Cutler-Hammer

# SV9000 QUICK REFERENCE GUIDE

**Important:** This guide is intended to provide a quick reference to the SV9000's BASIC and STANDARD features for startup, programming and service. It does not replace the need to thoroughly read and understand the User Manual and SVReady™ Application Manual.

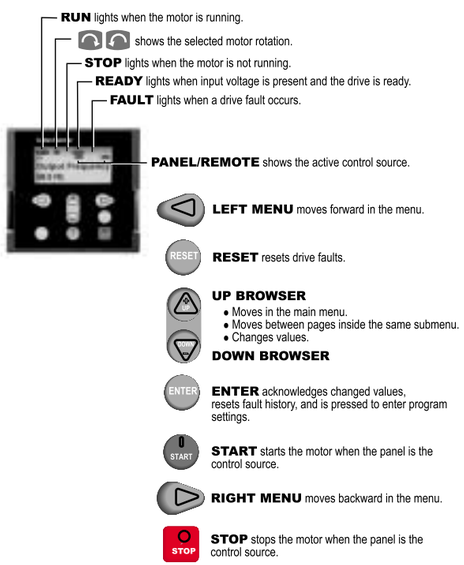
Shipped from the factory, the SV9000 drive has (7) SVReady Applications, with the drive's default set to **BASIC Application**. This guide is based on the use of the **BASIC** or **STANDARD Application** outlined in the User Manual and SVReady Application Manual.

For the **BASIC Application** –
Control I/O signals are fixed and not programmable.

For the **STANDARD Application** –
DIA1-DIA3, Control I/O signals as well as output signals R01-R02 are programmable.

Other applications have different terminal block assignments and different parameter numbers or functions. These may be selected from System Parameter Group 0, parameter P0.1. Refer to the SV9000 User Manual for detailed information.

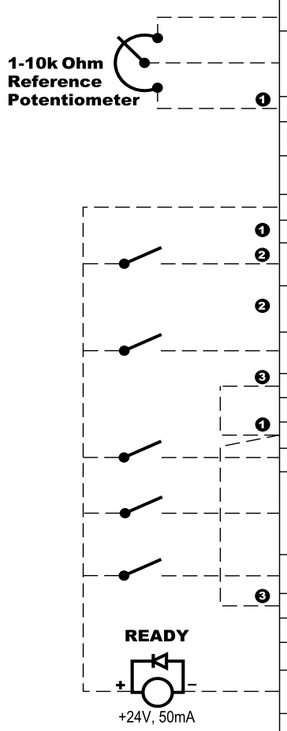
## 1. SVMulti-line™ CONTROL PANEL OPERATION




## 2. START-UP and I/O CONNECTIONS

Shipped from the factory the SV9000 is set to run forward from a contact closure at input DIA1, and to run in reverse from a contact closure at input DIA2. To Run from a Keypad Setting –

- Go to menu screen M4.
- Press the RIGHT MENU button, then the UP/DOWN BROWSER button to go to application screen B2.
- Press the ENTER button to switch from remote control to panel control.
- Press the START button to start the drive.
- Go to menu screen M3.
- Press the RIGHT MENU button until R1 starts to blink.
- Press the UP BROWSER button to the desired motor frequency.
- Press the START button to start the drive.
- Go to menu screen M1, then press the UP/DOWN BROWSER button to go to application screen V1 and view the output frequency.




