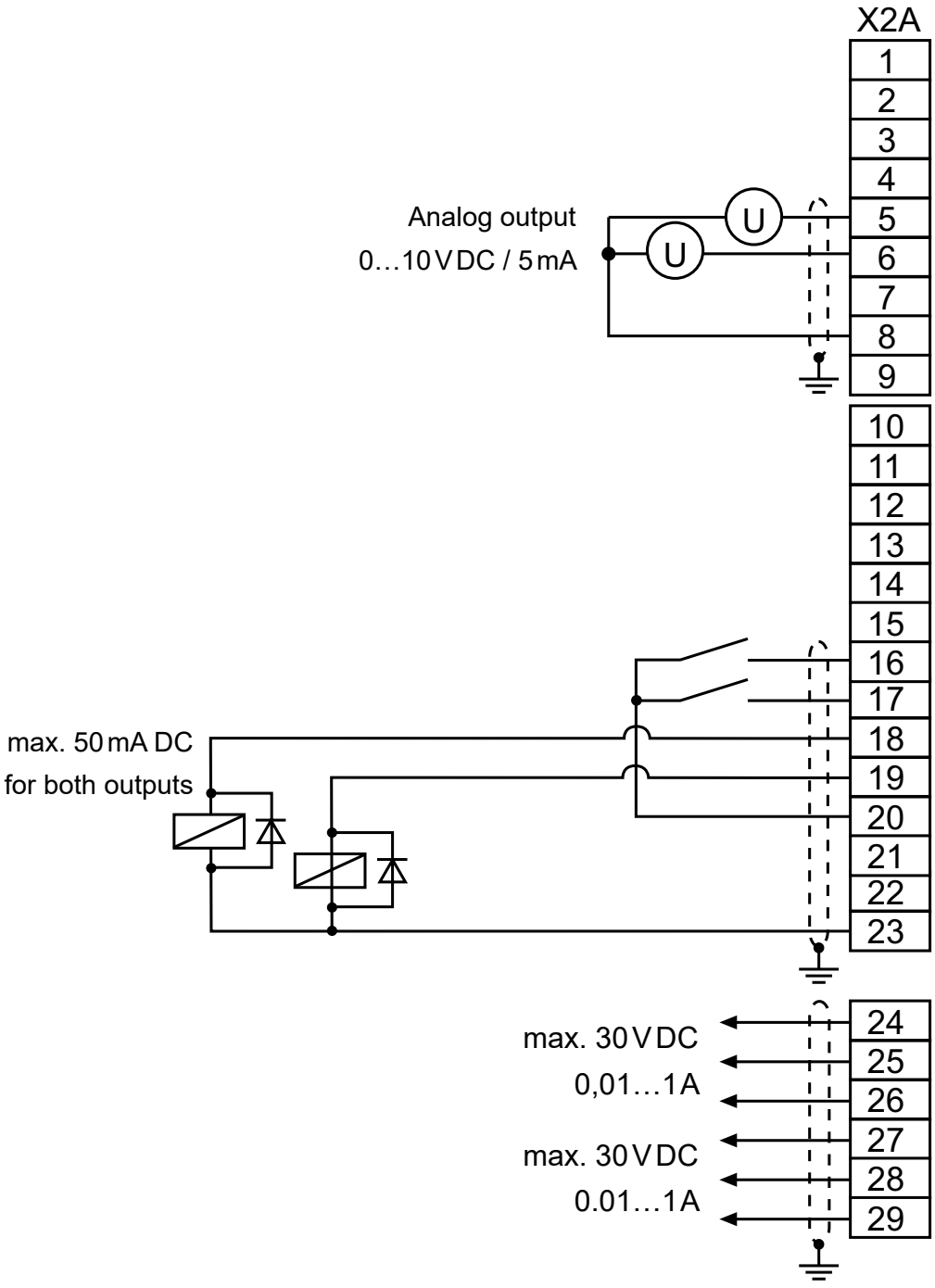
PIN	Function	Name	Explanation	
1...4	without function - -	-	-	
5	Analog output 1:	ANOUT1	Analog output of the DC output current 0…10 VDC ≙ 0…200 %	Voltage range: 0…±10 V Ri: 100 Ω Resolution: ±10Bit
6	Analog output 2:	ANOUT2	Analog output of the DC voltage 0…10 VDC ≙ 0…1000 VDC	
7	without function - -	-	-	
8	Analog mass	COM	Mass for analog in- and outputs	
9	Analog mass	COM		
10	without function - -	I1	-	Ri: 2,1 kΩ Scan time: 4 ms
11	without function - -	I2	-	
12	without function - -	I3	-	
13	without function - -	I4	-	
14	Slave input	I5	only interconnected operation 00.R5.0DM-I000	
15	without function - -	I6	-	
16	Start	ST	Thyristors switched through Error reset during opening	
17	Reset	RST	Reset; only possible in fault condition	
18	Transistor output 1	O1	„Run“; is set, if the thyristors are switched trough	
19	Transistor output 2	O2	„Error" is set, if the unit switched off on error	
20	24 V-output	Uout	Power supply for digital inputs	I_{max}: 100 mA
21	without function - -	-	-	
22	Digital ground	0V	Reference potential for digital in-/outputs	
23	Digital ground	0V		
24	Relay 1 / NO contact	RLA	Relay output Ready for operation signal	max. 30 V DC 0.01…1 A
25	Relay 1 / NC contact	RLB		
26	Relay 1 / switching contact	RLC		
27	Relay 2 / NO contact	FLA	Relay output phase error warning	
28	Relay 2 / NC contact	FLB		
29	Relay 2 / switching contact	FLC		

