

# MagnePulse DMC

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## Industrial Lifting Magnet Control Manual



**MAGNETEK**

MATERIAL HANDLING

**ELECTROMOTIVE SYSTEMS**

Software Version 10.03x

Part Number 144-45300 R4

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## General Information

### Product Manual Safety Information

Magnetek, Inc. (Magnetek) offers a broad range of radio remote control products, control products and adjustable frequency drives, and industrial braking systems for overhead material handling applications. This manual has been prepared by Magnetek to provide information and recommendations for the installation, use, operation and service of Magnetek's material handling products and systems (Magnetek Products). Anyone who uses, operates, maintains, services, installs or owns Magnetek Products should know, understand and follow our instructions and safety recommendations in this manual for Magnetek Products.

The recommendations in this manual do not take precedence over any of the following requirements relating to cranes, hoists and lifting devices:

- Instructions, manuals, and safety warnings of the manufacturers of the equipment where the radio system is used,
- Plant safety rules and procedures of the employers and the owners of facilities where the Magnetek Products are being used,
- Regulations issued by the Occupational Health and Safety Administration (OSHA),
- Applicable local, state or federal codes, ordinances, standards and requirements, or
- Safety standards and practices for the overhead material handling industry.

This manual does not include or address the specific instructions and safety warnings of these manufacturers or any of the other requirements listed above. It is the responsibility of the owners, users and operators of the Magnetek Products to know, understand and follow all of these requirements. It is the responsibility of the owner of the Magnetek Products to make its employees aware of all of the above listed requirements and to make certain that all operators are properly trained. No one should use Magnetek Products prior to becoming familiar with and being trained in these requirements.

#### WARRANTY INFORMATION

For information on Magnetek's product warranties by product type, please visit the Magnetek Material homepage on [www.magnetek.com](http://www.magnetek.com).

# Electrical Safety

## Warning Symbols

For your own safety, please pay special attention to the instructions marked with these warning symbols:



= Dangerous Voltage



= General Warnings




= General Caution

## Warnings

	<b>1</b>	ONLY A QUALIFIED ELECTRICIAN SHOULD PERFORM THE ELECTRICAL INSTALLATION.
	<b>2</b>	Internal components and circuit boards (except the isolated I/O terminals) are at utility potential when the MagnePulse DMC is connected to the line. This voltage is extremely dangerous and may cause death or severe injury if you come in contact with it.
	<b>3</b>	When the MagnePulse DMC is connected to the utility, the line connections L1, L2, L11+ and capacitor connections are live even if the magnet is not running.
	<b>4</b>	The drive control I/O terminals are isolated from the line potential through the interface board. The interface board may have dangerous external voltages connected through the control disconnect even when main power is removed by the main disconnect.
	<b>5</b>	An upstream disconnect/protection device is to be used as noted in the National Electric Code (NEC).
	<b>6</b>	Only spare parts obtained from a Magnetek authorized dealer can be used.


## Safety Instructions

	<b>1</b>	The MagnePulse DMC is meant only for fixed installation. Do not make any connections or measurements when the MagnePulse DMC is connected to the utility.
	<b>2</b>	After disconnecting the utility (main and control disconnects opened), wait until the unit charge indicator on the control enclosure is extinguished. Wait at least 5 minutes before doing any work on the MagnePulse DMC connections. Do not open the cover before this time has run out.
	<b>3</b>	Do not make any voltage withstand or megger tests on any part of the MagnePulse DMC.
	<b>4</b>	Disconnect the magnet cables from the MagnePulse DMC before meggering the magnet cables.
	<b>5</b>	Do not touch the IC-circuits on the circuit boards. Static voltage discharge may destroy the components.
	<b>6</b>	Before connecting to the utility, make sure that the cover of the MagnePulse DMC is fastened.
	<b>7</b>	Make sure that nothing but the DC magnet is connected to the magnet terminals.

## Grounding

The MagnePulse DMC will operate properly on a floating (ungrounded) DC power bus, or on a grounded power bus system (positive or negative). It is recommended that if a grounded system exists, the unit should be grounded to that system in accordance with NEC and local codes.

## Running the Magnet

	<b>1</b>	Before running the magnet, make sure that the magnet is properly secured on the hook and wired properly.
	<b>2</b>	Maximum magnet current should never be set to exceed the magnet's rated capability.
	<b>3</b>	Be sure to read magnet owner's manual before operating the control.

## Receiving

### General Information

Magnetek's MagnePulse DMC Magnet Controller provides reduced and reversing current control of DC industrial lifting magnets.

Standard features include:

- 5 to 2000 A DC control capacity
- Adjustable and repeatable control
- Programmable variable current control for increased efficiency and longer magnet life
- Modular construction, with easily accessible front wired components.
- Decreased power consumption — reduced current maintains full load
- Numerous safety circuits for maximum protection of personnel and components
- Controller display for ease of monitoring and troubleshooting with computer diagnostic capability
- Solid-state design eliminates wearing parts and reduces maintenance time

**Table 1: Typical Equipment List**

<u>Quantity</u>	<u>Item Description</u>
1	Magnet controller in NEMA Type 1 enclosure (standard) or optional NEMA Type 1 gasketed, NEMA Type 3, NEMA Type 4 or NEMA Type 12 enclosure, or open panel
1 ~ 4	Industrial Lifting Magnet
1	Operator controls
1	DB Transistor
1	DB Resistor

## Receiving Check List

Upon receipt, check each item against the packing slip to ensure the item is the same as ordered.

If shipping damage is noted, contact and file a claim with the carrier immediately.

If there is a discrepancy between the packing slip and received items, contact Magnetek immediately to resolve.

If there is a discrepancy between your purchase order and the received items, contact Magnetek immediately to resolve.

## Disclaimer of Warranty

Magnetek, hereafter referred to as company, assumes no responsibility for improper programming of a control by untrained personnel. A control should only be programmed by a trained technician who has read and understands the contents of this manual. Improper programming of a control can lead to unexpected, undesirable, or unsafe operation or performance of the control. This may result in damage to equipment or personal injury. Company shall not be liable for economic loss, property damage, or other consequential damages or physical injury sustained by the purchaser or by any third party as a result of such programming. Company neither assumes nor authorizes any other person to assume for Company any other liability in connection with the sale or use of this product.

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### **WARNING**

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Improper programming of a control can lead to unexpected, undesirable, or unsafe operation or performance of the control.

## Storage

### Long Term Storage

Powering up the MagnePulse DMC every six months is quite beneficial. Over longer periods of time without power, the controls' electrolytic DC bus capacitors require reformation, especially if stored in an area of high temperatures. Capacitor reformation is required if controllers are stored without power for more than 1 to 2 years. This process can be avoided by powering up the control bi-annually for 30 to 60 minutes.

*NOTE Bus cap reforming alone may not restore full control functionality after 1 to 2 years of storage without power.*

Controls contain large bus capacitors that have the potential to be reformed. However, printed circuit boards also contain electrolytic capacitors that may not function after several years without power. Magnetek recommends replacing the PCBs should the control's functionality not be restored after bus cap reforming.

### Capacitor Reforming

The electrical characteristics of aluminum electrolytic capacitors are dependent on temperature; the higher the ambient temperature, the faster the deterioration of the electrical characteristics (i.e., leakage current increase, capacitance drop, etc.). If an aluminum electrolytic capacitor is exposed to high temperatures such as direct sunlight, heating elements, etc., the life of the capacitor may be adversely affected. When capacitors are stored under humid conditions for long periods of time, the humidity will cause the lead wires and terminals to oxidize, which impairs their solderability. Therefore, aluminum electrolytic capacitors should be stored at room temperature, in a dry location and out of direct sunlight.

In the event that a capacitor has been stored in a high ambient environment for more than 1 or 2 years, a voltage treatment reformation process to electrolytic capacitors may have to



be performed. When stored above room temperatures for long periods of time, the anode foil may react with the electrolyte, increasing the leakage current. After storage, the application of even normal voltages to these capacitors may result in higher than normal leakage currents. In most cases the leakage current levels will decrease in a short period of time as the normal chemical reaction within the capacitor occurs. However, in extreme cases, the amount of gas generated may cause the safety vent to open.

Capacitors, when used in controls that are stored for long periods of time, should be subjected to a voltage treatment/reforming process as noted below, which will reform the dielectric and return the leakage current to the initial level.

***Control Bus Capacitor Reforming Procedure:***

1. Connect the control inputs L11 (+), L7 (+), L8 (-) and L2 (-) to a rectifier with variac input.
2. Make sure the variac voltage setting is turned down so that when input power is applied to the variac, the output of the rectifier will be at or near 0 volts DC.
3. Apply power to the variac, listening for abnormal sounds and watching for abnormal visual indications in the control. If the variac has an output current indication, make sure the current is very near zero with zero or a steady output voltage applied.
4. Slowly turn the variac up, increasing the variac's output voltage to nominal rated input voltage over a time period of 10 to 20 minutes. In other words, ramp the voltage up at a rate of approximately 10 to 20 volts/minute to 200 VDC.
5. Let the output voltage remain at rated voltage for 30 to 60 minutes while keeping close watch for abnormal signs within the control. While increasing the variac's output voltage, the current will momentarily increase as current is necessary to charge the capacitors.
  - a. For 400 VDC units: after 30 to 60 minutes has elapsed remove power from the variac, allow for the DC bus to discharge and disconnect terminals L7 and L8.
  - b. Repeat steps 2-5, ramping the input voltage up to 400 VDC.
6. Once 30 to 60 minutes elapse, remove power and install control for intended use.

If any abnormal indications occur during this process, it is recommended that the process be repeated. Otherwise, this completes the capacitor reforming procedure.

## Installation



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### **DANGER**

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#### **Hazard of Electrical Shock or Burn**

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Up to 600 volts may exist in this controller. Use extreme care to avoid unpleasant or lethal shock. Disconnect input power before wiring and/or servicing motor or control.

### ***Mounting***

Mount and secure components as instructed below and in accordance with information on the dimension and control drawing included with the equipment.

### ***Control Panel***

Refer to the referenced dimension drawing for dimensions and mounting hole locations. Use all mounting holes. Install controller in a ventilated, clean, dry atmosphere. Maximum ambient temperature must not exceed 122°F (50°C) and must avoid contaminated atmospheres (metal chips, water spray, acids, etc.) unless the design is suitable for these environments.

### ***Wiring***

Wire all equipment according to the control panel drawing included with the equipment. Observe all notes on diagrams and follow all NEC and local codes.

**Note:** Do not connect the magnet to controller at this time.

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### **CAUTION**

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Observe local codes for correct wire size, grounding, etc. Input must be between 200 – 320 volts DC for standard controls and 360 – 600V DC for high voltage controls.

## Start-Up Procedures

The control panels are factory tested before shipment. However, certain additional tests and adjustments must be made on site to ensure safe operation for the specific magnet and application.

**Note:** If the controller does not operate during start-up despite correct adjustments, check for:

- (1) wiring errors, (2) loose connections, (3) grounds in wiring between magnet, controller, pushbuttons, and master switch, (4) magnet overload or magnet malfunctions, (5) incorrect line voltage or polarity.

## Preliminary Checks

1. Be sure dirt, wire fragments, shipping wedges, etc., are removed from the controller if present.
2. Check that wiring is correct, screws are tight and vent holes are clear.


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 **CAUTION**

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Never use a megger to check wiring unless **ALL** electronic boards are removed, and IGBTs and diodes are jumpered from anode to cathode or disconnected.

3. If magnet megger check is required, ensure that all magnet leads are disconnected at the magnet conduit box.
4. Check to ensure that the magnet area is free of metal and electronic products.

	<b>1</b>	This equipment is applicable to high voltage systems. Only qualified technicians should install the MagnePulse DMC Magnet control panels.
	<b>2</b>	Safety glasses should be worn at all times. Proper clothing should also be worn.
	<b>3</b>	Personnel should shield/remove any machinery that can be caused to move by the magnet being controlled to prevent damage.
	<b>4</b>	The magnet should be resting on a solid surface.
	<b>5</b>	Whenever voltage has been disconnected from the controller, the capacitor bank can take up to 5 minutes for the voltage to reduce to a safe level.

## Operator Controls

The operator controls must be wired as shown in the schematic diagram shipped with the control panel.

## Cable Connections

Power supply and magnet connections should be verified before being connected securely to the controller.

## DMC Magnet Power-up

1. Check Installation:
  - a. Confirm that the magnet is connected to the magnet control: T1 to Magnet +, T2 to Magnet -.

- b. Verify that all connections are correct.
2. Apply Control Power by closing the control breaker or knife switch.
  - a. Confirm that the display is working.
3. Restore Factory Default Settings (C07):

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 **WARNING**

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Only qualified personnel should make parameter changes. Improper parameter settings can result in equipment damage or personnel injury.

- a. Check parameter C04 for proper use of internal or external current transformers (CTs).
  - b. From magnet nameplate, enter the current, voltage and resistance values in parameters D00, F02, and F04
4. Turn off the control power by opening the control circuit breaker or knife switch.
5. Apply Main Power:
  - a. Close the Main circuit breaker or knife switch.
  - b. Close the control circuit breaker or knife switch.
  - c. Monitor the bus with a voltmeter and confirm that the DC bus voltage increases to the collector voltage and the MAIN LED is lit.
  - d. Check the AC ripple voltage on the bus by setting the voltmeter to AC volts. If the AC ripple voltage is above 40 volts, a DC line choke wired into the L1 line is recommended. Consult Magnetek for selection guidance.
6. Run the control at low current limit:
  - a. Run at Lift then Drop.
  - b. Confirm that M contactor picks up and that the tips close before controller becomes active. (Increase D11, Start Delay, if contactor arcs on closing or UV trip occurs.)
  - c. Confirm voltage spike during current reversal does not cause overvoltage fault.
  - d. Confirm that no current overshoot/undershoot occurs.
  - e. Confirm that magnet currents approximately match expected values and that magnet current clamp meter measurement agrees with display Group A monitor parameter A00. If the readings are greater than 10% check the link settings on the driver board (**Table 30**).
7. Program Current and Time settings in Group E to obtain desired performance.

- a. Confirm voltage spike during current reversal does not cause overvoltage fault.

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 **CAUTION**

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Using extreme caution, confirm that the CDBR and resistor can safely discharge the magnet energy. Measure resistor current and duty cycle to verify the CDBR and resistor is not being overworked.

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 **WARNING**

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Only qualified personnel should make parameter changes. Improper parameter settings can result in equipment damage or personnel injury.

# Operating Principles

## Solid-State Control

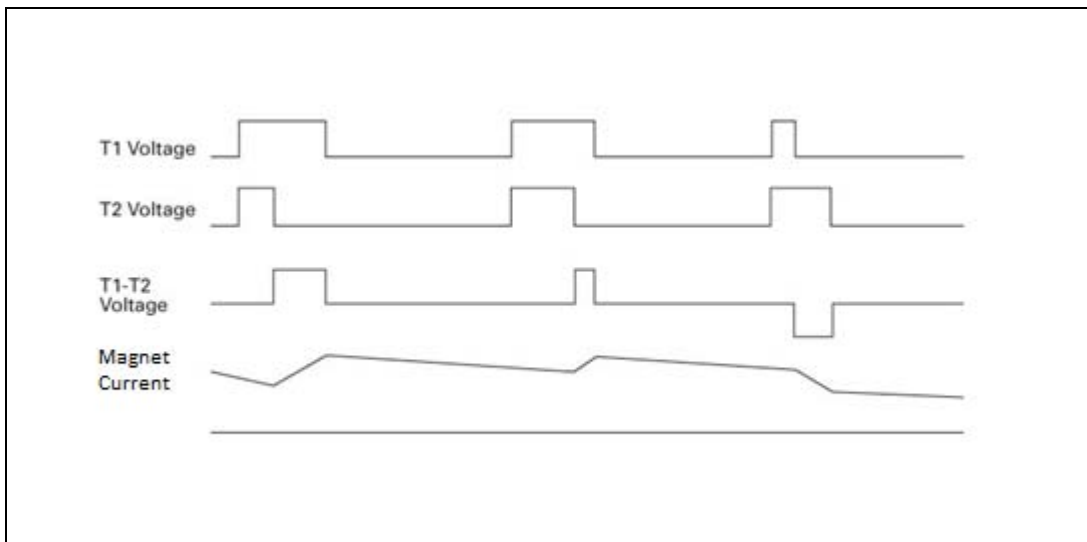
The MagnePulse DMC is a controller designed for industrial lifting magnets. Unlike typical systems that use contactors to reverse current, the MagnePulse DMC uses high-speed power semiconductor switches with controlled ON/OFF duty cycles in order to control magnet current. When the semiconductor switches are fully ON, their voltage drop is typically less than 2V, therefore the power they dissipate is a small fraction of the power that they control. Unlike resistive current control in switched stages, control by semiconductors can be made smooth and step-less. Furthermore, characteristics can easily be varied to suit a specific application or process.

## Regeneration

MagnePulse DMC is a fully regenerative controller. This means that the energy stored in the magnet coils will regenerate back to the DC bus capacitors during periods of fast current transients. The efficiency of the controller is sufficiently high to allow it to recover some energy from the load and return it to the DC supply. If the DC supply cannot absorb the magnet's energy a DB transistor and resistor is required.

