Magnetek

HPV 900 AC Vector Elevator Drive Technical Manual

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HPV 900 DRIVE RATINGS

Rated Input Voltage	Rated HP	Rated kW	Continuous Output Current General Purpose Rating	Continuous Output Current Elevator Duty Cycle* Rating	Maximum Output Current for 5 Sec	Cube Size**	Model Number***
230V	7.5	5.5	25	29	62.5	A	HPV900-2025-0E1-xx
	10	7.5	27	31	67.5	B	HPV900-2027-0E1-xx
	15	11	41	47	102	B	HPV900-2041-0E1-xx
	20	15	52	60	130	B	HPV900-2052-0E1-xx
	25	18	75	84	170	B+	HPV900-2075-0E1-xx
	30	22	88	99	200	B+	HPV900-2088-0E1-xx
	40	30	104	120	260	C	HPV900-2104-0E1-xx
460V	5	3.7	8	9	20	A	HPV900-4008-0E1-xx
	10	7.5	16	18	40	A	HPV900-4016-0E1-xx
	15	11	21	24	52.5	A	HPV900-4021-0E1-xx
	20	15	27	31	67.5	B	HPV900-4027-0E1-xx
	25	18	34	39	85	B	HPV900-4034-0E1-xx
	30	22	41	47	102	B	HPV900-4041-0E1-xx
	40	30	52	60	130	B	HPV900-4052-0E1-xx
	50	37	65	75	162	C	HPV900-4065-0E1-xx
	60	45	77	89	192	C	HPV900-4077-0E1-xx
	75	55	96	111	240	C	HPV900-4096-0E1-xx

Table 1 - HPV 900 Drive Ratings

NOTE: all ratings at 60/50Hz and 10 kHz carrier frequency
all ratings for based on a geared elevator application,
for gearless ratings, see Appendix 8.

For more information on altitude, temperature, and carrier frequency derating, see section 2.2.4.
Replaced model numbers: –2068 replaced by –2075 and –2080 replaced by –2088, see Appendix 15.
** For more information on the Elevator Duty Cycle Rating, see section 5.9.*
*** Cube size dimensions, mounting holes, and weights are shown in Appendix 1.*
**** From more information on model numbers, see section 1.3.*

1 INTRODUCTION

1.1 DRIVE DESCRIPTION

1.1.1 Dedicated to Elevator Industry

The HPV 900 is a dedicated digital AC vector drive tailored to the elevator industry. It encompasses high overload capacity, coupled with advanced closed loop vector control techniques for superior motor control.

1.1.2 Hardware Features

Designed with high overload capacity
The HPV 900 can be used without horsepower derating, which is common with standard drives. The drive can run 2.5 times* rated current for 5 seconds and 1.5 times rated current for 60 seconds.
For more information, see section 5.3.1.
* Note: increased rated currents for B+ cubes do not allow for 2.5 times maximum current.

Designed and tested to meet the elevator duty cycle
The HPV 900 is designed for a worst case duty cycle (180 starts/hr and 90 cycles/hr). The drive can operate continuously up to 116% of rated current. *For more information, see section 5.9.*

Internal Dynamic Brake IGBT
There is no need to add external braking IGBT (common with standard drives)
Also, the braking IGBT is rated for a 100% duty cycle.

Designed for a high operating temperature
The HPV 900 was designed for an operating ambient air temperature range of:
-10°C (14°F) to 55°C (130°F)

Provides internal isolated encoder power supply
The HPV 900 provides connections for encoder power (both +5 and +12 VDC). The isolated encoder power supply separates the processor power from the encoder for better noise immunity.

Isolated encoder signals
For better noise immunity, the encoder signals are optically isolated from the HPV 900's processor.

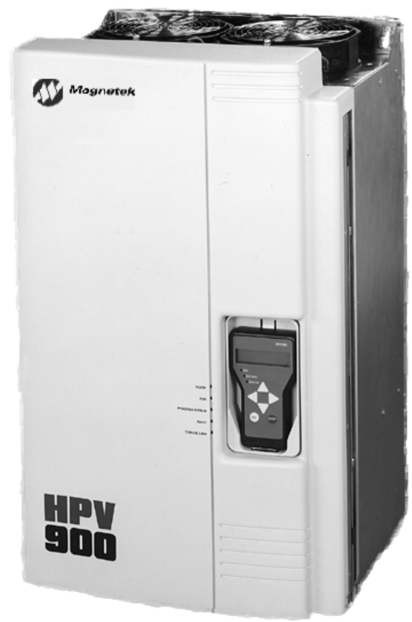


Figure 1. 1 - HPV 900

Carrier frequency of 10kHz without drive derating
A fixed programmable carrier frequency (2.5 to 16 kHz): Above 10 kHz linearly derate both the continuous and peak current levels by 5% for each 1kHz to a maximum derating of 25% above 15kHz.

Designed with long-life components
General Comparison with standard drives (stronger in all critical power components)
- *Bus capacitors:* HPV 900 has more capacitance with higher ripple current capability, higher voltage rating, and longer life.
- *Diode bridge:* HPV 900 has 2.5 times the current capability over standard drives.
- *IGBTs:* Even with drives with that have equivalently rated IGBTs, the heat sinks & fans are oversized in HPV 900, making it more robust. (i.e. allows the HPV 900 to operate in the same application with longer life and to operate at a higher ambient temperatures)

Allows connection to a 12-pulse transformer by providing two sets of input rectifiers
With the 12 pulse transformer configuration, the $5^{th}$and 7^{th} harmonics are eliminated minimizing the current THD. This also gives the lowest RMS input current with the best power factor. Another benefit is that the bus capacitor ripple current is lower and at a higher frequency, extending the life of the product. *(not available on some models, see Appendix 11)*

Accuracy in tracking analog speed command
Analog speed command is sampled every 2 msec with 12 bit accuracy. The signal is ±10 Volts DC with software gain and offset available.

Drive's control board is state-of-the-art technology
The HPV 900 control board contains: a flash based controller with surface mount devices, a 33MHz Digital Signal Processor (DSP), and a VHDL based Field Programmable Gate Array (FPGA).

I/O terminals with removable terminals
Removable terminals reduce wiring time, if control change is necessary.

- *RS-422 serial channel:* RS-422 serial channel at 19.2 K baud with optically isolated receiver.
- *Programmable: (9) digital inputs, (4) digital outputs, (2) relay outputs:* Digital I/O are optically isolated with a 2 msec update rate (logic inputs have 2 msec scan rate with a 4 msec update rate).
- *Analog: (2) programmable outputs, (2) inputs:* Analog I/O with a 2 msec update rate.

Digital input power supply options (internal or external)
The digital input power can use the internal +24VDC supply or use a user supplied external +24VDC supply. *For more information, see section 2.5.1.*

Connections available for battery back-up operation
Easy connections to the DC bus make the connections available for battery back-up operation.

Full function removable digital operator
The HPV 900 hand-held, push button, digital operator is removable and fully programmable with a LCD 2x16-character display.

Designed with a long life relay output (loop contactor relay)
A relay output with an electrical service life of up to 3,000,000 operations depending on operating current. *For more information, see Appendix 16.*

1.1.3 Software Features

Parameters are in elevator industry terminology
Examples: contract car speed parameter in fpm or m/s and S-curves defined accel/decel (ft/s^2 or m/s^2) & jerk rates (ft/s^3 or m/s^3)

Fewer and more easily navigated parameters
The HPV 900 has fewer parameters than standard drives (elevator specific software) and allows for advanced parameters to be hidden (easier navigation).

Allows for a pre-torque command
The pre-torque command helps to eliminate car roll-back by priming the speed regulator via a pre-torque command on an analog input channel (i.e. from a load weighing device)

Reducing effects of the elevator rope resonance for difficult hoistways
The High / Low Gain feature reduces response of speed regulator at higher speeds. *For more information, see section 5.1.4.1.* The Tach Rate gain feature subtracts a portion of the speed feedback derivative from the output of the speed regulator. *For more information, see section 5.1.4.5.*

Internal speed generation via four internal S-curves with separate leveling jerk rate
The HPV 900's multiple S-curves can be configured for short runs, long runs, emergency stopping, and inspection. Each S-curve has four unique characteristics: accel rate, decel rate, jerk rate, and separate leveling jerk rate. *For more information, see section 5.1.3.2.*

Drive ensures no false multi-step speed commands
Since multi-step speed commands are selected with external contacts, a new command selection must be present for 50ms before it is recognized.

Controlling brake slippage during the stop
The Ramp Down Stop feature is an option that allows the motor torque to be gradually reduced while setting the brake. *For more information, see section 5.1.4.9.*

No need for mechanical disconnect to tune critical motor parameters
The Adaptive Tune feature calculates the no-load current (magnetizing current) and the rated slip of the motor. *For more information, see section 5.6.2.1.*

Drive can be readily connected to virtually any unknown motor with minimal set-up
If an existing or unknown motor is encountered in the field, the adjuster need only enter nameplate data – no specific data requirements. Then running the elevator up and down the hoistway a couple times activates the HPV 900's adaptive tune circuit to achieve best performance.

Drive calculates elevator system inertia
With the HPV 900 software, no complex calculations or tests are necessary. The HPV 900 uses engineering units (not just arbitrary gains) for speed regulator tuning and the critical tuning parameter, inertia, is calculated by the drive. *For more information, see section 5.8.*

Drive can be pre-configured making job site set-up as simple as two parameter changes.
The HPV 900 can be pre-configured with customer specific parameter defaults. On the job site, the pre-configured HPV 900 need only have the "Contract Car Speed" parameter changed.

Drive can have a library of motor parameters
For ease in set-up, a library of motor parameters can be in the HPV 900 software.

Internal motor overload
The user defined motor overload curve meets the CSA/UL requirements. *For more information, see section 5.3.2.*

Unique elevator speed regulator providing the best ride quality and improved landing accuracy
The Elevator Speed Regulator provides no overshoot at the end of accel or decel periods. A typical PI speed regulator has an overshoot at the end of the accel or decel periods. *For more information, see section 5.1.4.2.*

Easily enabled overspeed test feature
To help with elevator inspections, the HPV 900 provides a means to multiply the speed command and overspeed limit by user defined parameters. *For more information, see section 5.1.2.*

Quick flux build-up in the motor
The HPV 900 can build up the flux in the motor in 120 to 160 msec. A "flux built-up" signal is available for use by the car controller.

Optimized flux weakening for elevator applications
With standard drives, only 100% of the motor's rated torque can be achieved at rated speed. The HPV 900 optimized flux reference allows for additional torque capability (up to 200% depending on motor) at the motor's rated speed. This allows the HPV 900 to obtain maximum KVA utilization of the drive. *For more information, see section 5.1.4.2.*

Drive has the ability to control the mechanical brake and the motor contactor
The HPV 900 software has handshaking signals available for use in the control of the elevator's mechanical brake and the motor contactor. *For more information, see section 5.2.*

Provides serial communications for control of drive
An RS-422 serial channel at 19.2 K baud with a Magnetek standard elevator protocol.

Ability to upload/download parameters via a PC
The HPV 900 has the ability to upload and download the parameters values via a PC.

1.2 DRIVE SPECIFICATIONS

1.2.1 Ratings

- Horse Power ratings
  - 230 Volt AC input:
    7.5, 10, 15, 20, 25, 30, and 40 HP
  - 460 Volt AC input:
    5, 10, 15, 20, 25, 30, 40, 50, 60, and 75 HP
- 150% of continuous current rating (general purpose rating) for 60 seconds
- 250% of continuous current rating (general purpose rating) for 5 seconds*
  * Note: increased rated currents for B+ cubes do not allow for 250% maximum current.

1.2.2 Performance Features

- Control Method:
  Digital flux vector, Space Vector PWM
  (1/3 less switching loss then Sine coded)
- Speed Command Sources:
  Serial channel; Analog channel;
  and Multi-step command
- Speed Control:
  Range: 0 to rated speed
  Accuracy: ±0.02%
- Speed Reference Resolution
  Multi-step reference: 0.1ft/min / 0.001m/s
  Analog reference: 0.05%
- Speed Reference Signal: -10V to +10V
- Four distinctive programmable S-curves with: adjustable accel / decel rates and adjustable jerk rates (accel/decel & leveling)
- Torque Limit: Setting range: 0 to 250% motoring/regeneration set independently
- Selectable Functions: Multi-step speed operation (16 steps max.) and S-curves accel / decel (4 selectable max.)
- Adaptive Tune: Adjusts motor parameters automatically by: calculating the percentage no load current and estimating the rated rpm
- Estimates Inertia: Calculates the inertia of the entire elevator for easy tuning of the speed regulator
- Functions Available: Configuration and tuning of the speed regulator; Specifying the input line and motor parameters; Monitoring various internal signals; Fault annunciation & Fault log viewing.

1.2.3 Input Power

- Voltage: 200 - 240 VAC, 3-phase, ± 10%
  380 - 480 VAC, 3-phase, ± 10%
- Frequency: 48 - 63 Hz
- Line Impedance: 3% without choke
  1% with choke
- Nominal Voltage Levels:
  230 & 460 VAC, 3-phase, 60/50 Hz

1.2.4 Output Power

- Voltage: 0 - Input Voltage
- Frequency: 0 - 120 Hz
- Carrier Frequency: 2.5 kHz - 16 kHz

1.2.5 Digital Inputs

Nine (9) programmable opto-isolated logic inputs.

- Voltage: 24VDC pull-up
  (internal or external)
- Sinking Current: inputs 1&2 = 18 mA
  inputs 3-10 = 9 mA
- Scan Rate: 2 msec.
- Update Rate: 4 msec.

1.2.6 Digital Outputs

Two (2) programmable Form-C relays.
For more on the relay specifications, see Appendix 16

- Relay 1: 2A at 30VDC / 250VAC
  (inductive load)
- Relay 2: 7.5A at 110VAC
  5A at 24VDC
  (inductive load)
- Update Rate: 2 msec.

Four (4) programmable opto-isolated open collectors.

- Voltage: 50 Volts DC (max.)
- Capacity: ≤ 150 mA
- Update Rate: 2 msec.

1.2.7 Analog Inputs

Two (2) differential inputs.

- Voltage: ± 10 Volts DC
- Channel 1: Speed Command
- Channel 2: Pre Torque Command
- Resolution: 12 Bit
- Software gain and offset available
- Update Rate: 2 msec**.**

1.2.8 Analog Outputs

Two (2) programmable differential outputs.

- Voltage: ± 10 Volts DC
- Capacity: 10 mA
- Resolution: 12 Bit
- Update Rate: 2 msec.

1.2.9 Encoder Feedback

- Supply Voltage: 12VDC or 5VDC
- Capacity: 200mA or 150mA
- PPR: 600 - 10,000
- Maximum Frequency: 300 kHz
- Input: 2 channel quadrature
  5 or 12 volts dc differential
  (A, /A, B, /B)

1.2.10 Design Features

- DC Bus Choke: Connections for optional external DC Bus Choke
- Internal Dynamic Brake IGBT: Connections for external Dynamic Brake Resistor
- Serial Channel: Optically isolated RS422 port

1.2.11 Protective Features

- Internal motor overload protection per UL/CSA
- Overspeed Fault
- Drive Overload Fault
- DC Bus Overvoltage and Undervoltage Faults
- Overcurrent Fault
- Phase Overcurrent Fault
- Open Phase Fault
- Overtemperature Fault
- Encoder Malfunction Fault

1.2.12 Environmental

- Operating ambient air temperature range -10°C (14°F) to 55°C (130°F)
- Altitude 1000m (3300 ft) without derating
- Relative humidity 95% (non-condensing)
- Environment: protected from corrostive gases; conductive dust
- Vibration: displacement of 0.032mm < 57Hz; peak acceleration 0.5g > 57Hz

1.2.13 Standards and Reliability

- UL and CSA listed*
  Note: B+ cubes are only CSA listed.
- CE
- Surface mount devices

1.3 DRIVE MODEL NUMBER

The HPV 900 nameplate contains a fifteen digit model number, which provides complete identification of the drive. Figure 1. 2 detail the model number.

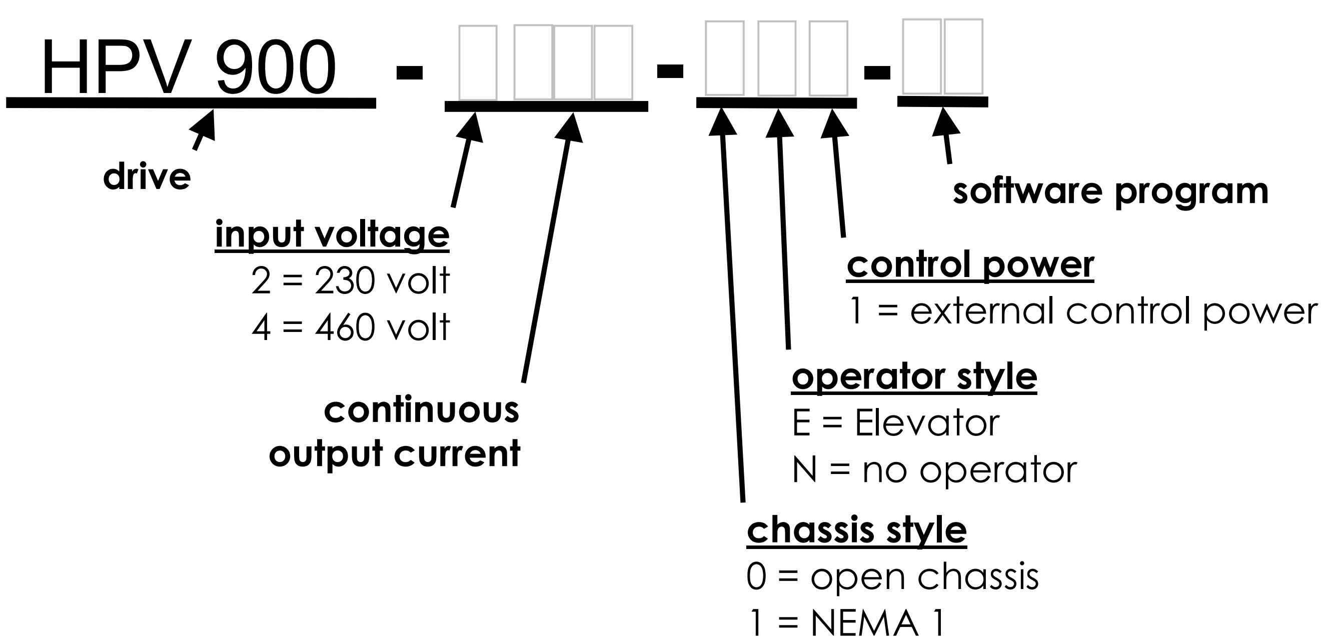


Figure 1. 2 - Model Number

1.4 DIGITAL OPERATOR

The digital operator for the HPV 900 is a hand-held push button operator with LCD display, which connects to the drive via a 9-pin DB9 cable. The Digital Operator receives power from the drive, and uses a cable for communication with the drive.

A single digital operator can easily be removed and transferred to another drive, *see Figure 1. 3.*

For details on the operation of the digital operator, *see section 3.2.*

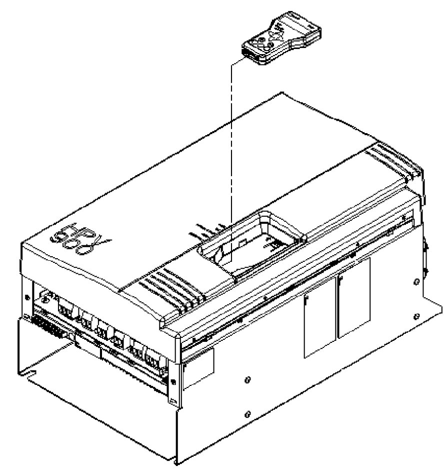


Figure 1. 3 - Digital Operator Insertion

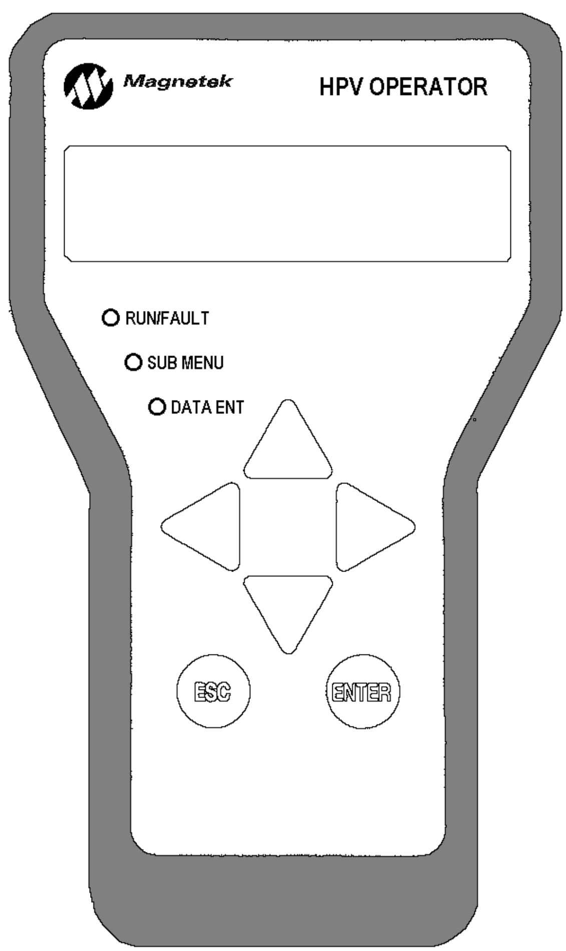


Figure 1. 4 - Digital Operator

2 INSTALLATION AND START UP

2.1 START-UP PROCEDURE

The following is a recommended start-up procedure:

1. The HPV 900 is thoroughly tested at the factory. Verify the drive has been installed without shipping and installation damage. (see Section 2.2.1 - Receiving)

2. Review the HPV 900 technical manual, TM4090, shipped with the drive.

3. Verify the proper drive model numbers and voltage ratings as specified on the purchase order.

4. Verify the drive has been installed in accordance with Section 2.2.2 - Physical . For guildlines on CE compliance, see Section 5.11 and for recommended line filters, see Appendix 7.

5. Verify the encoder has been selected and installed in accordance with Section 2.3 - SELECTING AND MOUNTING OF ENCODER.

6. Inspect the security of the supply line power, ground connections, and all control circuit connections. (see Appendix 10 - WIRE TERMINAL SPECIFICATIONS) Ensure that the main circuit input/output precautions are observed. (see Section 2.4.1 - Main Circuit Input/Output) . Also, ensure that the control circuit precautions are observed. (see Section 2.4.2 - Control Circuit)

7. Verify that the input voltage matches the drive's rating.

8. Verify that the motor is wired for the application voltage and amperage.

9. Tighten all of the three-phase power and ground connections. Please check that all control and signal terminations are also tight. As they sometimes come loose during the shipment process.

   Please refer to Section 2.6.1 - Pre-Power Check and Section 2.6.2 - CSA Warnings.

   IMPORTANT: Double-check all the power wires and motor wires (R/R1, S/S1, T/T1, U, V, & W) to make sure that they are securely tightened down to their respective lugs (loose wire connections may cause problems at any time).

   IMPORTANT: Insure the incoming line supply IS CONNECTED to the drive INPUT TERMINALS R/R1, S/S1, & T/T1 and NOT to the output motor terminals U,V, & W.

10. Insure the DC Choke link is in place, if a DC choke is NOT used. Also, insure the links are in place between R & R1, S & S1, and T & T1, if a 12-pulse transformer is NOT used.

11. Insure a Dynamic Braking Resistor is connected to the drive, see recommended values in Appendix 2.

12. Measure and verify transformer primary and secondary volts

13. Check for balanced Vac from phase to ground.

14. Verify the accuracy of the drive's input line-to-line voltage in parameter INPUT L-L VOLTS (A4). (see Section 3.4.4 - POWER CONVERT A4 Sub-menu)

    NOTE: The INPUT L-L VOLTS parameter helps to determine the DC bus undervoltage alarm/fault level.

15. Enter / Verify the encoder pulses entered in the ENCODER PULSES (A1) parameter matches the encoder's nameplate. (see Section 3.4.1 - DRIVE A1 Sub-menu)

16. Select one of the two default motors (either 4 or 6 pole) for the MOTOR ID (A5) parameter (or select a valid motor ID, if available).

    Enter / Verify the following from the motor's nameplate:
    - Motor HP or KW rating (RATED MTR POWER)
    - Motor Voltage (RATED MTR VOLTS)
    - Motor Excitation Frequency in Hz (RATED EXCIT FREQ)
    - Rated Motor current (RATED MOTOR CURR)
    - Number of Motor Poles (MOTOR POLES)
    - Rated Motor Speed at full load in RPM (RATED MTR SPEED)

    (see Section 3.4.5 - MOTOR A5 Sub-menu)

17. Enter / Verify The hoistway parameters:
    - CONTRACT CAR SPD (A1)- parameter programs the elevator contract speed in ft/min or m/s.
    - CONTRACT MTR SPD (A1) parameter programs the motor speed at elevator contract speed in RPM.

    (see Section 3.4.1 - DRIVE A1 Sub-menu)

    NOTE: The above two parameters create the interaction that allow engineering units to be used throughout the HPV 900 software.

18. Run the drive in low speed inspection mode and…
    - Start with default values for INERTIA (A1) and % NO LOAD CURR (A5) parameters.
    - Verify encoder polarity… the motor phasing should match the encoder phasing. *Common failure mode: Encoder Fault with Torque Limit LED.* (see Section 2.5.4.2)
    - Verify proper hoistway direction…can be reversed with the MOTOR ROTATION (C1) parameter. (see Section 3.5.1 - USER SWITCHES C1 Sub-menu)
    - Verify that the Safety Chain / Emergency Stop works

    For more information on the various operation mode adjustments, see Section 2.7 - OPERATION MODE.

19. Run the drive in high speed mode and…
    - Follow the Adaptive Tune procedure, see Section 5.7 – ADAPTIVE TUNE.
    - Follow the Estimating System Inertia procedure, see Section 5.8 - ESTIMATING SYSTEM INERTIA.

See section 2.7.5 - Operation Tools

This completes the recommended start-up procedure. Please refer to the remainder of the technical manual for additional information.

2.2 PHYSICAL INSTALLATION

2.2.1 Receiving

The HPV 900 is thoroughly tested at the factory. After unpacking, verify the part number with the purchase order (invoice). Any damages or shortages evident when the equipment is received must be reported to the commercial carrier that transported the equipment. Assistance, if required, is available from your sales representative.

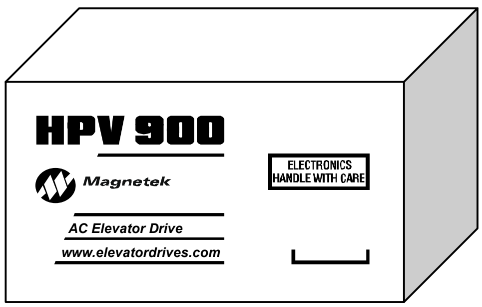


Figure 2. 1 - Shipping Carton

2.2.2 Physical Location

NOTE: See Appendix 1 for drive dimensions

Location of the HPV 900 is important for proper operation of the drive and normal life expectancy. The installation should comply with the following:

- DO NOT mount in direct sunlight, rain or extreme (condensing) humidity.
- DO NOT mount where corrosive gases or liquids are present.
- AVOID exposure to vibration, airborne dust or metallic particles.
- DO NOT allow the ambient temperature around the control to exceed the ambient temperature listed in the specification, *see section 1.2.12.*
- Mount control vertically using mounting holes provided by Magnetek.
- Allow at least 7cm (2.5 in) clearance above and at least 7 to 13 cm (2.5 to 5 in) clearance below the unit.
- Allow 3 cm (1 in) clearance to either side of the drive and allow 6cm (2.5 in) clearance for opening of the door.
- Separate grounded metal conduit is required for input, output and control wiring.

2.2.3 Drive Cooling

The unit should be installed in an open ventilated area where free air can be circulated around the control. The installation should comply with the following:

- When necessary, the cooling should be provided by using filtered air.
- If the cooling coming inside the control cabinet contains airborne dust, filter the incoming air as required and clean the cooling surface of the HPV 900 regularly using compressed air and a brush. An uncleaned heatsink operates at an efficiency less than that of cooling design specifications. Therefore, drive may fault on thermal protection if heatsink is not cleaned periodically.
- Allow at least 7 to 13 cm (2.5 to 5 in) clearance above and below the unit.
- Allow at least 3 to 7 cm (1 to 2.5 in) clearance on either side of the unit.

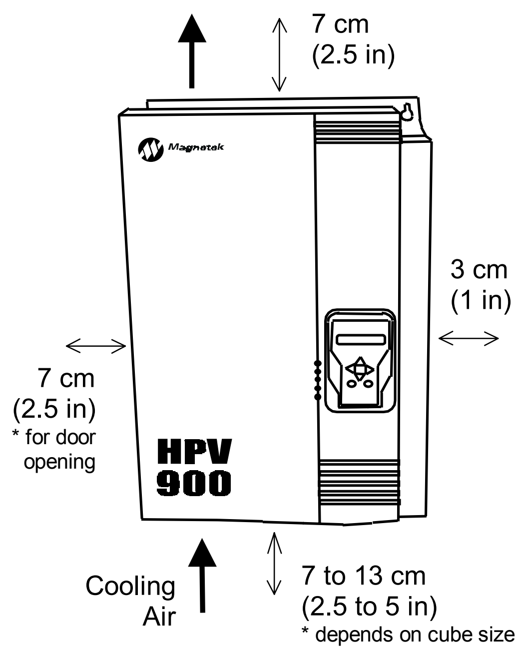


Figure 2. 2 - Mounting Distances

2.2.4 Drive Derating

2.2.4.1 Altitude Derating

Control ratings apply to 1000 meters (3300 feet) altitude without derating. For installations at higher altitudes, derate both the continuous and peak current levels 5% for each 300 m (1000 ft) above 1000 m (3300 ft).

2.2.4.2 Temperature Derating

Control ratings apply for 55°C (130°F) inside the customer's control cabinet. Derate both the continuous and peak current levels by 5% for temperatures above 55°C (130°F) up to a maximum of 60°C (140°F).

2.2.4.3 Derating for Carrier Frequency

Control ratings apply for carrier frequencies up to and including 10 kHz. Above that linearly derate both the continuous and peak current levels by 5% for each 1kHz.

2.3 SELECTING AND MOUNTING OF ENCODER

2.3.1 Encoder Specification

The HPV 900 has connections for an incremental two-channel quadrature encoder.

For better noise immunity, the HPV 900 provides…

- an isolated power supply, which separates the processor power from the encoder
- optically isolated encoder signals from the HPV 900's processor

The HPV 900 encoder feedback requirements are listed in the specification, *see section 1.2.9.*

2.3.2 Encoder Considerations

Electrical interference and mechanical speed modulations are common problems that can result in improper speed feedback getting to the drive. To help avoid these common problems, the following electrical and mechanical considerations are suggested.

IMPORTANT

Proper encoder speed feedback is essential for a drive to provide proper motor control.

2.3.2.1 Electrical Considerations

- If possible, insulate both the encoder case and shaft from the motor. (see section 2.3.3.1)
- Use twisted pair cable with shield tied to chassis ground at drive end. (see section 2.5.4.1)
- Use limited slew rate differential line drivers. (see section 5.5.3.1)
- Do not allow capacitors from internal encoder electronics to case. (see section 5.5.3.2)
- Do not exceed the operating specification of the encoder/drive. (see section 5.5.3.3)
- Use the proper encoder supply voltage and use the highest possible voltage available. (see section 5.5.3.4) (i.e. HPV 900 - 12VDC preferred)

2.3.2.2 Mechanical Considerations

- Use direct motor mounting without couplings. (see section 2.3.3.1)
- Use hub or hollow shaft encoder with concentric motor stub shaft. (see section 2.3.3.2)
- If possible, use a mechanical protective cover for exposed encoders. (see section 2.3.3.4)

2.3.3 Encoder Mounting

2.3.3.1 Insulating Encoder from Motor

It is preferred that both the encoder case and shaft are insulated from the motor, in order to minimize encoder bearing currents and ground noise.

There will be PWM electrical noise on the motor shaft that will take the easiest path to ground. If the encoder is not electrically isolated from the motor, this path could be through the encoder bearings and/or electronics. Encoder bearing current will reduce the life of the bearings and create additional ground noise. The solution would be to electrically isolate both the encoder shaft and case from the motor.

Insulating the encoder case from the motor also reduces ground current coupling from the motor frame to the internal electronics of the encoder. Ground noise from the motor frame can disturb the operation of the encoder and propagate down the connected cable to disturb the transmission of the encoder signals. (i.e. there can be coupling from the case to the internal electronics even though a discrete capacitor is not present)

Figure 2. 6 shows how to insulate a hollow-shaft encoder from the motor.
(similar mounting hardware and insulating insert can be used for hub-shaft encoders)

2.3.3.2 Direct Motor Mounting

Use direct motor mounting without couplings, in order to avoid eccentricities and to provide for zero backlash

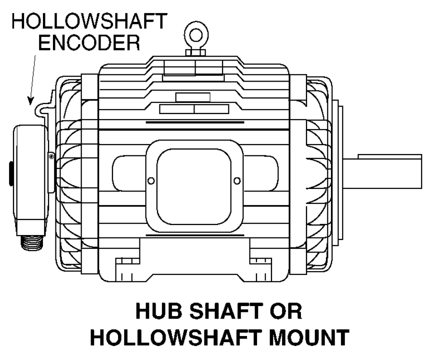


Figure 2. 3 - Direct Motor Mount

Direct mounted encoders do not have shafts and are mounted directly onto the motor shaft. Examples include hub-shaft or hollow-shaft models with integral flexible mounts. These have no separate shaft to shaft coupling. In addition, there may be no need for mounting brackets or adapters.

Direct mounted encoders do not have shafts and are mounted directly onto the motor shaft. Examples include hub-shaft or hollow-shaft models with integral flexible mounts. These have no separate shaft to shaft coupling. In addition, there may be no need for mounting brackets or adapters.

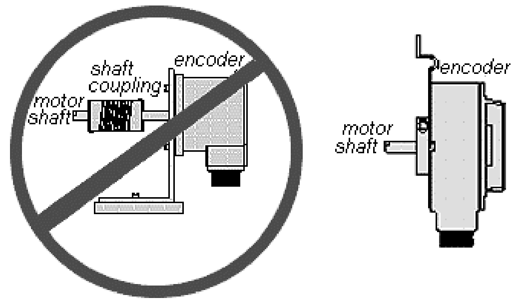


Figure 2. 4 - Avoiding Couplings

2.3.3.3 Motor Stub Shaft

Use hub or hollow shaft encoder with concentric motor stub shaft and use a flexible encoder mount rather than a flexible shaft coupling.

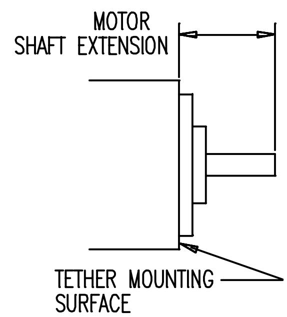


Figure 2. 5 - Motor Stub Shaft

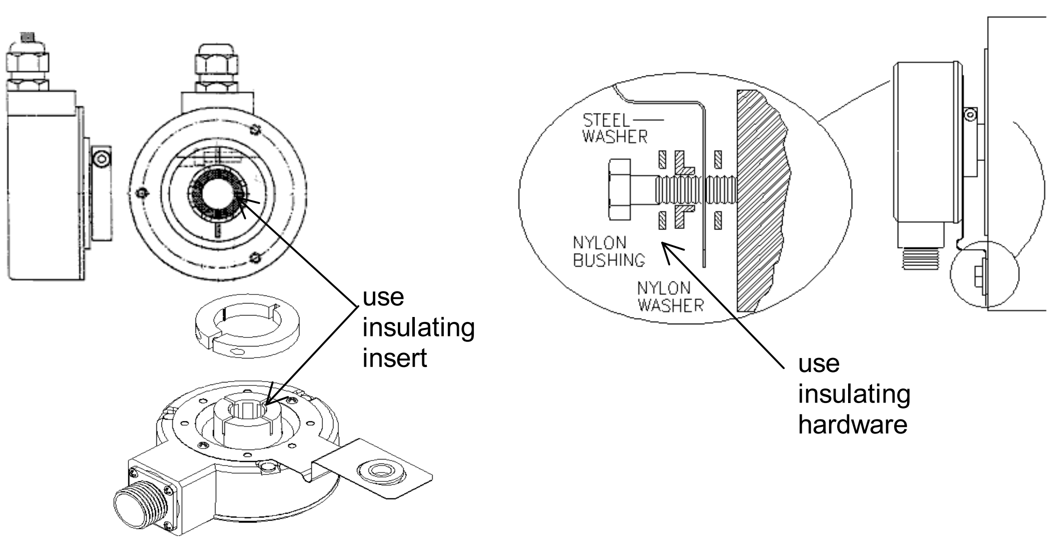


Figure 2. 6 - Insulating Encoder from Motor

It is preferred that a solid shaft extension is specified from the motor manufacturer for a length recommended by the encoder manufacturer.

Although it is not the preferred method, installations that employ a screwed on sub shaft adapter should:
- use the original hole used to machine the motor shaft
- use locktight to hold the thread in position
- align the stub shaft to 0.002 inches TIR or less with a dial indicator

A hub-shaft or hollow-shaft encoder should be mounted so that its shaft receptacle is in as close as possible alignment with the axis of the motor shaft. Clamp or set screws should then be tightened to secure the encoder.

REMEMBER: If you are following the preferred method of insulating the encoder from the motor, install the proper insulating hardware.

NOTE: Do not defeat or restrict the flexure. This causes failure of the encoder or driving shaft bearings.

2.3.3.4 Encoder Protective Covers

In order to protect the encoders from mechanical damage, it is preferred that for exposed encoders a mechanical protective cover is used.

Encoders are vulnerable to mechanical damage from impact. Encoders can be damaged by impact during installation or during exposed operation. Motors are even sometimes lifted by the encoders on one end. Therefore, it is preferred that the encoder be protected by a cover as shown below.

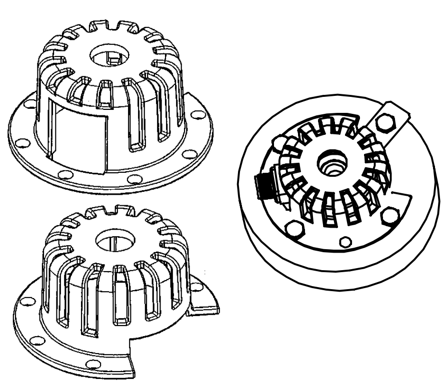


Figure 2. 7 - Protective Covers

2.4 ELECTRICAL INSTALLATION

NOTE: See General Safety Precautions in section 2.6.2 (CSA Warnings)

The HPV 900 drives are rated for 200/208/230V and 380/400/460V three phase system. The necessary protection and equipment includes the three power leads and a grounding lead. The input & output conductors and the branch circuit protection must be sized to meet the local electrical code requirements.

See Figure 2. 11 - Interconnection Diagram.

2.4.1 Main Circuit Input/Output

Observe the following precautions:

- Use 600V vinyl sheathed wire or equivalent. Wire size should be determined considering voltage drop of leads. *For more information on suggested wire sizing, see Appendix 9.*
- Never connect main AC power to the output terminals: U, V, and W.
- Never allow wire leads to contact metal surfaces. Short circuit may result.
- SIZE OF WIRE MUST BE SUITABLE FOR CLASS I CIRCUITS.
- Motor lead length should not exceed 45m (150 ft) and motor wiring should be run in a separate conduit from the power wiring. If lead length must exceed this distance, contact Magnetek for proper installation procedures.
- Use UL/CSA certified connectors sized for the selected wire gauge. Install connectors using the specified crimping tools specified by the connector manufacturer.

Refer to Figure 2. 11 for completing the connections.

2.4.1.1 Input Power Connections

Terminals: R & R1, S & S1, and T & T1 provide connections for AC input power. Two position removable links are provided for the following pairs of terminals: R:R1, S:S1, T:T1. With the links in place power can be supplied as a three phase source.

IMPORTANT

Class J Input Fusing is required for
the A-cube models: -4008, -4016, -4021, and –2025. *For more information, see Appendix 5.*

2.4.1.2 Motor Lead Connections

U, V, & W terminals provide connection points for the motor leads.

2.4.1.3 DC Choke Connections

Terminals +1 and +2 provide connection points for a user supplied DC choke. A two position removable link is provided to the pair of terminals. With this link, the drive can be operated without the use of a DC choke.

2.4.1.4 Brake Resistor Connections

Terminals +3, -, and +4 provide connection points for an external user supplied braking resistor. Connect the external brake resistor between terminals +3 and +4. Terminals: +3 and - are the positive and negative rails of the DC bus. (see Figure 2. 8, Figure 2. 9, and Figure 2. 10)

2.4.1.5 Equipment Grounding

A terminal block is provided for the required user supplied equipment grounding.

2.4.2 Control Circuit

Observe the following precautions:

Use twisted shielded or twisted-pair shielded wire for control and signal circuit leads. The shield sheath MUST be connected at the HPV 900 ONLY. The other end should be dressed neatly and left unconnected (floating). Wire size should be determined considering the voltage drops of the leads.
Lead length should not exceed 45m (150 ft).
Signal leads and feedback leads should be run in separate conduits from power and motor wiring.

Use UL / CSA certified connectors sized for the selected wire gauge. Install connectors using the crimping tools specified by the connector manufacturer.

Refer to Figure 2. 11 for completing encoder connections; analog inputs; logic inputs; and logic outputs at the HPV 900's Control Board.

IMPORTANT
Parameter adjustments will have to be made for the specific analog input, logic inputs, and logic outputs to be used for the installation.

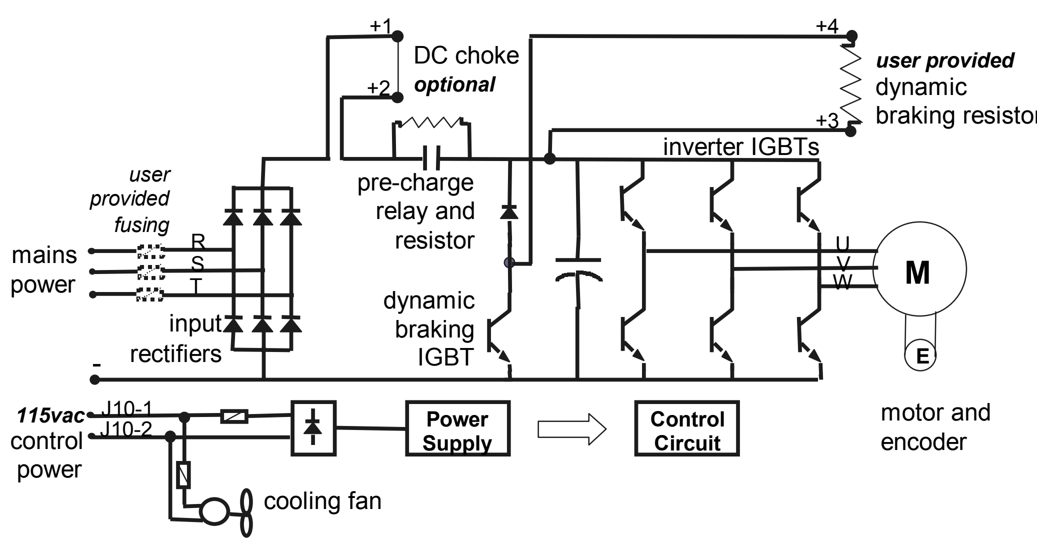


Figure 2. 8 – Main Circuit Block Diagram (A-cube)

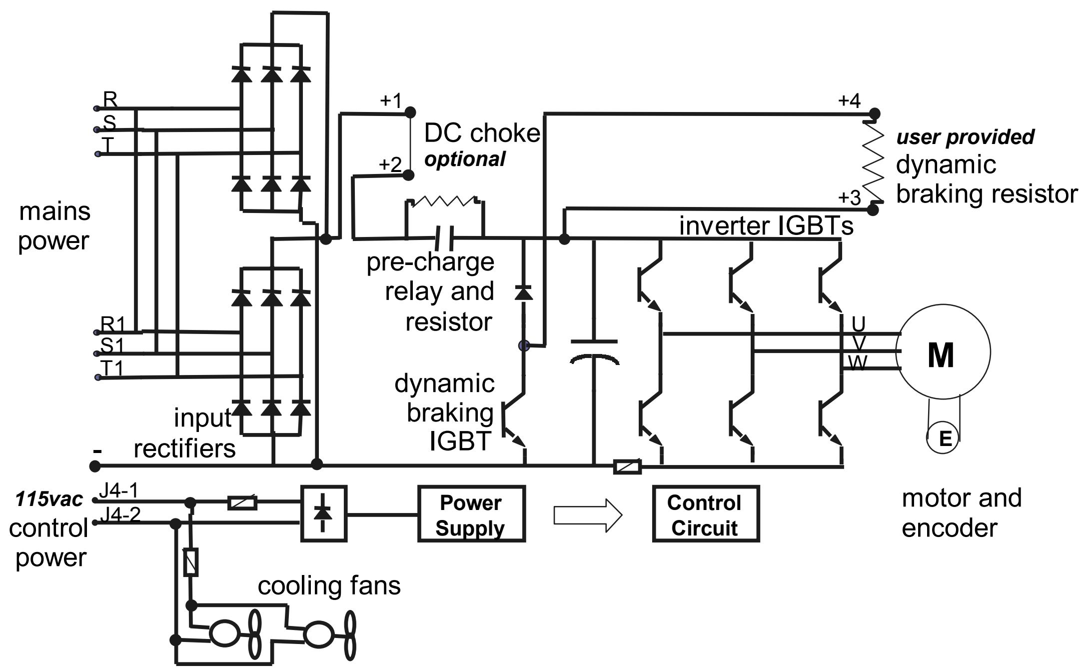


Figure 2. 9 - Main Circuit Block Diagram (B-cube and B+ cube)

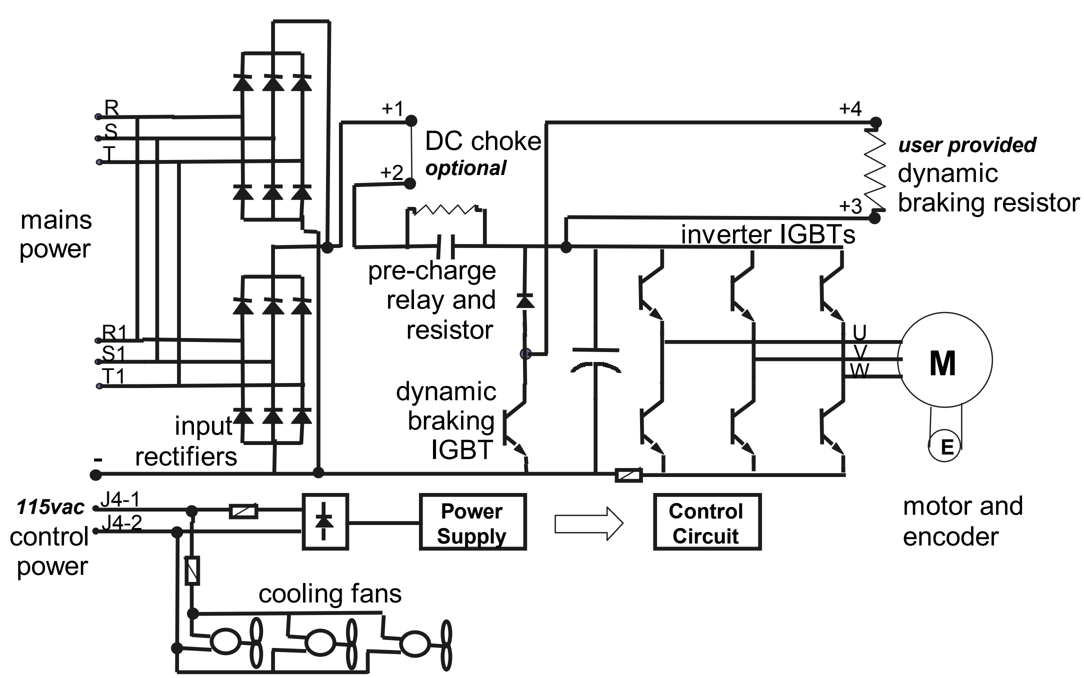


Figure 2. 10 - Main Circuit Block Diagram (C-cube)

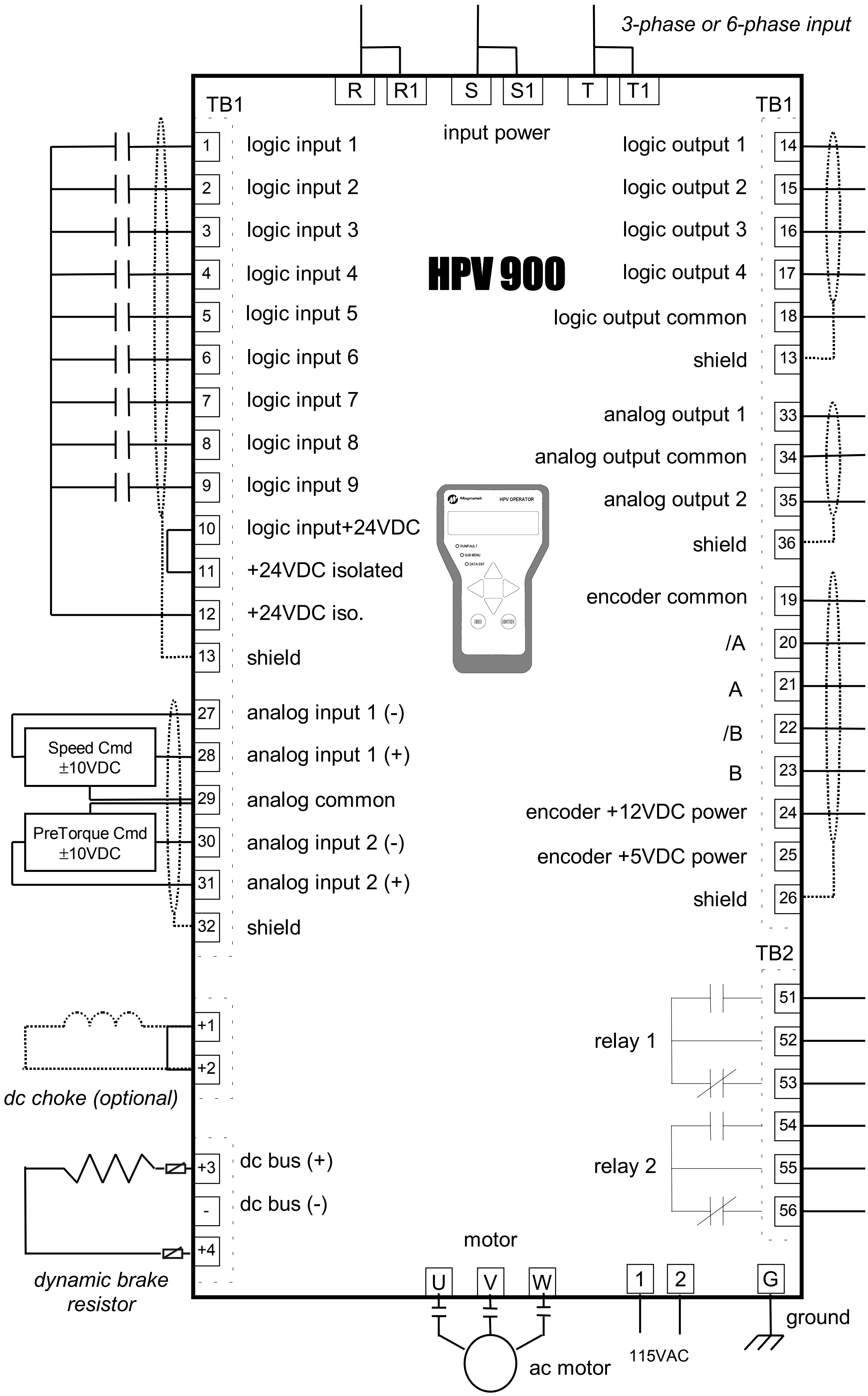


Figure 2. 11 - Interconnection Diagram

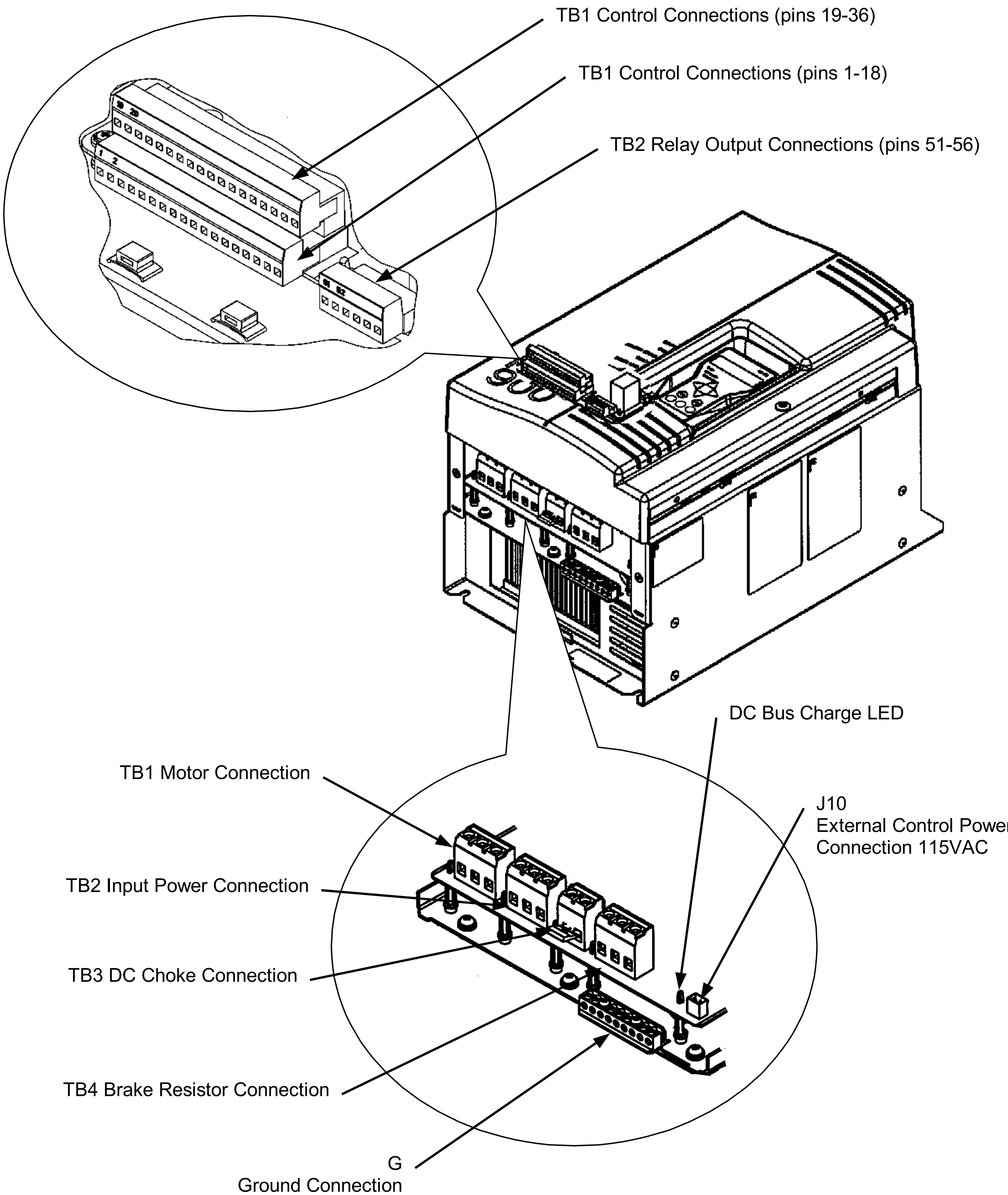


Figure 2. 12 - Terminal Connections (A-cube)

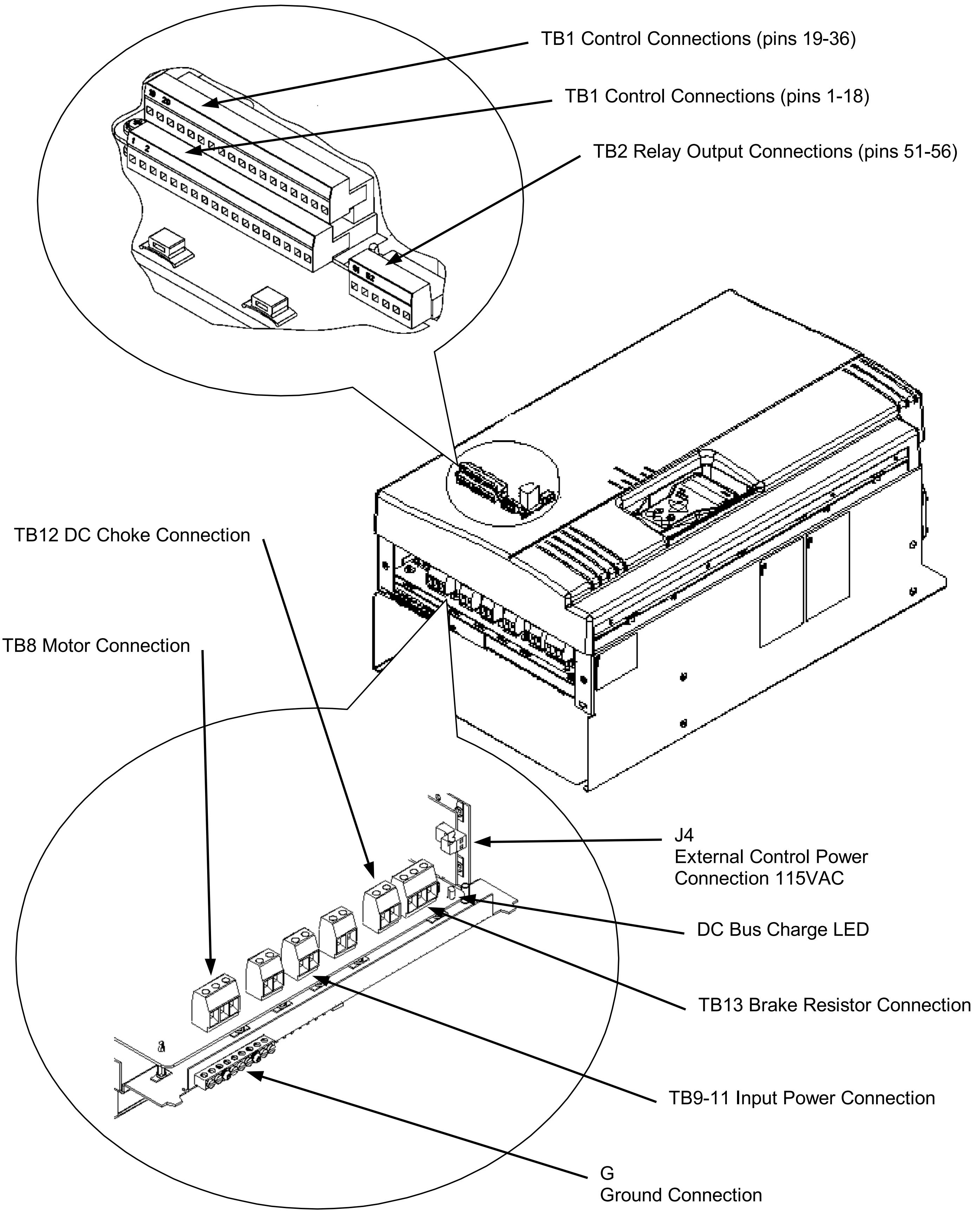


Figure 2. 13 - Terminal Connections (B-cube)

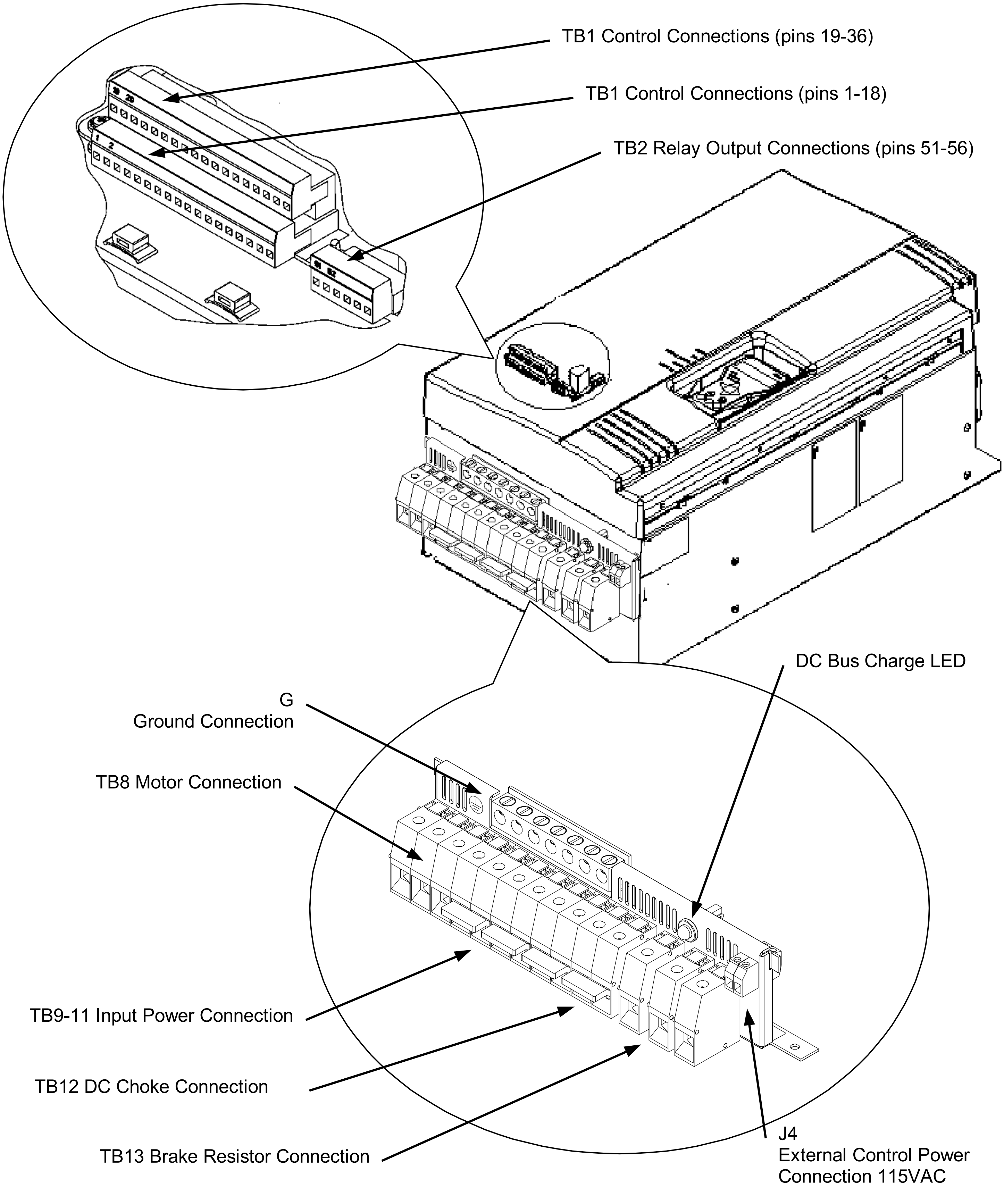


Figure 2. 14 - Terminal Connections (B+ cube)

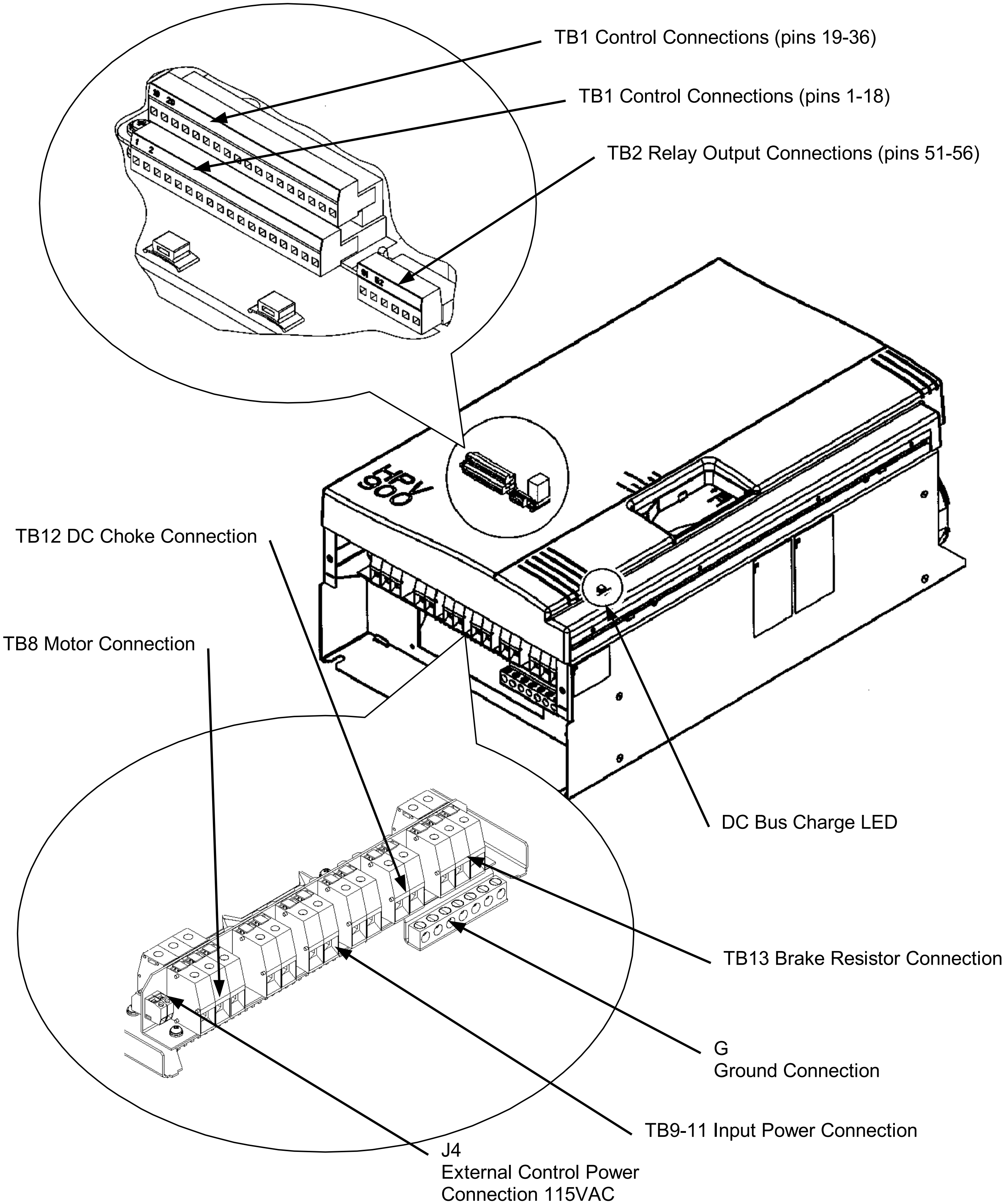


Figure 2. 15 - Terminal Connections (C-cube)

2.5 INTERCONNECTIONS

The HPV 900 Interconnection is detailed in Figure 2. 16.

