Adjustable Speed Drive Controllers for Asynchronous Motors

VSD 17

User's Manual
Fractional to 40 HP—
200 to 575 VAC

Receiving, Installation, Configuration and Startup

SQUARE D

⚠ DANGER

HAZARDOUS VOLTAGE

- **Read and understand this bulletin in its entirety before installing or operating VSD17 drive controllers. Installation, adjustment, repair and maintenance of these drive controllers must be performed by qualified personnel.**
- **Disconnect all power before servicing drive controller. WAIT ONE TO TWO MINUTES until DC bus capacitors discharge. The DC bus LED is not an accurate indication of the absence of DC bus voltage.**
- **DO NOT short across DC bus capacitors or touch unshielded components or terminal strip screw connections with voltage present.Install all covers and close door before applying power or starting and stopping the drive controller.**
- **User is responsible for conforming to all applicable code requirements with respect to grounding all equipment. For drive controller grounding points, refer to terminal connection drawings.**
- **Many parts in this drive controller, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.**

Before servicing this controller:

- **Disconnect all power.**
- **Place a "DO NOT TURN ON" label on drive controller disconnect.**
- **Lock disconnect in open position.**

PLEASE NOTE

Electrical equipment should be serviced only by qualified electrical maintenance personnel, and this document should not be viewed as sufficient instruction for those who are not otherwise qualified to operate, service or maintain the equipment discussed. Although reasonable care has been taken to provide accurate and authoritative information in this document, no responsibility is assumed by Schneider Canada Inc. for any consequences arising out of the use of this material.

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1 GENERAL

1.1 PRODUCT CHANGES

Schneider Canada Inc. reserves the right to discontinue or make modifications to the design of its products without prior notice, and holds no obligation to make modifications to products sold previously. Schneider Canada Inc. also holds no liability for losses of any kind which may result from this action.

1.2 WARRANTY

Schneider Canada Inc. warrants the VSD17 Series AC motor control to be free of defects in material and workmanship for a period of twelve months from the date of sale to the user or the date of shipment, which ever occurs first. Any control component, which under normal use, becomes defective, within the stated warranty time period, shall be returned to Schneider Canada Inc., freight prepaid, for examination. Schneider Canada Inc. reserves the right to make the final determination as to the validity of a warranty claim, and sole obligation is to repair or replace only components which have been rendered defective due to faulty material or workmanship. No warranty claim will be accepted for components which have been damaged due to mis-handling, improper installation, unauthorized repair and/or alteration of the product, operation in excess of design specifications or other misuse, or improper maintenance. Schneider Canada Inc. makes no warranty that its products are compatible with any other equipment, or to any specific application, to which they may be applied and shall not be held liable for any other consequential damage or injury arising from the use of its products.

This warranty is in lieu of all other warranties, expressed or implied. No other person, firm or corporation is authorized to assume, for Schneider Canada Inc., any other liability in connection with the demonstration or sale of its products.

1.3 RECEIVING

Inspect all cartons for damage which may have occurred during shipping. Carefully unpack equipment and inspect thoroughly for damage or shortage. Report any damage to carrier and/or shortages to supplier. All major components and connections should be examined for damage and tightness, with special attention given to PC boards, plugs, knobs and switches.

1.4 CUSTOMER MODIFICATION

Schneider Canada Inc., its sales representatives and distributors, welcome the opportunity to assist our customers in applying our products. Many customizing options are available to aid in this function. Schneider Canada Inc. cannot assume responsibility for any modifications not authorized by its engineering department.

2 THEORY

2.1 DESCRIPTION OF AC MOTOR OPERATION

Three phase AC motors are comprised of two major components, the stator and the rotor. The stator is a set of three electrical windings held stationary in the motor housing. The rotor is a metal cylinder, fixed to the motor drive shaft, which rotates within the stator. The arrangement of the stator coils and the presence of three phase AC voltage give rise to a rotating magnetic field which drives the rotor. The speed at which the magnetic field rotates is known as the synchronous speed of the motor. Synchronous speed is a function of the frequency at which the voltage is alternating and the number of poles in the stator windings.

The following equation gives the relation between synchronous speed, frequency, and the number of poles:

$$Ss = 120\ f/p$$

Where: Ss = Synchronous speed (rpm), f = frequency (Hz), p = number of poles

In three phase induction motors the actual shaft speed differs from the synchronous speed as load is applied. This difference is known as "slip". Slip is commonly expressed as a percentage of synchronous speed. A typical value is three percent at full load.

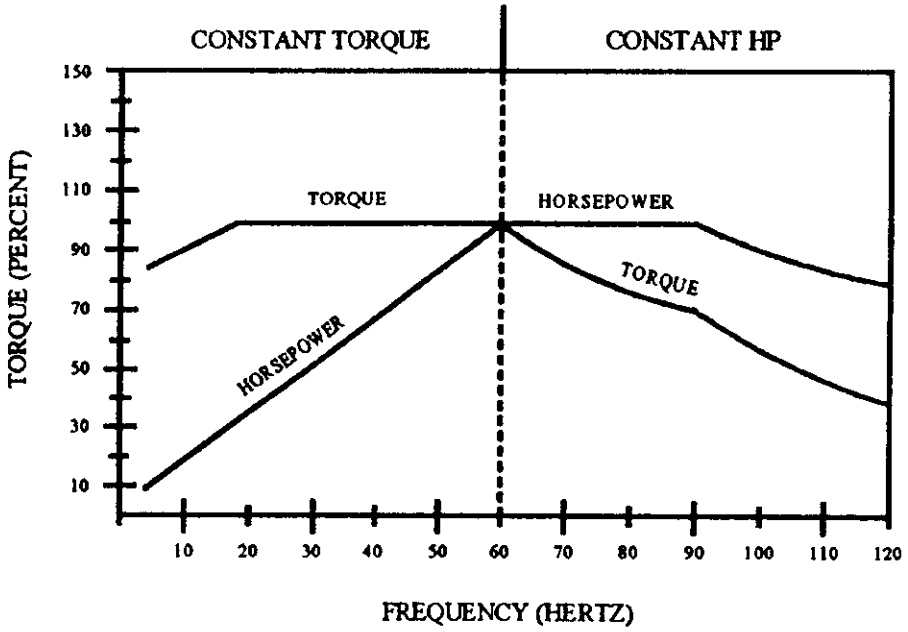
The strength of the magnetic field in the gap between the rotor and stator is proportional to the amplitude of the voltage at a given frequency. The output torque capability of the motor is, therefore, a function of the applied voltage amplitude at a given frequency. When operated below base (rated) speed, AC motors run in the range of "constant torque". Constant torque output is obtained by maintaining a constant ratio between voltage amplitude (Volts) and frequency (Hertz). For 60 Hz motors rated at 230, 460, and 575 Vac, common values for this V/Hz ratio are 3.83, 7.66, and 9.58 respectively. Operating with these V/Hz ratios generally yields optimum torque capability. Operating at lower ratio values results in lower torque and power capability. Operating at higher ratio values will cause the motor to overheat. Most standard motors are capable of providing full torque output from 3 to 60 Hz. However, at lower speeds, where motor cooling fans become less effective, supplemental cooling may be needed to operate at full torque output continuously.

If the frequency applied to the motor is increased while the voltage remains constant, torque capability will decrease as speed increases. This will cause the horsepower capability of the motor to remain approximately constant. Motors run in this mode when operated above base speed, where drive output voltage is limited by the input line voltage. This operating range is known as the "constant horsepower" range. The typical maximum range for constant

horsepower is about 2.3 to 1 (60 to 140 Hz). The diagram below depicts the operating characteristics of a typical AC induction motor.

⚠ WARNING

Consult motor manufaturer before operating motor and/or driven equipment above base speed



2.2 DRIVE FUNCTION DESCRIPTION

The VSD17 Series is a 16 bit microprocessor based, keypad programmable, variable speed AC motor drive. There are four major sections; an input diode bridge and filter, a power board, a control board, and an output intelligent power module.

2.2.1 DRIVE OPERATION

Incoming AC line voltage is converted to a pulsating DC voltage by the input diode bridge. The DC voltage is supplied to the bus filter capacitors through a charge circuit which limits inrush current to the capacitors during power-up. The pulsating DC voltage is filtered by the bus capacitors which reduces the ripple level. The filtered DC voltage enters the inverter section of the drive, composed of six output intelligent insulated gate bi-polar transistors (IGBT's) which make up the three output legs of the drive. Each leg has one intelligent IGBT connected to the positive bus voltage and one connected to the negative bus voltage. Alternately switching on each leg, the intelligent IGBT produces an alternating voltage on each of the corresponding motor windings. By switching each output intelligent IGBT at a very high frequency (known as the carrier frequency) for varying time intervals, the inverter is able to produce a smooth, three phase, sinusoidal output current wave which optimizes motor performance.

2.2.2 CIRCUIT DESCRIPTION

The control section consists of a control board with a 16 bit microprocessor, keypad and display. Drive programming is accomplished via the keypad or the serial communications port. During operation the drive can be controlled via the keypad, by control devices wired to the control terminal strip, or by the the serial communications port. The Power Board contains the control and protection circuits which govern the six output IGBT's. The Power Board also contains a charging circuit for the bus filter capacitors, a motor current feedback circuit, a voltage feedback circuit, and a fault signal circuit. The drive has several built in protection circuits. These include phase-to-phase and phase-to-ground short circuit protection, high and low line voltage protection, protection against excessive ambient temperature, and protection against continuous excessive output current. Activation of any of these circuits will cause the drive to shut down in a fault condition.

2.2.3 VSD17 ANALOG INPUT SIGNALS

The drive allows for three speed reference input signals: speed potentiometer (2.5 to 10 kOhm), 4-20 mA, or 0-10 VDC. For control by a speed pot., the wiper lead is connected to terminal TB-5A, and the high and low end leads are connected to terminals TB-6 and TB-2, respectively. For 4-20 mA control, wire the positive to terminal TB-5B and the negative to terminal TB-2. For 0-10 VDC control, wire the positive to terminal TB-5A and the negative to terminal TB-2. Refer to the diagrams in Section 15 - VSD17 SERIES CONTROL WIRING DIAGRAMS.

The input impedance of terminal TB-5A (0-10 VDC input) is 200 kilohms, and the input impedance of terminal TB-5B (4-20 mA input) is 100 ohms. Terminal TB-2 is circuit common.

2.2.4 VSD17 ANALOG OUTPUT SIGNALS

There are two terminals that can supply analog output signals proportional to output frequency or load. Terminal TB-10A can provide a 0-10 VDC or a 2-10 VDC signal proportional to output frequency, and TB-10B can provide the same signals proportional to load. The 2-10 VDC signals can be converted to a 4-20 mA signal using a resistor in series with the signal such that the total load resistance is 500 ohm. See Parameters: 42 - TB10A OUT, 43 - @TB10A, 44 - TB10B OUT, and 45 - @TB10B in Section 18 - DESCRIPTION OF PARAMETERS.

2.2.5 VSD17 STATUS OUTPUT RELAYS

The control board has one FORM C relay at terminals TB-16, TB-17, and TB-18. Contacts are rated for 2 amps at 28 VDC or 120 Vac.

There are also two open-collector outputs at terminals TB-14 and TB-15. The open-collector circuit is a current sinking type rated at 30 VDC and 40 mA maximum. An external power supply (30 VDC max.) must be used to power the open-collector outputs. The drive does not have a dedicated power supply for the open-collector outputs.

The FORM C relay and the open-collector outputs can be programmed to indicate any of the following: RUN, FAULT, /FAULT (INVERSE FAULT), LOCK (FAULT LOCKOUT), AT SPEED, ABOVE #3, I LIMIT (CURRENT LIMIT), or AUTO/MAN. See Parameters: 52 - TB14 OUT, 53 - TB15 OUT, and 54 - RELAY, in Section 18 - DESCRIPTION OF PARAMETERS.

The following describes the possible relay output settings:

NONE — This setting disables the relay output.

RUN — The relay energizes when the drive is given a START command, and remains energized until: a STOP command is given and the output frequency has decelerated to 0.5 Hz, the drive has "tripped", or the input voltage is removed. Note that this relay indicates only that the drive is in the RUN mode. It does not necessarily indicate that the motor is turning.

FAULT — The relay energizes when input voltage is applied to the drive and remains energized until the drive "trips" into a fault condition, or input voltage is removed.

/ FAULT — INVERSE FAULT - The relay energizes when the drive "trips" into a fault condition, and remains energized until the fault condition is cleared.

LOCK — FAULT LOCKOUT - This relay is used when the drive is programmed to automatically restart after a fault. The relay energizes when input voltage is applied to the drive and remains energized until the drive has faulted and unsuccessfully attempted five restarts, or input voltage is removed.

AT SPEED — The relay energizes when the drive reaches the commanded frequency. To avoid a "chattering" relay (constantly energizing and de-energizing) , due to small fluctuations in speed, the relay will change states only when the speed has changed by $\pm$ 3 Hz.

ABOVE #3 — The relay energizes when the output frequency of the drive exceeds the value corresponding to the SPEED #3 value, and de-energizes when the output frequency returns to a value lower than the SPEED #3 value. See Parameter 3 - SPEED #3 in Section 18 - DESCRIPTION OF PARAMETERS.

I LIMIT — CURRENT LIMIT - The relay energizes when the drive is operating in current limit. Once the current limit relay is energized, it remains energized for a minimum of 500ms, regardless of whether the drive is still in current limit. At the end of the 500ms interval, the relay will de-energize if the drive is no longer in current limit. See Parameter 16 - CURRENT in Section 18 - DESCRIPTION OF PARAMETERS.

AUTO/MAN — The relay energizes when the drive is in the AUTOMATIC MODE, and de-energizes in the MANUAL MODE. See Parameter 28 - AUTO/MAN in Section 14.2.6 - SPEED REFERENCE SELECTION.

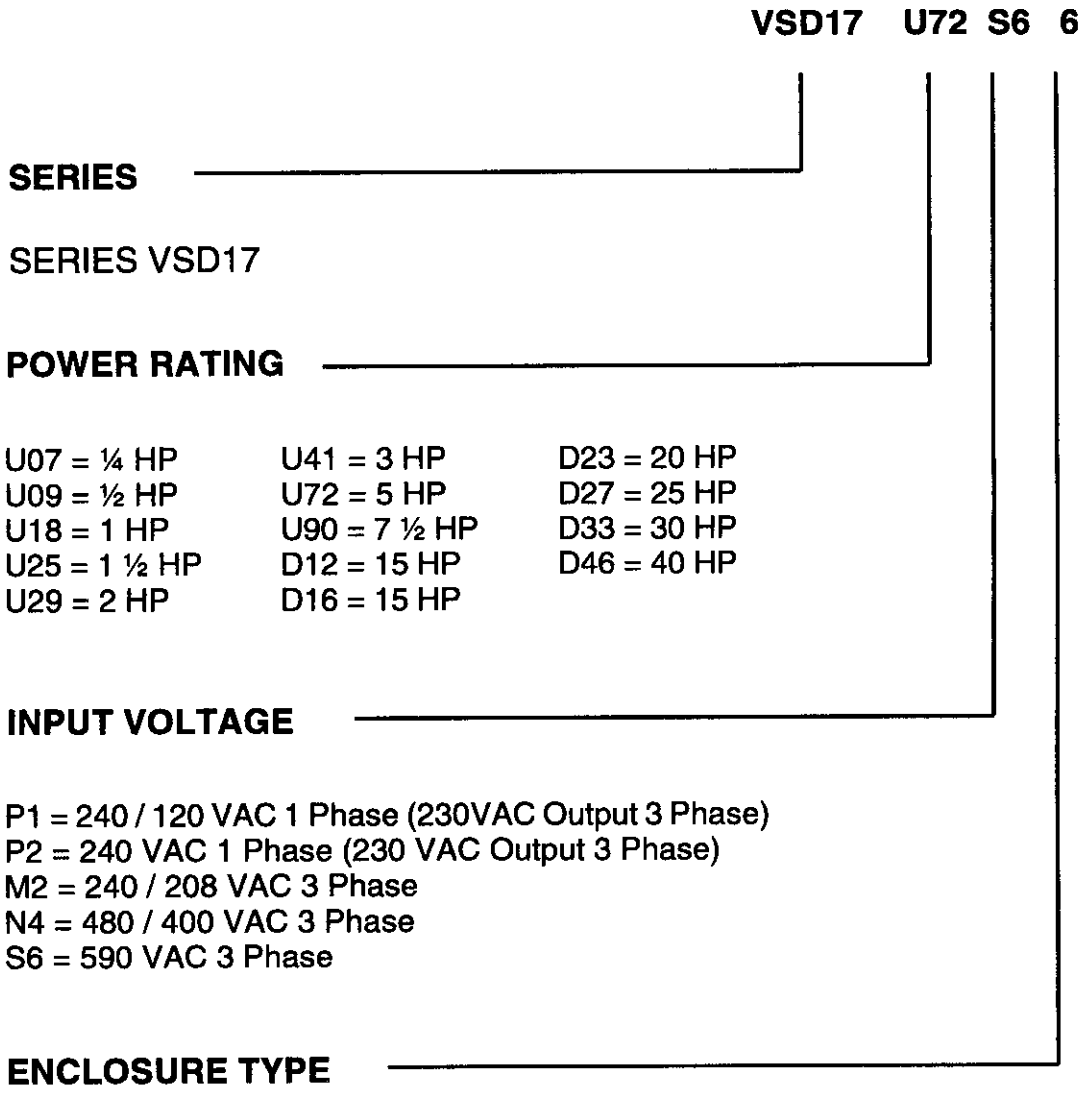
3 DESIGN SPECIFICATIONS FOR VSD17 SERIES

Storage Temperature	-20° to 70° C
Ambient Operating Temperature (With 2.5 and 8 kHZ carrier, derate for higher carriers)	Chassis 0°- 55° C Type 1 (IP 31) 0°- 50° C Type 4 (IP 65) 0°- 40° C Type 12 (IP 54) 0°- 40° C
Ambient Humidity	Less than 95% (non-condensing)
Maximum Altitude	3300 feet (1000 meters) above sea level
Input Line Voltages	240/120 Vac , 240/200 Vac, 480/400 Vac, and 590 Vac
Input Voltage Tolerance	+10%, -15%
Input Frequency Tolerance	48 to 62 Hz
Output Wave Form	Sine Coded PWM
Output Frequency	0-120 Hz Standard
Carrier Frequency	2.5 kHz to 14 kHz
Frequency Stability	+/- 0.00006% / °C
Service Factor	Typically greater than 96%
Overload Current Capacity	150% of drive output rating for one minute
Speed Reference Follower	0-10 VDC, or 4-20 mA
Control Voltage	15 VDC
Analog Outputs	0 - 10 VDC, or 2 - 10 VDC Proportional to speed or load
Digital Outputs	Form C relay: 2 A at 28 VDC or 120 Vac Open-collector outputs: 40 mA at 30 VDC

4 VSD17 SERIES MODEL DESIGNATION CODE

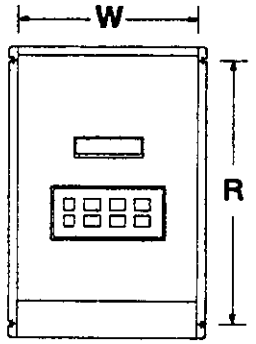
The model number of a VSD17 Series drive gives a full description of the basic drive unit (see example below). Options such as door interlocked disconnects, input line fuses, input line and load reactors, EMI/RFI filter, manual and automatic transfer bypass, additional door mounted operator controls, remote stations, etc. can also be provided.

