ASP40 PLUS SERIES

DART CONTROLS

Instruction Manual

PROGRAMMABLE DIGITAL "CLOSED / OPEN LOOP" MOTOR SPEED CONTROL SYSTEM FOR AC AND DC DRIVES

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Quick Jump

What models and options are available?
See page 36.

Looking for detailed specifications?
See page 37.

Want to get started fast?
See basic electrical hook-up details on page 5.
See mechanical installation details on page 3.
See some sample applications starting on page 32.

Need Help?
See troubleshooting on page 35.

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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NOTE: This manual revision is applicable to Accu-Set *plus* software Version 14 and up. See pages 15 and 18 for information on determining the software version numbers of a particular unit.

Introduction

The Accu-Set *plus* 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, and provides a DC "speedpot" signal to an external "Drive". A flexible Open-Loop mode is also available for applications where using a speed pickup isn't practical or desired. The Accu-Set *plus* is easily configured to operate as a digital speed controller, time-based process controller, or a ratiometric follower controller in master-slave systems. Featuring Dart's new ModularBus expansion slot architecture, the Accu-Set *plus* is ideal for volume OEM Adjustable Speed Control applications requiring specialized inputs and outputs, such as our OPT420 optically-isolated 4-20mA I/O card that comes factory-installed in the ASP40-420 or our OPT51 Serial Interface card. Contact Dart Controls' Sales Department for details. The unique ModularBus expandability makes the Accu-Set *plus* series ideal for applications such as Water and Waste Treatment Systems, Conveyor Oven Controllers and Synchronized Conveyor Lines, to name a few.

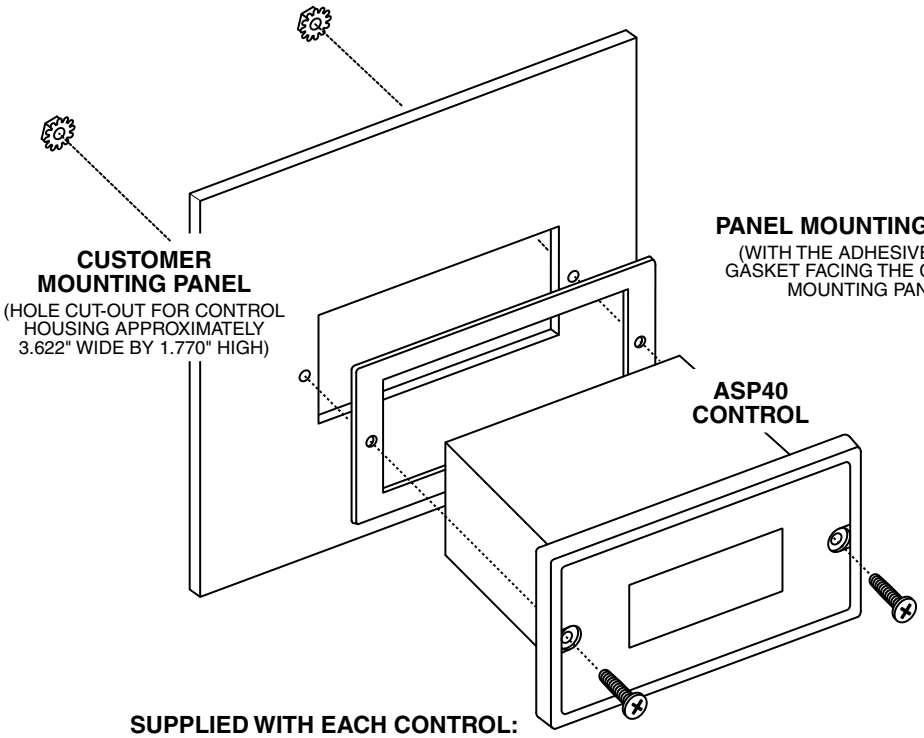
The ASP40's Durable 1/8 DIN NEMA 4/4X aluminum housings can be easily mounted in a panel or control cabinet. The new optional pluggable terminal block allows the user to quickly install or replace units without the hassle of physically removing and reattaching wires. The units can be ordered with either the standard European-style 5mm terminal block or the optional “pluggable” connector.

General Features

- Microprocessor-based design allows for incredible flexibility to suit your process control needs
- ModularBus expansion makes it possible for the Accu-Set *plus* to accomodate a wide variety of I/O
- Digital closed-loop algorithm ensures accuracy of $\pm$1/2 RPM of set speed or equivalent
- Digital open-loop operation available, where a speed pickup is impractical or undesired
- 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, alarm options, and more
- Internal program-enable jumper selectively prevents tampering with unit’s configuration
- Universal power supply accepts any line voltage inputs from 85-250VAC @ 50-60Hz without switches or jumpers. The unit automatically adjusts as needed.
- Transient voltage protection prolongs unit's life in harsh industrial environments
- Speed pickup input compatible with a variety of signal input types including: Hall-Effect Pickups, Photoelectric, TTL, etc. Note: Open collector devices must be capable of sinking at least 3mA
- Self-contained power supply for external speed pickups, limited to 5V @ 50mA
- Two separate programmable alarm outputs with Form C contacts (Note: 1 output standard; 2 outputs when OPT420 used)
- 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 4/4X rated aluminum housing with Polycarbonate membrane and gasket (which are included) meet NEMA 4X standards when used with NEMA 4X enclosures
- European-style 5mm terminal block or pluggable terminal block available
- cULus approval pending
- 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:
    - Master, Rate Mode – Controls in rate unit such as RPM, Gallons per Second, etc.
    - Master, Time Mode – Controls in time unit such as HH:MM, MM:SS, SS:TT, or other unit
    - Follower Mode – Controls in percentage of master rate. This mode allows the Accu-Set *plus* control to precisely follow the actions of a master process

Installation and Mechanical Dimensions

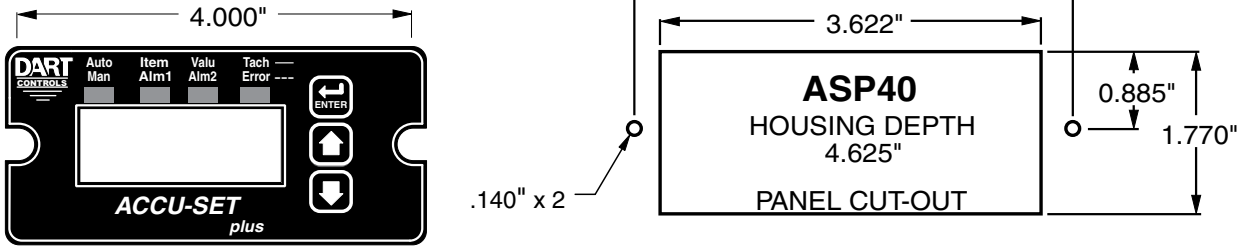
Exploded Panel View



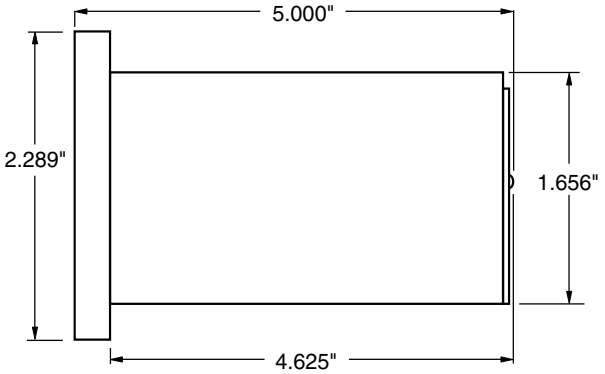
SUPPLIED WITH EACH CONTROL:

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



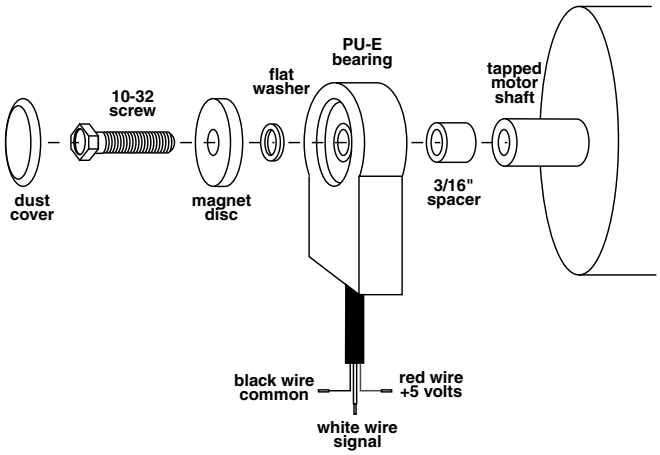
ASP40 Dimensions



PU-E Series Pickup Installation (*Required* for Closed-Loop Only)

The PU-E series pickup is an economical way to monitor motor speed. Its design provides for ease of installation in otherwise difficult to reach areas. The PU-E operates from a +5V power supply, producing a 5 volt square wave whose frequency is proportional to speed. This signal is fed into the Accu-Set *plus* control as a speed or position reference for the microprocessor.

