

COMBIVERT



Installation & Operation Instructions F5 A Housing Servo System

This manual describes the KEB COMBIVERT F5 series motor control. This manual focuses attention on installation, connection as well as basic operation. Due to the various application possibilities and extensive programming capabilities with this unit, it was necessary to provide separate documentation which contains all of this detailed information. Please visit our Web site www.kebco.com or contact you local sales office. A list of additional manuals is provided at the end of this book.

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, uninsulated, and possibly also moving or rotating parts, as well as hot surfaces.

Removal of the protective covers, improper use, improper installation or misoperation, 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 within 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 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 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. Observation 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!

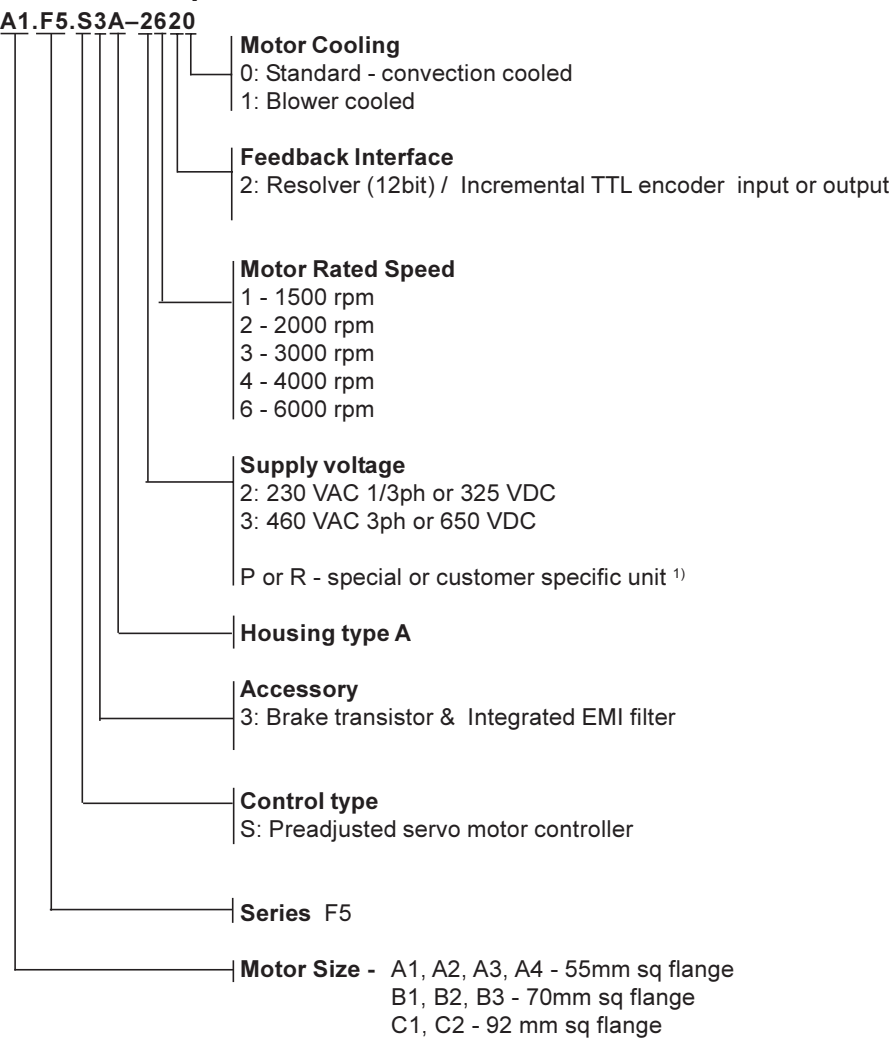
2. Product Description

2.1 Application

The KEB COMBIVERT F5 A-SERVO control is designed exclusively for the control and regulation of AC synchronous servo motors. The operation of other electric devices and loads is prohibited and can lead to the destruction of the unit.

The controller is tuned to the specified KEB SM servo motor at the factory. The controller is given a unique part number which corresponds to this adjustment. The servo control is a component which is intended for installation as a part of an electric system or machine.

2.2 Servo control part number identification



6 ¹⁾ For special units the last three digits are custom defined

2.3 Servo control technical data

Control size		04		04
Housing size		A		A
Input Ratings				
Supply voltage	[V]	180...260 ±0 VAC		305...500 ±0 VAC
		230VAC rated		460VAC rated
Supply voltage frequency	[Hz]	50 / 60 +/- 2		
Input phases		1	3	3
Rated input current	[A]	4	2.8	1.8
Maximum input fuse	[A]	10	5	5
Recommended wire gauge	[awg]	14	16	16
Output Ratings				
Rated output power	[kVA]	0.8		1.0
Rated motor power	[kW]	0.66		0.54
Rated output current	[A]	2.0		1
Peak current (30 seconds)	[A]	8.0		5.6
Over current fault (E_OC) trip level	[A]	9.6		6.7
Output voltage	[V]	3 x 0...V input		
Output frequency	[Hz]	0...400Hz		
Rated switching frequency	[kHz]	8		8
Maximum switching frequency	[kHz]	8		8
Power loss at rated operation ¹⁾	[W]	25		25
Stall current at 8kHz	[A]	2.3		1.6
Braking Circuit				
Min. braking resistance ²⁾	[Ohm]	82		150
Typ. braking resistance ²⁾	[Ohm]	100		330
Max. braking current	[A]	5.5		5.5
Installation Information				
Max. shielded motor cable length at 8 kHz ³⁾	[ft]	66		66
Tightening torque for terminal strip	[in lb]	Not applicable		
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		

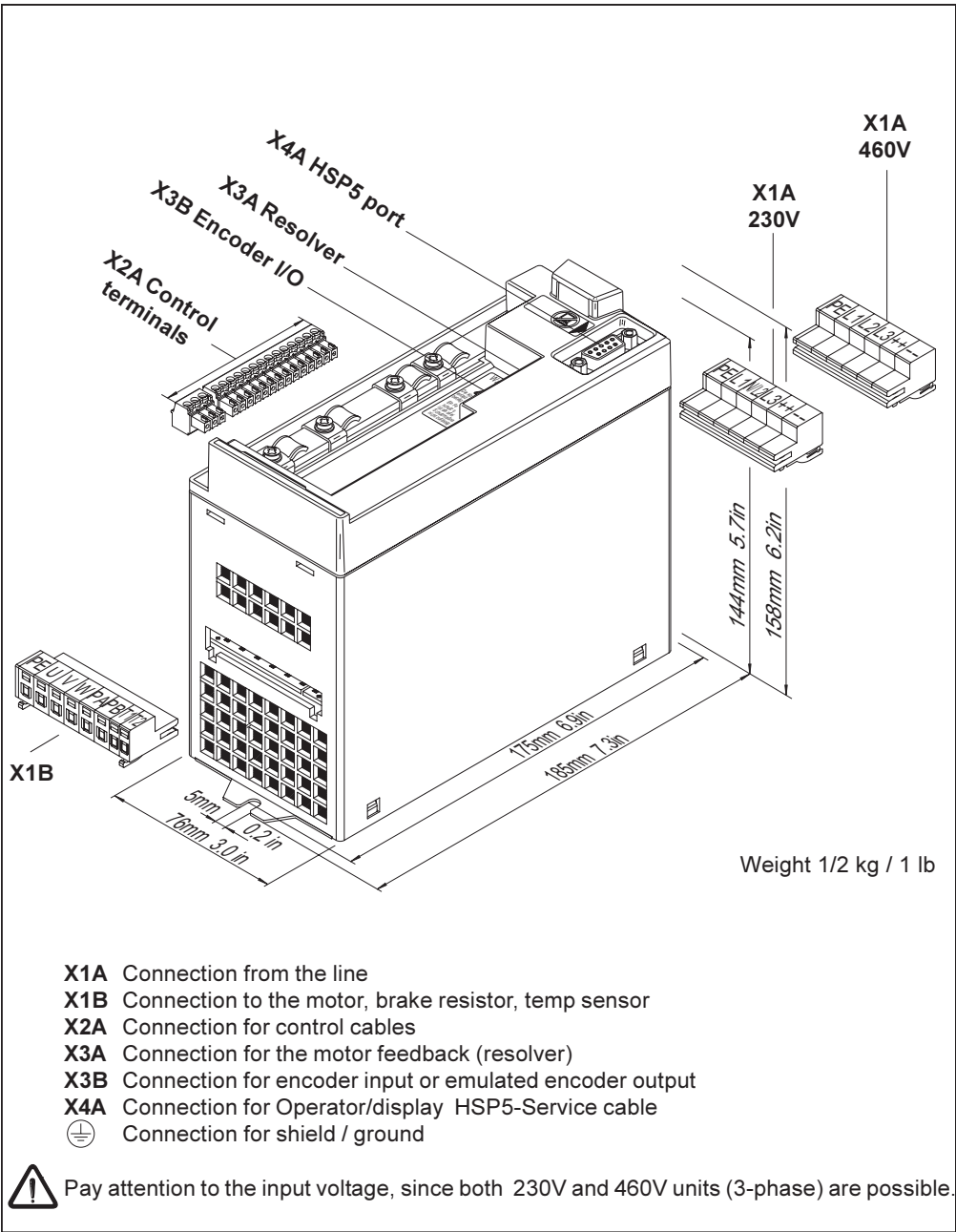
1) Rated operation means rated switching frequency, rated voltage, and rated output current.

2) Only for units with the braking circuit installed.

3) Maximum cable length is based on the use of shield motor cables, ground current limitations, EMI levels set forth in EN55011. Contact KEBCO for more information.