| Terminal | | Signal | Description | | |
|---|---|---|---|---|---|
| 1 | $+10V_{ref}$ | Reference Output | Potentiometer Voltage, etc. | | |
| 2 | $V_{in}$ + | Analog Input Voltage (range = 0-10V DC) | Frequency reference activated when terminals 14 & 15 are open and parameter 1.17 = 0 (default value) | | |
| 3 | GND | I/O Ground | Reference and Control GND | | |
| 4 | $I_{in}$ + | Analog Input Current (range 0-20mA) | Frequency reference activated when terminals 14 & 15 are closed – or – If parameter 1.17 = 1, when terminals 14 & 15 are open. | | |
| 5 | $I_{in}$ – | | | | |
| 6 | +24V | Control Voltage Output | Switch Voltage, etc. (0.1A max.) | | |
| 7 | GND | I/O Ground | Reference and Control Ground | | |
| 8 | DIA1 | Start Forward (programmable in STANDARD) | Contact Closed = Start Forward | | |
| 9 | DIA2 | Start Reverse (programmable in STANDARD) | Contact Closed = Start Reverse | | |
| 10 | DIA3 | External Fault Input (programmable in STANDARD) | Contact Open = No Fault<br>Contact Closed = Fault | | |
| 11 | CMA | DIA1-DIA3 Common | Connect to GND or +24V | | |
| 12 | +24V | Control Voltage Output | Switch Voltage, etc. (0.1A max.) | | |
| 13 | GND | I/O Ground | Reference and Control Ground | | |
| 14 | DIB4 | Multi-Step Speed Select 1 | DIB4 | DIB5 | Freq. Ref |
| 15 | DIB5 | Multi-Step Speed Select 2 | open<br>closed<br>open<br>closed | open<br>open<br>closed<br>closed | Ref. $V_{in}$ (parameter 1.17 = 0)<br>Multi-Step Ref. 1<br>Multi-Step Ref. 2<br>Ref. $I_{in}$ (Terms. 4 & 5) |
| 16 | DIB6 | Fault Reset | Contact Open = No Action<br>Contact Closed = Fault Reset | | |
| 17 | CMB | DIB4-DIB6 Common | Connect to GND or +24V | | |
| 18 | $I_{out}$ + | Output Frequency Analog Output | Programmable in STANDARD (parameter 3.1) (range 0-20mA/$R_L$ max. 500 Ohm) | | |
| 19 | $I_{out}$ – | | | | |
| 20 | D01 | Digital Output READY | Programmable in STANDARD (parameter 3.6) Open Collector (I≤50mA, V≤48V DC) | | |
| 21 | R01 | Relay Output 1 RUN ❹ | Programmable in STANDARD (parameter 3.7) | | |
| 22 | R01 | | | | |
| 23 | R01 | | | | |
| 24 | R02 | Relay Output 2 FAULT ❹ | Programmable in STANDARD (parameter 3.8) | | |
| 25 | R02 | | | | |
| 26 | R02 | | | | |

❶ GND terminals 3, 7 and 13 are internally connected.

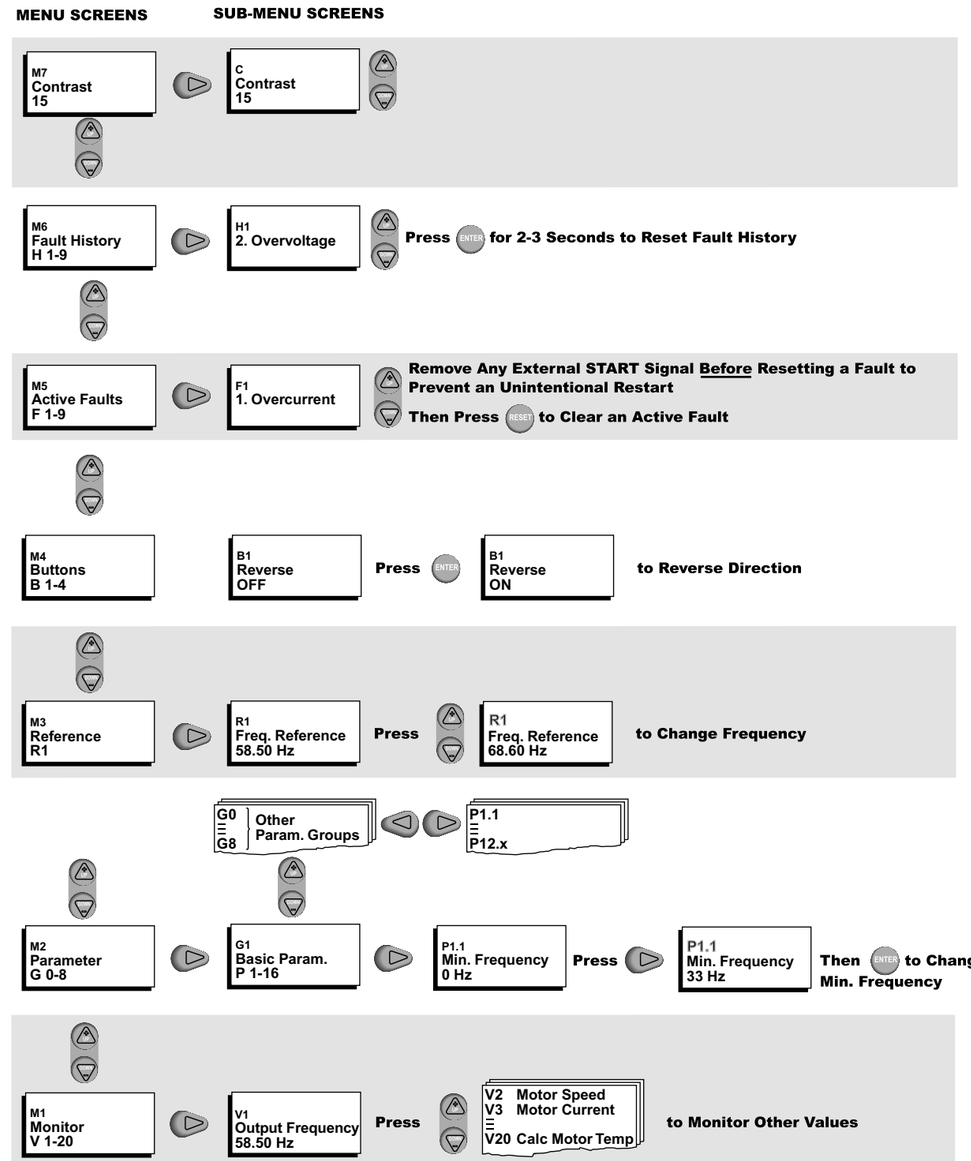
❷ For the STANDARD Application, input signals at DIA1 and DIA2 are programmed as a pair using parameter 2.1.

