Micro-Speed®

Operation Manual

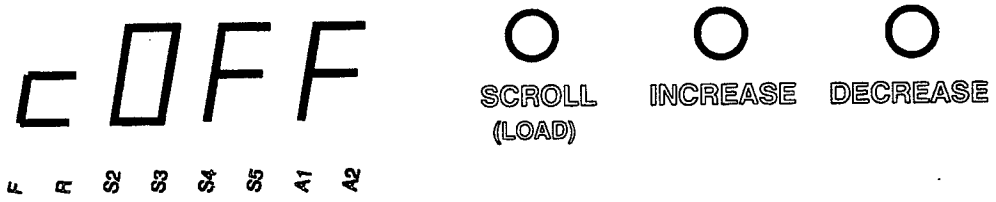
Use with version **B** drives.

Always match manual with drive. Drive version noted by last letter in serial number.

SN#_____

MODEL #_____

PANEL #_____



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970304

SAFETY FIRST

The following safety precautions are necessary to insure the safety of those operating and working around the Micro-speed® and the controlled machinery.

LOAD BRAKE IS REQUIRED

A load brake is necessary in hoisting application. The Micro-speed® alone will not hold a load or stop it from falling. This load brake should hold the load when electrical power is not applied. Hoists using worm geared motors may be an exception to this rule.

BRAKE CONTROL WIRED THROUGH FAULT OUTPUTS

The brake should be wired so it will stop all motion whenever a fault occurs. This is accomplished by wiring the coil of the brake contractor in series with both the brake control terminals (B1, and B2) and the fault terminals (R2 and R3) on the Micro-speed®.

BRAKE RESISTOR MOUNTED IN SAFE ENCLOSURE WITH ADEQUATE VENTILATION

If the Micro-speed® requires an external braking resistor, it must be mounted in a safe manner. The resistors can become extremely hot and has bare high voltage connections warranting placement in a touch-safe enclosure away from flammable material. The resistors will remain electrically hot for several minutes after the power has been disconnected. Also the possibility of the resistor melting is present and requires the enclosure to prevent any molten material from causing injury or damage.

DON'T SERVICE DRIVE UNTIL BUSS CHARGE LAMP IS OUT

If the red lamp on the cover of the Micro-speed® is lit, then there is still a dangerous electrical charge stored in the unit. Do not attempt to service the Micro-speed® or any attached wiring until this light is out. Even after power is disconnected, power will remain in the unit and the lamp will remain lit approximately 4 minutes.

GROUND DRIVE PROPERLY

The chassis of the drive must be grounded. Use grounding lug on Micro-speed® or the terminal marked "G"

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1. Message from the Manufacturer

Power Electronics International Inc. stands behind its product. If any problems ever arise, feel free to contact the factory and our engineers will help you. Our engineers will also help you retrofit a Micro-speed® to any unique or special application, even changes to the Micro-speed® may be made and ordered special.

2. Overview

The Micro-speed® variable speed motor drive is designed to control the speed of 3-phase AC motors. It has many unique features that have been tailored for easy utilization in Bridge, Trolley, and Hoist applications. Some of these features are the following:

- 115 VAC control inputs are standard. These inputs can be directly connected to a pendant station without the need for an interface card. These inputs are extremely rugged.

- The smaller Micro-speed® has braking resistors built in.
- Most of the programming parameters are for cranes.
- Gang-set™ programmability. Eight preset programs are stored in the Micro-speed® to get you up and running fast.
- Flexible pendant control. Just by changing the program, the user can obtain 1-5 speeds, two speed infinitely variable, three speed infinitely variable, or a multispeed control with a low speed potentiometer.

On all Micro-speed's you will find a display and three buttons marked scroll, increase, decrease. The display will show OFF when the Micro-speed® is not driving the motor, and when the drive is running, the display will indicate the frequency (speed) in Hertz at which the motor is being driven. The display is also used when a problem arises and to protect itself the Micro-speed® shuts down (this is called a fault). On the display will be shown the letter "F" followed by a number. This is a code which can be looked up in this manual to determine why the Micro-speed® faulted.

Also the display and buttons are used to program the drives. The Micro-speed® contains 28 programmable parameters labeled A1 through A28. These "A" parameters are what molds the Micro-speed® to the special needs of each application. By initiating a few pokes at the buttons a list of the Micro-speed's characteristics can be displayed and then changed to suit the individual need of your application. The "A" values control things like; the acceleration rate, the deceleration rate, how soon to release the brake after the motor starts, how much slip should be compensated, what speed to run the motor, should the motor coast to a stop, or be ramped down (decelerated) to a stop, and many others. In order to speed up the process of programming your Micro-speed®, Power Electronics has included a number of specialized pre-set "A" values, Gang-Sets™, that can be easily loaded into the Micro-speed®. As few as three key strokes may be needed to get the Micro-speed® up and running. Once the Gang-Set™ of your choice has been loaded into the Micro-speed®, individual changes to the "A" values can then be made in order to fine tune the drive to your application. We note that fine-tuning must always be done after a Gang-set™ has been loaded, not before, since loading a Gang-set™ erases all previous changes. All access to these programming parameters, either through fine-tuning individual values or through a Gang-set™ operation, can be prohibited by locking the Micro-speed's program. Once locked, the program can be unlocked to allow access. Precise directions for programming the Micro-speed®, as well as a description of the function of each "A" value, are contained in the Programming section of this manual.

Besides these "A" values there are also "E" values or Diagnostic variables. Some of these "E" variables function to check the prior faults which the Micro-speed® experienced, others will help check that the wiring is done correctly.

Two different types Micro-speed's are available, a standard drive and a hoist drive. The difference between a standard drive and a hoist drive is in its programming only. Specifically, a standard drive allows the user to choose either ramping to a stop or coasting to a stop. In ramping to a stop, the drive slows the motor down under power and then sets the brake. In coasting to a stop, the drive stops powering the motor the instant it loses its forward or reverse signal and sets the brake. A hoist drive only allows the user to choose the coast to a stop option -- there are no other differences.

Also on the front of the Micro-speed® is a red BUSS CHARGE LAMP. This lamp indicates the presence of high voltage on the internal bus capacitors. Never service the Micro-speed® while the red BUSS CHARGE LAMP is on. It takes about six minutes for the lamp to go off after power has been removed from the drive.

The terminals on the Micro-speed® are divided into two types. The power terminals and the control terminals.

The power terminals are L1, L2, and L3 which connect to the line voltage, T1, T2, and T3 which connect to the motor, P1 and P2 which connect to an external braking resistor and Y1 and Y2 which also connect to line voltage to supply power for the Micro-speed®'s logic circuitry. These power terminals are found on the bottom level of the Micro-speed®. The braking resistor terminals and the logic supply terminals are found only on the larger Micro-speed®s, those for 460 VAC 7.5 hp or 230 VAC 5 hp and above. There is also a grounding terminal or lug available for proper grounding of the drive.

Braking resistors are required on all bridge and trolley applications and on most Hoist applications. Smaller Micro-speed®s have them built in. For larger Micro-speed®s, 460 VAC 7.5 hp or 230 VAC 5 hp and above, they must be supplied externally, housed in a touch-safe vented enclosure that will contain any molten metal that may melt off the resistors if they are on too long. Also, a drive contactor is to be used with external resistors. A drive contactor is a three-phase contactor that feeds line voltage to L1, L2, and L3 to the Micro-speed® and is controlled by the fault relay output contacts on the control board. This contactor will open when the drive senses a fault, removing main power from the drive and hence from the braking resistor to insure its deactivation. With a drive contactor arrangement, the logic supply inputs Y1 and Y2 are fed by the line side of the drive contactor.

The control terminals are all found on the logic board and consist of the 115 VAC inputs which connect to the pendant, brake control outputs to control the brake contactor coil, form C fault relay outputs, AUXilary inputs for a variety of uses including connection to a motor overload, and an analog input section for potentiometer or current input.

A Power Electronics HDB board is required for most hoists using a Micro-speed® drive. An HDB board supplies an extra margin of safety to the hoist user by bringing the mechanical brake under the direct control of the operator instead of under the direct control of the drive. An HDB board need not be used in situations where the load would be certain not to fall if the motor was not powered and the mechanical brake was open. A load brake is usually not enough meet this condition since they only insure that the load will fall at a controlled rate and don't insure a stop.

3. Installation

3.1. Environment

1. MOUNTING: Mount the Micro-speed® vertically on panel with spacing that allows adequate ventilation of the heat sink.

2. AMBIENT TEMPERATURE for the Micro-speed® should not exceed 45°C or go below -10°C.

3. DO NOT expose the Micro-speed® to metal shavings, excessive vibration (no more than .5G) , corrosive or high relative humidity environments.

3.2. Safety Requirements/Warnings

1. GROUNDING: Ensure that the unit is properly grounded. Use grounding lug on Micro-speed® or terminal marked "G".

2. BUSS CHARGE LAMP: Do not touch any electrical component or attempt to wire the Micro-speed® while any power is supplied to the unit, or while the BUSS CHARGE lamp is on. The BUSS CHARGE lamp should go out about four minutes after power is removed from the L1, L2, and L3 terminals.

3. LOAD BRAKE: A load brake is necessary in hoisting application. The Micro-speed® alone will not hold a load or stop it from falling. This load brake should hold the load when electrical power is not applied. Hoists using worm geared motors may be an exception to this rule.

4. BRAKE CONTROL WIRED THROUGH FAULT OUTPUTS
The brake should be wired so it will stop all motion whenever a fault occurs. This is accomplished by wiring the coil of the brake contactor in series with both the brake control terminals (B1, and B2) and the fault terminals (R2 and R3) on the Micro-speed®.

5. BRAKE RESISTOR MOUNTED IN SAFE ENCLOSURE WITH ADEQUATE VENTILATION
If the Micro-speed® requires an external braking resistor, it must be mounted in a safe manner. The resistors can become extremely hot and has bare high voltage connections warranting placement in a touch-safe enclosure away from flammable material. The resistors will remain electrically hot for several minutes after the power has been disconnected. Also the possibility of the resistor melting is present and requires the enclosure to prevent any molten material from causing injury or damage.

3.3. Wiring Practices and System Requirements

1. GROUNDING: To ensure that the unit is properly grounded you must ground the heat sink. (Use grounding lug on Micro-speed® or terminal marked "G")

2. FUSING: Always branch protect drive with fuses. Circuit breakers may be used instead.

3. DON'T accidentally put 115VAC into the AUX1 and AUX2 terminals. All that is needed is a contact closure between them and the COM terminal.

4. DON'T use contactors on the output of the control.

5. Drive must be hard wired to motor. Use conduit or festooning. Do not allow any rails or any device that may open the connection between the motor and the drive to be installed.

6. With Arc-welding equipment and similar devices, destructively large spikes and high voltages can be induced on the power lines. In such cases, use an isolation transformer on the input of the Micro-speed®, or use an input inductor.

7. ALWAYS wire the N.C. contact on the fault relay in the Micro-speed® in series with the brake contactor to drop out the brake in case of a fault.

