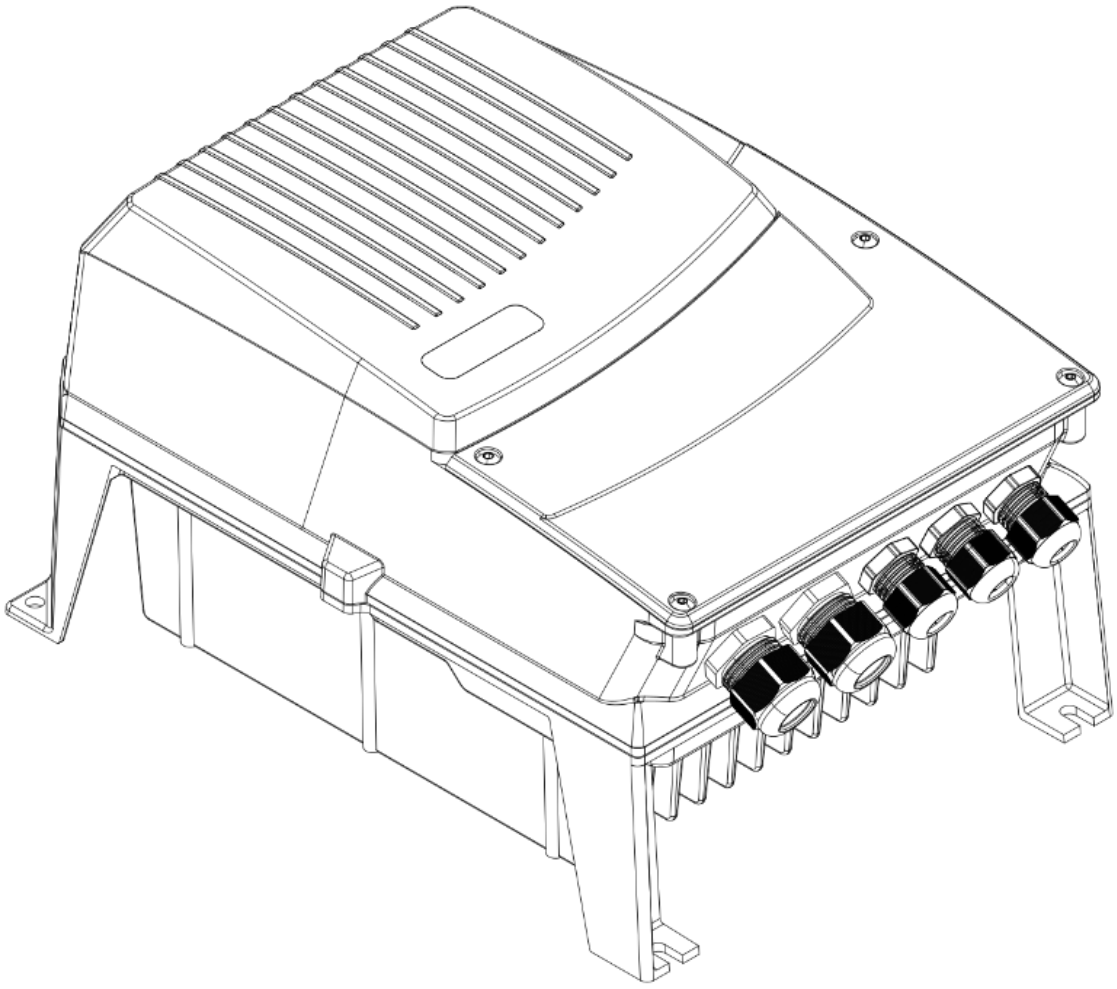
SPEED DRIVE 3.5KW



QUICK GUIDE

KMD2-1CX0

Rev.1.2 03/2026

KELD

1. INTRODUCTION.

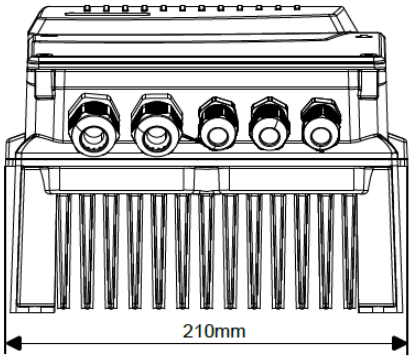
The KMD2 is a wall or cabinet mountable drive for controlling permanent magnet motors (See Section 3.2: Safety Installation). This quick guide provides information for safe installation and commissioning of the frequency inverter.

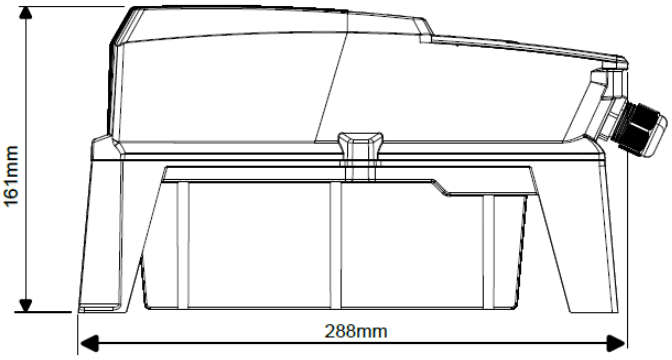
2. TECHNICAL DATA.

