BLM SERIES

DART CONTROLS

Instruction Manual

PROGRAMMABLE DIGITAL "CLOSED LOOP" MOTOR SPEED CONTROL SYSTEM FOR BRUSHLESS MOTORS



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Quick Jump

Looking for Programming Parameters?
See pages 18 - 34.

Looking for detailed specifications?
See page 38.

Want to get started fast?
See basic electrical hook-up details on page 5.
See mechanical installation details on page 4.
See some sample applications starting on page 35.

Need Help?
See troubleshooting on page 37.

Warranty

Dart Controls, Inc. (DCI) warrants its products to be free from defects in material and workmanship. The exclusive remedy for this warranty is DCI factory replacement of any part or parts of such product which shall within 12 months after delivery to the purchaser be returned to DCI factory with all transportation charges prepaid and which DCI determines to its satisfaction to be defective. This warranty shall not extend to defects in assembly by other than DCI or to any article which has been repaired or altered by other than DCI or to any article which DCI determines has been subjected to improper use. DCI assumes no responsibility for the design characteristics of any unit or its operation in any circuit or assembly. This warranty is in lieu of all other warranties, express or implied; all other liabilities or obligations on the part of DCI, including consequential damages, are hereby expressly excluded.

NOTE: Carefully check the control for shipping damage. Report any damage to the carrier immediately. Do not attempt to operate the drive if visible damage is evident to either the circuit or to the electronic components.

All information contained in this manual is intended to be correct, however information and data in this manual are subject to change without notice. DCI makes no warranty of any kind with regard to this information or data. Further, DCI is not responsible for any omissions or errors or consequential damage caused by the user of the product. DCI reserves the right to make manufacturing changes which may not be included in this manual.

WARNING

Improper installation or operation of this control may cause injury to personnel or control failure. The control must be installed in accordance with local, state, and national safety codes. Make certain that the power supply is disconnected before attempting to service or remove any components!!! If the power disconnect point is out of sight, lock it in disconnected position and tag to prevent unexpected application of power. Only a qualified electrician or service personnel should perform any electrical troubleshooting or maintenance. At no time should circuit continuity be checked by shorting terminals with a screwdriver or other metal device.

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Introduction

The Brushless Micro-Drive motor control is a compact, microprocessor-based unit capable of being either field or factory configured for a number of industry's motion control needs. The control is designed around a velocity form PID algorithm. The Brushless Micro-Drive is easily configured to operate as a digital speed controller and time-based process controller. The Brushless Micro-Drive is ideal for volume OEM Adjustable Speed Control applications. Contact Dart Controls' Sales Department for details.

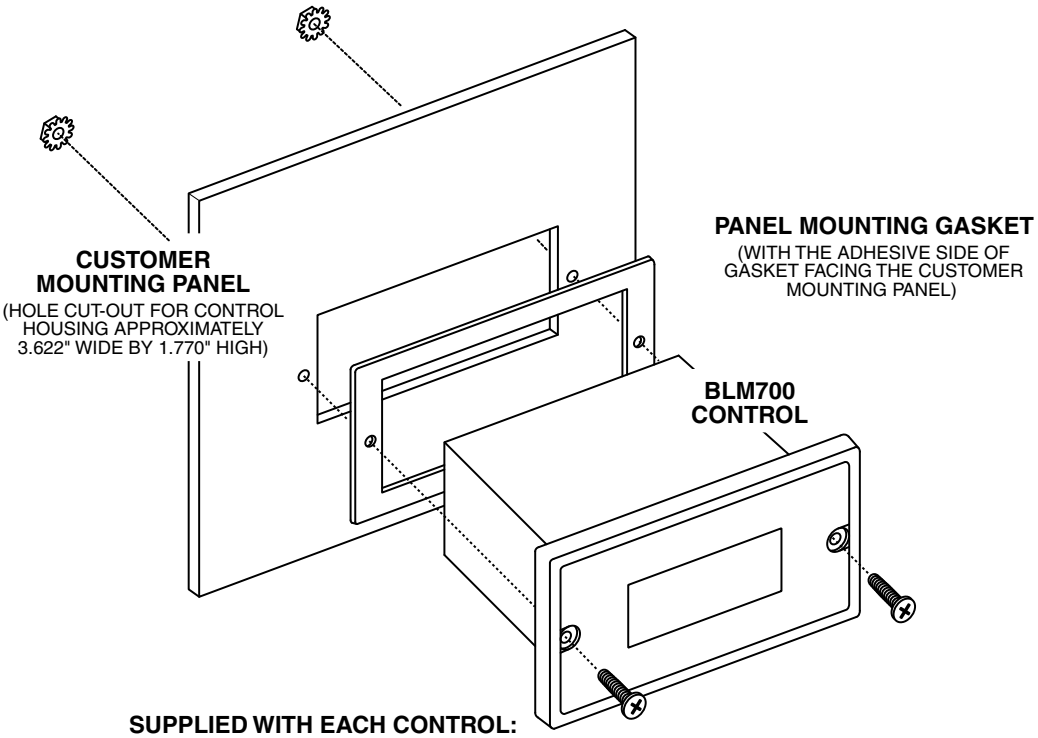
The Brushless Micro-Drive's durable 1/8 DIN NEMA 4X aluminum housing can be easily mounted in a panel or control cabinet. The new pluggable terminal block allows the user to quickly install or replace units without the hassle of physically removing and reattaching wires.

General Features

- Microprocessor-based design allows for incredible flexibility to suit process control needs
- ModularBus expansion makes it possible for the BLM to accomodate a wide variety of I/O
- Digital closed-loop algorithm ensures accuracy of $\pm$1/2 RPM of set speed or equivalent
- Non-volatile memory stores settings without batteries, even when power has been removed
- Factory or field programmable via front-panel keypad
- Many adjustable settings include min, max, accel, decel, display options, and more
- Internal program-enable jumper selectively prevents tampering with unit’s configuration
- Power supply input accepts 12 or 24-48VDC (Jumper selectable).
- Transient voltage protection prolongs unit's life in harsh industrial environments
- Self-contained power supply for external speed pickups, limited to 5V @ 50mA
- One separate programmable alarm output with Form C contacts (second alarm with -420 option)
- Flexible user inputs support Inhibit, Emergency-Stop, and Jog functionality
- Large 4 digit, 1/2” LED display, with user-settable decimal point (colon displayed in Time mode)
- Durable NEMA 4X rated aluminum housing with Polycarbonate membrane and gasket (which are included) meet NEMA 4X standards when used with NEMA 4X enclosures
- Wide operating ambient temperature range of -10°C to 45°C (14°F to 113°F)
- Multiple operating modes are available in closed-loop operation, including:
    - Rate Mode – Controls in rate unit such as RPM, Gallons per Minute, etc.
    - Time Mode – Controls in time unit such as HH:MM, MM:SS, SS:TT, or other unit
- 60^{o} or 120^{o} Hall Sensor spacing is jumper selectable
- Forward or Reverse rotation of motor is jumper selectable

Installation and Mechanical Dimensions

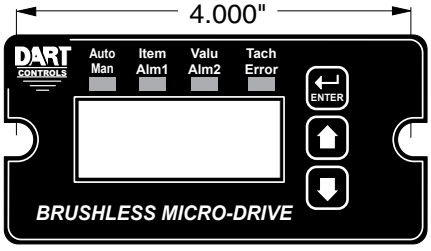
Exploded Panel View

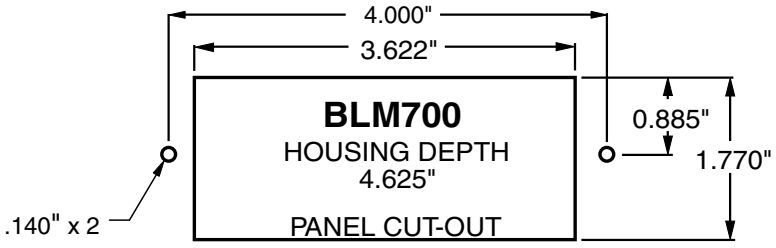


SUPPLIED WITH EACH CONTROL:

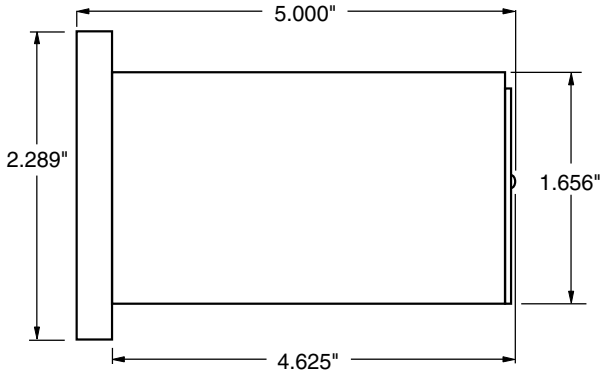
1) GASKET
2) (2) 6-32 X 3/4 PANHEAD BLACK OXIDE STAINLESS SCREWS
3) (2) #6 NUT WITH LOCKWASHER

Cut-out and Mounting Dimensions



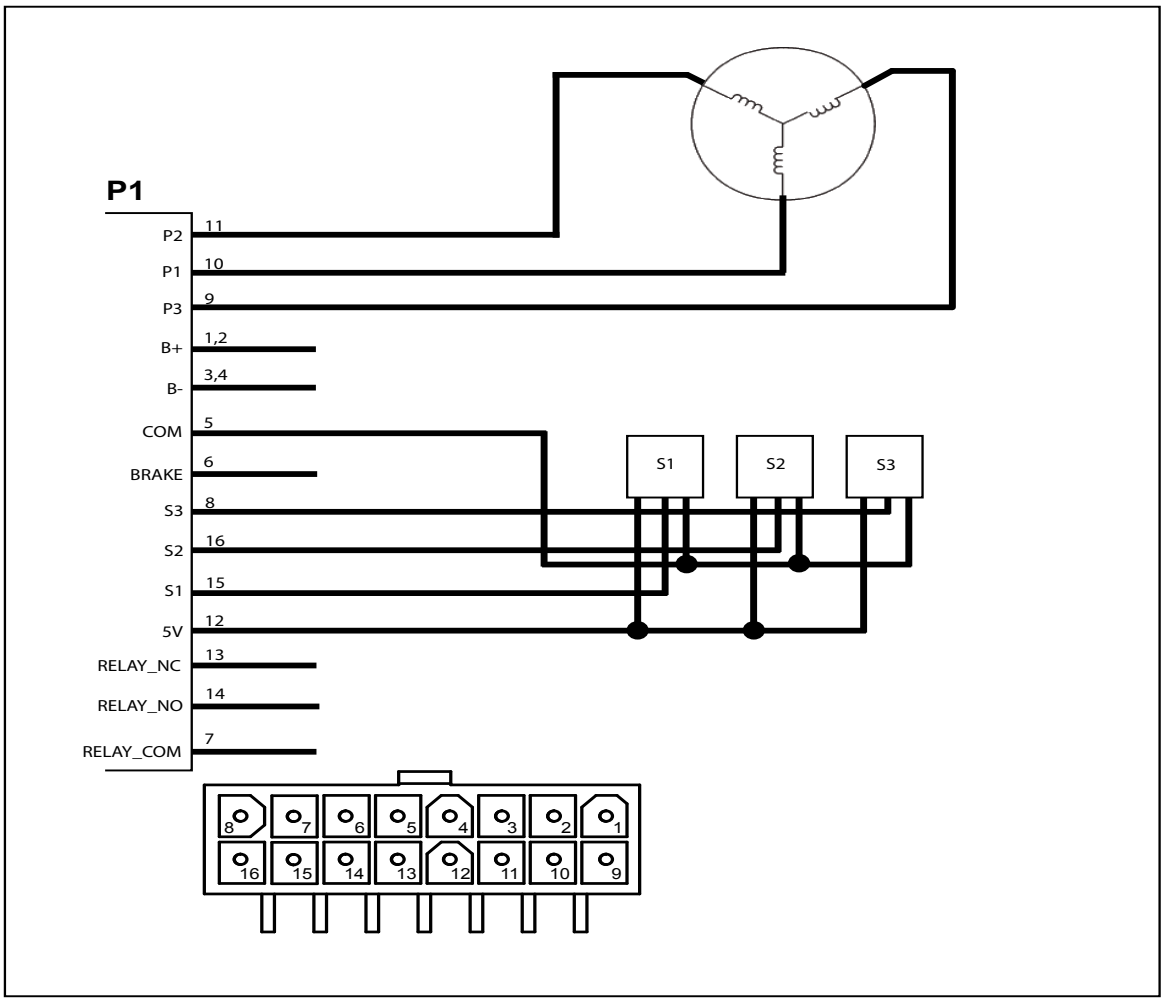


BLM700 Dimensions



Electrical Installation & Diagrams

P1 Terminal Block Hook-Up Diagrams



P1 Terminal Block Descriptions

P1-1&2 (B+) - The Positive input from an external DC power supply.

P1-3&4 (B-) - The Negative input from an external DC power supply.

P1-5 (COM) - This is the common terminal. The speed sensor common lead as well as any other source needing to reference the control common will be connected to this terminal.

P1-6 (BRAKE) - This is the Remote Input Brake terminal. When this terminal is connected to common, the motor will stop.

P1-7 (RELAY_COM) – Relay common contact.

P1-8 (S3) – This is the Sensor 3 input from the motor.

P1-9 (P3) – Phase 3 of the motor is connected to this terminal.

P1-10 (P1) - Phase 1 of the motor is connected to this terminal.

P1-11 (P2) – Phase 2 of the motor is connected to this terminal.

P1-12 (+5V) – This is a self-contained +5VDC power supply capable of up to 50mA. The speed sensor supply lead can be connected to this terminal for its power source.

P1-13 (RELAY_NC) – Relay normally closed contact.

P1-14 (RELAY_NO) – Relay normally open contact.

P1-15 (S1) – This is the Sensor 1 input from the motor.

P1-16 (S2) – This is the Sensor 2 input from the motor.

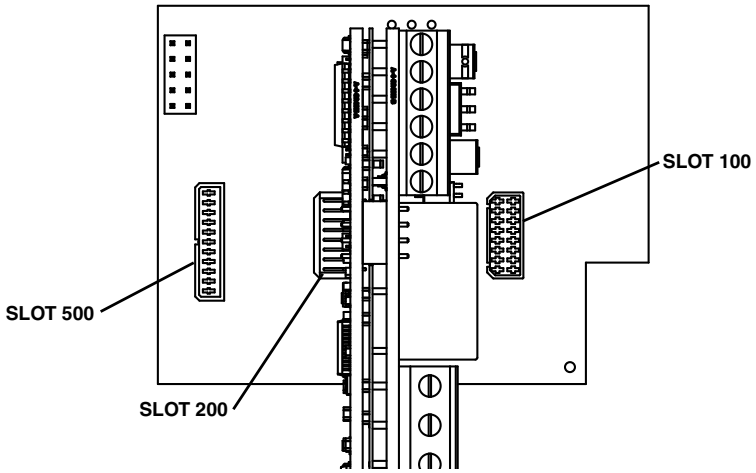
OPT420 Installation & Diagrams

Installing the OPT420 in Slot 200 (ONLY!) of the Host Drive

The OPT420 is a Dart ModularBus "option card" featuring an Optically-Isolated 4-20mA Current Loop Input and an Optically-Isolated 4-20mA Current Loop Output. Both the input and output are Optically-Isolated from the Host Drive, circuit common, earth ground, and from each other. In addition, a non-isolated SPST switch input is provided. In the typical application with a BLM, that switch is used to determine where the Host Drive gets its "Target Speed" setting from. Additionally, the BLM701P-420 has an "Auto/Manual" LED Annunciator which displays whether the source of the Target Setting comes from the 4-20mA input ("Auto") or from the "front panel" Target setting ("Manual").