❸ Connect CMA/CMB inputs to either logic high or logic low depending upon your application. Refer to the SV9000 User Manual and SVReady Application Manual for additional information.

❹ Maximum Switching Voltage: 300V DC, 250V AC
Maximum Switching Load: 8A/24V DC – 0.4A/250V DC – 2kVA/250V AC
Maximum Continuous Load: 2A rms

## 3. SCREEN DISPLAYS

Use the LEFT and RIGHT MENU buttons to enter the desired menu, then the UP and DOWN BROWSER button to access the desired item.





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## 4. FAULT and WARNING INDICATIONS

If the drive faults, the FAULT indicator lights and screen M5 will display one of the following faults. If more than one fault has occurred, the UP/DOWN BROWSER button can be used to view the active faults.

- Once a fault has been cleared, to restart the drive and clear an active fault, press the RIGHT MENU button, then the START button. The readout will return to the same display it had before the drive tripped.
- To view the drive's fault history, go to menu screen M6 and use the MENU button to access the first fault, then the BROWSER button to view any additional stored faults. Pressing the ENTER button for 2-3 seconds will reset the fault history list.

| FAULT CODE | | POSSIBLE CAUSE |
|---|---|---|
| F1 | Overcurrent | Output current has 400% of base rating. Check for sudden load increase, input motor lead short and/or motor failure. |
| F2 | Overvoltage | DC Bus voltage has exceeded 135% of supply voltage (parameter 1.14). Deceleration time may be too fast and/or utility has high overvoltage spikes. |
| F3 | Ground Fault | Total motor phase current does not equal zero. Check for motor or drive output lead insulation failure. |
| F4 | Inverter Fault | Faulty gate driver or IGBT bridge operation. Check for external electrical interference or drive component failure. |
| F5 | Charging Switch | Charging switch not closed when START command received. Check for external electrical interference or drive switch failure. |
| F9 | Undervoltage | DC Bus Voltage has dropped below 65% of supply voltage (parameter 1.14) |
| F10 | Input Line Supervision | Input line loss of one or more drive input phases. |
| F11 | Output Phase Supervision | Output phase current loss. |
| F12 | Brake Chopper Supervision | Brake resistor not installed – Brake resistor failure or brake chopper failure. |
| F13 | Drive Undertemperature | Drive heatsink temperature below –10°C. |
| F14 | Drive Overtemperature | Drive heatrsink temperature above 75°C for Standard units, or 80°C for Compact NEMA 1 units. |
| F15 | Motor Stalled | Motor stall protection circuit has tripped. |
| F16 | Motor Overtemperature | Drive motor temperature monitor function has determined that the motor is overtemperature. Check motor load. |
| F17 | Motor Underload | Motor underload condition has been sensed. |
| F18 | Analog Input Hardware Fault | Drive control board component failure. |
| F19 | Option Board Identification | Drive option board identification read failure. |
| F20 | 10V Voltage Reference | Drive control or option board +10V reference short. |
| F21 | 24V Supply | Drive control or option board +24V supply source short. |
| F22<br>F23 | EEPROM Checksum Fault | Default parameters have not been reset after FAULT Reset. Check for external electrical interference or drive component failure. |
| F25 | Microprocessor Watchdog | Check for external electrical interference or drive component failure. |
| F26 | Panel Communication Fault | Communication connection between drive keypad panel and the drive has failed. |
| F29 | Thermistor Protection | I/O expander board thermistor input has detected a motor overtemperature. |
| F36 | Analog Input $I_{IN}$ < 4mA (signal range selected = 4-20mA) | Analog current input $I_{IN}$ < 4mA. Check signal current level and analog input wiring. |
| F41 | External Fault | External digital input fault. |