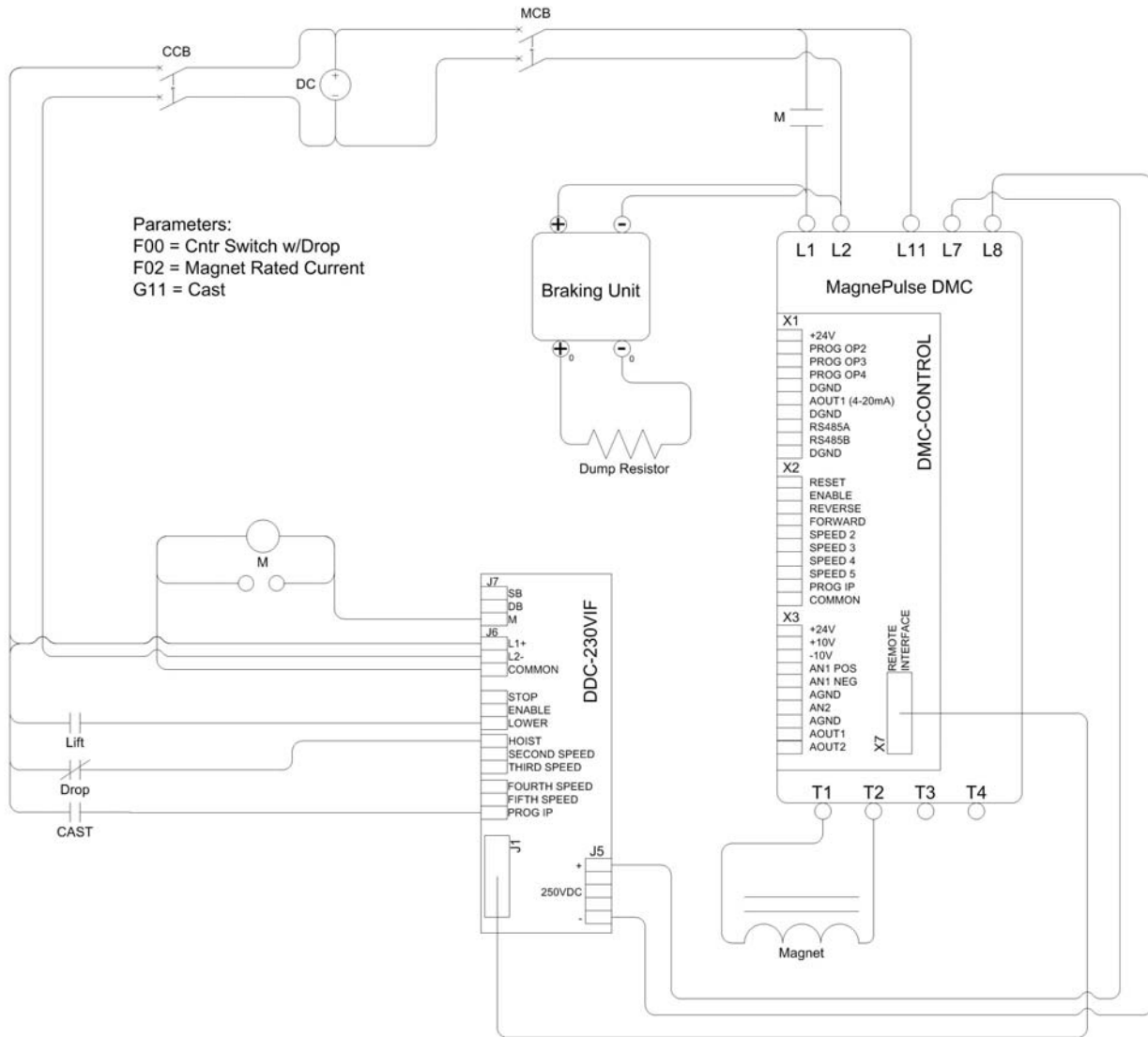
## Pulse Width Modulation

In the MagnePulse DMC, the semiconductors used for power control are Insulated Gate Bipolar Transistors (IGBTs). Pulse Width Modulation (PWM) is used to produce an output voltage on each terminal that is a proportion of the DC supply voltage by controlling the duty cycles of the top and bottom IGBTs of each half bridge. In **Figure 1**, the voltage that appears across the magnet coil is the difference between that of two terminals and may be made positive or negative as desired. The pulse frequency, typically 1 kHz, is high enough for the inductance of the magnet coil to act as a very effective smoothing choke. The currents that flow have a small amount of high frequency ripple but are substantially the same as if they had been derived from a smooth DC source.



**Figure 1: Pulse Width Modulation**

## Controller Configurations



**Figure 2: Typical Lift-Drop Input Mode Wiring with Cast Feature**

**\*Note:** MCB is selected to function as a disconnect only. It is not suitable for branch magnet circuit protection.

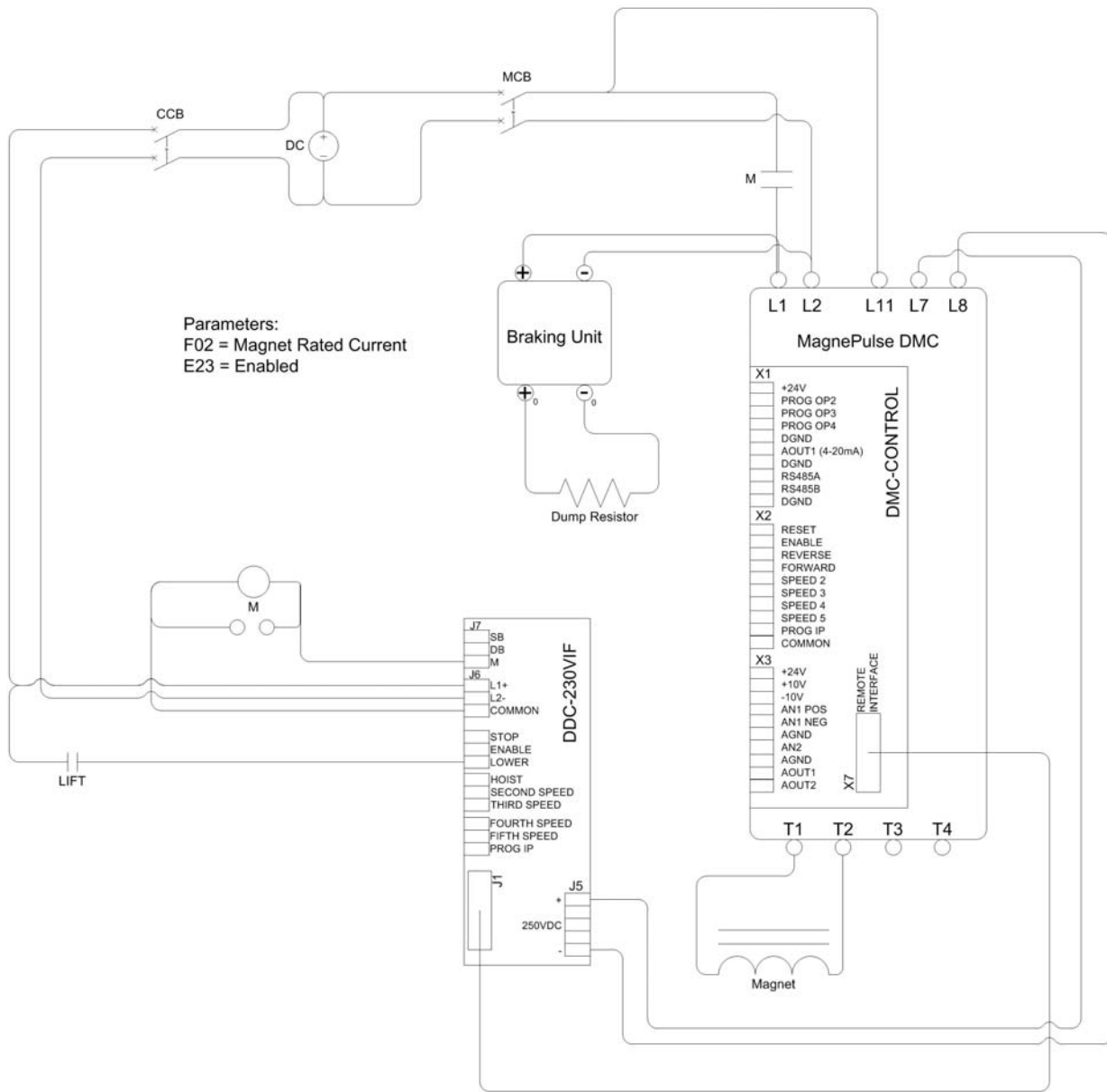
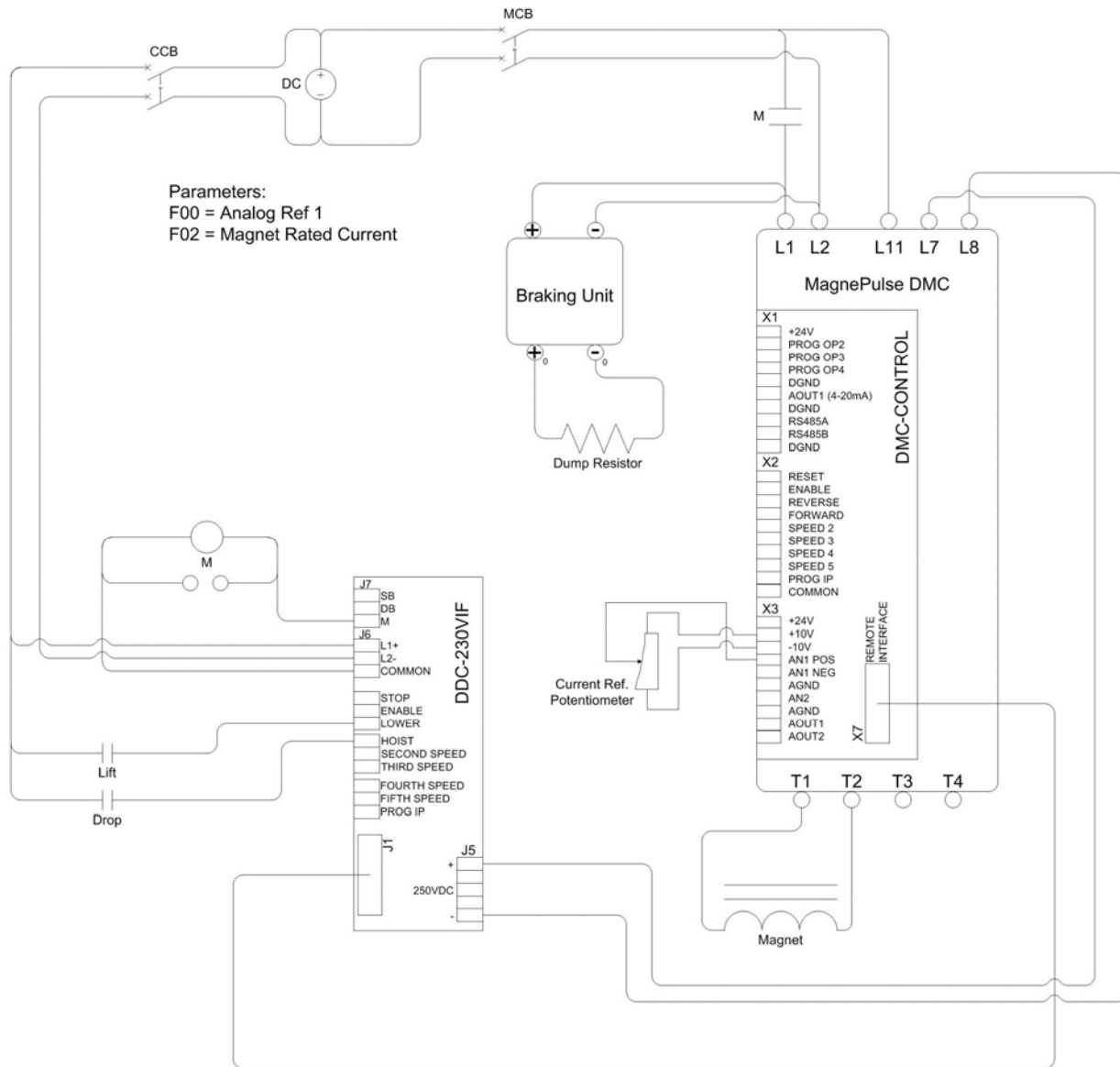
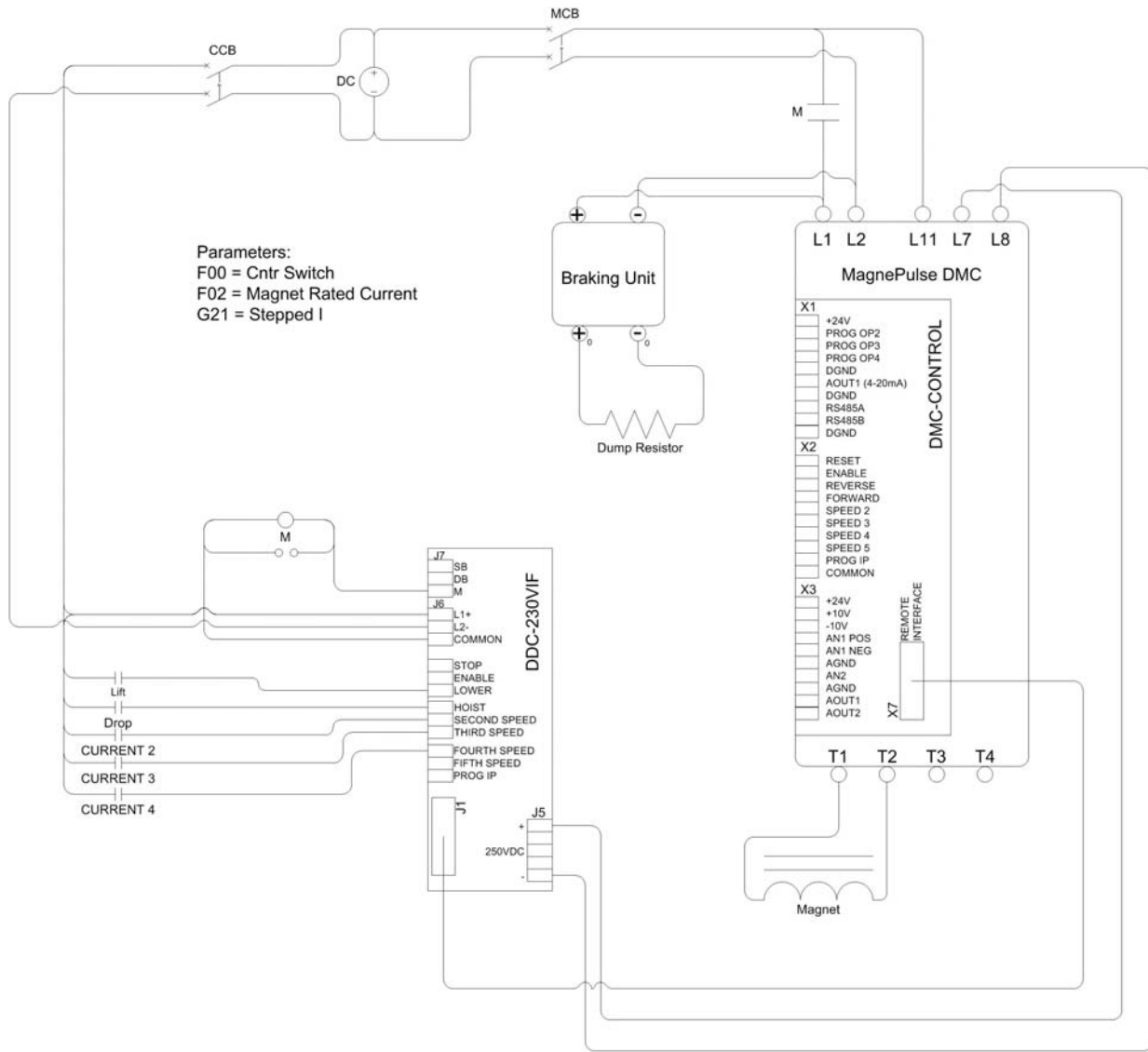


Figure 3: Typical Lift Input Mode Wiring with Auto Clean





**Figure 4: Typical Analog Input Mode Wiring**



**Figure 5: Typical Stepped Current Input Mode Wiring**

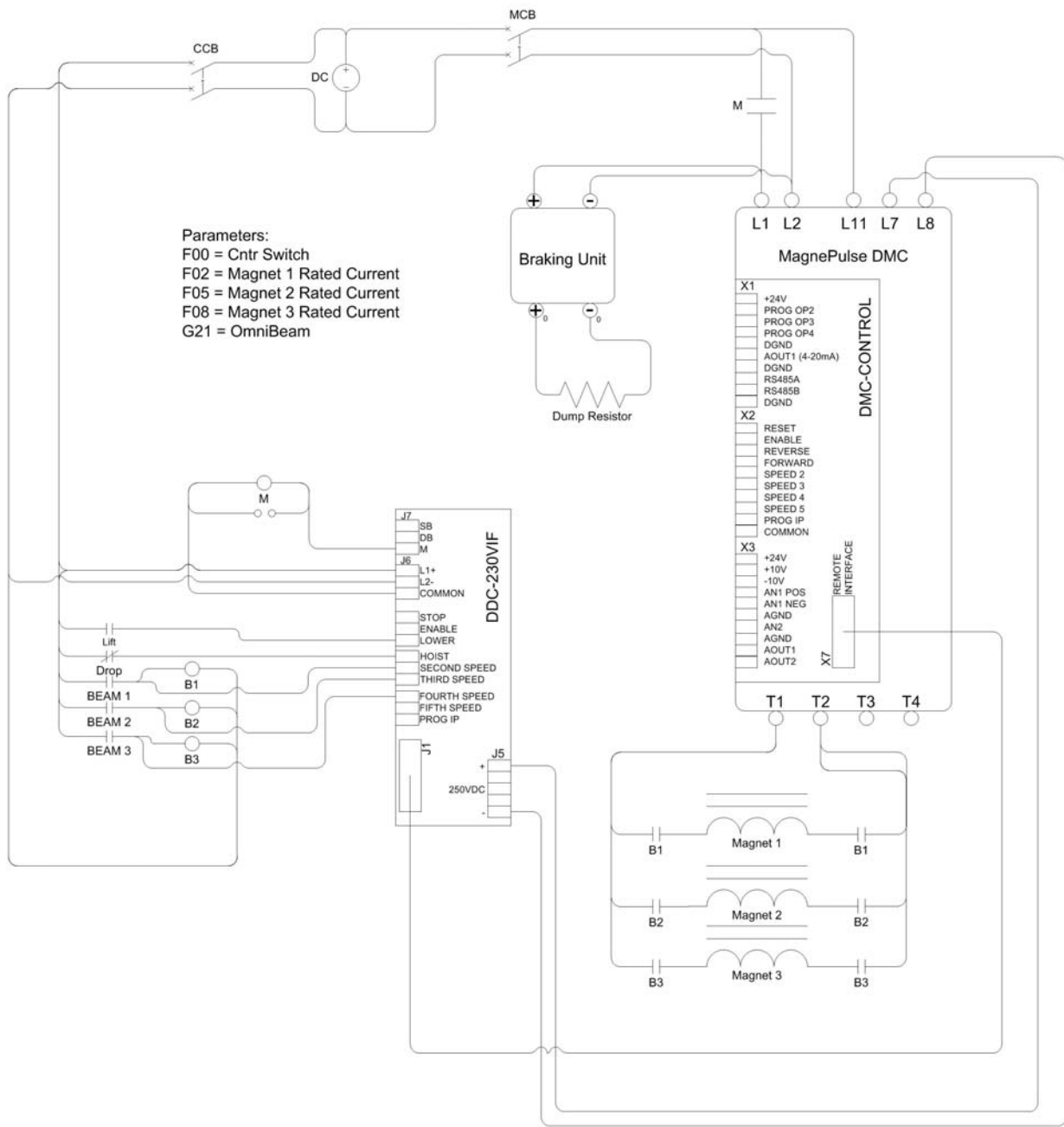


Figure 6: Typical Lift-Drop Input Mode Wiring with OmniBeam Feature

# Specifications

## Electrical Ratings

**Table 2: Electrical Ratings**

Description	Specification	
<b>Power</b>		
Current Range	5 amps to 2000 amps continuous	
Supply Bus Voltage +10% to -20%	200 to 320V DC Standard 360 to 640V DC Optional	
Grounding Configurations	Full Floating, Grounded Positive, or Grounded Negative	
DV/DT Rise	1500 volts per microsecond maximum	
Switching Frequency	1 kHz	
<b>Control I/O</b>		
Digital Inputs	DMC-CONTROL	8 inputs (24 VDC)
	DDC-230VIF	8 inputs (200-300 VDC)
	DMC-120A60IF	8 inputs (120 VAC, +10/-15%, 60±3 Hz)
Digital Outputs	DMC-CONTROL	3 outputs (24 VDC, 40 mA)
	DDC-230VIF	2 programmable, 1 main line (230 VDC, 1A)
	DMC-120A60IF	2 programmable, 1 main line (120 VAC/30 VDC, 1A)
Analog Inputs	DMC-CONTROL	2 inputs (0-10 VDC or 4-20 mA, 250Ω)
Analog Outputs	DMC-CONTROL	2 outputs (0-10 VDC or 4-20 mA, 250Ω)
<b>Communication</b>		
RS-232	Modbus RTU	
RS-485	Modbus RTU	
<b>Protective Functions</b>		
Reverse Polarity	Software and hardware detection	
Power Loss	One second control Ride-Through capability Power circuit Ride-Through time is proportional to magnet current	
Undervoltage	Trip @ less than 50% $V_{in}$ for greater than one second	
Control Magnet Short Circuit	Current Control Overload Trip IGBT Individual Overload Trip IGBT Overcurrent Safe Failure Mode	
Control Thermal	Heat Sink Overtemperature Alarm and Shutdown Enclosure Overtemperature Shutdown	
Magnet Thermal	Resistive Temperature Trip	
Magnet Overload	Electronic Time trip	
Magnet Continuity	Continuous	
Fuse Protection	DC BUS Power Fuse Interface Board Fused	
Charge Indicator	Visual indicator on control unit indicating charge state on the capacitor bank. Backlight display indicates control voltage presence.	
Magnet Ground Detection	Trip level is hardware set and is non-adjustable.	