Caution: The PU-E cord should not be grouped with other wires or cords. For applications with PU-E wire over 6 feet long, or noisy environments, a shielded cable is recommended. Connect the shield to the common terminal on the Accu-Set *plus*, leaving the shield on the PU-E end floating. (Note: see application note on website on how to add to cable length: http://www.dartcontrols.com/wp-content/uploads/2011/04/Longer-PU-Series-Cable.pdf)



CAUTION:
DO NOT OVER TIGHTEN MOUNTING SCREW !!

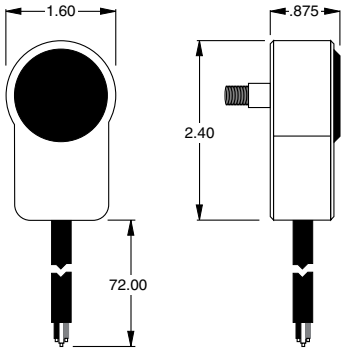
No other mounting screws are necessary, as the cord will keep the unit from rotating.

Model Number**	Pulses per Revolution[1]
PU-2E or PU-2R	1
PU-4E or PU-4R	2
PU-20E or PU-20R	10
PU-40E or PU-40R	20

** 'E' models are for indoor use and 'R' models are for wash down / outdoor use

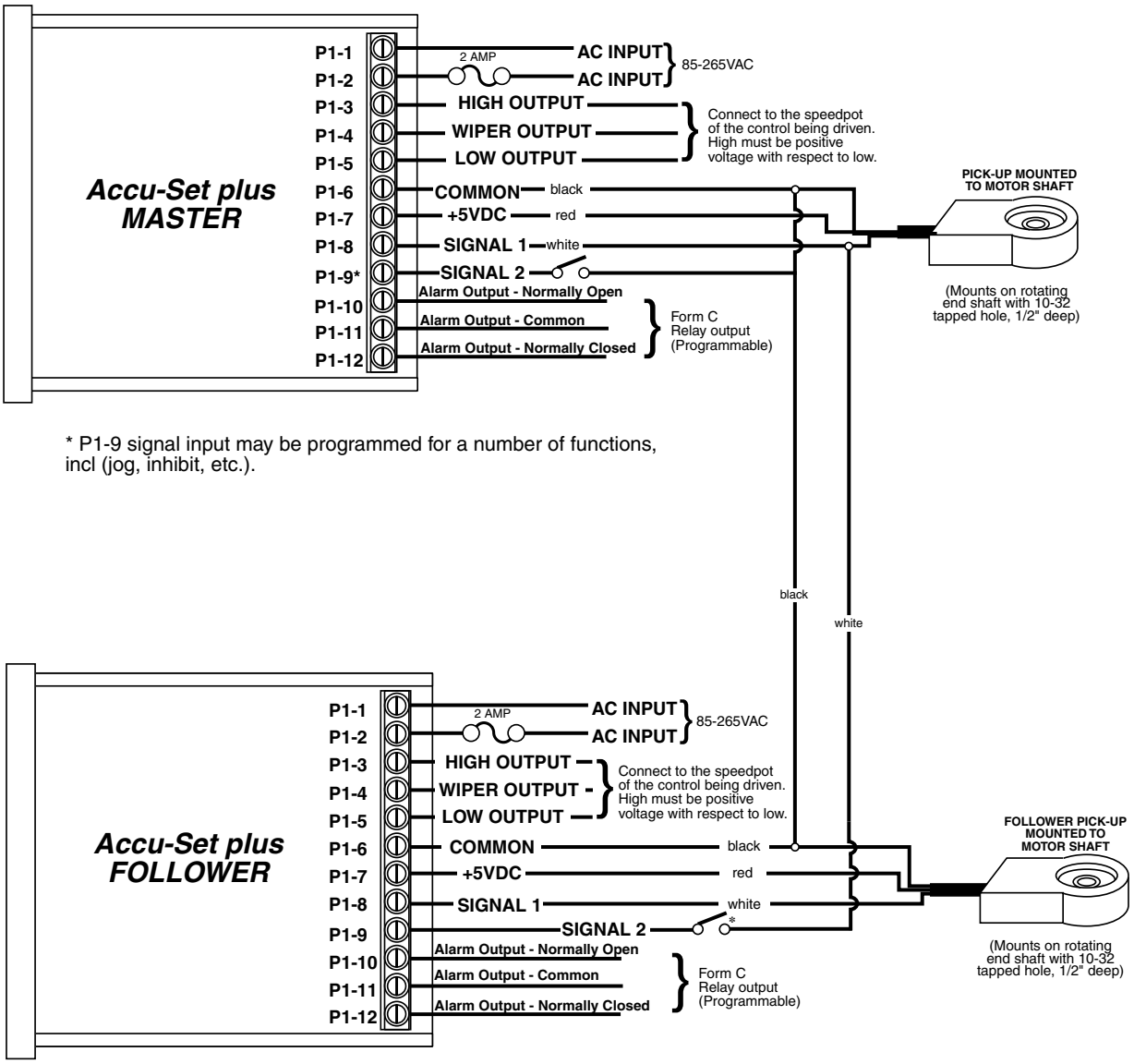
Note 1: It is recommended to use the highest possible pulse/revolution possible without exceeding maximum drive input capability

Dimensions



Electrical Installation & Diagrams

P1 Terminal Block Hook-Up Diagrams



NOTE: Speed Pickups shown above are not required for Open-Loop operation.

ASP40 P1 Terminal Block Descriptions

P1-1 (AC / N) – For single phase AC lines connect the Neutral side of your AC line to this terminal. For systems with two hot AC lines, connect either of the Hot AC lines to this terminal.

P1-2 (AC / L) – For single phase AC lines connect the Hot side of your AC line to this terminal. For systems with two hot AC lines, connect either of the Hot AC lines to this terminal.

P1-3 (HI) - This is the POT HI reference terminal. This terminal must be connected to the most positive speed pot input terminal of the "partner" Drive. This terminal will generally be referred to as Pot HI or +V for positive supplies and Com for negative supplies.

P1-4 (WP) - This is the Wiper output terminal. This terminal will output an analog voltage signal proportional to the reference voltages connected to P1-3 (HI) and P1-5 (LO). This terminal should be connected to the wiper or signal input of the partner Drive.

P1-5 (LO) - This is the POT LO reference terminal. This terminal must be connected to the most negative speed pot input terminal of the partner Drive. This terminal will generally be referred to as Pot LO or Com for positive supplies and –V for negative supplies.

P1-6 (COM) – This is the common point for the control logic. The speed sensor common lead as well as any other source needing to reference the control common will be connected to this terminal.

P1-7 (+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.

P1-8 (S1) – This is the signal input terminal for the motor's digital pickup or encoder (Closed-Loop only). This signal is internally "pulled-up" to +5VDC via a 2.2K ohm resistor.

P1-9 (S2) – This input can be programmed to perform a number of advanced functions. In Follower Mode, this input is the signal input terminal for the master's digital pickup or encoder. In Master modes (Rate and Time), this input can be configured to function as an emergency stop, inhibit, or jog command. This signal is internally "pulled-up" to +5VDC via a 2.2K ohm resistor.

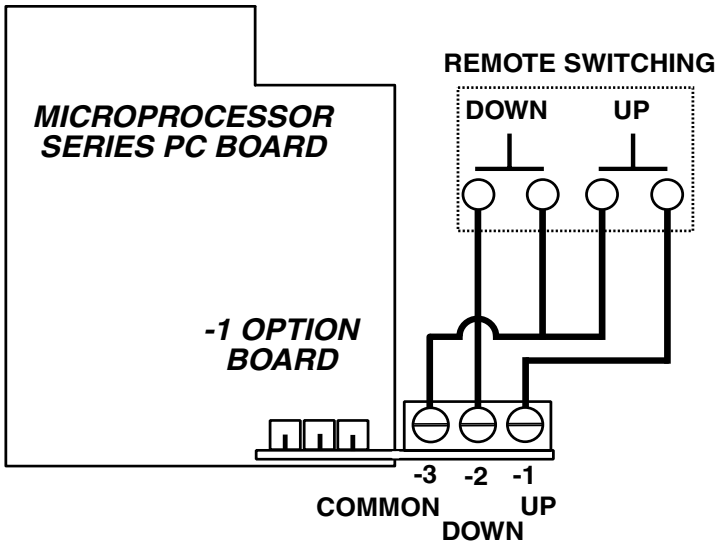
P1-10 (1NO) – This is the normally-open contact of the user assignable relay output.

P1-11 (1C) – This is the common contact of the user assignable relay.

P1-12 (1NC) – This is the normally-closed contact of the user assignable relay output.

-1 Option Wiring

The -1 option board is a module which allows external up and down push buttons to be wired to the unit. These buttons operate exactly like the Up and Down buttons on the user interface. This module is commonly used to allow PLCs or hand-held pendants to operate the front-panel remotely. The wiring for the external buttons is attached via a 3mm European terminal block on the -1 option board. The buttons are activated by connecting the terminal labeled Com to either the Up or Down terminal.