In "Manual Mode", the Host Drive uses its normal Front Panel display and Up/Down buttons to set the Target Speed (or Time). However, in "Auto Mode", the Host Drive follows the OPT420's 4-20mA Current Loop signal. In either mode, the OPT420's Current Loop Output provides a real-time updating 4-20mA signal that represents the Host Drive motor's Actual (Tach) Speed. This is primarily used by a SCADA system to provide "feedback" that the SCADA's speed setting was received and acted upon by the Host Drive.

OPT 420 INSTALLATION



IMPORTANT: THE OPT420 MAY ONLY BE INSTALLED IN MODULARBUS SLOT "200". Installing in any other slot will simply result in the OPT420 "not working". Normal operation will resume when the OPT420 is placed in the Host Drive's ModularBus Slot "200".

Also, the OPT420 comes with Default Values that should allow a simple checkout procedure to verify that everything is hooked-up correctly and functioning. See the OPT420 Item (Parameter) Table for further details.

When the OPT420 is first installed, the following message will appear on the display.

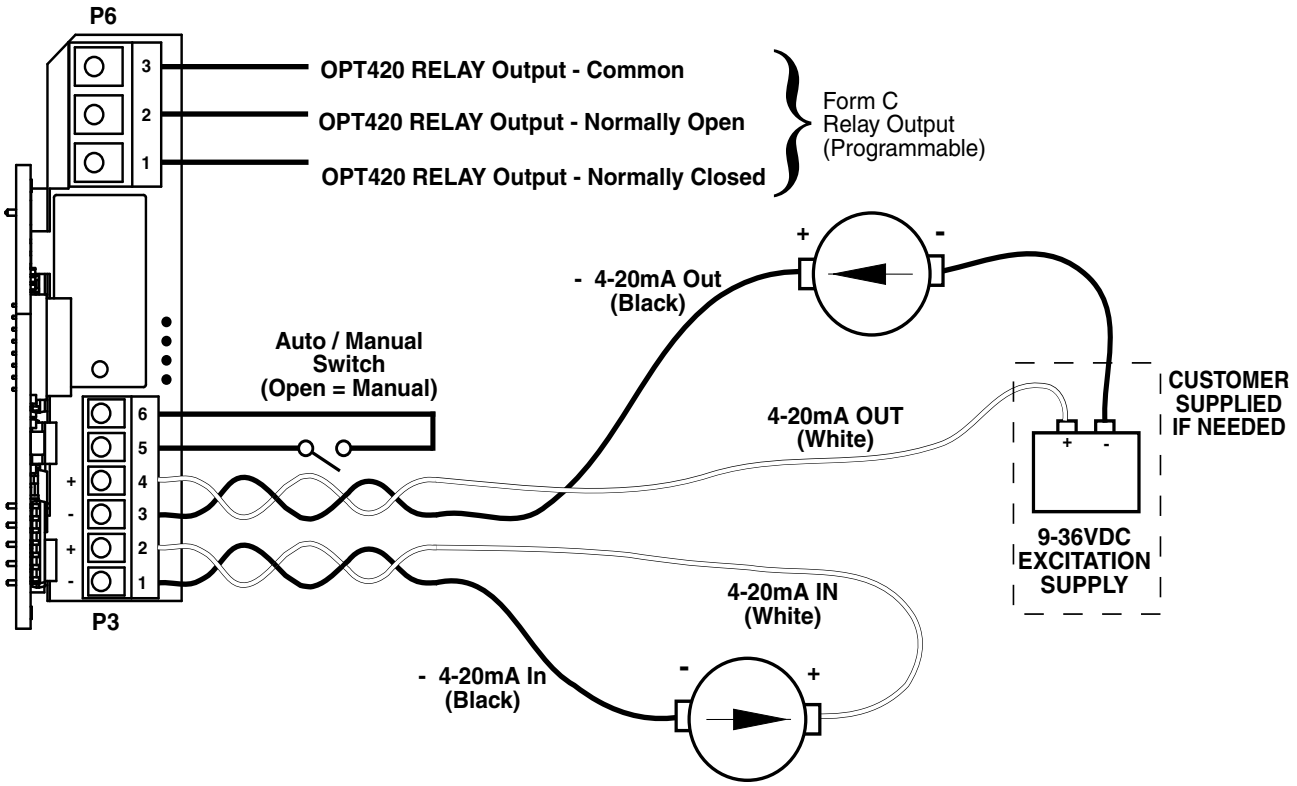
> Configuration Change--Card in slot is different than stored configuration--Up button to store factory defaults...dn button to ignore card.

If the up button is pushed, the factory settings will be installed and the card will be initialized. If the down button is pushed, the factory settings will NOT be installed and the card will NOT be initialized.

OPT420 P3 & P6 Terminal Block Hook-Up Diagrams

IMPORTANT: THE OPT420 DOES NOT SUPPLY LOOP "EXCITATION VOLTAGE". If the flowmeter, SCADA system, etc. does not have a Loop Excitation supply, an external voltage must be provided from +9 to +36VDC capable of at least 50mA for each of the two 4-20mA Current Loops (Input and Output), as shown in the diagram below. Additionally, if the Input and Output must be isolated from each other, two excitation supplies may be needed.

OPT 420 HOOK-UP DIAGRAM (TYPICAL)



OPT420 P3 Terminal Block Descriptions

P3-1 (- 4-20mA Input) – Connect this terminal to the next 4-20mA device in the loop, or, if the OPT420 is the last device in the current loop, then connect this terminal to the - (negative) side of the current loop.

P3-2 (+ 4-20mA Input) –Connect this terminal to the previous 4-20mA device in the loop, or, if the OPT420 is the first device in the current loop, then connect this terminal to the + (positive) side of the current loop.

P3-3 (- 4-20mA Output) – Connect this terminal to the next 4-20mA device in the loop, or, if the OPT420 is the last device in the current loop, then connect this terminal to the - (negative) side of the current loop.

P3-4 (+ 4-20mA Output) –Connect this terminal to the previous 4-20mA device in the loop, or, if the OPT420 is the first device in the current loop, then connect this terminal to the + (positive) side of the current loop.

P3-5 (S1 Input) – Connect this terminal to one side of a SPST switch to control Auto/Manual Operation. If switch is OPEN (or unconnected), BLM701P-420 Target Speed will come from its Target Speed setting (as usual), if the switch is CLOSED, BLM701P-420 Target Speed will follow the OPT420 4-20mA Current Loop Input. This signal is internally "pulled-up" via a 15K ohm resistor.

P3-6 (COM) – This is the common point for the control logic. Normally, the other side of the SPST Auto/Manual switch would be connected to this terminal. **Note that this means that the Auto/ Manual switch is NOT "isolated".**

OPT420 P6 Terminal Block Descriptions

P6-1 (NC) – This is the normally-closed contact of the user-assignable OPT420 Alarm 1 relay.

P6-2 (NO) – This is the normally-open contact of the user-assignable OPT420 Alarm 1relay.

P6-3 (C) – This is the common contact of the user-assignable OPT420 Alarm 1 relay.

Hook-up Overview

Brushless DC motors have eight (8) wires: three (3) armature (phase) wires, three (3) motor sensor wires, and two (2) wires for sensor power and sensor common. BLDC motors come with one of two sensor configurations, 60 or 120 degrees.

All BLDC motors, no matter what the hook-up status, are connected to the BLM700 control as shown in the hook-up diagram.

The power should be off until the hook-up procedure is complete.

12V/24-48VDC Voltage Jumper

There is a jumper on the bottom PCB of the control for different DC input voltage settings. This jumper is used with a 3 pin header, JP1. If the DC supply voltage is nominally 12VDC, place this jumper in the 2 pins of JP1 that are close to the "12V" position. If the DC supply is greater than 20V, but less than 50V, place the jumper close to the "24/48V" position.

60°/120° Sensor Spacing Jumper

There is a jumper on the control to switch between 60° and 120° hall sensor spacings. This jumper is used with a 3 pin header, JP2. Place this jumper in the 2 pins of JP2 that are close to "60" position for 60° operation, or in the 2 pins of JP2 that are close to "120" position for 120° operation.

FWD/REV Jumper

There is a jumper on the bottom board of the control for reversing the direction of the motor. This jumper is used with a 3 pin header, JP3. After initial turn on of the motor, if the motor shaft is rotating in the wrong direction, stop the motor and change the location of the jumper to the other unused jumper pin and center pin of JP3.

Hook-up Procedure for Motors With Timing Diagrams

It is prudent that when first testing the motor a DC ammeter be placed in series with the DC source. Zero to twenty amperes is fine (an analog movement is preferable).

Most manufacturers of BLDC motors send timing diagrams with their product. These diagrams show the sequencing of the Hall sensor outputs as related to the three motor phases. See pages 24 & 25. The Hall sensor sequencing is very useful, but since everyone has a slightly different way of notating the same information, deciphering the motor phases is typically quite confusing. The recommended procedure is to hook up the sensors according to their diagrams, then test for the proper motor phases. The current limit circuitry will protect the control from miswired phases.

First, determine the spacing of the motor Hall sensors. They will either be 60 or 120 degrees. Usually the motor manufacturer will supply the spacing. If they don't, compare the sensor diagram sent with the motor with those at the end of this manual. Observe that 60 degree spacing will, at some position, have all sensor lines at logic high. With 120 degree spacing, all three sensors are never at the same logic level at the same time.

Once the spacing is determined, return to the section "60°/120° Sensor Spacing" (page 5) and make sure the control is set correctly. Return to the correct wiring diagram and connect the sensors to terminals S3, S2 and S1 of P1. Notice that for the 60 degree spacing there is a specific sensor line that leads the sequence, followed by a line lagging by 60 degrees, and a third line lagging the second by 60 degrees. It is important that the middle line in the train be connected to terminal S2 of P1.

After the sensors are connected, attach the sensor power line to terminal 5V of P1. The sensor common line is connected to terminal COM of P1. Now attach the three motor armature wires and test for proper hook-up.

We recommend arbitrarily attaching the phase lines to terminals P1, P2, and P3 of connector P1. Choose a configuration, test it, and then keep track of the results on paper.

Now apply power to the control. Slowly increase the speed setting by pressing the "UP" arrow. Watch for erratic rotation or excessive source current. If either occurs, immediately press the "DOWN" arrow to reduce speed, and turn off the power. Try a new phase line configuration, apply power and test again. There are six (6) different combinations for connecting the three phase lines to the control. One of them will work. The correct combination will allow smooth rotation of the motor, and the lowest current draw from the DC source.

Hook-up Procedure for Motors Without Timing Diagrams

If the BLDC motor has no timing diagram, it is possible, with a little patience, to sort out the various leads and operate it with the BLM700 control. Find a voltmeter that will read a 5 volt logic level.

First, separate the three motor armature wires from the sensor wires. Armature wires are usually a heavier gauge wire. Once the armature wires are found, check them by measuring the resistance between any two. The resistance should be low, under 100 ohms, and be the same across any two of the three wires. The remaining five wires are the three sensors, sensor power, and sensor common. To find the power and common, look for color and gauge differences. If all else fails, call the motor manufacturer. Once the sensor power leads have been located, the remaining three leads will be the Hall sensors. Now construct a timing diagram using the sensor lines. First, connect the motor to the control, but leave off the three motor armature wires. Don't worry about sensor spacing at this time. Next, connect the voltmeter to any sensor lead. Reference the meter to terminal COM of P1. Apply power and slowly rotate the motor shaft by hand. The meter should move from 0 to ≈ 5 volts as the Hall sensor switches. Check the other two sensors for switching.

Now, compare each sensor against the others and draw a timing diagram. The motor can now be hooked up with this new information using the procedure for motors with timing diagrams.

Adjustments

Current Limit

Dart has factory set the Current Limit to 125% of 8.0 Amps DC. The setting should not need to be increased. If the current limit needs to be set to a lower value, do so by adjusting the Current Limit trimpot (CL) CCW until the desired setting is achieved.

Setting Current Limit

Current Limit should normally be set to approximately 125% of the FLA rating of the motor that is running. To set current limit for the specific motor or application, follow these steps while monitoring motor current:

1) Preset Current Limit trimpot (CL) fully CW.
2) Run motor at full or normal running speed.
3) Load motor to 125% of its FLA rating or the desired maximum load.
4) Measure the DC input current with an analog DC current meter placed in series with the positive DC input lead.
5) Decrease the Current Limit trimpot setting until the motor current begins to drop, and then slowly increase the setting until just reaching the desired maximum current as obtained in step 3.

Note: Do not use the Current Limit trimpot as a torque control or to reduce the speed of a motor.

Internal Fault LED

The internal fault LED (Red) indicates that there is a fault condition present with the control. One or several of the following fault conditions can be present: invalid sensor input code, 60°/120° phasing jumper in wrong position, over current condition (i.e. Current Limit set too low), undervoltage lockout (i.e. +12V supply is less than 10.0V) or thermal shutdown (i.e. U4 is too hot). Typical fault conditions are: invalid sensor attachment, 60°/120° phasing jumper is in the wrong position, or Current Limit is set too low.

Basic Operating Instructions

Control Algorithm Discussion and P-I-D Tuning

A true P-I-D speed control algorithm is employed in the BLM701P which allows precise and quick response to set speed or load changes. The three items, 26, 27 and 28 (Proportional, Integral, Derivative, respectively) are adjustable as shown on page 16. P-I-D can be tuned to get precise speed response and regulation.

When adjusting P-I-D, begin by using the factory defaults the control is preset to: P (Item 26) to 90, I (Item 27) to 15, D (Item 28) to 2. If further adjustment of P-I-D is needed, follow the steps below.

To adjust P: (Item 26)

Run the motor from zero speed to the set speed. If the start up response of the motor is too slow, increase “P” in increments of 20 until the desired start up response time is obtained. If the start up response time is too fast, decrease “P” in increments of 10 until the desired response is reached. “P” is used to adjust the start up response time only. The start up response time is approximately 0 to 60% of the set speed. “I” can be used if adjustment of the upper response time (60 to 100% of the set speed) is needed.

To adjust I: (Item 27)

Run the motor from zero speed to the set speed. If the upper response time (60 to 100% of the set speed) has any hesitation or has too slow of a response, then increase “I” in increments of 5 until the hesitation is eliminated and/or the desired upper response time is obtained. If the upper response time is too fast or has too much overshoot, decrease “I” in increments of 3 until the overshoot is eliminated and/or the desired upper response time is reached.

To adjust D: (Item 28)

"D" can be used to dampen the effect of "P". By making "D" too large, the response time of the control can be reduced, so keep "D" as small as possible on non-regenerative controls.

