10 List of Parameters

10.1 Menu 0 — Standard parameters

p0	Minimum frequency	mnem	MN	R–W
Range	0.0 to p1 Hz	Def. val.	0.0	
Related parameters	p1, p10 to p12, p20 to p26, b4, b14			

Use in unipolar mode to define the minimum frequency of the Drive in order to determine the minimum speed of the motor.

p1	Maximum frequency	mnem	MX	R–W
Range	p0 to ULF Hz	Def. val.	50.0 (EUR) 60.0 (USA)	
Related parameters	p0, p10 to p12, p20 to p26, b4, b14			

Set at a value to define the maximum frequency above which the motor will not operate.

(ULF = Upper Limit Frequency)

p2	Acceleration time	mnem	AL	R–W
Range	0.2 to 999 sec	Def. val.	5.0	
Related parameters	p3, b14			

Set at the time required for the Drive to accelerate the motor from 0Hz to the upper limit frequency (ULF) set in **b14**. Acceleration is also referred to as **ramp**. Refer to Figure 10–1.

$$t_{acc} = p2 \frac{(f_2 - f_1)}{ULF}$$

p3	Deceleration time	mnem	DL	R–W
Range	0.2 to 999 sec	Def. val.	10.0	
Related parameters	p2, b14			

Set at the time required for the Drive to decelerate the motor from ULF to 0Hz. Deceleration is also referred to as **ramp**. Refer to Figure 10–2.

$$t_{dec} = p3 \frac{(f_1 - f_2)}{ULF}$$

(ULF = Upper limit frequency)

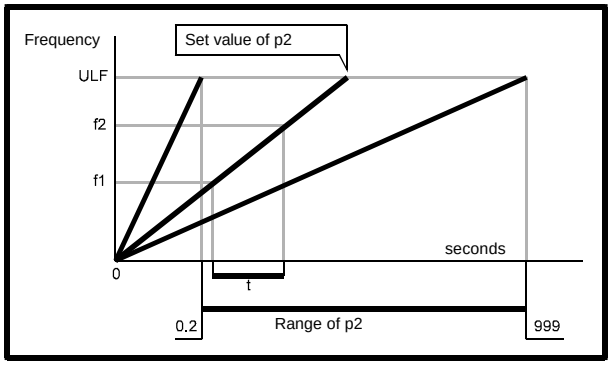

Figure 10–1 Acceleration time p2. The time t to acceleration from f_1 to f_2 depends on the value selected for ULF as well as for p2.

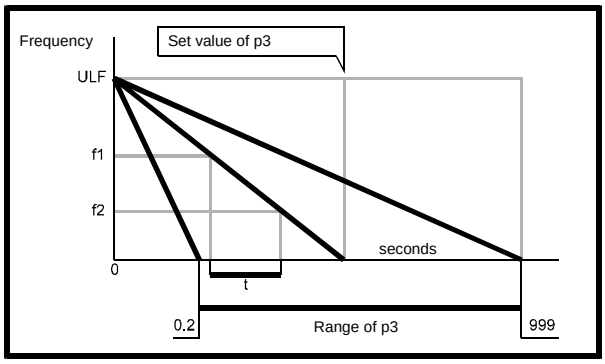

Figure 10–2 Deceleration time p3. The time t to deceleration from f_1 to f_2 depends on the value selected for ULF as well as for p3.

When any of the following conditions apply, it may be necessary to increase the value of **p3** to prevent excessive voltage occurring on the DC bus during braking and causing the Drive to trip (trip code **OV**).

- When **b27** is set at 1
- If the AC supply voltage is at or near the maximum permissible value for the Drive
- If the DC-bus voltage is raised by the action of an external source (eg. when DC buses are connected in parallel)
- When long motor cables are used

p4	Timed current limit	mnem	TR	R–W
Range	p5 to 150% %FLC	Def. val.	150	
Related parameters	p5			

Set the maximum level of controlled output current. This must be greater than the value of **p5**.

(FLC = Full-load current).

p5	Maximum continuous current	mnem	TH	R–W
Range	10% to 105% %FLC	Def. val.	100	
Related parameters	p4			

Set the level of continuous output current which may be supplied to the motor. The relationship between **p5** and the motor rated current is:

$$\mathbf{p5} = \frac{\textbf{Motor full load current}}{\textbf{Drive full load current}} \times \mathbf{100}$$

Since a Drive is usually selected to have a maximum continuous current rating to match that of the motor, to prevent overheating of the motor at full load, the motor Full Load Current (FLC) must not be exceeded.

To set **p5** accurately, enter the value of the percentage FLC that is shown on the display (see step 13 in *Operation in terminal mode* in Chapter 6 *Getting Started*) when the actual motor current is at the FLC value. Use a suitable current probe or power analyser to measure the actual current.

Current in excess of the value of **p5** initiates **I x t** protection.

The trip time of the Drive $= \frac{\mathbf{k} \times \mathbf{p5}}{\mathbf{\%I - p5}}$ seconds.

k = 25.7
FLC = Full-load current

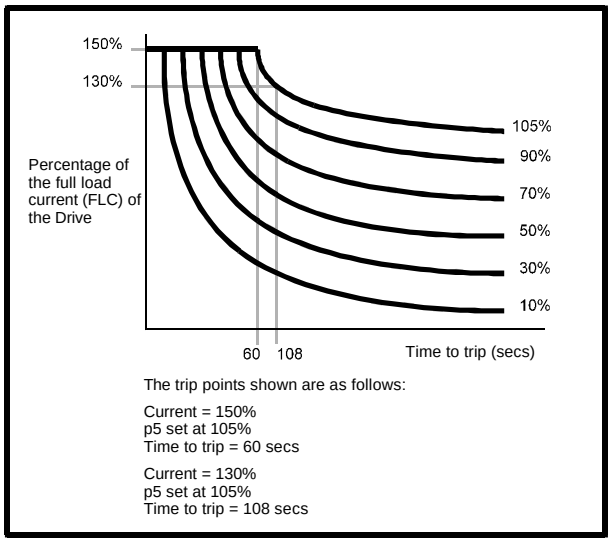

Figure 10–3 I x t characteristics

p6	Torque (Voltage) boost	mnem	BO	R–W
Range	0 to 25.5 %V	Def. val.	5.1 (EUR) 3.0 (USA)	
Related parameters	b3			

Parameter **p6** is used to set the relationship between output voltage and frequency. The output voltage is dependent on the following:

AC supply voltage
Output frequency
Maximum-voltage frequency set in **pc**
Torque boost set in **b3**

Caution

Avoid setting p6 at an excessive value for the motor. Doing so may cause the magnetic circuits in the motor to be saturated. Under these circumstances excessive currents will be drawn which could damage the motor over a period of time if it is not adequately protected (see the description for p5).

Setting p6 at an excessive value does not improve the starting torque; the motor may not start at all, even under no load. Furthermore, DC injection braking may not function properly (see the description for p8).

p6 set at 0

Load regulation

At frequencies below [**pc** ÷ 2], voltage boost increases with frequency. At frequencies above [**pc** ÷ 2], voltage boost depends on the value of load current.

The maximum amount of boost is 12.5% of the AC supply voltage.

Full load
No boost

The output voltage increases linearly with frequency to [**pc** ÷ 2]. At this frequency, the output voltage equals 58.5% of the AC supply voltage, giving 12.5% boost in relation to the output voltage under no load. Above this frequency, the output voltage rises linearly to 100%, maintaining the 12.5% boost.

