

VLT[®] Series 3000 Instruction Manual

175R5162 - Document Version 5.00

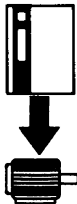
This manual applies to all VLT[®] Series 3002-3250 Adjustable Frequency Drives with software version 3.02 and 3.12 or newer. To determine software version refer to Parameter 603, Name Plate.



WARNING:

Touching the electrical parts, even when the AC line has been disconnected, can cause serious injury or death. Before touching any electrical components wait at least:

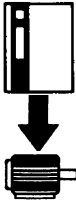
4 minutes for VLT 3002-3032, 230V; 3002-3052, 460V,
14 minutes for VLT types 3032-3052, 230V,
14 minutes for VLT types 3060-3250, all voltages.

VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052	
	Constant load (CT): Nominal [HP]	1	2	3	5	7.5	10	15	20	30	40	50	
	Output current continuous Amps	5.4	7.8	10.6	19.0	25.0	32.0	46.0	61.0	80.0	104.0	130.0	
	intermittent Amps (60 s)	6.7	12.5	17.0	30.0	40.0	51.2	73.6	97.6	120.0	156.0	195.0	
	Output continuous [kVA]	2.1	3.1	4.2	7.6	10.0	12.7	18.3	24.3	32.0	41.0	52.0	
	intermittent [kVA] (60 s)	2.7	4.9	6.7	12.0	15.9	20.4	29.3	38.9	48.0	62.0	78.0	
	Max. motor size [HP]	1.5	3	5	7.5	10	15	20	30	40	50	60	
	Quadratic load (VT) Nominal [HP]	1	2	3	7.5	10	15	20	30	40	50	60	
	Output current continuous Amps	5.4	7.8	10.6	25.0	32.0	46.0	61.0	88.0	104.0	130.0	154.0	
	Output continuous [kVA]	1.9	2.9	4.0	10.0	12.7	18.3	24.3	35.1	41.0	52.0	58.0	
	Max. motor size [HP]	1.5	3	5	10	15	20	25	30	40	50	60	
	Max. wire size [AWG]	12	12	12	6	6	6	4	4	2/0	2/0	2/0	
	Max. motor cable length	1000 feet, unshielded*											
	Output voltage [%]	0-100, of AC line voltage											
	Output frequency [Hz]	0-120 or 0-500; programmable											
	Rated motor voltage [V]	200 / 220 / 230											
Rated motor frequency [Hz]	50 / 60 / 87 / 100												
Thermal protection	Built-in thermal motor protection (electronic); and thermistor acc. to DIN44081												
Switching on the output	Unlimited (frequent switching may cause cut-out)												
Ramp times [s]	0.1 to 3600												
VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052	
Max. input constant load [A]		6.8	9.1	13.3	17.5	22.2	26.4	41.7	52.2	78.0	102.0	128.0	
Current quadratic load [A]		6.8	9.1	13.3	23.1	29.6	42.0	56.8	72.3	102.0	128.0	152.0	
Max. wire size [AWG]		12	12	12	6	6	6	4	4	2/0	2/0	2/0	
Max. pre-fuses [A]		20	25	25	40	50	60	80	125	150	150	150	
AC line voltage [V]		3Ø 200 / 220 / 230 ± 10%											
AC line frequency [Hz]		50 / 60											
Power factor / cos φ		0.9 / 1.0											
Efficiency		0.96, at 100% load											
Switching on the input		5 times per minute											
Radio interference, conducted EMI (with shielded motor cables):		VLT type 3002-04: EN 55011, class A, gr. 1, with option class B, gr. 1											
		VLT type 3006-22 with option: EN 55011, class A, gr. 1											
		VLT type 3032-52 with option: EN 55011, class A, gr. 1											
VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052	
Enclosure type and Unit weight [lb]:	Open chassis (IP00) Chassis (IP20) NEMA 1 (IP21) NEMA 12 (IP54)	16 - 16 24	16 - 16 24	16 - 16 24	- 55 - 75	- 57 - 82	- 68 - 106	- 108 - 139	- 119 - 152	- 325 - 325	- 325 - 325	- 325 - 325	- 325 - 325
Power loss at max. load	CT [W] VT [W]	60 60	105 105	130 130	270 425	425 580	399 651	615 929	935 1350	760 950	910 1110	1110 1290	
Vibration test	[g]	0.7											
Relative humidity	[%]	Max. 95 DIN 40040 cl. E.											
Ambient temperature (acc. VDE 0160):	[°C] [°C]	-10 → +40, at full load operation -25 → +65, storage/transport											
VLT protection		Ground and short circuit proof											
EMC applied standards:	Emmision Immunity	EN 50081 - 1, VDE 0875, VDE 0871; EN 50081 - 2, VDE 0875, VDE 0871 IEC 801 - 2, IEC 801 - 4, IEC 801 - 5, VDE 0160, SEN 361503											

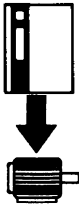
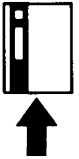

* If shielded cable is to be used, consult Danfoss for max. cable length.

Specification Chart

AC Line: 3 Phase, 380/400/415V

VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052
	Constant load (CT): Nominal [HP]	1	2	3	5	7.5	10	15	20	30	40	50
	Output current continuous Amps	2.8	4.1	5.6	10.0	13.0	16.0	24.0	32.0	44.0	61.0	73.0
	intermittent Amps (60 s)	3.5	6.5	9.0	16.0	20.8	25.6	38.4	51.2	70.4	97.6	117.0
	Output continuous [kVA]	2.0	2.9	4.0	7.2	9.3	11.5	17.3	23.0	31.6	43.8	52.3
	intermittent [kVA] (60 s)	2.5	4.6	6.4	11.5	15.0	18.4	27.6	36.8	50.6	75.1	84.1
	Max. motor size [HP]	1.5	3	5	7.5	10	15	20	30	40	50	60
	Quadratic load (VT) Nominal [HP]	1	2	3	7.5	10	15	20	30	40	50	60
	Output current continuous Amps	2.8	4.1	5.6	13.0	16.0	24.0	32.0	44.0	61.0	73.0	88.0
	Output continuous [kVA]	2.0	2.9	4.0	9.3	11.5	17.3	23.0	31.6	43.8	52.3	63.3
	Max. motor size [HP]	1.5	3	5	7.5	15	20	25	40	50	60	75
	Max. wire size [AWG]	12	12	12	12	12	6	6	6	4	4	4
	Max. motor cable length	1000 feet, unshielded*										
	Output voltage [%]	0-100, of AC line voltage										
	Output frequency [Hz]	0-120 or 0-500; programmable										
	Rated motor voltage [V]	380 / 400 / 415										
Rated motor frequency [Hz]	50 / 60 / 87 / 100											
Thermal protection	Built-in thermal motor protection (electronic); and thermistor acc. to DIN44081											
Switching on the output	Unlimited (frequent switching may cause cut-out)											
Ramp times [s]	0.1 to 3600											
VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052
Max. input constant load [A]		2.8	4.8	7.0	10.0	13.0	13.8	21.8	30.7	41.9	55.6	66.5
Current quadratic load [A]		2.8	4.8	7.0	13.0	17.0	22.0	31.0	41.5	57.5	66.5	80.0
Max. wire size [AWG]		12	12	12	12	12	6	6	6	4	4	4
Max. pre-fuses [A]		16	16	16	25	25	50	63	63	80	100	125
AC line voltage [V]		3Ø 380 / 400 / 415 ± 10% (VDE 0160)										
AC line frequency [Hz]		50 / 60										
Power factor / cos φ		0.9 / 1.0										
Efficiency		0.96, at 100% load										
Switching on the input		5 times per minute										
Radio interference, conducted EMI (with shielded motor cables):		VLT type 3002-08: EN 55011, class A, gr. 1, with option class B, gr. 1 VLT type 3011-52 with option: EN 55011, class A, gr. 1										
VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052
Enclosure type and Unit weight [lb]:	Open chassis (IP00)	16	16	16	26	31	-	-	-	-	-	-
	Chassis (IP20)	-	-	-	-	-	55	57	68	108	119	119
	NEMA 1 (IP21)	18	18	18	29	33	-	-	-	-	-	-
	NEMA 12 (IP54)	24	24	24	31	33	75	82	106	139	152	152
Power loss at max. load	CT [W]	60	100	130	195	200	270	425	580	880	1390	1875
	VT [W]	60	100	130	280	300	425	580	880	1390	1875	2155
Vibration test [g]		0.7										
Relative humidity [%]		Max. 95 DIN 40040 cl. E.										
Ambient temperature (acc. VDE 0160):	[°C]	-10 → +40, at full load operation					-10 → +40/45, ct/vt at full load operation					
	[°C]	-25 → +65, storage/transport					-25 → +65, storage/transport					
VLT protection		Ground and short circuit proof										
EMC applied standards:	Emmision	EN 50081 - 1, VDE 0875, VDE 0871; EN 50081 - 2, VDE 0875, VDE 0871										
	Immunity	IEC 801 - 2, IEC 801 - 4, IEC 801 - 5, VDE 0160, SEN 361503										

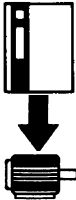


* If shielded cable is to be used, consult Danfoss for max. cable length.

VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052
	Constant load (CT): Nominal [HP]	1	2	3	5	7.5	10	15	20	30	40	50
	Output current continuous Amps	2.6	3.4	4.8	8.2	11.0	14.5	21.7	27.9	41.6	54.0	65.0
	intermittent Amps (60 s)	3.4	5.5	7.7	13.1	17.6	23.2	34.7	44.6	66.2	86.4	104.0
	Output continuous [kVA]	2.3	2.9	4.1	7.1	9.5	12.6	18.8	24.1	36.0	46.8	56.3
	intermittent [kVA] (60 s)	2.9	4.7	6.7	11.3	15.2	20.1	30.1	38.6	57.3	74.8	90.1
	Max. motor size [HP]	1.5	3	5	7.5	10	15	20	30	40	50	60
	Quadratic load (VT) Nominal [HP]	1	2	3	5	7.5	15	22	30	40	50	60
	Output current continuous Amps	2.6	3.4	4.8	8.2	12.6	21.7	27.9	41.6	54.0	65.0	78.0
	Output continuous [kVA]	1.6	2.9	4.1	7.1	9.5	18.8	24.2	35.9	46.8	56.3	67.5
	Max. motor size [HP]	1.5	3	5	7.5	15	20	25	40	50	60	75
	Max. wire size [AWG]	12	12	12	12	12	6	6	6	4	4	4
	Max. motor cable length	1000 feet, unshielded*										
	Output voltage [%]	0-100, of AC line voltage										
	Output frequency [Hz]	0-120 or 0-500; programmable										
	Rated motor voltage [V]	440 / 460 / 500										
Rated motor frequency [Hz]	50 / 60 / 87 / 100											
Thermal protection	Built-in thermal motor protection (electronic); and thermistor acc. to DIN44081											
Switching on the output	Unlimited (frequent switching may cause cut-out)											
Ramp times [s]	0.1 to 3600											
VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052
	Max. input constant load [A]	2.6	3.4	4.8	8.2	11.0	15.6	23.4	30.0	44.6	58.2	70.0
	Current quadratic load [A]	2.6	3.4	4.8	8.2	12.6	23.4	30.0	44.6	58.2	70.0	84.0
	Max. wire size [AWG]	12	12	12	12	12	6	6	6	4	4	4
	Max. pre-fuses [A]	10	15	20	25	25	30	40	50	60	100	125
	AC line voltage [V]	3Ø 440 / 460 / 500 ± 10% (VDE 0160)										
	AC line frequency [Hz]	50 / 60										
	Power factor / cos φ	0.9 / 1.0										
	Efficiency	0.96, at 100% load										
	Switching on the input	2 times per minute										
	Radio interference, conducted EMI (with shielded motor cables):	VLT type 3002-08: EN 55011, class A, gr. 1, with option class B, gr.1 VLT type 3011-52 with option: EN 55011, class A, gr. 1										
VLT TYPE		3002	3003	3004	3006	3008	3011	3016	3022	3032	3042	3052
	Enclosure type and Unit weight [lb]:	16	16	16	26	31	-	-	-	-	-	-
	Open chassis (IP00)	-	-	-	-	-	55	57	68	108	125	125
	Chassis (IP20)	18	18	18	29	33	-	-	-	-	-	-
	NEMA 1 (IP21)	24	24	24	31	33	75	82	106	139	152	152
	NEMA 12 (IP54)	60	100	130	160	200	174	287	580	958	1125	1467
	Power loss at max. load CT [W]	60	100	130	160	300	281	369	880	1133	1440	1888
	VT [W]	60	100	130	160	300	281	369	880	1133	1440	1888
	Vibration test [g]	0.7										
	Relative humidity [%]	Max. 95 DIN 40040 cl. E.										
	Ambient temperature (acc. VDE 0160):	-10 → +40, at full load operation						-10 → +40/45, ct/vt at full load operation				
	-25 → +65, storage/transport						-25 → +65, storage/transport					
VLT protection	Ground and short circuit proof											
EMC applied standards:	Emmision	EN 50081 - 1, VDE 0875, VDE 0871; EN 50081 - 2, VDE 0875, VDE 0871										
	Immunity	IEC 801 - 2, IEC 801 - 4, IEC 801 - 5, VDE 0160, SEN 361503										

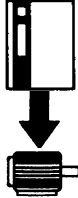


* If shielded cable is to be used, consult Danfoss for max. cable length.

Specification Chart

AC Line: 3 Phase, 380/400/415V

VLT TYPE		3060	3075	3100	3125	3150	3200	3250	
	Constant load (CT): Nominal [HP]	60	75	100	125	150	200	250	
	Output current continuous Amps	86	105	139	168	205	243	302	
	intermittent Amps (60 s)	129	158	209	252	308	365	453	
	Output continuous [kVA]	60	73	96	116	142	168	209	
	intermittent [kVA] (60 s)	89	109	144	175	213	253	314	
	Quadratic load (VT) Nominal [HP]	75	100	125	150	200	250	300	
	Output current continuous Amps	105	139	168	205	243	302	368	
	intermittent Amps (60 s)	116	153	189	226	267	332	405	
	Output [kVA]	73	96	116	142	168	209	255	
	Max. cable size [AWG]	2/0	2/0	500mcm	500mcm	500mcm	2x250mcm	2x250mcm	
	Max. motor cable length	1000 feet, unshielded*							
	Switching on the output	Unlimited (frequent switching may cause cut-out)							
	Output voltage [%]	0-100, of AC line voltage							
	Output frequency [Hz]	0-120 or 0-500; programmable							
	Rated motor voltage [V]	380 / 400 / 415							
Rated motor frequency [Hz]	50 / 60 / 87 / 100								
Thermal protection	Built-in thermal motor protection (electronic); and thermistor acc. to DIN44081								
VLT TYPE		3060	3075	3100	3125	3150	3200	3250	
	Input current continuous Amps	85	103	138	167	202	242	308	
	intermittent Amps	127	155	208	251	303	363	461	
	Quadratic load continuous Amps	103	138	167	202	242	308	366	
	intermittent Amps	114	152	184	222	266	338	403	
	Max. cable size [AWG]	250mcm	250mcm	2x250mcm	2x250mcm	2x250mcm	2x250mcm	2x250mcm	
	Radio interference, conducted EMI	With option: EN 55011, class A, gr.1							
	Pre-fuses [A]	150	150	250	250	300	450	500	
	AC line voltage [V]	3Ø 380 / 400 / 415 ± 10%							
	AC line frequency [Hz]	50 / 60							
	Power factor / cos φ	0.9 / 1.0							
	Efficiency	0.96, at 100% load							
	Switching on the input	1 time per minute							
	VLT TYPE		3060	3075	3100	3125	3150	3200	3250
		Enclosure type NEMA 1 (IP21)	323	323	464	464	484	673	673
		and NEMA 12 (IP54)	323	323	464	464	484	673	673
Unit weight [lb]:									
Power loss at CT [W]		1282	1603	2160	2757	3307	4554	5491	
max. load: VT [W]		1603	2160	2757	3307	4554	5491	6694	
Vibration test [g]		0.7							
Relative humidity [%]		Max. 95 DIN 40040 cl. E.							
Ambient temperature [°C]		At full load operation -10 → +45; CT mode, -10 → +40; VT mode							
(acc. VDE 0160): [°C]		-30 → +70, storage/transport							
VLT protection		Ground and short circuit proof							
EMC applied standards:		Emmission	EN 50081 - 1, VDE 0875, VDE 0871; EN 50081 - 2, VDE 0875, VDE 0871						
Immunity		IEC 801 - 2, IEC 801 - 4, IEC 801 - 5, VDE 0160, SEN 361503							

*If shielded cable is to be used consult Danfoss for max. cable length.

VLT TYPE		3060	3075	3100	3125	3150	3200	3250
	Constant load (CT): Nominal [HP]	60	75	100	125	150	200	250
	Output current continuous Amps	77	96	124	156	180	240	302
	intermittent Amps (60 s)	116	144	186	234	270	360	453
	Output continuous [kVA]	67	83	107	135	156	208	262
	intermittent [kVA] (60 s)	100	125	161	203	234	312	392
	Quadratic load (VT) Nominal [HP]	75	100	125	150	200	250	300
	Output current continuous Amps	96	124	156	180	240	302	361
	intermittent Amps (60 s)	106	136	172	198	264	332	397
	Output [kVA]	83	107	135	156	208	262	313
	Max. cable size [AWG]	2/0	2/0	500mcm	500mcm	500mcm	2x250mcm	2x250mcm
	Max. motor cable length	1000 feet, unshielded*						
	Switching on the output	Unlimited (frequent switching may cause cut-out)						
	Output voltage [%]	0-100, of AC line voltage						
	Output frequency [Hz]	0-120 or 0-500; programmable						
	Rated motor voltage [V]	380 / 400 / 415 / 440 / 460 / 500						
Rated motor frequency [Hz]	50 / 60 / 87 / 100							
Thermal protection	Built-in thermal motor protection (electronic); and thermistor acc. to DIN44081							
VLT TYPE		3060	3075	3100	3125	3150	3200	3250
	Input current continuous Amps	76	94	123	155	177	239	308
	intermittent Amps	114	142	185	233	266	358	461
	Quadratic load continuous Amps	94	123	155	177	239	308	359
	intermittent Amps	104	136	171	195	263	338	395
	Max. cable size [AWG]	250mcm	250mcm	2x250mcm	2x250mcm	2x250mcm	2x250mcm	2x250mcm
	Radio interference, conducted EMI	With option: EN 55011, class A, gr. 1						
	Pre-fuses [A]	150	150	250	250	300	450	500
	AC line voltage [V]	3Ø 380 / 400 / 415 / 440 / 460 / 500 ± 10%						
	AC line frequency [Hz]	50 / 60						
	Power factor / cos φ	0.9 / 1.0						
	Efficiency	0.96, at 100% load						
	Switching on the input	1 time per minute						
VLT TYPE		3060	3075	3100	3125	3150	3200	3250
	Enclosure type NEMA 1 (IP21)	323	323	464	464	484	673	673
	and NEMA 12 (IP54)	323	323	464	464	484	673	673
	Unit weight [lb]:							
	Power loss at CT [W]	1282	1603	2160	2757	3307	4554	5491
	max. load: VT [W]	1603	2160	2757	3307	4557	5491	6694
	Vibration test [g]	0.7						
	Relative humidity [%]	Max. 95 DIN 40040 cl. E.						
	Ambient temperature [°C]	At full load operation -10 → +45; CT mode, -10 → +40; VT mode						
	(acc. VDE 0160): [°C]	-30 → +65, storage/transport						
	VLT protection	Ground and short circuit proof						
	EMC applied standards:	Emmision Immunity	EN 50081 - 1, VDE 0875, VDE 0871; EN 50081 - 2, VDE 0875, VDE 0871 IEC 801 - 2, IEC 801 - 4, IEC 801 - 5, VDE 0160, SEN 361503					

*If shielded cable is to be used consult Danfoss for max. cable length.

WARNING:



The VLT® Series 3000 Adjustable Frequency Drive (AFD) contains dangerous voltages when connected to line voltage. Only a competent electrician should carry out the electrical installation.

Improper installation of the motor or the AFD may cause equipment failure, serious injury or death. Follow this manual and local and national safety codes.

It is possible for the VLT to start upon application of AC power. **DO NOT** attempt any maintenance on the VLT, motor or system machinery without verifying that the AC power has been disconnected.

DO NOT touch any electrical parts after the AC line has been disconnected for at least 14 minutes. This allows for capacitor discharge.

NOTE: The STOP key on the VLT keypad DOES NOT disconnect the AC line.

CAUTION:

The motor may start without warning during operation and programming of the parameters. Activate the STOP key on the VLT keypad when changing data.

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

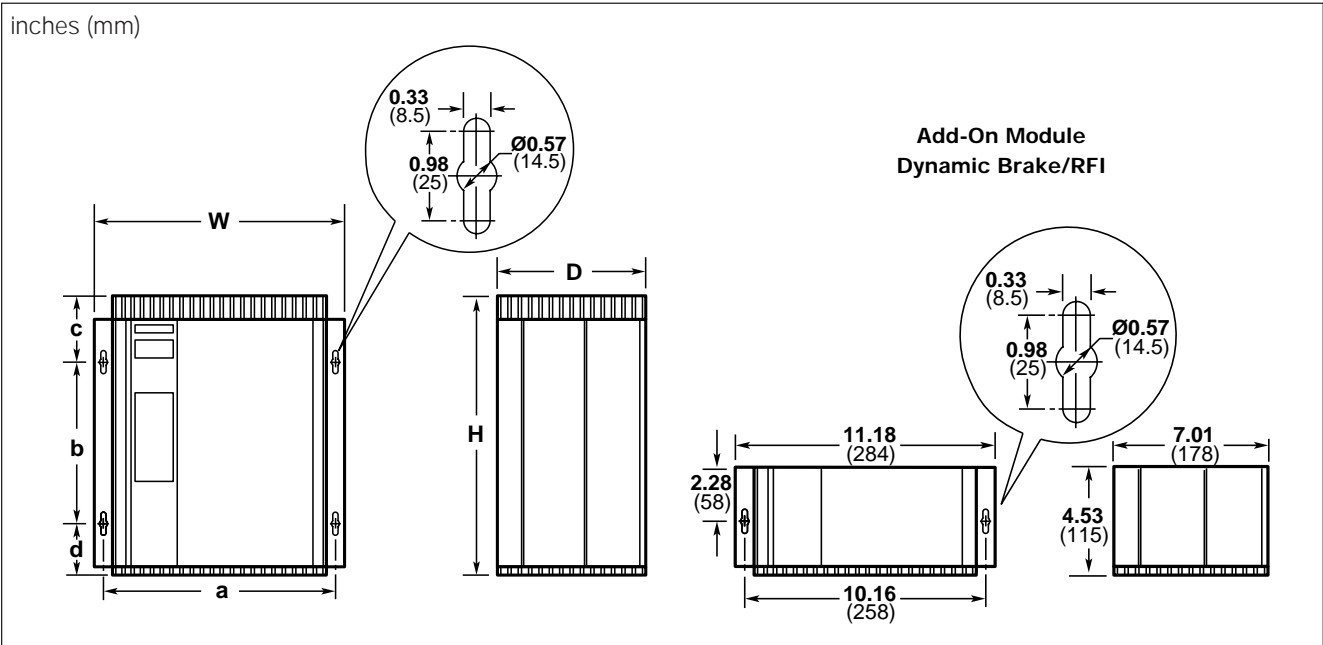
The Electronic Thermal Relay (ETR) in UL/cUL listed VLT's provides class 20 motor overload protection in accordance with the NEC in single motor applications, when parameter 315 is set for "TRIP" and parameter 107 is set for nominal motor rated (nameplate) current.

Danfoss VLT® and CE Marking

Danfoss CE marks our VLT® Adjustable Frequency Drives (AFD) according to the ElectroMagnetic Compatibility (EMC) Directive 89/336/EEC and Low-Voltage Directive 73/23/EEC.

When the installation specification is followed and shielded motor cables are used per instruction manuals provided with the drive, we guarantee the AFD complies with the EMC Directive 89/336/EEC. Please consult the RFI Filter Product Manual and EMC Installation Guidelines (175R5187).

Upon request we will issue a declaration of conformity to the EMC and low-voltage directives. A manufacturer's declaration for the Machinery Directive 89/392/EEC is also available.

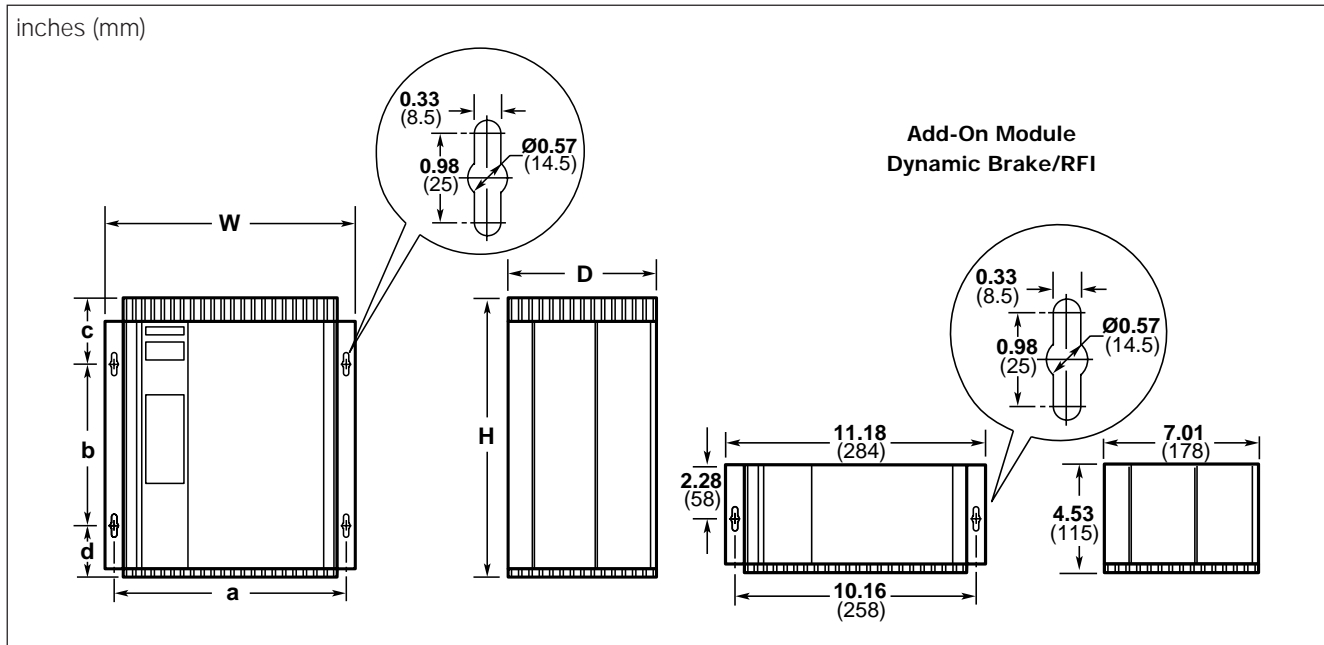


Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis*	230							
Chassis*	380	11.81 (300)	11.18 (284)	7.01 (178)	10.16 (258)	7.48 (190)	2.17 (55)	2.17 (55)
Chassis*	460							
NEMA 1*	230							
NEMA 1*	380	14.17 (360)	11.18 (284)	7.01 (178)	10.16 (258)	7.48 (190)	3.35 (85)	3.35 (85)
NEMA 1*	460							
NEMA 12	230							
NEMA 12	380	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)
NEMA 12	460							

VLT 3002 with Integral Dynamic Brake and/or RFI Options

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	All Voltages	17.32 (440)					2.17 (55)	2.17 (55)
NEMA 1		19.69 (500)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	3.35 (85)	3.35 (85)
NEMA 12		20.87 (530)						3.35 (85)

* Additional dimensions for Fan Option:
 Chassis (all voltages) 2.36 (60) to H; 2.36 (60) to c
 NEMA 1 (all voltages) 1.18 (30) to H; 1.18 (30) to c

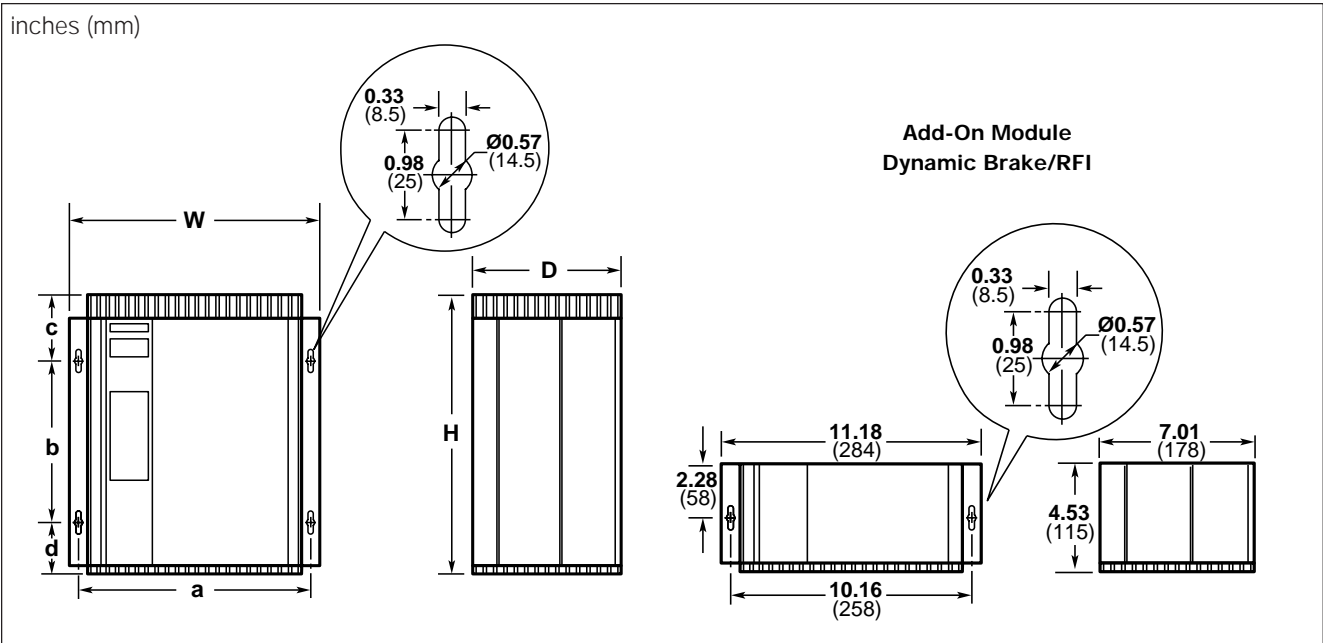


Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis*	230							
Chassis*	380	11.81 (300)	11.18 (284)	7.01 (178)	10.16 (258)	7.48 (190)	2.17 (55)	2.17 (55)
Chassis*	460							
NEMA 1*	230							
NEMA 1*	380	14.17 (360)	11.18 (284)	7.01 (178)	10.16 (258)	7.48 (190)	3.35 (85)	3.35 (85)
NEMA 1*	460							
NEMA 12	230							
NEMA 12	380	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)
NEMA 12	460							

VLT 3003 with Integral Dynamic Brake and/or RFI Options

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	All Voltages	17.32 (440)					2.17 (55)	2.17 (55)
NEMA 1		19.69 (500)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	3.35 (85)	3.35 (85)
NEMA 12		20.87 (530)						3.35 (85)

* Additional dimensions for Fan Option:
 Chassis (all voltages) 2.36 (60) to H; 2.36 (60) to c
 NEMA 1 (all voltages) 1.18 (30) to H; 1.18 (30) to c

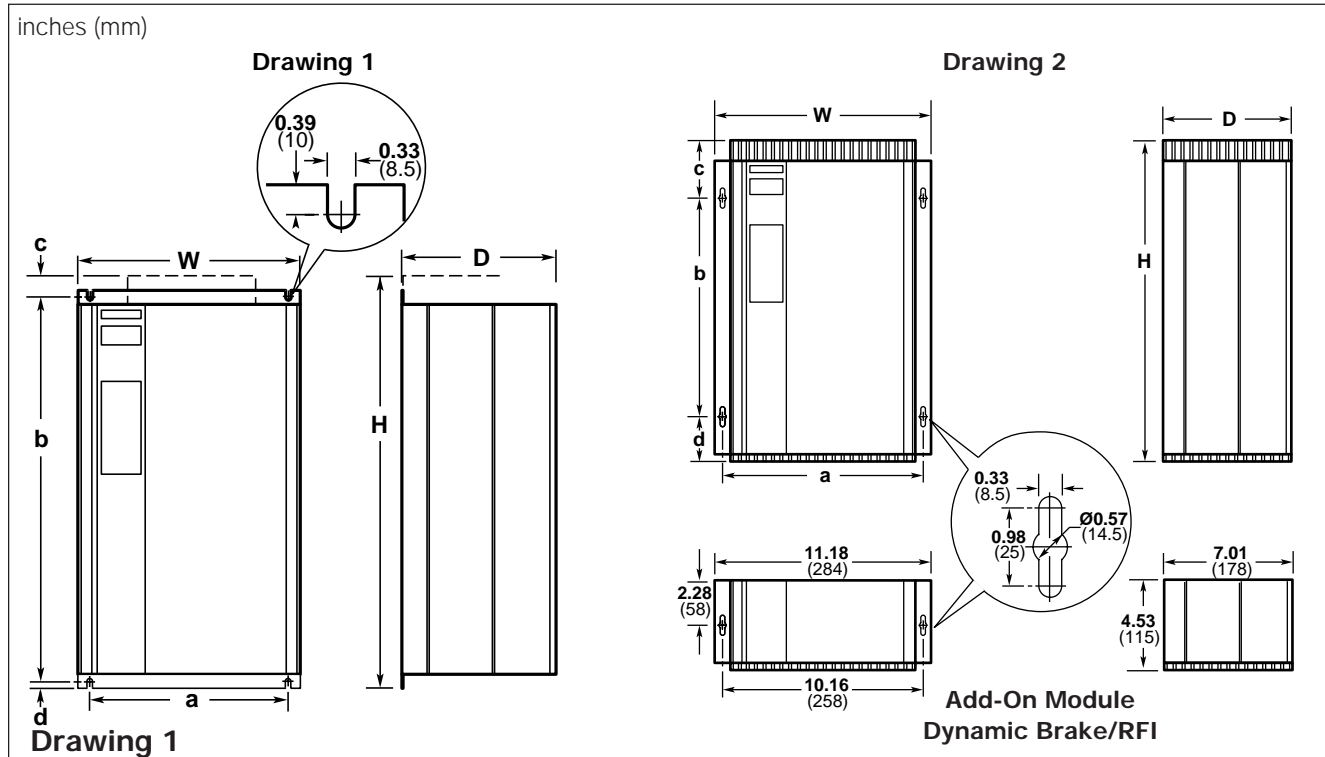


Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis*	230							
Chassis*	380	11.81 (300)	11.18 (284)	7.01 (178)	10.16 (258)	7.48 (190)	2.17 (55)	2.17 (55)
Chassis*	460							
NEMA 1	230	15.35 (390)					4.53 (115)	
NEMA 1*	380	14.17 (360)	11.18 (284)	7.01 (178)	10.16 (258)	7.48 (190)	3.35 (85)	3.35 (85)
NEMA 1*	460	14.17 (360)					3.35 (85)	
NEMA 12	230							
NEMA 12	380	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)
NEMA 12	460							

VLT 3004 with Integral Dynamic Brake and/or RFI Options

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	All	17.32 (440)					2.17 (55)	2.17 (55)
NEMA 1	230	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)
NEMA 1	380/460	19.69 (500)					3.35 (85)	3.35 (85)
NEMA 12	All	20.87 (530)					4.53 (115)	3.35 (85)

* Additional dimensions for Fan Option:
 Chassis (all voltages) 2.36 (60) to H; 2.36 (60) to c
 NEMA 1 (380/460 VAC only) 1.18 (30) to H; 1.18 (30) to c



Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	230	25.98 (660)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	0.39 (10)	0.39 (10)
NEMA 1	230	26.77 (680)					1.18 (30)	

Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis*	380	17.32 (440)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	2.17 (55)	2.17 (55)
Chassis*	460							
NEMA 1*	380	19.69 (500)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	3.35 (85)	3.35 (85)
NEMA 1*	460							
NEMA 12	230	31.89 (810)	13.78 (350)	11.02 (280)	12.83 (326)	22.05 (560)	7.09 (180)	2.76 (70)
NEMA 12	380	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)
NEMA 12	460	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)

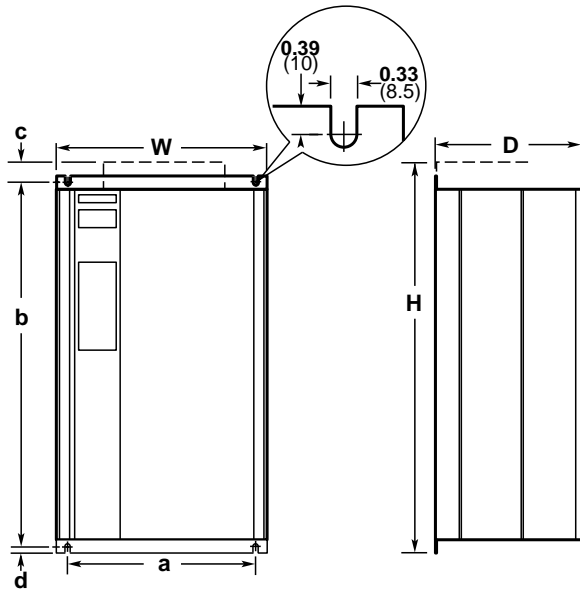
VLT 3006 with Integral Dynamic Brake and/or RFI Options

Type	Input VAC**	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis		21.65 (550)					2.17 (55)	2.17 (55)
NEMA 1	380/460	24.02 (610)	11.18 (284)	7.01 (178)	10.16 (258)	17.32 (440)	3.35 (85)	3.35 (85)
NEMA 12		25.20 (640)					4.53 (115)	3.35 (85)

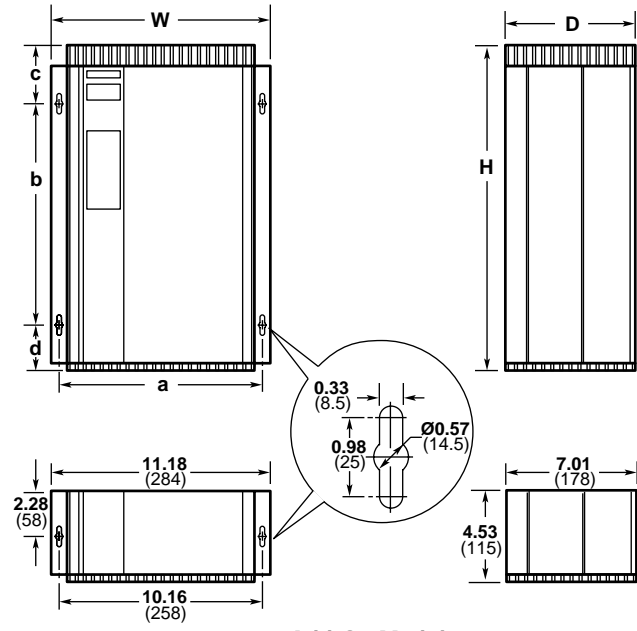
* Additional dimensions for Fan Option: Chassis (380/460 VAC only) 2.36 (60) to H; 2.36 (60) to c;
 NEMA 1 (380/460 VAC only) 1.18 (30) to H; 1.18 (30) to c.
 ** 230 VAC dimensions do not change with options.

inches (mm)

Drawing 1



Drawing 2



Add-On Module
Dynamic Brake/RFI

Drawing 1

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis NEMA 1	230	25.98 (660) 26.77 (680)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	0.39 (10) 1.18 (30)	0.39 (10)

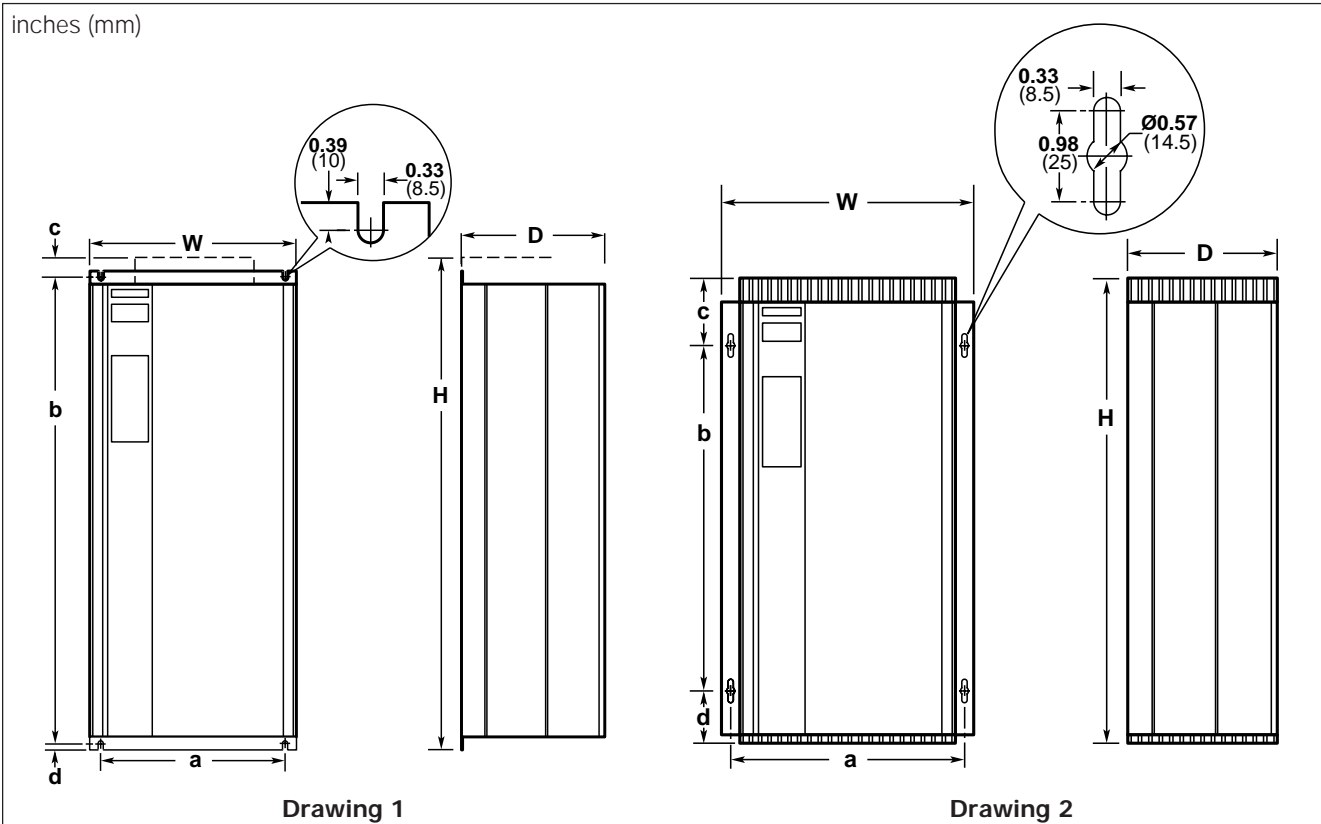
Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis Chassis	380 460	19.69 (500)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	2.17 (55)
NEMA 1 NEMA 1	380 460	20.87 (530)	11.18 (284)	7.01 (178)	10.16 (258)	12.99 (330)	4.53 (115)	3.35 (85)
NEMA 12 NEMA 12 NEMA 12	230 380 460	31.89 (810) 20.87 (530) 20.87 (530)	13.78 (350) 11.18 (284) 11.18 (284)	11.02 (280) 7.01 (178) 7.01 (178)	12.83 (326) 10.16 (258) 10.16 (258)	22.05 (560) 12.99 (330) 12.99 (330)	7.09 (180) 4.53 (115) 4.53 (115)	2.76 (70) 3.35 (85) 3.35 (85)

VLT 3008 with Integral Dynamic Brake and/or RFI Options

Type	Input VAC*	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis NEMA 1 NEMA 12	380/460	24.02 (610) 25.20 (640) 25.20 (640)	11.18 (284)	7.01 (178)	10.16 (258)	17.32 (440)	4.53 (115)	2.17 (55) 3.35 (85) 3.35 (85)

* 230 VAC dimensions do not change with options.



