Instruction Manual

Model AF-1200
Adjustable Frequency AC Drive

Cutler-Hammer

EATON

THE AF1200 SERIES

DRIVE MODEL AND VOLTAGE				
RATED HP	208 / 230 VAC	380 / 415 VAC	460 VAC	575 VAC
1	AF12201_	AF12301_	AF12401_	AF12501_
2	AF12202_	AF12302_	AF12402_	AF12502_
3	AF12203_	AF12303_	AF12403_	AF12503_
5	AF12205_	AF12305_	AF12405_	AF12505_
7.5	AF12207_	AF12307_	AF12407_	AF12507_
10	AF12210_	AF12310_	AF12410_	AF12510_
15	AF12215_	AF12315_	AF12415_	AF12515_
20	AF12220_	AF12320_	AF12420_	AF12520_
25	AF12225_	AF12325_	AF12425_	AF12525_
30	AF12230_	AF12330_	AF12430_	AF12530_
40	AF12240_	AF12340_	AF12440_	AF12540_
50	AF12250_	AF12350_	AF12450_	AF12550_
60	AF12260_	AF12360_	AF12460_	AF12560_
75	----------	AF12375_	AF12475_	AF12575_
100	----------	AF123100_	AF124100_	AF125100_
125	----------	----------	AF124125_	----------

CAUTION !

READ ALL INSTRUCTIONS BEFORE INSTALLING OR OPERATING DRIVE.

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1.1 GENERAL

1.1.1 PRODUCT CHANGES

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

1.1.2 WARRANTY

Cutler-Hammer warrants the AF1200 series AC motor control to be free of defects in material and workmanship for a period of 1 year from the date of sale to the user, or eighteen months from the date of manufacture, which ever occurs first. Any control component, which under normal use, becomes defective, within the stated warranty time period, shall be returned to Cutler-Hammer, freight prepaid, for examination. Cutler-Hammer reserves the right to make the final determination as to the validity of a warranty claim, and sole obligation is to repair or replace only components which have been rendered defective due to faulty material or workmanship. No warranty claim will be accepted for components which have been damaged due to mis-handling, improper installation, unauthorized repair and/or alteration of the product, operation in excess of design specifications or other misuse, or improper maintenance. Cutler-Hammer makes no warranty that its products are compatible with any other equipment, or to any specific application, to which they may be applied and shall not be held liable for any other consequential damage or injury arising from the use of its products.

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

1.1.3 RECEIVING

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

1.1.4 CUSTOMER MODIFICATION

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

2.1 AF1200 SERIES MODEL DESIGNATION CODE

The model number of a AF1200 Series drive gives a full description of the basic drive unit (see example below). Options such as dynamic braking, additional door mounted operator controls, remote operator stations, door interlocked disconnects, etc. are listed separately.

EXAMPLE: AF12505AB

(575 VAC, 5 HP, TYPE-1 ENCLOSURE)

AF12 5 05 * AB - (XXX)

SERIES:

AF12 = AF1200 SERIES

INPUT VOLTAGE:

1 = 120 VAC (SPECIAL)	4 = 460 VAC
2 = 208 / 230 VAC	5 = 575 VAC
3 = 380 / 415 VAC	6 = 346 / 380 VAC

RATED HORSEPOWER:

01 = 1 HP	15 = 15 HP	60 = 60 HP
02 = 2 HP	20 = 20 HP	75 = 75 HP
03 = 3 HP	25 = 25 HP	100 = 100 HP
05 = 5 HP	30 = 30 HP	125 = 125 HP
07 = 7.5 HP	40 = 40 HP	
10 = 10 HP	50 = 50 HP	

INPUT:

T = THREE PHASE INPUT ON DRIVE MODEL WHICH USUALLY HAS SINGLE PHASE INPUT ONLY (1 HP).

ENCLOSURE TYPE

A =	CHASSIS	NONE - OPEN FRAME
AB =	TYPE 1	VENTED COVER
C =	TYPE 4	ENCLOSED WATER TIGHT
D =	TYPE 12	ENCLOSED DUST TIGHT

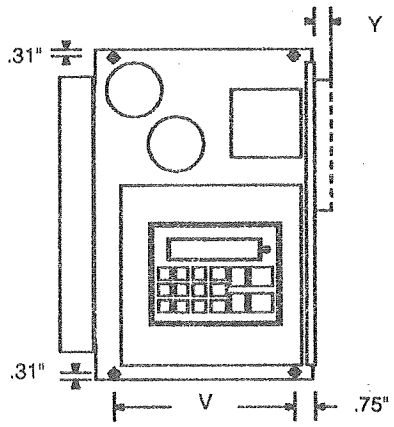
SPECIAL DESIGNATION

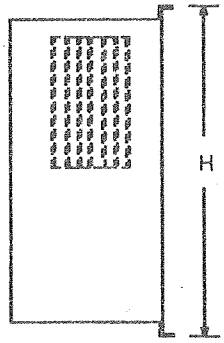
NON-STANDARD SPECIAL MODELS HAVE A THREE DIGIT SUFFIX

DIMENSION DATA

AF1200 SERIES, LOW HP,
CHASSIS AND TYPE 1 ENCLOSED

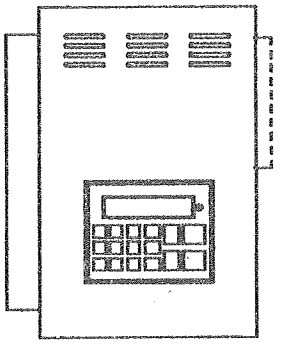
CHASSIS

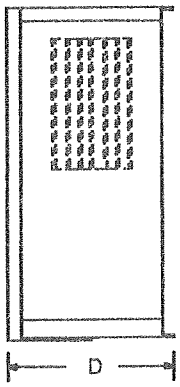


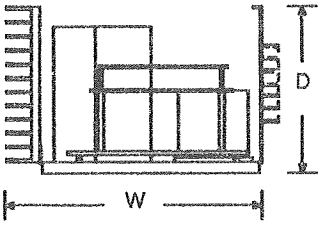


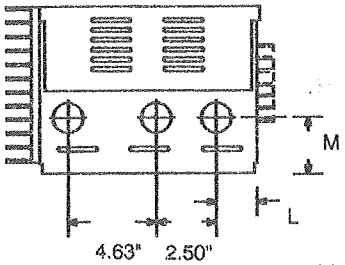
(4) MOUNTING HOLES -
.25" DIA.

TYPE 1









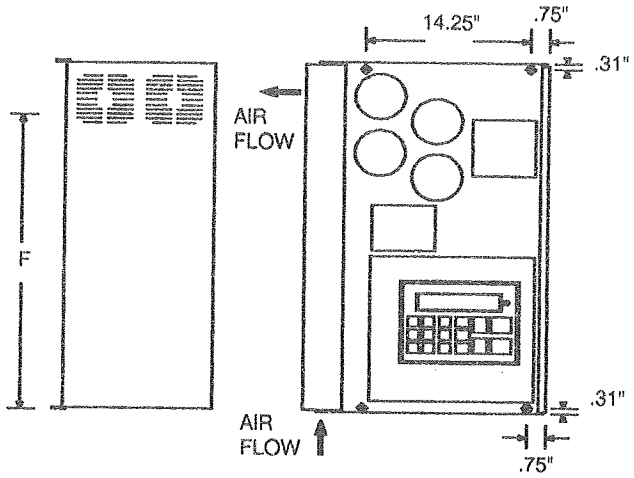
CENTER CONDUIT HOLE -
1.13" DIA.

OUTER CONDUIT HOLES -
'B' DIA.

HP	VOLT.	CHASSIS	TYPE 1	H	W	D	L	M	V	B	Y
1	230 VAC	AF12201A	AF12201AB	14.00"	10.00"	6.60"	1.13"	2.50"	7.88"	1.13"	N/A
	460 VAC	AF12401A	AF12401AB	14.00	10.00	6.60	1.13	2.50	7.88	1.13	N/A
	575 VAC	AF12501A	AF12501AB	14.00	10.00	6.60	1.13	2.50	7.88	1.13	N/A
2	230 VAC	AF12202A	AF12202AB	14.00	10.50	6.60	1.13	2.50	7.88	1.13	N/A
	460 VAC	AF12402A	AF12402AB	14.00	10.50	6.60	1.13	2.50	7.88	1.13	N/A
	575 VAC	AF12502A	AF12502AB	14.00	10.50	6.60	1.13	2.50	7.88	1.13	N/A
3	230 VAC	AF12203A	AF12203AB	14.00	11.00	6.60	1.13	2.50	7.88	1.13	N/A
	460 VAC	AF12403A	AF12403AB	14.00	11.00	6.60	1.13	2.50	7.88	1.13	N/A
	575 VAC	AF12503A	AF12503AB	14.00	11.00	6.60	1.13	2.50	7.88	1.13	N/A
5	230 VAC	AF12205A	AF12205AB	16.50	11.25	8.90	1.13	3.50	7.88	1.13	N/A
	460 VAC	AF12405A	AF12405AB	14.00	11.00	6.60	1.13	2.50	7.88	1.13	N/A
	575 VAC	AF12505A	AF12505AB	14.00	11.00	6.60	1.13	2.50	7.88	1.13	N/A
7.5	230 VAC	AF12207A	AF12207AB	16.50	11.25	8.90	1.13	3.50	7.88	1.13	N/A
	460 VAC	AF12407A	AF12407AB	16.50	11.25	8.90	1.13	3.50	7.88	1.13	N/A
	575 VAC	AF12507A	AF12507AB	16.50	11.25	8.90	1.13	3.50	7.88	1.13	N/A
10	230 VAC	AF12210FA	AF12210AB	24.00	13.00	8.90	2.13	3.50	9.75	1.38	1.75"
	460 VAC	AF12410FA	AF12410AB	24.00	13.00	8.90	2.13	3.50	9.75	1.38	1.75
	575 VAC	AF12510FA	AF12510AB	24.00	13.00	8.90	2.13	3.50	9.75	1.38	1.75
15	460 VAC	AF12415FA	AF12415AB	24.00	13.00	8.90	2.13	3.50	9.75	1.38	1.75
	575 VAC	AF12515FA	AF12515AB	24.00	13.00	8.90	2.13	3.50	9.75	1.38	1.75

AF1200 SERIES, HIGH HP,(FAN COOLED), CHASSIS AND TYPE 1 ENCLOSED

CHASSIS



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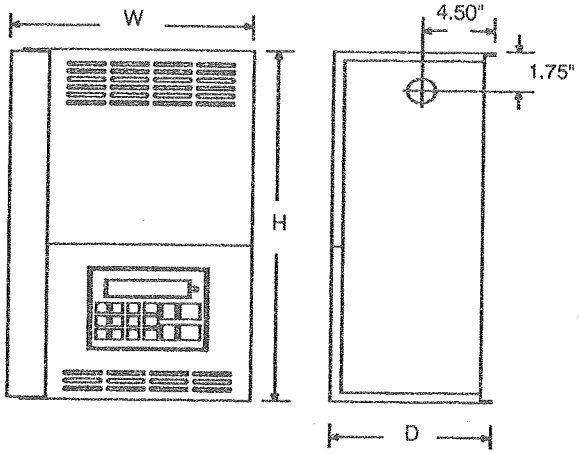
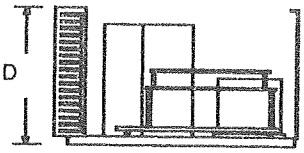
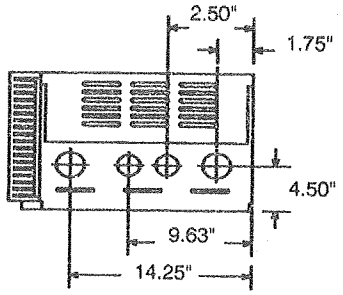






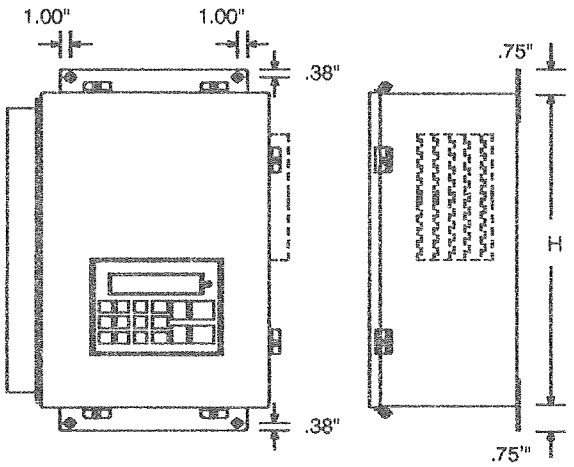
CENTER CONDUIT HOLES ARE 1.13" DIA
OUTER CONDUIT HOLES ARE DIA. "B"

