Installation, Operation and Maintenance Manual

VLT® 6000 Series
Adjustable Frequency Drive

Danfoss

⚠ DANGER

Rotating shafts and electrical equipment can be hazardous. Therefore, it is strongly recommended that all electrical work conform to National Electrical Code (NEC) and all local regulations. Installation, start-up and maintenance should be performed only by qualified personnel.

Factory recommended procedures, included in this manual, should be followed. Always disconnect electrical power before working on the unit.

Although shaft couplings or belt drives are generally not furnished by the manufacturer, rotating shafts, couplings and belts must be protected with securely mounted metal guards that are of sufficient thickness to provide protection against flying particles such as keys, bolts and coupling parts. Even when the motor is stopped, it should be considered "alive" as long as its controller is energized. Automatic circuits may start the motor at any time. Keep hands away from the output shaft until the motor has completely stopped and power is disconnected from the controller.

Motor control equipment and electronic controls are connected to hazardous line voltages. When servicing drives and electronic controls, there will be exposed components at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case of an emergency. Disconnect power whenever possible to check controls or to perform maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on electric control or rotating equipment.

Safety Guidelines

1. The drive must be disconnected from the AC line before any service work is done.
2. The "Stop/Off" key on the local control panel of the drive does not disconnect the equipment from the AC line and is not to be used as a safety switch.
3. Correct protective grounding of the equipment must be established. The user must be protected against supply voltage and the motor must be protected against overload in accordance with applicable national and local regulations.
4. Ground currents are higher than 3 mA.

Warnings Against Unintended Start

1. While the drive is connected to the AC line, the motor can be brought to a stop by means of external switch closures, serial bus commands or references. If personal safety considerations make it necessary to ensure that no unintended start occurs, these stops are not sufficient.
2. During programming of parameters, the motor may start. Be certain that no one is in the area of the motor or driven equipment when changing parameters.
3. A motor that has been stopped may start unexpectedly if faults occur in the electronics of the drive, or if an overload, a fault in the supply AC line or a fault in the motor connection or other fault clears.
4. If the "Local/Hand" key is activated, the motor can only be brought to a stop by means of the "Stop/Off" key or an external safety interlock.

NOTE
It is responsibility of user or person installing drive to provide proper grounding and branch circuit protection for incoming power and motor overload according to National Electrical Code (NEC) and local codes.

The Electronic Thermal Relay (ETR) in UL listed VLTs provides Class 20 motor overload protection in accordance with NEC in single motor applications, when parameter 117 is set for "ETR TRIP 1", "ETR TRIP 2", "ETR TRIP 3", or "ETR TRIP 4", and parameter 105 is set for rated motor (nameplate) current.

⚠ DANGER

Touching electrical parts may be fatal – even after equipment has been disconnected from AC line. To be sure that capacitors have fully discharged, wait 14 minutes after power has been removed before touching any internal component.

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SOFTWARE VERSION NOTICE: These Operating Instructions are used for all VLT 6000 Series Drives with software version 2.X and all prior versions. The software version number can be determined from parameter 624, *Software Version*.

General

The specific installation instructions may vary depending upon the model of VLT 6000 Series being installed. When this occurs, the model can be identified by a "VLT Type 6XXX" number. This number can be found on the red nameplate on the outside of the left side of the drive enclosure, or the outside of the right side of a drive with an auxiliary enclosure. A cross reference from the VLT Type to the Danfoss Graham model number can be found on the next page.

The drive must always be installed vertically. To ensure that no injury or damage occurs, the drive must always be firmly attached to the wall or the floor before further installation work is carried out.

Clearances

The drive is cooled by means of air circulation. For proper cooling, the minimum distances above and below the unit must be maintained as shown in the table below. For units with an auxiliary enclosure mounted with the drive on a back panel, the required clearances are measured from the top and bottom of the drive, not the back panel.
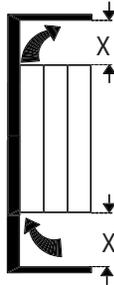

Drive Type	Top Clearance	Bottom Clearance	Must be mounted flush to wall
VLT 6002-6005, 200-240V VLT 6002-6011, 380-460V	4" (100mm)	4" (100mm)	No
VLT 6006-6032, 200-240V VLT 6016-6062, 380-460V	8" (200mm)	8" (200mm)	Yes
VLT 6042-6062, 200-240V VLT 6075-6125, 380-460V	9" (225mm)	9" (225mm)	Yes
VLT 6150-6275, 380-460V	12" (300mm)	12" (300mm)	Yes
VLT 6350-6550, 380-460V	16" (400mm)	floor mount	Yes

All drives can be mounted with no side clearance. VLT 6350-6550 drives require 25 inches (605 mm) front space for access.

All drives except VLT 6002-6005, 200 to 240 V and VLT 6002-6011, 380 to 460 V must be mounted directly to the wall with no spacers. This is to ensure that air flow is in contact with the heatsink all the way from the bottom of the drive. If this is not possible, a metal plate at least as large as the back of the drive must be firmly mounted to the back of the drive. See the Cross Reference Table on the next page to convert model numbers to drive type.

All drives except VLT 6002-6005, 200 to 240 V and VLT 6002-6011, 380 to 460 V must be mounted directly to a solid wall with no spacers between the drive and the wall.
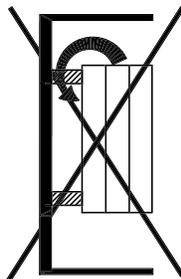
Sufficient space must be left in front of the drive to provide for door swing on units with a hinged door. In addition, sufficient room must be available for installation and service access. On units with an auxiliary enclosure, the auxiliary enclosure door will have a greater door swing than the drive. See the dimensional drawings of the auxiliary enclosure which are included with the drive.

Plenum Mounting

The drive is UL rated for plenum mounting. If the drive is to be mounted in the plenum, allow sufficient access for servicing. All normal clearance, temperature and humidity limitations apply.

Grounding Plate

VLT Type 6002-6005, 200 to 240 V and VLT 6002-6001, 380 to 460 V drives with a NEMA 1 enclosure have a plastic bottom cover with provision for conduit entry. To meet UL requirements, the metal grounding plate must be in place above the plastic bottom cover. It must be grounded to the chassis, and the conduit grounded to it. If the grounding plate is not factory installed, it must be installed in the drives that have a plastic bottom panel to ensure proper grounding of the conduit to the enclosure. Connect the ground wire from the grounding plate to the ground tab marked with the ground symbol.

This tab is located near the AC line terminal strip. Mount the bottom cover on the control unit. ⏚

Shielded Wires

Wires to control signals should be shielded to reduce radio frequency noise interference.

When RFI is a concern, shielded cable should be used between the drive and the motor.

If unshielded control wires are used, control inputs are subject to signal disturbances. Such disturbances may affect drive operation. Extreme noise levels may disturb the microprocessor of the control card.

The shield of the control wires must be grounded at the cable clamp at the bottom of the drive, but the shield must continue with the cable all the way up to the control card. The shield is not to be connected to any of the terminals on the control card. For safety reasons, the insulation around the shield should only be removed where it is connected to the cable clamp. The insulation should be left on the shield between the clamp and the terminals.

Generally speaking, all conductors coming from a shielded control cable must be as short as possible. Long conductor ends attract noise. The shield must be connected to the chassis by means of the cable clamp. Long pigtails on the shield reduce the effectiveness of the shield.

Cross Reference —
Model Number to VLT Type

208 V Input

Model Number	VLT Type	Max. Nominal Output HP	Max. Drive Output Current
VLT6000C4.6	6002	1	4.6
VLT6000C6.6	6002	1½	6.6
VLT6000C7.5	6003	2	7.5
VLT6000C11	6004	3	10.6
VLT6000C17	6006	5	16.7
VLT6000C24	6008	7½	24.2
VLT6000C31	6011	10	30.8
VLT6000C46	6016	15	46.2
VLT6000C59	6022	20	59.4
VLT6000C75	6027	25	74.8
VLT6000C88	6032	30	88
VLT6000C114	6042	40	114
VLT6000C143	6052	50	143
VLT6000C169	6062	60	169

460 V Input

Model Number	VLT Type	Max. Nominal Output HP	Max. Drive Output Current
VLT6000H2.1	6002	1	2.1
VLT6000H3.0	6002	1½	3.0
VLT6000H3.4	6003	2	3.4
VLT6000H4.8	6004	3	4.8
VLT6000H8.2	6006	5	8.2
VLT6000H11	6008	7½	11.0
VLT6000H14	6011	10	14
VLT6000H21	6016	15	21
VLT6000H27	6022	20	27
VLT6000H34	6027	25	34
VLT6000H40	6032	30	40
VLT6000H52	6042	40	52
VLT6000H65	6052	50	65
VLT6000H77	6062	60	77
VLT6000H106	6075	75	106
VLT6000H130	6100	100	130
VLT6000H160	6125	125	160
VLT6000H190	6150	150	190
VLT6000H240	6175	200	240
VLT6000H302	6225	250	302
VLT6000H361	6275	300	361
VLT6000H443	6350	350	443
VLT6000H540	6400	450	540
VLT6000H590	6500	500	590
VLT6000H678	6550	600	678

230 V Input

Model Number	VLT Type	Max. Nominal Output HP	Max. Drive Output Current
VLT6000E4.2	6002	1	4.2
VLT6000E6.6	6002	1½	6.6
VLT6000E7.5	6003	2	7.5
VLT6000R11	6004	3	10.6
VLT6000E17	6006	5	16.7
VLT6000E24	6008	7½	24.2
VLT6000E31	6011	10	30.8
VLT6000E46	6016	15	46.2
VLT6000E59	6022	20	59.4
VLT6000E75	6027	25	74.8
VLT6000E88	6032	30	88
VLT6000E104	6042	40	104
VLT6000E130	6052	50	130
VLT6000E154	6062	60	154

380 V Input

Model Number	VLT Type	Max. Nominal Output kW	Max. Drive Output Current
VLT6000F3.0	6002	1.1	3.0
VLT6000F4.1	6003	1.5	4.1
VLT6000F5.6	6004	2.2	5.6
VLT6000F7.2	6005	3	7.2
VLT6000F10	6006	4	10
VLT6000F13	6008	5.5	13
VLT6000F16	6011	7.5	16
VLT6000F24	6016	11	24
VLT6000F32	6022	15	32
VLT6000F38	6027	18.5	37.5
VLT6000F44	6032	22	44
VLT6000F61	6042	30	61
VLT6000F73	6052	37	73
VLT6000F90	6062	45	90
VLT6000F106	6075	55	106
VLT6000F147	6100	75	147
VLT6000F177	6125	90	177
VLT6000F212	6150	110	212
VLT6000F260	6175	132	260
VLT6000F315	6225	160	315
VLT6000F368	6275	200	368

575 V Input

Model Number	VLT Type	Max. Nominal Output HP	Max. Drive Output Current
VLT6000J2.7	6016	2	2.7
VLT6000J3.9	6016	3	3.9
VLT6000J6.1	6016	5	6.1
VLT6000J9.0	6016	7½	9
VLT6000J11	6016	10	11
VLT6000J17	6016	15	17
VLT6000J22	6022	20	22
VLT6000J27	6027	25	27
VLT6000J32	6032	30	32
VLT6000J41	6042	40	41
VLT6000J52	6052	50	52
VLT6000J62	6062	60	62

Input Fuses

All drives must have input fuses installed in the power supply to the drive. These fuses may be specified as an option to the drive and supplied by Danfoss Graham. If specified, they will be installed by Danfoss Graham in an enclosure external to the drive which may include other optional features. If not supplied by Danfoss Graham, they must be supplied by the installer of the drive at the time of installation.

The required type of fuse for each drive size is shown in the table below. The fuse rating shown is both the maximum and the recommended fuse rating.

The drives are suitable for use on circuits capable of delivering not more than 100,000 RMS symmetrical amps, 500 volts maximum (600 volts maximum for 575 volt drives), when used with the recommended fuses.

208 Volt Input

Model Number	VLT Type	Maximum Fuse Rating	Bussman Type
VLT6000C4.6	6002	10	KTN-R or JJN
VLT6000C6.6	6003	15	KTN-R or JJN
VLT6000C7.5	6003	20	KTN-R or JJN
VLT6000C11	6004	25	KTN-R or JJN
VLT6000C17	6006	50	KTN-R or JJN
VLT6000C24	6008	50	KTN-R or JJN
VLT6000C31	6011	50	KTN-R or JJN
VLT6000C46	6016	60	KTN-R or JJN
VLT6000C59	6022	80	KTN-R or JJN
VLT6000C75	6027	125	KTN-R or JJN
VLT6000C88	6032	125	KTN-R or JJN
VLT6000C114	6042	150	FWX or FWH
VLT6000C143	6052	200	FWX or FWH
VLT6000C169	6062	250	FWX or FWH

575 Volt Input

Model Number	VLT Type	Maximum Fuse Rating	Bussman Type
VLT6000J2.7	6016	6	KTS-R or similar
VLT6000J3.9	6016	6	KTS-R or similar
VLT6000J6.1	6016	10	KTS-R or similar
VLT6000J9	6016	20	KTS-R or similar
VLT6000J11	6016	25	KTS-R or similar
VLT6000J17	6016	40	KTS-R or similar
VLT6000J22	6022	40	KTS-R or similar
VLT6000J27	6027	50	KTS-R or similar
VLT6000J32	6032	60	KTS-R or similar
VLT6000J41	6042	80	KTS-R or similar
VLT6000J52	6052	100	KTS-R or similar
VLT6000J62	6062	125	KTS-R or similar

All fuse ratings are in amps

460 Volt Input

Model Number	VLT Type	Maximum Fuse Rating	Bussman Type
VLT6000H2.1	6002	6	KTS-R or JJS
VLT6000H3.0	6002	6	KTS-R or JJS
VLT6000H3.4	6003	10	KTS-R or JJS
VLT6000H4.8	6004	10	KTS-R or JJS
VLT6000H8.2	6006	20	KTS-R or JJS
VLT6000H11	6008	25	KTS-R or JJS
VLT6000H14	6011	30	KTS-R or JJS
VLT6000H21	6016	40	KTS-R or JJS
VLT6000H27	6022	40	KTS-R or JJS
VLT6000H34	6027	50	KTS-R or JJS
VLT6000H40	6032	60	KTS-R or JJS
VLT6000H52	6042	80	KTS-R or JJS
VLT6000H65	6052	100	KTS-R or JJS
VLT6000H77	6062	125	KTS-R or JJS
VLT6000H106	6075	150	FWH
VLT6000H130	6100	200	FWH
VLT6000H160	6125	250	FWH
VLT6000H190	6150	300	FWH
VLT6000H240	6175	350	FWH
VLT6000H302	6225	400	FWH
VLT6000H361	6275	500	FWH
VLT6000H443	6350	600	FWH
VLT6000H540	6400	700	FWH
VLT6000H590	6500	800	FWH
VLT6000H678	6550	800	FWH

All fuse ratings are in amps

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Locations of Conduit Entry, Terminal Blocks
and Switches

NEMA 1

SWITCH 1-4

L1 L2 L3
91 92 93

U   V   W   PE
96 97 98 99

88   89
-DC +DC

01 02 03
AUX RELAY

RFI-SWITCH

ON
OFF

DANFOSS
175HA365.10
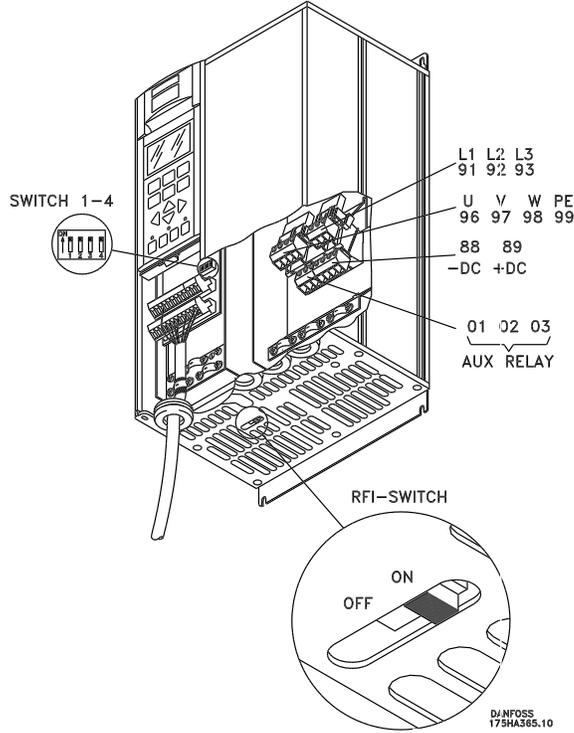
VLT 6002-6032, 200 to 240 V
VLT 6002-6062, 380 to 575 V
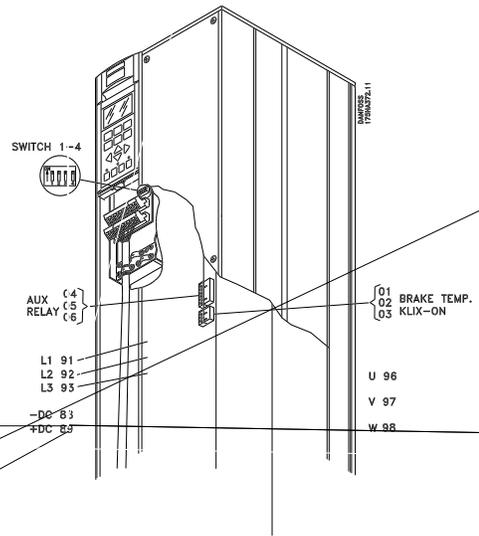
SWITCH 1-4

DANFOSS
175HA372.11

AUX   04
RELAY 05
       06

01
02 BRAKE TEMP.
03 KLIX-ON

L1 91
L2 92
L3 93

U 96

V 97

-DC 88
+DC 89

W 98

VLT 6042-6062, 200 to 240 V, VLT 6075-6125, 380 to 460 V   VLT 6150-6275, 380 to 460 V

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Locations of Conduit Entry, Terminal Blocks and Switches (continued)

NEMA 12
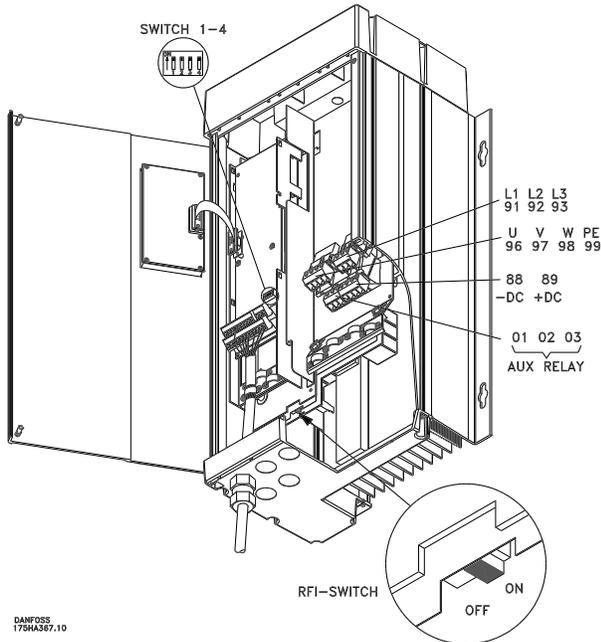
VLT 6002-6005, 200 to 240 V, VLT 6002-6011, 380 to 460 V
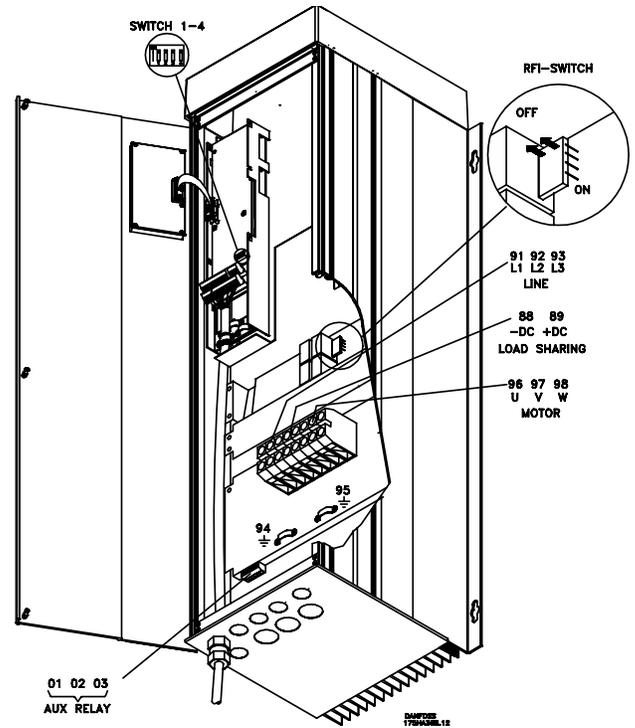
VLT 6006-6032, 200 to 240 V; VLT 6016-6032, 380 to 460 V

VLT 6042-6062, 200 to 240 V; VLT 6075-6125, 380 to 460 V

VLT 6150-6275, 380 to 460 V

NEMA 1 and NEMA 12

Soft charge fuses

Input snubber fuses

SWITCH 1-4

ON
1 2 3 4

105 BRAKE
106 TEMP.
104 KLIX-ON

24Vd.c.
35-   36+

R/L1/91

S/L2/92

T/L3/93

02 03 01
AUX RELAY

U/T1/96

V/T2/97

W/T3/98

+DC 89

−DC 88

R−/81

R+/82
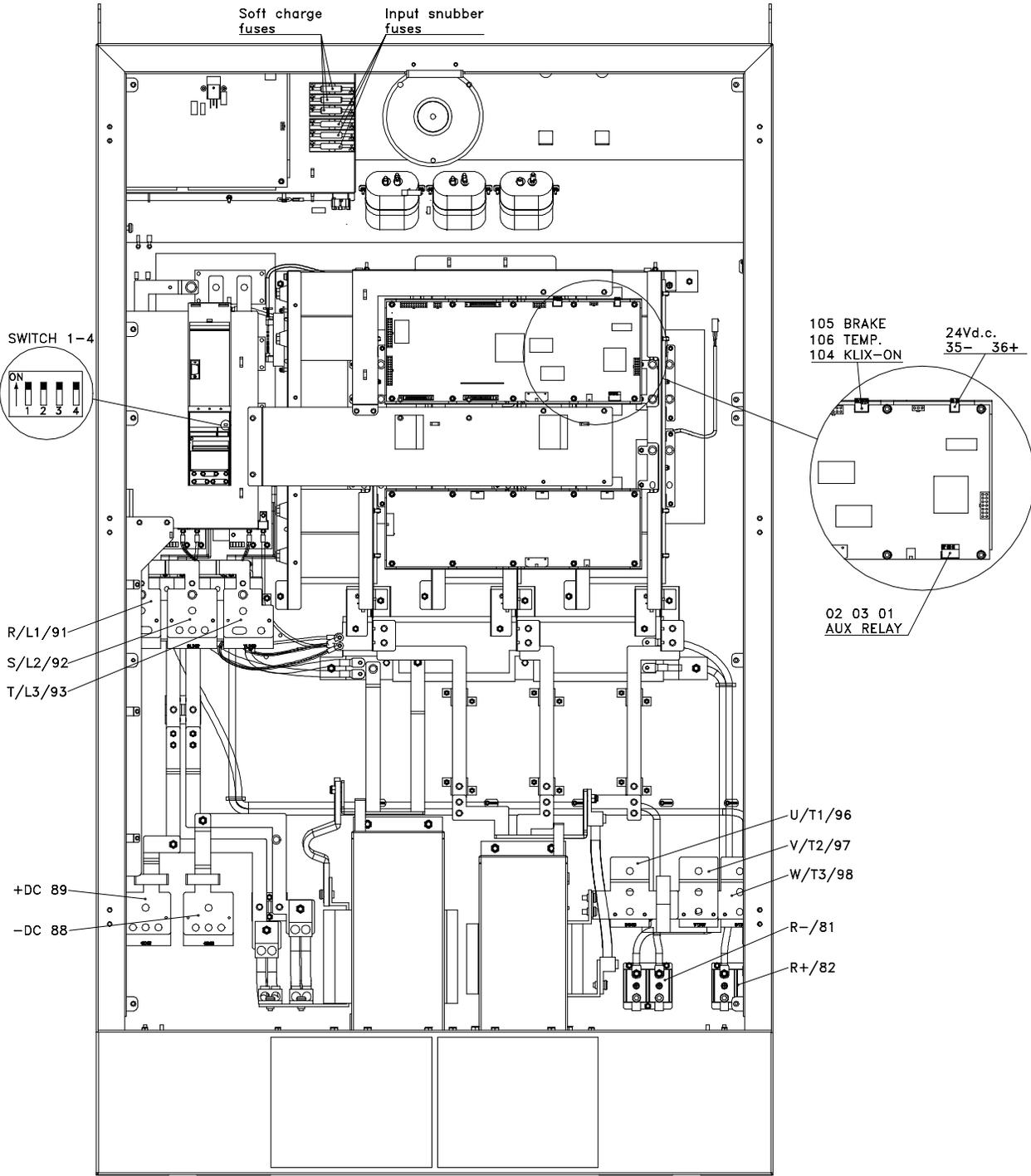
176FA046.10

VLT 6350-6550, 380 to 460 V

Location of Input Power (Mains) and Output Power (Motor Terminal Blocks)

Connect input power to the terminals identified as L1, L2 and L3.

Connect the motor leads to the terminals identified as U, V and W.

⚠WARNING

Connecting input power to motor terminals will result in drive failure when the power is applied.
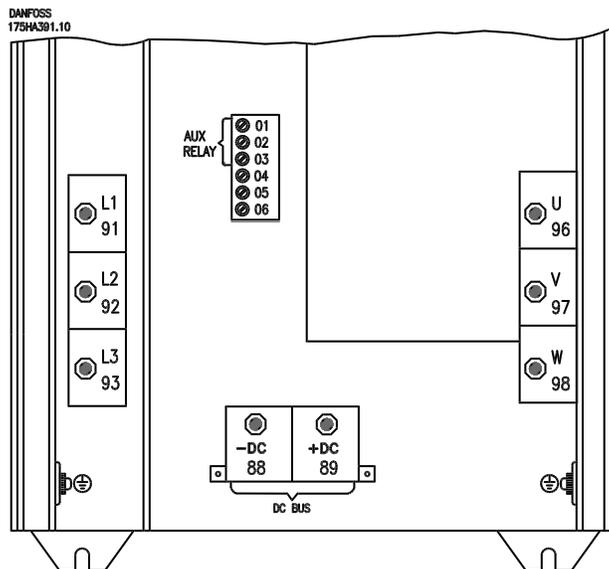
NEMA 1 and NEMA 12
VLT 6002-6005, 200-240 V
VLT 6002-6011, 380-460 V

NEMA 1
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V
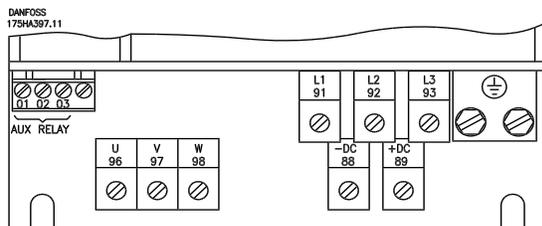
NEMA 1
VLT 6006-6032, 200-240 V
VLT 6016-6062, 380-575 V
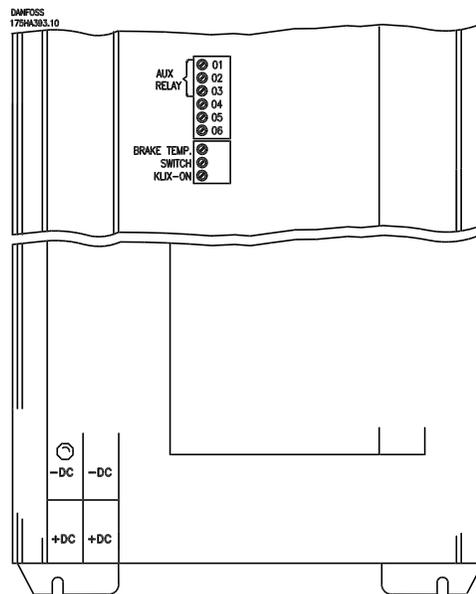
NEMA 1
VLT 6150-6275, 380-460 V

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Location of Input Power (Mains) and Output Power (Motor Terminal Blocks), continued

Connect input power to the terminals identified as L1, L2 and L3.

94 —— LL1 —— 95

AUX RELAY

NEMA 12
VLT 6006-6032, 200-240 V
VLT 6016-6062, 380-460 V

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175HA392.10

AUX
RELAY
01
02
03
04
05
06

BRAKE TEMP
SWITCH
KLIX—ON

L1
L2
L3
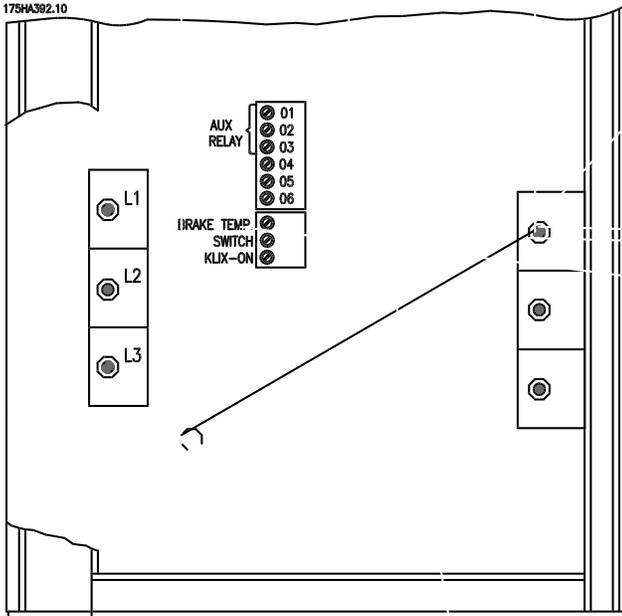
NEMA 12
VLT 6150-6275, 380-460 V

NEMA 12
VLT 6042-6062, 200-240 V
VLT 6075-6125, 380-460 V

Location of Input Power (Mains) and Output Power (Motor Terminal Blocks), continued

Connect input power to the terminals identified as L1, L2 and L3.
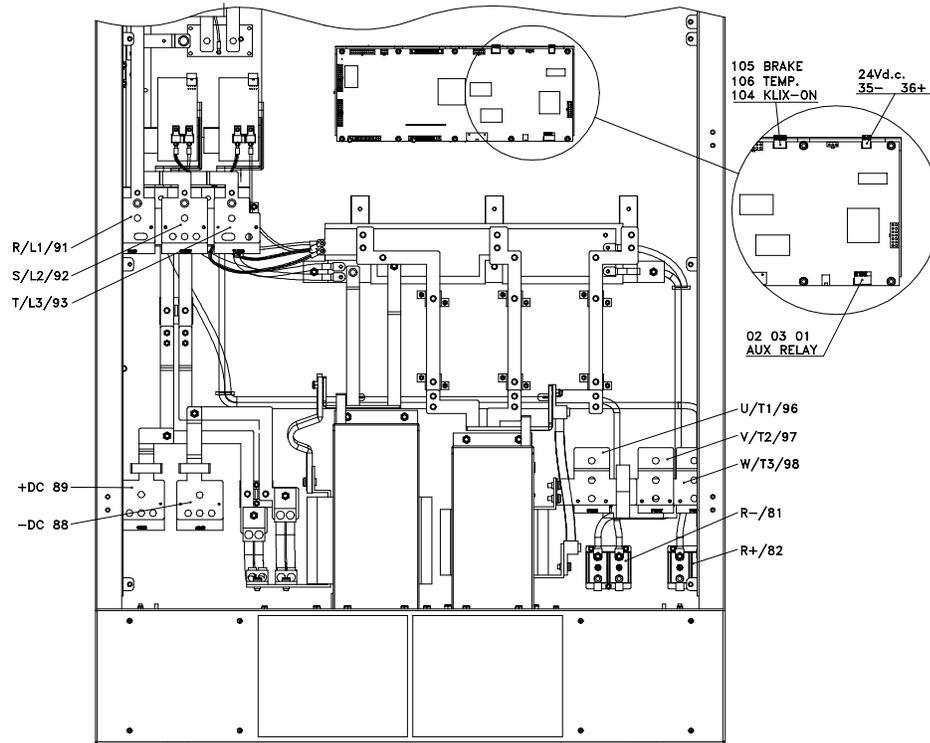
176FA044.10

NEMA 1 and NEMA 12, VLT 6350-6550, 380-460 V
without disconnector and mains fuses
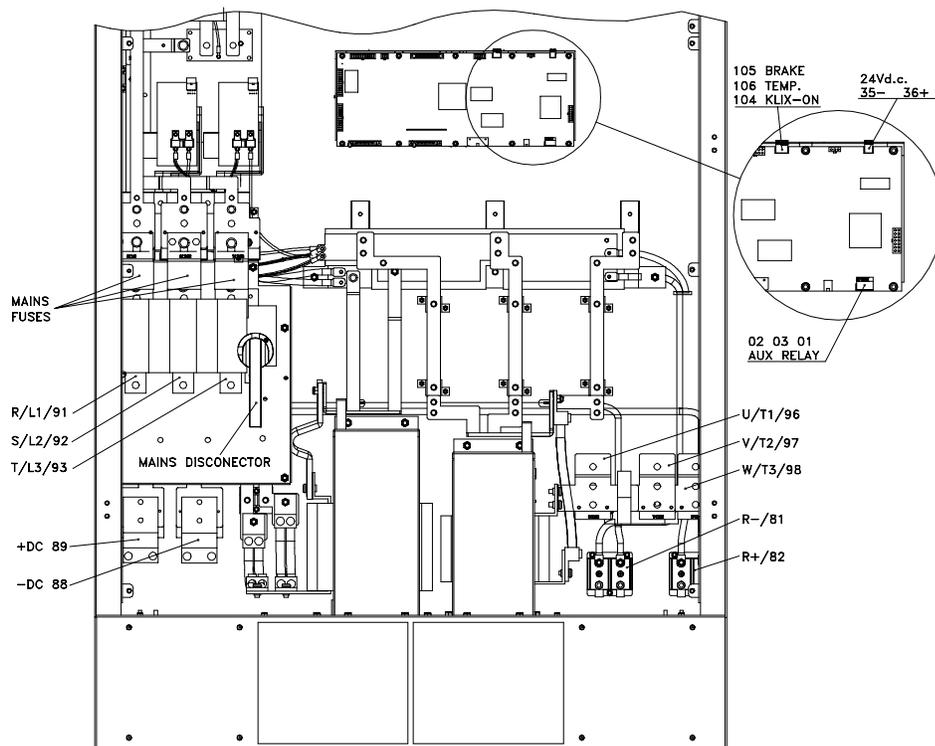
176FA045.10

NEMA 1 and NEMA 12, VLT 6350-6550, 380-460 V
with disconnector and mains fuses

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Power Connections

Make all power connections with 75°C rated copper wiring.

Conduit entry must be from the bottom on all drives. Conduit entries are provided on smaller drives. For drives with auxiliary enclosures, refer to the dimensional drawings provided for conduit entry locations.

To meet UL requirements, install the metal grounding plate in all drives that have a plastic bottom. Install the grounding plate just above the plastic bottom. Ground the metal plate to the chassis and ground the conduit to the metal plate.

The conduit entries provide strain relief for the wires in drives mounted in NEMA 1 or NEMA 12 enclosures. With chassis mounted drives, the power and control wires must have strain relief supplied by the installer. Do NOT rely on the terminal blocks to provide strain relief.

Input Power Connection

For drives with no auxiliary enclosure, connect input power to drive terminals L1, L2, and L3, (terminal numbers 91, 92, and 93). If an auxiliary enclosure is provided, input power connections are made in the auxiliary enclosure. Refer to the connection diagrams shipped with the drive.

Size wiring to the input current of the drive as shown in the tables below. Maximum AWG wire size is also provided.

⚠CAUTION

Enclosures for larger drives and auxiliary enclosures are made of metal. To avoid getting metal chips into electronics, do not drill any holes after unit has been installed in a vertical position.

⚠WARNING
**Connecting input power to motor terminals will result in drive failure when power is applied.**

Motor Wiring Connection

For drives with no auxiliary enclosure, connect the motor to drive terminals U, V, and W (terminal numbers 96, 97, and 98). Terminal 99 is earth ground. If an auxiliary enclosure is provided, refer to the connection diagrams shipped with the drive. Ground the shield on the motor wire, if used, at both the drive and the motor.

⚠DANGER
For operator safety, it is important to ground drive properly.

Grounding

Ground the drive properly. Use a ground wire at least 7 AWG (10mm^2). Connect the ground wire directly to a reliable earth ground. Do not use the conduit connecting to the drive as a replacement for a ground wire. Do not ground one drive to another in a "daisy chain" fashion.

Electronic Thermal Protection

The electronic thermal relay is UL approved for single motor thermal protection as long as the following is complied with:

1. Parameter 117, *Thermal Protection*, is set to ETR TRIP.
2. Parameter 105, *Motor Current*, is set for the full-load nameplate motor current.

460 VAC Input Current/Wire Gage

Drive Input Current	Maximum AWG	Model
2.5	10	H2.1
2.5	10	H3.0
3.4	10	H3.4
4.8	10	H4.8
8.3	10	H8.2
10.6	10	H11
14	10	H14
21	6	H21
27.6	6	H27
34	6	H34
41	6	H40
53	2	H52
64	2	H65
77	2	H77
103	1/0	H106
145	2/0	H130
174	3/0	H160
206	2x1/0	H190
256	2x1/0	H240
317	2x3/0	H302
366	2x4/0	H361
443	3x1/0	H443
540	3x3/0	H540
590	3x3/0	H590
678	3x4/0	H678

575 VAC Input Current/Wire Gage

Drive Input Current	Maximum AWG	Model
2.5	6	J2.7
3.0	6	J3.9
6.0	6	J6.1
9.0	6	J9.0
10.0	6	J11
16.7	6	J17
21.6	6	J22
26.6	6	J27
31.5	6	J32
40.3	2	J41
51.2	2	J52
61.0	0	J62

All current ratings are in amps.

208 VAC Input Current/Wire Gage

Drive Input Current	Maximum AWG	Model
5.0	10	C4.6
6.0	10	C6.6
7.0	10	C7.5
10.0	10	C11
16.0	10	C17
23.0	6	C24
30.0	6	C31
46.0	6	C46
59.2	2	C59
74.8	2	C75
88.0	0	C88
101.3	1/0	C114
126.6	3/0	C143
149.9	4/0	C169

Terminal Tightening Torque

Tighten terminals connecting the drive input power, output to the motor(s) and ground to the values shown in the tables below. Drives with 200 to 240 volts of 88 amps and less, and drives with 380 to 575 volts of 90 amps and less, have removable terminal blocks with screws. Larger drives have fixed bolts. (See the drive nameplate for maximum drive output current.)

NOTE
Tighten terminals of 575 volt drives of 32 amps and below to 17 in-lbs (1.8 Nm), and above 32 amps to 28 in-lbs (3.0 Nm).

200 to 240 VAC Terminal Tightening Torque

Max. Drive Output Current	Torque in-lbs (Nm)
6.6	5 (0.6)
7.5	5 (0.6)
10.6	5 (0.6)
16.7	5 (0.6)
24.2	17 (1.8)
30.8	17 (1.8)
46.2	28 (3.0)
59.4	28 (3.0)
74.8	28 (3.0)
88	35 (4.0)
114	100 (11.3)
143	100 (11.3)
169	100 (11.3)

380 to 460 VAC Terminal Tightening Torque

Max. Drive Output Current	Torque in-lbs (Nm)	Max. Drive Output Current	Torque in-lbs (Nm)
to 10	5 (0.6)	147	100 (11.3)
16	5 (0.6)	177	100 (11.3)
24	17 (1.8)	212	100 (11.3)
32	17 (1.8)	260	100 (11.3)
37.5	17 (1.8)	315	100 (11.3)
44	28 (3.0)	368	100 (11.3)
61	28 (3.0)	487	372 (42.0)
73	28 (3.0)	594	372 (42.0)
90	28 (3.0)	649	372 (42.0)
106	100 (11.3)	746	372 (42.0)

All current ratings are in amps.