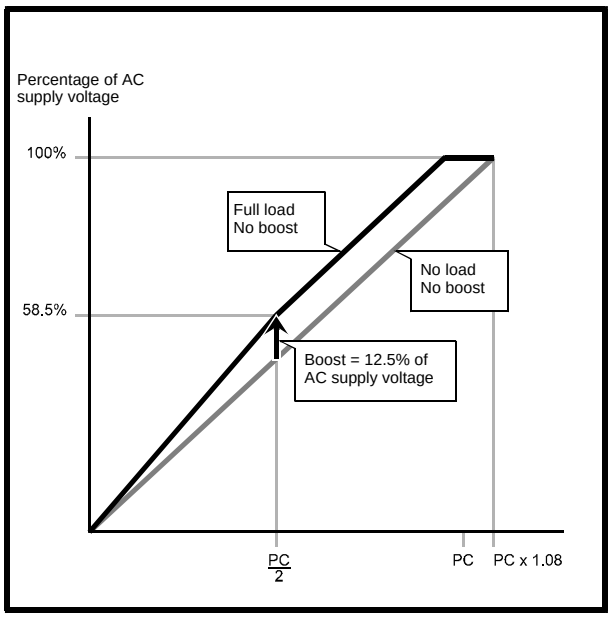

Figure 10–4 The relationship between no-load and full-load boost when no boost is applied (p6 set at 0)

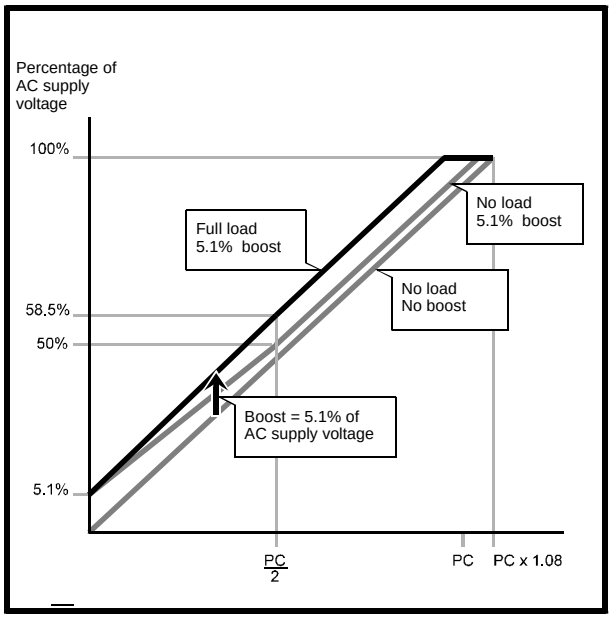

Figure 10–5 The relationship between no-load and full-load boost when 5.1% boost is applied (p6 set at 5.1)

p6 set at 5.1%

No load
5.1% boost

The output voltage increases with frequency from 5.1% of the AC supply voltage to [**pc** ÷ 2]. At this frequency, the output voltage equals [46 + (**p6** ÷ 2)]% of the AC supply voltage, giving [**p6** ÷ 2]% boost in relation to the output voltage under no load. Above this frequency, the output rises linearly to 100%, maintaining the [**p6** ÷ 2]% boost.

Full load
5.1% boost

The output voltage increases linearly with frequency from 5.1% of the AC supply voltage to [**pc** ÷ 2]. At this frequency, the output voltage equals 58.8% of the AC supply voltage, giving 12.5% boost. Above this frequency, the output voltage rises linearly to 100%, maintaining 12.5% boost.

p6 set at 25.5%

No load
25.5% boost

The output voltage increases linearly with frequency from 5.1% of the AC supply voltage to [**pc** ÷ 16]. At this frequency, the output voltage equals 29.5% of the AC supply voltage. Above this frequency, the output voltage rises linearly to [**pc** ÷ 2]. At this frequency, the output voltage equals [46 + (**p6** ÷ 2)]% of the AC supply voltage giving [**p6** ÷ 2]% boost. Above this frequency, the output voltage rises linearly to 100%, maintaining the [**p6** ÷ 2]% boost.

Full load
25.5% boost

The output voltage increases linearly with frequency from 5.1% of the AC supply voltage to [**pc** ÷ 16]. At this frequency, the output voltage equals 29.5% of the AC supply voltage, giving 25.5% boost. Above this frequency, the output voltage rises to 100%, maintaining the 25.5% boost.

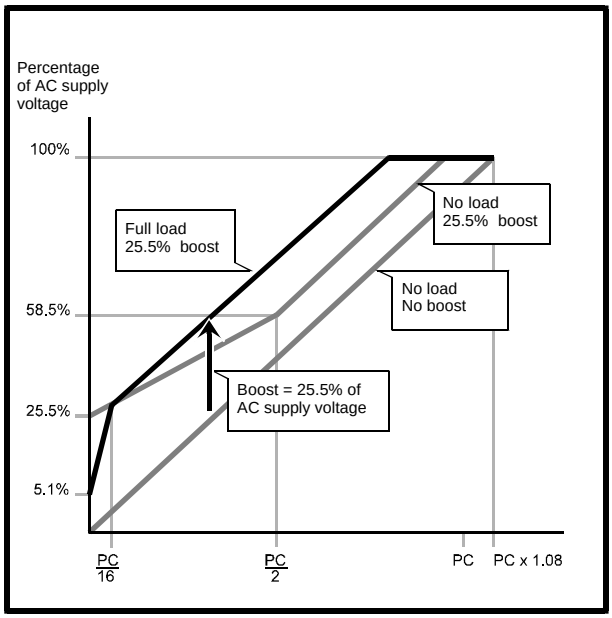

Figure 10–6 The relationship between no-load and full-load boost when 25.5% boost is applied (p6 set at 25.5)

p7	**Slip compensation**		mnem	SL	R–W
Range	0 to 5 when b14 = 120 0 to 10 when b14 = 240 0 to 20 when b14 = 480 0 to 25 when b14 = 960	Hz	Def. val.	0.0	
Related parameters	b14, b5				

Use to increase output frequency in relation to load in order to compensate for motor slip.

$$\text{Compensation} = \frac{I_{Load}\,\%}{p5} \times p7\,(\text{Hz})$$

Where $\mathbf{I_{load}}$ is the percentage load current as on the Dinverter display (see Section 6-1).

p8	**DC injection brake current**		mnem	BR	R–W
Range	40% to 150%	%FLC	Def. val.	150 (EUR) 120 (USA)	
Related parameters	b2, b7				

Use to set the maximum level of injection braking current.