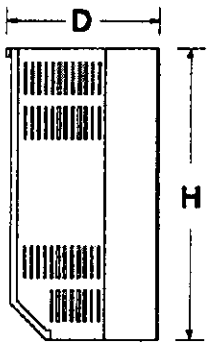
EXAMPLE: VSD17U18S68
(VSD17 SERIES, 575 VAC, 1HP, TYPE 4/12 ENCLOSURE)

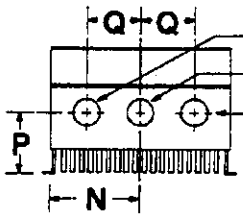


5 DIMENSIONAL DATA

5.1 CHASSIS AND TYPE 1 ENCLOSED







Conduit Holes:
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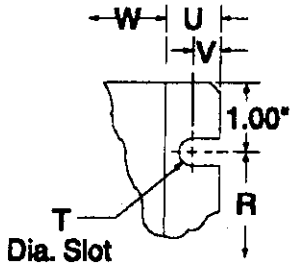
0.88" Dia.
S Dia.



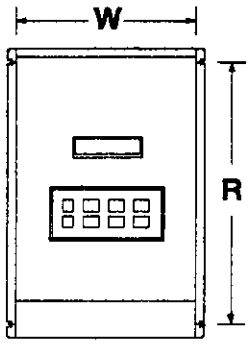
Mounting Tab Detail

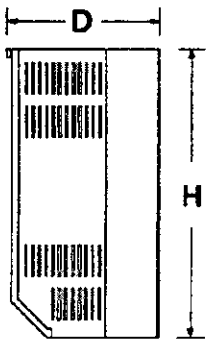
IF W ≤ 7.86"
T = 0.20"
U = 0.34"
V = 0.19"

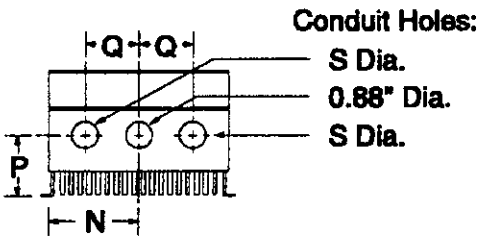
IF W = 10.26"
T = 0.28"
U = 0.44"
V = 0.24"

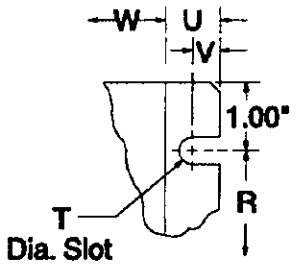
HP	INPUT VOLTAGE	MODEL	H	W	D	N	P	Q	R	S
0.25	240 / 120	VSD17U07P16	7.50	4.70	3.33	2.35	1.60	1.37	5.50	0.88
0.5	240 / 120	VSD17U09P16	7.50	6.12	3.63	3.77	1.80	1.37	5.50	0.88
	240	VSD17U09P26	7.50	4.70	3.63	2.35	1.90	1.37	5.50	0.88
	240 / 200	VSD17U09M26	7.50	4.70	3.63	2.35	1.90	1.37	5.50	0.88
1	240 / 120	VSD17U18P16	7.50	6.12	4.22	3.77	2.40	1.37	5.50	0.88
	240	VSD17U18P26	7.50	4.70	4.33	2.35	2.60	1.37	5.50	0.88
	240 / 200	VSD17U18M26	7.50	4.70	4.33	2.35	2.60	1.37	5.50	0.88
	480 / 400	VSD17U18N46	7.50	4.70	3.63	2.35	1.90	1.37	5.50	0.88
	590	VSD17U18S66	7.50	4.70	3.63	2.35	1.90	1.37	5.50	0.88
1.5	240 / 120	VSD17U25P16	7.50	6.12	4.22	3.77	2.40	1.37	5.50	0.88
	240	VSD17U25P26	7.50	6.12	4.22	3.77	2.40	1.37	5.50	0.88
	240 / 200	VSD17U25M26	7.50	4.70	4.33	2.35	2.60	1.37	5.50	0.88
2	240	VSD17U29P26	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
	240 / 200	VSD17U29M26	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
	480 / 400	VSD17U29N46	7.50	6.12	4.22	3.77	2.40	1.37	5.50	0.88
	590	VSD17U29S66	7.50	6.12	4.22	3.77	2.40	1.37	5.50	0.88
3	240	VSD17U41P26	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
	240 / 200	VSD17U41M26	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
	480 / 400	VSD17U41N46	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
	590	VSD17U41S66	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88

All Dimensions shown are in inches









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IF W = 10.26"
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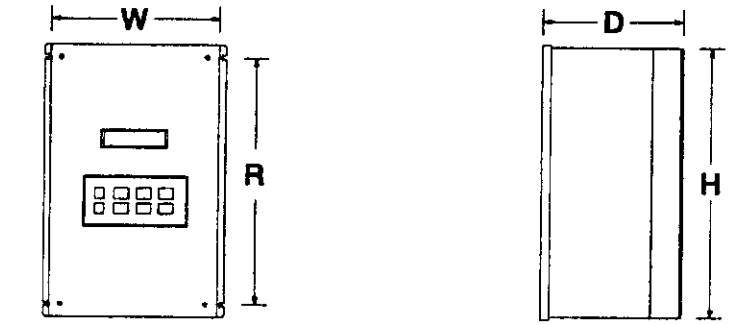
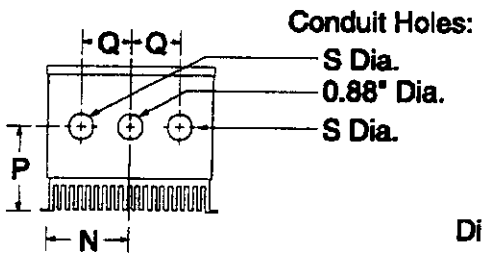
V = 0.24"

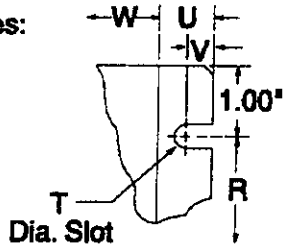
HP	INPUT-VOLTAGE	MODEL	H	W	D	N	P	Q	R	S
5	240 / 200	VSD17U72M26	7.88	7.86	5.94	5.13	3.95	1.50	5.88	1.13
	480 / 400	VSD17U72N46	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
	590	VSD17U72S66	7.50	6.12	5.12	3.77	3.30	1.37	5.50	0.88
7.5	240 / 200	VSD17U90M26	9.38	7.86	6.84	3.93	4.19	2.00	5.88	1.13
	480 / 400	VSD17U90N46	9.38	7.86	6.25	5.13	3.95	1.50	5.88	1.13
	590	VSD17U90S66	9.38	7.86	6.25	5.13	3.95	1.50	5.88	1.13
10	240 / 200	VSD17D12M26	11.25	7.86	6.84	3.93	4.19	2.00	7.75	1.38
	480 / 400	VSD17D12N46	9.38	7.86	6.84	3.93	4.19	2.00	5.88	1.13
	590	VSD17D12S66	9.38	7.86	7.40	3.93	4.19	2.00	5.88	1.13
15	240 / 200	VSD17D16M26	12.75	7.86	6.84	3.93	4.19	2.00	9.25	1.38
	480 / 400	VSD17D16N46	11.25	7.86	6.84	3.93	4.19	2.00	7.75	1.38
	590	VSD17D16S66	12.75	7.86	6.84	3.93	4.19	2.00	9.25	1.38
20	240 / 200	VSD17D23M26	12.75	10.26	7.74	5.13	5.00	2.50	9.25	1.38
	480 / 400	VSD17D23N46	12.75	7.86	6.84	3.93	4.19	2.00	9.25	1.38
	590	VSD17D23S66	12.75	7.86	7.40	3.93	4.19	2.00	9.25	1.38
25	480 / 400	VSD17D27N46	12.75	10.26	7.74	5.13	5.00	2.50	9.25	1.38
	590	VSD17D27S66	12.75	10.26	7.74	5.13	5.00	2.50	9.25	1.38
30	480 / 400	VSD17D33N46	12.75	10.26	7.74	5.13	5.00	2.50	9.25	1.38
	590	VSD17D33S66	12.75	10.26	8.25	5.13	5.00	2.50	9.25	1.38
40	480/400	VSD17D46N46	15.75	10.26	7.74	5.13	5.00	2.50	12.25	1.38
	590	VSD17D46S66	15.75	10.26	7.74	5.13	5.00	2.50	12.25	1.38

All Dimensions shown are in inches

5.2 TYPE 4 AND 4X ENCLOSED







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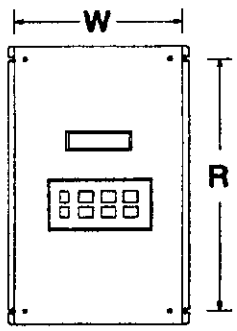
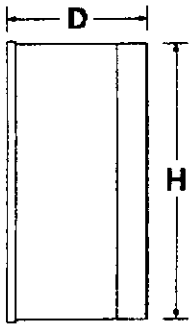
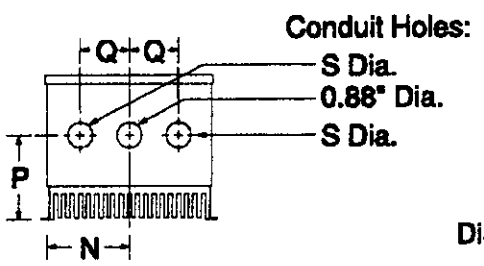
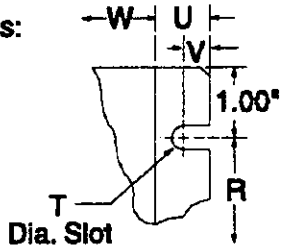
HP	INPUT VOLTAGE	MODEL	H	W	D	N	P	Q	R	S
0.25	240 / 120	VSD17U07P1-	7.88	6.12	3.63	3.06	2.00	1.37	5.88	0.88
0.5	240 / 120	VSD17U09P1-	7.88	7.86	3.75	4.80	2.10	1.37	5.88	0.88
	240	VSD17U09P2-	7.88	6.12	4.35	3.06	2.70	1.37	5.88	0.88
	240 / 200	VSD17U09M2-	7.88	6.12	4.35	3.06	2.70	1.37	5.88	0.88
1	240 / 120	VSD17U18P1-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
	240	VSD17U18P2-	7.88	6.12	4.35	3.06	2.70	1.37	5.88	0.88
	240 / 200	VSD17U18M2-	7.88	6.12	4.35	3.06	2.70	1.37	5.88	0.88
	480 / 400	VSD17U18N4-	7.88	6.12	4.35	3.06	2.70	1.37	5.88	0.88
	590	VSD17U18S6-	7.88	6.12	4.35	3.06	2.70	1.37	5.88	0.88
1.5	240	VSD17U25P2-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
	240 / 200	VSD17U25M2-	7.88	6.12	5.25	3.06	3.60	1.37	5.88	0.88
2	240	VSD17U29P2-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
	240 / 200	VSD17U29M2-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
	480 / 400	VSD17U29N4-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
	590	VSD17U29S6-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
3	240	VSD17U41P2-	7.88	7.86	5.90	4.80	4.25	1.37	5.88	0.88
	240 / 200	VSD17U41M2-	7.88	7.86	5.90	4.80	4.25	1.37	5.88	0.88
	480 / 400	VSD17U41N4-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88
	590	VSD17U41S6-	7.88	7.86	4.90	4.80	3.25	1.37	5.88	0.88

All Dimensions shown are in inches









Mounting Tab Detail

IF W ≤ 7.86"
T = 0.20"
U = 0.34"
V = 0.19"

IF W = 10.26"
T = 0.28"
U = 0.44"
V = 0.24"

HP	INPUT VOLTAGE	MODEL	H	W	D	N	P	Q	R	S
5	240 / 200	VSD17U72M2-	8.38	10.26	6.90	5.13	5.25	2.00	6.38	1.13
	480 / 400	VSD17U72N4-	7.88	7.86	5.90	4.80	4.25	1.37	5.88	0.88
	590	VSD17U72S6-	7.88	7.86	5.90	4.80	4.25	1.37	5.88	0.88
7.5	240 / 200	VSD17U90M2-	11.75	10.26	8.35	5.13	5.75	2.00	11.25	1.38
	480 / 400	VSD17U90N4-	9.75	10.26	7.20	5.13	5.25	2.00	6.38	1.13
	590	VSD17U90S6-	9.75	10.26	7.20	5.13	5.25	2.00	6.38	1.13
10	480 / 400	VSD17D12N4-	11.75	10.26	8.35	5.13	5.75	2.00	9.75	1.13
	590	VSD17D12S6-	11.75	10.26	8.35	5.13	5.75	2.00	9.75	1.13

All Dimensions shown are in inches

6 DRIVE RATINGS

VSD17---P1- Series Ratings	Single Phase Input

Model	Input[1] 240 / 120 Vac, 50-60 Hz	Output 0 to 230 Vac 3 Phase

Model Number[2]	Rated HP	Input line current at 120 Vac Amps	Input line current at 240 Vac Amps	Power (KVA)	Nominal current Amps	Max. transient Currents (60s)
VSD17U07P1-	1/4	6.0	3.0	0.72	1.4	2.1
VSD17U09P1-	1/2	9.2	4.6	1.1	2.2	3.3
VSD17U18P1-	1	16.2	8.1	1.9	4.0	6.0
VSD17U25P1-	1.5	20.8	10.4	2.5	5.2	7.8

1. See section 8 for recommended fuse type.
2. Last letter of model code designates enclosure type

VSD17---P2- Series Ratings	Single Phase Input

Model	Input[1] 240 Vac, 50-60 Hz	Output 0 to 230 Vac 3 Phase

Model Number[2]	Rated HP	Input line current Amps	Power (KVA)	Nominal current Amps	Max. transient Currents (60s)
VSD17U09P2-	1/2	5.0	1.2	2.2	3.3
VSD17U18P2-	1	9.0	2.2	4.0	6.0
VSD17U25P2-	1.5	11.6	2.8	5.2	7.8
VSD17U29P2-	2	14.9	3.6	6.8	10.2
VSD17U41P2-	3	20.9	5.0	9.6	14.4

1. See section 8 for recommended fuse type.
2. Last letter of model code designates enclosure type

VSD17---M2- Series Ratings	Three Phase Input

Model	Input[1] 240 / 208 Vac, 50-60Hz	Output 0 to 230 V/ 200Vac 3 Phase

Model Number[2]	Rated HP	3 Phase input only Input line current 240 / 208 Vac Amps	Power (240V/208V) (KVA)	Ouput current (230V / 200V) Amps	Max. transient Currents (60s) (230V / 200V) Amps
VSD17U09M2-	1/2	2.7 / 3.1	1.1	2.2 / 2.5	3.3 / 3.75
VSD17U18M2-	1	4.8 / 5.6	2.0	4.0 / 4.6	6.0 / 6.9
VSD17U25M2-	1.5	6.2 / 7.2	2.6	5.2 / 6.0	7.8 / 9.0
VSD17U29M2-	2	8.1 / 9.4	3.4	6.8 / 7.8	10.2 / 11.7
VSD17U41M2-	3	11.3 / 13.0	4.7	9.6 / 11.0	14.4 / 21.6
VSD17U72M2-	5	17.7 / 20.4	7.4	15.2 / 17.5	22.8 / 34.2
VSD17U90M2-	7.5	25.5 / 29.4	10.6	22.0 / 25.0	33.0 / 37.5
VSD17D12M2-	10	31.8 / 36.6	13.2	28.0 / 32.0	42.0 / 48.0
VSD17D16M2-	15	47.6 / 54.8	19.8	42.0 / 48.0	63.0 / 72.0
VSD17D23M2-	20	61.0 / 70.2	25.3	54.0 / 62.0	81.0 / 93.0

1. See section B for recommended fuse type
2. Last letter of model code designates enclosure type.

VSD17---N4- Series Ratings	Three Phase Input

Model	Input[1] 480 Vac, 50-60Hz	Output 0 to 460 Vac 3 Phase

Model Number[2]	Rated HP	3 Phase input only Input line current 480 Vac[3] Amps	Power (KVA)	Ouput current Amps	Max. transient Currents (60s) Amps
VSD17U18N4-	1	2.4	2.0	2.0	3.0
VSD17U29N4-	2	4.1	3.4	3.4	5.1
VSD17U41N4-	3	5.7	4.7	4.8	7.2
VSD17U72N4-	5	8.9	7.3	7.6	11.4
VSD17U90N4-	7.5	12.8	10.6	11.0	16.5
VSD17D12N4-	10	15.9	13.2	14.0	21.0
VSD17D16N4-	15	23.8	19.8	21.0	31.5
VSD17D23N4-	20	30.5	25.3	27.0	40.5
VSD17D27N4-	25	38.4	31.9	34.0	51.0
VSD17D33N4-	30	45.2	37.6	40.0	60.0
VSD17D46N4-	40	59.0	49.0	52.0	78.0

1. See section 8 for recommended fuse type.
2. Last letter of model code designates enclosure type
3. For 400 Vac input voltage, multiply the input and output current ratings by 1.15 and the ouput voltage by 0.87..