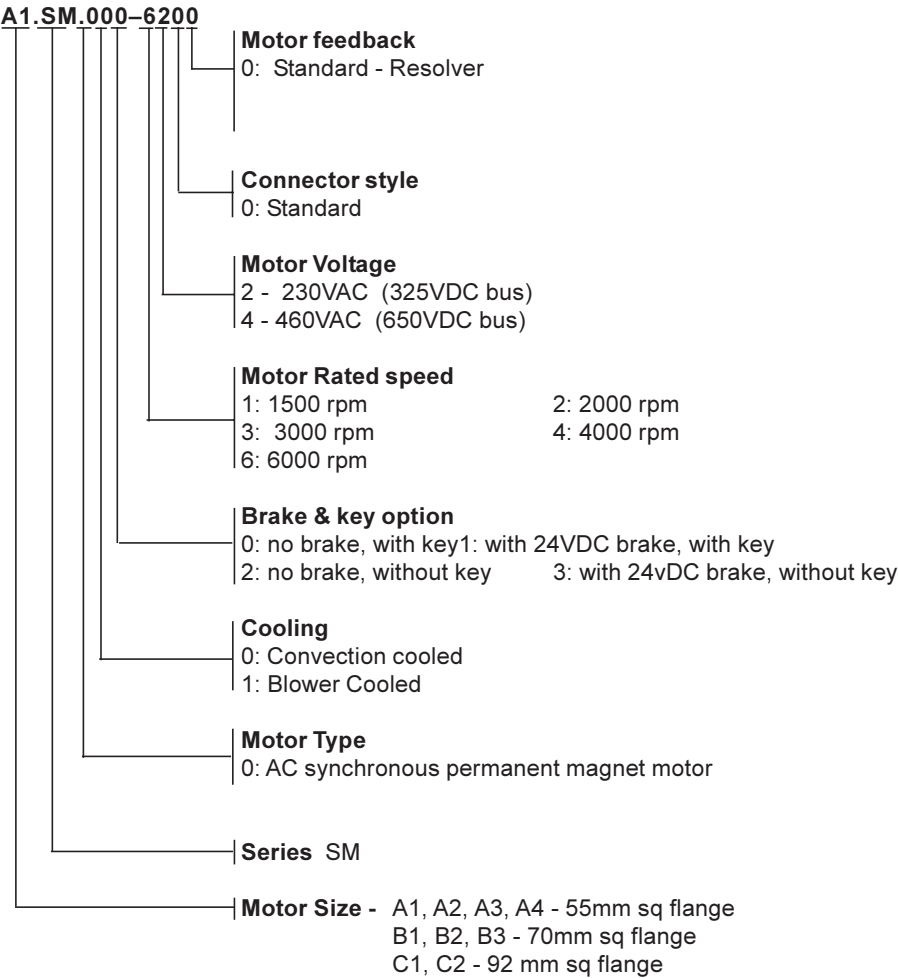
Product Description

2.4 Dimensions and terminals



2.5 Servo motor part number identification

The servo motor is delivered along with the servo controller to create a matched system.



Product Description

2.6 Servo motor technical data

The electrical data and some mechanical data of the servo motors are listed on the following pages. For further information especially regarding the axial and radial shaft loading, mounting configurations, environmental concerns, brake specifications etc., please refer to the more detailed servo motor instruction manual 00.SM.01B-K001. Always familiarize yourself with all safety and technical information before operating the servo motor.

The following operating data is unique to the combination of the F5 A Servo system and the selected motors. Different performance characteristics may be possible when using the F5M as the servo controller.

The servo motor is delivered along with the servo controller to create a matched system. If the motor data is changed it can be readjusted with the following information.

2.6.1 A size motors

Motor Size Speed and Voltage			A1		A2		A3		A4
			6200	6400	6200	6400	4200	6400	3200
Parameter	Ratings								
	Stall torque	Nm lb in	0.34 3.0		0.50 4.4		0.65 5.8		1.00 8.9
CP.11	Rated torque	Nm lb in	0.32 2.8	0.32 2.8	0.48 4.2	0.48 4.2	0.60 5.3	0.60 5.3	0.80 7.1
CP.12	Rated speed	rpm	6000	6000	6000	6000	4000	6000	3000
CP.13	Rated frequency	Hz	300	300	300	300	200	300	150
CP.14	Rated current	A	1.3	0.9	1.7	1.1	1.3	1.3	1.7
	Rated Power	Watts	201	201	302	302	251	377	251
CP.15	Voltage constant Ke	V/1000rpm	20	27.6	20	32.8	35.2	35.2	40
CP.16	Stator inductance	mH	9.9	18.7	5.4	14.5	12.2	12.2	10.7
CP.17	Stator resistance	ohms	21	40.5	8.7	25.8	18.9	18.9	13.1
CP.18	Stall current	A	1.2	0.85	1.5	1	1.2	1.2	1.6
CP.28	Maximum torque	Nm lb in	1.0 8.9	1.0 8.9	1.4 12.4	1.4 12.4	1.8 15.9	1.8 15.9	2.4 21.2
	Speed at T _{max}	rpm	5750	10000	9750	9450	3100	9350	2750
	Maximum Speed	rpm	9400	10000	10000	10000	5300	10000	4650
	Mechanical Specifications								
	Rotor inertia	kg cm ² lb in ²	0.17 0.058		0.24 0.082		0.31 0.106		0.45 0.154
	Overall length	mm	121		133		145		170
	Mass	kg / lb	1 / 2.2		1.2 / 2.6		1.4 / 3.1		1.8 / 4.0
	Shaft diameter	mm	9						
	Flange pilot	mm	40						
	Flange square	mm	55						

2.6.2 B size motors

Motor Size Speed and Voltage			B1		B2		B3
			4200	4400	3200	4400	2200
Parameter	Ratings						
		Nm lb in	0.65 5.8		1.40 12.4	1.50 13.3	2.20 19.5
CP.11	Rated torque	Nm lb in	0.60 5.3	0.60 5.3	0.95 8.4	1.30 11.5	2.00 17.7
CP.12	Rated speed	rpm	4000	4000	3000	4000	2000
CP.13	Rated frequency	Hz	200	200	150	200	100
CP.14	Rated current	A	2	0.9	2	1.4	2
	Rated Power	Watts	251	251	299	545	419
CP.15	Voltage constant Ke	V/1000rpm	20.8	48	38	57	60
CP.16	Stator inductance	mH	11.5	61	21	49	29
CP.17	Stator resistance	ohms	6.8	40	7	17	9.2
CP.18	Stall current	A	1.9	0.9	2.3	1.6	2.3
CP.28	Maximum torque	Nm lb in	1.8 15.9	1.8 15.9	2.9 25.7	3.9 34.5	6.0 53.1
	Speed at T _{max}	rpm	6850	4550	1400	4100	900
	Maximum Speed	rpm	9150	7800	4400	6450	2750
	Mechanical Specifications						
	Rotor inertia	kg cm ²	0.22		0.36		0.57
		lb in ²	0.075		0.123		0.195
	Overall length	mm	136		160		195
	Mass	kg / lb	1.5 / 3.3		2.1 / 4.6		2.9 / 6.4
	Shaft diameter	mm	11				
	Flange pilot	mm	60				
	Flange square	mm	70				

Product Description

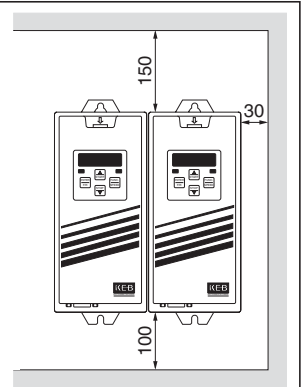
2.6.2 C size motors

Motor Size			C1				C2	
Speed and Voltage			4200	3400	4400	6400	2200	3200
Parameter	Ratings							
	Stall torque	Nm	0.95				2.70	2.50
		lb in	8.4				23.9	22.1
CP.11	Rated torque	Nm	0.75	0.80	0.75	0.70	2.40	2.10
		lb in	6.6	7.1	6.6	6.2	21.2	18.6
CP.12	Rated speed	rpm	4000	3000	3000	6000	2000	3000
CP.13	Rated frequency	Hz	200	150	150	300	100	150
CP.14	Rated current	A	1.8	0.7	0.9	1.3	1.6	2.0
	Rated Power	Watts	314	251	314	440	503	658
CP.15	Voltage constant Ke	V/1000rpm	27.5	66.5	50.2	33.6	78.8	59
CP.16	Stator inductance	mH	17.1	101	57.6	25.9	34.4	19.3
CP.17	Stator resistance	ohms	12.1	74.9	39.4	18.9	13.1	6.9
CP.18	Stall current	A	2.0	0.8	1.1	1.6	1.9	2.3
CP.28	Maximum torque	Nm	2.3	2.4	2.3	2.1	7.2	6.3
		lb in	19.9	21.2	19.9	18.6	63.7	55.8
	Speed at T _{max}	rpm	3900	3000	4550	7950	850	1850
	Maximum Speed	rpm	6700	5550	7500	10000	2250	3050
	Mechanical Specifications							
	Rotor inertia	kg cm ²	1.2				2.7	
		lb in ²	0.410				0.923	
	Overall length	mm	156				180	
	Mass	kg / lb	2.7 / 6.0				3.9 / 8.6	
	Shaft diameter	mm	14					
	Flange pilot	mm	80					
	Flange square	mm	92					

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:

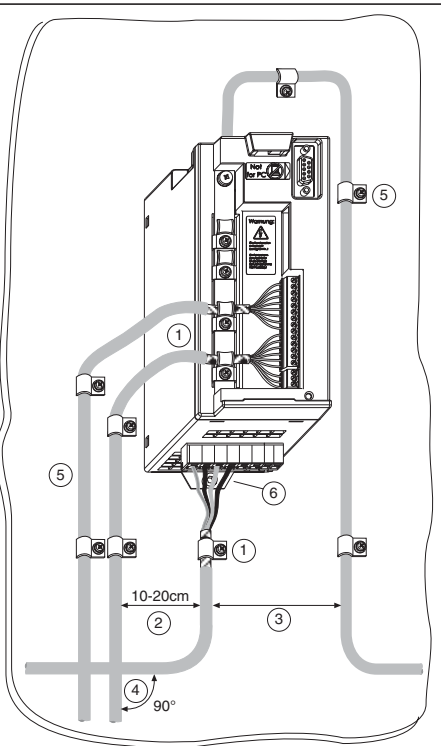
- Mount in a stationary location with low vibration. Contact KEBCO when mounting on a moving system.
- Adhere to minimum clearance distances in diagram 3.1. Multiple units can be mounted side by side with zero clearance.
- Some units have forced airflow from bottom to top using a thermostatically controlled 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.
- The sub-panel on which the F5 A-Servo control is mounted must have a surface area of at least 93 in² (example 17 in x 5.5 in) for proper heat dissipation. The minimum value for multiple units is simply this times the number of units.
 - 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 and "Explosion Proof" environment.



