Motor rotation direction should be checked after installation.

Micro-Speed® MD™

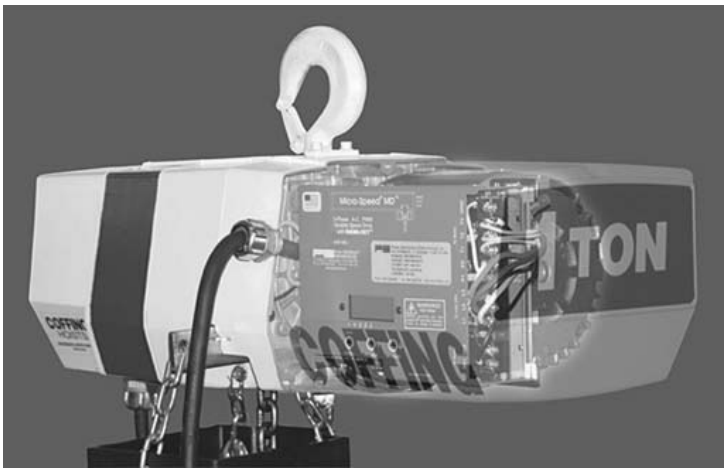
With additional new features

Operation Manual

Use with Micro-Speed MD™ Version 2.1 drives.

Always match manual with drive serial number.

Power Electronics® International, Inc.
561-8 Plate Dr., East Dundee, IL 60118-2467 USA
Phone: (847)428-9494 Fax: (847)428-7744



With Gang-Set® Technology

DESIGNED, ENGINEERED, AND MANUFACTURED, IN THE U.S.A.

This manual includes many features used in the Power Electronics International, Inc. standard series of drives, including CX® series among others. Utilize appropriate sections for your Coffing Hoist MD Series drive applications.

IMPORTANT NOTES FOR INSTALLING THE MICRO-SPEED CX

Hardwire (festoon) from motor to Micro-Speed® MD™.

Install DOUBLE SHOE conductor devices.

Always branch protect each drive.

Motor rotation direction should be checked after installation.

Wire according to PE drawings or APPROVED changes. Check with PE when modifying the drawings.

Make sure on retrofit cranes, especially older ones, that other mechanical and electrical parts are in good working order, i.e., are beams aligned? Is brake working properly? etc.

When in doubt, call PE before applying the drive.

Read this manual and see our web page for other notes.

In applications where electrical arc welders, electrical smelting pots, punch presses, or other devices causing voltage spikes / line surges are present, inductors or 3-phase isolation transformers should be used. Separate inductors should be used near the L1, L2, L3 power input of each Micro-Speed® CX™. Power Electronics can supply the appropriate inductors for you application.

When testing Micro-Speed® MD™ drives or control panels, first disconnect the motor leads before operating the drive. This way it is possible to confirm that all other functions are operating properly.

When in doubt call PE before applying the drive.

If a Micro-Speed® MD™ needs factory servicing, please obtain a PE RMA number (Return Material Authorization) by calling: 1-888-220-9494.

Do not ship anything back to the factory without calling for a RMA number first!

When re-shipping, the drive should be protected from damaging bumps and hammering from the truck transporting the Completed crane or equipment.

Check the applied voltage with the displayed voltage at start up before energizing the motor(s). If it is not in range DO NOT run the motor(s).

Some features on the 2.1 Version unit are not available on earlier versions. Please make sure you keep the manual with the correct units.

Micro-Speed® MD v2.1 – Parameter Changes

All the basic procedures and parameters are the same as previous Micro-Speed® drives. The following enhancements for increased functionality have been added. See the appropriated sections in the manual for complete descriptions and details.

TABLE OF CONTENTS

We have added some new features with more to follow…

1. The "U" (unit) parameters have been added.
Changing the "U" parameters will set certain "L" values and globally control what is loaded in to the "A" parameters on a Gang-Set™.

2. L10 Cut Off Frequency
Is the frequency below which the drive turns off when a direction signal is not present. The drive will ramp down to L10 using A5 and then turn off.

3. L11 Quick Stop™ Upper Limit
Sets maximum ramp time for stopping. Drives uses the lesser of A5 and L11.

4. L12 Parameter Lock
Locks all parameters from modification except L12 (itself).

5. L13 Aux. Relay Mode
Allows multiple uses for the Auxiliary relay.

There are two areas that have been altered.

1. Ramp/Coast mode has been moved from L8 to U1.

2. A18 through A37 have been moved to L18 and L37 respectively..

Micro-Speed® v2.1 – Unit Setup

Use these guidelines when the unit parameters need to be changed.

1. Set the "U" parameters first
This will set certain "L" parameters and prime some of the Gang-Set™ A values.
The code to get into the "L" and "U" parameters is 369

2. Perform a Gang-Set™.
This allows the unit values to be loaded into the "A" parameters

3. Set your operation mode (A9) if it needs changing
Such as for analog inputs

4. Set your other parameters as required
There isn't any order to follow unless the "U" unit parameters are changed.

Please see the appropriate manual for how to perform these steps.

Power Electronics International, Inc.
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AFTER HOURS:800-373-8306
FAX: 847-428-7744
E-MAIL: service@PEinfo.com

MESSAGE FROM THE MANUFACTURER

Power Electronics International Inc. stands behind its products. If any problems ever arise, feel free to contact the factory and our engineers will help you (888-220-9494). Our engineers will also help you fit a Micro-Speed® MD to any unique or special applications. Changes to the Micro-Speed® MD may be made and ordered special for special uses.

SAFETY FIRST!

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

LOAD BRAKE IS REQUIRED

A load brake is necessary in hoisting applications. An electro-mechanical holding brake alone does not fulfill this requirement. The Micro-Speed® MD alone will not hold a load or stop it from falling. Hoists using worm geared motors may be an exception to this rule.

BRAKE CONTROL WIRED THROUGH FAULT OUTPUTS

The brake control can be wired through the AUX relay for added safety during faults. 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—when not used for other purposes) on the Micro-Speed® MD.

BRAKE RESISTOR MOUNTED IN SAFE ENCLOSURE WITH ADEQUATE VENTILATION

If the Micro-Speed® MD requires an external dynamic regenerative 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 melt down is present and requires the special enclosure to prevent any molten material from causing injury or damage.

DON'T SERVICE DRIVE UNTIL BUSS CHARGE LAMP IS OUT

Before servicing, disconnect power and wait at least 5 minutes. If the red charge lamp is still on after 5 minutes, wait until it is off. The red charge lamp must be off before proceeding further. It is necessary to follow these precautions because dangerous electrical energy will remain in the unit even after power is disconnected.

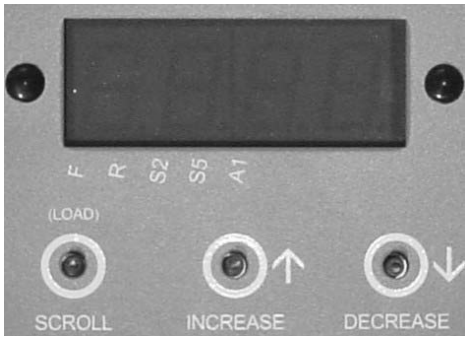
GROUND DRIVE PROPERLY

The chassis of the drive must be grounded. Use grounding terminal or lug on Micro-Speed® MD.

INTRODUCTION

The Micro-Speed® MD 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, Hoist, and Monorail applications. Some of these features are the following:

115 VAC control inputs are standard. These inputs can be directly connected to a pendant station or radio/IR remote control without the need for an interface card. These inputs are extremely rugged.
The small Micro-Speed® MDs (5 horsepower and under) have braking resistors built in.
Many programming parameters are specially designed to aid in crane applications.
Gang-set™ programmability. Eight preset programs are stored in the Micro-Speed® MD to get you up and running fast.
Flexible pendant control. The user can choose from a variety of different pendant and speed control configurations.
Infinite selection of speeds with just a two or three step button.
Special pendant modes for radio controls allowing one hand to be free during multi-speed operation and other modes.



On each Micro-Speed® MD you will find a display and three buttons marked SCROLL (LOAD), INCREASE, and DECREASE. The display will show rOFF or cOFF when the Micro-Speed® MD is not driving the motor, r= ramp down mode (horizontal motion bridge-trolley-monorail), c= coast to stop mode (vertical motions hoist) 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. To protect itself the Micro-Speed® MD shuts down (this is called a fault), and 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® MD faulted.

Also, the display and buttons are used to program the Micro-Speed® MD. There are 54 programmable parameters labeled A1 through A17, and L1 through L37. These parameters are what molds the Micro-Speed® MD to the special needs of each application. With just a few pokes at the buttons, a list of the Micro-Speed® MD's characteristics can be displayed and then changed to suit the individual needs of your application. The "A" values control areas like: the acceleration rate, the deceleration rate, how soon to release the brake after the motor starts, how much slip should be compensated, and what speed to run the motor. The "L" values control areas like: should the motor coast to a stop or be ramped down (decelerated) to a stop, how the end of motion limit switches function, voltage setting, and the extreme settings of speed, acceleration, and deceleration allowed for your application. These "L" values are automatically locked so the end user cannot inadvertently change the values, possibly causing unexpected operation and danger. In order to speed up the process of programming your Micro-Speed® MD, Power Electronics has included a number of pre-set "A" value sets (Gang-Sets™), that can be easily loaded into the Micro-Speed® MD. <u>As few as three key strokes</u> may be needed to get the Micro-Speed® MD specially programmed for your application and running. Once the Gang-Set™ of your choice has been loaded into the Micro-Speed® MD, individual changes to the "A" values can then be made to fine tune the drive to your application. *Note: Fine-tuning is always done after a Gang-set™ has been loaded, not before*. Loading a Gang-set™ will erases all previous changes. Access to these programming parameters can be protected by locking the Micro-Speed® MD. Once locked, the program can be unlocked to allow access.

Precise directions for programming the Micro-Speed® MD, 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 prior faults which the Micro-Speed® MD experienced, others will help check that the wiring is done correctly, such as pendant and brake wiring.

The Micro-Speed® MD will display one of two different messages when not driving the motor. The COAST to a stop mode (displayed "cOFF"), and the RAMP to a stop mode (displayed "rOFF"). The COAST mode will stop powering the motor and instantly set the brake when the forward or reverse control signal is removed. The RAMP mode slows the motor down under power and then sets the brake. DO NOT use the RAMP mode when the Micro-Speed® MD is used for vertical motions such as a HOIST. This mode is set by the locked parameter - L8. Setting L8 also allows switching from Gang-Set™ 1-4 or 5-8

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

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

The power terminals are found on the bottom level of the Micro-Speed® MD. The L1, L2, and L3 terminals connect to the 3-phase line. T1, T2, and T3 connect to the motor. P1 and P2 connect to an external braking resistor. The braking resistor terminals are used only on the larger Micro-Speed® MD's, those for 460 VAC 7.5 hp or 230 VAC 7.5 hp and above. There is also a grounding terminal or lug available for proper grounding of the drive.

Braking resistors (dyanmic braking/regenerative braking) are required on all bridge and trolley applications and on a minority of Hoist applications. Smaller Micro-Speed® MD's have resistors built in. For larger Micro-Speed® MD's, 460 VAC 7.5 hp or 575 VAC 7.5 hp and above, resistors must be supplied externally. The resistors should be housed in a touch-safe vented enclosure that will contain any molten metal that may melt off the resistors if they over heat or are shorted.

All control terminals are found on the logic board and consist of the 115 VAC inputs which connect to the pendant, brake control outputs which control the brake contactor coil, form C fault relay outputs, auxiliary inputs for a variety of uses including connection to limit switches, and an analog input section for potentiometer or current input. All low voltage terminals should be wired with class 1 wiring or equivalent.

QUICK SETUP AND RUN

I. WIRING

A. Wire the Micro-Speed® MD according to your needs, use the appropriate procedures and drawings found in the section labeled Installation.

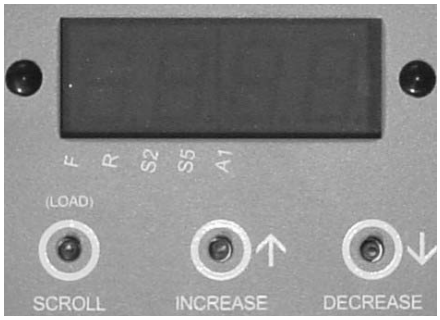
B. Visually double check your wiring. Before applying any power, be especially sure that connections to the T1, T2, T3, COM, and ST terminals are correct. Incorrect wiring of these terminals may cause damage to the Micro-Speed® MD requiring factory service.