## Environmental Specifications

**Table 3: Environmental Specifications**

Description	Specification
<b>Temperature</b>	
Ambient Operating Temperature	-10°C (no frost) to + 40°C enclosed at 60% duty -10°C (no frost) to + 65°C* internal enclosure temperature
Storage Temperature	-40°C to +65°C
Relative Humidity	< 90% No Condensation
<b>Altitude</b>	
Altitude	3300 Feet (1000 meters) 3000 meters Maximum
<b>Deration</b>	
Temperature	2% rated current lower per 1°C above 50°C
Altitude	1% rated current for each 100 meters above 1000
Maximum Control Deration	20% rated current total
<b>EMC</b>	
Immunity	Designed to meet the requirements of EN50081-2
Emissions	Designed to meet the requirements of EN50081-2
<b>Vibration/Shock</b>	
Vibration	Designed to meet the requirements of IEC 721-3-3
Shock	Designed to meet the requirements of IEC 68-2-27

\* Maximum rated temperature of 65°C at the drive chassis with factory approved air handling system

## Model Ratings

**Table 4: Model Ratings**

200-320 Volts		360-600 Volts	
Models	Max. Cold Magnet Amps	Models	Max. Cold Magnet Amps
L133-DMC	133	H133-DMC	133
L400-DMC	400*	H400-DMC	400*
L400F-DMC	400	H400F-DMC	400

Controllers should be sized according to Cold Magnet Amps.

\*The 400 amp controller is used as the master drive with up to four follower controllers (L400F-DMC or H400F-DMC).

**Table 5: Component Selection Guide**

Current Rating	DBU	Resistor
67A	CDBR-2022D	EDB2067DMCWL
133A	CDBR-2045B	EDB2133DMCWL
200A	CDBR-2110B	EDB2200DMCWL
400A	CDBR-2110B (qty 2)	EDB2200DMCWL (qty 2)

## Chassis Drawings

Parts List			
ITE	QT	MAGNETEK PART NUMBER	DESCRIPTION
3	1	144-45266	FAN-24VDC-4"-95CFM
46	1	144-45350	CONTRL BOARD
56	1	144-45063	DISPLAY BOARD
67	1	144-45065	FUSE 150A/500V 2.75"
69	1	144-45058	DRIVER BOARD WITH POWER SUPPLY

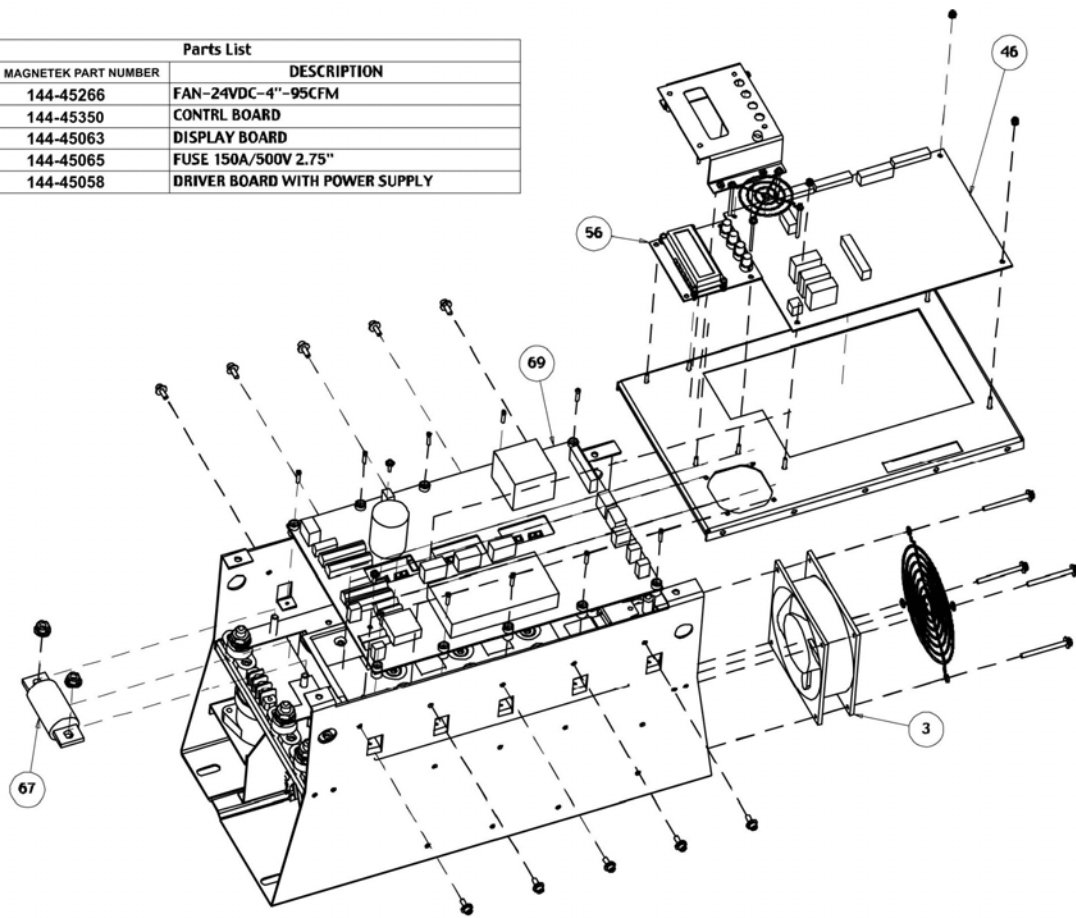


Figure 7: Exploded View – 133A Low Voltage Control Chasis

Parts List			
ITEM	QT	MAGNETEK PART NUMBER	DESCRIPTION
16	1	144-45350	CONTROL BOARD
17	1	144-45354	LV DRIVER BOARD WITH POWER SUPPLY
		144-45356	HV DRIVER BOARD WITH POWER SUPPLY
18	1	144-45064	DC BUS DISCHARGE BOARD
30	1	144-45063	DISPLAY BOARD
46	1	144-45066	FUSE 500A/500V 3.25IN
88	1	144-45090	FAN-24VDC-6.75"-235CFM

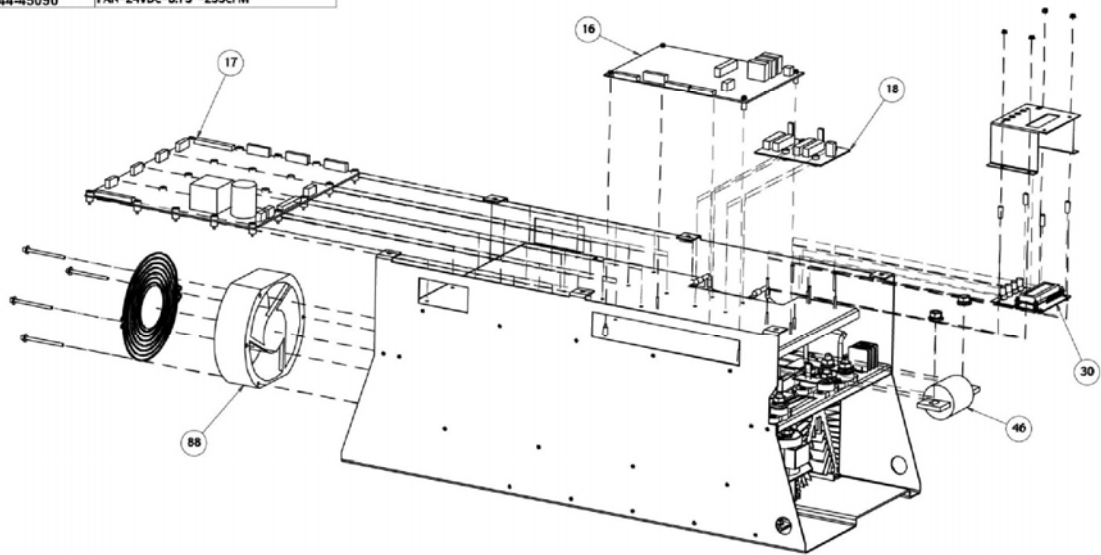
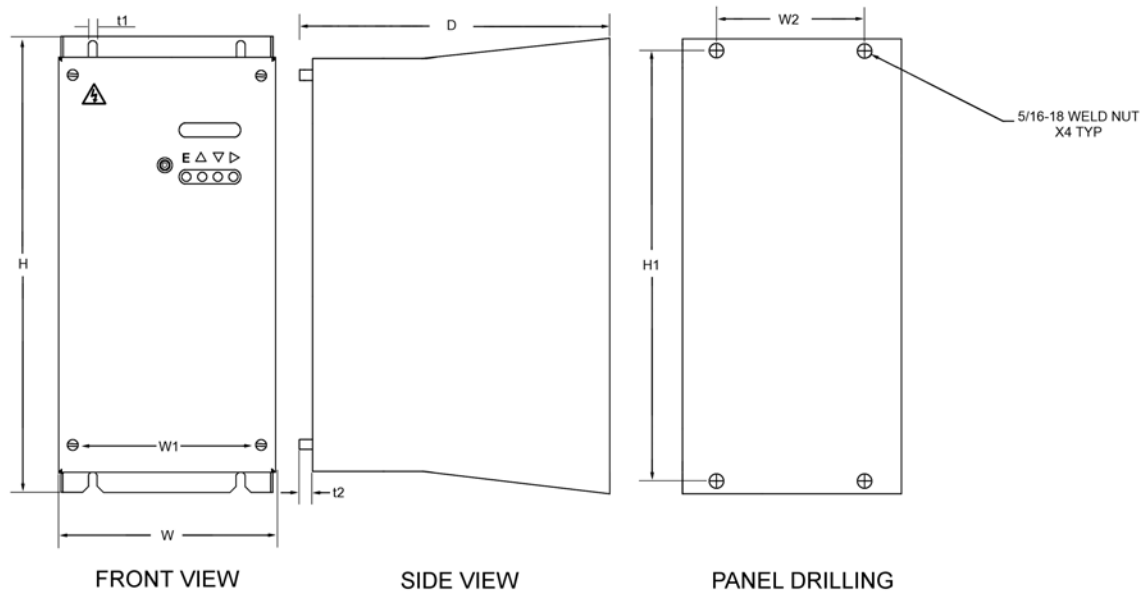
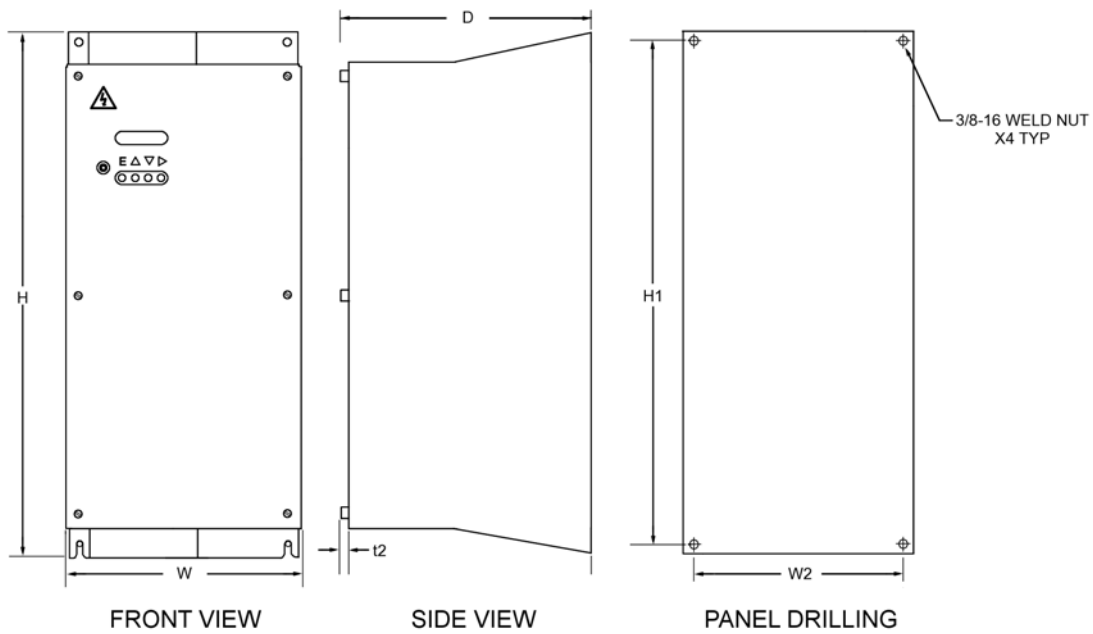


Figure 8: Exploded View – 200/400 A and High Voltage Drive Chassis



**Figure 9: 133A Low Voltage Control Chassis**



**Figure 10: 133A High Voltage and 400A Control Chassis**

**Table 6: Chassis Dimensions**

Model	Figure Number	Dimensions (in)								Weight
		W	H	D	W1	W2	H1	t1	t2	
L133-DMC	9	8.57	18.50	12.50	7.00	6.00	17.50	.35	.50	44 lbs.
H133-DMC L400-DMC H400-DMC L400F-DMC H400F-DMC	10	13.17	30.00	14.17	--	11.90	28.87	--	.50	119 lbs.



## Thermal Characteristics Watts/Amps

Table 7: Thermal Characteristics

Max. Current Rating	Watts/Amp @ Max. Rating
133	5
400	4
800	4
1200	4
1600	4
2000	4

**Note:** Add 15% watts for power wiring and current carrying devices for total controller watts. Convert to BTU/HR by multiplying by 3.41.

**Example:** Calculated generated watts and BTU/HR for a magnet rated at 44 amps.

$$\text{Watts} = (44 \text{ Amps} \times \frac{5 \text{ Watts}}{\text{Amp}}) \times 1.15 = 253 \text{ Watts}$$

$$\text{BTU/HR} = 253 \text{ Watts} \times 3.41 \frac{\text{BTU/HR}}{\text{Watt}} = 863 \text{ BTU/HR}$$

# Control Board Terminals

## Connector X1

**Table 8: Control Board Terminal X1**

Pin	Name	Signal Format	Description
1	+24V		+24VDC source
2	PROG_OP2	Open-collector negative logic	Programmable logic output 24V DC 50 mA
3	PROG_OP3	Open-collector negative logic	Programmable logic output 24V DC 50 mA
4	PROG_OP4	Open-collector negative logic	Programmable logic output 24V DC 50 mA. Shared function with 230V DC SB output on Interface Card
5	GND		Logic ground
6	AOUT1(4/20 mA)	4..20 mA	Programmable analog output 1 current loop output
7	GND		Logic ground
8	RS485A/RS232TX	RS485/RS232	RS485A or RS232 transmit
9	RS485B/RS232RX	RS485/RS232	RS485B or RS232 receive
10	GND		Logic ground

## Connector X2

**Table 9: Control Board Terminal X2**

Pin	Name	Signal Format	Description
1	RESET	Isolated 24VDC positive logic.	Selects RESET or STOP
2	ENABLE	Isolated 24VDC positive logic.	Enable input
3	REVERSE	Isolated 24VDC positive logic.	Selects LOWER or REVERSE motion (lift)
4	FORWARD	Isolated 24VDC positive logic.	Selects HOIST or FORWARD motion (drop/clean)
5	SPEED2	Isolated 24VDC positive logic.	Selects SECOND SPEED
6	SPEED3	Isolated 24VDC positive logic.	Selects THIRD SPEED
7	SPEED4	Isolated 24VDC positive logic.	Selects FOURTH SPEED
8	SPEED5	Isolated 24VDC positive logic.	Selects FIFTH SPEED
9	PROG_IP	Isolated 24VDC positive logic.	Programmable logic input
10	DIP COMMON		Isolated input common

**Connector X3****Table 10: Control Board Terminal X3**

Pin	Name	Signal Format	Description
1	+24V		24V source (0.2A max, not isolated from logic ground).
2	+10V		+10V analog reference (10 mA max)
3	-10V		-10V analog reference (10 mA max)
4	ANALOG IP 1(+)	-10..+10V or 4..20 mA differential	Programmable analog input 1 – high
5	ANALOG IP 1(-)		Programmable analog input 1 – low
6	ANALOG GND		Analog ground
7	ANALOG IP 2	0..10V or 4..20 mA	Programmable analog input 2
8	ANALOG GND		Analog ground
9	AOUT1(0/10V)	0V..+10V	Programmable analog output 1
10	CURRENT	0V..+10V	Magnet current signal (absolute)

# Controller Setup

## Using the Digital Display

Each MagnePulse DMC control has a display for monitoring the DMC operation and adjusting parameters. The MagnePulse DMC has a 2-line LCD to display information. Four pushbuttons are used to control the display and to carry out adjustments.

### 2-Line x 16-Character LCD

The LCD has the following appearance at power-up. This is the first screen of the MAIN MENU.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Line 1					M	A	G	N	E	T	E	K				
Line 2		M	a	g	n	e	P	u	l	s	e		D	M	C	



Figure 11: 2-Line x 16-Character LCD

### Keypad Operation and Navigation

*In the display mode, the keys have the following functions:*

▶ RIGHT Key

This key is used to select the menu to be displayed. Up to 7 sub-menus, A to G, are accessed in sequence by pressing this key. When the last menu is reached, the display rotates back to the main menu.

