MOTORTRONICS

Solid State AC Motor Control

CSD Series
Variable Frequency
AC Drive
½ - 30 HP

OPERATION & SERVICE MANUAL

REV2
7080601MN

Table of Contents

Chapter 1 - Introduction

This manual provides detailed programming information for the ***CSD Series*** adjustable frequency AC drive. For basic start up instructions see the *"Quick Startup"* Manual.

1.1 General

The ***CSD Series*** is a compact AC drive featuring front panel keypad and display, plus an easy to use keypad mounted potentiometer. The ***CSD Series*** combines application flexibility with ease of operation. It is ideally suited for the vast number of applications where variable speed operation is the requirement, but without the need for extensive programming. In addition to the many conventional features available on today's drives, the ***CSD Series*** is capable of operating via RS232 or RS485 via optional cabling and software.

1.2 Receiving

Upon receipt of this product you should immediately do the following:

- Inspect the box for possible shipping damage (if damaged, you should notify the freight carrier and file a claim within 15 days of receipt).
- Verify the model number on the box matches your purchase order.
- Confirm the ratings sticker on the unit matches your motor's current and voltage rating.

1.3 WARNING!

Do not service equipment with voltage applied! Unit can be the source of fatal electrical shocks! To avoid shock hazard, disconnect main power before working on the drive. More than one disconnect switch may be required to de-energize the equipment. Verify that the DC bus is completely discharged before servicing. Warning labels (not supplied) must be attached to terminals, enclosure and control panel; also, take a VDC reading. This should read 0 VDC prior to working on the unit. Note: Unit does not provide overspeed protection or incorporate current limiting control.

1.4 Theory of Operation

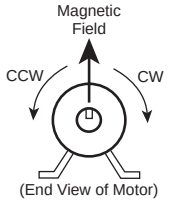


Figure 1-1
Direction of Rotation

1.4.1 Variable Speed Control of AC Motors

A standard three-phase motor is designed to operate at fixed voltage and fixed speed (frequency). To operate variable speed, a variable frequency waveform must be supplied to power the motor. Because of the spatial distribution and interconnections of the motor's internal windings, the application of three-phase power will produce a rotating magnetic field around its periphery. As shown in Figure 1-1, this field may rotate either clockwise or counterclockwise, depending upon the phase sequence of the three-phase source. The speed of rotation of this magnetic field is called "synchronous speed".

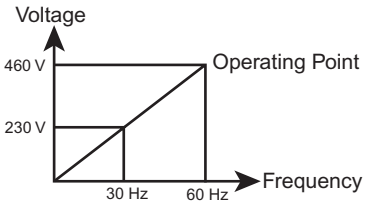


Figure 1 - 2
Volts per Hertz Ratio

This speed is described by this simple formula:

$$\textbf{Synchronous Speed} = \frac{120 \times \text{Frequency}}{\text{\# of Poles}}$$

Where:

- Synchronous speed is in RPMs (Revolutions Per Minute)
- Poles are the number of poles built into the motor.
- Frequency is the applied frequency of the power fed to the motor.

As you can see, synchronous speed is directly proportional to the applied frequency. By increasing or decreasing this frequency, you can increase or decrease the rotational speed of the magnetic field. This is the underlying theory behind the operation of the adjustable frequency drives.

Changing the speed is only half the problem. The motor was designed to run at a fixed operation point as shown in the nameplate (frequency voltage). This point can be described by a "volts per hertz" (V/Hz) ratio which relates to the strength of the magnetic field. To maintain constant field strength and constant torque, we must maintain this ratio. Since we vary the frequency to change the synchronous speed, we must simultaneously change the applied voltage to maintain the necessary V/Hz ratio. As an example: For a constant torque application, if the frequency is cut in half, the voltage must also be cut in half as shown in Figure 1 - 2.

The final concept to be introduced is known as motor "slip". The actual torque output by an induction motor is proportional to the product of the V/Hz ratio and the slip. Slip is simply defined as the difference between synchronous speed and the actual motor shaft speed. With constant V/Hz excitation, the motor must slip to produce more torque. The greater the torque requirement, the greater amount of motor slip and the slower the resultant shaft speed.

1.4.2 Drive Power Section

Refer to Figure 1 - 3. The input (converter) of the power section is a three-phase, rectifier bridge used to convert the incoming AC voltage into DC voltage. This DC voltage is then filtered by the DC bus capacitors to produce a clean, ripple-free DC level. The converter also includes a current limiting, pre-charge circuit. This circuit is used to control the current inrush while the capacitors are building up their charge when power is first applied to the drive unit. Once they are charged, this circuit serves no further useful purpose, so it is bypassed. The output (inverter) section consists of six transistors which are switched by the microprocessor to produce the variable voltage, variable frequency output waveform necessary to control the V/HZ ratio as discussed in the previous section. The result of this switching is a "chopped up square wave" voltage that produces a nearly sinusoidal motor current waveform.

Note: *The shape of the voltage waveform prohibits accurate measurement with most types of voltmeters. The most accurate measurement is obtained by using a "rectifier" type AC voltmeter. If this type of meter is unavailable, use an analog meter and check to insure the three-phase output voltage is balanced (this shows all transistors are switching evenly, even if the actual voltage reading is meaningless).*

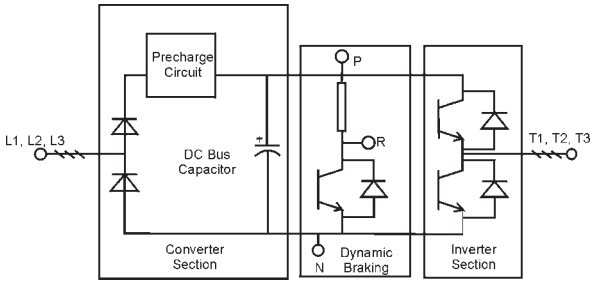


Figure 1 - 3
Power Section Block Diagram

The ***CSD Series*** unit offers an optional function called dynamic braking. Dynamic braking, in adjustable frequency drives, allows the motor to produce 100% braking torque for a 10% duty cycle for four-quadrant operation (like DC regenerative drives). With dynamic braking, the regenerative energy from the motor is dissipated by switching the dynamic braking transistor to shunt the regenerative current from the DC bus capacitors through the braking resistor (See Figure 1 - 3). This circuit is optional in the CSD drive line, please contact the factory if your application requires dynamic braking.

1.4.3 Logic Section

The heart of the drive's control section is the Central Processing Unit (CPU). This component handles the logic functions, including output waveform generation, monitoring of commands, and self-diagnostics. The CPU also simplifies troubleshooting and setup by displaying and storing very specific, alpha-numeric fault codes displayed on the keypad. For example, you can immediately determine if an overcurrent (OC) trip occurred during start, acceleration, deceleration or constant speed operation by the unique fault code corresponding to each of these conditions.

The output waveform is "sine-coded, Pulse Width Modulation (PWM)", which gained wide acceptance because of its high starting torque and smooth low speed motor rotation capabilities. In addition, the motor's "torque per amp" ratio is good, implying a very efficient output current waveform. The drive can accept control commands (run or frequency reference inputs) from either the terminal strip or the integral keypad. The terminal frequency reference command can be either 0-10 VDC, 0-5 VDC or 4-20 mA. The drive's actual output frequency can be monitored directly from the keypad or from a remote meter connected to the drive's analog meter output (0-10VDC, current regulated).

1.4.4 Motor Rating for Variable Speed Application

Motortronics recommends, whenever possible, the use of "drive duty" motors to prevent premature motor failures that may occur in some variable frequency drive applications. "Drive duty" motors have increased insulation on the first few turns of the motor, preventing failures from "punch through" of the insulation in 400-600 volt class, low horsepower motors. "Punch through" is caused by a proportionally higher amount of the dv/dt output of the drive being dropped across the first few turns of the motor. "Drive duty" motors also provide rated cooling during all speed ratings. This feature prevents failure due to reduced cooling capabilities when a TEFC (totally enclosed fan cooled) motor is being run at reduced speed and in constant torque applications. Motortronics recommends that the motor manufacturer be consulted in all variable frequency drive applications to ensure that the motor will be able to perform the application requirements.

Chapter 2 - Installation

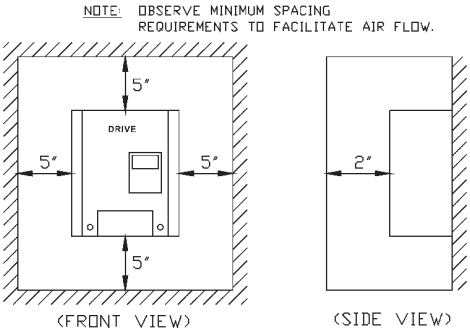


Figure 2 - 1
Location and Positioning

2.1 Location

Proper location of the ***CSD Series*** is necessary to achieve specified performance and normal lifetime operation. The ***CSD Series*** should always be installed in an area where the following conditions exist:

- Ambient operating temperature:
  Enclosed unit: -10 to 40° C (14 to 104° F).
  Chassis unit: -10 to 50° C (14 to 122° F).
- Protected from rain and moisture
- Shielded from direct sunshine
- Free from metallic particles and corrosive gas.

Make sure there is sufficient clearance around the ***CSD Series*** unit for cooling, wiring and maintenance purposes. To maximize the effective air flow (and cooling), the inverter should be installed with its heatsink ribs oriented vertically. We also recommend you remove the front cover if possible when you mount the inverter inside a larger enclosure. This will further improve the air flow over the electronic components and improve the unit's reliability. (Fig. 2 - 1). Refer to the chart below for model heat dissipation requirements when installing your unit.

Model Number	Drive (HP)	Drive Efficiency (%)	Rated Current (Amps)	Drive Loss (W)	Min. Req. Air Vol. (CFM)	Min. Sfc. Area. Steel Box (Sq. Ft)	Min. Sfc. Area Fiberglass Box (Sq. Ft)
CSD-2P5	0.5	95.56	3.1	23.25	4.04	4.65	7.27
CSD-201	1	96.74	4.5	33.75	5.87	6.75	10.55
CSD-202	2	97.26	7.5	56.25	9.78	11.25	17.58
CSD-203	3	97.44	10.5	78.75	13.70	15.75	24.61
CSD-205	5	97.44	17.5	131.25	22.83	26.25	41.02
CSD-207	7.5	97.47	26	195.00	33.91	39.00	60.94
CSD-210	10	97.44	35	262.50	45.65	52.50	82.03
CSD-215	15	97.61	49	367.50	63.91	73.50	114.84
CSD-220	20	97.66	64	480.00	83.48	96.00	150.00
CSD-230	30	97.87	87	652.50	113.48	130.50	203.91
CSD-401	1	97.64	2.3	24.15	4.20	4.83	7.55
CSD-402	2	98.04	3.8	39.90	6.94	7.98	12.47
CSD-403	3	98.21	5.2	54.60	9.50	10.92	17.06
CSD-405	5	98.19	8.8	92.40	16.07	18.48	28.88
CSD-407	7.5	98.21	13	136.50	23.74	27.30	42.66
CSD-410	10	98.20	17.5	183.75	31.96	36.75	57.42
CSD-415	15	98.28	25	262.50	45.65	52.50	82.03
CSD-420	20	98.35	32	336.00	58.43	67.20	105.00
CSD-430	30	98.35	48	504.00	87.65	100.80	157.50

Table 2 A - Drive Heat Loss

2.2 Dimensions

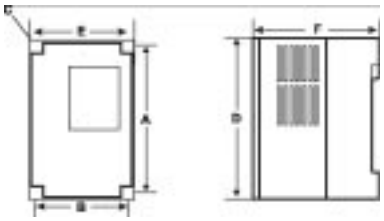


Figure 2 - 2A
NEMA 1 Dimensions

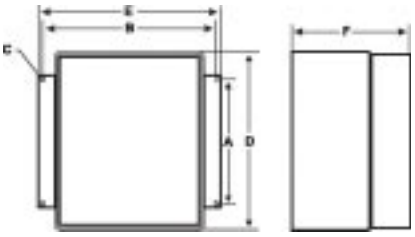


Figure 2 - 2B
NEMA 4/4x Dimensions

Enclosure	Dim. Ref. #	Mounting Dim.			Overall Dimensions		
		D	E	F	G	H	I
NEMA 1	1	5.9	3.8	0.2	6.4	4.2	5.3
	2	6.9	5.4	0.2	7.3	5.9	6
	3	8.1	6.9	0.2	8.5	7.3	6.5
	4	11.3	7.3	0.2	11.9	7.8	7.8
	5	15.2	9.3	0.3	15.8	9.9	9.5
NEMA 4/4X	6	8.9	7.1	0.21	9.5	7.9	5.7
	7	10.8	8.3	0.21	11.8	9.1	8.4
	8	9	8.4	0.28	12	9	9
	9	12	11	0.28	15.7	12.2	10
	10	16.3	10.2	0.21	16.9	12.3	10.6
	11	22	22.3	0.28	24	24.3	12.3

	Model Number	Max HP CT/VT	Rated Amps CT/VT	KW	NEMA 1 Dim. Ref. #	NEMA 4/4X Dim. Ref. #
200V Class (200 - 230V)	**CSD-2P5***	0.5	3.1	0.4	1	6
	CSD-201*	1	4.5	0.75	1	6
	CSD-202*	2	7.5	1.5	2	8
	CSD-203*	3	10.5	2.2	3	8
	CSD-205	5	17.5	3.7	3	9
	CSD-207	7.5	26	5.5	4	9
	CSD-210	10	35	7.5	4	10
	CSD-215	15/20	49/55	11	5	11
	CSD-220	20/25	64/72	15	5	11
	CSD-230	30/40	87/98	22	5	11

	Model Number	Max HP CT/VT	Rated Amps CT/VT	KW	NEMA 1 Dim. Ref. #	NEMA 4/4X Dim. Ref. #
400V Class (380 - 460V)	**CSD-401**	1	2.3	0.75	2	7
	CSD-402	2	3.8	1.5	2	7
	CSD-403	3	5.2	2.2	3	8
	CSD-405	5	8.8	3.7	3	9
	CSD-407	7.5	13	5.5	4	10
	CSD-410	10	17.5	7.5	4	10
	CSD-415	15/20	25/28	11	5	11
	CSD-420	20/25	32/36	15	5	11
	CSD-430	30/40	48/54	22	5	11

*These models accept single phase input (200/230V) without derating.

Table 2B - Dimensions

2.3 Specifications

Model	HP	Rated Motor (KW)	Rated Current (A)	Rated Output (KVA)	Input Voltage	Output Voltage
CSD-2P5*	0.5	0.4	3.1	1.2	1 or 3 Phase 200-230V ±10% 50/60 Hz ±5%	3 Phase 200-230V
CSD-201*	1	0.75	4.5	1.7		
CSD-202*	2	1.5	7.5	2.9		
CSD-203*	3	2.2	10.5	4.0		
CSD-205	5	3.7	17.5	6.7		
CSD-207	7.5	5.5	26	9.9		
CSD-210	10	7.5	35	13.3		
CSD-215	15	11	49	18.7		
CSD-220	20	15	64	24.4		
CSD-230	30	22	87	33.2		
CSD-401	1	.75	2.3	1.7	3 Phase 380-460V ±10% 50/60 Hz ±5%	3 Phase 380-460V
CSD-402	2	1.5	3.8	2.9		
CSD-403	3	2.2	5.2	4.0		
CSD-405	5	3.7	8.8	6.7		
CSD-407	7.5	5.5	13	9.9		
CSD-410	10	7.5	17.5	13.3		
CSD-415	15	11	25	19.1		
CSD-420	20	15	32	24.4		
CSD-430	30	22	48	36.6		

** These models accept single phase input (200-230V) without derating.*

Table 2 C - Specifications

Control Characteristics	Carrier Frequency		1 - 12 KHz
	Frequency Control Range		0.1 - 400 Hz
	Frequency Accuracy		Digital: 0.01% Analog: 0.4%
	Frequency Resolution		0.01 HZ with computer of PLC control, 0.1 Hz with keypad control with frequency above 100 Hz
	Frequency Setting Signal		0 - 5, 0 - 10V, 4 - 20mA, 10K Potentiometer Optional card: Bi-polar ± 5 or ±10 Vdc command available. (Specify bi-polar command signal range)
	Stall Prevention		Programmable between 30% - 200%
	ACCEL/DECEL Time		2 separate programmable ACCEL/DECEL times 0.1 - 3600 SEC with 2 S-curves Programmable DECEL or free run to stop
	Starting Torque		150% for up to 1 minute
	Braking Torque	200V & 400V Class	Standard braking torque = 20% 100% braking torque available with addition of optional resistors (plus braking transistors on units rated 15HP and above)
	V/f Pattern		18 patterns, one curve programmable
	Output Power Circuit		IGBT transistors in a sine-coded PWM (Pulse Width Modulated) firing scheme
Protection Functions	Instantaneous Overcurrent		Approximately 200% of unit rated current
	Overload Capacity of Drive		150% for 1 minute
	Motor Overload Protection		Programmable electronic thermal overload relay
	Overvoltage		200V Class: DC bus exceeds 427V 400V Class: DC bus exceeds 854V
	Undervoltage		200V Class: DC bus voltage drop < 200V 400V Class: DC bus voltage drop < 400V
	Momentary Power Loss		Programmable 0~2 seconds: unit can be restarted via speed search
	DC Bus Protection		Motor coast to stop at blown fuse
	Heat Sink Fin Overheat		Protected by thermister/thermostat
	Power Charge Indication		Via charge LED
	Ground Fault Protection	Start -up	Standard on all units
		Running	Standard on all units
Operation Conditions	Input Signal	Operation Signal	Forward/Reverse operation; individual command
		Multifunction Input Selection	Standard: 3 dry contact inputs only Optional: 120 Vac interface card
	Output Signal	Multifunction Output	1 output 35Vdc, 50mA maximum
		Fault Output	250 Vac 1A, 30 Vdc 1A maximum
	Built-in Functions		Frequency reference bias/gain, upper lower limit, auto/manual torque boos, frequency meter gain calibration, auto reset attempt, skip frequency, S-curve: ACCEL/DECEL, current limit, carrier frequency adjust (1 - 12 KHz), communication link function, energy saver, vibration control, 7 process timers
	Digital Operator Monitor		Frequency command, output frequency, output current, output voltage, P-N bus voltage, rotation direction, engineering units
	Analog Output Monitor		Analog output (0-10V), possible to select output frequency, setting frequency, output voltage and P-N bus voltage
Environmental Conditions	Enclosure		NEMA 1 (IP20) standard, NEMA 4 /4X also available (up to 10HP)
	Location and Altitude		Indoor (protected from gas and dust) 3,300 feet (without derating). Use in an enclosure with filtered forced ventilation, or if standalone, in a clean pollution-free environment
	Ambient Temperature		Enclosed: -10º C to 40º C (14º F to 104º F) Chassis: -10º C to 50º C (14º F to 122º F)
	Storage Temperature		-10º C to 50º C (14º F to 122º F)
	Humidity		0 - 95% non-condensing
	Vibration		0.5G
	EMC		EMC 89/336/EEC
Approvals	UL listed and Canadian UL (cUL) listed, CE Approved		

Chapter 3 - Wiring

This chapter deals with the recommended wiring practices for the ***CSD Series*** adjustable frequency drive. Please remember, you must always conform to the National Electrical Code (NEC) and any applicable local codes. Always make sure the keypad display is off, that the red Charge LED (LED 101) on the PC board is off, and the DC bus is discharged before adding or changing any wiring!

WARNING!
This section involves working with potentially lethal voltage levels! Caution must be used to prevent personal harm.

3.1 Main Power Wiring

Main power wiring precautions:
Remember, the following wiring guidelines are only suggestions. You must always conform to the NEC and your locally accepted wiring practices.

Model	Min. Power Wire Size	Max. Non-Delay Fuse (2)	Max. Delay Fuse (2)	Max. Delay Circuit Breaker (2)	Min. Ground Wire Size
CSD-2P5	14 AWG	10 A	10 A	10 A	14 AWG
CSD-201					
CSD-202		15 A	15 A	15 A	
CSD-203	12 AWG	20 A	20 A	20 A	12 AWG
CSD-205					
CSD-207	10 AWG	30 A	30 A	30 A	10 AWG
CSD-210	8 AWG	80 A	50 A	70 A	8 AWG
CSD-215	6 AWG	125 A	70 A	100 A	6 AWG
CSD-220	4 AWG	150 A	80 A	125 A	
CSD-230	2 AWG	225 A	125 A	200 A	4 AWG
CSD-401	14 AWG	10 A	10 A	10 A	14 AWG
CSD-402					
CSD-403		15 A	15 A	15 A	
CSD-405					
CSD-407	12 AWG	20A	20 A	20 A	12 AWG
CSD-410					
CSD-415	10 AWG	30 A	30 A	30 A	10 AWG
CSD-420	8 AWG	80 A	50 A	70 A	8 AWG
CSD-430	6 AWG	125 A	70 A	100 A	6 AWG

Table 3 A - Suggested Power Circuit Wiring and Components

***Note 1**: See NEC article 430 and NEC article 310 for sizing or branch circuit conductors.*
***Note 2**: See NEC article 430 part D for motor branch circuit, short circuit and ground fault protection sizing.*
***Note 3**: See NEC article 250 for sizing of ground conductors.*

- **NEVER CONNECT THE INPUT POWER WIRING TO DRIVE OUTPUT TERMINALS T1, T2, T3. IF YOU DO, THE UNIT WILL BE DAMAGED.**
- **DO NOT touch any circuit components while AC power is on or immediately after the main AC power is disconnected from the unit. You MUST wait for the LED on the control board to extinguish.**
- **DO NOT make any interconnection to the circuit before unit is disconnected from the AC power line and the power LED on the unit is extinguished. Failure to adhere to this warning could result in serious or lethal injury.**
- This unit is only intended for use in pollution degree 2 macro-environment or equivalent.
- Never use a MEGGER to check the motor wires while the drive is connected. The semiconductor output module will be destroyed by the high transient voltage.
- If the source feeding the drive is greater than 500 KVA you should install a three-phase, AC input line reactor to prevent possible damage to the input rectifier bridge (3% impedance, minimum).
- If the input voltage imbalance is greater than 2%, you should also apply an AC input line reactor (3% impedance, minimum).
- If you are using a single-phase input supply, be sure to connect the incoming power to terminals L1 and L2 of the drive.
- Make sure there are no power factor correction capacitors connected directly to the input or on the output leads of the drive.
- To comply with NEC requirements for branch circuit protection you may need an externally fused disconnect.
- Recommended values for input wiring are also given in Table 3 A. For 230 V units be sure to use wire rated for 300 volts; for 460 V.
- Always use UL/CSA approved wire and listed field wiring lug kits or listed ring terminals.
- Physically separate power and control wiring. If they must cross, do so at 90 degree angles.
- Never install Start/Stop Magnetic Contactor (MC) between drive output terminals and motor. The transient de-energizing surge of the magnetic contactor will destroy the unit or cause the drive to trip.
- Never use a Start/Stop Magnetic Contactor (MC) on the line side of the drive to Start/Stop the drive.
- Use shielded cable for all control wiring connections to the TM2 terminal block. Ground the shield at the other end of the cable (not to the drive).
- Use copper conductors only, size field wiring based on 75° C wire only.
- Follow the Table 3 B for suitable supply circuits on specific drives. (Information based on UL 508 table 47.2, February 23, 1993.)

Model	Max Voltage	Max Supply Short Circuit Rating (Symmetrical Amperes)
CSD-2P5 to CSD-201	230V	1000
CSD-202 to 230	230V	5000
CSD-401	460V	1000
CSD-402 to 430	460V	5000

Table 3 B - Suitable Supply Circuits

3.2 Grounding

Always be sure to make a positive ground connection to the Earth terminal of the drive. This is necessary for both protection of personnel and for reliable, trouble free operation. Following are additional guidelines for proper grounding:

- See Table 3 A for minimum ground wire size.
- Resistance to ground should be 100 ohms or less.
- Never ground the drive with welding or other high current machines.
- When several units are used together they should all be grounded to a common pole. Alternatively, connecting all of the Earth (E) terminals together and running a single wire to the ground pole is acceptable. **Be sure you do not form a ground loop with the ground wires.**
- Wire must be class 1 wire with a voltage rating minimum of 300V for 230 VAC systems and 600V for 460 VAC systems.
- Control wiring should not be run in the same conduit or raceway with power or motor wiring.

