

# User Guide

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The manufacturer accepts no liability for any consequences resulting from inappropriate, negligent or incorrect installation, or adjustment of the optional operating parameters of the drive or from mismatching of the drive to the motor. SP1-Drive (1-Phase "in" / 1-Phase "out") is designed for use with Permanent-Split-Capacitor (PSC) or Shaded-Pole motors. It is not recommended for use with switch-type motors (e.g., Split-Phase, Cap Start or Cap Start-Cap Run).

The contents of this User Guide are believed to be correct at the time of printing. In the interests of a commitment to a policy of continuous improvement, the manufacturer reserves the right to change the specification of the product or its performance or the contents of the User Guide without notice.

### SAFETY

This variable speed drive product (SP1-Drive) is intended for professional incorporation into complete equipment or systems. If installed incorrectly it may present a safety hazard. The SP1-Drive uses high voltages and currents, carries a high level of stored electrical energy, and is used to control mechanical plant that may cause injury. Close attention is required to system design and electrical installation to avoid hazards in either normal operation or in the event of equipment malfunction.

System design, installation, commissioning and maintenance must be carried out only by personnel who have the necessary training and experience. They must read carefully this safety information and the instructions in this Guide and follow all information regarding transport, storage, installation and use of the SP1-Drive, including the specified environmental limitations. **Please read the IMPORTANT SAFETY INFORMATION below, and all Warning and Caution boxes elsewhere.**

### SAFETY NOTICES

**WARNING** is given where there is a hazard that could lead to injury or death of personnel  
**CAUTION** is given where there is a hazard that could lead to damage to equipment.

### IMPORTANT SAFETY INFORMATION

#### Safety of machinery, and safety-critical applications

SP1-Drive hardware and software are designed and tested to a high standard and failures are unlikely.

**WARNING** The level of integrity offered by the SP1-Drive control functions – for example stop/start, forward/reverse and maximum speed, is not sufficient for use in safety-critical applications without independent channels of protection. All applications where malfunction could cause injury or loss of life must be subject to a risk assessment and further protection provided where needed. Within the European Union, all machinery in which this product is used must comply with Directive 89/392/EEC, Safety of Machinery. In particular, the electrical equipment should comply with EN60204-1.

### Electromagnetic Compatibility (EMC)

SP1-Drive is designed to high standards of EMC. EMC data is provided in a separate EMC Data Sheet, available on request. Under extreme conditions, the product might cause or suffer disturbance due to electromagnetic interaction with other equipment. It is the responsibility of the installer to ensure that the equipment or system into which the product is incorporated complies with the EMC legislation of the country of use. Within the European Union, equipment into which this product is incorporated must comply with 89/336/EEC, Electromagnetic Compatibility.

When installed as recommended in this User Guide, the radiated emissions levels of all SP1-Drive are less than those defined in the Generic radiated emissions standard EN61000-4. When correctly fitted with an SW EMC Filter (Mains filter), the conducted emission levels are less than those defined in the Generic radiated emissions standard EN61000-3 (class B) for screened cable lengths of < 5 m and with EN61000-4 (class A) for screened cable lengths of < 10 m.

The SP1-Drive conforms with the following standards:

- 1) CE marked for low voltage directive
- 2) UL508C Power conversion equipment
- 3) IEC 664-1 Insulation coordination for equipment within low voltage systems
- 4) EN61800-3 Adjustable Speed electrical power drive systems – Part 3 (EMC)
- 5) EN 61000-2, -3, -4 Generic Immunity / Emissions standards (EMC)

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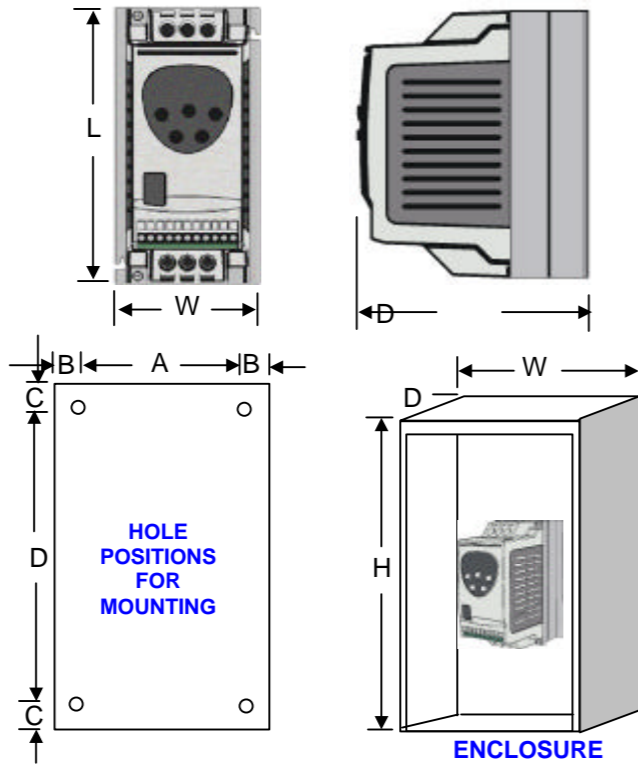
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### MECHANICAL INSTALLATION

