Control Techniques

CONTROL TECHNIQUES

Commander GP
Product Data

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Product Overview & Key Features

Responding to customer driven priorities

Since its formation in 1973, Control Techniques has become a global specialist dedicated to the design, manufacture and supply of AC and DC drives, servos and drive systems, with over 1 million drives commissioned to date. This dedication to understanding and satisfying customer needs ensures that we produce a range of world class products all designed to meet the varying application requirements of industry. In response to customer driven priorities for a simple, easy to use, general purpose open loop inverter, Control Techniques have developed the Commander GP.

Commander GP

The Commander GP is an advanced AC drive for use with AC induction motors. Every unit can operate in either V/Hz, or sensorless vector mode.

Sizes

There are four physical sizes comprising 18 different models ranging from 0.75 kW to 110 kW.

Simple to use

In order to simplify initial start up a number of pre-defined application Macros are available for the following functions: Default mode, Easy mode, Motorised potentiometer, Preset Speeds, Torque control, PID control.

Technology

Many of the features of Commander GP would not be possible without the use of advanced technology. The GP drive employs State of the Art microprocessor technology which controls all drive functions. The inverter ASIC (Application Specific Integrated Circuit) synthesises an adjustable carrier frequency PWM (Pulse Width Modulation) output controlling the IGBT (Insulated Gate Bipolar Transistor) inverter section. All printed circuit boards are manufactured using surface mount technology.

General features

- Coast & Ramp to Stop modes
- Programmable security code
- Bright two line LED display
- Dynamic injection/braking
- 0.75kW to 110kW
- Well structured parameter system

Excellent performance

- Open loop vector control providing full torque at very low speeds (1Hz)
- 150% overload for 1 minute
- Accurate autotune for optimum motor shaft performance
- Very quiet motor operation with high switching frequency output up to 12kHz
- Output frequency to 1000 Hz
- Reduced torque ripple
- In-built motor over and under voltage protection
- In-built braking transistor
- Motor overload protection
- Voltage boost

Performance features

- Sensorless Vector control
- 336µs speed loop sample time
- 176µs current loop sample time
- 16 bit speed loop
- 12 bit current loop
- Fast current loop with PI control

Maintenance features

- Full internal protection & diagnostics
- Common control board through entire range
- Pluggable control terminals

Operating modes

The Commander GP can be configured to operate in the following operating modes:

Open-loop

For use with standard AC induction motors.

The Drive applies power to the motor at frequencies which are varied by the user. The motor speed is a result of the output frequency of the Drive and slip due to the mechanical load.

V/Hz mode

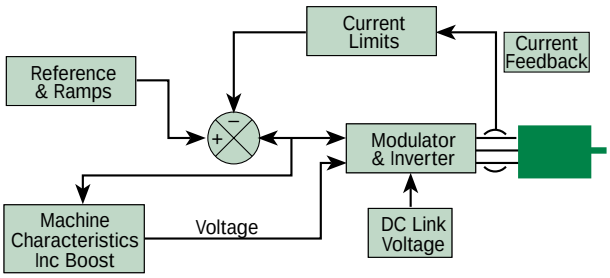
In this mode the drive can power one motor or a number of motors connected in parallel (each motor must be protected against overload; This is described in the Installation Guide).

Improved motor performance can be acheive by applying the following:

- Slip compensation
- Fixed boost

Fixed boost applies a fixed voltage boost at low frequencies.

Open Loop V/Hz Mode



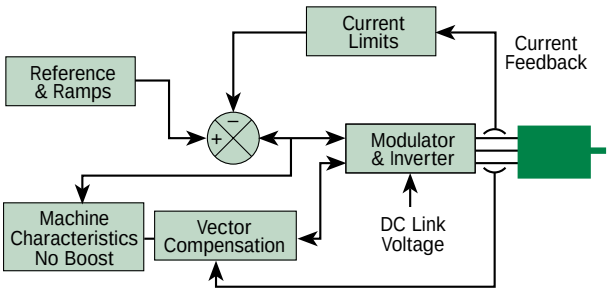
Typical examples of Applications;
Conveyors, Centrfugal Loads (Fans & Pumps), Multi-Motor Control, etc

Open Loop vector mode

This mode of operation maintains almost constant flux by dynamically adjusting the motor voltage according to the load on the motor.

Open-loop Vector Control provides full torque down to 1Hz giving an excellent speed range to cover most general purpose applications.

Open Loop Vector Mode



Typical examples of Applications;
Conveyors, Extruders, Mixers, Textile Machines, etc

Default configurations

The Drive is supplied in either of two default configurations to suit the continent in which it is sold. The configurations are distinguished as follows:

European voltage, 50Hz supply

USA voltage, 60Hz supply

The drive is dispatched from the factory in the appropriate default configuration for the continent in which it is to be sold. The default configuration is macro 0 and also defines the following functions:

Europe

- Ability to select positive logic for the digital I/O (Negative logic is default).
- Ability to adjust the current loop PI Gains.

USA

- Ability to select digital control by two or three wires.
- Frequency demand indication.

Introduction to Application Macros

Commander GP operation can be simplified by using pre-configured application macros. These macros are held in the internal memory of the drive and are user selectable.

Macro summary

Macro	Function
0	Default mode
1	Easy mode
2	Motorised potentiometer
3	Preset speeds
4	Torque control
5	PID macro

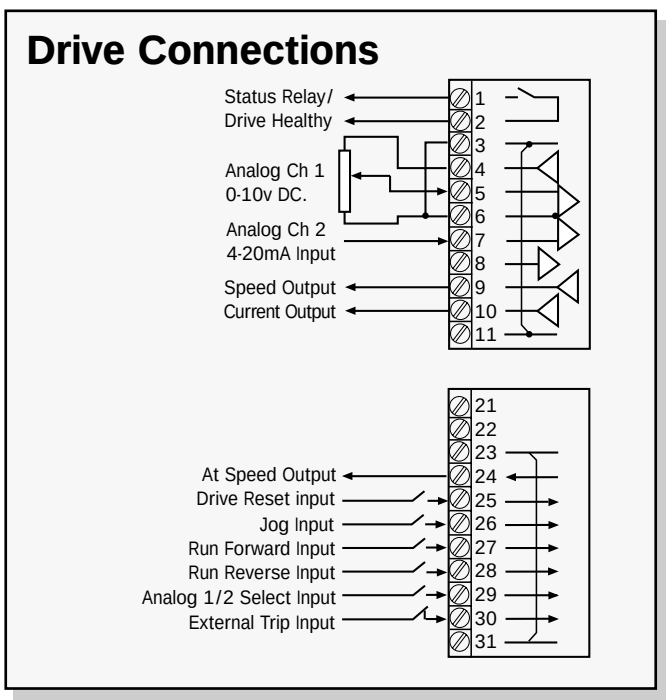
When a Macro is not enabled, the drive operates in the default configuration

Macro 0 – Default mode

Macro 0 places the Drive in a default configuration for general - purpose use.
Refer to section 'Menu 0 Parameters' for the list of default settings.