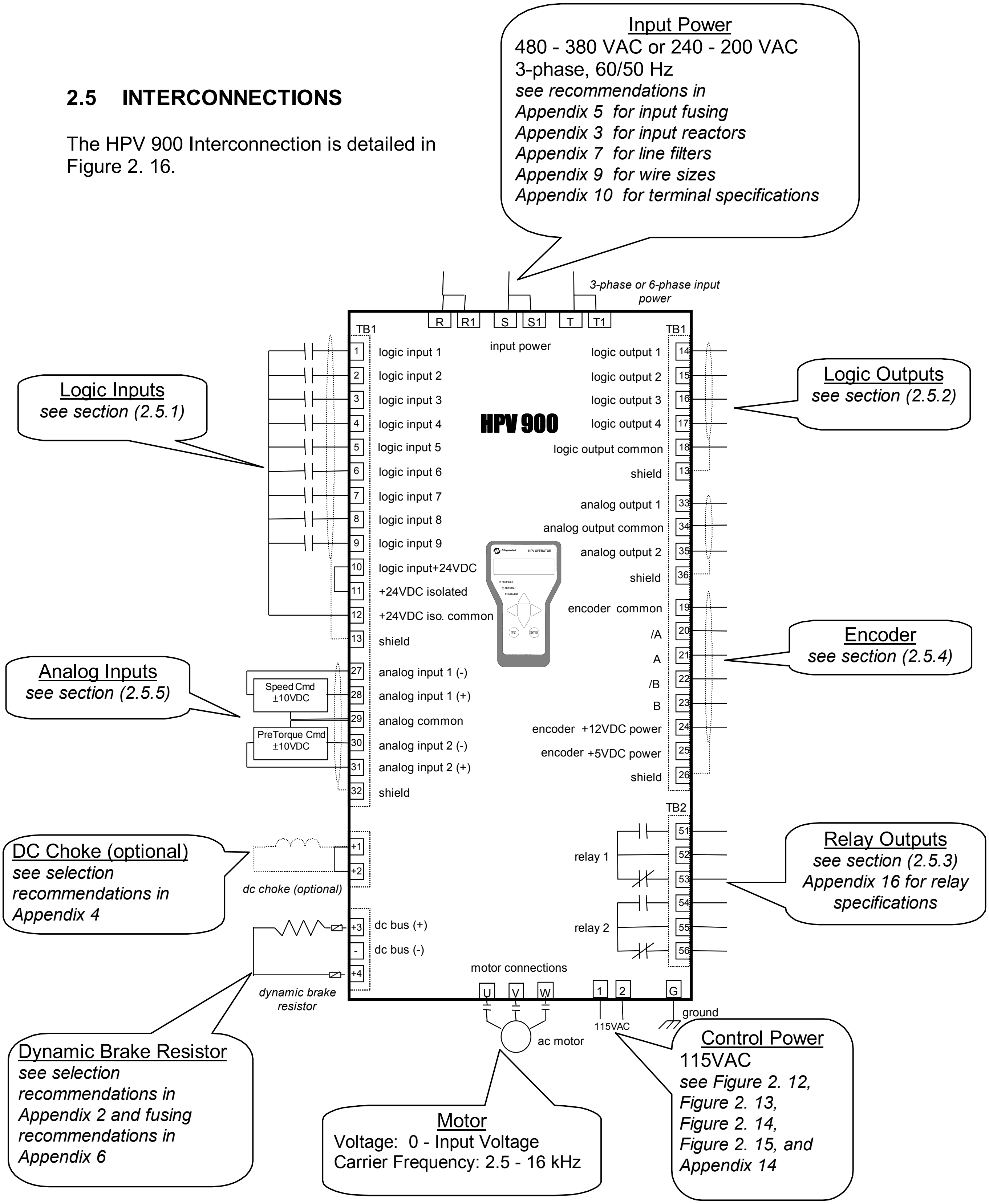


Figure 2. 16 - Interconnection Diagram Reference

2.5.1 Logic Inputs

The HPV 900's nine programmable logic inputs are opto-isolated. The inputs become "true" by closing contacts or switches between the logic input terminal and voltage source common. The voltage supply for the logic inputs is 24VDC.

The choices for the voltage source common depend on if the user is using an external voltage supply or using the internal voltage supply.

Figure 2. 17 shows the connection for using the internal voltage supply. And in this case, the voltage source common is TB1-12 (+24VDC isolated common).

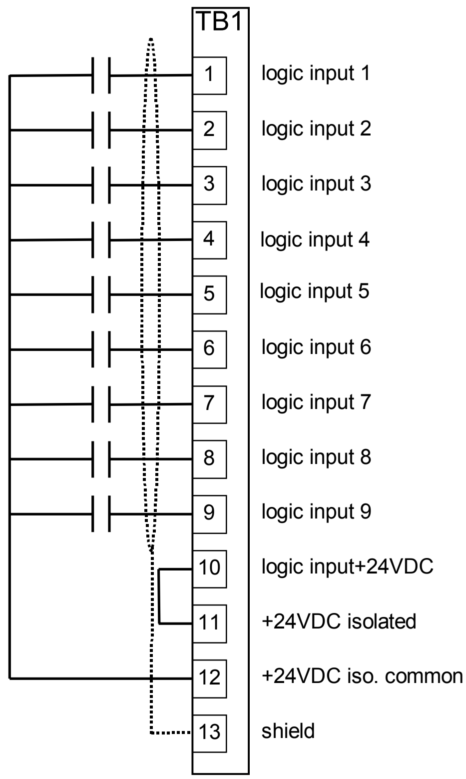


Figure 2. 17 - Logic Inputs (Internal Supply)

Figure 2. 18 shows the connection for using the external voltage supply. And in this case the voltage source common is negative side of the external voltage supply.

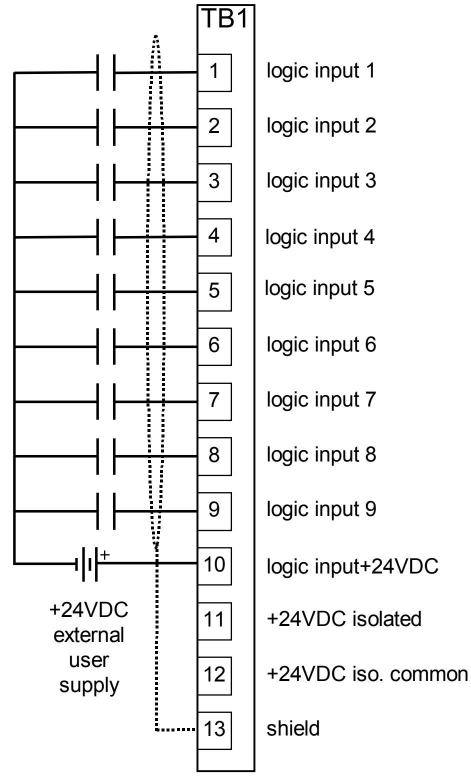


Figure 2. 18 - Logic Inputs (External Supply)

The logic inputs have two different sinking current ratings.

- logic inputs 1 and 2 - sink 18mA.
- logic inputs 3, 4, 5, 6, 7, 8, and 9 - sink 9mA.

The switches or contacts used to operate the logic inputs may be replaced by logic outputs from a PLC or car controller. If the outputs are open collector, the ground is needs to be connected to the proper voltage source common.

For more information on the programming the logic inputs, see section 3.5.2.

2.5.2 Logic Outputs

The HPV 900's four programmable logic outputs are opto-isolated, open collector. The outputs are normally open and can withstand an applied maximum voltage of 50VDC. When the outputs become "true", the output closes and are capable of sinking up to 150mA between the logic output terminal and the logic output common (TB1-18). Figure 2. 19 shows the logic output terminals.

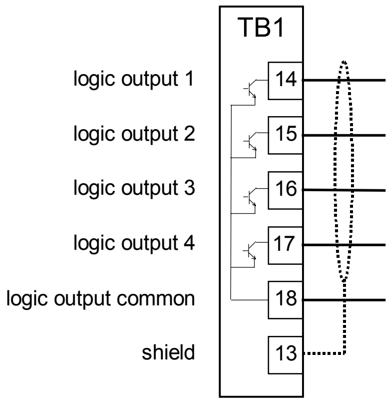


Figure 2. 19 - Logic Outputs

For more information on the programming the logic outputs, see section 3.5.3.

2.5.3 Relay Outputs

The HPV 900's two programmable relay logic outputs are Form-C relays. The have both normally open and normally closed contacts. Relay 2 is designed for more operations and is recommended for use with in controlling the motor contactor. Relay 1 is recommended for use with the fault circuitry.

The specifications for each relay are as follows:
<u>Relay 1</u>

- 2A at 30VDC / 250VAC (inductive load)

<u>Relay 2</u>

- 7.5A at 110VAC / 5A at 24VDC (inductive load)

For more on the relay specifications, see Appendix 16

Figure 2. 20 shows the logic output terminals.

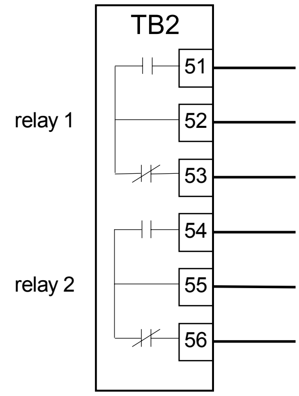


Figure 2. 20 - Relay Outputs

For more information on the programming the relay outputs, see section 3.5.3.

2.5.4 Encoder

The HPV 900 has connections for an incremental two-channel quadrature encoder. The drive's encoder circuitry incorporates resolution multiplication and complimentary outputs.

2.5.4.1 Encoder Wiring

Use twisted pair cable with shield tied to chassis ground at drive end, in order to minimize magnetic and electrostatic pick-up current and to minimize radiated and conducted noise.

Reasonable care must be taken when connecting and routing power and signal wiring. Radiated noise from nearby relays (relay coils should have R/C suppressors), transformers, other electronic drives, etc. may be induced into the signal lines causing undesired signal pulses.

Power leads and signal lines must be routed separately. Signal lines should be shielded, twisted and routed in separate conduits or harnesses spaced at least 12 inches apart from power wiring. This protects the cable from physical damage while providing a degree of electrical isolation. Also, do not run cable in close proximity to other conductors which carry current to heavy loads such as motors, motor starters, contactors, or solenoids. Doing so could result in electrical transients in the encoder cable, which can cause undesired signal pulses. Power leads are defined as the transformer primary and secondary leads, motor leads and any 120 VAC or above control wiring for relays, fans, thermal protectors, etc.

Continuity of wires and shields should be maintained from the encoder through to the controller avoiding the use of terminals in a junction box. The shield and shield drain wires must be insulated from other objects. This helps to minimize radiated & induced noise problems and magnetically induced ground loops.

Always use an encoder with complementary output signals. Connect with twisted-pair shielded wire so that wire-induced currents will self-cancel, as shown in Figure 2. 22.

NOTE: DO NOT ground the encoder through both the machine and the cable wiring. Connect the shield at the receiver device only. If the shield is connected at both ends, noise currents will flow through the shield and degraded performance will result.

2.5.4.2 HPV 900 Encoder Specifications

The HPV 900 requires the use of an encoder coupled to the motor shaft. The encoder power can be either a 5VDC or 12VDC supply. The capacity of each power supply is the following:

- supply voltage: 12VDC
  200mA capacity
- supply voltage: 5VDC
  150mA capacity

The HPV 900 can accept encoder pulses of:

- 600 to 10,000 pulses per revolution (ppr)
- a maximum frequency of 300kHz

IMPORTANT

Motor phasing should match the encoder feedback phasing. If the phasing is not correct, the motor will not accelerate up to speed. It will typically oscillate back and forth at zero speed, and the current will be at the torque limit. Swapping A and /A or switching two motor phases should correct this situation.

The encoder pulses per revolution must by entered in the ENCODER PULSES parameter, *see section (3.4.1)*.

The encoder connection terminals are shown in Figure 2. 21.

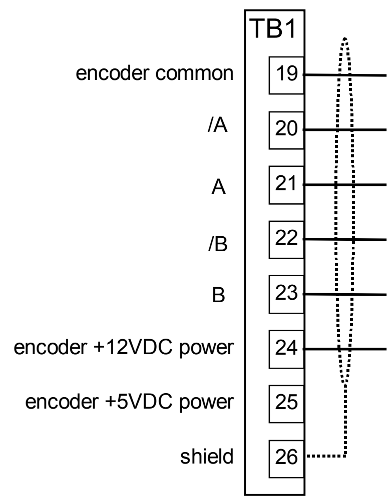


Figure 2. 21 - Encoder Connections

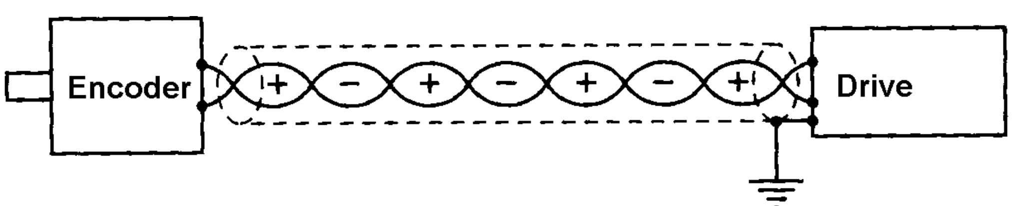


Figure 2. 22 - Encoder Wiring

2.5.5 Analog Inputs

The HPV 900 has two non-programmable differential analog input channels.

- Analog input channel 1 is reserved for the speed command (if used).
- Analog input channel 2 is reserved for the pre-torque command (if used).

The analog input channels are bipolar and have a voltage range of ±10VDC.

Available with the analog channels is multiplier gain parameters (SPD COMMAND MULT and PRE TORQUE MULT) and bias parameters (SPD COMMAND BIAS and PRE TORQUE BIAS). These parameters are used to scale the user's analog command to the proper range for the drive software. The formula below shows the scaling effects of these two parameters.

$$\left(\begin{matrix} \textit{analog} \\ \textit{channel} \\ \textit{input} \\ \textit{voltage} \end{matrix} - \textit{BIAS}\right) \times \textit{MULT} = \begin{matrix} \textit{signal} \\ \textit{drive} \\ \textit{software} \\ \textit{uses} \end{matrix}$$

For more on the multiplier gain or bias parameters, see sections (3.4.1),(5.1.1.2), and (5.1.4.7.2).

The scaling of the analog input signals follows:

- Speed Command
  +10VDC = positive contract speed
  -10VDC = negative contract speed
- Pre Torque Command
  +10VDC = positive rated torque of motor
  -10VDC = negative rated torque of motor

NOTE: The drive cannot recognize voltages outside of the ±10VDC on its analog input channels.

The HPV 900 provides common mode noise rejection with the differential analog inputs. The connection of these two inputs is shown in Figure 2. 23.

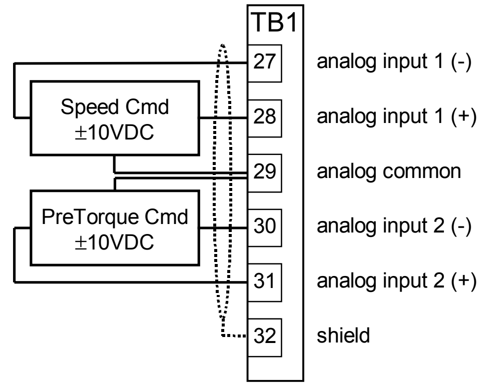


Figure 2. 23 - Analog Inputs (Differential)

Figure 2. 24 shows the connection for the analog inputs, if they are configured to be single ended. In this configuration, the HPV 900 noise immunity circuitry is not in effect.

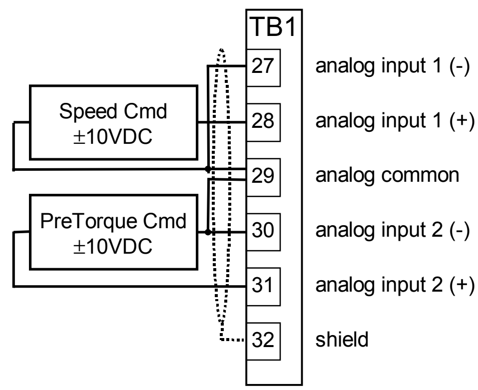


Figure 2. 24 - Analog Inputs (Single Ended)

2.5.6 Analog Outputs

The HPV 900 has two programmable differential analog output channels. The two analog output channels were designed for diagnostic help. *For more information on programming the analog output channels, see section (0).*

The analog output channels are bipolar and have a voltage range of ±10VDC.

Available with the analog channels is multiplier gain parameters (ANA 1 OUT GAIN and ANA 2 OUT GAIN) and a bias or offset parameters (ANA 1 OUT OFFSET and ANA 2 OUT OFFSET). These parameters are used to scale the user's analog outputs to the proper range for the drive software. The formula below shows the scaling effects of these two parameters.

$$\left(\begin{array}{c}\textit{signal}\\ \textit{drive}\\ \textit{software}\\ \textit{creates}\end{array} - OFFSET\right) \times BIAS = \begin{array}{c}\textit{analog}\\ \textit{channel}\\ \textit{output}\\ \textit{voltage}\end{array}$$

For more on the gain or offset parameters, see section (3.4.1).
The scaling of the analog output signals is detailed in section (3.4.1).

The connection of these two inputs is shown in Figure 2. 25.

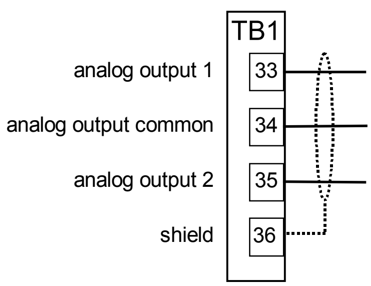


Figure 2. 25 - Analog Outputs

2.6 INITIAL START-UP

2.6.1 Pre-Power Check

CAUTION

TO PREVENT DAMAGE TO THE DRIVE. THE FOLLOWING CHECKS MUST BE PERFORMED BEFORE APPLYING THE INPUT POWER.

A. Inspect all equipment for signs of damage, loose connections, or other defects.

B. Ensure the three phase line voltage is within ±10% of the nominal input voltage. Also verify the frequency (50 or 60 Hz) is correct for the elevator control system.

C. Remove all shipping devices.

D. Ensure all electrical connections are secure.

E. Ensure that all transformers are connected for proper voltage.

2.6.2 CSA Warnings

The following are written warnings located on the drive chassis. They appear in both English and French. In this section, these warnings appear in English only.

Caution—Risk of Electric Shock: Capacitive voltages above 50V may remain for 5 minutes after power is disconnected

Caution—Risk of Electric Shock: More than one live circuit : See diagram

The following written warning is also located on the drive chassis.

This device provides motor overload protection in accordance with NEC and CEC requirements. This device is factory configured to stop the motor from a motor overload trip. See instruction manual for options.

WARNING: Separate Motor Overcurrent Protection is required to be provided in accordance with the Canadian Electrical Code, Part 1, and NEC.

For more information on the motor overload feature, see section 5.3.2.

2.7 OPERATION MODE

2.7.1 Operation Signals

In order to operate the drive in any configuration, two logic inputs need to be configured to the following:

- <u>DRIVE ENABLE</u> - An external logic input intended to be used with the elevator control's safety chain as a permissive that provides a way for external logic to shut down the drive. The drive will not be permitted to run until this signal is true.
- <u>RUN (or RUN UP / RUN DOWN)</u> - An external logic input that commands the drive to run. But, before a run command can be recognized, the software must be up & ready and no faults can be present.

For more information on configuring logic inputs, see section 3.5.2. For more information on the proper sequencing of these signals, see section 5.2.

2.7.2 Source of Speed Command

The three possible sources for the HPV 900's speed command are following:

- multi-step command
- analog channel
- serial channel

The SPD COMMAND SRC (C1) parameter select the source of the speed command, see section 0.

2.7.2.1 Multi-Step Speed Command

The multi-step speed command uses the logic inputs to select various speeds.

2.7.2.1.1 Multi-Step Signals

In order to use the multi-step speed commands, the logic inputs can to be configured to any of the following:

- STEP REF Bx – up to four inputs, which can be used together as a 4-bit command to select the various multi-step speeds, see section 0.
- UP/DWN – can be used to changed the sign of the speed command.
- S-CURVE SEL x – can be used to select one of the four s-curves. (without any s-curve selection the default S-CURVE 0 is used)

For more information on configuring logic inputs, see section 3.5.2. For more information on the proper sequencing of these signals, see section 5.2.

2.7.2.1.2 Multi-Step Parameters

- SPEED COMMAND x – defines the speed for one of fifteen adjustable speed commands (in ft/min or m/sec), see section 0.
- ACCEL RATE x or DECEL RATE x – defines acceleration or deceleration rate for the selected s-curve (in ft/s^2 or m/s^2). Remember, the higher the number the faster the accel or decel, see section 0.
- JERK RATE x or LEV JERK x – defines the jerk rates for the selected s-curve (in ft/s^3 or m/s^3). Remember, the higher the number the sharper the speed change, see section 0.

2.7.2.2 Analog Speed Command

The analog speed command uses a bipolar ($\pm$10V) signal to generate of speed reference.

2.7.2.2.1 Analog Signals

The analog input channel #1 is configured for the analog speed command, see section 2.5.5.

The logic inputs can to be configured to any of the following:

- UP/DWN – can be used to changed the sign of the speed command.
- S-CURVE SEL x – recommended that these inputs are not used when using analog speed command (therefore, the default S-CURVE 0 is used)

For more information on configuring logic inputs, see section 3.5.2. For more information on the proper sequencing of these signals, see section 5.2.

2.7.2.2.2 Analog Parameters

- SPD COMMAND MULT and SPD COMMAND BIAS - These parameters are used to scale the user's analog speed command to the proper range for use by the drive software, see section 3.4.1.
- ACCEL RATE 0 or DECEL RATE 0 – it is recommended that the accel and decel rates are used as a slew limit (ACCEL RATE 0 = DECEL RATE 0 = 7.99 ft/s/s), see section 5.1.3.4.
- JERK RATE 0 or LEV JERK 0 – it is recommended that the jerk rates are turned off (JERK RATE 0 = LEV JERK 0 = 0 ft/s/s/s), see section 5.1.3.4.

2.7.2.3 Serial Speed Command

The serial channel is a RS-422 serial port located on the drive control board. *For further information, see section (5.4).*

2.7.2.3.1 Serial Parameters

- ACCEL RATE 0 or DECEL RATE 0 – it is recommended that the accel and decel rates are used as a slew limit (ACCEL RATE 0 = DECEL RATE 0 = 7.99 ft/s/s), see section 5.1.3.4.
- JERK RATE 0 or LEV JERK 0 – it is recommended that the jerk rates are turned off (JERK RATE 0 = LEV JERK 0 = 0 ft/s/s/s), see section 5.1.3.4.

2.7.3 Contactor Control

The HPV 900 has the ability to control the motor contractor. When the RUN command is recognized, the CLOSE CONTACT logic output will become true. This in turn will close an AC contactor between the drive and the motor. The operation of the HPV 900 cannot continue until the drive has confirmation that the contactor has been closed via the CONTACT CONFIRM logic input.

2.7.3.1 Contactor Signals

In order for the HPV 900 to receive feedback from the contactor, a logic input needs to be configured as CONTACT CONFIRM.

For more information on configuring logic inputs, see section 3.5.2. For more information on the proper sequencing of these signals, see section 5.2.

2.7.3.2 Contactor Parameters

- CONTACT FLT TIME **-** sets the amount of time allowed for the contactor's auxiliary contacts to reach the user commanded state before a CONTACTOR FLT occurs, see section 3.4.1.

2.7.4 Brake Control

The HPV 900 has the ability to control the mechanical brake.

2.7.4.1 Brake Signals

In order for the HPV 900 to receive feedback from the brake, logic inputs need to be configured as.

- MECH BRAKE PICK - Auxiliary contacts from mechanical brake. Asserted when brake is picked (lifted).

For more information on configuring logic inputs, see section 3.5.2.

In order for the HPV 900 to control the mechanical the brake, logic outputs need to be configured as:

- BRAKE PICK - The output is true when the speed regulator is released and is used to open the mechanical brake

For more information on configuring logic inputs, see section 3.5.3.

For more information on the proper sequencing of these signals, see section 5.2.6.

2.7.4.2 Brake Parameters

- BRK PICK FLT ENA - enables brake control faults (needs to be enabled), see section 0.
- BRAKE PICK TIME - sets the amount of time allowed for brake control faults, see section 3.4.1.

2.7.5 Operation Tools

The following can be useful when setting up and operating the HPV 900.

2.7.5.1 Drive's Status LEDs

READY - drive is ready to run
RUN - drive is in operation
PROGRAM INVALID - not sensing any valid software in the drive's control board
FAULT - drive has declared a fault
TORQUE LIMIT - drive has reached its torque limit

For more information, see section 4.6.

2.7.5.2 Display Menus

DISPLAY 1 & 2 D0 menu - two identical menus that allow the user to monitor the drive's running parameters. This menu is divided into two sub-menus ELEVATOR DATA D1 and POWER DATA D2.

For more information, see section 3.3.

2.7.5.3 Utility Menu

HIDDEN ITEMS U2 - allows the user to enable and disable the hidden parameters. When the hidden parameters are disabled, the number of keystrokes necessary to navigate the standard parameters is reduced.
UNITS U3 - the user can choose either Metric units or standard English measurements units for certain monitor parameters displays and for parameters in the sub-menus of the Adjust A0 menu.
RESTORE DFLTS U5 - allows the to reset all the parameters to there default values.

For more information, see section 3.6.

3 PARAMETERS

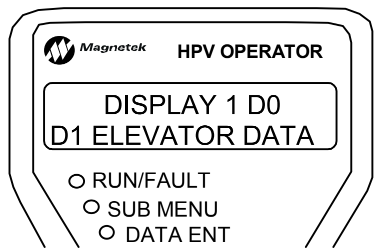
3.1 PARAMETER INTRODUCTION

This section describes the parameter menu structure; how to navigate this menu structure via the HPV 900 digital operator; and a detailed description of each parameter.

Parameters are grouped under six major menus:

- ADJUST A0 section 3.4
- CONFIGURE C0 section 3.5
- UTILITY U0 section 3.6
- FAULTS F0 section 3.7
- DISPLAY 1 D0 section 3.3
- DISPLAY 2 D0 section 3.3

When the SUB-MENU LED is *not* lit , the currently selected menu is shown on the top line of the Digital Operator display and the currently selected sub-menu is shown on the bottom line of the Digital Operator display.



The menu/sub-menu tree is shown in Figure 3. 1. The menu/sub-menu trees showing the parameters is shown in Figure 3. 3 and Figure 3. 4.

Display 1 D0
- Elevator Data D1
- Power Data D2

Adjust A0
- Drive A1
- S-Curves A2
- Multistep Ref A3
- Power Convert A4
- Motor A5

Configure C0
- User Switches C1
- Logic Inputs C2
- Logic Outputs C3
- Analog Outputs C4

Utility U0
- Password U1
- Hidden Items U2
- Units U3
- Ovrspeed Test U4
- Restore Dflts U5
- Drive Info U6
- Hex Monitor U7

Faults F0
- Active Faults F1
- Fault History F2

Display 2 D0
- Elevator Data D1
- Power Data D2

Figure 3. 1 – Menu/Sub-Menu Tree

3.2 MENUS

Each menu have a number of sub-menus, see Figure 3. 1. Following is a listing of the menus:

- ADJUST A0
- CONFIGURE C0
- UTILITY U0
- FAULTS F0
- DISPLAY 1 D0
- DISPLAY 2 D0

3.2.1 Menu Navigation

The digital operator keys operate on three levels, the menu level, the sub-menu level and the entry level. At the menu level, they function to navigate between menus or sub-menus. At the sub-menu level, they navigate between sub-menus or menu items. At the entry level, they are used to adjust values or select options. Six (6) keys are used for this navigation, they are:

1) The up arrow key.
2) The down arrow key.
3) The left arrow key.
4) The right arrow key.
5) The “ENTER” key.
6) The “ESCAPE” key.

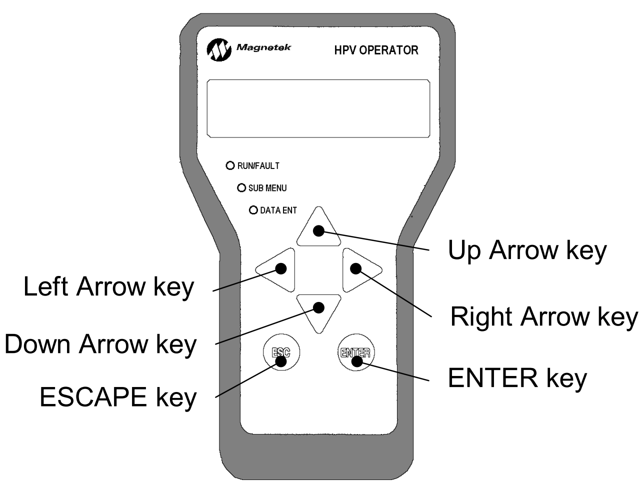
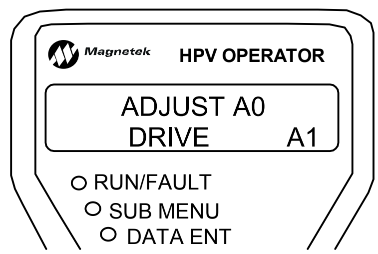


Figure 3. 2 - Digital Operator Keys

How these keys operate is dependent on the “level” (i.e. menu, sub-menu or entry level.) In general, the “ENTER” and “ESCAPE” keys control the level. That is the ENTER key used to move to a lower level and the ESCAPE key is used to move to a higher level. The arrow keys control movement. With the up and down arrow keys controlling vertical position. And the left and right arrow keys controlling horizontal position.

3.2.2 Navigation at the Menu Level

At the menu level, the up and down arrow keys cause the display to show the sub-menus. The side arrow keys cause the display to select which menu is active. When the end is reached (either up, down, left or right), pressing the same key will cause a wrap around (see Figure 3. 5).

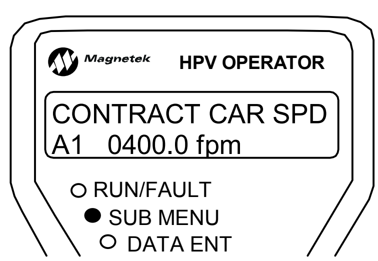


Each menu will remember the last accessed sub-menu. The left and right arrow keys will navigate between these last active sub-menus. This remembrance of last active sub-menu is volatile and will be lost at power down.

When any sub-menu is displayed, pressing the “ENTER” key will place the operator in the sub-menu level.

3.2.3 Navigation at the Sub-menu Level

When in the sub-menu level, the SUB-MENU LED on the digital operator is lit. At the sub-menu level, the positioning keys work slightly different than they did at the menu level. The up and down arrow keys now select separate items in the sub-menu.



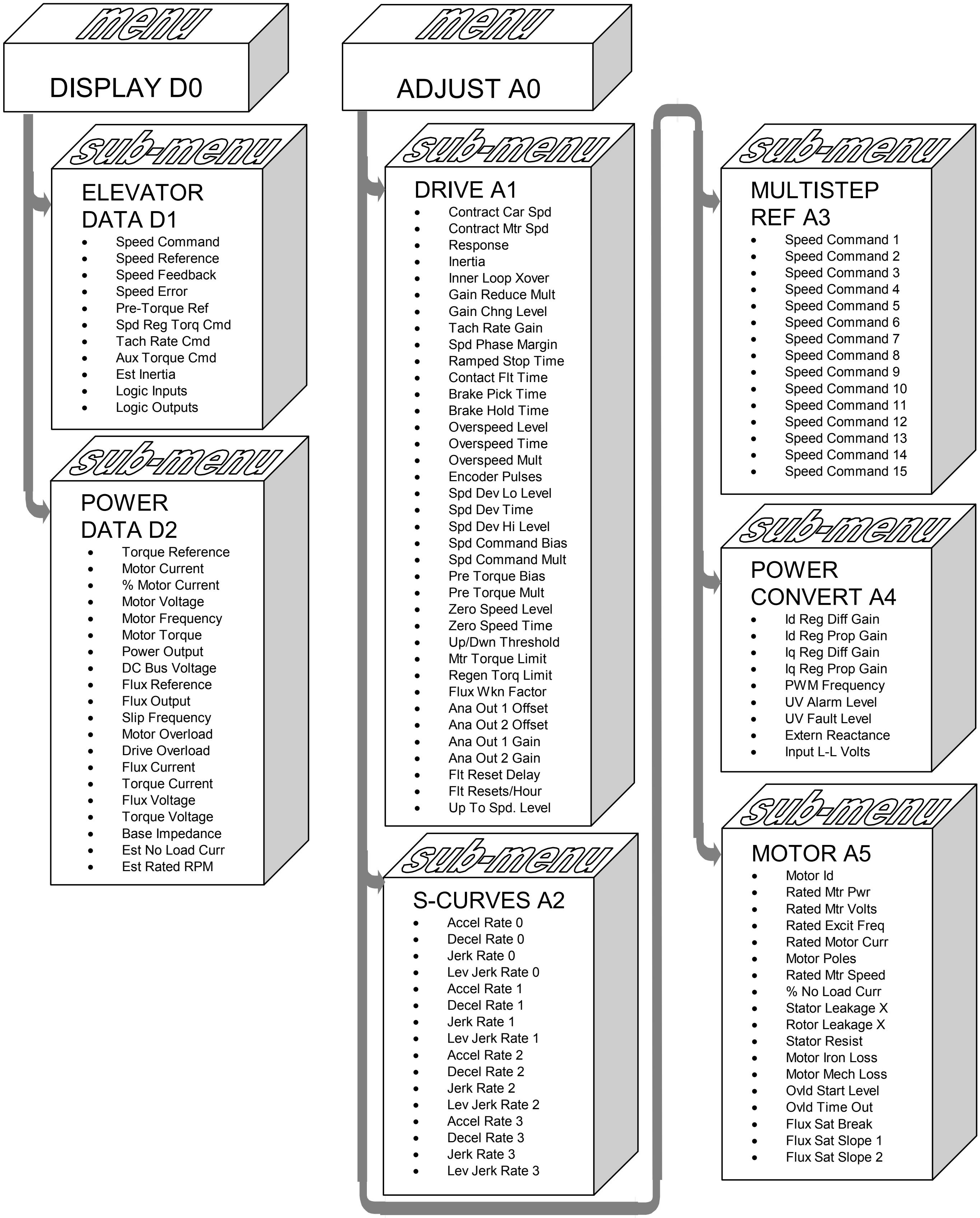


Figure 3. 3 - All HPV 900 Parameters (hidden and standard)

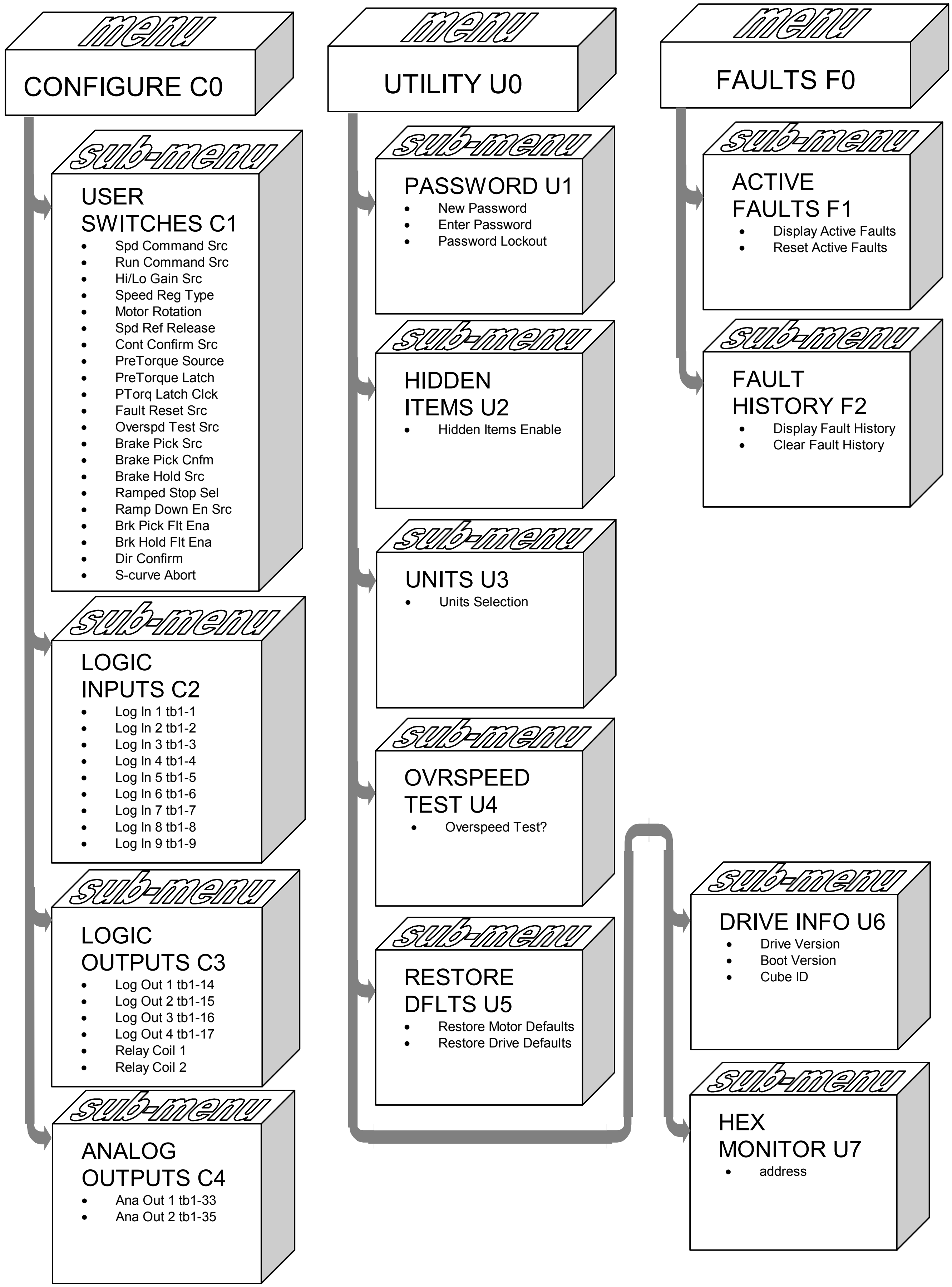


Figure 3. 3 - All HPV 900 Parameters (hidden and standard) – (continued)

3.2.4 Hidden Parameters

There are two types of parameters: standard and hidden. Standard parameters are available at all times. Hidden parameters are for more advanced functions and are available only if activated. Activation of the hidden parameters is accomplished by setting of a utility parameter, HIDDEN ITEMS U2. *See details in section 3.6.2.*

While Figure 3. 3 shows the standard and hidden parameters, Figure 3. 4 shows only the standard parameters.

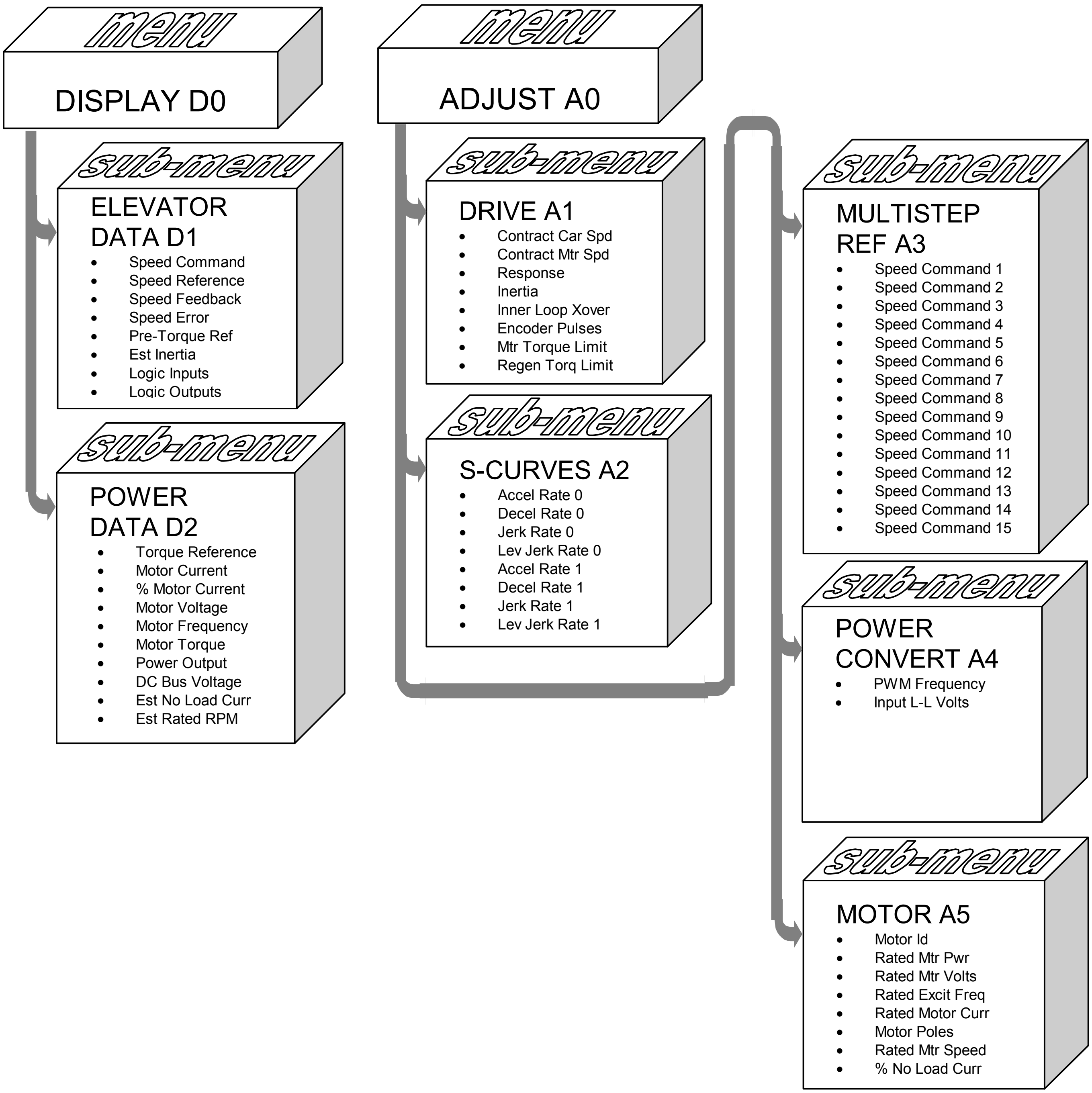


Figure 3. 4 - Standard Parameters (hidden parameters disabled)

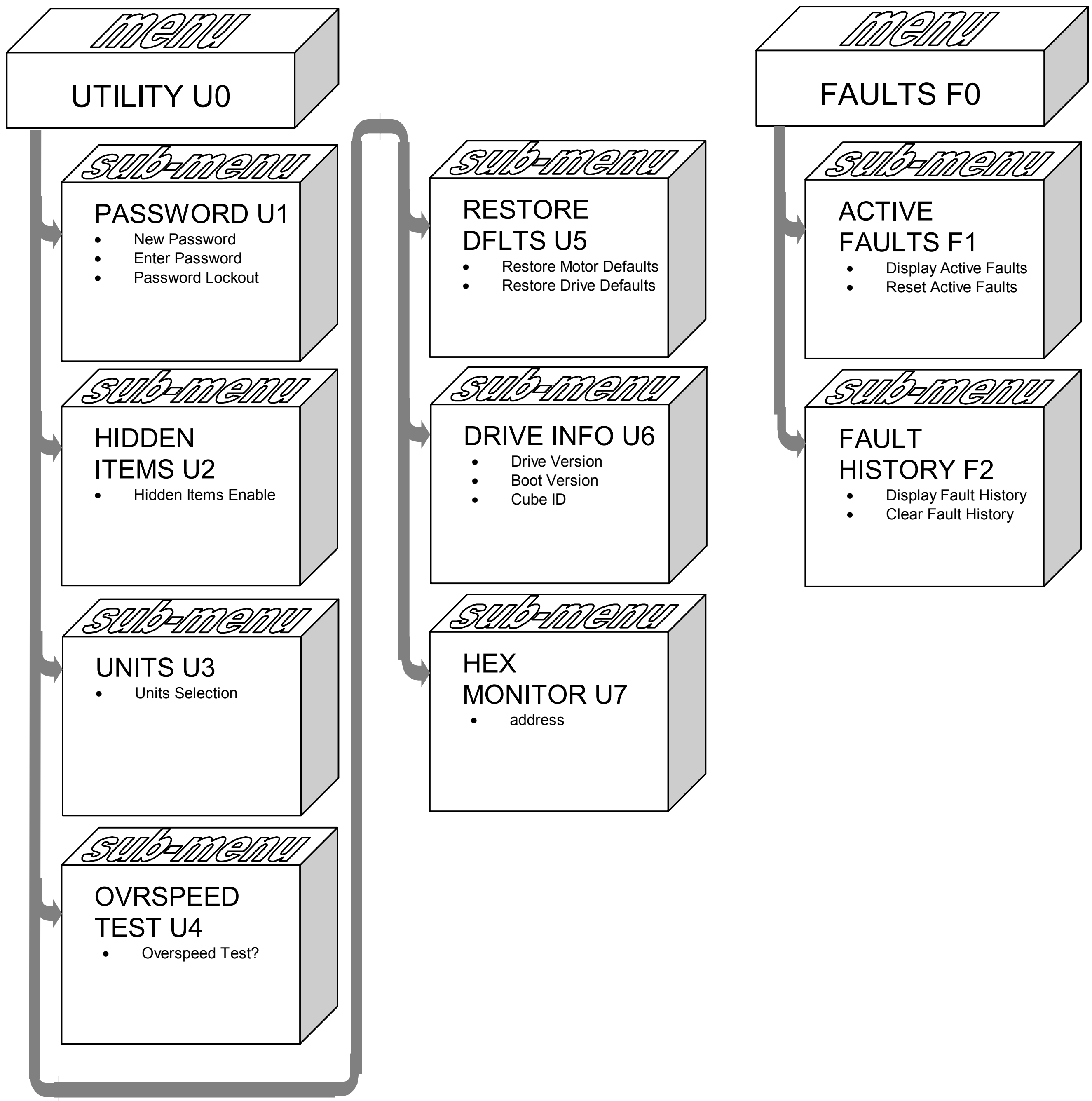


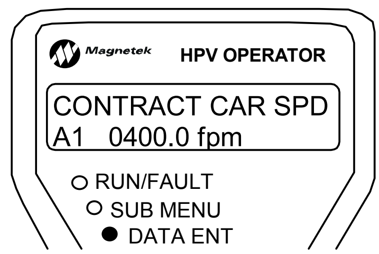
Figure 3. 4 - Standard Parameters (hidden parameters disabled) – (continued)

At any time pressing the “ESCAPE” key will return to the menu level. Upon exiting a sub-menu via the “ESCAPE” key, the last item number is “remembered”. The next time this sub-menu is entered, it is entered at the “remembered” item number.

This feature can be used to obtain quick access to two monitor values. Two menus one labeled Display 1 D0 (see section 3.3) and one labeled Display 2 D0 (see section 3.3) have the same display items. One item can be selected one under the Display 1 menu and another under the Display 2 menu. The left and right arrow keys can then be used to move back and forth between these two display items. Remember, that the “remembering” of sub-menus and sub-menu items is volatile and is lost at power-down.

3.2.5 Navigation at the Entry Level

When in the entry level, the DATA ENT LED on the digital operator is lit. At the entry level, the function of keys are redefined. The “ESCAPE” key remains as the key used to move back to the higher level (in this case to the sub-menu level). The left and right arrow keys are used as cursor positioning keys and the up and down arrow keys are used as increment and decrement keys.



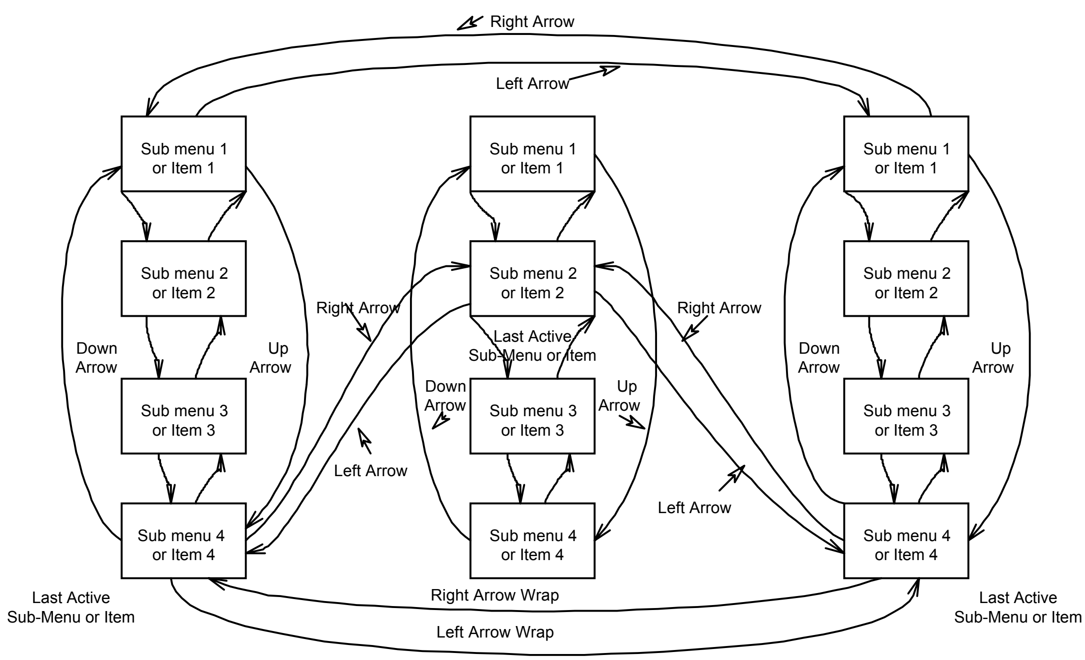


Figure 3. 5 - Menu Navigation

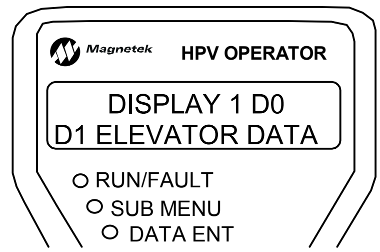
3.3 DISPLAY 1 & 2 D0 MENU

These two identical menus allow the user to monitor running parameters. These displays vary as operating conditions change; no user setting is possible.

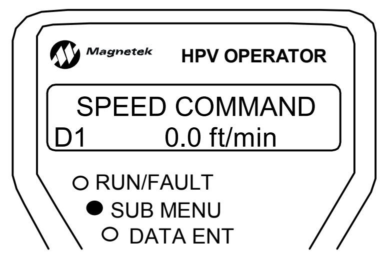
NOTE: The units in which the running parameter values are displayed are determined by the UNITS SELECTION setting *(see section 3.6.3)*.

NOTE: When the word ***Hidden*** appears above a parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

The sub-menu is identified by its full name on the bottom line of the digital operator display when the SUB MENU LED is *not* lit.



When the SUB MENU LED is ON, the two letter code for the sub-menu appears at the far left of the bottom line of the display.



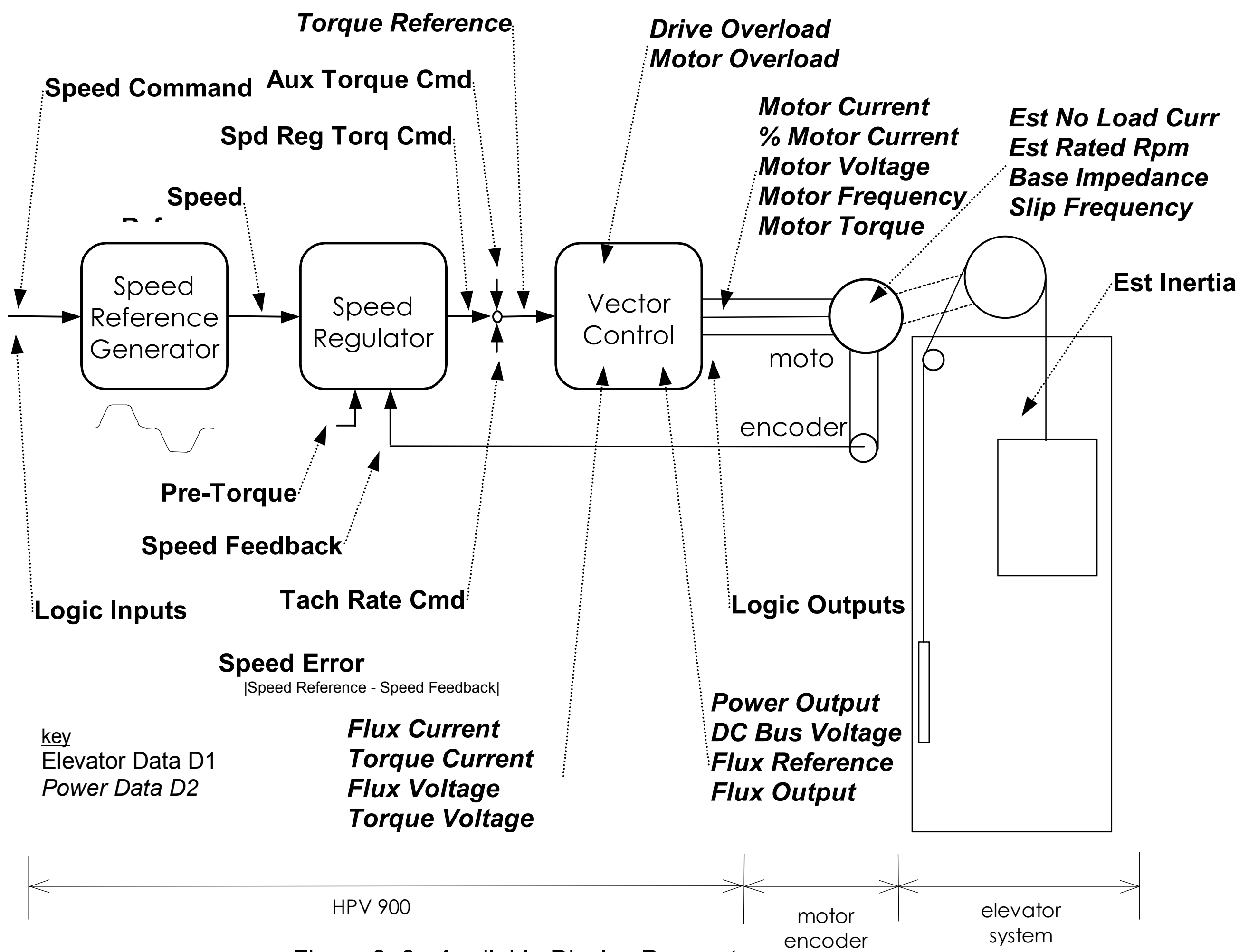


Figure 3. 6 - Available Display Parameters

These two display menus each have two sub-menus:

- **ELEVATOR DATA D1 3.3.1**
- **POWER DATA D2 3.3.2**

A summary of the Elevator Data is shown in Table 3. 1. A summary of the Power Data is shown in Table 3. 2.

Name	Description	Units	Hidden
Speed Command	Speed command before speed reference generator	ft/min or m/s	N
Speed Reference	Speed reference after speed reference generator	ft/min or m/s	N
Speed Feedback	Encoder feedback used by speed regulator	ft/min or m/s	N
Speed Error	Speed reference minus speed feedback	ft/min or m/s	N
Pre-Torque Ref	Pre-torque reference	% rated torque	N
Spd Reg Torq Cmd	Torque command from speed regulator	% rated torque	Y
Tach Rate Cmd	Torque command after tach rate gain function	% rated torque	Y
Aux Torque Cmd	Feedforward torque command from auxiliary source	% rated torque	Y
Est Inertia	Estimated elevator system inertia	seconds	N
Logic Outputs	Displays the status of the logic outputs	1=true 0=false	N
Logic Inputs	Displays the status of the logic inputs	1=true 0=false	N

Table 3. 1 - Elevator Data

Name	Description	Units	Hidden
Torque Reference	Torque reference used by vector control	% rated torque	N
Motor Current	RMS motor current	Amps	N
% Motor Current	Percent motor current	%rated current	N
Motor Voltage	RMS motor terminal voltage	Volts	N
Motor Frequency	Electrical frequency output	Hz	N
Motor Torque	Calculated motor torque output	% rated torque	N
Power Output	Calculated drive power output	KW	N
DC Bus Voltage	Measured DC bus voltage	Volts	N
Flux Reference	Flux reference used by vector control	% rated flux	Y
Flux Output	Measured flux output	% rated flux	Y
Slip Frequency	Commanded slip frequency	Hz	Y
Motor Overload	Percent of motor overload trip level reached	%	Y
Drive Overload	Percent of drive overload trip level reached	%	Y
Flux Current	Measured flux producing current	%rated current	Y
Torque Current	Measured torque producing current	%rated current	Y
Flux Voltage	Flux voltage reference	% rated volts	Y
Torque Voltage	Torque voltage reference	% rated volts	Y
Base Impedance	Drive calculated base impedance	Ohms	Y
Est No Load Curr	Estimated no load current	%rated current	N
Est Rated RPM	Estimated rated RPM	RPM	N

Table 3. 2 - Power Data

3.3.1 ELEVATOR DATA D1 Sub-menu

SPEED COMMAND

(Speed Command)

Monitors the speed command before the speed reference generator (input to the S-Curve). This command comes from either multi-step references, speed command from analog channel #1, or the serial channel.

	English	Metric
Units:	ft/min	m/sec
Decimal:	+XXXX.X	+XX.XXX

SPEED REFERENCE

(Speed Reference)

Monitors the speed reference being used by the drive. This is the speed command after passing through the speed reference generator (which uses a S-Curve).

	English	Metric
Units:	ft/min	m/sec
Decimal:	+XXXX.X	+XX.XXX

SPEED FEEDBACK

(Speed Feedback)

Monitors the speed feedback coming from the encoder. It is based on contact speed, motor rpm and encoder pulses per revolution. The drive converts from motor RPM to linear speed using the relationship between the CONTRACT CAR SPD and CONTRACT MTR SPD parameters.

	English	Metric
Units:	ft/min	m/sec
Decimal:	+XXXX.X	+XX.XXX

SPEED ERROR

(Speed Error)

Monitors the speed error between the speed reference and the speed feedback. It is equal to the following equation:

$$\left| \left(\begin{matrix} speed \\ reference \end{matrix} \right) - \left(\begin{matrix} speed \\ feedback \end{matrix} \right) \right| = \begin{matrix} speed \\ error \end{matrix}$$

	English	Metric
Units:	ft/min	m/sec
Decimal:	+XXXX.X	+XX.XXX

PRE-TORQUE REF

(Pre-Torque Reference)

Monitors the pre torque reference, coming from either analog channel #2 or the serial channel.

Units: % rated torque

Decimal: +XXX

SPD REG TORQ CMD

Hidden (Regulator Torque Command)

Monitors the speed regulator's torque command. This is the torque command before it passes through the tach rate gain function or the auxiliary torque command. It is the torque required for the motor to follow the speed reference.

Units: % rated torque

Decimal: +XXX

TACH RATE CMD

Hidden (Tachometer Rate Command)

Monitors the torque command from the tach rate gain function, (if used), *see section (5.1.4.5).*

Units: % rated torque

Decimal: +XXX

AUX TORQUE CMD

Hidden (Auxiliary Torque Command)

Monitors the feedforward torque command from auxiliary source, when used.

Units: % rated torque

Decimal: +XXX

EST INERTIA

(Estimated Inertia)

Estimated elevator system inertia. *For more details on estimating the elevator system inertia see section (5.6).*

Units: % rated torque

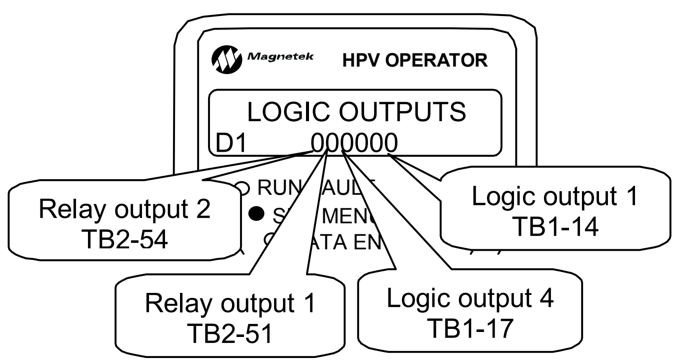
Decimal: +XXX.XX

LOGIC OUTPUTS

(Logic Outputs Status)

This display shows the condition of the logic outputs.

Units: 1=true 0=false

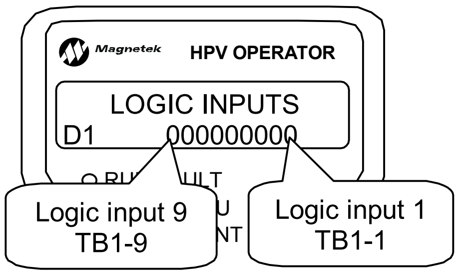


LOGIC INPUTS

(Logic Inputs Status)

This display shows the condition of the logic inputs.

Units: 1=true 0=false



3.3.2 POWER DATA D2 Sub-menu

TORQUE REFERENCE

(Torque Reference)

Monitors the torque reference used by the drive for vector control. This value is calculated by:

$$\begin{pmatrix} speed \quad reg \\ torque \\ cmd \end{pmatrix} + \begin{pmatrix} aux \\ torque \\ cmd \end{pmatrix} + \begin{pmatrix} tach \\ rate \\ cmd \end{pmatrix} = \begin{matrix} torque \\ reference \end{matrix}$$

Units: % rated torque
Decimal: +XXX

MOTOR CURRENT

(RMS Motor Current Output)

Monitors the RMS motor output current.

Units: A (Amps)
Decimal: XXX.XX

% MOTOR CURRENT

(Percent Motor Current)

Monitors the motor current as a percent of rated motor current.

Units: % motor rated current
Decimal: XXX

MOTOR VOLTAGE

(Motor Voltage Output)

Monitors the RMS motor terminal line-line voltage.

Units: V (Volts)
Decimal: XXX

MOTOR FREQUENCY

(Motor Frequency Output)

Monitors the electrical frequency of the motor output.

Units: Hz
Decimal: XXX.X

MOTOR TORQUE

(Motor Torque Output)

Calculated motor output torque in terms of percent rated torque.

Units: % rated torque
Decimal: +XXX

POWER OUTPUT

(Power Output)

Calculated drive power output.

Units: kW
Decimal: +XXX.XX

DC BUS VOLTAGE

(DC Bus Voltage)

Measured voltage of the DC bus.

Units: V (Volts)
Decimal: XXX

FLUX REFERENCE

(Flux Reference)

Flux reference used by the vector control of the drive.

Units: % rated flux
Decimal: XXX

FLUX OUTPUT

Hidden (Flux Output)

Measured value of the flux output.

Units: % rated flux
Decimal: XXX

SLIP FREQUENCY

Hidden (Slip Frequency)

Displays the commanded slip frequency of the motor.

Units: Hz
Decimal: +XXX.XX

MOTOR OVERLOAD

Hidden (Motor Overload)

Displays the percentage of motor overload trip level reached. Once this value reaches 100% the motor has exceeded its user defined overload curve and a motor overload alarm is declared by the drive. For more information on the motor overload curve, *see section (0)*.

Units: % rated current of motor
Decimal: XXX

DRIVE OVERLOAD
Hidden (Drive Overload)
Displays the percentage of drive overload trip level reached. Once this value reaches 100% the drive has exceeded its overload curve and a drive overload fault is declared. For more information on the drive overload curve, *see section (5.3.1)*.
Units: % rated current of drive
Decimal: XXX

FLUX CURRENT
Hidden (Flux Current)
Displays the flux producing current of the motor.
Units: % rated current
Decimal: +XXX

TORQUE CURRENT
Hidden (Torque Current)
Displays the torque producing current of the motor.
Units: % rated current
Decimal: +XXX

FLUX VOLTAGE
Hidden (Flux Voltage)
Displays the flux voltage reference.
Units: % rated volts
Decimal: +XXX

TORQUE VOLTAGE
Hidden (Torque Voltage)
Displays the torque voltage reference.
Units: % rated volts
Decimal: +XXX

BASE IMPEDANCE
Hidden (Base Impedance)
Displays the drive calculated base impedance, which is based on the RATED MTR PWR and the RATED MTR VOLTS parameters, *see section (3.4.5*). This value is used to calculate the Per Unit values of the system impedances (i.e. EXTERN REACTANCE and STATOR RESIST).
Units: Ohms
Decimal: XXX.XXX

EST NO LOAD CURR
(Estimated No Load Current)
Estimated no load current of the motor calculated by the HPV 900's adaptive tune. For more information on the HPV 900's adaptive tune, *see section (5.6.2.1).*
Units: %
Decimal: XXX.X

EST RATED RPM
(Estimated Rated RPM)
Estimated rated rpm of the motor calculated by the HPV 900's adaptive tune. For more information on the HPV 900's adaptive tune, *see section (5.6.2.1).*
Units: RPM
Decimal: XXXX.X

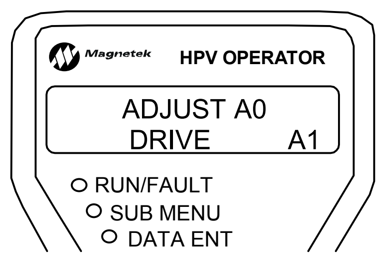
3.4 ADJUST A0 Menu

The ADJUST A0 menu provides selections and settings which are used to configure the drive to the specific motor and elevator application.

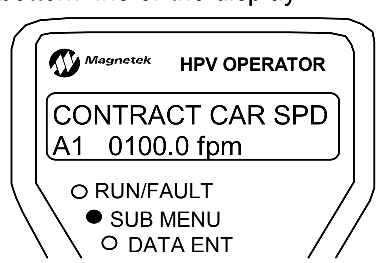
This menu has seven sub menus:

- **DRIVE A1** **3.4.1**
- **S-CURVES A2** **3.4.2**
- **MULTISTEP REF A3** **3.4.3**
- **POWER CONVERT A4** **3.4.4**
- **MOTOR A5** **3.4.5**

The sub-menu is identified by its full name on the bottom line of the Digital Operator display when the SUB MENU LED is *not* lit.



When the SUB MENU LED is ON, the two letter code for the sub-menu appears at the far left of the bottom line of the display.



3.4.1 DRIVE A1 Sub-menu

This sub-menu contains drive software parameters, which are used to configure the drive for specific installations.

NOTE: When the word ***Hidden*** appears with the parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2)*

NOTE: When the word ***Lockout*** appears with the parameter description, the parameter cannot be changed when the drive is in the RUN mode.

Table 3. 3 summarizes the available Drive parameters.