Installation and Connection

3.2 Good EMC installation techniques

- 1) Mount the COMBIVERT F5 on a conductive (zinc or nickel plated not painted) sub-panel. 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 metal cable clamp to contact cable shield on all sides. Using a single strand of the shield or the drain wire form 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 CO EMI (CE) filter is used, it must be mounted as close as possible and to the same sub-panel as the COMBIVERT F5 motor control. The filter must have large bare surface contact with the sub-panel. 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 sub-panel.



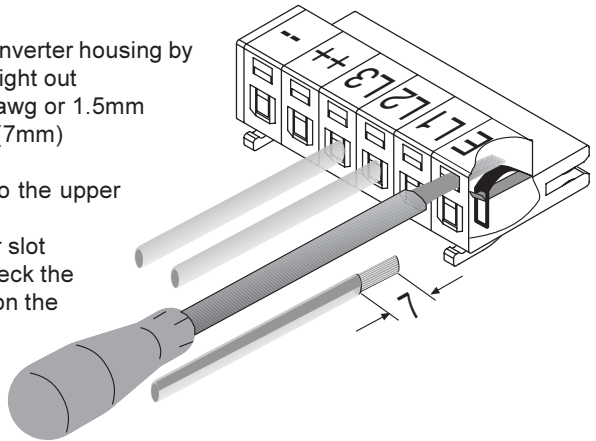
You can find further instructions regarding EMC and proper wiring considerations by contacting KEB CO technical support or visiting the web site www.kebco.com.

3.3 Connection of power circuit

3.3.1 Wiring the connectors

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



3.3.2 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 amps 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 300VACrms for 230 V units and 500VACrms for 460V 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.

Installation and Connection

3.3.3 Line connection terminal X1.A

Line connection
230 V 1-phase
use #14 awg

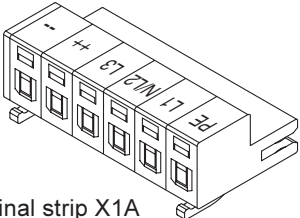
X1.A

	--
	++
	L3
N	N/L2
L1	L1
PE	PE

Line connection
230 V 3-phase
use #16 awg

X1.A

	--
	++
L3	L3
L2	N/L2
L1	L1
PE	PE



Terminal strip X1.A
Provides connections for:

- 230 V AC / 1-phase (L1/L2)
- 230 V AC / 3-phase (L1, L2, L3)
- DC-Supply 250...370 V DC (++, --)

DC-connection 230 V-class
use # 14 awg

250...370 V DC

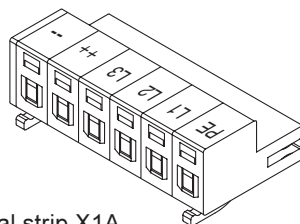
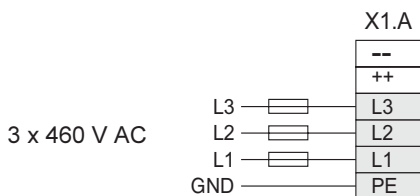
X1.A

-	--
+	++
	L3
	N/L2
	L1
	PE

For branch circuit protection use fuses rated for DC voltage. (Bussmann type FWP)

- 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 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.
- Class CC (Bussmann type LP-CC 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 at least 600V for 460V units. See table in section 2.3 for over current protection ampere ratings.
- 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 KEBCO.
- Line chokes can be used to reduce harmonics, conducted high frequency noise, and can extend the lifetime of the unit. Consult KEBCO for more information.

*Line connection 460 V 3-phase
use #16 awg*



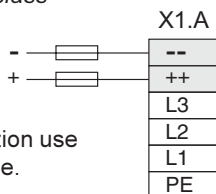
Terminal strip X1A

Provides connections for:

- 460 V AC / 3-phase (L1, L2, L3)
- DC-Supply 420...720 V DC (++, --)

*DC-connection 460 V-class
use #14 awg*

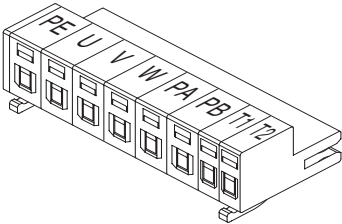
420...720 V DC



For branch circuit protection use
fuses rated for DC voltage.
(Bussmann type FWP)


Installation and Connection

3.3.4 Servo motor connection



Terminal X1B provides connections for:

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



- Plug and unplug the connectors only with the supply voltage turned off.
- Observe correct phase sequence of the servo motor phase wires!
- Maximum motor cable length is 20 m / 66 ft shielded

Motor connector

GND

U

V

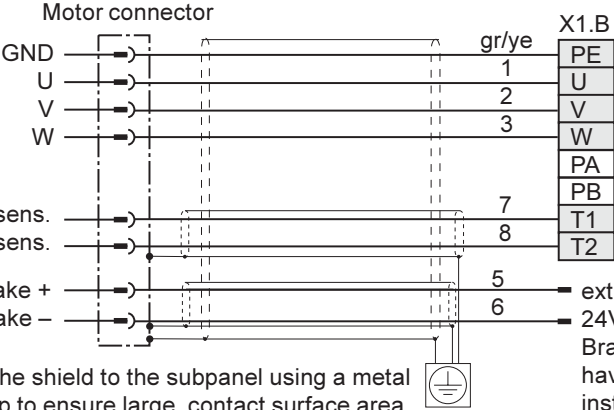
W

PTC-Therm. sens.

PTC-Therm. sens.

Brake +

Brake -



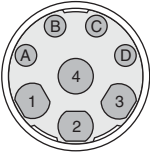
X1.B

PE
U
V
W
PA
PB
T1
T2

Connect the shield to the subpanel using a metal cable clamp to ensure large contact surface area. The shield can not be connected to the controller!

ext. brake supply circuit
24VDC 1A (optional).
Brake control relay must have arc suppression installed across the contacts and the coil!

Servo motor
Power connector



Connector Pin No.	Name	Cable Cond. No.
1	U	1
4	V	2
3	W	3
2	GND	Green-yellow
A	Brake +	5
B	Brake -	6
C	PTC	7
D	PTC	8

The PTC sensor is a resistive type thermal sensor designed to trigger at 145°C. The trip resistance is 1.65k...4k ohm and the reset value is below 0.75k...1.65k ohm. If any other sensors are connected in series with this sensor the total resistance of all sensors can not exceeded these values. Do not run the wire from this sensor with any other control wires as they carry high voltage noise from the motor power leads.

3.3.6 Connection of the braking resistor

Typical braking resistors for COMBIVERT F5 A-Servo motor controls

F5 Size	Voltage	Part Number	Ohms	PD	P6
04	230V	09.BR.100-1100	180	82	1500
04	460V	09.BR.100-6390	390	90	1500

PD = continuous power dissipation in watts, P6 = peak repetitive power dissipation with a 6 sec on time and 120 sec cycle time. KEBCO can offer many types of braking resistors, please contact your sales representative for more information.

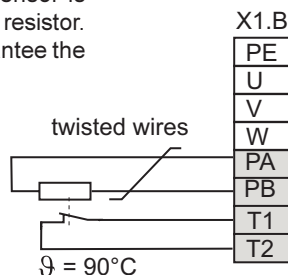
Braking resistor connection with high temperature drive fault

- The resistor has a PTC type sensor and is connected to the T1, T2 terminal on the COMBIVERT F5. If a motor temperature sensor is used it should be placed in series with the sensor of the braking resistor.

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.



Installation and Connection

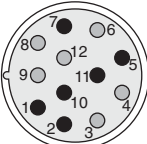
3.4 Feedback interface connection

 The feedback cables may only be connected and disconnected when the A-Servo control is turned off. This means line supply voltage and the 24VDC control circuit supply!

3.4.1 X3A-Resolver connection to KEB motors

- Max. cable length 20 m / 66 ft
- The resolver cable and integral RJ-45 connector are shielded unlike most computer grade Ethernet cables.

Servo motor
resolver
connector

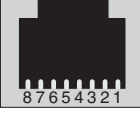


Housing

SIN -	1	○	○	5	SIN -	red
SIN +	10	○	○	4	SIN +	blue
REF -	5	○	○	6	REF -	yellow
REF +	7	○	○	3	REF +	green
COS -	2	○	○	8	COS -	pink
COS +	11	○	○	7	COS +	grey

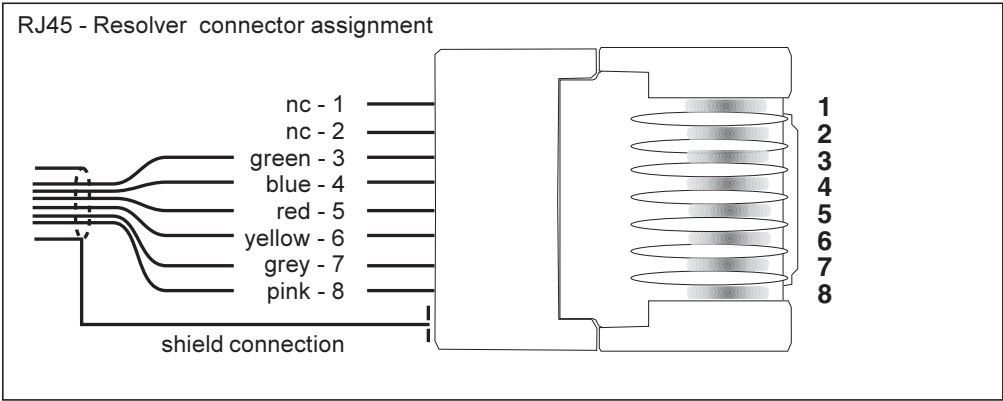
Housing

wire color



Socket X3A

Cable Part Number	Length
00.F5.0C1-0002	2m / 6.6ft
00.F5.0C1-0003	3m / 3.9ft
00.F5.0C1-0005	5m / 16.5ft
00.F5.0C1-0010	10m / 33ft
00.F5.0C1-0015	15m / 49.5ft * special low capacitance cable
00.F5.0C1-0020	20m / 66ft * special low capacitance cable

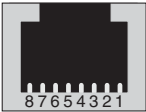


3.4.2 X3B-Incremental encoder input / emulated output

The encoder interface X3B is with default parameter settings, an incremental encoder output emulating the resolver position. The resolution of the emulated output is fixed at 1024 ppr for units with resolver feedback. The emulation is handled entirely through a resolver to digital chip and is independent of the microprocessor of the servo control. The emulated position signal is available as long as the 24VDC control voltage is applied to the A-Servo control.