VSD17---S6- Series Ratings	Three Phase Input

Model	Input[1] 590 Vac, 50-60Hz	Output 0 to 575 Vac 3 Phase

Model Number[2]	Rated HP	3 Phase input only Input line current 590 Vac[3] Amps	Power (KVA)	Ouput current Amps	Max.transient Currents (60s) Amps
VSD17U18S6-	1	1.9	1.9	1.6	2.4
VSD17U29S6-	2	3.3	3.4	2.7	4.0
VSD17U41S6-	3	4.6	4.7	3.9	5.8
VSD17U72S6-	5	7.1	7.3	6.1	9.1
VSD17U90S6-	7.5	10.5	10.7	9.0	13.5
VSD17D12S6-	10	12.5	12.8	11.0	16.5
VSD17D16S6-	15	19.3	19.7	17.0	25.5
VSD17D23S6-	20	24.9	25.4	22.0	33.0
VSD17D27S6-	25	30.5	31.2	27.0	40.5
VSD17D33S6-	30	36.2	37.1	32.0	48.0
VSD17D46S6-	40	46.5	47.5	41.0	61.5

1. See section 8 for recommended fuse type.
2. Last letter of model code designates enclosure type
3. For 480 Vac input voltage, multiply the rated HP by 0.83 and the output voltage by 0.83.

7 INSTALLATION

⚠ WARNING

Drives must not be installed where subjected to adverse environmental conditions! Drives must not be installed where subjected to : combustible, oily, or hazardous vapors or dust; excessive moisture or dirt; strong vibration; excessive ambiant temperatures. Consult Schneider Canada for more information on the suitability of a drive to a particular environment

The drive should be mounted on a smooth vertical surface capable of safely supporting the unit without vibrating. The LCD display has an optimum field of view, this should be considered when determining the mounting position.

Chassis models must be installed in an electrical enclosure which will provide complete mechanical protection and maintain uniform internal temperature within the drive's ambient operating temperature rating. All drive models **MUST be mounted** in a **vertical position** for proper heatsink cooling. Maintain a minimum of **two inches above and below** the drive and a minimum of **two to three inches on either side** of units. Fans or blowers should be used to insure proper cooling in tight quarters. **Do not mount drives above other drives or heat producing equipment** that would impede the cooling of the drive. Note the ambient operating temperature ratings for each drive model.

If it is necessary to drill or cut the drive enclosure or panel , extreme care must be taken to avoid damaging drive components or contaminating the drive with metal fragments (which cause shorting of electrical circuits). Cover drive components with a clean cloth to keep out metal chips and other debris. Use a vacuum cleaner to clean drive components after drilling, even if chips do not appear to be present. Do not attempt to use positive air pressure to blow chips out of drive, as this tends to lodge debris under electronic components. Contaminating the drive with metal chips can cause drive failure and will void the warranty.

8 INPUT AC LINE REQUIREMENTS

⚠ DANGER

HAZARDOUS VOLTAGE

Hazard of electrical shock. Disconnect incoming power and wait three minutes before servicing the drive. Capacitors retain charge after power is removed.

8.1 VOLTAGE:

The input voltage must match the drive's nameplate voltage rating. Voltage fluctuation must not vary by greater than 10% overvoltage or 15% undervoltage.

NOTE: Drives with dual rated input voltage must be programmed for the proper supply voltage - see Parameter 0 - LINE VOLTS in Section 18 - DESCRIPTION OF PARAMETERS SECTION.

The drive is suitable for use on a circuit capable of delivering not more than 18,000 rms symmetrical amperes, at the drive's rated voltage. This applicable only when a 3% Impedance reactor and current limiting fuses are installed at the input power of the VSD17 drive.

Three phase voltage imbalance must be less than 2.0% phase to phase. Excessive phase to phase imbalance can cause severe damage to the drive's power components.

Motor voltage should match line voltage in normal applications. The drive's maximum output voltage will equal the input voltage. Use extreme caution when using a motor with a voltage rating which is different from the input line voltage.

8.2 kVA RATINGS:

If the kVA rating of the AC supply transformer is greater than ten times the input kVA rating of the drive, a drive isolation transformer, or a 3% to 5% input line reactor (also known as a choke) must be added.

8.3 INPUT FUSING AND DISCONNECT REQUIREMENTS

A circuit breaker or a disconnect switch with fuses must be provided in accordance with the National Electric Code (NEC), Canadian Electrical Code (CEC) and all local codes.

The VSD17 Series drive is capable of withstanding up to 150% current overload for 60 seconds. Select a fuse or magnetic trip circuit breaker rated at 1.5 times the input current rating of the drive (the minimum fuse size should be 10 amps, regardless of input current rating). Refer to Section 6 - DRIVE RATINGS.

Minimum voltage rating of the protection device should be; 250 VAC for 240/120 VAC and 240/200 VAC rated drives, and 600 VAC for 480/400 VAC and 590 VAC drives.

Current limiting type fuses should be used when input fusing is required. Select fuses with low I^2T values, rated at 200,000 AIC. Recommended fuses are Bussman type KTK-R or JJS. Similar fuses with equivalent ratings by other manufacturers may also be acceptable.

9 VOLTAGE SELECTION

INPUT VOLTAGE RATINGS

VSD17---P1- Series drives are rated for 240/120 Vac, 50-60 Hz input. The drive will function with input voltage of 120 Vac (+ 10%, -15%) at 48 to 62 Hz when wired for 120 Vac input, or with input voltage of 240 Vac (+ 10%, - 15%), at 48 to 62 HZ, when wired for 240 Vac input.

VSD17---P2- and VSD17---M2- Series drives are rated for 240/200 Vac, 50-60 Hz input. The drive will function with input voltages of 200 to 240 Vac (+ 10%, - 15%), at 48 to 62 Hz.

VSD17---N4- Series drives are rated for 480/400 Vac, 50-60 Hz input. The drive will function with input voltages of 400 to 480 Vac (+ 10%, - 15%), at 48 to 62 Hz.

VSD17---S6- Series drives are rated for 590/480 Vac, 50-60 Hz input. The drive will function with input voltages of 480 to 590 Vac (+ 10%, - 15%), at 48 to 62 HZ.

NOTE: Parameter 0 - LINE VOLTS must be programmed according to the applied input voltage. See Section 18 - DESCRIPTION OF PARAMETERS.

10 POWER WIRING

Note drive input and output current ratings and check applicable electrical codes for required wire type and size, grounding requirements, over-current protection, and incoming power disconnect, before wiring the drive. Size conservatively to minimize the voltage drop.

GENERAL WIRING PRACTICES

Good wiring practices require the separation of control circuit wiring from all power (line and load) wiring. Power wiring to the motor must have the maximum possible separation from all other power wiring, whether from the same drive or other drives; **do not run in the same conduit.** This separation reduces the possibility of coupling electrical noise between circuits.

When wiring VSD17 Drives, follow the wiring practices required by national and local electrical codes in addition to the practices below:

- Use metallic conduit for all drive controller wiring. Do not run control and power wiring in the same conduit.
- Metallic conduits carrying power wiring or low-level control wiring must be separated by at least 4 in (10 cm).
- Non-metallic conduits or cable trays used to carry power wiring must be separated from metallic conduit carrying low-level control wiring by at least 12 in (30.5cm).
- Whenever power and control wiring cross, the metallic conduits and non-metallic conduits or trays must cross at the right angles.
- In some installations, conducted emissions to the line from the drive controller must be attenuated to prevent interference with telecommunication, radio and sensitive electronic equipment. In these instances, attenuating filters may be required.

INPUT WIRING PRECAUTIONS

⚠ DANGER

HAZARDOUS VOLTAGE

Hazard of electrical shock. Disconnect incoming power and wait three minutes before servicing the drive. Capacitors retain charge after power removal.

Input fusing and a power disconnect switch or contactor MUST be wired in series with terminals L1, L2, L3 (L1 and L2 if input is single phase). These may be supplied by Schneider Canada Inc., as an option. If one has not been supplied by Schneider Canada Inc., a disconnect means must be wired during installation. This disconnect must be used to power down the drive when

servicing, or when the drive is not to be operated for a long period of time, but should not be used to start and stop the motor. Repetitive cycling of a disconnect or input contactor (more than once every two minute) may cause damage to the drive.

WIRING FOR SINGLE PHASE OR THREE PHASE INPUT

If the drive is nameplated for 240/120VAC single input:

For 120VAC input voltage; wire the input to terminals L1 and N and jumper terminals L1 to L2.
For 240VAC input voltage; wire to terminals L1 and L2 (do not wire to N)
Refer to Power wiring diagram.

If the drive is nameplated for three phase input only, wire the input to terminals L1, L2 and L3.

OUTPUT WIRING PRECAUTIONS

⚠ WARNING

DRIVE CONTROLLER DAMAGE

Drive controller will be damaged if input line voltage is applied to output terminals (U/T1, V/T2, W/T3). Check power conections before energizing drive controller.

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE, SEVERE PERSONAL INJURY OR DEATH.

The drive controller is sensitive to the amount of capacitance (either phase-to-phase or phase-to-ground) present on the output power conductors. The excessive capacitance may cause nuisance tripping of the drive controller.

Follow the guidelines below when selecting output cable:

- Cable type: the selected cable must have a low capacitance phase-to-phase and phase to ground. Do not use mineral impregnated cable because it has a very high capacitance. Immersion of cables in water increases capacitance.
- Cable length: the longer the cable, the greater the capacitance. An L.C. filter should be installed if cable lengths is greater than 50 ft (15m).Consult Schneider Canada Inc. for additional information.
- Proximity to output cables from other drive controllers: because of the high frequency switching and increased capacitance, the drive may fault under some conditions.
- Do not use lightning arrestors or power factor correction capacitors on the output of the drive controller.

For installation where cable capacitances may be a problem, an inductor can be installed between the drive controller and the motor. Consult Schneider Canada Inc. for additional information.

All three power output wires, from T1, T2 and T3 to the motor , must be kept tightly bundled and run in a separate conduit away from all other power and control wirings.

Do not install contactors between drive and motor without consulting Schneider Canada Inc. for more information.

GROUNDING

For safe, dependable operation, the drive controllers must be grounded according to national and all local codes.

To ground the drive controller:

- Connect a copper wire from the grounding terminal to the power system ground conductor. Wire size is determined by the drive controller size and by national and local codes.
- Verify resistance to ground is one ohm or less. Improper grounding causes intermittent and unreliable operation.

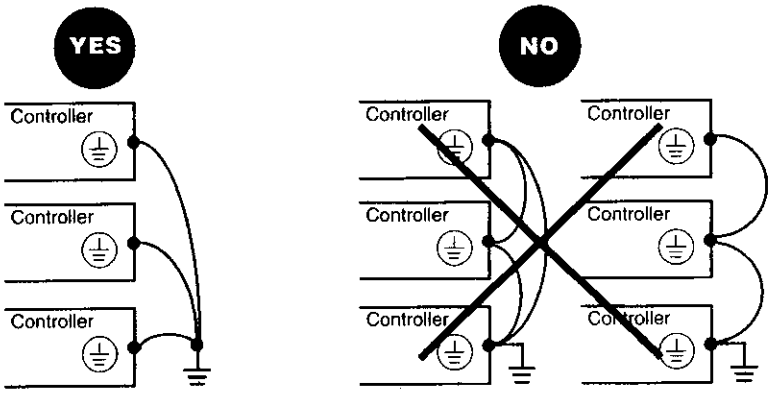
⚠ DANGER

HAZARDOUS VOLTAGE.

- **Ground equipment using screw provided. Drive controller must be properly grounded before applying power.**
- **Do not use metallic conduits or shields as a ground conductor**

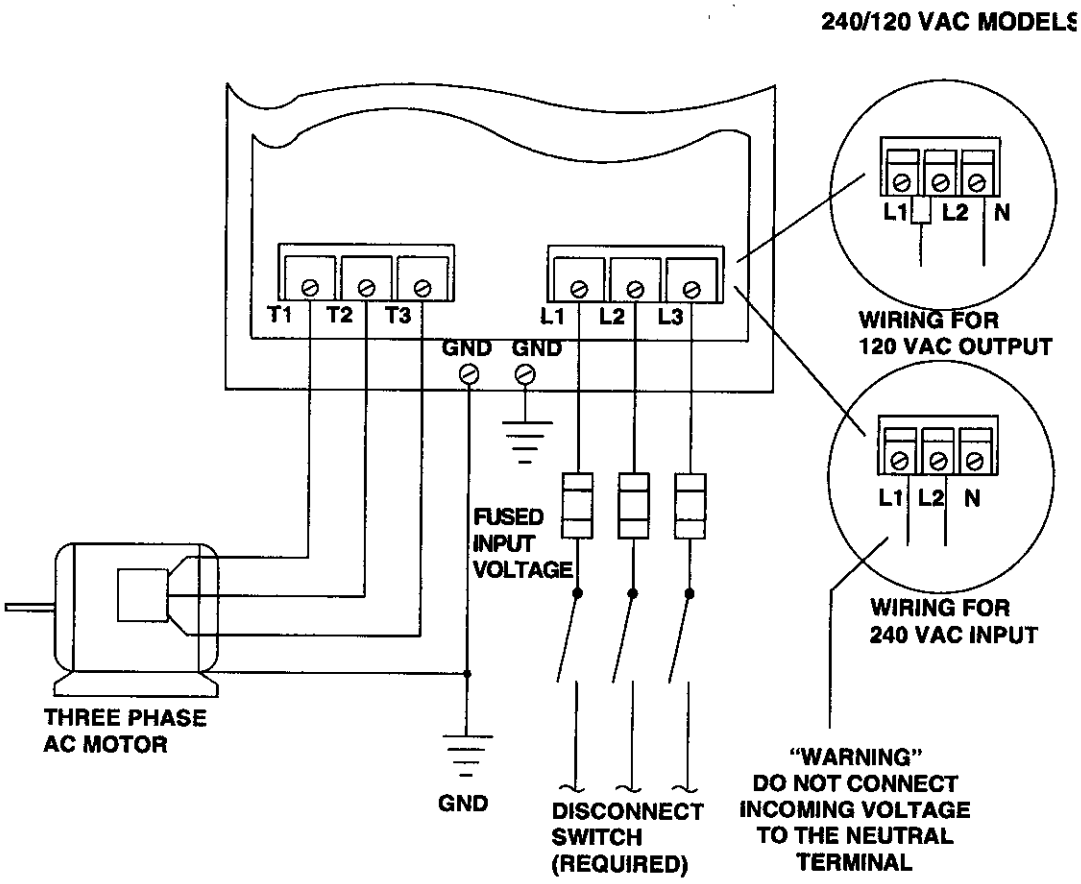
FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE, SEVERE PERSONAL INJURY OR DEATH.

Multiple drive controllers must be grounded as shown. Do not loop or series the ground cables.



Grounding Multiple Drive Controllers

11 VSD17 SERIES POWER WIRING DIAGRAM



⚠ WARNING

DRIVE CONTROLLER DAMAGE

Drive controller will be damaged if input line voltage is applied to output terminals (U/T1, V/T2, W/T3). Check power conections before energizing drive controller.

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE, SEVERE PERSONAL INJURY OR DEATH.

INSTALL, WIRE, AND GROUND IN ACCORDANCE WITH ALL APPLICABLE CODES.

Notes:

1. Wire the motor for the proper voltage per the output rating of the drive. Motor wires MUST be run in a separate steel conduit away from control wiring and incoming AC power wiring.
2. Do not install contactors between the drive and the motor without consulting Schneider Canada for more information. Failure to do so may result in drive damage.
3. Remove any existing, and do not install, power factor correction capacitors between the drive and the motor. Failure to do so will result in drive damage.
4. Use only UL and CSA listed and approved wire.
5. Minimum wire voltage ratings: 300 V for 120, 200 and 240 Vac systems, and 600 V for 400, 480, and 590 Vac systems.
6. Wire guage must be based on a minimum of 150% of the rated output current of the drive, and a minimum 75° C insulation rating. Use copper wire only.
7. Wire and ground in accordance with NEC or CEC, and all applicable local codes.

12 INITIAL POWER UP

⚠ DANGER

HAZARDOUS VOLTAGE

Hazard of electrical shock. disconnect incoming power and wait three minutes before servicing the drive. Capacitors retain charge after power removal

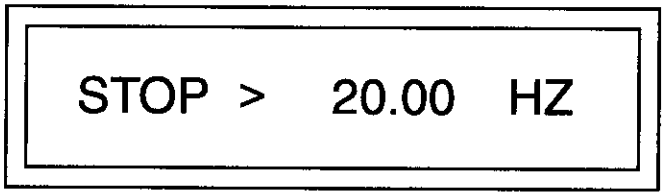
Before attempting to operate the drive, motor, and driven equipment be sure all procedures pertaining to installation and wiring have been properly followed.

Disconnect the driven load from the motor. Verify that the drive input terminals (L1, L2, and L3) are wired to the proper input voltage per the nameplate rating of the drive.

⚠ WARNING

Incoming ac power must not be connected to output terminals T1, T2, and T3! Do not cycle input power to the drive more than once every two minutes.

Energize the incoming power line. The LCD display should light and flash "TESTING" and then show the voltage and horsepower rating of the drive. The display should then show "STOP > 20.00 HZ" which indicates that the drive is stopped, forward direction is selected, and the speed setpoint is 20.00 Hz:



If the display does not appear, remove the incoming power, wait three minutes for the bus capacitors to discharge, and verify correct installation and wiring. If the wiring is correct, re-apply incoming power and note the display for drive status. If the display still does not appear call the factory for assistance. If the drive powers up correctly, follow the procedure given below to check the motor rotation:

1. Use the "DOWN" arrow key to decrease the speed setpoint to the minimum value allowed (.50 Hz if Parameter 10 - MIN FRQ has not been changed).

2. Press the "START" key. The drive should indicate RUN, but if the speed setpoint is .50 Hz, the motor may not rotate. Press the "UP" arrow key to increase the speed setpoint until the motor starts to rotate.

3. If the motor is rotating in the wrong direction, press the "STOP" key, remove power from the drive, wait three minutes for the bus capacitors to discharge, and swap any two of the motor wires connected to T1, T2, and T3.

NOTE: The drive is phase insensitive with respect to incoming line voltage. Therefore, to change the motor rotation, the phases must be swapped at the drive output terminals or at the motor.

13 KEYPAD CONTROL

The drive can be operated in a number of different ways: keypad (local), control devices wired to the terminal strip (remote), serial communications, or a combination of the terminal strip and either the keypad or serial communications. The drive should first be operated from the keypad during initial start-up. Refer to Sections 14 - CONTROL WIRING, and 18 - DESCRIPTION OF PARAMETERS for information on remote operation.

13.1 KEYPAD FUNCTIONS IN LOCAL MODE

START/STOP — To start the drive, press the START key. To stop the drive, press the STOP key.
NOTE: The STOP key is active in both local and remote mode.

SPEED CONTROL — To increase the speed setpoint, press the UP arrow key. To decrease the speed setpoint, press the DOWN arrow key.