Macro 1 – Easy mode

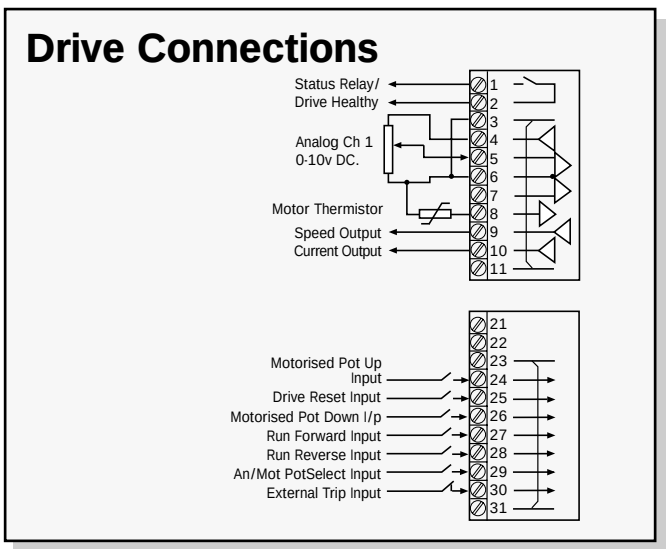
Easy mode defines the most commonly used features with only 10 parameters. These parameters are numbered 0.01 to 0.10

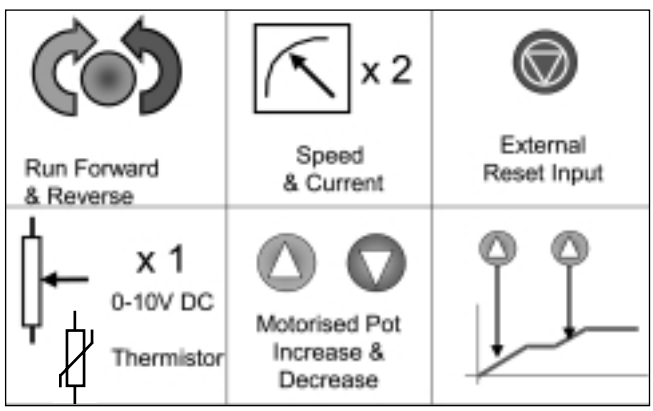


Parameter	Description
0.01	Minimum Speed
0.02	Maximum Speed
0.03	Acceleration time
0.04	Deceleration time
0.05	Reference select
0.06	Current limit
0.07	Voltage mode
0.08	Voltage boost
0.09	Dynamic V/F
0.10	Motor Speed (rpm)

Macro 2 – Motorised potentiometer

With this function it is possible to emulate a motorised potentiometer within the Commander GP by simply supplying two logic input signals to increase or decrease the "potentiometer". The output of the "potentiometer" may be routed to control any of the drive's non-bit parameters such as speed, torque or current limit. The function may be configured to return to the previous set speed or start at zero after each power up.



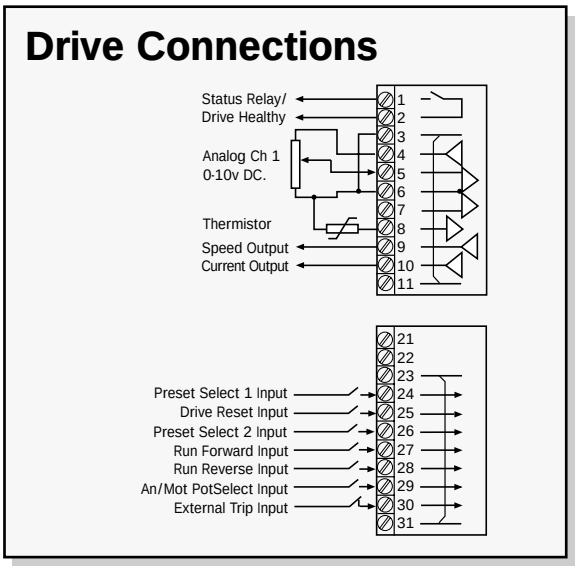


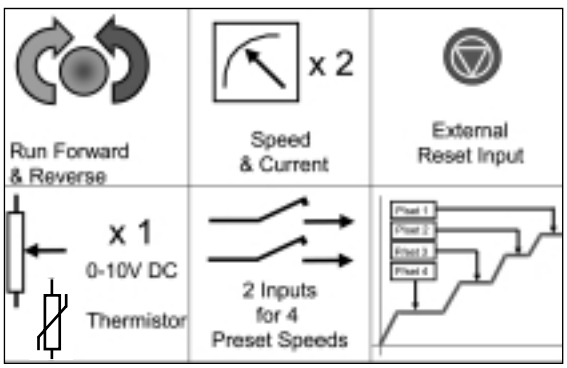
Introduction to Application Macros

Macro 3 – Preset speeds

By using this macro up to four preset frequencies / speeds can be used. Preset values must be programmed into individual parameters. Frequency / speed selection is done by activating terminal 29 and putting a binary combination on terminals 24 and 26.

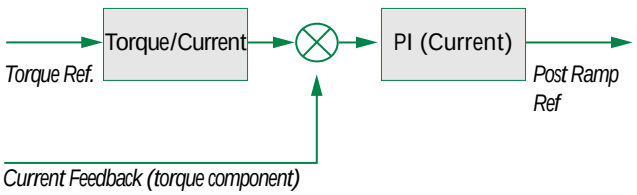
Terminal 24	Terminal 26	Speed
Open	Open	As set in Pr 0.25
Open	Closed	As set in Pr 0.26
Closed	Open	As set in Pr 0.27
Closed	Closed	As set in Pr 0.28

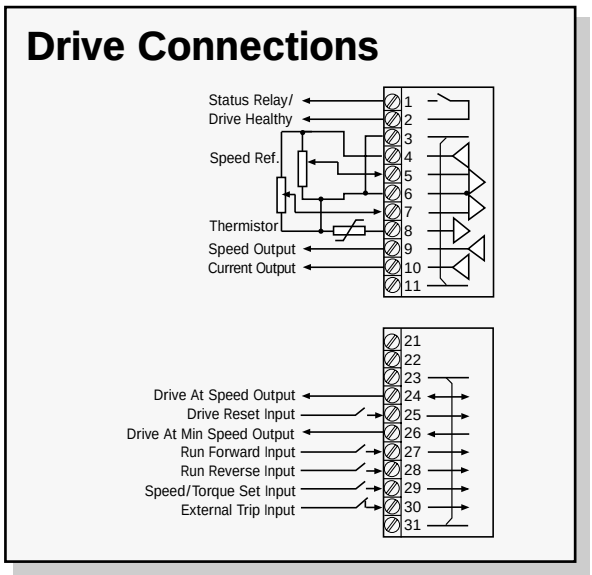


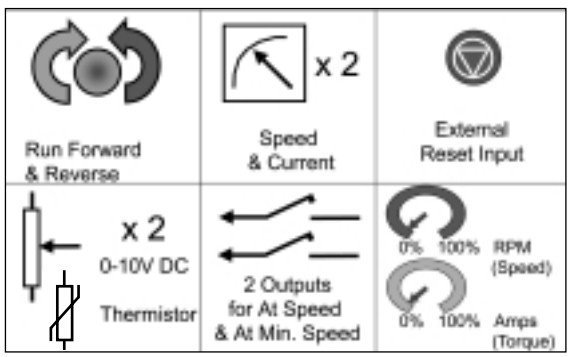


Macro 4 – Torque control

When this macro is selected a drive can be operated in Speed or Torque control by using terminal 29.
If in Speed control mode, speed is maintained independent of load within the limits of the drive. In Torque control mode the drive will attempt to reach the speed set point but only with the torque available as defined by the torque reference signal.