Name	Description	Units	Hidden	Lockout
Contract Car Spd	Elevator contract speed	m/s or ft/min	N	Y
Contract Mtr Spd	Motor speed at elevator contract speed	RPM	N	Y
Response	Sensitivity of the speed regulator	rad/sec	N	N
Inertia	System inertia	sec	N	N
Inner Loop Xover	Inner speed loop crossover frequency (only with Ereg speed regulator)	rad/sec	N	N
Gain Reduce Mult	Percentage of response of the speed regulator used when in the low gain mode	%	Y	N
Gain Chng Level	Speed level to change to low gain mode (only with internal gain switch)	% rated speed	Y	N
Tach Rate Gain	Helps with the effects of rope resonance	%	Y	N
Spd Phase Margin	Sets phase margin of speed regulator (only with PI speed regulator)	degrees	Y	N
Ramped Stop Time	Time to ramp torque from rated torque to zero (only with torque ramp down stop function)	seconds	Y	N
Contact Flt Time	Time before a contactor fault is declared	seconds	Y	N
Brake Pick Time	Time before a brake pick fault is declared	seconds	Y	N
Brake Hold Time	Time before a brake hold fault is declared	seconds	Y	N
Overspeed Level	Threshold for detection of overspeed fault	% contract spd	Y	N
Overspeed Time	Time before a overspeed fault is declared	seconds	Y	N
Overspeed Mult	Multiplier for overspeed test	%	Y	N
Encoder Pulses	Encoder counts per revolution	none	N	Y
Spd Dev Lo Level	Range around the speed reference for speed deviation low logic output	% contract spd	Y	N
Spd Dev Time	Time before speed deviation low logic output is true	seconds	Y	N
Spd Dev Hi Level	Level for declaring speed deviation alarm	% contract spd	Y	N
Spd Command Bias	Subtracts an effective voltage to actual speed command voltage	volts	Y	Y
Spd Command Mult	Scales analog speed command	none	Y	Y
Pre Torque Bias	Subtracts an effective voltage to actual pre torque command voltage	volts	Y	Y
Pre Torque Mult	Scales pre-torque command	none	Y	Y
Zero Speed Level	Threshold for zero speed logic output	% contract spd	Y	Y
Zero Speed Time	Time before zero speed logic output is declared true.	seconds	Y	Y
Up/Dwn Threshold	Threshold for detection of up or down direction	% contract spd	Y	Y
Mtr Torque Limit	Motoring torque limit	% rated torque	N	N
Regen Torq Limit	Regenerating torque limit	% rated torque	N	N
Flux Wkn Factor	Defines the torque limit at higher speeds	% torque	Y	N

Table 3. 3 - DRIVE A1 Parameters

Name	Description	Units	Hidden	Lockout
Ana Out 1 Offset	Subtracts an effective voltage to actual analog output 1	%	Y	N
Ana Out 2 Offset	Subtracts an effective voltage to actual analog output 2	%	Y	N
Ana Out 1 Gain	Scaling factor for analog output 1	none	Y	N
Ana Out 2 Gain	Scaling factor for analog output 2	none	Y	N
Flt Reset Delay	Time before a fault is automatically reset	seconds	Y	N
Flt Resets / Hour	Number of faults that is allowed to be automatically reset per hour	faults	Y	N
Up to Spd. Level	Threshold for up to spd logic output	% contract spd	Y	N

Table 3. 3 - DRIVE A1 Parameters (continued)

CONTRACT CAR SPD
Lockout (Contract Car Speed)
This parameter programs the elevator contract speed in feet per minute (fpm) or meters per second (m/s).
Default: 400.0 fpm / 2.000 m/s
Min: 0.0 / 0.00 Max: 3000.0 / 16.00
Units: fpm or m/s

CONTRACT MTR SPD
Lockout (Contract Motor Speed)
This parameter programs the motor speed at elevator contract speed in revolutions per minute (rpm).
Default: 1130.0 rpm
Min: 3000.0 Max: 50.0
Units: rpm (revolutions per minute)

RESPONSE
(Response)
This parameter sets the sensitivity of the drive's speed regulator in terms of the speed regulator bandwidth in radians. The responsiveness of the drive as it follows the speed reference will increase as this number increases. If the number is too large, the motor current and speed will become jittery. If this number is too small, the motor will become sluggish.
Default: 10.0 rad/sec
Min: 1.0 Max: 20.0
Units: rad/sec (radians per second)

INERTIA
(System Inertia)
This parameter sets the equivalent of the system inertia in terms of the time it takes the elevator to accelerate to motor base speed at rated torque. *For more details on estimating the elevator system inertia, see section (5.6).*
Default: 2.00 sec
Min: 0.25 Max: 50.00
Units: sec (seconds)

INNER LOOP XOVER
(Inner Loop Cross Over)
This parameter sets the inner speed loop cross over frequency. This parameter is only used by the Elevator Speed Regulator (Ereg).
Default: 2.0 rad/sec
Min: 0.1 Max: 20.0
Units: rad/sec (radians per second)

GAIN REDUCE MULT
Hidden (Gain Reduce Multiplier)
This parameter is the percent of 'response' the speed regulator should use in the 'low gain' mode. This value reduces the RESPONSE value when the drive is in 'low gain' mode. (i.e. setting this parameter to 100% equals no reduction in gain in the 'low gain' mode)
For further information, see section (5.1.4.1)
Default: 100 %
Min: 10 Max: 100
Units: %

GAIN CHNG LEVEL
Hidden (Gain Change Level)
When the gain control is set to internal, the drive will control the high/low gain switch. This parameter sets the speed reference level, when the drive is in 'low gain' mode. *For further information, see section (5.1.4.1) or HI/LO GAIN SRC parameter in section (3.5.1).*
Default: 100.0%
Min: 000.0 Max: 100.0
Units: % rated speed

TACH RATE GAIN
Hidden (Tach Rate Gain)
This parameter can be used to help to reduce the effects of rope resonance. It should be adjusted only *after* the INERTIA, and RESPONSE has been set correctly. *For further information, see section (5.1.4.5).*
Default: 00.0%
Min: 00.0 Max: 30.0
Units: none

SPD PHASE MARGIN
Hidden (Speed Phase Margin)
This parameter sets the phase margin of the speed regulator assuming a pure inertial load. This parameter is only used by the PI speed regulator.
Default: 80 degrees
Min: 45 Max: 90
Units: degrees

RAMPED STOP TIME
Hidden (Ramped Stop Time)
This parameter is only used by the torque ramp down stop function and sets the time to ramp torque from rated torque to zero.
After the elevator lands and the brake is applied, the torque ramp down function allows the torque to ramp down at an even level. This helps eliminate the 'bump' felt upon landing caused by the torque being immediately dropped to zero. *For further information, see RAMPED STOP SEL and RAMP DOWN EN SRC parameters in section (3.5.1).*
Default: 0.20 seconds
Min: 0.00 Max: 2.50
Units: seconds

CONTACT FLT TIME
Hidden (Contact Fault Time)
When external logic inputs are used to confirm the closing of the motor contactor, this parameter sets the amount of time allowed for the contactor's auxiliary contacts to reach the user commanded state before a CONTACTOR FLT occurs.
Default: 0.50 seconds
Min: 0.10 Max: 5.00
Units: seconds

BRAKE PICK TIME
Hidden (Brake Pick Time)
If the brake pick fault is enabled, this parameter sets the time allowed for the brake pick feedback not to match the brake pick command before a BRK PICK FLT occurs. Also, when the user switch SPD REF RELEASE is set to BRAKE PICKED, it determines the amount of time the drive will command zero speed after the RUN command is removed (time allowed for the brake to close). *For further information, see BRK PICK FLT ENA parameter section (3.5.1).*
Default: 1.00 seconds
Min: 0.00 Max: 5.00
Units: seconds

BRAKE HOLD TIME
Hidden (Brake Hold Time)
If the brake hold fault is enabled, this parameter sets the time allowed for the brake hold feedback not match the brake hold command before a BRK HOLD FLT occurs. *For further information, see BRK HOLD FLT ENA parameter in section (3.5.1) and logic output descriptions in section (3.5.3.1).*
Default: 0.20 seconds
Min: 0.00 Max: 5.00
Units: seconds

OVERSPEED LEVEL
Hidden (Overspeed Level)
This parameter sets the percentage of rated speed the drive uses (in conjunction with OVERSPEED TIME, below) to determine when an OVERSPEED fault occurs.
Default: 115.0 %
Min: 100.0 Max: 150.0
Units: % rated speed

OVERSPEED TIME
Hidden (Overspeed Time)
This parameter sets the time that the drive can be at or above the OVERSPEED LEVEL, before the drive declares an OVERSPEED FLT.
Default: 1.00 seconds
Min: 0.00 Max: 9.99
Units: seconds

OVERSPEED MULT
Hidden (Over Speed Multiplier)
This parameter sets the percentage of rated speed for the OVERSPEED TEST. *See section (3.6.4.3) for the procedure on running an overspeed test.*
Default: 125 %
Min: 100 Max: 150
Units: % contract speed

ENCODER PULSES
Lockout (Encoder Pulses)
This parameter sets the pulses per revolution (before the x4 logic) the drive receives from the encoder.
Default: 1024
Min: 00600 Max: 10000
Units: pls/rev (pulses per revolution)

SPD DEV LO LEVEL
Hidden (Speed Deviation Low Level)
This parameter defines a range around the speed reference. When the speed feedback is within this range (in conjunction with SPD DEV TIME) the drive will set the SPEED DEV LO logic output. *For more information see section (5.1.4.10).*
Default: 10.0 %
Min: 00.1 Max: 20.0
Units: % contract speed

SPD DEV TIME
Hidden (Speed Deviation Time)
This parameter defines the time the speed feedback needs to be in the range around the speed reference defined by SPD DEV LO LEVEL before the Speed Deviation Low logic output is true. *For more information see section (5.1.4.10).*
Default: 0.50 seconds
Min: 0.00 Max: 9.99
Units: seconds

SPD DEV HI LEVEL
Hidden (Speed Deviation High Level)
This parameter defines a threshold around the speed reference. If the speed feedback is outside of this threshold the drive will declare a Speed Deviation Alarm and the Speed Deviation Low logic output will become true..
For more information see section (5.1.4.10).
Default: 10.0%
Min: 00.0 Max: 99.9
Units: % contract speed

SPD COMMAND BIAS
Hidden / *Lockout* (Speed Command Bias)
This parameter subtracts an effective voltage to the actual analog speed command (channel 1) voltage signal. *For more information, see section (5.1.1.2).*

$$\left(\begin{matrix}\text{analog}\\ \text{channel\#1}\\ \text{input}\\ \text{voltage}\end{matrix} - \begin{matrix}\text{SPD}\\ \text{COMMAND}\\ \text{BIAS}\end{matrix}\right) \times \begin{matrix}\text{SPD}\\ \text{COMMAND}\\ \text{MULT}\end{matrix} = \begin{matrix}\text{signal}\\ \text{drive}\\ \text{software}\\ \text{uses}\end{matrix}$$

Default: 0.00 V
Min: 0.00 Max: 6.00
Units: Volts (V)

SPD COMMAND MULT
Hidden / *Lockout* (Speed Command Multiplier)
This parameter scales the analog speed command (channel 1). *For more information, see section (5.1.1.2).*

$$\left(\begin{matrix}\text{analog}\\ \text{channel\#1}\\ \text{input}\\ \text{voltage}\end{matrix} - \begin{matrix}\text{SPD}\\ \text{COMMAND}\\ \text{BIAS}\end{matrix}\right) \times \begin{matrix}\text{SPD}\\ \text{COMMAND}\\ \text{MULT}\end{matrix} = \begin{matrix}\text{signal}\\ \text{drive}\\ \text{software}\\ \text{uses}\end{matrix}$$

Default: 1.00
Min: 0.90 Max: 5.00
Units: none

PRE TORQUE BIAS
Hidden / *Lockout* (Pre-Torque Bias)
This parameter subtracts an effective voltage to the actual analog pre torque command (channel 2) voltage signal. *For more information, see section (5.1.4.7.2).*

$$\left(\begin{matrix}\text{analog}\\ \text{channel\#2}\\ \text{input}\\ \text{voltage}\end{matrix} - \begin{matrix}\text{PRE}\\ \text{TORQUE}\\ \text{BIAS}\end{matrix}\right) \times \begin{matrix}\text{PRE}\\ \text{TORQUE}\\ \text{MULT}\end{matrix} = \begin{matrix}\text{signal}\\ \text{drive}\\ \text{software}\\ \text{uses}\end{matrix}$$

Default: 0.00 V
Min: 0.00 Max: 6.00
Units: volts

PRE TORQUE MULT
Hidden / Lockout (Pre-Torque Multiplier)
This parameter scales the analog pretorque command (channel 2). *For more information, see section (5.1.4.7.2).*

$$\left(\begin{matrix}\textit{analog}\\ \textit{channel\#2}\\ \textit{input}\\ \textit{voltage}\end{matrix} - \begin{matrix}\textit{PRE}\\ \textit{TORQUE}\\ \textit{BIAS}\end{matrix}\right) \times \begin{matrix}\textit{PRE}\\ \textit{TORQUE}\\ \textit{MULT}\end{matrix} = \begin{matrix}\textit{signal}\\ \textit{drive}\\ \textit{software}\\ \textit{uses}\end{matrix}$$

Default: 1.00
Min: -10.00 Max: 10.00
Units: none

ZERO SPEED LEVEL
Hidden / Lockout (Zero Speed Level)
This parameter sets the threshold for zero speed detection. This is only used to generate the zero speed logic output.
Note: if DIR CONFIRM (C1) is enabled, this parameter also sets the threshold for the termination of the test to confirm the polarity of the analog speed command.
Default: 1.00 %
Min: 0.00 Max: 99.99
Units: % contract speed

ZERO SPEED TIME
Hidden / Lockout (Zero Speed Time)
This parameter sets the time at which the drive is at the ZERO SPEED LEVEL before zero speed logic output is true.
Default: 0.10 seconds
Min: 0.00 Max: 9.99
Units: seconds

UP/DWN THRESHOLD
Hidden / Lockout (Directional Threshold)
This parameter sets the threshold for the direction sense logic outputs. If speed feedback does not reach this level, the drive will not detect a directional change. This is only used to generate the direction sense logic outputs (car going up and car going down).
Default: 1.00 %
Min: 0.00 Max: 9.99
Units: % contract speed

MTR TORQUE LIMIT
(Motor Torque Limit)
This parameter sets the maximum torque allowed at when in the motoring mode. This parameter may need adjustment to reduce the effects of field weakening. *For further information see section (5.1.5.1).*
NOTE: The Torque Limit LED will be light once the limit defined by this parameter is reached (see Table 4. 1).
Default: 200.0 %
Min: 000.0 Max: 250.0
Units; % rated torque

REGEN TORQ LIMIT
(Regenerative Mode Torque Limit)
This parameter sets the maximum amount of regenerative torque the drive will see during regeneration. This parameter may need adjustment to reduce the effects of field weakening. *For further information see section (5.1.5.1).*
NOTE: The Torque Limit LED will be light once the limit defined by this parameter is reached (see **Table 4. 1**).
Default: 200.0 %
Min: 000.0 Max: 250.0
Units: % rated torque

FLUX WKN FACTOR
Hidden (Flux Weakening Factor)
This parameter limits the maximum amount of torque available at higher speeds. When the drive is commanding higher speeds, this parameter defines a percentage of the defined torque limits (MTR TORQUE LIMIT and REGEN TORQ LIMIT). This parameter is used to reduce the effects of field weakening and reduce the amount of motor current produced at higher speeds. *For further information, see section (5.1.5.1).*
Default: 100.0 %
Min: 060.0 Max: 100.0
Units: % of defined torque limits

ANA 1 OUT OFFSET
Hidden (Digital to Analog #1 Output Offset)
Offset for scaling Analog Output Channel #1.

$$\left(\begin{matrix}\textit{signal}\\ \textit{drive}\\ \textit{software}\\ \textit{creates}\end{matrix} - \begin{matrix}\textit{ANA}\\ \textit{OUT}\\ \textit{OFFSET}\end{matrix}\right) \times \begin{matrix}\textit{ANA}\\ \textit{OUT}\\ \textit{GAIN}\end{matrix} = \begin{matrix}\textit{analog}\\ \textit{channel}\\ \textit{output}\\ \textit{voltage}\end{matrix}$$

Default: 0.00 %
Min: -99.9 Max: 99.9
Units: %

ANA 2 OUT OFFSET
Hidden (Digital to Analog #2 Output Offset)
Offset for scaling Analog Output Channel #2.

$$\left(\begin{matrix}\text{signal}\\ \text{drive}\\ \text{software}\\ \text{creates}\end{matrix} - \begin{matrix}\text{ANA}\\ \text{OUT}\\ \text{OFFSET}\end{matrix}\right) \times \begin{matrix}\text{ANA}\\ \text{OUT}\\ \text{GAIN}\end{matrix} = \begin{matrix}\text{analog}\\ \text{channel}\\ \text{output}\\ \text{voltage}\end{matrix}$$

Default: 0.00 %
Min: -99.9 Max: 99.9
Units: %

ANA 1 OUT GAIN
Hidden (Digital to Analog #1 Output Gain)
Adjusts the scaling for the Analog Output Channel #1.
NOTE: value of 1.0 = 0 to 10VDC signal.

$$\left(\begin{matrix}\text{signal}\\ \text{drive}\\ \text{software}\\ \text{creates}\end{matrix} - \begin{matrix}\text{ANA}\\ \text{OUT}\\ \text{OFFSET}\end{matrix}\right) \times \begin{matrix}\text{ANA}\\ \text{OUT}\\ \text{GAIN}\end{matrix} = \begin{matrix}\text{analog}\\ \text{channel}\\ \text{output}\\ \text{voltage}\end{matrix}$$

Default: 01.0
Min: 00.0 Max: 10.0
Units: none

ANA 2 OUT GAIN
Hidden (Digital to Analog #2 Output Gain)
Adjusts the scaling for the Analog Output Channel #2.
NOTE: value of 1.0 = 0 to 10VDC signal.

$$\left(\begin{matrix}\text{signal}\\ \text{drive}\\ \text{software}\\ \text{creates}\end{matrix} - \begin{matrix}\text{ANA}\\ \text{OUT}\\ \text{OFFSET}\end{matrix}\right) \times \begin{matrix}\text{ANA}\\ \text{OUT}\\ \text{GAIN}\end{matrix} = \begin{matrix}\text{analog}\\ \text{channel}\\ \text{output}\\ \text{voltage}\end{matrix}$$

Default: 01.0
Min: 00.0 Max: 10.0
Units: none

FLT RESET DELAY
Hidden (Fault Reset Delay)
When the drive is set for automatic fault reset, this is the time before a fault is automatically reset. *For further information, see FAULT RESET SRC and parameters in section (3.5.1).*
Default: 5
Min: 0 Max: 120
Units: seconds

FLT RESETS/HOUR
Hidden (Fault Resets per Hour)
When the drive is set for automatic fault reset, this is the number of faults that is allowed to be automatically reset per hour. *For further information, see FAULT RESET SRC and parameters in section (3.5.1).*
Default: 3
Min: 0 Max: 10
Units: faults

UP TO SPD. LEVEL
Hidden (Up to Speed Level)
This parameter sets the threshold for the up to speed logic output. This is only used to generate the up to speed logic output
Default: 080.00 %
Min: 000.00 Max: 110.00
Units: % contract speed

3.4.2 S-CURVES A2 Sub-menu

An important feature of the HPV 900 is the internal S-curve function. The S-curves are specified by four parameters: acceleration rate (ft/s^2 or m/s^2), deceleration rate (ft/s^2 or m/s^2), leveling jerk rate (ft/s^3 or m/s^3), and jerk rate (ft/s^3 or m/s^3).

Since an adjustable jerk rate is helpful for smooth landings, the jerk rates are split for ease in elevator fine tuning. The jerk rate parameter specifies: acceleration from the floor (jerk in), jerk out acceleration , jerk in deceleration. And the leveling jerk parameter specifies the deceleration jerk out.

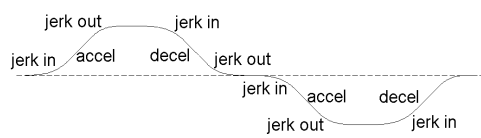


Figure 3. 7 - S-Curve

There are four S-curve patterns available in the drive and each S-curve is customized by four parameters:

Parameters for S-curve-0 (SC0):
- ACCEL RATE 0
- DECEL RATE 0
- JERK RATE 0
- LEV JERK 0

Parameters for S-curve-1 (SC1):
- ACCEL RATE 1
- DECEL RATE 1
- JERK RATE 1
- LEV JERK 1

Parameters for S-curve-2 (SC2):
- ACCEL RATE 2
- DECEL RATE 2
- JERK RATE 2
- LEV JERK 2

Parameters for S-curve-3 (SC3):

- ACCEL RATE 3
- DECEL RATE 3
- JERK RATE 3
- LEV JERK 3

3.4.2.1 S-Curve Pattern Selection

The default S-curve pattern is S-curve-0 (SC0). To make the other patterns available, the user must assign S-CURVE SEL 0 and/or S-CURVE SEL 1 as logic input(s), *see section (3.5.2)*. The logic input(s) can then be used to select one of the S-curve patterns, as follows:

Logic Inputs Assigned	S-curves Available
None	SC0 only
SEL 0 only	SC0 or SC1
SEL 1 only	SC0 or SC2
SEL 0 & SEL 1	SC0, SC1, SC2 or SC3

Table 3. 4 - S-curve Availability

logic input S-CURVE SEL 1	SEL 0	S-curve selected
0	0	SCO
0	1	SC1
1	0	SC2
1	1	SC3

Table 3. 5 - Selecting S-curves

A summary of S-Curve parameters is shown in Table 3. 6.

NOTE: When the word ***Hidden*** appears above a parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: When the word ***Lockout*** appears above a parameter description, it parameter cannot be changed when the drive is in the RUN mode.

For more detailed information on the S-curve settings see the HPV 900 Application section (5.6).

Name	Description	Units	Hidden	Lockout
Accel Rate 0	Acceleration rate #0	ft/s^2 or m/s^2	N	Y
Decel Rate 0	Deceleration rate #0	ft/s^2 or m/s^2	N	Y
Jerk Rate 0	Accel jerk in, accel jerk out, decel jerk in #0	ft/s^3 or m/s^3	N	Y
Lev Jerk Rate 0	Leveling jerk rate (decel jerk out) #0	ft/s^3 or m/s^3	N	Y
Accel Rate 1	Acceleration rate #1	ft/s^2 or m/s^2	N	Y
Decel Rate 1	Deceleration rate #1	ft/s^2 or m/s^2	N	Y
Jerk Rate 1	Accel jerk in, accel jerk out, decel jerk in #1	ft/s^3 or m/s^3	N	Y
Lev Jerk Rate 1	Leveling jerk rate (decel jerk out) #1	ft/s^3 or m/s^3	N	Y
Accel Rate 2	Acceleration rate #2	ft/s^2 or m/s^2	Y	Y
Decel Rate 2	Deceleration rate #2	ft/s^2 or m/s^2	Y	Y
Jerk Rate 2	Accel jerk in, accel jerk out, decel jerk in #2	ft/s^3 or m/s^3	Y	Y
Lev Jerk Rate 2	Leveling jerk rate (decel jerk out) #2	ft/s^3 or m/s^3	Y	Y
Accel Rate 3	Acceleration rate #3	ft/s^2 or m/s^2	Y	Y
Decel Rate 3	Deceleration rate #3	ft/s^2 or m/s^2	Y	Y
Jerk Rate 3	Accel jerk in, accel jerk out, decel jerk in #3	ft/s^3 or m/s^3	Y	Y
Lev Jerk Rate 3	Leveling jerk rate (decel jerk out) #3	ft/s^3 or m/s^3	Y	Y

Table 3. 6 - S-CURVES A2 Parameters

ACCEL RATE 0
Lockout (S-curve-0 Acceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

DECEL RATE 0
Lockout (S-curve-0 Deceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

JERK RATE 0
Lockout (S-curve-0 Jerk Rate)
Accel jerk in, accel jerk out, & decel jerk in.
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

LEV JERK RATE 0
Lockout (S-curve-0 Leveling Jerk Rate)
Leveling jerk rate (decel jerk out)
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

ACCEL RATE 1
Lockout (S-curve-1 Acceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

DECEL RATE 1
Lockout (S-curve-0 Deceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

JERK RATE 1
Lockout (S-curve-1 Jerk Rate)
Accel jerk in, accel jerk out, & decel jerk in.
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

LEV JERK RATE 1
Lockout (S-curve-1 Leveling Jerk Rate)
Leveling jerk rate (decel jerk out)
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

ACCEL RATE 2
Hidden / Lockout (S-curve-2 Acceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

DECEL RATE 2
Hidden / Lockout (S-curve-2 Deceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

JERK RATE 2
Hidden / Lockout (S-curve-2 Jerk Rate)
Accel jerk in, accel jerk out, & decel jerk in.
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

LEV JERK RATE 2
Hidden / Lockout (S-curve-2 Leveling Jerk Rate)
Leveling jerk rate (decel jerk out)
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

ACCEL RATE 3
Hidden / Lockout (S-curve-3 Acceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

DECEL RATE 3
Hidden / Lockout (S-curve-3 Deceleration Rate)
Default: 3.00 ft/s/s or 0.900 m/s/s
Min: 0.00 / 0.000 Max: 7.99 / 3.999
Units: ft/s^2 or m/s^2

JERK RATE 3
Hidden / Lockout (S-curve-3 Jerk Rate)
Accel jerk in, accel jerk out, & decel jerk in.
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

LEV JERK RATE 3
Hidden / Lockout (S-curve-3 Leveling Jerk Rate)
Leveling jerk rate (decel jerk out)
Default: 8.0 f/s/s/s or 2.400 m/s/s/s
Min: 0.00 / 0.000 Max: 29.9 / 9.999
Units: f/s^3 or m/s^3

3.4.3 MULTISTEP REF A3 Sub-menu

The multi-step speed reference function is one possible way for the drive to accept speed command. To use this function, the user can enter up to fifteen speed commands (CMD1 – CMD15) and assign four logic inputs as speed command selections.

Note: CMD0 is reserved for zero speed, therefore is not accessible to the user for programming.

During operation, the user will encode a binary signal on the four logic inputs (see Table 3. 7) that determines which speed command the software should use. The user need not use all four speed command selection bits; if no logic input is specified for one of the selection bits, that bit is always zero. For instance, if no logic input is specified for the most significant bit (B3), that bit will be zero and the user can select from CMD0 - CMD7.

IMPORTANT

Since these speed commands are selected with external contacts, a new command selection must be present for 50ms before it is recognized.

logic input STEP REF				multi-step speed
B3	B2	B1	B0	command
0	0	0	0	CMD0
0	0	0	1	CMD1
0	0	1	0	CMD2
0	0	1	1	CMD3
0	1	0	0	CMD4
0	1	0	1	CMD5
0	1	1	0	CMD6
0	1	1	1	CMD7
1	0	0	0	CMD8
1	0	0	1	CMD9
1	0	1	0	CMD10
1	0	1	1	CMD11
1	1	0	0	CMD12
1	1	0	1	CMD13
1	1	1	0	CMD14
1	1	1	1	CMD15

Table 3. 7 - Multi-step Selection

An example of the use of the multi-step command is as follows:

- All speed commands are positive.
- CMD0 specifies zero speed.
- CMD1 specifies leveling speed.
- CMD2 specifies inspection speed.
- CMD3 specifies an overspeed limit.
- CMD4 – CMD15 specify different top speeds depending on number of floors in the run.

For typical use, the user will have all speed commands to be positive, in which case a logic input s (UP/DWN or RUNUP & RUNDOWN) must also be specified to determine up or down direction, s*ee details in section (3.5.2).* It is possible for the user to specify both positive and negative values for CMD1 - CMD15, in which case logic input bit(s) are not needed.

NOTE: When the word ***Hidden*** appears above a parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2)..*

NOTE: When the word ***Lockout*** appears above a parameter description, it parameter cannot be changed when the drive is in the RUN mode.

For all speed command have the following parameter ranges and units apply:

SPEED COMMAND
Lockout (Speed Command)
Multi-step speed command
Default: 0.0 ft/min or 00.000 m/sec
Min: -3000.0 / -16.0 Max: 3000.0 / 16.0
Units: ft/min or m/sec

Name	Description	Units	Hidden	Lockout
Speed Command 1	Multi-step speed command #1	ft/min or m/sec	N	Y
Speed Command 2	Multi-step speed command #2	ft/min or m/sec	N	Y
Speed Command 3	Multi-step speed command #3	ft/min or m/sec	N	Y
Speed Command 4	Multi-step speed command #4	ft/min or m/sec	N	Y
Speed Command 5	Multi-step speed command #5	ft/min or m/sec	N	Y
Speed Command 6	Multi-step speed command #6	ft/min or m/sec	N	Y
Speed Command 7	Multi-step speed command #7	ft/min or m/sec	N	Y
Speed Command 8	Multi-step speed command #8	ft/min or m/sec	N	Y
Speed Command 9	Multi-step speed command #9	ft/min or m/sec	N	Y
Speed Command 10	Multi-step speed command #10	ft/min or m/sec	N	Y
Speed Command 11	Multi-step speed command #11	ft/min or m/sec	N	Y
Speed Command 12	Multi-step speed command #12	ft/min or m/sec	N	Y
Speed Command 13	Multi-step speed command #13	ft/min or m/sec	N	Y
Speed Command 14	Multi-step speed command #14	ft/min or m/sec	N	Y
Speed Command 15	Multi-step speed command #15	ft/min or m/sec	N	Y

Table 3. 8 - MULTISTEP REF A3 Parameters

Name	Description	Units	Hidden	Lockout
Id Reg Diff Gain	Flux current regulator differential gain	none	Y	N
Id Reg Prop Gain	Flux current regulator proportional gain	none	Y	N
Iq Reg Diff Gain	Torque current regulator differential gain	none	Y	N
Iq Reg Prop Gain	Torque current regulator proportional gain	none	Y	N
PWM Frequency	Carrier frequency	kHz	N	N
UV Alarm Level	Voltage level for undervoltage alarm	%nominal bus	Y	N
UV Fault Level	Voltage level for undervoltage fault	%nominal bus	Y	N
Extern Reactance	External choke reactance	% base Z	Y	Y
Input L-L Volts	Nominal line-line AC input Voltage, RMS	Volts	N	N

Table 3. 9 - POWER CONVERT A4 Parameters

3.4.4 POWER CONVERT A4 Sub-menu

This drive software power related parameters.

NOTE: When the word ***Hidden*** appears above a parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: When the word ***Lockout*** appears above a parameter description, it parameter cannot be changed when the drive is in the RUN mode.

A summary is shown in Table 3. 9.

Id REG DIFF GAIN
Hidden (Current Regulator Differential Gain for Flux Generation)
The differential gain for the current regulator flux generation. This parameter is meant for advanced operation, therefore, the parameter will rarely need to be changed from the default value.
Default: 1.00
Min: 0.80 Max: 1.20
Units: none

Id REG PROP GAIN
Hidden (Current Regulator Proportional Gain for Flux Generation)
The proportional gain for the current regulator flux generation. This parameter is meant for advanced operation, therefore, the parameter will rarely need to be changed from the default value.
Default: 0.30
Min: 0.20 Max: 0.40
Units: none

Iq REG DIFF GAIN
Hidden (Current Regulator Differential Gain for Torque Generation)
The differential gain for the current regulation of motor torque. This parameter is meant for advanced operation, therefore, the parameter will rarely need to be changed from the default value.
Default: 1.00
Min: 0.80 Max: 1.20
Units: none

Iq REG PROP GAIN
Hidden (Current Regulator Proportional Gain for Torque Generation)
The proportional gain for the current regulator torque generation. This parameter is meant for advanced operation, therefore, the parameter will rarely need to be changed from the default value.
Default: 0.30
Min: 0.20 Max: 0.40
Units: none

PWM FREQUENCY
(PWM Frequency)
This parameter sets the PWM or 'carrier' frequency of the drive. The carrier is defaulted at 10.0 kHz, which is well out of audible range. The drive does not derate when the PWM frequency is set to 10kHz or below. *For more information on derating see section (2.2.4.3)*
Default: 10.0 kHz
Min: 2.5 Max: 16.0
Units: kHz

UV ALARM LEVEL
Hidden (Undervoltage Alarm Level)
This parameter sets the level (as a percentage of the INPUT L-L VOLTS) at which an under voltage alarm will be declared.
Default: 90%
Min: 80 Max: 99
Units: % of nominal bus

UV FAULT LEVEL
Hidden (Undervoltage Fault Level)
This parameter sets the level (as a percentage of the INPUT L-L VOLTS) at which an under voltage fault will occur. Default: 80%
Min: 50 Max: 99
Units: % of nominal bus

EXTERN REACTANCE
Hidden / Lockout (External Reactance)
This parameter sets the externally connected reactance (as a percentage of base impedance) between the drive and the motor.
Default: 00.0 %
Min: 0.0 Max: 10
Units: % reactance

INPUT L-L VOLTS
(Input Line to Line Voltage - Input Voltage)
This parameter sets the input voltage or AC line input voltage to the drive.
Default: 460 or 230 Vrms
Min: 110 Max: 480
Units: volts (V) rms

3.4.5 MOTOR A5 Sub-menu

This sub-menu contains parameters, which are programmed with information about the motor being controlled by the drive.

IMPORTANT

The parameters in this sub-menu defined the motor model, which is very important for proper operation. Ensure that the data is accurate. *See the START-UP PROCEDURE - step #16, section (2.1).*

NOTE: When the word ***Hidden*** appears above a parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: When the word ***Lockout*** appears above a parameter description, it parameter cannot be changed when the drive is in the RUN mode.

A summary of the motor parameters is shown Table 3. 10.

Name	Description	Units	Hidden	Lockout
Motor ID	Motor Identification	none	N	Y
Rated Mtr Power	Rated motor output power	HP / KW	N	Y
Rated Mtr Volts	Rated motor terminal RMS voltage	Volts	N	Y
Rated Excit Freq	Rated excitation frequency	Hz	N	Y
Rated Motor Curr	Rated motor current	Amps	N	Y
Motor Poles	Motor poles	none	N	N
Rated Mtr Speed	Rated motor speed at full load	RPM	N	Y
% No Load Curr	Percent no load current	%rated current	N	N
Stator Leakage X	Stator leakage reactance	% base Z	Y	N
Rotor Leakage X	Rotor leakage reactance	% base Z	Y	N
Stator Resist	Stator resistance	% base Z	Y	N
Motor Iron Loss	Iron loss at rated frequency	% rated power	Y	N
Motor Mech Loss	Mechanical loss at rated frequency	% rated power	Y	N
Ovld Start Level	Maximum continuous motor current	% rated current	Y	Y
Ovld Time Out	Time that defines motor overload curve	seconds	Y	Y
Flux Sat Break	Flux saturation curve slope change point.	% flux	Y	Y
Flux Sat Slope 1	Flux saturation curve slope for low fluxes	PU slope	Y	Y
Flux Sat Slope 2	Flux saturation curve slope for high fluxes	PU slope	Y	Y

Table 3. 10 - MOTOR A5 Parameters

MOTOR ID

Lockout (Motor Identification)

This parameter allows for the selection of specific sets of motor parameters. A listing of each Motor ID with its corresponding set of motor parameters is shown in Table 3. 11

motor parameter	Motor ID	
	4 pole dflt	6 pole dflt
Rated Mtr Power	0.0 HP	0.0 HP
Rated Mtr Volts	0.0 V	0.0 V
Rated Excit Freq	0.0 Hz	0.0 Hz
Rated Motor Curr	0.0 A	0.0 A
Motor Poles	0	0
Rated Mtr Speed	0.0 rpm	0.0 rpm
% No Load Curr	35.00%	45.00%
Stator Leakage X	9.00%	7.50%
Rotor Leakage X	9.00%	7.50%
Stator Resist	1.50%	1.50%
Motor Iron Loss	0.50%	0.50%
Motor Mech Loss	1.00%	1.00%
Flux Sat Break	75%	75%
Flux Sat Slope 1	0%	0%
Flux Sat Slope 2	50%	50%

Table 3. 11 - Motor ID Parameters

* values should be obtained from the motor nameplate

NOTE: The default motor selections need to have the motor nameplate information entered in the appropriate motor parameters. The other motor parameters are already set to nominal values.

IMPORTANT

Whichever Motor ID is used, the Adaptive Tune Procedure should be followed to obtain maximum motor performance. *See section (5.7.2).*

RATED MTR PWR*

Lockout (Rated Motor Power)

This parameter sets the rated power in horsepower (HP) or kilowatts (kW) of the motor.
Default: per MOTOR ID
Min: 1.0 Max: 500.0
Units: HP/kW

RATED MTR VOLTS*

Lockout (Rated Motor Voltage)

This parameter sets the rated motor voltage.
Default: per MOTOR ID
Min: 190.0 Max: 575.0
Units: Volts (V)

RATED EXCIT FREQ*

Lockout (Rated Motor Excitation Freq.)

This parameter sets the excitation frequency of the motor.
Default: per MOTOR ID
Min 5.0 Max: 400.0
Units: Hz

RATED MOTOR CURR*
Lockout (Rated Motor Amps)
This parameter sets the rated motor current.
Default: per MOTOR ID
Min: 1.00 Max: 800.00
Units: Amps (A)

MOTOR POLES*
Lockout (Motor Poles)
This parameter sets the number of poles in the motor.
NOTE: This must be an even number or a Setup Fault #3 will occur.
Default: per MOTOR ID
Min: 2 Max: 32
Units: none

RATED MTR SPEED*
(Rated Motor Speed)
This parameter sets the rated rpm of the motor (nameplate speed). This parameter sets the window (±25%) around which the adaptive tune can adjust the motor's rated rpm. *For more information on the adaptive tune, see section (5.7.2).* NOTE: This is a function of the motor only and does not need to be the same as the CONTRACT MTR SPD parameter setting, *see section (3.4.1*).
Default: per MOTOR ID
Min: 50.0 Max: 3000.0
Units: rpm

% NO LOAD CURR
(Percent No Load Current)
This parameter sets the percent no load current of the motor. This parameter sets the window (±25%) around which the adaptive tune can adjust the motor's percent no load current. *For more information on the adaptive tune, see section (5.7.2).*
Default: per MOTOR ID
Min: 10.0 Max: 80.0
Units: % Current

STATOR LEAKAGE X
Hidden (Stator Leakage Reactance)
This parameter sets the stator reactance leakage, as a percent of the BASE IMPEDANCE, which appears in the Power Data display, *see section (3.3.2)*.
NOTE: The base impedance is based on the RATED MTR PWR and RATED MTR VOLTS parameters.
Default: per MOTOR ID
Min: 0.00 Max: 20.0
Units: % reactance of base impedance

ROTOR LEAKAGE X
Hidden (Rotor Leakage Reactance)
This parameter sets the rotor reactance leakage, as a percent of the BASE IMPEDANCE, which appears in the Power Data display, *see section (3.3.2).*
NOTE: The base impedance is based on the RATED MTR PWR and RATED MTR VOLTS parameters.
Default: per MOTOR ID
Min: 0.00 Max: 20.0
Units: % reactance of base impedance

STATOR RESIST
Hidden (Stator Resistance)
This parameter sets the amount of resistance in the motor stator, as a percent of the BASE IMPEDANCE, which appears in the Power Data display, *see section (3.3.2).*
NOTE: The base impedance is based on the RATED MTR PWR and RATED MTR VOLTS parameters.
Default: per MOTOR ID
Min: 0.0 Max: 20.0
Units: % resistance of base impedance

MOTOR IRON LOSS
Hidden (Motor Iron Loss)
This parameter sets the motor iron loss at rated frequency.
Default: per MOTOR ID
Min: 0.0 Max: 15.0
Units: % of rated power

MOTOR MECH LOSS
Hidden (Motor Mechanical Losses)
This parameter sets the motor mechanical losses at rated frequency.
Default: per MOTOR ID
Min: 0.0 Max: 15.0
Units: % of rated power

OVLD START LEVEL
Hidden / Lockout (Motor Overload Start Level)
This parameter defines maximum current at which motor can run continuously. This parameter is also one of the two parameters that define the motor overload curve. *For more information on the motor overload curve, see section (0).*
Default: 110 %
Min: 100 Max: 150
Units: % rated current

OVLD TIME OUT
Hidden / Lockout (Motor Overload Time Out)
This parameter defines the amount of time before a motor overload alarm occurs when the motor is running at the current level defined below:

$$\begin{pmatrix} OVLD \\ START \\ LEVEL: \end{pmatrix} + \begin{pmatrix} 40\% \\ rated \\ motor \\ current \end{pmatrix}$$

This is the other parameter used to define the overload curve. *For more information on the motor overload curve, see section (0).*
Default: 60.0 sec
Min: 5.0 Max: 120.0
Units: Seconds (sec)

FLUX SAT BREAK
Hidden / Lockout (Flux Saturation Break Point)
This parameter sets the flux saturation curve slope change point.
Default: per MOTOR ID
Min: 0 Max: 100
Units: % Flux

FLUX SAT SLOPE 1
Hidden / Lockout (Flux Saturation Slope #1)
This parameter sets the flux saturation curve slope for low fluxes.
Default: per MOTOR ID
Min: 0.00 Max: 200.0
Units: PU slope 100%

FLUX SAT SLOPE 2
Hidden / Lockout (Flux Saturation Slope #2)
This parameter sets the flux saturation curve slope for high fluxes.
Default: per MOTOR ID
Min: 0.00 Max: 200.0
Units: PU slope 100%

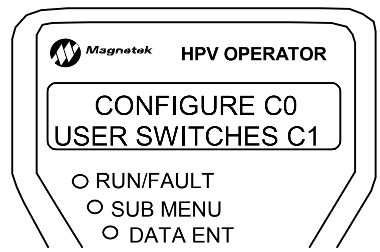
3.5 CONFIGURE C0 MENU

The CONFIGURE C0 menu contains the configuration parameters for the drive.

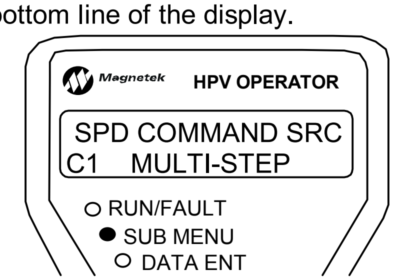
This menu has four sub-menus:

- **USER SWITCHES C1 3.5.1**
- **LOGIC INPUTS C2 3.5.2**
- **LOGIC OUTPUTS C3 3.5.3**
- **ANALOG OUTPUTS C4 3.5.4**

The sub-menu is identified by its full name on the bottom line of the Digital Operator display when the SUB MENU LED is *not* lit.



When the SUB MENU LED is ON, the two letter code for the sub-menu appears at the far left of the bottom line of the display.



3.5.1 USER SWITCHES C1 Sub-menu

This sub-menu contains the operation configurations for the drive.

A summary of the user switches parameters is shown in Table 3. 12.

User Switches	Description	Hidden	Lockout
Spd Command Src	Speed Command Source	Y	Y
Run Command Src	Run Command Source	Y	Y
Hi/Lo Gain Src	High / low gain change switch source	Y	Y
Speed Reg Type	Chooses speed regulator: Ereg or PI regulator	Y	Y
Motor Rotation	Allows user to reverse direction of motor rotation.	Y	Y
Spd Ref Release	Determines when speed reference release is asserted (for use when the drive controls the mechanical brake)	Y	Y
Cont Confirm Src	Determines if an external logic input is used for contactor confirm.	Y	Y
PreTorque Source	Determines if a pre torque command is used and if used, it determines the source of the pre torque command.	Y	Y
PreTorque Latch	Chooses if analog pre-torque command is latched	Y	Y
PTorq Latch Clck	Determines source of pre torque latch control (if used)	Y	Y
Fault Reset Src	Fault reset source	Y	Y
Overspd Test Src	Determines external logic source to initiate overspeed test	Y	Y
Brake Pick Src	Determines the source of the brake pick command (if drive controls mechanical brake)	Y	Y
Brake Pick Cnfm	Determines if a logic input is used for brake pick confirm	Y	Y
Brake Hold Src	Determines the source of the brake hold command. (if drive controls mechanical brake)	Y	Y
Ramped Stop Sel	Chooses between normal stop and torque ramp down stop	Y	Y
Ramp Down En Src	Determines the source that signals the torque ramp down stop (if used)	Y	Y
Brk Pick Flt Ena	Brake pick fault enable(if drive controls mechanical brake)	Y	Y
Brk Hold Flt Ena	Brake hold fault enable(if drive controls mechanical brake)	Y	Y
Ex Torq Cmd Src	Sets source of external torque command	Y	Y
Dir Confirm	Allows confirmation of polarity of analog speed command	Y	Y
S-Curve Abort	Addresses handling of a speed command change before S-Curve target speed	Y	Y

Table 3. 12 - USER SWITCHES C1 Parameters

SPD COMMAND SRC

Hidden / *Lockout* (Speed Command Source)

Default: MULTI-STEP

Choices: analog input
multi-step
serial

This parameter designates the source of the drive's speed command. The choices are the multi-step logic inputs, the analog input channel #1, and the serial channel. *For more information, see section (5.1.1).*

RUN COMMAND SRC

Hidden / *Lockout* (Run Command Source)

Default: EXTERNAL TB1

Choices: external tb1
serial
serial+extrn

This parameter allows the user to choose the source of the run command from one of the following sources: an external run signal from a logic input (external tb1), a run signal transferred across a serial channel (serial), or a signal from both the seral channel and a logic input (serial+extrn). If a signal is required from a logic input (either externaltb1 or serial+extrn), the Run signal on TB1 must be selected. *See section (3.5.2*)

HI/LO GAIN SRC
Hidden / *Lockout* (High / Low Gain Source)
Default: INTERNAL
Choices: external tb1
serial
internal
This parameter determines the source of the high / low gain switch. *For more information, see section (5.1.4.1).*

SPEED REG TYPE
Hidden / *Lockout* (Speed Regulator Type)
Default: ELEV SPD REG
Choices: elev spd reg
pi speed reg
external reg

This switch toggles between the Elevator Speed Regulator (Ereg) and the PI Speed Regulator. Magnetek recommends the use of the Elevator Speed Regulator for better elevator performance. *For more information, see section (5.1.4.2).*

If set to external regulator, the drive will be configured as a torque controller. *For more information, see section (5.1.4.2.3).*

IMPORTANT

This assumes the car controller is doing its own closed-loop speed regulation. (i.e. a completely closed outer speed loop with the car controller having its own encoder feedback).
The source of the external torque command is determined by the EXT TORQ CMD SRC (C1) parameter.

MOTOR ROTATION
Hidden / *Lockout* (Motor Rotation)
Default: FORWARD
Choices: forward
reverse
This parameter allows the user to change the direction of the motor rotation. As an example, if the car controller is commanding the up direction and the car is actually going in a down direction, this parameter can be changed to allow the motor rotation to match the car controller command.

SPD REF RELEASE
Hidden / *Lockout* (Speed Reference Release)
Default: REG RELEASE
Choices: reg release
brake picked
The user can select when the Speed Reference Release signal is asserted:
1) If the user does not want the drive to wait for the mechanical brake to be picked then SPD REF RELEASE can be made equal to REG RELEASE;
2) If the user does want the drive to wait for the brake to be picked then SPD REF RELEASE is not asserted until BRAKE PICKED becomes true.

CONT CONFIRM SRC
Hidden / *Lockout* (Contactor Confirm Source)
Default: NONE
Choices: none
external tb1
This switch selects if hardware confirmation of motor contactor closure is necessary before drive attempts to pass current through motor. If hardware confirmation is available set to EXTERNAL TB1 and select the Contact Cnfirm signal on a logic input terminal, *see section (3.5.2)*.

PreTorque SOURCE
Hidden / *Lockout* (Pre-Torque Source)
Default: NONE
Choices: none
analog input
serial
This switch determines if a pre torque command is used and if used the source. *For more information see section (5.1.4.7).*

Pre-Torque LATCH
Hidden / *Lockout* (Pre-Torque Latch)
Default: NOT LATCHED
Choices: not latched
latched
This parameter determines if the pre-torque signal is latched. *For more information, see section (5.1.4.7.3).*
NOTE: If PreTorque Source has been set to NONE, the setting does not have any effect on the operation of the drive.

PTorq LATCH CLCK
Hidden / Lockout (Pre-Torque Latch Clock)
Default: EXTERNAL TB1
Choices: external tb1
serial

If the PRE-TORQUE LATCH has been set to LATCHED, then this parameter chooses the source for latch control. If set to EXTERNAL TB1, the Pre-Trq Latch signal on TB1 must be selected, *see section (3.5.2). For more information see section (5.1.4.7.3).*

FAULT RESET SRC
Hidden / Lockout (Fault Reset Source)
Default: EXTERNAL TB1
Choices: external tb1
serial
automatic

This parameter determines the source of the drive's external fault reset from one of the following sources: an external fault reset signal from a logic input (external tb1), a fault reset signal transferred across a serial channel (serial), or the drive automatically resets the faults (automatic). The user also has the option to reset faults directly through the operator. *See section (3.7.2.2), Resetting Active Faults*.

Automatic Fault Reset
If the fault reset source is set to automatic, the faults will be reset according to the setting of the FLT RESET DELAY and FLT RESETS/HOUR parameters, *see section (3.4.1).* When a logic input is defined as "fault reset", *see section (3.5.2)* and this logic input signal is transitioned from false to true: an active fault will be reset and automatic fault reset counter (defined by FLT RESETS/HOUR) will be reset to zero.

CAUTION

If the run signal is asserted at the time of a fault reset, the drive will immediately go into a run state. Unless using the auto-fault reset function (FAULT RESET SRC=automatic), then the run command needs to be cycled.

OVERSPEED TEST SRC
Hidden / Lockout (Overspeed Test Source)
Default: EXTERNAL TB1
Choices: external tb1
serial

This switch determines the source of the overspeed test. Operation of the overspeed test function is specified by the OVRSPEED MULT parameter *(see section 3.4.1).* Regardless of the setting of this parameter, the user can call for the overspeed test via the Digital Operator, *see section (3.6.4.3). For more information, see section (5.1.2).*

BRAKE PICK SRC
(Brake Pick Source)
Default: INTERNAL
Choices: internal
serial

If the BRAKE PICK SRC is set to INTERNAL, the HPV 900 will attempt to pick (lift) the brake when magnetizing current has been developed in the motor.

BRAKE PICK CNFM
Hidden / Lockout (Brake Pick Confirm)
Default: NONE
Choices: none
external tb1

If this switch is set to EXTERNAL TB1, the HPV 900 will wait for brake pick confirmation before releasing the speed reference. When set to EXTERNAL TB1, the MECH BRK PICK signal on TB1 must also be selected, *see section (3.5.2)*

BRAKE HOLD SRC
Hidden / Lockout (Brake Hold Source)
Default: INTERNAL
Choices: internal
serial

If set to internal, the drive will command the mechanical brake to hold mode until confirmation of brake picked exists.

RAMPED STOP SEL
Hidden / *Lockout* (Ramp Stop Select)
Default: NONE
Choices: none
ramp on stop
This parameter allows the selection of the Torque Ramp Down Stop function. This function is used to gradually remove the torque command after the elevator has stopped and the mechanical brake has been set. This prevents a shock and possible 'bump' felt in the elevator from the torque signal going to zero too quickly. *For more information, see section (5.1.4.9).*

RAMP DOWN EN SRC
Hidden / *Lockout* (Ramp Down Enable Source)
Default: EXTERNAL TB1
Choices: external tb1
run logic
serial
If RUN LOGIC is selected, the user can remove the run command and the drive will delay in dropping the run command until torque ramp down stop function is complete.
If EXTERNAL TB1 or SERIAL is selected, the user must keep the run command while allowing the Torque Ramp Down Stop function to be completed.

BRK PICK FLT ENA
Hidden / *Lockout* (Brake Pick Fault Enable)
Default: DISABLE
Choices: disable
enable
When this parameter is set to ENABLE, the brake pick command and confirmation must match within the specified time in BRK PICK TIME parameter, *see section (3.4.1)* or a brake pick fault is declared.

BRK HOLD FLT ENA
Hidden / *Lockout* (Brake Hold Fault Enable)
Default: DISABLE
Choices: disable
enable
When this parameter is set to ENABLE, the brake hold command and confirmation must match within the specified time in BRK HOLD TIME parameter, *see section (3.4.1)* or a brake hold fault is declared.

EX TORQ CMD SRC
Hidden / Lockout (Torque Command Source)
Default: NONE
Choices: none
serial
analog input
Sets the source of the external torque command when the SPEED REG TYPE (C1) is set to external reg.
When set to analog input the scaling in analog input channel #2 will be
- +10VDC = positive 250% of the rated torque of the motor
- -10VDC = negative 250% of the rated torque of the motor

NOTE:
- if EX TORQ CMD SRC is set to either analog input, ensure the PreTorque SOURCE (C1) parameter is set to either none or serial
- if SPEED REG TYPE is set to external reg and EX TORQ CMD SRC is set to either serial or analog input, the drive is a torque controller
- if SPEED REG TYPE is set for a speed regulator (either pi speed reg or elev spd reg) and EX TORQ CMD SRC is set to either serial or analog input , the torque command is an auxiliary torque command (torque feedforward command)

DIR CONFIRM
Hidden / *Lockout* (Direction Confirm)
Default: DISABLE
Choices: disable
enable
When enabled, the function allows confirmation of the polarity of the initial analog speed command via the Run Up or Run Down logic input commands.
- If the Run Up logic input is selected and true with the polarity of the analog signal positive, then the analog speed command is accepted unchanged.
- If the logic input Run Down logic input is selected and true with the polarity of the analog speed command negative, the analog speed command is accepted unchanged.
- If however, the logic input Run Up is true and the polarity is negative or the logic input Run Down is true and the polarity is positive, then the speed command is held at zero.

NOTE: This check is made only during the start. The test is only done at the start to allow the analog signal to reverse during leveling. The test is terminated when the analog signal is of the correct polarity and the magnitude exceeds a threshold level. The threshold level is set by the ZERO SPEED LEVEL (A1), *see section (3.4.1).* Until the threshold level is exceeded all analog signals of the incorrect polarity are clamped to zero.

S-CURVE ABORT
Hidden / Lockout (S-Curve Abort)
Default: DISABLE
Choices: disable
enable

This parameter, S-CURVE ABORT (C1), addresses how the HPV 900's S-Curve Speed Reference Generator handles a reduction in the speed command before the S-Curve Generator has reached its target speed. For more information, see Section (5.6.2.1).

<u>Disabled</u>
With a normal S-curve function, a change in the speed command is never allowed to violate the defined acceleration or jerk rates. If a reduction in the speed command is issued before the S-Curve generator has reached its target speed, then the jerk rate dictates what speed is reached before the speed may be reduced.

<u>Enabled</u>
The optional S-Curve abort has been selected. In this case when the speed command is reduced, the speed reference immediately starts to reduce violating the jerk limit (thus no jerk out phase), which could be felt in the elevator.

For optional S-Curve abort to be active requires that:

- The speed command source must be selected as Multi-step (SPD COMMAND SRC=multi-step).
- The S-curve Abort function must be ENABLED (S-CURVE ABORT = enabled).

3.5.2 LOGIC INPUTS C2 Sub-menu

This sub-menu contains the parameters that define the logic inputs on TB1 terminals 1-9 (s*ee Figure 3. 8).*

LOG IN 1 TB1-1
Hidden / Lockout
Default: DRIVE ENABLE
Choices *See section 3.5.2.1.*

LOG IN 2 TB1-2
Hidden / Lockout
Default: RUN
Choices *See section 3.5.2.1.*

LOG IN 3 TB1-3
Hidden / Lockout
Default: FAULT RESET
Choices *See section 3.5.2.1.*

LOG IN 4 TB1-4
Hidden / Lockout
Default: UP/DWN
Choices *See section 3.5.2.1.*

LOG IN 5 TB1-5
Hidden / Lockout
Default: S-CURVE SEL 0
Choices *See section 3.5.2.1.*

LOG IN 6 TB1-6
Hidden / Lockout
Default: STEP REF B0
Choices *See section 3.5.2.1.*

LOG IN 7 TB1-7
Hidden / Lockout
Default: STEP REF B1
Choices *See section 3.5.2.1.*

LOG IN 8 TB1-8
Hidden / Lockout
Default: STEP REF B2
Choices *See section 3.5.2.1.*

LOG IN 9 TB1-9
Hidden / Lockout
Default: EXTRN FAULT 1
Choices *See section 3.5.2.1.*

NOTE: The user can assign particular functions to each input terminal. Only one function per terminal is allowed and multiple terminals cannot have the same function. When a function is assigned to an input terminal, it is removed from the list of possible selections for subsequent terminals.

NOTE: When the word ***Hidden*** appears with the parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: When the word ***Lockout*** appears with the parameter description, the parameter cannot be changed when the drive is in the RUN mode.

NOTE: The *current* setting of each parameter is displayed in all caps; all other choices in the list are displayed in lower case.

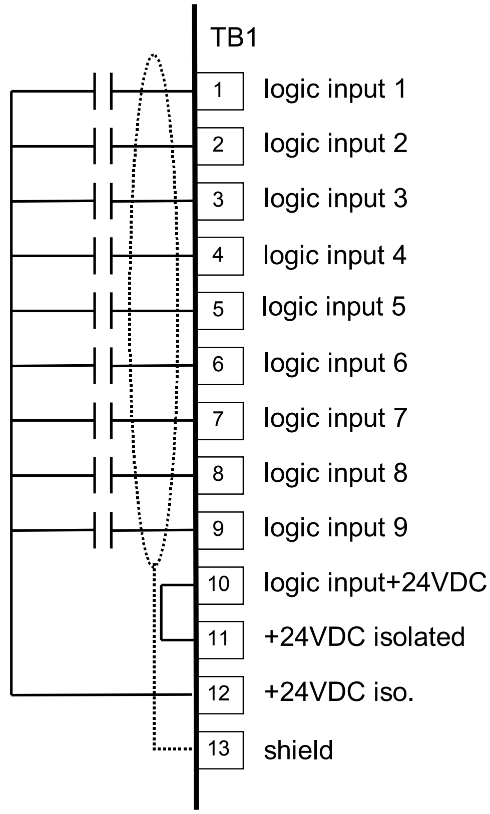


Figure 3. 8 - Logic Input Connections

A summary of all the available input logic functions is shown in Table 3. 13.

Logic Functions	Description
Contact Cfirm	Auxiliary contacts from motor contactor.
Drive Enable	Must be asserted to permit drive to run. This does not initiate run, just permits initiation.
Extrn Fault 1	User input fault #1
Extrn Fault 2	User input fault #2
Extrn Fault 3	User input fault #3
Fault Reset	Asserting this input attempts to reset faults.
Low Gain Sel	Low gain for the speed regulator is chosen when this input is asserted.
Mech Brake Hold	Auxiliary contacts from mechanical brake. Asserted when brake is in hold mode.
Mech Brake Pick	Auxiliary contacts from mechanical brake. Asserted when brake is picked (lifted).
No Function	Input not assigned
Ospd Test Src	Asserting input, applies the overspeed multiplier to the speed command for the next run.
Pre-Trq Latch	Transition from false to true latches pre torque command.
Run	If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation.
Run down	If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with negative speed commands.

Table 3. 13 - Input Logic Functions

Logic Functions	Description
Run up	If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with positive speed commands.
S-Curve Sel 0	Bit 0 of S-curve selection
S-Curve Sel 1	Bit 1 of S-curve selection
Step Ref B0	Bit 0 of multi-step speed command selection
Step Ref B1	Bit 1 of multi-step speed command selection
Step Ref B2	Bit 2 of multi-step speed command selection
Step Ref B3	Bit 3 of multi-step speed command selection
Trq ramp down	Asserting this ramps torque output to zero at “Ramped Stop Time parameter” rate.
Up/Dwn	This logic can be used to change the sign of the speed command. false = no inversion, true = inverted.

Table 3. 13 - Input Logic Functions (continued)

3.5.2.1 Choices for LOGIC INPUTS

The following is a list of the available choices for each of the logic input terminals.

contact cfirm

(Contact Confirm Signal)

Closure of the auxiliary contacts confirming closure of the motor contactor. *For more information, see section (5.2.2).*

drive enable

(Drive Enable)

Enables drive to run. This signal must be asserted to permit drive to run. This does not initiate run, just permits initiation. *For more information, see section (5.2.2).*

.

extrn fault 1 (External Fault 1)
extrn fault 2 (External Fault 2)
extrn fault 3 (External Fault 3)
Closure of this contact will cause the drive to declare a fault and perform a fault shutdown.

fault reset

(Fault Reset)

If the FAULT RESET SRC switch is set to EXTERNAL TB1, the drive’s fault circuit will be reset when this signal is true. If the FAULT RESET SRC switch is set to AUTOMATIC, the drive’s fault circuit will be reset when this signal is true and the automatic fault reset counter (defined by FLT RESETS/HOUR) will be reset to zero.
NOTE: This input is edge sensitive and the fault is reset on the transition from false to true.

low gain sel

(Low Gain Select Signal)

If the HI/LO GAIN SRC switch is set to EXTERNAL TB1, the low gain mode is chosen for the speed regulator when this signal is true.

mech brk hold

(Mechanical Brake Hold Signal)

Auxiliary contact closures confirming when the mechanical brake is in the hold mode (engaged). *For more information, see section (5.2.8).*

mech brk pick

(Mechanical Brake Pick Signal)

Closure of auxiliary contacts confirming the mechanical brake has been picked (lifted). *For more information, see section (5.2.8).*

no function

(No Function)

When this setting is selected for one of the TB1 input terminals, any logic input connected to that terminal will have no effect on drive operation.

ospd test src

(Overspeed Test Source)

This function works only if the OVRSPEED TEST SRC switch is set to EXTERNAL TB1. A true signal on this input applies the OVERSPEED MULT to the speed command for the next run. After the run command has dropped, the drive returns to 'normal' mode and must be re-configured to perform the overspeed function again. The OVERSPEED FLT level is also increased by the OVERSPEED MULT, allowing the elevator to overspeed without tripping out on an overspeed fault.

NOTE: This input must be taken false then true each time that an overspeed test is run. If the input is left in the true, it is ignored after the first overspeed test.

pre-trq latch

(Pre-Torque Latch)

Closing a contact between this input and ground latches the pre torque command present on the analog channel #2. *For more information, see section (5.1.4.7.3).*

run

(Run)

If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation. *For more information, see section (5.2.2).*

run down

(Run Down)

If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with negative speed commands.

Note: if both RUN UP and RUN DOWN are true then the run is not recognized.

Note: if DIR CONFIRM (C1) is enabled, this input will not change the polarity of the speed command and will be used to confirm the polarity of the analog speed command as well as starting the operation of the drive.

run up

(Run Up)

If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with positive speed commands.

Note: if both RUN UP and RUN DOWN are true then the run is not recognized.

Note: if DIR CONFIRM (C1) is enabled, this input is also used to confirm the polarity of the analog speed command as well as starting the operation of the drive.

s-curve sel 0 (S-Curve Select bit-0)
s-curve sel 1 (S-Curve Select bit-1)

These two bits are used to select one of four s-curve selections. *For more information, see section (5.1.3.2).*

step ref b0 (Speed Selection bit-0)
step ref b1 (Speed Selection bit-1)
step ref b2 (Speed Selection bit-2)
step ref b3 (Speed Selection bit-3)

Four inputs, which must be used together as a 4-bit command for multi-step speed selection. *For more information, see section (5.1.1.2.1).*

trq ramp down

(Torque Ramp Down Signal)

This function works only if the RAMP STOP SEL switch is set to RAMP TO STOP and RAMP DOWN EN SRC is set to EXTERNAL TB1. This will enable the torque ramp down stop function. *For more information, see section (5.1.4.9).*

up/dwn

(Up/Down Signal)

This signal is used to change the sign of the speed command. Default is FALSE; therefore, positive commands are for the up direction and negative speed command are for the down direction. Making this input true reverses the car's direction.

3.5.3 LOGIC OUTPUTS C3 Sub-menu

This sub-menu contains the parameters that define the logic outputs on TB1 terminals 14-17 and two relays on TB2 terminals 51-53 & 54-56 (see *Figure 3. 9 and Figure 3. 10).*

LOG OUT 1 TB1-14
Hidden / Lockout
Default: READY TO RUN
Choices: *see section (3.5.3.1)*

LOG OUT 2 TB1-15
Hidden / Lockout
Default: RUN COMMANDED
Choices: *see section (3.5.3.1)*

LOG OUT 3 TB1-16
Hidden / Lockout
Default: MTR OVERLOAD
Choices: *see section (3.5.3.1)*

LOG OUT 4 TB1-17
Hidden / Lockout
Default: ENCODER FLT
Choices: *see section (3.5.3.1)*

RELAY COIL 1
Hidden / Lockout
Default: FAULT
Choices: *see section (3.5.3.1)*

RELAY COIL 2
Hidden / Lockout
Default: SPEED REG RLS
Choices: *see section (3.5.3.1)*

NOTE: When the word ***Hidden*** appears with the parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: When the word ***Lockout*** appears with the parameter description, the parameter cannot be changed when the drive is in the RUN mode.

NOTE: The *current* setting of each parameter is displayed in all caps; all other choices in the list are displayed in lower case.

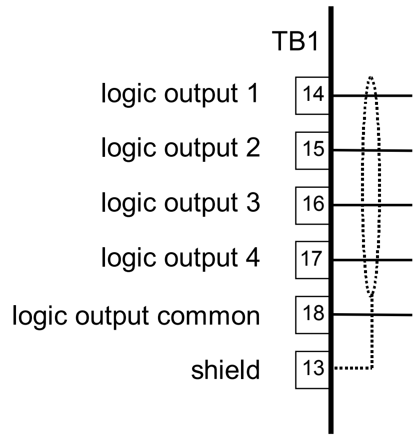


Figure 3. 9 - Logic Output Connections

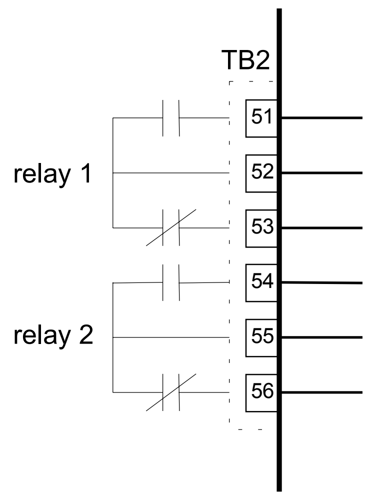


Figure 3. 10 - Relay Output Connections

A summary of what would cause each logic output choice to be true is shown in Table 3. 14.

Output Function	Description
Alarm	An alarm declared by the drive
Alarm+Flt	A fault or alarm is declared by the drive
Brake Alarm	A brake fault is declared while the drive is running
Brake Hold	The brake pick confirmation is received
Brake Pick	Signal used to pick (open) the mechanical brake
Brk Hold Flt	Brake hold state has not matched the commanded state
Brk IGBT Flt	Brake IGBT has reached overcurrent
Brk Pick Flt	Brake pick state has not matched the commanded state
Car Going Dwn	The motor is moving in negative direction faster than user specified speed
Car Going Up	The motor is moving in positive direction faster than user specified speed
Charge Fault	DC bus has not charged
Close Contact	The drive has been enabled & commanded to run and no faults are present
Contactor Flt	Contactor state has not matched the commanded state
Curr Reg Flt	The actual current measurement does not match commanded current
Drv Overload	The drive has exceeded the drive overload curve
Encoder Flt	Encoder is disconnected or not functioning, while attempting to run
Fan Alarm	Cooling fan failure
Fault	A fault declared by the drive
Flux Confirm	The drive's estimate of flux has reached 90% of reference.
Fuse Fault	DC bus fuse is open
Ground Fault	Sum of all phase currents exceeds 50% of rated current
In Low Gain	Low gain or response is now being used by the speed regulator
Motor Trq Lim	The drive has exceeded the motoring torque limit
Mtr Overload	The motor has exceeded the motor overload curve
No Function	Output not assigned
Not Alarm	The output is true when an alarm is NOT present.
Over Curr Flt	Phase current exceeded 300%
Overspeed Flt	The drive has exceeded the overspeed level
Overtemp Flt	Heatsink temperature exceeded 105°C (221°F)
Overvolt Flt	DC bus voltage exceeded 850VDC for 460V drive or 425 VDC for 230V drive
Ovrtemp Alarm	Heatsink temperature exceeded 90°C (194°F)
Phase Fault	Open motor phase
Ramp Down Ena	Indicates the torque is being ramped to zero
Ready To Run	The drive's software has initialized and no faults are present
Regen Trq Lim	The drive has exceeded the regenerating torque limit
Run Commanded	The drive is being commanded to run
Run Confirm	The drive has been enabled & commanded to run; no faults are present; the contactor has closed; and the IGBTs are firing
Speed Dev	The speed feedback is failing to properly track the speed reference
Speed Dev Low	The speed feedback is properly tracking the speed reference
Speed Ref Rls	Flux is confirmed and brake is picked (if used)
Speed Reg Rls	Flux is confirmed and brake is commanded to be picked (if used)
Undervolt Flt	DC bus voltage has dropped below a specified percent
Up To Speed	The motor speed is above a user defined level
UV Alarm	DC bus voltage has dropped below a specified percent
Zero Speed	The motor speed is below a user defined level

Table 3. 14 - Output Logic Functions

3.5.3.1 Choices for LOGIC OUTPUTS

The following is a list of the available choices for each of the logic output terminals.

alarm

(Alarm)

The output is true when an alarm is declared by the drive.

alarm+flt

(Alarm and/or Fault)

The output is true when a fault and/or an alarm is declared by the drive.

brake alarm

(Brake Alarm)

The output is true when the dynamic brake resistor is in an overcurrent condition and the drive is in a run condition.

brake hold

(Brake Hold)

The output is true when the brake pick confirmation is received. It is used to show the mechanical brake is remaining open. This function is used with brakes that need to have less than 100% voltage to hold the brake open. *For more information, see section (5.2.8).*

brake pick

(Brake Pick)

The output is true when the speed regulator is released and is used to open the mechanical brake. *For more information, see section (5.2.8).*

brk hold flt

(Brake Hold Fault)

The output is true when the brake hold command and the brake feedback do not match for the user specified time.

brk IGBT flt

(Brake Fault)

The output is true when the dynamic brake resistor is in a overcurrent condition and the drive is not in a run condition.

brk pick flt

(Brake Pick Fault)

The output is true when the brake pick command and the brake feedback do not match for the user specified time.

car going dwn

(Car Going Down)

The output is true when the motor moves in negative direction faster than the user specified speed. *For more information, see section (3.4.1).*

car going up

(Car Going Up)

The output is true when motor moves in positive direction faster than user specified speed. *For more information, see section (3.4.1).*

charge fault

(Charging Fault)

The output is true when the DC bus voltage has not stabilized above the voltage fault level or the charge contactor has not closed after charging.

close contact

(Close Motor Contactor)

The output is true when the run command is given, the drive is enabled, the software has initialized, and no faults are present. *For more information, see section (5.2.6).*

contactor flt

(Contactor Fault)

The output is true when the command to close the contactor and the contactor feedback do not match before the user specified time.

curr reg flt

(Current Regulator Fault)

The output is true when the actual current measurement does not match commanded current.

drv overload

(Drive Overload)

The output is true when the drive has exceeded the drive overload curve. *For more information, see section (5.3.1).*

encoder flt

(Encoder Fault)

The output is true when the drive is in a run condition and the encoder is:

- not functioning
  or
- not connected.

fan alarm

(Fan Alarm)

The output is true when the fan on the drive is not functioning.

fault

(Fault)

The output is true when a fault is declared by the drive.

flux confirm

(Motor Flux Confirmation)

The output is true when the drive has confirmed there is enough flux to issue a speed regulator release (the drive's estimate of flux must reach 90% of reference).

fuse fault

(Fuse Fault)

The output is true when the DC bus fuse on has blown.

ground fault

(Ground Fault)

The output is true when the sum of all phase current exceeds 50% of rated current of the drive.

in low gain

(In Low Gain)

The output is true when the speed regulator is in "low gain" mode. *For more information, see section (5.1.4.1).*

motor trq lim

(Motor Torque Limit)

The output is true when the torque limit has been reached while the drive is in the motoring mode. The motoring mode is defined as the drive delivering energy to the motor. *For more information, see section (3.4.1).*

mtr overload

(Motor Overload)

The output is true when the motor has exceeded the user defined motor overload curve. *For more information, see section (0).*

no function

(No Function)

This setting indicates that the terminal or relay will not change state for any operating condition; i.e. the output signal will be constantly false.

not alarm

(Not Alarm)

The output is true when an alarm is NOT present.

over curr flt

(Motor overload current fault)

The output is true when the phase current has exceeded 300% of rated current.

overspeed flt

(Overspeed Fault)

The output is true when the motor has gone beyond the user defined percentage contract speed for a specified amount of time.

overtemp flt

(Heatsink Over Temperature Fault)

The output is true when the drive's heatsink has exceeded 105°C (221°F).

overvolt flt

(Over Voltage Fault)

The output is true when the DC bus voltage exceeds 850VDC for a 460V class drive or 425VDC for a 230V class drive.

ovrtemp alarm

(Drive Over Temperature Alarm)

The output is true when the drive's heatsink temperature has exceeded 90°C (194°F).

phase fault

(Phase Loss)

The output is true when the drive senses an open motor phase.

ramp down ena

(Ramp Down Enable)

The output is true after a torque ramp down stop has been initiated by either a logic input, the serial channel, or internally by the drive. When this output is true the torque is being ramped to zero. *For more information, see section (5.1.4.9).*

ready to run

(Ready to Run)

The output is true when the drive's software has been initialized and no faults are present. *For more information, see section (5.2.2).*

regen trq lim

(Regeneration Torque Limit)

The output is true when the torque limit has been reached while the drive is in the regenerative mode. The regenerative mode is defined as when the motor is returning energy to the drive. When the drive is in regenerative mode, the energy is dissipated via the dynamic brake circuitry (internal brake IGBT and external brake resistor). *For more information, see section (3.4.1).*

run commanded

(Run Commanded)

The output is true when the drive is being commanded to run. *For more information, see section (5.2.2).*

run confirm

(Run Command Confirm)

The output is true after the software has initialized, no faults are present, the drive has been commanded to run, the contactor has closed and the IGBTs are firing.

speed dev

(Speed Deviation)

The output is true when the speed feedback is failing to properly track the speed reference. The speed deviation needs to be above a user defined level.
(Speed Dev. = reference - feedback)
For more information, see section (5.1.4.10).

speed dev low

(Speed Deviation Low Level)

The output is true when the speed feedback is properly tracking the speed reference. The speed deviation needs to be within a user defined range for a user defined period of time.
(Speed Dev. = reference - feedback)
For more information, see section (5.1.4.10).

speed ref rls

(Speed Reference Release)

The output is true when the speed regulator is released. When this output is true, the speed reference is allowed to change from zero. *For more information, see section (5.2.2).*

speed reg rls

(Speed Regulator Release)

The output is true when the speed regulator is released. *For more information, see section (5.2.2).*

up to speed

(Up to Speed)

The output is true when the motor speed is above the user specified speed. *For more information, see section (3.4.1).*

undervolt flt

(Low Voltage Fault)

The output is true when the DC bus voltage drops below the user specified percent of the input line-to-line voltage. *For more information, see section (3.4.4).*

uv alarm

(Low Voltage Alarm)

The output is true when the DC bus voltage drops below the user specified percent of the input line-to-line voltage. *For more information, see section (3.4.4).*

zero speed

(Zero Speed)

The output is true when the motor speed is below the user specified speed for the user specified time. *For more information, see section (3.4.1).*

3.5.4 ANALOG OUTPUTS C4 Sub-menu

This sub-menu contains the parameters that define the two D/A analog outputs on TB1 terminals 33 and 35. *See Figure 3. 11.*

ANA OUT 1 TB1-33
Hidden

Default:	TORQUE REF
Choices:	see section (3.5.4.1).