FORWARD/REVERSE — To change rotation direction, press the FWD/REV key and then press the ENTER key within three seconds.
NOTE: Parameter 27 - ROTATION must be set to FWD & REV for this key to be active.

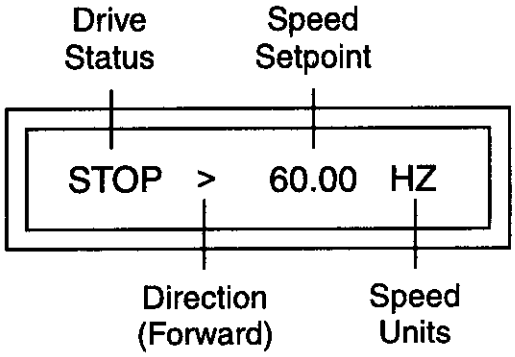
SPEED REFERENCE — To toggle between MANUAL speed control and AUTOMATIC speed control, press the AUTO/MAN key and then press the ENTER key within three seconds.
NOTE: Parameter 28 - AUTO/MAN must be set to BOTH for this key to be active. See Section 14 - CONTROL WIRING for information on automatic speed references.

13.2 VSD17 SERIES DISPLAY

The following describes the possible display configurations for the VSD17 Series drive.

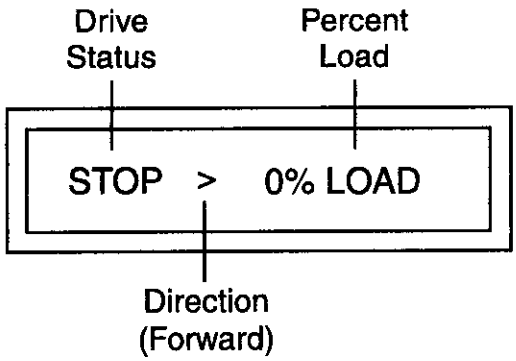
13.2.1 VSD17 SERIES DISPLAY IN STOP MODE

When the drive is in the STOP mode, there are three possible displays. The first is the SPEED display, which looks like this:

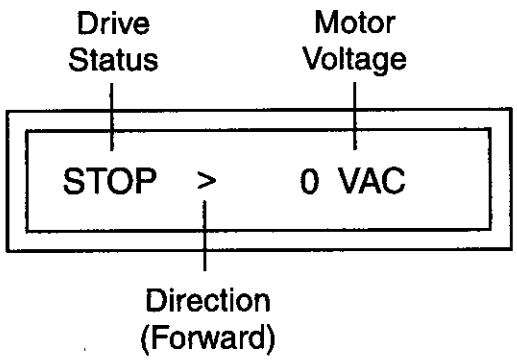


NOTE: See Parameter 31 - HZ UNITS for the SPEED UNITS display options.

Pressing the ENTER key will change the display from the SPEED indication to the % LOAD indication:



Pressing the ENTER key again will change the display from the % LOAD indication to the VAC (motor voltage) indication:



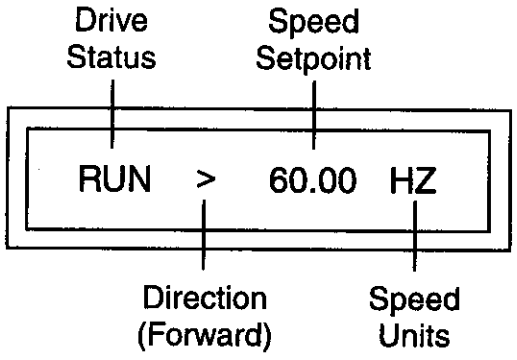
Pressing ENTER again will change the display back to the SPEED indication.

The following table shows the possible DRIVE STATUS indications that can appear on the drive display:

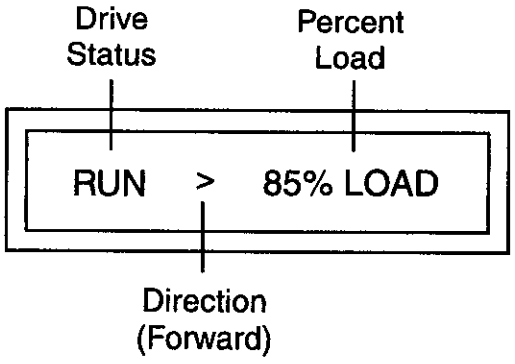
DRIVE STATUS TABLE	
DISPLAY	**DESCRIPTION**
STOP	Drive is in STOP mode - No output to the motor.
RUN	Drive is in RUN mode and is within +/- 3 Hz of the speed setpoint.
FAULT	Drive has shut down due to a FAULT condition. If the fault condition has passed, pressing the STOP key will clear the fault and return the drive to the STOP mode.
LOCK	Drive is in FAULT LOCKOUT due to five unsuccessful restart attempts.
BRAKE	DC BRAKE is energized.
LIMIT	Drive is in CURRENT LIMIT due to an overloaded motor, or ACCEL is too fast.
F DEC	Drive is in DECEL FREEZE because DECEL is too fast.

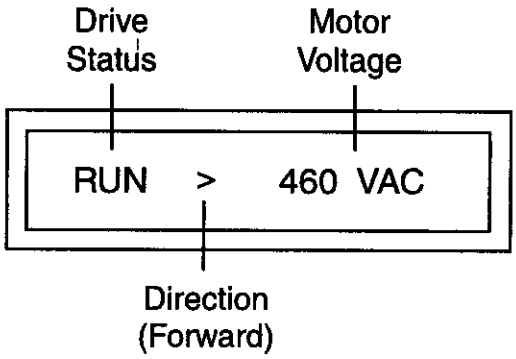
13.2.2 VSD17 SERIES DISPLAY IN RUN MODE

When the drive is in the RUN mode, the default display will look like this:



As in the STOP mode, the ENTER key can be used to toggle the display from SPEED to % LOAD to VAC (motor voltage):

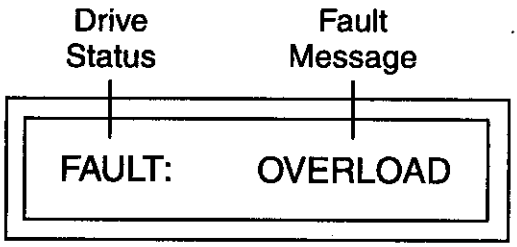




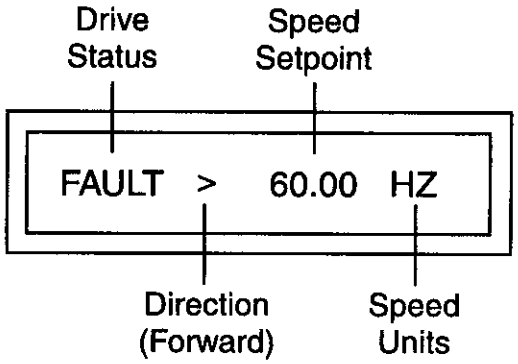
NOTE: During acceleration and deceleration to the SPEED SETPOINT, the DRIVE STATUS will show the actual drive speed. When the SPEED SETPOINT is reached, the DRIVE STATUS will change to RUN (or STOP if the drive is decelerating to a STOP).

13.2.3 VSD17 SERIES DISPLAY IN FAULT MODE

When the drive trips on a fault, the display will automatically change to the FAULT display, which indicates the FAULT MESSAGE:



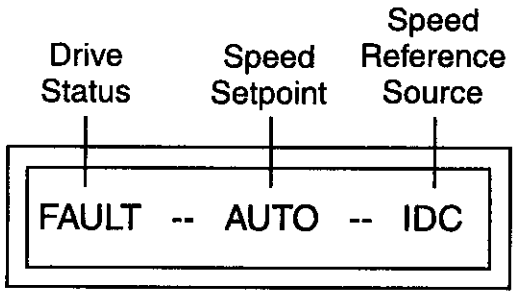
In FAULT mode, the ENTER key will toggle the display between four screens: FAULT, SPEED, % LOAD and VAC. The DRIVE STATUS for these displays will be FAULT. An example is shown below of the drive in the FAULT mode displaying SPEED.



13.2.4 VSD17 SERIES DISPLAY IN AUXILIARY MODE

If the ENTER key is held down, the display will change to the auxiliary status screen, which indicates the control source (LOCAL, REMOTE, or SERIAL), AUTO or MANUAL mode, and the speed reference source. When the ENTER key is released, the display will return to the previous screen.

An example of the auxiliary status screen is shown below:



The table below shows the possible SPEED REFERENCE SOURCE indications for the auxiliary status display:

SPEED REFERENCE TABLE	
DISPLAY	**DESCRIPTION**
KEY	KEYPAD - UP and DOWN arrow keys
VDC	0 - 10 VDC analog input at TB-5A
IDC	4 - 20 mA analog input at TB-5B
SP#1	PRESET SPEED #1
SP#2	PRESET SPEED #2
SP#3	PRESET SPEED #3
SP#4	PRESET SPEED #4
JOG	JOG SPEED (In JOG mode, JOG SPEED = PRESET SPEED #2)
MOP	Electronic "MOTOR OPERATED POT" Used with TB-13A (DEC FREQ) and TB-13B (INC FREQ)

14 CONTROL WIRING

14.1 CONTROL WIRING PRECAUTIONS

All control inputs and outputs of the drive controller are isolated from the input lines, however certain control wiring precautions must be followed:

- Control wiring conductor runs must be kept short and direct. Follow the conduit and circuit separation listed in "GENERAL WIRING PRACTICES" See Section 10.
- Control contacts used with the drive controller inputs must be rated for operation at open circuit voltages of 24 VDC and closed circuit currents of 10mADC.
- Twisted cable with a pitch of 1 to 2 inches is required for analog inputs and outputs. Use of a shielded cable is recommended. The shield must be terminated to ground at one end only. It is generally recommended that the shield be terminated at the drive controller.
- The coils of all relays and solenoids connected to the output contacts of the drive controller must be equipped with appropriate transient suppressors.
- For proper control wiring, conductors must be routed to avoid contact with other voltage potentials in the drive controller. Wire insulation must have the appropriate voltage rating for the voltage present.

TB-2: CIRCUIT COMMON

The TB-2 terminals are used as circuit common for the Start/Stop, Forward/ Reverse, input select, Local/Remote, analog input and analog output functions. These are three TB-2 terminals available on the terminal strip, and they are all internally connected to each other on the main control board. If necessary TB-2 may be connected to chassis ground.

14.2 START/STOP AND SPEED CONTROL

14.2.1 KEYPAD CONTROL

The drive can be controlled by the keypad or by devices wired to the terminal strip. The drive will run from the keypad "out of the box", requiring no connections to the terminal strip. Refer to Section 13 - KEYPAD CONTROL.

14.2.2 REMOTE MODE SELECTION

The REMOTE mode can be selected by one of two methods:

1. Program Parameter 30 - CONTROL to REMOTE, or:
2. Program CONTROL to BOTH, set the TB-13A or TB-13C function to LOCAL SELECT, and DO NOT make a contact closure between TB-13A or TB-13C

and TB-2 (making the contact closure will select LOCAL mode).

⚠ WARNING

If control is set to local, TB-1 is disabled and cannot be used as a stop switch! Incorrect use of TB-1 may result in damage to equipment and/or injury to personnel! See Parameter 30 - Control.

⚠ WARNING

Stop (TB-1) and external fault (TB-13D) circuitry may be disabled if parameters are reset to factory defaults! The drive must be reprogrammed after a RESET in order to insure proper operation (See Parameter 65 - Program).

FAILURE TO DO SO MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

14.2.3 TWO-WIRE START/STOP CONTROL

A two-wire start/stop circuit can be accomplished by one of three methods on the VSD17 Series drive. Follow the appropriate procedure listed below:

FORWARD ROTATION ONLY

1. Select REMOTE mode (see above).
2. Connect a jumper between TB-12A and TB-2 to provide a permanent START command to the drive.
3. Wire a normally open maintained contact between TB-1 and TB-2. Closing this contact will START the drive and opening this contact will STOP the drive.

FORWARD and REVERSE ROTATION

1. Select REMOTE mode (see above).
2. Program Parameter 27 - ROTATION to FWD & REV to allow rotation in both directions.
3. Program Parameter 49 - TB13C to START REVERSE. This will force TB-12A to act as START FORWARD.
4. Select the desired rotation by closing the appropriate terminal (TB-12A for forward, or TB-13C for reverse) to TB-2. This can be done with a toggle switch or equivalent circuit.
5. Wire a normally open maintained contact between TB-1 and TB-2. Close this contact to START the drive, and open this contact to STOP the drive.

14.2.4 ALTERNATE TWO-WIRE START/STOP CONTROL METHOD

⚠ WARNING

This method requires TB-13C to be set for RUN REVERSE, which will disable TB-1 as a STOP switch! Incorrect use of TB-1 may result in damage to equipment and/or injury to personnel! Refer To Parameter 49 - TB13c.

FORWARD ROTATION ONLY

1. Select REMOTE mode (see above).
2. Program Parameter 27 - ROTATION to FWD & REV.
3. Program Parameter 49 - TB13C to RUN REVERSE. This will force TB-12A to act as RUN FORWARD.
4. Wire a normally open maintained contact between TB-12A and TB-2. Close this contact to START the drive in FORWARD, and open this contact to STOP the drive.

FORWARD and REVERSE ROTATION with TWO RUN CONTACTS

1. Follow 1-4 above and also wire a normally open maintained contact between TB-13C and TB-2. Close this contact to START the drive in REVERSE, and open this contact to STOP the drive.

FORWARD and REVERSE ROTATION with ONE RUN CONTACT

1. Follow 1-3 above and wire a normally open maintained contact between TB-2 and the common of a single-pole, double-throw toggle switch. Wire the poles of the toggle switch to TB-12A and TB-13C. Refer to the wiring diagram in Section 15.2.

14.2.5 THREE-WIRE START/STOP CONTROL

A three-wire start/stop circuit can be accomplished by one of two methods on the VSD17 Series drive. Follow the appropriate procedure listed below:

FORWARD ROTATION ONLY

1. Select REMOTE mode (see above).
2. Wire a normally closed momentary STOP contact between TB-1 and TB-2. Momentarily open this contact to STOP the drive.
3. Wire a normally open momentary START contact between TB-12A and TB-2. Momentarily close this contact to START the drive.

FORWARD and REVERSE ROTATION with TWO START CONTACTS

1. Select REMOTE mode (see above).

2. Program Parameter 27 - ROTATION to FWD & REV.
3. Program Parameter 49 - TB13C to START REVERSE.
4. Wire a normally closed momentary STOP contact between TB-1 and TB-2. Momentarily open this contact to STOP the drive.
5. Wire a normally open momentary START FORWARD contact between TB-12A and TB-2. Momentarily close this contact to START the drive in FORWARD.
6. Wire a normally open momentary START REVERSE contact between TB-13C and TB-2. Momentarily close this contact to START the drive in REVERSE.

NOTE: If the drive is operating in one direction, and is given the START command for the opposite direction, the drive will decelerate to 0 Hz and then accelerate back to the speed setpoint in the opposite direction.

FORWARD and REVERSE ROTATION with ONE START CONTACT

1. Follow 1-4 above and wire a normally open momentary contact between TB-2 and the common of a single-pole, double-throw toggle switch. Wire the poles of the toggle switch to TB-12A and TB-13C. See the wiring diagram in Section 15.3.

14.2.6 SPEED REFERENCE SIGNALS

The drive allows for three analog speed reference inputs: a speed potentiometer (2.5 to 10 kOhm), 0-10 VDC, or 4-20 mA.

SPEED POT — Connect the wiper to terminal TB-5A, and connect the high and low end leads to terminals TB-6 and TB-2, respectively.

0-10 VDC — Wire the positive to terminal TB-5A and the negative to terminal TB-2. TB-5A input impedance is 200 kilohms.

4-20 mA — Wire the positive to terminal TB-5B and the negative to terminal TB-2. TB-5B input impedance is 100 ohms.

14.2.7 SPEED REFERENCE SELECTION

AUTO/MAN vs. LOCAL/REMOTE

In the VSD17 Series drive, AUTO/MAN refers to speed control, and LOCAL/REMOTE refers to START/STOP control. AUTOMATIC or MANUAL speed control selection is affected by whether the drive is in LOCAL or REMOTE mode.

In LOCAL mode (keypad start/stop control), AUTOMATIC and MANUAL speed control is selected using Parameter 28 - AUTO/MAN. When set to BOTH, the AUTO/MAN button on the keypad is active and is used to

toggle between MANUAL (keypad or speed pot) and AUTOMATIC (0-10 VDC, 4-20 mA, or preset speeds) speed control. When set to MANUAL, speed control is governed by Parameter 29 - MANUAL, which selects either KEYPAD or 0-10 VDC (speed pot). When set to AUTOMATIC, one of the TB-13 input selects must be set to the desired speed reference, and that terminal must be closed to TB-2. The drive will then respond to the automatic speed reference. If one of the TB-13 input selects is set for a speed reference, and the contact closure is not made to TB-2, speed control will remain in AUTO mode, but the drive will respond to the keypad or speed pot, depending on Parameter 29 - MANUAL. Therefore, if the Form C relay or open-collector outputs are set to indicate AUTO/MAN mode, they will still indicate AUTO mode.

In REMOTE mode (terminal strip start/stop control), speed control is selected using the TB-13 input selects. For AUTOMATIC speed control, one of the TB-13 input selects must be set to the desired speed reference, and that terminal must be closed to TB-2. The drive will then respond to the automatic speed reference. If none of the TB-13 input selects are closed to TB-2, speed control will default to MANUAL mode, and the drive will respond to the keypad or speed pot, depending on Parameter 29 - MANUAL. This will cause the Form C relay or open-collector outputs to indicate MANUAL mode if set to indicate AUTO/MAN mode.

0 - 10 VDC and 4 - 20 mA INPUT SIGNALS

TB-13A, TB-13B, and TB-13C can all be programmed for 0-10 VDC or 4-20 mA input.

PRESET SPEEDS

TB-13A can be set to SPEED #1, TB-13B to SPEED #2, and TB-13C to SPEED #3. Closing any two of these terminals to TB-2 will select SPEED #4. Refer to Parameters 1-4: SPEED #1 - #4 in Section 18 - DESCRIPTION OF PARAMETERS.

JOG

The JOG function only works when the drive is in REMOTE mode, and only when the drive is in a STOP condition. TB-13B can be programmed for either JOG FORWARD or JOG REVERSE. The jog speed is set by PRESET SPEED #2. Close TB-13B to TB-2 to JOG, and open the contact to STOP.