▲ UP Key

This key is used to select a parameter within the selected menu. Each press of the UP key increments to the next parameter. The selection rolls over from the last parameter to the first.

▼ DOWN Key

This key is used to select a parameter within the selected menu. Each press of the DOWN key decrements to the previous parameter. The selection rolls over from the first parameter to the last.

E ENTER Key

This key is used to switch from the display mode to the parameter adjustment mode.

*In the Parameter Adjustment mode the keys have the following functions:*

▶ RIGHT Key

This key is used to position the flashing cursor within the numerical data field to select the digit to be adjusted.

▲ UP Key

This key is used to increment the selected digit. On incrementing from 9 to 0 the next left digit is incremented if it is present.

▼ DOWN Key

This key is used to decrement the selected digit. On decrement from 0 to 9, the next left digit will decrement if it is present.

E ENTER Key

This key is used to store the new value and return to the display mode.

### ***Charge and Control Indicator Light***



### **⚠ WARNING**

The charge indicator light on the display indicates the capacitor bank condition. When the light is on the capacitor bank has voltage, which can be harmful to personnel. The capacitor bank will fully discharge in 6 minutes when both the main and control circuit breaker or knife switch is opened.

The control indicator light indicates the presence of control voltage to the control unit. This light will be on whenever the control circuit breaker or knife switch is closed.

## **DMC Menus**

Title Screen

- Group A: Monitor Sub Menu
- Group B: Access Sub Menu
- Group C: Controller Rating Setup Sub Menu
- Group D: Protection Sub Menu
- Group E: Magnet Control Setup Sub Menu
- Group F: Magnet Specification Sub Menu
- Group G: I/O Configuration Sub Menu
- Group H: Fault Sub Menu

# Parameter Tables

## Group A: Monitor

**Table 11: Magnet Current and Voltage**

Variable Number	Name	Function	Unit
A00	Magnet Current	Displays the value of magnet current derived from controller terminal T1 current measurement.	0.1A
A02	Magnet Voltage	Displays the value of the magnet voltage measurement derived from controller terminals T1 and T2.	0.1V
A03	DC Bus Voltage	Displays the voltage on the controller DC bus capacitors.	0.1V

**Table 12: Magnet Status**

Variable Number	Name	Function	Unit
A04	Magnet Res	Magnet Calculated Resistance (Note: only calculated during steady state current by I Agree)	0.001 Ohm
A05	Magnet Temp	Magnet Calculated Temperature (Note: calculated using cold magnet resistance parameters and steady state magnet resistance)	C
A08	Control Ref	Input reference from master switch/analog reference	0.1%

**Table 13: Control Power, Energy, and Operation Cycles**

Variable Number	Name	Function	Unit
A09	Input Power	Displays instantaneous power input from the main DC supply.	kW
A10	Energy Used	Displays the accumulated energy used by the controller.	0.1 kWh
A11	No of Operations	Operation Counter (99 max. count after which counter resets to zero).	1
A12	No of Operations x 100	Operation Counter (increments 1 for every 100 operations up to 65,535 after which it resets to zero).	100
A13	Elapsed Hours	Accumulated time controller is enabled.	1 hr

**Table 14: Analog Input Status**

Variable Number	Name	Function	Unit
A14	Analog Input 1	Displays the % full scale of analog input 1.	0.1%
A15	Analog Input 2	Displays the % full scale of analog input 2.	0.1%

**Table 15: Current Control**

Variable Number	Name	Function	Unit
A16	Magnet Current Ref	Displays the magnet calculated current reference as a percentage of the magnet(s) rated current.	0.1%
A17	Magnet FB Rel	Displays the relative magnet current feedback as a percentage of the magnet(s) rated current.	0.1%

**Table 16: I/O Status**

Variable Number	Name	Function	Unit
A21	Logic Inputs	Bit 0 is the display's right-most bit Bit 0: Enable Bit 1: Forward (Drop) Bit 2: Reverse (Lift) Bit 3: Speed 2 Bit 4: Speed 3 Bit 5: Speed 4 Bit 6: Speed 5 Bit 7: Not Used Bit 8: Programmable Input Bit 9: Module Fault Bit 10: Module Out of Service Bit 11: Power Supply Loss Bit 12: Ground Fault	Bit
A22	Logic Outputs	Bit 0 is the display's right-most bit Bit 0: M Contactor (Interface Board - M) Bit 1: Prog OP 1 (Interface Board - DB) Bit 2: Prog OP 2 Bit 3: Prog OP 3 Bit 4: Prog OP 4 (Interface Board – SB)	Bit

**Table 17: Controller Status**

Variable Number	Name	Function	Unit
A23	Heatsink Temp	Displays the temperature of the semiconductor heatsink reading.	0.1°C
A24	Ambient Temp	Displays the ambient temperature at the electronic control card reading. Fault at 75 °C reset at 65 °C	0.1°C
A25	Overload Level	Displays the accumulated value of magnet current overload. This register increments above 110% current and decrements when current falls below 110%. Fault occurs when value reaches 18000.	1
A26	T1 Duty Cycle (Advanced Tool)	Displays the PWM duty cycle (% time ON) at terminal T1 (connected to armature terminal A1).	0.1%
A27	T2 Duty Cycle (Advanced Tool)	Displays the PWM duty cycle (% time ON) at terminal T2 (connected to armature terminal A2).	0.1%





### Controller Status (Continued)

Variable Number	Name	Function	Unit
A30	Fault Status (Advanced Tool) (Displays the active trip before reset)	0 = No fault 1 = Control Supply Under voltage (CUV) 2 = Under voltage (UV1) 3 = Heatsink Over temperature Alarm (Temp Alarm) 4 = Heatsink Over temperature Trip (Temp Trip) 5 = Short Circuit (SC) (IGBT driver module) 6 = Over voltage Trip (OV) 7 = External Fault Maj 8 = External Fault Min 9 = Not Used 10 = Not Used 11 = Not Used 12 = Not Used 13 = Magnet Overload (MOL) 14 = Master Switch not in Off Position (MS) 15 = Change of Setting (CRC) 16 = Ambient Temp 17 = Ground Fault 18 = Module out of service (MOS) 19 = Open Magnet Coil	
A31	Sequence Status (Advanced Tool)	Displays the current sequence state: 0 = Initialization Power Up 1 = Locked Out 2 = Ready 3 = Start Delay 4 = Lift 5 = Hold 6 = Dribble 7 = Drop 8 = Clean-off 9 = Zero I 10 = Stop 11 = Fault 12 = Memory Update 13 = Latched Fault 14 = Power Loss Ride-Through	

## Group B: Access

**Table 18: Group B – Access**

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level*
B00	Password	0	0 65535	1	0
B01	Access Level Monitor User Engineer	Monitor	0 2	—	0
B02	Control Firmware Version	Monitor	—	—	0
B03	Control Firmware Subversion	Monitor	—	—	0
B05	Modbus AN 1	Analog Reference which is transmitted via Modbus for analog input 1	—	—	0
B06	Modbus AN 2	Analog Reference which is transmitted via Modbus for analog input 2	—	—	0

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** WARNING**

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This product requires passwords to make parameter changes. It is the responsibility of the purchaser/user to safeguard these passwords and make them available only to qualified trained personnel. Improper parameter setup can damage equipment, pose a hazard to personnel and result in unexpected operation. Note that once entered, the password remains active until the control is either powered down or is reset using the S1 (Reset) button on the Interface Card.

### **Access Level – B01**

\*Parameter groups B through H indicate the access level required to change the parameter. Access levels are defined as:

- 0 = Monitor: permits monitoring of control operation.
- 1 = User: permits adjustment of performance settings.
- 2 = Engineer: permits adjustment of application settings.

### **Modbus AN1 and AN2 – B05 and B06**

These are the monitor parameters for Modbus analog control. The values displayed are the analog signals being transmitted to the control from the Modbus Master.

**Group C: Controller Rating Setup**

**Table 19: Group C – Controller Rating Setup**

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level
C01	Voltage Class	Set by DIP SW Position 4	0 = 200/360V 1 = 400/720V	1	0
C02	Current Class	Set by DIP SW Position 1 & 2	0 = 67A 1 = 133A 2 = 200A 3 = 400A *Note 1	1	0
C03	Parallel Stacks	1	1 5 *Note 1	1	2
C04	Magnet Setup	0	0 = Internal CT 1 = Ext CT 20A 2 = Ext CT10A 3 = Ext CT 5 A *Note 2	1	2
C05	Input Bus Voltage	250	200 – 360 200 – 720 *Note 3	1V	2
C07	Default Values	No Action	0 = No Action 1 = Store User 2 = Restore User 3 = Restore Factory	1	1

**Note 1:** When current class C02 switches are set to 400 A and the C03 value is greater than 1 the current class display will change with the C03 setting. When the DIP switches are set for 67 Amp and C04 External CT is selected the C02 will display 33A after the control is reset.

**Note 2:** Internal CT default setting can only be changed when Current Class C02 is set to 67A setting.

**Note 3:** Input Bus voltage range is dependent upon Voltage Class setting displayed in parameter C01.

### Voltage Class – C01

This parameter defines the measurement scaling for the DC bus voltage; it must match the nameplate rating of the controller. Incorrect setting of this parameter will result in incorrectly scaled values for magnet voltages. Failure to set this parameter correctly will cause incorrect voltages to be indicated on the display. Reference **Figure 15** and **Table 27** for proper setting of position 4 on SW1.

### Current Class – C02

This parameter defines the measurement scaling for magnet current, it must match the nameplate rating of the controller. Failure to set this parameter correctly will result in the magnet being operated at the wrong current. This will cause incorrect currents to be indicated on the display and will also cause the current limits and magnet overload protection to operate incorrectly. Reference **Figure 15** and **Table 27** for proper settings of position 1 and 2 on SW1. When SW1-1 and SW2-2 are on (400A setting) the current class display changes when parameter C03 is greater than 1. See **Table 20** in the Parallel Stacks description.

### Parallel Stacks – C03

This parameter is used when parallel converter units are combined with a 400A unit to obtain current capacities above 400A. This parameter must be equal to the total number of converter units including the master. Failure to set this parameter correctly will result in the magnet being operated at the wrong current. This will cause incorrect currents to be indicated on the display and will also cause the current limits and magnet overload protection to operate incorrectly. Parameter can only be changed if 400A switch position is on.

**Table 20: Parallel Stacks Configuration**

Controller Amps	Parameter Value	C02 Value
400	1	400amps
800	2	800amps
1200	3	1200amps
1600	4	1600amps
2000	5	2000amps

### Magnet Setup – C04

This parameter defines where the current signals are derived, either from internal CTs or external CTs. External CTs require the use of the External CT field board on the T1 and T2 terminals.

The external CTs are only used with the 33A controls that are connected to magnets below 20A. The external CT board is mounted externally to the controller on the control panel. Refer to **Figure 16** and **Table 28** for jumper setting information.

When using the external CTs it is necessary to make sure that the jumper settings and the parameter setting (C04) agree to avoid operational problems. Also make sure that the jumper connections on driver board are according to **Table 29**. Whenever the external CT is selected the C02 parameter will display 33A. This is another quick check for the proper link settings on driver board. 133 AMP to 400 AMP switch positions will not allow the parameter to change from Internal CT.

### **Input Voltage – C05**

Parameter specifies the nominal bus voltage of the DC supply system. It also sets the undervoltage trip point (50%) and the overvoltage trip point (140%). The maximum overvoltage trip point is limited to 420V in the low voltage control and 840V in the high voltage control. Default setting is determined by SW1 DIP Switch position 4 setting.

### **Default Values – C07**

Provides the ability to store and restore the user parameter setup into the flash memory of the control. Also provides the ability to load factory default settings. Access to store and restore is provided by the engineering password level.

To store the user settings, select Store User Setting after all of the parameters are set and checked for accuracy.

To restore the user settings, select Restore User Setting.

To restore the factory settings, select the Restore Factory Setting. It will be necessary to reset the parameters for proper operation for the specific control and magnet used since the default settings are not control specific as the user settings are. This parameter is useful when first setting up the control or changing the control card.

The default settings will not become effective until the controller is powered down or reset through the S1 switch on the interface card.

---

### **WARNING**

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Before installing a control board, whether from another control or from inventory, control board DIP switches and parameters must be properly programmed. Incorrect control setup can cause equipment damage or personnel injury.

**Group D: Protection**

**Table 21: Group D - Protection**

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level
D00	Magnet Rated Volts	230	200 – 360 200 – 720 *Note 1	1V	2
D01	Magnet Volt Limit	0	0 – 360 0 – 720	1V	2
D03	Power Loss Level	200	0 – 360 0 – 720	1 V	2
D07	Ground Fault	Disabled	0 = Enabled 1 = Disabled	1	2
D08	OH Alarm Level	85°C	70 85	1°C	2
D09	OH Trip Level	90°C	70 115	1 °C	2
D11	Start Delay	300	0 2500	1 ms	2
D12	Stop Delay	0	0 2500	1 ms	2
D14	Magnet Temp Alarm	0°C	0 700	1 °C	2
D15	Magnet OT Enable	0°C	0 800	1 °C	2
D16	OH Fan Enable	60.0°C	0 70.0	0.1 °C	2
D17	OA Temp Enable	75.0°C	0 95.0	0.1 °C	2
D18	MOC Detect Level	0.0	0.0 50.0	0.1%	2
D19	MOC Detect Time	0	0 2500	1 ms	2
D30	Reset Attempts	3	0 10	—	2
D31	Reset Flt Sel	0084	0000 03FF	—	2

**Note 1:** Input Bus voltage range is dependent upon Voltage Class setting displayed in parameter C01.

### **Magnet Rated Voltage – D00**

This parameter is normally set to the magnet nameplate voltage rating. This parameter value is used to scale the magnet voltage feedback.

**Rectified Systems** When applying a standard 230V DC magnet to a 300 or 360V DC rectified system it will be necessary to adjust this parameter to obtain the correct display reading. For the 300V system, the values should be 1.3 times the nominal magnet ratings. For the 360V system, the values should be 1.57 times the nominal ratings. The multiplication factor is the ratio of the rectified volts over the nominal magnet volts. The magnet current does not change much, so it can remain at the magnet rated value.

---

 **CAUTION**

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When applying this control to rectified systems make sure that the rectifier has the ability to handle the regenerative energy produced by the magnet. If it does not, additional equipment will be necessary to prevent controller faults from overvoltage.

### **Magnet Volt Limit – D01**

This parameter will limit the output voltage to the magnet. Setting D01 to 0 will disable this feature.

### **Undervoltage Level – D03**

This parameter defines the DC bus voltage level the control will enter the power loss ride-through state. Once in the power loss ride through state the control will base block, allowing the magnet current to charge the DC bus capacitors until the DC bus rises to C05. At which point the control will recharge the magnet until the magnet and DC bus are dissipated of their stored energy. Setting D03 to 0 disables the power loss ride-through feature.

### **Ground Fault – D07**

This parameter enables the ground fault protection. LK10 on the driver board needs to be set open and the D07 must be changed to Enabled. The trip setting default is 50% of the controller continuous current rating displayed in parameter C02. LK12, found on the driver board, can adjust the trip level at 50%, 20%, 10%, or 5%.

### **OH Alarm Level – D08**

This parameter sets the temperature level at which the semiconductor heatsink provides a warning of possible shutdown. When this temperature level is reached, the control will cut back the current and allow only 150% maximum current for the one minute cycle and not the 200% for three seconds. The level is adjustable from 70 to 85°C.

### **OH Trip Level – D09**

This parameter sets the heatsink temperature where the control will fault and shut down until the heatsink cools below the reset level of 90°C. The trip level is adjustable from 70 to 115°C.

---

 **WARNING**

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A faulted control will disable magnet current and drop the load.

### **Start Delay – D11**

This parameter allows time for the main contactor to close before the control loops activate the magnet. This delay will be present at the start of every requested cycle. If arcing occurs on the contact tips or UV trip occurs, extend the time to eliminate.

### **Stop Delay – D12**

This parameter sets the time before the next lift cycle can be activated. To obtain the quickest ready state, set this parameter to 0.

### **Magnet Temperature Alarm – D14**

This parameter sets magnet temperature that will set the magnet temperature alarm (MTA) and enable Alarm programmable output. This feature is used to notify the operator that an over temperature condition may occur during the current lift and should find a safe place to lower the load. Setting the parameter to 0 will disable the alarm feature.

### **Magnet OT Enable – D15**

This parameter sets the magnet temperature that will set the magnet over temperature fault. The fault will consequently disable magnet current. Setting the parameter to 0 will disable the fault feature.

### **OH Fan Enable – D16**

This parameter specifies heatsink temperature that the fan will turn on at. Lowering this parameter increases the semiconductor life expectancy, but decreases the fan's life expectancy.

### **OA Temp Enable – D17**

This parameter specifies the ambient temperature at the control board that the control will fault and shut down on an ambient over temperature (AOT) fault. Setting this parameter to 0 will disable the fault.

---

** WARNING**

---

A faulted control will disable magnet current and drop the load.

### **MOC Detect Level – D18**

This parameter specifies magnet current level that will enable a magnet open circuit (MOC) fault. Setting this parameter to zero disables the MOC fault.

---

** WARNING**

---

A faulted control will disable magnet current and drop the load.

### **MOC Detect Time – D19**

This parameter specifies the duration the magnet current must be below the MOC Detect Level before a fault is logged.

### **Reset Attempts – D30**

This parameter sets how many automatic reset attempts are allowed for the faults selected in D31. If the reset attempts max out, G11 or G22 could be used to reset a fault.



### Reset Flt Sel – D31

This parameter selects what faults can be automatically reset when the fault condition is gone.

	Digit 4				Digit 3				Digit 2				Digit 1			
<b>HEX</b>	<b>0</b>				<b>0</b>				<b>8</b>				<b>4</b>			
<b>Binary</b>	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
<b>Bit</b>	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Fault
0	CUV
1	UV1
2	OT1
3	OV
4	EXF
5	EXFMN
6	MOT
7	AOT
8	GF
9	MOC
10	Not used
11	Not used
12	Not used
13	Not used
14	Not used
15	Not used

Binary Number	Hexadecimal Conversion
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Example: In this example, AOT, MOT, OV, and UV1 need to be resettable. UV1 corresponds to Bit 1, and should be set to a value of 1. OV corresponds to Bit 3, and should also be set to 1. Bits 1 and 3 contribute to the final value of Digit 1, resulting in a binary value of 1010. Per the binary to hexadecimal conversion chart, the binary value 1010 will convert to A. MOT and AOT correspond to Bits 6 and 7, so both should be set to 1. They contribute to the final value of Digit 2, resulting in a binary value of 1100, which converts into the hex value of C. Since the other bits are set to 0 for the other Digits (resulting in a binary and hex value of 0), the final value to be entered into Parameter D31 is 00CA.