Encoder output specifications

Max frequency: ~170 kHz at 10,000 rpm
 Signals: RS 422 / A&B track signals and zero signal
 max. cable length: 50 m / 165 ft

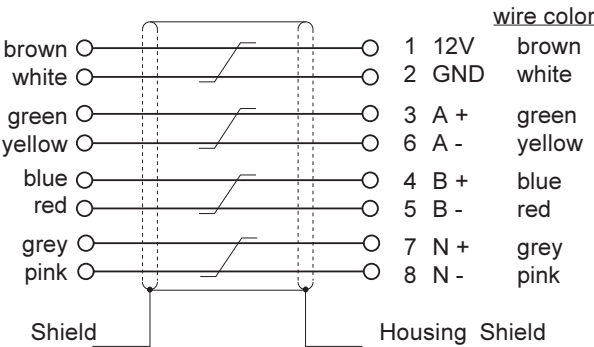


Socket X3B

The GND (0V) output should be connected to the motion control's 0V digital common to equalize the zero volt levels in each system.

PIN No.	Signal
1	NC
2	GND (0V)
3	A+
4	B+
5	B-
6	A-
7	N+
8	N-

RJ45 to flying lead cable



Cable Part Number Length
 00.F5.0C1-8005 5m / 16.5ft

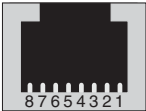
Installation and Connection

X3B Incremental encoder input

The encoder interface X3B is software switchable from an incremental encoder output emulating the resolver position into an incremental encoder input. To do so please refer to parameter EC.10 in the F5 M/S application manual.

Encoder input specifications

Max. input frequency: < 300 kHz
Signals: RS 422 / 2 track signals and zero signal
max. cable length: 50 m / 165 ft
Approved encoder types: RS 422 line driver (5V TTL) signals
10-30VDC supply voltage

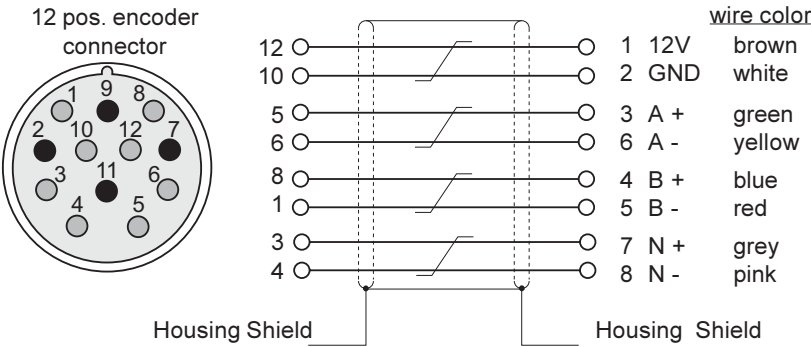


Socket X3B

PIN No.	Signal
1	12V
2	GND
3	A+
4	B+
5	B-
6	A-
7	N+
8	N-

The 12 V supply voltage at X3B will support a maximum load current of 100 mA. If higher voltages / currents are needed for the supply of the incremental encoder, then the encoder must be supplied independently with an external voltage.

RJ45 to encoder connector cable



Cable Part Number

Length

00.F5.0C1-3002	2m / 6.6ft
00.F5.0C1-3003	3m / 3.9ft
00.F5.0C1-3005	5m / 16.5ft
00.F5.0C1-3010	10m / 33ft

Miscellaneous cables/adapters

00.F5.0C1-20P5	RJ45 master to RJ45 follower for electronic line shafting L= 0.5m / 20in
00.F5.0C0-0009	RJ45 to SUBD 9 pin female connector L= 50mm / 2in
00.F5.0C0-0008	RJ45 to SUBD 15pin female connector L= 50mm/ 2in

3.5 Control interface

3.5.1 X2A Control terminal strip

- Tightening torque 2.0...2.2 lb in. Do not over tighten.
- Use shielded/twisted cables
- Connect the shield on the control end of the cable to ground using the shield clamps on the A-Servo controller.

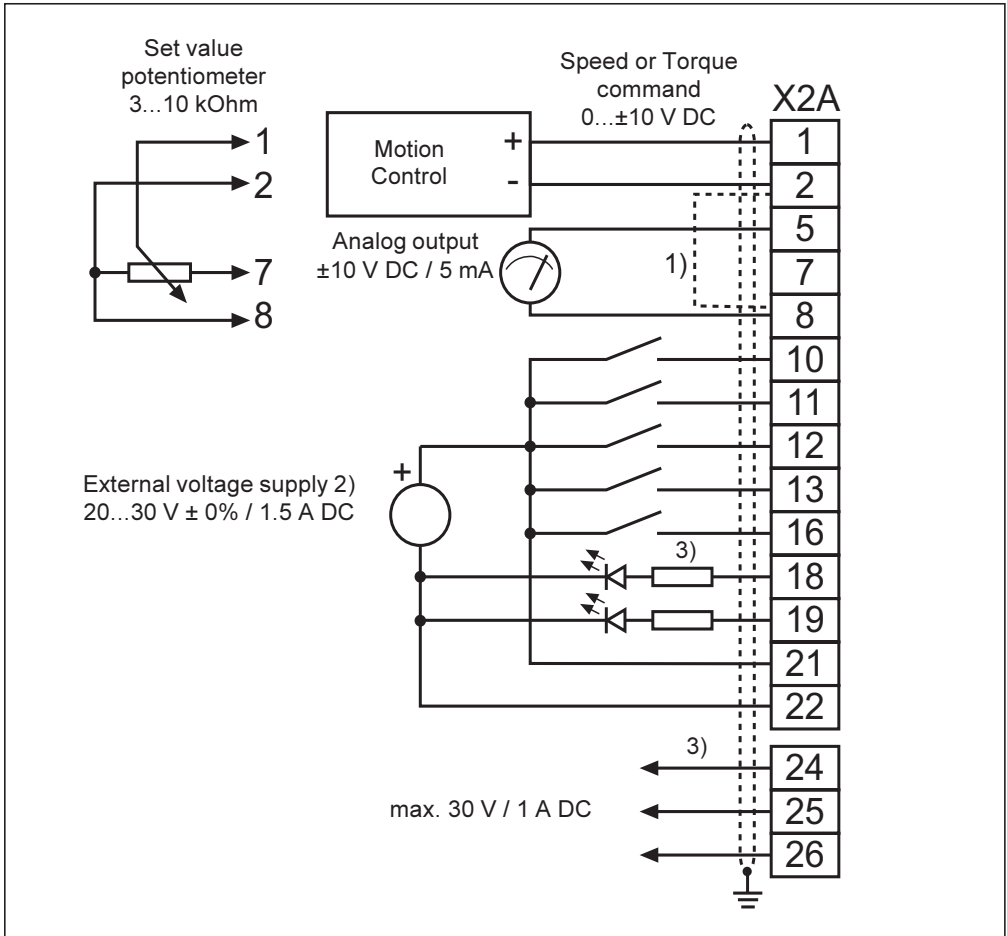
X2A



PIN	Function	Name	Description
1	+Analog input	AN+	Differential voltage input 0...±10 VDC gives 0...± maximum speed or torque; (Rin = 55 kΩ)
2	- Analog input	AN-	
5	Analog output	AN OUT1	±Actual speed, 0...±10 VDC = 0...±2 x rated speed 5 mA load
7	+10V output	CRF	Reference voltage output for set value potentiometer (+10 VDC / max. 4 mA)
8	Analog Common	COM	Mass for analog inputs and outputs
10	Digital Speed 1	I1	digital speed value is adjusted in CP.23 digital speed value is adjusted in CP.24 Triggers a fault when active, see CP.36 for response (All inputs "on" voltage = 13...30V DC ± 0% (Rin=2.1 kΩ))
11	Digital Speed 2	I2	
12	External Fault	I3	
13	No Function	I4	
16	Drive Enable	ST	This input must be supplied with an external voltage of 20...30 V ± 0 % / 100mA DC to enable the power stage of the A-Servo controller. When switching off this input all drive faults are reset.
18	Out 1 (run)	O1	Output is active when no faults occur and current <u>flows</u> to the motor, actual speed is zero or greater. Output is active when actual speed = set speed Maximum load is 50mA between the two outputs
19	Out 2 (at speed)	O2	
21	Control stage supply voltage	V _{in}	Voltage supply of the control card. This input must be supplied by an external regulated voltage supply of 20...30 V ± 0 % / 500 mA. Using this external supply the control stage remains operative when the high voltage supply is turned off.
22	Digital Common	0V	Common for the external power supply and all digital inputs/outputs
24	Relay 1 / NO contact	RLA	Switches when a drive fault occurs Maximum load 30 V DC / 1 A;
25	Relay 1 / NC contact	RLB	
26	Relay 1 / switching cont.	RLC	

Installation and Connection

3.5.2 Connection of the control terminal strip



1) Connect this jumper only if a potential difference of > 30 V exists between the motion control and the A-Servo control, i.e. between the control 0V commons. The internal resistance is then reduced to 30 kOhm. Without the jumper, the analog input functions as a true differential input with high common mode noise rejection. It is also possible to connect a wire between terminal X2A.8 of the A-Servo control and the common terminal of the motion control. This will maintain the common mode noise rejection but provide a ground reference between the two systems.

2) The supply of the control circuit through an external voltage source keeps the control in operation even if the power stage is switched off. To prevent undefined output conditions first switch on the control power supply and after that the high voltage supply.

3) In case of inductive loads on the outputs arc suppression must be used (i.e. free-wheeling diode)!

