Model M3506
Current Controller

Customer Reference Manual

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Bonitron, Inc.
Nashville, TN

An industry leader in providing solutions for AC drives.

ABOUT BONITRON

Bonitron designs and manufactures quality industrial electronics that improve the reliability of processes and variable frequency drives worldwide. With products in numerous industries, and an educated and experienced team of engineers, Bonitron has seen thousands of products engineered since 1962 and welcomes custom applications.

With engineering, production, and testing all in the same facility, Bonitron is able to ensure its products are of the utmost quality and ready to be applied to your application.

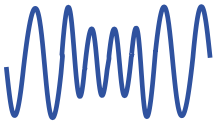
The Bonitron engineering team has the background and expertise necessary to design, develop, and manufacture the quality industrial electronic systems demanded in today's market. A strong academic background supported by continuing education is complemented by many years of hands-on field experience. A clear advantage Bonitron has over many competitors is combined on-site engineering labs and manufacturing facilities, which allows the engineering team to have immediate access to testing and manufacturing. This not only saves time during prototype development, but also is essential to providing only the highest quality products.

The sales and marketing teams work closely with engineering to provide up-to-date information and provide remarkable customer support to make sure you receive the best solution for your application. Thanks to this combination of quality products and superior customer support, Bonitron has products installed in critical applications worldwide.

AC Drive Options

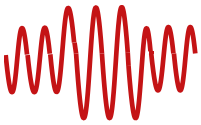
In 1975, Bonitron began working with AC inverter drive specialists at synthetic fiber plants to develop speed control systems that could be interfaced with their plant process computers. Ever since, Bonitron has developed AC drive options that solve application issues associated with modern AC variable frequency drives and aid in reducing drive faults. Below is a sampling of Bonitron's current product offering.

World Class Products



Undervoltage Solutions

Uninterruptible Power for Drives
(DC Bus Ride-Thru)
Voltage Regulators
Chargers and Dischargers
Energy Storage



Overvoltage Solutions

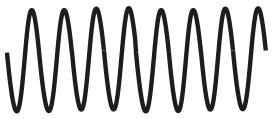
Braking Transistors
Braking Resistors
Transistor/Resistor Combo
Line Regeneration
Dynamic Braking for Servo Drives

Common Bus Solutions

Single Phase Power Supplies
3-Phase Power Supplies
Common Bus Diodes

Portable Maintenance Solutions

Capacitor Formers
Capacitor Testers



Power Quality Solutions

12 and 18 Pulse Kits

Green Solutions

Line Regeneration

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1. INTRODUCTION

1.1. WHO SHOULD USE

This manual is intended for use by anyone who is responsible for integrating, installing, maintaining, troubleshooting, or using this equipment with any AC Drive System.

Please keep this manual for future reference.

1.2. PURPOSE AND SCOPE

This manual is a user's guide for the Model M3506 Programmable Current Controller. It will provide the user with the necessary information to successfully install the M3506.

In the event of any conflict between this document and any publication and/or documentation related to the drive system, the latter shall have precedence.

1.3. MANUAL VERSION AND CHANGE RECORD

As the latest rev (03) of this manual, this version incorporates graphs, additional data and Bonitron's new formatting.

The About Bonitron section was updated in Rev 04.

The manual template was updated in Rev 05.

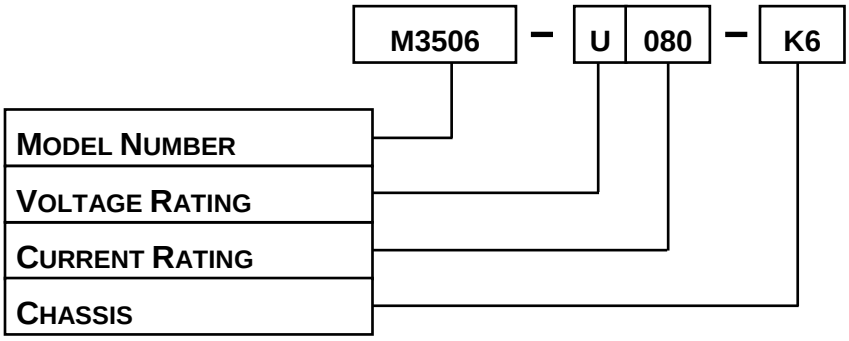
Figure 1-1: M3506 50 Amp Current Controller

2. PRODUCT DESCRIPTION

The M3506 Current Controller is designed to output a regulated DC current into various seal wire impedances, with consistent rise and fall times. The AC power feed supply can range from 10VAC to 130VAC. The controller can achieve better than 1% regulation with a 20% change in load or line. The current can be controlled by an external 5k reference pot which is tailored with a limit pot, or by a 4-20mA remote control loop. The enable input uses its own isolated voltage, and can be enabled with a dry contact, or a 12V signal. No control signals should ever be earth grounded. A 0-10mA output is available for reading the current. This output is held for 2 seconds after the current is gone so that the meter will read steady while unit is in production. For more detailed information on unit operations please refer to the Cryovac User Manual

2.1. PART NUMBER BREAKDOWN

Figure 2-1: Example of Current Controller Part Number Breakdown



BASE MODEL NUMBER:

The Base Model Number for the Current Controller is M3506.

VOLTAGE RATING

The Voltage Rating is indicated by a Code Letter….

Table 2-1: Voltage Rating

RATING CODE	AC VOLTAGE (NOMINAL)
U	115VAC Line / 160VDC Bus

CURRENT RATING:

The Current rating is represented by a 3-digit value. For instance, the rating for a 50 Amp unit is 050.

CHASSIS:

The Chassis is determined by the unit Current Rating.

Table 2-2: Chassis Size

CURRENT	CHASSIS DESCRIPTION
50	C6 (6"W X 11.75"H X 8.5"D
80	K6 (7.12"W X 20"H X 10.5"D)

NOTE: The new part number for the unit previously known as M3506-0004 is M3506-U050-C6, as per the above chart.

2.2. GENERAL SPECIFICATIONS CHART

Table 2-3: 50 Amp Controller Specifications

Please see Table 2-4 for 80 Amp Controller Specifications.