#### CAUTION

- Carefully inspect the SP1-Drive before installation to ensure it is undamaged.
- Store the SP1-Drive in its box until required. Storage should be clean and dry Temperature range -40 °C to +60 °C.
- Install the SP1-Drive on a flat, vented, flame-resistant vibration-free mounting within an IP54 or equivalent enclosure (EN60529).
- Flammable material should not be placed close to the drive.
- The entry of conductive or flammable foreign bodies should be prevented.
- Max. ambient temperature 50 °C, min. -5 °C.
- Relative humidity must be less than 95% (non-condensing).

In case of size 1...2, the SP1-Drive can be installed side-by-side with their heatsink flanges touching. If drives are mounted above another keep a distance of 300 mm (size 1 & 2. The enclosure should either be force ventilated or large enough to allow natural cooling (allow 0.1 m<sup>3</sup> per kW of drive rating).



### SP1-DRIVE DIMENSIONS

	Size 1	Size 2
Length mm	155	260
Width mm	80	100
Depth mm	130	175
Weight kg	1.1	2.6
A mm	72	92
B mm		4
C mm		25
D mm	105	210
Fixings	2 × M4	
Power terminal torque settings	1 Nm	1 Nm

Control terminal torque settings: 0.5 Nm

### ENCLOSURE - NON VENTED DIMENSIONS

DRIVE POWER RATING	SEALED UNIT		
	W	H	D
Size 1 115 V / 230 V	300	400	200
Size 2 115 V / 230 V	450	600	300

### ENCLOSURE – VENTED DIMENSIONS

DRIVE POWER RATING	VENTED UNIT			FORCE VENTED (WITH FAN)			
	W	H	D	W	H	D	Air Flow
Size 1	300	400	150	200	300	150	> 15 m <sup>3</sup> / h
Size 2	400	600	250	300	400	250	> 45 m <sup>3</sup> / h