	Digit 4				Digit 3				Digit 2				Digit 1			
<b>HEX</b>	<b>0</b>				<b>0</b>				<b>C</b>				<b>A</b>			
<b>Binary</b>	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0
<b>Fault</b>					A	G	A		A	M	F	E	O	O	U	C
					O	F	O		O	O	D	X	V	T	V	U
					C		T		T	T	B	F		1	1	V
											K					

**Group E: Magnet Control Setup**

**Table 22: Group E – Magnet Control Setup**

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level
E00	Lift Current	100.0%	0 100%	0.1%	2
E01	Hold Current	75.0%	0 100%	0.1%	2
E02	Dribble Current	-10.0%	100.0% -100.0%	0.1%	2
E03	Clean Current	15.0%	0 100%	0.1%	2
E04	Cast Rate	1%/s	0.1 100	0.1%/s	2
E05	Lift Time	15.0	0.2 30.0	0.1 s	2
E06	Dribble Rate	2%/s	0.1 100	0.1%/s	2
E07	Clean Time	0.8	0.2 30.0	0.1 s	2
E08	Decreased Lift	10%	0 100	0.1%	2
E09	Lift Current 1	100%	0 100	0.1%	2
E10	Lift Current 2	80%	0 100	0.1%	2
E11	Lift Current 3	60%	0 100	0.1%	2
E12	Lift Current 4	40%	0 100	0.1%	2
E13	Lift Current 5	20%	0 100	0.1%	2
E14	Clean Current 1	20%	0 100	0.1%	2
E15	Clean Current 2	40%	0 100	0.1%	2
E16	Clean Current 3	60%	0 100	0.1%	2
E17	Clean Current 4	80%	0 100	0.1%	2
E18	Clean Current 5	100%	0 100	0.1%	2

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level
E20	I Agree	1.0	0 10.0	0.1%	2
E21	P Gain	1.0	0.1 50.0	0.1	2
E22	I Gain	0.2	0.1 50.0	0.1	2
E23	Auto Clean	Disabled	0 = Enabled 1 = Disabled	1	2

#### **Lift Current and Lift Time – E00 and E05**

When using Lift or Lift-Drop input modes the Lift Current parameter sets the desired current level, as a percentage of magnet rated current, to pick and magnetize the load. Once both the Lift Current has been achieved and the Lift Time has expired the control will enter the Hold sequence.

#### **Hold Current – E01**

When using Lift or Lift-Drop input modes this parameter sets the desired current level, as a percentage of magnet rated current, to hold the magnetized load.

#### **Dribble Current and Dribble Rate – E02 and E06**

In Lift-Drop input mode the Dribble parameter sets the rate of reduction of magnet current when the Lift command is removed. Once the Dribble Current level has been achieved the magnet current is no longer reduced.

### Clean Current and Clean Time – E03 and E07

When using Lift or Lift-Drop input modes the Clean Current parameter sets the desired current level, as a percentage of magnet rated current, to rapidly drop the load. In Lift input mode, once the Lift Time has expired the control will enter the Zero I sequence. In Lift-Drop input mode once the Clean Time has expired or the Drop command is removed the control will enter the Zero I sequence.

In Lift input mode the control enters the Drop sequence when the Lift command is removed.

In Lift-Drop input mode the control enters the Drop sequence when the Drop command is applied.

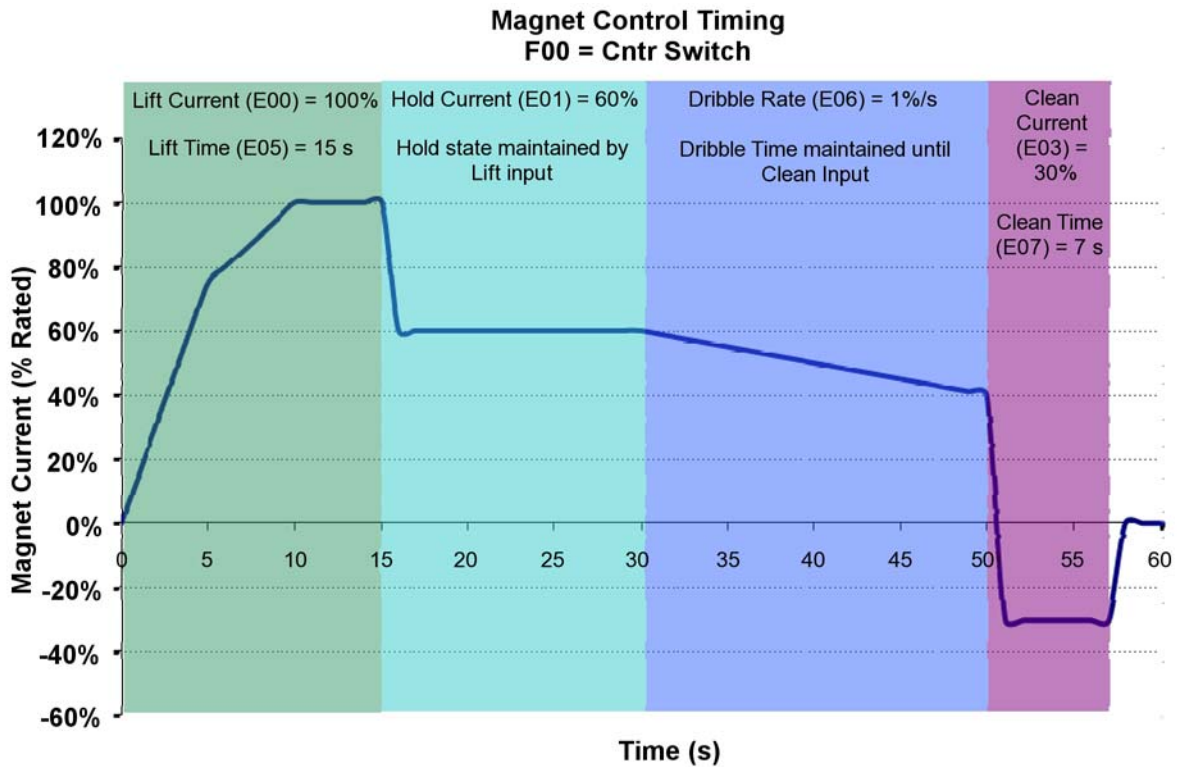


Figure 9: Example Lift-Drop Input Mode Current Profile

## Cast Rate – E04

Cast Rate is enabled by PROG IP and parameter G11 and can be applied in Lift and Lift-Drop input modes. When the Cast feature is enabled the Hold current is reduced by the rate specified by this parameter. The Cast input is only active during the Hold state

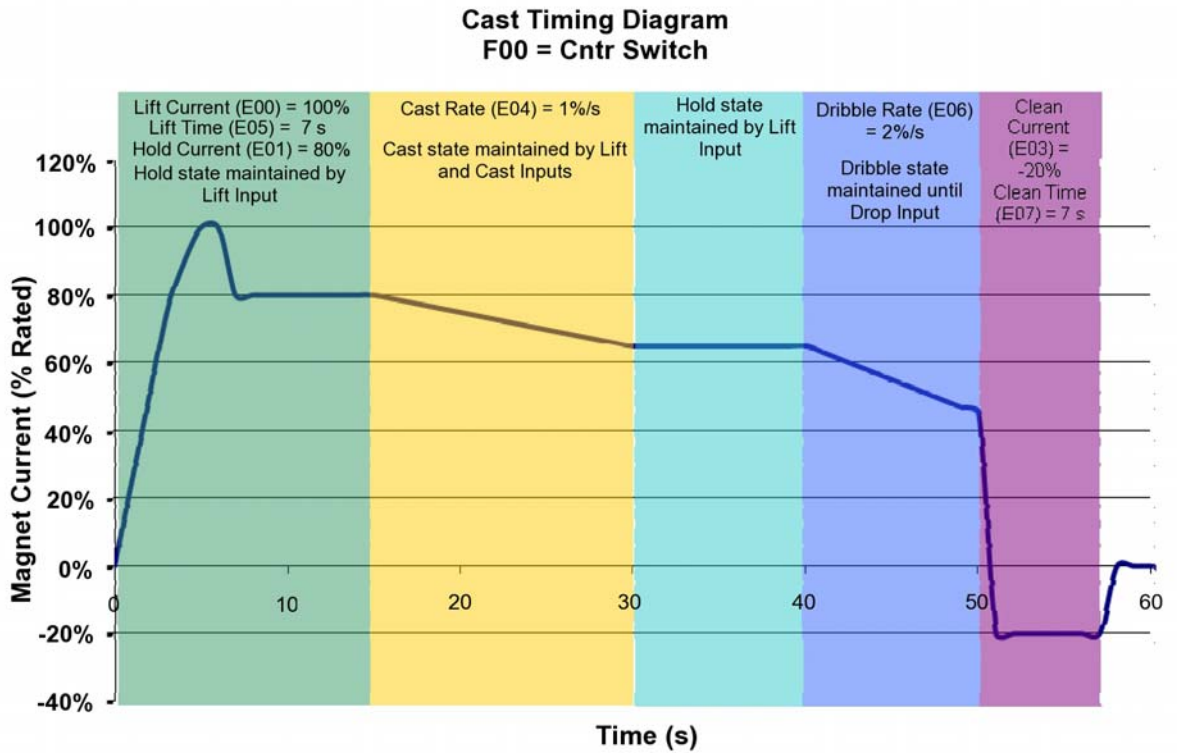


Figure 10: Example Cast Feature Current Profile

### Decreased Lift – E08

Decreased Lift is enabled by PROG IP and parameter G11 and is useful in Lift and Lift-Drop input modes. When the Decreased Lift feature is enabled it reduces the typical Lift and Hold currents by multiplying the Decreased Lift parameter by those Lift and Hold Current parameters.

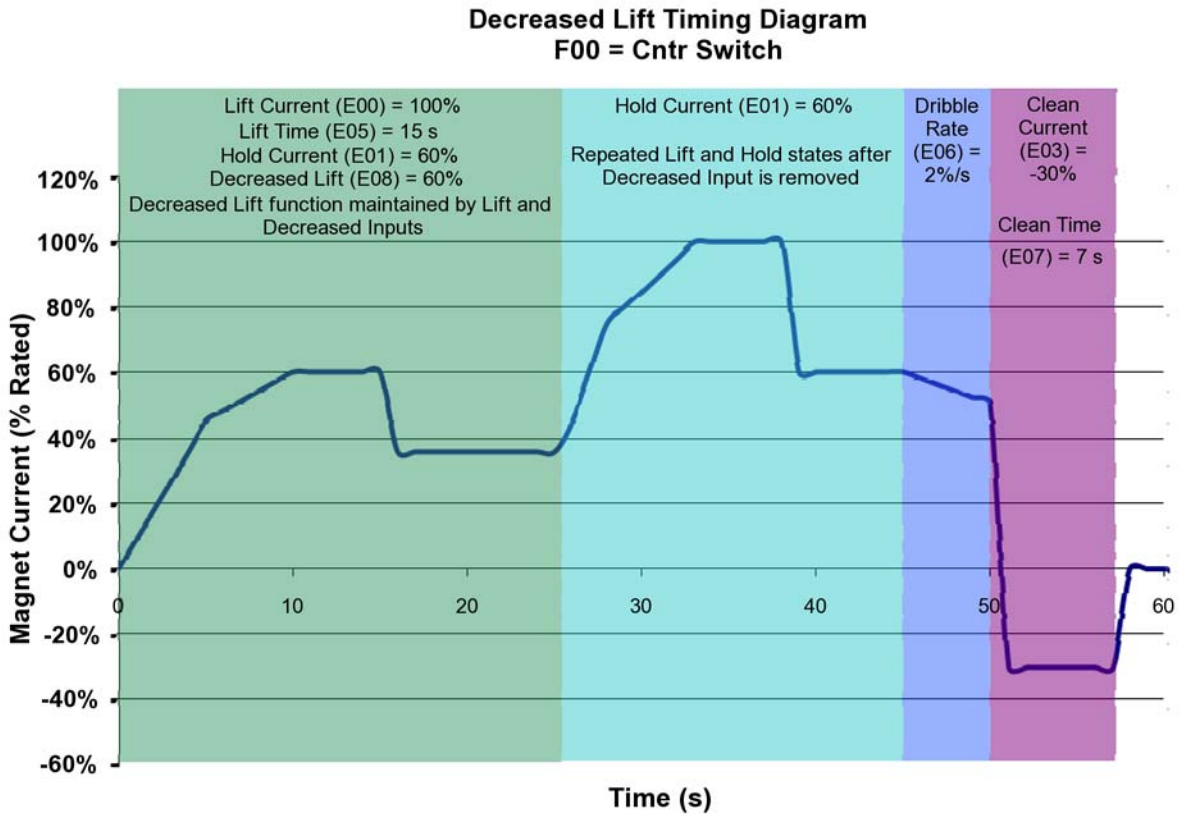


Figure 11: Example Decreased Lift Feature Current Profile

### Lift and Clean Current 1 ~ 5 – E09 ~ E18

Lift and Clean Current 1 ~ 5 parameters are used in Stepped I input mode. These parameters are used to set discrete current levels using the SPEED and direction inputs. The HOIST input enables Lift Current 1 and the DROP input enables Clean Current 1. For safety reasons if SPEED 4 input was lost and SPEED 3 and SPEED 5 inputs are enabled, the SPEED 3 setting will be used to maintain the load.

### I Agree – E20

This parameter defines current window that the Magnet Current Reference (A16) parameter must be within the Magnet Current Feedback (A17) parameter to leave the lift sequence, enter the Clean sequence, and enable the temperature and resistance monitoring functions.

### P Gain – E21

This parameter sets the current proportional gain and acts as the damper to the current loop. If this value is set too high the magnet current will vary erratically. If this value is set too low the current response will be sluggish and pick times will be increased.

**I Gain – E22**

This parameter sets the current integral gain and acts as the spring to the current loop and helps the current regulator respond quickly to changes in current demand.

**Auto Clean – E23**

When enabled this parameter automatically enters the Drop sequence when the Lift command is removed.

Enabled = Lift input mode

Disabled = Lift-Drop input

## Group F: Magnet Specification Setup

**Table 23: Group F – Magnet Specification Setup**

Parameter No.	Parameter Name	Factory Default	Min./Max.	Unit	Access Level
F00	Current Reference Source	Cntr Switch	Cntr Switch Analog Ref 1 Analog Ref 2 Ser An Ref 1 Ser An Ref 2	—	2
F02	Magnet 1 Current	C02/2	0 C02	0.1A	2
F03	Magnet 1 Inductance Gain	2.0	0.1 50.0	0.1%/s	2
F04	Magnet 1 Resistance	4.00	0.01 60.00	0.01 Ohm	2
F05	Magnet 2 Current	0	0 C02	0.1A	2
F06	Magnet 2 Inductance Gain	2.0	0.1 50.0	0.1%/s	2
F07	Magnet 2 Resistance	4.00	0.01 60.00	0.01 Ohm	2
F08	Magnet 3 Current	0	0 C02	0.1A	2
F09	Magnet 3 Inductance Gain	2.0	0.1 50.0	0.1%/s	2
F10	Magnet 3 Resistance	4.00	0.01 60.00	0.01 Ohm	2
F11	Magnet 4 Current	0	0 C02	0.1A	2
F12	Magnet 4 Inductance Gain	2.0	0.1 50.0	0.1%/s	2
F13	Magnet 4 Resistance	4.00	0.01 60.00	0.01 Ohm	2

### Current Reference Source – F00

This parameter selects the source of the current reference. Cntr Switch setting allows inputs through the 230V DC interface card or 24V DC control card. The Cntr Switch setting is required for the following input modes: Lift, Lift-Drop, Stepped I.

The Analog Reference 1 setting directs the software to look at terminals X3-4, X3-5 and X3-6 on the control board for its voltage input. Analog Reference 2 directs the software to terminals X3-6 and X3-7 on the control card for the voltage input. Parameters G00 through G06 must also be set to operate properly.

Ser An 1 and Ser An 2 references are commanded using the Modbus RTU1 function codes 6 and 3 through the communication port (reference section 3.15 in Appendix A). The values received by the microprocessor can be monitored in parameters B05 and B06. Parameters G16 through G20 must also be set up properly to enable MODBUS communication and control.

### Magnet 1 Current – F02

This parameter is the magnet current setting and should be set to the magnet's full load nameplate rating. The default setting is 50% of the control Current Class rating parameter C02.



### **Magnet 1 Inductance Gain – F03**

This parameter sets the rate of current reference change when decreasing the current in the magnet. Lower values will allow for smaller, slower voltage spikes on the DC bus. Higher values will allow for faster current response.

### **Magnet 1 Resistance – F04**

This parameter must be set to the magnet's cold resistance value (~25°C). The cold resistance is used to calculate current magnet temperature.

### **Magnet 2 ~ 4 Current – F05, F08, and F11**

The Magnet 2 ~ 4 Current parameters are used when the SPEED IP function is set to OmniBeam. These parameters are used to scale the current delivered to magnets 2 ~ 4 when they are enabled. When various magnets are enabled the respective Magnet 1 ~ 4 Current parameters are summed to obtain the maximum current reference.

### **Magnet 2 ~ 4 Inductance Gain – F06, F09, and F12**

These parameters function identically to F03 when the OmniBeam function is enabled. When various magnets are enabled the respective Inductance Gains are averaged.

### **Magnet 2 ~ 4 Resistance – F07, F10, and F13**

These parameters function identically to F04 when the OmniBeam function is enabled. When various magnets are enabled the total resistance is calculated using the parallel resistance formula.

**Group G: I/O Configuration**

**Table 24: Group G – I/O Configuration**

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level
G00	Analog IP1 Ref Type	0/+10V	0/+10V ± 10V 4/20 mA	—	2
G01	Analog IP1 Ref Gain	1.00	0.00 10.00	0.01	2
G02	Analog IP1Bias	0.0%	-10.0 +10.0	0.1%	2
G04	Analog IP2 Type	0/+10V	0/+10V 4/20 mA	1	2
G05	Analog IP2 Gain	1.00	0.00 10.00	0.01	2
G06	Analog IP2 Bias	0.0%	-100.0 +100.0	0.1%	2
G08	Analog Out Gain	1.00	0.00 10.00	0.01	2
G09	Analog Out Bias	0.0%	-100.0 +100.0	0.1%	2
G10	Analog Out Func	Magnet Current	Magnet Current Line Voltage Magnet Voltage	—	2
G11	Prog IP Func	Not Used	Not Used Cast Decreased Lift Ext Fault (Major) Ext Fault (Minor) Fault Reset Magnet OT Alarm Hoisting	—	2
G12	Prog. OP1 Func	Cntr Ready	Cntr Ready	—	2
G13	Prog. OP2 Function	Cntr Fault	Cntr Fault (Any)	—	2
G14	Prog. OP3 Function	Cntr Alarm	Cntr Alarm	—	2
G15	Prog. OP4 Function	Power Loss	Lift Hold Dribble Drop Clean Off I Agree Power Loss Cntr Fault (Major) Cntr Fault (Minor) Battery Required	—	2

Parameter No.	Parameter Name	Factory Default	Min. Max.	Unit	Access Level
G16	Serial Baud Rate	19200	2400 4800 9600 19200	—	2
G17	RS232/485 Select	RS232	RS232 RS485	—	2
G18	Serial Format	8E1	8E1 8-bit even parity 1 stop bit 8O1 8-bit odd parity 1 stop bit 8N1 8-bit no parity 1 stop bit 8N2 8-bit no parity 2 stop bits	—	2
G19	Modbus Address	1	1 247	1	2
G20	Drive Control	Hwd-IO	Hwd-IO Serial Comm	—	2
G21	SPEED IP Func	Not Used	Not Used OmniBeam Stepped I	—	2
G22	Reset IP Func	Disabled	Disabled Flt Rest NO Flt Reset NC	—	2
G23	Mntn Clean IP	Enabled	Enabled Disabled	—	2
G25	Enable IP Func	Not Used	Not Used Drive Enable Battery Enabled	—	2

### **Analog IP1 and IP2 Type – G00 and G04**

These parameters define the signal format for the analog inputs.