3.6 Digital operator

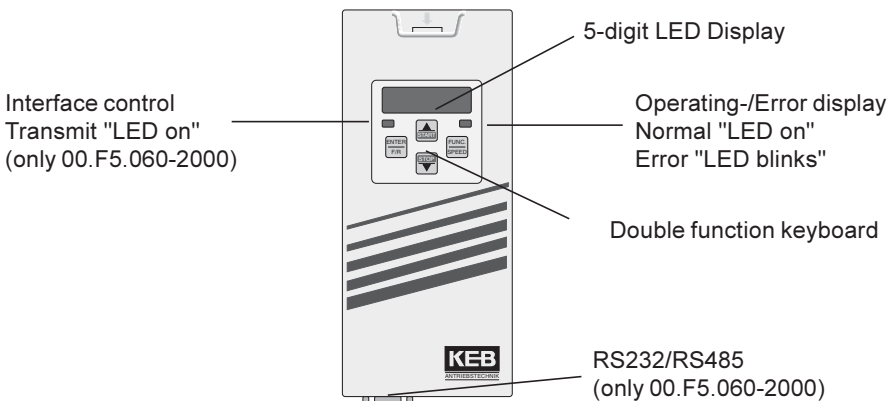
As an accessory for displaying and editing "CP" parameter values, a "digital operator" is necessary. To remotely mount the digital operator, a operator remote cable is required (option: cable 00.F5.0C0-1xxx).



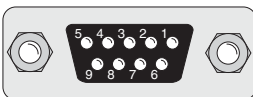
To prevent malfunctions, the inverter must be brought into **nOP** status (remove signal from control release terminal 16) before connecting / disconnecting the operator. When starting the inverter without an operator, it is started with the last stored values in memory.

Standard Operator: Part No. 00.F5.060-1000

Serial Operator: 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 Part No. 00.F5.0C0-0001)**, otherwise, it would lead to the destruction of the PC-interface.



PIN	RS485	Signal	Description
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 ($I_{max} = 10 \text{ mA}$)
7	C/C'	DGND	Data reference common
8	A	TxD-A	Transmitter signal A/RS485
9	B	TxD-B	Transmitter signal B/RS485

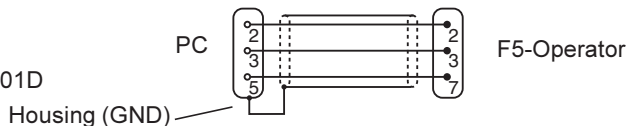
9-Pin SUB-D Female Connector

9-Pin SUB-D Male Connector

RS232-cable 3m

PC / Operator

Part. No. 00.58.025-001D



3. Operation of the Unit

3.1 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.



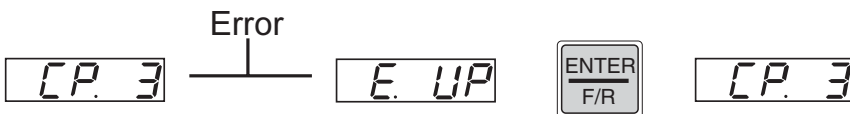
With **UP** and **DOWN**, the value of the parameter number is increased / decreased.



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 (CP.28, CP.32, CP.33, CP.34) the adjusted value is accepted and stored nonvolatile by pressing **ENTER**.



If a drive fault occurs during operation, the current 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. 3), 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, then turn off the signal at X2A.16. The fault will reset on the falling edge.

3.2 Parameter summary

Display	Parameter	Setting range	Resolution	Factory setting
CP. 0	Password input	0...9999	1	—
CP. 1	Actual speed (resolver)	—	0.125 rpm	—
CP. 2	Set speed	—	0.125 rpm	—
CP. 3	Inverter status	—	—	—
CP. 4	Phase current	—	0.1 A	—
CP. 5	Phase current / Peak value	—	0.1 A	—
CP. 6	Actual torque	—	0.01 Nm	—
CP. 7	Actual DC bus voltage	—	1 V	—
CP. 8	Actual DC bus voltage / Peak value	—	—	1 V—
CP. 9	Output voltage	—	1 V	—
CP.10	Speed control / Torque control	4...5	1	4
CP.11	Rated motor torque	0.1...3276.7 Nm	0.1 Nm	— ²⁾
CP.12	Rated motor speed	0...32000 rpm	1 rpm	— ²⁾
CP.13	Rated motor frequency	0.0...1600.0 Hz	0.1 Hz	— ²⁾
CP.14	Rated motor current	0.0...500.0 A	0.1 A	— ²⁾
CP.15	Motor voltage constant	0...500	1	— ²⁾
CP.16	Motor winding inductance	0.01...500.00 mH	0.01 mH	— ²⁾
CP.17	Motor winding resistance	0.000...50.000 Ohm	0.001 Ohm	— ²⁾
CP.18	Motor current for zero speed	0.0...5000.0 A	0.1 A	— ²⁾
CP.19 ¹⁾	Load motor dependent parameter	0	—	0
CP.20	Absolute position (resolver)	0...65535	1	57057
CP.21	Change rotation	0...3	1	0
CP.22	Maximum speed	0...4000 rpm	0.125 rpm	2100 rpm
CP.23	Step speed 1	-4000...4000 rpm	0.125 rpm	100 rpm
CP.24	Step speed 2	-4000...4000 rpm	0.125 rpm	-100 rpm
CP.25	Acceleration time	0.00...300.00 s	0.01 s	5.00 s
CP.26	Deceleration time	-1; 0.00...300.00 s	0.01 s	5.00 s
CP.27	S-curve time	0.00 (off)...5.00 s	0.01 s	0.00 s (off)
CP.28 ¹⁾	Torque reference source	0...5	1	2
CP.29	Torque limit	-10000.00...10000.00	0.01 Nm	— ²⁾
CP.30	KP speed	0...32767	1	300
CP.31	KI speed	0...32767	1	100
CP.32	Carrier frequency	2/4/8/12/16 kHz	—	8
CP.33 ¹⁾	Relay output 1 / Function	0...75	1	4
CP.34	No function / reserved	—	—	—
CP.35	No function / reserved	—	—	—
CP.36	Response to external fault	0...6	1	0

¹⁾ Enter-Parameter

²⁾ Based on selected motor



Due to measuring accuracies, computation resolution and influences resulting from temperature change, tolerances in the current and torque values must be taken into consideration when they are used to trigger events or limit operation. These values are also dependent on the normal manufacturing tolerances of the motor. Thus larger tolerances are possible due to variations in one motor to the next.

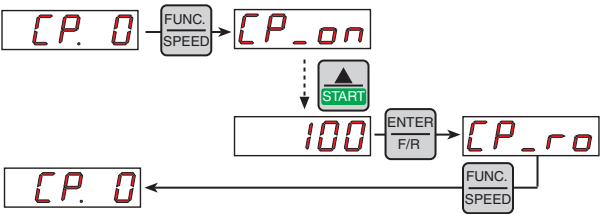
Operation of the Unit

3.3 Password input

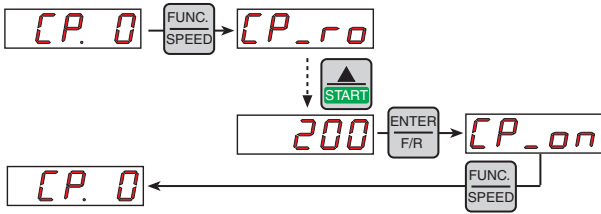


From the factory, the frequency inverter is supplied without password protection, this means that all parameters can be adjusted. After programming, the unit can be protected against unauthorized access thus preventing the values from being changed.

Locking the
CP-Parameters
(Read only)



Releasing the
CP-Parameters
(Read & Write)



3.4 Operating display

The following parameters can be used to monitor the system performance during operation.

Actual speed



Display of actual motor speed (resolver). If the control release or the direction of rotation are not switched, the set speed is displayed. A counterclockwise rotating field (reverse) is represented by a negative sign. A precondition for the correct display is the correct connection of the motor (phase sequence) and the correct adjustment of the direction of rotation (CP.21).

Set speed



Display of actual set speed. For control reasons, the set speed is displayed even if the drive enable (X2A.16) is turned off. The sign should match the sign of the analog command signal.

Inverter status

CP. 3

The status display shows the actual working conditions of the inverter. Possible displays and their meanings are listed below: *Additional status messages, see chapter 4 on "Error Diagnosis".*

noP

"no Operation" no signal at control release, modulation switched off, output voltage = 0 V, drive is disabled.

LS

"Low Speed" no direction signal, modulation switched off, output voltage = 0 V, drive is disabled.

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.

Phase current

CP. 4

Display of the actual real-time phase current in ampere.

Phase current / Peak value

CP. 5

CP.5 makes it possible to recognize the max. real-time phase current within an operating cycle. The highest value of CP.4 is stored in CP.5. The peak value in memory can be cleared by pressing the UP, DOWN or ENTER key or by writing via serial communication any value to the address of CP.5. Switching off of the inverter also clears the memory.


Actual torque

CP. 6

The displayed value corresponds to the actual motor torque in "Nm", which is calculated from the active phase current. Current motor data (CP.11...CP.18) is required for this displayed value. If the actual motor data deviates greatly from the nameplate (adjusted values), the accuracy of this torque value be reduced.

Operation of the Unit

Actual DC Bus voltage Display of actual DC-bus voltage in volts. Note displays only when terminal X2.16 (enable) is active. Typical values shown in table:

	V-class	Normal operation	Over volt. (E.OP)	Under volt. (E.UP)
	230 V	300...330 V DC	approx. 400 V DC	approx. 216 V DC
	460 V	530...700 V DC	approx. 800 V DC	approx. 240 V DC

Actual DC Bus voltage / Peak value CP.8 makes it possible to recognize instantaneous voltage peaks within an operating cycle. Peak value of CP.7 is stored in CP.8. The peak value in memory can be cleared by pressing the UP, DOWN or ENTER key or by writing any value via serial bus to the address of CP.8. Switching off of the inverter also clears CP.8.




Output voltage Display of the actual output voltage in volts.




3.5 Basic adjustment of the drive

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

Speed / Torque control Torque or speed control mode is selected with this parameter.