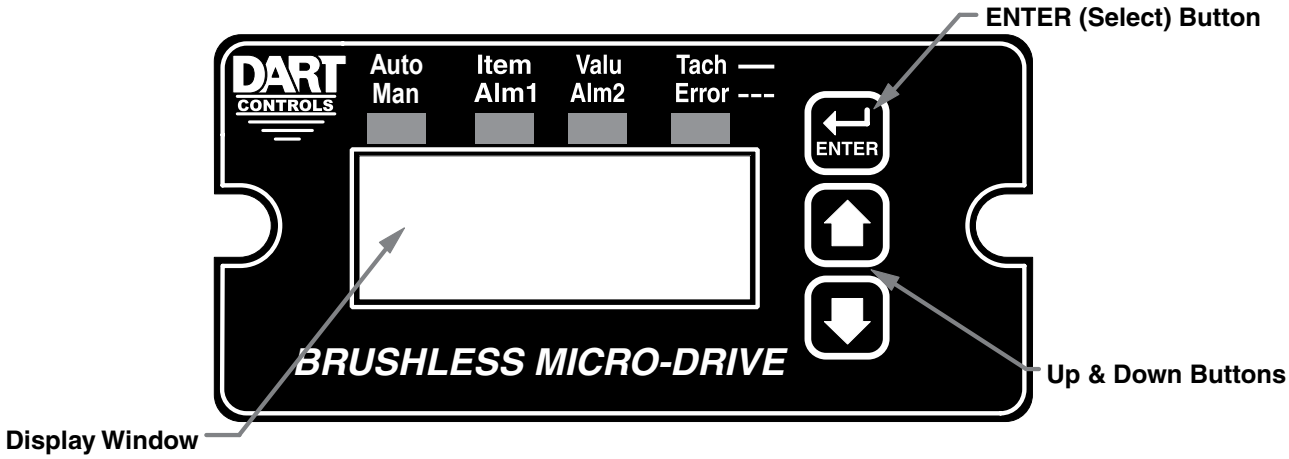
Note: The proportion of P-I-D seems to be more critical than the individual values, i.e.. values of 50-50-50 will achieve virtually the same results as 999-999-999.

Rate and Time Mode Explained

In Rate Mode, the BLM controls the rate of the motor by tracking the motor's pickup pulses which are applied to Sensor Input A (SA). In this mode, the display indicates in rate units such as Gallons-per-minute, feet-per-second, or RPM.

In Time Mode, the BLM controls the process time by tracking the motor's pickup pulses which are applied to Sensor Input A (SA). In this mode, the display indicates in time units such as HH:MM or MM:SS, where HH is hours, MM is minutes, and SS is seconds. This mode is most-commonly used in time-sensitive processes such as conveyor ovens and plating applications.

Visual Reference



How to Change an Item's Value (The Short Story)

1. Hold down the Enter button until Item-Selection Mode is entered. The 'Item' Annunciator will light
2. Using the Up and Down buttons, select the desired Item number to view or edit
3. Press the Enter button to change the value of the Item. The 'Valu' Annunciator will light
4. Using the Up and Down buttons, change the Item's value as desired
5. Press the Enter button to permanently save the changes (Returns to Item-Selection Mode)
6. Select Item Zero ("0") and press the Enter button to return to Running Mode

Operating the User Interface (The Long Story)

Although the BLM user interface is very versatile, it is also simple to setup and operate. With just a few button presses, it allows the user to configure a number of adjustable Items. The LED display has three basic operating modes: Running Mode, Item-Selection Mode, and Value Mode. "Item" and "Value" modes also have specific visual indicators (LED "Annunciators") that allow the user to immediately determine the current state or mode of the user interface. **Note: Item-Selection Mode (and Value Mode) can only be entered if the Program Enable jumper is in the "On" position.**

Running Mode is the default display of the unit when power is applied. The BLM will spend the majority of its time in this mode. In Running Mode, the display shows the Target or Actual ("Tach") speed value in the user-defined Engineering Units format for rate or time. The control will continuously attempt to drive the motor to the requested Target. In this display mode, the Up and Down buttons increase or decrease the displayed target value until either the display minimum or display maximum limit is reached. Depending on the alarm configuration, these buttons may also serve as an alarm-silence or alarm-reset button. For example, displays for rate and time operating modes could be 13.60 and 45:30 respectively.

Additionally, the BLM701P-420 has an "Auto/Manual" Annunciator which displays a "solid" light if the source of the Target Setting comes from the 4-20mA input ("Auto"), or a "blinking" light if the Target Setting comes from the "front panel" Target setting ("Manual").

Item-Selection Mode can be entered by simply pressing and holding the Enter button down for about three seconds. Once in Item-Selection Mode, the "Item" Annunciator will illuminate. The display will indicate the currently selected Item number for editing purposes. Pressing the Up or Down button will increase or decrease the selected Item number on the display. Although the Item numbers are in numerical order, some numbers are skipped. These numbers represent reserved Items that are not yet implemented and are not displayed.

Further, Item numbers above 999 are actually located on the ModularBus card(s) that are installed in the "Host" Drive. The numbering scheme is the ModularBus "slot number (100, 200 or 500) times 10, plus the Item Number. Once the desired Item number is displayed, a press of the Enter button will change the display to the Value Mode. So, for example, to view/edit Item 20 on a ModularBus card in Slot 200, "Browse" to Item number 2020 (200 X 10 + 20).

When in Item-Selection Mode, pressing the Enter button with Item 0 selected will cause the unit to return to Running Mode. See the Software Items for a list of available Items.

Value Mode is used to modify the value of the selected Item. When in Value Mode, the "Valu" Annunciator will illuminate. Pressing the Up or Down button increases or decreases the selected Item's value. With only one exception, value changes take effect immediately. For example, when adjusting P-I-D settings, the change in response can be observed "live", which greatly facilitates the P-I-D "tuning" process. Once the desired value is showing in the display window, pressing the Enter button again will return to Item-Selection Mode and the new value will be saved in permanent memory. Removing power from the unit while in Value Mode will result in the specified new value being lost, and the previous (old) value being used. This can be used as an "undo", for example, during editing a value that is being edited in the wrong Item. **Note: Changes to Item 10, Operating Mode, do not take effect until power is removed and re-applied to the BLM.**

Detailed Configuration Instructions

Default Configuration

When shipped from the factory, the following basic settings are in place:

Rate Mode Operation in RPM

Sensor Pulses per Revolution: 2 (4 poles)

Decimal Point Display: Off

Display Range: 0 - 2400

Speed Range: 0 - 2400 RPM

Accel and Decel: 2500 RPM per second

Alarm Output: Disabled

Resetting the Unit to Factory Defaults

The factory-default settings can be easily restored using either of two methods. Both methods require the Program Enable jumper to be in the “On” position. The first is to apply power to the unit with both the Enter and Down buttons pressed for 3 seconds. The second is to change the value of parameter 95 to 5.

JP1 (Program Enable Jumper)

The JP1 jumper is located under the dust cover on the back end of the upper board. When the jumper is set to the "Off" position, all programming features are locked out to the front panel user. When the jumper is in the "On" position, the programming parameters are open to change. JP1 is shipped from the factory set in the "On" position.

Setting and Reading "SoftSwitches"

Like many other devices, the BLM has the ability to select between a number of "yes/no" or "on/off" options, depending upon the application. Traditionally, this sort of option-selecting was done with some sort of physical switch or switches (such as a "DIP switch'), or by other means, such as the "jumper block" used to enable/disable Programming on the BLM. There are two problems with this approach to option-selection: 1) Both DIP switches and "jumper blocks" are physically large, and most require that the device be at least partially disassembled to gain access to them; 2) On a device with more than just a very few options, the number and combinations of switches quickly becomes overwhelming.

Because of these drawbacks, the BLM takes a different approach (where appropriate): SoftSwitches.

It is easiest to think of an Item containing SoftSwitches as a DIP switch containing from one to thirty-two switches. But instead of actually flipping a switch "on" or "off", you can set and read these "switches" as a *Binary-Coded-Decimal*, or *"BCD"* number. Now, before you say "Binary numbers! Those are for computers!", let's look at this another way. Each "switch", from #1 through #32, has been assigned a decimal number that represents its position in the make-believe DIP switch assembly. When that number is used, it means that the switch is "on". For example, the decimal number that represents switch #4 is 8, the number that represents switch #6 is 32, and so on. See the table below for a full explanation of these values. Note: Due to display limitations, switches 15 through 32 are currently unused.

Switch#	BCD Value	Switch#	BCD Value
1	**1**	**8**	**128**
2	**2**	**9**	**256**
3	**4**	**10**	**512**
4	**8**	**11**	**1024**
5	**16**	**12**	**2048**
6	**32**	**13**	**4096**
7	**64**	**14**	**8192**

So, **the Binary-Coded-Decimal (BCD) number contained in a SoftSwitch Item is nothing more than the *sum* of the numbers representing the "on" switches.** For example, if you wanted to set switches #1, #4, and #7 to the "on" position, you would place the number *73* (1 + 8 + 64) into the Item containing those SoftSwitches; if you wanted to set switches #5 and #6 "on", you would place the number *48* (16 + 32) into the Item, and so forth. **Simply "add-up" the BCD values of the switches you wish to "turn on", and place the total, or "sum", into the Item containing the SoftSwitches.**

The settings of the SoftSwitches can also be read the same way: For example, if an Item containing the SoftSwitches has been set to the number *11*, you can tell that switches #1, #2 and #4 are "on". You can tell this by *subtracting* the BCD values, from highest to lowest, *starting at the highest value that is less than or equal to the "total"*. Keep subtracting, but if you get a negative number as a result, then don't subtract that BCD value (add it back in before proceeding). Work your way "downward" in this manner toward Switch #1, but when your total reaches *zero*, you are finished.

Try a few examples of your own, and very soon you will be easily setting and reading SoftSwitches.

Setting and Reading "Alarm" Conditions

Taking advantage of the "SoftSwitches" feature described on last page, the BLM700 Series is equipped with *two* "Alarm" outputs, which can be independently set to Activate on any of 16,384 possible combinations of "conditions" or "events" that could be occuring at any one time. See table below for a list of these Condition "Flags".

The conditions are logically "OR-ed" together to form the particular Alarm output. If the SoftSwitches for the "Tach Outside Limits" and the "Sensor Input Stalled" Conditions for Alarm1 are set to "On", then Alarm1 will be "true" when either one or both of those Conditions are "true". However, for even more flexibility, each condition can be combined in a logical "AND" fashion to "override" the Alarm output.

Additionally, each Condition can be "inverted" before being sent to the "AND" function, for even greater flexibility. Please note that if a particular Condition is inverted, the corresponding "switch" in the appropriate "AND" Item (52/72) is inverted as well.

Further, setting any of the "Softswitch" Items in the OR/Invert/AND Alarm Conditions (Items 50-52 and 70-72) to a value of zero effectively removes the effect of their "logic" from the "Circuit". Therefore, even though the Alarm logic conditions are "cascaded" OR -> Invert -> AND, if, for example, the application does not need any "AND" conditions, simply set the value of the AND Item 52 and/or 72 to zero, and the "AND" function will be "jumped around". In that case, however, it would also be best to set the "Inverter" Item (51 and/or 71) to zero as well.

Table1: BCD Values for Drive Condition "Flags"

BCD Value	Description
0	(No Flags are currently Active)
1	Accel/Decel Ramp In Progress
2	S1 (Main) Actual Speed (Tach) is Outside Alarm Limits
4	Target Speed is Outside Alarm Limits
8	Target Speed = 0
16	S1 (Main) Pickup is Stalled
32	S2 (Leader) Pickup is Stopped (Valid only in 'Follower' Mode)
64	Jog Function is Activated
128	Inhibit Function is Activated
256	E-Stop Function is Activated
512	Drive is at Maximum Output
1024	"Run" Condition
2048	Reserved
4096	Reserved

Table2: BCD Values for Drive Condition "Flags"

	Description
0	(No Flags are currently Active)
1	Slot 100 Alarm1 Activated (Valid only if ModularBus card installed in this slot)
2	Slot 200 Alarm1 Activated (Valid only if ModularBus card installed in this slot)
4	Slot 500 Alarm1 Activated (Valid only if ModularBus card installed in this slot)
8	Maintenance Timer
16	Reserved
32	Reserved
64	Reserved
128	Reserved
256	Reserved
512	Reserved
1024	Reserved
2048	Reserved
4096	Reserved

"Alarm" Output Routing

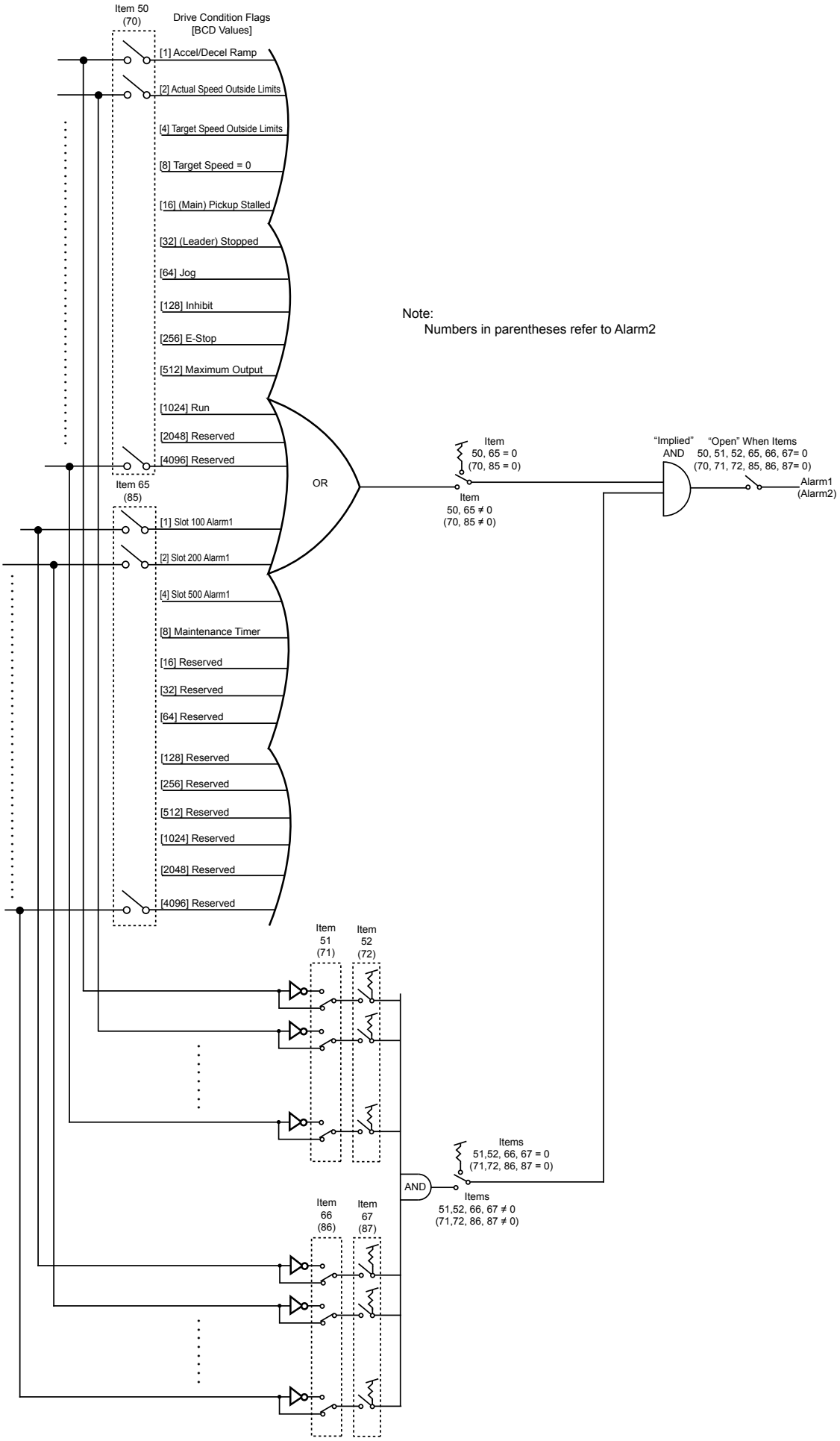
The "output" of Alarm1 is permanently "routed" to drive the Form-C Relay output on the BLM itself (see Hook-up Diagram, P1-7, P1-13, and P1-14). The "output" of Alarm2, however, can be *Routed* (through the use of Item 81) to any one of the three ModularBus "slots", 100, 200 or 500.