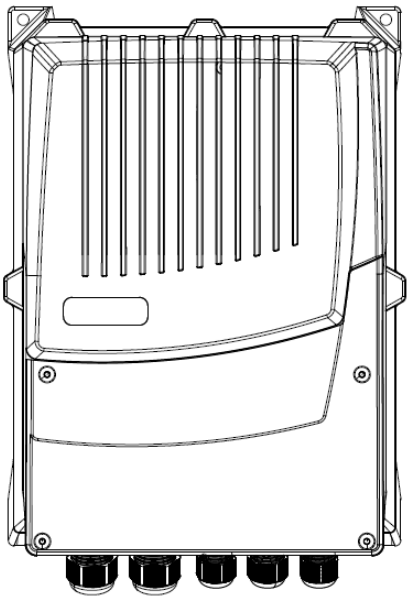
Power supply		
Power size	kW	3.5
Horsepower	Hp	4.5
Efficiency	%	>95% at 400V 3.5kW
Voltage	VAC	3x(190Vac-480Vac)
Frequency	Hz	50/60
Max.imbalance voltage	%	±2
Supply current (max)	Arms	10
Power Factor		(Without active PFC)
Switching on supply voltage		Once every 2 minutes
Conductor cross-section	mm^2	1.5-2.5
Motor output		
Nominal shaft motor power	kW	3.5
Max.output voltage	Vac	3 x 430Vac (@480Vac input)
Max.output current	Arms	10
Frequency	Hz	0-400Hz
Environment		
Operational ambient temp.	°C	-20 ...40 (frost and condensation free)
Storage ambient temp.	°C	-40 ...60
Humidity	%	10...90 (non-condensing)
Maximum altitude	m	2000 (Derate above 1000m: 1% / 100m)
Cooling	m/s	3 (recommended)
Protection rating		IP 66
Protection		
Input fuse (internal)	A	None
Impulse protection (internal)	kV	±1.0 (VDR protection)
Output protection		Short-circuit protection between phases
Overload protection		Power input, current output and temperature (derating)
Control Board		
Num. Digital Inputs		2
Digital Input Function		Start-stop, Reverse, Enable, Backup
Relay output rated load		250Vac 5A (2A inductive)
Num. Analog Inputs		1
Auxiliary voltage output	V	10
Auxiliary output max. current	mA	7.3
Analog Input type	V	0-10V (max.30Vdc)
Analog Input impedance	kΩ	200
Communication		RS-485-RTU
Conductor cross-section	mm^2	0.2-1.5

