GE
Industrial Solutions

WORLDWIDE PARTNER

AF-6 Series Drives ED.02

Built-in features
Built-in simplicity

GE imagination at work

AF-6 Series Drives

Highlight of benefits

One family
- Designed for general purpose applications
- For both constant and variable torque applications
- Just one drive series to run an entire production line
- Broad range: 180W to 1.4 MW, 230 V – 690 V

Designed for lifetime
- Built-in DC chokes increase the lifetime of the capacitors
- Conformal coating available

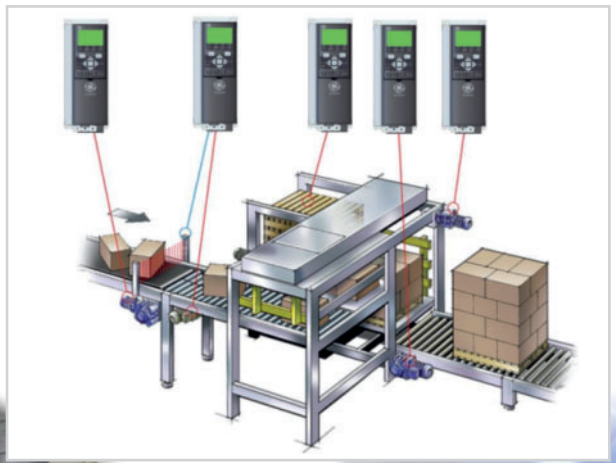
Low operating costs
- Low energy consumption – up to 98% efficiency
- Less energy needed for cooling
- Automatic Energy Optimizer (AEO) potentially saves up to 5% energy compared to standard drives
- Low cost of ownership – no periodic maintenance/ replacement cost
- Energy saving up to 40% depending on the application

Constant torque applications Heavy Duty

Constant torque applications include those where the load does not change significantly with the speed as conveyors, lifting gear and mixers.

A motor block on a conveyor will always weight the same, regardless of whether the conveyor is running at low or high speed.
The torque required to move this motor block is always the same. Although friction and acceleration torques will vary depending on the operating state, the torque requirement for the load remains constant.

The power required by a system of this type is proportional to the torque required and to the speed of the motor.
Savings can be achieved directly if the speed can be reduced at constant load. Adapting the speed of the belt to the quantity of goods to be transported not only enables those goods to be processed without interruption but also leads to a reduction on the energy required.
Even if it is not possible or desirable to adapt the speed, most speed drives will still bring about reductions in energy consumption, since they regulate the motor's output voltage depending on load and as the load rises, it will increase the voltage.



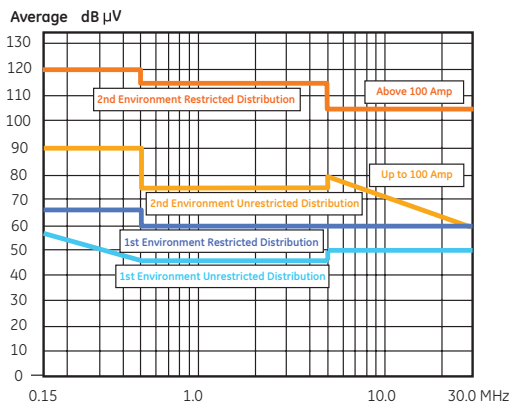
Variable torque applications Light Duty

Often involve pumps and fans. However, a distinction has to be made in the case of pumps. Although the most popular types of centrifugal pump have a quadratic torque characteristic but eccentric, vacuum or positive displacement pumps have a constant torque characteristic. Pumps and fans have a significant share of all power consumed by industrial applications, with consumption levels approximately at 40%. Speed control is a simple yet very effective way of saving energy where fans and pumps with variable load torques are concerned.

Reducing the speed generates a cubic reduction in energy requirements. This significant potential for savings makes all applications with variable torque ideal candidates for the implementation of energy saving. Operators need to take into account that changes in speed alter the operating point and affect the efficiency. If the difference between the maximum power required and average part-load operation is too great, systems should be cascaded. It is often the case that investments pay for themselves relatively quickly when existing systems are converted.