3.3 Power Connection Diagram

Note: In single phase input applications, connect the AC power source to L1 and L2.

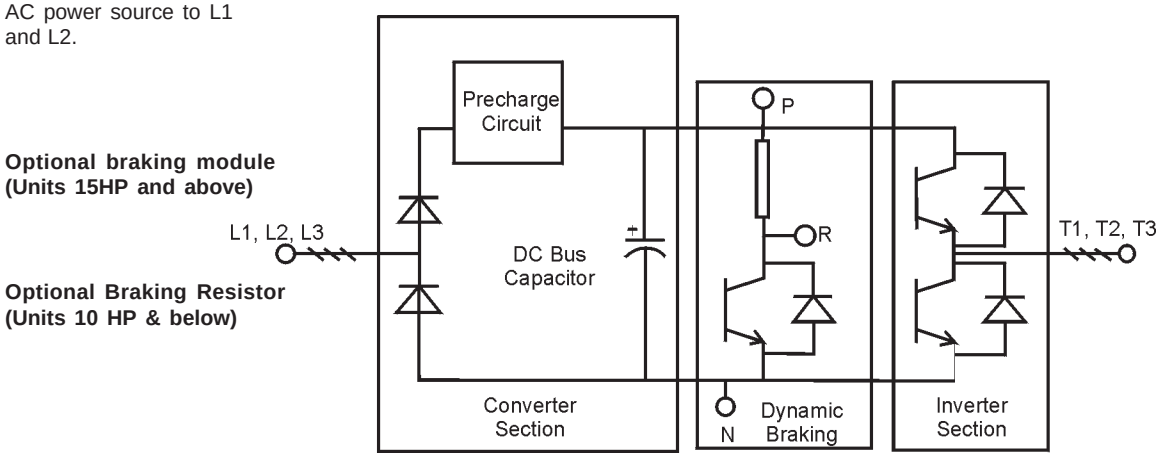
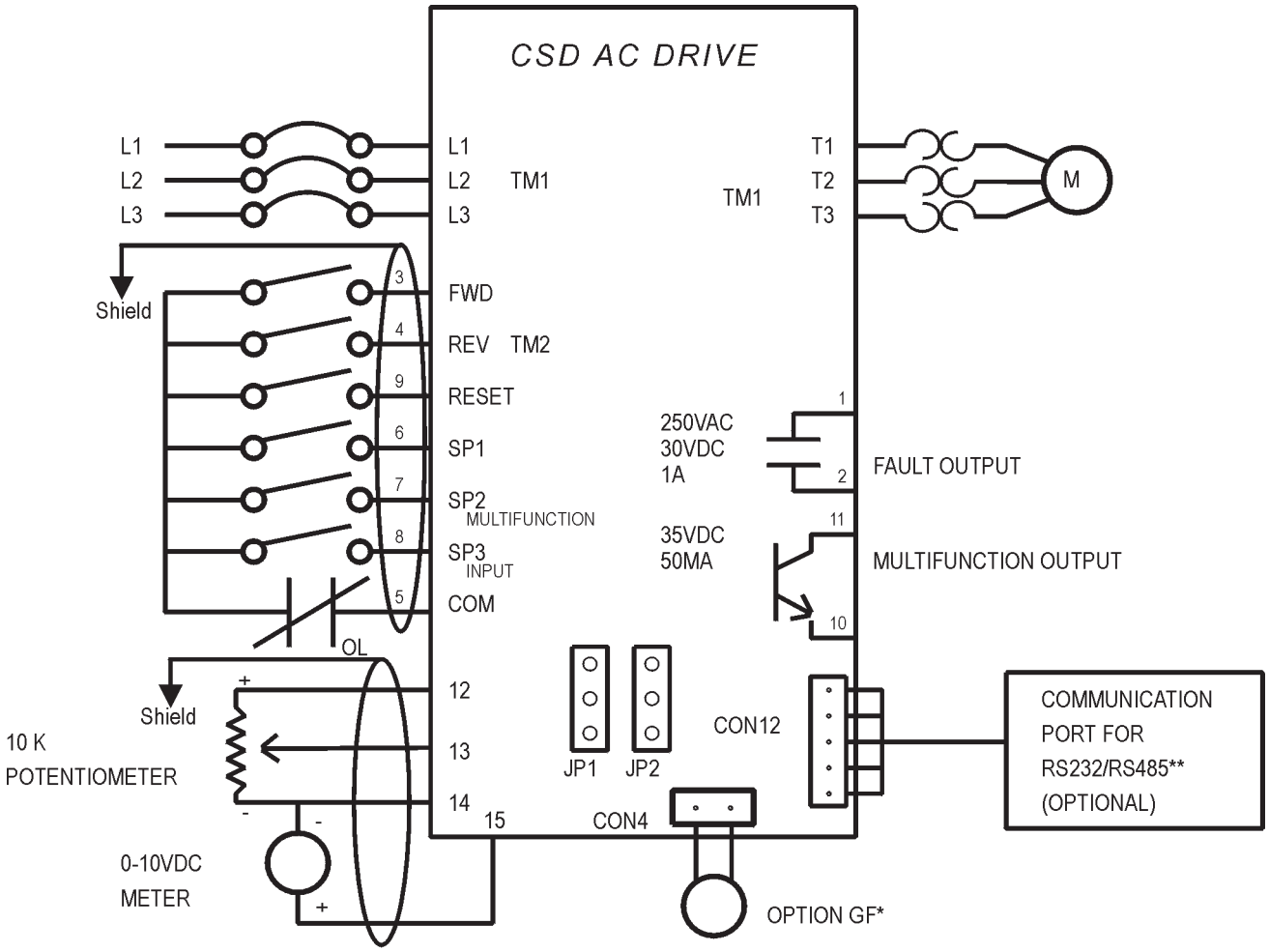


Figure 3 - 1
Power Wiring Diagram

Motor Overload Protection

Motors should have external thermal overload protection. Due to the characteristics of variable frequency drive applications, the best thermal protection for the motor is using a thermostat imbedded in the stator of the motor and interlocking this contact in the drive's control logic.

3.4 Control Terminal Function



0-5VDC OR POT JUMPER JP1-PINS 1 & 2

0-10VDC JUMPER JP2 PINS 2 & 3

4-20 mA JUMPER JP1 PINS 2 & 3

* Ground fault on start is standard on all models. Running ground fault is optional except on 230V≥5HP, 460V ≥7HP

**Jumper Con 12 Pins 1 and 2 when communication is not used.

Figure 3 - 2
Control Terminal Function

3.5 Brake Motor Magnetic Contactor

The ***CSD Series*** generates a variable voltage output. For this reason, when using a brake motor with the drive, the brake power supply must be connected directly to the AC line power. **DO NOT** take the power from the drive output. A suitable surge absorber should be installed across the brake coil to prevent transient surge when the coil is de-energized. See wiring diagram (Fig. 3 - 3) for possible brake coil connections. See section 3.5.1 for suggested values of snubber components.

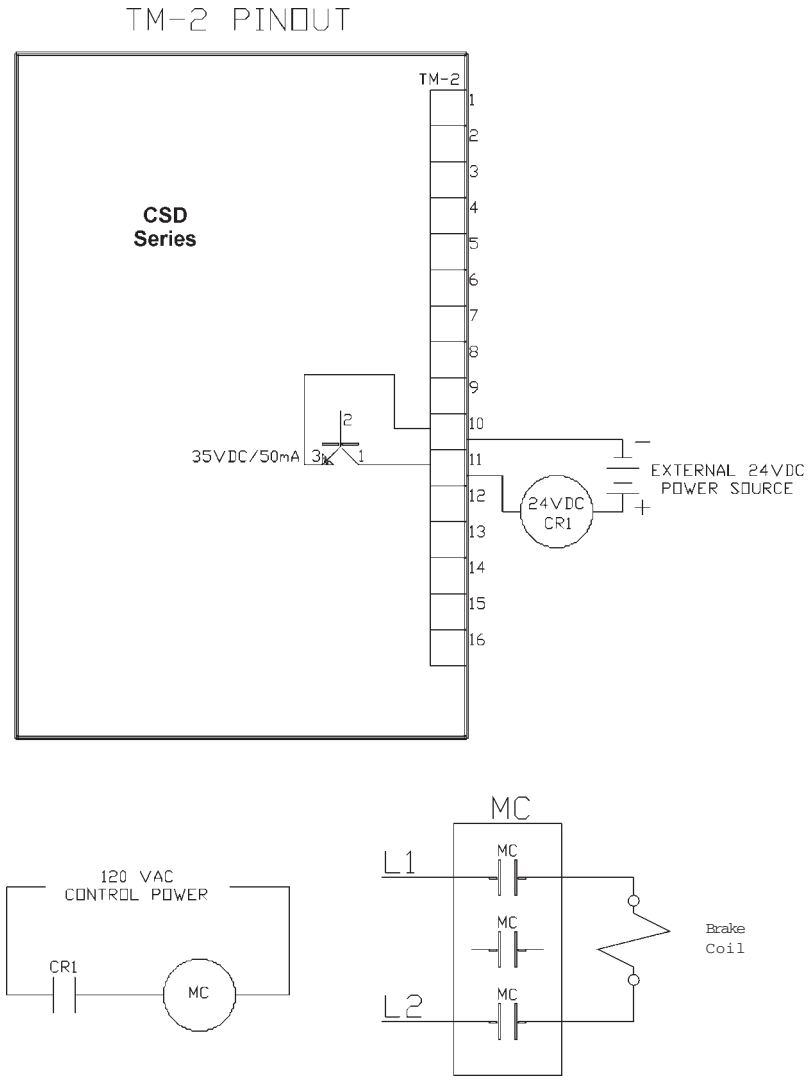


Figure 3 - 3
Brake Coil Connections

3.5.1 Coil Surge Suppression Wiring

Coils can cause EMI (Electromagnetic interference). To minimize EMI, Motortronics recommends that all coils be installed with surge suppression components. For AC coil brakes, use an R-C snubber type suppressor. For DC Coil Brakes use a diode type suppressor (See Table 3 C and Figure 3 - 4 for details).

Typical Components
AC Snubber Ratings

	R	C
120 VAC Relays	150 Ω 2W	0.47 μ F 300 VDC
220 VAC Contactors	150 Ω 5W	0.47 μ F 500 VDC
440 VAC Contactors	220 Ω 5W	0.47 μ F 1000 VDC

Table 3 C

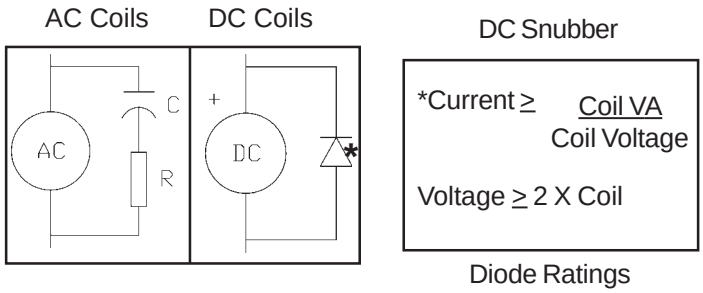


Figure 3 - 4

3.6 Line Reactors

- Source KVA must be limited to less than 500 KVA to protect against premature rectifier assembly failure. If source KVA exceeds 500 KVA, installation of appropriate reactor is required. If multiple drives are used, installation of individual reactors is not required (one reactor capable of combined amperage is acceptable).

Model Number	Part Number	Current (Amps)	Inductance (mH)
CSD-2P5, 201	10-RL-00402	4	6
CSD -202	10-RL-00802	8	3
CSD-203	10-RL-01202	12	2.5
CSD-205	10-RL-01802	18	1.5
CSD-207	10-RL-02502	25	1.2
CSD-210	10-RL-03502	35	0.8
CSD-215	10-RL-04502	45	0.7
CSD-220	10-RL-05502	55	0.5
CSD-230	10-RL-08002	80	0.4
CSD-401	10-RL-00202	2	20
CSD-402, 403	10-RL-00403	4	9
CSD-405	10-RL-00803	8	5
CSD-407	10-RL-01203	12	4.2
CSD-410	10-RL-01803	18	2.5
CSD-415	10-RL-02503	25	2.0
CSD-420	10-RL-03503	35	1.2
CSD-430	10-RL-04503	45	1.2

Table 3 D - Suggested Line Reactor Values

3.6.1 Initial Power Up

- For initial test run procedure, see Chapter 7.
- For initial start-up procedure, see Chapter 6.

3.7 External Brake Resistor Ratings

Standard braking torque for all models is 20%. For 100% braking torque external braking transistors, resistors and/or a braking module may need to be added. (See chart below)

External Brake Resistor Values				
Model Number	**Resistor Part Number**	**Resistance (ohms)**	**Watts**	**Brake Transistor module**
CSD-2P5	BRSD-21	200	60	N/A
CSD-201	BRSD-21	200	60	
CSD-202	BRSD-22	100	150	
CSD-203	BRSD-23	70	200	
CSD-205	BRSD-25	40	300	
CSD-207	BRSD-27	25	500	
CSD-210	BRSD-210	20	600	
CSD-215	RK1	13.6	800	DBM-100-230
CSD-220	RK2	10	900	
CSD-230	RK3	8	1200	
CSD-401	BRSD-41	750	60	N/A
CSD-402	BRSD-42	400	150	
CSD-403	BRSD-43	250	200	
CSD-405	BRSD-44	150	300	
CSD-407	BRSD-48	100	500	
CSD-410	BRSD-410	80	600	
CSD-415	RK4	75	800	DBM-50-460
CSD-420	RK5	50	1200	
CSD-430	RK6	32	1600	

Table 3 E - External Brake Resistor Ratings

3.8 Power Terminal Block (TM1) Description

The control part of the ***CSD Series*** drive is the TM1 or Power Terminal Block (the large terminal block on the bottom PC board). Listed in Table 3 F are the function descriptions of TM1. The symbols in parentheses are the European equivalent codes.

Symbol	Function Description
L1 (R)	Input terminals of AC line power:
L2 (S)	Single Phase: L1/L2 (L1/L3 for CSD-230)
L3 (T)	Three Phase: L1/L2/L3
N	External braking unit terminals
P	External braking resistor terminals
R	
T1 (U)	Output terminals
T2 (V)	
T3 (W)	
P1, P	External DC reactor terminals

Table 3 F - TM1 Descriptions

Model Number	TM1 Layout
CSD-2P5	1
CSD-201	
CSD-202	
CSD-203	
CSD-205	
CSD-207	
CSD-210	
CSD-215	2
CSD-220	3
CSD-230	4
CSD-401	1
CSD-402	
CSD-403	
CSD-405	
CSD-407	
CSD-410	
CSD-415	3
CSD-420	
CSD-430	

Table 3 G - TM1 Layout

Model #	TM1 Torque Specs	TM2 Torque Specs
CSD-2P5	12 LB-IN	7 LB-IN
CSD-201		
CSD-202	16 LB-IN	
CSD-203	13.8 LB-IN	
CSD-205		
CSD-207		
CSD-210		
CSD-215	22.1 LB-IN	
CSD-220		
CSD-230		
CSD-401	16 LB-IN	
CSD-402		
CSD-403	13.8 LB-IN	
CSD-405		
CSD-407		
CSD-410		
CSD-415	22.1 LB-IN	
CSD-420		
CSD-430		

Table 3 H - TM Torque Specs

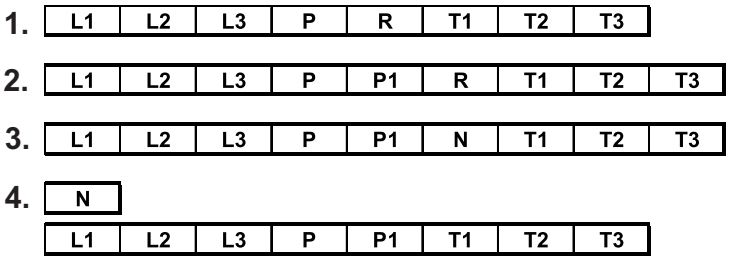


Figure 3 - 5
TM1 Terminal Block
See Table 3 G for the terminal block configuration in your unit.

Follow the above diagram when wiring your CSD Series drive. Also:

- Never connect the input power wiring to the drive terminals T1, T2, T3, P, or R. The drive will fail.
- Always use UL/CSA approved wiring and lugs.
- Always make a positive ground termination to the Earth terminal of the drive.
- The P & R terminals are for resistor attachment only. If you connect power to these points, the drive will fail.

Chapter 4 - Remote Control

This section reviews the external controls and the speed potentiometer on the keypad. If you are using the keypad (without the speed potentiometer) you do not need to review this section.

4.1 Control Terminal Block (TM2) Function Description

The control terminal block (TM2) is the block on the top PC board. The following diagram illustrates the physical representation of the terminal block (TM2) and the available connections when you open the cover of the CSD enclosure. Connections 3-9 are dry contacts only. Dry contact control wire connections must be less than 10 feet in length. Motortronics recommends using shielded cable or twisted pairs. Note TM2 torque specs is 7IN-LB.

As you finish each connection, complete the accompanying programming. Carefully review all diagrams and programming details so the connections are made correctly.

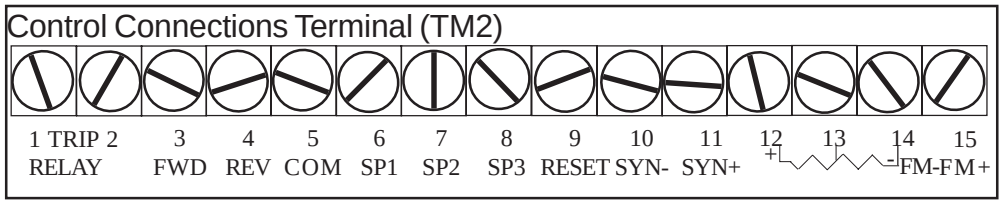


Figure 4 - 1
TM2 Terminal Block

Wiring of control circuits (TM2) and power circuits (TM1) must comply with the separation of circuits requirements so that there is a physical spacing between conductors of different circuits. The class 2 circuits and limited voltage/ current circuits of TM2 are to be connected with wires suitable for connection to the class 1 circuits or line voltage terminals of TM1. Use the two lower holes in the end plate for wiring to the class 1 circuits of TM1. Use a separate hole in the end plate for wiring to the class 2 circuit of TM2.

Symbol		Function / Description
1	Trip Relay	Fault relay output terminals: (refer to Fn97, 98) Contact rating: 250 VAC/1A (30VDC/1A)
2		
3	FWD	Operation control terminals (refer to Fn03 & Fn10)
4	REV	
5	COM	Ground common for terminals 3,4,6,7,8,9
6	SP1	Multi function input terminals (refer to Fn56 - Fn58)
7	SP2	
8	SP3	
9	RESET	Reset terminals (refer to Fn 16)
10	SYN-	Negative terminal for multifunction output (Fn61) Contact Rating: 35 VDC, 50mA
11	SYN+	Positive terminal for multifunction output (Fn61) Contact Rating: 35 VDC, 50mA
12	+	+5V power terminal for potentiometer (Pin 3)
13		Analog Input: Analog frequency signal imput terminal (Fn26 - Fn28) (Pin 2 of potentiometer or positive terminal of 0-5VDC, 0-10VDC, 4-20mA)
14	FM-	Analog Common: common terminal for analog frequency (Pin 1 of potentiometer or negative terminal of 0-5VDC, 0-10VDC, 4-20mA
15	FM+	Analog Output (+): Multifunction output terminal (refer to Fn46) Range of output signal: 0-10VDC

Table 4 A - Terminal TM2 Connection Descriptions

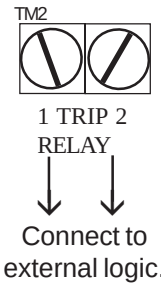
4.1.1 Terminals 1 & 2

Function: Fault/Trip Relay

Relay Contact to output alarm signal when protective circuit is activated.
Contact Rating: 250 VAC/1 Amp or 30 VDC/1 Amp
Refer to Fn 97 - Fn98 for programming the functionality of the fault relay.

This allows remote indication of an drive trip condition and sends this signal, depending on Fn98, to external logic. The keypad will flash a fault code and the contact on TM2 - 1 & 2 (rated at 1 Amp, 250VAC or 30VDC) will change state when the drive indicates a fault signal such as an over current (OC) or over voltage (OV).

Normally Open = Program Fn98 to 0000
Normally Closed = Program Fn98 to 0100.



NOTE: *With power removed from the drive, the contact is open regardless of programming.*

4.1.2 Terminals 3 & 4

Function: (RUN/STOP, FWD/REV), (FWD/STOP, REV/STOP) or Momentary START/STOP

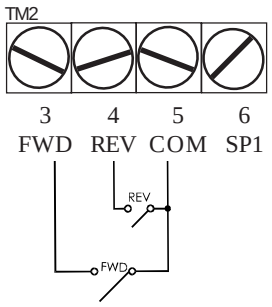
(effective only in remote control Fn10=0001) **as well as Reverse lockout and Initial Frequency Operation** .

The drive offers three methods of remote operation. This unique function allows the use of either (run/stop, forward/reverse), (forward/stop, reverse/stop) or momentary start/stop operation to meet different application requirements. These three modes of operating are selected via Fn03.

On/Off Control (only applicable when Fn10 = 0001)**:** Depending on the type of control, use one of the three following configurations for on/off control. ***Note:*** *The length of the wire connections between TM2 and the switches should be less than ten feet. Use dry contacts only for connections. An optional 120 VAC interface card is available, contact factory for more information.*

4.1.2a Maintain FWD/STOP Switch and Maintain REV/Stop Switch

The diagrammed connections allow remote control to start/stop and change motor rotation with Maintain Switches. One switch will function as the forward run switch and the other will function as the reverse run switch. ***Note:*** *If reverse direction is not required, reverse switch is not necessary.*

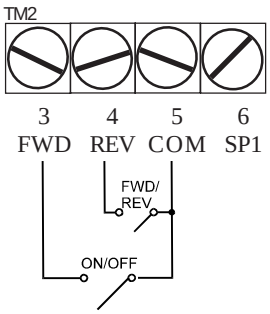


Program Fn10 to 0001
Program Fn03 to 0000

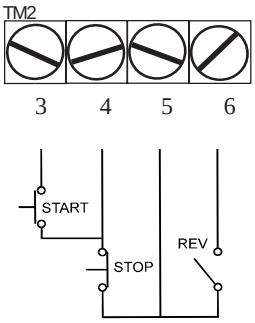
Note: *If the forward and reverse contacts are closed simultaneously, the drive will shut off.*

4.1.2b Maintain ON/OFF Switch and Maintain FWD/REV Switch

The diagrammed connections allow remote control to start/stop and change motor direction with Maintain Switches. One switch will function as the on/off and the other switch will function as the forward/reverse switch. ***Note:*** *If reverse direction is not required, FWD/REV switch is not necessary.*



Program Fn10 to 0001
Program Fn03 to 0001



Program Fn10 to 0001
and Fn3 to 0010

Start = N.O. (Momentary)
Stop = N.C.(Momentary)
Rev. = Maintain Switch
(Closed)
Fwd. = Maintain Switch

4.1.2c Momentary Start/Stop Switches and Maintain FWD/REV Switch

The diagrammed connections allow remote control to momentarily start/stop and maintain the motor direction. A Momentary Normally Open (N.O.) switch is required for starting. A Momentary Normally Closed (N.C.) switch is required for stopping. A Maintain Switch must be used for forward/reverse motor control. ***Note:*** *If reverse is not required, the Maintain switch is not necessary.*

4.1.2d Reverse Lockout

Allows or prohibits the drive to run in the reverse direction.
Fn03 = X0XX: Reverse is allowed
X1XX: Reverse is prohibited

4.1.3 Terminals 5 & 10

Function: Ground Common

Terminal 5 is the ground common for terminals 3 through 9.
Terminal 10 is the ground common for terminal 11 only.