Drawing 1

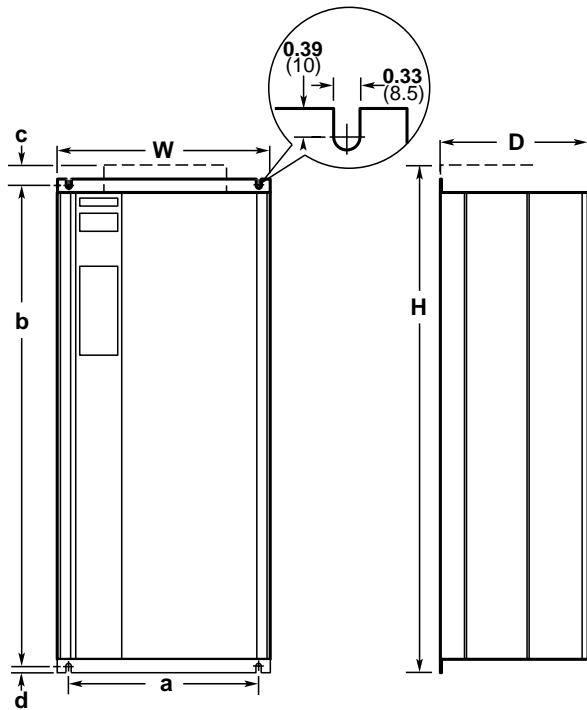
Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	230	30.71 (780)						
Chassis	380	25.98 (660)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	0.39 (10)	0.39 (10)
Chassis	460	25.98 (660)				25.20 (640)		
NEMA 1	230	31.50 (800)						
NEMA 1	380	26.77 (680)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	1.18 (30)	0.39 (10)
NEMA 1	460	26.77 (680)				25.20 (640)		

Drawing 2

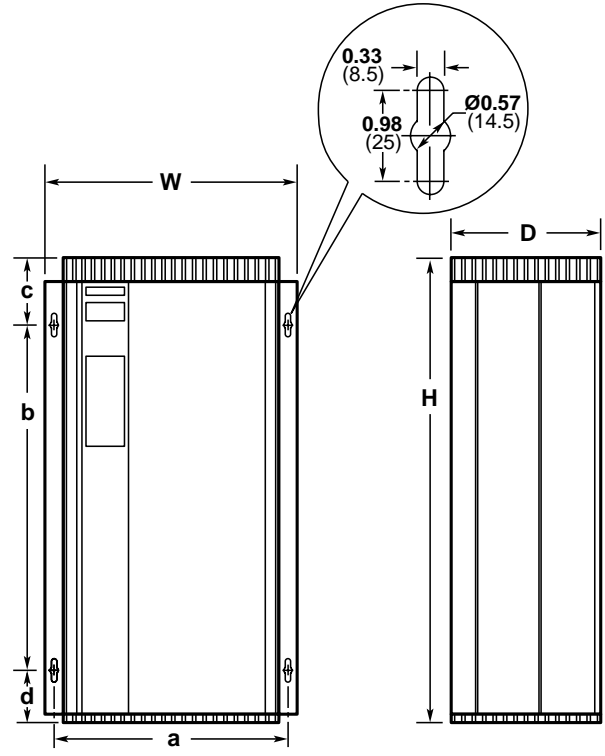
Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
NEMA 12	230							
NEMA 12	380	31.89 (810)	13.78 (350)	11.02 (280)	12.83 (326)	22.05 (560)	7.09 (180)	2.76 (70)
NEMA 12	460							

Note: Dynamic Brake/RFI can be built in.

inches (mm)



Drawing 1



Drawing 2

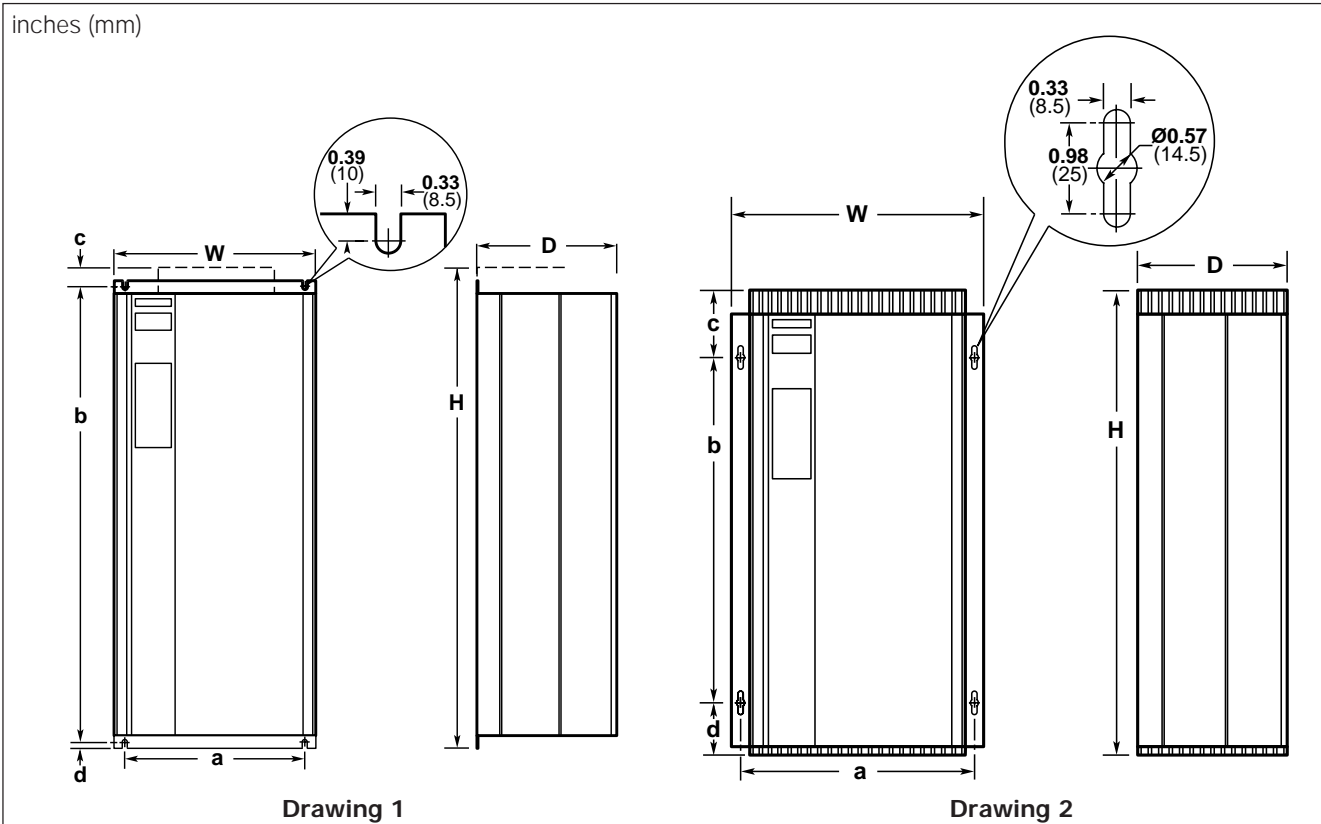
Drawing 1

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	230	37.40 (950)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)		
Chassis	380	25.98 (660)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	0.39 (10)	0.39 (10)
Chassis	460	25.98 (660)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)		
NEMA 1	230	38.39 (975)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	1.38 (35)	
NEMA 1	380	26.77 (680)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	1.18 (30)	0.39 (10)
NEMA 1	460	26.77 (680)	9.53 (242)	10.24 (260)	7.87 (200)	25.20 (640)	1.18 (30)	

Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
NEMA 12	230	37.01 (940)	15.67 (398)		14.72 (374)	27.17 (690)		
NEMA 12	380	31.89 (810)	13.78 (350)	11.02 (280)	12.83 (326)	22.05 (560)	7.09 (180)	2.76 (70)
NEMA 12	460	31.89 (810)	13.78 (350)		12.83 (326)	22.05 (560)		

Note: Dynamic Brake/RFI can be built in.



Drawing 1

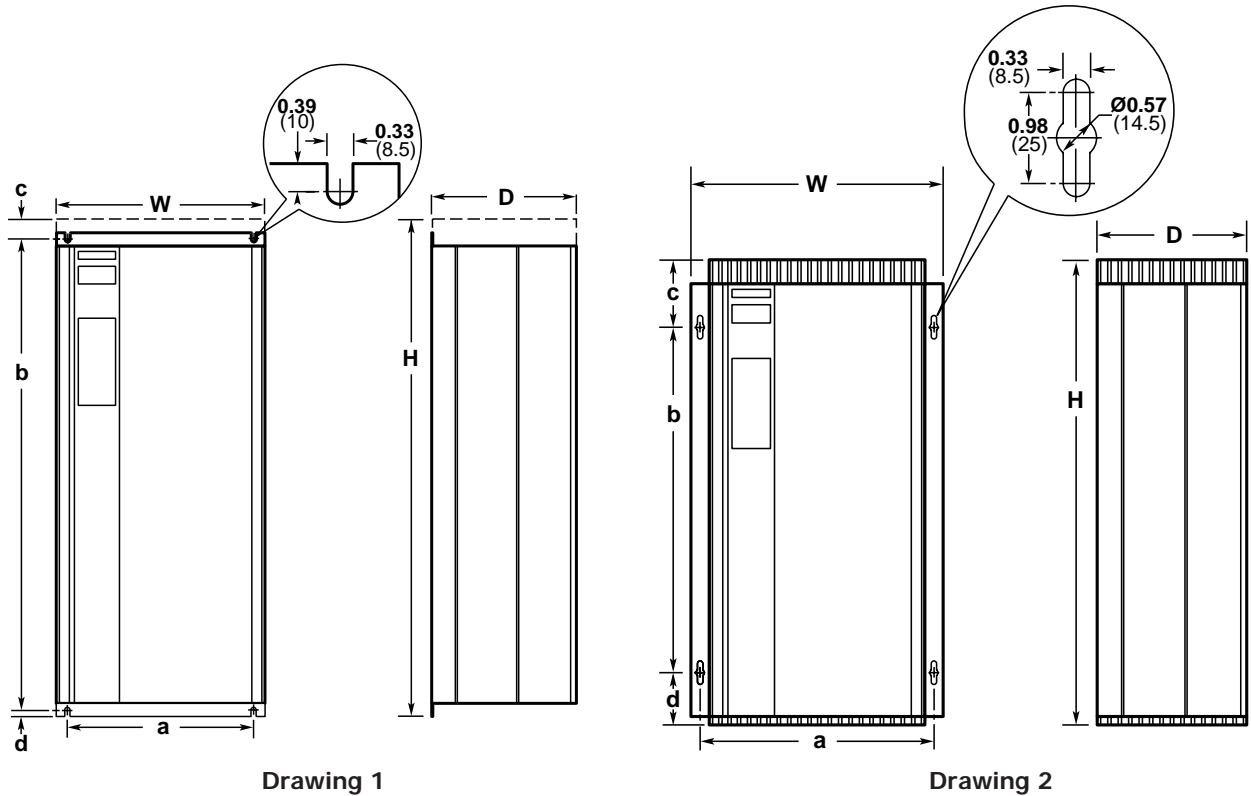
Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	230	37.40 (950)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)		
Chassis	380	30.71 (780)	9.53 (242)	10.24 (260)	7.87 (200)	29.92 (760)	0.39 (10)	0.39 (10)
Chassis	460	30.71 (780)	9.53 (242)	10.24 (260)	7.87 (200)	29.92 (760)		
NEMA 1	230	38.89 (975)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	1.38 (35)	
NEMA 1	380	31.50 (800)	9.53 (242)	10.24 (260)	7.87 (200)	29.92 (760)	1.18 (30)	0.39 (10)
NEMA 1	460	31.50 (800)	9.53 (242)	10.24 (260)	7.87 (200)	29.92 (760)	1.18 (30)	

Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
NEMA 12	230	37.01 (940)	15.67 (398)		14.72 (374)	27.17 (690)		
NEMA 12	380	31.89 (810)	13.78 (350)	11.02 (280)	12.83 (326)	22.05 (560)	7.09 (180)	2.76 (70)
NEMA 12	460	31.89 (810)	13.78 (350)		12.83 (326)	22.05 (560)		

Note: Dynamic Brake/RFI can be built in.

inches (mm)



Drawing 1

Drawing 2

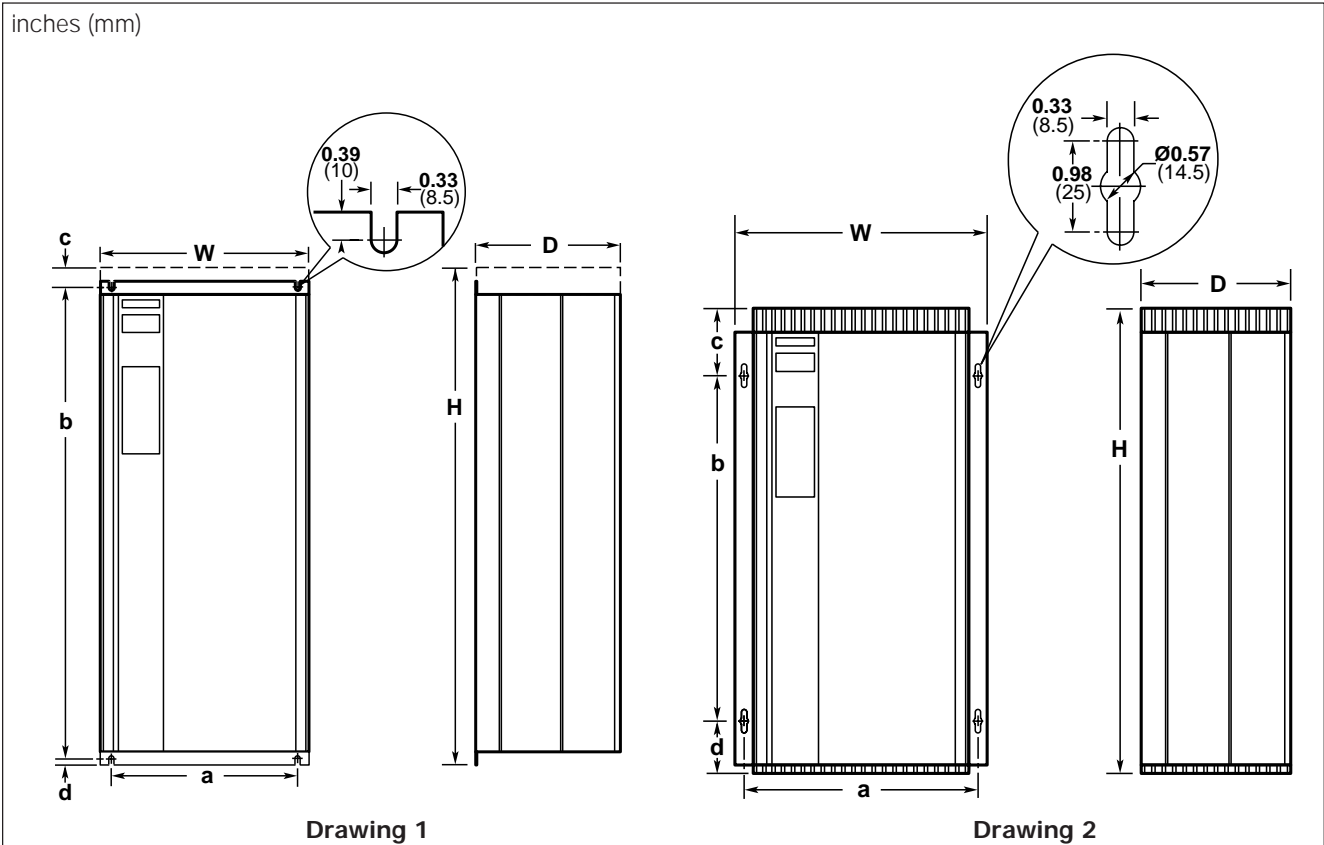
Drawing 1

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	380	37.40 (950)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	0.39 (10)	0.39 (10)
Chassis	460							
NEMA 1	230	Refer to page 2 - 13						
NEMA 1	380	38.39 (975)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	1.38 (35)	0.39 (10)
NEMA 1	460							

Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
NEMA 12	230	Refer to page 2 - 13						
NEMA 12	380	37.01 (940)	15.67 (398)	11.02 (280)	14.72 (374)	27.17 (690)	7.09 (180)	2.76 (70)
NEMA 12	460							

Note: Dynamic Brake/RFI can be built in.



Drawing 1

Drawing 2

Drawing 1

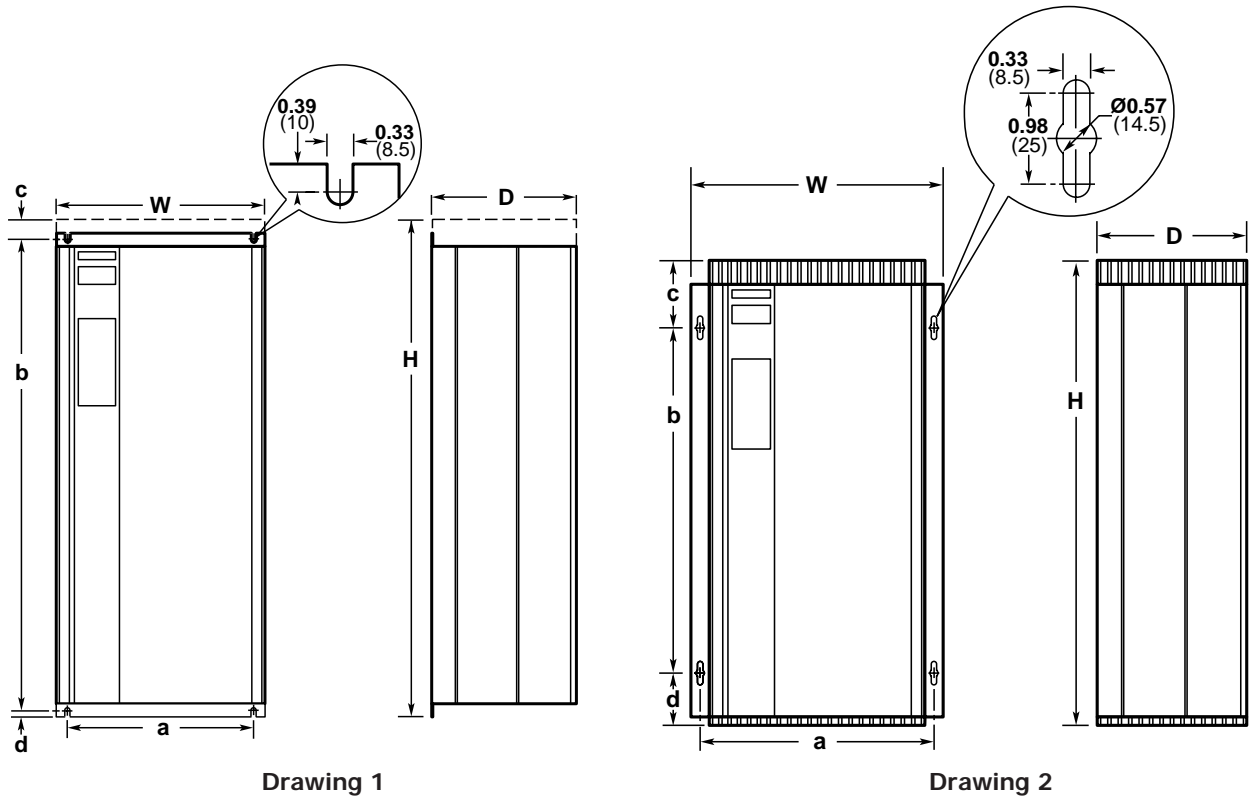
Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	380	37.40 (950)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	0.39 (10)	0.39 (10)
Chassis	460							
NEMA 1	230	Refer to page 2 - 14						
NEMA 1	380	38.39 (975)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	1.38 (35)	0.39 (10)
NEMA 1	460							

Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
NEMA 12	230	Refer to page 2 - 14						
NEMA 12	380	37.01 (940)	15.67 (398)	11.02 (280)	14.72 (374)	27.17 (690)	7.09 (180)	2.76 (70)
NEMA 12	460							

Note: Dynamic Brake/RFI can be built in.

inches (mm)



Drawing 1

Drawing 2

Drawing 1

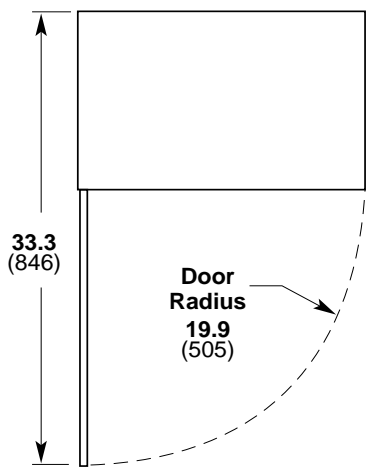
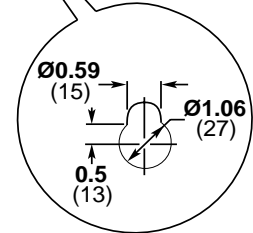
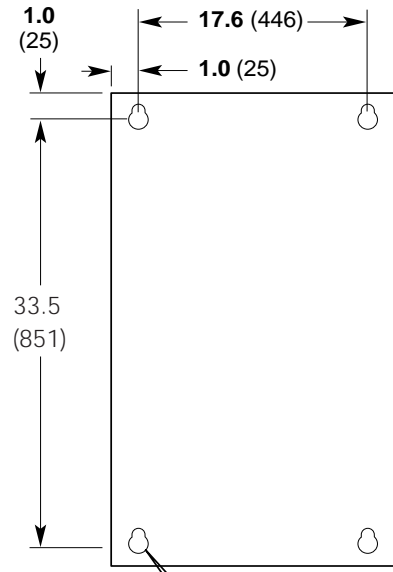
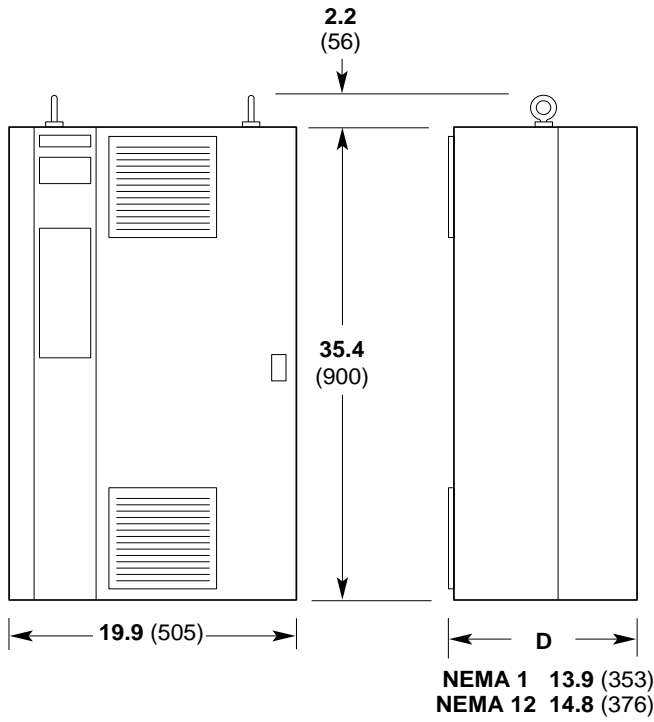
Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
Chassis	380	37.40 (950)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	0.39 (10)	0.39 (10)
Chassis	460							
NEMA 1	230	Refer to page 2 - 15						
NEMA 1	380	38.39 (975)	12.09 (307)	11.65 (296)	10.63 (270)	36.61 (930)	1.38 (35)	0.39 (10)
NEMA 1	460							

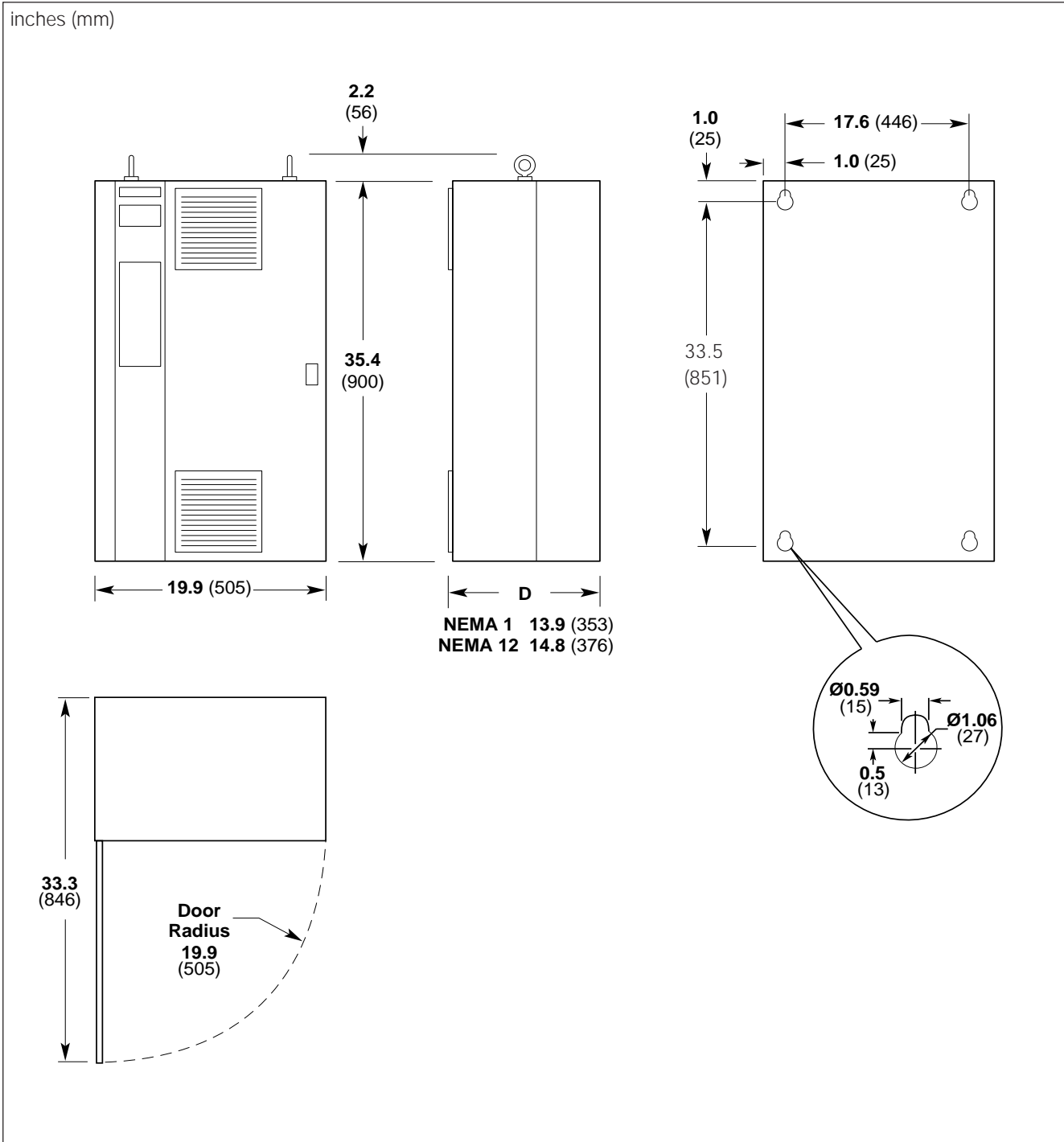
Drawing 2

Type	Input VAC	Overall Dimensions			Mounting Dimensions			
		H	W	D	a	b	c	d
NEMA 12	230	Refer to page 2 - 15						
NEMA 12	380	37.01 (940)	15.67 (398)	11.02 (280)	14.72 (374)	27.17 (690)	7.09 (180)	2.76 (70)
NEMA 12	460							

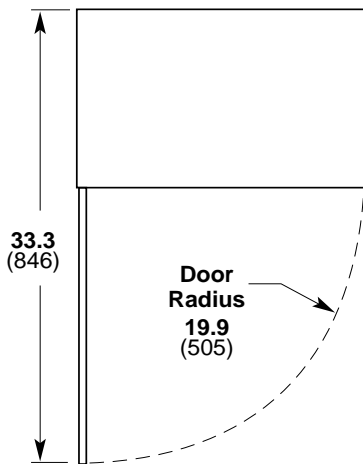
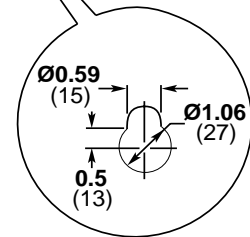
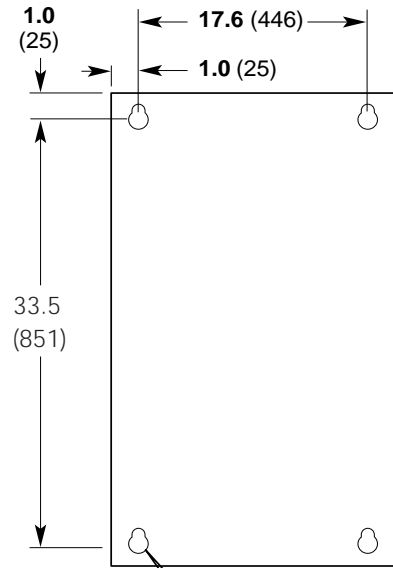
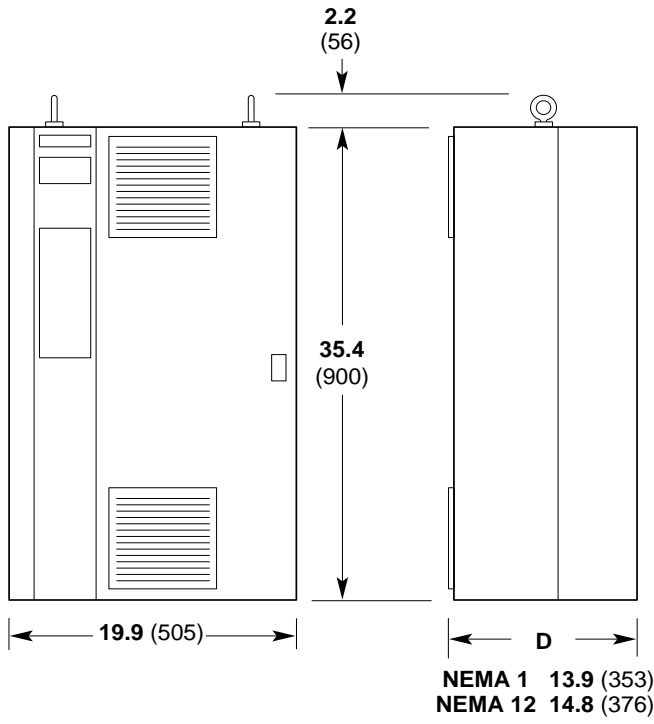
Note: Dynamic Brake/RFI can be built in.

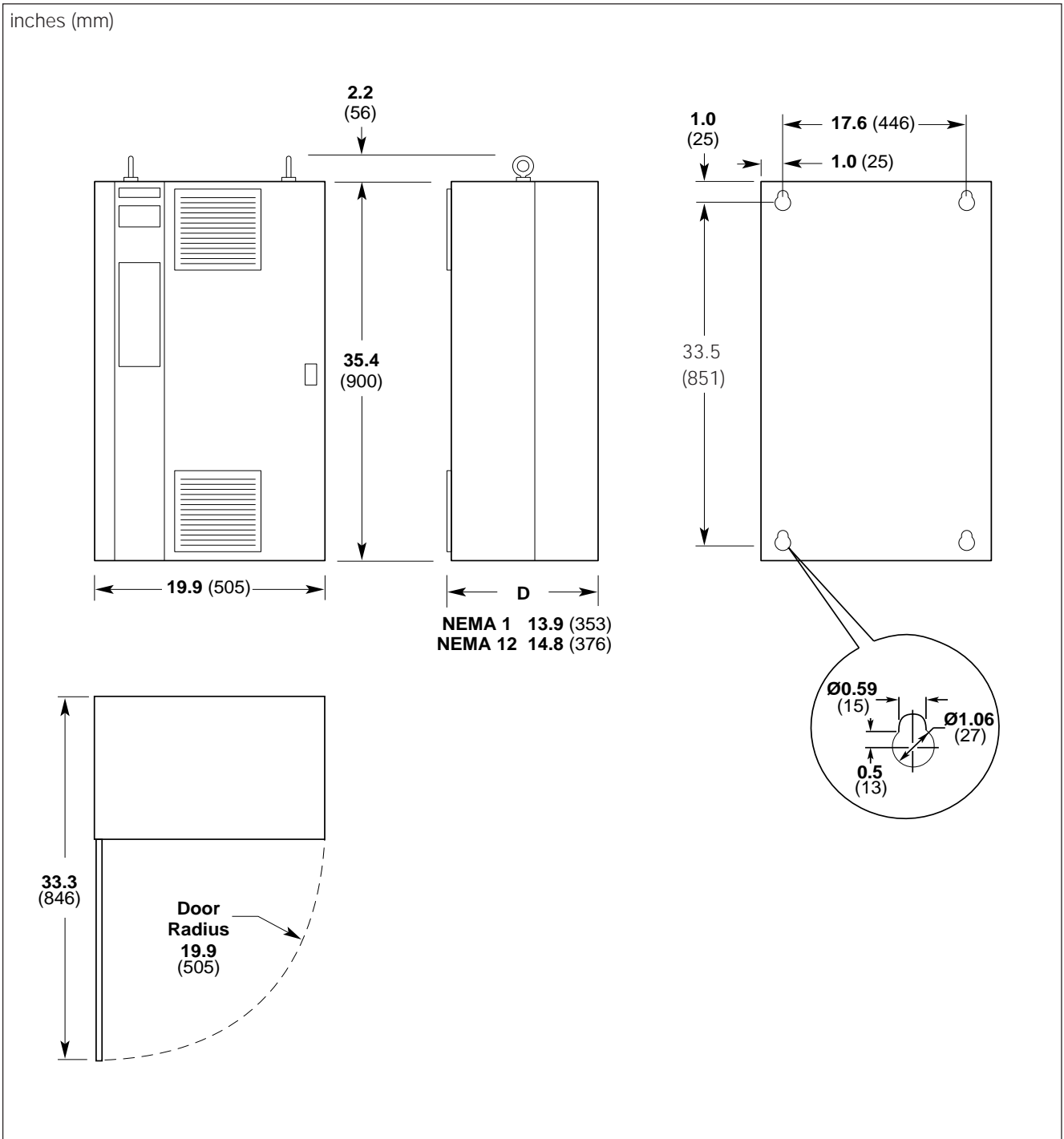
inches (mm)



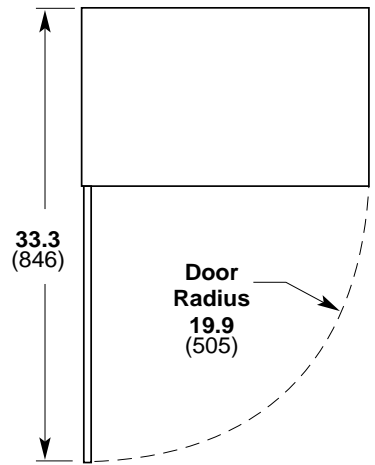
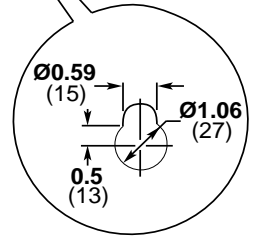
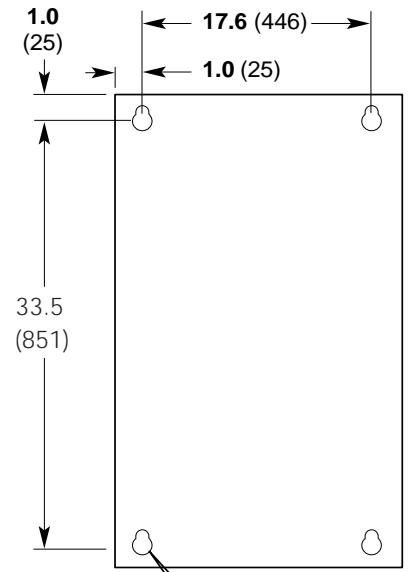
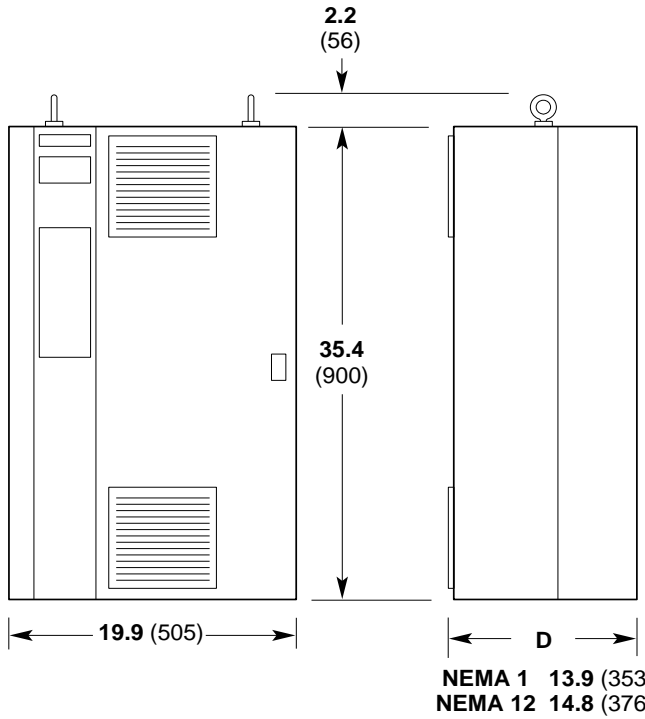