Built-in class A2 RFI filter

- Drive is ready to use and faults due to incorrect installation or wrong filter selection are avoided
- No over sizing of drive necessary – with motor cables of up to 300m, depending of the power rating of the drive
- Immunity from electrical interference and minimal emission
- Saves panel space and installation costs
- A1 and B1 filter also available as factory option
- Facilitates meeting CE EMC directives (requirement for EU markets)



Domestic - 1st Environment	
EN55011 cl. B1	EN61800-3 cl. C1
EN55011 cl. A1	EN61800-3 cl. C2
Industrial - 2nd Environment	
EN55011 cl. A2	EN61800-3 cl. C3
EN55011 cl. A2	EN61800-3 cl. C3

Built-in DC link reactor

- Low harmonic emission: THDi < 48%
- No voltage drop => full output voltage
- Reduces installation cost
- Fulfils EN 61000-3-2/3-12
- True power factor 0.9

Reliable operation in harsh environment

- Protection against environmental pollution, aggressive gasses, moisture and dust
- Reduces the probability of failure resulting in less down-time
- Increases the lifetime of the drive
- High protection Class 3C2 **as standard** and increased protection in harsh environments with Class 3C3 **as optional**
- Optional conformal coating is tested to ANSI/ISA S71.04-1985 Class G3 (airborne gasses - harsh) and Class GX (airborne gasses - severe)

Intelligent heat management

- Cooling fans are easily cleaned without touching the electronics
- 100% cooling air via segregated rear heat-sink– protects the electronic against aggressive environments
- Temperature controlled fan

High immunity

- Immunity to fluctuating supply voltage (+/- 10%)
- Efficient overvoltage protection
- Fully short-circuit- and earth-leakage proof
- 100kA prospective short-circuit current capability

AF-600 FP - Special pump functions

No flow detection

- No flow detection is based on speed and power
- Two sets of data must be programmed into the drive
- Manual or auto set up
- Used to enable sleep mode in closed loop systems for energy savings

End-of-curve protection

- If there is a water leak in the pipe, it will not produce pressure
- The pump is delivering a large volume of water but cannot maintain the static head
- Drive will go to full flow to try producing pressure (set point)
- The drive running at high speed with a feedback signal less than 97.5% of the set point pressure causes End of Curve action

Dry pump protection

- Special no-flow condition, where pressure can not be produced, if there is no water
- Drive will go to full speed to try producing full pressure
- Low power consumption at high speed causes Dry Pump action

PC software tool DCT-10

One PC tool for all tasks
- Explorer-like view
- On and offline commission
- Help description for each drive parameter
- Oscilloscope function
- Option programming
- Logging of alarms and warnings for improved system performance and documentation

Interacts with process management
Communicates through USB, RS485 or Network

Plug-in option modules

- Tailored for specific application needs
- Low handling cost
- Easy service/ upgrade with a wide range of options
- Field installable Plug n' Play and self configuring

1 A slot : Network option modules
2 B slot : I/O option modules
3 24Vdc External supply option module

Control wiring and PC connections

- Reduced installation time - Pluggable terminal block for easy installation
- Improved installation quality
- Spring terminals provide better contact than screw terminals
- Thin or thick wires (1.5mm² solid/1.0mm² stranded wire)

Built-in control card I/O

Inputs / Outputs
- 6 digital I/O (0-24Vdc)
  - 2 configurable as Digital Outputs
  - 2 configurable as Pulse I/O
  - Configurable as PNP or NPN
- 2 form C relay outputs with on/off delays
- 2 analogue Input (0-10V or 0/4-20mA)
- 1 analogue Output (0/4-20mA)

Serial ports
- RS 485 Port
  - Supports multi-drop connections
  - Supports 1.2 km cables
  - Switchable network termination
  - Modbus RTU
- USB Port
  - Simple USB direct cable connection ~3m max.
  - Point - to - point

Network option modules

- Support for all leading protocols
- Easy installation and commissioning
  - Top cable entry -or-
  - Bottom cable entry (if used you cannot add I/O option modules)
- Built-in Networks: Modbus RTU

Only for AF650 GP and AF600 FP
- Network option modules: Profibus DP, DeviceNet, Ethernet IP, Modbus TCP, Profinet RT
- Additional Option Modules for AF-600 FP: BACnet and LonWorks