II. VERIFY CONTROL WIRING (R1, R2, R3, B1, COM, ST, F, R, S2, S3, S4, S5, AX1, AX2)

A. Apply power to the Micro-Speed® MD.
If a fault code is displayed, "F4" for example, turn to section on Faults.

B. Check the control wiring by using the following procedure:

1. Press and hold the scroll button, until the “E” appears, then release the scroll button.
2. Press and release the scroll button repeatedly until “E8” is displayed and wait.
3. The display should look similar to below (Fig. 1). Each vertical line represents the on or off condition of a control input terminal. The terminal represented is labeled right below that vertical line. If the line is in the down position, that terminal is off (not energized). If the line is in the up position, that terminal is energized.



4. Press the pendant buttons while watching the display. If wired properly the corresponding red line will jump up.
5. Manually operate any switches attached to the Auxiliary terminals and verify that the correct red line changed appropriately. Auxiliary switches are often normally closed, if this is the case the red line should be up (energized) and jump down (not energized) when the switch is operated.
6. When finished press and hold the scroll button until "cOFF" or "rOFF" is displayed.

III. VERIFY ANALOG CONTROL WIRING (0V, I1, +5)

Skip this step if these terminals are not used.

A. If an analog input device is used, such as a potentiometer, the wiring and operation can be checked by performing the following procedure:

1. Press and hold the scroll button, when "E" appears release the scroll button.
2. Poke repeatedly at the scroll button until "E7" appears. Soon after a number will appear. This number represents the percentage of the analog input voltage. A voltage of zero is displayed as "0.0"%, an input of the full voltage is displayed as "100.0"%. If a potentiometer is used and the wiring is correct, turning the knob will cause the display to change accordingly.
3. When finished press and hold the scroll button until "cOFF" or "rOFF" is displayed.

IV. CHANGING RAMP / COAST MODE

A. Press and hold the scroll button, when "U" appears release the scroll button. Soon after "U0" will appear, then "0" will appear.

B. Press and hold or repeatedly poke the increase or decrease button until the correct code number is displayed. For safety reasons this code number can be found on the very last page.

C. Poke repeatedly at the scroll button until "U1" appears. Soon after "on" or "OFF" will appear. This shows if the ramp down is turned on or off.

1. If you want to use the Micro-Speed® MD for a Bridge / Trolley motion, press the increase button to turn the ramp down on. "on" will be displayed.
2. If you want to use the Micro-Speed® MD for a Hoist motion, press the decrease button to turn the ramp down off. "OFF" will be displayed.

D. When finished press and hold the scroll button until "cOFF" or "rOFF" is displayed.

V. CHOOSE A GANG-SET®

A. Choose a Gang-set™ from the list below that most closely matches your application.

Bridge / Trolley (Horizontal Motions)

Pb01 1-speed
Pb02 2-step push-button infinitely variable
Pb03 3-step push-button infinitely variable
Pb04 1 to 5 speed, can be used for 1, 2, 3, 4, or 5 step push-button.
Note: If "rOFF" is displayed, then this Gang-set™ are immediately accessible. If this is the appropriate Gang-set™ for your application, then you may skip to step "VIII. OPERATION."

Hoist (Vertical Motions)

PH05 3-step push-button infinitely variable
PH06 1 to 5 speed, can be used for 1, 2, 3, 4, or 5 step push-button.
Note: If "cOFF" is displayed, then this Gang-set™ is immediately accessible. If this is the appropriate Gang-set™ for your application, then you may skip to step "VIII. OPERATION."
PH07 1 to 5 speed with low speed potentiometer on pendant control.
PH08 2-step push-button infinitely variable

B. It may be necessary to change your Micro-Speed® MD to Hoist or Bridge / Trolley motion. Find the statement below which matches your situation and proceed to the recommended step.

If "rOFF" is displayed and you want to load a Hoist Gang-set™, then go to step VI. CHANGING RAMP / COAST MODE.
If "rOFF" is displayed and you want to load a Bridge / Trolley Gang-set™, then go to step VII. LOADING A GANG-SET™.
If "cOFF" is displayed and you want to load a Hoist Gang-set™, then go to step VII. LOADING A GANG-SET™.
If "cOFF" is displayed and you want to load a Bridge / Trolley Gang-set™, then go to step VI. CHANGING RAMP / COAST MODE.

VI. LOADING A GANG-SET®

A. Press and hold all three buttons simultaneously until “PH 0” or “Pb 0” appears in the display (this takes about 1 second) and then release the buttons. “**PH**” refers to “**H**oist”. “**Pb**” refers to “**b**ridge/Trolley”
B. Use the increase and decrease buttons to choose the desired program.
C. Press the scroll button down until "cOFF" or "rOFF" appears in the display (this takes about 1 second) and then release the button.

VII. OPERATION

A. The Micro-Speed® MD is now ready for use. While operating you will discover that things may not work as fast or slow, or as precise as you would like. Gang Set™ settings should be acceptable for 90% of standard crane applications. Many aspects of the performance of the Micro-Speed® MD can be adjusted and fine tuned. If you find it is necessary to adjust some aspect of the performance you will want to read about the individual "A" parameters. See the following sections:
Individual "A" parameter programming
“A” parameter description
B. If you have a familiarity with the "A" parameters you can use the "A" parameter reference chart at the end of the manual and the following procedure to change them.

VIII. CHANGING RAMP / COAST MODE

A. Press and hold the scroll button, when "U" appears release the scroll button. Soon after "U0" will appear, then "0" will appear.
B. Press and hold or repeatedly poke the increase or decrease button until the correct code number is displayed. For safety reasons this code number can be found on the very last page.
C. Poke repeatedly at the scroll button until "U1" appears. Soon after "on" or "OFF" will appear. This shows if the ramp down is turned on or off.
    1. If you want to use the Micro-Speed® MD for a Bridge / Trolley motion, press the increase button to turn the ramp down on. "on" will be displayed.
    2. If you want to use the Micro-Speed® MD for a Hoist motion, press the decrease button to turn the ramp down off. "OFF" will be displayed.
D. When finished press and hold the scroll button until "cOFF" or "rOFF" is displayed.

IX. CHANGING "A" PARAMETERS

A. Make sure the Micro-Speed® MD is on but not driving a motor and the display reads "rOFF" or "cOFF".
B. Press the scroll button on the cover of the Micro-Speed® MD. Hold this button down until "A" appears in the display (this takes about a second) 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.
C. 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 appears on the display.
D. The parameter label will be displayed for about 1 second and then the value that it is currently programmed to will be displayed. Use the increase and decrease buttons to alter this value as desired.
E. To change another parameter repeat steps C and D.
F. To exit the "A" programming mode, press and hold the scroll button down until the display reads "cOFF" or "rOFF". This will take about 5 seconds during which the current parameter label will be displayed.

X. UNLOCKING THE Micro-Speed® MD

A. This procedure is necessary when the message "LOC" is displayed, while trying to change a parameter. The Micro-Speed® MD is factory shipped unlocked, so this unlocking step is not necessary unless someone previously locked it.
    1. Press and hold both the increase and decrease buttons until "L--U" appears.
    2. Poke the increase or decrease until "UnL" appears. "UnL" = unlock. "LOC" = lock.
    3. Press and hold the scroll button until "cOFF" or "rOFF" is displayed.

INSTALLATION

EXPOSURE: DO NOT expose the Micro-Speed® MD to excessive vibration (not more than .5G), heat above 50° C, corrosive gasses, dust, steel particles, high relative humidity (condensative), or environments where sources of electrical noise are present. A proper Nema rated enclosure should be provided for the application of the existing environments.

AMBIENT TEMPERATURE: The environmental ambient temperature for the Micro-Speed® MD should not exceed 50°C (122°F) or go below -10°C (14°F). Call Power Electronics if your application has ambients outside this range.

ENVIRONMENT

MOUNTING: Mount the Micro-Speed® MD vertically on a panel out of direct sunlight or radiant heat with spacing that allows adequate ventilation of the heat sink. (See the Drive Clearance Chart)

DRIVE CLEARENCE & WIRING CHART — (MD series not included)

Frame Size	Space Required Above and Below Drive	Space Required Left and Right of Drive	Minimum Enclosure Sizing	Input/Output Power Wire Sizing (90deg C)	Power Wire Clamping Torque
a2	1.75"	1”	12 x 14 x 6.75"	10-14 AWG	8 lb-in
a2d	1.75”	1”	19 x 20 x 9"	10 AWG	8 lb-in
b	1.75”	1”	Not Required	8-14 AWG	16 lb-in
d3	3”	1.5”	Not Required	8 AWG	
d2	3”	1.5”	Not Required	4-8 AWG	
e2	4”	2”	Not Required	2-6 AWG	
f2	4”	2”	Not Required	1/0-4 AWG	
g	5”	2”	Not Required	3/0-2/0 AWG	

SAFETY REQUIREMENTS/WARNINGS

1. GROUNDING: Ensure that the unit is properly grounded to prevent electrical shock and to help reduce electrical noise. If no adequate ground is at the mounting location, run a separate ground cable from the grounding terminal or lug on the drive to good earth ground.

2. BUSS CHARGE TIME: Do not touch any electrical component or attempt to wire the Micro-Speed® MD while any power is supplied to the unit, or while the buss still has a charge on it. **Caution before servicing, disconnect power and wait at least 5 minutes**, **and if the charge lamp is still on after 5 minutes, wait until it is off**. It is necessary to follow these precautions because dangerous electrical energy will remain in the unit even after power is disconnected. **Always wait a minimum of 5 minutes after removing power.**

3. LOAD BRAKE: A load brake is necessary in hoisting application. The Micro-Speed® MD 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. For more information, see section 2.6 "Controlling a mechanical brake".

4. BRAKE RESISTOR MOUNTED IN SAFE ENCLOSURE WITH ADEQUATE VENTILATION
If the Micro-Speed® MD 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.

5. BYPASS SYSTEMS: If a secondary bypass magnetic contactor system is used to bypass the drive, the bypass system and drive should be interlocked so that the drive is in the off mode before the bypass contactors are engergized. It is necessary to open the input and output on the drive in a bypass system, then engage the bypass sytem, so not to expose the drive output to line voltage

WIRING PRACTICES & SYSTEM REQUIREMENTS

1. GROUNDING: To ensure that the unit is properly grounded you must ground the heat sink. (Use the grounding lug or grounding terminal on the Micro-Speed® MD)
2. FUSING: Always branch protect the Micro-Speed® MD with fuses or circuit breakers.
3. DO NOT use contactors on the output, this will eventually destroy the Micro-Speed® MD.
4. Drive must be hard wired to motor. Use conduit or festooning. Do not install any rails or other device which may open the connection between the motor and the drive.
5. Always use a 3-phase isolation transformer or an inductor on the input of the Micro-Speed® MD, when used near equipment which intermittently draws high current, such as arc-welding or smelting equipment.
6. Always wire the N.C. contact (terminals R2, R3) of the Micro-Speed® MD's AUX relay in series with the brake contactor's coil to drop out the brake in case of a fault if this relay is not used for any other purpose.
7. If not using festooning, use DOUBLE SHOE TYPE collectors on the conductor bar.
8. If possible, try to run these three groups of wires -- motor wires, brake wires, and control wires -- separately.
9. Use shielded wire to run any analog signal to the drive and ground the shield near the drive.
10. Wire the N.C. contact of the external overload device used in series with an ST terminal and the X2 (common) terminal on the 110V control transformer.
11. Suitable for use on a circuit capable of delivering not more than 5,000 RMS Symmetrical Amperes, 600 Volts maximum.

DRIVE FUSING

It is necessary to fuse the input power of each Micro-Speed® MD individually. Fuses should be of the Time delay type. Fusing for 480 VAC mains must use a voltage rating of 500 VAC or higher. Fusing for 230 VAC mains must 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 below may 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-R (600vac midget size, up to 30 amps) or
LPJ (600vac small, 1-600 amps) or Class RK1 Time Delay style (Large) LPSRK=250vac & LPNRK=600vac

Or equivalent.