POWER SECTION

PARAMETER	SPECIFICATION
3∅ AC Input	67VAC up to 3kW, 120VAC up to 6kW
Fuses	Bussman FWH-60 included
Earth ground	From AC feed source
Max DC Output Voltage	130V into 2.6Ω @ 50 amps
Max DC Output Current	40 amps continuous 50 amps @ 75% duty cycle
Torque	45 inch lbs maximum

CONTROL SECTION

PARAMETER	SPECIFICATION
120VAC	120VAC control power
Torque	10 in-lbs maximum
Control Ground	No control signals should be earth grounded

STATUS INDICATORS

PARAMETER	SPECIFICATION
CURRENT ON	Green LED is ON when controller is enabled
OVERTEMP	Red LED is ON if unit is overheated
CONTROL VOLTAGE	Green LED is ON when 120VAC control power is present
BUS VOLTAGE	Amber LED is ON when AC input is present

Table 2-4: 80 Amp Controller Specifications

Please see Table 2-3 for 50 Amp Controller Specifications.

POWER SECTION

PARAMETER	SPECIFICATION
3∅ AC Input	67VAC up to 6kW, 120VAC up to 12kW
Fuses	FWH-80 (not included)
Earth ground	From AC feed source
Max DC Output Voltage	130V into 1.625 Ω@ 80 amps
Max DC Output Current	80 amps continuous 100 amps @ 75% duty cycle
Torque	45 inch lbs maximum

CONTROL SECTION

PARAMETER	SPECIFICATION
120VAC	120VAC control power
Torque	10 in-lbs maximum
Control Ground	No control signals should be earth grounded

STATUS INDICATORS

PARAMETER	SPECIFICATION
CURRENT ON	Green LED is ON when controller is enabled
OVERTEMP	Red LED is ON if unit is overheated
CONTROL VOLTAGE	Green LED is ON when 120VAC control power is present
BUS VOLTAGE	Amber LED is ON when AC input is present

2.3. General Precautions and Safety Warnings

DANGER!

- **High voltages may be present!**
- **Never attempt to operate this product with the enclosure cover removed!**
- **FAILURE TO HEED THESE WARNINGS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH!**

CAUTION!

- **This product will generate high ambient temperatures during operation.**
- **This product should be installed accordingly on non-flammable surfaces with clearances of at least two inches in all directions.**
- **Inoperable units should be replaced or returned for evaluation and/or repair by qualified technicians**
- **Before attempting installation or removal of this product, be sure to review all drive and/or resistive load documentation for pertinent safety precautions.**
- **Installation and/or removal of this product should only be accomplished by a qualified electrician in accordance with National Electrical Code or equivalent regulations.**

ANY QUESTIONS AS TO APPLICATION, INSTALLATION, OR SERVICE SAFETY SHOULD BE DIRECTED TO THE EQUIPMENT SUPPLIER.

3. INSTALLATION INSTRUCTIONS

WARNING!

Installation and/or removal of this product should only be performed by a qualified electrician in accordance with National Electrical Code or local codes and regulations.

Proper installation of the Current Controller should be accomplished following the steps outlined below. Be sure to refer to the AC Drive instruction manual as these steps are performed. Please direct all installation inquiries that may arise during the installation and start up of this product to the equipment supplier or system integrator.

3.1. ENVIRONMENT

The module should be installed in an area protected from moisture and falling debris. Buildup of dust or debris may cause poor performance and possibly a failure. Operating in a wet environment can pose a shock hazard. The recommended temperature range for operating or storing this module is 0°C to+40°C.

3.2. UNPACKING

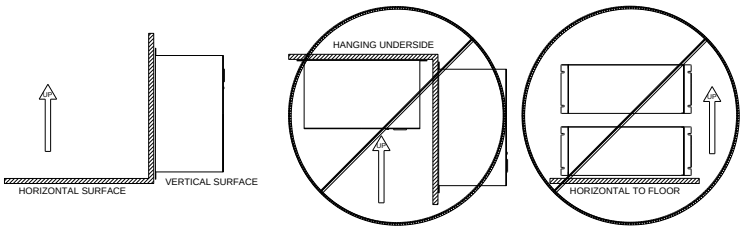
Upon receipt of this product, please verify that the product received matches the product that was ordered and that there is no obvious physical damage to the unit. If the wrong product was received or the product is damaged in any way, please contact the supplier from which the product was purchased.

3.3. MOUNTING

The installation site for the module should be chosen with several considerations in mind:

- The unit requires a minimum clearance of two (2) inches in all directions around it when mounted near a non-heat source.
- Unit should not be exposed to falling debris or condensation.
- Once the installation site has been selected as outlined above, the unit should be mounted in place. The M3506 must be properly oriented for proper heat flow through the units. The M3506 must be mounted with the rear surface of the unit to the mounting surface. Unit should be mounted vertically as shown in Example A of Figure 3-1.
- **Do Not** mount the unit upside-down or on the underside of a mounting surface as shown in Example B of Figure 3-1.
- **Do Not** mount unit in a horizontal position with its side parallel to the mounting surface or floor as shown in Example C of Figure 3-1.

Figure 3-1: M3506 Mounting Orientation



Example A Example B Example C

Table 3-1: M3506 Chassis and Mounting Dimensions

UNIT	CHASSIS			MOUNTING			REFERENCE FIGURE
	H	W	D	H	W	D	
50 Amp	11.75	6.0	7.70	11.0	4.5	7.7	3-2
80 Amp	20.0	7.35	10.25	19.25	5.0	10.25	3-3

