COMBIVERT

USA

INDUSTRIAL MOTION CONTROL, LLC

Installation Guide & Operation Manual

IMC
INDUSTRIAL MOTION CONTROL, LLC.

FOR TECHNICAL SUPPORT PLEASE CALL INDUSTRIAL MOTION CONTROL, LLC AT (847) 459-5200

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The icons below are used to draw draw attention to the reader. They have the following meanings:

Danger!
Warning!
Caution!

Attention!
Observe at all costs!

Information
Hint
Tip

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1. Safety and Operating Instructions

Safety and operating instructions for AC motor controls

(in conformity with the low-voltage directive 73/23/EEC)

1. General

AC motor controls, depending on their degree of protection, may have exposed live, un-insulated, and possibly also moving or rotating parts, as well as hot surfaces.

Removal of the protective covers, improper use, improper installation or operation, can be dangerous and result in serious personal injury and or damage to property.

This document must be read in its entirety before attempting to apply voltage to the KEB COMBIVERT F5.

All functions of, installation and commissioning as well as maintenance are to be carried out by skilled or certified technical personnel (Observe IEC 364 or CENELEC HD 384 or DIN VDE 0100 and IEC 664 or DIN/VDE 0110, NEC and all national and local codes and accident prevention rules!).

For the purposes of these basic safety instructions, "skilled technical personnel" means persons who are familiar with the installation, mounting, commissioning and operation of the product and have the qualifications needed for the performance of their functions.

2. Intended use

AC motor controls are components designed for installation and operation in electrical installations or machinery.

In case of installation in machinery, commissioning of the drive converter (i.e. the starting of normal operation) is prohibited until the machinery has been proved to conform to the provisions of the directive 89/392/EEC (Machinery Safety Directive - MSD). Account is to be taken of EN 60204.

Commissioning (i.e. the starting of normal operation) is admissible only where conformity with the EMC directive (89/336/EEC) has been established. The KEB COMBIVERT F5 motor controls meet the requirements of the low-voltage directive 73/23/EEC. They are subject to the harmonized standards of the series DIN EN 50178/VDE 0160 in conjunction with EN 60439-1/ VDE 0660, part 500, and EN 60146/ VDE 0558.

The technical data as well as information concerning the supply conditions shall be taken from the name plate and from the documentation and shall be strictly observed.

3. Transport, storage

The instructions for transport, storage and proper use shall be complied with.

The climatic conditions shall be in conformity with EN 50178.

4. Installation

The installation and cooling of the unit shall be in accordance with the specifications contained with in this document.

The unit shall be protected against excessive force or strain. In particular, no components must be bent or isolating distances altered in the course of transportation or handling. No contact shall be made with electronic components and contacts.

Drive converters contain electrostatic sensitive components which are can be damaged through improper use or handling. Electric components must not be mechanically damaged or destroyed (potential health risks).

5. Electrical connection

RISK OF ELECTRIC SHOCK! Always disconnect the supply voltage before installing or servicing the KEB COMBIVERT F5 motor control! Wait five minutes for the before attempting to change any connections as the internal DC bus must first discharge.

If it is necessary to work with the voltage supply turned on, always comply with the applicable national accident prevention rules (ex O.S.H.A.).

The electrical installation shall be carried out in accordance with the relevant requirements (NEC and local codes). For further information, see documentation.

Instructions for installation in accordance with EMC requirements, like shielding, grounding, location of filters and wiring, are included in the documentation. They must always be complied with. Motor controls bearing a CE marking do not preclude adherence to proper EMC installation requirements. Observance of the allowed values required by EMC law is the responsibility of the designer or manufacturer of the installation or machine.

6. Operation

Installations which include motor controls shall be equipped with additional control and protective devices in accordance with the relevant applicable safety requirements. Changes to the motor control by means of the operating software are admissible.

After disconnection of the motor control from the supply voltage, live parts and power terminals must not be touched because DC BUS capacitors may still be energized. Always follow the printed warnings on the unit.

During operation, all covers and doors shall be kept closed.

7. Maintenance and servicing

The manufacturer's documentation shall be followed.

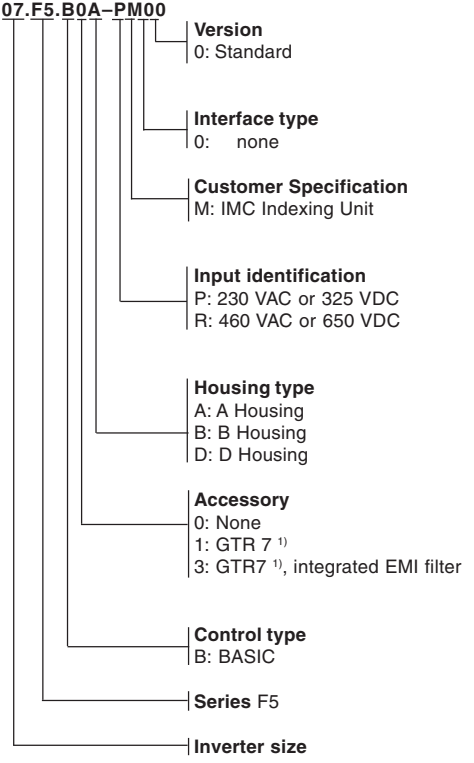
KEEP SAFETY INSTRUCTIONS IN A SAFE PLACE!

2. Product Description

2.1 Application

The KEB COMBIVERT F5 series motor control is designed exclusively for the control and regulation of induction motors. The operation of other electric devices and loads is prohibited and can lead to the destruction of the unit.
The F5 series motor control is a component which is intended for the installation in electric systems or machines.

2.2 Part Number Identification



1) GTR 7: Braking transistor
2) PFC: Power Factor Correction

2.3 Technical Data

2.3.1 Technical Data 230V Class

Inverter Size		**5**	**7**	**9**	**10**	**12**
Recommended Motor Power	**[hp]**	**1/2**	**1**	**2**	**3**	**5**
Housing size		**A**	**A**	**B**	**B**	**D**
Input Ratings						
Supply voltage	[V]	180…260 ±0 (230 V rated voltage)				
Supply voltage frequency	[Hz]	50 / 60 +/- 2				
Input phases		1	1	1 3	1 3	3
Rated input current	[A]	4.0	8.0	14 9.5	19 13	21
Recommended maximum input fuse	[A]	15	15	20 15	25 20	25
Recommended wire gauge[1)]	[awg]	14	14	12 14	10 12	10
Output Ratings						
Rated output power	[kVA]	0.9	1.6	2.8	4.0	6.6
Rated motor power	[kW]	0.37	0.75	1.5	2.2	4.0
Rated output current	[A]	2.0	4.0	6.8	9.6	15.2
Peak current (30 seconds)	[A]	4.1	7.2	12.6	18.0	29.7
Over current fault (E.OC) trip level	[A]	5.0	8.6	15.1	21.6	35.6
Overload curve (see annex)		1				
Output voltage	[V]	3 x 0…V input (3 x 0…255V)				
Output frequency	[Hz]	Generally 0 to 1600Hz (limited by control board and carrier frequency)				
Rated switching frequency	[kHz]	4	8	16	8	8
Maximum switching frequency	[kHz]	8	8	16	16	16
Power loss at rated operation[4)]	[W]	30	55	90	105	210
Stall current at 4kHz	[A]	2.3	4	7	10	16.5
Stall current at 8kHz	[A]	2.3	4	7	10	16.5
Stall current at 16kHz	[A]	–	–	7	8	10
Braking Circuit						
Min. braking resistance [2)]	[Ohm]	-	-	47	33	27
Typ. braking resistance [2)]	[Ohm]	-	-	68	56	33
Max. braking current	[A]	-	-	9.5	12	15
Installation Information						
Max. shielded motor cable length at 4 kHz [3)]	[ft]	30	30	330		
Max. shielded motor cable length at 8 kHz [3)]	[ft]	30	30	330		
Max. shielded motor cable length at 16kHz [3)]	[ft]	–	–	130	330	
Tightening torque for terminal strip	[in lb]	4.5				
Environmental						
Max. heat sink temperature TOH	[°C]	90°C / 194°F				
Storage temperature	[°C]	-25…70 °C / -13…158°F				
Operating temperature	[°C]	-10…45 °C / 14…113°F				
Housing design / protection		Chassis / IP20				
Relative humidity		max. 95% without condensation				
Approvals						
Tested in accordance with…		EN 61800-3 /UL508C				
Standards for emitted interference		EN 55011 Class B / EN 55022 Class A				
Standards for noise immunity		IEC 1000-4-2 / -3 / -4 / -5/ -6				
Climatic category		3K3 in accordance with EN 50178				

1) The wire gauge is based on the maximum fuse rating, copper wire with minimum 75°C insulation rating, THHW or equivalent. If branch circuit protection is selected based on rated input current, the wire size could be reduced.
2) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")
3) With units with integrated EMI filter the distance is less:
up to max. 5m line length and 4kHz operating frequency = Limit Value B (EN 55011)
up to max. 10m line length and 16kHz operating frequency = Limit Value A (EN 55022)
4) Rated operation means rated input voltage, rated output current, and rated carrier frequency.

2.3.2 Technical Data 460V Class

Inverter Size		5	7	9	10	12	13	14
Recommended Motor Power	[hp]	1/2	1	2	3	5	7.5	10
Housing size		A	A	A	B	B	D	D
Input Ratings								
Supply voltage	[V]	305…500 ±0 (460 V Nominal voltage)						
Supply voltage frequency	[Hz]	50 / 60 +/- 2						
Input phases		3	3	3	3	3	3	3
Rated input current	[A]	1.4	2.5	4.8	6.7	10.6	15.4	19.6
Recommended maximum input fuse	[A]	15	15	15	15	20	20	25
Recommended wire gauge[1)]	[awg]	14	14	14	14	12	12	10
Output Ratings								
Rated output power	[kVA]	0.90	1.8	2.8	4.0	6.6	8.3	11.0
Rated motor power	[kW]	0.37	0.75	1.5	2.2	4.0	5.5	7.5
Rated output current	[A]	1.0	1.8	3.4	4.8	7.6	11.0	14.0
Peak current (30 seconds)	[A]	2.3	4.7	7.4	10.4	17.0	21.6	29.7
Over current fault (E.OC) trip level	[A]	2.8	5.6	8.9	12.5	21.0	25.9	35.6
Overload curve (see annex)		1						
Output voltage	[V]	3 x 0…V Line						
Output frequency	[Hz]	Generally 1600Hz however it is limited by the switching frequency						
Rated switching frequency	[kHz]	4	4	4	8	4	4	4
Maximum switching frequency	[kHz]	4	4	4	16	4	16	4
Power loss at rated operation[2)]	[W]	45	50	60	120	150	185	185
Stall current at 4kHz	[A]	1.3	2.6	4.1	5.8	7.6	12	14
Stall current at 8kHz	[A]	-	-	-	5.8	-	9.5	-
Stall current at 16kHz	[A]	-	-	-	4.9	-	5.8	-
Braking Circuit								
Min. braking resistance [3)]	[Ohm]	390	180	110	82	82	56	56
Typ. braking resistance [3)]	[Ohm]	620	300	150	270	150	100	85
Max. braking current	[A]	2.2	4.5	7.5	10	10	15	15
Installation Information								
Max. shielded motor cable length at 4 kHz [4)]	[ft]	30	30	30	330	165	300	300
Max. shielded motor cable length at 8 kHz [4)]	[ft]	-	-	-	165	–	300	-
Max. shielded motor cable length at 16kHz [4)]	[ft]	-	-	-	100	–	300	-
Tightening torque for terminal strip	[in lb]	4.5						
Environmental								
Max. heat sink temperature TOH	[°C]	90°C / 194°F						
Storage temperature	[°C]	-25...70 °C / -13…158°F						
Operating temperature	[°C]	-10...45 °C / 14…113°F						
Housing design / protection		Chassis / IP20						
Relative humidity		max. 95% without condensation						
Approvals								
Tested in accordance with…		EN 61800-3 /UL508C						
Standards for emitted interference		EN 55011 Class B / EN 55022 Class A						
Standards for noise immunity		IEC 1000-4-2 / -3 / -4 / -5/ -6						
Climatic category		3K3 in accordance with EN 50178						

1) The wire gauge is based on the maximum fuse rating, copper wire with minimum 75°C insulation rating, THHW or equivalent. If branch circuit protection is selected based on rated input current, the wire size could be reduced.