⚠ WARNING

When operating in JOG mode, the STOP key WILL NOT stop the drive. To stop the drive, the contact between TB-13B and TB-2 must be opened.

MOP - MOTOR OPERATED POT

TB-13A and TB-13B are used for this function, which sets the speed of the drive using contacts wired to the terminal strip. Set TB-13A for DEC FREQ, and set TB-13B for INC FREQ. Closing TB-13A to TB-2 will activate the DEC FREQ function, and will cause the speed setpoint to decrease until the contact is opened. DEC FREQ will operate when the drive is in RUN mode or STOP mode. Closing TB-13B to TB-2 will activate the INC FREQ function, and will cause the speed setpoint to increase until the contact is opened. INC FREQ will only operate when the drive is in RUN mode.

NOTE: If TB-13A, TB-13B, and TB-13C are all programmed for speed references, and two or three of the terminals are closed to TB-2, the higher terminal has priority and will override the others. For example, if TB-13A is programmed for 0-10VDC, and TB-13C is programmed for PRESET SPEED #1, closing both terminals to TB-2 will cause the drive to respond to PRESET SPEED #1, because TB-13C overrides TB-13A.

14.2.8 ANALOG OUTPUT SIGNALS

There are two terminals that can supply analog output signals proportional to output frequency or load. Terminal TB-10A can provide a 0-10 VDC or a 2-10 VDC signal proportional to output frequency, and TB-10B can provide the same signals proportional to load. The 2-10 VDC signals can be converted to a 4-20 mA signal using a 500 ohm resistor in series with the signal. See Parameters: 42 - TB10A OUT, 43 - @TB10A, 44 - TB10B OUT, and 45 - @TB10B in Section 18 - DESCRIPTION OF PARAMETERS.

14.2.9 DRIVE STATUS OUTPUT CONTACTS

The control board has one FORM C relay at terminals TB-16, TB-17, and TB-18. Contacts are rated 2 amps at 28 VDC or 120 Vac.

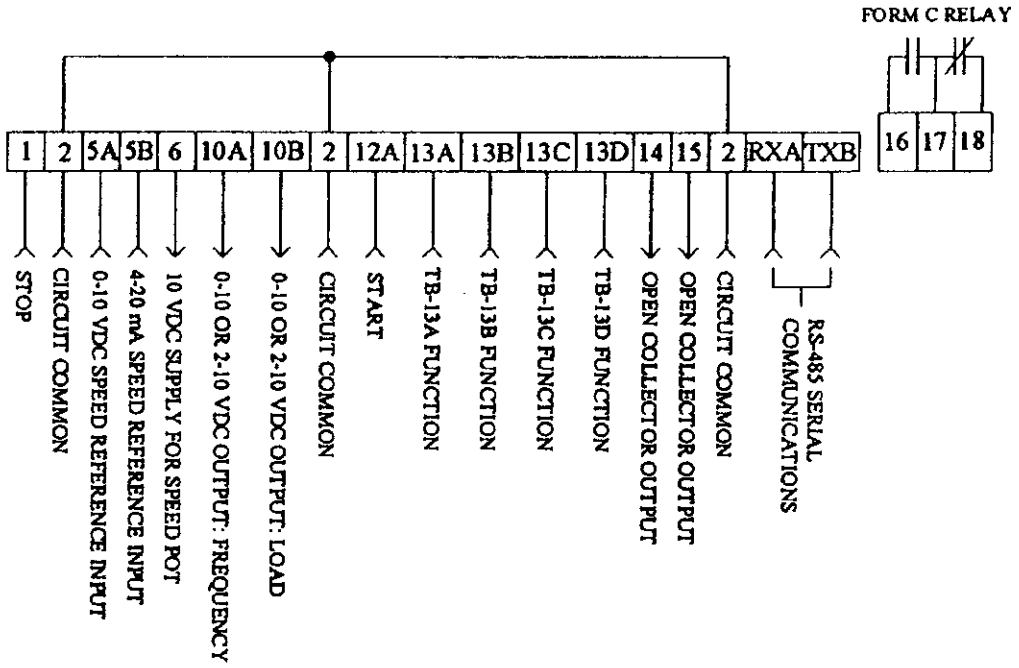
There are also two open-collector outputs at terminals TB-14 and TB-15. The open-collector circuit is a current-sinking type rated at 30 VDC and 40 mA maximum. An external power supply (30 VDC max) must be used to power the open-collector outputs. The drive does not have a dedicated power supply for the open-collector outputs.

The FORM C relay and the open collector outputs can be programmed to indicate any of the following: RUN, FAULT, /FAULT (INVERSE FAULT), LOCK (FAULT LOCKOUT), AT SPEED, ABOVE #3, I LIMIT (CURRENT LIMIT), or AUTO/MAN. See Parameters: 52 - TB14 OUT, 53 - TB15 OUT, and 54 - RELAY. Refer to Section 2.2.5 for a complete description of each of these status indications.

15 VSD17 SERIES CONTROL WIRING DIAGRAMS

15.1 VSD17 SERIES TERMINAL STRIP

Shown below is the terminal strip on the main control board, along with a brief description of the function of each terminal. Wiring shown above the terminal strip indicates internal wiring on the main control board.

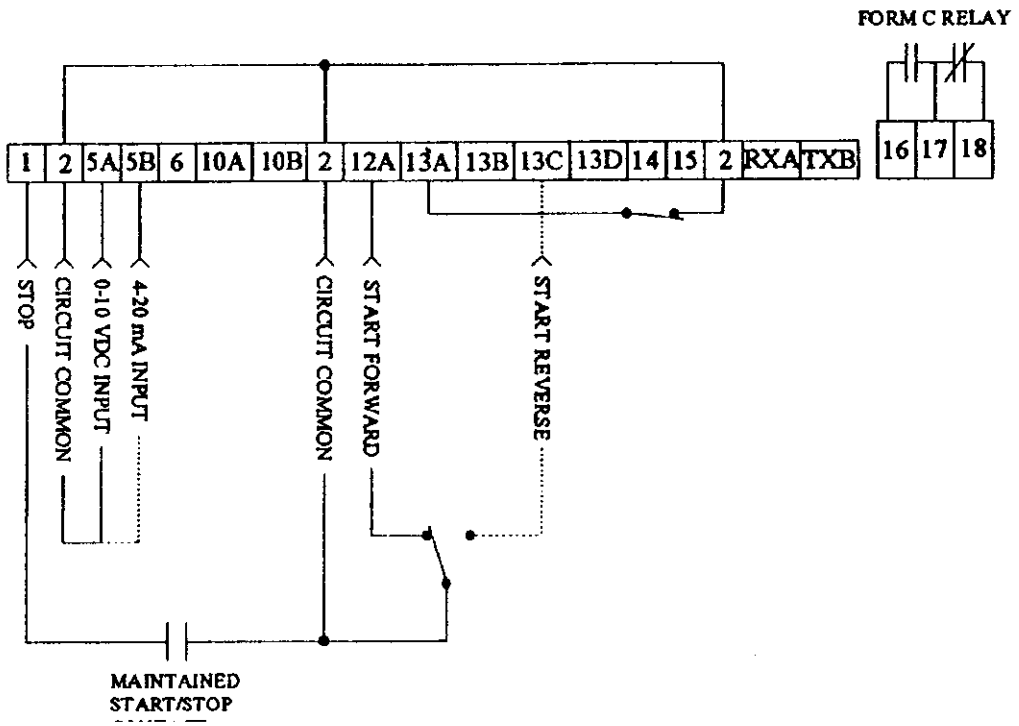


NOTE: The function of terminals TB-10A, TB-10B, TB-13A, TB-13B, TB-13C, TB-13D, TB-14, TB-15, TB-16, and TB-18 are dependent on the programming of certain parameters. In most cases, the name of the parameter matches the number of the terminal, allowing quick and easy programming of the terminals to suite the application. The exception is TB-16 and TB-18, which are governed by Parameter 54 - RELAY.

A complete description of operating the drive in the REMOTE mode can be found in Section 14.2. The following diagrams provide a quick reference to wire the drive for the most common configurations.

15.2 TWO-WIRE START/STOP CONTROL

Shown below is the wiring diagram for a typical two-wire start/stop control scheme, using one maintained contact (such as that from a PLC) for START and STOP commands. Close the contact to START, and open the contact to STOP. Also shown is the wiring for a 0-10 VDC or 4-20 mA speed reference signal.

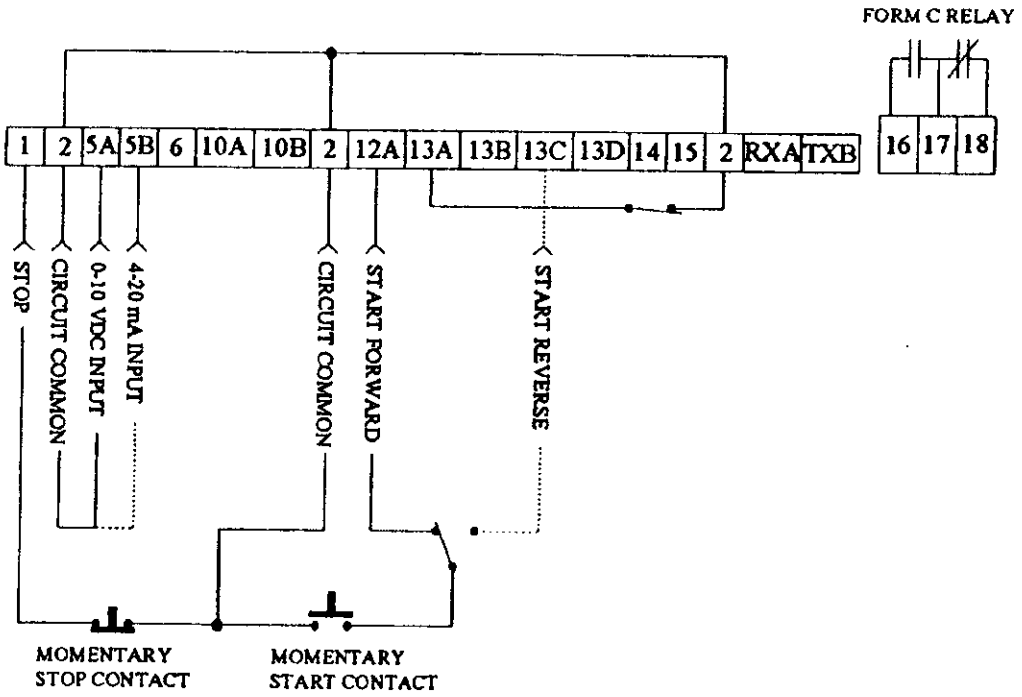


In the diagram above, TB-13A is programmed for either a 0-10 VDC or 4-20mA input speed reference. TB-13A is then closed to TB-2 which causes the drive to respond to the selected input speed reference. If the contact is opened, the drive would respond to the keypad or a speed pot, depending on the setting of Parameter 29 - MANUAL.

NOTE: If REVERSE rotation is required, TB-13C must be programmed for START REVERSE (Refer to Parameter 49 - TB13C in Section 18 - DESCRIPTION OF PARAMETERS). If only FORWARD rotation is required, TB-13C does not need to be programmed, and TB-12A can be wired directly to TB-2.

15.3 THREE-WIRE START/STOP CONTROL

Shown below is the wiring diagram for a typical three-wire start/stop control scheme, using momentary contacts (such as pushbuttons) for START and STOP commands. Also shown is the wiring for a 0-10 VDC or 4-20 mA speed reference signal.

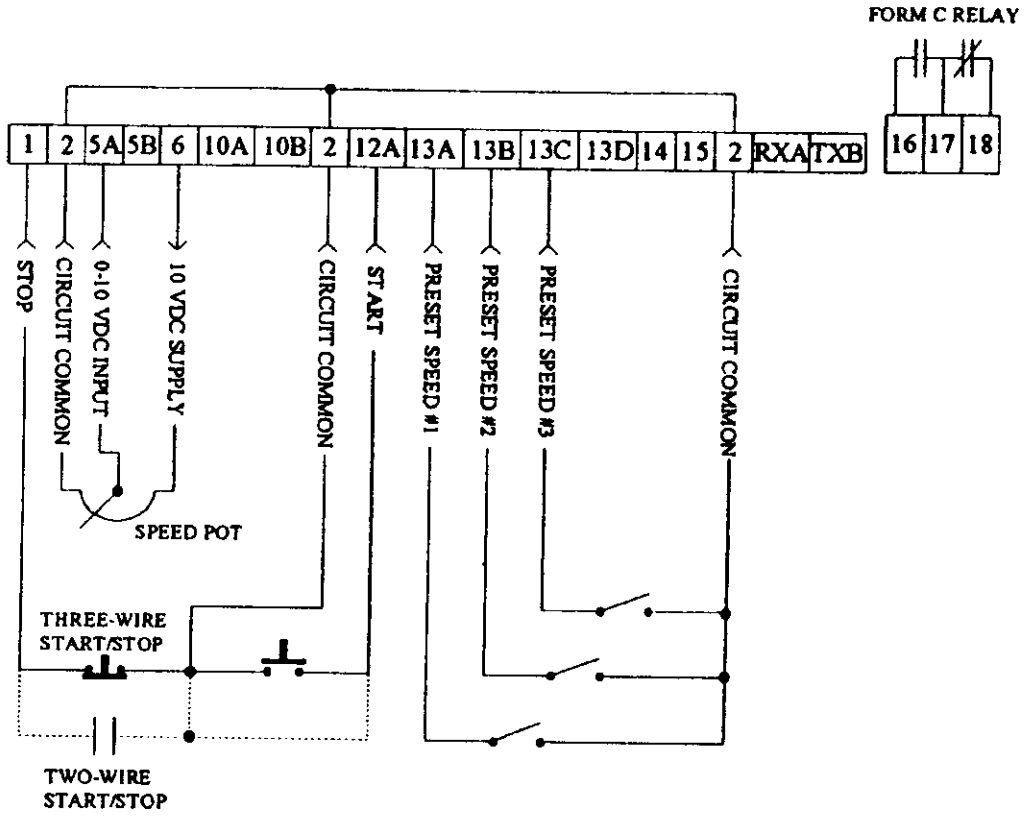


In the diagram above, TB-13A is programmed for either a 0-10 VDC or 4-20mA input speed reference. TB-13A is then closed to TB-2 which causes the drive to respond to the selected input speed reference. If the contact is opened, the drive would respond to the keypad or a speed pot, depending on the setting of Parameter 29 - MANUAL.

NOTE: If REVERSE rotation is required, TB-13C must be programmed for START REVERSE (Refer to Parameter 49 - TB13C in Section 18 - DESCRIPTION OF PARAMETERS). If only FORWARD rotation is required, TB-13C does not need to be programmed, and TB-12A can be wired directly to one side of the START contact.

15.4 SPEED POT AND PRESET SPEED CONTROL

Shown below is the wiring diagram for a control scheme that utilizes a speed pot and PRESET SPEEDS for speed control, and either a two-wire or three-wire START/STOP circuit:



In the above diagram, TB-13A is set for SPEED #1, TB-13B is set for SPEED #2, and TB-13C is set for SPEED #3 (see Parameters: 47 - TB13A, 48 - TB13B, and 49 - TB13C).

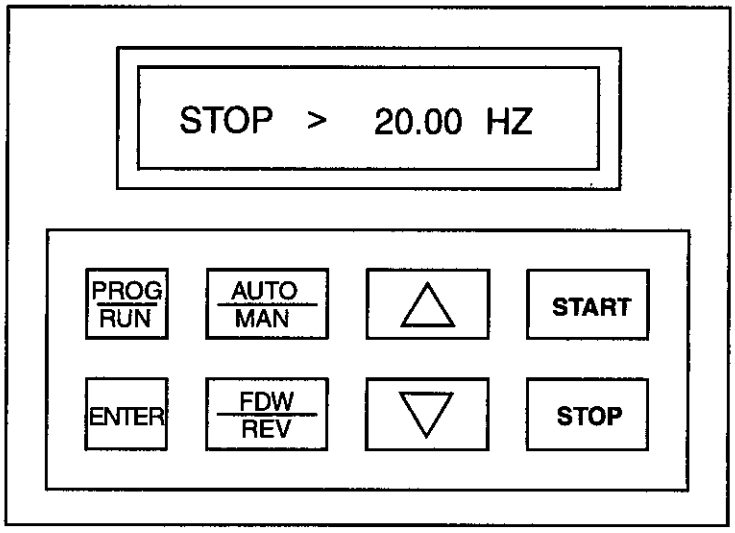
To select a preset speed, close the appropriate preset speed contact to TB-2. To select SPEED #4, close any two of the three preset speed contacts to TB-2 (see Parameters 1-4: SPEED#1-#4). If neither of the preset speeds are selected by a contact closure, the speed reference source will default to the keypad or speed pot, depending on the setting of Parameter 29 - MANUAL.

NOTE: If REVERSE rotation is required, TB-13C cannot be used for SPEED #3. TB-13C must be programmed for RUN REVERSE or START REVERSE, and only TB-13A and TB-13B can be used for preset speeds. This will result in three preset speeds being available: SPEED #1, SPEED #2, and SPEED #4 (see Parameters 1-4: SPEED#1-#4).

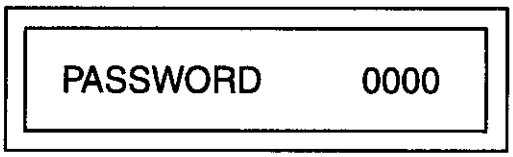
16 PROGRAMMING THE VSD17 SERIES DRIVE

16.1 PROGRAMMING THE PARAMETERS

The VSD17 Series keypad serves two purposes: operating the drive when in the LOCAL mode, and programming the parameters for particular applications. The keypad is shown below, along with the display that should appear when the drive is first powered up:



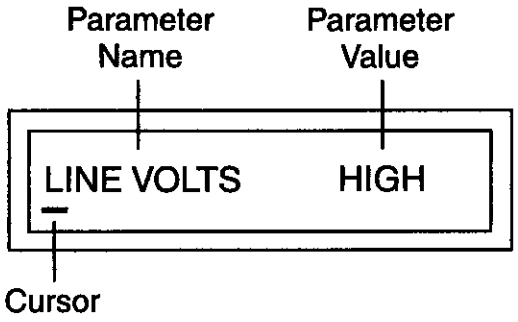
To program the drive, the PROGRAM mode must be entered by pressing the PROG/RUN button. If the password protection is disabled, pressing the PROG/RUN button will result in direct entry into the PROGRAM mode. If the password protection is enabled, the PASSWORD prompt will appear when an attempt is made to enter the PROGRAM mode. The PASSWORD prompt appears as follows:



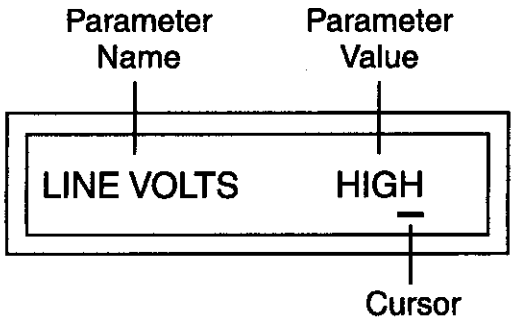
To enter the password, use the UP and DOWN arrow keys to scroll to the password value, and then press the ENTER key.

