MAGNETEK
UNCOMMON POWER

DSD 412 DC Elevator Drive Technical Manual

CS00407 rev 05

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FNCT.#	DESCRIPTION	UNIT	RANGE	DEFAULT	SITE SETTING	SITE SETTING
1	CURRENT LIMIT.	%	0 - 300	250		
2	USE SELF- TUNE VALUES	LOGIC	0 - 1	0=OFF		
3	RTD. ARMATURE AMPS	ADC	2.0 - 1250.0	50.0		
4	ARMATURE OHMS	OHMS	0.001 - 5.000	0.100		
6	ARMATURE INDUCTANCE	HNY	0.0010 - 1.000	0.0100		
7	RTD. ARMATURE VOLTS	VDC	150 - 550	240		
8	I REG CROSSOVER	RAD	100 - 1000	500		
9	NOMINAL AC INPUT	VAC	150 - 525	230		
10	ENCODER PPR	P/R	600 - 19999	1024		
11	RATED MOTOR RPM	RPM	50.0 - 1999.0	1150.0		
12	OVERSPEED %	%	0.0 - 150.0	110.0		
14	V SENSE %	%	0.0 - 100.0	25.0		
15	T SENSE %	%	0.0 - 100.0	5.0		
16	ENCDR / MTR RATIO	-	1.000 - 19.000	1.000		
17	RATED CAR SPEED	-	1.0 - 1900.0	400.0		
21	EXT ACCEL LIMIT	n/S^2	2.00 - 10.00	4.20		
22	ERROR LIST RESET	LOGIC	0 - 1	0=OFF		
32	FULL FIELD DETECT	%	30 - 90	80		
38	ARM VLT RESPONSE	RAD	1.0 - 4.0	2.0		
39	HI SPEED BANDWIDTH	RAD	1 - 15	6.0		
40	LO SPEED BANDWIDTH	RAD	1 - 15	6.0		
41	PER-UNIT INERTIA	SEC	0.10 - 9.99	2.00		

QUICK REFERENCE FOR SET-UP PARAMETERS

FNCT.#	DESCRIPTION	UNIT	RANGE	DEFAULT	SITE SETTING	SITE SETTING
42	STIFFNESS	-	0.2 - 9.9	1.0		
49	WEAK FIELD CURRENT	ADC	0.2 - 40.0	40.0		
50	FULL FIELD CURRENT	ADC	0.20 - 40.00	1.90		
51	MOTOR FIELD L/R	SEC	0.10 - 10.00	0.54		
52	RTD. FIELD VOLTS DC	VDC	50 - 525	240		
53	STANDBY FIELD AMPS	%	10 - 100	25		
54	FIELD RESPONSE	RAD	1.0 - 10.0	5.0		
55	FIELD CONTROL AC SOURCE VOLTS	VAC	0 - 525	0		
63	U/D PICK-UP	%	0.01 - 100.0	0.10		
64	LOW SPEED THRESHOLD	%	0.1 - 100.0	2.0		
80	OVER SPEED TEST	LOGIC	0 - 1	0=OFF		
81	OVER SPEED MULT	-	1.00 - 1.50	1.00		
82	REFERENCE MULT	-	0.500 - 2.000	1.000		
83	MOTOR OVERLD TIME	SEC	2.0 - 500.0	48.0		
84	MOTOR OVERLD LEVEL	PU	0.5 - 2	1.15		
85	I DECAY RAMP	SEC	0.01 - 2.50	0.20		
86	ANALOG SPD REF ZERO	PU	-0.02 - 0.02	0.0000		
87	PRE-TORQUE MULT	-	0.25 - 2.00	1.00		
88	DSPR DELAY TIME	MIN	0 - 60	0 (OFF)		
89	BRAKE PICK TIMER	SEC	0.5 - 5.0	1.0		
90	BRAKE DROP TIMER	SEC	0.5 - 5.0	1.5		
91	MUST STOP TIMER	SEC	0.1 - 5.0	2.0		

FNCT.#	DESCRIPTION	UNIT	RANGE	DEFAULT	SITE SETTING	SITE SETTING
92	BRAKE AUTO STOP ON	LOGIC	0 - 1	0=OFF		
93	ANALOG OUT 0 BIAS	-	-1 - +1	0.0		
94	ANALOG OUT 1 BIAS	-	-1 - +1	0.0		
95	ANALOG OUT 0 SELECT TB1(45)	NUM	0 - 8	1		
96	ANALOG OUT 1 SELECT TB1(46)	NUM	0 - 8	3		
97	ANALOG OUT 0 MULT	-	00.10 - 10.00	0.80		
98	ANALOG OUT 1 MULT	-	00.10 - 10.00	0.80		
99	SPEED ERROR TRIP TIME	SEC	0.20 - 5.00	5.00		
100	SPEED ERROR TRIP LEVEL	%	0.0 - 100.0	100.0		
101	AUTO FAULT RESET ON	LOGIC	0 - 1	0=OFF		
102	3S LOOP FLT	LOGIC	0 - 1	0=OFF		
104	SERIAL GAIN SWITCH	LOGIC	0 - 1	0=OFF		
105	GAIN SWITCH SPEED	PU	0.00 - 1.10	1.10		
107	TACH RATE GAIN	%	0.0 - 30.0	0.0		
110	REFERENCE MODE SELECT	NUM	1 – 4	2		
111	ARCH TRAV DISABLE	LOGIC	0 - 1	1=ON		
112	FEEDBACK SELECT	NUM	0 - 1	1 = ENCODER		
113	ARM VOLTS @ MAX SPEED	VDC	650 - 0	100		
114	PRE-TORQUE ENABLE	LOGIC	0 - 1	0=OFF		
115	RNUP RNDN ENABLE	LOGIC	0 - 1	0=OFF		
116	DECEL RATE LATCH	LOGIC	0 - 1	0=OFF		
120	SPEED ERROR DETECT TIME	SEC	0.0 - 5.0	0.5		

FNCT.#	DESCRIPTION	UNIT	RANGE	DEFAULT	SITE SETTING	SITE SETTING
121	SPEED ERROR THRESHOLD	%	0.0 - 15.0	2.0		
130	ARB MODE	NUM	0 - 2	0 (OFF)		
131	ARB BANDWIDTH	RAD	1.0 - 15.0	6.0		
132	ARB DAMPING	-	0.01 - 20.00	2.00		
133	ARB SPD THRESHOLD	%	0.0 - 10.0	0.0		
150	BINARY SELECT ON	LOGIC	0 - 1	1=ON		
151	PRESET SPEED #1	-	0.0 - 1900.0	0.0		
152	PRESET SPEED #2	-	0.0 - 1900.0	0.0		
153	PRESET SPEED #3	-	0.0 - 1900.0	0.0		
154	PRESET SPEED #4	-	0.0 - 1900.0	0.0		
155	PRESET SPEED #5	-	0.0 - 1900.0	0.0		
156	PRESET SPEED #6	-	0.0 - 1900.0	0.0		
157	PRESET SPEED #7	-	0.0 - 1900.0	0.0		
170	ACCEL #1 TIME	SEC	0.50 - 15.00	5.00		
171	ACCEL #2 TIME	SEC	0.50 - 15.00	5.00		
172	DECEL #1 TIME	SEC	0.50 - 15.00	5.00		
173	DECEL #2 TIME	SEC	0.50 - 15.00	5.00		
174	ACCEL #1 % S	%	0.1 - 100.0	25.0		
175	ACCEL #2 % S	%	0.1 - 100.0	25.0		
176	DECEL #1 % S	%	0.1 - 100.0	25.0		
177	DECEL #2 % S	%	0.1 - 100.0	25.0		

FNCT.#	DESCRIPTION	UNIT	RANGE	DEFAULT	SITE SETTING	SITE SETTING
178	ACCEL #3 TIME	SEC	0.50 - 15.00	5.00		
179	DECEL #3 TIME	SEC	0.50 - 5.00	5.00		
180	ACCEL #3 % S	%	0.1 - 100.0	25.0		
181	DECEL #3 % S	%	0.1 - 100.0	25.0		
182	INVERT ALARM RELAY	LOGIC	0 - 1	0=OFF		
183	K3 LGC OUT SELCT	NUM	1 - 4	1		
184	K4 LGC OUT SELCT	NUM	1 - 4	1		
185	K5 LGC OUT SELCT	NUM	1 - 4	1		
186	K6 LGC OUT SELCT	NUM	1 - 4	1		
187	K7 LGC OUT SELCT	NUM	1 - 4	1		
190	NOTCH DEPTH	-	0 - 10	0		
191	NOTCH PERIOD	-	0 - 10	7		
192	F413 DETECTION LVL	PU	0.05 - 0.50	0.05		

Table 1: Drive Parameters

READ-OUT AND CONTROL FUNCTIONS

FNCT.#	DESCRIPTION	UNIT
600	CAR SPEED	-
601	MOTOR RPM	RPM
602	SPEED REF	-
603	PRE-TORQ SIGNL	%
609	CEMF VOLTS	VDC
610	MOTOR ARM V	VDC
611	MOTOR ARM I	ADC
612	MOTOR FIELD I	ADC
613	MEASURED R	OHM
614	MEASURED L	HNY
615	MEAS. FIELD L/R	SEC
616	MEASURED SPEED ERROR	%
617	LINE FREQ	HZ
618	HEAT SINK TEMP	DEG C
619	MEASURED AC LINE VOLTS	VAC
620	FIELD TRACKING	PU
621	SERIAL COMM ON	LOGIC
688	CUBE I.D.	-
689	FIELD RANGE	-
690	PCU - VERSION	404
691	PCU - RELEASE	-
692	DAY	-
693	MONTH	-
695	YEAR	-
696	BETA “P”	-
697	VERSION “SA”	407
698	DCU -RELEASE	-
699	CUSTOMER ID	9

Table 2: Monitor Functions

FNCT.#	DESCRIPTION
22	CLEAR ERRORS LIST
000	VIEW FAULT LIST
800	VIEW ERROR LIST
801	FAULT/ERROR ACTIONS
980	TRACE MONITOR
981	VERIFY I/O
993	CLEAR NV RAM
994	SAVE/RECALL FUNCTION
995	LOAD DEFAULTS
997	SELF TUNE
998	PCU DIAGNOSTICS

Table 3: Misc Commands

FAULT #	DESCRIPTION
97	OVERSPEED TRIP
98	TACH/ENCODER LOSS
99	REVERSE TACH/ENCODER
117/118	SERIAL COM FAULT
400	MOTOR OVERLOAD
401	EXCESSIVE FIELD CURRENT
402	CONTACTOR FAULT
403	5 MIN FULL FIELD FAULT
404	OPEN ARMATURE CIRCUIT FAULT
405	SAFETY CIRCUIT FAULT
406	10% LOW LINE ALARM
407	DCU CEMF ALARM
408	PCU CEMF FAULT
409	PCU RESET FAULT
410	SPEED ERROR TRIP FAULT
411	MAXIMUM AUTO RESETS FAULT

FAULT #	DESCRIPTION
413	FIELD CURRENT TRACKING FAULT
414	SOFTWARE COMPATABILITY F
Prot	CORRUPTED NV RAM DATA
900	PCU LOOP FAULT
901	PCU IST FAULT
902	POWER SUPPLY FAULT
903	LINE SYNC FAILURE
904	LOW LINE FAULT
905	FIELD LOSS
907	THERMISTOR FAULT
908	OVER TEMPERATURE
909	EXCESSIVE RIPPLE
910	BLOWN FUSE
915	PARAMETER SETUP
917	REVERSE ARM. V. FEEDBACK
919	RATED VAC. SETTING ERROR

FAULT #	DESCRIPTION
920	RATED ARM. VOLT. SETTING
921	BRIDGE RATING FAULT
923	RATED ARM. I. SETTING ERROR
924	RATED FIELD I. SETTING ERROR
925	FIELD PCB SENSE FAULT
926	PCU WATCHDOG
929	IFLD FB CANNOT BE REDUCED TO ZERO DURING SELFTUNE.
930	IFLD FB CANNOT GET TO RATED
931	EXCESS OPEN CIRCUIT VOLTAGE DURING SELFTUNE.
932	ARMATURE CEMF VOLTAGE IN XCESS DURING SELFTUNE.
933	IARM DOES NOT INCREASE TO NEAR TEST AMPS DURING SELFTUNE.

FAULT #	DESCRIPTION
934	CALC ARML IS UNDER RANGE DURING SELFTUNE.
935	VOLTAGE FEEDBACK AND BUSS VOLTAGE DOESN'T MATCH DURING SELFTUNE
936	ESTOP CONTACT WAS OPENED DURING SELF TUNE
937	LOW READ BACK VOLTAGE FEEDBACK DURING SELFTUNE
938	LOW READ BACK FROM DC BUSS CIRCUIT DURING SELFTUNE
939	FAULTY HARDWARE IN THE FIELD INTERFACE CIRCUIT
940	FIELD A/D READING IS SATURATED

Table 4: Fault References

Introduction

Drive Description

The DSD 412 Drive is a complete digital system drive that provides individual drive and system control in one compact package. It is of 12SCR Regenerative configuration. The drive uses two microprocessors, one for the Power Conversion Unit (PCU) circuitry, one for the Drive Control Unit (DCU) circuitry. Interface to other equipment is provided with Local I/O [Input/Output], or RS-232 & RS-422 serial communications. Extensive diagnostics and setup capability are provided through two Control/Display Units.

The Standard Control Display Unit (SCDU)

is mounted on the Drive Control PCB and consists of a 4-1/2 digit numeric LED display, four push buttons and READ/WRITE colored LEDs. The SCDU can be used for all setup functions and many diagnostics.

The Portable Control Display Unit (PCDU)

is an optional hand-held device that can be plugged into any analog controlled DSD drive and used for all the same functions as the SCDU plus some advanced diagnostics. There exists a version of this PCDU which will work with the serial version DSD 412, contact Magnetek for more information. The PCDU has two lines of sixteen alphanumeric characters and a thirty-key keypad. Parameters are entered and displayed in common understandable units. The drive can be completely setup prior to actual running and changes can be made during operation. Keypad entry of changed parameters, protected memory, and factory default values allow the operator to modify data with minimum risk to the process. The DSD 412 is a power cube. Depending on rating of the unit, the power cube is in one of four chassis sizes. Refer to the outline dimension drawings furnished in section 6. Each power cube is designed for mounting inside a qualified electrical enclosure. Space allowances for air circulation, additional components, outgoing terminals, and wire bends must be provided. Hinged door swing-out clearance is the same as the width dimension.

Drive Ratings and Specifications

The DSD 412 Elevator Drive is designed to be connected to a three wire ungrounded power system, or a four wire grounded or ungrounded power system.

Basic Drive Specifications

- 10-300 Amps (Special order up to 1285Amps or 600VAC)
- 3 Phase, 48/62 Hz
- 1.0 Service Factor
- 150% full load current for one minute
- 250% full load current for 5 seconds
- Full-wave six-pulse SCR control
- Regulation (of set speed) to 0.05% with digital encoder speed feedback
- Current regulated shunt field control
- Automatic Field weakening.
- Self-adapting to incoming line power

Service Conditions

- Line voltage 150-525 Vac, ±10%, 3 phase.
- 115 volt, ±10%, 1 phase control power from a separate source.
- Frequency 48-62 Hz
- Operating Temperature 0-45° C (55° C max at DSD chassis)
- Altitude to 3300 feet above sea level. Derate 5% for each 1,000 ft above 3300 ft.
- Relative Humidity 95% (noncondensing)

Protective Features

- Programmed memory protection
- Self-protected Control V power supply
- Fast phase-back of loop current
- Contactor interlock for E-Stop
- I^2t motor overload protection
- AC line current limiting fuses
- Automatic power up test.
- Control power supply loss detection
- Isolated and grounded electronics
- Encoder/Tachometer monitoring and loss protection.
- Input line monitoring
- Phase sequence insensitive
- dv/dt protection (snubbers)
- 1400 PRV Thyristors
- Instantaneous over-current protection.
- Phase loss protection
- DC bus fuse
- Field current economizer and loss protection

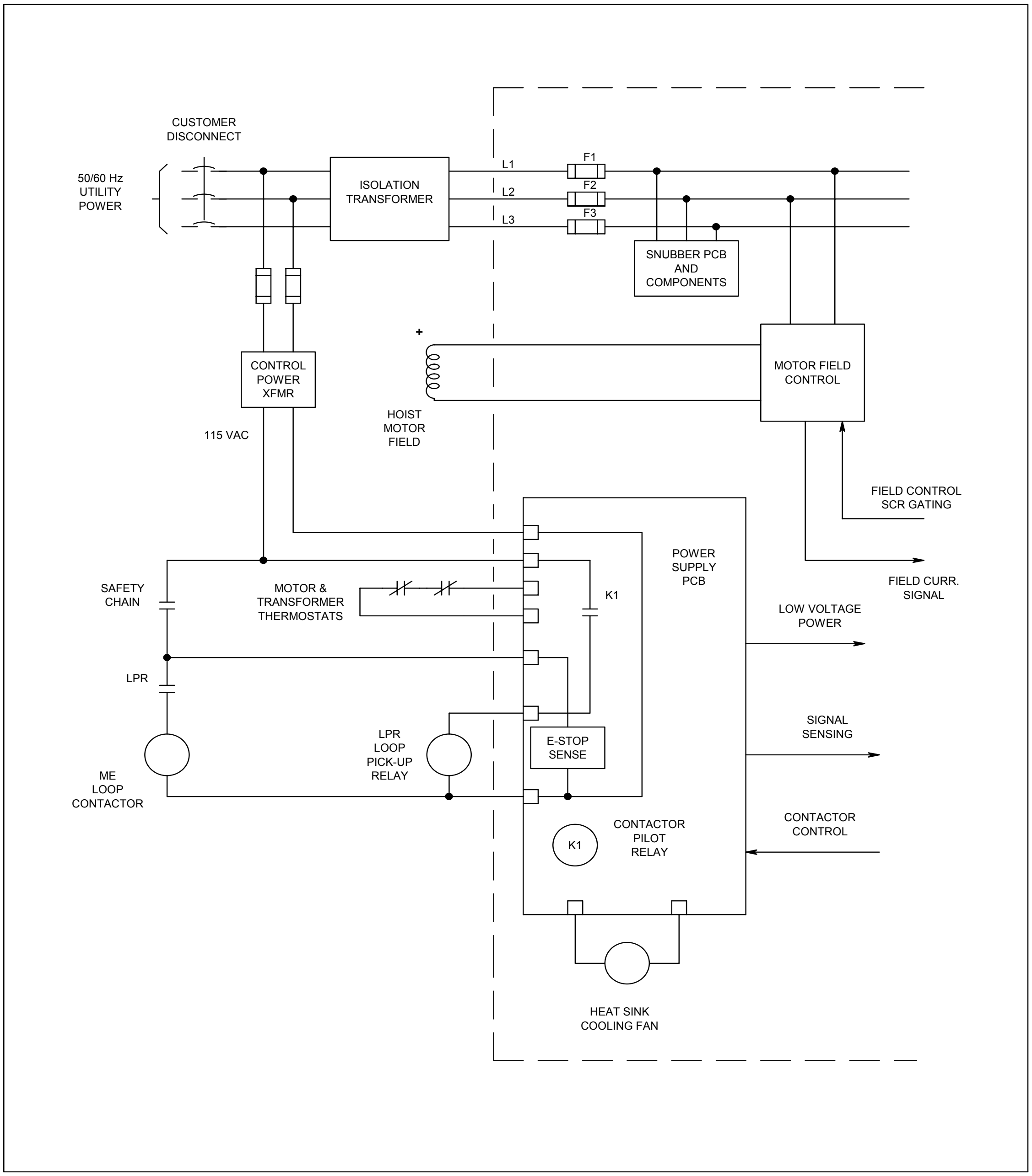


Figure 1: DSD 412 Block Diagram A

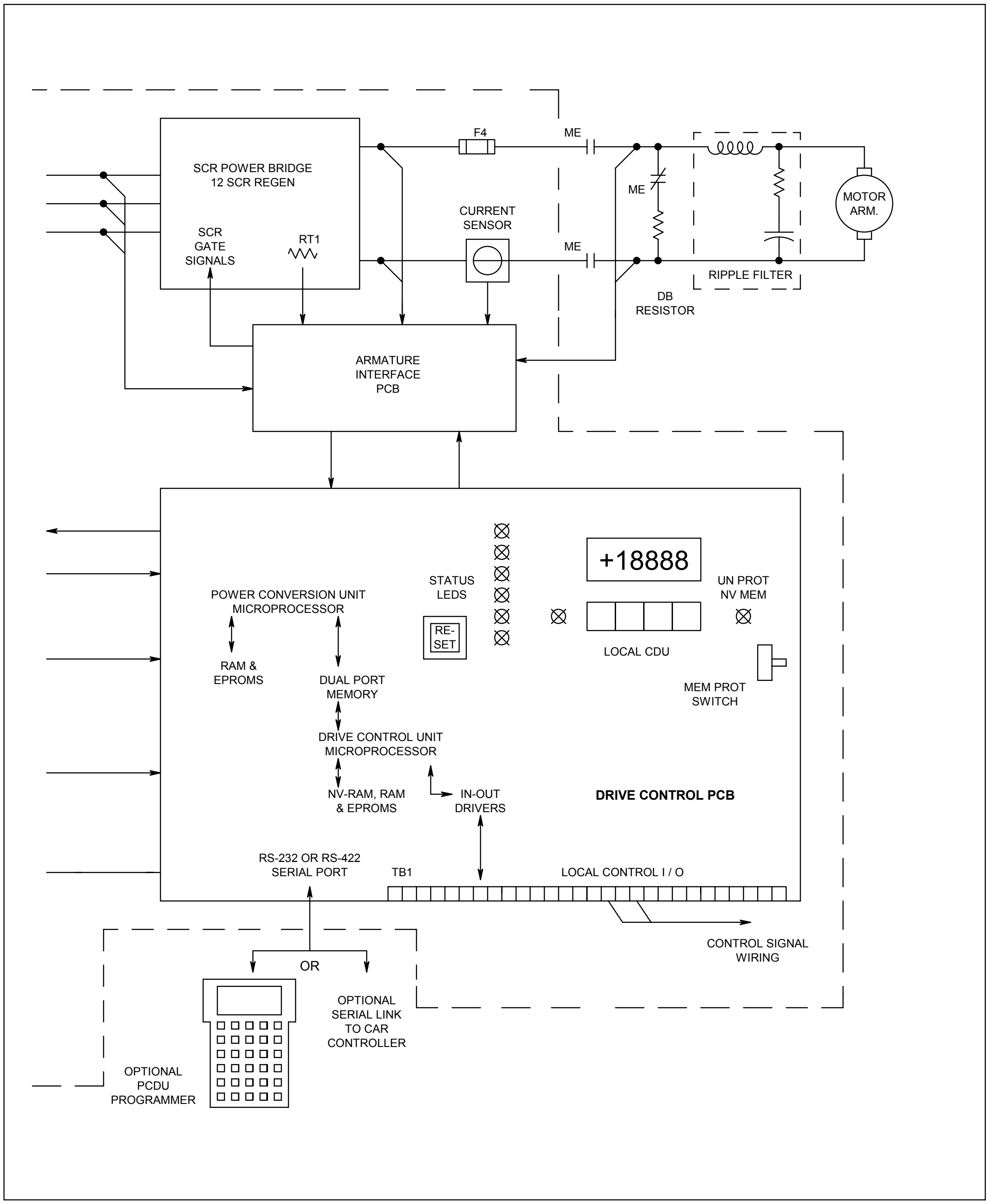


Figure 2: DSD 412 Block Diagram B

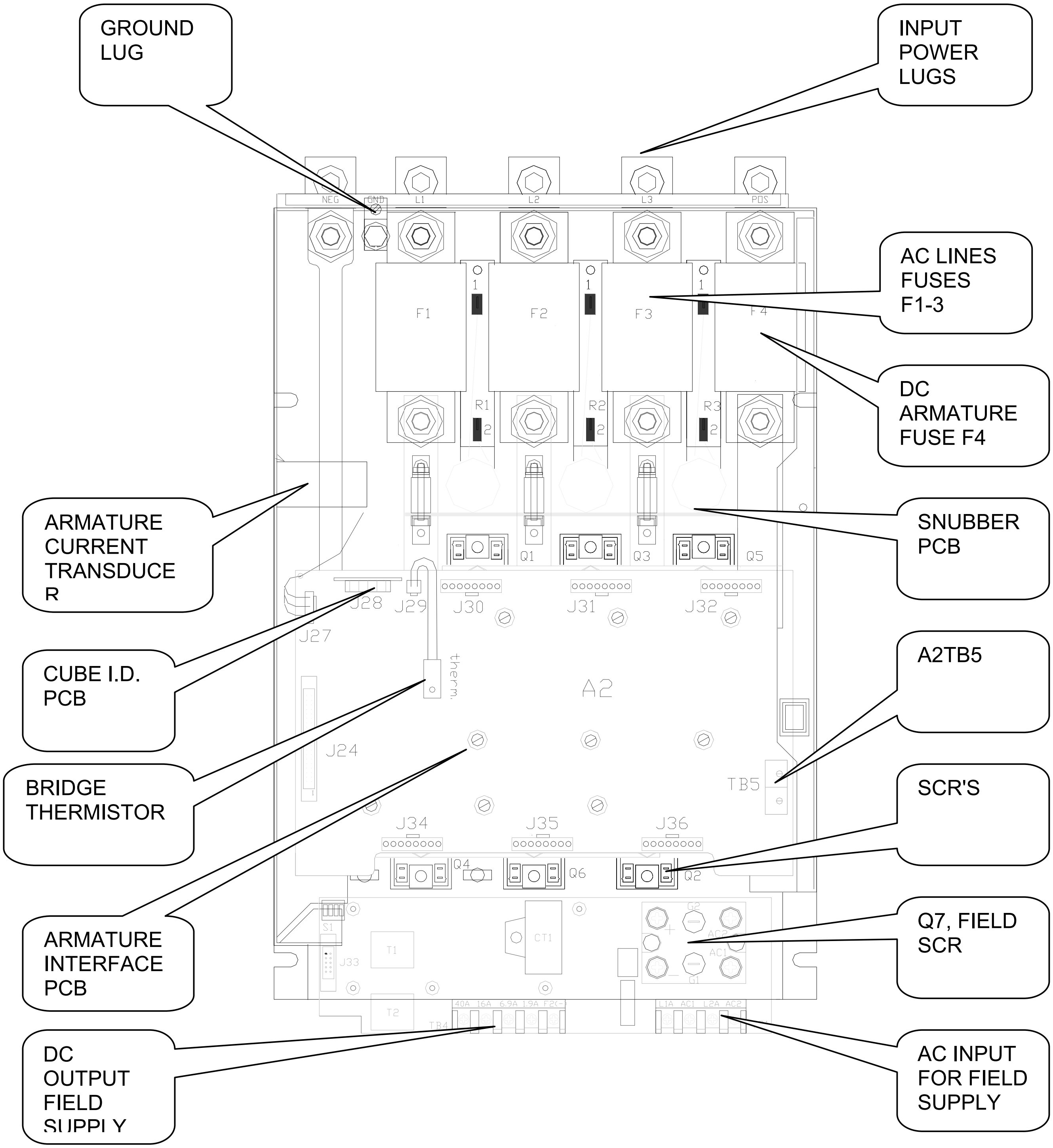


Figure 3: Component Layout Front View

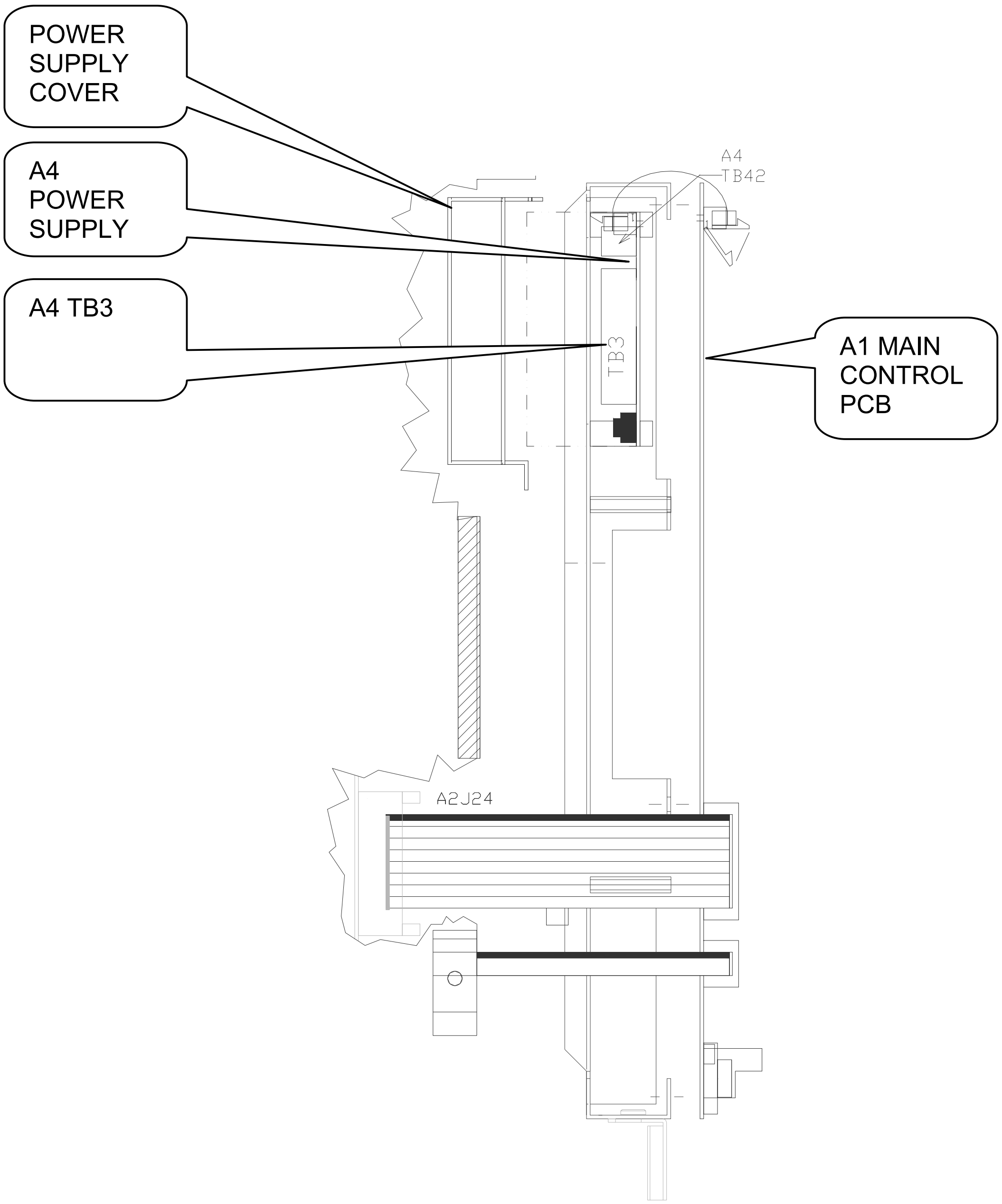


Figure 4: Component Layout Right Side View

Power Conversion Unit

Description

The Power Conversion Unit circuitry has three major functions;

1. It converts three phase AC input power to variable DC voltage for application to a motor armature.
2. It converts motor generated DC power to three-phase power to feed back to the line.
3. It converts single phase AC input power to a variable DC voltage for application to a motor field.

Two sources of power are required. A three-phase power isolation transformer adjusts the utility mains voltage to that required to operate DSD 412 efficiently with the needs of the DC hoist motor. 115VAC control power from a separate source is used to power the low voltage power supply, cooling fans, relay and contactor logic.

Three phase input power is applied through the AC line fuses to twin 6-SCR power bridges for forward and reverse control. The PCU microprocessor controls armature current based on a reference received from the Drive Control Unit microprocessor. Output from the PCU microprocessor is sent to the Armature Interface PCB, which produces the gating signals for power SCRs. The SCR bridge output is an adjustable DC voltage, which is applied to the motor armature circuit. Power circuit AC and DC measurement signals are routed to voltage dividers on the Armature Interface PCB, and scaled values are sent to the PCU microprocessor. Armature current is also measured and the feedback signal is routed through the Armature Interface PCB to the PCU microprocessor. An over current trip function monitors this signal to initiate an instantaneous static trip (IST) in the event of excessive output current.

Single-phase power is also applied through the AC line fuses to the Field Rectifier Module. SCR gating signals from the PCU microprocessor control the field rectifier SCRs. A separate current measuring device is used to monitor the DC current flowing to the motor field. Additional connections allow for a separate step-up or step-down transformer to be used to power the motor field rectifier from voltage mains different from that for the motor armature.

If optional dynamic braking resistors (DBR) are present they are applied across the motor armature to dissipate rotational energy whenever the loop contactor is dropped out. This helps to bring the motor to a stop even when utility power is lost.

The largest component of the PCU is the SCR bridge (Heat Sink Assembly). The heat sink is an extruded aluminum structure that dissipates the heat generated by the SCRs mounted on the front surface (or between heat sink sections, in large size power cubes). The SCRs control the current to the motor armature and in turn are controlled by the Armature Interface PCB mounted in front of the SCRs. Three input power line fuses are provided. A DC Bus fuse protects the motor armature circuit. A thermistor (and thermostat on some ratings) senses heat sink temperature and gives an over-temperature warning if an over-temperature occurs.

Access to the SCR Bridge is obtained by opening the hinged door containing the Drive Control PCB A1.

> **WARNING**
>
> Opening the hinged door with power applied to the drive exposes dangerous voltage levels. The hinged door should only be opened by a qualified service technician, and only when the power to the drive is turned off.

Hardware Descriptions

DSD 412 Power Supply PCB (A4)

Provides +5V, +15V, -15V, and +24V to the control circuits and has fold-back current limit protection. It also provides 115VAC connections for the main contactor, motor thermostat and fans.

Armature Interface PCB (A2)

Provides the interface circuitry between the digital firing pulses generated by the Drive Control PCB and the high current SCR gating pulses controlling the armature current. It also provides feedback signals from the power section to the Drive Control PCB. A small 'cube ID' circuit board is attached to the Armature Interface PCB to identify the ampere capacity of the SCR power bridge to the PCU processor.

SCR's

The drive uses different selections of doubler packs or individual "hockey puck" SCRs according to the horsepower ranges specified below:

MOTOR ARMATURE CURRENT	SCR TYPE
25A - 195 A	Doubler
300 - 1285 A	"Hockey Puck"

Field Interface PCB (A3)

Provides the interface circuitry between the digital firing pulses generated by the Drive Control PCB and transformer isolated SCR gating pulses controlling the field current. It also contains the field feedback circuitry and the field SCR snubber circuit.

Cell snubber PCB (A5)

Is provided for SCR protection. These are selected to work efficiently with utility line impedance between 2 and 8 percent, including that of the power input transformer.

Drive Control PCB (A1)

Mounted on the hinged door, this board provides the microprocessors, memory and support circuits needed to control drive operation. Two control circuits are provided on this PCB. One for controlling the Power Conversion Unit (PCU), and another for speed regulation and higher-level functions, called the Drive Control Unit (DCU). These two circuits communicate primarily through a Dual-Port Random Access Memory (DPRAM) IC (integrated circuit) device.

Drive Control Unit

The major element of the DCU is a 16/32-bit Motorola 68000 microprocessor. Random Access Memory (RAM) provides memory space to store values that are maintained only while power is on. Non Volatile Random Access Memory (NVRAM) maintains drive control parameters for the DCU when the power is off. Two EPROM's (Electrically Programmable Read Only Memory) devices, U39 & U40, contain the specific drive program instructions for the DCU microprocessor.

Power Conversion Unit Control

The major element of the PCU control circuit is a 16-bit Intel 80C196 microprocessor. Again, RAM and EPROM devices, U13 & U14, provide memory space and computer instructions for the PCU. Any PCU parameters that need to be maintained while power is off are kept in NVRAM of the DCU and passed through the DPRAM.

Local I/O

In an elevator application, the Local I/O [Input/Output] allow the drive to have inputs and outputs (I/O) such as RUN, STOP, Encoder Feedback, Analog Reference Input, Fault condition relay logic output, etc. connected directly to the drive or passing through a serial communications device.

Connection to the Local I/O is made via A1TB1 and/or the serial interface connection at terminal point J1 mounted directly on the Drive Control PCB (A1).

Front Panel Controls and Indicators

The upper right corner of the power cube cover contains the operator controls and indicators. Although accessible with the cover in place, all of these components are part of the Drive Control PCB (A1).

DRIVE RESET Button (S1)

Pressing this button causes the drive to clear critical and non-critical faults and to restore drive operation when faults are present. This button will have no affect when the drive in enabled.

Status LEDs

Located to the right of the RESET button is a vertical strip of six light emitting diodes (LEDs):

- **READY** — Indicates that the drive is ready to operate.
- **RUN** — DC loop contactor is closed and drive is controlling motor speed.
- **I LIMIT** — Drive operation is demanding current limit armature current.
- **OVERLOAD** — Motor armature current is in overload region. If lighted when the drive is stopped, indicates that an overload trip has occurred.
- **E-STOP** — Drive contactor safety interlock is detected as open. Drive will not run when this light is on.
- **FAULT** — Indicates that a declared drive fault exists. The Fault/Error Code List defines what conditions the drive will recognize as faults.

Standard Control Display Unit

The major part of the SCDU is a 4-1/2-digit numeric LED display. Each of its four full digits can display the values of 0 to 9 plus limited alphabetic characters. The so-called half digit can display only the value 1 and a plus or minus sign. Underneath this display are a green LED, labeled DATA, a red LED, labeled DATA PEND, and a row of four push buttons.