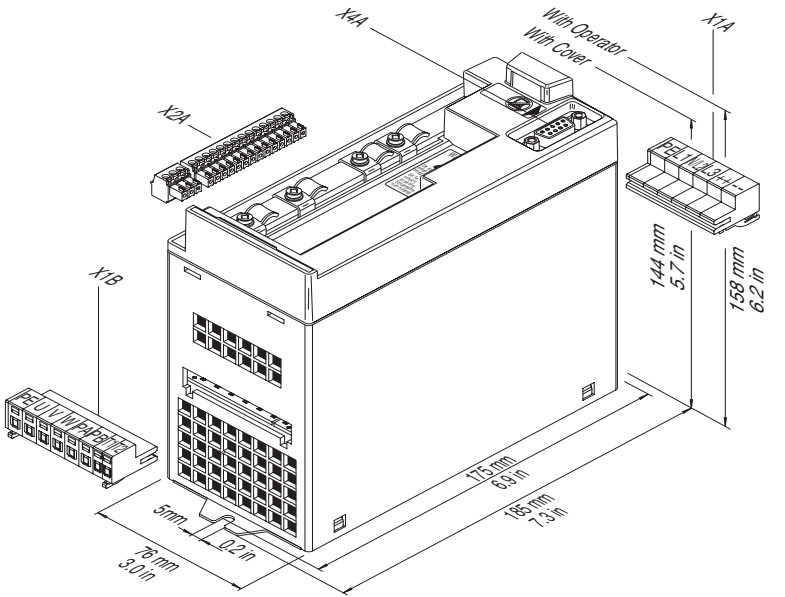
2) Rated operation means, rated input voltage, rated output current, and rated carrier frequency.

3) This data is only valid for units with internal brake transistor GTR 7 (see "unit identification")

4) With units with integrated EMI filter the distance is less:
up to max. 5m line length and 4kHz operating frequency = Limit Value B (EN 55011)
up to max. 10m line length and 16kHz operating frequency = Limit Value A (EN 55022)

2.4 Dimensions and terminals

2.4.1 A Housing



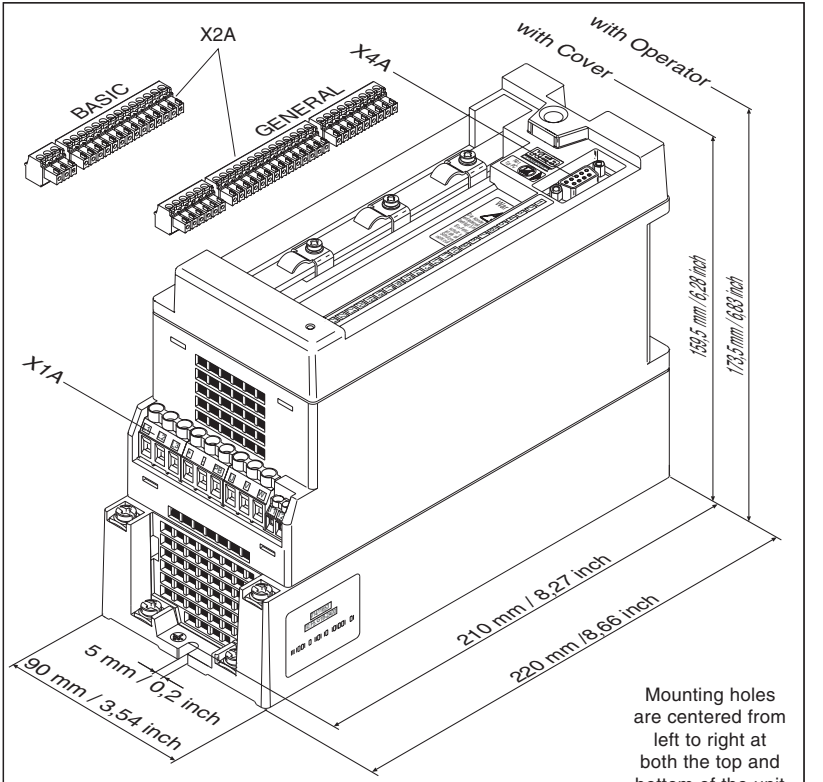
Weight 1/2 kg / 1 lb

X1A Connection from the line
X1B Connection to the motor, brake resistor, temp sensor
X2A Connection for control cables
X4A Connection for Operator/display HSP5-Service cable
⏚ Connection for shield / ground

⚠ Pay attention to the input voltage, since both 230V and 460V units (3-phase) are possible. On the 230 VAC sytems The PA, PB, T1, T2 terminals will be not included on the inverter.

⚠ On the 460 VAC inverters a jumper must be placed between T1 & T2 if a thermo sensing device isn't used. T1 & T2 are located on terminal X1B.

2.4.2 B Housing



Mounting holes are centered from left to right at both the top and bottom of the unit

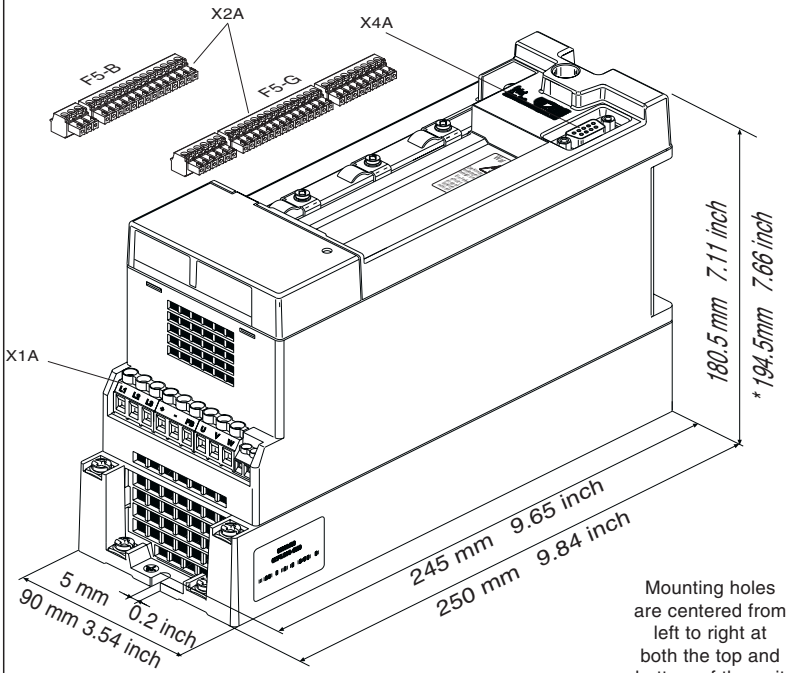
X1A Connection from the line, motor, braking resistor and temperature sensor/switch
X2A Connection for control cables
X4A Connection for Operator/display HSP5-Service cable
⏚ Connection for shield / ground

Weight 2 kg / 4 lb

⚠ Pay attention to the input voltage, since both 230V and 460V units (3-phase) are possible.

⚠ A jumper must be placed between T1 & T2 if a thermo sensing device isn't used. T1 & T2 are located on terminal X1A.

2.4.3 D Housing



Mounting holes are centered from left to right at both the top and bottom of the unit

Weight 3 kg / 6.6 lb

X1A Connection from the line, motor, braking resistor and temperature sensor
X2A Connection for control cables
X4A Connection for Operator/display HSP5-Service cable
⏚ Connection for shield / ground

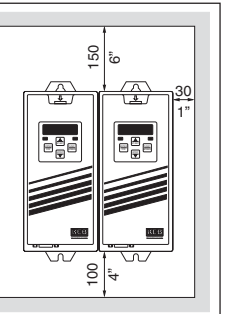
⚠ Pay attention to the input voltage, since both 230V and 460V units (3-phase) are possible.

⚠ A jumper must be placed between T1 & T2 if a thermo sensing device isn't used. T1 & T2 are located on terminal X1A.

3. Installation and Connection

3.1 Control Cabinet Installation

Enclosure type:	IP20/ Open Type
Operation temperature:	-10...45 °C / 14...113°F
Storage temperature:	-25...70 °C / -13...158°F
max. heat sink temperature:	90 °C / 194°F
Climatic category:	3K3 in accordance with EN 50178
Relative humidity:	max. 95 % without condensation
Power derating for high altitude:	1% for every 100m/330ft above 1000m/3300ft
Maximum altitude for operation:	2000m / 6,600ft

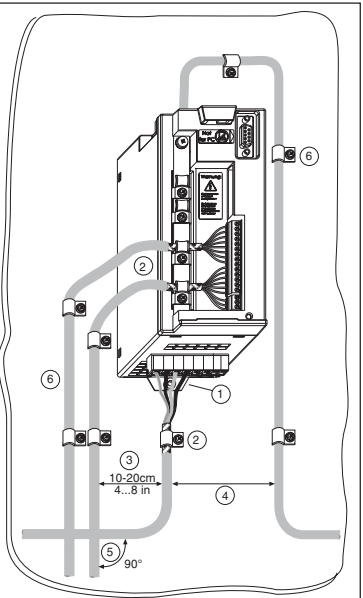


Dia. 3.1

Installation requirements:

- Mount in a stationary location with low vibration. Contact KEB when mounting on a moving system.
- Adhere to minimum clearance distances in diagram 3.1. Multiple units can be mounted side by side with zero clearance.
- Most units have forced airflow from bottom to top using a thermostatically controlled variable speed fan. Leave space above and below the unit for proper air flow.
- Prevent dust or debris from entering the unit, especially during the construction of the control panel. Metal chips can cause internal shorts or malfunctions.
- Installation in a sealed enclosure requires proper cooling, be sure to over size control cabinet or provide suitable cooling device.
- Protect the unit against conductive and corrosive gases and liquids.
- Water, mist, or steam should not be allowed into the unit.
- Do not allow water to condense within the unit
- The COMBIVERT F5 must not be installed in a “Explosion Proof” environment.

3.2 Good EMC Installation Techniques



1) Mount the COMBIVERT F5 on a conductive (zinc or nickel plated not painted) subpanel. This sub plate serves as the central grounding point for the machine.
2) Always connect the shield of motor and control cables with maximum surface area, use a metal cable clamp to contact cable shield on all sides. Using a single strand of the shield or the drain wire from the shield as the only connection can reduce the shield's effectiveness by 70%.
3) The distance between control and power cables should be at least 10..20 cm / 4...8 inches.
4) Keep the motor and power cable spatially separated especially if running parallel.
5) If it cannot be avoided, cross control and power cables and motor cables at a right angle.
6) Install all cables as close as possible to the mounting plate - ideally in a metal wireway.
7) Ridged metal conduit can be used as a shield for the motor cables. Always observe the following points:
   - Remove all paint from the control panel where the conduit is to be secured.
   - Securely fasten all conduit fittings.
   - Run only the motor wires through the conduit. All other wires must be pulled through a separate conduit.
   - Connect the control panel to the sub panel with a heavy ground strap.
8) If a KEB EMI (CE) filter is used, it must be mounted as close as possible and to the same subpanel as the COMBIVERT F5 motor control. The filter must have large bare surface contact with the subpanel. Use only the wires from the filter to connect to the inverter. Never add additional lengths of wire.
9) All ground connections should be as short as possible. Always avoid creating ground loops. NEC requires a ground conductor connected to every COMBIVERT F5 controller in spite of the metal on metal connection to the subpanel.

You can find further instructions regarding EMC and proper wiring considerations by contacting KEB technical support or visiting the web site www.kebamerica.com.

3.3 Connection of Power Circuit

3.3.1 Wiring instructions

RISK OF ELECTRIC SHOCK! Always disconnect supply voltage before servicing the COMBIVERT F5. Wait 5 minutes before attempting to change the connections as the DC Bus capacitors may still be charged.

Absolutely pay attention to the nameplate voltage of the KEB COMBIVERT and the connected line voltage. A 230V-unit will be immediately destroyed on a 460V-power supply. Never exchange the line and motor cables. The unit will be destroyed.

The COMBIVERT F5 motor controls specified in this manual are suitable for use on a circuit capable of delivering not more than 10kA rms symmetrical ampers at the rated maximum voltage.