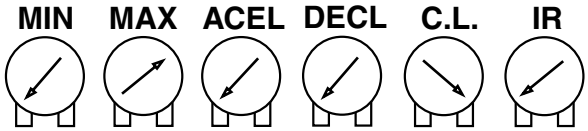
Basic Operating Instructions

Initial *Drive* Adjustments

Regardless of whether the Accu-Set *plus* is being used in Closed-Loop or Open-Loop operation, it is helpful to know how to set the typical "initial" adjustments on the "Drive" being controlled.

IMPORTANT: If the "Drive" that the ASP40 is controlling has a "Max Speed" or "Gain" setting, that will interact with the Accu-Set *plus* setup. Therefore, it is best to start with the Drive's "Max Speed" or "Gain" control set to about a 2/3 of its highest setting, as shown on the drawing below. If the Max Speed/Gain on the Drive is set too low, the ASP40 may not ever be able to attain the desired speed setting, and if it is set too high, it may be difficult or impossible to achieve stability, or in the worst case, the system may "hunt" or "oscillate". Also, if the Drive has Current Limit settings, during P-I-D "Tuning" (only), the Current Limit should, if at all possible, be set such that the Drive is not "in Current Limit". Further if the Accu-Set *plus* is in *Closed-Loop* operation, the Drive should never require "I.R. Comp", so set that control to minimum (and leave it there). Similarly, the ASP40 has both Accel and Decel, so those Drive settings should be set to minimum (and left there).

Initial Trimmer Settings



Note: Set C.L. appropriately *after* P-I-D Tuning!

Closed-Loop Control Algorithm Discussion and P-I-D Tuning

If the Accu-Set *plus* is configured for Closed-Loop operation, a true P-I-D speed control algorithm is employed, 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 150, "I" (Item 27) to 20, "D" (Item 28) to 10. 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: Generally speaking, 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.

Closed-Loop Master (Rate & Time) and Follower (Ratio) Modes

The Accu-Set *plus* controls have two basic modes of operation, master and follower. In the Master modes, the controls are capable of operating independently; whereas, in the Follower Mode, the control requires a signal from a master to operate. The Follower Mode is used in applications which require the Accu-Set *plus* to closely follow a master process. For example, if a factory has ten conveyors which must be synchronized over long periods of time, an industrial engineer could use one Accu-Set *plus* as a master control for the first conveyor and nine Accu-Set *pluses* as slaves or followers which would receive their speed commands from the first conveyor's master control or pickup.

In Master Rate Mode, the Accu-Set *plus* controls the rate of the motor by tracking the motor's pickup pulses which are applied to signal input 1 (S1). In this mode, the display indicates in rate units such as Gallons-per-minute, feet-per-second, or RPM.

In Master Time Mode, the Accu-Set *plus* controls the process time by tracking the motor's pickup pulses which are applied to signal input 1 (S1). 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.

In Follower Mode, the Accu-Set *plus* tracks the rate of the pulses which are applied to the master signal input (S2). From these pulses, it calculates the speed of the master process in RPMs. This rate is then multiplied by the percentage which is displayed on the user interface. The display is in 0.1% of master units. For example, 675 = 67.5 percent of master speed. A master running at 1350 RPM, would cause the follower to run its motor at 67.5% * 1350 RPM or 911.25 RPM. Typical follower applications include synchronized rotation, synchronized conveyors, and some web-material processes.

Open-Loop Control Algorithm Discussion and Setup

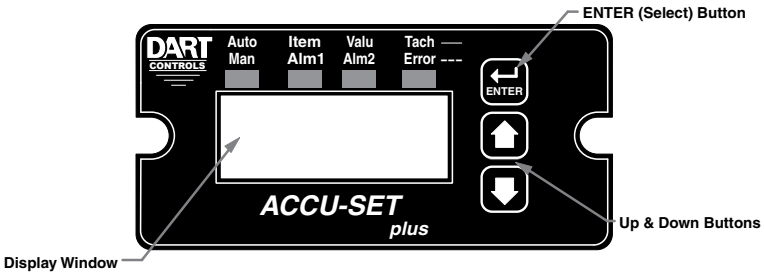
If the Accu-Set *plus* is configured for Open-Loop operation, the P-I-D control method described above is not used, nor is a Speed Pickup required. Instead, a control method is employed which is not based on "speed", but rather a "Percentage of Maximum" output voltage that will be developed across the "LO" and "WP" terminals (P1-5 and P1-4, respectively), which in turn is used to control the attached "Drive". In Open-Loop operation, the Accu-Set *plus* operates as a "Master" "Rate" (in this case, % of Max output) control *only*. Setting the "Operation Mode" (Item 10) to "Master Time" or "Follower" modes will result in unpredictable operation.

Setup consists of setting the "Motor Control Method" (Item 22) to a value of 32, plus the 4 Items that define the "scaling" of the output voltage. Two of the Items, "Display Min" (Item 20) and "Display Max" (Item 21) perform the same function as in Closed-Loop operation; that is, defining the "range" of valid "Engineering Units" to which the Accu-Set *plus* can be set. The other two Items "Output Percent Min" (Item 26) and "Output Percent Max" (Item 27) are used to define the Minimum and Maximum Output Voltage percentages that will be scaled across the "Engineering Units" range set by Display Min and Display Max, above. Items 26 and 27 represent values that define the Output percentages to "tenths of a percent" accuracy. In other words, a setting of "1000" actually means "100.0" (percent). Care should be taken that value in Item 21 is greater than the value in Item 20, and the value in Item 27 is greater than the value in Item 26.

Once the desired setup of the Accu-Set *plus* is achieved, "IR Comp" and "Current Limit" settings on the "Drive" that is being controlled by the Accu-Set *plus* should be adjusted according to the manufacturer's setup procedure and the requirements of the particular application.

TIP: Although not used to control the *Output* of the Accu-Set *plus*, A Speed Pickup (if available) can still be connected to *Display* "Actual" (Tach) Speed, and for "Actual Speed" Alarm Limits. Otherwise, those two functions should not be used in Open-Loop operation.

Front Panel 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 Accu-Set *plus* 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 Accu-Set *plus* 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, time, or (in "Follower" mode) percentage of Master. 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, time, and follower operating modes could be 13.60, 45:30, and 1000, respectively.

Additionally, the ASP40-420 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 Accu-Set *plus*.**

Detailed Configuration Instructions

Accu-Set *plus* Default Configuration

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

Closed-Loop Rate Mode Operation in RPM

S1 and S2 Signal Input Pulses per Revolution: 20 (to use a PU-40E)

Decimal Point Display: None

Display Range: 0 - 2400

Speed Range: 0 - 2400 RPM

Accel and Decel: 9999 RPM per second

Signal Input 2 (S2) Mode: Jog (JOG1) @ 1000 RPM when Low

Alarm 1 and Alarm 2 Outputs: Disabled

Resetting the Accu-Set *plus* 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 Item 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" from the front panel user. When the jumper is in the "On" position, the programming Items are open to change. JP1 is shipped from the factory set in the "On" position.

Setting and Reading "SoftSwitches"

Like many other devices, the Accu-Set *plus* 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 Accu-Set *plus*. There are two problems with this appraoch 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 Accu-Set *plus* 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**		

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" posiition, 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 above, the Accu-Set *plus* 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 "Pickup 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