ANA OUT 2 TB1-35
Hidden

Default:	SPEED FEEDBK
Choices:	see section (3.5.4.1).

A summary of the analog output functions is shown in Table 3. 15.

NOTE: When the word ***Hidden*** appears with the parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: The *current* setting of each parameter is displayed in all caps; all other choices in the list are displayed in lower case.

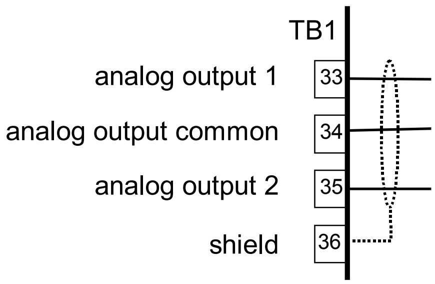


Figure 3. 11 - Analog Output Connections

3.5.4.1 Choices for ANALOG OUTPUTS

The following is a list of the available choices for each of the analog output terminals.

aux torq cmd
(Auxiliary Torque Command)
Additional torque command from auxiliary source.
D/A Units: % rated torque

bus voltage
(DC Bus Voltage Output)
Measured DC bus voltage.
D/A Units: % of peak in

current out
(Current Output)
Percent motor current.
D/A Units: % rated current

Output Function	Description
Aux Torq Cmd	Additional torque command from auxiliary source
Bus Voltage	Measured DC bus voltage
Current Out	Percent motor current
Drv Overload	Percent of drive overload trip level reached
Flux Current	Measured flux producing current
Flux Output	Measured flux output
Flux Ref	Flux reference used by vector control
Flux Voltage	Flux producing voltage
Frequency Out	Electrical frequency
Mtr Overload	Percent of motor overload trip level reached
Power Output	Calculated power output
PreTorque Ref	Pre-torque reference
Slip Freq	Commanded slip frequency
Spd Rg Tq Cmd	Torque command from speed regulator
Speed Command	Speed command before S-Curve
Speed Error	Speed reference minus speed feedback
Speed Feedbk	Speed feedback used by speed regulator
Speed Ref	Speed reference after S-Curve
Tach Rate Cmd	Torque command from tach rate gain function
Torq Current	Measured torque producing current
Torq Voltage	Torque producing voltage
Torque Output	Calculated torque output
Torque Ref	Torque reference used by vector control
Voltage Out	RMS motor terminal voltage

Table 3. 15 - Analog Output Functions

drv overload
(Drive Overload)
Percent of drive overload trip level reached.
D/A Units: % of trip point

flux current
(Flux Producing Current)
Measured flux producing current.
D/A Units: % rated current

flux output
(Flux Output)
Measured flux output.
D/A Units: % rated flux

flux ref
(Flux Reference)
Flux reference used by vector control.
D/A Units: % rated flux

flux voltage
(Flux Producing Voltage)
Flux producing voltage reference.
D/A Units: % rated volts

frequency out
(Frequency Output)
Electrical frequency.
D/A Units: % rated freq

mtr overload
(Motor Overload)
Percent of motor overload trip level reached.
D/A Units: % of trip point

power output
(Power Output)
Calculated power output.
D/A Units: % rated power

pretorque ref
(PreTorque Reference)
Pre-torque reference.
D/A Units: % base torque

slip freq
(Motor Slip Frequency)
Commanded slip frequency.
D/A Units: % rated freq

spd rg tq cmd
(Speed Regulator Torque Command)
Torque command from speed regulator.
D/A Units: % base torque

speed command
(Speed Command)
Speed command before S-Curve
D/A Units: % rated speed

speed error
(Speed Error)
Speed reference minus speed feedback.
D/A Units: % rated speed

speed feedbk
(Speed Feedback)
Speed feedback used by speed regulator.
D/A Units: % rated speed

speed ref
(Speed Reference)
Speed reference after S-Curve
D/A Units: % rated speed

tach rate cmd
(Tachometer Rate Command)
Torque command from tach rate gain function.
D/A Units: % base torque

torq current
(Torque Producing Current)
Measured torque producing current.
D/A Units: % rated current

torq voltage
(Torque Producing Voltage)
Torque producing voltage reference.
D/A Units: % rated volts

torque output
(Torque Output)
Calculated torque output.
D/A Units: % rated torque

torque ref
(Torque Reference)
Torque reference used by vector control.
D/A Units: % base torque

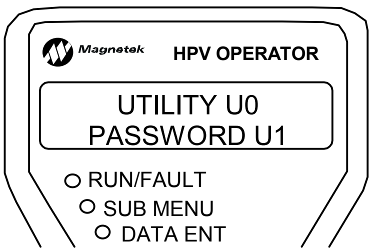
voltage out
(Voltage Output)
RMS motor terminal voltage.
D/A Units: % rated volts

3.6 UTILITY U0 MENU

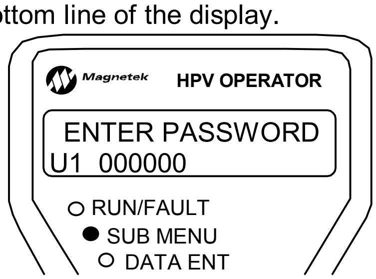
This menu has five sub-menus:

- **PASSWORD U1** **3.6.1**
- **HIDDEN ITEMS U2** **3.6.2**
- **UNITS U3** **3.6.3**
- **OVRSPEED TEST U4** **3.6.4**
- **RESTORE DFLTS U5** **3.6.5**
- **DRIVE INFO U6** **3.6.6**
- **HEX MONITOR U7** **3.6.7**

The sub-menu is identified by its full name on the bottom line of the Digital Operator display when the SUB MENU LED is *not* lit.



When the SUB MENU LED is ON, the two letter code for the sub-menu appears at the far left of the bottom line of the display.



NOTE: When the word ***Hidden*** appears with the parameter description, it indicates that its appearance in the list is controlled by the HIDDEN ITEMS setting. *See details in section (3.6.2).*

NOTE: When the word ***Lockout*** appears with the parameter description, the parameter cannot be changed when the drive is in the RUN mode.

3.6.1 PASSWORD U1 Sub-menu

The following three different screens are used by the password function:

- ENTER PASSWORD
- NEW PASSWORD
- PASSWORD LOCKOUT

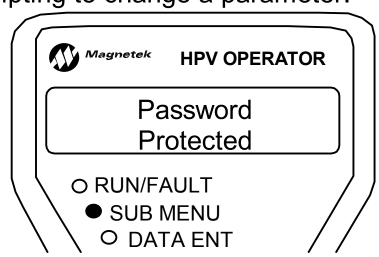
3.6.1.1 Password Function

The password function allows the user to select a six-digit number for a password. The password function allows the user to lockout changes to the parameters until a valid password is entered.

And with the password lockout enabled, all parameters and display values will be able to be viewed but, no changes to the parameters will be allowed until a correct password is entered.

3.6.1.2 Parameter Protection

If the password lockout is enabled, the following message will appear on the display when attempting to change a parameter.



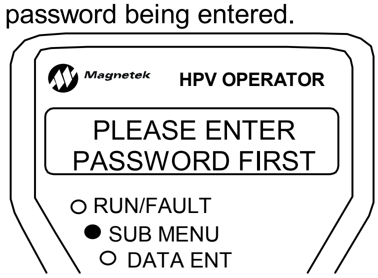
In order to change a parameter after password lockout has been enabled, the following two steps must be followed in the PASSWORD sub-menu:

1) A valid password must be entered in the ENTER PASSWORD screen.
2) The password lockout must be DISABLED in the PASSWORD LOCKOUT screen.

3.6.1.3 PASSWORD Sub-menu Protection

The following message will appear when in the PASSWORD sub-menu, if you are trying to:

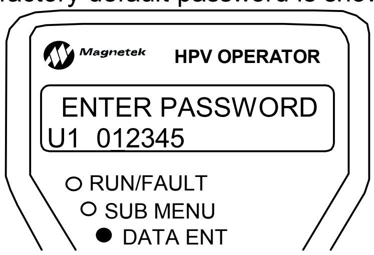
- Enable or disable the password lockout without a valid password being entered.
- Enter a new password without a valid password being entered.



3.6.1.4 ENTER PASSWORD Screen

This screen allows the user to enter in a password. A valid password must be entered before enabling or disabling the password lockout or changing to a new password.

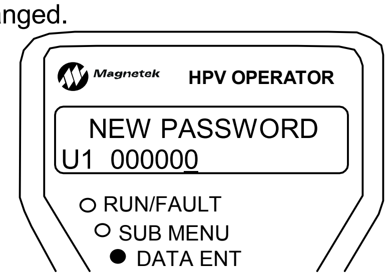
The factory default password is shown below.



3.6.1.5 NEW PASSWORD Screen

This screen is used to change the established password.

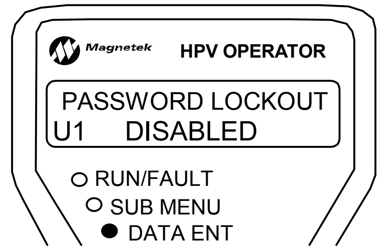
NOTE: Remember that a valid password must be entered at the ENTER PASSWORD screen before the established password can be changed.



3.6.1.6 PASSWORD LOCKOUT Screen

This screen is used to enable and disable password lockout. The factory default for password lockout is DISABLED.

NOTE: Remember that a valid password must be entered at the ENTER PASSWORD screen before the password lockout condition can be changed.

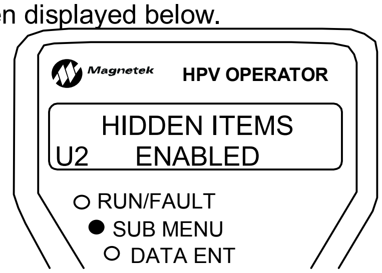


3.6.2 HIDDEN ITEMS U2 Sub-menu

The HIDDEN ITEMS sub-menu allows the user to select whether or not “hidden” parameters will be displayed on the Digital Operator.

There are two types of parameters, standard and hidden. Standard parameters are available at all times. Hidden parameters are available only if activated.

The default for this function is ENABLED (meaning the hidden parameters are visible). To disable the HIDDEN ITEMS option, go to this screen displayed below.



All parameters in the HPV 900 that are designated as “hidden” have the word ***Hidden*** included before their function description throughout this manual. Also, a comparison table listing the hidden and standard parameters is shown in Figure 3. 3 and Figure 3. 4.

Legend	Default	Hidden	Lockout
HIDDEN ITEMS	ENABLED	N	N

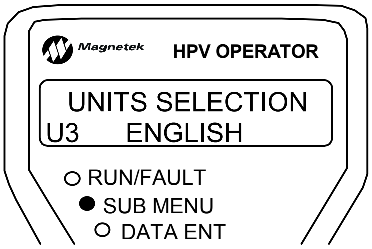
Table 3. 16 - Hidden Items Function

Legend	Type	Max/Min	Default	Hidden	Lockout
ENTER PASSWORD	Numeric	999999/0	012345	N	N
NEW PASSWORD	Numeric	999999/0	none	N	N
PASSWORD ENABLE	LOGIC	NA	DISABLED	N	N

Table 3. 17 - Password Function

3.6.3 UNITS U3 Sub-menu

When the UNITS SELECTION sub-menu is displayed, the user can choose either Metric units or standard English measurements units for use by the drive's parameters.



IMPORTANT

The units selection must be made before entering any setting values into the parameters. The user can not toggle between units after drive has been programmed.

Legend	Default	Hidden	Lockout
UNITS	ENGLISH	N	Y

Table 3. 18 - Units Function

3.6.4 OVERSPEED TEST U4 Sub-menu

The speed command is normally limited by Overspeed Level parameter (OVERSPEED LEVEL), which is set as a percentage of the contract speed (100% to 150%). But in order to allow overspeed tests during elevator inspections, a means is provided to multiply the speed command by the Overspeed Multiplier parameter (OVERSPEED MULT). *For more information, see section (3.4.1).*

An overspeed test can be initiated by:
- an external logic input
- the serial channel
- directly from the digital operator.

3.6.4.1 Overspeed Test via Logic Input

The external logic input can be used by:
- Setting the Overspeed Test Source parameter to external tb1, *see section (3.5.1).*
- Defining an logic input terminal to ospd test src, *see section (3.5.2).*

NOTE: This logic input requires a transition from false to true to be recognized - this prevents the overspeed function from being permanently enabled if left in the true state.

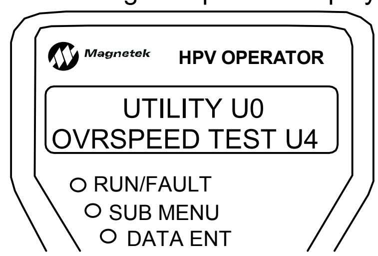
3.6.4.2 Overspeed Test via Serial Channel

The serial channel can be used by setting Overspeed Test Source parameter to serial, *see section (3.5.1).*

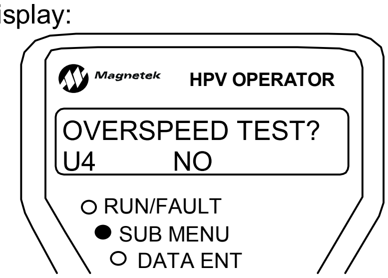
3.6.4.3 Overspeed Test via Operator

The Digital Operator can also initiate the overspeed test by performing the following:

- While the Digital Operator display shows

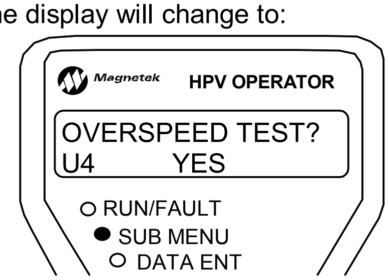


Press the ENTER key. The sub-menu LED will turn on, and the Digital Operator will display:



- Press the ENTER key again. The sun menu LED will go out and data ent LED will turn on.

- Press the up arrow or down arrow key and the display will change to:



- Press the ENTER key to begin the overspeed test.

The value in the Overspeed Mult parameter is applied to the speed reference and the overspeed level, so that the elevator can be operated at greater than contract speed and not trip on an Overspeed Fault.
When the Run command is remove after the overspeed test, overspeed test reverts back to its default of NO. In order to run another overspeed test via the Digital Operator, the above steps must be repeated again.

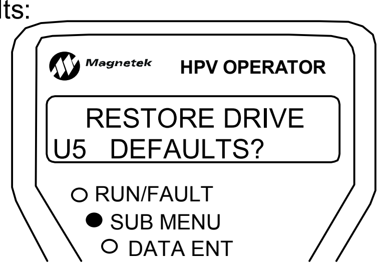
3.6.5 RESTORE DFLTS U5 Sub-menu

Two different functions are included in this sub-menu.

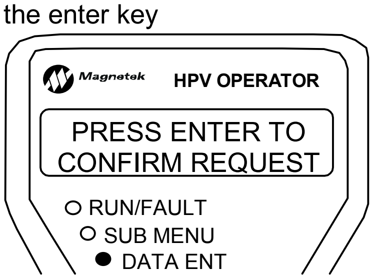
3.6.5.1 RESTORE DRIVE DEFAULTS

This function resets all parameters to there default values except the parameters in the MOTOR A5 sub-menu.

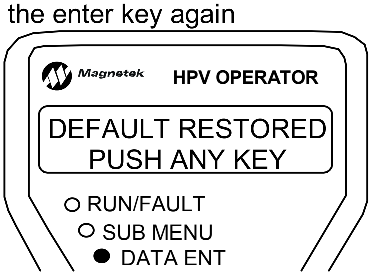
The following shows how to restore the drive defaults:



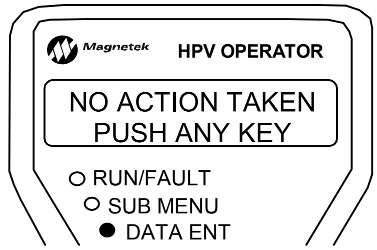
Press the enter key



Press the enter key again

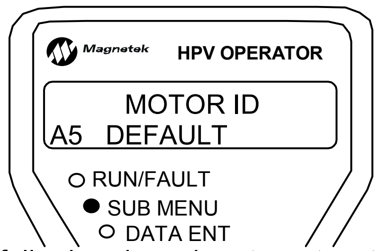


If the esc key is pressed, instead the reset action will be aborted

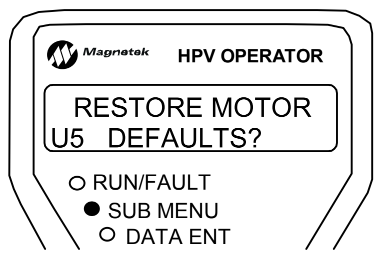


3.6.5.2 RESTORE MOTOR DEFAULTS

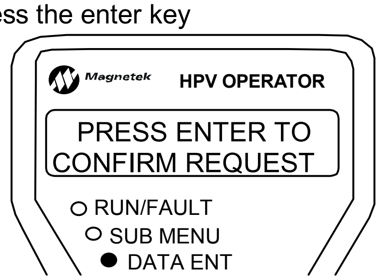
This function resets the parameters in the MOTOR A5 sub-menu to the defaults defined by the MOTOR ID parameter in that sub-menu.



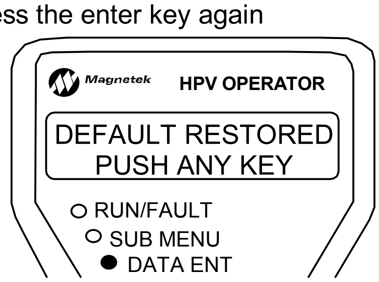
The following shows how to restore the motor defaults for the defined motor ID:



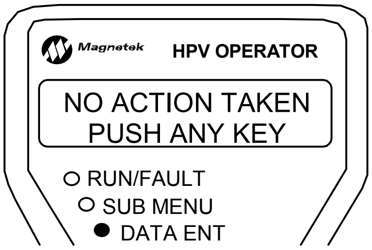
Press the enter key



Press the enter key again



If the esc key is pressed, instead the reset action will be aborted

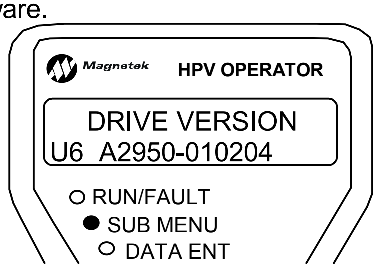


3.6.6 DRIVE INFO U6 Sub-menu

Three different screens are included in this sub-menu, each display an identification number.

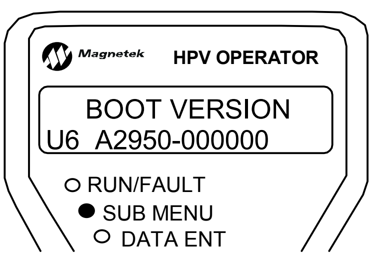
3.6.6.1 DRIVE VERSION Screen

Shows the software version of the drive software.



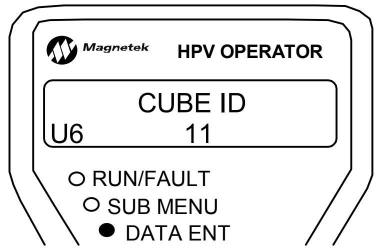
3.6.6.2 BOOT VERSION Screen

Shows the lower level software version of the drive.



3.6.6.3 CUBE ID Screen

Displays the cube identification number of the drive. See Table 3. 19



volts	hp	kw	model	cube size	ID#
460V	5	3.7	-4008	A	5
	10	7.5	-4016	A	7
	15	11	-4021	A	8
	20	15	-4027	B	9
	25	18	-4034	B	10
	30	22	-4041	B	11
	40	30	-4052	B	12
	50	37	-4065	C	13
	60	45	-4077	C	14
	75	55	-4096	C	15
230V	7.5	5.5	-2025	A	31
	10	7.5	-2027	B	32
	15	11	-2041	B	34
	20	15	-2052	B	35
	25	18	-2068	C	36
	30	22	-2080	C	37
	40	30	-2104	C	38
	25	18	-2075	B+	39
	30	22	-2088	B+	40

Table 3. 19 - Cube ID Numbers

3.6.7 HEX MONITOR U7 Sub-menu

The hex monitor was designed for fault and parameter diagnostics. It is intended for use by Magnetek personnel.

3.7 FAULTS F0 MENU

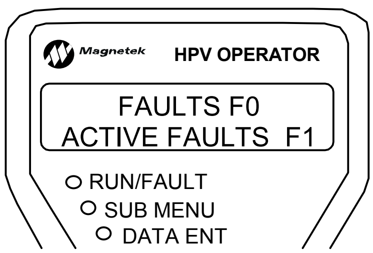
The FAULTS F0 menu does not access settable parameters; instead, it provides a means of examining the drive's active faults and the fault history.

This menu also allows for clearing of active faults in order to get the drive ready to return to operation after a fault shutdown.

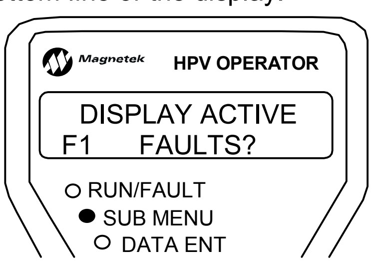
This menu is divided into two sub-menus:

- **ACTIVE FAULTS F1 3.7.2**
- **FAULT HISTORY F2 3.7.3**

The sub-menu is identified by its full name on the bottom line of the Digital Operator display when the SUB MENU LED is *not* lit.



When the SUB MENU LED is ON, the two letter code for the sub-menu appears at the far left of the bottom line of the display.



3.7.1 Faults and Alarms

Two classes of warnings are reported by the HPV 900; these are identified as Faults and Alarms.

3.7.1.1 Faults and Fault Annunciation

A fault a severe failure that will stop a drive if it has been running and prevent the drive from starting as long as it is present. All faults require some type of action by the user to clear.

There are five means of fault annunciation.

- The Fault LED on the front panel of the HPV 900 will illuminate.

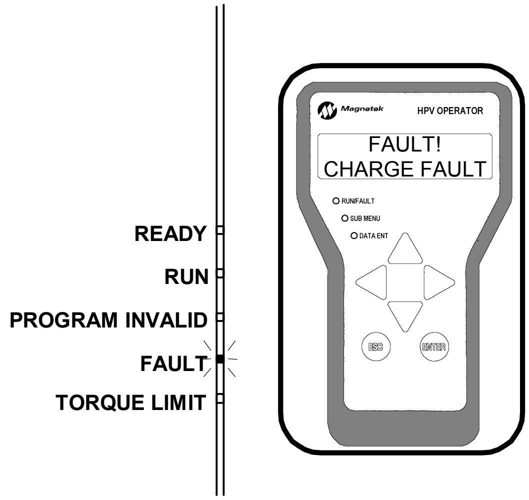
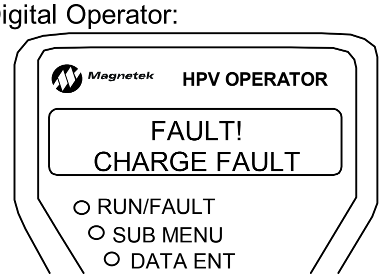


Figure 3. 12 - Fault LED

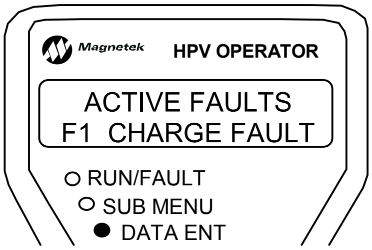
- A priority message will be seen on the Digital Operator:



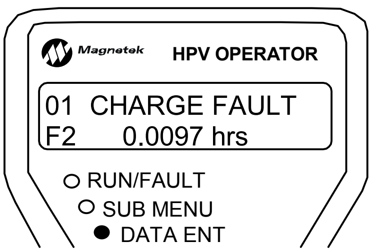
A priority message will overwrite what ever is currently displayed. The user can clear this message by pressing any key on the Digital Operator keypad. If another fault is present, the next fault will appear as a priority message.

NOTE: Clearing the fault priority message from the display DOES NOT clear the fault from the active fault list. The faults must be cleared by a fault reset before the drive will run.

- The fault will be placed on the active fault list. The active fault list will display and record currently active faults. The faults will remain on the fault list until an active fault reset is initiated.



- The fault will be placed on the fault history. The fault history displays the last 16 faults and a time stamp indicating when each happened. The fault history IS NOT affected by an active fault reset or a power loss. The fault history can be cleared via a user initiated function.



- The user can assign a fault to an external logic output. *(see section (3.5.3))*

3.7.1.2 Fault Clearing

Most faults can be cleared by performing a fault reset. The fault reset can be initiated by:

- an external logic input
- the serial channel
- automatically by the drive

For more information, see section (3.5.1).

CAUTION

If the run signal is asserted at the time of a fault reset, the drive will immediately go into a run state.

CAUTION

If the run signal is asserted at the time of a fault reset, the drive will immediately go into a run state. Unless using the auto-fault reset function (FAULT RESET SRC=automatic, *see section (3.5.1))* then the run command needs to be cycled.

A fault reset can also be done via the Digital Operator, *see section (3.7.2.2)*

3.7.1.3 Fault Displays

A summary of the HPV 900 faults is shown in Table 3. 20.

Fault Name	Description	Fault Clear	Logic Out?
AtoD Fault	AtoD on control board is not responding	power on reset	No
Bridge Fault	An overcurrent or overtemperature condition	fault reset	No
Brk Hold Flt	Brake hold state has not matched the commanded state	fault reset	Yes
Brk IGBT Flt	Brake IGBT has reached overcurrent.	fault reset	Yes
Brk Pick Flt	Brake pick state has not matched the commanded state	fault reset	Yes
Charge Fault	DC bus has not charged.	fault reset	Yes
Contactor Flt	Contactor state has not matched the commanded state	fault reset	Yes
Cube data Flt	Cube parameters checksum is invalid	power on reset	No
Cube ID Fault	Cube identification is bad	fault reset	No
Curr Reg Flt	Current regulator fault.	fault reset	Yes
DCU data Flt	DCU parameters checksum is invalid	power on reset	No
Drive Ovrload	The drive has exceeded the drive overload curve	fault reset	Yes
Encoder Flt	Encoder is disconnected or not functioning, while attempting to run	fault reset	Yes
Extrn Fault 1	User defined external logic fault input #1	fault reset	No
Extrn Fault 2	User defined external logic fault input #2	fault reset	No
Extrn Fault 3	User defined external logic fault input #3	fault reset	No
Fuse Fault	DC bus fuse is open	fault reset	Yes
Ground Fault	Sum of all phase currents exceeds 50% of rated current	fault reset	Yes

Table 3. 20 - Faults

Fault Name	Description	Fault Clear	Logic Out?
Motor ID Flt	Motor identification is bad	fault reset	No
Mtr data Flt	Motor parameters checksum is invalid	power on reset	No
Over Curr Flt	Phase current exceeded 300%	fault reset	Yes
Overspeed Flt	The drive has exceeded the overspeed level	fault reset	Yes
Overtemp Flt	Heatsink temperature exceeded 105°C (221°F)	fault reset	Yes
Overvolt Flt	DC bus voltage exceeded: 850VDC for 460V drive or 425 VDC for 230V drive	fault reset	Yes
PCU data Flt	PCU parameters checksum is invalid	power on reset	No
Phase Flt	Open motor phase	fault reset	Yes
Setup Fault 1	The rated motor speed and excitation frequency, must satisfy formula	fault reset	No
Setup Fault 2	Number of poles and encoder pulses, must satisfy formula	fault reset	No
Setup Fault 3	Number of motor poles must be even	fault reset	No
Setup Fault 4	Contract motor speed and encoder pulses, must satisfy formula	fault reset	No
Setup Fault 5	Rated motor power and voltage, must satisfy formula	fault reset	No
Setup Fault 6	Multi-step speed references have exceeded a defined limit	fault reset	No
Setup Fault 7	Run logic inputs are defined incorrectly	fault reset	No
Setup Fault 8	Confirms proper set-up of Analog Speed Command direction confirm function	fault reset	No
Undervolt Flt	DC bus voltage has dropped below a specified percent	fault reset	Yes

Table 3. 20 - Faults (continued)

3.7.1.4 Fault Descriptions

The following is a list of the HPV 900 faults, with a description of what each fault indicates.

AtoD FAULT

(Analog to Digital Fault)

The Analog to Digital conversion on the drive's control board is not working properly.

BRIDGE FAULT

(Bridge Fault)

The integrated power module is sensing an overcurrent or overtemperature condition *(only A-cubes)*

BRK HOLD FLT

(Brake Hold Fault)

The brake hold command and the brake feedback did not match for the time specified by the Brake Hold Time parameter, *see section (3.4.1)*. This fault can be disabled by Brake Hold Fault Enable parameter, *see section (3.5.1).*

BRK IGBT FLT

(Brake Transistor IGBT Fault)

Dynamic brake resistor overcurrent. This fault is latched by the software, but does not declare a fault until after the run command is dropped. This is done in order for the elevator to safely reach a floor and unload the passengers before a fault is declared.

BRK PICK FLT

(Brake Pick Fault)

The brake pick command and the brake feedback did not match for the time specified with Brake Pick Time parameter, *see section (3.4.1)*. This fault can be disabled by Brake Pick Fault Enable parameter, *see section (3.5.1).*

CHARGE FLT

(Charge Fault)

The DC bus voltage has not stabilized above the voltage fault level within 2 seconds or the charge contactor has not closed after charging.

CONTACTOR FLT

(Contactor Fault)

The command to close the contactor and the contactor feedback do not match before the time specified by the Contact Flt Time parameter, *see section (3.4.1)*. This fault can be disabled by Contactor Confirm Source parameter to none, *see section (3.5.1).*

CUBE DATA FLT

(Cube Data Fault)

The cube (drive) parameters checksum is invalid.

CUBE ID FLT

(Drive Identification Fault)

The identification for the drive is bad. This will normally happen only at the initial power up of the drive.

CURR REG FLT

(Current Regulator Fault)

Actual current measurement does not match commanded current.

DCU DATA FLT

(Drive Control Unit Data Fault)

The DCU parameters checksum is invalid.

DRV OVRLOAD

(Drive Current Overload)

The drive has exceeded the drive overload curve. Once the DRIVE OVERLOAD display value, *see section (3.5.1)* reaches 100%, the drive has exceeded its overload curve and a drive overload fault is declared by the drive. *For more information, see section (5.3.1).*

ENCODER FLT

(Encoder Fault)

The drive is in a run condition and the encoder is:

- not functioning
  or
- not connected.

EXTRN FAULT 1

(External Fault #1)

User defined external logic fault input #1, *see section (3.5.2.1).*

EXTRN FAULT 2

(External Fault #2)

User defined external logic fault input #2. *(see section 3.5.2.1)*

EXTRN FAULT 3

(External Fault #3)

User defined external logic fault input #3, *see section (3.5.2.1)*

FUSE FAULT

(Fuse Fault)

The DC bus fuse on the drive is open.

GROUND FLT

(Ground Fault)

The sum of all phase current exceeds 50% of rated current of the drive.

MOTOR ID FLT

(Motor Identification Fault)

The identification for the motor is bad. This will normally happen only at the initial power up of the drive.

MTR DATA FLT

(Motor Data Fault)

Motor Parameters checksum is invalid.

OVERCURR FLT

(Overcurrent Fault)

The phase current exceeded 300% of rated current.

OVERSPEED FLT

(Overspeed Fault)

Generated when the motor has gone beyond the user defined percentage contract speed for a specified amount of time. This is defined by Overspeed Level parameter and Overspeed Time parameter, *see section (3.4.1)*.

OVERTEMP FLT

(Drive Over Temperature Fault)

The heatsink on the drive has exceeded 105°C (221°F).

OVERVOLT FLT

(Over Voltage Fault)

The DC bus voltage of the drive exceeded:

- 850 Volts for a 460V class drive
- 425 Volts for a 230V class drive.

PCU DATA FLT

(Power Conversion Unit Data Fault)

The PCU parameters checksum is invalid.

PHASE FLT

(Motor Phase Fault)

The drive senses an open motor phase.

SETUP FLT #1

(Setup Fault #1)

This fault is declared if the rated motor speed and excitation frequency do not satisfy:

$$9.6 < \left[120\begin{pmatrix}rated\\excitation\\frequency\end{pmatrix}\right]-\left[\begin{pmatrix}\#\\poles\end{pmatrix}\begin{pmatrix}rated\\motor\\speed\end{pmatrix}\right] < 1222.3$$

SETUP FLT #2

(Setup Fault #2)

This fault is declared if the number of poles and encoder pulses per revolution do not satisfy:

$$\frac{\begin{pmatrix}encoder\\pulses\end{pmatrix}}{\begin{pmatrix}\#\\poles\end{pmatrix}} > 64$$

SETUP FLT #3

(Setup Fault #3)

This fault is declared if the number of poles is not an even number.

SETUP FLT #4

(Setup Fault #4)

This fault is declared if the contract motor speed (in rpm) and encoder pulses/revolution do not satisfy:

$$300{,}000 \langle \begin{pmatrix}contract\\motor\\speed\end{pmatrix}\begin{pmatrix}encoder\\pulses\end{pmatrix} \langle 18{,}000{,}000$$

SETUP FLT #5

(Setup Fault #5)

This fault is declared if the rated motor power (in watts) and rated motor voltage do not satisfy:

$$(0.07184)\left[\frac{\begin{pmatrix}rated\\motor\\power\end{pmatrix}}{\begin{pmatrix}rated\\motor\\voltage\end{pmatrix}}\right] \langle \begin{matrix}general\\purpose\\current\\rating\\of\\drive\end{matrix}$$

SETUP FLT #6

(Setup Fault #6)

This fault is declared if the multi-step speed references have exceeded a defined limit, which is defined in terms of a percentage of contract speed (CONTRACT CAR SPD parameter).

Name	Setup Fault #6 Limit (as a % of contract speed)
Speed Command 1	> 110%
Speed Command 2	> 110%
Speed Command 3	> 110%
Speed Command 4	> 110%
Speed Command 5	> 110%
Speed Command 6	> 110%
Speed Command 7	> 110%
Speed Command 8	> 110%
Speed Command 9	> 110%
Speed Command 10	> 110%
Speed Command 11	> 110%
Speed Command 12	> 110%
Speed Command 13	> 110%
Speed Command 14	> 110%
Speed Command 15	> 110%

SETUP FLT #7

(Setup Fault #7)

This fault is declared if the run logic inputs are defined incorrectly. You can either choose group #1 (RUN and UP/DWN) or group #2 (RUN UP and RUN DOWN). But you cannot mix and match or this fault will be declared.

SETUP FLT #8

(Setup Fault #8)

This fault is declared if the DIR CONFIRM (C1) parameter is enabled and any of the following conditions are not met:

- A logic input (C2) must be assigned to RUN UP.
- A logic input (C2) must be assigned to RUN DOWN.
- The SPD COMMAND SRC (C1) parameter must be set to ANALOG INPUT

UNDERVOLT FLT

(Low Voltage Fault)

Generated during a run condition when the DC bus voltage drops below the user specified percent of the input line-to-line voltage. The input line-to-line voltage is specified by the Input L-L Volts parameter and the fault level is specified by the Undervoltage Fault Level parameter. *For more information, see section (3.4.4).*

3.7.1.5 Alarm Annunciation

An alarm is only meant for annunciation. It will not stop the operation of the drive or prevent the drive from operating.

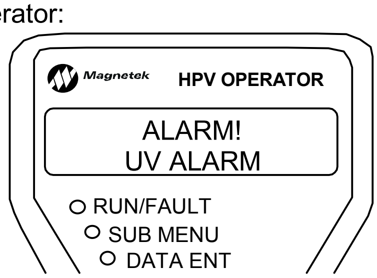
When the alarm annunciation is cleared, the alarm is no longer displayed and is not stored.

Since an alarm does not stop the operation of the drive, the HPV 900 has some control as to how frequently an alarm will be displayed. For example, after an alarm has been cleared once while the drive is operating, it will not be displayed again until after another run command is given to the drive.

Alarms will not keep the drive from running but an alarm condition can signify the start of a fault condition.

There are two means of alarm annunciation.

- A priority message will be sent to Digital Operator:



  A priority message will replace whatever is currently being displayed on the screen. The user can clear the alarm notice by touching any key on the Digital Operator keypad. If another alarm exists after the original alarm is cleared, it will appear as another priority message.

- The alarms can be assigned to an external logic output, *see section (3.5.3)*

3.7.1.6 Alarm Displays

A summary of the HPV 900's alarms is shown in Table 3. 21.

3.7.1.7 Alarm Descriptions

BRAKE ALARM

(Brake Alarm)

Dynamic brake resistor overcurrent . This is initially treated as an alarm so the elevator can safely reach a floor and unload the passengers before the alarm becomes a fault. After the run command has been dropped, this alarm becomes a Brake IGBT fault.

DIR CONFLICT

(Direction Conflict)

Declared when the speed command is held at zero due conflict with the analog speed command polarity and the run up / run down logic.
NOTE: DIR CONFIRM (C1) must be enabled

FAN ALARM

(Fan Alarm)

The heatsink cooling fan on the drive is not functioning. Check wiring or fan for malfunctions.

ALARM NAME	DESCRIPTION
Brake Alarm	A brake fault is declared while the drive is running
Dir Conflict	Declared when the speed command is held at zero due conflict with the analog speed command polarity and the run up / run down logic
Fan Alarm	Cooling fan failure
Mtr Overload	The motor has exceeded the motor overload curve
Ovrtemp Alarm	Heatsink temperature exceeded 90°C (194°F)
Speed Dev	The speed feedback is failing to properly track the speed reference
UV Alarm	DC bus voltage has dropped below a specified percent

Table 3. 21 - Alarms

MTR OVERLOAD

(Motor Overload)

The motor had exceeded the user defined motor overload curve. Once the MOTOR OVERLOAD display value *(see section 3.3.2)* reaches 100% the motor has exceeded its defined overload curve and a motor overload alarm is declared by the drive. *For more information, see section (0).*

NOTE: The motor overload can not exceed the drive overload capability, otherwise a drive overload fault will occur.

OVRTEMP ALARM

(Drive Over Temperature Alarm)

The heatsink on the drive has exceeded 90°C (194°F).

SPEED DEV

(Speed Deviation)

An alarm is declared when the speed feedback is failing to properly track the speed reference. The speed deviation needs to be above a user defined level specified by the Speed Deviation High Level parameter, *see section (3.4.1).* (Speed Dev. = reference - feedback)
For more information, see section (5.1.4.10).

UV ALARM

(Under Voltage Alarm)

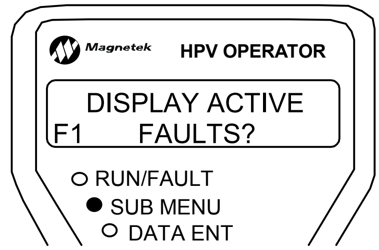
Generated during a run condition when the DC bus voltage drops below the user specified percent of the input line-to-line voltage. The input line-to-line voltage is specified by the Input L-L Volts parameter and the alarm level is specified by the Undervoltage Alarm Level parameter. *For more information, see section (3.4.4).*

3.7.2 ACTIVE FAULTS F1 Sub-menu

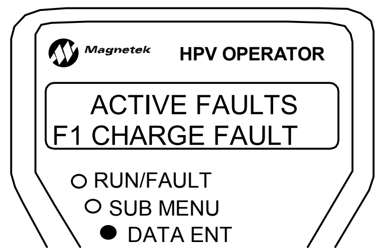
This sub-menu contains a list of the active faults. This sub-menu also allows the user to reset the active faults.

3.7.2.1 Active Faults List

The active fault list displays and records the active faults. The faults will remain on the fault list until a fault reset is initiated.



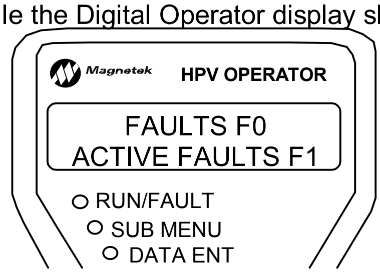
Press the enter key to enter the active fault list. Use the up and down arrow keys to scroll through the active faults.



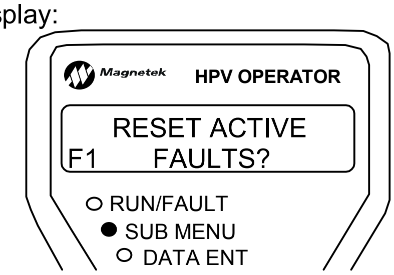
3.7.2.2 Resetting Active Faults

The Reset Active Faults function allows the user to initiate a fault reset via the digital operator, regardless of the setting of the Fault Reset Source parameter. *(see section 3.5.1)*

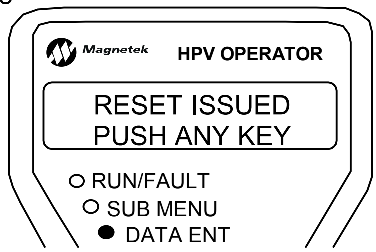
- While the Digital Operator display shows:



Press the ENTER key. The sub-menu LED will turn ON, and the Digital Operator will display:



- Press the ENTER key again to begin the fault reset procedure. The sub-menu LED will go out and the data ent LED will turn on.



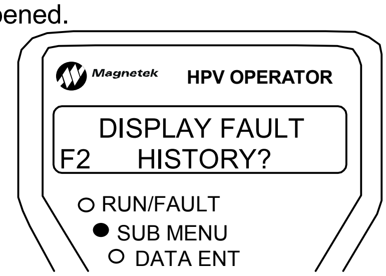
3.7.3 FAULT HISTORY F2 Sub-menu

This sub-menu contains a list of up to the last sixteen faults.

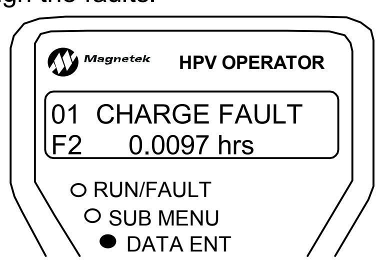
NOTE: The fault history is not affected by the fault reset or a power loss. The fault history can only be cleared by a function in this sub-menu.

3.7.3.1 Fault History

All faults will placed on the fault history. The fault history displays the last 16 faults that have occurred and a time stamp indicating when each happened.



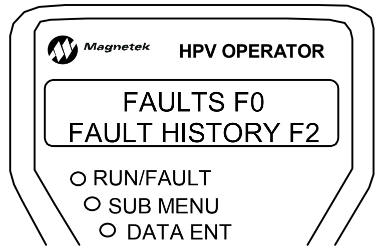
Press the enter key to enter the fault history. Use the up and down arrow keys to scroll through the faults.



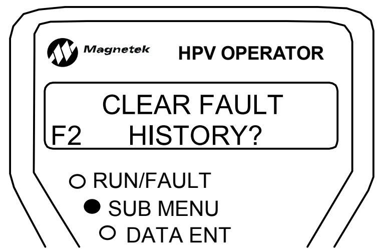
3.7.3.2 Clearing Fault History

The fault history is not affected by the fault reset or a power loss. The fault history can only be cleared via the user function described below.

- While the Digital Operator display shows:

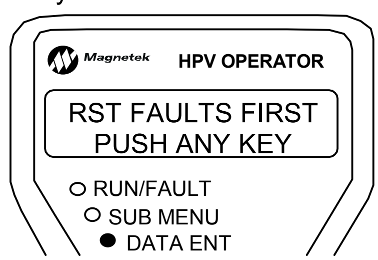


Press the ENTER key. The sub-menu LED will turn ON, and the Digital Operator will display:

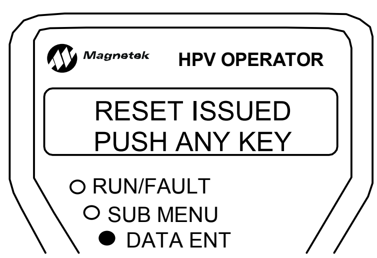


- Press the ENTER key again to begin the fault reset procedure.

The active faults must be cleared in order to clear the fault history. If not the following message will appear when trying to clear the fault history.



The sub-menu LED will go out and the data ent LED will turn on.



4 MAINTENANCE

4.1 MAINTENANCE OVERVIEW

Preventive maintenance is primarily a matter of routine inspection and cleaning. The most important maintenance factors are the following:

- Is their sufficient air flow to cool the drive?
- Has vibration loosened any connections?

The HPV 900 needs to have sufficient air flow for long, reliable operation. Accumulated dust and dirt accumulation can reduce air flow and cause the heat sinks to overheat. The heat sinks can be kept clean by brushing, while using a vacuum cleaner.

Periodically, check air filters on enclosure doors, clean if dirty and replace as necessary.

Periodically, clean the cooling fans to prevent dirt buildup. At the same time, check that the impellers are free and not binding in the housing.

Periodically, check all mounting and electrical connections. Any loose hardware should be tightened.

WARNING

Hazardous voltages may exist in the drive circuits even with drive circuit breaker in off position. NEVER attempt preventive maintenance unless incoming power and control power is disconnected and locked out. Also, ensure the DC Bus charge light is out. *For location of DC bus charge light, see Figure 2. 12, Figure 2. 13, Figure 2. 14, or Figure 2. 15*

4.2 DRIVE SERVICING

Remember when servicing the HPV 900: Hazardous voltages may exist in the drive circuits even with drive circuit breaker in off position.

IMPORTANT

Use extreme caution: Do not touch any circuit board, the drive, or motor electrical connections without making sure that the unit is properly grounded and that no high voltage is present.

NEVER attempt maintenance unless:

- the incoming three phase power and control power is disconnected and locked out.
- also, ensure the DC Bus charge light is out.
- even with the light out, we recommend that you use a voltmeter between (+3) and (-) to verify that no voltage is present.

If after 5 minutes the DC bus charge light remains ON or voltage remains between terminals (+3) and (-):

- First, check that the incoming three phase power is disconnected
- Once the incoming three phase power is disconnected, it will be necessary to discharge the DC bus with a “bleeder” resistor.

4.2.1 Discharging DC bus with “Bleeder” Resistor

IMPORTANT

Use extreme caution when connecting the bleeding resistor.

- Using a 250ohm/100 watt “bleeder” resistor, connect the resistor leads to the (+3) and (-) terminals located on the brake resistor terminal.
- The resistor leads should be connected for 20 seconds or until the DC bus charge light extinguishes.
- Once the DC bus charge light is out, verify with a voltmeter that no voltage exists between the (+3) and (-) terminals.
- It will be necessary to have the drive repaired or replaced.

4.3 LIFETIME MAINTENANCE

The HPV 900 is a AC digital drive. It is intended to last for twenty years in the field assuming the drive is installed and run according to Magnetek specifications and recommendations. The following recommendations for part replacement to ensure twenty-year life is as follows:

- **Fans - 3 to 8 years**
  depending on ambient temperature and dust
- **Bus Capacitors - 8 to 15 years**
  depending on ambient temperature and elevator system load profile

4.4 REFORMING BUS CAPACITORS

The following is a procedure for reforming the electrolytic bus capacitors.

- If the drive has been stored for more than 9-months, it is recommended that the bus capacitors be reformed.
- After 18 months of storage it is ***mandatory*** that the bus capacitors are reformed.

The bus capacitors in the HPV 900 can be reformed *without removing them from the drive.*

To reform the capacitors, voltage must be gradually increased as follows:

- Increase the AC input voltage from zero at a very slow rate, approximately 7 VAC per minute, reaching full rated voltage after about an hour.

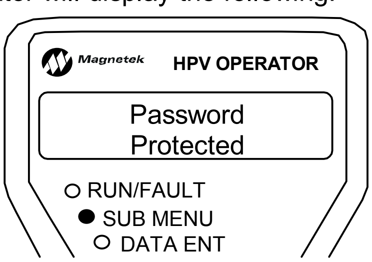
This will reform the capacitors.

4.5 PARAMETERS LOCKED OUT

The following three conditions would cause parameter changes to be locked out.

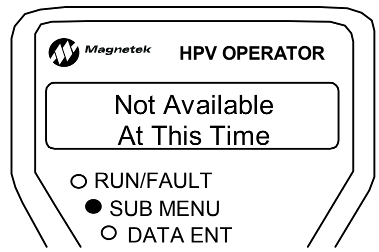
- The password protection is enabled.
- The drive is running and the parameter being changed is protected by Run Lockout.
- The hidden items are disabled and the parameter to be change is a hidden parameter.

When the password protection is enabled and a parameter is trying to be changed, the digital operator will display the following:



For more information, see section (3.6.1).

When the drive is in a Run condition and a parameter is trying to be changed, the digital operator will display the following:



This means the parameter cannot be changed, when the drive is running. The parameter can be changed once the drive's run command is removed.

When the hidden items function is disabled and a parameter is cannot be found in the menus. The hidden items will need to be enabled. *For more information, see section (3.6.2).*

4.6 TROUBLESHOOTING GUIDE

Table 4. 1 list the HPV 900's status LEDs (see Figure 4. 1) along with a description.

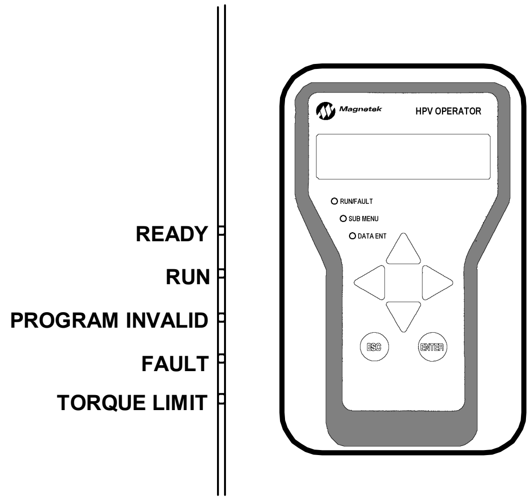


Figure 4. 1 - Status LEDs

Status LED	Description	Possible Causes & Corrective Action
READY (green)	The drive is ready to run meaning: • The software is up and ready. • No faults are present.	N/A
RUN (green)	The drive is in operation. • RUN & DRIVE ENABLE logic inputs true • Current being sent to the motor	N/A
PROGRAM INVALID (red)	The HPV 900 is not sensing any valid software in the drive's control board.	**Drive is Not Sensing Software** ➲ Power cycle the drive. ➲ If re-occurs, replace Drive Control board ➲ If re-occurs, check the power supplies, *see section (4.7).* If there is a problem with power supplies, the drive needs to be replaced
FAULT (red)	The drive has declared a fault.	**Fault Present in the Drive** ➲ Use digital operator to check the fault and consult Table 4. 2.
TORQUE LIMIT (amber)	The drive has reached its torque limit.	**Incorrect Wiring** ➲ Motor phasing should match the encoder feedback phasing. If the phasing is not correct, the motor will not accelerate up to speed. It will typically oscillate back and forth at zero speed, and the current will be at the torque limit. ➲ Switch either two motor phases or swap two encoder wires (A and /A). **Drive and/or Motor is Undersized** ➲ Verify drive and/or motor sizing. May need a larger capacity HPV 900 and or motor. **Check Parameter Settings** ➲ Check the torque limit parameters MTR TORQUE LIMIT and REGEN TORQ LIMIT (A1) – maximum 250% ➲ Check speed regulator parameters RESPONSE and INERTIA (A1)

Table 4. 1 - Status LED Troubleshooting Guide

Table 4. 2 list the HPV 900's faults and alarms along with possible causes and corrective actions.

Note:

- **fault** - a severe failure that will stop a drive if it has been running and prevent the drive from starting as long as it is present. All faults require some type of action by the user to clear.
- **alarm** - only meant for annunciation. It will NOT stop the operation of the drive or prevent the drive from operating.

Name	Description	Possible Causes & Corrective Action
AtoD Fault	The Analog to Digital conversion on the drive's control board is not working properly.	**Drive Control PCB Failure** ➲ Replace Drive Control board
Brake Alarm *(alarm)*	Dynamic brake resistor overcurrent. Note: After the run command has been dropped, this alarm becomes a Brake IGBT fault.	**Brake Resistor problem** ➲ Braking Resistor is shorted.
Bridge Fault	The integrated power module is sensing an overcurrent or overtemperature condition *(only A-cubes)*	**Overcurrent Problem** ➲ Check for a possible short between the motor windings. ➲ Verify dynamic brake resistor size (could be too small) **Overtemperature Problem** ➲ Reduce Ambient Temperature ➲ Clean heat sink ➲ Check for cooling fan failure The drive may need to be replaced, if no other problem found.
Brk Hold Flt	The brake hold command and the brake feedback did not match for the time specified with Brake Hold Time parameter.	**Check Parameter Settings** ➲ Check BRAKE HOLD SRC (C1) parameter for the correct source of brake hold feedback ➲ Check BRAKE HOLD TIME (A1) parameter for the correct brake hold time. If nuisance fault, the fault can be disabled by BRK HOLD FLT ENA (C1) parameter.
Brk IGBT Flt	Dynamic brake resistor overcurrent.	**Brake Resistor problem** ➲ Braking Resistor is shorted. When this fault occurs while the elevator is in motion, it will be declared as a brake fault alarm until the run condition is removed. If the drive is in regeneration an Overvolt Fault may occur instead.

Table 4. 2 – Fault / Alarm Troubleshooting Guide

Name	Description	Possible Causes & Corrective Action
Brk Pick Flt	The brake pick command and the brake feedback did not match for the time specified with Brake Pick Time parameter.	**Check Parameter Settings and Mechanical Brake Pick Signal Wiring** ➲ Check the correct logic input is configured for the correct TB1 terminal and set to MECH BRK PICK (C2) ➲ Check wiring between the mechanical brake and the terminal on TB1. ➲ Check BRAKE PICK SRC (C1) parameter for the correct source of brake pick feedback ➲ Check BRAKE PICK TIME (A1) parameter for the correct brake hold time. If nuisance fault, the fault can be disabled by BRK PICK FLT ENA (C1) parameter.
Charge Fault	The DC bus voltage has not stabilized above the voltage fault level within 2 seconds or the charge contactor has not closed after charging.	**DC Choke Connection** ➲ Check that the DC choke link is present or if using DC choke, check DC choke connections **DC Bus Low Voltage** ➲ Increase input AC voltage with the proper range ➲ Check wiring and fusing between main AC contactor and the drive ➲ Drive may need to be replaced
Contactor Flt	The command to close the contactor and the contactor feedback do not match before the time specified by the Contact Flt Time parameter.	**Check Parameter Settings and Contactor** ➲ Check CONTACT FLT TIME (A1) parameter for the correct contactor fault time. ➲ Check wiring to logic input configured as CONTACT CFIRM ➲ Contactor hardware problem If nuisance fault, the fault can be disabled by CONT CONFIRM SRC (C1) parameter (set to none).
Cube data Flt	The cube (drive) parameters checksum is invalid.	**Parameters Corrupted** ➲ Re-enter parameters and power-cycle ➲ If re-occurs, replace Drive Control board
Cube ID Fault	The identification number for the drive is invalid.	**Hardware Problem** ➲ Power cycle the drive. ➲ If re-occurs, replace Drive Control board ➲ If re-occurs, the drive needs to be replaced

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Curr Reg Flt	Actual current does not match the command current. The drive is commanding more motor voltage then is available on the input.	**Current Regulation problem** ➲ Check for a low input line ➲ Check if drive accurately reading the dc bus • Measure the dc bus with a meter across terminals +3 and – • Compare that with the value on the digital operator, DC BUS VOLTAGE (D2) ➲ Complete Adaptive Tune and Inertia procedure, *see section (5.6.2.1) and (5.8).* ➲ Check for a possible motor open phase ➲ Check if contactor is closing. ➲ Check for accurate motor parameters (A5) • Verify motor nameplate values are entered correctly • Complete Adaptive Tune and Inertia procedure, *see section (5.6.2.1) and (5.8).* • As a last step, calculate motor parameters from motor's equivalent circuit, *see section (5.9)* ➲ Otherwise, replace the drive
DCU data Flt	The DCU parameters checksum is invalid.	**Parameters Corrupted** ➲ Check & re-enter parameters and power cycle the drive ➲ If re-occurs, replace Drive Control board
Dir Conflict *(alarm)*	Declared when the speed command is held at zero due conflict with the analog speed command polarity and the run up / run down logic DIR CONFIRM (C1) must be enabled. *For more information on this function, see section (5.1.1.2.1).*	**Check Parameter Settings** ➲ Sensitivity determined by the ZERO SPEED LEVEL (A1) **Confirm Speed Command Polarity** ➲ Check polarity of the analog speed command on analog channel #1 ➲ Compare that with the RUN UP (positive) and RUN DOWN (negative) logic input status If nuisance, the function can be disabled by DIR CONFIRM (C1) parameter.

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Drv Ovrload	The drive has exceeded the drive overload curve.	**Excessive Field Weakening** ➲ Decrease FLUX WKN FACTOR (A1) parameter ➲ Decrease both MTR TORQUE LIMIT (A1) and REGEN TORQ LIMIT (A1) parameters ➲ Watch for the Torque Limit LED (see Figure 4. 1), if lite the torque limits or the flux weakening factor parameters were decreased too much. **Accurate Motor Parameters** ➲ Verify motor nameplate values are entered correctly ➲ Complete Adaptive Tune and Inertia procedure, *see section (5.6.2.1) and (5.8).* ➲ As a last step, calculate motor parameters from motor's equivalent circuit, *see section (5.9).* **Excessive Current Draw** ➲ Decrease accel/decel rate ➲ Is elevator car being held in position? (i.e. mechanical brake not releasing) ➲ Mechanical brake may not have properly released **Encoder Problem** ➲ Check encoder coupling: align or replace ➲ Encoder failure (replace encoder) ➲ Check encoder count parameter ENCODER PULSES (A1) **Motor Problem** ➲ Check for motor failure **Drive Sizing** ➲ Verify drive sizing. May need a larger capacity HPV 900

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Encoder Flt	The drive is in a run condition and the encoder is: • not functioning or • not connected. or • phasing is not proper with the motor.	**Encoder Should Match Motor Phasing** ➲ Usually drive's torque limit LED is "ON" ➲ Switch either two motor phases or swap two encoder wires (A and /A) **Encoder Power Supply Loss** ➲ Check 12 or 5 volt supply on terminal strip **Accurate Motor Parameters** ➲ Verify motor nameplate values are entered correctly ➲ Complete Adaptive Tune and Inertia procedure, *see section (5.6.2.1) and (5.8).* ➲ As a last step, calculate motor parameters from motor's equivalent circuit, *see section (5.9).* **Response of Speed Regulator** ➲ Enter accurate INERTIA (A1) parameter, *see section 5.8 for procedure.* ➲ Increase RESPONSE (A1) parameter **Encoder Coupling Sloppy or Broken** ➲ Check encoder to motor coupling **Excessive Noise on Encoder Lines** ➲ Check encoder connections. Separate encoder leads from power wiring (cross power lead at 90°) **Other Conditions Causing Fault** ➲ Check encoder count parameter ENCODER PULSES (A1) ➲ Possible motor phase loss ➲ Possible bad Brake IGBT **Hardware Problem** ➲ Replace Drive Control board.
Extrn Fault 1	User defined external logic fault input	**Check Parameter Settings and External Fault Signal Wiring** ➲ Check the correct logic input is configured for the correct TB1 terminal and set to EXTRN FAULT 1 (C2) ➲ Check external fault is on the correct terminal on TB1.

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Extrn Fault 2	User defined external logic fault input	**Check Parameter Settings and External Fault Signal Wiring** ➲ Check the correct logic input is configured for the correct TB1 terminal and set to EXTRN FAULT 2 (C2) ➲ Check external fault is on the correct terminal on TB1.
Extrn Fault 3	User defined external logic fault input	**Check Parameter Settings and External Fault Signal Wiring** ➲ Check the correct logic input is configured for the correct TB1 terminal and set to EXTRN FAULT 3 (C2) ➲ Check external fault is on the correct terminal on TB1.
Fan Alarm *(alarm)*	The heatsink cooling fan on the drive is not functioning.	**Excessive Heat** ➲ Reduce Ambient Temperature ➲ Clean heat sink ➲ Check for cooling fan failure
Fuse Fault	The DC bus fuse on the drive is open.	**Hardware Problem** ➲ Check if motor is faulty ➲ Check if any output phases shorted to ground. ➲ The drive may need to be replaced.
Ground Fault	The sum of all phase currents has exceeded 50% of the rated amps of the drive.	**Improper Wiring** ➲ Reset drive faults. Retry. If cleared, reconnect motor and control. If problem continues possible short between the motor windings and chassis ➲ If problem continues, check system grounding ➲ Also, the drive may need to be replaced.
Motor id Flt **Mtr data Flt**	Motor parameters checksum is invalid.	**Parameters Corrupted** ➲ Check parameters and reset ➲ If re-occurs, replace Drive Control board

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Mtr Overload *(alarm)*	The motor had exceeded the user defined motor overload curve.	**Verify Overload Curve Parameters** ➲ Check both OVLD START LEVEL (A1) and OVLD TIME OUT (A1) parameters*, see section (0).* **Excessive Field Weakening** ➲ Decrease FLUX WKN FACTOR (A1) parameter ➲ Decrease both MTR TORQUE LIMIT (A1) and REGEN TORQ LIMIT (A1) parameters ➲ Watch for the Torque Limit LED (see Figure 4. 1), if lite the torque limits or the flux weakening factor parameters were decreased too much. **Accurate Motor Parameters** ➲ Verify motor nameplate values are entered correctly ➲ Complete Adaptive Tune and Inertia procedure, *see section (5.6.2.1) and (5.8).* ➲ As a last step, calculate motor parameters from motor's equivalent circuit, *see* ***section (5.9).*** **Excessive Current Draw** ➲ Decrease accel/decel rate ➲ Is elevator car being held in position? (i.e. mechanical brake not releasing) ➲ Mechanical brake may not have properly released **Encoder Problem** ➲ Check encoder coupling: align or replace ➲ Encoder failure (replace encoder) ➲ Check encoder count parameter ENCODER PULSES (A1) **Motor Problem** ➲ Check for motor failure

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Overcurr Flt	The phase current exceeded 300% of rated current.	**Encoder Problem** ➲ Check encoder coupling: align or replace ➲ Encoder failure (replace encoder) **Motor Problem** ➲ Possible motor lead short ➲ Check for motor failure **Excessive Load** ➲ Verify motor and drive sizing. May need a larger capacity HPV 900 **Accurate Motor Parameters** ➲ Verify motor nameplate values are entered correctly ➲ Complete Adaptive Tune and Inertia procedure, *see section (5.6.2.1) and (5.8).* ➲ As a last step, calculate motor parameters from motor's equivalent circuit, *see* ***section (5.9).*** **Hardware Problem** ➲ The drive may need to be replaced.
Overspeed Flt	Generated when the motor has gone beyond the user defined percentage contract speed for a specified amount of time.	**Check Parameter Settings** ➲ Check OVERSPEED LEVEL (A1) parameter for the correct level. ➲ Check OVERSPEED TIME (A1) parameter for the correct time. Note: This fault is defined by Overspeed Level parameter and Overspeed Time parameter.
Ovrtemp Alarm *(alarm)*	The heatsink on the drive has exceeded 90°C (194°F).	**Excessive Heat** ➲ Reduce Ambient Temperature ➲ Clean heat sink ➲ Check for cooling fan failure
Overtemp Flt	The heatsink on the drive has exceeded 105°C (221°F).	**Excessive Heat** ➲ Reduce Ambient Temperature ➲ Clean heat sink ➲ Check for cooling fan failure

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Overvolt Flt	The DC bus voltage of the drive exceeded: • 850 Volts for a 460V class drive • 425 Volts for a 230V class drive.	**Too High of Braking Resistor Value** ➲ Check for no braking resistor ➲ Possible Brake IGBT Failure ➲ Possible brake resistor is open **Dynamic Braking Wiring Problem** ➲ check dynamic brake hardware wiring **High Input Voltage** ➲ Decrease input AC voltage with the proper range ➲ Use reactor to minimize voltage spikes **Drive Accurately Reading the Dc Bus** ➲ Measure the dc bus with a meter across terminals +3 and – ➲ Compare that with the value on the digital operator, DC BUS VOLTAGE (D2) **Hardware Problem** ➲ Replace Drive Control board
PCU data Flt	PCU parameters checksum is invalid.	**Parameters Corrupted** ➲ Check parameters and power cycle ➲ If re-occurs, replace Drive Control board
Phase Flt	The drive senses an open motor phase. The drive senses more than one motor phase crossing zero at the same time.	**Motor Problem** ➲ Check motor wiring ➲ Check for motor failure ➲ Check for bad contactor or contactor timing issue.
Setup Fault 1	This fault is declared if the rated motor speed and excitation frequency do not satisfy: $9.6 < \left[120\begin{pmatrix} rated \\ excitation \\ frequency \end{pmatrix}\right] - \left[\begin{pmatrix} \# \\ poles \end{pmatrix}\begin{pmatrix} rated \\ motor \\ speed \end{pmatrix}\right] < 1222.3$ *…checks for too low or too high value of slip*	**Check Parameters Settings:** ➲ Check RATED EXCIT FREQ (A5) parameter for correct setting ➲ Check RATED MTR SPEED (A5) parameter for correct setting ➲ Check MOTOR POLES (A5) parameter for correct setting
Setup Fault 2	This fault is declared if the number of poles and encoder pulses per revolution do not satisfy: $\frac{\begin{pmatrix} encoder \\ pulses \end{pmatrix}}{\begin{pmatrix} \# \\ poles \end{pmatrix}} > 64$	**Check Parameters Settings:** ➲ Check ENCODER PULSES (A1) parameter for correct setting ➲ Check MOTOR POLES (A5) parameter for correct setting
Setup Fault 3	This fault is declared if the number of poles is not an even number.	**Check Parameters Settings:** ➲ Check MOTOR POLES (A5) parameter for correct setting

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Setup Fault 4	This fault is declared if the contract motor speed (in rpm) and encoder pulses/revolution do not satisfy: $300{,}000 < \begin{pmatrix} contract \\ motor \\ speed \end{pmatrix} \begin{pmatrix} encoder \\ pulses \end{pmatrix} < 18{,}000{,}000$	**Check Parameters Settings:** ➲ Check ENCODER PULSES (A1) parameter for correct setting ➲ Check CONTRACT MTR SPD (A1) parameter for correct setting
Setup Fault 5	This fault is declared if the rated motor power (in watts) and rated motor voltage do not satisfy: $(0.07184)\left[\frac{\begin{pmatrix} rated \\ motor \\ power \end{pmatrix}}{\begin{pmatrix} rated \\ motor \\ voltage \end{pmatrix}}\right] < \begin{matrix} general \\ purpose \\ current \\ rating \\ of \\ drive \end{matrix}$	**Check Parameters Settings:** ➲ Check RATED MOTOR PWR (A5) parameter for correct setting ➲ Check RATED MTR VOLTS (A5) parameter for correct setting
Setup Fault 6	This fault is declared if the multi-step speed references have exceeded a defined limit, which is defined in terms of a percentage of contract speed (CONTRACT CAR SPD parameter).	**Check Parameters Settings:** ➲ Check SPEED COMMAND1-16 (A3) parameters, if greater than 110% of CONTRACT CAR SPD (A1) parameter
Setup Fault 7	This fault is declared if the run logic inputs are defined incorrectly. You can either choose group #1 (RUN and UP/DWN) or group #2 (RUN UP and RUN DOWN). But you cannot mix and match or this fault will be declared.	**Check Parameters Settings:** ➲ Check configurations of logic inputs (C2) – either RUN & UP/DWN or RUN UP & RUN DOWN
Setup Fault 8	This fault is declared if the DIR CONFIRM (C1) parameter is enabled and any of the following conditions are not met: • A logic input (C2) must be assigned to RUN UP. • A logic input (C2) must be assigned to RUN DOWN. • The SPD COMMAND SRC (C1) parameter must be set to ANALOG INPUT *... Confirms proper set-up of Analog Speed Command direction confirm function*	**Check Parameters Settings:** ➲ Check configurations of logic inputs (C2) for two logic input defined as RUN UP & RUN DOWN ➲ Verify SPD COMMAND SRC (C1) is set to ANALOG INPUT If nuisance fault and not using Up-Down Confirm function disabled by setting the DIR CONFIRM (C1) parameter to DISABLED

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Speed Dev *(alarm)*	The speed feedback is failing to properly track the speed reference. • Sensitivity determined by SPD DEV HI LEVEL (A1) parameter.	**Fault LED lite?** ➲ If fault LED lite, check which fault occurred ➲ Speed Deviation is only an alarm and will not light the Fault LED **Check Parameters Settings:** ➲ Verify SPD DEV HI LEVEL (A1) is set to the proper level. **Torque Limit LED lite?** ➲ If Torque Limit LED lite during running, verfiy the Fault LED is NOT lite. ➲ Then, increase the torque limit parameters MTR TORQUE LIMIT and REGEN TORQ LIMIT (A1) – maximum 250%
Tq Lim **2Hi 4cube**	The torque limits (based on the defined motor) exceed the cube's capacity *(only B+ cubes)*	**Check Parameters Settings** ➲ Verify motor nameplate values are entered correctly in the A5 sub-menu ➲ Decrease both MTR TORQUE LIMIT (A1) and REGEN TORQ LIMIT (A1) parameters **Drive Sizing** ➲ Verify drive sizing. May need a larger capacity HPV 900
Undervolt Flt	Generated during a run condition when the DC bus voltage drops below the user specified percent of the input line-to-line voltage. The input line-to-line voltage is specified by the Input L-L Volts parameter and the fault level is specified by the Undervoltage Fault Level parameter.	**Low Input Voltage** ➲ Check INPUT L-L VOLTS (A4) and UV FAULT LEVEL (A4) parameters ➲ Disconnect Dynamic Braking resistor and re-try. ➲ Verify proper input voltage and increase, if necessary, the input AC voltage within the proper range ➲ Check for a missing input phase ➲ Check power line disturbances due to starting of other equipment **Drive Accurately Reading the Dc Bus** ➲ Measure the dc bus with a meter across terminals +3 and – ➲ Compare that with the value on the digital operator, DC BUS VOLTAGE (D2) **Hardware Problem** ➲ The drive may need to be replaced.