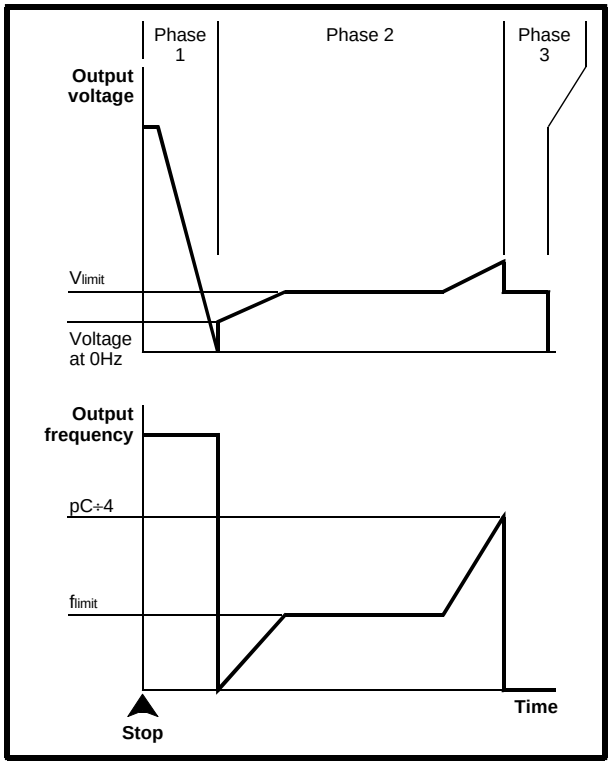

Figure 10–7 DC injection braking

Phase 1

The motor is de-fluxed by the applied motor voltage being reduced rapidly to zero while the frequency is maintained constant. The frequency is then reduced to 0Hz.

Phase 2

The frequency is increased from 0Hz (at a rate that is independent of **p2** *Acceleration time*). During the course of this frequency increase, the voltage increases to a level V_{limit} at which point the load current (as a percentage of FLC) equals the value set in parameter **p8**.

The Drive is then held in current limit for the time required for the motor speed to reduce to just above f_{limit}. At this point, the load-current starts to reduce. The frequency then continues to increase to the value of **pC**/4Hz (this is observed as a brief period of acceleration of the motor) before phase 3 commences.

Phase 3

A DC voltage proportional to V_{limit} is applied for 1 second to bring the motor to a halt.

Note

The voltages in phase 2 follow the standard V/f curves as described in Figures 10–4 to 10–6 (they are independent of the setting of b54 *Voltage-to-frequency ratio selector*). The setting of p6 *Torque (voltage) boost* and b3 *Low-speed torque-boost selector* will affect the voltage at 0Hz, which must not be higher than V_{limit} otherwise DC injection braking will fail.

If p6 is set at an excessive value for the motor, the current drawn might exceed the value set in p8 *DC injection brake current* (even when the motor has slowed down to f_{limit}) so that the Drive cannot complete phase 2. If this problem occurs, decrease the value of p6 or increase the value of p8.

Caution

When DC injection braking is being used, certain configurations of the Drive may cause the Drive *not* to stop the motor. If this occurs, make the following adjustments:

- **Increase the value of parameter p8**
- **Decrease the value of parameter p6**
- **Set parameter b14 at 11.7(kHz)**

p9	Serial address	mnem	SE	R–W
Range	0 to 99	Def. val.	11	
Related parameters	b6, b12			

Use to identify the Drive for serial communications.

pA	Fault log	mnem	T0 (pA0) to T9 (pA9)	RO
Range	0 to 9	Def. val.	0 to 9	
Related parameters	None			

This parameter contains the trip codes for the last ten trips, from the most recent (PA0) to the ninth previous (PA9).

See Chapter 11 *Diagnostics* for details of how to read the fault log and interupt the codes.

pb	Security code	mnem	SC	R–W
Range	Keypad: 100 to 255 Serial Comms: 0 to 255	Def. val.	0	
Related parameters	None			

This parameter is used to contain the security code number.

See Chapter 8 *Security* for details of setting up and using parameter **pb**.

b0	Speed or Torque reference selector	mnem	DS–14	R–W
Range	0 or 1	Def. val.	1	
Related parameters	p0, p1, p4			

Set **b0** at 0 to select Torque reference. The speed is set using **p1**. The direction is determined by the Forward/Reverse key.

Set **b0** at 1 to select Speed reference. Speed and Torque references are both active. The Torque reference is subject to the limit set in **p4**

b1	Keypad Auto or Manual Start selector	mnem	DS–13	R–W
Range	0 or 1	Def. val.	1	
Related parameters	None			

Keypad mode

The setting of **b1** defines the behaviour of the Drive when AC power is applied.

b1 set at 0 (Keypad Auto Start)

The Drive starts the motor as soon as AC power is applied to the Drive.

b1 set at 1 (Keypad Manual Start)

When AC power is applied to the Drive, the display shows **rdY** alternating with the set speed.

To start the Drive, press 

Drive tripped

If the Drive is in a trip condition when AC power is applied, press the following keys in the order given to start the Drive:

Terminal mode

The setting of **b1** defines the behaviour of the Drive under the following conditions:

After a momentary loss of AC power when the motor is running (ie. the display does not go blank)

UU trip shown on the display

b1 set at 0

When AC power is restored, the Drive automatically re-starts the motor. The display returns to showing the set speed.

b1 set at 1

When AC power is restored, the Drive remains tripped. The display continues to show **UU**.

b2	**Stopping mode selector**	mnem	DS–12	R–W
Range	0 or 1	Def. val.	0	
Related parameters	b7, b27			

Make settings for the required stopping mode, as follows:

Parameter	**Settings**			
b27	0	0	0	0
b2	0	0	1	1
b7	0	1	0	1
When **Enable** signal is removed (terminal C9)	Standard ramp	Coast	DC injection	High-level ramp
When **RUN** signal is removed (terminal C10 or C12)	Standard ramp	Standard ramp	Standard ramp	High-level ramp
When **SPEED** reference is reduced (terminal C2 or C5)	Standard ramp	Standard ramp	Standard ramp	High-level ramp
Display	**Speed** or **% FLC**	**Inh**	**dC**	**Speed** or **% FLC**

When **b27** is set at 1, see parameter **b27** for the stopping conditions.

Standard ramp

If regenerated energy causes the DC-bus voltage to reach its upper threshold level, deceleration ceases. When the DC-bus voltage then falls to below its lower threshold level, deceleration continues. This can result in speed being reduced in steps and the overall deceleration time extended.

If the regenerated energy is excessive, the Drive will trip (trip code: **OV**).

High-level ramp

Deceleration is continuous. If the DC-bus voltage reaches its maximum limit, the Drive will trip (trip code **OV**).

Use this mode when a braking resistor is connected to the Drive (see *External braking resistor* in Chapter 4 *Installing the Drive*).

Coast

Following a **STOP** command, the output stage of the Drive is immediately disabled, allowing the motor to coast.

1 second after the **STOP** command, the display shows **rdY** and the Drive can be re-started.

DC injection

See parameter **p8**.

b3	**Low-speed torque boost selector**	mnem	DS–11	R–W
Range	0 or 1	Def. val.	0	
Related parameters	p6			

Set **b3** at 0 to select auto boost. This is dependent on the load. The maximum voltage boost is set in **p6**.