4.1.4 Terminals 6, 7 & 8

Function: Multifunction Terminals (factory set at preset speeds). When programmed as preset speed contacts, the drive allows the user to select up to seven speed points. The frequency (speed) of each point is set via the digital operator interface. Multispeed control is described below.

Set multiple speeds as required. If seven speeds or less are required, set the speed parameters on Speeds 1 to 7. (See Table 4 B). These terminals also serve other functions such as jog, second accel/decel time selection, emergency stop, base block, speed search, energy savings mode enable/disable, control signal source selection, computer communication control enable/disable, accel/decel prohibit, raise or lower command, sequence control & speed, and control source selection. See Fn 56 - Fn58 for details on other uses of the multifunction digital input contacts.

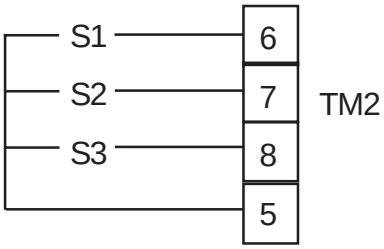


Figure 4 - 2
Speed Switch Connections

Switch #			Speed	Description
SP3	*SP2*	*SP1*		
0	0	1	Speed 1	Frequency output increases to Hz of Fn 17 and continues to run at constant Hz.
0	1	0	Speed 2	Frequency output increases to Hz of Fn 18 and continues to run at constant Hz.
0	1	1	Speed 3	Frequency output increases to Hz of Fn 19 and continues to run at constant Hz.
1	0	0	Speed 4	Frequency output increases to Hz of Fn 20 and continues to run at constant Hz.
1	0	1	Speed 5	Frequency output increases to Hz of Fn 21 and continues to run at constant Hz.
1	1	0	Speed 6	Frequency output increases to Hz of Fn 22 and continues to run at constant Hz.
1	1	1	Speed 7	Frequency output increases to Hz of Fn 23 and continues to run at constant Hz.
0	0	0	Speed 8	Frequency output increased to Hz set by Fn11 control mode.

1 = Closed
0 = Open

Table 4 B - Speed Switch

4.1.5 Terminal 11

Function: Multifunction Output (Contact rated for 50mA at 35VDC maximum)

This terminal is used for the drive's programmable function, open-collector output. This output can serve any of three purposes, depending upon the value programmed into Fn61:

Fn61 = 00 - 05: transistor is normally *off*.

06 - 11: transistor is normally *on*.

a. 00/06: "Run" mode output. The open collector transistor will be turned on (terminal #11 pulled low) while the drive is running.

b. 01/07: Up to desired frequency mode output. The transistor is turned on, pulling terminal #11 low while the output frequency matches the frequency reference command.

c. 02/08: "Bandwidth" mode output. The transistor is turned on when the output frequency is in agreement with the value programmed in Fn08 $\pm$ the value programmed in Fn09.

d. 03/09: Frequency detection greater than mode output. The transistor is turned on when output frequency>than the value programmed into Fn08.

e. 04/10: Frequency detection less than mode output. The transistor is turned on when the output frequency is < the value programmed into Fn08.

f. 05/11: Over torque detection mode output. The transistor is turned on when the drive detects an over torque condition.

4.1.6 Terminal 9

Function: Reset

The drive can be reset from fault condition by connecting terminal 9 to ground common (terminal 5). Reset is effective in both remote control (Fn10=1) and digital operation control (Fn10=0).

4.1.7 Terminal 14

Function: Common for terminals 12, 13 & 15.

Negative terminal of 10K ohm frequency command potentiometer or positive terminal of 0-10V, 0-5V, 4-20 mA analog signal command negative terminal. Also, negative terminal for frequency meter connected to Pin 15.

4.1.8 Terminals 12 & 13

Function: Remote Frequency Command

Terminal 12: Positive terminal of 10K ohm frequency command potentiometer.

Terminal 13: Wiper of 10K ohm frequency command potentiometer or 0-10V, 0-5V, 4-20mA analog signal command positive terminal.

4.1.9 Terminal 15

Function: Remote Frequency Meter Drive

Positive terminal of full scale moving coil 10VDC frequency meter at 1mA maximum.

4.2 Remote Analog Frequency Command Jumpers

Jumpers 1 and 2 can be used to select remote frequency command signal (See Figures 4 - 3 & 4 - 4).

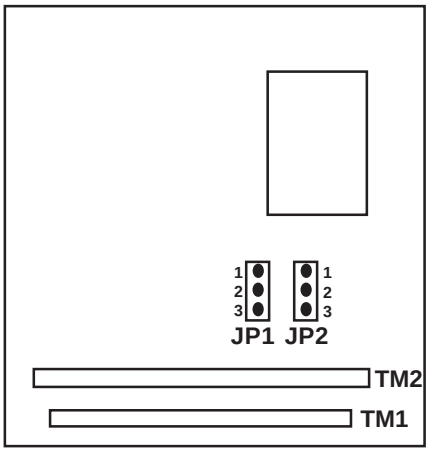
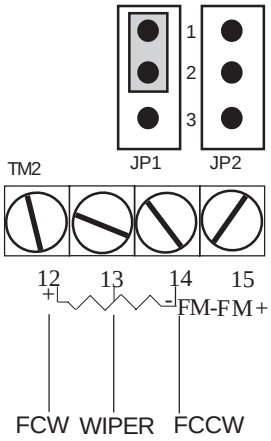


Figure 4 - 3
Jumper Locations

(JP1) Jumper 1	(JP2) Jumper 2	Remote Freq. Command Signal
1 2 3	1 2 3	0 - 5 VDC Analog Signal or 10k Ohm Potentiometer - (Factory Default)
1 2 3	1 2 3	4 - 20 mA Analog Signal
1 2 3	1 2 3	0 - 10 VDC Analog Signal
1 2 3	1 2 3	Not Used

Figure 4 - 4
Function of Jumpers

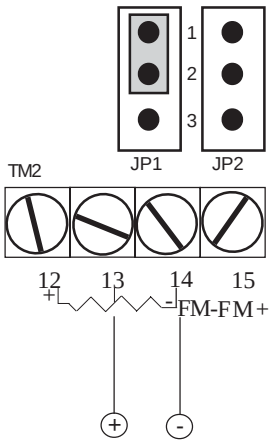


Program Fn11 to 0002

4.2.1 Remote Potentiometer Control

This allows motor speed control from a remote potentiometer. Use a 10k ohm, 2 watt linear taper potentiometer connected as shown.

Connect the FCW* of the potentiometer to TM2-12, the potentiometer wiper to TM2-13 and the FCCW** of the potentiometer to TM2-14. Place shorting jumper on JP1 - pins 1 and 2 (as indicated by the gray area).
*Fully clockwise
**Fully counter clockwise



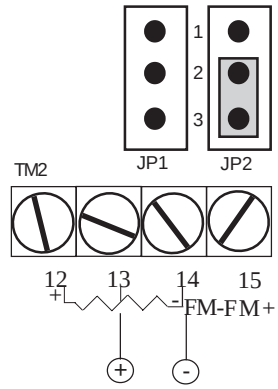
Program Fn11 to 0002

4.2.2 Remote 0-5 VDC Analog Control Signal

This allows motor speed control from a remote analog 5 VDC signal connected as shown.

Connect the positive lead of the signal to TM2-13 and the negative lead of the control signal to TM2-14. Place shorting jumper on pins 1 and 2 of JP1 (as indicated by the gray area).

4.2.3 Remote 0-10VDC Analog Control Signal

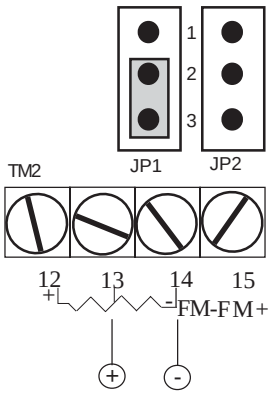


Program Fn11 to 0002

This allows motor speed control from a remote analog 10VDC signal connected as shown.

Connect the positive lead of the control signal to TM2-13 and the negative lead of the control signal to TM2-14. Place shorting jumper on pins 2 and 3 of JP2 (as indicated by the gray area).

4.2.4 Remote 4-20mA Analog Control Signal



Program Fn11 to 0002

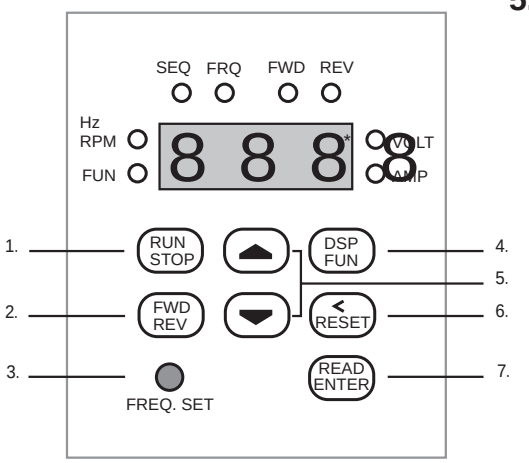
This allows motor speed control from a remote analog 20mA signal connected as shown.

Connect the positive lead of the control signal to TM2-13 and the negative lead of the control signal to TM2-14. Place shorting jumper on pins 2 and 3 of JP1 (as indicated by the gray area).

Chapter 5 - Digital Operator Control/Keypad Operation

5.1 Introduction

This chapter explains the command keys, LED Display, flashing lights and shows how easy the ***CSD Series*** is to program.



* The numerical display will blink in stop mode

Figure 5 - 1
Keypad Display

LED	The LED is on when ...
FUN	Programming functions
Hz/RPM	Output displays is in Hertz or RPM
SEQ	Remote start/stop is selected
FRQ	Remote speed control is selected
FWD	Forward direction is selected
REV	Reverse direction is selected
VOLT	Output display is in volts
AMP	Output display is in amps

Table 5 A - LED Description

LEDs
The chart above describes the meaning of illuminated LEDs
(For location, see Figure 5 - 1).

Easy Programming
The **CSD Series** has two basic programming loops:
Operation Loop - changes frequency to increase/decrease motor speed.
Programming Loop - changes function settings.

Command Keys

1. RUN/STOP - With keypad control, this starts and stops the motor.
2. FWD/REV - With keypad control, this controls the direction of motor shaft rotation.
3. FREQ. SET - Potentiometer used to control motor speed. (See section 5.3, Fn11)
4. DSP/FUN - Used to show either operating display or functions.
5. UP/DOWN - Changes the numeric display to higher or lower setting.
6. SHIFT LEFT/RESET - This is a digit selection key. Using shift/left arrow moves flashing LED to the left for faster numeric parameter change. Use reset if the drive has tripped. Pushing this key will reset the faults if the fault condition has been cleared.
7. READ/ENTER - Allows you to read the function data or to enter new function settings.

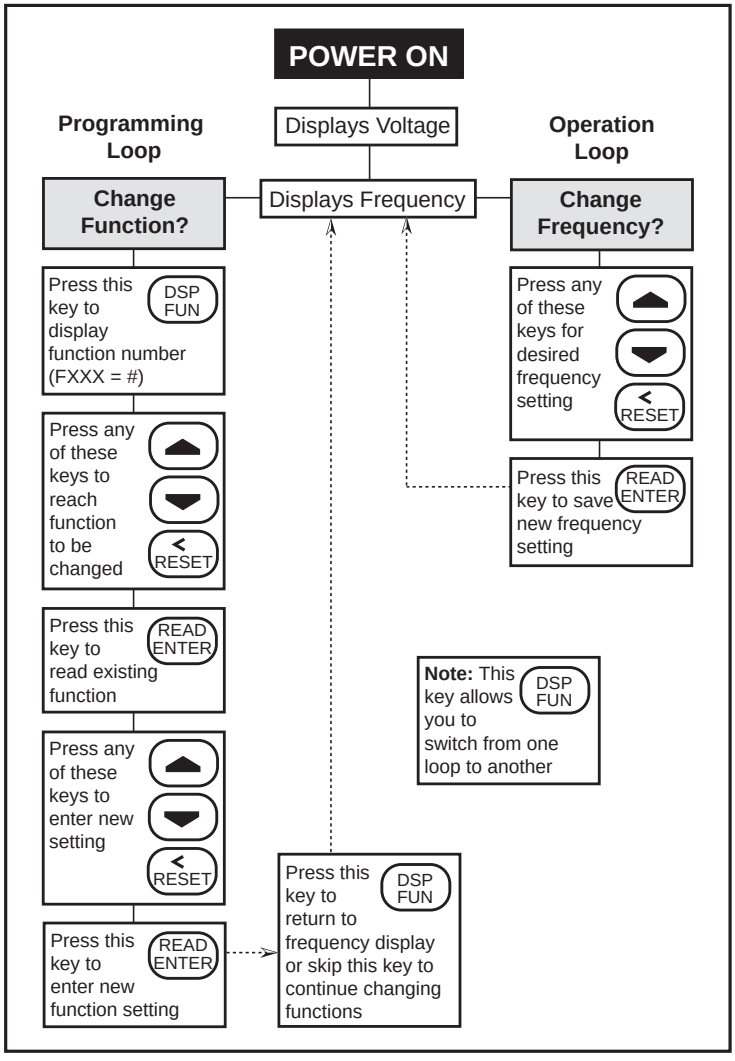


Figure 5 - 2
Programming Loops

5.1.1 The CSD Function List

The following list includes the basic information on each function within the CSD. For detailed function information, review the referenced page. Also, the Function Notes, in and at the end of this section, are for any additional operator notes.

Fn XX	Function	Page	Description	Set Unit	Range	Factory Setting	Remark
00	Capacity	29	Capacitor Selection	1	N/A		*3
01	Accel/Decel time	29	Accel time 1	0.1 sec	0.1-3600 sec	10 sec	*1 *4
02			Decel time 1				
03	Remote Operation Select/ Rev. Lockout/ Initial Frequency	30	XX00: FWD/STOP, REV/STOP XX01: FWD/REV, RUN/STOP XX10: 3 Wire Control Mode X0XX: REV Command Enable 01XX: REV Command Disable 0XXX: Drive remembers last speed 1XXX: Drive always starts at minimum speed			0000	
04	Parameter Lock Select	31	XXX1: Enable (Fn17-25) XXX0: Disable (Fn17-25) XX1X: Enable (Functions except Fn17-25) XX0X: Disable (Functions except Fn17-25)			0000	
05	V/f Pattern	31	V/f Pattern Selected	1	0-18	9	*3
06	Freq. Limit	32	Frequency Output Upper Limit	0.01 Hz	0-400 Hz	60	*3
07			Frequency Output Lower Limit			0 Hz	
08	Speed Agreed Detection	32	Up to desired frequency setting	0.01 Hz	0-400Hz	0 Hz	
09			Up to frequency setting detection width/2		0-30 Hz		
10	Control Mode Select	32	0: Digital Operator Control 1: Remote Control			0	
11	Frequency Command Method Select	32	0: Run by Fn25 1: Run by POT on digital operator 2: Run by POT on TM2 (terminals 12-14) or analog signal 3: Run by multifunction input frequency command (terminals 6-8)			0	
12	Stall Prevention	33	XXX0: Stall prevention during accel enabled XXX1: Stall prevention during accel disabled XX0X: Stall prevention during decel enabled XX1X: Stall prevention during decel disabled X0XX: Stall prevention during running enabled X1XX: Stall prevention during running disabled 0XXX: Stall prevention decel time set by Fn02 1XXX: Stall prevention decel time set by Fn15			0000	
13		34	Stall prevention startng level during accel	1%	30-200%	110%	

Table 5 B - CSD Function List

Fn XX	Function	Page	Description	Set Unit	Range	Factory Setting	Remark
14	Stall Prevention	34	Stall prevention during run	1%	30-200%	160%	
15			Decel time during stall prevention	0.1 sec	0.1-3600 sec	3 sec	1*
16	Direct Start and Reset	34	XXX0: Direct start enable when remote RUN command ON XXX1: Direct start disable when remote RUN command ON XX0X: Reset effective only if remote RUN command OFF XX1X: Reset effective regardless of remote RUN command condition			0000	
17	Multispeed & Timer Control	35	Multispeed 1	0.01 Hz	0-400 Hz	5.00 Hz	1*
18			Multispeed 2			10.00 Hz	1*
19			Multispeed 3			20.00 Hz	1*
20			Multispeed 4			30.00 Hz	1*
21			Multispeed 5			40.00 Hz	1*
22			Multispeed 6			50.00 Hz	1*
23			Multispeed 7			60.00 Hz	1*
24		36	Jog Frequency Reference			2.00 Hz	1*
25	Master Frequency	36	Master frequency reference from digital operator	0.01 Hz	0-400 Hz	5.00 Hz	*1
26	Analog Input Frequency Command	36	Frequency reference	0.01 Hz	0-400 Hz	0 Hz	*1
27			Voltage reference ratio 1	0.1%	0-100.0%	0%	*1
28			Voltage reference ratio 2		0-999.9%	100%	*1
29			Positive/Negative direction	1	0: Positive 1: Negative	0	*1
30	Power Voltage	37	Voltage of power supply	0.1V	185-575 V		*3
31	Momentary Power Loss	37	Momentary power loss ride through time	0.1	0-2 sec	0.5 sec	
32			XXX0: Disabled XXX1: Enabled			0	
33	Analog Input Signal Scan Times	37	TM2 Pin13 (A/D) scan time	1	1-100	100	Unit = 2mS
34	Auto Restart	37	Auto restart interval	0.1 sec	0-800 sec	0 sec	
35			Number of auto restart attempts	1	0 - 10	0	
36	Motor Poles	37	Number of motor poles	2 Poles	2-8 Poles	4 Poles	
37	V/f Pattern	38	Maximum frequency	0.01 Hz	50-400 Hz	60 Hz	
38			Maximum voltage ratio	0.1%	0-100%	100%	
39			Mid frequency	0.01 Hz	0.11-400 Hz	3.0 Hz	
40			Mid voltage ratio	0.1%	0-100%	7.5%	
41			Voltage ratio at 0.1 Hz				
42	Start Frequency	38	Start frequency adjustment	0.01 Hz	0.1-10 Hz	1 Hz	

Notes:

**1: Settings can be changed during run mode*

**2: Settings cannot be changed in communication mode*

**3: Settings will not change when returning to factory defaults.*

**4: SETTINGS RANGE: The settings of accel/decel time and frequency are only four digits when set by keypad (for example: 3599 sec/399.9 Hz), but 5 digits (for example: 3599.9 sec or 399.99 Hz) when controlled by programmable controller (PLC) or computer in communication mode.*

Fn XX	Function	Page	Description	Set Unit	Range	Factory Setting	Remark
43	Carrier Freq.	38	Carrier Frequency Adjustment	1	0-15	14	
44	Stopping Mode and Braking Resistor Protection	39	XXX0: Decel to stop XXX1: Free run to stop XX0X: Braking resistor overheat protection disabled XX1X: Braking resistor overheat protection enabled			0000	
45	Multifunction Analog Output Selection (terminals 15 and 16)	393	Gain of multifunction analog	1%	0-200%	100%	*1
46			0: Output frequency (Fn06 max.) 1: Set frequency (Fn06 max.) 2: Output voltage (VAC) 3: DC Voltage (Vpm)			0	*1
47	Display Mode	39	XXX0: Output voltage (VAC) diplay disabled XXX1: Output voltage (VAC) display enabled XX0X: DC Voltage display disabled XX1X: DC Voltage display enabled X0XX: Output current (Iac) display disabled X1XX: Ouput current (Iac) display enabled			0000	*1
48	Dynamic Braking and Priority of Stopping and Speed Search and AVR Control	39	XXX0: Enhanced braking capacity XXX1: Standard braking capacity XX0X: STOP key effective in remote control mode XX1X: STOP key ineffective in remote control mode X0XX: Speed search controlled by terminals on TM2 X1XX: Speed search effective when inverter starts 0XXX: AVR function effective 1XXX: AVR function ineffective			0000	
49	Accel/Decel Time 2	40	Accel Time 2	0.1 sec	0.1-3600 sec	10.0	*1, *4
50			Decel Time 2	0.1 sec	0.1-3600 sec	10.0	*1, *4
51	Display Mode	40	Display Mode Selection	1	0-5	0	*1
52			Line Speed Display	1	0-9999	1800	*1
53	DC Braking	41	DC Braking Time	0.1 sec	0-25.5	0.5 sec	
54			DC Braking injection frequency	0.1 Hz	0.1-10 Hz	1.5 Hz	
55			DC Braking Level	0.1%	0-20%	8%	
56	Multifunction Input	41	Multi-input 1 (terminal 6)	00: SP1 01: SP2 02: SP3 03: Jog 04: Accel/Decel Time 05: Emergency Stop 06: Base Block 07: Speed Search 08: Energy Saving Mode 09: Control Sig. Select 10: Command Control 11: Accel/Decel prohibit 12: Up contact		00	
57			Multi-input 2 (terminal 7)			01	

Notes:

**1: Settings can be changed during run mode*

**2: Settings cannot be changed in communication mode*

**3: Settings will not change when returning to factory defaults.*

**4: SETTINGS RANGE: The settings of accel/decel time and frequency are only four digits when set by keypad (for example: 3599 sec/399.9 Hz), but 5 digits (for example: 3599.9 sec or 399.99 Hz) when controlled by programmable controller (PLC) or computer in communication mode.*

Fn XX	Function	Page	Description	Set Unit	Range	Factory Setting	Remark
58	Multifunction Input	41	Multi-input 3 (terminal 8)	13: Down Contact 14: Sequence Control 15: Master/aux speed		02	
59		44	Reserved				
60		44	Reserved				
61	Multifunction output	44	Multi-output 1 (terminals 11 & 10)	00: Run mode 01: Up to desired Freq. 02: FOUT = Fn08±Fn09 03: FOUT > Fn08 04: FOUT < Fn08 05: Overtorque Protection		00	
62-63		45	Reserved				
64			Reserved				
65	Prohibit Frequency Control	45	Setting prohibited frequency 1	0.01 Hz	0-400 Hz	0 Hz	
66			Setting prohibited frequency 2	0.01 Hz	0-400 Hz	0 Hz	
67			Setting prohibited frequency 3	0.01 Hz	0-400 Hz	0 Hz	
68			Setting prohibited frequency range	0.01 Hz	0-10 Hz	0 Hz	
69	Electronic Thermal Protection	46	XXX0: Electronic thermal motor portection effective XXX1: Electronic thermal motor protection ineffective XX0X: Electronic thermal characteristics in accordance with standard motor XX1X: Electronic thermal characteristics in accordance with special motor X0XX: Drive OL protection: 103% continuous 150% for one minute X1XX: Drive OL protection: 113% continuous 123% for one minute 0XXX: Free run to stop after electronic thermal motor protection is energized 1XXX: Operation continued after electronic thermal motor protection is energized			0000	
70	Electronic Thermal Overload Reference Current	47	Motor rated current	0.1 A		Depend on motor spec.	
71			Drive Trip when OL detected & torque boost enable	00: Coast to stop after OL 01: Operation continued after OL		0000	
72	Torque Boost	47	Torque boost gain	0.1%	0.0-10.0%	0.0%	*1
73-74		47	Reserved				
75	Slip Comp.	47	Motor current without load				
76			Motor rated slip	0.01 Hz	0.00-6.00 Hz	0.00 Hz	*1

Fn XX	Function	Page	Description	Set Unit	Range	Factory Setting	Remark
77	Overtorque Control	48	XXX0: Overtorque detection disabled XXX1: Overtorque detection enabled XX0X: Enable only if at set frequency XX1X: Enable during operation X0XX: Operation continued after overtorque is detected X1XX: Free run to stop after overtorque is detected			0000	
78			Overtorque detection level	1%	30-200%	160%	
79			Overtorque detection time	0.1 sec	0-25 sec	0.1 sec	
80	S Curve	48	S curve time 1 during accel/decel time 1	0.1 sec	0-4 sec	0.2 sec	
81			S curve time 2 during accel/decel time 2			0.6 sec	
82	Energy Savings	49	XX00: Energy savings disabled XX01: Energy savings controlled by multi-input terminals only				
83			Energy savings gain	1%	0-100%	80%	*1
84	Sequence Control	49	XXX0: Process timer disabled XXX1: Process timer enabled XX0X: Set frequency output after process timer finishes counting XX1X: Zero speed output after process timer finishes			0000	
85			Process timer 1	0.1 sec	0-3600 sec	0 sec	
86			Process timer 2				
87			Process timer 3				
88			Process timer 4				
89			Process timer 5				
90			Process timer 6				
91			Process timer 7				
92	Vibration Control	50	Vibration control times	1	1-100	5	*1
93			Vibration control gain	0.1%	0-100%	0%	
94			Vibration control bias	1%	0-30%		
95		50	Reserved				
96			Reserved				

Notes:

**1: Settings can be changed during run mode*

**2: Settings cannot be changed in communication mode*

**3: Settings will not change when returning to factory defaults.*

**4: SETTINGS RANGE: The settings of accel/decel time and frequency are only four digits when set by keypad (for example: 3599 sec/399.9 Hz), but 5 digits (for example: 3599.9 sec or 399.99 Hz) when controlled by programmable controller (PLC) or computer in communication mode.*

Fn XX	Function	Page	Description	Set Unit	Range	Factory Setting	Remark
97	Fault Contact (F.C.) Control	50	XXX0: F. C. is not energized during auto restart operation XXX1: F.C. is energized during auto restart operation XX0X: F.C. is not energized during momentary power loss detection XX1X: F.C. is energized during momentary power loss X0XX: F.C. is not energized during external Emergency Stop X1XX: F.C. is energized during external Emergency Stop 0XXX: F.C. is not energized during external baseblock 1XXX: F.C. is energized during external baseblock			0000	
98		51	XXX0: F.C. is not energized after overtorque is detected XXX1: F.C. is energized after overtorque is detected XX0X: F.C. is not energized after electronic thermal motor protection trip XX1X: F.C. is energized after electronic thermal motor protection trip X0XX: F.C. is normally open (N/O) X1XX: F.C. is normally closed (N/O) 0XXX: F.C. is not energized after electronic thermal inverter protection trip 1XXX: F.C. is energized after electronic thermal inverter protection trip			0000	
99		51	Reserved				
100	Comm. Parameter Control	51	Communication identification number	1	1-32	1	*2, *3
101			Baud rate of communication	1	0: 4800 bps 1: 9600 bps 2: 19200 bps	1	
102			XXX0: 1 stop bit XXX1: 2 stop bits XX0X: Even partiy XX1X: Odd parity X0XX: With parity X1XX: Without parity 0XXX: 8 bits data 1XXX: 7 bits data			1100	*2
103-122		51	Reserved				
123	Factory Setting	52	1111: Reset to factory setting			0000	
124	CPU Version	52	CPU Version				*3
125	Fault Sequence Reference	52	Record of last three fault indications			1. 2. 3.	