8. If not using festooning, use DOUBLE SHOE TYPE collectors on the conductor bar.

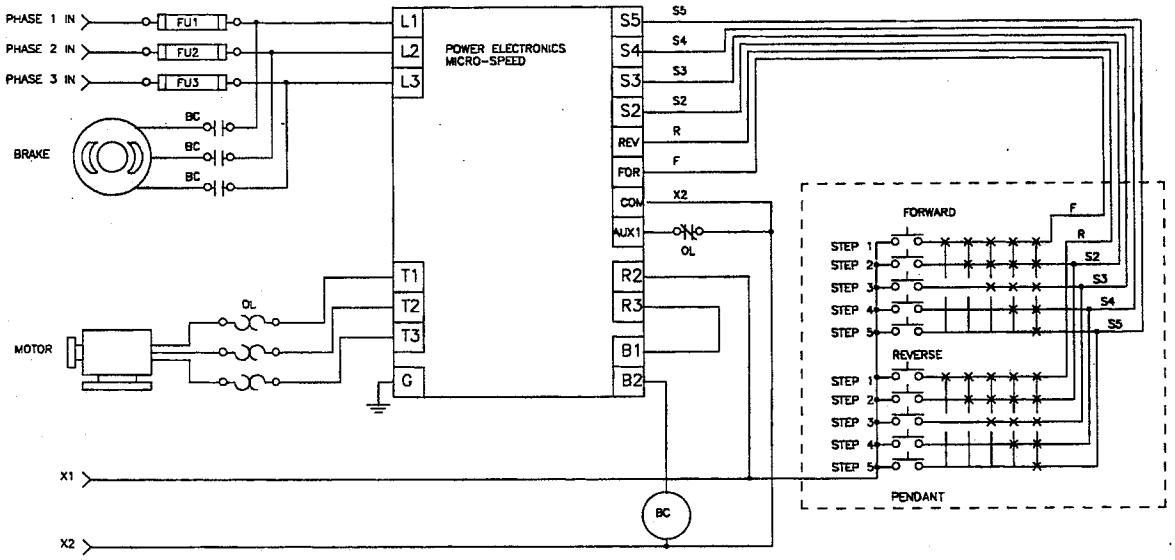
9. If possible, Try to run these three groups of wires -- motor wires, brake wires, and control wires -- separately.

10. Use shielded wire to run any analog signal to the drive and ground the shield near the drive.

11. Wire the N.C. contact on any external overload device used in series with an AUX terminal and the COM terminal and program that input as an external trip input.

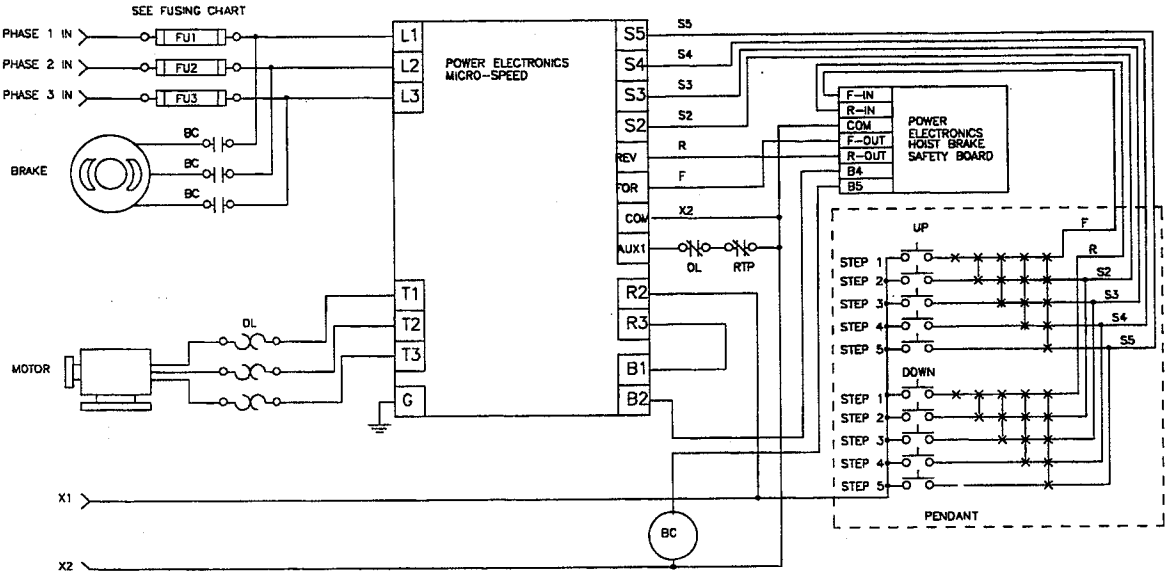
3.4. Bridge/Trolley Wiring Diagram for A size drives

(A size is 460VAC 5HP and below, 230VAC 3HP and below)



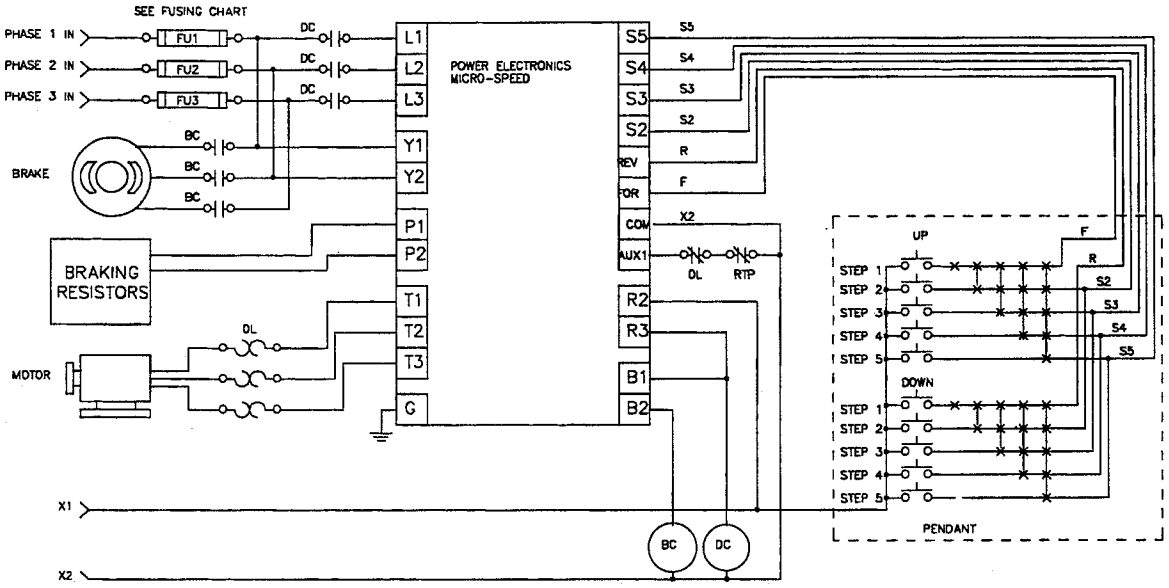
3.5. Hoist Wiring Diagram for A size drives

(A size is 460VAC 5HP and below, 230VAC 3HP and below)



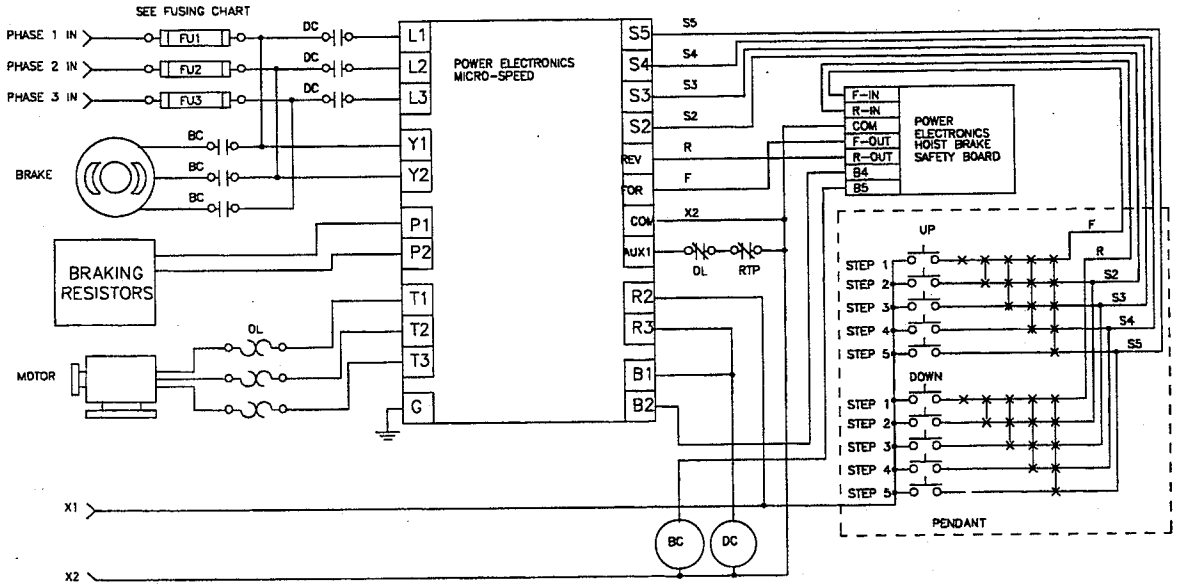
3.6. Bridge/Trolley Wiring Diagram for C, D size drives

(C, D size are 460VAC 7.5HP and above, 230VAC 5HP and above)



3.7. Hoist Wiring Diagram for C,D size drives

(C, D size are 460VAC 7.5HP and above, 230VAC 5HP and above)



3.8. Micro-speed® fusing chart

Fusing of each on the input power side is necessary. Fuses should be of the Time delay type. 480vac mains must use a voltage rating of 500 VAC or higher for fuses. 230vac mains may use a voltage rating of 250 VAC or higher. The midget size fuses are easier to use on panels. Other crosses to the suggested fuses may also be utilized....

LITTLEFUSE:
CCMR (600vac midget size, up to 30 amps) or
JTD (600vac small, 1-600 amps) or
Class RK1 Time Delay style (Large) LLSRK=250vac & LLNRK=600vac.

BUSSMAN:
FNQ (600vac midget size, up to 10 amps) or
LPJ (600vac small, 1-600 amps) or
Class RK1 Time Delay style (Large) LPSRK=250vac & LPNRK=600vac

DRIVE HP	480 VAC	208-230 VAC
1	5 Amp	
2	5 Amp	10 Amp
3	6 Amp	12 Amp
5	10 Amp	20 Amp
7.5	20 Amp	40 Amp
10	20 Amp	40 Amp
15	30 Amp	60 Amp
20	40 Amp	80Amp
25	50 Amp	100Amp
30	60 Amp	120Amp
40	80 Amp	
50	100 Amp	
60	120 Amp	

3.9. BRAKING RESISTOR VALUES CHART

Ohm values must be according to Power Electronics recommendations. Chart shows values for horizontal motion, for vertical motion see Hoisting section below to determine wattage (ohms stay the same). Braking resistor banks are available from Power Electronics. Minimum is 300W with 300W increments above. Part numbers R--W---- are available through Power Electronics.