200 to 240 VAC Auxiliary Control Panel Tightening Torques

Max. Drive Output Current	Overload Relay	Power Terminal Blocks	Circuit Breaker	Disconnect or Transfer Switch	Main or Bypass Fuse Block	Drive Fuse Block	Ground Terminal
to 6.6	15 (1.7)	15 (1.7)	22 (2.5)	7 (0.8)	20 (2.3)	35 (4.0)	45 (5.1)
7.5	15 (1.7)	15 (1.7)	22 (2.5)	7 (0.8)	25 (2.8)	35 (4.0)	45 (5.1)
10.6	15 (1.7)	15 (1.7)	22 (2.5)	7 (0.8)	25 (2.8)	35 (4.0)	45 (5.1)
16.7	15 (1.7)	15 (1.7)	22 (2.5)	7 (0.8)	25 (2.8)	35 (4.0)	45 (5.1)
24.2	15 (1.7)	50 (5.7)	22 (2.5)	7 (0.8)	45 (5.1)	45 (5.1)	45 (5.1)
30.8	15 (1.7)	50 (5.7)	22 (2.5)	7 (0.8)	120 (13.6)	45 (5.1)	45 (5.1)
46	75 (8.5)	50 (5.7)	44 (5.0)	18 (2.0)	120 (13.6)	120 (13.6)	45 (5.1)
61.2	75 (8.5)	275 (31.1)	44 (5.0)	18 (2.0)	120 (13.6)	275 (31.1)	50 (5.6)
74.8	120 (13.6)	275 (31.1)	44 (5.0)	18 (2.0)	120 (13.6)	275 (31.1)	50 (5.6)
88	120 (13.6)	275 (31.1)	44 (5.0)	70 (8.0)	120 (13.6)	275 (31.1)	50 (5.6)
115	120 (13.6)	275 (31.1)	44 (5.0)	375 (42.4)	275 (31.1)	150 (16.9)	50 (5.6)
143	250 (28.3)	275 (31.1)	50 (5.6)	375 (42.4)	275 (31.1)	150 (16.9)	120 (13.6)
169	275 (31.4)	275 (31.1)	50 (5.6)	375 (42.4)	275 (31.1)	150 (16.9)	150 (16.9)

380 to 575 VAC Auxiliary Control Panel Tightening Torques

Max. Drive Output Current	Overload Relay	Power Terminal Blocks	Circuit Breaker	Disconnect or Transfer Switch	Main or Bypass Fuse Block	Drive Fuse Block	Ground Terminal
10	15 (1.7)	15 (1.7)	22 (2.5)	7 (0.8)	20 (2.3)	25 (2.8)	45 (5.1)
16	15 (1.7)	15 (1.7)	22 (2.5)	7 (0.8)	25 (2.8)	25 (2.8)	45 (5.1)
24	75 (8.5)	15 (1.7)	22 (2.5)	7 (0.8)	25 (2.8)	45 (5.1)	45 (5.1)
32	75 (8.5)	35 (4.0)	22 (2.5)	7 (0.8)	45 (5.1)	45 (5.1)	45 (5.1)
37.5	75 (8.5)	35 (4.0)	22 (2.5)	18 (2.0)	45 (5.1)	45 (5.1)	45 (5.1)
44	75 (8.5)	50 (5.6)	44 (5.0)	18 (2.0)	45 (5.1)	120 (13.6)	45 (5.1)
61	75 (8.5)	110 (12.5)	44 (5.0)	18 (2.0)	120 (13.6)	120 (13.6)	50 (5.6)
73	75 (8.5)	110 (12.5)	44 (5.0)	55 (6.2)	120 (13.6)	275 (31.1)	50 (5.6)
90	75 (8.5)	110 (12.5)	44 (5.0)	70 (8.0)	120 (13.6)	275 (31.1)	50 (5.6)
106	120 (13.6)	110 (12.5)	50 (5.6)	375 (42.4)	275 (31.1)	150 (16.9)	50 (5.6)
147	250 (28.3)	275 (31.1)	50 (5.6)	375 (42.4)	275 (31.1)	150 (16.9)	120 (13.6)
177	275 (31.1)	275 (31.1)	50 (5.6)	375 (42.4)	275 (31.1)	150 (16.9)	150 (16.9)
212	275 (31.1)	275 (31.1)	50 (5.6)	375 (42.4)	450 (50.8)	275 (31.1)	150 (16.9)
260	275 (31.1)	275 (31.1)	375 (42.4)	500 (56.5)	450 (50.8)	275 (31.1)	150 (16.9)
315	375 (42.4)	375 (42.4)	375 (42.4)	500 (56.5)	450 (50.8)	275 (31.1)	150 (16.9)
368	375 (42.4)	375 (42.4)	375 (42.4)	375 (42.4)	375 (42.4)	275 (31.1)	150 (16.9)

All current ratings are in amps. All torques are in in-lbs (Nm). All TB1 connections must be torqued to 8 in-lbs (0.9 Nm).

Multiple Motors

The VLT 6000 can control several motors at once, all changing speed together. The sum of the nameplate currents of all the motors must not exceed the current rating of the drive.

⚠WARNING

When multiple motors are used, VLT 6000 electronic thermal relay cannot be used to provide individual motor protection. A separate motor overload must be supplied for each motor.

If the multiple motors are of significantly different sizes, starting problems may occur. This is because the higher electrical resistance of smaller motors will require more start voltage than larger motors.

⚠CAUTION

Automatic Motor Adaptation and Automatic Energy Optimization cannot be used for multiple motor installations.

External DC Bus Connection

Terminals 88 and 89 access the DC bus of the drive. They can provide DC backup power for the drive or to connect to a 12-pulse input rectifier.

⚠DANGER

Terminals 88 and 89 will be at approximately 150% of line voltage and remain at high voltage for up to 14 minutes after power has been removed from the drive.

⚠WARNING

Do not connect anything to terminals 88 and 89 without first consulting with Danfoss Graham.

High Voltage Form C Relay

The connections for the high-voltage relay are terminals 01, 02, 03. The high-voltage relay is programmed in parameter 323, *Relay Output 1.*

> 1+3 normally closed, 1+2 normally open
> Max. 240 VAC, 2 Amp
> Min. 24 VDC, 10 mA or
> 24 VAC, 100 mA

Max. wire gage: 10 AWG (4 mm^2)
Terminal Torque: 5 in-lbs (0.5 - 0.6 Nm)
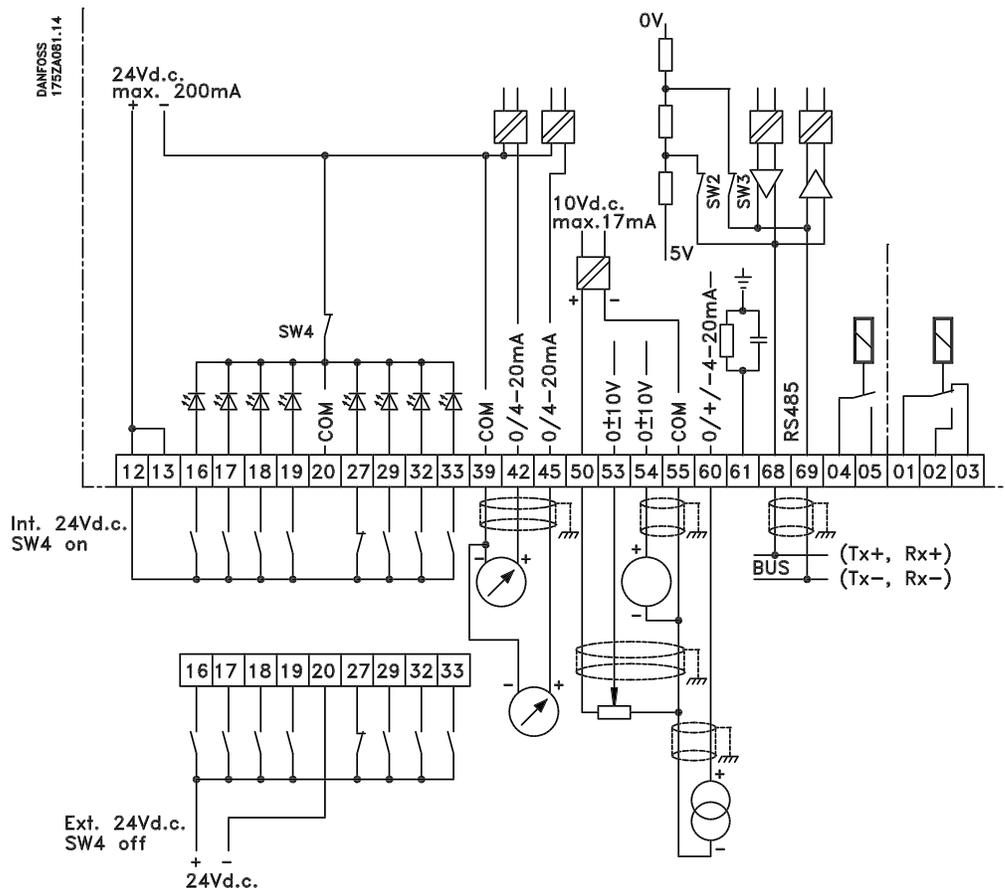
Electronic Control Terminals

Control Connections

All terminals for the low voltage control wires are located under the protective cover below the keypad. Remove the cover with a screwdriver or other pointed object as shown below.

DANFOSS
175ZA02.10
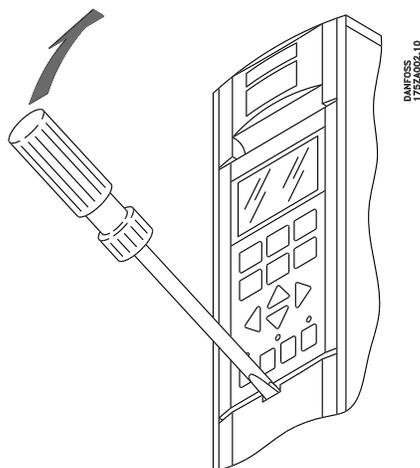
Electrical Installation, Control Terminals

Torque the control terminals to 5 in-lbs (0.5-0.6 N-m)

The diagram below shows the location of the control terminals. The programming section of the manual covers the programmable terminals in greater depth.
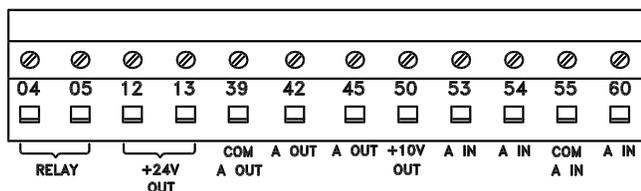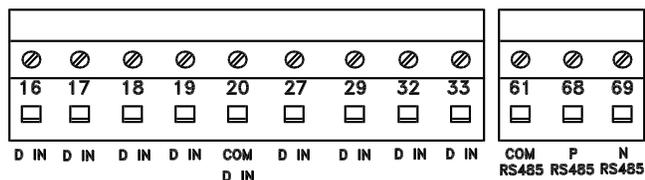
DANFOSS
175HA379.10

The following is a description of the functions of the control terminals. Many of these terminals have multiple functions determined by parameter settings.

No.	Function
01, 02, 03	Form C relay output. Maximum 240 VAC, 2 A. Minimum 24 VDC, 10 mA or 24 VAC, 100 mA. (Location of Form C relay output varies with unit type. See connection diagram with unit for location.)
04, 05	30 VAC, 42.5 VDC, 1 A relay output can be used for indicating status and warnings.
12, 13	Voltage supply to digital inputs and external transducers. For the 24 VDC to be used for digital inputs, switch 4 on the control card must be closed, position "on." The maximum output current is 200 mA.
16 - 33	Digital inputs. R = 2 kohm. <5 V = logical "0", >10 V = logical "1". See parameters 300 through 307, *Digital Inputs*.
20	Common for digital inputs.
39	Common for analog and digital outputs.
42, 45	Analog and digital outputs for indicating frequency, reference, current and torque. The analog signal is 0 to 20 mA, or 4 to 20 mA at a maximum of 500 Ω. The digital signal is 24 VDC at a minimum of 600 Ω. See parameters 319-322, *Analog/digital Outputs*.
50	10 VDC, 17 mA maximum analog supply voltage to potentiometer and thermistor.
53, 54	0 to 10 VDC voltage input, R = 10 kΩ.
55	Common for analog inputs. This common is isolated from the common of all other power supplies. If, for example, the drive's 24 VDC power supply is used to power an external transducer which provides an analog input signal, terminal 55 must be wired to terminal 39.
60	0 to 20 mA or 4 to 20 mA, analog current input, R = 188 Ω. See parameters 314 through 316.
61	Shield for serial communication.
68, 69	RS-485 interface and serial communication. When the drive is connected to an RS-485 serial communication bus, DIP switch settings on the control card may have to be reset. See *Dip Switches 1 through 4* in this manual.

17

Typical Control Connections

Shown below are typical interfaces between the VLT 6000 and other components in an HVAC system. The terminal numbers and the functions of the terminals are identical on all VLT 6000s. An optional relay card, not shown, can provide four additional Form C output relays. The RS-485 connections allow direct communication through the drive's built-in serial communication protocols: Johnson Controls Metasys® N2, Siemens System 600 FLN®, or VLT Software Dialog®. LonWorks® and Profibus® are available through option cards that fit into the relay output card location.

Typical* VLT 6000 Wiring

3 Phase Power Input — 91 (L1), 92 (L2), 93 (L3), 99 (PE)

External DC Bus Connection — 88 (-), 89 (+)

Switch Mode Power Supply
10 V DC 17 mA
24 V DC 200 mA

(U) 96, (V) 97, (W) 98, (PE) 95 — Motor

+10 V DC — 50 (+10 V OUT)
0 - 10 V DC Ref. Input* — 53 (A IN)
0 - 10 V DC Ref. Input* — 54 (A IN)
55 (COM A IN)
4 - 20 mA Ref. Input* — 60 (A IN)
12 (+24 V OUT)
13 (+24 V OUT)
Reset* — 16 (D IN)
Lockout* — 17 (D IN)
Run/Stop* — 18 (D IN)
Reverse* — 19 (D IN)
20 (COM D IN) SW4
Interlock* — 27 (D IN)
Preset Speed* — 29 (D IN)
Setup Select* — 32 (D IN)
Setup Select* — 33 (D IN)

(AUX RELAY) 01, (AUX RELAY) 02, (AUX RELAY) 03 — Fault Indication* 240 V AC, 2 A
(RELAY) 04, (RELAY) 05 — Run Indication* 30 V AC, 1 A
(COM A OUT) 39, (A OUT) 42 — Output Current Indication* 4 - 20 mA
(A OUT) 45 — Output Speed Indication* 4 - 20 mA
5 V, 0 V, SW2, SW3
RS-485 Interface
(P RS-485) 68, (N RS-485) 69 — RS-485
(COM RS-485) 61

* The operation of all control inputs and outputs is programmable.
   Typical terminal functions are shown.

⚠CAUTION

Incoming power, motor wiring and control wiring should be run in three separate conduits or raceways.

Electrical Installation, Control Wiring

Torque: 5 - 6 in-lbs
Screw size: M3

Shield control wires, when necessary, to reduce interference from electrical noise by means of a cable clamp at both ends to the metal enclosure of the unit. Connect the shield to earth ground. Very long control wires may create 60 Hz interference. This problem can be solved by connecting one end of the shield to earth with a 0.1 µF capacitor, keeping the leads as short as possible. If this doesn't solve the problem, disconnect the shield's connection to earth ground at the end opposite to the drive.

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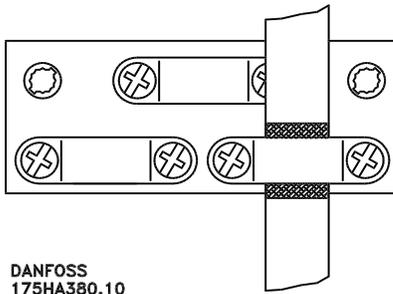
DIP Switches 1 through 4

DIP switches are located on the control card.

They are used for serial communication and the common of digital inputs 16 through 33. The switch positions shown are the factory settings.
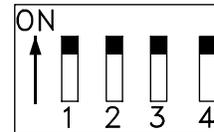
Switch 1 is not used.

Switches 2 and 3 are used for terminating serial communication. On the first and last drive in a multiple device network, or on the only drive of a single drive network, switches 2 and 3 must be ON (the default setting). On all other drives in a multiple device network, set switches 2 and 3 to OFF.

Switch 4 separates the common for the internal 24 VDC supply from the common of the external 24 VDC supply. Normally this switch is ON and the power supply is present at terminals 12 and 13. Set Switch 4 to the OFF position when an external 24 VDC supply is used.

Ground Leakage Current

It is normal for there to be some leakage current from the drive to earth ground. Paths of current leakage are shown on the drawing below. The leakage current will exceed 3.5 mA.
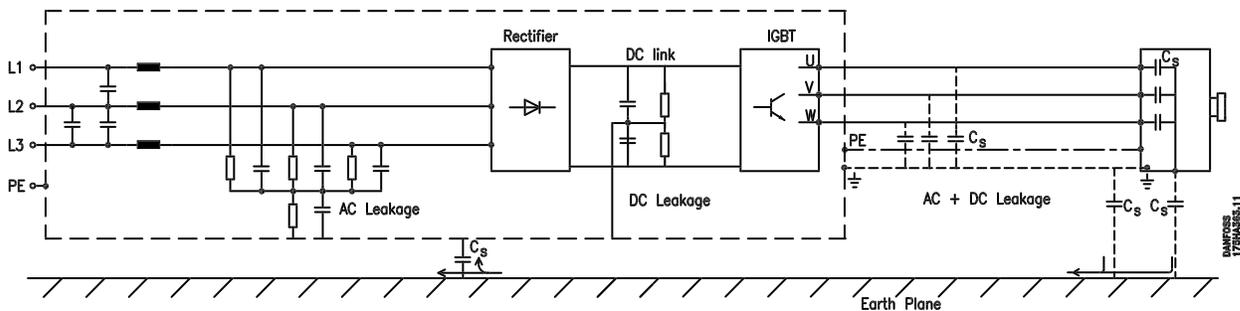
Paths of Normal Current Leakage to Ground

Galvanic Isolation

Galvanic isolation offers protection from electric shock. All control terminals of all VLT 6000 drives, and terminals 1 through 3 of the relay output, offer galvanic isolation as long as the RFI switch (if provided) is in the ON position. The galvanic isolation in the VLT 6000 conforms to the European standard EN 50178. (See figure below.)

The components that make up the galvanic isolation are:

1. Power supply, including signal isolation.
2. Gate drive for the IGBTs, the trigger transformers and opto-couplers.
3. The output current Hall effect transducers.
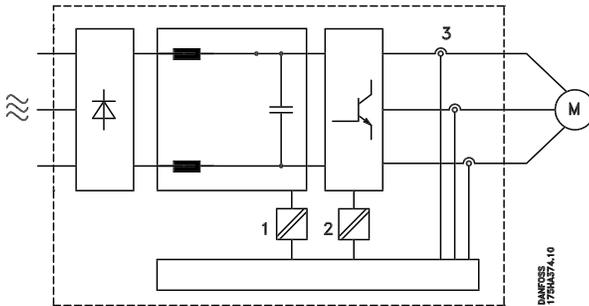
Galvanic Isolation

Electrical Noise

In general, electrical noise can be divided into two forms: wire-borne electromagnetic interference (EMI), and radiating radio frequency interference (RFI).

Using shielded motor cables reduces RFI but increases EMI. This is because shielded wires have a greater capacitance than unshielded wires. Unshielded input power connections to the drive generate more noise in the radio frequency range on the AC line. The shield reduces the radiated noise, but increases the low-frequency electromagnetic noise on the AC line. But, since the noise current is taken back to the unit through the shield, only a small electromagnetic field is generated from shielded motor wires.

With an EMI filter, the noise level on the AC line will be reduced to about the same level for shielded and unshielded wires alike.

Connect the motor wiring shield, if used, in the enclosure of the drive as well as at the motor. Use shield brackets to avoid "pigtail" shield ends. Even short "pigtails" increase the shield's impedance at higher frequencies, which reduces the shield's effect and increases the noise produced.

It is generally easier and less complicated to use unshielded motor wires than shielded cables. If unshielded wires are used, the RFI will be greater. But, since the strength of the radiated signal decreases with distance from the signal source, radiated noise is generally not a problem.

To reduce the noise level from the total system (drive + installation) make the motor wiring as short as possible.

Provide separate conduits, or raceways, for power, motor and control wiring to provide the greatest immunity from distortion.

## Application Control Connection Examples
Two-wire Start/Stop

In Auto mode, closing the contact to terminal 18 will make the drive run. In any mode, opening the safety interlock contact to terminal 27 will stop the drive.

```
DANFOSS
176FA001.10

 4
 5
12  +24V
13
39

16
17
18  PAR. 302
19
20
27  PAR. 304
```
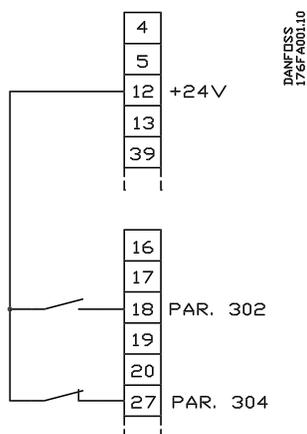
Set Parameter 302 to Start.
Set Parameter 304 to External Fault.

Digital Speed Up/down

Closing the switch to terminal 32 will make the drive accelerate. Closing the switch to terminal 33 will make the drive decelerate.

```
DANFOSS
176FA004.11

 4
 5
12  +24V
13
39

27
29  Par. 305
32  Par. 306
33  Par. 307
```
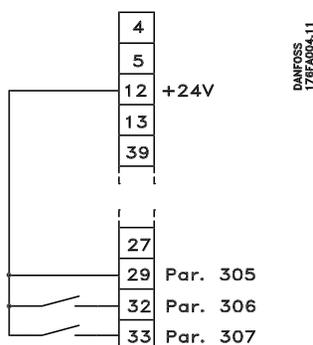
Set Parameter 306 to Speed up.
Set Parameter 307 to Speed down.
Set Parameter 305 to Freeze reference.

Potentiometer Reference

A manual potentiometer is used as a input reference for the drive.

```
DANFOSS
176FA005.11

54
50  + 10V out
1kohm
53  PAR. 308
55  Com. analog input
```
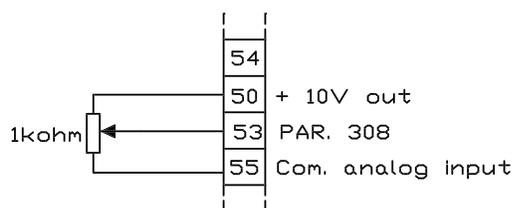
Set Parameter 308, *Terminal 53, Analog Input Voltage,* to Reference.
Set Parameter 309, *Terminal 53, Min. Scaling,* to 0 V.
Set Parameter 310, *Terminal 53, Max. Scaling,* to 10 V.

Run Permissive

After receiving a run command, the drive will apply power to the damper motor and wait until it receives "permission" via the switch that is connected to terminal 16.

```
 4
 5
12
13

Run
permis-
sive

16  Par. 300 Run permissive
17
18  Par. 302 Start
19
20
27  Par. 304
29

~            Open     01
0        M   Close    02   Start command active
Damper              03
motor

DANFOSS
175HA561.14
```
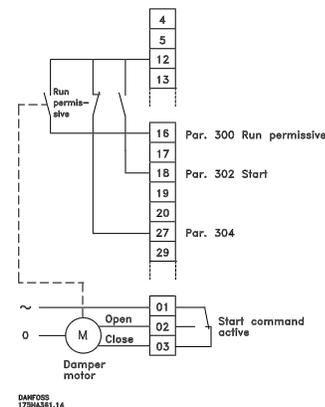
Set Parameter 300 to Run Permissive.
Set Parameter 302 to Start.
Set Parameter 304 to External Fault.
Set Parameter 323 to Start Signal Applied.

Two Feedback Signals

The drive processes two independent feedback signals during closed loop operation. It can respond to the sum, difference, average, minimum or maximum of these signals.

```
          +   50
0–10V     −   53  Par. 308 Feedback
          −   54  Par. 311 Feedback
0–10V     +   55  Com. analog input
              60

DANFOSS
175HA553.12
```
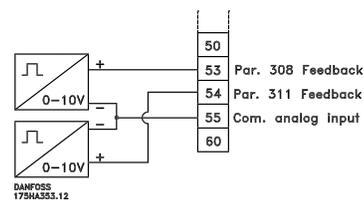
Set Parameter 308 to FEEDBACK.
Set Parameter 311 to FEEDBACK
Set Parameter 417 for the desired operation.

Transmitter Connection

The drive's internal 24 VDC power supply is used to power an external 4 to 20 mA transducer.

```
Two-wire
transmitter      12  +24V
                 39  Com. analog output
                 42

4–20mA           55  Com. analog input
                 60  PAR. 314, 4–20mA

Transmitter
with external
supply           54
Vac          ~   55  Com. analog input
supply           60  PAR. 314, 0/4–20mA
         0/4–20mA

DANFOSS
176FA006.13
```
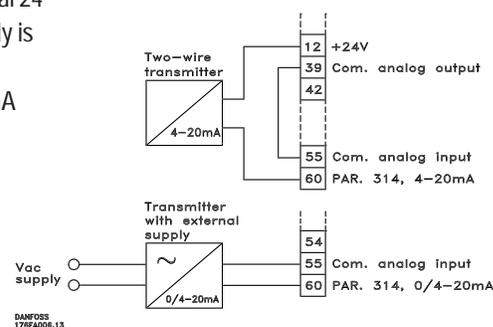
Set Parameter 314, *Terminal 60, Analog Input Curent,* to correspond to the purpose of the 4 to 20 mA signal.
Set Parameter 315, *Terminal 60, Min. Scaling,* to 4 mA
Set Parameter 316, *Terminal 60, Max. Scaling,* to 20 mA.

Because the commons of the +24 VDC power supply and the input reference follower have separate circuit commons, it is necessary to connect a jumper between terminals 39 and 55.

Control Panel

The Local Control Panel (LCP), normally mounted on the front of the drive, is a complete interface for programming and operating the drive. The control panel can be removed from the drive and installed up to 10 feet (3 meters) from the drive by using a remote mounting kit.

The control panel has five functions:
1. Display
2. Keys for changing the display
3. Keys for changing programming parameters
4. Keys for controlling drive operation
5. Indicator lamps

The LCP uses a four-line, alpha-numeric, back-lit, LCD display. The display can show four operating data values and three operating condition values continuously. During programming, all the information required for quick, effective parameter setup of the drive will be displayed. As a supplement to the display, there are three indicator lamps for power on (ON), warning (WARNING) and alarm (ALARM).

All drive parameters can be changed from the control panel, unless this ability has been locked out by setting parameter 016, *Lock for Data Change*, to Locked, or by a digital input to terminals 16 through 33. See the related parameters for more information.

Keys for Parameter Changes
The keys are divided into groups by function. The keys between the display and indicator lamps are used for parameter setup, selecting the display indication during normal operation and controlling the drive speed during local speed control operation. The keys below the indicator lamps are used for Start/Stop control and selection of the operating site.
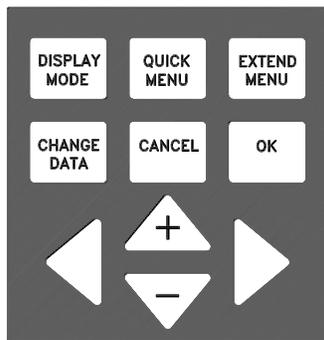
The DISPLAY MODE key is used to select the mode of the display or to return to the Display Mode from either the Quick Menu or the Extend Menu mode.
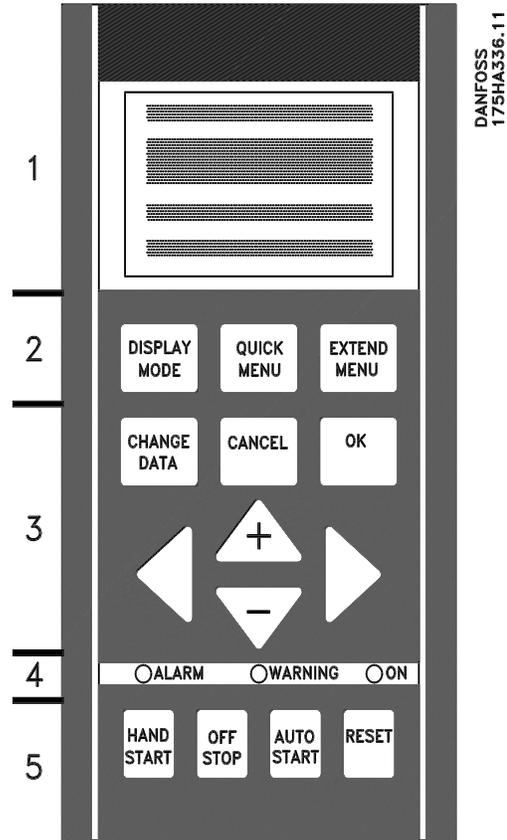
The QUICK MENU key gives access to the parameters available for the Quick Menu setup. Parameters in this menu are the 12 most important setup parameters for the drive.

The EXTEND MENU key gives access to all parameters.

The CHANGE DATA key is used for changing the value of a parameter selected either in the Extend Menu or the Quick Menu mode. The desired parameter is first selected. Then the CHANGE DATA key is pressed to enable the editing of the parameter. The underline in the display will move under the parameter's value to show that it is being edited.

The CANCEL key is used if a change of the selected parameter is not to be carried out.

The OK key is used for confirming a change of the parameter selected.

22
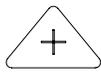
The + and - keys are used to scroll through parameters and to change the value of a chosen parameter. These keys are also used to change the local reference. In Display Mode, these keys are used to switch between readouts.
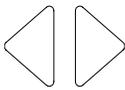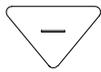
The ◁ and ▷ keys are used to select a parameter group and also to move the cursor to the desired digit when changing numerical values.

Indicator Lamps

At the bottom of the control panel is a red alarm LED, a yellow warning LED, and a green power on LED.

○ALARM	○WARNING	○ ON
red	yellow	green

If certain threshold values are exceeded, the alarm and/or warning lamps will flash and text describing the alarm or warning condition will be displayed.

Local Control
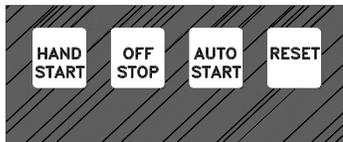
Below the indicator lamps are keys which are used to determine the point of control. Each of these keys can be individually enabled or disabled using parameter 012 through 015. The Hand Start and Auto Start keys will also be disabled if any of the control terminals are programmed for either Remote Hand or Remote Auto.

The HAND START key is used if the drive is to be started from the control panel. Pressing HAND START will give a start command to the drive.

⚠WARNING

If a minimum speed is set in parameter 201, *Output Frequency Low Limit*, motor will start and ramp up to this frequency when HAND START is pressed. If drive is already running in Auto Mode when the HAND START key is pressed, it will switch to run in Hand Mode at same speed.

The OFF/STOP key is used for stopping the connected motor in either the Hand or Auto mode. Enable or Disable via parameter 013. If this stop function is activated, the second line in the LCD display will flash.

AUTO START is used if the drive is to be started via the control terminals and/or serial communication. When a remote start signal is active, the drive will start if the AUTO START key has been pressed.

⚠DANGER

A start signal via digital inputs may cause drive to start at any time. Remove power to drive before working on output wiring, motor or any driven equipment.

The RESET key is used for manually resetting the drive after a fault trip (alarm). In this case, the top line of the display will show TRIP (RESET). If the top line of the display shows TRIP (AUTO START), the drive will automatically restart. If the top line of the display shows TRIPLOCK (DISC. MAINS), input power to the drive must be removed before the trip can be reset.

Display Mode

Information is displayed on the LCD by selecting one of three programmable display modes. Pressing the Display Mode key toggles among the displays. When in Mode II, pressing and holding down the Display Mode key accesses an additional mode used to identify the data units the display is showing. (See Navigation Between Display Modes.)

In normal operation, any four meters can be shown continuously on the first and second lines of the display. Parameters 008, 009 and 010 select the three readouts displayed on the top line. Parameter 007, *Large Display Readout,* selects the meter displayed on line 2. In Display Mode, the + and - keys choose any meter on the LCD.

A list on the next page gives the operating data that can be shown on the three meter readouts for line 1 and the large display (line 2).

The right side of line 2 shows the active setup number and an arrow indicateing the direction of motor rotation. Clockwise indicates forward and counterclockwise indicates reverse. The arrow body disappears if a stop command is given or if the output frequency falls below 0.01 Hz.

Warnings and alarms (fault trips) will also be displayed. For an alarm, "ALARM" and the alarm number is shown in line 2 with an explanation in line 3 or in lines 3 and 4. For a warning, "WARN." and the warning number is shown in line 2 and an explanation in 3 and/or 4. Both alarms and warnings cause the display to flash.

The line 4 automatically displays the operating status of the drive.

The table below gives the operating data options for the first and second lines of the display.

Data Item:	Unit:
Resulting reference, %	%
Resulting reference	unit chosen in par. 415
Frequency	Hz
% of maximum output frequency	%
Motor current	A
Power	kW
Power	HP
Output energy	kWh
Hours run	hours
User defined readout	unit chosen in par. 006
Setpoint 1	unit chosen in par. 415
Setpoint 2	unit chosen in par. 415
Feedback 1	unit chosen in par. 415
Feedback 2	unit chosen in par. 415
Feedback	unit chosen in par. 415
Motor voltage	V
DC link voltage	V
Thermal load on motor	%
Thermal load on VLT	%
Input status, digital input	binary code
Input status, analog terminal 53	V
Input status, analog terminal 54	V
Input status, analog terminal 60	mA
Pulse reference	Hz
External reference	%
Heat sink temperature	°C

Display Mode I:

Below is an example of Display Mode I, in which the drive is running in setup 1, in Auto mode, with remote reference, at an output frequency of 40 Hz.
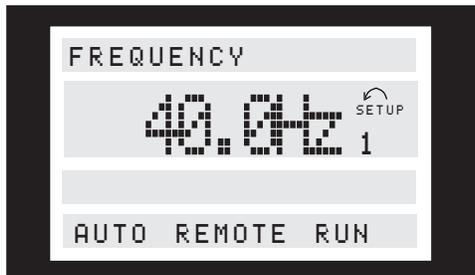
The text in line 1, FREQUENCY, describes the meter shown in line 2. Line 2 shows the current output frequency (40.0Hz), direction of rotation (reverse), and active setup (1).

Line 4 is the status line and the information is automatically generated for display by the drive in response to its operation. It shows that the drive is in auto mode, with remote reference, and that the motor is running. Some possible displays of the status line are shown below.
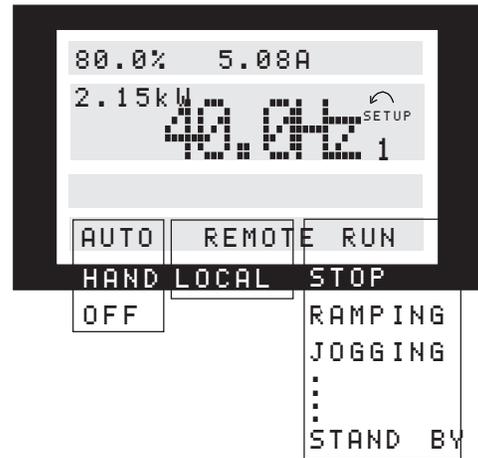
The left part of the status line indicates where the drive Run/Stop command is from, and whether it is on or off. AUTO means that Run/Stop control is via the control terminals and/or serial interface; HAND indicates that the drive started locally by the Hand Start key. OFF means that the drive ignores all control commands and the motor will not run.

The center part of the status line indicates the reference source that is active. REMOTE means that the reference is from the control terminals. LOCAL indicates that the reference is determined by the + and - keys on the control panel.

The right part of the status line indicates the drive's operational status.

Display Mode II:

This display mode makes it possible to have three meters displayed at the same time on line 1. The meters displayed are selected through parameters 008, 009 and 010.
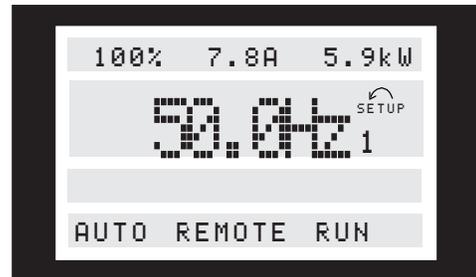
Display Mode III:

This display mode is shown when the drive is in Display Mode II and the Display Mode key is pressed and held. In the first line, a description of the three top meters in Display Mode II is shown. The other lines are unchanged. When the key is released, Display Mode II is again shown.

```
REF%  CURR.A POW.   kW
    50.0Hz    SETUP
              1

AUTO  REMOTE  RUN
```

Display Mode IV:

This display mode is available when local reference is selected. In this display mode, the speed reference is increased or decreased via +/- keys.

The first line shows the present speed reference. The second line shows the present drive output frequency. The third line show a bar graph of the relative value of the present drive output frequency in relation to the maximum frequency.

```
USE +/-          56Hz
    40Hz    SETUP
            1
0■■■■■■■■□□------60
HAND    LOCAL
```

Navigation Between Display Modes

```
FREQUENCY
   40.0Hz   SETUP
            1

AUTO  REMOTE
```
Display Mode I

```
DISPLAY
MODE
```
With local/remote reference

```
DISPLAY
MODE
```
With remote controlled reference

```
DISPLAY
MODE
```
With local reference

```
USE +/-          56Hz
    40.0Hz   SETUP
             1
0■■■■■■■■□□------60
HAND  LOCAL
```
Display Mode IV

```
DISPLAY
MODE
```
With local reference

```
80%   7.8A   5.9kW
   40.0Hz   SETUP
            1

AUTO  REMOTE  RUN
```
Display Mode II

Keep DISPLAY MODE key down

```
DISPLAY
MODE
```

Release DISPLAY MODE key

```
REF%   CURR.A   POW. kW
   40.0Hz   SETUP
            1

AUTO  REMOTE  RUN
```
Display Mode III

Quick Menu

The QUICK MENU key gives access to 12 of the most important setup parameters of the drive. After programming, the drive will, in many cases, be ready for operation. The 12 Quick Menu parameters are shown in the table below. A complete description of the function is given in the parameter sections of this manual.

Quick Menu Item Number	Parameter Name	Description
1	001 Language	Selects language used for all displays.
2	102 Motor Power	Sets output characteristics of drive based on kW (HP) of motor. See chart in parameter 102, *Motor Power*, to convert HP to kW.
3	103 Motor Voltage	Sets output characteristics of drive based on voltage of motor.
4	104 Motor Frequency	Sets output characteristics of drive based on nominal frequency of motor. This is typically equal to line frequency.
5	105 Motor Current	Sets output characteristics of drive based on full load current in amps (FLA) of motor. This sets overload protection for motor.
6	106 Motor Nominal Speed	Sets output characteristics of drive based on nominal full load speed of motor.
7	201 Minimum Frequency	Sets minimum controlled frequency at which motor will run.
8	202 Maximum Frequency	Sets maximum controlled frequency at which motor will run.
9	206 Ramp Up Time	Sets time to accelerate motor from 0 Hz to nominal motor frequency set in Quick Menu Item 4.
10	207 Ramp Down Time	Sets time to decelerate motor from nominal motor frequency set in Quick Menu Item 4 to 0 Hz.
11	323 Relay 1 Function	Sets function of high voltage Form C relay.
12	326 Relay 2 Function	Sets function of low voltage Form A relay.

To Enter or Change Quick Menu Parameter Data

Enter or change parameter data or settings in accordance with the following procedure.

1. Press Quick Menu key.
2. Use '+' and '-' keys to find parameter you chose to edit.
3. Press Change Data key.
4. Use '+' and '-' keys to select correct parameter setting. To move to a different digit within parameter, use ◄ and ► arrows. *Flashing cursor indicates digit selected to change.*
5. Press Cancel key to disregard change, or press OK key to accept change and enter new setting.

Example of Changing Parameter Data

Assume Parameter 206, *Ramp Up Time,* is set at 60 seconds. Change the ramp up time to 100 seconds in accordance with the following procedure.

1. Press Quick Menu key.
2. Press '+' key until you reach Parameter 206, *Ramp Up Time.*
3. Press Change Data key.
4. Press ◄ key twice – hundreds digit will flash.
5. Press '+' key once to change hundreds digit to '1.'
6. Press ► key to change to tens digit.
7. Press '-' key until '6' counts down to '0' and setting for *Ramp Up Time* reads '100 s.'
8. Press OK key to enter new value into drive controller.

NOTE
Programming of extended parameters functions available through Extended Menu key is done in accordance with same procedure as described for Quick Menu functions.

Extended Menu

In some applications, the Quick Menu items will not set up all the desired characteristics of the drive. To access all the parameters, including the Quick Menu parameters, press the Extend Menu key. The Programming section of this manual will describe in detail all the parameters available through the Extended Menu.

Changing Data

To change any parameter in either the Quick Menu mode or the Extended Menu mode, press the CHANGE DATA key. When the CHANGE DATA key is pressed, the data in line four will be underlined, and a cursor will be shown if the parameter controls numeric data.