4.1.2 Connection of the control

In order to avoid malfunctions caused by interference voltage supply at the control inputs, the following instructions must be observed:

EMC

- Use shielded/drilled cables
- Lay shield on one side of the inverter onto earth potential
- Lay power and control cable **separately** (about 10…20 cm distance); lay cables in a right angle

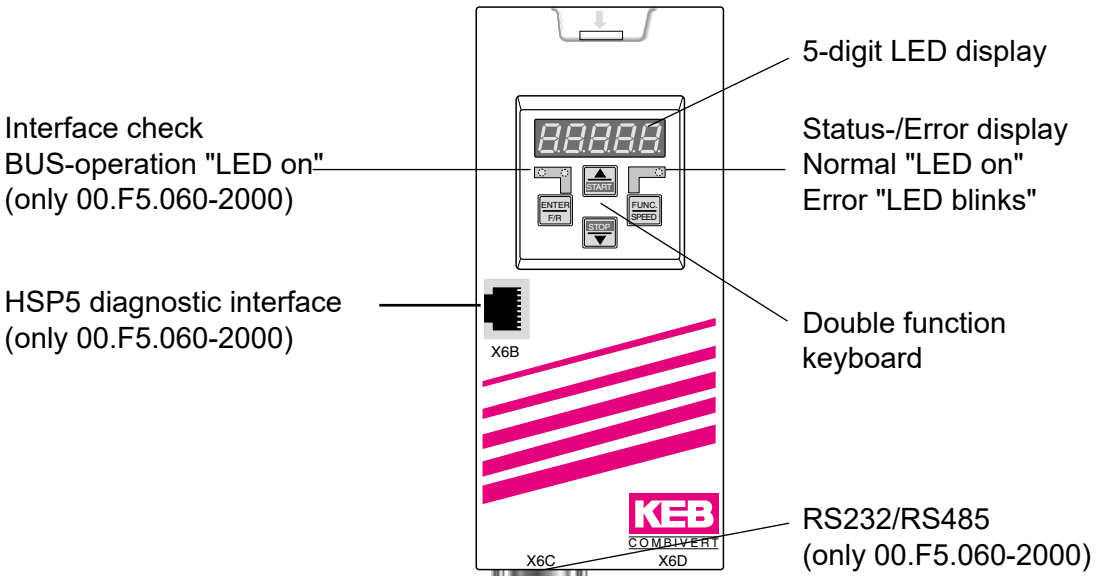


5. Operation of the Unit

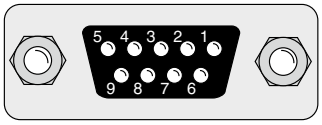
An operator is necessary as accessories for local or external (Option: cable 00.F5.0C0-1xxx) programming of the frequency inverter KEB COMBIVERT. In order to avoid malfunctions the frequency inverter must be brought into status nOP before plug-on/remove of the operator (open control release). During starting of the frequency inverter it always starts with the last stored values/factory setting.

5.1 Operator

Digital operator with operation and display: Part No. 00.F5.060-1000
Interface operator additionally with serial interface: Part No. 00.F5.060-2000

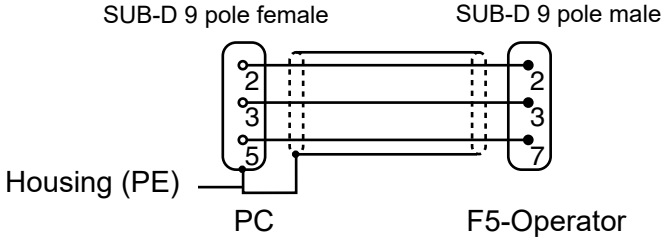


Only use the operator interface for the serial data transfer to RS232/485.The direct connection, PC to the inverter is only valid with a special cable **(HSP5 PartNo. 00.F5.0C0-0001), otherwise, it would lead to the destruction of the PC-interface**!



PIN	RS485	Signal	Meaning
1	-	-	reserved
2	-	TxD	transmission signal RS232
3	-	RxD	receive signal RS232
4	A‘	RxD-A	receive signal A RS485
5	B‘	RxD-B	receive signal B RS485
6	-	VP	voltage supply plus +5 V (Imax=10 mA)
7	C/C‘	DGND	data reference potential
8	A	TxD-A	transmission signal A RS485
9	B	TxD-B	transmission signal B RS485

RS232-cable 3m
PC / Operator
Part No. 00.58.025-001D

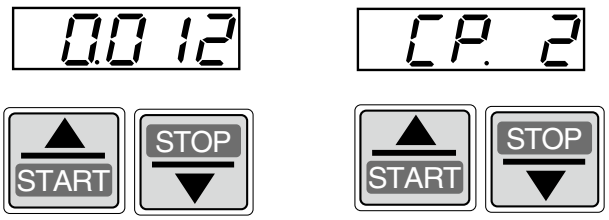


5.1.1 keyboard

When switching on KEB COMBIVERT R5 the value of parameter CP.1 is displayed. (change-over of the keyboard function see Drivemode)

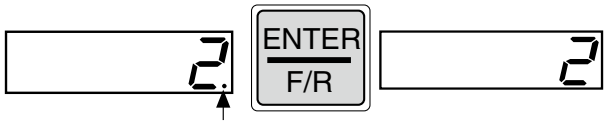
The **function** key is used to change between parameter value and parameter number.