### ELECTRICAL INSTALLATION

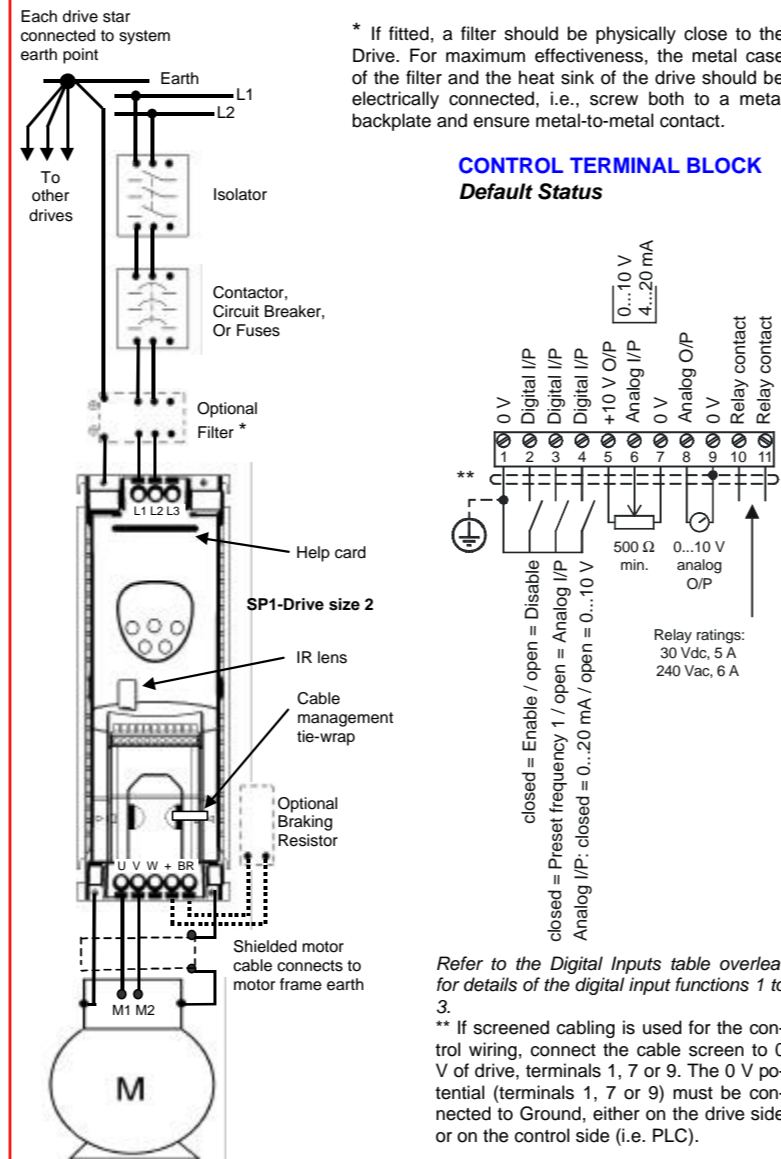
#### WARNING

- SP1-Drives should be installed only by qualified electrical persons and in accordance with local and national regulations and codes of practice.
- **Electric shock hazard!** Disconnect and **ISOLATE** the SP1-Drive before attempting any work on it. High voltages are present at the terminals and within the drive for up to 10 minutes after disconnection of the electrical supply.
- Ensure correct earthing connections, see diagram below.
- The earth cable must be sufficient to carry the maximum supply fault current which normally will be limited by the fuses or MCB.

#### CAUTION

- Ensure that the supply voltage and frequency correspond to the rating of the SP1-Drive as delivered.
- An isolator or similar should be installed between the power supply and the drive.
- Never connect the mains power supply to the SP1-Drive output terminals U and V.
- Protect the drive by using slow-blowing HRC fuses or Circuit Breaker located in the mains supply of the drive (refer to local standards).
- Do not open the connection between the drive and the motor if the power stages are enabled!
- Lay motor, line power and signal cables as far away from each other as possible and separately.
- Ensure that screening or armouring of power cables is effected in accordance with the connections diagram below.
- Ensure that all terminals are tightened to the appropriate torque (see table, left).

Connect drive according to diagram below, ensuring that motor terminal box connections are correct (see diagram, right). Refer to the **ELECTRICAL DATA** overleaf for the sizes of cabling and wiring. It is recommended that the power cabling should be PVC-insulated shielded cable, laid in accordance with local industrial regulations and codes of practice.



### GROUNDING (EARTHING)

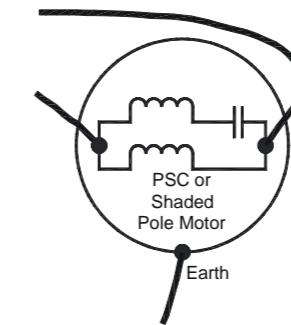
The ground (⊕) terminal of each SP1-Drive should be individually connected **DIRECTLY** to the site earth (ground) busbar (through the filter if installed) as shown. SP1-Drive ground connections should not loop from one drive to another, or to, or from any other equipment. Ground loop impedance must conform to local industrial safety regulations. To meet UL regulations, UL approved ring crimp terminals should be used for all earth wiring connections.

### OPERATION – BASICS + GETTING STARTED

#### WARNING

- The STOP function does not remove potentially lethal high voltages. **ISOLATE** the drive and wait 10 minutes before starting any work on it.
- If it is desired to operate the drive at any frequency/speed above the rated speed (P-09/ P-10) of the motor, consult the manufacturers of the motor **and** the driven machine about suitability for over-speed operation.
- The fan (if fitted) to the heatsink of the SP1-Drive starts automatically when the heatsink temperature reaches approximately 40 °C. When the heatsink is at room temperature the fan will be stopped.

### PSC MOTOR WIRING



### EASY START-UP

When delivered, the SP1-Drive is in the default state, meaning that it is set to operate in terminal mode and all parameters (P-xx) have the default values as shown overleaf.

- Connect a control switch between the control terminals 1 and 2.
- Connect a potentiometer (500 Ω min to 10 kΩ max) between terminals 5 and 7, and wiper to terminal 6.
- Set the control switch between pins 1 and 2 open so that the drive is 'disabled'.
- With the potentiometer set to zero, switch on the supply to the drive. The display will show StoP.
- Close the control switch, terminals 1-2. The drive is now 'enabled' and the output frequency/speed will ramp up to 50 Hz immediately for time determined in P-32 (2-sec) before ramping back down to the minimum speed set in P-02 (10.0 Hz). The speed of the motor can now be controlled by the potentiometer. Turn the potentiometer to maximum. The motor will accelerate to 50 Hz (the default value of P-01) under the control of the accelerating ramp time P-03. The display shows H 50.0 (50 Hz) at max speed.
- To display motor current (A), briefly press the Navigate key ⇐.
- Press ⇨ again to return to speed display.
- To stop the motor disable the drive by opening the control switch (terminals 1-2).

If the enable/disable switch is opened the drive will decelerate to stop at which time the display will show StoP. If the potentiometer is turned to zero with P-02 set to 0.0 Hz and the enable/disable is closed the display will show 0.0 Hz, if left like this for 20 seconds the drive will go into standby mode, display shows Strdy, waiting for a speed reference.