The DATA and DATA PEND LEDs are used to indicate the significance of the LED display data, and the four push buttons (DATA/FCTN, › [UP], › [DOWN], and fl) are used to operate the SCDU. The functions and capabilities of the SCDU are explained in greater detail in Section 3.

Non-Volatile RAM Protection

To the left of the four push buttons of the SCDU there is a red LED labeled MEM UNPROT. This LED is lit when the “protected” portion of the non-volatile random access memory (NVRAM) can be written to. Protection of the NVRAM is determined by the switch labeled S3 which is located just under the MEM UNPROT LED. When this switch is in the "ON" position, the NV RAM UNPROTECTED LED is off and the protected portion of the NVRAM cannot be written to. This prevents setup parameters and other important constants from being accidentally erased or changed. When these parameters need to be changed the switch can be moved to the "OFF" position, removing the write protection and causing the NV RAM UNPROTECTED LED to be lit. Refer to the section described as saving parameters.

The NV RAM PROTECTION switch should be left in THE "ON" position (UN-PROTECTED NV MEM LED OFF) to protect the NVRAM during the critical power-up and power-down periods.

Precautionary Statements

In addition to notes, the following types of precautionary statements appear in this manual.

IMPORTANT

A statement of conditions that should be observed during drive setup or operation to ensure dependable service.

CAUTION

A statement of conditions that must be observed to prevent undesired equipment faults or degraded drive system performance

WARNING

A statement of conditions that MUST BE OBSERVED to prevent personal injury, death, or serious equipment damage.

How To Contact Magnetek

For additional information contact any Magnetek Representative or contact the DSD 412 Elevator Technical Support Staff at:

Magnetek Elevator Products
N50 W13605 Overview Drive
Menomonee Falls, Wisconsin 53051 USA

PHONE: 800 236-1705 (all numbers USA)
OR 262-252-6999
FAX: 262 790-4142

Magnetek Industrial Controls UK Limited
Cranfield Innovation Centre, University Way
Cranfield Bedfordshire MK43 OBT UK
PHONE: +44(0) 1234 756036
FAX: +44(0) 1234 756037

See us on the web at www.elevatordrives.com

Installation

Pre-Installation Considerations

Receipt of Shipment

All equipment is tested against defect at the factory. Any damages or shortages evident when the equipment is received must be reported immediately to the commercial carrier who transported the equipment. Assistance, if required, is available from your Magnetek representative. Always refer to the order number, equipment description, and serial number when contacting Magnetek.

Unpacking Instructions

Remove the protective shipping material from around the equipment. Remove all packing material. Unbolt the equipment from its crate. Inspect for loose wiring. Make sure that all contact wedges and other shipping devices have been removed.

Packing Instructions for Reshipment or Storage

For long periods of storage, equipment should be covered to prevent corrosion and should be placed in a clean, dry, location. If possible, equipment should be stored in its original crating. Periodic inspection should be made to ensure that the equipment is dry and that no condensation has accumulated. The equipment warranty does not cover damage due to improper storage.

The drive should be packed in its original shipping container if it is required that it be shipped. Assistance, if required, is available from your Magnetek representative.

Physical Installation

The DSD 412 Elevator Drive is air-cooled. The lowest HP rated units are cooled by convection; all other units are equipped with a fan to ensure adequate airflow. Select a site for installing the drive that is clean and well ventilated. Maintenance will be minimized if the drive is located in a clean atmosphere.

The standard drive is designed for vertical mounting. Attach the drive to a cabinet panel or other vertical structure using the mounting holes provided at the back of the drive. Ensure that the unit is level.

Selecting, Mounting and Wiring of the Digital Encoder

Encoder Selection

A quality encoder is recommended for use with the DSD 412 controller for speed feedback. The encoder should be a two channel, quadrature, zero speed type device with differential line drivers. The DSD 412 drive supplies +5V power for an encoder, however the encoder and feedback signals may operate from another source, up to 15 volts if desired. The Pulses per Revolution count must be sufficient to provide an adequate frequency feedback at very low speeds, and yet not exceed 300 kHz (per channel) at top speed. For most elevator applications this target will be met when the feedback frequency (per channel) is greater than 50KHz at contract speed. For gearless machines, which have a base speed around 100RPM, a 10,000PPR encoder is a good choice for direct connection to the motor shaft. For geared machines, with motors running at 1750 or 1150RPM, 2500PPR encoder may be used. Direct mounted hollow shaft encoders, electrically insulated from motor shaft and motor frame will yield the best results. The use of an analog AC or DC tachometer is not supported by DSD 412 elevator drives software or hardware.

Mounting

Proper mounting and alignment of the digital encoder used for speed feedback is very critical for the smooth operation of the DSD 412 controller. Even the slightest wobble of the encoder shaft due to misalignment can cause once-per-revolution torque pulsation that have the potential of exciting natural rope resonance frequencies.

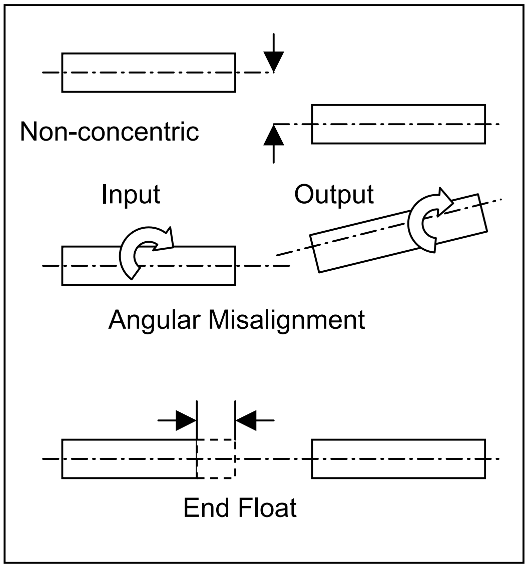


Figure 5: Common Problems in Encoder Mounting

The Magnetek recommendation for mounting the encoder used for motor speed feedback is to direct connect it to the motor shaft, usually to the end opposite the drive end. Normally a stub shaft is mounted in the end of the motor shaft. The stub shaft must be absolutely concentric (share the same center) with the motor shaft, and have no angular misalignment. The encoder is normally face mounted to a bracket that is mounted on the motor. A standard NEMA 56 “C” face adapter bracket may be used, or a special fabricated bracket may be designed and used. The encoder should be mounted on the bracket and positioned so that the encoder shaft and the stub shaft are concentric and have no angular misalignment or run-out. The coupling should have electrical insulation to isolate the motor shaft from that of the encoder. The body of the encoder should be electrically insulated from the motor frame.

An alternate method of mounting which has been used in the elevator industry is to drive the encoder with a rubber wheel that runs on the brake surface of the sheave. This approach may be satisfactory for many applications, *but it can introduce instability and is not recommended*:

1. Excessive bearing wear can occur in the encoder due to the method of mounting and holding the rubber wheel against the sheave.
2. Lack of concentricity of the measuring wheel.
3. The rubber wheel can develop a flat spot when it sits idle for an extended time. This goes away after a short time of operation, but it can affect performance while it exists.
4. An angular misalignment can cause the measuring wheel to skip or hop sideways, causing a disturbance in the feedback signal.

Coupling

Almost regardless of the care used in mounting the encoder, there is likely to be some small amount of misalignment. A good quality coupling between the encoder shaft and the motor stub shaft can help avoid the remaining problems due to shaft runout.

A good coupling will also offer some protection for the encoder against end float, a condition which exists in gearing on direction changes, and which can be transmitted through the motor. Again, the coupling should provide electrical insulation between the motor and encoder shafts.

Encoder Wiring

Wiring between the encoder and the DSD 412 drive should be shielded cable with 3 twisted pairs. The pairs should be made up of A and A, B and B, +5VDC and common. The shield should be insulated from the encoder case, and only connected at the drive end, to A1TB1(6). This cable should be run in a separate conduit between the encoder and the DSD 412. If the encoder must be connected to two receivers (DSD 412 and car controller), the cable should run from the encoder to the drive (with this portion of the shield connected at the drive) and then from the Drive to the car controller (with the portion of the shield connected to the car controller). Do not tie the two shields together.

Electrical Hook up

Ensure that wire size and disconnect devices conform to the installation contractor's drawings and to all applicable codes.

Power Connections

The three phase input power to the drive is fuse protected internal to the Drive. However, it is recommended to provide branch circuit protection by means of a circuit breaker in accordance with the National Electrical Code, (USA) or as may be required by other local electrical codes.

Signal Connections

All low power, low voltage wiring to the DSD 412 controller should be run separate from the 115VAC or higher power connections and the DC motor armature and field connections. These include:

Encoder Wiring
Speed Reference Wiring
Pre-Torque Reference Wiring
24 VDC Logic Inputs
Analog Outputs
Open Collector Logic Outputs

Rewiring these signals in shielded wire is recommended to avoid noise pickup.

Grounding

The DSD 412 controller, the utility power system feeding it and all other connected power equipment should be grounded as follows:

- The facility power ground and grounding wire sizes should comply with NEC, UL, CSA and other applicable codes for power distribution safety.
- A common grounding stud or buss bar should be provided within the drive enclosure cabinet, electrically bonded to the metal enclosure.
- A grounding wire should be provided directly from the grounding terminal on the DSD 412 drive chassis to the common grounding stud.
- A grounding wire should be provided directly from the electrical sub-panel on which the DSD 412 drive is mounted to the common grounding stud. Other electrical equipment, such as fans or relay circuits may be grounded to the electrical sub-panel.
- A grounding wire should be provided directly from the elevator motor frame to the common grounding stud.
- A grounding wire should be provided directly from the power isolation transformer frame to the common grounding stud.
- A grounding wire should be provided directly from building steel to the common grounding stud.
- If an armature circuit ripple filter is used, a grounding wire should be provided directly from the ripple filter inductor frame to the common grounding stud. The sub-panel for capacitor mounting within the filter should have a grounding wire to the inductor frame.
- The secondary side of the power isolation transformer should remain un-grounded.
- The low voltage circuit common should be grounded by connecting A1TB1-43 or A1TB1-44 to A1TB11.

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 range of 150 to 525 VAC. The drive is not sensitive to phase sequence. Input power specifications are contained on the drive nameplate or the drive system Schematic Diagram.
C. Remove all shipping devices and relay wedges. Manually operate all contactors and relays to ensure that they move freely.
D. Ensure that all electrical connections are secure.
E. Ensure that all transformers are connected for proper voltage according to the Drive system Interconnection Diagram.

Drive Start up

Refer to the recommended connections shown in the connection diagrams. Attach a voltmeter across the 115VAC source for the control power supply, at A4TB3-1 & A4TB3-7.

Apply the control and three-phase power and verify that the control power is between 103 VAC and 126VAC. Then press the RESET push button on the front of the power cube, and observe the drive power-up sequence as described below.

Drive power-up sequence

The power up sequence can be observed by monitoring the Standard Control/Display Unit (SCDU) on the front of the power cube.

1. First, all of the segments on the digital LED display and all of the LEDs will light for about 1 second.
2. Then the LEDs and display should extinguish. The drive will perform internal checks. The SCDU will display 'tESt' while a self-test is being performed.
3. If the drive passes the self-test, then the SCDU will display 'P-UP'. READY LED will light

Abnormal Display Conditions

Displays other than those mentioned above may occur. The following is a list of abnormal display conditions that may occur, and the actions necessary to correct the situation:

1. If no digits or LEDs light up, then check for proper voltage between the 115 Vac control power lines, or for blown 115 Vac control power fuses, or for a defective Control Voltage Power Supply in the power cube.
2. If horizontal segment(s) of the SCDU display are lit, then one or more phases of the three-phase power are missing. Measure and verify three phase power input at the drive terminals. Check the three-phase power fuses. see section describing standard control/display unit operation for more detailed information about this test.
3. If the FAULT LED lights, and a fault code appears on the SCDU, then refer to the Fault/Error Codes List to see what caused the fault and to find the correct solution. A fault code is the letter 'F' followed by a number representing the fault. see section describing standard control/display unit operation for more detailed information about fault reporting and clearing.
4. If the SCDU displays 'Prot', then the initial checks found that the protected non-volatile RAM (NVRAM) has not been initialized. Move the NV RAM PROTECTION switch to "OFF" in order to allow the micro-processor to initialize the NVRAM with preprogrammed default values. Notice that the NV RAM UNPROTECTED LED is now lit to indicate the NV RAM PROTECTION switch position. Next, press the RESET push button. The drive will go through its power up sequence again; however, this time it will initialize the unprotected NVRAM and load in factory supplied default parameter values.

Fan Check

On drives with a blower motor (power bridge fan), verify that the fans are working.

Verify Parameters

When the READY LED on the SCDU is lit, all the selectable parameter data should be checked and/or verified to the proper values as follows:

1. VERIFY OR CHANGE EACH PARAMETER VALUE for the particular application and motor involved.
2. Perform PCU DIAGNOSTICS Function 998 should to verify armature and field circuitry.
3. Perform SELF-TUNE PARAMETER TEST Function 997 to measure and verify various motor parameters essential for proper operation.
4. STORE PARAMETERS, Function 994, so that power can be removed and reapplied without losing the entered parameters.

5. Set the NV RAM PROTECT switch to the protect position (UN PROT NV RAM light is off) to ensure that set up data cannot be corrupted.
6. Operate drive, using external control signal inputs shown on the Interconnection Diagram.

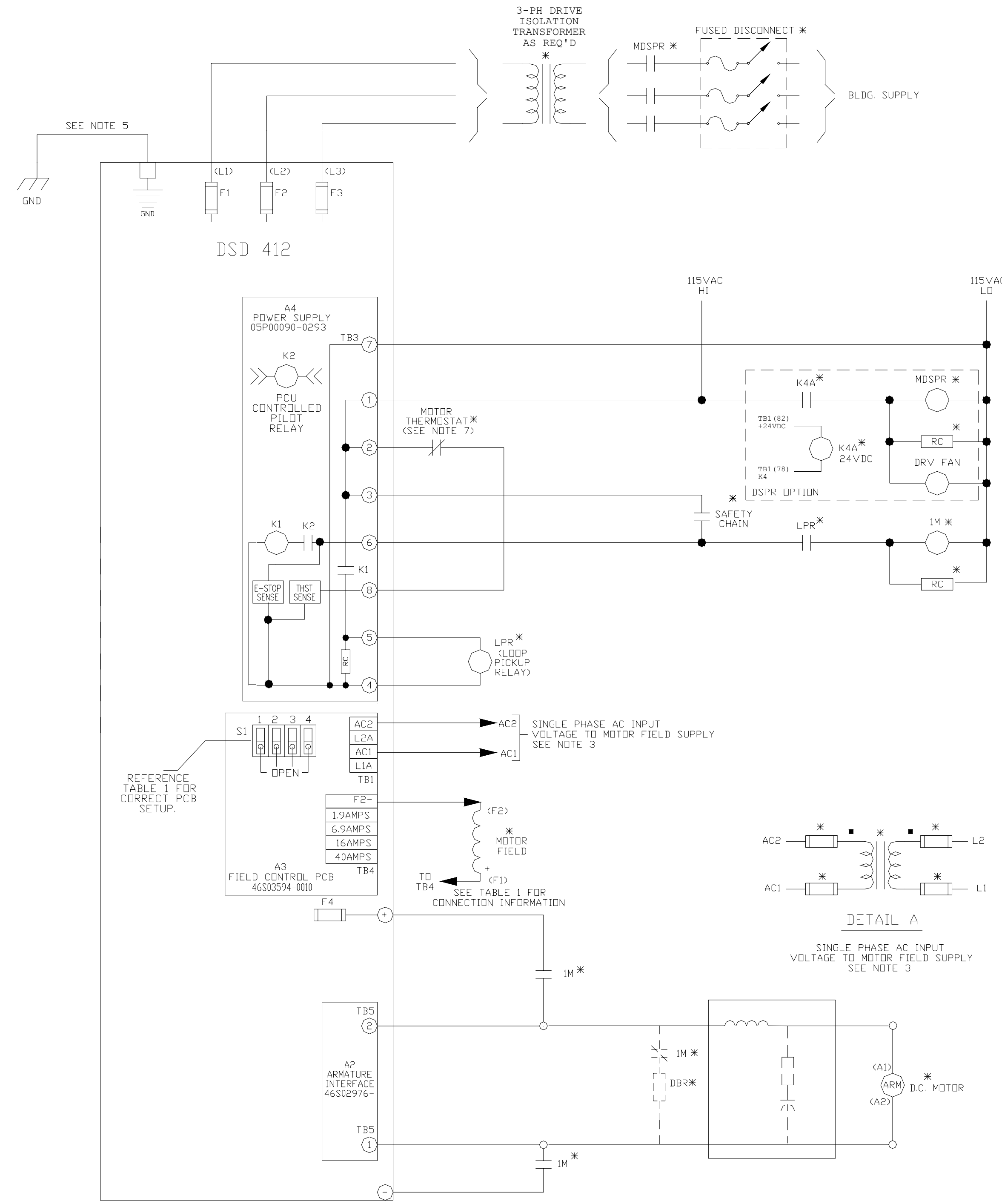


Figure 6: Typical Power Wiring

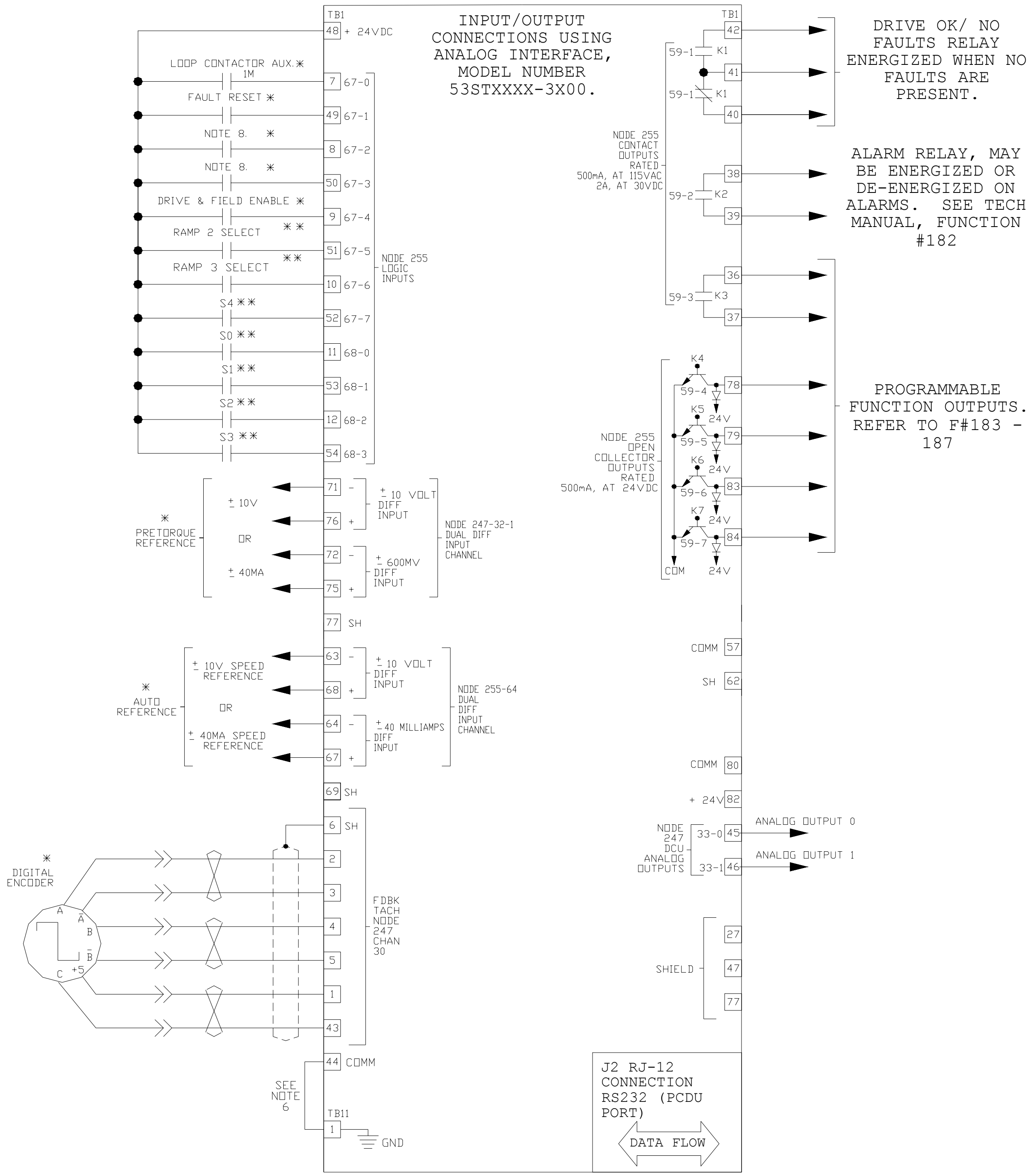


Figure 7: Typical Analog Signal Wiring

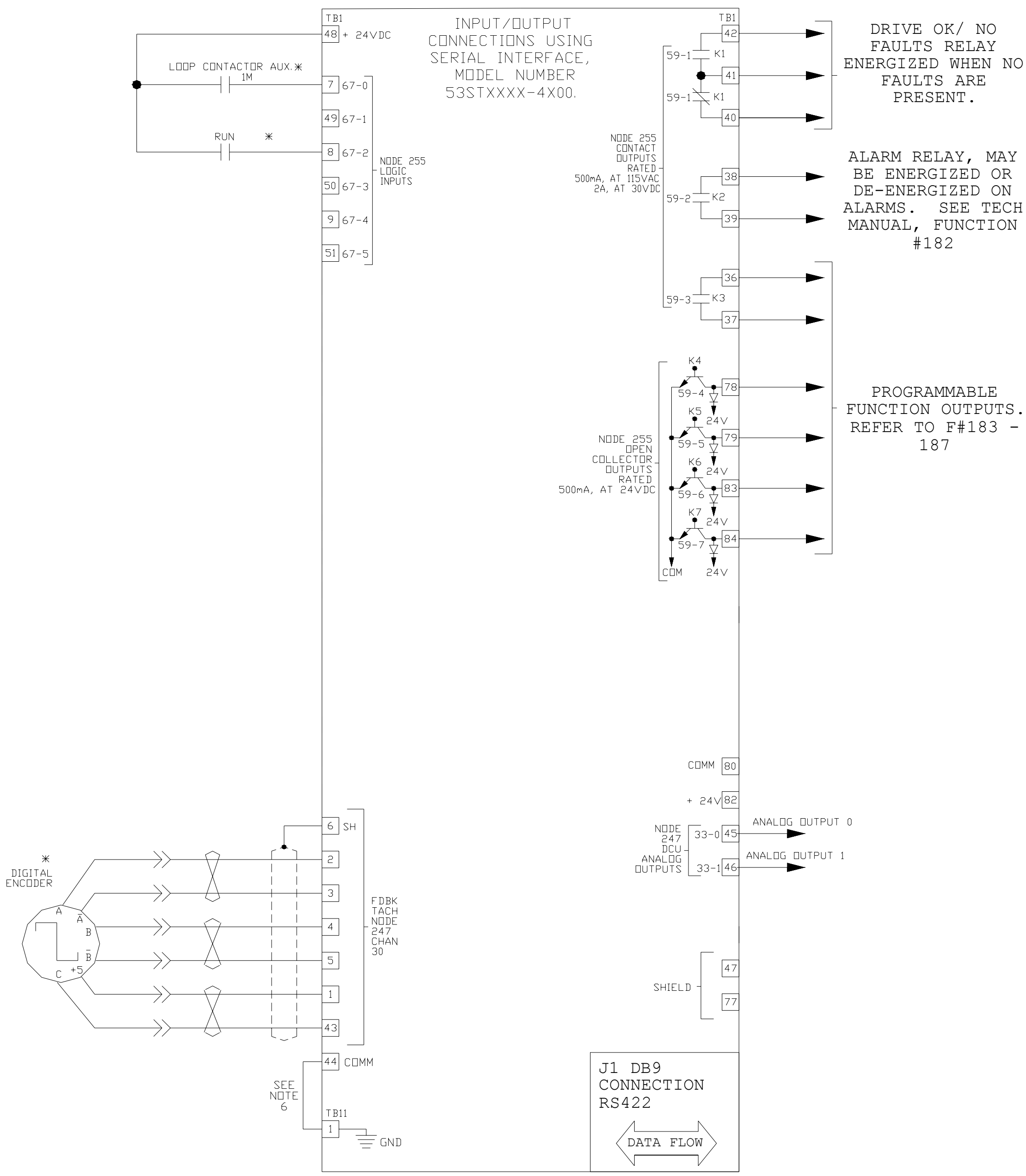


Figure 8: Typical Serial Signal Wiring

NOTES:

1. ITEMS NOT SUPPLIED BY MAGNETEK ARE INDICATED WITH AN ASTERISK (*) OR (**).

2. THE DC MOTOR CONNECTIONS SHOWN IS FOR CCW ROTATION FACING THE COMMUTATOR END. TO REVERSE ROTATION, INTERCHANGE A1 AND A2 AT THE MOTOR. DO NOT CONNECT SERIES FIELD (IF SUPPLIED WITH MOTOR).

3. THE DRIVE IS PREWIRED TO HAVE THE AC SUPPLIED TO THE FIELD RECTIFIER DERIVED FROM L1 AND L2. IF A DIFFERENT VOLTAGE IS REQUIRED MOVE THE ORIGINAL WIRES FROM AC1 AND AC2 TO L1A AND L2A. THE ALTERNATE SUPPLY SHOULD THEN BE BROUGHT INTO AC1 AND AC2. THIS CONNECTION IS PHASE SENSITIVE (SEE FIG 2.1a, DETAIL A).

4. ITEMS MARKED (**) ONLY APPLY WHEN THE INTERNAL PRESET SPEED OPTION IS USED.

5. ATTACH TO BUILDING GROUND.

6. INSTALL JUMPER FROM TB1(44) TO TB11(1).

7. CONNECTION MUST BE MADE FOR PROPER DRIVE OPERATION. IF MOTOR THERMOSTAT IS NOT INSTALLED COMPLETE WITH A JUMPER WIRE.

8. FUNCTION OF CONTACT INPUTS DEPENDS ON PROGRAMMING OF FUNCTION #115. SEE DIAGRAM THIS PAGE AND DESCRIPTION OF F#115.

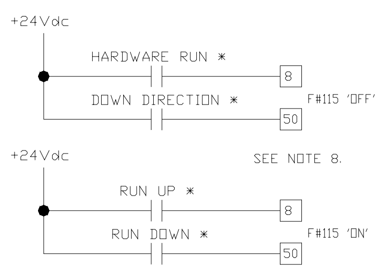


TABLE 1

RATED MOTOR FIELD CURRENT RANGE	TB4 CONNECTION	S1 SETTING 1	2	3	4
16.1 - 40.0	40A	X	□	□	□
7.0 - 16.0	16A	□	X	□	□
2.0 - 6.9	6.9A	□	□	X	□
0.2 - 1.9	1.9A	□	□	□	X

X = CLOSED
□ = OPEN

FAILURE TO FOLLOW THIS TABLE MAY CAUSE DAMAGE TO DRIVE AND/OR EQUIPMENT.

Figure 9: Power/ Signal Wiring Notes

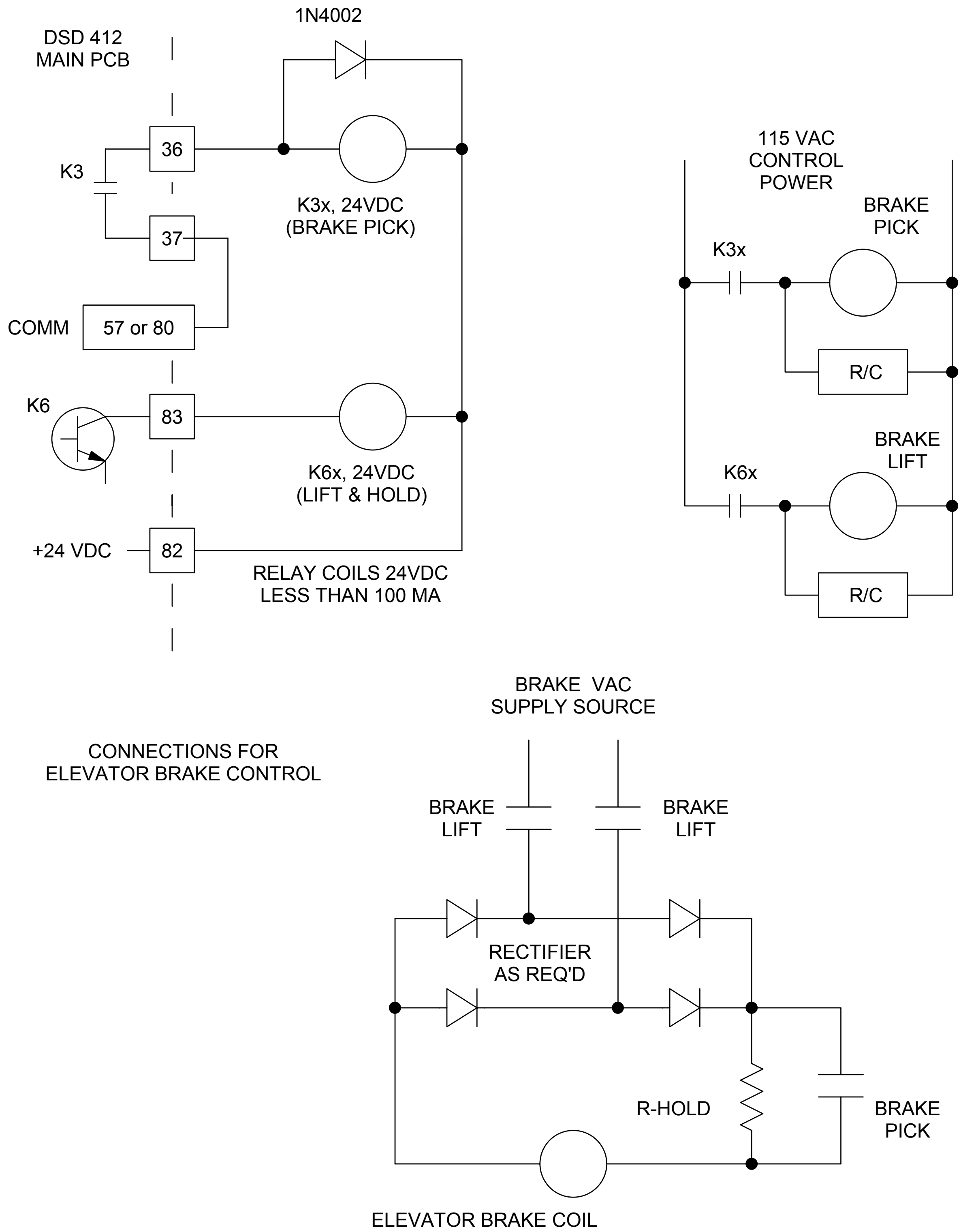


Figure 10: Drive Brake Control Feature

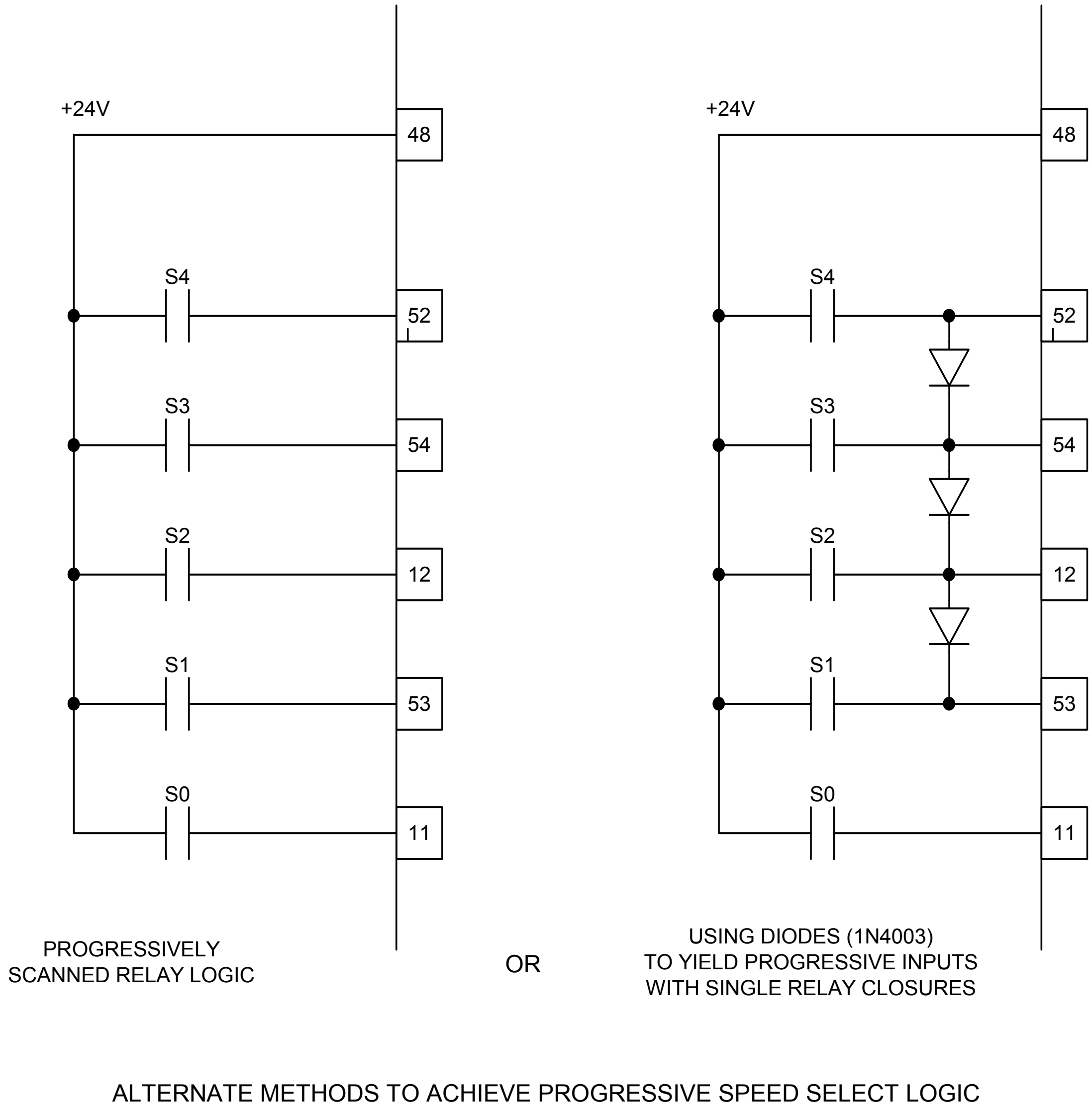


Figure 11: Speed Select Logic Input Wiring

Standard Control/Display Unit Operation

General

The Standard Control/Display Unit (SCDU) is used to change and/or monitor various drive dependent operational set points and perform diagnostics for the Magnetek DSD Elevator Drive. The SCDU is located in the upper right corner of the Drive Control PCB and is accessible through the power cube cover. This Control/Display Unit is present on every Magnetek DSD 412 Elevator Drive.
The SCDU consists of a 4-button keypad, a 4-1/2 digit numeric LED display, red and green colored LEDs, an "NVRAM PROTECT" switch (marked NV RAM PROTECTION on the power cube cover), and a red LED that shows the status of the "NVRAM PROTECT" switch.

Start-Up Operation

When power is first applied to the drive, *all of the segments on the 4-1/2-digit display will turn on briefly* in order to show that all are functioning:

+1.	8.	8.	8.	8.

█ █ Both LEDs Off

After this lamp test is completed, an internal check is made to determine if the NVRAM chips have ever been used before, or if the EPROM's are the same as before power down. If not, the drive software will attempt to load the defaults into the NVRAM chips. *The SCDU displays the word 'Prot' if the NV RAM PROTECTION switch is in the position that will not allow any updates of the NVRAM:*

	P	r	o	t

If the display shows 'Prot', it is necessary to move the NV RAM PROTECT switch to the "OFF" position and press the CPU RESET button in order to load defaults into NVRAM and restart the drive. Then set the NV RAM PROTECT switch back to "ON". This 'Prot' message will only happen when: A. The drive is powered up for the very first time. B. If the software in the drive is changed. C. The NVRAM chip (U56) is changed.

After the LED lamp test has completed, the drive software will now perform a fuse test on each of the three line fuses. If any power conversion fuse is open, the SCDU will indicate this on its display. The SCDU display is arranged in a similar manner to the physical placement of the 3 line fuses in the power cube. The middle segments of the three right-most digits are used to indicate blown fuses. For example, if the left-most line fuse is bad, the SCDU will report it as follows:

		—		

█ ▯ Red LED Lit

If any two or more fuses are blown, the SCDU display will be:

		—	—	—

█ ▯ Red LED Lit

The operator should then identify which fuses have failed.

The drive will not operate unless all three line fuses are functional. If the SCDU indicates a bad fuse, power must be removed from the drive, the fuse replaced and power reapplied.

After the drive has performed all three tests (lamp test, RAM test, and fuse test), the SCDU displays one of two final messages. If there are any faults present at this time, the SCDU will display a Fault code. The display will be *similar* to:

	F	4	0	7

Both LEDs Off

where the leading 'F' indicates a fault and the 3 digits following the 'F' indicate the fault number. If however, there are no faults present, the SCDU displays the normal power-up message:

	P	-	U	P

Both LEDs Off

This 'P-UP' display will remain on the SCDU until a key is pressed or a fault occurs.

After Power-Up

After the drive has powered up and the SCDU display is showing 'P-UP' or a fault number, it can be used to enter new parameters, monitor drive operation, and/or perform certain drive diagnostics. *Every operation that the SCDU can perform is called a 'function'.* There may be up to 1000 functions defined within the DCU.