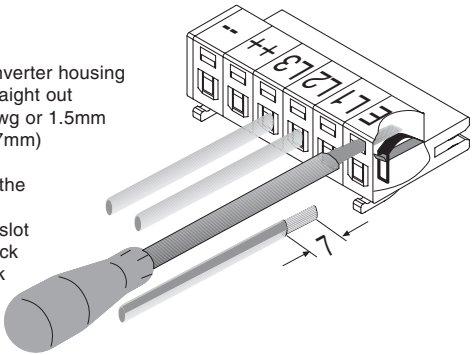
Connection of the F5 series motor control to voltage systems configured as corner grounded delta, center tap grounded delta, open delta, or ungrounded delta may defeat the internal noise suppression. With this type of voltage supply the maximum phase to ground voltage is 300VAC for 230 VACrms units and 500 VACrms for 600VAC units. A balanced, center ground wye connection is always recommended. The three phase voltage imbalance must be less than 2% phase to phase. Greater imbalance can lead to destruction of the unit.

3.3.2 Terminal X1.A & Line Connection

A Housing:

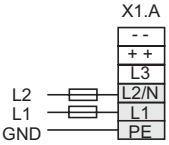
Steps to wire the connectors

- Remove the connector from the inverter housing by grasping it firmly and pulling straight out
- The maximum wire gauge is 14 awg or 1.5mm
- Strip the insulation back 0.25 in (7mm)
- The use of ferrules is optional
- Press a flathead screwdriver into the upper slot
- Slide the bare wire into the lower slot
- Remove the screw driver and check the wire connection by pulling back on the wire to ensure it stays

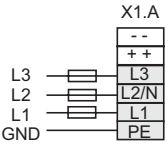


A Housing:

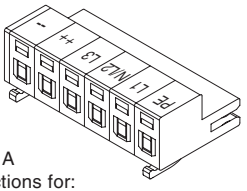
Line connection 230 V 1-phase



Line connection 230 V 3-phase & 460 V 3-phase



A Housing:

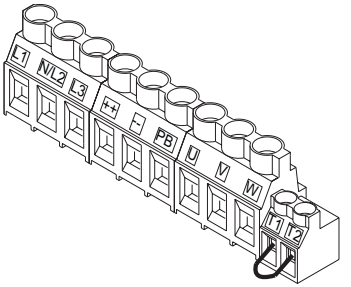


Terminal strip X1A
Provides connections for:

- 230 VAC/1-phase (L1,L2/N)
- 230 VAC/3-phase (L1, L2/N,L3)
- 230 VAC/DC-Supply 250...370 V DC (++, --)
- 460 VAC/3-phase (L1, L2, L3)
- 460 VAC/DC-Supply 420...720 V DC (++, --)

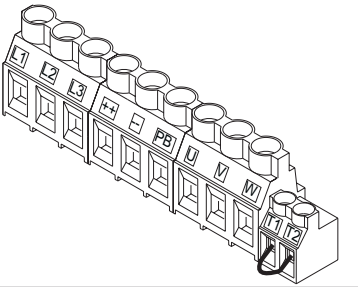
Installation and Connection

B & D Housings:



Terminal strip X1A / 230 V - class
Provides connections for:
- 230 V AC / 1-phase (L1/L2)
- 230 V AC / 3-phase (L1, L2, L3)
- DC-Supply 250...370 V DC (++, --)

B & D Housings:

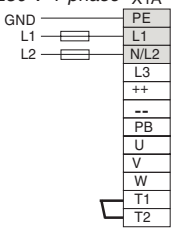


Terminal strip X1A / 460 V - Class
Provides connections for:
- 460 V AC / 3-phase (L1, L2, L3)
- DC-Supply 420...720 V DC (++, --)

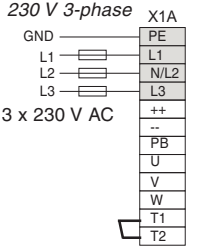
- ++, PB — Braking resistor
- U, V, W — Motor
- T1, T2 — Temperature sensor/Switch

*Jumper T1/T2 if no temperature sensing device

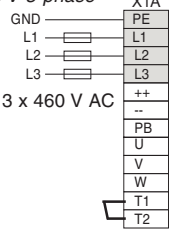
Line connection
230 V 1-phase



Line connection
230 V 3-phase

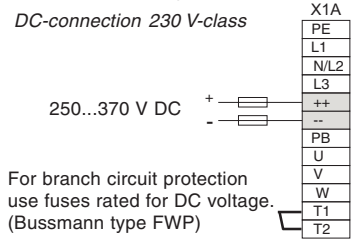


Line connection
460 V 3-phase



A, B, and D Housings:

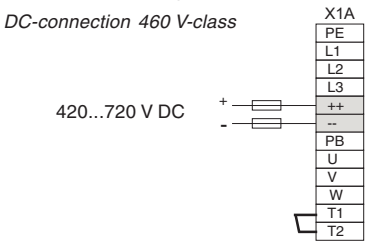
DC-connection 230 V-class



**X1A terminal layout varies depending on housing*

A,B, and D Housings:

DC-connection 460 V-class

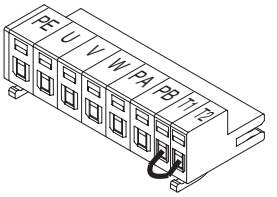


**X1A terminal layout varies depending on housing*

- Always note the rated voltage, select the appropriate over current protection devices, select a disconnect device, and select the proper wire size before beginning the wiring process. Wire the COMBIVERT F5 according to NEC Class 1 requirements.
- Always use UL listed or CSA approved copper wire with a minimum temperature rating of 75°C. The wire gauge listed in the tables in section 2.3 is based on the maximum fuse rating, copper wire and a 75°C insulation rating (THHW or equivalent). If a lower level of over current protection is used, it may be possible to reduce the size of the wire. Use 300V rated wire for 230V systems and 600V rated wire for 460V systems.
- A disconnect switch or contactor shall be provided as a means of turning off the supply voltage. Repetitive cycling on and off of the supply voltage more than once every 5 minutes can lead to damage of the unit.
- B Housing and Larger: Class J (Bussmann type LPJ or equivalent) fuses or a circuit breaker with type D trip characteristic must be used to provide branch circuit protection of the COMBIVERT F5. The voltage rating of the fuse or circuit breaker shall be at least 250V for 230V units and 600V for 460V units. See tables in section 2.3 for over current protection amperage ratings.
- A Housing: Class CC (Bussmann type LP-CC or equivalently) fuses or a circuit breaker with type D trip characteristic must be used to provide branch circuit protection of the COMBIVERT F5. The voltage rating of the fuse or circuit breaker shall be at least 250V for 230V units. See table in section 2.3 for over current protection amperage ratings.
- B Housing and Larger: Terminal tightening torque for the power terminals is 0.5 Nm / 4 lbin
- A: Housing: Power connection must be installed as indicated on the previous page. Always be sure to double check power connections for tightness.
- For installation requiring line side ground fault protection (GFI) consult KEB.
- Line chokes can be used to reduce harmonics, conducted high frequency noise, and can extend the lifetime of the unit. Consult KEB for more information.

3.3.3 Motor Connection

A Housing:



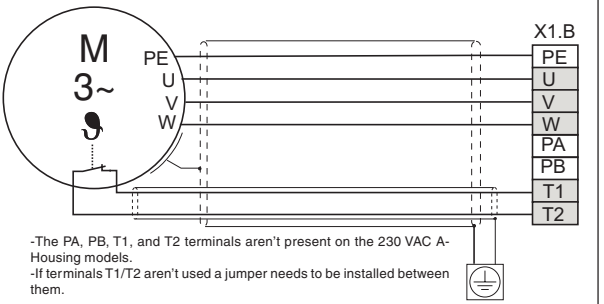
Terminal X1B provides connections for:

- ++, PB Braking resistor
- U, V, W Motor
- T1, T2 Temperature sensor/Switch

NOTE: The T1/T2 terminals aren't present on the 230 VAC A-housing inverters.

A Housing:

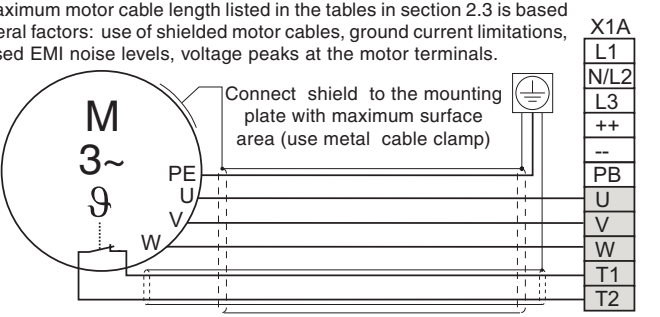
⚠ The maximum motor cable length listed in the tables in section 2.3 is based on several factors: use of shielded motor cables, ground current limitations, increased EMI noise levels, voltage peaks at the motor terminals.



-The PA, PB, T1, and T2 terminals aren't present on the 230 VAC A-Housing models.
-If terminals T1/T2 aren't used a jumper needs to be installed between them.

B & D Housings:

⚠ The maximum motor cable length listed in the tables in section 2.3 is based on several factors: use of shielded motor cables, ground current limitations, increased EMI noise levels, voltage peaks at the motor terminals.



Motor-temperature sensor is optional
(can be NC switch or PTC type sensor)

NOTE: If terminals T1/T2 aren't used a jumper needs to be installed between them.

3.3.4 Motor Overload Protection

The COMBIVERT F5 motor control by default provides motor overload protection at 130% of the unit's rated output current. See tables in section 2.3 for rated output current. Two additional motor overload protection systems are available.

Electronic Motor Overload Protection

This software function provides speed dependent I^2t overload protection and is approved by UL as a solid state overload protection device according to UL508C section 42 and NEC 430 Part C. The trip current is adjustable as well as whether the motor is self cooled or blower cooled.

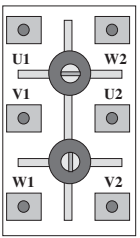
Motor Winding Temperature Sensor

- Connects to Terminals T1, T2. These terminals as default need to be jumpered.
- Trip resistance level 1.65...4 kOhm
- Reset resistance level 0.75...1.65 kOhm
- This function can be activated or deactivated through a software parameter. The default setting is On.
- Do not run sensor wires in the same conduit or wire way as other control cables. These sensor wires most likely are carrying high frequency noise from the motor.
- If the sensor wires are part of the motor cable they must be shielded independently from the motor wires.

3.3.5 Motor Terminal Connections

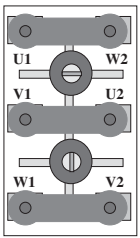
The motor connections should always be verified for correct voltage configuration before power is appiled. (jumpers may be in place from factory testing) The motor terminals (U,V,W) from the indexing drive, should be connected to the motor terminals U1, V1, W1.

No Connection



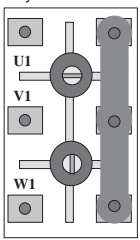
No jumpers in place

Delta Connection



230V
Jumper setting

Wye Connection



460V
Jumper setting

The ground terminal at the motor should be connected to the ground terminal on the inverter. The motor cables should be shielded and the sheild should be connected to the inverter. The direction of rotation of the motor can be changed by reversing any two phases. (U1 to V1, V1 to U1)

Terminals T1&T2 need to be jumpered on the inverter if not using a thermo sensing device. The 230VAC A-Housing doesn't have these terminals.

3.3.6 IMC Motors

Hp	Operating Voltage	Speed [RPM]	Mounting Configuration	Motor Part Number
1/8	230V/460V	1690	IEC 56-B14	92C81286010000
1/6	230V/460V	1685	IEC 63-B14	92C81286020000
1/4	230V/460V	1685	IEC 63-B14	92C81286030000
1/3	230V/460V	1640	IEC 71-B14 (square)	92C49952070000
		1690	IEC 71-B14	92C49952080000
1/2	230V/460V	1685	IEC 71-B14	92C49953170000
		1685	NEMA 56C	92C49953180000
3/4	230V/460V	1710	IEC 80-B14	92C49954080000
		1710	NEMA 56C	92C49954090000
1	230V/460V	1710	IEC 80-B14	92C49955430000
		1710	NEMA 56C	92C49955410000
1.5	230V/460V	1720	IEC 90-B14	92C49956230000
		1720	NEMA 145TC	92C49956220000
2	230V/460V	1710	IEC 90-B14	92C49957340000
		1710	NEMA 145TC	92C49957330000
3	230V/460V	1720	IEC 100-B14	92C49958240000
		1720	NEMA 182TC	consult factory
4	230V/460V	1730	IEC 100-B14	92C81285010000
5	230V/460V	1735	IEC 112-B14	92C49959260000
		1735	NEMA 182TC	92C49959280000
7.5	230V/460V	1720	IEC 112-B14	consult factory
		1720	NEMA 213TC	consult factory
10	230V/460V	1750	IEC 112-B14	consult factory

The above motors are also rated to operate on European 220V/380-50Hz or 230V/400V-50Hz systems. When operating on these types of voltage supplies, parameter CP.5 must be set to 50.0 for proper motor operation.