Horse Power	Fuse Sizes For 385-410, 460, & 575 V	Fuse Sizes For 208-230 V
1	6 Amp	12 Amp
2	6 Amp	12 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	160 Amp
50	100 Amp	200 Amp
60	120 Amp	
75	150 Amp	
100	200 Amp	

BRAKING RESISTORS

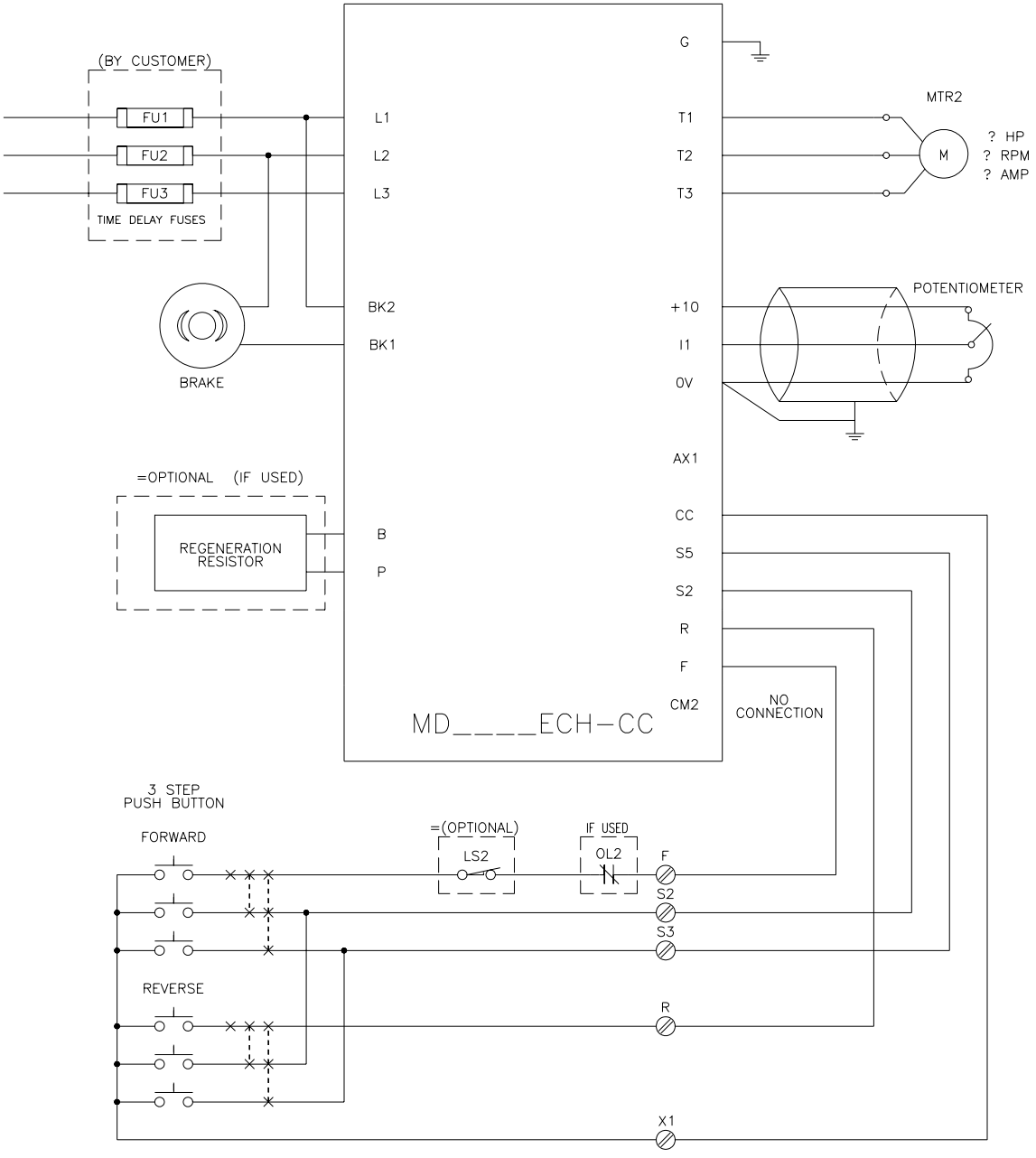
All Micro-Speed® MD's require braking resistors though some may already be internal to the unit. The Micro-Speed® MD uses the braking resistors whenever it decelerates a large mass or load. The required size of these resistors depends on the application, the motor's horsepower, and the motor's voltage. Most Power Electronics Drives 5 horsepower and lower (all voltages) have internal Braking Resitors. The Micro-Speed® MD series does not. The ohm values must be according to

HORSE-	230 VAC		460
POWER	Ohms	PART #	Ohms
1	125	Call	500
2	62	Call	250
3	40	Call	160
5	25	Call	100
7.5	12	R723T	50
10	12	R1023T	50
15	8	R1023T	33
20	6	R1023T	25
25	5	R1023T	20
30	4	R1023T	16
40	3	R1023T	12
50	2.4	R1023T	10
60	2		8.3
75	1.7		6
100	1.2		5

Power Electronics recommendations. Wattage values can be increased for higher duty cycles and greater reliability. The chart below shows values for horizontal motion. For vertical motion see the Hoisting Applications section below to determine wattage (ohms remain the same).

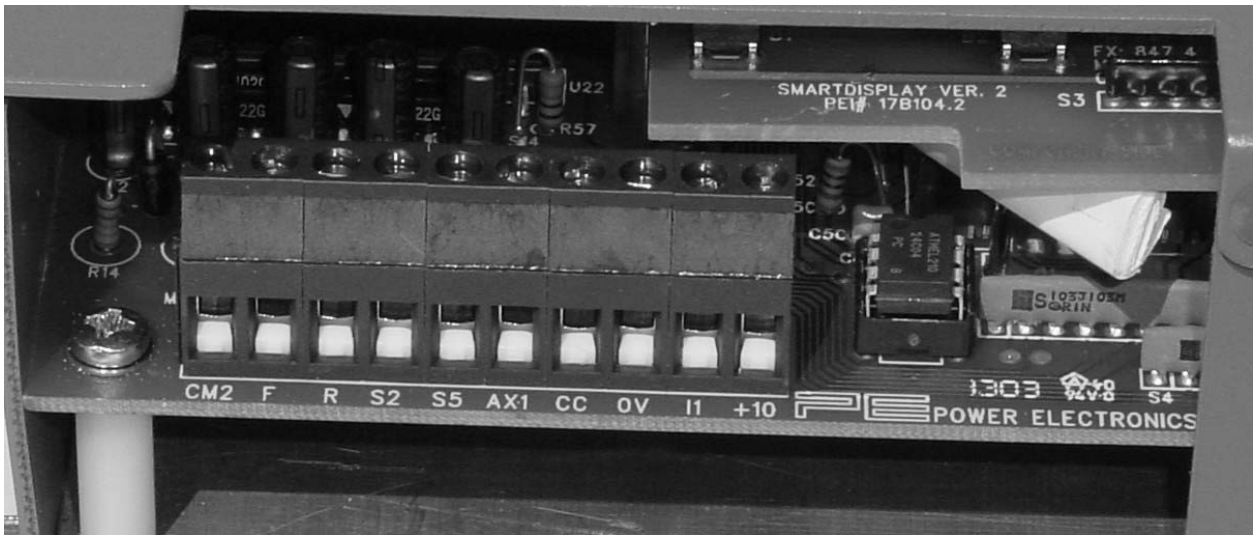
HOISTING APPLICATIONS

The majority of hoists do not require braking resistors. The load brake is responsible for absorbing the energy produced when lowering a load. Unnecessarily installed braking resistors, would only get used when the load brake has worn and is not functioning adequately. In this situation the braking resistors may hide the load brake's problem by absorbing what energy the load brake is no


(BY CUSTOMER)
FU1
FU2
FU3
TIME DELAY FUSES
BRAKE
L1
L2
L3
BK2
BK1
G
T1
T2
T3
+10
I1
0V
AX1
CC
S5
S2
R
F
CM2
B
P
MD____ECH-CC
MTR2
M
? HP
? RPM
? AMP
POTENTIOMETER
=OPTIONAL (IF USED)
REGENERATION RESISTOR
NO CONNECTION
3 STEP PUSH BUTTON
FORWARD
REVERSE
=(OPTIONAL)
LS2
IF USED
OL2
F
S2
S3
R
X1

CONTROL TERMINALS

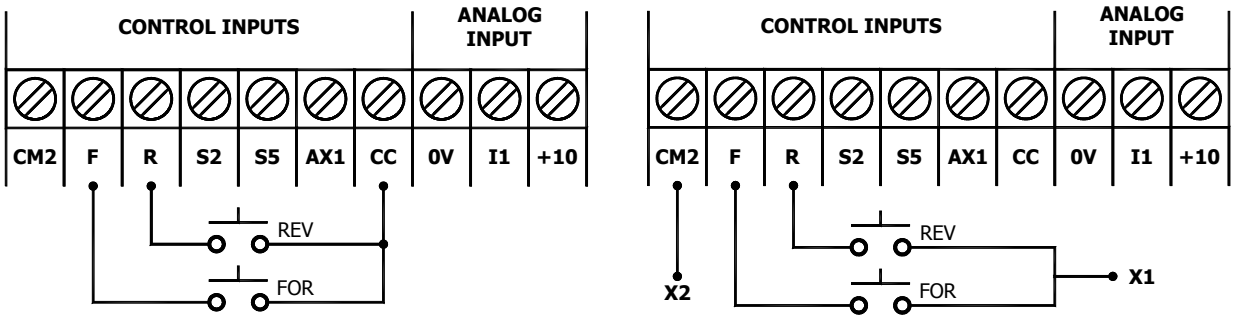
TERM.	CATEGORY	DESCRIPTION
0V	ANALOG COMMON	Zero volts. Common terminal for I1.
I1	ANALOG INPUT	Analog Signal Input. 0-5 volt or 0-10 volt or 4-20mA.
+10	ANALOG SUPPLY	+10 VDC Power supply for analog signal.
CM2	COMMON (For 115VAC Units)	Common (X2) terminal for the F, R, S2, S5, and AX1 inputs.
CC	COMMON (Supply for CC Units)	Common (+24vdc) terminal for the F, R, S2, S5, and AX1 inputs.
F	FORWARD INPUT	Forward runs motor in forward direction (also used as the LOW SPEED input).
R	REVERSE INPUT	Reverse runs motor in reverse direction (also used as the LOW SPEED input).
S2, S5	(Speed choices)	SPEEDS - Programmable speed selections
AX 1	AUXILIARY INPUT	Programmable input.



CM2 F R S2 S5 AX1 CC OV I1 +10

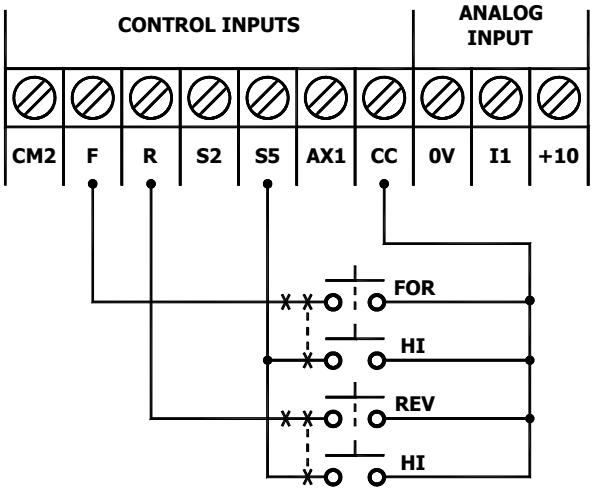
WIRING OF 1-STEP PUSH BUTTON SWITCH

Most MD style units use “CC” inputs (standalone system) without need of 115 V signal. Other control signal voltages are available for the “panel” style system other than 115 vac.