Figure 3-2: 50 Amp Controller Dimensional Outline

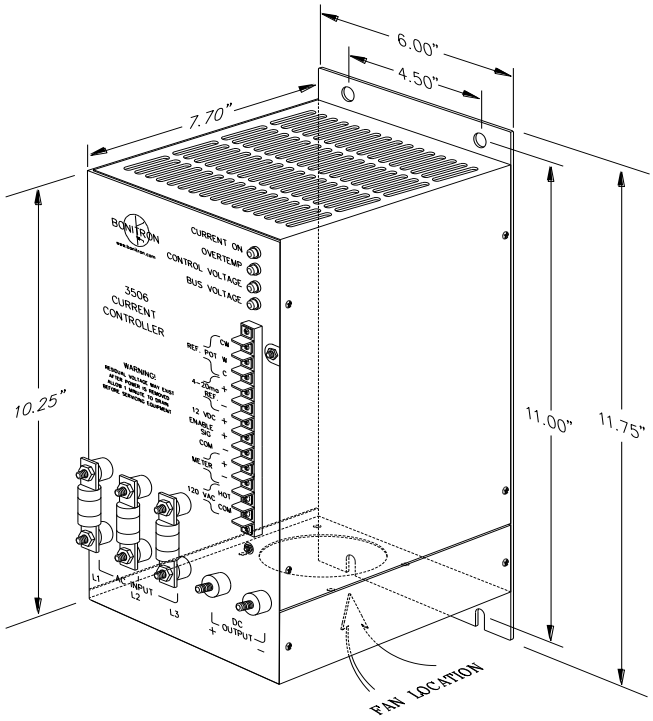


Figure 3-3: 80 Amp Controller Dimensional Outline

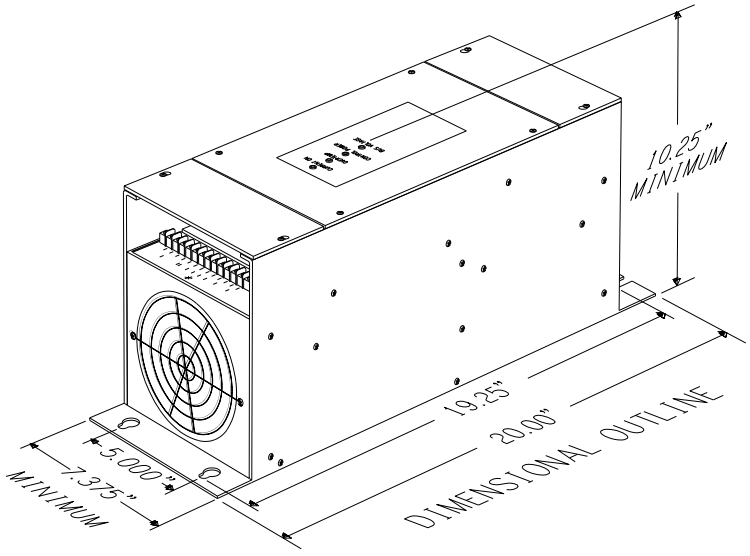
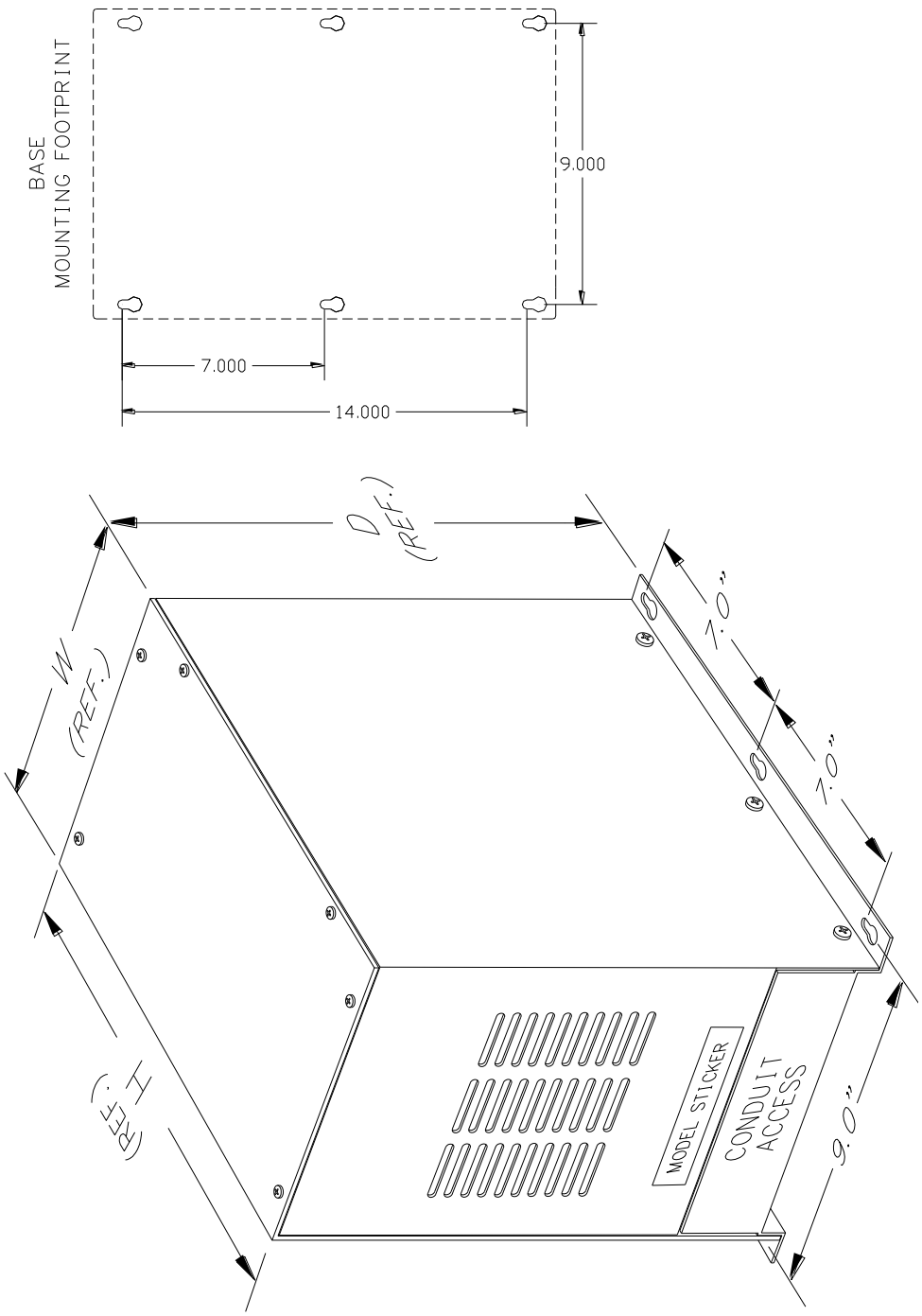


Table 3-2: Cryovac Transformer and Mounting Dimensions

	UNIT SIZE			MOUNTING		
	H	W	D	H	W	D
XFMR	16.0	9.5	15.6	14.00	9.0	15.6

Figure 3-4: Cryovac Transformer Dimensional Outline



3.4. WIRING AND CUSTOMER CONNECTIONS

3.4.1. POWER WIRING

Max torque for power wiring

- 50 Amp unit = 45 in-lbs.
- 80 Amp unit = 32 in-lbs.