With **UP** and **DOWN** the value of the parameter number is increased/ decreased with changeable parameters.

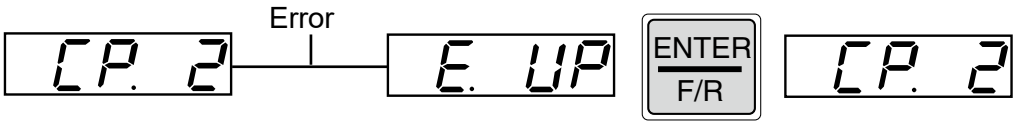


Principally during a change, parameter values are immediately accepted and stored non-volatile. However, with some parameters it is not useful that the adjusted value is accepted immediately. When this type of parameter is changed a point appears behind the last digit.

The adjusted value is accepted and non-volatile stored with ENTER.



If a malfunction occurs during operation, the actual display is overwritten by the alarm message. The alarm message in the display is reset by ENTER.



With ENTER only the error message in the display is reset. In order to reset the error itself, the cause must be removed or a power-on reset must be made. In the status display (CP. 1) the error will still be shown.

5.2 Parameter summary

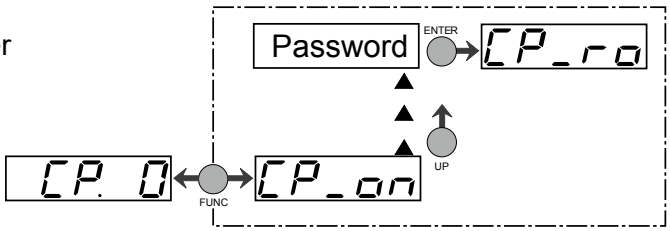
The CP parameters are one of the parameter selection defined by KEB. You need an application manual in order to get access to the entire parameters.

Display	Parameter	Setting range	Resolution	Fact. setting
CP. 0	Password input	0…9999	1	–
CP. 1	Status display	–	–	–
CP. 2	AC input current	–	0.1A	–
CP. 3	DC output current	–	0.1A	–
CP. 4	DC - output current / peak value	–	1 %	–
CP. 5	current DC - utilization	–	1V	–
CP. 6	current DC - voltage	–	1V	–
CP. 7	DC output voltage	–	1V	–
CP.8	DC - output voltage / peak value	–	1V	–
CP.9	Heat sink temperature	–	1 °C	–
CP.10	Charging time factor	100…500 %	1 %	100 %
CP.11	Analog output 1 gain	-20.00…20.00	1	1.00
CP.12	Analog output 2 gain	-20.00…20.00	0.01	1.00
CP.13	AC-Phase current L1	–	0.1A	–
CP.14	AC-Phase current L2	–	0.1A	–
CP.15	AC-Phase current L3	–	0.1A	–

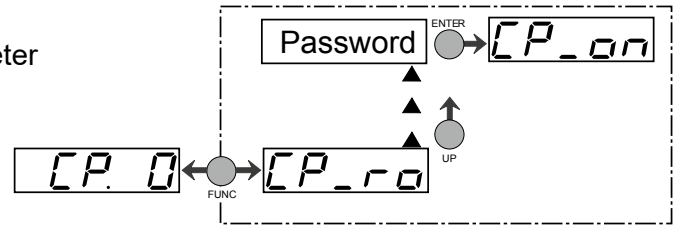
5.3 Password input

Ex works the frequency inverter is supplied without password protection, this means that all changeable parameters can be adjusted. After parameterizing the inverter can be secured against unauthorized access. The adjusted mode is stored.

Blocking the CP-Parameter



Releasing the CP-Parameter



5.4 Parameter Description

The following parameters serve for the functional monitoring during operation.

CP. 1
Inverter state

The status display indicates the actual operating condition of the inverter. Possible displays and their meaning:

noP	"no Operation" Starting terminal not bridged, thyristors blocked, output voltage = 0 V
run	"run" supply unit ready for operation; Thyristors connected
charG	"charge" DC output voltage is loaded on actual DC voltage
GFt	"Ground Fault test" is displayed during power-on test.
E.GF1	Earth fault during power-on test
E.GF2	Earth fault during operation
E.cto	"Error charge time out" DC output voltage could not be loaded within the adjusted charging time.
E.rEco	"Error rectifier output" Difference between DC output voltage and actual DC voltage during the operation higher than 200 V.
E.UPh	"Error Phase failure" detects an error in one input phase (see 6.6.5). The utilization of L1, L2 and L3 is compared all 4 ms with the average value of the effective input currents (CP. 2) If after triple scanning (12 ms) a difference of >15 % of one phase to CP.2 is detected, then • a prewarning is released and switched off after 60 s, if the difference is < 50 %. • immedeiately switched off, if the difference is ≥ 50 %.

CP. 2
AC current

Display of the average value of the effective input currents of phase L1...L3 in ampere.

CP. 3
DC current

Display of the actual DC output current in ampere.

CP. 4
DC current peak value

This display enables a detection of short-term current peaks, as the highest value that occurred is stored.
The peak value can be reset with UP or Down when the unit is switched on. Switching off the unit deletes the peak value.

CP. 5
Actual DC gain

Display of the actual utilization of the supply unit in percent. 100 % correspond to the rated current.

CP. 6
Actual DC voltage

Display of the current DC voltage in volt. The value is measured in the charge circuit. The value serves as comparison value to the DC output voltage.