### SIMPLE PARAMETER ADJUSTMENTS

The factory-set default parameter values may give satisfactory performance, however certain adjustments may be beneficial.

#### Maximum and Minimum Speeds P-01 & P-02

Set P-01 to the maximum speed and P-02 to the minimum speed for your application. These limits are mirrored for negative speeds. If a non-zero minimum speed is set in P-02, the motor will ramp (P-03) to this minimum speed as soon as the drive is enabled.

#### Acceleration and Deceleration P-03 & P-04

Ramps which are too short will cause the drive to deliver currents in excess of full load current and may result in it tripping out or the motor stalling.

#### Stop Mode P-05

Select method of stopping required when drive is disabled. Ramp to stop (P-05 = 0) decelerates the motor at the rate set by deceleration ramp time P-04. Freewheel/ Coast to stop (P-05 = 1) disables the drive output immediately, allowing the motor to decelerate naturally due to friction or under the control of a mechanical brake.

#### V/F Characteristic P-06

Certain loads such as fans and centrifugal pumps need less torque at low speed. Set P-06 = 1 to a higher value to reduce power loss at low speeds for this load type. '0' creates max torque.

#### Rated Current, Rated Frequency and Rated Speed P-08, P-09, P-10.

Parameters P-08 and P-09 should be set to correspond with the rated current and frequency shown on the motor rating plate.

Parameter P-10 is optional. If this parameter is set to zero (default state), speed will be displayed in Hz; if speed indication is required in rpm, enter the motor rated speed (speed at full load) from the motor rating plate. This also activates the slip compensation feature which improves speed regulation (holding) for varying load conditions.

#### Voltage Boost P-11

Any load which is 'sticky' to start will benefit from a voltage boost on starting. P-11 permits a boost of up to 25% of full motor voltage to be applied.

NOTE: Use of this parameter increases motor heating at low speeds.

#### Terminal or Keypad Control P-12

Terminal control (P-12 = 0) is used when the drive needs to be controlled from some remote point, such as a control panel interface or machine system.

Keypad control (P12 = 1 or 2) is used for local, manual control and commissioning.

**Extended Parameter Set P15 to P-40 and P-00**  
The Extended Parameter Set is intended for use by specialist drives engineers and technicians and will not generally be required for simple applications.

### OPERATION – USING THE KEYPAD

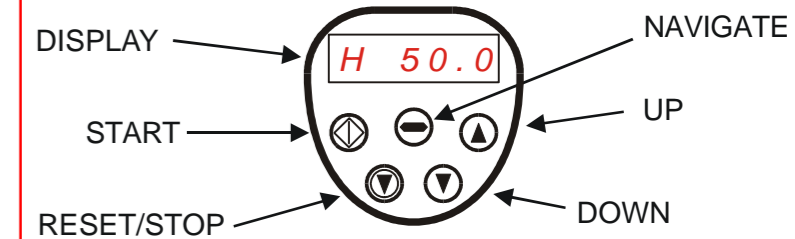
#### MANAGING THE KEYPAD

When the drive is delivered from the factory, only the Standard Parameter Set (see overleaf) is accessible.

To access the **Standard Parameter Set**, press the Navigate key ⏏ for >1 sec.

- Scroll through P-01 to P-14 (and roll over to P-01) by pressing ▲ or ▼
- To display the **parameter value**, press ⏏
- To **edit the parameter value**, press ▲ or ▼
- To **return to the parameter number**, press ⏏
- To **store a value and / or exit from edit mode**, press ⏏ for >1 sec or press no button for >20 sec.

To access the **Extended Parameter Set**, set P-14 = 101 and press ⏏



**NOTE** To restrict unauthorized access, make P-37 = any value from 0 to 9999.

- When in the Extended Parameter Set (except P-00), the display will revert to normal if no button is pressed for >20 sec.
- When P-00 is accessed, the display will revert to normal if no button is pressed for >60 sec.

To **SAVE CHANGES** to Parameter settings, switch the power supply off and wait for the drive to power down (screen blank) before switching on.

NOTE that this assumes P-38 = 0 (default). If P-38 = 1, changes are not saved.

To **RESTORE ALL DEFAULT VALUES**, stop the drive and when display shows StoP, press and hold the ▲, ▼ and STOP keys simultaneously for 1 second. The display will show P-DEF. Access code P-37 will revert to 101 but the hours-run meter P-39 is not affected. Press STOP to resume normal operation.