3.4.1.1. SOURCE CONSIDERATIONS

M3506-U050 requires 6.5kW feed at 120VAC.
M3506-U080 requires 10.5kW feed at 120VAC.

3.4.1.2. GROUNDING REQUIREMENTS

M3506 chassis should be earth grounded.
DC output should NOT be earth grounded.

3.4.2. I/O WIRING

Figure 3-5: 50 Amp Controller Wiring (C6)

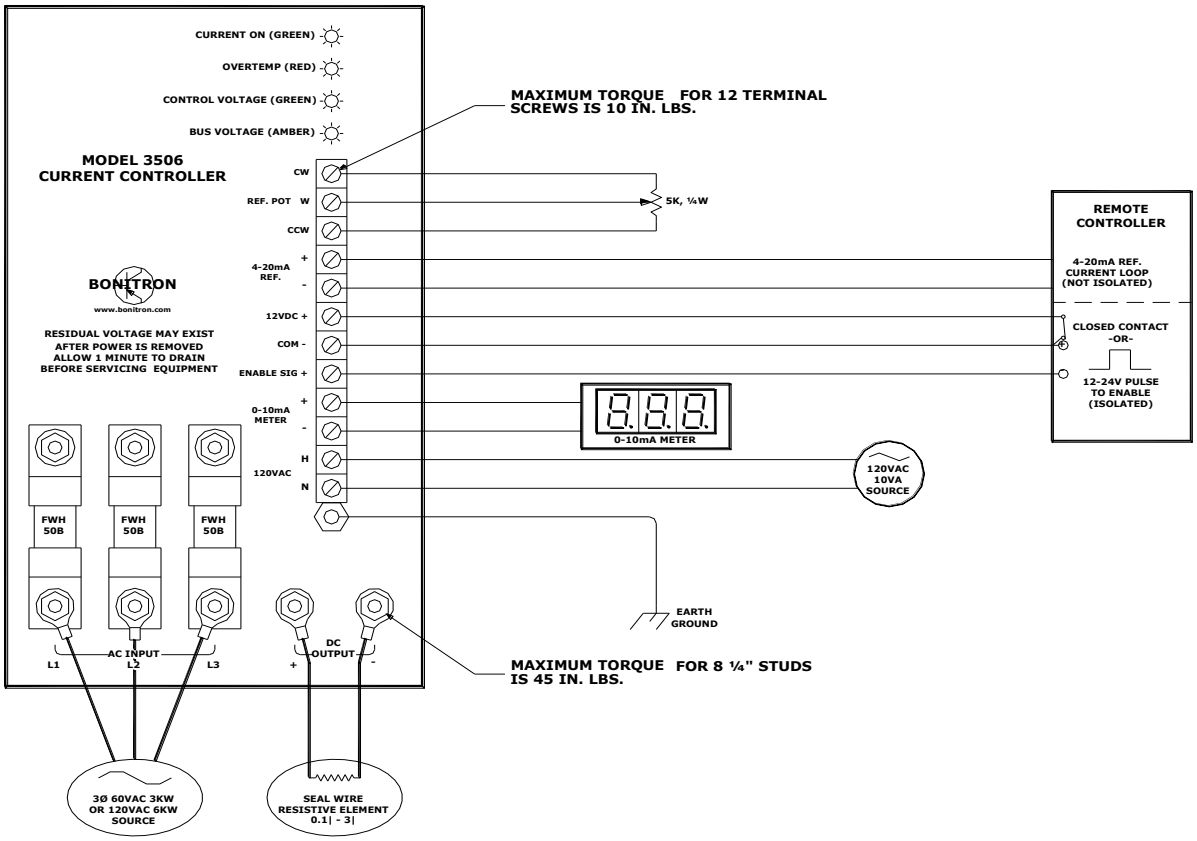
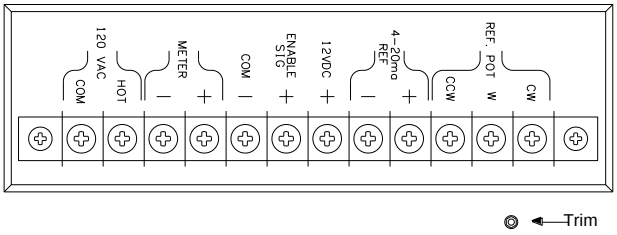


Figure 3-6: 80 Amp Controller Wiring (K6)



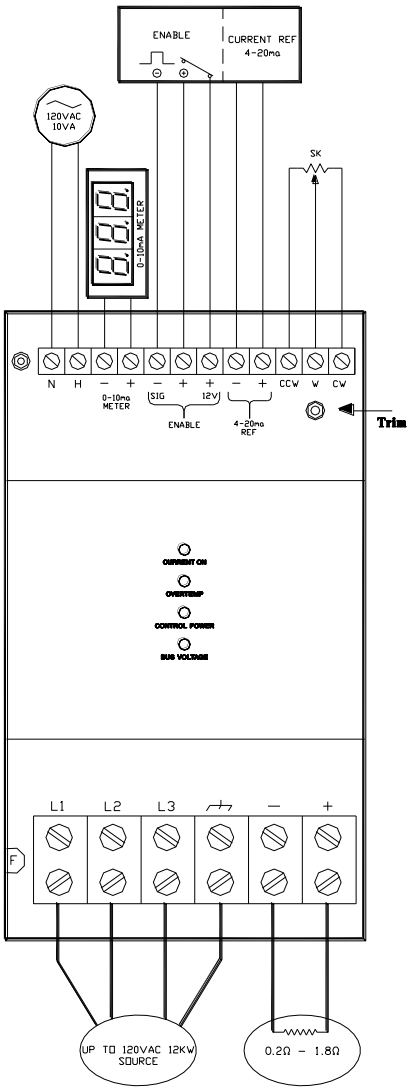
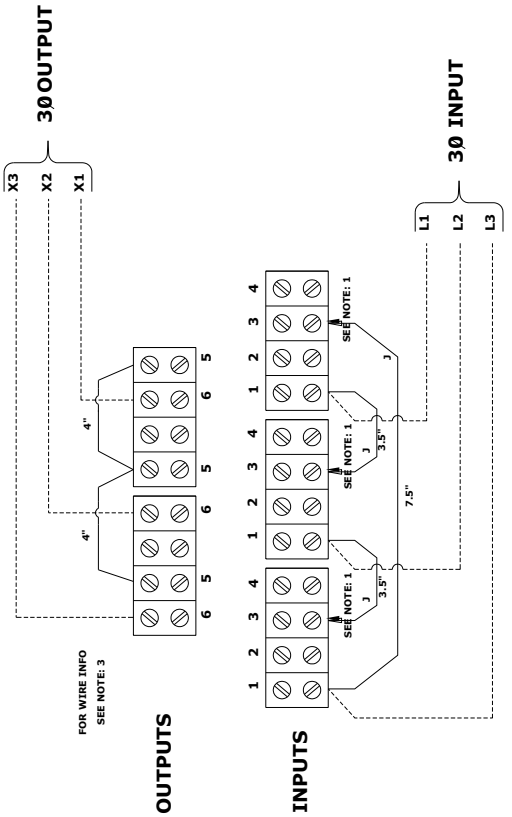