Inquiry customer data for dimensioning of variable speed drives

Nominal Motor Data (Type Plate)			
Motor Type :	Manufacturer:		
Nominal Power Pn:	kW		
Nominal Voltage Un (Y/Δ):	V	Nominal Current I_N (Y/Δ):	A
Nominal Speed:	min^{-1}	cos φ	
Specifications:			
Grid Voltage:		Grid Type (IT/TT/TN):	
Length of Motorcable:		Degree of EMC :	
Application Area (Industry / Residential) :			
Special Exigencies:			
Application Description:			
Torque characteristics (Constant/Quadratic):			
Overload (110/160%):			
Speed Range:			
Braking Torque:			
Desired Functionalities:			
Specification:			
Communication System:			
Protection Degree:	IP	Special Ambient Conditions	

Notes

AF-60 LP - Micro Drives

The Micro Drive AF-60 LP is a compact but powerful and easy to use AC variable frequency drive.
The drive is available in its standard configuration that includes built-in Brake chopper for 1.5kW and above, single-turn potentiometer for speed reference and LCD keypad display that can be remotely mounted.

Following models are available:
- Single-phase, 230Vac, from 0.18 to 2.2kW
- Three-phase, 230Vac, from 0.25 to 3.7kW
- Three-phase, 400Vac, from 0.37 to 22kW

Approvals / Marking

UL, cUL, C-Tick

Applications

- Fans
- Pumps
- Mixers
- Conveyors
- Material handling
- Industrial machinery, including: agitators, lathes, spinning machines, machine tools, packaging equipment, plastics and woodworking

Features

Ready to start from the beginning
- Self-protecting features
- 150% current overload up to 1 minute
- "Pick up" start (catch a spinning motor)
- Potentiometer on keypad
- Keypad is hot pluggable and can be password protected
- RS485 communication, Modbus protocol
- RFI class A1 filter built-in
- Dynamic brake incorporated from 1,5kW
- High level functions, PID for feedback systems, mechanical brake control for lifts
- Easy to use PC software
- Integrated logic control, PLC

Built-in durability
- Robust housing (IP20) protects the drive and allows side-by-side mounting
- Conformal coated circuit boards and high quality capacitors maximize uptime
- Intelligent heat management leads to long life

Built-in simplicity speeds installation and set-up
- Installation and set-up immediate
- Wiring diagram, template and quick guide
- DIN-rail kit optional, to 2.2kW (unit sieze M1 and M2)

Product numbering system diagram

Description	6K	LP	2	3	F25	X	9	A1
GE product code								
Drive type		LP = AF-60 LP Micro Drive						
Input voltage			2 = 230V, 50/60 Hz 4 = 400V, 50/60 Hz					
Input Phase				1 = 1-phase 3 = 3-phase				
HP rating					F25 = 1/4 HP 001 = 1 HP 010 = 10 HP			
Factory installed options						X = Keypad		
Enclosure type							9 = IP20/Open	
Version								A1 = 1st version B1 = Future version

Product number for illustrative purposes only

IP20

230 Vac, 1-phase, 50/60 Hz input

Nominal motor ratings								
Power kW	Current A	Cat. No.	Ref. No.	Unit Size	Efficiency (%) [1]	Losses (W) [1]	IP21 kit	DIN-rail mounting kit
0.18	1.2	6KLP21F25X9A1	**404774**	M1	94.5	15.5	NEMA1ACLP1	RMACLP1
0.37	2.2	6KLP21F50X9A1	**404775**	M1	95.6	25.0	NEMA1ACLP1	RMACLP1
0.75	4.2	6KLP21001X9A1	**404776**	M1	96.0	44.0	NEMA1ACLP1	RMACLP1
1.5	6.8	6KLP21002X9A1	**404777**	M2	96.7	67.0	NEMA1ACLP2	RMACLP1
2.2	9.6	6KLP21003X9A1	**404778**	M3	97.1	85.1	NEMA1ACLP3	N/A

230 Vac, 3-phase, 50/60 Hz input

0.25	1.5	6KLP23F33X9A1	**404779**	M1	94.9	20.0	NEMA1ACLP1	RMACLP1
0.37	2.2	6KLP23F50X9A1	**404780**	M1	95.8	24.0	NEMA1ACLP1	RMACLP1
0.75	4.2	6KLP23001X9A1	**404781**	M1	96.3	39.5	NEMA1ACLP1	RMACLP1
1.5	6.8	6KLP23002X9A1	**404782**	M2	97.2	57.0	NEMA1ACLP2	RMACLP1
2.2	9.6	6KLP23003X9A1	**404783**	M3	97.4	77.1	NEMA1ACLP3	N/A
3.7	15.2	6KLP23005X9A1	**404784**	M3	97.4	122.8	NEMA1ACLP3	N/A