MOUNTING HOLES: .31" DIA. IF 'H' LESS THAN OR EQUAL TO 29"
.37" DIA. IF 'H' GREATER THAN 29"

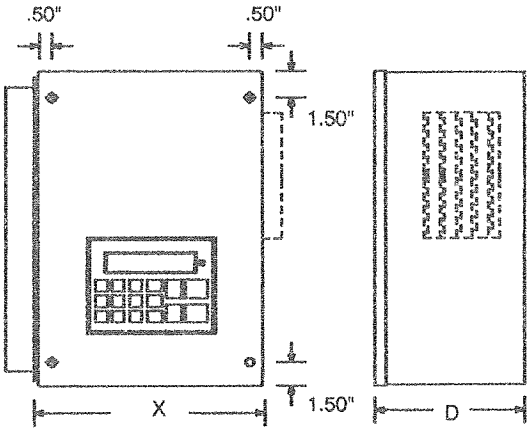
HP	VOLTAGE	CHASSIS	TYPE 1	H	W	D	F	B
15	230 VAC	AF12215A	AF12215AB	29.00"	18.50"	10.50"	24.00"	1.38"
20	230 VAC	AF12220A	AF12220AB	29.00	18.50	10.50	24.00	1.38
	460 VAC	AF12420A	AF12420AB	21.00	18.50	10.50	16.00	1.38
	575 VAC	AF12520A	AF12520AB	21.00	18.50	10.50	16.00	1.38
25	230 VAC	AF12225A	AF12225AB	29.00	18.50	10.50	24.00	1.38
	460 VAC	AF12425A	AF12425AB	29.00	18.50	10.50	24.00	1.38
	575 VAC	AF12525A	AF12525AB	21.00	18.50	10.50	16.00	1.38
30	230 VAC	AF12230A	AF12230AB	35.00	19.00	11.75	30.00	1.75
	460 VAC	AF12430A	AF12430AB	29.00	18.50	10.50	24.00	1.38
	575 VAC	AF12530A	AF12530AB	29.00	18.50	10.50	24.00	1.38
40	230 VAC	AF12240A	AF12240AB	35.00	19.00	11.75	30.00	1.75
	460 VAC	AF12440A	AF12440AB	29.00	18.50	10.50	24.00	1.38
	575 VAC	AF12540A	AF12540AB	29.00	18.50	10.50	24.00	1.38
50	230 VAC	AF12250A	AF12250AB	35.00	19.00	11.75	30.00	1.75
	460 VAC	AF12450A	AF12450AB	35.00	19.00	11.75	30.00	1.75
	575VAC	AF12550A	AF12550AB	35.00	19.00	11.75	30.00	1.75
60	230 VAC	AF12260A	AF12260AB	47.00	20.25	13.00	40.25	2.00
	460 VAC	AF12460A	AF12460AB	35.00	19.00	11.75	30.00	1.75
	575 VAC	AF12560A	AF12560AB	35.00	19.00	11.75	30.00	1.75
75	460 VAC	AF12475A	AF12475AB	35.00	19.00	11.75	30.00	1.75
	575 VAC	AF12575A	AF12575AB	35.00	19.00	11.75	30.00	1.75
100	460 VAC	AF124100A	AF124100AB	47.00	20.25	13.00	40.25	2.00
	575 VAC	AF125100A	AF125100AB	47.00	20.25	13.00	40.25	2.00
125	460 VAC	AF124125A	AF124125AB	47.00	20.25	13.00	40.25	2.00

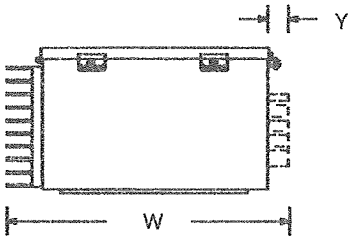
AF1200 SERIES, LOW HP
TYPE 4 AND TYPE 12 ENCLOSED

TYPE 4

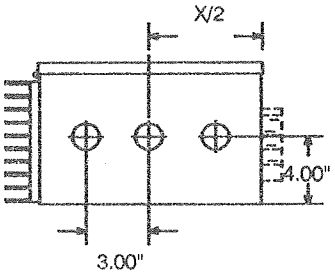


TYPE 12





4 MOUNTING HOLES - .28" DIA.

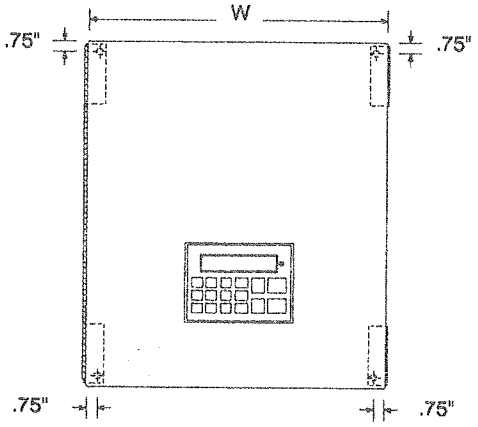


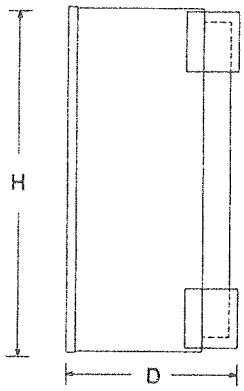
4 MOUNTING HOLES - .28" DIA. KNOCKOUTS

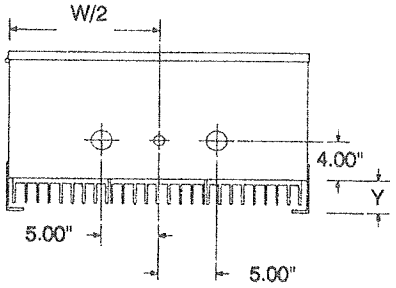
CONDIT HOLES - 1.13" DIA.

	VOLT.	TYPE 4	TYPE 12	H	W	D	X	Y
1	230 VAC	AF12201C	AF12201D	14.00"	12.75"	8.00"	12.00"	0.00"
	460 VAC	AF12401C	AF12401D	14.00	12.75	8.00	12.00	0.00
	575 VAC	AF12501C	AF12501D	14.00	13.25	8.00	12.00	0.00
2	230 VAC	AF12202C	AF12202D	14.00	13.25	8.00	12.00	0.00
	460 VAC	AF12402C	AF12402D	14.00	13.25	8.00	12.00	0.00
	575 VAC	AF12502C	AF12502D	14.00	13.25	8.00	12.00	0.00
3	230 VAC	AF12203C	AF12203D	14.00	13.75	8.00	12.00	0.00
	460 VAC	AF12403C	AF12403D	14.00	13.75	8.00	12.00	0.00
	575 VAC	AF12503C	AF12503D	14.00	13.75	8.00	12.00	0.00
5	230 VAC	AF12205C	AF12205D	16.50	14.00	10.00	12.00	0.00
	460 VAC	AF12405C	AF12405D	14.00	13.75	8.00	12.00	0.00
	575 VAC	AF12505C	AF12505D	14.00	13.75	8.00	12.00	0.00
7.5	230 VAC	AF12207C	AF12207D	16.50	14.00	10.00	12.00	0.00
	460 VAC	AF12407C	AF12407D	16.50	14.00	10.00	12.00	0.00
	575 VAC	AF12507C	AF12507D	16.50	14.00	10.00	12.00	0.00
10	230 VAC	AF12210C	AF12210D	24.00	17.75	10.00	14.00	1.75
	460 VAC	AF12410C	AF12410D	24.00	17.25	10.00	14.00	1.75
	575 VAC	AF12510C	AF12510D	24.00	17.25	10.00	14.00	1.75
15	230 VAC	AF12215C	AF12215D	29.00	21.50	12.00	17.00	2.00
	460 VAC	AF12415C	AF12415D	24.00	17.75	10.00	14.00	1.75
	575 VAC	AF12515C	AF12515D	24.00	17.75	10.00	14.00	1.75
20	460 VAC	AF12420C	AF12420D	29.00	21.25	12.00	17.00	2.00
	575 VAC	AF12520C	AF12520D	29.00	21.25	12.00	17.00	2.00
25	575 VAC	AF12525C	AF12525D	29.00	21.50	12.00	17.00	2.00

AF1200 SERIES, HIGH HP
TYPE 4 AND TYPE 12 ENCLOSED







CENTER CONDUIT HOLE - 1.13" DIA.

OUTER CONDUIT HOLES - 'B' DIA.

DRIVES SHIPPED WITH "CAPLUGS" IN CONDUIT HOLES

HP	VOLTAGE	TYPE 4	TYPE 12	H	W	D	Y	B
20	230 VAC	AF12220C	AF12220D	32.00"	27.00"	14.00"	2.50"	1.38"
25	230 VAC	AF12225C	AF12225D	36.00	32.00	16.00	3.00	1.75
	460 VAC	AF12425C	AF12425D	32.00	27.00	14.00	2.50	1.38
30	230 VAC	AF12230C	AF12230D	36.00	32.00	16.00	3.00	1.75
	460 VAC	AF12430C	AF12430D	32.00	27.00	14.00	2.50	1.38
	575 VAC	AF12530C	AF12530D	32.00	27.00	14.00	2.50	1.38
40	230 VAC	AF12240C	AF12240D	36.00	32.00	16.00	3.00	1.75
	460 VAC	AF12440C	AF12440D	36.00	32.00	16.00	3.00	1.75
	575 VAC	AF12540C	AF12540D	36.00	32.00	16.00	3.00	1.75
50	230 VAC	AF12250C	AF12250D	36.00	32.00	16.00	3.00	1.75
	460 VAC	AF12450C	AF12450D	36.00	32.00	16.00	3.00	1.75
	575 VAC	AF12550C	AF12550D	36.00	32.00	16.00	3.00	1.75
60	230 VAC	AF12260C	AF12260D	48.00	32.00	20.00	4.50	2.00
	460 VAC	AF12460C	AF12460D	36.00	32.00	16.00	3.00	1.75
	575 VAC	AF12560C	AF12560D	36.00	32.00	16.00	3.00	1.75
75	460 VAC	AF12475C	AF12475D	48.00	32.00	20.00	4.50	2.00
	575 VAC	AF12575C	AF12575D	48.00	32.00	20.00	4.50	2.00
100	460 VAC	AF124100C	AF124100D	48.00	32.00	20.00	4.50	2.00
	575 VAC	AF125100C	AF125100D	48.00	32.00	20.00	4.50	2.00
125	460 VAC	AF124125C	AF124125D	48.00	32.00	20.00	4.50	2.00

4.1 DRIVE RATINGS

AF12200 SERIES RATINGS							
MODEL		INPUT (208, 230 VAC, 50 - 60 HZ)				OUTPUT (0-208, 0-230 VAC)	
NUMBER	RATED HP	MAIN FUSE	PHASE	CURRENT (AMPS)	POWER (KVA)	CURRENT (AMPS)	POWER (KVA)
AF12201_	1	10	1	8.2	1.9	4	1.6
AF12202_	2	20	1/3	15.3/8.3	3.5/3.3	6.8	2.7
AF12203_	3	30	1/3	21.8/11.8	5.0/4.7	9.6	3.8
AF12205_	5	30	3	18.4	7.3	15.2	6.1
AF12207_	7.5	30	3	21.7	8.7	22	8.8
AF12210_	10	45	3	27.5	11.0	28	11.2
AF12215_	15	60	3	41.4	16.5	42	16.7
AF12220_	20	90	3	53.3	21.3	54	21.5
AF12225_	25	90	3	67.1	26.8	68	27.1
AF12230_	30	125	3	79.0	31.6	80	31.9
AF12240_	40	175	3	103.0	41.0	104	41.4
AF12250_	50	200	3	128.0	51.1	130	51.8
AF12260_	60	250	3	152.0	60.6	154	61.4

AF12300 SERIES RATINGS							
MODEL		INPUT (380, 415 VAC, 50 - 60 HZ)				OUTPUT (0-380, 0-415 VAC)	
NUMBER	RATED HP	MAIN FUSE	PHASE	CURRENT (AMPS)	POWER (KVA)	CURRENT (AMPS)	POWER (KVA)
AF12301_	1	10	1	5.0	1.9	2.4	1.6
AF12302_	2	15	1/3	9.3/5.1	3.5/3.3	4.1	2.7
AF12303_	3	20	1/3	13.2/7.1	5.0/4.7	5.8	3.8
AF12305_	5	20	3	11.1	7.3	9.2	6.1
AF12307_	7.5	20	3	13.2	8.7	13.3	8.8
AF12310_	10	30	3	16.7	11.0	17.0	11.2
AF12315_	15	45	3	24.8	16.3	25.0	16.5
AF12320_	20	45	3	32.7	21.5	33.0	21.7
AF12325_	25	60	3	40.6	26.7	41.0	27.0
AF12330_	30	60	3	47.6	31.3	48.0	31.6
AF12340_	40	100	3	62.2	40.9	63.0	41.4
AF12350_	50	120	3	78.0	51.3	79.0	51.8
AF12360_	60	150	3	92.0	60.6	93.0	61.2
AF12375_	75	175	3	113.8	74.9	116.0	76.3
AF123100_	100	200	3	146.9	96.7	150.0	98.7