3. INSTALLATION

3.1. MECHANICAL DIMENSIONS

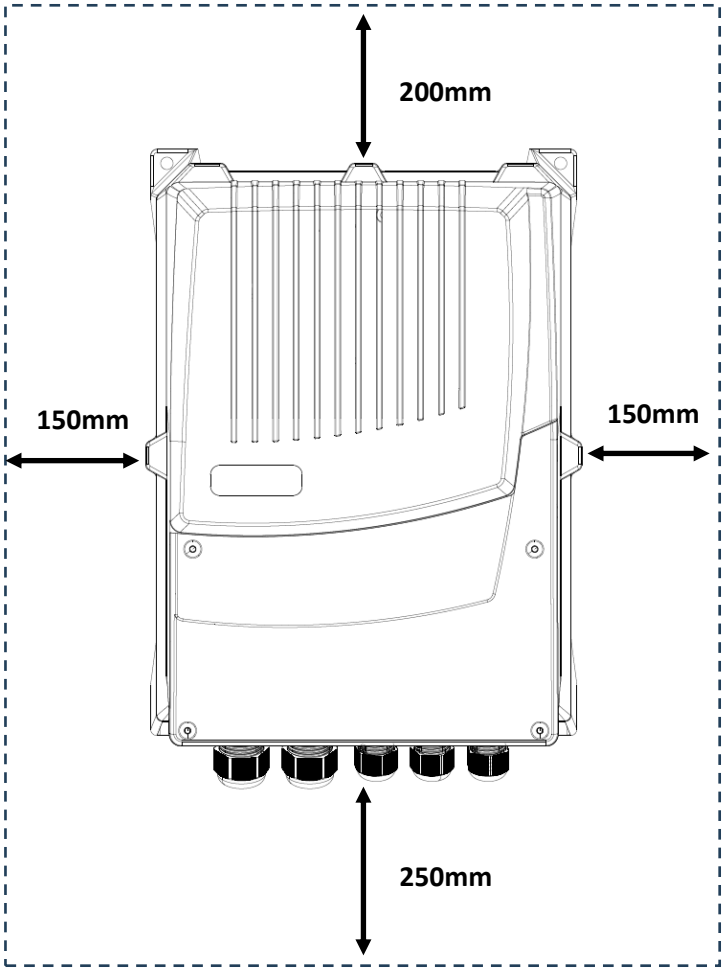






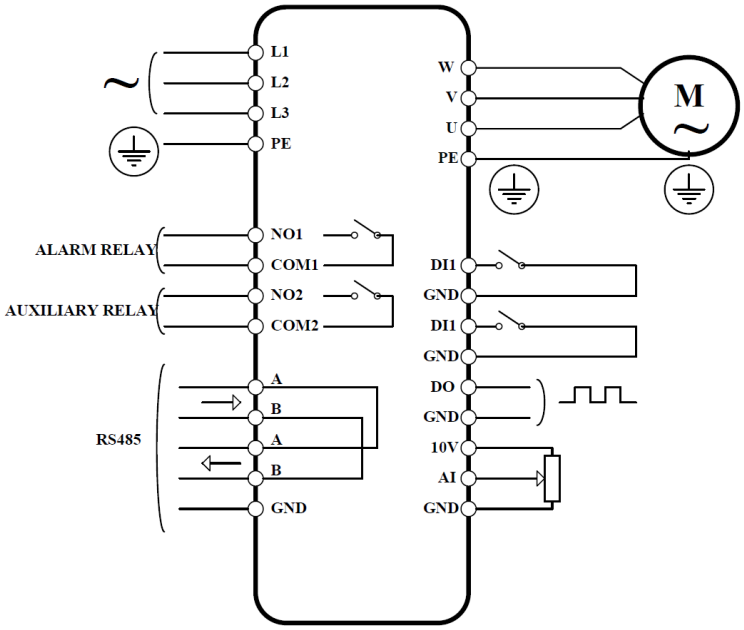
3.2. SAFETY INSTALLATION

- The drive must only be installed by qualified personnel.
- Never work on the drive, motor cable or motor when input power is applied. After disconnecting the input power, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you start working on the drive, motor or motor cable.
- When the drive is connected to the mains, there is a risk that the motor could start unintentionally, causing a risk of dangerous situations and personal injuries.
- Before connecting mains voltage, drive, motor and fan components must be properly fitted, and covers and cable glands must be properly fitted and closed.
- Do not mount the drive on a flammable base.
- The mounting location should be free from vibration.
- Do not mount the drive in any area with humidity, corrosive airborne chemicals or potentially dangerous dust particles.
- Avoid mounting close to high heat sources or direct sunlight.
- The mounting location must be free from condensation
- Correct air clearance around the drive must be observed.
- To ensure proper cooling of the drive, it must be positioned in such a way that the passing airflow can cool the heatsink. If the drive is installed in a reduced air flow or mounted outside a direct airstream, the output power will be reduced.

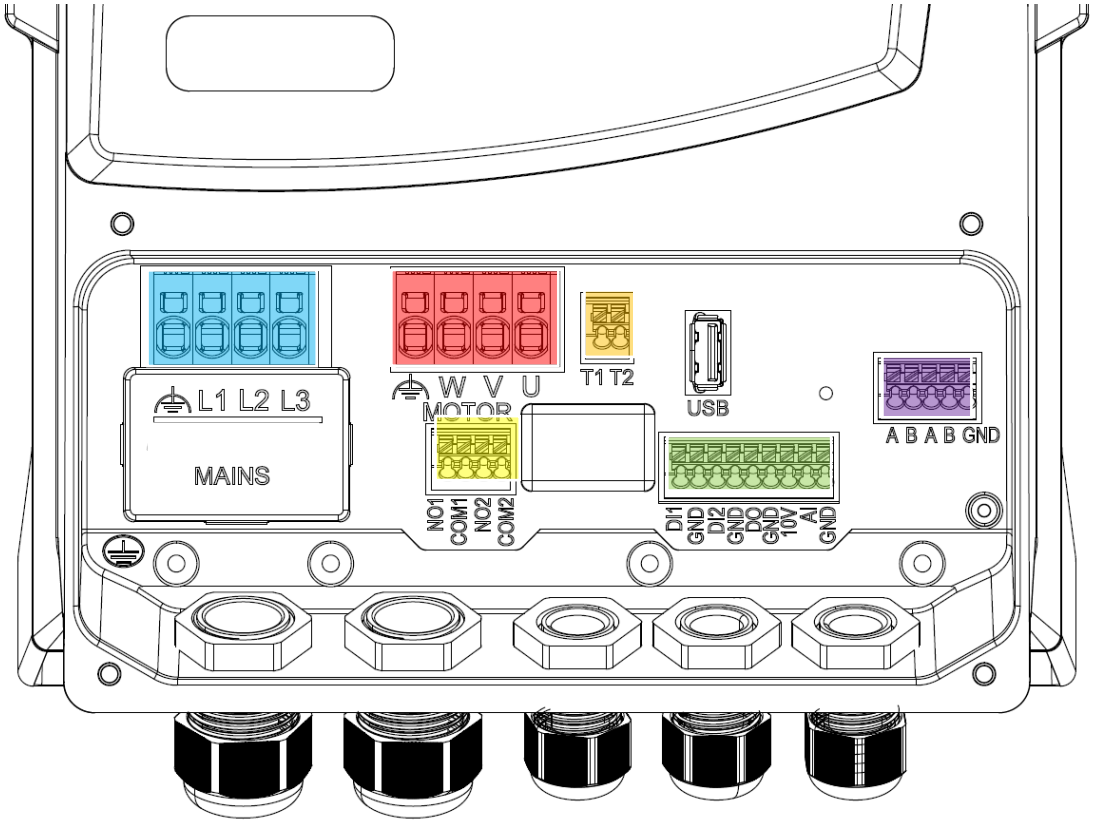


4. ELECTRICAL INSTALLATION

4.1. APPLICATION SCHEMATIC



4.2. CONNECTION DIAGRAM



Mains Power	
⏚	Earth
L1	Mains Line 1
L2	Mains Line 2
L3	Mains Line 3
Motor Output	
⏚	Earth
W	W phase
V	V Phase
U	U Phase
Temperature sensor	
T1	Motor temperature sensor PT100 /PTC /Clixon
T2	Motor temperature sensor PT100 /PTC /Clixon
Relay Output	
NO1	Normally open alarm relay
COM1	Common alarm relay
NO2	Normally open auxiliary relay
COM2	Common auxiliary relay
I/O Connector	
DI1	Digital input 1
GND	Digital input 1 common
DI2	Digital input 2
GND	Digital input 2 common
DO	Digital output
GND	Digital output common
10V	+10V reference voltage
AI	Analog Input (0-10V)
GND	Analog Input common
Communication	
A	A RS485 signal
B	B RS485 signal
A	A RS485 signal
B	B RS485 signal
GND	RS485 common