	<table><tr><th>Value</th><th>Function</th></tr><tr><td>4</td><td>Speed control (regulated operation)</td></tr><tr><td>5</td><td>Torque control (regulated operation)</td></tr></table>	Value	Function	4	Speed control (regulated operation)	5	Torque control (regulated operation)
Value	Function						
4	Speed control (regulated operation)						
5	Torque control (regulated operation)						

Adjustment range: 4...5
Resolution: 1
Factory setting: 4

 **Motor parameters CP.11 - CP.18 and CP.28 should be preadjusted for the selected KEB motor supplied with the F5 A-Servo control. The values can be verified against those in the tables in section 2.6 “Servomotor technical data”.**

Rated motor torque Adjustment of rated motor torque according to the name plate rating of the motor. See section 2.6 “Servomotor technical data” for adjustment values of other KEB servo motors.



Adjustment range: 0.1...3276.7 Nm
Resolution: 0.1 Nm
Factory setting: dependent on motor

Rated motor speed

CP.12

Adjustment of motor rated speed according to the name plate rating of the motor. See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0...32000 rpm
Resolution: 1 rpm
Factory setting: dependent on motor

Rated motor frequency

CP.13

Adjustment of motor rated frequency according to the name plate rating of the motor. See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0.0...1600 Hz
Resolution: 0.1 Hz
Factory setting: dependent on motor

Rated motor current

CP.14

Adjustment of motor rated current according to the name plate rating of the motor. See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0.0...500.0 A
Resolution: 0.1 A
Factory setting: dependent on motor

Motor voltage constant

CP.15

Adjustment of motor voltage constant (K_E) according to the technical data sheets for the motor. The motor voltage constant is the **peak value** of the voltage between the phases at a speed of 1000 rpm (i.e. V/Krpm). See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0...500 V/Krpm
Resolution: 1 V/Krpm
Factory setting: dependent on motor

Operation of the Unit

Motor winding inductance

CP.16

Adjustment of motor winding inductance according to the technical data sheets for the motor. See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0.1...500.00 mH
Resolution: 0.01 mH
Factory setting: dependent on motor

Motor winding resistance

CP.17

Adjustment of motor winding resistance (R_M) according to the technical data sheets for the motor. See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0.000...50.000 Ohm
Resolution: 0.001 Ohm
Factory setting: dependent on motor

Motor current for zero speed

CP.18

Adjustment of motor current for zero speed according to the technical data sheets for the motor. See section 2.6 "Servomotor technical data" for adjustment values of other KEB servo motors.

Adjustment range: 0.0...5000.0 A
Resolution: 0.1 A
Factory setting: dependent on motor

Load motor dependent parameter

CP.19

Factory settings correspond to the amplifier size and motor ratings. CP.19 must be set once if the motor data (CP.11...18) is changed. The torque curve, torque limit and current controller will be readjusted. The torque limit is set at a value that is within the speed range; based on inverter rated current, but not exceeding the rated motor torque x 3.

The keypad display will show a value of zero. By pressing enter the motor data is loaded and all internal parameters are adjusted. The display will change to "PASS". Press enter again to clear the message and return to normal operation. NOTE: the motor data can only be loaded when terminal X2A.16 is disabled!

Factory setting: 0

Absolute position

CP.20

This parameter makes it possible to align the resolver to a servo motor. If the zero position of the motor is unknown, an automatic alignment is required.

Before adjusting, check the direction of rotation. Manually rotate the motor shaft clockwise and notice a positive value for CP.1; if negative, the direction of rotation must be changed with parameter CP.21. With the correct direction of rotation, the alignment process can begin as follows:

- Disconnect load from motor shaft, as it must rotate freely.
- Open (*remove power*) control release (terminal X2A.16)
- Input a value of 2206 into CP.20 using up-down arrow keys, than depress enter key on keypad.
- Close (*apply power*) control release (terminal X2A.16)

Notice the oscillation of the motor shaft as it searches for its zero position. The adjustment is finished when the displayed value in CP.20 does not change for 5 seconds, then open control release and switch off the unit. If the error message E.EnC is displayed during alignment process, check CP.21 for direction of rotation, rotate the motor shaft manually by approximately 180 degrees and repeat the steps listed above.

Once the alignment is complete, the resulting alignment value can be used for all motors provided the relationship between the feedback device and the rotor pole pairs is consistent. Then for future installations it is only necessary to enter this value in CP.20.

All motors provided by KEB have the feedback device aligned to the rotor at the factory thus resulting in the same alignment value. Therefore it is not necessary to perform the above procedure when you use a KEB motor. In this case simply enter the value "57057" in parameter CP.20.

Adjustment range: 0...65535
Resolution: 1
Factory setting: 57057

Change rotation

CP.21

The speed display at CP.1 must be positive when manually rotating the motor shaft in a clockwise direction when looking at the motor flange. The measured (resolver) direction of rotation can be reversed through this parameter.

Value	Function
0	Sin+ Sin- not exchanged
1	Sin+ Sin- exchanged
2/3	reserved for pulse sensor input

Adjustment range: 0...3
Resolution: 1
Factory setting: 0

Operation of the Unit

3.6 Special adjustments

The following parameters serve for the optimization of the drive and the adaptation to certain applications. These adjustments can be ignored at the initial start-up.

Maximum speed

CP.22

In order to limit the motor speed for your application, a maximum speed value must be entered into CP.22. Because of speed ripples, speed over shoot or hardware defects (e.g. defective resolve) the actual speed may exceed these limits.

Adjustment range: 0...4000 rpm
Resolution: 0.125 rpm
Factory setting: 2100 rpm

Up to 10,000 rpm with special settings. Consult the F5 M/S application manual for more information

Jog speed 1 and 2

X2A.10

CP.23

X2A.11

CP.24

Two fixed speeds can be adjusted. The selection is made by the inputs X2A.10 and X2A.11.

If the selected speed is greater than the fixed limit of CP.22, the speed will be internally limited.

Adjustment range:-4000...4000 rpm
Resolution: 0.125 rpm
Factory setting CP.23:100 rpm
Factory setting CP.24:-100 rpm



Input X2A.10 + X2A.11 = Fixed speed 3
(factory setting = 0 rpm)

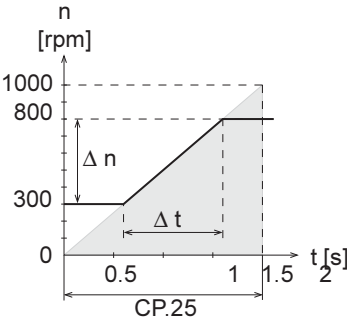
The fixed speed 3 can not be adjusted in the CP mode.

Acceleration time

CP.25

Defines the time needed to accelerate from 0 to 1000 rpm. The actual acceleration time is proportional to the speed change (Δn).

Adjustment range:0.00...300.00 s
Resolution: 0.01 s
Factory setting: 5.00 s



Δn speed change
 Δt acceleration time for Δn

Example:

The drive should accelerate from 300 rpm to 800 rpm in 1 s.

$$\Delta n = 800 \text{ rpm} - 300 \text{ rpm} = 500 \text{ rpm}$$

$$\Delta t = 1 \text{ s}$$

$$\text{CP.25} = \frac{\Delta t}{\Delta n} \times 1000 \text{ rpm} \frac{1 \text{ s}}{500 \text{ rpm}} = \frac{1 \text{ s}}{500 \text{ rpm}} \times 1000 \text{ rpm} = 2 \text{ s}$$

**Deceleration
time**

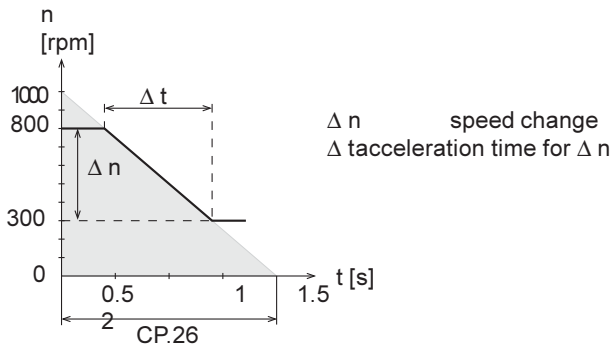
CP.26

Defines the time needed to decelerate from 1000 to 0 rpm. The actual deceleration time is proportional to the speed change (Δn). A value of -1, will use the accel value in CP.25 for the decel time (Display: "=Acc")!.

Adjustment range:-1; 0.00...300.00 s

Resolution: 0.01 s

Factory setting: 5.00 s



Example:

The drive should decelerate from 800 rpm to 300 rpm in 1 s.

$$\Delta n = 800 \text{ rpm} - 300 \text{ rpm} = 500 \text{ rpm}$$

$$\Delta t = 1 \text{ s}$$

$$\text{CP.26} = \frac{\Delta t}{\Delta n} \times 1000 \text{ rpm} \frac{1 \text{ s}}{500 \text{ rpm}} = \frac{1 \text{ s}}{500 \text{ rpm}} \times 1000 \text{ rpm} = 2 \text{ s}$$

Operation of the Unit

S-curve time

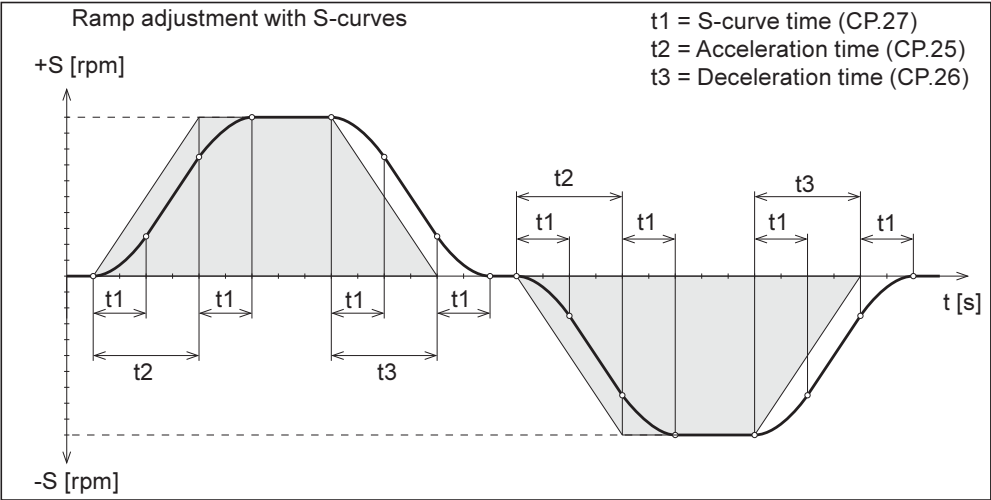
CP.27

For some applications, it is of advantageous when the drive starts and stops jerk-free. This is achieved by modifying the acceleration and deceleration ramps. The modification time; called the S-curve time, can be adjusted with CP.27.