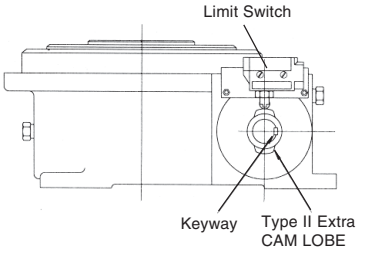
3.3.7 EMI(CE) Filters

The KEB COMBIVERT frequency inverters are optionally available with EMI filters. If you have a 1/2, 1, 2 Hp 460VAC system your unit comes equipped with this item. These filters allow the KEB COMBIVERT to meet CE EMC directive 89/339. All filters are dimensioned for the inverter's rated current and are designed to meet the conducted emission limit as defined by EN55011/B.

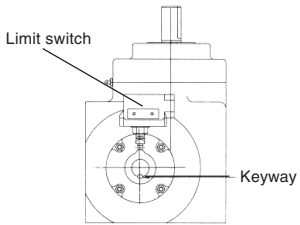
The filter kits contain all required hardware for installation. The filters include the sheilded supply wires which connect the filter to the inverter. Depending on the available space and filter type, the filter can either be installed under the frequency inverter (Back Mount), or beside the frequency inverter (Panel Mount).

EMI (CE) Filters					
Voltage Class	Phases	Filter Kit	Mounts with Inverter size	Style	Dimensions [in] [HxWxL]
230 VAC	1	92C84982210000	05 & 07	Panel Mount	1.6x3.5x9.8
230 VAC	1	92C84982220000	09 & 10	Back Mount/Panel Mount	1.6x3.5x9.8
230 VAC	3	92C84982230000	12	Back Mount/Panel Mount	1.6x3.5x11.2
460 VAC	3	92C84982240000	10	Back Mount/Panel Mount	1.6x3.5x9.8
460 VAC	3	92C84982250000	12	Back Mount/Panel Mount	1.6x3.5x9.8
460 VAC	3	92C84982260000	13	Back Mount/Panel Mount	1.6x3.5x11.2
460 VAC	3	92C84982270000	14	Back Mount/Panel Mount	2.0x3.5x11.2

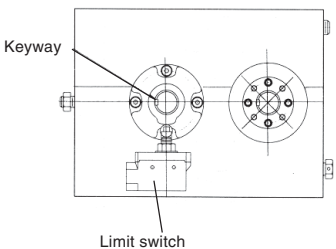
3.3.8 CAM Gear Box



A standard Roller Gear unit with the CAM & Limit Switch mounted on the correct keyway position directly opposite of the output shaft, 90 degrees(clockwise or counter clockwise) from the CAM Lobe. The CAM & Limit Switch may also be mounted on the reducer. *If the unit has a “Type II” motion, a special Limit Switch CAM is needed with one extra Lobe, 180 degrees from the first Lobe. (as shown)



A standard right angle unit with the CAM & Limit Switch mounted on the housing has a correct keyway position directly opposite of the CAM Lobe. CAM & Limit Switch may also be mounted on the reducer.



A standard parallel unit with the CAM & Limit Switch mounted on the housing has a correct keyway position directly opposite of the output shaft, 90 degrees (clockwise or counter clockwise) from the CAM Lobe. CAM & Limit Switch may also be mounted on the reducer.

For the correct dwell location of the cam or input shaft keyway see the IMC CAMCO-Ferguson assembly drawing for your unit.

3.4 Breaking Resistor

3.4.1 Explanation

The COMBIVERT F5 inverter can be equipped with an external braking resistor for limited 4 quadrant operation. The energy the motor regens into the inverter during deceleration is dissipated through the internal braking transistor to the braking resistor.

The braking resistor heats up during braking. If it is installed inside a control cabinet, sufficient interior cooling must be provided! The resistor should be mounted above and a minimum of 9 inches away from the inverter or in a separate enclosure!

3.4.2 Options

Panel Mount Braking Resistors							
Voltage Class	Recommended Inverter Size	Minimum Inverter Size	Kit Number	Resistance [Ù]	Rated Power [W]	Peak Power [W]	Dimensions [in] [HxWxL]
230 V	-	09	92C84982410000	100	82	1500	1.57x.95x9.5
230 V	09	09	92C84982420000	68	120	2200	1.57x.95x11.8
230 V	10,12	10	92C84982430000	33	250	4400	3.15x1.00x11.8
230 V	-	12	92C84982440000	27	300	5400	3.15x1.0x15.75
460 V	05	05	92C84982450000	390	90	1500	1.57x.95x9.5
460 V	07	07	92C84982460000	270	130	2100	1.57x.95x11.8
460 V	09	07	92C84982470000	150	230	3700	3.15x1.00x11.8
460 V	10	10	92C84982480000	110	350	5000	3.15x1.0x15.75
460 V	12,13,14	10	92C84982490000	85	410	6500	3.15x1.0x15.75

Peak power is classified as the peak repetitive power dissipation with a 6 sec on time and 120 sec cycle time. KEB can offer many types of braking resistors, please contact your sale representative for more information.

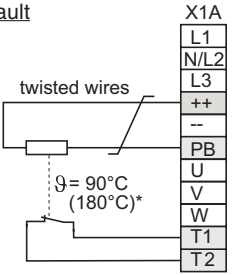
Back Mount Braking Resistor					
Kit Number	Voltage Class	Inverter Size	Resistance [Ù]	Rated Power [W]	Peak Power [W]
92C84982510000	230 V	9	160	35	900
	460 V	10			3400
92C84982520000	230 V	10	82	35	1700
	460 V	12			6650
92C84982530000	230 V	12	82	35	1700
	460 V	13,14			6650

Peak power is classified as the peak repetitive power dissipation with a 3 sec on time and 120 sec cycle time. The Back Mount Breaking Resistor adds 1.2 inches onto the height of the inverter.

3.4.3 Connection

Braking resistor connection with high temperature drive fault

- The resistor has a PTC type sensor and is connected to the T1, T2 terminal on the COMBIVERT F5. If a motor temperature sensor and braking resistor sensor is used they should be placed in series. Note: if the braking transistor in the unit fails, there is no guarantee the voltage to the resistor will be shut off!

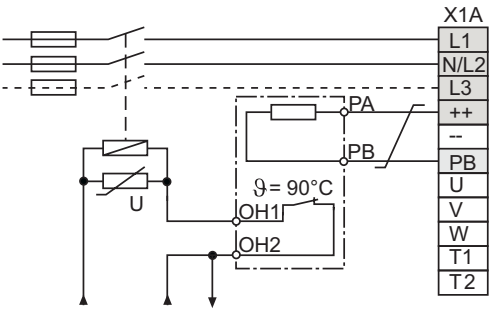


Braking resistors can develop very high surface temperatures, therefore install away from other devices, above the motor control and where people can not inadvertently come in contact with it.

* The panel mount breaking resistors listed on page 22 have a NC thermal contact rated at 180°C/356°F. Back mount resistors have a thermal contact rated at 90°C/194°F.

Braking resistor connection with high temp disconnect feature

- The resistor has a NC mechanical switch type temperature sensor.
- If the resistor becomes too hot, the sensor switch opens and disconnects the COMBIVERT F5 from the supply voltage.
- In the event of a complete failure of the internal braking transistor, this is the only way to disconnect the resistor from the power source!



120 or 24 V AC/DC

3.4.4 Selection

Different braking resistors are available from KEB. They are selected according to their application requirements. The selection formulas and technical data of the resistors are listed on the following pages. In most cases the suggested braking resistor is sufficant. This can be verified using the procedure below.

***Braking resistors aren't required on 1/3 to 1 HP applications**

1. Establish desired braking time.
2. Calculate braking time without braking resistor (t_{Bmin}).
3. If the desired braking time is shorter than the calculated braking time, it will be necessary to use a braking resistor. ($t_B < t_{Bmin}$)
4. Calculate braking torque (T_B) taking the load torque (T_L) into account. T_L is a positive value for friction and windage and negative for overhauling loads.
5. Calculate peak braking power (P_B). This must always be calculated for the "worst case" (n_{max} to standstill).
6. Selection of the braking resistors:
   a) The resistor should be selected so that $P_R > P_B$.
   b) P_N is to be selected according to the duty cycle factor (d.c.f.).
   The braking resistors may only be used for the specified value. The maximum ON period of the braking resistor may not be exceeded.
   6 % d.c.f. = maximum braking time 8 s
   25 % d.c.f. = maximum braking time 30 s
   40 % d.c.f. = maximum braking time 48 s
   Longer ON periods require specially-designed braking resistors. Take into ac count the current through the braking transistor.
7. Check whether the desired braking time is attained with the selected braking resistor (t_{Bmin}).

Note: Consider the capacity of the braking resistor and motor. The braking torque may not exceed the rated torque of the motor by more than 1.5 times. To realize maximum possible braking torque, the frequency inverter must be sized for the increased motor current.

Braking time

The braking time is adjusted in the frequency inverter through the deceleration parameters. If the selected deceleration time is too short, either the peak inverter current level or the maximum DC bus voltage will be exceeded. The error message ***E.OC*** or ***E.OP*** will result. The following formulas can be used to determine an allowable braking time.

Formulas

1. Braking time without braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \bullet (n_1 - n_2)}{307 \bullet (K \bullet T_N + T_L)}$$

Valid range: $n_1 > n_N$
(field weakening)

2. Braking torque (required)

$$T_B = \frac{(J_M + J_L) \bullet (n_1 - n_2)}{(307 \bullet t_{B)}} - T_L$$

Conditions: $T_B - 1.5 \bullet T_N$
$f < 1.4$ x rated frequency of motor

3. Peak braking power

$$P_B = \frac{T_B \bullet n_1}{7.04}$$

Conditions: $P_B < P_R$

4. Braking time with braking resistor

$$t_{Bmin} = \frac{(J_M + J_L) \bullet (n_1 - n_2)}{307 \bullet K \bullet T_N + T_L + \left(\frac{(P_R \bullet 7.04)}{(n_1 - n_2)} \right)}$$

Valid range: $n_1 > n_N$

Conditions: $\frac{P_R \bullet 9.55}{(n_1 - n_2)} - T_N \bullet (1.5 - K)$

$f < 1.4$ x rated frequency of motor

$P_B < P_R$

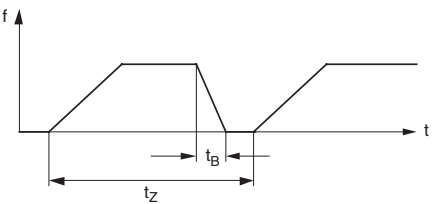
On period d.c.f.