AF12400 SERIES RATINGS							
MODEL		INPUT (460 VAC, 50 - 60 HZ)				OUTPUT (0-460 VAC)	
NUMBER	RATED HP	MAIN FUSE	PHASE	CURRENT (AMPS)	POWER (KVA)	CURRENT (AMPS)	POWER (KVA)
AF12401_	1	5	1	4.1	1.9	2.0	1.6
AF12402_	2	10	1/3	7.7/4.2	3.5/3.3	3.4	2.7
AF12403_	3	15	1/3	10.9/5.9	5.0/4.7	4.8	3.8
AF12405_	5	15	3	9.2	7.3	7.6	6.1
AF12407_	7.5	20	3	10.9	8.7	11.0	8.8
AF12410_	10	20	3	13.8	11.0	14.0	11.2
AF12415_	15	30	3	20.7	16.5	21.0	16.7
AF12420_	20	45	3	26.7	21.3	27.0	21.5
AF12425_	25	60	3	33.6	26.8	34.0	27.1
AF12430_	30	60	3	39.6	31.6	40.0	31.9
AF12440_	40	100	3	51.4	41.0	52.0	41.4
AF12450_	50	100	3	64.2	51.1	65.0	51.8
AF12460_	60	125	3	76.0	60.6	77.0	61.4
AF12475_	75	150	3	95.0	75.6	96.0	76.5
AF124100_	100	175	3	122.0	97.6	124.0	98.8
AF124125_	125	200	3	154.0	122.8	156.0	124.3

AF12500 SERIES RATINGS							
MODEL		INPUT (575 VAC, 50 - 60 HZ)				OUTPUT (0-575 VAC)	
NUMBER	RATED HP	MAIN FUSE	PHASE	CURRENT (AMPS)	POWER (KVA)	CURRENT (AMPS)	POWER (KVA)
AF12501_	1	5	1	3.3	1.9	1.6	1.6
AF12502_	2	10	1/3	6.2/3.4	3.5/3.3	2.7	2.7
AF12503_	3	15	1/3	8.7/4.7	5.0/4.7	3.9	3.9
AF12505_	5	15	3	7.4	7.3	6.1	6.1
AF12507_	7.5	15	3	8.8	8.8	9.0	8.9
AF12510_	10	20	3	10.9	10.9	11.0	11.0
AF12515_	15	30	3	16.8	16.7	17.0	16.9
AF12520_	20	45	3	21.4	21.3	22.0	21.5
AF12525_	25	45	3	27.0	26.9	27.0	26.9
AF12530_	30	60	3	31.7	31.6	32.0	31.9
AF12540_	40	60	3	40.7	40.5	41.0	40.9
AF12550_	50	100	3	51.6	51.3	52.0	51.8
AF12560_	60	100	3	61.5	61.2	62.0	61.7
AF12575_	75	125	3	76.0	75.7	77.0	76.7
AF125100_	100	150	3	98.0	97.4	99.0	98.6

5.1 DESIGN SPECIFICATIONS

Storage Temperature	-20° to 70° C	
Ambient Operating Temp.	Chassis	0° - 55°C
	Type 1 Enclosed	0° - 50°C
	Type 4 and 12 Enclosed	0° - 40°C
Models Ambient Humidity	Less than 93% (non-condensing)	
Maximum Altitude	3300 feet above sea level	
Input voltage Tolerance	+/- 12%	
Reference Voltage	0-5 VDC, 0-10 VDC, 4-20 mADC (Isolated, common to control voltage)	
Control Voltage	20 VDC (Isolated, common to reference voltage)	
Wave Form	Sine Coded Pulse Width Modulated	
Output Signals		
Proportional to frequency	4-20 mA, 0-5,10 VDC, 12 VDC pulse train	
Proportional to load	0-1 mA	
Frequency Stability	+/- 0.00006% / °C	
Service Factor	1.15 (115% continuous)	
Overload Capacity	180% for one minute	
Output Frequency	0-120 Hz	

6.1 THEORY

6.1.1 DESCRIPTION OF AC MOTOR OPERATION

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

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

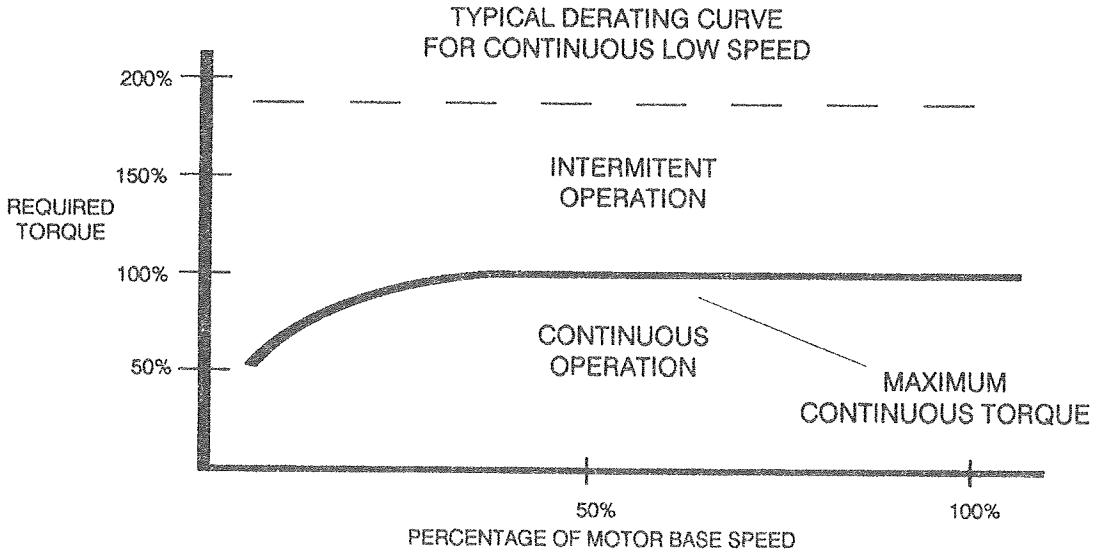
$Ss = 120\ f/p$

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

In three phase induction motors the actual shaft speed differs from the synchronous speed as load is applied. This difference is known as "slip". Slip is commonly expressed as a percentage of synchronous speed and common values are about three percent.

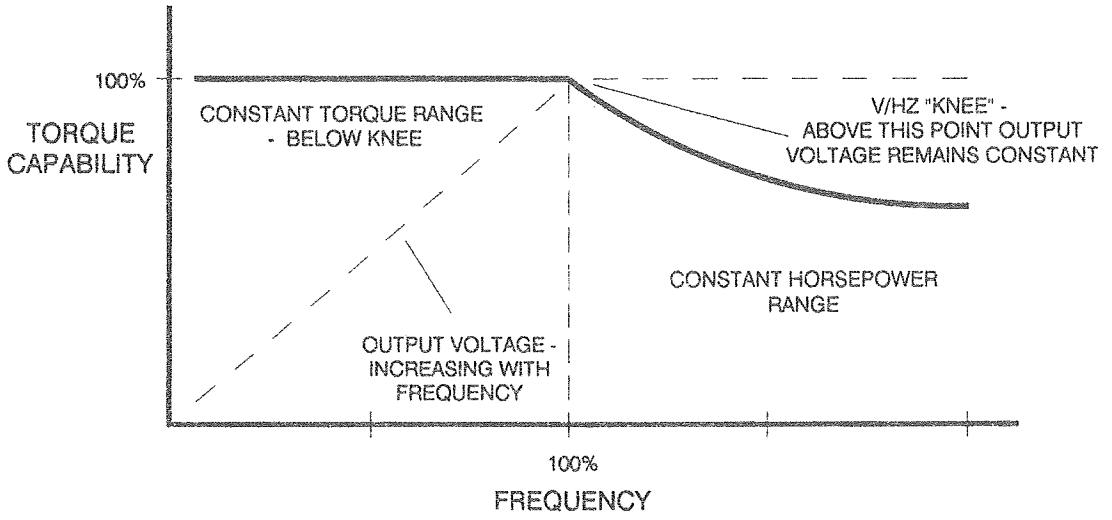
The strength of the magnetic field in the gap between the rotor and stator is proportional to the amplitude of the voltage at a given frequency. The output torque capability of the motor is, therefore, a function of the applied voltage amplitude at a given frequency. When operated below base (rated) speed, AC motors are commonly run in a mode known as "constant torque". Constant torque output is obtained by maintaining a constant ratio between voltage amplitude (volts) and frequency (hertz). For 60 hertz 230, 460, and 575 volt motors, common values for this volts to hertz ratio are 3.83, 7.66, and 9.58 respectively. Operating with these values of the volts to hertz ratio generally yields optimum torque capability. Operating at lower ratio values lowers torque and power capability. Operating at higher ratio values will cause the motor to over heat. Most standard motors are capable of providing full torque output from 3 to 60 hertz. However, at lower speeds, where motor cooling fans become less effective, supplemental cooling may be needed to operate at full torque output continuously. A typical motor derating curve is depicted below.

If the motor's applied frequency is increased while voltage remains constant, its torque capability will decrease as speed increases. This will cause horsepower capability of the



motor to remain approximately constant. Motors are commonly run in this mode when operated above base speed, where drive output voltage is limited by the input line voltage. This operating range is known as the "constant horsepower" range. The typical maximum range for constant horsepower is about 2.3 to 1 (60 to 140 Hz). The diagram below depicts the operating characteristics of a typical AC induction motor. WARNING! Consult motor maufacturer before operating above base speed.

AC MOTOR OPERATING RANGES



6.1.2 DRIVE FUNCTION DESCRIPTION

The AF1200 is a 16 bit microprocessor based, keypad programmable variable speed AC motor drive. The AF1200 has four major sections; an input diode bridge and filter, a driver board, a control board, and an output transistor bridge.

DRIVE OPERATION

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

CIRCUIT DESCRIPTION

The control section of the AF1200 Series consists of a control board with a 16 bit microprocessor and keypad interface board with an 8 bit microprocessor. Drive programing is accomplished via the kepad or an optional serial communications port. During operation the drive can be controlled via the keypad, by control devices wired to the control terminal strip, or by the optional serial communications port. The Base Driver Board of the AF1200 incorporates six amplifiers and protection circuits which supply power to the six output transistors. The Base Driver Board also contains a charging and discharging circuit for the BUS filter capacitors, an isolated motor current feedback circuit, a voltage feedback circuit, and a fault signal circuit. The AF1200 has many built in protection circuits. These include phase-to-phase and phase-to-ground short circuit protection, high and low line voltage

protection, protection against excessive ambient temperature and against continuous excessive output current. Activation of any of these circuits will cause the drive to shut down in a protection "trip".

OUTPUT SIGNALS

The AF1200 has terminals for three output signals, which are proportional to output frequency; a 4 - 20 mA signal between terminals 2 and 10D, a 0-5 VDC signal between terminals 2 and 10B, and a 12 VDC pulse train (at 6 times the output frequency) between terminals 2 and 10C. A 0-1 mA output signal, which is proportional to motor current, is available between terminals 2 and 11 for load indication.

AUXILLARY RELAY CONTACTS

The AF1200 series control board has two sets of FORM C contacts at terminals 16 through 21. Contacts are rated 2 amps at 28 VDC or 120 VAC. Each set of contacts can be programmed for several different functions - see the DESCRIPTION OF PARAMETERS section.

7.0.1 VOLTAGE SELECTION

The AF12200 Series can operate on input voltages of 230 VAC (+/- 12%) or 208 VAC (+/- 12%) and the AF12300 Series can operate on input voltages of 380 VAC (+/- 12%) or 415 VAC (+/- 12%) by setting the control transformer for the proper voltage.

208 VOLT INPUT ON AF12200 SERIES DRIVES

AF12200 DRIVES (230 VAC MODELS): Model AF12200 is normally shipped set to operate on 230 VAC.Models AF12201 - AF12207 can be operated on 208 VAC by moving plug (PL3), on the driver board, to the 208 V position. For operation on 230 VAC, plug PL3 MUST be in the 230 V position. On models AF12210 - AF12260, 208 VAC or 230 VAC operation can be set with switch SW901 on the Line Voltage Board. Moving this switch selects the proper primary winding in the Control Transformer.