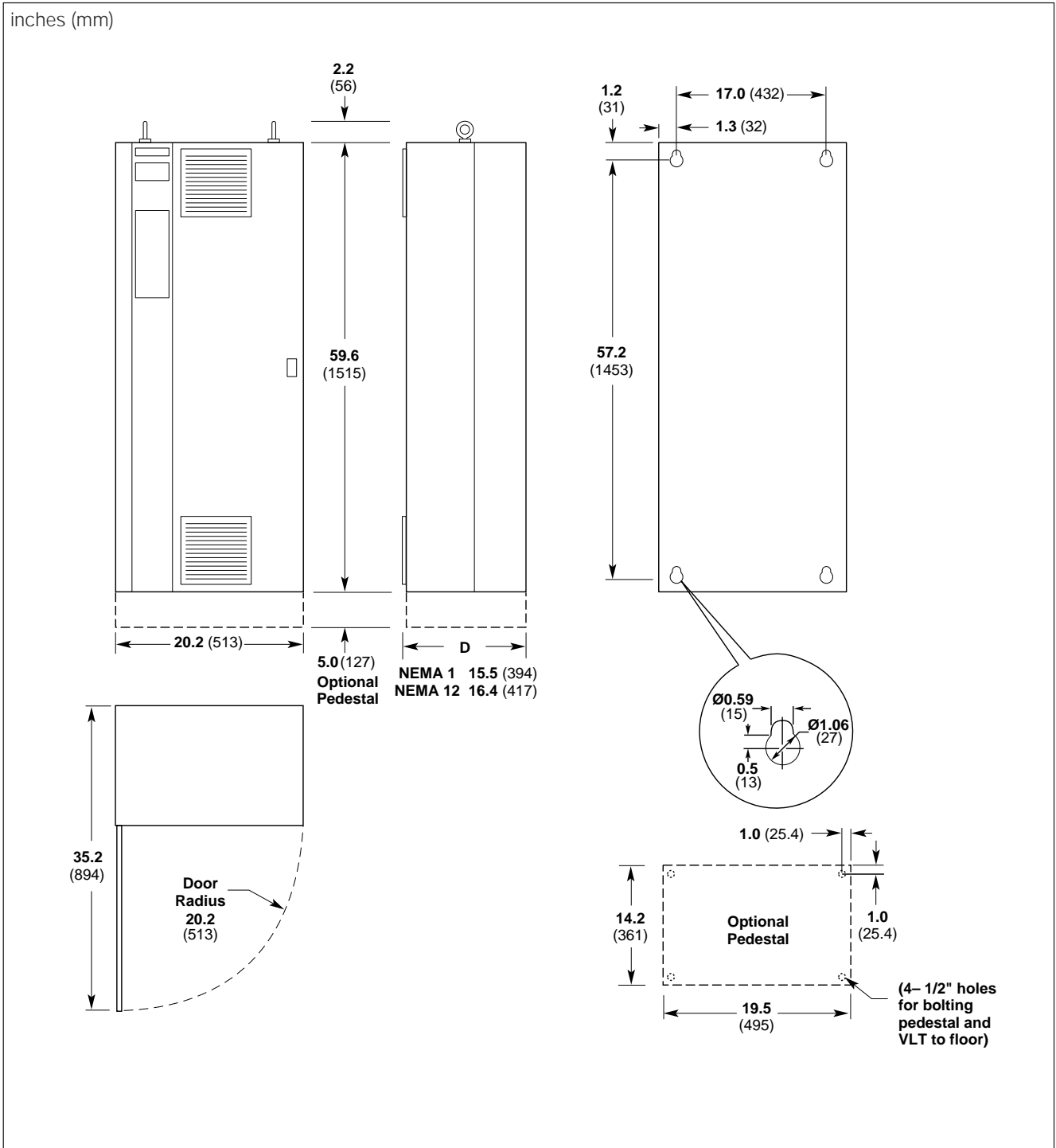
inches (mm)



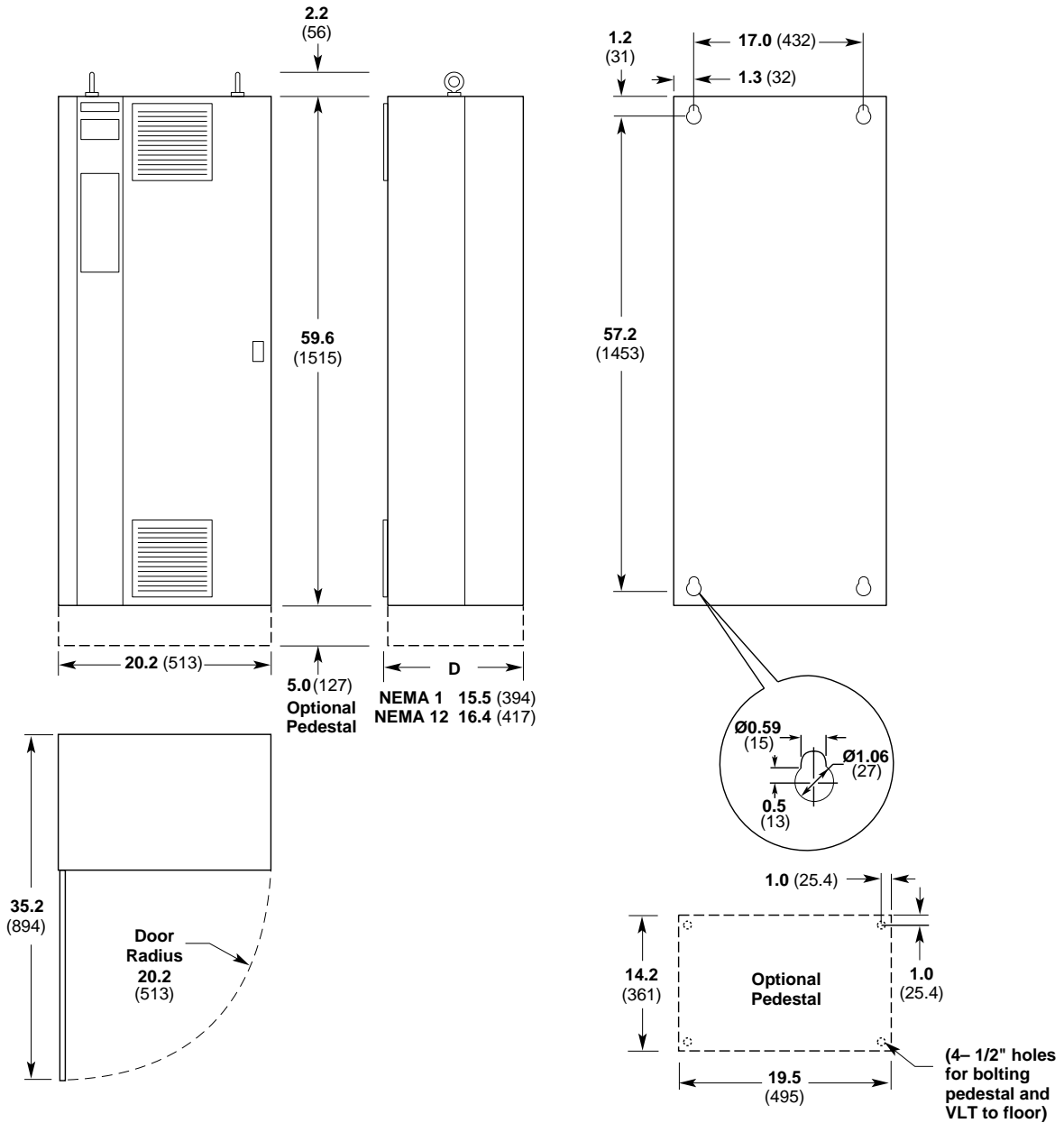


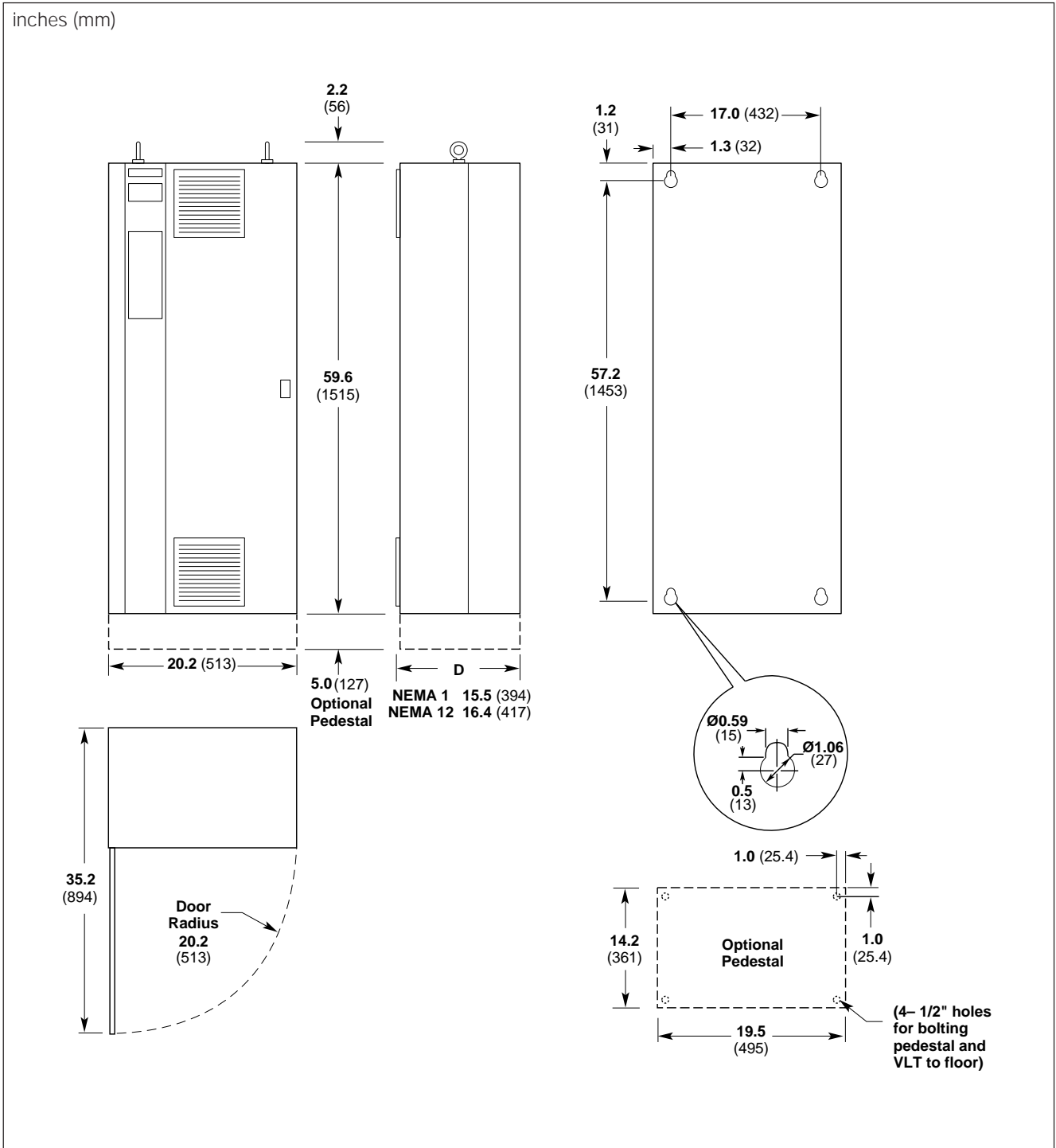
inches (mm)



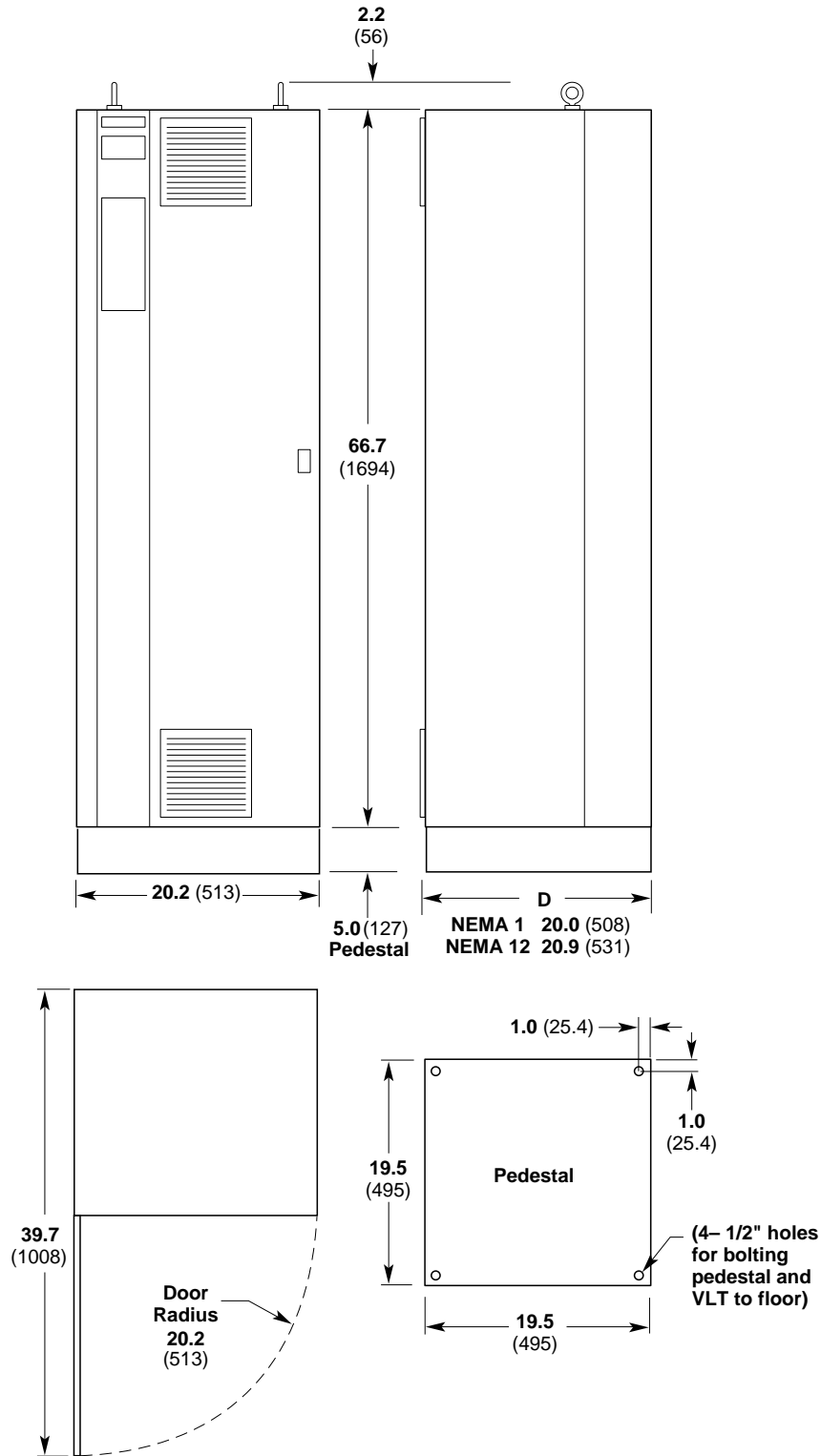


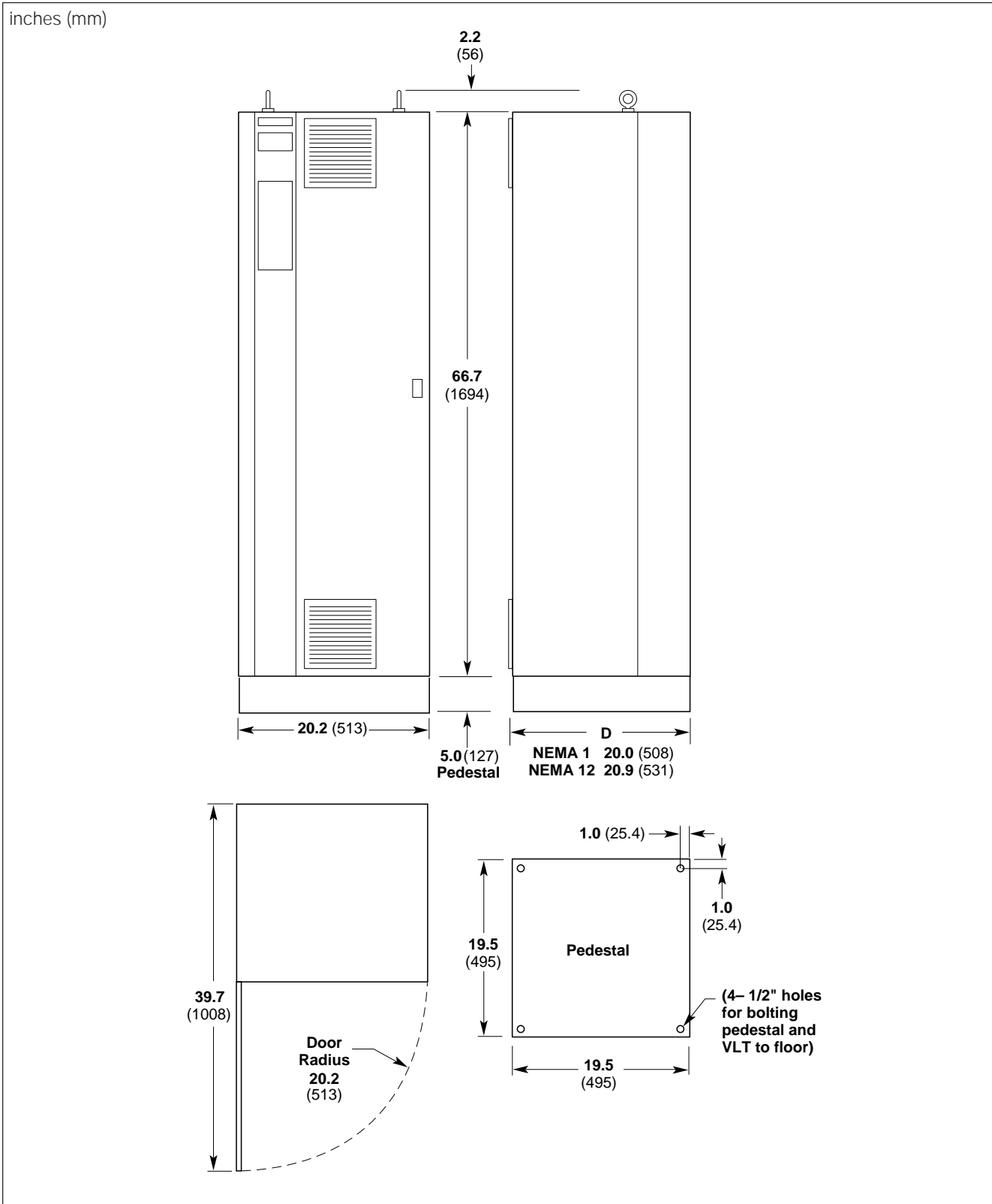
inches (mm)





inches (mm)

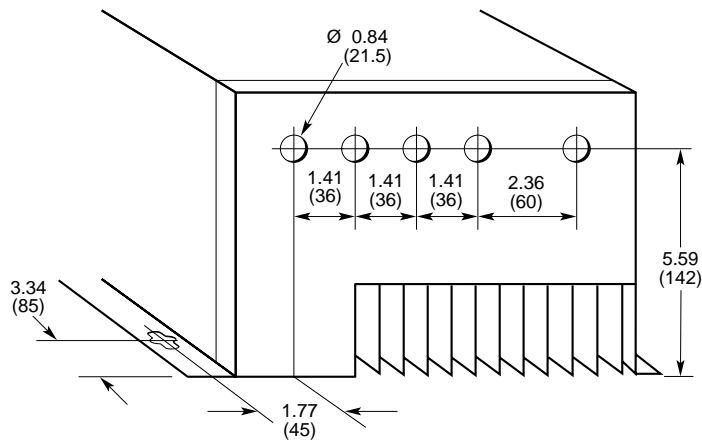




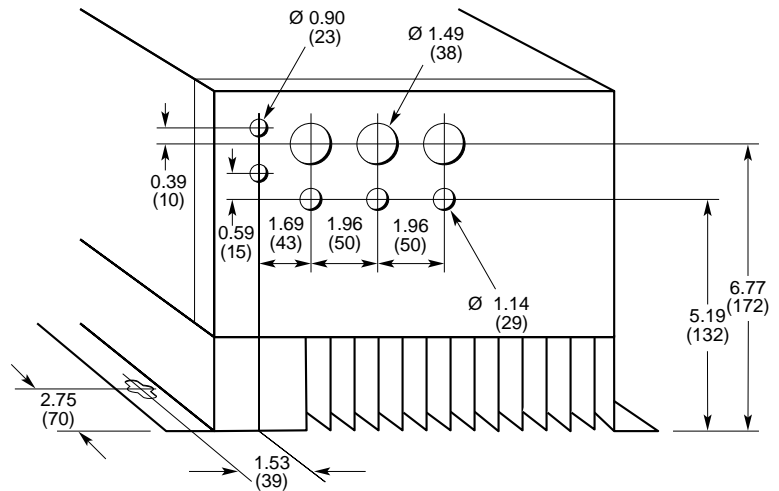
The bottom covers of VLT 3002-3052 NEMA 1 and NEMA 12 enclosure types are provided with wiring access knock-outs.

These units are also supplied with a bonding plate, which must be used for UL and cUL approved applications.

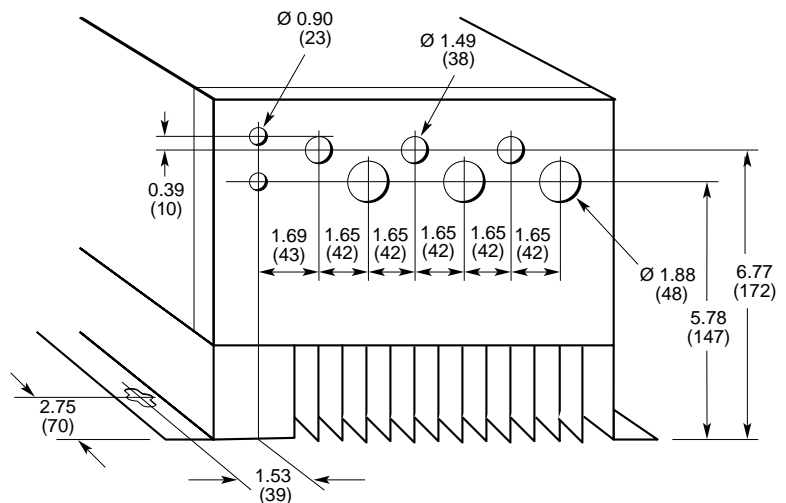
VLT 3002-3006, 230V
VLT 3002-3008, 380 and 460V
NEMA 1 (IP21) and
NEMA 12 (IP54)



VLT 3008-3011, 230V
VLT 3011-3022, 380 and 460V
NEMA 12 (IP 54)

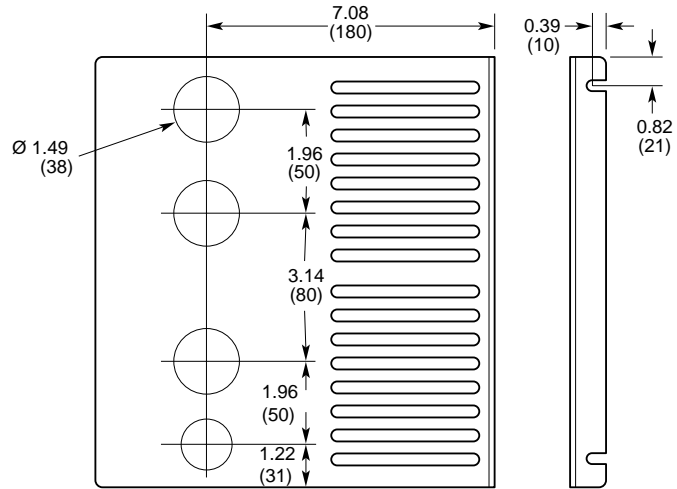


VLT 3016-3022, 230V
VLT 3032-3052, 380 and 460V
NEMA 12 (IP54)

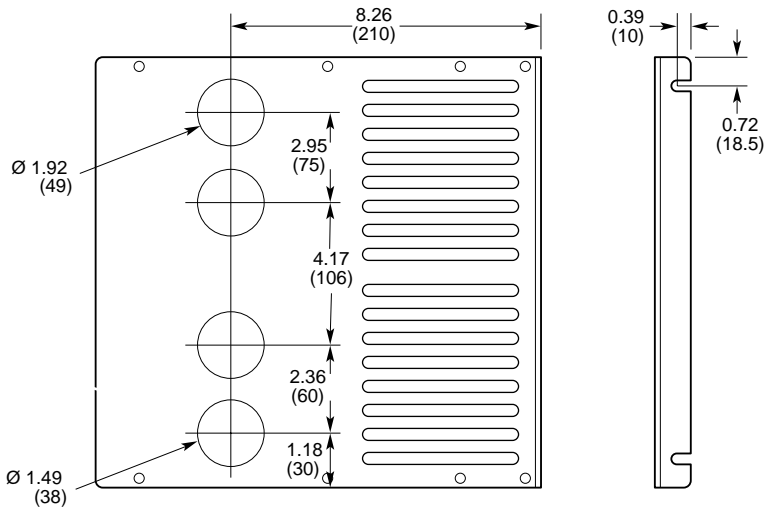


The bottom plates of VLT 3006-3022, 230V and VLT 3011-3052, 380 and 460V chassis types are provided with wiring access knock-outs.

**VLT 3006-3011, 230V
VLT 3011-3022, 380 and 460V
Chassis (IP20)**



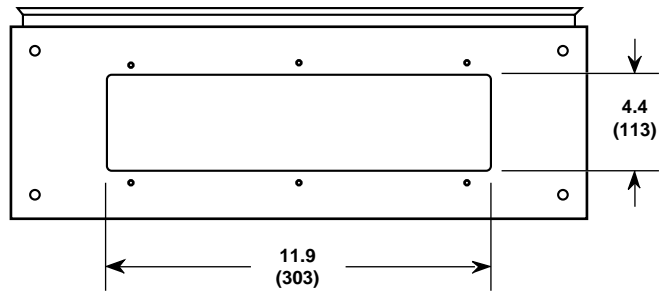
**VLT 3016-3022, 230V
VLT 3032-3052, 380 and 460V
Chassis (IP20)**



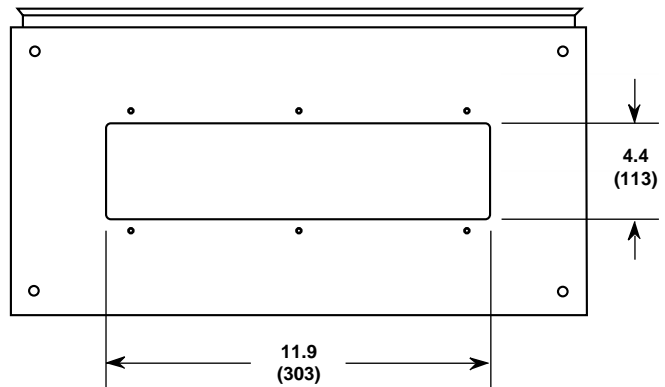
An Access Plate and gasket have been provided in the bottom of the VLT to make punching holes for conduit connection easier. Caution should be taken not to damage the gasket on the VLT when removing or installing the Access Plate.

CAUTION: The Access Plate must be in place in the final installation to insure proper operation and cooling of the VLT. Failure to properly seal the access area can result in an overtemperature condition.

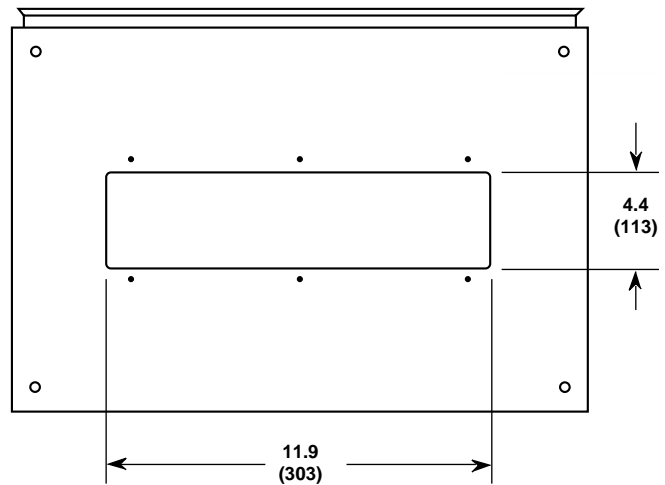
VLT 3032-3052, 230V
VLT 3060-3075



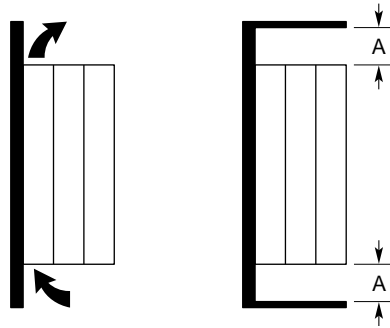
VLT 3100-3150



VLT 3200-3250



VLT Type
3002-3022,
230V
and
VLT Type
3002-3052,
380V, 460V

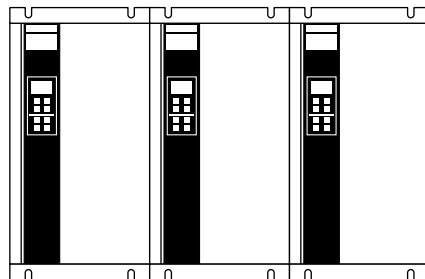
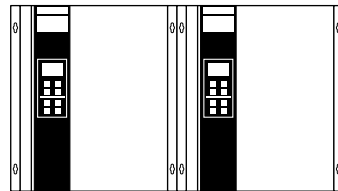


The VLT Series 3000 is cooled by natural or forced air convection. Air must be allowed to pass freely under and over the unit.

The VLT must be mounted on a flat, vertical surface to ensure proper air flow.

To maintain air flow a certain minimum distance free-air clearance must be observed above and beneath the VLT:

Enclosure type	A Ins. (mm)
Chassis (IP00)	3.9 (100)
NEMA 1 (IP21)	3.9 (100)
NEMA 12 (IP54)	5.9 (150)
Chassis (IP20)	7.9 (200)



In multiple drive applications, the VLT can be installed with the flanges side by side or enclosures next to each other as shown. No minimum distance on the sides is required.

Installation

Mounting and Cooling

**VLT Type
3032-3052,
230VAC
and
VLT Type
3060-3150,
380-500VAC**

WARNING: The VLT is unstable when standing vertical. The unit should be mounted to the wall or floor before any further installation is attempted. Failure to observe caution could result in serious injury or equipment damage.

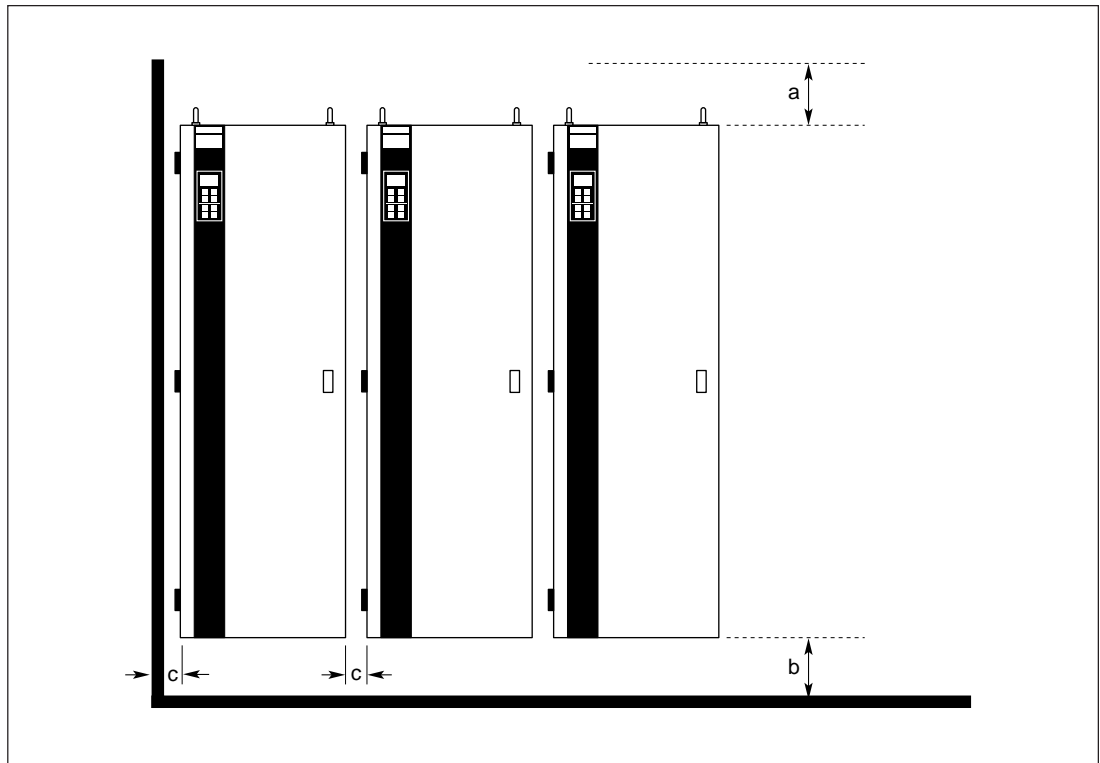
CAUTION: For proper cooling the wiring access plate in the bottom of the VLT must be in place during operation. Failure to properly seal the access area can result in an over-temperature condition.

The VLT Series 3060-3250 units are cooled by forced air circulation. The units use a door fan for cooling the internal components as well as fan(s) on the rear heatsink. To remain within all specifications minimum distance for air flow must be maintained on the sides, top, bottom and front of the units.

Specifications on each power size are found in the following minimum mounting dimensions chart. Please note that the wall mounted configurations clearance on the sides is limited by mechanical interface only.

NOTE: A minimum front clearance of 6 inches must be observed if the unit is being mounted in another enclosure.

Wall Mounted



Dimension inches (mm)	VLT Type		
	3032-3052, 230VAC 3060-3075, 380-500V	3100-3150, 380-500V	3200-3250, 380-500V
a	6.7 (170)	9.1 (230)	Floor mount only
b	6.7 (170)	9.1 (230)	
c	Limited only by mechanical interface		

**VLT Type
3100-3250
380-500VAC**

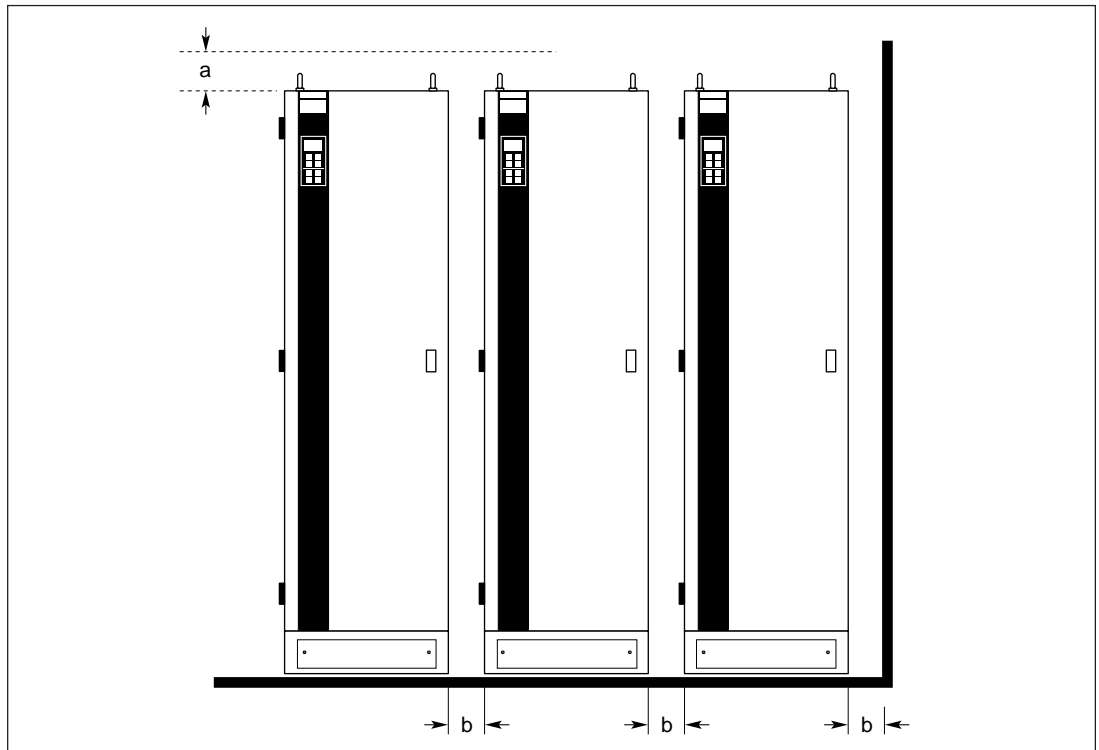
WARNING: The VLT is unstable when standing vertical. The unit should be mounted to the wall or floor before any further installation is attempted. Failure to observe caution could result in serious injury or equipment damage.

CAUTION: For proper cooling the wiring access plate in the bottom of the VLT must be in place during operation. Failure to properly seal the access area can result in an over-temperature condition.

When utilizing the floor mount pedestal on the VLT 3100-3250 units, it is necessary to provide adequate space on the sides to allow for sufficient airflow through the base vents. Refer to the minimum mounting dimensions chart below.

NOTE: A minimum front clearance of 6 inches must be allowed if the unit is being mounted in another enclosure.

Floor Mounted



Dimension inches (mm)	VLT Type		
	3032-3052, 230VAC 3060-3075, 380-500V	3100-3150, 380-500V	3200-3250, 380-500V
a	Wall mount only	9.1 (230)	10.3 (262)
b		5.1 (130)	5.1 (130)

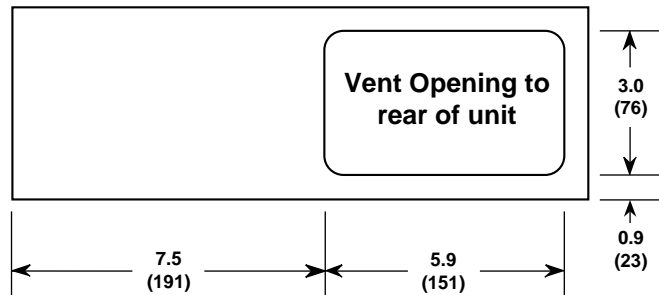
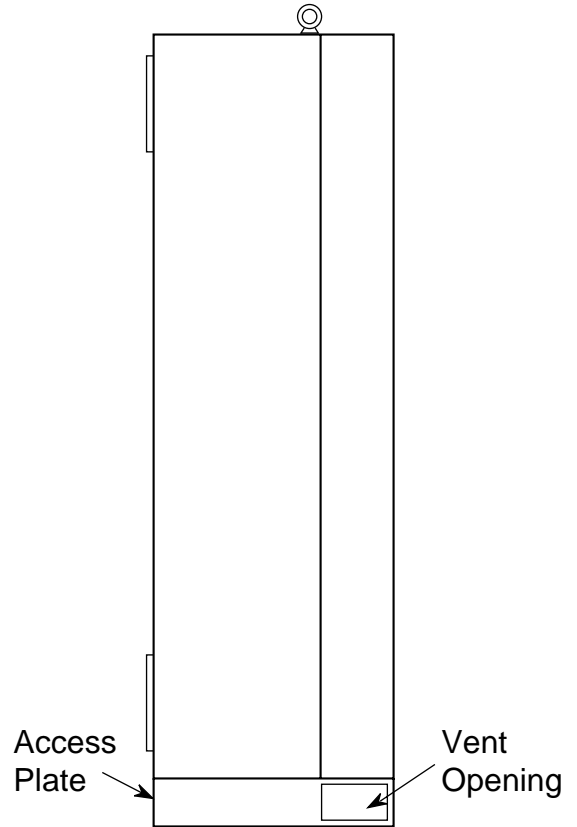
Pedestal

VLT types 3100-3150 may be mounted using an optional pedestal. VLT types 3200-3250 are mounted with a factory-supplied pedestal only.

The pedestal has a vent opening which must be aligned with the rear of the VLT.

CAUTION: The pedestal also has a removable access plate in the front. For proper cooling this plate, as well as the wiring access plate in the bottom of the VLT, must be in place during operation. Failure to properly seal the access area can result in an over-temperature condition.

VLT 3100-3250 (Side view)



VLT Type	A	B	C	D
3100-3150	7.5 (191)	5.9 (151)	0.9 (23)	3.0 (76)
3200-3250	11.3 (287)	6.9 (176)	0.4 (10)	3.9 (100)



WARNING

Touching the electrical parts, even when the AC line has been disconnected, can cause serious injury or death.

Before touching any electrical components wait at least:
4 minutes for VLT types 3002-3052,
14 minutes for VLT types 3032-3052, 230V,
14 minutes for VLT types 3060-3250.