### OPERATING IN KEYPAD MODE

Set P-12 = 1 or 2 (this allows the SP1-Drive to be controlled from the keypad):

- Enable the drive by closing digital input 1. The display will show StoP.
- Press the START key. The drive is now 'enabled' and the output frequency/speed will ramp up to 50 Hz immediately for time determined in P-32 (2-sec) before ramping back down to the minimum speed set in P-02 (10.0 Hz).
- Press ▲ to increase speed
- The motor will increase in speed until ▲ is released. **CAUTION:** the rate of acceleration is controlled by the setting of P-03, check this before starting.
- Either Press ▼ to decrease speed
- The drive will decrease speed until ▼ is released. The rate of deceleration is limited by the setting in P-04
- Or Press the STOP key. The drive will decelerate to min speed (P-02) at the rate set in P-04.
- To stop the motor set P-02 (min speed) to 0.0 Hz, or open digital input 1.
- To preset a target speed prior to enable press the stop key whilst the drive is stopped. The display will show the target speed, use the ▲ and ▼ to adjust as required then press the Stop key to return the display to StoP. Pressing the START key will start the drive accelerating at 50 Hz for time set in P-32 before continuing to the target speed.

The operation of the keypad can be duplicated using remote pushbuttons connected to the control terminals, see Application Note AN21. In this mode, if P30 is set to Auto-0.4, then the drive will run as soon as the drive enable is applied (terminal 1 & 2 is closed).

### SP1-DRIVE OPTIONS

- The following additional products are available:
- EMC filters to meet EN 50081-1 and EN 50081-2 for conducted emissions.
- IR Remote Control: multi-language LCD infrared remote control and programming unit.
- PC Software: PC based program for storing, editing and printing parameter sets.
- Braking resistor (Size 2 only).
- RS232/485 serial communications interface unit.
- Smart Drive Fieldbus Gateway for connection to Profibus DP, DeviceNet, & Modbus communication systems.
- SmartPort: remote keypad and LED display, with scalable display and PI for feedback control systems.
- SmartLink: fibre optic cable used to connect networks of SP1-Drive and SP1-Drive to SmartPort.
- Dual relay output and dual analog input.
- Enclosed (IP54) SP1-Drive.
- SP1-Drive Coolplate with heat sink removed for mounting to a cooled surface.

### FURTHER INFORMATION

Website, [www.bergeselectronic.com](http://www.bergeselectronic.com)

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## STANDARD PARAMETER SET

Par.	Description	Range	Default	Explanations	Set to
P-01	Maximum speed	P-02 to 5 × P-09 (max 1 kHz)	50 Hz	Maximum speed limit – Hz or rpm. See P-10.	
P-02	Minimum speed	0 to P-01 (max 1 kHz)	10 Hz	Minimum speed limit – Hz or rpm. See P-10.	
P-03	Accel ramp time (s)	0 to 3,000 s	5 s	Acceleration ramp time from 0 to base speed (P-9) in seconds.	
P-04	Decel ramp time (s)	0 to 3,000 s	5 s	Deceleration ramp time from base speed (P-9) to 0 in seconds.	
P-05	Stop mode select	0, 2: Ramp stop 1: Coast to stop	0	If the supply is lost and P-05 = 0 then the drive will try to continue running by reducing the speed of the load using the load as a generator. If P-05 = 2, the drive ramps at P-07 to stop.	
P-06	V/F characteristic	0: Constant torque, 1..10: Variable torque, Pump/fan, HVAC	5	Set to lower values for more torque at lower frequency (P-06 = 0, Linear).	
P-07	Fast stop (s)	0.0 to 25 s. (Disabled when 0.0 s)	0.0 s	Deceleration ramp time after mains loss (P-05 = 0 or 2) or when fast stop activated (see P-19). When P-05 = 2 and P-07 = 0, activating the fast stop disables the drive without braking (effectively coasting to stop).	
P-08	Motor rated current limit	0 to current rating of drive (Amps)	Drive rating	Rated (nameplate) current of the motor (Amps).	
P-09	Motor rated frequency	25 Hz to 1 kHz	50 Hz	Rated (nameplate) frequency of the motor. Changing P-09 resets P-02, P-10 & P-28 to 0, & P-01 = P-09.	
P-10	Motor rated speed	0 to 60,000 rpm	0	When non-zero, speed is displayed in rpm in parameters P-01, P-02, P-20...P-23, P-27 and P-28; also slip compensation is automatically activated whenever this parameter is non-zero – see also P-24.	
P-11	Boost level	0 to 25% of max output voltage	3%	Applies an adjustable boost to the SP1-Drive voltage output at low speed to increase motor torque. For continuous operation at low speed use a forced ventilated motor.	
P-12	Terminal or Keypad control of drive	0: Terminal control 1: Keypad control – fwd only 2: Keypad control – rev only 3: Terminal control (IR transmit master/slave mode enabled) Drive speed/status transmitted. 4: Terminal control (IR transmit master/slave mode enabled). Drive speed ref transmitted	0 (Terminal)	When P-12 = 2, the keypad START key toggles between forward and reverse, after STOP drive will start in the same direction as it was last running. 3: Terminal control with SP1-Drive speed info transmitted via IR link (IR Remote Control can be used when drive stopped). 4: Terminal control with SP1-Drive scaled speed ramp info transmitted via IR link even when drive stopped (unable to use IR Remote Control). (For a more detailed explanation of this parameter see application note AN 24)	
P-13	Trip log	Last four trips stored	Read only	Most recent 4 trips stored in order of occurrence, i.e., on entry, display shows most recent first. Press ▲ or ▼ to step through all four.	
P-14	Extended menu access	Code 0 to 9999	0	Set to "101" (default) for extended menu access. Change code in P-37 to prevent unauthorized access to the Extended Parameter Set.	