WARNING!
Operation of the drive on 230 VAC input while the drive is set for 208 VAC input will damage the Control Transformer, Driver Board, Control Board, and Output Transistors.

415 VOLT INPUT ON AF12300 SERIES DRIVES

AF12300 DRIVES (380 VAC MODELS): Model AF12300 is normally shipped set to operate on 380 VAC.Models AF12301 - AF12307 can be operated on 415 VAC by moving plug (PL3), on the driver board, to the 415 V position. For operation on 380 VAC, plug PL3 MUST be in the 380 V position. On models AF12310 - AF123100, 380 VAC or 415 VAC operation can be set with switch SW901 on the Line Voltage Board. Moving this switch selects the proper primary winding in the Control Transformer.

WARNING!
Operation of the drive on 415 VAC input while the drive is set for 380 VAC input will damage the Control Transformer, Driver Board, Control Board, and Output Transistors.

8.1 INSTALLATION

WARNING!

DRIVES MUST NOT BE INSTALLED WHERE SUBJECTED TO ADVERSE ENVIRONMENTAL CONDITIONS! DRIVES MUST NOT BE INSTALLED WHERE SUBJECTED TO: COMBUSTIBLE, OILY, OR HAZARDOUS VAPORS OR DUST; EXCESSIVE MOISTURE OR DIRT; STRONG VIBRATION; EXCESSIVE AMBIENT TEMPERATURES. CONSULT CUTLER-HAMMER FOR MORE INFORMATION ON THE SUITABILITY OF THE AF1200 SERIES DRIVE TO A PARTICULAR ENVIRONMENT.

All models of the AF1200 drive should be mounted on a smooth vertical surface capable of safely supporting the unit without vibrating. The LCD display has an optimum field of view, this should be considered when determining the mounting position.

Chassis models must be installed in an electrical enclosure which will provide complete mechanical protection and maintain uniform internal temperature below 55° C. Drives MUST be mounted in a vertical position for proper heatsink cooling. Maintain a minimum of three to four inches above and below the drive and a minimum of two inches on either side of of units rated below 20 HP. Maintain a minimum of six to eight inches above and below the drive and a minimum of four inches on either side of of units rated above 20 HP. Fans or blowers should be used to insure proper cooling in tight quarters. Do not mount drives above other drives or heat producing equipment. Upper limits of the ambient operating temperature for each of the enclosure types are as follows: Chassis models (A or FA style) 55° C (130° F) Ventilated Type 1 models (AB and FAB style) 50° C (122° F) Type 4 and Type 12 models (C and D style) 40° C (104° F).

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

9.1 WIRING

Note drive input and output current ratings and check applicable electrical codes for required wire type and size, grounding requirements, over-current protection, and incoming power disconnect, before wiring the AF1200 drive. Input and output wire should have insulation rated to a minimum of 105° C (221° F). Size conservatively to minimize the voltage drop.

9.1.1 POWER WIRING

CAUTION!

DO NOT WIRE INCOMING AC POWER TO TERMINALS T1, T2, OR T3! THIS WILL CAUSE SEVERE DAMAGE TO THE DRIVE.

An input power disconnect switch or contactor MUST be wired in series with terminals L1, L2, and L3 (L1 and L2 if input is single phase). This may be supplied by Cutler-Hammer as an option. If one has not been supplied by Cutler-Hammer, a disconnect means must be wired during installation. This disconnect must be used to power down the drive when servicing, or when drive is not to be operated for a long period of time, but should not be used to start and stop the motor. Start and stop the motor with the drive run/stop circuit. Repetitive cycling of an input contactor (more than once every two minutes) may cause severe damage to the drive.

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

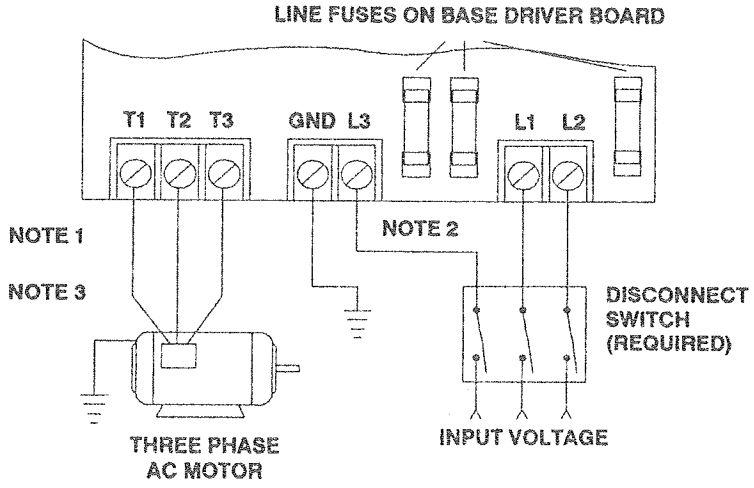
All three power output wires, from terminals T1, T2, and T3 to the motor, must be kept tightly bundled and run in a separate conduit away from other wiring. Do not install contactors between drive and motor without consulting Cutler-Hammer for more information.

10.0.1 AF1200 SERIES POWER WIRING DIAGRAM

WARNING!
DO NOT WIRE INPUT VOLTAGE TO T1, T2, OR T3!

WIRE INPUT VOLTAGE TO BASE DRIVER BOARD TERMINALS (L1, L2, L3) ON MODELS:

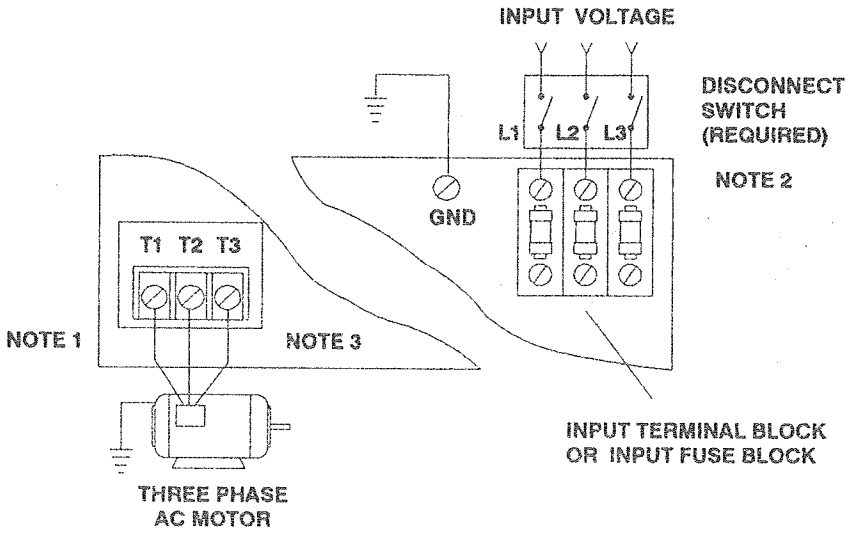
AF12201A-AF12207D
AF12301A-AF12307D
AF12401A-AF12407D
AF12501A-AF12507D



DO NOT CYLCLE INPUT POWER MORE THAN ONCE EVERY TWO MINUTES. FREQUENT CYCLING MAY DAMAGE CHARGE CIRCUIT.

WIRE INPUT VOLTAGE TO FUSE BLOCK TERMINALS (L1,L2, L3) ON MODELS:

AF12210A-AF12260D
AF12310A-AF123100D
AF12410A-AF124125D
AF12510A-AF125100D



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

NOTES:

1.) WIRE THE MOTOR FOR THE PROPER VOLTAGE PER THE OUTPUT RATING OF THE DRIVE. MOTOR WIRES MUST BE RUN IN A SEPARATE CONDUIT AWAY FROM CONTROL WIRING AND INCOMING AC POWER WIRES.

2.) USE TERMINALS L1 AND L2 FOR DRIVES RATED FOR SINGLE PHASE INPUT.

3.) DO NOT INSTALL CONTACTORS BETWEEN DRIVE AND MOTOR, WITHOUT FIRST CONSULTING CUTLER-HAMMER FOR MORE INFORMATION. OPERATING CONTACTORS BETWEEN DRIVE AND MOTOR MAY RESULT IN SEVERE DAMAGE.

11.0.1 CONTROL WIRING

The AF1200 can be controlled by the keypad or by operators wired to the control terminal strip. To run the drive from the keypad wire the control per the instruction in the OPERATING BY KEYPAD CONTROL section.

Control wiring, when run external to the drive, MUST be in a separate conduit and away from all input and output power wiring. Use twisted wires or shielded cable grounded at drive panel ONLY.

Terminals marked 2 are the digital circuit common used for the start, stop, jog, fwd/rev, input select, local/remote, and E-stop functions. Terminal 2A is the circuit common for analog speed reference inputs and analog speed and load indicating outputs. If necessary terminal 2 and 2A may both be connected to ground.

RUN COMMAND

Start-stop control of the AF1200 Series can be accomplished by either a two wire or a three wire circuit. For two wire control, terminal 2 is connected to terminal 12A and the run contact is wired to terminals 1 and 2. For three wire control, a normally closed switch is wired to terminals 1 and 2 (stop signal) and a normally open switch is wired to terminals 2 and 12A (start signal).

SPEED REFERENCE SIGNAL

The AF1200 allows for four speed reference signal types; a speed potentiometer (0-5 volt), 4-20 mA, 0-5 VDC or 0-10 VDC signals. For control by a speed pot., the wiper lead is connected to terminal 5A, and the high and low end leads are connected to terminals 6 and 2A, respectively. For 4-20 mA control, wire the positive to terminal 5B and the negative to terminal 2A. For 0-5 VDC control or 0-10 VDC control, wire the positive to terminal 5C or 5D, respectively, and the negative to terminal 2A.

The input impedance of the speed control potentiometer and 0-5VDC inputs is 100 K ohms, the 0-10 VDC input is 200 K ohms and the 4-20 mA input is 100 ohms (0.4 to 2.0 VDC). Terminal 2A is circuit common and the minus connection.

OUTPUT FREQUENCY AND LOAD SIGNALS

The AF1200 is equipped with output signals that are proportional to output frequency (speed) and current (load). These signals can be used to interface with other equipment or to operate speed and load meters. Three signals proportional to frequency are available: A 4-20 mA DC current signal between terminals 10D and 2A (capable of sourcing 9 VDC @ 1 mA); a 0-10 VDC voltage signal between terminals 10B and 2A (capable of sourcing 5 mA @ 10 VDC); and a frequency output (50% duty cycle pulse train) between terminals 10C and 2 (12 VDC open circuit, 2200 ohm source impedance). The frequency is six times the drive output frequency. Note: The output type must be selected in the case of the analog outputs - see the PARAMETER DESCRIPTION section.

A 0-1 mA DC current signal between terminals 11 and 2A is proportional to output current and can be used to indicate the motor load.This signal is capable of sourcing up to 10 VDC @ 1 mA.

AUXILLIARY OUTPUT CONTACTS

The AF1200 control board has two auxilliary relays with form "C" contacts which can be used to indicate several different drive functions - see the PARAMETER DESCRIPTION section.

The terminals for relay number one are 16, 17, and 18. The terminals for relay number two are 19, 20, and 21. Terminals 17 and 20 are the respective commons. Contacts between 16 and 17, and 19 and 20 are normally open (N.O.). Contacts between 17 and 18, and 20 and 21 are normally closed (N.C.). Contacts are rated 2 amps at 28 VDC or 120 VAC.

FORWARD-REVERSE

Terminals 12B and 12C are use to select direction of motor rotation in the remote mode. Terminal 12B must be closed to terminal 2 to select forward or terminal 12C must be closed to terminal 2 to select reverse, in order for the drive to start when in the remote mode.