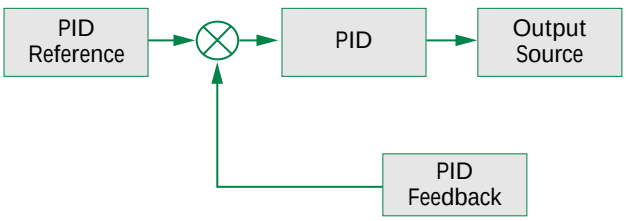


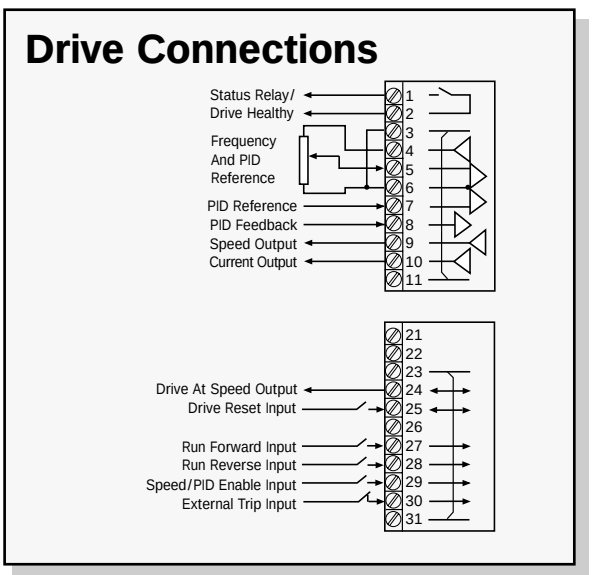


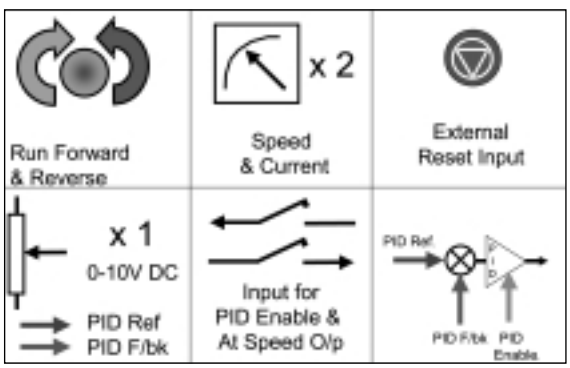
Introduction to Application Macros

Macro 5 – PID control

This macro configures the drive to control a motor with reference to a PID control signal. In PID control, the error resulting from differences between the PID feedback and PID reference is passed through a limiter, a scaling stage and finally the error is added to the frequency / speed signal.







Additional Configurable Functions

Analogue Input modes

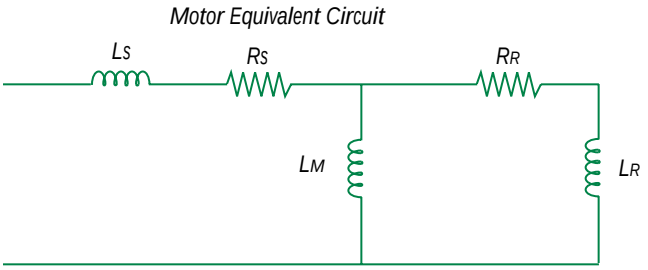
There are multiple analogue signal input possibilities. All analogue inputs can be voltage or current type. If a current signal configuration is chosen, there are several choices for signal type and several choices for how the drive handles a signal loss.

ANALOGUE MODE	SIGNAL TYPE	ACTION UPON SIGNAL LOSS
0	Voltage	N/A
1	0-20mA	Signal Treated as Zero
2	20-0mA	Signal Treated as Zero
3	4-20mA	Drive Trips
4	20-4mA	Drive Trips
5	4-20mA	Drive Runs At Min (or Low) Speed
6	20-4mA	Drive Runs At Min (or Low) Speed
7	4-20mA	Drive Runs At Previous Speed
8	20-4mA	Drive Runs At Previous Speed
9	Thermistor A.I. 3 Only	Drive Trips if S/C Detected
10	Thermistor A.I. 3 Only	No Short Circuit Detection

Autotune

The Commander GP is capable of measuring the motor's stator resistance (Rs) and magnetising inductance (Lm). These values allow the drive to establish a mathematical model of the motor's electrical circuit for use in open loop vector control. The magnetising inductance is measured upon command through a bit parameter, and is only performed when instructed to. The Commander GP may be configured to measure the stator resistance automatically every time the drive is enabled or powered-up. Automatic measurement can also be disabled.

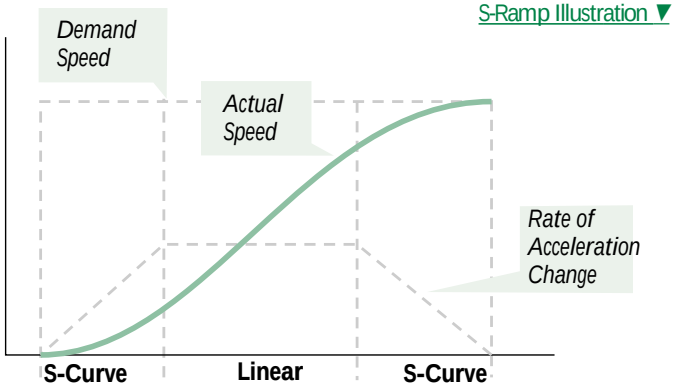
Autotune Illustration ▼



S-Ramp

The acceleration and deceleration ramps can be configured as S-ramps. This function provides smoother starting and stopping for sensitive loads. The user can adjust the maximum rate of change of acceleration (time squared), which in effect defines the curvature of the S-ramp.

S-Ramp Illustration ▼



Preset Speeds

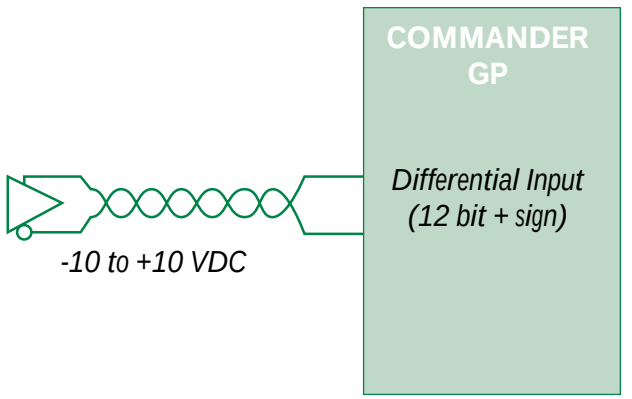
The Commander GP has four preset speeds which can be selected by terminal inputs.

LOGIC INPUT A	LOGIC INPUT B	SELECTED PRESET
0	0	1
0	1	2
1	0	3
1	1	4

High resolution differential input

The Commander GP is equipped with one differential analogue input which has a >12 bit (+ sign) resolution. This input can receive a +10V to -10V bipolar input or it can be configured as a single ended unipolar input.

High Resolution Differential Input Illustration ▼



Default Parameters (macro 0)

Listed below are the Default values for Macro 0 in Commander GP along with the relevant parameters which are for monitoring only. Parameters 0.00 to 0.10 and 0.31 to 0.50 apply to all Macro Configurations. For parameters specific to each Macro configuration refer to the Commander GP User Guide.

Pr	Function	Default Value
0.00	Macro Selection, Configuration, Save	0Hz
0.01	Min Frequency	0Hz
0.02	Max Frequency	50(60 USA) Hz
0.03	Acceleration Rate	5 S/100 Hz
0.04	Deceleration Rate	10 S/100 Hz
0.05	Reference Selector	0 (4 USA) Hz
0.06	Current Limit	150%
0.07	Voltage Mode Selector	Ur.1
0.08	Boost Voltage	3%
0.09	Dynamic V/F Select	0-Bit Par.
0.10	Estimated Motor Speed	(M) RPM
0.11	Pre-Ramp Reference	(M) Hz
0.12	Post Ramp Reference	(M) Hz
0.13	Motor-Active Current	(M) A
0.14	Jog Reference	1.5 Hz
0.15	Ramp Mode Selector	Stnd.Ct
0.16	Stop Mode Selector	rP
0.17	Torque Mode Selector	0
0.18	S Ramp Enable	0-Bit Par.
0.19	S Ramp dA/dt Limit	3.1 S^2 /100 Hz
0.20	Skip Frequency 1	0Hz
0.21	Skip Band 1	0.5Hz
0.22	Skip Frequency 2	0Hz
0.23	Skip Band 2	0.5Hz
0.24	Analogue Input 1 Mode Selector	Volt
0.25	Analogue Input 2 Mode Selector	Volt
0.26	Not Used	
0.27	EUR>Negative Logic Select	0-Bit Par.
	USA>Sequencing Mode Selector	4
0.28	EUR>Current Loop Proportional Gain	20
	USA>Frequency Demand	
0.29	EUR>Current Loop Integral Gain	40
	USA>Terminal 29	1.41
	Destination Parameter	
0.30	FWD/Rev Key Enable	0-Bit Par.
0.31	Macro Number	(M)
0.32	Serial Comms Mode	ANSI 4
0.33	Drive Rated Current (FLC)	(M) A
0.34	User Security Code	149