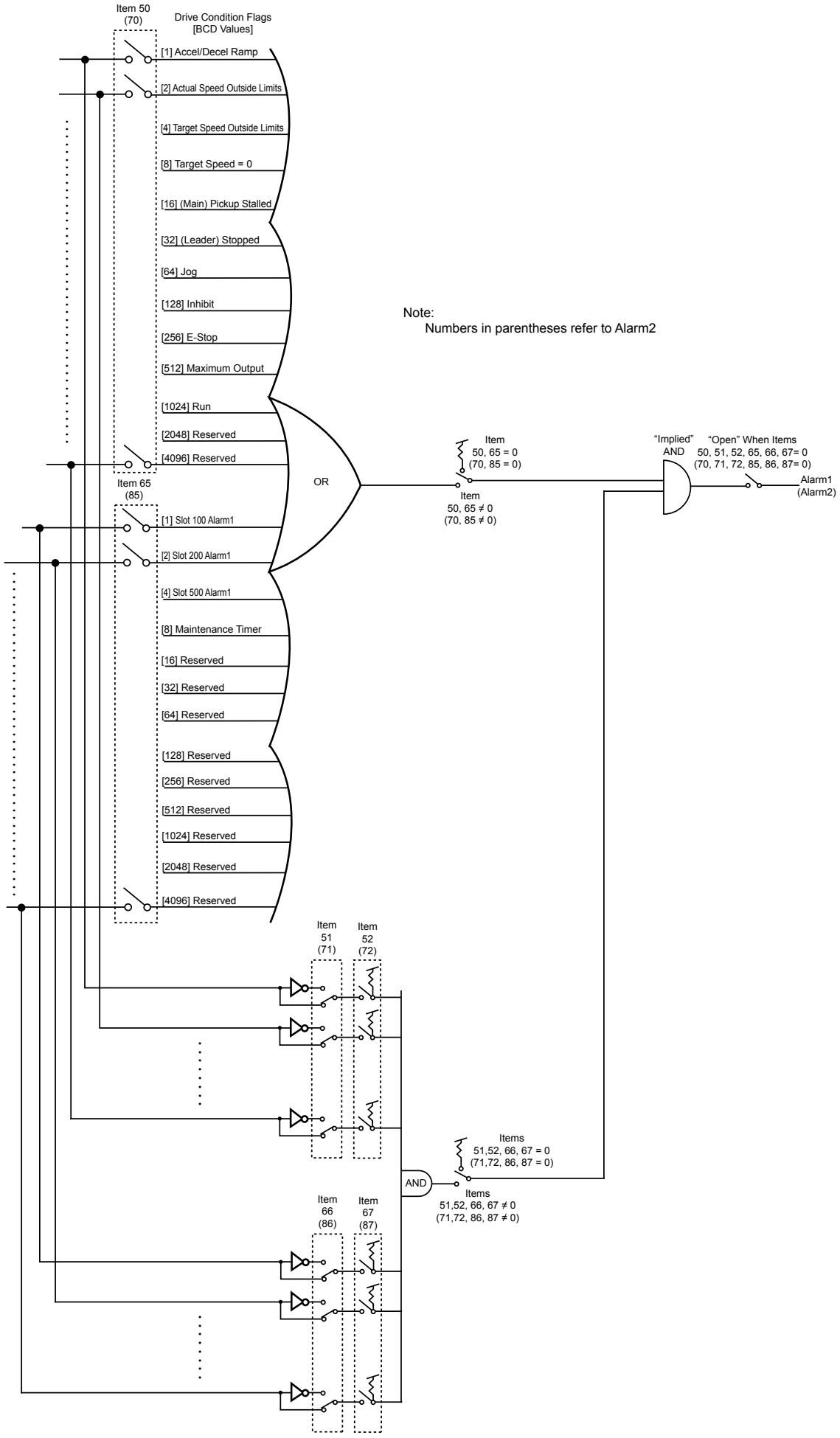
The "output" of Alarm1 is permanently "routed" to control the Form-C Relay output on the Accu-Set *plus* itself (see Hook-up Diagram, P1-9 through P1-11). The "output" of Alarm2, however, can be *Routed* (through the use of Item 81) to control a Relay located in any one of the three ModularBus "slots", 100, 200 or 500.

Accu-Set *plus* 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 (or 70 for Alarm2) 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 32 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)
Items
51,52, 66, 67 = 0
(71,72, 86, 87 = 0)
AND
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	46 = ASP40	—	46	n/a
2	Software Version	1 – 9999	—	n/a	n/a
3	Hardware Version	1 – 9999	—	n/a	n/a
4	DartNet Version	1-9999	—	n/a	n/a
5	Serial Number (Major)	0-9999	—	n/a	n/a
6	Serial Number (Minor)	0-9999	—	n/a	n/a
8	Drive Condition Flags	(See “Flags” Table 1)	BCD	n/a	n/a
9	Drive Condition Flags	(See “Flags” Table 2)	BCD	n/a	n/a
	General Setup Items				
10	Operating Mode	1 = Rate Mode 2 = Time Mode 3 = Follower Mode	—	1	
11	Display Brightness	0 – 31 (Dim – Bright)	—	26	
12	Display Mode	1 = Target Speed Display 2 = S1 Actual Speed Display 3 = S2 (Leader) 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 = Jog1 4 = Jog 2 5 = Auto/Man 4-20mA Card	—	0	
19	Output Invert	0 = Normal 1 = Inverted	—	0	
	Control Loop Items				
20	Display Minimum	0 – 9998	(Eng. Units)	0	
21	Display Maximum	1 – 9999	(Eng. Units)	2400	
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 31 DO NOT USE! 32 = “Open Loop” Operation (see pg. 10)	—	1	
23	Accel Setting	1 – 9999	(Eng. Units)	9999	
24	Decel Setting	0 – 9999	(Eng. Units)	9999	
26	**P**roportional Gain[1] (Output % Min)[2]	0 – 9999	—	150	
27	**P**roportional Gain[1] (Output % Min)[2]	0 – 9999	—	20	
28	**D**erivative Gain[1]	0 – 9999	—	10	
29	Startup Lag Compensation	0 – 5000	—	0	

Software Parameters (Items), cont'd

Item	Description	Value Range	Units	Factory Default	User Setting
	Signal Input #1 Setup Items				
30	S1 Display Reference[3]	1 – 9999	(Eng. Units)	2400	
31	S1 Reference RPM[3]	1 -9999	RPM	2400	
32	S1 Pulses Per Revolution[3]	1 – 9999	PPR	20	
33	S1 Inital Stall Timeout[3]	0, 5 – 9999 (0 = Defeat)	Sec.	0	
34	Signal Input 1 (S1) Running Stall Timeout[3]	0 – 9999 (0 = Defeat)	1/10 Sec.	0	
	Signal Input #2 Setup Items				
35	S2 Input Configuration	1 = Disabled (Use for Follower Mode) 2 = E-Stop When S2 High 3 = E-Stop When S2 Low 4 = Inhibit When S2 High 5 = Inhibit When S2 Low 6 = Jog When S2 High 7 = Jog When S2 Low	—	7	
36	Setpoint for Jog1 Function	1 – 9999	(Eng. Units)	1000	
37	S2 Pulses Per Revolution (Follower Only) [1]	1 – 9999	PPR	20	
38	S2 Stopped Timeout (Follower Mode Only) [1]	0 – 9999 (0 = Defeat)	1/10 Sec.	0	
39	Disable S2 in Manual Mode	0 = Disabled 1 = Enabled	—	0	
40	UIN1 Input Configuration	1 = Disabled	—	1	
41	Setpoint for Jog2 Function	1 – 9999	(Eng. Units)	1000	
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 = 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	
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	

Software Parameters (Items), cont'd

Item	Description	Value Range	Units	Factory Default	User Setting
	Alarm Output #1 Setup Items (con't)				
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	
	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 ASP40 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

NOTE 1: Closed-Loop Operation only; NOTE 2: Open-Loop Operation only; NOTE 3: Requires a Speed Pickup

Software Parameters (Items), cont'd

Item	Description	Value Range	Units	Factory Default	User Setting
	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 1 = Slot 200 2 = Slot 500	—	1	
121	Follower Target Source	1 = Pickup 2 = Slot 100 3 = Slot 200 4 = Slot 500	—	1	
122	Follower Percent Source	1 = Slot 100 2 = Slot 200 3 = 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 ASP40 is 46. In this manual, where appropriate, the "Controller" portion of this product is referred to as the "Accu-Set *plus"*.

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 "Flags" table on page 14 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 "Flags" table on page 15 for the BCD values.

Item 10 – Operating Mode
This Item defines the operating mode for the entire unit. There are two basic modes of operation, master and follower. In master modes, the unit controls the load using either rate or time units. In follower mode, the unit controls the load in percentage of master rate.

NOTE: Power must be removed and re-applied to the Accu-Set *plus 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 Accu-Set *plus*:

Mode 1 – Master, Rate Mode
In Rate Mode, the Accu-Set *plus* displays in user-defined rate "Engineering Units" such as RPM, Gallons per Hour, or Feet per Second.

Mode 2 – Master, Time Mode
In Time Mode, the Accu-Set *plus* 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. Do not use this mode in Open-Loop operation (see pg. 10).

Mode 3 – Follower Mode
In Follower Mode, the Accu-Set *plus* displays in percentage units, where 1000 equals 100.0 percent of the master rate. For example, if the display indicates 985, 98.5, or 9.85, the Accu-Set *plus* will attempt to run at exactly 98.5 percent of the master rate. Display settings are always entered ignoring the decimal point's position. Do not use this mode in Open-Loop operation (see pg. 10).

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 Accu-Set *plus* is used in the same panel as other pieces of equipment with LED displays and a uniform display brightness is desired. Simply adjust the Accu-Set *plus* to match its surroundings.

Item 12 – Display Mode
This Item selects what the Accu-Set *plus* 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 or 3 (Main Tach or Leader Tach, respectively), pressing the ENTER button will briefly show the Target Speed/Time.

The following Display Modes are available for the Accu-Set *plus*:

Mode 1 – Target Speed/Time Display
In Rate Mode, the Accu-Set *plus* displays the Target Speed in user-defined rate Engineering Units such as RPM, Gallons per Hour, or Feet per Second. In Time Mode, the Accu-Set *plus* displays the Target Time in time units using the format AA:BB. In Follower Mode, the Accu-Set *plus* displays the Target Speed in percentage units, where 1000 equals 100.0 percent of the Master rate.