If the 4 to 20 mA signal is chosen for analog input 2, SW2-D on the control board must be moved to the ON position to connect the 250 ohm resistor to ground.

The SW2 switch on control board must be set up properly for analog input 1 usage. Refer to **Table 26** for setting information of SW2 switch.

### **Analog IP1 and IP2 Gain – G01 and G05**

Sets the input 1 scaling gain factor. A value of one means that 100% of the voltage or current signal equals 100% current command. A value of 3 means that 100% of the voltage or current signal equals 300% current command.

### **Analog IP1 and IP2 Bias – G02 and G06**

This parameter allows the input signal to be offset by plus or minus 100%. The bias compensates for signal variances. It also can be used to limit the commanded speed range below 100%.

### **Analog Output Gain – G08**

Determines the analog output scaling factor. A value of “1” means that 100% of the output variable produces a 10V signal at terminal X3-9 or a 20 mA signal at terminal X1-6. A value of “3” means that 33.3% of the output variable produces a 10V signal at terminal X3-9 or a 20 mA signal at terminal X1-6 and analog ground terminal X3-6.

### **Analog Out Bias – G09**

This parameter allows the input signal to be offset by plus or minus 10%. The bias compensates for signal variances.

### **Analog Out Func – G10**

This parameter selects the output function to be monitored via 0 to 10V signal at terminal X3-9 or the 4 to 20 mA signal available at terminal X1-6. Output functions available to monitor include: Magnet Current, Line Voltage, or Magnet Voltage.

### **Programmable IP – G11**

Parameters G11 set up the function of the programmable logic and speed 5 inputs. This input can be 230V DC through the interface card slowdown terminal. It can also be a 24V DC input signal connected to the X2-9 terminal on the control card. Note that setting this parameter configures the same function for the 230V or 24V DC input.

Cast function when activated will reduce the magnet current in the Hold state at a preprogrammed rate. This function can only be used in the Lift or Lift-Drop input modes.

Decreased Lift function when activated will lessen the magnet current in the Lift and Hold states by a preprogrammed gain. This function can only be used in the Lift or Lift-Drop input modes.

External major fault when activated will shut the controller down and register the occurrence in the fault log. Input contact is NC.

External fault minor when activated will log the occurrence in the fault log and prevent initiation of the next lift sequence.

Fault Reset will clear a latched fault if the fault is no longer present and return the controller to the Ready state.

Magnet OT Alarm is intended to be used with a Klixon to notify the controller and operator an overtemperature condition has occurred in the magnet.

Hoisting when activated will bypass the lift time, E05, and enter the hold state.

### Programmable OP1, OP2, OP3, and OP4 – G12 ~ G15

These parameters set the function for the programmable outputs. Programmable function selections are: Controller Ready, Controller Fault (any), Controller Alarm, Lift, Hold, Dribble, Drop, Clean Off, I Agree, Power Loss, Controller Fault (major), Controller Fault (minor), and Battery Required.

Prog OP1 is a 230V DC output and is located only on the Interface Card terminal DB.

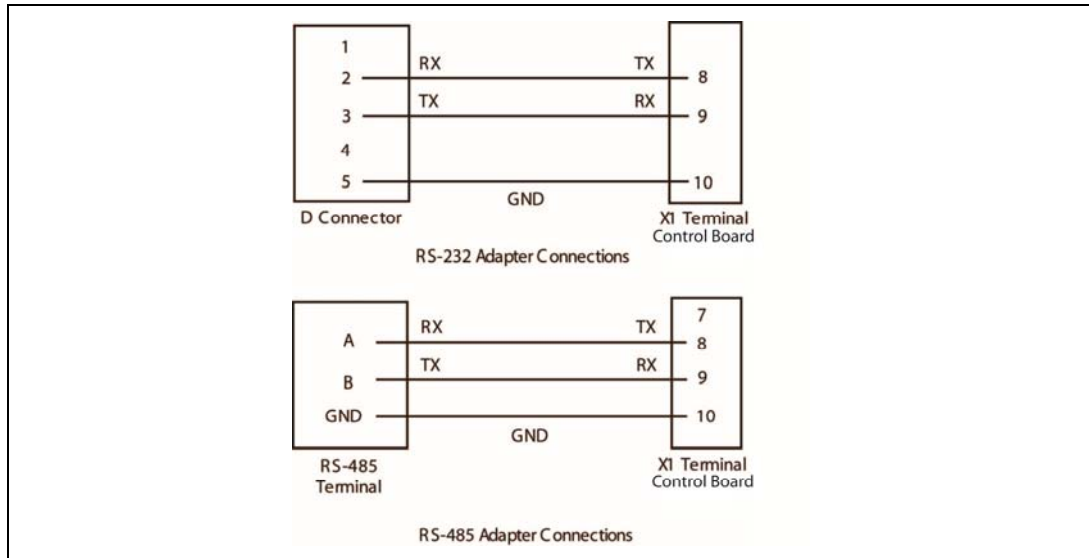
Prog OP2 is a 24V 40 mA open-collector output on terminal X1-2 of the control card.

Prog OP3 is a 24V 40 mA open-collector output on terminal X1-3 of the control card.

Prog OP4 is a shared function. This is a 24V 40 mA open-collector output on terminal X1-4 of the control card and also a 230V DC output on the interface card terminal SB.

### Serial Baud Rate – G16

This parameter selects the baud rate for the serial communication. The X1 terminal on Control board is used to make the connections to the controller. An inexpensive adapter cable will need to be made to connect the controller to a laptop computer using a 232 D connector. Make the connections as indicated for 232 computer communications in **Figure 16**.



**Figure 12: Serial Connections**

### RS-232/RS-485 Select – G17

This parameter selects serial communication configuration. Terminal X1-8, X1-9 and X1-10 are configured with this selection. Use the proper adapter connection. If RS-485 is selected, make sure that the LK2 setting is correct for the resistor termination for the network (reference **Figure 15**).

### Serial Format – G18

This parameter selection formats the data to be received and transmitted. Eight bit with or without parity and number of stop bits can be selected.

### MODBUS Address – G19

This sets the MODBUS Address for the controller configured in an RS-485 MODBUS network.

## Drive Control – G20

This directs drive control to board I/O (Hwd-IO) or MODBUS RTU-1 Control (Serial COMM1). It is possible to change from serial communication to hardware I/O through the MODBUS parameter change. It is not possible to change from hardware I/O to serial communication unless the parameter is changed manually.

## SPEED IP Function – G21

This parameter selects the special MagnePulse magnet control functions.

The OmniBeam function allows the user to select from one to four magnets to be powered by the controller. The SPEED 2 input enables Magnet 1, the SPEED 3 input enables Magnet 2, the SPEED 4 input enables Magnet 3, and the SPEED 5 input enables Magnet 4. To start a pick at least one magnet must be enabled when this feature is selected.

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 **CAUTION**

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Parameters F02, F05, F08 and F11 must be programmed properly to prevent magnet damage. Do not enable additional magnets during operation. Magnets must be of sufficiently similar inductance and current rating to prevent individual magnet overload.

The Stepped I function allows for picking and dropping discrete loads. The FORWARD input enables Lift Current 1 and the REVERSE input enables Clean Current 1. Each successive SPEED input enables the successive current command.

## Reset IP Function – G22

This parameter allows the reset switch to be used as a fault reset. If the use of this function is desired, make sure LK 3 is in the correct position (reference **Figure 15**).

## Maintain Clean IP – G23

When enabled, this parameter will stop the clean cycle if the clean/drop input is opened.

If disabled, this parameter will allow a momentary clean/drop switch to complete the clean time (E07). A lift command engaged during the clean cycle will take the drive out of the clean state.

## Enable IP Function – G25

This parameter allows the input signal to properly regulate the drive. If Drive Enable is selected, the drive requires the enable input to be active in order to enter the lift sequence.

Battery Enabled is selected when a battery back-up is used. Enabling this will prevent SC faults while the drive and battery are on at the same time.

Group H: Fault History

**Table 25: Group H – Fault History**

The “Fault Time” parameters are the elapsed time corresponding to parameter A13 at which the fault occurred.

Parameter No.	Parameter Name	Access Level
H00	Fault 1	0
H01	Fault 1 Time	0
H02	Fault 2	0
H03	Fault 2 Time	0
H04	Fault 3	0
H05	Fault 3 Time	0
H06	Fault 4	0
H07	Fault 4 Time	0
H08	Fault 5	0
H09	Fault 5 Time	0
H10	Fault 6	0
H11	Fault 6 Time	0
H12	Fault 7	0
H13	Fault 7 Time	0
H14	Fault 8	0
H15	Fault 8 Time	0
H16	Fault 9	0
H17	Fault 9 Time	0
H18	Fault 10	0
H19	Fault 10 Time	0
H20	Fault 11	0
H21	Fault 11 Time	0
H22	Fault 12	0
H23	Fault 12 Time	0
H24	Fault 13	0
H25	Fault 13 Time	0
H26	Fault 14	0
H27	Fault 14 Time	0
H28	Fault 15	0
H29	Fault 15 Time	0
H30	Fault History Reset	2

**Fault History Reset – H30**

This parameter will clear all fault information from the H menu when selected. Entering a value of 1 in H30 clears all of the fault history.

0 = Maintain Fault History

1 = Reset Fault History

# DMC Printed Circuit Boards

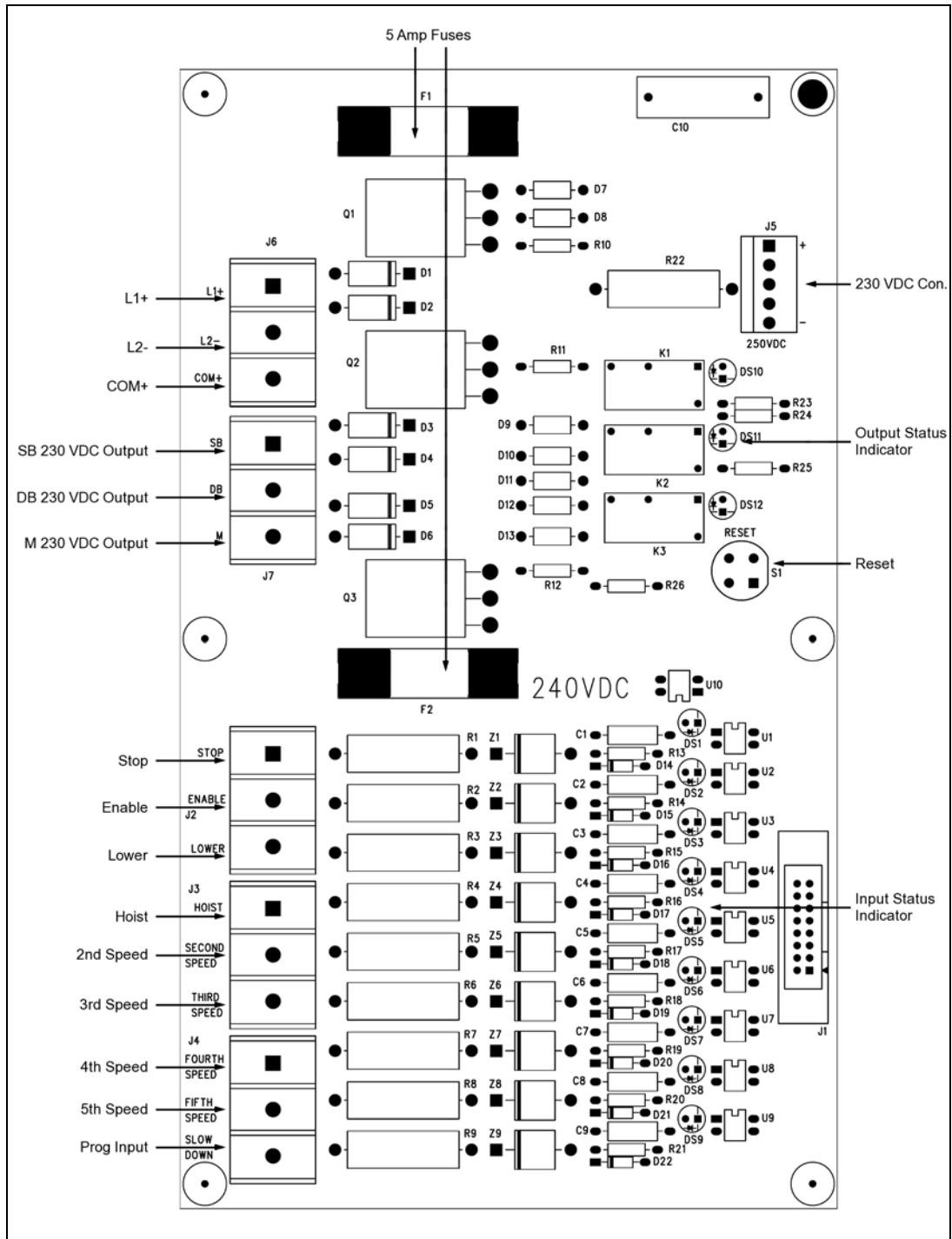


Figure 13: Interface Circuit Board (Model Number DDC-230VIF)



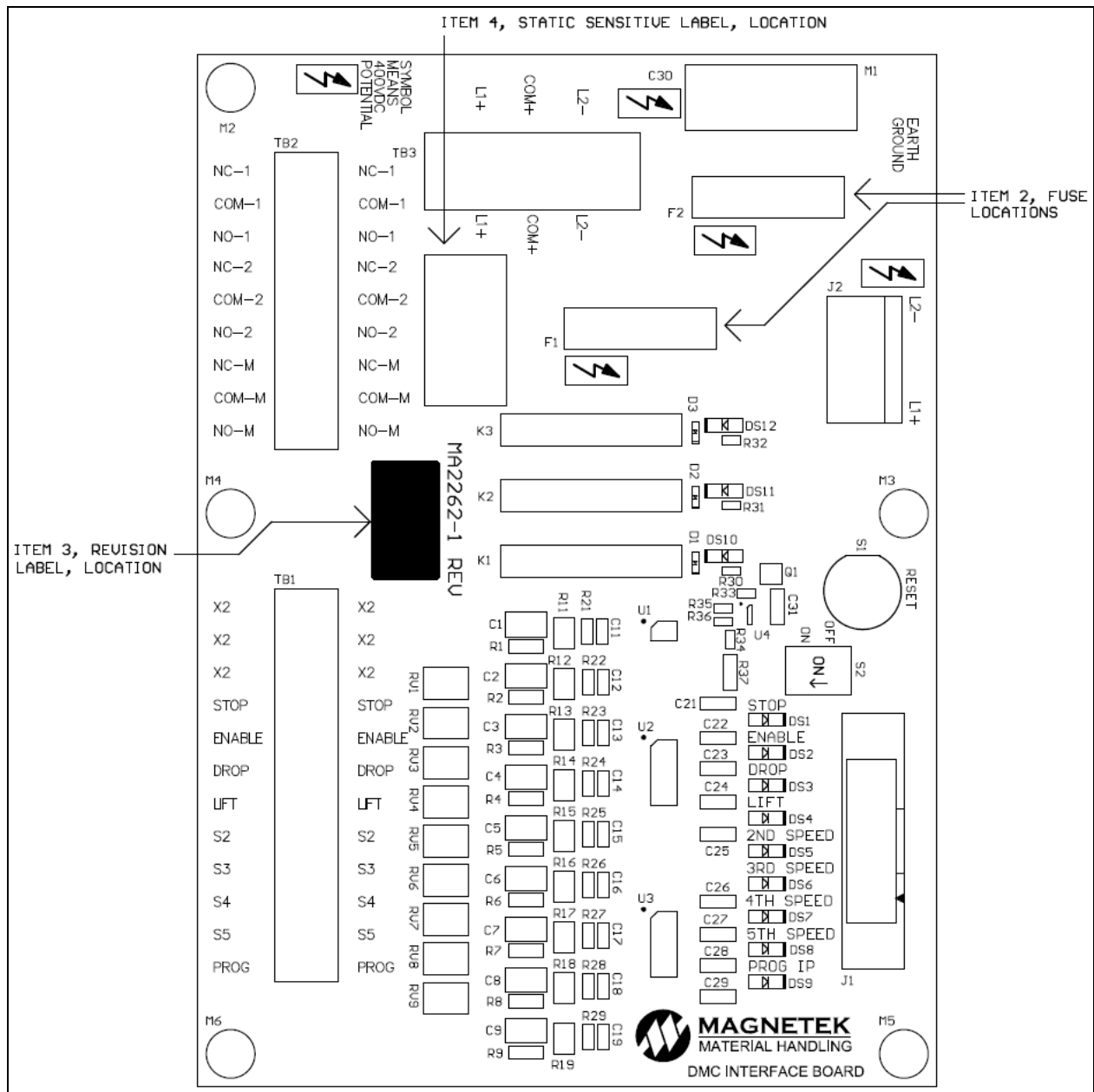
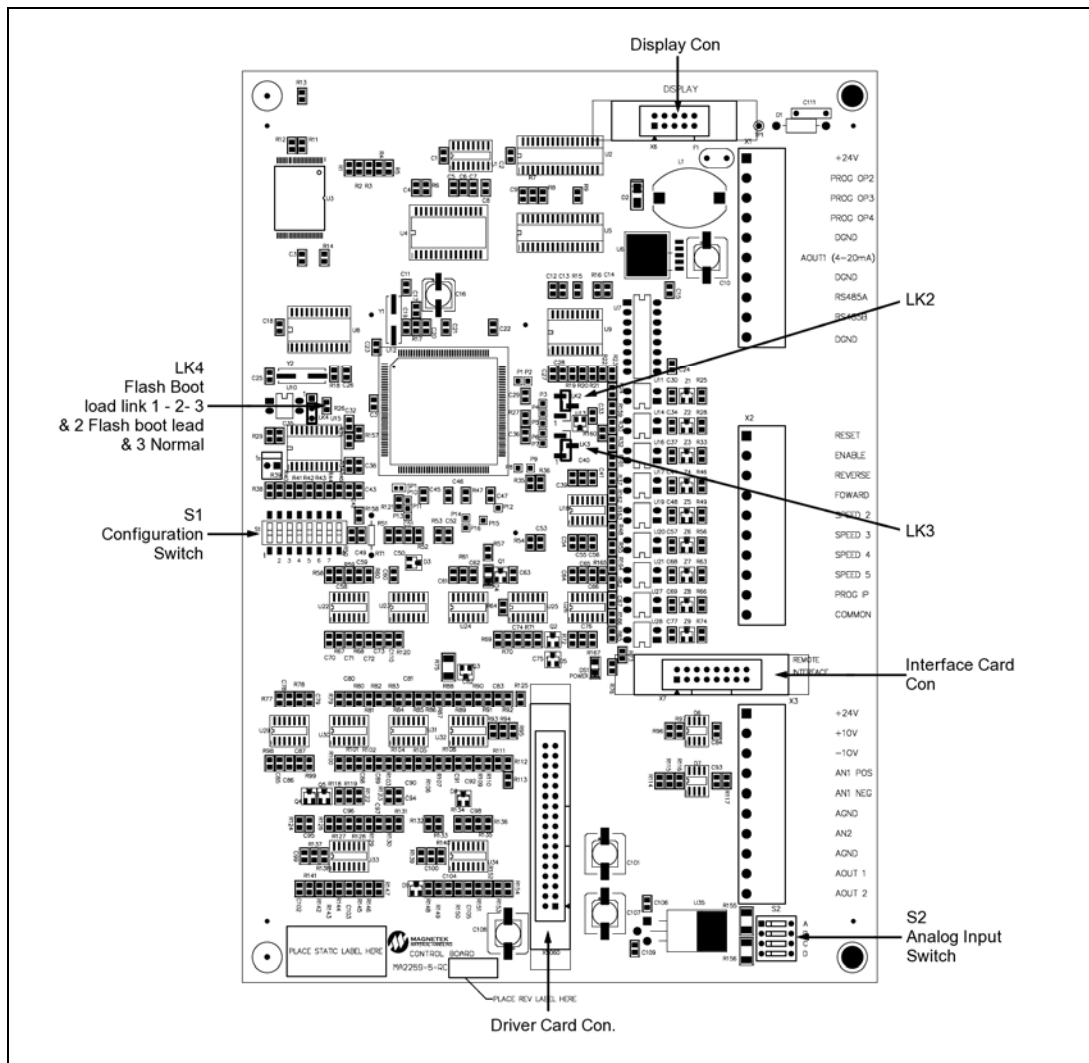