Pr	Function	Default Value
0.35	Keypad Reference	(M) Hz
0.36	Serial Comms Baud Rate	4800 Baud
0.37	Serial Comms Address	1.1
0.38	Initial Parameter Displayed	0.10
0.39	Synchronised to a Spinning Motor	0-Bit Par.
0.40	Autotune	0-Bit Par.
0.41	PWM Switching Frequency Selector	3 kHz
0.42	Motor - Number of Poles	4 Poles
0.43	Motor - Power Factor	0.92
0.44	Motor - Rated Voltage	400(460 USA)
0.45	Motor - Rated Speed	0 RPM
0.46	Motor - Rated Current	FLC A
0.47	Motor - Rated Frequency	50(60 USA)
0.48	Drive Software Build Number	(M)
0.49	Security Status	1
0.50	Drive Software Version	(M)

*(M): Monitoring Only

Options

Drive flexibility

UD50 Additional I/O

- Low cost external control
- 2 Status relays
  Relay 2: At or below min speed
  Relay 3: At speed
- 2 Digital inputs
  F10: Offset select frequency
  F11: Torque mode select
- 3 Digital outputs
  F7: Drive running
  F8: Motor overload alarm
  F9: Heatsink overload alarm
- 2 Analogue inputs
  A in 4: Frequency offset
  A in 5: Torque reference
- 1 Analogue output
  A out 3: Total current

UD50

Terminal	*Function*
40	Relay for Minimum Frequency
41	Relay for At Frequency Reference
42	Relay Common
43	0V Common (Digital)
44	Digital Input for Frequency Reference Offset Select
45	Digital Input for Torque Offset Reference Select
46	Not Used
47	0V Common (Digital)
48	Digital Output for 'Drive Running' indication
49	Digital Output for 'Motor Current Overload Alarm Indicator'
50	Digital Output for Drive Heatsink Temperature Alarm Indicator
51	Analogue Input for Frequency Offset
52	Analogue Input for Torque Offset
53	0V Common (Analogue)
54	Analogue Output to Indicate Total Current
55	OV Common (Analogue)

Drive set-up

UD55 Cloning Module

- Easy set-up of multiple drives
- Simplifies the transfer of parameters between Drives
- Stores up to 8 full parameter sets

Drive communications

UD71 Serial Communications Module

- RS232 or RS485 communications for industrial process control

Specification

AC supply requirements

380V to 480V ±10% 3-phase
Maximum supply imbalance: 2% negative phase sequence (equivalent to 3% voltage imbalance between phases)
48 to 62 Hz

Motor requirements

Number of phases: 3
Voltage: 380V ~ 480V ±10%

Temperature, humidity and cooling method

Ambient temperature range:
–10°C to 50°C (14°F to 122°F). Output current de-rating may apply at high ambient temperatures.
Cooling method: Natural convection
Maximum humidity: 95% non-condensing at 40°C (104°F)
Storage temperature range: –40°C to 50°C (–40°F to 122°F)
Maximum storage time: 12 months

Altitude

Altitude range: 0 to 4000m (13000 ft), subject to the following conditions: 1000m to 4000m (330 feet to 13000 ft) above sea level: de-rate the maximum output current from the specified figure by 1% per 100m (330 ft)

Vibration

Maximum vibration:
≤0.5g as specified in IEC 68–2–61; 1982

Ingress protection

Gland plate(s) not fitted: IP00
Gland plate(s) fitted; cable glands not fitted: IP20
Cable-glands fitted; glands fitted: IP40, NEMA 1

Starts per hour

By electronic control: unlimited
By interrupting the AC supply:
model sizes 1 and 2: ≤ 20
model sizes 3 and 4: ≤ 10

Accuracy and resolution

The following data applies to the Drive only; it does not include the performance or the source of the control signals.
Output-frequency accuracy:≤ ±0.1%
Output-frequency resolution: ≤ ± 0.001 Hz

Frequencies and speed

PWM switching frequency:
3kHz nominal (selectable up to 12kHz)
Maximum output frequency: 1000Hz
Speed regulation: 1 ~ 2%
Speed control range: 50:1

Specification

Power and Current ratings

40°C (104°F) ambient	Nominal motor power (4 pole)		Maximum permissible continuous output current					Nominal AC supply current
Model	@380V	@460V	3kHz	4.5kHz	6kHz	9kHz	12kHz	
GPD 1401	0.75 kW	1.0 HP	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A	3.1 A
GPD 1402	1.1 kW	1.5 HP	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A	3.2 A
GPD 1403	1.5 kW	2.0 HP	3.8 A	3.8 A	3.8 A	3.8 A	3.8 A	5.5 A
GPD 1404	2.2 kW	3.0 HP	5.6 A	5.6 A	5.6 A	5.6 A	4.5 A	8.4 A
GPD 1405	4.0 kW	5.0 HP	9.5 A	9.5 A	8.5 A	7.0 A	5.5 A	9.5 A
GPD 2401	5.5 kW	7.5 HP	12.0 A	12.0 A	12.0 A	12.0 A	11.7 A	13.7 A
GPD 2402	7.5 kW	10.0 HP	16.0 A	16.0 A	16.0 A	14.2 A	11.7 A	16.3 A
GPD 2403	11.0 kW	15.0 HP	25.0 A	21.7 A	18.2 A	14.2 A	11.7 A	24.3 A
GPD 3401	15.0 kW	25.0 HP	34.0 A	34.0 A	34.0 A	28.0 A	23.0 A	34.0 A
GPD 3402	18.5 kW	30.0 HP	40.0 A	40.0 A	37.0 A	28.0 A	23.0 A	39.0 A
GPD 3403	22.0 kW	30.0 HP	46.0 A	46.0 A	40.0 A	32.0 A	26.6 A	46.0 A
GPD 3404	30.0 kW	40.0 HP	60.0 A	47.0 A	40.0 A	32.0 A	26.7 A	59.0 A
GPD 3405	37.0 kW	50.0 HP	70.0 A	56.0 A	46.0 A	35.0 A	28.0 A	74.0 A
GPD 4401	45.0 kW	75.0 HP	96.0 A	96.0 A	88.0 A	70.0 A	–	96.0 A
GPD 4402	55.0 kW	100.0 HP	124.0 A	104.0 A	88.0 A	70.0 A	–	120.0 A
GPD 4403	75.0 kW	125.0 HP	156.0 A	124.0 A	105.0 A	80.0 A	–	151.0 A
GPD 4404	90.0 kW	150.0 HP	180.0 A	175.0 A	145.0 A	110.0 A	–	173.0 A
GPD 4405	110.0 kW	150.0 HP	202.0 A	175.0 A	145.0A	110.0 A	–	190.0 A

50°C (122°F) ambient	Nominal motor power (4 pole)		Maximum permissible continuous output current				
Model	@380V	@460V	3kHz	4.5kHz	6kHz	9kHz	12kHz
GPD 1401	0.75KW	1.0HP	2.1 A	2.1 A	2.1 A	2.1 A	2.1 A
GPD 1402	1.1KW	1.5HP	2.8 A	2.8 A	2.8 A	2.8 A	2.8 A
GPD 1403	1.5KW	2.0HP	3.8 A	3.8 A	3.8 A	3.8 A	3.3 A
GPD 1404	2.2KW	3.0HP	5.6 A	5.6 A	5.1 A	4.0 A	3.3 A
GPD 1405	4.0KW	5.0HP	6.9 A	5.9 A	5.1 A	4.0 A	3.3 A
GPD 2401	5.5KW	7.5HP	12.0 A	12.0 A	12.0 A	11.6 A	9.7 A
GPD 2402	7.5KW	10.0HP	16.0 A	16.0 A	14.7 A	11.6 A	9.7 A
GPD 2403	11.0KW	15.0HP	20.0 A	17.3 A	14.7 A	11.6 A	9.7 A
GPD 3401	15.0KW	25.0HP	34.0 A	34.0 A	28.0 A	21.0 A	17.9 A
GPD 3402	18.5KW	30.0HP	40.0 A	34.0 A	28.0 A	21.0 A	17.9 A
GPD 3403	22.0KW	30.0HP	44.0 A	36.0 A	31.0 A	24.0 A	20.6 A
GPD 3404	30.0KW	40.0HP	44.0 A	36.0 A	31.0 A	24.0 A	20.9 A
GPD 3405	37.0KW	50.0HP	50.0 A	41.0 A	34.0 A	26.0 A	23.0 A
GPD 4401	45.0KW	75.0HP	95.0 A	85.0 A	75.0 A	60.0 A	–
GPD 4402	55.0KW	100.0HP	105.0 A	85.0 A	75.0 A	60.0 A	–
GPD 4403	75.0KW	125.0HP	135.0 A	105.0 A	85.0 A	65.0 A	–
GPD 4404	90.0KW	150.0HP	180.0 A	150.0 A	125.0 A	95.0 A	–
GPD 4405	110.0KW	150.0HP	190.0 A	150.0 A	125.0 A	95.0 A	–