The procedure for changing data depends on whether the value of the parameter is a number or a item from a list.
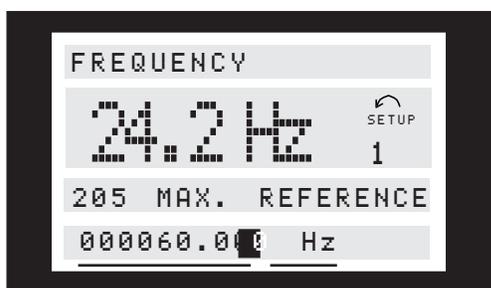
Parameter is a Number

To change a number, move the cursor to the digit to be changed by using the $\triangleleft \triangleright$ keys. Then change the digit by using the + and - keys.
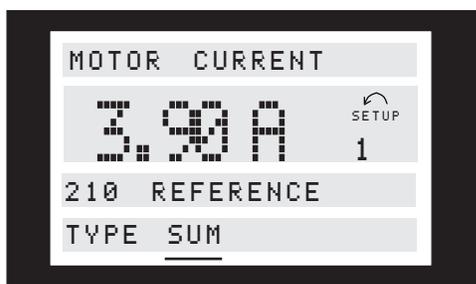
Parameter is a Value Chosen from a List

If the selected parameter's value is selected from a list, its value can be changed by using the + and - keys.

When the desired value is displayed, press the OK key to accept the new value. If you wish to cancel the change and return to the previously accepted value, press the CANCEL key. If neither OK nor CANCEL is pressed, the new value will be accepted after 20 seconds.

Step Change of Numeric Values

The values of certain numeric items can also be selected from a list. These parameters are *Motor Power*, parameter 102; *Motor Voltage*, parameter 103; and *Motor Frequency*, parameter 104. To select a value not on the list, use the $\triangleleft$ and $\triangleright$ keys to select the digit to be changed, as described above.

Manual Initialization of Parameters

It is possible to reset nearly all parameters back to their original default values at once. To reset the drive parameters to their read only memory default values, remove power from the drive. Press and hold the Display Mode, Change Data and OK keys down while reapplying power. Shortly after power is reapplied, the bottom line of the display will read "Initial-ized". After the display stops changing, release the keys. If "Initialized" did not appear, repeat the procedure.

These parameters are not reset by manual initialization:

Parameter 600	Operating hours
Parameter 601	Hours run
Parameter 602	kWh counter
Parameter 603	Number of power-ups
Parameter 604	Number of overtemperatures
Parameter 605	Number of overvoltages

Initialization can also be done using Parameter 620.

⚠CAUTION

Manual initialization using either this procedure or parameter 620 will reset drive to standard default parameters. Any special programming for application that was performed at factory, during start-up or subsequently, will be lost. If desired parameters have been previously stored in drive's local control panel (LCP), it may be better to download those parameters from LCP using parameter download functions of parameter 004.

Uploading Parameters

At any time the present parameters may be copied to the local control panel (LCP). This may be useful when setting up multiple drives. It is also useful when it is desired to return to a previous set of parameters. See parameter 004, *LCP Copy*, for more information.

Manually initializing the drive using either the procedure described above or parameter 620, *Operating Mode*, does not change the values uploaded to the local control panel.

VLT 6000 Start-Up

Pre-installation Checks

1. Compare drive model number to what was ordered.
2. Ensure each of following are rated for same voltage:
   - Drive
   - Power line
   - Motor
3. Record following motor data:
   - Voltage
   - Frequency
   - Full load current
   - Full load speed
   - Power — convert HP to kW (See conversion table in parameter 102, *Motor Power*, in this manual.)
4. Ensure that rated drive current is equal to or greater than total full load current.
   - For multiple motor operations, add up full load current ratings of all motors.
   - Drive can be *at most* one size smaller than motor.
   - If drive rating is less than motor, full motor output cannot be achieved.
5. Check motor wiring:
   - Any disconnect between drive and motor should be interlocked to drive safety interlock circuit to avoid unwanted drive trips.
   - No power factor correction capacitors can be connected between drive and motor.
   - Two speed motors must be wired permanently for full speed.
   - Y-start, △-run motors must be wired permanently for run.

Installation Checks

1. Input fusing in power supply for all drives must be provided (see *Input Fuses* section in this manual).
2. Environmental concerns — for standard NEMA 1 drive:
   - Clean air supply
   - Dry air (max 95% relative humidity, non-condensing)
   - 14°F to 104°F ambient temperature operating range, or as rated
   - 3,300 foot maximum elevation with no derating
3. Mounting
   - Vertical
   - Drives with heat sink fins exposed in back of unit must be mounted against a solid surface (see *Clearances* section in this manual).
   - Keep any construction dirt out of drive.
4. Wiring
   - Wire drive in accordance with instructions and diagrams received with drive.
   - Separate conduits must be provided to drive for input power, output power, and control wiring.
   - Note that safety interlock and remote run/stop circuitry is 115 VAC for drives with bypasses.
   - Use knockouts or conduit entry plates. Avoid metal shavings in cabinet.
   - Protect signal wires from noise.
   - Ground each drive individually.
   - Double check input and output power wiring for correct location.

Setting Up Drive for Motor Start

Enter motor nameplate data into drive through Quick Menu.

1. Parameter 101:
   - If one motor is connected to drive, set to AEO FUNCTION.
   - If more than one motor connected to drive, set to MULTIPLE MOTORS. (Parameter 108, MULTIPLE MOTOR STARTING VOLTAGE should be adjusted later to provide reliable starts and minimum starting current.)
2. Parameter 102, MOTOR POWER (in kW) (See conversion table in parameter 102, *Motor Power*, in this manual.)
3. Parameter 103, MOTOR VOLTAGE
4. Parameter 104, MOTOR FREQUENCY
5. Parameter 105, MOTOR CURRENT
6. Parameter 106, MOTOR SPEED
7. Parameter 107, (optional) select AUTOMATIC MOTOR ADAPTATION and run AMA in accordance with procedure in parameter 107, *Automatic Motor Adaptation,* in this manual.
8. Press HAND START key to initiate operation in local control.

Operational Tests — HAND

1. Check motor rotation from drive. If incorrect, disconnect input power from drive and reverse two leads between drive and motor.
2. If a bypass is provided, check motor rotation in bypass mode. If incorrect, disconnect input power from drive and reverse two input power leads.
3. Accelerate motor quickly to full speed and verify operation.
4. Decelerate motor quickly to stop and verify operation.
5. Operate motor over entire speed range while closely checking for resonance.

Operational Tests — AUTO

1. Ensure that drive follows run/stop and safety interlock commands from system.
2. Ensure drive follows speed reference, or feedback, from system.

Final Adjustments

1. Use parameters 216 through 220 to reject any resonant points.
2. Lock out keypad functions, as required.

General Troubleshooting

1. Display Messages:
   - AUTO START—Drive has tripped off and is in process of automatically restarting.
   - TRIP—Drive has tripped off. Press RESET to start.
   - TRIP LOCKED—Drive has tripped off. Remove and apply power before restarting with RESET.
2. Refer to *Warnings and Alarms* section in this manual.
3. Check tightness of all connections and wires for proper location.
4. Measure input signals.
5. Check drive input and output for balanced voltage and current.

Programming

EXTEND MENU

Using the Extend Menu key, it is possible to access to all the parameters for the drive.

Description of Parameters

Parameters are grouped by function. The groups are:

Operation and Display	Parameters 001 through 017
Load and Motor	Parameters 100 through 117
References and Limits	Parameters 200 through 228
Input and Outputs	Parameters 300 through 328
Application Functions	Parameters 400 through 427
Serial Communication	Parameters 500 through 566
Service Functions	Parameters 600 through 631
Relay Card Functions	Parameters 700 through 711

The numbers shown in the square brackets ([ ]) after the parameter values are used in serial communications to choose the parameter value from the list. They are not shown on the local control panel when programming the drive locally.

Setup Configuration

The drive has four setups that can be programmed independently. The active setup can be selected in parameter 002, *Active Setup*. The active setup number is shown on the right of line two in the display under the word "Setup."

It is also possible to set the drive to Multi-Setup to allow switching setups through digital inputs or serial communication.

More than one setup can be used. An example would be a changing setups for day/night or summer/winter operation.

Parameter 003, *Copying of Setups,* enables copying from one setup to another.

By means of parameter 004, *LCP Copy*, any setup can be transferred from one drive to another using the removable local control panel (LCP). First, upload all parameter values to the control panel installed in the drive. Insert this panel into the next drive. Download all parameter values from the control unit to the second drive. Repeat this procedure to program additional drives.

Operation and Display
Parameters 000 through 017

This parameter group deals with the display, control keys and other general functions.

001 Language	(Language)
Value:	
✭ English (ENGLISH)	[0]
German (DEUTSCH)	[1]
French (FRANCAIS)	[2]
Danish (DANSK)	[3]
Spanish (ESPA¥OL)	[4]
Italian (ITALIANO)	[5]
Swedish (SVENSKA)	[6]
Dutch (NEDERLANDS)	[7]
Portuguese (PORTUGUESA)	[8]

Function:

This parameter determines the language to be used on the display.

Description of choice:

There is a choice of the languages indicated.

002 Active Setup	(ACTIVE SETUP)
Value:	
Factory Setup (FACTORY SETUP)	[0]
✭ Setup 1 (SETUP 1)	[1]
Setup 2 (SETUP 2)	[2]
Setup 3 (SETUP 3)	[3]
Setup 4 (SETUP 4)	[4]
Multi-Setup (MULTI SETUP)	[5]

Function:

This parameter defines the setup number that controls the drive.

All parameters can be programmed in four individual parameter setups, Setup 1, Setup 2, Setup 3 and Setup 4.

In addition, a pre-programmed read-only setup, called the Factory Setup, exists.

Description of choice:

Factory Setup contains the parameter values preset at the factory. This setup can be used as a data source if the other setups are to be returned to a known state.

Setups 1 through 4 are four individual setups that can be selected as required.

Multi-Setup is used if remote switching between different setups is required. Terminals 16, 17, 29, 32, 33 and the serial communication port can be used for switching between setups.

✭ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Connection Examples:

Setup Change
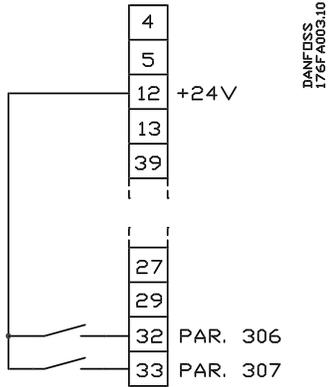
Selection of setup using terminals 32 and 33.
See the descriptions of parameters 300 through 307.
Parameter 306 = Selection of Setup, lsb
Parameter 307 = Selection of Setup, msb
Parameter 002 = Multi Setup

003	Copying of Setups	(Setup Copy)
Value:		
✸	No copying (NO COPY)	[0]
	Copy active Setup to Setup 1 (COPY TO SETUP 1)	[1]
	Copy active Setup to Setup 2 (COPY TO SETUP 2)	[2]
	Copy active Setup to Setup 3 (COPY TO SETUP 3)	[3]
	Copy active Setup to Setup 4 (COPY TO SETUP 4)	[4]
	Copy active Setup to all (COPY TO ALL)	[5]

Function:

A copy is made from the active setup selected in parameter 002, *Active Setup*, to the setup or setups selected in parameter 003, *Copying of Setups*.

NOTE
Copying is only possible when drive is stopped.

Description of choice:

The copying starts when the required copying function has been selected and the OK key has been pressed.

The display indicates when copying is in progress.

004	LCP Copy	(LCP COPY)
Value:		
✸	No copying (NO COPY)	[0]
	Upload all parameters (UPLOAD ALL PARAMET.)	[1]
	Download all parameters (DOWNLOAD ALL PARAM.)	[2]
	Download power-independent parameters (DOWNLOAD SIZE INDEP.)	[3]

Function:

Parameter 004, LCP Copy, is used to copy all parameter setups to or from the Local Control Panel (LCP). This can be used to store a backup copy of all parameters in the LCP or to copy all setups from one drive to another.

Description of choice:

Select Upload all parameters if all parameter values are to be copied from the drive to the LCP.

Select Download all parameters if all parameter values are to be copied from the LCP to the drive on which the control panel has been mounted.

Select Download power-independent parameters if only the power-independent parameters are to be downloaded. This allows the parameters from one drive to be easily copied to another drive of a different size.

NOTE
Copying is only possible when drive is stopped.

Setup of User-Defined Readout

Parameter 005, Maximum Value of User-Defined Readout, and Parameter 006, Unit for User-Defined Readout, allow users to design their own readout which can be seen if the User-Defined Readout has been selected as one of the displayed meters. The range is set in parameter 005, Maximum Value of User-Defined Readout and the unit is determined in parameter 006, Unit for User-Defined Readout. The choice of unit determines whether the relationship between the output frequency and the readout is a linear, square or cubed. Units representing rates (RPM, CFM, GPM, etc.) are linear. Units representing pressure (PSI, in. wg., etc.) are square. Units representing power (HP, kW, etc.) are cubed.

✸ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

005 Maximum Value of User-Defined Readout (CUSTOM READOUT)

Value:

0.01 - 999,999.99	★100.000

Function:

This parameter determines the value that the user defined meter will display when the drive's output frequency is the value set in parameter 202, *Output Frequency High.*

Description of choice:

Set the required value for maximum output frequency.

006 Unit for User Defined Readout (CUST. READ. UNIT)

Value:

|			
	No unit [1]	[0]	GPM[1]	[21]
★	% [1]	[1]	gal/s[1]	[22]
	rpm [1]	[2]	gal/min [1]	[23]
	ppm [1]	[3]	gal/h[1]	[24]
	pulse/s [1]	[4]	lb/s[1]	[25]
	l/s [1]	[5]	lb/min [1]	[26]
	l/min [1]	[6]	lb/h [1]	[27]
	l/h [1]	[7]	CFM [1]	[28]
	kg/s [1]	[8]	ft3/s [1]	[29]
	kg/min[1]	[9]	ft3/min [1]	[30]
	kg/h [1]	[10]	ft3/h [1]	[31]
	m3/s [1]	[11]	ft3/min [1]	[32]
	m3/min [1]	[12]	ft/s [1]	[33]
	m3/h[1]	[13]	in wg [2]	[34]
	m/s [1]	[14]	ft wg [2]	[35]
	mbar [2]	[15]	PSI [2]	[36]
	bar [2]	[16]	lb/in [2]	[37]
	Pa [2]	[17]	HP [3]	[38]
	MPa [2]	[18]		
	MWG [2]	[19]		
	kW [3]	[20]		

[1] Linear units (flow or speed)
[2] Squared units (pressure)
[3] Cubed units (power)

Function:

Select a unit to be shown with the display of the User Defined Readout. If flow or speed units are selected, the relationship between readout and output frequency will be a linear one. If pressure units are selected, the ratio will be square. If power units are selected, the ratio will be cubed.

The value and the unit are shown in display mode whenever User Defined Readout has been selected in one of parameters 007 through 010, *Display Readout.*
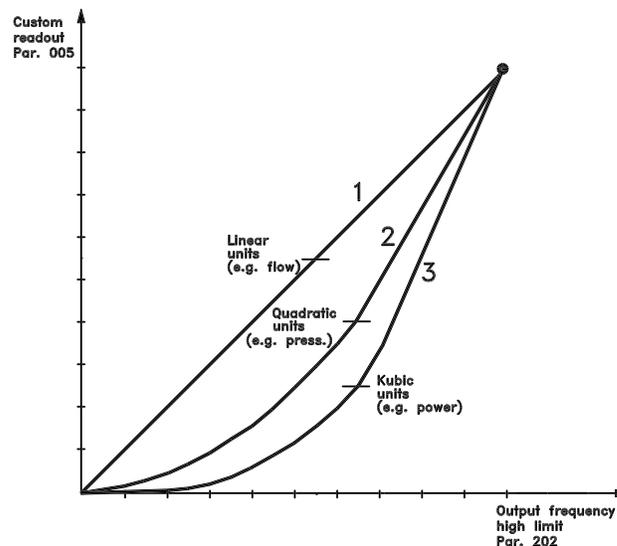
Description of choice:

Select the required unit for User Defined Readout.

007 Large Display Readout (LARGE READOUT)

Value:

	Resulting reference [%] (REFERENCE [%])	[1]
	Resulting reference [unit] (REFERENCE [UNIT])	[2]
	Frequency [Hz] (FREQUENCY [HZ])	[3]
★	% of maximum output frequency [%] (FREQUENCY [%])	[4]
	Motor current [A] (MOTOR CURRENT [A])	[5]
	Power [kW] (POWER [KW])	[6]
	Power [HP] (POWER [HP])	[7]
	Output energy [kWh] (ENERGY [UNIT])	[8]
	Hours run [Hours] (HOURS RUN [h])	[9]
	User-defined readout [-] (CUSTOM READ. [UNITS])	[10]
	Setpoint 1 [unit] (SETPOINT 1 [UNITS])	[11]
	Setpoint 2 [unit] (SETPOINT 2 [UNITS])	[12]
	Feedback 1 (FEEDBACK 1 [UNITS])	[13]
	Feedback 2 (FEEDBACK 2 [UNITS])	[14]
	Feedback [unit] (FEEDBACK [UNITS])	[15]
	Motor voltage [V] (MOTOR VOLTAGE [V])	[16]
	DC link voltage [V] (DC VOLTAGE [V])	[17]
	Thermal load, motor [%] (THERM.MOTOR LOAD [%])	[18]
	Thermal load, VLT [%] (THERM.DRIVE LOAD [%])	[19]
	Digital input [Binary code] (DIGITAL INPUT [BIN])	[20]
	Analog input 53 [V] (ANALOG INPUT 53 [V])	[21]
	Analog input 54 [V] (ANALOG INPUT 54 [V])	[22]
	Analog input 60 [mA] (ANALOG 60 [mA])	[23]
	Pulse reference [Hz] (PULSE REFERENCE [Hz])	[24]
	External reference [%] (EXT. REFERENCE [%])	[25]
	Heat sink temp. [°C] (HEATSINK TEMP [°C])	[26]
	Free programming array (FREE PROG. ARRAY)	[27]

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Function:

This parameter allows a choice of the data value to be shown in large digits on line two of the display when power is first applied to the drive. In Display Mode I, II, and III, the + and - keys allow the display on this line to be changed when the drive is in operation.

Description of choice:

No readout can only be selected in parameters 008 through 010, *Small Display Readout*, but not in parameter 007, *Large Display Readout.*

Resulting reference [%] gives the total of all references as a percentage of parameter 205, *Maximum Reference.*

Reference [unit] gives the total of all references. This is displayed in Hz in open loop. In closed loop, the reference unit is selected in parameter 415, *Process Units.*

Frequency [Hz] gives the output frequency of the drive.

% of maximum output frequency [%] is the output frequency as a percentage of parameter 202, *Output Frequency High Limit.*

Motor current [A] is the average phase current of the motor.

Power [kW] is the actual power, in kW, delivered to the motor.

Power [HP] is the actual power, in HP, delivered to the motor.

Output energy [kWh] is the energy delivered by the motor since the latest reset was made using parameter 618, *Reset of kWh Counter.*

Hours run [Hours] is the number of hours that the motor has run since the latest reset was made using parameter 619, *Reset of Hours Run Counter.*

User Defined readout [-] is a user defined value, calculated on the basis of the present output frequency, as well as the scaling in parameter 005, *Maximum Value of User-Defined Readout*, and the unit in parameter 006, *Unit for User-Defined Readout.*

Setpoint 1 [unit] is the setpoint value programmed in parameter 418, Setpoint 1. The unit is selected in parameter 415, *Process Units.*

Setpoint 2 [unit] is the setpoint value programmed in parameter 419, Setpoint 2. The unit is selected in parameter 415, *Process Units.*

Feedback 1 [unit] is the value of the feedback signal applied to Terminal 53. The unit is selected in parameter 415, *Process Units.*

Feedback 2 [unit] is the value of the feedback signal applied to Terminal 54. The unit is selected in parameter 415, *Process Units.*

Feedback [unit] is the total feedback signal using the unit scaling selected in parameter 413, Minimum Feedback; parameter 414 *Maximum Feedback*; parameter 415, *Process Units*; and parameter 417, *2 Feedback Calc.*

Motor voltage [V] is the voltage supplied to the motor.

DC link voltage [V] is the drive DC bus voltage.

Thermal load, motor [%] is the calculated thermal load of the motor. 100% is the cutout limit. See also parameter 117, *Motor Thermal Protection.*

Thermal load, VLT [%] is the calculated thermal load of the drive. 100% is the trip point.

Digital input [Binary code] is the signal status from the 8 digital inputs (16, 17, 18, 19, 27, 29, 32 and 33). Terminal 16 corresponds to the bit at the far left. '0' = no signal, '1' = connected signal.

Analog input 53 [V] is the voltage applied to terminal 53.

Analog input 54 [V] is the voltage applied to terminal 54.

Analog input 60 [mA] is the current applied to terminal 60.

Pulse reference [Hz] is the pulse frequency in Hz applied to terminal 17 or terminal 29.

External reference [%] is the sum of the external references as a percentage of parameter 205, *Maximum Reference.*

Heat sink temp. [°C] is the present heat sink temperature of the drive. The trip point is 90 ± 5°C for NEMA 1 units and 80 ± 5°C for NEMA 12 units.

Free Programming Array is reserved for future use. It is only available in parameter 007, *Large Display Readout.*

008	Small Display Readout 1.1
	(SMALL READOUT 1)

Value:

    See parameter 007, *Large Display Readout*

★ Reference, %

Function:

This parameter selects the meter to be displayed on the left display on line 1.

Showing three different meters on line 1 is recommended when setting up the PID. This allows tracking how the process reacts to a change of reference.

To select the meter to display, press the Display Mode button.

Description of choice:

There is a choice of 26 different meters. See parameter 007, *Large Display Readout.*

009	Small Display Readout 1.2
	(SMALL READOUT 2)

Value:

    See parameter 007, *Large Display Readout*

★ Motor current [A]

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Function:

See the functional description for parameter 008, *Small Display Readout.*

Description of choice:

There is a choice of 26 meters, see parameter 007 *Large Display Readout.*

010	Small Display Readout 1.3 (SMALL READOUT 3)
Value:	

See parameter 007 *Large Display Readout*

★ Power [HP]

Function:

See the functional description for parameter 008 *Small Data Readout.*

Description of choice:

There is a choice of 26 different data values, see parameter 007 *Large Display Readout.*

011	Unit of Local Reference (UNIT OF LOC REF)	
Value:		
	Hz (HZ)	[0]
★	% of output frequency range (%) (% OF FMAX)	[1]

Function:

This parameter sets the unit that will be displayed in Display Mode IV when the drive's speed is being controlled locally.

Description of choice:

Choose the desired unit for local reference.

012	Hand Start on LCP (HAND START BUTTON)	
Value:		
	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

Function:

This parameter allows disabling the Hand/Start key on the keypad.

Description of choice:

If *Disable* is selected in this parameter, the Hand/Start key will be disabled.

013	OFF/STOP on LCP (STOP BUTTON)	
Value:		
	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

Function:

This parameter allows disabling the Off/Stop key on the keypad.

Description of choice:

If *Disable* is selected in this parameter, the Off/Stop key will be disabled.

⚠CAUTION

If *Disable* is selected, motor cannot be stopped by Off/Stop key.

014	Auto Start on LCP (AUTO START BTTN)	
Value		
	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

Function:

This parameter allows disabling the Auto/Start key on the keypad.

Description of choice:

If *Disable* is selected in this parameter, the Auto/Start key will be disabled.

015	Reset on LCP (RESET BUTTON)	
Value:		
	Disable (DISABLE)	[0]
★	Enable (ENABLE)	[1]

Function:

This parameter allows disabling the Reset key on the keypad.

Description of choice:

If *Disable* is selected in this parameter, the Reset key will be inactive.

⚠CAUTION

Do not disable Reset unless a remote reset is available through digital inputs and parameters 300 through 307.

016	Lock for Data Change (DATA CHANGE LOCK)	
Value:		
★	Not Locked (NOT LOCKED)	[0]
	Locked (LOCKED)	[1]

Function:

This parameter allows locking out parameter changes at the local control panel.

Description of choice:

If *Locked* is selected, data modifications in the parameters cannot be made. Parameter changes will be possible through serial communication.

Parameters 007 through 010, *Display Readout* can be changed at the local control panel.

The local control panel can also be locked or unlocked by a digital input controlled by parameters 300 through 307.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

017   Operating State at Power Up
(POWER UP ACTION)

Value:

★ Auto restart (AUTO RESTART)   [0]
    OFF/STOP (OFF/STOP)   [1]

Function:

Selects auto or manual restart when power is reapplied after an outage occurs to a running drive.

Description of choice:

Auto restart is selected if the drive is to resume operation after a power outage.

OFF/STOP is selected if the drive is to remain stopped after a power outage. To restart, press the Hand/Start or Auto/Start key at the keypad.

⚠CAUTION

If HAND/START or AUTO/START are disabled by parameters 012 and 014, motor will not be able to restart if *OFF/STOP* is selected.

Load and Motor
Parameters 100 through 117

This parameter group controls output power and other output characteristics of the drive.

For correct operation, motor nameplate data must be entered into parameters 102 through 106 either through the Quick Menu or the Extended Menu. In addition, automatic motor adaptation, DC braking and motor thermal protection can be set by this parameter group.

100   Configuration   (CONFIG. MODE)

Value:

★ Open loop (OPEN LOOP)   [0]
    Closed loop (CLOSED LOOP)   [1]

Function:

This parameter is used for selecting closed loop or open loop operation.

Description of choice:

If *Open loop* is selected, speed control is changed directly by the speed reference signal. Any feedback signal applied to the drive will have no effect on the drive's speed.

If *Closed loop* is selected, the internal process regulator is available to accept feedback signal(s) to provide the desired speed regulation.

NOTE
If Open Loop is selected, parameters associated with setting up PID controller are not accessible. Therefore, it is important to properly set parameter 100, *Configuration*, first when closed loop operation is required.

101   Torque Characteristics   (VT CHARACT)

Value:

★ Automatic Energy Optimization
    (AEO FUNCTION)   [0]
   Parallel motors (MULTIPLE MOTORS)   [1]

Function:

This parameter configures the drive for single or multiple motor operation.

Description of choice:

Select *Automatic Energy Optimization* (AEO) for all single motor applications. When AEO has been selected, only one motor may be connected to the drive at a time.

The AEO function will automatically and continuously monitor the load and adjust the output voltage to maximize motor and drive efficiency and performance. After the motor reaches the set speed, the AEO function reduces the output voltage to the motor, if the load will allow. When the load is light, the voltage is reduced, as shown in the graph below. This lower voltage reduces motor heating and motor noise, and increases efficiency.

Select *Parallel motors* when more than one motor is connected in parallel to the output. In this case, it is necessary to set a start voltage in parameter 108, *Start Voltage of Parallel Motors.*
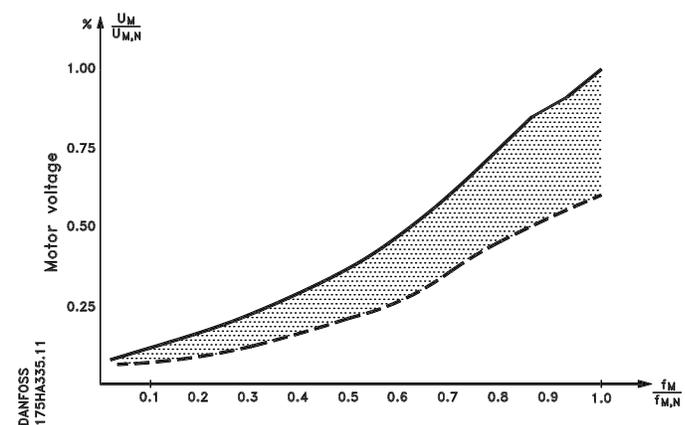
★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

⚠ CAUTION

It is very important that values set in parameters 102, *Motor Power,* through 106, *Rated Motor Speed,* correspond accurately to nameplate data of motor.

102	Motor Power	(MOTOR POWER)
Value:		
0.25 kW	(0.33 HP)	[25]
0.37 kW	(0.5 HP)	[37]
0.55 kW	(0.75 HP)	[55]
0.75 kW	(1 HP)	[75]
1.1 kW	(1.5 HP)	[110]
1.5 kW	(2 HP)	[150]
2.2 kW	(3 HP)	[220]
3 kW	--	[300]
4 kW	(5 HP)	[400]
5.5 kW	(7.5 HP)	[550]
7.5 kW	(10 HP)	[750]
11 kW	(15 HP)	[1100]
15 kW	(20 HP)	[1500]
18.5 kW	(25 HP)	[1850]
22 kW	(30 HP)	[2200]
30 kW	(40 HP)	[3000]
37 kW	(50 HP)	[3700]
45 kW	(60 HP)	[4500]
55 kW	(75 HP)	[5500]
75 kW	(100 HP)	[7500]
90 kW	(125 HP)	[9000]
110 kW	(150 HP)	[11000]
132 kW	(175 HP)	[13200]
160 kW	(200 HP)	[16000]
200 kW	(300 HP)	[20000]
250 kW	--	[25000]
300 kW	--	[30000]
315 kW	(350 HP)	[31500]
355 kW	(450 HP)	[35500]
400 kW	(500 HP)	[40000]
500 kW	(600 HP)	[50000]
★ Depends on the unit		

Function:

Set the power value that corresponds to the nameplate power of the motor. The default setting is the full rating of the drive.

Description of choice:

Select a value that equals the nameplate data on the motor. It is also possible to set any power within the range of the drive.

103	Motor Voltage	(MOTOR VOLTAGE)
Value:		
200 V		[200]
208 V		[208]
220 V		[220]
230 V		[230]
240 V		[240]
380 V		[380]
400 V		[400]
415 V		[415]
440 V		[440]
460 V		[460]
480 V		[480]
500 V		[500]
575 V		[575]
★ Depends on the unit		

Function:

Set the rated motor voltage.

Description of choice:

Select a value that equals the nameplate data on the motor. This may be less than the input voltage. It is also possible to set any voltage within the range of the drive.

104	Motor Frequency	(MOTOR FREQUENCY)
Value:		
50 Hz (50 Hz)		[50]
★ 60 Hz (60 Hz)		[60]

Function:

This is where the rated motor frequency is selected. This is usually the frequency of the power line.

Description of choice:

Select the desired value. It is also possible to set any frequency within the range of the drive.

⚠ CAUTION

Enter correct value in parameter 105, *Motor Current*, since this forms part of VVC$^+$ control. Changing values in parameter 102, *Motor Power*, or parameter 103, *Motor Voltage,* after motor current has been entered in parameter 105 can automatically change the value in parameter 105.

105	Motor Current	(MOTOR CURRENT)
Value:		
0.01 to drive rating	★ Set based on motor nameplate.	

Function:

The rated motor current in amps is used for setting output current and providing motor thermal protection. It is important to set the motor current to the full load current rating (FLA) of the motor.

Description of choice:

Set a value that equals the nameplate data on the motor.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

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⚠CAUTION

It is important to set correct value in parameter 106, *Rated Motor Speed***, since this forms part of VVC+ control feature. Changing value in parameter 104,** *Motor Frequency***, after rated motor speed has been entered in parameter 106 may automatically change the value in parameter 106.**

106	Rated Motor Speed	(MOTOR NOM. SPEED)

Value:

100 through 60000

★ Depends on parameter 102, *Motor Power*

Function:

This is where the value is set that corresponds to the rated motor speed shown on the motor nameplate.

Description of choice:

Choose a value that corresponds to the motor nameplate data.

107	Automatic Motor Adaptation, AMA
	(AUTO MOTOR ADAPT)

Value:

★	Optimization disable (NO AMA)	[0]
	Automatic adaptation (RUN AMA)	[1]
	Automatic adaptation with LC-filter	
	(RUN AMA WITH LC-FILT)	[2]

Function:

Automatic Motor Adaptation (AMA) is an advanced procedure that measures electrical characteristics of the motor. This procedure does not run the motor.

AMA optimizes the adjustment of the drive to the motor. This feature is particularly useful with nonstandard motors, higher HP motors, and when the drive-to-motor cable length is long. Although it is not necessary to run AMA, it is highly recommended for optimum operation and increases the capability of the Automatic Energy Optimization function selectable in parameter 101, *Torque Characteristics*.

For the best adjustment of the drive, it is recommended to carry out AMA on a cold motor.

⚠CAUTION

Repeated AMA runs may lead to a heating of motor that will result in an increase of stator resistance. This will reduce accuracy. Allow motor to cool before running AMA.

If an output LC-filter has been connected between the drive and the motor, select the *Automatic Adaptation with LC-Filter*. If the complete AMA procedure is desired, remove the LC-filter, run *Automatic Adaptation* (RUN AMA), and reinstall the filter.

NOTE
Some motors may be unable to run AMA. *Automatic Motor Adaptation with LC-Filter* **is a reduced AMA procedure which can be effective in such cases when run without an LC-filter installed since results measure motor's stator and effects of cable length.**

The following must be noted when the AMA function is used:

- Before running AMA, the correct nameplate data for the motor must be entered in parameters 102 to 106.
- Total automatic motor adaptation may take up to 10 minutes.
- Alarms and warnings will be shown in the display if faults occur during motor adaptation.
- AMA can only be carried out if the rated motor current of the motor is at least 35% of the rated output current of the drive.
- To cancel AMA, press the OFF/STOP key.

⚠CAUTION

AMA cannot be used on multiple motor applications.

Description of choice:

Select *Automatic Adaptation* if the drive is to carry out a complete automatic motor adaptation procedure.

Select *Automatic Adaptation with LC-Filter* if an LC-filter has been placed between the drive and the motor or to run a reduced AMA without an LC-filter installed.

Procedure for Automatic Motor Adaptation:

1. Set motor parameters, 102 through 106, according to motor nameplate data.
2. Connect 24 VDC from terminal 12, or external to drive, to terminal 27.
3. Select either *Automatic Adaptation* or *Automatic Adaptation with LC-Filter* in parameter 107, *Automatic Motor Adaptation, AMA.*
4. Start drive by pressing Hand Start or connect terminal 18 (start) to terminal 12 and press Auto Start.

If the Automatic Motor Adaptation is to be stopped prior to completion: Press OFF/STOP key.

After a normal sequence, the display reads: AMA STOP
1. Press RESET key. Drive is now ready for operation.

NOTE
RESET key must be pressed after AMA is completed to load results into drive.

If there is a fault, the display reads: ALARM 22
1. Press RESET key to clear fault.
2. Check alarms section in this manual for possible causes of alarm.

If there is a warning, the display reads: WARNING (39 through 42)
1. Check warnings section in this manual for possible causes of warning.
2. Press CHANGE DATA key and select *Continue* if AMA is to continue despite warning, or press OFF/STOP key to stop AMA.

108 Start Voltage of Parallel Motors (MULTIM.START VOLT)

Value:

0.0 through parameter 103 *Motor Voltage*
★ depends on par. 103 *Motor Voltage*

Function:

This parameter sets the voltage at 0 Hz for all drives with two or more motors connected in parallel.

The start voltage represents a supplementary voltage input to the motor. Increasing the start voltage will increase the starting torque. A start voltage is especially useful for small motors (<5 HP) as they have a higher stator resistance than larger motors.

This function is only active if *Parallel Motors* has been selected in parameter 101, *Torque Characteristics*.

Description of choice:

To set the start voltage, monitor the motor current while starting the load and choose the starting voltage that gives the lowest starting current. Start with a small value and increase only as required for reliable starting.

109 Resonance Dampening (RESONANCE DAMP.)

Value:

0 to 500 %   ★100 %

Function:

High-frequency resonances in the motor can be eliminated by adjusting this parameter.

Description of choice:

Adjust the dampening percentage for smoothest high speed operation.

110 High Breakaway Torque (HIGH START TORQ.)

Value:

0.0 to 0.5 sec.   ★ OFF

Function:

The drive is able to breakaway high friction loads. This high starting torque, approximately 1.6 x rated torque is available for up to 0.5 seconds. The current level is limited by the protective circuits of the drive. OFF corresponds to 0.0 sec.

Description of choice:

Set the time for which high starting torque is desired.

111 Start Delay   (START DELAY)

Value:

0.0 to 120.0 sec.   ★ 0.0 sec.

Function:

This parameter allows a delayed start of the drive after the conditions for start have been fulfilled. After the start delay time has elapsed, the drive will start and ramp up to the commanded speed.

Description of choice:

Set the desired time before the drive will start.

112 Motor Preheat   (MOTOR PREHEAT)

Value:

★   Disable (DISABLE)   [0]
    Enable (ENABLE)   [1]

Function:

The motor preheat function protects the motor from condensation by running a small DC current through the motor. Motor preheat is only active during stop when control voltage is applied to terminal 27.

Description of choice:

Select *Disable* if this function is not required. Select *Enable* to activate motor preheating. The amount of motor preheating is set in parameter 113.

⚠WARNING

Be sure to check parameter 113 if parameter 112, *Motor Preheat*, is enabled. Excessive current or preheating time may damage motor.

113 Motor Preheat DC Current (PREHEAT DC-CURR.)

Value:

0 to 100 %   ★ 50 %

The maximum value depends on the rated motor current.

Function:

The motor can be preheated when stopped by applying DC current to it. A holding torque can also be provided.

Description of choice:

The motor can be preheated by means of a DC current. At 0%, the function is inactive; at a value higher than 0%, a DC current will be supplied to the motor whenever it is stopped. A windmilling fan can be held by providing a holding toque by using this parameter.

⚠WARNING

Do not apply any more current than required. Too high a current applied for too long a time will overheat motor.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

DC Braking

Applying DC current to the motor will brake the motor. Parameter 114, *DC Braking Current*, sets the DC braking current as a percentage of the rated motor current. Parameter 115, *DC Braking Time*, sets the amount of time that the DC current will be applied. Parameter 116, *DC Brake Cut-in Frequency*, sets the frequency at which DC braking begins when the motor decelerates during a stop.

If terminal 19 or 27 (parameters 303 or 304 *Digital Input)* has been programmed to *DC Braking Inverse* and shifts from logic '1' to logic '0', the DC braking will be activated immediately.

When the start signal on terminal 18 changes from logic '1' to logic '0', the DC braking will be activated when the output frequency becomes lower than the brake cut-in frequency.

If a DC brake current is set in parameter 114, the drive's switching frequency will be limited to 4 kHz during the braking.

⚠WARNING
A high braking current supplied for a long time will overheat motor. Use only the DC braking current and time required.

⚠CAUTION
Do not use DC braking function if inertia of driven load is more than 20 times inertia of motor.

114 DC Braking Current (DC BRAKE CURRENT)
Value:

  0 to 100%   ★ 50 %
The maximum value depends on the rated motor current.

Function:
This parameter is used for setting the DC braking current that is applied:

1. When the DC brake frequency set in parameter 116 *DC Brake Cut-in Frequency* has been reached during a stop.
2. When DC brake inverse is active via terminal 19 or 27, or via the serial bus.

The DC braking current will be active for the duration of the DC braking time set in parameter 115 *DC Braking Time.*

Description of choice:
To be set as a percentage value of the rated motor current set in parameter 105 *Motor Current.*

100% DC braking current corresponds to the value set in parameter 105.

115 DC Braking Time (DC BRAKE TIME)
Value:

  0.0 to 60.0 sec.   ★ 10.0 sec.

Function:
This parameter sets the time that the DC braking is active.

Description of choice:
Set the desired time.

116 DC Brake Cut-in Frequency (DC BRAKE CUT-IN)
Value:

  0.0 (OFF) to setting of parameter 202   ★ OFF

Function:
This parameter is used for setting the frequency at which DC braking begins after a stop command is issued.

Description of choice:
Set the desired frequency for braking to begin upon deceleration.

⚠CAUTION
Most HVAC applications do not required braking or holding. It is suggested that parameter 114 remains set at 0 unless unusual application requirements call for braking or holding torque.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

117	Motor Thermal Protection
	(MOT.THERM PROTEC)

Value:

No protection (NO PROTECTION)	[0]
Thermistor warning (THERMISTOR WARNING)	[1]
Thermistor trip (THERMISTOR FAULT)	[2]
ETR Warning 1 (ETR WARNING 1)	[3]
★ ETR Trip 1 (ETR TRIP 1)	[4]
ETR Warning 2 (ETR WARNING 2)	[5]
ETR Trip 2 (ETR TRIP 2)	[6]
ETR Warning 3 (ETR WARNING 3)	[7]
ETR Trip 3 (ETR TRIP 3)	[8]
ETR Warning 4 (ETR WARNING 4)	[9]
ETR Trip 4 (ETR TRIP 4)	[10]

Function:

The drive is able to monitor the motor temperature in two different ways:

By a thermistor installed in the motor. The thermistor is connected to one of the analog input terminals (53 or 54).

Calculation of the thermal load by the Electronic Thermal Relay (ETR) is based on current, frequency and time. This is compared with the rated motor current and the rated motor frequency. The calculations take into account the reduced cooling of the motor at low speeds.

ETR Tip 1 through 4 and ETR Warning 1 through 4 correspond to the four drive setups. This enables the use of the ETR function to protect up to four different motors if a different setup is used for each different motor.

⚠ CAUTION

If multiple setups are used, be sure to program complete motor data (parameters 102 through 106) and parameter 117 in each setup. This can be done manually, or parameter 003 can be used to copy all data from one setup into one or more setup groups.