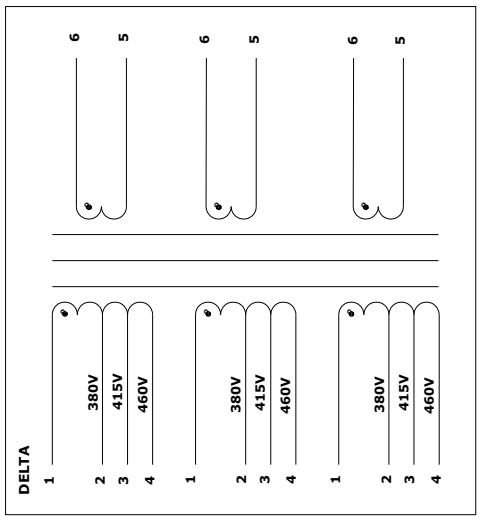
Figure 3-7: Terminal Configuration 1

CUSTOMER INFORMATION



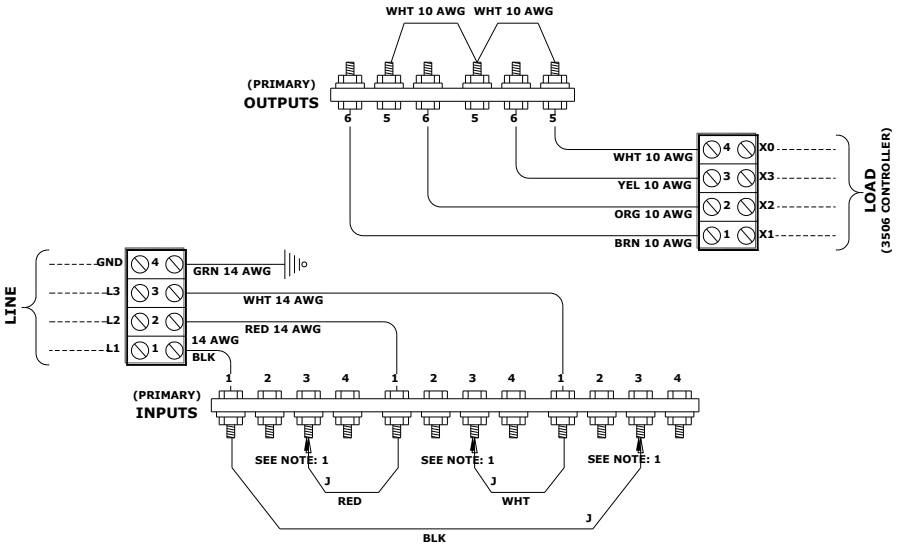
NOTES:

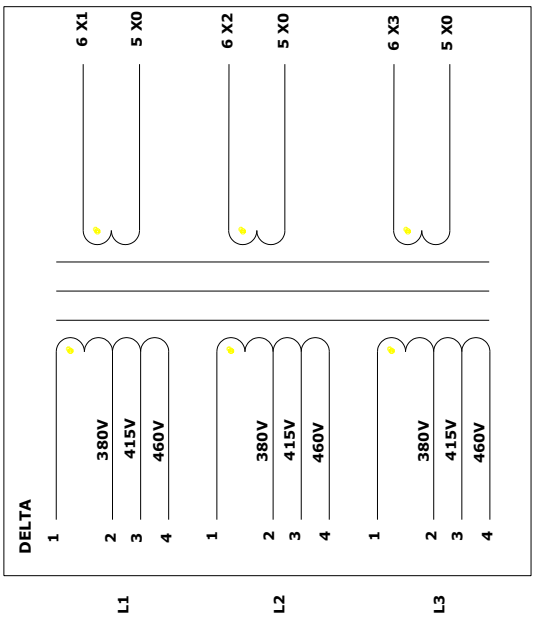
1. JUMPERS J, CAN BE CHANGED FROM H0-H2 TO H0-H1 OR H0-H3 FOR -5% AND +5% 3Ø OUTPUT RESPECTIVELY
2. FOR INTERCONNECTION WITH M3506-002 CURRENT CONTROLLER, SEE DWG. #010242
3. USE 10AWG, TEFLON COATED, 200 C TEMP WIRE



BONITRON KIT#	XFMR. ASSY. PART#	XFMR PART#	LINE VOLTAGE	KW	SEAL TYPE
M3506-KIT-380-3	XR ISO-3KVA-3P-380-67	FM-7869	380-460	3	END SEAL
M3506-KIT-415-3	XR ISO-3KVA-3P-415-67	FM-7869	380-460	3	END SEAL
M3506-KIT-460-3	XR ISO-3KVA-3P-460-67	FM-7869	380-460	3	END SEAL
M3506-KIT-380-6	XR ISO-6KVA-3P-380-120	FM-7931	380-460	6	SIDE SEAL
M3506-KIT-415-6	XR ISO-6KVA-3P-415-120	FM-7931	380-460	6	SIDE SEAL
M3506-KIT-460-6	XR ISO-6KVA-3P-460-120	FM-7931	380-460	6	SIDE SEAL

Figure 3-8: Terminal Configuration 2





NOTES:

1. JUMPERS J, CAN BE CHANGED FROM H0-H2 TO H0-H1 OR H0-H3 FOR 380V AND 460V.
2. FOR INTERCONNECTION WITH M3506-002 CURRENT CONTROLLER, SEE DWG. #010242.