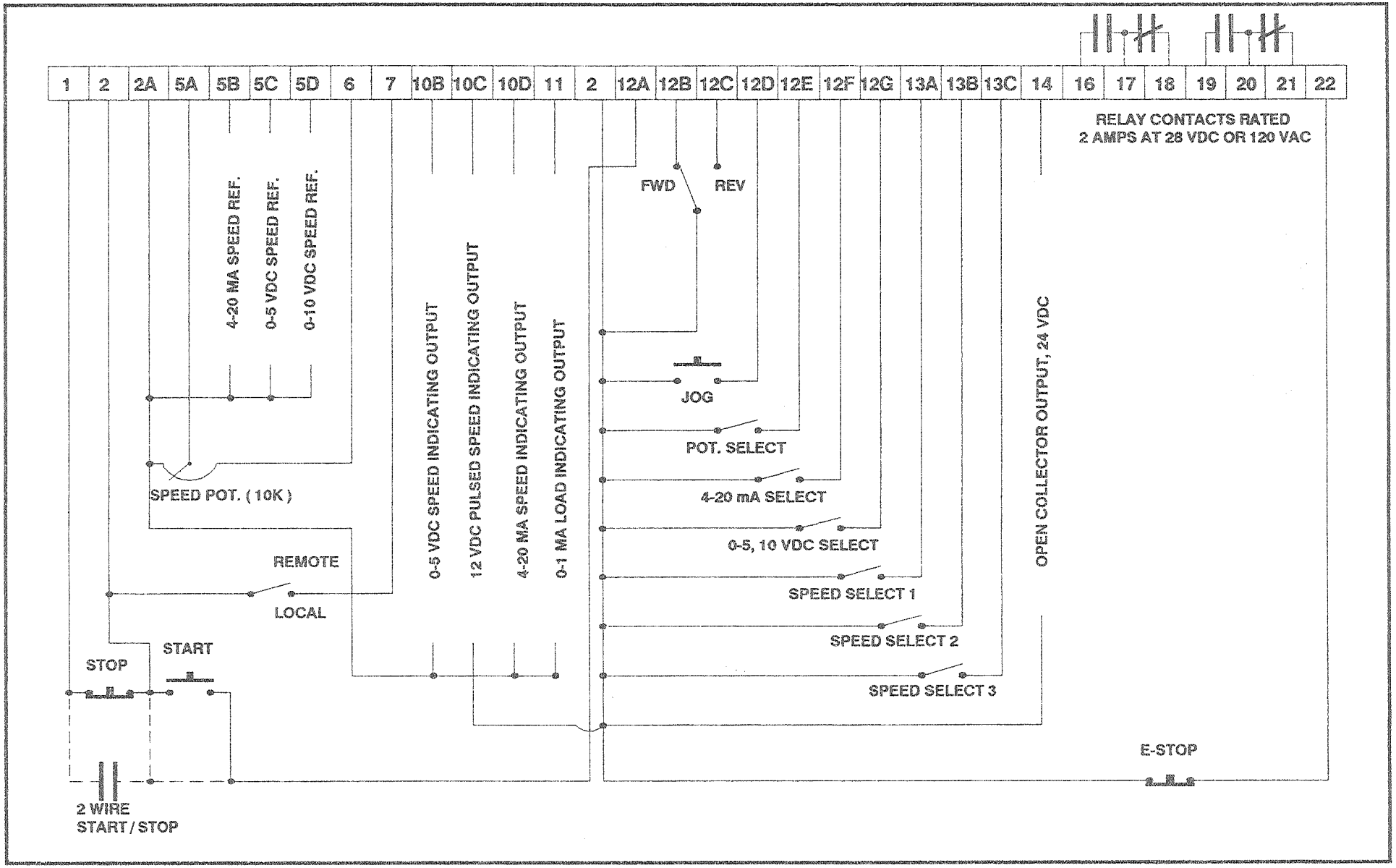
JOG

Closing the remote jog circuit, terminal 2 to terminal 12D, will cause the drive to enter the remote jog mode. When jogging the drive will start, if not already in the run mode, ramp to the jog speed at the jog accel (or decel) rate and run at the jog speed until the jog cicuit is opened.

SPEED REFERENCE SELECTION

A speed reference is selected by closing one of the terminals 12E through 13C to terminal 2.

Closing terminal 12E to 2, activates a pot. wired to terminals 2A, 5A, and 6. Closing terminal 12F to 2, activates a 4 - 20 mA speed reference wired to terminals 2 and 5B. Closing terminal 12G to 2, activates a 0 - 5 VDC or 0 - 10 VDC speed reference wired to terminals 2 and 5C or 5D. Closing different combinations of terminals 13A, 13B, and/or 13C to terminal 2, will activate one of the seven speed presets. See "PARAMETERS 11 - 17 PRESET SPEEDS" in the DESCRIPTIONS OF PARAMETERS section.


1
2
2A
5A
5B
5C
5D
6
7
10B
10C
10D
11
2
12A
12B
12C
12D
12E
12F
12G
13A
13B
13C
14
16
17
18
19
20
21
22
RELAY CONTACTS RATED
2 AMPS AT 28 VDC OR 120 VAC
4-20 MA SPEED REF.
0-5 VDC SPEED REF.
0-10 VDC SPEED REF.
0-5 VDC SPEED INDICATING OUTPUT
12 VDC PULSED SPEED INDICATING OUTPUT
4-20 MA SPEED INDICATING OUTPUT
0-1 MA LOAD INDICATING OUTPUT
OPEN COLLECTOR OUTPUT, 24 VDC
FWD
REV
JOG
POT. SELECT
4-20 mA SELECT
0-5, 10 VDC SELECT
SPEED SELECT 1
SPEED SELECT 2
SPEED SELECT 3
SPEED POT. (10K)
REMOTE
LOCAL
START
STOP
E-STOP
2 WIRE
START / STOP

13.1 INITIAL POWER UP

WARNING!
HAZARD OF ELECTRICAL SHOCK! THE DRIVE'S POWER COMPONENTS, BASE DRIVER BOARD AND MOTOR ARE AT LINE VOLTAGE WHEN THE INCOMING LINE IS ENERGIZED AND FOR UP TO THREE MINUTES AFTER LINE VOLTAGE IS REMOVED. ALWAYS REMOVE LINE VOLTAGE AND CHECK WITH A DC VOLTAGE METER TO BE SURE BUS CAPACITORS HAVE DISCHARGED BEFORE SERVICING DRIVE.

Before attempting to operate drive, motor, and driven equipment be sure all procedures pertaining to installation and wiring have been properly followed. Before powering up the drive for the first time, wire the drive for operation via the keypad (see OPERATING BY KEYPAD CONTROL), then follow the procedures below.

Disconnect the driven load from the motor. Verify that the drive input terminals L1, L2, and L3 (L1 and L2 for single phase input) are wired to the proper input voltage (per the nameplate rating of the drive). For AF12200 and AF12300 series drives, verify the control transformer voltage has been properly selected, as noted in the "VOLTAGE SELECTION" section.

WARNING!
INCOMING AC POWER MUST NOT BE WIRED TO T1, T2, OR T3!
DO NOT CYCLE INCOMING AC MORE THAN ONCE PER TWO MINUTES!

Energize the incoming power line. The LCD display should light and indicate the standby mode. If the display does not appear remove the incoming power, wait three minutes, check to be sure the bus capacitors have discharged, and verify correct installation of wiring. If wiring is correct, re-apply incoming power, note display for drive status. Next follow the procedures in the "PROGRAMMING" section to properly configure the parameter values.

Power down the drive and wait for the bus capacitors to discharge, then wire the proper (correct voltage) leads of the motor to T1, T2, and T3. Press start. If the motor rotates in the wrong direction, remove the incoming power, wait three minutes, check to be sure the bus capacitors have discharged and swap motor wires connected to T1and T2.

Rewire control wiring per directions in the CONTROL WIRING section, if required.

14.1 OPERATING BY KEYPAD CONTROL

The AF1200 Series drive can be operated by the keypad (local mode), by control devices wired to the control terminal strip (remote mode), or by a combination of the two. For simplicity it is recommended that units be run in the keypad control mode during initial start up. For information on wiring remote operators see the CONTROL WIRING section and the DESCRIPTION OF PROGRAMMABLE PARAMETERS sections.

SETTING UP FOR CONTROL BY THE KEYPAD

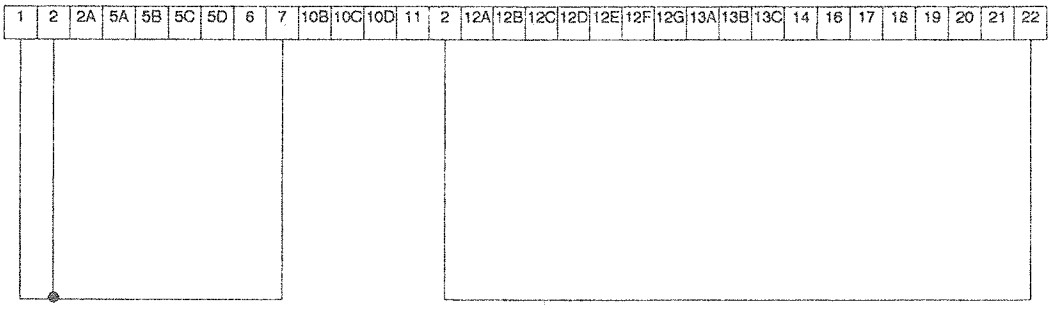
To operate by keypad control first wire the AF1200 Series drive per the diagram depicted below:

WIRING THE AF1200 FOR BASIC KEYPAD CONTROL

1.) 2 to 1 de-activates remote start/stop.

2.) 2 to 7 to activates local (keypad) mode.

3.) 2 to 22 to de-activates E-stop.



Note : To Run in the remote mode, in addition to opening terminals 2 to 7, several terminal closures must be made: A direction must be selected by closing 12B or 12C to 2. A speed reference type must be selected by closing 12E, 12F, 12G, 13A, 13B, or 13C to terminal 2. Terminal 12D , JOG, activates the jog function - THIS CIRCUIT OVERRIDES THE START/STOP FUNCTION AND CAUSES THE DRIVE TO RUN AT THE SPEED DETERMINED BY THE JOG SPEED PARAMETER.

KEYPAD FUNCTIONS IN LOCAL OPERATING MODE

START, STOP - Note: STOP key is always active.

SPEED CONTROL - To change the speed via the keypad press the UP ARROW and DOWN ARROW keys to scroll to the desired speed, or input the desired speed with the numerical keys and press ENTER.

JOGGING - To enter the keypad jog mode, press the JOG key while holding down the STOP key, and then release both keys. "JOG" will appear in the speed reference portion of the display. The drive will now jog whenever the JOG button is pressed. Press any key other than JOG to exit the jog mode.

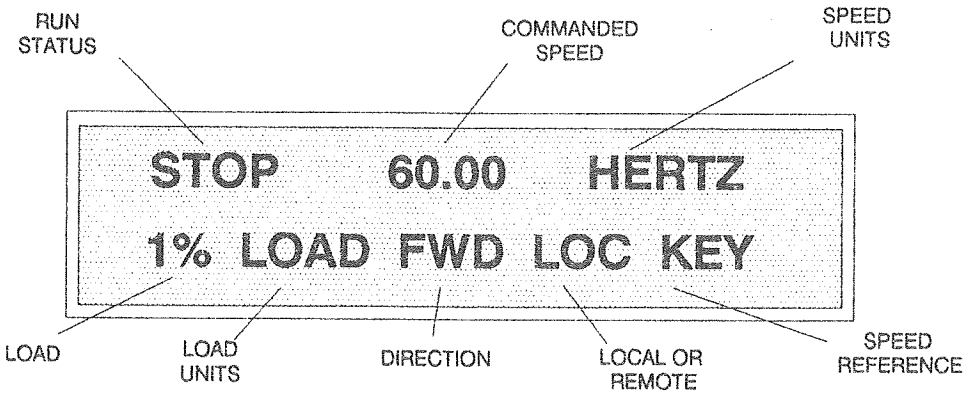
FORWARD/REVERSE - To change the direction of rotation press the FWD/REV key then press the ENTER key. Note: Parameter #66 must be set to FWD + REV for this key to be active.

SPEED REFERENCE SELECTION (AUTO/MANUAL) - To change between keypad speed control and some other speed reference type press the AUTO/MAN key and then press ENTER. To activate a speed reference type other than keypad control, the corresponding terminal (12E, 12F, 12G, 13A, 13B, or 13C) on the control strip must be connected to terminal 2. See the control wiring section. Note: Parameter #67 must be set to ENABLE for this key to be active.

CLEARING MISS-KEYED INPUTS - Use the CLEAR key to clear errors made while entering data.

VIEWING A FAULT - To view the present fault condition press ENTER while in the operating mode. To view previous faults press Prog/Run and then ENTER. (Previous faults are stored in parameter #200 see the DESCRIPTION OF PARAMETERS section).

THE AF1200 DISPLAY IN THE OPERATING MODE



15.1 DIAGNOSTIC DISPLAY

The diagnostic display is an eight segment LED located to the left of the keypad on the AF1200 Series control board. This LED acts as a complement to the 2X20 LCD screen on the keypad to indicate the status of the drive by displaying one of the symbols in the table below. Fault trip conditions are also displayed on the LCD keypad display and stored under "PREVIOUS FAULTS", parameter #200.