The VLT Adjustable Frequency Drive contains dangerous voltages when connected to line voltage. Only a competent electrician should carry out the electrical installation.

Improper installation of the motor or the VLT may cause equipment failure, serious injury or death. Follow this manual and national and local safety codes.

CAUTION: It is the responsibility of the user or the person installing the VLT to provide proper grounding, as well as motor overload and branch circuit protection according to the National Electrical Code and local codes.

NOTE: Due to high leakage currents and three phase bridge circuitry, use of Residual Current Detectors (RCD) are not recommended in European Community applications.

Danfoss VLT® and CE Marking

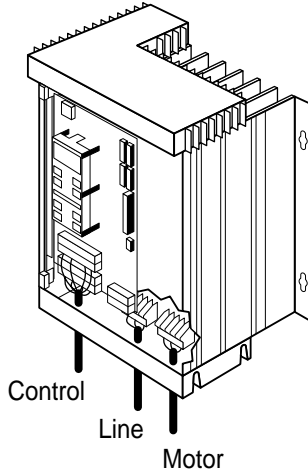
Danfoss CE marks our VLT® Adjustable Frequency Drives (AFD) according to the Electro Magnetic Compatibility (EMC) Directive 89/336/EEC and Low-Voltage Directive 73/23/EEC.

When the installation specification is followed and shielded motor cables are used per instruction manuals provided with the drive, we guarantee the AFD complies with the EMC Directive 89/336/EEC. Please consult the RFI Filter Product Manual and EMC Installation Guidelines (175R5187).

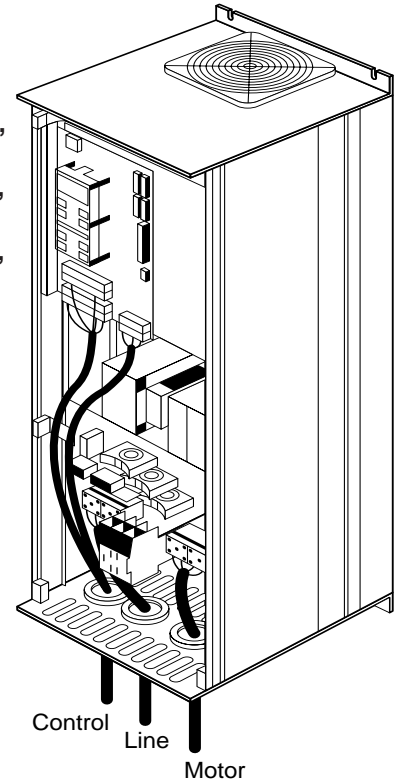
Upon request we will issue a declaration of conformity to the EMC and low-voltage directives. A manufacturer's declaration for the Machinery Directive 89/392/EEC is also available.

Typical Wire Routing

VLT Type
 3002-3004, 230V
 3002-3008, 380V
 3002-3008, 460V



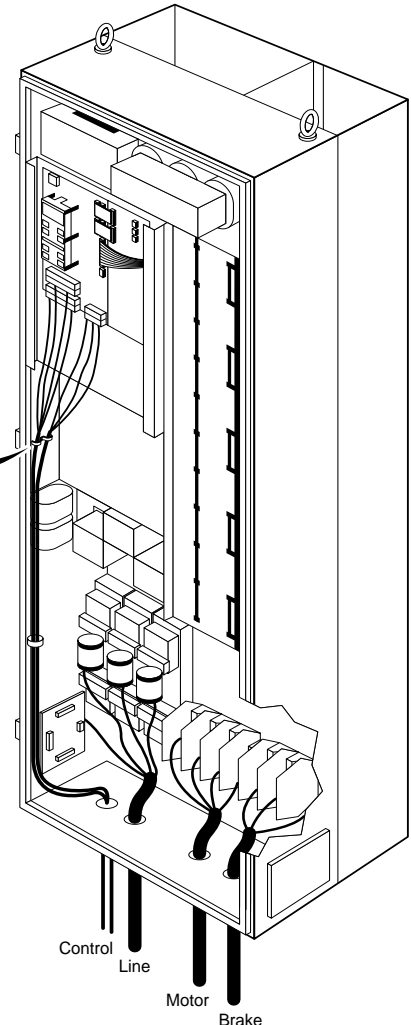
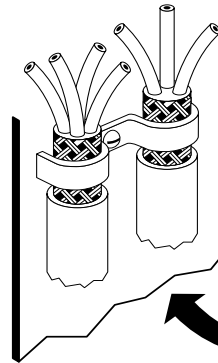
VLT Type
 3006-3022, 230V
 3011-3052, 380V
 3011-3052, 460V



NOTE: When replacing covers on VLT types 3002-3052 the front cover screws will need to be retightened to 14-23 inch pounds.

The AC line and motor terminals are located in the lower section of the VLT enclosure.

VLT Type
 3032-3052, 230V
 3060-3250, 380/460V




The VLT types 3032-3052, 230V and VLT types 3060-3250 have an access plate in the bottom of the unit to make punching holes for conduit connection easier.

Caution must be taken not to damage the gasket when removing or installing the access plate.

In the final installation the access plate must be in place to ensure proper operation and cooling of the VLT.

UL/cUL Bonding Plate Installation

On VLT types 3002-3052 NEMA 1 and NEMA 12 models the Bonding Plate supplied with the unit must be used for UL/cUL approved applications.

Attach the green and yellow bonding plate ground wire to a proper ground connection labled  in the VLT Adjustable Frequency Drive.

Place the bonding plate on the bottom cover. Align the pre-punched holes of the bonding plate with the conduit fitting knock-outs in the bottom cover.

On Chassis (IP20) type units, the bonding plate has a bus bar (instead of a wire) which aligns with the ground terminals in the VLT Adjustable Frequency Drive.

Line Wiring

For typical AC line connection, refer to the appropriate figure for your unit.

The Specification Chart sections in this manual list the proper cable sizes and lengths.

VLT 3002-3022, 230V VLT 3002-3052, 460V Typical Line Connection

Refer to the Terminal Torque chart for proper line terminal torque specifications.

Use the following customer supplied input fusing, UL/cUL 230 and 460V Units BUSS KTN-R (230V), KTS-R (500V) or exact equivalent.

NOTE: These units have a 100,000 AMP short circuit rating when protected by these fuses.

VLT Type	Max Branch Fuse Amps	
	230V	460V
3002	20	10
3003	25	15
3004	25	20
3006	40	25
3008	50	25
3011	60	30
3016	80	40
3022	125	50
3032	–	60
3042	–	100
3052	–	125

VLT 3032-3052, 230V VLT 3060-3250, 460V Typical Line Connection

Refer to the Terminal Torque chart for proper line terminal torque specifications.

Fuses supplied by factory; BUSSMANN type JJS or exact equivalent.

NOTE: These units have a 100,000 AMP short circuit rating when protected by the above fuses.

VLT Type	Max Branch Fuse Amps	
	230V	460V
3032	150	–
3042	150	–
3052	150	–
3060	–	150
3075	–	150
3100	–	250
3125	–	250
3150	–	300
3200	–	450
3250	–	500

Terminal Torque Specifications

Observe these terminal torques for proper cable connection.

Terminal Torque Specifications are in Lb-In.

VLT type	Line	Motor
3002-3016 (all VAC)	12	12
3022-3052 (all VAC)	31	31
3032-3052 (230VAC)	275	53
3060-3075 (all VAC)	275	53
3100-3150 (all VAC)	275	87
3200-3250 (all VAC)	375	52

Motor Wiring

For typical motor connection, refer to the appropriate figure for your unit.

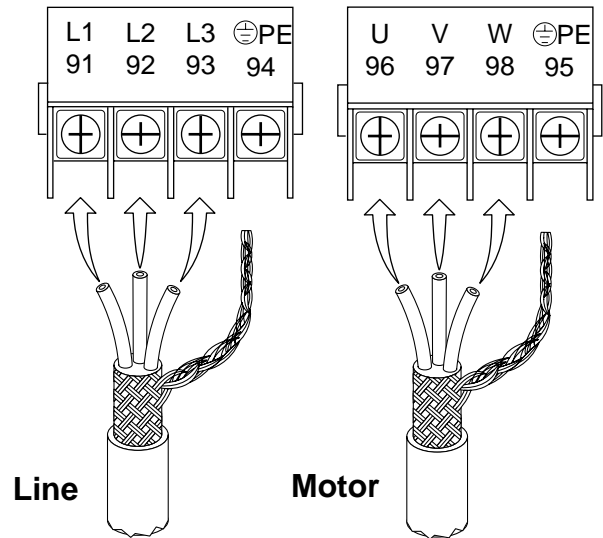
See the chart above for proper motor terminal torque specifications.

NOTE: Shielded motor cables are optional in most U.S. applications. Refer to CE Marking section in this manual.

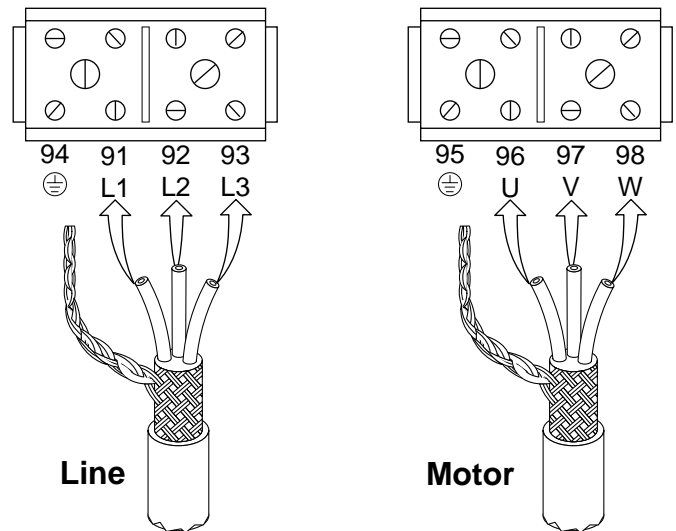
When parameter 315 is set for TRIP and parameter 107 is set for nominal motor rated (nameplate) current, the Electronic Thermal Relay (ETR) in UL/cUL listed VLT's provides class 20 motor overload protection in accordance with NEC in single motor applications.

Typical Line and Motor Connection

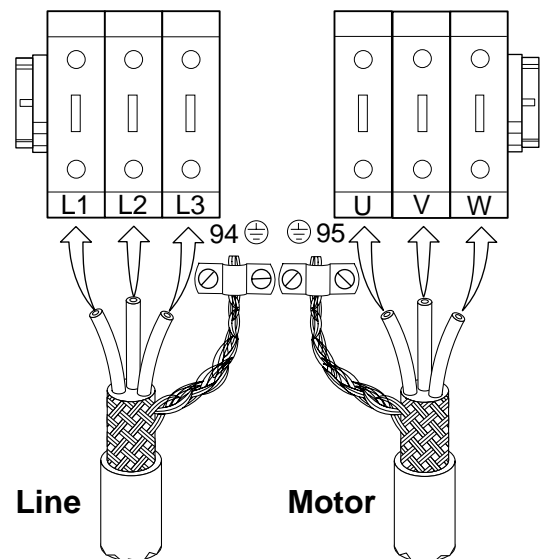
VLT 3002-3004, 230V
VLT 3002-3008, 380 and 460V



VLT 3006-3008, 230V
VLT 3011-3022,
380 and 460V

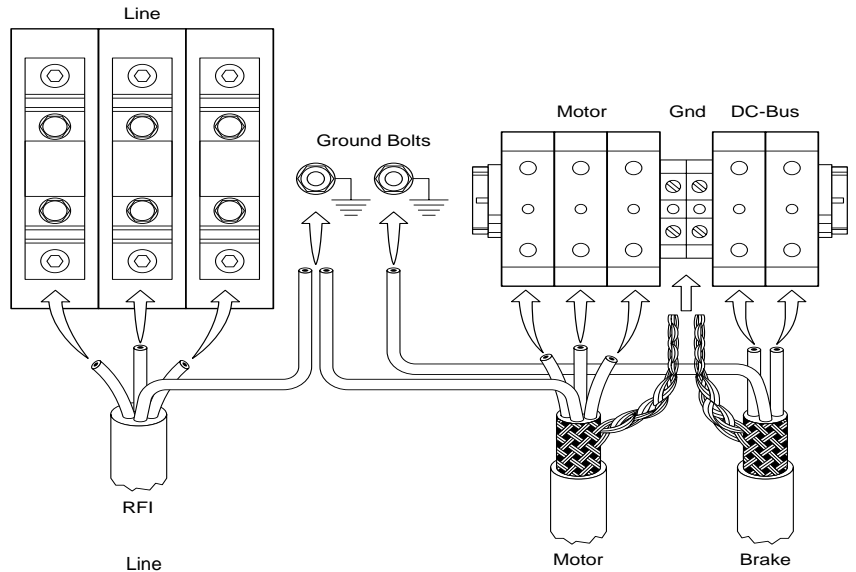


VLT 3011-3022, 230V
VLT 3032-3052,
380 and 460V

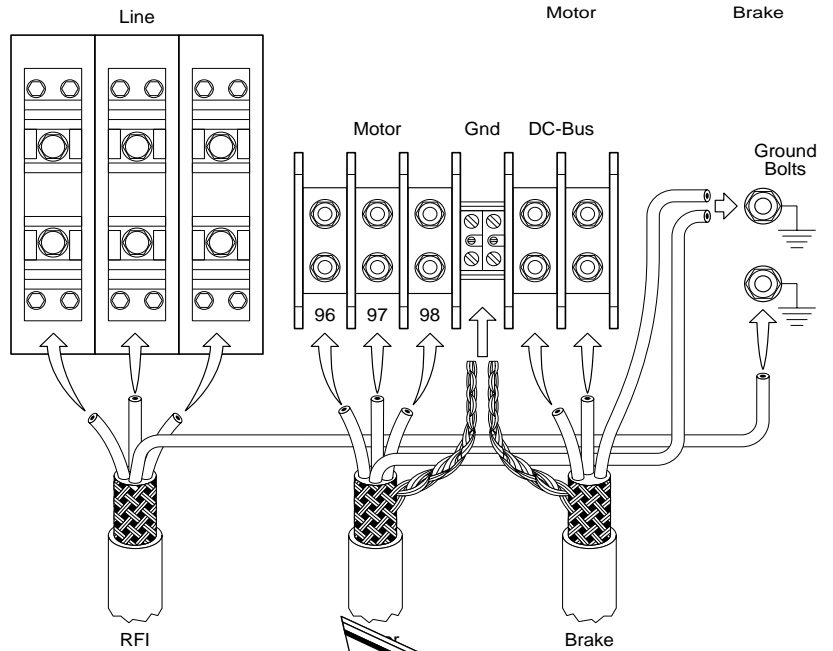


Typical Line and Motor Connection

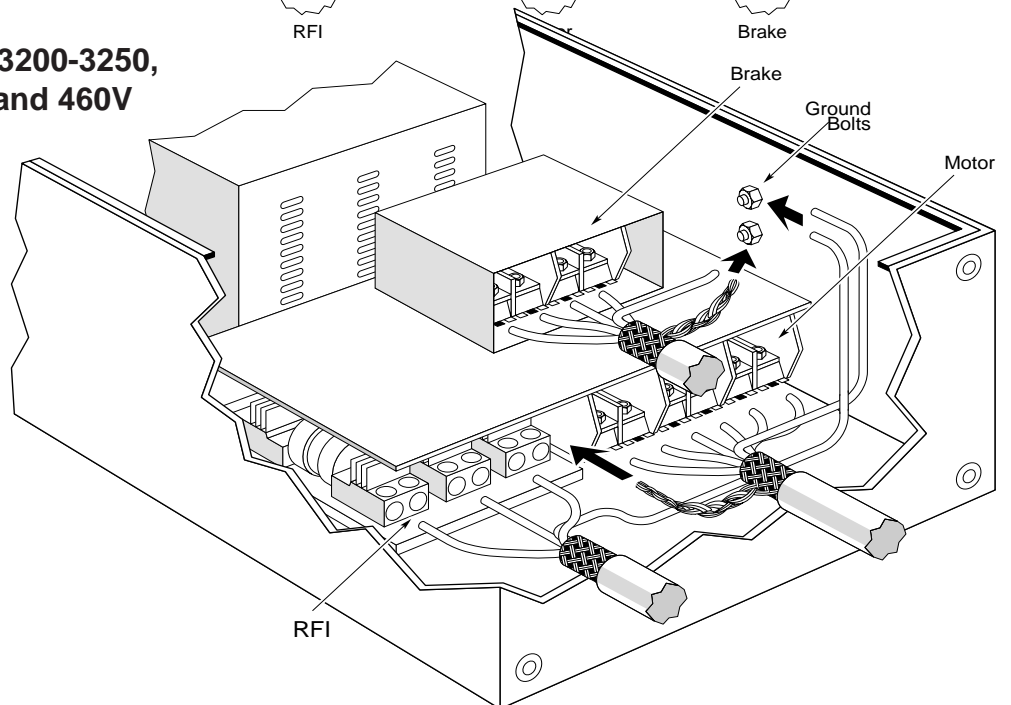
VLT 3032-3052,
230V
VLT 3060-3075,
380 and 460V



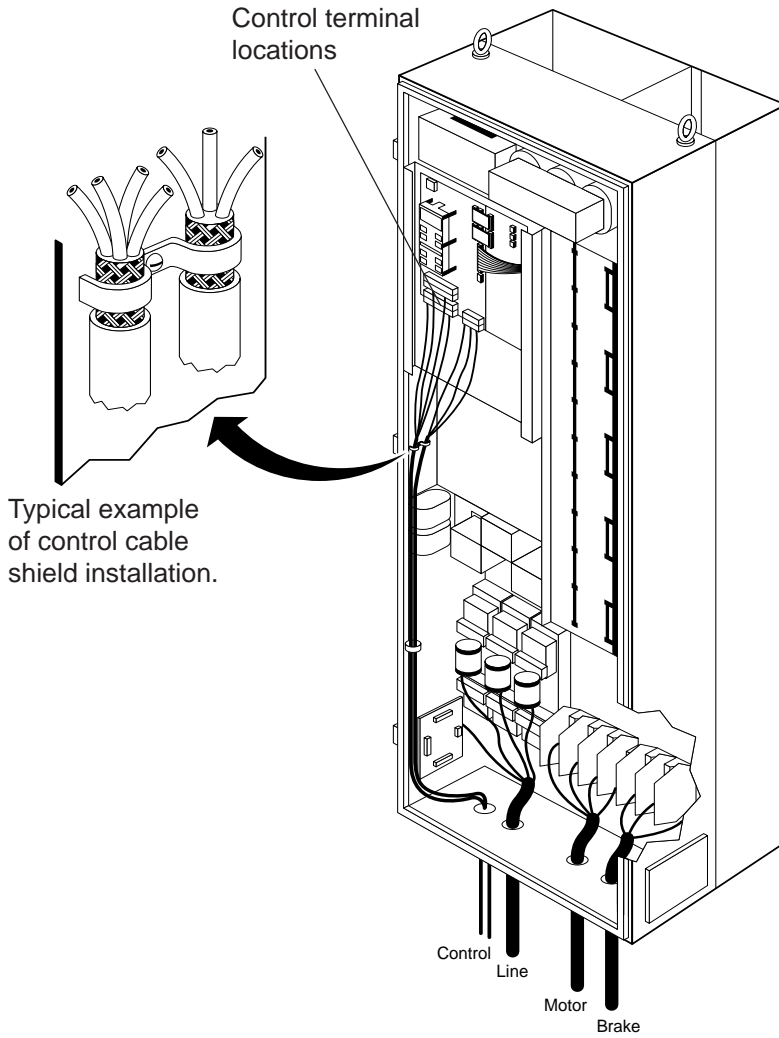
VLT 3100-3150,
380 and 460V



VLT 3200-3250,
380 and 460V



Control Signal Wiring



The control signal cables need to be shielded in order to prevent the possibility of radio frequency (RFI) interference and comply with VDE0875 specifications.

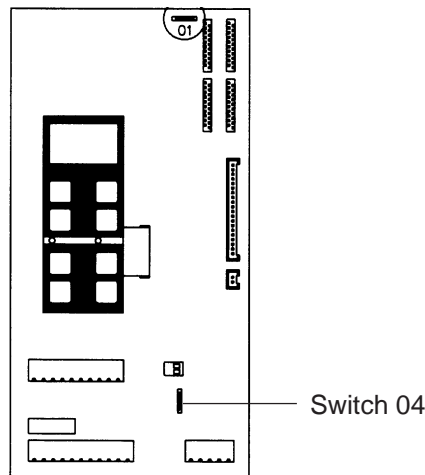
The earth ground wire of the shielded cable is terminated at the control card terminals 38 or 61. The other end of the shielded cable must be cut back and taped off.

If non-shielded cables are used, the control inputs can occasionally be subject to signal disturbance resulting in intermittent operation.

In preventing the possibility of RFI problems the routing of the control signals is very important. The control signals should be kept as far away as possible from high level cables such as the AC line and motor cables. If the control signal cable must be routed within six inches of a power cable, shielded cable such as Beldin 18 gauge is strongly recommended.

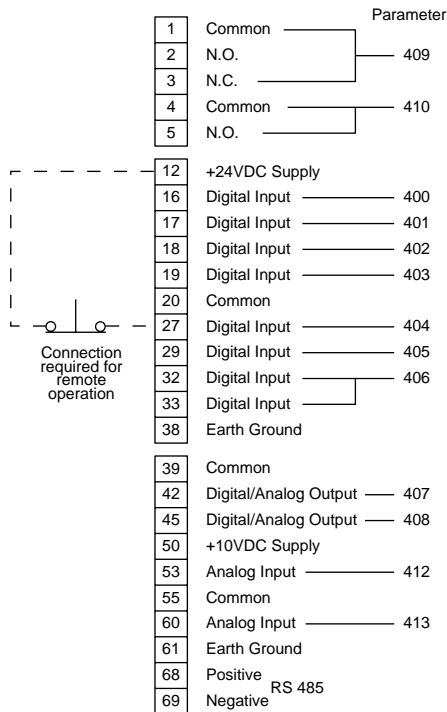
The control signals are connected to the terminals as shown in the figure. For ease of wiring, the terminal blocks are removable. Tighten terminal screws to 4.5 Lb-In.

NOTE: To comply with the European Economic Community (EEC) Machinery Directive (89/392/EEC), Electromagnetic Compatibility Directive (89/336/EEC) and Low Voltage Directive (73/23/EEC) follow the installation instructions in this manual and the RFI Filter Product Manual. Optional RFI filter part numbers are provided in the Danfoss Adjustable Speed Drives for AC and DC Motor Control Catalog. Contact your local Danfoss Distributor or the factory for further information.



Switch 04:
When closed, terminal 61 has a direct connection to ground. When open, terminal 61 has connection to ground via an RC link.

Control Terminals



Terminal 01-03;* max. 240V, max. 2 Amp, min. 24VDC, 100mA or 24VAC, 100mA.

Terminal 04-05;* max. 240V, max. 2 Amp, min. 24VDC, 100mA or 24VAC, 100mA.

Terminal 12; 24VDC, max. 140mA
Terminal 20; Common for digital inputs

Terminal 16-33; $0 \pm 24V$ $R_i = 2 k\Omega$
Terminal 42-45; $0/4-20$ mA max. 470Ω

Terminal 39; Common for analog/digital outputs
Terminal 50; 10VDC, max. 12mA
Terminal 53; $\pm 0-10VDC$, $R_i = 10 k\Omega$
Terminal 55; Common for analog reference inputs

Terminal 60; $0/4-20mA$, $R_i = 226 \Omega$
Terminal 68-69; RS 485 bus

* In VDE applications; max. 250V, 2 Amp

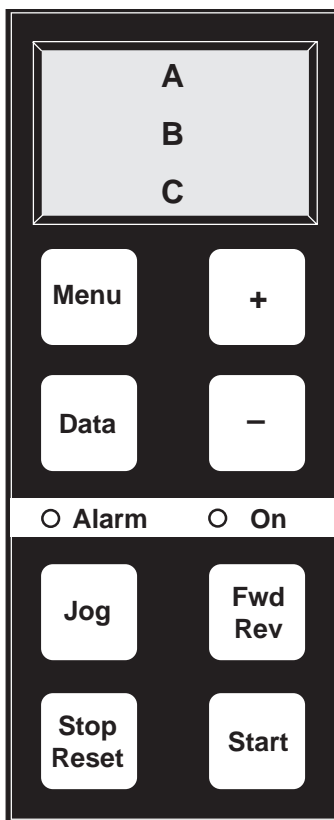
Control Terminal and Function Cross-reference

Terminal 16	reset	stop	freeze reference	set-up select	thermistor		
Terminal 17	reset	stop	freeze reference		pulse 100Hz	pulse 1kHz	pulse 10kHz
Terminal 18	start	latched start	no operation				
Terminal 19	reversing	start reverse	no operation				
Terminal 27	motor	quick stop	DC-brake	reset and motor coasting	latched stop		
Terminal 29	jogging	freeze jog	freeze reference	digital reference			
Terminal 32	speed select	speed up	set-up select	4 set-up extended			
Terminal 33		speed down					

<p>Typical Logic Wiring Examples</p>	<p>0-10VDC Reference Parameter 412 = 0-10VDC 411 = Linear</p>	<p>Two or more VLTs with one 4-20mA Signal Parameter 413 = 4-20mA Signal 407 = Ref. Min., Ref. Max. 4-20mA Alternate method: substitute terminal 45 for 42; substitute parameter 408 for 407</p>
	<p>2 - Wire Start/Stop Parameter 402 = Start 404 = Quick Stop</p>	
	<p>3-Wire Transmitter 4-20mA Parameter 413 = 4-20mA 411 = Linear</p>	<p>Multiple Menu Select Parameter 001 = Multi setup 402 = Start 406 = Setup Select</p> <p>O = Open, C = Closed</p>
	<p>3 - Wire Start/Stop Parameter 400 = Stop 402 = Latched Start</p>	
<p>Analog Speed & Direction Signal Parameter 411 = Proportional w/reversing 412 = 0-10VDC</p>		
<p>Potentiometer Reference Parameter 412 = 0-10VDC 411 = Linear</p>	<p>Pulse Train Speed Control Parameter 401 = Pulse Input 100Hz or = 1KHz or + 1KHz Set for max. input frequency</p>	<p>Alternate Method Parameter 001 = Multi setup 400 = Setup Selector 401 = Setup Selector 402 = Start</p>

Typical Logic Wiring Examples		
<p>Forward-Stop-Reverse Parameter 402 = Start 403 = Start Reverse</p>	<p>PID (Closed Loop) Control Parameter 101 = Closed Loop 114 = Current 412 = 0-10VDC 413 = 4-20mA</p>	<p>Four Internally Preset Speeds Parameter 204 = External On/Off 205 = Speed #1 206 = Speed #2 207 = Speed #3 208 = Speed # 4 402 = Start 405 = Digital Reference 406 = Speed Select</p>
<p>Digital Speed Up/Down Parameter 402 = Start 405 = Freeze Reference 406 = Speed Up/Down</p>	<p>4-20mA Speed Control w/Tach Feedback Parameter 101 = Closed Loop 114 = Voltage 412 = 0-10VDC 413 = 4-20mA</p>	<p>O = Open, C = Closed</p>

VLT Control Panel



All Danfoss VLT Series 3000 AC drives utilize the same control card throughout the entire 1-300 HP range. The VLT control panel consists of a keyboard and a display.

The keyboard is used for two purposes: local control and programming. The display communicates VLT, motor and application information to the operator.

Located on the control panel is a red and green status LED. When the green status LED is illuminated, there is AC power applied to the VLT. The red LED is used for alarm indications. In an ALARM MODE, the LED will flash.

The display is a three-line LCD display. Line A is used for operating displays. It shows the value corresponding to the setting in DISPLAY MODE. The set value remains in the display line during programming of parameters. Line B shows information about parameters and direction of motor operation. Line C shows information about status and setup or data value. It is possible to program the unit to provide two independent operational displays simultaneously (refer to Quick Setup Section).

Initialization

Initialization is used to return to a known status (factory setting). Initialization is required on change of a software version or if so many of the parameters have been changed that the current situation is no longer evident.

Two methods of initialization are possible.

Initializing via Parameter 604 restores all factory settings with exception of:

- Communication parameters 500 and 501;
- Field Bus parameters 820, 821 822, 904, and 918;
- Operation Data parameter 600;
- and the Fault Memory parameter 602.

Manual initialization is used to restore all parameters to factory default settings including those which are not changed by Parameter 604 initialization.

For manual initialization:


Remove power and wait for the display to go out.


Press and hold keys MENU, DATA, JOG simultaneously while applying input power.



When "init eeprom" appears in the third line of the display, release the keys and wait for the initialization process to complete.

Operation

Programming Keys

 is used to enter MENU MODE from either DATA MODE or DISPLAY MODE. MENU is also used for entering a specific group of parameters.

 is used for entering DATA MODE or DISPLAY MODE from MENU MODE. DATA is also used to move the cursor in data values.

The  and  keys are used for scrolling through Groups, Parameters and Data Value selections. Additionally these keys are used for speed up and down when operating in Local mode.

Operator Keys

Four keys are provided for local control:





With the exception of the Start key the keys can be programmed to be enabled or disabled to prevent unwanted use in certain applications.

Local Stop: Local Stop is accomplished by pressing the Stop/Reset key on the front control panel. The local stop command has been designed to override all run signals whether local or remote. When a local stop has been made the top line of the display will flash. The only way to resume running from a local stop condition is to initiate a local start.



Local Forward/Reverse: Local Forward/Reverse will be automatically disabled if remote operation is selected. In remote, it is not possible to make direction changes from the keypad.

Operational Modes

The VLT will be in DISPLAY MODE when the motor is running in normal operation. DISPLAY MODE provides various information concerning the current status of the VLT and motor.

The  and  keys are used to scroll among the 12 main display readouts:

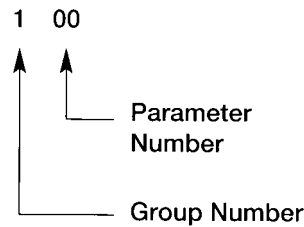
- Reference
- Frequency Hz
- Display Feedback unit
- Current A
- Torque %
- Power kW
- Power HP
- Energy kWh
- Output voltage V
- DC voltage V
- Motor ETR value %
- Inverter ETR value %

The MENU MODE is used to select and change operating parameters. The  and  keys are used in the MENU

MODE to select a parameter group or an individual parameter or the data value of a given parameter.

Group	Description	Parameters
0	Operation and Display	000-099
1	Load and motor	100-199
2	Reference and limits	200-299
3	Functions and timers	300-399
4	Input and Output	400-499
5	Serial data interface	500-599
6	Service and diagnostics	600-699

Parameter Numbering






The parameter number consists of three digits as shown.

The left digit indicates the Group, and the two digits at the right specify the parameter number in the specific Group.




Moving through the Program

After the first power up, the drive is in DISPLAY MODE. To program the VLT's various Groups, use the MENU key to enter the MENU GROUP MODE.

To travel through the available Groups,





use the  key followed by the  or  keys.

Changing a Parameter number in a Group


Parameters in each group can be entered in the selected group by also using the  key followed by  or  key.

Changing a Numerical Data Value

The Data Value can be a continuous (numerical) value of figures within a specified range (i.e., volts, Hz, etc.), or it can be a discrete value represented by the text.

 or  . All the other data value words that can be chosen will be shown one at a time by using the  or  key.


The new data value will be stored in the software when leaving the DATA MODE.

Please Note: It is necessary to press  to stop the motor before changing the data value of some parameters.

Due to space considerations, several words have been abbreviated on the display.

When leaving the DATA MODE, the word shown in the display will be stored.

If the data value of the chosen parameter is a discrete value, a text will appear in the display. The text shown represents the chosen parameter. In order to change it, press

Please Note: In order to change the data value of some parameters, it is necessary to press  .

Time-out

If the VLT is left in DATA MODE, a 20 second time-out will prevent unwanted change of data.

It is possible to return to DATA MODE and program the parameter that was blocked by

The software leaves DATA MODE after 20 seconds if no operation is recorded.

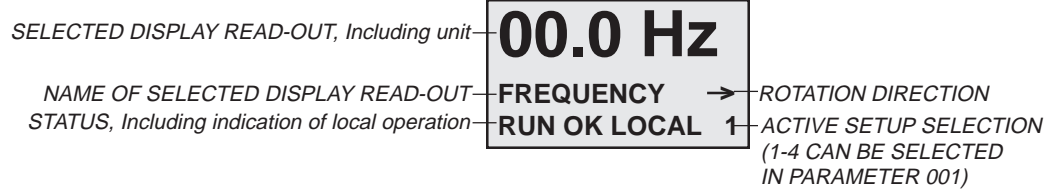
the time-out with a single stroke on  .

Note: The 20 second time-out does not occur in parameter 004, Local Reference.

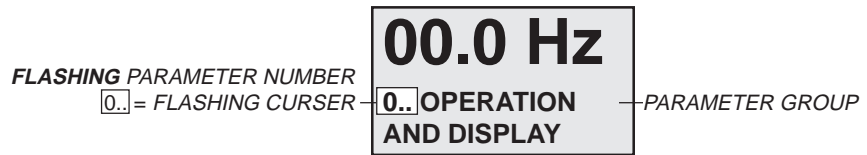
Operation

Operational Modes

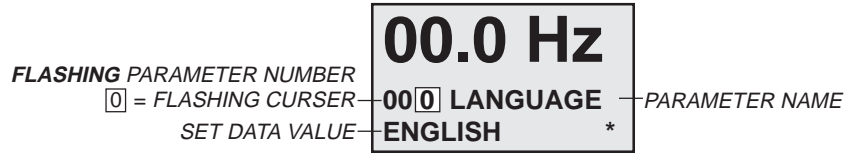
Display Mode



Menu Group Mode



Parameter Mode



Data Mode

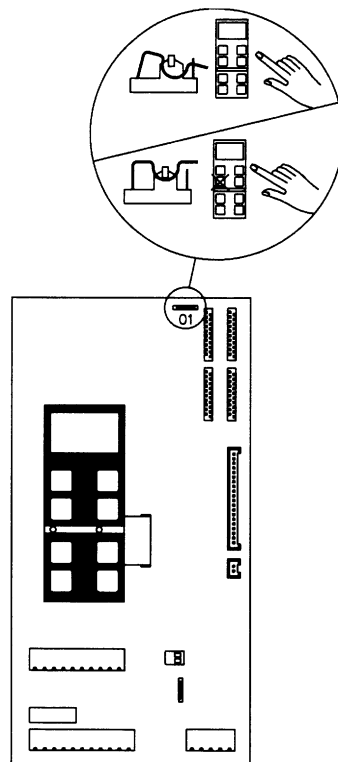


Alarm Mode



* Indicates selection can not differ from setup to setup.

LOCK - Switchpin



To avoid unwanted programming of the VLT, a "LOCK" switchpin (01) has been provided on the Control Card.

An open switchpin will lock out the programming function of the keyboard. Local START/STOP type operation is possible if enabled.

EXAMPLE: You want to set the VLT for local operation and to change the local reference (motor speed) by means of "+" and "-" keys.

Enter menu mode

0.0Hz
 FREQUENCY
 UNIT READY 1

"Menu" key

Enter group 0..

0.0Hz
 0..OPERATION AND
 DISPLAY

"Menu" key

Select parameter 003

0.0Hz
 000 LANGUAGE
 ENGLISH *

3 x "+" key

Enter data mode

0.0Hz
 003 LOCAL/RE
 REMOTE *

"Data" key

Select data = LOCAL

0.0Hz
 LOCAL/REMOTE
 REMOTE *

2 x "+" key

Enter data value

0.0Hz
 LOCAL/REMOTE
 LOCAL *

"Menu" key

Select parameter 004

0.0Hz
 003 LOCAL/RE
 LOCAL *

"+" key

Enter data mode

0.0Hz
 004 LOCAL SPEE
 00.00 *

"Data"



Increase or decrease the output frequency


60.0Hz
 004 LOCAL SPEE
 60.00 *

"+" key "-" key



Programming Keys

When the supply voltage is connected, the VLT is automatically in DISPLAY MODE after start-up. Please note that the size and voltage of the VLT are shown on the display during start-up. If the voltage and size shown on the display does not correspond to the actual VLT size and AC line voltage, the correct information can be set in parameter 650.


Press  once to switch to MENU GROUP MODE. From MENU GROUP MODE press  once to switch to MENU PARAMETER MODE.

Use the  key to switch to DATA MODE.

Data can now be changed.

The  and  keys are used to select a group of parameters, one particular parameter or a data value.

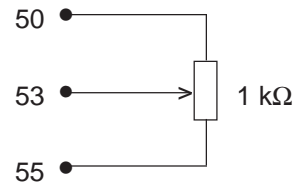
Data values can only be changed using the

 and  keys. Pressing the  key

stores the new data values in the memory. This also takes place automatically after 20 seconds if the data values have been changed.

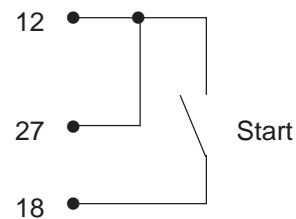
Speed Reference

A potentiometer 1 kΩ is connected to terminals 50, 53 and 55.



Starting and Stopping

Start the frequency converter by connecting +24 VDC (terminal 12) to start (terminal 18) and freewheel stop (terminal 27)



Initialization

Initialization is used to return to a known status (factory setting). Initialization is required on change of a software version or if so many of the parameters have been changed that the current situation is no longer evident.

Two methods of initialization are possible.

Initializing via Parameter 604 restores all factory settings with exception of:

Communication parameters 500 and 501;
Field Bus parameters 820, 821 822, 904,
and 918; Operation Data parameter 600;
and the Fault Memory parameter 602.

Manual initialization is used to restore all parameters to factory default settings including those which are not changed by Parameter 604 initialization.

For manual initialization:

Remove power and wait for the display to go out.

Press and hold keys MENU, DATA, JOG simultaneously while applying input power.

When "init eeprom" appears in the third line of the display, release the keys and wait for the initialization process to complete.

In most cases it is sufficient to program the VLT according to items 1-10 shown below. If the factory setting has been changed the drive will need to be initialized.

Standard motor running in constant torque application without a brake module on the VLT.

Item	Parameter	Description	Settings	Display
1	000	Language	Select: "English"	ENGLISH
2	103	Motor output	See nameplate and select closest setting	
3	104	Motor voltage	See nameplate	
4	105	Motor frequency	See nameplate	
5	106	Auto motor tune	Items 1-4 must be carried out first. Select: "On" The compensation menus 109-113 are now tuned automatically. During auto motor tune the motor should be unloaded or only loaded at max. 50%. Auto motor tune is not possible in connection with parallel running of several motors on one VLT. This also applies to motor outputs which cannot be set in parameter 103, and synchronous, reluctance and other specialized motors. After tuning, the VLT is stopped by pressing the Stop/Reset key and restart by pressing the Start key. WARNING: During auto motor tune the motor will start for a brief period.	ON
6	201	Min. frequency	Set required frequency	
7	202	Max. frequency	Set required frequency	
8	215	Ramp-up 1	Set required ramp time	
9	216	Ramp-down 1	Set required ramp time	
10		Start VLT	This is by supplying terminals 18 and 27 with 24 VDC from terminal 12 or by using an external 24 VDC supply.	

The following settings are used for local operation and start

Item	Parameter	Description	Settings	Display
1	003	Operation mode	Select: "Local"	LOCAL
2	004	Local reference	Set required output frequency using the "+" or "-" keys	

Dual Display

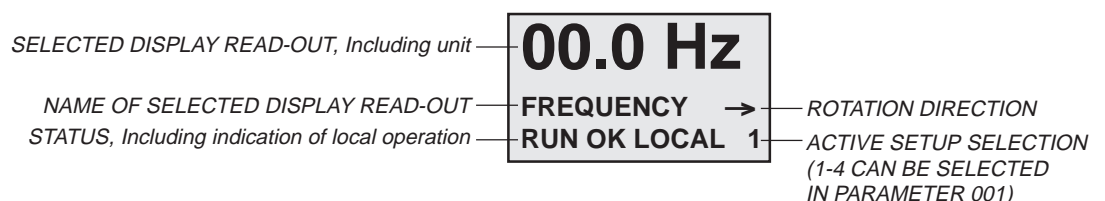
Parameter 605 Personal Display Select

You can have two different display read-outs in the display at the same time. The extra read-out selected in parameter 605 will be shown in line 2 of the display.

NOTE:

To be able to see both lines simultaneously, the display must be in Display Mode.

EXAMPLE: The frequency in Hz in line 1, indication of frequency in line 2, and indication of status of operation in line 3. The other data values are selected to read another operation value in line 2, so that it is possible to display the frequency in line 1 and current in line 2 simultaneously. There are 14 different data values that can be selected.