Mode 2 – S1 (Main Pickup) Actual Speed (Tach) Display
In Rate Mode, the Accu-Set *plus* displays the Actual Speed in user-defined rate Engineering Units such as RPM, Gallons per Hour, or Feet per Second. In Time Mode, the Accu-Set *plus* displays the Actual Time in time units using the format AA:BB. In Follower Mode, the Accu-Set *plus* displays the Actual Speed in percentage units, where 1000 equals 100.0 percent of the Master rate.

Mode 3 – S2 (Leader) Actual Speed (Tach) Display

Mainly useful for diagnosing and setup of Master-Follower applications, selecting this Mode shows the Leader Speed (on the S2 Input) in RPM Units (only).

Item 13 – Decimal Point (DP) Position (used in Rate and Follower Modes 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 Accu-Set *plus*.

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 Accu-Set *plus*.

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 Control is in "Run" Mode will place the Control in Inhibit, obeying the "acel/decel rules" found in Item 42. Additionally, if the S2 input is set up to provide Inhibit control, it is active as well, with the following rules. Either the DoubleClick and/or S2 can cause the control to go into Inhibit, but both the DoubleClick AND S2 have to be "negated" (set to allow the control to "run") before the control will exit "Inhibit" mode and begin to "run" normally again. **Note that the DoubleClick action works as a "toggle"**, so the operation could be somewhat confusing if S2 is "routed" to the Inhibit, along with the DoubleClick, but this behavior is necessary for "safety" reasons.

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

Mode 3: Route DoubleClick to Jog1
Same as Mode 1, but DoubleClick is Routed to the Jog1 function, causing the control to temporarily run at the Target Speed in Item 36. See, also, Item 36.

Mode 4: Route DoubleClick to Jog2
Same as Mode 1, but DoubleClick is Routed to the Jog2 function, causing the control to temporarily run at the Target Speed in Item 41. See, also, Item 41.

Mode 5: Auto/Manual 4-20mA Card
Same as Mode 1, but DoubleClick switches the drive from manual to auto or vice versa and in manual mode the front keypad has control. The Auto/Man Annunciator indicates what mode the control is operating.

Item 19 – Output Invert
This Item controls whether the "wiper" output (WP) signal of the ASP40 (P1-4) moves toward the POTHI voltage applied to P1-3 ("Normal"), or toward the POTLO voltage applied to P1-5 ("Inverted"), as the ASP40 attempts to make the motor speed *increase*. See, also, ASP40 P1 Terminal Block Descriptions, pg. 5.

Mode 0: Normal Output

Mode 1: Inverted Output

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. In Follower Mode, this is set in percentage (actually, 10ths of percentage) of the master rate. For example, in Follower Mode, a Target of 150 represents 15.0 percent of the master rate.

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. In Follower Mode, this is set in percentage (actually, 10ths of percentage) of the master rate. For example, in Follower Mode, a Target of 1250 represents 125.0 percent of the master rate.

Item 22 – Motor Control Method
This Item controls three behaviors in the Accu-Set *plus:* In Closed-Loop operation (values < 32), this Item enables/disables Low-Speed "Gain-Tracking" and/or Ultra-Low-Speed Control Mode ("gearbox" mode). In addition, **when set to a value of 32, this Item enables Open-Loop operation, but when set to a value of 0 through 3, this Item enables Closed-Loop operation**.

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 Accu-Set *plus* 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 that you may consider enabling this Mode if that shaft is turning less than 10 RPM, and the pickup produces less than 10 Pulses Per Revolution (PPR). Use this Mode only if speed stability can not be achieved by adjusting the PID settings (Items 26 – 28).

Closed-Loop Modes:

Mode 0: Disabled
Closed-Loop operation enabled. Both Low-Speed-Gain-Tracking and Ultra-Low-Speed Control Mode are Defeated.

Mode 1: Low-Speed-Gain-Tracking (Only) Enabled
Closed-Loop operation enabled. Low-Speed-Gain-Tracking is Enabled, Ultra-Low-Speed Control Mode is Defeated.

Mode 2: Ultra-Low-Speed Control Mode (Only) Enabled
Closed-Loop operation 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
Closed-Loop operation enabled. Both Low-Speed-Gain-Tracking and Ultra-Low-Speed Control Mode are Enabled.

Modes 4-31: Unused

Open-Loop Modes:

Mode 32: Open-Loop operation Enabled
This is the "Master Enable" for Open-Loop operation. See the “Basic Operating Instructions” section of the manual for more details.

Item 23 – Acceleration Setting

This Item determines how fast the Accu-Set *plus* 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. In Follower Mode, this Item is set in RPM units.

Item 24 – Deceleration Setting

This Item determines how fast the Accu-Set *plus* 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. In Follower Mode, this Item is set in RPM units.

Item 26 – Closed-Loop Proportional (P) Gain / Open-Loop Output Percentage Minimum

Closed-Loop Operation (Item 22 set to a value < 32)
In Closed-Loop operation, 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 Accu-Set *plus* 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.

Open-Loop Operation (Item 22 set to a value = 32)
In Open-Loop operation, this Item sets the percentage (from 0% to 100.0%) of the voltage supplied across the LO (P1-5) and HI (P1-3) terminals that will be Output across the LO (P1-5) and WP (P1-4) terminals when the Target "Speed" setting is equal to (or less than) the Display Minimum (Item 20). See the “Basic Operating Instructions” section of the manual for more details.

Item 27 – Closed-Loop Integral (I) Gain / Open-Loop Output Percentage Maximum

Closed-Loop Operation (Item 22 set to a value < 32)

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.

Open-Loop Operation (Item 22 set to a value = 32)

In Open-Loop operation, this Item sets the percentage (from 0% to 100.0%) of the voltage supplied across the LO (P1-5) and HI (P1-3) terminals that will be Output across the LO (P1-5) and WP (P1-4) terminals when the Target "Speed" setting is equal to (or greater than) the Display Maximum (Item 21). See the “Basic Operating Instructions” section of the manual for more details.

Item 28 – Derivative (D) Gain (Unused in Open-Loop operation)

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 29 – Startup Lag Compensation

Somewhat analogous to a “Min. Speed” control on analog motor speed drives, this sets a “minimum output” that is applied as soon as the Target Speed is above Zero RPM. Careful use of this setting can help with “stiction” (the tendency for motors to require a bit more “oomph” to “break free” when starting from a dead stop). However, values that are too high may make the motor “creep” or even be unable to attain a desired target speed. In Follower Mode, this setting can also help the Follower start up in better “sync” with the Leader.

Item 30 – Signal Input 1 (S1) (Main Pickup) Display Reference (Speed Pickup Required)

This is **the number to be displayed when at the user-specified motor Reference <u>RPM</u>**. 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. In Follower Mode, this value is the percentage of the master rate in 0.1% units. For example, 1000 equates to 100%.

Item 31 – Signal Input 1 (S1) Reference RPM (Speed Pickup Required)

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. In Follower Mode, this value is not used.

Item 32 – Signal Input 1 (S1) Pulses per Revolution (Speed Pickup Required)

This sets the number of pulses per revolution for the signal input 1 (S1). The Accu-Set *plus* supports pickups and encoders from 1 to 9999 pulses per revolution.

Item 33 – Signal Input 1 (S1) Initial Stall Timeout (Speed Pickup Required)

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 pickup pulse before the MD *plus* 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, 52, 70, 71, or 72.)

Item 34 – Signal Input 1 (S1) Running Stall Timeout (Speed Pickup Required)
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 pickup pulses before the MD *plus* 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, 52, 70, 71, or 72.)

Item 35 – Signal Input 2 (S2) Input Configuration
This Item determines the operating mode of signal input 2 (S2).

Mode 1: Disabled (Follower Mode)
The S2 input is inactive. This is the required setting for Follower Mode.

Mode 2: Emergency Stop When S2 High (Not Wired To Common)
When the S2 input is at an electrically high (+5V) state or allowed to float disconnected, the Accu-Set *plus* will enter emergency-stop mode. While in this mode, the "wiper" output will immediately be turned off. Once the S2 input returns to an electrically low state or wired to the unit’s common, the output will become active.

Mode 3: Emergency Stop When S2 Low (Wired To Common)
When the S2 input is at an electrically low state or wired to the unit’s common, the Accu-Set *plus* will enter emergency-stop mode. While in this mode, the "wiper" output will immediately be turned off. Once the S2 input returns to an electrically high (+5V) state or allowed to float disconnected, the output will become active.

Mode 4: Inhibit When S2 High (Not Wired To Common)
When the S2 input is at an electrically high (+5V) state or allowed to float disconnected, the Accu-Set *plus* will enter inhibit mode. While inhibited, the "wiper" output will decrease according to the decel setting until zero output is reached. Once the S2 input returns to an electrically low state or is wired to the unit’s common, the output will start to accelerate toward the previous running value.