Figure 14: 120 VAC Interface Board (Model Number DMC-120A60IF)



**Figure 15: Control Card (Model Number DMC-CONTROL)**

**LK2**

For RS-485 communication, the link should be on pins 1 and 2 (top pins).

**LK3**

If the link is on pins 1 and 2 and parameter G22 is not disabled, the RESET input will act as a fault reset only. Place the link on pins 2 and 3 if a drive reset is intended.

**Table 26: Control Board S2 DIP Switch Settings**

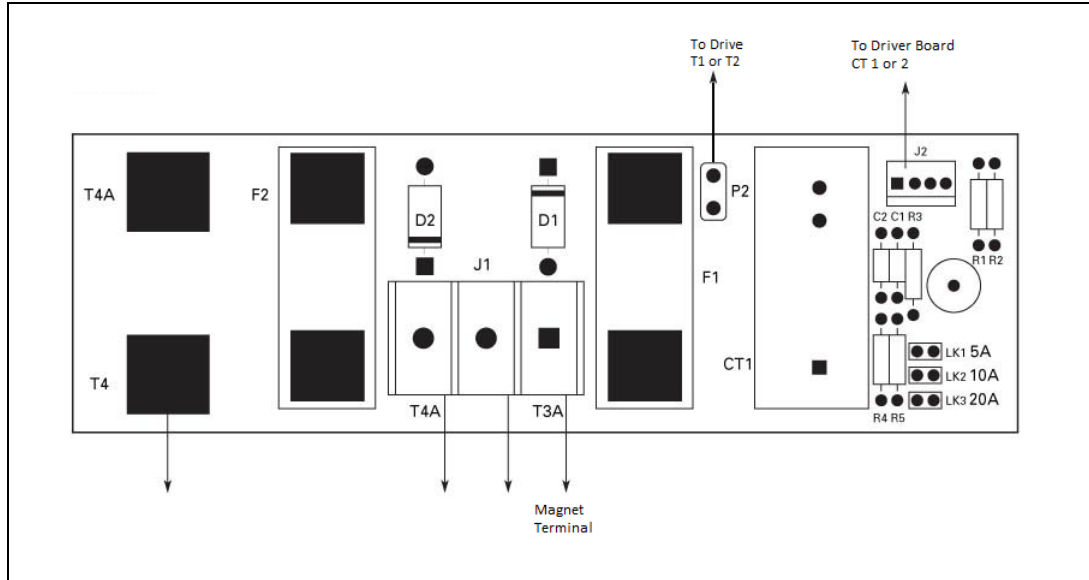
SW POS	OFF ← (OPEN)	ON → (CLOSED)
A	AN1 -10/+10V	AN1 4/20 mA
B	AN1 Diff	AN1 Non Diff
C	AN1 X1	AN1 X2
D	AN2 0/+10V	AN2 4/20 mA

**Table 27: Control Board S1 DIP Switch Settings****S1 Positions 1 and 2 — Current Rating**

Current Class	Switch Setting	
N2 67A	S1-1 OFF	S1-2 OFF
N3 133A	S1-1 ON	S1-2 OFF
N4 200A	S1-1 OFF	S1-2 ON
N5 400A	S1-1 ON	S1-2 ON

**SW1 Position 4 — Voltage Rating**

Voltage Class	Switch Setting
200/360V	S1-4 OFF
400/720V	S1-4 ON



**Figure 16: External CT Board**

**Table 28: Jumper Setting for External CT Board**

Amps	LK1	LK2	LK3
5	Open	Open	Open
10	Open	Closed	Open
20	Open	Closed	Closed

**Table 29: Driver Board Settings for Use with External CT Board**

133 A Controller Driver Board			
	LK1	LK2	LK3
5	Closed	Closed	Open
10	Closed	Closed	Open
20	Closed	Closed	Open

**Table 30: Gate Drive Board Link Settings**

The current feedback scaling is determined by SIP jumpers LK1, LK2 and LK3 or LK5:

Current Class	Current Feedback Scaling
67A maximum	LK1, LK2, LK3 IN
133A maximum	LK1, LK2, LK3 OUT
200A maximum	LK1, LK2, LK5 IN
400A maximum	LK1, LK2, LK5 OUT

If ground fault detection is enabled, SIP jumper LK10 must be correctly positioned: OUT

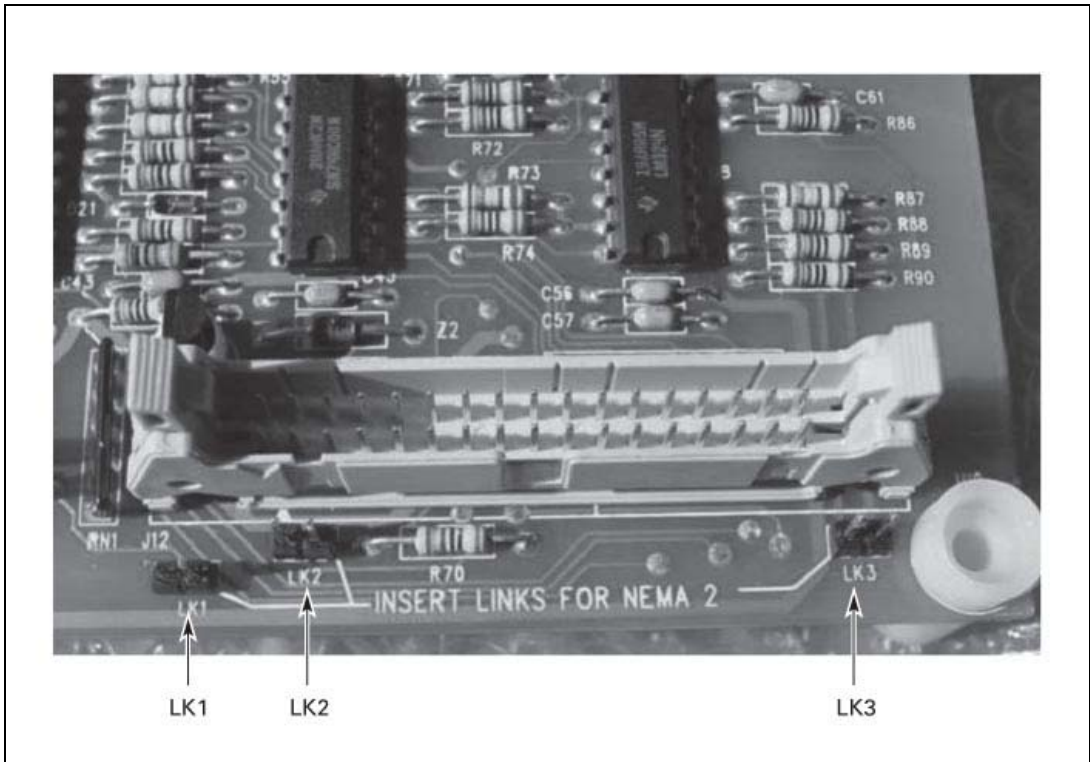
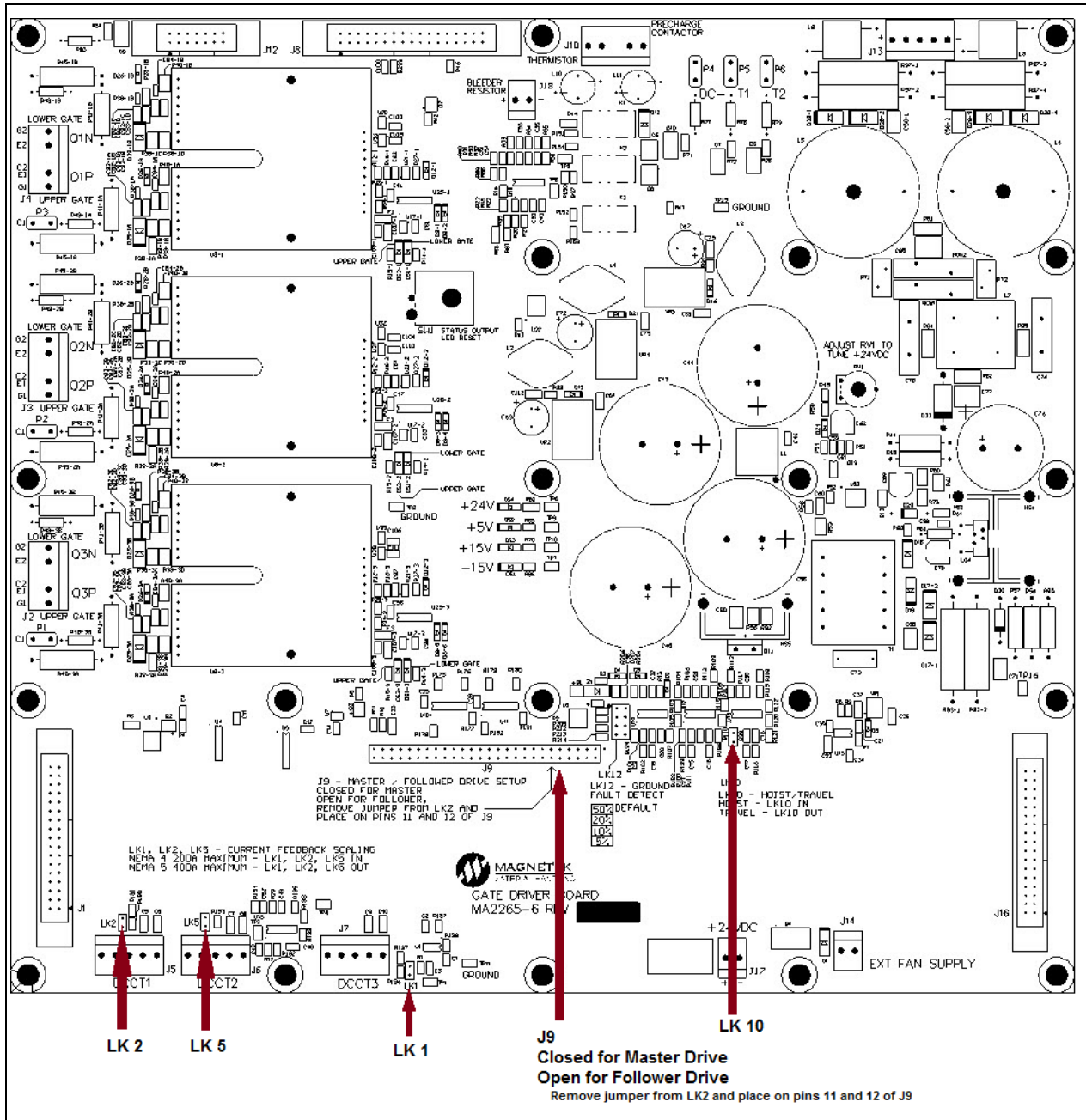


Figure 17: Driver Board (used on 200/320 VDC 133A) Model Number DDC-LN3-GATE



**Figure 18: Driver Board (used on 200/320 VDC 400A) Model Number DDC-LN5-GATE6**

*NOTE: When using a follower drive, do not use a DDC-HN5-GATE or DDC-LN5-GATE (green driver board) with a DDC-LN5-GATE6 or DDC-HN5-GATE6 (black driver board).*

# Troubleshooting

## Fault Codes and Corrective Action

In this troubleshooting section “check” means investigating whether an item is functioning and in an acceptable physical condition, and then taking corrective action (adjusting, fixing, replacing, etc.) as necessary. In the Corrective Action column, it may not be necessary to perform all of the steps to correct the problem. There are two types of faults in the MagnePulse DMC. They are defined as “Minor Fault” and “Major Fault”. A Major Fault will be recorded in the Fault History and requires opening of the master switch to reset the Fault. A Minor Fault is generally a status type Fault that may not require a reset.

**Table 31: Fault Codes and Corrective Action**

Fault Code - Text	Type of Fault	Description	Corrective Action
CRC – Change of Settings	Fault (major)	DIP switches have been changed or a parameter setting has been corrupted.	<ol style="list-style-type: none"> <li>1. If the DIP switch settings changed, at least one parameter must be modified, or there should be a Factory Default reset.</li> <li>2. If no DIP switch settings changed, review the parameter settings to ensure proper operation of the drive.</li> <li>3. Power down the drive, or reset the drive with the microprocessor reset switch SW1 on the interface board.</li> </ol>
CUV - Control Power Loss	Fault (major)	The 24V power supply has fallen below 19V.	<ol style="list-style-type: none"> <li>1. Ensure Power is present at the drive and it is turned on.</li> <li>2. Ensure that all connections on the gate driver board are in the correct position and securely fastened.</li> <li>3. Ensure that all ribbon cables are securely fastened to the control board.</li> <li>4. Verify power supply LEDs are on.</li> <li>5. For NEMA sizes 4 and above, check TP6 = +24VDC, TP7 = -15V, TP10 = +15VDC, TP9 = +5VDC</li> <li>6. Check control board terminals X1 pin1 and X3 pin1 for 24 VDC.</li> <li>7. Replace control board.</li> <li>8. Replace gate drive board.</li> </ol>
External Fault	Dependent on input selection	External fault input activated.	<ol style="list-style-type: none"> <li>1. May not require corrective action.</li> <li>2. Verify that the External device that signaled the External fault is functioning properly.</li> <li>3. Check that programmable input Function G11 is set properly.</li> <li>4. Verify External Fault Logic circuitry is functioning correctly.</li> </ol>

<b>Fault Code - Text</b>	<b>Type of Fault</b>	<b>Description</b>	<b>Corrective Action</b>
Ground Fault	Fault (minor)	A Ground Fault has been detected.	<ol style="list-style-type: none"> <li>1. Check the magnet circuit for shorts to ground.</li> <li>2. Check that displayed Magnet Current Function A00 equals Actual Magnet Current using a clamp on amp meter.</li> <li>3. Check for a short circuit in the magnet or wiring using a Megger. Ensure that the magnet is disconnected from the control.</li> </ol>
MOC – Magnet Open Circuit	Fault (major)	Indicates that the magnet coil is open or that current is not passing from control terminals T1 to T2.	<ol style="list-style-type: none"> <li>1. Monitor A00 for Magnet current feedback.</li> <li>2. Check magnet circuit and wiring.</li> <li>3. Perform Diode and IGBT test per Transistor and Diode Check Table.</li> </ol>
MOL – Magnet Overload	Fault (minor)	Indicates the control board is not regulating current to the magnet properly and the magnet may be overloaded.	<ol style="list-style-type: none"> <li>1. Check DIP switch settings on the control board.</li> <li>2. Check magnet current rating parameters.</li> <li>3. Check for correct gate driver board link settings.</li> </ol>
MOS – Module out of Service	Fault (major)	Indicates that one or more follower units are out of service.	<ol style="list-style-type: none"> <li>1. Verify the setting in parameter C03.</li> <li>2. Ensure that follower controller is powered up correctly.</li> <li>3. Ensure that the gate drive board data bus able is connected between master and follower(s) (J1 and J16).</li> <li>4. Verify on follower(s) gate drive board that bus connector J9 has only pins 11 and 12 jumpered.</li> </ol>
MS - Master Switch	Alarm	Drive inputs not in OFF position when drive powered up.	<ol style="list-style-type: none"> <li>1. Is the master switch centered?</li> <li>2. Ensure input logic wiring is functioning correctly.</li> <li>3. Check that Logic Inputs on Function A21 are functioning properly.</li> <li>4. Check that programmable input Function G11 is set properly.</li> </ol>
AOT– Over Ambient	Fault (minor)	The ambient temperature monitored by the control board is 70° C or greater.	<ol style="list-style-type: none"> <li>1. Monitor ambient temperature by A24.</li> <li>2. Decrease ambient temperature.</li> <li>3. Ensure that fans are functional.</li> <li>4. Ensure heatsink is free of dirt and debris.</li> <li>5. Add air conditioner.</li> </ol>



<b>Fault Code - Text</b>	<b>Type of Fault</b>	<b>Description</b>	<b>Corrective Action</b>
OT1 – Heatsink Temp	Fault (major)	Indicates that an excessive heatsink temperature rise has occurred.	<ol style="list-style-type: none"> <li>1. Reduce current limits.</li> <li>2. Ensure that heatsink temperature (monitor A23) is below 90° C.</li> <li>3. Ensure that the heatsink cooling fans are operating properly.</li> <li>4. Ensure that heatsink is free of dirt and debris.</li> <li>5. Ensure that ambient temperature is within specifications.</li> </ol>
OV – Over Voltage	Fault (major)	Indicates excessive DC input voltage or supply not able to accept reverse current flow during regeneration.	<ol style="list-style-type: none"> <li>1. Ensure that the incoming supply voltage is not rising above tolerance.</li> <li>2. Check DC bus voltage shown by monitor function A03.</li> <li>3. Check the dump resistor and wiring.</li> </ol>
SC - Short Circuit	Fault (major)	Indicates that the drive has detected an output short circuit.	<ol style="list-style-type: none"> <li>1. For NEMA sizes 4 and above, check TP6 = +24VDC, TP7 = -15V, TP10 = +15VDC, TP9 = +5VDC</li> <li>2. Disconnect magnet and/or dump resistor from control.</li> <li>3. Check for shorts in the wiring and magnet using a digital meter or continuity tester.</li> <li>4. Perform Diode and IGBT test per Transistor and Diode Check Table. ***Never Megger the control.</li> <li>5. Check for a short circuit in the magnet or wiring using a Megger.</li> </ol>
UV1 - Undervoltage	Fault (major)	Indicates that the main DC supply voltage is too low or that the M contactor did not close.	<ol style="list-style-type: none"> <li>1. Check DC bus voltage shown by monitor function A03.</li> <li>2. Ensure that the incoming power supply voltage is not dropping below tolerance.</li> <li>3. Ensure Power is present at the drive and it is turned on.</li> <li>4. Ensure that all connections on the gate driver board are in the correct position and securely fastened.</li> <li>5. Ensure that all ribbon cables are securely fastened to the control board.</li> <li>6. Replace control board.</li> <li>7. Replace gate drive board.</li> </ol>

## Short Circuit Check

When a short circuit occurs, the Gate Driver Board (DDC-LN5-GATE6 or DDC-HN5-GATE6) can be used as a troubleshooting tool to narrow down where the short is located. This is especially helpful when there are multiple follower drives. Each drive (master and follower) has the same Gate Driver Board that will notify the user with LEDs if a short has occurred on that individual drive. To help further, there are two LEDs designated to show if the short occurred on the upper or lower gate for each IGBT.