BLM700 Alarm "Logic"

Note: The "circuitry" shown below is actually implemented in software, not hardware, and although it makes little difference to the final output produced, that fact should be kept in mind.

Also note that the "switches" on the outputs of the "OR gate", the "AND gate", and the "Implied" AND gate are only under *indirect* user control. That is, they are set "automatically" by the action of other settings that *are* under user control. For example, the "switch" on the output of the "OR gate" is *automatically* set to the "uppermost" position (as shown on the drawing, below) when Item 50 is set to zero."

Often there is more than one way to "connect" the signals and "logic" to acheive the desired result. But determining the proper signal "polarity" to use is *often* a tricky problem in "logic circuits". Sometimes it takes a bit of careful planning to arrange "inverted" and "non-inverted" signals properly. Also, keep in mind that standard logic "tricks", such as the use of "Negative Logic" techniques, can be used to further expand your options. See the Application Example on page 31 for further details.


Item 50
(70)
Drive Condition Flags
[BCD Values]
[1] Accel/Decel Ramp
[2] Actual Speed Outside Limits
[4] Target Speed Outside Limits
[8] Target Speed = 0
[16] (Main) Pickup Stalled
[32] (Leader) Stopped
[64] Jog
[128] Inhibit
[256] E-Stop
[512] Maximum Output
[1024] Run
[2048] Reserved
[4096] Reserved
Item 65
(85)
[1] Slot 100 Alarm1
[2] Slot 200 Alarm1
[4] Slot 500 Alarm1
[8] Maintenance Timer
[16] Reserved
[32] Reserved
[64] Reserved
[128] Reserved
[256] Reserved
[512] Reserved
[1024] Reserved
[2048] Reserved
[4096] Reserved
OR
Item
50, 65 = 0
(70, 85 = 0)
Item
50, 65 ≠ 0
(70, 85 ≠ 0)
"Implied"
AND
"Open" When Items
50, 51, 52, 65, 66, 67= 0
(70, 71, 72, 85, 86, 87= 0)
Alarm1
(Alarm2)
Note:
Numbers in parentheses refer to Alarm2
Item
51
(71)
Item
52
(72)
Item
66
(86)
Item
67
(87)
AND
Items
51,52, 66, 67 = 0
(71,72, 86, 87 = 0)
Items
51,52, 66, 67 ≠ 0
(71,72, 86, 87 ≠ 0)

Software Parameters (Items)

Item	Description	Value Range	Units	Factory Default	User Setting
0	Selecting this item exits to “Run” Mode	n/a	—	n/a	n/a
	Read-Only Items				
1	Model Number	47 = BLM700P	—	47	
2	Software Version	1 – 9999	—	n/a	
3	Hardware Version	1 – 9999	—	n/a	
4	DartNet Version	1 – 9999	—	n/a	
5	Serial Number (Major)	0 – 9999	—	n/a	
6	Serial Number (Minor)	0 – 9999	—	n/a	
8	Drive Condition Flags	(See “Flags” Table 1)	BCD	n/a	
9	Drive Condition Flags	(See “Flags” Table 2)	BCD	n/a	
	General Setup Items				
10	Operating Mode	1 = Rate Mode 2 = Time Mode	—	1	
11	Display Brightness	0 – 31 (Dim – Bright)	—	26	
12	Display Mode	1 = Target Speed Display 2 = S1 Actual Speed Display	—	1	
13	Decimal Point Position	0 = D.P. Disabled [XXXX] 1 = [X.XXX] 2 = [XX.XX] 3 = [XXX.X] 4 = [XXXX.]	—	0	
14	Keypad Mode	1 = Linear, Constant Rate 2 = Non-Linear, Accelerating Rate	—	2	
15	Keypad Scroll Delay	0 – 30 (Fast – Slow)	—	10	
16	Power-up Target Speed	1 = Force Zero Speed 2 = Force Power-up Value 3 = Use Previous Target Speed	—	3	
17	Power-Up Value	0 – 9999	(Eng. Units)	0	
18	Front-Panel DoubleClick Destination	0 = DoubleClick *Ignored* 1 = Inhibit 2 = EStop 3 = Jog	—	0	
19	Reserved				
	Control Loop Items				
20	Display Minimum	0 – 9998	(Eng. Units)	0	
21	Display Maximum	1 – 9999	(Eng. Units)	3600	
22	Motor Control Method	0 = Gain Tracking Off, Low Speed Mode Off 1 = Gain Tracking On, Low Speed Mode Off 2 = Gain Tracking Off, Low Speed Mode On 3 = Gain Tracking On, Low Speed Mode On 4 through 32 DO NOT USE!	—	1	
23	Accel Setting	1 – 9999	(Eng. Units)	9999	
24	Decel Setting	1 – 9999	(Eng. Units)	9999	
26	**P**roportional Gain	0 – 9999	—	90	
27	**I**ntegral Gain	1 – 9999	—	15	
28	**D**erivative Gain	0 – 9999	—	2	
29	Reserved				

Software Parameters (Items), cont'd

Item	Description	Value Range	Units	Factory Default	User Setting
	Signal Input #1 Setup Items				
30	Sensor Input Display Reference	0 – 9999	(Eng. Units)	2400	
31	Sensor Input Reference RPM	0 – 9999	RPM	2400	
32	Sensor Input Pulses Per Revolution	1 – 9999	PPR	2	
33	Sensor Input Initial Stall Timeout	0, 5 – 9999 (0 = Defeat)	Sec.	0	
34	Sensor Input Running Stall Timeout	0 – 999.9 (0 = Defeat)	1/10 Sec.	0	
35	Reserved				
36	Jog Set Point	1 – 9999	(Eng. Units)	1000	
37	Reserved				
38	Reserved				
40	Reserved				
41	Reserved				
42	Inhibit Configuration	0 = No Accel/Decel 1 = Decel Only, No Accel 2 = Accel Only, No Decel 3 = Both Accel and Decel	—	0	
	Alarm Output #1 Setup Items				
50	Alarm1 Logical “OR” Activation Conditions	(See “Flags” Table 1)	BCD	0	
51	Alarm1 Logical Inverters	(See “Flags” Table 1)	BCD	0	
52	Alarm1 Logical “AND” Activation Conditions	(See “Flags” Table 1)	BCD	0	
53	Alarm1 Output Style & Reset Mode	1 = Constant & Auto-Reset 2 = Constant & Manual Reset 3 = Pulsed & Auto Reset 4 = Pulsed & Manual Reset	—	1	
54	Alarm1 Reset Configuration	1 = No Silence, Reset on Enter But. 2 = Reserved 3 = Reserved 4 = Silence & Reset on Enter But. 5 = Reserved 6 = Reserved	—	1	
55	Annunciator Alm1 Flash On Active Alarm1	0 = No Annunciator Flash 1 = Annunciator Flash	—	0	
56	Alarm1 Output Pulse “ON” Time	1 – 3600	Secs.	1	
57	Alarm1 Output Pulse “OFF” Time	1 – 3600	Secs.	1	
58	Alarm1 Output Pulse Count	0 – 9999	—	0	
59	Alarm1 Lower Limit	0 – 9999	(Eng. Units)	0	
60	Alarm1 Upper Limit	0 – 9999	(Eng. Units)	9999	
65	Alarm1 Logical “OR” Activation Conditions	(See “Flags” Table 2)	BCD	0	
66	Alarm1 Logical Inverters	(See “Flags” Table 2)	BCD	0	
67	Alarm1 Logical “AND” Activation Conditions	(See “Flags” Table 2)	BCD	0	

Software Parameters (Items), cont'd

Item	Description	Value Range	Units	Factory Default	User Setting
	Alarm Output #2 Setup Items				
70	Alarm2 Logical “OR” Activation Conditions	(See “Flags” Table 1)	BCD	0	
71	Alarm2 Logical Inverters	(See “Flags” Table 1)	BCD	0	
72	Alarm2 Logical “AND” Activation Conditions	(See “Flags” Table 1)	BCD	0	
73	Alarm2 Output Style & Reset Mode	1 = Constant & Auto-Reset 2 = Constant & Manual Reset 3 = Pulsed & Auto Reset 4 = Pulsed & Manual Reset	—	1	
74	Alarm2 Reset Configuration	1 = No Silence, Reset on Enter But. 2 = No Silence, Reset on S2 High 3 = No Silence, Reset on S2 Low 4 = Silence & Reset on Enter But. 5 = Silence & Reset on S2 High 6 = Silence & Reset on S2 Low	—	1	
75	Annunciator Alm2 Flash On Active Alarm2	0 = No Annunciator Flash 1 = Annunciator Flash	—	0	
76	Alarm2 Output Pulse “ON” Time	1 – 3600	Secs.	1	
77	Alarm2 Output Pulse “OFF” Time	1 – 3600	Secs.	1	
78	Alarm2 Output Pulse Count	0 – 9999	—	0	
79	Alarm2 Lower Limit	0 – 9999 (Eng. Units)	(Eng. Units)	0	
80	Alarm2 Upper Limit	0 – 9999 (Eng. Units)	(Eng. Units)	9999	
81	Alarm2 Output Routing	1 = Reserved 2 = Use Slot 100 Alarm1 Output 3 = Use Slot 200 Alarm1 Output 4 = Use Slot 500 Alarm1 Output	—	3	
85	Alarm2 Logical “OR” Activation Conditions	(See “Flags” Table 2)	BCD	0	
86	Alarm2 Logical Inverters	(See “Flags” Table 2)	BCD	0	
87	Alarm2 Logical “AND” Activation Conditions	(See “Flags” Table 2)	BCD	0	
	Item Memory Commands (Actions)				
95	Restore MD40/50 Settings to Factory Defaults (affects Drive Settings Only)	0 = Do Nothing & Exit 5 = Restore Factory Defaults	—	0	n/a
96	Restore ModularBus Card(s) Settings to Factory Defaults (Card(s) Settings Only)	0 = Do Nothing & Exit 100 = Restore Slot 100 Defaults 200 = Restore Slot 200 Defaults 500 = Restore Slot 500 Defaults	—	0	n/a
98	Save “Environment” (Drive and ALL ModularBus Card(s) Settings) to “User Save” storage area	0 = Do Nothing & Exit 5 = Copy current Settings TO Settings2 (or Settings1 if currently using Settings2)	—	0	n/a
99	Restore/Swap “Environment” (Drive and ALL ModularBus Card(s) Settings) from “User Save” storage area	0 = Do Nothing & Exit 5 = Copy (Restore) current Settings FROM Settings2 (or Settings1 if currently using Settings2) 10 = Swap Between Settings1 & 2	—	0	n/a
	Maintenance Timer Setup Items				
100	Activate Maintenance Message after this amount of time	0 = Off 1 = 1 - 9999	(in hours)	0	
101	Reset Maintenance Timer	0 = Do Nothing & Exit 5 = Reset	—	0	n/a
102	Current Value of Maintenance Timer	(Read Only)	(in hours)	0	n/a
103	Scale Timer	0 = Disabled 1 – 9999 = Scale Factor	—	0	
120	Auto/Manual Slot Control	0 = Slot 100 (Not Available) 1 = Slot 200 2 = Slot 500	—	1	

Item (Parameter) Descriptions

Item 0 – Exit to Running Mode
When Item 0 is selected in Item-Selection Mode, the unit will return to Running Mode and, depending on the value of Item 12, will display the running (Target) or actual (Tach) value. This should be selected once changes to Items are completed.

Item 1 – Model Number (Read Only)
This number represents the base model number for the product. The model code for the BLM700 Series is 47. In this manual, where appropriate, the "Drive" portion of these products are referred to as the "Brushless Micro-Drive".

Item 2 – Software Version (Read Only)
The software version is a code which identifies the software "build number" of the unit.

Item 3 – Hardware Version (Read Only)
The hardware version is a code which identifies which hardware was used to build the unit.

Item 4 – ModularBus Protocol Version (Read Only)
The ModularBus protocol version is a code which identifies the *highest* (most-recent) version of the ModularBus protocol with which this unit is compatible.

Item 5 & 6 – Serial Number, Major & Minor (Read Only)
These Items are reserved for future use as an electronic serial number and are unique to each manufactured unit.

Item 8 – Drive Condition Flags (Read Only)
This is a Binary Coded Decimal ("BCD") representation of the currently active "Flags" representing certain real-time conditions and/or modes in which the drive is operating. This display is updated several times per second to reflect the up-to-the-second status of the drive and its ModularBus cards, if any. See Tables 1 & 2 for the BCD values.

Item 9 – Drive Condition Flags, Table 2 (Read Only)
This is a Binary Coded Decimal ("BCD") representation of the currently active "Flags" representing certain real-time conditions and/or modes in which the drive is operating.This display is updated several times per second to reflect the up-to-the-second status of the drive and its ModularBus cards, if any. See Tables 1 & 2 for the BCD values.

Item 10 – Operating Mode
This Item defines the operating mode for the entire unit. The unit controls the load using either rate or time units.

NOTE: Power must be removed and re-applied to the Brushless Micro-Drive for a change in Operating Mode to take effect. It is also strongly suggested the Target Speed be reduced to zero and the setting of Items 16, 17, 20, 21, 30 & 31 be reviewed carefully prior to doing so.

The following Operating Modes are available for the Brushless Micro-Drive:

Mode 1 – Rate Mode
In Rate Mode, the Brushless Micro-Drive displays in user-defined rate "Engineering Units" such as RPM, Gallons per Hour, or Feet per Second.

Mode 2 – Time Mode
In Time Mode, the Brushless Micro-Drive displays in time units using the format AA:BB. By default AA:BB represents minutes (AA) and seconds (BB). Optionally, it can be configured to represent hours (AA) and minutes (BB) or other user-defined units with a 1:60 relationship. When setting Items which are configured in engineering units, the programmed value is the determined by the formula (AA * 60) + BB. In HH:MM displays, this is the total number of minutes. In MM:SS displays, this is the total number of seconds.