Mode 5: Inhibit When S2 Low (Wired To Common)
When the S2 input is at an electrically low state or wired to the unit’s common, the Accu-Set *plus* will enter inhibit mode. While inhibited, the "wiper" output will decrease according to the decel setting until zero output is reached. Once the S2 input returns to an electrically high (+5V) state or allowed to float disconnected, the output will start to accelerate toward the previous running value.

Mode 6: (JOG1) Jog When S2 High (Not Wired To Common)
When the S2 input is at an electrically high (+5V) state or allowed to float disconnected, the Accu-Set *plus* will enter JOG1 mode. While in JOG1 mode, the display will immediately change to the programmed JOG1 setpoint, Item 36. The unit will start accelerating or decelerating toward the JOG1 setting at the configured accel and decel rates. Once the S2 input returns to an electrically low state or is wired to the unit’s common, the output will start to accelerate or decelerate toward the previous running value. In Follower Mode, the unit will operate as its own master. This allows an application to jog by overriding a stopped master.

Mode 7: (JOG1) Jog When S2 Low (Wired To Common)
When the S2 input is at an electrically low state or wired to the unit’s common, the Accu-Set *plus* will enter JOG1 mode. While in JOG1 mode, the display will immediately change to the programmed JOG1 setpoint, Item 36. The unit will start accelerating or decelerating toward the JOG1 setting at the configured accel and decel rates. Once the S2 input returns to an electrically high (+5V) state or allowed to float disconnected, the output will start to accelerate or decelerate toward the previous running value. In Follower Mode, the unit will operate as its own master. This allows an application to jog by overriding a stopped master.

Item 36 – Signal Input 2 (S2) Setpoint for JOG1 Function
When the S2 configuration, Item 35, is set to one of the JOG1 modes, this Item defines the JOG1 setpoint in engineering units. If the Accu-Set *plus* operating mode is set to Follower Mode, then this Item is set in RPM units. This allows a follower control to be jogged when the master is stopped.

Item 37 – Signal Input 2 (S2) ("Leader") Pulses per Revolution (for Follower Mode Only)
When in Follower Mode, this is the number of pulses per revolution for the signal input 2 (S2) used as the "Leader" input. The Accu-Set *plus* supports pickups and encoders from 1 to 9999 pulses per revolution (PPR). This is Unused in Open-Loop operation.

Item 38 – Signal Input 2 (S2) Leader Stopped Timeout (Follower Mode Only)
When the Target Speed (percentage) is above zero, this Item determines the maximum time in units of 0.1 seconds that can elapse after the *last* S2 (Leader) pickup pulse before the Accu-Set *plus* considers the Leader as "stopped". Setting this value too low may result in unstable low-speed "following". Setting it too high may result in Follower "run-on". A value of zero defeats this timeout. Unused in Open-Loop operation.

Item 39 – Disable Signal Input 2 (S2) in Manual Mode
When setting this item to a value of 1, the S2 will be disabled when the unit is put into manual mode. If the value is set to 0 then the S2 will work in both manual and auto modes.

Item 40 – User Input 1 (UIN1) Configuration
This Item determines the operating mode of user input 1 (UIN1).

Mode 1: Disabled
The UIN1 input is inactive.

Item 41 – User Input 1 (UIN1) Setpoint for JOG2 Function
When the UIN1 configuration, Item 40, is set to one of the JOG2 modes, this Item defines the JOG2 setpoint in engineering units. If the ASP *plus* operating mode is set to Follower Mode, then this Item is set in RPM units. This allows a follower control to be jogged when the master is stopped.

Item 42 – Inhibit Configuration
This Item determines the accel/decel profile of the Accu-Set *plus* 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 Accu-Set *plus* will immediately shut off its "wiper" output, disregarding any Decel setting, and when coming out of Inhibit, the Accu-Set *plus* 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 Accu-Set *plus* will Decel to a stop using the setting in Item 24, but when coming out of Inhibit, the Accu-Set *plus* will immediately return to its Target Speed, disregarding any Accel setting.

Mode 2: Accel Only, No Decel
When going into Inhibit, the Accu-Set *plus* will immediately shut off its "wiper" output, disregarding any Decel setting, but when coming out of Inhibit, the Accu-Set *plus* 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 Accu-Set *plus* will Decel to a stop using the setting in Item 24, and when coming out of Inhibit, the Accu-Set *plus* 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 Condition Flags. A setting of zero defeats this "OR" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" 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 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" 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 Condition Flags. A setting of zero defeats this "AND" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" 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: 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 ceases 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 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 Alarm 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 Alarm 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 and Follower Modes, 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 and Follower Modes, 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 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" 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" 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" 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 Condition Flags. A setting of zero defeats this "OR" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" 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 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" 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 Condition Flags. A setting of zero defeats this "AND" function entirely. Please see the sections "Setting and Reading Softswitches" and "Setting Alarm Conditions" 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 and Follower Modes, 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 and Follower Modes, 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 Accu-Set *plus* 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 Accu-Set plus 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 Accu-Set plus 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 Accu-Set plus 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" 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" 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" 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 Accu-Set *plus,* 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 Accu-Set *plus* (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 96 – Factory Default ModularBus Card Command
When set to the desired ModularBus Slot number (100, 200, 500) and the ENTER button is pressed, the Default settings for that ModularBus card's Items will be copied to the selected Slot's "partition" in the non-volatile storage of the Accu-Set *plus*. **THIS ACTION CANNOT BE UNDONE!** Note that the Item settings for a particular ModularBus card are actually stored on its "host" Accu-Set *plus*, rather than on the ModularBus card itself. The advantage of this is that if a ModularBus card fails, a replacement can be quickly installed without having to be (re)configured, provided it is installed in the same Slot.

The valid values for this Item are:

Mode 100: Restore Factory Defaults for card in ModularBus Slot 100
Assumes there is a card in Slot 100.

Mode 200: Restore Factory Defaults for card in ModularBus Slot 200
Assumes there is a card in Slot 200.

Mode 500: Restore Factory Defaults for card in ModularBus Slot 500
Assumes there is a card in Slot 500.

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 Accup-Set *plus* 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 Accu-Set *plus* 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 Accu-Set *plus* (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.

Item 121 – Follower Target Source
This setting defines where the follower gets its target speed.

Item 122 – Follower Percent Source
When the control is in follower mode, this determines what controls the percent of Master setting.

Application Example

SCADA-driven Closed-Loop Pump Controller with 4-20mA I/O, plus"Fault" and "Run" Relay Outputs

Description:

An Accu-Set *plus* (with OPT420 installed) waste pump control connected to a SCADA system to receive its target speed setting from the SCADA's 4-20mA output. The Accu-Set *plus* will display the actual pump rate in liters per minute, and will also continuously report the pump's actual rate to the SCADA system using the OPT420's 4-20mA output. The display should indicate in the format "xxx.x" (LPM). The output of the Accu-Set *plus* will control a third-party AC drive connected to a 30HP AC induction motor.

System features a visual alarm (Annunciator) and dry relay contact output which will warn the operator if any of the following "Fault" conditons have occurred: Actual or Target speed is outside specified limits, the waste flow has stopped, the Accu-Set plus is at maximum output, or the 4-20mA input signal has dropped below about 3mA (loop broken). Additionally, the "Fault" alarm will not activate if the Target speed is zero, the "Inhibit" input is active, or an accel/decel ramp is in progress. The alarm should not be able to be silenced but should automatically reset when flow rates have returned to normal.

Additionally, the system will provide a "Run" signal (as a dry relay contact) back to the SCADA to signal that the pump is indeed running (or not, as commanded by the SCADA).

Motor, Pump and Flowmeter Specifications and Alarm Limits:

Pump Output: 9.5 shaft rotations/liter

Flow Transducer: 73 pulses/liter

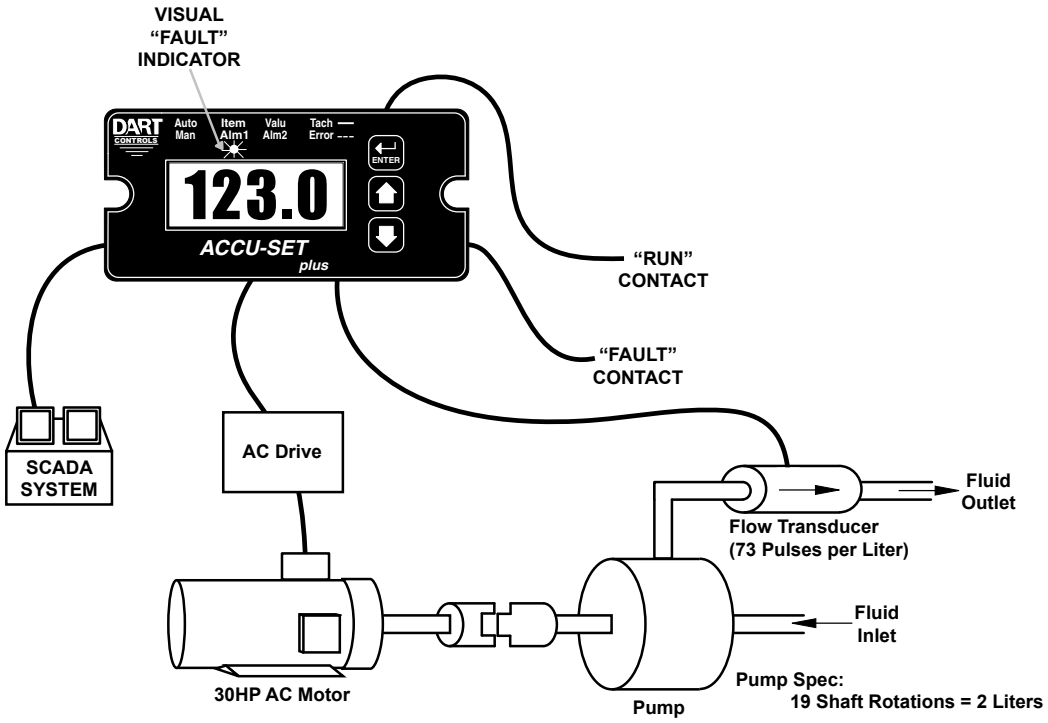
Desired Min. Flow Rate: 20 liters/minute, Max: 150 liters/minute