- When a drive warning occurs, one of the following warning codes and description is displayed. Warnings do not disable drive functions and do not have to be cleared.

| WARNING CODE | | ACTION |
|---|---|---|
| A15 | Motor Stalled | Motor Stall Protection - Check Motor. |
| A16 | Motor Overtemperature | Motor Thermal Protection - Decrease Motor Loading. |
| A17 | Motor Underload | Check Motor Load. |
| A24 | Fault History Values, MWh Counters or Operating Day/Hour Counters Have been Changed | No Action Can Be Taken. |
| A28 | A Selected Application Change has Failed | Re-Enter the Application Change. |
| A30 | Unbalanced Phase Current | Contact Cutler-Hammer Adjustable Frequency Drives Technical Information and Support. |
| A45 | SV9000 Overtemperature | SV9000 Operting Temperature has exceeded 70°C - Check for Restricted Air Flow and/or Dirty or Blocked Drive CoolingFins. |
| A46 | Analog Input Reference | Analog Input Reference $I_{in}$+ (Term. 5) <4mA - Check the Input Current Loop. |
| A47 | External Warning | Check the External Fault Circuit or Device. |

Shaded WARNINGS will be displayed within the **BASIC** or **STANDARD Application**.

The remaining warnings will be displayed if programmed in the **STANDARD Application**.