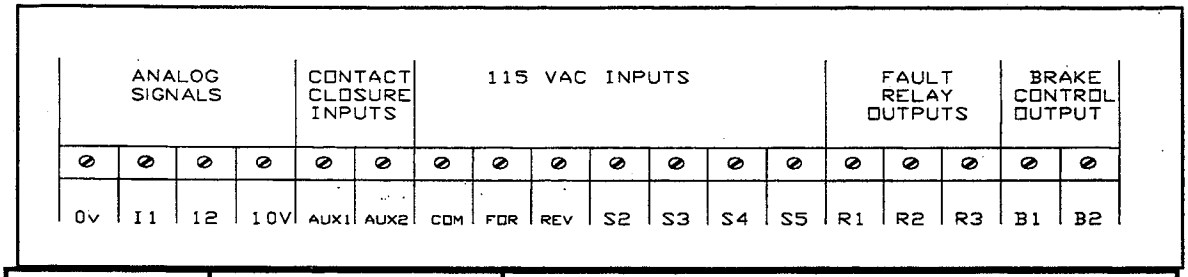
HORSEPOWER	460 VAV	230 VAC
1	Internal	internal
2	Internal	Internal
3	Internal	Internal
5	Internal	25 Ohm 300W R25W300
7.5	50 Ohm 600W R50W600	12 Ohm 600W R12W600
10	50 Ohm 600W R50W600	12 Ohm 600W R12W600
15	33 Ohm 900W R33W900	8 Ohm 900W R8W900
20	25 Ohm 1200W R25W1200	6 Ohm 1200W R6W1200
25	20 Ohm 1500W R20W1500	5 Ohm 1500W R5W1500
30	16 Ohm 1800W R16W1800	4.2 Ohm 1800W R4.2W1800
40	12 Ohm 2400 W R12W2400	
50	10 Ohm 3000W R10W3000	
60	8.3 Ohm 3600W R8.3W3600	

HOISTING APPLICATIONS

For most cases, like when hoisting with a load brake or worm gear type motor, use 1/3 of the above watt values. For example a 10 hp 460vac hoist with a load brake would have 1/3 x 600 W = 200 watts the minimum would be an R50W300 regeneration resistor pack. A larger wattage may be used and will increase the reliability of the resistor. When in doubt go with more Watts. Never change the ohmic value!

Hoisting without a load brake: Call factory, see warnings!

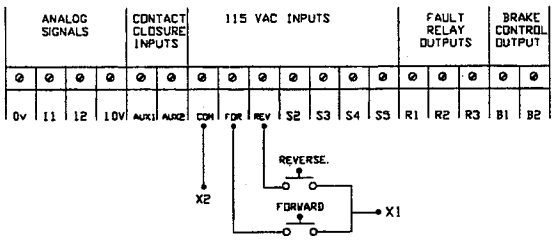
3.10. Control Input Description



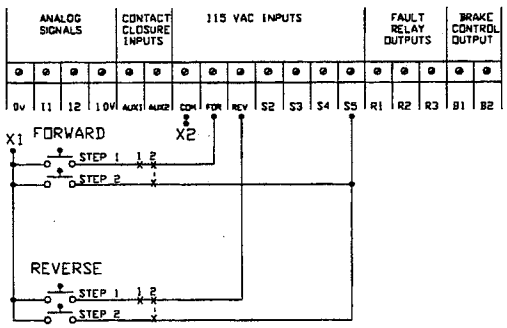
TERMINALS	CATEGORY	DESCRIPTION
0V	ANALOG INPUTS (variable speed control w/potentiometer)	Zero volts. Common terminal for inputs, I1 and I2.
I1		0 - 10 V signal input.
I2		0 - 20 ma signal. (Not to be used in conjunction with I1.)
10V		10 VDC Power supply for analog signal.
AUX 1	CONTACT CLOSURE INPUTS (used with COM)	Programmable input. External tripping out unit. Never input 115VAC or other control voltage into this terminal!
AUX 2		PROGRAMMABLE INPUT.**NEVER** input 115vac or other control voltage into this terminal! Can also be set to trip out the drive as in Aux1.
COM	115 V INPUTS (Speed choices)	COMMON - EXTERNAL CONTROL SIGNAL. "X2" - Used with both 115vac inputs and contact closure inputs.....
FOR		FORward turns motor in forward direction (also used as the LOW SPEED input).
REV		REVerse turns motor in reverse direction (also used as the LOW SPEED input).
S2 S3 S4 S5		SPEEDS - Programmable speed selections
R1 R2 R3	FAULT RELAY OUTPUT	Normal form "C" relay. Fault relay will switch, and unit will shut down whenever the drive senses a fault condition. R2 is the common terminal, R1 is n/o, and R3 is n/c.
B1 B2	BRAKE CONTROL OUTPUT	Brake output can switch up to 115 VAC, .5 Amp line. (Ex. 115VAC) Use to control a brake relay. This is a triac output and can only switch AC currents.

3.11. Pendant Wiring Options

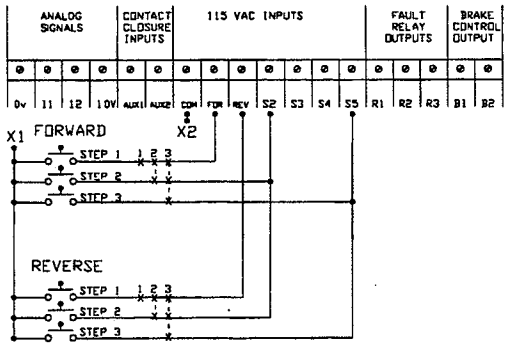
WIRING OF 1-STEP PUSH BUTTON SWITCH



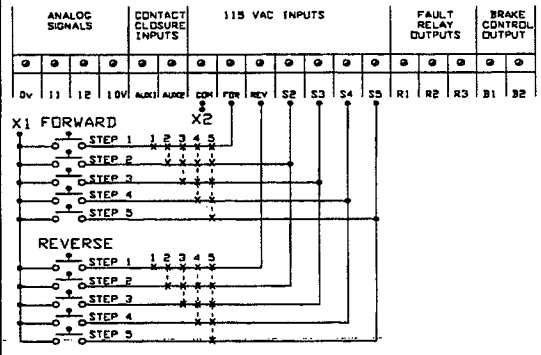
WIRING OF 2-STEP PUSH BUTTON SWITCH



WIRING OF 3-STEP PUSH BUTTON SWITCH



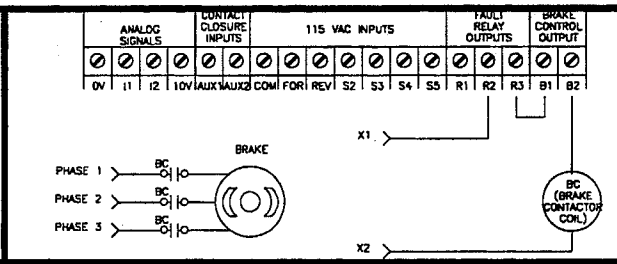
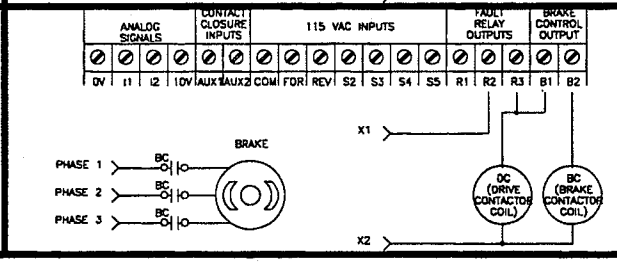
WIRING OF 5-STEP PUSH BUTTON SWITCH



3.12. Controlling a Mechanical Brake

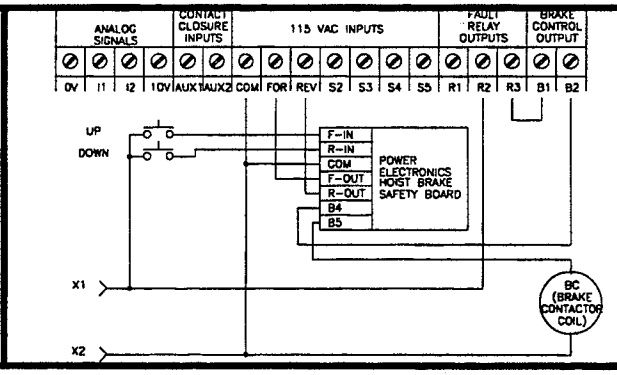
Typical brakes found on hoists and bridge trolleys, when energized, will allow the motor to turn. When de-energized, the motor will stop. If a mechanical brake is used it should be controlled by the Micro-speed® through a brake contactor. The brake control terminals B1 and B2 are able to switch any AC voltage up to 230 V 1 Amp. For vertical motion (i.e. a hoist), a Power Electronics Hoist Brake Safety Board should also be wired in series with the brake contactor coil. This will put the brake under the direct control of the hand switch button for an added level of safety.

HORIZONTAL TRAVEL, BRAKE WIRING DIAGRAM (BRIDGE / TROLLEY)

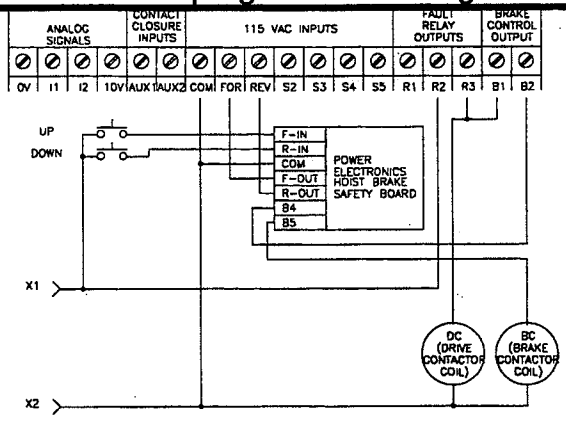
wiring diagram for the brake on horizontal motions when a drive contactor is not used.	
wiring diagram for the brake on horizontal motions when a drive contactor is used.	

VERTICAL TRAVEL, BRAKE WIRING DIAGRAM (HOIST)

When using the Hoist Brake Safety Board the ramp down must be off .

wiring diagram for the brake on a hoist when a drive contactor is not used. (A drive contactor is used whenever external braking resistors are used)	

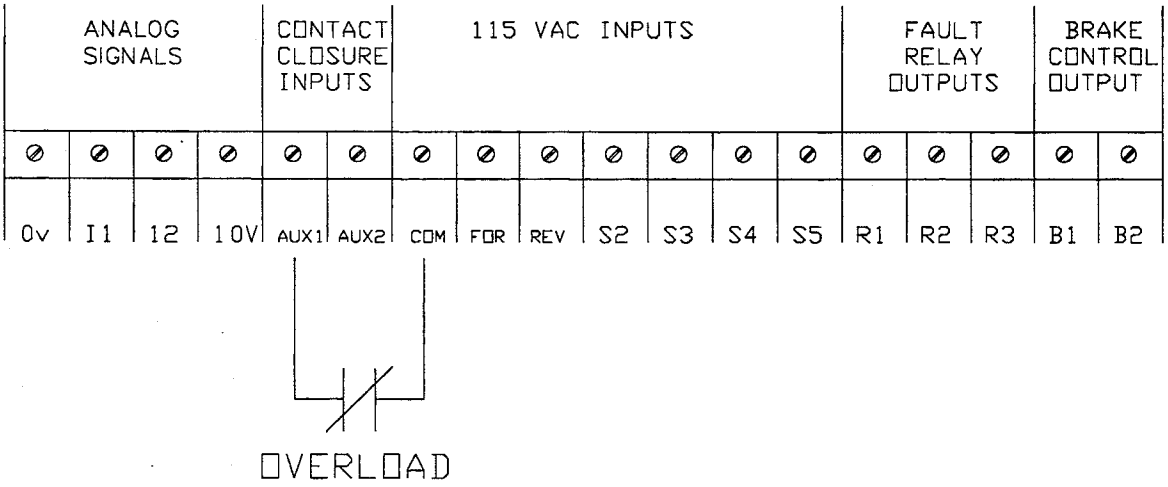
wiring diagram for the brake on a hoist when a drive contactor is used.



3.13. AUXILARY INPUTS

The AUXilary terminals function when a connection to COMmon is made or broken. Voltages are never connected to these terminals! The A drive parameters A3, A7, A18, A19, A27, and A28 determine what the AUXilary terminals will be used for. AUX.1 will generally be wired to an overload.