Set **b3** at 1 to select fixed boost. This is independent of the load. The value is set in **p6**.

b4	Bipolar select	mnem	DS–10	R–W
Range	0 or 1		Def. val.	1
Related parameters	p0, p1			

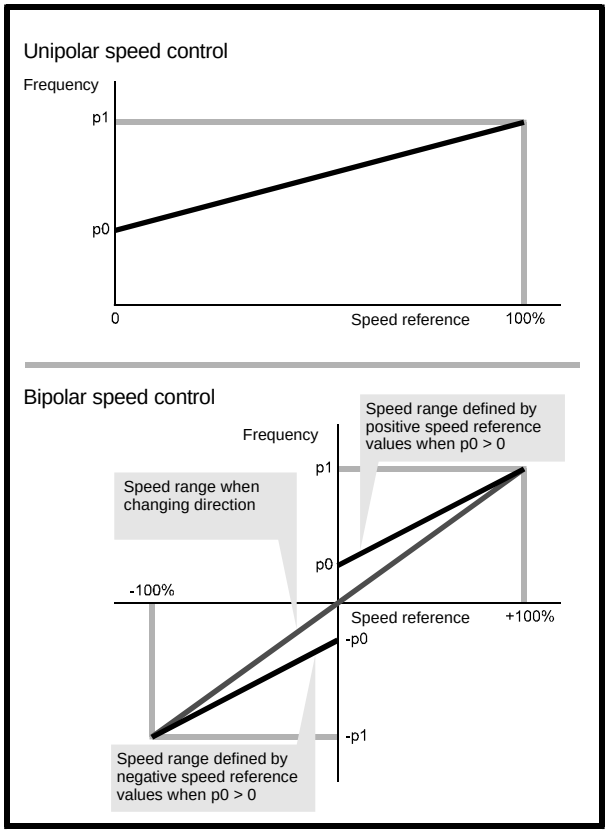

Figure 10–8 Speed ranges in unipolar and bipolar modes

b4 set at 0

Bipolar mode selected. An analog signal applied to terminal C2 is scaled so that +10V corresponds to the positive value set in p1. –10V corresponds to the negative value.

b4 set at 1

Unipolar mode selected. An analog signal applied to terminal C2 is scaled so that +10V corresponds to the value set in **p1**. 0V corresponds to the value set in **p0**.

Negative input signals are treated the same as 0V.

b5	Logic selector	mnem	DS–9	R–W
Range	0 or 1		*	
Related parameters	None			

* **b5** does not have a default setting, and is not affected when **b13** *Parameter reset* is set at 1.

Set **b5** at 0 to select positive logic (0 = 0V, 1 = 24V).
Set **b5** at 1 to select negative logic (0 = 24V, 1 = 0V).

Since the setting of **b5** takes effect only when AC power is applied to the Drive, after changing the setting of **b5**, remove and re-connect AC power.

Warning

Connecting a Drive configured in negative logic to a positive-logic PLC could cause the Drive to start the motor automatically when power is connected to the Drive.

b6	Speed reference selector	mnem	DS–8	R–W
Range	0 or 1		Def. val.	0
Related parameters	b9, b11			

Set **b6** and apply a signal to terminal C11 to select the source of the speed reference, as follows:

b6 set at 0
Terminal C11 not connected

Speed is controlled by an analog voltage applied to terminal C2.

Parameters may be read using serial communications.

b6 set at 0
Terminal C11 connected to 0V

Speed is controlled by an analog current applied to terminal C5.

Parameters may be read using serial communications.

b6 set at 1
C11 not connected

Speed is controlled by an analog voltage applied to terminal C2.

Parameters may be read using serial communications.

b6 set at 1
C11 connected to 0V

Speed is controlled using serial communications. Read–write parameters may be changed using serial communications.

b7	Stopping mode selector	mnem	DS–7	R–W
Range	0 or 1		Def. val.	0
Related parameters	b2, b27			

See parameter **b2**.

b8	Display mode selector	mnem	DS–6	R–W
Range	0 or 1		Def. val.	0
Related parameters	None			

Set **b8** at 0 for the frequency to be displayed.
Set **b8** at 1 for the % FLC to be displayed.

When **b9** is set to 0 for operation in Keypad mode, **b8** has no effect; only the frequency can then be displayed.

b9	Terminal or Keypad mode selector	mnem	DS–5	R–W
Range	0 or 1		Def. val.	1
Related parameters	b51			

Set **b9** at 0 to select Keypad mode.
Set **b9** at 1 to select Terminal mode.

b10	Display time-out mode	mnem	DS–4	R–W
Range	0 or 1		Def. val.	0
Related parameters	None			

Set **b10** at 0 for the display to return from Edit mode to Status mode after eight seconds of no key presses.
Set **b10** at 1 for the display to return from Edit mode to Status mode by pressing the **Mode** key for 1 second.

b11	Remote reference input selector	mnem	DS–2,3	R–W
Range	4.20, 20.4 or 0.20		Def. val.	4.20
Related parameters	b26, b28			

Select the range of the current signal applied to terminal C5, as follows:

b11 set at **4.20**

4mA Minimum frequency
20mA Maximum frequency

b11 set at **20.4**

20mA Minimum frequency
4mA Maximum frequency

b11 set at **0.20**

0mA Minimum frequency
20mA Maximum frequency

The direction of rotation is controlled by signals applied to terminals C10 and C12.

b12	Baud rate selector	mnem	DS–0	R–W
Range	4.8 or 9.6		Def. val.	4.8
Related parameters	p9, b6			

Select the required baud rate as follows:
4.8 = 4800 baud
9.6 = 9600 baud

b13	Parameter reset	mnem		R–W
Range	0 or 1		Def. val.	0
Related parameters	All R–W parameters			

Before resetting all R–W parameters to their default values, check that the safety of the system will not be impaired.

Set **b13** at 1 to reset all parameters to the corresponding default setting, except for **b5** *Logic selector* and those in Menu 60. When the Drive parameters are reset, **b13** returns to 0.

b14	Switching frequency and frequency range selector		mnem	FQ	R–W
Range	2.9, 5.9, 8.8, 11.7 120, 240, 480, 960	kHz Hz	Def. val.		2.9, 120
Related parameters	p0, p1, p7, pc, p10 to p12, p20 to p26				

Two entries are required for this parameter. The first entry defines the PWM switching frequency. When the Mode key is pressed, the second entry is displayed. This defines the Upper Limit Frequency (ULF).

Note that higher ULFs can be selected only when a higher PWM switching frequency is used.

PWM frequency (kHz)	Permissible settings for ULF (Hz)			
2.9	120	240		
5.9	120	240		
8.8	120	240	480	
11.7	120	240	480	960

PWM switching frequency

Setting a higher PWM frequency has the following effects:

More heat produced in the Drive
Less torque produced at very low speed
Higher ULF can be set
Less acoustic noise produced by the motor

Note

The electrical noise emissions increase with higher PWM switching frequencies. See *Electromagnetic compatibility* in Chapter 2 *Data*.

Upper Limit Frequency (ULF)

When using a standard 50Hz or 60Hz motor, the ULF should be set at 120Hz. If a special high-speed motor is used, the ULF may be set at a higher value.

The behaviour of other control functions is dependent on the ULF value, as follows:

Minimum frequency set in **p0**
Maximum frequency set in **p1**
Acceleration time set in **p2**
Deceleration time set in **p3**
Maximum voltage frequency set in **pC**

Warning

After changing the value of b14, ensure p0, p1, p2, p3 and pC are set correctly before starting the Drive.

pc	Maximum voltage frequency		mnem	BS	R–W
Range	[ULF ÷ 16] to ULF	Hz	Def. val.		50 (EUR) 60 (USA)
Related parameters	b14, b54				

Set the lowest frequency at which the Drive is able to deliver the rated output voltage.
(ULF = Upper Limit Frequency)

pd	Menu selector		mnem		R–W
Range	0, 10, 20, 30, 40, 50, 60		Def. val.		0
Related parameters	None				

Enter the required menu number to display parameters in another menu,. The menus are as follows:

Value	Menu
0	Standard parameters
10	Skip frequencies and bands
20	Preset speeds
30	Preset accelerations and jog
40	Preset decelerations and jog
50	Auto reset
60	Drive information

Parameter **pd** appears at the end of each menu.