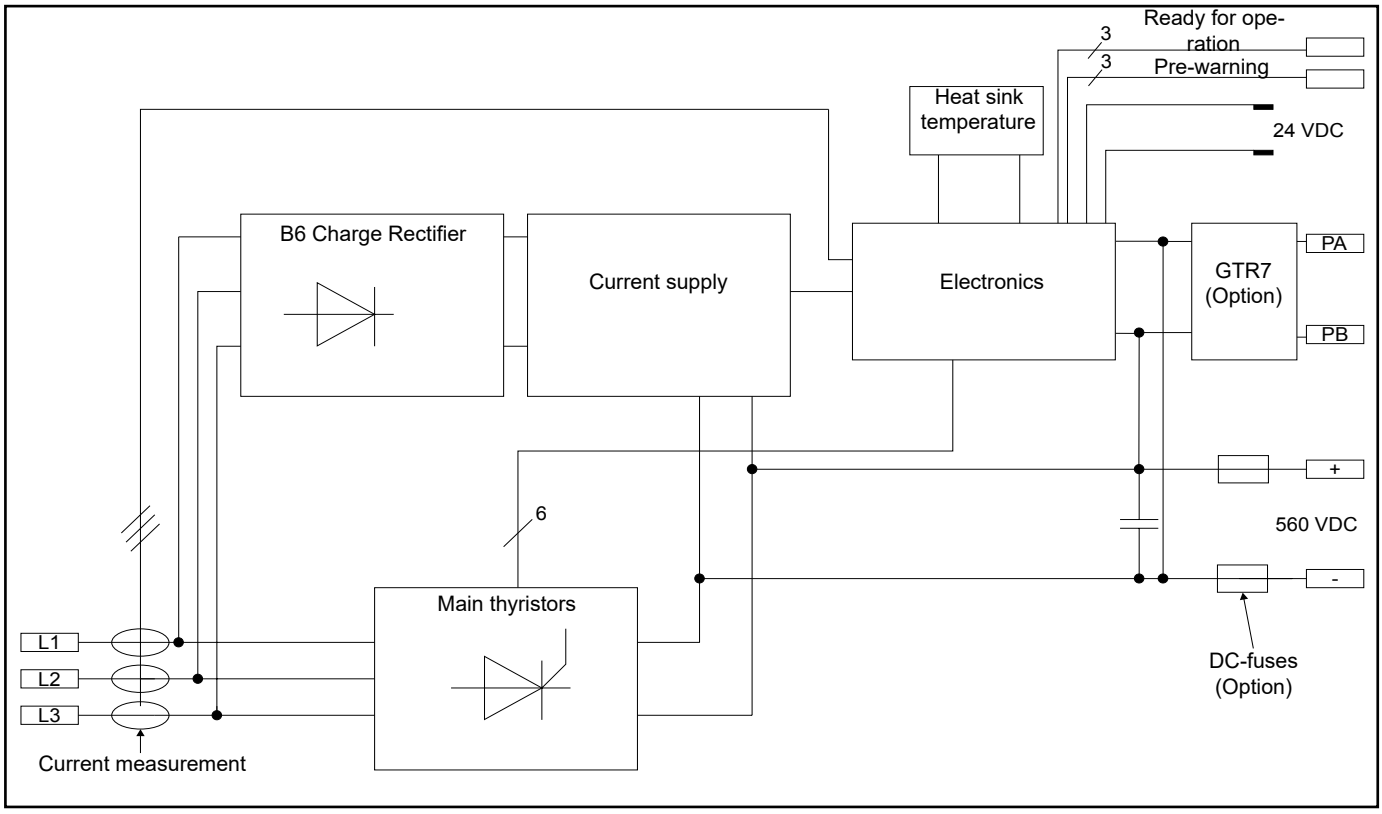
CP. 7
DC-Output voltage

Display of the current DC output voltage in volt. The value is measured at the output terminals of the supply unit.

CP. 8 **DC - output voltage / peak value**	This display enables a detection of short-term voltage peaks, as the highest value that occurred is stored. The peak value can be reset with UP or Down when the unit is switched on. Switching off the unit deletes the peak value.
CP. 9 **Heat sink temperature**	Display of the actual heat sink temperature in °C. First a prewarning is given out if the heat sink temperature is too high, so a controlled deceleration of the unit is possible. The thyristors are blocked when reaching the max. heat sink temperature of 90 °C, if there is no reaction to the pre-warning.
CP.10 **Charging time factor**	The charge time is dependent on the connected total capacity. The preset value of 100% is 16 s. If the charge time should be exceeded in case of very large capacities, the charge time can be extended up to 500 % with the charge time factor.
CP.11 **Analog output 1 gain**	At a gain of "1" the analog output 1 outputs a signal in a range of 0...10 VDC = 0...150 % I_{DC} which corresponds to the DC-output current. The gain can be adjusted with CP.11 in a range of ±20,00. The analog output can be adapted thereby to individual requirements.
CP.12 **Analog output 2 gain**	At a gain of "1,00" the analog output 2 outputs a signal in a range of 0...10 VDC = 0...800 V U_{DC} which corresponds to the DC- output current. The gain can be adjusted with CP.11 in a range of ±20,00. The analog output can be adapted thereby to individual requirements.
CP.13 **AC-Phase current L1**	CP.13 displays the rms value of the input current of phase L1 in ampere.
CP.14 **AC-Phase current L2**	CP.14 displays the rms value of the input current of phase L2 in ampere.
CP.15 **AC current L3**	CP.15 displays the rms value of the input current of phase L3 in ampere.