All SCDU functions have at least 2 levels, and some functions use 3 levels. The two colored LEDs below the lower left corner of the 4-1/2-digit display are used to indicate which level of a particular function the SCDU is currently at. The top level of the SCDU operation is called the "Function" level. *The two colored LEDs are off when the SCDU is in the "Function" level.* The ▲ or ▼keys are used to select a function number to be accessed while at this level. The ▲ key increments the function number in the display while the ▼ key decrements it. The SCDU will ramp the displayed function number when the ▲ or ▼ key is pressed and held for 1/2 second or longer.

The DATA/FCTN key is used to toggle between the "Data" level and the "Function" level. Press the DATA/FCTN key when the desired function number is in the display. At this point, the SCDU leaves the "Function" level and enters the "Data" level. Note that the green LED is now lit. This operation is consistent for every function on the SCDU, although the data actually displayed while the LED is GREEN is function-number specific. Examples of every type of SCDU function are given in subsequent sections. All function numbers are shared between the SCDU and the PCDU (Portable Control/Display Unit). *There are some functions, however, that can only be performed with the PCDU. When such a function number is selected on the SCDU and the DATA/FCTN key is pressed, the SCDU's display will change to:*

	P	c	d	u

Both LED's Off

Changing Parameter Functions

SCDU functions are used to modify and/or display setup points that the drive needs for operation. Items that would typically fall into this category are functions such as Accel Times, Regulator Gains, Rated Speed and any other parameters. The following steps show how to modify a given parameter via the SCDU display.

1) Use the ▲ and ▼ keys to select the function number to be accessed. The two colored LEDs remain off during this step. For example, if #040 is chosen:

			4	0

Both LEDs Off

2) Press the DATA/FCTN key to enter the "Data" level for this function number. The green LED is lit to indicate that the number being shown is the current actual value for this parameter. For example, if function 40 is currently set for a value of 10.6, it will be displayed as:

		1	0.	6

□ ■ Green LED Lit

3) Use the ▲ and ▼ keys to ramp the number in the SCDU display to the desired value. Note that the red LED is lit to indicate that the value being displayed is NOT the actual value, but rather is in the process of being changed. Each parameter has an upper and lower limit. *The following display will occur when the lower limit is exceeded:*

	_	_	_	_

■ □ Red LED Lit

Similarly, if the upper limit is exceeded, the SCDU displays:

	—	—	—	—

■ □ Red LED Lit

The SCDU display will increment from ‘10.6’ to ‘11.0’ if the ▲ key is pressed 4 times:

		1	1.	0

■ * Red LED Lit

4) Press the ENTER key to transfer the value in the SCDU display to the actual value used by the drive. Note that the green LED will now light to indicate that this value is now the actual value for this parameter:

		1	1.	0

* ■ Green LED Lit

If the ENTER key is pressed while the display is indicating that the upper or lower limit has been exceeded, the display will change to the appropriate limit and the green LED will light.

5) Press the DATA/FCTN key to put the SCDU back into the "Function" level. As with the example above, the SCDU display will be similar to:

			4	0

■ ■ Both LED’s Off

All changes made become active values upon pressing the ENTER key. They remain active until the next reset, or until the drive is powered down. When the drive is reset or powered up the value reverts to the value

stored in NVRAM. If changes are to be permanent, use function 994 to save the changed value in NVRAM.

Due to programming considerations it may be possible to access a value that cannot be changed. In this case the CDU function will proceed as described until the ENTER key is pressed to change the value. In this case the value will simply ignore any requested changes and remain the same.

Viewing Monitor Functions

Items that would typically fall into this category are Speed Feedback, Armature Current and Armature Voltage.

To view one of these values, it must have been previously programmed in the the drive. The following steps show how to display a given value on the SCDU display.

1) Use the ▲ and ▼ keys to select the function number (between 600 and 799) to be accessed. The two colored LEDs remain off during this step. For example, if 600 is selected, the SCDU display will be:

		6	0	0

▮ ▮ Both LED's Off

2) Press the DATA/FCTN key to enter the "Data" level for this function number. The green LED is lit to indicate that actual data is currently being viewed. If the data for function 604 is currently at 20.94 for example, the SCDU display will change to:

	2	0.	9	4

▯ ▮ Green LED Lit

The SCDU's display is updated immediately if the value for the selected function changes.

> **NOTE**
>
> Values displayed with these function numbers cannot be modified.

Error Reporting

The drive has two methods available to report errors and faults. Each error condition may utilize ONE OR BOTH OR NEITHER of the reporting methods.

The most conventional method is called 'fault recording'. If this method is enabled for a particular error, the red FAULT LED and a unique fault code number will appear on the SCDU at the moment when the error occurs. Each occurrence of a fault is recorded in an area in RAM called the Fault List. The Fault List stores the 16 OLDEST faults and *stops recording faults* as soon as the 16th fault occurs. *This list is erased when the drive is powered down or reset.* Whether or not the drive stops or continues to run is dependent on the way the particular fault is implemented.

Most standard faults are set up so that the drive will stop if a fault occurs. Faults stored on the Fault List will appear when viewing Function 0.

The second method for error handling is called 'error recording'. Error recording differs from fault recording in three respects:

1. The error condition *will not* be shown on the SCDU or the red Fault LED.
2. The error list stores the 16 most recent errors and *always* overwrites the oldest error with the newest error.
3. This list is maintained in battery-backed-up RAM and is retained when the drive is powered down or reset. Operation of the drive is totally independent of whether error recording is enabled or not.
4. The Errors List may be viewed at function 800.

Function 801

Used to display or alter the Fault & Error Disposition List. This list is consulted any time an error condition occurs to determine whether it should be reported as an error, a fault, or both. The process for changing the entry in the disposition list for a particular error using the SCDU is as follows:

1) Use the ▲ and ▼ keys to select function number # 801 from the function level. The two colored LEDs remain off during this step.

		8	0	1

▮ ▮ Both LED's Off

2) Press the DATA/FCTN key to enter the "Data" level for function #801. The green LED will light and the error code last modified, with function #801, will be in the SCDU display. The SCDU displays error code #13 (illegal instruction) initially:

			1	3

□ ■ Green LED Lit

3) Use the ▲ and ▼ keys to select the error code entry in the Disposition List that is about to be changed/viewed. For example, if the disposition for error code 102 (Numeric Underflow) is to be modified, press the key until the SCDU display changes to:

		1	0	2

□ ■ Green LED Lit

4) Press the ENTER key when the desired error code is displayed on the SCDU. The red LED now lights, and the SCDU display changes as well to a format of 'E.xF.y'.

The 'E' and 'F' are abbreviations for Error and Fault respectively. The 'x' and 'y' will be either '1' or '0' to indicate which list will record the error. For example, if the display is 'E.1F.1', the error is recorded in both lists. If the display is 'E.0F.1', the error is recorded in the fault list, but not in the error list. If the display is 'E.0F.0', *neither* list records the error. In the example above, the factory set default disposition for a numeric overflow F#102 is to record the error in the Error List, but not in the Fault List. In this case, the SCDU display is:

	E.	1	F.	0

■ □ **Red LED Lit**

5) Press either the ▲ or ▼ key repeatedly to change the numbers after the 'E' and 'F' from '1' to '0' and vice-versa. Starting from no declarations, the displays are: 'E.0F.0', 'E.0F.1', 'E.1F.0', and 'E.1F.1'. For example, if the disposition for this error should be changed so that it is *NOT* recorded in either the Fault or Error list, press the ▼ key once so the display changes to:

	E.	0	F.	1

■ □ Red LED Lit

This display indicates that the Numeric Underflow error will now be recorded in the Fault List, but not in the Error List.

Pressing the ▼ key once more will change the display to:

	E.	0	F.	0

■ □ Red LED Lit

This is the desired status for the new disposition of the Numeric Underflow error, which is to ***not*** report it to either the Fault or Error List.

6) Press the ENT key when the new disposition code is in the display. At this point, the green LED will light, and the SCDU displays the error code again:

		1	0	2

□ ■ Green LED Lit

The ▲ and ▼ keys can now be used to select another error code to be modified, as in step 3.

7) When all changes in the Error Disposition List are finished, pressing ENTER key will exit back to the function level:

		8	0	1

■ ■ Both LED's Off

Fault Display/Clear

The drive stores the first 16 faults that have been reported to the Fault List, **Function # 0**. Once the Fault List is filled with 16 faults, it will not accept any more entries. *The data in this buffer is not retained when the power is lost.* Each time a fault condition occurs, and its entry in the Disposition List is set to record also in the Fault List, the new fault is placed on the list, provided the list is not full.

Function 0

Reserved for viewing the Fault List. The steps to view the Fault List are as follows:

1) Use the ▲ and ▼ keys to select Function # 0. The two colored LEDs remain off during this step. Note that simply pressing the ▲ key once can access this function, <u>if the SCDU display is 'P-UP'.</u>

2) Press the DATA/FCTN key to enter the "Data" level for this function. The green LED is now lit to indicate that the fault codes currently in the Fault List are being displayed. The very first display at this point is the word 'ALL':

		A	**L**	**L**

The SCDU display always displays the fault code that will be removed if the ENTER key is pressed. If the ENTER key is pressed at this time, *every fault currently in the Fault List will be removed from the list.*

Each fault in the Fault List can be shown on the SCDU display and optionally cleared.

> **IMPORTANT**
>
> The process of clearing a fault from the Fault List *DOES NOT* actually clear the condition that caused the fault.

To view the first fault on the list, press the ▲ key. If there is a Numeric Underflow fault 102 is on the Fault List, for example, the SCDU display will change to:

		1	**0**	**2**

□ ■ Green LED Lit

The contents of the Fault List may be examined by using the ▲ and ▼ keys. The ▼ key moves down the fault list while the ▲ key moves up the fault list. The first fault in the list is the first fault actually declared. The SCDU displays the word 'End' *after the last fault has been displayed:*

		E	**n**	**d**

□ ■ Green LED Lit

Error Display

The drive is able to store the most recent 16 errors that have been reported to the Error List. This list is constantly updated, *with the newest error overwriting the oldest in the list.* This list is held in battery-backed-up RAM (NVRAM), so it is retained when power is lost. Each time an error condition occurs, and if its entry in the Disposition List is set to allow recording in the Error List, that new error is placed in the list

Function 800

Reserved for viewing the Error List in NVRAM. The steps to view the Error List are as follows:

1) Use the ▲ and ▼ keys to select function 800. The two colored LEDs remain off during this step.

		8	**0**	**0**

■ ■ Both LEDs Off

2) Press the DATA/FCTN key to enter the "Data" level for the view error function. The green LED is now lit to indicate that an error

code is currently being viewed. If the error in this slot is a Numeric Underflow fault 102 for example, the SCDU will display:

		1	**0**	**2**

Green LED Lit

Other errors currently in the Error List can be viewed by pressing the ENTER key to display the Error Code again, then use either the ▲ or ▼ key to move to the next slot in the list. The procedure outlined above should be repeated as necessary to view the Error Code number for other errors in the Error List.

Non-Volatile Ram Access

Every parameter that the drive uses has three separate areas in memory associated with it. There is a factory-set default value for each parameter which is stored in the "read only" EPROM chips. There is an area in the active RAM which the drive uses while it is running. There is also an area in NVRAM reserved for each parameter. The values in the NVRAM area are copied to the active RAM every time the drive is powered up or the reset button is pressed. This split level approach makes it possible to return to the last set of 'stable' parameters in NVRAM if some errors are made during fine-tuning of the active drive parameters. The purpose of this function is to perform transfers between the NVRAM parameter list and the active parameter list.

Function 994 is used to perform the transfer of data between the NVRAM and active parameter lists. The process for copying data to or from the NVRAM parameter list is as follows:

1) Use the ▲ and ▼ keys to select function 994 from the function level. The two colored LEDs remain off during this step.

		9	**9**	**4**

Both LEDs Off

2) Press the DATA/FCTN key to enter the "Data" level for function 994. The green LED is now lit to indicate that this function is currently being accessed. It is possible to SAVE the current active parameters in RAM to the NVRAM parameter list, or to RESTORE the current parameters from the NVRAM parameter list to ACTIVE RAM. *Note that a RESTORE is the same operation that occurs inherently every time the drive is powered up.* Upon entering the data level for this function, the SCDU displays:

	r	**E**	**S**	**t**

Green LED Lit

The ▲ and ▼ keys can be used to toggle between the above display, which indicates a pending RESTORE operation, and the following display, which indicates a pending SAVE:

	S	**A**	**V**	**E**

Red LED Lit

Note that as soon as either the ▲ or ▼ key is pressed, the red LED will light.

3) Press the ENTER key to actually perform the transfer of data. If ENTER is pressed while 'SAVE' is displayed, the SCDU display may change to:

	P	**r**	**o**	**t**

This display means that the NV RAM PROTECTION switch is in the incorrect position preventing writes to the NVRAM. Move the switch to the "OFF" position, press the DATA/FCTN key, and start over from step 2.

If the SAVE or RESTORE operation was successful, *the green LED will light*. For example, if a SAVE were performed, the display would be:

	S	A	V	E

Green LED Lit

Load Default Function

Every parameter in the drive has a factory-set default value that is loaded when the drive is powered up for the very first time. These default parameters may not be optimal values for the drive when actually running, but they will generally allow the drive to function. It is possible to reload these default parameters with **Function 995** of the SCDU. A re-load of the defaults would generally be done when the drive is operating erratically and it is suspected that one or more parameters were improperly set.

CAUTION

Use of the LOAD DEFAULTS function will overwrite EVERY parameter currently being used by the drive with the factory set default for each parameter. There is no way to restore parameters to their previous value once this function is used.

Function 995 is used to perform the transfer of data from the default parameter list to the ACTIVE RAM parameter list. The process for accessing the Load Defaults Function is as follows:

1) Use the ▲ and ▼ keys to select **function 995** from the function level. The two colored LEDs remain off during this step.

		9	9	5

Both LEDs Off

2) Press the DATA/FCTN key to enter the "Data" level for function 995. The green LED is now lit to indicate that this function is currently being accessed. The SCDU will now display:

	L	O	A	d

Green LED Lit

3) Press the ENTER key to actually perform the Load Defaults transfer. After the transfer has completed, the SCDU displays the word 'dOnE':

	d	O	n	E

Green LED Lit

4) A cycling of control power is then necessary to implement the default settings onto the display.

Self Tune Function

The DSD 412 Elevator drive has a built-in current regulator SELF TUNING function 997. When activated, this feature measures total motor armature circuit resistance, inductance including wiring, and the field L/R time constant. The drive then uses the measured value in conjunction with the parameter entered for “CROSSOVER FREQUENCY” to calculate integral and proportional gains for the current regulator and to set the field regulator gains properly. After running the Self Tune Parameter Measurement function, the values for armature resistance and armature inductance are stored in NVRAM. It is important to note that it is possible to override the values that have been dynamically calculated for Armature Resistance, Armature Inductance, and Field L/R Time Constant by the “USE SELF-TUNE” item in the parameter menu (Function 2). The dynamically calculated values are used if “USE SELF-TUNE” is set to “ON” while the *manually entered* values (entered in parameter’s 4, 6, and 51) are used if this item is set to “OFF”.

NOTE:

Armature current is circulated through the armature circuit during parts of the PCU Parameter Measurement function. The PCU will reduce the field current to zero on motors with a shunt field in order to minimize motor rotation. If the PCU detects significant motor voltage during the test, the PCU parameter measurement function will abort.

Ripple Filter Consideration

It is important to note that when applying a LRC output filter (Ripple Filter), the drive performance will be affected. For this reason, it is necessary to run the SELF-TUNE test with the *output configuration that will be used*. For example, if the filter is used with the capacitor fuse installed, then the SELF-TUNE test must also be run with the filter fuse installed. If the capacitors are not needed, then the fuse should be pulled and the SELF-TUNE test should be run with the fuse pulled.

The process for accessing the PCU PARAMETER MEASUREMENT function is as follows:

1) Use the ▲ and ▼ keys to select function 997 from the function level. The two colored LEDs remain off during this step.

		9	9	7

▮▮ Both LEDs Off

2) Press the DATA/FCTN key to enter the "Data" level for Function 997. The green LED is now lit to indicate that this function is currently being accessed. The SCDU displays the word 'Prot' if the NV RAM PROTECTION switch is in the position that will not allow any updates to the NVRAM:

	P	r	o	t

If the 'Prot' message appears, press the DATA/FCTN key to return to the "Function" level, move the NVRAM PROTECTION switch to the "OFF" position, and press the DATA/FCTN key again. The SCDU will jump to step #3 when the NVRAM PROTECTION switch is in the correct position upon entering this function.

3) The SCDU displays the word 'Entr' to prompt the user to press the ENTER key as further confirmation that the PCU parameter measurement function is about to be performed:

	E	n	t	r

▯▮ Green LED Lit

4) Press the ENTER key to actually start the PCU Parameter Measurement function. The PCU <u>*will not*</u> begin the measurement routine if a SEVERE PCU FAULT exists. The PCU will declare a SEVERE FAULT under several conditions including an IST fault, power supply failure, line sync loss, low line, or DCU failure. If a SEVERE FAULT exists when the PCU starts the parameter measurements, the SCDU displays:

	S	F	L	t

▯▮ Green LED Lit

Severe faults can only be cleared by pressing the reset button on the Drive Control PCB, by cycling power to the drive, or by replacing the bad component if applicable. The SCDU displays the word 'tESt' while it is performing the parameter measurements and there were no SEVERE FAULTS when the ENTER key was pressed:

	t	E	S	t

□ ■ Green LED Lit

5) Press the **DATA/FCTN key to exit the PCU parameter measurement routine and return to the "Function" level. The SCDU displays:**

		9	9	7

■ ■ Both LEDs Off

6) After completion of SELF-TUNE, enable Function 2. (Unless using manual entry)

Power Conversion Diagnostics

The drive has built-in diagnostic routines that can be performed via the SCDU. The PCU diagnostic routines are able to test for four failure modes. The first test that the PCU performs is a test of the three line fuses. Assuming the three line fuses are all OK, the PCU then performs a test for shorted SCRs/ doubler packs. If this test indicates no shorted SCRs/doublers, the PCU then verifies that less than 5% of the value entered for “Rated Field Current” is attainable. The PCU then tests for open SCRs by passing current through the forward bridge followed by the reverse bridge, and finally checks polarity of voltage feedback. The result of the test is displayed on the SCDU after the test completes. The SCDU will light certain unique LED patterns on its display corresponding with the failure (see displays in the procedure that follows). The Fault Codes F910 (Blown Fuse), F911 (Shorted SCR), F912 (Open SCR), and F917 (Reverse Armature Feedback Wires) will not appear on the SCDU if the Error Disposition List is programmed so that they are not reported to the Fault List.

> WARNING
>
> Armature current is circulated through the armature circuit during parts of the PCU Diagnostics Function. The PCU will reduce the field current to zero on motors with a shunt field in order to minimize motor rotation. However, a PERMANENT MAGNET motor must have its shaft locked mechanically prior to running the PCU Diagnostics routine. If the PCU detects significant motor voltage during the test, the PCU Diagnostics Function will abort.

The process for accessing the PCU Diagnostics Function is as follows:

1) Use the ▲ and ▼ keys to select Function 998 from the function level. The two colored LEDs remain off during this step.

		9	9	8

■ ■ Both LEDs Off

2) Press the DATA/FCTN key to enter the "Data" level for Function # 998. The green LED is now lit to indicate that this function is currently being accessed. The SCDU prompts the user to press the ENTER key by displaying:

	E	n	t	r

□ ■ Green LED Lit

3) Press the ENTER key to actually start the PCU diagnostics. While the PCU is per-forming the Function 998 Diagnostics test, the SCDU displays:

	t	E	S	t

□ ■ Green LED Lit

The PCU will not begin the diagnostic routines if a SEVERE PCU FAULT exists. The PCU will declare a SEVERE FAULT under several conditions including an IST Fault, power supply failure, line sync loss, low line, or DCU failure. If a SEVERE FAULT exists when the PCU starts the diagnostic tests, the SCDU displays:

	S	F	L	t

Green LED Lit

Severe faults can only be cleared by pressing the CPU reset button on the Drive Control PCB or by cycling power to the drive.
If the display stays on 'tESt' and the contactor doesn't pick up, there is a fault in motor field connections or settings.

If all tests indicate that there are no failed power components (SCRs and fuses), the SCDU displays:

	P	A	S	S

Green LED Lit

Press the DATA/FCTN key to exit the PCU Diagnostics routine and return to the "Function" level. The SCDU displays:

		9	9	8

Both LEDs Off

If the PCU detects one or more ***Open AC Fuses***, it displays the fault code for a blown fuse **(F910):**

	F	9	1	0

Both LEDs Off

If the PCU detects one or more *shorted SCR/doubler packs*, the SCDU displays the fault code for a shorted doubler (F911):

	F	9	1	1

Both LEDs Off

Remove power from the drive to replace the SCR(s) that are shorted, and repeat this test until the SCDU displays the 'PASS' message.

If the PCU detected one or more *open SCR/doubler packs*, the SCDU displays the fault code for an open SCR/doubler pack (F912):

	F	9	1	2

Both LEDs Off

Remove power from the drive, consult Section 5, MAINTENANCE, to replace the SCR(s) that are open, and repeat this test until the SCDU displays the 'PASS' message.

If the PCU detects Reversed Armature Feedback wires, it displays the fault code for a Reverse Armature Fault (F917):

	F	9	1	7

Both LEDs Off

Remove power from the drive, *reverse the Armature Feedback wires*, and repeat this test until the SCDU displays the 'PASS' message. *This fault also occurs if the Armature FB wires are not connected.*

Drive Setup & Adjustments

Software Operating Features

- The DSD 412 is configured by software to operate geared and gearless elevators and lifts. The SA407 Drive Control software contains desirable feature improvements from the previous version, SA274. Basic features include...
- User choice of operating speed reference
- External analog reference follower
- Serial link reference follower
- Internal reference generator with S-Curve smoothing, to one of 7 preset speeds (8 speeds including zero)
- User choice of ft/min or m/sec speed programming and display units
- User choice between binary or progressive relay selected internal preset speeds.
- Selectable input control logic for Run-Up / Run-Down or Run / Direction relay control with internal preset speeds.
- MagneTek exclusive E-Reg, elevator velocity regulator
- Simplified analog or serial link Pre-Torque operation to prevent roll-back on starts
- Controlled Current Ramp-Down to prevent elevator brake thumping at stops
- Internal frequency notch filter to reject rope resonance interference.
- Closed loop motor field current regulator with simplified motor field weakening and stand-by adjustments
- Maintainance Armature Voltage Feedback mode.
- User selectable choices for relay logic output, including:
- Drive OK / No Faults relay
- Invert/Noninvert Alarms Relay
- Drive operating, OK to release brake
- Car above/below speed X threshold
- Car above/below Zero speed threshold
- Car Moving Up
- Car Moving Down
- Speed Error above/below X threshold for Y seconds.
- Drive Standby Power Reduction
- User selectable analog diagnostic trace outputs
- Diagnostic indicator for verifying logic input and output conditions
- Analog speed reference zero adjustment
- Alarm Relay to indicate important but non-critical conditions
- Motor or transformer thermostat over-temperature
- Motor Over-Load
- Drive Over-Heating
- Low Utility Line Input
- Safety related fault trapping with diagnostics, including:
- Motor Over-Current
- Motor field Malfunction
- Contactor Failure
- Severe Utility Line disturbances
- Encoder Loss
- Over-Speed Trip
- User selectable automatic or external commanded Fault Reset
- New features have been arranged to be compatible with present installations of DSD 412 using General Elevator software SA274. The factory default settings of software SA407 are such that it will act like SA274 software. The user must consciously re-program one or more selectable features to do otherwise.
- Several new useful features have been added for SA407, plus more diagnostic codes to help pinpoint the cause of problems when things go wrong during commissioning. See the appropriate sections for explanations of Anti-RollBack, Brake Control, Drive Standby Power Reduction, and operation with a Uni-Polar Analog reference. Ramp rates 3 are now activated by external logic command at A1TB1-10.

Motor Field Current Control

Motor field current is held at Stand-By amps function 53 when the elevator is idle. When the Drive Enable command is given, field current will rise as fast as possible to the level programmed in function 50. The drive will not allow a drive start to occur until motor field current rises above the threshold level set at function 32. At high speed, the motor field current will automatically weaken to the level set at function 49. If the field current feedback fails to track the field current reference by more than 5% for 5 seconds Fault ‘413’ will be declared. The universal motor field control module supplied with DSD 412 can operate motor fields from 0.2 through 40.0 ADC.

There are connection provisions for using a user supplied voltage source.

Analog Velocity Follower

The elevator car controller provides an analog velocity reference to the drive at A1TB1-63 and A1TB1-68. The signal may be bi-polar +/-10 VDC to indicate speed and travel direction, or a positive only unipolar signal with the direction of travel selected by logic commands. See descriptions of function 110 and function 115. In most cases the signal profile will be adjusted by the car controller for precise landing positioning. The velocity reference passes directly to the E-Reg closed loop velocity controller, except for an internal rate limiter function 21 to buffer any unexpected electrical noise. Start and Stop commands are via 24VDC logic inputs. The analog velocity reference signal may be adjusted using function 82 'Gain' or function 86 'Bias'.

Internal Preset Speed & Profile Generator

The elevator car controller provides 24VDC logic input commands to select one of 7 pre-determined running speeds. The DSD 412 drive generates a smooth S-Curve acceleration profile to transition between speed selections. Either of three separately adjustable ramp times may be selected. The direction of travel may be determined by either a single (up/dn) or dual (Run-Up / Run-Dn) logic commands. There are provisions for allowing or disallowing non-stop direction reversals. The internal pre-set speed-operating mode is selected by setting #110 to 2. The speed sensitivity of pre-set speeds is altered by #82. Set #82 to 1.00 for proper calibration.

Serial Link Follower

The elevator car controller provides the equivalent of an analog reference command over a digital serial link. The drive returns operating status conditions and messages. Primary Start and Stop commands are 24VDC logic for redundant safety. This operating mode is selected by setting #110 to 3. The speed sensitivity of the serial velocity reference may be adjusted using function 82.

Maintainance mode - Armature Voltage Feedback

A DC motor with rated field current applied will produce rated armature voltage when spinning at rated speed. This will result in speed regulation in the range of 5%. When in this mode, operation over base speed will not be possible as the field weakening is inhibited. When this mode is enabled it will still be possible to monitor the feedback from the encoder although it will not used for speed regulation. Due to the nature of this mode of operation the speed regulator gain will be defaulted at 2 radians to prevent unstable operation (it shouldn't require to be changed from this point). A new parameter F#38 was added for this purpose so it won't be required to modify the normal speed regulator gains F#39 and #40, when it switched. See descriptions for functions 112 and 113 for setting this mode.

Pre-Torque

When enabled by function 114, the speed error integrator will be pre-conditioned by the supplied pre-torque signal before starting E-Reg. This will cause motor armature current to begin at a magnitude proportional to the pre-torque command to prevent elevator motion or rollback when the elevator brake is released. The pre-torque signal will be from either an analog or serial link digital source as selected by software Mode switch function 110.

Current Ramp-Down

When the DSD 412 drive is told to cease operation by removal of the Run logic command, (and after Brake Drop time if that function is engaged) the armature current reference ramps down to zero at a constant rate controlled by function 85. When armature current ramp-down is complete, the contactor will be opened. In the event that the contactor opens unexpectedly, as reported by the feedback contact at A1TB1-7, or in the event of a severe drive fault, there will be no timed delay for current ramp-down.

Electronic Motor Over-Load

An electronic motor over-load function is provided to take the place of heater type power components. Motor armature current is continuously monitored and the heating effect is calculated over time. A motor overload trip will not automatically stop the drive, but is an important alarm signal to elevator car controller to help prevent equipment damage.

External/Auto Fault Reset

An external Fault Reset command signal from the car controller may be applied to logic input A1TB1-49. Or, an automatic Fault Reset will occur 5 seconds after a drive fault occurs, if enabled by function 101. This will enable the car controller to quickly recover from a re-settable fault. One Fault will be subtracted from a fault count accumulation every 20 minutes. The maximum number of Auto-Resets that can be accumulated is 5. The Auto-Reset function will then require manual intervention.

Over-Speed Test

Two adjustment functions are provided to help testing of the elevator governor over-speed trip. Function 81 defines a reference multiplier value. Logic function 80 turns the effect of that multiplier on and off. However, be aware that the Drive Over-Speed trip fault F97, set by function 12, is a fixed percent of rated rpm and will also be tested, and indeed should trip. To ensure that the drive Over-Speed Trip does not interfere with the governor test, one must temporarily raise the value set in function 12 to be above the trip speed of the governor.

Anti-Rollback (ARB)

When enabled, the drive will utilize a position / velocity regulator to combat elevator rollback on starting and during re-leveling. See descriptions for functions 130 through 133.

Drive Standby Power Reduction (DSPR)

Drive turns off 3-phase power to the transformer during periods of non-use to save energy. See descriptions functions 88 and 184.

Brake Control Logic

Two programmable logic outputs control external power relays. The Brake Lift output will indicate when the drive is holding the car and the elevator brake should be released (lifted and held). The timed Brake Pick output is intended to assist lifting of the brake. Removal of the drive Run logic command will cause the drive to go to zero speed and hold the car for an adjustable time while the brake is dropped (set). Motor current ramp-down will be delayed until after the brake has dropped. See descriptions for adjustments #89, 90, 91, & 92.

Adjustment Function Descriptions

Function # 1
Current Limit
Units: %
Range: 0.0 – 300.0
Default: 250.
This entry sets the positive and negative current limit for the drive. Set as a percent of Rated Armature Amps (Function 3).

Function # 2
Use Self-Tune
Units: Logic
Range: 0 (Off) – 1 (On)
Default: 0 (OFF)
This entry selects the source of critical numeric value adjustments for tuning the motor armature current regulator. Values for motor resistance, R, motor inductance, L, and motor field time constant L/R may come from either manually entered values or automatically determined by a self-tune measurement. With function 2 set to 0, OFF, the settings of functions 4, 6, and 51 will be used. With function 2 set to 1, ON, the values determined by self-tuning and held at display locations 613, 614, and 615 will be automatically used.
Note: Setting this function to a 1 will *not change the values stored in function 4, 6, or 51.*

Function # 3
Rated Arm I
Units: ADC
Range: 2.0 - 1250.0
Default: 50.0
This entry is specified by the motor nameplate or "Rated Run Current" amps, for the motor used with the drive.

Function # 4
Armature Ohms
Units: OHM
Range: 0.001 – 5.000
Default: 0.1
The total armature circuit resistance. The value to be entered is best measured by monitoring MEASURED_R, F613 after the SELF-TUNE function has been completed. This value is used to calculate armature current regulator gains and to calculate motor CEMF.

Function # 6
Armature Inductance
Units: HNY
Range: 0.001 – 1.0000
Default: 0.01
This is the value of the motor circuit inductance. If a ripple filter is being used, the value entered should include effects of the ripple filter. The value to be entered is best measured by monitoring F614 - Measured Motor Circuit Inductance, after the SELF-TUNE function has been completed. This value is used to calculate armature current regulator gains.

Function # 7
Rated Arm V
Units: VDC
Range: 150. – 550.
Default: 240
This entry sets the motor nameplate full load, full speed voltage required by the motor used with the drive. It should agree with the motor nameplate VFL

Function # 8
I Reg Crossover
Units: RAD
Range: 100. – 1000.
Default: 500.
This entry sets the bandwidth of the current regulator in radians. The nominal setting for this entry for most cases would be 250 radians. The responsiveness of the armature current regulator will increase as this number increases. If this number is too large, the motor current may fluctuate. If this number is too small, the motor response may become sluggish.

Function # 9
Nom AC Voltage
Units: VAC
Range: 150. – 525.
Default: 230
This entry sets the nominal AC line to line voltage applied to the drive from the secondary of the isolation transformer. This value should agree with the transformer nameplate value as adjusted by any +/- primary taps, within ±5 volts. This value sets the Low Line and Excessive CEMF detection thresholds.

Function # 10
Encoder P/R
Units: P/R
Range: 600. – 19,999.
Default: 1024.
This entry sets the per channel pulses per revolution per the encoder nameplate.

Function # 11
Motor RPM
Units: RPM
Range: 50.0 – 1999.0
Default: 1150
This entry sets the motor speed at rated elevator contract speed. The motor RPM X Encoder PPR X Encoder/Motor Ratio is what will actually be speed regulated. May be used to compensate for minor sheave diameter variations. Adjust this setting to obtain the correct linear speed at 1.0 per unit velocity reference.

Function # 12
Overspeed %
Units: %
Range: 0.0 – 150.0
Default: 110.0
This entry sets the positive and negative overspeed trip point of the motor used on the drive. If the motor speed exceeds this value, the drive will fault. This value is entered as a percent of rated motor speed (RPM).

Function # 14
Volt Sense %
Units: %
Range: 0.0 – 100.0
Default: 25.0
This entry sets the minimum armature voltage where the tach loss and reverse tach functions will become operative. This parameter prevents nuisance tach faults at low speeds and high torque loads. For example, if the rated motor armature voltage is 500 Vdc and this input is set at 10%, the tach loss function will become operative only when the armature voltage is above 50 Vdc. This numeric input adjusts the tach loss sensing function ability to ignore motor IR drop.

Function # 15
Tach Sense %
Units: %
Range: 0.0 - 100.0
Default: 5.0
This entry sets the percentage of tach feedback below which a tach loss will be declared. But this alone will not result in a tach loss fault being declared. Thus, a tach loss will be declared when the per unit armature voltage is above the level that is the sum of function 14 VOLT SENSE %, and function 15, TACH SENSE % and the per unit tach feedback is less than the value entered for TACH SENSE %. For example, for default values of 25%, for function 14 and 5%, for function15, a Tach Loss will be declared when motor voltage is above 30% (25+5) and the encoder speed feedback indicates less than 5% speed.

Function # 16
Encoder/Motor Ratio
Units: -
Range: 1.000 - 19.000
Default: 1.000
This is the ratio of encoder RPM to motor RPM. If friction wheel drive is utilized for the encoder, the motor sheave diameter divided by the tach wheel diameter should be entered here. This value will multiply the encoder pulses per revolution to obtain proper motor rpm speed feedback information and regulation. If the encoder is direct coupled to the motor shaft, this function must be set to a value of 1.0.

Function # 17
Rated Car Speed
Units: -
Range: 1.0 – 1,900.0
Default: 400.0
This entry sets the calibration factor for internal pre-set speeds and car speed display via function function 600. The units may be ft/min or m/sec or cm/sec as determined by the user. However the units used for this parameter must also be used to set all other pre-set speeds. When the motor is turning at rated speed in RPM as programmed in function 11, then function 600 will display the number in programmed 17.

Function # 21
External Accel Limit
Units: ***
Range: 2.00 – 10.00
Default: 4.20
This is the maximum acceleration rate for the elevator when an external analog or serial link speed reference is used. This function provides a slew rate limit in the event of noise or other discontinuity on the externally supplied reference signal. *This entry must be set higher than that of the incoming speed dictation ramp, or the elevator speed will not track the desired reference velocity.*
*** The units will be distance/SEC^2, where distance uses the same units as function 17.

Function # 22
Error List Reset
Units: Logic
Range: 0 (Off) - 1 (On)
Default: 0
This entry resets the F800 error list, removing all faults on the list. This may be used to clear out old data to begin capturing a fresh record.

Function # 32
Full Field Detect
Units: % (of #50)
Range: 30. - 90.
Default: 80.
This entry sets the threshold for sensing a motor-field-at-full-amps condition. The motor field must be above (function 50) X (function 32) for internal logic to recognize that the motor field current is nearly up to the full field value. Motor field current must be above this value before the drive will be allowed to start. If told to start prematurely, the drive will wait for motor field to rise above this value before picking the loop contactor.

Function # 38
Armature Voltage Bandwidth
Units: RAD
Range: 1.0 – 4.0
Default: 2.0
This entry sets the bandwidth when operating in the Armature Voltage Feedback Mode. This parameter is engaged when function 112 = 0.

Function # 39
High Speed Bandwidth
Units: RAD
Range: 1.0 – 15.0
Default: 6.0
This entry sets the closed loop bandwidth response of the velocity regulator at speeds above the setpoint identified in #105. The tracking delay between the speed dictation ramp and the actual motor speed during the linear portion of the acceleration or deceleration ramp will be 1/(function 40) seconds. A setting lower than that of function 40 is useful to suppress rope vibration effects at high speed. This simplified adjustment takes the place of the 'Gain Reduce' function supplied in earlier versions software.

Function # 40
Low Speed Bandwidth
Units: RAD
Range: 1.0 – 15.0
Default: 6.0
This entry sets the closed loop bandwidth response of the velocity regulator at speeds below the setpoint identified in function 105. The tracking delay between the speed dictation ramp and the actual motor speed during the linear portion of the acceleration or deceleration ramp will be 1/(function 40) seconds. *Increasing the value of Function 40 will make the drive more responsive, but may also cause unwanted amplification of mechanical vibration or rope resonance.*

Function # 41
Per-Unit Inertia
Units: SEC
Range: 0.10 – 9.99
Default: 2.00
This value is the ratio of the effective inertia of the moving elevator system mass to the rated torque strength of the motor. The units, seconds, would be the time it would take to accelerate the elevator inertia to rated speed using rated motor amps. This value affects the feed-forward gain of the velocity regulator and affects how well it will follow a changing reference speed

Function # 42
Stiffness
Units: —
Range: 0.2 – 9.9
Default: 1.0
This setting affects the proportional gain and Phase Margin of the regulator. Increasing this setting will make the regulator more responsive to correct mechanical load speed variances, but can cause it to amplify

unwanted mechanical disturbances. Reducing the setting value will provide smoother operation but at the expense of time-delayed reaction to velocity errors, particularly noticeable when re-leveling.