10.2 Menu 10 — Skip frequencies

p10 p11 p12	**Skip frequency 1** **Skip frequency 2** **Skip frequency 3**	mnem	S1 S2 S3	R–W
Range	Between the values of p0 and p1 Hz	Def. val.	0	
Related parameters	p0, p1, p13 to p15			

If the mechanical system resonates at one or more frequencies, setting Skip frequencies prevents the Drive operating at these frequencies. During accceleration and deceleration, the Drive ignores the Skip frequencies.

Note

If the values of p0 and p1 are changed, it may be necessary to change the Skip frequencies in order to keep them within the permissible frequency range.

When **p10**, **p11** and **p12** are set at **p0** or **p1**, the Skip frequency is disabled.

p13 p14 p15	**Skip band 1** **Skip band 2** **Skip band 3**	mnem	B1 B2 B3	R–W
Range	±0.5 to ±5.0 Hz	Def. val.	±0.5	
Related parameters	p0, p1, p10 to p12			

Select the width of a band either side of the related Skip frequency through which the output frequency is required to pass but not stabilize.

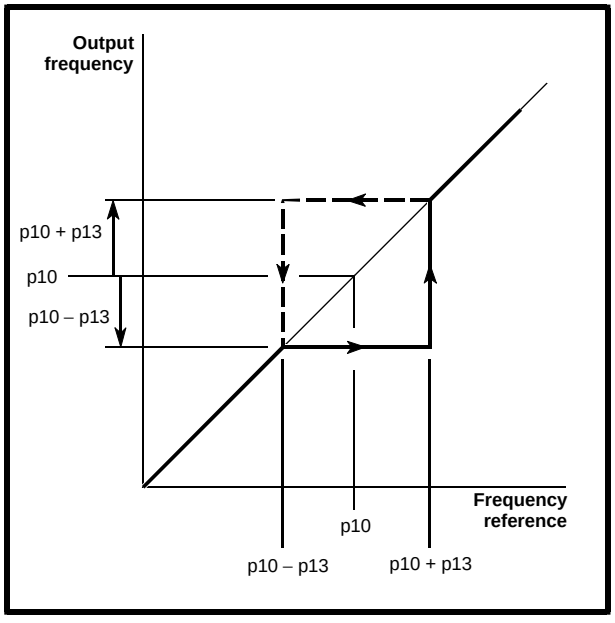

Figure 10–9 Action of Skip frequencies

10.3 Menu 20 — Preset speeds

p20 ~ p26	**Preset speeds**		R–W
Range	p0 to ±p1 Hz	Def. val.	0

Enter the required preset speeds.

Parameter	Preset speed	mnemonic	Related parameters
p20	1	P1	p30, p40 b20, b21, b22, b23
p21	2	P2	p31, p41 b20, b21, b22, b23
p22	3	P3	p32, p42 b20, b21, b22, b23
p23	4	P4	p33, p43 b20, b21, b22, b23
p24	5	P5	p34, p44 b20, b21, b22, b23
p25	6	P6	p35, p45 b20, b21, b22, b23, b28
p26	7	P7	p36, p46 b20, b21, b22, b23, b28

Note

If the values of p0 or p1 are changed, it may be necessary to change the values of p20 to p26 to maintain them within the permissible range.

When **b28** is set at 1 to select PI control, the functions of parameters **p25** and **p26** are changed as follows:

p25 Proportional gain
p26 Integral gain

p27	**Jog Speed**	mnem	PJ	R–W
Range	±15 Hz	Def. val.	+1.5 (EUR) +5.0 (USA)	
Related parameters	p37, p47, b20, b21, b22, b23			

When adjusting the jog speed, press the Forward/Reverse key to set the direction of rotation of the motor during jog.

b20	**Preset speed selector**	mnem	C1–8	R–W
Range	0 or 1	Def. val.	0	
Related parameters	p20 to p27			

Set **b20** at 0 to select three preset speeds and jog. Terminals B8 and B9 are used to select the three preset speeds. Terminal B10 is used for jog control.

The jog function operates only when the display shows **rdY**.

Note

The jog acceleration and deceleration times are always controlled by parameters p37 and p47.

Set **b20** at 1 to select seven preset speeds. Terminals B8, B9 and B10 are used to control these preset speeds. Jog is not available in this mode.

b21 b23	**Preset ramp selectors**	mnem	C1–9 C1–6	R–W
Range	0 or 1	Def. val.	b21 = 0 b23 = 0	
Related parameters	p2, p3, p20 to p27, p30 to p37, p40 to p47			

A combination of settings for parameters **b21** and **b23** selects acceleration and deceleration times. The settings can also be used to configure terminals B8, B9 and B10 as ramp select inputs.

b21 set at 0
b23 set at 0

The preset speeds use the acceleration and deceleration times set in **p2** and **p3**.

b21 set at 1
b23 set at 0 or 1

The preset speeds use their own acceleration and deceleration times, as follows:

Preset speed 1 (**p20**) uses Preset acceleration 1 (**p30**) and Preset deceleration 1 (**p40**)

Preset speed 2 (**p21**) uses Preset acceleration 2 (**p31**) and Preset deceleration 2 (**p41**)

b21 set at 0
b23 set at 1

Terminals B8, B9 and B10 can be configured as digital inputs for selecting pre-programmed acceleration and deceleration times. The output frequency is determined by the reference frequency since the preset speeds set in **p20** to **p26** are ignored. Refer to the following tables:

b20 set at 0 (3 preset speeds and jog)

Terminals		Acceleration set in...	Deceleration set in...
B9	**B8**		
O/C	O/C	p2	p3
O/C	0V	p30	p40
0V	O/C	p31	p41
0V	0V	p32	p42

Note

The jog control input on terminal B10 operates normally.

b20 set at 1 (7 preset speeds)

Terminals			Acceleration set in...	Deceleration set in...
B10	**B9**	**B8**		
O/C	O/C	O/C	p2	p3
O/C	O/C	0V	p30	p40
O/C	0V	O/C	p31	p41
O/C	0V	0V	p32	p42
0V	O/C	O/C	p33	p43
0V	O/C	0V	p34	p44
0V	0V	O/C	p35	p45
0V	0V	0V	p36	p46

b21 set at 1
b23 set at 1

The preset speeds use their own acceleration and deceleration times, as follows:

Preset speed 2 (**p21**) uses Preset acceleration 2 (**p31**) and Preset deceleration 2 (**p41**)

Preset speed 3 (**p22**) uses Preset acceleration 3 (**p32**) and Preset deceleration 3 (**p42**)

Preset speed 4 (**p23**) uses Preset acceleration 4 (**p33**) and Preset deceleration 4 (**p43**)

Preset speed 5 (**p24**) uses Preset acceleration 5 (**p34**) and Preset deceleration 5 (**p44**)

Preset speed 6 (**p25**) uses Preset acceleration 6 (**p35**) and Preset deceleration 6 (**p45**)

Preset speed 7 (**p26**) uses Preset acceleration 7 (**p36**) and Preset deceleration 7 (**p46**)

b22	**Preset speed reversal selector**	mnem	C1–7	R–W
Range	0 or 1	Def. val.	0	
Related parameters	p20 to p26			

Set **b22** at 0 to enable the direction of rotation to be controlled by terminals C10 and C12 when the motor is running.