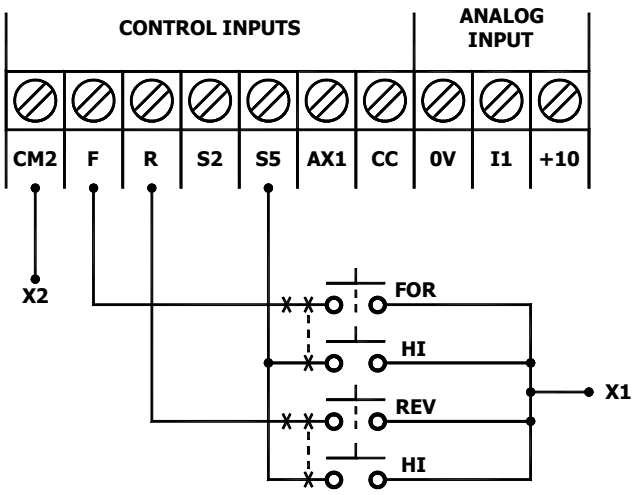


WIRING OF 2-STEP PUSH BUTTON SWITCH

CONTACT CLOSURE “CC” INPUTS

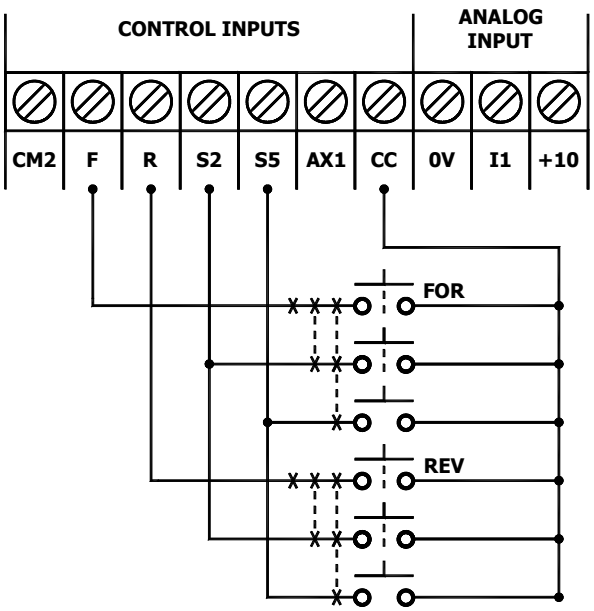


115V CONTROL INPUTS

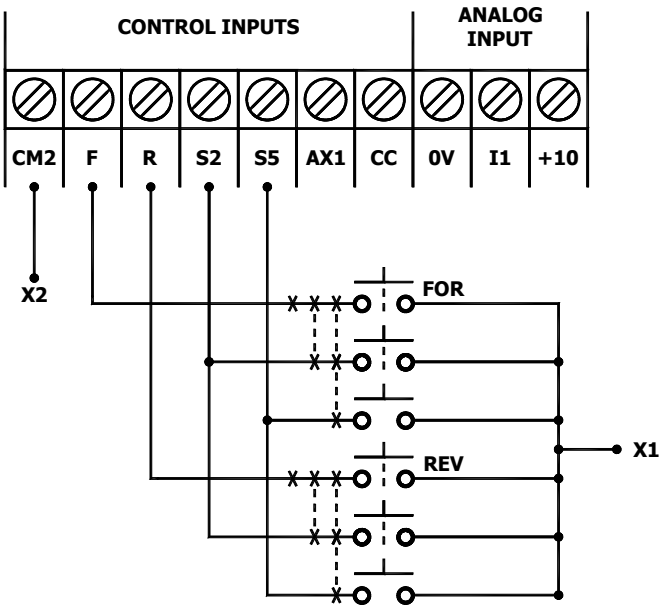


WIRING OF 3-STEP PUSH BUTTON SWITCH

CONTACT CLOSURE "CC" INPUTS

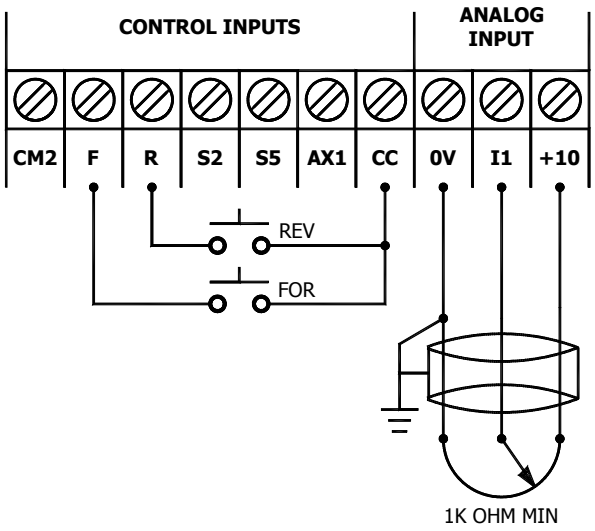


115V CONTROL INPUTS

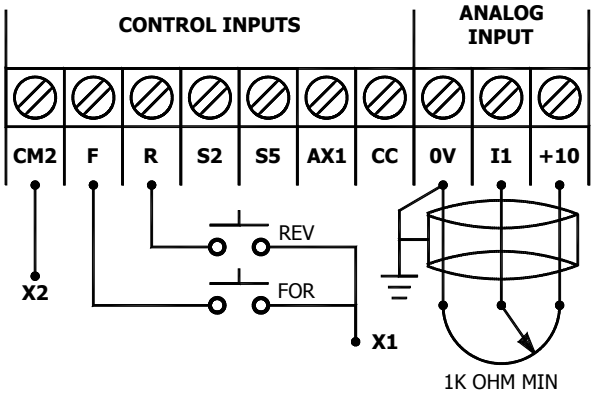


WIRING FOR ANALOG INPUTS

CONTACT CLOSURE "CC" INPUTS



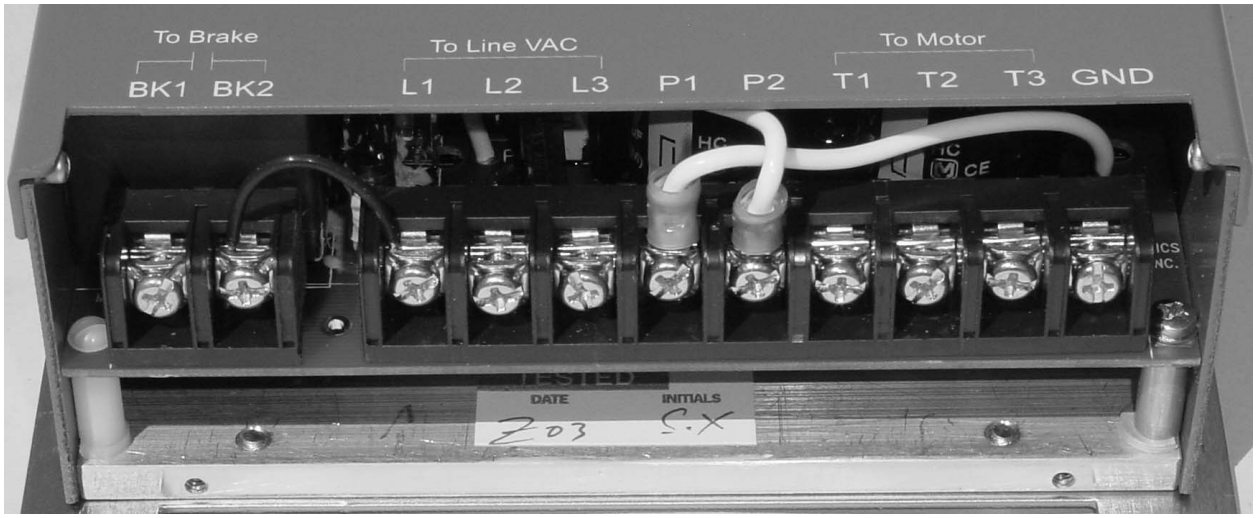
115V CONTROL INPUTS



WIRING FOR MOMENTARY MODE

CONTROLLING A MECHANICAL BRAKE

Typical brakes found on hoists and bridge trolleys, when energized, will allow the motor to turn. When power is removed, the motor is stopped. If a mechanical brake is used it should be controlled by the Micro-Speed® MD through its single phase AC brake contactor. The brake control terminals B1 and B2 are able to switch any DC control voltage up to 24 V at 1/2 Amp or any AC control or power voltage up to 460 V at 2 Amps. This allows control of a single phase AC brake directly with the Micro-Speed® MD.



BRAKE WIRING DIAGRAM for HORIZONTAL and VERTICAL TRAVEL , (BRIDGE, TROLLEY and HOIST)

BK1 BK2 L1 L2 L3 T1 T2 T3 GND

ANALOG INPUTS

Wiring to these terminals is not necessary for the operation of the Micro-Speed® MD. The Analog signal terminals are used to vary the speed of the drive. A potentiometer can be wired to these terminals. Turning the knob on the potentiometer directly controls the speed of the motor. Or a sensor can be wired to these terminals in place of the potentiometer, allowing the sensor to control the speed of the motor. Wire with Class 1 wiring or equivalent.

The 0V terminal is the common terminal. This terminal is the common terminal for both the input terminal and the five volt power supply.

The I1 terminal is the analog input terminal. This terminal must be set for the type of signal you are using. This is done by changing the jumper that is located on the right side of the top circuit board behind the control terminals. To change the setting, carefully pry up and off the black shunt. Then reinstall the shunt in the necessary position.

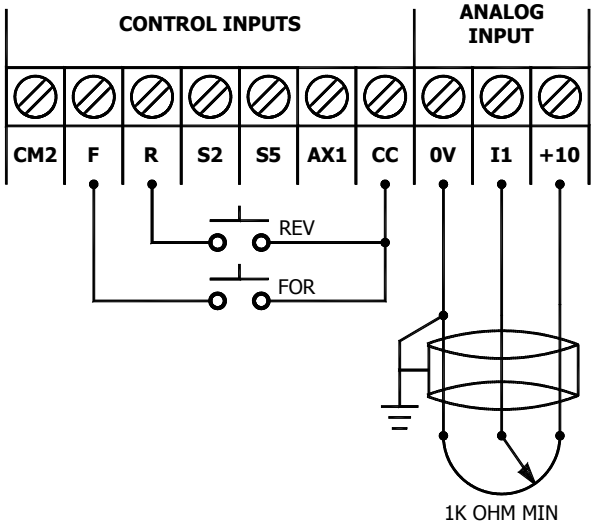
There are three choices:

5	0-5 volt signal (factory setting) (10k ohms)
10	0-10 volt signal (20k ohms)
20	0-20 ma signal. (250 ohms) Also set L30 to 20% for 4 to 20 ma input

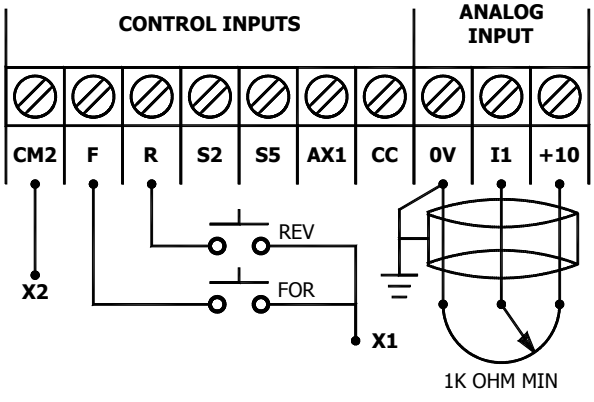
The +10 terminal is a positive 10 volt power supply output.
This terminal can be used along with the 0V terminal to supply power for a potentiometer or sensor.
-Note : Cable should be shielded and have 0V pin floating. The shielded cable should be grounded to the chassis.

ANALOG INPUT-WIRING LOW SPEED POTENTIOMETER DIAGRAM

CONTACT CLOSURE "CC" INPUTS



115V CONTROL INPUTS



PROGRAMMING FOR ANALOG INPUT

A9 Must be set to 3. When a Forward of Reverse input is active and there is no other speed input (S2-S5) then the drive will ramp to and run at the speed determined by the analog input.

A17 This determines the frequency associated with a full 100% analog input signal

L30 This determines at what percentage signal the drive assigns minimum signal. Any signal below is treated as minimum. The input signal above L30 is scaled from low speed (A12) to the analog upper limit (A17). You would need to set L30 to 20% for a 4-20 ma input

PROGRAMMING THE Micro-Speed® MD™

THE "A" PARAMETERS

The Micro-Speed® MD has 57 parameters that can be programmed to tailor the drive's operation to the needs of the user. These parameter are labeled A1 through A17 , L0 through L37 and U0 through U2. 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 methods in which to program these parameters. The simplest is to "GANG-SET" one of the 8 preset programs. 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 Micro-Speed® MD's 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. This ability to easily program the Micro-Speed® MD can also be locked to prevent accidental changes in the program. It can be unlocked at anytime, to allow changes. To the right is at a table listing the Micro-Speed® MD's 17 "A" parameters along with there name and programming range.