## EXTENDED PARAMETER SET

Par.	Description	Range	Default	Explanations	Set to
P-15	Motor rated voltage	115 V product: 40 V to 150 V 230 V product: 40 V to 250 V	115 V for 115 V 230 V for 230 V	When P-15 is non-zero, the applied motor voltage is controlled and scaled so that the specified voltage is achieved at rated freq (P-09)	
P-16	Analog input format (V/mA)	Voltage: 0–10 V, 10–0 V Current: 4–20 mA, 0–20 mA, 20–4 mA	0–10 V	Analog input format (on terminal 6).	
P-17	Switching frequency	8, 16, 32 kHz	16 kHz	Effective power stage switching frequency. Improvements in acoustic noise and output current waveform occur with increasing switching frequency at the expense of increased losses within the drive.	
P-18	Relay output function	0: Drive enabled 1: Drive healthy (not tripped) 2: Motor at set speed 3: Motor speed > zero 4: Motor at max speed (P-01) 5: Motor current overload	1	Relay output function. Contacts closed if selected condition is true. When P-18 = 3, (zero speed), the relay contacts close when the output frequency is greater than 5% of base frequency. The drive is in overload when the motor current exceeds P-08	
P-19	Digital inputs function select	0 to 5, See digital input table	0	Defines function of digital inputs (see also P-16 and Digital Inputs table).	
P-20	Preset speed 1	–P-02 (min) to P-01 (max)	50 Hz/rpm	Defines Speed Preset1.	
P-21	Preset speed 2	–P-02 (min) to P-01 (max)	0 Hz/rpm	Defines Speed Preset 2.	
P-22	Preset speed 3	–P-02 (min) to P-01 (max)	0 Hz/rpm	Defines Speed Preset 3.	
P-23	Preset speed 4	–P-02 (min) to P-01 (max)	0 Hz/rpm	Defines Speed Preset 4.	
P-24	Reserved				
P-25	Analog output function	(A) 0: Motor Speed 1: Motor current (D) 2: Drive enabled 3: Set speed	0	Analog output select. When P-25 = 0 then 10 V = 100% of P-01, or if P-25 = 1 then 10 V = 200% of P-08. P-25 = 2 or 3 gives a 10 V digital output.	
P-26	Reserved				
P-27	Skip freq/speed	P-02 (min) to P-01 (max)	0 (inactive)	Centre point for skip frequency band. The skip frequency band defined by P-27, P-28 is mirrored around zero for negative speeds.	
P-28	Skip freq/speed band	0 to 100% of rated speed/freq. P-09	0 Hz/rpm	Width of skip frequency band, the center of which is defined by P-27.	
P-29	Reserved				
P-30	Drive start mode	Edge-r: Close Digital input 1 after power up to start drive Auto-0: drive runs whenever Digital input 1 closed. Auto-1..4: as Auto-0, except 1..4 Attempts to restart after a trip	Auto-0	When set to Edge-r, if drive is powered up with Digital Input 1 closed (enabled), drive will not run. The switch must be opened & closed after power up or after a clearing a trip for the drive to run. When set to Auto-0, drive will run whenever digital input 1 is closed (if not tripped). Auto-1..4 makes 1..4 attempts to automatically restart after a trip (25 s between attempts). If fault has cleared drive will restart. Drive must be powered down, reset on the keypad or reset by re-enabling the drive to reset auto-reset counter. When P-12 is set to 1 or 2, P-30 changes automatically to Edge-r.	
P-31	Boost frequency	0 to 250 Hz	50 Hz	SP1-Drive start up frequency maintained during the startup boost period.	
P-32	Boost duration	0 to 25 s	2 s	Time for which the startup boost period is maintained.	
P-33	Boost start voltage	0 to 100%	20%	% of operational motor voltage applied at start of startup boost period. The applied voltage is increased to the operational voltage at end of startup boost period.	
P-34	Brake resistor enable	0: Disable 1: Enable with overload monitor 2: Enable without overload monitor	0	Activates the internal braking transistor. When P-34 = 1 the braking resistor is protected by the drive against overload. When P-34 = 2, a thermal overload relay must be used to protect the resistor and drive.	
P-35	Analog input scaling factor	25% to 500%	84%	Scales the analog input at control terminal 6 up or down, or the digital reference in keypad (or Slave) mode up or down (see P-12).	
P-36	Drive address (s-comms)	0 to 63 (0 = disable)	1	Distinct drive address for serial comms. 0 = comms disabled.	
P-37	Access code definition	0 to 9999	101	Defines Extended Parameter Set access code, P-14.	
P-38	Parameter access lock	0: Parameters can be changed, auto-saved on power down 1: Parameter changes not saved on power down 2: Read-only. No changes allowed.	0 (write access and auto-save are enabled)	Controls user access to parameters. When P-38 = 0, all parameters can be changed and these changes will be stored automatically. When P-38 = 1, changes may be made but these will not be stored when the SP1-Drive powers down. When P-38 = 2, parameters are locked and cannot be changed thus preventing unauthorised access.	
P-39	Hours run meter	0 to 99999 hours	Read only	Not affected by reset-to-default command.	
P-40	Software checksum	0000 to FFFF (hex)	Read only	Drive rating, drive type, software version and software checksum codes. Press ▲ or ▼ to step through all four.	