## 5. BASIC and STANDARD PROGRAMMING PARAMETERS

| PARAMETER NO. & NAME | RANGE & DESCRIPTION | DEFAULT | SET TO |
|---|---|---|---|
| **BASIC PARAMETERS** | | | |
| 1.1 Minimum Frequency | 0-Parameter 1.2 | 0 Hz | |
| 1.2 Maximum Frequency | Parameter 1.1 – 120/500 Hz | 60 Hz | |
| 1.3 Acceleration Time 1 | 0.1-3000.0 sec. – *Δt between Parameters 1.1 – 1.2* | 3.0 sec. | |
| 1.4 Deceleration Time 1 | 0.1-3000.0 sec. – *Δt between Parameters 1.2 – 1.1* | 3.0 sec. | |
| 1.5 Multi-Step Speed Reference 1 | Parameters 1.1 – 1.2 | 10.0 Hz | |
| 1.6 Multi-Step Speed Reference 2 | Parameters 1.1 – 1.2 | 60.0 Hz | |
| 1.7 Current Limit | 0.1 – 2.5 × $I_{nSV9}$ – *Where $I_{nSV9}$ = Output Amp Limit of the Drive* | 1.5 × $I_{nSV9}$ | |
| 1.8 V/Hz Ratio Selection (STOP) | 0 = Linear<br>1 = Squared<br>2 = Programmable | 0 | |
| 1.9 V/Hz Optimization (STOP) | 0 = None<br>1 = Auto Torque Boost | 0 | |
| 1.10 Nominal Motor Nameplate Voltage (STOP) | 180-690V | 2 = 230V<br>4 = 380V<br>5 = 480V<br>6 = 575V | |
| 1.11 Nominal F.L. Motor Nameplate Frequency (STOP) | 30-500 Hz – *Sets the Value of Parameter 6.1* | 60 Hz | |
| 1.12 Nominal F.L. Motor Nameplate Speed (STOP) | 1-20000 RPM | 1720 RPM | |
| 1.13 Nominal F.L. Motor Nameplate Current | 0.1-25 × $I_{nSV9}$ – *Where $I_{nSV9}$ = Drive Current Rating* | 2.5 × $I_{nSV9}$ | |
| 1.14 Supply Voltage (STOP) | 2 = 208-240V<br>4 = 380-440V<br>5 = 380-500V<br>6 = 525-690V | 2 = 230V<br>4 = 380V<br>5 = 480V<br>6 = 575V | |
| 1.15 Parameter Conceal (STOP) | 0 = All Parameter Groups Visible<br>1 = Only Group 1 Visible | 0 | |
| 1.16 Parameter Value Lock | 0 = All Parameters Can Be Changed<br>1 = No Parameter Can Be Chnaged | 0 | |
| 1.17 Basic Frequency Reference Selection (STOP) | 0 = Analog Volt Ref. from Terms. 2-3<br>1 = Analog Amp Ref. from Terms. 4-5<br>2 = Ref. from Control Panel | 0 | |
| 1.18 Analog Input ($I_{in}$) Range | 0 = 0-20mA Input from Terms. 4-5<br>1 = 4-20mA Input from Terms. 4-5 | 0 | |
| **INPUT SIGNAL PARAMETERS** | | | |
| 2.1 START/STOP Logic Selection (STOP) | DIA1: 0 = Start Forward, 1 = Start/Stop, 2 = Start/Stop, 3 = Start Pulse<br>DIA2: 0 = Start Reverse, 1 = Reverse, 2 = Run Enable, 3 = Stop Pulse | 0 | |
| 2.2 DIA3 Function (terminal 10) (STOP) | 0 = Not Used<br>1 = Ext. Fault Closing Contact<br>2 = Ext. Fault Opening Contact<br>3 = Run Enable<br>4 = Accel/Decel Time Select<br>5 = Reverse if Parameter 2.1 = 3 | 1 | |
| 2.3 Reference Offset for Analog Current Input | 0 = 0-20mA<br>1 = 4-20mA | 0 | |
| 2.4 Reference Scaling – Minimum Value | 0-Parameter 2.5 – *Selects the Frequency that Corresponds to the Min. Ref. Signal* | 0 Hz | |
| 2.5 Reference Scaling – Maximum Frequency Value (Set by Parameter 1.2) | 0-$f_{max}$ – *Selects the Frequency that Corresponds to the Max. Ref. Signal – No Scaling If = 0 – Parameter 1.2 If > 0* | 0 Hz | |
| 2.6 Reference Invert | 0 = No Inversion<br>1 = Reference Inverted | 0 | |
| 2.7 Reference Filter Time | 0.00-10.00 sec. – *0.00 = No Filtering* | 0.10 sec. | |

STOP Indicates that the parameter may only be changed when the drive is stopped.

❶ If parameter 1.2 > motor synchronous speed, check motor and drive system compatibility.

❷ 1720 RPM = default value for (4) pole motor and nominal size drive.

Only shaded parameters and parameter settings are accessible with the **BASIC Application**.

With the exception of parameter 1.18, all parameters and parameter settings are accessible with the **STANDARD Application**.