Adjustment range:0.00 (off)...5.00 s
Resolution: 0.01 s
Factory setting: 0.00 s (off)



In order to defined the ramps with activated S-curve time, the acceleration and deceleration times (CP.25 and CP.26) must be adjusted higher than the S-curve time (CP.27).



Torque reference / Source

CP.28

With this parameter the required set point source for torque control can be adjusted.

Value	Meaning
0	AN1+ / AN1- 0%... ±100% = 0...±CP.29
1	Reserved
2	Digital absolute CP.29
3-5	only function in application mode

Adjustment range: 0...5
Resolution: 1
Factory setting: 2
Note: Enter-Parameter

Torque reference / Absolute

CP.29

The absolute torque reference of the drive is adjusted with CP.29 when in torque controlled mode, with CP.10 = 5 and digital set point source setting of CP.28 = 2. The sign is for direction of rotation. In speed-controlled mode with CP.10 = 4, this parameter works as a torque limit. The sign has no effect. Factory setting depends on unit size.

Adjustment range: -10000.00... 10000.00 Nm

Resolution: 0.01 Nm

Factory setting: -

KP speed

CP.30

The proportional factor of the speed controller is adjusted in these parameters (See chapter 5 "Tuning instructions for speed control mode").

Adjustment range: 0...32767

Resolution: 1

Factory setting: 300

KI speed

CP.31

The integral factor of the speed controller is adjusted in these parameters (See chapter 5, Adjustment instruction for speed controller).

Adjustment range: 0...32767

Resolution: 1

Factory setting: 100

Carrier frequency

CP.32

The carrier frequency is fixed at 8kHz.

Operation of the Unit

Relay output 1 / Function

CP.33

CP.33 determines the function of the relay output (Terminal X2A.24...X2A.26).

Value	Function
0	No function (off)
1	Active (on)
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 during abnormal stopping
7	Over load (.OL) alert signal
8	Over temperature (.OH) alert signal (power modules)
9	External Over temperature (.dOH) alert signal motor
10	Electronic motor protection (.OH2) tripped
11	Over temperature (.OHI) alert signal within inverter interior
12	Loss of signal error (less than 2mA for AnIn1 4...20 mA)
13	Reserved
14	Maximum constant current (Stall) exceeded
15	LAD stop
16	DC-braking active
17	Power off
18	Brake control active
19	No function in CP mode
20	Actual value = set value (CP.3= Fcon, rcon; not at nOP, LS error)
21	Accelerate (CP.3 = FAcc, rAcc, LAS)
22	Decelerate (CP.3 = FdEc, rdEc, LDS)
23	Actual direction of rotation = Set direction of rotation
24-31	No function in CP mode
32	Reserved
33	Reserved
34	No function in CP mode
35	Reserved
36-39	No function in CP mode
40	Hardware current limit active
41	Modulation on-signal
42	ANOUT3 - PWM signal
43	ANOUT4 - PWM signal
44-48	No function in CP mode
49	Rotation forward
50	Rotation reverse
51	OL2 warning
52	Current control limit active
53	Speed control limit active
54-72	No function in CP mode
73	Absolute value active power > switching level
74	active power > switching level
75	No function in CP mode

Factory setting CP.33: 4

Note: Enter-Parameter

Reserved for
future use

CP.34

Reserved for
futur use

CP.35

Response to
external fault

CP.36

These parameters are not assigned at the factory to any function in the F5A-Servo control. Do not adjusted these parameters.

This parameter determines the response of the drive when a signal is present at terminal X2A.12 (I3) triggering an external fault. Select the response desired according to the following table:

CP.36	Display	Response	Restart
0	E.PRx	Immediate disabling of output to motor	Correct fault; Activate reset by removing signal at X2A.16
1	E.PRx	Quick stop / disabling of output to motor after reaching zero speed	
2	E.PRx	Quick stop with holding torque at 0 speed	Automatic reset when the fault condition no longer exists
3	A.PRx	Immediate disabling of output to motor	
4	A.PRx	Quick stop / disabling of output to motor after reaching zero speed	
5	A.PRx	Quick stop with holding torque at 0 speed	
6	None	No effect on the operation of the drive ! Fault is ignored !	

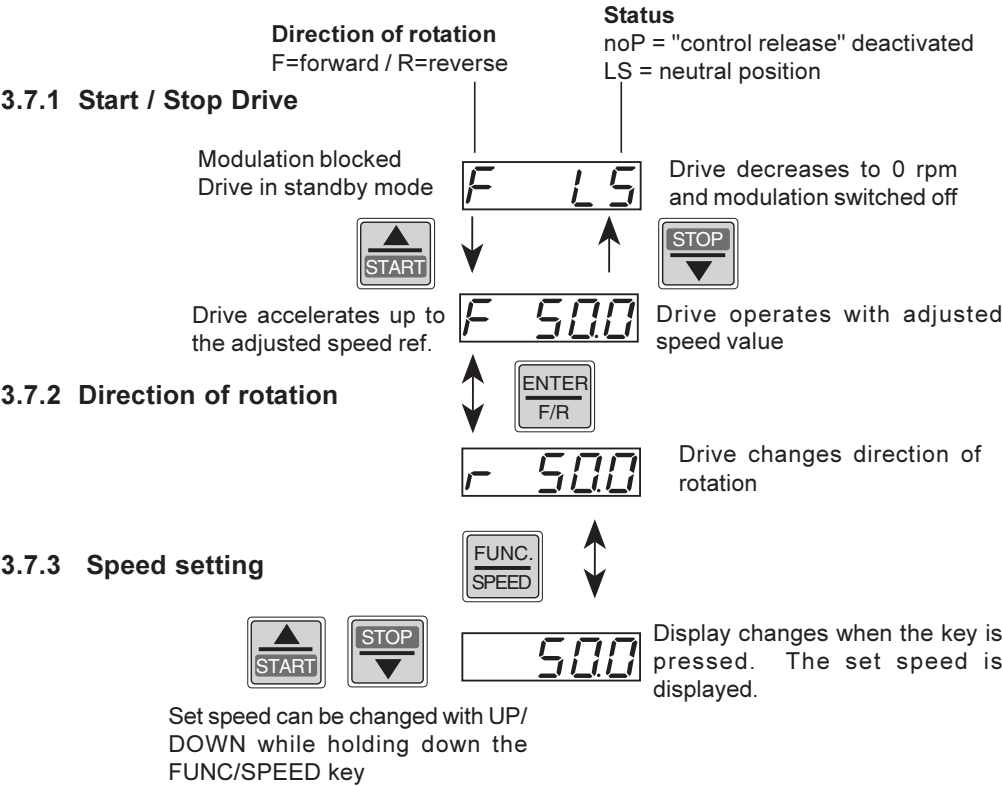
Adjustment range: 0...6

Resolution: 1

Factory setting: 0

3.7 The "Drive Mode"

The "Drive Mode" is one of the operating modes of the KEB COMBIVERT that permits manual starting of the motor by the operator. After applying a signal to the control release terminal 16, the speed reference and rotation setting are adjusted through the keypad. In order to activate the "Drive Mode", the corresponding **password** must be entered in **CP.0**. The display switches over as follows.



4. Error Diagnosis

KEB COMBIVERT **"Error messages"** are represented with an "E.xxx" error code in the display. Immediately following the error, voltage supply to the motor is turned off. Restart is possible only after resetting the fault.

"Malfunctions" are represented with an "A.xxx" error code in the display. Responses can vary depending on the programmed condition. The "value" column displays the numeric message value, if read via serial communication bus.

Display	Error Name	Val	Description and causes
E. OP	ERROR over potential	1	Error: Over voltage (DC-bus circuit) Occurs, if DC-bus voltage rises above the permissible value (230V units: 400 VDC and for 460V units: 800 VDC): <ul style="list-style-type: none"> • Poor control adjustment (over shooting) • Input voltage spikes, too high or interference voltages. • Deceleration ramps too short • Braking resistor damaged, undersized or not connected • PF correction capacitor switching at substation
E. UP	ERROR under potential	2	Error: Under voltage (DC-bus circuit). Occurs, if DC-bus voltage falls below the permissible value. (230V units: 216 VDC and for 460V units: 240 VDC): <ul style="list-style-type: none"> • Input voltage too low, unstable or wire gauge too small. • Inverter sized too small for given application. • Supply voltage drops intermittently via generator / transformer. • Missing input phase or input not connected properly. • Connection to an unbalanced supply (i.e. corner ground delta). • Separate control power supply and switched off power circuit.
E. OC	ERROR over current	4	Error: Over current > Occurs, if peak current is exceeded: <ul style="list-style-type: none"> • Accel. or decel. time too short and /or the load is too big. • Short-circuit and/or ground fault at the output. • Motor larger than recommended for inverter size. • Motor cable too long and /or EMC problems. • 50 Hz 400V motor running on inverter connected to 480V. • Motor rated frequency (CP.13) not adjusted correctly.
E.OHI	ERROR over heat internal	6	Error: Over heating in the interior: error can only be reset at E.nOHI, if the interior temperature has fallen by at least 3°C
E.nOHI	no ERROR over heat int.	7	No longer over heating in the interior E.OHI, interior temperature has fallen by at least 3°C
E. OH	ERROR over heat control	8	Error: Over temperature of power module. Reset error at E.nOH: <ul style="list-style-type: none"> • Insufficient air flow at the heat sink (dirty). • Ambient temperature high or fan clogged or not functioning.
E.dOH	ERROR motor over heat	9	Error: Over temperature signal from motor temperature sensor. Reset at E.ndOH, when sensor resistance decreases: <ul style="list-style-type: none"> • Terminals T1, T2; resistance >1650 Ohm or jumper wire loose. • Motor over loaded, see also E.OC and E.OL. • Temperature sensor or cable breakage.
E.nEd	no ERROR detected	10	No defined error recognized (should not occur)

Error Diagnosis

E.ndOH	no ERROR mtr over heat	11	No longer over temperature 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 pwr unit incorr.	14	Error: Software version for power circuit and control card are different. Error cannot be reset.
E.LSF	ERROR charging circuit	15	Error: Load-shunt relay has not picked up, occurs for a short time during the switch-on phase, but must automatically be reset immediately (separate supply after 10s E.UP). If the error message remains the following causes may be applicable: <ul style="list-style-type: none"> • Load-shunt defective • Input voltage wrong or too low • High losses in the supply cable • Braking resistor wrongly connected or damaged • Braking module defective
E. OL	ERROR over load	16	Error: Over load 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): <ul style="list-style-type: none"> • Poor control adjustment (over shooting). • Increased friction or jam in the mechanical system. • Inverter not correctly sized for application. • Motor larger than recommended for inverter size. • Motor incorrectly wired. • Encoder damaged. • Motor rated frequency (CP.13) is not adjusted correctly. • 480V supply to inverter that is operating a 50 Hz/ 400V motor.
E.nOL	no ERROR over load	17	No more over load, 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 monitoring time (Watchdog) of communication between operator and PC has been exceeded.
E.OL2	ERROR over load 2	19	Error: Too much current flowing while output frequency is below 3 hz. Can only be reset when display shows E.nOL2. Cool-down time must elapse. Lower carrier frequency to prevent.
E.nOL2	no ERROR over load 2	20	No more over load, 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 com.	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.