Alarm Min.10 liters/minute, Max: 180 liters/minute

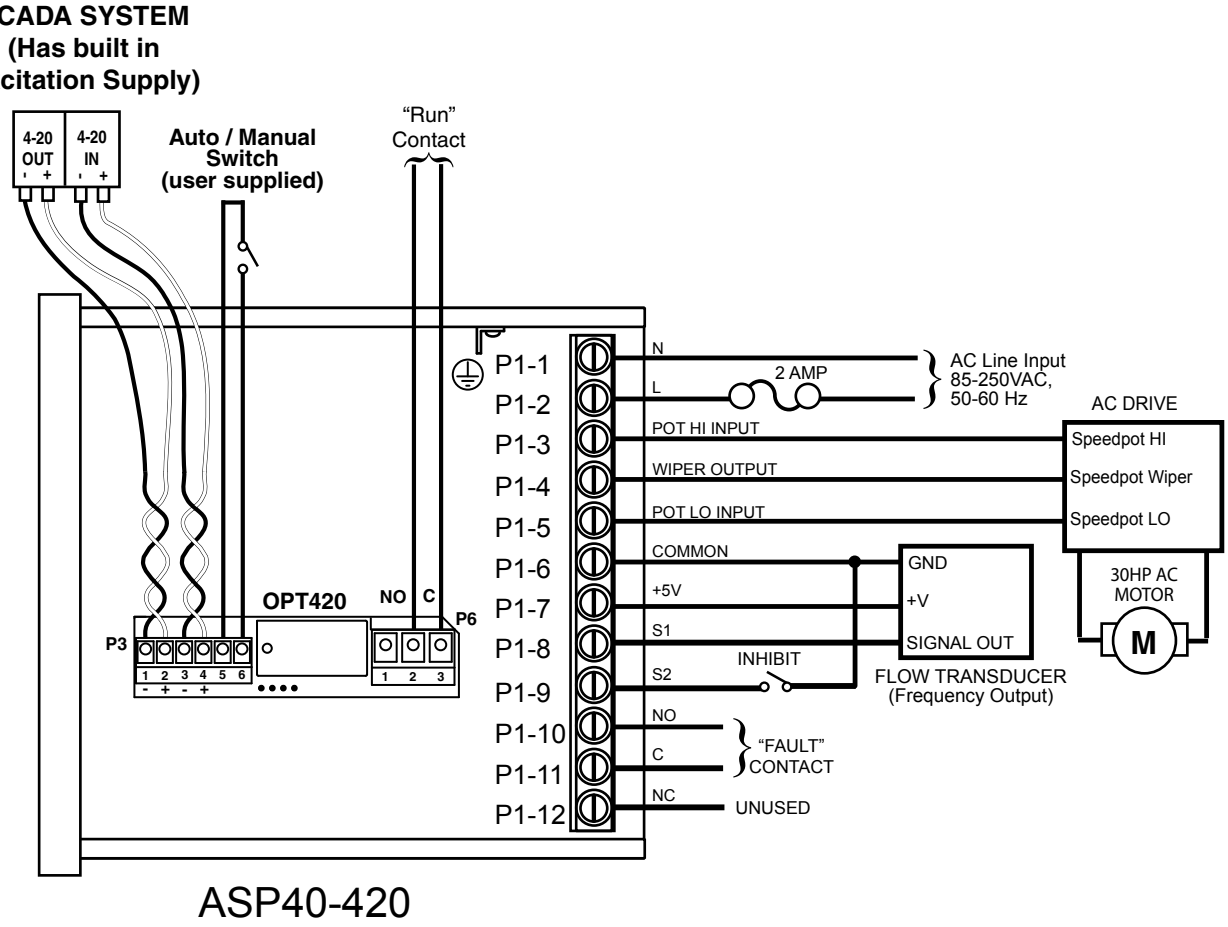
Accel Rate: 100 liters/minute, Decel Rate: 50 liters/minute

SCADA 4-20mA scaling (both input and output): 4mA = zero LPM, 20mA = 200 LPM

Application Diagram:



Wiring Diagram:



ASP40-420

Relevant Math and Various Other Settings for this Application:

Since the pump is 9.5 "shaft rotations" per Liter, and the max. desired flow rate is 150.0 LPM, and the motor is a 1:1 drive, that means the motor speed at 150.0 LPM will be 9.5 X 150.0, or 1,425 RPM., to which we will set Item 31, S1 Reference RPM.

Next, Item 30, Display Reference will be set to "1500", which is what we want the display to read (disregarding the decimal point) when the motor is running at our Reference speed of 1,425 RPM.

Since we already know that the Flow Transducer has a pulse output rate of 73 pulses per liter, all we need to do is set Item 32, S1 Pulses Per Revolution, (which in this case, is somewhat mis-named) to 73. That way, the controller is "thinking" in LITERS per minute, but "controlling" the motor in REVOLUTIONS per minute.

The Accel and Decel rates are expressed in "Display Units" (Engineering Units) per second, so we have to divide our desired accel and decel rates by 60. Therefore, we will set Item 23, Accel Setting, to 17, which is 1000 (100.0 disregarding the decimal point) / 60 (and rounded up), and Item 24, Decel Setting, to 8, which is 500 (50.0) / 60.

Even though not really "math", let's talk about the BCD settings for the "Fault" conditions, which are used to control the Alarm1 relay. The application requires that a "Fault" condition is "true" (active) when Actual Speed is Outside Limits, *OR* Target Speed is Outside Limits, *OR* waste flow has stopped (Main Pickup (Flowmeter) Stalled), *OR* the Accu-Set *plus* is at Max. Output, *OR* the 4-20mA Input loop appears "broken". Consulting the table on page 14, sees that Item 50, Alarm1 *OR* Conditions, needs to be set to a value of 2 + 4 + 16 + 512, which equals 534 and Item 65, Alarm1 *OR* Conditions set to 1.

Conversely, the "Fault" output is wanted to *NOT* activate if any of the following conditions are true: Target speed (either through the 4-20mA input or the "front panel") is set to zero, *OR* an accel/decel ramp is in progress, *OR* an "Inhibit" input is active (S2 will be set for use as an Inhibit input). But you say "Wait! We already set the "OR" conditions! How do we do this?"

Here is where the magic of "negative logic" comes in: remember that "*NOT*" above? That implies that we will be using the "inverters" (Item 51 in the case of Alarm1), and the trick is, in negative-logic-land,

a "Positive Logic" *AND* is actually a "Negative Logic" *OR*. So, to set up that "but *NOT* if this *OR* this *OR* this" condition, we simply set both the Inverters (Item 51 for Alarm1) as well as the *AND* conditions (Item 52 for Alarm1) to the BCD sum of the "Flags" we wish to consider. Therefore, again consulting the table on page 14, we should set Items 51 and 52 to a value of 137, which is the BCD sum of 1 + 8 + 128.

Referring to the "Alarm Logic" diagram on page 15, you will see an additional "implied" *AND* function that "*AND*s" the result of the *OR* as well as the *INVERT-AND* "cascade". Since an "AND" function is controlled by a "false" condition, (and since a logic "high" is "true"), you can see that any of the conditions selected in the *INVERT-AND* cascaded logic will make the result (output) be false (low), thus preventing any of the *OR*'d conditions from causing Alarm1, which we are using as our "Fault" relay, to activate.

It is important to note that as shown by the Alarm Logic diagram on page 15, when Item 50 (or 70 for Alarm2) is set to zero, the "Implied *AND*" is effectively "removed", thus allowing for "*AND*-only" Alarm condition logic. *OR*-only alarm logic is accomplished by setting both Items 51 and 52 (or 71 and 72 for Alarm2) to zero, which disconnects the output of the *INVERT-AND* logic, and instead substitues a "pull up" to a "logic true" (high) level, which satisfies the "Implied *AND*", and allows the *OR* conditions to control the Alarm output exclusively.