4.3. PROTECTIVE EARTH CONNECTION

- Ground terminal PE must always be grounded.
- The leakage current generates in the ground connection is less than 3.5mA so it is not necessary to take reinforced grounding as indicated by EN/IEC61800-5-1.
- The diameter of the ground terminal must be at least equal than the diameter of the phase conductor.
- The motor ground must be connected to its dedicated ground connection.
- If a residual current device (RCD) is used for extra personal protection:
    - Use only RCD of Type B (detect AC and DC currents)
    - Use RCDs with an inrush delay may be necessary.
    - Dimension RCDs according to the system configuration and environmental considerations.
    - We advise to protect each drive with a separate RCD.
- Protective earthing of the drive in combination with the use of RCDs must always performed in accordance with applicable local and international standards and directives.

4.4. POWER SUPPLY CONNECTION

- Dimension the input power cables according to local regulations.
- Min. and max. wire section:
    - Spring-loaded push-in clamp, suitable for 0.25 mm^2 - 24 AWG up to 6 mm^2 - 8AWG
    - Recommended cable section 2.5mm2 AWG14
    - Use a bladed screwdriver, 0.6x3.5 mm max, to unlock
- The cable must be rated for at least 70ºC maximum permissible temperature of the conductor in continuous use.
- The conductivity of the PE conductor must be at least equal to that the phase conductor (same cross-sectional area)
- A shielded symmetrical cable is recommended.
- The assigned cable gland is M20 for cable diameters from 7 to 13mm.

4.5. MOTOR CONNECTION

- The motor cable must be connected to the terminals marked ‘U’, ‘V’, ‘W’ and ‘PE’.
- The motor ground must be connected to its dedicated ground connection. There are 4 grounding points (M4) available for easy connection.
- To meet the EMC requirements keep the motor cable as short as possible (less than 2.5m).
- A shielded symmetrical cable is recommended.
- The assigned cable gland is M20 for cable diameters from 7 to 13mm.

4.6. CONTROL TERMINAL CONNECTIONS

- Min. and max. wire section:
  - 0.2 - 1.5 mm^2 (24 - 16 AWG) solid or stranded cable.
- Do not reverse the input signal or connect the +10V to signal ground. The drive could be damaged.
- Do not apply signals with voltage outside the indicated limits, the drive could be damaged.
- Shielded cable is not necessary for I/O signal and communication cables. Twisted pair cables are recommended.
- Power and Control Signal cables should be routed separately where possible, and must not be routed parallel to each other.
- The assigned cable gland is M16 for cable diameters from 5 to 9mm.

4.7. EMC COMPLIANT INSTALLATION

- All models have built-in EMC filter.
- Always use shielded cables for Supply cable.
- Shielded cable is not necessary for I/O signal and communication cables.
- The auxiliary voltage output (10V) is not intended to be used as a power supply for other products, if used, the driver might not fulfill the EMC regulations.
- To comply with C1 category emissions an external filter may be required. The cable between the filter and the driver should be as short as possible.
- In a domestic environment this product may cause radio interference in which case supplementary mitigation measures may be required.

4.8. CIRCUIT BREAKER SELECTION

- Provide overload protection to avoid overheating of the cables in the installation. Overcurrent protection must always be carried out according to local and national regulations.
- If a circuit breaker is used, a MCB 16A Type B is recommended.

5. MODBUS CONFIGURATION.

- The drive can be configured via modbus rs485. The default parameters for serial communication are:
  - Baud rate 115200
  - Bit data 8
  - No parity
  - Stop bits 2
  - Drive address 1

5.1. HOLDING REGISTERS.

Par.	Description	Min.	Max.	Units
Special				
#0	**Special**	**0**	**32767**	
	Triggers special commands in the drive. This parameter is not stored in memory. It's used to restore the default firmware parameters, by writing a "2" and to reset any alarm by sending a "1".			
Application parameters				
#1	**Min. RPM**	**10**	**9000**	**rpm**
	Minimum speed at which the motor will be controlled			
#2	**Max. RPM**	**10**	**9000**	**rpm**
	Maximum speed for the motor and application			
#3	**Acceleration**	**1**	**9000**	**rpm/s**
	Determines the maximum acceleration rate that the drive will impose to the motor [rpm/s]. The correct value depends both on the motor and the load.			
#4	**Deceleration**	**1**	**9000**	**rpm/s**
	Determines the maximum deceleration rate that the drive will impose to the motor [rpm/s]. The correct value depends both on the motor and the load.			
#5	**Coast speed**	**0**	**9000**	**rpm**
	Speed below which the motor will be coasting when a zero speed is set			
#6	**Resonance range [1] start**	**0**	**9000**	**rpm**
	Configure in case of mechanical resonance; Start of the resonance band			
#7	**Resonance range [1] end**	**0**	**9000**	**rpm**
	Configure in case of mechanical resonance; End of the resonance band			
#8	**Resonance range [2] start**	**0**	**9000**	**rpm**
	Configure in case of mechanical resonance; Start of the resonance band			