Function # 49
Weak Field Current
Units: ADC
Range: 0.2 – 40.0
Default: 40.0
This input is the motor field current the drive should provide at rated motor RPM. Set this value to produce rated motor CEMF (no load voltage) at rated top speed. NOTE: Motor field current will not exceed the setting of function 50. Setting or leaving this value at default simply means that the field will not weaken at high speeds.

Function # 50
Rated/Full Field Current
Units: ADC
Range: 0.20 – 40.00
Default: 1.9
This is the motor field current amperes the drive should provide when starting and at low speed. It should agree with Rated / Full / or Forcing Motor Field Current per the motor nameplate.

Function # 51
Field L/R
Units: SEC
Range: 0.10 – 10.00
Default: 0.54
This is the Motor Field time constant, L/R. It is an important value to determine motor field current regulator gains. See function 615 after performing the Self-Tune.procedure

Function # 52
Rated Field Vdc
Units: VDC
Range: 50 – 525
Default: 240
This is the Rated Field Voltage necessary to produce Full field amps function 50. It is used to calculate motor field circuit resistance and determine motor field current regulator gains. Improper adjustment can affect stability.

Function # 53
Standby Field Current
Units: %
Range: 10 - 100
Default: 25
This percent of the full field current amperes that the drive should provide when the elevator system is at rest (i.e. no Run command or Field Enable command received).

Function # 54
Field Response
Units: RAD
Range: 1.0 – 10.0
Default: 5.0
This input defines the desired motor field current regulator bandwidth in radians per second.

Function # 55
Field Source Volts AC
Units: VAC
Range 0. – 525.
Default: 0
This is the single-phase AC voltage used to power the Field Rectifier module. The factory default value of zero will let the drive automatically select the same value as supplied for the nominal AC voltage as set by function 9. This conforms to factory supplied wiring supplied at AC1 and AC2 on the field interface PCB. Set this only if an external transformer is used to supply a different voltage to power the motor field circuit, set this value to the nominal Vac provided at terminals AC1 and AC2.

Function # 63
U/D Bit Pickup
Units: % (of rated speed)
Range: 0.01 – 100.00
Default: 0.1
This entry defines the zero speed threshold for detection of motion via encoder measurement. It controls the Moving-Up/Down, & Zero Speed detector output signals, and determines when ARB will be turned back ON if function 130 is set to 2.

Function #64
Low Speed Threshold
Units: %
Range: 0.1 – 100.0
Default: 2.0
This entry sets the speed threshold where the At-Low-Speed indicator will turn ON and OFF. This can be used to indicate when the elevator is moving below the door pre-opening speed. See programmable output function F or M at functions 183 through 187. The adjustment value is percent of rated maximum speed as set by function 17. Hysteresis is 5% of the set value.

Function # 80
Over-Speed Test
Units: LOGIC
Range: 0 (Off) – 1 (On)
Default: 0 (OFF)
This is a logic input that is used to activate an over-speed multiplier value, (function 81). When running the test increase F#12 to prevent the drive from faulting on Overspeed (Fault 97).

Function # 81
Over-Speed Mult
Units: —
Range: 1.00 – 1.50
Default: 1.00
This is the value of speed reference multiplier that will be used to run an elevator over-speed test when function 80 is ON. This function also multiplies function 82.

Function # 82
Reference Multiplier
Units: —
Range: 0.500 – 2.000
Default: 1.000
This value is a multiplier for external analog or serial link velocity references. It may be used to adjust the actual calibration of the reference signals or to cause the elevator to run at a different speed from a +/-10 volt analog or other full-scale serial reference command. The elevator will run at Rated Speed (function 11 and function 17) from an analog reference of 10V, when function 82 is set to 1.000, and function 80 is 'OFF'.

Function # 83
Motor Ovld Tout
Units: SEC Range: 2.0 – 500.0
Default: 48.0
This value shapes the motor overload time-out curve.

Function # 84
Motor Overload Level
Units: PU
Range: 0.50 – 2.00
Default: 1.15
This value sets the threshold level where the motor overload function will begin to operate. Sustained motor current above this value will eventually cause an overload trip according to the time set in #83.

Function # 85
I Decay Ramp
Units: SEC
Range: 0.01 – 2.500
Default: 0.200
This value controls the rate of decay of motor armature current during normal elevator stops. This helps to prevent brake 'thumping' when the drive is shut down and the brake is required to hold the car. The drive Run logic command must remain active until the elevator comes to a stop and the mechanical brake is set. Armature current ramp-down will begin after the RUN command is removed from the drive. When the ramp-down is complete, the contactor will be told to open. NOTE: The Drive Enable command must remain ON and the elevator Safety-Chain must remain closed until after the contactor actually opens for this feature to work properly.

Function # 86
Analog Speed Ref Zero
Units: PU
Range: -0.02 – 0.02
Default: 0.00
At zero speed if the motor is creeping it may be necessary to adjust this parameter to compensate. Adjust this parameter until motion is stopped at zero speed. After adjusting the low end of the profile it may also be necessary to adjust the reference at the top end of the profile. Refer to function 82 to set the speed reference gain.

Function # 87
Pre-Torque Mult
Units: -
Range: 0.25 - 2.00
Default: 1.00
This value multiplies the available pre-torque reference signal for calibration adjustment. If this is set to 1.0, a +/-10V analog signal or full-scale serial link signal will cause 1 per unit (rated) armature current pre-torque level.

Function #88
DSPR Delay Time
Units: MIN
Range: 0 – 60 Minutes
Default: 0 (Disabled).
Determines the power OFF delay time for DSPR. If set to zero (0), DSPR will be disabled. Power will then remain ON at all times.

Function #89
Brake Pick Timer
Units: SEC
Range: 0.5 – 5.0 Seconds
Default: 1.0
Adjusts the ON time for the Brake Pick relay to be energized each time elevator brake lift should be started. The internal velocity reference will remain at zero during the Brake Pick time. Set to the actual time to complete lifting of the brake to prevent pulling through the brake during an elevator start.

Function #90
Brake Drop Timer
Units: SEC
Range: 0.5 – 5.0 Seconds
Default: 1.5
The time for the elevator brake to drop and set when de-energized by the Lift and Pick relays. Adjusts the time for the drive to keep holding the car at zero velocity while the brake drops.

Function #91
Must Stop Timer
Units: SEC
Range 0.1 – 5.0 Seconds
Default: 2.0
Used only when elevator brake control is engaged. Establishes a limit on how long the drive may continue to run after the Run command logic line is released. This is a back-up means to cause the drive to stop in case zero speed is not achieved for any reason.

Function #92
Brake Auto Stop ON
Units: Logic
Range: 0 (Off) – 1 (On)
Default: 0
When ON, causes the controlled stop and Brake sequence to commence when the speed reference is set to zero...OR when the hardware Run logic input is de-energized. A brake function output must also be enabled.

Function #93
Analog Out 0 Bias
Units: PU
Range: -1.0 to +1.0
Default: 0.0
Provides an offset adjustment for analog output channel 0.

Function #94
Analog Out 1 Bias
Units: PU
Range: -1.0 to +1.0
Default: 0.0
Provides an offset adjustment for analog output channel 0.

Function # 95
Analog Output 0
Units: Logic
Range: 0 - 8
Default: 1
Sets the specific analog output signal to be observed at TB1-45 and TP41. Selections are:
0 = Trace Buffer 0
1 = Raw Speed Command
2 = Ramped Speed command
3 = Encoder Feedback
4 = Armature Current Reference
5 = Measured Armature Current
6 = Measured Armature Voltage
7 = Field current Reference
8 = Measured Field Current
The voltage measured will be a function of the operating level of the parameter being displayed and the signal multiplier function 97. Signal range is limited to and will saturate at ±10V.

Function # 96
Analog Output 1
Units: Logic
Range 0 - 8
Default: 3
This entry sets the specific analog output signal to be observed at TB1-46 and TP44. Selections are:
0 = Calculated CEMF
1 = Raw Speed Command
2 = Ramped Speed command
3 = Encoder Feedback
4 = Armature Current Reference
5 = Measured Armature Current
6 = Measured Armature Voltage
7 = Field current Reference
8 = Measured Field Current
The voltage measured will be a function of the operating level of the parameter being displayed and the signal multiplier function 98. Signal range is limited to and will saturate at ±10V.

Function # 97
Analog Out 0 Multiplier
Units: PU
Range: 0.10 – 10.00
Default: 0.80
This entry sets the specific multiplier value for Analog Output #0. A value of 0.8 will set 8.0 volts of output for a 1 per unit signal, with some headroom to show over-scale.

Function # 98
Analog Out 1 Multiplier
Units: PU
Range: 0.10 – 10.0
Default: 0.80
This entry sets the specific multiplier value for Analog Output #1. A value of 0.8 will set 8.0 volts of output for a 1 per unit signal, with some headroom to show over-scale.

Function # 99
Speed Error Trip Time
Units: SEC
Range: 0.20 – 5.00
Default: 5.00
This value sets the time sensitivity of the Speed Error Trip detection function. Speed errors larger than function 100, for longer than function 99 seconds will cause a Speed Error Trip and automatic drive shut down with Fault F410.

Function # 100
Speed Error Trip Threshold
Units: %
Range 0.0 - 100.0
Default: 100.0
This value sets the magnitude sensitivity of the Speed Error Trip detection function. Speed errors larger than function 100, for longer than function 99 seconds will cause a Speed Error Trip and automatic drive shut down with Fault F410.

Function # 101
Auto Fault Reset
Units: Logic
Range: 0 (Off) - 1 (On)
Default: 0 (Off)
This function allows the Drive to automatically reset drive faults that caused a shutdown without an external Fault Reset command. When turned ON, the drive will attempt an automatic fault reset 5 seconds after the fault occurs. If successful, the drive may then be restarted. This feature is made inoperable by setting function 101 to 0 (off).
Note: A Fault count total is accumulated. One fault count is removed from the total every 20 minutes. An accumulation of 5 counted faults will cause fault 411 Maximum Resets Attempted and the need for a manual reset for continued operation.

Function # 102
3 Second Loop Fault
Units: Logic
Range: 0 (Off) – 1 (On)
Default: 0 (Off)
This function selects the detection time for loop contactor faults. These occur when the contactor acknowledge feedback contact fails to open or close according to the commanded state of the contactor coil driver. Small contactors should operate within 450 milliseconds and should use the default value, 0, or OFF. If large contactors are used with large hp drives, set this value to ON to yield a 3 second fault detection time.

Function # 104
Serial Gain Switch
Units: Logic
Range: 0 (Off) – 1 (On)
Default: 1(On)
This function selects the source of the gain switch control to be from local or serial link commands. If an analog reference velocity or

pre-set speed selects are used, set this value to 0, off. If a gain switch will be from the serial link, set this value to 1, ON. [function 104 on and function 110 set for analog or pre-set speeds results in no gain switching.]

Function # 105
Gain Switch Speed
Units: PU
Range: 0.00 – 1.10
Default: 1.10
This function is only used if function 104 is off. The value determines the speed where velocity regulator gain is switched. If the speed reference is below the value of function 105, the closed loop gain will correspond to that set by function 40. If the speed reference value is above set point function 105, then closed loop bandwidth will be as set in function 39.

Function # 107
Tach Rate Gain
Units: %
Range: 0.00 - 30.00
Default: 0.00
This value adjusts the gain of differential encoder/tach rate feedback. It can be useful to help attenuate vibration and rope resonance effects. Disable this function by setting the value to zero. If using this feature, keep the setting as low as possible consistent with good operation.

Function #110
Reference Mode Select
Units: Logic
Range: 1 - 4
Default: 2
This function allows the user to select the source of the velocity reference signal.
Setting this value to 1 enables the drive to follow the magnitude and direction polarity of an external analog reference, and external ramp/slew limit rates function 21.
Setting this value to 2 (default) enables the 1 of 7 internal pre-set speed selects via function 151 through 157 (preset speeds) and function 170 through 181 (accel/decel, jerk rates). See also function 115 for direction control and function 150 for speed selects.
Setting this value to 3 enables serial link control of the velocity reference, and external ramp/slew limits rates of function 21.
Setting this value to 4 enables a uni-polar analog reference to be used with external direction logic commands. External ramp/slew limit rates of #21 will also be used.

Function #111
Arched Travel Disable (Jerk Abort)
Units: Logic
Range: 0 (Off) – 1 (On)
Default: 1 (On)
Previously named Jerk Abort Enable. When ON, changing the speed reference to a value less than or equal the actual speed will cause the S-Curve reference generator to immediately stop acceleration, and begin to decel if appropriate. When OFF, changing the reference to a lower speed will cause a jerk-out (of any existing accel) and jerk-in to a decel sequence. If done while accelerating, Arched Travel will be the result.

Function #112
Encoder Feedback Enable
Units: NUM
Range: 0 (Off) – 1 (On)
Default: 1 (On)
Setting this value to 0, off, enables the Armature Voltage Feedback Mode to operate. This parameter must be set to 1 for normal operation of the drive. When in this mode the encoder feedback monitor function 601 will still be active to allow for troubleshooting, however this signal will not affect speed regulation. This mode is intended for maintainance and troubleshooting only.

Function #113
Armature Voltage @ Max Speed
Units: VDC
Range: 0 - 650
Default: 100
This parameter will control the speed which the motor will reach when operating in the Armature Voltage Feedback Maintainance Mode. The theory would be that the motor will operate up to this level of VDC if given a 100% speed command. The speed can be increased or decreased by either raising (Increase Speed) or lowering (Decrease Speed) this number or reducing (Increase Speed) or increasing (Decrease Speed) function 50 'Rated Field Current'.

Function #114
Pre-Torque Enable
Units: logic
Range: 0 (Off) – 1 (On)
Default: 0 (Off)
Setting this value to 1, on, enables the pre-torque function to operate. The pre-torque value from the analog pre-torque input will be multiplied by function 87 and used to pre-stress the velocity error integrator to that armature current per unit value upon starting. If function 110 is set to 3 for serial link control, the pre-torque reference input will be from the serial link message. The adjusted pre-torque value used at the start of an elevator run may be viewed during the run via function 603...If pre-torque is not used, leave this function set to 0, 'OFF'.

Function #115
Run-Up/Run-Down Select
Units: logic
Range 0 (Off) – 1 (On)
Default: 0 (Off)
This function selects how the drive will determine the RUN Direction when REF-MODE function 110 is set for internal pre-set speeds. When this is set to 0 (OFF) 24V relay logic input A1TB1-8 will be a Hardware RUN command. A1TB1-50 will be the UP (Logic low or OFF), or Down (+24V or ON) command. When this is set to 1 (ON) 24 V relay logic input at A1TB1-8 will be a Run-Up command A1TB1-50 will be a Run-Down command. If REF-MODE function 110 is set to 1 or 3 for following bi-directional external analog or serial link velocity commands, the polarity of that signal will always be followed. In that case, either A1TB1-8 or A1TB1-50 may be used as a Hardware Run command input (but not both).

Function #116
Decel Rate Latch
Units: logic
Range 0 (Off) – 1 (On)
Default: 0 (Off)
When set, this control bit causes the decel ramp rate active at the start of decel to remain in effect until the decel sequence is completed. This function will momentarily override logic input commands at A1TB1-10 and A1TB1-51.

Function #120
Speed Error Detect
Units: SEC
Range: 0.0 – 5.0
Default: 0.5
This value sets the time sensitivity of the Speed- Error-is-Low detector. This is a useful indicator to tell when/if the drive is following the velocity reference properly. Exceeding the set limits of this detector does not shut the drive down. The detector results can be sent to a logic output. See also, function 99, 100, 121 and the description of logic outputs 183 through 187.

Function #121
Speed Error Threshold
Units: %
Range: 0.0 – 15.0
Default: 2.0
See function 120. This value sets the magnitude sensitivity of the Speed-Error-is-Low Detector. Units are a percent of rated speed function 17.

Function #130
ARB Mode
Units: -
Range: 0 – 2
Default: 0
This selects between 3 possible Anti-Rollback operating modes.
"0" to disable all Anti-Rollback features. Only E-Reg will be engaged
"1" to enable Anti-Rollback when the drive is started.
"2" to enable Anti-Rollback when starting the drive and when the velocity again comes to a stop at the next landing.

Function #131
ARB Bandwidth
Units: RAD
Range: 1 – 30
Default 6.
Determines the gain of the velocity and position regulator when ARB is ON. This is the unity gain crossover frequency in Radians/sec. Increasing this setting will cause the position loop to respond faster with less accumulated position error.

Function #132
ARB Damping
Units: -
Range: 0.1 – 10
Default: 2.0
Adjusts damping of the position regulator when ARB is ON. Increasing this setting will cause a smoother but slower recovery of position error. Reducing this setting will let ARB recover a position error more quickly and abruptly.

Function #133
ARB Speed Threshold
Units: %
Range: 0.0 – 10% (of rated speed)
Default: 0.0%
Determines the reference speed where ARB will be turned OFF and E-Reg will be engaged when the drive is started, if function 130 is set to 1 or 2. This setting should be as low as possible to prevent regulator transfer bumps when starting, but it must be set high enough to remain engaged during re-leveling or to ignore a small analog zero reference offset when using an external analog signal reference.

Function #150
Binary/Progressive Pre-Set Speed Select
Units: logic
Max: 1 (BINARY)
Min: 0 (PROGRESSIVE)
Default: 1 (BINARY)
Determines the method for selecting pre-set speeds from external relay logic applied to A1TB1-11, 12, 52, 53 and 54)

Function #151 through #157
Pre-Set Speeds 1 through 7
Units: -
Range: 0.0 – 1900.0
Default: 0.0
These function values specify the elevator car speed for each individual pre-set speed setting. The units must agree with that set for Rated Car Speed in function 17. [If feet per minute is used at function 17, then the units for function 151through 157 shall also be feet per minute.] No value for function 151through 157 should be larger than that for function 17. All values are positive numbers. The selected reference speed and direction will be determined by the setting of function 110, 115, 150, and 24V relay logic inputs. It is certainly possible to connect the selection of one or more pre-set speed logic input control lines to also activate a different Ramp Rate #2 or #3. See also the Decel Rate Latch, function 116. With careful thinking, one can obtain many specific combinations of pre-set speeds and Ramp Rates with a minimum of relay contacts.

Note 1: Switch select inputs S0-S4 are 24V logic input signals available on A1TB1 with the following assignments:
S0 = A1TB1-11
S1 = A1TB1-53
S2 = A1TB1-12
S3 =A1 TB1-54
S4 = A1TB1-52

Note 2: For S0 – S4...
+18 - 24VDC (ON) = 1
<5VDC (OFF) = 0

Note 3: Connecting A1TB1-10 to A1TB1-11 will automatically select Ramp #3 with selection of pre-set speed #1.

BINARY Preset Speed Operation
(#150) = 1 = ON

S4	S3	S2	S1	S0	SPD #	ADJ (#nn)
X	X	0	0	0	ZERO	NONE
X	X	0	0	1	1	(151)
X	X	0	1	0	2	(152)
X	X	0	1	1	3	(153)
X	X	1	0	0	4	(154)
X	X	1	0	1	5	(155)
X	X	1	1	0	6	(156)
X	X	1	1	1	7	(157)

Table 5: Binary Preset Speed Select

PROGRESSIVE Preset Speeds
(#150) = 0 = OFF

S4	S3	S2	S1	S0	SPD #	ADJ (#nn)
0	0	0	0	0	ZERO	NONE
0	0	0	0	1	1	(151)
0	0	0	1	0	2	(152)
0	0	1	1	0	3	(153)
0	1	1	1	0	4	(154)
1	1	1	1	0	5	(155)

Table 6: Progressive Preset Speed Operation

Note 4: When Progressive Speed Select mode is used, any combination of S0-S4 not shown in Table will result in zero speed being selected.

Note 5. When Reference Mode Select (function 110) is set for Analog or Serial velocity reference control, inputs S0-S4 have no affect.

Function #170
Accel #1 Time
Units: SEC
Range: 0.50 – 15.0
Default: 5.00
Total acceleration time in seconds for S-curve ramp #1 to occur from zero speed to rated elevator speed. Effective only when internal pre-set speeds are used.

Function #171
Accel #2 Time
Units: SEC
Range: 0.50 – 15.0
Default: 5.00
Total acceleration time in seconds for S-curve ramp #2 to occur from zero speed to rated elevator speed. Effective only when internal pre-set speeds are used.

Function #172
Decel #1 Time
Units: SEC
Range: 0.50 – 15.0
Default: 5.00
Total deceleration time in seconds for S-curve ramp #1 to occur from rated speed to zero speed. Effective only when internal pre-set speeds are used.

Function #173
Dec #2 Time
Units: SEC
Range: 0.50 – 15.0
Default: 5.00
Total deceleration time in seconds for S-curve ramp #2 to occur from rated speed to zero speed. Effective only when internal pre-set speeds are used.

Function #174
Accel #1 %S
Units: % Range: 0.1 – 100.0
Default: 25.0
The percent of time that will be spent in the controlled jerk or S-portion of the timed ramp curve during ramped acceleration #1. A percent S of 0.1% corresponds to almost all linear acceleration. A percent S of 100% will make the S-curve #1 smooth with no linear acceleration portion. Effective only when internal pre-set speeds are used.

Function #175
Accel #2 %S
Units: %
Range: 0.1 – 100.0
Default: 25.0
The percent of time that will be spent in the controlled jerk or S-portion of the timed ramp curve during ramped acceleration #2. A percent S of 0.1% corresponds to almost all linear acceleration. A percent S of 100% will make the S-curve #1 smooth with no linear acceleration portion. Effective only when internal pre-set speeds are used.

Function #176
Decel #1 %S
Units: %
Range: 0.1 – 100.0
Default: 25.0
The percent of time that will be spent in the controlled jerk or S-portion of the timed ramp curve during ramped deceleration #1. A percent S of 0.1% corresponds to almost all linear deceleration. A percent S of 100% will make the S-curve #1 smooth but with no linear deceleration portion. Effective only when internal pre-set speeds are used.

Function #177
Decel #2 %S
Units: SEC
Range: 0.1 – 100.0
Default: 25.0
The percent of time that will be spent in the controlled jerk or S-portion of the timed ramp curve during ramped deceleration #2. A percent S of 0.1% corresponds to almost all linear deceleration. A percent S of 100% will make the S-curve #2 smooth with no linear deceleration portion. Effective only when internal pre-set speeds are used.

Function #178
Accel #3 Time
Units: SEC
Range: 0.50 – 15.00
Default 5.00
Total acceleration time in seconds for S-curve ramp #3 to occur from zero speed to rated

elevator speed. Effective only when logic input A1TB1-10 is active. Selecting this ramp rate will override Rates 1 or 2.

Function #179
Decel #3 Time
Units: SEC
Range: 0.50 – 15.00
Default 5.00
Total deceleration time in seconds for S-curve ramp #3 from rated speed to zero speed. Effective only when logic input A1TB1-10 is active. Selecting this ramp rate will override Rates 1 or 2.

Function #180
Accel #3 %S
Units: %
Range: 0.1 – 100.0
Default: 25.0
The percent of time that will be spent in the controlled jerk or S-portion of the timed ramp curve during ramped acceleration #3. A percent S of 0.1% corresponds to almost all linear acceleration. A percent S of 100% will make the S-curve #3 smooth with no linear acceleration portion.

Function #181
Decel #3 %S
Units: %
Range: 0.1 – 100.0
Default: 25.0
The percent of time that will be spent in the controlled jerk or S-portion of the timed ramp curve during ramped deceleration #3. A percent S of 0.1% corresponds to almost all linear deceleration. A percent S of 100% will make the S-curve #1 smooth with no linear deceleration portion.

Function #182
Invert Alarm Relay
Units: logic
Range: 0 (Off) – 1 (On)
Default: 0 (OFF)
Alarms are classified as non-critical faults detected by the DSD 412 that pose no immediate need to stop operation. The Alarm output relay K2 (on the Drive Control PCB, A1) is reserved for non-critical fault indications. It has a normally open contact wired to A1TB1-38 and 39). With function 182 set to 0 (OFF), the default, relay K2 will pick-up, closing the contact on the occurrence of a non-critical fault. With function 182 set to a 1 (ON), the relay will be picked-up during normal operating conditions and drop out on the occurrence of a non-critical fault or Alarm. Alarms are presently identified as drive over-temperature or thermistor failure, motor or transformer thermostat over-temperature, and motor overload trip. Other conditions may be selectable to be alarms or critical faults.

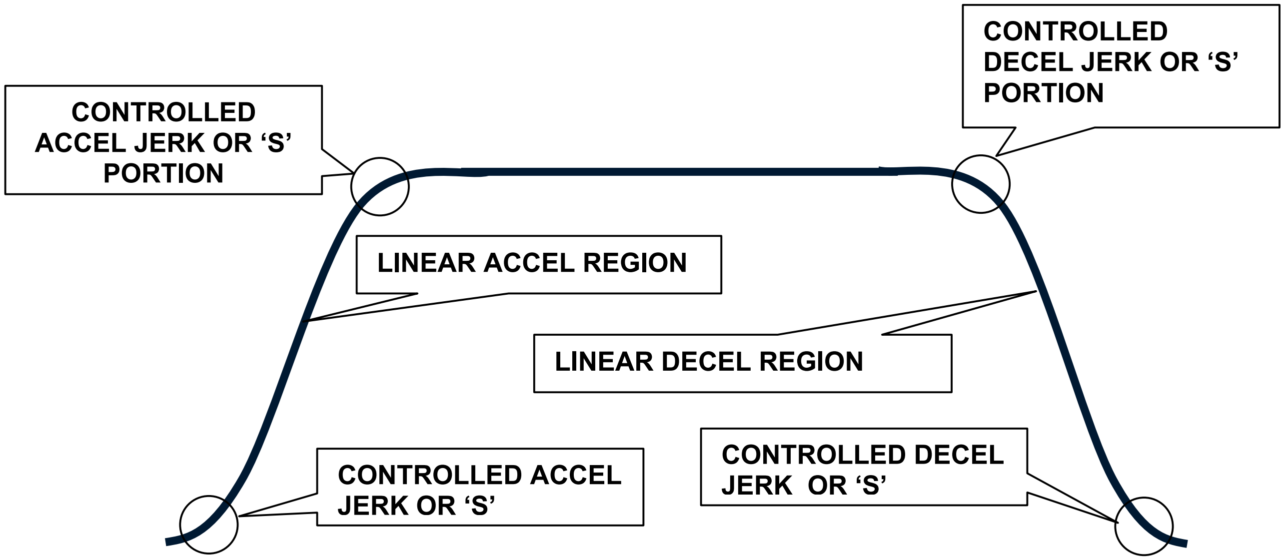


Figure 12: S-Curve Accel/Decel Cycle

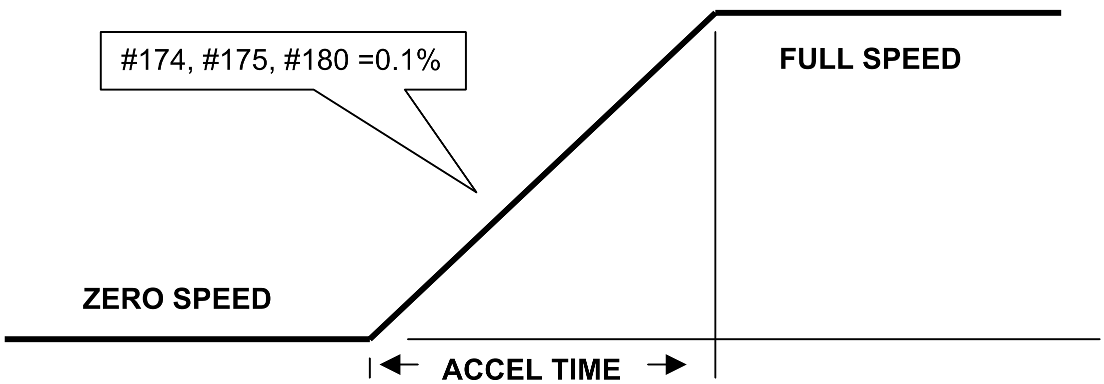


Figure 13: S-Curve Accel with min %S

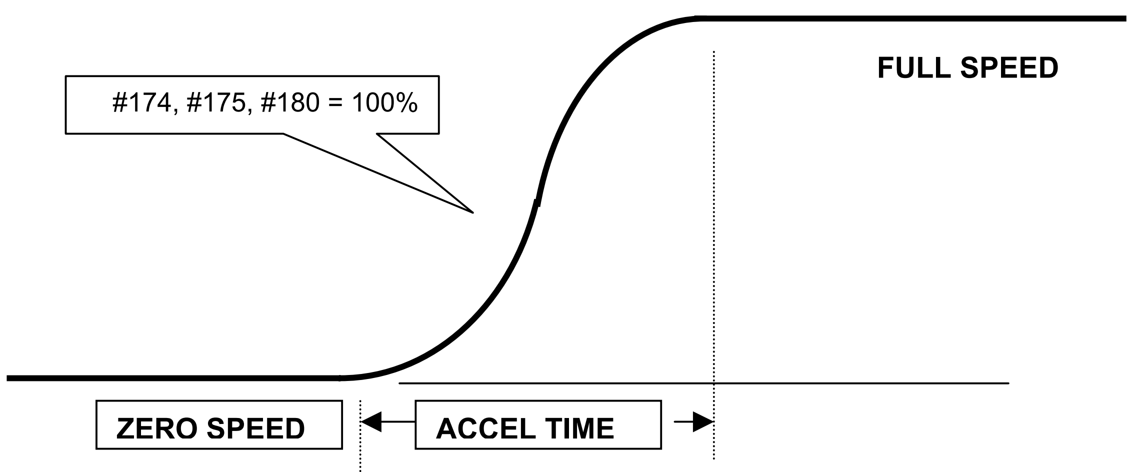


Figure 14: S-Curve with 100% S

Functions #183 - #187
Logic Output Selects

The function of relay and open-collector logic output channels, K3-K7 on the Drive Control PCB, are programmable. Each output has several choices of functions. The descriptions below identify how each option works. Table 4.2.3 identifies how to map a particular function to a particular output channel. [For example to program output K6, A1TB1-83 to indicate when the drive is at zero speed, option “J”, set function 186 to be “2”.] The factory default values (1) will program K3-K7 to the same function as older software SA274.

Logic Output Options

A – Excessive Field Current
Relay K3 is picked during normal operating conditions with N.O. contact closed. Relay K3 drops and contact opens if measured motor field current ever exceeds 125% of Rated Field current, function 50. When programmed to control output K4, the output will be active during normal operation, and become inactive if motor field current ever exceeds 125% of Rated Field current, function 50. This function can be used as a warning of a malfunction condition that could cause damage to the motor field.

B – High CEMF or Low Line
Output becomes active if motor CEMF becomes greater than 1.09 X drive VAC input, or if VAC input falls below 0.9 X Rated VAC, function 9. This is a warning indication that there may be operating or adjustment problems associated with too much CEMF or a drooping power line.

C – Run Engaged
Output becomes active when the drive speed regulator is in operation. This output is inactive during armature current ramp-down or if the contactor is open. May be used as an indication that the drive is in control and that the elevator brake may be released.

D – Moving Up
Output becomes active when encoder velocity is greater than the setting of function 63 in the UP direction. May be used to verify proper car direction.

E – Moving Down
Output becomes active when encoder velocity is greater than the setting of function 63 in the DOWN direction. May be used to verify proper car direction.

F – LOW SPEED
Output becomes active when encoder speed is less than the setting of function 64. May be used to indicate low speed for door pre-opening logic.

G – FIELD is UP
Output becomes active when motor field current has risen above the threshold value programmed in function 32, or drive is in operation. May be used to indicate when the drive Start command will function without delay.

H –SPEED ERROR is LOW
Output becomes active when Speed Error is less than function 121 for longer than function 120 seconds. May be used to indicate that the drive is correctly following the programmed velocity profile.

I – SPEED ERROR is HIGH
Output becomes active when Speed Error is greater than function 121 for longer than function 120 in seconds. May be used to indicate that the drive is not following the programmed velocity profile. This is the opposite logical state of H.

J – ZERO SPEED
Output becomes active when encoder speed is below the setting of function 63 in either direction. May be used to indicate that deceleration is complete and the brake may be set without any bumps.

K – MOVING
Output becomes active when encoder speed is greater than the setting of function 63 in either direction. This is the opposite logical state of J.

L – LIFT BRAKE
Output K6 becomes active when elevator brake should be lifted. Will de-energize when the brake should be dropped.

M – HIGH SPEED
Output becomes active when encoder speed is greater than the setting of function 64 in either direction. This is the opposite logical state of F. May be used to prevent or enable door pre-opening logic.

N – BRAKE PICK
Output K3 becomes active for time function 89 each time a Brake Lift sequence is started.

Will be de-energized when the brake should be dropped.

P – DSPR CONTROL
Output K4 is active to pull in an external power control relay when the drive is supposed to be powered up for operation. Output becomes inactive after a DSPR time delay time-out. See function 88.

	FUNCTION SELECT SETTING	1 (DEFAULT)	2	3	4
Output Circuit	A1TB1 CONNECTION	SELECTED FUNCTION			
Output K3, Controlled by Function #183 N.O. Relay	A1TB1-36&37	A	F	C	N
Output K4, Controlled by Function #184 Open Collector Type	A1TB1-78	B	A	G	P
Output K5, Controlled by Function #185 Open Collector Type	A1TB1-79	C	G	H	I
Output K6, Controlled by Function #186 Open Collector Type	A1TB1-83	D	J	K	L
Output K7, Controlled by Function #187 Open Collector Type	A1TB1-84	E	F	I	M

Table 7: Programmable Output Selections

Function #190
Notch Depth
Units: none
Range: 10 - 0
Default: 0
Controls the depth of the notch filter used for a rope resonance counter-measure. When set to zero, the filter is not active. Increase the setting toward 10 as required to suppress system resonance.

Function #191
Notch Period
Units: none
Range: 10 - 0
Default: 7
Controls the center frequency of the rope resonance notch filter. This is not a continuous adjustment as the frequency is selected in steps according to Table 8: Notch Period steps

ENTRY NUMBER	NOTCH FREQUENCY
0	100 Hz
1	50
2	33
3	25
4	20
5	17
6	14
7	12
8	11
9	10
10	9

Table 8: Notch Period steps

Function #192
F413 DETECT LVL
Units: PU
Range: 0.05 - 0.50
Default: 0.05

This parameter sets the level of difference of the field current reference and the feedback at which the drive will display the F413 warning. If all of the criteria is correct in the field circuit and in the parameter setup the F413 warning should not appear. The tracking error can be monitored on F620. If the error is out of tolerance due to low or sagging line voltage and the issue cannot be resolved increase this parameter to eliminate the warning. This level is in PU where #50 rated field amps = 1.0PU

ie. 0.05 would correlate with 5% difference between the feedback and the reference.

Display Monitor Functions

Function # 600
Car Speed
Units: -

This display is the measured velocity of the elevator. Units are as set in function 17.

Function # 601
Motor Speed
Units: RPM

This display is the measured elevator motor RPM.

Function # 602
Dictated Speed Reference
Units: -

This display is the reference velocity after accel/decel rate control conditioning. Units are as set in function 17.

Function # 603
Pre-Torque Input
Units: %

This display is the pre-torque reference as applied to starting the velocity regulator. The value is latched to display the pre-torque value used at the start of a run. Prior to a start, the displayed value is that of the analog or serial link input. This function works only when pre-torque enable control, functions 114 is turned ON. Units are a percent of Rated Motor Amps.

Function # 609
CEMF Vdc
Units: VDC

This display is the CEMF of the motor calculated from measured motor voltage, current and armature circuit resistance functions 4.

Function # 610
Motor Armature V
Units: VDC

This display is the measured voltage output to the motor armature circuit.

Function # 611
Motor Arm Current
Units: Amps DC

This display is the measured drive output to the motor armature circuit.

Function # 612
Motor Field Current
Units: Amps DC

This display is the measured motor field current.

Function # 613
Measured Motor Resistance
Units: OHMS

This is the measured motor armature circuit resistance calculated during self-tune.

Function # 614
Measured Motor Inductance
Units: HENRIES

This is the measured motor armature circuit inductance calculated during self-tune.

Function # 615
Measured Field L/R Time Constant
Units: Seconds

This is the motor field time-constant measured during self-tune.

Function # 616
Speed Error
Units: %

This displays the difference between the speed reference and speed feedback.

Function # 617
AC Line Frequency
Units: Hz

This display is the measured frequency of the 3-phase AC line.

Function # 618
Heatsink Temp
Units: C°

This display is the measured heat sink temperature of the drive in C°.

Function # 619
AC Line Voltage
Units: Volts rms Line-Line

This display is the measured 3-phase AC input line-line voltage.

Function # 620
F413 Tracking level
Units: PU

This is the difference between the Field Current reference and the Feedback. F413 warning will result if higher than F192 for 5 seconds.

Function # 621
Serial Communication Control Enabled
Units: LOGIC

This logic will be ON if RS422 (or RS232) control communications is enabled for drive control. Does not include use of PCDU.

Functions # 688-699
The following read-only values identify the drive hardware set up and control software stored in E-PROMs U13, U14, U39, & U40.