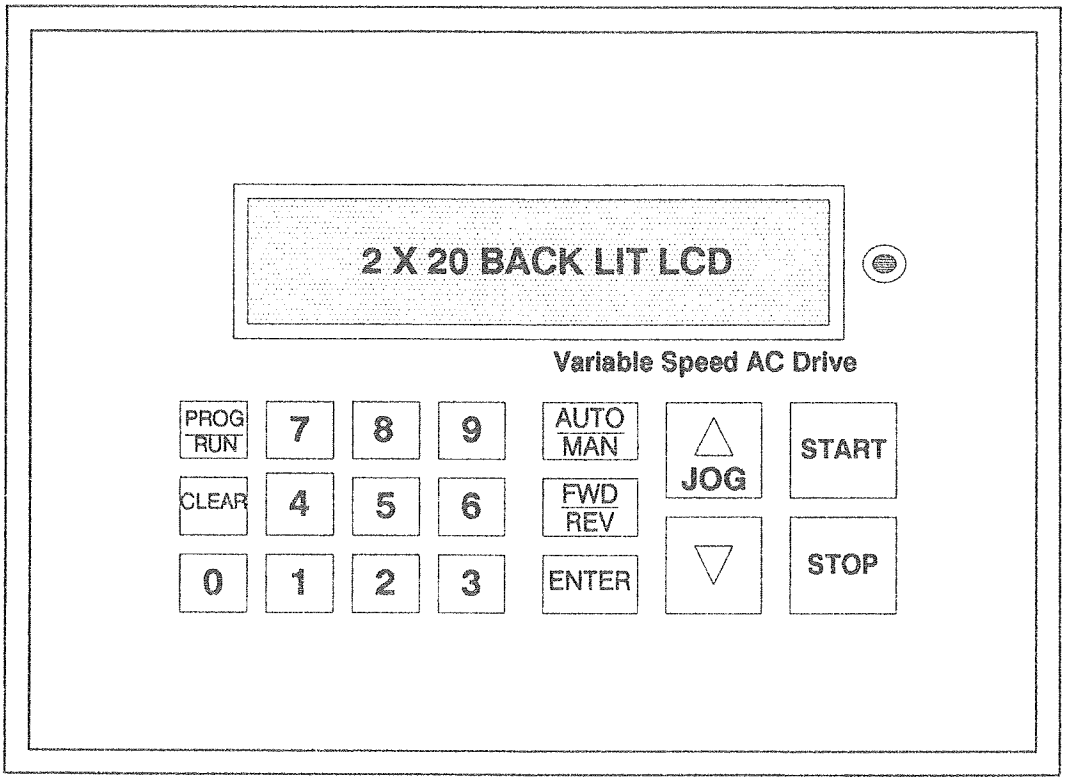
DIAGNOSTIC DISPLAY CODES		
SYMBOL	**MEANING**	**DRIVE STATUS**
--	INPUT	INPUT POWER PRESENT - STANDBY MODE
O	OUTPUT	ROTATING "O" - RUN MODE
A	AMBIENT	HIGH TEMPERATURE TRIP - 75° C
C	CURRENT	DRIVE OPERATING IN CURRENT LIMIT
F	FAULT	OUTPUT FAULT TRIP
H	HIGH	HIGH VOLTAGE TRIP
L	LOW	LOW VOLTAGE TRIP
P	PROTECT	MOTOR (OVERLOAD) PROTECTION TRIP
8	OVER RIDE	OPERATING IN DECEL OVER RIDE MODE
e	ERROR	START ERROR TRIP (START CLOSED AT POWER-UP)
E	E-STOP	EMERGENCY STOP TRIP CIRCUIT OPEN (TERM. 22)
U	LOGIC ERROR	LOGIC RESET ERROR

16.1 PROGRAMMING

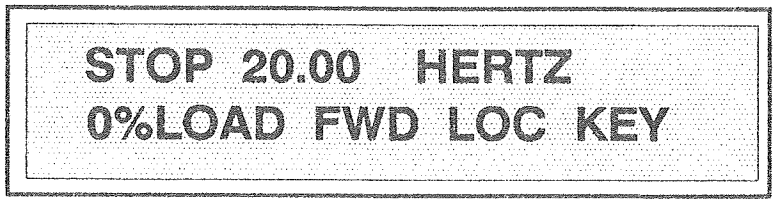
The AF1200 is programmed by using the keypad to enter the program parameter list (menu) and change parameter values. The keypad is also used to operate the drive when in the local mode (terminal 7 is closed to terminal 2). An LED to the right of the LCD display indicates the presence of power to the control board.

THE AF1200 SERIES KEYPAD

When the AF1200 Series is first powered up it will be in the operating mode in standby. The display will appear as follows:



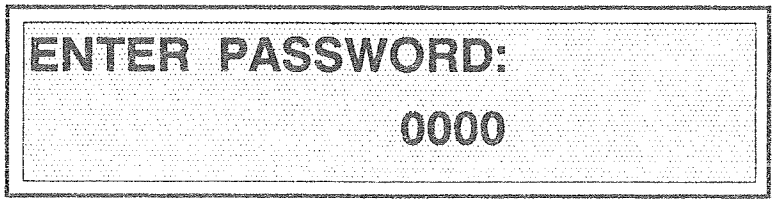
To program the AF1200 Series drive, first access the program mode by pressing the PROG/RUN button. This will result in either direct entry into the program mode if password proctection is disabled or the ENTER PASSWORD prompt will be displayed if password protection is enabled. If the ENTER PASSWORD: prompt is displayed (see diagram below)



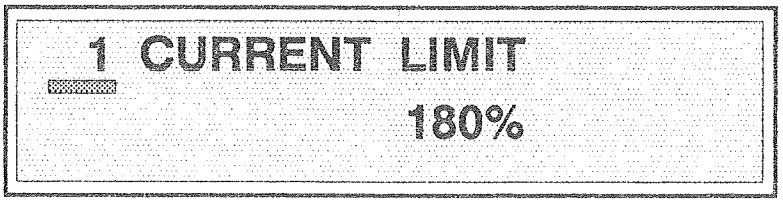
input the appropriate password and press the ENTER key (if an asterisk is showing in the upper right hand corner of the display, it is not necessary to input the password before pressing ENTER).

Upon entering the program mode the first item in the parameter list will be displayed (see below).

To change the displayed parameter, scroll through the menu using the UP and DOWN keys, or move directly to the desired point by keying in a new parameter number with the numerical keys and then pressing ENTER.



To change the parameter value, press ENTER to move the "cursor" (highlighted character) from the parameter number ("1" in the above example) to the parameter value ("180%" in the above example). Then while the cursor is on the parameter value change the parameter



value by scrolling to the desired value using the UP and DOWN keys and pressing the ENTER key. Numeric parameter values may also be changed by keying in the desired value via the numerical keys and then pressing ENTER.

See the PARAMETER MENU and PARAMETER DESCRIPTION sections for more information on programming.

17.1 PROGRAMMABLE PARAMETER MENU

PARAMETER MENU				
ITEM NUMBER	PARAMETER NAME	VALUE LIMIT OR MENU CHOICE	DEFAULT SETTING	PASSWORD LEVEL
1	CURRENT LIMIT	5 - 180 %	180 %	1
2	THERMAL OVERLOAD	50 - 150 %	150 %	1
3	SLIP COMPENSATION	0 - 3.0 %	0.0 %	1
4	SPEED @ 4 MA / 0 VDC	0.00 - 360.00 HZ	0.00 HZ	1
5	SPEED @ 20 MA / 10 VDC	0.00 - 360.00 HZ	60.00 HZ	1
9	PRESET ACC / DEC	ENABLED, DISABLED	DISABLED	1
11-17	SPEED PRESETS #1- #7	0.50 - 120.00 HZ	10.00 HZ	1
19	JOG SPEED	0.50 - 120.00 HZ	10.00 HZ	1
20	NORMAL ACCEL	0.1 - 3600.0 SEC	30.0 SEC	1
21-27	PRESET #1 - #7 ACCEL	0.1 - 3600.0 SEC	30.0 SEC	1
29	JOG ACCEL	0.1 - 3600.0 SEC	30.0 SEC	1
30	NORMAL DECEL	0.1 - 3600.0 SEC	30.0 SEC	1
31-37	PRESET #1 - #7 DECEL	0.1 - 3600.0 SEC	30.0 SEC	1
39	JOG DECEL	0.1 - 3600.0 SEC	30.0 SEC	1
41	SKIP SPEED #1	0.00 - 120.00 HZ	0.00 HZ	2
42	SKIP SPEED #2	0.00 - 120.00 HZ	0.00 HZ	2
43	SKIP SPEED #3	0.00 - 120.00 HZ	0.00 HZ	2

PARAMETER MENU				
ITEM NUMBER	PARAMETER NAME	VALUE LIMIT OR MENU CHOICE	DEFAULT SETTING	PASSWORD LEVEL
44	SKIP BANDWIDTH	0.00 - 10.00 HZ	2.00 HZ	2
50	FREQUENCY OUTPUT TYPE	0-10V / 0-20 MA, 2-10V / 4-20 MA	0-10V / 0-20 MA	2
51	FREQUENCY OUT @ MAXIMUM	1.00 - 360.00 HZ	60.00 HZ	2
54	LOAD OUT @ MAXIMUM	10 -200 %	125 %	2
61	MINIMUM FREQUENCY	0.10 - 120.00 HZ	0.50 HZ	2
62	MAXIMUM FREQUENCY	0.10 - 120.00 HZ	60.00 HZ	2
63	IR COMPENSATION	0.0 - 20.0 %	0.00 %	2
64	STABILITY	NORMAL, LOW COMP, HIGH COMP	NORMAL	2
65	COAST TO STOP	ENABLED, DISABLED	DISABLED	2
66	FORWARD / REVERSE	FWD ONLY, REV ONLY, FWD + REV	FWD ONLY	2
67	AUTO / MANUAL SEL.	ENABLED, DISABLED	ENABLED	2
70	AUTO START	ENABLED, DISABLED	DISABLED	2
71	RESTART ON FAULT	ENABLED, DISABLED	DISABLED	2
72	RESTART LIMIT	0 - 10 TIMES	3 TIMES	2
73	RESTART DELAY	1.0 - 180.0 SEC	5.0 SEC	2
75	RESTART DECEL	1.0 - 999.9 SEC	10.0 SEC	2

PARAMETER MENU				
ITEM NUMBER	PARAMETER NAME	VALUE LIMIT OR MENU CHOICE	DEFAULT SETTING	PASSWORD LEVEL
76	RESTART CURRENT LIMIT	10 - 180 %	75 %	2
80	DC BRAKE	DISABLED, TIMED, CONTINUOUS	DISABLED	2
82	DC BRAKE LOAD	1 - 180 %	20 %	2
83	DC BRAKE TIME	0.1 - 300.0 SEC	5.0 SEC	2
90	SPEED UNITS	HZ, RPM, % RPM	HZ	2
91	SPEED MULTIPIER	0.10 - 400.00	60.00	2
92	LOAD UNITS	AMPS, % LOAD	% LOAD	2
93	LOAD MULTIPLIER	0.01 - 300.00	1.00	2
100	BASE FREQUENCY	10.0 - 360.00 HZ	60.00 HZ	2
101	V/HZ CURVE TYPE	LINEAR - 1.0, VAR TORQUE - 1.3, VAR TORQUE - 1.6, VAR TORQUE - 2.0	LINEAR - 1.0	2
104	AUTO V BOOST	0 - 30.0 %	0.0 %	2
105	MANUAL V BOOST	0 - 30.0 %	2.0 %	2
121	RELAY #1 FUNCTION	RUN, FAULT, FAULT LOCKOUT, AT SPEED, ABOVE SET SPEED, CURRENT LIMIT, FOLLOWER PRESENT, NO FUNCTION	RUN	2
122	RELAY #2 FUNCTION	RUN, FAULT, FAULT LOCKOUT, AT SPEED, ABOVE SET SPEED, CURRENT LIMIT, FOLLOWER PRESENT, NO FUNCTION	FAULT	2

PARAMETER MENU				
ITEM NUMBER	PARAMETER NAME	VALUE LIMIT OR MENU CHOICE	DEFAULT SETTING	PASSWORD LEVEL
123	RELAY SET SPEED	0.00 - 120.00 HZ	.50 HZ	2
124	TB-14 FUNCTION	RUN, FAULT, FAULT LOCKOUT, AT SPEED, ABOVE SET SPEED, CURRENT LIMIT, FOLLOWER PRESENT, NO FUNCTION	NO FUNCTION	2
130	DRIVE HP	0 - 199.9 HP	0.0 HP	2
132	MAINTENANCE TARGET	0 - 65,000 HR	0 HR	2
142	CLEAR HISTORY	ENABLED, DISABLED	DISABLED	2
144	SOFTWARE VERSION	213-012X	213-012X	2
145	SERIAL COMMUNICATIONS	PROGRAM, CONTROL, PROG. AND CONTROL, DISABLED, DETECT, MONITOR ONLY	PROGRAM	2
146	SERIAL TIME OUT	0 - 600 SEC	8 SEC	2
147	SERIAL ADDRESS	1 - 30	1	2
148	ENABLE PASSWORDS	ENABLED, DISABLED	ENABLED	2
149	LEVEL 1 PASSWORD	0000 - 9999	9100	2
150	LEVEL 2 PASSWORD	0000 - 9999	0019	2
200	PREVIOUS FAULT	THIS "PARAMETER" IS FOR VIEWING ONLY	N/A	0

18.1 DESCRIPTION OF PARAMETERS

1 - CURRENT LIMIT

The current limit setting determines the maximum value of the output current. This is usually done to limit motor torque capability. For most applications the current limit is maintained at the maximum setting.