5.2 Function Parameter Setting (Effective in Program Mode)

5.2.1 Changing the Function Parameter (Also review diagram in Section 5.1)

	Key Operation	Description
1.	"DSP/FUN"	Enter program mode Displays the current function code
2.	"UP" or "DOWN" or "SHIFT" key	Press the "UP" or "DOWN" or "SHIFT" key to select the desired function code.
3.	"READ/ENTER" key	Display the current function parameter
4.	"UP" or "DOWN" or "SHIFT" key	Press the "UP" or "DOWN" or "SHIFT" key to change the displayed function parameter
5.	"READ/ENTER" key	Press the "READ/ENTER" key to save the displayed function parameter into memory
6.	Repeat Steps 2 through 5	Changing another function parameter
7.	When done programming press "DSP/FUN"	Enter run mode and display frequency

Table 5 C - Changing Parameters

5.3 Function Descriptions

Fn00 = Drive Capacity Selection

Fn00 defines the drive model number to the microprocessor. Fn00 is set at the factory for the model number of the drive.
See Section 9.3 - Reference for drive model number definitions.
DO NOT CHANGE! For Informational Purposes Only.

Fn01 = Acceleration time 1 - Factory Setting = 10 sec.; Range = 0.1 - 3600 sec.

Fn02 = Deceleration time 1 - Factory Setting = 10 sec.; Range = 0.1 - 3600 sec.

The set time indicates the interval required before the frequency output reaches 60 Hz. The accel/decel times are effective in digital operator and remote control. The accel/decel times can be set from 0.1 - 3600 seconds. The accel/decel time is based on 60 Hz. Use the following formulas for calculating the accel/decel time to a certain operational frequency if the operational frequency is different from 60 Hz.

1. Formula for calculating accel/decel time:

$$\text{Accel. time} = \text{Fn01 (or Fn49)} \times \frac{\text{Preset frequency}}{60}$$

$$\text{Decel. time} = \text{Fn02 (or Fn50)} \times \frac{\text{Preset frequency}}{60}$$

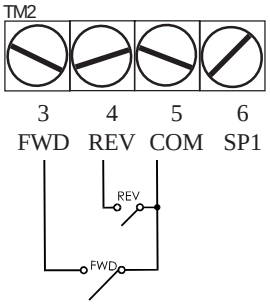
2. There is a second accel/decel time available. This can be adjusted by changing Fn49 and Fn50. The selection of accel or decel times 1 or 2 is made by changing one of the multifunction digital input terminals to an accel/decel time selection contact. See Fn56 - Fn58 for proper programming of input contacts to control which accel/decel time is in current use.

3. Accel time 1 or 2, Decel time 1 or 2, and S curve 1 or 2 can be controlled by a signal from the external input terminal (TM2 pins 6 - 8) as long as Fn56-Fn58 = 4 (N.O.) or 20 (N.C.).

4. An S curve function is available. The S curve function provides a smooth ramp into and out of the acceleration/deceleration mode. It lessens the mechanical shock to systems when a change of speed command is performed by the drive. Program Fn80 and Fn81 to the time required by the application to ramp into and out of the accel/decel rate. A setting of 0 disables the S curve. The total accel/decel time will increase by the values programmed into Fn80 and Fn81.

Fn03 = Remote Start/Stop Operation Select - Factory Setting = 0000

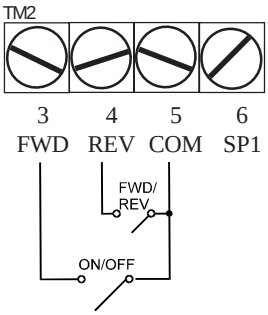
This function is only applicable if remote Start/Stop has been selected by changing Fn10 = 0001.



Program Fn10 to 0001
Program Fn03 to 0000

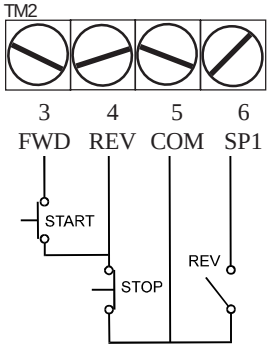
Note: *If the forward and reverse contacts are closed simultaneously, the drive will shut off.*

XX00: FWD/STOP, REV/STOP Maintain button
Connect FWD/STOP, REV/STOP buttons as shown:



Program Fn10 to 0001
Program Fn03 to 0001

XX01: FWD/REV, ON/OFF Maintain button
Connect FWD/REV, ON/OFF buttons as shown:



Program Fn10 to 0001
Program Fn03 to 0010

Start = N.O.(Momentary)
Stop = N.C.(Momentary)
Rev. = Maintain Switch (Closed)
Fwd. = Maintain Switch (Open)

XX1X: Three Wire START/STOP, FWD/REV
Connect as shown:

X0XX: REV Command Enable
X1XX: REV Command Disable
(Enables or disables the reverse direction)
Only valid if Fn11=
0XXX: Drive Initial Speed is Last Speed Ran
1XXX: Drive Initial Speed is Fixed at minimum speed (Fn07).
Specifies whether the drive will restart at the last speed ran or the minimum speed set by Fn07.

Note: Emergency Stop Mode

Even when the drive is in the remote start/stop mode, the stop button on the mounted keypad can be used to stop the drive in an emergency stop mode. To enable this feature program Fn48 = XX0X. To disable this feature, program Fn 48 = XX1X. If the stop button on the mounted keypad is depressed, the drive must be powered down to reset.

CSD-2P5 - 203 & CSD 401 - 405

Pattern	Fn=	Fmax	Vmax	Fmid	Vmid	Fmin	Vmin
GP	0	50 Hz	100	2.5	7.5	0.1	7.5
CT	1				10		
	2				15		
	3				20		
VT	4			25	17.5		
	5				25		
CHP	6			5	15		
	7				20		
	8				25		
GP	9	60 Hz		3	7.5		
CT	10				10		
	11				15		
	12				20		
VT	13			30	17.5		
	14				25		
CHP	15			6	15		
	16				20		
	17				25		

CSD-205 - 210, CSD-407 - 410

Pattern	Fn=	Fmax	Vmax	Fmid	Vmid	Fmin	Vmin
GP	0	50 Hz	100	2.5	7.5	0.1	7.5
CT	1				9		
	2				10.5		
	3				12		
VT	4			25	17.5		
	5				25		
CHP	6			5	10.4		
	7				13		
	8				15.4		
GP	9	60 Hz		3	7.5		
CT	10				9		
	11				10.5		
	12				12		
VT	13			30	17.5		
	14				25		
CHP	15			6	10.4		
	16				13		
	17				15.4		

CSD-215 - 230, CSD-415 - 430

Pattern	Fn=	Fmax	Vmax	Fmid	Vmid	Fmin	Vmin
GP	0	50 Hz	100	2.5	6.5	0.1	6.5
CT	1				7.5		6.1
	2				8.5		5.5
	3				9.5		4.9
VT	4			25	20		6.1
	5				25		5.8
CHP	6			5	10		5.1
	7				12		4.7
	8				14		4.2
GP	9	60 Hz		3	6.5		6.5
CT	10				7.5		6.1
	11				8.5		5.5
	12				9.5		4.9
VT	13			30	20		6.1
	14				25		5.8
CHP	15			6	10		5.1
	16				12		4.7
	17				14		4.2

Table 5 D - V/f Pattern Selection

Fn04 = Parameter Lock Select - Factory Setting = 0000

Prevents accidental changing of parameters (Fn17-25).

XXX0: Fn17 - 25 ENABLED
Allows access to the preset speed functions

XXX1: Fn17 - 25 DISABLED
Protects the preset speed functions

XXOX: ALL PARAMETERS EXCEPT Fn17 - 25 ENABLED
Allows access to all parameters excluding the preset speeds

XX1X: ALL PARAMETERS EXCEPT Fn 17 - 25 DISABLED
Protects all other parameters except the preset speeds

Fn05 = V/f Pattern Selection - Factory Setting = 9; Range = 0 - 18

The ***CSD Series*** drive offers 18 preprogrammed V/f patterns for a variety of applications. Fn05 determines which pattern is applied. In addition to the 18 predefined patterns the user can custom design a V/f pattern when Fn05=18. Programming Fn05 = 18 enables Fn37 - Fn41, which determines the shape of the custom V/f pattern.

0 or 9: General purpose (GP) applications, choose 0 (for 50 Hz) or 9 (for 60 Hz).

1,2,3,10,11,12: Constant torque (CT) applications, choose 1-3 (50 Hz) or 10-12 (60 Hz).

4,5,13,14: Variable torque (VT) applications, choose 4-5 (50 Hz) or 13-14 (60 Hz).

6,7,8,15,16,17: Constant horsepower (CHP) applications, choose 6-8 (50 Hz) or 15-17 (60 Hz).

18: Custom programmed V/F pattern (Enables Fn37 - Fn41).

After choosing your V/f pattern, run motor under worse case loading. A properly programmed drive should spin a loaded motor at 10 Hz. If the motor does not spin at a frequency of 10 Hz, choose a higher starting torque V/f pattern. If there is not a suitable preprogrammed V/f pattern for the application, change Fn05 = 18 and select the required values for Fn37 - Fn41 to satisfy the application's requirements. Review the charts for the correct programming of the customer V/f pattern settings.

The tables and graphs describe the preprogrammed V/f patterns available:

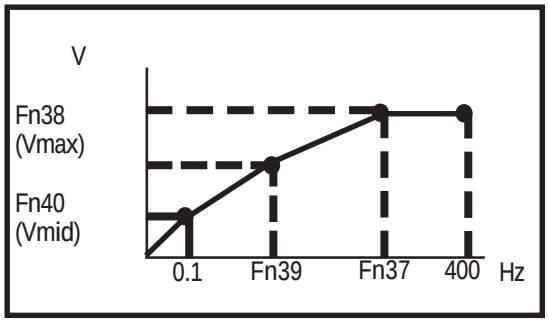


Figure 5 - 3
V/f Pattern Selection

GP = General Purpose
CT = Constant Torque
VT = Variable Torque
CHP = Constant Horsepower

Fn06 = Frequency output upper limit - Factory Setting = 60 Hz;
Range = 0 - 400 Hz
Fn07 = Frequency output lower limit - Factory Setting = 0;
Range = 0 - 400 Hz

Fn06 and Fn07 program maximum and minimum allowable frequencies. The drive will not increase the frequency to a value > Fn06. The drive will not decrease the frequency to a value < Fn 07 as long as a run command is maintained.

IMPORTANT!!!

If Fn07 = 0 Hz, the drive output will be stopped if the frequency command reaches 0 Hz. If Fn07>0 Hz and a run command exists, the drive will run at the frequency of Fn07 even if the frequency command is lower than the frequency setting of Fn07.

Digital Multifunction Output. (See Fn61 on page 36 for description and examples.)
Fn08 = Fn12 = Stall Prevention During Accel/Decel/Running:
Fn09 = Up to frequency setting detection bandwidth -
Factory Setting = 0; Range = 0 - 30 Hz
Fn61 = Multifunction output

Fn10 = Start/Stop Control Mode Select - Factory Setting = 0

Used to control the source of the start/stop signal.

0: Digital operator control - If the keypad is to be the source of the start/stop command signal.

1: Remote control - If the terminal strip TM2 is to be the source of the start/stop command signal.

If using the terminal strip for start/stop control, ensure that Fn03 is also correctly programmed.

Note: *Even when the drive is in the remote start/stop mode, the stop button on the keypad can be used to stop the drive in an emergency stop mode. To enable this feature, program Fn48 = XX0X. To disable this feature, program Fn48 = XX1X.*

Note: *The start/stop command is set via TM2 when Fn10 = 1 and any multifunction terminal (Fn56-58) is programmed as an open control signal selector switch (Fn56-58 = 9). The start/stop command is keypad controlled when the signal selector switch is closed and Fn56-58 = 9.*

Fn11 = Frequency Command Method Select - Factory Setting = 0

Determines the drive's control method of output frequency.

0: The keypad arrow keys are used to control the drive speed. In this mode, the arrow keys change the display to the new desired frequency. Then press the read/enter key to enter the new speed into the drive.

1: The potentiometer mounted on the keypad controls the drive speed. Turn the potentiometer fully counterclockwise to reduce the drive frequency to minimum. Turn the potentiometer fully clockwise to increase the drive frequency to maximum.

Note: When Fn11 = 1 and one of the multifunction terminals 6 - 8 = 15, the frequency is set by the potentiometer on the keypad when the multifunction terminal input is off. When the multifunction terminal input is on, the frequency is set by the analog input on TM2 pins 13 and 14.

2: Run by potentiometer connected to TM2 (terminal 12-14)

When Fn11 = 2 the analog speed signal brought into TM2 pin 13 will control the speed of the drive. Several modes of control can be achieved:

**For 0-5 VDC analog command signal control:* connect the command signal positive to TM2-13 and the command signal negative toTM2-14. Also install the shorting plug on JP1 pins 1 and 2.

**For 0-10 VDC analog command signal control:* connect the command signal positive to TM2-13 and the command signal negative to TM2-14. Also install the shorting plug on JP2 pins 2 and 3.

**For 4-20MA analog command signal control:* connect the command signal positive to TM2-13 and the command signal negative to TM2-14. Also install the shorting plug on JP1 pins 2 and 3.

**For potentiometer control:* connect the fully clockwise position of the potentiometer to TM2-12, connect the wiper of the potentiometer to TM2-13 and connect the fully counter clockwise position of the potentiometer to TM2-14.

Note: *The start/stop command is set via the potentiometer on the keypad when Fn11 = 1 and any multi function terminal (Fn56-58) is programmed as an open control signal selector switch (Fn56-58 = 9). The start/stop command is keypad controlled when the signal selector switch is closed and Fn56-58 = 9.*

Note: *The start/stop command is set via the analog input on TM2 pins 12 - 14 when Fn11 = 2 and any multifunction terminal (Fn56-58) is programmed as an open control signal selector switch (Fn56-58 = 9). The start/stop command is keypad controlled when the signal selector switch is closed and Fn56-58 = 9.*

3: (Up/Down) Run by multi-function input frequency command (terminals 6-8)

When Fn11 = 3 and if Fn56-58 = 12 or 13, the multifunction input terminals TM2 pins 6 - 8 act as arrow keys to increase and decrease speed. Programming Fn56 - 58 = 12 changes that particular terminal to an up command. Programming Fn56 - 58 = 13 changes that particular terminal to a down command. When the run command is on, the drive will accelerate to the frequency in Fn25. When the up command is on, the drive starts to accelerate. When the up command is off, the drive will stop accelerating and run at constant speed. When the down command is on the drive will start to decelerate and when the down command is off the drive will run at constant speed.

Fn12 = Stall Prevention During Accel/Decel/Running:

XXX0: Stall prevention during accel enabled

This setting allows the drive to automatically extend the acceleration time if it detects a stall condition beginning to occur.

XXX1: Disables stall prevention during accel (the above feature)

XX0X: Stall prevention during decel enabled

This setting allows the drive to automatically extend the deceleration time if it detects a stall condition beginning to occur.

XX1X: Disables stall prevention during decel disable (the above feature)

X0XX: Stall prevention during running enabled

This setting allows the drive to automatically lower frequency to closely match the motor speed and when the stall condition has cleared, will reaccelerate the motor back to operational speed.

X1XX: Disables stall prevention during running (the above feature)

0XXX: Stall prevention decel time set by Fn02

The rate at which the drive output will decelerate is dependent upon the programming of the left most digit of Fn12. If Fn12 = 0XXX deceleration rate = Fn02.

1XXX: Stall prevention decel time set by Fn15.

If Fn12 is 1XXX the deceleration rate = Fn15.

Fn13 = Stall prevention level during accel - Factory Setting = 110%; Range = 30% - 200%

Fn13 determines the level of current (measured in percent of drive rated current) at which stall prevention will activate when the drive is in the acceleration mode.

Fn14 = Stall prevention level during running - Factory Setting = 160%; Range = 30% - 200%

Fn14 determines the level of current (measured in percent of drive rated current) at which stall prevention will activate when the drive is in the constant speed mode.

Fn15 = Decel time during stall prevention - Factory Setting = 3 Sec.; Range = 0.1 - 3600 seconds

Fn15 can determine the rate of deceleration if the drive enters the stall prevention mode during constant speed if Fn12 = 1XXX.

Fn16 = Direct Start Prohibit (Effective in Remote Control Only, Fn10 = 1) - Factory Setting = 0000

If this function is enabled, the drive will not start immediately after power is reapplied. The drive must enter stopping mode first (See Figure 18 below).

XXX0: Direct start enable when remote RUN command ON

XXX1: Disables direct start when remote RUN command ON

Note: In this mode, when power is applied, the drive will display STP1 indication that a run command existed when power was applied and the safety feature is preventing the drive from running. Remove the run command and then reapply.

XX0X: Reset is invalid unless the drive is stopped

XX1X: Reset is effective.

Important! If the application allows, we strongly recommend that you enable this function for the safety of personnel and equipment.

Multispeed and Timer Control:

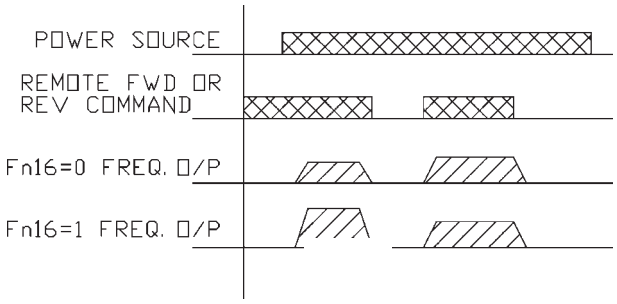


Figure 5 - 4
Priority of Running Command

Fn17 - Fn23 = 0 - 400 Hz: Multispeed 1 - 7

Fn17 - Fn23 are seven preset speed settings. When Fn56 - 58 changes from 0 to 2, the switches connected to TM2 pins 6 - 8 can control the speed of the drive. ***Note:*** *For Fn56 - 58, entering 00-15 provides normally open (N.O.) contacts and 16-31 provides normally closed (N.C.) contacts.*

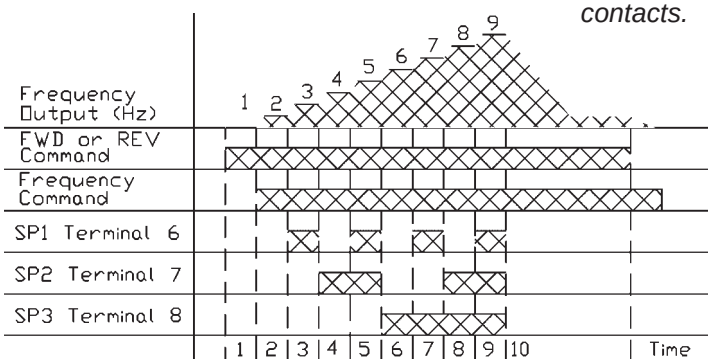


Figure 5 - 5a

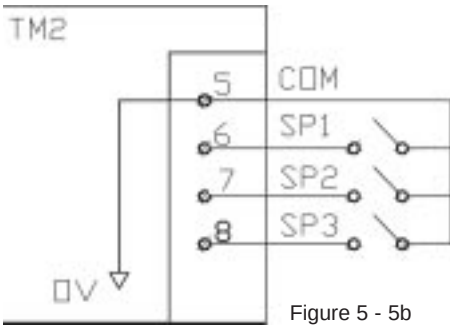


Figure 5 - 5b

Two timer functions can be used to control speeds for Fn17 - 23. In the first timer function, if Fn84 = XXX1 and Fn56 - 58 = 0 - 2, or 16 - 18, then this changes the multifunction input switches from preset speed contacts to timer input contacts. A pulse signal is received on the multifunction input, the drive will run at the time specified by Fn85 - Fn91 at the frequency specified by Fn17 - Fn23. After the time has elapsed, the drive will return to the frequency set by keypad or external analog signal input depending on the programming of Fn11. (See Figure 5 - 5c .)

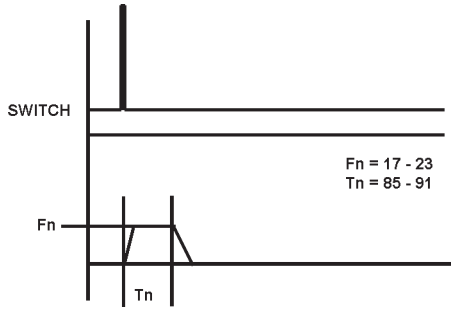


Figure 5 - 5c

On the second timer function, if Fn84 = XXX1 and Fn56 - Fn58 = 14 or 30, this changes the multifunction input to an automatic cycle initialization contact. When the contact is momentarily made on TM2, the drive will go to the speed of Fn17 for time of Fn85, then will go to the speed of Fn18 for time of Fn86. This continues through the seven preset speeds of Fn17 - 23 for the seven preset times of Fn85 - 91. After the timed cycle has elapsed, the drive will return to the frequency set by keypad or external analog signal input depending on the programming of Fn11. (See Figure 5 - 5d.)