Description of choice:

Select *No protection* if no warning or trip is desired when the motor is overheated.

Select *Thermistor warning* if a warning is desired when the motor thermistor reaches its trip point.

Select *Thermistor trip* if a fault is desired when the motor thermistor reaches its trip point.

Select *ETR Warning 1 through 4,* if a warning is desired when the motor is overheated according to the ETR calculations.

The drive can also be programmed to give off a warning signal one of the digital outputs.

Select *ETR Trip 1 through 4* if a fault is desired when the motor is overheated according to the ETR calculations.

Motor Thermal Protection

The motor temperature is calculated on the basis of motor current, output frequency and time. The graph shows the amount of time that the drive can provide a current level to the motor at the rated motor frequency, 20% of rated motor frequency and 200% of rated motor frequency.

39
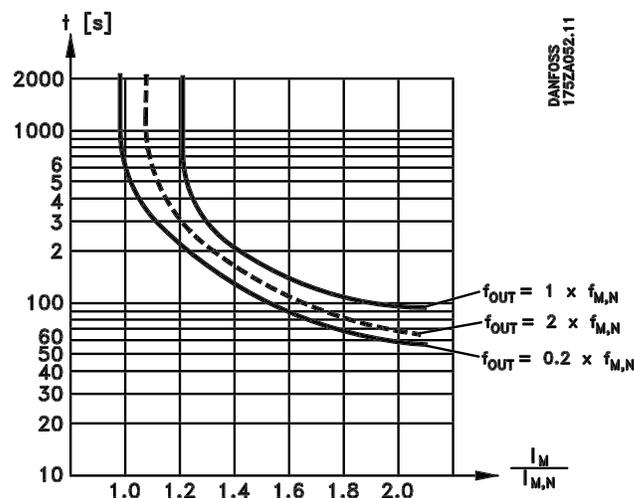
References and Limits
Parameters 200 through 228

In this parameter group, the frequencies and references of the drive are set.

This parameter group includes:

- Setting of ramp times
- Choice of four preset references
- Setting four bypass frequencies
- Setting maximum current to motor
- Setting warning limits for current, frequency, reference and feedback

200	Output Frequency Range
	(FREQUENCY RANGE)

Value:

★	0 to 120 Hz (0 - 120 HZ)	[0]
	0 to 1000 Hz (0 - 1000 HZ)	[1]

Function:

Choose one of two maximum output frequency ranges.

Description of choice:

Select the output frequency range that includes the highest output frequency required for normal operation.

⚠WARNING

HVAC applications will almost never require output frequency greater than 120 Hz. Check with Danfoss Graham, manufacturer of motor, and manufacturer of driven equipment before selecting 1000 Hz range.

201	Output Frequency Low Limit
	(MIN. FREQUENCY)

Value:

0.0 to parameter 202	★ 0.0 Hz

Function:

Set the minimum speed at which the motor is to run.

Description of choice:

A value from 0.0 Hz to the *Output Frequency High Limit* frequency set in parameter 202 can be selected. The drive will not be able to run continuously at an output frequency below this value in any mode.

NOTE
For fan applications, factory setting of parameter 201 is 6 Hz. For pump applications, factory setting for parameter 201 is 18 Hz.

202	Output Frequency High Limit
	(MAX. FREQUENCY)

Value:

Parameter 201 to parameter 200	★ 60 Hz

Function:

Set the highest speed at which the motor is to run.

NOTE
Output frequency of drive can never assume value higher than 1/10th of switching frequency. See parameter 407, *Switching Frequency*.

Description of choice:

A value from the choice made in parameter 201 to the choice made in parameter 200 can be selected. The drive will not be able to run continuously at an output frequency below this value in any mode.

⚠WARNING

HVAC applications seldom require output frequency greater than 60 Hz. Check with Danfoss Graham, manufacturer of motor, and manufacturer of driven equipment before selecting maximum frequency greater than 60 Hz.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Reference Handling

Reference handling is shown in the block diagram at the bottom of this page. The block diagram shows how a change in a parameter can affect the resulting reference.

Parameters 203 to 205, *Reference Handling, Minimum and Maximum Reference,* and parameter 210, *Reference Type,* define the way reference handling can be carried out. These parameters are active both in closed loop and open loop operation.

In closed loop operation, the resulting reference is affected by parameters 418 and 419, *Setpoints,* as well as by remote references.

Remote references can be:
- external references, including analog inputs 53, 54 and 60; pulse references through terminals 17 or 29 and references from serial communication.
- preset references.

The resulting reference can be shown in the display as a percentage by selecting *Reference [%],* or as a unit by selecting *Reference [unit]* in parameters 007 through 010. The sum of the external references can be shown in the display in a percentage of the range from *Minimum Reference* to *Maximum Reference.* Select *External Reference, [%]* in parameters 007 through 010 *Display Readout* if a readout is required.

It is possible to have both internal preset references and external references at the same time. In parameter 210, *Reference Type,* a choice is made of how the preset references are to be combined with the external references.

An independent local reference exists, where the resulting reference is set by means of the + and - keys. In all cases, the output frequency range is limited by parameter 201, *Output Frequency Low Limit,* and parameter 202, *Output Frequency High Limit.*

⚠CAUTION
If local reference is active, drive is *always* in *Open Loop*, regardless of choice made in parameter 100, *Configuration*.

The unit of the local reference can be set either as Hz or as a percentage of the output frequency range. The unit is selected in parameter 011, *Unit of Local Reference.*

203	Reference Handling	(REFERENCE SITE)
Value:		
★	Hand/Auto linked reference	
	(LINKED TO HAND/START)	[0]
	Remote controlled reference (REMOTE)	[1]
	Local reference (LOCAL)	[2]
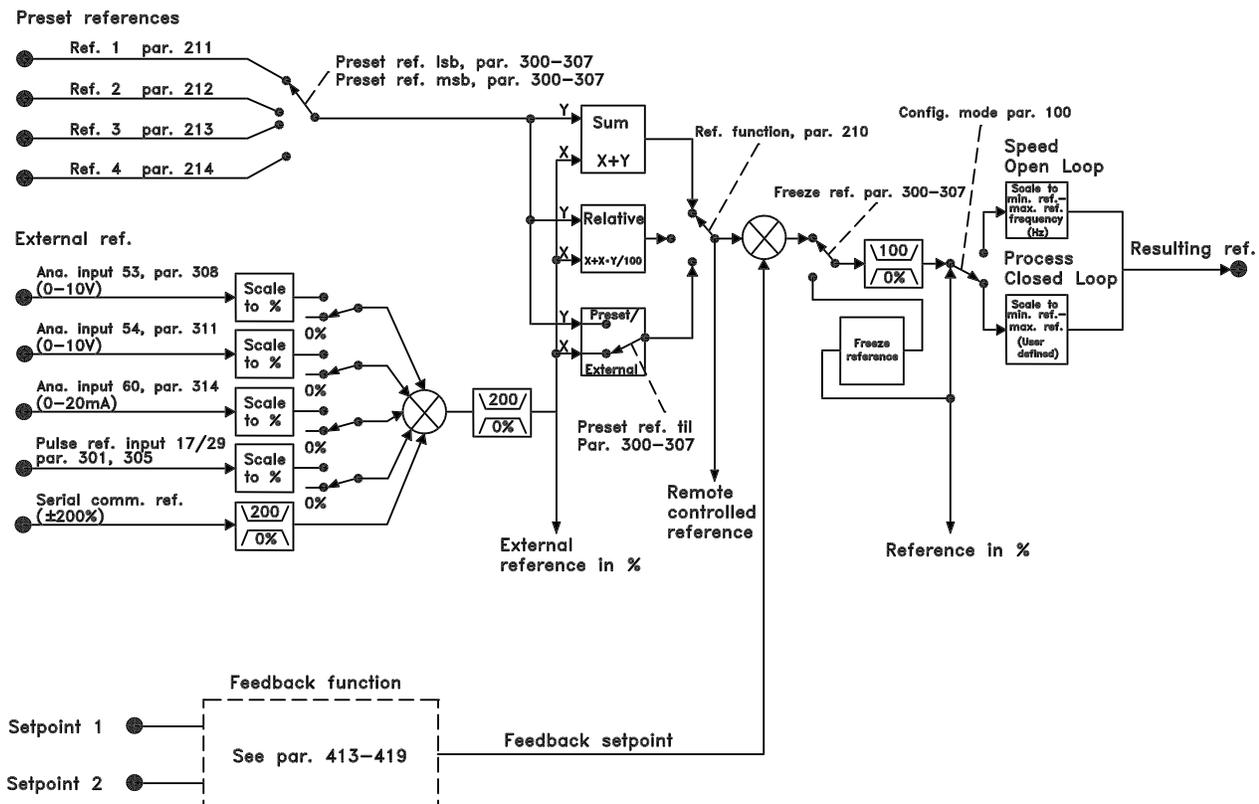
★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Function:

This parameter chooses the active resulting reference. If *Hand/Auto linked reference* is selected, the resulting reference will depend on whether the drive is in Hand or Auto mode.

The table below shows which reference is active when *Hand/Auto linked reference*, *Remote reference* or *Local reference* has been selected. The Hand mode or Auto mode can be selected via the keypad or by a digital input set in parameters 300 through 307 *Digital Inputs.*

Reference Handling	Hand Mode	Auto Mode
Hand/Auto	Local ref. active	Remote ref. active
Remote	Remote ref. active	Remote ref. active
Local	Local ref. active	Local ref. active

Description of choice:

If *Hand/Auto linked reference* is chosen, the motor speed in Hand mode will be set by the local reference, while in Auto mode it is set by the remote references and any setpoints selected.

If *Remote reference* is selected, the motor speed will depend on remote references and any setpoints selected, regardless of whether Hand mode or Auto mode has been chosen.

If *Local reference* is selected, the motor speed will only depend on the local reference set via the control panel, regardless of whether Hand mode or Auto mode has been selected.

204   Minimum Reference   (MIN. REFERENCE)
Value:

If parameter 100, *Configuration = Open loop*,
0.000Hz to parameter 205, *Maximum Reference.* ✶ 0.000 Hz

If parameter 100 *Configuration = Closed loop*,
parameter 413, *Minimum Feedback,* to
parameter 205, *Maximum Reference.*   ✶ 0.000 Hz

Function:

The *Minimum Reference* sets the minimum value of the sum of all references. If *Closed loop* has been selected in parameter 100, *Configuration*, the minimum reference is limited by parameter 413, *Minimum Feedback.*

Minimum reference is ignored when the local reference is active. In this case, minimum reference is determined by parameter 201, *Minimum Frequency.*

NOTE
For fan applications, factory setting of parameter 204 is 6 Hz. For pump applications, factory setting for parameter 204 is 18 Hz.

The unit for the reference can be seen from the following table:

	Unit
Parameter 100 *Configuration = Open loop*	Hz
Parameter 100 *Configuration = Closed loop*	Par. 415

Description of choice:

Minimum Reference is the lowest reference value that can be set for the drive.

205   Maximum Reference   (MAX. REFERENCE)
Value:

If parameter 100, *Configuration = Open loop*,
parameter 204, *Minimum Reference*,
  to 1000.000 Hz   ✶60.000 Hz

If parameter 100, *Configuration = Closed loop*,
parameter 204, *Minimum Reference*, to
parameter 414, *Maximum Feedback.*   ✶60.000 Hz

Function:

The *Maximum Reference* sets the maximum value of the sum of all references. If *Closed loop* has been selected in parameter 100, *Configuration*, the maximum reference cannot be set above parameter 414, *Maximum Feedback.* The *Maximum Reference* is ignored when the local reference is active.

The reference unit can be determined from the following table:

	Unit
Parameter 100 *Configuration = Open loop*	Hz
Parameter 100 *Configuration = Closed loop*	Par. 415

Description of choice:

Maximum reference is the highest reference value that can be set for the drive.

✶ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

206	Ramp Up Time	(RAMP UP TIME)

Value:

   1 to 3600 seconds   ★ Depends on the unit

Function:

The ramp up time is the acceleration time from 0 Hz to the rated motor frequency set in parameter 104. It is assumed that the output current does not reach the current limit set in parameter 215. This determines the maximum acceleration rate for all modes of operation.

Description of choice:

Program the desired accel time. Too long of a ramp up time can cause sluggish drive operation. Too short of a ramp up time can cause the drive to go into current limit during acceleration or cause unacceptable torque pulses in the controlled system.

NOTE
For fan applications, factory setting of parameter 206 is 60 seconds. For pump applications, factory setting for parameter 206 is 10 seconds.
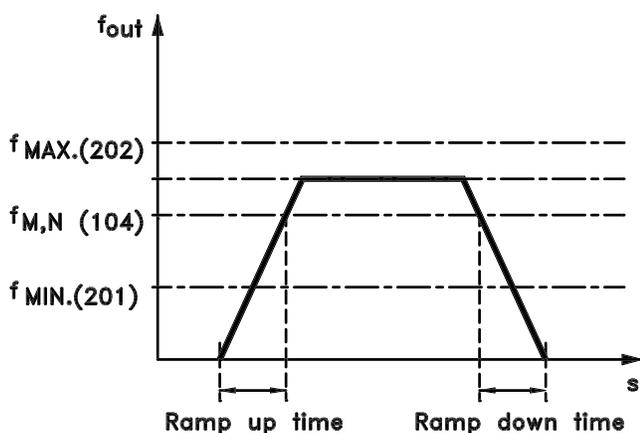
DANFOSS
175HA334.10

207	Ramp Down Time	(RAMP DOWN TIME)

Value:

   1 to 3600 seconds   ★ Depends on the unit

Function:

The ramp-down time is the deceleration time from the rated motor frequency set in parameter 104 to 0 Hz. This ramp-down time may be automatically extended to prevent an overvoltage trip if the load regenerates to the drive. This determines the maximum deceleration rate for all modes of operation.

Description of choice:

Program the desired decel time. Too long of a ramp down time can cause sluggish operation. Too short of a ramp down time can cause the drive to trip off due to high DC bus voltage or cause unacceptable torque pulses in the controlled system.

NOTE
For fan applications, factory setting of parameter 207 is 60 seconds. For pump applications, factory setting for parameter 207 is 10 seconds.

208	Automatic Ramp Down	(AUTO RAMPING)

Value:

   Disable (DISABLE)   [0]
★ Enable (ENABLE)   [1]

Function:

This function ensures that the drive does not trip during deceleration if the decel time set is too short. If, during deceleration, the DC bus voltage increases to the maximum value permitted, the drive automatically extends the ramp-down time.

⚠CAUTION
If auto ramping is enabled, ramp time can be considerably longer than that set in parameter 207.

Description of choice:

Program this function as *Enable* to avoid trips caused by too rapid a deceleration.

209	Jog Frequency	(JOG FREQUENCY)

Value:

   Parameter 201, *Output Frequency Low Limit,* to parameter 202 *Output Frequency High Limit*   ★ 10.0 Hz

Function:

The jog frequency is the fixed output frequency at which the drive is running when the jog function is activated.

Jog can be activated via the digital inputs.

Description of choice:

Set the desired frequency.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Reference Type

The example below shows how the resulting reference is calculated when Preset references are used together with Sum and Relative references set in parameter 210, *Reference Type*. A formula for calculating the resulting reference is given under Calculation of Resulting Reference. See the drawing under Reference Handling.

Example:
The following parameters have been set:

Parameter 204 *Minimum Reference:*	10 Hz
Parameter 205 *Maximum Reference:*	60 Hz
Parameter 211 *Preset Reference:*	15%
Parameter 308 *Terminal 53, Analog Input:*	Reference
Parameter 309 *Terminal 53, Min. Scaling:*	0 V
Parameter 310 *Terminal 53, Max. Scaling:*	10 V

When parameter 210 *Reference Type* is set to Sum, one of the adjusted *Preset References*, parameters 211 through 214, will be added to the external references as a percentage of the reference range. If terminal 53 has an analog input voltage of 4 V, the resulting reference will be:

Parameter 210 *Reference type = Sum*

Parameter 204 *Minimum Reference*	= 10.0 Hz
Reference contribution at 4 V	= 16.0 Hz
Parameter 211 *Preset Reference*	= 6.0 Hz
Resulting reference	= 32.0 Hz

If parameter 210 *Reference Type* is set to *Relative,* one of the adjusted *Preset References* parameters 211 through 214 will be totaled as a percentage of the sum of the present external references. If terminal 53 has an analog input voltage of 4 V, the resulting reference will be:

Parameter 210 *Reference type = Relative*

Parameter 204 *Minimum Reference*	= 10.0 Hz
Reference contribution at 4 V	= 16.0 Hz
Parameter 211 *Preset Reference*	= 2.4 Hz
Resulting reference	= 28.4 Hz

The graph in the next column shows the resulting reference while the external reference changes from 0 to 10 V. Parameter 210, *Reference Type* has been programmed for *Sum* and *Relative.* Parameter 211, *Preset Reference 1,* is programmed for 0%.
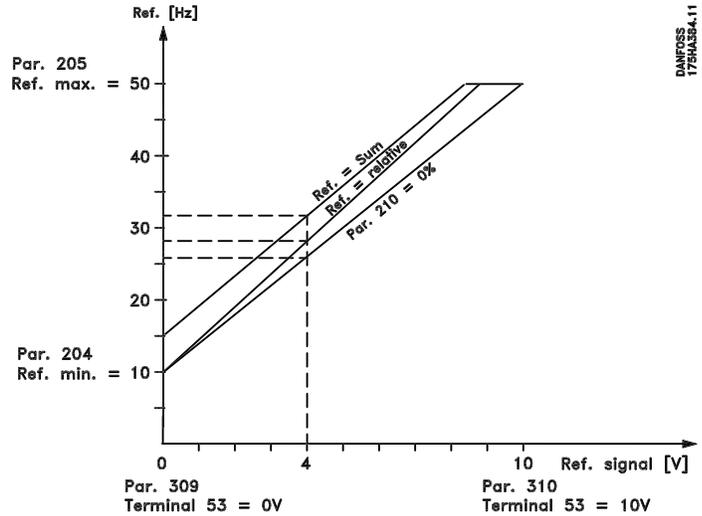
210	Reference Type	(REF. FUNCTION)
Value:		
	Sum (SUM)	[0]
	Relative (RELATIVE)	[1]
★	External/preset (EXTERNAL/PRESET)	[2]

Function:

It is possible to define how the preset references are added to the other references. For this purpose, *Sum* or *Relative* is used. It is also possible, by using the *External/Preset* function, to select between the external references and a preset reference.

Description of choice:

If *Sum* is selected, one of the preset references (parameters 211 through 214, *Preset Reference)* is added to the other external references as a percentage of the reference range (minimum reference through maximum reference).

If *Relative* is selected, one of the adjusted preset references (parameters 211 through 214, *Preset Reference*) is added as a percentage of the total external reference.

If *External/Preset* is selected, it is possible to shift between the external references and the preset references using terminals 16, 17, 29, 32 or 33 (parameters 300, 301, 305, 306 or 307, *Digital Inputs*). Preset references are a percentage value of the reference range. External reference is the sum of the analog references, pulse references and any references from serial communication.

⚠CAUTION

If *Sum* or *Relative* is selected, one of preset references will always be active. If preset references are not used, they must be set to 0%.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

211	Preset Reference 1	(PRESET REF. 1)
212	Preset Reference 2	(PRESET REF. 2)
213	Preset Reference 3	(PRESET REF. 3)
214	Preset Reference 4	(PRESET REF. 4)

Value:

   -100.00 % to +100.00 %   ★ 0.00%

      of the reference range or external reference

Function:

Four different preset references can be programmed in parameters 211 to 214, *Preset Reference*. The preset reference is stated as a percentage of the reference range or as a percentage of the other external references, depending upon the choice made in parameter 210, *Reference Type*.

The choice of preset references is made by activating terminals 16, 17, 29, 32 or 33, as shown in the table below.

Terminal 17/29/33 preset reference msb	Terminal 16/29/32 preset reference lsb	
0	0	Preset reference 1
0	1	Preset reference 2
1	0	Preset reference 3
1	1	Preset reference 4

Description of choice:

Set the required preset reference(s) that is/are to be used.

215	Current Limit	(CURRENT LIMIT)

Value:

   0.1 to 1.1 x rated current   ★ Depends on the unit

Function:

This is where the maximum output current is set. If the motor attempts to draw more than this amount of current, the drive will reduce its output frequency until the current is less than or equal to the current limit value.

The factory setting corresponds to the rated output current. If the current limit is to be used as motor protection, the rated motor current must be set. If the current limit is set within the range of 1.0 to 1.1 times the rated output current of the drive, the drive can only handle current greater than its rated output intermittently. After the load has been higher than rated output current limit, it must be reduced to a level that is lower than the rated current of the drive for a period of time.

Note that if the current limit is set to less than the maximum value of the drive, acceleration torque is reduced correspondingly.

Description of choice:

Set the required maximum output current.

216	Frequency Bypass, Bandwidth
	(FREQUENCY BYPASS B.W.)

Value:

   0 (OFF) to 100 Hz   ★ DISABLED

Function:

Mechanical resonance in the driven system sometimes makes it desirable to avoid operation at critical speeds.

These output frequencies can be programmed in parameters 217 through 220.

In this parameter, *Frequency Bypass, Bandwidth*, the width of the frequency to be bypassed is defined.

Description of choice:

The bypass bandwidth is equal to the programmed bandwidth frequency. This bandwidth will be centered around each bypass frequency.

217	Frequency Bypass 1	(BYPASS FREQ. 1)
218	Frequency Bypass 2	(BYPASS FREQ. 2)
219	Frequency Bypass 3	(BYPASS FREQ. 3)
220	Frequency Bypass 4	(BYPASS FREQ. 4)

Value:

   0 to 120 or 1000 Hz   ★ 120.0 Hz

The frequency range depends on the selection made in parameter 200, *Output Frequency Range*.

Function:

Some systems require that some output frequencies be avoided because of mechanical resonance problems in the system.

Description of choice:

Enter the frequencies to be avoided.

See also parameter 216, *Frequency Bypass, Bandwidth*.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Warning Functions

The warning functions in parameters 221 through 228 are not active during ramp-up after a Start command, ramp down after a Stop command, or while stopped. The warning functions are activated when the output frequency has reached the resulting reference.

The signal outputs can be programmed to generate a warning signal via terminal 42 or 45 and via the relay outputs.

The reference limits in parameter 226, *Warning: High Reference* and parameter 227, *Warning: Low Reference* are only active when remote reference has been selected.

221 Warning: Low Current (WARN. LOW CURR)
Value:
0.0 to parameter 222 *Warning: High current*   ✭ 0.0 A

Function:
When the motor current is below the limit programmed in this parameter, the display shows a flashing CURRENT LOW, provided *Warning* has been selected in parameter 409, *Function in Case of No Load*. The drive will trip if parameter 409 has been selected as *Trip*. This can be used to indicate when a belt between the motor and the driven load is broken.

Description of choice:
The lower signal limit must be programmed within the normal working range of the drive.
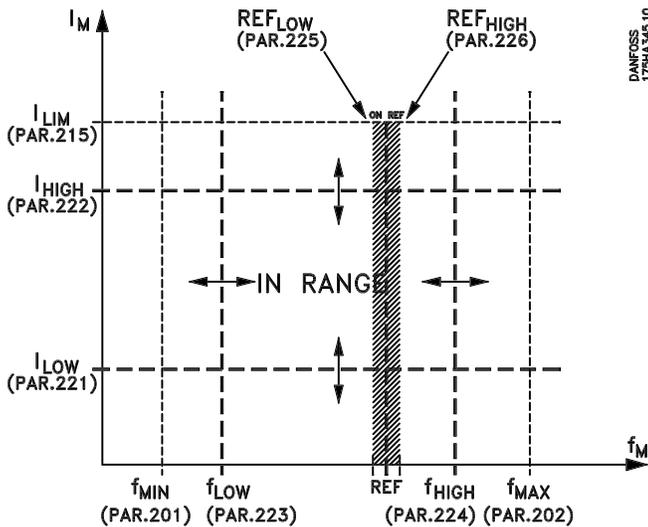
222 Warning: High Current (WARN. HIGH CURR)
Value:
Parameter 221 to rated current   ★ Rated current

Function:
If the motor current is above the limit programmed in this parameter, the display shows a flashing CURRENT HIGH.

Description of choice:
The upper signal limit of the motor frequency must be programmed within the normal working range of the drive. See the drawing at parameter 221, *Warning: Low Current.*

223 Warning: Low Frequency (WARN. LOW FREQ)
Value:
0.0 to parameter 224   ★ 0.0 Hz

Function:
If the output frequency is below the limit programmed in this parameter, the display will show a flashing F OUT < FLOW.

Description of choice:
The lower signal limit of the motor frequency must be programmed within the normal working range of the drive. See drawing at parameter 221 *Warning: Low current.*

224 Warning: High Frequency (WARN. HIGH FREQ.)
Value:
Par. 200 *Output frequency range* = 0 to 120 Hz
parameter 223 - 120 Hz   ✭ 120.0 Hz
Par. 200 *Output frequency range* = 0 to 1000 Hz
parameter 223 - 1000 Hz   ✭ 120.0 Hz

Function:
If the output frequency is above the limit programmed in this parameter, the display will show a flashing F OUT > F HIGH

Description of choice:
The higher signal limit of the motor frequency must be programmed within the normal working range of the drive. See the drawing at parameter 221, *Warning: Low Current.*

✭ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

225 Warning: Low Reference
(WARN. LOW REF)
Value:

-999,999.999 - *High Reference* (par. 226) ★ -999,999.999 Hz

Function:

When the total remote reference is less than the limit programmed in this parameter, the display shows a flashing REF. < REF. LOW

The reference limits in parameter 226, *Warning: High Reference* and parameter 225, *Warning: Low Reference* are only active when remote reference has been selected.

In *Open Loop,* the unit for the reference is Hz, while in *Closed Loop* the unit is programmed in parameter 415, *Process Units.*

Description of choice:

When parameter 100, *Configuration,* has been programmed for *Open Loop*, the lower signal limit of the reference must be programmed within the normal working range of the drive. If parameter 100 is programmed as *Closed Loop*, Low Reference must be within the reference range programmed in parameters 204 and 205.

226 Warning: High Reference
(WARN. HIGH REF)
Value:

Reference Low (par. 225) to 999,999.999 ★ -999,999.999 Hz

Function:

If the resulting reference is below the limit programmed in this parameter, the display flashes REF. > REF. HIGH.,

The reference limits in parameter 226 *Warning: High Reference* and parameter 225 *Warning: Low Reference* are only active when remote reference has been selected.

In *Open Loop,* the unit for the reference is Hz, while in *Closed Loop* the unit is programmed in parameter 415, *Process Units.*

Description of choice:

The high reference warning must be programmed within the normal working range of the drive, provided parameter 100 *Configuration* has been programmed for *Open Loop*. If parameter 100 has been programmed for *Closed Loop,* Reference High must be within the reference range programmed in parameters 204 and 205.

227 Warning: Low Feedback
(WARN .LOW FDBK)
Value:

-999,999.999 to High Feedback (parameter 228)

★ -999,999.999

Function:

If the feedback signal is below the limit of Low Feedback programmed in this parameter, the display will flash FEEDBACK < FOB LOW.

The unit for feedback is programmed in parameter 415, *Process Units.*

Description of choice:

Set the desired value within the feedback range, parameter 413, *Minimum Feedback,* and parameter 414, *Maximum Feedback.*

228 Warning: High Feedback
(WARN. HIGH FDBK)
Value:

Low Feedback (parameter 227) to 999,999.999

★999,999.999

Function:

If the feedback signal is above the limit programmed in this parameter, the display will show a flashing FEEDBACK > FOB HIGH.

The unit for feedback is programmed in parameter 415, *Process Units.*

Description of choice:

Set the required value within the feedback range, parameter 413, *Minimum Feedback,* and parameter 414, *Maximum Feedback.*

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Inputs and Outputs
Parameters 300 through 328

In this parameter group, the functions of the drive input and output terminals are defined. The digital inputs are through terminals 16, 17, 18, 19, 27, 32 and 33. Inputs are programmed by parameters 300 through 307. The table below shows the functions available for input.

Digital inputs require a signal of 0 or 24 VDC. A signal lower than 5 VDC is a logic '0', while a signal higher than 10 VDC is a logic '1'.

The terminals for the digital inputs can be connected to the internal 24 VDC supply through terminals 12 and 13, or an external 24 VDC supply can be connected.

The drawings at the right show one setup using the internal 24 VDC supply and one setup using an external 24 VDC supply.

```
 12  16  17  18  19  ⌇  33      Internal 24Vdc
                                Sw. 4 ON          DANFOSS 175HA346.10

 16  17  18  19  20  ⌇  33      External 24Vdc
 0/24Vdc                        Sw. 4 OFF         DANFOSS 175HA347.10
```
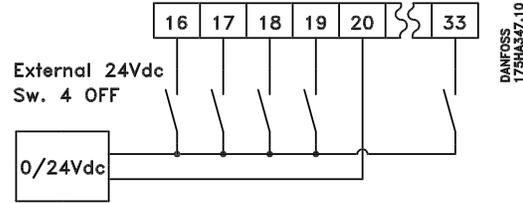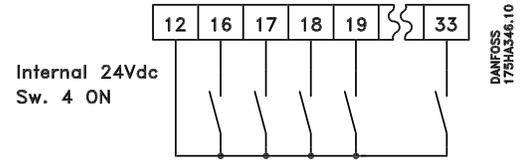
Switch 4 is used for separating the common potential of the internal 24 VDC supply from the common potential of an external 24 VDC supply. Switch 4 is the DIP switch on the far right of the group of DIP switches located on the lower right of the control card, just above the control terminals.
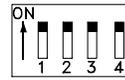
```
ON
 1  2  3  4        DANFOSS 175ZA068.10
```

When Switch 4 is in the OFF position, the external 24 VDC supply is galvanically isolated from the drive.

Digital Inputs	Terminal No.	16	17	18	19	27	29	32	33
	Parameter	300	301	302	303	304	305	306	307
Value:									
No function	(NO OPERATION)	[0]	★[0]	[0]	[0]		[0]	★[0]	★[0]
Reset	(RESET)	★[1]	[1]				[1]	[1]	[1]
Coasting stop, inverse	(COAST INVERSE)					[0]			
Reset and coasting stop, inverse	(RESET & COAST INVERSE)							[2]	
Start	(START)				★[1]				
Reversing	(REVERSE)					★[1]			
Reversing and start	(START REVERSE)					[2]			
DC-braking, inverse	(DC BRAKE INVERSE)					[3]	[1]		
Safety interlock	(SAFETY INTERLOCK)					★[2]			
Freeze reference	(FREEZE REFERENCE)	[2]	[2]				[2]	[3]	[2]
Freeze output	(FREEZE OUTPUT)	[3]	[3]				[3]	[4]	[3]
Selection of Setup, lsb	(SETUP SELECT LSB)	[4]					[4]	[5]	
Selection of Setup, msb	(SETUP SELECT MSB)			[4]			[5]		[4]
Preset reference, on	(PRESET REF. ON)	[5]	[5]				[6]	[6]	[5]
Preset reference, lsb	(PRESET REF. LSB)	[6]					[7]	[7]	
Preset reference, msb	(PRESET REF. MSB)			[6]			[8]		[6]
Speed down	(SPEED DOWN)		[7]				[9]		[7]
Speed up	(SPEED UP)	[7]					[10]	[8]	
Start enabled	(RUN PERMISSIVE)	[8]	[8]				[11]	[9]	[8]
Jog	(JOG)	[9]	[9]				★[12]	[10]	[9]
Data change lock	(PROGRAMMING LOCK)	[10]	[10]				[13]	[11]	[10]
Pulse reference	(PULSE REFERENCE)		[11]				[14]		
Pulse feedback	(PULSE FEEDBACK)								[11]
Hand start	(HAND START)	[11]	[12]				[15]	[12]	[12]
Auto start	(AUTOSTART)	[12]	[13]				[16]	[13]	[13]

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

In parameters 300 through 307, *Digital Inputs,* the functions of terminals 16 through 33 are selected.

These options are shown in the table on the previous page.

No Function is selected if the drive is not to react to signals transmitted to the terminal.

Reset allows reset of the drive after a resettable fault. Not all faults can be reset without removing and reapplying the input power. Faults that require the removal of input power are called trip lock faults. See "List of Warnings and Alarms" table in the back of this manual.

Coasting Stop, Inverse is used to release the motor immediately by turning off the output transistors. The motor will coast freely to a stop. Logic '0' implements coasting to a stop.

Reset and Coasting Stop, Inverse is used for activating coasting stop at the same time as reset. Logic '0' implements coasting stop and reset.

DC Braking, Inverse is used for stopping the motor by energizing it with a DC voltage for a given time, as set by parameters 114 and 115. Logic '0' implements DC braking. See the DC braking parameters.

Safety Interlock is the same as *Coasting Stop, Inverse*, except *Safety Interlock* generates an alarm message on the display when terminal 27 is logic '0'. The alarm message will also be active through digital outputs 42 and 45 and relay outputs 1 and 2, if programmed for *Safety Interlock*.

⚠WARNING

Do not choose *Safety Intelock* for drives with software version 1.03. See parameter 624 to determine software version of drive.

Start is selected for a remote Start/Stop command.
Logic '1' = Start.   Logic '0' = Stop.

Reversing is used for changing the direction of rotation of the motor. Logic '0' is for forward. Logic '1' is for reverse. The drive can be safely reversed while it is driving the motor. The reversing signal only changes the direction of rotation, it does not activate the start function. It is not active in *Closed Loop* mode.

Reversing and Start is used for Start/Stop and reversing using the same signal. A start signal through terminal 18 starts the drive in the forward directrion. If both terminal 18 and a reversing and start terminal are given a logic '1' at the same time, the drive will not start. It is not active in *Closed Loop.*

Freeze Reference freezes the present reference. The frozen reference can only be changed by means of *Speed Up* or *Speed Down.* The frozen reference is saved after a stop command and when power is removed.

Freeze Output freezes the present output frequency. The frozen output frequency can now only be changed by means of *Speed Up* or *Speed Down.*

⚠WARNING

If *Freeze Output* is active, the drive cannot be stopped via terminal 18.

To stop the drive when *Freeze Output* is active, one of the four methods listed below must be used.

- Turn off the *Freeze Output* function and perform a normal stop.
- Press the keypad Off/Stop key.
- Remove the control voltage to terminal 27.
- If terminal 19 is programmed in prameter 303 for *DC Brake Inverse*, remove the control voltage to it.

Selection of Setup, Lsb* and *Selection of Setup, Msb*** enables digital selection of the four possible setups. To enable this, parameter 002 *Active Setup* must be set to *Multi Setup.*

	Setup, Msb	Setup, Lsb
Setup 1	0	0
Setup 2	0	1
Setup 3	1	0
Setup 4	1	1

*Lsb - Least significant bit. **Msb - Most significant bit.

Preset Reference, on is used for switching between remote controlled reference and preset reference. This assumes that *Remote/preset* has been selected in parameter 210, *Reference Type.* Logic '0' = remote controlled references active; logic '1' = one of the four preset references is active in accordance with the table below.

Preset Reference, Lsb and *Preset reference, Msb* enables a choice of one of the four preset references, in accordance with the table below.

	Preset ref. msb	Preset ref. lsb
Preset ref. 1	0	0
Preset ref. 2	0	1
Preset ref. 3	1	0
Preset ref. 4	1	1

Speed Up and *Speed Down* are selected if digital control of the up/down speed is desired. This function is only active if *Freeze Reference* or *Freeze Output* has been selected.

As long as there is a logic '1' on the terminal selected for *Speed Up*, the reference or the output frequency will increase by the *Ramp-up Time* set in parameter 206.

As long as there is a logic '1' on the terminal selected for *Speed Down*, the reference or the output frequency will decrease by the *Ramp-down Time* set in parameter 207.

Pulses (logic '1' minimum high for 3 ms and a minimum pause of 3 ms) will lead to a change of speed of 0.1% (reference) or 0.1 Hz (output frequency).

Example:

	Terminal (16)	Terminal (17)	Freeze ref./ Freeze output
No speed change	0	0	1
Speed down	0	1	1
Speed up	1	0	1
Speed down	1	1	1

The speed reference frozen through the control panel can be changed even if the drive has stopped. In addition, the frozen reference will be retained in memory after power interruption.

Run Permissive. Run Permissive is used to require a second "run permission" signal in addition to the normal run command, either in Hand or Auto mode. When a run command alone is given, the display will show RUN REQ., but the drive will not start. The drive can also indicate that a run has been requested through one of the transistorized or relay outputs. When, in addition to the run command, a logic '1' is applied to the *Run Permissive* terminal, the drive will run. If more than one terminal is programmed for *Run Permissive*, a logic '1' at any of these terminals will allow the drive to run.

Jog is used to start the drive and run it at the frequency set in parameter 209, *Jog Frequency*. Jog is active in both Hand and Auto mode.

Jog is not active if a stop command has been given through the keypad or terminal 27.

Data change lock is selected if changes to parameters are not to be made via the control panel. It is be possible to change parameters through the serial bus.

Pulse reference is selected if the frequency of a pulse train is to be used as a reference signal. 0 Hz corresponds to parameter 204, *Minimum Reference.* The frequency set in parameter 327, *Pulse Reference, Maximum Frequency* corresponds to parameter 205 *Maximum Reference.*

Pulse feedback is selected if the frequency of a pulse train is to be used as a feedback signal. Parameter 328, *Pulse Feedback, Maximum Frequency* is the pulse frequency that corresponds to maximum feedback.

Hand start is selected if an external signal is used to switch the drive to Hand mode. A logic '1' (*Hand Start* active) will start the motor. A logic '0' will stop the motor. The drive will then be in OFF/STOP mode, unless there is an active *Auto Start* signal from an external source. Programming one of the digital inputs for *Hand Start* will disable the LCP Hand Start and Auto Start keys.

⚠DANGER

Active *Hand* and *Auto* signals from digital inputs can cause drive to start unexpectedly. Remove power from drive before servicing driven equipment.

Auto start is selected if an external signal is sent to switch the drive to Auto mode. When a start signal is active on the control terminals or the serial communication port, the drive will start the motor. If *Auto Start* and *Hand Start* are active at the same time on the control terminals, *Auto Start* will have the higher priority. If *Auto Start* and *Hand Start* are not active, the motor will stop and the drive will then be in the OFF/STOP mode. Programming one of the digital inputs for *Hand Start* will disable the LCP Hand Start and Auto Start keys.

Analog Inputs

Two analog inputs for voltage signals, terminals 53 and 54, and an analog input for current, terminal 60, are provided for reference and feedback signals. A thermistor can be connected to the voltage inputs, terminals 53 or 54.

The two analog voltage inputs can be scaled over the range of 0 to 10 V DC. The current input can be scaled over the range of 0 to 20 mA.

The table below shows the possible analog input programming.

Parameter 317, *Time Out,* and Parameter 318, *Function After Time Out,* allow activation of a time-out function on all analog inputs. If the signal value of the reference or feedback signal connected to one of the analog input terminals drops below 50% of the minimum scaling, the function set in parameter 318, *Function After Time Out*, will be activated after the time-out set in parameter 317.

308	Terminal 53, Analog Input Voltage
(A1 [V] 53 FUNCT.)	

Function:

This parameter is used to select the required function to be linked to terminal 53.

Description of choice:

No operation. Selected if the drive is not to react to signals connected to the terminal.

Reference. Selected to enable change of reference by means of an analog reference signal. If reference signals are connected to several inputs, these reference signals will be summed.

Feedback. If a feedback signal is connected, a voltage input may be connected to either terminal 53 or 54, or a current input conected to terminal 60. If a two zone PID control is used, the feedback signals must be voltage inputs and applied to terminals 53 and 54. See *Feedback Handling*.

Thermistor. Selected if a thermistor in the motor stops the drive in case of motor overtemperature. The cutout value is 3 kohm. A Klixon thermal switch may also be connected to this input. If parallel sensors are used, the thermistors/thermal switches can be connected in series. The drive will shut down when the total resistance exceeds 3 kohms.

Parameter 117, *Motor Thermal Protection,* must be programmed for *Thermal Warning* or *Thermistor Trip,* and the thermistor must be inserted between terminal 53 or 54, *analog voltage input*, and terminal 50, *10 V supply*.

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175HA183.10
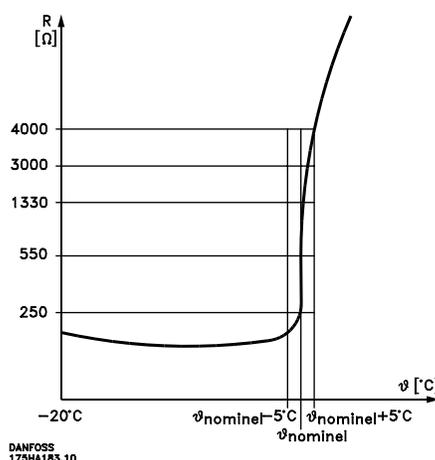
Analog Inputs	Terminal Number	53 (Voltage)	54 (Voltage)	60 (Current)
	Parameter	**308**	**311**	**314**
Value:				
No operation	(NO OPERATION)	★[0]	★[0]	[0]
Reference	(REFERENCE	[1]	[1]	★[1]
Feedback	(FEEDBACK)	[2]	[2]	[2]
Thermistor	(THERMISTOR)	[3]	[3]	

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

309 Terminal 53, Minimum Scaling (AI 53 SCALE LOW)

Value:

0.0 to 10.0 V ★ 0.0 V

Function:

This parameter is used for setting the signal value that corresponds to the minimum reference or the minimum feedback, parameter 204, *Minimum Reference,* or parameter 413, *Minimum Feedback.* See *Reference Handling* or *Feedback Handling*.