"A"	Name	Range
A1	Accel 1	0.1 - 30 sec
A2	Accel 2	0.1 - 30 sec
A3	Accel mode	Mode: 0 - 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 - 5
A8	Voltage boost	1-30%
A9	Operation Mode	Mode: 0 - 7
A10	Slip comp.	-10 to 10 Hz
A11	Not Available	
A12	Low speed	1 - 120Hz
A13	Speed 2	1 - 120Hz
A14	Not Available	
A15	Not Available	
A16	Speed 5	1 - 120Hz
A17	Analog upper limit	1 - 120Hz

LOCKING AND UNLOCKING THE Micro-Speed® MD™

Locking the program will prevent the user from getting into the Gang-Set™, the "A", and the "L" programming modes, 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® MD:

1. Make sure the Micro-Speed® MD is on but not driving a motor and the display reads cOFF or rOFF.
2. Press the increase and decrease buttons on the cover of the Micro-Speed® MD 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 or decrease button 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.

*These parameters are new on this version

Gang-Set ® PROGRAMMING

The Micro-Speed® MD contains 8 pre-set Gang-Set™programs, labeled from Pb01 through PH08. Each Gang-set™ program is actually just a list of "A" and "L" values which are factory chosen. When the Micro-Speed® MD is Gang-Set™, each "A" parameter is reprogrammed to a new factory chosen value. The Gang-Set™ procedure is a simple and quick way to get the Micro-Speed® MD 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. Therefore, all fine-tuning of individual "A" parameters must be done after Gang-setting and not before.

Each Gang-Set™ program contains general settings for a specific Micro-Speed® MD application. For field safety, the Micro-Speed® MD will only display those Gang-Set™ programs which apply to the Ramp down setting (U1) of the Micro-Speed® MD. For Hoisting applications be sure to set U1 to OFF; you will then be able to access the Hoist Gang-Sets™. For Bridge or Trolley application you may want to set L8 to On; you will then be able to access the Bridge / Trolley Gang-Sets™. To choose a Gang-Set™, you should match your application to the chart on the next page:

L0	Code	0-999
L1	Accel lower limit	0.1-30.0 sec
L2	Accel upper limit	0.1-30.0 sec
L3	Decel lower limit	0.1-30.0 sec
L4	Decel upper limit	0.1-30.0 sec
L5	Speed upper limit	1.0-120Hz
L6	AX limit switch mode	0,1,2
L7	Limit switch decel time	0.1-30.0 sec
L8	Ramp down to stop	on - off
L9	Line Voltage	230, 460, 510
*L10	Cut off Frequency	0.0-120.0 Hz
*L11	Quick Stop upper limit	0.1-30.0 sec
*L12	Parameter Lock	Loc, Unl
*L13	Not Available	
L14	N/A	N/A
L15	N/A	N/A
L16	N/A	N/A
L17	N/A	N/A
L18	Max Hz	1- 120Hz
L19	Max Hz enforce mode	0,1,2
L20	N/A	N/A
L21	Volt peak	30-120Hz
L22	N/A	N/A
L23	N/A	N/A
L24	Timer	0-600 sec
L25	Brake Hold Time	-5.0-2.0 sec
L26	Dead Time	-5.0 to 5.0 sec
L27	Reset mode	0,1,2,3,4,5
L28	Trip MODE	0 to 8
L29	N/A	N/A
L30	Analog Offset	0 to 75 Hz
L31	Pulse Start Voltage	1 to 30% line VAC
L32	Pulse Start Time	0 to 2 seconds
L33	D.C. Injection Brake Voltage	1 to 30% line VAC
L34	D.C. Injection Time	0 to 2 seconds
L35	Drive Starting Hz	0 to 10 Hz
L36	AX1 MODE	0 OR to 120 Hz
L37	Not Available	

GANG-SET® CHART

Bridge / Trolley (horizontal motion) -- "U1" needs to be set On, "rOFF" should be displayed.

P**b** 0	No change, use to exit Gang-set mode without changing current settings.
P**b**01	1-speed
P**b**02	2-step push-button infinitely variable
P**b**03	3-step push-button infinitely variable
P**b**04	5-speed, can be used for 1, 2, 3, 4, or 5-speeds.

Hoist (vertical motion) -- "U1" needs to be set OFF, "cOFF" should be displayed.

P**H** 0	No change, use to exit Gang-set mode without changing current settings.
P**H**05	3-step push-button infinitely variable
P**H**06	5-speed, can be used for 1, 2, 3, 4, or 5-speeds.
P**H**07	5-speed with low speed potentiometer on pendant control.
P**H**08	2-step push-button infinitely variable

To Gang-set the Micro-Speed® MD:

1. Make sure the Micro-Speed® MD is on but not driving a motor and the display reads cOFF/ rOFF.
2. Press all three buttons on the cover of the Micro-Speed® MD simultaneously. Hold these buttons down until PH 0 or Pb 0 appears in the display (this takes about 1 second), then release the buttons.
3. Use the increase and decrease buttons to choose the desired program. If the desired Gang-Set™ cannot be accessed, it is necessary to change "U1".
4. Press the scroll button down until LOAd appears in the display (this takes about 1 second) and release the button.

The Gang-Set™ programs PH 0 and Pb 0 are special. Programming PH 0 or Pb 0 will cause the Micro-Speed® MD to leave the Gang-Set™mode without changing any "A" parameters.
Once the Micro-Speed® MD is Gang-Set™, it is not possible to tell which Gang-Set™ program was used.

INDIVIDUAL “A” PROGRAMMING

The Gang-Set®mode cannot be entered if the unit is locked.
The Micro-Speed® MD’s 17 “A” parameters can be viewed and programmed individually.

To program an "A" parameter individually:

1. Make sure the Micro-Speed® MD is on but not driving a motor and the display reads rOFF or cOFF.
2. Press and hold the scroll button on the cover of the Micro-Speed® MD until "A" appears in the display (this takes about 3 seconds), 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 appears on the display.
4. The parameter label will be displayed for about 1 second and then the 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.
6. To finally leave the "A" programming mode, press and hold the scroll button down until the display reads cOFF/rOFF. This will take about 5 seconds during which the current parameter label will be displayed .

To view the "A" parameters without changing their programmed values, use the same procedure as above but do not use the increase or decrease buttons to change any values.

The "A" values cannot be changed, but can still be viewed if the Micro-Speed® MD is locked. The message LOC will appear if the increase or decrease button is pushed while locked.

"A" PARAMETER DESCRIPTIONS

A1 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 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 A3 ACCELERATION MODE

Adjustable mode 0,1,2,3,4,5
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 AX1 is activated, during which A2 will be used.
2	A1 is used except when input AX2 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.
5	Mode 5 determines that acceleration rate A2 will be used when the speed of the drive is below the low speed setting A12. Acceleration rate A1 will be used for speed above A12.

A4 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 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 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

A7

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. In each of these modes A4 is assumed to be the longest time and A6 the shortest.

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 AX1 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 AX2 is activated.

4 A4 is used for decelerating between speeds.
A5 is used for decelerating to a stop and reversing.
A6 is used whenever AX1 is activated.

5 A4 is used for decelerating between speeds.
A5 is used for decelerating to a stop and reversing.
A6 is used whenever AX2 is activated.

A8 VOLTAGE BOOST

A8

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 drive 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 and DC Injection feature. If the values in L31 or L33 are lower than A8 then A8's value will be used.

A9 A9 OPERATION MODE

Adjustable mode: 0,1,2,3,4,5,6,7.
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® MD will:

Ramp down or Coast to stop (depending on the setting of U1) when the forward or reverse signal is removed.

Hold 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 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.

Accelerate or decelerate toward the appropriate programmed speed if any of the speed inputs are activated (S2, S3, S4, or S5) along with either the forward or reverse signal.

Popular use with 2 two-step buttons:

One two-step button (connected to F terminal) operates the forward motion while held down. The first step initially operates the speed programmed at A12, there after this step freezes the changing speed, holding that speed. The next step (connected to S5 terminal) operates the speed programmed at A16.

One two-step button (connected to R terminal) operates the reverse motion while held down. The first step initially operates the speed programmed at A12, there after this step freezes the changing speed, holding that speed. The next step (connected to S5 terminal) operates the speed programmed at A16.

Pushing the pendant button down to step #1 would initially cause the drive to go into low speed (A12). Pressing the button further to step #2 would cause the drive to accelerate to high speed (A16). If before the drive reaches high speed the button was shifted back to step #1, the drive would stop accelerating and hold that speed. If the ramp down option (L8) is on, the drive can be decelerated to a lower speed by releasing the button 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 (U1) is on. Hence, this mode can be used on bridges or trolleys where one usually uses the ramp down option. This mode can also be used on hoist as well. Since hoists must set the ramp down option off, the user can only increase speeds, not decrease them.

1 <u>3 STEP INFINITELY VARIABLE.</u>

In this mode, the Micro-Speed® MD will:

Ramp down or Coast to stop (depending on the setting of L20) when the forward or reverse signal is removed.

Accelerate or decelerate toward the low speed setting A12 if either the forward or reverse signal is present without any speed inputs being activated.

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 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.

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.

Popular use with 2 three-step buttons.

One three-step button operates the forward motion while held down. The first step (connected to F terminal) operates the speed programmed at A12. The next step (connected to S2 terminal) freezes the changing speed, holding that speed. The next step (connected to S5 terminal) operates the speed programmed at A16.
One three-step button operates the reverse motion while held down. The first step (connected to R terminal) operates the speed programmed at A12. The next step (connected to S2 terminal) freezes the changing speed, holding that speed. The next step (connected to S5 terminal) operates the speed programmed at A16.

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 L8)
STEP #1 = Ramp to low speed (A12)
STEP #2 = HOLD at present speed.
STEP #3 = Accelerate to High speed (A16)

2 5 SPEED

In this mode, the Micro-Speed® MD will:

Ramp down or Coast to a stop (depending on the setting of L20) when the forward or reverse signal is removed.
Accelerate or decelerate toward the low speed setting A12 if either the forward or reverse signal is present without any speed inputs being activated.
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.

POPULAR USE WITH 2-THREE-STEP BUTTONS

Button step.	Wire Forward button to.	Wire Reverse button to.	Action
1	F	R	Ramp to speed set at A12.
2	S2	S2	Ramp to speed set at A13.
3	S3	S3	Ramp to speed set at A14.
4	S4	S4	Ramp to speed set at A15.
5	S5	S5	Ramp to speed set at A16.
6	AX1	AX1	Ramp to speed set at L36.
7	AX2	AX2	Ramp to speed set at L37.

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). This mode can also be used with a single-step, two-step, three-step, up to a seven-step pendant equally well. Only wire up the speed inputs that are needed.

3 5 SPEED WITH LOW SPEED POTENTIOMETER

For use with 2 multi-step buttons.

One multi-step button (connected to F terminal) operates the forward motion while held down, and each step operates the corresponding programmed speeds: Potentiometer setting, A13, A14, A15, A16.

One multi-step button (connected to R terminal) operates the reverse motion while held down, and each step operates the corresponding programmed speeds: Potentiometer setting, A13, A14, A15, A16.

The potentiometer will control the speed when either the Forward or Reverse button is held at its initial step.

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 potentiometer (pot.) is turned, to increase and decrease the drives speed.

Button step	Wire Forward button to	Wire Reverse button to	Action
1	F	R	Ramp to speed set at A12.
2	S2	S2	Ramp to speed set by pot.
3	S3	S3	Ramp to speed set at A14.
4	S4	S4	Ramp to speed set at A15.
5	S5	S5	Ramp to speed set at A16.
6	AX1	AX1	Ramp to speed set at L36.
7	AX2	AX2	Ramp to speed set at L37.

4 5 SPEED RATCHET MODE

For use with 4 single-step buttons.

One button (F) operates forward motion while held down.
One button (R) operates reverse motion while held down.
One button (S5) ratchets up to next programmed speed:
A12 --> A13 --> A14 --> A15 --> A16.
One button (S2) ratchets down to next programmed speed:
A16 --> A15 --> A14 --> A13 --> A12.

In this mode the Micro-Speed® MD will:

Ramp down or Coast to stop (depending on the setting of L20) when the forward or reverse signal is removed.
Accelerate or decelerate toward the next speed by momentarily activating the increase (S5) or decrease (S2) input.
Ramp down or Coast to stop (depending on the setting of L20) when the forward or reverse signal is removed.

This mode is most popular for use with a pendant or radio control that has four single step buttons. Two buttons are used to select low speed forward or low speed reverse. The other two buttons are used to increase or decrease to one of the five possible speeds. Each momentary press of the increase button (S5) causes the Micro-Speed® MD to accelerate to the next highest programmed speed. Each momentary press of the decrease button (S2) causes the Micro-Speed® MD to decelerate to the next lowest programmed speed. In this mode the five speed increments would be programmed in A12 (initial speed), A13, A14, A15, and A16. This mode helps free one hand from the controls since only one button has to be held to keep the Micro-Speed® MD running at the selected speed.