FUNCTION #	DESCR.	VALUE
688	CUBE I.D.	Table 9
689	FIELD RANGE	Table 10
690	U13/U14 "97SAXXX"	404
691	PCU RELEASE	
692	DAY	
693	MONTH	
695	YEAR	
696	BETA "P"	
697	U39/U40 "97SAXXX"	407
698	DCU - REVISION	
699	CUSTOMER VERSION I.D.	9

FIELD CURRENT RANGE (2 - 200HP)
Indicates actual SW1 setting

#689 SW1 Read-Back	Minimum Rated Field Amps DC	Maximum Rated Field Amps DC
1	0.2	1.9
3	7.0	16.0
6	2.0	6.9
8	16.1	40.0

FIELD CURRENT RANGE (250 - 800HP)
Indicates actual SW1 setting

#689 SW1 Read-Back	Minimum Rated Field Amps DC	Maximum Rated Field Amps DC
3	2.0	16.0
8	16.1	40.0

Table 10: Field Current Range

CUBE I.D. No.	HP 53ST***	Max Inpt ***Vac
1	002, 003	525
3	005, 007	525
6	010, 015	525
9	020, 025, 030	525
12	040, 050, 060	525
15	075, 100, 125	525
18	150	525
21	200	525
24	250	525
28	300	525
31	400	525
34	500	525
37	600	525
40	700	525
43	800	525
44	040, 050, 060	600
45	075, 100, 125	600
46	200	600
47	300	600
48	400	600
49	600	600
50	800	600

*** This number should agree with the DSD 412 drive data nameplate.

Table 9: Cube I.D. Number

Drive Set-Up

Field Regulator Set-Up

Proper control of motor field current requires knowledge of the motor field resistance, the electrical time constant, and the line voltage available to control power to the motor field. Motor field resistance is calculated from the settings of Rated Field Volts #52 and Full Field Current #50. The time constant and available AC input voltage is supplied by settings #51 and #55. If a separate source of field circuit voltage is used, #55 should be set at that voltage. Otherwise leave #55 set at zero to automatically utilize the main input voltage setting of #9. If #2 is set to ON, the Self-Tune measured value for L/R #615 will be used instead of #51. Verify that the above settings are correct. The scaling of measured motor field current is also important. Verify that the motor field wiring is connected correctly to the proper ampere range tap at TB4, and that SW1 is set accordingly. Check the calibration of measured field current, drive display #612, against that of a separate DC clamp-on ammeter clipped around a motor field wire.
If motor field weakening is not required at top speed leave WEAK FIELD CURRENT #49 set to 40 amps or set it equal to RATED FIELD CURRENT #50. Set STANDBY FIELD CURRENT #53 as desired during drive idle.

If top speed is greater than the motor base speed, set WEAK FIELD CURRENT #49 so that actual motor voltage does not exceed the RATED ARMATURE VOLTS #7 during a high speed, full load run. The crossover point between Full Field and Weak Field current will be automatically calculated. Motor field current will be adjusted by those settings and measured encoder speed. The DSD 412 drive does not directly regulate armature voltage. This is determined by field current adjustment settings and measured rotational speed.

Be sure to adjust motor field current so that rated armature voltage is achieved at top speed before attempting to set Per-Unit Inertia.

Note: If Field Current is set too low, the necessary motor torque may not be available, resulting in excessive motor armature current or current limiting. If Field Current is set too high, the armature voltage may exceed voltage-limiting points, resulting in faults F407 or F408. Either condition may create an elevator tracking error.

AC Input Voltage Requirement & Adjustment

The line-to-line AC rms input voltage to the drive should be greater than or equal to the rated Full Load Armature Voltage.
To adjust the transformer taps, run the elevator at full motoring load and rated motor RPM. (Empty car down) During the constant speed portion of the profile, measure the AC voltage input to the drive (Secondary of Isolation Transformer, #619, and the DC Armature Voltage #610.
If the Armature Voltage is greater than the Input Line Voltage, adjust transformer primary taps to get the next higher voltage level on the transformer secondary.

Speed Regulator Adjustment

The Magnetek DSD 412 drive uses a proprietary velocity regulator called E-Reg. This is a double speed loop encoder feedback regulator designed specifically for elevator / lift applications where the objective is to smoothly follow a repeated accel/decel speed pattern reference with a relatively fixed load. The following characteristics are important:
Follow the reference speed with a consistent tracking delay See Figure 16.
No overshoot at the end of acceleration
Precision speed following, including at zero speed
Feed forward for inertia forcing
Rejection of resonant load characteristics
Ability to start with a pre-primed error to counteract load offset roll-back

Primary adjustments for E-Reg **are:**
High & Low Speed Bandwidth – #39 & 40
Sets the desired drive response from Speed Reference changes to motor speed. Units are Radians/sec of the closed loop crossover frequency bandwidth. The constant time lag characteristic of E-Reg will be 1/Response, in seconds. Increasing the Response setting will increase the gain to improve velocity-tracking performance.

Per-Unit Inertia
Function 41
Sets all regulator gains to adjust for elevator system inertia. The numeric value of Per Unit Inertia is a ratio of equivalent rotating inertia Vs rated motor strength. Units are in seconds. If System Inertia is set too low, velocity overshoot will occur. If set too high, there may be hesitation or undershoot when approaching a new target speed.

Stiffness
Function 42
Sets the gain of internal PI error amplification and inner loop regulator gain. Affects the responsiveness of the drive to ignore or react to load disturbances. Range 0.5 to 9. No calibrated units. Low numeric values will yield smooth performance while following reference changes. High numeric values will yield better response to speed errors and load disturbances, but can cause amplification of elevator rope resonance.

Gain Switch Speed
Function 105
Sets the speed where regulator gain will switch bandwidths. Below this speed the setting of #40 will be used. Above this speed, the effective setting of Bandwidth #39 will be used. Units are in Per Unit of rated speed (where 1.00 represents 100% of rated speed). The default setting of 1.1pu means that regulator bandwidth will never switch, and therefore always be controlled by #40.

Gain Reduce
Function 108
The Gain Reduce multiplier function has been replaced by two separate settings, #39 & #40.

Tach Rate Gain
Function 107
Sets the amount of derivative speed feedback from the encoder. Units are in %, with range from 0 to 30%. This can help stabilize velocity-tracking oscillation caused by rope stretch in tall hoist-ways. Not an effective countermeasure against ordinary rope resonance.

Notch Filter
Function 190 & 191
An adjustable frequency notch filter is provided to help suppress regulator responses to a specific frequency. This is an effective countermeasure to avoid amplification of typical 9 – 14 Hz rope resonance. See Table 8

Tuning E-REG
The basic concept and purpose of E-Reg is to have a relatively low closed encoder loop bandwidth to prevent amplification of natural rope oscillations, but to feed changes in the velocity reference directly forward to control motor torque with a relatively high gain. This then forces the inertia of the elevator to follow the reference speed, while the relatively low gain PI error regulator is required to only make minor corrections. This is ideal for elevators and lifts, as they tend to be relatively high inertia loads with a steady load torque offset while running. The steady state load torque is a function of elevator cab, payload, and counterweight gravity balance and will be different for each elevator run as it is a function of payload and direction. Most elevators will have minimal operating friction. Verify that settings for basic parameters are correct and that the armature current/torque regulator and motor field regulator are properly tuned. The critical adjustments include:
Motor armature – I-lim #1, Self-Tune #2, Rated-Amps #3, R #4, L #6, VDC #7, Ix #8, & VAC #9.
Motor Field – WkAdc #49, RtdAdc #50, L/R #51, VDC #52, Istndby #53, Response #54, SourceVAC #55.
Speed Loop – EncoderPPR #10, RPM #11, Ratio #16, Rtd Spd #17

Setting Per-Unit Inertia Function 41
Be sure to have completed adjustment of the motor field current regulator BEFORE making final adjustments of system inertia. Start with default values for Response Bandwidth #39 &40, Per Unit Inertia #41 and Stiffness #42. Use a speed profile with a minimal amount of S-Curve smoothing. Select two elevator landings far enough apart so that the elevator can attain maximum speed between stops. [But not the end landings during initial tuning.] It is a good idea to begin at a restricted low speed like inspection speed for initial verification. Run the elevator up and down repeatedly between the same two landings while monitoring car speed via function #600 on the DSD 412 local display. The objective is to have the car speed accelerate right up to the desired speed, so look for speed

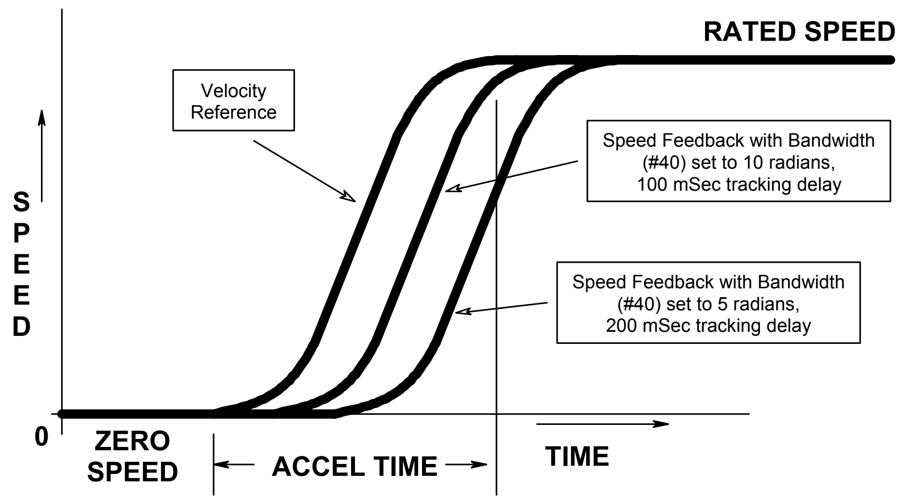
overshoot or undershoot as the car reaches set speed.
If there is speed overshoot – INCREASE the setting for Per Unit Inertia #41 in proportion to the amount of overshoot.
If the speed ramps up as expected but slowly creeps up to the final desired speed (undershoot) – DECREASE the setting for Per Unit Inertia.
Repeat the above at higher set speeds until the car will accelerate up to rated top speed, or decelerate back down to zero speed, without over/under shoot. Ideally, the Per Unit Inertia should be set with a balanced carload as this represents a typical payload. If initial tests are made with an empty car, increase the setting found with the above method by 10% to estimate the additional effect of passenger payload. Save this setting using the DSD 412 function #994.

Setting Low Speed Bandwidth #40
The setting of Speed Bandwidth will affect the ability to accurately track the velocity reference with changes in payload mass and changes in rope balance throughout the length of the hoistway. Increase the Bandwidth setting for more consistent tracking. Note that E-Reg will always have a constant tracking delay during acceleration and deceleration. See Figure 4.4.1. This is a normal result of the characteristic that avoids speed overshoot typical of ordinary PI type speed regulators. Increasing the Bandwidth setting will tighten up the tracking delay. However, be aware that it may also increase the likelihood of amplifying encoder vibration and rope resonance interference. A setting of 5.0 to 8.0 is normal for most elevators. The consistent tracking delay of E-Reg can easily be accommodated in the elevator landing position controls by simply making the car slow-down start 1/#40 seconds earlier in the cycle to compensate for the tracking delay. Setting the Speed Bandwidth to a high value in order to compensate for a poor Per Unit Inertia setting is an improper adjustment. There may be some minor interaction between the Bandwidth and Stiffness adjustments.

Setting Stiffness #42
Increasing the Stiffness setting will increase proportional speed error gain. This allows the regulator to respond faster to measured speed error whether it be caused by reference or encoder speed changes. Increase this setting to overcome frictional starting lags at low speed during elevator re-leveling, particularly with worm-gear friction elevators. Other gains in the regulator are automatically re-adjusted to maintain the same bandwidth as set by the Speed Bandwidth adjustment. However, be aware that increasing the Stiffness setting will also cause more amplification of rope resonant disturbances. Reducing the Speed Bandwidth with an increased Stiffness setting may be an appropriate countermeasure.

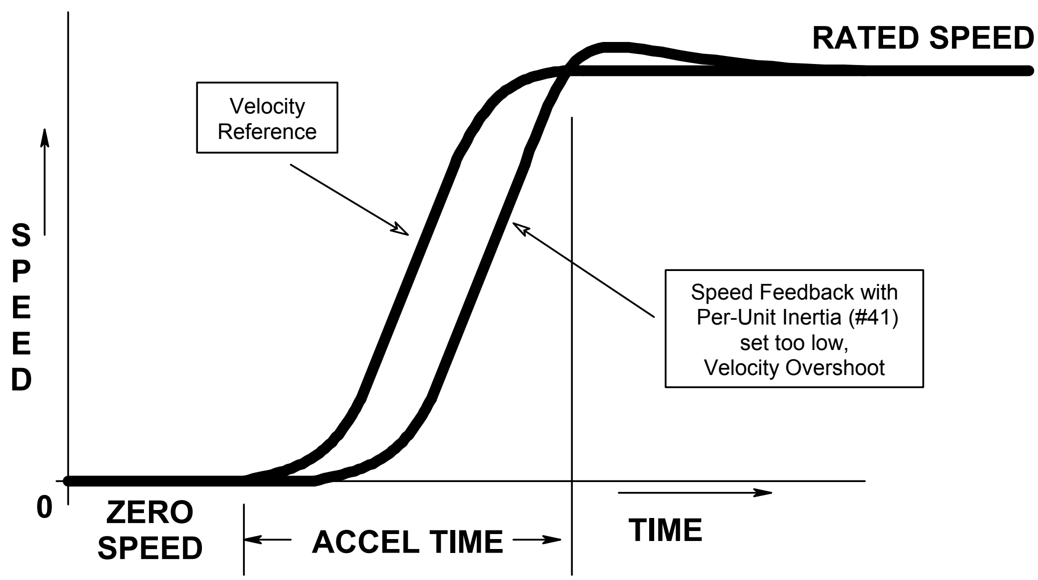
Setting Gain Switch Speed and High Speed Bandwidth, #105 & #39
If higher settings of Speed Bandwidth and Stiffness are necessary to achieve repeatable good floor landing and take-off characteristics, but rope oscillations or other mechanical vibrations occur at higher speeds a good countermeasure is to lower the bandwidth setting (gain) at higher speeds. Set the Gain Switch Speed #105 to a speed below where the vibrations occur. Set High Speed Bandwidth #39 to a value less than that of #40 to help suppress system oscillations.

Setting Tach Rate Gain, #107
This function controls derivative encoder feedback. Increase this setting to suppress rope stretch bouncing or similar other disturbances. Very helpful in high rise buildings for smooth landing performance. However – This feature can sometimes cause amplification of minor vibrations, causing them to become worse. Keep this adjustment set to zero unless demonstrated to provide a useful purpose.



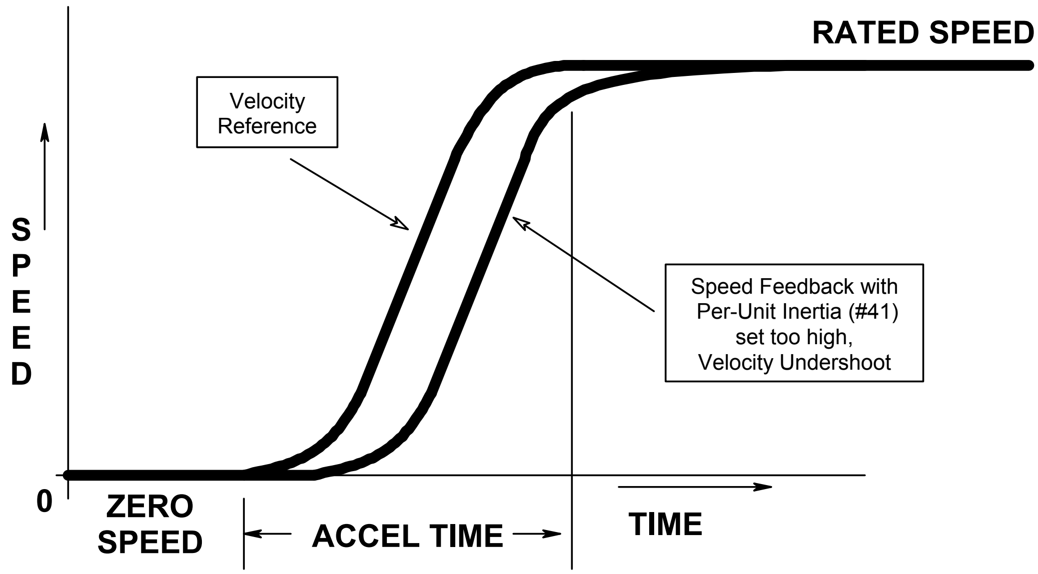
E-Reg Velocity Tracking with proper PU-Inertia. No over/under shoot

Figure 15: E-REG Tracking Profiles (1)



E-Reg Velocity Tracking
Per-Unit Inertia Setting TOO LOW, Velocity Over-Shoot

Figure 16: E-REG Tracking Profiles (2)



E-Reg Velocity Tracking
Per-Unit Inertia Setting TOO HIGH, Velocity Under-Shoot

Figure 17: E-REG Tracking Profiles (3)

Using The Notch Filter

Some hoist ways may have rope resonance's that cause occasional vibrations, roughness of ride or continuous oscillations at certain low frequencies. There may be critical hoistway locations or payload weight combinations that tend to be more sensitive than others. The effects are often felt rather than heard. The frequency sensitive notch filter, placed in the software path of the torque / armature current reference signal, can be effective to suppress the response of the DSD 412 drive to amplify those frequencies. Adjustments for this filter are via #191, the period, or center frequency of the filter, and #190, the depth of the notch, or its ability to attenuate. Use the filter as follows:
Determine the approximate frequency of the oscillations or rope 'ringing'.
Use Table 8 #191 to set a center frequency value slightly higher than that of the observed disturbance. The default value of 7 (12 Hz) will be sufficient in many cases.
Increase the value of #190 to suppress the tendency to respond or amplify rope resonance.
CAUTION: Be aware that the ability of the drive to follow the speed commanded by the car controller is altered by these adjustments. If the frequency of the filter is set too low, or the notch depth is set too deep, there may be interference problems associated with operating the closed loop velocity regulator or position control loops within the Car Controller. Typical symptoms would include position overshoot of floor landings and potentially repetitive speed oscillations or speed 'hunting'. If these symptoms occur, back off on the Notch Depth setting #190 and/or reduce the setting of #191 (Notch Period), increasing the notch center frequency to avoid interference.

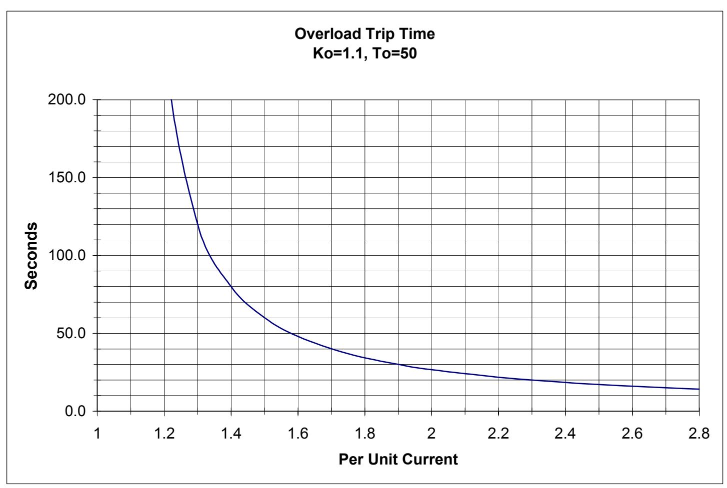
Motor Overload

Motor armature current is sensed and mathematically integrated over time to detect potential over heating caused by a dragging brake shoe or other repeated abuse beyond ratings of the equipment. The calculation formula used for the electronic motor overload is:

$$t = T/2(i - Ko)$$

Where:
t = Calculated time to trip in seconds
i = Measured Per Unit motor current. Drive Param #3 defines motor Per Unit current in amperes.
T = Time to trip setting #83 at motor current of (Ko+0.5) per unit current.
Ko = Maximum Per Unit current that will not cause an Overload Trip #84.

The USA National Electric Code (NEC) requires that the overload be adjusted to detect overheating of the motor and motor wiring by using rated motor current as the comparison base. This is not the same as rated current capability of the drive. The NEC requirement is that the overload must trip at 1.15 Pu current (no time specified), and after 60 seconds at 1.5 Pu current, and after 10 seconds at 2 Pu current. It is recommended that the default values of Ko=1.1 and T=50 be used. This will provide no tripping with average motor current of 1.1 Pu or less, and a tripping time of 62 sec at 1.5 Pu. See the timing graph of Figure 18: Motor Overload



MOTOR OVERLOAD, Ko=1.1, T=50

Figure 18: Motor Overload

Sticking Brake Detection

A sticking elevator brake can be detected by observing Speed Error. The unexpected friction caused by a sticking brake will create an abnormally large speed error, in order to get the large motor current necessary for the drive motor to produce enough torque to pull through the brake. This cause for motor current is not the same as that during normal accel/decel where a change in velocity command drives the demand for motor current and torque, but speed/velocity tracking remains on target. Therefore the Speed Error detection method will be more effective than using the Current X Time motor overload function to detect this equipment malfunction.

If it is desired that detection of a sticking brake should cause an automatic shutdown of the drive.

> See the explanation for function parameter settings #99 and #100. Set #99 to 2 seconds. Set #100 to 10% or lower as necessary to cause the function to trip off with drive shutdown Fault F410 when the brake does stick, but not so sensitive that normal accel or decel causes an F410 shut-down. Verify by test that empty car down or full payload weight up will not cause nuisance trips.

If it is desired that a sticking brake be detected, but not cause an automatic drive shutdown....

> See the explanation for programmable logic output type 'H' or 'I' using parameter adjustments #120 and #121. Follow the directions for parameters #183-187 to program either function 'H' or 'I' to activate or deactivate a logic output. Set #120 for a detection time of 2 seconds. Set #121 to 10% or lower as necessary to cause the function to operate when the brake does stick, but not so sensitive that normal accel or decel operation causes false detections. Verify by test that empty car down or full payload weight up will not cause nuisance trips.

Start – Stop Timing

A typical elevator run sequence is shown in Figure 19: Elevator Start - Stop Timing A descriptive explanation is given below.
Start Sequence – Mode 2, internal pre-set speeds

1. Close Drive & Field Enable – Sets field current reference to Full Field, enables drive to operate. This contact must be held closed during entire elevator run, including armature current ramp down. Opening of this contact will disable the drive and cause the loop contactor to be dropped immediately.
2. Close Safety-Chain circuit. – Must be closed for drive to start. Must remain closed during entire elevator run. Otherwise, an F405 fault will result.
3. Select desired direction and speed – May be done before or after drive is told to Run.
4. Close Hardware Run (or Run-Up or Run-Down contact) – Causes LPR to pick when field current is greater than setting #32. LPR picks contactor, which closes Loop Confirm – Drive will begin running by pre-loading the speed error integrator with the available pre-torque signal, if enabled at Function #114. Logic Output Selection 'C', Run Engaged, will become energized to indicate that the drive has control of motor speed. Speed will begin to accelerate toward desired speed, if not set at zero. If contactor fails to pick, F402. If motor armature circuit is not closed before Loop Confirm closes, an F98 or F901 may occur.
5. Release brake - Timing of actual brake release must be coordinated with starting the drive and/or changing the target speed. The drive must be running and be either pre-torqued, or starting to accelerate, or have ARB engaged to prevent rollback.
6. A new target speed and or direction may be selected before or after the drive is started. When speed rises above the setting of #64, the Low Speed logic indicator will turn off. (Output function 'F')

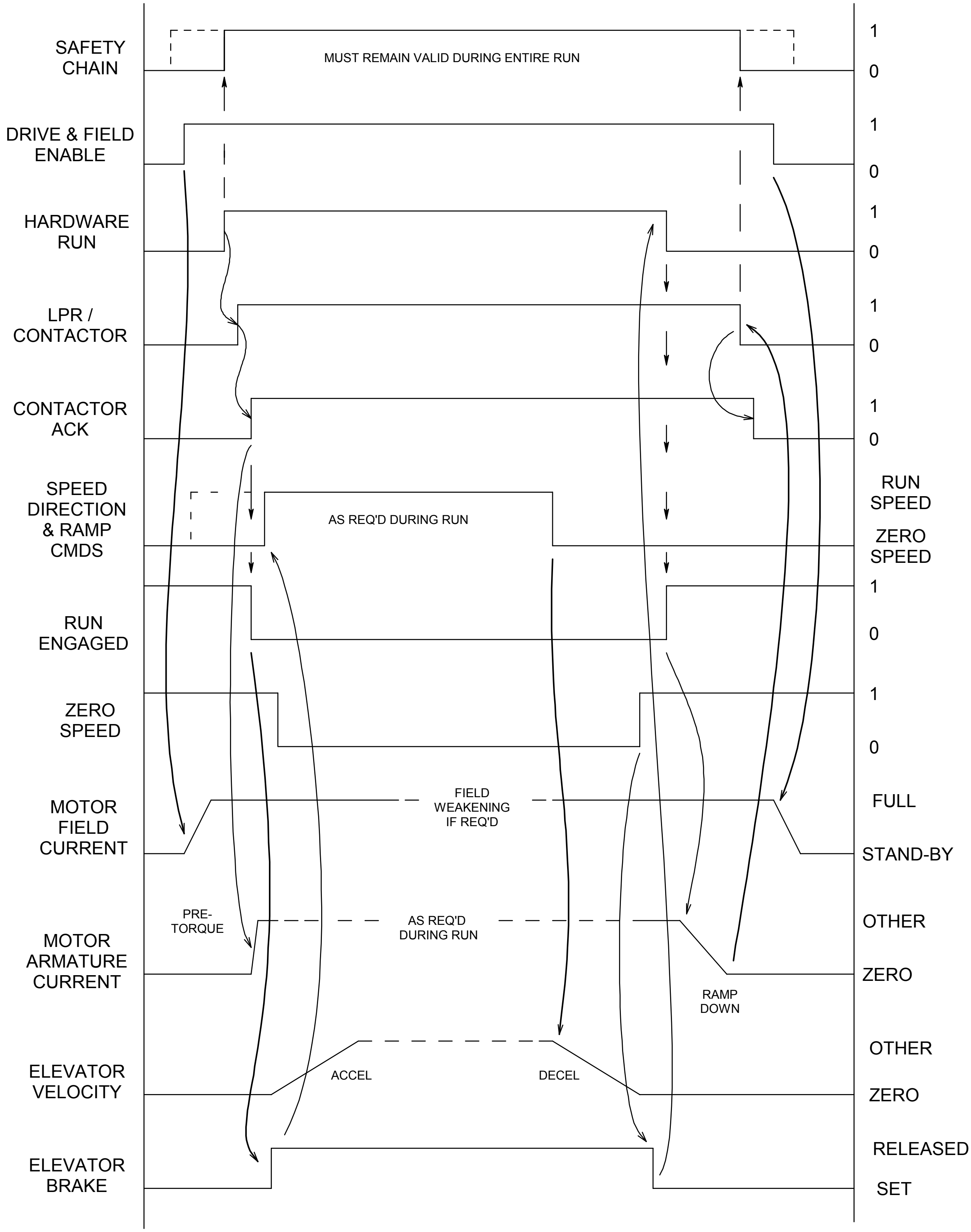


Figure 19: Elevator Start - Stop Timing

Stop Sequence

1. Select leveling or zero speed reference – Will cause start of deceleration to new target speed.
2. When speed becomes less than the setting of #64, the Low Speed logic indicator will become active to indicate a door pre-opening speed. (Output function 'F')
3. Select zero speed – Will cause drive to decelerate to zero speed & hold car position. When speed drops below the setting of #63, the Zero Speed logic indicator (Output function 'J or K') will become active.
4. Set elevator brake – Wait the appropriate amount of time for the brake to drop, or use a brake limit switch to confirm when the brake is physically set.... Then
5. Open Hardware Run contact (or Run-Up or Run-Down contact) – Will cause drive to stop controlling speed, turn the Run Engaged logic indicator (Output function 'C') off, and ramp armature current down to zero in time set by function #85. Drive will open LPR, contactor, & Loop confirm when Ramp-down is complete. If contactor confirm fails to open, F402 fault will result.
6. Open Safety Chain (if desired) – Must remain closed for current ramp-down to happen. If current ramp-down is not desired, set #85 to minimum. Expect some contactor barking. If Safety Chain opens unexpectedly while drive is running, F405 fault will result. Safety chain may remain closed.
7. Open Drive & Field Enable (if desired) – Will cause field current to go to stand-by/idle value. May remain active if drive will be restarted shortly. However, if drive is not restarted within 5 minutes with Drive & Field Enable active, F403 fault will result.

Preset Speed Logic Sequence

Binary - The internal pre-set-speed selector in binary mode (fctn #150 ON) uses 3 input lines to select 1 of 8 pre-set speeds (including zero), see Table 11. Binary logic reduces the number of control lines but the logic inputs to select those independent speeds may not be properly de-bounced at the sending or receiving end. This may allow an unintended speed to be momentarily selected. To prevent this from happening, the user should consider using 4 pre-set speeds, including zero, selected in a gray scale progressive manner (only one switch changes at a time).

Progressive - An alternate method of one-at-a-time control that has more pre-set speeds and takes advantage different Ramp Rates (R-R) during operation, set #150=Off for Progressive input control, see Table 12. Connect A1TB1-10 to A1TB1-54, and A1TB1-51 to A1TB1-12 to automatically activate R-R 2 with a 1 Floor Run and R-R 3 with Multi-Floor runs. R-R 1 will be activated for leveling and inspection, speed #1. If Decel Rate Latch #116 is ON, these rates will be held active during deceleration.

Example:
(With #150=On)

S2	S1	S0	Pre-set #	Use
0	0	0	none	Zero Speed select
0	0	1	1	Leveling Speed
0	1	1	3	1 Floor Run Speed
1	1	1	7	Multi-floor Run Speed
0	1	0	2	Inspection Speed (could also be speed 4, 5, or 6)

NOTE: Always set all other unused pre-set speeds to zero.

Table 11: Binary Input Control

Example:
(With #150 = Off, & #112 = On)

S4	S3	S2	S1	S0	Pre-set #	Use
0	0	0	0	0	none	Zero Speed select
0	0	0	0	1	1	Inspection speed w/ R-R 1 rates
0	0	0	1	0	2	Leveling Speed, w/ R-R 1
0	0	1	1	0	3	1 Floor Run Speed, w/ R-R 2
0	1	1	1	0	4	Multi-floor Run Speed, w/ R-R 3
1	1	1	1	0	5	Express zone speed (optional)

Table 12: Progressive Input Control

2. Stopping Distance

The internal S-Curve velocity generator of the Magnetek DSD 412 drive is digital in nature and is therefore very repeatable. The Accel/Decel time is fixed per the selected rate adjustment setting. The time setting represents the total acceleration time from zero to rated speed (or vice-versa), and is independent of any S-Curve selection. The starting and stopping distance from and to any other digitally pre-set speed can be pre-calculated and will also be repeatable.

The distance traveled during deceleration to zero or to a lower leveling speed will be:
S = Tsec x DeltaFPM/RatedFPM x (LevelingFPM/5 + DeltaFPM/10) (inches)

Where DeltaFPM is the change in steady state running speed in feet per minute

However there is fixed delay and an uncertainty of actual time to recognize and start obeying a logic command to start the deceleration cycle. The fixed delay is 0.01 seconds and the uncertainty is 0.018 seconds maximum. During this time the elevator will still be moving at running speed, creating an uncertainty in the actual stopping distance.

This delay plus uncertainty distance will be:
Serror ≤ RunningFPM x 0.028 x 12/60 = RunningFPM x 0.0056 (inches)

So the total maximum stopping distance or deceleration distance to leveling speed will be:
Stotal ≤ Tsec x DeltaFPM/RatedFPM x (LevelingFPM/5 + DeltaFPM/10) + RunningFPM x 0.0056 (inches)

For multi-floor runs, the slow-down vane switch must be at least that distance from the landing or the floor may be missed.

For single floor runs, the acceleration distance may be calculated similar to above, without the uncertainty error. The slow-down vane switch for the next landing must be at least that far away from the beginning of the run. The single floor target running speed and/or accel/decel times must be adjusted to meet the above criteria conditions or the landing may be missed.

Note that if minimum flight time is desired a different deceleration rate may be selected to optimize the result. A longer decel time can result in a faster flight time since less time is spent at leveling speed. A second set of accel/decel parameters may be activated by use of the optional Ramp Rate Select contacts.

An optimizing procedure would be:
1. Set the Accel Time and percent jerk for ride quality.
2. For short runs, (i.e. where the distance from the starting floor to the vane switch is less than the distance from the vane switch to the stopping floor) set the target speed so that the accel distance is less than the distance from the start to the vane switch.
3. Set the Decel Time so that the stopping distance is just a little less than the distance from the vane switch to the stopping floor.
4. For multi floor runs set the speed to contract speed and set the decel time so that the decel distance is just slightly less than the distance from the vane switch to the target floor. Other options certainly exist.

Drive & Field Enable

The Drive & Field Enable contact input enables the drive to run and also acts as a command to fully energize the motor field. Closing Drive & Field Enable in advance of the Hardware Run, or Run-Up / Run-Down, command will allow time for the motor field to become fully energized for a minimum of starting delays. When the Drive & Field Enable circuit is open, the motor field circuit will be energized at the stand-by current level. If Field Enable remains ON for more than 5 minutes without running the drive, an F403 will occur and the Full Field condition will be turned OFF.

RUN w/ DIRECTION & RUN-UP / RUN-DOWN

One of two methods may be selected to Run the drive and determine the direction. Use function #115 to select.

1.) Hardware Run & Reverse (#115 = Off)

The Hardware Run input starts the drive. The Reverse contact controls the direction. The Drive & Field Enable signal must also be energized and remain so for this to occur. The desired direction command should be stable before a non-zero speed reference is selected. CAUTION – The direction control from this input is not interlocked with any other logic condition. This facilitates direction control while re-leveling or performing a quick reverse while heading for a 'home landing', but it also means that an intermittent contact or broken wire can make the car go in the wrong direction!

2.) Run-Up & Run-Down (#115 = On)

Two separate logic inputs are provided to start the drive in either the up or down direction. The Drive & Field Enable signal must also be energized and remain so for this to occur. If both Up and Down directions are active simultaneously, the drive will not start. This prevents a single relay contact or wiring failure from starting the drive in the wrong direction. Once running, the direction may be reversed by closing the contact for the new direction and releasing that for the old. This is allowed at any speed. If the command contact closures overlap, speed control will remain active and the contactor will not drop.

Using Pre-Torque

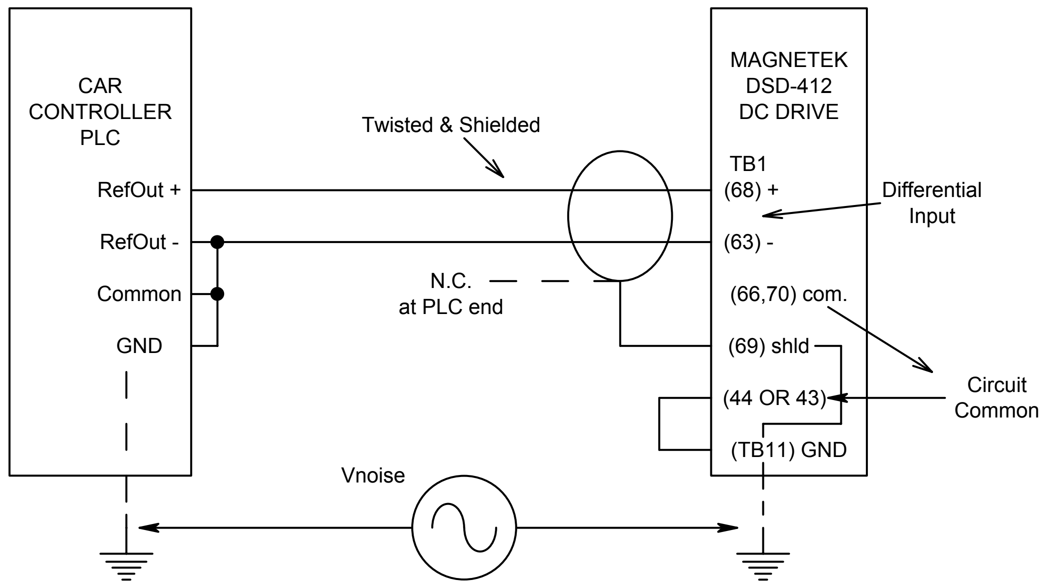
When enabled by function #114, the value and direction of the analog pre-torque signal input will be captured and latched each time the drive is started by closure of the motor dc loop contactor in response to activating the Run command. That value will be used to pre-load the speed error integrator and provide a starting value of motor armature current and torque. When set properly, that torque will be sufficient to hold the elevator car and prevent rollback. Operation is fully automatic when enabled by function #114. No external sequencing is necessary. If serial link control is ON, the pre-torque value will be from the serial link.

Using External Velocity Commands

Operation with an external analog velocity command is similar to the sequences above. This mode is programmed via the logic select function #110. Setting #110 to a 1 enables the bi-directional analog follower mode. The actual car direction will always follow the polarity of analog reference. Both the Drive & Field Enable and the Hardware Run signals must be active to cause the drive to run. When function #110 is set to 4, the uni-polar analog follower mode is active. The drive will control the speed of the elevator based on the positive value of the supplied analog reference. The direction of travel will be determined by the status of either the direction select (function #115 =OFF) or Run-Up/Run-Down (function #115=ON) logic input command lines. Both the Drive & Field Enable and the Hardware Run signals must be active to cause the drive to run.

Analog reference wiring is sensitive to electrical noise interference. The reference signal channels are differential and should be wired with twisted pair, shielded cable, as shown in Figure 7: Typical Analog Signal Wiring. Be sure that the cable shield is connected only at the drive end.

Avoiding Analog Signal Ground Noise



Proper connections.
Noise current does not flow through signal wires or shield.
Common mode voltage noise is rejected at differential reciever.