Description of choice:

Set the required voltage value. For reasons of accuracy, voltage losses in long signal lines should be compensated for. If the time out functions in parameter 317, *Time Out,* and parameter 318, *Function After Time Out*, are to be used, the value must be set to > 1 V.

310 Terminal 53, Maximum Scaling (AI 53 SCALE HIGH)

Value:

0.0 to 10.0 V ★ 10.0 V

Function:

This parameter is used to set the signal value that corresponds to the maximum reference value or the maximum feedback, parameter 205, *Maximum Reference,* or parameter 414, *Maximum Feedback*. See *Reference Handling* or *Feedback Handling*.

Description of choice:

Set the required voltage value.

For reasons of accuracy, voltage losses in long signal lines should be compensated for.

311 Terminal 54, Analog Input Voltage (AI [V] 54 FUNCT.)

Value:

See the description of parameter 308. ★ No operation

Function:

This parameter selects the function of terminal 54.

The input signal is scaled by parameter 312, *Terminal 54, Minimum Scaling,* and by parameter 313, *Terminal 54, Maximum Scaling*.

Description of choice:

See description of parameter 308.

For reasons of accuracy, voltage losses in long signal lines should be compensated for.

312 Terminal 54, Minimum Scaling (AI 54 SCALE LOW)

Value:

0.0 to 10.0 V ★ 0.0 V

Function:

This parameter is used to set the signal value that corresponds to the minimum reference value or the minimum feedback, parameter 204, *Minimum Reference,* and parameter 413, *Minimum Feedback*. See *Reference Handling* or *Feedback Handling*.

Description of choice:

Set the required voltage value. For reasons of accuracy, voltage losses in long signal lines should be compensated for.

If the time out function is to be applied, parameter 317, *Time Out,* and parameter 318, *Function After Time Out*, the value must be set to > 1 V.

313 Terminal 54, Maximum Scaling (AI 54 SCALE HIGH)

Value:

0.0 to 10.0 V ★ 10.0 V

Function:

This parameter is used to set the signal value that corresponds to the maximum reference value or the maximum feedback, parameter 205, *Maximum Reference,* or parameter 414, *Maximum Feedback*. See *Reference Handling* or *Feedback Handling*.

Description of choice:

Set the required voltage value. For reasons of accuracy, voltage losses in long signal lines should be compensated for.

314 Terminal 60, Analog Input Current (AI [mA] 60 FUNCT.)

Value:

See description of parameter 308. ★ Reference

Function:

This parameter selects the function of terminal 60.

Scaling of the input signal is set by parameter 315, *Terminal 60, Minimum Scaling,* and by parameter 316, *Terminal 60, Maximum Scaling*.

Description of choice:

See description of parameter 308, *Terminal 53, Analog Input Voltage*.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

315 Terminal 60, Minimum Scaling (AI 60 SCALE LOW)

Value:

0.0 to 20.0 mA   ★ 4.0 mA

Function:

This parameter determines the signal value that corresponds to the minimum reference or the minimum feedback, parameter 204 *Minimum Reference,* parameter 413, *Minimum Feedback*. See *Reference Handling* or *Feedback Handling*.

Description of choice:

Set the required current value.

If the time-out function is to be used, parameter 317, *Time Out,* and parameter 318, *Function After Time Out*, the value must be set to > 2 mA.

316 Terminal 60, Maximum Scaling (AI 60 SCALE HIGH)

Value:

0.0 to 20.0 mA   ★ 20.0 mA

Function:

This parameter determines the signal value that corresponds to the maximum reference or maximum feedback, parameter 205, *Maximum Reference Value,* or parameter 414, *Maximum Feedback*. See *Reference Handling* or *Feedback Handling*.

Description of choice:

Set the desired current value.

317 Time Out (LIVE ZERO TIME)

Value:

1 to 99 sec.   ★ 10 sec.

Function:

If the signal value of the reference or feedback signal connected to one of the input terminals 53, 54 or 60 drops to below 50% of the minimum scaling for a longer period than the Live Zero time, the function selected in parameter 318, *Function After Time Out*, will be activated.

This function will only be active if, in parameter 309 or 312, a value has been selected for *Terminals 53 and 54, Minimum Scaling,* that exceeds 1 V, or if, in parameter 315, *Terminal 60, Minimum Scaling*, a value has been selected that exceeds 2 mA.

Description of choice:

Set the desired time.

318 Function After Time Out (LIVE ZERO FUNCT.)

Value:

★ Off (NO FUNCTION) [0]
Freeze output frequency
(FREEZE OUTPUT FREQ.) [1]
Stop (STOP) [2]
Jog (JOG FREQUENCY) [3]
Max. output frequency (MAX FREQUENCY) [4]
Stop and trip (STOP AND TRIP) [5]

Function:

This is where to select the function to be activated after the end of the time-out period, parameter 317, *Time Out*.

If a time-out function occurs at the same time as a bus time-out function, parameter 510, *Bus Time Interval Function*, the time-out function in parameter 318 will be activated.

Description of choice:

The output frequency of the drive can:
- go to minimum (NO FUNCTION)
- be frozen at the present value (FREEZE OUTPUT FREQUENCY)
- stop (STOP)
- run at the jog frequency set in parameter 209 (JOG FREQUENCY)
- run at the maximum frequency set in parameter 202 (MAX. FREQUENCY)
- stop and send an alarm (STOP AND TRIP)

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Analog/Digital Outputs

The two analog/digital outputs available through terminals 42 and 45 can be programmed to show a status or an analog value such as frequency. The status signal is a 24 VDC output.

For the analog output, there is a choice of three types of output signal: 0 to 20 mA, 4 to 20 mA or 0 to 32000 pulses. The pulse rate is set by parameter 322, *Terminal 45, Output, Pulse Scaling*.

See the Electrical Installation, Control Terminals section of this manual for the ratings of these outputs.

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Analog/Digital Outputs	Terminal Number	42	45
	Parameter	319	321
Value:			
No function (NO FUNCTION)		[0]	[0]
Drive ready (READY)		[1]	[1]
Standby (STAND BY)		[2]	[2]
Running (ENABLED & NO WARNING		[3]	[3]
Running at ref. value (RUNNING AT REFERENCE)		[4]	[4]
Running, no warning (RUNNING NO WARNING)		[5]	[5]
Local reference active (DRIVE IN LOCAL REF.)		[6]	[6]
Remote controlled references active (DRIVE IN REMOTE REF.)		[7]	[7]
Alarm (ALARM)		[8]	[8]
Alarm or warning (ALARM OR WARNING)		[9]	[9]
No alarm (NO ALARM)		[10]	[10]
Current limit (CURRENT LIMIT)		[11]	[11]
Safety interlock (SAFETY INTERLOCK)		[12]	[12]
Start command active (START SIGNAL APPLIED)		[13]	[13]
Reversing (RUNNING IN REVERSE)		[14]	[14]
Thermal warning (THERMAL WARNING)		[15]	[15]
Hand mode active (DRIVE IN HAND MODE)		[16]	[16]
Auto mode active (DRIVE IN AUTO MODE)		[17]	[17]
Sleep mode (SLEEP MODE)		[18]	[18]
Output frequency lower than parameter 223 (F OUT < F LOW)		[19]	[19]
Output frequency higher than parameter 223 (F OUT > F HIGH)		[20]	[20]
Out of frequency range (FREQ. RANGE WARN.)		[21]	[21]
Output current lower than I_{LOW} parameter 221 (I OUT < I LOW)		[22]	[22]
Output current higher than I_{HIGH} parameter 222 (I OUT > I HIGH)		[23]	[23]
Out of current range (CURRENT RANGE WARN)		[24]	[24]
Out of feedback range (FEEDBACK RANGE WARN.)		[25]	[25]
Out of reference range (REFERENCE RANGE WARN)		[26]	[26]
Relay 123 (RELAY 123)		[27]	[27]
Input phase loss (MAINS PHASE LOSS)		[28]	[28]
Output frequency, (OUT. FREQ. 0-20 mA)		[29]	[29]
Output frequency, (OUT. FREQ. 4-20 mA)		[30]	★ [30]
Output frequency (pulse sequence), (OUT. FREQ. PULSE)		[31]	[31]
External reference, (EXT. REF. 0-20 mA)		[32]	[32]
External reference, (EXTERNAL REF. 4-20 mA)		[33]	[33]
External reference (pulse sequence), (EXTERNAL REF. PULSE)		[34]	[34]
Feedback, (FEEDBACK 0-20 mA)		[35]	[35]
Feedback, (FEEDBACK 4-20 mA)		[36]	[36]
Feedback (pulse sequence), (FEEDBACK PULSE)		[37]	[37]
Output current, 0-20 mA (MOTOR CUR. 0-20mA)		[38]	[38]
Output current, 4-20 mA (MOTOR CUR. 4-20mA)		★ [39]	[39]
Output current (pulse sequence), 0 - 32000 p (MOTOR CUR PULSE)		[40]	[40]
Output power, 0-20 mA (MOTOR POWER 0-20mA)		[41]	[41]
Output power, 4-20 mA (MOTOR POWER 4-20mA)		[42]	[42]
Output power (pulse sequence), 0- 32000 pulses (MOTOR POWER PULSE)		[43]	[43]

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Function:

These outputs can act both as digital and analog outputs. If used as a digital output, a 0 or 24 VDC signal is transmitted. If used as an analog output, either a 0 to 20 mA signal, a 4 to 20 mA signal, or a pulse sequence with a frequency of 0 to up to 32,000 Hz is transmitted.

Description of choice:

No function. Selected if this output is always to remain off.

Drive ready. The drive's control card receives a supply voltage and the drive is ready for operation.

Stand by. The drive is ready for operation, but no start command has been given. No warning.

Running. The drive is running or the drive is in the sleep mode.

Running at ref. value. The drive is at the speed commanded by the reference.

Running, no warning. The drive is running and there are no warnings.

Local reference active. The motor's speed is being controlled by the local reference through the keypad. This output will also be on if the drive is set up for loal speed control but the jog function has been activated.

Remote references active. The motor's speed is being controlled by a remote reference or a preset speed.

Alarm. The drive has been stopped by an alarm.

Alarm or warning. An alarm or a waring exists in the drive.

No alarm. The drive has no alarm.

Current limit. The output current is greater than or equal to the value programmed in parameter 215, *Current Limit.* The speed of the drive is being limited to keep the current from increasing.

Safety interlock. Terminal 27 has been programmed for *Safety Interlock* in parameter 304, and no control voltage has been applied to it.

Start command active. The drive is either running or it has received a run command. This is commonly used in conjunction with the drive's run permissive control.

Reversing. The drive is running in the reverse direction.

Thermal warning. The temperature limit of either the motor, the drive, or a thermistor connected to an analog input has been exceeded.

Hand mode active. The drive is operating in the Hand run/stop mode.

Auto mode active. The drive is operating in the Auto run/stop mode.

Sleep mode. The drive is stopped because of Sleep Mode.

Output frequency lower than low frequency warning level. The output frequency is lower than the value set in parameter 223, *Warning: Low Frequency.*

Output frequency higher than high frequency warning level. The output frequency is higher than the value set in parameter 224, *Warning: High Frequency.*

Out of frequency range. The output frequency is outside the frequency range programmed in parameter 223, *Warning: Low Frequency,* and 224, *Warning: High Frequency.*

Output current lower than low current warning level. The output current is lower than the value set in parameter 221, *Warning: Low Current.* This can be used to indicate a broken belt.

Output current higher than high current warning level. The output current is higher than the value set in parameter 222, *Warning: High Current.*

Out of current range. The output current is outside the range programmed in parameter 221, *Warning: Low Current,* and parameter 222, *Warning: High Current.*

Out of feedback range. The feedback signal is outside the range programmed in parameter 227 *Warning: Low Feedback,* and 228 *Warning: High feedback.*

Out of reference range. The reference is outside the range programmed in parameter 225, *Warning: Low Reference,* and parameter 226, *Warning: High Reference.*

Relay 123. This function is only used when a Profibus option card is installed.

Input phase loss. An incoming power phase is missing.

Output frequency: 0 to 20 mA, 4 to 20 mA, and 0 to 32,000 pulses. An output signal proportional to the output frequency in the range from 0 to *Output Frequency, High Limit,* set by parameter 202.

External reference: 0 to 20 mA, 4 to 20 mA, and 0 to 32,000 pulses. An output signal proportional to the resulting reference value in the range from *Minimum Reference* to *Maximum Reference,* set by parameters 204 and 205.

Feedback Minimum to Feedback Maximum: 0 to 20 mA, 4 to 20 mA, and 0 to 32,000 pulses. An output signal proportional to the reference value in the range from *Minimum Feedback* to *Maximum Feedback,* set by parameters 412 and 413.

Output Current: to 20 mA, 4 to 20 mA, and 0 to 32,000 pulses. An output signal proportional to the output current in the range from 0 to maximum output current as set by parameter 105, *Motor Current.*

Output power: 0 to 20 mA, 4 to 20 mA, and 0 to 32,000 pulses. Generates an output signal proportional to the present output power. 20 mA corresponds to the value set by parameter 102, *Motor Power.*

319   Terminal 42, Output (AD 42 FUNCTION)

Value:

★ MOTOR CUR. 4-20 mA

See the description of analog/digital outputs.

Function:

This output can function both as a digital and an analog output. When used as a digital output, it generates a 24 V (max. 40 mA) signal. For the analog outputs, there is a choice of 0 to 20 mA, 4 to 20 mA or a pulse sequence.

Description of choice:

See the description of analog/digital outputs.

320   Terminal 42, Output Pulse Scaling (AO 42 PULS SCALE)

Value:

1 to 32000 Hz   ★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value for the maximum pulse frequency.
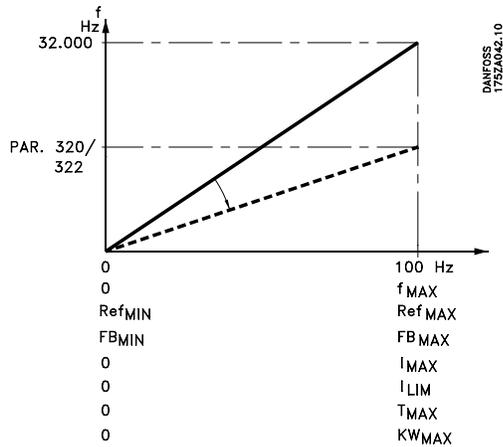
321   Terminal 45, Output (AO 45 FUNCTION)

Value:

★ OUT. FREQ. 4 - 20 mA

See the description of analog/digital outputs.

Function:

This output can function both as a digital and an analog output. When used as a digital output, it generates a 24 V (max. 40 mA) signal. For the analog outputs, there is a choice of 0 to 20 mA, 4 to 20 mA or a pulse sequence.

Description of choice:

See the description of analog/digital outputs.

322   Terminal 45, Output Pulse Scaling (AO 45 PULS SCALE)

Value:

1 to 32000 Hz   ★ 5000 Hz

Function:

This parameter allows scaling of the pulse output signal.

Description of choice:

Set the desired value for the maximum pulse frequency.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Relay Outputs

Relay outputs 1 and 2 can be used to give the present status or a warning.
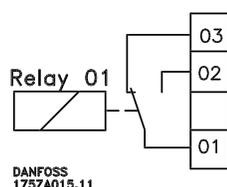
Relay 1:
1 - 3 normally closed, 1 - 2 normally open
Maximum: 240 VAC/DC, 2 A
Minimum: 24 VAC, 100 mA;
            24 VDC, 10 mA
The high voltage relay connections are located near the input power and motor terminals.
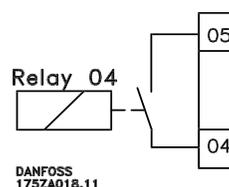
Relay 2:
4 - 5 normally open
Maximum: 30 VAC, 1 A,
            42.5 VDC, 1 A

The low voltage relay terminals are located on the control wiring terminal strips.

Relay outputs	Relay Number	1	2
	Parameter	323	326
Value:			
No function (NO FUNCTION)		[0]	[0]
Ready signal (READY)		[1]	[1]
Waiting for start (ENABLED & NO WARNING)		[2]	[2]
Running (RUNNING)		[3]	★ [3]
Running at ref. value (RUNNING AT REFERENCE)		[4]	[4]
Running, no warning (RUNNING NO WARNING)		[5]	[5]
Local reference active (DRIVE IN LOCAL REF)		[6]	[6]
Remote controlled references active (DRIVE IN REMOTE REF.)		[7]	[7]
Alarm (ALARM)		[8]	[8]
Alarm or warning (ALARM OR WARNING)		[9]	[9]
No alarm (NO ALARM)		★ [10]	[10]
Current limit (CURRENT LIMIT)		[11]	[11]
Safety interlock (SAFETY INTERLOCK)		[12]	[12]
Start command active (START SIGNAL APPLIED)		[13]	[13]
Reversing (RUNNING IN REVERSE)		[14]	[14]
Thermal warning (THERMAL WARNING)		[15]	[15]
Hand mode active (DRIVE IN HAND MODE)		[16]	[16]
Auto mode active (DRIVE IN AUTO MODE)		[17]	[17]
Sleep mode (SLEEP MODE)		[18]	[18]
Output frequency lower than low frequency, parameter 223 (F OUT < F LOW)		[19]	[19]
Output frequency higher than high frequency, parameter 224 (F OUT > F HIGH)		[20]	[20]
Out of frequency range (FREQ RANGE WARN.)		[21]	[21]
Output current lower than low current, parameter 221 (I OUT < I LOW)		[22]	[22]
Output current higher than high current, parameter 222 (I OUT > I HIGH)		[23]	[23]
Out of current range (CURRENT RANGE WARN.)		[24]	[24]
Out of feedback range (FEEDBACK RANGE WARN.)		[25]	[25]
Out of reference range (REFERENCE RANGE WARN.)		[26]	[26]
Relay 123 (RELAY 123)		[27]	[27]
Mains fault (MAINS PHASE LOSS)		[28]	[28]
Control word bit 11/12 (CONTROL WORD 11/12)		[29]	[29]

Description of choice:

See descriptions of [0] through [28] for the Analog/Digital Outputs.

Control word bit 11/12. Relay 1 and relay 2 can be activated through serial communication. Bit 11 activates relay 1 and bit 12 activates relay 2.

If parameter 556, *Bus Time Interval Function,* becomes active, relay 1 and relay 2 will cut out if they are activated through serial communication.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

323 Relay 1, Output Function
(RELAY1 FUNCTION)

Function:

★ NO ALARM

Relay 1 is a form C relay that can be used for status indications and warnings. The relay is activated when the programmed condition occurs.

Time delays for relay 1 are programmed in parameter 324, *Relay 1, ON Delay,* and parameter 325, *Relay 1, OFF Delay.*

Description of choice:
See data choice and connections under Relay Outputs.

324 Relay 1, ON Delay
(RELAY1 ON DELAY)

Value:
0 to 600 sec.   ★ 0 sec.

Function:
This parameter determines the time delay before the relay activates.

Description of choice:
Enter the desired value.

325 Relay 1, OFF Delay
(RELAY1 OFF DELAY)

Value:
0 to 600 sec.   ★ 2 sec.

Function:
This parameter determiness the time delay before the relay deactivates.

Description of choice:
Enter the desired value.

326 Relay 2, Output Function
(RELAY2 FUNCTION)

Value:

★ RUNNING

See the functions of relay 1.

Function:
Relay 2 is a form A relay that can be used for status indications and warnings. The relay is activated when the programmed condition occurs.

Description of choice:
See data choice and connections under Relay Outputs.

327 Pulse Reference, Maximum Frequency
(PULSE REF. MAX)

Value:
100 to 65,000 Hz at terminal 29   ★ 5,000 Hz
100 to 5,000 Hz at terminal 17

Function:
This parameter is used to set the pulse value that corresponds to the maximum reference, parameter 205, *Maximum Reference.*

The pulse reference signal can be connected to terminal 17 or 29.

Description of choice:
Set the required maximum pulse reference.

328 Pulse Feedback, Maximum Frequency
(PULSE FDBK MAX.)

Value:
100 to 65,000 Hz at terminal 33   ★ 25,000 Hz

Function:
This parameter is used to set the pulse value that corresponds to the maximum feedback value. The pulse feedback signal is connected to terminal 33.

Description of choice:
Set the desired feedback value.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Application Functions
Parameters 400 through 427

Special functions of the drive are set up in this parameter group. This includes the proportional, integral, derivitative controller (PID) and setting the sleep mode function.

Additionally, this parameter group includes:
- Reset function
- Flying start
- Interference reduction
- Loss of load
- Carrier frequency
- Selection of process units

400	Reset Function	(RESET FUNCTION)
Value:		
	Manual reset (MANUAL RESET)	[0]
	Automatic reset x 1 (AUTOMATIC X 1)	[1]
	Automatic reset x 2 (AUTOMATIC X 2)	[2]
	Automatic reset x 3 (AUTOMATIC X 3)	[3]
	Automatic reset x 4 (AUTOMATIC X 4)	[4]
	Automatic reset x 5 (AUTOMATIC X 5)	[5]
	Automatic reset x 10 (AUTOMATIC X 10)	[6]
	Automatic reset x 15 (AUTOMATIC X 15)	[7]
	Automatic reset x 20 (AUTOMATIC X 20)	[8]
★	Infinite automatic reset (INFINITE AUTOMATIC)	[9]

Function:

This parameter allows a choice of manual or automatic reset after a fault trip. There is also a choice of the number of times the unit will attempt to restart. The time between each attempt is set in parameter 401, *Automatic Restart Time.*

Description of choice:

If *Manual Reset* is selected, the Reset key must be pressed or a digital input given to reset the drive.

If auto reset after a fault trip is desired, select one of the Automatic reset choices.

⚠DANGER
If any automatic reset choices are selected, motor can start without warning.

401	Automatic Restart Time	
	(AUTORESTART TIME)	
Value:		
	0 to 600 seconds	★ 10 sec.

Function:

This parameter sets the automatic reset time delay until each reset is attempted. One of the automatic resets must be selected in parameter 400, *Reset Function.*

Description of choice:
Set the desired time before each restart attempt.

⚠CAUTION
When parameter 402, *Flying Start*, is enabled, motor may turn forward and reverse a few revolutions even with motor stopped. In highly dynamic pumping processes, it is recommended to disable *Flying Start* function.

402	Flying Start	(FLYING START)
Value:		
★	Disable (DISABLE)	[0]
	Enable (ENABLE)	[1]
	DC brake and start (DC BRAKE AND START)	[3]

Function:

This function makes it possible for the drive to 'catch' a rotating motor when the drive is started. The drive will sense the speed of rotation and direction of rotation of the motor and synchronize with it.

This function is active whenever a start command is present.

For the drive to catch the spinning motor, the motor speed must be lower than the maximum frequency set in parameter 202.

Description of choice:

Select *Disable* if this function is not required.

Select *Enable* if the drive is to 'catch' and control a rotating motor.

Select *DC brake and start* if the drive is to brake the motor by means of the DC brake first, and then start. Ensure that parameters 114 through 116, *DC Braking,* are set appropriately. Select *DC brake and start* if the motor may be externally driven at a significant speed in the reverse direction.

> **NOTE**
> **For fan applications, factory setting for *Flying Start* is Enable. For pump applications, factory setting for *Flying Start* is Disable.**

Sleep Mode

Sleep mode makes it possible to stop the drive when the system demand drops below a preset level. When the demand increases to a higher preset level, the drive will restart. A significant amount of energy can be saved using sleep mode. Unlike a set-back time clock, the drive is always available to run when the demand reaches the preset "wake up" level. Sleep mode is not active if *Local Reference* is selected in parameter 203, *Reference Handling*, or if the *Jog* function activates via digital inputs. Sleep mode operates in both *Open Loop* and *Closed Loop*.

✳ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Activate sleep mode in parameter 403, *Sleep Mode Timer*. In this parameter, set how long the output frequency must be lower than the sleep frequency set in parameter 404, *Sleep Frequency,* before sleep mode activates. After the set time, the drive will ramp down the motor to a stop, as controlled by parameter 207, *Ramp Down Time*. If the output frequency needed to meet the system demand rises above the sleep frequency during the timed period, the drive will simply ramp up to the demanded frequency.

When the sleep mode timer expires and the drive is stopped in sleep mode, a theoretical output frequency is calculated based upon the reference signal. When the theoretical output frequency rises above the frequency set in parameter 405, *Wake-up Frequency*, the drive will restart the motor and ramp up to the commanded reference.

For closed loop operation, it may be useful to "over satisfy" the system before putting the drive into sleep mode. The boost setpoint parameter provides for this. After the sleep mode timer expires, the drive will reset the set point based on the value in parameter 406, *Boost Setpoint*. Once this new setpoint is satisfied, the drive enters sleep mode. A setting of 100% in parameter 406, *Boost Setpoint,* indicates no setpoint boost. Boost setpoint is only active in *Closed Loop*, selected in parameter 100, *Configuration.*
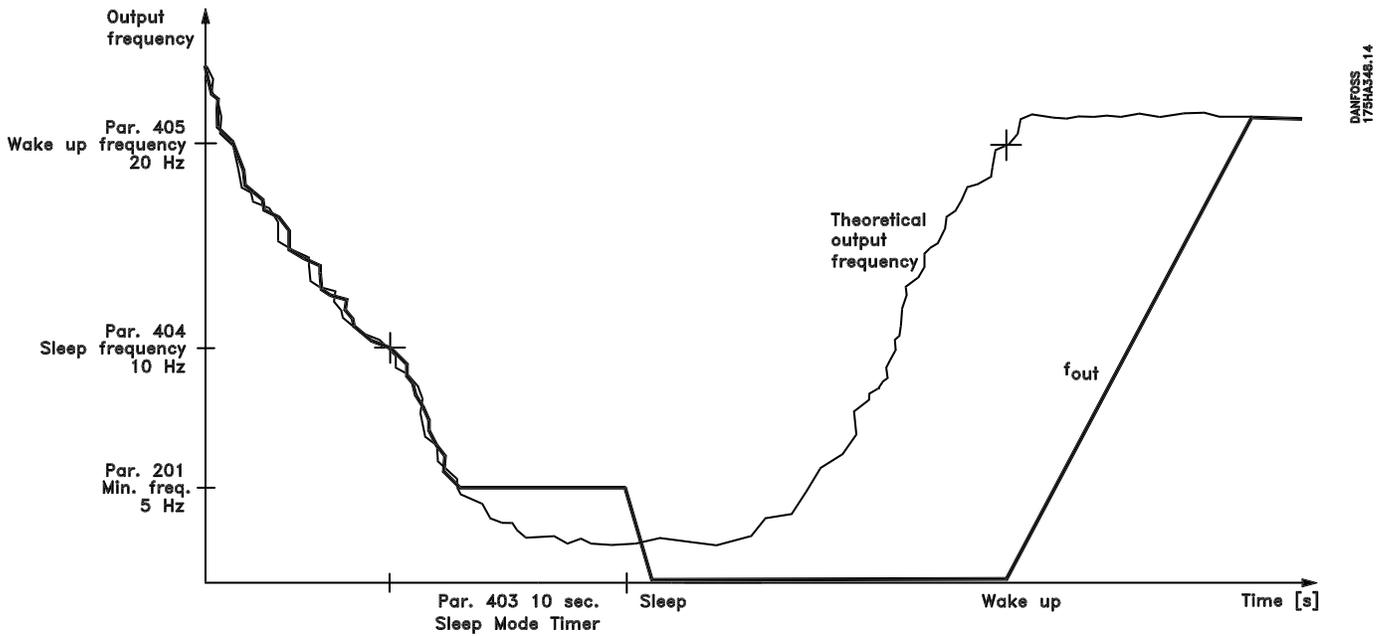
403   Sleep Mode Timer   (SLEEP MODE TIMER)

Value:

0 to 300 seconds (OFF)   ★ OFF

Function:

This parameter enables the drive to stop the motor if the load on the system is minimal. The timer starts when the output frequency drops below the frequency set in parameter 404, *Sleep Frequency*. When the time set has passed, the drive will stop. The drive will restart when the theoretical output frequency exceeds the frequency set in parameter 405, *Wake-up Frequency*.

Description of choice:

Select OFF if this function is not wanted.

Set the amount of time that the drive must run at or below the sleep frequency before it stops and "goes to sleep."

404   Sleep Frequency (SLEEP FREQUENCY)

Value:

0.0 to parameter 405, *Wake-up Frequency*   ★ 0.0 Hz

Function:

When the output frequency falls below this set value, the timer set in parameter 403, *Sleep Mode Timer*, will start. The drive's speed will follow the reference signal until the timer times out.

Description of choice:

Choose the output frequency at which the drive will activate the sleep mode timer. It is generally best to set SLEEP FREQUENCY equal to the minimum frequency set in parameter 201, *Output Frequency Low Limit* and parameter 204, *Minimum Reference.* This is because the sleep mode isn't active until after the drive output frequency equals the sleep frequency. If the sleep frequency is less than the minimums, the sleep mode cannot activate.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

405　Wake-up Frequency (WAKEUP FREQUENCY)

Value:

Parameter 404 to parameter 202, *Maximum Frequency*

★ 60 Hz

Function:

When the theoretical output frequency exceeds the preset value, the drive restarts the motor.

Description of choice:

Set the required frequency.

406　Boost Setpoint　(BOOST SETPOINT)

Value:

0 to 200 %　★ 100 % of setpoint

Function:

This function can only be used if *Closed Loop* has been selected in parameter 100, *Configuration.*

In some systems, it may advantageous to increase the set point of the system before the drive stops the motor. This extends the time that the drive will be stopped and reduces cycling of the motor.

Description of choice:

Set the required *Boost Setpoint* as a percentage of the resulting reference under normal operation. 100% corresponds to the boost.

407　Switching Frequency　(SWITCHING FREQ.)

Value:

Depends on the current rating of the unit.

Function:

The value of this parameter determines the maximum switching frequency of the inverter. If *Fixed Switching Frequency* has been selected in parameter 408, *Interference Reduction Method,* this will be the fixed inverter switching frequency. Changing the switching frequency may reduce audible noise from the motor. The output frequency of the drive can never be a greater than 1/10 of the switching frequency.

Description of choice:

When the motor is running, the switching frequency may be adjusted by parameter 407, *Switching Frequency,* until the sound level is as low as possible.

Switching frequencies higher than 4.5 kHz will result in automatic derating of the maximum continuous output current of the drive. The derate is linear from 4.5 kHz to the maximum switching frequency of the drive. At maximum switching frequency, the continuous output current from the drive will be limited to 60% of the rated current. To avoid possible problems at high load when using a high switching frequency, it may be desirable to select Automatic Switching Frequency Modulation in parameter 408, below.

⚠CAUTION

Switching frequencies higher than 4.5 kHz automatically derate maximum continuous output of drive.

408　Interference Reduction Method
(NOISE REDUCTION)

Value:

★	ASFM (ASFM)	[0]
	Fixed switching freq. (FIXED SWITCHING FREQ.)	[1]
	LC filter fitted (LC-FILTER CONNECTED)	[2]

Function:

Used to select different methods for reducing the amount of audible noise from the motor.

Description of choice:

ASFM (Automatic Switching Frequency Modulation) uses the maximum switching frequency possible while providing the output required by the load. The load is automatically monitored and the switching frequency set accordingly. The maximum switching frequency is set in parameter 407, *Switching Frequency.*

Fixed Switching Frequency makes it possible to set a fixed switching frequency. The switching frequency is set in parameter 407, *Switching Frequency.*

LC-filter fitted is to be used if an LC filter is installed between the drive and the motor. This prevents excessive heating of the LC filter.

409　Function in Case of No Load
(FUNCT. LOW CURR.)

Value:

	Trip (TRIP)	[0]
★	Warning (WARNING)	[1]

Function:

This parameter can be used for monitoring the V-belt of a fan or other power transmission component to make sure it has not broken. This function is activated when the output current goes below the current level set in parameter 221, *Warning: Low Current.* This function is not active during a start until the drive has reached the speed reference. It is also not active while the drive is stopped or while it is decelerating to a stop.

Description of choice:

In the case of a *Trip*, the drive will stop the motor if the output current drops below the value set in parameter 221.

If *Warning* is selected, the drive will give a warning if the output current drops below the value set in parameter 221.

✸ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

410   Function at Input Phase Loss
(MAINS FAILURE)

Value:

Trip (TRIP)	★ [0]
Autoderate & Warning (AUTODERATE & WARNING)	[1]
Warning (WARNING)	[2]

Function:

This determines the action of the drive when one of the incoming power phases is lost. Some action is required to control the level of ripple voltage on the DC bus to avoid damage to the DC bus capacitors.

Description of choice:

At *Trip*, the drive stops the motor within a few seconds (depending on drive size).

If *Autoderate & Warning* is selected, the drive will export a warning and reduce the output current to 30% of maximum current to maintain operation.

⚠CAUTION

If *Warning* is selected, life expectancy of drive will be reduced when input phase loss persists.

At *Warning*, only a warning will be exported when an input phase loss occurs, but in severe cases, other extreme conditions might result in a trip.

Drive display will show MAINS PHASE LOSS.

For drives with software version 2.0 or later, select *Autoderate & Warning.* Set parameter 412, *Trip Delay Overcurrent,* to OFF.

⚠CAUTION

At phase loss, the cooling fan of NEMA 12 drives cannot be powered. To avoid overheating, external power supply can be connected. Contact Danfoss Graham for further information.

411   Function at Drive Overtemperature
(FUNCT. OVERTEMP)

Value:

Trip (TRIP)	★ [0]
Autoderate & Warning (AUTODERATE & WARNING)	[1]

Function:

Select the function to be activated when the drive is exposed to an overtemperature condition.

Description of choice:

At *Trip*, the drive stops the motor and exports an alarm.

At *Autoderate & Warning*, the drive first reduces the switching frequency to minimize internal loss. If the overtemperature condition persists, the drive reduces the output current until the heat sink temperature stabalizes. A warning is issued when the function is active.

For drives with software version 2.0 or later, select *Autoderate & Warning.* Set parameter 412, *Trip Delay Overcurrent,* to OFF.

412   Trip Delay Overcurrent   (OVERLOAD DELAY)

Value:

0 to 60 sec. (OFF)	★ 60 sec.

Function:

When the output current has reached the current limit set in parameter 215, *Current Limit,* and remains there for the time selected in this parameter, the drive will trip.

Description of choice:

Select how long the drive will run in current limit before it trips.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

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Feedback Signals in Open Loop

In some drives, feedback signals and feedback parameters are only used in closed loop operation. In the VLT 6000, the feedback signals are also active in open loop operation. Although they don't effect the speed of the drive, they can be displayed on the drive's meters. Parameters 227 and 228 can set high and low limits for the feedback signals, which can activate warnings.

For open or closed loop operation, the feedback signal is scaled in parameters 413 and 414 *Minimum* and *Maximum Feedbac*k, and the unit displayed is chosen in parameter 415, *Process Units.*

413	Minimum Feedback	(MIN. FEEDBACK)
Value:		

-999,999.999 to *Maximum Feedback*, Parameter 414 ★ 0.000

Function:
Parameters 413 *Minimum Feedback* and 414 *Maximum Feedback,* are used to scale the feedback signal.

Description of choice:
Set the value to be shown on the display when the feedbck signal is at its minimum value.

414	Maximum Feedback	(MAX. FEEDBACK)
Value:		

Minimum Feedback to 999,999.999 ★ 100.000

Function:
See the description of parameter 413, *Minimum Feedback.*

Description of choice:
Set the value to be shown on the display when the feedback signal is at its maximum.

415	Units Relating to Closed Loop		
	(REF. / FDBK. UNIT)		
Value:			
	No unit	[0]	°C	[21]
★	%	[1]	GPM	[22]
	rpm	[2]	gal/s	[23]
	ppm	[3]	gal/min	[24]
	pulse/s	[4]	gal/h	[25]
	l/s	[5]	lb/s	[26]
	l/min	[6]	lb/min	[27]
	l/h	[7]	lb/h	[28]
	kg/s	[8]	CFM	[29]
	kg/min	[9]	ft^3/s	[30]
	kg/h	[10]	ft^3/min	[31]
	m^3/s	[11]	ft^3/h	[32]
	m^3/min	[12]	ft/s	[33]
	m^3/h	[13]	in wg	[34]
	m/s	[14]	ft wg	[35]
	mbar	[15]	PSI	[36]
	bar	[16]	lb/in^2	[37]
	Pa	[17]	HP	[38]
	kPa	[18]	°F	[39]
	m wg	[19]		
	kW	[20]		

Function:
Selects the unit shown on the feedback display.

The selected unit is used if *Reference [unit]* or *Feedback [unit]* has been selected in one of the parameters 007 through 010, as well as in the Display Mode. It will be the unit for *Minimum/Maximum Feedback.* In *Closed Loop,* the unit is also used as the unit for *Minimum/Maximum Reference* and *Minimum/Maximum Feedback,* as well as *Setpoint 1* and *Setpoint 2.*

Description of choice:
Select the unit for the reference/feedback signal.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

PID for Process Regulation

The built-in proportional, integral, derivative (PID) controller in the drive maintains a constant condition (pressure, temperature, flow, etc.) in the system. It adjusts motor speed based upon a reference and/or setpoint and the feedback signal. The PID controller is activated by setting parameter 100, *Configuration*, to *Closed loop*.

A transmitter supplies the PID controller with a feedback signal from the process to indicate its current state. The type of feedback signal in use depends upon the type of process.

This means that deviations that occur between the reference/setpoint and the actual process state are sensed. Such deviations are compensated for by the PID regulator by adjusting the output frequency as required by the difference (or error) between the reference/setpoint and the feedback signal.

The PID controller in the drive has been designed for use in HVAC applications and to perform a number of specialized functions. Previously, it was necessary for a building management system to handle these special functions by installing extra modules to program the system.

With the VLT 6000, there is no need for extra modules to be installed. Only the reference and/or setpoint and a selected feedback signal need to be programmed. An advanced feature of the VLT 6000 is the drive's ability to accept two feedback signals, making two-zone regulation possible.

Voltage drop in long control cables can be compensated for by using the scaling parameters for the analog inputs.

Feedback

The feedback signal must be connected to the drive according to the table below, depending on the type of feedback signal and the settings of the associated parameters listed.

Feedback type	Terminal	Parameters
Pulse	33	307
Voltage	53 or 54	308, 309, 310 or 311, 312, 313
Current	60	314, 315, 316
Bus feedback 1*	68 and 69	537
Bus feedback 2*	68 and 69	538

* The bus feedbacks can only be set by serial communication.

If two analog feedback signals are to be used, they both must be voltage signals.

The *Minimum Feedback* and *Maximum Feedback*, parameters 413 and 414, must be set for the feedback signals. The type of process unit for the signals is selected in parameter 415, *Process Units.*

Reference (Set Point)

In parameter 205, *Maximum Reference,* the maximum value of the sum of all reference signals is set.

The *Minimum Reference,* set in parameter 204, indicates the smallest value that the resulting reference can assume.

The reference range cannot exceed the feedback range.

If multiple *Preset References* are required, use multiple setups or set them in parameters 211 to 214 *Preset Reference.* See *Reference Handling.*

If a current signal is used as a feedback signal, voltage can be used as an analog reference. Use the table below to decide which terminal to use and which parameters to program.

Reference type	Terminal	Parameters
Pulse	17 or 29	301 or 305
Voltage	53 or 54	308, 309, 310 or 311, 312, 313
Current	60	314, 315, 316
Preset reference		211, 212, 213, 214
Setpoints		418, 419
Bus reference *	68 and 69	

* The bus reference can only be set by serial communication.

Terminals that are not used should be set to *No function.*

Inverse Regulation

Normal regulation means that the motor speed increases when the reference/setpoint is higher than the feedback signal. Inverse regulation means that the motor speed decreases when the reference/setpoint is higher than the feedback signal. If there is a need for inverse regulation, inverse must be programmed in parameter 420, *PID Normal/Inverse Control.*

Anti-Windup

The process controller is factory set with an active anti-windup function. This function ensures that when either a frequency limit or a current limit is reached, the integrator will be reset to zero. If the frequency limit or current limit is cleared, the integrator will turn on again. This function can be disabled in parameter 421, *PID Anti-windup.*

Start-up Conditions

In some applications, the optimum setting of the process regulator takes a long time to reach. In such cases, a start-up frequency can be entered in parameter 422, *PID Start-up Frequency.* The drive will ramp directly to this frequency before PID control begins. This avoids control by deviation between the reference/setpoint and the actual state of the process during acceleration. It also avoids overshoot of the process requirement during acceleration due to lag in the feedback signal.