ON period d.c.f for cycle time $t_Z < 120$ s

$$d.c.f = \frac{t_B}{t_Z} \bullet 100\ \%$$

ON period d.c.f for cycle time $t_Z > 120$ s

$$d.c.f = \frac{t_B}{120\ s} \bullet 100\ \%$$



Definitions

K = 0.25 for motors up to 2 hp
0.20 for motors 3 to 5 hp
0.15 for motors 7.5 to15 hp
0.08 for motors 20 to 60 hp
0.05 for motors 75 to 400 hp

J_M =	Moment of inertia of the motor [lb ft²]	T_B =	Braking torque (required) [ft lbs]	
J_L =	Moment of inertia of the load [lb ft²]	T_L =	Load torque [ft lbs]	
n_1 =	Motor speed before deceleration [rpm]	t_B =	Braking time (required) [s]	
n_2 =	Motor speed after deceleration [rpm] (Stand still = 0 rpm)	t_{Bmin} =	Minimum braking time	[s]
		t_Z =	Cycle time	[s]
n_N =	Motor rated speed [rpm]	P_B =	Peak braking power	[W]
T_N =	Motor rated torque [ft lbs]	P_R =	Peak power dissipation of the resistor	[W]

3.5 Control Circuit: F5-BASIC

3.5.1 Terminal Strip Connections

PIN	Function	Description
1	+ Analog input 1	Voltage input for speed control, resolution:11 Bit, 0...±10 VDC, scan time: 2 ms
5	Analog Output	Outputs 10 VDC when motor speed is 0 rpm
7	+10V Output	Analog supply voltage for speed ref. +10 VDC ±5%, max. 4 mA
8	Analog Common	Common for analog In- and Outputs
10	Quick Stop	0 V = Quick Stop, +24 V = Normal Operation
11	Stop Signal	Stop Signal: +24 V pulse starts stop sequence
14	Start Signal	Momentary signal starts index
15	Direction Select	0 V = Forward, +24 V = Reverse
16	Control Release	+24 V = Drive enabled; Drive fault reset when signal removed
20	24V-Output	Approx. 24V Output (max.100 mA)
22	Digital Common	Common for digital In-/Outputs
24	Relay 1, NO contact	Fault Output
25	Relay 1, NC contact	Drive Ready
26	Relay 1, switching cont.	Switching Constant, Ratings: max. 30 V DC, 1 A
24	Relay 2, NO contact	Programmable Relay; Actual Frequency (CP.22) > Level (CP.23)
25	Relay 2, NC contact	Actual Frequency(CP.22) < Level (CP.23) *** Default Zero Speed Output ***
26	Relay 2, switching cont.	Switching Constant, max. 30 V DC, 1 A

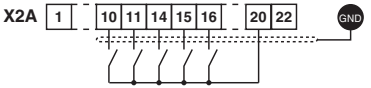
3.5.2 Connection of the control signals

In order to prevent a malfunction caused by interference voltage on the control inputs, the following steps should be observed:

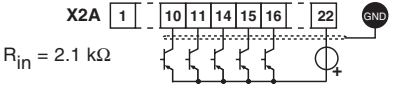
- Establish a common ground point for all ground connections.
- Use shielded cable with twisted pair wires.
- Terminate shield wires to earth ground, only at inverter.
- Separate control and power wires 8" or more apart.
- Control and power wires to cross at a right angle.

3.5.3 Digital Inputs

Use of **internal** voltage supply



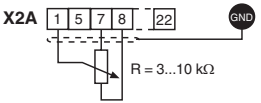
Use of **external** voltage supply



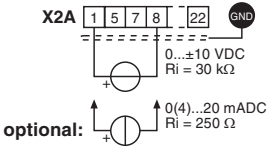
20...30 VDC Regulated

3.5.4 Analog Inputs

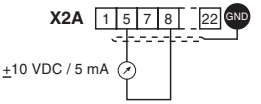
Internal analog speed ref. setting



External analog speed ref. setting

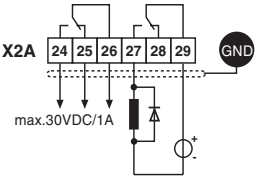


3.5.5 Analog Output



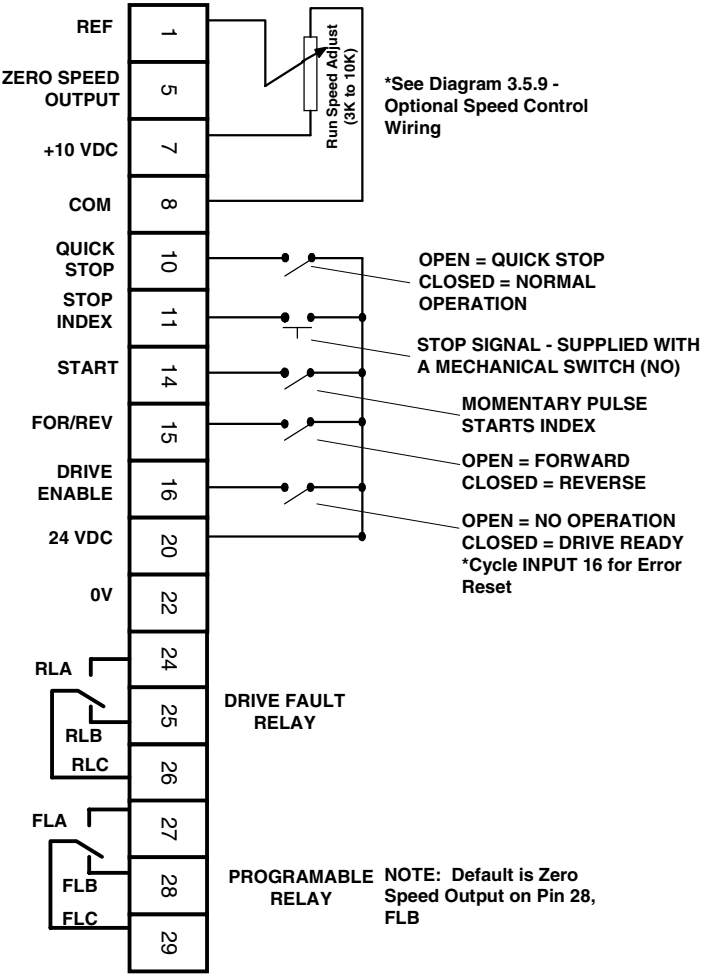
3.5.6 Relay Outputs

In case of inductive load on the relay output, protective wiring must be provided (e.g. free-wheeling diode)!



3.5.7 Suggested wiring

If the thermal protection won't be used a jumper between terminals T1 & T2 need to be added.

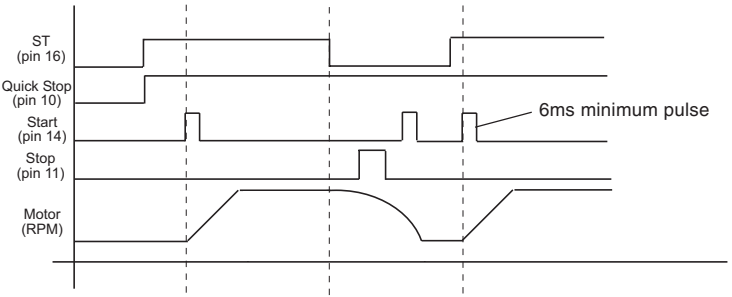


3.5.8 Operation Explanation

As a momentary signal is sent to INPUT 14 the drive indexes until it receives a signal on INPUT 11. On reception of signal on INPUT 11 the drive either decelerates and stops or the stop point is delayed for a positioning stop. This depends on the value entered in CP.27.

In the index mode, the start pulse takes priority over the stop pulse.

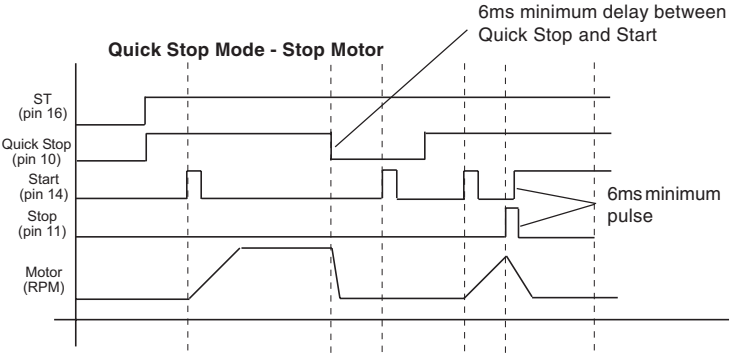
Disabled Mode - Motor Voltage Off



ST: Loss of signal shuts off the motor voltage - the motor will coast to a stop
Quick Stop: Ignored
Start pulse: Ignored
Stop signal: Ignored

Drive reactivates into indexing mode - motor stopped condition or Quick Stop mode depending on Quick Stop input!

Quick Stop Mode - Stop Motor

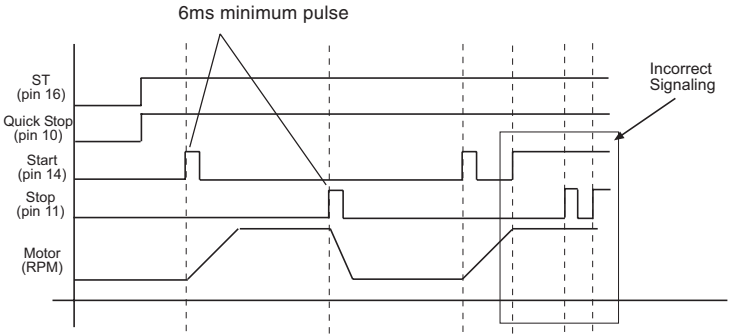


ST: Must be high
Quick Stop: Loss of signal decelerates the load to a stop
Start pulse: Ignored
Stop signal: Ignored

Drive reactivates into indexing mode - motor stopped condition!

Examples of Correct and Incorrect Signaling

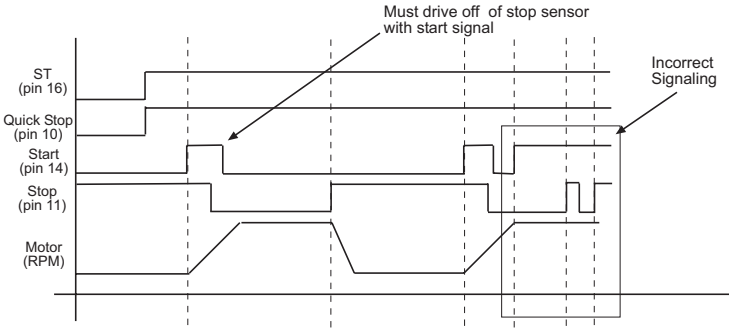
Indexing Mode



ST: Must be high
Quick Stop: Must be high
Start pulse: Motor accelerates and runs at speed
Stop signal: Motor decelerates and stops at a repeatable distance from the stop sensor

* Incorrect singaling
1. Start pulse overrides the stop signal
2. Start input must be low for stop signal to function

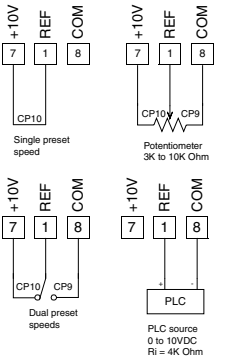
Indexing Mode - Stopping on stop sensor



ST: Must be high
Quick Stop: Must be high
Start pulse: Motor accelerates and runs at speed
Stop signal: Motor decelerates and stops at a repeatable distance from the stop sensor (sensor still made)

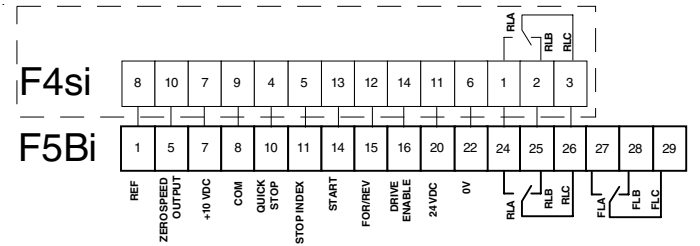
* Incorrect singaling
1. Start pulse overrides the stop signal
2. Start input must be low for stop signal to function

3.5.9 Optional Speed Control Wiring

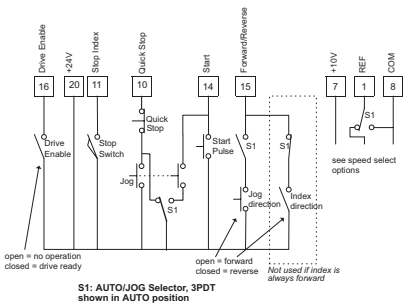


3.5.10 F4si to F5Bi conversion

There are two differences between the F4si and F5Bi drives. First the numbering of the pins has changed, these are shown below. Seconded is that the internal voltage supply is 24 VDC and not 15VDC. If external hardware is used verify the compenants compatiblity.



3.5.11 Optional Jog Wiring

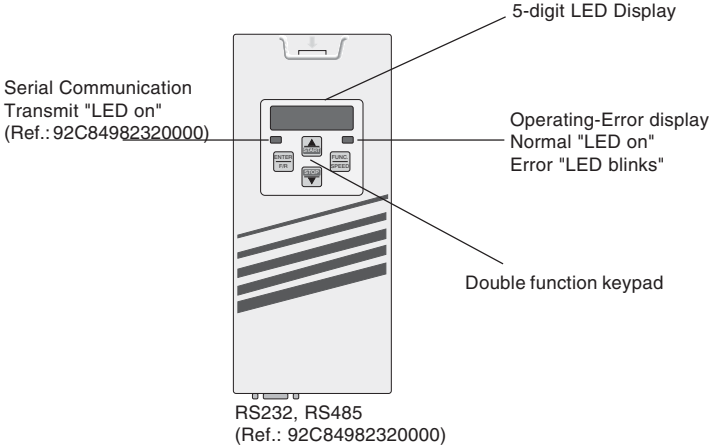


4. Operation of the inverter

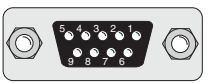
As an accessory for displaying and editing "CP" parameter values, a "digital operator" is necessary. To remotely mount the digital operator, a operator remote cable is required. To prevent malfunctions, the inverter must be brought into ***nOP*** status *(remove signal from control release terminal 16)* before connecting / disconnecting the operator. When starting the inverter without an operator, it is started with the last stored values.