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Name	Description	Possible Causes & Corrective Action
Uv Alarm *(alarm)*	Generated during a run condition when the DC bus voltage drops below the user specified percent of the input line-to-line voltage. The input line-to-line voltage is specified by the Input L-L Volts parameter and the fault level is specified by the Undervoltage Alarm Level parameter.	**Low Input Voltage** ➲ Check INPUT L-L VOLTS (A4) and UV ALARM LEVEL (A4) parameters ➲ Disconnect Dynamic Braking resistor and re-try. ➲ Verify proper input voltage and increase, if necessary, the input AC voltage within the proper range ➲ Check for a missing input phase ➲ Check power line disturbances due to starting of other equipment **Drive Accurately Reading the Dc Bus** ➲ Measure the dc bus with a meter across terminals +3 and – ➲ Compare that with the value on the digital operator, DC BUS VOLTAGE (D2) **Hardware Problem** ➲ The drive may need to be replaced.

Table 4. 2 – Fault / Alarm Troubleshooting Guide (continued)

Table 4. 3 list the HPV 900's operator communications messages along with possible causes and corrective actions.

Operator Communication Messages	Description	Possible Causes & Corrective Action
Ready, Waiting For Drive	The operator is waiting to establish communications with the drive's control board.	**Normal, if displayed momentarily** ➲ No action is required, if the message disappears shortly after power-up of the operator. **Bad Connector Connection** ➲ Remove and re-seat the operator in its cradle. ➲ If re-seating of the operator does not work, the operator or the drive's control board may need to be replaced.
Comm Fault Invalid Checksum	The operator received four consecutive invalid messages.	**Noise or Bad Connector Connection** ➲ Remove and re-seat the operator in its cradle. ➲ If re-seating of the operator does not work, the operator or the drive's control board may need to be replaced.
Comm Fault No Drv Handshake	The operator lost communications with the drive's control board.	**Bad Connector Connection** ➲ Remove and re-seat the operator in its cradle. ➲ If re-seating of the operator does not work, the operator or the drive's control board may need to be replaced.

Table 4. 3 - Operator Troubleshooting Guide

4.7 TESTPOINTS

The testpoints are located on the HPV 900 Control Board. Figure 4. 2 shows the layout of the testpoints on the Control Board. Figure 4. 3 shows where to check the power supplies. Figure 4. 4 shows some other useful testpoints.

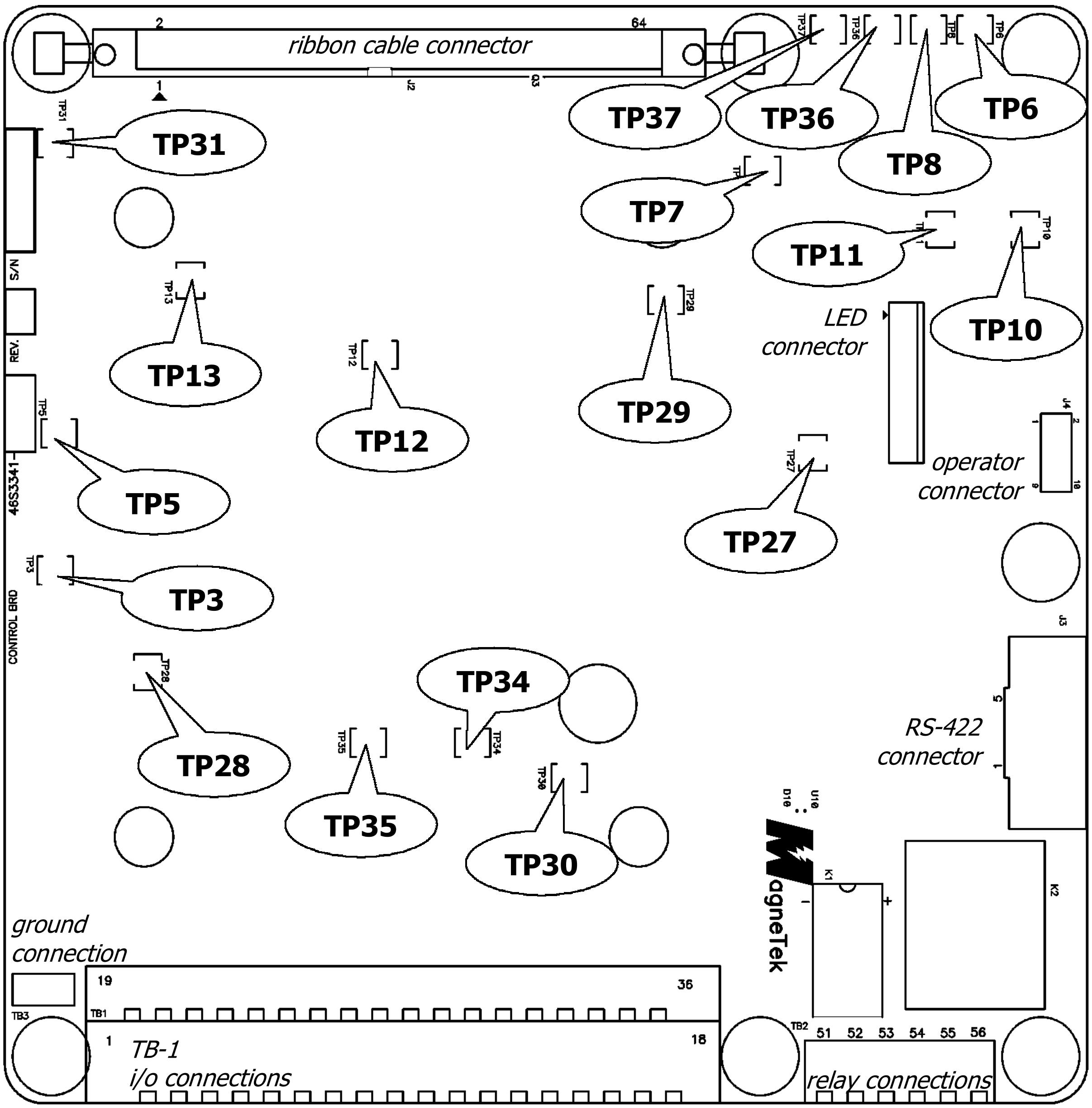


Figure 4. 2 -Testpoint Layout

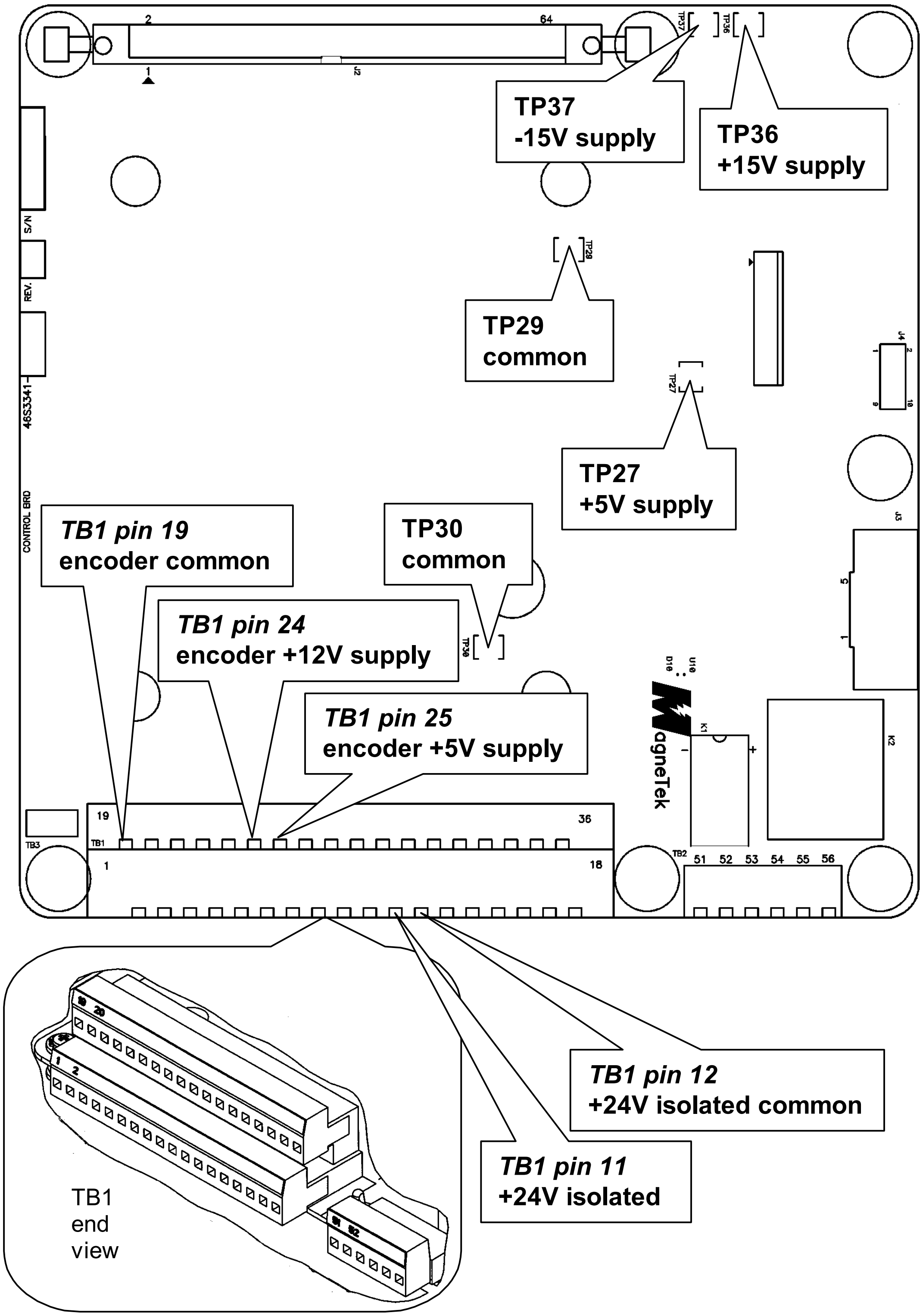
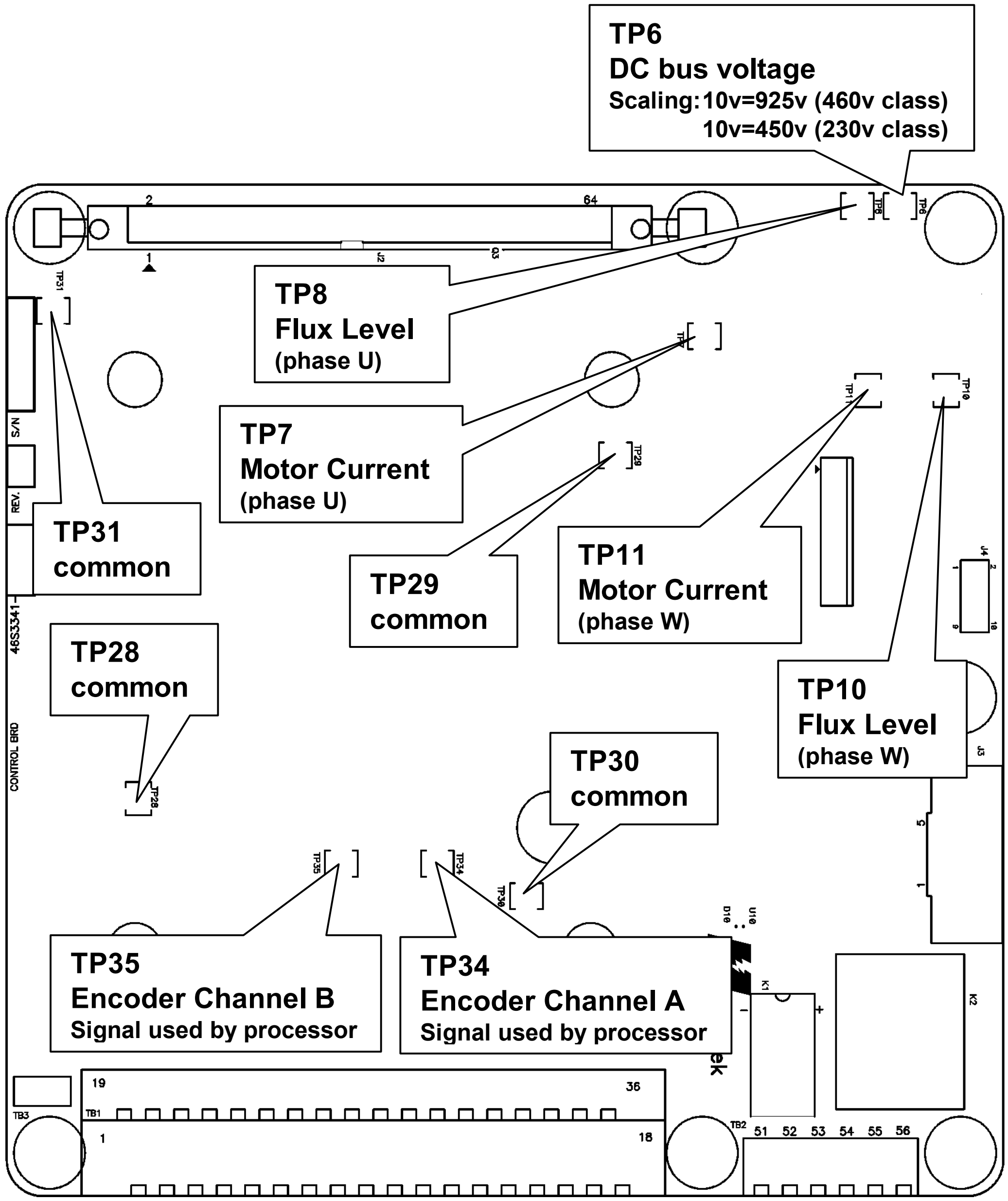


Figure 4. 3 - Checking Power Supplies



Other testpoints
TP3, TP5, TP12, and TP13
No function (at this time)

Figure 4. 4 - Other Useful Testpoints

5 APPLICATION

5.1 DRIVE SOFTWARE

The HPV 900 is a dedicated fully, digital AC vector drive tailored to the elevator industry. Following is a description of the drive software.

A block diagram of the software is shown in Figure 5. 1.

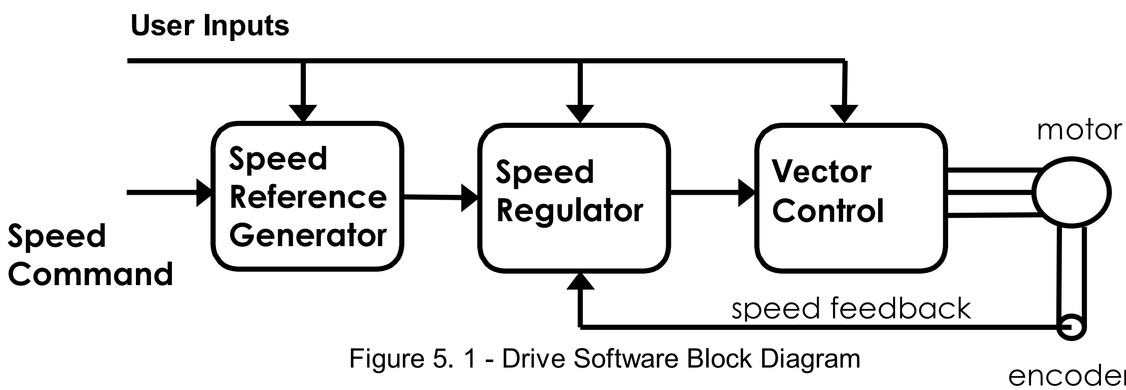


Figure 5. 1 - Drive Software Block Diagram

The drive software consists of the following:

- Speed Command – *see section (5.1.1*).
- Speed Reference Generator – *see section (5.1.3*).
- Speed Regulator – *see section (5.1.4).*
- Vector Control – *see section (5.1.5).*

5.1.1 Speed Command Generation

The three possible sources for the speed command are following:

- serial channel
- analog channel
- multi-step command

5.1.1.1 Serial Channel

The serial channel is a RS-422 serial port located on the drive control board. *For further information, see section (5.4).*

5.1.1.2 Analog Channel

The analog channel is bipolar (±10V). The speed command channel is predetermined as analog channel #1. Available with the analog channel is a Speed Command Multiplier (SPD COMMAND MULT) and Speed Command Bias (SPD COMMAND BIAS). These parameters are used to scale the user's analog speed command to the proper range for use by the drive software. The formula below shows the scaling effects of these two parameters.

$$\left(\begin{matrix} \textit{analog} \\ \textit{channel\#1} \\ \textit{input} \\ \textit{voltage} \end{matrix} - \begin{matrix} \textit{SPD} \\ \textit{COMMAND} \\ \textit{BIAS} \end{matrix}\right) \times \begin{matrix} \textit{SPD} \\ \textit{COMMAND} \\ \textit{MULT} \end{matrix} = \begin{matrix} \textit{signal} \\ \textit{drive} \\ \textit{software} \\ \textit{uses} \end{matrix}$$

In the following example, the user is supplying the drive a 0 to +10V signal on analog channel #1 and the user wants to control the speed from positive contract speed to negative contract speed. Therefore, the signal on analog channel #1 will need to be scaled before it is used by the drive software by configuring the parameters as shown in Figure 5. 2.

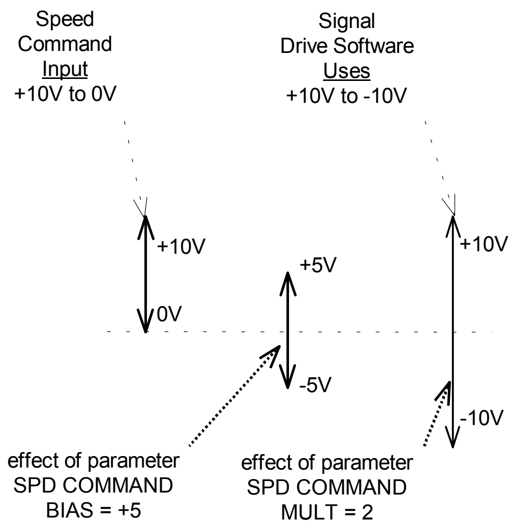


Figure 5. 2 - Example Analog Gain & Bias

The sign of the analog speed command can be changed via up/down logic input (UP/DWN). When the logic input is false there is no inversion, but when the logic input is true the speed command is inverted. Normally, positive commands are for the up direction and negative speed commands are for the down direction. Thus, making the up/down input true reverses the car's direction.

As an example, the user is supplying the drive a 0 to +10V signal on analog channel #1 and the user wants to control the speed from positive contract speed to negative contract speed. Since to user is already supplies a signal for zero to positive contract speed, the user can use the up/down logic input to reverse the sign of the speed command.

5.1.1.2.1 Analog Speed Command Polarity Confirmation

The DIR CONFIRM (C1) parameter enable a function that allows confirmation of the polarity of the initial analog speed command via the Run Up or Run Down logic input commands.

- If the Run Up logic input is selected and true with the polarity of the analog signal positive, then the analog speed command is accepted unchanged.
- If the logic input Run Down logic input is selected and true with the polarity of the analog speed command negative, the analog speed command is accepted unchanged.
- If however, the logic input Run Up is true and the polarity is negative or the logic input Run Down is true and the polarity is positive, then the speed command is held at zero.

NOTE: This check is made only during the start. The test is only done at the start to allow the analog signal to reverse during leveling. The test is terminated when the analog signal is of the correct polarity and the magnitude exceeds a threshold level. The threshold level is set by the ZERO SPEED LEVEL (A1), *see section 3.4.1.* Until the threshold level is exceeded all analog signals of the incorrect polarity are clamped to zero.

5.1.1.3 Multi-Step Commands

To use the multi-step command source, the user can enter fifteen discrete speed commands (CMD1 - CMD15) and assign four logic inputs as speed command selections; CMD0 is reserved for zero speed. But, the user can specify CMD1 - CMD15 to be any speed command either positive or negative.

For typical use, the user will have all speed commands to be positive, in which case a logic input (UP/DWN) must also be specified to determine UP or DOWN direction. It is possible for the user to specify both positive and negative values for CMD1 - CMD15, in which case the UP / DOWN logic input bit is not needed.

During operation, the user will encode a binary signal on the four logic inputs (see Table 5. 1) that determines which speed command the software should use. The user need not use all four speed command selection bits; if no logic input is specified for one of the selection bits, that bit is always zero. For instance, if no logic input is specified for the most significant bit (B3), that bit will be zero and the user can select from CMD0 - CMD7.

	logic input			multi-step
	STEP REF			speed
B3	B2	B1	B0	command
0	0	0	0	CMD0
0	0	0	1	CMD1
0	0	1	0	CMD2
0	0	1	1	CMD3
0	1	0	0	CMD4
0	1	0	1	CMD5
0	1	1	0	CMD6
0	1	1	1	CMD7
1	0	0	0	CMD8
1	0	0	1	CMD9
1	0	1	0	CMD10
1	0	1	1	CMD11
1	1	0	0	CMD12
1	1	0	1	CMD13
1	1	1	0	CMD14
1	1	1	1	CMD15

Table 5. 1 - Multi-Step Selection

An example of the use of the multi-step command is as follows:

- All speed commands are positive.
- CMD0 specifies zero speed.
- CMD1 specifies leveling speed.
- CMD2 specifies inspection speed.
- CMD3 specifies an overspeed limit.
- CMD4 – CMD15 specify different top speeds depending on number of floors in the run.

Since these speed commands are selected with external contacts, a new command selection must be present for 50ms before it is recognized. This eliminates the situation where a zero speed command may erroneously be specified while transitioning between two non-zero states (i.e. while transitioning, all contacts may be open briefly).

5.1.2 Overspeed Test

In order to allow overspeed tests during elevator inspections, a means is provided to multiply the speed command the Overspeed Multiplier parameter (OVERSPEED MULT). The result of this multiplication is not subject to the overspeed level limit. *For more information, see section (3.4.1).*

To initiate an overspeed test, the user can select from:

- an external logic input (OSPD TEST SRC), *see section (3.5.2)*
- the serial channel
- directly from the operator, *see section (3.6.4)*

To use an external logic input or the serial channel to initiate an overspeed test, the Overspeed Test Source parameter (OVERSPEED TEST SRC) must be set-up properly. *For more information, see section (3.5.1).*

Once an overspeed test is initiated, it is applied to the next run. The overspeed test logic requires a transition from FALSE to TRUE to be recognized. This prevents the overspeed function from being permanently enabled if left in the TRUE state.

5.1.3 Speed Reference Generation

A block diagram of the speed reference generator is shown in Figure 5. 3.

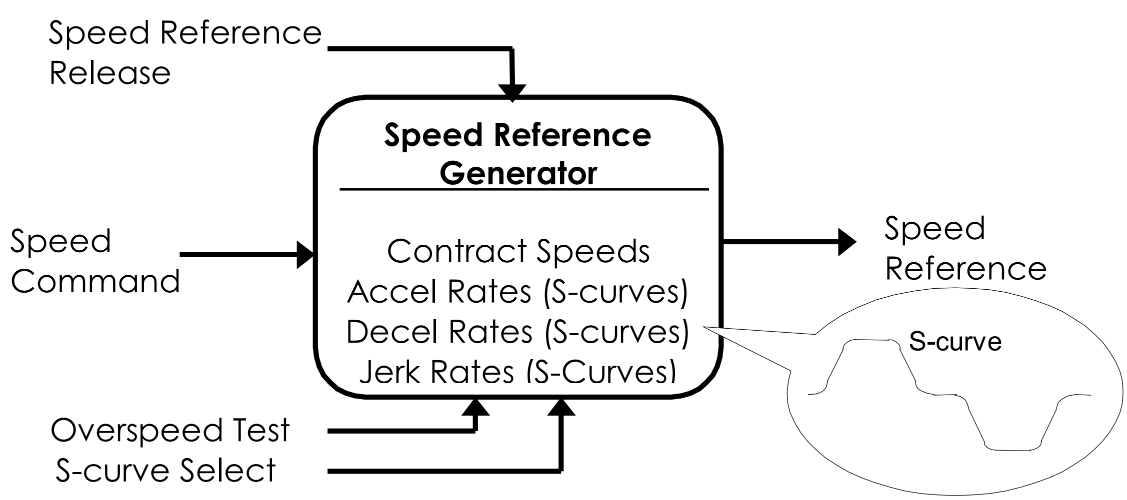


Figure 5. 3 - Speed Reference Generator Block Diagram

The inputs to the speed reference generator are the following:

- Speed Command – the HPV 900 commanded speed and is described above in *section (5.1.1*).
- Overspeed Test – used to initiate an overspeed test, *see section (5.1.2).*
- S-curve Select – used to select one of four available of the drive's available S-curves, *see section (5.1.3.2).*
- Speed Reference Release – an internal signal to the drive and is described in detail in the drive sequencing section, *see section (5.2).*

The output of the speed reference generator is a speed reference.

5.1.3.1 Contract Speeds

The two contract speeds are the contract car speed and the contract motor speed. The interaction between these two parameters allow engineering units to be used throughout the HPV 900 software.

The contract car speed is defined as the elevator contract speed in fpm (feet per minute) or m/s (meters per second).

The contract motor speed is defined as the motor speed at elevator contract speed in rpm (revolutions per minute).

For more information on the Contract Speed parameters see section (3.4.1).

In the speed reference generator, the speed command is passed through an S-curve block in order to produce a speed reference. The S-curve definitions are shown in
Figure 5. 4.

5.1.3.2 HPV 900 S-curve Definition

To simplify the S-curve definitions the HPV 900 defines:

- the jerk rate as: the jerk when going into an acceleration; the jerk when going out of an acceleration; and the jerk when going into a deceleration.
- the leveling jerk rate as the jerk when going out of a deceleration.

Therefore, the HPV 900 defines a S-curve by four parameters:

- accel rate (ft/s^2 or m/s^2)
- decel rate (ft/s^2 or m/s^2)
- jerk rate (ft/s^3 or m/s^3)
- leveling jerk rate (ft/s^3 or m/s^3)

For more detailed information on the S-curve see section (5.4).

The HPV 900 provides the user with the ability to specify up to four sets of S-curve data (SC0 - SC3). Also, the user has the ability to assign up to two logic inputs (SC select 0 and SC select 1) for use in selecting the various S-curves.

During operation, the user will encode a binary signal on the two logic inputs (see Table 5. 3) that determine which S-curve the software will use. The user need not use the two S-curve selection bits; if no logic input is specified for one of the selection bits, that bit is always zero. For instance, if no logic input is specified for SC select 1, that bit will be zero and the user can select from SC0 and SC1 (see Table 5. 2).

For more detailed information on the S-curve parameters see section (3.4.2).

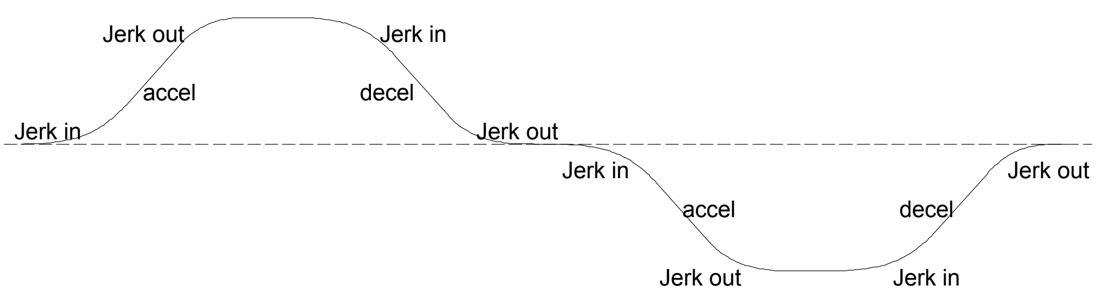


Figure 5. 4 - S Curve Definitions

Logic Inputs Assigned	S-Curves Available
none	SC0
SC select 0 assigned SC select 1 not assigned	SC0 or SC1
SC select 0 not assigned SC select 1 assigned	SC0 or SC2
SC select 0 assigned SC select 1 assigned	SC0, SC1, SC2 or SC3

Table 5. 2 - Possible S-curve Selection Assignments

logic input S-CURVE SEL 1	S-CURVE SEL 0	S-curve selected
0	0	SCO
0	1	SC1
1	0	SC2
1	1	SC3

Table 5. 3 - S-curve Selection Table

5.1.3.3 Disabling Parts of the S-curve

The jerk rates can be turned off by setting the jerk rates to zero.

The accel / decel rates can also be turned off by setting them to zero. But, setting the accel / decel rates to zero is not recommended.

5.1.3.4 S-curve with Analog / Serial

When using speed commands given via the analog or serial channel, it is recommended that the accel and decel rates are used as a slew limit and the jerk rates turned off.

This is accomplished by setting the accel / decel rates to be greater then used by the car controller and setting the jerk rates to zero.

5.1.4 Speed Regulator

The speed regulator for the HPV 900 can be is a closed loop regulator with a torque limit. Also available with the speed regulator is a pre-torque command and a Torque Ramp Down function. The block diagram of the speed regulator is shown in Figure 5. 5.

The inputs to the speed regulator are the following:

- Speed Reference – the output of the speed reference generator and is described in *section (5.1.3)*.
- High / Low Gain – used to select, usually at higher speeds, a lower gain (response) in the speed regulator, *see section (5.1.4.1).*
- Pre-Torque – used to primes the speed regulator with an initial torque command, *see section (5.1.4.7).*
- Torque Command – used control the drive via a torque command from an external speed regulator, *see section (5.1.4.2.3).*
- Torque In – allows for a torque feedforward command to be added into the torque command via the serial channel or an analog input, *see section (5.1.4.8).*
- Tach Rate Gain – used for the tach rate function, which is used help dampen the rope resonance, *see section (5.1.4.5).*
- Ramp Down Enable – used to initiate the torque ramp down function, *see section (5.1.4.9).*
- Speed Regulator Release – an internal signal to the drive and is described in detail in the drive sequencing section, *see section (5.2).*

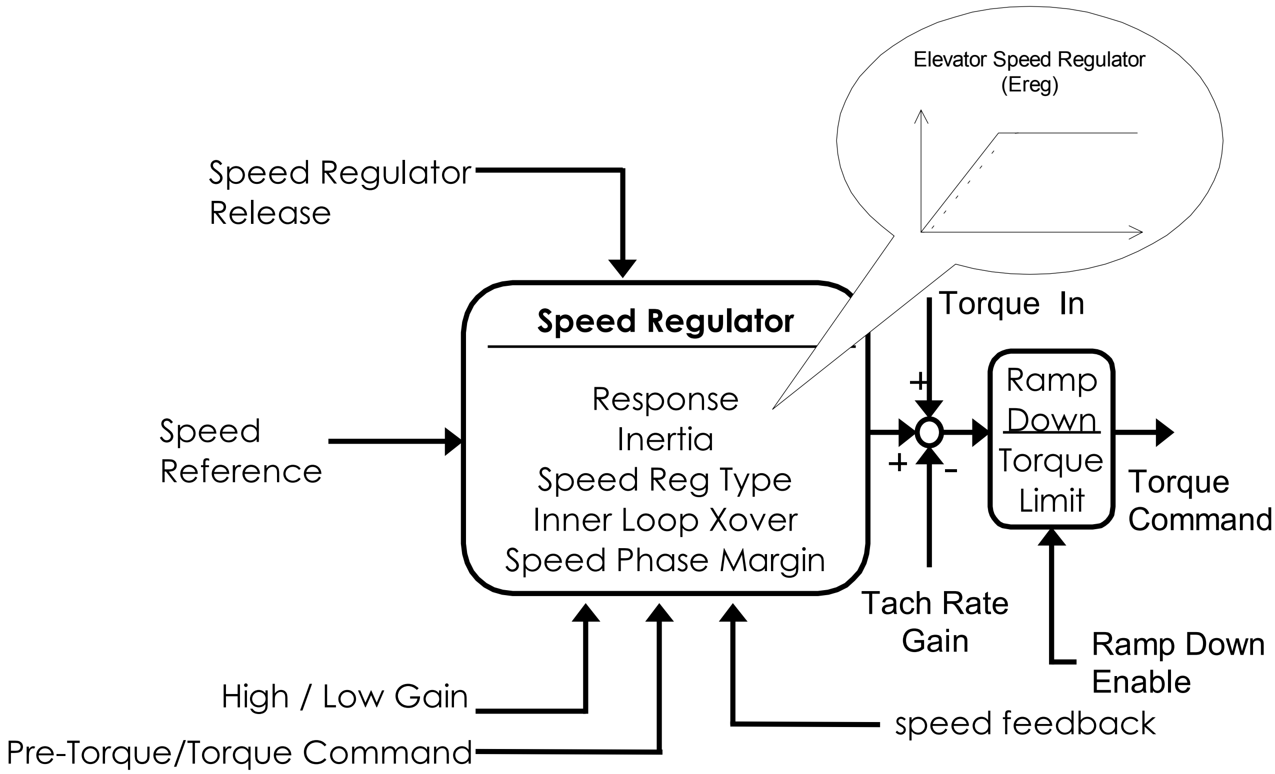


Figure 5. 5 - Speed Regulator Block Diagram

Internal to the speed regulator are the following:

- Response – sets the response (or gain) of the drive's speed regulator, see *section (5.1.4.3*).
- Inertia – is defined as the elevator system inertia and the value is used by the speed regulator, *see section (5.1.4.4).*
- Speed Reg Type – used to select the type speed regulator. The recommended choice is the Elevator Speed Regulator (Ereg), *see section (5.1.4.2.1).* The other speed regulator option is the PI Speed Regulator, *see section (5.1.4.2.2).*
- Inner Loop Xover – used by Elevator Speed Regulator (Ereg), *see section (5.1.4.2.1).*
- Speed Phase Margin – used by the PI Speed Regulator, *see section (5.1.4.2.2).*
- Ramp Down – the torque ramp down function, *see section (5.1.4.9).*
- Torque Limit – the speed regulator's torque limits, *see section (5.1.4.6).*

The output of the speed regulator is a torque command.

5.1.4.1 High / Low Gain

The speed regulator high / low gain function was developed in response to high performance elevator requirements where the resonant nature of the elevator system interferes with the speed response of the drive.

When the speed response (gain) is set to high levels, the resonant characteristics created by the spring action of the elevator ropes can cause car vibration. To solve this problem, the speed regulator is set to a low enough response (gain) so that the resonant characteristics of the ropes are not excited.

This is accomplished by controlling the sensitivity or response of the speed regulator via the high / low gain switch and gain reduce multiplier.

By using the gain reduce multiplier, the user can specify a lower response (gain) for the speed regulator when the drive is at higher speeds. The gain reduce multiplier (GAIN REDUCE MULT) tells the software how much lower, as a percentage, the speed regulator response (gain) should be. *For more information, see section (3.4.1).*

The high / low gain switch determines when the HPV 900 is in 'low gain' mode. In the 'low gain' mode, the gain reduce multiplier has an effect on the speed regulator's response (gain).

The drive allows for the high / low gain switch to be controlled either externally or internally. The high / low gain source parameter (HI/LO GAIN SRC) allows for this external or internal selection, *see section (3.5.1)*.

The high / low gain switch can be controlled externally by either:

- a logic input, *see section (3.5.2)*
- the serial channel.

The high / low gain switch can also be controlled internal by:

- the gain change level parameter (GAIN CHNG LEVEL), which defines a percentage of contract speed, *see section (3.4.1).*

With the drive set to internal control, the speed regulator will go into 'low gain' mode when the drive senses the motor is above a defined speed level. The defined speed level is determined by the gain change level parameter. An example of internal high / low gain control is shown in Figure 5. 6

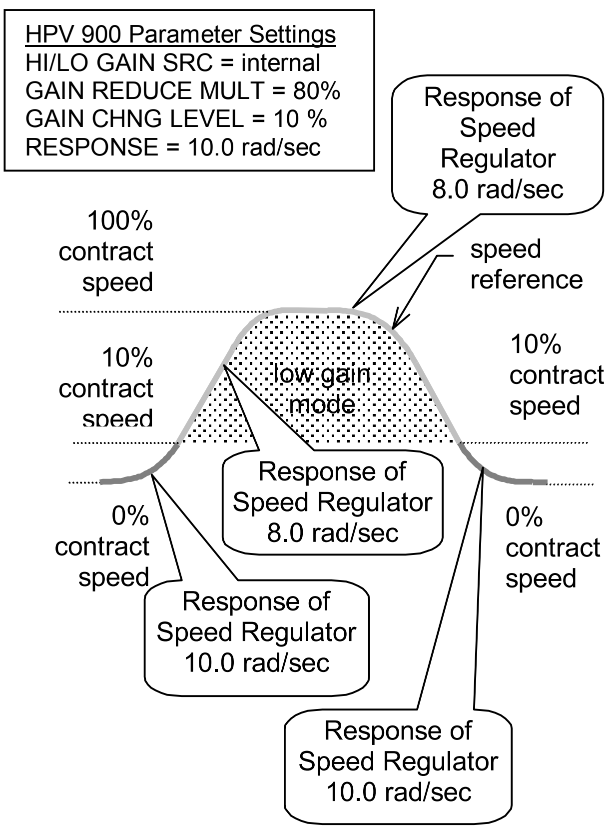


Figure 5. 6 - High / Low Gain Example

5.1.4.2 Speed Regulator Types

The HPV 900 has the following two closed loop speed regulation options and an option for turning off the internal speed regulator:

- Elevator Speed Regulator (Ereg)
- PI Speed Regulator
- External Speed Regulator

The Elevator Speed Regulator is recommended for use with elevator applications but is not required. The regulator type can be changed by using the SPEED REG TYPE (C1) parameter, *see section (3.5.1).*

5.1.4.2.1 Elevator Speed Regulator (Ereg)

The use of the Elevator Speed Regulator allows the overall closed loop response between speed reference and speed to be ideal for elevator applications. The desirable features of the Elevator Speed Regulator are:

- no overshoot at the end of accel period
- no overshoot at the end of decel period

One characteristic of the Elevator Speed Regulator is that during the accel / decel period the speed feedback does not match the speed reference creating a speed error or tracking delay. As an example, the Elevator Speed Regulator's speed response is shown for a ramped speed reference in Figure 5. 7.

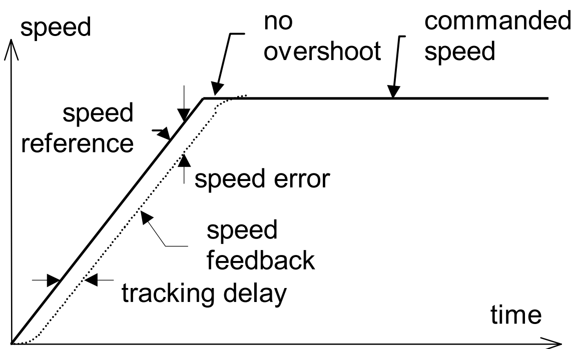


Figure 5. 7 – Ereg Example

The Elevator Speed Regulator is tuned by:

- System Inertia parameter (INERTIA), which is easy to obtain by using the drive software to estimate the system inertia, *see section (5.8); section (3.4.1); and section (5.1.4.4).*
- Response parameter (RESPONSE), which is the overall regulator bandwidth in radians per sec, *see section (3.4.1) and section (5.1.4.3).* This parameter defines the responsiveness of the speed regulator.

The tracking delay shown in Figure 5. 7 is defined as (1/RESPONSE) seconds. The tracking delay is not effected by the gain reduce multiplier.

The inner loop crossover parameter (INNER LOOP XOVER) should not need to be changed, *see section (3.4.1).* But if the number is changed, it must satisfy the following formula:

$$\textit{inner loop crossover} < \textit{response} \times \textit{gain reduce multiplier}$$

5.1.4.2.2 PI Speed Regulator

When the Proportional plus Integral (PI) speed regulator is used, the response to a speed reference is different. As an example, the PI Speed Regulator's speed response is shown for a ramped speed reference in Figure 5. 8. With the PI speed regulator, the end of each accel and decel period, there will be an overshoot. The amount of overshoot will be a function of the defined phase margin and response parameters.

Because of this overshoot, the PI regulator is not recommended for elevator control

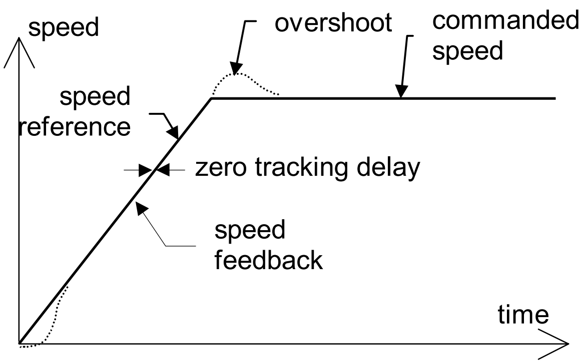


Figure 5. 8 - PI Speed Regulator Example

The PI Speed Regulator is tuned by:

- System Inertia parameter (INERTIA), which is easy to obtain by using the drive software to estimate the system inertia, *see section (5.8); section (3.4.1); and section (5.1.4.4).*
- Response parameter (RESPONSE), which is the overall regulator bandwidth in radians per sec, *see section (3.4.1) and section (5.1.4.3).* This parameter defines the responsiveness of the speed regulator.
- Speed Phase Margin parameter (SPD PHASE MARGIN) is used only by the PI Speed Regulator to define the phase margin of the speed regulator, *see section (3.4.1).*

5.1.4.2.3 External Speed Regulator

If the SPEED REG TYPE (C1) parameter is set to external regulator, the drive will be configured as a torque controller.

IMPORTANT

This assumes the car controller is doing its own closed-loop speed regulation. (i.e. a completely closed outer speed loop with the car controller having its own encoder feedback).

The source of the external torque command is determined by the EXT TORQ CMD SRC (C1) parameter. The options are serial and analog input (via analog input channel #2).
When set to analog input the scaling in analog input channel #2 will be

- +10VDC = positive 250% of the rated torque of the motor
- -10VDC = negative 250% of the rated torque of the motor

NOTE: if EX TORQ CMD SRC is set to either analog input, ensure the PreTorque SOURCE (C1) parameter is set to either none or serial

Torque Control Handshaking Signals

- Logic inputs – DRIVE ENABLE and RUN
- Logic outputs – SPD REG RLS (speed regulator release)

Also, the following faults/alarms have noted changes:

- Encoder Flt - Since the speed ref will be zero during torque control, the drive will only be able to check for an encoder fault at the higher speeds, when it compares motor voltage with encoder pulses.
- Overspeed Flt - Need to properly set the CONTRACT CAR SPD and CONTRACT MTR SPD (A1) parameters.

- Speed Dev - will need to be set out of the way by setting the SPD DEV HI LEVEL (A1) parameter to 99.9%

5.1.4.3 Speed Regulator Response

This parameter sets the response of the regulator in terms of the speed regulator bandwidth in rad/sec. This parameter defines the responsiveness of the drive as it follows the speed reference, *see section (3.4.1).*

If the response is set to a large number, the speed error and tracking delay will be small. But, the speed regulator will be less stable.

If the response is set to a small number, the speed regulator will be more stable. But, the speed error and tracking delay will be large.

A lower gain (response) can be specified for the speed regulator at higher speeds by using the high / low gain switch *(see section 5.1.4.1)*.

5.1.4.4 Inertia

This parameter sets the elevator system inertia in seconds and is used to accurately tune the speed regulator, *see section (3.4.1).*

The system inertia is the time in seconds it takes the elevator system to accelerate from zero to rated speed, while the motor is producing the rated torque.

The HPV 900 software can be used to calculate the inertia of the elevator system, see section (5.8).

5.1.4.5 Tach Rate Gain

The tach rate function is available for high performance systems that exhibit problems with rope resonance characteristics.

This function subtracts a portion of the speed feedback derivative from the output of the speed regulator. The Tach Rate Gain parameter (TACH RATE GAIN) selects a unitless gain factor that determines how much of the derivative is subtracted, *see section (3.4.1).*

5.1.4.6 Torque Limit

The following two parameters adjust these maximum torque limits:

- Motor Torque Limit parameter (MTR TORQUE LIMIT) – sets the maximum torque allowed when the drive is in motoring mode *(see section 3.4.1).*
- Regenerative Mode Torque Limit parameter (REGEN TORQ LIMIT) - sets the maximum amount of regenerative torque the drive will allow during regeneration, *see section (3.4.1).*

Both these torque limits can have an effect on field weakening, *see section (5.1.5.1).*

5.1.4.7 Pre-Torque

Pre-torque is the value of torque that the drive should produce as soon as the speed regulator is released to prevent rollback due to unbalanced elevator loads.

This ‘priming’ of the speed regulator is done with the pre-torque command, which is used when the speed regulator release is asserted. The speed regulator release is an internal signal to the drive and is described in detail in the drive sequencing section, *see section (5.2).*

The two possible sources for the pre-torque command are following:

- serial channel
- analog channel

For more information on the Pre-Torque Source parameter, see section (3.5.1).

5.1.4.7.1 Pre-Torque Via Serial Channel

The serial channel is a RS-422 serial port located on the drive control board. *For further information, see section (5.4).*

5.1.4.7.2 Pre-Torque Via Analog Channel

The pre-torque channel is bipolar (±10V). The speed command channel is predetermined as analog channel #2. Available with the analog channel is a Pre-Torque Command Multiplier (PRE TORQUE MULT) and Pre-Torque Bias (PRE TORQUE BIAS). These parameters are used to scale the user’s analog pre-torque command to the proper range for use by the drive software.

The formula below shows the scaling effects of these two parameters.

$$\left(\begin{matrix} analog \\ channel\#2 \\ input \\ voltage \end{matrix} - \begin{matrix} PRE \\ TORQUE \\ BIAS \end{matrix} \right) \times \begin{matrix} PRE \\ TORQUE \\ MULT \end{matrix} = \begin{matrix} signal \\ drive \\ software \\ uses \end{matrix}$$

In the following example, the user is supplying the drive a 0 to +10V signal on analog channel #2 and the user wants to supply a pre-torque command from positive 100% of the motor's rated torque to negative 100% of the motor's rated torque. Therefore, the signal on analog channel #1 will need to be scaled before it is used by the drive software by configuring the parameters as shown in Figure 5. 9.

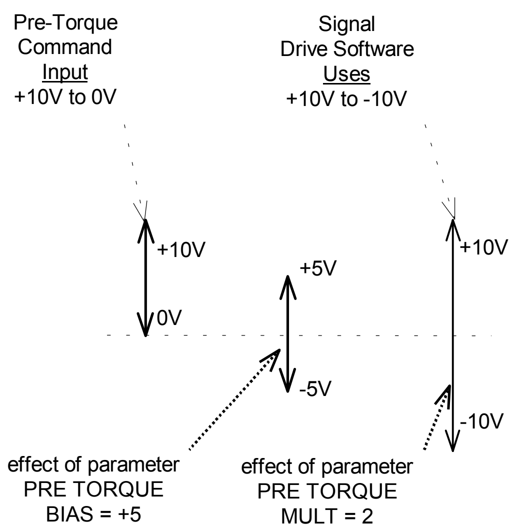


Figure 5. 9 - Example Analog Gain & Bias

5.1.4.7.3 Using Pre-Torque Latch

Some car controllers send the pre-torque and speed command on the same analog channel (see Figure 5. 10). To facilitate this, the HPV 900 has the option of latching the pre-torque command.

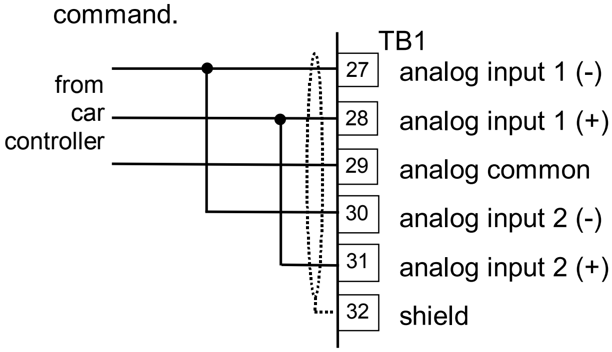


Figure 5. 10 – One Channel Analog Cmds

If pre-torque latching is selected using the Pre-Torque Latch parameter *(see section* 0*)*, a FALSE to TRUE transition on the pre-torque latch clock latches the value on the pre-torque channel (analog input channel 2) into the drive. This channel is allowed to change any time except during this transition without affecting the value of the latched pre-torque command.

The Pre-Torque Latch Clock controls when the pre-torque command is latched. The Pre-Torque Latch clock parameter (PTorq LATCH CLCK) determines the source of this latch control. The two choices for latch control are the serial channel or a logic input (EXTERNAL TB1). *For more information see section (3.5.1).*

The latched pre-torque command is used by the speed regulator when the internal Speed Regulator Release signal is asserted. Once the pre-torque command is used the latch and the pre-torque command is cleared. *For more information on the Speed Regulator Release signal, see section (5.2).*

5.1.4.8 Torque Feedforward Command

If the SPEED REG TYPE (C1) parameter is set for a speed regulator (either pi speed reg or elev spd reg) and the EX TORQ CMD SRC (C1) parameter is set to either serial or analog input , the torque command is an auxiliary torque command (torque feedforward command).

When the EX TORQ CMD SRC (C1) parameter is set to analog input the scaling in analog input channel #2 will be

- +10VDC = positive 250% of the rated torque of the motor
- -10VDC = negative 250% of the rated torque of the motor

NOTE: if EX TORQ CMD SRC is set to either analog input, ensure the PreTorque SOURCE (C1) parameter is set to either none or serial

5.1.4.9 Torque Ramp Down

A function unique to elevators involves the interaction between the motor torque and the mechanical brake that holds the elevator. Under full load conditions at the end of a run, if the brake is set and the motor torque is removed quickly, some brake slippage may occur. Therefore, the option of gradually reducing the motor torque is provided by the Torque Ramp Down Stop function.

Upon being enabled by the Ramped Stop Select Parameter (RAMPED STOP SEL), *see section (3.5.1)*, the torque command is linearly ramped to zero from the value that was present when the 'Ramp Down Enable' was selected.

The Ramp Down Enable has the following three possible sources:

- An input logic bit (EXTERNAL TB1)
- The run logic – initiated by the removal of the run command
- The serial channel

The Ramp Down Enable Source parameter (RAMP DOWN EN SRC) is used to select one of the above options, *see section (*0*).*

A method of providing the Ramp Down Enable would be with a logic signal (EXTERNAL TB1) that is dedicated to that function. The Ramp Down Enable would be asserted while the Run command is still present and remain there until the ramp is completed, after which the Run command would be removed.

The RUN LOGIC option to trigger the Ramp Down Enable from the Run command is provided. In this case, removal of the Run command enables the Ramp Down Stop Function.

The time it takes for the HPV 900 to perform its ramped stop is determined by the Ramped Stop Time Parameter, *see section (3.4.1).* The Ramped Stop Time parameter (RAMPED STOP TIME) selects the amount of time it would take for the drive to ramp from the rated torque to zero torque.

5.1.4.10 Speed Deviation

The following two functions are available to indicate how the speed feedback is tracking the speed reference.

- Speed Deviation Low – indicates that the speed feedback is tracking the speed reference within a defined range.
- Speed Deviation High – indicates that the speed feedback is failing to properly track the speed reference.

The Speed Deviation Low function has the ability to set a configurable logic output*, see section (3.5.3).* The logic output will be true, when the speed feedback is tracking the speed reference within a defined range around the speed reference for a defined period of time (see Figure 5. 11). The defined range is determined by the Speed Deviation Low Level parameter (SPD DEV LO LEVEL) and the defined time is determined by the Speed Deviation Time parameter (SPD DEV TIME), *see section (3.4.1).*

The Speed Deviation High function annunciates a Speed Deviation Alarm*, see section (3.7.1.7)*, and has the ability to set a configurable logic output*, see section (3.5.3).* The alarm will be annunciated and the logic output will be true, when the speed feedback is not properly tracking the speed reference and is outside a defined range around the speed reference (see Figure 5. 11). The defined range is determined by the Speed Deviation High Level parameter (SPD DEV HI LEVEL), *see section (3.4.1).*

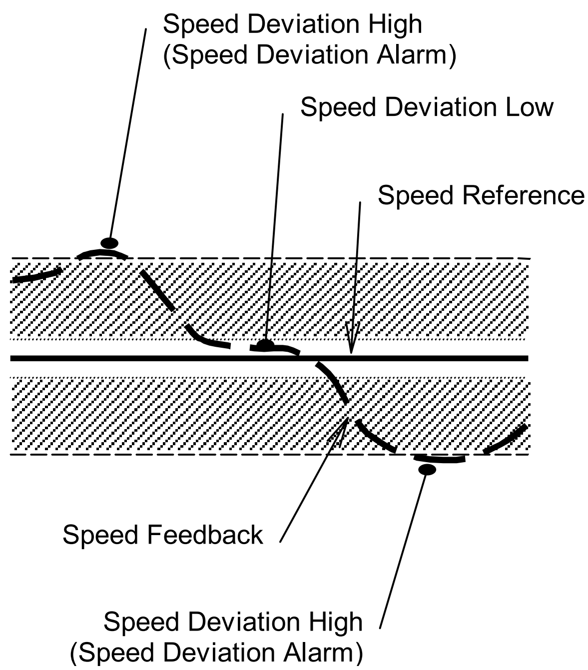


Figure 5. 11 - Speed Deviation Example

5.1.5 Vector Control

The torque control of the HPV uses digital flux vector control technology. The block diagram of the vector control is shown in Figure 5. 12

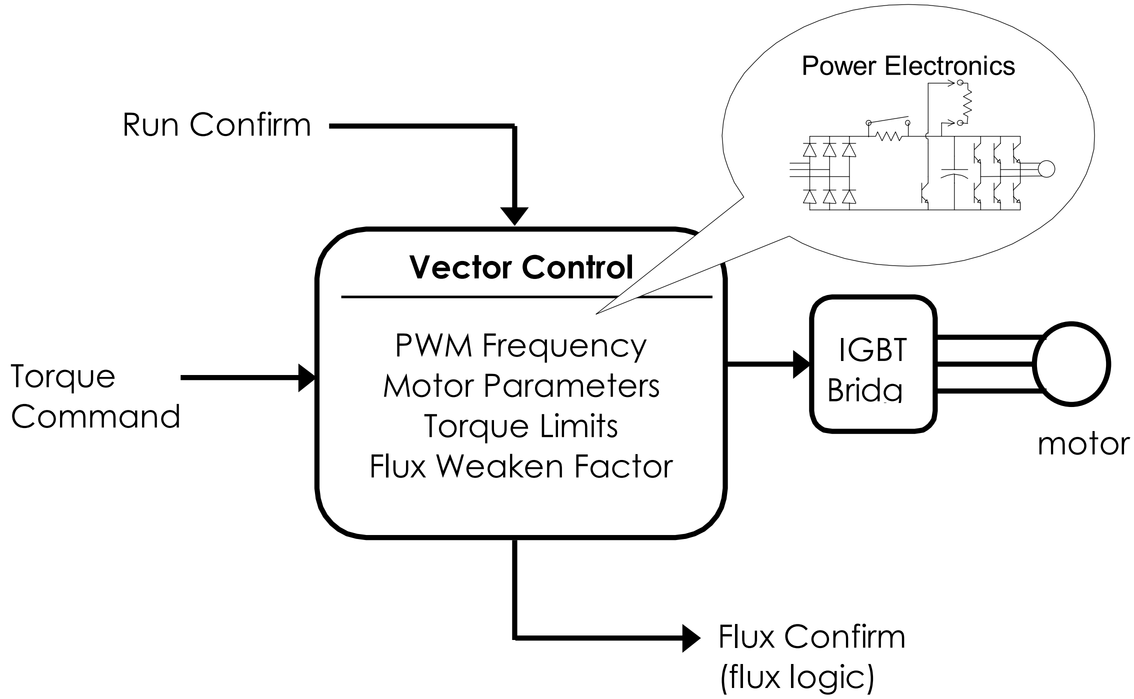


Figure 5. 12 - Vector Control Block Diagram

The inputs to the vector control are the following:

- Torque Command– the output of the speed regulator and is described above in *section (5.1.4*).
- Run Confirm – an internal signal to the drive and is described in detail in the drive sequencing section, *see section (5.2).*

Internal to the vector control are the following:

- PWM Frequency – sets the pulse width modulation frequency or 'carrier' frequency of the drive, see *section (3.4.4).*
- Motor Parameters – used to defined the characteristics of the motor connected to the drive, *see section (3.4.5).*
- Torque Limits – the HPV 900 defined torque limits, *see section (5.1.4.6).* The setting of these parameters have an effect on when the HPV 900 goes into field weakening, *see section (5.1.5.1).*
- Flux Weaken Factor – is defined, *see section (5.1.5.1).*

The output of the vector control goes through the power electronics to the motor.

- Flux Confirm – an internal signal generated by the drive, when the drive's estimated flux level reaches 90% of the flux reference. This signal is the "flux logic" input shown in the drive sequencing section, *see section (5.2).*

5.1.5.1 Field Weakening

The HPV 900 will calculate the rated flux level by using the following motor parameters:

- rated motor voltage
- rated motor current
- rated excitation frequency
- stator resistance
- stator and rotor leakage reactances.

As motor speed increases, the drive will calculate the maximum available flux and decrease the flux automatically. This 'field weakening' will cause less torque to be available during this time.

5.1.5.1.1 Traditional Flux Weakening

Traditionally, AC drives set the flux level to 100% up to rated speed, then reduce it above rated speed.

The product of flux and speed produces a CEMF. The drive's output voltage must overcome the CEMF and voltage drop across the leakage inductance to produce current.

With traditional flux control, the drive cannot supply more than 100% current and therefore 100% torque, at the motor's rated speed.

The speed-torque curve of a traditional AC drive is shown in Figure 5. 13.

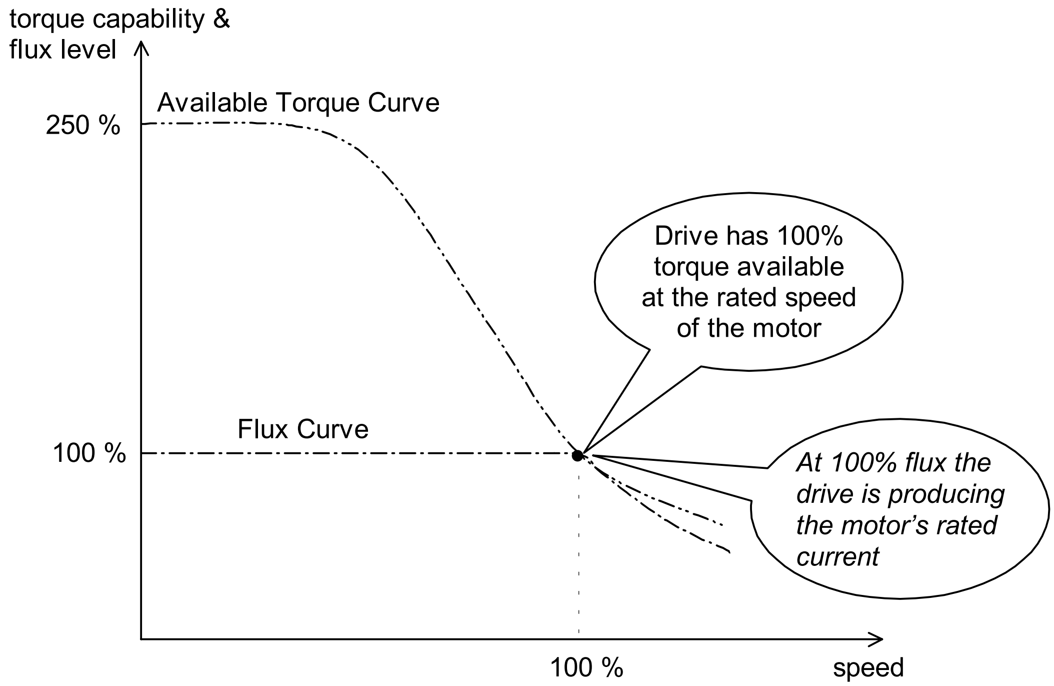


Figure 5. 13 - Speed-Torque Curve (Traditional Flux Weakening)

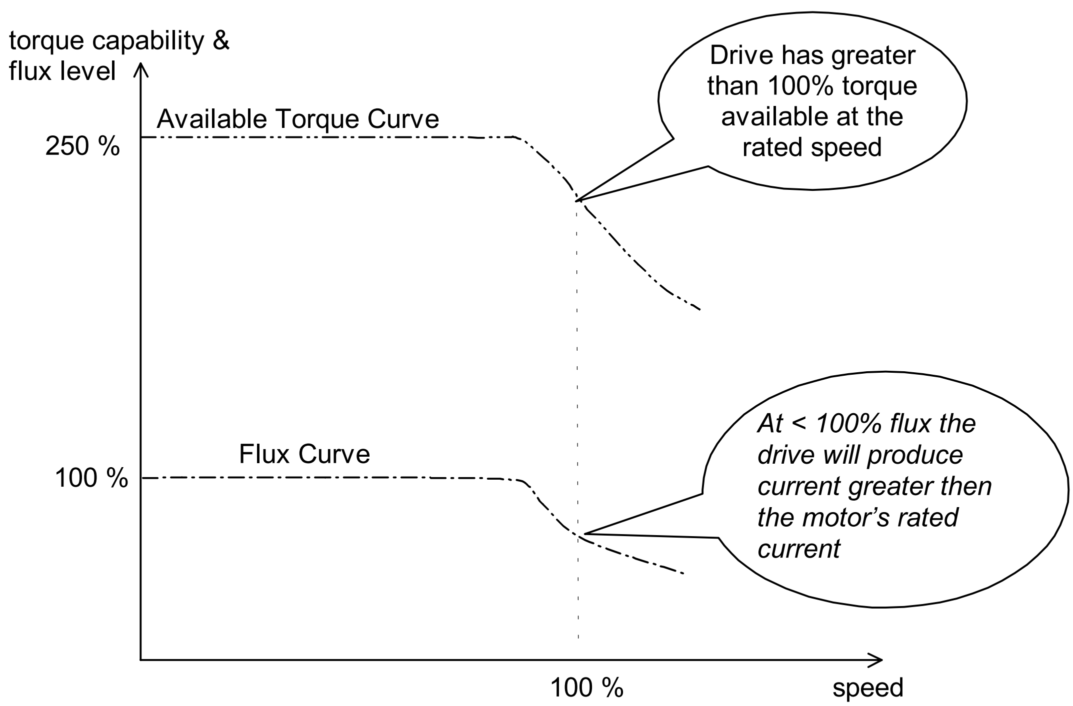


Figure 5. 14 - Speed-Torque Curve (HPV 900 Flux Weakening)

5.1.5.2 Flux Weakening

In the HPV 900, flux weakening begins before the motor reaches rated speed.

The drive can supply more than 100% current, since the CEMF is lower. Therefore, the drive can produce more than 100% of the motor's rated torque at the rated speed.

Figure 5. 14 shows the speed-torque curve of a drive system operating at 250% current. Note that the "earlier" flux weakening allows the drive to supply more than 100% torque at rated speed.

However, this increased torque capability requires more than 100% motor current to produce 100% torque at rated speed.

5.1.5.3 Flux Weakening Parameters

The following three HPV 900 parameters effect both the available torque curve and flux level curve:

- Motor Torque Limit (MTR TORQUE LIMIT)
- Regenerative Mode Torque Limit (REGEN TORQ LIMIT)
- Flux Weakening Factor (FLUX WKN FACTOR)

The highest of the two torque limits is used as the torque limit that defines the two curves.

An example of the effects of the torque limit on the amount of flux weakening needed and the amount of torque available through the entire speed range is shown in Figure 5. 15.