Item 11 – Display Intensity
This Item adjusts the intensity of the LED display digits in the front panel of the unit. The values of 0 – 31 correspond to a gradual change from very dim to very bright. This is often useful when the Brushless Micro-Drive is used in the same panel as other pieces of equipment with LED displays and a uniform display brightness is desired. Simply adjust the Brushless Micro-Drive to match its surroundings.

Item 12 – Display Mode
This Item selects what the BLM700P Series will show on its display during Run Mode. Note that it can "toggle" between whatever the Display Mode is set to and its "opposite" by briefly pressing and releasing the ENTER button. For example, if this Item is set to 1 (Target Speed/Time), pressing the ENTER button will briefly show the Actual (Tach) Display (and illuminate the "Tach" LED Annunciator). Conversely, if this Item is set to 2 (Main Tach), pressing the ENTER button will briefly show the Target Speed/Time.

The following Display Modes are available for the Brushless Micro-Drive:

Mode 1 – Target Speed/Time Display
In Rate Mode, the Brushless Micro-Drive displays the Target Speed in user-defined rate Engineering Units such as RPM, Gallons per Hour, or Feet per Second. In Time Mode, the Brushless Micro-Drive displays the Target Time in time units using the format AA:BB.

Mode 2 – S1 Actual Speed (Tach) Display
In Rate Mode, the Brushless Micro-Drive displays the Actual Speed in user-defined rate Engineering Units such as RPM, Gallons per Hour, or Feet per Second. In Time Mode, the Brushless Micro-Drive displays the Actual Time in time units using the format AA:BB.

Item 13 – Decimal Point (DP) Position (used in Rate Mode Only)
This selects the format of the display with respect to the decimal point's position. This Item does not effect the value entry for other Items. For example, if the user desires to display 10.00 at 300RPM, then Item 30 would be set to 1000, Item 31 would be set to 300, and Item 13 would be set to 2.

Mode 0: Fixed XXXX

Mode 1: Fixed X.XXX

Mode 2: Fixed XX.XX

Mode 3: Fixed XXX.X

Mode 4: Fixed XXXX.

Item 14 – Keypad Mode
This Item selects the operating mode of the front-panel push buttons. In some applications, increasing or decreasing the scroll rate provides the user more controllability when entering settings. Items 14 and 15 affect only the Up and Down buttons when the user interface is in Running Mode. These settings also apply to remote Up / Down buttons which are attached via the -1 option board.

Mode 1: Linear, Constant Rate
In linear mode, pressing and holding the Up or Down buttons will cause the display to continuously change value in the requested direction until either the Display Minimum or Display Maximum is reached. The displayed value will scroll at a constant rate which is specified using Item 15.

Mode 2: Non-linear, Accelerating Rate
In non-linear mode, pressing and holding the Up or Down buttons will cause the display to continuously change value in the requested direction until either the Display Minimum or Display Maximum is reached. The displayed value will initially scroll at a slow rate and increase in speed until the maximum scroll rate is achieved. The initial scroll rate is specified using Item 15.

Item 15 – Keypad Scroll Delay
This Item sets the scroll speed for the front-panel push buttons. The function of this Item varies slightly depending on the Keypad Mode. See Item 14 for more details.

Item 16 – Power-up Target Speed
This Item determines the default Running Value when power is initially applied to the Brushless Micro-Drive.

Mode 1: Default to Zero
When in this mode, the unit will default to zero (engineering units).

Mode 2: Default to Power-Up Value
When in this mode, the unit will default to the Power-up Value, Item 17.

Mode 3: Default to Previously Running Value
When in this mode, the unit will default to the previous running value before power was removed. A previous running value must have been active for at least 3 seconds to be recalled after power has been disconnected and reapplied.

Item 17 – Power-up Value
When Power-up Mode is set to 2, this Item will designate the default display value at power-up in the user's desired units of measure ("engineering units"), e.g. RPM, GPM, FPM, etc.

Item 18 – Front Panel DoubleClick Routing
This Item determines what happens if the user "Double-Clicks" the Enter Button (two button presses quickly) on the front panel of the Brushless Micro-Drive.

Mode 0: DoubleClick Ignored
When in this mode, DoubleClicking on the Enter Button will have no effect.

Mode 1: Route DoubleClick to Inhibit
When in this mode, Double-Clicking on the Enter Button with the drive "running" will place the Drive in Inhibit. **Note that the DoubleClick action works as a "toggle".**

Mode 2: Route DoubleClick to EStop
Same as Mode 1, but DoubleClick is Routed to the E-Stop function.

Mode 3: Route DoubleClick to Jog
Same as Mode 1, but DoubleClick is Routed to the Jog function, causing the control to temporarily run at the Target Speed in Item 36. See, also, Item 36.

Mode 4: Reserved

Item 20 – Display Minimum
This Item defines the lower end of the display range. This is the value which limits how low the user is able to scroll the displayed value in Running Mode. In Rate and Time modes, this value is set in engineering units.

Item 21 – Display Maximum
This Item defines the upper end of the display range. This is the value which limits how high the user is able to scroll the displayed value in Running Mode. In Rate and Time modes, this value is set in engineering units.

Item 22 – Motor Control Method
This Item controls two behaviors in the Brushless Micro-Drive, Low-Speed "Gain-Tracking", and Ultra-Low-Speed Control Mode ("gearbox" mode). When set to a value of 1 (or 3), this item automatically (and proportionally) reduces the "gain" of the PID values when the Target Speed (in RPMs) is less than 200. This greatly increases the overall stability at low speeds in applications that require a very wide range of Target Speeds, without having to unduly compromise control responsiveness at higher speeds. When set to a value of 2 (or 3), this Item adjusts the speed-control characteristics of the Brushless Micro-Drive to enhance the smoothness of speed control when in a situation where the "tach pickup" must be installed on the "low speed side" of a very slowly turning gear-motor output shaft. A rule of thumb would probably be to consider enabling this Mode if the shaft is turning less than 10 RPM, and the pickup produces less than 10 Sensor Input Pulses Per Revolution. Use this Mode only if speed stability can not be achieved by adjusting the PID settings (Items 26 – 28).

Mode 0: Disabled
Both Low-Speed-Gain-Tracking and Ultra-Low-Speed Control Mode are defeated.

Mode 1: Low-Speed-Gain-Tracking (Only) Enabled
Low-Speed-Gain-Tracking is enabled, Ultra-Low-Speed Control Mode is defeated.

Mode 2: Ultra-Low-Speed Control Mode (Only) Enabled
Low-Speed-Gain-Tracking is defeated, Ultra-Low-Speed Control Mode is enabled.

Mode 3: Low-Speed-Gain-Tracking and Ultra-Low-Speed Control Mode (Both) Enabled
Both Low-Speed-Gain-Tracking and Ultra-Low-Speed Control Mode are enabled.

Item 23 – Acceleration Setting
This Item determines how fast the Brushless Micro-Drive will accelerate toward the displayed target setting. This Item is set in engineering units of change per second, such as RPM, GPM, or feet per second.

Item 24 – Deceleration Setting
This Item determines how fast the Brushless Micro-Drive will decelerate toward the displayed target setting. This Item is set in engineering units of change per second, such as RPM, GPM, or feet per second.

Item 26 – Proportional (P) Gain
The Proportional Gain is the first of three Items which define the responsiveness of the control with respect to how fast it responds to changing loads. Because the Brushless Micro-Drive controls are true velocity-form PID control, the higher the P Gain, the more aggressively the unit will respond to a change in load or target speed. See the "Basic Operating Instructions" section of the manual for more details.

Item 27 – Integral (I) Gain
The Integral Gain is the second of two Items which define the responsiveness of the control with respect to how fast it responds to changing loads. The higher the I Gain, the more aggressively the unit will drive the load. However, it will sometimes be necessary to decrease the I Gain and/or increase the P Gain to prevent unwanted oscillation and instabilities. See the "Basic Operating Instructions" section of the manual for more details.

Item 28 – Derivative (D) Gain
The Derivative Gain is the third of the three Items which define the responsiveness of the control with respect to how fast it responds to changing loads. Although most applications will run fine with the D Gain set to zero, sometimes adding a little "D" will help minimize overshoot and undershoot. See the "Basic Operating Instructions" section of the manual for more details.

Item 30 – Sensor Input (S1) Display Reference
This is **the number to be displayed when at the user-specified motor Reference RPM**. In Rate Mode, this value represents rate units such as feet, ounces, or revolutions. In Time Mode, this value represents the reference time measured in seconds or minutes. If the desired display is HH:MM, then all values should be entered in minutes. If MM:SS is desired, then all values should be entered in seconds.

Item 31 – Sensor Input (S1) Reference RPM
This is the **reference RPM at which the Display Reference value should be displayed.** In Rate and Time Modes, this value represents the RPM of the encoder to which the Display Reference corresponds.

Item 32 – Sensor Input (S1) Pulses per Revolution
This is the number of sensor pulses per revolution for the sensor input (S1). The number of sensor pulses per revolution is half of the number of motor poles. The Brushless Micro-Drive supports sensors and encoders from 1 to 9999 pulses per revolution.

Item 33 – Sensor Input (S1) Initial Stall Timeout
When the Target Speed is above zero RPM, this Item determines the maximum time in units of seconds that can elapse before the *first* S1 sensor pulse before the Brushless Micro-Drive considers itself in a "Stall" Condition. It is not advisable to set this lower than approximately 10 seconds (a value of 10), or it may be difficult to achieve startup in a low-speed application. A value of zero defeats this timeout. (Note: This parameter will only work if the alarm is set for stall on any of the items 50, 51, or 52.)

Item 34 – Sensor Input (S1) Running Stall Timeout
When the Target Speed is above zero RPM, this Item determines the maximum time in units of 0.1 Seconds that can elapse between S1 sensor pulses before the Brushless Micro-Drive considers itself in a "Stall" Condition. It is not advisable to set this lower than approximately 10 seconds (a value of 100), or it may be difficult to achieve startup in a low-speed application. Also note that the S1 Pulses Per Revolution (PPR) must be taken into account when determining the proper setting for this timeout. A value of zero defeats this timeout. (Note: This parameter will only work if the alarm is set for stall on any of the items 50, 51, or 52.)

Item 36 – Jog Setpoint
This Item defines the JOG setpoint in engineering units.

Item 42 – Inhibit Configuration
This Item determines the accel/decel profile of the BLM when it is going into and out of "Inhibit" Mode. There are 4 possible settings:

Mode 0: No Accel/Decel
When going into Inhibit, the BLM will immediately shut off its output, disregarding any Decel setting, and when coming out of Inhibit, the BLM will immediately return to its Target Speed, disregarding any Accel setting. This is exactly like the "E-Stop" behavior.

Mode 1: Decel Only, No Accel
When going into Inhibit, the BLM will Decel to a stop using the setting in Item 24, but when coming out of Inhibit, the BLM will immediately return to its Target Speed, disregarding any Accel setting.

Mode 2: Accel Only, No Decel
When going into Inhibit, the BLM will immediately shut off its output, disregarding any Decel setting, but when coming out of Inhibit, the BLM will Accelerate to its Target Speed, using the Accel setting in Item 23.

Mode 3: Use Both Accel and Decel
When going into Inhibit, the BLM will Decel to a stop using the setting in Item 24, and when coming out of Inhibit, the BLM will Accelerate to its Target Speed, using the Accel setting in Item 23.

Item 50 – Alarm 1 Logical "OR" Activation Conditions (Flags Table 1)
This Item, in conjunction with Items 51 & 52, defines which conditions will result in the Alarm 1 output being activated. The function is that of a Logical "OR"ing of the selected Drive Condition Flags. A setting of zero defeats this "OR" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 51 – Alarm 1 Logical Activation Condition Inverters (Flags Table 1)
This Item, in conjunction with Items 50 & 52, defines which conditions will result in the Alarm 1 output being activated. The function allows selected Drive Condition Flags to be "inverted" before being presented to the "inputs" of the "AND" function (see Item 52). Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 52 – Alarm 1 Logical "AND" Activation Conditions (Flags Table 1)
This Item, in conjunction with Items 50 & 51, defines which conditions will result in the Alarm 1 output being activated. The function is that of a Logical "AND"ing of the selected Drive Condition Flags. A setting of zero defeats this "AND" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 53 – Alarm 1 Output Style & Reset Configuration
This setting configures the output mode and reset method for the Alarm 1 output.

Mode 1: Constant & Auto Reset
In this mode, the alarm output will remain active until the alarm condition ceases to exist. The alarm will automatically reset when the conditions return to normal.

Mode 2: Constant & Manual Reset
In this mode, the alarm output will remain active until the alarm is reset manually. See Item 54 for details.

Mode 3: Pulse & Auto Reset
In this mode, the alarm output will pulse on and off until the alarm condition ceases to exist. The pulsed modes are commonly used for audible alarms where a constant output would be considered distracting or awkward. The alarm will automatically reset when the conditions return to normal.

Mode 4: Pulse & Manual Reset
In this mode, the alarm output will pulse on and off until the alarm is reset manually. See Item 54 for reset details. The pulsed modes are commonly used for audible alarms where a constant output would be considered distracting or awkward.

Item 54 – Alarm 1 Reset Configuration
This setting determines which actions will cause an active alarm to be silenced or reset.

Mode 1: No Silencing, Reset On ENTER Button Press
In this mode, an active alarm cannot be silenced. Once the alarm condition ceases to exist, however, the ENTER button may be pressed to cause a manual reset.

Mode 2: Reserved

Mode 3: Reserved

Mode 4: Silencing Enabled, Reset On ENTER Button Press
When the conditions for an active alarm persist, pressing any user-interface button will result in the alarm being silenced or deactivated, but not reset. A second attempt to reset the alarm must be made after the condition ceases to exist to clear the alarm.

Mode 5: Reserved

Mode 6: Reserved

Item 55 – Alarm 1 Annunciator Flash On Alarm
When set to 1, this will cause the “Alm1” LED Annunciator to flash when an alarm 1 condition is active. A setting of zero defeats this function.

Item 56 – Alarm 1 Pulse "ON" Time
This Item defines the number of seconds the output should be enabled during the ‘on’ phase of an active pulsing alarm’s output.

Item 57 – Alarm 1 Pulse "OFF" Time
This Item defines the number of seconds the output should be disabled during the ‘off’ phase of an active pulsing alarm’s output.

Item 58 – Alarm 1 Pulse Count
This setting determines how many pulses are output when the alarm is activated and is configured in the pulse output style. *When 0 is entered, the unit will be set for continuous pulses while the alarm is active.*

Item 59 – Alarm 1 Lower Limit
This setting defines either the lower limit or the lower end of a range for the alarm region. Alarm limits are set in engineering units without regard to decimal point or colon position. In Rate Mode, a limit of 123 could represent a display value of 123, 12.3, 1.23, or 0.123. When in Time Mode, a limit of 123 would represent 1:23 on the display.