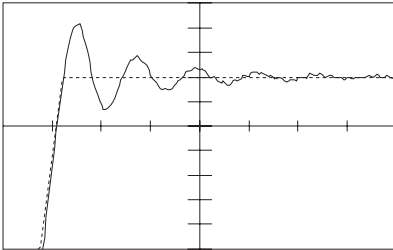
E.ENC	E. resolver/ encoder	32	Error: Resolver or encoder cable and/or connection wiring
E.nOH	no E. overheat control	36	Internal or external temperature has dropped to a safe level.
E.SET	ERROR set	39	Error: Set selection: attempt to select a locked parameter set.
E.PRF	ERROR prot. rot. for.	46	Error: 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: Change in power circuit identity; with a valid power circuit this error can be reset by confirming new power stage in SY.3 (application mode).
E.DRI	ERROR driver relay	51	Error: Driver relay. Relay; for drive voltage on power circuit, has not energized even with control release signal enabling drive.
E.HYB	ERROR hybrid	52	Error: Invalid encoder interface identifier
E.CO1	ERROR counter over run	154	Error: Counter over flow encoder channel 1
E.CO2	ERROR counter over run	255	Error: Counter over flow 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	57	Error: uP 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 speed is larger than the max. output speed
A.OHI	ABN.STOP over heat int.	87	Warning: Over temperature in the interior
A.nOH	no A. overheat control	88	Warning: No more over temperature of power module
A. OH	A.STOP overheat control	89	Warning: Over temperature of power module
A. EF	ABN.STOP external fault	90	Warning: External error
A.ndOH	no A. drive over heat	91	Warning: No more over temperature of motor temperature sensor. Motor sensor is low-resistance again.
A.nOHI	no A.STOP over heat int.	92	Warning: No more over temperature in the interior
A.buS	ABN.STOP bus	93	Warning: Watchdog for communication between operator/control

Error Diagnosis

			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 mtr over heat	96	Warning: Over temperature of motor temperature sensor
A.OH2	ABN.STOP mtr protect.	97	Warning: Electronic motor protective relay has tripped
A.nOL	no ABN.STOP over load	98	Warning: No more over load, OL counter has reached 0 %.
A. OL	ABN.STOP over load	99	Warning: Over load can only be reset at A.nOL, if OL counter has again reached 0 %
A.OL2	ABN.STOP over load 2	100	Warning: Over load can only be reset at A.nOL2, if cool-down time has elapsed
A.nOL2	no ABN.STOP over load 2	101	Warning: No more over load, the cool-down time has elapsed
A.SET	ABN.STOP set	102	Warning: Set selection: attempt to select a locked parameter set.

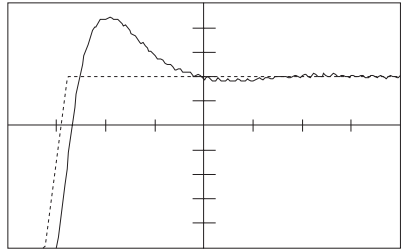
5. Tuning instruction for speed control mode

Set and actual speed can be displayed with the PC software KEB "COMBIVIS" using the scope function. If one of the following example speed curve occurs during acceleration, the speed controller (CP.30, CP.31) should be adjusted according to the notes.



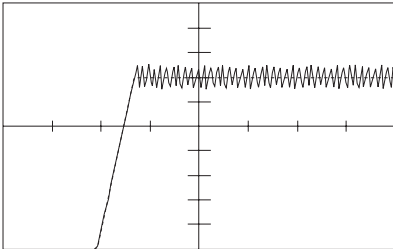
Problem: Very long transient process

Solution: Increase KP speed (CP.30); eventually reduce KI speed (CP.31)



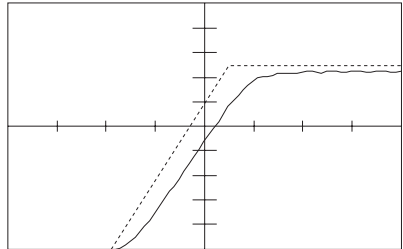
Problem: Speed overshoot too high

Solution: Increase KP speed (CP.30); eventually reduce KI speed (CP.31)



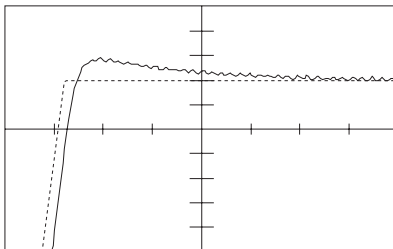
Problem: Sustained short interval oscillation, noise, and vibration

Solution: Decrease KP speed (CP.30)



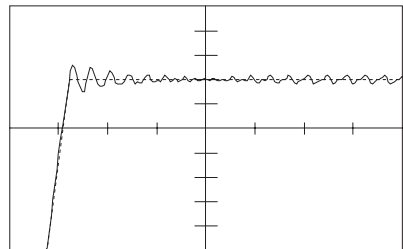
Problem: Transient too slow / remaining system deviation

Solution: Increase KI speed (CP.31)



Problem: Overshoot too long, speed decreases as load increases

Solution: Increase KI speed (CP.31)



Problem: Sustained long interval oscillations

Solution: Reduce KI speed (CP.31) and / or reduce KP speed (CP.30)

Quick Reference

6. Quick Reference - CP Parameter's

Display settings	Parameter	Setting range	Resolution	Customer
CP. 0	Password input	0...9999	1	—
CP. 1	Actual speed (resolver)	—	0.125 rpm	—
CP. 2	Set speed	—	0.125 rpm	—
CP. 3	Inverter status	—	—	—
CP. 4	Phase current	—	0.1 A	—
CP. 5	Phase current / Peak value	—	0.1 A	—
CP. 6	Actual torque	—	0.01 Nm	—
CP. 7	Actual DC bus voltage	—	1 V	—
CP. 8	Actual DC bus voltage / Peak value	—	1 V	—
CP. 9	Output voltage	—	1 V	—
CP.10	Speed control / Torque control	4...5	1	_____
CP.11 ²⁾	Rated motor torque	0.1...3276.7 Nm	0.1 Nm	_____
CP.12 ²⁾	Rated motor speed	0...32000 rpm	1 rpm	_____
CP.13 ²⁾	Rated motor frequency	0.0...1600.0 Hz	0.1 Hz	_____
CP.14 ²⁾	Rated motor current	0.0...500.0 A	0.1 A	_____
CP.15 ²⁾	Motor voltage constant	0...500	1	_____
CP.16 ²⁾	Motor winding inductance	0.01...500.00 mH	0.01 mH	_____
CP.17 ²⁾	Motor winding resistance	0.000...50.000 Ohm	0.001 Ohm	_____
CP.18 ²⁾	Motor current for zero speed	0.0...5000.0 A	0.1 A	_____
CP.19 ¹⁾	Load motor dependent parameter	0	—	_____
CP.20	Absolute position (resolver)	0...65535	1	_____
CP.21	Change rotation	0...3	1	_____
CP.22	Maximum speed	0...4000 rpm	0.125 rpm	_____
CP.23	Step speed 1	-4000...4000 rpm	0.125 rpm	_____
CP.24	Step speed 2	-4000...4000 rpm	0.125 rpm	_____
CP.25	Acceleration time	0.00...300.00 s	0.01 s	_____
CP.26	Deceleration time	-1; 0.00...300.00 s	0.01 s	_____
CP.27	S-curve time	0.00 (off)...5.00 s	0.01 s	_____
CP.28 ¹⁾	Torque reference source	0...5	1	_____
CP.29 ²⁾	Torque limit	-10000.00...10000.00	0.01 Nm	_____
CP.30	KP speed	0...32767	1	_____
CP.31	KI speed	0...32767	1	_____
CP.32 ¹⁾	Carrier frequency	2/4/8/12/16 kHz	-	_____
CP.33 ¹⁾	Relay output 1 / Function	0...75	-	_____
CP.34	No Function / reserved	-	-	_____
CP.35	No Function / reserved	-	-	_____
CP.36	Response to external fault	0...6	1	_____

¹⁾ Enter-Parameter

²⁾ Based on selected motor

You can find supplementary manuals and instructions which can be downloaded from

www.kebco.com

General instructions

- Part 1 EMC-and safety instructions for CE instalations (Must be supplied when unit is shipped to Europe)

Unit-specific instructions

- Part 2 Power Circuit for complete power range
- Part 3 Control Circuit for B/G, M, or S version

Service notes

- Up/Download of parameter lists with KEB COMBIVERT
- Error messages

Detailed Instructions and information for application design and development

- Application Manual
- Preparation of a user-defined parameter menu
- Programming of the digital inputs

All documents are also available in printed version, please contact your local sales office. Some of the above documentation is free while some of it must be purchased.



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