Button.	Wire button to.	Action
Forward	F	Ramp to speed set at A12.
Reverse	R	Ramp to speed set at A12.
Decrease	S2	Ramp down to next speed: A16->A15->A14->A13->A12.
Increase	S5	Ramp up to next speed: A12->A13->A14->A15->A16.

5 **2 SPEED TOGGLE.**

For use with 3 single-step buttons.

One button (connected to FOR terminal) operates the forward motion while held down, when first pressed the speed will equal that programmed at A12.
One button (connected to REV terminal) operates the reverse motion while held down, when first pressed the speed will equal that programmed at A12.
One button (connected to S5 terminal) when pressed and released, toggles between the speeds programmed at A12 and A16.

For use with 3 single-step buttons.

Ramp down or Coast to stop (depending on the setting of L20) when the forward or reverse signal is removed.
Accelerate or decelerate toward the other speed setting if the toggle button is momentarily pressed and either the forward or reverse signal is present.
Accelerate or decelerate toward the appropriate programmed speed if any of the speed inputs S2, S3, or S4 are activated along with if either the forward or reverse signal.

This mode is most popular for use with a pendant or radio control that has three single-step buttons. Two buttons are used to select the direction, low speed forward or low speed reverse. The other button is used to toggle between the low speed programmed at A12 and a higher speed programmed at A16. Each momentary press of the toggle button, wired to S5, causes the Micro-Speed® MD to accelerate or decelerate from high to low speed or from low to high speed. This mode helps free one hand from the controls since only one button has to be held to keep the Micro-Speed® MD running at the selected speed.

Button.	Wire button to.	Action
Forward	F	Ramp to speed set at A12.
Reverse	R	Ramp to speed set at A12.
Toggle	S5	Toggle between A12 and A16.

6 **MULTI-SPEED MOMENTARY.**

For use with 3 to 8 single-step buttons.

One button operates the forward motion while held down, when initially pressed the speed will equal that programmed at A12.

One button operates the reverse motion while held down, when initially pressed the speed will equal that programmed at A12.

Each additional button (connected to S2 - S5, AX1, AX2 terminals) when pressed and released, changes to the speed programmed at the terminals respective A variable.

This mode is intended for use with a pendant or radio control that has four or more single-step buttons. Two buttons are used to select the direction, low speed forward or low speed reverse. The additional buttons are used to select additional programmed speeds. These additional speed can be operated by momentarily pressing and releasing the corresponding button. The Micro-Speed® MD will continue operating at that speed until another button is pressed or the direction button is released. This mode helps free one hand from the controls since only one button has to be held to keep the Micro-Speed® MD running at the selected speed.

Button	Wire to.	Action
Forward	F	Ramp to speed set at A12.
Reverse	R	Ramp to speed set at A12.
Speed Select	S2	Ramp to speed set at A13.
Speed Select	S3	Ramp to speed set at A14.
Speed Select	S4	Ramp to speed set at A15.
Speed Select	S5	Ramp to speed set at A16.
Speed Select	AX1	Ramp to speed set at L36.
Speed Select	AX2	Ramp to speed set at L37.

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 **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 **A11 NOT AVAILABLE.**

A12 **A12 LOW SPEED (FORward terminal, REVerse terminal)**
Adjustable from 1.0 Hz to 120Hz.
Sets the low speed setting of the Micro-Speed® MD. This speed is usually invoked when either the forward or reverse terminal is activated.

A13 **A13 SPEED 2 (S2 terminal)**
Adjustable from 1.0 Hz to 120Hz.
Sets the second speed setting of the Micro-Speed® MD. This speed is usually invoked when the S2 terminal is activated.

A14 **A14 NOT AVAILABLE.**

A15 **A15 NOT AVAILABLE.**

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

A17 **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.

"L" PARAMETER DESCRIPTION

The "L" parameters contain critical settings like:
Should the motor coast to a stop, or be ramped down (decelerated) to a stop.
How the end of motion limit switches function.
The line voltage required.
The extreme settings of speed, acceleration, and deceleration allowed for your application.

These "L" parameters are where crucial aspects and limits for your application are programmed. These values determine how the Micro-Speed® MD will perform and sets the maximum allowable limits for some "A" parameter values. These limits need to be set within the limits of the application. Example; Set L5 to limit the speed of the bridge to 60Hz. Reasons for this could be; the crane was not designed for a speed greater, cannot stop safely, or to ensure operators safety. These "L" values are automatically locked so the end user cannot inadvertently change the values, possibly causing unexpected operation and danger. Below is a listing the Micro-Speed® MD's 37 "L" parameters along with there name and programming range.

L0 CODE VARIABLE

L0

In order to change any of the following "L" variables a code must be entered in this location. If the code is not entered, it is still possible to view the other "L" values but when a change is attempted the word "COdE" will be displayed.

L1 ACCELERATION LOWER LIMIT

L1

Adjustable from 0.1 to 30.0 seconds.
This setting determines the shortest amount of time that an acceleration parameter can be programmed to. This value is the minimum amount of time it will take for the drive to accelerate from 0 to 60 Hz.

L2 ACCELERATION UPPER LIMIT

L2

Adjustable from 0.1 to 30.0 seconds.
This setting determines the longest amount of time that an acceleration parameter can be programmed to. This value is the maximum amount of time it will take for the drive to accelerate from 0 to 60 Hz.

L3 DECELERATION LOWER LIMIT

L3

Adjustable from 0.1 to 30.0 seconds.
This setting determines the shortest amount of time that a deceleration parameter can be programmed to. This value is the minimum amount of time it will take for the drive to decelerate from 60 to 0 Hz.

L4 DECELERATION UPPER LIMIT

L4

Adjustable from 0.1 to 30.0 seconds.
This setting determines the longest amount of time that a deceleration parameter can be programmed to. This value is the maximum amount of time it will take for the drive to decelerate from 60 to 0 Hz.

L5 **L5 SPEED UPPER LIMIT**

Adjustable from 1.0 to 120 Hz.
This setting determines the highest speed that a an "A" parameter can be programmed to.

L6

L6 AUXILIARY LIMIT SWITCH MODE

Adjustable from 0, 1, 2.
This setting adjusts how the Micro-Speed® MD will react if limit switches are used. This mode will only stop the motion in the needed direction. The motion in the opposite direction will still operate normally.
In order for this mode to operate properly the limit switches must be wired to the appropriate Auxiliary terminal:

1. Auxiliary 1 (AX1) must be wired to the limit switch which stops the forward direction.
2. Auxiliary 2 (AX2) must be wired to the limit switch which stops the reverse direction.

Set this mode to fit your application:

Mode 0 Auxiliary limit switch mode off. Use this setting if no limit switches are used or if you are wiring the switches in a manor which does not require this mode.

Mode 1 When limit switch is opened, motion will ramp gently to a stop using the deceleration rate programmed in "L7". This mode cannot be chosen if the ramp down feature "L8" is set to off.

Mode 2 When limit switch is opened, motion will coast to a stop, allowing the mechanical brake to instantly set. In this mode motion will be halted instantly by your mechanical brake.

L7 **L7 LIMIT SWITCH DECELERATION TIME**

Adjustable from 0.1 to 30.0 seconds.
If "L6" is set to mode 1, this setting determines how quickly the Micro-Speed® MD will ramp to a stop when the limit switch opens. This value is the amount of time it will take for the drive to decelerate from 60 to 0 Hz.

L8 **L8 N/A**

L9 **L9 USER VOLTAGE**

The value displayed represents the A.C. voltage which the Micro-Speed® MD requires to operate.

L10 **L10 CUT OFF FREQUENCY**

Adjustable from 0.0 – 120.0 Hz
Determines the Frequency below which the drive turns off when a direction signal is not present. The drive will ramp down to this frequency and then turn off.

L11 **L11 QUICK STOP UPPER LIMIT**

Adjustable from 0.1 to 30.0 sec
Set the maximum ramp for any ramp to stop function. Drive uses A5 or L11 (whichever is lower)

L12 **L12 PARAMETERS LOCK**

Adjustable from Loc to Unl
This function locks the Parameters from Modification

L13 AUX RELAY FUNCTION

L13

Adjustable from 0-5
Determines the function of the AUX relay

0 Fault indicator (Default setting)
1 Inverse Fault (Fail Safe)
2 Drive Ready (Activated when the drive is ready for run signal)
3 Run Signal (Activated when the drive is receiving a run signal)
4 Activated when the full ramp speed has been reached
5 Activated when there is no speed.

L14 NOT AVAILABLE

L14

L15 NOT AVAILABLE

L15

L16 NOT AVAILABLE

L16

L17 NOT AVAILABLE

L17

L18 MAXIMUM FREQUENCY LIMIT

L18

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 Auxiliary signals. Useful when different operations require restrained speeds. See L19 to choose mode.

L19 MAXIMUM FREQUENCY LIMIT ENFORCEMENT MODE

L19

Adjustable mode 0, 1, 2.
Determines if and when the frequency of the drive will be limited by L18.

A19	When enforced
0.	Never
1.	When AX1 is activated.
2.	When AX2 is activated.
3.	When AX1 is not activated
4.	When AX2 is not activated
5.	Always
6.	Always for FOR
7.	Always for REV
8.	When AX1 is not activated, only for FOR motion limited
9.	When AX2 is not activated, only for FOR motion limited
10.	When AX1 is not activated, only for REV motion limited
11.	When AX2 is not activated, only for REV motion limited
12.	REV always limited, FOR limited when AX1 is not activated.
13.	REV always limited, FOR limited when AX2 is not activated.
14.	FOR always limited, REV limited when AX1 is not activated.
15.	FOR always limited, REV limited when AX2 is not activated.
16.	When AX1 is not activated, FOR motion limited, when AX2 is not activated, REV motion limited.

L20 NOT AVAILABLE

L20

L21

L21 VOLTAGE PEAK

Adjustable from 45Hz to 120Hz. The factory setting is 60Hz.

Sets the Frequency (speed) where full line voltage is output to the motor. This setting causes changes in the motors torque at frequencies near 60Hz. Caution should be used since this adjustment can cause the motors temperature to increase. 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).

If a motor with a voltage rating lower than the line voltage is to be used, then this setting should be adjusted to compensate. Contact the factory to determine the setting and limitations for your application.

L22

L22 NOT AVAILABLE

L23

L23 NOT AVAILABLE

L24

L24 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.

L25

L25 INITIAL BRAKE HOLD TIME

Adjustable from -5.0 to 2.0 seconds.

This value determines the amount of time the mechanical brake is held after a go signal (control button is pressed). The negative times close the brake contacts B1 and B2 before the motor is energized. This is helpful when the mechanical brake is slow. 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.

L26

L26 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.

L27

L27 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	The Micro-Speed® MD will reset
0	Only upon powering up drive.
1	When the FORward or REVerse input is toggled OFF-ON-OFF.
2	When AX1 is activated.

3 When AX2 is activated.
4 When AX1 is activated or when the FORward or REVerse input is toggled OFF-ON-OFF.
5 When AX2 is activated or when the FORward or REVerse input is toggled OFF-ON-OFF.

L28 AUXILIARY TRIP MODE

L28

Adjustable mode 0-8.
This variable assigns terminals AX1 or AX2 for an external trip circuit. When a fault condition is observed on terminal A1, the Micro-Speed® MD shuts down and the fault code F6 will be displayed. F7 will be displayed for terminal AX2. A fault condition will cause the Micro-Speed® MD to trip-out even if the motor is not being driven. Possible uses: overload on motor, limit switches.

A28	**The Micro-Speed® MD will trip**
0	Neither terminal is used.
1	When AX1 is energized.
2	When AX2 is energized.
3	When AX1 or 2 is energized
4	When AX1 is not energized.
5	When AX2 is not energized.
6	When AX1 or 2 is not energized.
7	When AX1 is connected to a normally closed external overload and unit is running.
8	When AX2 is connected to a normally closed external overload and unit is running.

L29 NOT AVAILABLE

L29

L30 ANALOG OFFSET

L30

Adjustable from 0.0 to 75.0% of potentiometer's range.
determines the voltage / current setting where the analog signal starts sensing. Example: With a pot. wired to the I1 terminal and this setting at 50%, the first 50% of the pot. will be ignored by the Micro-Speed® MD. This can easily be seen by viewing the diagnostic E7 and turning the pot.
Set to 20% when a 4-20 milliamp input is used.