The diagram below shows a normally closed contact of a motor current overload device. When this contact opens an external fault condition is signaled to the Micro-speed® through the AUX1 terminal. Parameter A28 would be set to 4 (trip when AUX1 is deactivated.)



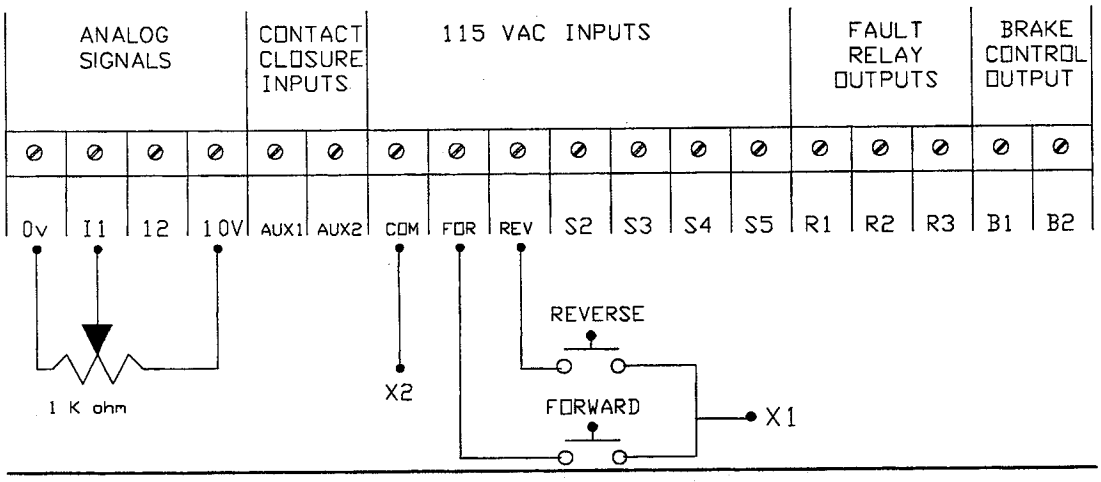
Aux to COM must have a jumper if the n/c contact is not used with an overload. The drive will stay in the OFF mode without it. Set parameter value of A28 to determine which Aux is used.

3.14. ANALOG INPUTS

The Analog signal terminals are used to vary the speed of the drive. Wiring to these terminals is not necessary for the operation of the Micro-speed®. Either terminal I1 is used or terminal I2 is used, never both. The general application uses terminal I1. I1 sense a voltage change and is used with a potentiomeent that is connected between 0V and 10V. I2 sense a 4 - 20 ma current flow between 0V and I2.

As a precaution against false signals, any wires connected to the analog input section and traveling more than several feet should be shielded and kept away from power wires. Connect the shield to the chassis ground. Wire such as "Belden" brand shielded cable 3 conductor, 22 AWG (Belden #8771) or equivalent. It is generally not necessary to shield the potentiometer wire on pendant hand switch stations.

ANALOG INPUT-WIRING LOW SPEED POTENTIOMETER DIAGRAM



4. Programming the Micro-speed®

The Micro-speed® has 28 parameters that can be programmed to taylor the drive's operation to the needs of the user. They are labeled as A1 through A28 and are referred to as the "A" parameters. These parameters tell the drive such things as how fast to accelerate or decelerate, what speeds to run at, how long to hold the brake, and so forth. There are two ways in which to program these parameters. The first is to "GANG-SET™" a preset program into all these parameters all at once, and the other is to set all the parameters individually, one by one. By using the Gang-set™, only a few button strokes are needed to fill all the drive parameter values and get you up and running fast. We recommend using a GANG-SET™ then going back and fine tune some "A" parameters individually to better meet the needs of your application. The programming ability of the Micro-speed® can also be locked to prevent accidental changes in the program. It can also be unlocked to allow changes. Below is at a table listing the Micro-speed®'s 28 "A" parameters along with there name and programming range.

"A" parameters

"A"	Name	Range
A1	Accel 1	0.1-30 sec
A2	Accel 2	0.1-30 sec
A3	Accel mode	mode: 0,1,2,3,4
A4	Decel 1	0.1-30 sec
A5	Decel 2	0.1-30 sec
A6	Decel 3	0.1-30 sec
A7	Decel mode	mode: 0, 1,2,3,4,5
A8	Voltage Boost DC Injection	1-30%
A9	Operation Mode	mode:0,1,2,3,4,5,6,7
A10	Slip comp.	-10 to 10 Hz
A11	Pulse Start / DC Injection time	0 - 2.0 sec
A12	Low speed	1- 120Hz
A13	Speed 2	1- 120Hz
A14	Speed 3	1- 120Hz

"A"	Name	Range
A15	Speed 4	1- 120Hz
A16	Speed 5	1- 120Hz
A17	Analog upper limit	1- 120Hz
A18	Max Hz	1- 120Hz
A19	Max Hz enforce	mode: 0,1,2
A20	Ramp down	ON - OFF
A21	Volt peak	30-120Hz
A22	Stall prev.	ON - OFF
A23	Pulse Start / DC Injection Volts	1-30.0%
A24	Timer	0-600 sec
A25	Initial Brake Hold time	0.0-2.0 sec
A26	Dead time	-5.0 to 5.0 sec
A27	Reset mode	©: 0,1,2,3,4,5
A28	Trip mode	mode: 4,5

4.1. Locking and unlocking the Micro-speed®

Locking the program will prevent the user from getting into both the Gang-set™ mode and the "A" programming mode, thus preventing the user from altering the program in any way. Unlocking the program allows normal access to these modes.

To lock or unlock the Micro-speed®:
1. Make sure the Micro-speed® is on but not driving a motor and the display reads OFF.
2. Press the increase and decrease buttons on the cover of the Micro-speed® simultaneously. Hold these buttons down until LOC or UNL appears in the display (this takes about 5 second) and then release the buttons.
3. Poke the increase and decrease buttons to choose the desired lock mode (choose LOC to lock the program or choose UNL to unlock the program).
4. Press the scroll button down until OFF appears in the display and then release the button.

4.2. Gang-set™ programming

The Micro-speed® contains 8 pre-set Gang-set™ programs, labeled from PA01 through PA08. Each program contains general settings for a specific Micro-speed® application. To choose a Gang-set™ you should match your application to that shown

Bridge / Trolley
- PA01 1-speed
- PA02 2-position push-button infinitely variable
- PA03 3-position push-button infinitely variable
- PA04 5-speed - can be used for 1 through 5-speeds

Hoist
- PA05 3-position push-button infinitely variable
- PA06 5-speed - can be used from 1 to 5-speeds
- PA07 5-speed with low speed potentiometer on pendant control.
- PA08 2-position push-button infinitely variable

To Gang-set™ the Micro-speed®:
1. Make sure the Micro-speed® is on but not driving a motor and the display reads OFF.
2. Press all three buttons on the cover of the Micro-speed® simultaneously. Hold these buttons down until PA00 appears in the display (this takes about 1 second) and then release the buttons.
3. Use the increase and decrease buttons to choose the desired Gang-set™ program.
4. Press the scroll button down until LOAd appears in the display (this takes about 1 second) and then release the button.

Each Gang-set™ program is actually just a list of 28 values which are factory chosen. When the Micro-speed® is Gang-set™, all that happens is that each "A" parameter will be reprogrammed to a new value in the factory chosen list. The Gang-set™ procedure is a simple and quick way to get the Micro-speed® up and running. However, since each "A" parameter is reprogrammed every time a Gang-set™ is initiated, all previous custom adjustments to individual "A" parameters will be lost. Hence, all fine-tuning of individual "A" parameters must come after Gang-setting and not before.

The Gang-set™ program PA00 is special. Programming PA00 will cause the Micro-speed® to leave the Gang-set™ mode without changing any "A" parameters.

For Micro-speed®s specifically designated for hoisting, only PA05 through PA08 are available to be Gang-set™.

Once the Micro-speed® is Gang-set™, one can not read out which Gang-set™ program was used.

The Gang-set™ mode cannot be entered if the unit is locked.

4.3. Individual "A" parameter programming

The Micro-speed®'s 28 parameters can be viewed and programmed individually.

To program an "A" parameter individually:

1. Make sure the Micro-speed® is on but not driving a motor and the display reads OFF.
2. Press the scroll button on the cover of the Micro-speed®. Hold this button down until -A- appears in the display (this takes about 3 seconds) and then release the button. The label A1 will appear on the display and 1 second later the value that A1 is programmed to will be displayed.
3. Poke the scroll button several times fairly quickly (less than 1 second between pokes) and watch the sequence of parameter labels A1, A2, A3,... appear on the display. Stop poking the scroll button when the label of the parameter you want to alter -- say A12 for instance -- appears on the display.
4. The parameter label will be displayed for about 1 second and then the parameter value that it is currently programmed to will be displayed. Use the increase and decrease buttons to alter this value as desired.
5. To change another parameter go back to step 3 and poke the scroll button until the label of the next parameter you want to alter appears on the display and then continue on as before.
6. To finally leave this "A" programming mode, press and hold the scroll button down until the display reads OFF. This will take about 5 seconds during which the current parameter label -- say A12 again -- will be displayed .

To view the "A" parameters without changing their programmed values, use the same procedure as above but without using the increase or decrease buttons to change any values.

The "A" programming mode can not be entered if the programmed is locked.

4.4. "A" parameter description

A1 ACCELERATION RATE 1

Adjustable from 0.1 to 30.0 seconds.
This setting determines the amount of time it will take for the drive to accelerate from 0 to 60 Hz.
The ACCELERATION MODE (A3) determines when this rate will be used.

A2 ACCELERATION RATE 2

Adjustable from 0.1 to 30.0 seconds.
This setting determines the amount of time it will take for the drive to accelerate from 0 to 60 Hz.
The ACCELERATION MODE (A3) determines when this rate will be used.

A3 ACCELERATION MODE

Adjustable mode 0,1,2,3,4

Determines when Acceleration Rate 1 (A1) and Acceleration Rate 2 (A2) will be used:

A3	Acceleration rate used by drive
0	A1 is used always, A2 is never used.
1	A1 is used except when input Aux. 1 is activated, during which A2 will be used.
2	A1 is used except when input Aux. 2 is activated, during which A2 will be used.
3	A1 is used except when input S5 is activated, during which A2 will be used.
4	The acceleration of the drive is programmed to simulate the acceleration profile of a wound rotor motor. The drive will interpolate between rates A1 and A2 to determine the acceleration rate to be used depending on the difference between the target speed of the drive and the speed at which the drive is momentarily running. If the drive is told to change its frequency by only a few hertz, Then the acceleration rate will be A1. If the drive is told to change its frequency by a large amount, say 60 Hz, then the acceleration rate will be closer to A2. If the drive is about 30 Hz from its intended final speed, then the instantaneous acceleration rate will be somewhere between A1 and A2. This mode allows one to vary the break away acceleration from a stopped position by varying the initially applied speed signal. A quick start * can be achieved by initially directing the unit to go full speed. A soft initial acceleration can be achieved by gradually increasing the speed signal. * Here, A2 is presumed to be set quicker than A1.

A4 DECELERATION RATE 1

Adjustable from 0.1 to 30.0 seconds.

This setting determines the amount of time it will take for the drive to decelerate from 60 to 0 Hz.

The DECELERATION MODE (A7) determines when this rate will be used.

A5 DECELERATION RATE 2

Adjustable from 0.1 to 30.0 seconds.

This setting determines the amount of time it will take for the drive to decelerate from 60 to 0 Hz.