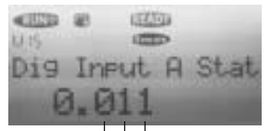
| PARAMETER NO. & NAME | RANGE & DESCRIPTION | DEFAULT | SET TO |
|---|---|---|---|
| **OUTPUT & SUPERVISION PARAMETERS** | | | |
| 3.1 Analog Output Function (STOP) | 0 = Not Used – *100% Scale*<br>1 = Motor Freq. *0 – Parameter 1.2*<br>2 = Motor Speed *0 – Max. Speed*<br>3 = Motor Current *0 – 2.0 × $I_{nSV9}$*<br>4 = Motor Torque *0 – 2 × $T_{nMot}$*<br>5 = Motor Power *0 – 2 × $P_{nMot}$*<br>6 = Motor Volt. *0 – 100% × $V_{nMot}$*<br>7 = DC Link Volt. *0 – 1000V* | 1 | |
| 3.2 Analog Output Filter Time | 0.00-10.00 sec. – *0.00 = No Filtering* | 1.00 sec. | |
| 3.3 Analog Output Inversion | 0 = No Inversion<br>1 = Analog Output Inverted | 0 | |
| 3.4 Analog Output Minimum | 0 = 0mA<br>1 = 4mA | 0 | |
| 3.5 Analog Output Scale | 10-1000% | 100% | |
| 3.6 Digital Output Function (STOP) | 0 = Not Used<br>1 = Ready<br>2 = Run<br>3 = Fault ❸<br>4 = Fault Inverted ❸<br>5 = SV9000 Overheat Warning<br>6 = External Fault or Warning ❸<br>7 = Reference Fault or Warning<br>8 = Warning ❸<br>9 = Reversed<br>10 = Multi-Step Speed Selected<br>11 = At Speed<br>12 = Motor Regulator Activated<br>13 = Output Freq. Limit Supervision<br>14 = Control from I/O Terminal | 1 | |
| 3.7 Relay Output 1 Function (STOP) | – Same as Parameter 3.6 – | 2 | |
| 3.8 Relay Output 2 Function (STOP) | – Same as Parameter 3.6 – | 3 | |
| 3.9 Output Frequency Limit Supervision Function | 0 = No Supervision<br>1 = Low Limit Supervision<br>2 = High Limit Supervision | 0 | |
| 3.10 Output Frequency Limit Supervision Value | 0-Parameter 1.2 | 0.0 Hz | |
| 3.11 I/O Expander Board Analog Output Function | 0-7 – *Same as Parameter 3.1* | 3 | |
| 3.12 I/O Expander Board Analog Output Scale | 10-1000% – *Same as Parameter 3.5* | 100% | |
| **DRIVE CONTROL PARAMETERS** | | | |
| 4.1 Accel/Decel Ramp 1 Shape | 0.0-10.0 sec.<br>0.0 = Linear<br>> 0.0 = S-Curve Accel/Decel Time | 0.0 sec. | |
| 4.2 Accel/Decel Ramp 2 Shape | 0.0-10.0 sec.<br>0.0 = Linear<br>> 0.0 = S-Curve Accel/Decel Time | 0.0 sec. | |
| 4.3 Acceleration Time 2 | 0.1-3000.0 sec. | 10.0 sec. | |
| 4.4 Deceleration Time 2 | 0.1-3000.0 sec. | 10.0 sec. | |
| 4.5 Brake Chopper (STOP) | 0 = Brake Chopper Not in Use<br>1 = Brake Chopper in Use<br>2 = External Brake Chopper | 0 | |
| 4.6 START Function | 0 = Ramp<br>1 = Flying Start | 0 | |
| 4.7 STOP Function | 0 = Coast<br>1 = Ramp | 0 | |
| 4.8 DC Braking Current | 0.15 A – 1.5 × $I_{nSV9}$ A – *Where $I_{nSV9}$ = Output Amp Limit of the Drive* | 0.5 × $I_{nSV9}$ A | |
| 4.9 DC Braking Time at STOP | 0.00-250.00 sec. – *0.00 = No Braking* | 0.00 sec. | |
| **PROHIBIT FREQUENCY PARAMETERS** | | | |
| 5.1 Prohibit Frequency Range Low Limit | $f_{min}$ – Parameter 1.2 – *Where $f_{min}$ = Parameter 1.1* | 0.0 Hz | |
| 5.2 Prohibit Frequency Range High Limit | Parameters 1.1 – 1.2 – *0.0 = No Skip Frequency Range* | 0.0 Hz | |
| **MOTOR CONTROL PARAMETERS** | | | |
| 6.1 Motor Control Mode (STOP) | 0 = Frequency Control<br>1 = Speed Control | 0 | |
| 6.2 Switching Frequency (STOP) | 1.0-16.0 kHz – *HP Dependent – Refer to Derating Curves in User Manual* | 10/3.6 kHz | |
| 6.3 Field Weakening Point (STOP) | 30-500 Hz | Parameter1.11 | |
| 6.4 Voltage at Field Weakening Point (STOP) | 15 – 200% × $V_{nMot}$ – *Where $V_{nMot}$ is Output Voltage from the Drive to the Motor* | 100% × $V_{nMot}$ | |
| 6.5 V/Hz Curve Mid-Point Frequency (STOP) | 0.0-$f_{max}$ – *Where $F_{max}$ = Parameter 1.2* | 0.0 Hz | |
| 6.6 V/Hz Curve Mid-Point Voltage (STOP) | 0.00 – 100.00% × $V_{nMot}$ – *Where $V_{nMot}$ is Output Voltage from the Drive to the Motor* | 0.00% × $V_{nMot}$ | |
| 6.7 Output Voltage at Zero Frequency (STOP) | 0.00 – 100.00% × $V_{nMot}$ – *Where $V_{nMot}$ is Output Voltage from the Drive to the Motor* | 0.00% × $V_{nMot}$ | |
| 6.8 Overvoltage Controller | 0 = Controller is Off<br>1 = Controller is On | 1 | |
| 6.9 Undervoltage Controller | 0 = Controller is Off<br>1 = Controller is On | 1 | |
| **PROTECTION PARAMETERS** | | | |
| 7.1 Response to Reference FAULT | 0 = No Action<br>1 = Warning<br>2 = FAULT – Stop Set by Parameter 4.7<br>3 = FAULT – Coast Stop | 0 | |
| 7.2 Response to External FAULT | 0 = No Action<br>1 = Warning<br>2 = FAULT – Stop Set by Parameter 4.7<br>3 = FAULT – Coast Stop | 2 | |
| 7.3 Phase Supervision of the Motor | 0 = No Action<br>2 = FAULT | 2 | |
| 7.4 Ground Fault Protection | 0 = No Action<br>2 = FAULT | 2 | |
| 7.5 Motor Thermal Protection | 0 = No Action<br>1 = Warning<br>2 = FAULT | 2 | |
| 7.6 Stall Protection | 0 = No Action<br>1 = Warning<br>2 = FAULT | 1 | |
| **AUTORESTART PARAMETERS** | | | |
| 8.1 Auto Restart – Number of Tries | 0-10 | 0 | |
| 8.2 Auto Restart – Multi-Attempt Maximum Trial Time | 1-6000 sec. | 30 sec. | |
| 8.3 Auto Restart – START Function | 0 = Ramp<br>1 = Flying Start | 0 | |