4.1 Digital Operator

Standard Operator: Part No. 92C84982310000
Serial Operator: Part No. 92C84982320000



Only use the **operator interface** for the serial data transfer to RS232, 485. The direct connection from PC to the inverter is only valid with a **special cable otherwise it will lead to the destruction of the PC-interface!**



PIN	RS485	Signal	Meaning
1	–	–	reserved
2	–	TxD	Transmitter signal, RS232
3	–	RxD	Receiver signal, RS232
4	A'	RxD-A	Receiver signal A, RS485
5	B'	RxD-B	Receiver signal B, RS485
6	–	VP	Voltage supply-Plus +5V (I_{max} = 10 mA)
7	C, C'	DGND	Data reference potential
8	A	TxD-A	Transmitter signal A, RS485
9	B	TxD-B	Transmitter signal B, RS485

4.1.1 Keypad

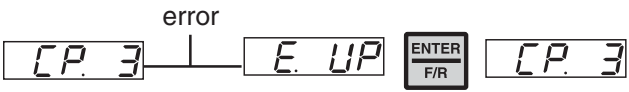
When switching on the KEB COMBIVERT F5, the value of parameter CP.1 appears in the operator display. (see "Drive Mode" to switch the keypad function)

The **function key** (FUNC) changes between the parameter value and parameter number.

With **UP** (▲) and **DOWN** (▼), the value of the parameter number is increased or decreased.

Generally; when a value is changed, parameter values are immediately accepted and stored nonvolatile. However, with some parameters it is not useful that the adjusted value is accepted immediately. In these cases the adjusted value is accepted and stored nonvolatile by pressing **ENTER**.

If a drive fault occurs during operation, the display changes to the drive fault message. The drive fault message in the display is cleared by pressing **ENTER**.



Pressing **ENTER** only clears the fault message in the display. In the Inverter status display (CP. 2), the fault is still displayed until the inverter has been reset. In order to reset the fault itself the cause must be identified and removed, than a reset signal applied to terminal 16, F5-Basic, or a power-on reset (cycle supply voltage off and then on) must occur.

4.2 Parameter Summary

Display	Parameter	Setting Range	Resolution	Factory Setting
CP.0	Password Input	0 ... 9999	1	Read Only
CP.1	Actual Frequency Display	-	.0125	Read Only
CP.2	Inverter State	-	-	Read Only
CP.3	Actual Utilization	-	1 %	Read Only
CP.4	Peak Utilization	-	1 %	Read Only
CP.5	Rated Frequency	0.0000 ... 400.0000 Hz	.0125 Hz	60.0000 Hz
CP.6	Boost	0.0 ... 25.5 %	0.1 %	5.0 %
CP.7	Acceleration Time	0.00 ... 300.00 s	0.01 s	.15 s
CP.8	Deceleration Time	-0.01; 0.00 ... 300.00 s	0.01 s	.12 s
CP.9	Minimal Frequency	0.0000 … 70.0000 Hz	0.0125 Hz	20.0000 Hz
CP.10	Maximal Frequency	0.0000 … 70.0000 Hz	0.0125 Hz	60.0000 Hz
CP.14	Max. Ramp Current	0…200 %	1 %	200 %
CP.15	Max. Constant Current	0…200 %	1 %	200: off
CP.16	Speed Search Condition	0…15	1	0: off
CP.17	Voltage Stabilization	1…650 V (off)	1 V	LTK
CP.20	DC Braking Mode	0…9	1	1: LS + actual value = 0
CP.21	DC Braking Time	0.00…100.00 s	0.01 s	.10 s
CP.22	Relay 2 Output Condition	0…68	1	27: actual value> level
CP.23	Relay 2 Output Level	± 300000.00	0.01	0.10
CP.27	Positioning Delay	-0.02 ... 327.67 s	0.01 s	0.00 s
CP.35	Customer Rev. Iden.	0 ... 65535	1	1
CP.36	Customer Iden. Number	0 ... 65535	1	10141

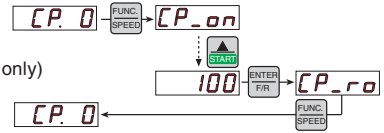
1) LTK - depending on power circuit

4.3 Password Input

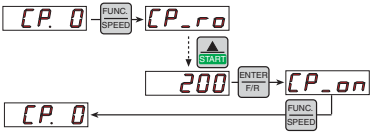
CP. 0

From the factory, the frequency inverter is supplied without password protection, this means that all parameters can be adjusted. After programming, the unit can be protected against unauthorized access thus preventing the values from being changed.

Locking the CP-Parameters (Read only)



Releasing the CP-Parameters



4.4 Operating Displays

The parameters below provide the user with the ability to monitor various operating characteristics of the drive. These parameters are very useful during commissioning and trouble shooting.

Actual frequency display

CP. 1

Display of the actual output frequency with a resolution of 0.0125 Hz. The digital operator will display "noP" or "LS" if the enable (terminal 16) or the direction of rotation (terminal 14 or 15) are not energized. The rotation of the motor is indicated by the sign.

Examples:

183 Output frequency 18.3 Hz, rotation forward

-183 Output frequency 18.3 Hz, rotation reverse

Inverter status display

CP. 2

The status display shows the actual working conditions of the inverter. Possible displays and their meanings are:

noP "no Operation" control release (terminal 16) signal removed, modulation off, output voltage = 0 V, drive is disabled.

LS " Low Speed " no direction signal at F or R (terminal 14 or 15), modulation off, output voltage = 0 V.

FAcc "Forward Acceleration" drive accelerates with direction of rotation forward .

FdEc "Forward Deceleration" drive decelerates with direction of rotation forward.

rAcc "Reverse Acceleration" drive accelerates with direction of rotation reverse.

rdEc "Reverse Deceleration" drive decelerates with direction of rotation reverse.

Fcon "Forward Constant" drive runs with a constant speed and direction of rotation forward.

rcon "Reverse Constant" drive runs with constant speed and direction of rotation reverse.

Other status messages; such as error(E.xxx) and malfunction (A.xx) codes, are described towards the end of this manual.

Actual inverter load

CP. 3

Display of the actual inverter loading in percent. 100% rate of utilization is equal to the inverter rated current. Only positive values are displayed, meaning there is no difference between motor and regenerative operation.

Peak inverter load

CP. 4

CP.4 makes it possible to display the peak inverter loading during operation in percent. Only positive values are displayed, meaning there is no differentiation between motor and regenerative operation.

4.5 Adjustment of the Drive

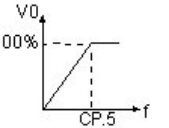
The following parameters determine the fundamental operating data of the drive. They should be checked and/or adjusted for the application.

Rated frequency

CP. 5

The inverter will output the applied input voltage or the voltage value adjusted in CP.17 at the frequency value adjusted in this parameter. This parameter is typically adjusted for the motor rated frequency. **Note: Motors can overheat when the rated frequency is incorrectly adjusted!**

Adjustment range:	0...400 Hz
Resolution:	0.0125 Hz
Factory setting:	60 Hz

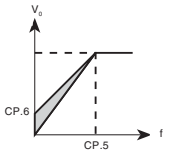


Boost

CP. 6

In the lower speed range losses in the motor become greater. This parameter can be used to boost the voltage in order to overcome these losses. With proper adjustment, the torque output of the motor will remain constant even at the lowest speeds.

Adjustment range:	0.0...25.5 %
Resolution:	0.1 %
Factory setting:	5.0 %



Adjustment:

1) Determine the load level (CP.3) with no-load operation at the rated frequency.
2) Then run at about 10 Hz and adjust the torque boost, so that about the same load level (CP.3) is achieved as with the rated frequency.

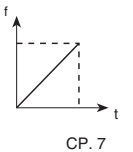
During continuous operation; if the motor operates at low speed and too much voltage, it can lead to overheating of the motor.

Acceleration time

CP. 7

The parameter determines the time needed to accelerate from 0 Hz to 100 Hz. The actual acceleration time is proportional to the frequency change (delta f).

$$\frac{100\ \text{Hz}}{\text{delta f}} \times \text{actual acceleration time} = \text{CP.7}$$



CP. 7

Adjustment range:	0.00...300.00 s
Resolution:	0.01 s
Factory setting:	0.15 s

Example: actual acceleration time = 5s; the drive should accelerate from 10 Hz to 60 Hz, delta f = 60 Hz - 10 Hz = 50 Hz

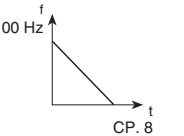
$$\text{CP.7} = (100\ \text{Hz} / 50\ \text{Hz}) \times 5\ \text{s} = 10\ \text{s}$$

Deceleration time

CP. 8

The parameter determines the time needed to decelerate from 100 Hz to 0 Hz. The actual deceleration time is proportional to the frequency change (delta f).

$$\frac{100\ \text{Hz}}{\text{delta f}} \times \text{actual deceleration time} = \text{CP.8}$$



Adjustment range:	-1; 0.00...300.00 s
Resolution:	0.01 s
Factory setting:	.12 s

By depressing DOWN arrow key, one increment passed the 0.0, the display will show "**=Acc**". This means the same value stored in CP.7 (Decel=Accel time)!

Example: actual deceleration time = 5s; the drive should decelerate from 60 Hz to 10 Hz. delta f = 60 Hz - 10 Hz = 50 Hz

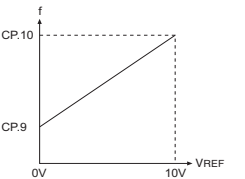
CP.8 = (100 Hz / 50 Hz) x 5 s = 10 s

Minimum frequency

CP. 9

The frequency the inverter outputs with 0V applied to the analog input or if the activated mode frequency is lower than this value.

Adjustment range:	0...70 Hz
Resolution:	0.0125 Hz
Factory setting:	20.0 Hz



Maximum frequency

CP. 10

The frequency the inverter outputs with 10V applied to the analog input.

Adjustment range:	0...70 Hz
Resolution:	0.0125 Hz
Factory setting:	60.0 Hz

Max. ramp current

CP.14

This function acts as an adjustable current limit during acceleration or deceleration. It can be used to prevent the load current from exceeding the inverter's peak current rating, thereby preventing shut down with an E.OC fault. When the load level reaches the adjusted value, the acceleration or deceleration is stopped until the load drops below the adjusted value. Note: if this parameter is adjusted too low, the motor may not be able to accelerate to full speed. The motor will run at a low speed. CP.2 displays "LAS" when the function is active.

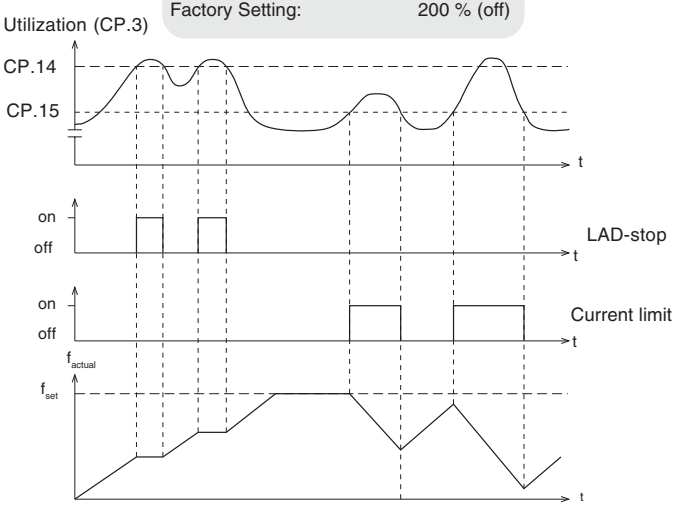
Adjustment range:	0...200 %
Resolution:	1 %
Factory setting:	200 %

Max. constant current

CP.15

This function acts as an adjustable current limit when operating at a constant speed. It can be used to prevent the load current from exceeding the inverter's over current level, thereby preventing shut down of the inverter with an E.OC fault. When the load level reaches the adjusted value, the output frequency is reduced until the load drops below the adjusted value, after which the frequency is increased again to the previous value. Setting the value too low may prevent the motor from running at the desired speed. CP. 2 displays "SSL" when the function is active.