6. Functional Description

6.1 Block Diagram of the Supply Unit



6.2 Switch-on procedure

The charging procedure of the connected frequency inverters starts with releasing mains voltage to the input terminals L1, l2, L3 and starting of the control. The pre-charging occurs via a current source, which enables loading of very high DC link capacities. The obtained charging time is depending on the value of the connected DC link capacities and the mains voltage. After executed pre-charging and checking the ground fault free at the DC bus the release of the thyristor block takes place. No phase angle control is executed, the thyristors are driven with 0° control angle, so the behaviour is like a B6-rectifier bridge.
The "RUN" - signal is set at the control terminals of the power supply unit and can be processed further by the master control. A load current may only be taken from the power supply unit after setting the "RUN" - signal, since otherwise a power off of the pre-charging unit occurs and an error message is output.

6.3 Power-Off the Supply Unit

Power-off occurs by disconnecting the mains voltage and/or the starting signal at the control card at the supply unit.

6.4 Error During Operation

An error signal is output on tripping the protective functions and the thyristors are switched off. The following operating conditions are supervised:

- Heat sink temperature (Error: >= 90°C)
- Interior temperature (Error: ~ 80°C)
- Current
- Ground fault by differential current measurement
- DC voltage (Error: <= 240V DC voltage and >= 820V DC voltage)

First a prewarning is given out if the heat sink temperature is too high, so a controlled deceleration of the unit is possible. The thyristors are blocked when reaching the max. heat sink temperature of 90 °C, if there is no reaction to the pre-warning.

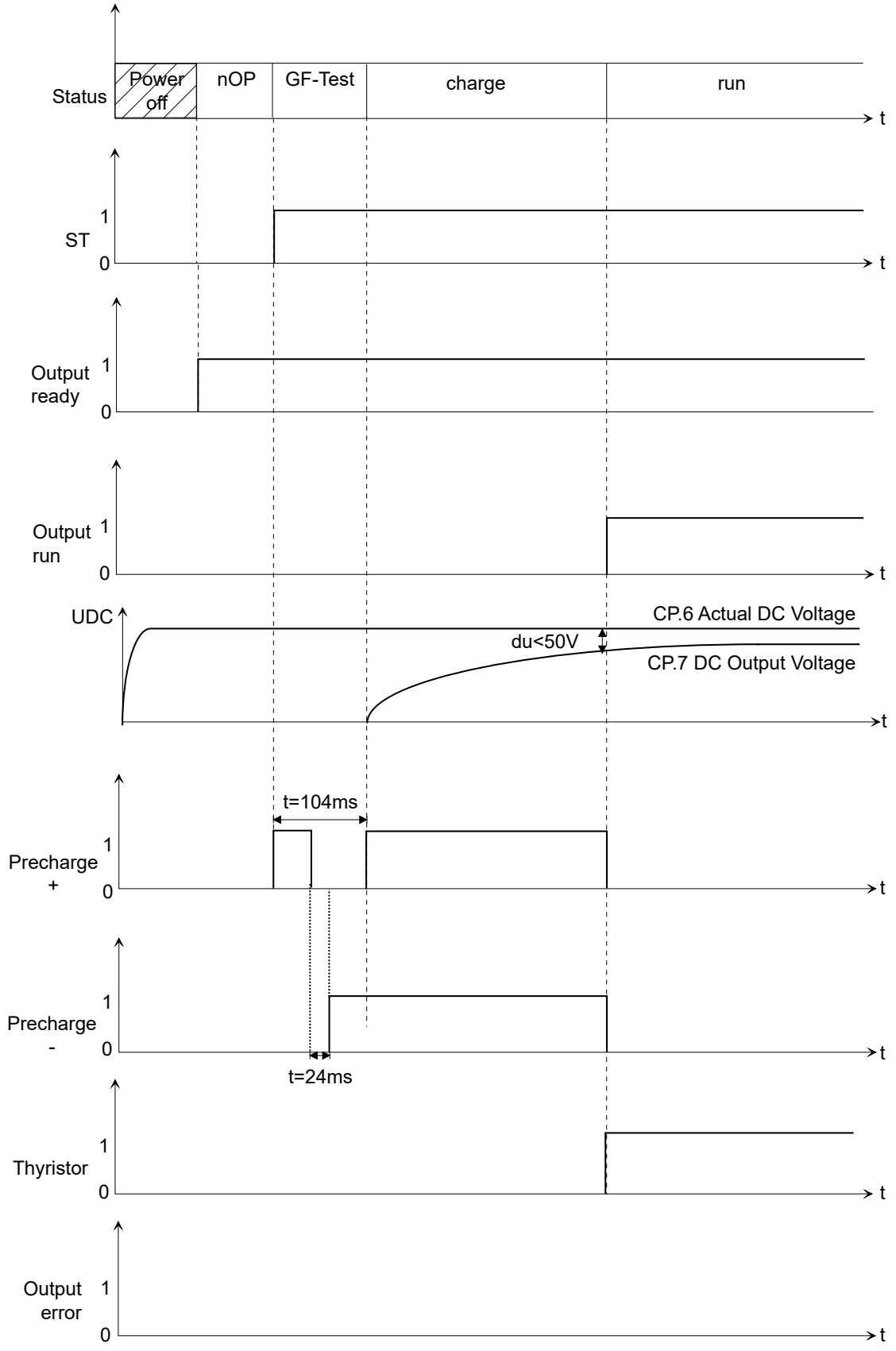
6.5 Braking option

The brake transistor is controlled with a DC link voltage starting from 740 V DC.