Dissipation

Model	Nominal rating		Maximum total power dissipation				
	@380V	@460V	3kHz	4.5kHz	6kHz	9kHz	12kHz
GPD 1401	0.75kW	1.0HP	80 W	80 W	90 W	90 W	90 W
GPD 1402	1.1kW	1.5HP	90 W	90 W	100 W	100 W	110 W
GPD 1403	1.5kW	2.0HP	100 W	110 W	110 W	120 W	130 W
GPD 1404	2.2kW	3.0HP	130 W	130 W	140 W	150 W	150 W
GPD 1405	4.0kW	5.0HP	180 W	190 W	190 W	190 W	170 W
GPD 2401	5.5kW	7.5HP	210 W	230 W	250 W	280 W	310 W
GPD 2402	7.5kW	10HP	270 W	290 W	310 W	320 W	310 W
GPD 2403	11.0kW	15HP	400 W	380 W	360 W	330 W	310 W
GPD 3401	15.0kW	25HP	570 W	620 W	670 W	660 W	630 W
GPD 3402	18.5kW	30HP	660 W	720 W	730 W	660 W	630 W
GPD 3403	22.0kW	30HP	730 W	800 W	770 W	730 W	700 W
GPD 3404	30.0kW	40HP	950 W	830 W	790 W	740 W	710 W
GPD 3405	37.0kW	50HP	1090 W	990 W	920 W	850 W	800 W
GPD 4401	45kW	75HP	1460 W	1610 W	1630 W	1530 W	–
GPD 4402	55kW	100HP	1910 W	1780 W	1670 W	1560 W	–
GPD 4403	75kW	125HP	2370 W	2130 W	2030 W	1860 W	–
GPD 4404	90kW	150HP	2640 W	2890 W	2700 W	2470 W	–
GPD 4405	110kW	150HP	2970 W	2910 W	2720 W	2490 W	–

NOTE: The default switching frequency is 3kHz

Overall dimensions

H Height including mounting brackets

W Width

D Projection forward of panel when surface mounted

F Projection forward of panel when through-panel mounted

R Projection rear of panel when through-panel mounted

Dimension	Model size				
	1	2	3	4	5
H	368mm 14 1/4 in	368mm 14 1/4 in	364mm 14 5/16 in	743mm 29 1/4 in	1319mm 51 15/16 in
W	95mm 3 3/4 in	190mm 7 1/2 in	375mm 14 3/4 in	500mm 19 11/16in	355mm 14 in
D	200mm 7 7/8 in	200 mm 7 7/8 in	260mm 10 1/4 in	260mm 10 1/4 in	484mm 19 in
F	120mm 4 1/4 in	120mm 4 1/4 in	120mm 4 1/4 in	120mm 4 1/4 in	340mm 13 1/6 in
R	80mm 3 1/8 in	80mm 3 1/8 in	140mm 5 1/2 in	140mm 5 1/2 in	144mm 5 11/16 in

Specification

Weights

Model size	kg	lb
1	4	8.8
2	8	17
3	22	49
4	70	154

Electromagnetic compatibility (EMC) conducted emission

This is a summary of the EMC performance of the Drive. For full details, refer to the Unidrive EMC Data Sheet which can be obtained from a Drive Centre or distributor listed on the back cover.

Immunity

Compliance with immunity standards does not depend on installation details. The Drive meets EN50082–2 (generic immunity standard for the industrial environment) and the following specifications from the IEC1000–4 group (derived from IEC801):

Part 2, Electrostatic discharge: Level 3

Part 3, Radio frequency field: Level 3

Part 4, Transient burst: Level 4 at the control terminals

Part 4 Transient burst:
Level 4 at the control terminals
Level 3 at the power terminals

Part 5, Surge (at the AC supply terminals):
Level 4 line-to-ground
Level 3 line-to-line (as specified by EN50082–2 informative annex)

Part 6, Conducted radio frequency: Level 3

Emission

Compliance with emission standards depends on rigorous adherence to the installation guidelines, including the use of the specified RFI filter in the AC supply circuit. Compliance also depends on the PWM switching frequency used in the output stage of the Drive, and the length of the motor cable. For full details, refer to the Unidrive EMC Data Sheet which can be obtained from a Drive Centre or distributor listed at the end of this Product Data Guide.

RFI Filter data

Model	RFI Filter			
	Size	Part Number	Maximum power dissipation (W)	IP rating
GPD 1401	A	4200-0010	25	IP20
GPD 1402	A	4200-0010	25	IP20
GPD 1403	A	4200-0010	25	IP20
GPD 1404	A	4200-0010	25	IP20
GPD 1405	A	4200-0010	25	IP20
GPD 2401	B	4200-0027	40	IP20
GPD 2402	B	4200-0027	40	IP20
GPD 2403	B	4200-0027	40	IP20
GPD 3401	C	4200-1051	60	IP00
GPD 3402	C	4200-1051	60	IP00
GPD 3403	C	4200-1051	60	IP00
GPD 3404	C	4200-1071	100	IP00
GPD 3405	D	4200-1071	100	IP00
GPD 4401	E	4200-1111	120	IP00
GPD 4402	F	4200-1171	150	IP00
GPD 4403	F	4200-1171	150	IP00
GPD 4404	F	4200-1171	150	IP00
GPD 4405	H	4200-1220	200	IP00

NOTE: Back Plate mounted RFI filters

When the motor cable is to exceed 50m (165 feet), use RFI filter size 8 (4200-0027).

Footprint filters are available for drive sizes 1 and 2. Refer to your local drive centre for more details.

Dynamic Braking

Resistor connections

The external braking resistor should be connected to the Unidrive terminals labelled (+) and (-) on the terminal strip on Unidrive size 1 & 2 or the stud connections on Unidrive size 3 & 4. The resistor *must* be thermally protected in the unlikely event that the braking transistor fails. This thermal device must either disconnect the input AC power to the Inverter or disconnect the resistor from the circuit. Please contact the a Drive Centre for additional application information.

Custom resistor values

The resistor ohmic value is based on the torque required to stop the motor (and connected load) in the time dictated by the application. The first equation to be solved is the torque required knowing the required stop time.

$$T = \frac{J \times N}{t_d \times 307} \text{ (Ft - Lb) or } T = \frac{2\pi J \times N}{t_d \times 60} \text{ (Nm)}$$

Where:

J = *Total Inertia (Lb-Ft² or Kgm²)*
N = *Motor Max. Speed (RPM)*
t_d = *Decel Time (Sec.)*
T = *Torque (Ft-Lb or Nm)*

The torque required must be equal or less than 1.5 x motor/drive capability.

$$HP_{(brake)} = \frac{T \times N}{5250} \text{ or } P_{(kW)} = \frac{T \times N}{30}$$

The ohmic value of the resistor can now be calculated using the following formula:

$$R = \frac{(V_b)^2}{HP_{(brake)} \times 746} \text{ or } R = \frac{(V_b)^2}{P_{(kW)}}$$

Where:

V_b = *Bus voltage level when braking*
= *750 VDC*

Minimum values

The calculated minimum ohmic value is limited by the braking transistor supplied in the Commander GP being used. The following is a list of the minimum values.