The DECELERATION MODE (A7) determines when this rate will be used.

A6 DECELERATION RATE 3

Adjustable from 0.1 to 30.0 seconds.

This setting determines the amount of time it will take for the drive to decelerate from 60 to 0 Hz.

The DECELERATION MODE (A7) determines when this rate will be used.

A7 DECELERATION MODE

Adjustable mode 0,1,2,3,4,5.
Determines when Deceleration Rate 1 (A4), Deceleration Rate 2 (A5), and Deceleration Rate 3 (A6) will be used. We remark that in each of these modes A4 is assumed to be the longest time and A6 the shortest. If A4≥ A5≥ A6 does not hold then the Micro-speed® will adjust these values so that it does. The rule used in adjusting these values is simple. A5 is always assumed to be the shorter of A4 and A5. Furthermore, A6 is always assumed to be the shorter of A4, A5 and A6.

A7 Deceleration rate used by drive

0 A4 is used for decelerating between speeds,
A5 is used for decelerating to a stop.
A6 is used for decelerating during reverse plugging.

1 A4 is used for decelerating between speeds,
A5 and A6 are used for decelerating to a stop, and reverse plugging.
In this mode, the deceleration of the drive is programmed to simulate the deceleration profile of a wound rotor motor control when it is reverse plugged. The drive will interpolate between rates A5 and A6 to determine the deceleration rate to be used depending on how much the drive is reverse plugged. If the drive is reverse plugged in low speed (S2,S3,S4, AND S5 are not activated) then the deceleration rate will be approximately that set by A5. If the drive is reverse plugged in high speed (if S5 is activated) then the deceleration rate will be approximately that set by A6. If the drive is reverse plugged in some middle speed (S2, S3, or S4 is activated but S5 is not) then the deceleration rate will be somewhere between A5 and A6.

2 A4 is used for decelerating between speeds, and for decelerating to a stop,
A5 is used for reversing.
A6 is used whenever Aux. 1 is activated.

3 A4 is used for decelerating between speeds, and for decelerating to a stop.
A5 is used for reversing.
A6 is used whenever Aux. 2 is activated.

4 A4 is used for decelerating between speeds.
A5 is used for decelerating to a stop and reversing.
A6 is used whenever Aux. 1 is activated.

5 A4 is used for decelerating between speeds.
A5 is used for decelerating to a stop and reversing.
A6 is used whenever Aux. 2 is activated.

A8 VOLTAGE BOOST

Adjustable from 1% to 30% of full line voltage.
Voltage Boost - increases the torque at low frequencies. During low frequency output, the voltage output of the inverter will be increased by the amount set by this memory location. This effectively increases the torque for these low frequencies. (The value in this memory location also determines the minimum voltage for the Pulse Start / DC Injection feature. If the value in A23's memory location is less, the value in this location will be used.)

A9 Operation mode

Adjustable mode 0,1,2,3.
Determines which of the different pendant control schemes will be used.

A9 Operation mode description

0 2 STEP INFINITELY VARIABLE

In this mode, the Micro-speed® will:

1. ramp down or Coast to stop (depending on the setting of A20) when the forward or reverse signal is removed.
2. Hold at the speed it is currently running at if either the forward or reverse signal is present without any speed inputs being activated. The speed will not be held fixed if the the forward or reverse signal present requires the motor to reverse its direction. In this case the motor will reverse its direction first. Also the speed will not be held fixed below the low speed setting programmed in A12, it will first ramp up to A12 before holding the speed steady.
3. accelerate or decelerate toward the appropriate programmed speed if any of the speed inputs are activated (S2, S3, S4, or S5) along with if either the forward or reverse signal.

This mode is most popular when used with a two step pendant. Usually, the first step of the pendant controls the forward and reverse signal to the drive and the second step activates terminal S5. Pushing the pendant button down to step #1 would initially cause the drive to go into low speed (12). Pressing the button further to step #2 would cause the drive to accelerate to high speed (16). If before the drive reaches high speed the button was shifted back to step #1, the drive would stop accelerating and hold the speed at its current level. If the ramp down option (A20) is on, the drive can be decelerated to a lower speed by removing ones finger from the pendant thus allowing the drive to decelerate, and then pressing down to step #1 before it stops. This will cause the drive to freeze its speed at a lower level. We note that one can decelerate only when the ramp down option (A20) is on. Hence this mode finds its most use on bridges or trolleys where one usually uses the ramp down option. This mode can also be used on hoist as well. But, since on all hoists the ramp down option must be off,

the user can only increase speeds, not decrease them. Below is a table summarizing the action of a two-speed pendant in this mode

Pendant switch operation:

Open = Ramp down or Coast to stop
(Ramp down (A20) must be on in order to freeze while decelerating.)
Step #1 = Low speed and hold at present speed (if above low speed, A12).
Step #2 = Accelerate to HIGH speed. (A16)

1 3 STEP INFINITELY VARIABLE WITH RAMP TO STOP.

In this mode, the Micro-speed® will:

1. ramp down or Coast to stop (depending on the setting of A20) when the forward or reverse signal is removed.
2. accelerate or decelerate toward the low speed setting A12 if either the forward or reverse signal is present without any speed inputs being activated.
3. Hold at the speed it is currently running at if either the forward or reverse signal is present and only speed signal S2 is activated. The speed will not be held fixed if the the forward or reverse signal present requires the motor to reverse its direction. In this case the motor will reverse its direction first. Also the speed will not be held fixed below the low speed setting programmed in A12, it will first ramp up to A12 before holding the speed steady.
4. accelerate or decelerate toward the appropriate programmed speed if any of the speed inputs S3, S4, or S5 are activated along with if either the forward or reverse signal.

This mode is most popular when used with a three step pendant. Usually, the first step of the pendant controls the forward and reverse signal to the drive and the second step activates terminal S2 and the third step activates terminal S5. Pushing the pendant button down to step #1 would cause the drive to go into low speed(12). Pressing the button further to step #2 would cause the drive to hold its speed fixed and pressing down to step #3 would cause the drive to accelerate to high speed (A16). If before the drive reaches high speed the button was shifted back to step #2, the drive would stop accelerating and hold the speed at its current level. This mode has an advantage over the two-speed infinitely variable mode when used on hoists because it allows one to slow down even when the ramp down option is OFF as must be with any hoist. Below is a table summarizing the action of a two-speed pendant in this mode

Pendant switch operation

Open = Ramp down or Coast to stop (determined by A20)
STEP #1 = Ramp to low speed (A12)
STEP #2 = HOLD at present speed.
STEP #3 = Accelerate to High speed (16)

2 **5 SPEED**

In this mode, the Micro-speed® will:

1. ramp down or Coast to stop (depending on the setting of A20) when the forward or reverse signal is removed.
2. accelerate or decelerate toward the low speed setting A12 if either the forward or reverse signal is present without any speed inputs being activated.
3. accelerate or decelerate toward the appropriate programmed speed if any of the speed inputs S2, S3, S4, or S5 are activated along with if either the forward or reverse signal.

This mode is most popular when used with a five step pendant. Usually, the first step of the pendant controls the forward and reverse signal to the drive and the second step activates terminal S2, the third activates S3, the forth S4 and the fifth S5. Pushing the pendant button down to step #1 would cause the drive to go into low speed. Pressing the button further to step #2 would cause the drive to go into second speed. Pressing the button down to step #3, step #4, and step #5 would cause the drive to go into speeds 3, 4, and 5 respectively. In this mode the five speeds would be programmed in A12 (low speed), A13, A14, A15, and A16 (high speed). One can also use this mode to operate from single, two, and three step pendants equally well. Only wire up the speed inputs that are needed. Below is a table summarizing the action of a two-speed pendant in this mode

Pendant switch operation
Open = Ramp down or Coast to stop (determined by A20)
STEP #1 = Ramp to low speed (A12)
STEP #2 = Ramp to second speed (A13)
STEP #3 = Ramp to third speed (A14)
STEP #4 = Ramp to forth speed (A15)
STEP #5 = Ramp to fifth speed (A16)

3 **5 SPEED WITH LOW SPEED POTENTIOMETER**

This mode is identical to the 5-speed mode except that the low speed setting will now be determined by an external analog input, usually a potentiometer, instead of A12. The potentiometer can control any speed range between 1 and 120Hz. The upper limit of the potentiometer is determined by setting A17, the lower limit of the pot is determined by setting A12. (These values can be exchanged, thus changing the direction the pot. is turned to increase and decrease the drives speed)

4 RESERVED FOR FUTURE USE
5 RESERVED FOR FUTURE USE
6 RESERVED FOR FUTURE USE

7 **5 SPEED WITH LOW SPEED RAMP UP**

This mode is identical to the 5-speed mode except that the when in low speed for more than 2 seconds the drive will accelerate, at the rate set by A2, to the speed set in A17.

A10 SLIP COMPENSATION

Adjustable from -10 Hz to 10 Hz.

If the value stored in this memory is positive, the frequency of the drive in the forward direction will be increased by the amount. If the value stored in this memory location is negative, the frequency of the drive in the reverse direction will be increased by the absolute value of the stored amount. This is a useful feature if the motor experiences more drag in one direction than in the other, such as a hoist. In such a case one can compensate for this drag by increasing the frequency output of the drive in the direction that experiences the drag.

A11 PULSE START / DC INJECTION BRAKE TIME

Adjustable from 0.0 to 2.0 seconds.

This value determines both Pulse Start time, which is active only when Ramp down (A20) is OFF, and DC Injection time, which is active only when Ramp down (A20) is on.

Pulse Start:

When Ramp down is off the Pulse Start feature is enabled. The Pulse Start feature applies an Increased initial torque to the motor for an amount of time determined by this variable. A setting of 0 will disable this feature. This feature is useful for breaking away "sticky" load brakes on hoists.

See Pulse Start / DC Injection Voltage (A23) to set the initial torque value.

DC Injection:

When Ramp down is on, the DC Injection feature is enabled. The DC Injection feature applies a DC (holding) current into the motor after it ramps to a stop. This memory location determines the amount of time that the drive will inject the DC braking current into the motor. A setting of 0 will disable this feature.

See Pulse Start / DC Injection Voltage (A23) to set the holding torque value.

A12 LOW SPEED (FORward terminal, REVerse terminal)

Adjustable from 1.0 Hz to 120Hz.

Sets the low speed setting of the Micro-speed®. This speed is usually invoked when either the forward or reverse terminal is activated.

A13 SPEED 2 (S2 terminal)

Adjustable from 1.0 Hz to 120Hz.

Sets the second speed setting of the Micro-speed®. This speed is usually invoked when the S2 terminal is activated.

A14 SPEED 3 (S3 terminal)
Adjustable from 1.0 Hz to 120Hz.
Sets the third speed setting of the Micro-speed®. This speed is usually invoked when the S3 terminal is activated.

A15 SPEED 4 (S4 terminal)
Adjustable from 1.0 Hz to 120Hz.
Sets the forth speed setting of the Micro-speed®. This speed is usually invoked when the S4 terminal is activated.

A16 SPEED 5 (S5 terminal)
Adjustable from 1.0 Hz to 120Hz.
Sets the fifth speed setting of the Micro-speed®. This speed is usually invoked when the S5 terminal is activated.

A17 ANALOG SIGNAL UPPER LIMIT FREQUENCY SETTING
Adjustable from 1.0 Hz to 120Hz.
Used with a potentiometer, see A9 mode 3. Sets the frequency the drive will output when pot. is turned to its upper limit.