Adjustment range:	0...200 % (off)
Resolution:	1 %
Factory Setting:	200 % (off)



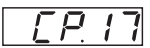
Speed search condition

When starting the frequency inverter into a spinning motor, an E.OC fault can be triggered because of the difference between the actual motor speed and the inverter set speed. By activating speed search, the inverter searches for the actual motor speed, adjusts its output frequency to match. It will then accelerate with the adjusted ramp time to the given set value. During speed search CP.2 displays "SSF". This parameter determines under which conditions the function will operate. Parameter values can be selected individually or any combinations.
Example: CP.16=12 means after reset **or** after auto-restart (E.UP).

Value	Condition
0	Function off
1	Control release enabled (terminal 16)
2	Power on
4	After fault reset
8	After auto-restart (reset) E.UP

Adjustment range:	0...15
Resolution:	1
Factory setting:	8
Note:	Enter-Parameter

Voltage stabilization



This parameter can be used to regulate the output voltage in relation to the rated frequency. With this function active, voltage variations at the input as well as on the DC bus will have only a small influence on the output voltage (V/Hz-characteristic). This function can be used to adapt the output voltage for special motors and can also prevent damage to the motor resulting from over or under voltage supply.

Adjustment range:	1...650 V (off)
Resolution:	1 V
Factory setting:	PSD
Note:	Enter-Parameter

PSD (Power Stage Dependent)

In the example below using a motor rated at 230 V / 60Hz, the output voltage is too high due to our supply being 250 V and CP.17 off. By setting CP.17 to the correct rated motor voltage of 230 V, the voltage is clamped thereby giving the motor the correct voltage.

If the supply voltage drops to190 V and CP.17=230 V, the inverter will still provide rated voltage to the motor up until 190V. The output voltage can not be increased further beyond the input therefore the motor will operate in field weakening. To calculate at which frequency this will occur use the following formula:

$$f = (60Hz/\ 230\ V)*190\ V = 50\ Hz$$

$CP.17 = 230V \qquad V_{supply} = 190V$

* Both scenarios above, it is assumed no boost (CP.6=0%).

DC-braking Mode

During DC-braking, the motor is not decelerated by a controlled ramp. Quick braking without regen voltage can be achieved by applying a DC voltage to the motor winding. Parameter values listed on the next page, determine how the DC-braking is triggered.

Value	DC-Braking Activation
0	Deactivated
1	Activates when direction signal is removed and the output frequency has reached 0Hz. The braking time is dependent on CP.21 or until the next direction of rotation.
2*	Activates as soon as the direction signal is removed.
3*	Activates as soon as the direction signal is removed or changed.
4*	Activates as soon as the direction signal is removed and if the real frequency goes below 4 Hz.
5*	Activates when the real frequency goes below 4 Hz.
6*	Activates as soon as the set value goes below 4 Hz.
7	Reserved - No Function
8	Reserved - No Function
9	Activates before the acceleration ramp when a direction signal is given. The time is dependent on CP.21.

* Braking time depends on the actual frequency.

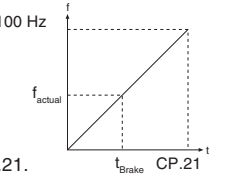
Adjustment range:	0...9
Resolution:	1
Factory setting:	1
Note:	Enter-Parameter

DC-braking Time

CP.21

If the braking time depends on the actual frequency (CP.20 = 2...7), it is calculated as follows:

$$t_{Brake} = \frac{CP.21 \times f_{real}}{100\ Hz}$$



Otherwise the braking time corresponds to CP.21.

Adjustment range:	0.00...100.00 s
Resolution:	0.01 s
Factory setting:	0.10 s

Relay output 2

CP.22

CP.22 determines the function of Relay Output 2.
Relay output 2 (terminal X2A.27...X2A.29)

The switching level of CP.22 is CP.23!

Value	Function
0	No function
1	On; active when unit has voltage applied to it
2	Run signal; also by DC-braking
3	Ready signal (no error)
4	Fault relay
5	Fault relay (no auto-reset)
6	Warning or error message at abnormal stopping
7	Overload alert signal
8	Overtemperature alert signal power modules
9	External Overtemperature alert signal motor
10	Motor thermal relay tripped (OH2)
11	Overtemperature alert signal interior (OHI)
12	Cable breakage on analog input 1 (4...20 mA)
13	Cable breakage on analog input 2 (4...20 mA) {F5G only}
14	Max. constant current (stall, CP.15) exceeded
15	Max. ramp current (LA-Stop CP.14) exceeded
16	DC-braking active
17	Power off
18	Motor brake control
19	PID control difference > switching level {F5G only}
20	Actual value=set value (CP.2=Fcon, rcon; not at noP, LS error,SSF)
21	Accelerate (CP.2 = FAcc, rAcc, LAS)
22	Decelerate (CP.2 = FdEc, rdEc, LdS)
23	Real direction of rotation = set direction of rotation

24	Actual load utilization (CP.3) > 100%
25	Active current > switching level
26	Actual DC voltage >switching level
27	Actual frequency (CP.1) > switching level
28	Set frequency > switching level
29	Ref. point run complete {F5G only}
30	Actual torque > level {F5G only}
31	Absolute speed on AN1 > switching level
32	Absolute speed on AN2 > switching level {F5G only}
33	Absolute. speed on AN3 > switching level {F5G only}
34	Set value on AN1 > switching level
35	Set value on AN2 > switching level {F5G only}
36	Set value on AN3 > switching level {F5G only}
37	Timer 1 > switching level
38	Timer 2 > switching level
39	Reserved {F5M}
40	Hardware current limit active
41	Modulation on-signal
42	ANOUT3 PWM
43	ANOUT4 PWM {F5G only}
44	Inverter status (ru.0) = switching level
45	Power transistor temperature > switching level
46	Motor temperature > switching level
47	Ramp output > switching level
48	Phase current > switching level
49	Rotation forward
50	Rotation reverse
51	OL2 warning {F5G only}
52	Reserved {F5M}
53	Reserved {F5M}
54	Reserved {F5M}
55	Reserved {F5M}
56	Reserved {F5M}
57	Reserved {F5M}
58	Reserved {F5M}
59	Digital input (ru.22} "AND" > switching level {F5B only*}
60	Digital input (ru.22} "OR" > switching level {F5B only*}
61	Digital input (ru.22} "NAND" > switching level {F5B only*}
62	Digital input (ru.22} "NOR" > switching level {F5B only*}
63	Absolute value ANOUT1 > switching level {F5B only*}
64	Reserved {F5B only*}
65	Absolute speed on ANOUT1 > switching level {F5B only*}
66	Reserved {F5B only*}

*These functions are currently not supported by the F5G in the B housing.

Factory setting CP.22:	27
Note:	Enter-Parameter

Relay output 2 Switching level

CP.23

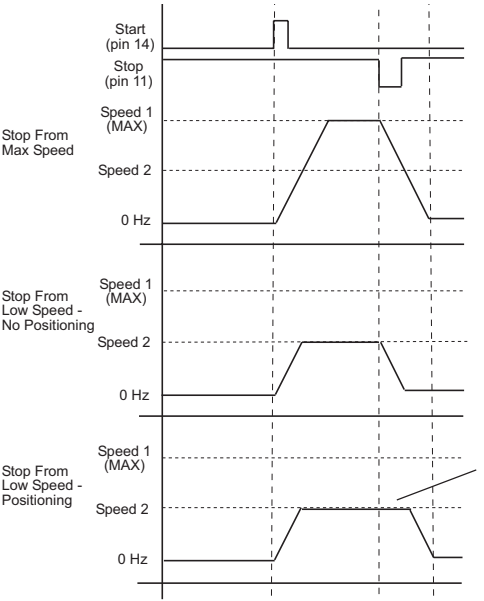
This parameter determines the switching point for relay output 2. Since the operator display can only view 5 characters, the last digits are not displayed for the higher values. Note; all conditions chosen with CP.22 don't require use of CP.23.

Adjustment range:	-30000.00...30000.00
Resolution:	0.01
Factory setting:	0.00

Positioning Delay

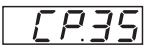
CP.27

The positioning function enables the approach of a position with a signal from different frequencies. With parameter CP.27 the stop position can be adjusted, which entails an additional constant running time. CP. 27 selects positioning on/off and if positioning is on and additional run time. This additional run time is added to every speed. In the example below CP.27 is set to 0.00. This selects posiitioning without a positioning delay.



Setting	Function
-2; S_int	Positioning Off
-1; Off	Positioning Off
0.00...327.67	Positioning On; positioning delay by adjusted value
Factory Setting	0.00; Positioning On; No delay

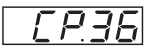
Program Revision Identifier



This parameter identifies the revision number of the programing in the drive. This will allow for easy identification of errors or upgrades to the software. Please don't change this parameter.

Adjustment range:	0 ... 65355
Resolution:	1
Factory setting:	1

Customer Identification Number



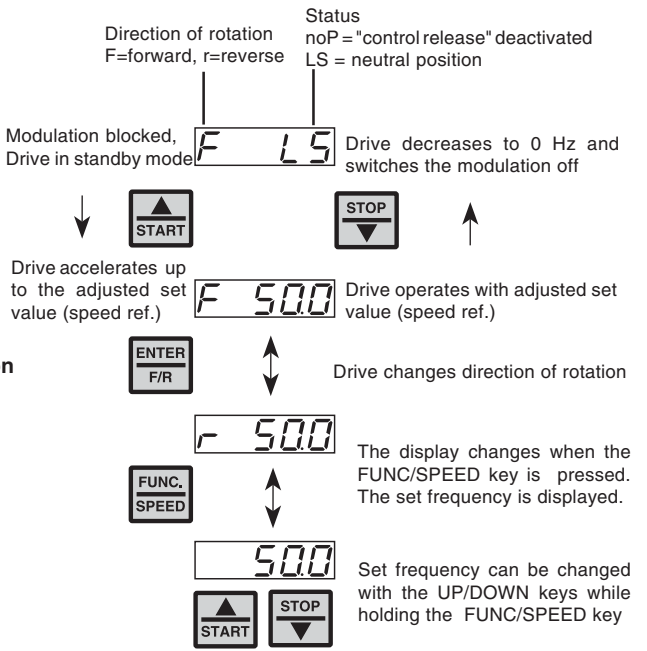
The customer identification number allows verification of the programming in the inverter. This will simplify identification of software. Please don't change this parameter.

Adjustment range:	0 ... 65355
Resolution:	1
Factory setting:	10141

4.6 The "Drive Mode"

The Drive Mode is a operating mode of KEB COMBIVERT that permits the manual starting of the drive through the keypad display unit. After applying a signal to the control release terminal 16, the set value (speed ref.) and rotation setting are effected exclusively over the keypad. In order to activate the Drive Mode the corresponding **password** (500) must be entered **in CP.0**. The display switches over as follows.

4.6.1 Start / Stop Drive



4.6.2 Changing the Direction of Rotation

4.6.3 Speed setting

4.6.4 Leaving "Drive Mode"

To exit the Drive Mode the inverter must be in status “stop” (Display noP or LS). Press the FUNC and ENTER keys simultaneously for about 3 seconds to leave the Drive Mode. The CP-parameters appear in the display.

5. Error Diagnosis

KEB COMBIVERT **Error messages** are always represented with an "E.xx" and the appropriate error code in the display. Errors cause the immediate turn off of the output to the motor. Restart is possible, only after reset.

Malfunctions are represented with an "A.xx" and the appropriate code. Responses to malfunctions can vary depending on the programmed condition.

In the following table the error codes and their causes are described.