#9	**Resonance range [2] end**	**0**	**9000**	**rpm**
	Configure in case of mechanical resonance; End of the resonance band			
#10	**Fixed speed setting**	**0**	**9000**	**rpm**
	If fixed speed setting is selected by "input type", this speed will be the set speed as soon as the inverter is powered up.			
#11	**Speed threshold low**	**0**	**9000**	**rpm**
	Minimum speed for PWM output mode 3			
#12	**Speed threshold high**	**0**	**9000**	**rpm**
	Maximum speed for PWM output mode 3			
#13	**Time full speed at start up**	**0**	**32767**	**s**
	The time the fan will run at full speed at start up			
I/O configuration				
#18	**Input type**	**0**	**8**	
	It configures how the speed is set: 0 -Modbus 1-Analog 2-Parameter 3-Percent 4-Not used 5-Not used 6-Analog-Backup 7-Analog- Multiple speed presets 8-Modbus - Multiple speed presets DI1=open DI2=open →Speed set = Analog input /Modbus speed DI1=closed DI2=open →Speed set = 85% HR10 Fixed speed DI1=open DI2= closed →Speed set = 70% HR10 Fixed speed DI1=closed DI2= closed →Speed set = 100% HR10 Fixed speed			
#19	**Rotation**	**0**	1	
	Reverse the motor rotation: 0-Forward 1-Reverse			
#20	**Dig. In. config.**	**0**	**3**	
	Digital inputs enable/disable: 0-Both disabled 1- DI2 enabled (Start/Stop or 70% Backup depending on the function) 2- DI1 enabled (Reverse or Backup or 85% Backup depending on the function) 3- Both enabled			
#21	**Potentiometer min**	**0**	**100**	**V*10**
	Below this voltage, the potentiometer will be considered zero			
#22	**Potentiometer max**	**0**	**100**	**V*10**

	Above this voltage, the potentiometer will be considered 10V			
#23	**PWM out mode**	**0**	**3**	
	Working mode of the tachometric (PWM) output 0-Speed - Shows current speed 1-Alarm code - Shows Alarm code 2-Threshold - Shows when speed is above "Speed threshold low" 3 -Range - Shows when between "Speed threshold low" and "Speed threshold high"			
#24	**Relay output**	**0**	**5**	
	Relay 1 output mode: 0-Drive running 1-Drive healthy 2-At speed 3-Faulted 4-Over threshold 5-Inside range			
#25	**Logo Level**	**0**	**1000**	
	Logo Brightness level			
Communication				
#29	**Modbus ADDR**	**247**	**1**	
	Modbus address for RS485 communication, has to be unique in the bus. Communication will be lost when changed until master is configured			
#30	**Modbus Par/Stop**	**0**	**2**	
	Parity and bit stop configuration: 0-8-None-2 1-8-Odd-1 2-8-Even-1			
#31	**Baudrate**	**96**	**1152**	**bps/100**
	Modbus baudrate: 96-9600bps 192-19200bps 384-38400bps 576-57600bps 1152-115200bps			
#32	**Com timeout**	**0**	**6000**	**s**
	Communication timeout. If the inverter doesn't receive communication for this period of time, it stops the motor with an alarm			
#33	**Enable timeout alarm**	**0**	**1**	
	Enabling stop due to internal communication timeout alarm 0-No 1-Yes			

Current / Power limits				
#37	**Max. current**	**100**	**13000**	**mA**
	Is the maximum peak value of the line current [A]. The algorithm will never drive the motor while in closed loop over this value. If the load requires more current than the maximum, the motor speed will automatically be decreased so it's never surpassed.			
#38	**Maximum Power**	**0**	**3100**	**W**
	Is the maximum power the Drive will allow [W], if the load on the motor increases over the maximum power, the speed will be reduced automatically. The dynamic behavior of this control loop is determined by the Power Kp and Ki ,parameters, allowing the adjustment of the overload response.			
Dynamics / speed stability				
#45	**Max err rpm**	**1**	**9000**	**rpm**
	Maximum allowed error between set and real speed before increasing the speed in the same sign as the error			
#46	**Speed low filter**	**0**	**500**	**s*1000**
	Speed filter constant time for low speeds			
#47	**Speed high filter**	**0**	**500**	**s*1000**
	Speed filter constant time for high speeds			
#48	**Speed Kp**	**0**	**32767**	
	Proportional constant for the motor speed control loop			
#49	**Speed Ki**	**0**	**32767**	
	Integral constant for the motor speed control loop			
Motor parameters				
#56	**Pole couples**	**1**	**24**	
	Number of pairs of poles of the motor			
#57	**Stator Resistance**	**0**	**32767**	**Ω*100**
	Motor phase resistance (half of whatever is measured between two motor phases) Is best to use the value measured by the drive during tuning and not the actual motor resistance as the motor tuning will take into account the cable and other internal errors. In some motors the stator resistance will increase due to internal heating, if this effect is very high, it can be beneficial to tune the motor a second time while it's hot			
#58	**Synch. Inductance**	**0**	**32767**	**mH*10**
	Is the motor inductance as measured by the Drive during tuning [mH]. In theory should be near $\frac{1}{2} \cdot (Ld + Lq)$ but the final value can be adjusted depending on the motor behavior at different speeds. Usually higher torque requirements will result in an inductance lower than the initial measured value.			