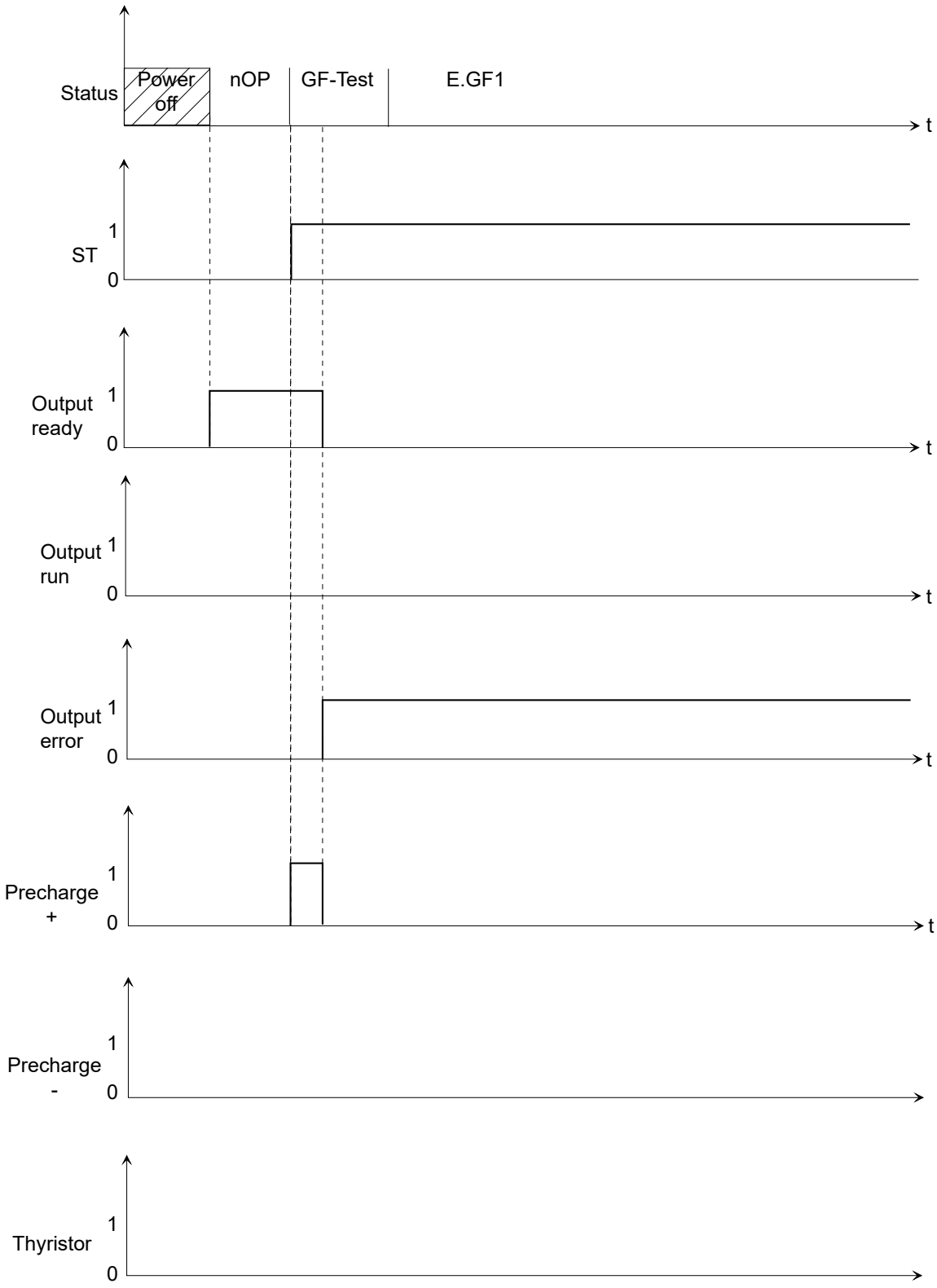
6.6 Flow charts

On the following pages there are some flow charts for a better understanding of the different operating conditions.