Group 0: Operation and Display

- Language Select
- Local Remote Operation
- Menu Select

Group 1: Load and Motor

- Open/Closed Loop Control
- Adaptive Motor Tuning
- PID Function (also refer to PI Regulation in the Appendix)

Group 2: References and Limits

- Min./Max. Frequency
- Ramp Times
- Carrier Frequency

Group 3: Functions and Timers

- Braking
- Flying Start
- Motor Thermal Protection

Group 4: Inputs and Outputs

- Digital Inputs
- Output Signals
- Analog Inputs

Group 5: Serial Data Interface

- RS485 Interface

Group 6: Service and Diagnostics

- Diagnostics
- Nameplate Information
- Personal Display Select

The following is a description of each of the parameters and the Data Value contained within them.

For each function description in the left column, the three-digit parameter number is given with the type of message seen on the LCD display shown in the shaded box. If no shaded box is given, the display reads the same as the text.

The numbers given in brackets [] signify the parameter choice when programming via the RS-485 serial communication port.

The Data Values to be chosen for each parameter are listed in the center column.

The right hand column gives a description of the function that the parameter's Data Value will provide.

000
Language Select

LANGUAGE

- Value:**
- * ENGLISH [0]
 - GERMAN [1]
 - FRENCH [2]
 - DANISH [3]
 - SPANISH [4]
 - ITALIAN [5]

This parameter selects the language that will be displayed.

001
Menu Setup Select

SETUP OPER

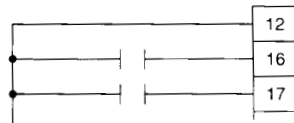
- Value:**
- FACTORY SET [0]
 - * SETUP 1 [1]
 - SETUP 2 [2]
 - SETUP 3 [3]
 - SETUP 4 [4]
 - MULTI-SETUP [5]

Four (4) identical menu sets are available in the VLT software. Each of the menu sets contain all of the parameters listed in the Parameter Chart. The menu sets are identical, but totally independent of each other. This allows the parameters for each menu set to be programmed individually; such as different Current Limits, Slip Comp., etc.

MENU Setup	Term 16 or 32	Term 17 or 33
1	0	0
2	1	0
3	0	1
4	1	1

(0 = open, 1 = closed)

Switching between menu sets can be done locally or by means of a remote input. In local mode select the desired operating menu set from this parameter. For remote selection choose MULTI-SETUP then program terminals 16 and 17 or 32 and 33 for SET-UP SELECT. To select menu sets follow the wiring examples and truth table.



FACTORY SET contains the factory default parameter selections. It is possible to run in the factory setup but parameter changes are not allowed.

NOTE: Parameters which display an (*) asterisk in the lower right hand corner of the display can not be independently set from one step to another.

002
Setup Copy

MENU SET C

- Value:**
- * DO NOT COPY [0]
 - COPY TO 1 FROM # [1]
 - COPY TO 2 FROM # [2]
 - COPY TO 3 FROM # [3]
 - COPY TO 4 FROM # [4]
 - COPY TO ALL FROM # [5]

A menu setup can be copied to one of the other setups or to all the other setups simultaneously.

Choose the setup source, locally from parameter 001 or remotely via terminals 16 and 17 or 23 and 33. Choose the setup destination at this parameter. The copying process begins when leaving Data Mode either by pressing the Menu button or allowing the Time-Out function to occur. The third line of the display will flash while the copy function is in process. When complete the Data Value will automatically be set to DO NOT COPY.

(* Indicates factory default settings)

003
Operation Place

LOCAL/RE

- Value:**
- * REMOTE [0]
 - LOCAL W/EXTERNAL STOP [1]
 - LOCAL [2]

WARNING:
During data value changes the VLT may recognize that a RUN condition exists.

NOTE: If LOCAL is selected the VLT will only operate from the keyboard, and not recognize any external control signals.

CHOOSING LOCAL programs the VLT to be controlled only by the key board display mounted on the front of the VLT. With this selection speed control is only possible via parameter 004. In LOCAL the remote terminal inputs are ignored.

To operate the VLT using remote inputs choose REMOTE Then program the appropriate terminals in the 400 group for desired control functions.

NOTE: Terminal 27 must be connected to terminal 12 via a jumper or a normally closed contact to enable Remote operation.

LOCAL W/EXTERNAL STOP programs the VLT to operate locally but with the possibility of an external remote stop function. The remote stop function must be connected between terminals 12 and 27 with a normally closed contact. Parameter 404 must then be programmed for MOTOR COASTING or RESET and MOTOR COASTING.

004
Local Reference

LOCAL SPEE

- Value:**
0.00 - f_{MAX} (parameter 202)

This parameter sets the running frequency of the VLT when operating in LOCAL or LOCAL W/ EXTERNAL STOP. Local reference must be enabled in parameter 010.

Once the cursor is placed on the data value the speed reference is changed by using the "+" and "-" keys on the front of the key board display.

The status of the Local Reference at power loss is determined by the programmed value in parameter 014.

The Time-Out function does not apply to this parameter.

005
Display Value

VALUE AT M

- Value:**
1 - 9999

The data value recorded will be read out in the display when the output frequency is equal to the MAX frequency (f_{MAX}) recorded in parameter 202. This is useful for customizing the display to represent application specific information; i.e., in./min., ft/sec., etc.

Select the engineering unit to be displayed in parameter 117. When using closed loop control, this display value represents the feedback value. In that case, program this display output in parameters 115, 116, and 117.

EXAMPLE: It is desired to display RPM. Determine the RPM of the driven machine when running at the speed programmed in Fmax, parameter 202. (ie: Fmax = 60 Hz, motor base speed = 1725 RPM at 60 Hz. Enter the value of 1725 in this parameter). Select parameter 117 to display in RPM.

(* Indicates factory default settings)

Parameter Group 0

Operation and Display

Parameters 006-010 allow the user to enable or disable certain functions of the keypad.
Remote control inputs are not effected by these selections.

006 Local Reset LOCAL RESE	Value: DISABLE * ENABLE	[0] [1]	The option of resetting faults from the key board display can be enabled or disabled via this parameter. Disabling or enabling the Local Reset function does not effect the status of the selection made regarding Local Stop in parameter 007.
007 Local Stop LOCAL STOP	Value: DISABLE * ENABLE WARNING: During data value changes, the VLT may recognize that a RUN condition exists.	[0] [1]	The ability to stop the VLT from the key board display can be enabled or disabled via this parameter. Select ENABLE if the local stop key is to function. If the VLT is running when the stop function is disabled it will not be possible to stop the VLT from the keypad. Disabling or enabling the local stop function does not effect the status of the selection made regarding Local Reset in parameter 006.
008 Local Forward/ Reverse LOCAL FWD	Value: * DISABLE ENABLE	[0] [1]	The ability to change direction of operation while operating in Local Mode is determined by this parameter. Select ENABLE if local control of forward and reverse is to be allowed. Local control of forward and reverse is disabled automatically and will not function if Remote control has been chosen in parameter 003.
009 Local Jogging LOCAL JOG	Value: * DISABLE ENABLE	[0] [1]	This parameter selection enables or disables the function of the jog key on the key board display. When enabled, the jog function is only active while the jog key is held depressed.
010 Local Reference LOC REFERE	Value: DISABLE * ENABLE	[0] [1]	This parameter disables or enables the use of the Local Reference value as programmed in parameter 004.

(* Indicates factory default settings)

011
Reset Energy Counter

Value:
 * NO RESET [0]
 RESET [1]

The energy counter provides an accumulative total of the kilowatt hours the VLT has consumed since last reset (Reset is initiated when leaving DATA MODE).

ENERGY COU

012
Reset Hour Counter

Value:
 * NO RESET [0]
 RESET [1]

The hour counter provides an accumulative total of the hours the VLT has been in a run condition since the last reset (Reset is initiated when leaving DATA mode).

HOUR COUNT

014
Power On Mode

Value:
 AUTO RESTART [0]
 Auto restart on local operation, maintain speed reference.
 * LOC = STOP [1]
 Stopped on local operation, use saved reference.
 LOC = STP + REF = 0 [3]
 Stopped at local operation, set speed reference at 0.

POWER UP M

This parameter determines the Local Mode operating state of the VLT at power up. In addition, the status of the reference when using remote digital speed up/ speed down is also effected by this parameter.

Auto Restart is selected if the unit is to power up under the same conditions that applied at power down. EXAMPLE: If the VLT was running at 60 Hz at power down, the VLT will return to running at 69 Hz when power is reapplied.

Loc = Stop is selected if the unit is to remain stopped at power up until a start command is given. The speed reference as recorded in parameter 004 is saved, and the VLT will return to the programmed speed when started.

Loc = Stop + Ref = 0 is selected if the VLT is to remain stopped at power up until a start command is given. The speed reference as recorded in parameter 004 will automatically be set to zero.

This selection will also cause the digital speed up/speed down reference to be set to zero, however, the operating state of the VLT will be determined by the remote input status at the time power is applied.

(* Indicates factory default settings)

015
Setup Selection
Programming

SETUP PROG

Value:

PREPROGRAMMED (Factory Set)	[0]
SETUP 1 (Setup 1)	[1]
SETUP 2 (Setup 2)	[2]
SETUP 3 (Setup 3)	[3]
SETUP 4 (Setup 4)	[4]
* SETUP=PARAM 001 (Setup=P001)	[5]

WARNING: The VLT must be returned to data value SETUP = PARAMETER 001 to allow normal operation upon exiting parameter 015.

The menu setup in which the program (change data) can be selected.

It is possible to program the 4 menu setups independently of which setup the VLT is operating in (selected in parameter 001). This concerns programming via the keyboard and the serial bus (RS485).

PREPROGRAMMED contains the factory set data and can be used as a data source if the other setups are to be brought to a known status. The language is always English. It is not possible to change data once this setup has been chosen.

SETUP 1-4 is 4 individual setups which can be used as required. These can be programmed freely, irrespective of which setup the VLT is running in.

SET = PARAM 001 directs the control to follow the setup as selected in parameter 001.

NOTE: If data is changed in the setup in which the VLT is currently running, the changes have an immediate impact on the unit's function. This applies to both parameters 001 and 015.

(* Indicates factory default settings)

100
Load

LOAD TYPE

- Value:**
- VARIABLE TORQUE LOW [0]
 - VARIABLE TORQUE MEDIUM [1]
 - VARIABLE TORQUE HIGH [2]
 - CT START VT LOW [3]
 - CT START VT MEDIUM [4]
 - CT START VT HIGH [5]
 - CONSTANT TORQUE [6]
 - * CONSTANT TORQUE COMP [7]
 - CONSTANT TORQUE WITH [8]
 - FOUR QUADRANT COMP

(1) Variable Torque Low, (2) Medium, and (3) High, select between different profiles of the V/f ratio from 0 to 100% speed. All three of the profiles result in maximum voltage at maximum speed but differ in the voltage delivered at a given speed. For example; At 60% speed VT Low delivers approximately 35% voltage and VT High approximately 50% The choice of the curve will effect overall energy consumption and acoustic noise levels.

For additional breakaway torque capability select a VT curve with CT start. Start Voltage (parameter 109) and Start Compensation (parameter 110) can then be adjusted for maximum performance.

If using parallel or synchronous motors select strictly Constant Torque. This selection removes the compensations from the equation which could otherwise result in motor instability.

Constant Torque Comp is suitable for most standard induction motors running CT loads. To improve speed regulation in applications with over-hauling loads choose Constant Torque with Four Quadrant Comp. This activates Negative Slip Compensation, parameter 113.

101
Speed Control

SPEED CONT

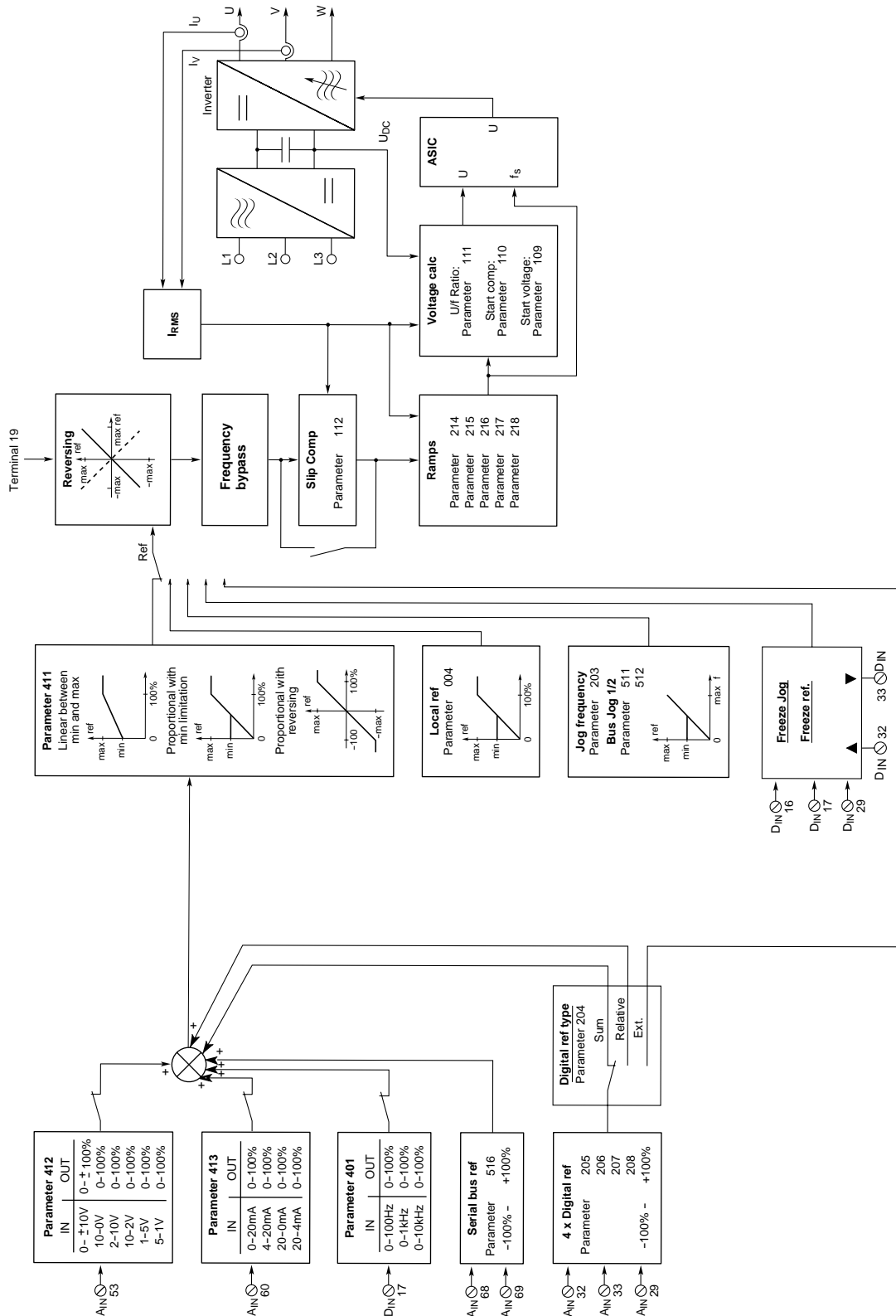
- Value:**
- OPEN LOOP [0]
 - * SLIP COMPENSATED [1]
 - CLOSED LOOP [2]

Selects between various degrees of speed regulation. Selecting Open Loop cancels the effect of Slip Compensation. By selecting Slip Compensated the slip of the motor can be overcome improving speed regulation to ± 0.5% over a 10-90% change in load. Adjust parameter 112 (Slip Compensation) for the optimal level of compensation required. Selecting Closed Loop enables the VLT's internal PID regulator improving speed regulation to ± 0.1%. Selecting PID requires the selection of a feedback device (parameter 114) and the proper entries to parameter 119 through 123.

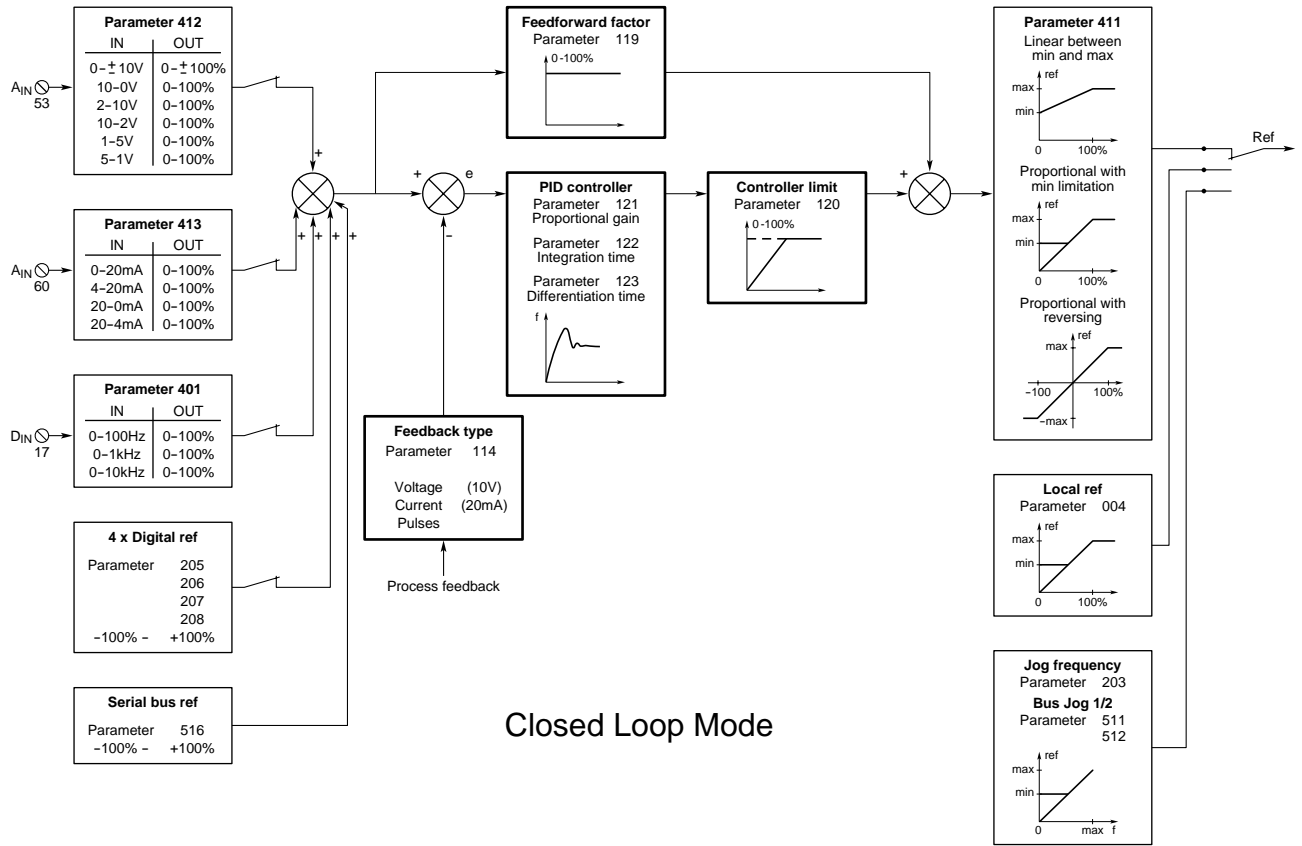
When parallel motors are connected select Open Loop to avoid system instability.

(* Indicates factory default settings)

Open Loop Mode



Closed Loop Mode



Closed Loop Mode

102
Current Limit Control

SET CUR LI

- Value:**
- ☛PROGRAM SET [0]
 - 10VDC SIGNAL [1]
 - 20mA SIGNAL [2]

Selects the control method for current limit. Program Set provides a fixed level for current limit as is programmed in parameter 209. A voltage or current signal can be used to vary the level of current limit from 0% current to the value programmed in parameter 209. Voltage signals are input on Terminal 53 and current signals are input on Terminal 60. A speed reference either digital or remote must also be provided. If a remote speed or feedback signal is used it can not be the same type of signal as used for controlling current.

103
Motor Power

MOTOR POWE

- Value:**
- UNDER SIZE [0]
 - ☛NOMINAL SIZE [1]
 - OVER SIZE [2]

Display will provide a numerical value for the three possibilities, depending on the unit.

Read the motor rated output of the motor nameplate and record the value in kW. Use the kW to HP conversion table if the motor is only rated in HP. It is possible to record one of three motor sizes in each frequency converter: one size under, nominal size, or one size over. For example, on a VLT 3022 (15 kW motor), you can choose a data value of "11", "15" or "22".

The VLT resets parameters 107 through 113 automatically to a nominal value when parameter 103 is changed.

HP	.75	1	1.5	2	3
KW	.55	.75	1.1	1.5	2.2
HP	5	7	10	15	
KW	4	5.5	7.5	11	
HP	20	30	40	50	
KW	15	22	30	37	
HP	60	75	100	125	
KW	75	90	110	132	
HP	150	200	250	300	
KW	132	160	200	250	

104
Motor Voltage

MOTOR VOLT

- Value:**
- 200-230V Range
 - ☛200V [0]
 - 220V [1]
 - 230V [2]
 - 380-415V Range
 - ☛380V [3]
 - 400V [4]
 - 415V [5]
 - 440-500V Range
 - 440V [6]
 - ☛460V [7]
 - 500V [8]

Within the voltage rating of the VLT three motor voltages can be selected. Read the rated motor voltage from the nameplate of the motor and enter that value here. Parameters 107 to 113 will be changed automatically in relation to the voltage selected.

(* Indicates factory default settings)

<p>105 Motor Frequency</p> <p>MOTOR FREQ</p>	<p>Value: 50Hz 60Hz 87Hz 100Hz</p>	<p>[0] [1] [2] [3]</p>	<p>Read the rated motor frequency from the nameplate of the motor and enter that value here. Parameters 107-113 will change automatically in relation to the frequency selected.</p>
--	---	------------------------------------	--

<p>106 Adaptive Motor Tuning</p> <p>AUTO MOTOR</p>	<p>Value: ☛Tuning OFF Tuning ON</p>	<p>[0] [1]</p>	<p>Adaptive tuning optimizes the parameter settings of 108 to 113 for the motor connected. This function can only be used if the motors nameplate values for Motor Power, Motor Voltage, and Motor Frequency can be programmed accurately. For motor values other than those available in the Data selection manual programming of parameters 108 through 113 will be required.</p> <p>CAUTION: During part of the tuning process the motor will run at 20Hz in the programmed direction. The motor load may not exceed 50 percent of the motors full load capacity.</p> <p>NOTE: Following the tuning process DO NOT adjust parameters 108 through 113 unless required by the application. Check, and adjust as necessary, the motor current value programmed in parameter 107. This value is not set by the tuning process.</p>
--	--	--------------------	---

To initiate the tuning process; enter the appropriate values in parameters 103, 104, and 105. Select "Tuning On" and provide the VLT with a run command from either the local keypad or the remote terminals. Following the tuning process the VLT will display "Alarm", "Trip" Tuning OK or Tuning Fault. If OK, press the reset button on the keypad. If not OK parameters 108 through 113 must be programmed manually. Parameter 106 will automatically be returned to Tuning Off.

<p>107 Motor Current</p> <p>MOTOR CURR</p>	<p>Value: $I_{MAG}(P108) - I_{VLT,MAX}$ (Intermittent amps)</p>	<p>The Electronic Thermal Relay (ETR) in UL listed VLT's provides class 20 motor overload protection in accordance with NEC in single motor applications, when parameter 315 is set for "TRIP" and parameter 107 is set for nominal motor rated (name plate) current.</p>	<p>Read the motors Full Load Amp (F.L.A.) rating from the nameplate and enter that value here. The accuracy of this entry is important for various calculations made by the VLT and to ensure proper protection is provided by the Electronic Thermal Relay if selected in parameter 315.</p>
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Note that the motor current value can not be lower than Magnetization Current as set in parameter 108. If a motor that is 2 or more times smaller than the nominal rating of the VLT is connected it will be necessary to lower parameter 108 so the correct current can be entered here.

<p>108 Motor Magnetizing</p> <p>MOTOR MAG</p>	<p>Value: $0.3 - I_{M,N}(P107)$</p>	<p>NOTE: DO NOT reset parameter 108-113 after using Adaptive Motor Tuning.</p>	<p>Enter the magnetizing current of the motor connected. This value is basically the current drawn by a motor running unloaded. The absolute value can be found in the manufacturers catalog or on the nameplate of some motors. If unknown, allow the VLT to select the value or choose an approximate value from the table of factory defaults.</p>
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(* Indicates factory default settings)

109
Start Voltage **Value:**
 0.0 - ($V_{MTR,NOM} + 10\%$)

START VOLT

Start Voltage is used to compensate for inadequate starting torque. The factory setting will be adequate for most applications. For loads requiring high starting torque Start Voltage will most likely need to be increased.

If several motors are connected in parallel Start Voltage will normally have to be increased.

Too much Start Voltage can result in excessive current being drawn at start up and motor instability especially at low speeds.

110
Start Compensation **Value:**
 0.00 - 99 V/A

START COMP

NOTE: For multiple motor applications Start Compensation must be set to Zero
 On VLT models 3060 to 3250, Start Compensation should normally be left at the factory default setting of 0.

Start Compensation provides a voltage supplement to the output as the load increases. This parameter assists in starting loads requiring high starting torques and loads with changing demands as speed increases. Too much Start Compensation can result in excessive current being drawn at start up and motor instability.

111
V/f Ratio **Value:**
 0.00 - 20 V/Hz

V/F RATIO

The V/F Ratio determines the amount of voltage delivered for each Hertz of frequency. For example a 7.66 V/F Ratio provides 7.66 Volts for every Hz or approximately 460 Volts at 60 Hertz. Adjustment is not required unless the motor voltage and frequency can not be programmed in parameters 104 and 105.

112
Slip Compensation **Value:**
 0.0 - 20%

SLIP COMP

Slip Compensation is used to overcome the loss in speed as the load and the amount of motor slip increases. Properly adjusted, Slip Compensation will provide speed regulation of 0.5% over a 10 to 90% change in load. To adjust, tach the motor speed at minimum load, then tach the speed at maximum load. Adjust the value until the speed at maximum load matches the speed at minimum load. For multiple motor applications Slip Compensation must be set to Zero.

113
Negative Slip Compensation **Value:**
 0.0 - 20%

NEG. SLIP

NOTE: For multiple motor applications Negative Slip Compensation must be set to Zero. Negative Slip Comp is only active when parameter 100 has been programmed for "Constant Torque with Four Quadrant Comp"

Negative Slip Compensation is used to overcome the gain in speed when overhauling loads are generated back to the VLT. To adjust, tach the motor speed during non regenerative conditions, then tach the motor speed during regenerative conditions. Adjust the value until the speed of the motor under both conditions is equal.

(* I ndicates factory default settings)

<p>114 Feedback Type</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;">FEEDBACK T</div>	<p>Value: VOLTAGE ←CURRENT PULSES</p>	<p>[0] [1] [2]</p>	<p>Selects the feedback signal type when using the internal PID controller.</p> <p>The signal is input on Terminal 17, for pulses, Terminal 53, for voltage, and Terminal 60, for current. The terminal chosen must also be programmed to accept the feedback signal. When choosing the feedback signal the reference set point signal can not be of the same type.</p>
--	--	----------------------------	---

<p>115 Display Value at Minimum Feedback</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;">DIS VLU @ MI</div>	<p>Value: 0 - 9999 ←0</p>	<p>[0] [1] [2]</p>	<p>Parameters 115 and 116 are programmed to provide a display readout that is proportional to the feedback signal when operating in closed loop mode. If for example the feedback signal equates to a motor operating between 1000 and 1500 RPM, the value of 1000 would be entered in parameter 115 and 1500 in parameter 116. Choose display engineering unit in parameter 117.</p>
--	--	----------------------------	---

<p>116 Display Value at Maximum Feedback</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;">DIS VLU @ MA</div>	<p>Value: 0 - 9999 ←100</p>	<p>[0] [1] [2]</p>	<p>Parameters 115 and 116 are programmed to provide a display readout that is proportional to the feedback signal when operating in closed loop mode. If for example the feedback signal equates to a motor operating between 1000 and 1500 RPM, the value of 1000 would be entered in parameter 115 and 1500 in parameter 116. Choose display engineering unit in parameter 117.</p>
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<p>117 Display Unit</p> <div style="border: 1px solid black; padding: 2px; width: fit-content;">DISPLAY UN</div>	<p>Value:</p> <table border="0" style="width: 100%;"> <tr> <td>←%</td><td>[0]</td><td></td><td>[20]</td></tr> <tr> <td>°C</td><td>[1]</td><td>°F</td><td>[21]</td></tr> <tr> <td>PPM</td><td>[2]</td><td>PPM</td><td>[22]</td></tr> <tr> <td>Pa</td><td>[3]</td><td>In HG</td><td>[23]</td></tr> <tr> <td>bar</td><td>[4]</td><td>bar</td><td>[24]</td></tr> <tr> <td>rpm</td><td>[5]</td><td>RPM</td><td>[25]</td></tr> <tr> <td>l/sec.</td><td>[6]</td><td>gal/sec.</td><td>[26]</td></tr> <tr> <td>m³/sec</td><td>[7]</td><td>ft³/sec.</td><td>[27]</td></tr> <tr> <td>l/min</td><td>[8]</td><td>gal/min.</td><td>[28]</td></tr> <tr> <td>m³/min</td><td>[9]</td><td>ft³/min.</td><td>[29]</td></tr> <tr> <td>l/h</td><td>[10]</td><td>gal/hr</td><td>[30]</td></tr> <tr> <td>m³/h</td><td>[11]</td><td>ft³/h</td><td>[31]</td></tr> <tr> <td>kg/sec</td><td>[12]</td><td>LB/sec.</td><td>[32]</td></tr> <tr> <td>kg/min</td><td>[13]</td><td>LB/min.</td><td>[33]</td></tr> <tr> <td>kg/h</td><td>[14]</td><td>LB/h</td><td>[34]</td></tr> <tr> <td>T/h</td><td>[15]</td><td>ton/min.</td><td>[35]</td></tr> <tr> <td>m</td><td>[16]</td><td>FT</td><td>[36]</td></tr> <tr> <td>Nm</td><td>[17]</td><td>LP FT</td><td>[37]</td></tr> <tr> <td>m/sec.</td><td>[18]</td><td>FT/sec.</td><td>[38]</td></tr> <tr> <td>m/min.</td><td>[19]</td><td>FT/min.</td><td>[39]</td></tr> </table>	←%	[0]		[20]	°C	[1]	°F	[21]	PPM	[2]	PPM	[22]	Pa	[3]	In HG	[23]	bar	[4]	bar	[24]	rpm	[5]	RPM	[25]	l/sec.	[6]	gal/sec.	[26]	m ³ /sec	[7]	ft ³ /sec.	[27]	l/min	[8]	gal/min.	[28]	m ³ /min	[9]	ft ³ /min.	[29]	l/h	[10]	gal/hr	[30]	m ³ /h	[11]	ft ³ /h	[31]	kg/sec	[12]	LB/sec.	[32]	kg/min	[13]	LB/min.	[33]	kg/h	[14]	LB/h	[34]	T/h	[15]	ton/min.	[35]	m	[16]	FT	[36]	Nm	[17]	LP FT	[37]	m/sec.	[18]	FT/sec.	[38]	m/min.	[19]	FT/min.	[39]	<p>Choose the engineering unit to be displayed when using parameters 115 and 116.</p> <p>Parameters 115 through 117 are for display purposes only. Adjustment of these parameters has no other effect on the feedback signal.</p>
←%	[0]		[20]																																																																															
°C	[1]	°F	[21]																																																																															
PPM	[2]	PPM	[22]																																																																															
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m/min.	[19]	FT/min.	[39]																																																																															

Parameters 119 through 125 are used in conjunction with the PID regulator. No adjustment is necessary if PID is not being used.

119
Feed-Forward Factor

Value:
0 - 500%
☛100%

FEED FWD F

The percentage of Feed Forward determines how much of the reference setpoint is transferred directly to the output, bypassing the PID regulator. Choosing 100 percent means the PID controller regulates speed by making only small changes to the setpoint. Choosing a value less than 100% would result in the regulator having an effect on a larger portion of the setpoint and in turn may also result in undesirable overshoot.

120
Controller Range

Value:
0 - 100%
☛100%

CONTRL RAN

The Control Range sets the bandwidth of the output of the PID regulator as a percentage of the maximum frequency programmed in parameter 202. As the bandwidth is reduced, speed variations will be smaller and if reduced too far will limit the operating range of the PID regulator.

121
Proportional Gain

Value:
OFF - 10.00
☛0.01

PROPRT/L G

Proportional gain acts as a multiplier to the error signal present between the setpoint and the feedback signal. Sufficient gain is required to reduce the offset between the error signal and the setpoint. High gain selections result in large responses to small errors. Higher gain selections may provide faster regulation response, but may also cause instability in the process.

122
Integral Time

Value:
0.01 sec - 9999 sec
☛OFF

INTEGRAL T

The integral time function is used to reduce or eliminate the offset. The amount of offset error is calculated and added to the proportional correction. For each integral time period, while an error exists, the integral function will add the offset error to the proportional correction. The shorter the integral time, the more often the offset correction is made. Short integral times result in fast dynamic response, but too short results in overshoot and ringing which will cause instability. Long integral times slow the responsiveness and too long may prevent the setpoint from ever being reached.

(* Indicates factory default settings)

123
Differentiation Time
Value:
OFF - 10.00
←OFF

DIFFERNTL

The differential time function is used to eliminate overshoot. The differential function predicts the amount of overshoot. Short differential times create fast responses as the corrections are made immediately at the presence of the error. Longer times result in slower response but larger contributions to the error correction signal. Differential time is normally used in high inertia applications. Since this function predicts overshoot it can also cause instability if rapid setpoint changes are made.

124
Low Pass Filter
Value:
0 - 10.00 sec
←0.00

LOWPASS FI

Establishes a cutoff frequency at which point the PID regulator will not respond to a frequency higher than the cutoff. The value selected sets the period time of the cutoff frequency.

For example: A choice of 0.1 sets the cutoff frequency at 10Hz, $1/0.1 = 10$. The PID regulator will then only respond to feedback signals which vary at a frequency of less than 10Hz.

125
Feedback Factor
Value:
0 - 500%
←100%

FEEDBACK F

The feedback is used if the feedback transmitter can not be selected optimally for the scaled range of the setpoint. For example: If when the setpoint is 50% the feedback is only 25% a factor of 200% could be entered to correct the scaling. ($25\% \times 200\% = 50\%$).

200
Frequency Range
FREQ RANGE

Value:
 * 0 - 120 Hz
 0 - 500 Hz

[0]
 [1]

Enter the maximum desired VLT output frequency range.

CAUTION:
 When exceeding 120hz, verify that motor/application is properly designed.

201
Min Frequency
MIN FREQUE

Value:
 0 - f_{MAX}
 * 0.00 Hz

Enter the output frequency corresponding to the minimum reference input.

202
Max Frequency
MAX FREQUE

Value:
 $f_{MIN} - f_{RANGE}$
 * Depending on unit

Enter the output frequency corresponding to the maximum reference input. The max. frequency will be limited by the Frequency Range set in Parameter 200.

203
JOG Frequency
JOG FREQUE

Value:
 0 - f_{RANGE}
 * 10 Hz

Provides a preset fixed output frequency during a JOG command. The JOG frequency can be lower than the minimum output frequency recorded in parameter 201.

204
Digital Reference Type
DIG REF

Value:
 * SUM
 RELATIVE
 EXT. ON/OFF

[0]
 [1]
 [2]

The digital reference is set in percentage of f_{MAX} (sum) or of the analog reference (relative) (-100% to +100%). Max. frequency will always limit the output.

205
Digital Reference 1
REF 1 DIG

Value:
 -100% to +100%
 * 0

Only one of the digital references can be active at any one time.

Activating the digital reference remotely is done on terminal input 32 and 33.

206
Digital Reference
REF 2 DIG

Value:
 -100% to +100%
 * 0

Parameter 405 allows for switching the external control of the digital references ON and OFF externally using terminal input 29.

207
Digital Reference 3
REF 3 DIG

Value:
 -100% to +100%
 * 0

32	33	
0	0	Digital reference 1
1	0	Digital reference 2
0	1	Digital reference 3
1	1	Digital reference 4

208
Digital Reference 4
REF 4 DIG

Value:
 -100% to +100%
 * 0

SUM: Will "SUM" the digital reference to the analog input.
 RELATIVE: The digital reference will act as a multiplier to the analog input.
 EXT. ON/OFF: Switches between analog input and digital reference.

(* Indicates factory default settings)

Refer to graph for parameters 209-213

**209
Current Limit**

CURRENT LI

Value:
 $0 - I_{VLT-MAX}$
 * Depending on unit

Sets the max allowable output current of the VLT. The factory set value corresponds to a 160% load of the nominal motor size. Settings between 105% and 160% may be applied during intermittent operation. If the Current Limit Value is set too low, the motor may not start.

**210
Warning Frequency Low**

LOW FREQ A

Value:
 $0 - f_{RANGE}$
 * 0.0

A logic output may be programmed to provide an alarm signal using parameters 407-410.

This value sets the lower warning frequency $f_{CR,LOW}$ of the VLT operation range.

If the output frequency drops below $f_{CR,LOW}$, the display shows RUN OUT RANGE.

**211
Warning Frequency High**

HI FREQ A

Value:
 $0 - f_{RANGE} + 10\%$
 * 132Hz

A logic signal output may be programmed to provide an alarm signal using parameters 407-410.

This value sets the high warning frequency $f_{CR,HIGH}$ of the VLT operation range.

If the output frequency rises above $f_{CR,HIGH}$, the display shows FREQ VAR HIGH.

**212
Warning Current Low**

LO CURR A

Value:
 $0 - I_{VLT, MAX}$
 * 0.0

A logic signal output may be programmed to provide an alarm signal using parameters 407-410.

This value sets the lower warning current $I_{CR,LOW}$ of the VLT operation range.

If the output current drops below $I_{CR,LOW}$, the display shows RUN OUT RANGE.

**213
Warning Current High**

HI CURR A

Value:
 $0.0 - I_{VLT, MAX}$
 * $I_{VLT, MAX}$

The signal output may be programmed to provide an alarm signal using parameters 407-410.

This value sets the high warning current $I_{CR,HIGH}$ of the VLT's operation range.

If the output current is higher than $I_{CR,HIGH}$, the display shows CURR VAR HIGH.

(* Indicates factory default settings)

214
Ramp Type

RAMP TYPE

Value:
* LINEAR
S CURVE 1
S CURVE 2
S CURVE 3

[0]
[1]
[2]
[3]

Select the shape of the ramp up and the ramp down. The sine shapes provides a softer start and stop during the acceleration and deceleration.

A minimum of 3 seconds ramp time is recommended when using a S-curve ramp.

Ramp Type

215
Ramp-up Time

RAMP UP TI

Value:
0.00 - 3600 SEC
* Depending on unit

The ramp-up time t_a is the acceleration time from 0 Hz to the rated motor frequency. This assumes that the output current is not higher than the current limit in parameter 209.

216
Ramp-down Time

RAMP DOWN

Value:
0.00 - 3600 SEC
* Depending on unit

The ramp down time t_d is the deceleration time from the rated motor frequency to 0 Hz. The time may be affected by excessive load inertia.

High braking energy may require installation of a dynamic brake option.

217
Alternative Ramp-up Time

ALT UP RA

Value:
0.00 - 3600 SEC
* Depending on unit

The alternative ramp-up provides an acceleration time independent of the ramp found in parameter 215.

The alternative ramp-up is only activated with a JOG command (terminal 29, parameter 405).

The alternative ramp-down provides a deceleration time independent of the ramp found in parameter 216.

218
Alternative Ramp-down Time

ALT DOWN

Value:
0.00 - 3600 SEC
* Depending on unit

The alternative ramp down is activated during a remote Quick Stop command or release of the JOG command (terminal 27, parameter 404).

(* Indicates factory default settings)

Parameter Group 2

References and Limits

219
Frequency Bypass 1
Value:
0 - f_{RANGE}
* 120

FREQ 1 BYP

220
Frequency Bypass 2
Value:
0 - f_{RANGE}
* 120

FREQ 2 BYP

221
Frequency Bypass 3
Value:
0 - f_{RANGE}
* 120

FREQ 3 BYP

222
Frequency Bypass 4
Value:
0 - f_{RANGE}
* 120

FREQ 4 BYP

223
Frequency Bypass
Bandwidth
Value:
0 - 100%
* 0

BYPASS B W

224
Carrier Frequency
Value:
2 - 14kHz
* 4.5kHz

CARRIER FR

De-Rated 30% at 14kHz
Linearly back down to 5kHz

CAUTION: Do not exceed 4.5kHz with the VLT 3060-3250.

(* Indicates factory default settings)

Some systems require that certain output frequencies are avoided because of resonance problems.

Enter up to four (4) of the frequencies to be avoided and record the band-width in percentage of the frequency.

The bypass bandwidth is entered as a percentage (%) of the set bypass frequencies. Example:
Bypass set at: 20Hz
Bandwidth set at: 10%
Size of Skip Frequency = 2Hz
VLT will not allow maintained operation in 19-21Hz range.

The value recorded sets the internal carrier frequency of the VLT. The carrier frequency is modulating the switching of the inverter output transistors.

NOTE: On models VLT 3060-3250 DO NOT exceed 5kHz switching frequency.