NOTE: The factory default password is 0019.

Once the correct password is entered, the PROGRAM mode will be entered and the first parameter will be displayed, which is Parameter 0 - LINE VOLTS. This is shown below:



To scroll through the parameters, use the UP and DOWN arrow buttons on the keypad. When the desired parameter is found, press the ENTER key to shift the cursor from the parameter name to the parameter value. In this example, the cursor shifts from LINE VOLTS to HIGH:



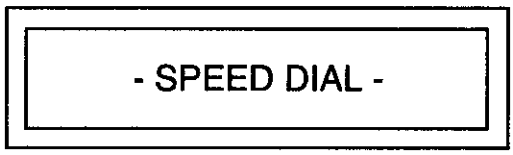
The parameter value can then be changed using the UP and DOWN arrow buttons. If the parameter has a numerical value, the UP arrow will increase the value and the DOWN arrow will decrease the value. If the parameter has specific choices that can be selected, the UP and DOWN arrow keys will scroll through the list of possible settings. When the desired value or option is selected, press the ENTER key to store the new setting. If the new setting is not ENTERED, it will not take effect and the old setting will still be valid.

If the PROG/RUN key is pushed while the cursor is highlighting the parameter value, the value will change back to the original setting (if it had been changed, but not ENTERED), and the cursor will shift back to the parameter name. Pressing PROG/RUN again will exit the PROGRAM mode. If the PROGRAM mode is entered again within two minutes, the last parameter that was viewed, or changed, will come up on the display. After two minutes has elapsed, the password will have to be entered again when attempting to access the PROGRAM mode.

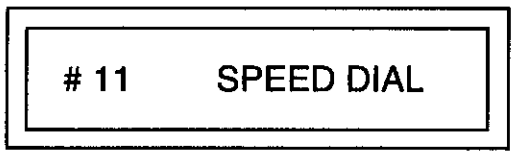
16.2 PARAMETER ACCESS USING SPEED DIAL

SPEED DIAL is used to access parameters quickly using the parameter number. Once accessed, the parameter can be programmed as described in Section 16.1. SPEED DIAL is accessed by pressing the AUTO/MAN key while

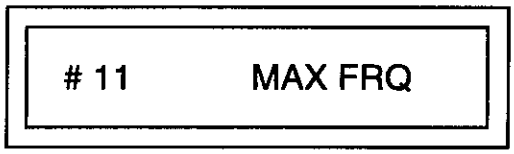
in the PROGRAM mode. This will activate the SPEED DIAL display as shown below:



Once in SPEED DIAL, the UP and DOWN arrow keys will allow the operator to scroll through the parameter numbers. The display will continue to show SPEED DIAL while scrolling through the parameter numbers, as shown below:



When the desired parameter is reached, the SPEED DIAL display will be replaced by the parameter name:



Once the desired parameter is displayed on the screen, press the ENTER key to display the parameter name and present setting. The parameter setting can now be changed by the method described in Section 16.1. Press the AUTO/ MAN key to return to SPEED DIAL.

17 PARAMETER MENU

PARAMETER MENU			
PARAM. NUMBER	PARAMETER NAME	RANGE OF ADJUSTMENT	FACTORY DEFAULT
0	LINE VOLTS	HIGH, LOW	HIGH
1	SPEED #1	MIN FRQ - MAX FRQ	20.00 Hz
2	SPEED #2	MIN FRQ - MAX FRQ	20.00 Hz
3	SPEED #3	MIN FRQ - MAX FRQ	20.00 Hz
4	SPEED #4	MIN FRQ - MAX FRQ	20.00 Hz
5	SKIP #1	MIN FRQ - MAX FRQ	.00 Hz
6	SKIP #2	MIN FRQ - MAX FRQ	.00 Hz
7	BAND WID	.00 - 10.00 Hz	.00 Hz
8	ACCEL	0.1 - 3600 SEC (NOTE 1)	30.0 SEC
9	DECEL	(NOTE 2)	30.0 SEC
10	MIN FRQ	.00 - 120.0 Hz	.50 Hz
11	MAX FRQ	1.00 - 120.0 Hz	60.00 Hz
12	DC BRAKE	(NOTE 2)	.0 VDC
13	DC TIME	.0 - 999.9 SEC	.0 SEC
14	DYN BRAKE	OFF, ON	OFF
16	CURRENT	25 - 180 % (NOTE 3)	180%
17	MOTOR OL	25 - 100 %	100%
18	BASE	20.00 - 360.0 Hz	60.00 Hz
19	FX BOOST	.0 - 30.0 %	NOTE 2
20	AC BOOST	.0 - 20.0 %	.0 %
21	SLIP COMP	.0 - 5.0 %	.0 %
22	TORQUE	CONSTANT, VARIABLE	CON-STANT
23	CARRIER	2.5, 8, 10, 12, 14 kHz	2.5 kHz
25	START	NORMAL,POWER-UP, AUTO RE-, RE-BREAK	NORMAL
26	STOP	RAMP, COAST	COAST
27	ROTATION	FORWARD, REVERSE FWD&REV, FWD@LOC	FORWARD
28	AUTO/MAN	AUTO, MANUAL, BOTH	BOTH
29	MANUAL	KEYPAD, 0-10 VDC	KEYPAD
30	CONTROL	LOCAL, REMOTE, BOTH	LOCAL
31	HZ UNITS	HERTZ, RPM, % HZ /SEC, / MIN, /HR, NONE	HERTZ
32	HZ MULT	.10 - 650.0	1.00
33	SPEED DP	XXXXX, XXX.X, XX.XX, X.XXX, .XXXX	XXXXX

NOTE 1: RANGE FOR 25, 30, AND 40 HP UNITS: 0.3 - 3600 SEC.
NOTE 2: REFER TO SECTION 18 - DESCRIPTION OF PARAMETERS.
NOTE 3: IF LINE VOLTS IS SET TO "LOW", RANGE IS 25 - 150%.

PARAMETER MENU			
PARAM. NUMBER	**PARAMETER NAME**	**RANGE OF ADJUSTMENT**	**FACTORY DEFAULT**
34	LOAD MLT	95 - 139 %	100%
35	CONTRAST	LOW, MED, HIGH	MED
39	TB5 MIN	.00 - 360.0 Hz	.00 Hz
40	TB5 MAX	.00 - 360.0 Hz	60.00 Hz
42	TB10A OUT	NONE, 0-10V, 2-10V	NONE
43	@TB10A	3.00 - 360.0 Hz	60.00 Hz
44	TB10B OUT	NONE, 0-10V, 2-10V	NONE
45	@TB10B	10 - 200 %	125 %
47	TB13A	NONE, 0-10VDC, 4-20MA, SPEED#1, LOC SEL, DEC FREQ	NONE
48	TB13B	NONE, 0-10VDC, 4-20MA, SPEED#2, INC FREQ, JOG FWD, JOG REV	NONE
49	TB13C	NONE, 0-10VDC, 4-20MA, SPEED#3, LOC SEL, RUN REV, STRT REV	NONE
50	TB13D EXT	FAULT, /FAULT	FAULT
52	TB14 OUT	NONE, RUN, FAULT, / FAULT, LOCK, @ SPEED, ABOVE#3, I LIMIT, AUT/ MAN	NONE
53	TB15 OUT	NONE, RUN, FAULT, / FAULT, LOCK, @ SPEED, ABOVE#3, I LIMIT, AUT/ MAN	NONE
54	RELAY	NONE, RUN, FAULT, / FAULT, LOCK, @ SPEED, ABOVE#3, I LIMIT, AUT/ MAN	NONE
57	SERIAL	DISABLE, ENABLE	DISABLE
58	ADDRESS	1 - 30	30
61	PASSWORD	0000 - 9999	0019
63	SOFTWARE	VIEW - ONLY	N/A
64	MONITOR	OFF, ON	ON
65	PROGRAM	MAINTAIN, RESET 60, RESET 50	RESET 60
66	HISTORY	MAINTAIN, CLEAR	MAINTAIN
69	LANGUAGE	(NOTE 2)	ENGLISH
70	FAULT HISTORY	VIEW - ONLY	N/A

NOTE 2: REFER TO SECTION 18 - DESCRIPTION OF PARAMETERS.

18 DESCRIPTION OF PARAMETERS

0 - LINE VOLT (LINE VOLTAGE)

This parameter programs the drive for the correct input voltage. For actual line voltages of 230/240, 460/480, and 575/590 Vac, set this parameter to HIGH. For actual line voltages of 200/208, 380/415, and 460/480 Vac (on 590 Vac models), set this parameter to LOW. For 240/120 Vac single-phase input models, set this parameter to HIGH. Refer to the following table:

INPUT LINE VOLTAGE SELECTION				
MODEL NUMBER	**RATED INPUT VOLTAGE**	**INPUT PHASE**	**ACTUAL LINE VOLTAGE**	**PARAMETER SETTING**
VSD17---P1-	240 / 120 Vac	1	230/240 Vac	HIGH
	240 / 120 Vac	1	115/120 Vac	HIGH
VSD17---P2-	240 Vac	1	230/240 Vac	HIGH
VSD17---M2-	240 / 200 Vac	3	230/240 Vac	HIGH
	240 / 200 Vac	3	200/208 Vac	LOW
VSD17---N4-	480 / 400 Vac	3	460/480 Vac	HIGH
	480 / 400 Vac	3	380/415 Vac	LOW
VSD17---S6-	590 / 480 Vac	3	575/590 Vac	HIGH
	590 / 480 Vac	3	460/480 Vac	LOW

1-4 - SPEED #1- #4 (PRESET SPEEDS #1, #2, #3, AND #4)

PRESET SPEEDS are only active when the drive is in AUTO mode.

Preset speeds are activated via contact closures between terminal TB-2 and terminals TB-13A, TB-13B, and TB-13C. The parameters that correspond to these terminals must be programmed for the SPEED function (see Parameters: 47 - TB13A, 48 - TB13B, and 49 - TB13C). The preset speeds can only be set to values that are within the range defined by the minimum and maximum frequency (see Parameters: 10 - MIN FREQ, and 11 - MAX FREQ). Refer to the following table for activation of preset speeds:

PRESET SPEED ACTIVATION			
SPEED #	**TB-13A to TB-2**	**TB-13B to TB-2**	**TB-13C to TB-2**
1	CLOSED	OPEN	OPEN
2	OPEN	CLOSED	OPEN
3	OPEN	OPEN	CLOSED
4	CLOSED	CLOSED	OPEN
	CLOSED	OPEN	CLOSED
	OPEN	CLOSED	CLOSED

NOTE: SPEED #4 is selected if any two of the three TB-13 terminals are closed to TB-2.

5,6 - **SKIP #1** & **#2** (SKIP SPEED #1 & #2)

7 - **BAND WID** (SKIP BANDWIDTH)

These parameters are used to prevent the drive from operating continuously at critical speeds, or frequencies, that cause excessive mechanical vibration of the driven equipment. The SKIP SPEEDS (Parameters 5 and 6) and the SKIP BANDWIDTH (Parameter 7) are used to define up to two speed avoidance ranges. The SKIP SPEED settings define the starting point of the speed range that is to be avoided, and the SKIP BANDWIDTH setting defines how far the speed range extends beyond SKIP SPEED.

Example: The critical frequency is 21 Hz, and a bandwidth of 2 Hz is desired. Therefore, set SKIP #1 to 20 Hz and set SKIP BANDWIDTH to 2 Hz. This results in a speed range from 20 Hz to 22 Hz that the drive will not operate within continuously. If the drive were operating at 25 Hz and then commanded to operate at a speed within the range of avoidance, the drive would decelerate to 22 Hz and remain at that frequency until commanded to 20 Hz or below. The drive would then decelerate through the range of avoidance to the new frequency. Likewise, if the drive were operating at 18 Hz, and then commanded to operate at a speed within the range of avoidance, the drive would accelerate to 20 Hz and remain at that frequency until commanded to a speed of 22 Hz or above. The drive would then accelerate through the range of avoidance to the new frequency.

8 - **ACCEL** (ACCELERATION TIME)

This parameter sets the acceleration rate for all speed reference sources (keypad, speed pot, 4-20 mA, 0-10 VDC, jog, and the preset speeds). The ACCEL setting indicates time to accelerate from 0 Hz to the BASE FREQUENCY (Parameter 18).

Example: If ACCEL is set to 30 seconds, and the BASE FREQUENCY is set for 60 Hz, the drive will ramp from 0 Hz to 60 Hz in 30 seconds. This is a linear function, therefore the drive would ramp up to 30 Hz in 15 seconds, etc.

NOTE: The ability to accelerate a given load at a particular rate will be limited by the output power capability of the drive/motor combination. The acceleration of high-inertia and high-friction loads may be affected by the current limiting characteristics of the drive. See Parameters: 16 - CURRENT, 19 - FX BOOST, and 20-AC BOOST for more information.

9 - **DECEL** (DECELERATION TIME)

This parameter sets the deceleration rate for all speed reference sources. The DECEL setting indicates the time to decelerate from BASE FREQUENCY to 0 Hz. As with Parameter 8 - ACCEL, this is a linear function. If the drive is set to COAST to stop, this parameter will have no effect when a STOP command is given.

The range of adjustment for DECEL depends on the horsepower and voltage rating, and whether Dynamic Braking is being used. Refer to the table below:

DECELERATION LIMITS				
HORSEPOWER / VOLTAGE RATING			DECEL RANGE	
240/200 Vac (NOTE 1)	480/400 Vac	590/480 Vac	WITHOUT DB (NOTE 2)	WITH DB
.25 - 7.5 HP	1 - 7.5 HP	N/A	0.3 - 3600 SEC	0.1 - 3600 SEC
10 - 20 HP	10 - 20 HP	1 - 7.5 HP	0.5 - 3600 SEC	0.1 - 3600 SEC
N/A	25 - 40 HP	10 - 20 HP	1.0 - 3600 SEC	0.2 - 3600 SEC
N/A	N/A	25 - 40 HP	2.0 - 3600 SEC	0.2 - 3600 SEC

NOTE 1: 240/120 Vac units have the same limits as 240/200 Vac units.

NOTE 2: The parameter value can be set below the minimum value shown, but the value shown is the operational limit of the drive. For example, if DECEL is set for 0.1 seconds on a 10 HP drive without dynamic braking, the actual deceleration time would be 0.3 seconds.

If an attempt is made to decelerate a high-inertia load too quickly, the motor will regenerate voltage back into the drive. This will cause the DC bus voltage to rise, which can result in a HI VOLTS fault. In order to prevent faulting, the drive will enter DECEL FREEZE, which halts the deceleration until the DC bus voltage returns to a normal level. The drive will then begin to decelerate again, and if necessary, will enter DECEL FREEZE repeatedly to avoid faulting. If a very short deceleration time is programmed, DECEL FREEZE may not be able to compensate fast enough, resulting in a HI VOLTS fault.

In applications where very short deceleration times are required on high-inertia loads, dynamic braking may be required. Consult the factory for more information on the Dynamic Braking option.

10 - **MIN FRQ** (MINIMUM FREQUENCY)

This parameter defines the lower limit of the drive's speed range. MIN FRQ is used in conjunction with MAX FRQ (Parameter 11 below) to define the operating range of the drive.

If MIN FRQ is set to a value above 0.0 Hz, the drive will ramp up from 0.0 Hz when given a start command. Once running, however, the drive will not operate below the MIN FRQ setting unless the rotation is changed, or a stop command is issued and the drive is programmed to ramp to a stop.

If the MINIMUM FREQUENCY is set to 0.0 Hz, the drive may be operated in ZERO SPEED mode (drive is in RUN state, but there is no output to the motor). ZERO SPEED operation can be used in applications requiring the ability to start and stop the drive using only the selected speed reference. The drive will start when the speed reference is raised above 0 VDC or 4 mA, and it will stop when the reference is lowered to 0 VDC or 4 mA. Note that the drive

must be initially started using one of the normal start commands (keypad or terminal strip).

11 - **MAX FRQ** (MAXIMUM FREQUENCY)

This parameter defines the upper limit of the drive's speed range. MAX FRQ is used in conjunction with MIN FRQ (Parameter 10 above) to define the operating range of the drive.

⚠ CAUTION

MACHINERY OVERSPEED

Some motors and/or loads may not be suited for operation above nameplate motor speed and frequency. Consult motor manufacturer before operating motor above rated speed.

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE OR PERSONAL INJURY.

12 - **DC BRAKE** (DC BRAKE VOLTAGE)

⚠ WARNING

NO HOLDING TORQUE

- **DC injection braking does not provide holding torque at zero speed.**
- **DC injection braking does not function during loss of power or drive controller fault**
- **When required, use seperate brake function for holding torque**

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE, SEVERE PERSONAL INJURY OR DEATH

⚠ CAUTION

MOTOR OVERHEATING AND DAMAGE

Application of DC injection braking for long periods of time can cause motor overheating and damage. Protect motor from extended periods of DC injection braking.

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE OR PERSONAL INJURY

DC braking creates a braking torque by injecting DC voltage into the motor. This parameter sets the magnitude of that DC voltage. The point at which the drive applies DC braking to the motor depends on which STOP mode is programmed (either COAST or RAMP, see Parameter 26 - STOP).

If the drive is set to COAST, DC braking is activated when the stop command is given. In this case, DC braking helps decelerate the motor. This is useful in applications where a quick deceleration is desired on a load that would normally take a long time to coast to a stop.

If the drive is set to RAMP, DC braking is activated when the output frequency reaches 0 Hz. In this case, the drive decelerates the load to a near stop and then DC braking is used to stop and hold the motor. This is useful in applications where the load needs to be stopped in a certain position. Similar applications with high-inertia loads utilize both dynamic braking and DC braking. The dynamic braking allows the high-inertia load to be decelerated quickly, while the DC braking stops the load in the desired position.