Note: *A new speed setting or timer setting cannot be inserted into an ongoing timer and speed function. The priority of the preset speed signals is as follows: Jog >>Multiple Speed>>Digital operator. The jog contact has the highest priority and the digital operator has the lowest priority.*

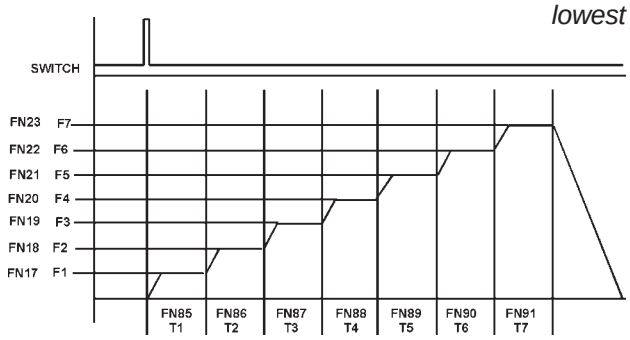


Figure 5 - 5d

SP3	SP2	SP1	Inverter Freq. Output	Ref No.
Off	Off	Off	Set by external signal or digital operator	2
Off	Off	On	Frequency of Fn17	3
Off	On	Off	Frequency of Fn18	4
Off	On	On	Frequency of Fn19	5
On	Off	Off	Frequency of Fn20	6
On	Off	On	Frequency of Fn21	7
On	On	Off	Frequency of Fn22	8
On	On	On	Frequency of Fn23	9

Table 5 E

Fn24 = Jog frequency reference - Factory Setting = 2.0 Hz; Range = 0 - 400 Hz

Fn24 sets the jog speed. The jog speed can be activated by one of the multiple function input switches TM1 pins 6 - 8 by programming Fn56 - Fn58 = 3. Activating the multifunction input switch will cause the drive's frequency reference to change to the value set in Fn24.

Fn25 = Master Frequency Reference

Frequency operation is used in digital operation control (Fn11 = 0) The master frequency can be changed by pressing the ∧ and ∨ directly but do not need to set the function code to Fn25 when the drive is in master frequency operation.

Analog Frequency Signal Control (See Figure 5 - 6 and Table 5 F below)

Fn26 - 29 control the offset and gain of the analog input signal. These functions are only effective when Fn11 = 1 or 2. Note: Fn28 must be greater than Fn27

Fn26 = Frequency reference - Factory Setting = 0 Hz; Range = 0.0 - 400 Hz

Fn27 = Voltage reference ratio 1 - Factory Setting = 0%; Range = 0 - 100%

Fn26 and Fn27 are offset controls. Fn26 tells the drive what speed to run with a minimum analog input signal. Fn27 tells the drive the deadband on the bottom of the analog input signal before the drive begins to respond.

Fn28 = Voltage reference ratio 2 - Factory Setting = 100%; Range = 0 - 999.9%

Fn28 is the gain control. Fn28 tells the drive at what frequency to run with the maximum analog input signal existing at the analog input.

Fn29 = Positive/Negative direction - Factory Setting = 0; 0 Positive, 1 Negative

Fn29 can be used to invert the command signal. With Fn29 = 1, the maximum analog input signal will produce the minimum speed and the minimum analog input signal will produce the maximum speed.

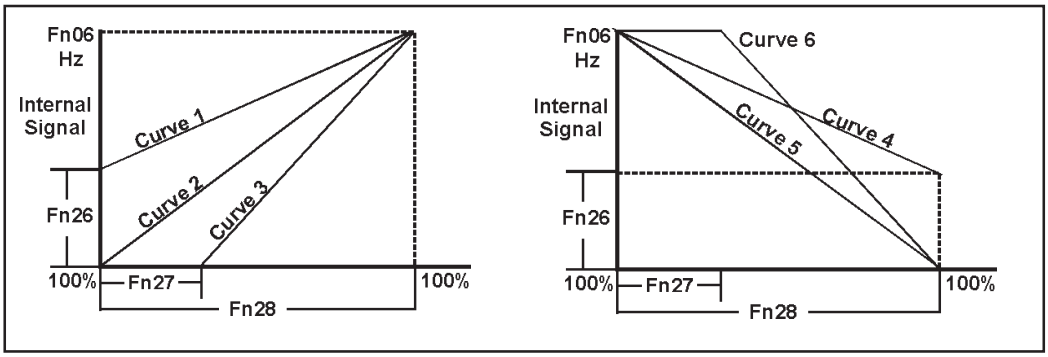


Figure 5 - 6

	Fn26	Fn27	Fn28	Fn29
Curve 1	Set freq.	Set 0	Set %	0
Curve 2	Set 0	Set 0	Set %	0
Curve 3	Set 0	Set %	Set %	0
Curve 4	Set Freq.	Set 0	Set %	1
Curve 5	Set 0	Set 0	Set %	1
Curve 6	Set 0	Set %	Set %	1

Table 5 F - Analog Frequency Signal Control

Fn30 = Voltage of Power Supply

Fn30 must be programmed to the supply voltage. Fn30 provides the correct voltage to the motor for the various V/f patterns. It also determines the braking transistor setpoint.

Restart From Momentary Power Loss:

Fn31 and Fn32 allow the drive to ride through a momentary power loss of up to two seconds without tripping on undervoltage. When the power comes back, if it is within the time set by Fn31, the drive tracks the motor at its current operating speed and then reaccelerates to its operational speed. There is no limit to the number of times this feature can be activated as long as the power loss is less than the value in Fn31.

Fn31 = Momentary power loss ride through time -
Factory Setting = 0.5 sec; Range = 0 - 2 sec.

Fn32 = XXX0: Disable
XXX1: Enable

If the power loss time is greater than Fn31 and the application requires that the drive still restart upon reapplication of power, program Fn34 and Fn35 to allow automatic reset of a fault and restart of the drive.

Fn33 = Analog Input Signal Scan Times -
Factory Setting = 100 2ms; Range = 0 - 100 2ms

The value of terminal 13 (A/D) input signal is scanned at a rate of 2ms. The drive calculates the average value of this signal based on (2msx Fn33). The drive will then respond to this calculated speed, filtering out noise on the command signal line.

Auto Restart

Fn34 and Fn35 allow the drive to automatically reset a fault condition, restart the drive and use speed search to return the motor to speed after the fault condition clears.

Fn34 = Auto Restart Interval - Factory Setting = 0 sec;
Range = 0 - 800 sec.

Fn35 = Number of Auto Restart Attempts - Factory Setting = 0;
Range = 0 - 10 times:

Programming Fn35 = 0 disables this feature.

To enable this feature, program Fn35 to the maximum number of times the drive will attempt to reset the fault. Program Fn34 to the delay period between the fault condition notice and the subsequent fault reset by the drive. Auto restart is only effective if the drive is in the run mode. The number of auto restart attempts will be reset after either 10 minutes has elapsed without a fault condition or the reset key is depressed on the keypad or via TM2.

Note: *Fn97 determines when the fault contact (TM2 pins 1 and 2) will energize on a fault if the auto restart circuit is trying to restart the motor. If Fn97 =XXX0, the fault terminal will not function while auto restart is working (except for an OL fault). If Fn 97 = XXX1 the fault terminal will function even while auto restart is working.*

Fn36 = Display Mode Control - Factory Setting = 4 Poles;
Range = 2-8 motor poles

Fn36 tells the drive the number of poles in the motor. The drive uses this number to calculate the RPM of the motor at a given frequency. This number can be displayed on the keypad by programming Fn51 = 1. Program into Fn36 the number of motor poles.

Fn37 to Fn41: Custom Program V/f Pattern Setpoints.

If there is not a suitable preprogrammed V/f pattern for the application, change Fn5 = 18 and select the required values for Fn37 to Fn41 that will satisfy the requirements of the application. See Figure 5 - 7 and Table 5 G for a graphic description of the correct programming of the custom V/f pattern settings. Depending on the application, when Fn37 is changed, Fn06 may need to be changed.

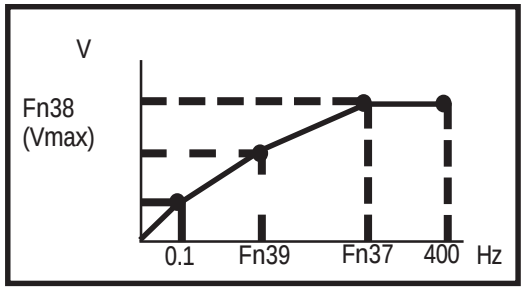


Figure 5 - 7
V/f Pattern

Table 5 G - V/f Patterns

Pattern	Fn=	Fmax	Vmax	Fmid	Vmid	Fmin	Vmin
GP	0	50 Hz	100	2.5	7.5	0.1	7.5
CT	1				10		
	2				15		
	3				20		
VT	4			25	17.5		
	5				25		
CHP	6			5	15		
	7				20		
	8				25		
GP	9	60 Hz		3	7.5		
CT	10				10		
	11				15		
	12				20		
VT	13			30	17.5		
	14				25		
CHP	15			6	15		
	16				20		
	17				25		

CSD-2P5 - 203 & CSD 401 - 405

Pattern	Fn=	Fmax	Vmax	Fmid	Vmid	Fmin	Vmin
GP	0	50 Hz	100	2.5	6.5	0.1	6.5
CT	1				7.5		6.1
	2				8.5		5.5
	3				9.5		4.9
VT	4			25	20		6.1
	5				25		5.8
CHP	6			5	10		5.1
	7				12		4.7
	8				14		4.2
GP	9	60 Hz		3	6.5		6.5
CT	10				7.5		6.1
	11				8.5		5.5
	12				9.5		4.9
VT	13			30	20		6.1
	14				25		5.8
CHP	15			6	10		5.1
	16				12		4.7
	17				14		4.2

CSD-215 - 230, CSD-415 - 430

Pattern	Fn=	Fmax	Vmax	Fmid	Vmid	Fmin	Vmin
GP	0	50 Hz	100	2.5	7.5	0.1	7.5
CT	1				9		
	2				10.5		
	3				12		
VT	4			25	17.5		
	5				25		
CHP	6			5	10.4		
	7				13		
	8				15.4		
GP	9	60 Hz		3	7.5		
CT	10				9		
	11				10.5		
	12				12		
VT	13			30	17.5		
	14				25		
CHP	15			6	10.4		
	16				13		
	17				15.4		

CSD-205 - 210, CSD-407 - 410

GP = General Purpose
CT = Constant Torque
VT = Variable Torque
CHP = Constant Horsepower

Fn43 =	Carrier Freq.
0	1 KHz
1	1.2 KHz
2	1.8 KHz
3	2 KHz
4	2.4 KHz
5	3 KHz
6	3.6 KHz
7	4 KHz
8	4.8 KHz
9	5 KHz
10	6 KHz
11	7.2 KHz
12	8 KHz
13	9 KHz
14	10 KHz
15	12 KHz

Table 5 H - Fn43 Settings

Fn42 = Start Frequency Adjustment - Factory Setting = 1 Hz; Range = 0.1 to 10 Hz

Fn42 determines the drive's initial frequency at start up. Program Fn42 to set the initial start frequency the application requires. ***Note:*** *If speed search has been enabled, the drive will override this feature, find the actual frequency of the motor and start the output pattern at that point.*

Fn43 = Carrier Frequency - Factory Setting = 14; Range = 0 to 15*

Fn 43 changes the drive's carrier frequency. The larger the number in Fn43, the higher the carrier frequency. A higher carrier frequency provides quieter motor operation but generates more heat inside the motor. High carrier frequencies can also cause interference to external electronic devices or cause unwanted motor vibration. A lower carrier frequency causes less heat generation in the motor but will be slightly louder. Choose the correct carrier frequency for the application.

Fn44 = Stopping Mode and Braking Resistor Protection - Factory Setting = 0000

Controls the stopping style and the brake resistor protection circuit.

XXX0: Decel to stop with a stop command.

XXX1: Free run (coast) to stop with a stop command.

XX0X: Braking resistor overheat protection disable

XX1X: Braking resistor overheat protection enable - the drive monitors brake resistor current and if too much current is detected in the resistor in too short a period of time, the drive will trip and OH1 will be displayed. The drive will reset after the brake resistor cools off.

Multifunction Analog Output

The multifunction analog output (TM2-15) can be used to track several different parameters of the drive. The output of terminal 15 is 0-10VDC at a maximum current draw of 1mA.

Fn45 = Gain of multifunction analog output - Factory Setting = 100%; Range - 0-200%

A gain control to compensate for inaccuracies of external monitoring equipment.

Fn46 = Multifunction analog output selection - Factory Setting = 0; Range = 0-3

0: Output freq. (Fn06 max) 10VDC/Fn06 - enables the output to follow the drive output frequency.

1: Set frequency (Fn06 max) 10VDC/Fn06 - enables this output to follow the set frequency.

2: Output voltage (VAC): 10VDC/Fn30 - enables this output to follow the output AC voltage of the drive.

3: DC voltage (VPN): 10VDC/450VDC/900VDC for 400V series - enables the output to follow the DC bus voltage program.

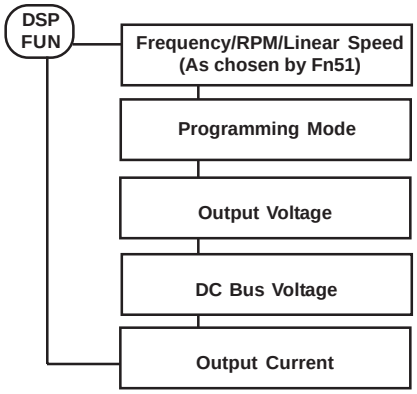


Figure 5 - 8
Display Mode Control

Fn47 = Display Mode Control - Factory Setting = 0000

Fn47 can add several parameters to the keypad display.

XXX0: Disables output voltage display

XXX1: Enables output voltage display on the keypad

XX0X: Disables DC bus voltage current display

XX1X: Enables DC bus voltage current display on the keypad

X0XX: Disables output current display

X1XX: Enables output current display on the keypad

The customer can toggle between these displays with the DSP/FUN key on the keypad. To toggle through various displays, depress the DSP/FUN key. (See Figure 5 - 8.)

Fn48 = Dynamic Braking and Priority of Stopping and Speed Search and AVR Control - Factory Setting = 0000

Fn48 controls several parameters

XXX0: Enhanced braking capacity - controlling the drive's braking capacity, the drive will adjust the output voltage to absorb the inertia energy of load and thereby increase the braking capability.

XXX1: Standard braking capacity - disables the above feature.

XX0X: Stop key effective in remote control mode - allows the stop key on the keypad to be an emergency stop the drive even in remote control mode. Once the stop key on the keypad is depressed the drive will stay in a locked out condition until power is cycled to the drive.

XX1X: Stop key ineffective in remote control mode - disables the above feature.

The speed search is used in windmilling applications. The drive will find the operational speed of the motor and start.

X0XX: Speed search controlled by terminals on TM2 - allows the user to enable speed search at all times or only through one of the multifunction inputs on TM2 pins 6 - 8. Programming Fn56 - Fn58 = 7 (N.O.) or 23 (N.C.) converts the input command signal on TM2 to the speed search enable signal. The speed search capability of the drive can only be enabled by one of the multifunction input commands on TM2 pins 6 - 8.

X1XX: Speed search effective when drive starts

0XXX: AVR function effective - enables automatic regulation of motor voltage.

1XXX: AVR function ineffective - disables the above feature.

Fn49 - Fn 50: Refer to Fn01

Fn49 = Acceleration Time 2 - Factory Setting = 10.0 sec; Range = 0.1 - 3600 sec.

Fn50 = Deceleration Time 2 - Factory Setting = 10.0 sec; Range = 0.1 - 3600 sec.

Fn49 and Fn50 provide a second set of acceleration/deceleration times. The selection of accel or decel times 1 or 2 is made by changing one of the multifunction digital input terminals to an accel/decel time selection contact. Set Fn56 - Fn58 = 04(N.O.) or 20 (N.C.) to enable the multifunction digital input terminal to be used as an accel/decel time selection switch. Program into Fn49 the required secondary acceleration time and program into Fn50 the required secondary deceleration time.

Display Mode Control - Fn51 and Fn52 can be used to determine the display mode of the keypad.

Fn51 = Factory Setting = 0; Range = 0 - 5

Fn52 = Factory Setting = 1800; Range = 0 - 9999

Fn51 = 0: Display frequency (Hz), display preset frequency during stop mode and operation frequency during run mode.

1: Display RPM of motor with the formula = (120/Fn 36) X Frequency Output where Fn36 is the number of poles of the motor, ensure that the correct information is programmed into Fn36.

2: Line speed display mode in integral (XXXX) with the formula = (Output Frequency/Fn06) x Fn 52

3: Line speed display mode in one digit decimal (XXXX) with the formula = (Output Frequency/Fn06) X (Fn52/10)

4: Line speed display mode in two digit decimal (XXXX) with the formula = (Output Frequency/Fn06) X (Fn 52/100)

5: Line speed display mode in three digit decimal (XXXX) with the formula = (Output Frequency/Fn06) X (Fn 52/1000)

Fn52 = Line speed display in accordance with maximum output frequency (Fn06)

Stopping Mode

The CSD drive, after decelerating the load to zero speed applies a small amount of DC current into the motor to bring the motor to a final stop. The parameters of this DC injection braking capability are defined by Fn53 - Fn55. Program Fn53 - Fn55 as required by the application.

Fn53 = DC Braking time - Factory Setting = 0.5 sec.; Range = 0 - 25.5 sec
Amount of time the DC current is applied to the motor.

Fn54 = DC Braking Injection Freq. - Factory Setting = 1.5 Hz.; Range = 0.1 - 10 Hz
The frequency at which, while the drive is decelerating, it will switch from dynamic braking to DC injection braking.

Fn55 = DC Braking level - Factory Setting = 8%; Range = 0 - 20%
Defines the magnitude of the DC current and, thereby, the magnitude of DC torque to the motor.

Multifunction Input:

The multifunction input contacts of TM2 pins 6,7 and 8 can be defined by Fn56 to Fn58.
Fn56 defines the functionality of the multifunction digital input contact on TM2-6.
Fn57 defines the functionality of the multifunction digital input contact on TM2-7.
Fn58 defines the functionality of the multifunction digital input contact on TM2-8.
Note: *When it is discussed "Programming this function..." Fn56-58 is the reference.*
Note: *Changing these functions to 00-15 has normally open (N.O.) contacts or changing to 16-31 has normally closed (N.C.) contacts.*

Fn56 - Fn58 = Programming this function with the following:

00/16: SP1 (Multispeed 1): Refer to Fn17
- defines this terminal as a preset speed switch #1

01/17: SP2 (Multispeed 2): Refer to Fn17
- defines this terminal as a preset speed switch #2

02/18: SP3 (Multispeed 3): Refer to Fn17
- defines this terminal as a preset speed switch #3.

By programming these terminals as preset speed contacts, the drive can be run at up to seven different speeds depending on the switch position. Example: Function 56 = 00, 57 = 01 and 58 = 02. For more information, review page 32 for Fn17 - Fn23. This table represents the output of the drive for various switch combinations:

SP3	SP2	SP1	Inverter Freq. Output	Ref No.
Off	Off	Off	Set by external signal or digital operator	2
Off	Off	On	Frequency of Fn17	3
Off	On	Off	Frequency of Fn18	4
Off	On	On	Frequency of Fn19	5
On	Off	Off	Frequency of Fn20	6
On	Off	On	Frequency of Fn21	7
On	On	Off	Frequency of Fn22	8
On	On	On	Frequency of Fn23	9

Table 5 I - Multi Speed Output

03/19: Jog operation: Refer to Fn17
Defines this terminal as a jog speed switch. By programming one of the multifunction switches as a jog contact, it can be used to force the output frequency to the value in Fn24.

04/20: Accel/Decel time selection: Refer to Fn01 - point 2Defines this terminal as a second accel/decel time switch. By programming one of the multifunction switches as second accel/decel time switch the customer can select between Fn01 and Fn02 controlling accel/decel time and Fn49 and Fn50 controlling accel/decel time.

05/21: External emergency stop

Defines this terminal as an emergency stop command. By programming one of the multifunction switches as an emergency stop the customer can override a run command and force the drive to decelerate to a stop. Once the emergency stop signal is removed, the run/stop command must be removed and reengaged to get the drive to restart. The fault contact is controlled by Fn97 as follows:

Fn97= X0XX: Fault contact is not energized after external emergency stop signal is received

X1XX: Fault contact is energized after external emergency stop signal is received

06/22: External baseblock

Defines this terminal as a base block command (coast to a stop). By programming one of the multifunction switches as a baseblock contact, the customer can override a run command and force the drive's output to turn off immediately allowing the motor to coast to a stop. After the baseblock command disappears, the run/stop command must be removed and reapplied to restart the drive. The fault contact is controlled by Fn97 as follows:

Fn97 = 0XXX: Fault contact is not energized after external baseblock.

1XXX: Fault contact is energized after external baseblock.

07/23: Speed search: Refer to Fn48

Defines this terminal as a speed search command. This feature is only available if Fn48 = X0XX. When one of the multifunction input command signals is programmed to a speed search contact, the drive can be remotely instructed to either start at the initial frequency reference of Fn42 or start using the speed search feature. Energizing the multifunction input that is programmed at the speed search contact will allow the drive to use speed search for its start frequency. De-energizing the multifunction input that is programmed as the speed search contact will allow the drive to use Fn42 as its starting frequency.

08/24: Energy saving mode: Refer to Fn82

Defines this terminal as an energy saving mode switch. This feature is only available if Fn82 = XX01. When the contact is energized, the output voltage of the drive will be adjusted to minimize the amount of energy required to maintain motor speed. With this contact de-energized the output voltage will be a function of the V/F pattern only.

09/25: Control signal selection

Defines this terminal as a control signal selection switch. By programming one of the multifunction switches as a control signal selection switch the customer can remotely select the source of the speed reference signal as a start stop signal as described below. When the multi-input terminal is OFF, the Operation command and/or Frequency command is either from digital operator or remote control (TM2) - according to the settings of Fn10/Fn11. When the multi-input terminal is ON, the operation command and/or frequency command is from the digital operator regardless of the settings of Fn10/Fn11.

10/26: Communication control mode selection

Defines this terminal as a communication enable/disable switch. By programming a multifunction input switch as a communication control mode selection switch, the customer can select whether the unit accepts its command signals through the communications port on Con 12, or via the keypad on the drive. With the multi-input terminal off during communication, the drive can receive run/stop and frequency command signal from external communication source. The function

parameters can be changed by the external communication source. The keypad and TM2 signals for run/stop and frequency control will be disabled. The keypad can still be used for displaying voltage/current/ frequency or emergency stop but the keypad can not be used for changing function parameters. With the multi-input terminal on during communication, the drive run/stop and frequency command signal is controlled by the drive itself. The external communication source can still read parameters but will not be able to control start/stop or the frequency reference.

11/27: Accel/Decel prohibit

Defines this terminal as a Accel/Decel prohibit contact. By programming one of the multifunction input contacts to an accel/decel prohibit signal, the contact can be used to momentarily stop acceleration or deceleration. When the contact is de-energized, the drive will continue to accelerate or decelerate to its final value.

12/28: UP command

13/29: DOWN command

Defines this terminal as an up command contact. Programming this function to 13 (N.O.) or 29(N.C.) defines this terminal as a down command contact. This function is only active if Fn 11=3. By Programming the multifunction input contact as an up or down command contact, the customer is able to remote the up/down commands that currently exist on the keypad. When the up contact is energized, the drive will increase speed until the up contact is de-energized. When the down contact is energized, the drive will decrease speed until the down contact is de-energized. If both contacts are energized at the same time the drive will not accelerate or decelerate until one or the other direction is selected. "Zero speed stop" control can be available if DOWN command is on constantly. Drives start to run out of the "zero speed stop" mode if UP command is energized.

Note: *In STOP mode the UP/DOWN command is ineffective.*

14/30: Sequence control: Refer to Fn17 and Fn84-Fn91

Defines this terminal as an auto sequence initialization contact. This feature is only available with Fn84 = XXX1. When Fn84 = XXX1 and Fn 56-58 = 14 or 30 this changes the multifunction input to an auto sequence initialization switch. When the contact is momentarily made on TM2 the drive will go to the speed of Fn17 for time of Fn85, then will go to speed of Fn18 for time of Fn86 and so on through the seven preset speeds of Fn17 - 23 for the seven preset times of Fn85 - 91. After the timed cycle has elapsed, the drive will return to frequency set by keypad or external analog signal input depending on the programming of Fn11.