Set **b22** at 1 to enable the direction of rotation to be controlled by the polarity of preset speeds **p20** to **p26**. To reverse the rotation when adjusting a preset speed, press:

b24 **b25**	**Analog output selector**	mnem	C1–5 C1–4	R–W
Range	0 or 1	Def. val.	b24 = 0 b25 = 0	
Related parameters	p1, p5			

b24 set at 0
b25 set at 0

An analog voltage signal proportional to the Drive frequency is produced on terminal B1.

Voltage range: 0 to ±10V
Maximum current: 5mA
Accuracy: ±5% of full-scale
0V at 0Hz
+10V at +**p1**, −10V at −**p1**

An analog current signal proportional to the load on the motor is produced on terminal B2.

Current range: 4 to 20mA
Accuracy: ±10% above 15Hz with matched motor
4mA at 0% FLC
20mA at 150% FLC (motoring and regenerating)

b24 set at 0
b25 set at 1

An analog voltage signal proportional to the load on the motor is produced on terminal B1.

Voltage range: 0V to ±10V
Maximum current: 5mA
Accuracy: ±10% above 15Hz with matched motor
0V at 0% FLC
+10V at 150% FLC motoring
−10V at 150% FLC regenerating

An analog current signal proportional to the Drive frequency is produced on terminal B2.

Current range: 4 to 20mA
Accuracy: ±5% of full-scale
4mA at 0Hz
20mA at ±**p1**

b24 set at 1
b25 set at 0

A digital signal of +10V is produced on terminal B1 when the output current of the Drive equals the percentage of full load current (FLC) entered in **p5**.

An analog current output signal proportional to the load on the motor is produced on terminal B2.

Current range: 4 to 20mA
Accuracy: ±10% above 15Hz with matched motor
4mA at 0% FLC
20mA at 150% FLC (motoring or regenerating)

b24 set at 1
b25 set at 1

A digital signal of +10V is produced on terminal B1 when the output current of the Drive equals the percentage of full load current (FLC) entered in **p5**.

An analog current output signal proportional to the Drive frequency is produced on terminal B2.

Current range: 4 to 20mA
Accuracy: ±5% of full-scale
4mA at 0Hz
20mA at ±**p1**

b26	**Current-loop loss selector**	mnem	C1–3	R–W
Range	0 or 1	Def. val.	0	
Related parameters	None			

Set **b26** at 0 for the Drive to trip on loss of current loop. The Drive trips when the current applied to terminal C5 falls below 3mA.

Set **b26** at 1 for the Drive not to trip on loss of current loop.

b27	Normal-running ramp selector	mnem	C1–2	R–W
Range	0 or 1		Def. val.	0
Related parameters	b2, b7			

Set **b27** at 1 for high-level ramp deceleration instead of standard-ramp deceleration when **b2** and **b7** are set as follows:

Parameter	Settings			
b27	1	1	1	1
b2	0	0	1	1
b7	0	1	0	1
When **Enable** signal is removed (terminal C9)	High-level ramp	Coast	DC injection	High-level ramp
When **RUN** signal is removed (terminal C10 or C12)	High-level ramp	High-level ramp	High-level ramp	High-level ramp
When **SPEED** reference is reduced (terminal C2 or C5)	High-level ramp	High-level ramp	High-level ramp	High-level ramp
Display	**Speed** or **% FLC**	**Inh**	**dC**	**Speed** or **% FLC**

High AC supply voltages, Parallel DC buses, Spurious increases in DC-bus voltage

It is advisable to set **b27** at 1 when either or both the following conditions apply:

- The AC supply voltage is at or near the maximum permissible value for the Drive
- The DC-bus voltage is raised by the action of an external source (eg. when DC buses are connected in parallel, or when long motor cables cause spurious increases in DC-bus voltage)

Setting **b27** at 1 prevents the standard-ramp function from becoming confused and indefinitely prolonging the deceleration ramp. In this case, the Drive would not stop the motor.

Adjusting the deceleration time

When **b27** is set at 1, it may be necessary to increase the value of **p3** *Deceleration time* in order to prevent the Drive tripping due to excessive DC-bus voltage (trip code **OV**).

b28	PI control selector	mnem	PI	R–W
Range	0 or 1		Def. val.	0
Related parameters	p25, p26, b11			

The PI loop in the Drive can be used to control the speed of a motor in applications where a constant level (pressure, air-flow, temperature, etc) needs to be maintained. A transducer is used to feed back a signal representing the quantity that is to be controlled. If the feedback signal is lower than the required level, the Drive responds by increasing the motor speed until the required level is attained. If the feedback signal is higher than the required level, the Drive responds by reducing the motor speed towards zero (but never into reverse) until the required level is attained.

To select PI control, set **b28** at 1 and connect terminal C11 to 0V.

A combination of settings for **b28** and connections to terminal C11 (Local/Remote) selects the source of the frequency reference, as follows:

b28	Terminal C11	Frequency source
0	O/C	Local
0	0V	Remote
1	O/C	Local
1	0V	PI loop

If the transducer fails, this arrangement allows local control of the Drive to be selected without changing the setting of **b28**. This ensures the system can remain in operation.

When **b28** is set at 1 to select PI control, ***p25*** and **p26** are no longer used as preset speeds. Their functions become as follows:

p25 Proportional gain
p26 Integral gain

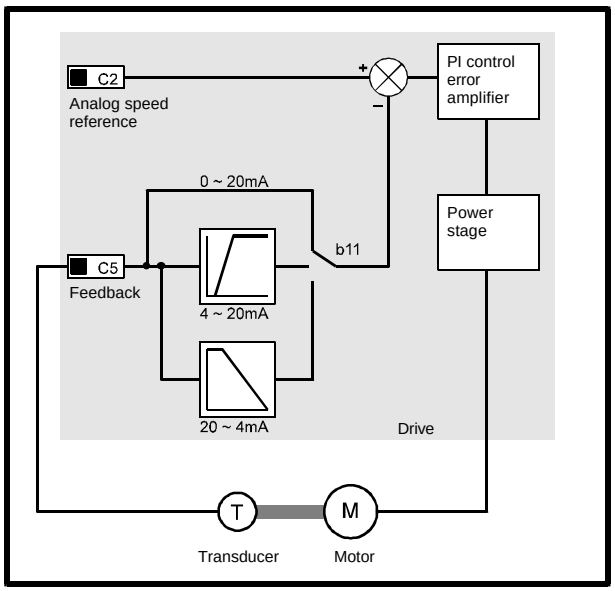

Figure 10–10 PI control loop

The required level of the quantity that is being controlled is set by a reference signal applied to terminal C2 (local speed reference input). The feedback from the transducer is applied to terminal C5 (remote speed reference input).

The transducer output must be in one of the following ranges:

4 to 20mA
20 to 4mA
0 to 20mA

Refer to parameter **b11** *Remote reference input selector*.

If the transducer output is a voltage signal, the signal must be converted and scaled into an appropriate current signal.