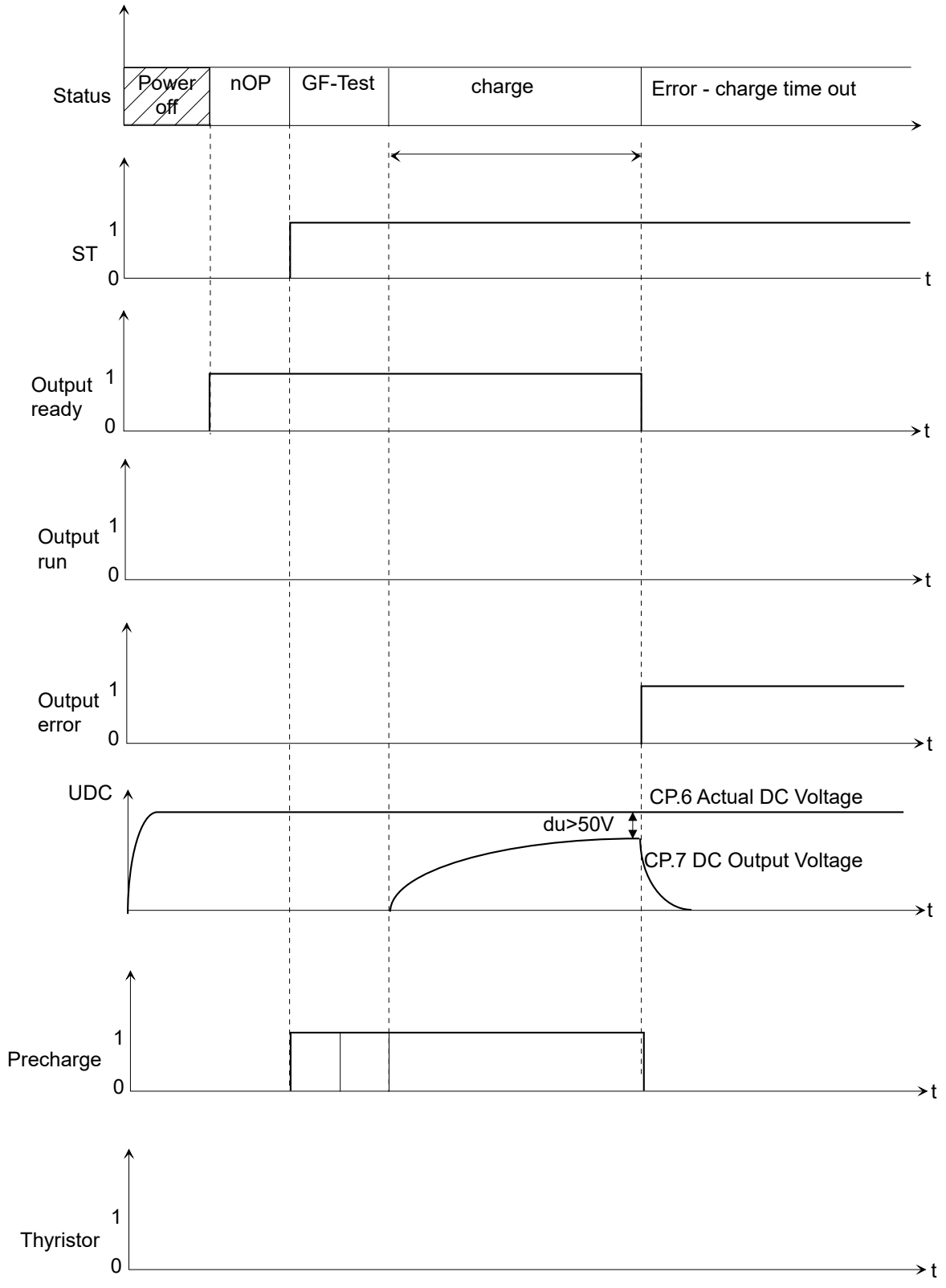
6.6.1 Power-on with Normal Conditions



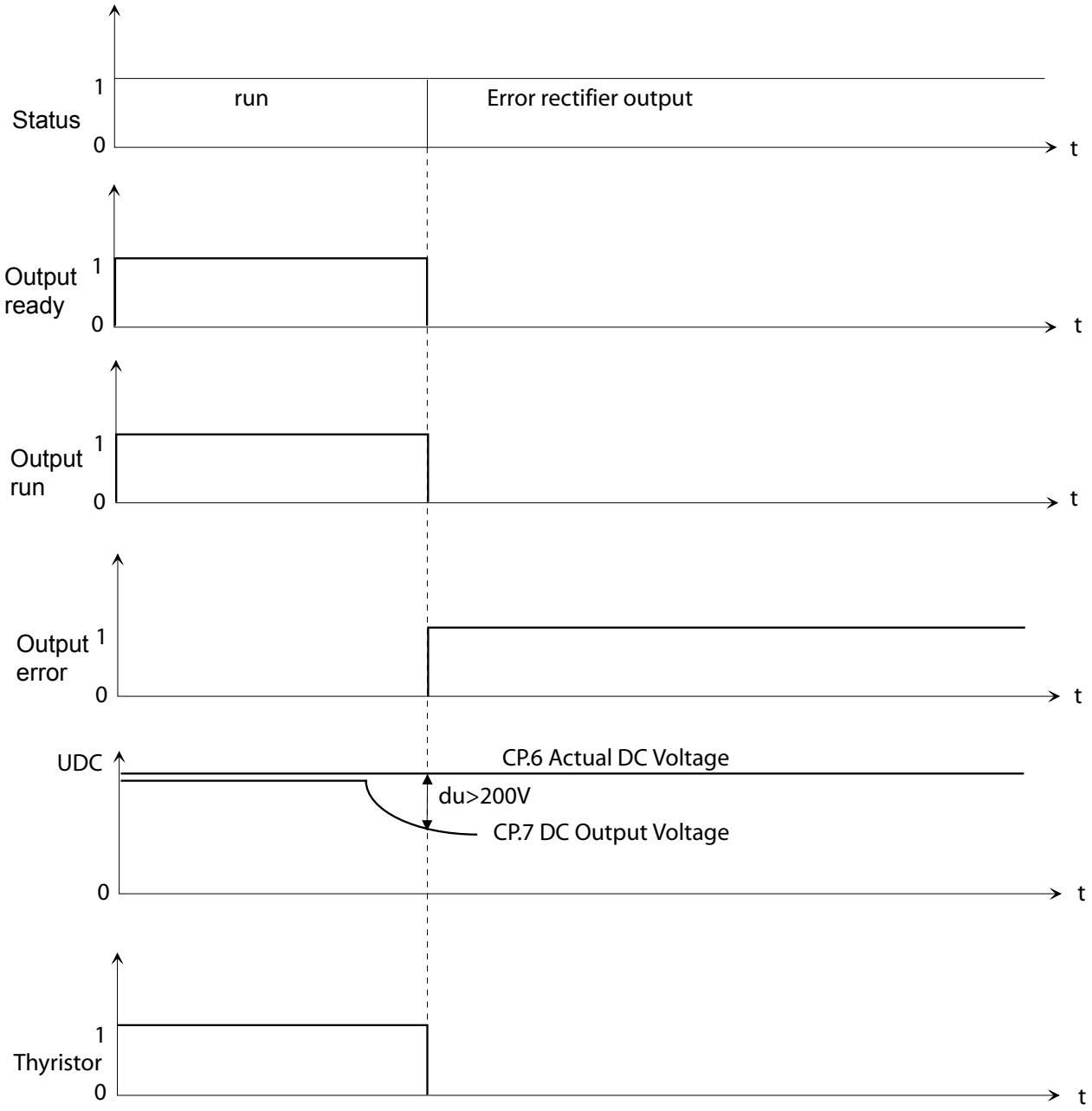
6.6.2 Ground Fault during Power-on to +DC