Item 60 – Alarm 1 Upper Limit
This setting defines either the upper limit or the upper end of a range for the alarm region. Alarm limits are set in engineering units without regard to decimal point or colon position. In Rate Mode, a limit of 123 could represent a display value of 123, 12.3, 1.23, or 0.123. When in Time Mode, a limit of 123 would represent 1:23 on the display.

Mode 5: Silencing Enabled

Item 65 – Alarm 1 Logical "OR" Activation Conditions (Flags Table 2)
This Item, in conjunction with Items 66 & 67, defines which conditions will result in the Alarm 1 output being activated. The function is that of a Logical "OR"ing of the selected Drive Condition Flags Table 2. A setting of zero defeats this "OR" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 66 – Alarm 1 Logical Activation Condition Inverters (Flags Table 2)
This Item, in conjunction with Items 65 & 67, defines which conditions will result in the Alarm 1 output being activated. The function allows selected Drive Condition Flags Table 2 to be "inverted" before being presented to the "inputs" of the "AND" function (see Item 67). Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 67 – Alarm 1 Logical "AND" Activation Conditions (Flags Table 2)
This Item, in conjunction with Items 65 & 66, defines which conditions will result in the Alarm 1 output being activated. The function is that of a Logical "AND"ing of the selected Drive Condition Flags Table 2. A setting of zero defeats this "AND" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 70 – Alarm 2 Logical "OR" Activation Conditions (Flags Table 1)
This Item, in conjunction with Items 71 & 72, defines which conditions will result in the Alarm 2 output being activated. The function is that of a Logical "OR"ing of the selected Drive Condition Flags. A setting of zero defeats this "OR" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 71 – Alarm 2 Logical Activation Condition Inverters (Flags Table 1)
This Item, in conjunction with Items 70 & 72, defines which conditions will result in the Alarm 2 output being activated. The function allows selected Drive Condition Flags to be "inverted" before being presented to the "inputs" of the "AND" function (see Item 72). Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 72 – Alarm 2 Logical "AND" Activation Conditions (Flags Table 1)
This Item, in conjunction with Items 70 & 71, defines which conditions will result in the Alarm 2 output being activated. The function is that of a Logical "AND"ing of the selected Drive Condition Flags. A setting of zero defeats this "AND" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 73 – Alarm 2 Output Style & Reset Configuration
This setting configures the output mode and reset method for the Alarm 2 output.

Mode 1: Constant & Auto Reset
In this mode, the alarm output will remain active until the alarm condition ceases to exist. The alarm will automatically reset when the conditions return to normal.

Mode 2: Constant & Manual Reset
In this mode, the alarm output will remain active until the alarm is reset manually. See Item 74 for details.

Mode 3: Pulse & Auto Reset
In this mode, the alarm output will pulse on and off until the alarm condition ceases to exist. The pulsed modes are commonly used for audible alarms where a constant output would be considered distracting or awkward. The alarm will automatically reset when the conditions return to normal.

Mode 4: Pulse & Manual Reset
In this mode, the alarm output will pulse on and off until the alarm is reset manually. See Item 74 for reset details. The pulsed modes are commonly used for audible alarms where a constant output would be considered distracting or awkward.

Item 74 – Alarm 2 Reset Configuration
This setting determines which actions will cause an active alarm to be silenced or reset.

Mode 1: No Silencing, Reset On ENTER Button Press
In this mode, an active alarm cannot be silenced. Once the alarm condition ceases to exist, however, the ENTER button may be pressed to cause a manual reset.

Mode 2: No Silencing, Reset On S2 Input High (Not Wired To Common)
Similar to Mode 1. Once the alarm condition ceases to exist, setting the S2 input to a high (+5V) state or allowing it to float disconnected will cause a manual reset.

Mode 3: No Silencing, Reset On S2 Input Low (Wired To Common)
Similar to Mode 1. Once the alarm condition ceases to exist, setting the S2 input to a low (COM) state or wiring it to common will cause a manual reset.

Mode 4: Silencing Enabled, Reset On ENTER Button Press
When the conditions for an active alarm persist, pressing any user-interface button will result in the alarm being silenced or deactivated, but not reset. A second attempt to reset the alarm must be made after the condition cease to exist to clear the alarm.

Mode 5: Silencing Enabled, Reset On S2 Input High (Not Wired To Common)
Similar to Mode 4. Setting the S2 input to a high (+5V) state or allowing it to float disconnected will cause the alarm to be silenced or reset depending on the current state of the alarm conditions.

Mode 6: Silencing Enabled, Reset On S2 Input Low (Wired To Common)
Similar to Mode 4. Setting the S2 input to a low (COM) state or wiring it to common will cause the alarm to be silenced or reset depending on the current state of the alarm conditions.

Item 75 – Alarm 2 Annunciator Flash On Alarm
When set to 1, this will cause the "Alm2" LED Annunciator to flash when an alarm 2 condition is active. A setting of zero defeats this function.

Item 76 – Alarm 1 Pulse on Time
This Item defines the number of seconds the output should be enabled during the 'on' phase of an active pulsing alarm's output.

Item 77 – Alarm 1 Pulse off Time
This Item defines the number of seconds the output should be disabled during the 'off' phase of an active pulsing alarm's output.

Item 78 – Alarm 1 Pulse Count
This setting determines how many pulses are output when the alarm is activated and is configured in pulse output style. *When 0 is entered, the unit will be set for continuous pulses while the alarm is active.*

Item 79 – Alarm 1 Lower Limit
This setting defines either the lower limit or the lower end of a range for the alarm region. Alarm limits are set in engineering units without regard to decimal point or colon position. In Rate Mode, a limit of 123 could represent a display value of 123, 12.3, 1.23, or 0.123. When in Time Mode, a limit of 123 would represent 1:23 on the display.

Item 80 – Alarm 1 Upper Limit
This setting defines either the upper limit or the upper end of a range for the alarm region. Alarm limits are set in engineering units without regard to decimal point or colon position. In Rate Mode, a limit of 123 could represent a display value of 123, 12.3, 1.23, or 0.123. When in Time Mode, a limit of 123 would represent 1:23 on the display.

Item 81 – Alarm 2 Output Routing
This setting allows the BLM to control the "Alarm 1" Output of a selected ModularBus "Slot", provided of course that there is a ModularBus card that supports this function installed in the selected slot. The valid values for this Item are:

Mode 1: Not Used

Mode 2:Route Alarm 2 Output to ModularBus Slot 100 Alarm 1 Output
In this mode, the BLM Alarm 2 Output will directly control the Alarm 1 Output of a ModularBus Card installed in Slot 100, if that card supports this feature.

Mode 3:Route Alarm 2 Output to ModularBus Slot 200 Alarm 1 Output
In this mode, the BLM Alarm 2 Output will directly control the Alarm 1 Output of a ModularBus Card installed in Slot 200, if that card supports this feature.

Mode 4:Route Alarm 2 Output to ModularBus Slot 500 Alarm 1 Output
In this mode, the BLM Alarm 2 Output will directly control the Alarm 1 Output of a ModularBus Card installed in Slot 500, if that card supports this feature.

Item 85 – Alarm 2 Logical "OR" Activation Conditions (Flags Table 2)
This Item, in conjunction with Items 86 & 87, defines which conditions will result in the Alarm 2 output being activated. The function is that of a Logical "OR"ing of the selected Drive Condition Flags Table 2. A setting of zero defeats this "OR" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 86 – Alarm 2 Logical Activation Condition Inverters (Flags Table 2)
This Item, in conjunction with Items 85 & 87, defines which conditions will result in the Alarm 2 output being activated. The function allows selected Drive Condition Flags Table 2 to be "inverted" before being presented to the "inputs" of the "AND" function (see Item 87). Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

Item 87 – Alarm 2 Logical "AND" Activation Conditions (Flags Table 2)
This Item, in conjunction with Items 85 & 86, defines which conditions will result in the Alarm 2 output being activated. The function is that of a Logical "AND"ing of the selected Drive Condition Flags Table 2. A setting of zero defeats this "AND" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" in the manual for further details.

"Action" Items (Commands), Items 95 through 99

Rather than being a "setting" or a "switch" type Item, Items 95 through 99 are used to trigger a certain "Action" or "Script" that generally performs some Utility function for the Brushless Micro-Drive, and/or a ModularBus card installed in the drive. The "value" settings are used as a kind of "key" to make sure these functions are not accidentally "triggered".

Item 95 – Factory Default Drive Command
When set to a value of 5, and then pressing the ENTER button, the Brushless Micro-Drive (Drive only) will be reset to factory default settings. **THIS ACTION CANNOT BE UNDONE!** This Command can also be achieved by applying power to the unit with both the Enter and Down buttons depressed. *The programming jumper must be in the "On" position for this Command to function.* Any ModularBus card settings are unaffected.

Item 98 – Save (copy) current "Environment" Settings TO User Save Area
When set to a value of 5, and then pressing the ENTER button, the Brushless Micro-Drive will prompt the user to Save the current "environment" (Settings for the drive and all installed ModularBus cards) TO whichever User Save area ("Settings1" or "Settings2") that is *not* currently being used as the "Working" Settings. **THIS ACTION CANNOT BE UNDONE!** Pressing the "Up" button will Save the settings; pressing any other button will Cancel the operation.
TIP: This feature is often used by OEMs to save their customized settings to a "safe" area, that later can be easily Restored if the need arises.
NOTE: Unless a "Swap" command has been used (see Item 99), the "Working" area is "Settings1". Therefore, this command will normally Save to "Settings2".

Item 99 – Restore/Swap current "Environment" Settings FROM User Save Area
When set to a value of 5 (for "Restore") or 10 (for "Swap"), and then pressing the ENTER button, the Brushless Micro-Drive will prompt the user to Copy the current "environment" (Settings for the drive and all installed ModularBus cards) FROM whichever User Save area ("Settings1" or "Settings2") that is *not* currently being used as the "Working" Settings. or to "Change" (Swap) between using "Settings1" and "Settings2" as the "Working" Settings area. The "Copy" (Restore) is "destructive", but the "Change" (Swap) is not.

The valid values for this Item are:

Mode 5: Restore Environment from whichever User Save area is not "Current"
Will copy "Settings2" (or "Settings1") settings to the Current ("Working") settings. If the "Working" Settings are coming from "Settings1", then the values in "Settings2" will be used. If the "Working" Settings are coming from "Settings2", then the values in "Settings1" will be used. Either way, the result is that "Settings1" and "Settings2" will end up containing the same values. **THIS ACTION CANNOT BE UNDONE!**

Mode 10: Swap "Working" Settings between "Settings1" and "Settings2"
Non-Destructively "swaps" the "Working" Settings between using "Settings1" and "Settings2". This allows the user to easily play "what-if" type of speculation with one or more Items, without fear of "losing" their current settings. **THE SWAP CAN BE DONE AS MANY TIMES AS DESIRED**.
TIP: The easiest way to find out which area "Settings1 or Settings2" is the "Working" (current) settings, is to enter this mode, and watch the "prompt" to see which area is being offered to "Change to". The current "Working" settings area is the one that is "opposite". For example, if the "prompt" offers to Change to "Settings2", then the Brushless Micro-Drive (and any ModularBus cards) are currently using "Settings1" as the "Working" area, and vice versa. Then, "Cancel" the "Swap".

Item 100 – Maintenance Timer ON/OFF
This item is used to turn on/off the maintenance timer and setting the length of time before the timer will trip. By setting this item to 0, the timer is disabled. By setting this item to a value of greater than 0, indicates the time (in hours) when the maintenance timer will trip. The display will show "MAIn" when the maintenance timer has exceeded it's set time (Item 100).

Item 101 – Reset Maintenance Timer
When the maintenance timer has reached its time limit, this item is used to reset the timer and start the timer from zero by setting this item to a value of 5.

Item 102 – Current Time (In Hours)
This displays the current time in hours that the unit has been running.

Item 103 – Timer Scaler
This option can be used to extend the maintenance time of the device when the system is not working as hard as it could. Scaling allows the timer to be scaled when the motor is running below a pre-set value. If the value is set to 0, then the scaler is disabled. The timer will be scaled from 0 to 100% based on the speed from 0 to the value placed in Item 103. When the motor speed is at or above the pre-set value, the timer will be incremented at a 1:1 ratio (100% or one hour for each hour). If the motor is running below the pre-set value, then the overall percentage that the motor is running with respect to the pre-set value, will be used as the percentage when accumulating the time.

Example: Item 103 set for 1600, motor is running at 800 RPM (50% of Item 103), then every 2 hours that the motor is running at 800 RPM will be 1 hour added to the maintenance timer.

Item 120 – Auto/Manual Slot Control
This setting determines what slot controls the Auto setting when switched to the Auto Mode. Power must be cycled Off/On after selection changes and Item 81 must match same slot selection.

OPT420 Software Parameters (Items)

				Default	Setting
	Read-Only Identification Items				
1	Model Number	420 = OPT420	—	420	n/a
2	Software Version	1 – 9999	—	—	n/a
3	Hardware Version	1 – 9999	—	—	n/a
4	Device Type	100 = Type 1 ModularBus Card	—	100	n/a
5	Minimum Supported Framework Version	1 – 9999	—	—	n/a
6	Maximum Supported Protocol Version	1 – 9999	—	—	n/a
7	Serial Number (Major)	0-9999	—	n/a	n/a
8	Serial Number (Minor)	0-9999	—	n/a	n/a
	4-20mA Input Scaling Items				
20	OPT420's Target Speed to Drive @ 4mA Input Current	0 – 9999 (Limited by Drive's Display Minimum Setting)	Drive's Eng. Units	0	
21	OPT420's Target Speed to Drive @ 20mA Input Current	0 – 9999 (Limited by Drive's Display Maximum Setting)	Drive's Eng. Units	2400	
22	4mA Input Trim	-600 – +600[1]	—	0	
23	20mA Input Trim	-600 – +600[1]	—	0	
	4-20mA Output Scaling Items				
40	Actual (S1 tach) Speed from Drive needed to Produce 4mA Output Current from OPT420	0 – 9999	Drive's Eng. Units	0	
41	Actual (S1 tach) Speed from Drive needed to Produce 20mA Output Current from OPT420	0 – 9999	Drive's Eng. Units	2400	
42	4mA Output Trim	-600 – +600[1]	—	0	
43	20mA Output Trim	-600 – +600[1]	—	0	
	Read-Only Real-time Process Variables				
70	Input Current to OPT420	0 – 4095	ADC Steps	n/a	n/a
71	Target Speed to Drive from OPT420	0 – 9999	Drive's Eng. Units	n/a	n/a
72	Output Current to Drive from OPT420	0 – 4095	DAC Steps	n/a	n/a
73	OPT420 Condition Flags (not yet implemented)	0 = No Active "Flags" 1 – 9999 = Flags Activated	BCD	0	n/a
74	OPT420 Auto/Manual Switch State	0 = Manual Mode 1 = Auto Mode	—	0	n/a

[1] Host Drive's Display will Flash to indicate Negative Values

OPT420 Item (Parameter) Descriptions

Item 1 – Model Number (Read Only)
This number represents the base model number for the product. The model code for the OPT420 ModularBus card is, logically enough, 420. In this manual, where appropriate, the "Drive" in which this OPT420 card is installed is called, generically, the "Host Drive".