Setting up PI control

To achieve optimum performance using PI control, use the following procedure:

1. Set **p2** and **p3** as low as is practical without upsetting the load or tripping the Drive. Verify this by starting and stopping the Drive in local control. Setting **p2** or **p3** too high may affect the dynamic performance of the Drive.
2. Connect an oscilloscope probe to terminal C5.
3. Set the local speed reference (terminal C2) to represent a level of the controlled quantity that is significantly higher than that obtained before the AC supply is connected to the Drive.
4. Start the Drive and observe the oscilloscope trace as the Drive tries to increase the controlled quantity to the set level. Increase the value of parameter ***p25*** *Proportional gain* as necessary.
5. Stop the Drive and repeat steps 3 to 5 using progressively higher values for ***p25***. If instability is observed (refer to Figure 10–10), decrease the value of ***p25*** slightly.
6. Stop the Drive and repeat steps 3 to 6 using the last value of ***p25*** and but progressively higher values of **p26** *Integral gain*. If instability is observed, decrease the value of **p26** slightly.
7. Set the local speed reference (terminal C2) at the required value.

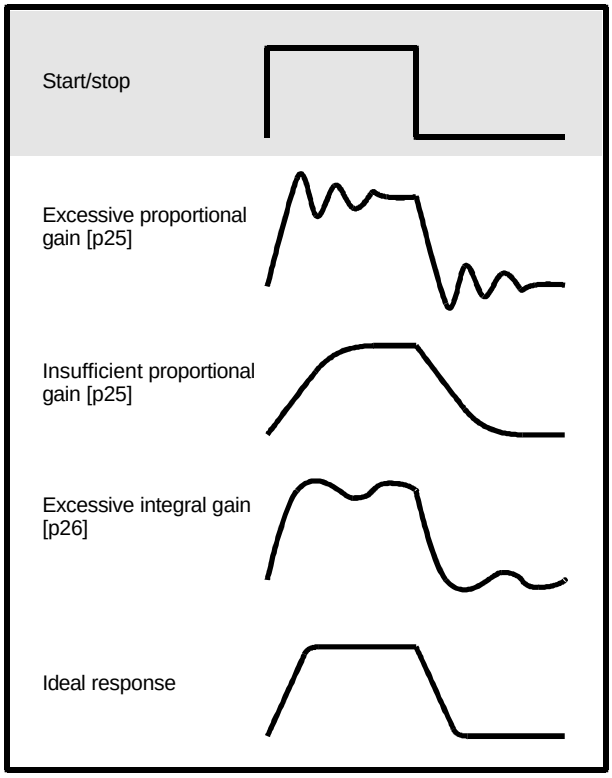

Figure 10–11 Effects of adjusting the proportional and integral gains

10.4 Menu 30 — Preset acceleration times

Calculating acceleration and deceleration times

Use the following equations to calculate the time required to accelerate from speed $\mathbf{f_1}$ to Preset speed 1, or to decelerate from speed $\mathbf{f_1}$ to Preset speed 1.

$$\mathbf{t_{acc}} = \mathbf{p30}\ \frac{(\mathbf{p20} - \mathbf{f_1})}{\mathbf{ULF}}$$

$$\mathbf{t_{dec}} = \mathbf{p40}\ \frac{(\mathbf{f_1} - \mathbf{p20})}{\mathbf{ULF}}$$

Where:

The value of **p20** defines the speed prior to the change.

t = Time required for the Drive output frequency to change

ULF = Upper Limit Frequency in Hz (value of parameter **b14**

To calculate acceleration and deceleration for other preset speeds, substitute the appropriate parameter numbers in the equations (eg. for acceleration to Preset speed 2, use parameters **p31** and **p21**. For deceleration, use parameters **p41** and **p21**). See **p30 ~ p36** and **p40 ~ p46** below.

When the speed is returned from a preset speed to the speed reference (by opening the appropriate contact at terminals B8, B9 or B10), the acceleration ramp set in **p2** and the deceleration ramp set in **p3** are applied.

p30 ~ p36	**Preset accelerations**			R–W
Range	0.2 to 600	sec	Def. val.	5.0

Enter the required preset acceleration times.

Parameter	Preset accel	mnemonic	Related parameters
p30	1	A1	p20, p40 b21, b22, b23
p31	2	A2	p21, p41 b21, b22, b23
p32	3	A3	p22, p42 b21, b22, b23
p33	4	A4	p23, p43 b21, b22, b23
p34	5	A5	p24, p44 b21, b22, b23
p35	6	A6	p25, p45 b21, b22, b23
p36	7	A7	p26, p46 b21, b22, b23

p37	**Jog acceleration**		mnem	AJ	R–W
Range	0.2 to 600	sec	Def. val.		0.2
Related parameters	p27, p47, b21, b22, b23				

Enter the required jog acceleration time.

10.5 Menu 40 — Preset deceleration times

p40 ~ p46	Preset decelerations			R–W
Range	0.2 to 600	sec	Def. val.	10.0
Related parameters				

Enter the required preset deceleration times.

Parameter	Preset decel	mnemonic	Related parameters
p40	1	D1	p20, p30 b21, b22, b23
p41	2	D2	p21, p31 b21, b22, b23
p42	3	D3	p22, p32 b21, b22, b23
p43	4	D4	p23, p33 b21, b22, b23
p44	5	D5	p24, p34 b21, b22, b23
p45	6	D6	p25, p35 b21, b22, b23
p46	7	D7	p26, p36 b21, b22, b23

p47	Jog deceleration		mnem	DJ	R–W
Range	0.2 to 600	sec	Def. val.	0.2	
Related parameters	p27, p37, b21, b22, b23				

Enter the required jog deceleration time.

10.6 Menu 50 — Automatic reset

p50	Number of reset attempts		mnem	RN	R–W
Range	0, 1, 2, 3, 4, 5		Def. val.	0	
Related parameters	None				

Set **p50** at the number of automatic resets (attempted or successful) that may be performed before a manual reset is needed.

Set **p50** at 0 to disable automatic reset.

While an automatic reset is being attempted, the number of remaining attempts is shown flashing on the display (this figure decrements by 1 for each attempt).

The attempts counter is restored to the value of **p50** when any of the following occur:

AC supply is applied to the Drive
p50 is changed
A trip is manually reset

Note

The automatic reset function does not operate when an external trip (trip code: Et) or phase loss trip (trip code: ph) has occurred.

p51	Reset delay		mnem	RD	R–W
Range	1.0 to 5.0	secs	Def. val.	1.0	
Related parameters	None				

Set **p51** at a value to delay the start of the automatic reset after the occurrence of a trip.

b50	Status relay selector		mnem	C1–10	R–W
Range	0 or 1		Def. val.	0	
Related parameters	None				

Set **b50** at 0 for the status relay contacts to be closed for **Drive normal**.
Set **b50** at 1 for the status relay contacts to be closed for **At speed**.

The relay contacts open when AC power is removed or when the Drive trips.

b51	FORWARD/REVERSE key selector	mnem	C1–11	R–W
Range	0 or 1	Def. val.	0	
Related parameters	None			

When **b9** is set at 0, set **b51** at 0 to disable the FORWARD/REVERSE key.

Set **b51** at 1 to enable the FORWARD/REVERSE key.

b52	Synchronize to a spinning motor selector	mnem	C1–12	R–W
Range	0 or 1	Def. val.	0	
Related parameters	None			

Set **b52** at 1 to enable the Drive to be synchronized with a motor whose shaft is spinning, without causing the Drive to trip.

When the Drive receives a RUN command, the Drive scans the motor frequency from the value of **p1** to 0Hz in the last direction of motor rotation, and from the value of **p1** to 0Hz in the opposite direction. The Drive frequency will then be synchronized with the motor speed.