By lowering the torque limit you can effectively reduce the amount of field weakening needed and reduce the amount of current needed by the motor at motor's rated speed. The trade-off is you have lower over-all torque available.

In order to have more torque available at the lower speeds, the HPV 900 has the Flux Weakening Factor parameter, which effectively reduces the amount of torque available only at the higher speeds. This will allow the HPV 900 to have a higher flux level at the motor's rated speed and require less current to produce rated torque.

An example of the effects of the flux weakening factor on the amount of flux weakening needed and the amount of torque available through the entire speed range is also shown in Figure 5. 15.

The maximum amount of torque available can be defined as the following:

- At low speeds… the torque limit parameters
- At high speeds… function of the torque limit parameters and the flux weakening factor

For more information on the torque limit parameters or the flux weakening factor, see section (3.4.1).

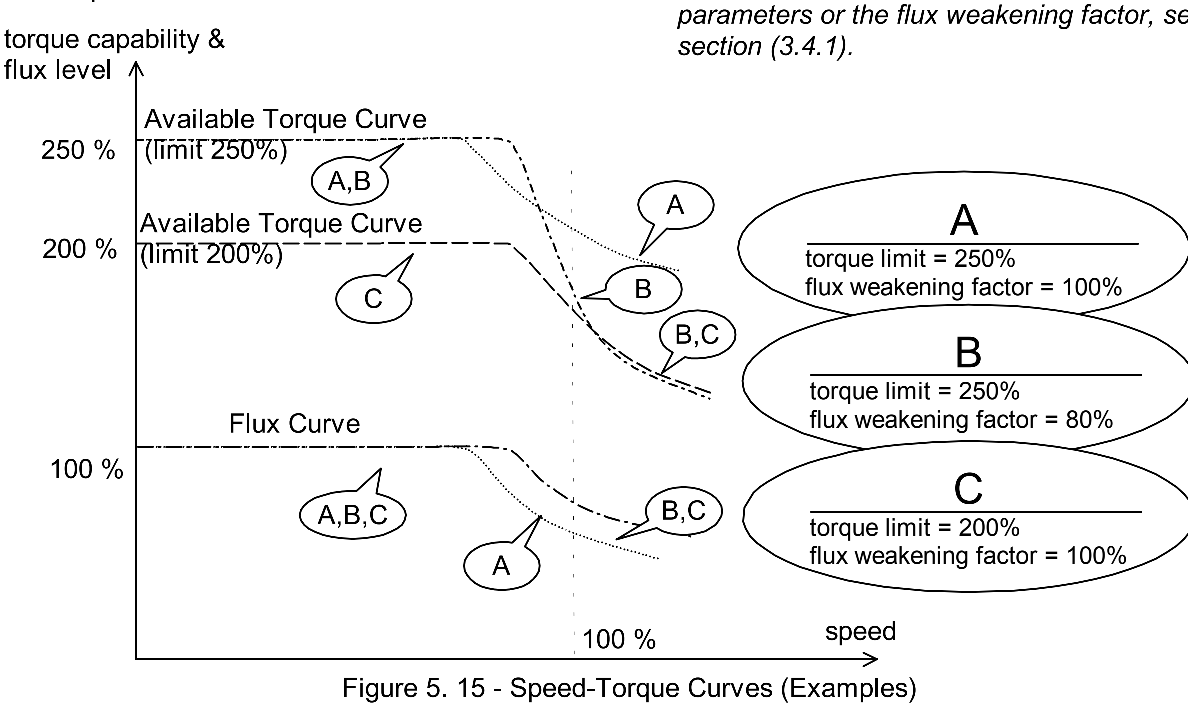


Figure 5. 15 - Speed-Torque Curves (Examples)

5.2 DRIVE SEQUENCING

In order to ensure proper operation, the interaction between the car controller and the drive need to correspond to a defined sequence of events.

This section details the following:

- When to apply the speed command (either by multi-step, analog, or serial).
- The interaction of opening and closing the motor contactor.
- The interaction of picking (opening) and setting (closing) the mechanical brake.
- The necessity of the drive enable (linked to safety chain).
- When to apply the run command (either RUN, RUN UP, or RUN DOWN).
- The states of some drive feedback signals via logic outputs (either open collector or relay).

5.2.1 Drive Sequencing Summary

Standard
- The car controller controls both the motor contactor and the mechanical brake.

With Contactor Feedback
- The car controller controls both the motor contactor and the mechanical brake.
- The drive receives feedback from the motor contactor.

Using Torque Ramp Down Feature
- The car controller controls both the motor contactor and the mechanical brake.
- With this function enabled and the brake is set, the drive will gradually reduce the motor torque (to help control brake slippage).

Using Pre-Torque Command
- Shows timing for Pre-Torque command

With Brake / Contactor Control
- The drive can control both the motor contactor and the mechanical brake.
- The drive can receive feedback from both the motor contactor and the mechanical brake.

5.2.2 Standard I/O Sequence

Figure 5. 16 details the HPV 900's standard input/output sequence. Where the car controller controls both the motor contactor and the mechanical brake.

5.2.2.1 Standard Sequencing Timing Diagram Notes

1) The edge ***h*** represents the motor contactor state when the car controller controls the motor contactor. With this case, ***a*** time should be greater then the time taken by the contactor to close in order to avoid the drive attempting to pass current while the contactor is closing.
2) The edge ***b*** (up/down and S-curve sel) should be applied before or at the Run command
3) The duration ***c*** is the time taken by the drive to build the flux ≈ 150 msec
4) The mechanical brake should be picked when the Speed Regulator Release (output) goes true, but the mechanical brake should be set before the Speed Regulator Release (output) goes false.
5) During the brake pick time = ***d***, the speed reference should be zero
6) During the brake apply time (at the end of the run) ***e***, the speed command must be zero
7) The edge ***g*** should occur during ***e*** & ***f***
8) ***f*** time should be greater then the time taken by contactor open

Other notes:
- These timing are as seen by the drive
- It is also assumed that during ***e*** the actual speed has become zero. (i.e. the actual speed is zero before edge ***g***)

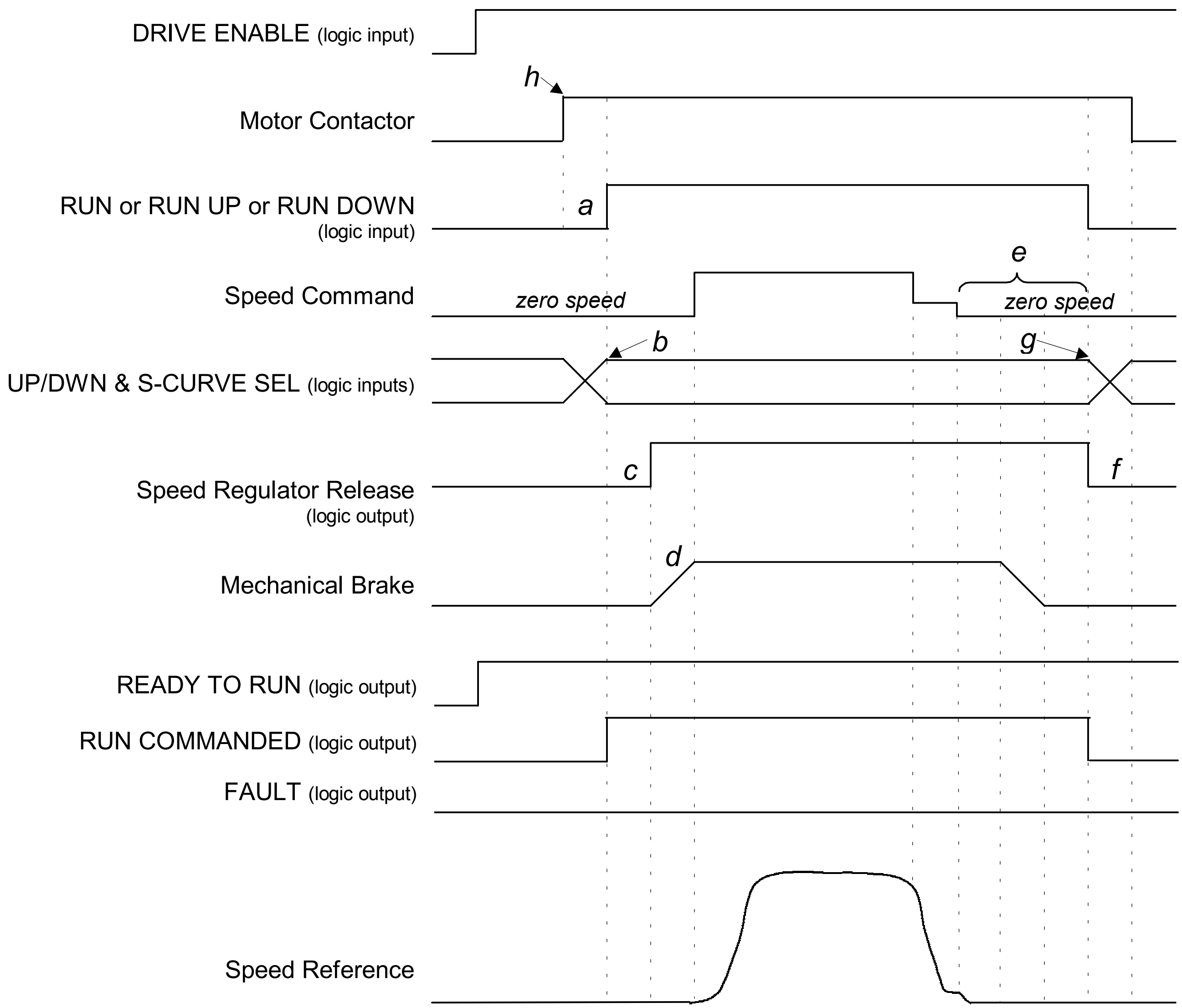


Figure 5. 16 - Standard Timing Diagram

5.2.3 I/O Sequence with Motor Contactor Feedback

Figure 5. 17 details the changes in the input/output sequence when drive receives feedback from the motor contactor. Where the car controller controls both the motor contactor and the mechanical brake, but the drive receives feedback from the motor contactor.

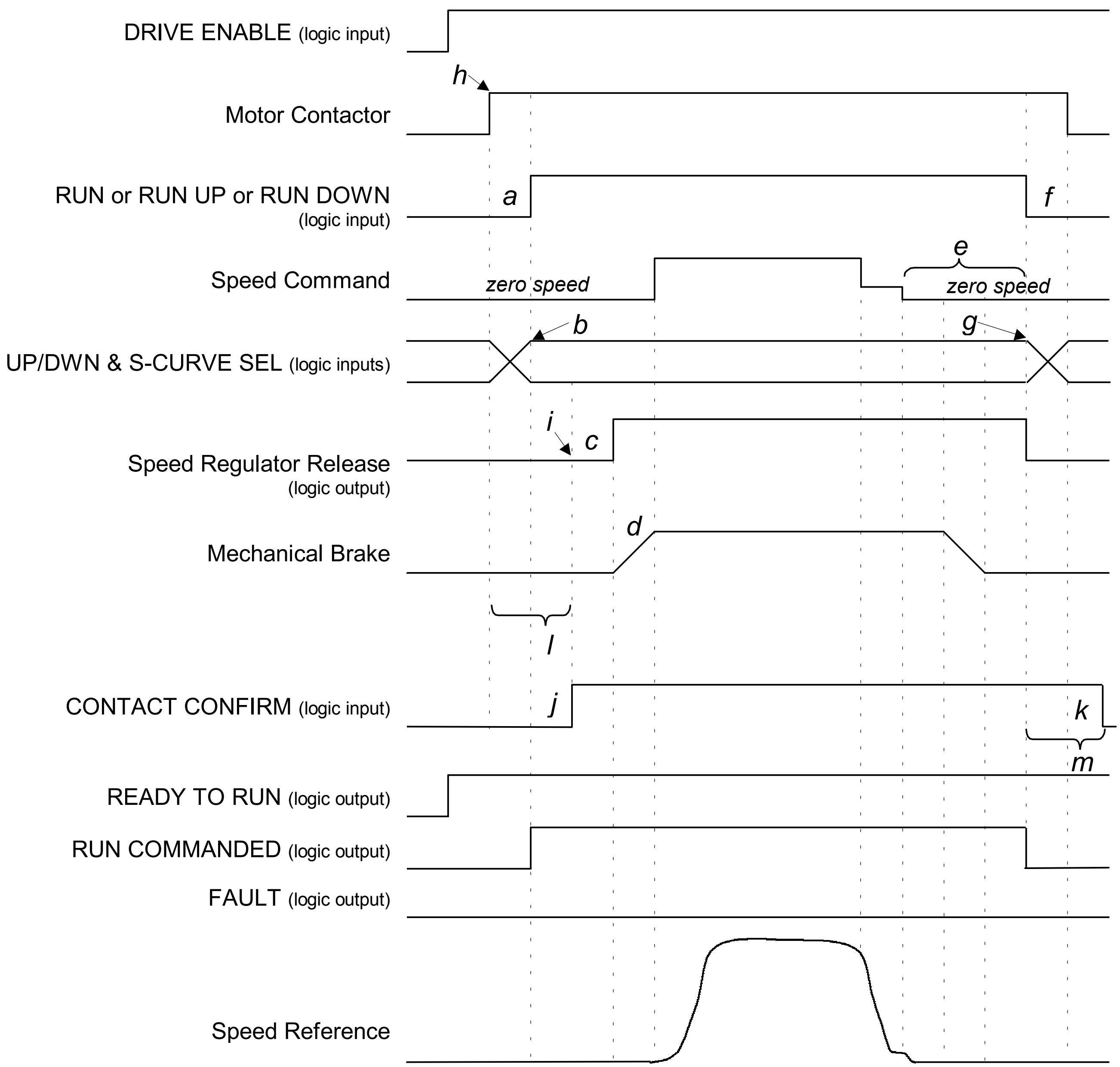


Figure 5. 17 - Timing Diagram with Motor Contactor Feedback

5.2.3.1 Sequencing Notes with Contactor Feedback Timing Diagram

1) The edge ***h*** represents the motor contactor state when the car controller controls the motor contactor.
2) The edge ***b*** (up/down and S-curve sel) should be applied before or at the Run command
3) When using contactor confirm (CONT CONFIRM SRC=external tb1), the edge ***i*** shows the speed regulator release signal is held up until the CONTACT CONFIRM logic input goes true.
4) The duration ***c*** is the time taken by the drive to build the flux ≈ 150 msec
5) The mechanical brake should be picked when the Speed Regulator Release (output) goes true, but the mechanical brake should be set before the Speed Regulator Release (output) goes false.
6) During the brake pick time = ***d***, the speed reference should be zero
7) During the brake apply time (at the end of the run) ***e***, the speed command must be zero
8) The edge ***g*** should occur during ***e*** & ***f***
9) ***f*** time should be greater then the time taken by contactor open
10) ***l*** and ***k*** represent the time needed for the contactor feedback to reach the drive.
11) ***j*** and ***m*** represent the time between the run signal and the contact confirm signal. The time needs to be less than the CONTACT FLT TIME parameter or a Contactor Fault will occur.

Other notes:

- These timing are as seen by the drive
- It is also assumed that during ***e*** the actual speed has become zero. (i.e. the actual speed is zero before edge ***g***)
- Contact Flt Time (A1) defines the time before a Contactor Fault is declared.
  - the time starts with drive enable going true and either the run signal (run, runup, or rundown) or contact confirm logic input going true
  - the time ends with either the contact confirm or run signal (opposite of above so both signals are true) must then go true before the contact fault time (or Contactor Fault declared)

5.2.4 I/O Sequence using the Torque Ramp Down Feature

Figure 5. 18 details the changes in the input/output sequence when using the Torque Ramp Down function. Where the car controller controls both the motor contactor and the mechanical brake. With this function enabled and the brake is set, the drive will gradually reduce the motor torque (to help control brake slippage). *For more information, see section (5.1.4.9).*

5.2.4.1 Sequencing Notes using Torque Ramp Down Feature Timing Diagram

1) The edge ***h*** represents the motor contactor state when the car controller controls the motor contactor. With this case, ***a*** time should be greater then the time taken by the contactor to close in order to avoid the drive attempting to pass current while the contactor is closing.
2) The edge ***b*** (up/down and S-curve sel) should be applied before or at the Run command
3) The duration ***c*** is the time taken by the drive to build the flux ≈ 150 msec
4) The mechanical brake should be picked when the Speed Regulator Release (output) goes true, but the mechanical brake should be set before the Speed Regulator Release (output) goes false.
5) During the brake pick time = ***d***, the speed reference should be zero
6) During the brake apply time (at the end of the run) ***e***, the speed command must be zero
7) The edge ***g*** should occur during ***e*** & ***f***
8) ***f*** time should be greater then the time taken by contactor open
9) ***h*** represents the time, after the mechanical brake is set, that the torque output will ramp to zero (based on RAMPED STOP TIME parameter). This is the Torque Ramp Down feature and needs to be enabled (RAMPED STOP SEL=ramp on stop / RAMP DOWM EN SRC=run logic)

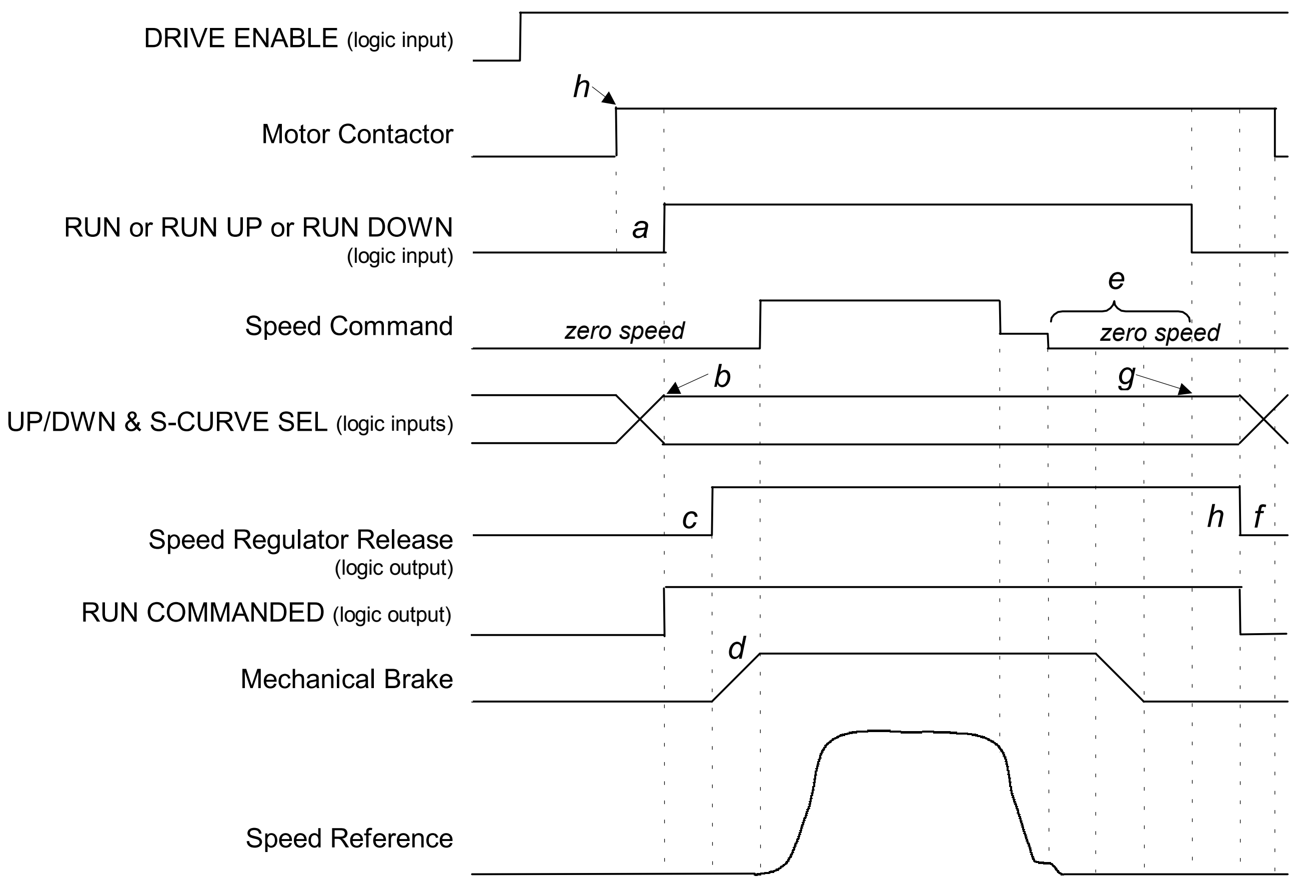


Figure 5. 18 - Timing Diagram using Torque Ramp Down feature

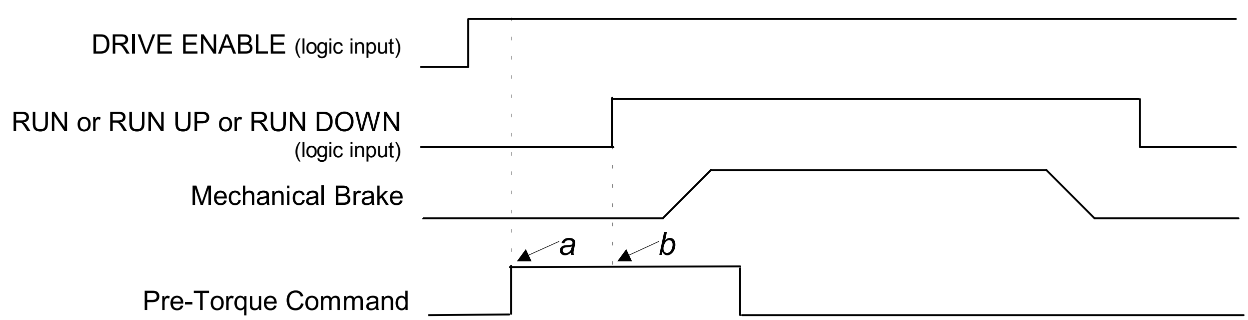


Figure 5. 19 – Timing Diagram using Pre-Torque Command

Other notes:

- These timing are as seen by the drive
- It is also assumed that during ***e*** the actual speed has become zero. (i.e. the actual speed is zero before edge ***g***)

5.2.5 I/O Sequence using the Pre-Torque Command

Figure 5. 19 shows timing for Pre-Torque command.

5.2.5.1 Sequencing Notes using Pre-Torque Command Timing Diagram

1) The edge ***a*** shows that the Pre-Torque Command must be applied before the RUN command
2) At edge ***b*** (when the RUN command is applied), the drive software uses the value present on analog channel #2 for the Pre-Torque Command, if enabled (PreTorque SOURCE=analog input)

5.2.6 I/O Sequence with Brake / Contactor Control

Figure 5. 20 details the HPV 900's standard input/output sequence. Where the drive controls and could get feedback from both the motor contactor and the mechanical brake.

5.2.6.1 Sequencing Notes with Brake / Contactor Control Timing Diagram

1) The edge ***h*** represents the motor contactor state when the car controller controls the motor contactor. With this case**, *a*** time should be greater then the time taken by the contactor to close in order to avoid the drive attempting to pass current while the contactor is closing.
2) The edge ***i*** represents the motor contactor state when the drive controls the motor contactor via the CLOSE CONTACT (logic output). With this case, the ***a*** time would be determined by the drive.
3) The edge ***b*** (up/down and S-curve sel) should be applied before or at the Run command
4) When using contactor confirm (CONT CONFIRM SRC=external tb1), the edge ***l*** shows the speed regulator release signal is held up until the CONTACT CONFIRM logic input goes true.
5) The duration ***c*** is the time taken by the drive to build the flux ≈ 150 msec
6) To control the mechanical brake, set following parameters: BRAKE PICK SRC=internal and SPD REF RELEASE =brake picked. And use the BRAKE PICK (logic output) to control the brake.
7) The edge ***j*** shows when the brake is picked. Becomes true when the speed regulator release goes true.
8) During the brake pick time = ***d***, the speed reference should be zero
9) When using brake pick confirm (BRAKE PICK CNFM=external tb1), the speed reference will be held at zero speed until the MECH BRAKE PICK (logic input) is true, thus assuring the speed reference being zero during the brake pick time.
10) ***m*** and ***n*** represent the time needed for the brake feedback to reach the drive. They need to less than the BRAKE PICK TIME parameter or a Brk Pick Flt will occur.
11) When the RUN command is removed (at the end of the run) ***e***, the speed command must be zero
12) The edge ***k*** shows when the brake is set. Goes false when the run signal goes false.
13) ***g*** time is based on the BRAKE PICK TIME and starts when the RUN command goes false.
14) Ensure that the ***g*** time is greater than the amount of time for the brake to set.
15) ***f*** time should be greater then the time taken by contactor open
16) ***o*** and ***p*** represent the time needed for the contactor feedback to reach the drive. They need to less than the CONTACT FLT TIME parameter or a Contactor Fault will occur.

Other notes:

- These timing are as seen by the drive
- It is also assumed that by edge ***e*** the actual speed is zero.
- When using brake pick confirm logic input (MECH BRAKE PICK), a Brake Pick Fault can be enabled and will declare a fault if the brake pick confirm logic input does not go true at the beginning of a run and false at the end of the run before the time defined by the BRAKE PICK TIME.

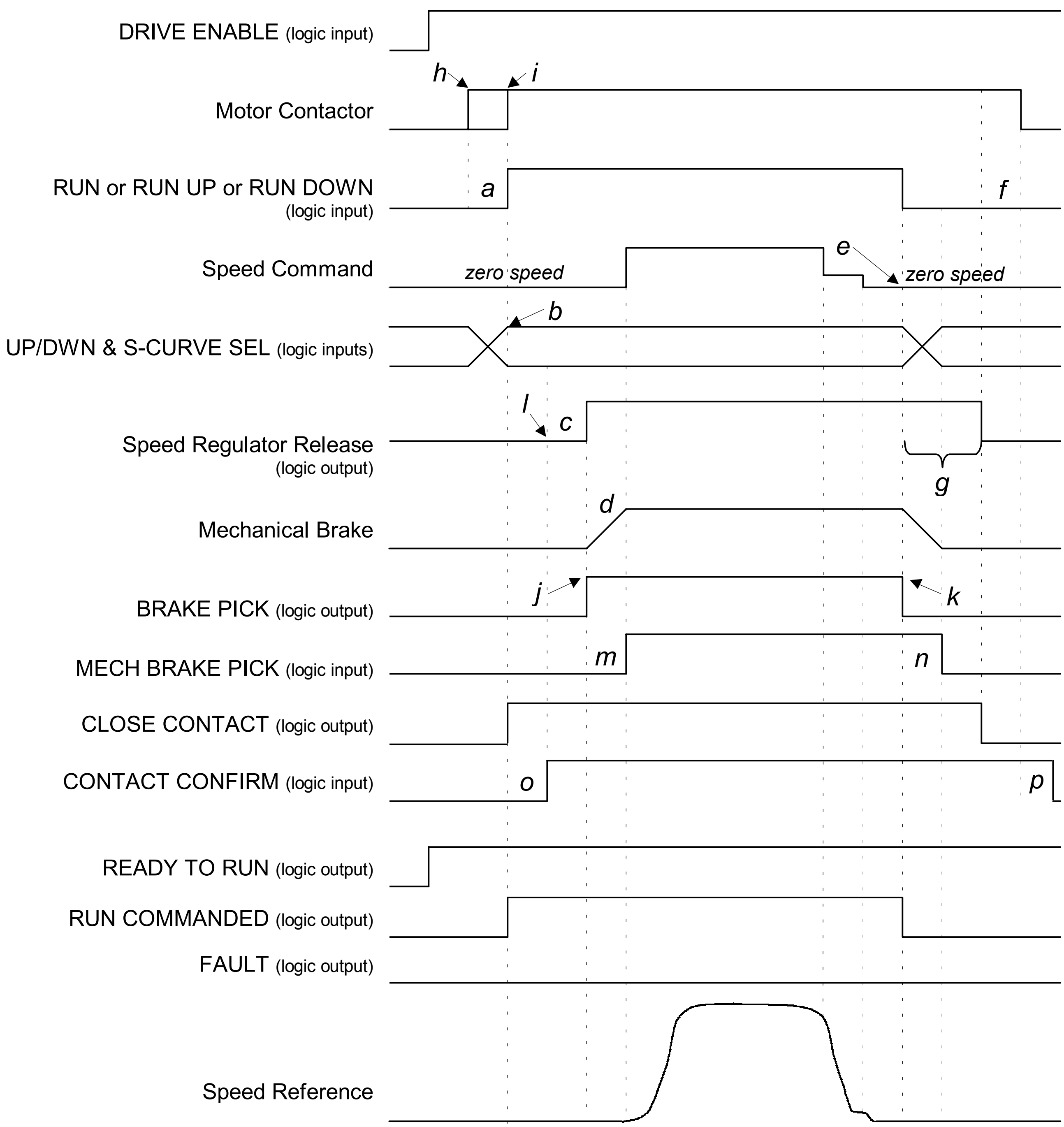


Figure 5. 20 - Timing Diagram with Brake / Contactor Control

5.2.7 Sequencing Descriptions

DRIVE ENABLE
An external logic input intended to be used with the elevator control's safety chain as a permissive that provides a way for external logic to shut down the drive. The drive will not be permitted to run until this signal is true.

Motor Contactor
If the car controller controls the motor contactor, the motor contactor must be closed before the run command is issued and should remain closed until at least the RUN COMMANDED logic output goes false. If the drive controls the motor contactor, it is done via the CLOSE CONTACT logic output and a feedback option is available with the CONTACT CONFIRM logic input.

RUN (or RUN UP / RUN DOWN)
An external logic input that commands the drive to run. But, before a run command can be recognized, the Ready to Run output must be true. For the Ready to Run output to be true, the following conditions must be present: the software must be up & ready and no fault can be present.

- RUN - If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation.
- RUN DOWN - If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with negative speed commands. Note: if both RUN UP and RUN DOWN are true then the run is not recognized.
- RUN UP - If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with positive speed commands. Note: if both RUN UP and RUN DOWN are true then the run is not recognized.

Speed Command
The commanded speed profile from the multi-step logic inputs, the analog channel, or the serial channel.

UP/DWN or S-CURVE SEL
The following external logic outputs:

- UP/DWN logic input - used to change the sign of the speed command (change also be accomplished with the RUN UP / RUN DOWN)
- S-CURVE SEL logic inputs – used to select different s-curves

These logic inputs should be selected before the run command is initiated.

Speed Regulator Release
An internal signal to the drive used to control the HPV 900's speed regulator. When the output is true current is being sent to the motor.

Mechanical Brake
Shows the state of the mechanical brake. A true state is when the brake is picked (open). The mechanical brake should be picked before a non-zero speed command is given. The drive can also control the mechanical brake, it is done via the BRAKE PICK logic output and a feedback option is available with the MECH BRAKE PICK logic input.

READY TO RUN
An external logic output the signals the following: the software must be up & ready and no faults are present

RUN COMMANDED
An external logic output reflects the condition of the RUN logic input.

FAULT
An external logic output that becomes true when a fault is present in the drive.

Speed Reference
Shows the speed reference as it follows the HPV 900's internal S-Curve.

Pre-Torque
Used to prime the speed regulator with an initial torque command. When it is used, the HPV 900 should receive its pre-torque command via the analog channel or the serial channel.

BRAKE PICK
An external logic output used to pick the mechanical brake. To enable this function, set the following User Switches (C1) parameters: BRAKE PICK SRC=internal and SPD REF RELEASE=brake picked. The signal will become true when the speed regulator release goes true and go false when the run signal goes false.

MECH BRAKE PICK
An external logic input to signal the mechanical brake is picked "open". To enable this feedback, set the following User Switches (C1) parameter: BRAKE PICK CNFM=external tb1. Also, a brake pick fault is available to ensure the brake pick confirm logic input does go true at the beginning of a run and false at the end of the run before the time defined by the BRAKE PICK TIME. The brake pick fault is enabled via the following User Switches (C1) parameter: BRK PICK FLT ENA=enable.

CLOSE CONTACT
An external logic output used to close the motor contactor. The signal will become true when the run command goes true and go false when the speed regulator release goes false.

CONTACT CONFIRM
An external logic input to signal the motor contactor has closed. To enable this feedback, set the following User Switches (C1) parameter: CONT CONFIRM SRC=external tb1. Also, a contactor fault is available to ensure the contact confirm logic input does go true at the beginning of a run and false with the speed regulator release before the time defined by the CONTACT FLT TIME.

5.2.8 Sequencing Logic Flow Diagram

Figure 5. 21 details the logic signals that are used to create the following three drive internal signals:

- Speed Reference Release – used by the Speed Reference Generator
- Speed Regulator Release – used by the Speed Regulator
- Run Confirm – used by the Vector Control

5.2.9 LOGIC I/O RELATIONSHIP

The relationship between the drive sequencing input and output logic is detailed in Figure 5. 22.

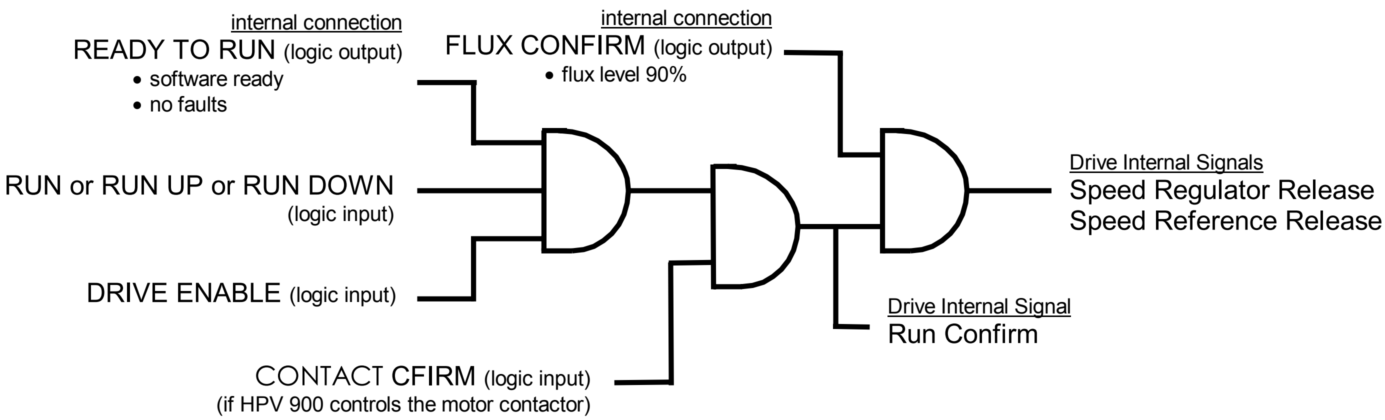


Figure 5. 21 - Drive Sequencing Logic Flow Diagram

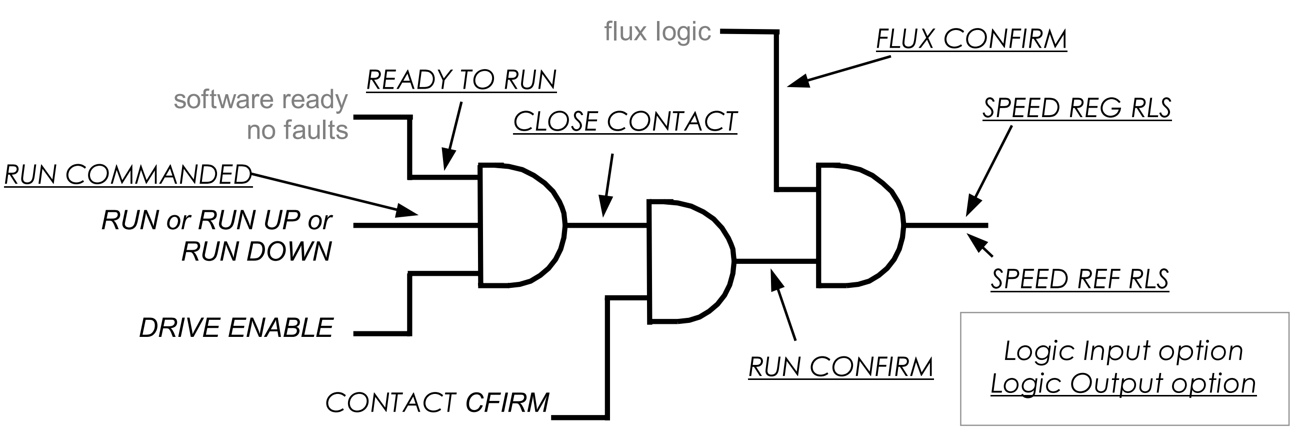


Figure 5. 22 - Drive Sequencing I/O Relationship

5.3 OVERLOAD

The elevator drive has two overload functions: a drive overload and a motor overload both calculated by the drive.

The drive overload is a fixed function that is based on the maximum current capability of the drive and generates a fault.

The motor overload is a user selectable function that is intended to protect the motor from thermal overload and generates an alarm.

These overloads are independent of each other. If the motor overload is setup to allow more current than the drive can produce then the drive overload will protect the IGBTs.

5.3.1 Drive Overload

The drive provide steady state currents of 150% for 60 seconds and 250% for 5 seconds, where 100% current is the general purpose rated amps for a particular horsepower drive. The overload curves are shown in Figure 5. 23 and Figure 5. 24.

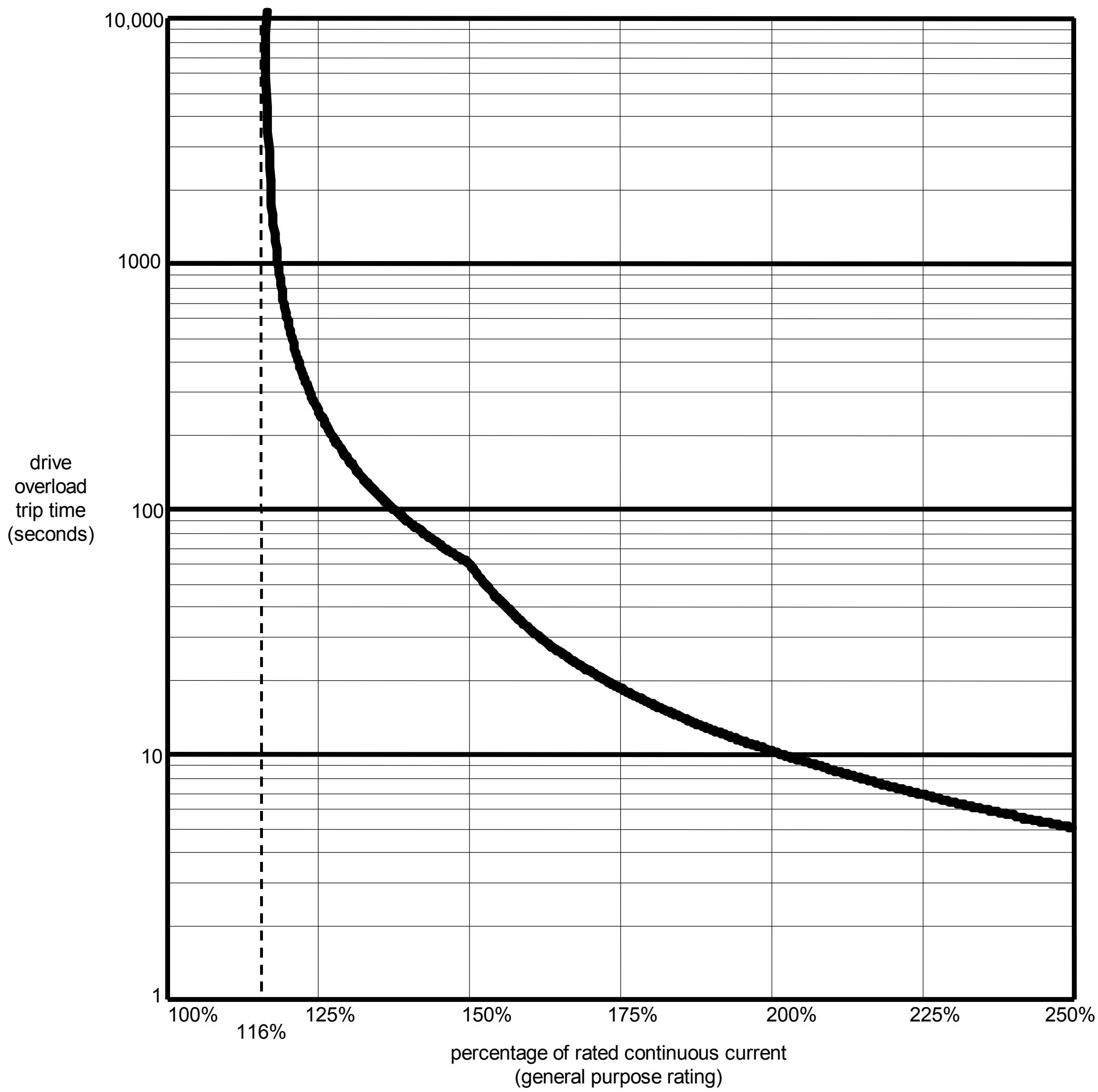


Figure 5. 23 - Drive Overload Curve (except B+ cubes)

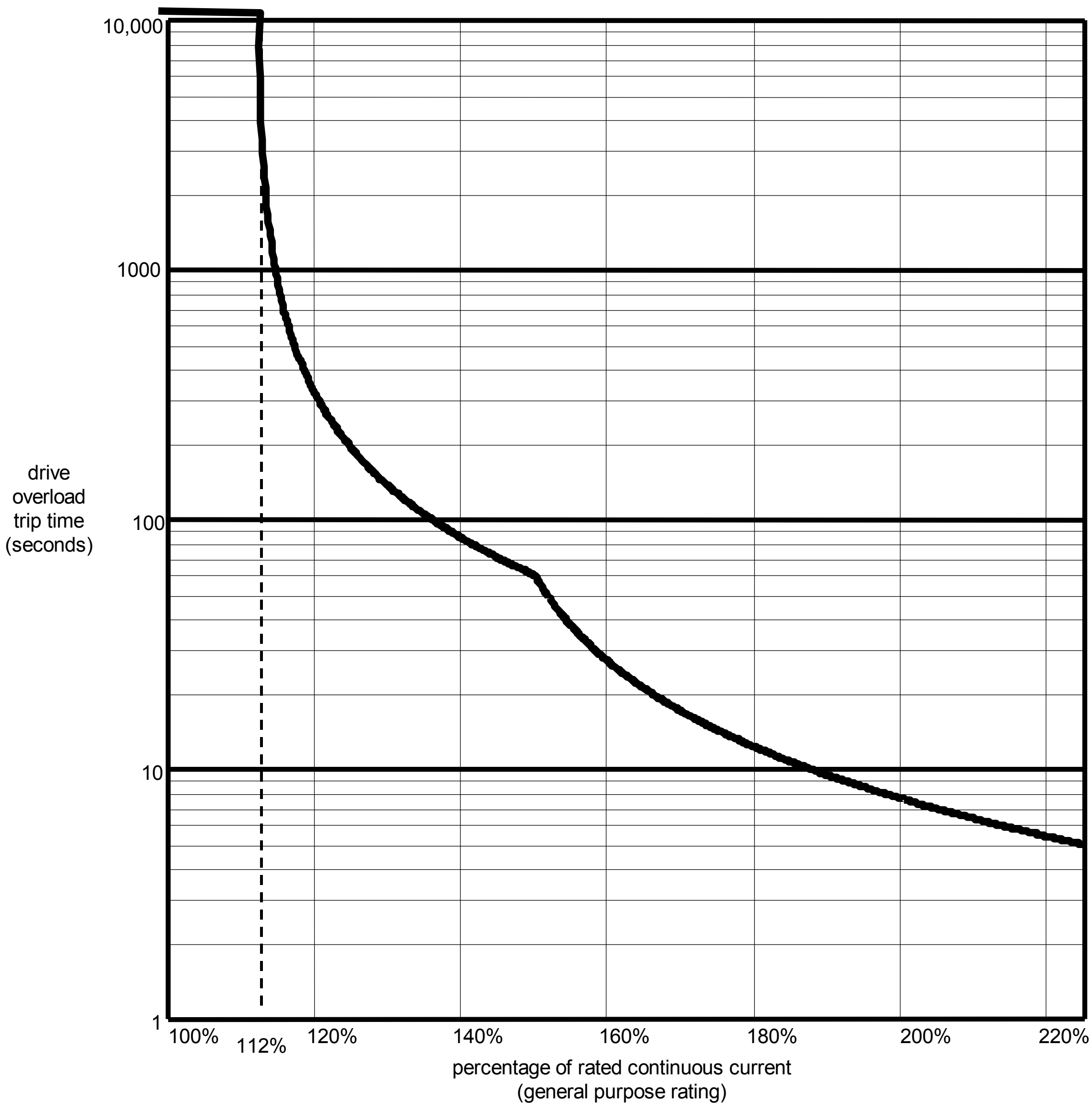


Figure 5. 24 - Drive Overload Curve (only B+ cubes)

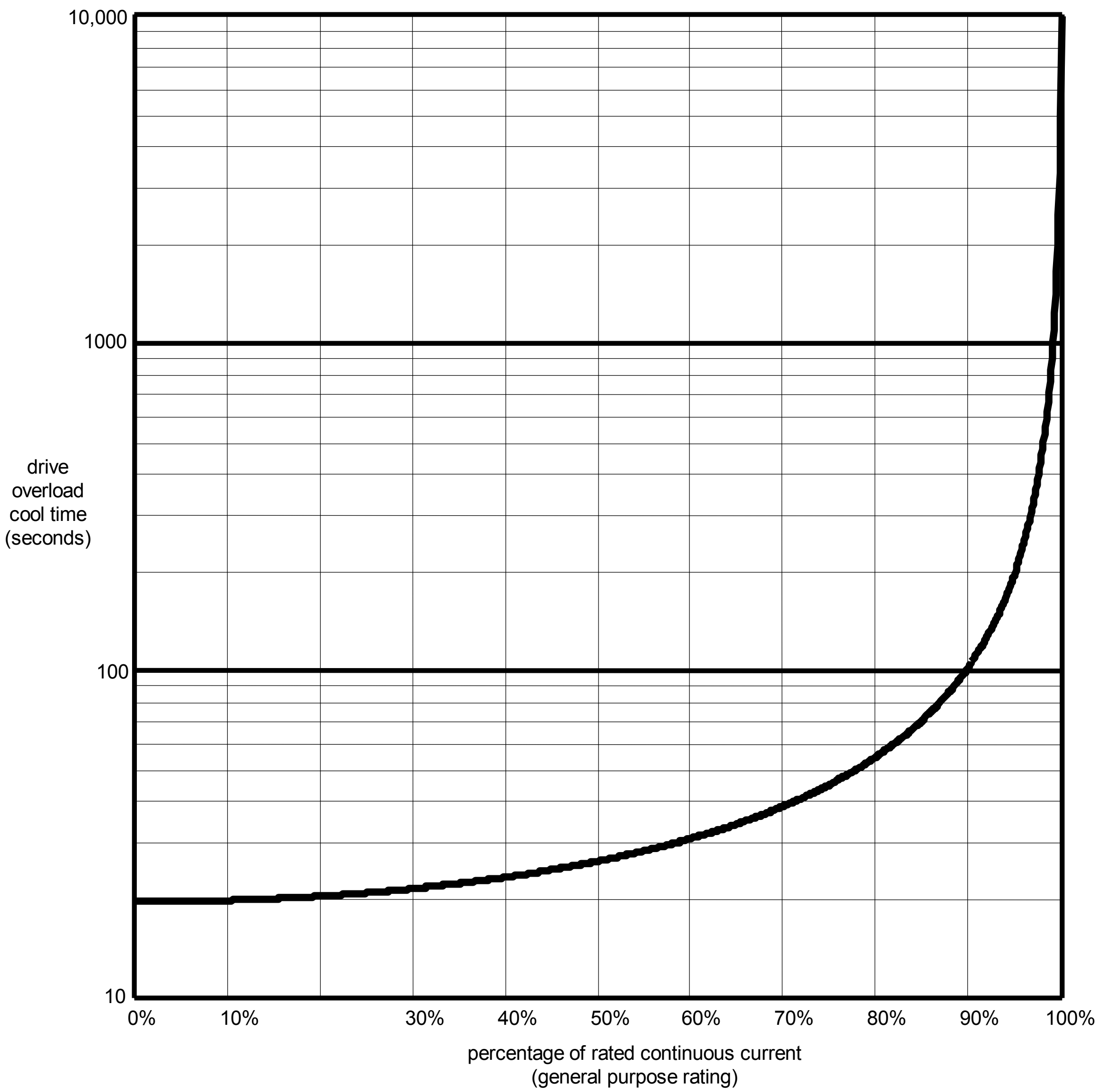
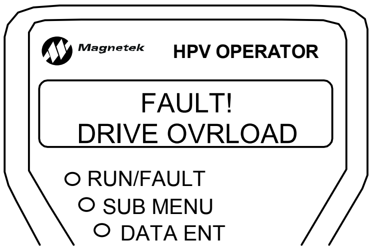
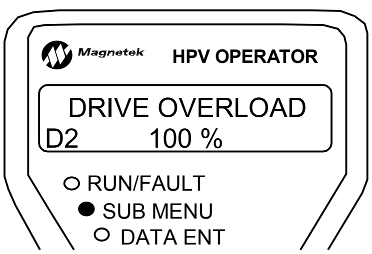


Figure 5. 25 - Drive Overload Cooling Curve

When the drive had exceeded the defined drive overload curve, the drive will declare an drive overload fault. *For more information, see section (3.7.1.3).*



The drive overload fault can also be assigned to a logic output *(see section 3.5.3).*
Under the POWER DATA display sub-menu, The DRIVE OVERLOAD value displays the percentage of motor overload trip level reached. Once this value reaches 100% the drive has exceeded its defined overload curve and a drive overload fault is declared by the drive. *For more information, see section (3.3.2).*



5.3.2 Motor Overload

Unlike the drive overload, the motor overload parameters can be adjusted by the user. The following two parameters *(see section 3.4.5)* are used to define the motor overload curve.

- The motor current overload start level (OVLD START LEVEL) parameter defines maximum current at which motor can run continuously.

- The motor current time out (OVLD TIME OUT) parameter is the other parameter used to define the overload curve. This parameter is defined as the as the amount of time before a motor overload alarm occurs when the motor is running at the current level defined below:

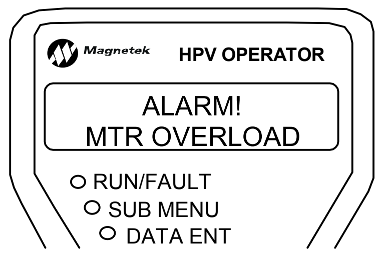
$$\begin{pmatrix} OVLD \\ START \\ LEVEL \end{pmatrix} + \begin{pmatrix} 40\% \\ rated \\ motor \\ current \end{pmatrix}$$

In Figure 5. 26, three overload curves are shown. Curve #1 is the default motor overload curve. The parameter settings that define the three overload curves are shown in Table 5. 4.

	OVLD START <u>LEVEL</u>	OVLD TIME <u>OUT</u>
curve #1	110%	60 sec
curve #2	110%	40 sec
curve #3	120%	70 sec

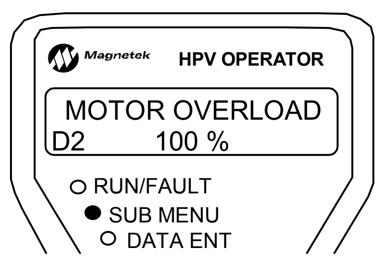
Table 5. 4 - Motor Overload Parameters

When the motor had exceeded the user defined motor overload curve, the drive will declare an motor overload alarm. *For more information, see section (3.7.1.7).*



The motor overload alarm can also be assigned to a logic output *(see section 3.5.3).*

Under the POWER DATA display sub-menu, The MOTOR OVERLOAD value displays the percentage of motor overload trip level reached. Once this value reaches 100% the motor has exceeded its user defined overload curve and a motor overload alarm is declared by the drive. *For more information, see section (3.3.2).*



The drive will only declare a motor overload and the user is responsible for action.

But, if the user wants the drive to declare a fault on a motor overload the following need to be completed:

- logic output configured to MTR OVERLOAD
- logic input configured to EXT FAULT
- wire the EXT FAULT logic input terminal to the to MTR OVERLOAD logic output terminal
- wire the logic input common terminal to the logic output common

With the above set-up, the drive will then declare an External Fault on a motor overload.

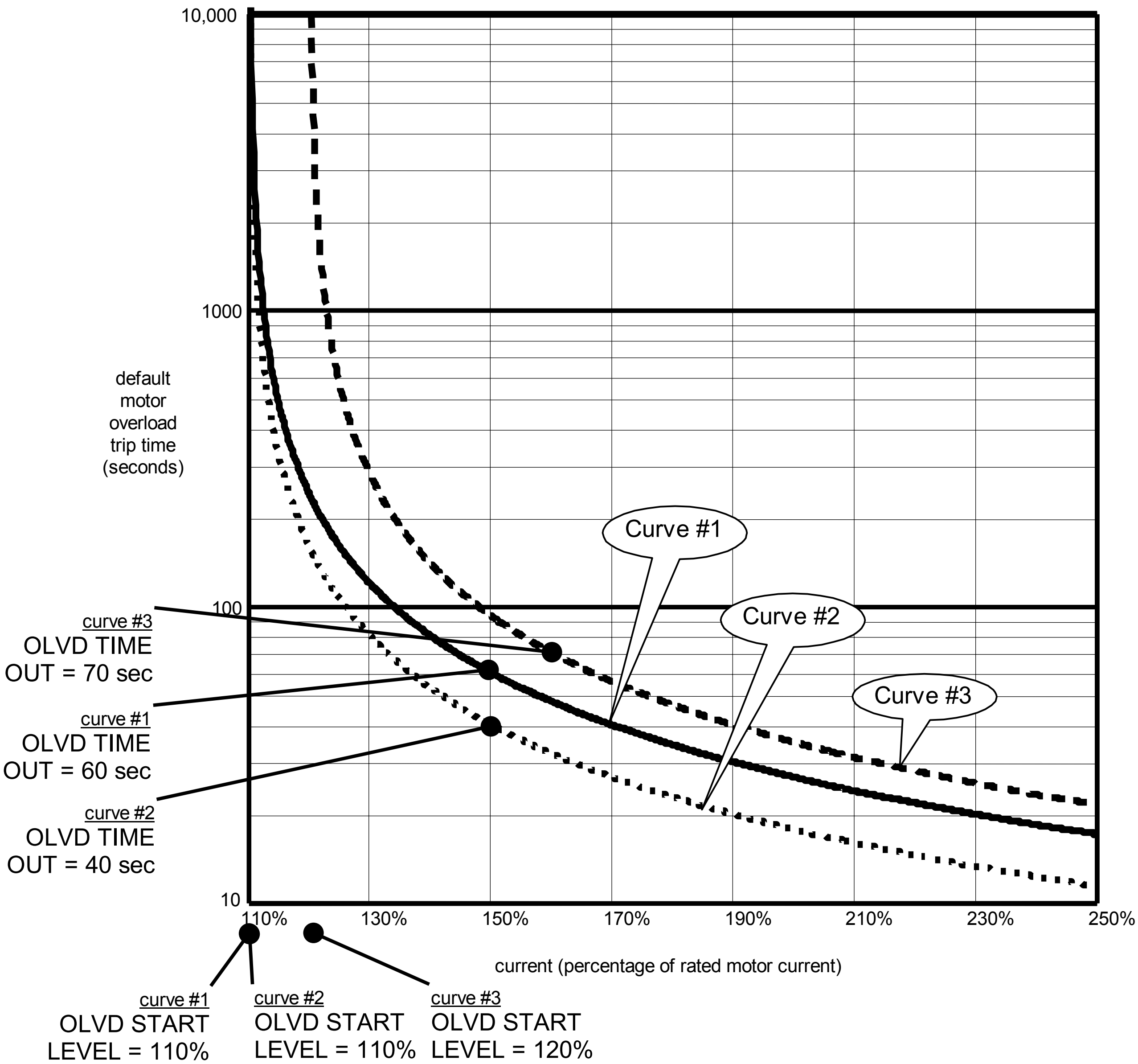


Figure 5. 26 - Motor Overload Curve

5.4 SERIAL COMMUNICATIONS

The HPV 900 has the ability to communicate via a RS-422 serial port. The communications is full-duplex at 19200 bit/sec. A detailed serial protocol specification provides the technical details on the Magnetek standard elevator protocol

5.4.1 Serial Functions

Following can be controlled via the serial port:

- Speed Command
- Run Command
- High / Low Gain Control
- Pre-Torque Command And Control
- Overspeed Test
- Torque Ramp Down Function
- Auxiliary Torque Command
- Mechanical Brake Control
- Fault Reset

Following can be monitored via the serial port:

- Faults (both active and history)
- Software version number and cube id
- Status of all hardware logic inputs and outputs.
- Values of various drive display variables.

The serial port also allows for read / write access to all parameters.

5.4.2 Serial Channel

Communications is full-duplex over a 19200 bit/sec, RS-422 channel.

The receive channel on the drive is optically isolated. The transmit channel is not isolated. However, if the car controller optically isolates it's receive channel, and no other pins are connected, complete electrical isolation can be obtained between the car controller control and the drive control grounds.

Data is sent in bytes with 1 start bit, 8 data bits, 1 stop bit and no parity.

The HPV-900 to car controller connection is made with a straight through cable with a 9-pin D-Sub connector. Table 5. 5 shows the signals used by the HPV-900.

Pin	Car Control I/O	Description
1	Not connected	-
2	Not connected	-
3	Input	TX - (Transmit Data)
4	Output	RX + (Receive Data)
5	Not connected	-
6	Not connected	-
7	Input	TX + (Transmit Data)
8	Output	RX - (Receive Data)
9	Not connected	-

Table 5. 5 - Serial Port Pinout

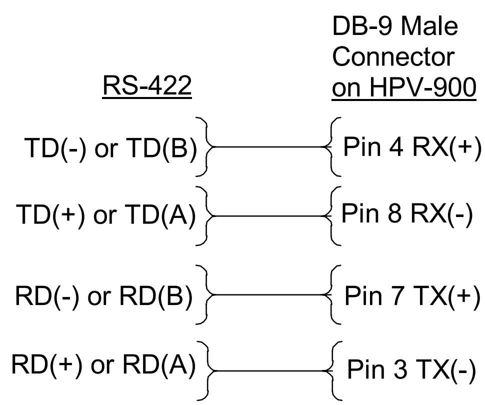


Figure 5. 27 - Wiring between HPV 900 and RS422

It is recommended that the HPV 900's transmission line be terminated with a termination resistor of 100 ohms ½ watt. The HPV 900's receiving line is already terminated internally in the drive with a 100 ohms ½ watt resistor.

IMPORTANT

It is recommended car controller's receiving line be terminated with a 100 ohms ½ watt

5.4.2.1 RS-422/RS-232 Conversion.

Serial communications to and from the HPV900 uses RS-422. If the car controller uses RS-232, a converter is required to convert from RS-232 to RS-422 levels.
Converters can be available in a number of different connector configurations.

These are either "port" powered or requiring an external power supply. If port powered, one of the handshake lines on the RS-232 side must be asserted high. Also, check the converter specification to see if the converter already has internal termination.

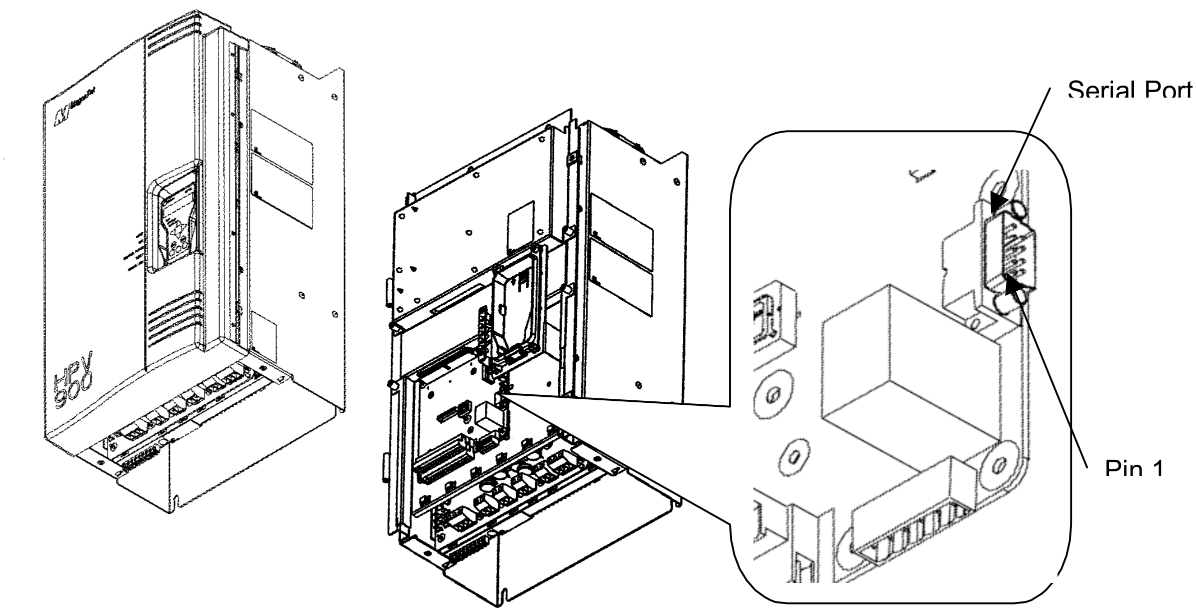


Figure 5. 28 - Serial Port Location

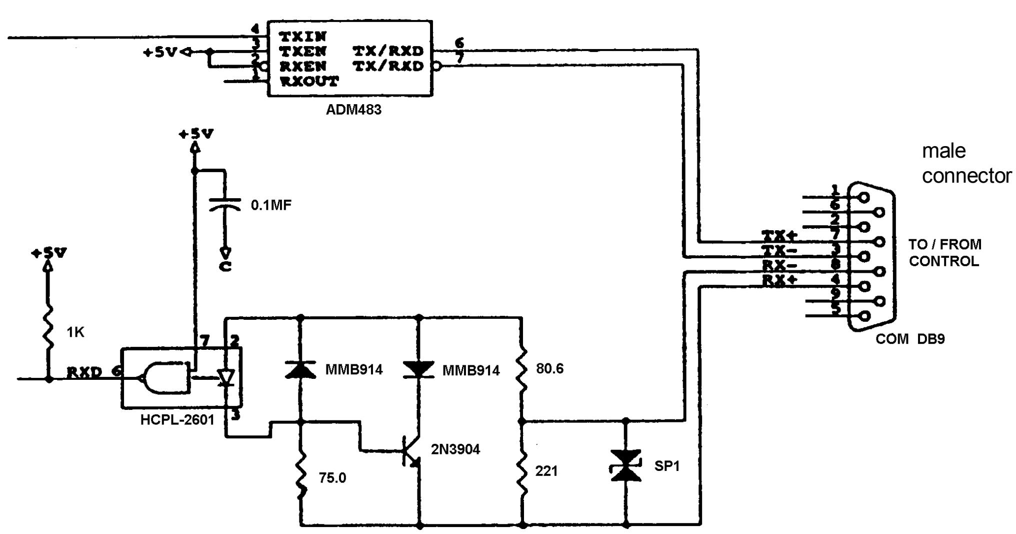


Figure 5. 29 - HPV 900 Serial Interface Circuit

5.5 ENCODER

5.5.1 Encoder Specification

The HPV 900 has connections for an incremental two-channel quadrature encoder.

For better noise immunity, the HPV 900 provides…

- an isolated power supply, which separates the processor power from the encoder
- optically isolated encoder signals from the HPV 900's processor

The HPV 900 encoder feedback requirements are listed in the specification, *see section (1.2.9).*

5.5.2 Encoder Considerations

Electrical interference and mechanical speed modulations are common problems that can result in improper speed feedback getting to the drive. To help avoid these common problems, the following electrical and mechanical considerations are suggested.

IMPORTANT

Proper encoder speed feedback is essential for a drive to provide proper motor control.

5.5.2.1 Electrical Considerations

- Preferred that both the encoder case and shaft are insulated from the motor, *see section (2.3.3.1).*
- Use twisted pair cable with shield tied to chassis ground at drive end, *see section (2.5.4.1).*
- Use limited slew rate differential line drivers, *see section (5.5.3.1).*
- Do not allow capacitors from internal encoder electronics to case, *see section (5.5.3.2).*
- Do not exceed the operating specification of the encoder/drive, *see section (5.5.3.3).*
- Ensure proper encoder supply voltage and use highest voltage range available, *see section (5.5.3.4).* (i.e. HPV 900 - 12VDC preferred)

5.5.2.2 Mechanical Considerations

- Use direct motor mounting without couplings, *see section (2.3.3.2).*
- Use hub or hollow shaft encoder with concentric motor stub shaft, *see section (2.3.3.3).*
- Preferred that for exposed encoders a mechanical protective cover is used, *see section (2.3.3.4).*

5.5.3 Encoder Electronics

5.5.3.1 Differential Line Drivers

Use limited slew rate differential line drivers, in order to minimize transmission line reflections use type 7272 drivers.

Encoder's line drivers transition from logic states in a fraction of a microsecond. The fast rise and fall times of the driver's circuitry can interact with the cable impedance and create significant ringing on the receiver end of the cable. This can interfere with the encoder signals and the operation of the drive. To reduce the ringing, it is recommended that the encoder use type 7272 line drivers, which have slower rise and fall times.

Also to improve performance, line driver outputs should use differential pairs of complementary outputs, each paired with its inverse. This allows the signal to be used with a differential line receiver, which improves the noise margin, cancels common-mode noise and helps to reject ringing from the cable.

5.5.3.2 Capacitors from Electronics to Case

Do not allow capacitors from internal encoder electronics to case, in order to minimize ground current noise injection and minimize the coupling of high frequency noise.

Encoders are sometimes supplied with an internal capacitor from circuit common to case ground to drain electrical noise from common to building ground. However, PWM drives have extremely high frequency noise that is coupled to the frame and shaft of the motor. A capacitor placed between the encoder case and the encoder electronics will couple this noise into the encoder, where it can interfere with normal operation.

The result is intermittent rough operation, motor reversal or no operation at all. The presumption is that there is a drive or encoder problem. An improvement is to remove any internal encoder capacitors between electrical common and the case.

The above analysis assumes that the electrical wiring is correct and that the shield on the encoder cable is properly grounded, *see section (2.5.4.1).*

The scope traces in Figure 5. 30 and Figure 5. 31 show a noise comparison of output signals from similar encoders with and without internal capacitors, both connected to a motor with typical PWM switching noise on the frame.

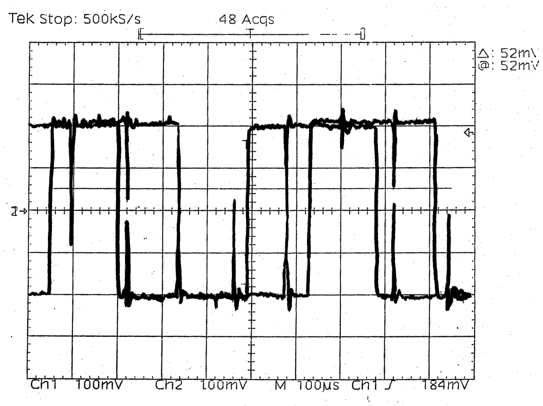


Figure 5. 30 - Encoder with a capacitor (common to ground)

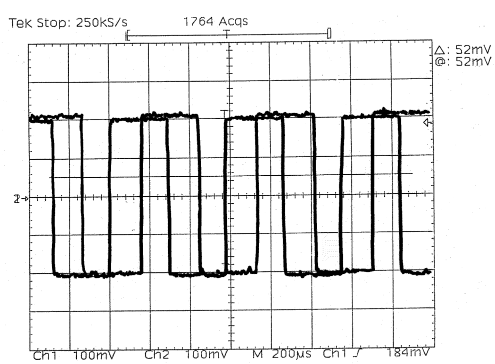


Figure 5. 31 - Encoder with no capacitor (common to ground)

5.5.3.3 Exceeding Operating Specification

Do not exceed the operating specification of the encoder/drive, in order to prevent the encoder from providing incorrect data.

All encoders have inherent mechanical and electronic limitations regarding speed. The combination of several design factors including bearings, frequency response of the electronics, and PPR of the encoder, etc. combine to determine "maximum operating speed". Exceeding the maximum speed may result in incorrect data or premature failure. Both the electrical and mechanical encoder specifications can be provided by the encoder manufacturer.