Parameter 224 allows for the adjustment of the VLT carrier frequency from 2kHz to 14kHz. The factory default setting of 4.5kHz is acceptable in the majority of industrial installations, but in areas where motor acoustic noise is a concern, it will be reduced by increasing the carrier frequency. The application will need to be derated in situations that use a carrier frequency greater than 4.5kHz as follows:

a) To prevent an overload on the internal VLT motor coils, the maximum motor cable lead length cannot exceed 130 feet (40 meters) when the carrier frequency is greater than 4.5kHz.

b) The maximum current (torque) is linearly derated from 100% at 4.5kHz to 60% when operating at 14kHz.

225
Output frequency -
Dependent carrier
frequency

Data Value:
 DISABLE
 HIGH CARR @LOW
 LOW CARR @LOW

[0]
 [1]
 [2]

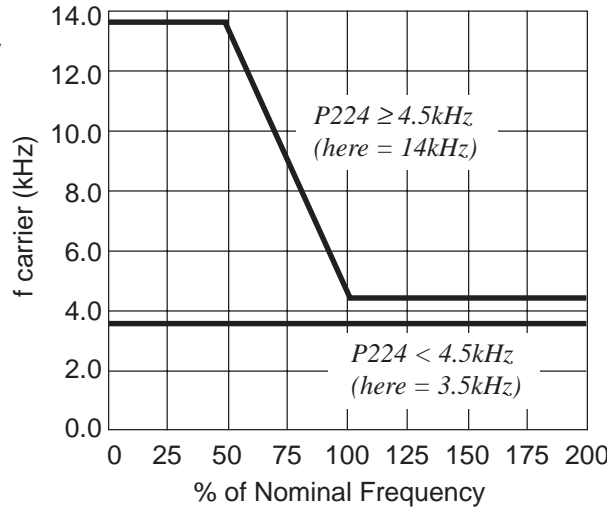
The parameter allows the option for the VLT series 3000 carrier frequency to be self-tuning dependent upon the operating output frequency. Parameter 225 interacts with the carrier frequency set in Parameter 224; CARRIER FREQUENCY in the following manner:

DISABLE [0]:

The VLT will operate with the fixed carrier frequency set in Parameter 224; CARRIER FREQUENCY.

NOTE: For models VLT 3032-3052/230V and VLT 3060-3250/380-500V, the factory default is Data Value [2]. For all other models, the factory default is Data Value [0].

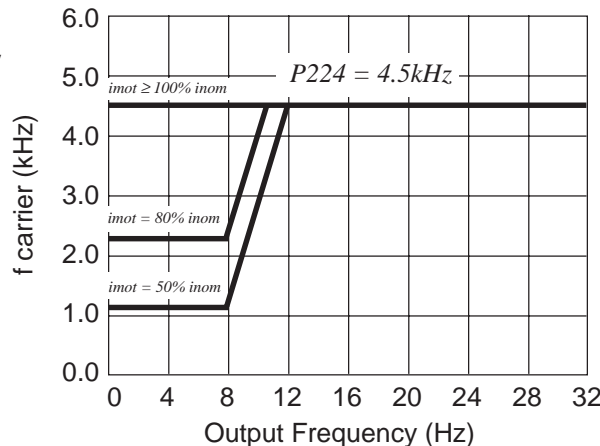
High Carrier Frequency at Low Speed (Figure 1)



HIGH CARR @LOW [1] (Figure 1):

When the VLT unit is running from 0 to 50% of its nominal output frequency (speed), the carrier frequency is operating at the value set in Parameter 224. When the output frequency exceeds 50%, the carrier decreases proportionally and linearly to 4.5kHz. If Parameter 224 is set for ≤ 4.5kHz, the carrier frequency will remain consistent over the entire output frequency range. NOTE: Figure 1 is an example of parameter 224 set to 3.5kHz.

Low Carrier Frequency at Low Speed (Figure 2)



LOW CARR @LOW [2] (Figure 2):

This Data Value is only active for the VLT Series 3032-3052 / 230V and VLT 3060-3250 / 380-500V. This Data Value is specifically useful to obtain smooth low speed performance. During low speed (0-12Hz) operation the carrier frequency will modulate automatically based on motor speed and current. When the output frequency is >12Hz the carrier frequency will be maintained at the value set in Parameter 224.

(* Indicates factory default settings)

230
Brake Cut-out
Frequency

Value:
 0.5Hz-f_{RANGE}
 * 003.0Hz

BRAKE OFF

Parameter 230 through 233 are provided for installations that involve the use of electro-mechanical brake to control the load.

Relay 01 or 04 can be used to provide a control signal to the brake's controller to activate and de-activate the brake appropriately.

Select the frequency at which the external brake is to be released via Relay 01/04.

The electromechanical brake must hold the motor until the selected frequency is reached, after which the brake is released (voltage impressed via a relay).

If the frequency with connected start signal drops below the selected value, the voltage to the brake is removed and it again becomes active.

231
Brake Cut-in
Frequency

Value:
 0.5Hz-f_{RANGE}
 * 003.0Hz

BRAKE ON F

Select the frequency at which the external brake is to be activated by stop via Relay 01/04.

The electromechanical brake on the motor must first be activated (voltage removed) when the frequency during ramp-down reaches the set value.

232
Current,
Minimum value

Value:
 $0.0 \times I_{VLT,MAX} - I_{LIM}$
 * $0.5 \times I_{MAG}$

CURR MIN V

Select the minimum current value to release the brake.

The brake is released (voltage impressed via a relay) when the minimum current value is reached.

This function is not active until expiration of the time set in parameter 233.

233
Current,
Delay time

Value:
 0.0 - 1.0 sec
 * 0.10 sec

CURR DLAY

Select the delay time for the current monitoring (parameter 232).

it is necessary to allow the motor current to rise to a selected value (parameter 232) before release of the brake (voltage impressed via a relay).

If 0.0 sec. is selected, the brake is not released until the preselected minimum current is reached.

(* Indicates factory default settings)

300
Brake Option
BRAKE OPTI

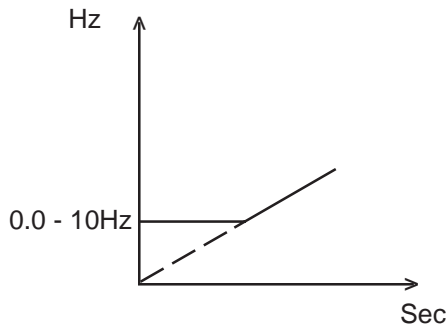
Value:
 * NOT APPLIED [0]
 APPLIED [1]

Used to adapt the overvoltage monitoring, depending on the presence of a brake option.

301
Start Frequency
START FREQ

Value:
 0.0 - 10 Hz
 * 0.0

Set the start frequency to the value where the motor should begin running.



302
Start Delay
START DELA

Value:
 0.0 - 1 SEC
 * 0.0

The VLT will start on the frequency programmed in parameter 301 and begin ramping up after the start delay time is over.

303
High Starting Torque
HI START T

Value:
 0.0 - 1 SEC
 * 0.0

Set the time required for high starting torque situations. High starting torque temporarily cancels the current limit and the VLT is allowed to supply current up to the maximum inverter component current limit (approximately 200%).

304
Power Fail
POWER FAIL

Value:
 * NORMAL POWER DOWN [0]
 NORMAL RAMP DOWN [1]
 ALTERNATIVE RAMP DOWN [2]

Select one of the three RAMP-DOWN functions to prolong ride through time during power outages. The actual time will be dependent on the load on the motor. Selecting NORMAL RAMP or ALTERNATIVE RAMP will keep the software active for longer duration during a power down situation.

(* Indicates factory default settings)

305
Flying Start

FLYING STA

Value:
 * NO FLYING START [0]
 SAME DIRECTION [1]
 BOTH DIRECTIONS [2]
 DC BRAKE-BEFORE-START [3]

Select FLYING START if the motor shaft is likely to be rotating before start is initiated. FLYING START can also restart the drive after long line interruptions without stopping.

Flying Start provides the opportunity to "catch" a spinning motor and assume control of its speed. For details on some typical scenarios for Flying Start, see the figure below.

To properly produce a flying start function, refer to the following examples 1, 2 and 3. Example 4 will not produce a flying start.

Example 1:
 ① AC line, ② Start, ③ Enable. Before closing ①, both ② and ③ must be closed and maintained.

Example 2:
 Both Start and Enable are permanently jumpered so that upon closure of the AC line, a Flying Start will be active.

Example 3:
 A contactor on the VLT output with an interlock logic contact for the Enable will provide a Flying Start. The VLT has AC power supplied constantly.

Example 4:
 This Example demonstrates a typical start command that does not produce a Flying Start.

(* Indicates factory default settings)

306
DC Braking Time

Value:
0 - 60 SEC
* 0.0

DC BRAKE T

DC Injection Braking will provide braking torque on an asynchronous motor's shaft during deceleration by injecting a DC current to the stator. The DC current is regulated so as not to exceed the current limit in parameter 209. Parameter 306 determines the duration of time the DC current is injected.

307
DC Brake Cut-in Frequency

Value:
0 - f_{RANGE}
* 001.0

DC-BRK ON

Enter at what output frequency the injection will start. Maximum Frequency is determined by the range selected in parameter 200.

308
DC Brake Voltage

Value:
0 - 50V
* Depending on unit

DC-BRK VOL

Enter the magnitude of the DC voltage to induct the DC current.

309
Reset Mode

Value:
* MANUAL [0]
AUTOMATIC x 1 [1]
AUTOMATIC x 2 [2]
AUTOMATIC x 3 [3]
AUTOMATIC x 4 [4]
AUTOMATIC x 5 [5]
AUTOMATIC x 6 [6]
AUTOMATIC x 7 [7]
AUTOMATIC x 8 [8]
AUTOMATIC x 9 [9]
AUTOMATIC x 10 [10]
START INHIBIT [11]

RESET MODE

If it is desired that the VLT try to automatically restart after a trip, record AUTO RESET.

WARNING:
The motor may start without warning.

Record how many times the VLT should attempt to start automatically within a 10 min. period.

Manual reset may be allowed either from a remote or local command, see parameter 006.

Start Inhibit requires cycling of the AC power.

310
Trip Delay at Current Limit

Value:
0 - 60 SEC
* OFF

TRIP DLY @ C

When the VLT registers that the output current has exceeded the current limit ILIM, (parameter 209), it will await a trip command. Enter the time duration the VLT should wait before tripping out.

311
Trip Delay at Inverter Fault

Value:
0 - 35 SEC
* Depending on unit

TRIP DLY @ F

When the VLT registers an inverter fault, it will await a trip command. Record the time duration desired before tripping out.

312
Max Auto Restart Time

Value:
0 - 10 SEC
* 5 SEC

AUTO RESTA

Enter the amount of time for an automatic reset (parameter 309) before tripping out.

(* Indicates factory default settings)

313
Motor Check

Value:
 * OFF [0]
 ON [1]

If programmed "ON", the presence of a motor is checked when motor coast is enabled (terminal 27 = ON).

MOTOR CHEC

Note:
 Parameter 313 is NOT operational on models VLT 3060-3250 and VLT 3032-3052/230V.

If no motor is connected, NO MOTOR is displayed. Motor Check is activated every 30 secs. for a 3 sec. duration.

314
Motor Preheat

Value:
 * OFF [0]
 ON [1]

If "ON" is selected, the motor will be preheated by a DC current when motor coast is enabled (terminal 27 = ON). Motor Preheat is active for a 30 second duration and off for 3 seconds. Motor Preheat injects a current equal to 70% of the drives default value.

MOTOR PRE

Note:
 Parameter 314 is NOT operational on models VLT 3060-3250 and VLT 3032-3052/230V.

315
Motor Thermal Protection

Value:
 * OFF [0]
 WARNING 1 [1]
 TRIP 1 [2]
 WARNING 2 [3]
 TRIP 2 [4]
 WARNING 3 [5]
 TRIP 3 [6]
 WARNING 4 [7]
 TRIP 4 [8]

The VLT calculates if the motor temperature exceeds the permissible limits. Enter OFF if no warning or trip is desired. Enter WARNING if an ALARM, OVER TEMP readout in the display is desired. A logic signal output may be programmed for remote indication of WARNING, see parameters 407-410. Selecting TRIP causes the VLT to trip out if the temperature is exceeded, following parameters 309-312.

MOTOR THER

316
Relay ON-Delay

Value:
 0 - 10 SEC
 * 0

The VLT can be programmed to provide an alarm signal via the relay signal outputs on terminals 01, 02, 03 (Relay 01).

TIMER 1

317
Relay OFF-Delay

Value:
 0 - 10 SEC
 * 0

Parameters 316 and 317 provide delay timers to control the response time for the switch ON/OFF delay of the relay associated with terminals 01, 02, 03 (Relay 01).

TIMER 2

(* Indicates factory default settings)

400
Binary Input 16

INPUT 16

- Value:
 * RESET
 STOP
 FREEZE REFERENCE
 SETUP SELECTOR
 THERMISTOR

- [0]
- [1]
- [2]
- [3]
- [4]

This parameter is used for programming the function of Terminal 16 on the logic terminal block. Unless stated otherwise in a data values description, Terminal 12 is reference for Terminal 16.

RESET: Provides a reset following a fault condition upon a closure.

STOP: A normally closed (NC) contact which stops the VLT when opened.

FREEZE REFERENCE: In a closed condition, the VLT will lock its output frequency to the speed reference value last present. If freeze reference is active when AC power is removed, the unit will power up and resume operating at that value.

SETUP SELECT: Used in conjunction with Terminal 17 and parameter 001 providing an external input for selection of one of the four menu sets in which to operate (see Parameter 001 for details).

Setup	Terminal 17	Terminal 16
1	0	0
2	0	1
3	1	0
4	1	1

NOTE: If multiple setup selections have been made in parameter 001, then the option is available with Terminal 16 between setup 1 ("0") and setup 2 ("1"). If there is a need for more than 2 setups, both Terminals 16 and 17 (parameter 401) are used to select setup.

ALARM
 TRIP
 MOTOR TRIP

THERMISTOR: Selected if a motor's possible built-in thermistor is to be able to stop the VLT if the motor overheats. The cut-out value is $\geq 3 \text{ k}\Omega$. The thermistor is connected between Terminal 50 (+10V) and Terminal 16. When the thermistor's resistance exceeds $3 \text{ k}\Omega$, the VLT will show the display to the left.

The thermistors can be connected in a series in the operation of parallel-coupled motors. The number of thermistors permitted in a series depends upon the thermistor's ohmic value in heated operating status.

NOTE: If a thermistor is selected in parameter 400 without being connected, the VLT engages the ALARM mode. To come out of this status, the stop/reset button must be held while the data value is changed using the "+/-" keys.

(* Indicates factory default settings)

401
Binary Input 17

INPUT 17

- Value:**
 RESET
 STOP
 * FREEZE REFERENCE
 SETUP SELECTOR
 PULSE INPUT 100Hz
 PULSE INPUT 1kHz
 PULSE INPUT 10kHz

- [0]
- [1]
- [2]
- [3]
- [4]
- [5]
- [6]

Used to select between various function options available for Terminal 17. Terminal 12 is reference for Terminal 17.

The RESET, STOP, FREEZE REFERENCE and SELECT SETUP options are the same as those defined for Terminal 16.

PULSE INPUT: Terminal 17 can be used for pulse train signals in the ranges 0-100 Hz, 0-1 kHz and 0-10 kHz.

The pulsing signal can be used as a speed reference for ordinary operation either as set-point or as feedback signal on operation in "closed loop" (PID regulator), also see parameter 101. Pulse generators with PNP signal outputs can be used between Terminals 12 and 17. Note; Frequencies higher than 1kHz require pulse generators with a push-pull output.

402
Binary Input 18

INPUT 18

- Value:**
 * START
 LATCH START
 NO OPERATION

- [0]
- [1]
- [2]

This parameter is used for selecting function options for Terminal 18, Terminal 12 is reference

START: Select if a start/stop function is required (see the Typical Logic Wiring section).

LATCH START: Allows a momentary closure in order to lock the VLT into a running condition, typical in 3-wire Start/Stop configurations. A direction change or stop command is necessary to unlock the run condition.

NO OPERATION: Deactivates the terminal completely.

(* Indicates factory default settings)

403
Binary Input 19

INPUT 19

Value:
* REVERSING
START REVERSE
NO OPERATION

[0]
[1]
[2]

Parameter 403 determines the operation of Terminal 19, Terminal 12 is the reference.

REVERSING: This option only dictates a directional change (open = forward; close = reverse). This input does not produce a start command. For operation of the VLT, a start command must be present on another terminal.

START REVERSE: A maintained closure produces a reverse and a start command simultaneously; a separate start command is not necessary.

NO OPERATION: Deactivates the terminal completely.

<p>2 - WIRE START/STOP</p> <p>Parameter 402 = Star Parameter 404 = Quick Stop</p>	<p>3 - WIRE START/STOP</p> <p>Parameter 400 = Stop Parameter 401 = Reset Parameter 402 = Latched Start Parameter 403 = No operation Parameter 404 = Quick Stop Parameter 405 = Jog</p>
--	---

Note: For a 3-wire START/STOP operation, program Parameter 400 for STOP and Parameter 402 for LATCHED START. Use a normally closed contact on Terminal 16 and a normally open contact on Terminal 18, with both referenced to Terminal 12.

(* Indicates factory default settings)

404
Binary Input 27

INPUT 27

Value:

* MOTOR COASTING
QUICK-STOP
DC BRAKE
RESET & MOTOR COASTING
STOP

[0]
[1]
[2]
[3]
[4]

Parameter 404 is used for selecting function options for Terminal 27, Terminal 12 is reference.

Note: The motor can only operate if there is a closure between Terminal 12 and Terminal 27. An open condition will mean a command via the RS-485 serial port can override a open ("O") command.

MOTOR COASTING: A normally closed input which, when opened, will cause the motor to be released and coast to a stop.

QUICK-STOP: This selection governs the stopping of a motor according to an alternative ramp time in Parameter 218. This option is a normally closed input which, when opened, will ramp down to zero following the shortest deceleration rate of 0.5 seconds (it will also use the DC injection braking if the unit has been programmed to activate it).

DC BRAKE: This option is used in conjunction with optional dynamic brake accessories; to provide full braking down to zero speed. It is activated on an open ("O") logic condition.

RESET & MOTOR COASTING: An open condition will cause the motor to coast to zero while simultaneously resetting the fault condition.

STOP: A momentary opening will cause the unit to lock into a stopped condition until a start command is received.

(* Indicates factory default settings)

405
Binary Input 29

INPUT 29

Value:
* JOG
JOGGING FREEZE
FREEZE REFERENCE
DIGITAL REFERENCE
RAMP SELECTION

[0]
[1]
[2]
[3]
[4]

Parameter 405 is used for selecting different function options for Terminal 29, Terminal 12 is reference.

JOG: Upon closure, the AFD will operate at the speed determined by the speed referenced in Parameter 203. A separate start command to activate this option is **not** required.

JOGGING FREEZE: While using the jogging speed as the basis, this option is selected if Terminals 32/33 (Parameter 406) are to be used for digital speed control UP/DOWN. A closed contact on Terminal 29 will freeze the jogging reference, and then the speed can be changed with the help of Terminal 32/33.

FREEZE REFERENCE: This option can be selected in order to use Terminals 32/33 (Parameter 406) for digital speed control UP/Down (motor potentiometer). Logic "1" on Terminal 29 will freeze the present reference, and the speed can be changed using Terminal 32/33 (Parameter 406 = speed UP/DOWN).

DIGITAL REFERENCE: Upon a closure, this option is used to select one of the digital references in Parameters 205-208 or one of the following; analoge input voltage (Parameter 412), analoge input current (Parameter 413) or bus reference (Parameter 516).

The digital reference can function only if the "external On/Off" option has been selected in Parameter 204. When the digital reference is activated the speed direction is determined exclusively by the reference sign (\pm).

RAMP SELECTION: Different ramp times can be selected by using Terminal 29:
Terminal 29 = "0" - Ramp (Par. 215/216)
Terminal 29 = "1" - Alt. Ramp (Par. 217/218)

The selected ramp UP/DOWN times apply on START/STOP via Terminal 18 or Terminal 19 and during reference changes.

The selection of Quick Stop via Terminal 27 will automatically activate the alternative ramp-down time (Parameter 218).

(* Indicates factory default settings)

406
Binary Input 32/33

INPUT 32/33

Value:
 SPEED SELECT [0]
 SPEED UP/DOWN [1]
 SETUP SELECT [2]
 ←4 SETUP EXTENDED [3]

Parameter 406 selects between different function options for Terminals 32/33.

SPEED SELECT

Digital Reference	Terminal 32	Terminal 33
1 (parameter 205)	0	0
2 (parameter 206)	1	0
3 (parameter 207)	0	1
4 (parameter 208)	1	1

SPEED SELECT: With the aid of the following binary code table, select between 4 different preprogrammed speed references.

SPEED UP/DOWN

	Terminal 32	Terminal 33
No reference Change	0	0
Increase reference	1	0
Reduce reference	0	1
Reduce reference	1	1

SPEED UP/DOWN: Selected for digital speed control up/down. This function is only active if the Freeze reference/Freeze jogging has been selected in Parameters 400, 401 or 405, and the equivalent Terminals 16, 17 or 29 are closed ("1"). If Terminal 32 is closed ("1"), then the output frequency will increase towards f_{MAX} (Parameter 202). If Terminal 33 is closed ("1"), the output frequency will decrease towards f_{MIN} (Parameter 201). Terminal 33 is most significant and takes priority in the advent of closures on both.

A pulse (closure with a duration between 20 ms and 500 ms) will cause a speed change of 0.1 Hz to the output. Logic "1" for more than 500 ms will cause the output frequency to change according to the set ramps (Parameters 215 and 216).

Speed reference can be set even though the unit has stopped; but this does not apply during a motor coasting, quick stop or DC brake command on Terminal 27. If the speed reference has been constant for at least 15 seconds, then it will be stored even if the AC line has been interrupted (see Parameter 014).

SETUP SELECT

Setup	Terminal 32	Terminal 33
1	0	0
2	1	0
3	0	1
4	1	1

SETUP SELECT: If "multi setup" has been selected in Parameter 001, then it is possible to choose remotely between setup 1, setup 2, setup 3 or setup 4 as described in the table to the left.

(* Indicates factory default settings)

406
Binary Input 32/33

INPUT 32/33

(Continued)

4 SETUP EXTENDED: This option provides the same function on Terminals 32/33 as the first generation of VLT® Series 3000 with the extended control card and 4 setup functions. If the Freeze Reference was not selected in parameters 400, 401 or 405, then follow the setups as illustrated below.

Setup	Terminal 32	Terminal 33
1	0	0
2	0	1
3	1	0
4	1	1

If the Freeze Reference was selected in parameters 400, 401 or 405, then selection can be made between two functions using Terminal 16 , 17 or 29.

Terminal 16, 17 or 29 = "0"

Setup	Terminal 32	Terminal 33
1	0	0
2	0	1
3	1	0
4	1	1

Terminal 16, 17 or 29 = "1"

	Terminal 32	Terminal 33
Freeze Reference (sum)	0	0
Increase reference	0	1
Reduce reference	1	0
Reduce reference	1	1

(* Indicates factory default settings)

Digital/Analog Output Signals

Parameters 407 and 408 determine the type and definition of the solid-state output signal on Terminals 42 and 45 of the control card's ten-position terminal block. On signal output 42 and signal output 45, it is possible to choose between three types of signals; digital (24V), analog (0-20mA or 4-20mA). The digital signal (24V) is used to indicate selected status and warnings; and the analog (0-20 mA and 4-20 mA) can be used for analog readouts.

DATA 0/12: Control card and software systems are normal; the motor is out of the current ratings.

DATA 13/14: 0-100 Hz is for the verification of the actual output frequency regardless of what the frequency f_{MAX} was set at in Parameter 202.

DATA 15/16: 0- f_{MAX} sets the output signal range from 0 to frequency f_{MAX} set in Parameter 202.

DATA 17/18: REF_{MIN} - REF_{MAX} sets the output signal range to match the sum of the analog input ranges set in Parameters 413 and 414.

DATA 19/20: FB_{MIN} - FB_{MAX} sets the output signal range to match the range of the feedback signal chosen in either Parameter 412 or 414.

DATA 21/22: 0 - I_{MAX} sets the output signal range from 0 to the rated output current I_{MAX} of the VLT.

DATA 23/24: 0 - I_{LIM} sets the output signal range from 0 to the rated output current I_{LIM} recorded in Parameter 209.

DATA 25/26: 0- T_{MAX} sets the output signal range from 0 to the rated torque T_{MAX} of the VLT.

(* Indicates factory default settings)

407
Signal Output 42

OUTPUT 42

Parameters 407 and 408 determine the type and definition of the solid-state output signal on Terminals 42 and 45 of the control card's ten-position terminal block. On signal output 42 and signal output 45, it is possible to choose between three types of signals; digital (24V), analog (0-20mA or 4-20mA). The digital signal (24V) is used to indicate selected status and warnings; (0-20 mA and 4-20 mA) can be used for analog readouts.

Value:

CONTROL READY	[0]	[0]	Control card & software systems normal.
UNIT READY [1]	[1]	[1]	VLT inverter section ready for operation.
UNIT READY REMOTE CONTROL	[2]	[2]	VLT in remote mode; ready for operation.
ENABLED NO WARNING	[3]	[3]	VLT in run condition, no faults registered.
RUNNING [4]	[4]	[4]	VLT is in operation and producing output.
RUNNING NO WARNING	[5]	[5]	VLT is in operation, no faults registered.
RUNNING IN RANGE NO WARNING	[6]	[6]	VLT is operating within specified speed parameters and no faults are registered.
RUN ON REF NO WARNING	[7]	[7]	VLT's out operating at specified reference and no faults are registered.
ALARM [8]	[8]	[8]	VLT has registered a fault condition.
ALARM OR WARNING	[9]	[9]	Under present circumstances a fault condition is inevitable.
CURRENT LIMIT [10]	[10]	[10]	Current limit in Param. 209 exceeded.
OUT OF FREQUENCY RANGE	[11]	[11]	The motor is out of the specified freq. range set in Parameters 210-211.
OUT OF CURRENT RANGE	[12]	[12]	The motor is out of the current settings.
0 - 100 Hz 0-20 mA	[13]	[13]	0-100Hz is used for the verification of actual output freq. regardless of what the freq. f_{MAX} was set at in Param. 202.
0 - 100 Hz 4-0 mA	[14]	[14]	0- f_{MAX} has set the output signal range from 0 to freq. f_{MAX} set in Param. 202.
0 - f_{MAX} 0-20 mA	[15]	[15]	REF_{MIN} - REF_{MAX} sets the output signal range to match the sum of the analog input ranges set in Param. 413 and 414.
0 - f_{MAX} 4-20 mA	[16]	[16]	FB_{MIN} - FB_{MAX} sets the output signal range to match the range of the feedback signal chosen in either Param. 412 or 414.
REF_{MIN} - REF 0-20 mA	[17]	[17]	0- I_{MAX} sets the output signal range from 0 to the rated output current I_{MAX} of the VLT.
REF_{MIN} - REF 4-20 mA	[18]	[18]	0- I_{LIM} sets the output signal range from 0 to the rated output current I_{LIM} recorded in Parameter 209.
FB_{MIN} - FB 0-20 mA	[19]	[19]	0- T_{MAX} sets the output signal range from 0 to the rated torque T_{MAX} of the VLT.
FB_{MIN} - FB 4-20 mA	[20]	[20]	
* 0- $I_{(current) MAX}$ 0-20 mA	[21]	[21]	
0- $I_{(current) MAX}$ 4-20 mA	[22]	[22]	
0- $I_{(current) LIM}$ 0-20 mA	[23]	[23]	
0- $I_{(current) LIM}$ 4-20 mA	[24]	[24]	
0- $T_{(torque) MAX}$ 0-20 mA	[25]	[25]	
0- $T_{(torque) MAX}$ 4-20 mA	[26]	[26]	

(* Indicates factory default settings)

408
Signal Output 45

OUTPUT 45

Value:

CONTROL READY	[0]
UNIT READY	[1]
UNIT READY REMOTE CONTROL	[2]
ENABLED NO WARNING	[3]
RUNNING	[4]
RUNNING NO WARNING	[5]
RUNNING IN RANGE NO WARNING	[6]
RUN ON REF NO WARNING	[7]
ALARM	[8]
ALARM OR WARNING	[9]
CURRENT LIMIT	[10]
OUT OF FREQUENCY RANGE	[11]
OUT OF CURRENT RANGE	[12]
0 - 100 Hz	0-20 mA [13]
0 - 100 Hz	4-20 mA [14]
* 0 - f_{MAX}	0-20 mA [15]
0 - f_{MAX}	4-20 mA [16]
REF _{MIN} - REF	0-20 mA [17]
REF _{MIN} - REF	4-20 mA [18]
FB _{MIN} - FB	0-20 mA [19]
FB _{MIN} - FB	4-20 mA [20]
0 - $I_{(current) MAX}$	0-20 mA [21]
0 - $I_{(current) MAX}$	4-20 mA [22]
0 - $I_{(current) LIM}$	0-20 mA [23]
0 - $I_{(current) LIM}$	4-20 mA [24]
0 - $T_{(torque) MAX}$	0-20 mA [25]
0 - $T_{(torque) MAX}$	4-20 mA [26]

Please see function descriptions in Parameter 407, as well as, Output Signal illustrations on page 10-8.

409
Relay Output 01

RELAY 01

Value:

CONTROL READY	[0]
UNIT READY	[1]
UNIT READY REMOTE CONTROL	[2]
ENABLED NO WARNING	[3]
* RUNNING	[4]
RUNNING NO WARNING	[5]
RUNNING IN RANGE NO WARNING	[6]
SPEED=REF NO WARNING	[7]
ALARM	[8]
ALARM OR WARNING	[9]
CURRENT LIMIT	[10]
OUT-OF-FREQUENCY RANGE	[11]
OUT-OF-CURRENT RANGE	[12]
MOTOR THERMANL OVERLOAD	[13]
READY AND NO MOTOR	[14]
THERMAL OVERLOAD READY; NO MOTOR THERMAL	[15]
OVERLOAD; REMOTE READY	[15]
NO OVER/UNDER VOLTS	[16]
MOTOR MAGNETIZED	[17]

This parameter determines the use of Relay Output 01 to indicate various status and warnings. Relay 01 is a single-pole, double-throw, Form C type providing normally open and normally closed contacts. The relay is activated when the conditions of the data values are fulfilled. To provide delay ON and OFF times for the relay, program required times in Parameters 317 and 318.

When Relay Output 01 is not active, there will be no connection between Terminal 01 and Terminal 02. The Relay Output 01 is potentially free with a maximum load rating of 240 VAC, MAX 2A.

[0] - [12]: See explanation in Parameter 407.
[17]: "MOTOR MAGNETIZED" must be selected in order to utilize the relay for brake control with the external brake. See parameters 230 through 233 for details.

(* Indicates factory default settings)

410
Relay Output 04

RELAY 04

- Value:**
- CONTROL READY [0]
 - UNIT READY [1]
 - * UNIT READY REMOTE CONTROL [2]
 - ENABLED NO WARNING [3]
 - RUNNING [4]
 - RUNNING NO WARNING [5]
 - RUNNING IN RANGE NO WARNING [6]
 - SPEED=REFERENCE [7]
 - NO WARNING ALARM [8]
 - ALARM OR WARNING [9]
 - CURRENT LIMIT [10]
 - OUT-OF-FREQUENCY RANGE [11]
 - OUT-OF-CURRENT RANGE [12]
 - MOTOR THERMANL OVERLOAD [13]
 - READY AND NO MOTOR [14]
 - THERMAL OVERLOADREADY; NO MOTOR THERMAL OVERLOAD; REMOTE READY [15]
 - NO OVER/UNDER VOLTS [16]
 - MOTOR MAGNETIZED [17]

This parameter determines the use of Relay Output 04 to indicate various status and warnings. Relay 04 is a single-pole, single-throw, Form A type providing normally open contact. The relay is activated when the conditions of the selected data values are fulfilled. When Relay Output 04 is not active, there will be no connection between Terminals 04 and 05.

Relay Output 04 is potentially free with a maximum load rating of 240VAC, MAX 2A.

[0] - [12]: See explanation in Parameter 407.
[17]: See explanation in Parameter 409.

Terminal 01-03;* max. 240V, max. 2 Amp, min. 24VDC, 100mA or 24VAC, 100mA.

Terminal 04-05;* max. 240V, max. 2Amp, min. 24VDC, 100mA or 24VAC, 100mA.

* In VDE applications; max. 250V, 2 Amp

411
Analog Reference

ANALOG REF

- Value:**
- * LINEAR BETWEEN MIN & MAX [0]
 - PROPORTIONAL W/MIN. LIMIT [1]
 - PROPORTIONAL W/REVERSING [2]

These selections determine how the AFD follows an analog speed reference signal.

(* Indicates factory default settings)

412
Analog Input 53

INPUT 53

- Value:**
- NO OPERATION *) [0]
 - ↔0-1-±10VDC [1]
 - 10-0VDC [2]
 - 2-10VDC [3]
 - 10-2VDC [4]
 - 1-5VDC [5]
 - 5-1VDC [6]

Specifications for the voltage input:
 Rated Voltage: ±10V (programmable)
 Max. Voltage: ±37V (continuous)
 Input Resistance: 10kΩ
 Resolution: 10 bit

Record the type of analog signals to input on Terminals 53 and 60 on the control card's ten-position terminal block. Two choices exist between voltage or current and normal or inverse signals.

If both inputs (53 and 60) are used for reference signals, the total reference signal will be the sum of the two. The sum is registered with a sign (±).

A flashing "REF FAULT" indicates an inappropriate selection.

If the PID Controller is being used, one of the inputs must be used for setting the feedback signal. If Remote Current Control (Par. 102) is being used, one of the inputs must be used for setting the current limit.

Specifications for the voltage input:
 Rated Current: ±0/4-20 mA (programmable)
 Max. Current: ±29 mA
 Input Resistance: 200kΩ
 Resolution: 10 bit

413
Analog Input 60

INPUT 60

- Value:**
- NO OPERATION *) [0]
 - ↔0-20 mA [1]
 - 4-20 mA [2]
 - 20-0 mA [3]
 - 20-4 mA [4]

*) If Terminal 53 and/or Terminal 60 are not used, then "NO OPERATION" should be selected in Parameters 412 and 413 in order to avoid the risk of a reference fault.

414
Time Out

TIME OUT

- Value:**
- 0 - 99 OFF * 100 OFF

If one of the "live zero" (4-20 mA) signals has been selected for reference (Par. 412/413) and is less than half of the offset (i.e. 2 mA), a fault message and a required operating status will then be activated after the termination of the programmed interval. If a "live zero" signal has not been selected, then Parameters 414 and 415 have no effect on the operating status.

415
Time Out Function

TIME OUT A

- Value:**
- ↔FREEZE [0]
 - STOP [1]
 - JOG [2]
 - MAX [3]

Upon recognition of a lost signal, the VLT's reference can be frozen in the Current Value, Stop, Jogging Frequency (in Parameter 203) or the Maximum Frequency (in Parameter 202).

This function is not active for Local Speed reference (see Parameter 004) when open loop or slip compensation is selected in Parameter 101.

(* Indicates factory default settings)

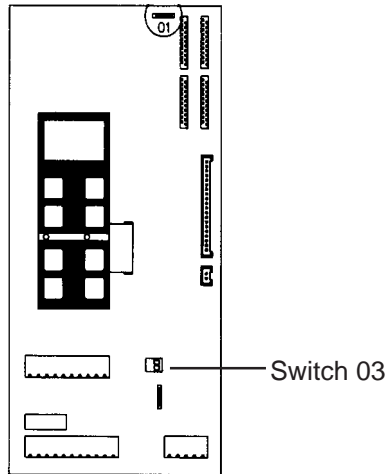
Group 5 -- Serial Data Interface

The RS 485 serial bus (terminals 68 and 69) allows the reading and setting of the drive's parameters, as well as transmitting reference and control commands to it.

The serial bus can be used by up to 31 drives per master without using a repeater. If 3 repeaters are used, up to 99 drives can be connected to one master.

Danfoss can provide a serial communication program "VLS Dialog", which allows an IBM compatible personal computer (PC) to communicate with VLT drives over an RS 485 serial interface. This program allows controlling the drive(s) remotely through the computer without the need for any additional programming. Contact Danfoss literature department for information.

It is important to connect and terminate the serial bus with the correct impedance to avoid any reflections which may disturb the data transmission in the cable. Set the switches 03.1 and 03.2 in the "on" position in the last drive connected to the serial bus.



The following information provides detailed specifications of the serial communications format for those who wish to customize their own serial communication software. Communication takes place by means of a special protocol.

The data format consists of 10 bits; one start bit (logical 0), eight data bits and one stop bit (logical 1). There is no parity check. Set the speed of transmission in parameter 501 and the address of each unit in parameter 500.

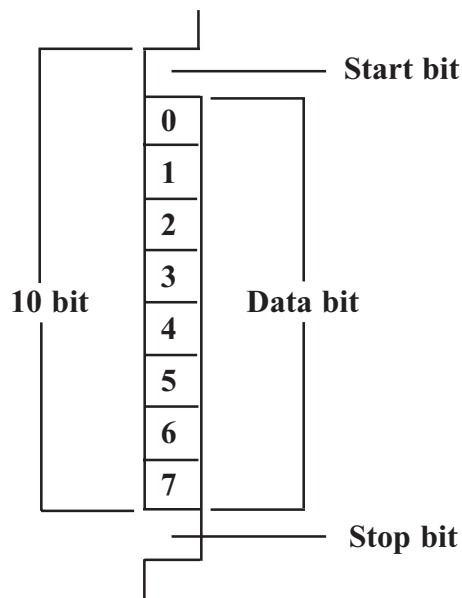
Message (telegram) format (protocol)

The communication protocol consists of 22 ASCII characters. These characters make it possible to operate, set and read parameters and to receive status feedback from the drive.

Communication takes place as follows:

The master sends a message to the drive. Then the master awaits a reply from the drive before sending a new message. The reply to the master is a copy of the message sent by the master, now containing any updated data values and the status of the drive.

Data format



Telegram format

Function	byte #	ASCII
Start byte	1	<
Address	2	
	3	
Control character	4	
	5	
	6	
	7	
Control/Status word	8	
	9	
	10	
	11	
Parameter #	12	
	13	
	14	
	15	
Sign Data	16	
	17	
	18	
	19	
Comma	20	
Check sum	21	
	22	>

Byte 1:

Start byte, which in this case must be the character "<" (ASCII: 60).

Byte 2 and 3:

The two-digit address of the frequency converter. This address is also programmed in parameter 500. Sending to address 00 means transmission to all units connected to the bus. None of the units will reply, but they will carry out the command.

Byte 4:

Control parameter telling the drive what to do with the following data values.

U (update)

Means that the data value, bytes 13 through 19, must be read into the drive parameter specified by bytes 9 through 12.

R (read)

Means that the master wishes to read the data value of the parameter in bytes 9 through 12.

C (control)

Means that the frequency converter reads only the four command bytes, 5 through 8, and returns with status. Parameter number and data value are ignored.

I (read index)

Means that the frequency converter reads the index and parameter and returns with status. The parameter is stated in bytes 9 through 12 and index is stated in bytes 13 through 18.

Parameters with indices are read-only parameters. Action will be taken on the control word. Two-dimensional indices (x,y) (parameters 601 and 602) are separated by a comma, see byte 19.

Example:

Index	=	x, y
Data value	=	013.05
		↓
Byte 14 through 18	=	01305
Byte 19	=	2

Control and status words, used to send commands to the frequency converter and to send status from the frequency converter to the master.

Byte 9 through 12:

The parameter number is inserted in these bytes.

Byte 13:

Used for the sign before data value in bytes 14 through 18. All characters other than "-" are taken as "+".

Byte 14 through 18:

Here is placed the data value of the parameter stated in bytes 9 through 12. The value must be a whole number. If a decimal point is needed, it is stated in byte 19.



NOTE: Some data values have brackets with a number, for example "[0]". Use this number instead of the "Text" data value.

Byte 19:

The position of the decimal point in the data value stated in bytes 14-18. The number states the number of characters after the decimal point. Consequently, byte 19 can be 0, 1, 2, 3, 4 or 5. For example, the number 23.75 is stated:

Byte no.	13	14	15	16	17	18	19
in ASCII character	+	2	3	7	5	0	3

If byte 19 = 9, this indicates an unknown parameter.

Byte 20 and 21:

Used for check sum control from bytes 2 up to and including 19. The decimal values of the ASCII characters are added and reduced to the two low characters, for example: $\Sigma 235$ - reduced = 35. If there is to be no control, the function can be cancelled by means of the "?" character (ASCII: 63) in the two bytes.

Byte 22:

Stop byte, stating the end of the telegram. The character ">" is used (ASCII: 62).

Control Word, bytes 5 through 8 in the message. The control word is used to send control commands from the controller to the drive. According to the data format, 1 byte consists of 8 databits, but in the control word only the 4 least significant bits of each byte are used, which means that ASCII characters from A to O can be used. The table below gives the meaning of the individual bits in the control word.