Differentiator Gain Limit

The differentiation control reacts to the rate of change of the error between the setpoint and the feedback signal. This is seldom needed for HVAC applications. If the differentiation function becomes too dominant, the differentiation factor can be limited. This is done in parameter 426, *PID Differentiator Gain Limit*.

Lowpass Filter

Noise on the feedback signal can be reduced by using the built-in lowpass filter. Set a suitable lowpass filter time constant. This time constant determines the cutoff frequency of the filter.

If the lowpass filter has been set to 0.1s, the cut-off frequency will be 10 RAD/sec., corresponding to $(10/2 \times \pi) = 1.6$ Hz. This means that any noise on the feedback signal whose frequency is greater than 1.6 Hz will be filtered out. Choose a suitable time constant in parameter 427, *PID Lowpass Filter Time*.

Optimization of the Process Regulator

The basic settings have now been made; all that remains to be done is to optimize the proportional gain, the integration time and, if needed, the differentiation time. These are set by parameters 423, 424 and 425. In most processes, this can be done by following the guidelines below.

1. Start the motor.
2. Set parameter 423, *PID Proportional Gain,* to 0.3 and increase it until the feedback signal becomes unstable. Then reduce the value until the feedback signal has stabilized. Now lower the proportional gain by about half (40% to 60%).
3. Set parameter 424, *PID Integration Time,* to 20 seconds and reduce the value until the feedback signal becomes unstable. Increase the integration time until the feedback signal stabilizes. Now increase the integration time from 15% to 50%.
4. Parameter 425, *PID Differentiation Time,* is only used in very fast-acting systems and should be left off for most HVAC applications. When it is used, the typical value is 1/4th the value set in parameter 424, *PID Integration Time.* The differentiator should only be used when the setting of the proportional gain and the integration time have been fully optimized.

Starting and stopping the drive will produce the necessary error signal in the process to set the PID.

PID Overview

The block diagram below shows reference and setpoint in relation to the feedback signal.
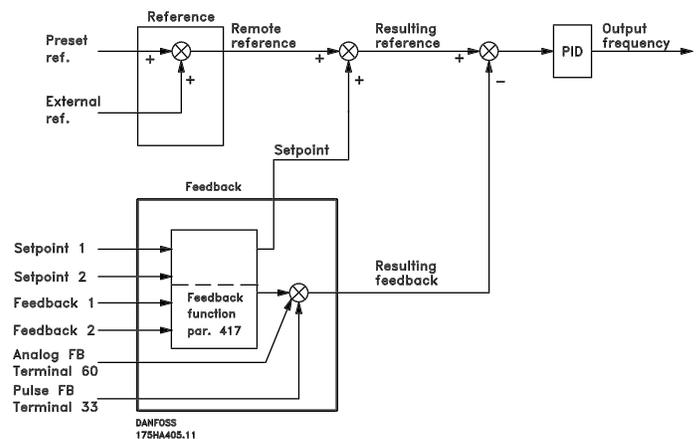
As can be seen, the remote reference is added to Setpoint 1 or Setpoint 2. The setpoint that is active depends on the value of parameter 417, *Feedback Function*.

Feedback Handling

Handling of the feedback signal(s) can be seen from the block diagram on the next page. The block diagram shows how and by which parameters the feedback handling is affected.

Feedback signals can be voltage, current, pulse and bus feedback signals. In two zone feedback systems, both feedback signals must be voltage signals (terminals 53 and 54). Please note that *Feedback 1* consists of bus feedback 1, (parameter 537) added to the feedback signal value of terminal 53. *Feedback 2* consists of bus feedback 2, (parameter 538) added to the feedback signal value of terminal 54.

In addition, the drive has an internal calculator capable of converting a pressure signal into a "linear flow" feedback signal. This function is activated in parameter 416, *Feedback Conversion.*

The parameters for feedback handling are active both in closed and open loop modes. In open loop, the feedback signal can be displayed on one of the drive's meters and the drive can produce warnings if the feedback signal is beyond the range set in parameters 227, *Warning: Low Feedback* and 228, *Warning: High Feedback.*

During closed loop operation, there are three ways to use the PID controller and setpoint and feedback signals:

1. 1 setpoint and 1 feedback
2. 1 setpoint and 2 feedbacks
3. 2 setpoints and 2 feedbacks

1 Setpoint and 1 Feedback

If only one setpoint and one feedback signal are used, parameter 418, *Setpoint 1* will be added to the remote reference, if a remote reference is used. The sum of the remote reference, if any, and *Setpoint 1* becomes the resulting reference, which will then be compared with the feedback signal.

1 Setpoint and 2 Feedbacks

As above, parameter 418, *Setpoint 1,* will be added to the remote reference, if a remote reference is used. Depending on the feedback function selected in parameter 417, *Feedback Function*, the two feedback signals will be compared to the setpoint. A description of the individual feedback functions is given in parameter 417, *Feedback Function*.

2 Setpoints and 2 Feedbacks

Parameter 418, *Setpoint 1*, is the setpoint for zone 1. Feedback for zone 1 is the sum the feedback signals at terminal 53 and Bus Feedback 1. Parameter 419, *Setpoint 2*, is the setpoint for zone 2.

Parameter 417, *Feedback Function*, selects whether the drive will attempt to have both feedback signals be at least equal to their respective setpoints (2 zone min.) or be at most equal to their respective setpoints (2 zone max.).

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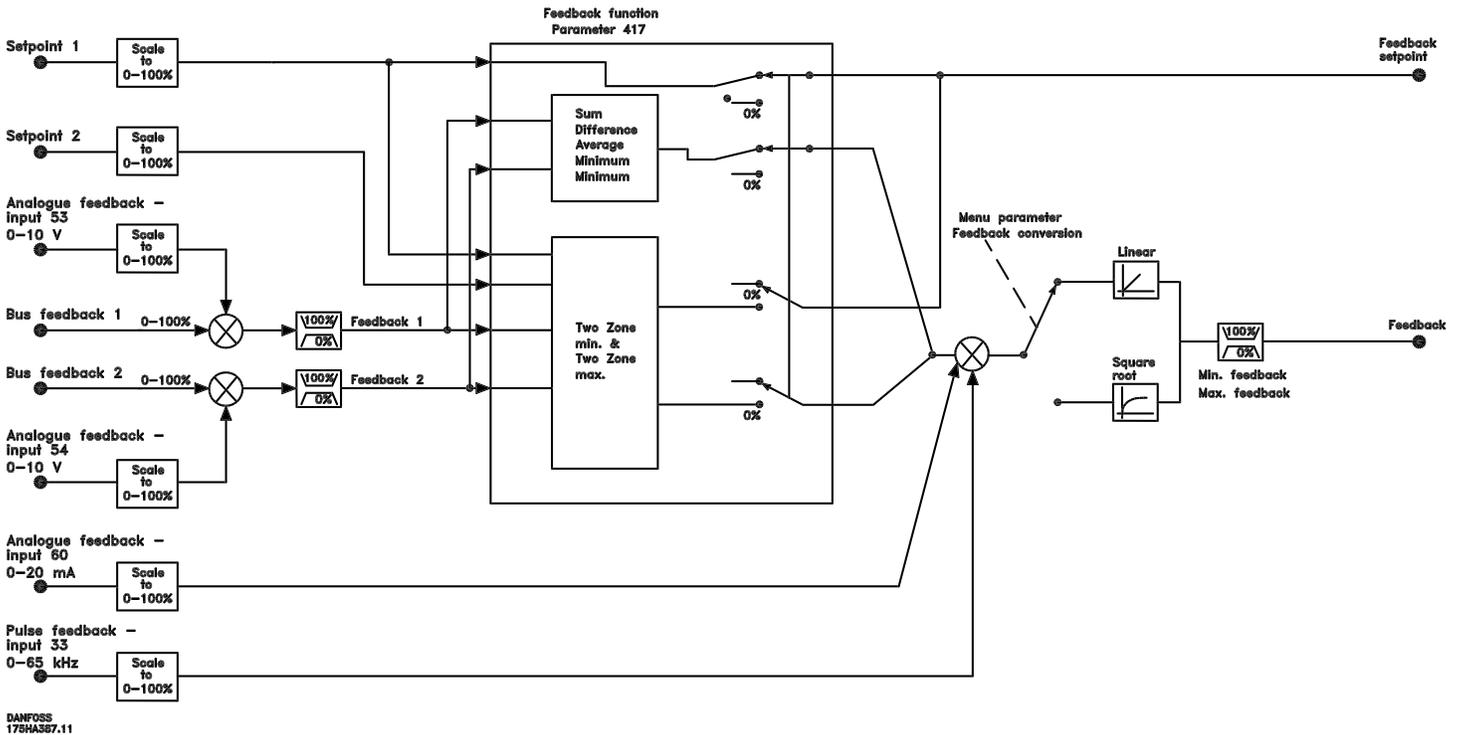
416   Feedback Conversion (FEEDBACK CONV.)

Value:

★	Linear (LINEAR)	[0]
	Square root (SQUARE ROOT)	[1]

Function:

In this parameter, a function is selected which converts a feedback signal from the process to a feedback value that equals the square root of the connected signal.

This can be used where regulation of a flow is required and the feedback is from a pressure sensor (flow is proportional to the square root of pressure). This conversion makes it possible to set the reference in such a way that there is a linear connection between the reference and the flow required. See diagram below.

Feedback conversion should not be used if two-zone regulation has been selected in parameter 417, *Feedback Function*.

Description:

If *Linear* is selected, the feedback signal and the feedback value will be proportional.

If *Square root* is selected, the drive first takes the sqaure root of the feedback signal.
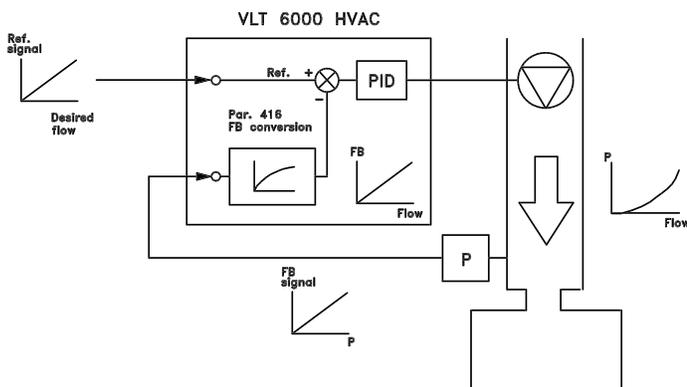
417   Feedback Function   (2 FEEDBACK, CALC.)

Value:

	Minimum (MINIMUM)	[0]
★	Maximum (MAXIMUM)	[1]
	Sum (SUM)	[2]
	Difference (DIFFERENCE)	[3]
	Average (AVERAGE)	[4]
	Two-zone minimum (2 ZONE MIN)	[5]
	Two-zone maximum (2 ZONE MAX)	[6]

Function:

This parameter sets the calculation method whenever two feedback signals are used.

Please note that *Setpoint 1* is added to the remote reference when *Minimum*, *Maximum*, *Sum*, *Difference* or *Average* is selected.

Description of choice:

If *Minimum* is selected, the drive will compare *Feedback 1* with *Feedback 2* and regulate on the basis of the lower feedback value.

Feedback 1 = Sum of parameter 537, *Bus Feedback 1,* and the feedback signal value of terminal 53.

Feedback 2 = Sum of parameter 538, *Bus Feedback 2,* and the feedback signal value of terminal 54.

If *Maximum* is selected, the drive will compare *Feedback 1* with *Feedback 2* and regulate on the basis of the higher feedback value.

If *Sum* is selected, the drive will total *Feedback 1* with *Feedback 2*. Please note that *Setpoint 1* will be added to the remote reference.

If *Difference* is selected, the drive will subtract *Feedback 1* from *Feedback 2*.

If *Average* is selected, the drive will calculate the average of *Feedback 1* and *Feedback 2*. Please note that *Setpoint 1* will be added to the remote reference.

If *2-zone Minimum* is selected, the drive will calculate the difference between *Setpoint 1* and *Feedback 1* as well as *Setpoint 2* and *Feedback 2*. The drive will regulate its output speed based on the larger difference. A positive difference, (a setpoint higher than the feedback), is always larger than a negative difference.

If *2-zone Maximum* is selected, the drive will calculate the difference between *Setpoint 1* and *Feedback 1* as well as *Setpoint 2* and *Feedback 2*.

After the calculation, the drive will use the smaller difference. A negative difference (a setpoint lower than the feedback) is always smaller than a positive difference.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

418   Setpoint 1   (SETPOINT 1)

Value:

Feedback Minimum to Feedback Maximum   ★ 0.000

Function:

Setpoint 1 is used to provide the setpoint reference for 1 setpoint PID control and the setpoint for zone 1 in 2 setpoint PID control. External and preset references may be added to its value.

In open loop, *Setpoint 1* should be set to 0, to prevent parameter 417, *Feedback Function,* from affecting the reference.

See description of parameter 417, *Feedback Function.*

Description of choice:

Set the required value. The process unit is selected in parameter 415, *Process Units.*

419   Setpoint 2   (SETPOINT 2)

Value:

Feedback minimum to Feedback maximum   ★ 0.000

Function:

Setpoint 2 is used to provide the sepoint reference for zone 2 in 2 zone PID. In open loop, *Setpoint 2* should be set to 0, to prevent parameter 417, *Feedback Function,* from affecting the reference.

See description of parameter 417.

Description of choice:

Set the required value. The process unit is selected in parameter 415, *Process Units.*

420   PID Normal/Inverse Control
(PID NOR/INV. CTRL)

Value:

★   Normal (NORMAL)   [0]
   Inverse (INVERSE)   [1]

Function:

This determines how the drive's PID controller responds to an error between the setpoint and feedback.

Used in *Closed Loop,* (parameter 100).

Description of choice:

If the drive is to reduce the output frequency when the feedback signal increases, select *Normal.*

If the drive is to increase the output frequency when the feedback signal increases, select *Inverse.*

421   PID Anti-windup   (PID ANTI WINDUP)

Value:

   Off (DISABLE)   [0]
★   On (ENABLE)   [1]

Function:

It is possible to choose whether the PID controller integrator is to continue to sum the error signal when it is not possible to increase or decrease the output frequency to correct the error.

Used in *Closed Loop*, parameter 100.

Description of choice:

The factory setting is *On*, which means that the error integrator is cleared if either the current limit, the voltage limit or the maximum or minimum frequency has been reached. The integrator will not function again until regulation is possible. Select *Off* if the integrator is to continue integrating even if it is not possible to correct the error.

422   PID Start-up Frequency
(PID START VALUE)

Value:

Minimum frequency to maximum frequency
    (set by parameters 201 and 202)   ★ 0 Hz

Function:

The drive will react to a start signal as if in open loop following the acceleration ramp. When the programmed start frequency has been reached, it will change to closed loop operation. This can enable the system to stabilize more quickly.

Used in *Closed Loop*, parameter 100.

Description of choice:

Set the required start frequency. For software versions prior to 2.0, do not set this frequency between 0.1 and 7.7 Hz.

⚠CAUTION

If drive is running in current limit before desired start frequency is obtained, PID will not be activated. To avoid this, start frequency must be low enough to ensure that drive does not go into current limit. This can be done during operation.

✴ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

423 PID Proportional Gain
(PID PROP. GAIN)

Value:

0.00 to 10.00 ★ 0.30

Function:

The proportional gain determines the amount of speed correction that the drive will make in response to the size of the error signal.

Used in *Closed Loop*, parameter 100.

Description of choice:

Quick regulation is obtained by a high gain, but, if the gain is too high, the process may become unstable. See Optimization of the Process Regulator for information on adjusting this.

424 PID Integral Time
(PID INTEGR. TIME)

Value:

0.01 to 9999.00 sec. (OFF) ★ OFF

Function:

The integrator adds the error signal over time and uses this to correct the speed of the drive.

The integration time is the time needed by the integrator to have the same effect as the proportional gain.

Used in *Closed Loop* parameter 100.

Description of choice:

Fast regulation is obtained by setting a short integration time. However, if this time is too short, the process will overcorrect and become unstable. See Optimization of the Process Regulator for information on adjusting this.

425 PID Differentiation Time
(PID DIFF. TIME)

Value:

0.00 (OFF) to 10.00 sec. ★ OFF

Function:

The differentiator responds to the rate of change of the error signal.

The quicker the error changes, the greater the response from the differentiator.

Used in *Closed Loop*, parameter 100.

Description of choice:

Fast regulation can be obtained by means of a long differentiation time. If this time is too long, the process may overshoot. The differentiator is generally set of OFF in HVAC appliations. See Optimization of the Process Regulator for information on adjusting this.

426 PID Differentiator Gain Limit
(PID DIFF. GAIN)

Value:

5.0 to 50.0 ★ 5.0

Function:

When the differentiator is ued, fast changes in the error can sometimes cause unstable operation. In these cases it may be useful to limit the contribution of the differentiator.

Used in *Closed Loop,* parameter 100.

Description of choice:

A lower limit will improve stability, but will reduce the effect of the differential.

427 PID Lowpass Filter Time
(PID FILTER TIME)

Value:

0.01 to 10.00 ★ 0.01

Function:

Noise on the feedback signal can be reduces by the lowpass filter.

Used in *Closed Loop*, parameter 100.

Description of choice:

Select the desired time constant (t).

The cut off frequency equals $\frac{1}{2\pi t}$. For example, if a time constant of 0.1 s is programmed, the cut off frequency for the lowpass filter will be $1/(2\pi (.1)) = 1.6$ Hz.

The PID controller will then only respond to changes in the feedback signal whose frequency is less than 1.6 Hz.
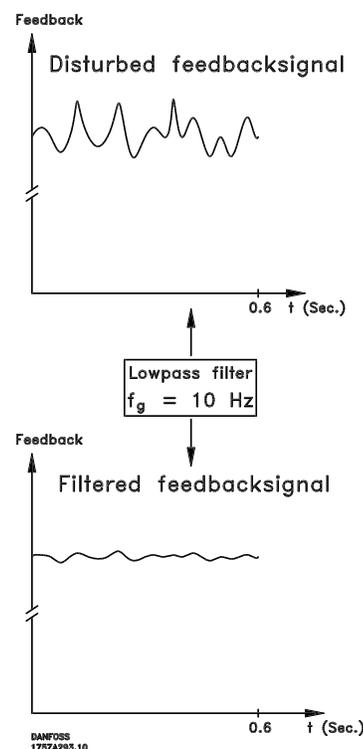
★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.
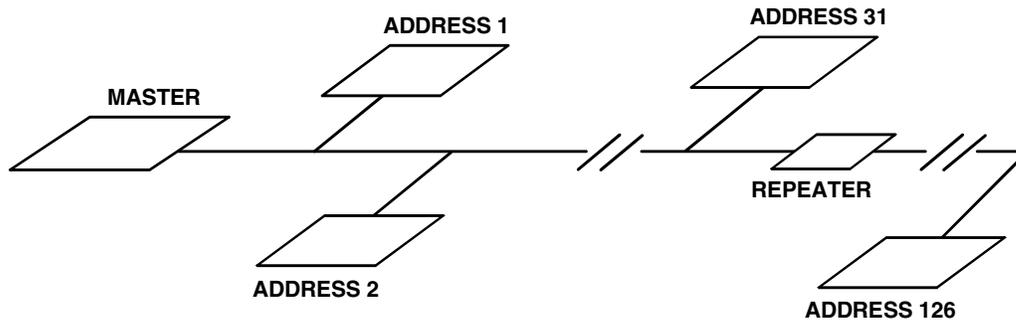
Protocols

All VLT 6000 drives have an RS-485 port which allows controlling the drive by one of three different serial communication protocols. The three protocols, which can be selected in parameter 500, *Protocol*, are:

- Johnson Controls Metasys N2®
- Siemens FLN®
- Danfoss FC protocol

Metasys N2 is a registered trademark of Johnson Controls.

FLN is a registered trademark of Siemens.

If Danfoss FC protocol is to be selected, set parameter 500, *Protocol* to *FC protocol* .

For further information on operating the drive through N2 or FLN communication, request the N2 or FLN Operator's Manual from Danfoss Graham.

Packet Communication

Control and Reply Packets

The packet communication in a master/slave system is controlled by the master. The drives are the slaves. A maximum of 31 VLT 6000 drives can be connected to one master unless a repeater is used. If a repeater is used, a maximum of 126 drives can be connected to one master.

The master continuously sends packets addressed to the slaves and awaits reply packets from them. The response time of the slaves is a maximum of 50 ms.

Only a slave that has received a faultless packet addressed to that slave will respond by sending a reply packet.

Broadcast

When a master sends a packet to all slaves connected to the bus at the same time, it is called a broadcast. In broadcast communication, if the packet has been correctly received, the slaves do not send reply packets to the master.

Contents of a Character (byte)

Each transferred character begins with a start bit. Subsequently, eight data-bits are transferred, corresponding to one byte. Each character is sent with a parity bit to produce even parity (i.e., an even number of binary 1's in the eight data-bits and the parity bit combined). A character ends with a stop bit and therefore consists of a total of eleven bits.

Start bit	0	1	2	3	4	5	6	7	Even Parity	Stop Bit
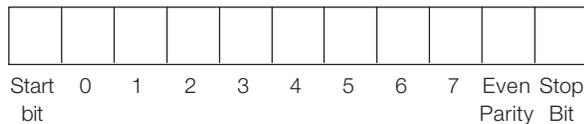
Packet Buildup with FC Protocol

Each packet begins with a start character (STX) = 02 Hex, followed by a byte that gives the packet length (LGE) and a byte that gives the drive address (ADR). Next a number of data bytes is sent. The size of the packet is variable, depending upon the packet type. The packet ends with a data control byte (BCC).

STX	LGE	ADR	Data	BCC
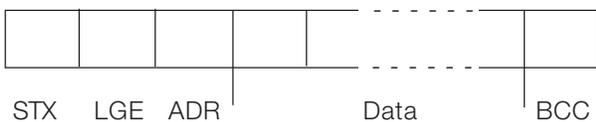
Packet Times

The speed of communication between a master and a slave depends on the baud rate. The baud rate of the drive must be the same as the baud rate of the master. Select the baud rate of the drive in parameter 502, *Baud Rate*.

After a reply packet from the slave, there must be a minimum pause of two characters (22 bits) before the master is able to send another packet. At a baud rate of 9600 baud, there must be a minimum pause of 2.3 msec. After the master has completed the packet, the response time of the slave back to the master is a maximum 20 msec., with a minimum pause of two characters.

Pause time, minimum:	2 characters
Response time, minimum:	2 characters
Response time, maximum:	20 msec.
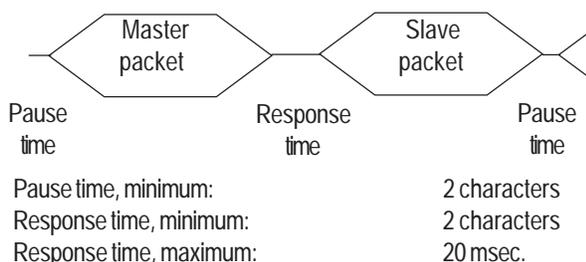
The time between individual characters in a packet is not to exceed two characters, and the packet must be completed within 1.5 times the rated packet time. If the baud rate is 9600 and the packet length is 16 baud, the packet must be completed within 27.5 msec.

= Time between characters

Packet Length (LGE)

The packet length is the number of data bytes plus address byte ADR plus data control byte BCC.

Packets with four data bytes have a length of:
LGE = 4 + 1 + 1 = 6 bytes

Packets with twelve data bytes have a length of:
LGE = 12 + 1 + 1 = 14 bytes

Packets that contain text have a length of 10+n bytes. Ten is the fixed characters, while 'n' is variable, depending on the length of the text.

Drive Address (ADR)

Two different address formats are used in which the address range of the drive is either from 1 through 31 or from 1 through 126.

1. Address format 1-31

The byte for this address range has the following profile:

7	6	5	4	3	2	1	0
0	X						
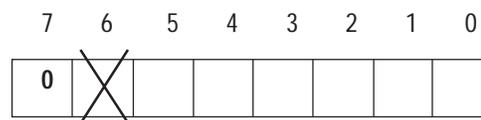
Bit 7 = 0 (address format 1 through 31 active)

Bit 6 is not used

Bit 5 = 1: Broadcast, address bits (0 through 4), not used

Bit 5 = 0: No Broadcast

Bit 0 through 4 = Drive address 1 through 31

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1. Address format 1 through 126

The byte for the 1 through 126 address range has the following profile:

7	6	5	4	3	2	1	0
1							

Bit 7 = 1 (address format 1 through 126 active)

Bit 0 through 6 = Drive address 1 through 126

Bit 0 through 6 = 0 Broadcast

The slave sends the address byte back to the master in the reply packet in unchanged form.

Example:

A packet is sent to drive address 22 using address format 1 through 31:

7	6	5	4	3	2	1	0
0	0	0	1	0	1	1	0

Data Control Byte (BCC)

The data control byte can be explained by means of an example: Before the first byte of the packet is received, the calculated check sum (BCS) is 0.

7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0

After the first byte (02H) has been received:
BCS = BCC EXOR "first byte"
(EXOR = exclusive-or gate)
BCS   = 0 0 0 0 0 0 0 0
EXOR

"first byte"   = 0 0 0 0 0 0 1 0 (02H)
BCC   = 0 0 0 0 0 0 1 0

Each additional, subsequent byte is gated with BCS EXOR and results in a new BCC, such as:
BCS   = 0 0 0 0 0 0 1 0
EXOR

"second byte" = 1 1 0 1 0 1 1 0 (D6H)
BCC   = 1 1 0 1 0 1 0 0

Data Character (byte)

The buildup of data blocks depends on the type of packet. There are three types of packets. The packet type applies to both control packets (master→slave) and reply packets (slave→master).

The three types of packets are the following:

1. Parameter block, used for transferring parameters between master and slave. The data block has 12 bytes (6 words) and also contains the process block.

PKE	IND	PWE_{HIGH}	PWE_{LOW}	PCD1	PCD2
Parameter block				Process block	

2. Process block, built up as a data block with four bytes (two words), covering:
   - Control word and reference value (from master to slave)
   - Status word and present output frequency (from slave to master).

PCD 1	PCD 2

Process block

3. Text block, used for reading or writing texts via the data block.

PKE	IND	Ch 1	Ch2	Ch n	PCD1	PCD2
Text block				Process block		

1. Parameter Bytes
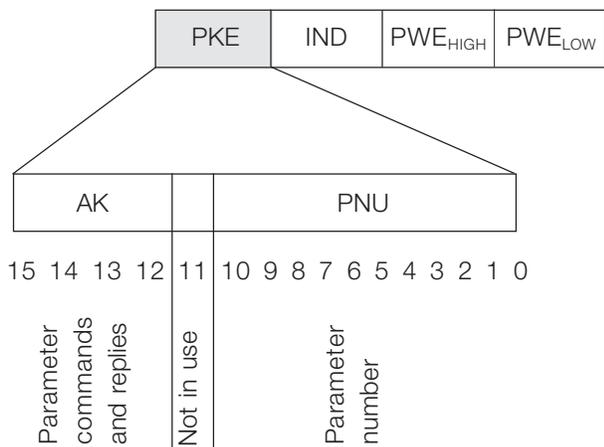
Parameter commands and replies (AK)
Bits no. 12-15 are used for transferring parameter commands from master to slave and the slave's processed reply back to the master.

Parameter Commands Master→Slave:
Bit no.

15	14	13	12	Parameter command
0	0	0	0	No command
0	0	0	1	Read parameter value
0	0	1	0	Write parameter value in RAM (word)
0	0	1	1	Write parameter value in RAM (double word)
1	1	0	1	Write parameter value in RAM and EEPROM (double word)
1	1	1	0	Write parameter value in RAM and EEPROM (word)
1	1	1	1	Read/write text

Reply slave→master:
Bit no.

15	14	13	12	Reply
0	0	0	0	No reply
0	0	0	1	Parameter value transferred (word)
0	0	1	0	Parameter value transferred (double word)
0	1	1	1	Command cannot be executed
1	1	1	1	Text transferred

If the command cannot be carried out, the slave will send this reply (0111) *Command cannot be executed* and give the following error message in the parameter value (PWE):

(reply 0111)	Error message
0	The parameter number used does not exist
1	There is no write access to the parameter called
2	The data value exceeds the parameter limits
3	The used sub-index does not exist
4	The parameter is not of the array type
5	The data type does not match the parameter called
17	Data change in the parameter called is not possible in the present mode of the drive. Some parameters can only be changed when the motor has stopped
130	There is no bus access to the parameter called
131	Data change is not possible because factory setup has been selected

Parameter Number (PNU)
Bits no. 0-10 are used for transmitting parameter numbers. The function of a given parameter can be seen from the parameter description in the programming section.

Index

Index is used together with the parameter number for read/write access to parameters with an index, such as parameter 615, *Error Code*.

Index has 2 bytes - a lowbyte and a highbyte. However, only the lowbyte is used. See the example on the following page.

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Example - Index:

The first error code (index [1]) in parameter 615, *Error code,* must be read.

PKE = 1267 Hex (read parameter 615, *Error Code*).

IND = 0001 Hex - Index no. 1.

1267 H	0001 H	⋮
PKE	IND	PWE
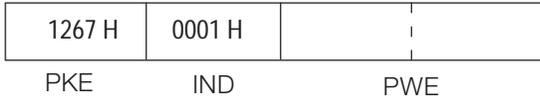
The drive will respond in the parameter value (PWE) block by means of an error code with a value from 1 through 99. See *List of Warnings and Alarms* to identify the error code.

Parameter Value (PWE)

PKE	IND	PWE$_{HIGH}$	PWE$_{LOW}$

The parameter value block consists of 2 words (4 bytes). Its value depends on the command given (AK). If the master inquires about a parameter value, the PWE block contains no value.

If a parameter value is to be changed by the master (write), the new value is entered in the PWE block and sent to the slave.

If the slave responds to a parameter requirement (read command), the present parameter value is transferred in the PWE block and returned to the master.

If a parameter does not contain a numerical value, but several data selection options, for example parameter 001, *Language*, where [0] is *English* and [4] is *Spanish*, the data value is selected by writing the value in the PWE block. See the example on the following page.

Through serial communication, it is only possible to read parameters with data type 9 (text string). In VLT 6000 drives, parameters 621 through 631, *Nameplate Data* are data type 9. For example, it is possible in parameter 621, *Unit Type*, to read the unit size and input voltage range.

When a text string is transferred (read), the packet length is variable, since the texts have different lengths. The packet length is stated in the 2nd byte of the packet, called LGE.

In order to read a text via the PWE block, the parameter command (AK) must be set to 'F' Hex.

The index character is used to indicate whether the command in question is a read or write command.

For a read command, the index must have the following format:

04	00 H
Highbyte	Lowbyte
IND	
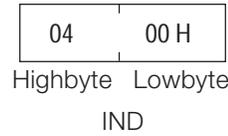
The drive has two parameters for which a text can be written. These are parameters 533 and 534, *Display Text*. See the description in the parameter section of this manual. In order to write a text via the PWE block, the parameter command (AK) must be set to 'F' Hex.

For a write command, the index must have the following format:

05	00 H
Highbyte	Lowbyte
IND	
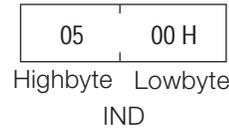
The following data types are supported by the drive:

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

Unsigned means there is no sign included in the packet.

Example - Write a parameter value:

Parameter 202, *Output Frequency, High Limit,* is to be changed to 100 Hz. This value must be remembered after a power failure, so it is written in EEPROM.

PKE = E0CA Hex - Write to parameter 202, *Output Frequency, High Limit*

IND = 0000 Hex

PWE_{HIGH} = 0000 Hex

PWE_{LOW} = 03E8 Hex - Data value 1000, corresponding to 100 Hz, see *Conversion.*

E0CA H	0000 H	0000 H	03E8 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

The reply from the slave to the master will be:

10CA H	0000 H	0000 H	03E8 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

Example - Choice of a Data Value:

kW is to be selected in parameter 415, *Process Units.* This value must be remembered after a power failure, so it is written in EEPROM.

PKE = E19F Hex - Write to parameter 415, *Process Units*

IND = 0000 Hex

PWE_{HIGH} = 0000 Hex

PWE_{LOW} = 0014 Hex - Choose data choice *kW* [20]

E19F H	0000 H	0000 H	0014 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

The reply from the slave to the master will be:

119F H	0000 H	0000 H	0014 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

Example - Read a parameter value:

The value in parameter 206, *Ramp Up Time,* is required. The master sends the following inquiry:

PKE = 10CE Hex - read parameter 206, *Ramp Up Time*

IND = 0000 Hex

PWE_{HIGH} = 0000 Hex

PWE_{LOW} = 0000 Hex

10CE H	0000 H	0000 H	0000 H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

If the value in parameter 206, *Ramp Up Time,* is 10 seconds, the reply from the slave to the master will be as follows:

10CE H	0000 H	0000 H	000A H
PKE	IND	PWE_{HIGH}	PWE_{LOW}

Conversion

The different attributes for each parameter can be seen in the section on factory settings.

Since a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals.

Example:

Parameter 201: *Minimum Frequency*, conversion factor 0.1. If parameter 201 is to be set to 10 Hz, a value of 100 must be transferred, since a conversion factor of 0.1 means that the transferred value will be multiplied by 0.1. A value of 100 will therefore be understood as 10.0.

Conversion Table

Conversion Index	Conversion Factor
74	3.6
2	100
1	10
0	1
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Process word

The process word block is divided into two blocks each of 16 bits, which always come in the sequence stated.
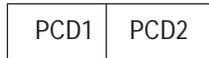
	PCD1	PCD2
Control packet (master→slave)	Control word	Reference value
Reply packet (slave→master)	Status word	Given output frequency

Control Word per FC Protocol

The control word is used for transmitting commands from a master (PC) to a slave (drive).

Master→Slave

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Bit no.
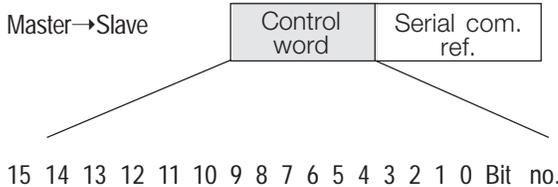
Bit	Bit = 0	Bit =1
00		Preset ref. lsb
01		Preset ref. msb
02	DC braking	
03	Coasting stop	
04	Quick stop	
05	Freeze output frequency	
06	Ramp stop	Start
07		Reset
08		Jog
09	No function	No function
10	Data not valid	Data valid
11		Activate relay 1
12		Activate relay 2
13		Choice of setup lsb
14		Choice of setup msb
15		Reversing

Bit 00/01:

Bits 00 and 01 are used for choosing between the four pre-programmed references parameters 211 through 214, *Preset Reference,* as shown in the table below.

Preset Reference	Parameter	Bit 01	Bit 00
1	211	0	0
2	212	0	1
3	213	1	0
4	214	1	1

NOTE
Parameter 508, *Choice of Preset Reference,* is used to choose how bits 00/01 are to be gated with the corresponding functions of the digital inputs.

Bit 02, DC BRAKE:

Bit 02 = 0 enables DC braking. Set braking current and duration in parameter 114, *DC Braking Current,* and in parameter 115, *DC Braking Time.*

NOTE
Parameter 504, *DC Brake,* is used for selecting how bit 02 is to be gated with the corresponding function of terminal 27.

Bit 03, Coasting Stop:

Bit 03 = 0 means that the drive will coast to a stop.
Bit 03 = 1 means that the drive is able to start the motor, provided the other conditions for starting are fulfilled.

NOTE
In parameter 503, _Coasting Stop,_ the choice is made of how bit 03 is to be gated with the corresponding function of terminal 27.

Bit 04, Quick Stop:

Bit 04 = 0 leads to a stop in which the motor speed is ramped down to a stop as set in parameter 207, _Ramp Down Time._

Bit 05, Freeze Output Frequency:

Bit 05 = 0 means that the given output frequency is frozen. The frozen output frequency can now only be changed with the digital inputs programmed for _Speed Up_ and _Speed Down._

NOTE
If _Freeze Output_ is active, drive cannot be stopped via Bit 06, _Start,_ or through terminal 18. Drive can only be stopped in following ways:
● **Bit 03, Coasting Stop**
● **Terminal 27**
● **Bit 02, DC Braking**
● **Terminal 19 programmed for DC Braking**

Bit 06, Ramp Stop/Start:

Bit 06 = 0 leads to a stop in which the motor speed is ramped down to stop through parameter 207, _Ramp Down Time._
Bit 06 = 1 means that the drive is able to start the motor, provided the other conditions for starting are fulfilled.

NOTE
Parameter 505, _Start,_ determines how bit 06, _Ramp Stop/Start,_ is gated and corresponding function of terminal 18.

Bit 07, Reset:

Bit 07 = 0 leads to no reset.
Bit 07 = 1 means that a trip is reset.
Reset is activated on the leading edge of the signal, at the time the signal changes from logic 0 to logic 1.

Bit 08, Jog:

Bit 08 = 1 means that the output frequency is determined by parameter 209, _Jog Frequency._

Bit 09, No function:

Bit 09 has no function.

Bit 10, Data Not Valid/Data Valid:

Used for telling the drive whether the control is to be used or ignored.
Bit 10 = 0 means that the control word is ignored.
Bit 10 = 1 means that the control word is used. This function is relevant because the control word is always contained in the packet, regardless of the type of packet used. Therefore it is possible to disconnect the control word if it is not to be used in connection with updating or reading of parameters.

Bit 11, Relay 1:

Bit 11 = 0   Relay 1 is not activated.
Bit 11 = 1   Relay 1 is activated, provided _Control Word Bits 11/12_ has been selected in parameter 323, _Relay Outputs._

Bit 12, Relay 2:

Bit 12 = 0   Relay 2 is not activated.
Bit 12 = 1   Relay 2 is activated, provided _Control Word Bits 11/12_ has been selected in parameter 326, _Relay Outputs._

NOTE
If time-out period set in parameter 556, _Bus Time Interval Function,_ is exceeded, relays 1 and 2 will have voltage removed if activated via serial communication.

Bits 13/14, Choice of Setup:

Bits 13 and 14 are used to choose among the four menu setups in accordance with the following table:

Setup	Bit 14	Bit 13
1	0	0
2	0	1
3	1	0
4	1	1

This function is only possible if _Multi Setup_ has been selected in parameter 004.

NOTE
In parameter 507, _Choice of Setup,_ a choice is made of how bits 13/14 are gated with corresponding function of digital inputs.

Bit 15, No function/reversing:

Bit 15 = 0 leads to no reversing
Bit 15 = 1 leads to reversing
In the factory setting, reversing has been selected as digital in parameter 506, _Reversing._ Bit 15 will only allow reversing, if _bus_ or _logic or_ has been selected, or _logic and_ has been selected and a signal is present at terminal 19.

Status Word per FC Protocol

The status word is used to inform the master (e.g., a PC) of the condition of the slave (drive).

Slave→Master

Status word	Output frequency

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Bit no.

Bit	Bit = 0	Bit =1
00	Trip	Control ready
01		Drive ready
02		Stand by
03	No trip	Trip
04	Not in use	
05	Not in use	
06	Not in use	
07	No warning	Warning
08	Speed reference	Speed = reference
09	Local operation	Serial comm. control
10	Out of frequency range	
11		Running
12	No function	No function
13		Voltage warning high/low
14		Current limit
15		Thermal warning

Bit 00, Control Ready:
Bit 00 = 1 The drive is ready for operation.
Bit 00 = 0 The drive has tripped.

Bit 01, Drive Ready:
Bit 01 = 1 The drive is ready for operation, but terminal 27 is a logic 0 and/or a coasting command has been received via serial communication.

Bit 02, Standby:
Bit 02 = 1 The drive is able to start the motor when a start command is given.

Bit 03, No Trip/Trip:
Bit 03 = 0 means that the drive is not in an error state.
Bit 03 = 1 means that the drive has tripped and needs a reset signal in order for operation to be resumed.

Bit 04, Not in use:
Bit 04 is not used in the status word.

Bit 05, Not in use:
Bit 05 is not used in the status word.

Bit 06, Not in use:
Bit 06 is not used in the status word.

Bit 07, No warning/warning:
Bit 07 = 0 means there is no warning.
Bit 07 = 1 means a warning has occurred.

Bit 08, Speed ≠ Reference/Speed = Reference:
Bit 08 = 0 means that the motor is running, but that the present speed is different from the preset speed reference. This may be the case when the speed is being ramped up or down after a start or stop command.
Bit 08 = 1 means that the present motor speed equals the preset speed reference.

Bit 09, Local Operation/Serial Communication Control:
Bit 09 = 0 means that OFF/STOP has been activated on the control unit, or that the drive is in Hand mode. It is not possible to control the drive through serial communication.
Bit 09 = 1 means that it is possible to control the drive through serial communication.