To determine the encoder's maximum operating speed:

Step 1: Determine maximum electronic operating speed in RPM.

$$RPM = \frac{Encoder\ freq.\ response\ (kHz)\ x\ 60}{Encoder\ PPR}$$

Step 2:

A. If the RPM calculated in Step 1 is less than or equal to the encoder's maximum mechanical RPM specification, then the RPM calculated in Step 1 is the maximum operating speed specification for this particular encoder application.
B. If the RPM calculated in Step 1 is greater than the encoder's maximum mechanical RPM specification, then the maximum mechanical RPM specification is the maximum operating speed for this encoder application.

Step 3:

Compare the maximum operating speed as determined in Step 2 above with the application requirements.

To determine if the application exceeds the operating specification of the HPV 900:

- Calculate the maximum pulses per revolution (PPR) for this application (using the HPV 900 frequency limit of 300 kHz and 120% of the application's top speed)

$$PPR_{max} = \frac{300{,}000\ Hz\ x\ 60}{max\ applicatio\ n\ RPM\ \times 1.2}$$

- Verify that the selected encoder's PPR is below the calculated maximum PPR (PPRmax) for this application

5.5.3.4 Encoder Supply Voltage

Ensure proper encoder supply voltage and use highest possible voltage available, in order to ensure proper operation and increase noise immunity

Ensure that the voltage drop of the encoder wiring is such that the minimum power supply voltage for operating the encoder is not violated. (i.e. 5VDC ±5% power supply and 5VDC ±10% encoder specification is violated when the encoder draws 0.3 A and it is wired with 500 ft at 22 AWG)

- Use an encoder with an internal supply regulator
- Use a wide supply range encoder (i.e. 5 – 15 VDC)

It is also preferred that the encoder be powered by the HPV 900's 12VDC power supply in order to help with noise immunity by having the signals at a higher voltage level.

5.5.4 Encoder Theory

An incremental encoder, often referred to as a tachometer, is normally used for position and velocity information. Velocity data is generated by looking at the number of pulses within a given time period.

Quadrature encoders have dual channels, A and B, which are phased 90°, electrically apart. An important benefit of having two output signals is that the direction of rotation can be determined by monitoring the phase relationship between these two channels.

Another important benefit of quadrature encoders is the capability of providing very high resolutions by multiplying the number of output pulses. In a dual channel encoder, a four times multiplication of the output count or resolution can be achieved by externally counting the rising and falling edges of each channel (A and B). A 1,024 pulses per revolution quadrature encoder, for example, can generate 4,096 pulses per revolution by employing this technique.

In addition to the need to count pulses accurately, correct position feedback depends on eliminating any false signals resulting from electrical noise. Incremental encoders are susceptible to noise, especially when the encoder cable is in the proximity of large electrical motors or switching gear. Noise problems can be eliminated or greatly reduced by using an encoder that providing complementary outputs. As shown in Figure 5. 33, a correct signal will generate two simultaneous outputs. As channel /A goes high, channel A goes low. If this doesn't occur, the signal is assumed to be the result of electrical noise and is ignored.

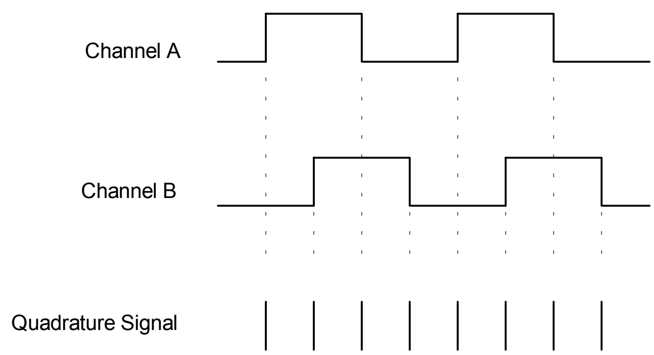


Figure 5. 32 - Dual Channel - Quadrature Encoder Signals

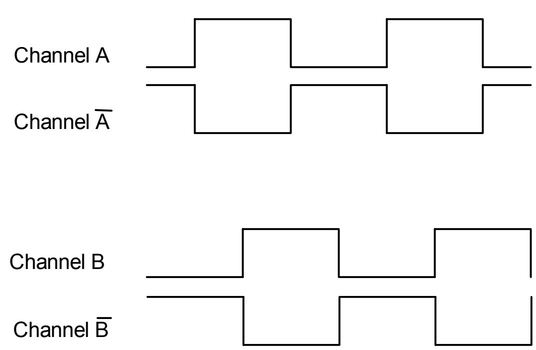


Figure 5. 33 - Complementary Encoder Output

5.6 S-CURVE

5.6.1 S-Curve Details

The HPV 900 speed command is passed through an internal S-curve in order to produce the speed reference. In general, the S curve function takes an arbitrary speed command and generates a speed reference subject to the conditions that the maximum accel, decel and jerk rates not be exceeded. The speed command is typically the target speed that the reference is headed to.

5.6.1.1 Definitions

Figure 5. 34 below shows the six parameters associated with an S-Curve data set:

- Accel - Maximum allowed acceleration rate (ft/s^2 or m/s^2)
- Decel - Maximum allowed deceleration rate (ft/s^2 or m/s^2)
- Acc Jerk In - Maximum allowed change in acceleration towards Accel (ft/s^3 or m/s^3)
- Acc Jerk Out - Maximum allowed change in acceleration from Accel (ft/s^3 or m/s^3)
- Decel Jerk In - Maximum allowed change in deceleration towards Decel (ft/s^3 or m/s^3)
- Decel Jerk Out - Maximum allowed change in deceleration from Decel (ft/s^3 or m/s^3)

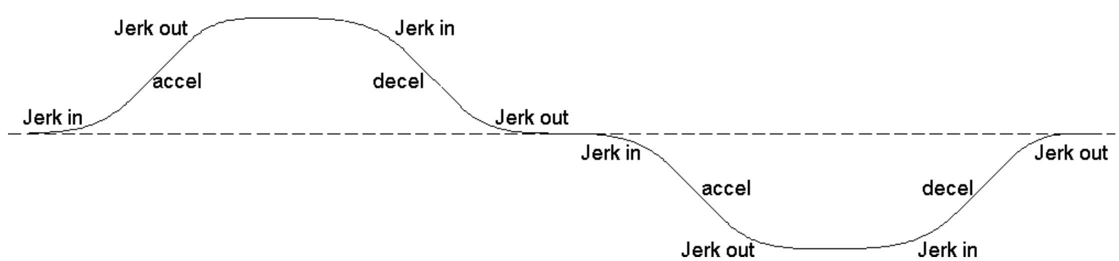


Figure 5. 34 - S-Curve Definitions

5.6.1.2 S-curve Parameters

A HPV 900 S-curve is specified by four parameters: acceleration (accel) rate, deceleration (decel) rate, leveling jerk (lev jerk) rate, and jerk rate. The jerk rates are split in order to facilitate elevator fine tuning.

- Accel Rate - acceleration rate
- Decel Rate - deceleration rate
- Jerk Rate - accel jerk in, accel jerk out, and decel jerk in
- Leveling Jerk Rate - decel jerk out

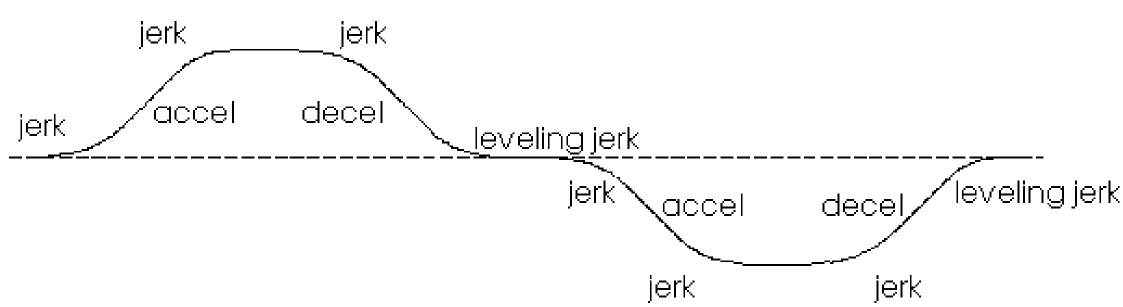


Figure 5. 35 - S-Curve Parameters

Figure 5. 36 shows an example of jerk rates, accelerations, and speed commands for a given S-curve.

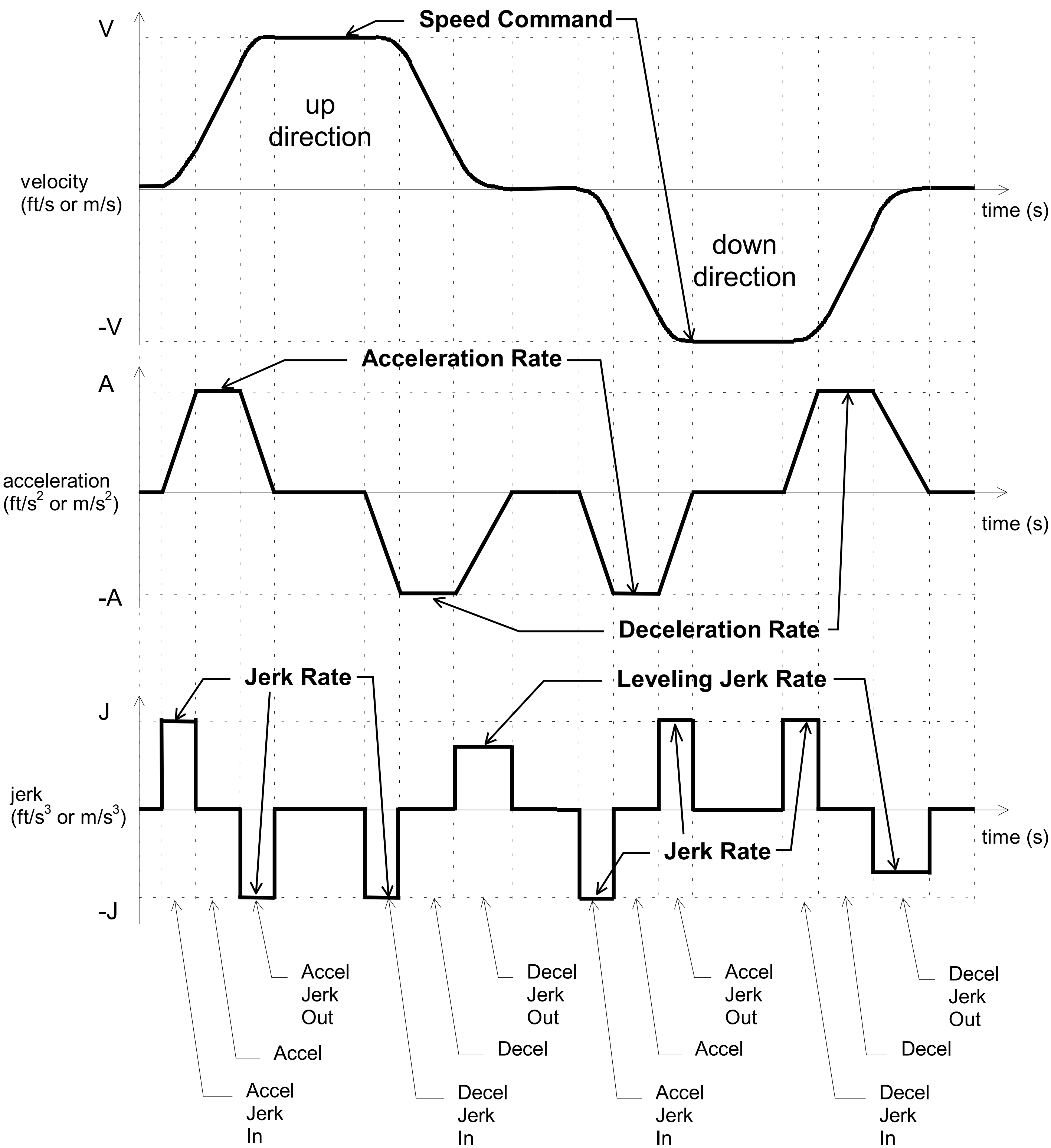


Figure 5. 36 - Example Of Jerk Rates, Accelerations, and Speed Commands

5.6.2 S-Curve Performance

The performance of the S-curve is represented in Figure 5. 37, Figure 5. 38, Figure 5. 39, Figure 5. 40, and Figure 5. 41. All figures show the speed command (generated by the user) and an internal speed reference generated by the drive.

NOTE: the performance shown in Figure 5. 37, Figure 5. 38, Figure 5. 39, Figure 5. 40, and Figure 5. 41 is with the S-CURVE ABORT (C1) parameter is disabled.

The common set-up conditions are:

- Contract speed: 400 ft/min (2 m/s)
- Accel rate: 3.3 ft/s^2 (1 m/s^2)
- Decel rate: 3.3 ft/s^2 (1 m/s^2)
- Jerk Rate: 6.6 ft/s^3 (2 m/s^3) at all “four” corners of an elevator run.

Figure 5. 37: Speed command and speed reference during accel to a speed of 400 ft/min (2 m/s) . The jerk-in and jerk-out times are 0.5 sec. The linear accel portion is about 1.5 sec.

Figure 5. 38: Speed command and speed reference during decel from 400 ft/min (2 m/s) . The jerk-in and jerk-out times are 0.5 sec. The linear decel portion is about 1.5 sec.

Figure 5. 39: Speed command and speed reference during one elevator up run. The speed command was changed to 0 after reaching the contract speed. This figure has same information as Figure 5. 37 and Figure 5. 38.

Figure 5. 40: Speed command and speed reference during an elevator up run where the speed command was changed before reaching the contract speed AND before completing the jerk-out phase of the S-curve. Under this condition, the speed will continue to rise up to the speed command and then start the decel portion of the elevator run. In other words, if the speed command is changed during the jerk-out phase, the jerk-out phase is completed before starting the slow down.

Figure 5. 41: Speed command and speed reference during an elevator up run where the speed command was changed before reaching the contract speed BUT during the linear accel portion of the S-curve. (about 50% speed reference was reached). Under this condition, first the jerk-out phase begins (the speed reference increases) and at the end of the jerk-out phase normal decel begins. This decel’s tail end is exactly same as the tail end of Figure 5. 38.

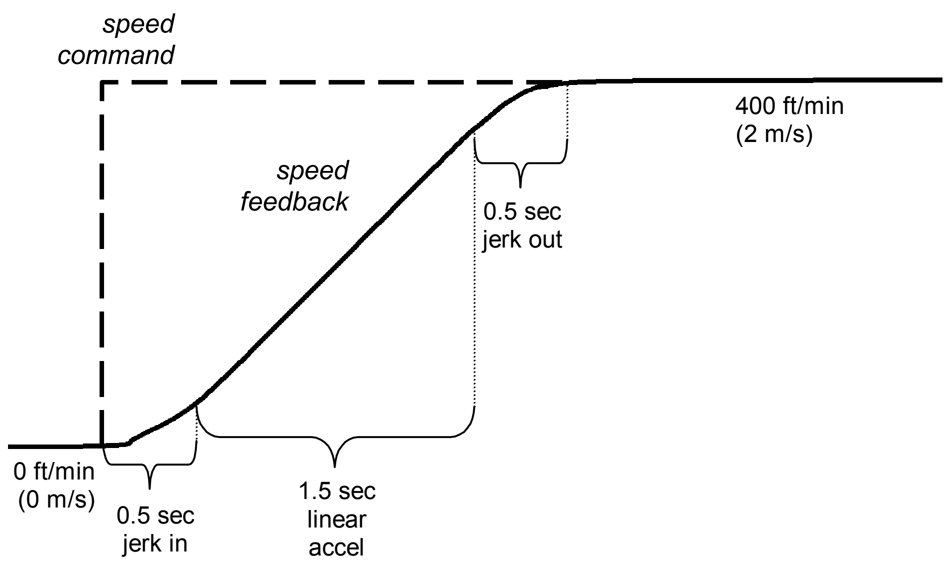


Figure 5. 37 - During Acceleration

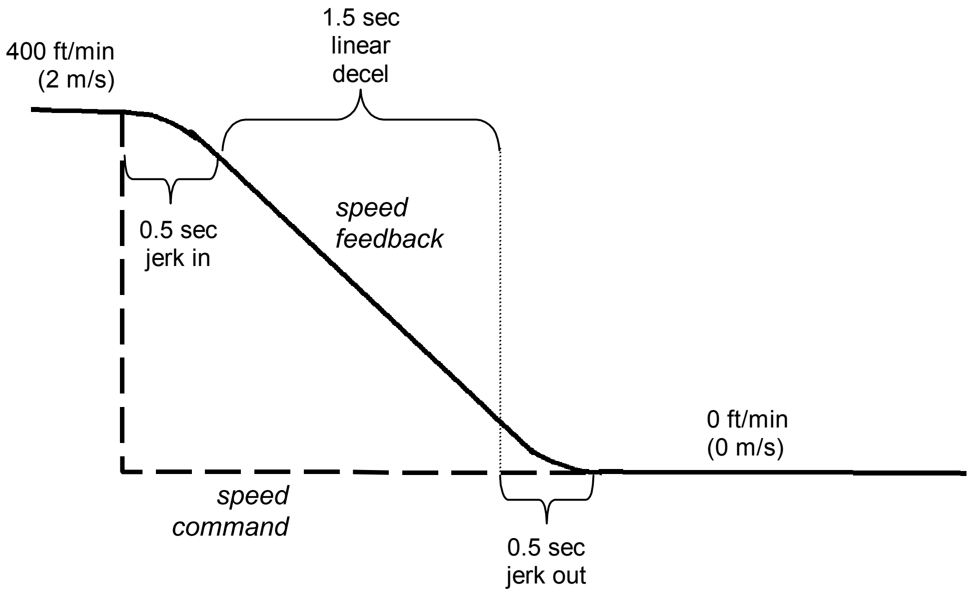


Figure 5. 38 - During Deceleration

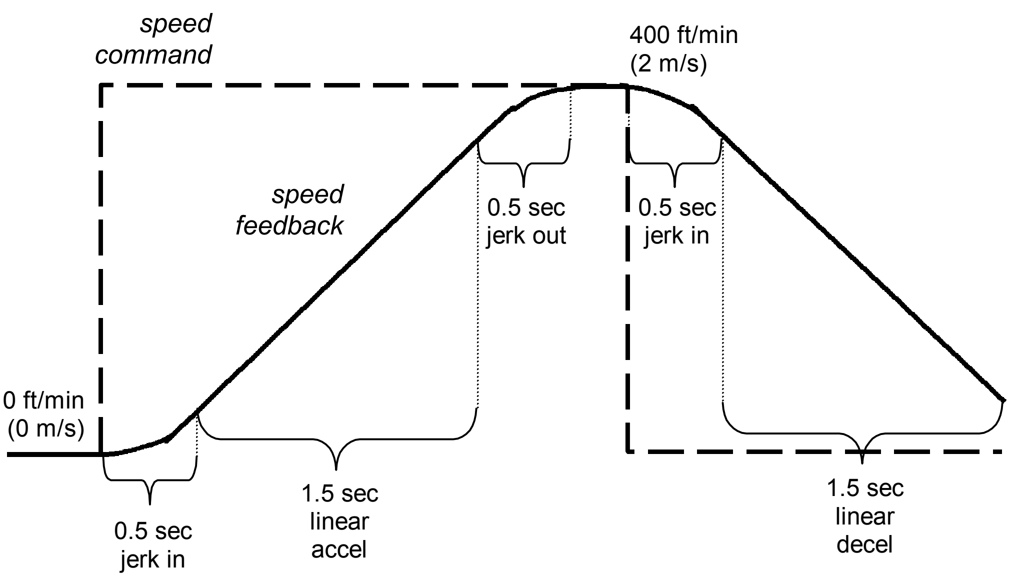


Figure 5. 39 - Speed Change During Constant Speed

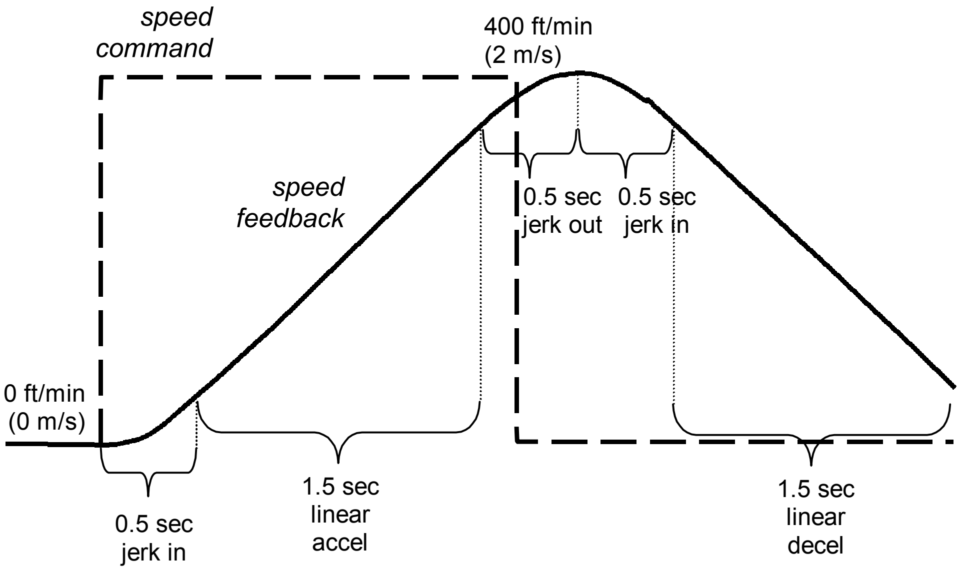


Figure 5. 40 - Speed Change During Jerk Out

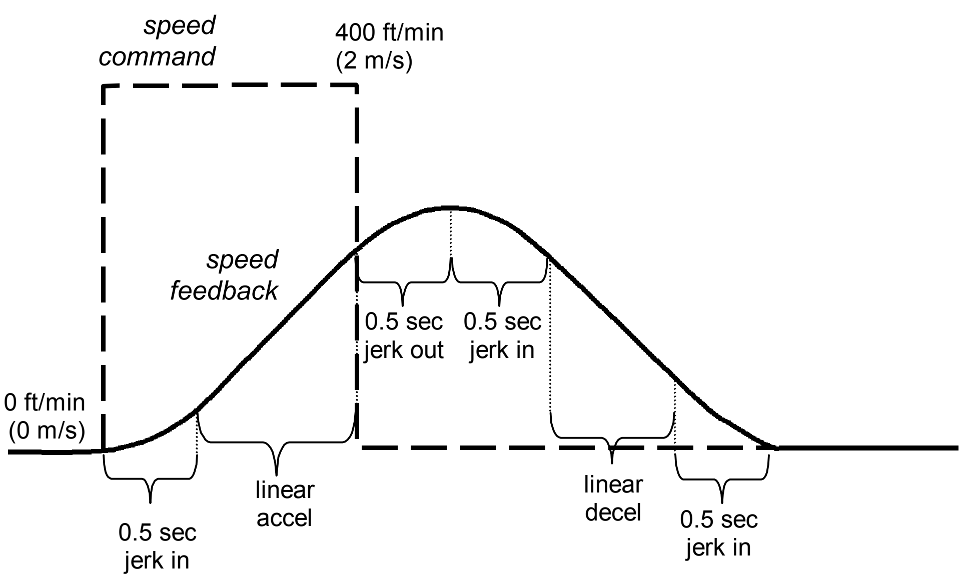


Figure 5. 41 - Speed Change During Linear Accel

5.6.2.1 S-CURVE ABORT (C1) Parameter

This parameter, S-CURVE ABORT (C1), addresses how the HPV 900's S-Curve Speed Reference Generator handles a *reduction* in the speed command before the S-Curve Generator has reached its target speed.

Note: the default for the S-CURVE ABORT (C1) parameter is disabled.

5.6.2.1.1 S-curve Function with S-CURVE ABORT = disabled

With a normal S-curve function, a change in the speed command is never allowed to violate the defined acceleration or jerk rates. If a reduction in the speed command is issued before the S-Curve generator has reached its target speed, then the jerk rate dictates what speed is reached before the speed may be reduced.

Figure 5. 42 below shows this type of operation. Note the jerk rates are very low to exaggerate proportion of S in the curve to clearly show the overshoot in speed so that the maximum jerk rate is not violated. In this figure, a reduction in the speed command occurs from a high speed command (which was not yet achieved on the output of the S-Curve) to a low speed command. Note that the speed reference (S-Curve output) continued to increase after the speed command was reduced. This increase is speed was necessary to avoid violation of the jerk rate setting.

5.6.2.1.2 S-curve Function with S-CURVE ABORT = enabled

In Figure 5. 43 below, the optional S-Curve abort has been selected. In this case when the speed command is reduced, the speed reference immediately starts to reduce violating the jerk limit (thus no jerk out phase), which could be felt in the elevator.

For optional S-Curve abort to be active requires that:

- The speed command source must be selected as Multi-step (SPD COMMAND SRC=multi-step).
- The S-curve Abort function must be ENABLED (S-CURVE ABORT = enabled).

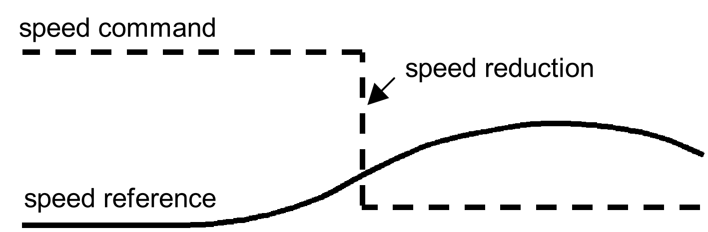


Figure 5. 42 - Normal S-curve Abort

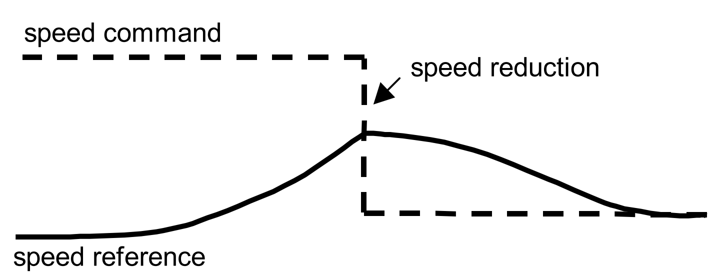


Figure 5. 43 - Optional S-curve Abort

5.7 ADAPTIVE TUNE

The adaptive tune automatically calculates, under certain operating conditions, the percentage no load current and the rated rpm (slip frequency). The HPV 900 software uses these two adaptive tune calculated values to obtain the maximum performance from the motor.

5.7.1 Adaptive Tune Operating Conditions

The HPV 900 software estimates the motor's percent no load current and the motor's rated rpm. These estimated values are only estimated around a window of ±25% of the parameter settings for:

- percent no-load current (% NO LOAD CURR)
- rated motor speed (RATED MTR SPEED)

The adaptive tune will estimate:

- the motor's percent no load current when the motor torque is below 20%.
- the motor's rated rpm when the motor torque is above 30%.

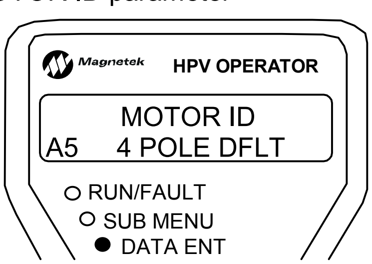
5.7.2 Using the Adaptive Tune to Obtain Maximum Motor Performance

The following is a step-by-step procedure to optimize the window around which the adaptive tune will estimate its two values.

NOTE: Although the listed speeds are recommended, the adaptive tune procedure can be ran initially at lower speeds, as long as the speed is greater than 10% of contract speed.

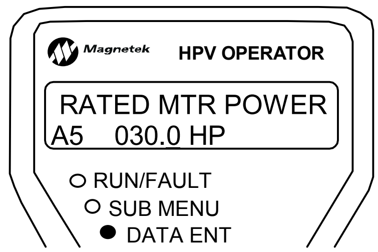
5.7.2.1 Initial Set-up

- Select a valid Motor ID or one of the two default motors (either 4 or 6 pole) for the MOTOR ID parameter



The default motor selections for the motor id will place a zero values in the motor nameplate parameters (see Figure 5. 44). This selection will also load nominal values for the other motor parameters listed in Table 5. 6.

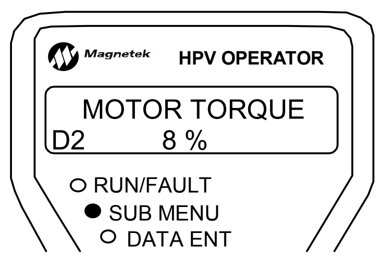
- Now, enter the motor nameplate data into the needed motor nameplate parameters (see Figure 5. 44)



5.7.2.2 Tuning Motor No-Load Current

With a <u>balanced car, run the car at 70% contract speed</u> from top floor to the bottom floor then back to the top floor.

- During these runs verify under DISPLAY MENU - POWER DATA D2 that the MOTOR TORQUE is between ±15%. If the value is larger then ±15% the car is not balanced correctly.



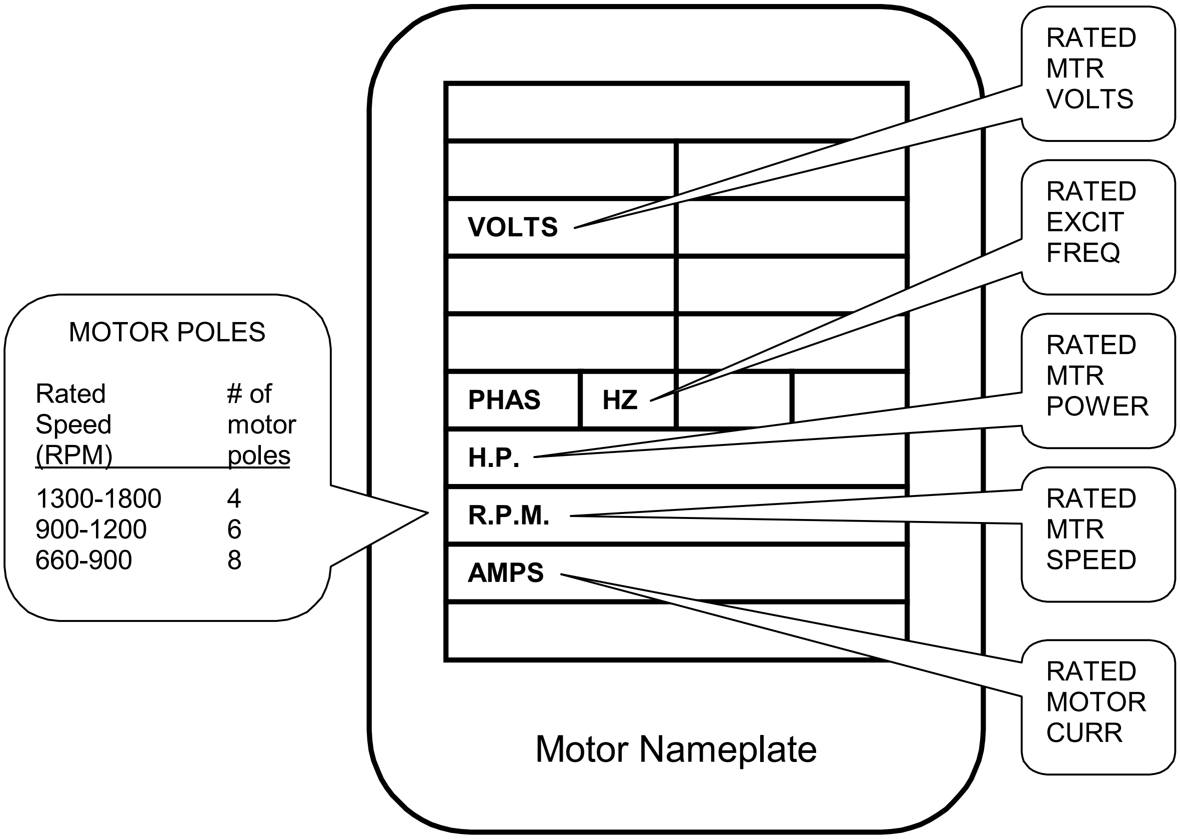


Figure 5. 44 - Motor Parameters Entered from Motor Nameplate

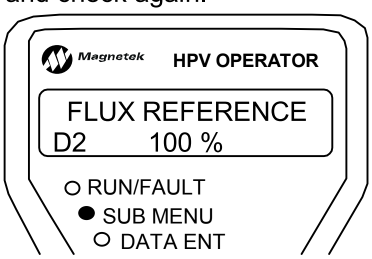
description	*parameter*	*4 pole dflt*	*6 pole dflt*
percentage no load current	% NO LOAD CURR	35.0 %	45.0 %
stator leakage reactance	STATOR LEAKAGE X	9.0 %	7.5 %
rotor leakage reactance	ROTOR LEAKAGE X	9.0 %	7.5 %
stator resistance	STATOR RESIST	1.5 %	1.5 %
motor loss - motor iron loss	MOTOR IRON LOSS	0.5 %	0.5 %
motor loss - motor mechanical loss	MOTOR MECH LOSS	1.0 %	1.0 %
flux curve - flux saturation break point	FLUX SAT BREAK	75 %	75 %
flux curve - flux saturation slope #1	FLUX SAT SLOPE 1	0 %	0 %
flux curve - flux saturation slope #2	FLUX SAT SLOPE 2	50 %	50 %

Table 5. 6 - Nominal Values for Motor Parameters

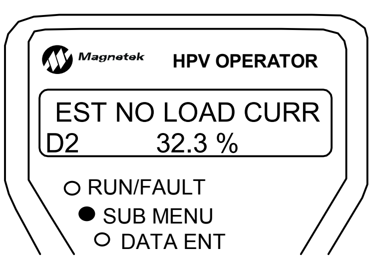
NOTE: If you are having problems getting the motor torque under 15% the cause may be:

- <u>No compensation chains</u>
  If the elevator system has no compensation chains, achieving balanced condition may be difficult. In that case, the MOTOR TORQUE should be between ±15% for as much of the run as possible.
- <u>High elevator system friction</u>
  If the elevator system has high friction, achieving motor torque of under 15% may be difficult. In that case, have less than the balance car weight in the car, thus letting the counterweight help to overcome the frictional losses. In this case, the you should look only at the estimated values in the up direction and run the car in the up direction a number of times before changing any parameter settings.

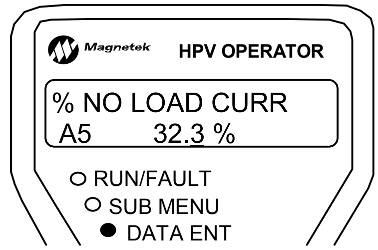
- Also, verify that the FLUX REFERENCE is 100%. If the value is not equal to 100% reduce the speed to less then 70% contract speed and check again.



- While still performing these top / bottom runs observe under DISPLAY MENU - POWER DATA D2 the EST NO LOAD CURR value.



Enter this estimated value into the motor parameter.

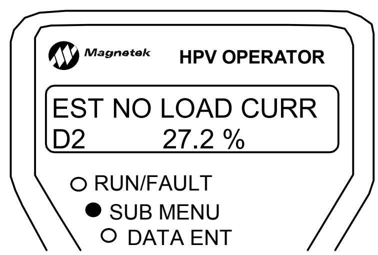


- Continue iterating the above two steps until the two values are within 2%. If the values do not converge after two iterations, verify the information entered in the initial set-up (section (5.7.2.1)) is correct.
- After the values converge, again verify the MOTOR TORQUE < 15% and the FLUX REFERENCE = 100%.

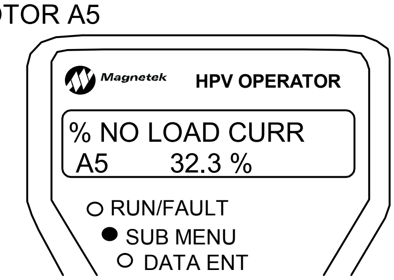
5.7.2.3 Tuning Motor's Flux Saturation Curve

With a <u>balanced car, run the car at 100% contract speed</u> from top floor to the bottom floor then back to the top floor.

- During these top / bottom runs observe under DISPLAY MENU - POWER DATA D2 the EST NO LOAD CURR value.

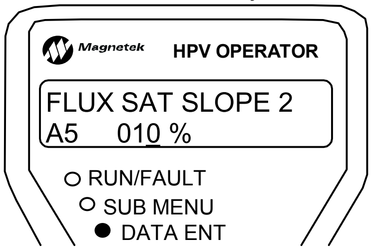


- Compare the displayed value EST NO LOAD CURR with the value entered for % NO LOAD CURR under the ADJUST MENU - MOTOR A5



If the EST NO LOAD CURR is 2% larger than the % NO LOAD CURR then, decrease the FLUX SAT SLOPE 2 by 10%.

- If the EST NO LOAD CURR is 2% smaller than the % NO LOAD CURR then, increase the FLUX SAT SLOPE 2 by 10%.



NOTE: If the EST NO LOAD CURR and % NO LOAD CURR are within 2% of each other, then continue on to Tuning the Rated Motor RPM.

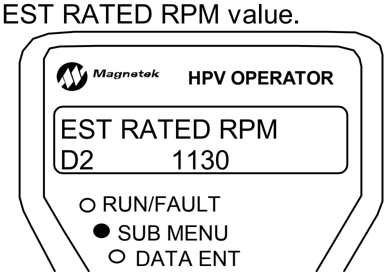
- Continue iterating FLUX SAT SLOPE 2 in 10% increments until the EST NO LOAD CURR and % NO LOAD CURR are within 2% of each other.

  NOTE: Remember <u>change only the FLUX SAT SLOP 2</u> parameter DO NOT change any other parameter (these were fixed in the previous steps).

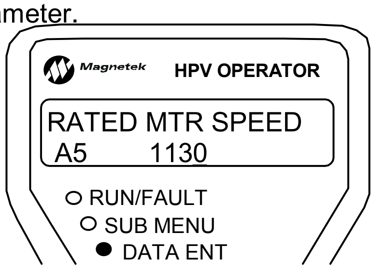
5.7.2.4 Tuning Rated Motor RPM

With a <u>full-load car, run the car at 100% contract speed</u> from top floor to the bottom floor then back to the top floor.

- During these top / bottom runs observe under DISPLAY MENU - POWER DATA D2 the EST RATED RPM value.



- Enter this estimated value into the motor parameter.



- Continue iterating the above to steps until the two values are within 3 RPM.

  NOTE: Remember <u>change only the RATED MTR SPEED</u> parameter DO NOT change any other parameter (these were fixed in the previous steps).

5.8 ESTIMATING SYSTEM INERTIA

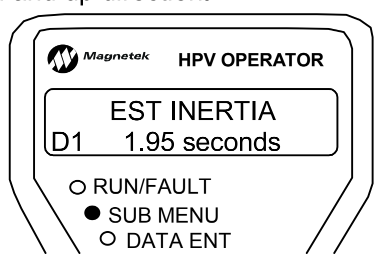
The HPV 900 software can be used to calculate the inertia of the entire elevator, which is used for accurate tuning of the speed regulator.

The following is a step-by-step procedure for using the HPV 900 to estimate the elevator system inertia.

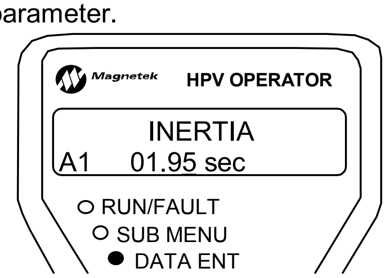
5.8.1 Using the Software to Estimate the System's Inertia

With a <u>balanced car, run the car at 100% contract speed</u> from top floor to the bottom floor then back to the top floor.

- Observe the EST INERTIA under DISPLAY MENU - ELEVATOR DATA D1 for both the down and up direction.



- Average the two values and enter the DRIVE A1 parameter.



5.9 MOTOR PARAMETER CALCULATION

The default motor selections (4 POLE DFLT or 6 POLE DFLT will load nominal values (see Table 5. 6) for the following motor parameters: % NO LOAD CURR, STATOR LEAKAGE X, ROTOR LEAKAGE X, STATOR RESIST, MOTOR IRON LOSS, and MOTOR MECH LOSS.

Most of the time the nominal values will work just fine. But in some cases, these motor parameter values must be precisely calculated.

5.9.1 Motor Manufacturer Data

The following is list of data that would be needed from a motor manufacturer in order to precisely calculate the motor parameters.

1. Rated voltage
2. Rated frequency
3. Rated kW or HP
4. Rated (full-load) Current (under conditions 1,2 and rated torque)
5. Power factor (under 1,2 and rated torque)
6. Rated RPM (under 1,2 and rated torque)
7. No load Current under 1 and 2
8. Iron Loss under 1 and 2
9. Mechanical loss under 1 and 2
10. Per phase Stator resistance
11. Stator leakage Inductance
12. Rotor leakage Inductance

5.9.2 Calculation from the Motor's Equivalent Circuit

This section details how to calculate the following HPV 900 motor parameters, which are entered as a percentage of the base impedance:

- Stator Leakage Reactance (STATOR LEAKAGE X)
- Rotor Leakage Reactance (ROTOR LEAKAGE X)
- Stator Resistance (STATOR RESIST)

Also,

- Motor Iron Loss (MOTOR IRON LOSS)
- Motor Mechanical Loss (MOTOR MECH LOSS)
- Initial value for Percentage No Load Current (% NO LOAD CURR)

The following data is required:

- Rated motor power in KW (or HP)
- Rated motor frequency (f)
- Rated motor current (I_{rated})
- Rated motor line-to-line voltage (V_{l-l})
- Equivalent single-phase circuit of the motor

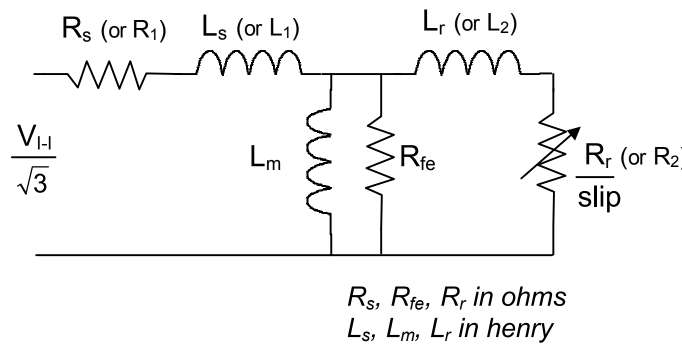


Figure 5. 45 - Equivalent single-phase circuit of the motor (Y connected)

5.9.2.1 Calculate Base Impedance

Calculate Z_{base} (base impedance)

$$Z_{base} = \frac{V_{l-l}^2}{power\ (in\ kW) \times 1000}$$

note: KW = HP $\times$ 0.746

5.9.2.2 Calculate Stator Resistance

Calculate R_s (STATOR RESIST) as a percentage of the base impedance

$$R_s(\%) = \frac{R_s\ \ (in\ ohms)}{Z_{base}} \times 100$$

note: R_s is per phase (Y connected)

5.9.2.3 Calculate Stator Reactance

Calculate L_s (STATOR LEAKAGE X) as a percentage of the base impedance

$$L_s(\%) = \frac{2\pi f \times L_s \quad \text{(in henry)}}{Z_{base}} \times 100$$

note: if XL_s are available then do not use ($2\pi f$) and L_s is per phase (Y connected)

5.9.2.4 Calculate Rotor Reactance

Calculate L_r (ROTOR LEAKGE X) as a percentage of the base impedance

$$L_r(\%) = \frac{2\pi f \times L_r \quad \text{(in henry)}}{Z_{base}} \times 100$$

note: if XL_r are available then do not use ($2\pi f$) and L_r is per phase (Y connected)

5.9.2.5 Calculate Motor Iron Loss

Calculate Motor Iron Loss (MOTOR IRON LOSS) as a percentage of the motor's rated power

$$\%\,\text{Iron Loss} = \frac{V_{l-l}^2 \times \dfrac{1}{R_{fe} \quad \text{(in ohms)}}}{\text{power (in KW)} \times 1000} \times 100$$

$$\%\,\text{Iron Loss} = \frac{\text{total iron loss (in kW)}}{\text{power (in KW)} \times 1000} \times 100$$

note: KW = HP $\times$ 0.74 and R_{fe} is per phase (Y connected)

5.9.2.6 Calculate Motor Mechanical Loss

Calculate Motor Mechanical Loss (MOTOR MECH LOSS) as a percentage of the motor's rated power

$$\%\,\text{Mechanical Loss} = \frac{\text{total loss (in kW)}}{\text{power (in KW)} \times 1000} \times 100$$

note: KW = HP $\times$ 0.746

5.9.2.7 Calculate Percentage No Load Current

Calculate Percentage No Load Current (%NO LOAD CURR) as a percentage of the motor's rated current

$$\%\,\text{no load current} = \frac{\left(\dfrac{V_{l-l}}{\sqrt{3}}\right)}{2\pi f \times L_m \times I_{rated}}$$

note: if XL_m are available then do not use ($2\pi f$) and L_m is per phase (Y connected)

After this initial value is entered, use the adaptive tune procedure (see section 5.6.2.1) to properly tune.

5.10 ELEVATOR DUTY CYCLE

The HPV 900 Ratings Table (see Figure 5. 46) has the following two continuous current ratings:

- Continuous Output Current General Purpose Rating
- Continuous Output Current Elevator Duty Cycle Rating

The General Purpose rating defines the maximum amount of current the drive can produce if the drive was to run non-stop.

The Elevator Duty Cycle Rating defines the maximum amount of current the drive can produce following the worst case Elevator System Load Profile.

The details of the Elevator System Load Profile are shown in Figure 5. 47 and Table 5. 7.

Rated Full-Load Current

Rated Current From the Elevator System Load Profile

Rated Input Voltage	Rated HP	Rated kW	Continuous Output Current General Purpose Rating	Continuous Output Current Elevator Duty Cycle* Rating	Maximum Output Current for 5 Sec	Cube Size**	Model Number***
230V	7.5	5.5	25	29	62.5	A	HPV900-2025-0E1-xx
	10	7.5	27	31	67.5	B	HPV900-2027-0E1-xx
	15	11	41	47	102	B	HPV900-2041-0E1-xx
	20	15	52	60	130	B	HPV900-2052-0E1-xx
	25	18	75	84	170	B+	HPV900-2075-0E1-xx
	30	22	88	99	200	B+	HPV900-2088-0E1-xx
	40	30	104	120	260	C	HPV900-2104-0E1-xx
460V	5	3.7	8	9	20	A	HPV900-4008-0E1-xx
	10	7.5	16	18	40	A	HPV900-4016-0E1-xx
	15	11	21	24	52.5	A	HPV900-4021-0E1-xx
	20	15	27	31	67.5	B	HPV900-4027-0E1-xx
	25	18	34	39	85	B	HPV900-4034-0E1-xx
	30	22	41	47	102	B	HPV900-4041-0E1-xx
	40	30	52	60	130	B	HPV900-4052-0E1-xx
	50	37	65	75	162	C	HPV900-4065-0E1-xx
	60	45	77	89	192	C	HPV900-4077-0E1-xx
	75	55	96	111	240	C	HPV900-4096-0E1-xx

Range for continuous current operation

NOTE: all ratings at 60/50Hz and 10 kHz carrier frequency
all ratings for based on a geared elevator application,
for gearless ratings, see Appendix 8.

For more information on altitude, temperature, and carrier frequency derating, see section 2.2.4.
Replaced model numbers: –2068 replaced by –2075 and –2080 replaced by –2088, see Appendix 15
* *For more information on the Elevator Duty Cycle Rating, see section 5.9.*
** *Cube size dimensions, mounting holes, and weights are shown in Appendix 1.*
*** *From more information on model numbers, see section 1.3.*

Figure 5. 46 – Descriptions of Ratings Table Labels

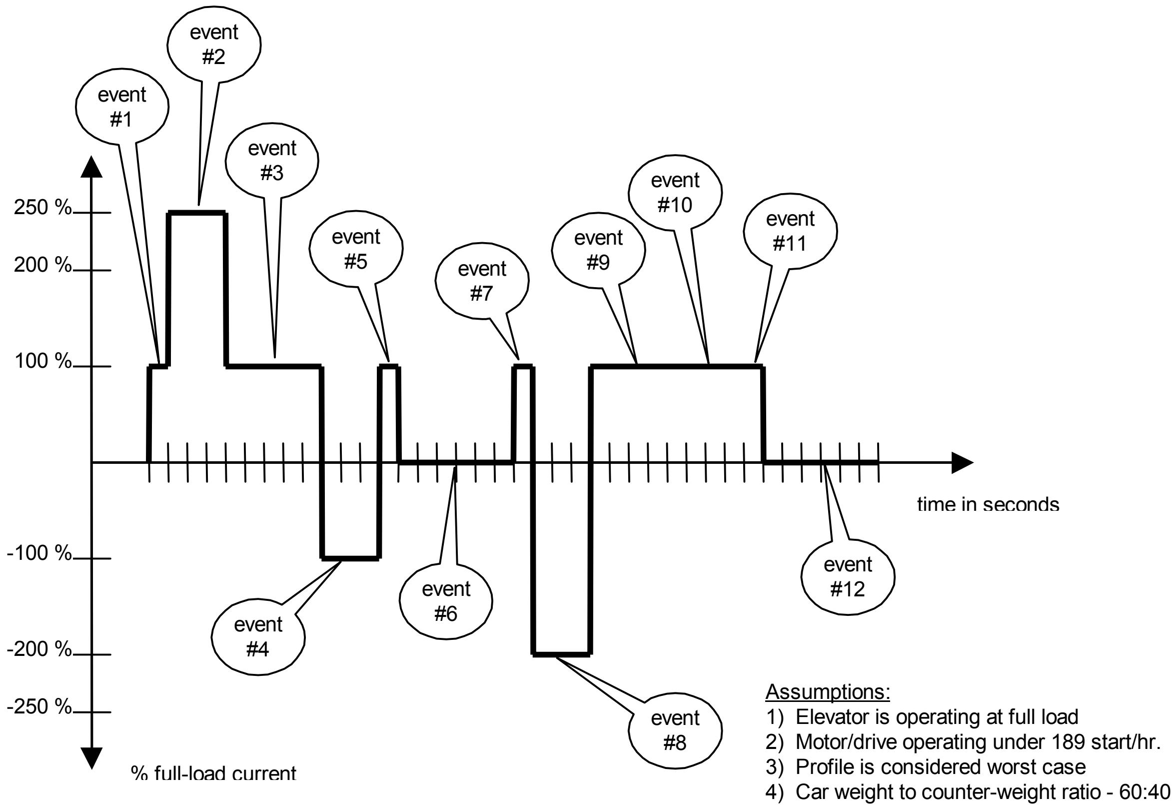


Figure 5. 47 - Elevator System Load Profile (except B+ cubes)

Event	Description	Time (s)	Current (per unit)	Current (% full load)	(I^2t)
1	Pre torque	1	1	100%	1.0
2	Accel up	3	2.5	250%	18.75
3	Cruise	5	1	100%	5.0
4	Decel up	3	1	100%	3.0
5	Post torque	1	1	100%	1.0
6	Rest	6	0	0%	0.0
7	Pre torque	1	1	100%	1.0
8	Accel down	3	2	200%	12
9	Cruise	5	1	100%	5.0
10	Decel down	3	1	100%	3.0
11	Post torque	1	1	100%	1.0
12	Rest	6	0	0%	0.0
	Total	38			50.75
RMS Per Unit Current for Load Profile					1.16
Percentage of Full-Load Current for Load Profile					116%
Cycles per hour					95
Starts per hour					189

Table 5. 7 - Elevator System Load Profile (except B+ cubes)

Event	Description	Time (s)	Current (per unit)	Current (% full load)	(I^2t)
1	Pre torque	1	1	100%	1.0
2	Accel up	3	2.25	225%	15.2
3	Cruise	5	1	100%	5.0
4	Decel up	3	1	100%	3.0
5	Post torque	1	1	100%	1.0
6	Rest	7	0	0%	0.0
7	Pre torque	1	1	100%	1.0
8	Accel down	3	2.25	225%	15.2
9	Cruise	5	1	100%	5.0
10	Decel down	3	1	100%	3.0
11	Post torque	1	1	100%	1.0
12	Rest	7	0	0%	0.0
	Total	40			50.4
RMS Per Unit Current for Load Profile					1.12
Percentage of Full-Load Current for Load Profile					112%
Cycles per hour					90
Starts per hour					180

Assumptions:
1) Elevator is operating at full load
2) Motor/drive operating under 180 start/hr.
3) Profile is considered worst case
4) Car weight to counter-weight ratio - 60:40

Table 5. 8 - Elevator System Load Profile (only B+ cubes)

5.11 CE Guidelines

Below are guidelines for CE compliance.

5.11.1 Standards

EN 61800-3 6.3.2.1	Adjustable speed electrical power drive systems – Part 3: EMC product standard including specific test methods environment 2
EN 12015 7.2	Product family standard for lifts, escalators and passenger conveyers Rated input current 25-100A

5.11.2 Recommended Line Filter

A line filter must be connected between the main power supply and input three phase input terminals to comply with the standards listed above. Appendix 7 lists the recommended line filters to be used with HPV 900 drives.

5.11.3 Installation Guidelines for EMI/RFI Issues

The HPV 900 drive should be installed in a control panel or metal enclosure. Enclosure manufacturers' designs vary and it is not the intent of this document to cover all designs. Some designs require different countermeasures than other designs. This paper covers only the general points of enclosure design when the HPV 900 drive is used.

5.11.3.1 Countermeasures For the Enclosure.

Radio frequency interference of various wavelengths emitted by electrical components are scattered randomly inside a control panel. This RFI induces noise on the cables within the control panel. When these cables are led out of the control panel, the cables containing the RFI noise act as antenna and radiate noise externally.

If drives or other control equipment are connected to a power supply without using a line filter, high frequency noise generated in the equipment can flow into the power supply.

Problems related to these emissions include:

- Radiated noise from the electric components inside the control panel or from the connecting cables.
- Radiated noise from the cables leading out of the control panel.
- Conducted noise and radiated noise (due to conducted noise) flowing from the control panel into the main input cables.

The basic countermeasures against the above conditions include modification of the control panel structure. Using EMI gaskets, ferrite cores, shielded cable, and enhanced grounding is also beneficial. The separation of signal and power wires is essential.

To help comply it is necessary to prevent the leakage or penetration of radio waves through cable entrances and installation holes in the enclosure.

Modifications to the enclosure include the following:

1. The enclosure should be made of ferrous metal and the joints at the top, bottom, and side panels should be continuously welded to make them electrically conductive.

2. The paint on the joint sections should be removed back to the bare metal to provide good electrical conductance.

3. Be careful to avoid gaps which could be created when panels become warped due to over tightening of retaining screws.

4. The section where the cabinet and door fit should have a ridged structure to avoid any gaps where RFI may leak.

5. There should be no conducting sections which are left floating electrically.

6. Both the cabinet and drive unit should be connected to a common ground.

5.11.3.2 Enclosure Door Construction

To help comply it is necessary to reduce RFI by eliminating gaps around doors used for opening/closing the control panel.

1. The door should be made of ferrous metal.

2. Conductive packing should be used between the doors and the main unit. Assure conductivity by removing the paint on the sections which contact the door.

3. Be careful to avoid gaps which could be opened when panels are warped due to the tightening retaining screws, etc.

5.11.3.3 Wiring External to the Enclosure

To help comply, the treatment of cables is the most important countermeasure. The grounding and the treatment of gaps in the external connection sections between the control panel and the machine are also important. It is recommended that the OEM / installer examine the present structure of all cable entrances.

Screened/shielded cable must be used for the motor cable (20 meters, 65 feet. max). The screen of the motor cable must be grounded at both ends by a short connection using as large an area as practical. The output lead section of the control panel should be treated to minimize leakage of RFI by eliminating clearances. The grounding surfaces should be metal conductors (steel solid or flexible conduit) and conductance should be assured by the following:

- Ground the connectors at both ends.
- The motor should be grounded.
- Flexible conduit (metallic) connected to a junction box should be grounded.

Group the wiring external to the enclosure into six separate steel conduits:

1. AC main input power,
2. AC control input power,
3. output to the motor,
4. motor encoder/thermistor wiring,
5. low voltage control including analog and digital inputs and outputs,
6. dynamic braking resistor.

5.11.3.4 Wiring Internal to the Enclosure

The most effective treatment for cables is shielding. Screened / shielded cable is recommended within the control panel. Use cables with a woven screen. The screen of the cable should be securely grounded using the largest area and shortest distance practical. Shield terminations must be as short as possible. It is recommended to ground the screen of the cable by clamping the cable to the grounding plate.

5.11.3.5 Panel Layout

The line filter and the drive must be mounted on the same metal panel. The metal panel should be securely grounded. The filter should be mounted as close as possible to the drive. Power cables should be kept as short as possible.

Appendix
1 DIMENSIONS, MOUNTING HOLES, & WEIGHTS

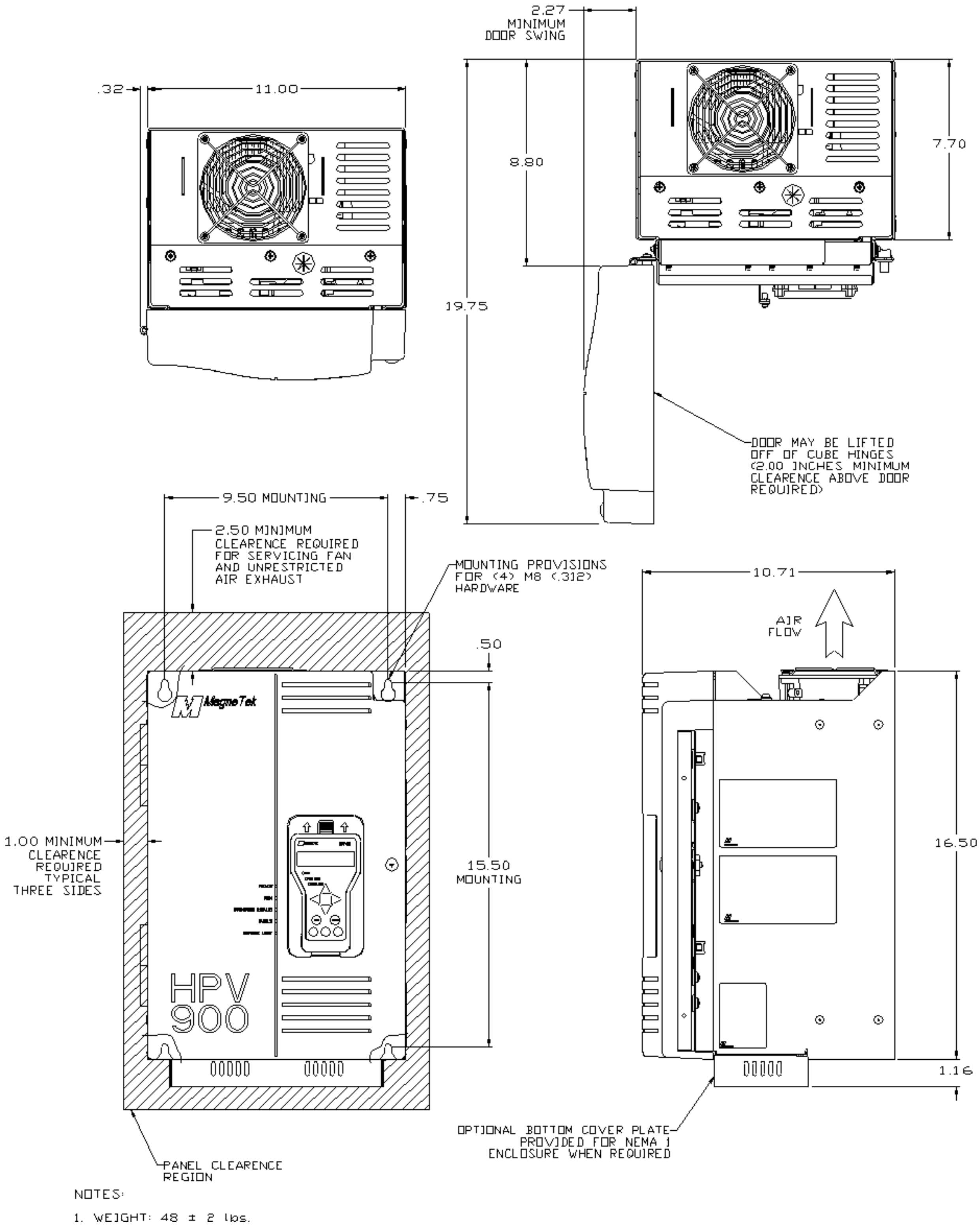
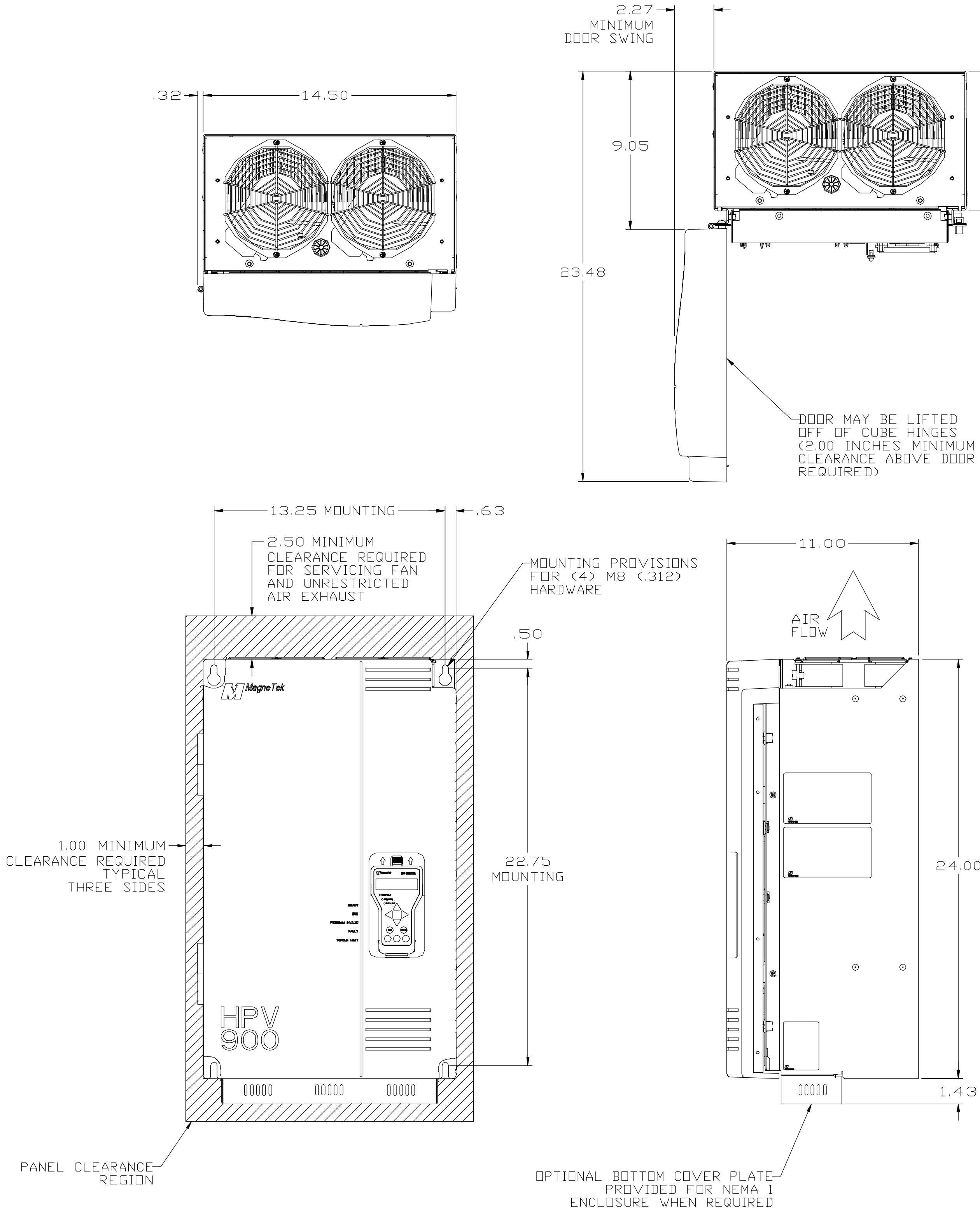


Figure A1. 1 – A-cube Dimensions and Mounting Holes



NOTES:

1. WEIGHT: 78 ± 2 lbs.

Figure A1. 2 – B-cube Dimensions and Mounting Holes

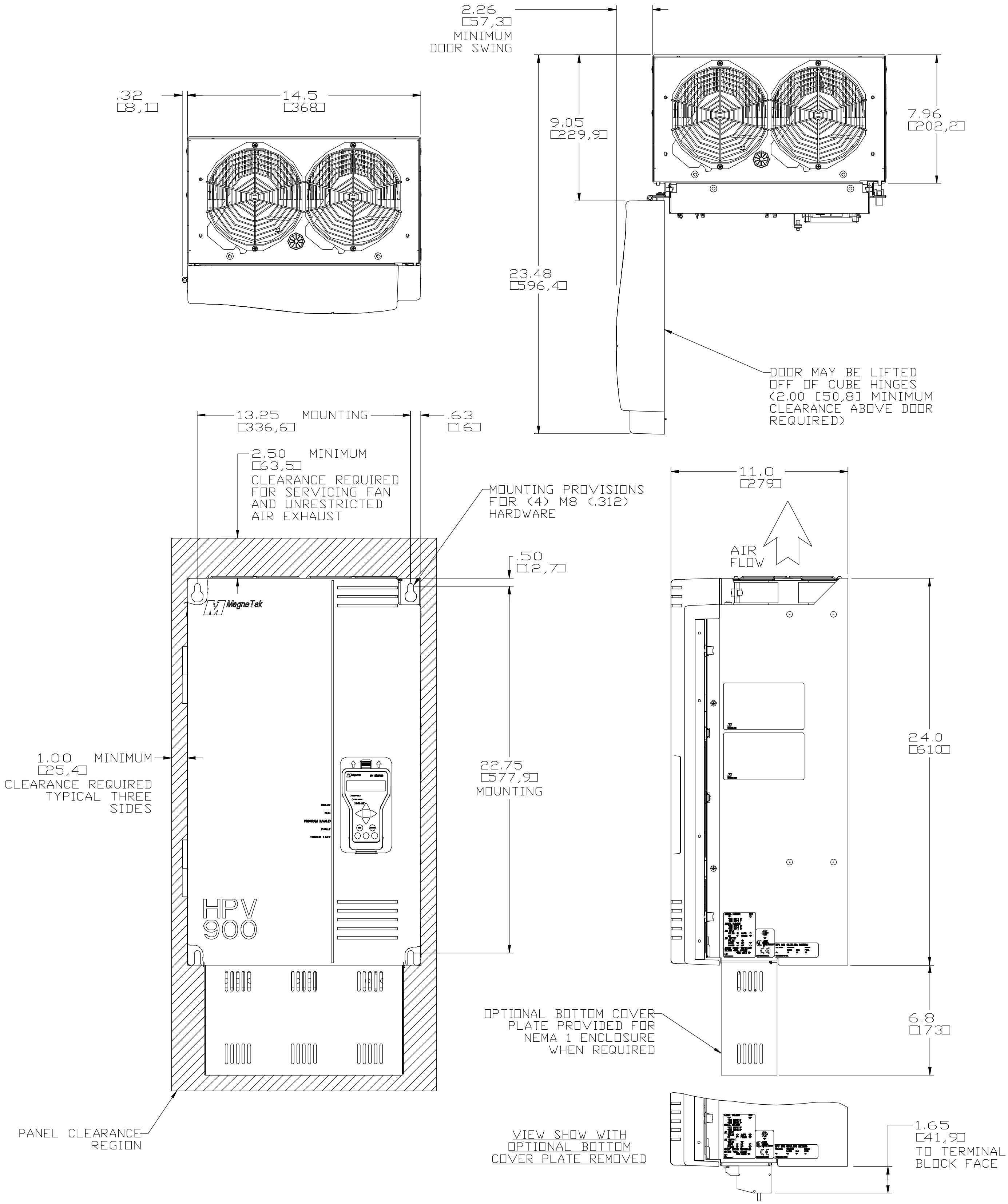


Figure A1. 3 - B+ cube Dimensions and Mounting Holes

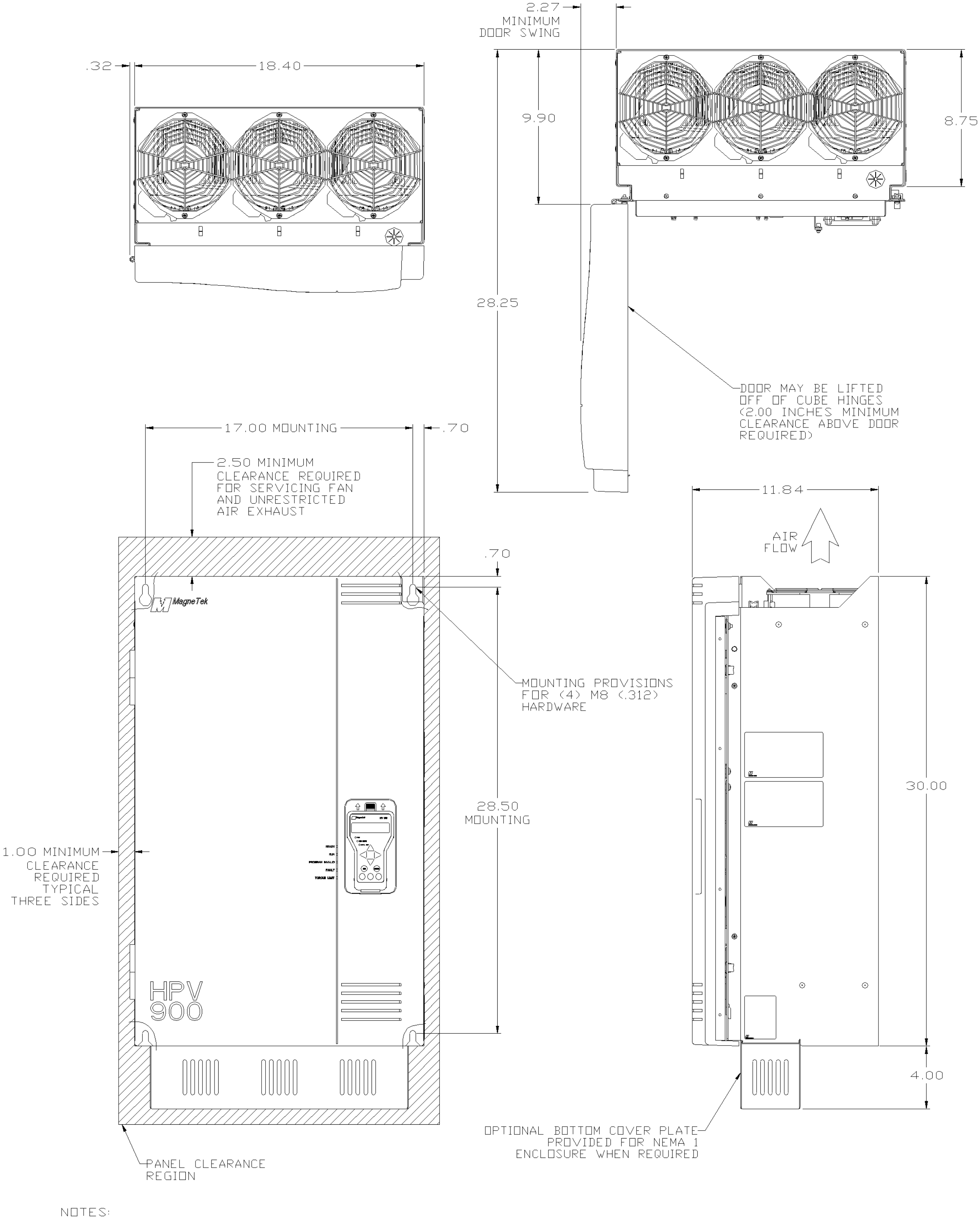


Figure A1. 4 – C-cube Dimensions and Mounting Holes

Appendix

2 DYNAMIC BRAKING RESISTOR SELECTION

Cube HP	Cube kW	Model	Power Dissipation kW (Worm Gear)	Resistor Value Range (Worm Gear)	Power Dissipation kW (Planetary Gear)	Resistor Value Range (Planetary Gear)
5	3.7	-4008	0.8	150 Ω - 40 Ω	1.7	75 Ω - 40 Ω
10	7.5	-4016	1.6	75 Ω - 20 Ω	3.4	40 Ω - 20 Ω
15	11	-4021	2.4	50 Ω - 20 Ω	5.0	25 Ω - 20 Ω
20	15	-4027	3.2	40 Ω - 16 Ω	6.8	20 Ω - 16 Ω
25	18	-4034	4.0	30 Ω - 11 Ω	8.5	15 Ω - 11 Ω
30	22	-4041	4.8	27 Ω - 11 Ω	10	13 Ω - 11 Ω
40	30	-4052	6.4	20 Ω - 8 Ω	14	10 Ω - 8 Ω
50	37	-4065	8.0	16 Ω - 4 Ω	17	7.5 Ω - 4 Ω
60	45	-4077	9.6	13 Ω - 4 Ω	20	6.3 Ω - 4 Ω
75	55	-4096	12	10 Ω - 4 Ω	25	5 Ω - 4 Ω

Note: 460 V, Regeneration dc bus voltage = 800V

Table A2. 1 - 460V Brake Resistor Recommendations

Cube HP	Cube kW	Model	Power Dissipation kW (Worm Gear)	Resistor Value Range (Worm Gear)	Power Dissipation kW (Planetary Gear)	Resistor Value Range (Planetary Gear)
7.5	5.5	-2025	1.2	27 Ω - 10 Ω	2.5	13 Ω - 10 Ω
10	7.5	-2027	1.6	20 Ω - 8 Ω	3.4	9.5 Ω - 8 Ω
15	11	-2041	2.4	13 Ω - 5.5 Ω	5.0	6.3 Ω - 5.5 Ω
20	15	-2052	3.2	10 Ω - 4 Ω	6.8	4.7 Ω - 4 Ω
25	18	-2075	4.0	8 Ω - 2 Ω	8.5	3.8 Ω - 2 Ω
30	22	-2088	4.8	6.6 Ω - 2 Ω	10	3.2 Ω - 2 Ω
40	30	-2104	6.4	5 Ω - 2 Ω	14	2.3 Ω - 2 Ω

Note: 230 V, Regeneration dc bus voltage = 400V

Table A2. 2 - 230V Brake Resistor Recommendations

Assumptions for Brake Resistor Recommendations

1) Peak regenerative requirement is: (Cube KW) * 2.5 * (Gear Efficiency) * (Motor Efficiency). This occurs at start of deceleration under maximum overhauling load (for counterweight < 50%, this is full load car, start of decel going down). From peak regen power the maximum resistor is calculated as: $R = V_{dc}^2 / P_{peak}$
2) Motor efficiency is 95%, jerk out is assumed to be infinite
3) 250% regenerative torque limit
4) Worm gear efficiency = 45%; planetary gears = 95%
5) For power dissipations, a 50% duty cycle is assumed (i.e. elevator runs continuously up and down but regenerates 50% of the time). Also, 100% regenerative power required. Average power = (Cube KW) * 1.0 * (Gear Efficiency) * (Motor Efficiency) * 0.5
6) Minimum resistor values based on 100% of device rated current except for 5/10/15HP at 460V cubes (uses 80%).