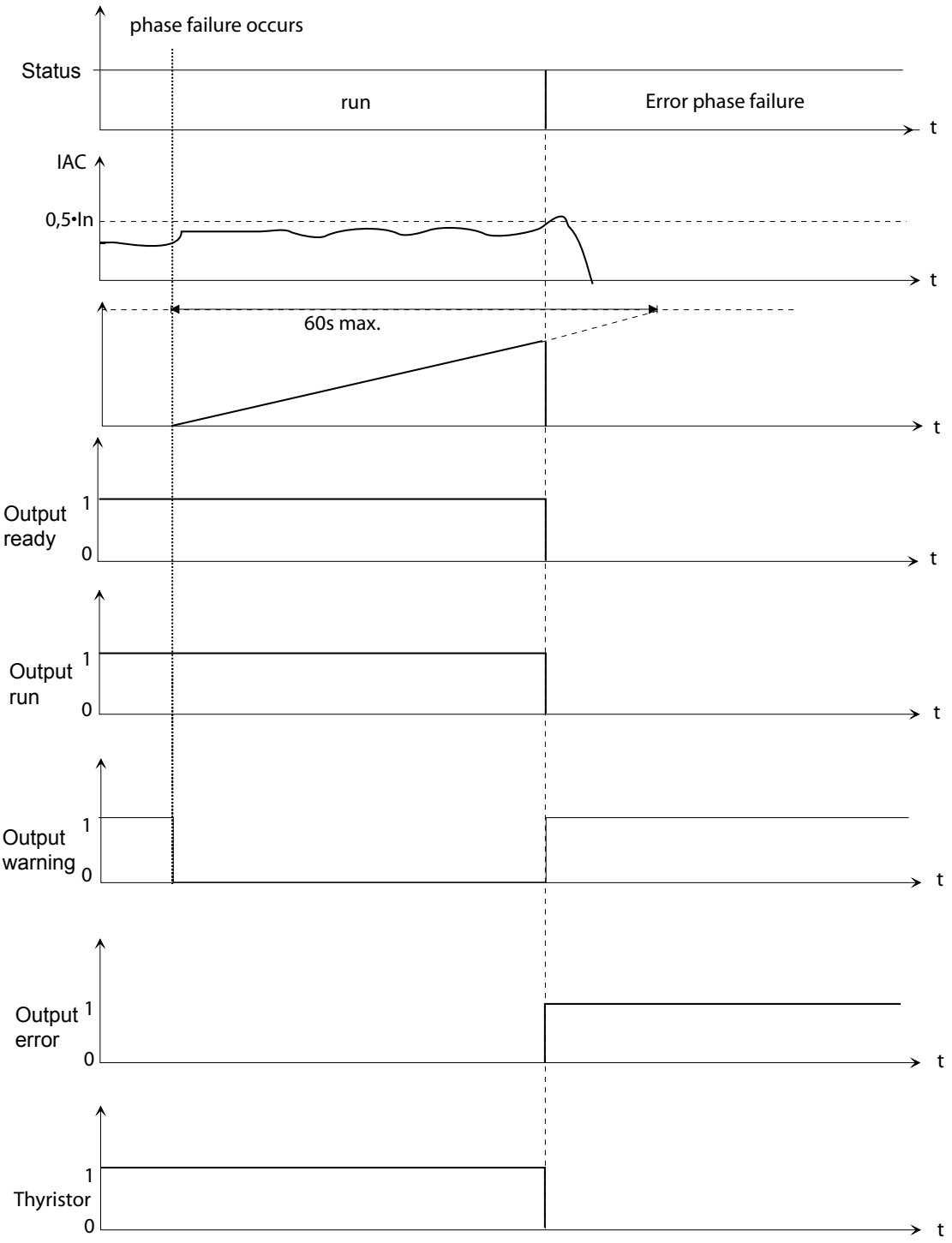
6.6.3 Charge Time Exceeding during Power-on



6.6.4 Output error during Operation



6.6.5 Phase Error during Operation (E.UPh)



The utilization of L1, L2 und L3 is compared with ru.13. If after triple scanning (12 ms) a difference of >15 % of one phase to CP.13 is detected, then

- at ru.13 <50% a warning is triggered and switched off after 60 s, status = E.UPh
- at ru.13 ≥ 50 % is immediately switched off, status = E.UPh

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