#59	**P.M. Flux**	**0**	**32767**	**mWb*10**
	Is the permanent magnets flux as measured by the Drive during tuning			
#60	**Current Kp**	**0**	**32767**	
	Proportional constant of the current control loop. Is determined during the tuning stage and usually should be left as it is.			
#61	**Current Ki**	**0**	**32767**	
	Integral constant of the current control loop. Is determined during the tuning stage and usually should be left as it is.			
#62	**Startup Id reference**	**0**	**13000**	**A*1000**
	Id reference during startup			
#63	**pll_k1**	**0**	**32767**	
	Observer Phase Locked Loop constant k1.			
#64	**pll_k2**	**0**	**32767**	
	Observer Phase Locked Loop constant k2.			
#65	**pll_k3**	**0**	**32767**	
	Observer Phase Locked Loop constant k3.			
#66	**Kp af**	**0**	**32767**	***100**
	Proportional gain of observer PI. Observer gains. Very small or very big gains lead the motor not starting. To check that these parameters are well adjusted, both maximum speed operation and startup should be checked and run in stable way. The lower speed you want to run the motor, the lower the constants need to be.			
#67	**Ki af**	**0**	**32767**	***100**
	Integral gain of observer PI.			
#68	**Shortcircuit comps**	**0**	**1**	
	Use of the uC internal short-circuit comparators			
#69	**Block speed**	**0**	**9000**	**rpm**
	Threshold for locked rotor alarm. Speed under it is detected blocking or rotor stuck			
#70	**Rotor locked level**	**0**	**10**	**%/10**
	Ratio of max current above which the motor is considered locked			
#71	**Block alarm time**	**0**	**32767**	**s*100**
	Timeout for locked rotor alarm			
#72	**Power Kp**	**0**	**32767**	
	Power limit proportional control loop			
#73	**Power Ki**	**0**	**32767**	
	Power limit integral control loop			
#76	**Nominal speed motor**	**0**	**9000**	**rpm**

#77	**Bemf motor**	**0**	**1000**	**V**
	Bemf at nominal speed (Vfn peak)			
#78	**Deceleration Id reference**	**0**	**13000**	**A*1000**
	Id reference during deceleration			
#79	**Blocking current**	**0**	**13000**	**A*1000**
	Maximum current in blocking function			
Temperature				
#81	**Sampling Freq.**	**4000**	**16000**	**Hz**
	Frequency for current sampling, with ratio=1 it also equals the switching frequency			
#82	**Frequency reduction**	**0**	**12000**	**Hz**
	Switching frequency reduction when motor speed increases over threshold			
#83	**Fr. red. turn on speed**	**0**	**9000**	**rpm**
	Speed threshold over which the switching frequency will be reduced			
#84	**Temp Hyst.**	**0**	**200**	**°C*10**
	Hysteresis for all temperature alarms			
#85	**Derating margin**	**10**	**1000**	**°C*10**
	When any temperature is closer to its limit than this margin, the derating will be active			
#86	**Max temp MOD**	**300**	**1400**	**°C*10**
	Maximum allowed power module temperature			
#87	**Max temp PCB**	**250**	**1200**	**°C*10**
	Maximum allowed temperature on the PCB			
Configurable limits				
#93	**Min rpm limit**	**0**	**9000**	**rpm**
	Password protected limit for minimum speed			
#94	**Max rpm limit**	**0**	**9000**	**rpm**
	Password protected limit for maximum speed			
#95	**Max Curr Limit**	**100**	**13000**	**mA**
	Password protected limit for current			
#96	**Max power limit**	**0**	**3100**	**W**
	Password protected limit for power			
#98	**Level 2 password r0**	**0**	**65335**	
	Will read 0 unless user access level is >=2			

#99	**Level 2 password r1**	**0**	**65335**	
	Will read 0 unless user access level is >=2			
#100	**Level 2 password r2**	**0**	**65335**	
	Will read 0 unless user access level is >=2			
#101	**Level 2 password r3**	**0**	**65335**	
	Will read 0 unless user access level is >=2			

5.2. COUNTERS REGISTERS.

Par.	Description	Units
#1000	**Status**	
	Status of the firmware of the motor control microprocessor and the user microprocessor.	
#1001	**Motor version**	
	Firmware version of the motor control microprocessor	
#1002	**Interface version**	
	Firmware version of the user microprocessor	
#1003	**Hard.model**	
	Device hardware reference	
#1004	**Modbus address**	
	Modbus address for RS485 communication	
#1005	**Baudrate**	
	Modbus baudrate	
#1006	**BitStop**	
	Parity and bit stop configuration	
#1007	**Low Volt cnt**	
	Low voltage alarm counter (Count occurs every time a drive is disconnected from power)	
#1008	**High Volt cnt**	
	High voltage alarm counter	
#1009	**Short cnt**	
	Shortcircuit alarm counter	
#1010	**IPM overtemp cnt**	
	IPM overtemperature alarm counter	