## DIGITAL INPUTS – TERMINAL MODE (P-12 = 0, 3 or 4)

P-19	Input 1 function	Input 2 function	Input 3 function	Additional Information
0	Open: Stop (disable) Closed: Run (enable)	Open: Analog input Closed: Speed Preset 1	Volts/Current analog input	The format of the current analog input is defined by P-16, if P-16 is set to 0–10 V a 4–20 mA format will be assumed when input 3 closed.
1	Open: Stop (disable) Closed: Run (enable)	Open: Analog input Closed: Speed Preset 1/2, (Digital Input 3 selects)	Open: Speed Preset 1 Closed: Speed Preset 2	
2	Open: Stop (disable) Closed: Run (enable)	Digital Input 2 Open + Digital Input 3 Open = Preset / Jog Speed 1 Digital Input 2 Closed + Digital Input 3 Open = Preset / Jog Speed 2 Digital Input 2 Open + Digital Input 3 Closed = Preset / Jog Speed 3 Digital Input 2 Closed + Digital Input 3 Closed = Preset / Jog Speed 4		
3	Open: Stop (disable) Closed: Run (enable)	External trip input: Open: TRIP; Closed: OK	Open: Analog Input Closed: Speed Preset 1	
4	Normally Open (N.O.) Momentarily Close to run	Normally Closed (N.C.) Momentarily Open to stop	Open: Analog Input Closed: Speed Preset 1	
5	Open: Stop (disable) Closed: Run (enable)	Close to run Open to fast stop (P-07)	Open: Analog Input Closed: Speed Preset1	Wire break mode. Fast stop (P-07) activated when input 1 & input 2 closed at same time.

## DIGITAL INPUTS – KEYPAD MODE (P-12 = 1 or 2)

P-19	Input 1 function	Input 2 function	Input 3 function	Additional Information
0, 1, 2, 4, 5	Open: Stop (disable) Closed: Run (enable)	Closed: remote up pushbutton	Closed: remote down pushbutton	Closing inputs 2 & 3 at same time starts the drive.
3	Open: Stop (disable) Closed: Run (enable)	External trip input: Open: TRIP; Closed: no trip	Open: Keypad speed reference Closed: Preset/Jog Speed 1	Allows use of motor thermistor in keypad mode. Speed reference is set by pushbuttons.

Digital inputs are auto-sensing active high or active low (positive or negative logic) – active <8 V or >20 V, in-active >12 V and <16 V or no connection.

## TROUBLESHOOTING

**TO CLEAR A TRIP CONDITION** Remove the condition which caused the trip and press the STOP key or re-enable the drive. The drive will restart according to the mode selected by P-30. If the motor is stopped and the display shows **STOP**, there is no fault; the drive output is disabled and the drive is ready to run.