Minimum resistance values and peak power rating for the braking resistor at 40°C (10.4°F)

Model	Minimum resistance	Instantaneous power rating
GPD 1401~GPD 1405	40Ω	15kW
GPD 2401	40Ω	15kW
GPD 2402~GPD 2403	30Ω	20kW
GPD 3401~GPD 3405	10Ω	60kW
GPD 4401~GPD 4405	5Ω	120kW

The minimum resistance allows the braking resistor to dissipate up to approximately 150% of the power rating of the Drive for up to 60 seconds

Average power dissipation

The average power dissipated in the resistor for intermittent operation is then simply the number of watts dissipated per stop times the duty cycle (D).

Where:

$$D = \frac{t_d}{t_d + t_{off}}$$

In order to use this formula for average power dissipation, the brake resistor must be off long enough for the temperature of the resistor to return to ambient temperature between braking cycles. Also, the maximum on time (or decel time) should not exceed the peak capabilities of the power resistor. Typically, a power resistor has the capability of dissipating 10 times rated wattage for 5 to 10 seconds.

Peak power rating

The peak power handling ability of the resistor must meet or exceed the following:

$$PPK = (Vb)^2/R$$

Specification

Control Inputs and Outputs for Macro 0 General Purpose mode

TERMINAL	I/O TYPE & FUNCTION	RATING
1	Status Relay Contact Dry contact output pole 1/2 *Drive Healthy*	Normally open contacts 5A, 240 VAC resistive
2	Status Relay Contact Dry contact output pole 2/2	
3	Circuit Common 0 VDC Analogue reference	
4	+10 VDC supply for external analogue signal device	± 1% Voltage tolerance 10 mA output current (current limit protected)
5	Analogue Input 1 (non-inverting Differential input) *Analogue Frequency Reference 1*	Bipolar ±10 VDC, 0-20mA, 20-0mA, 4-20mA, 20-4mA 100kΩ input impedance 12-bit plus sign resolution, ≤ 2mS sampling
6	Analogue Input 1 (inverting input) Programmable Differential Analogue Input	
7	Analogue Input 2 Single-ended Analogue Input *Analogue Frequency Reference 2*	Bipolar ± 10V DC, 0-20mA, 20-0mA, 4-20mA, 20-4mA 100kΩ input impedance 10-bit plus sign resolution ≤ 2mS sampling period
8	Motor Thermistor Input Single-ended Analogue Input	
9	Analogue Output 1 Single-ended Analogue Voltage Bipolar *Frequency Output*	±10 VDC @ 10mA (max) 1kΩ minimum load resistance 10-bit plus sign resolution, 8mS update period Short circuit protected
10	Analogue Output 2 Single-ended Analogue Voltage Bipolar *Torque Output*	
11	0V Common (Analogue) 0 VDC Analogue Common	
21	OV Common	
22	+24 VDC User Supply	Voltage Tolerance: ±10%, Nominal Output: 200 mA Overload Output: 240 mA including Terminal 24 Protection: current foldback above 240mA
23	0V Common (Digital) 0 VDC Digital reference	
24	Digital Output 1 *At speed*	Negative logic Push-pull output, 0 - +24 VDC 200mA max output, overload output 240mA including terminal 22
25	Digital Input 1 *Drive reset* (momentary contact)	Negative or Positive logic Voltage Range 0 - +24 VDC Negative logic levels: Inactive state > +15V Active state < +5V Positive logic levels: Inactive state < +5V Active state > +15V
26	Digital Input 2 *Jog* (select)	
27	Digital Input 3 *Run Forward*	
28	Digital Input 4 *Run Reverse*	
29	Digital Input 5 *Local (default)/Remote*	
30	Digital Input 6 *External Trip*	
31	0V Common (Digital) 0 VDC digital reference	

NOTE: There are no terminals numbered 12, 13...., 20 on the Commander GP.

Drive reset is a momentary close contact (not retained). All other Digital inputs are in wire proof mode (contact must be retained).

Protection

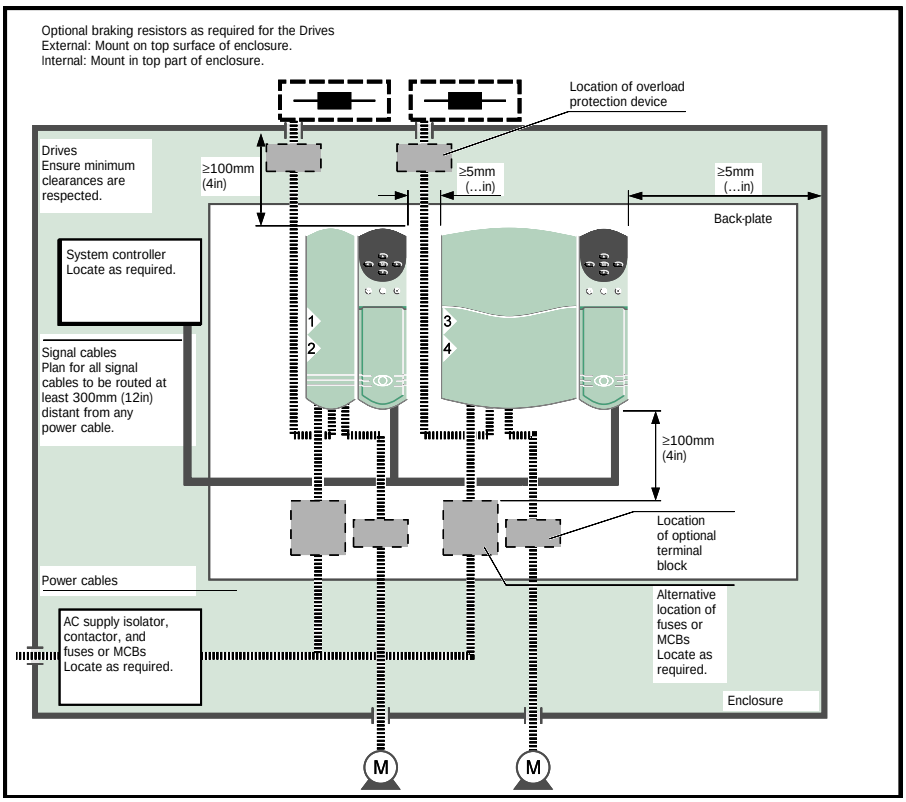
DC Bus Undervoltage Trip	350 VDC
DC Bus Overvoltage Trip	830 VDC
MOV Voltage Transient Protection (Line to Line & Line to Ground)	160 Joules, 1400 Volts Clamping
Drive Overload Trip	Current overload value is exceeded. Programmable to allow up to 150% of Drive Current for one minute.
Instantaneous Overcurrent Trip	215% of Drive rated current
Phase Loss Trip	DC bus ripple threshold exceeded
Overtemperature Trip	Drive heatsink temperature exceeds 95°C
Short Circuit Trip	Protects against output phase fault
Ground Fault Trip	Protects against output phase to ground fault
Motor Thermal Trip	Electronically protects the motor from overheating due to Loading conditions