	ASCII	CONTROL WORD															
		Byte 8				Byte 7				Byte 6				Byte 5			
		N O	C H O I C E	C H O I C E	N O	N O	D A T A	J O G	J O G	N O	R A M P	H O L D	Q U I C K - S T O P	C O A S T	O F F	O F F	O F F
0	F U N C T I O N / R E V E R S I N G	O F	O F	F U N C T I O N	F U N C T I O N	N O T / V A L I D	O F F	O F F	F U N C T I O N	S T O P / R A M P	/	R A M P	/	E N A B L E D	3	2	1
1		S E T - U P	S E T - U P	C A T C H - U P	S L O W D O W N	/	/	O N	O N	/	S T A R T	/	R A M P				
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
@		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A		0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
B		0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
C		0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
D		0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
E		0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
F		0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
G		0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1
H		1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
I		1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
J		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
K		1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1
L		1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
M		1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1
N		1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0
O		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
P																	

X = Indifferent; if P is used in a group of 4 bits, the current status is maintained. Only the groups with characters ≠ P are activated. Bit 10 = 0 means that there is no change from the current status.

Bit 00, OFF1/ON1:

Ordinary ramp stop using the ramp time in parameter 216. Bit 00 = "0" causes a stop; bit 00 = "1" means that the drive is able to start if the other conditions for doing so have been fulfilled.

Bit 01, OFF2/ON2:

Coast stop. Bit 01 = "0" causes a coast t stop; bit 01 = "1" means that the frequency converter is able to start if the other conditions for doing so have been fulfilled.

Bit 02, OFF3/ON3:

Quick-stop using the ramp time in parameter 218. Bit 02 = "0" causes a quick-stop; bit 02 = "1" means that the drive is able to start if the other conditions for doing so have been fulfilled.

Bit 03, COAST/ENABLED:

Coast stop. Bit 03 = "0" causes a stop; bit 03 = "1" drive is able to start if the other conditions for doing so have been fulfilled. Note: In parameter 503 a choice is made as to how bit 03 is to be combined with the corresponding function on the digital inputs.

Bit 04, QUICK-STOP/RAMP:

Quick-stop using the ramp time in parameter 218. Bit 04 = "0" causes a quick-stop; bit 04 = "1" means that the drive is able to start if the other conditions for doing so have been fulfilled.

The function of bit 04 can be redefined to DC braking in parameter 514; otherwise the function is as described. Note: In parameter 504 and 505 a choice is made as to how bit 04 is combined with the corresponding function on the digital inputs.

Bit 05, HOLD/RAMP ENABLED:

Ordinary ramp stop using the ramp time in parameter 216. Bit 05 = "0" leads to a stop; bit 05 = "1" means that the drive is able to start if the other conditions for doing so have been fulfilled.

Bit 06, RAMP STOP/START:

Ordinary ramp stop using the ramp time in parameter 216. Bit 06 = "0" causes a stop; bit 06 = "1" means that the drive is able to start if the other conditions for doing so have been fulfilled. Note: In parameter 506 a choice is made as to how bit 06 is combined with the corresponding function on the digital inputs.

Bit 07, NO FUNCTION/RESET:

Reset of trip. Bit 07 = "0" causes no reset; bit 07 = "1" means that a trip is reset. Note: In parameter 508 a choice is made as to how bit 07 is combined with the corresponding function on the digital inputs.

Bit 08, JOG 1 OFF/ON:

Activation of the pre-programmed speed in parameter 511 (Bus JOG 1). JOG 1 is only possible when bit 04 = "0" and bit 00-03 = "1".

Bit 09, JOG 2 OFF/ON:

Activation of the pre-programmed speed in parameter 512 (Bus JOG 2). JOG 2 is only possible when bit 04 = "0" and bit 00-03 = "1". If both JOG 1 and JOG 2 are activated (bits 08 and 09 = "1"), JOG 1 has the higher priority, i.e. the speed programmed in parameter 511 is used.

Bit 10, DATA NOT VALID/VALID:

Used for telling the drive whether the control word 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 message, no matter what type of message is being used (see byte 4), i.e. it is possible to disregard the control word if it is not to be used in connection with updating or reading of parameters.

Bit 11, NO FUNCTION/SLOW DOWN:

Used for reducing the speed reference by the value of parameter 513.

Bit 11 = "0" means that the reference is not changed.

Bit 11 = "1" means that the reference is reduced. The function of bits 11 and 12 can be redefined to be the choice of digital reference in parameter 515, in accordance with the following table:

Digital reference/ parameter	Bit 14	Bit 13
1/205	0	0
2/206	0	1
3/207	1	0
4/208	1	1



NOTE: In parameter 510 a choice is made of how bit 1/12 is combined with the corresponding function on the digital inputs.

Bit 12, NO FUNCTION/CATCH-UP:

Used to increase the speed reference by the value of parameter 513. Bit 12 = "0" means that the reference is not changed; bit 12 = "1" means that the reference is increased. If both slow-down and catch-up are activated (bits 11 and 12 = "1"), slow-down has the higher priority, i.e. that the speed reference is reduced. The function of bits 11 and 12 can be redefined to become the choice of digital reference; see the description of bit 11 in the above.

Bit 13/14, CHOICE OF SETUP:

Bits 13 and 14 are used for choosing between 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 enabled if *Multi setups* have been selected in parameter 001.



NOTE: In parameter 509 a choice is made of how bit 13/14 is combined with the corresponding function on the digital inputs.

Bit 15, NO FUNCTION/REVERSING:
Reversing of the direction of rotation of the motor. Bit 15 = "0" leads to no reversing; bit 15 = "1" leads to reversing. Please note that the original setting for reversing in parameter 507 is *digital*; bit 15 only leads to reversing if *bus*,

logical or or *logical and* has been selected (*logical and* only in connection with terminal 19).

Example:

The following control word can be used if the drive is to be given a start command:

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
0/1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1
ASCII	@				D				G				O			

Status Word, bytes 5 through 8 in the message:

The status word is used to inform the controller about the status of the drive.

The status word has been placed in bytes 5 through 8 in the response message from the drive to the controller. The below table gives the meaning of the individual bits of the status word:

ASCII		Status word															
		Byte 8				Byte 7				Byte 6				Byte 5			
		T I M E R S	C U R R E N T	V O L T A G E	V L T O K	D O E S	O U T	L O C A L	S P E E D	N O	S T A R T	O N	O N	N O	C O A S T	V L T	C O N T R O L S
0	1	OK	OK	OK	OK	NOT RUN	OPERATING	WARRNING	WARRNING	ENABLED	3	2	FAULT	ENABLED	NOT READY	NOT READY	
1	OVERSHOOT	OVERSHOOT	OVERSHOOT	STALLS	AUTO-START	RUNS	RANGE/FREQ LIMIT OK	WARRNING	WARRNING	START	3	2	TRIP	ENABLED	READY	READY	
		15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
@		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A		0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1
B		0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
C		0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
D		0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0
E		0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
F		0	1	1	0	0	1	1	0	0	1	1	0	0	1	1	0
G		0	1	1	1	0	1	1	1	0	1	1	1	0	1	1	1
H		1	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0
I		1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1
J		1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0
K		1	0	1	1	1	0	1	1	1	0	1	1	1	0	1	1
L		1	1	0	0	1	1	0	0	1	1	0	0	1	1	0	0
M		1	1	0	1	1	1	0	1	1	1	0	1	1	1	0	1
N		1	1	1	0	1	1	1	0	1	1	1	0	1	1	1	0
O		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Bit 00, CONTROLS NOT READY / READY:

Bit 00 = "0" means that bit 00, 01 or 02 of the control word is "0" (OFF1, OFF2 or OFF3), or that the drive has tripped. Bit 00 = "1" means that the drive is ready to run when it receives the necessary start signals.

Bit 01, DRIVE NOT READY / READY:

Same meaning as bit 00.

Bit 02, COAST/ENABLED:

Bit 02 = "0" means that bit 00, 02 or 03 of the control word is "0" (OFF1, OFF2, OFF3 or Coasting), or that drive has tripped. Bit 02 = "1" means that bits 00, 01, 02 and 03 of the control word is "1", and that the drive has not tripped.

Bit 03, NO FAULT/TRIP:

Bit 03 = "0" means that the drive is not in a state of fault; bit 03 = "1" means that the drive has tripped and that it requires a reset signal before being able to run.

Bit 04, ON2/OFF2:

Bit 04 = "0"
means that bit 01 of the control word = "1".
Bit 04 = "1"
means that bit 01 of the control word = "0".

Bit 05, ON3/OFF3:

Bit 05 = "0"
means that bit 02 of the control word = "1".
Bit 05 = "1"
means that bit 02 of the control word = "0".

Bit 06, START ENABLED/NOT ENABLED:

Bit 06 is always "0" if "Start not Enabled" [11] has not been selected in parameter 309. If "Start not Enabled" [11] has been selected in parameter 309, bit 06 will be "1" after reset of a trip, after activation of OFF2 or OFF3 and after connection to AC line voltage. "Start not Enabled" is reset, setting bit 00 of the control word at "0" and bits 01, 02 and 10 at "1".

Bit 07, NO WARNING/WARNING:

Bit 07 = "0" means that there is no unusual situation; bit 07 = "1" means that an unusual situation has arisen for the drive. All warnings will make bit 07 go to "1".

Bit 08, SPEED REF/SPEED = REF.:

Bit 08 = "0" means that the current speed of the motor is different from the speed reference. This could be the case, for example, while the speed is being ramped up/down at start/stop. Bit 08 = "1" means that the current speed of the motor is equal to the preset speed reference.

Bit 09, LOCAL CONTROL/BUS CONTROL:

Bit 09 = "0" means that the drive has stopped by means of the stop key on the operating panel, or that "local" or "local with external coasting stop" has been selected in parameter 003. Bit 09 = "1" means that it is possible to control the frequency converter via the serial port.

Bit 10, OUT OF RANGE/FREQUENCY OK:

Bit 10 = "0" means that the output frequency is outside the limited set in parameter 210 (Warning: Low frequency) and parameter 211 (Warning: High frequency). Bit 10 = "1" means that the output frequency lies within the mentioned limits.

Bit 11, DOES NOT RUN/RUNS:

Bit 11 = "0" means that the drive does not run. Bit 11 = "1" means that the drive has received a start signal, or that the output frequency is higher than 0.5 Hz.

Bit 12, VLT OK/STALLS, AUTOSTART:

Bit 12 = "0" means that there is no temporary overloading of the inverter; bit 12 = "1" means that the inverter has stopped because of an overload, but that the drive has not tripped. The unit will continue to work when the overload has disappeared.

Bit 13, OK/OVER- OR UNDERVOLTAGE:

Bit 13 = "0" means that the drive's voltage limits have not been exceeded. Bit 13 = "1" means that the DC bus voltage is too low or too high.

Bit 14, CURRENT OK/OVERSHOOT:

Bit 14 = "0" means that the motor current is smaller than the current limit selected in parameter 209. Bit 14 = "1" means that the current limit of parameter 209 has been exceeded.

Bit 15, TIMERS OK/OVERSHOOT:

Bit 15 = "0" means that the timers for thermal motor protection and thermal drive protection have not exceeded 100%. Bit 15 = "1" means that one of the timers has exceeded 100%.

Example:

The status word below says that the motor is running on the desired speed reference, but outside the defined frequency area. Consequently, bit 10 = "0" (out of frequency range) and bit 07 = "1" (warning). Voltage, current and timers are OK.

Bit	15	14	13	12	11	10	09	08	07	06	05	04	03	02	01	00
0/1	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1	1
ASCII	@				K				H				G			

Message Example:

A drive, with address 1, is to be given a start signal and a speed reference that corresponds to 40 Hz.

A start signal is given by means of the control word and the speed reference is given to parameter 516, bus reference, 80% corresponding to 40 Hz, since the maximum frequency is 50 Hz. This results in the following message:

Message from the master (PC or PLC) to the frequency converter

Function	Byte Number	ASCII Character	Decimal Value
Start-byte	1	<	60
Address	2	0	48
	3	1	49
Control character	4	U	85
Control/statusword	5	0	79
	6	G	71
	7	D	68
	8	@	64
Parameter no.	9	0	48
	10	5	53
	11	1	49
	12	6	54
Sign	13	+	43
Data value	14	0	48
	15	0	48
	16	0	48
	17	8	56
	18	0	48
Decimal point	19	0	48
Check-sum	20	0	48
	21	7	55
Stop-byte	22	>	62

Check-sum: bytes 2-19 = 1007, reduced to 07.

Response Message from the Drive to the Controller:

Function	Byte no.	ASCII-character	Decimal value
Start-byte	1	<	60
Address	2	0	48
	3	1	49
Control character	4	U	85
Control/status word	5	G	71
	6	H	72
	7	K	75
	8	@	64
Parameter no.	9	0	48
	10	5	53
	11	1	49
	12	6	54
Sign	13	+	43
Data value	14	0	48
	15	0	48
	16	0	48
	17	8	56
	18	0	48
Decimal point	19	0	48
Check-sum	20	0	48
	21	7	55
Stop-byte	22	>	62

Check-sum: bytes 2 through 19 = 1007, reduced to 07.

Fault Messages for Read/Write Parameters:

Byte 19 in the response message from the drive takes the value 9 if it is not possible to carry out the selected write or read command. At the same time, a cause code is given in bytes 17 and 18. The following cause codes exist:

Code Cause

- 00 The parameter number does not exist
- 01 There is no read/write access to the selected parameter
- 02 A nonexisting index no. has been selected

- 03 Index reading is used for a parameter that has no indices
- 04 The parameter is write-protected (read only). This may be because the factory set-up has been selected
- 05 The parameter cannot be changed while the motor is running
- 06 The data value lies outside the parameter range
- 07 Illegal command value (Byte 19)
- 08 The data value read is > 99999
- 99 Other fault

Switch 04:

- 04 closed: Terminal 61 is connected to chassis ground.
- 04 open: Terminal 61 is connected to chassis ground via an RC link.

When switch 04 is closed, there is no voltage isolation between the signal lines (terminals 68 and 69) and the ground. This may lead to noise problems if a controller which is not isolated from earth ground is used. In this case, the RS 485 connection should be made as follows: Switch 04 must be open, the shield of the signal cable must be connected to the cable clamp below the control card, but not to terminal 61. The shield should be left on the wire and should extend as close to the terminal strip as possible. The shield should be insulated, to avoid contact with other circuitry.

500
Address

Value:
01-99
* 01

ADDRESS

Specify an address for each unit. If the master (PLC or PC) addresses 00, the message is written to all connected drives at the same time. The unit will, in this case, not give a reply to the master. If the number of units is over 31, a repeater must be used. Parameter 500 can not be changed via the serial bus, RS 485.

501
Baud Rate

Value:
300, 600, 1200, 2400, 4800, *9600

BAUD RATE

This parameter sets the speed at which the bits of character are sent.

It is defined as the number of bits sent per second. The VLT's transmission speed must be set equivalent to the PC/PLC's transmission speed. Parameter 501 cannot be selected via the serial bus, RS485.

The data transmission itself, determined by the baud rate setting, is only part of the total communication time. The total time to send a telegram to the VLT and receive an answer is between 320 ms and 480 ms.

502
Data Readout

- Value:**
- * 0 REFERENCE %
 - 1 FREQUENCY Hz
 - 2 FEEDBACK "UNIT"
 - 3 CURRENT A
 - 4 TORQUE %
 - 5 POWER kW
 - 6 POWER HP
 - 7 ENERGY kWh
 - 8 OUTPUT VOLTAGE V
 - 9 DC VOLTAGE V
 - 10 MOTOR ETR VALUE %
 - 11 INVERTER ETR VALUE %
 - 12 DIGITAL INPUT BINARY CODE
 - 13 ANALOG INPUT
 - 14 ANALOG INPUT
 - 15 WARNING BINARY CODE
 - 16 CONTROL WORD
 - 17 STATUS WORD
 - 18 ALARM PARAM BINARY CODE

DATA READO

This parameter can only be read and is used to read displays, status reports, warnings and alarms via the serial bus, RS485. the individual data values are read using index reading (byte 4 = 1), and the index number of the required data value is stated in bytes 14 - 19 as shown below. The possible range is 000.00-018.00. Example of reading of index number 12: 012.00.

Index	0	1	2	0	0	2
Byte	14	15	16	17	18	19

The data values cannot be read in the display for parameter 502.

Description of choices;

Index 0-11:

12 process data, which also can be read in "display mode". The stated unit is not read, only the value. Index 0 (reference) is only external references, i.e. pulse input (terminal 17), analog inputs (terminals 53 and 60) and bus reference (parameter 516).

(* Indicates factory default settings)

502
Data Readout

DATA READO

(continued)

Index 12:

A decimal value to be converted to an 8-bit binary code.

Example:

Decimal								16
Binary	0	0	0	1	0	0	0	0
Terminal	33	32	29	27	19	18	17	16

Index 13/14:

Decimal value between 0 and 1023, where 0 corresponds to 0% and 1023 to 100% of the selected output signal, e.g. 0-10V.

Index 15:

Decimal value to be converted to a 16-bit binary code. Each bit represents a warning according to the table below. When a warning is given, the equivalent bit has the value "1".

Bit	Warning
0	Current limit
1	No motor
2	Reference fault
3	Motooverloaded
4	Inverter overloaded
5	Frequency warning low
6	Frequency warning high
7	Current warning low
8	Current warning high
9	EEPROM fault
10	24V fault
11	Excess current
12	Voltage warning high
13	Voltage warning low
14	Overvoltage
15	Undervoltage

Index16:

Decimal value to be converted to a 16-bit binary code. Each bit represents a control command. When a control command is activated, the equivalent bit has the value "1".

Index 17:

Decimal value to be converted to a 16-bit binary code. Each bit represents a status report. When a status report is activated, the equivalent bit has the value "1".

(* Indicates factory default settings)

502
Data Readout

DATA READO

(continued)

Index 18:

Decimal value to be converted to a 16-bit binary code. Each bit represents an alarm according to the table below. When an alarm is given, the equivalent bit has the value "1".

Bit	Alarm
0	Trip locked
1	Control/option card fault
2	Current limit
3	Not used
4	Not used
5	Auto optimization
6	Motor overload
7	Inverter overloaded
8	Inverter fault
9	Undervoltage
10	Overvoltage
11	Overcurrent
12	Ground fault
13	Not used
14	Excess temperature
15	Thermistor input activated

(* Indicates factory default settings)

503
Coasting

COAST

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

504
Q-Stop

Q-STOP

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

505
DC- Brake

DC-BRAKE

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

506
Start

START

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

507
Direction

DIRECTION

Value:
* DIGITAL
BUS
LOGIC AND
LOGIC OR

[0]
[1]
[2]
[3]

508
Reset

RESET

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

509
Setup Select

SETUP SELE

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

510
Speed Select

SPEED SELE

Value:
DIGITAL
BUS
LOGIC AND
* LOGIC OR

[0]
[1]
[2]
[3]

In parameters 503 to 510, you can choose to control the VLT adjustable frequency drive via the control terminals (digital) and/or via the bus.

DIGITAL: VLT responds to local/remote operation only.

BUS: VLT responds responds to signal via the RS-485 bus only.

LOGIC AND: Select if the control command is only to be activated when the signal is active from both the control word and digital input. Active signal "1".

Digital input	Control word	Control command
0	0	0
0	1	0
1	0	0
1	1	1

LOGIC OR: Select if the control command is to be activated when the signal is active from either the control word or digital input. Active signal "1".

Digital input	Control word	Control command
0	0	0
0	1	1
1	0	1
1	1	1

NOTE: Parameters 503-505 concern stop functions, see example parameter 503 (free-wheeling). Active stop signal "0".

Parameter 503 = Logic AND

Digital input	Control word	Control command
0	0	Free-wheeling
0	1	Motor running
1	0	Motor running
1	1	Motor running

Parameter 503 = Logic OR

Digital input	Control word	Control command
0	0	Free-wheeling
0	1	Free-wheeling
1	0	Free-wheeling
1	1	Motor running

(* Indicates factory default settings)

<p>511 Bus Jog 1</p> <p>BUS JOG 1</p>	<p>Value: 0 - f_{RANGE} * 010.0</p>	<p>Two fixed speeds set in Hz equivalent to JOGGING frequency in parameter 203. Bus jogging 1 and 2 can only be activated via the control word when serial bus communication is used (also see description of the control word's bit 08 and 09).</p>
<p>512 Bus Jog 2</p> <p>BUS JOG 2</p>	<p>Value: 0 - f_{RANGE} * 010.0</p>	
<p>513 Catch-up Value</p> <p>CATCHUP/SL</p>	<p>Value: 0 - 100% * 0</p>	<p>The drive's output frequency can be reduced or increased via the control word's bit 11 and 12 by the value set as a percentage of the present output frequency.</p>
<p>514 Bus Bit 4</p> <p>BUS BIT 4</p>	<p>Value: * Q STOP DC BRAKE</p>	<p>Bit 4 of the control word can be used for either quick stop via alternative ramp-down or DC brake.</p>
<p>515 Bus Bit 11/12</p> <p>BUS BIT 11</p>	<p>Value: * CATCH-UP SLOW DOWN DIGITAL SPEED SELECT</p>	<p>Bit 11/12 of the control word can either be used for 'catch-up/slow-down' or for selection of digital reference.</p>
<p>516 Bus Bit 11/12</p> <p>BUS REFERE</p>	<p>Value: -100% - +100% * 00.00</p>	<p>Is used to receive the desired reference as a percentage of f_{MAX} via serial communication.</p>
<p>517 Store Data</p> <p>STORE DATA</p>	<p>Value: * OFF ON</p>	<p>[0] Data values change via serial bus communication are not saved automatically when the AC line voltage is switched off, and therefore parameter 517 must be used to save changed data values</p> <p>[1] .</p> <p>Description of choices: When "on" is selected, it takes approximately 10 seconds to save all parameters' data values, and parameter 517 then automatically takes the value "off". Only the data values in the active menu setup are saved, i.e. the save function must be performed in each of the setups used.</p> <p>NOTE: The save function can only be activated when the VLT has stopped.</p>

(* Indicates factory default settings)

600
Operation Data

OPERATION

- Value:**
 * 0 TOTAL OPERATION HOURS
 1 RUNNING HOURS
 2 kWh
 3 NUMBER OF POWER UPS
 4 NUMBER OF OVER-TEMPERATURE
 5 NUMBER OF OVER-VOLTAGE

(Index 000.00-005.00)
 Display of most important operation data.
Display range: Total number of operation hours/running hours/kWh is 0.0-99999 (under 10000 with 1 decimal).
 Number of power ups/number of overtemps/number of overvoltages is 0-99999.
Serial communication: Total number of operation hours/running hours/kWh returned as floating comma values.
 Number of power ups/number of overtemps/number of overvoltages returned as whole figures.
 Total number of operation hours/running hours/kWh reset automatically after manual initialization.
 NOTE: The stated data is saved every 8 hours. kWh can be reset via parameter 011. Operation hours can be reset via parameter 012.
 Number of power ups/number of overtemps/number of overvoltages saved as they occur.

601
Data Log

DATA LOG

	0	1	2	3	4	-	-	19
Digital input [0]								
Control word [1]								
Status word [2]								
Reference % [3]								
Frequency out [4]								
Phase current [5]								
D.C. voltage [6]								

(Index 000.00-019.16)
 Logging of data for the last few seconds of operation.
Digital inputs: stated in hex code (0-FFFF).
Control word: stated in hex code (0-FFFF) for bus operation RS 485.
Status word: stated in hex code (0-FFFF) for bus operation RS 485.
Reference states the control signal as a percentage (0-100%).
Frequency out states the unit's output frequency in Hz (0.0-999.9).
Phase current is the unit's output current in A (0.0-999.0).
DC voltage states the intermediate circuit voltage in VDC (0-999).

(* Indicates factory default settings)

601
Data Log
(continued)

DATA LOG

		0	1	2	3	4	-	-	19
Digital input	[0]								
Control word	[1]								
Status word	[2]								
Reference %	[3]								
Frequency out	[4]								
Phase current	[5]								
D.C. voltage	[6]								

Twenty log values (0-19) are given. The lowest number (0) contains the newest last stored data value, and the highest log number (19) contains the oldest data value. The data values are logged every 160ms for as long as the start signal is active. The data log contains the last 20 log values (approx. 3.2 sec.) before a stop signal is given (start not active), or a trip. However, it is possible to scroll through the log values. The data log is reset during start-up on AC line connection.

602
Fault Memory

FAULT MEMO

		0	1	2	3	4	-	-	7
Fault code	[0]								
Time	[1]								
Value	[2]								

(Index 000.00-007.02)
Storage of data on trip.
Fault code indicates the reason for a trip by a figure code between 1 and 15:
Fault code Alarm
 1 Inverter fault
 2 Overvoltage
 3 Undervoltage
 4 Over-current
 5 Ground fault
 6 Excess temperature
 7 Inverter overload
 8 Motor overload
 9 Current limit
 10 Trip locked
 11 Control card or option card fault
 13 Auto-optimization fault
 15 Thermistor input activated, see parameter 400/terminal 16
Time states the value of the total number of operating hours on trip. Display range 0.0-999.9.
Value states e.g. at what voltage or current a trip has taken place. Display range 0.0-999.9. On serial communication, the fault code is returned as a whole number. Time and value are returned as floating decimal values.
 Eight log values are given (0-7). The lowest log number (0) contains the newest/last stored data value, and the highest log number (7) contains the oldest data value.
 An alarm can only be represented once. The fault log is reset after manual initialization. Irrespective of which log set is being read, the display will automatically shift to log number 0 if a new trip occurs.

(* Indicates factory default settings)

603
Type Plate

NAMEPLATE

- Value:**
 * 0 TYPE
 1 UNIT VOLTAGE
 2 SOFTWARE TYPE
 PROCESS
 HVAC
 PROFIBUS PROC
 PROFIBUS HVAC
 SYNCRON OPT
 MODBUS + PROC
 MODBUS – HVAC
 3 SOFTWARE VERSION

- [1]
[2]
[3]
[4]
[5]
[6]
[7]

The unit's key data can be read off via the display or bus (RS 485).
Type indicates unit size and basic function (e.g. VLT type 3006 or VLT type 3008).
Unit voltage indicates the voltage for which the unit has been built or has been set to parameter 650.
Software type indicates whether the software is standard or special.
Software version indicates the version number.

604
Operation Mode

OPERATION

- Value:**
 * RUN NORMAL
 RUN WITH INVERTER DISABLE
 CONTROL CARD TEST
 INITIALIZE

- [0]
[1]
[2]
[3]

In addition to the normal function, the parameter can be used for 2 different tests. Three is also a possibility of manual initialization of all parameters (except parameters 501, 600 and 602).
Normal function is used in normal operation with a motor in the selected application.
Function with inverter disabled is selected for control of the control signal's influence on the control card and its functions without the inverter driving the motor.
Control card test is selected for control of the control card's analog, digital inputs; analog, digital and relay outputs; and the control voltage of +10V. This test requires connection of a test connector with internal connections. The following procedure is used:
 1) Press Stop.
 2) Insert test connector in the pins.
 3) Select control card test in parameter 604.
 4) Disconnect AC line voltage and wait for light in the LCD display to go out.
 5) Connect AC line voltage
 6) Press Start.
 The test will now run through three stages with an OK or fault report depending on the result. If there is a fault report, the control card must be replaced.
 Initialization is selected for factory setting of the unit without resetting of parameters 500, 501, 600 and 602.
 Procedure:
 1) Select initialization.
 2) Press Menu.
 3) Disconnect AC line voltage and wait for light in the LCD display to go out.
 4) Connect AC line voltage.

(* Indicates factory default settings)

605
Personal
Display Select

DISPLAY SE

Value:	
* STANDARD DISPLAY	[0]
REFERENCE %	[1]
FREQUENCY Hz	[2]
FEEDBACK UNIT	[3]
CURRENT A	[4]
TORQUE %	[5]
POWER kW	[6]
HP	[7]
ENERGY kWh	[8]
OUTPUT VOLTAGE VLT	[9]
DC VOLTAGE VLT	[10]
VLT THERM %	[11]
MOTOR THERM %	[12]
RUNNING HOURS	[13]
INPUT STATUS "BINARY CODE"	[14]

You can have two different display read-outs in the display at the same time. The extra read-out selected in this parameter will be shown in line B of the display.

Standard display is selected for normal reading of e.g. the frequency in Hz in line 1, indication of "frequency" in line 2 and indication of status of operation in line 3. The other data values are selected to read another operation value in line 2, so that it is possible to display the frequency in line 1 and current in line 2 simultaneously. There are 14 different data values to select between.

NOTE: to be able to see both lines simultaneously, the display must be in Display Mode.

Display Mode

SELECTED DISPLAY READ-OUT, Including unit

00.0 Hz

NAME OF SELECTED DISPLAY READ-OUT STATUS, Including indication of local operation

**FREQUENCY
RUN OK LOCAL 1**

ROTATION DIRECTION
ACTIVE SETUP SELECTION
(1-4 CAN BE SELECTED
IN PARAMETER 001)

650
VLT Type

VLT TYPE

Used to indicate in which unit the control card is placed, in cases where the control card cannot decide for itself, or to select voltage range in multi-voltage units if the factory setting deviates from what is required.

The parameter is used to select the correct VLT type/size/voltage for VLT types 3060-3250 and VLT types 3575-3800, which are multi-voltage units. If the factory-set voltage does not correspond to the voltage in the application for which the unit is used, the following procedure is used:

- 1) Select the required VLT type/size/voltage.
- 2) Select parameter 604, data value initialization.
- 3) Disconnect AC line voltage and wait for the light in the LCD display to go out.
- 4) Connect the AC line voltage.

NOTE: During start-up the display shows the selected new data.

(* Indicates factory default settings)

Status Messages

- EEPROM FAULT
Software cannot store any data changes.
- OFF 2
(Serial data interface only) Motor coast followed by relay off.
- OFF 3
(Serial data interface only) Quick stop followed by relay off.
- START INHIBIT
(Serial data interface only) Start is inhibited until control word bit 0 is toggled.
- UNIT READY (LOCAL)
Control card power section is powered up and okay.
- ENABLED STOP (LOCAL)
Unit ready and motor coast inverse signal is on. No warning, is present; no start signal applied.
- START (LOCAL)
Enable and start signal applied; no or too low reference signal or motor current.
- HOLD
Start signal is applied, but ramping is blocked (serial data interface only).
- RUN OK (LOCAL)
Unit is running on reference and in range.
- JOGGING (LOCAL)
- RAMPING (LOCAL)
- FREEZE
Reference is "frozen"; change possible by speed UP/DOWN.
- RUN OUT RANGE
Unit is running on reference, but out of the range set up by menus (either current or frequency), such as High Frequency, Low Frequency, Current, etc.
- CURRENT LIMIT
- NO MOTOR
Enabled, but DC test shows that no motor is connected.
- REF FAULT
4-20 mA signal not okay.
- NO 24 VOLT
Internal power supply is not operational.
- INVERT TIME (ETR)
Electronic inverter protection close to limit.
- MOTOR TIME (ETR)
Electronic motor protection close to limit. At 97% the warning is given, at 100% a trip will occur.
- VOLTAGE LOW - VOLTAGE HIGH
The control card registers that the DC bus voltage is out of limits. Power section is running.

NOTE:
During READY, ENABLE, START and RUNNING conditions the message "LOCAL" indicates that the local operation or stop prevents remote control. Local stop is furthermore indicated by a flashing DATA display.

Reset Messages

- **STALLING**
Short-term interruption of operation; ride through is attempted.
- **AUTOSTART**
Operation is stopped; unit will attempt restart.
- **TRIP (LOCKED)**
Operation is stopped; external manual reset required. When the trip is locked, reset can only be accomplished by cycling AC power on and off.

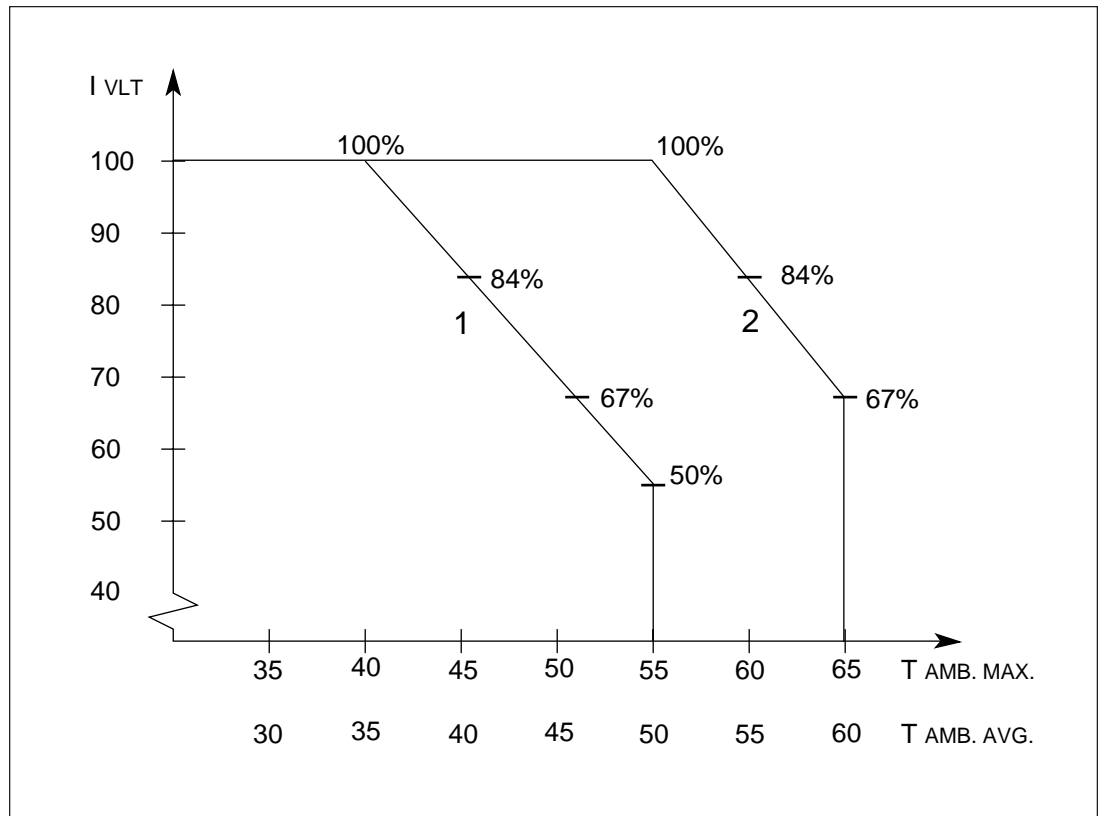
Alarm Messages

- **INVERTER FAULT**
Power section NOT OKAY.
- **MAINS PHASE FAULT (loss of line phase)**
- **OVER VOLTAGE-UNDER VOLTAGE**
Power section has stopped the inverter due to voltage limits exceeded.
- **OVER CURRENT**
Power section has stopped the inverter due to short circuit,
- **GROUND FAULT**
Power section has stopped the inverter due to ground leakage.
- **OVER TEMP**
Power section has stopped the inverter due to high heatsink temperature.
- **OVER LOAD (ETR)**
Unit has been running too long at intermittent current.
- **MOTOR TRIP (ETR or THERMISTOR)**
- Motor has been running too long at intermittent current.
- **KEY DISABLED**
The inverter is in Factory set Mode, parameter 001.

Derating for ambient temperature:
 The ambient temperature is the maximum temperature allowed. The average over 24 hours must have at least 5°C lower in accordance with VDE 160 5.2.1.1.

If the VLT® Adjustable Frequency Drive is operated at temperatures above 40°C (45°C in CT), then a derating of the continuous output current is necessary,

Derating for Ambient Temperature

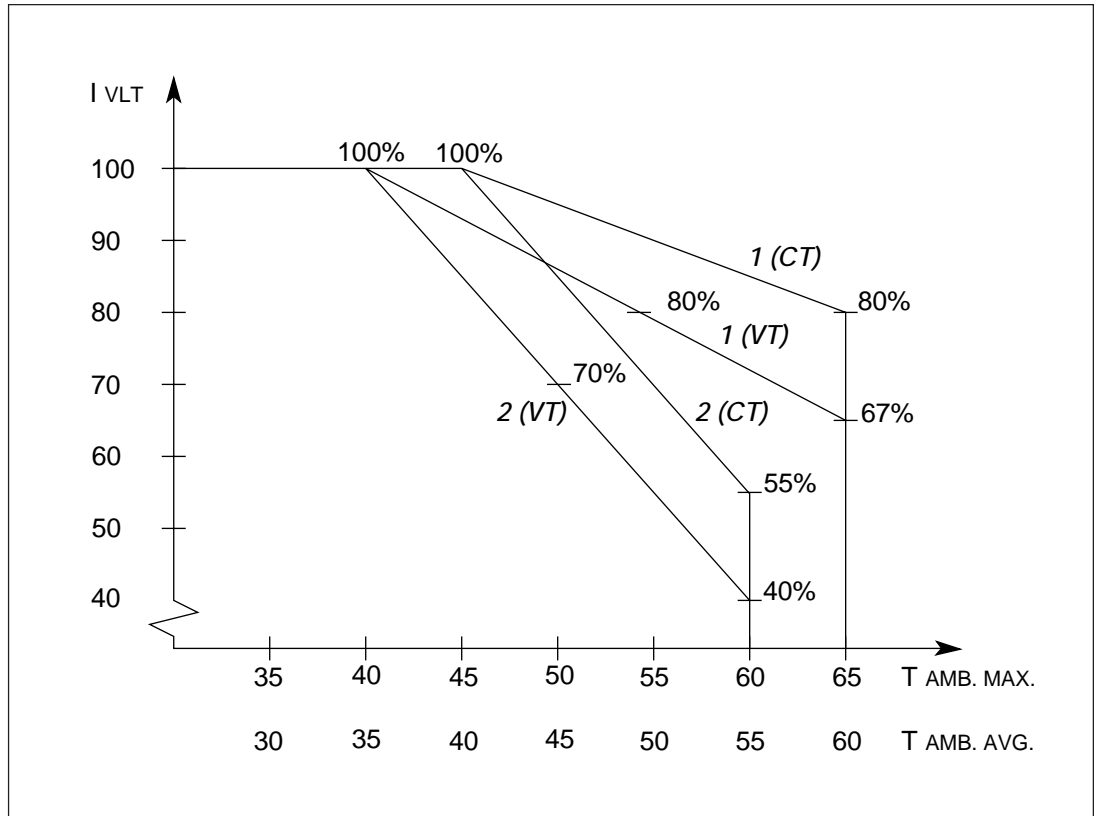


1. VLT 3002-3008; Chassis/NEMA 12
2. VLT 3002-3008: NEMA 1 mounted with top fan. VLT 3004 (200V), 3006 (400, VT) and 3008 (400/500V) has a fan in NEMA 1 version, following curve 1.

Derating for ambient temperature:
 The ambient temperature is the maximum temperature allowed. The average over 24 hours must be at least 5°C lower in accordance with VDE 160 5.2.1.1.

If the VLT® Adjustable Frequency Drive is operated at temperatures above 40°C (45°C in CT), then a derating of the continuous output current is necessary,

Derating for Ambient Temperature
 (continued)



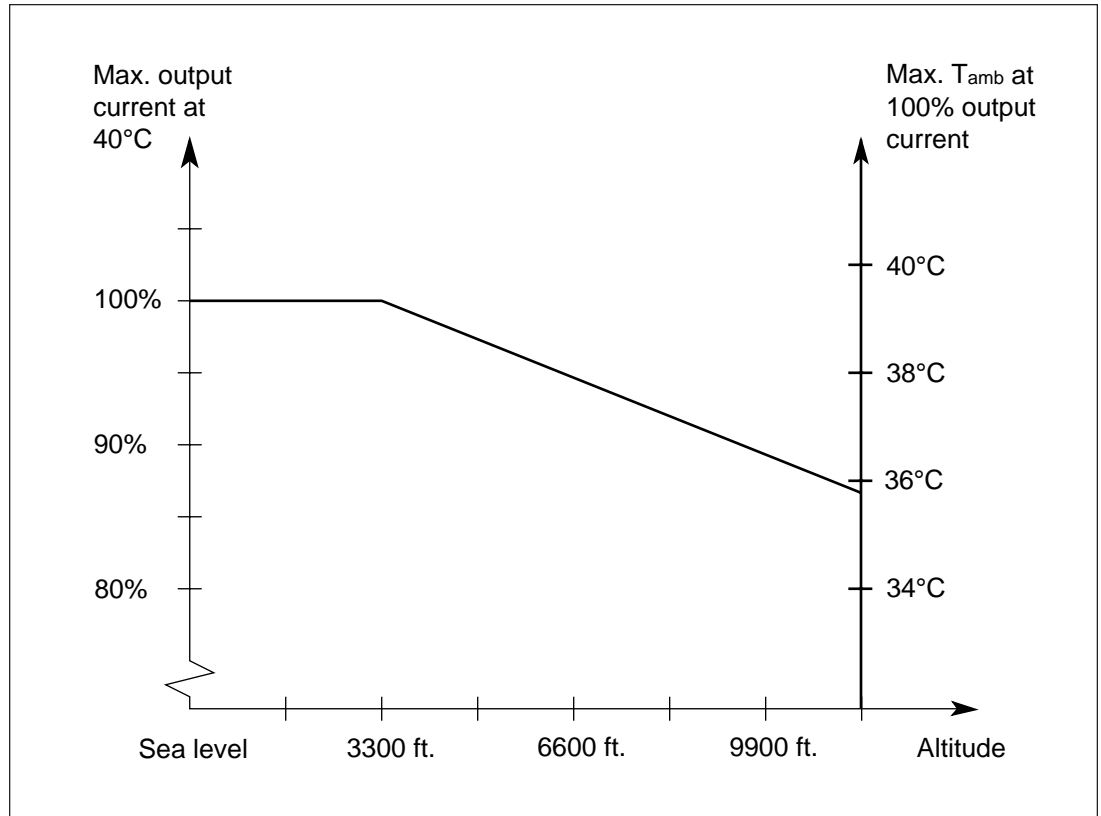
- 1. VLT 3011-3052: Chassis
- 2. VLT 3011-3052; NEMA 12

Derating for air pressure:

Above 3300 ft the ambient temperature (t_{AMB}) or max. output current (IVLT < MAX) must be derated according to the graph below:

1. Derating of output current versus altitude at $t_{AMB} = \text{max. } 40^{\circ}\text{C}$.
2. Derating of max. t_{AMB} versus altitude at 100% output current.