Figure 20: Analog Signal Ground Noise

Serial Link Connections

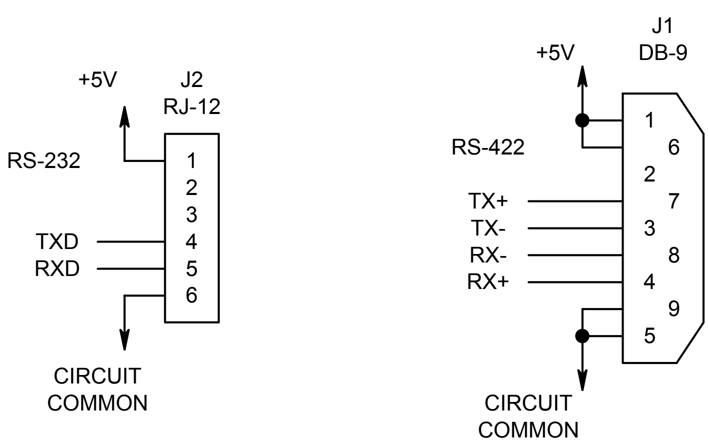


Figure 21: Serial Link Connections

Serial Communication Specification

See Function #110 to enable this feature. The serial communication link between a host and the DSD 412 consists of two messages. There will be a *Demand Velocity/PreTorque Command* sent from the host to the DSD 412 every 15 MS. There will be a *Demand Velocity Response* message sent from the DSD 412 to the host every 45 MS.

After power up the drive will wait 10 seconds for the first Drive Velocity Command (DC) message to be received from the car controller. If this time expires, a 20 SEC COMM FLT (F117) will be declared. Once communications has been established, a valid DC message must be received at least in 150 MS intervals. If this time window expires, a 150 MS COMM FLT (F118) will be declared.

Frame format: 10 bits (N81) @ 19.2K baud. RS232 may be used with the 46S02975-03xx Drive Control PCB at connector J2. RS422 requires the 46S02975-04xx PCB with a DB9 J1 connector. Pin-out is per Figure 21: Serial Link Connections

Demand Velocity Command message from the host is as follows:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Sync Byte FAh	Sync Byte 05h	Logic command Byte 1	Logic comman d Byte 2	Numeric command (high byte)	Numeric command (low byte)	PCDU keystroke	Checksum

Bytes 1&2: These bytes will always be set to FAh and 05h respectively. They are used for the purpose of synchronizing the DSD 412 to the start of an incoming message from the host.

Byte 3: {N259_C001} This byte contains the logic commands sent from the host to the DSD 412. The bit definitions are listed below:
B0: =1 to act as a synchronization bit for incoming messages from the host.
B1: =1 to act as a synchronization bit for incoming messages from the host.
B2: 0=Stop requested 1=Run requested
B3: 0=No request to clear faults 1=Clear fault requested
B4: 0=*Demand Velocity* is not DOWN 1=*Demand Velocity* is DOWN
B5: 0=*Demand Velocity* is not UP 1=*Demand Velocity* is UP
B6: 0=Idle field command 1=Full field command
B7: A rising edge of this signal acts as a latch to capture the Numeric Command and interpret it as a new Pre-Torque value. This signal should be set to a zero by the host before it sends a new Pre-torque value or when the host receives confirmation that the drive is in the run mode.

Byte 4: {N259_C002} This byte contains additional logic commands from the host to the DSD 412. [Drive function #104 must be set to a 1 for this control to be active.]
B0: 0= No gain reduction 1= Velocity loop gain reduction is ON
B1-B7 are spares

Bytes 5&6: {N259_C000} These two bytes represent a signed 16 bit numeric value. The definition of this value is determined by the status of Byte 3, Bit 7. If bit 7 is a 1, the value will be interpreted as a pre-torque signal. If byte 3, bit 7 is a 0, the value will be interpreted as a velocity reference.. The limits for this value are: 7FFFh = +1 per-unit, 0000h = zero, 8000h = -1.0 per-unit.

Byte 7: The data in this byte is passed to the PCDU routines and is interpreted as a new PCDU keystroke. If no 'key' is being pressed (a great majority of the time) the value of this byte will be 00h. It is the responsibility of the host to insure that this byte contains the new non-zero keystroke data for only one 15 MS transmission period. If this is not done, the DSD 412 will act as if a given key is being 'held down' instead of being pressed and released. The host must pace the placement of non-zero data in this byte no more frequently than one character every 250 MS.

This is done to give the PCDU routines enough time to transmit the proper response display (possibly up to 32 ASCII characters) before the next keystroke is read.

Byte 8: This byte contains the calculated checksum of the data within this packet. It is the modulo-256 sum of bytes 1 through byte 7 inclusive.

<u>Demand Velocity Response</u> message from the DSD 412 is as follows:

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9	Byte 10	Byte 11
Sync Byte FAh	Sync Byte 05h	Control Status 1	Control Status 2	Control Status 3	Numeric Data high byte	Numeric Data low byte	PCDU display 1	PCDU display 2	PCDU display 3	Check-sum

Bytes 1&2: These bytes will always be set to FAh and 05h respectively. They are used for synchronizing the host to the start of an incoming *Demand Velocity Response* message from the DSD 412.

Byte 3: {N259_C010} This byte contains 8 logic status signals as defined below:
B0: =1 to act as a synchronization bit for the host
B1: =1 to act as a synchronization bit for the host
B2: 0=Tach direction is not UP 1=Tach direction is UP
B3: 0=Tach direction is not DOWN 1=Tach direction is DOWN
B4: 0=No tach overspeed fault 1=Tach overspeed fault F97
B5: 0=No tach loss fault 1=Tach loss fault F98
B6: 0=No reverse tach fault 1=Reverse tach fault F99
B7: 0=No Serial Communications Fault 1=Serial Communications Fault

Byte 4: {N259_C011} This byte contains 8 logic signals to indicate drive faults.
B0: 0=No Motor over-load 1=Motor over-load fault F400
B1: 0=No excessive field current 1=Excessive field current F401
B2: 0=No contactor failure 1=Contactor failure F402
B3: 0=Drive is not at CEMF limit 1=Drive is at CEMF limit F407 or F408
B4: 0=E-STOP circuit is closed 1=E-STOP circuit is open
B5: 0=No E-STOP fault 1=E-STOP fault F405
B6: 0=No drive fault exists, READY 1=A drive fault exists, NOT READY
B7: 0=Drive NOT READY (test mode or Fault) 1=Drive is READY

Byte 5: {N259_C012} This byte contains 8 logic signals to indicate additional faults:
B0: 0=No Loop fault exists 1=Loop fault exists F900
B1: 0=No PCU IST fault 1=PCU IST fault F901
B2: 0=No line synchronization failure 1=Line synchronization failure F903
B3: 0=No low line fault 1=Low line fault F904
B4: 0=No field loss fault 1=Field loss fault F905
B5: 0=No Line Droop 1=Line Droop below 90% of nominal F406
B6: 0=Speed Regulator not Released 1=Speed Regulator is Released
B7: Spare

Bytes 6&7: These two bytes contain an echo of the most recent Numeric Command target value from the host. The format of the value is identical to that previously defined in the **Demand Velocity** message.

Bytes 8-10: These 3 bytes contain ASCII display data normally intended for a serial terminal device connected to the host. The host should simply pass all non-zero data (displayable ASCII characters) that it receives in these two slots to the device that is emulating the PCDU. The host may ignore bytes in these fields if they are set to 00h meaning that the DSD 412 has no data to display at this time. A full PCDU display is 2 rows of 16 characters. Therefore, an update of an *entire* screen would require several packets.

Byte 11: This byte contains the calculated checksum of the data within this packet. It is the modulo-256 sum of bytes 1 through byte 10 inclusive.

Using Anti-Rollback (ARB)

Elevator rollback occurs when an elevator motor drive is started and the brake is released but the hoist motor has not yet developed enough torque to prevent gravity from moving the car. The car may move up or down depending on the overall balance of equipment and payload. Velocity regulators normally used for speed regulation will eventually detect unwanted movement and react to halt the car. But there will be a position error accumulated during that process that can represent many inches of unwanted car movement relative to the landing. This effect is most noticeable with low friction gear-less elevators. It may be totally masked by the friction of an elevator driven through worm gears. Rollback by itself does not pose any hazards, but it does give an uneasy, out of control feeling to passengers. In many installations brake release timing is adjusted so that the brake is released just as the car begins to accelerate toward the next landing to mask the rollback effect. This often results in jerky starts as the brake linings release. The correct countermeasure is to weigh the car just as the doors close to determine the degree of gravity unbalance, then pre-torque the motor so that when the brake is released all forces are balanced. This method is very effective, but does require expensive calibrated load weighing equipment.
The purpose of the Magnetek Anti-rollback feature is to help prevent rollback on elevators that do not use load weighing or do not use the motor pre-torque capability provided by the Magnetek drive. It uses a double integrator (type 2) regulator when operating at zero speed to hold the elevator car at an average speed of zero and to regulate a constant position as the brake is released. When the velocity reference leaves zero speed to accelerate the car toward the next landing, the active velocity regulator is switched to be E-Reg to precisely track (follow) the velocity reference profile. Be aware that this anti-rollback feature works from encoder/tachometer signals. So there must and will be some movement in order for the feature to function, but the position error generated by elevator movement will recover. The bandwidth gain of the system will determine how much movement will occur. Several new operating options and adjustments are provided. Refer to the individual descriptions for Drive Functions #130 - #132 and #63.

Set-Up And Tuning Of Anti-Rollback (ARB)

1. The ARB function uses adjustment settings #41 (Per Unit Inertia), and #42 (speed regulator Stiffness). These settings and others are critical for good performance of the E-Reg velocity regulator. The first step for good ARB performance is to disable ARB by setting #130 to 0 (zero) and to tune all other E-Reg adjustments for a smooth ride and good floor-to-floor elevator performance. Be sure that the car weight and counterweights have been adjusted to be at the final values. Follow the suggested procedures for tuning E-Reg as listed in this Tech Manual. Ignore elevator rollback while adjusting primary elevator performance features. If rope resonance exists, also adjust the notch filter for minimum interference. Then tune up ARB last as necessary to prevent elevator rollback with an unbalanced payload.
2. After all other adjustments are satisfactory, set #130 to a 1 to enable ARB when starting an elevator run. Set up the following initial ARB adjustment values. Be sure to read ADJUSTMENT HINTS and CAUTIONS listed below.
   a) Set #131, ARB Bandwidth, to 2 times the setting in #40.
   b) Set the initial value of #132, ARB damping, to 0.5.
   c) If the drive will be using an internally generated velocity reference or serial link commands (#110 set to **2** or **3**) set #133, ARB Speed Threshold to 0.0%. If the drive will be using an **external** analog velocity reference (#110 set to **1**), set #133 to 0.5%.
3. With the car empty at a convenient landing, prepare to start the elevator drive, call for zero velocity from the car controller via the normal way, release

the elevator brake, and observe any car motion. When the car comes to a stop, the observation is complete, set the brake and stop the drive, again through normal control channels. Do so and observe that...

   a) The contactor picks, and the drive does start.
   b) There may be some initial upward motion, but the car should return to its original position within a second or so.
   c) When motion is halted, there will be motor armature current producing torque holding the car. This can be observed at #611 on the local display or a separate DC clamp-on ammeter, if available.
   d) Set the brake and turn the drive OFF via normal commands. (In that order, to prevent the car from drifting away!)

4. Repeat #3 several times and.....
   a) Increase the setting of #131 (ARB Bandwidth) to reduce the amount of initial movement as desired. But there may be more jerkiness. Reducing the setting of #131 will allow more movement, but with less jerk. Adjust #131 for a good compromise.
   b) Reduce the setting of #132 (ARB Damping) to speed up the position recovery, or increase the setting for a softer recovery, as desired.
   c) If oscillations occur, release the brake and shut down the drive or reduce the setting of #131 to stop them. This may be a practical limit for position tightness in this particular hoistway. See the hints below for using the notch filter.
5. Change the reference velocity to run the car at normal speeds. Make several empty single or multiple floor runs up and down to observe the complete starting action. The adjustments made so far should not alter landing position accuracy. Ride the car to observe the quality of adjustment.
6. If weights are available, load the car to payload capacity. Repeat the observations and adjustments of #4 with a full load. In this case the initial movement should be downward. Then repeat floor runs as in #5 with a full load. Ride the car to verify smoothness.

Adjustment procedure is complete.

ARB Adjustment Hints And Cautions

1. Caution the ARB function can increase regulator bandwidth far beyond that required for controlling the speed of the elevator. It does so at only near zero speed, but when the ARB gain bandwidth is boosted it is possible that one or more mechanical resonant frequencies may become excited to produce unacceptable vibration. If an annoying vibration does occur, try to determine the resonant frequency. Then use the notch filter to tune it out if possible. Be aware that the notch filter does cause additional phase shift lag. This can and will interfere with the operation of E-Reg and ARB. Tune the notch filter to the resonant frequency and adjust notch depth to the smallest value that suppresses the vibration. Then turn ARB off and verify or re-tune E-Reg to yield acceptable performance. Then re-tune ARB settings to control rollback. Some hoist ways may not be compatible with high gain ARB settings.
2. The adjustment settings for Speed Bandwidth, Per-Unit Inertia, and Stiffness #40, 41, & 42 are used by both the velocity regulator (E-Reg) and the velocity control portion of ARB, therefore adjustment of #40, #41, & #42 will alter the performance of anti-rollback controls. A high setting for Stiffness #42 will help the velocity control respond to changes in load but will cause longer settling times for both velocity and ARB position regulation. Be sure to tune the velocity controls of the elevator BEFORE adjusting controls for ARB Bandwidth and Damping, #131 & #132. Changing any ARB settings, #130 - #133, will not interfere with other velocity control tuning.
3. Elevator rollback is a function of gravity load unbalance of the car. This is what causes the car to move when the brake is released, even though the reference velocity may still be at zero. However,

there is a finite time required for ARB to measure unwanted car motion via the encoder, produce a counteracting motor torque, and then return the car to the original position. The reaction time is controlled by #131, ARB Bandwidth. The smoothness and time to settle is controlled by #132, ARB Damping. The need for ARB starts only when the elevator brake is actually released, not when it is told to release. (A subtle difference in electromechanical timing.) But the allotted time for ARB to function will cease as soon as the velocity reference (internal or external) moves away from zero speed and crosses the threshold identified by #133.

a) Ideally, there would be adequate dwell time after release of the brake for ARB settling to occur. But elevator floor-to-floor time specifications do not necessarily allow for any time delay. If the resulting ARB time is cut short by release of the velocity reference before position settling is complete, the car will begin to accelerate toward the next landing from wherever it may be in the ARB cycle. The position regulator to speed regulator change-over will be smooth, but the repeatability of velocity profile tracking during acceleration may be altered by the amount of load unbalance and the value of the threshold set in #133. Keep this setting as low as possible for best results.
b) If #133 is set too low ARB may be terminated too early, particularly when using an external analog reference. This will result in elevator rollback that could have been prevented.
c) If acceleration of the velocity profile is started and crosses the threshold set by #133 before the elevator brake actually releases, ARB will not function and may result in elevator roll-back as acceleration begins. This, and the jerk or vibration sometimes felt by passengers as the motor pulls through the brake to start the car, is a result of poor velocity reference release Vs brake release timing. With ARB the velocity reference should not be released to move away from zero until after the brake is mechanically released. Otherwise the ARB feature cannot work.

4. Anti-Rollback can be used with external load weighing and pre-torque, as these features are independent of each other. If motor pre-torque values are not precisely correct at the time of starting the elevator drive, as may occur during elevator re-leveling, the features of ARB will intervene to help reduce rollback. If pre-torque is accomplished correctly, Anti-rollback will not need to do anything. However, it can still cause vibration or oscillation if ARB gains are set too high.
5. It is not always convenient to use payload weights during adjustment. Most elevators are counterweighted such that an empty car represents an unbalanced load of 43-57%, with the counterweight being heavier. If Anti-rollback works effectively with an empty car at all landing stops, it should also perform adequately with full payload weight in the car. Step 6 in the adjustment procedure indicates how to verify and adjust ARB operation with a full car payload, but it is not always necessary.
6. Anti-rollback may also be used to hold the car at a constant position at the end of an elevator run. Normally this is not required because the velocity regulator, E-Reg, will stabilize and hold an armature current value as necessary to hold the car at a standstill at the end of an elevator run. However, turning ARB back on may be useful to aid car re-level positioning without first setting the brake for a total drive re-start. Set #130 to a 2 to re-enable ARB when the car returns to zero speed at the end of an elevator run. Zero speed in this case is measured by the encoder, not the reference, and defined by #63. ARB will remain enabled until the drive is either shut down by removal of Run or Run-Up/Run-Down or Drive & field Enable logic signals, or the internal

velocity reference is increased to again be larger than the threshold set by #133. If #63 is set too high, there may be a jerk felt as the car comes to rest and the control switches to the ARB zero speed / position hold mode. If #63 is set too low, minor disturbances and movement may delay and possibly prevent control transfer to the ARB hold mode because the measured encoder speed over a relatively short measuring time appears to not fall below the threshold value. Set #63 to the lowest value that yields repeatable results.

Using Drive Stand-By Power Reduction (DSPR)

Elevators often sit idle for many hours during a 24-hour day. Even though the DSD 412 drive can be set up to reduce motor field current to a stand-by level, a significant amount of power is continually lost by having the 3-phase main power transformer energized and cooling fans running. Now it is possible to set a timer so that when the elevator has not been used for a length of time, an external contactor can disconnect the main transformer and turn cooling fans off. When car controller logic recognizes that a new elevator call has been placed and asserts the Drive and Field Enable contact at TB1-9, the drive will re-enable the 3-phase primary power, resynchronize to the power line and restart cooling fans. While 3-phase power is OFF motor field current will be zero amperes, regardless of the setting of Standby Amps set at #53.

The DSPR feature is programmable by selection of output option L on relay K4. See table 4.2.3. The time delay before power is turned OFF is adjusted at #88, DSPR Delay. This timer is held in reset whenever the drive is enabled, and timing for a delayed shutdown whenever the drive is at rest and the Enable control line is inactive. If the DSPR delay time value at #88 is set to zero (0), the timing function is defeated and power will remain continuously ON. A pilot relay must be added to panel wiring to operate a primary power contactor. 115 VAC control power to the drive must remain ON for this feature to be operative. Refer to installation diagrams supplied in Section 2 at Figure(s) 2.1 for all suggested electrical connections. Normal operation of DSPR when power is first applied or when a Dive Fault Reset is performed is that Relay K4 will be de-energized, or will become de-energized, turning main power OFF. It will then energize/re-energize to turn 3-phase power ON. Setting DSPR delay at #88 to zero will not change that part of the operation.

If DSPR is not wanted, or other external logic prevents the 3-phase power from actually turning OFF, the drive will not care and continue to respond normally, except that motor field current will go to zero during a DSPR time-out. However, external relay logic must not turn 3-phase power OFF unexpectedly, or the drive will declare an F406, F903 or F904.

NOTE: PCU software in EPROM sockets U13 & U14 must be labeled SA0404 (displayed by function #690), AND the software in sockets U39 & U40 (displayed by function #697) must be labeled SA0407 for the DSPR feature to be available.

Using Elevator Brake Controls

Two relay control outputs are provided (Brake Lift, Brake Pick) by programmable output selection functions #186 and #183. Three timers are provided, Brake Pick #89, Brake Drop #90, Must Stop #91. Suggested wiring is shown in Figure 10: Drive Brake Control Feature. Operation is as follows:

Elevator Start with Brake Control:
1. The drive is started by activating first the ENABLE then RUN command lines. The contactor will pick (pull in), and when acknowledge, the drive will start the current and velocity regulator by priming it to provide pre-torque armature current (if enabled). The internal velocity reference will always start at zero.
2. Once Start is confirmed, the Brake Lift and Brake Pick lines will both become active. This will apply full voltage to the brake coil and cause the brake to lift.
3. The Brake Pick output will deactivate at the end of Brake Pick time #89, and release the internal velocity reference clamp so that the drive can begin acceleration. The Brake Lift output will

remain active. (Dropping of the external Brake Pick relay will reduce voltage to the elevator brake coil.)

Elevator Stop with Brake Control:

1. Automatic setting of the Brake and drive shutdown sequence may begin at any speed.
2. The Drive RUN command is released by customer's logic. This will set the internal reference speed to zero and start the Must Stop Timer. The velocity regulator will continue to control velocity and current, driving the speed to zero via the decel rate.
3. When the drive measures encoder speed as being zero (adjustable by #63) the Brake Lift and Brake Pick outputs will de-energize. The drive velocity regulator will continue to hold zero speed while the brake drops, as set by the Brake Drop Timer #90.
4. When the Brake Drop Timer expires, motor armature current ramp-down will occur, as set by #85. This will gradually transfer torque from motor to brake to help prevent brake 'thumping'.
5. When Current ramp-down is complete, the drive will cease operating and open the contactor.
6. If Brake Auto Stop #92 is ON, AND a zero speed command is present, AND the drive is stopped, the sequence of 2 – 5 above will be activated.
   NOTE: The drive will turn OFF with the Drive Run and Enable commands still active. These signals must be cycled to recover and re-start from this auto-stop operation.
7. If the Must Stop Timer #91 expires before zero speed is achieved, the Brake Lift and Brake Pick relay outputs will be de-energized and the drive will shut down regardless of the actual velocity. This is a secondary back up means of ensuring that the elevator will stop

Drive Faults

The following Faults are custom to the SA407 Generation 2 DSD 412 software.

Function Error Code Listing

***** DCU ERRORS *****

DISPLAY # - DESCRIPTION
13 = ILLEGAL INSTRUCTION
14 = LINE 1010 EMULATOR
15 = LINE 1111 EMULATOR
16 = PRIVELEGE VIOLATION
17 = DIVIDE BY ZERO
21 = WATCHDOG TIMEOUT
22 = RESERVED INTERRUPT
23 = UNINITIALIZED INTERRUPT
24 = TRACE EXCEPTION
26 = SPURIOUS EXCEPTION
97 = OVERSPEED TRIP
98 = TACH/ENCODER LOSS
99 = REVERSE TACH/ENCODER
100 = NOT A NUMBER
101= MATH OVERFLOW
102 = MATH UNDERFLOW
103 = FLOATING POINT DIVIDE BY ZERO
104 = SIGN ERROR IN SPEED REG
112 = BAD PCDU POINTER
113 = MISSING PCU
114 = LOCKED UP QUEUES
115 = MULTIPLEXER CONFIG. ERROR
117 = 20 SEC COMM. START FAULT
118 = 150 MSEC COMM. MSG FAULT
220 = DCU ROM BUS ERROR
221 = DCU RAM BUS ERROR
222 = DCU NVRAM BUS ERROR
223 = DCU DPRAM BUS ERROR
232 = UNKNOWN BUS ERROR
240 = DCU ROM BUS ERROR
241 = DCU RAM ADDRESS ERROR
242 = DCU NVRAM ADDRESS ERROR
243 = DCU DPRAM ADDRESS ERROR
252 = UNKNOWN ADDRESS ERROR

*****DRIVE FAULTS/ERRORS*****

DISPLAY # - DESCRIPTION
400 = MOTOR OVERLOAD
401 = EXCESSIVE FIELD CURRENT
402 = CONTACTOR FAULT
403 = 5-MIN FULL FIELD FAULT
404 = OPEN ARMATURE CIRCUIT FAULT
405 = SAFETY CIRCUIT FAULT
406 = 10% LOW LINE ALARM
407 = EXCESSIVE DCU CEMF ALARM
408 = EXCESSIVE PCU CEMF FAULT
409 = UNEXPECTED PCU RESET
410 = SPEED ERROR FAULT
411 = MAX AUTO-RESETS ATTEMPTED
413 = FIELD CURRENT TRACKING FAULT
414 = SOFTWARE COMPATABILITY FAULT

***** PCU ERRORS *****

DISPLAY # - DESCRIPTION
900 = PCU LOOP FAULT
901 = PCU IST FAULT
902 = POWER SUPPLY FAULT
903 = LINE SYNC FAILURE
904 = LOW LINE FAULT
905 = FIELD LOSS
906 = DCU FAILURE
907 = THERMISTOR FAULT
908 = OVER TEMPERATURE
909 = EXCESSIVE RIPPLE
910 = BLOWN FUSE
911 = SHORTED SCR
912 = OPEN SCR
915 = PARAMETER SETUP FAULT
916 = FORCING FAULT
917 = REVERSE ARM. V. FEEDBACK
919 = RATED VAC. SETTING ERROR
920 = RATED ARM. VOLT. SETTING
921 = BRIDGE RATING FAULT
923 = RATED ARM. I. SETTING ERROR
924 = RATED FIELD I. SETTING ERROR
925 = FIELD PCB SENSE FAULT
926 = PCU WATCHDOG TIMEOUT FAULT
929 = FIELD CURR. WON’T GO TO ZERO
930 = FIELD CURR. WON’T GO TO RATED
931 = OPEN CIRCUIT CEMF FAULT
932 = CLOSED CIRCUIT CEMF FAULT
933 = ARM CURRENT WON’T INCREASE
934 = LOW ARM INDUCTANCE
935 = WRONG BUS VS ARM VOLTS FBK
936 = E-STOP OPENED DURING TEST
937 = LOW ARMATURE VOLTS FBK
938 = LOW BUS VOLTS FBK
939 = FIELD FB HARDWARE FAILURE
940 = FIELD A/D OVERFLOW FAILURE
Prot = CORRUPTED NV RAM DATA

Troubleshooting

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
400	**MOTOR OVERLOAD FAULT ---** Indicates that the drive has delivered excess motor amps for a significant period of time. Refer to #83 and #84 for proper set-up. Check for dragging elevator brake or weakened motor field. A motor overload fault does not automatically shut down the drive, but is annunciated via the ALARM relay output K2. See #182
401	**EXCESSIVE FIELD CURRENT ---** Indicates that measured motor field current exceeded 125% of rated current #50. – Causes: Partially shorted motor field coil. Check motor field. Wrong data entry causing unstable motor field current regulator. Review and verify settings for #49, 50, 51, 52, 54, & 55. Mis-wiring of module A3. Verify that phasing is correct. Wrong current tap at A3, TB4, or A3 SW1 setting. Verify. Malfunction of motor field power circuit. Check module A3.
402	**LOOP CONTACTOR FAULT**— The Loop Contactor auxiliary contact does not pick up or drop out within the designated time as requested by the DSD 412 drive. See #102. – Causes: Defective Loop Contactor Aux. Check for proper feedback at TB1-7. Defective Contactor. Check for open coil or mechanical binding. Defective Pilot Relay LPR. Interference from other elevator relay contact circuits.
403	**FIVE-MINUTE FULL FIELD –** Indicates that the Drive and Field Enable control circuit at TB1-9 was active for 5 minutes without starting the drive. This can cause motor field burnout. Check car controller relay logic.
404	**OPEN ARMATURE CIRCUIT –** A large current error existed for ½ second. Check the DC link fuse F4. Check motor armature circuit wiring. Check power poles in the DC loop contactor.
405	**SAFETY CIRCUIT FAULT**— The Safety Circuit is not closed. The Drive has detected that the Safety Circuit wired between TB3-1 and TB3-6 on the Power Supply A4 was not closed for 100 MS before a “Drive Run” command was given, or that it opened unexpectedly while the loop contactor was closed. Check for intermittent connections in the Safety Chain.
406	**LOW LINE ALARM –** Indicates that the input AC line voltage sagged more than 10% below nominal line volts as set at #9. This does not shut down the drive but may be an indication that work is needed to avoid future Low Line shut down faults, F904.

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
407	**DCU CEMF FAULT - The** CEMF of the motor exceeded 109% of measured AC input voltage to the Drive. This is a warning only and does not cause an automatic drive shut down. – Causes: 3 Phase Input AC Line Voltage drooped or is too low. CEMF on motor rises above VAC input voltage. Motor field current set too high. Verify weak field set point #49 Vs desired motor voltage at top speed. Check & correct motor field control tuning to prevent CEMF overshoot. . Review and verify settings for #49, 50, 51, 52, 54, & 55.
408	**PCU CEMF FAULT -** The CEMF of the motor exceeded 118% of the rated VAC input voltage to the Drive. This fault causes a drive shut down to prevent fuse blowing. – Causes: 3 Phase Input AC Line Voltage is low. Check and correct. Incorrect motor field current setting or field regulator miss-operation causing excessive CEMF. Check & correct. Excessive drive speed overshoot. Correct with velocity regulator adjustments. Check and correct motor field control dynamic tuning to prevent CEMF overshoot. Review and verify settings for #49, 50, 51, 52, 54, & 55.
409	**PCU RESET** — PCU processor was unexpectedly reset. Verify that correct PCU software and revision level is being used. Possible problem with main circuit card hardware. Look for external noise interference. Ensure that equipment and signal grounding connections are proper. Correct as necessary. If problem remains, replace Drive Control PCB.
410	**SPEED ERROR TRIP FAULT ---** Indicates that a large speed error existed for a significant period of time. Look for dragging brake or weak motor field. See the explanations for #99 & #100.
411	**MAX AUTO-RESETS ATTEMPTED ---** Indicates that more than 5 automatic resets were necessary in less than 20 minutes of accumulated time. See the explanation for #101.
413	**FIELD CURRENT TRACKING FAULT ---** Indicates that the *ACTUAL* field current is failing to track the field current *COMMAND* by more than F192 (Default = 0.05) for 5 seconds. *This is not a shut down fault*. 1. Check AC voltage on AC1 and AC2 – Typically 1.5 to 2.5 times VAC (min), where VACmin = VDC/0.9 or (Full Fld Amps * Field resistance)/0.9 2. Drives not using correct self-tune values and/or field response set incorrectly. 3. Monitor F620 Fld Trkg Diff, it should be less than F192 "F413 Detection Level". By setting F192 higher it can eliminate this warning, Caution should be observed prior to doing this, If the proper conditions exist the data on F620 display should not exceed 0.05PU for over 5 seconds.

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
414	**SOFTWARE COMPATABILITY FAULT** --- Indicates that the PCU (U13,U14) Version and or Revision won't operate with the DCU (U39,U40) installed in the drive. 1. Contact Magnetek
13-17, 21-26, 100-104, 112-114, 220-234, 240-254, 926	**MISC FAULTS** - Problem with either hardware or software on the Drive Control PCB. See list at Section 4.5. Check and/or replace U13, U14, U39, U40 (EPROM's). Replace Drive Control PCB A1.
117 / 118	**SERIAL COMMUNICATION FAULT** 117 = Serial comm. not started within 20 seconds after drive reset or power up. 118 = Valid serial comm. message not received for more than 150 MS. 1. Ensure that host is connected and sending valid messages. 2. Look for and correct electrical grounding noise interference problem. 3. If Serial comm. is not being used do not set #110 to selection 3.
97	**OVERSPEED FAULT** - The motor speed has exceeded the trip level set in function #12, as measured by the encoder. #12 is a percentage of the motor speed value set in #11. Possible cause Incorrect setting of #10, #11 or #12. Poor speed regulator tuning - Check #40, 41 & 42 Velocity reference set above rated speed. Intermittent velocity encoder.
98	**TACH LOSS FAULT** - The drive does not see the encoder velocity in proportion to armature voltage indication of speed. Refer to Function explanations for #14 and #15. Ensure that the encoder is working. Look for loose connections. Raise the value for #14 if motor has high resistance. Ensure that the contactor feedback circuit at A1TB1-7 does not close before the armature power poles. See timing diagram Fig. 4.4.7.
99	**REVERSED TACH FAULT** — The digital encoder and motor voltage signals do not agree in direction of rotation. Probable cause: Encoder leads are reversed. Reverse connections for A and A/NOT.
900	**PCU LOOP FAULT** - The contactor did not close or opened unexpectedly. Or the motor voltage exceeded 30% of rated motor voltage #7 during Self-Tune #997. When this occurs, the Severe Fault flag is set and the DSD 412 current reference is forced to zero. This fault will shutdown the drive. Check the contactor aux feedback circuit to TB1-7. Check contactor and LPR coils for proper operation. Check that power is being applied to LPR from the power supply at TB3- 5. (Will be momentary until F900 occurs.) If not there, suspect an internal relay failure. Replace A4, Power Supply PCB.

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
901	**PCU IST FAULT** – Current flow in excess of 300% of rated armature current detected. Check for: 1. Ground fault or intermittent connection in motor armature circuit. 2. Faulty current measuring module. 3. Poor current regulator tuning.
902	**POWER SUPPLY FAULT** (CPU Reset Required) The Low Voltage Power Supply (A4) output has dropped below 60% of the rated voltage. This fault will shutdown the drive. Possible causes; Loss of 115VAC power. Short circuits in +5V, +/-15V, or +24V circuits, possibly external to the drive. Failed Power Supply Blown fuse internal to power supply.
903	**LINE SYNCRONIZATION FAULT** (CPU Reset Required) The Phase Locked Loop has lost synchronization with the 3 Phase AC input power supply. When this occurs, the Severe Fault flag is set and the current reference is forced to zero. Generally this is caused by AC input power problems and is self-correcting. This fault will shutdown the Drive. This fault will often occur with a F904 fault.
904	**LOW LINE VOLTAGE FAULT** The AC input power has dropped below 80% of the Nominal AC Line Voltage #9 for 3 consecutive cycles or lower than 50% for one cycle. When this occurs, the Severe Fault flag is set and the DSD 412 current reference is forced to zero. This fault will shutdown the Drive.
905	**FIELD LOSS FAULT** This fault will shutdown the Drive. The field current feedback has dropped below 80% of the expected current during the following conditions: #49 when Drive is in Field Weakening Mode (Top speed). #50 when Drive is in Full Field Mode (Accel or Decel). #53 when Drive is in Standing Field Mode (not running). Probable causes are: Open circuit failure of motor field or motor field wiring. Hardware failure of motor field control circuitry. Loss of power or incorrect phasing to Field Rectifier.
906	**DCU FAILURE FAULT** (DSD 412 Power down is required.) The update of the Dual Port RAM from the Drive Control Unit (DCU) is unreliable. This requires the replacement of the Drive Control PCB, A1. This fault will shutdown the drive.
907	**THERMISTOR FAULT** The thermistor is found to be open or shorted. Check and/or replace the thermistor. It should measure between 2K – 10K ohms at 20C room temperature. A Thermistor Fault will also occur if the machine room ambient temperature is below 0C as the resistance it detected is too high to be measured. An open thermostat on larger drives will also indicate F907. This fault will not shutdown the Drive.

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
908	**OVER TEMPERATURE FAULT -** The calculated SCR junction temperature is above 125 degrees Centigrade. This is calculated from the thermistor heat sink measurement and measured armature output current heating effects of SCRs. Possible causes: Ambient temperature too high. Check for cause. Clogged air filter in cabinet. Clean or replace air filter. Clogged heat sinks. Clean Heatsink fins. Cooling fan failure. Replace defective cooling fan(s) in power cube. Note: This fault will not shutdown the Drive**.**
909	**RIPPLE FAULT** - Repeated high peak to average motor armature current. The cause of this condition may be defective hardware that can be discovered through the PCU Diagnostics CDU function, #998. It may also occur due to poor regulator tuning or other oscillatory operation condition.
910	**BLOWN FUSE** FAULT - One or more of the three AC line fuses is open. This condition is checked on power-up and upon request through the PCU F#998 PCU Diagnostics function. Detection is accomplished by measurements via voltage dividers on the Armature Interface PCB, A2. Possible causes are; One or more of AC input fuses are blown. Power wiring problem-check wiring. Faulty DSPR power relay.
911	**SHORTED SCRS/DOUBLER FAULT** (DSD Power Down is required.) One of the SCR/Doubler packs has a short circuit between the SCRS. This condition is checked only upon request through the PCU #998 Diagnostics CDU function. The optional handheld PCDU will also identify which SCR pair is bad.
912	**OPEN SCR FAULT** (DSD Power Down is required.) One of the SCRs does not conduct current. This condition is checked only upon request through the PCU #998 Diagnostics CDU function. The optional handheld PCDU will also identify which SCR pair is bad. Check for faulty SCR gating leads.
915	**PARAMETER SETUP FAULT** (DSD power down is required.) One of the following parameters is not within the range of the chassis hardware. Rated Volts #7 or #9 Rated Current #3 or #50 Corrective action: Enter correct parameter data, save to NVRAM. Reset the drive & re-start.
916	**FORCING FAULT –** The prohibit rotation bit was removed with the loop picked-up. This fault can only occur when using the handheld PCDU.