A18 MAXIMUM FREQUENCY LIMIT
Adjustable from 1.0 Hz to 120Hz.
The Maximum Frequency Limit feature will not allow the drive to run at a frequency (speed) greater than this value when activated. Used only with Aux. signals. Useful when different operations require restrained speeds. See A19 to choose mode.

A19 MAXIMUM FREQUENCY LIMIT ENFORCEMENT MODE
Adjustable mode 0, 1, 2.
Determines if and when the frequency of the drive will be limited by A18.

A19	When enforced
0	Never
1	When Aux. 1 is activated.
2	When Aux. 2 is activated.

A20 RAMP DOWN TO STOP

Adjustable : ON or OFF

ON = The drive will perform a controlled deceleration to a stop and then set the mechanical brake when it loses its forward or reverse signal. Used on HORIZONTAL motion, NEVER used for HOISTING applications.

OFF = The drive will set the electromechanical brake instantly when the drive loses its forward or reverse signal and the drive will instantly stop powering the motor. This is necessary on HOISTING or any situation where immediate stopping action is necessary or when coasting to a stop is required without an electromechanical brake.

A21 Voltage Peak

Adjustable from 30Hz to 120Hz.

Sets the Frequency (speed) where full line voltage is output to the motor. The normal value is 60Hz.

Also makes other voltage motors usable with 460VAC line.

A22 Stall Prevention

Adjustable : ON or OFF

Prevents stalling while trying to accelerate or decelerate an increased or swinging load. This is done by automatically extending the acceleration or deceleration times when a heavy load is sensed. The acceleration time is limited to a 300% (3 times) extension of the time and the deceleration time is limited to a 33% (1/3) extension of the time values set in A4, A5, or A6.

A23 PULSE START / DC INJECTION VOLTAGE

Adjustable from 1% to 30% of full line voltage

Pulse Start:

When Ramp down is off the Pulse Start feature is enabled.

This memory location determines the amount of initial voltage (hence initial torque) that will be applied while starting the motor. If this value is less than the Voltage Boost (A8) value, the Pulse Start feature will be disabled. See Pulse Start / DC Injection Time (A11) to set the time duration of the Pulse Start.

DC Injection:

When Ramp down is on the DC Injection feature is enabled.

This memory location determines the amount of DC voltage the drive will use to inject a DC current into the motor after it ramps to a stop. If this value is less then the Voltage

Boost (A8) setting then A8's value will override this value. See Pulse Start / DC Injection Time (A11) to set the time duration of the DC injection.

A24 TIMER

Adjustable from 0 (off) to 600 seconds.

This feature doesn't allow the motor to be run for an amount of time greater then the set value. When the drive is stopped the timer will reset, and the next go signal will start the timer again. When time lapses, drive will trip out and display f11. This feature used only in special situations. This value determines the maximum amount of time the motor is allowed to run without stopping. The Normal setting of 0 will disable the timer.

A25 INITIAL BRAKE HOLD TIME

Adjustable from 0.0 to 2.0 seconds.

This value determines the amount of time the mechanical brake is held after a go signal (control button is pressed). This feature, usually used on a hoist, prevents the load from slipping down while the motor's magnetic field is building up. Normal setting for Bridge or Trolley is 0 (off), and for a Hoist 0.2 seconds is recommended.

A26 DEAD TIME

Adjustable from -5.0 to 5.0 seconds

This value determines the amount of time the drive will remain in the off status, before the drive will accept a valid go signal.

The normal setting is 0.0 seconds, and at this setting a small delay still remains. After the drive reaches its off status this timer starts, and the drive will not respond to a command until this timer runs down. The dead time is normally not enforced when the motor reaches zero speed as it is reversing directions. However, if a negative time is programmed, the drive will insure that the motor also experiences the dead time whenever it reverses direction. The negative sign only determines this mode, the number still represents the amount of dead time.

Increasing the dead time is useful on a hoist with a mechanical brake which is slow to set. It will reduce the chance of tripping out the drive (F1), due the load still moving when a go signal is applied. Increasing the dead time sufficiently will insure that the brake sets and the motor stops before the drive attempts to power the motor again.

A27 RESET MODE

Adjustable mode 0,1,2,3,4,5

This feature allows a choice of ways in which the operator can reset any trip out that the drive has executed.

A27	Will reset
0	Only upon powering up drive.
1	When the FORward or REVerse input is toggled OFF-ON-OFF.
2	When Aux. 1 is activated.
3	When Aux. 2 is activated.
4	When Aux. 1 is activated or when the FORward or REVerse input is toggled OFF-ON-OFF.

5 When Aux. 2 is activated or when the FORward or REVerse input is toggled OFF-ON-OFF.

A28 EXTERNAL TRIP MODE

Adjustable mode 4,5.

This variable assigns either Aux. 1 or Aux. 2 as the external trip circuit. Possible uses: overload on motor.

A28	Will trip
4	When Aux. 1 is deactivated. (F6 displayed when tripped)
5	When Aux. 2 is deactivated. (F7 displayed when tripped)

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5. Diagnosing Problems

There are two key features in the Micro-speed® that assist the user in diagnosing problems. The first is the displaying of fault codes when the drive trips out. The second consists of 11 diagnostic "E" memory locations that are accessible through the buttons and display on the front panel.

When problem arises, such as excessive current draw, the Micro-speed® will protect itself by shutting down and displaying a fault code. This action is called faulting out or tripping out. The fault code reveals information about the type of fault that occurred. By looking up the cause of the fault in the listing later in this section, one can gain information of how to solve the problem.

The 11 "E" memory locations are accessible in a manner similar to the "A" programming parameters except that they can not be programmed. They either display diagnostic information or they perform a function when the increase or decrease buttons are pushed. With these 11 memory locations one can recall the last four faults codes that occurred, activate the brake and fault relay contacts individually and read out the state of every input on the logic board.

At the end of this section, there is a trouble shooting guide for some common problems that occur. We note, however, that following every fault code description later in this section, there is a listing of the possible causes and corrective measures that may be taken.

5.1. Faults

5.1.1. How the Micro-speed® responds to a fault

When a fault occurs, five events will happen:

1. The Micro-speed® will turn off.
2. The brake outputs, B1 and B2 , will open.
3. The fault relay will switch.
4. The fault error code will be displayed.
5. The fault error code will be stored at E1.

5.1.2. Resetting after a fault

The method by which the Micro-speed® may be reset is determined by programming parameter A27. Usually, the Micro-speed® is programmed to reset when the button on the pendant station is toggled (release-press-release). It may also be programmed to reset by activating an AUX terminal. No matter what A27 is programmed for, resetting of the Micro-speed® can always be accomplished by turning off and then turning on the line power feeding the drive.

5.1.3. Remembering faults

The Micro-speed® will remember the last four faults. They are stored in the Diagnostics memory locations E1,E2, E3, E4. Memory location E1 contains the most recent fault code.These locations could help diagnosis a problem - including motor and other mechanical conditions. These memory locations can be cleared through memory location E11, in which case they will display code F0.

5.1.4. Interpreting Fault codes

When a fault occurs one of the following codes will be displayed, action should be taken to correct the cause. The following table will explain each fault and give possible causes. If the appropriate changes do not relieve the problem then please contact the factory for further assistance.

5.1.4.1. Fault code F0

NO FAULT - Fault memory is clear.

5.1.4.2. Fault code F1

CURRENT TRIP - Current has risen to over 200% of rated output current.

The CURRENT TRIP is the most common fault and has many causes. Observing how the Micro-speed® and the machine it is driving act at the moment the fault occurs will help the user in diagnosing the cause of the fault. If the drive trips out immediately when it receives a forward or reverse signal then the cause could be:

1. Cause: Output semiconductor is shorted. An output semiconductor short can be tested for by disconnecting the motor leads from the drive and running the drive at some speed. The drive will trip out with no motor attached if there is an output short.
Solution: Send drive back to factory for repair.

2. Cause: Motor problems. Specifically, a short in the motor, motor leads shorted together, motor leads shorted to ground, the motor windings are wired wrong, the motor is the wrong voltage, the motor may be single phasing, or the current rating of the motor is too large for the drive. Also, some motors have internal brakes that receive power are from the three motor leads -- this type motor should not be used with investors unless the brake power leads can be brought out separately and powered from the line and not the drive.

3. Cause: Mechanical brake not operating properly. Make sure that any mechanical brake that is used is picking away cleanly without any dragging. Some motors have internal brakes make sure these are also operating.

4. The voltage boost setting A8 (and/or the pulse start voltage setting if the ramp down option is off) is too high.
Solution: Lower the setting.

5. If the fault occurs while the motor is accelerating, then we suggest increasing the acceleration time A1 (and A2 if it is used). Turning on the stall prevention feature A22 will also help. If increasing the time is unacceptable or does not work, the voltage boost A8 and the voltage peak A21 functions may also help. Play around with the voltage boost first. Try increasing it gradually and see how the machine works. Then, gradually lower the voltage peak function and see how the machine works. Do not lower the voltage peak function to less than 90% of its nominal rating. Recall that the nominal voltage peak setting is (Incoming Line Voltage)x(full Hz of motor)/(full motor voltage)

6. If the fault occurs while the motor is decelerating, then we suggest first observing whether the trip occurs when decelerating between speed, decelerating to a stop, or decelerating during a reverse plug condition. The three deceleration parameters A4, A5, and A6 govern these three rates and increasing the appropriate parameters may alleviate the problem. One could also set A5 and A6 to their maximum value and just increase A4 gradually to obtain a setting that will work. Turning on the stall prevention feature A22 will also help. If increasing the time is unacceptable or does not work, try changing the voltage boost A8.

7. If the fault occurs while the motor is running at a constant speed then the load may be swinging. Try turning on the stall prevention feature A22. Increasing the acceleration and deceleration times may also help reduce the swinging.

8. In the case where the motor does not turn but the drive ramps up and then trips out, one should first check that any mechanical brake that is used is picking away cleanly, that there is no mechanical binding in the system, and that the motor is wired properly and not single phasing. If these check out, the voltage boost A8 and the voltage peak A21 functions may help. Try changing the voltage boost gradually, first by increasing and if that does not work then by decreasing. Then try lowering the voltage peak function and see how the machine works. Do not lower the voltage peak function to less than 90% of its nominal rating. Recall that the nominal voltage peak setting is (Incoming Line Voltage)x(full Hz of motor)/(full motor voltage). Try increasing and decreasing the voltage boost again.

If the ramp down option A20 is off, then one may try the pulse start option (A11 and A23) to jar the mechanism loose. Try setting A11 to .7 seconds and then gradually increase A23 until the drive trips out instantly, then back A23 down a little, to about 1.5% less than the trip out value.

On a HOIST, sometimes the load brake will stick and cause the motor freeze. The drive seems to ramp up and then trip out. In this case, try the pulse start option first, and then try the voltage boost and voltage peak functions.

9. Cause: Some mechanical binding is occurring.
Solution: Investigate source of binding and fix.

10. Cause: Sometimes electrical noise can be induced on the motor leads from other wires that run along side them, such as brake leads. When the brake operates, the noise from the arcing in the brake contactor can trip out the drive. This failure can be ruled out if the drive does not fault out at the instant the brake contactor switches
Solution: Run motor leads in a conduit separate from other leads.

11. Cause: Starting into a spinning motor.
Solution: Don't start into a spinning motor.
If the motor is spinning because the brake is setting slow, then use the dead time parameter A26 to increase amount of time the brake has to set before the drive will start again.

12. A slow mechanical brake on a HOIST may not be able to stop the motor before the Micro-speed® is signaled to begin powering the motor again. This effectively causes the Micro-speed® to start into a spinning motor. Increase the dead time parameter A26 to increase amount of time the rotor has to lose its magnetic field. Usually 1.5 seconds is more than sufficient.