Bit 10, Out of Frequency Range:
Bit 10 = 0 if the output frequency is outside the range established by the values in parameter 201, *Output Frequency Low Limit,* and parameter 202, *Output Frequency High Limit.*
Bit 10 = 1 means that the output frequency is within the limits of those parameters.

Bit 11, Not Running/Running:
Bit 11 = 0 means that there is no output from the drive.
Bit 11 = 1 means that the drive has a start signal, or that the output frequency is greater than 0 Hz.

Bit 12, No Function:
Bit 12 has no function.

Bit 13, Voltage Warning High/Low:
Bit 13 = 0 means that there is no voltage warning.
Bit 13 = 1 means that the DC voltage of the drive intermediate circuit is too low or too high.

Bit 14, Current Limit:
Bit 14 = 0 means that the output current is less than or equal to the value in parameter 215, *Current Limit.*
Bit 14 = 1 means that the output current is higher than the value in parameter 215, *Current Limit,* and the drive will trip after the time set in parameter 412, *Trip Delay Overcurrent,* has passed if the output current is not reduced.

Bit 15, Thermal Warning:
Bit 15 = 0 means there is no thermal warning.
Bit 15 = 1 means that the temperature limit has been exceeded either in the motor, in the drive or from a thermistor connected to an analog input.

Serial Communication Reference

Master→Slave

Control word	Serial com. ref.

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Bit no.

The serial communication reference is transmitted to the drive in the form of a 16-bit word. The value is transmitted as whole numbers 0 through ±32767 (±200 %).
16384 (4000 Hex) corresponds to 100 %.

The serial communication reference has the following format:

0 through 16384 (4000 Hex) - 0 through 100% (parameter 204, *Minimum Reference* - Par. 205, *Maximum Reference*).

It is possible to change the direction of rotation through the serial reference. This is done by converting the binary reference value to 2's complement. See example in next column.

Example - Control word and serial communication reference:

The drive must receive a start command, and the reference is to be set to 50% (2000 Hex) of the reference range.

Control word = 047F Hex. Start command
Reference = 2000 Hex. 50 % reference

047F H	2000 H
Control word	Reference

The drive is to receive a start command, and the reference is to be set to -50% (-2000 Hex) of the reference range.
The reference value is first converted to the first complement; then 1 binary is added to get 2's complement:

2000 Hex = **0010 0000 0000 0000** binary
1´ complement = **1101 1111 1111 1111** binary
                                    + **1** binary
2´ complement = **1110 0000 0000 0000** binary

Control word = 047F Hex. Start command
Reference = E000 Hex. -50 % reference

047F H	E0000 H
Control word	Reference

Present Output Frequency

Slave→Master

Status word	Output frequency

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 Bit no.

The value of the output frequency of the drive at any given time is transmitted as a 16-bit word. The value is transmitted in the form of whole numbers 0 through ±32767 (±200%).

16384 (4000 Hex) corresponds to 100%.
The output frequency has the following format:

0 through 16384 (4000 Hex) @ 0 to 100% (Parameter 201, *Output Frequency Low limit* - Parameter 202, *Output Frequency High Limit*).

Example - Status Word and Present Output Frequency:

The master receives a status message from the drive that the present output frequency is 50% of the output frequency range.

Parameter 201, *Output Frequency Low Limit* = 0 Hz

Parameter 202, *Output Frequency High Limit* = 60 Hz

Status word = 0F03 Hex. Status message

Output frequency = 2000 Hex. 50% of the frequency range, corresponding to 30 Hz.

0F03 H	2000 H
Status word	Output frequency

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Serial Communication
Parameters 500 through 536

This parameter group sets up the drive for serial communication.

There is a choice of three protocols: FC (VLT protocol), Johnson Controls Metasys N2 and Siemens FLN. In order to use serial communication to control the drive, address and baud rate must always be set. In addition to controlling the drive, operational data from the drive including reference, feedback, motor temperature and others can be read through serial communication.

500	Protocol	(PROTOCOL)
Value:		
★ FC protocol (FC PROTOCOL)		[0]
Metasys N2 (METASYS N2)		[1]
Landis & Staefa FLN (FLN)		[2]
Function:		

There is a choice of three different protocols.

Description of choice:
Select the required control word protocol.

501	Address	(ADRESSE)
Value:		
Parameter 500 *Protocol = FC protocol*		
0 through 126		★ 1
Parameter 500 *Protocol = Metasys N2*		
1 through 255		1
Parameter 500 *Protocol = FLN*		
0 through 98		1
Function:		

In this parameter it is possible to allocate an address in a serial communication network to each drive.

Description of choice:
The individual drive must be given a unique address. If the number of drives exceeds 31, a repeater must be used. Parameter 501, *Address,* cannot be chosen via serial communication but is set via the keypad.

502	Baud Rate	(BAUDRATE)
Value:		
300 Baud (300 BAUD)		[0]
600 Baud (600 BAUD)		[1]
1200 Baud (1200 BAUD)		[2]
2400 Baud (2400 BAUD)		[3]
4800 Baud (4800 BAUD)		[4]
★ 9600 Baud (9600 BAUD)		[5]
Function:		

In this parameter, the speed at which data is transmitted via serial communication is programmed. Baud rate is defined as the number of bits transmitted per second.

Description of choice:
The transmission speed of the drive must be set at a value that corresponds to the transmission speed of the master. Parameter 502, *Baud Rate,* cannot be selected through serial communication; it must be set by the keypad. The data transmission time itself, which is determined by the baud rate selected, is only part of the total communication time.

503	Coasting Stop	(COASTING)
Value:		
Digital input (DIGITAL INPUT)		[0]
Serial communication (SERIAL PORT)		[1]
Logic and (LOGIC AND)		[2]
★ Logic or (LOGIC OR)		[3]
Function:		

In parameters 503 through 508, a choice can be made to control the drive via the digital inputs and/or by serial communication.

If *Digital input* is selected, the command can only be carried out through digital input.

If *Serial communication* is selected, the command can only be carried out through serial communication.

If *Logic and* is selected, the command must be by both serial communication and a digital input.

If *Logic or* is selected, the command can be made by either digital or serial communication.

Description of choice:
The tables below show whether the motor is running or coasting when *Digital Input*, *Serial Communication*, *Logic and* or *Logic or* has been selected.

NOTE
Terminal 27 and bit 03 of control word are active when logic 0 is selected.

Digital Input			*Serial Communication*		
Term. 27	Serial Comm.	Function	Term. 27	Serial Comm.	Function
0	0	Coasting	0	0	Coasting
0	1	Coasting	0	1	Motor run
1	0	Motor run	1	0	Coasting
1	1	Motor run	1	1	Motor run

Logic and			*Logic or*		
Term. 27	Serial Comm.	Function	Term. 27	Serial Comm.	Function
0	0	Coasting	0	0	Coasting
0	1	Motor run	0	1	Coasting
1	0	Motor run	1	0	Coasting
1	1	Motor run	1	1	Motor run

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

504	DC Brake	(DC BRAKE)

Value:

	Digital input (DIGITAL INPUT)	[0]
	Serial communication (SERIAL PORT)	[1]
	Logic and (LOGIC AND)	[2]
★	Logic or (LOGIC OR)	[3]

Function:

See the functional description under parameter 503, *Coasting*.

Description of choice:

The table below shows when the motor is running and is DC-braking when *Digital input*, *Serial communication*, *Logic and* or *Logic or* has been selected.

NOTE
DC braking inverse, through terminals 19 and 27, and bit 03 of the control word, is active when logic 0 is selected.

Digital Input			Serial Communication		
Term. 19/27	Serial Comm.	Function	Term. 19/27	Serial Comm.	Function
0	0	DC brake	0	0	DC brake
0	1	DC brake	0	1	Motor run
1	0	Motor run	1	0	DC brake
1	1	Motor run	1	1	Motor run

Logic and			Logic or		
Term. 19/27	Serial Comm.	Function	Term. 19/27	Serial Comm.	Function
0	0	DC brake	0	0	DC brake
0	1	Motor run	0	1	DC brake
1	0	Motor run	1	0	DC brake
1	1	Motor run	1	1	Motor run

505	Start	(START)

Value:

	Digital input (DIGITAL INPUT)	[0]
	Serial communication (SERIAL PORT)	[1]
	Logic and (LOGIC AND)	[2]
★	Logic or (LOGIC OR)	[3]

Function:

See the functional description under parameter 503 *Coasting*.

Description of choice:

The table below shows when the motor has stopped and gives the situations in which the drive has a start command when *Digital input, Serial communication, Logic and* or *Logic or* has been selected.

Digital Input			Serial Communication		
Term. 18	Serial Comm.	Function	Term. 18	Serial Comm.	Function
0	0	Stop	0	0	Stop
0	1	Stop	0	1	Start
1	0	Start	1	0	Stop
1	1	Start	1	1	Stop

Logic and			Logic or		
Term. 18	Serial Comm.	Function	Term. 18	Serial Comm.	Function
0	0	Stop	0	0	Stop
0	1	Stop	0	1	Start
1	0	Stop	1	0	Start
1	1	Start	1	1	Start

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

506 Reversing (REVERSING)

Value:

- ★ Digital input (DIGITAL INPUT) [0]
- Serial communication (SERIAL PORT) [1]
- Logic and (LOGIC AND) [2]
- Logic or (LOGIC OR) [3]

Function:

See the functional description under parameter, 503 *Coasting*.

Description of choice:

The table below shows when the motor is running forward and reverse when *Digital input*, *Serial communication*, *Logic and* or *Logic or* has been selected.

Digital Input			Serial Communication		
Term. 19	Serial Comm.	Function	Term. 19	Serial Comm.	Function
0	0	Forward	0	0	Forward
0	1	Forward	0	1	Forward
1	0	Reverse	1	0	Forward
1	1	Reverse	1	1	Reverse

Logic and			Logic or		
Term. 19	Serial Comm.	Function	Term. 19	Serial Comm.	Function
0	0	Forward	0	0	Forward
0	1	Forward	0	1	Reverse
1	0	Forward	1	0	Reverse
1	1	Start	1	1	Reverse

507 Selection of Setup (SELECTING OF SETUP)
508 Selection of Preset Reference (SELECTING OF SPEED)

Value:

- Digital input (DIGITAL INPUT) [0]
- Serial communication (SERIAL PORT) [1]
- Logic and (LOGIC AND) [2]
- ★ Logic or (LOGIC OR) [3]

Function:

See the functional description under parameter 503 *Coasting*.

Description of choice:

The table below shows the Setup (parameter 002 *Active Setup*) that has been selected via *Digital input*, *Serial communication*, *Logic and* or *Logic or*. The table also shows the preset reference (parameters 211 through 214, *Preset reference*) that has been selected via *Digital input*, *Serial communication*, *Logic and* or *Logic or*.

Digital Input				
Bus Msb	Bus Lsb	Setup/Preset Msb	Setup/Preset Lsb	Setup No. Preset Ref. No.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	1
0	1	0	1	2
0	1	1	0	3
0	1	1	1	4
1	0	0	0	1
1	0	0	1	2
1	0	1	0	3
1	0	1	1	3
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

Serial Communication				
Bus Msb	Bus Lsb	Setup/Preset Msb	Setup/Preset Lsb	Setup No. Preset Ref. No.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	2
0	1	0	1	2
0	1	1	0	2
0	1	1	1	2
1	0	0	0	3
1	0	0	1	3
1	0	1	0	3
1	0	1	1	3
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4
1	1	1	1	4

Logic and				
Bus Msb	Bus Lsb	Setup/Preset Msb	Setup/Preset Lsb	Setup No. Preset Ref. No.
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	2
0	1	1	0	1
0	1	1	1	2
1	0	0	0	1
1	0	0	1	1
1	0	1	0	3
1	0	1	1	3
1	1	0	0	1
1	1	0	1	2
1	1	1	0	3
1	1	1	1	4

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

Logic or				
Bus Msb	Bus Lsb	Setup/Preset Msb	Setup/Preset Lsb	Setup No. Preset Ref. No.
0	0	0	0	1
0	0	0	1	2
0	0	1	0	3
0	0	1	1	4
0	1	0	0	2
0	1	0	1	4
0	1	1	0	2
0	1	1	1	3
1	0	0	0	3
1	0	0	1	4
1	0	1	0	3
1	0	1	1	4
1	1	0	0	4
1	1	0	1	4
1	1	1	0	4
1	1	1	1	4

509 through 532 — Data Read-Out

Value:

Parameter No.	Description	Display Text	Unit	Updating Interval
509	Resulting reference	(REFERENCE %)	%	80 msec.
510	Resulting reference [unit]	(REFERENCE [UNIT])	Hz, rpm	80 msec.
511	Feedback [unit]	(FEEDBACK)	Par. 415	80 msec.
512	Frequency [Hz]	(FREQUENCY)	Hz	80 msec.
513	User-defined readout	(CUSTOM READOUT)	Hz x scaling	80 msec.
514	Motor current [A]	(CURRENT)	Amp	80 msec.
515	Power [kW]	(POWER KW)	kW	80 msec.
516	Power [HP]	(POWER HP)	HP	80 msec.
517	Motor voltage [V]	(MOTOR VOLT)	VAC	80 msec.
518	DC link voltage [V]	(DC LINK VOLTAGE)	VDC	80 msec.
519	Thermal load, motor [%]	(MOTOR TEMPERATURE)	%	80 msec.
520	Thermal load, VLT [%]	(VLT TEMPERATURE)	%	80 msec.
521	Digital input	(DIGITAL INPUT)	Binary	80 msec.
522	Terminal 53, analog input [V]	(TERMINAL 53, ANALOG INPUT)	Volt	20 msec.
523	Terminal 54, analog input [V]	(TERMINAL 54, ANALOG INPUT)	Volt	20 msec.
524	Terminal 60, analog input [mA]	(TERMINAL 60, ANALOG INPUT)	mA	20 msec.
525	Pulse reference [Hz]	(PULSE REFERENCE)	Hz	20 msec.
526	External reference [%]	(EXTERNAL REFERENCE)	%	20 msec.
527	Status word	(STATUS WORD HEX)	Hex	20 msec.
528	Heat sink temperature [°C]	(HEAT SINK TEMP.)	°C	1.2 sec.
529	Alarm word	(ALARM WORD, HEX)	Hex	20 msec.
530	Control word	(VLT CONTROL WORD, HEX)	Hex	2 msec.
531	Warning word	(WARNING WORD)	Hex	20 msec.
532	Extended status word	(STATUS WORD)	Hex	20 msec.

Function:

These parameters can be read through the serial communication port and the display. See also parameters 007 through 010, *Display Readout.*

Description of choice:

Resulting Reference, parameter 509 gives a percentage for the resulting reference in the range from *Minimum Reference* to *Maximum reference.* See also Reference Handling.

Resulting reference [unit], parameter 510 gives the resulting reference by means of the unit Hz in *Open Loop*, parameter 100. In *Closed Loop*, the reference unit is selected in parameter 415, *Units with Closed Loop.*

Feedback [unit], parameter 51, gives the resulting feedback value by means of the unit/scaling selected in parameters 413, 414 and 415. See also Feedback Handling.

Frequency [Hz], parameter 512, gives the output frequency of the drive.

User Defined Read Out, parameter 513, gives a user defined value calculated on the basis of the present output frequency and unit, as well as the scaling in selected in parameter 005, *Maximum Value of User Defined Read Out.* The unit is selected in parameter 006, *Unit for User Defined Read Out.*

Motor Current [A], parameter 514, gives the motor current in A.

Power [kW], parameter 515, gives the present power provided to the motor in kW.

Power [HP], parameter 516, gives the present power provided to the motor in HP.

Motor Voltage, parameter 517, gives the voltage fed to the motor.

DC Link Voltage, parameter 518, gives the intermediate circuit voltage of the drive.

Thermal Load, Motor [%], parameter 519, gives the calculated/ estimated thermal load on the motor. 100% is the trip point. See also parameter 117, *Motor Thermal Protection.*

Thermal Protection, VLT [%], parameter 520, gives the calculated/ estimated thermal load on the drive. 100% is the trip point.

Digital Input, parameter 521, gives the signal status of the 8 inputs (16, 17, 18, 19, 27, 29, 32 and 33). Input 16 corresponds to the bit to the extreme left. 0 = no signal, 1 = signal connected.

Terminal 53, Analog Input [V], parameter 522, gives the voltage value of the signal on terminal 53.

Terminal 54, Analog Input [V], parameter 523, gives the voltage value of the signal on terminal 54.

Terminal 60, Analog Input [mA], parameter 524, gives the current value of the signal on terminal 60.

Pulse Reference [Hz], parameter 525, gives a pulse frequency in Hz connected to one of the terminals 17 and 29.

External Reference, parameter 526, gives the sum of external references as a percentage (sum of analog/pulse/serial communication) in the range from *Minimum Reference, Ref* to *Maximum reference.*

Status Word, parameter 527, gives the present status word of the drive in hex.

Heat Sink Temperature, parameter 528, gives the present heat sink temperature of the drive.

Alarm Word, parameter 529, gives a hex code for the alarm on the drive.

Control Word, parameter 530, gives the present control word of the drive in hex.

Warning Word, parameter 531, indicates in hex warnings from the drive.

Extended Status Word, parameter 532, indicates in hex code whether there is a warning from the drive.

533	Display Text 1	(DISPLAY TEXT ARRAY 1)

Non-functional.

534	Display Text 2	(DISPLAY TEXT ARRAY 2)

Non-functional.

535	Bus Feedback 1	(BUS FEEDBACK1)

Value:

0 through 16384 decimal (0 through 4000 Hex)   ★ 0

Function:

Via the serial communication port, this parameter allows writing of a bus feedback value which will then form part of the feedback handling. *Bus Feedback 1* will be added to any feedback value registered on terminal 53.

Description of choice:

Write the required bus feedback value via serial communication.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

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536 Bus Feedback 2 (BUS FEEDBACK 2)

Value:

0 through 16384 decimal (0 through 4000 Hex) ★ 0

Function:

Via serial communication, a bus feedback value can be written in this parameter that will become part of the feedback handling system. *Bus Feedback 2* will be added to any feedback value on terminal 54.

Description of choice:

Write the required bus feedback value via the serial communication.

NOTE
Parameters 555, *Bus Time Interval*, and 556, *Bus Time Interval Function*, are only active when *FC Protocol* has been selected in parameter 500, *Protocol.*

555 Bus Time Interval (BUS TIME INTERVAL)

Value:

1 to 99 sec. ★ 60 sec.

Function:

In this parameter, the maximum time allowed between the receipt of two packets in a row is set. If this time is exceeded, the serial communication is assumed to have stopped and the choice made in parameter 556, *Bus Time Interval Function*, will be carried out.

Description of choice:

Set the required time.

556 Bus Time Interval Function (BUS TIME INTERVAL FUNCTION)

Value:

★	Off (NO FUNCTION)	[0]
	Freeze output (FREEZE OUTPUT)	[1]
	Stop (STOP)	[2]
	Jogging (JOG FREQUENCY)	[3]
	Max. output frequency (MAX FREQUENCY)	[4]
	Stop and trip (STOP AND TRIP)	[5]

Function:

In this parameter, the required reaction from the drive is selected when the time set in parameter 555, *Bus Time Interval*, has been exceeded.

Description of choice:

The output frequency of the drive can be frozen at the present value, frozen as selected in parameter 211, *Preset Reference 1*, frozen as selected in parameter 202, *Maximum Output Frequency*, or stop and show a fault.

560 N2 override release time (N2 OVER.REL.TIME)

Value:

1 - 65534 (OFF) sec. ★ OFF

Function

The maximum time is set between the receipt of two N2 messages. If the time is exceeded, serial communication is assumed stopped and all points in the N2 point-map which are overridden will be released in the following order:

1. Release analog outputs from point address (NPA) 0 to 255.
2. Release binary outputs from point address (NPA) 0 to 255.
3. Release internal floating points from point address (NPA) 0 to 255.
4. Release internal integer points from point address (NPA) 0 to 255.
5. Release internal byte points from point address (NPA) 0 to 255.

Description of choice:

Set the required time.

565 FLN bus time interval (FLN TIME INTER.)

Value:

1 - 65534 sec. ★ 60 sec.

Function

The maximum time is set between the receipt of two FLN messages. If the time is exceeded, serial communication is assumed stopped and the required reaction is set in parameter 566, *FLN Bus Time Interval Function.*

Description of choice:

Set the required time.

566 FLN bus time interval function (FLN TIME FUNCT.)

Value:

★	Off (NO FUNCTION)	[0]
	Freeze output (FREEZE OUTPUT)	[1]
	Stop (STOP)	[2]
	Jogging (JOG FREQUENCY)	[3]
	Max. output frequency (MAX.SPEED)	[4]
	Stop and trip (STOP AND TRIP)	[5]

Function

The required reaction from the adjustable frequency drive is selected when the time set in parameter 565, *FLN Bus Time Interval*, has been exceeded.

Description of choice:

The output frequency of the adjustable frequency drive can be frozen at the present value at any given time, frozen at parameter 211, *Preset Reference 1*, frozen at parameter 202, *Max. Output Frequency*, or stop output and show a fault.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

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Warning Words, Extended Status Word and Alarm Word

Warning Word, Extended Status Word and Alarm Word are shown in hex format on the display. If there is more than one warning or alarm, the sum of the warnings or alarms will be shown.

The descriptions of the Extended Status Words, Warning Words and Alarm Words can be read out via the serial bus in parameter 531, *Warning Word;* 532, *Extended Status Word;* and 529, *Alarm Word.*

Hex Code	Extended Status Word
00000001	Overvoltage control active
00000002	Start delay
00000004	Sleep boost active
00000008	Sleep mode active
00000010	Automatic motor adaptation completed
00000020	Automatic motor adaptation running
00000040	Reversing and start
00000080	Ramp operation
00000100	Reversing
00000200	Speed = reference
00000400	Running
00000800	Local reference = 1
	Remote controlled reference = 0
00001000	OFF mode = 1
00002000	Auto mode = 0, Hand mode = 1
00004000	Start blocked
00008000	Start blocked signal missing
00010000	Freeze output
00020000	Freeze output blocked
00040000	Jogging
00080000	Jog blocked
00100000	Stand by
00200000	Stop
00400000	DC stop
00800000	Drive ready
01000000	Relay 123 active
02000000	Drive ready
04000000	Control ready
08000000	Start prevented
10000000	Profibus OFF3 active
20000000	Profibus OFF2 active
40000000	Profibus OFF1 active
80000000	Reserved

Hex Code	Warning Word
00000001	Reference high
00000002	Fault in EEprom on control card
00000004	Fault in EEprom on power card
00000008	HPFB bus timeout
00000010	Serial communication timeout
00000020	Overcurrent
00000040	Current limit
00000080	Motor thermistor
00000100	Motor overtemperature
00000200	Inverter overtemperature
00000400	Undervoltage
00000800	Overvoltage
00001000	Voltage warning low
00002000	Voltage warning high
00004000	Mains phase fault
00008000	Live zero fault
00010000	Under 10 Volt (terminal 50)
00020000	Reference low
00040000	Feedback high
00080000	Feedback low
00100000	Output current high
00200000	Out of frequency range
00400000	Profibus communication fault
00800000	Output current low
01000000	Output frequency high
02000000	Output frequency low
04000000	AMA - motor too small
08000000	AMA - motor too big
10000000	AMA - check par. 102, 103, 105
20000000	AMA - check par. 102, 104, 106
40000000	Reserved
80000000	Reserved

Hex Code	Alarm Word
00000001	Unknown fault
00000002	Trip locked
00000004	Auto-optimization not OK
00000008	HPFB bus timeout
00000010	Serial communication timeout
00000020	ASIC fault
00000040	HPFP bus timeout
00000080	Standard bus timeout
00000100	Short-circuiting
00000200	Switchmode fault
00000400	Earth fault
00000800	Current limit
00001000	Overcurrent
00002000	Motor thermistor
00004000	Motor overheated
00008000	Inverter overheated
00010000	Undervoltage
00020000	Overvoltage
00040000	Mains phase fault
00080000	Live zero fault
00100000	Heat sink temperature too high
00200000	Motor phase W missing
00400000	Motor phase V missing
00800000	Motor phase U missing
01000000	Profibus communication fault
02000000	Inverter fault
04000000	Output current low
08000000	Safety stop
10000000	Reserved

![Danfoss logo]

Service Functions
Parameters 600 through 631

This parameter group contains functions useful for troubleshooting the drive including operating data, data log and fault log.

It also has information on the nameplate data of the drive.

Function:
These parameters can be read out through the serial communication port as well as on the control panel display.

Description of choice:
Parameter 600, *Operating Hours*

Shows the number of hours the drive has had power applied. The value is saved every hour and when the power is removed. This value cannot be reset.

Parameter 601, *Hours Run*

Shows the number of hours the drive has powered the motor. This parameter can be reset in parameter 619, *Reset of Hours Run Counter*. The value is saved every hour and when the power is removed.

Parameter 602, *kWh Counter*

Shows the output power of the drive. The calculation is based on the mean value in kWh over one hour. This value can be reset using parameter 618, *Reset of kWh Counter*.

Parameter 603 *Number of Power Ups.*

Shows the number of times power has been applied to the drive.

Parameter 604, *Number of Overtemperature Trips*

Shows the number of overtemperature trips from the heatsink temperature sensor on the drive.

Parameter 605, *Number of Overvoltage Trips*

Shows the number of overvoltage trips from the sensor of DC link voltage of the drive. The count is only taken when Alarm 7 *Overvoltage* is activated.

600-605 Operating Data Value:

Value:

Parameter Number	Description Operating Data:	Display Text	Unit	Range
600	Operating Hours	(OPERATING HOURS)	Hours	0 through 130,000.0
601	Hours Run	(RUNNING HOURS)	Hours	0 through 130,000.0
602	kWh Counter	(KWH COUNTER)	kWh	-
603	Number of Power-ups	(POWER UPS)	Occurences	0 through 9999
604	Number of Overtemp Trips	(OVER TEMPS)	Occurences	0 through 9999
605	Number of Overvoltage Trips	(OVER VOLTS)	Occurences	0 through 9999

Value:

Parameter no.	Description Data log:	Display Text	Unit	Range
606	Digital Input	(LOG: DIGITAL INP)	Decimal	0 through 255
607	Control Word	(LOG: BUS COMMAND)	Decimal	0 through 65535
608	Status Word	(LOG: BUS STAT WD)	Decimal	0 through 65535
609	Reference	(LOG: REFERENCE)	%	0 through 100
610	Feedback	(LOG: FEEDBACK)	Par. 414	-999,999.999 through 999,999.999
611	Output Frequency	(LOG: MOTOR FREQ.)	Hz	0.0 through 999.9
612	Output Voltage	(LOG: MOTOR VOLT)	Volt	50 through 1000
613	Output Current	(LOG: MOTOR CURR.)	Amp	0.0 through 999.9
614	DC Link Voltage	(LOG: DC LINK VOLT)	Volt	0.0 through 999.9

Function:

With these parameters, it is possible to see up to twenty saved values, or data logs. Data log [1] is the most recent and [20] the oldest log. When a start command has been given, a new entry to the data log is made every 160 ms. If there is a trip or if the drive is stopped, the 20 latest data log entries will be saved and the values will be visible in the display. This is useful to view the operation of the drive just before a trip. These values will be lost if power is removed from the drive.

The drawing below shows a display. The data log number is shown in the square brackets at the left of the forth line of the display.
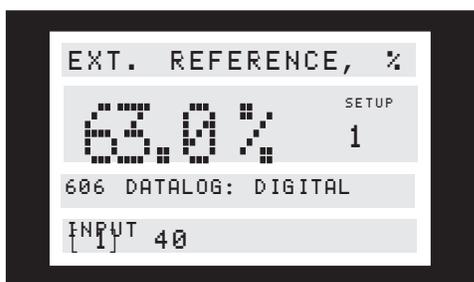
Data logs [1] through [20] can be read by first pressing CHANGE DATA, followed by the + and - keys to change data log numbers.

Parameters 606 through 614, *Data Log,* can also be read out via the serial communication port.

Description of choice:

Parameter **606** *Data Log: Digital Input*:

This is where the latest log data is shown in decimal code, representing the status of the digital inputs. Translated into binary code, terminal 16 corresponds to the bit to the extreme left and to decimal code 128. Terminal 33 corresponds to the bit to the extreme right and to decimal code 1.

The table can be used for converting a decimal number into a binary code. For example, digital 40 corresponds to binary 00101000. The nearest smaller decimal number is 32, corresponding to a signal on terminal 18. 40-32 = 8, corresponds to the signal on terminal 27.

Terminal	16	17	18	19	27	29	32	33
Decimal number	128	64	32	16	8	4	2	1

Parameter 607 *Data Log: Control Word*:
This is where the latest log data is given in decimal code for the control word of the drive. The control word can only be changed via serial communication. The control word is read as a decimal number which is to be converted into hex. See the control word profile under the section *Serial communications.*

Parameter 608, *Data Log: Status Word*:
This gives the latest log data in decimal code for the status word. The status word is read as a decimal number which is to be converted into hex. See the status word profile under the section *Serial communication.*

Parameter 609, *Data Log: Reference*:
This gives the latest log data for the resulting reference.

Parameter 610, *Data Log: Feedback*:
This gives the latest log data for the feedback signal.

Parameter 611, *Data Log: Output Frequency*:
This gives the latest log data for the output frequency.

Parameter 612, *Data Log: Output Voltage*:
This gives the latest log data for the output voltage.

Parameter 613, *Data Log: Output Current*:
This gives the latest log data for the output current.

Parameter 614, *Data Log: DC Link Voltage*:
This gives the latest log data for the intermediate circuit voltage.

615 Fault Log: Error Code
(F. LOG: ERROR CODE)

Value:

[Index 1-10] Error Code: 0 - 99

Function:

This parameter makes it possible to see the reason why a fault trip occurs. Ten log values, indicated as [1] through [10] are stored.

The lowest log number [1] contains the most recently saved data value; the highest log number [10] contains the oldest data value.

If there is a fault trip, it is possible to see its cause, the time and possibly the values or output current or output voltage. See the section on Warnings and Alarms for a table explaining the error codes.

Description of choice:

The fault log is only reset after manual initialization.

616 Fault Log: Time (F. LOG: TIME)

Value:

[Index 1-10] Hours: 0 - 130,000.0

Function:

This parameter makes it possible to see the total number of hours run in connection with the 10 most recent fault trips. Ten log values, indicated as [1] through [10] are stored.

The lowest log number [1] contains the most recently saved data value: the highest log number [10] contains the oldest data value.

Description of choice:

The fault log is only reset after manual initialization.

617 Fault Log: Value (F. LOG: VALUE)

Value:

[Index 1 - 10] Value: 0 - 9999

Function:

This parameter makes it possible to see the value at which a fault trip occurred. The unit of the value depends on the alarm active in parameter 615, *Fault Log: Error Code*.

Description of choice:

The fault log is only reset after manual initialization.

618 Reset of kWh Counter (RESET KWH COUNT)

Value:

★ No reset (DO NOT RESET) [0]
Reset (RESET COUNTER) [1]

Function:

Reset to zero of parameter 602, *kWh Counter.*

Description of choice:

If *Reset* has been selected and the OK key is pressed, the kWh counter of the drive is reset. This parameter cannot be selected via the serial port.

619 Reset of Hours Run Counter
(RESET RUN. HOUR)

Value:

★ No reset (DO NOT RESET) [0]
Reset (RESET COUNTER) [1]

Function:

Reset to zero of parameter 601, *Hours Run*.

Description of choice:

If *Reset* has been selected and the OK key is pressed, parameter 601 *Hours-run* is reset to zero. This parameter cannot be selected via the serial port.

620 Operating Mode (OPERATION MODE)

Value:

★ Normal function (NORMAL OPERATION) [0]
Function with deactivated inverter
(OPER. W/INVERT.DISAB) [1]
Control card test (CONTROL CARD TEST) [2]
Initialization (INITIALIZE) [3]

Function:

In addition to its normal function, this parameter can be used for two different tests.

It is possible to reset to the default factory settings for all Setups, except parameters 500, *Address*; 501 *Baud Rate;* 600-605, *Operating Data;* and 615-617, *Fault Log.*

Description of choice:

Normal function is used for normal operation of the motor.

Function with deactivated inverter is selected to operate the control card using its control signals without running the motor.

Control card test is used to test the analog and digital inputs, analog and digital outputs, relay output and the power supplies of the control card.

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.

A test connector with the connections shown below is required for this test.

Set test connector set up as follows:
1. Connect 4, 16, 17, 18, 19, 27, 29, 32 and 33.
2. Connect 5 and 12.
3. Connect 39, 20 and 55.
4. Connect 42 and 60.
5. Connect 45, 53 and 54
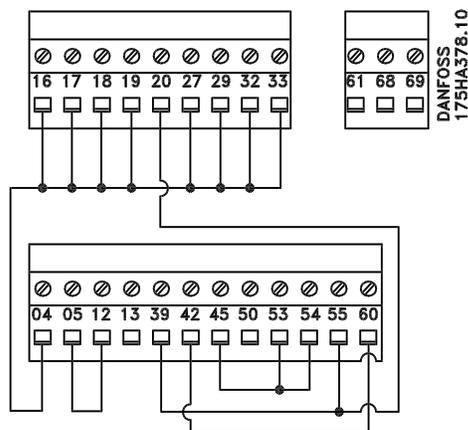
Test the control card in accordance with the following procedure:

1. Select *Control Card Test*.
2. Remove input power and wait for light in display to go out.
3. Insert test connector described above.
4. Reconnect input power.
5. Press OK key. (Test cannot run without control panel in place.)
6. Drive automatically tests control card.
7. Remove test connector and press OK key when drive displays "TEST COMPLETED."
8. Parameter 620, *Operating Mode,* is automatically set to *Normal Function*.

If the control card test fails, the drive will display "TEST FAILED." Replace the control card.

Initialization is selected to reset the drive to its factory default settings without resetting parameters 501 *Address*, 502 *Baud Rate;* 600-605, *Operating Data;* and 615-617, *Fault Log.*

⚠CAUTION
Choosing *Initialization* resets drive to read-only memory default parameter values. This erases any special programming which may have been done to drive. It may be preferrable to use parameter 004 to download all parameters from local control panel (LCP).

Iinitialization the drive to factory default settings in accordance with the following procedues:

1. Select *Initialization*.
2. Press OK key.
3. Remove input power and wait for light in display to go out.
4. Connect input power.
5. Initialization of all parameters will be carried out in all Setups with exception of parameters 501, *Address;* 502, *Baud Rate;* 600-605, *Operating Data;* and 615-617, *Fault Log*.

Value:

Parameter	Description	Display text
Number	Nameplate:	
621	Unit Type	(DRIVE TYPE)
622	Power Component	(POWER SECTION)
623	VLT Ordering No.	(ORDERING NO)
624	Software Version No.	(SOFTWARE VERSION)
625	Control Panel Identification No.	(LCP ID NO.)
626	Database Identification No.	(PARAM DB ID)
627	Power Component Identification No.	(POWER UNIT DB ID)
628	Application Option Type	(APPLIC. OPTION)
629	Application Option Ordering No.	(APPLIC. ORDER NO)
630	Communication Option Type	(COM. OPTION)
631	Communication Option Ordering No.	(COM. ORDER NO)

Function:

Identification information for the drive can be read from parameters 621 through 631, *Nameplate* via the display or the serial communication port.

Description of choice:

Parameter 621, *Nameplate: Unit Type*:

VLT type gives the unit size and input voltage. See Cross Reference - Model Number to VLT Type to convert this do the drive's model number.

Parameter 622, *Nameplate: Power Component*:

This gives the type of power card installed in the drive.

Parameter 623, *Nameplate: VLT Ordering Number:*

This gives the ordering number for the specific drive. Because this number does not specify any special options or programming that was provided with the drive, it is better to refer to the serial number printed on the Danfoss Graham nameplate when contacting the factory about the drive.

Parameter 624, *Nameplate: Software Version Number:*

This gives the present software version number of the drive.

Parameter 625, *Nameplate: LCP Identification Number:*

This gives the identification number of the keypad (LCP) of the unit.

Parameter 626, *Nameplate: Database identification Number:*

This gives the identification number of the software's database.

Parameter 627, *Nameplate: Power Component Identification Number:*

This gives the identification number of the database of the drive.

Parameter 628, *Nameplate: Application Option Type:*

This gives the type of application options fitted to the basic drive.

Parameter 629, *Nameplate: Application Option Ordering Number:*

This gives the ordering number for the application option of the basic drive. Because this number does not specify any special options or programming that was provided with the drive, it is better to refer to the serial number printed on the Danfoss Graham nameplate when contacting the factory about the drive.

Parameter 630, *Nameplate: Communication Option Type:*

This gives the type of communication option card installed in the drive, if any.

Parameter 631, *Nameplate: Communication Option Ordering Number:*

This gives the ordering number for the communication option.

Relay Card Functions
Parameters 700 through 711

Parameters 700 through 711 are only activated if a relay option card is installed in the drive. A relay card can be field installed in the drive if desired.

Activation/deactivation can be programmed in parameters 701, 704, 707 and 710, *Relay 6, 7, 8 and 9, ON Delay;* and parameters 702, 705, 708 and 711 *Relay 6, 7, 8 and 9, OFF Delay.*

700	Relay 6, Function	(RELAY6 FUNCTION)
703	Relay 7, Function	(RELAY7 FUNCTION)
706	Relay 8, Function	(RELAY8 FUNCTION)
709	Relay 9, Function	(RELAY9 FUNCTION)

Function:

This output activates a relay.

Relay outputs 6, 7, 8 and 9 can be used for showing status and warnings. The relay is activated when the conditions for the relevant data values have been fulfilled. Because these have the same possible functions as relay 1, see the description under parameter 323.

701	Relay 6, ON Delay	(RELAY6 ON DELAY)
704	Relay 7, ON Delay	(RELAY7 ON DELAY)
707	Relay 8, ON Delay	(RELAY8 ON DELAY)
710	Relay 9, ON Delay	(RELAY9 ON DELAY)

Value:

  0 to 600 sec.   ★ 0 sec.

Function:

This parameter allows a delay of the activation of relays 6, 7, 8 and 9 (terminals 1, and 2).

Description of choice:

Enter the desired value.

702	Relay 6, OFF Delay	(RELAY6 OFF DELAY)
705	Relay 7, OFF Delay	(RELAY7 OFF DELAY)
708	Relay 8, OFF Delay	(RELAY8 OFF DELAY)
711	Relay 9, OFF Delay	(RELAY9 OFF DELAY)

Value:

  0 to 600 sec.   ★ 0 sec.

Function:

This parameter is used to delay the deactivation time of relays 6, 7, 8 and 9 (terminals 1 and 2).

Description of choice:

Enter the desired value.

This parameter allows a delay of the activation of relays 6, 7, 8 and 9 (terminals 1, and 2).

Electrical Installation of the Relay Card

The relays are connected as shown below.

Relay 6-9
A-B make, A-C break
Max. 240 VAC, 2 Amp
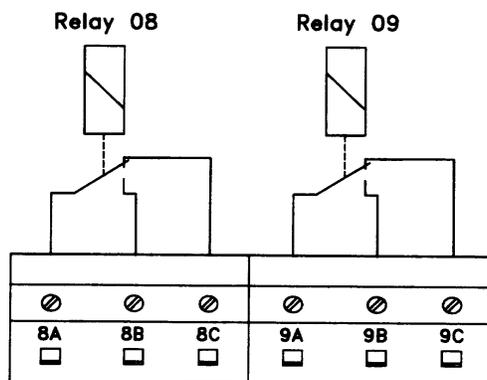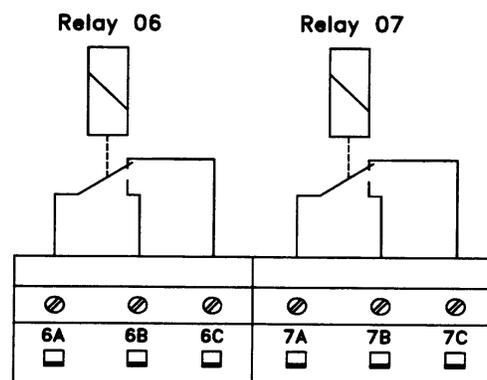
To achieve double isolation, mount the plastic foil as shown below.

DANFOSS
175HA475.10

★ Indicates default parameter. Depending upon the application, the drive may be delivered with other parameters selected.
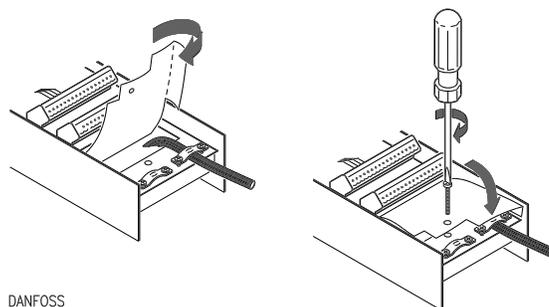
Status Messages

Status messages appear in the fourth line of the display as shown below.