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
917	**REVERSE ARMATURE POLARITY -** (DSD power down is required.) This fault will show up when doing the F998 PCU Diagnostics Test. It indicates that the polarity of the Armature Voltage Feedback wires is reversed or missing. Check connections on A1TB5-1 and A1TB5-2 of the Armature Interface PCB, A2. F909 faults and/or very poor drive/ride performance may occur if not corrected.
919	**LINE VOLTAGE SETTING FAULT** (DSD power down is required.) This fault is declared if a number is entered for the Rated Line Voltage, #9 that is outside the acceptable range of 150 to 525VAC. If 0 is entered, the rated line voltage defaults to 230 or 460 VAC depending on the line voltage sensed.
920	**LOAD VOLTAGE SETTING FAULT** (DSD power down is required.) Declared if the Rated Armature Voltage, #7 value is outside the acceptable range of 150 to 700 VDC.
921	**BRIDGE RATING FAULT** (DSD power down is required.) The bridge type is determined by reading a sense resistor on the Cube ID PCB plugged into the A2 Armature Interface PCB. The resistor value identifies the ampere rating and current feedback scaling of the physical hardware. This failure occurs if the computer cannot identify the drive size. Possible causes: J14 on Main Control PCB is not seated properly. Missing or wrong Cube ID PCB. Wrong PCU software in U13 & 14. Faulty Armature Interface PCB – replace PCB. Faulty Drive Control PCB – replace PCB.
923	**LOAD CURRENT SETTING FAULT -** (DSD power down is required.) This fault is declared if a number is entered for Rated Armature Current, #3 that is outside the acceptable range of 0.125 to 2.0 times the bridge current rating as determined by the bridge sense resistor on the Cube ID PCB, on the Armature Interface PCB.
924	**FIELD CURRENT SETTING FAULT** (DSD power down is required.) This fault is declared if a number is entered for Rated Field Current #50 that is outside the acceptable range of the Field Interface board, A3 current rating as determined by the field sense resistor selected by SW1 on the Field Interface PCB.
925	**FIELD SENSE FAULT -** (DSD power down is required.) The field bridge rating is determined by reading a sense resistor on the Field Interface board selected by SW1. This resistance identifies the motor field current feedback scaling for the A/D converter. If the resistance value is not recognized a Field Sense Fault is declared. This indicates that there is a hardware fault on the Field Interface PCB, Drive Control PCB, or within the interconnecting cables and hardware. Check that J13 is seated properly and that the cable is not defective.
926	**PCU WATCHDOG -** (DSD power down is required.) This fault is declared when the PCU is reset via its own software watchdog timer. It is an indication of a PCB hardware problem more

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
	so than a DCU or PCU software problem. A likely cause is severe electrical interference. Check for: Faulty EPROM's or socket connections at U13, U14, U39 or U40. Ensure that all panel relays have working R/C coil suppression. Include relays that may be operating door opener equipment. Look for relays where the +24V and 115VAC signals are being switched in the same relay. There must be arc barriers between contact poles to avoid "spark splash" from 115 VAC circuits into 24 VDC logic. Check for intermittent grounds in the power circuit and in 24Vdc signal wiring. Noise generated over the encoder feedback, power supply, or Drive Control PCB can cause this fault. Verify all connections and verify that the Drive Control PCB is properly grounded. This fault is usually caused by electrical noise causing the DSD 412 microprocessor to malfunction. If this occurs when the car is stationary, the car controller can quickly reset it. An elevator passenger doesn't see any effect.
Prot	**CORRUPTED NVRAM DATA –** The NVRAM has lost parameter set up data. This fault will occur if the battery within NVRAM chip U56 is weak. The drive display will show '**Prot**" if a loss of data is detected when power has been re-applied, and the processor attempts to load in default values while the NV-Protect switch is in the 'safe' ON position. MagneTek recommends replacing U56 every 8 years.
" P.L. "	**POWER LOSS** - Loss of 115 VAC control power. — Check cable connection at TB3 of Power Supply Assembly A4. Ensure that control power is always above 92 VAC.
" – – – "	**BLOWN FUSES** or loss of 3 phase input power. – Check for blown line fuses. If fuses are not blown, verify that AC input voltage to drive is present. Verify that power supply voltages are valid at TP1, 2, 3, & 4 on the main PCB. Check connections to the Armature Interface PCB and ribbon cable at J4.
F929	**Motor field current does not reduce to near zero within 6 seconds. Verify motor field current with an independent clamp-on DC ammeter.** Probable causes: Incorrect phasing of Vac supply to field control module. Provide correct single phase supply wiring per connections shown in Figs. 2.1 of this manual: Faulty SCR/Rectifier power module for motor field. Replace. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
F930	**Motor field current does not increase to near rated amperes within 6 seconds. Verify motor field current with an independent clamp-on DC ammeter.** Probable causes: Motor field not connected. Not enough voltage available to achieve rated field current. Maximum Vdc output to motor field is 0.9 X Vac input at terminals A3TB1, AC1 & AC2. At –10% low line, the maximum Vdc output is 0.8 x Vac. If this voltage is not enough to produce rated field current through the resistance of the motor field winding, reconnect the field windings for lower voltage (and higher current) or provide a step-up transformer for the motor field circuit as shown in Figure 2.1 of this manual: Improper settings for the connected motor field. Insure that the proper current tap at A3TB4 is used, and that calibration switch A3S1 is set correctly, and that adjustments #49, #50, #52, and #55 are set correctly. Faulty SCR/Rectifier power module for motor field. Replace. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F931	**Excessive open circuit voltage to motor armature circuit. Measured armature voltage is greater than 10% of rated volts #7.** Probable Causes: Motor is rotating, producing CEMF. Unbalanced SCR leakage with low voltage setting of #7. Increase #7 for test. Damaged SCR(s) *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F932	**Armature CEMF volts >20% of rated during test.** Probable causes: Motor rotating during the test producing CEMF. High motor armature resistance. Ensure that brush commutator is clean. Temporarily increase Rated Armature Volts, #7 during the test. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F933	**Motor armature current does not increase to near test amps within 6 seconds.** Probable causes: Faulty motor armature circuit. Check wiring and motor for open circuit. Open SCR or missing SCR gating. Perform Self-Diagnostics to verify. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F934	**Calculated armature inductance is less than 0.00017 Henry.** The drive will not Self Tune with less than 170 micro-henries of load inductance. Verify that inductance is really that low. Verify that Vac value at #9 is correct. Manually enter the minimum value into #5. Parameter #2 must be set to OFF. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).

ERROR/FAULT CODE	PROBABLE CAUSE/ — CORRECTIVE ACTION
F935	**Calibration of bus voltage and armature voltage feedback circuits do not match.** Probable causes: Missing wire to bus or armature voltage feedback circuits. Component problem - Feedback voltage divider ratios do not match. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F936	**E-Stop contact was opened during test. Test data is not valid. Jumper E-Stop circuit and re-test.** *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F937	**Low read-back volts from motor armature circuit.** Probable Causes: Missing wire to armature voltage feedback at A2TB5-1 & A2TB1-2. Component problem – Feedback voltage divider ratio does not match that identified in Cube ID PCB. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F938	**Low read-back volts from DC bus circuit.** Probable Causes: Missing wire to bus voltage feedback. (Discrete wires on drives larger than 300 amps DC.) Component problem – Feedback voltage divider ratio does not match that identified in Cube ID PCB. *may occur during Self-Tune (Fctn #997) or Self-Diagnostic (Fctn #998).
F939	**Faulty Field Control Hardware.** Probable Causes: Component problem – Replace Field Interface Board. If fault is still present replace the Main Control Board. *may only occur during power-up.
F940	**Field Current Feedback A/D Saturated** Field A/D reading is saturated for more than 15 seconds.Probable Causes: Component problem – Replace Field Interface Board. If fault is still present replace the Main Control Board.

Table 13: Fault Code Descriptions

OTHER CONDITIONS	PROBABLE CAUSE / CORRECTIVE ACTION
NO LED DISPLAY WITH POWER ON	**No power at TB3 or failed power supply.** Verify 115 Vac control voltage at TB3(1 & 2) Verify that cable J11 is seated properly. Short circuit on external wiring dragging down the power supply. Verify by temporary removal of wires at TB1(48, 82, & 1). If display operation is restored. fix external problem. Short circuit internal to current measuring transducer. Verify by removal of J27. If display operation is restored, replace the current transducer. DO NOT RUN THE DRIVE WITH CURRENT TRANSDUCER DISCONNECTED. 5. Faulty or missing EPROM'S or faulty socket connections at U13, 14, 39, 40.
LOSS OF STORED PARAMETER DATA	**Severe electrical disturbance with NV-Protect switch in OFF position, or failure to actually save the data, or weak battery within U56.** Remember to SAVE the data when parameters are changed. See Section 3.6 Return NV-Protect switch to ON when parameter data changes are completed. Magnetek recommends replacing U56 every 8 years.
DRIVE DISPLAY INDICATES BLOWN FUSES WHEN ALL FUSES TEST GOOD WITH OHMMETER	**Control power applied before 3-phase armature supply. Short circuit in +/-15 V wiring circuits prevents analog circuit measurements from working.** Verify that 3-phase power and control power are supplied simultaneously. Or that drive faults will be RESET by external circuits after 3-phase power is applied. Read power supply voltages at test points near the top front of PCB A1. TP8 is circuit common. TP1, 2, 3, & 4 (just below J11, to right of silver metal can U8) should be +24V, +15V, -15V, +5V, +/-5% respectively. If voltages in step 2 are low, unplug ribbon cables at J13 and J14 (A1 PCB, lower left). If power supply voltages are restored, pursue cause of short circuit on those cables. Suspect faulty current transducer or cable. Remove power supply cover. Disconnect power supply at J11. Re-measure voltages at marked test points on power supply PCB. If voltages are OK with J11 disconnected and fault was not found in step 3, replace main PCB.
REPEATED FALSE OVER-TEMPERATURE INDICATIONS	Leakage current between the thermistor on the heat-sink and the thermistor leads can cause an elevated temperature to be measured. Replace failing thermistor and/or thermostats. Conditions out of the range specified tempurature range.

Figure 22: Other Faulting Conditions

Input – Output Signal Verification

The Control Display Unit (CDU) function #981 may be used to directly read and track the status of logic input and output signals at DSD 412 drive terminals. This is an easy way to verify the integrity of input and output logic signals to the drive. Refer to specific connection diagrams for your application to confirm the definition of how each signal is being used. The I/O indicator technique as described below will work regardless of whether or not the particular terminals and signals are used by internal software logic or actually wired into your application. Function #981 does not work with the Portable Control display Unit.

Here's how to use this valuable troubleshooting tool:

1. Press the Up ▼ or Down ▲ keys and go to F#981.

2. Press the DATA FCTN KEY. The green light should turn ON to indicate that data is being displayed.

3. Segments on the local Control Display Unit will light up to indicate active input and output logic actions. Vertical segments represent input signals and horizontal segments represent output signals as identified below.

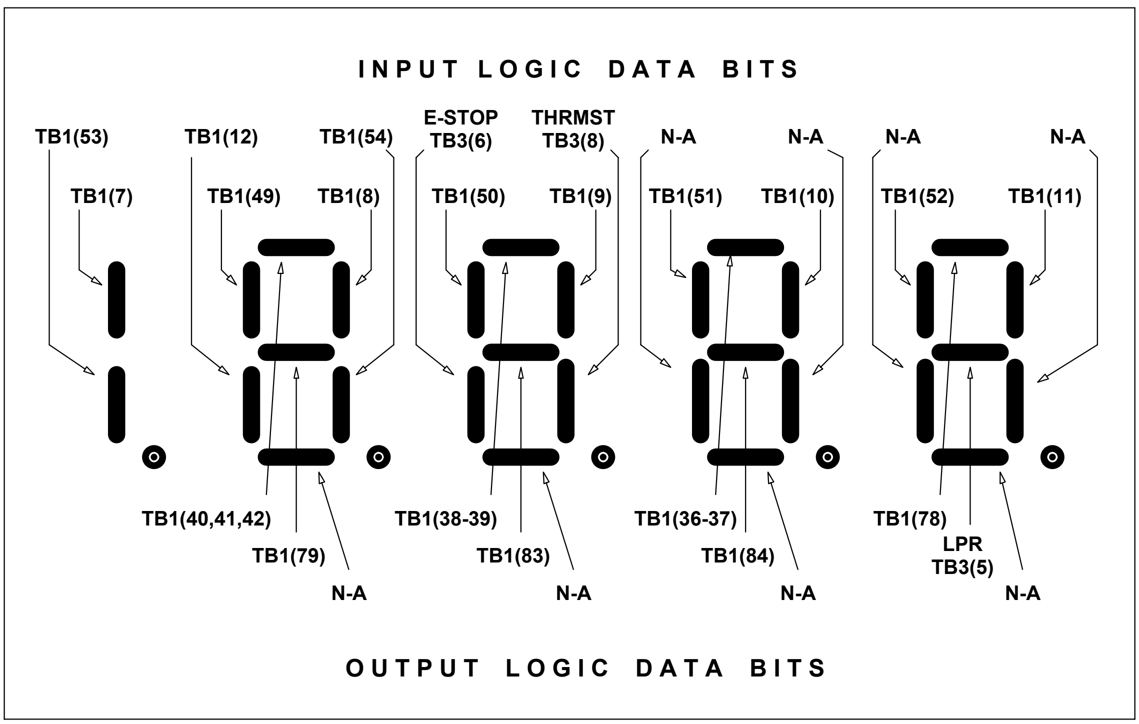


Figure 23: I/O Monitor Function

Maintenance

Preventive Maintenance

> **WARNING**
>
> HAZARDOUS VOLTAGES MAY EXIST IN THE DRIVE CIRCUITS EVEN WITH DRIVE CIRCUIT BREAKER IN OFF POSITION. NEVER ATTEMPT PREVENTIVE MAINTENANCE UNLESS INCOMING THREE-PHASE AND CONTROL POWER IS DISCONNECTED AND LOCKED OUT.

Preventive maintenance is primarily a matter of routine inspection and cleaning. The rectifier bridge heat sinks should be kept clean by brushing while using a vacuum cleaner. Excess dust and dirt accumulation on the heat sinks can cause overheating of the SCRs.

Periodically check all electrical connections; tighten as required.

Periodically check air filters on enclosure doors, if applicable; clean if dirty, 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. Each fan motor is permanently lubricated; the fan should be replaced if the shaft does not spin freely.

If/When drive faults occur, follow those aids based on the observed Error/Fault code. In some instances, the fault tracing required to determine the necessary repairs is too extensive to list in detail in this manual; for those faults, it is recommended that Magnetek be called for assistance.

Some of the probable causes in Table 13: Fault Code Descriptions mention problems at connectors, all of which are on the Drive Control PCB. Table 14: Connector Definitions describes the basic function of each connector, and Figure 24: Connector and E-prom Locations on the board.

Repair and Replacement Procedures

Replacement parts are listed in **Section 6**. Either the common name or reference designator of a particular part may be used to locate the item in the Recommended Spare Parts Table to find a replacement part number. Be sure to use the proper table corresponding to the ampere rating on the drive nameplate.

Printed Circuit Boards

> **IMPORTANT**
>
> When replacing any printed circuit board (PCB) or any integrated circuit (IC) in the DSD drive, proper Electro-static Discharge (ESD) procedure MUST be followed.

Repair of printed circuit boards requires special techniques and test equipment. ***For this reason, field repair is not authorized, and replacement of a suspect board is recommended.***

Defective or questionable printed circuit boards should be returned to MagneTek, for repair and test. The printed circuit board should be ESD protected, then individually protected with an inch thickness of soft wrapping material before it is packed in a suitable carton. MagneTek assumes no responsibility for printed circuit boards returned without proper return tags and forms. Contact your Magnetek sales representative for proper return tags and forms.

CONNECTOR	TYPE	FUNCTION
J1	DB-9	Provides interface to connections for external RS422 serial link controls. J1 and J2 are mutually exclusive.
J2	RJ-12 Phone jack plug 6-pin	Provides interface connection for external RS232 devices. The optional PCDU plugs into this connector. J1 and J2 are mutually exclusive.
J11	20-Pin Header	Provides power supply voltages and control signals to the Drive Control PCB from the DSD 412 Power Supply PCB.
J13	10-Pin Header	Provides power supply and board sensing connections to the DSD401 Signal Interface PCB, A3. [This cable is the same as that used to connect the standard DSD 412 field Interface PCB.]
J14	40-Pin Header	Provides control and feedback signal connections to the Armature Interface PCB
J31	10-Pin Header	Connects TB1 logic signals to Signal Interface PCB A3.
J32	4-Pin Header	Connects analog output signals from TB1 to Signal Interface PCB A3.
J33	10-Pin Header	Connects J13 to Signal Interface PCB, A3.

Table 14: Connector Definitions

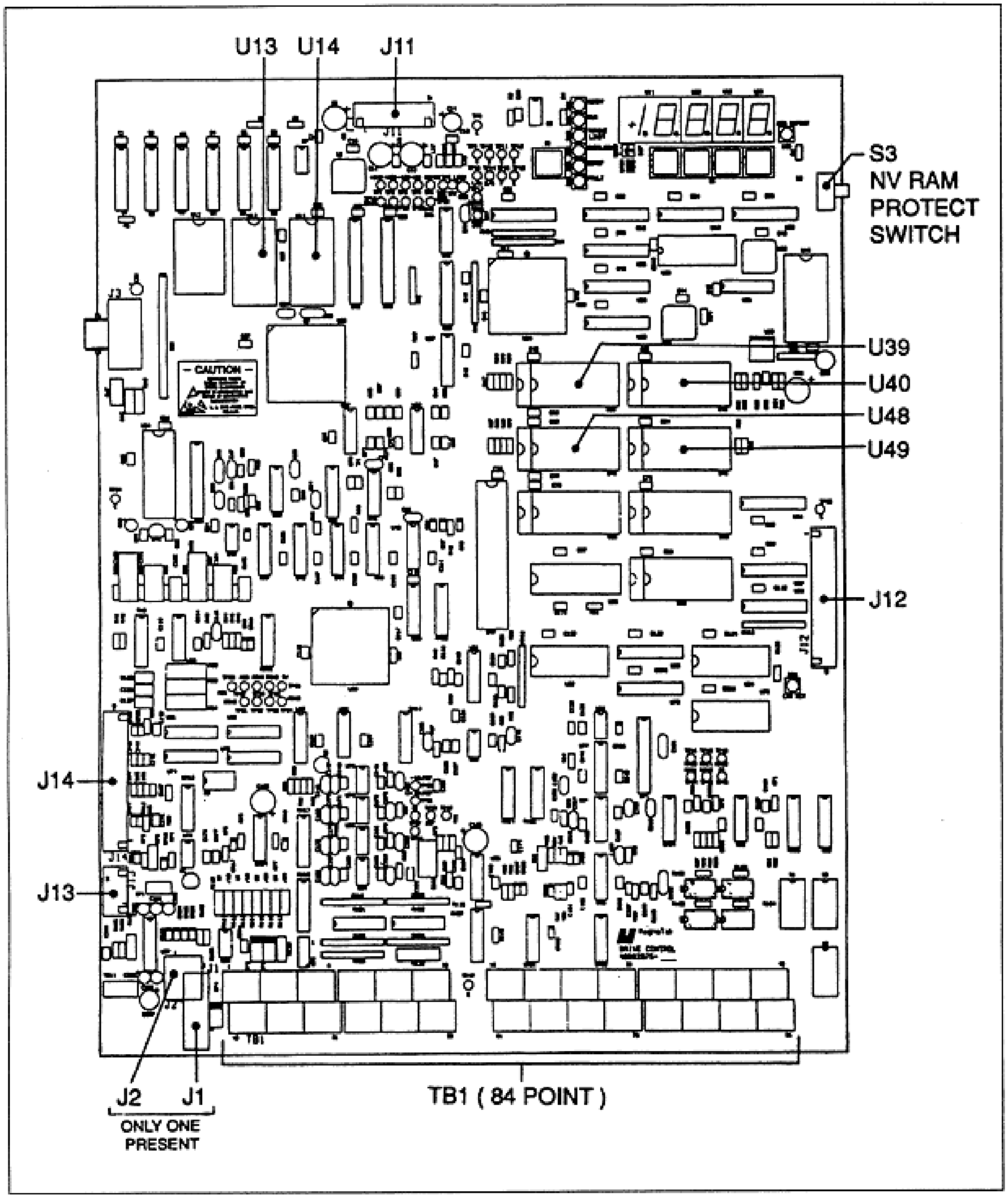


Figure 24: Connector and E-prom Locations

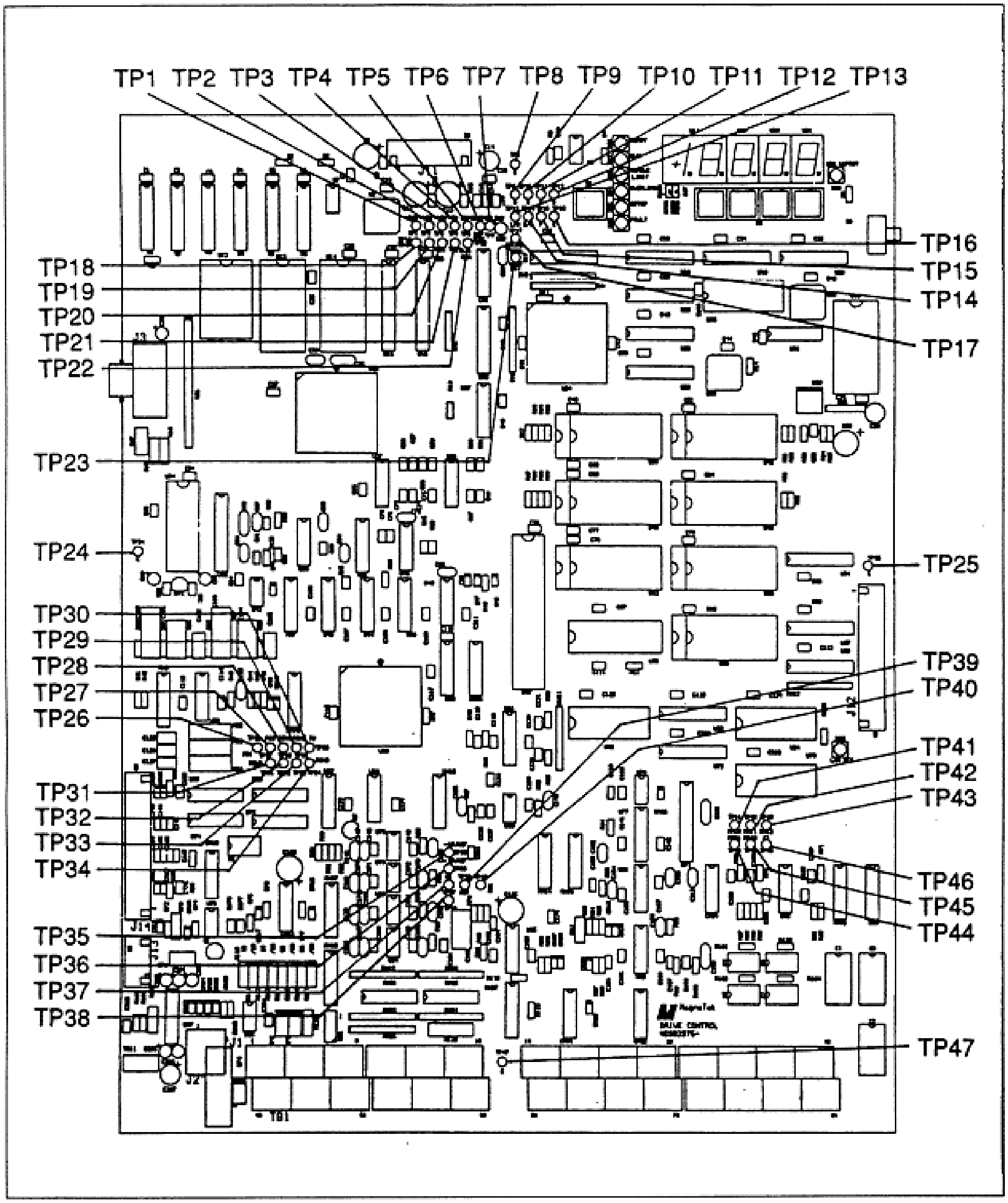


Figure 25: Test Point Locations

TEST POINT	FUNCTION	DESCRIPTION
TP1 TP2 TP3 TP4	+24V SUPPLY +15V SUPPLY –15V SUPPLY + 5V SUPPLY	+24V SUPPLY +15V SUPPLY –15V SUPPLY + 5V SUPPLY
TP5 TP6 TP7	EMERGENCY STOP OPEN THERMOSTAT OPEN LOW PWR SUPPLY WARN	HI = EMERGENCY STOP IS OPEN HI = THERMOSTAT IS OPEN HI = LOW 115VAC TO PWR SUPPLY
TP8 TP24 TP25 TP47	COMMON COMMON COMMON COMMON	COMMON COMMON COMMON COMMON
TP9 TP10 TP11 TP12	A SCAN TIME B SCAN TIME C SCAN TIME D SCAN TIME	HI = DCU A SCAN IS RUNNING HI = DCU B SCAN IS RUNNING HI = DCU C SCAN IS RUNNING HI = DCU D SCAN IS RUNNING
TP13 TP14	LAN E/O	Chip select for LAN mode; High = Active EVEN/ODD Address Select; High = +5V
TP15 TP16 TP17	F SCAN TIME E SCAN TIME ABCDE SCAN TIME	HI = DCU F Scan is running HI – DCU E Scan is running HI = DCR ABCDE or F Scan s are running
TP18 TP19 TP20 TP21	BUS DIR RESERVED FOR TESTING RESERVED FOR TESTING RESERVED FOR TESTING	N/A N/A N/A N/A
TP22	ARMATURE DISABLE	Logic 1 when Forward or Reverse Bridge is firing. Jumper to COMMON to disable Bridge.
TP23	WATCHDOG DISABLE	Logic 0 during POWER-UP CPU RESET; Otherwise a Logic 1.
TP26 TP27	ANALOG OUTPUT, TB1-26 ANALOG OUTPUT, TB1-27	Analog Output Signal on TB1-26. Analog Output Signal on TB1-25.

TEST POINT	FUNCTION	DESCRIPTION
TP28 TP29	CB LAG BA LAG	C-B PHASE SIGNAL B-A PHASE SIGNAL
TP30	ARMATURE VOLTAGE	SCALING = 100/1 (100VDC ON ARMATURE = 1VDC ON TP30)
TP31 TP32 TP33 TP34	ANALOG INPUT ANALOG INPUT ANALOG INPUT ANALOG INPUT	ANALOG INPUT SIGNAL ON TB1-58. ANALOG INPUT SIGNAL ON TB1-59. ANALOG INPUT SIGNAL ON TB1-60. ANALOG INPUT SIGNAL ON TB1-61.
TP35 TP36	- 10V REFERENCE OUTPUT +10V REFERENCE OUTPUT	- 10V REF OUTPUT AT TB1-29. +10V REF OUTPUT AT TB1-28.
TP37	ARMATURE CURRENT FEEDBACK	3V @ 1 Per Unit (Use Shielded Probe to avoid noise pick-up. Noise will cause erratic Drive operation) See TP39
TP38	ANALOG TACH FEEDBACK	ANALOG TACH SIGNAL (When used)
TP39	ARMATURE CURRENT FEEDBACK	Filtered Armature Current Feedback Signal. Average of Armature Current.
TP40	DIFF ANALOG INPUT	+/- 10V DIFF INPUT ON TB1-63, 68 *OR* +/- 600MV DIFF INPUT ON TB1-64, 67
TP41	ANALOG OUTPUT #0	Analog Output to TB1-45
TP42	DIFF ANALOG INPUT, +/-10V, OR +/- 0-600MV	DIFF INPUT, +/-10V TO TB1-71, 76 *OR* +/- 0-600MV DIFF INPUT TO TB1-72, 75
TP43	DIFF ANALOG INPUT +/- 10V	DIFF INPUT, +/- 10V TO TB1-30, 31
TP44	ANALOG OUTPUT #1	ANALOG OUTPUT to TB1-46
TP45	DIFF ANALOG INPUT, +/- 600MV	+/- 600MV TO TB1-34, 35
TP46	FIELD CURRENT FEEDBACK	1.9A Term, TP46 = 6.7V@1.9A 6.9A Term, TP46 = 6.7V@6.9A 16.0A Term, TP46 = 6.7V@16.0A 40.0A Term, TP46 = 6.7V@40.0A

Table 15: Test Point Definitions

Drive Control PCB Replacement.

1. Release the front cover of the drive by pulling out the four corner fasteners, approximately 1/4 inch, until they snap; then remove the cover.
2. Mark each cable and wire to ensure proper reconnection; before disconnecting them.
3. Disconnect all cables and wires from the Drive Control PCB. Remove nine screws holding the Drive Control PCB to the swing out door chassis from the front, and remove the Drive Control PCB from the power cube.
4. If there is an optional circuit board attached to the back of the Drive Control PCB, disconnect the Local I/O cable from J12 on the Drive Control PCB. Then remove the mounting screws which secure the Local I/O PCB to the back of the Drive Control PCB. Re-attach the same Local I/O PCB to the replacement Drive Control PCB using the same hardware in reverse order. Re-attach the J12 cable.
5. Mount the new Drive Control PCB into the power cube by reversing procedure in steps 1 through 3. Be sure to re-use the small diameter flat washers under the screw heads on the Drive Control PCB to maintain proper electrical clearances.
6. *Remove* integrated circuits (ICs) U13, U14, U39, U40 as appropriate, from the defective Drive Control PCB. Install into the same positions on the new board. Ensure that polarity notch on IC is aligned with the silk screen notch on the board. Each IC is marked with the proper “U” number in the bottom left hand corner of its label.
7. Perform Start-Up Procedure.

IC Replacement

IMPORTANT

When replacing any printed circuit board (PCB) or any integrated circuit (IC) in the DSD drive, proper Electro-static Discharge (ESD) procedure MUST be followed.

EPROM Replacement

To replace an EPROM (U13, U14, U39, U40), first check that the new device has the same “U” number on its label as the defective device. Remove the existing device and install the replacement in the same position. Then perform the Start-Up Procedure in Drive Start .

NVRAM Replacement

To replace an NVRAM device (U56), remove the defective device and install the replacement in the same position. Then perform the Start-Up Procedure. If you have kept a record of the parameter settings you should be able to re-load all parameter values, save the data and go. If you do not have a record of the working drive parameter settings, you must re-enter and re-tune all parameters by repeating all drive adjustment procedures.

Testing and Replacement of Power Components.

Fuse Replacement

Whenever attaching a fuse, wire or bus bar to another component to achieve an electrical connection, always apply a thin coating of electrically conductive joint compound to all contacting surfaces. Magnetek recommends using Joint-Al-Z compound for all bolted electrical power connections.

Diagnosis of fuses — The input AC fuses are checked when power is initially applied during the Start-Up sequence of the drive, and again when a PCU DIAGNOSTICS #998 is performed. The output DC fuse is checked only when a PCU DIAGNOSTICS #998 is performed. when running, blown fuses may cause an F910 or F404. *With input power disconnected*, the fuses may be checked with an ohmmeter while still in place in the circuit. Replace any fuse that indicates a resistance reading of more than a fraction of an ohm. Re check that the fuse is indeed open/blown when removed from the circuit. Be aware that other circuitry may cause a low resistance reading to appear across a blown fuse. If there are doubts about the fuse being good or bad, remove connections to at least one end before measurement. For maximum assurance to prevent call-backs, Magnetek recommends replacing all three AC line fuses even when only one or two are blown.

If the drive blows AC input fuses, check for shorted SCRs before power is re-applied. While the input fuses are removed for replacement, measure circuit resistance from each AC line to AC line on the SCR power bridge side of the fuse connections, and from each AC line to the DC output busses. If resistance readings are less than 100 K-ohms, suspect shorted or badly damaged SCRs. Replace those faulty parts before attempting to power up again with fresh fuses.

There is a small fuse inside the Drive Power Supply, A4. This fuse may blow if 115 Vac control power has surged above 135 volts. If there is voltage at A4TB3-1 & A4TB3-7, but the power supply does not appear to work, this fuse may be checked by removing the power supply cover. A blown power supply fuse does not necessarily mean that the power supply is faulty as the fuse also protects a transient surge suppressor contained within. External surges on the 115VAC control voltage power source can cause this fuse to blow.

Testing and Replacement of Power Semiconductors and Snubber Components.

If SCRs are suspect, test for short circuits before disassembly to help locate the problem. Refer to specific instructions in this manual for the drive ampere size. Perform the suggested ohmmeter tests to verify that there are no direct short circuits. Then perform the PCU DIAGNOSTICS #998. These tests will perform shorted and open SCR tests to help indicate which SCRs need replacement.

Several different DSD 412 power circuit configurations exist in order to handle rated currents from 25 to 1350 amperes. Refer to the proper sub-section in this manual according to rated drive current as listed on the nameplate for specific service information for the individual power conversion units.

Testing and Replacement of the Motor Field Control Module and PCB

Components of the DSD 412 for control of motor field consist of the A3 PCB and associated SCR/Rectifier module Q7 located under the PCB. Input power is single phase voltage supplied to A3TB1 terminals AC1 and AC2. Motor field current DC amperes are measured by a current transducer (CT) located on the PCB. Connecting the F1 (+) field wire to TB4 selects the full scale current range. Switch A3S1 is used to tell the microprocessor what 'tap' is being used.

If the desired motor field current cannot be obtained:

1. Verify that the proper AC voltage is available at terminals A3TB1-AC1 & A3TB1AC2. Verify that #55 is set to this nominal value. This voltage is phase sensitive and must be derived as shown in drawing of Figure 2.1a.
2. Verify motor field current flow calibration by reading motor current with a separate clamp-on DC ammeter. Compare the reading with that of #612. If these two readings do not correspond, verify that A3S1 is correctly set and that the F1(+) lead is connected to the right tap.
3. Read and verify VDC output to the motor field between A3TB4 F2(-) and A3TB4F1(+).
4. Turn all power off. Temporarily remove one power feed wire from A3TB1-AC1 and test the SCR/Rectifier module for shorts with an ohmmeter between each screw connection to the PCB. If short circuits exist, replace the module AND the PCB.

Field Control A3 PCB Replacement

1. Label and disconnect all power wires to terminals on the PCB. Disconnect ribbon connector J13.
2. Disconnect wires G1 & G2 from the SCR/Rectifier module. Remove 4 screws holding PCB to SCR/Rectifier module. Remove PCB at each plastic post by gently pulling straight out.
3. Reverse the above procedure to reassemble. Torque the 4 SCR/Rectifier module screws to 18 in-lbs.

Field Control SCR/Rectifier Replacement

1. Remove the A3 PCB according to the above.
2. Remove the 2 cap screws securing the module to the heat-sink and remove the damaged module.
3. Wipe the mounting surface clean. Use a new thermal mounting pad or a thin coating of thermal grease on the bottom of the replacement module. Orient the

module with AC1 & AC2 terminals toward the right side of the unit. Use cupped washers under the mounting screw heads. Tighten mounting hardware to 18 inch-lbs.

4. Reassemble the A3 PCB and all electrical connections.

Repair of the 195Amp Assembly

The layout of basic component parts of the 100-195ADC DSD 412. Figure 3: Component Layout Front View

Snubber Circuit

The snubber capacitor components are mounted on the Snubber PCB. Power resistors are mounted on the heat sink. Snubber circuit repair is either PCB replacement or resistor replacement. When replacing resistors, a new thermally conductive pad or a thin even coating of thermal grease is required between the device and the heat sink.

Removal and Replacement of the Armature Interface PCB

1. Label and disconnect the gating leads from the Armature Interface PCB by gently squeezing the white connectors, J30-32 & J34-36, and pulling straight out. There is no need to remove the leads from the SCR modules unless they later prove to be defective.
2. Tag and remove each wire going to TB 5. Disconnect J24 and J27 from the PCB.
3. Remove 9 screws securing the Armature Interface PCB in place, and remove the PCB. Do not lose these screws and washer hardware. All will be need to re-establish proper electrical connections at time of re-assembly.
4. The Cube ID PCB is located at J28. If the Armature Interface PCB is to be replaced, ensure that the replacement PCB has an identical Cube ID PCB, or re-use the original unit.
5. Replace the Armature Interface PCB in reverse order of disassembly. Torque mounting screws down to 20 inch-pounds.

SCR Testing and Replacement

1. Using a multimeter on the X100 range, press the positive probe to the positive (+) DC bus bar and the negative probe to each of the three AC bus bars to measure the resistance between them. The reading in each case should be infinity. Since most SCRs fail by shorting, a low resistance could indicate a defective SCR. This procedure, continued in steps 7 & 8, checks a pair of SCRs in parallel, which are in the same module. Therefore, the entire module must be changed to replace the defective SCR.
2. Press the positive multimeter probe to the negative (–) DC bus bar and the negative probe to each of the three AC bus bars. Again, all readings should be infinity.
3. Reverse the multimeter probes and repeat the above two steps. Again, all readings should be infinity.
4. To check the gate resistance of the SCRs, set the multimeter to X1 range. Measure the resistance from the gate (+) (white lead or pin closest to the end of the device) to the cathode (–) (red lead or pin closest to the gate). Repeat on the other gate-cathode pairs. There are two pairs per SCR module. Compare readings with Table 16: SCR Gate Resistance Testing.

METER READING	SCR CONDITION
Less than 5 Ohms	Shorted (BAD)
5-100 Ohms	Acceptable
100 Ohms-1K Ohms	Questionable
More than 1K Ohms	Open (BAD)

Table 16: SCR Gate Resistance Testing

NOTE:

If SCRs were indicated as bad, continue to disassemble for repair by...

1. Remove the Armature Interface PCB.
2. Remove the four power fuses.
3. Label and remove one end of the two wires that go between L1A, AC1 and L2A, AC2 on the Field Interface PCB.

4. On the 195ADC chassis, remove the Snubber PCB, the AC bus bars, and the appropriate DC bus bar to gain access to the SCR modules. Save all hardware, as it will be needed for re-assembly. Screw lengths are important.
5. RRemove each defective SCR module, taking care not to scratch or burr the heat sink surface. Remove and discard the coated aluminum thermal wafer, if present. Save all screws and washer hardware. It will be needed in the proper order for re-assembly. Remove the gate & cathode lead assembly from the defective module.
6. To install new SCR module(s), ensure that the heat-sink surface and bottom of the SCR module is clean and free from any dirt. Install a new thermal wafer by first removing the protective paper coating and lining it up with the mounting holes on the heat-sink. A thin, even coating of thermal joint compound applied to the bottom of the SCR module may be used instead of the thermal wafer. Position the module on the heat sink and loosely install the mounting screws with washers. Do not tighten mounting screws more than finger tight at this time.
7. Apply a thin coating of Joint-Al-Z on all mating electrical surfaces and replace all bus bars. Start all hardware screws making them finger tight., Ensure proper alignment of all components, then torque bus bar mounting screws to 26 inch-pounds.

IMPORTANT

DO NOT use a torque wrench to tighten SCR module mounting hardware. The correctly flattened Belleville washer as described below provides the proper mounting pressure.