400 Vac, 3-phase, 50/60 Hz input

0.37	1.2	6KLP43F50X9A1	**404785**	M1	95.5	25.5	NEMA1ACLP1	RMACLP1
0.75	2.2	6KLP43001X9A1	**404786**	M1	96.0	43.5	NEMA1ACLP1	RMACLP1
1.5	3.7	6KLP43002X9A1	**404787**	M2	97.2	56.5	NEMA1ACLP2	RMACLP1
2.2	5.3	6KLP43003X9A1	**404788**	M2	97.1	81.5	NEMA1ACLP2	RMACLP1
4	9	6KLP43005X9A1	**404789**	M3	98.0	133.5	NEMA1ACLP3	N/A
5.5	12	6KLP43007X9A1	**404790**	M3	98.0	166.8	NEMA1ACLP3	N/A
7.5	15.5	6KLP43010X9A1	**404791**	M3	98.0	217.5	NEMA1ACLP3	N/A
11	23	6KLP43015X9A1	**404792**	M4	97.4	342	NEMA1ACLP4	N/A
15	31	6KLP43020X9A1	**404793**	M4	97.4	454	NEMA1ACLP4	N/A
18.5	37	6KLP43025X9A1	**404794**	M5	98.0	428	NEMA1ACLP5	N/A
22	43	6KLP43030X9A1	**404795**	M5	97.9	520	NEMA1ACLP5	N/A

Brake chopper is included with 1.5kW drives and above
(1) At rated load conditions

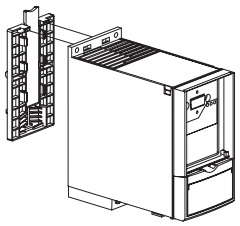
Options and accessories

Remote mounting kit for keypad

Remote mounting kit for mounting keypad on enclosure doors.
Kit includes gasket, mounting brackets, and cable. Keypad is rated IP21.

Description	Cat. No.	Ref. No.
Remote mounting kit for keypad cable (3m)	RMKYPDACLP1	**404797**

DIN-rail mounting kit

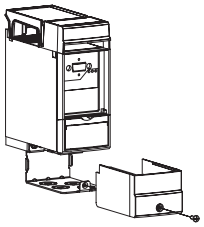


This adapter can be used to mount AF-60 LP Micro Drives at 0.75kW and below to 35mm DIN-rail.

Description	Cat. No.	Ref. No.
DIN-rail mounting kit for unit size M1 or M2[1]	RMACLP1	**404806**

(2) Please note that these DIN-rail mounting kits only include bottom cover.

IP21 kit

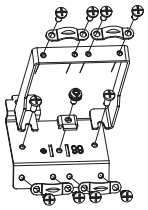


This kit can be mounted to the IP20 protected AF-60 LP Micro Drives to provide IP21 protection.

Description	Cat. No.	Ref. No.
For 0.75kW and below drives (unit size M1)	NEMA1ACLP1	**404798**
For 1.5kW at 230V, 2.2kW at 400V and below drives (unit size M2)	NEMA1ACLP2	**404799**
For 2.2kW at 230V, 3.7kW at 400V and above drives (unit size M3)	NEMA1ACLP3	**404800**
For 11kW and 15kW at 400V drives (unit size M4)	NEMA1ACLP4[2]	**404801**
For 18.5kW and 22kW at 400V drives (unit size M5)	NEMA1ACLP5[2]	**404802**

(2) Please note that these IP21 kits only include bottom cover.