❸ In the **STANDARD Application**, Protection Parameters may be programmed to provide either a fault or a warning.

## 6. MONITORING and PROGRAMMING

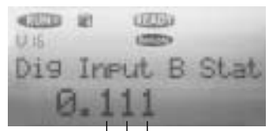
The SV9000 Multi-line Control Panel provides two additional functions for indication and control.

The first function monitors the status of the input and output digital devices. The status of these devices may be seen by accessing the Monitor Menu and viewing screen V15, V16 or V17.




**SCREEN V15**
0 = open
1 = closed

| Input | Terminal |
|---|---|
| DIA1 closed | 8 |
| DIA2 closed | 9 |
| DIA3 open | 10 |




**SCREEN V16**
0 = open
1 = closed

| Input | Terminal |
|---|---|
| DIB4 closed | 14 |
| DIB5 closed | 15 |
| DIB6 closed | 16 |

**SCREEN V17**
0 = open
1 = closed

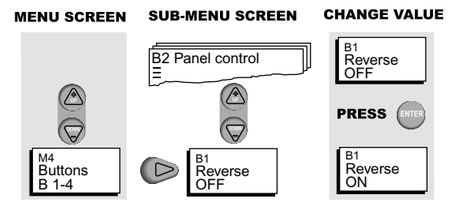
| Input | Terminal |
|---|---|
| Digital output closed (sinking current) | 20 |
| Relay 1 closed | 21 |
| Relay 2 open | 24 |

The second function provides the ability to program the ENTER button to perform a different function for the Programmable Pushbutton Menu, M4.

There are four functions available for the ENTER button, but only for the M4 menu. The ENTER button reverts to its normal function in all other menus.

| BUTTON | | FUNCTION | FEEDBACK | |
|---|---|---|---|---|
| | | | WHEN = ON | WHEN = OFF |
| B1 | Reverse | Changes the motor's direction of rotation only when the Keypad Panel is the active control source. | Forward | Reverse |
| B2 | Active Control Source | Selects between I/O terminals and Keypad Panel. | I/O Terminal Control | Keypad Panel Control |
| B3 | Operating Hours and Trip Counter Reset | Resets the operating hours trip counter. | No Reset | Resets the Operating Hours |
| B4 | MWh Trip Counter Reset | Resets the MWh trip counter. | No Reset | Resets the MWh Trip Counter |

When the ENTER button is pressed, the displayed parameter value changes and the new setting will be used.




7. For more information on Cutler-Hammer Products . . . call 1-800-525-2000, or visit our web site at www.cutlerhammer.eaton.com.

For Engineering Services . . . call 1-800-498-2678.

For Cutler-Hammer Adjustable Drives technical information and support . . . call 1-800-322-4986.