13. Cause: Residual magnetic field in rotor. The drive may trip out if the drive begins to power the motor too soon after it has stopped. (this fault is rare)
Solution: Increase the dead time parameter A26 to increase amount of time the rotor has to lose its magnetic field. Usually 1.5 seconds is more than sufficient.

14. Cause: Some mechanical device in the drive train is not made for use with a variable frequency drive. For instance, some mechanical soft-starting devices or clutches will not operate when driven at less than full speed. On a hoist, sometimes the load brake may be installed wrong.

15. A slow mechanical brake on a HOIST may not be able to stop the motor before the Micro-speed® is signaled to begin powering the motor again. This effectively causes the Micro-speed® to start into a spinning motor. Increase the dead time parameter A26 to increase amount of time the rotor has to lose its magnetic field. Usually 1.5 seconds is more than sufficient.

16. Cause: The load is too large.
Solution: Reduce load or increase motor and drive capacity.

17. Certain kinds of Nema type D motors produce a lot of slip at low frequencies and may not budge a load until it ramps up to a fairly high frequency, sometimes 30 Hz or more, at which point the drive will trip out. This slip can not be completely eliminated but it can be reduced. First try lowering the voltage peak function and see how the machine works. Do not lower the voltage peak function to less than 90% of its nominal rating. Recall that the nominal voltage peak setting is (Incoming Line Voltage)x(full Hz of motor)/(full motor voltage).Then try changing the voltage boost gradually, first by increasing and if that does not work then by decreasing (increasing is usually the most effective method in this case).

5.1.4.3. Fault code F2

CURRENT OVERLOAD - Motor has been running at 150% of rated drive amps for 1 minute.

1. Cause: The load is too large.
Solution: Reduce load or increase motor and drive capacity.
2. Cause: Motor's current rating is higher than the Micro-speed®'s current rating.
Solution: Increase capacity of the drive.
3. Cause: Motor problems. Specifically, the motor windings may be wired wrong or for the wrong voltage or the motor may be single phasing. Also, some motors have internal brakes that receive power are from the three motor leads -- this type motor should not be used with investors unless the brake power leads can be brought out separately and powered from the line and not the drive.
4. The voltage boost setting A8 (and/or the pulse start voltage setting if the ramp down option is off) is too high.
Solution: Lower the setting.
5. Cause: Some mechanical device in the drive train is not made for use with a variable frequency drive. For instance, some mechanical soft-starting devices or clutches will not operate properly when driven at less than full speed.
6. Cause: Some mechanical binding is occurring.
Solution: Investigate source of binding and fix.

7. Cause: Mechanical brake not operating properly. Make sure that any mechanical brake that is used is picking away cleanly without any dragging. Some motors have internal brakes make sure these are also operating.

5.1.4.4. Fault code F3

BRAKING RESISTOR ON TOO LONG - The braking resistor has been on too long.

1. Cause: The resistance of the external braking resistor may be too large.
Solution: The resistance of the braking resistor is considered too large if it more than 110% of the value listed in the BRAKING RESISTOR section of this manual. If this is the case, replace the resistor with one that agrees with this spec. Never use a resistor that has less ohms than the spec calls for.
2. Cause: Line voltage too high. Make sure incoming line voltage is within spec.
3. Cause: Transistor shorted in drive. To check this, detach the motor and run the drive at some speed and check the DC voltage across the open resistor (be careful here, as much as 800 volts may be present). There should be only a few volts present at most. If not, return the drive to the factory for repair.
4. On a hoist, this fault may indicate that the load brake is slipping excessively or that it has failed completely.

5.1.4.5. Fault code F4

LOW BUSS VOLTAGE - The voltage across the main buss capacitors has dropped below a preset level.

Causes and solutions:
1. Cause: On Micro-speed®s that use an external drive contactor, this fault may be caused by the drive contactor opening causing a power loss on terminals L1, L2, and L3.
Solution: Investigate why drive contactor opened.
Also, when some other fault occurs, the Micro-speed® will itself open the drive contactor causing a loss of power on L1, L2, and L3, thus resulting in an F4 being displayed on the screen after a few minutes. In this case the original fault can be read out in diagnostic memory location E1.
2. Cause: Blown bus fuse internal to Micro-speed®. This can usually be diagnosed by getting an F4 while the charge light is still lit.
Solution: This internal fuse is oversized and rarely blows unless something else is wrong in the drive. We suggest that the drive be shipped back to the factory for repair.
3. Cause: Malfunction in Micro-speed®.
Solution: Return the drive to the factory for repair.

5.1.4.6. Fault code F5

OVER VOLTAGE TRIP - The voltage across the main buss capacitors has increased above a preset level.

Causes and solutions:
1. Cause: Drive is decelerating too fast.
Solution: Increase the deceleration times in A4, A5, and A6. You may only need to increase the faster of these times to get drive to function properly. It is usually easier to start by increasing both A5 and A6 to their maximum setting of 30.0 seconds and then gradually increase A4 to get proper operation.

2. Cause: Drive has started into a spinning motor.
Solution: Make sure motor has stopped before is allowed to power motor.

3. Cause: The external braking resistor may be miswired, open, missing, or its resistance value may be too large.
Solution: The resistance of the braking resistor is considered too large if it more than 110% of the value listed in the BRAKING RESISTOR section of this manual. If this is the case, replace the resistor with one that agrees with this spec. Never use a resistor that has less ohms than the spec calls for.

If no braking resistor is used you will probably need to add one. See the BRAKING RESISTOR section of this manual.

If the braking resistor is open, one must try to identify its cause. Follow the following steps:

i) Check that the resistor(s) are wired properly.

ii) Check to see if anything could have touched one of the wires feeding the resistor to create a short. If you find this is the case we recommend that the drive be shipped back to the factory--even if it appears to function properly when a new resistor is put in-- with a note describing what was found so that the transistor that powers the resistor can be replaced.

iii) Check to see if the resistor had at least as many watts as the spec calls for (see the BRAKING RESISTOR section). If not, replace the resistor with one that agrees with this spec. In rare instances, even the watt rating in our spec will not be high enough (perhaps the duty cycle of the machine is very high). In this case, increase the watt rating. Call the factory for help if needed.

iv) It is possible that the transistor in the drive that powers the resistor has shorted.

To check this, detach the motor and run the drive at some speed and check the DC voltage across the open resistor (be careful here, as much as 800 volts may be present). There should be only a few volts present at most. If not, return the drive to the factory for repair.

v) A hoist is a special case, an open resistor may be a sign that no load brake is present, or, if a load brake is present, that it is slipping or broken and should be checked.

Some types of hoists, such as some worm gear types, have enough friction to hold a full load even if the mechanical brake is held open. If the hoist being used is not of this type, then we strongly recommend that a load brake is to be used. If it is not then the watt rating of the resistor must be increased dramatically. In such a case, call the factory.

Occasionally, one will find load brakes that will not stop a moving load, but only insure a safe controlled lowering of the load in case of failure. Such types will usually require the watt rating of the resistor to be increased. In such a case, call the factory.

Most often, a load brake will produce enough friction to stop a moving load. However, even these types may wear and begin to slip or even break. If the load brake is broken it should be fixed. If it is just worn and slipping, it is still best to have it fixed, but the wattage rating of the resistor can be increased, if needed, to help out a bit. In such cases, call the factory.

5.1.4.7. Fault code F6

AUX1 TRIP - Terminal AUX1 is indicating an external fault.

Cause: This fault occurs when the external fault mode parameter (A28) is programmed to a 4 and the connection between the AUX1 and the COM terminals has opened. Hence, either A28 has been programmed wrong or some safety device (perhaps the motor overload) wired between the AUX1 and the COM terminals has tripped.

We note that A28 can not be programmed to disable the external fault feature. It must assign the feature to either AUX1 or AUX2. In practice, however, the feature can be disabled by placing a jumper wire between the appropriate AUX terminal and the COM terminal.

We also note that AUX1 is a low voltage input. By applying 115vac (either accidentally or by miswiring) between this and the COM terminal, the AUX1 terminal may become permanently damaged and will act as if it is open even if it is connected to the COM terminal. One can usually remedy this situation by reprogramming A28 to a 5 and then proceeding to use AUX2 instead of AUX1.

5.1.4.8. Fault code F7

AUX2 TRIP - Terminal AUX2 is indicating an external fault.
Cause: This fault occurs when the external fault mode parameter (A28) is programmed to a 5 and the connection between the AUX2 and the COM terminals has opened. Hence, either A28 has been programmed wrong or some safety device wired between the AUX2 and the COM terminals has tripped.

We also note that AUX2 is a low voltage input. By applying 115vac (either accidentally or by miswiring) between this and the COM terminal, the AUX2 terminal may become permanently damaged and will act as if it is open even if it is connected to the COM terminal. One can usually remedy this situation by reprogramming A28 to a 4 and then proceeding to use AUX1 instead of AUX2.

We note that A28 cannot be programmed to disable the external fault feature. It must assign the feature to either AUX1 or AUX2. In practice, however, the feature can be disabled by placing a jumper wire between the appropriate AUX terminal and the COM terminal.

5.1.4.9. Fault code F8

"A" PARAMETERS OUT OF SPEC. Memory used by Micro-speed® has lost data.
Try reprogramming the "A" parameters individually or by a Gang-set™., else return to factory for repair.

5.1.4.10. Fault code F9

CPU ERROR - failure of CPU
Solution: Return unit to factory for repair.

5.1.4.11. Fault code F10

PARAMETER MEMORY CHIP ON LOGIC BOARD IS NOT OPERATING PROPERLY.
Solution: Try reprogramming "A" parameters, else return to factory for repair.

5.1.4.12. Fault code F11

TIMER - Motor has run for a time longer than that allotted by the timer A24

Causes and solutions:
1. Cause: Unattended motor driven device stalled or jammed.
Solution: Investigate why motor stalled and correct problem. Perhaps the load was heavy enough to cause the motor not to turn in low speed due to excessive slip. Increasing the voltage boost (A8) or low speed setting (A12) might help.
2. Cause: Programmer accidentally enabled the timer.
Solution: Disable timer by setting A24 to zero.
3. Cause: Timer set for too short of a period.

Solution: Increase time set in A24.

5.2. DIAGNOSTIC "E" VARIABLES

The Micro-speed® is equipped with several diagnostic features each of which is accessible by using the display and the three buttons on the front cover of the drive. These diagnostic features are associated with 11 "E" memory locations labeled E1 through E11.

5.2.1. Accessing an "E" diagnostic memory location

To view or operate a diagnostic feature:

1. Make sure the Micro-speed® is on but not driving a motor and the display reads OFF.
2. Press and hold the scroll button on the cover of the Micro-speed®. First an "-A-" will appear then in a few second an "-E-" will appear. Release the scroll button when the "-E-" appears. The label E1 will appear on the display and 1 second later the contents stored in the E1 memory location will be displayed.
3. Poke the scroll button several times fairly quickly (less than 1 second between pokes) and watch the sequence of parameter labels E1, E2, E3,... appear on the display. Stop poking the scroll button when the label of the memory location you want to view -- say E8 for instance -- appears on the display.
4. The memory location label will be displayed for about 1 second and then the memory contents will be displayed to be read by the user. If this diagnostic memory location is associated with a diagnostic function, you may operate the function at this time by pressing the increase or decrease buttons..
5. To view or operate another diagnostic feature go back to step 3 and poke the scroll button until the label of the next "E" memory location you want appears and then continue on as before.
6. To finally leave this "E" diagnostic mode, press and hold the scroll button down until the display reads OFF. This will take about 5 seconds during which the current memory location label -- say E8 again -- will be displayed.