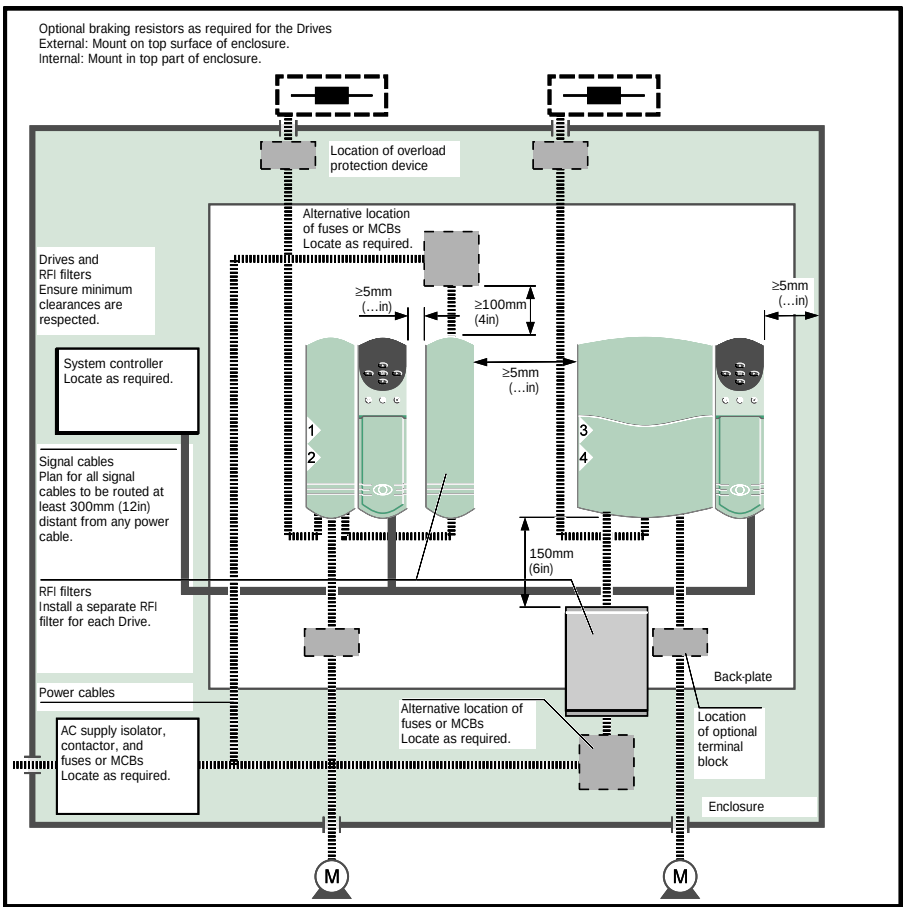
Cable & Fuse recommendations

FUSES and CABLES					
CATALOGUE NUMBER	AC Supply Cables		Motor Cables		Fuse ① Rating
	mm2	AWG	mm2	AWG	Amps
GPD1401	1.5	16	1.5	16	6
GPD1402	2.5	14	2.5	14	10
GPD1403	2.5	14	2.5	14	10
GPD1404	2.5	14	2.5	14	10
GPD1405	2.5	14	2.5	14	16
GPD2401	2.5	14	2.5	14	16
GPD2402	4.0	10	4.0	10	35
GPD2403	4.0	10	4.0	10	20
GPD3401	6	8	6	8	40
GPD3402	10	6	10	6	50
GPD3403	10	6	10	6	60
GPD3404	16	4	16	4	70
GPD3405	25	4	25	4	80
GPD4401	35	2	35	2	100
GPD4402	35	2	35	2	125
GPD4403	50	2/0	50	2/0	160
GPD4404	70	2/0	70	2/0	200
GPD4405	95	3/0	95	3/0	250

Pre-Installation

Panel guidelines





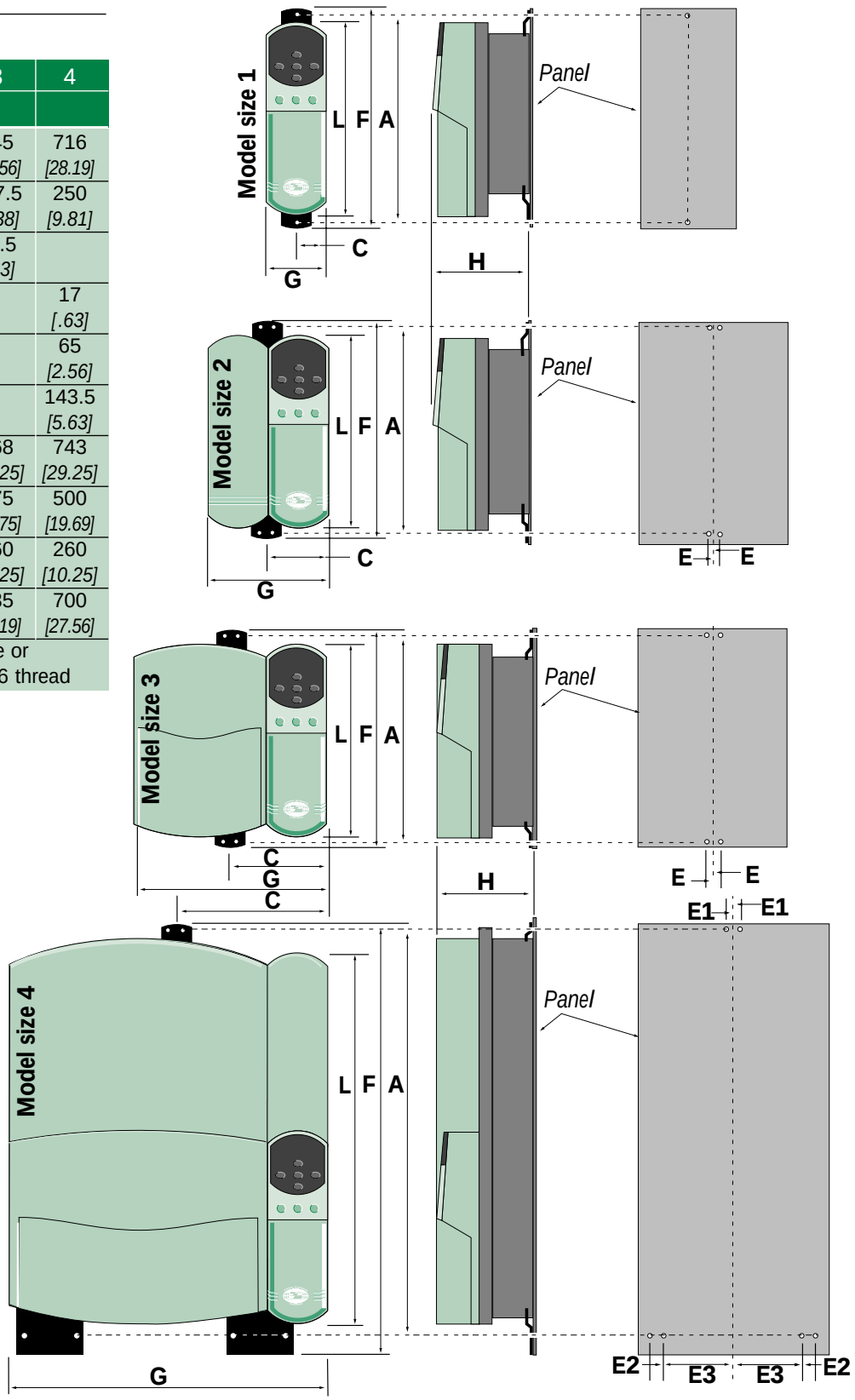
① Consult Drive Centre for Filter details.

Drive mounting dimensions

Surface mounting

Model Size	1	2	3	4
Dimension ①				
A	345 *[13.56]*	345 *[13.56]*	345 *[13.56]*	716 *[28.19]*
C	47.5 *[1.88]*	95 *[3.75]*	187.5 *[7.38]*	250 *[9.81]*
E		16.5 *[.63]*	16.5 *[.63]*	
E1				17 *[.63]*
E2				65 *[2.56]*
E3				143.5 *[5.63]*
F	368 *[14.25]*	368 *[14.25]*	368 *[14.25]*	743 *[29.25]*
G	95 *[3.75]*	190 *[7.50]*	375 *[14.75]*	500 *[19.69]*
H	200 *[7.88]*	200 *[7.88]*	260 *[10.25]*	260 *[10.25]*
L	335 *[13.19]*	335 *[13.19]*	335 *[13.19]*	700 *[27.56]*
Mounting hole diam.	6.5 *[.16]* clearance or $^1/_4$ UNF M6 thread			

① Dimensions in mm and [inches].