Due to heat generated in the motor, DC braking should only be used in applications where the load is stopped infrequently. In high duty-cycle applications, dynamic braking is recommended because the heat is dissipated through external resistor banks, rather than in the motor. When used, DC BRAKE should be set to the lowest voltage that provides satisfactory operation in order to minimize motor heating. The maximum voltage available depends on the voltage rating on the voltage rating of the drive. Refer to table below:

MAXIMUM DC BRAKE VOLTAGE			
VSD17---P1-	VSD17---P2- VSD17--M2-	VSD17---N4-	VSD17---S6-
240/120 Vac	240 / 208 Vac	480 / 400 Vac	590 / 480 Vac
24 Volts	24 Volts	48 Volts	59 Volts

13 - **DC TIME** (DC BRAKE TIME)

This parameter determines the length of time that the DC braking voltage is applied to the motor. DC TIME should be set to the lowest value that provides satisfactory operation in order to minimize motor heating.

NOTE: If this parameter is set to 999.9 seconds (the maximum value), the DC braking will be continuous.

14 - **DYN BRAK** (DYNAMIC BRAKE)

This parameter enables the dynamic braking circuit. Set this parameter to ON only if the optional dynamic braking circuit board and resistors are installed.

Dynamic braking is used in applications where high-inertia loads need to be decelerated quickly. When this is attempted, the motor regenerates voltage back into the drive, causing the DC bus voltage to rise, eventually resulting in a HI VOLTS fault. With the dynamic braking option, the DC bus voltage is monitored, and when it reaches a certain level, a transistor is switched on that connects an external resistor bank across the DC bus. This allows the regenerated energy from the motor to be dissipated through the resistors as heat, which keeps the DC bus voltage below the trip level.

16 - **CURRENT** (CURRENT LIMIT)

The current limit setting determines the maximum value of the drive's output current. This is usually done to limit motor torque capability. For most applications the current limit is maintained at the maximum setting. Depending on the setting of Parameter 0 - LINE VOLTS, the drive is capable of delivering 150% or 180% of rated output current.

When the drive enters current limit, it will attempt to avoid an OVERLOAD fault by entering FREQUENCY FOLDBACK, which commands the drive to decelerate in order to reduce the output current. When the overcurrent condition passes, the drive will return to normal operation and accelerate back to the speed setpoint. However, if the drive cannot reduce the current quickly enough by decelerating, it will trip on an OVERLOAD fault. If the drive enters FREQUENCY FOLDBACK while accelerating a high-inertia load, the time required to reach the speed setpoint will be longer than the ACCEL (Parameter 8) setting would indicate.

NOTE: At 150% output current, the drive will trip on an OVERLOAD fault after one minute. At 180% current, the drive will trip after approximately thirty seconds (see Parameter 17 - MOTOR OL below).

17 - MOTOR THERMAL OVERLOAD PROTECTION

⚠ CAUTION

LOSS OF MOTOR OVERLOAD PROTECTION.

When using external overload relays connected to drive controller output, overload relay must be capable of operation over the expected range of drive controller output frequencies (including direct current).

When DC injection braking is used:

- **Overload relay must be suitable for operation with direct current flowing to the motor**
- **Do not use overload relays equipped with current transformers for sensing the motor current.**

FAILURE TO OBSERVE THESE PRECAUTIONS CAN RESULT IN EQUIPMENT DAMAGE.

⚠ CAUTION

MOTOR OVERHEATING

This drive controller does not provide direct thermal protection for the motor. Use of thermal sensor in the motor may be required for protection at all speeds and loading conditions. Consult motor manufacturer for thermal capability of motor when operating over desired speed range.

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE OR PERSONAL INJURY.

The MOTOR OVERLOAD setting is used to protect the motor from overheating due to excessive current draw. The trip time for the MOTOR OVERLOAD setting is based on what is known as an "inverse I^2t" function. This function allows the drive to deliver 150% of the rated output current for one minute, and even higher current levels for shorter periods of time. Once the overload circuit "times out", the drive will trip on an OVERLOAD fault.

The MOTOR OVERLOAD should be set to a value which is equal to the ratio (in percentage) of the motor full load current rating to the drive output current rating. This will result in an overload capacity of 150% of the MOTOR current rating for one minute. If this parameter is set to 100%, the motor will be allowed to draw 150% of the DRIVE output current rating for one minute. This distinction is important in cases where the motor full load current rating is less than the drive output current rating, such as applications where the drive is oversized to meet torque requirements.

Example: A 5 Hp, 480 Vac drive is operating a 3 HP motor with a full load current rating of 4.8 amps. Divide the motor current rating by the drive output current rating: 4.8 / 7.6 = 63%. Entering this value will allow continuous operation at 4.8 amps, and will also allow the motor to draw 7.2 amps (150% of 4.8 amps) for one minute. If the setting is left at 100%, the motor could draw 11.4 amps (150% of 7.6 amps) for one minute before faulting.

NOTE: The operation of the motor overload circuitry is affected by the setting of Parameter 34 - LOAD MLT.

18 - **BASE** (BASE FREQUENCY)

The BASE FREQUENCY determines the V/Hz ratio by setting the frequency at which the drive will output full voltage to the motor. For most applications the base frequency should be set to match the motor's rated frequency.

For example, if the drive is rated for 460 Vac output, and the BASE FREQUENCY is set to 60 Hz, the drive will maintain a constant ratio of 7.66 V/Hz (except when AC BOOST or FX BOOST are active, see Parameters 19 and 20) from 0 Hz to 60 Hz. This range is the region of constant torque. If the motor speed is increased past 60 Hz, the output voltage remains constant while the frequency increases, resulting in a reduced V/Hz ratio. This range, from 60 Hz to about 90 Hz, is the region of constant horsepower. Above 90

Hz, horsepower begins to drop off as frequency increases. Refer to Section 2.1 - DESCRIPTION OF AC MOTOR OPERATION.

19 - **FX BOOST** (FIXED BOOST)

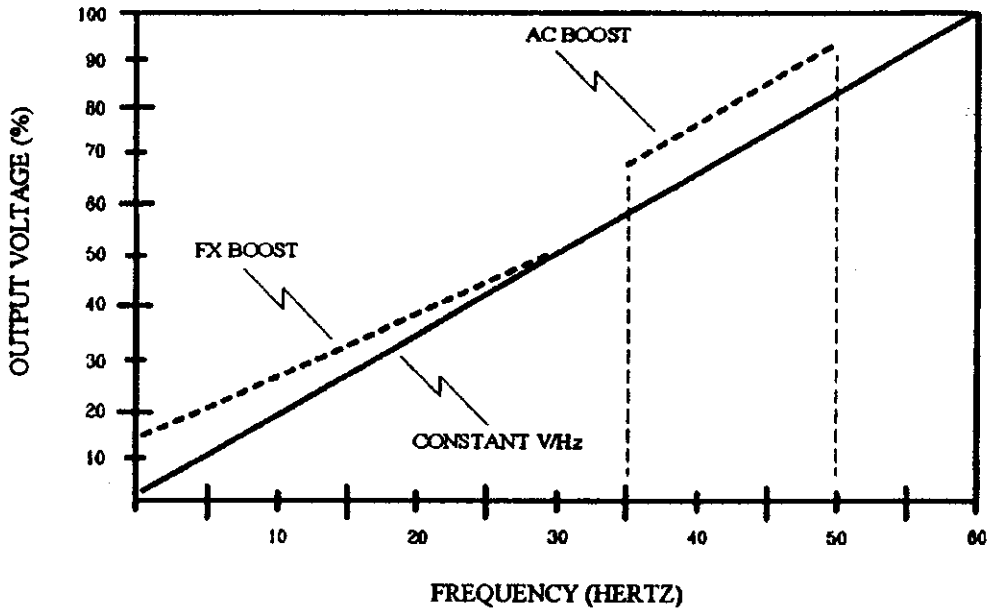
This parameter is used in applications which require high starting torque. FX BOOST increases the output voltage at lower output frequencies (below 30 Hz for 60 Hz base frequency), in order to boost the torque capability of the motor. Refer to the diagram below. The factory default for FX BOOST depends on the horsepower rating. Refer to the table below:

FX BOOST FACTORY DEFAULT SETTINGS			
HP	**FACTORY DEFAULT**	**HP**	**FACTORY DEFAULT**
.25 - 1	5.3 %	10	3.0 %
1.5	4.4 %	15	2.7 %
2	4.4 %	20	2.6 %
3	3.9 %	25	2.5 %
5	3.5 %	30	2.4 %
7.5	3.2 %	40	2.3 %

20 - **AC BOOST** (ACCELERATION BOOST)

AC BOOST is similar to FX BOOST, but is only active when the drive is accelerating. During acceleration, the output voltage is increased according to the setting of AC BOOST, which increases motor torque. Refer to the diagram below. AC BOOST, like FX BOOST, is used in applications with high-inertia loads.

FX AND AC BOOST



The above diagram illustrates how FX BOOST and AC BOOST alter the V/Hz ratio to increase motor torque.

FX BOOST sets the boost at 0 Hz (approximately 15% in the example above), and as the output frequency approaches 30 Hz, the boost decreases to zero.

AC BOOST only functions during acceleration. In the diagram above, the drive is operating at 35 Hz and is then commanded to 50 Hz. The output voltage is increased by the AC BOOST setting (approximately 15% in the example above) during acceleration to the new speed setpoint. Once the new setpoint is reached, the output voltage returns to normal.

21 - **SLIP CMP** (SLIP COMPENSATION)

SLIP COMPENSATION is used to compensate for changes in motor speed ("slip") which occur due to changes in load. In a standard AC induction motor, as the load on the motor increases, the motor current increases and the motor shaft speed decreases. By increasing the output frequency in response to the increased motor current, SLIP COMPENSATION is able to counteract the reduction in motor speed due to increased load. This parameter is useful in applications where precise speed regulation is needed, even under changing load conditions. The use of SLIP COMPENSATION can result in speed regulation of less than 1% of base speed in most applications. SLIP COMPENSATION is often set to 3%, which is the standard slip rating of most AC induction motors.

22 - **TORQUE** (TORQUE CURVE SELECTION)

This parameter is used to select whether the output of the drive follows a constant V/Hz curve or a variable V/Hz curve. The default setting is CONSTANT, and should be used for constant torque applications. Setting this parameter to VARIABLE will optimize efficiency for variable torque applications, such as pumps and fans, but will not affect the current limiting ability of the drive.

23 - **CARRIER** (CARRIER FREQUENCY)

This parameter sets the carrier frequency, or switching frequency of the output IGBT's. Higher switching rates result in less audible noise to be emitted from the motor, but the efficiency of the drive decreases as the carrier frequency increases. Therefore, this parameter should be set to the lowest value which yields acceptable sound levels. Available settings are: 2.5 kHz, 8 kHz, 10 kHz, 12 kHz and 14 kHz.

NOTE: The 2.5 kHz carrier frequency is a variable carrier. The carrier frequency remains at 1.5 kHz up to 25 Hz output frequency, and is synchronized above 25 Hz to a fixed multiple of 60 times the drive's output frequency. As an example, if the output frequency of the drive was set to 45 Hz, the carrier frequency would be 2.7 kHz (45 Hz x 60 = 2700 Hz).

NOTE: The ability to operate a drive in the quiet (high carrier frequency) mode is dependent on the drive horsepower rating, driven load, drive enclosure, and the ambient temperature. Operation above 8kHz may require derating the drive.

25 - **START** (START MODE)

This parameter selects the starting method for the drive, and can be set for one of the following:

NORMAL	The drive will start when the appropriate contact closure is made (maintained or momentary depending on whether the drive is set up for a two-wire or three-wire start/stop) on the terminal strip. To start the drive in NORMAL mode, a start command must be issued at least two seconds AFTER input power is applied.
POWER-UP	The drive will automatically start upon application of input power. The drive MUST be wired for a two-wire start/stop control with a maintained start contact (refer to Section 14 - CONTROL WIRING). The start command MUST be present when power is applied for this function to operate.
AUTO RE-	The drive will automatically restart after a protective fault or upon application of input power. As with the POWER-UP option, a start command must be present for this function to operate.
RE-BRAKE	After a fault, the drive will apply voltage equal to the DC BRAKE setting for 15 seconds and then restart. This is done to ensure the motor is stopped at the time of the restart attempt as the drive will not start into a spinning motor.

NOTE: POWER UP, AUTO RE-, and RE-BRAKE settings are only active when the drive is in REMOTE mode (see Parameter 30 - CONTROL).

NOTE: After a fault, the drive will attempt to restart five times, and if unsuccessful, will shut down on a FAULT LOCKOUT. Every 15 minutes that passes will decrement the restart counter by one. Therefore, 75 minutes after a successful restart, the restart counter is fully reset, and the drive can once again attempt five restarts.

NOTE: The drive WILL NOT restart after the following faults: CONTROL and PWR SAG. Also, if an OUTPUT fault occurs at a speed below 1.5 Hz, only one restart will be attempted because there may be a problem with an output transistor..

⚠ WARNING

UNINTENDED EQUIPMENT ACTION

- **Automatic restart can only be used for machines or installations that present no danger for personnel or equipment in the event of automatic restarting.**
- **Equipment operation must conform with national and local safety regulations.**

FAILURE TO OBSERVE THIS PRECAUTION CAN RESULT IN EQUIPMENT DAMAGE, SEVERE PERSONAL INJURY OR DEATH.

26 - **STOP** (STOP MODE)

This parameter selects whether the motor will COAST to a stop, or RAMP to a stop, when the drive is given a stop command.

COAST	When a stop command is given, the drive shuts off the output to the motor, allowing it to coast to a stop. In this mode, the time it takes the motor to stop is governed by the inertia of the driven load.
RAMP	When a stop command is given, the drive will decelerate the motor to a stop over a period of time according to Parameter 8 - DECEL.

27 - **ROTATION** (ROTATION DIRECTION)

This parameter is used to limit the motor rotation direction to forward or reverse, or to allow rotation in both directions. The parameter can be set to one of the following:

FORWARD	Rotation is allowed in the forward direction only. This selection disables the FWD/REV button on the keypad and TB-13C (REVERSE).
REVERSE	Rotation is allowed in the reverse direction only. This selection disables the FWD/REV button on the keypad and TB-12A (FORWARD). TB-13C must be programmed for either RUN REV or STRT REV for this function to operate in the REMOTE mode.
FWD&REV	Rotation is allowed in both directions. The FWD/REV button is enabled. Rotation can be changed from the keypad (LOCAL mode), or the terminal strip (REMOTE mode). In the REMOTE mode, TB-13C must be programmed for either RUN REV or STRT REV for this function to operate.

⚠ WARNING

If TB-13C is programmed for run reverse, TB-1 is disabled and cannot be used as a stop switch! This is true in local and remote mode.

INCORRECT USE OF TB-1 MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

Refer to Parameter 49 - TB13C for more information.

FWD@LOC — In LOCAL mode, rotation is allowed in the forward direction only. In REMOTE mode, rotation is allowed in both directions.

NOTE: If the rotation is changed while the drive is running, the drive will decelerate to 0 Hz, and then accelerate back up to the speed setpoint in the opposite direction.

28 - **AUTO / MAN** (AUTO / MANUAL SPEED CONTROL)

This parameter is used to select the method of speed control when the drive is in the LOCAL mode. The choices are explained below:

MANUAL — The drive will accept a speed reference from the keypad (UP and DOWN ARROW keys) or a speed potentiometer (wired to TB-2, 5A, and 6). Parameter 29 - MANUAL below selects either keypad or speed potentiometer. The AUTO/MAN button on the keypad is disabled.

AUTO — The drive will accept a 0-10 VDC input signal on TB-5A and TB-2, a 4-20 mA input signal on TB-5B and TB-2, or one of the three PRESET SPEEDS. The programming of TB-13A, TB-13B and TB-13C determines which AUTO reference is selected. The AUTO/MAN button on the keypad is disabled.

BOTH — The AUTO/MAN key on the keypad is enabled and can be used to toggle between MANUAL and AUTO control ONLY if Parameter 30 - CONTROL is set to LOCAL.

NOTE: If this parameter is set to AUTO or BOTH, and a speed reference is not selected by a contact closure between TB-13A, TB-13B, or TB-13C and TB-2, the speed reference will default to the setting of Parameter 29 - MANUAL (KEYPAD or 0-10 VDC).

29 - **MANUAL** (MANUAL)

This parameter selects the speed reference source when the drive is set for MANUAL speed control (see Parameter 28 - AUTO/MAN above). The speed

reference options are KEYPAD (UP and DOWN ARROW keys), or 0 - 10 VDC (from a speed pot wired to TB-2, 5A, and 6; or some other 0-10 VDC source).

30 - **CONTROL** (START/STOP CONTROL)

This parameter is used to select the source of the start/stop command and direction control. The following explains the possible settings:

LOCAL — START/STOP and FORWARD/REVERSE commands from the keypad only.

> **⚠ WARNING**
>
> **If control is set to local, TB-1 is disabled and cannot be used as a stop switch!**
>
> INCORRECT USE Of TB-1 MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

REMOTE — START/STOP and FORWARD/REVERSE commands from the terminal strip only.

BOTH — LOCAL operation if TB-13A or TB-13C is programmed for LOCAL SELECT and a contact closure is made from TB-13A or TB-13C to TB-2. If the contact closure is not made, the drive will be in REMOTE mode.

> **⚠ WARNING**
>
> **Stop (TB-1) and external fault (TB-13D) circuitry may be disabled if parameters are reset to factory defaults! The drive must be reprogrammed after a reset in order to insure proper operation (See Parameter 65 - Program).**
>
> FAILURE TO DO SO MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

31 - **HZ UNITS** (SPEED UNITS)

HZ UNITS sets the units of the output speed display on the keypad. This parameter can be set to the following speed units: HERTZ, RPM, % HZ, /SEC, /MIN, /HR, and NONE.

NOTE: The intended use of "/SEC", "/MIN", and "/HR" are units per second, units per minute, and units per hour.

32 - **HZ MULT** (HERTZ MULTIPLIER)

The HZ MULTIPLIER is used to scale the output speed indication on the display. If HZ UNITS is set for HERTZ or % HZ, this parameter has no effect.

Multiplying the output frequency by the HZ MULTIPLIER will yield the desired speed value on the display.

Example: If the desired speed display is RPM, and a standard 60 Hz, 1800 RPM motor is being used, set HZ UNITS to RPM and set HZ MULTIPLIER to 30.00. This would result in a speed display of 1110 RPM for an output frequency of 37 Hz (37 Hz X 30 = 1110 RPM). Also, if there was a 100:1 gear reducer in the system, Parameter 33 - SPEED DP below could be set to XX.XX in order for the display to read 11.10 RPM, representing the output speed of the gear reducer rather than motor speed.