Note: *A new speed setting or timer setting cannot be inserted into an ongoing timer and speed function.*

15/31:Master/Auxiliary speed selection: Refer to Fn11

Defines this terminal as a master/auxiliary speed switch. This feature is only available with Fn11 = 1 or 2. When Fn11 = 1 and the master/ auxiliary speed switch is de-energized, the potentiometer mounted on the keypad will control the speed of the drive. Turning the potentiometer fully counterclockwise will reduce the frequency of the drive to minimum. Turning the potentiometer fully clockwise will increase the frequency of the drive to maximum. When the master/auxiliaryspeed switch is energized, the frequency is set by the analog input on TM2 pins 13 and 14. When Fn 11 = 2 and the master/auxiliary speed switch is de-energized, the analog speed signal brought into TM2 pin 13 will control the speed of the drive. When the master/auxiliary speed switch is energized, the frequency is set by the potentiometer on the keypad.

16-31: Changes 00-15 N.O. (normally open) contact to N.C. (normally closed) contact

Fn59 - Fn 60 = Reserved

Fn61 = Digital Multifunction Output - Factory Setting = 00; Range = 00 - 11

The open collector transistor output of TM1 pins 10 & 11 are used for several indications. Note that TM2 pins 10 and 11 is an open collector output rated for 50mA, 35 VDC. Do not apply AC voltage to this contact. Applying AC voltage to this contact will cause failure of the drive. Also applying DC voltage in the reverse polarity will cause failure of the drive. Program Fn61 for the style of control required of the open collector output. Entering a value 00-05 equals normally open (N.O.) contacts and entering a value of 06-11 equals normally closed (N.C.) contacts. Following is a description of functions for certain values of Fn61:

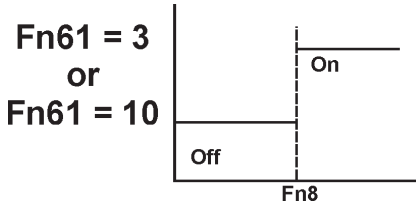
00/06: Run mode places the open collector output transistor in the run mode. Whenever, the output of the drive is > 0 Hz, the transistor will be on. When the output of the drive is = 0 Hz, the transistor will be off. Programing Fn61 = 06 places the open collector output transistor in the run mode. Whenever the output of the drive is > 0 Hz, the transistor will be off. When the output of the drive is = 0 Hz the transistor will be on.

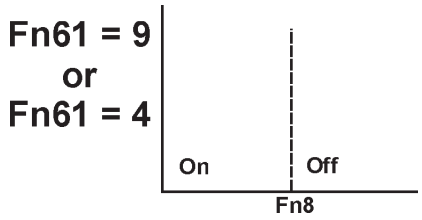
01/07: Up to desired frequency Fn61 = 01 places the open collector output transistor in the up to desired frequency mode. Whenever the output of the drive is at constant speed, the transistor will be on. When the drive is not up to desired frequency the transistor will be off. Programming Fn61 = 07 places the open collector out put transistor in the up to desired frequency mode. Whenever the output of the drive is at constant speed the transistor will be off. When the drive is not up to the desired frequency the transistor will be on.

02/08: Set frequency output - Fn08+/- Fn09 places the open collector output transistor in the bandwidth mode. Whenever the output of the drive is in agreement with the value in Fn08 plus or minus the value in Fn09 the transistor will be on. When the output of the drive is not in agreement with the value in Fn08 plus or minus the value in Fn09, the transistor will be off. Programming Fn61 = 08 places the open collector output transistor in the band width mode. Whenever the output of the drive is in agreement with the value in Fn08 $\pm$ Fn09 the transistor will be off. When the output of the drive is not in agreement with the value in Fn08 $\pm$ Fn09, the transistor will be on.

03/09: Frequency detection > Fn08

Places the open collector output transistor in the frequency detection greater than mode. Whenever the output of the drive is > Fn08 the transistor will be on. Whenever the output of the drive is $\leq$ Fn08 the transistor will be off. Programming Fn61 = 09 places the open collector output transistor in the frequency detection greater than mode. Whenever the output of the drive is > Fn08 the transistor will be off.





Whenever the output of the drive is ≤ Fn08 the transistor will be on.

04/10: Frequency detection < Fn08

Places the open collector output transistor in the frequency detection less than mode. When the output of the drive is < Fn08 the transistor will be on. Whenever the output of the drive is ≥ in Fn08 the transistor will be off. Programming Fn61 = 10 places the open collector output transistor in the frequency detection less than mode. When the output of the drive is < Fn08 the transistor will be off. Whenever the output of the drive is ≥ Fn08 the transistor will be on.

05/11: Over torque detection places the open collector output transistor in the overtorque detection mode. Whenever the drive detects an overtorque condition in the load, the transistor will turn on. When the drive does not detect an overtorque condition in the load, the transistor will turn off. Programming Fn61 = 11 places the open collector output transistor in the overtorque detection mode. Whenever the drive detects an overtorque condition in the load, the transistor will turn off. When the drive does not detect an overtorque condition in the load, the transistor will turn on.

Note: *Regardless of programming, when power is removed from the drive the transistor will be off.*

06-11: Changes Fn61 from normally off (open) to normally on (closed) control.

Fn62 - Fn 64: Reserved

Fn65 - Fn68: Prohibited Frequency Control

Fn65 = Setting prohibited freq. 1 - Factory Setting = 0 Hz; Range = 0 - 400 Hz
Fn66 = Setting prohibited freq. 2 - Factory Setting = 0 Hz.; Range = 0 - 400 Hz
Fn67 = Setting prohibited freq. 3 - Factory Setting = 0 Hz.; Range = 0 - 400 Hz
Fn68 = Setting prohibited freq. range (bandwidth) - Factory Setting = 0 Hz.; Range = 0 - 400 Hz

Fn65 - Fn68 can be used to program up to three prohibit frequency control ranges. These can be used to prevent mechanical oscillation that may occur at certain frequencies. Fn65 - Fn67 determine the three distinct frequency setpoints to be avoided by the drive. Fn68 defines the band width around these frequencies to be avoided by the drive. For example:

When Fn65 = 10.0 Hz, Fn66 = 20.0 Hz, Fn 67 = 30.0 Hz, Fn68 = 2.0 Hz
The skip freq. ranges are: 10 Hz ± 2 Hz = 8 - 12 Hz
20 Hz ± 2 Hz = 18 - 22 Hz
30 Hz ± 2 Hz = 28 - 32 Hz

Electronic Thermal Protection (motor and drive)

Fn69 - Fn71 define the thermal protection schemes to be used to protect the drive and the motor.

Fn69 = Factory Setting = 0000

Controls four parameters of motor protection. The first digit controls whether motor protection is provided by the drive or by another outside source.

XXX0: Electronic thermal motor protection effective

XXX1: Electronic thermal motor protection ineffective

The second digit controls whether the thermal protection curve is variable for a standard fan cooled motor or constant for a drive duty, constantly cooled motor.

XX00: Electronic thermal characteristics in accordance with standard fan cooled motor

XX10: Electronic thermal characteristics in accordance with drive duty motor

The third digit controls whether the motor overload protection curve is for a constant torque or variable torque application. When Fn69 = XX0X and Fn05 = 18, set Fn37 to the rated frequency of motor to ensure accurate thermal protection for the motor.

X0X0: Motor protection OL for constant torque : 103% continuous. 150% for one minute

- When motor output current exceeds 103% motor protection electronic thermal characteristics start operating. Motor protection (OL1) allows operation at 150% for one minute before shutting off drive output.

X1X0: Motor protection OL for variable torque: 113% continuous. 123% for one minute

- When motor output current exceeds 113% motor protection electronic thermal characteristics start operating. Motor protection (OL1) operates at 123% for one minute to shut off drive output (refer to curve (1) of Fig.21).

The fourth digit determines the mode of operation of the drive after an overload condition has been detected.

0XX0: Free run (coast) to stop after electronic thermal motor protection is energized

- To allow the motor to coast to a stop program Fn69 = 0XX0. After the electronic thermal motor protection is energized the drive will baseblock immediately and the display will blink OL1. To start the drive it is necessary to press RESET key or turn on the remote control RESET terminal.

1XX0: Operation continued after electronic thermal motor protection is energized. Allows the motor to continue to run after the overload condition is detected.

After electronic thermal motor protection is energized, the drive will continue running and start blinking OL1 until current is lower than 103% or 113%, depending on the setting of Fn69. See the following graphical representations of the effect of programming Fn69 on the electronic thermal motor overload curves.

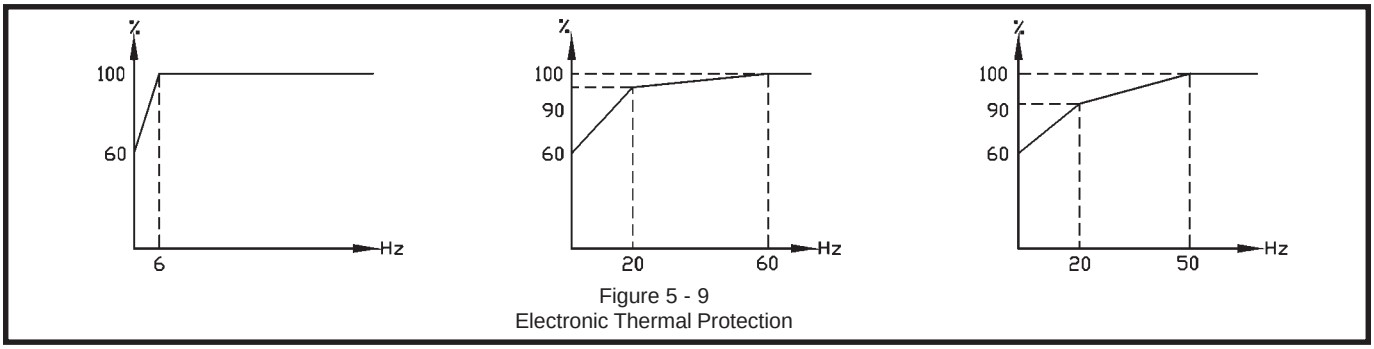


Figure 5 - 9
Electronic Thermal Protection

Fn70 = Electronic thermal overload reference current (motor rated current)

Defines the motor rated current for the drive to set up the overload protection curves as well as for slip compensation. Program the motor rated current (FLA) into Fn70.

Fn71 = Drive Overload Protection

XXX0: Free run (coast) to stop after electronic thermal drive protection is energized

XXX1: Operation continued after electronic thermal drive protection is energized

Fn71 determines the mode of operation of the drive after an overload condition has been detected. After electronic thermal drive protection is energized, the drive will baseblock immediately and the keypad will blink OL2. To start the drive, it is necessary to press RESET key or turn on the remote control RESET terminal. After the electronic thermal drive protection is energized, the drive will continue to run and the keypad will start blinking OL2 until current is lower than 110% rating.

Torque Boost Control

Fn71 =X0XX: Torque boost Enable

X1XX: Torque boost Disable

Note: Fn72 is only active with this feature activated.

Fn72= Torque compensation gain - Factory Setting = 0.0%;
Range = 0.0% - 10.0%

Allows the customer to manually define the amount of torque boost the drive puts out to the motor.

Fn73 = Reserved
Fn74 = Reserved

Slip Compensation

Fn75 and Fn76 can be used to allow the drive to automatically adjust the PWM (Pulse Width Modulation) output to control motor slip to the value specified by the motor manufacturer. Program Fn75 to the value of motor current in a no load condition.

Fn75 = Motor no load current
Fn76 = Motor rated slip - Factory Setting = 0.00 Hz;
Range = 0.00 - 6.00 Hz

Program Fn76 to the value of motor rated slip as calculated by the following formula:

Fn76 = (Fn36*/120) X (motor asynchronous speed**-motor rated speed)

*Fn36 = motor poles (2, 4, 6, etc.)

**motor asynchronous speed (RPM) = 120/Fn36 X motor rated frequency (50 or 60 Hz)

The adjustment to the PWM output control is calculated internally by the drive as follows:

Slip compensation frequency = [(output current - Fn75)/(Fn70 -Fn75)] X Fn76

*Fn70 = motor rated current

Overtorque Control

Fn77 - Fn79 define the characteristics of the drive's overtorque control. The drive will detect an overtorque condition if the motor current is above the detection level defined by Fn78 for the time defined by Fn79.

Fn77 = Overtorque Control - Factory Setting = 0000

The first digit defines whether overtorque detection is to be enabled or disabled.

XXX0: Overtorque detection disabled

XXX1: Overtorque detection enabled

The second digit defines whether overtorque detection is active only when drive is running at constant speed or if overtorque detection is always active regardless of whether the drive is accelerating, decelerating or at constant speed.

XX01: Enabled only if at set frequency (running at constant speed)

XX11: Enabled during operation (during acceleration, deceleration or constant speed)

The third digit defines whether drive operation is to be stopped or continued after an overtorque condition has been detected.

X0X1: Operation continued after overtorque is detected - (the drive will continue to run and the keypad will start blinking OL3 until output current is lower than Fn78 setting.)

X1X1: Free run to stop after overtorque is detected (- the drive baseblocks immediately and the display blinks OL3. To start running, press RESET key or turn on remote control RESET terminal.)

Fn78 = Overtorque detection level - Factory Setting = 160%; Range = 30 - 200%

Fn79 = Overtorque detection time - Factory Setting = 0.1 sec.; Range = 0 - 25 sec

Note: When Fn61 = 05 (N.O.) or 11 (N.C.) the multifunction output terminal (TM2-11) functions as an overtorque detection output. Overtorque detection output signal is available only if overtorque function is enabled (Fn77 = XXX1).

S-Curve Parameters

An S-curve function is available. The S-curve function provides a smooth ramp into and out of the accel/decel mode. It lessens the mechanical shock to the systems when a change of speed command is performed by the drive.

Fn80 = S-curve time 1 in the period of Accel/Decel time 1 - Factory Setting = 0.2 sec.; Range = 0 - 4 sec.

Fn81 = S-curve time 2 in the period of Accel/Decel time 2 - Factory Setting = 0.6 sec.; Range = 0 - 4 sec.

Program Fn80 and Fn81 to the time required by the application to ramp into and out of the accel/decel rate. A setting of 0 disables the S-curve. The total accel/decel time will increase by the values programmed into Fn80 and Fn81. S-curve 1 or 2 can be controlled by a control signal from the external input terminal (Tm2 pins 6,7 or 8) as long as Fn56 - Fn58 is programmed as a 4 (N.O.) or 20 (N.C.).

Energy Savings Control

Fn82 and Fn83 provide energy savings for variable torque applications. In variable torque applications the load is usually a high inertia load that requires large starting torques but lower running torque.

Fn82 = Defines when and if energy savings capability is available. To monitor energy savings change Fn47 = 0001 which will display output voltage on keypad.

XX00: Energy savings disabled

XX01: Energy savings controlled by multi-input terminals only at set frequency.

Enable energy savings mode through the multifunction input terminal (TM2 pins 6 - 8). In this mode, if the multifunction input terminal is on the output voltage will decrease gradually (to previous output voltage X Fn83). When the input terminal is off, output voltage will go up to previous voltage gradually. To program one of the multifunction input terminals to an energy savings enable switch, program Fn56 - Fn58 = 8 (N.O.) or 24 (N.C.).

Fn83 = Energy saving gain - Factory Setting = 80%; Range = 0 - 100%

Fn83 determines the gain (voltage level) at constant speed during energy savings mode. Adjust Fn83 to a value that provides minimum motor current draw at constant speed.

Process Time Parameters

Fn85-Fn91 define the process timer functions. These parameters are only available if one of the multifunction digital input switches (SP1, SP2 or SP3) is defined as a process timer initialization switch.

Fn 17 - Fn 23 = 0-400 Hz

Fn84 = Sequence Control - Factory Setting = 0000

XXX0: Process timer disabled

XXX1: Process timer enabled

XX0X: Set frequency output after process timer finishes counting

XX1X: Zero speed output after process timer finishes counting

Fn 85 - Fn 91 = Process timer 1 - Process timer 7 -
Factory Setting = 0 sec.; Range = 0 - 3600 sec:

There are two timer functions for which Fn17 - 23 are the preset speeds:

In the first timer function, if Fn84 = XXX1 and Fn56 to Fn60 = 0 - 2 (N.O.) or 16 -18 (N.C.) then this changes the multifunction input switches from preset speed contacts to timer input contacts. When Fn84 = XXX1 and Fn56 - Fn60 = 0 - 2 (N.O.) or 16 - 18 (N.C.) and a pulse signal is received on the multifunction input, the drive will run at the time specified by Fn85 - Fn91 at the frequency specified by Fn17-Fn23. After the time has elapsed, the drive will return to the frequency set by keypad, or external analog signal input, depending on the programming of Fn11. (See Figure 5 - 10.)

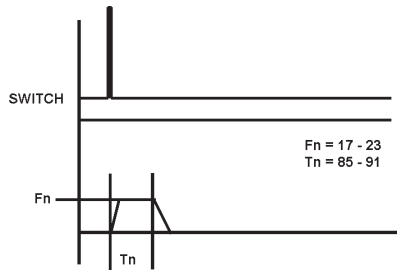


Figure 5 - 10A
1st Process Time Parameter

In the second timer function, if Fn84 = XXX1 and Fn56 - 60 = 14 or 30, then this changes the multifunction input to an automatic cycle initialization contact. When the contact is momentarily made on TM2 the drive will go to the speed of Fn17 for time of Fn85, then will go to speed of Fn18 for the time of Fn86. This continues through the seven preset speeds of Fn17 - 23 for the seven preset times of Fn85 - 91. After the timed cycle has elapsed the drive will return to frequency set by keypad, or external analog signal input, depending on the programming of Fn11. (See Figure 5 - 11.)

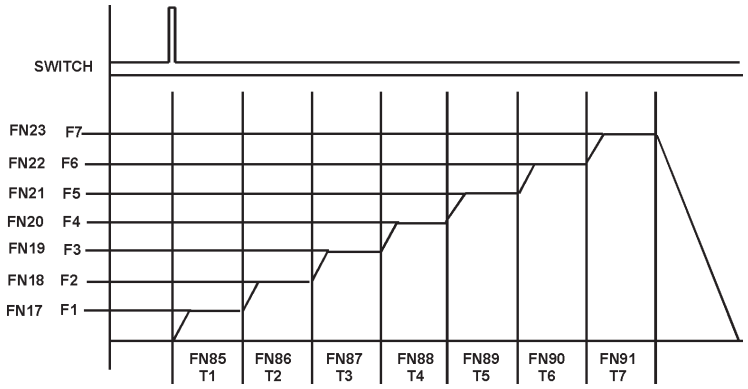


Figure 5 - 10B
2nd Process Time Parameter

Note: *A new speed setting or timer setting cannot be inserted into an ongoing timer and speed function. The priority of the preset speed signals is as follows: Jog >> Multiple Speed >> Digital Operator. The jog contact has the highest priority and the digital operator has the lowest priority.*

Vibration Prevention Control

Fn92-94 minimizes the system mechanical vibration that is connected to the motor.

Fn92 = Vibration prevention times (Units = 2mS) - Factory Setting = 5; Range = 1 - 100

Determine the vibration cycle and adjust Fn92 to 1/4 of the vibration cycle to minimize oscillation. To determine the optimum setting for Fn92 use the following formula:
Fn92 = [Vibration Time(mSEC)/8]

Fn93 = Vibration prevention gain - Factory Setting = 0%; Range = 0 - 100%

Minimizes the magnitude of the mechanical vibration at full load.

Fn94 = Vibration prevention bias - Factory Setting = 0%; Range = 0 - 30%

Minimizes the magnitude of the mechanical vibration at no load.

Fn95 = Reserved
Fn96 = Reserved

Fault Contact Control - Factory Setting for Fn97 & Fn98 = 0000

Fn97 - Fn98 define the fault contact on TM2 pins 1 and 2 and what fault contact the application requires.

Fn97 =XXX0: Fault contact is *not* energized during auto restart operation after any fault (excluding OL faults).
XXX1: Fault contact is energized during auto restart operation after any fault (excluding OL faults).
XX0X: Fault contact is *not* energized during momentary power loss detection.
XX1X: Fault contact is energized during momentary power loss detection.
X0XX: Fault contact is *not* energized after external emergency stop signal is received.
X1XX: Fault contact is energized after external emergency stop signal is received.
0XXX: Fault contact is *not* energized during external baseblock.
1XXX: Fault contact is energized during external baseblock.

Fn98: XXX0: Fault contact is *not* energized after overtorque (OL3) is detected.
XXX1: Fault contact is energized after overtorque (OL3) is detected
XX0X: Fault contact is *not* energized after electronic thermal motor protection (OL1) is acting.
XX1X: Fault contact is energized after electronic thermal motor protection (OL1) is acting.
X0XX: Fault contact is normal open (N.O.).
X1XX: Fault contact is normal closed (N.C.).
0XXX: Fault contact is *not* energized after electronic thermal drive protection (OL2) is acting
1XXX: Fault contact is energized after electronic thermal drive protection (OL2) is acting

Fn99: Reserved

Communication Mode

Fn100 - Fn102 define the communication parameters of the drive.

Fn100 = Communication identification number - Factory Setting = 1; Range = 1 - 32

Fn100 provides an identification number to each individual drive for communications. When using more than one drive in a communications loop, ensure that each individual drive has a unique identification number programmed into Fn100. Having more than one drive in a communications loop with the same ID number will cause communications conflicts.

Fn101 = Baud rate of communication - Factory Setting = 1; Range = 0/1/2 (4800/9600/19200)

Fn101 defines the baud rate of communication between drives and the host computer. Ensure that all devices in a communication loop are programmed to the same baud rate.

Fn102 = Communication agreement - Factory Setting = 1100; Range =

XXX0: 1 stop bit
XXX1: 2 stop bits
XX0X: Even parity
XX1X: Odd parity
X0XX: Without parity
X1XX: With parity
0XXX: 8 bits data
1XXX: 7 bits data

Fn102 defines for the drive the characteristic of the communication string. There are basically two styles of communication that can be performed with the drive. Using the RS485 Kit, up to 32 drives can be connected to one host computer for control. Using the RS232 Kit, one drive can be connected to a host computer for both control and programming functions. Software exists for both modes using a standard PC as the host computer. If the application requires custom programming, copies of the drive protocol can be obtained from Motortronics

Fn103 - Fn122 = Reserved

Fn123 = 1111: Revert to Factory Setting

The parameters of the drive can be set back to factory settings (with the exception of Fn0, 5, 6, 30, 100-106, 124) by programming Fn123 = 1111.

Fn124 = CPU Version

The CPU version is factory set. **Do not change this information.**

Fn125 = Fault Sequence Reference

To assist in troubleshooting, the drive remembers the last three fault codes automatically in its EEPROM memory. Once in Fn125, depressing the increase (∆) and decrease (∇) keys on the keypad will display the last three faults recorded. Refer to the fault code indication in this manual for an explanation of possible causes of these faults and possible solutions.

Chapter 6 - Initial Start Up

This chapter deals with the basic start up of the drive. The procedures range from the first power off checks to actual motor operation. It assumes all of the program settings are left at the factory values.

WARNING!

This chapter deals with potentially lethal voltage levels. You must be certain that personnel are thoroughly trained in the applicable safety precautions before proceeding with this section! Always make sure the keypad display is off, the red charge LED on the PC board is off and the DC bus is completely discharged before adding or changing wiring!

6.1 Checks Before Power up

Please check these points before you apply power to the drive:

- Confirm the input power wiring is connected to terminals L1, L2, L3 or L1, L2 for single-phase input applications (L1/L3 for CSD-230).
- **Warning: DO NOT connect the incoming power to the drive output terminals. The unit will be damaged!**
- Verify the incoming line voltage is within the unit's specifications and is balanced to within 2%. If not, add an AC input line reactor to prevent possible drive damage (3% impedance, minimum).
- Confirm the motor wiring is connected to terminals T1, T2, T3 and free from grounds.
- Make sure there are no loose wire strands.
- Be sure all screw connections are tight.