BONITRON KIT#	XFMR. ASSY. PART#	XFMR PART#	LINE VOLTAGE	KW	SEAL TYPE
M3506-KIT-380-3	XR ISO-3KVA-3P-380-67	FM-7869	380-460	3	END SEAL
M3506-KIT-415-3	XR ISO-3KVA-3P-415-67	FM-7869	380-460	3	END SEAL
M3506-KIT-460-3	XR ISO-3KVA-3P-460-67	FM-7869	380-460	3	END SEAL
M3506-KIT-380-6	XR ISO-6KVA-3P-380-120	FM-7931	380-460	6	SIDE SEAL
M3506-KIT-415-6	XR ISO-6KVA-3P-415-120	FM-7931	380-460	6	SIDE SEAL
M3506-KIT-460-6	XR ISO-6KVA-3P-460-120	FM-7931	380-460	6	SIDE SEAL

4. OPERATION

4.1. FUNCTIONAL DESCRIPTION

Power for the load is derived from the 3-phase, 60 or 120VAC input. Control power is derived from a single phase 120VAC input. An isolated 12V supply output is available for the external enable signal so that the enable can be driven directly from a non-isolated source.

Upon application of power, the DC bus will be charged and will await enable and current control commands. Once an enable command is given, the M3506 Current Controller will begin switching to supply current to the load directly proportional to the current control signal.

The load power can be controlled by changing the current signal level, or the enable ON time. Adjusting the externally mounted potentiometer or changing the remote 4-20mA signal will vary the current level output.

The load current can be monitored via an external 0-10mA signal proportional to the actual current.

M3506 controller will maintain a steady output current level within 1% of set-point, even as the AC line changes voltage and the load wire changes resistance due to its internal heating.

4.2. FEATURES

4.2.1. ALL CONTROL SIGNALS CONNECT TO TS1

- For 50A units TS1 is on the front panel of the controller.
- For 80A units TS1 is at the top of the controller, behind the top cover plate.

CONTROL VOLTAGE

120VAC control power hot connects to TS1-11 and neutral connects to TS1-12. Earth ground is connected to ground stud at bottom of terminal strip.

ENABLE

The current enable signal is connected to TS1-7 & 8, and is high to enable controller. A 12VDC isolated supply to allow use with a non-isolated enable source is found at TS1-6 & 8. Enable contact can be connected to TS1-6 & 7, or an enable voltage can be connected to TS1-7 & 8.

EXTERNAL REFERENCE POT

A 5k potentiometer can be used to control the current from the local front panel of the cabinet housing the current controller. The pot can be connected to TS1-1, 2 & 3. When the pot is used for control, jumper J2 must be ON.

EXTERNAL 4-20MA REFERENCE

A 4-20mA loop can be used to control the current from a remote source. This loop can be connected to TS1-4 & 5. When the 4-20mA control is used for control, jumper J3 must be ON.

0-10MA CURRENT METER OUTPUT

A 0-10mA output loop is provided to monitor the current level output. This loop can be connected to TS1-9 &10.

4.2.2. M3506 INCLUDES FRONT PANEL INDICATORS.

CURRENT ON
Green LED indicates the remote enable command has been received and is active.

OVERTEMP
Red LED indicates the controller has overheated.

CONTROL VOLTAGE
Green LED indicates the 120 control voltage is present.

BUS VOLTAGE
Amber LED indicates bus voltage is present. LED will be brighter for a 120V than for a 60V input.

4.3. STARTUP

4.3.1. PRE-POWER CHECKS

1. Remove side panel and ensure pcb jumpers are in the correct position for control scheme:
   - J1 = ON for 60VAC 3-phase input power
   - J1 = OFF for 120V 3-phase input power (Factory set for 120VAC input power)
   - J2 = ON for current control via front panel 5k potentiometer
   - J3 = ON for current control via remote 4-20mA loop
2. Re-install side cover
3. Ensure all control connections are made to proper terminations at TS1
4. Ensure 3-phase AC power is properly connected
   - 50 amp units - bottom of fuses on front panel
   - 80 amp units - TS2-1, 2 & 3
5. Ensure seal wire is connected to DC output terminals, and is not earth grounded
   - 50 amp units - bottom right DC terminals
   - 80 amp units - TS2-5 & 6. Earth ground to TS2-4

4.3.2. STARTUP PROCEDURE AND CHECKS

1. Apply 115VAC control power
   - Control power LED should illuminate
2. Apply main 3- phase power
   - DC bus LED should illuminate
3. Preset current command to desired level
4. Turn on enable signal and ensure:
   - Enable LED illuminates
   - Output current goes to set-point
   - 0-10mA meter reads output current

4.4. OPERATIONAL ADJUSTMENTS

There is a LIMIT pot used to limit the 5k reference pot maximum current:

50 AMP UNITS:
This is located on the front panel near the top and to the right of TS1. It is factory set to limit the current to 36 amps.

80 AMP UNITS:
This is located to the right of TS1 under the top cover plate. It is factory set to limit the current to 80 amps.

4.5. CALIBRATION

M3506 is factory calibrated and should not be adjusted in the field. Send the unit back to Bonitron if calibration is required.

Table 4-1: M3506 Factory Calibration Specifications

PARAMETER	SPECIFICATION	
	50 AMP UNITS	80 AMP UNITS
REF POT	5kW potentiometer for local current setpoint Full CW = 50 amps output Full CCW = 9 amps	5kW potentiometer for local current setpoint Full CW = 80 amps output Full CCW = 16 amps
REF POT Limit	Limits Ref Pot: Full CW ≈ 55 amps Full CCW ≈ 26 amps Factory set for 36 amps	Limits External Ref Pot: Full CW ≈ 105 amps Full CCW ≈ 70 amps Factory set for 80 amps
4-20mA REF	4-20mA loop for remote current setpoint, 20mA = 50 amps	4-20mA loop for remote current setpoint, 20mA = 80 amps
ENABLE SIG	The enable is optically isolated; 12-24V @ 12mA signal = current on, or closed contact = current on.	The enable is optically isolated; 12-24V @ 12mA signal = current on, or closed contact = current on.
METER	0-10mA output, 10mA = 50 amps output	0-10mA output, 10mA = 80 amps output

5. MAINTENANCE AND TROUBLESHOOTING

Repairs or modifications to this equipment are to be performed by Bonitron approved personnel only. Any repair or modification to this equipment by personnel not approved by Bonitron will void any warranty remaining on this unit.