The BCD programming for Alarm2, which we are using to control the relay on the OPT420 to form a "Run" output, is much simpler. The Accu-Set *plus* has an "already cooked" "Run" condition (see Table, page 14), which is true (active) when the Target Speed is greater than zero, AND the main pickup has received at least one pulse. Therefore, set Item 70, the Alarm2 "*OR*", to the "Run" condition's BCD value, 1024. Items 71 and 72 are set to zero. To have the OPT420's relay output to be controlled by our "Run" condition (Alarm2), set Item 81, Alarm2 Output Routing, at its default value of 3 (assuming the OPT420 is in slot 200).

In addition to these settings, there are various other Items that control the Alarm Limits, Alarm "Reset" behavior, the Alarm1 "Annunciator", the Displayed Decimal Point position, etc. See the Item Configuration table below for further details.

Table: Item Configuration (all other Items may be set to factory defaults, or as desired): Note: Item numbers above 999 are located in the OPT420 ModularBus Card Options Manual located on the Dart website under support/operations manuals.

Item #	Value	Notes
12	2	Set the Display to show ACTUAL (not "Target") Liters per Minute flow through the pump
13	3	Desired Decimal Point Display is XXX.X
20	200	Minimum Rate (Target Speed) is 20.0 LPM ("200" on the display)
21	1500	Maximum Rate is 150.0 LPM ("1500" on the display)
23	17	Accel rate is 17 Liters per SECOND, or 100 Liters per MINUTE
24	8	Decel rate is 8 Liters per SECOND, or 50 Liters per MINUTE
30	1500	This is the Display Reference value. 150.0 LPM ("1500" on the display)
31	1425	This is the calculated *RPM* speed of the pump motor at the Display Reference value, above
33	10	Number of Seconds for "Initial" Stall Timeout
34	100	Number of tenths-of-seconds for the "Running" Stall Timeout
35	5	Using the S2 Input for an Active "Low" Inhibit Input (See Wiring Diagram, above)
42	3	Motor will decel to zero speed upon Inhibit, and accel back to speed when Inhibit released
50	534	"Fault" (Alarm1) will Activate on several conditions. See "Description", above, for details.
51	137	Along with Item 52, forms conditions that will SUPPRESS the "Fault" (Alarm1) from Activating
52	137	This "AND", with Item 51, forms a Neg. Logic "OR" to Suppress "Fault" (Alarm1) Activation
59	100	"Fault" (Alarm1) needs to Activate when Target or Actual "Speed" is less than 10.0 LPM.
60	1800	"Fault" (Alarm1) needs to Acivate when Target of Actual "Speed" is greater than 180.0 LPM
65	1	"Fault" (Alarm1) will Activate on several conditions. See "Description", above, for details.
70	1024	"Run" (Alarm2) is being used to reflect the "Run" condition Flag (Routed to OPT420 Relay)
2021	2000	Value to send from OPT420 to Host Drive when OPT420 receives 20mA on its Input terminals
2041	2000	Value from Host Drive to OPT420 that will cause 20mA to flow across its Output terminals

Troubleshooting

Problem	Possible Case	Solution
Display is blank	Power not applied	Using a volt meter, verify that a voltage between 85 and 250VAC is measured between the L and N 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.
When power is applied, “LF-L” is displayed	AC line supplying power to unit has too much noise	Review routing of power wires in machine to minimize electrical noise. Look for other devices which share the same circuit which may be producing unacceptable levels of line noise. In some applications, such as welding equipment, a careful regiment of applying an AC line filter, re-routing wires, dividing circuits, using shielded cable, and properly grounding devices will usually solve the problem.
	AC line supplying power to unit has an abnormally low frequency	The unit is designed to operate with AC lines from 48-62 Hertz (cycles per second). This is typically not a problem because the international standards are 50 and 60 Hertz.
When power is applied, “LF-H” is displayed	AC line supplying power to unit has too much noise	Review routing of power wires in machine to minimize electrical noise. Look for other devices which share the same circuit which may be producing unacceptable levels of line noise. In some applications, such as welding equipment, a careful regiment of applying an AC line filter, re-routine wires, dividing circuits, using shielded cable, and properly grounding devices will usually solve the problem.
	AC line supplying power to unit has an abnormally high frequency	The unit is designed to operate with AC lines from 48-62 Hertz (cycles per second). This is typically not a problem because the international standards are 50 and 60 Hertz.
The alarm output does not seem to function	Alarm output parameters not configured properly	Alarm output parameters not configured properly Review alarm output parameters. The alarm relay output can be tested by selecting the “Always On” value for the Activation Condition parameters for the alarm output. When doing this, the relay click should be audible and the NC (Normally Closed) and C (Common) terminals should become internally shorted at the terminal block.

Technical Support Options

- Visit the Dart Controls Web Site at: *www.dartcontrols.com*
- Email technical support at: *sales@dartcontrols.com*
- Telephone technical support at 317-733-2133 ext. 460

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Models & Options

Model Table

Model	Input Voltage @ 50 - 60Hz	Pickup or Encoder Required?
ASP40 / ASP40-420	85-250VAC	Yes

Available Options

Option Suffix	Description	Example
-1	Expansion board which adds support for remote push button wiring via a European-style terminal block.	ASP40-1, ASP40-420-1
-P	Optional pluggable European-style terminal block	ASP40-P, ASP40-420-P
-9	Blank Lexan	ASP40-9, ASP40-420-9
OPT420	420 Input / Output option card	OPT420
OPT51	Serial communications option card for Plus Series controls	OPT51

Note: All options shown are Factory Installed Only except OPT420 and OPT51.

Recommended Accessories

Model	Description	Pulses Per Revolution	PPM Output Range
PU-2E	Hall Effect, Single Channel	1	0 – 20,000 note 1
PU-4E	Hall Effect, Single Channel	2	0 – 40,000 note 1
PU-20E	Hall Effect, Single Channel	10	0 – 200,000 note 1
PU-40E	Hall Effect, Single Channel	20	0 – 400,000 note 1
PU-2R	Hall Effect, Single Channel	1	0 – 20,000 note 1
PU-4R	Hall Effect, Single Channel	2	0 – 40,000 note 1
PU-20R	Hall Effect, Single Channel	10	0 – 200,000 note 1
PU-40R	Hall Effect, Single Channel	20	0 – 400,000 note 1
CF-60	Hall Effect, Single Channel	60	0 – 600,000 note 2

NOTES:
1 – 20,000 RPM maximum rotational velocity
2 – When used with the MD40P, MD50P or MD50E

'E" models are for indoor use and "R" models are for wash down / outdoor use

Agency Approvals

ASP40 ..... cULus Pending

Specifications

Electrical

Line Input Voltage ..... Any Voltage from 85-250VAC
Line Input Frequency ..... Any Frequency from 48-62 Hertz
Signal Input Voltage Range ..... 5VDC to 24VDC (square wave, referenced to P1-6 COMMON)
Speed Pickup Input Frequency Range (S1 and S2 Inputs) .....0 – 600,000 Pulses per Minute @ 5V square wave
Display Range .....0.001 – 9,999
Units of Operation (“Engineering Units”) .....User Programmable, any Units
Sensor / Pickup Power Supply ..... 5V @ 50mA
ASP40 Isolated Alarm Relay Output Rating .....250VAC @ 5A
Voltage Difference between PotLo and PotHi Inputs ..... 2VDC to 24VDC
Pot Wiper Output voltage range ..... PotLo +50mVDC to PotHi – 50mVDC

Mechanical

Display Type .....LED, Red, 4 Digit, ½” Height
Housing Type ASP40-420 (with supplied gasket) .....NEMA 4X
Connector Style (pluggable connector optional) ..... 12-position 5mm European Style
Terminal Block Torque Setting .....4.4 in. lb. Max (.5Nm)
Faceplate Material ..... Polycarbonate with Polycarbonate Overlay
Housing Material .....Aluminum
Length ASP40-420 (Required Panel Depth) ..... 4.625” (117.48mm)
Faceplate Width ..... 4.539” (115.29mm)
Weight ASP40-420 .....15.30 oz. (433.86g)

Environmental

Operating Temperature Range----------10C to 45C (15F to 115F)
Operating Humidity Range (max.)---------- 95%, non-condensing

Dimension Chart

Model	*Width*	*Height*	*Depth*
ASP40 English (inches)			
Housing	3.62	1.66	4.625
Lens	4.539	2.289	0.375
ASP40 Metric (millimeters)			
Housing	91.94	42.16	117.27
Lens	115.28	58.14	9.53

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.

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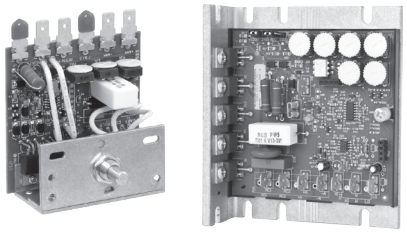

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Dual Input voltage, adjustable HP range, isolated signal follower and reversing options

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Low Voltage/Battery PWM Drives
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