6.2 Checking Motor Rotation

CAUTION!

If possible, you should uncouple the motor from the driven machinery to prevent system damage if the motor is turning in the wrong direction. The three-phase, AC induction motor may rotate either clockwise or counterclockwise, depending upon the phase sequence of the applied power. Before you run the machine, you must first check the direction of the motor rotation. This is best accomplished by giving a brief jog command. If the rotation is wrong, you should remove power from the drive, wait for the charge lamp to turn off and switch any two of the three motor leads.

Note: *Switching the input power leads feeding the drive unit will not change direction of motor rotation.*

KEYPAD INPUT - Checking for Motor Direction of Rotation	
Key Sequence	***Description***
	Apply input power
Press ∧, ∨, <	Sets frequency to 5 Hz
Press RUN/STOP	Unit will accelerate to 5 Hz Note direction of rotation
Press RUN/STOP Mode Key	Unit turns off

Table 6 A - Motor Rotation Verification

Keypad Start-up

	Display Example
1. Apply AC power. After a five second power up the display will indicate as shown.	05.00 *
2. Press RUN STOP to run motor and display output frequency.	05.00
3. Press < RESET scroll to the left to select each of the four digits for the required speed. (Active digit will blink)	25.00
Press ▲ ▼ to set each of the four digits for the desired speed.	
4. Press READ ENTER to enter the data into the drive. This will cause the motor to accelerate to the desired speed.	25.00
5. Press FWD REV to decelerate to zero speed and accelerate up to set speed in the *opposite* direction.	25.00
6. Press FWD REV to decelerate to zero speed and accelerate to set speed in the *forward* direction.	25.00
7. Press RUN STOP to decelerate to zero speed and stop the motor.	25.00 *

Figure 6 - 1
Keypad Operation

6.3 Keypad Operation

After the direction of motor rotation is verified you are ready to operate the drive unit from the keypad. The example in Figure 6 -1 explains the keypad operation.

*Display will blink in the stop mode.

Enabling potentiometer on keypad;
(The potentiometer on the keypad can be used to control frequency by programming Fn11 = 0001.)

6.4 Programming Terminal Strip Operation

If the keypad operation is satisfactory, you are ready to operate from the keypad or switch to terminal strip (remote) control of the unit. To do this you will need to change the following settings:

- Fn10 = 1: for terminal strip start/stop run control
- Fn11 = 2: for terminal strip signal reference control

Even though you can separate these functions to have partial control at the terminal strip and partial control at the keypad, the programming example shown in Table 6 B assumes you will control both the reference and the run/stop from the terminal strip.

TERMINAL STRIP - Turn On Motor		
Key Sequence	***Description***	***Operator Display***
	The unit is in operating mode.	Flashing
Press DSP/FUN (function) Key	The unit goes into programming mode.	Fn0
Press ∧, v, <	Access the Fn10 which controls the run/stop mode.	Fn10
Press READ/ENTER	Display shows the current function parameter.	0 (factory setting)
Press UP arrow	Change the data of Fn10.	1
Press READ/ENTER	New data for Fn10 is stored.	Flashing
Press ∧, v, <	Access the Fn11 parameter which controls the speed signal reference.	Fn11
Press READ/ENTER	Display shows current function parameter.	0 (factory setting)
Press UP arrow	Change the data for Fn11.	2
Press READ/ENTER	New data for Fn11 is stored.	Flashing

Table 6 B - Terminal Strip Power Control

Kw	Rated Motor Current		
	220V	380V	415V
.25	1.4	0.8	0.7
.37	2.1	1.2	1.2
.55	2.7	1.6	1.6
.75	3.4	2	1.8
1.1	4.4	2.6	2.6
1.5	6	3.5	3.5
2.2	8.7	5	5.0
3	11.5	6.6	6.2
4	14.7	8.5	7.5
5.5	19.8	11.5	11
7.5	26.5	15.5	14
11	39	22.5	21
15	52	30	28
18.5	64	36	35
22	45	43	40

HP	MOTOR FLA (Full Load Amps)			
	200V	208V	230V	460V
0.5	2.5	2.4	2.2	1.1
0.75	3.7	3.5	3.2	1.6
1	4.8	4.6	4.2	2.1
1.5	6.9	6.6	6.0	3.0
2	7.8	7.5	6.8	3.4
3	11.0	10.6	9.6	4.8
5	17.5	16.7	15.2	7.6
7.5	25.3	24.2	22	11
10	32.2	30.8	28	14
15	48.3	46.2	42	21
20	62.1	59.4	54	27
25	78.2	74.8	68	34
30	92	88	80	40

Table 6 C - Motor HP & Kw

6.5 Remote Operation

The drive unit is now ready for terminal strip control.

1. Set the speed reference command to zero.
2. Start the drive.
3. Slowly increase the speed potentiometer to full speed.
4. Stop the unit and proceed to Section 6.6 for parameter programming for the specific application. For further detailed descriptions of parameter programming see Chapter 5.

6.6 Initial Programming

This section details recommended programming. The ***CSD Series*** is provided with factory preset parameters that are suitable for most applications. Review the factory settings for each parameter before making any changes. Factory settings are noted in each of the following sections.

6.6.1 Motor Overload

Factory Setting:
Fn70 = Depends on model (Refer to chart at right)
Fn69 = 0 (Standard Motor)
This function allows you to enter the motor current into the CSD for proper thermal motor protection. Check your motor name plate for exact FLA. For your convenience, approximate standard motor FLAs are listed in the chart to the right.

1. Program Fn70 with the motor rated current.
2. Program Fn69 to:

Standard motor = 0000
Drive duty motor = 0010

Note: *Motortronics recommends that, whenever possible, the application use an "drive duty" motor to prevent premature failures specific to variable speed applications. See Chapter 1 - Introduction, Section 1.4.4 for more information.*

6.6.2 Setting V/f Pattern

Factory Setting: Fn05 = 9
If it is not a general purpose, 60 Hz application, program Fn05 as indicated in the chart to the right.

There are four basic types of loads:

- General Purpose - loads not covered by the categories listed below. Most applications work well with this V/f pattern.
- Variable Torque - centrifugal fans, pumps and blowers
- Constant Torque - conveyors
- Constant HP - cutting or machine tools

6.6.3 Momentary Power Loss Ride-thru

Factory Setting: Fn31 = 0.5 seconds (Range: 0-2 seconds)
Fn32 = 0 (Disabled)
If momentary power loss is common and the application requires continual running through these lapses:

1. Program Fn31 = 2 (seconds)
2. Program Fn32 = 1 (enables ride-thru)

If the drive continues to trip, enable the auto restart function. See Section 6.6.4

6.6.4 Auto Restart After Fault Trip

Factory Setting: Fn16 = 0000 (Restart disabled)
Fn34 = 0 (Restart interval. Range: 0-800 sec.)
Fn35 = 0 (Number of attempts. Range: 0-10)

Warning! **If the Auto Restart feature is enabled, it is strongly recommended that warning stickers be placed on the drive and in the operating area indicating that the equipment may automatically start!**

The unit can be programed to automatically attempt a restart after a fault condition.
Example:
1. Program Fn16 = 0010 (Restart enabled. See warning)
2. Program Fn34 = 2 (2 second interval)
3. Program Fn35 = 10 (10 tries)

6.6.5 Reset Parameters to Factory Settings

Factory Setting: Fn123 = 0000
The unit can be reset to factory settings by programming Fn123 = 1111.

Note: *The following parameter settings are not affected by a reset to factory settings:*
Fn00 = Factory use only
Fn05 = V/f pattern (see section 4.2)
Fn06 = Frequency output upper limit (factory set at 60 Hz. See section 5.3 page 30)
Fn30 = Supply voltage (factory set depending on the unit rating)
Fn100 - 106 and Fn124 = Communications (ID, baud rate, etc.)

6.6.6 Voltage of Power Supply

Fn30: Adjust Fn30 to reflect the power supply voltage

6.7 Jumper Selection for Analog Frequency Signal

Change the jumper position as required for the type of analog signal. (See page 18 for jumper location)
1. 0-5 VDC or Potentiometer control, shorting pants on JP1 Pin 1 and 2
2. 4 -20 mA control, shorting pants on JP1 Pins 2 and 3
3. 0 - 10 VDC control, shorting pants on JP2 Pins 2 and 3

Motor Rated Freq.	Type of Load	Set Fn05 to:
60 Hz	General Purpose	9
	Variable Torque	13
	Constant Torque	11
	Constant HP	16
50 Hz	General Purpose	0
	Variable torque	4
	Constant Torque	2
	Constant HP	7

Table 6 D - Type of Load

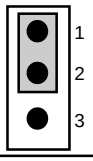
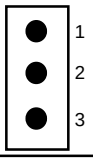
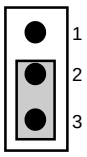
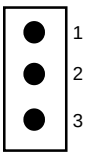
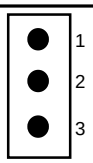
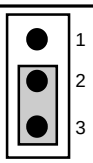
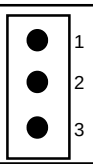
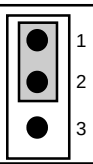
(JP1) Jumper 1	(JP2) Jumper 2	Remote Freq. Command Signal
		0 - 5 VDC Analog Signal or 10k Ohm Potentiometer - (Factory Default)
		4 - 20 mA Analog Signal
		0 - 10 VDC Analog Signal
		Not Used

Figure 6 - 2 Function of Jumper (Shorting Pants)

Chapter 7 - Failure Indication

7.1 Failure which cannot be manually reset.

Fault Code	Content	Probable Cause	What to Do
CPF	CPU software error	High electronic noise	Install RC type suppressor on all contactor/brake coils See section 3.5.2
EPR	EEPROM error	EEPROM is damaged	See Section 7.6
-OV-	Over voltage in stop mode	Detection circuit is damaged	See Section 7.6
-LV-	Low voltage in stop mode	1. Input voltage is too low 2. Current limit resistor (R1) or fuse burned out - 400V series units only 3. Detection circuit is damaged	1. Correct input voltage 2. Change current limit resistor or fuse 3. See Section 7.6
-OH-	Heatsink overheat in stop mode	1. Detection circuit is damaged 2. Ambient temperature is too high or ventilation is not good	1. Limit ambient temperature, clean heatsink fins or improve ventilation 2. See Section 7.6

7.2 Special Condition Indication

Fault Code	Meaning	Example
STP0	Zero speed stop	Indicates that RUN command exists but the frequency selected is 0 HZ. Increasing the frequency set point will eliminate this fault indication.
STP1	Direct start disable	Indicates that Power was applied to the drive with an existing Start command. To clear, remove and reapply start command. Change Fn16 to 0000 to run the CSD on Power up.
STP2	Emergency stop via STOP key command	1. Emergency stop via digital operator in remote control mode (Fn10 = 0001) by pressing the STOP key (Fn = 0000). Once STOP key is pressed during operation, the CSD will stop per the setting in Fn44 and display STP2. The CSD will not restart until the power is turned off and then turned on again.
		2. If the CSD is under communication control and Fn48 = 0, once STOP key is pressed, the CSD will stop per the setting in Fn44 and display STP2. The CSD will not restart until the computer sends a STOP command followed by a RUN command.
		3. STOP key cannot be used for emergency stop when Fn48 = 0010.
E.S.	Emergency stop via remote control command	Emergency stop via remote control mode (multifunction input terminals). The CSD will decelerate to stop and display E.S.
b.b.	External baseblock	External lockout signal trips unit via multifunction digital input terminal.

7.3 Failure which can be auto reset or manually reset.

Fault Code	Meaning	Probable Cause	What to do
OC-S	Over current during start	1. Motor is shorted. 2. Motor is grounded. 3. Transistor module is damaged.	1. Inspect and repair motor. 2. Remove grounding point. 3. Set Fn12 = 0000. 4. See Section 7.6.
OC-A	Over current during acceleration	1. Acceleration time is set too short. 2. Wrong V/f pattern selection. 3. Motor exceeds unit rating.	1. Extend acceleration 2. Select correct V/f pattern 3. Select a larger HP unit. 4. Set Fn12 = 0000.
OC-C	Over current during constant speed	1. Transient load changes 2. Input voltage changes	1. Check load condition. 2. Install a reactor between the power supply and the drive. 3. Set Fn12 = 0000.
OC-D	Over current during decel	1. Deceleration time is set too short	1. Extend deceleration time.
OC-B	Over current during braking	1. Braking frequency is set too high. 2. Braking voltage is set too high. 3. Braking time is set too long.	1. Reduce braking frequency. 2. Lower braking voltage. 3. Shorten braking time.
OV-C	Over voltage during constant speed operation	1. Deceleration time is set too short or load inertia is too high. 2. Input voltage fluctuations.	1. Extend deceleration time. 2. Correct the line voltage problem.
LC-C	Low voltage during constant speed	1. Input voltage is too low. 2. Input voltage fluctuations.	1. Correct input voltage. 2. Correct line voltage.
OH-C	Overheat during constant speed	1. Load is too great. 2. Ambient temperature is too high or ventilation is poor.	1. Check load condition. 2. Limit ambient temperature or clean drive fins.
OH1*	Braking resistor overload	1. Deceleration time is too short. 2. Frequent stopping. 3. Excessive load.	1. Extend deceleration time. 2. Extend run/stop cycle. 3. Increase resistance and wattage

Note: When braking resistor is overloaded during deceleration, the drive will stop braking and will display OH1. When heat is dissipated, OH1 will disappear and the drive will start braking again.

7.4 Failure which can be manually reset, but cannot be auto reset.

Fault Code	Meaning	Probable Cause	What to do
-OC-	Over current during stop mode	Detecting circuit failure	1. Set Fn12 = 0000 2. See Section 7.6
OL1	Motor overload	1. Excessive load 2. Incorrect V/f pattern selection 3. Incorrect motor FLA current selection	1. Select a larger HP unit 2. Select correct V/f pattern 3. Program correct motor FLA in drive
OL2	Drive overload	1. Excessive load 2. Incorrect V/f pattern selection	1. Select a larger HP unit 2. Select correct V/f pattern
OL3	Overtorque	1. Excessive load 2. Incorrect V/f pattern selection	1. Select a larger HP unit 2. Select correct V/f pattern

7.5 Operation Error Indications

Fault Code	Meaning	Probable Cause	What to do
LOC	Parameter / Frequency / REV / direction is locked	1. Tried to change parameter/ freq. that has been parameter protected by the user. 2. Tried to run in reverse direction when reverse is disabled.	1. Set Fn04 = 0 to disable protection 2. Set Fn03 = to enable REV
Err1	Operation Error	1. Tried to change freq. with keypad when CSD was set to remote freq. control. 2. Tried to change Fn124 (CPU). 3. Tried to change functions which cannot be changed	1. Set Fn11 = 0000 to return control to keypad 2. Fn124 (CPU version) cannot be changed 3. Change the functions in Stop mode only
Err2	Setting Error	Parameters set improperly	1. Reset parameters (return to factory presets if neccessary) 2. Consult factory
Err3	Setting Error	Parameters set improperly	1. Reset parameters (return to factory presets if neccessary). 2. Consult factory.
Err4	Setting Error	Incorrect programming of custom V/f pattern	Fn37 > Fn39 > 0.1 Hz
Err5	Parameter Setting Error	1. In disabled mode 2. Changed Fn01 or Fn102 during communication	1. Multifunction input switch programmed as communication disable switch is closed. Open switch before trying to reintialize communication 2. Fn101, Fn102 should be changed before attempting communication
Err6	Comm Error	Shorting jumpers not on pins 1&2 of Con7	Place jumpers on pins 1 & 2 of Con 12

7.6 One Final Fault Note

If the circuit breaker did not trip, remove power, wait 1 minute, reapply power and see if the trip condition clears. If the condition has not cleared, replace the drive. When replacing fuses, CSD drives rated 240VAC ≥ 2HP and all 480 VAC units have a DC bus line fuse. If the fuse opens due to a fault condition on the output of the drive, care must be used in replacing the fuse. **ONLY USE THE EXACT FUSE IN REPLACEMENT! MAKE SURE THE DC BUS IS TOTALLY DISCHARGED BEFORE REPLACING THE FUSE! FAILURE TO OBSERVE STANDARD SAFETY PRECAUTIONS COULD RESULT IN INJURY OR DEATH!**

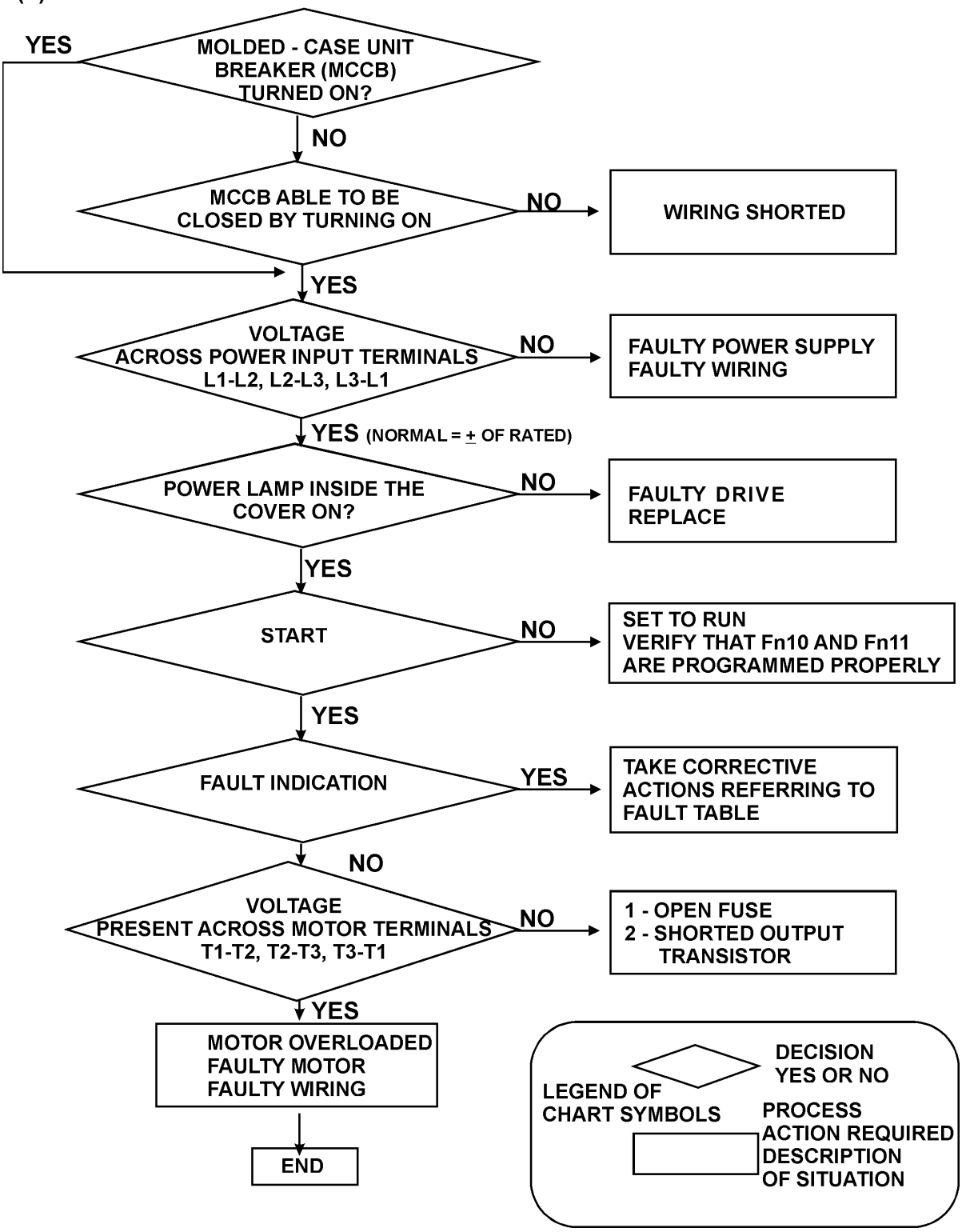
Chapter 8 - Troubleshooting

8.1 General Troubleshooting

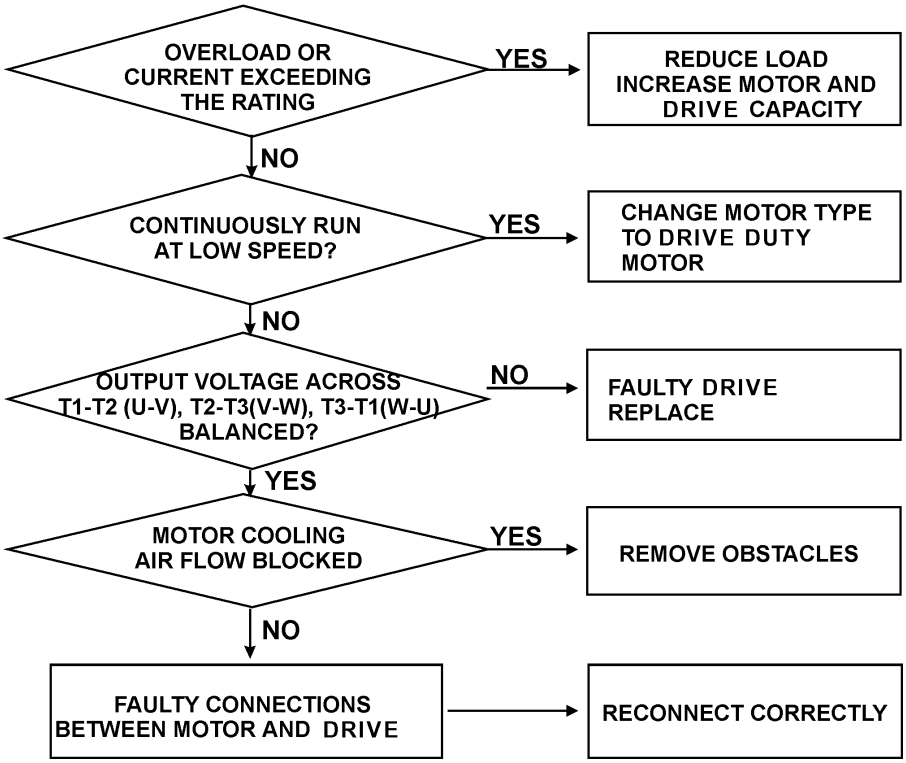
If the drive malfunctions, find the cause and take the corrective actions by following the flowcharts. If the cause cannot be located in the flowcharts contact MOTORTRONICS.

8.2 Power Section Troubleshooting

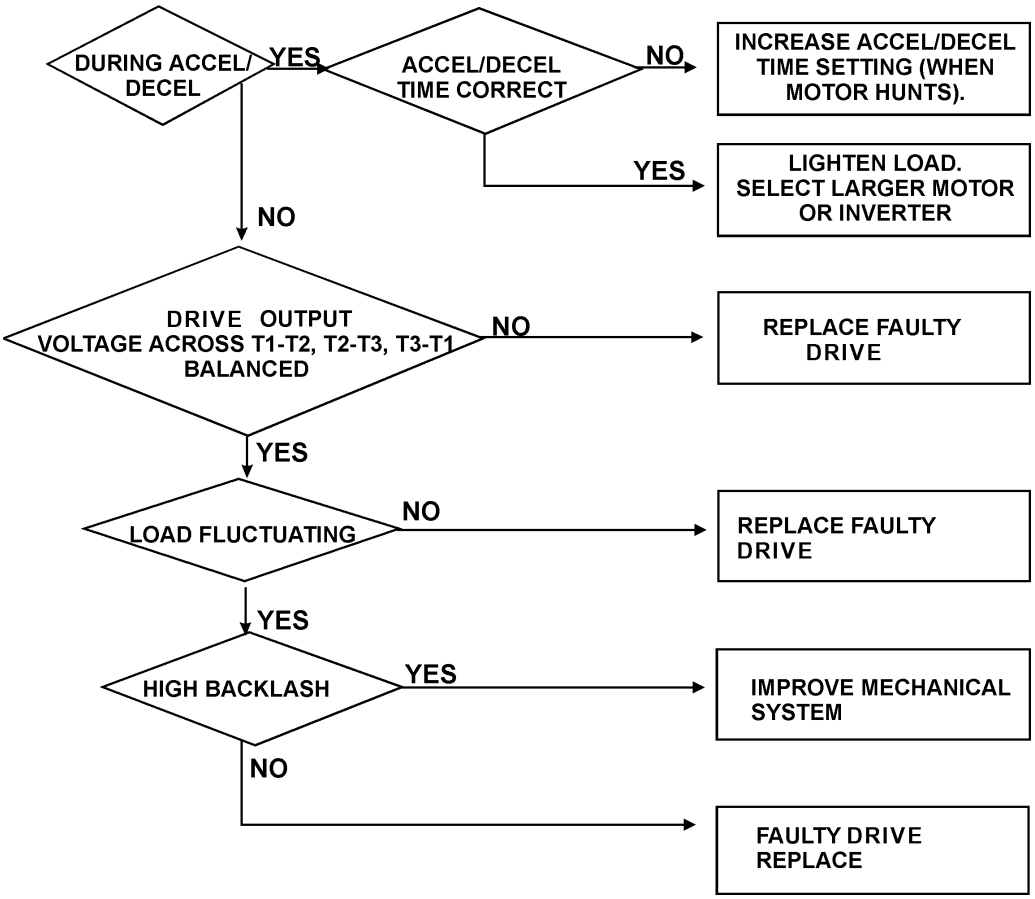
(1) MOTOR WILL NOT RUN



(2) MOTOR OVERHEAT



(3) MOTOR HUNTING / OVER CURRENT TRIP



Warning!