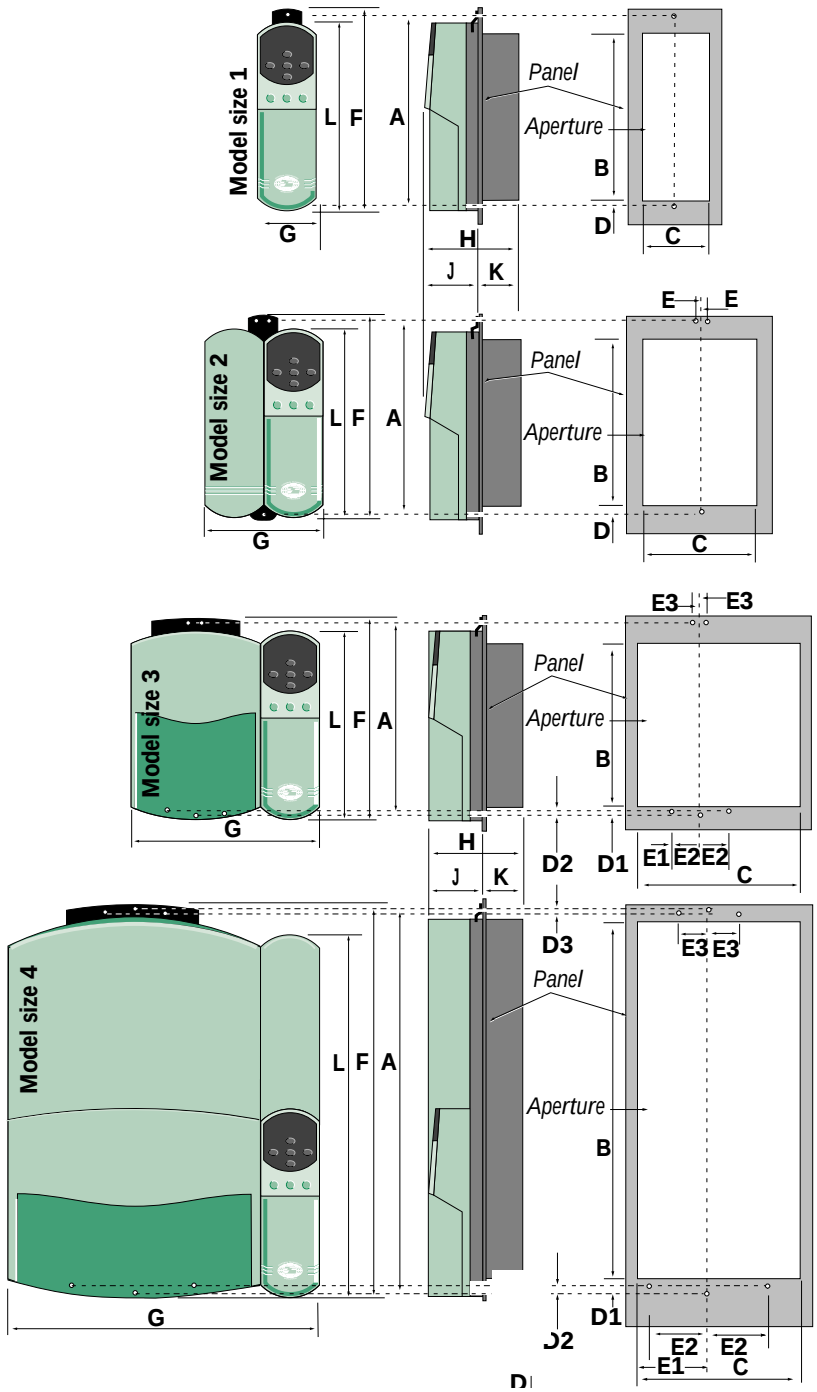
Pre-Installation

Drive mounting dimensions

Through-panel mounting

Model Size	1	2	3	4
Dimension ①				
A	345 *[13.56]*	345 *[13.56]*	345 *[13.56]*	717.5 *[28.25]*
B	295 *[11.63]*	295 *[11.63]*	287 *[11.31]*	650 *[25.56]*
C	86.5 *[3.38]*	182 *[7.19]*	358 *[14.13]*	482 *[19]*
D	*13 (0.5)*	*13 (0.5)*		
D1			16 *[.63]*	17 *[.63]*
D2			7 *[.25]*	7.5 *[.31]*
D3				3.5 *[.13]*
E		16.5 *[.13]*		
E1			131.5 *[5.19]*	192 *[7.56]*
E2			69 *[2.69]*	130 *[5.13]*
E3			16.5 *[.63]*	65 *[2.56]*
F	364 *[14.31]*	364 *[14.31]*	364 *[14.31]*	743 *[29.25]*
G	95 *[3.75]*	190 *[7.50]*	375 *[14.75]*	500 *[19.69]*
H	200 *[7.88]*	200 *[7.88]*	260 *[10.25]*	260 *[10.25]*
J ②	120 *[7.88]*	120 *[7.88]*	120 *[10.25]*	120 *[10.25]*
K ③	80 *[3.13]*	80 *[3.13]*	140 *[5.50]*	140 *[5.50]*
L	335 *[13.19]*	335 *[13.19]*	335 *[13.19]*	700 *[27.56]*
Mounting hole diam.	6.5 *[.16]* clearance or M6 $^{1}/_{4}$ UNF thread			

① Dimensions in mm and [inches].
② Plus thickness of gasket.
③ Minus thickness of gasket



Enclosure guidelines

Heat Dissipation in a sealed enclosure

If possible, locate heat-generating equipment in the lower part of the enclosure to encourage internal convection. Otherwise, use a taller enclosure or install stirrer fans.

The enclosure must be of adequate size to maintain sufficient cooling of the drive when it is installed inside a sealed enclosure. Heat generated by all the equipment in the enclosure must be taken into account. To calculate the minimum acceptable size of an enclosure, use the following procedure:

Calculate the minimum required surface area Ae *for the enclosure from:*

$$A_e = \frac{P}{k(T_i - T_{amb})}$$

Where:

T_{amb}	*Maximum ambient temperature in °C external to the enclosure.*
A_e	*Unobstructed heat-conducting are in mm^2.*
k	*Heat transmission coefficient of the enclosure material.*
T_i	*Maximum permissible operating temperature in °C.*
P	*Power in watts dissipated by all heat sources in the enclosure.*

Example:

To calculate the size of an enclosure for model GPD 1403 (1.5kW, 2HP).

The following conditions are assumed:

The Drive is surface-mounted inside the enclosure.

Only the top, front, and two sides of the enclosure are free to dissipate heat.

The enclosure is made from painted 2mm (.079in) sheet steel.

Maximum external air temperature: 30°C (86°F).

Insert the following values:

T_i = *40°C*
T_{amb} = *30°C*
k = *5.5 (typical for painted 2mm (.079in) sheet steel)*
P = *100 at 3kHz (see pages 18 &19)*

Note:

It is essential to include any other heat sources in the value of P.

The minimum required heat conducting area is then:

$$A_e = \frac{100}{5.5(40 - 30)} = 1.81m^2$$

Estimate two of the enclosure dimensions — the height (H) and depth (D), for instance. Calculate the width (W) from:

$$W = \frac{A_e - 2HD}{H + D}$$

Inserting H = D = 0.5m, obtain the minimum width:

$$W = \frac{1.81 - (2 \times 0.5 \times 0.5)}{0.5 + 0.5} = 0.81m$$

Heat Dissipation in a ventilated enclosure

If a high ingress protection rating is not required, the enclosure may be smaller. A ventilating fan can be used to exchange air between the inside and outside of the enclosure.

To calculate the volume of ventilating air, use the following equation:

$$V = \frac{3.1P}{T_i - T_{amb}}$$

Where V = Air-flow in m^3 per hour.

Example:

P = *100*
T_i = *40°C*
T_{amb} = *30°C*

Then:

$$V = \frac{3.1 \times 73}{40 - 30} = 31m^3 / hr$$

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