#1011	**PCB overtemp cnt**	
	PCB overtemperature alarm counter	
#1012	**Loss of sync cnt**	
	Lost synchronism alarm counter	
#1013	**Phase loss cnt**	
	Alarm counter for loss of an output phase	
#1014	**Derating cnt**	
	Counter for power reduction situations due to overtemperature protection	
#1015	**Mem.err. cnt**	
	Memory error counter	
#1016	**Max. IPM temp**	**°C*10**
	Record of the maximum temperature reached by the power module.	
#1017	**Max. PCB temp**	**°C*10**
	Record of the maximum temperature reached by the PCB.	
#1018	**Max. power**	**W**
	Record of the maximum power reached by the drive.	
#1019	**Max speed**	**rpm**
	Record of the maximum speed reached by the drive.	
#1020 - #1021	**Acc energy**	**Wh**
	Record of the total energy consumed by the drive since its first start-up.	
#1022	**Run hours**	**hours**
	Record of motor running time since its first start-up.	
#1023	**Run minutes**	**min**
	Record of motor running time since its first start-up.	
#1024	**Power on count**	
	Power connection counter	
#1025	**Starts count**	
	Motor starts counter	
#1026	**Write cmd count**	
	Parameter writing command counter.	
#1027	**User boot updates**	
	User microcontroller firmware update counter.	
#1028	**Motor boot updates**	
	Motor control microcontroller firmware update counter	

5.3. ALARM LOG.

The drive stores a log of the last 9 recorded alarms. The alarm log is a circular buffer, with the address of the last recorded alarm stored at address #1059.

Codes 0xAABB where AA is first alarm & BB is second alarm occurring simultaneously.

Par.	Description	Units
#1032	**Event 01 hour**	**hours**
	Motor running hours when the event occurred	
#1033	**Event 01 minutes**	**minutes**
	Motor running minutes when the event occurred	
#1034	**Event 01 alarm**	
	Code of the registered alarm.	
----------	----------	----------
#1056	**Event 09 hour**	**hours**
	Motor running hours when the event occurred	
#1057	**Event 09 minutes**	**minutes**
	Motor running minutes when the event occurred	
#1058	**Event 09 alarm**	
	Code of the registered alarm.	
#1059	**Last alarm index**	
	Address of the last recorded alarm	

1. OPERATION.

1.1. ANALOG CONTROL.

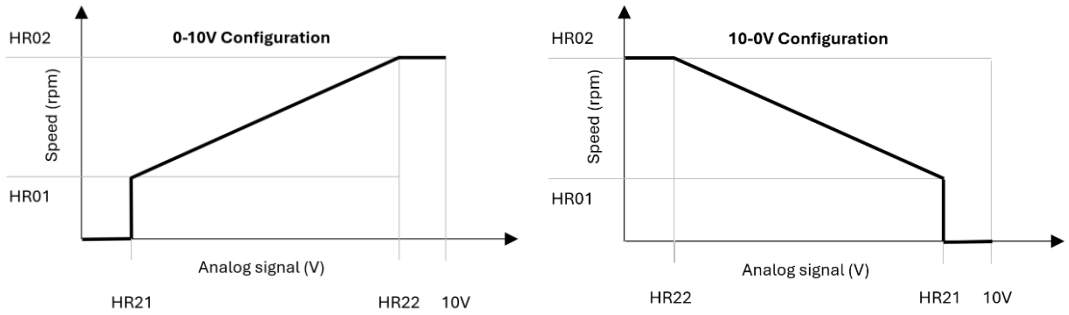
To select the analog input working mode, select parameter HR18 'Input type' to 'Analog'.

The control signal must be connected into the ANALOG INPUT and the reference to GND. This analog input could be:

- An external 0-10V / 10-0V signal. The input impedance is 200KΩ.
- A potentiometer. The available +10V power supply of the driver is intended to be used with a potentiometer of minimum 2KOhm, with a max absorbed current of 5mA.
- An external 4-20mA signal. It is necessary to add 0.1% precision resistances between the ANALOG INPUT and GND. The value of the resistance should be 500 Ω -> V signal ranges from 2V to 10V.

Through this setting the fan speed is proportional to the analog voltage input. The relationship between control voltage and fan speed is configured through parameters: HR01 Min.RPM, HR02 Max.RPM, HR21 Potentiometer min, HR22 Potentiometer max.

If HR21 < HR22 the control is configured for 0-10V, if HR21 > HR22 the configuration will be 10-0V. The behavior is described in the following figures:



1.2. MODBUS CONTROL

To select the analog input working mode, select parameter HR18 'Input type' to ‘Modbus’. Configure communication according to the parameters:

- HR29 Modbus ADDR
- HR30 Modbus Par/Stop
- HR31 Baudrate

Once communication is established, simply write the desired speed using the address ‘10002’.

6. DISPLAY TABLE.

The system status can be displayed through the Logo display on the driver board.

Logo color	Description	Blinking
White	Normal operation, standby	Low/High
Green	Normal operation, running	No
Blue	Bluetooth dongle detected	Low
Yellow	Operating in overtemperature derating situation	High
Orange	User firmware error	High
Purple	Motor firmware error	No
Green/purple/blue	Updating firmware	Yes
Red	Short circuit alarm	1 High / 2 Low
Red	Loss of synchronization alarma	1 High / 3 Low
Red	Generic alarm	1 High / 4 Low

7. ALARM TABLE.

Log Code	Description	Restart
0x01	Memory error	Drive locked
0x02	Short-circuit	2 automatic attempts
0x03	Lost synchronisms / locked rotor	10 automatic attempts
0x04	Input voltage out of range (only with motor stopped)	Autorestart
0x05	Low voltage running	Autorestart
0x06	Bus over-voltage	Autorestart
0x07	IPM Over-temperature	Autorestart
0x08	PCB Over-temperature	Autorestart
0x0B	Motor cable U disconnected	Drive locked
0x0C	Motor cable V disconnected	Drive locked
0x0D	Motor cable W disconnected	Drive locked
0x0E	No motor	10 automatic attempts

8. FLASHING A NEW FIRMWARE.

Flashing a new firmware to a KMD Drive could be needed to include new features, fix bugs in the firmware or to change the motor control algorithm.