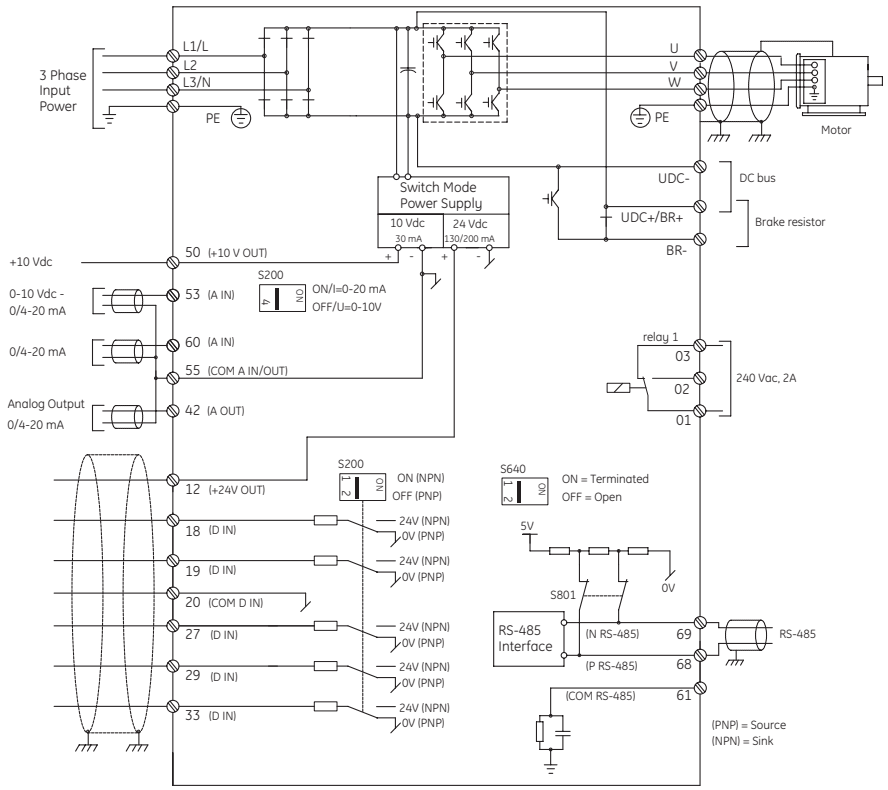
De-coupling plate kit



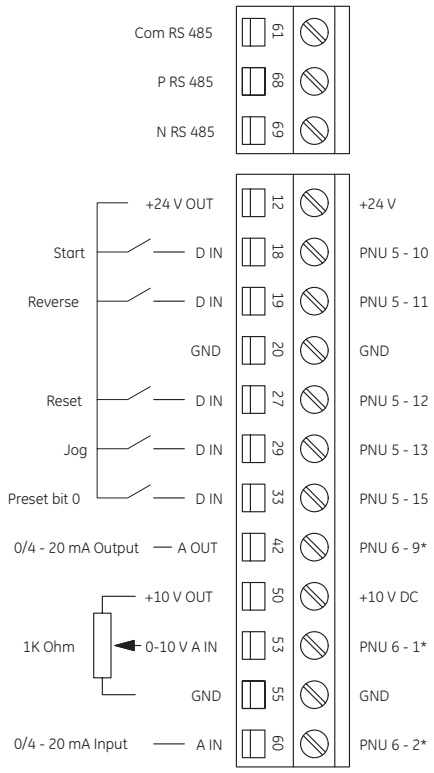
For EMC applications and strain relief for drive wiring.

Description	Cat. No.	Ref. No.
For 1.5kW at 230V, 2.2kW at 400V and below drives (unit size M1 and M2)	DEPLTACLP1	**404804**
For 2.2kW at 230V, 3.7kW at 400V and above drives (unit size M3)	DEPLTACLP2	**404805**
For 11kW at 400V and above drives (unit size M4 and M5)	DEPLTACLP3	**404803**

Basic wiring diagrams



Basic control terminal (PNP configuration and drive factory default settings)



Specifications

Environmental conditions

Enclosure	IP20 (IP21 with optional kit)
Installation location	For use at altitudes of (1000 m) or less without derating.
Ambient temperature	-10° to +50°C for above 45°C, there will be derating: please consult GE
Ambient humidity	5 to 95% RH (non-condensing)
Vibration	1.0 G
Storage temperature	-25° to 65°C

Standards

Approvals	CE, UL, cUL, and C-Tick Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes for 230V and 400V. WEEE and RoHS Compliant