The left part of the status line indicates the control point of the drive.

The center part of the status line indicates the reference location.

The last part of the status line gives the present status of the drive.
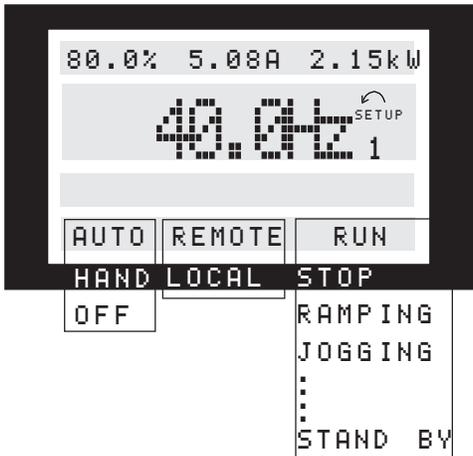
Auto Mode (AUTO)
The drive is in Auto mode, which means that Run/Stop control is carried out via the control terminals and/or serial communication. See also *Auto Start* .

Hand Mode (HAND)
The drive is in Hand mode, which means that Run/Stop control is carried out via the keys on the keypad. See also *Hand Start*.

OFF (OFF)
OFF/STOP is activated either by means of the keypad, or by the digital inputs *Hand Start* and *Auto Start,* both being a logic '0'. See also *OFF/ STOP* .

Local Reference (LOCAL)
If LOCAL has been selected, the reference is set via the + and - keys on the keypad. See also *Display Modes*.

Remote Controlled Reference (REM.)
If REMOTE has been selected, the reference is set via the control terminals or via serial communication. See also *Display Modes*.

Running (RUNNING)
The motor speed now corresponds to the resulting reference.

Ramp Operation (RAMPING)
The output frequency is changing.

Auto Ramp (AUTO RAMP)
Parameter 208, *Automatic Ramp Up/Down*, is enabled. The drive is attempting to avoid a trip from overvoltage by extending its decel ramp time.

Sleep Boost (SLEEP .BST)
The boost function in parameter 406, *Boost Setpoint,* is enabled. This function can only be enabled in *Closed Loop* operation.

⚠DANGER
When in *Sleep Mode*, motor may restart at any time without warning.

Sleep Mode (SLEEP)
The energy saving function in parameter 403, *Sleep Mode Timer,* is enabled. This status message shows that at present the motor has been stopped by sleep mode. It can restart automatically.

⚠DANGER
When in *Start Delay* mode, motor may restart at any time without warning.

Start Delay (START DEL)
A start delay time has been programmed in parameter 111, *Start Delay*. When the delay has passed, the drive will start and ramp up to the reference frequency.

⚠DANGER
When in *Run Request* mode, motor may restart at any time without warning.

Run Request (RUN REQ.)
A start command has been given, but the motor will not be started until a *Run Permission* signal is received via a digital input.

Jogging (JOG)
Jog has been enabled via a digital input or via serial communication.

⚠DANGER
When in *Jog Request*, motor may restart at any time without warning.

Jog Request (JOG REQ.)
A start command has been given, but the motor will remain stopped until a *Run Permission* signal is received via a digital input.

Freeze Output (FRZ.OUT.)
The ouput frequency has been frozen.

⚠DANGER

When in *Freeze Output Request*, motor may re-start at any time without warning.

Freeze Output Request (FRZ.REQ.)
A start command has been given, but the motor will remain stopped until a *Run Permission* signal is received via a digital input.

Reversing and Start (START F/R)
Reversing and start 2 on terminal 19, parameter 303, *Digital Inputs*; and *Start* on terminal 18, parameter 302, *Digital Inputs* are enabled at the same time. The motor will remain stopped until one of the signals becomes a logic '0'.

Automatic Motor Adaptation Running (AMA RUN)
Automatic motor adaptation has been enabled in parameter 107, *Automatic Motor Adaptation, AMA*.

Automatic Motor Adaptation Completed (AMA STOP)
Automatic motor adaptation has been completed. The drive is now ready for operation after the *Reset* signal has been given. Note that the motor will start after the drive has received the *Reset* signal.

Stand by (STANDBY)
The drive is able to start the motor when a start command is received.

Stop (STOP)
The motor has been stopped via a stop signal from serial communication.

DC stop (DC STOP)
The DC brake in parameter 114 through 116 has been enabled.

Drive Ready (UN. READY)
The drive is ready for operation, but terminal 27 is a logic '0' and/or a *Coasting Command* has been received via the serial communication.

Control Ready (CTR.READY)
This status is only active when a Profibus option card is installed.

Not Ready (NOT READY)
The drive is not ready for operation, because of a trip or because OFF1, OFF2 or OFF3 is a logic '0'.

Start Inhibited (START IN.)
This status will only be displayed if, in parameter 599, *Profidrive* [1] has been selected and OFF2 or OFF3 is a logic '0'.

Exceptions XXXX
The microprocessor of the control has stopped and the drive is not operating. The cause may be noise on the power line, motor leads or control wires.

Warnings and Alarms

The table below gives the drive's warnings and alarms and indicates whether the fault trip locks the drive. After a Trip Lock Fault, the input power must be removed, the cause of the fault corrected, and input power restored to reset the drive. A Trip can be reset manually in any one of three ways.

1) Pressing the keypad key RESET
2) A digital input
3) Serial communication

In addition, an automatic reset may be selected in parameter 400, *Reset Function* which will reset all non-trip lock faults.

Wherever an "X" is placed under both Warning and Alarm in the table below, this means that a Warning precedes the Alarm. It can also mean that it is possible to program whether a given fault is to result in a Warning or an Alarm. This is possible, for example, through parameter 117, *Motor Thermal Protection*. After a trip, the motor will be coasting and the drive's Alarm and Warning indications will flash. If the fault is removed, only the Alarm will flash. After a reset, the drive will be ready to start operation again.

No.	Description	Warning	Alarm	Trip Locked
1	10 Volts low (10 VOLT LOW)	X		
2	Live zero fault (LIVE ZERO ERROR)	X	X	
4	Mains failure (MAINS PHASE LOSS)	X	X	X
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X		
6	Voltage warning low (DC LINK VOLTAGE LOW)	X		
7	Overvoltage (DC LINK OVERVOLT)	X	X	
8	Undervoltage (DC LINK UNDERVOLT)	X	X	
9	Inverter overloaded (INVERTER TIME)	X	X	
10	Motor overloaded (MOTOR TIME)	X	X	
11	Motor thermistor (MOTOR THERMISTOR)	X	X	
12	Current limit (CURRENT LIMIT)	X	X	
13	Over current (OVERCURRENT)		X	X
14	Earth fault (EARTH FAULT)		X	X
15	Switch mode fault (SWITCH MODE FAULT)		X	X
16	Short-circuit (CURR.SHORT CIRCUIT)		X	X
17	Serial communication timeout (STD BUSTIMEOUT)	X	X	
18	HPFB bus timeout (HPFB TIMEOUT)	X	X	
19	Fault in EEprom on power card (EE ERROR POWER)	X		
20	Fault in EEprom on control card (EE ERROR CONTROL)	X		
22	Auto-optimisation not OK (AMA FAULT)		X	
29	Heat-sink temperature too high (HEAT SINK OVERTEMP.)		X	X
30	Motor phase U missing (MISSING MOT.PHASE U)		X	
31	Motor phase V missing (MISSING MOT.PHASE V)		X	
32	Motor phase W missing (MISSING MOT.PHASE W)		X	
34	HPFB communication fault (HPFB COMM. FAULT)	X	X	
35	Out of frequency range (OUT FREQ RNG/ROT LIM)	X		
37	Inverter fault (GATE DRIVE FAULT)		X	X
39	Check parameters 104 and 106 (CHECK P.104 & P.106)	X		
40	Check parameters 103 and 105 (CHECK P.103 & P.106)	X		
41	Motor too large (MOTOR TOO BIG)	X		
42	Motor too small (MOTOR TOO SMALL)	X		
60	Safety stop (EXTERNAL FAULT)		X	
61	Output frequency low (FOUT < FLOW)	X		
62	Output frequency high (FOUT > FHIGH)	X		
63	Output current low (I MOTOR < I LOW)	X	X	
64	Output current high (I MOTOR > I HIGH)	X		
65	Feedback low (FEEDBACK < FDB LOW)	X		
66	Feedback high (FEEDBACK > FDB HIGH)	X		
67	Reference low (REF. < REF. LOW)	X		
68	Reference high (REF. > REF. HIGH)	X		
69	Temperature auto derate (TEMP.AUTO DERATE)	X		
99	Unknown fault (UNKNOWN ALARM)		X	X

Warnings

A warning will flash in line 2, while an explanation is given in line 1.

```
MAINS PHASE LOSS

WARN. 4       SETUP
                1
```

Alarms

If an alarm is given, the present alarm number will be shown in line 2. Lines 3 and 4 of the display will offer an explanation.

```
TRIP (RESET)

ALARM 12      SETUP
                1
TORQUE LIMIT
```
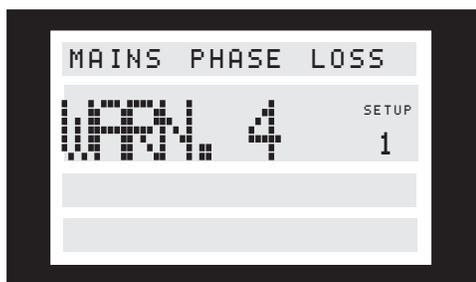
WARNING 1
Under 10 V (10 VOLT LOW)
The 10 V voltage from terminal 50 on the control card is below 10 V.

Remove some of the load from terminal 50, as the 10 volts supply is overloaded. Maximum load is 17 mA, minimum resistance is 590 Ω.

WARNING/ALARM 2
Live Zero Fault (LIVE ZERO ERROR)
The current or voltage signal on terminal 53, 54 or 60 is below 50% of the value preset in parameter 309, 312 and 315 *Terminal, Minimum Scaling.*

WARNING/ALARM 4
Mains Failure (MAINS PHASE LOSS)
Phase missing on the input power. Check the supply voltage to the drive.

WARNING 5
Voltage Warning High
(DC LINK VOLTAGE HIGH)
The intermediate DC circuit voltage is higher than *Voltage Warning High*, see table below. The drive is still controlling the motor.

WARNING 6
Voltage Warning Low (DC LINK VOLTAGE LOW)
The intermediate DC circuit voltage is lower than *Voltage Warning Low*, see table below. The drive is still controlling the motor.

WARNING/ALARM 7
Overvoltage (DC LINK OVERVOLT)
If the intermediate circuit voltage (DC) is higher than the *Overvoltage Limit* of the drive (see table below), the drive will trip after a fixed period. The length of this period depends upon the unit.

WARNING/ALARM 8
Undervoltage (DC LINK UNDERVOLT)
If the intermediate circuit voltage (DC) drops below the *Undervoltage Limit* of the inverter, the drive will trip after a fixed period. The length of the period depends upon the unit.

The voltage will be stated in the display. Check whether the supply voltage matches the drive rating.

WARNING/ALARM 9
Inverter Overload (INVERTER TIME)
The electronic thermal inverter protection reports that the drive is about to trip because of an overload. The counter for electronic thermal inverter protection gives a warning at 98% and trips at 100% showing an alarm. The drive cannot be reset until the counter drops below 90%.

Alarm/Warning limits:

Drive	208 to 230 volt		380 to 460 volt		575 volt
	VDC	VAC	VDC	VAC	VDC
Undervoltage alarm	211	164	402	313	621
Voltage warning, low	222	173	423	329	641
Voltage warning, high	384	270	737	519	965
Overvoltage alarm	425	299	765	538	975

WARNING/ALARM 10
Motor Overtemperature (MOTOR TIME)
According to the electronic thermal protection, the motor is overheated. Parameter 117, *Motor Thermal Protection,* allows a choice of whether the drive is to give a warning or an alarm when the *Motor Thermal Projection* reaches 100%. The fault is that the motor is overloaded to more than 100% of the preset rated motor current for too long. Check that the motor parameters 102 through 106 have been set correctly.

WARNING/ALARM 11
Motor Thermistor (MOTOR THERMISTOR)
The thermistor or the thermistor connection has been disconnected. Parameter 117, *Motor Thermal Protection,* allows a choice of whether the drive is to give a warning or an alarm. Check that the thermistor has been correctly connected between terminal 53 or 54 (analog voltage input) and terminal 50 (+ 10 V supply).

WARNING/ALARM 12
Current Limit (CURRENT LIMIT)
The current is higher than the value in parameter 215, *Current Limit,* and the drive trips after the time set in parameter 412, *Trip Delay Overcurrent,* has passed.

WARNING/ALARM 13
Overcurrent (OVER CURRENT)
The inverter peak current limit, approximately 200% of the rated current, has been exceeded. The warning will last approximately 1 or 2 seconds, and then the drive will trip and signal an alarm.

Turn off the drive and check for free rotation of the motor shaft and other causes of the overload.

ALARM 14
Earth Fault (EARTH FAULT)
There is current leakage from the output phases to earth, either in the leads between the drive and the motor or in the motor itself.

Remove power to the drive and correct the earth fault.

ALARM 15
Switch Mode Fault (SWITCH MODE FAULT)
Fault in the switch mode power supply (internal ±15 V supply).

Contact the Danfoss Graham service department.

ALARM 16
Short Circuiting (CURR. SHORT CIRCUIT)
There is a short circuit in the output from the drive.

Remove power to the drive and correct the short circuit.

WARNING/ALARM 17
Serial Communication Timeout (STD BUSTIMEOUT)
There is no serial communication with the drive.

This warning will only be enabled if parameter 510, *Bus Time Interval Function,* has been set to a value different from OFF.

If parameter 510, *Bus Time Interval Function,* has been set to *Stop and Trip* [5], the drive will first give off an alarm, then ramp down and finally trip while giving an alarm. It is possible to increase parameter 509, *Bus Time Interval.*

WARNING/ALARM 18
HPFB Bus Timeout (HPFB TIMEOUT)
There is no serial communication with the communication option card in the drive.

The warning will only be enabled if parameter 804, *Bus Time Interval Function,* has been set to anything but OFF. If parameter 804, *Bus Time Interval Function,* has been set to *Stop and Trip,* the drive will first give an alarm, then ramp down and finally trip while giving an alarm.

Parameter 803, *Bus Time Interval* could possibly be increased. Parameter 803 is only available when a communicaion option card is installed in the drive.

WARNING 19
Fault in the EEprom on the Power Card (EE ERROR POWER)
There is a fault on the power card EEPROM. The drive will continue to function, but is likely to fail at the next power-up. Contact the Danfoss Graham service department.

WARNING 20
Fault in the EEprom on the control card (EE ERROR CONTROL)
There is a fault in the EEPROM on the control card. The drive will continue to function, but is likely to fail at the next power-up. Contact the Danfoss Graham service department.

ALARM 22
Automatic Motor Adaptation Failed (AMA FAULT)
A fault has been found during automatic motor adaptation. The text shown in the display indicates a fault message.

AMA can only be carried out if there are no alarms during the AMA process.

CHECK 103, 105
Parameter 103 or 105 has a wrong setting. Correct the setting and repeat AMA.

LOW P 105
The motor is too small for AMA to be carried out. If AMA is to be enabled, the rated motor current, parameter 105, must be higher than 35% of the rated output current of the drive.
ASYMMETRICAL IMPEDANCE
AMA has detected an asymmetrical impedance in the motor connected to the system. The motor could be defective.

MOTOR TOO BIG
The motor connected to the system is too big for AMA to be carried out. The setting in parameter 102 does not match the motor used.

MOTOR TOO SMALL
The motor connected to the system is too small for AMA to be carried out. The setting in parameter 102 does not match the motor used.

TIME OUT
AMA fails because of noisy measuring signals. Retry until AMA is successfully completed. Please note that repeated AMA runs may heat the motor to a level where the stator resistance is increased.

INTERRUPTED BY USER
AMA has been interrupted by the user.

INTERNAL FAULT
An internal fault has occurred in the drive. Contact Danfoss Graham service department.

LIMIT VALUE FAULT
The parameter values found for the motor are outside the acceptable range within which the drive is able to work.

MOTOR ROTATES
The motor shaft is rotating. Make sure that the load is not able to make the motor shaft rotate while the AMA is being performed. Then start AMA all over.

ALARM 29
Heat Sink Temperature Too High (HEAT SINK OVER TEMP.):
The heatsink temperature became too high. For NEMA 1 drives, the limit is 90°C. For NEMA 12 drives, the limit is 80°C. The tolerance is ±5°C. The fault cannot be reset until the temperature of the heatsink has fallen below 60°C.

The fault could be due to the following:
- Ambient temperature too high
- Air obstructed
- Cooling fan(s) not operating
- Motor leads too long
- Too high a switching frequency

ALARM 30
Motor phase U missing (MISSING MOT.PHASE U):
Motor phase U, as indicated by the letters on the output terminal block is missing or has a high impedance.

Remove power to the drive and check motor phase U.

ALARM 31
Motor Phase V Missing (MISSING MOT.PHASE V):
Motor phase V, as indicated by the letters on the output terminal block is missing or has a high impedance.

Remove power to the drive and check motor phase V.

ALARM 32
Motor Phase W Missing (MISSING MOT.PHASE W):
Motor phase W, as indicated by the letters on the output terminal block is missing or has a high impedance.

Remove power to the drive and check motor phase W.

WARNING/ALARM 34
HPFB Communication Fault (HPFB COMM. FAULT)
The serial communication on the communication option card is not working.

WARNING 35
Out of Frequency Range (OUT FREQ RNG/ROT LIM):
This warning will occur if the output frequency has reached its *Output Frequency Low Limit*, parameter 201, or *Output Frequency High Limit,* parameter 202. If the drive is in *Closed Loop*, parameter 100, the warning will show in the display.

ALARM 37
Inverter fault (GATE DRIVE FAULT):
An output IGBT or the power card is defective. Contact the Danfoss Graham service department.

Auto Optimization Warnings 39 through 42
Automatic motor adaptation has stopped, because some parameters have probably been improperly set, or the motor used in too large or small for AMA to be carried out.

A choice must be made by pressing CHANGE DATA and choosing 'Continue' + OK or 'Stop' + OK.

If parameters need to be changed, select 'Stop', change the parameters and run AMA again.

WARNING 39
CHECK PAR. 104, 106
Parameters 104, *Motor Frequency*, or 106, *Rated Motor Speed*, have probably not been set correctly. Correct the setting and run AMA again.

WARNING 40
CHECK PAR. 103, 105
Parameter 103 *Motor Voltage,* or 105 *Motor Current,* has not been set correctly. Correct the setting and run AMA again.

WARNING 41
Motor Too Large (MOTOR TOO BIG)
The motor used is probably too large for AMA to be carried out. The setting in parameter 102 *Motor Power,* may not match the motor. Check the motor and select 'Continue' or [STOP].

WARNING 42
Motor Too Small (MOTOR TOO SMALL)
The motor used is probably too small for AMA to be carried out. The setting in parameter 102 *Motor Power,* may not match the motor. Check the motor and select 'Continue' or [STOP].

ALARM 60
Safety Stop (EXTERNAL FAULT)
Terminal 27, parameter 304, *Digital Inputs*, has been programmed for a *Safety Interlock* and is a logic '0'.

WARNING 61
Output Frequency Low (FOUT < FLOW)
The output frequency is lower than parameter 223, *Warning: Low Frequency.*

WARNING 62
Output Frequency High (FOUT > FHIGH)
The output frequency is higher than parameter 224, *Warning: High Frequency*.

WARNING/ALARM 63
Output Current Low (I MOTOR < I LOW)
The output current is lower than parameter 221, *Warning: Low Current.* Select the required function in parameter 409, *Function in Case of No Load.*

WARNING 64
Output Current High (I MOTOR > I HIGH)
The output current is higher than parameter 222, *Warning: High Current.*

WARNING 65
Feedback Low (FEEDBACK < FDB LOW)
The resulting feedback value is lower than parameter 227, *Warning: Low Feedback.*

WARNING 66
Feedback High (FEEDBACK > FDB HIGH)
The resulting feedback value is higher than parameter 228, *Warning: High Feedback.*

WARNING 67
Remote Reference Low (REF. < REF LOW)
The remote controlled reference is lower than parameter 225, *Warning: Low Reference.*

WARNING 68
Remote Reference High (REF. > REF HIGH)
The remote controlled reference is higher than parameter 226, *Warning: High Reference.*

WARNING 69
Temperature auto derate (TEMP.AUTO DERATE)
The heat sink temperature has exceeded the maximum value and the auto derating function in parameter 411 is active. *Warning: Temp.auto Derate.*

WARNING 99
Unknown Fault (UNKNOWN ALARM)
An unknown fault has occurred which the software is not able to handle. Contact Danfoss Graham service department.

Calculation of Resulting Reference

The calculation made below gives the resulting reference when parameter 210, *Reference Type,* is programmed for *Sum* and *Relative,* respectively. In *Open Loop,* parameters 418 and 419, *Setpoints 1* and *2,* should be set to 0. If they are not set to 0, parameter 417, *Feedback Function,* will affect the reference.

External reference is the sum of references from terminals 53, 54, 60 and serial communication. The sum of these can never exceed parameter 205, *Maximum Reference.*

External reference can be calculated as follows:

$$\text{Ext. ref.} = \frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Ana. signal } \textit{Term. 53} \text{ [V]}}{\text{Par. 310 } \textit{Term. 53 Max. scaling} - \text{Par. 309 } \textit{Term. 53 Min. scaling}} + \frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Ana. signal } \textit{Term. 54} \text{ [V]}}{\text{Par. 313 } \textit{Term. 54 Max. scaling} - \text{Par. 312 } \textit{Term. 54 Min. scaling}} +$$

$$\frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Par. 314 } \textit{Term. 60} \text{ [mA]}}{\text{Par. 316 } \textit{Term. 60 Max. scaling} - \text{Par. 315 } \textit{Term. 60 Min. scaling}} + \frac{\text{serial com. reference} \times (\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.})}{16384 \ (4000 \text{ Hex})}$$

Parameter 210, *Reference Type,* is programmed = *Sum*

$$\text{Res. ref.} = \frac{(\text{Par. 205 } \textit{Max. ref.} - \text{Par. 204 } \textit{Min. ref.}) \times \text{Par. 211-214 } \textit{Preset ref.}}{100} + \text{External ref.} + \text{Par. 204 } \textit{Min. ref.} + \text{Feedback setpoint}$$

Parameter 210, *Reference Type,* is programmed = *Relative*

$$\text{Res. ref.} = \frac{\text{External reference} \times \text{Par. 211-214 } \textit{Preset ref.}}{100} + \text{Par. 204 } \textit{Min. ref.} + \text{Feedback setpoint}$$

Factory Settings

Changes During Operation:

"Yes" means that the parameter can be changed while the drive is in operation. "No" means that the drive must be stopped before a change can be made.

4-Setup:

"Yes" means that the parameter can be programmed individually in each of the four setups. The same parameter can have four different data values. "No" means that the data value will be the same in all four setups.

Conversion Index:

This number refers to a conversion figure to be used when writing or reading to or from the drive by means of serial communication.

Since a parameter value can only be transferred as a whole number, a conversion factor must be used to transfer decimals.

Example:

Parameter 201: *Minimum Frequency*, conversion factor 0.1. If parameter 201 is to be set to 10 Hz, a value of 100 must be transferred, since a conversion factor of 0.1 means that the transferred value will be multiplied by 0.1. A value of 100 will therefore be understood as 10.0.

Data type:

Data type shows the type and length of the packet.

Conversion Index	Conversion Factor
74	3.6
2	100.0
1	10.0
0	1.0
-1	0.1
-2	0.01
-3	0.001
-4	0.0001

Conversion Index Factors

Data type	Description
3	Integer 16
4	Integer 32
5	Unsigned 8
6	Unsigned 16
7	Unsigned 32
9	Text string

Data Type Descriptions

0.. Operation and Display

#	Parameter Description	Factory Setting	Range	Changes During Operation	4-Setup	Conversion Index	Data Type
001	Language	ENGLISH		Yes	No	0	5
002	Active Setup	SETUP 1		Yes	No	0	5
003	Copying of Setups	NO COPY		No	No	0	5
004	LCP Copy	NO COPY		No	No	0	5
005	Max Value of User-defined Readout	100.000	0 - 999.999,999	Yes	Yes	-2	4
006	Unit for User-defined Readout	%		Yes	Yes	0	5
007	Big Display Readout	FREQUENCY, %		Yes	Yes	0	5
008	Small Display Readout 1.1	REFERENCE, %		Yes	Yes	0	5
009	Small Display Readout 1.2	MOTOR CURRENT, A		Yes	Yes	0	5
010	Small Display Readout 1.3	POWER, HP		Yes	Yes	0	5
011	Unit of Local Reference	% OF F MAX		Yes	Yes	0	5
012	Hand Start on LCP	ENABLE		Yes	Yes	0	5
013	OFF/STOP on LCP	ENABLE		Yes	Yes	0	5
014	Auto Start on LCP	ENABLE		Yes	Yes	0	5
015	Reset on LCP	ENABLE		Yes	Yes	0	5
016	Lock for Data Change	NOT LOCKED		Yes	Yes	0	5
017	Operating State at Power-up	AUTO RESTART		Yes	Yes	0	5

1.. Load and Motor

#	Parameter Description	Factory Setting	Range	Changes During Operation	4-Setup	Conversion Index	Data Type
100	Configuration	OPEN LOOP		No	Yes	0	5
101	Torque Characteristics	AEO FUNCTION		No	Yes	0	5
102	Motor Power	Depends on the unit	0.25 - 500 kW	No	Yes	1	6
103	Motor Voltage	Depends on the unit	200 - 575 V	No	Yes	0	6
104	Motor Frequency	60 Hz	24 - 1000 Hz	No	Yes	0	6
105	Motor Current	Depends on the unit	0.01 - I	No	Yes	-2	7
106	Rated Motor Speed	Depends on par. 102 Motor power	100-60000 rpm	No	Yes	0	6
107	Automatic Motor Adaptation, AMA	NO AMA		No	No	0	5
108	Start Voltage of Parallel Motors	Depends on par. 103	0.0 - par. 103	Yes	Yes	-1	6
109	Resonance Dampening	100%	0 - 500 %	Yes	Yes	0	6
110	High Breakaway Torque	OFF	0.0 - 0.5 sec.	Yes	Yes	-1	5
111	Start Delay	000.0 s	0.0 - 120.0 sec.	Yes	Yes	-1	6
112	Motor Preheater	DISABLE		Yes	Yes	0	5
113	Motor Preheater DC Current	50%	0 - 100 %	Yes	Yes	0	6
114	DC Braking Current	50%	0 - 100 %	Yes	Yes	0	6
115	DC Braking Time	10.0 s	0.0 - 60.0 sec.	Yes	Yes	-1	6
116	DC Brake Cut-in Frequency	OFF	0.0-par. 202	Yes	Yes	-1	6
117	Motor Thermal Protection	ETR TRIP 1		Yes	Yes	0	5

2.. References and Limits

#	Parameter Description	Factory Setting	Range	Changes during operation	4-Setup	Conversion Index	Data Type
200	Output Frequency Range	0 - 120 Hz	0 - 1000 Hz	No	Yes	0	5
201	Output Frequency Low Limit	Fans=6 Hz, Pumps=18 Hz	0.0 - par. 202	Yes	Yes	-1	6
202	Output Frequency High Limit	60 Hz	par. 201 - par. 200	Yes	Yes	-1	6
203	Reference Handling	LINKED TO HAND/AUTO		Yes	Yes	0	5
204	Minimum Reference	Fans=6 Hz, Pumps=18 Hz	0.000-Ref$_{MAX}$	Yes	Yes	-3	4
205	Maximum Reference	000060.000 Hz	Ref$_{MIN}$-999.999,999	Yes	Yes	-3	4
206	Ramp-up Time	Fans=60 sec., Pumps=10 sec.	1 - 3600 sec.	Yes	Yes	0	7
207	Ramp-down Time	Fans=60 sec., Pumps=10 sec.	1 - 3600 sec.	Yes	Yes	0	7
208	Automatic Ramp-up/down	ENABLE		Yes	Yes	0	5
209	Jog Frequency	10.0 Hz	par. 201 - par. 202	Yes	Yes	-1	6
210	Reference Type	EXTERNAL PRESET		Yes	Yes	0	5
211	Preset Reference 1	0.00%	-100.00 - 100.00 %	Yes	Yes	-2	3
212	Preset Reference 2	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
213	Preset Reference 3	0.00 %	-100.00 - 100.00 %	Yes	Yes	-2	3
214	Preset Reference 4	0.00 %	-100,00 - 100,00 %	Yes	Yes	-2	3
215	Current Limit	Depends on the unit	0 - I [A]	Yes	Yes	-1	6
216	Frequency Bypass Bandwidth	DISABLED	0 - 120 Hz	Yes	Yes	0	6
217	Frequency Bypass 1	120.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
218	Frequency Bypass 2	120.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
219	Frequency Bypass 3	120.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
220	Frequency Bypass 4	120.0 Hz	0.0 - par. 200	Yes	Yes	-1	6
221	Warning: Low Current	0.0 A	0.0 - par. 222	Yes	Yes	-1	6
222	Warning: High Current, I	I [A]	Par. 221 - I [A]	Yes	Yes	-1	6
223	Warning: Low Frequency	0.0 Hz	0.0 - par. 224	Yes	Yes	-1	6
224	Warning: High Frequency	120.0 Hz	Par. 223 - par. 200/202	Yes	Yes	-1	6
225	Warning: Low Reference	-999,999.999 Hz	-999,999.999 - par. 226	Yes	Yes	-3	4
226	Warning: High Reference	999,999.999 Hz	Par. 225 - 999,999.999	Yes	Yes	-3	4
227	Warning: Low Feedback	-999,999.999 Hz	-999,999.999 - par. 228	Yes	Yes	-3	4
228	Warning: High Feedback	999,999.999 Hz	Par. 227 - 999,999.999	Yes	Yes	-3	4

3.. Inputs and Outputs

#	Parameter Description	Factory Setting	Range	Changes During Operation	4-Setup	Conversion Index	Data Type
300	Terminal 16 Digital Input	RESET		Yes	Yes	0	5
301	Terminal 17 Digital Input	NO OPERATION		Yes	Yes	0	5
302	Terminal 18 Digital Input	START		Yes	Yes	0	5
303	Terminal 19 Digital Input	REVERSING		Yes	Yes	0	5
304	Terminal 27 Digital Input	SAFETY INTERLOCK		Yes	Yes	0	5
305	Terminal 29 Digital Input	JOG		Yes	Yes	0	5
306	Terminal 32 Digital Input	NO OPERATION		Yes	Yes	0	5
307	Terminal 33 Digital Input	NO OPERATION		Yes	Yes	0	5
308	Terminal 53, Analog Input Voltage	NO OPERATION		Yes	Yes	0	5
309	Terminal 53, Min. Scaling	0.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
310	Terminal 53, Max. Scaling	10.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
311	Terminal 54, Analog Input Voltage	NO OPERATION		Yes	Yes	0	5
312	Terminal 54, Min. Scaling	0.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
313	Terminal 54, Max. Scaling	10.0 V	0.0 - 10.0 V	Yes	Yes	-1	5
314	Terminal 60, Analog Input Current	REFERENCE		Yes	Yes	0	5
315	Terminal 60, Min. Scaling	4.0 mA	0.0 - 20.0 mA	Yes	Yes	-4	5
316	Terminal 60, Max. Scaling	20.0 mA	0.0 - 20.0 mA	Yes	Yes	-4	5
317	Live Zero Time	10 sec.	1 - 99 sec.	Yes	Yes	0	5
318	Function After Time Out	NO FUNCTION		Yes	Yes	0	5
319	Terminal 42, Output	MOTOR CURRENT	4 - 20 mA	Yes	Yes	0	5
320	Terminal 42, Output, Pulse Scaling	5000 Hz	1 - 32000 Hz	Yes	Yes	0	6
321	Terminal 45, Output	OUT. FREQ.	4 - 20 mA	Yes	Yes	0	5
322	Terminal 45, Output, Pulse Scaling	5000 Hz	1 - 32000 Hz	Yes	Yes	0	6
323	Relay 1, Output Function	NO ALARM		Yes	Yes	0	5
324	Relay 01, ON Delay	0 sec.	0 - 600 sec.	Yes	Yes	0	6
325	Relay 01, OFF Delay	2 sec.	0 - 600 sec.	Yes	Yes	0	6
326	Relay 2, Output Function	RUNNING		Yes	Yes	0	5
327	Pulse Reference, Max. Frequency	5000 Hz	Depends on input terminal	Yes	Yes	0	6
328	Pulse Feedback, Max. Freq.	25000 Hz	0 - 65000 Hz	Yes	Yes	0	6

4.. Application Functions

#	Parameter Description	Factory Setting	Range	Changes During Operation	4-Setup	Conversion Index	Data Type
400	Reset Function	INFINITE AUTOMATIC		Yes	Yes	0	5
401	Automatic Restart Time	10 sec.	0 - 600 sec.	Yes	Yes	0	6
402	Flying Start	Fans=ENABLE, Pumps=DISABLE		Yes	Yes	-1	5
403	Sleep Mode Timer	OFF	0 - 300 sec.	Yes	Yes	0	6
404	Sleep Frequency	0 Hz	Min freq - Par. 405	Yes	Yes	-1	6
405	Wake up Frequency	60 Hz	Par. 404 - max freq	Yes	Yes	-1	6
406	Boost Setpoint	100%	0 - 200 %	Yes	Yes	0	6
407	Switching Frequency	Depends on the unit	3.0 - 14.0 kHz	Yes	Yes	2	5
408	Interference Reduction Method	ASFM		Yes	Yes	0	5
409	Function in Case of No Load	WARNING		Yes	Yes	0	5
410	Function at Phase Loss	TRIP		Yes	Yes	0	5
411	Function at Over Temp	TRIP		Yes	Yes	0	5
412	Trip Delay Overcurrent	60 sec.	0 - 60 sec.	Yes	Yes	0	5
413	Minimum Feedback	0.000	-999,999.999 - FB_{MIN}	Yes	Yes	-3	4
414	Maximum Feedback	100.000	FB_{MIN} - 999,999.999	Yes	Yes	-3	4
415	Units Relating to Closed Loop	%		Yes	Yes	-1	5
416	Feedback Conversion	LINEAR		Yes	Yes	0	5
417	Feedback Calculation	MAXIMUM		Yes	Yes	0	5
418	Setpoint 1	0.000	Min to max fdbk.	Yes	Yes	-3	4
419	Setpoint 2	0.000	Min to max fdbk.	Yes	Yes	-3	4
420	PID Normal/Inverse Control	NORMAL		Yes	Yes	0	5
421	PID Anti Windup	ENABLE		Yes	Yes	0	5
422	PID Start-up Frequency	0 Hz	Min. to max. freq.			-1	6
423	PID Proportional Gain	0.30	0.00 - 10.00	Yes	Yes	-2	6
424	PID Integral Time	OFF	0.01 - 9999.00 s. (Off)	Yes	Yes	-2	7
425	PID Differentiation Time	OFF	0.0 (Off) - 10.00 sec.	Yes	Yes	-2	6
426	PID Differentiation Gain Limit	5.0	5.0 - 50.0	Yes	Yes	-1	6
427	PID Lowpass Filter Time	0.01	0.01 - 10.00	Yes	Yes	-2	6

#	Parameter Description	Factory Setting	Range	Changes during operation	4-Setup	Conversion Index	Data Type
500	Protocol	FC		Yes	Yes	0	5
501	Address	001	Depends on par.500	Yes	No	0	5
502	Baudrate	9600 BAUD		Yes	No	0	5
503	Coasting	LOGIC OR		Yes	Yes	0	5
504	DC-brake	LOGIC OR		Yes	Yes	0	5
505	Start	LOGIC OR		Yes	Yes	0	5
506	Reversing	DIGITAL INPUT		Yes	Yes	0	5
507	Selection of Setup	LOGIC OR		Yes	Yes	0	5
508	Selection of Preset Reference	LOGIC OR		Yes	Yes	0	5
509	Data Read-out: Reference %			No	No	-1	3
510	Data Read-out: Reference Unit			No	No	-3	4
511	Data Read-out: Feedback			No	No	-3	4
512	Data Read-out: Frequency			No	No	-1	6
513	User defined read-out			No	No	-2	7
514	Data Read-out: Current			No	No	-2	7
515	Data Read-out: Power, kW			No	No	1	7
516	Data Read-out: Power, HP			No	No	-2	7
517	Data Read-out: Motor Voltage			No	No	-1	6
518	Data Read-out: DC Link Voltage			No	No	0	6
519	Data Read-out: Motor temp.			No	No	0	5
520	Data Read-out: VLT Temp.			No	No	0	5
521	Data Read-out: Digital Input			No	No	0	5
522	Data Read-out: Terminal 53, Analog Input			No	No	-1	3
523	Data Read-out: Terminal 54, Analog Input			No	No	-1	3
524	Data Read-out: Terminal 60, Analog Input			No	No	4	3
525	Data Read-out: Pulse Reference			No	No	-1	7
526	Data Read-out: External Reference %			No	No	-1	3
527	Data Read-out: Status Word, Hex			No	No	0	6
528	Data Read-out: Heat Sink Temperature			No	No	0	5
529	Data Read-out: Alarm Word, Hex			No	No	0	7
530	Data Read-out: Control Word, Hex		No	No	0	6	
531	Data Read-out: Warning Word 1, Hex			No	No	0	7
532	Data Read-out: Warning Word 2, hex			No	No	0	7
533	Display Text 1			No	No	0	9
534	Display Text 2			No	No	0	9
535	Busfeedback 1	00000		No	No	0	3
536	Busfeedback 2	00000		No	No	0	3
555	Bus Time Interval	60 sec.	1 to 99 sec.	Yes	Yes	0	5
556	Bus Time Interval Function	NO FUNCTION		Yes	Yes	0	5
560	N2 Overide Release Time	OFF	1 to 65534 sec.	Yes	Yes	0	5
565	FLN Bus Time Interval	60 sec.	1 to 65534 sec.	Yes	Yes	0	5
566	FLN Bus Time Interval Function	OFF		Yes	Yes	0	5

6.. Service Functions

#	Parameter Description	Factory Setting	Range	Changes During Operation	4-Setup	Conversion Index	Data Type
600	Operating Data: Operating Hours			No	No	74	7
601	Operating Data: Hours Run			No	No	74	7
602	Operating Data: kWh Counter			No	No	2	7
603	Operating Data: No. of Power Ups			No	No	0	6
604	Operating Data: No. of Overtemps		No	No	0	6	
605	Operating Data: No. of Overvoltages		No	No	0	6	
606	Data Log: Digital Input			No	No	0	5
607	Data Log: Bus Command			No	No	0	6
608	Data Log: Bus Status Word			No	No	0	6
609	Data Log: Reference			No	No	-1	3
610	Data Log: Feedback			No	No	-3	4
611	Data Log: Output Frequency			No	No	-1	-3
612	Data Log: Output Voltage			No	No	-1	6
613	Data Log: Output Current			No	No	-2	3
614	Data Log: DC link Voltage			No	No	0	6
615	Fault Log: Error Code			No	No	0	5
616	Fault Log: Time			No	No	0	7
617	Fault Log: Value			No	No	0	3
618	Reset of kWh Counter	DO NOT RESET		Yes	No	0	5
619	Reset of Hours Run Counter	DO NOT RESET		Yes	No	0	5
620	Operating Mode	NORMAL OPERATION		Yes	No	0	5
621	Nameplate: Unit Type			No	No	0	9
622	Nameplate: Power Component			No	No	0	9
623	Nameplate: VLT Ordering No.			No	No	0	9
624	Nameplate: Software Version No.			No	No	0	9
625	Nameplate: LCP Identification No.		No	No	0	9	
626	Nameplate: Database Identification No.			No	No	-2	9
627	Nameplate: Power Component Identification No.			No	No	0	9
628	Nameplate: Application Option Type		No	No	0	9	
629	Nameplate: Application Option Ordering No.			No	No	0	9
630	Nameplate: Communication Option Type			No	No	0	9
631	Nameplate: Communication Option Ordering No.			No	No	0	9

7.. Option Card (for the four relay option card)

#	Parameter Description	Factory Setting	Range	Changes During Operation	4-Setup	Conversion Index	Data Type
700	Relay 6, Output Function	Running		Yes	Yes	0	5
701	Relay 6, On Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
702	Relay 6, Off Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
703	Relay 7, Output Function	NO FUNCTION		Yes	Yes	0	5
704	Relay 7, On Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
705	Relay 7, Off delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
706	Relay 8, Output Functions	NO FUNCTION		Yes	Yes	0	5
707	Relay 8, On Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
708	Relay 8, Off Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
709	Relay 9, Output Funcation	NO FUNCTION		Yes	Yes	0	5
710	Relay 9, On Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6
711	Relay 9, Off Delay	000 sec.	0 to 600 sec.	Yes	Yes	0	6

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