Item 2 – Software Version (Read Only)
The software version is a code which identifies the software "build number" of the unit.

Item 3 – Hardware Version (Read Only)
The hardware version is a code which identifies which hardware was used to build the unit.

Item 4 – ModularBus Card Device Type (Read Only)
This value is primarily used to determine whether the particular ModularBus card has on-board non-volatile storage for its Item settings. The OPT420 is a "Type 1" ModularBus card (value = 100), which does not have its own non-volatile storage. It depends on the Host Drive to store its Item settings. This means that if an OPT420 must be replaced in a Host Drive, the "new" OPT420 does not need to be configured. It will simply "inherit" the "old" OPT420's Item settings, provided it is placed in the same ModularBus Slot.

Item 5 – Minimum Supported Framework Version (Read Only)
The lowest software "framework" version that is compatible with this ModularBus card.

Item 6 – ModularBus Protocol Version (Read Only)
The ModularBus protocol version is a code which identifies the *highest* (most-recent) version of the ModularBus protocol with which this ModularBus card is compatible.

Item 7 & 8 – Serial Number, Major & Minor (Read Only)
These Items are reserved for future use as an electronic serial number and are unique to each manufactured unit.

Item 20 – OPT420's Target Speed to Host Drive @ 4mA of Input Current
This is the Target Speed setting that the OPT420 makes available to its Host Drive when there is 4mA of current flowing through the OPT420's Input Loop terminals. The setting is in the Host Drive's "Engineering Units", just as if the Target Speed was being entered on the Host Drive itself. This setting is limited by the Host Drive's Minimum Display setting.

Item 21 – OPT420's Target Speed to Host Drive @ 20mA of Input Current
This is the Target Speed setting that the OPT420 makes available to its Host Drive when there is 20mA of current flowing through the OPT420's Input Loop terminals. The setting is in the Host Drive's "Engineering Units", just as if the Target Speed was being entered on the Host Drive itself. This setting is limited by the Host Drive's Maximum Display setting. This setting should also be greater than the setting for Item 20, above.

Item 22 – 4mA Input Current Trim
Used to compensate for minor inaccuracies in the overall system that is connected to the OPT420's Input Loop terminals. This "trim", which has a range that goes both positive and negative, affects the 4mA endpoint of the OPT420's input range. To return to the factory-calibrated 4mA endpoint, set this Item to a value of zero.

Item 23 – 20mA Input Current Trim
Used to compensate for minor inaccuracies in the overall system that is connected to the OPT420's Input Loop terminals. This "trim", which has a range that goes both positive and negative, affects the 20mA endpoint of the OPT420's input range. To return to the factory-calibrated 20mA endpoint, set this Item to a value of zero.

Item 40 – Host Drive's Actual Speed (Tach) Value to Produce 4mA Output from OPT420
This is the Actual Speed (tach) value that the OPT420 translates into 4mA of current flow through the OPT420's Output Loop terminals. The setting is in the Host Drive's "Engineering Units", just as if the Tach Display was being viewed on the Host Drive itself.

Item 41 – Host Drive's Actual Speed (Tach) Value to Produce 20mA Output from OPT420
This is the Actual Speed (tach) value that the OPT420 translates into 20mA of current flow through the OPT420's Output Loop terminals. The setting is in the Host Drive's "Engineering Units", just as if the Tach Display was being viewed on the Host Drive itself.

Item 42 – 4mA Output Current Trim
Used to compensate for minor inaccuracies in the overall system that is connected to the OPT420's Output Loop terminals. This "trim", which has a range that goes both positive and negative, affects the 4mA endpoint of the OPT420's Output range. To return to the factory-calibrated 4mA endpoint, set this Item to a value of zero.

Item 43 – 20mA Output Current Trim
Used to compensate for minor inaccuracies in the overall system that is connected to the OPT420's Output Loop terminals. This "trim", which has a range that goes both positive and negative, affects the 20mA endpoint of the OPT420's Output range. To return to the factory-calibrated 20mA endpoint, set this Item to a value of zero.

Real-Time Process Variables (Read Only), Items 70 - 74

Rather than being a "setting" or a "switch" type Item, Items 70 through 74 on the OPT420 are used to view (only) certain Real-Time "Process" variables going to/from the OPT420. These Items are mainly useful in troubleshooting a particular application, rather than being of general-purpose use.

Item 70 – Input Current to OPT420
This shows the instantaneous input loop current to the OPT420, in raw ADC "steps". Since the OPT420 uses a 12-bit A/D, the range of this Item can be from 0 to 4095, although it will not get to these extremes in the typical 4-20mA setup. The actual number is of less interest than whether the numbers tend to "follow" a 4-20mA input signal.

Item 71 – Target Speed to Host Drive from OPT420
This shows the instantaneous "Target Speed" that the OPT420 has calculated to make available to the Host Drive, in the Host Drive's Engineering Units, based on the Input Current flowing through P3 1 & 2 on the OPT420, and the setting of OPT420 Items 20 through 23.

Item 72 – Output Current from OPT420
This shows the instantaneous output loop current from the OPT420, in raw DAC "steps". Since the OPT420 uses a 12-bit D/A, the range of this Item can be from 0 to 4095, although it will not get to these extremes in the typical 4-20mA setup. The actual number is of less interest than whether the numbers tend to "follow" the Host Drive's Actual (SA Sensor Input) "Tach" speed.

Item 73 – OPT420 Condition "Flags"
Not yet implemented.

Item 74 – OPT420 Auto/Manual (SA) Switch State
This shows the instantaneous state of the Auto/Manual switch input. A value of zero means that the OPT420 will report "Auto Mode" to the Host Drive. A value of 1 equals "Manual" mode.

Application Example

Conveyor Oven Control with Alarm Output

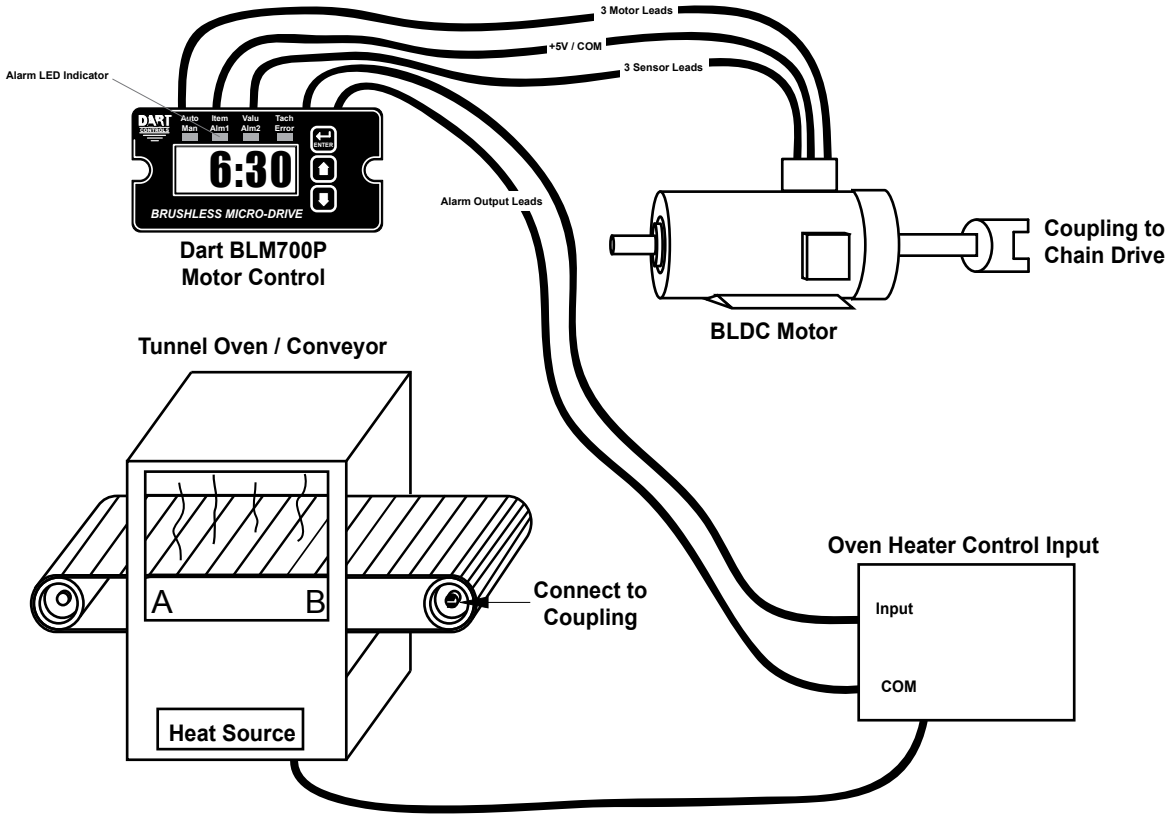
Description:

BLM motor controls can set and show the total travel time of a product on a conveyor through an oven-tunnel. An alarm output is available to trigger during various process events.

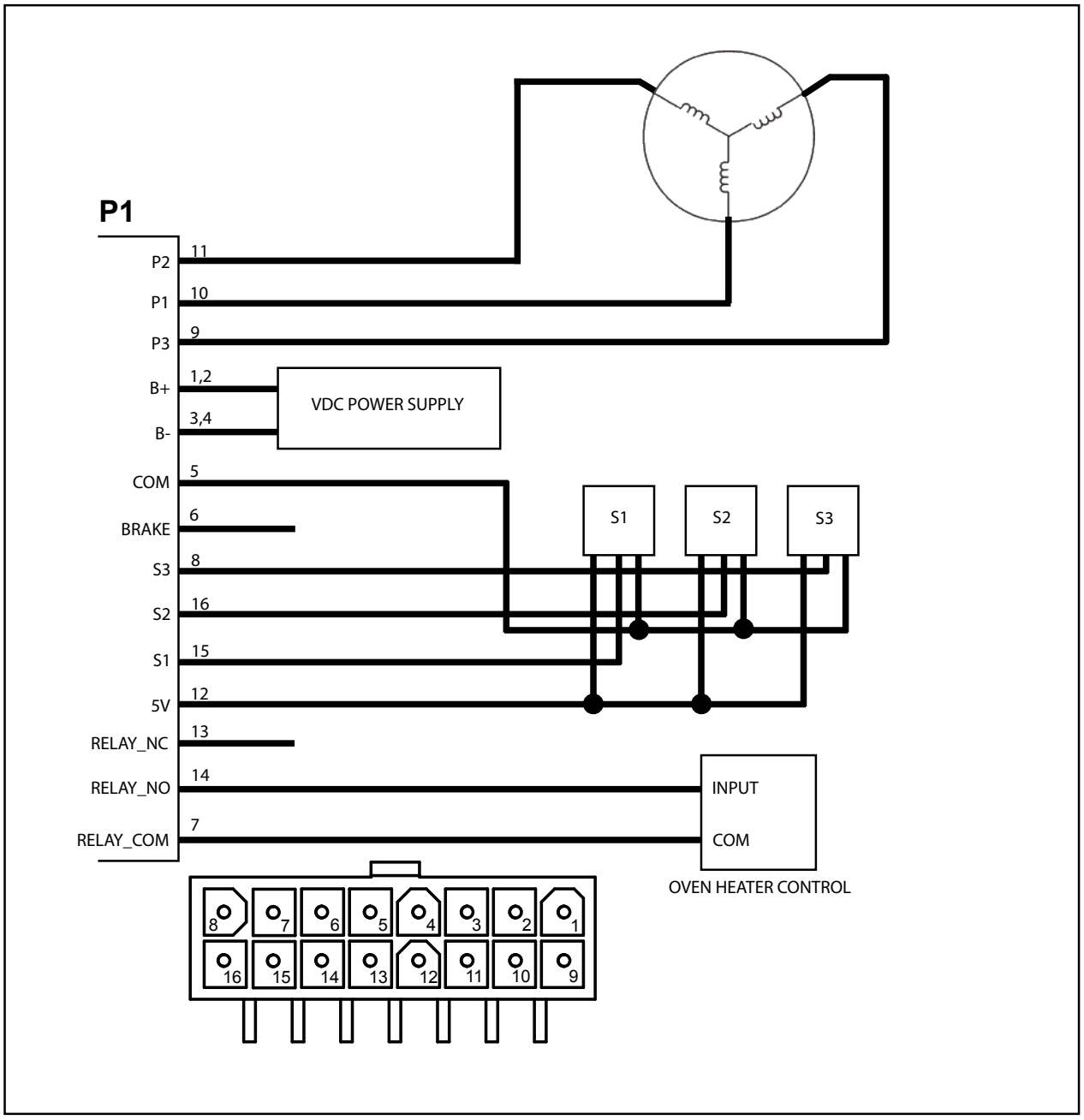
In this example application, a product is conveyed through an oven tunnel for an adjustable time between 6:30 and 12:15 (MM:SS). It was found through testing that when the motor speed is 1380 RPM a product is moved through the tunnel in 6:40.

If the conveyor unexpectedly stops, the alarm output is programmed to signal the oven control to shutdown the heater. Also, during the alarm event, an LED indicator on the display panel will flash. To reset the alarm output, the enter button is pressed..

Application Diagram:



Wiring Diagram:



Parameter Configuration:

Parameter	Value	Notes
10	2	Time mode setting. Display will show MM:SS
20	390	Display minimum time is set to 6:30 (MM:SS) For example: (6 minutes x 60 seconds) + 30 seconds = 390 seconds
21	735	Display maximum time is set to 12:15 (MM:SS) For example: (12 x 60 seconds) + 15 seconds = 735 seconds
30	400	Display is set to show 6:40 when motor is at 1380 RPM. For example: (6 minutes x 60 seconds) + 40 seconds = 400 seconds
31	1380	
50	16	Alarm output is set to trigger after loss of speed signal from the motor.
52	1	Alarm output is reset by pressing enter key. (Factory default setting)
55	1	Display alarm LED is set to flash when alarm is triggered.

Troubleshooting

Problem	Possible Cause	Solution
Display is blank	Power not applied	Using a volt meter, verify that the input supply voltage is measured between the P1-1 & P1-4 terminal block positions.
	Defective unit	Contact technical support for additional help and instructions.
Display is dim	Display intensity parameter is too low	Editing and increasing the display intensity parameter should cause the display digits to become brighter.
Displays Speed Incorrectly	Pulses per revolution is wrong	Edit the PPR parameter to match half of the number of motor poles.
Motor is Running Erractic	Senors/Phases attached incorrectly	Review the appropriate hook-up procedure for motors.

Technical Support Options

- Visit the Dart Controls Web Site at: *www.dartcontrols.com*
- Email technical support at: *sales@dartcontrols.com*
- Telephone technical support at 317-873-5211

What's special about www.dartcontrols.com?