2 - THERMAL OVERLOAD

The THERMAL OVERLOAD setting is used to protect the motor from over heating due to excess current. The trip time for the THERMAL OVERLOAD setting is based on what is known as an "inverse I squared t" function. This circuit emulates the function of a mechanical thermal overload relay (commonly refered to as "heaters").

Set the THERMAL OVERLOAD to a value which is equal to the ratio of the motor amp rating to the drive amp rating X 150%. This will restult in a trip at 150% of motor rating in one minute and allow for continuous operation at a 1.15 service factor.

3 - SLIP COMPENSATION

SLIP COMPENSATION is used to compensate for changes in motor speed ("slip") which occur due to changes in load. In a standard AC induction motor, as the load on the motor increases, the motor current increases and the motor shaft speed decreases. By increasing the output frequency in response to the increased motor current, the reduction in the motor speed due to increased load is greatly reduced. Speed regulation with no load to full load fluctuations of less than 1% of base speed are attainable in most applications. SLIP COMPENSATION is often set to 3% since that is the standard slip rating of most motors.

4 - SPEED @ 4MA/OV
5 - SPEED @ 20MA/OV

These two parameters determine the gain in the 4-20 MA (or 20-4 MA) and 0-10 VDC (or 10-0 VDC) follower circuit. The follower circuit is set to be either proportional (4 - 20) or inversely proportional (20 -4) depending on which value is larger. The speed follower extremes can be set to any value at or between 0 - 360 Hz.

9 - PRESET ACC/DEC

This parameter is used to ENABLE or DISABLE the individual acceleration and deceleration rates for each of the seven speed presets. When disabled the NORMAL ACCEL and NORMAL DECEL control the rate of acceleration and deceleration of all the presets.

11-17 - SPEED PRESETS #1-#7

Speed presets are pre-programmed speeds which are activated via contact closures between terminal 2 and terminal 13A, 13B, or 13C. The presets can be set to any value between the MINIMUM FREQUENCY and MAXIMUM FREQUENCY. The speed presets are activated by the multiplex scheme shown in the following table:

PRESET SPEED ACTIVATION			
PRESET NUMBER	T13A TO T2	T13B TO T2	T13C TO T2
ONE	CLOSED	OPEN	OPEN
TWO	OPEN	CLOSED	OPEN
THREE	OPEN	OPEN	CLOSED
FOUR	CLOSED	CLOSED	OPEN
FIVE	CLOSED	OPEN	CLOSED
SIX	OPEN	CLOSED	CLOSED
SEVEN	CLOSED	CLOSED	CLOSED

19 - JOG SPEED

The JOG SPEED controls the speed whether JOG is called for from the keypad (local JOG mode) or from a contact between terminals 2 and 12D (remote Jog mode). The JOG SPEED can be set to any value between the MINIMUM FREQUENCY and the MAXIMUM FREQUENCY. JOG SPEED is usually set to a low value (5-10 HZ). For information on activating the JOG function see the OPERATING FROM THE KEYPAD and CONTROL WIRING sections.

20 - NORMAL ACCEL

This parameter sets the acceleration rate when the speed is commanded from the keypad, a potentiometer, 4-20 MA, 0-5 VDC, or 0-10VDC. It also determines the acceleration for the preset speeds if the PRESET ACC/DEC is DISABLED. The NORMAL ACCEL does not have any effect when the speed is commanded by JOG.

The ability to accelerate a given load at a particular rate will be limited by the output power capabilities of the drive/motor combination.

NOTE: All acceleration and deceleration times are based on the time to increase or decrease speed from 0 HZ to the BASE FREQUENCY value.

21-27 - PRESET #1 ACCEL - PRESET #7 ACCEL

These parameters set each individual acceleration rate when the speed is commanded by the corresponding preset speed (#1-#7) and PRESET ACC/DEC is set to ENABLED.

29 - JOG ACCEL

This parameter sets the acceleration rate for the Jog speed.

30 - NORMAL DECEL

This parameter sets the deceleration rate when the speed is commanded by the keypad, potentiometer, 4 -20 mA, 0 - 5 VDC, 0 - 10 VDC, or speed presets when PRESET ACC/DEC is in the DISABLED mode. Dynamic braking may be needed to provide enough decelerating capacity to slow large inertia loads from higher speeds. See OPTIONS-DYNAMIC BRAKING.

31-37 - PRESET #1 DECEL - PRESET #7 DECEL

These parameters set each individual deceleration rate when the speed is commanded by the corresponding preset speed (#1-#7) and PRESET ACC/DEC is set to ENABLE.

39 - JOG DECEL

Jog Decel sets the deceleration rate for the Jog speed.

41 - 44 - SKIP SPEEDS

Parameters 41 through 44 are used to prevent continued operation at critical speeds. Critical speeds are speeds which cause mechanical resonance, usually causing excessive vibration in the driven equipment. The SKIP SPEEDS (parameters 41 - 43) and SKIP BANDWIDTH (parameter 44) are used to define up to three speed ranges which correspond to critical speeds (speed avoidance ranges). The SKIP SPEEDS are the mid-points of each of the speed avoidance ranges. The SKIP BANDWITH is the width of the speed avoidance ranges.

If the commanded speed lies within the speed avoidance range, the drive output speed will not enter the range. If the commanded speed lies on the opposite side of the speed avoidance range the output frequency will ramp to the value of the commanded frequency.

50 - FREQUENCY OUTPUT TYPE

This parameter selects the analog speed indicating output signals at terminals 10B and 10D to be either; 0-10VDC on terminal 10B and 0-20 mA on terminal 10D, or 2-10VDC on terminal 10B and 4-20 mA on terminal 10D.

51 - FREQUENCY OUT AT MAXIMUM

This parameter scales the the analog speed indicating output signals at terminals 10B and 10D. Set the parameter value to the drive output frequency which is to correspond to maximum output level of the speed indicating signal (10VDC or 20 mA).

54 - LOAD OUT AT MAXIMUM

This parameter scales the the analog load indicating output signal at terminal 11. Set the parameter value to the drive output current which is to correspond to the maximum output level of the load indicating signal (1 mA).

61 - MINIMUM FREQUENCY

The Minimum frequency determines the lowest output frequency (in Hertz) at which the the drive will operate continuously. Note that the lowest speed at which a standard AC induction motor can produce torque is limited by the slip range, usually 3% of full speed. This means a standard motor will not produce full rated torque below 2 Hz. Note: units are always in HERTZ. The minimum frequency range is .5 Hz up to the MAXIMUM FREQUENCY.

62 - MAXIMUM FREQUENCY

The Maximum frequency determines the highest output frequency (in Hertz) at which the the drive will operate continuously.

WARNING!
THE MAXIMUM FREQUENCY MUST BE SET LOW ENOUGH TO AVOID OVER SPEEDING THE MOTOR AND OR DRIVEN EQUIPMENT. OVER SPEEDING THE MOTOR AND/OR DRIVEN EQUIPMENT MAY RESULT IN DAMAGE TO EQUIPMENT AND INJURY TO PERSONNEL! CONSULT MOTOR MANUFACTURER BEFORE OPERATING MOTOR ABOVE ITS RATED SPEED!

63 - IR COMPENSATION

IR COMPENSATION is used to compensate for decreased torque capability due to the increasing effects resistance in the motor windings as current increases. As the motor load and therefore current increases, the drive will increase the output voltage to the motor to increase the torque capability.

64 - STABILITY

The STABILITY adjustment alters the drive output to compensate for differences in motor inductance, capacitance, and impedance. Certain motors may operate erratically under lightly loaded conditions. If motor operation is erratic at low load levels, adjusting the STABILITY setting to LOW COMP or HIGH COMP may give smoother operation.

65 - COAST TO STOP

This parameter sets the drive to either "coast to a stop" or "ramp to a stop". When the COAST TO STOP is in the ENABLED mode and a stop command is given, the motor will behave as though the drive was instantaneously disconnected. When the COAST TO STOP is in the DISABLED mode and a stop command is given, the drive output frequency will ramp down at a rate determined by the prevailing decel rate. Note: Dynamic braking may be needed to provide enough decelerating capacity to slow large inertia loads from higher speeds. See OPTIONS-DYNAMIC BRAKING.

66 - FORWARD / REVERSE

This parameter is used to the set motor direction and/or the function of the FWD/REV key on the keypad - it only has effect when the drive is in the local (LOC) mode. The parameter can

be set to one of three values: FWD ONLY, REV ONLY, FWD + REV. FWD ONLY and REV ONLY disable the FWD/REV key and set the motor direction to only forward or only reverse. FWD + REV enables the FWD/REV key allowing the motor direction to be changed from the keypad.

When FWD + REV is selected and the FWD/REV key is depressed to change the motor direction, the frequency will ramp down to zero speed at the decel rate and then ramp up to the set speed at the accel rate.

67 - AUTO / MANUAL SELECT

This parameter is used to ENABLE or DISABLE the AUTO/MAN key on the keypad. When the AUTO/MAN key is disabled the drive's speed reference will default to a speed reference activated by the terminal strip. If no other speed reference is activated on the terminal strip, the speed reference will default to the keypad.

70 - AUTO START

This parameter is used to automatically start the drive upon application of input power. The drive must be wired for two wire start/stop control with a maintained start contact which is in the closed position. NOTE: The drive output frequency will ramp up from zero (no speed search will be conducted) whenever this parameter is enabled.

WARNING!

INSURE THAT AUTOMATIC START WILL NOT CAUSE DAMAGE TO EQUIPMENT OR INJURY TO PERSONNEL!

71 - RESTART ON TRIP

This parameter sets the drive to either restart after a fault or to remain tripped until it is reset by calling for a stop.

If restart is ENABLED and the drive trips, the drive will attempt to restart after a time delay set by RESTART DELAY. If the drive is unable to restart, the drive will attempt additional restarts, each after a time delay. The number of attempted restarts is determined by the RESTART LIMIT.

The RESTART ON TRIP function is designed to restart into a coasting motor by conducting a speed search to catch the motor while it is still spinning, and then accelerate to the commanded speed.

The speed search is conducted by first restarting the drive at MAXIMUM FREQUENCY at a reduced voltage. The voltage is then increased and the motor current rises to a high level causing the drive to go into current limit (based on the RESTART CURRENT LIMIT setting). The motor current rises to a high level the current limit level because of the differential between the output frequency of the drive and the speed at which the motor is coasting. The drive output frequency then decelerates, at the RESTART DECEL rate, until the motor current drops below the current limit level (this occurs when the drive output frequency is matched to the motor speed). Once output frequency and motor speed are matched the drive output frequency is accelerated returning the motor to the commanded speed. NOTE: The drive output frequency will ramp up from zero in the event of restart after a power outage (no speed search will be conducted) if this parameter 70 AUTO START is enabled.

WARNING!

INSURE THAT AUTOMATIC RESTART WILL NOT CAUSE DAMAGE TO EQUIPMENT OR INJURY TO PERSONNEL!

72 - RESTART LIMIT

The RESTART LIMIT determines the number of times the drive will attempt to restart after a trip. If unable to restart (fault condition persists) within the set number of attempts, the drive will display FAULT LOCKOUT and cease attempting to restart. The drive will not attempt to restart in the event of an E-stop trip or into a shorted motor without first being reset.

73 - RESTART DELAY

The RESTART DELAY is the time delay in between restart attempts. During this time delay, the operator screen will be over written with a warning display, "WARNING! START PENDING." This parameter also determines the time period which must pass, after a fault, before the drive can be reset.

75 - RESTART DECEL

The RESTART DECEL sets rate at which the drive lowers the output frequency during a restart speed search. This parameter and the RESTART CURRENT LIMIT are set for a particular system by trial.

76 - RESTART CURRENT LIMIT

The RESTART CURRENT LIMIT determines the current limit value used during the auto restart on trip sequence.

80 - DC BRAKE

DC injection braking provides shaft stopping (holding) torque by supplying low level DC voltage to the motor's stator coils. DC braking can provide up to the motor's full rated torque (for short periods of time), from 10 Hz down to very low speeds.