L31 PULSE START BOOST

L31

Adjustable from 1% to 30% of line voltage
This memory location determines the amount of initial torque (initial voltage) that will be applied while starting the motor. This extra torque will be applied to the Start Frequency (L35) for the period of time set by L32 (Pulse Start Time). If this value is less than the Voltage Boost (A8) value, then A8's value will be used during the pulse start period.

L32 PULSE START TIME

L32

Adjustable from 0.0 to 2.0 seconds.
This memory location determines the amount of time that the pulse start boost and start frequency will be applied when starting the motor. A setting of 0 will disable these features. This feature is useful for breaking away "sticky" load brakes on hoists.
See Pulse Start Boost (L31) to set the initial torque value and Start frequency (L35) to set the initial speed.

L33

L33 DC INJECTION BRAKE BOOST

Adjustable from 1% to 30% of full line voltage
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. DC Injection Time (L34) to set the time duration of the DC injection.

L34

L34 DC INJECTION BRAKE TIME

Adjustable from 0.0 to 2.0 seconds.
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 DC Injection Brake Boost (L33) to set the holding torque value.

L35

L35 START FREQUENCY

Adjustable from 0.0 Hz to 10.0 Hz.
Sets a frequency that will be instantly applied to the motor. Instead of starting at 0 Hz and gradually accelerating to a desired speed, the motor will instantly attain this speed and gradually accelerate to a desired speed. Use along with L25 to eliminate load drop.

L36

L36 AUXILIARY 1 SPEED INPUT

Adjustable from 0 Hz to 120Hz.
Auxiliary terminals can be used to select additional speeds. When set to a value other than zero the AX1 terminal will act as an additional speed input terminal. The AX1 terminal takes priority over S2-S5 speed control inputs. Use to select up to seven individual speeds, depending on Operation Mode (see A9).

L37

L37 NOT AVAILABLE.

"U" PARAMETER DESCRIPTION

U0 CODE

U0

Adjustable from 0-999
Must enter in order to change the U variable setting. Press INC or DEC until code number is reached.

U1 RAMP DOWN TO STOP

U1

Adjustable : ON or OFF
Sets which set of gang sets are available. Sets L10 to 0 or 120 HZ.

ON When the forward or reverse control signal is not energized, the Micro-Speed® MD will perform a controlled deceleration to a stop and then set the mechanical brake. This mode can be used on HORIZONTAL motion, NEVER use 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.

U2 BASE FREQUENCY

U2

Adjustable from 25 – 120Hz
Set for the frequency rating of the motor. U2 determines the initial settings for the voltage peak, and high speed settings for Gang-Sets. (L21)

DIAGNOSING PROBLEMS

There are two key features in the Micro-Speed® MD 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 a problem arises, such as excessive current draw, the Micro-Speed® MD 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, 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 cannot 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. Following every fault code description, there is a listing of the possible causes and corrective measures that may be taken.

FAULTS

How the Micro-Speed® MD responds to a fault

When a fault occurs, five events will happen:

1. The Micro-Speed® MD will shut down.
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.

Resetting after a fault

The method by which the Micro-Speed® MD may be reset is determined by programming parameter L27. Usually, the Micro-Speed® MD is programmed to reset when the button on the pendant station is toggled (press-release). It may also be programmed to reset by activating an auxiliary terminal. No matter what L27 is programmed for, resetting of the Micro-Speed® MD can always be accomplished by turning off and then turning on the line power feeding the drive.

Remembering faults

The Micro-Speed® MD will remember the last four different 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.

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.

FAULT CODES

F0

F0 -- No fault

This value will be seen when checking the stored fault codes, if no fault was stored, or after the memory was cleared.

F1

F1 -- Current trip

Current has risen to over 300% of rated output current.

The CURRENT TRIP is the most common fault and has many causes. Observing how the Micro-Speed® MD and the machine it is driving act at the moment the fault occurs will help the user in diagnosing the cause of the fault. Note: Continued starting into a condition that causes F1's could damage the drive. 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 from the three motor leads -- this type motor should not be used with invertors unless the brake power leads can be brought out separately and powered from the line and not the drive.
Solution: Check motor and wiring, repair or replace if necessary.

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

4. Cause: Large current draw when accelerating. The voltage boost setting A8 may be too high and/or if the ramp down option is off, the pulse start boost setting (L31) may be too high.
Solution: Lower the setting.

5. Cause: The motor is slipping so excessively that torque is not efficiently produced. If the fault occurs while the motor is accelerating, then we suggest increasing the acceleration time AX1 (and AX2 if it is used). If increasing the time is unacceptable or does not work, try increasing the voltage boost. Increase it gradually in steps of about .5%. If raising the voltage boost helped but didn't completely solve the problem, try gradually lowing the voltage peak function (L21). 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. 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. 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 releasing 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, adjusting the voltage boost A8 and the voltage peak L21 functions may help. Try changing the voltage boost gradually by first increasing it's value 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 L8 is off, then one may try the pulse start option (L31 and L32) to jar the mechanism loose. Try setting L32 to .7 seconds and then gradually increase L31 until the drive trips out instantly, then back L31 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 L26 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® MD is signaled to begin powering the motor again. This effectively causes the Micro-Speed® MD to start into a spinning motor. Increase the dead time parameter L26 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 L26 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. Cause: The load is too large.
Solution: Reduce load or increase motor and drive capacity.

16. 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 cannot 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).

F3

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.

F4

F4 -- LOW BUSS VOLTAGE

The voltage across the main buss capacitors has dropped below a preset level. This fault is a normal occurrence every time power is remove from the Micro-Speed® MD. This fault is not save in the diagnostic memory E1-E4 since the Micro-Speed® MD will not operate while displaying F4 as long as the low voltage condition persists. This also saves the memory E1-E4 for other more severe fault codes.

1. Cause: If the Micro-Speed® MD has just been installed and this fault is displayed, the unit is probably set for use with a higher 3-phase line voltage than what it is presently wired to.
Solution: It may be possible to set "L9" to the desired line voltage, see "L" Locked Programmable Parameter, or replace with the proper voltage Micro-Speed® MD.
2. Cause: On Micro-Speed® MDs 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® MD 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.
3. Cause: Malfunction in Micro-Speed® MD.
Solution: Return the drive to the factory for repair.

F5

F5 -- OVER VOLTAGE TRIP

The voltage across the main buss capacitors has increased above a preset level.

1. Cause: If the Micro-Speed® MD has just been installed and this fault is displayed, the unit's L9 register most likely needs to be adjusted.
Solution: see "L" Locked Programmable Parameter
2. 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.

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

4. Cause: The external braking resistor may be wired wrong, 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 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.

F6

F6 -- AUXILIARY 1 (AX1) TRIP

Terminal A1 is indicating an external fault.

Cause: An external device (overload, limit switch, ect.) has tripped sending a signal to the AX1 terminal triggering the Micro-Speed® MD to fault out.
Solution: Determine reason for fault and repair if necessary. If fault occurs during installation, double check wiring and operation of attached devices also check that Auxiliary Trip Mode "L28" is set appropriately. The Micro-Speed® MD can be set to trip-out when power is removed or when power is applied to the auxiliary terminal.

F7

F7 -- AUXILIARY 2 (AX2) TRIP

Terminal A2 is indicating an external fault.

Cause: An external device (overload, limit switch, ect.) has tripped sending a signal to the AX2 terminal triggering the Micro-Speed® MD to fault out.
Solution: Determine reason for fault and repair if necessary. If fault occurs during installation, double check wiring and operation of attached devices also check that Auxiliary Trip Mode "L28" is set appropriately. The Micro-Speed® MD can be set to trip-out when power is removed or when power is applied to the auxiliary terminal.

F8

F8 -- "A" PARAMETERS OUT OF SPEC.

Memory used by Micro-Speed® MD has lost data.
Try reprogramming the "A" parameters individually or by a Gang-set®, else return to factory for repair.

F9

F9 -- CPU ERROR

Failure of CPU
Solution: Return unit to factory for repair.

F10

F10 -- MEMORY ERROR

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

F11

F11 -- TIMER

Motor has run for a time longer than that allotted by the timer L24

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 L24 to zero.
3. Cause: Timer set for too short of a period.
Solution: Increase time set in L24.

DIAGNOSTIC "E" VARIABLES

The Micro-Speed® MD 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.

Accessing an "E" diagnostic memory location

To view or operate a diagnostic feature:

1. Make sure the Micro-Speed® MD 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® MD. First a "-d-" will appear in a few second 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 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 will be displayed.

"E" PARAMETERS

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

Diagnostic memory location E1

E1 LAST FAULT--This memory location stores the fault code of last fault that occurred and the number of times it occured. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

Diagnostic memory location E2

E2 SECOND TO LAST FAULT--This memory location stores the fault code of second to last fault that occurred and the number of times it occured. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

Diagnostic memory location E3

E3 THIRD TO LAST FAULT--This memory location stores the fault code of third to last fault that occurred and the number of times it occured. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

Diagnostic memory location E4

E4 FORTH TO LAST FAULT--This memory location stores the fault code of forth to last fault that occurred and the number of times it occured. An F0 displayed means this memory location is clear, no fault is recorded. See memory location E11 to clear.

Diagnostic memory location E5

E5 NOT USED

Diagnostic memory location E6

NOT USED

E6

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.

E7

Diagnostic memory location E8

INPUT CIRCUIT TEST.
This diagnostic variable helps check if the control circuitry is correctly wired to the Micro-Speed® MD. 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: A1, A2, FORward, REVerse, S2, S3, S4, AND S5.

E8

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.

E9

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® MD is tripped out and hasn't yet been reset, this variable cannot be viewed or operated.

E10

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".

E11

GLOSSARY

Acceleration rate:
This is the exact amount of time it will take to change the frequency 60 Hz. An acceleration rate of 8 seconds means it will take 8 seconds to go from 0 Hz to 60 Hz.

Analog Input:
The three Micro-Speed® MD terminals marked "0V", "I1" , "+5" to which a potentiometer or other device may be connected.

Buck boost:
A way of increasing the line voltage. This is done using transformers wired in such a way that the output is a higher voltage than the line voltage.

Buck down:
A way of decreasing the line voltage. This is done using transformers wired in such a way that the output is a lower voltage than the line voltage. The schematic shows a 3-phase 575 VAC to 460 VAC buck down configuration. This buck down circuit is necessary to operating a Micro-Speed® MD from a 575 VAC line.

Branch protected:
Each branch of the electrical circuit controls a different motion, or motor. Each of these branches has its own set of fuses protecting just that motion. If the fuses of one branch should blow, the other motions on the other branches will continue to operate. This is refereed to as "Branch Circuit Protecting".

Coast Down “cOFF”:
When the Micro-Speed® MD is set to coast mode, power to the motor is cut off as soon as the pendent button is released. This allows the motor to coast freely until it stops. Normal, an electro-mechanical brake would engage, stopping the motor instantly.

DC Injection:
A method of applying DC voltage to a motor, causing the motor not to turn easily.

Deceleration rate:
This is the exact amount of time it will take to change the frequency 60 Hz. A deceleration rate of 8 seconds means it will take 8 seconds to go from 60 Hz to 0 Hz.

Gang-Set™:
A set of redefined A and L register values which can be loaded into the Micro-Speed® MD easily and quickly. These Gang-Sets are designed to be general starting points for specific applications. The technician can “go back” to standard settings with a few pushes of the buttons. Gang-Set TM is a trademark of Power Electronics International Inc.

Hz.:
Abbreviation for Hertz. Hz. is a unit of measure for frequency. A motor's speed in Rotations Per Minute is related to Frequency. The motor's information plate will show the R.P.M. for the motor's line frequency. A typical 60 Hz. motor runs at approximately 1800 R.P.M. Dividing the R.P.M. by the Hz. will tell you the R.P.M. for one Hz. For the typical motor described, the motor's speed, for every one Hz., will be approximately 30 R.P.M. If the Micro-Speed® MD were to drive this motor at 10 Hz. the motor would be turning at 300 R.P.M. (30 R.P.M. x 10 Hz.).

Input Inductor:
Device placed on power line before entering the Micro-Speed® MD. Input inductors are used to filter out line noise from the incoming power source.