5.1. PERIODIC TESTING

No periodic maintenance is necessary.

6. ENGINEERING DATA

6.1. RATINGS CHARTS

Figure 6-1: 10 Turn Dial Pot vs. Output Current for 80 Amp

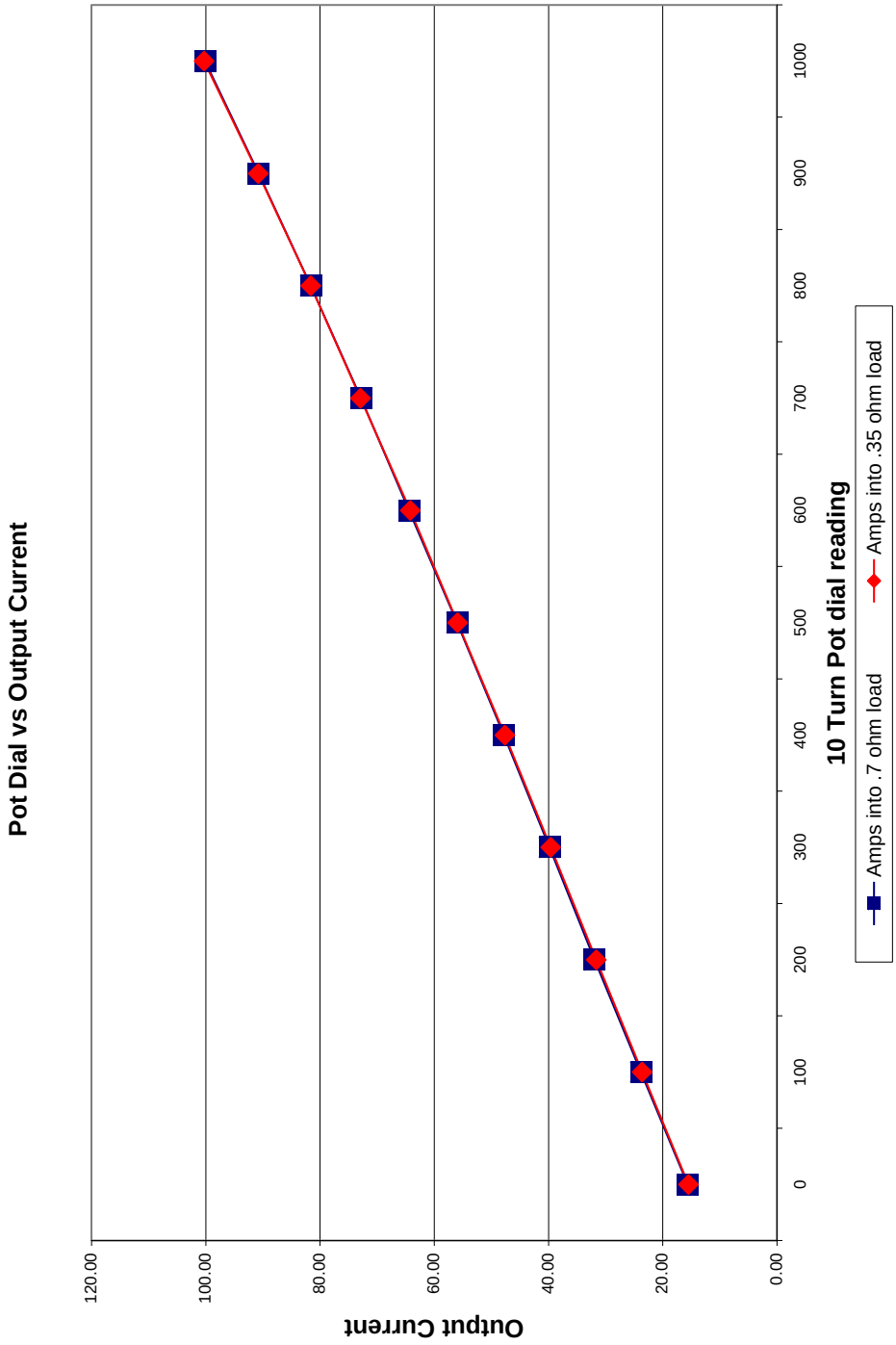