The following power section checks are power-off tests. You should remove the incoming power, wait for the red charge lamp to go out and then disconnect the power leads on terminals L1, L2, L3 and T1, T2, T3. Note: Digital VOMs will give false ohmic readings so they are unacceptable for the following tests. You can, however, use these digital meters if they have a diode tester (forward conduction voltage measurement). The following table gives good and bad readings for each power component. Using the diode check mode of the meter is preferable.

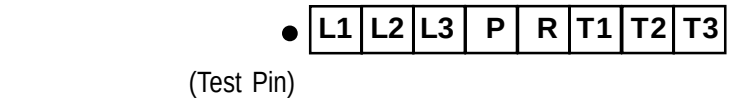


Figure 8 - 1
Sample Terminal Locations
(See Figure 3 - 5 for other terminal arrangements)

P = Positive of DC Bus

Component	Positive Lead	Negative Lead	Good (Ohm/VDC)	Bad (Ohm/VDC)
Output Transistors	T1, T2, T3	P	5-10 Ohms/0.3-0.6 VDC	0 Ohms/OVDC
	P	T1, T2, T3	Infinite Ohms	0 Ohms/0.1 VDC or less
	T1, T2, T3	Test Pin (N)	Infinite Ohms	0 Ohms/0 VDC
	Test Pin (N)	T1, T2, T3	5-10 Ohms/0.3-0.6 VDC	0 Ohms/0 VDC
Input Rectifiers	L1, L2, L3	P	5-10 Ohms/0.3-0.6 VDC	0 Ohms/0 VDC
	P	L1, L2, L3	Infinite Ohms	0 Ohms /0.1 VDC or less
	L1, L2, L3	Test Pin (N)	Infinite Ohms	0 Ohms /0.1 VDC or less
	Test Pin (N)	L1, L2, L3	5-10 Ohms/0.3-0.6 VDC	0 Ohms/0 VDC

Table 8 A - Power Connection Troubleshooting

8.3 Maintenance

The ***CSD Series*** drive requires no routine checks. It will function efficiently and its normal operation lifetime will be longer if it is kept clean, cool and dry. However, loose electrical connections will cause overheating, so the electrical connections should be checked ocassionally and look for any discoloration or other evidence of overheating.

WARNING!

During service inspection, turn off AC main circuit power and wait for charging indicator LED 101 to extinguish (at least 10 minutes) before touching any circuit components. Also ensure there is no DC voltage present before servicing the DC bus. Failure to adhere to this warning could result in serious or lethal injuries!

8.3.1 Mega Test

Check for tightness of electrical connections, discoloration or other signs of overheating. During service inspection, turn off AC main circuit power and wait for charging indicator LED 101 to extinguish (or at least 10 minutes) before touching any circuit components. Failure to adhere to this warning could result in serious or lethal injuries.

1. Clean up internal dust and dirt
2. Check for tightness of electrical connections.
3. Do Mega test
   a. Remove all connection wires from the complete unit when doing the Mega test.
   b. Connect all T & L leads together with jumper wire.
   c. Mega test can only be applied on main circuit.
   Note: Never do the Mega Test on control circuit. The insulation resistance of DC500V tester should be more than 5M ohm after completing this test.
   d. After completing test, remove jumpers installed in step (b).
   e. Reconnect all removed wires in step (a).

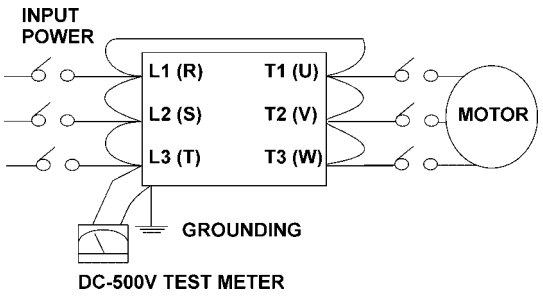


Figure 8 - 2
Mega Test

8.3.2 Ground Fault Protection When Motor is Running

If a "ground fault" occurs while motor is running, transient surge currents will destroy the power section of CSD. The CSD offers an optional ground fault protection unit to detect the surge current and disable the output section whenever ground fault occurs.

Installation:

1. Disconnect the CSD from power source.
2. Make sure that charge lamp (LED 101) extinguishes and wait for at least 10 minutes before taking next step.
3. Thread output line (T1, T2, T3) through ground fault current transformer and connect ground faulT current to CON 4 (as shown on diagram).
4. Be sure to thread all T1, T2 and T3 through ground Fault current transformer.
   *Max cross section of T1, T2 and T3 should ≤ 7mm.

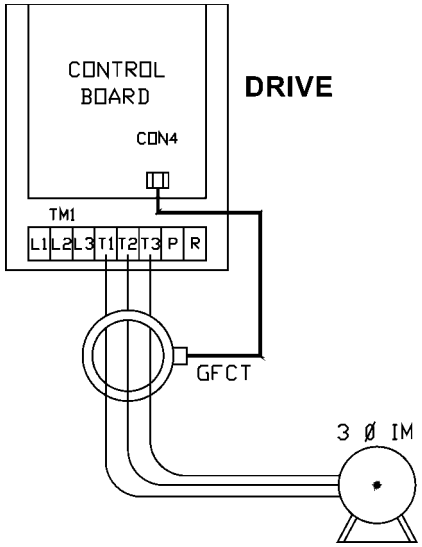


Figure 8 - 3
Ground Fault Connections

Note: Ground fault is standard on 230V, 5Hp and above, on 460V, 7Hp and above, and on all 600V units.

8.3.3 Fuse Replacement

CSD drives with 240VAC ≥ 2 HP and all 480 VAC have a DC Bus line fuse. If the fuse opens due do a fault condition on the output of the drive, care must be used in replacing the fuse. **ONLY USE THE EXACT FUSE IN REPLACEMENT! MAKE SURE THE DC BUS IS TOTALLY DISCHARGED BEFORE REPLACING THE FUSE! FAILURE TO OBSERVE STANDARD SAFETY PRECAUTIONS COULD RESULT INJURY OR DEATH!** Once the DC fuse is replaced, perform the trouble shooting procedures in Section 8.2 prior to energizing the drive.

Chapter 9 - Reference

9.1 Measurement of Voltage and Current

The procedure for measuring Primary and Secondary voltage and current will be somewhat different for VFD's because of the variety of measuring instruments and high harmonic content of the waveform. Refer to the following illustration for measurement techniques.

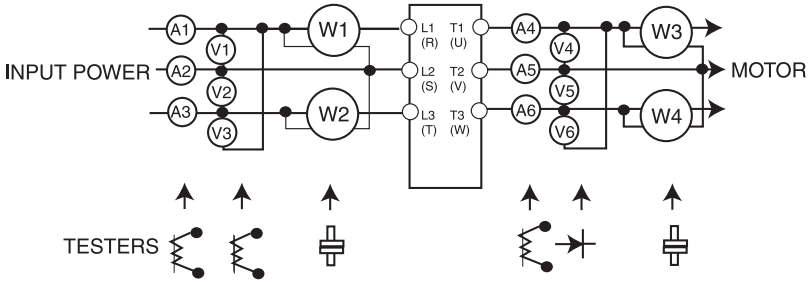


Figure 9-1 - Measuring Volage and Current

9.2 Electromagnetic Compatibility of AC Drives

Similar to all modern PWM variable speed drives the ***CSD Series AC Drives*** uses fast switching of high voltage and currents to achieve high efficiency and reduced motor acoustic noise. This results in electromagnetic interference (EMI) and radio frequency interference (RFI) that occurs at the switching frequency and harmonics of this frequency. The amount of interference is dependent on the amount of current the drive delivers to the load. For operational reasons the interference may need to be suppressed. As EMI and RFI can involve very complex coupling modes, not all solutions can be easily found.

- Practical solutions include:
- Mounting sensitive equipment at a distance from the drives.
- Providing screening and grounding on all cables, the drive motor and enclosure.
- Putting filters on the input and output sides of the drive.

Measurement	Testing Points	Tester	Remarks
Input Voltage Vi	V1 V2 V3	Moving Iron Type	
Input Current Ii	A1 A2 A3	Moving Iron Type	
Input Power Pi	W1 W2	Electrodynameter	Pi = W1 + W2
Input Power Factor PFi	$PFi = \frac{Pi}{\sqrt{3}Vi \bullet Ii} \times 100\%$		
Onput Voltage Vo	V4 V5 V6	Rectifier Type	± 3% of Maximum Output Voltage
Onput Current Io	A4 A5 A6	Moving Iron Type	Current should be under unit rated current
Onput Power Po	W3 W4	Electrodynameter	Po = W3 + W4
Output Power Factor PFo	$PFo = \frac{Po}{\sqrt{3}Vo \bullet Io} \times 100\%$		

Table 9 A - Testing for Voltage and Current

Filtering - The use of filters in suppressing EMI and RFI is aimed at preventing interference passing down power lines and changing impedance conditions so EMI on the ground system is redirected back to its source. A filter on the input side can use capacitors and chokes and has significant benefits in reducing EMI. Filters on the output must consist only of a low value choke. Positioning and installation of these devices is critical and manufacturer's guidelines should be strictly followed.

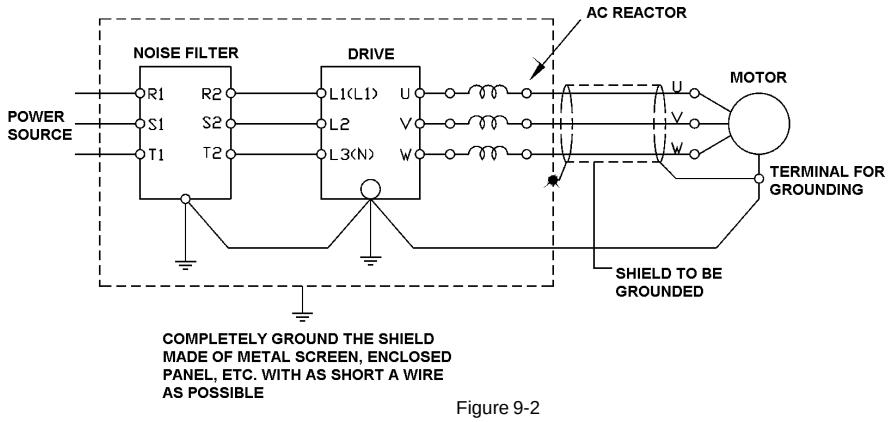


Figure 9-2
EMI/RFI Filtering

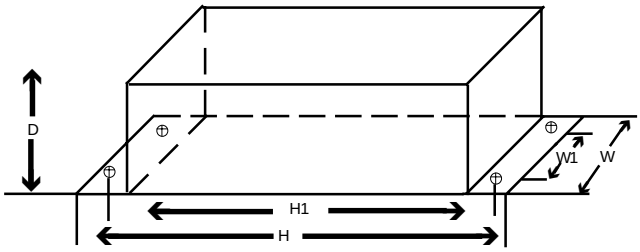


Figure 9-3
CE Filter Dimensions

Model Number	CE Filter Dimensions					
	Filter Model	Dimensions			Mounting Holes	
		H	*W*	*D*	*H1*	*W1*
CSD-2P5 CSD-201	10-CSD-201	7.8	4.49	1.18	7.2	3.78
CSD-202	10-CSD-202	9.3	6.3	1.8	8.2	5.5
CSD-203	10-CSD-203	10.4	7.7	2	9.7	6.9
CSD-401 CSD-402	10-CSD-402	9.1	6.2	1.6	8.4	5.4
CSD-403 CSD-405	10-CSD-405	10.3	7.6	1.6	9.5	6.9
CSD-205	10-16CE4	9.1	5.9	2.6	4.5	5.3
CSD-207	10-25 CE4	9.9	5.9	2.6	4.5	5.3
CSD-210	10-36CE4	9.9	5.9	2.6	4.5	5.3
CSD-215	10-50CE4	9.9	5.9	2.6	4.5	5.3
CSD-220	10-80CE4	16.8	6.7	3.5	14.8	5.1
CSD-230	10-110CE4	17.2	6.7	3.5	14.8	5.1
CSD-407 CSD-410	10-16CE5	9.1	5.9	2.6	4.5	5.3
CSD-415	10-25CE5	9.9	5.9	2.6	4.5	5.3
CSD-420	10-36CE5	9.9	5.9	2.6	4.5	5.3
CSD-430	10-50CE5	9.9	5.9	2.6	4.5	5.3

Table 9 B -CE Filter Selection Chart

Grounding - It is very important that effective EMI and RFI grounding be provided. EMI and RFI grounding provide a low HF impedance to earth.

This differs from standard safety grounding that presents a relatively high impedance to ground due to skin effect. Follow HF grounding procedures when making ground connections in these applications.

Screening - The cable from the inverter to the motor should be screened and solidly connected to both the inverter and motor using as much contact area as possible. Mounting the inverter into an grounded metal enclosure will also limit RFI. Guidelines for the positioning of filters, screening and grounding are shown on the diagram.

9.3 AC Drive Model Number Definitions

Model number	Fn-00
CSD-2P5	01
CSD-201	02
CSD-202	03
CSD-203	04
CSD-505	05
CSD-207	06
CSD-210	07
CSD-215	08
CSD-220	09
CSD-230	30
CSD-401	10
CSD402	11
CSD403	12
CSD-405	13
CSD-407	14
CSD-410	15
CSD-415	16
CSD420	17
CSD-430	18

Table 9 C - AC Drive Model Definitions

9.4 Extension Keypad Remote Cable

There are two (2) keypad sizes for the CSD series inverters. Please see Table 9 D for the appropriate extension keypad remote cable and then refer to the corresponding assembly diagram.

Model	Matched Remote Cable	Keypad
CSD-2P5 - CSD-205	CSD W300X *	NDOP-01
CSD-401- CSD-405		
CSD-207 - CSD-230	CSD W300XA *	NDOP-02
CSD-407 - CSD-430		

Table 9 D - Compatible Keypads and Cables

9.4.1 Digital Operator Remote Cable Connection (CSDW300X)

A. Plastic housing for digital operator

front side 1

rear side 3

B. Digital Operator 2

C. Remote cable 4

CSDW 3001 (1 meter)

CSDW 3002 (2 meter)

CSDW 3003 (3 meter)

D. Remote cable adapter 5

E. Accessory screws 6, 7, 8

- Turn off the power to the unit and verify that the power LED is extinguished.
- Remove the digital operator 2 and grounding wires (PE) from the unit.
- Place the digital operator 2 into plastic housing ① and ③ then use screw 8 to assemble the housing.
- Put the remote cable adapter 5 into the unit.
- Connect the remote cable terminal 4 to the digital operator, and connect the grounding wire.
- Connect the second remote cable terminal 9 to the remote cable adapter 5 and connect the grounding wire.
- Use accessory screws 6 and 7 to attach the remote operator to the panel.
- Proper grounding on the unit is necessary to prevent interference. (Grounding resistor must be less than 100 ohm, and the diameter of the grounding wire must be larger than 2mm^2.)

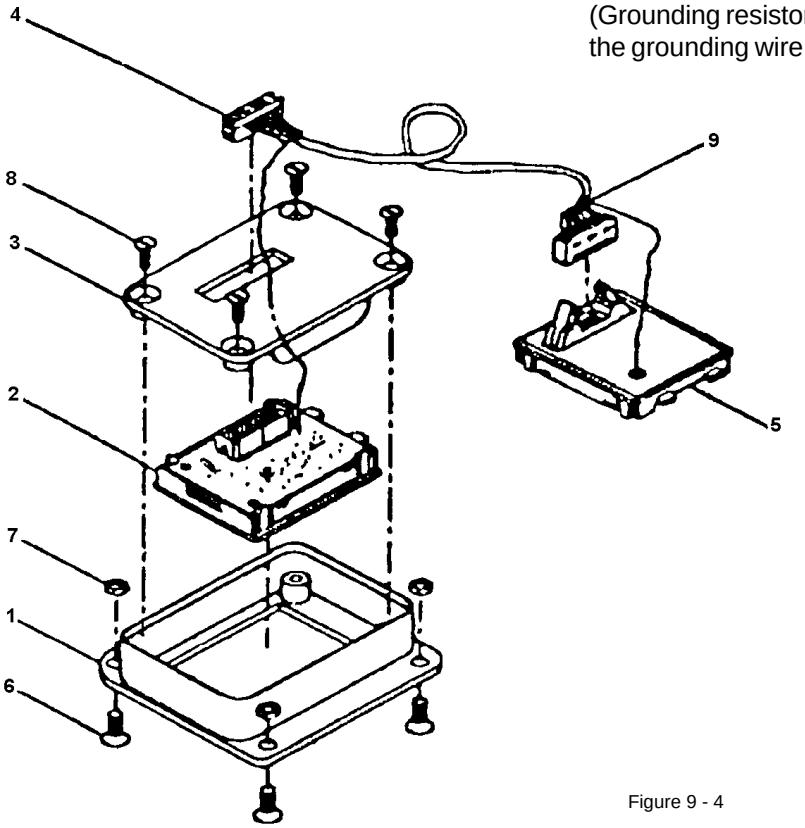


Figure 9 - 4

CSD300X Connection

9.4.2 Digital Operator Remote Cable Connection (CSDW 300XA)

A. NDOP-02 Digital Operator 1

B. Remote cable 2

CSDW 3001 A (1 meter)

CSDWW 3002 A (2 meter)

CSDWW 3003 A (3 meter)

C. Remote cable adapter 3

D. Accessory screws 4

Turn off the power to the unit and verify that the power LED is extinguished.

Remove the digital operator from unit. 1

Place the remote cable adapter into the unit. 3

Connect the both sides of the remote cable. 2

Use accessory screws to attach the digital operator to the panel. 4

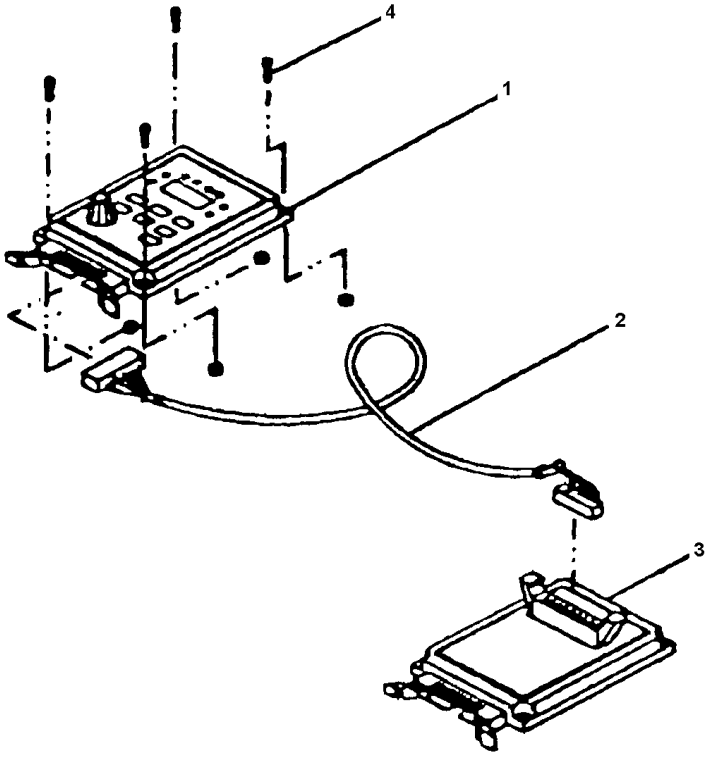


Figure 9 - 5

CSD300XA Connection

9.5 Drive Settings - The following chart may be used to record the changes made to the factory settings.

Fn XX	Function	Page	Set To	Check	Revised	Check
00	Capacity	29				
01 -02	Accel / Decel Time	29				
03	Remote Operation Select / Rev. Lockout / Initial Frequency	30				
04	Parameter Lock Select	31				
05	V/f Pattern	31				
06 - 07	Freq. Limit	32				
08 - 09	Speed Agreed Detection	32				
10	Control Mode Select	32				
11	Frequency Command Method Select	32				
12 - 15	Stall Prevention	33				
16	Drive Start and Reset	34				
17 -24	Multispeed & Timer Control	35				
25	Master Frequency	36				
26 - 29	Analog Input Frequency Command	36				
30	Power Voltage	37				
31 - 32	Momentary Power Loss	37				
33	Analog Input Signal Scan Times	37				
34 - 35	Auto Restart	37				
36	Motor Poles	37				
37 - 41	V/f Pattern	38				
42	Start Frequency	38				
43	Carrier Frequency	38				
44	Stopping Mode and Braking Resistor Protection	39				
45 -46	Multifunction Analog Output Selection (terminals 15 and 16)	39				
47	Display Mode	39				
48	Dynamic Braking and Priority of Stopping and Speed Search and AVR Control	39				
49 -50	Accel / Decel Time 2	40				
51 -52	Display Mode	40				
53 - 55	DC Braking	41				
56 - 58	Multifunction Input	41				
59 - 60	Reserved	44				
61	Multifunction Output	44				
62 - 64	Reserved	45				
65 - 68	Prohibit Frequency Control	45				
69	Electronic Thermal Protection	46				
70 -71	Electronic Thermal Overload Reference Current	47				
72	Torque Boost	47				
73 -74	Reserved	47				
75 -76	Slip Comp.	47				
77 -79	Overtorque Control	48				
80 -81	S Curve	48				
82 -83	Energy Savings	49				
84 -91	Sequence Control	49				
92 -94	Vibration Control	50				
95 -96	Reserved	50				
97 -98	Fault Control (F.C.) Control	50				
99	Reserved	51				
100 - 102	Comm. Parameter Control	51				
103 -122	Reserved	51				
123	Factory Setting	52				
124	CPU Version	52				
125	Fault Sequence Reference	52				

Table 9 E

Prepared By: Date:

Set By: Date:

Received By: Date:

Warranty Policy

Motortronics warrants its products to be free from defects in material and/or workmanship for a period of one year from date of installation, to a maximum of 18 months from the date of shipment as indicated by the unit's date code. The Company reserves the right to repair or replace any malfunctioning units under warranty at their option. All warranty repairs must be performed by the Company factory, or on site by a factory authorized service firm or personnel approved by the Company.

Solid state controls have different operation characteristics from those of electro-mechanical equipment. Because of these differences and the wide variety of applications for solid state controls, each application designer must verify that the solid state equipment is acceptable for his application. In no event will Motortronics be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment. The diagrams and illustrations in this document are included solely for illustrative purposes. Because of the number of different applications, Motortronics cannot be responsible or liable for actual use based on the examples or diagrams.

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