Fault Code	What has happened	What to do
P-deF	Default parameters loaded	Press STOP key, drive is ready to configure for particular application
O-I	Over current on drive output. Excess load on the motor.	<i>Motor at constant speed:</i> investigate overload or malfunction. <i>Motor starting:</i> load stalled or jammed. Check for motor wiring error. <i>Motor accelerating/decelerating:</i> The accel/dec time too short requiring too much power. If not possible to increase P-03 or P-04, a bigger drive will be required
O-Uolt	Over voltage on DC bus	Over voltage. Check that supply voltage is within drive limits. Increase decel. ramp time P-04. If a brake resistor is used, check that P-34 = 1 or 2.
U-Uolt	Under voltage on DC bus	This occurs routinely when power is switched off. If it occurs during running, check power supply voltage.
OI-b	Brake resistor short circuit	Check resistor cabling, if ok, check the brake resistor is not short circuit
I.t.trP	The drive has tripped on overload after delivering greater than 100% load for a period of time.	Check to see when the decimal points are flashing (drive in overload) and either decrease acceleration rate or load. Check cable length is within specification. Try increasing the value of the voltage applied to the motor i.e. reduce the value of P-06.
th-FIt	Faulty thermistor on heatsink.	Refer to <i>Berges electronic GmbH</i> .
E-triP	External trip (on dig. input 2 or 3)	External trip activated via digital input 2 when P-19 = 3. If used for motor thermistor, check motor temperature; the motor may need to be forced cooled particularly if running continuously at low speed and high torque.
EE-F	EEPROM fault. Parameters not saved, defaults reloaded.	Try again. If problem recurs, refer to <i>Berges electronic GmbH</i> .
PS-Trp	Internal power stage fault	Check wiring to motor, look for ph-ph or ph-Earth short circuit. Check drive ambient temp, additional space or cooling needed? Check drive is not forced into overload.
O-t	Heatsink over temperature	Check drive ambient temp. Additional space or cooling needed?
lin-F	Current analog input out of range	Analog input format of 4..20 mA selected and input current value <2 mA. If P-19 = 0, check the operation of digital input 3.
OL-br	Braking Resistor Overload	Increase decel. time, P-04 or reduce braking resistor value
SC-trP	Serial communications trip	Check SmartLink integrity between drives connected optically or electrically via RS485, check drives in a network have different addresses, P-36. If the SmartPort is used, check that the drive address of the SmartPort (P-36) matches that of the SP1-Drive. If multiple SP1-Drives are used in a network check that each drive has a unique address.

## PARAMETER ZERO

- Provides a *read only* window into the motor control software allowing key internal values to be viewed. This is useful for following signals through the drive control system when troubleshooting.
- Access, scroll, change and exit are as for any other parameter. The selected variable is at the left hand side of the display.
- There are 9 different windows listed below:
  - Unscaled analog input (%).
  - Speed ref. via scaled analog input (Hz).
  - Pre-ramp speed ref. (Hz).
  - Post-ramp speed ref. (Hz).
  - Slip speed (Hz).
  - Stator field frequency (Hz).
  - Applied motor voltage (V).
  - DC bus voltage (V).
  - Internal thermistor (NTC) value.

## GENERAL TECHNICAL DATA

- Supply frequency 48 to 62 Hz.
- Max. ambient temperature 50 °C.
- Max. altitude 2000 m.
- Derate above 1000 m, 1%/100 m.
- Derate output current 5%/ °C above max. ambient temp up to 50 °C.
- 1 × t protection above 100% output current.
- 150% overload protection for 60 sec.
- 175% overload allowable for 2 sec.
- Storage temperature –40 to +60 °C.

## ELECTRICAL DATA

### Smart Single Phase 1: Size 1

Model	SP1-xxxxx	K1S0003H01	K2S0003H01	K2S0007H01
Supply voltage	±10%	115	220–240	
Phases		1		
Motor output rating	kW HP	0.37 0.5	0.37 0.5	0.75 1
Output Amps	A	7.0	4.3	7.0
Fuse or Circuit Breaker rating	A	10	10	20
Max ambient temperature	°C 8 kHz °C 16 kHz °C 32 kHz	40 40 30	40 40 30	40 40 30
Motor cable size, Cu 75 °C	mm <sup>2</sup>	2.5	1.5	2.5
Max motor cable length	m	50		

### Smart Single Phase 1: Size 2 (with INTEGRAL BRAKING TRANSISTOR)

Model	SP1-xxxxx	K1S0005H02	K2S0015H02
Supply voltage	±10%	115	220–240
Phases		1	
Motor output rating	kW HP	0.55 0.75	1.1 1.5
Output Amps	A	10.5	10.5
Fuse or Circuit Breaker rating	A	20	20
Max ambient temperature	°C 8 kHz °C 16 kHz °C 32 kHz	40 40 30	40 40 30
Motor cable size, Cu 75 °C	mm <sup>2</sup>	2.5	2.5
Max motor cable length	m	100	
Min brake resistor	Ω	22	

### Voltage/Frequency (V/f) Characteristic

The V/f characteristic is defined by parameter P-06 as shown. Increasing the value of P-06 decreases the volts applied to the motor at a given frequency; reducing the voltage reduces the amount of current flowing in the motor hence the torque at the motor shaft. This feature is used to save energy in applications where the torque required at low speeds is less than at higher speeds. A particular value of P-06 should be determined by trial and error.