Input power supply

Rated Input AC voltage	200-240 Vac, 1-phase, 50-60 Hz, +/- 10% V 200-240 Vac, 3-phase, 50-60 Hz, +/- 10% V 380-480 Vac, 3-phase, 50-60 Hz, +/- 10% V
Maximum voltage imbalance	3% of rated supply voltage
True power factor	> 0.4 nominal at rated load
Displacement power factor	> 0.98
Switching on input power supply	Maximum twice/minute
Environment according to EN60664-1	Overvoltage category III/pollution degree 2

Output

Rated output voltage	0-100 % of supply voltage
Output frequency	0-200 Hz (Adv. Vector Control Plus Mode), 0-400 Hz (Volts/Hertz Mode)
Switching on output	Unlimited
Accel/decel times	0.05-3600 seconds
Overload current rating	150 % of drive rated current for 1 minute

Control

Control method	Sinusoidal PWM Control (V/Hz with torque vector control)
Switching frequency select	2, 4, 8, 12, 16 kHz
Operation method	Keypad operation: Hand, Off, Auto Digital Input: Programmable for Start/Stop, Forward/Reverse, Jog Timer operation: Stop after predetermined time frame Link operation: RS-485 Modbus RTU
Frequency reference setting	Up or Down buttons on keypad or external reference
Analog input	Built in potentiometer 0-10 Vdc analogue input 4-20 mA analogue input
Preset speeds	8 presets via digital inputs
Link operation	Drive RS-485 or Modbus RTU
Second reference setting	Switch from speed reference 1 to reference 2 via digital input
Trim reference setting	Available for speed reference offset via potentiometer, voltage input, or current input
Acceleration/deceleration time	0.05-3600 seconds (two acceleration and deceleration rates are selectable via digital inputs. Acceleration and deceleration patterns can be selected from linear or S-curve
DC injection braking	Starting frequency: 0.0-400 Hz Braking level: 0-150 % of rated current Braking time: 0.0-60.0 seconds
Frequency limit	0-400 Hz
Jump frequency control	Two jump (or skip) frequencies via parameter set to avoid mechanical vibration
Jogging operation	Operation via On key or digital input (Fwd or Rev)
Auto-restart after power failure	Restarts the drive without stopping after instantaneous power failure
Slip compensation	Maintains motor at constant speed with load fluctuations
Energy savings	Controls output voltage to minimize motor loss during constant speed operation
Start mode function	This functionality smoothly catches a spinning motor

Logic controler (LC)

Logic controller events	Over 23 types of programmable events
Comparators	Array of 4 comparators
Timers	Array of 3 timers, adjustable from 0.0 to 3600 sec
Logic rules	Array of 4 boolean logic rules
Logic controller states	Array of 20 logic controller action states

Process controler (PID)

Feedback select	No function, analogue input 1, analogue input 2, pulse input, local bus reference
Control	Normal or inverse
Anti windup	Disabled or enabled
Start speed	0.0-200 Hz
Proportional gain	0.00-10.00
Integral gain	0.10-9999 seconds
Feed forward factor	0-400 %
On reference bandwidth	0-200 %

Indication

LEDs	Green - drive is on Yellow - indicates a warning Red - indicates an alarm
Monitor Units Available	Frequency, current, voltage, power, horsepower, % load, speed, or time

Trip codes

2	Live zero error
4	Line phase loss
7	DC overvoltage
8	DC undervoltage
9	Drive overload
10	Motor overtemperature
11	Motor thermistor overtemperature
12	Torque limit
13	Overcurrent
14	Ground fault
16	Short circuit
17	Control word timeout
25	Brake resistor short-circuited
27	Brake chopper short-circuited
28	Brake check
29	Power board overtemperature
30	Missing U phase
31	Missing V phase
32	Missing W phase
38	Internal fault
47	Control voltage fault
51	Auto tune check - wrong motor parameters
52	Auto tune low inom - motor current is too low
59	Current limit
63	Mechanical brake low
80	Drive restored to factory settings

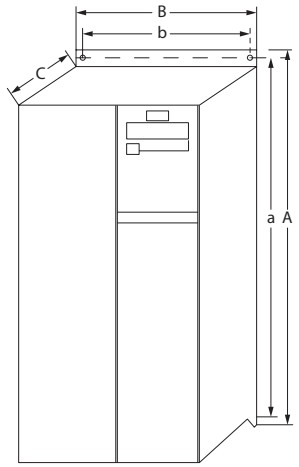
Monitoring parameters available

Power	kW
Power	HP
Motor voltage	V
Frequency	Hz
Motor current	A
Frequency	%
Motor thermal	%
DC link voltage	V
Drive current	A
Drive max current	A
Logic controller state	ON/OFF