33 - **SPEED DP** (SPEED DECIMAL POINT)

This parameter is used to move the decimal point location in the speed display. This parameter will not have any effect if HZ UNITS is set to HERTZ or % HZ. The possible settings are: XXXXX, XXX.X, XX.XX, X.XXX, and .XXXX. Refer to Parameter 32 - HZ MULT above for an example on the use of SPEED DP.

34 - **LOAD MLT** (LOAD MULTIPLIER)

This parameter is used to scale the load display. If the drive output current rating is higher than the motor full load current rating, the drive will not display 100% load when the motor is at full load. Setting this parameter to the ratio (in percentage) of the drive output current rating to the motor full load current rating will scale the load display to show the motor load instead of the drive load. This will result in a display of 100% when the motor is at full load.

The motor overload circuitry is also affected by this parameter. When the display reads 150% load, the drive will trip on OVERLOAD in one minute, regardless of the actual motor current. If this parameter is used to scale the display to show actual motor load, then Parameter 16 - MOTOR OL should be left at 100%. Likewise, if MOTOR OL has been set according to the motor full load rating, this parameter should be left at 100%. Changing both parameters will result in an OVERLOAD fault sooner than expected.

The output signal at TB-10B is also affected by this parameter. When set to the ratio of current ratings as explained above, the output signal will be proportional to motor load instead of drive load.

35 - **CONTRAST** (LCD DISPLAY CONTRAST)

This parameter is used to adjust the contrast of the drive display and can be set to LOW, MED, or HIGH in order to obtain the most visible display. If the drive is mounted lower than eye level, a HIGH setting may make the display more visible. Likewise, if the drive is mounted higher than eye level, a LOW setting may make the display more visible.

39 - **TB5 MIN** (TERMINAL TB-5 INPUT)

This parameter selects the output frequency of the drive that will correspond to the minimum analog speed reference input (0 VDC or 4 mA). This parameter is used in conjunction with Parameter 36 - TB5 MAX to define a

speed range for the drive that corresponds to the analog speed reference input (0 - 10 VDC or 4 - 20 mA).

40 - **TB5 MAX** (TERMINAL TB-5 INPUT)

This parameter selects the output frequency of the drive that will correspond to the maximum analog speed reference input (10 VDC or 20 mA). This parameter is used in conjunction with Parameter 35 - TB5 MIN to define a speed range for the drive that corresponds to the analog speed reference input (0 - 10 VDC or 4 - 20 mA).

NOTE: The drive can be programmed for inverse operation so that minimum speed reference corresponds to the maximum output frequency, and the maximum speed reference corresponds to the minimum output frequency. This is accomplished by setting TB5 MIN larger than TB5 MAX. Therefore, as the speed reference increases, the drive speed will decrease, and as the speed reference decreases, the drive speed will increase.

Example: The drive is being controlled by a pressure transducer that provides a 4-20 mA signal proportional to duct pressure. The minimum frequency desired is 20 Hz, and the maximum is 60 Hz. Set TB5 MIN for 60 Hz, and TB5 MAX for 20 Hz. As the duct pressure rises, the output signal from the transducer will increase, causing the speed of the drive to decrease. This results in a decrease in duct pressure and a decreasing transducer signal. The drive responds to the decreasing signal by increasing speed, which again raises the duct pressure. In this way, the average duct pressure can be maintained at a certain level. If the acceleration and deceleration rates are set too fast however, the drive will react quickly to signal changes which will cause the drive speed to "hunt" up and down excessively.

42 - **TB10A OUT** (TERMINAL TB-10A OUTPUT)

The analog output signal at TB-10A is proportional to the output frequency of the drive. This parameter selects whether that signal is 0-10 VDC or 2-10 VDC. The 2-10 VDC signal can be converted to a 4-20 mA signal by connecting a resistor in series with the signal such that the total load resistance is 500 ohm. If set to NONE, the function is disabled.

43 - **@ TB10A** (TERMINAL TB-10A SCALING)

This parameter scales the analog output signal at TB-10A. This is the output frequency at which the maximum output signal (10VDC) at TB-10A is desired.

Example: The drive is connected to a control system that requires a 0-5 VDC signal to indicate 0-60 Hz output frequency. If this parameter were set to 120 Hz, the drive would output 10 VDC at 120 Hz, and 5 VDC at 60 Hz. If the drive is only operated from 0-60 Hz, the control system would only receive the desired 0-5 VDC signal from the drive.

44 - **TB10B OUT** (TERMINAL TB-10B OUTPUT)

The analog output signal at TB-10B is proportional to the drive load. This parameter selects whether that signal is 0-10 VDC or 2-10 VDC. The 2-10 VDC signal can be converted to a 4-20 mA signal by connecting a resistor in series with the signal such that the total load resistance is 500 ohm.

45 - **@ TB10B** (TERMINAL TB-10B SCALING)

This parameter scales the analog output signal at TB-10B. The value programmed into this parameter is the drive load at which the maximum output signal (10VDC) at TB-10A is desired.

Example: The drive is connected to a control system that requires a 0-10 VDC signal to indicate 0-150% drive load. If this parameter were set to 150%, the drive would output 10 VDC at 150% load, and about 6.7 VDC at 100% load.

NOTE: The output signal at TB-10B is affected by the setting of Parameter 34 - LOAD MLT.

47 - **TB13A** (TB-13A INPUT FUNCTION)

This parameter is used to select the function of terminal TB-13A. Closing TB-13A to TB-2 activates the TB - 13A input function. The following functions can be selected:

NONE	Disables the TB-13A function.
0-10VDC	Selects 0-10 VDC as the AUTO speed reference input. The 0-10 VDC signal is wired to TB-5A and TB-2.
4-20 MA	Selects 4-20 mA as the AUTO speed reference input. The 4-20 mA signal is wired to TB-5B and TB-2.
SPEED#1	Selects PRESET SPEED #1 as the AUTO speed reference.
LOC SEL	Selects LOCAL mode when Parameter 30 - CONTROL is set to BOTH. Drive is in REMOTE mode if contact closure is not made.
DEC FREQ	Decrease frequency setpoint. Used with the MOP (motor operated pot) function. Refer to Section 14.2.6 - SPEED REFERENCE SELECTION.

48 - **TB13B** (TB-13B INPUT FUNCTION)

This parameter is used to select the function of terminal TB-13B. Closing TB-13B to TB-2 activates the TB - 13B function. The following functions can be selected:

NONE	Disables the TB-13B function.
0-10VDC	Selects 0-10 VDC as the AUTO speed reference input. The 0-10 VDC signal is wired to TB-5A and TB-2.
4-20 MA	Selects 4-20 mA as the AUTO speed reference input. The 4-20 mA signal is wired to TB-5B and TB-2.
SPEED#2	Selects PRESET SPEED #2 as the AUTO speed reference.
INC FREQ	Increase frequency setpoint. Used with the MOP (motor operated pot) function. Refer to Section 14.2.6 - SPEED REFERENCE SELECTION.
JOG FWD	Jog in the forward direction. Active only when drive is STOPPED. The jog speed is set by Parameter 2 - SPEED#2.
JOG REV	Jog in the reverse direction. Active only when drive is STOPPED. The jog speed is set by Parameter 2 - SPEED#2.

⚠ WARNING

When operating in jog mode, the stop key WILL NOT stop the drive. to stop the drive, the contact between TB-13B and TB-2 must be opened.

49 - TB13C (TB-13C INPUT FUNCTION)

This parameter is used to select the function of terminal TB-13C. Closing TB-13C to TB-2 activates the TB - 13C input function. The following functions can be selected:

NONE	Disables the TB-13C function.
0-10VDC	Selects 0-10 VDC as the AUTO speed reference input. The 0-10 VDC signal is wired to TB-5A and TB-2.
4-20 MA	Selects 4-20 mA as the AUTO speed reference input. The 4-20 mA signal is wired to TB-5B and TB-2.
SPEED#3	Selects PRESET SPEED #3 as the AUTO speed reference.
LOC SEL	LOCAL SELECT - Selects LOCAL mode when Parameter 30 - CONTROL is set to BOTH. Drive is in REMOTE mode if contact closure is not made.

RUN REV — RUN REVERSE - Run in reverse direction. Requires a maintained contact closure - close to RUN in reverse direction, open to STOP. This will cause TB-12A to function as RUN FORWARD, also requiring a maintained contact.

⚠ WARNING

If TB-13C is programmed for RUN REVERSE, TB-1 is disabled and CANNOT be used as a STOP switch! This is true in LOCAL and REMOTE mode.

INCORRECT USE OF TB-1 MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

STRT REV — START REVERSE - Start in reverse direction. Requires a momentary contact closure to RUN in reverse direction. A momentary STOP contact must be wired between TB-1 and TB-2. Setting this parameter to START REVERSE causes TB-12A to function as START FORWARD, also requiring a momentary contact closure to RUN in forward direction.

50 - TB13D EXT (TB-13D - EXTERNAL FAULT)

This parameter selects the operation of the EXTERNAL FAULT function for TB-13D.

FAULT — Sets TB-13D as a normally open contact. Closing TB-13D to TB-2 will cause the drive to trip on an EXTERNAL FAULT.

/ FAULT — Sets TB-13D as a normally closed contact. Opening the contact between TB-13D and TB-2 will cause the drive to trip on an EXTERNAL FAULT.

⚠ WARNING

STOP (TB-1) and EXTERNAL FAULT (TB-13D) circuitry may be disabled if parameters are reset to factory defaults! The drive must be reprogrammed after a RESET in order to insure proper operation (See Parameter 65 - PROGRAM).

FAILURE TO DO SO MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

CLEAR — Sets TB-13D as a normally open FAULT RESET. Close TB-13D to TB-2 to clear a FAULT.

NOTE: When set to CLEAR, TB-13D becomes the only terminal that can be used to clear a FAULT. Opening the STOP input at TB-1 will not clear a FAULT. However, the STOP key can still be used to clear FAULTS.

52 - **TB14 OUT** (TB-14 OPEN COLLECTOR OUTPUT)

This parameter sets the open-collector output indication for terminal TB-14. The following conditions can be selected: NONE, RUN, FAULT, / FAULT (INVERSE FAULT), LOCK (FAULT LOCKOUT), AT SPEED, ABOVE #3, I LIMIT (CURRENT LIMIT), or AUTO/MAN operation. Refer to Section 2.2 - DRIVE FUNCTION DESCRIPTION for more information.

The open-collector output circuit is a current-sinking type rated at 30 VDC and 40 mA maximum. An external power supply (30 VDC max.) must be used to power the open-collector outputs. The drive does not have a dedicated power supply for the open-collector outputs.

53 - **TB15 OUT** (TB-15 OPEN COLLECTOR OUTPUT)

This parameter sets the open-collector output indication for terminal TB-15. It has the same functionality as Parameter 52 - TB14 OUT above.

54 - **RELAY** (RELAY FUNCTION)

The control board has one auxiliary relay which can be programmed to indicate one of the following conditions: NONE, RUN, FAULT, / FAULT (INVERSE FAULT), LOCK (FAULT LOCKOUT), AT SPEED, ABOVE #3, CURRENT LIMIT, or AUTO/MAN operation. Refer to Section 2.2 - DRIVE FUNCTION DESCRIPTION for more detailed information.

The auxiliary relay has a set of FORM C contacts on TB-16, 17, and 18, rated 2 amps at 28 VDC or 120 VAC. Control wiring diagrams show relays in the rest state (coils NOT energized).

57 - **SERIAL** (SERIAL COMMUNICATIONS)

This parameter is used to activate serial communications. When using this feature, the drive can communicate with a personal computer (PC), programmable logic controller (PLC), or other external device that utilizes RS-485 serial communications for control. The serial interface may be used to read present parameter settings (uploading to the control device), write new parameter settings (downloading from the control device), monitor present drive activity, and control current drive activity.

NOTE: If a RESET command (Parameter 65 - PROGRAM) is issued through the serial link, this parameter will not default back to DISABLE. However, expicitly setting this parameter to DISABLE through the serial link will cut off communication with the drive.

If developing an application for a serial control device, refer to the RS-232/ RS-485 Modbus® Communications Protocol Specification.

58 - **ADDRESS** (SERIAL ADDRESS)

This parameter is used with the serial communications feature, and is intended for use in a multiple drive network (RS-485). The serial link will support from 1 to 30 drives, each drive having an address in the range of 1 to 30. If the serial communications option is not being used, leave this parameter set to the default setting of 30.

61 - **PASSWORD** (PASSWORD NUMBER)

This feature limits access to the programmable parameters for added security. The correct password must be entered in order to change any parameter settings.

Pressing the PROG/RUN button on the keypad will call up the PASSWORD prompt. If the correct password is entered, the PROGRAM MODE is entered and parameters can be changed.

If the wrong password is entered, the drive will flash ERROR: INCORRECT on the display and then return to the PASSWORD prompt to allow another attempt at entering the correct password.

If the ENTER key is pressed while PASSWORD reads 0000, the MONITOR MODE will be entered (if Parameter 51 - MONITOR, is set to ON), which will allow the parameters to be viewed (except for PASSWORD), but not changed.

NOTE: The factory default value is 0019.

NOTE: Programming PASSWORD to 0000 disables the function. When the password is disabled and the PROG/RUN button is pressed, the user will enter the PROGRAM MODE directly, without having to enter a password.

63 - **SOFTWARE** (SOFTWARE VERSION)

This parameter displays the software code and revision number of the control board software. This information is useful when contacting the factory for programming or troubleshooting assistance. This is a "view-only" parameter, and cannot be changed.

64 - **MONITOR** (MONITOR)

This parameter is used to enable (ON) or disable (OFF) the MONITOR MODE function. The functionality is explained below:

ON	Pressing the PROG/RUN key will call up the PASSWORD prompt. If the ENTER key is pressed while the password value reads 0000, the MONITOR MODE is entered and parameters can be viewed (except for PASSWORD), but not changed.
OFF	Pressing the PROG/RUN key will call up the PASSWORD prompt. If the ENTER key is pressed

while the password value reads 0000 (or any other incorrect value), it will be treated as in incorrect password and the display will flash ERROR: INCORRECT, and then return to the PASSWORD prompt to allow another attempt at entering the correct password.

65 - **PROGRAM** (PROGRAM FACTORY DEFAULTS)

This parameter is used to reset the programmable parameters back to the factory default settings. This parameter has four possible settings:

MAINTAIN	Maintain parameter settings as they are.
RESET 60	Resets parameters to factory defaults for 60 Hz base frequency.
RESET 50	Resets parameters to factory defaults for 50 Hz base frequency.
RST HIGH	Resets parameters to factory defaults for 650 Hz base frequency. This option will only appear if the drive is equipped with the High Frequency Output option.

When a factory reset is performed, the following terminals are affected:

TB-1 will be disabled because Parameter 30 - CONTROL will default to LOCAL.

TB-13D will default to a normally open EXTERNAL FAULT contact because Parameter 50 - TB13D EXT will be reset to FAULT.

⚠ WARNING

STOP (TB-1) and EXTERNAL FAULT (TB-13D) circuitry may be disabled if parameters are reset to factory defaults! The drive must be reprogrammed after a reset in order to insure proper operation.

FAILURE TO DO SO MAY RESULT IN DAMAGE TO EQUIPMENT AND/OR INJURY TO PERSONNEL!

NOTE: This parameter will display RESET 60, RESET 50 or RST HIGH until a change is made to one or more of the parameter settings. Once a parameter is changed, the display will change to MAINTAIN.

66 - **HISTORY** (CLEAR FAULT HISTORY)

This parameter is used to clear the previous faults in the FAULT HISTORY. When set to CLEAR and the ENTER key is pushed, the display will change to

MAINTAIN, and the FAULT HISTORY will display NO FAULT for each of the eight fault histories.

69 - **LANGUAGE** (LANGUAGE SELECTION)

The VSD17 Series drive can support other languages with the addition of an optional LANGUAGE EEPROM chip installed in socket U11 on the control board of the drive. If the EEPROM is not present, the default language will be ENGLISH. Also, this parameter is not affected when the parameters are reset using Parameter 65 - PROGRAM. Therefore, if a language other than ENGLISH is selected, it will remain in effect after a RESET.

70 - **FAULT HISTORY**

The FAULT HISTORY stores the previous eight fault conditions that caused the drive to trip. The information stored here is view-only, it can not be altered. The FAULT HISTORY can be used to determine if there is a pattern, or trend, to the faults, which may indicate a problem in the system. Refer to Section 19 - TROUBLESHOOTING for more information on faults.

19 TROUBLESHOOTING

The table below lists the fault conditions that will cause the drive to shut down, as well as some possible causes. Please contact the factory for more information on troubleshooting faults. The drive will not restart after a PWR SAG or a CONTROL fault. Also, the drive will only attempt one restart after an OUTPUT fault if it occurred below 1.5 Hz.

FAULT MESSAGES		
FAULT	**DESCRIPTION**	**POSSIBLE CAUSES**
OUTPUT	Output transistor fault - Output current exceeded 200% of drive rating.	Output shorted phase to ground. Output shorted phase to phase. FX or AC BOOST set too high. Bad transistor module (IPM).
LO VOLTS	Low DC Bus Voltage fault - DC bus voltage below 60% of normal.	Low line voltage.
HI VOLTS	High DC Bus Voltage fault - DC bus voltage above 120% of normal.	High line voltage. Overhauling load - DECEL too fast.
HI TEMP	Temperature fault - Internal drive temperature too high.	Ambient temperature too high. Fan failure (if equipped).
OVERLOAD	Current Overload fault - Output current rating exceeded for too long.	Drive undersized for application. Problem with the motor and/or the driven equipment.
PWR SAG	Power Sag fault - Control board voltage below tolerance.	Erratic AC line. Control board from another drive with different rating installed.
PWR TRAN	Power Transient fault - Low line voltage.	AC line dipped or sagged.
LANGUAGE	Language fault - Selected language not present.	Defective Language EEPROM. Language EEPROM (U11) removed after programming.
EXTERNAL	External fault - TB-13D is open or closed to TB-2, depending on Parameter 50 - TB13D EXT.	Check Parameter 50 - TB13D EXT Check devices wired between TB13D and TB-2.
DB ERROR	Dynamic Brake fault - DB circuitry has sensed a resistor overload.	The DB duty cycle is too high - resistors are overheating.
CONTROL	Control Board fault - Software has been installed that is not compatible with previous version.	Use Parameter 65 - PROGRAM to do a factory reset. This will clear the fault and update the software.
INTERNAL INTERN#	Internal fault - The microprocessor has sensed a problem.	Electrical noise on control wiring. Defective microprocessor.

SCHNEIDER CANADA

Service Centres:

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