Isolation Transformer:
A transformer used to isolate and filter excessive noise from the power lines. Also, these transformers keep line voltage at a constant level.

Load Drop:
Undesirable fall, usually less than a few inches, of the load being hoisted. Happens when hoisting operation

first starts. Caused because the mechanical brake releases before the motor builds up enough torque to hold or move the load. Solution: Set brake hold time (L25) longer.

N.C.:
A switch or relay which is normally in the "ON" position (closed) unless acted upon.

N.O.:
A switch or relay which is normally in the "OFF" position (open) unless acted upon.

Nominal:
Ideal value

Ohms:
A unit of measure for resistance. Resistance being an object's ability to reduce the flow of electricity. Resistors and potentiometers are measured in ohms.

Poke:
Momentarily pressing a button.

Potentiometer:
Sometimes refereed to as a "POT", this is a variable resistor. Rated in Ohms, potentiometers normally are adjustable from 0 Ohms resistance to their maximum rating. For the analog input of the MicroSpeed® MD, a 1 KOhm potentiometer may be used.

Ramp “rOFF”:
When the Micro-Speed® MD is set to ramp down mode, the output frequency driving the motor is reduced until reaching 0 Hz. A mechanical brake is then set.

Resistor:
Electronic device which resists the flow of electricity, thus generating heat. A resistor's value is measured in ohms and watts.

Watts:
The amount of power(heat) which a resistor can safely dissipate.
Watts = Amps x Volts.

GANG SET™ REFERENCE CHART

			Bridge / Trolley Motion				Hoist Motion			
			Pb01	Pb02	Pb03	Pb04	Ph05	Ph06	Ph07	Ph08
A	**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 speed-pot.**	**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	6.0	6.0	6.0	4.0	4.0	4.0	4.0
A3	Accel mode	0,1,2,3,4,5	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 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used
A6	Decel 3 Reverse Plug	0.1-30sec	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used	30 Not Used
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	0,1,2,3,4,5 ,6,7	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	n/a									
A12	Low speed (F,R)	1- 120Hz	U2	3.0	3.0	3.0	3.0	3.0	3.0	3.0
A13	Speed 2 - S2	1- 120Hz	U2	U2	U2	10.0	U2	10.0	10.0	U2
A14	n/a									
A15	n/a									
A16	Speed 5 - S5	1- 120Hz	U2	U2	U2	U2	U2	U2	U2	U2
A17	Analog upper limit (pot.)	1- 120Hz	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0

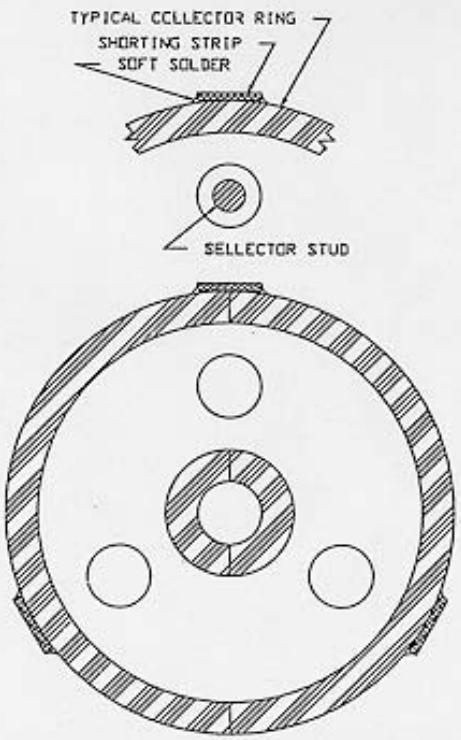
"L" AND "U" PARAMETER REFERENCE CHART

L0	Code	0-999	Default Setting	Description
L1	Accel lower limit	0.1-30.0 sec	0.1	Sets and locks range of acceleration variables (A1 & A2). Limits the quickest acceleration the user can set, this being the shortest time from 0 to 60 Hz.
L2	Accel upper limit	0.1-30.0 sec	30.0	Sets and locks range of acceleration variables (A1 & A2). Limits the slowest acceleration the user can set, this being the longest time from 0 to 60 Hz.
L3	Decel lower limit	0.1-30.0 sec	0.1	Sets and locks range of deceleration variables (A4 & A6). Limits the quickest deceleration the user can set, this being the shortest time from 60 to 0 Hz.
L4	Decel upper limit	0.1-30.0 sec	30.0	Sets and locks range of acceleration variables (A4 & A6). Limits the slowest deceleration the user can set, this being the longest time from 60 to 0 Hz.
L5	Speed upper limit	1.0-120Hz	U2	Sets and locks maximum range of the speed variables (A12 & A18). This value is the highest speed the user can set the Micro-Speed to go. V
L6	AX limit switch mode	0,1,2	0.0	When not energized: AX 1 stops FOR motion, AX 2 stops REV motion. 0 No limit switches. 1 Ramp gently to a stop. Distance required to stop will depend on speed and A4-A7. Can't be used if L8 is off. 2 Coast to a stop. Mechanical break will stop motion instantly.
L7	Limit switch decel time	0.1-30.0 sec	5.0	If L6 is set to 1, this value may control the deceleration rate when an AX is not energized. This deceleration is independent of any other values, it can be greater or less than any of the other deceleration values. Programming a Gang-set will not change this setting.
L8	N/A	N/A	See U1	N/A
L9	Line Voltage	230, 460, 510	Name Plate	The value displayed represents the A.C. line voltage required for the Micro-Speed® CX to operate.
L10	Cut off Frequency	0.0-120.0 Hz	U1 off = 120 U1 on = 0	Determines the Frequency below which the drive turns off when a direction signal is not present. The drive will ramp down to this frequency and then turn off.
L11	Quick Stop upper limit	0.1-30.0 sec	U1 off = 1.5 U1 on = 30.0	Sets the maximum ramp for any ramp to stop function. Drive uses A5 or L11 (whichever is set lower)
L12	Parameter	Loc, Unl	Unl	
L13	Aux Relay Function	0-5	0	0 = Fault indicator (default & excising) 1 = Inverse Fault (fail safe) 2 = Drive Ready 3 = Run Signal 4 = at speed 5 = at 0 speed
L14	N/A	N/A		N/A
L15	N/A	N/A		N/A
L16	N/A	N/A		N/A
L17	N/A	N/A		N/A
L18	Max Hz	1- 120Hz	U2	Used only with AX signals. When specified AX is activated, any speed selected above this

L19	Max Hz enforce mode	0,1,2	0	0 Never. 1 When AX 1 is energized 2 When AX 2 is energized 3 When AX 1 is not energized 4 When AX 2 is not energized 5 Always 6 Always only FOR 7 Always only REV 8 When AX 1 is not energized, only FOR motion limited 9 When AX 2 is not energized, only FOR motion limited 10 When AX 1 is not energized, only REV motion limited 11 When AX 2 is not energized, only REV motion limited 12 REV always limited, FOR limited when AX 1 is not energized 13 REV always limited, FOR limited when AX 2 is not energized 14 FOR always limited, REV limited when AX 1 is not energized 15 FOR always limited, REV limited when AX 2 is not energized 16 When AX 1 is not energized, FOR motion limited, when AX2 is not energized, REV motion is limited
L20	N/A	N/A		N/A
L21	Volt peak	30-120Hz	U2	Makes other voltage motors usable with 460VAC line. Special use for motors with inherent excess slip.
L22	N/A	N/A		N/A
L23	N/A	N/A		N/A
L24	Timer	0-600 sec	0	Doesn't allow motor to be run for an amount of time greater, without stopping 0 = No time limit (disabled)
L25	Brake Hold Time	0.0-2.0 sec	U1 off = .2 U1 on = 0.0	Amount of time mechanical brake is held after go signal. (Use: Hoisting app. stops load drop after go signal)
L26	Dead Time	-5.0 to 5.0 sec	U1 off = -0.1 U1 on = 0.0	Once stopped this amount of time must pass before drive will respond to go signal. -- = rev. plug not allowed. (Reduces chance of F1)
L27	Reset mode	0,1,2,3,4,5	1	0 Only upon powering up drive. 1 When the forward or reverse is toggled off-on-off. 2 When AX 1 is energized. 3 When AX 2 is energized. 4 When AX 1 is energized or when the forward input is toggled off-on-off. Or reverse input is toggled off-on-off 5 When AX 2 is energized or when the forward or reverse input is toggled off-on-off.
L28	Trip MODE	0 to 8	0	Sets operation of AX terminals for tripout (F6 and F7). Use: overload, limit switch, etc. 0 Neither used. 1 When AX1 is energized. 2. When AX 2 is energized 3. When AX 1 or 2 is energized 4 When AX 1 is not energized. 5 When AX 2 is not energized. 6 When AX 1 or 2 is not energized. 7 When AX 1 is connected to a normally closed external overload and unit is running. 8 When AX 2 is connected to a normally closed external overload and unit is running.

L29	**N/A**	**N/A**		**N/A**
L30	Analog Offset	0 to 75 %	0.0	Adjusts analog input. Sets % of signal not used. Uses: If 4-20mA signal is used set to 20% (also set jumper to 20).
L31	Pulse Start Voltage	1 to 30% line VAC	1.0	Determines the amount of extra torque that will be applied to the motor for the amount of time determined by A32 and during the break hold time A25. This additional torque will be applied to the start frequency.
L32	Pulse Start Time	0 to 2 seconds	0.0	Determines the amount of time that the Initial Speed (A35) will be applied to motor before accelerating from a stop.
L33	D.C. Injection Brake Voltage	1 to 30% line VAC	1.0	DC Injection: Determines amount of DC current (holding torque) applied to the motor after ramping down to 0 Hz.
L34	D.C. Injection Time	0 to 2 seconds	1.0	DC Injection: Determines the length of time that a DC (holding) current will be applied to the motor after ramping down to 0 Hz but before applying the brake. Produces a smooth stop for large to small loads.
L35	Drive Starting Hz	0 to 10 Hz	U1 off = 3.0 U1 on = 0.0	Sets a frequency that will be instantly applied to the motor, instead of starting at 0 Hz and gradually accelerating to speed, the motor will instantly attain this speed and gradually accelerate to the desired speed. Use along with A25 to eliminate load drop.
L36	AX1 MODE	0 = off OR 0.1 to 120 Hz	0.0	AX terminals can be used to select additional speeds, AX 1 terminal can act as an S6 terminal and the AX 2 terminal can act as an S7 terminal. AX terminals takes priority over S2-S5 speed control inputs, intended use with limit switches to limit speed near end of motion.
L37	n/a			
U				
U0	Code	0-999		Must enter in order to change U variable setting. Press INC or DEC until code number is reached
U1	Ramp/ Coast Mode	on, off	On for Bridge Off for Hoist	Enables or Disables the Ramp to a stop and Coast to a stop in one function.
U2	Base Frequency	25-120 Hz	60.0	This sets the voltage peak, and high speed

Method for modification of a Wound Rotor motor for use with Micro-speed/Power-speed variable speed a.c. crane drives



Above figure show a cross-section of rotor assembly. Note position of collector studs and position of the shorting strips in order to obtain a balanced rotor.

1. Remove end shield with brush rigging
2. Remove Brush rigging and brush holder studs
3. Move rotor assembly to a maintenance area for modification.
4. Prepare 3 Copper or Brass strips with a cross-section of about 1/16" x 1/2". Long enough to span all 3 collector rings. These shall be all the same size.....
5. Carefully SOFT solder these 3 collector rings spaced every 120 degrees in the same area as the collector ring studs. Apply heat to the collector ring until the solder flows along the shorting strip.
6. Be careful to use the SAME amount of solder or braze at all 9 points to keep from unbalancing the rotor assembly.
7. Carefully reassemble the rotor and endshield (less the brush holders, brushes, and studs).
8. Tape up ends of old, now unused (M) leads, on both ends or remove them entirely.

It is NOT advisable to short the brush assembly out to accomplish squirrel cage motor like use. The brushes will arc and destroy the variable speed drive. Any warranty of the drive will be voided. It is also advisable to be conservative or oversize when choosing a drive (amperage) since many wound rotor motors have been re-wound and the nameplate information (Primary amps) may not be correct.....

Locking and Unlocking the Micro-Speed CX Version 2.1 requires a code to be entered either in the U0 or L0 parameters. This code is **369**. You can enter this code by pressing and holding the increase button until the number displayed scrolls up to **369**, if you go past this number you can press the decrease button to adjust. Enter the code when you are at the correct parameter either U0 or L0.