5.2.2. Diagnostic "E" memory location functions

The following is a list of the 11 "E" memory locations along with a description of their usage.

5.2.2.1. Diagnostic memory location E1

LAST FAULT--This memory location stores the fault code of last fault that occurred. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

5.2.2.2. Diagnostic memory location E2

SECOND TO LAST FAULT--This memory location stores the fault code of second to last fault that occurred. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

5.2.2.3. Diagnostic memory location E3

THIRD TO LAST FAULT--This memory location stores the fault code of third to last fault that occurred. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

5.2.2.4. Diagnostic memory location E4

FORTH TO LAST FAULT--This memory location stores the fault code of forth to last fault that occurred. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

5.2.2.5. Diagnostic memory location E5

NOT USED

5.2.2.6. Diagnostic memory location E6

- NOT USED

5.2.2.7. Diagnostic memory location E7

POTENTIOMETER INPUT SETTING TEST.
If potentiometer is used, the display will show the percentage (0-100%) the dial is turned as you turn it. Use this to check potentiometer and wiring.

5.2.2.8. Diagnostic memory location E8

INPUT CIRCUIT TEST.
This diagnostic variable helps check if the control circuitry is correctly wired to the Micro-speed®.
In this mode 8 vertical lines are displayed. Each line segments will toggle to the upper segment when the corresponding control signal is applied. From left to right on the display: AUX1, AUX2, FORward, REVerse, S2, S3, S4, AND S5.

5.2.2.9. Diagnostic memory location E9

BRAKE CIRCUIT TEST
This diagnostic variable is useful for testing the braking circuitry. When either "Increase" or "Decrease" is pressed the brake terminals (B1 AND B2) will conduct, if properly wired the brake contactor will close.

5.2.2.10. Diagnostic memory location E10

FAULT RELAY TEST.
This diagnostic variable is useful for testing the fault output circuitry. When either "Increase" or "Decrease" is pressed, the form C contacts of the fault relay (terminals R1, R2, and R3) will switch. If the Micro-speed® is tripped out and hasn't yet been reset, this variable can not be viewed or operated.

5.2.2.11. Diagnostic memory location E11

CLEAR FAULT MEMORY.
This variable is used to clear the fault memory locations (E1 through E4). When either "increase" or "decrease" is pressed all the fault memory locations will display "F0".

6. Gang-set™ reference chart

for Micro-speed®s with version "B" program

(Also see "A" parameter reference chart)

			Bridge\Trolley Gang-Sets™				Hoist Gang-Sets™			
			PA01	PA02	PA03	PA04	PA05	PA06	PA07	PA08
"A" Label	Name	Setting Range	1-speed	2-pos. infinitely variable	3-pos. infinitely variable	5-speed (1-5sp)	3-pos. infinitely variable	5-speed (1-5sp)	5-speed w/ low speedpot.	2-speed infinitely variable
A1	Accel 1	0.1-30sec	6.0	6.0	6.0	6.0	4.0	4.0	4.0	4.0
A2	Accel 2	0.1-30sec	6.0 x	6.0 x	6.0 x	6.0 x	4.0 x	4.0 x	4.0 x	4.0 x
A3	Accel mode	0,1,2,3,4	0	0	0	0	0	0	0	0
A4	Decel 1 Between speeds	0.1-30sec	6.0	6.0	6.0	6.0	4.0	4.0	4.0	4.0
A5	Decel 2 Quik-stop™	0.1-30sec	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)
A6	Decel 3 Reverse Plug	0.1-30sec	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)	30 (limit)
A7	Decel mode	0,1,2,3,4, 5	0	1	1	1	0	0	0	0
A8	Voltage Boost	1-30%	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
A9	Operation Mode	0,1,2,3	2	0	1	2	1	2	3	0
A10	Slip comp	-10 to 10 Hz	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0
A11	PulseStart / DC Injection time	0 - 2.0sec	1.0	1.0	1.0	1.0	0.0 x	0.0 x	0.0 x	0.0 x
A12	Low speed (F,R)	1- 120Hz	60.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
A13	Speed 2 - S2	1- 120Hz	60.0 x	60.0 x	60.0	10.0	60.0	10.0	10.0	60.0
A14	Speed 3 - S3	1- 120Hz	60.0 x	60.0 x	60.0 x	20.0	60.0 x	20.0	20.0	60.0 x
A15	Speed 4 - S4	1- 120Hz	60.0 x	60.0 x	60.0 x	30.0	60.0 x	30.0	30.0	60.0 x
A16	Speed 5 - S5	1- 120Hz	60.0 x	60.0	60.0	60.0	60.0	60.0	60.0	60.0
A17	Analog upper limit (for pot.)	1- 120Hz	10.0 x	10.0 x	10.0 x	10.0 x	10.0 x	10.0 x	10.0	10.0 x
A18	Max Hz	1- 120Hz	60.0 x	60.0 x	60.0 x	60.0 x	60.0 x	60.0 x	60.0 x	60.0 x
A19	Max Hz enforce mode	0,1,2	0	0	0	0	0	0	0	0
A20	Ramp down	OFF - ON	ON	ON	ON	ON	OFF	OFF	OFF	OFF
A21	Volt peak	30-120Hz	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
A22	Stall prev.	on-off	ON	ON	ON	ON	OFF	OFF	OFF	OFF
A23	Pulse Start / DC Injection Voltage	1-30.0% (line VAC)	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
A24	Timer	0-600 sec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A25	Brake Hold Time	0.0-2.0 sec	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2
A26	Dead Time	-5.0 to 5.0 sec	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A27	Reset mode	0,1,2,3,4,5	1	1	1	1	1	1	1	1
A28	Trip mode	mode: 4,5	4	4	4	4	4	4	4	4

X=Value displayed but not used. When changing certain modes or using different wiring, from the standard wiring, they may become operable. Example: 2-speed infinitely variable (PAO2) would only use A12 & A16 speeds with A13, A14 & A15 speeds not wired in. The "X" is to help simplify setting in field.

(limit) = a value in the display which effectively turns "off" the functions

7. "A" parameter reference chart

for Micro-speed®s with version "B" program

"A" value	Title	Setting Range	Description and Variables
A1	Accel 1	0.1-30 sec	**Acceleration Time 1** (When variable used for each mode –>) — Always used; Used unless; Used unless; Used unless; Slowest Accel. Rate (small Hz (speed) change)
A2	Accel 2	0.1-30 sec	**Acceleration Time 2** (When variable used for each mode –>) — Never used; Aux.1 active; Aux.2 active; Input S5 active; Fastest Accel. Rate (large Hz (speed) change)
A3	Accels (mode)	mode: 0,1,2,3,4	**Mode Selection –>** — 0; 1; 2; 3; 4 Wound Rotor Profile
A4	Decel 1	0.1-30 sec	**Decelerating Time –>** — Between speeds; Between Speeds; Between Speeds & To Stop; Between Speeds & To Stop; Between Speeds; Between Speeds
A5	Decel 2	0.1-30 sec	**Decelerating Time –>** — To Stop; Decel to Stop Time (No Rev. Plug) (if < A4); Reverse Plug; Reverse Plug; To Stop Rev. Plug; To Stop Rev. Plug
A6	Decel 3	0.1-30 sec	**Decelerating Time –>** — Reverse Plug; Full Reverse Plug (S5) Decel Time (if < A4 or A5); Aux. 1 Activated; Aux. 2 Activated; Aux. 1 Activated; Aux. 2 Activated
A7	Decels (mode)	mode: 0, 1,2,3,4,5	**Mode -> Selection** — 0; 1 Infinitely Variable Decel; 2; 3; 4; 5
A8	Voltage Boost	1 - 30% (line VAC)	Voltage Boost: Increases torque in the low frequencies (motor speeds). (also determines minimum Pulse Start and minimum DC injection voltage)
A9	Operation Mode	mode: 0, 1,2,3,	Operation mode: **0** 2 Step infinitely variable w/ ramp to stop. **2** 5 Step 5 speed increments. (Type of Pendant) **1** 3 Step infinitely variable w/ ramp to stop. **3** 5 Step 5 speed w/ pot. on first step.
A10	Slip comp.	-10 to 10 Hz	Compensates for increased drag (loss of speed) in one direction (ex. hoisting up) by increasing all forward/up (+ Hz) speeds or reverse/down (- Hz) speeds by this value
A11	Pulse Start / DC Injection (Time)	0 - 2.0 sec	Pulse Start: Determines the amount of time that extra torque will be applied to motor when accelerating from a stop. DC Injection: Determines the length of time that a DC (holding) current will be applied to the motor after decelerating.
A12	Speed 1	1- 120Hz	Sets speed of first increment on pendant. (FORward terminal, REVerse terminal)
A13	Speed 2	1- 120Hz	Sets speed of second increment on pendant. (S2 terminal)
A14	Speed 3	1- 120Hz	Sets speed of third increment on pendant. (S3 terminal)
A15	Speed 4	1- 120Hz	Sets speed of forth increment on pendant. (S4 terminal)
A16	Speed 5	1- 120Hz	Sets speed of last increment on pendant. (S5 terminal)
A17	Analog upper limit	1- 120Hz	Set maximum speed attained when potentiometer is at maximum (throttle stop).
A18	Max Hz	1- 120Hz	Used only with Aux. signals. When specified Aux. is activated, any speed selected above this limit will be held at this limit.
A19	Max Hz enforce mode	mode: 0,1,2	0 Never 1 When Aux. 1 is activated 2 When Aux. 2 is activated
A20	Ramp down to stop	on - off	ON = A controlled deceleration to a stop is desired and then the mechanical brake is set. (NEVER USED ON HOISTING!) OFF= The electromechanical brake is set instantly with the release of the control buttons. (NECESSARY FOR HOISTING!) (USE: Immediate stopping or Coasting to a stop)
A21	Volt peak	30 - 120Hz	Makes other voltage motors usable with 460VAC line. Special use for motors with inherent excess slip.
A22	Stall prev.	on-off	Prevents stalling, due to increased load, by extending acceleration or deceleration time to compensate for insufficient motor torque. Overrides set rates (A1,A2,A4,A5,A6).
A23	Pulse Start / DC Injection (Volts)	1 - 30.0% (line VAC)	Pulse Start: Determines the amount of extra torque that will be applied to the motor when accelerating from a stop. DC Injection: Determines amount of DC current (holding torque) applied to the motor after decelerating. (A8's value used if greater than A23's value)
A24	Timer	0-600 sec	Doesn't allow motor to be run for an amount of time greater, without stopping 0 = No time limit (disabled)
A25	Brake Hold Time	0-2.0 sec	Amount of time mechanical brake is held after go signal. (Use: Hoisting app. stops load drop after go signal)
A26	Dead Time	-5 to 5 sec	Amount of time between drive off and next go signal. - = rev. plug affected (Reduces the chance of tripping F1 out)
A27	Reset (mode)	mode: 0, 1,2,3,4,5	**0** Only upon powering up drive. **1** When the forward or reverse input is toggled off-on-off. **2** When Aux. 1 is activated. **3** When Aux. 2 is activated. **4** When Aux. 1 is activated or when the forward or reverse input is toggled off-on-off. **5** When Aux. 2 is activated or when the forward or reverse input is toggled off-on-off.
A28	Trip (mode)	mode: 4,5	EXTERNAL TRIP MODE **4** When Aux. 1 is deactivated. **5** When Aux. 2 is deactivated.