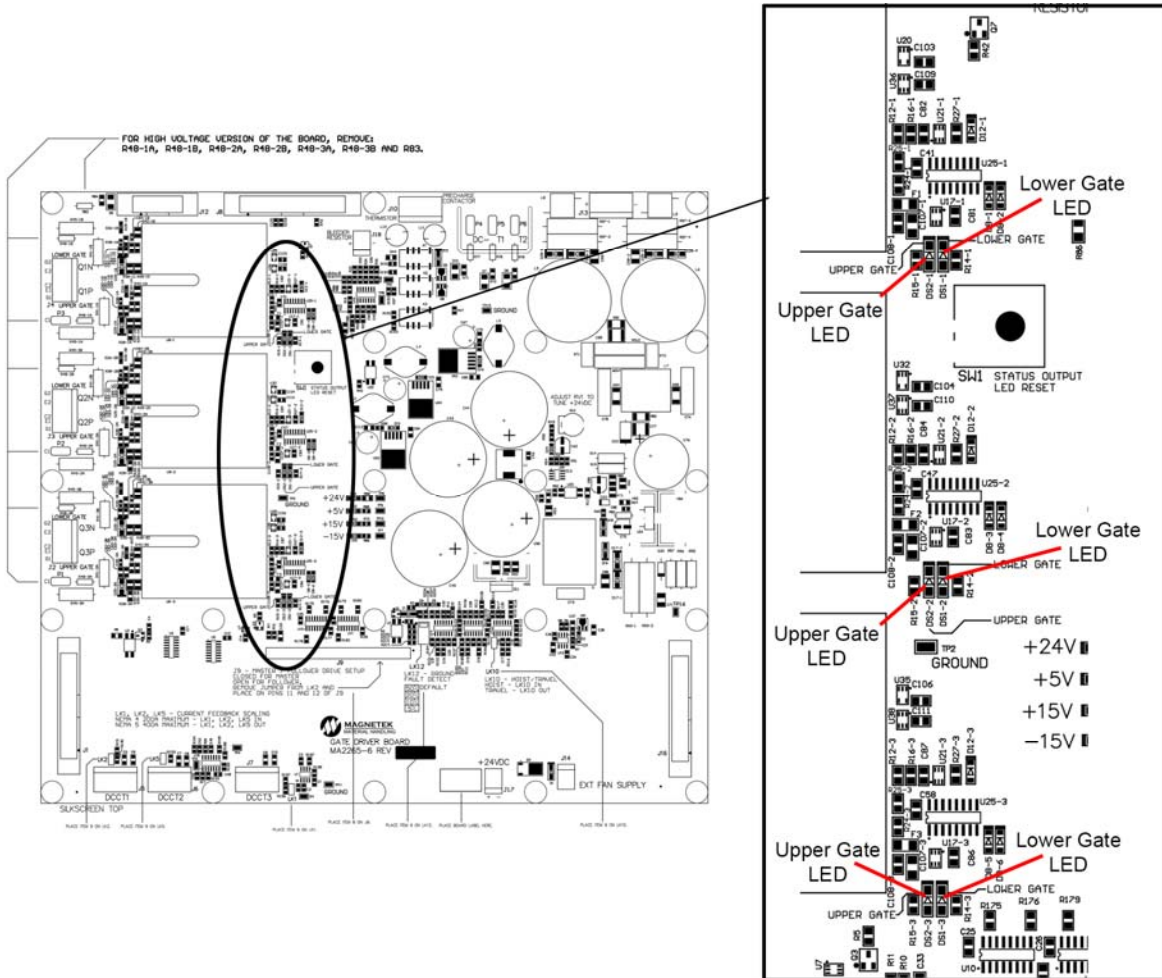


Figure 19: Gate Driver LED locations

## Transistor and Diode Check



### **⚠ DANGER**

Make sure that the MCB or MKS and CCB or CKS are in the open position and that the charge light and control light on the control are off.

Using a digital multimeter set the instrument to the diode mode and make the following checks:

**Table 32: Transistor and Diode Check**

Diode Check	Positive Probe	Negative Probe	Reading
D1P	T1	L1	0.312
D2P	T2	L1	0.312
D3P	T3	L1	0.312
D1N	L2	T1	0.312
D2N	L2	T2	0.312
D3N	L2	T3	0.312

IGBT Check	Positive Probe	Negative Probe	Reading
Q1P	L1	T1	>0.6
Q2P	L1	T2	>0.6
Q3P	L1	T3	>0.6
Q1N	T1	L2	>0.6
Q2N	T2	L2	>0.6
Q3N	T3	L2	>0.6

On the 400A and high voltage controls use the IGBT auxiliary connection. Remove the connectors from P1, P2 and P3 on the 144-45059 driver board and do a continuity check from the connector wire to T4 terminal. Typical measurement is about 0.3 ohms. Replace the IGBT if the reading is open.

**Note:** If BUS fuse is open, IGBT check will indicate that all transistors are opened. Check BUS fuse before taking readings.

# Appendix A – MODBUS RTU1 Communication

MagnePulse DMC Display Software version 2.00 and MagnePulse DMC Control Software version 10.xx are required to enable MODBUS RTU1 communication.

Parameters G16 through G20 and control board hardware settings must be set up to establish proper communication.

## 1. Protocol:

- 1.1 The protocol implemented for control communications is Modbus RTU1, as specified in the following documents:
- 1.2 Modicon Modbus Protocol Reference Guide PI-MBUS-300 Rev. J
- 1.3 MODBUS over Serial Line Specification & Implementation guide V1.0

## 2. Communications

- 2.1. Electrical Specification
- 2.2. Physical layer communications shall follow ANSI/TIA/EIA-232-F-1997 and ANSI/TIA/EIA-485-1998 specifications. RS-485 will be Two-Wire, or half duplex.
- 2.3. Data rate options
- 2.4. 9600 bps and 19.2 Kbps is implemented.
- 2.5. 19.2 Kbps will be the default data rate.
- 2.6. Addressing

## 3. Functionality

- 3.1. Command set
- 3.2. Parameter download
- 3.3. Parameter download shall be accomplished using the MODBUS Read General Reference Function code (4).
- 3.4. Parameter upload
- 3.5. Parameter upload shall be accomplished using the MODBUS Write General Reference Function code (16).
- 3.6. Parameter setting
- 3.7. Parameter upload shall be accomplished using the MODBUS Write General Reference Function code (16).
- 3.8. Diagnostic counters
- 3.9. Network diagnostics will be accomplished using the MODBUS Diagnostics function code.
- 3.10. Diagnostic sub functions are appropriate to the implementation.
- 3.11. Control Commands

- 3.12. Network direction control will be accomplished using the MODBUS Force Single Coil Function code (5) for writing, and Read Coil Status function code (1) for verification.
- 3.13. Network Run/Stop control will be accomplished using the MODBUS Force Single Coil Function code (5) for writing, and Read Coil Status function code (1) for verification.
- 3.14. Network discrete Speed Reference control will be accomplished using the MODBUS Force Single Coil Function code (5) for writing, and Read Coil Status function code (1) for verification.
- 3.15. Network analog Speed Reference control will be accomplished using the MODBUS Preset Single Register Function code (6) for writing, and Read Holding Register function code (3) for verification.
- 3.16. Parameter read and write access is limited to 10 values at the time in order to maintain control loop functionality.

#### **4. Addressing**

- 4.1 Parameter Download (Read General Reference Function code (20)) and Upload and Setting (Write General Reference Function code (16)).



#### 4.1.2. Parameter Menus “E – H”

Parameter “E” Menu E00 – E23	Register (in hex)	Parameter “F” Menu F00 – F13	Register (in hex)	Parameter “G” Menu G00 – G25	Register (in hex)	Parameter “H” Menu H00 – H30	Register (in hex)
E00	80	F00	A0	G00	C0	H00	E0
E01	81	F02	A2	G01	C1	H01	E1
E02	82	F03	A3	G02	C2	H02	E2
E03	83	F04	A4	G04	C4	H03	E3
E04	84	F05	A5	G05	C5	H04	E4
E05	85	F06	A6	G06	C6	H05	E5
E06	86	F07	A7	G08	C8	H06	E6
E07	87	F08	A8	G09	C9	H07	E7
E08	88	F09	A9	G10	CA	H08	E8
E09	89	F10	AA	G11	CB	H09	E9
E10	8A	F11	AB	G12	CC	H10	EA
E11	8B	F12	AC	G13	CD	H11	EB
E12	8C	F13	AD	G14	CE	H12	EC
E13	8D			G15	CF	H13	ED
E14	8E			G16	D0	H14	EE
E15	8F			G17	D1	H15	EF
E16	90			G18	D2	H16	E0
E17	91			G19	D3	H17	F1
E18	92			G20	D4	H18	F2
E20	94			G21	D5	H19	F3
E21	95			G22	D6	H20	F4
E22	96			G23	D7	H21	F5
E23	97			G25	D9	H22	F6
						H23	F7
						H24	F8
						H25	F9
						H26	FA
						H27	FB
						H28	FC
						H29	FD
						H30	FE

**4.2. Control Commands** (Force Single Coil Function code (05)).

Parameter	Coil Address High	Coil Address Low
Reset *	00	00
Enable	00	01
Drop (Forward)	00	02
Lift (Reverse)	00	03
Second Speed	00	04
Third Speed	00	05
Fourth Speed	00	06
Fifth Speed	00	07

- Force code 5 to address 0 forces all address to 0

**4.3. Control Commands** (Read Coil Function code (01)).

Parameters	Coil Address High	Coil Address Low
Reset: 1 Enable: 1 Drop (Forward): 1 Lift (Reverse): 1 Second Speed: 1 Third Speed: 1 Fourth Speed: 1 Fifth Speed: 1	00	00

**4.4. Current Reference Commands** (MODBUS Preset Single Register Function code (6) for writing, and Read Holding Register function code (3) for verification).

Parameters	Register Address High	Register Address Low
Analog IP1	00	00
Analog IP2	00	01



## MagnePulse DMC Parameter Listing

Parameter No.	Parameter Name	Factory Default	Reference Page
A00	Magnet Current	-	30
A02	Magnet Voltage	-	30
A03	DC Bus Voltage	-	30
A04	Magnet Resistance	-	30
A05	Magnet Temperature	-	30
A08	Control Reference	-	30
A09	Input Power	-	30
A10	Energy Used (KW)	-	30
A11	Number of Operations	-	30
A12	Number of Operations Times 100	-	30
A13	Elapsed Hours	-	30
A14	Analog Input 1	-	30
A15	Analog Input 2	-	30
A16	Magnet Current Ref	-	30
A17	Magnet Current Feedback Relative	-	30
A21	Logic Inputs	-	31
A22	Logic Outputs	-	31
A23	Heatsink Temp	-	31
A24	Ambient Temp	-	31
A25	Overload Level	-	31
A26	T1 Duty Cycle	-	31
A27	T2 Duty Cycle	-	31
A29	Control Status	-	32
A30	Fault Status	-	33
A31	Sequence Status	-	33

## MagnePulse DMC Parameter Listing (cont.)

Parameter No.	Parameter Name	Factory Default	Reference Page
B00	Password	0	34
B01	Access Level	Monitor	34
B02	Control Firmware Version	Monitor	34
B03	Control Firmware Subversion	Monitor	34
B05	Modbus AN 1	Modbus Analog Reference 1	34
B06	Modbus AN 2	Modbus Analog Reference 2	34
C01	Voltage Class	Set by D1P Pos 4	35
C02	Current Class	Set by D1P Pos 1 & 2	35
C03	Parallel Stacks	1	35
C04	Magnet Setup	Int CT	35
C05	Input Bus Voltage	250 V	35
C07	Default Values	No Action	35
D00	Magnet Rated Voltage	230 V	38
D01	Magnet Volt Limit	0 V	38
D03	Power Loss Level	200 V	38
D07	Ground Fault	Disabled	38
D08	OH Alarm Level	85°C	38
D09	OH1 Trip Level	90°C	38
D11	Start Delay	300 ms	38
D12	Stop Delay	0 ms	38
D14	Magnet Temperature Alarm	0°C	38
D15	Magnet OT Enable	0°C	38
D16	OH Fan Enable	60°C	38
D17	OA Temp Enable	75°C	38
D18	MOC Detect Level	0%	38
D19	MOC Detect Time	0 ms	38
D30	Reset Attempts	3	38
D31	Reset Flt Sel	0084	38

## MagnePulse DMC Parameter Listing (cont.)

Parameter No.	Parameter Name	Factory Default	Reference Page
E00	Lift Current	100.0%	42
E01	Hold Current	75.0%	42
E02	Dribble Current	-10.0%	42
E03	Clean Current	15.0%	42
E04	Cast Rate	1%/s	42
E05	Lift Time	15.0 s	42
E06	Dribble Rate	2%/s	42
E07	Clean Time	0.8 s	42
E08	Decreased Lift	10%	42
E09	Lift Current 1	100%	42
E10	Lift Current 2	80%	42
E11	Lift Current 3	60%	42
E12	Lift Current 4	40%	42
E13	Lift Current 5	20%	42
E14	Clean Current 1	20%	42
E15	Clean Current 2	40%	42
E16	Clean Current 3	60%	42
E17	Clean Current 4	80%	42
E18	Clean Current 5	100%	42
E20	I Agree	1.5%	43
E21	P Gain	1.0	43
E22	I Gain	0.2	43
E23	Auto Clean	Disabled	43

## MagnePulse DMC Parameter Listing (cont.)

Parameter No.	Parameter Name	Factory Default	Reference Page
F00	Current Reference Source	Cntr Switch	48
F02	Magnet 1 Current	C02/2	48
F03	Magnet 1 Inductance Gain	2.0	48
F04	Magnet 1 Resistance	4.00	48
F05	Magnet 2 Current	0	48
F06	Magnet 2 Inductance Gain	2.0	48
F07	Magnet 2 Resistance	4.00	48
F08	Magnet 3 Current	0	48
F09	Magnet 3 Inductance Gain	2.0	48
F10	Magnet 3 Resistance	4.00	48
F11	Magnet 4 Current	0	48
F12	Magnet 4 Inductance Gain	2.0	48
F13	Magnet 4 Resistance	4.00	48

## MagnePulse DMC Parameter Listing (cont.)

Parameter No.	Parameter Name	Factory Default	Reference Page
G00	Analog IP1 Ref Type	0/+10V	50
G01	Analog IP1 Ref Gain	1.00	50
G02	Analog IP1Bias	0.0%	50
G04	Analog IP2 Type	0/+10V	50
G05	Analog IP2 Gain	1.00	50
G06	Analog IP2 Bias	0.0%	50
G08	Analog Out Gain	1.00	50
G09	Analog Out Bias	0.0%	50
G10	Analog Out Func	Magnet Current	50
G11	Prog IP Func	Not Used	50
G12	Prog. OP1 Func	Cntr Ready	50
G13	Prog. OP2 Function	Cntr Fault (any)	50
G14	Prog. OP3 Function	Cntr Alarm	50
G15	Prog. OP4 Function	Power Loss	50
G16	Serial Baud Rate	19200	51
G17	RS232/485 Select	RS232	51
G18	Serial Format	8E1	51
G19	Modbus Address	1	51
G20	Drive Control	Hwd-IO	51
G21	SPEED IP Func	Not Used	51
G22	Reset IP Func	Disabled	51
G23	Mmnty Clean IP	Disabled	51
G25	Enable IP Func	Not Used	51

## MagnePulse DMC Parameter Listing (cont.)

Parameter No.	Parameter Name	Factory Default	Reference Page
H00	Fault 1	-	55
H01	Fault 1 Time (Hours)	-	55
H02	Fault 2	-	55
H03	Fault 2 Time (Hours)	-	55
H04	Fault 3	-	55
H05	Fault 3 Time (Hours)	-	55
H06	Fault 4	-	55
H07	Fault 4 Time (Hours)	-	55
H08	Fault 5	-	55
H09	Fault 5 Time (Hours)	-	55
H10	Fault 6	-	55
H11	Fault 6 Time (Hours)	-	55
H12	Fault 7	-	55
H13	Fault 7 Time (Hours)	-	55
H14	Fault 8	-	55
H15	Fault 8 Time (Hours)	-	55
H16	Fault 9	-	55
H17	Fault 9 Time (Hours)	-	55
H18	Fault 10	-	55
H19	Fault 10 Time (Hours)	-	55
H20	Fault 11	-	55
H21	Fault 11 Time (Hours)	-	55
H22	Fault 12	-	55
H23	Fault 12 Time (Hours)	-	55
H24	Fault 13	-	55
H25	Fault 13 Time (Hours)	-	55
H26	Fault 14	-	55
H27	Fault 14 Time (Hours)	-	55
H28	Fault 15	-	55
H29	Fault 15 Time (Hours)	-	55
H30	Fault Hist. Reset	-	55