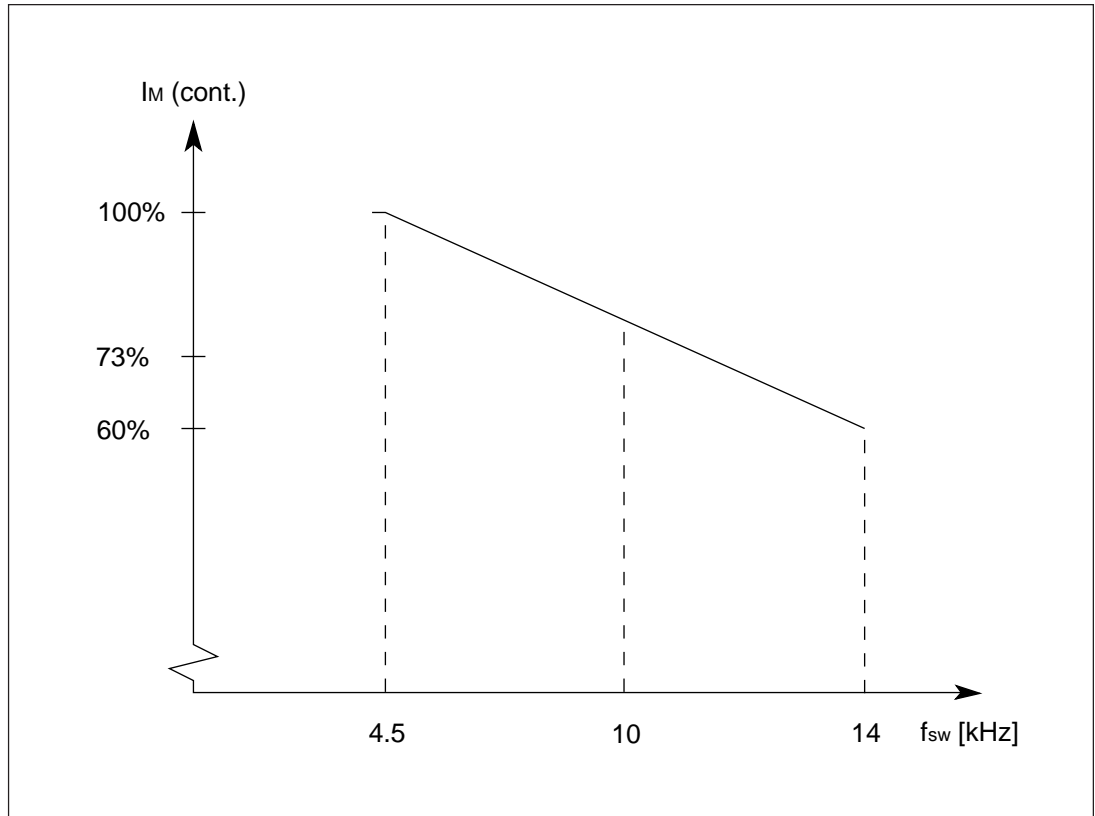
Derating for Air Pressure



Derating for higher switching frequencies:
 A higher switching frequency results in greater loss and stronger heat formation in the adjustable frequency drives transistors and motor coils.

The Adjustable frequency drive therefore automatically derates the maximum permitted constant output current $I_{VLT, N}$, when the switching frequency exceeds 4.5 kHz, Linear reduction down to 60% at 14 kHz (see graph).

Derating for Higher Switching Frequencies

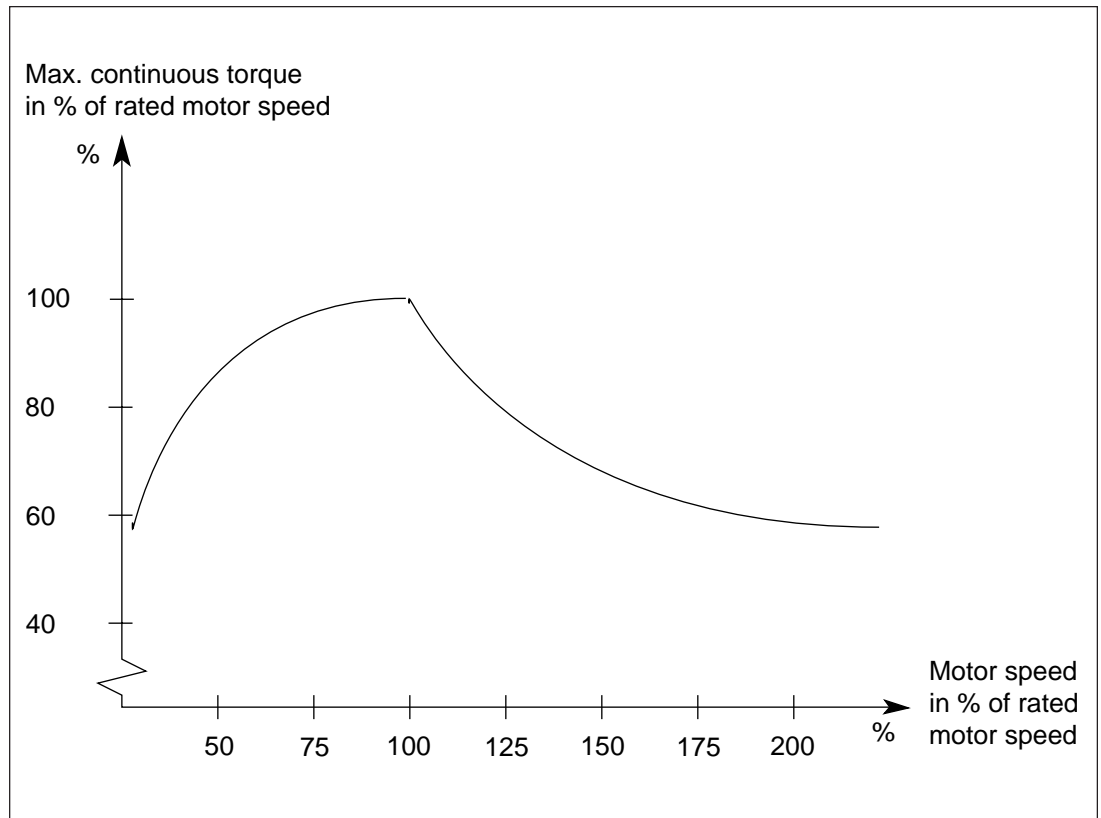


WARNING:
 VLT 3060-3250 CAN NOT exceed 4.5kHz.

Derating for running at low speed:
When a centrifugal pump or fan is controlled by the VLT Series 3000 it is not necessary to reduce the output current at low speed

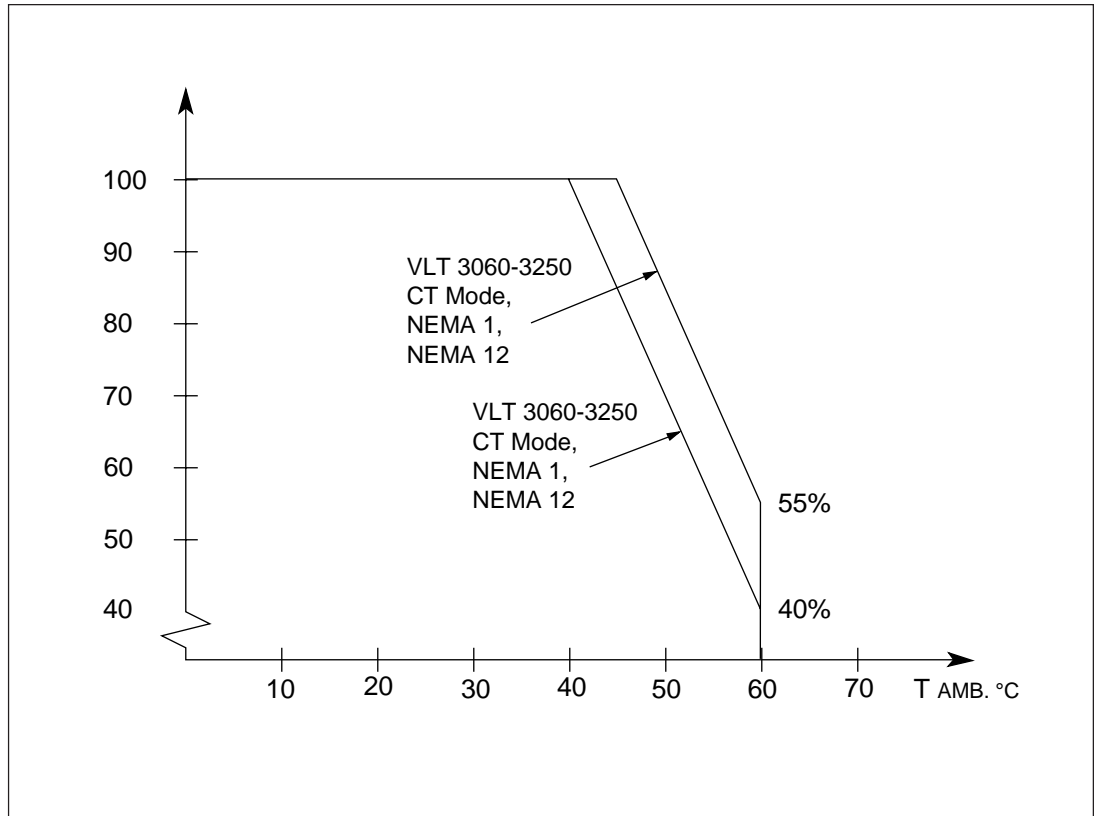
because of their load characteristics (VT) for centrifugal pumps/fans. Motors running constant load torque (CT) applications at low speed must be derated or force-cooled (see graph).

Derating for Running at Low Speed



Output current is derated 3% per 1 °C above maximum ambient temperature of the VLT.
(40 °C - VT Mode, 45 °C - CT Mode)
Absolute maximum ambient = 60 °C.

Derating for Ambient Temperature

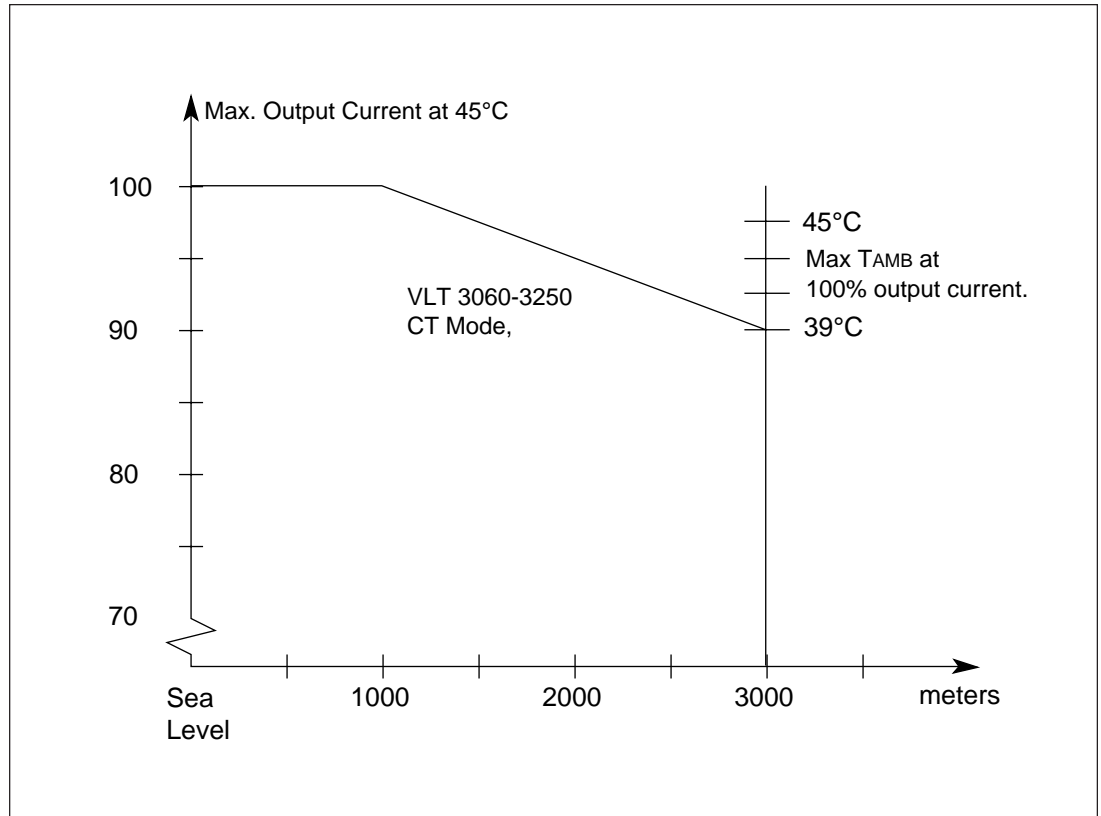


Below an altitude of 3300 feet (1000 meters), no derating is necessary. Above 3300 feet, derating is necessary as follows:

VLT 3060-3250 - CT Mode

At maximum ambient (45 °C), derate output current 5% per 3300 feet above 3300 feet.
At maximum rated current, derate ambient temperatures 3 °C per 3300 feet above 3300 feet.

Derating for Altitude CT Mode VLT 3060-3250

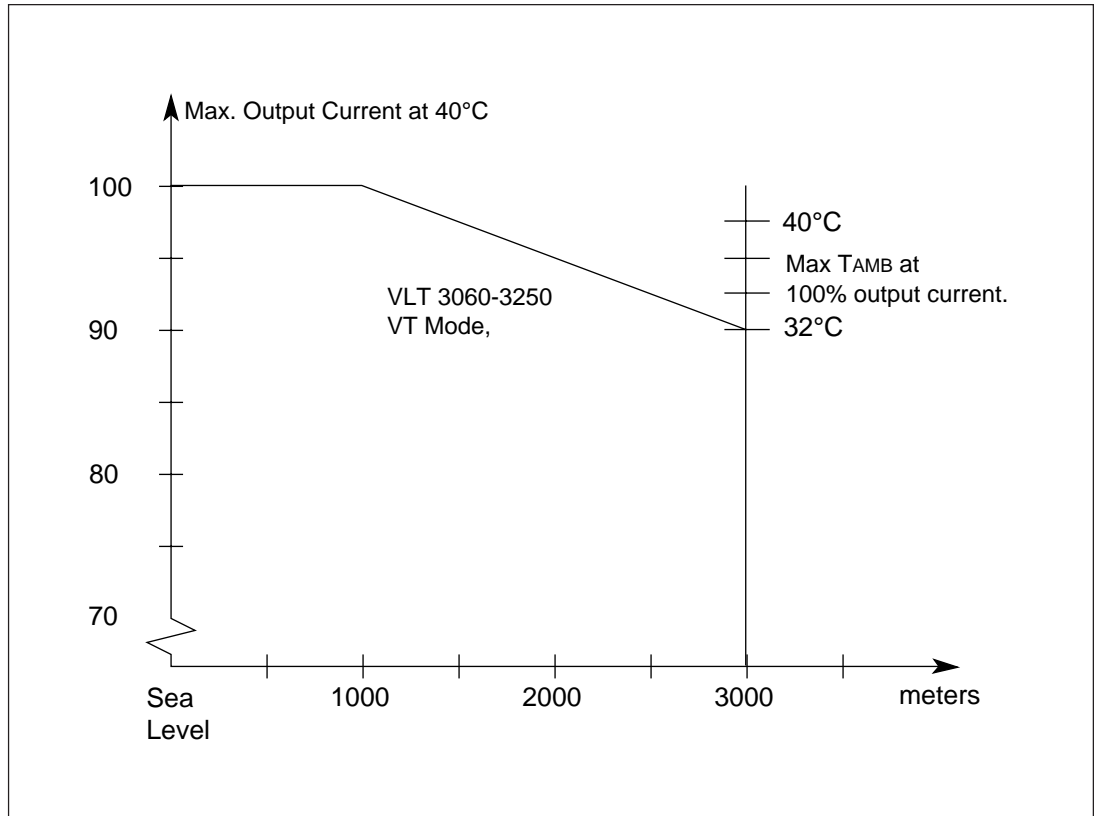


Below an altitude of 3300 feet (1000 meters), no derating is necessary. Above 3300 feet, derating is necessary as follows:

VLT 3060-3250 - VT Mode

At maximum ambient (40 °C), derate output current 5% per 3300 feet above 3300 feet.
 At maximum rated current, derate ambient temperatures 4 °C per 3300 feet above 3300 feet.

**Derating for
 Altitude
 VT Mode
 VLT 3060-3250**



The following instructions will enable quick and easy set-up of the PI regulation and associated parameter settings in the VLT® Series 2000, 3000 and 3500 Adjustable Frequency Drives. Detailed information about each parameter can be found in the respective instruction manuals.

Parameter 100:

Set the load type. There are several choices in each group but **variable torque medium** or **variable torque medium with AEO** will suit most pumps or fans.

Parameter 101:

Select **closed loop** operation.

Parameter 114:

Choose the type of **feedback signal** the transmitter is using. The default value is **current** as it is the most widely used signal type.

Parameter 115 & 116:

Are used to scale a display read-out which is proportional to the feedback transmitter signal. The value is displayed only if **feedback** has been selected in display mode. To get to display mode from any other mode press MENU & DATA keys simultaneously.

If a transmitter has a range of 0-5 bar, 0 can be set in parameter 115 and 5 in parameter 116. In parameter 117 the unit **bar** can be programmed.

The default values are 0 & 100, to display 0-100%.

Parameter 117:

Choose the unit of measurement for scaling the feedback signal of the transmitter set in parameter 115 & 116. The default value is %.

Parameter 119:

The feed forward factor allows a part of the set-point signal to by-pass the PID regulator. This gives faster response when starting up a system where the integration time (parameter 122) is very long, and the system error is small.

Set at 0%. Only add 5% at a time, and only if the system takes a long time to start up. Figure 1 shows the influence of the feed forward.

Parameter 120:

Controls the bandwidth of the output from PID controller. **Set at 100%.**

Parameter 121:

Controls the gain of the system. For most fan and pump systems it should not be higher than 0.9. If set to higher values the system may become unstable.

- **Centrifugal fans - between 0.1 - 0.6**

- **Centrifugal pumps - between 0.3 - 0.8**

Parameter 122:

Improves the final accuracy by integrating out the error.

- **Centrifugal fans - from 10-12 seconds**

- **Centrifugal pumps - from 3-8 seconds**

Parameter 123:

Differential time is not used in pump and fan systems.

Set to Off.

Parameter 124:

If the feedback signal is fluctuating it can be dampened with a time constant. This can occur on pump systems where the pipe can be shut off quickly and cause a standing wave of water.

Set initially to 0 seconds.

Parameter 125: (refer to example on page x.) **Leave at the default value of 100% unless the following conditions occur.**

- If the feedback signal does not match the standard analog signal choices in parameter 412 & 413 a value must be programmed which scales the feedback signal to a standard analog value.
- When using min. speed, parameter 201, it must be ensured that the min. speed % value is not greater than the set-point % value, otherwise the min. speed will over-ride the set-point.

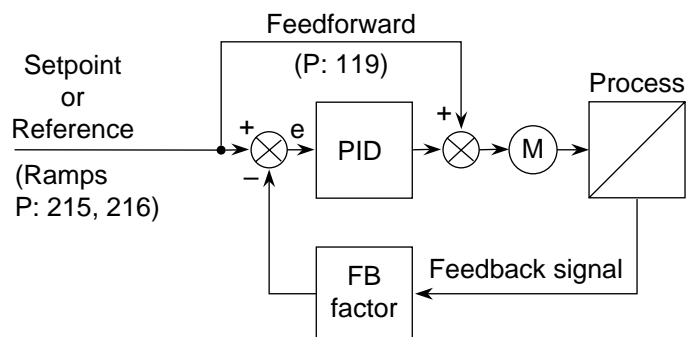


Figure 1.

Example:

The set-point is 40%, and the min. speed is 50%.

1. Selecting a new set-point. Choose a value that will raise the set-point about 10% higher than the min. speed.
New set-point = % min. speed x 1.1 = 55%
2. Setting parameter 125. Apply the same increase to this parameter. $100 \times 1.1 = 110\%$

Parameter 201:

Set min. frequency if required.

If you enter a min. speed you must observe the following:

- When min. speed is used parameter 411 must be set to "proportional with min. limit".
- If the min. frequency % is higher than the set-point % you must re-scale parameter 125 and the set-point.

Parameter 202:

Max. frequency is normally set to 50 Hz. Running centrifugal pumps and fans above this speed will cause overload of the pump or fan, as the power increases to the third power of the speed change.

Example:

If the speed increased to 60 Hz the power will increase by a massive 173%.

Set at 50 Hz.**Parameter 205:**

The internal set-point for the regulator.

Enter the set-point % value.

Externally it can be one of the choices of the analog values. Use of one of the analog choices will prevent its use as the feedback signal.

The use of the internal set-point reduces installation costs. Up to 4 internal set-points (by using parameters 205-208) can be selected by a combination of 2 switches. Refer to the instruction manual for further information.

The set-point can be found by calculating the percentage of required signal from the transmitter range.

Example:

A pressure transmitter has range of 0-10 bar. A set-point of 4 bar is required.

Set-point = $4/10 \times 100 = 40\%$

Enter 40 in parameter 205.

Parameter 214:

Use only linear ramps.

Parameter 215 & 216:

The ramps only function on starting and stopping the system.

Enter the ramp up and down times in seconds.

Parameter 315:

Set the motor thermal protection to **trip 1** if thermal protection of the motor is required.

Parameter 411:

This parameter must be changed from its default value when PID regulation is used.

Set to "proportional with min. limit".

Parameter 412-413:

Set the type of analog input signal for the set-point and feedback signals. Parameter 114 has previously set up the selection of the feedback signal type.

If parameter 205 (internal set-point) is used either current or voltage can be used as the feedback signal.

If one of the inputs is not used it must be set to no operation.

Normal or Inverse Control**Introduction:**

The control is called normal, if the motor speed is increased when the feedback signal goes down, and the motor speed is reduced if the feedback signal goes up. Typical for pump pressure systems and air handling units in variable air volume systems.

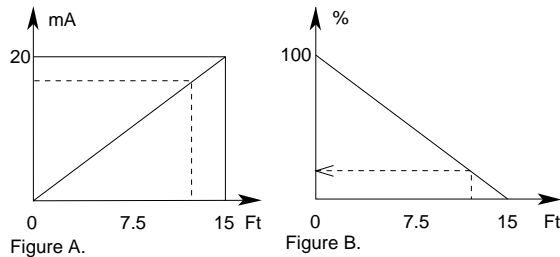
The control is called inverse if the motor speed is increased when the feedback signal is increased. Typical for pit pumping where: the faster the water flows into the pit, the faster the pump must pump out the water.

For inverse control; modification of the setpoint and feedback signal is required.

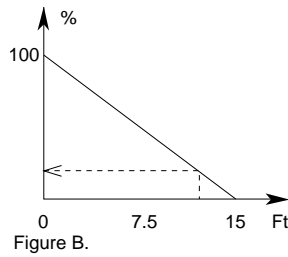
Example:

A transmitter has a 0-15 foot span equal to 0-20mA. The PID set-point must be set at 12 feet for inverse control.

- Enter 20-0 mA in parameter 413. The normal signal in figure A is converted to an inverse signal as shown in figure B.



Normal signal from transmitter
12 ft. represents 16mA (80%)

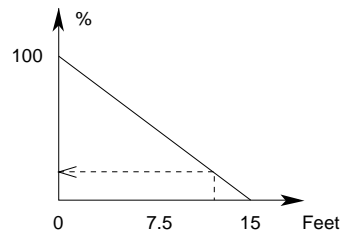


Inverted signal from par: 413
12 ft. represents 100%-80%=20%

- Calculate the set point for inverse control.

$$\text{Setpoint} = 100 - (4/5 \times 100) = 20\%$$

It can be seen in figure C how the set point is calculated.

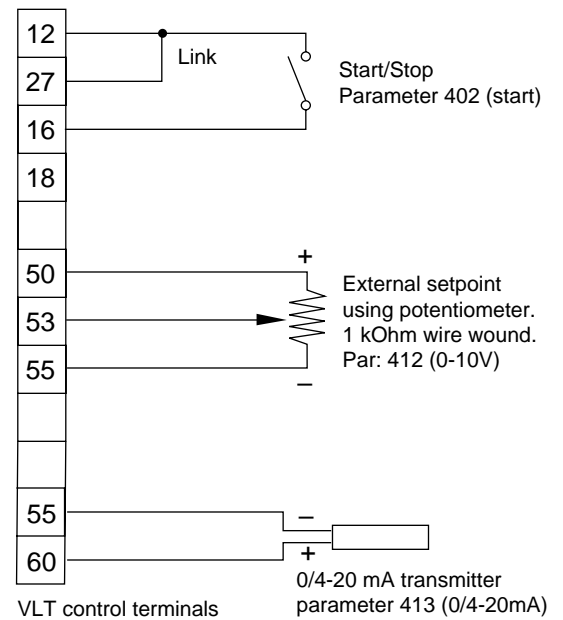


Inverted signal from par:413 (current)
where 12 ft. represents 100%-80%=20%

- If the internal set-point is used, ensure that parameter 412 (voltage input) is set to **no operation**.
- The values in parameter 115 & 116 must be reversed. The display at min. feedback in parameter 115 becomes display at max. feedback and parameter 116 becomes display at min. feedback.
- Connections and set-up are identical to normal control.

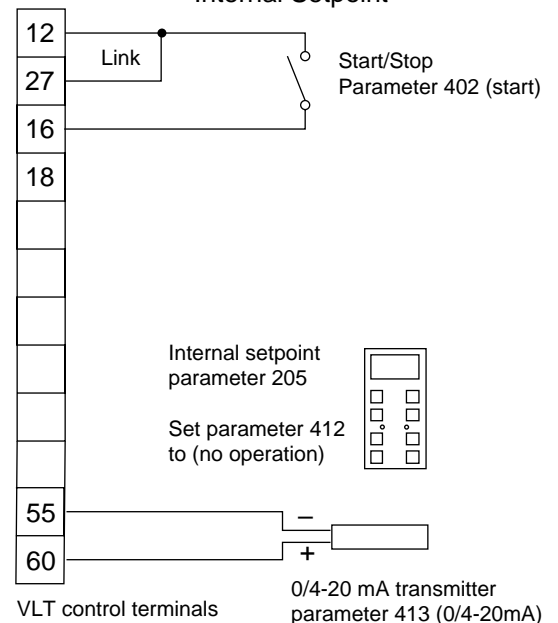
Electrical Connections

External Setpoint



NOTE: All control wiring needs to be shielded and the shield grounded to the clamps as shown in the respective instruction manuals.

Internal Setpoint



NOTE: All control wiring needs to be shielded and the shield grounded to the clamps as shown in the respective instruction manuals.

External Manual Control Over-ride

It is often necessary to run the machine manually for maintenance reasons.

Manual control can be carried out manually from the keypad of all the units.

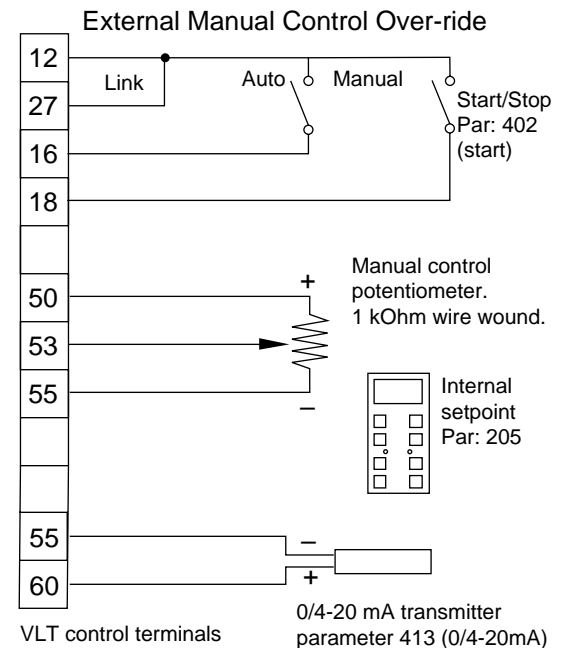
If remote control of the manual over-ride is required additional circuitry is necessary.

For the VLT Series 3500 special parameters are available for external manual over-ride. Refer to the VLT Series 3500 instruction manual.

The following circuit and instructions for external manual over-ride relates to the VLT Series 3000. The proposed control scheme is based on using 2 of the 4 menu set-ups. Menu set-up 1 has the parameters set for PI operation and Menu set-up 2 has the parameters set for manual control.

1. Set parameter 001 to multi set-up.
2. Set parameter 400 to select set-up.
3. Install an "Auto-Manual" switch across terminals 12 & 16. This will allow selection between the 2 menu set-ups. The bottom right hand corner of the display will show the menu set-up you are in.
4. Program menu set-up 1 for PI operation.
5. Select menu set-up 2 and alter the following parameters:
 - Parameter 100; Set to the same load type as in menu 1. You can check the parameter data in menu 2 against the parameter data in menu 1 by switching between menu set-ups while you are in that parameter.
 - Parameter 107-113; Set to the same load types as in menu 1.
 - Parameter 201-201; Max. and Min. Frequency can be set to suit manual control.
 - Parameter 209; Set to the same load type as in menu 1.
 - Parameter 215-216; Set the ramp times to suit the application.

- Parameter 315; Set the motor thermal overload protection to **trip 2**.
- Parameter 412; Set to **0-10 V**.
- Parameter 413; Set to **no operation**.



NOTE: All control wiring needs to be shielded and the shield grounded to the clamps as shown in the respective instruction manuals.

OPERATION and DISPLAY:	LOAD and MOTOR:	REFERENCES and LIMITS:	FUNCTIONS and TIMERS:	INPUTS and OUTPUTS:	SERIAL DATA INTERFACE:	SERVICE and DIAGNOSTICS:
000 LANGUAGE SELECT ^{s)} ENGLISH	100 LOAD ^{4,s)} CT COMPENSATED	*200 FREQUENCY RANGE 0-120 Hz	300 BRAKE OPTION ^{s)} NOT APPLIED	400 BINARY INPUT 16 ^{s)} RESET	500 ADDRESS 01	600 OPERATION DATA ^{s)} TOTAL OPERATING HRS.
001 MENU SETUP SELECT ^{s)} SETUP 1	101 SPEED CONTROL ^{4,s)} SLIP COMPENSATED	201 MIN. FREQUENCY ^{4,s)} 0.00 Hz	301 START FREQUENCY ^{4,s)} 0	401 BINARY INPUT 17 ^{s)} FREEZE REF.	501 BAUD RATE 9600	*601 DATA LOG ^{s)} DIG. IN
002 SETUP COPY DO NOT COPY	102 CURRENT LIMIT CONT. ^{s)} PROGRAMMED SET	202 MAX. FREQUENCY ^{4,s)} DEPENDING ON UNIT	302 START DELAY ^{4,s)} 0	402 BINARY INPUT 18 ^{s)} START	502 DATA READ-OUT ^{s)} REFERENCE %	602 DATA MEMORY ^{s)} CODE
003 OPERATION PLACE ^{s)} REMOTE	103 MOTOR POWER DEPENDING ON UNIT	203 JOG FREQUENCY ^{4,s)} 10	303 HIGH STRT TORQUE ^{4,s)} 0	403 BINARY INPUT 19 ^{s)} REVERSING	*503 COASTING ^{s)} OR	603 TYPE PLATE ^{s)}
004 LOCAL REFERENCE ^{s)} 0 Hz	104 MOTOR VOLTAGE DEPENDING ON UNIT	204 DIGITAL REF. TYPE ^{4,s)} SUM	304 AC LINE FAILURE ^{s)} NORMAL POWER DOWN	404 BINARY INPUT 27 ^{s)} MOTOR COASTING	*504 Q-STOP ^{s)} OR	604 OPERATION MODE ^{s)} RUN NORMAL
005 VALUE at MAX ^{s)} 0100	105 MOTOR FREQUENCY DEPENDING ON UNIT	205 DIGITAL REF. 1 ^{4,s)} 00.0	305 FLYING START ⁴⁾ NO FLYING START	405 BINARY INPUT 29 ^{s)} JOG	*505 DC BRAKE ^{s)} OR	605 PERSONAL DISPLAY ^{s)} SELECT
006 LOCAL RESET ^{s)} ENABLE	106 ADAPT. MOTOR TUNE OFF	206 DIGITAL REF. 2 ^{4,s)} 0	306 DC BRAKING TIME ^{4,s)} 0	406 BINARY INPUT 32/33 ^{s)} 4 SET-UP EXTENDED	*506 START ^{s)} OR	STANDARD DISPLAY VLT TYPE
007 LOCAL START/STOP ^{s)} ENABLE	107 MOTOR CURRENT ^{4,s)} DEPENDING ON UNIT	207 DIGITAL REF. 3 ^{4,s)} 0	*307 DC BRAKE CUT-IN FREQUENCY ^{4,s)}	407 SIGNAL OUTPUT ^{s)} 0-10mA	*507 DIRECTION ^{s)} DIGITAL	(SELF TUNING, DO NOT CHANGE)
008 LOCAL REVERSING ^{s)} DISABLE	108 MOTOR MAGNETIZE ^{4,s)} DEPENDING ON UNIT	208 DIGITAL REF. 4 ^{4,s)} 0	308 DC BRAKE VOLTAGE ^{4,s)} 001.0	408 SIGNAL OUTPUT 45 ^{s)} 0-1 ^{MAX} = 0-20mA	*508 RESET ^{s)} OR	
009 LOCAL JOGGING ^{s)} DISABLE	109 START VOLTAGE ^{4,s)} DEPENDING ON UNIT	209 CURRENT LIMIT ^{4,s)} DEPENDING ON UNIT	309 RESET MODE ^{s)} MANUAL	409 RELAY OUTPUT 01 ^{s)} READY MOTOR OK	*509 SET-UP SELECT ^{s)} OR	
010 LOCAL REFERENCE ^{s)} ENABLE	110 START COMP ^{4,s)} DEPENDING ON UNIT	210 WARN FREQ. LOW ^{4,s)} 0	310 TRIP DELAY AT CURRENT LIMIT ^{s)}	410 RELAY OUTPUT 04 ^{s)} UNIT READY	510 SPEED SELECT ^{s)} DIGITAL or BUS	
011 RESET ENERGY ^{s)} COUNTER	111 U/F RATIO ^{4,s)} DEPENDING ON UNIT	211 WARN FREQ. HIGH ^{4,s)} f_{WAVE} (from 200)	*311 TRIP DELAY AT INVERTER FAULT ^{s)}	411 REMOTE CONTROL ANALOG REF. TYPE ^{s)}	511 BUS JOG 1 ^{s)} 10	
012 RESET HOUR ^{s)} COUNTER	112 SLIP COMP ^{4,s)} DEPENDING ON UNIT	212 WARN CURRNT LOW ^{4,s)} 0	312 AUTO RESTART TIME ^{s)} 0	412 ANALOG INPUT 53 ^{4,s)} MIN. and MAX.	512 BUS JOG 2 ^{s)} 0/10.0	
*014 POWER-UP MODE ^{s)} LOC=STOP	113 NEG SLIP COMP ^{4,s)} DEPENDING ON UNIT	213 WARN CURRNT HIGH ^{4,s)} I_{VRTMAX} (from 209)	313 MOTOR CHECK ^{s)} OFF	413 ANALOG INPUT 60 ^{4,s)} 0-20 mA	513 CATCH-UP VALUE ^{s)} 000	
*015 SET-UP PROGRAM ^{s)} SETUP=P001	114 FEEDBACK TYPE ^{s)} CURRENT	214 RAMP TYPE ^{4,s)} LINEAR	*314 MOTOR PRE-HEAT ^{s)} OFF	414 TIME OUT ^{4,s)} OFF	514 BUS BIT 4 ^{s)} Q-STOP	
	115 DISPLAY VALUE AT MIN. FEEDBACK ^{s)}	215 RAMP-UP TIME ^{4,s)} DEPENDING ON UNIT	*315 MOTOR THERMAL ^{4,s)} PROTECTION	415 TIME OUT FUNCTION ^{4,s)} FREEZE	516 BUS REFERENCE ^{s)} 000.00	
	116 DISPLAY VALUE AT MAX. FEEDBACK ^{s)}	216 RAMP-DOWN TIME ^{4,s)} DEPENDING ON UNIT	316 RELAY ON-DELAY ^{s)} 0		517 STORE DATA VALUES ^{s)} OFF	
	117 DISPLAY UNIT ^{s)} %	217 ALT. RAMP-UP TIME ^{4,s)} DEPENDING ON UNIT	317 RELAY OFF-DELAY ^{s)} 0			
	119 FEED FWD FACTOR ^{4,s)} 100%	218 ALT RAMP-DWN TIME ^{4,s)} DEPENDING ON UNIT				
	120 CONTROL RANGE ^{4,s)} 100%	*219 FREQ. BYPASS 1 ^{4,s)} 120				
	121 PROPORTION GAIN ^{4,s)} OFF	*220 FREQ. BYPASS 2 ^{4,s)} 120				
	122 INTEGRAL TIME ^{4,s)} OFF	*221 FREQ. BYPASS 3 ^{4,s)} 120				
	*123 DIFFERENTIATION TIME ^{4,s)}	*222 FREQ. BYPASS 4 ^{4,s)} 120				
	124 LOW PASS FILTER ^{4,s)} OFF	223 BYPASS BAND WIDTH ^{4,s)} 0				
	125 FEEDBACK FACTOR ^{4,s)} 100%	224 CARRIER FREQ ^{4,s)} 4.5				
		*225 CARRIER FREQ ^{4,s)} DISABLE				
		*230 BRAKE OFF FREQ. ^{4,s)} 3 HZ				
		*231 BRAKE ON FREQ. ^{4,s)} 3 HZ				
		*232 CURR.MIN VALUE ^{4,s)} DEPENDING ON UNIT				
		*233 CURR. DELAY TIME ^{4,s)} 0.1				

**PARAMETER GROUPS AND
FACTORY DEFAULT SETTINGS**

DISPLAY MODE
READOUTS:
REFERENCE %
FREQUENCY Hz
DISPLAY FEEDBACK "UNIT"
CURRENT A
TORQUE %
POWER KW
ENERGY KWh
OUTPUT VOLTAGE V
DC VOLTAGE V
MOTOR ETR value %
INVERTER ETR value %

* INDICATES A NEW PARAMETER OR FACTORY DEFAULT SETTING CHANGE
4) AVAILABLE IN ALL 4 SETUPS
S) CAN BE CHANGED IN START MODE (RUNNING MOTOR)

OPERATION & DISPLAY:	LOAD & MOTOR:	REFERENCES & LIMITS:	FUNCTIONS & TIMERS:	INPUTS & OUTPUTS:	SERIAL DATA INTER.:	SERVICE & DIAG.:
000	100	200	300	400	500	600
001	101	201	301	401	501	601
002	102	202	302	402	502	602
003	103	203	303	403	503	603
004	104	204	304	404	504	604
005	105	205	305	405	505	605
006	106	206	306	406	506	650
007	107	207	307	407	507	
008	108	208	308	408	508	
009	109	209	309	409	509	
010	110	210	310	410	510	
011	111	211	311	411	511	
012	112	212	312	412	512	
014	113	213	313	413	513	
015	114	214	314	414	514	
	115	215	315	415	515	
	116	216	316		516	
	117	217	317		517	
	119	218				
	120	219				
	121	220				
	122	221				
	123	222				
	124	223				
	125	224				
		225				
		230				
		231				
		232				
		233				

CUSTOMER PARAMETER SETTINGS