Appendix

3 THREE-PHASE AC INPUT REACTOR SELECTION

Input Voltage	Cube HP	Cube KW	Model	Inductance (mH)	Amps
460 V	5	3.7	-4008	1.4 mH	16 A
	10	7.5	-4016	0.88 mH	25 A
	15	11	-4021	0.63 mH	35 A
	20	15	-4027	0.63 mH	35 A
	25	18	-4034	0.49 mH	45 A
	30	22	-4041	0.28 mH	80 A
	40	30	-4052	0.28 mH	80 A
	50	37	-4065	0.28 mH	80 A
	60	45	-4077	0.20 mH	110 A
	75	55	-4096	0.138 mH	180 A

Table A3. 1 - 460V Input Reactor Recommendations

Input Voltage	Cube HP	Cube KW	Model	Inductance (mH)	Amps
230 V	7.5	5.5	-2025	0.63 mH	35 A
	10	7.5	-2027	0.49 mH	45 A
	15	11	-2041	0.28 mH	80 A
	20	15	-2052	0.28 mH	80 A
	25	18	-2075	0.28 mH	80 A
	30	22	-2088	0.20 mH	110 A
	40	30	-2104	0.138 mH	180 A

Table A3. 2 - 230V Input Reactor Recommendations

Manufacturer Considerations:
When selecting a input reactor, the elevator load profile needs to be taking into account.
Consider the following when selecting a manufacturer.

- Repeated 250% overloads current values
- Heating of inductors due to overloads and harmonics
- Saturation of inductor
- Life of reactor
- Ambient temperature vs. inductor current curve. The drive can operate at 55°C (130°F).

Appendix
4 DC CHOKE SELECTION

Input Voltage	Cube HP	Cube KW	Model	Inductance (mH)	DC Current Rating (A)
460 V	5	3.7	-4008	1.5 mH	18 A
	10	7.5	-4016	0.38 mH	36 A
	15	11	-4021	0.38 mH	36 A
	20	15	-4027	0.38 mH	36 A
	25	18	-4034	0.12 mH	72 A
	30	22	-4041	0.12 mH	72 A
	40	30	-4052	0.12 mH	72 A
	50	37	-4065	0.10 mH	120 A
	60	45	-4077	0.10 mH	120 A
	75	55	-4096	0.10 mH	120 A

Table A4. 1 - 460V DC Choke Recommendations

Input Voltage	Cube HP	Cube KW	Model	Inductance (mH)	DC Current Rating (A)
230 V	7.5	5.5	-2025	0.38 mH	36 A
	10	7.5	-2027	0.38 mH	36 A
	15	11	-2041	0.12 mH	72 A
	20	15	-2052	0.12 mH	72 A
	25	18	-2075	0.10 mH	120 A
	30	22	-2088	0.10 mH	120 A
	40	30	-2104	0.10 mH	120 A

Table A4. 2 - 230V DC Choke Recommendations

NOTE:

Magnetek prefers the use of AC Input Reactor over the use of the DC Choke because:
The DC choke has the disadvantage of isolating the diode bridge from the capacitor bank, making the diode bridge more susceptible to damage from transient surges. On the otherhand, DC Chokes can be used where the line conditions preclude large surges.

Manufacturer Considerations:
When selecting a input reactor, the elevator load profile needs to be taking into account.
Consider the following when selecting a manufacturer.

- Repeated 250% overloads current values
- Heating of inductors due to overloads and harmonics
- Saturation of inductor
- Life of reactor
- Ambient temperature vs. inductor current curve. The drive can operate at 55°C (130°F).

Appendix
5 AC INPUT FUSING SELECTION

All fuses should be Class J, Low Peak Dual Element, Time delay 600VAC fuses.

Input Voltage	Cube HP	Cube KW	Model	Fusing Required?	Fuse Size (in Amps)
460 V	5	3.7	-4008	Yes	16 to 45 A
	10	7.5	-4016	Yes	25 to 45 A
	15	11	-4021	Yes	35 to 45 A
	20	15	-4027	No*	45 to 100 A
	25	18	-4034	No*	50 to 100 A
	30	22	-4041	No*	60 to 100 A
	40	30	-4052	No*	80 to 100 A
	50	37	-4065	No*	100 to 200 A
	60	45	-4077	No*	125 to 200 A
	75	55	-4096	No*	150 to 200 A

Table A5. 1 - 460V Fusing Recommendations

All fuses should be Class J, Low Peak Dual Element, Time delay 600VAC fuses.

Input Voltage	Cube HP	Cube KW	Model	Fusing Required?	Fuse Size (in Amps)
230 V	7.5	5.5	-2025	Yes	35 to 45 A
	10	7.5	-2027	No*	45 to 100 A
	15	11	-2041	No*	60 to 100 A
	20	15	-2052	No*	80 to 100 A
	25	18	-2075	No*	100 to 200 A
	30	22	-2088	No*	125 to 200 A
	40	30	-2104	No*	150 to 200 A

Table A5. 2 - 230V Fusing Recommendations

IMPORTANT

Class J Input Fusing is required for the A-cube models:

-4008, -4016, -4021, and –2025

* With all other models circuit breakers can be substituted for fuses in accordance with local codes

Appendix
6 DYNAMIC BRAKING RESISTOR FUSING SELECTION

All fuses should be rated for 800VDC

Input Voltage	Cube HP	Cube KW	Model	Fuse Type (Bussmann pn)	Fuse Size (in Amps)
460 V	5	3.7	-4008	FWS-10A20F	10 A
	10	7.5	-4016	FWJ-20A14F	20 A
	15	11	-4021	FWJ-25A14F	25 A
	20	15	-4027	FWJ-30A14F	30 A
	25	18	-4034	FWJ-40A	40 A
	30	22	-4041	FWJ-50A	50 A
	40	30	-4052	FWJ-70A	70 A
	50	37	-4065	FWJ-100A	100 A
	60	45	-4077	FWJ-125A	125 A
	75	55	-4096	FWJ-125A	125 A

Table A6. 1 - 460V DB Fusing Recommendations

All fuses should be rated for at least 400VDC

Input Voltage	Cube HP	Cube KW	Model	Fuse Type (Bussmann pn)	Fuse Size (in Amps)
230 V	7.5	5.5	-2025	FWH-25A14F	25 A
	10	7.5	-2027	FWH-35B	35 A
	15	11	-2041	FWH-50B	50 A
	20	15	-2052	FWH-70B	70 A
	25	18	-2075	FWH-100B	100 A
	30	22	-2088	FWH-125B	125 A
	40	30	-2104	FWH-150B	150 A

Table A6. 2 - 230V DB Fusing Recommendations

IMPORTANT

Dynamic Braking Resistor Fusing:
1. Fusing is intended to limit drive damage in the event of an external resistor failure or short circuit.
2. Fusing will NOT protect DB resistors or wiring in the event of an overload.
3. Fuse both resistor legs mounting fuses as close to the drive as possible.
4. Always use fast acting semiconductor type fuses of sufficient voltage rating.

Appendix

7 LINE FILTER SELECTION

The suggested Line Filters to help meet the requirements for the following CE standards:

- EN 61800-3:1996 + A11:2000; environment 2
- EN 12015:1998

Note: also see Section (5.11) for addtional installation guidelines

Input Voltage	Cube HP	Cube KW	Model	Filter Type (BLOCK pn)		Current Rating (A)	Voltage Rating (V)
460 V	5	3.7	-4008	HLD 110-500/16	B 0105030	16	500
	10	7.5	-4016	HLD 110-500/30	B 0105031	30	500
	15	11	-4021	HLD 110-500/30	B 0105031	30	500
	20	15	-4027	HLD 110-500/42	B 0105032	42	500
	25	18	-4034	HLD 110-500/42	B 0105032	42	500
	30	22	-4041	HLD 110-500/55	B 0105033	55	500
	40	30	-4052	HLD 110-500/75	B 0105034	75	500
	50	37	-4065	HLD 110-500/75	B 0105034	75	500
	60	45	-4077	HLD 110-500/100	B 0105035	100	500
	75	55	-4096	HLD 110-500/130	B 0105036	130	500

Table A7. 1 - 460V Line Filter Recommendations

Input Voltage	Cube HP	Cube KW	Model	Filter Type (BLOCK pn)		Current Rating (A)	Voltage Rating (V)
230 V	7.5	5.5	-2025	HLD 110-500/30	B 0105031	30	500
	10	7.5	-2027	HLD 110-500/30	B 0105031	30	500
	15	11	-2041	HLD 110-500/42	B 0105032	42	500
	20	15	-2052	HLD 110-500/75	B 0105034	75	500
	25	18	-2075	HLD 110-500/75	B 0105034	75	500
	30	22	-2088	HLD 110-500/100	B 0105035	100	500
	40	30	-2104	HLD 110-500/130	B 0105036	130	500

Table A7. 2 - 230V Line Filter Recommendations

Appendix
8 GEARLESS APPLICATION

Rated Input Voltage	Rated HP	Rated kW	Continuous Output Current Rating	Maximum Output Current	Motor Frequency	Maximum Carrier Frequency	Model Number
460V	30	22	38	75	7.5-15Hz	8kHZ	HPV900-4052-0E1-G1
	50	37	64	128	7.5-15Hz	8kHZ	HPV900-4096-0E1-G1

NOTE: all ratings at 60/50Hz and maximum 8 kHz carrier frequency

Table A8. 1 - Gearless Drive Ratings

Model Number	Rated HP	Rated kW	Power Dissipation kW (gearless)	Resistor Value Range (gearless)	Cube Size*
HPV900-4052-0E1-G1	30	22	10	15Ω - 8Ω	B
HPV900-4096-0E1-G1	50	37	17	9Ω - 4Ω	C

* *Cube size dimensions, mounting holes, and weights are shown in Appendix 1.*

Table A8. 2 - Gearless Dynamic Braking Resistor / Dimensions

Appendix

9 SUGGESTED WIRE SIZES

It is recommended that the same wire size be used for the input, output and DB resistor wiring and copper wire should only be used.

Conductor size, AWG	Amps Conductors with 105°C (221°F) insulation: In conduit or non ventilated raceway	Open or in ventilated raceway	Suggested HPV 900 Wire Sizes for various cubes ratings: 460V	230V
14	10	15	5HP(-4008)	
12	15	22		
10	22	35	10HP(-4016)	
8	35	55	15HP(-4021) 20HP(-4027)	7.5HP(-2025) 10HP(-2027)
6	52	80	25HP(-4034) 30HP(-4041) 40HP(-4052)	15HP(-2041) 20HP(-2052)
4	71	108		
3	80	121	50HP(-4065)	25HP(-2075)
2	90	140	60HP(-4077)	30HP(-2088)
1	107	164		
0	133	190	75HP(-4096)	40HP(-2104)

Note: wire ratings from: Table 2 – Allowable Ampacities of Insulated Copper Conductors Inside Industrial Control Equipment Enclosures (Based on a Room Ambient Temperature of 40°C (104°F)) source: CAN/CSA-B44.1-M91

Table A9. 1 - Suggested Wire Sizes

Appendix

10 WIRE TERMINAL SPECIFICATIONS

			Power Terminals *input, output & DB*		Ground Terminals		Control Power Terminals *115VAC*		Control Wiring Terminals *TB1 & TB2*	
V	hp	Model	Wire size range (AWG)	Torque Spec. (in-lb)	Wire size range (AWG)	Torque Spec. (in-lb)	Wire size range (AWG)	Torque Spec. (in-lb)	Wire size range (AWG)	Torque Spec. (in-lb)
230V	7.5	-2025	20 to 6	18 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	10	-2027	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	15	-2041	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	20	-2052	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	25	-2075	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb
	30	-2088	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb
	40	-2104	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb
460V	5	-4008	20 to 6	18 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	10	-4016	20 to 6	18 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	15	-4021	20 to 6	18 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	20	-4027	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	25	-4034	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	30	-4041	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	40	-4052	20 to 6	15 in-lb	14 to 6	20 in-lb	14 to 22	4.5 in-lb	14 to 22	4.5 in-lb
	50	-4065	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb
	60	-4077	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb
	75	-4096	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb

Note: use only copper wire

Table A10. 1 - Wire Terminal Specifications

Appendix
11 DRIVE RATINGS (with 12-pulse option)

Rated Input Voltage	Rated HP	Rated kW	Model Number	Continuous Output Current Rating (range)	Maximum Output Current for 5 Sec	12-pulse option
230V	7.5	5.5	HPV900-2025-0E1-xx	25-29	62.5	No
	10	7.5	HPV900-2027-0E1-xx	27-31	67.5	Yes
	15	11	HPV900-2041-0E1-xx	41-47	102	Yes
	20	15	HPV900-2052-0E1-xx	52-60	130	Yes
	25	18	HPV900-2075-0E1-xx	75-84	170	Yes
	30	22	HPV900-2088-0E1-xx	88-99	200	Yes
	40	30	HPV900-2104-0E1-xx	104-120	260	Yes
460V	5	3.7	HPV900-4008-0E1-xx	8-9	20	No
	10	7.5	HPV900-4016-0E1-xx	16-18	40	No
	15	11	HPV900-4021-0E1-xx	21-24	52.5	No
	20	15	HPV900-4027-0E1-xx	27-31	67.5	Yes
	25	18	HPV900-4034-0E1-xx	34-39	85	Yes
	30	22	HPV900-4041-0E1-xx	41-47	102	Yes
	40	30	HPV900-4052-0E1-xx	52-60	130	Yes
	50	37	HPV900-4065-0E1-xx	65-75	162	Yes
	60	45	HPV900-4077-0E1-xx	77-89	192	Yes
	75	55	HPV900-4096-0E1-xx	96-111	240	Yes

NOTE: all ratings at 60/50Hz and 10 kHz carrier frequency
all ratings for based on a geared elevator application,

Table A11. 1 - Drive Ratings (with 12-pulse option)

Appendix
12 INPUT / OUTPUT RATINGS

Rated Input Voltage	Rated HP	Rated kW	Model	Input			Output	
				Voltage V	Current A	Short Circuit Withstand Rating	Voltage V	Current A
	7.5	5.5	-2025	200-240	30	42 KA	0-input voltage	25
	10	7.5	-2027	200-240	33	42 KA	0-input voltage	27
2	15	11	-2041	200-240	45	42 KA	0-input voltage	41
3	20	15	-2052	200-240	57	42 KA	0-input voltage	52
0	25	18	-2075	200-240	92	10 KA	0-input voltage	75
V	30	22	-2088	200-240	107	10 KA	0-input voltage	88
	40	30	-2104	200-240	115	42 KA	0-input voltage	104
	5	3.7	-4008	380-480	10	42 KA	0-input voltage	8
	10	7.5	-4016	380-480	17	42 KA	0-input voltage	16
	15	11	-4021	380-480	26	42 KA	0-input voltage	21
4	20	15	-4027	380-480	33	42 KA	0-input voltage	27
6	25	18	-4034	380-480	40	42 KA	0-input voltage	34
0	30	22	-4041	380-480	45	42 KA	0-input voltage	41
V	40	30	-4052	380-480	57	42 KA	0-input voltage	52
	50	37	-4065	380-480	71	42 KA	0-input voltage	65
	60	45	-4077	380-480	85	42 KA	0-input voltage	77
	75	55	-4096	380-480	106	42 KA	0-input voltage	96

Table A12. 1 - Input / Output Ratings

Appendix
13 WATTS LOSS

460V	Power loss
5HP (-4008)	130 watts
10HP (-4016)	210 watts
15HP (-4021)	325 watts
20HP (-4027)	390 watts
25HP (-4034)	500 watts
30HP (-4041)	600 watts
40HP (-4052)	800 watts
50HP (-4065)	935 watts
60HP (-4077)	1150 watts
75HP (-4096)	1500 watts

230V	Power loss
7.5HP (-2025)	320 watts
10HP (-2027)	350 watts
15HP (-2041)	500 watts
20HP (-2052)	700 watts
25HP (-2075)	800 watts
30HP (-2088)	1000 watts
40HP (-2104)	1400 watts

Note: values calculated from the worse case condition of 116% of general purpose continuous current rating, 10kHz carrier frequency.

Table A13. 1 - Watts Loss per Drive Rating

Appendix
14 CONTROL POWER DISSIPATION

460V	Control Power (115VAC) Dissipation
5HP (-4008)	80 watts
10HP (-4016)	80 watts
15HP (-4021)	80 watts
20HP (-4027)	145 watts
25HP (-4034)	145 watts
30HP (-4041)	145 watts
40HP (-4052)	145 watts
50HP (-4065)	185 watts
60HP (-4077)	185 watts
75HP (-4096)	185 watts

230V	Control Power (115VAC) Dissipation
7.5HP (-2025)	80 watts
10HP (-2027)	145 watts
15HP (-2041)	145 watts
20HP (-2052)	145 watts
25HP (-2075)	145 watts
30HP (-2088)	145 watts
40HP (-2104)	185 watts

Table A14. 1 - Control Power Dissipation per Drive Rating

Appendix
15 REPLACED MODELS

The following details information for the replaced model numbers listed below:

- HPV 900-2068-0E1-xx replaced by HPV900-2077-0E1-xx
- HPV 900-2080-0E1-xx replaced by HPV900-2088-0E1-xx

Rated Input Voltage	Rated HP	Rated kW	Continuous Output Current General Purpose Rating	Continuous Output Current Elevator Duty Cycle* Rating	Maximum Output Current for 5 Sec	Cube Size**	Model Number***
230V	25	18	68	78	170	C	HPV900-2068-0E1-xx
	30	22	80	92	200	C	HPV900-2080-0E1-xx

Table A15. 1 - HPV 900 Drive Ratings

NOTE: all ratings at 60/50Hz and 10 kHz carrier frequency
all ratings for based on a geared elevator application.
For more information on altitude, temperature, and carrier frequency derating, see section 2.2.4.
* *For more information on the Elevator Duty Cycle Rating, see section 5.9.*
** *Cube size dimensions, mounting holes, and weights are shown in Appendix 1.*
*** *From more information on model number, see section 1.3.*

Cube HP	Cube kW	Model	Power Dissipation kW (Worm Gear)	Resistor Value Range (Worm Gear)	Power Dissipation kW (Planetary Gear)	Resistor Value Range (Planetary Gear)
25	18	-2068	4.0	8 Ω - 2 Ω	8.5	3.8 Ω - 2 Ω
30	22	-2080	4.8	6.6 Ω - 2 Ω	10	3.2 Ω - 2 Ω

Note: 230 V, Regeneration dc bus voltage = 400V

Table A15. 2 - Brake Resistor Recommendations

For Assumptions for Brake Resistor Recommendations, see Appendix 2.

Input Voltage	Cube HP	Cube KW	Model	Inductance (mH)	Amps
230 V	25	18	-2068	0.28 mH	80 A
	30	22	-2080	0.20 mH	110 A

Table A15. 3 - Input Reactor Recommendations

For Manufacturer Considerations, see Appendix 3.

Input Voltage	Cube HP	Cube KW	Model	Inductance (mH)	DC Current Rating (A)
230 V	25	18	-2068	0.10 mH	120 A
	30	22	-2080	0.10 mH	120 A

Table A15. 4 - DC Choke Recommendations

See note in Appendix 4.

All fuses should be Class J, Low Peak Dual Element, Time delay 600VAC fuses.

Input Voltage	Cube HP	Cube KW	Model	Fusing Required?	Fuse Size (in Amps)
230 V	25	18	-2068	No*	100 to 200 A
	30	22	-2080	No*	125 to 200 A

Table A15. 5 - Fusing Recommendations

* With all other models circuit breakers can be substituted for fuses in accordance with local codes

	Amps Conductors with 105°C (221°F) insulation		Suggested HPV 900 Wire Sizes for various cubes ratings
Conductor size, AWG	In conduit or non ventilated raceway	Open or in ventilated raceway	230V
3	80	121	25HP(-2075)
2	90	140	30HP(-2088)

Table A15. 6 - Suggested Wire Sizes

See note in Appendix 9.

			Power Terminals *input, output & DB*		Ground Terminals		Control Power Terminals *115VAC*		Control Wiring Terminals *TB1 & TB2*	
V	hp	Model	Wire size range (AWG)	Torque Spec. (in-lb)	Wire size range (AWG)	Torque Spec. (in-lb)	Wire size range (AWG)	Torque Spec. (in-lb)	Wire size range (AWG)	Torque Spec. (in-lb)
230	25	-2068	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb
	30	-2080	6 to 1/0	75 in-lb	14 to 1/0	35 in-lb	22 to 10	5.3 in-lb	14 to 22	4.5 in-lb

Note: use only copper wire

Table A15. 7 - Wire Terminal Specifications

Rated Input Voltage	Rated HP	Rated kW	Model Number	Continuous Output Current Rating (range)	Maximum Output Current for 5 Sec	12-pulse option
230V	25	18	HPV900-2068-0E1-xx	68-78	170	Yes
	30	22	HPV900-2080-0E1-xx	80-92	200	Yes

Table A15. 8 - Drive Ratings (with 12-pulse option)

NOTE: all ratings at 60/50Hz and 10 kHz carrier frequency
all ratings for based on a geared elevator application

Rated Input Voltage	Rated HP	Rated kW	Model	Input		Output	
				Voltage V	Current A	Voltage V	Current A
230V	25	18	-2068	200-240	75	0-input voltage	68
	30	22	-2080	200-240	88	0-input voltage	80

Table A15. 9 - Input / Output Ratings

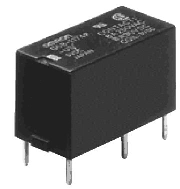
230V	Power loss*	Control Power (115VAC) Dissipation
25HP (-2068)	800 watts	185 watts
30HP (-2080)	1000 watts	185 watts

Table A15. 10 - Watts Loss / Control Power Dissipation per Drive Rating

** See note in Appendix 13.*

Appendix
16 RELAY SPECIFICATIONS

RELAY 1



Contact Data

Load	Standard	
	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4) (L/R = 7ms)
Rated Load	5 A at 250 VAC 5 A at 30 VDC	2 A at 250 VAC 2 A at 30 VDC
Carry current	5 A	
Max. operating voltage	380 VAC, 125 VDC	
Max. operating current	5 A	
Max. switching capacity	1,250 VA, 150 W	500 VA, 60 W
Min, permissible load	10mA, 5 VDC	

Table A16. 1 - Relay 1 Contact Data

Maximum Switching Capacity

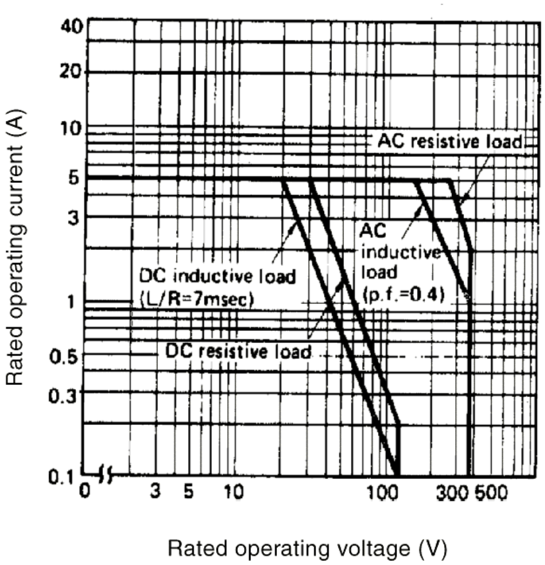


Figure A16. 1 - Relay 1 Maximum Switching Capacity

Electrical Service Life

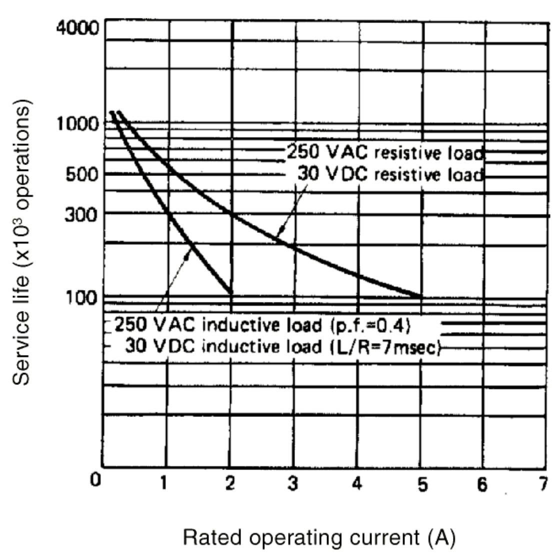


Figure A16. 2 - Relay 1 Electrical Service Life

RELAY 2

Contact Data

Load	Standard	
	Resistive load (p.f. = 1)	Inductive load (p.f. = 0.4) (L/R = 7ms)
Rated Load	10 A at 110 VAC 10 A at 24 VDC	7.5 A at 110 VAC 5 A at 24 VDC
Carry current	10 A	
Max. operating voltage	250 VAC, 125 VDC	
Max. operating current	10 A	
Max. switching capacity	1,100 VA, 240 W	830 VA, 120 W

Table A16. 2 - Relay 2 Contact Data

Maximum Switching Capacity

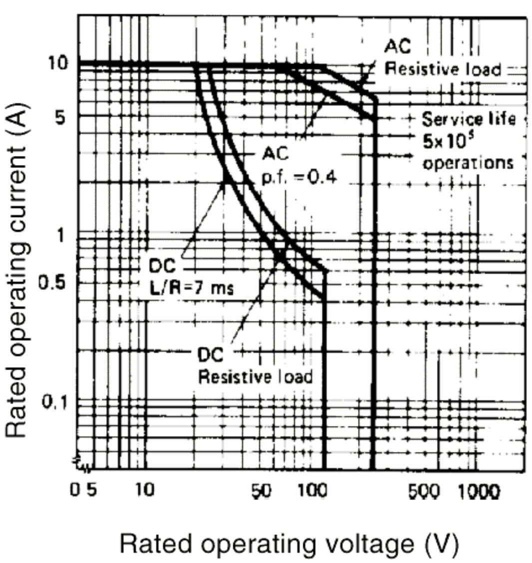


Figure A16. 3 - Relay 2 Maximum Switching Capacity

Electrical Service Life

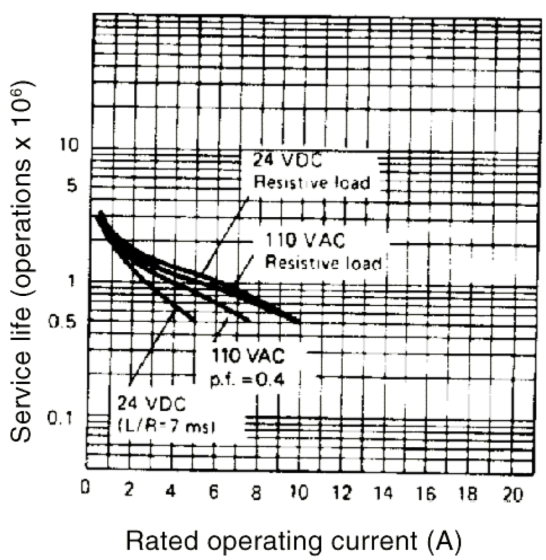


Figure A16. 4 - Relay 2 Electrical Service Life

Appendix
17 REPLACEMENT PARTS

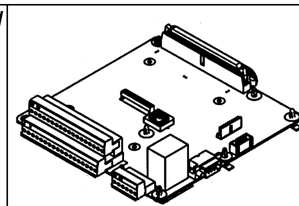
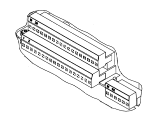
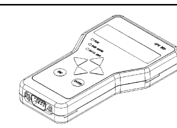
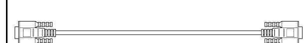
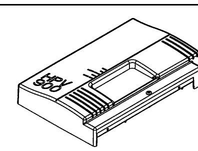
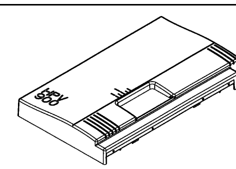
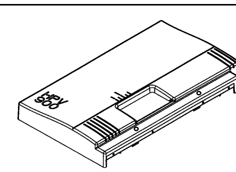
part number	description	detailed description	
HPV9-CTL0010-01	FRU,HPV900,Ctl PCB, Std Sfw	*Includes the control PCB, software flash, terminal blocks, grounding screw and hardware, and 7 spacers*	
HPV9-CTLTB	FRU,HPV900,Control TBs	*Control terminal blocks.*	
HPV9-PSTB-AB	FRU,HPV900,Control Power TB	*Terminal block for 115VAC control power*	
HPV-ELOP	FRU, HPV900 Oper, Elevator	*Digital operator*	
HPV-CABLE	FRU, HPV900 Oper, Cable	*Digital operator extension cable 2m (6.6 ft)*	
HPV9-COVRA00	FRU,HPV900,Cover,A	*Includes the front plastic cover, cover frame sheet metal, and hardware for A cube.*	
HPV9-COVRB00	FRU,HPV900,Cover,B (side opening)	*Includes the front plastic cover, cover frame sheet metal, and hardware for B and B+ cubes.*	
HPV9-COVRB01	FRU,HPV900,Cover,B (front opening)	*Includes the front plastic cover, cover frame sheet metal, and hardware for B and B+ cubes.*	

Table A17. 1 - Replacement Parts

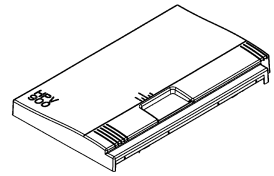
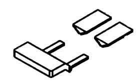
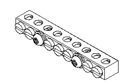
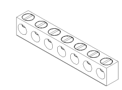
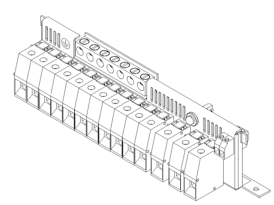
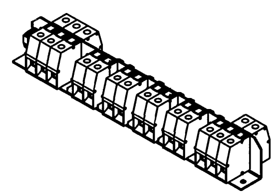
part number	description	detailed description	
HPV9-COVRC00	FRU,HPV900,Cover,C	*Includes the front plastic cover, cover frame sheet metal, and hardware for C cube.*	
HPV9-JMPAB	FRU,HPV900,TB Jumper,Cube A+B	*Terminal block jumpers (quantity=4) for A and B cubes*	
HPV9-JMPC	FRU,HPV900,TB Jumper,Cube C	*Terminal block jumpers (quantity=4) for B+ and C cubes*	
HPV9-GNDTB-AB	FRU,HPV900, Ground TB, Cube A+B	*Terminal block for the ground connections for A and B cubes*	
HPV9-GNDTB-C	FRU,HPV900, Ground TB, Cube C	*Terminal block for the ground connections for B+ and C cubes*	
HPV9-PWRTB-BP	FRU,HPV900, Power TB assembly, Cube B+	*Terminal block* assembly *for the power terminals for input power, DB resistor, ground, control 115VAC and DC bus LED for B+ cubes*	
HPV9-PWRTB-C	FRU,HPV900, Power TB assembly, Cube C	*Terminal block* assembly *for the power terminals for input power, DB resistor and control 115VAC for C cubes*	

Table A17. 1 - Replacement Parts (continued)

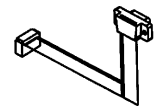
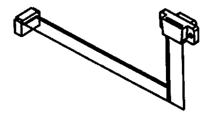
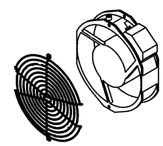
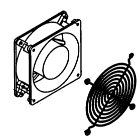
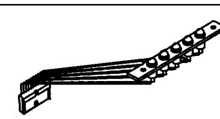
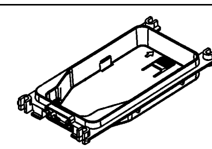
part number	description	detailed description	
HPV9-OPCABLE-AB	FRU,HPV900,Cable Cntl-Op Port, cube-AB	*Ribbon cable connecting Control PCB to the Operator Port (DB-9) for A, B, and B+ cubes*	
HPV9-OPCABLE-C	FRU,HPV900,Cable Cntl-Op Port, cube-C	*Ribbon cable connecting Control PCB to the Operator Port (DB-9) for C cubes*	
HPV9-FAN1BC	FRU,Fan,250CFM,115V	*Includes the 250CFM/115V fan and fan guard for B, B+, & C cubes*	
HPV9-FAN1A	FRU,Fan,105CFM,115V	*Includes the 105CFM/115V fan and fan guard for A cubes*	
HPV9-LED	FRU,HPV900,LED Assembly	*LED display assembly*	
HPV9-OPCRADLE	FRU,HPV900,Operator Cradle	*Operator Cradle*	

Table A17. 1 - Replacement Parts (continued)

Appendix
18 PARAMETER & MENU REFERENCE

parameter	*description*	*menu*	*units*	*hidden*	*lockout*
Elevator Data	*see section (3.3.1)*	***D1***			
Speed Command	Speed command before speed reference generator	D1	ft/min or m/s	N	
Speed Reference	Speed reference after speed reference generator	D1	ft/min or m/s	N	
Speed Feedback	Encoder feedback used by speed regulator	D1	ft/min or m/s	N	
Speed Error	Speed reference minus speed feedback	D1	ft/min or m/s	N	
Pre-Torque Ref	Pre-torque reference	D1	% rated torque	N	
Spd Reg Torq Cmd	Torque command from speed regulator	D1	% rated torque	Y	
Tach Rate Cmd	Torque command after tach rate gain function	D1	% rated torque	Y	
Aux Torque Cmd	Feedforward torque command from auxiliary source	D1	% rated torque	Y	
Est Inertia	Estimated elevator system inertia	D1	seconds	N	
Logic Outputs	Shows condition of logic outputs	D1	1=T 0=F	N	
Logic Inputs	Shows condition of logic outputs	D1	1=T 0=F	N	
Power Data	*see section (3.3.2)*	***D2***			
Torque Reference	Torque reference used by vector control	D2	% rated torque	N	
Motor Current	RMS motor current	D2	Amps	N	
% Motor Current	Percent motor current	D2	%rated current	N	
Motor Voltage	RMS motor terminal voltage	D2	Volts	N	
Motor Frequency	Electrical frequency output	D2	Hz	N	
Motor Torque	Calculated motor torque output	D2	% rated torque	N	
Power Output	Calculated drive power output	D2	KW	N	
DC Bus Voltage	Measured DC bus voltage	D2	Volts	N	
Flux Reference	Flux reference used by vector control	D2	% rated flux	Y	
Flux Output	Measured flux output	D2	% rated flux	Y	
Slip Frequency	Commanded slip frequency	D2	Hz	Y	
Motor Overload	Percent of motor overload trip level reached	D2	%	Y	
Drive Overload	Percent of drive overload trip level reached	D2	%	Y	
Flux Current	Measured flux producing current	D2	%rated current	Y	
Torque Current	Measured torque producing current	D2	%rated current	Y	
Flux Voltage	Flux voltage reference	D2	% rated volts	Y	
Torque Voltage	Torque voltage reference	D2	% rated volts	Y	
Base Impedance	Drive calculated base impedance	D2	Ohms	Y	
Est No Load Curr	Estimated no load current	D2	%rated current	N	
Est Rated RPM	Estimated rated RPM	D2	RPM	N	

Table A18. 1 - Parameter & Menu Reference

parameter	***description***	***menu***	***units***	***hidden***	***lockout***
Drive	*see section (3.4.1)*	***A1***			
Contract Car Spd	Elevator contract speed	A1	m/s or ft/min	N	Y
Contract Mtr Spd	Motor speed at elevator contract speed	A1	RPM	N	Y
Response	Sensitivity of the speed regulator	A1	rad/sec	N	N
Inertia	System inertia	A1	sec	N	N
Inner Loop Xover	Inner speed loop crossover frequency (only with Ereg speed regulator)	A1	rad/sec	N	N
Gain Reduce Mult	Percentage of response of the speed regulator using when in the low gain mode	A1	%	Y	N
Gain Chng Level	Speed level to change to low gain mode (only with internal gain switch)	A1	% rated speed	Y	N
Tach Rate Gain	Helps with the effects of rope resonance	A1	%	Y	N
Spd Phase Margin	Sets phase margin of speed regulator (only with PI speed regulator)	A1	degrees	Y	N
Ramped Stop Time	Time to ramp torque from rated torque to zero (only with torque ramp down function)	A1	seconds	Y	N
Contact Flt Time	Time before a contactor fault is declared	A1	seconds	Y	N
Brake Pick Time	Time before a brake pick fault is declared	A1	seconds	Y	N
Brake Hold Time	Time before a brake hold fault is declared	A1	seconds	Y	N
Overspeed Level	Threshold for detection of overspeed fault	A1	% contract spd	Y	N
Overspeed Time	Time before a overspeed fault is declared	A1	seconds	Y	N
Overspeed Mult	Multiplier for overspeed test	A1	%	Y	N
Encoder Pulses	Encoder counts per revolution	A1	none	N	Y
Spd Dev Lo Level	Range around the speed reference for speed deviation low logic output	A1	% contract spd	Y	N
Spd Dev Time	Time before speed deviation low logic output is true	A1	seconds	Y	N
Spd Dev Hi Level	Level for declaring speed deviation alarm	A1	% contract spd	Y	N
Spd Command Bias	Subtracts an effective voltage to actual speed command voltage	A1	volts	Y	Y
Spd Command Mult	Scales analog speed command	A1	none	Y	Y
Pre Torque Bias	Subtracts an effective voltage to actual pre torque command voltage	A1	volts	Y	Y
Pre Torque Mult	Scales pre-torque command	A1	none	Y	Y
Zero Speed Level	Threshold for zero speed logic output	A1	% contract spd	Y	Y
Zero Speed Time	Time before zero speed logic output is declared true.	A1	seconds	Y	Y
Up/Dwn Threshold	Threshold for detection of up or down direction	A1	% contract spd	Y	Y
Mtr Torque Limit	Motoring torque limit	A1	% rated torque	N	N
Regen Torq Limit	Regenerating torque limit	A1	% rated torque	N	N
Flux Wkn Factor	Defines the torque limit at higher speeds	A1	% torque	Y	N
Ana Out 1 Offset	Subtracts an effective voltage to actual analog output 1	A1	%	Y	N
Ana Out 2 Offset	Subtracts an effective voltage to actual analog output 2	A1	%	Y	N
Ana Out 1 Gain	Scaling factor for analog output 1	A1	none	Y	N
Ana Out 2 Gain	Scaling factor for analog output 2	A1	none	Y	N
Flt Reset Delay	Time before a fault is automatically reset	A1	seconds	Y	N
Flt Resets / Hour	Number of faults that is allowed to be automatically reset per hour	A1	faults	Y	N
Up to Spd. Level	Threshold for up to spd logic output	A1	% cont spd	Y	N

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	***description***	***menu***	***units***	***hidden***	***lockout***
S-Curves	*see section (3.4.2)*	***A2***			
Accel Rate 0	Acceleration rate #0	A2	ft/s^2 or m/s^2	N	Y
Decel Rate 0	Deceleration rate #0	A2	ft/s^2 or m/s^2	N	Y
Jerk Rate 0	Accel jerk in, accel jerk out, decel jerk in #0	A2	ft/s^3 or m/s^3	N	Y
Lev Jerk Rate 0	Leveling jerk rate (decel jerk out) #0	A2	ft/s^3 or m/s^3	N	Y
Accel Rate 1	Acceleration rate #1	A2	ft/s^2 or m/s^2	N	Y
Decel Rate 1	Deceleration rate #1	A2	ft/s^2 or m/s^2	N	Y
Jerk Rate 1	Accel jerk in, accel jerk out, decel jerk in #1	A2	ft/s^3 or m/s^3	N	Y
Lev Jerk Rate 1	Leveling jerk rate (decel jerk out) #1	A2	ft/s^3 or m/s^3	N	Y
Accel Rate 2	Acceleration rate #2	A2	ft/s^2 or m/s^2	Y	Y
Decel Rate 2	Deceleration rate #2	A2	ft/s^2 or m/s^2	Y	Y
Jerk Rate 2	Accel jerk in, accel jerk out, decel jerk in #2	A2	ft/s^3 or m/s^3	Y	Y
Lev Jerk Rate 2	Leveling jerk rate (decel jerk out) #2	A2	ft/s^3 or m/s^3	Y	Y
Accel Rate 3	Acceleration rate #3	A2	ft/s^2 or m/s^2	Y	Y
Decel Rate 3	Deceleration rate #3	A2	ft/s^2 or m/s^2	Y	Y
Jerk Rate 3	Accel jerk in, accel jerk out, decel jerk in #3	A2	ft/s^3 or m/s^3	Y	Y
Lev Jerk Rate 3	Leveling jerk rate (decel jerk out) #3	A2	ft/s^3 or m/s^3	Y	Y
Multi-Step	*see section (3.4.3)*	***A3***			
Speed Command 1	Multi-step speed command #1	A3	ft/min or m/sec	N	Y
Speed Command 2	Multi-step speed command #2	A3	ft/min or m/sec	N	Y
Speed Command 3	Multi-step speed command #3	A3	ft/min or m/sec	N	Y
Speed Command 4	Multi-step speed command #4	A3	ft/min or m/sec	N	Y
Speed Command 5	Multi-step speed command #5	A3	ft/min or m/sec	N	Y
Speed Command 6	Multi-step speed command #6	A3	ft/min or m/sec	N	Y
Speed Command 7	Multi-step speed command #7	A3	ft/min or m/sec	N	Y
Speed Command 8	Multi-step speed command #8	A3	ft/min or m/sec	N	Y
Speed Command 9	Multi-step speed command #9	A3	ft/min or m/sec	N	Y
Speed Command 10	Multi-step speed command #10	A3	ft/min or m/sec	N	Y
Speed Command 11	Multi-step speed command #11	A3	ft/min or m/sec	N	Y
Speed Command 12	Multi-step speed command #12	A3	ft/min or m/sec	N	Y
Speed Command 13	Multi-step speed command #13	A3	ft/min or m/sec	N	Y
Speed Command 14	Multi-step speed command #14	A3	ft/min or m/sec	N	Y
Speed Command 15	Multi-step speed command #15	A3	ft/min or m/sec	N	Y

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	*description*	*menu*	*units*	*hidden*	*lockout*
Power Convert	*see section (3.4.4)*	***A4***			
Id Reg Diff Gain	Flux current regulator differential gain	A4	none	Y	N
Id Reg Prop Gain	Flux current regulator proportional gain	A4	none	Y	N
Iq Reg Diff Gain	Torque current regulator differential gain	A4	none	Y	N
Iq Reg Prop Gain	Torque current regulator proportional gain	A4	none	Y	N
PWM Frequency	Carrier frequency	A4	kHz	N	N
UV Alarm Level	Voltage level for undervoltage alarm	A4	%nominal bus	Y	N
UV Fault Level	Voltage level for undervoltage fault	A4	%nominal bus	Y	N
Extern Reactance	External choke reactance	A4	% base Z	Y	Y
Input L-L Volts	Nominal line-line AC input Voltage, RMS	A4	Volts	N	N
Motor	*see section (3.4.5)*	***A5***			
Motor ID	Motor Identification	A5	none	N	Y
Rated Mtr Power	Rated motor output power	A5	HP / KW	N	Y
Rated Mtr Volts	Rated motor terminal RMS voltage	A5	Volts	N	Y
Rated Excit Freq	Rated excitation frequency	A5	Hz	N	Y
Rated Motor Curr	Rated motor current	A5	Amps	N	Y
Motor Poles	Motor poles	A5	none	N	N
Rated Mtr Speed	Rated motor speed at full load	A5	RPM	N	Y
% No Load Curr	Percent no load current	A5	%rated current	N	N
Stator Leakage X	Stator leakage reactance	A5	% base Z	Y	N
Rotor Leakage X	Rotor leakage reactance	A5	% base Z	Y	N
Stator Resist	Stator resistance	A5	% base Z	Y	N
Motor Iron Loss	Iron loss at rated frequency	A5	% rated power	Y	N
Motor Mech Loss	Mechanical loss at rated frequency	A5	% rated power	Y	N
Ovld Start Level	Maximum continuous motor current	A5	% rated current	Y	Y
Ovld Time Out	Time that defines motor overload curve	A5	seconds	Y	Y
Flux Sat Break	Flux saturation curve slope change point.	A5	% flux	Y	Y
Flux Sat Slope 1	Flux saturation curve slope for low fluxes	A5	PU slope	Y	Y
Flux Sat Slope 2	Flux saturation curve slope for high fluxes	A5	PU slope	Y	Y
User Switches	*see section (3.5.1)*	***C1***			
Spd Command Src	Speed Command Source	C1		Y	Y
Run Command Src	Run Command Source	C1		Y	Y
Hi/Lo Gain Src	High / low gain change switch source	C1		Y	Y
Speed Reg Type	Chooses speed regulator: Ereg or PI regulator	C1		Y	Y
Motor Rotation	Allows user to reverse direction of motor rotation.	C1		Y	Y
Spd Ref Release	Determines when speed reference release is asserted.	C1		Y	Y
Cont Confirm Src	Determines if an external logic input is used for contactor confirm.	C1		Y	Y
PreTorque Source	Determines if a pre torque command is used and if used, it determines the source of the pre torque command.	C1		Y	Y
PreTorque Latch	Chooses if analog pre-torque command is latched	C1		Y	Y
PTorq Latch Clck	Determines source of pre torque latch control (if used)	C1		Y	Y
Fault Reset Src	Fault reset source	C1		Y	Y

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	*description*	*menu*	*units*	*hidden*	*lockout*
User Switches	*(continued)*	***C1***			
Overspd Test Src	Determines external logic source to trigger overspeed test	C1		Y	Y
Brake Pick Src	If drive controls the mechanical brake, this determines the source of the brake pick command	C1		Y	Y
Brake Pick Cnfm	Determines if a logic input is used for brake pick confirm	C1		Y	Y
Brake Hold Src	If drive controls the mechanical brake, this determines the source of the brake hold command.	C1		Y	Y
Ramped Stop Sel	Chooses between normal stop and torque ramp down stop	C1		Y	Y
Ramp Down En Src	Determines the source that signals the torque ramp down stop (if used)	C1		Y	Y
Brk Pick Flt Ena	Brake pick fault enable	C1		Y	Y
Brk Hold Flt Ena	Brake hold fault enable	C1		Y	Y
Ex Torq Cmd Src	Sets source of external torque command	C1		Y	Y
Dir Confirm	Allows confirmation of polarity of analog speed command	C1		Y	Y
S-Curve Abort	Addresses handling of a speed command change before S-Curve target speed	C1		Y	Y
Logic Inputs	*see section (3.5.2)*	***C2***			
Log In 1 Tb1-1	Logic input configuration for Tb1-1	C2		Y	Y
Log In 2 Tb1-2	Logic input configuration for Tb1-2	C2		Y	Y
Log In 3 Tb1-3	Logic input configuration for Tb1-3	C2		Y	Y
Log In 4 Tb1-4	Logic input configuration for Tb1-4	C2		Y	Y
Log In 5 Tb1-5	Logic input configuration for Tb1-5	C2		Y	Y
Log In 6 Tb1-6	Logic input configuration for Tb1-6	C2		Y	Y
Log In 7 Tb1-7	Logic input configuration for Tb1-7	C2		Y	Y
Log In 8 Tb1-8	Logic input configuration for Tb1-8	C2		Y	Y
Log In 9 Tb1-9	Logic input configuration for Tb1-9	C2		Y	Y
logic input choices	*see section (3.5.2.1)*				
Contact Cfirm	Auxiliary contacts from motor contactor.	(C2)			
Drive Enable	Must be asserted to permit drive to run. This does not initiate run, just permits initiation.	(C2)			
Extrn Fault 1	User input fault #1	(C2)			
Extrn Fault 2	User input fault #2	(C2)			
Extrn Fault 3	User input fault #3	(C2)			
Fault Reset	Asserting this input attempts to reset faults.	(C2)			
Low Gain Sel	Low gain for the speed regulator is chosen when this input is asserted.	(C2)			
Mech Brake Hold	Auxiliary contacts from mechanical brake. Asserted when brake is in hold mode.	(C2)			
Mech Brake Pick	Auxiliary contacts from mechanical brake. Asserted when brake is picked (lifted).	(C2)			
No Function	Input not assigned	(C2)			
Ospd Test Src	Asserting input, applies the overspeed multiplier to the speed command for the next run.	(C2)			
Pre-Trq Latch	Transition from false to true latches pre torque command.	(C2)			
Run	If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation.	(C2)			

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	***description***	***menu***	***units***	***hidden***	***lockout***
logic input choices	*(continued)*				
Run down	If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with negative speed commands.	(C2)			
Run up	If drive is enabled through the DRIVE ENABLE logic input, this function will start drive operation with positive speed commands.	(C2)			
S-Curve Sel 0	Bit 0 of S-curve selection	(C2)			
S-Curve Sel 1	Bit 1 of S-curve selection	(C2)			
Step Ref B0	Bit 0 of multi-step speed command selection	(C2)			
Step Ref B1	Bit 1 of multi-step speed command selection	(C2)			
Step Ref B2	Bit 2 of multi-step speed command selection	(C2)			
Step Ref B3	Bit 3 of multi-step speed command selection	(C2)			
Trq ramp down	Asserting this ramps torque output to zero at "Ramped Stop Time parameter" rate.	(C2)			
Up/Dwn	This logic can be used to change the sign of the speed command. (false = no inversion, true = inverted)	(C2)			
Logic Outputs	*see section (3.5.3)*	***C3***			
Log Out 1 Tb1-14	Logic output configuration for Tb1-14	C3		Y	Y
Log Out 2 Tb1-15	Logic output configuration for Tb1-15	C3		Y	Y
Log Out 3 Tb1-16	Logic output configuration for Tb1-16	C3		Y	Y
Log Out 4 Tb1-17	Logic output configuration for Tb1-17	C3		Y	Y
Relay Coil 1	Relay output configuration for relay 1	C3		Y	Y
Relay Coil 2	Relay output configuration for relay 2	C3		Y	Y
logic output choices	*see section (3.5.3.1)*				
Alarm	An alarm declared by the drive	(C3)			
Alarm+Flt	A fault or alarm is declared by the drive	(C3)			
Brake Alarm	A brake fault is declared while the drive is running	(C3)			
Brake Hold	The brake pick confirmation is received	(C3)			
Brake Pick	Signal used to pick (open) the mechanical brake	(C3)			
Brk Hold Flt	Brake hold state has not matched the commanded state	(C3)			
Brk IGBT Flt	Brake IGBT has reached overcurrent	(C3)			
Brk Pick Flt	Brake pick state has not matched the commanded state	(C3)			
Car Going Dwn	The motor is moving in negative direction faster than user specified speed	(C3)			
Car Going Up	The motor is moving in positive direction faster than user specified speed	(C3)			
Charge Fault	DC bus has not charged	(C3)			
Close Contact	The drive has been enabled & commanded to run and no faults are present	(C3)			
Contactor Flt	Contactor state has not matched the commanded state	(C3)			

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	***description***	***menu***	***units***	***hidden***	***lockout***
logic output choices	*(continued)*				
Curr Reg Flt	The actual current measurement does not match commanded current	(C3)			
Drv Overload	The drive has exceeded the drive overload curve	(C3)			
Encoder Flt	Encoder is disconnected or not functioning, while attempting to run	(C3)			
Fan Alarm	Cooling fan failure	(C3)			
Fault	A fault declared by the drive	(C3)			
Flux Confirm	The drive's estimate of flux has reached 90% of reference.	(C3)			
Fuse Fault	DC bus fuse is open	(C3)			
Ground Fault	Sum of all phase currents exceeds 50% of rated current	(C3)			
In Low Gain	Low gain or response is now being used by the speed regulator	(C3)			
Motor Trq Lim	The drive has exceeded the motoring torque limit	(C3)			
Mtr Overload	The motor has exceeded the motor overload curve	(C3)			
No Function	Output not assigned	(C3)			
Not Alarm	The output is true when an alarm is NOT present.	(C3)			
Over Curr Flt	Phase current exceeded 300%	(C3)			
Overspeed Flt	The drive has exceeded the overspeed level	(C3)			
Overtemp Flt	Heatsink temperature exceeded 105°C (221°F)	(C3)			
Overvolt Flt	DC bus voltage exceeded 850VDC for 460V drive or 425 VDC for 230V drive	(C3)			
Ovrtemp Alarm	Heatsink temperature exceeded 90°C (194°F)	(C3)			
Phase Fault	Open motor phase	(C3)			
Ramp Down Ena	Indicates the torque is ramping to zero	(C3)			
Ready To Run	The drive's software has initialized and no faults are present	(C3)			
Regen Trq Lim	The drive has exceeded the regenerating torque limit	(C3)			
Run Commanded	The drive is being commanded to run	(C3)			
Run Confirm	The drive has been enabled & commanded to run; no faults are present; the contactor has closed; and the IGBTs are firing	(C3)			
Speed Dev	The speed feedback is failing to properly track the speed reference	(C3)			
Speed Dev Low	The speed feedback is properly tracking the speed reference	(C3)			
Speed Ref Rls	Flux is confirmed and brake is picked (if used)	(C3)			
Speed Reg Rls	Flux is confirmed and brake is commanded to be picked (if used)	(C3)			
Undervolt Flt	DC bus voltage has dropped below a specified percent	(C3)			
Up to Speed	The motor speed is above a user defined level	(C3)			
UV Alarm	DC bus voltage has dropped below a specified percent	(C3)			
Zero Speed	The motor speed below user defined level	(C3)			

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	description	menu	units	hidden	lockout
Analog Outputs	*see section (0)*	***C4***			
Ana Out 1 Tb1-33	Analog output channel #1 configuration	C4		Y	N
Ana Out 2 Tb1-35	Analog output channel #2 configuration	C4		Y	N
analog output choices	*see section (3.5.4.1)*				
Aux Torq Cmd	Additional torque command from auxiliary source	(C4)			
Bus Voltage	Measured DC bus voltage	(C4)			
Current Out	Percent motor current	(C4)			
Drv Overload	Percent of drive overload trip level reached	(C4)			
Flux Current	Measured flux producing current	(C4)			
Flux Output	Measured flux output	(C4)			
Flux Ref	Flux reference used by vector control	(C4)			
Flux Voltage	Flux producing voltage	(C4)			
Frequency Out	Electrical frequency	(C4)			
Mtr Overload	Percent of motor overload trip level reached	(C4)			
Power Output	Calculated power output	(C4)			
PreTorque Ref	Pre-torque reference	(C4)			
Slip Freq	Commanded slip frequency	(C4)			
Spd Rg Tq Cmd	Torque command from speed regulator	(C4)			
Speed Command	Speed command before S-Curve	(C4)			
Speed Error	Speed reference minus speed feedback	(C4)			
Speed Feedbk	Speed feedback used by speed regulator	(C4)			
Speed Ref	Speed reference after S-Curve	(C4)			
Tach Rate Cmd	Torque command from tach rate gain function	(C4)			
Torq Current	Measured torque producing current	(C4)			
Torq Voltage	Torque producing voltage	(C4)			
Torque Output	Calculated torque output	(C4)			
Torque Ref	Torque reference used by vector control	(C4)			
Voltage Out	RMS motor terminal voltage	(C4)			
Password	*see section (3.6.1)*	***U1***			
Enter Password	Allows the user to enter in a password	U1		N	N
New Password	Used to change the established password	U1		N	N
Password Lockout	Used to enable and disable password lockout	U1		N	N
Hidden Items	*see section (3.6.2)*	***U2***			
Hidden Items	Selects if the “hidden” parameters will be displayed on the Digital Operator.	U2		N	N
Units	*see section (3.6.3)*	***U3***			
Units	Choose either Metric units or standard English measurements units	U3		N	Y
Overspeed Test	*see section (3.6.4)*	***U4***			
Overspeed Test	Allows for Overspeed Test to be enabled via the digital operator	U4			
Restore Defaults	*see section (3.6.5)*	***U5***			
Drive Defaults	Resets all parameters to there default values except parameters in MOTOR A5	U5			
Motor Defaults	Resets the parameters in the MOTOR A5 to the defaults defined by the MOTOR ID	U5			

Table A18. 1 - Parameter & Menu Reference (continued)

parameter	*description*	*menu*	*units*	*hidden*	*lockout*
Drive Info	*see section (3.6.6)*	***U6***			
Drive Version	Shows the software version of the drive software	U6			
Boot Version	Shows the lower level software version of the drive	U6			
Cube ID	Displays the cube identification number of the drive	U6			
Hex Monitor	*see section (3.6.7)*	***U7***			
Active Faults	*see section (3.7.2)*	***F1***			
Display Active Faults	Contains a list of the active faults	F1			
Reset Active Faults	Allows for reset of active faults	F1			
Fault History	*see section (3.7.3)*	***F2***			
Display Fault History	Contains a list of up to the last sixteen faults	F2			
Clear Fault History	Allows for the clearing of the fault history	F2			

Table A18. 1 - Parameter & Menu Reference (continued)

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Configure C0

User Switches C1	● = default		
Spd Command Src	analog input	• multi-step	serial
Run Command Src	• external tb1	serial	serial+extrn
Hi/Lo Gain Src	external tb1	serial	• internal
Speed Reg Type	• elev spd reg	pi speed reg	external reg
Motor Rotation	• forward	reverse	
Spd Ref Release	• reg release	brake picked	
Cont Confirm Src	• none	external tb1	
PreTorque Source	• none	analog input	serial
PreTorque Latch	• not latched	latched	
PTorq Latch Clck	• external tb1	serial	
Fault Reset Src	• external tb1	serial	automatic
Overspd Test Src	• external tb1	serial	
Brake Pick Src	• internal	serial	
Brake Pick Cnfm	• none	external tb1	
Brake Hold Src	• internal	serial	
Ramped Stop Sel	• none	ramp on stop	
Ramp Down En Src	• external tb1	run logic	serial
Brk Pick Flt Ena	• disable	enable	
Brk Hold Flt Ena	• disable	enable	
Ex Torq Cmd Src	• none	analog input	serial
Dir Confirm	• disable	enable	
S-Curve Abort	• disable	enable	

Logic Inputs C2	default
Log In 1 tb1-1	DRIVE ENABLE
Log In 2 tb1-2	RUN
Log In 3 tb1-3	FAULT RESET
Log In 4 tb1-4	UP/DWN
Log In 5 tb1-5	S-CURVE SEL 0
Log In 6 tb1-6	STEP REF B0
Log In 7 tb1-7	STEP REF B1
Log In 8 tb1-8	STEP REF B2
Log In 9 tb1-9	EXTRN FAULT 1
Logic Outputs C3	
Log Out 1 tb1-14	READY TO RUN
Log Out 2 tb1-15	RUNCOMMANDED
Log Out 3 tb1-16	MTR OVERLOAD
Log Out 4 tb1-17	ENCODER FAULT
Relay Coil 1	FAULT
Relay Coil 2	SPEED REG RLS
Analog Outputs C4	
Ana Out 1 tb1-33	TORQUE REF
Ana Out 2 tb1-35	SPEED FEEDBK

note: parameters shown in *italics* are hidden parameters

Adjust A0

Drive A1	default	Drive A1	default	**S-Curves A2**	default
Contract Car Spd	400.0	*Spd Dev Hi Level*	10.0	Accel Rate 0	3.00
Contract Mtr Spd	1130	*Spd Command Bias*	0.00	Decel Rate 0	3.00
Response	10.0	*Spd Command Mult*	1.00	Jerk Rate 0	8.00
Inertia	2.0	*Pre Torque Bias*	0.00	Lev Jerk Rate 0	8.00
Inner Loop Xover	2.0	*Pre Torque Mult*	1.00	Accel Rate 1	3.00
Gain Reduce Mult	100	*Zero Speed Level*	1.00	Decel Rate 1	3.00
Gain Chng Level	000.0	*Zero Speed Time*	0.10	Jerk Rate 1	8.00
Tach Rate Gain	00.0	*Up/Dwn Threshold*	1.00	Lev Jerk Rate 1	8.00
Spd Phase Margin	80	Mtr Torque Limit	200.0	*Accel Rate 2*	3.00
Ramped Stop Time	0.20	Regen Torq Limit	200.0	*Decel Rate 2*	3.00
Contact Flt Time	0.50	Flux Wkn Factor	100	*Jerk Rate 2*	8.00
Brake Pick Time	1.00	*Ana Out 1 Offset*	0.00	*Lev Jerk Rate 2*	8.00
Brake Hold Time	0.20	*Ana Out 2 Offset*	0.00	*Accel Rate 3*	3.00
Overspeed Level	115	*Ana Out 1 Gain*	01.0	*Decel Rate 3*	3.00
Overspeed Time	1.00	*Ana Out 2 Gain*	01.0	*Jerk Rate 3*	8.00
Overspeed Mult	125	*Flt Reset Delay*	5	*Lev Jerk Rate 3*	8.00
Encoder Pulses	1024	*Flt Resets / Hour*	3		
Spd Dev Lo Level	10.0	*Up To Spd. Level*	80.00	Utility U0 - Units U3	
Spd Dev Time	0.50			• english	metric

note: parameters shown in *italics* are hidden parameters

Adjust A0

Multistep Ref A3	default	**Power Convert A4**	default	**Motor A5**	default
Speed Command 1	0	*Id Reg Diff Gain*	1.00	Motor ID	4 pole dflt
Speed Command 2	0	*Id Reg Prop Gain*	0.3	Rated Mtr Pwr	id
Speed Command 3	0	*Iq Reg Diff Gain*	1.00	Rated Mtr Volts	id
Speed Command 4	0	*Iq Reg Prop Gain*	0.3	Rated Excit Freq	id
Speed Command 5	0	PWM Frequency	10.0	Rated Motor Curr	id
Speed Command 6	0	*UV Alarm Level*	90	Motor Poles	id
Speed Command 7	0	*UV Fault Level*	80	Rated Mtr Speed	id
Speed Command 8	0	*Extern Reactance*	0.0	% No Load Curr	id
Speed Command 9	0	Input L-L Volts	460/230	*Stator Leakage X*	id
Speed Command 10	0			*Rotor Leakage X*	id
Speed Command 11	0			*Stator Resist*	id
Speed Command 12	0			*Motor Iron Loss*	id
Speed Command 13	0			*Motor Mech Loss*	id
Speed Command 14	0			*Ovld Start Level*	110
Speed Command 15	0			*Ovld Time Out*	60.0
				Flux Sat Break	id
				Flux Sat Slope 1	id
				Flux Sat Slope 2	id

Utility U0 - DRIVE INFO U6

Drive Version	Cube ID
Boot Version	

note: parameters shown in *italics* are hidden parameters

HPV 900

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