8. Now tighten the mounting hardware for any replaced SCR modules: Tighten each screw equally and alternately, ¼ turn at a time. Continue with this procedure until the Belleville washers become flat. An abrupt change in torque will be detected when the Belleville becomes flat.
9. Reinstall the AC and DC bus bars. Tighten bus bar mounting screws until Belleville washers become flat.
10. Reinstall the two power lead wires feeding the Field Interface PCB, if they were previously removed.
11. Reinstall the Armature Interface PCB and the Snubber PCB. Torque the mounting screws to 10 inch-pounds. All mounting screws must be in place for proper operation.
12. Reconnect each of the SCR gate and cathode leads to the Armature Interface PCB at plugs J30-32 and J34-36. If the gating leads were removed from the SCR module, the white gate leads go directly down to the SCR module pins closest to the end of the module. No wires cross.. If the assembly had red cathode leads, those leads plug into the SCR modules next to the gate leads.
13. Reconnect wires going to A2TB5-1 and A2TB5-2. Reinstall plugs at J24, J27, and J29.
14. Verify and reinstall fuses.

Cooling Fan Replacement

The cooling fan is located inside a plenum box near the bottom of the chassis. Remove 2 screws from each side of the chassis for access. The 115VAC supply plugs into the side of the fan motor.

Thermistor Replacement

The thermistor connects to the Armature Interface PCB at J28. It is located on the heat sink. Remove the Armature Interface PCB for replacement access. Place a light coating of thermal grease or Joint-Al-Z on bottom side of the thermistor before re-assembly.

Current Transducer Replacement

The Armature Current Transducer is mounted on the left side where the buss bar can pass through it. Remove the Armature Interface PCB for replacement access. Remove the DC output buss bar. Two screws on the chassis side-wall hold the transducer in place.

Repair of 300Amp Assembly

Magnetek recommends having an entire 300 amp drive chassis available as a spare part in order to get a faulty unit back in operation as quickly as possible. It is also possible to have the internal SCR Power Bridge assembly as a spare part for replacement in the field. Field repair of individual SCR parts is possible but requires the aid of alignment jigs, proper tools and considerable patience for proper success. Whole drives or SCR Power Bridge assemblies may be returned to the factory for repair.

Snubber Circuit

Snubber capacitors are mounted on a PCB attached to the underside of SCR heat sinks. To service these components, the entire SCR heat sink power bridge assembly must be removed from the chassis for access. Follow the steps below for power bridge removal. The snubber resistors are the large tubular devices located behind the AC line fuses, F1-F3. These can be replaced without removal of the power bridge assembly.

SCR Testing

Running PCU Diagnostics #998 should be the first test to determine if an SCR is faulty. If this test indicates a failure or if the drive has blown fuses, continue the procedure below to verify the need for repairs. The Heat Sink Assembly is composed of three Phase Assemblies, each containing four “hockey puck” type SCRs with heat sinks and clamps. Three phase assemblies are combined with upper and lower DC buss bars and front and back PCBs into a unified power bridge assembly, then placed into the drive chassis. A hockey puck packaged SCR must be clamped at high pressure in order to operate or to be properly tested with an ohmmeter. Ohmmeter testing of the SCRs can and should be done before any disassembly or removal of the SCR Power Bridge

Ohmmeter SCR Testing

1. Using a multi-meter on the X100 range, press the positive probe to the positive (+, right side) DC bus bar and the negative probe to each of the three AC bus bars (load side of AC line fuses) to measure the resistance between them. The reading in each case should be greater than 300 K-ohms. Since most SCRs fail by shorting, a low resistance could indicate a defective SCR. This procedure, continued in steps 2) & 3), checks a pair of SCRs mounted within the same heat sink half-phase assembly. If found defective, that half-phase assembly must be removed for further repair.
2. Press the positive multi-meter probe to the negative (–) DC bus bar and the negative probe to each of the three AC bus bars. Again, all readings should be greater than 300 K-ohms.
3. Reverse the multi-meter probes and repeat the above two steps. Again, all readings should be greater than 300 K-ohms.
4. Check SCR gate resistance for each device.
   a. Pull off the WHITE gate lead faston from the connection to the Armature Interface PCB. Use a multi-meter to measure the resistance from the white SCR gate wire, using the (+) ohmmeter lead, and the (-) ohmmeter lead to the red SCR cathode wire. Compare reading results per Table 16: SCR Gate Resistance Testing.
   b. Repeat the above for all 12 SCR devices.
5. If any of the above ohmmeter readings indicate a damaged SCR device, the entire Power Bridge Assembly must be removed for repair access of the individual SCRs.

Removal and Re-installation of the 300 Amp SCR Power Bridge

IMPORTANT
When removing wires and connectors during dis-assembly, make sure that they will stay in position or are properly labeled for reconnection.

1. **Remove** the entire Power Bridge in the following sequence:
   a. Remove the ribbon cable connector J24 and Current Transducer cable

J15 from the Armature Interface PCB.
- b. Remove the armature voltage feedback wires at TB5 on the Armature Interface PCB. Tag these wires for proper re-assembly.
- c. Remove AC input fuses, F1-F3.
- d. Remove the (-) DC output lug at top-left of the drive chassis.
- e. Remove the buss bar bolt to the Current Transducer, at lower right of the chassis
- f. Remove 2 hold-down nuts on the upper buss-bar.
- g. Remove 2 hold-down nuts at the lower buss-bar.
- h. The SCR Power Bridge is now loose. Remove it by pulling outward, tilting at the bottom so that the large tubular resistors cam clear the fuse mounting bracket.

2. To Reinstall a completely assembled SCR Power Bridge, follow all of the above steps in reverse order...and:
   - a. Use a thin coating of Joint-Al-Z compound at all electrical buss-bar to buss-bar interfaces.
   - b. Use the correct washers nuts and bolts as were removed for re-assembly. Start all nut and bolt hardware before tightening down at any location.
   - c. When in proper position,, torque down the 2 upper and 2 lower buss-bar mounting nuts to 200 inch-pounds.
   - d. Torque down the (-) output lug nut to 200 inch-pounds.
   - e. Torque down the bolt at the lower right buss-bar to xx inch-pounds.
   - f. Be sure to run PCU diagnostics when power is re-applied to verify that all is OK.

Removal and Replacement of the Armature Interface PCB

1. Remove flat cable connector at J24 and Current transducer cable at J15. Remove thermostat and thermistor connectors at J17, J18 & J20.
2. Tag and remove Armature Voltage Feedback wires at TB5.
3. Remove 12 pairs of the plug-on SCR gate and cathode leads.
4. Remove the 3 phase connection nuts at E31, E32 &E33, near middle of the PCB. Do not remove the threaded stud.
5. Remove the 6 large nuts at top and bottom of the PCB.
6. The PCB is now loose. Lift it off from remaining stud hardware.
7. The Cube ID PCB is located at J19. If the replacement Armature Interface PCB does not have a Cube ID PCB in place, remove it from the old, and place on to the new.
8. Re-install the replacement Armature Interface PCB, following steps 1-6 above in reverse order...and:

   - a. Be sure to re-use all washers and nuts as originally supplied. These mechanical ties also make electrical connections to the PCB.
   - b. Torque down the small nuts at E31-33 to 10 inch-pounds.
   - c. Torque down the larger 6 nuts to 70 inch-pounds.
   - d. Ensure that the Armature Voltage Feedback leads at TB5 are re-connected with the original polarity.
   - e. Ensure that the proper Cube ID PCB is installed at J19.

Cooling Fan Replacement

The cooling fan is held in place by 5 socket head cap screws. These require a 9/64 inch Allen wrench. The 115VAC supply cord plugs in from the side. Be sure to move the fan guard from the old fan to the new unit if replaced. Retorque mounting screws to 20 inch-pounds.

Thermistor Replacement

The thermistor connects from the heatsink up to J20 on the Armature Interface PCB. You must remove the Armature Interface PCB for access. Trim wires the correct length to avoid future insulation abrasion damage. Thermostat switches at J17 & J18 are accessed in the same way.

Current Transducer Replacement

The armature current transducer is mounted inside the lower right corner of the chassis.

1. Removal:
   - a. Remove the DC fuse F4.

b. Remove J15
c. Remove the buss-bar bolt to the lower right DC heat-sink buss.
d. Remove 4 #10 screws from the outside of the chassis. Two on the bottom near the fan. Two on the lower right side.
e. Pull out and up on the buss-bar connection for fuse F4. The entire assembly should come out, including the current transducer.

2. Re-install:
   a. Assemble the buss bars through the replacement transducer. Apply Joint-Al-Z to the buss bar interfaces. Screw in the bolt for the buss bar to F4 only finger tight.
   b. Slip the loose parts into the chassis from the top side, the reverse of 1)e) above.
   c. Align the transducer module mounting holes with those in the chassis. Start all 4 chassis mounting screws and then tighten them to 10 inch-pounds.
   d. Start the lower buss-bar bolt
   e. Remove J31 from the Signal Interface PCB. Lift this PCB to temporarily remove and bend connecting wires out of the way for access to the upper buss bolt by the current transducer.
   f. Place the upper buss bar over the fuse mounting stud.
   g. Now tighten both buss bar bolts to 40 inch pounds.
   h. Replace the Signal Interface PCB. Plug in J31 and J15.
   i. Replace fuse F4. Be sure to use the same washer / spacer arrangement to achieve flat mounting of the fuse tangs at both ends. Re-tighten fuse mounting to 70 inch-pounds

Spare Parts

Description	DSD 412 Rating	Reference Designator	Magnetek Part or kit Number	Quantity Per Drive
Fan	50A,100A	B1	LA05P00016-0048	1
Fan	195A	B1	LA05P00016-0012	1
Fan	300A	B1	LA05P00016-0008	1
AC Line Fuse, 50A/700V	25A	F1-F3	LA05P00017-0227	3
AC Line Fuse, 70A/700V	50A	F1-F3	LA05P00017-0155	3
AC Line Fuse, 150A/700V	100A	F1-F3	LA05P00017-0166	3
AC Line Fuse, 250A/700V	195A	F1-F3	LA05P00017-0220	3
AC Line Fuse, 400A/700V	300A	F1-F3	LA05P00017-0234	3
Armature Fuse, 70A/700V	25A	F4	LA05P00017-0155	1
Armature Fuse, 100A/700V	50A	F4	LA05P00017-0178	1
Armature Fuse, 200A/700V	100A	F4	LA05P00017-0179	1
Armature Fuse, 300A/700V	195A	F4	LA05P00017-0366	1
Armature Fuse, 500A/700V	300A	F4	LA05P00017-0235	1
SCR	25A	Q1-Q6	LA05P00050-0409	6
SCR	50A,	Q1-Q6	LA05P00050-0410	6
SCR	100A	Q1-Q6	LA05P00050-0412	6
SCR	195A 300A	Q1-Q12	LA46S03214-0010	12
Current Transducer	25A	U1	LA05P00217-0015	1
Current Transducer	50A	U1	LA05P00217-0014	1
Current Transducer	100A	U1	LA05P00217-0042	1
Current Transducer	195A	U1	LA05P00645-0018	1
Current Transducer	300A	U1	LA05P00217-0020	1
Thermistor Assembly	ALL	RT1	46S03596-0050	1
Thermostat	300A	S1, S2	46S03596-0060	2
Drive Control, main PCB (Analog, RS232)	ALL	A1	LA46S02975-9303	1
Drive Control PCB (RS422) (Includes U13, 14, 39 ,40 software chips)	ALL	A1	LA46S02975-9403	1
Field Interface PCB	ALL	A3	LA46S03594-0010	1
Field SCR/Rect Module	ALL	Q7	LA05P00050-0523	1
Armature Interface PCB	25A, 50A,	A2	LA46S02976-0032	1
Armature Interface PCB	100A,195	A2	LA46S02976-0032	1
Armature Interface PCB	A 300A	A2	LA46S03088-0012	1
Cube ID PCB	25A	A2J28	46S03577-1015	1
Cube ID PCB	50A	A2J28	46S03577-1030	1
Cube ID PCB	100A	A2J28	46S03577-1060	1
Cube ID PCB	195A	A2J28	46S03577-1125	1
Cube ID PCB	300A	A2J19	46S03577-1200	1
DSD 412 Power Supply	ALL	A4	LA05P00090-0293	1
Snubber PCB	25A	A5	LA46S03020-0010	1
Snubber PCB	50A	A5	LA46S03020-0020	1
Snubber PCB	100A	A5	LA46S03020-0030	1
Snubber PCB	195A	A5	LA46S03017-0010	1
Snubber PCB	300A	A5	LA46S03089-0010	1
Table, 10 Pos, Ribbon	25A	Drive Cont. A1-	05P00034-0762	1
	50A	J13	05P00034-0762	1
	100A	To	05P00034-0762	1
	195A	Field Interface	05P00034-0750	1
	300A	PCB, A3-J33	46S03396-0080	1

SPARE PARTS

Description	DSD 412 Rating	Reference Designator	Magnetek Part or kit Number	Quantity Per Drive
Cable, 20 Pos, Ribbon	ALL	Drive Cont. A1-J11 To Pwr Supply A4-J41	05P00034-0751	1
Cable, 40 Pos, Ribbon	ALL	Drive Cont A1-J14 To Arm Intfc A2-J24	05P00034-0752	1
Assembly, Harness, Gates	25A 50A 100A 195A 300A	Armature Intfc A2 To SCR Gate Conns.	46S03596-0040 46S03596-0040 46S03596-0040 46S03596-0030 300A Drive has Gate wiring on SCRs. Quick disconnect Fastons on SCR wires connect to Armature Intfc. PCB A2.	6 6 6 6
Pluggable Terminal Block, 8 position, female	All	Connects to TB3 of Power Supply A4	05P00060-0373	1
Cable, 115 VAC Cooling Fan, with Plug	ALL	Connects 115 Vac to fan. Required for DSPR option addition.	05P00016-0045	1
PCDU Hand-held Service / Adjustment Tool	ALL	Easy parameter adjustments with 2-line numeric read-out with English labels, direct entry numeric keypad.	05P00090-0267	Optional
Joint-Al-Z Electric Joint Compound	ALL	2 gram packet. Use at all busbar connections.	05P00100-0060	
NVRAM chip	ALL	U56 on A1	LA05P00226-0392	1
Software	ALL	U39, U40, U13, U14 on A1	LA46S03306-0020	1
Touch Proof Covers	25-100A	Top and Bottom Schroud	LA46S03403-0010	1
Touch Proof Covers	195A	Top and Bottom Schroud	LA46S03403-0020	1
Touch Proof Covers	300A	Top Schroud	LA46S03403-0060	1

Table 17: Spare Parts

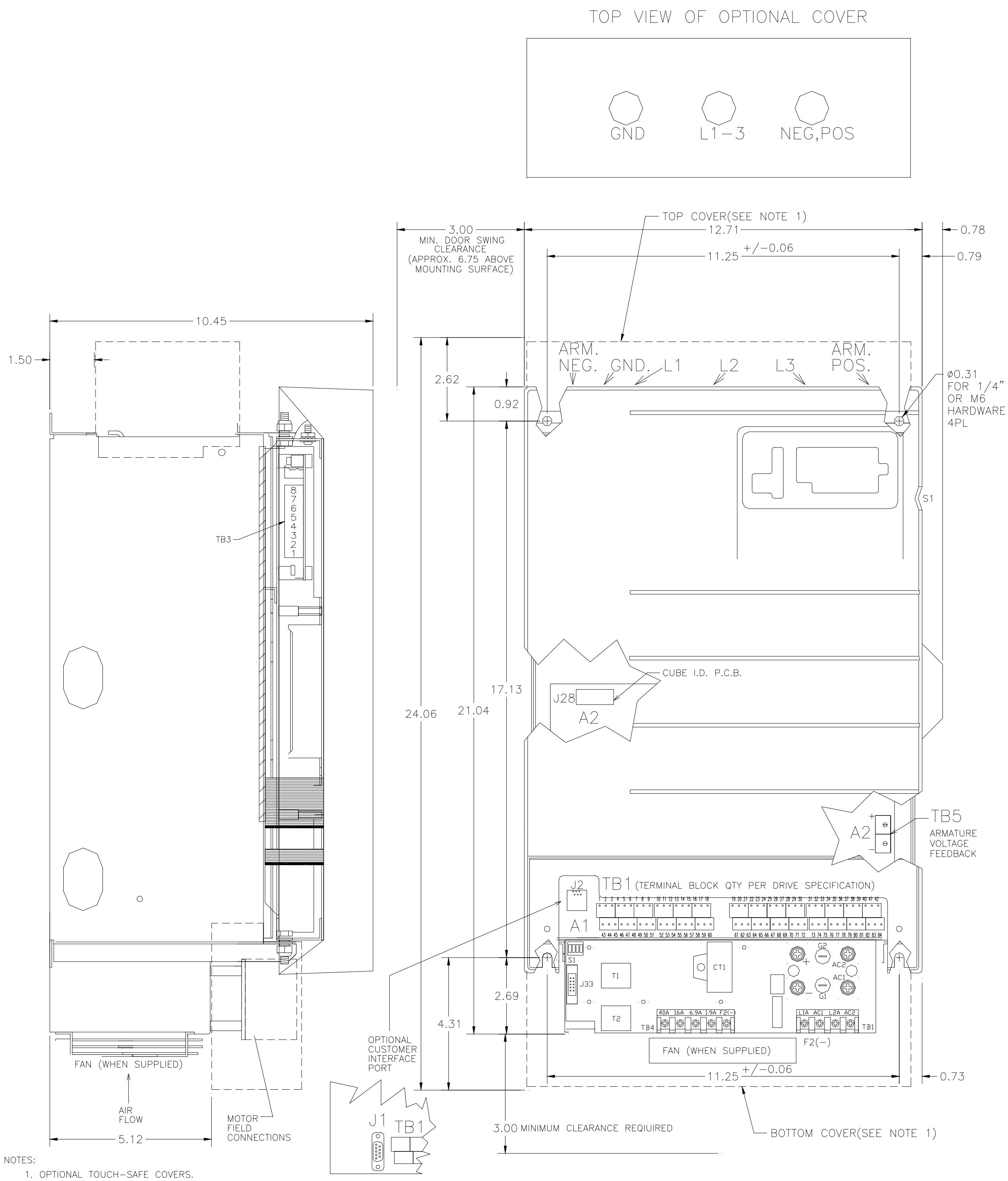


Figure 26: Drive Chassis Outline, DSD 412, 100 Amp

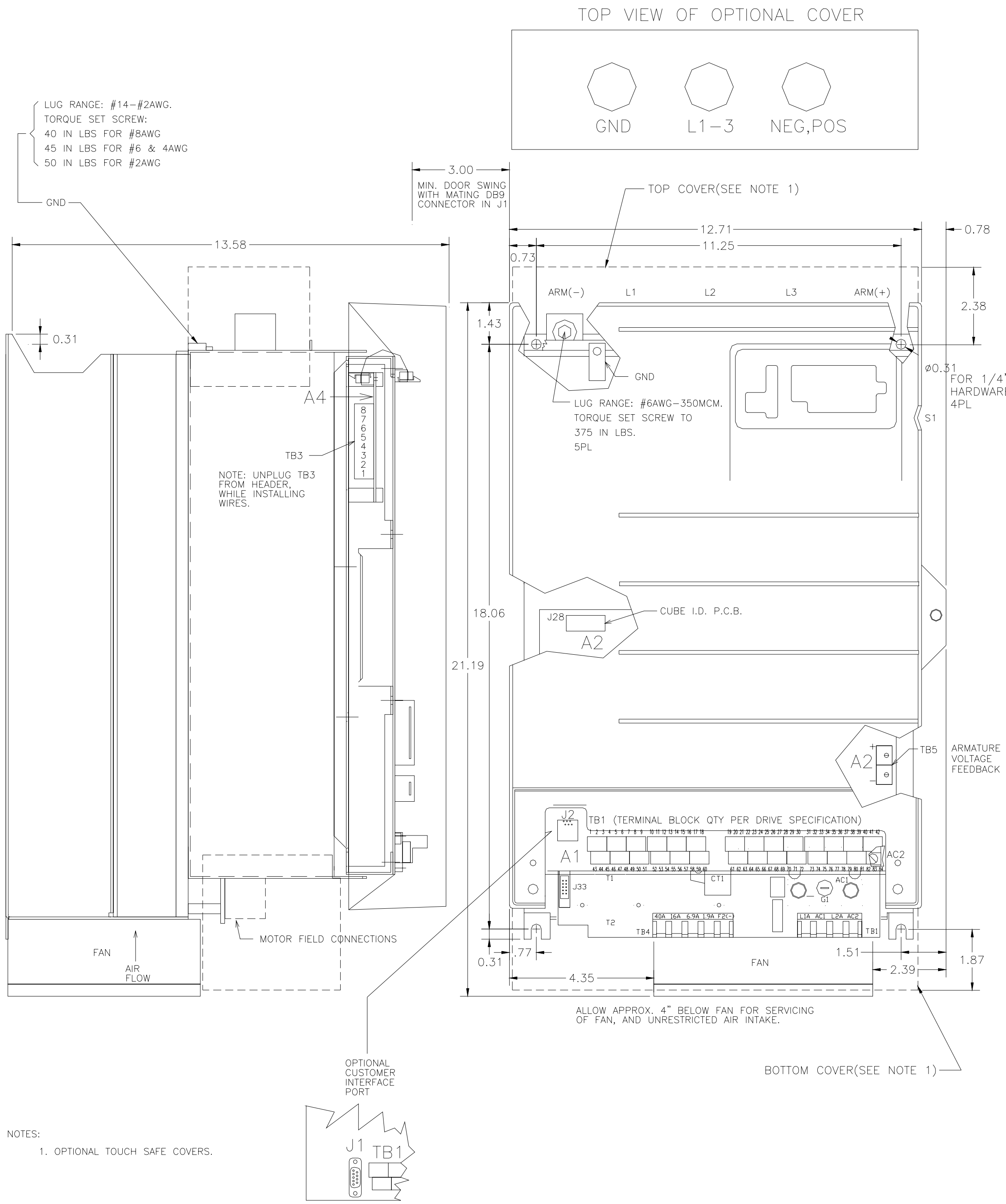


Figure 27: Drive Chassis Outline, DSD 412, 195 Amp

	GND	ARM(−)	L1−3	ARM(+)
COND. RANGE	1/0−14	750−1/0	600−4	800−300
TORQUE (in−lbs)	**	50	50	375

** TORQUE/GAUGE:
14−10AWG 25 in−lbs
8AWG 30 in−lbs
6−4AWG 35 in−lbs
3AWG−1/0 40 in−lbs

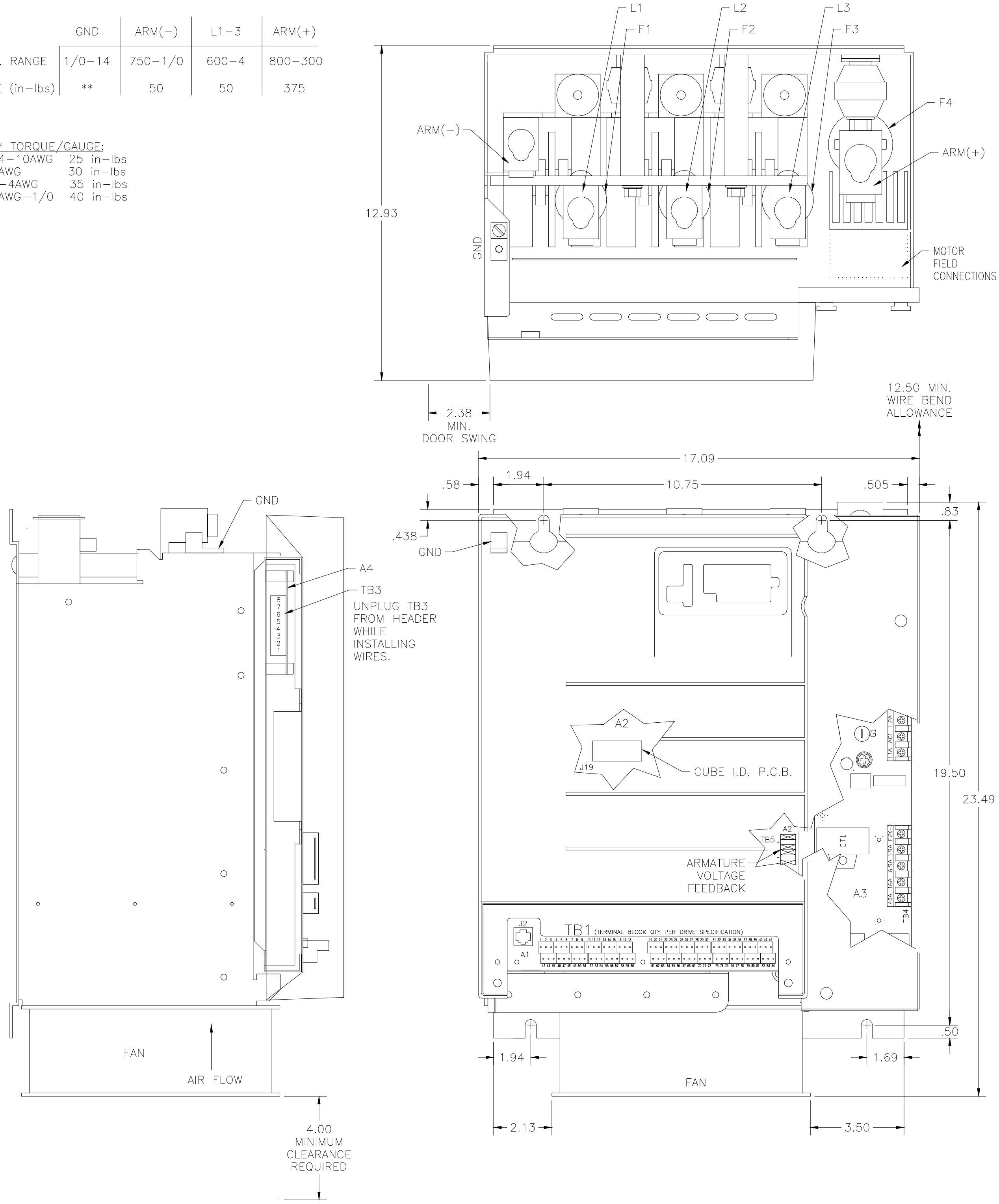


Figure 28: Drive Chasis Outline, DSD 412, 300 Amp

LAYOUT DRAWING 100A

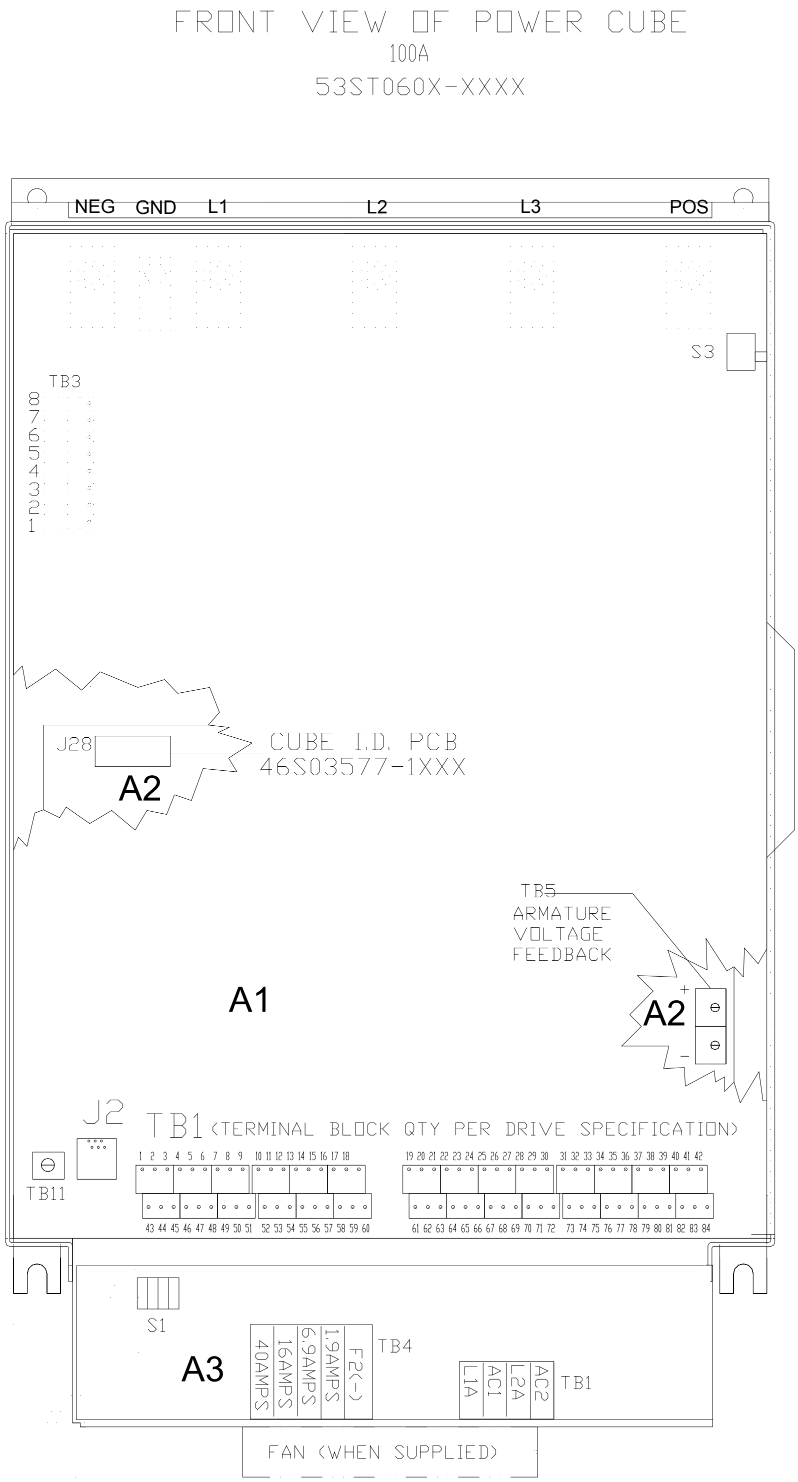


Figure 29: Layout, DSD 412, 100 Amp

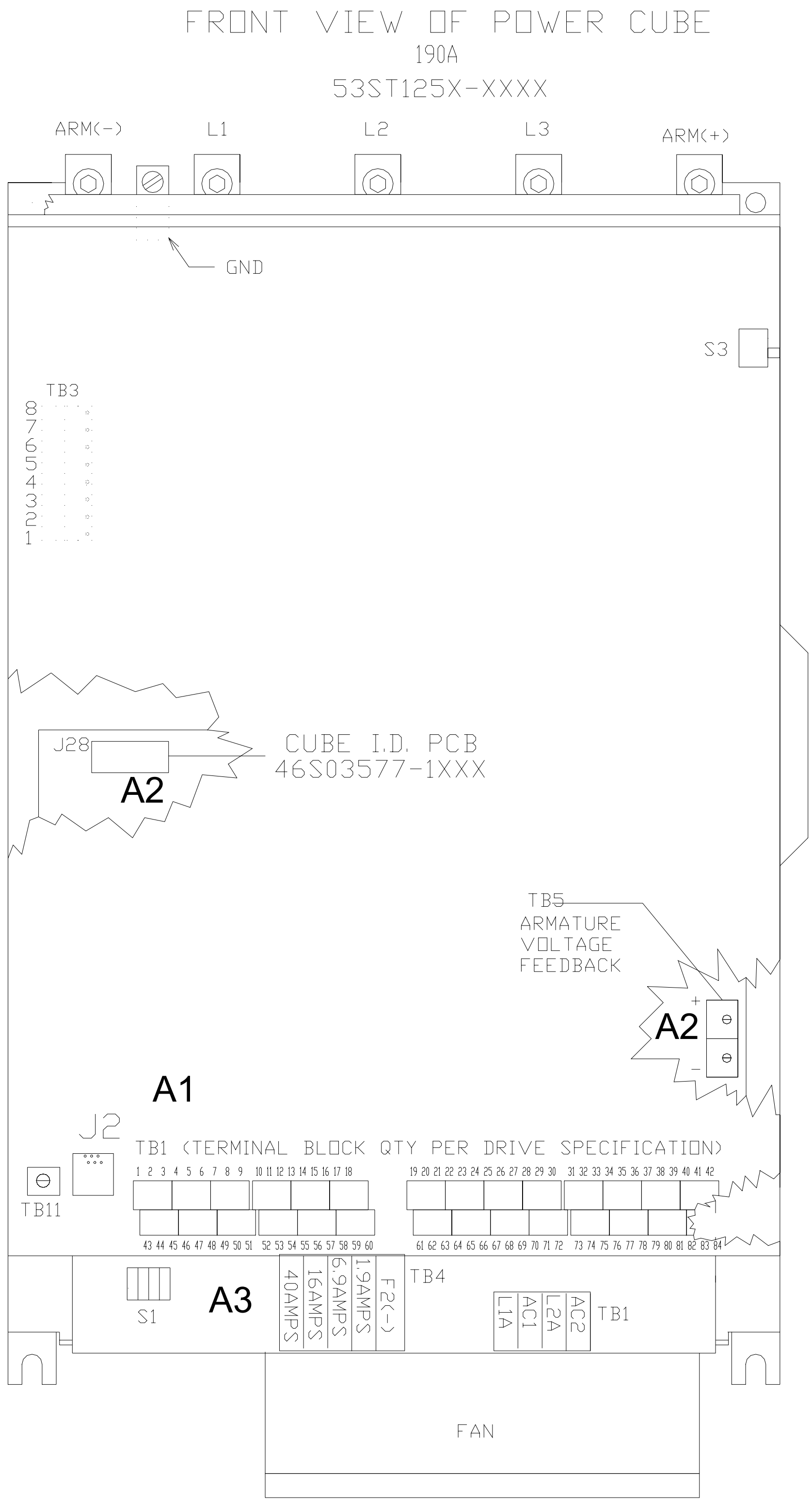


Figure 30: Layout, DSD 412, 195 Amp

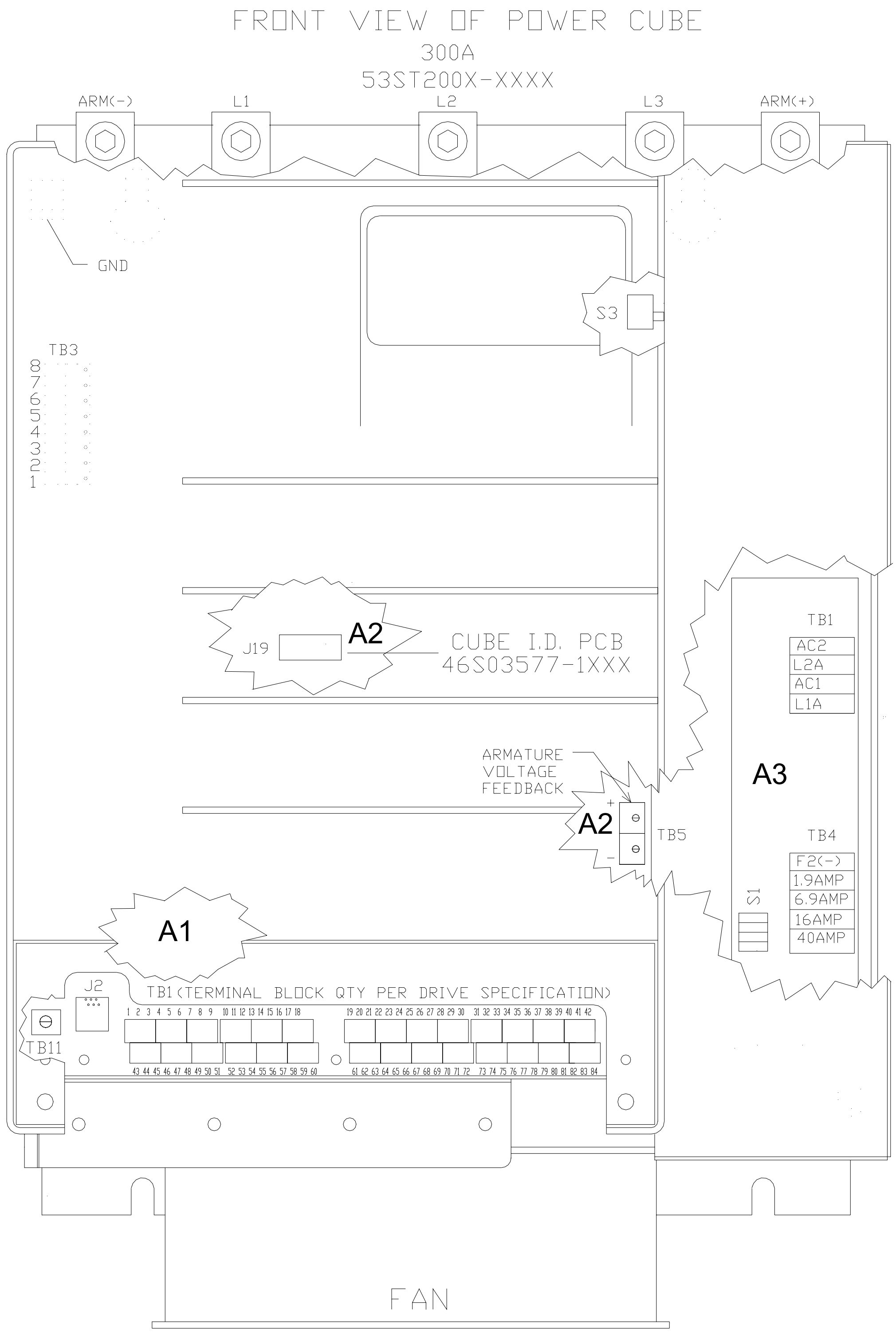


Figure 31: Layout, DSD 412, 300 Amp

DSD 412 DC Elevator Drive

Magnetek Elevator Products
N50 W13605 Overview Drive
Menomonee Falls, Wisconsin 53051
(800) 236-1705, (262) 252-6999, FAX (262) 790-4143
http://www.elevatordrives.com

Magnetek Elevator Products - Europe
20 Drake Mews, Crownhill
Milton Keynes, Bucks MK8 0ER UK
+44(0) 1908 261427, FAX +44(0) 1908 261674

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