The update is performed via the USB connector. Steps:

- Copy the file(s) we want to update onto the root folder of a thumb drive. We can update the motor control microcontroller, the user microcontroller, or both.

- Plug thumb drive into unpowered drive

- Power up the inverter; the update process begins automatically. The red LED will begin flashing 50% on - 50% off and the Logo display blinks green/purple/blue. After about 30 seconds, the LED will flash 90% on - 50% off and Logo display turns white. The update process will be complete.

- Turn off the inverter and disconnect the Pendrive.

- Reset parameters by setting HR0=2 (if needed).

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1. Purpose

This document defines the recommended procedure for commissioning a KMD inverter that has been stored for an extended period before being placed into service.

The main objective is to ensure the safe reactivation of the DC bus electrolytic capacitors, which may degrade when stored for long periods without applied voltage.

When aluminum electrolytic capacitors remain unenergized for extended periods, the dielectric oxide layer partially deteriorates. Applying full rated voltage immediately after long storage can result in excessive leakage current, overheating, or failure. Controlled energization allows the dielectric layer to reform gradually.

2. Storage Time Categories and Required Actions

2.1 Storage Time: Less than 1 Year

No special procedure is normally required.

Recommended actions:

- Perform a visual inspection of the inverter.
- Verify that no condensation or moisture is present.
- Ensure heatsink is unobstructed.
- Power the inverter normally.

No capacitor reforming procedure is required.

2.2 Storage Time: Between 1 and 2 Years

The inverter should be energized without load before normal operation.

Procedure:

1. Ensure the inverter output is not connected to a motor or that the motor is not started.
2. Apply rated input voltage to the inverter.
3. Leave the inverter powered for at least 30 minutes.
4. Verify that no alarms or abnormal heating occur.
5. After this stabilization period, the inverter may be placed into normal operation.

This step allows the DC bus capacitors to stabilize and partially reform.

2.3 Storage Time: More than 2 Years

A controlled capacitor reforming procedure is recommended before applying full input voltage.

Two acceptable methods are described below:

- Reforming using a variable autotransformer
- Reforming using a series current-limiting resistor

3. Capacitor Reforming Using a Variable Autotransformer

3.1 Equipment Required

- Variable autotransformer (Variac)
- AC voltmeter
- Time monitoring

3.2 Procedure

1. Disconnect the motor or ensure the inverter cannot start.
2. Connect the inverter input through the autotransformer.
3. Apply voltage progressively according to the following steps:

Applied Voltage	Duration
25% of rated input voltage	30 minutes
50% of rated input voltage	30 minutes
75% of rated input voltage	30 minutes
100% of rated input voltage	60 minutes

4. Verify that no alarms or abnormal heating occur.

This gradual voltage increase allows the aluminum oxide dielectric layer in the DC bus capacitors to reform safely.

4. Capacitor Reforming Using a Series Current-Limiting Resistor

This method may be used when a variable autotransformer is not available.

4.1 Typical Configuration

A high-power resistor is temporarily connected in series with the AC input supply of the inverter to limit the inrush and reforming current.

Typical resistor values for 1Ph/3Ph 230Vac input:

- Resistance: 100 Ω to 330 Ω (220 Ω recommended)
- Power rating: 700 W
- Type: high-power wirewound resistor

Typical resistor values for 3Ph 400Vac/480Vac input:

- Resistance: 330 Ω to 560 Ω (470 Ω recommended)
- Power rating: 1200 W
- Type: high-power wirewound resistor

4.2 Procedure

1. Ensure the inverter output is not connected to a running motor.
2. Insert the current-limiting resistor in series with the AC supply.
3. Energize the inverter through the resistor.
4. Maintain this condition for 30 to 60 minutes.
5. Verify that no abnormal heating or alarms occur.
6. Disconnect the power supply.
7. Remove the resistor and reconnect the inverter directly to the supply.
8. Power the inverter normally.

During this period the DC bus capacitors gradually charge and their dielectric layer reforms.

5. Preventive Maintenance Recommendation During Storage

To avoid capacitor degradation during storage, it is recommended to energize stored inverters periodically.

Recommended practice:

- If the inverter is stored for long periods, apply rated input voltage for approximately 30 minutes once every 12 months.
- The inverter does not need to drive a motor during this process.

- The purpose is simply to apply voltage to the DC bus capacitors, maintaining the integrity of the dielectric layer.

This periodic energization significantly reduces the need for capacitor reforming procedures when the equipment is eventually placed into service.

5. Safety Notes

- All procedures must be performed by qualified personnel.
- Ensure proper electrical protection and grounding.
- High voltages are present inside the inverter even when the motor is not connected.
- Never touch internal circuits while energized.

6. Summary

Storage Time	Recommended Action
< 1 year	Normal power-up
1–2 years	Energize inverter for 30 minutes without load
> 2 years	Perform capacitor reforming using autotransformer or series resistor

Following these procedures significantly reduces the risk of DC bus capacitor failure when placing an inverter back into service after extended storage.