When the Drive speed is synchronized with the motor speed, the Drive accelerates or decelerates the motor to the speed set by the frequency reference input.

During the scanning period, the display shows **Scn**.

b53	Status output selector	mnem	C1–13	R–W
Range	0 or 1	Def. val.	0	
Related parameters	None			

b53 is used to select the mode of operation of the **DRIVE STATUS output** (terminal A3), as follows:

Negative logic (b5 set at 1)

b53 set at 0

When the Drive is running, the **DRIVE STATUS output** transistor is on. When the Drive is not running, the transistor is off.

b53 set at 1

When the Drive is above **Minimum speed**, the **DRIVE STATUS output** transistor is on. When the Drive is at or below **Minimum speed**, the transistor is off.

Positive logic (b5 set at 0)

b53 set at 0

When the Drive is running, the **DRIVE STATUS output** transistor is off. When the Drive is not running, the transistor is on.

b53 set at 1

When the Drive is above **Minimum speed**, the **DRIVE STATUS output** transistor is off. When the Drive is at or below **Minimum speed**, the transistor is on.

b54	Voltage-to-frequency ratio selector	mnem	C1–14	R–W
Range	0 or 1	Def. val.	0	
Related parameters	pc, p6, b3			

Set **b54** at 1 to select dynamic voltage-to-frequency ratio. The output voltage is then dependent on load current.

At zero load, the applied voltage is 50% of the normal full voltage. As the load increases, the applied voltage increases in proportion to the load. Maximum voltage is applied at, and above, 70% of full load.

b55	Stop/reset key selector	mnem	C1–1	R–W
Range	0 or 1	Def. val.	0	
Related parameters	b9			

Operation in Terminal mode

b55 set at 0

Stop/reset has no function.

b55 set at 1

Stop/reset can be used to manually reset the Drive when it has tripped.

Warning

Pressing the red Stop/Reset key may cause the Drive to *start* if signals are still applied to any of the following terminals:

C9 *ENABLE*
C10 *RUN FORWARD*
C12 *RUN REVERSE*

The Drive may start also if Serial Communications control is in use requesting the Drive to run.

If the Drive is to be left running unattended, it is advisable to ensure b55 is set at 0.

Keypad mode

b55 set at 0 or 1

Stop/reset can be used to reset trips. The Drive displays **rdY** and will not start until either of the following occurs:

Run is pressed.

Parameter **b1** *Keypad Auto or Manual start selector* is set at 0 for Auto-start and the AC supply is next connected to the Drive.

b56	**Deceleration selector for non-important trips**	mnem	C1–0	R–W
Range	0 or 1		Def. val.	0
Related parameters	None			

When **b56** is set at 1, a non-important trip will cause the Drive to decelerate to a halt using the Standard ramp for deceleration (see parameter **b27**).

The non-important trips are as follows:

Oh Heatsink temperature
th Motor temperature
Et External trip
cL Loss of reference signal current loop

Terminal mode

When the Drive is in Terminal mode, the display shows a constant (not flashing) trip code during deceleration. When the Drive frequency reaches 0Hz, the output stage is disabled and the trip code flashes.

If the Drive is reset during deceleration it will decelerate to 0Hz, then accelerate to the set frequency.

Keypad mode

When the Drive is in Keypad mode, the display indicates the trip condition during deceleration by alternating between the set frequency value and the trip code.

If the Drive is reset during deceleration, it will not accelerate the motor to the set speed. The Drive will continue to decelerate to 0Hz and display **rdY** alternating with the value of the set frequency.

10.7 Menu 60 — Read-only parameters

p60	Power rating of the Drive	mnem	DR	RO
Range	kW	Def. val.		
Related parameters	None			

p60 shows the power rating of the Drive as follows:

Model	Number of phases	AC supply voltage	Motor rating		Value displayed
		V	kW	HP	
DIN1220075B	1	200 ~ 240	0.75	1.0	751
DIN1220150B	1	200 ~ 240	1.5	2.0	151
DIN1220220B	1	200 ~ 240	2.2	3.0	221
DIN3220075B	3	200 ~ 240	0.75	1.0	752
DIN3220150B	3	200 ~ 240	1.5	2.0	152
DIN3220220B	3	200 ~ 240	2.2	3.0	222
DIN3380075B	3	380 ~ 480	0.75	1.0	753
DIN3380110B	3	380 ~ 480	1.1	1.5	113
DIN3380150B	3	380 ~ 480	1.5	2.0	153
DIN3380220B	3	380 ~ 480	2.2	3.0	223
DIN3380300B	3	380 ~ 480	3.0	4.0	303
DIN3380400B	3	380 ~ 480	4.0	5.3	403

p61	Drive software version number	mnem	SV	RO
Range		Def. val.		
Related parameters	None			

p61 shows the software version of the Drive.

p62 p63	Duration of Drive running time	mnem	RL RH	RO
Range	Hrs	Def. val.		
Related parameters	None			

p62 shows the time the Drive has been running in hours. (eg. if the display shows 56.7 the Drive has been running for 567 hours — ignore the decimal point.)

p63 shows the time the Drive has been running in units of 1,000 hours. (eg. if the display shows 1.2, the Drive has been powered-up for 12,000 hours — ignore the decimal point.)

In this example, the total time the Drive has been powered-on is 12,567 hours.

Reading p62 and p63 on a host computer

The complete running-time figure is stored in the Drive as a 20-bit word. To read the running-time on a host computer, read the values of **RH** and **RL** and store them as separate hexadecimal numbers. Then combine the two hexadecimal numbers as in the following example:

RH = 0800

RL = 12AB

The combined hexadecimal number = 812AB. (The zeroes in the value of **RH** are ignored.)

Convert the hexadecimal number into a decimal number (the decimal value of 812AB is 529067).

Perform the following on the decimal number in order to obtain the running time in various units:

Hours

Divide by 16 (529067 ÷ 16 = 33066.7)

Days

Divide by 24 (33066.7 ÷ 24 = 1377.8)

Weeks

Divide by 7 (1377.8 ÷ 7 = 196.8)

Years

Divide by 52 (196.8 ÷ 52 = 3.78)

p64	DC bus braking level	mnem	BL	R–W
Range	540 to 840 VDC	Def. val.	750 (EUR) 770 (USA)	
Related parameters	b2, b7, b27			

The value of **p64** defines the DC bus voltage at which the braking resistor is switched into circuit.

Single-phase models
Three-phase 200V to 240V models

This parameter can be adjusted, but has no effect.

Fixed value: 377V

Three-phase 380V to 480V models

Enter the required value of DC bus voltage for DC braking to be applied.

Calculate the required voltage from:

$$\mathbf{p64} = \left(1.1 \times \mathbf{Vac}_{(nom)} \times \sqrt{2}\right) + 50$$

where:

Vac$_{(nom)}$ is the nominal AC supply voltage (subject to a ±10% tolerance)

Values in excess of the calculated value will cause the following to occur when braking:

Increased braking torque

Motor to be excessively fluxed

Drive can trip on overcurrent (OI)

Warning

Values below the calculated value can cause the braking circuit to be in continuous operation. This can destroy the braking resistor and present a fire hazard if the thermal protection described in *External braking resistor* in Chapter 4 *Installing the Drive* is not effective.

p65	(Unused)			

b60 ~ b65	Factory settings			

These parameters cannot be used.