- Changes to printed material and product offerings first appear online
- Product manuals and other literature are easily accessible
- All information can be easily displayed or printed as needed

Specifications

Electrical

Input Voltage..... (Jumper selectable) 10-14VDC or 18-53VDC
Load Current (continuous)..... 8 Amps
Overload Current.....150% for 30 seconds
Current Limit..... Adjustable 0 - 150%
Motor Hall Spacing (Electrical)..... (jumper selectable) 60° or 120°
Sensor Power Supply.....5V @ 50mA
Display Range.....0 – 9999
Units of Operation (“Engineering Units”).....User Programmable, any Units
Speed Regulation..... ±1/2 RPM

Mechanical

Display Type .....LED, Red, 4 Digit, ½” Height
Housing Type.....NEMA 4X
Connector Style (pluggable connector).....16-position, Dual Row (SAMTEC - IPBT-108-HI-T-D-RA)
Mated with SAMTEC: IPBD-08-D **
Faceplate Material..... Polycarbonate with Polycarbonate Overlay
Housing Material .....Aluminum
Length (Required Panel Depth)..... 4.625” (117.48mm)
Faceplate Width ..... 4.539” (115.29mm)
Weight BLM700 ..... 0.87 lbs (13.92 oz.) (394.625g)

** Use Samtec Model CC69L-1620-01-T-HP Connector Pins (16-20 AWG)

Environmental

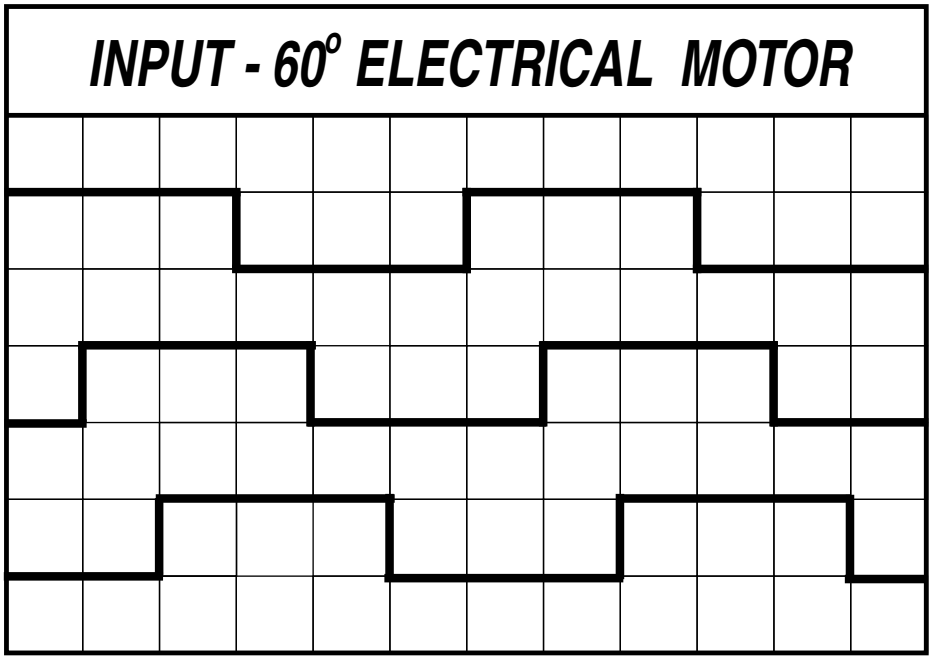
Operating Temperature Range---------- -10C to 45C (14F to 113F)
Operating Humidity Range (max.)---------- 95%, non-condensing

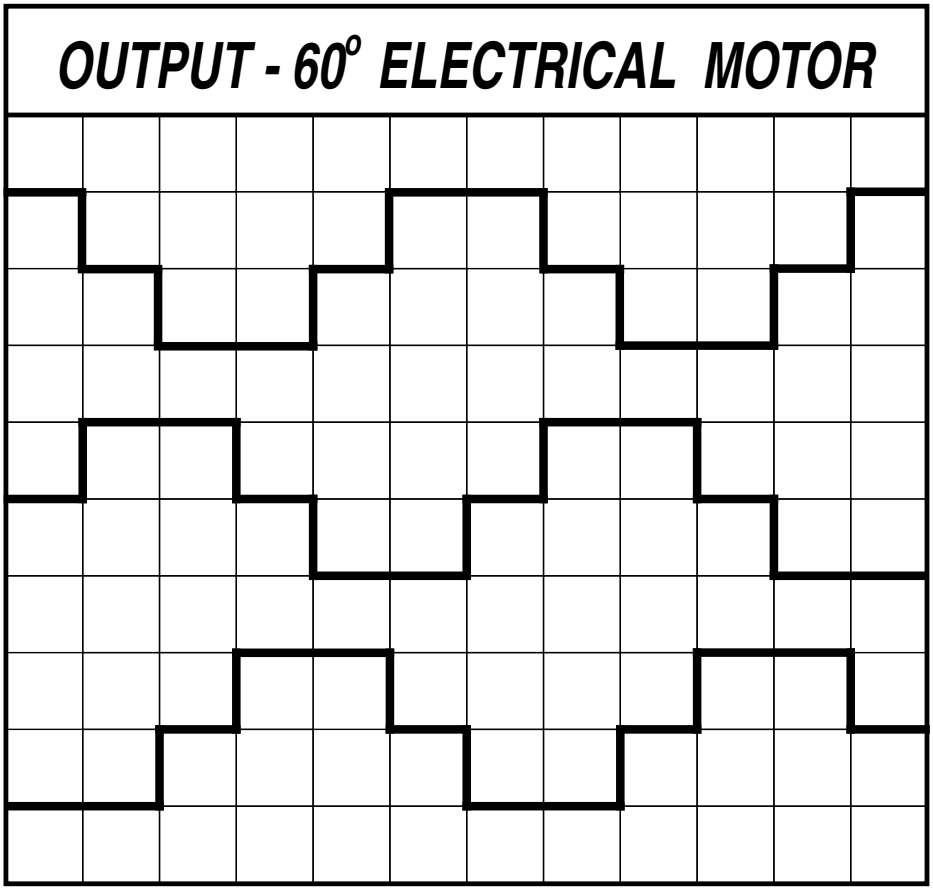
Dimension Chart

Model	*Width*	*Height*	*Depth*
English (inches)			
Housing	3.62	1.66	4.625
Lens	4.539	2.289	0.375
Metric (millimeters)			
Housing	91.94	42.16	117.27
Lens	115.28	58.14	9.53

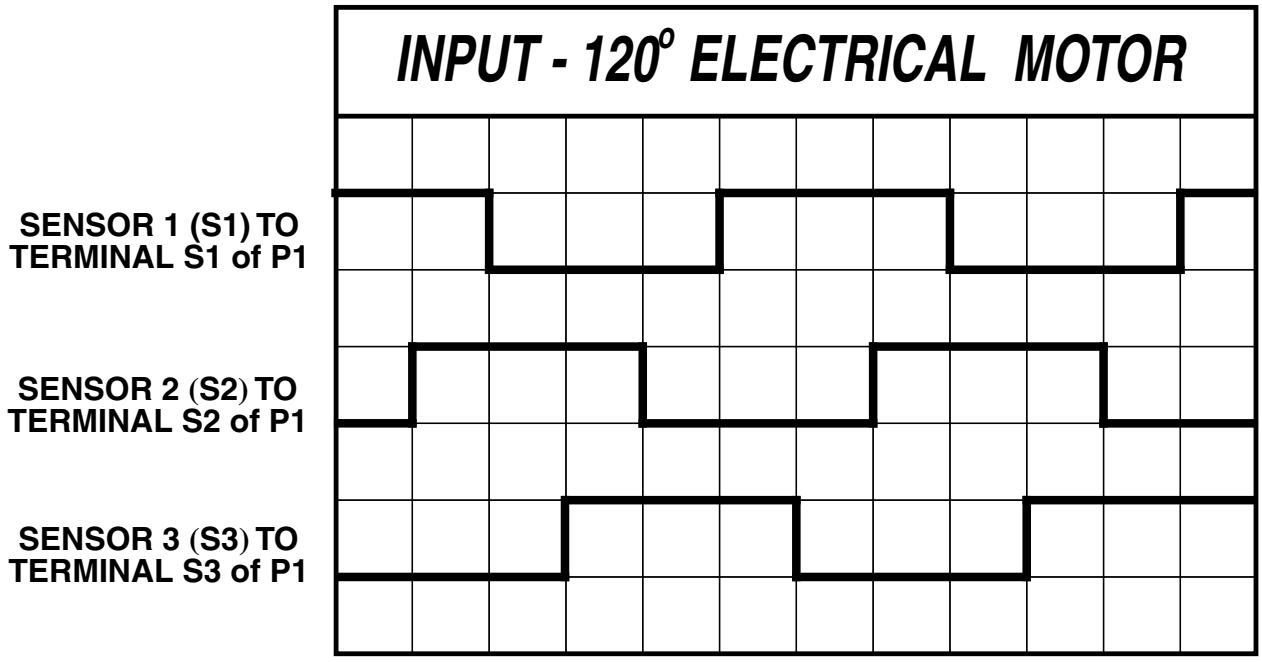
Timing Diagrams

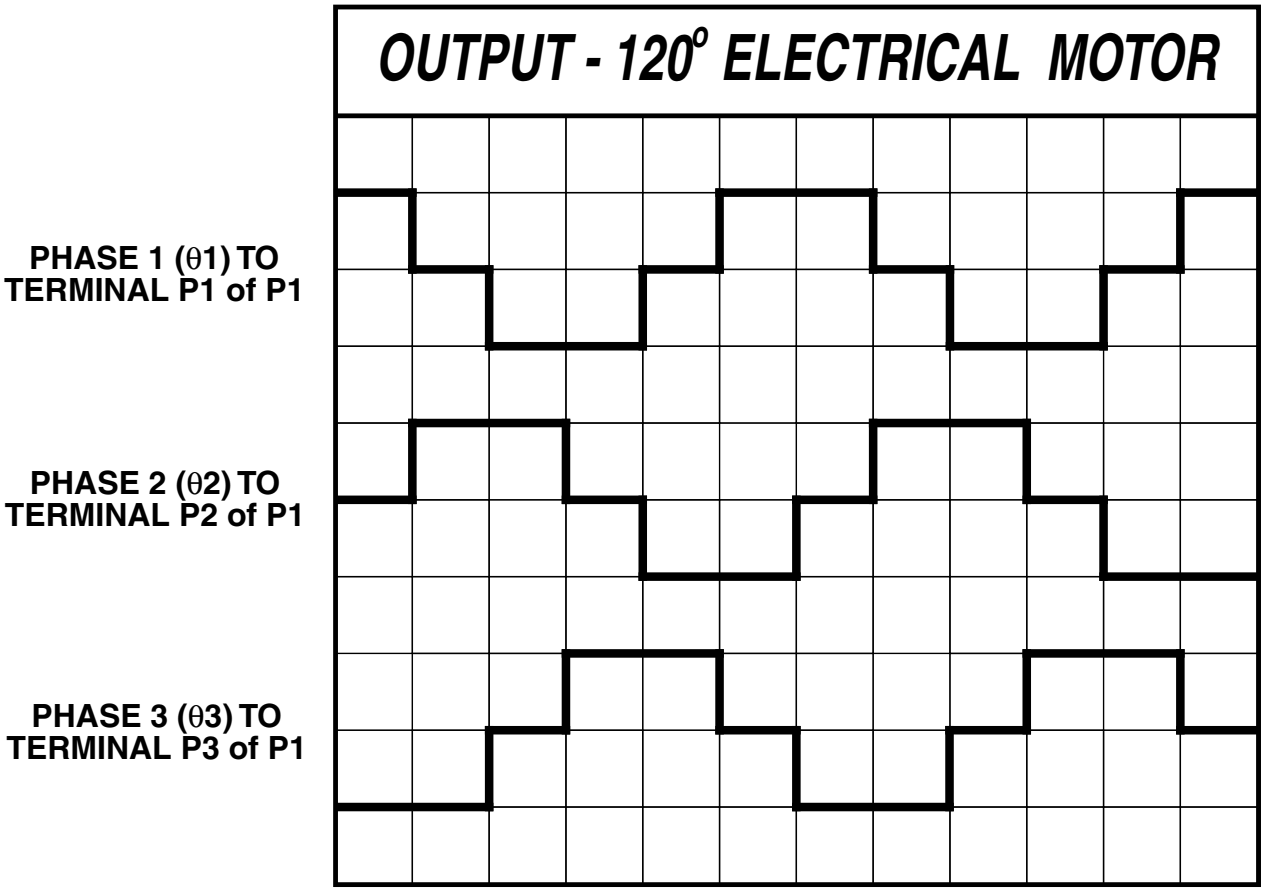
Timing For 60º Motor





Timing For 120º Motor





NOTES:

NOTES:

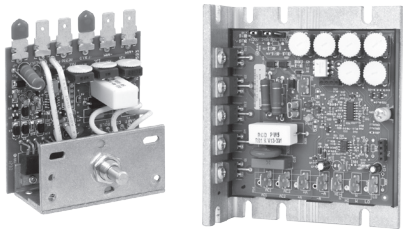
REPAIR PROCEDURE

In the event that a Product manufactured by Dart Controls Incorporated (DCI) is in need of repair service, it should be shipped, freight paid, to: Dart Controls, Inc., 5000 W. 106th Street, Zionsville, IN. 46077, ATTN: Repair Department. Please include Name, Shipping Address (no P.O. Box), Phone Number and if possible, e-mail address.

Those orders received from anyone without an existing account with DCI must specify if they will be paying COD or Credit Card (Master Card/Visa/American Express). This information is required before work will begin. If you have an account with Dart your order will be processed according to the terms listed on your account. Products with Serial Number date codes over 5 years old will automatically be deemed Beyond Economical Repair (BER). A new, equivalent device will be offered at a substantial discount.

Completed repairs are returned with a Repair Report that states the problem with the control and the possible cause. Repair orders are returned via UPS Ground unless other arrangements are made. If you have further questions regarding repair procedures, contact Dart Controls, Inc. at 317-873-5211.

YOUR MOTOR SPEED CONTROL SOLUTION PROVIDER



OEM Chassis SCR Drives
Dual Input voltage, adjustable HP range, isolated signal follower and reversing options



NEMA 4/4X SCR Drives
Dual Input voltage, adjustable HP range, isolated signal follower and reversing options



Low Voltage/Battery PWM Drives
Chassis and NEMA 4X versions, speed pot and signal follower operation



Digital SCR Drives
Closed loop accuracy, 4-20mA and serial communications, integral programmable display



Brushless DC Drives
Closed loop accuracy, line and low voltage versions through 1 HP



Digital Accessory & Resale Items
Motors to 700 HP, VFD's to 200 HP, NEMA rated encoder, digital programmable potentiometers and tachometers

Dart Controls, Inc. is a designer, manufacturer, and marketer of analog and digital electronic variable speed drives, controls, and accessories for AC, DC, and DC brushless motor applications.

Shown above is just a sampling of the expanded line of Dart controls that feature the latest in electronic technology and engineering. Products are manufactured in the U.S.A. at our Zionsville (Indianapolis, Indiana) production and headquarters facility - with over 2,000,000 variable speed units in the field.

In addition to the standard off-the-shelf products, you can select from a wide variety of options to customize controls for your specific application. For further information and application assistance, contact your local Dart sales representative, stocking distributor, or Dart Controls, Inc.

Dart Controls, Inc.

Manufacturer of high quality DC and AC motor speed controls and accessories since 1963.

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