CAUTION!
DC BRAKING MAY CAUSE SEVERE MOTOR HEATING!
BE SURE TO MAINTAIN MOTOR TEMPERATURE
WITHIN RATED LIMITS

This parameter sets the DC braking function to be either DISABLED or operational in a TIMED mode, or CONTINUOUS mode.

In the TIMED mode, DC braking energizes either when the output frequency reaches the DC BRAKE SPEED (COAST TO STOP (#65) is DISABLED) or immediately when a stop command is given (COAST TO STOP (#65) is ENABLED) and remains energized until a time period equal to the DC BRAKE TIME elapses.

In the CONTIUOUS mode, DC braking energizes either when the output frequency reaches the DC BRAKE SPEED (COAST TO STOP (#65) is DISABLED) or imediately when a stop command is given (COAST TO STOP (#65) is ENABLED) and remains energized until a start command is given.

82 - DC BRAKE LOAD

This parameter sets the magnitude of the current applied to the motor by the DC braking circuit. This parameter is based on the drive's name plate current rating. DC BRAKE LOAD should be set to the lowest possible value, which gives satisfactory operation, in order to minimize motor heating.

83 - DC BRAKE TIME

This parameter determines the duration of braking when in the TIMED mode. DC BRAKE TIME should be set to the lowest possible value, which gives satisfactory operation, in order to minimize motor heating.

90 - SPEED UNITS

SPEED UNITS sets the units of the output speed indication on the keypad display.

91 - SPEED MULTIPLIER

The SPEED MULTIPLIER is a calibration constant for the output speed indication on the keypad display. The speed multiplier is the constant which when multiplied by the frequency in Hertz, will give the desired displayed value.

92 - LOAD UNITS

LOAD UNITS sets the units of the output load indication on the keypad display.

93 - LOAD MULTIPLIER

The LOAD MULTIPLIER is a calibration constant for the output load indication on the keypad display. Setting this value to 1 while the LOAD UNITS are set to %LOAD configures the load indication to be a load percentage meter (this is the factory default). Setting the LOAD UNITS to AMPS and the LOAD MULTIPLIER to the nameplate amp rating of the drive configures the load indicator as an ammeter.

100 - BASE FREQUENCY

The BASE FREQUENCY is the frequency at which the drive output reaches full voltage. For most applications the base frequency should be set to the motor's rated frequency.

When the drive is set for constant torque output (V/HZ CURVE TYPE set to LINEAR-1.0), the BASE FREQUENCY is the determinent of the volts to hertz ratio. For example, if the drive is rated for 460 VAC and the BASE FREQUENCY is set to 60 HZ, the drive will maintain a constant of ratio 7.66 V/HZ (except when AUTO V BOOST or MANUAL V BOOST supercede).

101 - V/HZ CURVE TYPE

This parameter is used to change the relationship between the output voltage and frequency. Choices are; LINEAR-1.0, VAR-TORQUE-1.3,
VAR TORQUE-1.6, and VAR-TORQUE-2.0.

LINEAR-1.0 gives a linear relationship between voltage and frequency, V/HZ is a constant, yielding constant motor torque capability. The three VARIABLE TORQUE values (1.3, 1.6, 2.0) are used to gain optimum energy savings and reduce accoustical noise in variable torque applications such as pumps and fans. An infinite array of V/HZ patterns are available by adjusting the BASE FREQUENCY, V/HZ CURVE TYPE, MINIMUM FREQUENCY and MAXIMUM FREQUENCY.

104 - AUTO V BOOST

AUTO V BOOST supercedes the V/HZ setting determined by the BASE FREQUENCY and V/HZ CURVE TYPE to increase output voltage during acceleration. In order to boost motor torque, the output voltage is increased in the amount of the AUTO V BOOST setting whenever the drive is accelerating. AUTO V BOOST is usually used in applications with high inertia loads where quick accelerations are desired.

105 - MANUAL V BOOST

The MANUAL V BOOST supercedes the V/HZ setting determined by the BASE FREQUENCY and V/HZ CURVE TYPE and maintains a minimum voltage at lower frequency levels. MANUAL V BOOST is used in applications which require high starting torque. (e.g. conveyors, lifts and other loads which have high static friction or high inertia).

121, 122 - RELAY #1 FUNCTION, RELAY #2 FUNCTION

There are two auxilary relays which can be programmed for a variety of functions; RUN, FAULT, FAULT LOCKOUT, AT SPEED, and ABOVE SET SPEED, CURRENT LIMIT, FOLLOWER PRESENT, NO FUNCTION.

Each relay has a set of FORM C contacts rated 2 amps (5 amps resistive) at 28 VDC or 120 VAC. Control wiring diagrams show relays in the rest (coils NOT energized) state.

123 - RELAY SET SPEED

This value is the speed setting at which an auxiliary set for the ABOVE SET SPEED function will change states. The relay will energize as the output frequency rises to the RELAY SET SPEED value and de-energize as the output frequency falls below the RELAY SET SPEED value.

124 - TB - 14 FUNCTION

This parameter determines the function of an open collector output. This circuit is used when an additional status indicating relay is needed. The following functions ae available ; RUN, FAULT, FAULT LOCKOUT, AT SPEED, and ABOVE SET SPEED, CURRENT LIMIT, FOLLOWER PRESENT, NO FUNCTION.

Consult the factory before attempting to utilize this circuit.

130 - DRIVE HORSEPOWER

This parameter is used to scale the kilowatt hour meter display. Enter the horsepower rating of the drive (not the motor horsepower) as it appears on the drive data plate.

The kilowatt hour display is accessed by pressing ENTER while in the run mode. The kilowatt hour display is disabled if the drive horsepower parameter value is set to 0.0

132 - MAINTENANCE TARGET

This parameter sets the time period, in hours, for the maintenance target alarm. The maintenance target alarm alerts the operator that a given amount of accumulated run time has passed. This can be used to indicate the need for maintenance on the driven equipment.

After the time period set by this parameter has elapsed, a message is displayed indicating that the maintenance target has been reached. The message can be cleared by pressing any key on the keypad, but will be re-displayed each hour until a new maintenance target is set.

142 - CLEAR HISTORY

This parameter is used to clear the fault history log which is stored in parameter 200. To clear the list of ten previous faults, set this parameter to ENABLED. Pressing the ENTER key to enter ENABLED will clear the fault history log and return the parameter value to DISABLED.

144 - SOFTWARE VERSION

This parameter displays the version number of the drives's software. This information is useful if referring to the factory for programming or trouble shooting assistance. Since this value is a "view only" parameter, it's value cannot be changed.

145 - SERIAL COMMUNICATIONS

This parameter is used with the serial communications option. If the serial communications option is not installed, leave this parameter set to the default setting of PROGRAM.

If the serial communications option is installed, see the Serial Communications Software User's Guide for more information.

146 - SERIAL TIME OUT

This parameter is used with the serial communications option. If the serial communications option is not installed, leave this parameter set to the default setting of 8.

If the serial communications option is installed, see the Serial Communications Software User's Guide for more information.

147 - SERIAL ADDRESS

This parameter is used with the serial communications option. If the serial communications option is not installed, leave this parameter set to the default setting of 1.

If the serial communications option is installed, see the Serial Communications Software User's Guide for more information.

148 - ENABLE PASSWORDS

This parameter sets the programming mode to be password protected when set to the ENABLED mode. Password protection is based on a two level system. See the PARAMETER MENU for a listing of the password level for each parameter. Level one allows access to "low end" parameters which are changed more frequently. Level two allows access to all parameters which are user adjustable.

149 - LEVEL 1 PASSWORD

Factory default value - 9100

150 - LEVEL 2 PASSWORD

Factory default value - 0019

200 - PREVIOUS FAULTS

This "parameter" stores a fault history of ten previous fault conditions. If any fault trips have occured, the fault number and name will be stored here. View the previous faults by pressing ENTER and then scrolling through the previous faults with the UP and DOWN arrow keys. Possible values are shown in the table below.

FAULT HISTORY DISPLAYS	
DISPLAY	**DESCRIPTION (POSSIBLE CAUSE)**
START ERROR	INPUT POWER APPLIED WITH START CIRCUIT CLOSED , OR AUTO RESTART OR RESTART ON FAULT IS ENABLED WHILE DRIVE IS NOT SET FOR TWO WIRE CONTROL (TERMINAL 2 TO 12A NOT CLOSED)
HIGH CONTROL TEMPERATURE	HIGH AMBIENT TEMPERATURE OR HIGH HEATSINK TEMPERATURE
OUTPUT TRANSISTOR FAULT	FAULT DETECTED AT OUTPUT TRANSISTOR - PHASE TO PHASE OR PHASE TO GROUND SHORT
HIGH DC BUS VOLTAGE	HIGH INPUT LINE VOLTAGE OR REGENERATING MOTOR
LOW DC BUS VOLTAGE	LOW INPUT LINE VOLTAGE
MOTOR OVERLOAD PROTECTION	HIGH MOTOR AMPERAGE DRAW (OVERLOADED MOTOR)
EMERGENCY STOP	E-STOP CONNECTION (TERMINAL 2 TO TERMINAL 22 OPEN)
LOGIC RESET FAULT	FAILURE TO PROPERLY RE-INITIALIZE DRIVE MEMORY - (CONSULT FACTORY IF UNABLE TO RESET.)

Direct access is available to this parameter by pressing the PROG/RUN key and pressing ENTER (feature available when the parameter memory is not activated - asterisk not showing in the when the ENTER PASSWORD is displayed).

19.1 OPTIONS

19.1.1 DYNAMIC BRAKING

STANDARD DUTY DYNAMIC BRAKING

The standard duty dynamic braking option consists of a circuit board only (braking resistors are board mounted) on one through three horsepower models and a circuit board and separate resistor assembly on five through one hundred and twenty five horsepower models. Circuit boards are mounted to the drive panel with two 8-32x3/8 thread forming (chip free) screws and the resistor assembly, when required, is mounted to the inside of the enclosure using 10-32x3/8 thread forming (chip free) screws, lockwashers, and nuts.

When field mounting the standard dynamic brake option, note the accompanying installation and wiring instructions. Standard duty dynamic brakes are not recommended for continuous cycling applications which require stopping inertial loads greater than twice that of the motor; from 1800rpm more than eight times, from 2500 rpm more than four times,or from 3600 rpm more than two times, during a five minute period.

HEAVY DUTY DYNAMIC BRAKING

The heavy duty dynamic braking option is capable of providing more frequent stopping and stopping higher inertia loads than the standard duty dynamic braking option by using externally mounted resistors. All heavy duty dynamic braking options consist of a circuit board, a separate resistor assembly (mounted external to the enclosure containing the drive) and a protective ventilated cover for the resistor assembly. Resistor banks and covers are usually shipped loose when ordered with a drive, but can be factory mounted by Cutler-Hammer to the top of NEMA 12 enclosures upon request. Ventilated resistor bank covers are NEMA 1 rated and suited for use only in clean dry environments. When used in severe environments, HDB resistor banks must be enclosed in an appropriate electrical enclosure. Circuit boards are mounted to the drive panel with two 8-32x3/8 thread forming (chip free) screws and the resistor assembly and ventilated cover are mounted using 10-32x3/8 thread forming (chip free) screws, lockwashers, and nuts. When field mounting the heavy duty dynamic brake option, note the accompanying installation and wiring instructions.

Continuous braking ("hold back") of; 100% (of motor rated torque) at output frequencies up to 15 Hz (25% of motor base speed), 50% at output frequencies up to 30 Hz (50% of motor base speed), and 25% at output frequencies up to 60 Hz (100%of motor base speed) is possible. Intermittent (once per minute) braking ("hold back") at 180% of motor rated torque is possible for; thirty seconds at output frequencies up to 15 Hz (25% of motor base speed) fifteen seconds at output frequencies up to 30 Hz (50% of motor base speed), and seven seconds at output frequencies up to 60 Hz (100% of motor base speed). Heavy duty dynamic braking is not recommended for continuous cycling applications which require stopping inertial loads greater than twice that of the motor from 1800 rpm more than eight times, from 2500 rpm more than four times, or from 3600 rpm more than two times, during a one minute period. Consult Cutler-Hammer if assistance is needed when selecting or sizing a dynamic brake option. Please have available information concerning the number of stops per minute, required stopping time, motor operating speed, inertia of the driven load, and the motor frame size.

19.1.2 SERIAL COMMUNICATIONS PORT

See manual supplement.

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Eaton Yale Ltd.
Westinghouse &
Cutler-Hammer Products
3228 South Service Road
P.O. Box 5040, Station A
Burlington, Ontario L7R 3Y8
905/333-6442

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