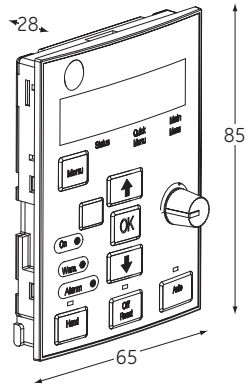
Dimensional drawings

Micro drives

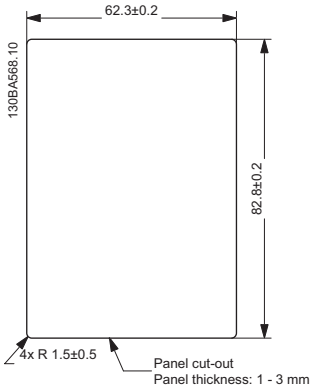
Unit size	Nominal motor power ratings (kW) 230 V 1ph	230 V 3ph	400 V 3ph	Height (mm) A	A (including decoupling plate)	a	Width (mm) B	b	Depth (mm) C	Weight kg
M1	0.18 - 0.75	0.25 - 0.75	0.37 - 0.75	150	205	140.4	70	55	148	1.1
M2	1,5	1,5	1.5 - 2.2	176	230	166.4	75	59	168	1.6
M3	2,2	2.2 - 3.7	4 - 7.5	239	294	226	90	69	194	3.0
M4	-	-	11 - 15	292	347.5	272.4	125	97	249	6.0
M5	-	-	18.5 - 22	335	387.5	315	165	140	256	9.5



Micro drive keypad



Micro drive keypad (weight 0.08 kg)

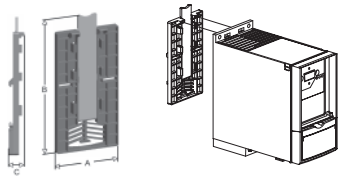


Micro drive keypad cut-out

Note: Please allow 5 cm between drives with field installed IP21 kits. Also, please consult the relevant AF-6 Series drives Operating Instructions for recommended clearance above and below each drive rating.

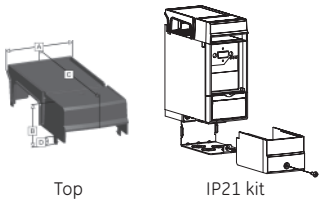
DIN-rail mounting kit for 0.75kW and below drives (unit size M1 and M2)

Cat. No.	Ref. No.	A (mm)	B (mm)	C (mm)
RMACLP1	**404806**	60	129	13.5



IP21 field installed kit – top

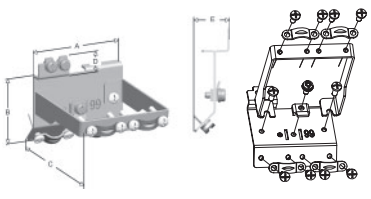
Cat. No.	Ref. No.	A (mm)	B (mm)	C (mm)	D (mm)
NEMA1ACLP1	**404798**	72	43	151	8
NEMA1ACLP2	**404799**	77	43	172	8
NEMA1ACLP3	**404800**	92	43	199	8



Top IP21 kit

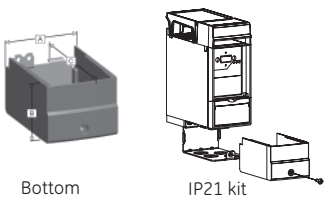
De-coupling plate kit

Cat. No.	Ref. No.	A (mm)	B (mm)	C (mm)	D (mm)	E (mm)
DEPLTACLP1	**404804**	70	52	100	14	22.6
DEPLTACLP2	**404805**	70	52	N/A	14	22.6



IP21 field installed kit – bottom

Cat. No.	Ref. No.	A (mm)	B (mm)	C (mm)	D (mm)
NEMA1ACLP1	**404798**	70	55	107	8
NEMA1ACLP2	**404799**	75	55	114	8
NEMA1ACLP3	**404800**	90	55	121	8



Bottom IP21 kit