Display	Description	Value	Meaning
E. OP	ERROR over voltage	1	Error: Overvoltage (DC-bus circuit) Occurs, if DC-bus voltage rises above the permissible value. Causes: • poor control adjustment (overshooting) • input voltage too high • interference voltages at the input • deceleration ramps too short • braking resistor damaged or undersized
E. UP	ERROR under voltage	2	Error: Under voltage (DC-bus circuit). Occurs, if DC-bus voltage falls below the permissible value. Causes: • input voltage too low or instable • inverter rating too small • voltage losses through wrong cabling • the supply voltage through generator / transformer breaks down at very short ramps • one phase of the input voltage is missing (ripple-detection) • with separate supply and switched off power circuit
E. OC	ERROR over current	4	Error: Over current Occurs, if the specified peak current is exceeded. Causes: • acceleration ramps too short • the load is too big at turned off acceleration stop and turned off constant current limit • short-circuit at the output • ground fault • deceleration ramp too short • motor cable too long • EMC
E.OHI	ERROR overheat internal	6	Error: Overheating in the interior: error can only be reset once the drive displays E.nOHI; this means the interior temperature has fallen by at least 3°C
E.nOHI	no ERROR overheat int.	7	No longer overheating in the interior E.OHI, interior temperature has fallen by at least 3°C
E. OH	ERROR overheat pow.mod.	8	Error: Overtemperature of power module. Error can only be reset at E.nOH. Causes: • insufficient air flow at the heat sink (soiled) • ambient temperature too high • ventilator clogged

E.dOH	ERROR drive overheat	9	Error: Overtemperature signal from motor temperature sensor. Error can only be reset at E.ndOH, when sensor resistance decreases. Causes: • resistor at the terminals T1, T2 >1650 Ohm • motor overloaded • line breakage to the temperature sensor
E.nEd	no ERROR detected	10	No defined error recognized (should not occur)
E.ndOH	no ERROR drive overheat	11	No longer overtemperature of motor Temperature SENSOR, SENSOR is again low-resistance.
E. PU	ERROR power unit	12	Error: General power circuit fault
NO.PU	power unit not ready	13	Power circuit not ready
E.PUIN	ERROR power unit invalid	14	Error: Software version for power circuit and control card are different. Error cannot be reset.
E.LSF	ERROR load shunt fault	15	Error: charging relay does not close after the DC bus voltage reaches its normal operating level. Occurs for a short time during the switch-on phase, but must automatically be reset immediately (after 10 sec's E.UP). If the error message re-mains, the following causes may be applicable: • load-shunt defective • input voltage incorrect or too low • high losses in the supply cable • braking resistor incorrectly connected or damaged • braking module defective
E. OL	ERROR overload	16	Error: Overload error can only be reset at E.nOL, if OL-counter has again reached 0%. Occurs, if an excessive load is applied longer than the permissible time (see technical data). Causes: • poor control adjustment (overshooting) • mechanical fault or overload in the application • inverter not correctly sized for application • motor incorrectly wired • encoder damaged
E.nOL	no ERROR overload	17	No more overload, OL-counter has reached 0%; after the error E.OL a cooling phase must elapse. This message appears upon completion of the cooling phase. The error can be reset. The inverter must remain switched on during the cooling phase.
E.buS	ERROR bus	18	Error: Adjusted time (Watchdog) of communication between operator and communication bus has been exceeded.
E.OL2	ERROR overload 2	19	Error: Overload while running below 3 Hz. Can only be reset at E.nOL2, if cool-down time has elapsed.
E.nOL2	no ERROR overload 2	20	No more overload, the cool-down time is terminated.
E.EEP	E. EEPROM defective	21	Error: EEPROM defective. After reset the error is repeated. (parameter values changed are erased in the EEPROM)

E.PUCO	E. power unit common.	22	Error: Parameter value could not be written to the power circuit. Acknowledgment from PC <> OK
E.OH2	ERROR motor protection	30	Error: Electronic motor protective relay has tripped.
E. EF	ERROR external fault	31	Error: External error is triggered when a digital input is being programmed as an external error input.
E.ENC	ERROR encoder	32	Error: Encoder cable and/or connection wiring
E.nOH	no E. over heat pow. mod.	36	Internal or external temperature has dropped to a safe level.
E.SET	ERROR set	39	Error: Set selection: It has been attempted to select a locked parameter set.
E.PRF	ERROR prot. rot. for.	46	Error: Locked direction of rotation clockwise
E.PRR	ERROR prot. rot. rev.	47	Error: Locked direction of rotation counterclockwise
E.PUCI	E. power unit code inv.	49	Error: during the initialization the power circuit could not be recognized or was identified as invalid.
E.PUCH	E. power unit changed	50	Error: Power circuit identification was changed; with a valid power circuit this error can be reset by writing to SY.3 (application mode).
E.DRI	ERROR driver relay	51	Error: Driver relay. Relay for driver voltage on power circuit has not picked up although control release was given.
E.HYB	ERROR hybrid	52	Error: Invalid encoder interface identifier
E.CO1	ERROR counter overrun 1	54	Error: Counter overflow encoder channel 1
E.CO2	ERROR counter overrun 2	55	Error: Counter overflow encoder channel 2
E. BR	ERROR brake	56	Error: This error can occur in the case of switched on brake control, if the load is below the minimum load level Pn.58 (application mode) at start up.
E.INI	ERROR initialization MFC	57	Error: MFC not booted
E.HYBc	ERROR hybrid changed	59	Error: Encoder interface identifier has changed, it must be confirmed over ec.0 or ec.10 (application mode).
E.ccd	ERROR calculation drive	60	Error: during the automatic motor stator resistance measurement
E.OS	ERROR over speed	105	Error: Real frequency is bigger than the max. Output frequency
A.OHI	ABN.STOP overheat int.	87	Warning: overtemperature in the interior
A.nOH	no A. overheat pow.mod.	88	Warning: no more overtemperature of power module
A. OH	A.STOP overheat pow.mod	89	Warning: Overtemperature of power module

A. EF	ABN.STOP external fault	90	Warning: external error. This will be shown on Quick Stop condition.
A.ndOH	no A. drive overheat	91	Warning: no more overtemperature of motor TEMPERATURE SENSOR. Motor SENSOR is low-resistance again.
A.nOHI	no A.STOP overheat int.	92	Warning: no more overtemperature in the interior
A.buS	ABN.STOP bus	93	Warning: Watchdog for communication between operator/ control card has responded
A.PRF	ABN.STOP prot. rot. for.	94	Warning: locked direction of rotation clockwise
A.PRR	ABN.STOP prot. rot. rev.	95	Warning: locked direction of rotation counterclockwise
A.dOH	ABN.STOP drive over heat	96	Warning: overtemperature of motor TEMPERATURE SENSOR
A.OH2	ABN.STOP motor protect.	97	Warning: electronic motor protective relay has tripped
A.nOL	no ABN.STOP overload	98	Warning: no more overload, OL counter has reached 0 %.
A. OL	ABN.STOP overload	99	Warning: Overload can only be reset at A.nOL, if OL counter has again reached 0 %
A.OL2	ABN.STOP overload 2	100	Warning: Overload can only be reset at A.nOL2, if cool-down time has elapsed
A.nOL2	no ABN.STOP overload 2	101	Warning: no more overload, the cool-down time has elapsed.
A.SET	ABN.STOP set	102	Warning: set selection: It has been attempted to select a locked parameter set.

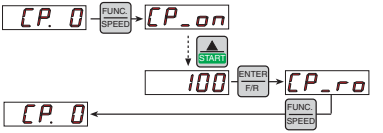
Display	Parameter	Setting Range	Resolution	Customer Setting
CP.0	Password Input	0 ... 9999	1	Read Only
CP.1	Actual Frequency Display	-	.0125	Read Only
CP.2	Inverter State	-	-	Read Only
CP.3	Actual Utilization	-	1 %	Read Only
CP.4	Peak Utilization	-	1 %	Read Only
CP.5	Rated Frequency	0.0000 ... 400.0000 Hz	.0125 Hz	
CP.6	Boost	0.0 ... 25.5 %	0.1 %	
CP.7	Acceleration Time	0.00 ... 300.00 s	0.01 s	
CP.8	Deceleration Time	-0.01; 0.00 ... 300.00 s	0.01 s	
CP.9	Minimal Frequency	0.0000 … 70.0000 Hz	0.0125 Hz	
CP.10	Maximal Frequency	0.0000 … 70.0000 Hz	0.0125 Hz	
CP.14	Max. Ramp Current	0…200 %	1 %	
CP.15	Max. Constant Current	0…200 %	1 %	
CP.16	Speed Search Condition	0…15	1	
CP.17	Voltage Stabilization	1…650 V (off)	1 V	
CP.20	DC Braking Mode	0…9	1	
CP.21	DC Braking Time	0.00…100.00 s	0.01 s	
CP.22	Relay 2 Output Condition	0…68	1	
CP.23	Relay 2 Output Level	± 300000.00	0.01	
CP.27	Positioning Delay	-0.02 ... 327.67 s	0.01 s	
CP.35	Customer Rev. Iden.	0 ... 65535	1	1
CP.36	Customer Iden. Number	0 ... 65535	1	10141

Write in customer settings for application specific adjustments. This will help in the problem solving proceess in the future. Also please don't adjust CP.35 and CP.36 from keypad this will help with trouble shooting in the future.

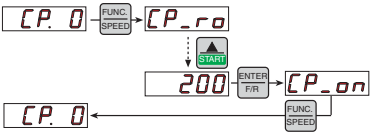
Password Input

From the factory, the frequency inverter is supplied without password protection, this means that all parameters can be adjusted. After programming, the unit can be protected against unauthorized access thus preventing the values from being changed.

Locking the CP - Parameters (Read only)



Releasing the CP-Parameters

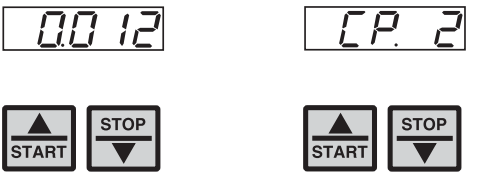


Parameter Display

When switching on the KEB COMBIVERT F5, the value of parameter CP.1 appears in the operator display. (see "Drive Mode" to switch the keypad function)

The **function key** (FUNC) changes between the parameter value and parameter number.

With **UP** (▲) and **DOWN** (▼), the value of the parameter number is increased/decreased.



7. Suggested Systems

		PART NUMBER
208/230 VAC 1 Phase Systems		
1/2 HP	Indexing Drive (size 5)	92C84982010000
	EMI filter	92C84982210000*
1 HP	Indexing Drive (size 7)	92C84982030000
	EMI filter	92C84982210000*
208/230 VAC 3 Phase Systems		
2 HP	Indexing Drive (size 9)	92C84982050000
	EMI filter	92C84982220000*
	Braking Resistor	92C84982420000*
3 HP	Indexing Drive (size 10)	92C84982070000
	EMI filter	92C84982220000*
	Braking Resistor	92C84982430000
5 HP	Indexing Drive (size 12)	92C84982090000
	EMI filter	92C84982230000*
	Braking Resistor	92C84982430000
400/460 VAC 3 Phase Systems		
1/2 HP	Indexing Drive (size 5) with internal EMI filter	92C84982020000
1 HP	Indexing Drive (size 7) with internal EMI filter	92C84982040000
2 HP	Indexing Drive (size 9) with internal EMI filter	92C84982060000
	Braking Resistor	92C84982470000*
3 HP	Indexing Drive (size 10)	92C84982080000
	EMI filter	92C84982240000*
	Braking Resistor	92C84982480000
5 HP	Indexing Drive (size 12)	92C84982100000
	EMI filter	92C84982250000*
	Braking Resistor	92C84982490000

**optional*

More options are available in larger sizes. Low inertia motors are also avaiable in IEC or NEMA configurations. These motors can be found on page 20.

8. Accessories

PC to Inverter Programming	PART NUMBER
F5 Serial Operator	92C84982320000
(Display, Keypad, COMBIVIS Port)	
COMBIVIS Serial Cable	92A78348030000

*COMBIVIS software can be downloaded at www.kebamerica.com

F5 Basic Operator - supplied with drive	92C84982310000
F5 Ethernet Operator	92C84982330000
F5 Devicenet Operator	92C84982340000
F5 Profibus Operator	92C84982350000
F5 Modbus Operator	92C84982360000
F5 SERCOS Operator	92C84982370000
F5 CAN Operator	92C84982380000
F5 Interbus Operator	92C84982390000

FOR TECHNICAL SUPPORT PLEASE CALL INDUSTRIAL MOTION CONTROL, LLC AT (847) 459-5200

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 00.MC.0U0-K000 03/2005