Figure 6-2: Linearity at Various Loads and Voltages – 80 Amp

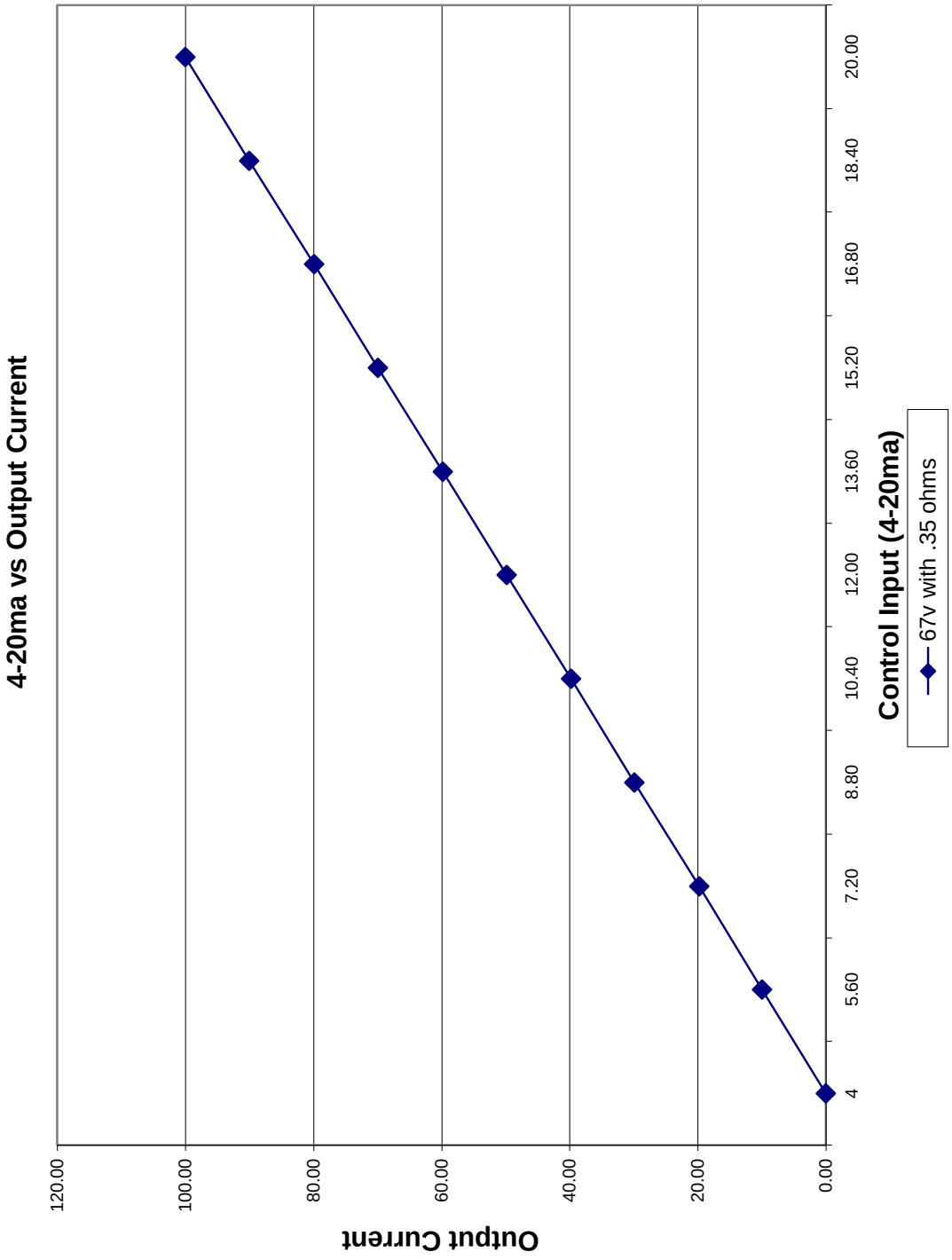


Figure 6-3: Line / Load Regulation at 67 Volts

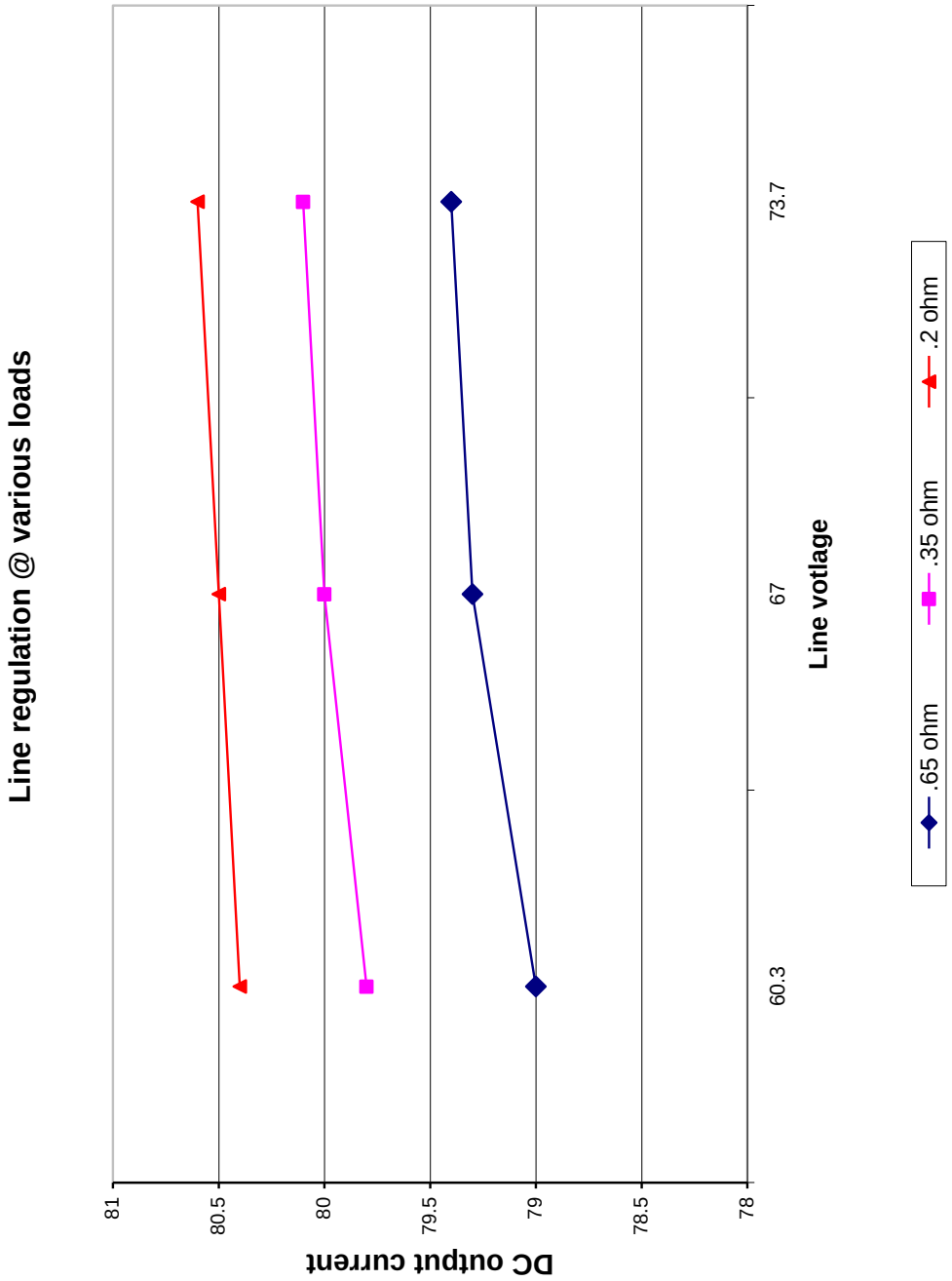
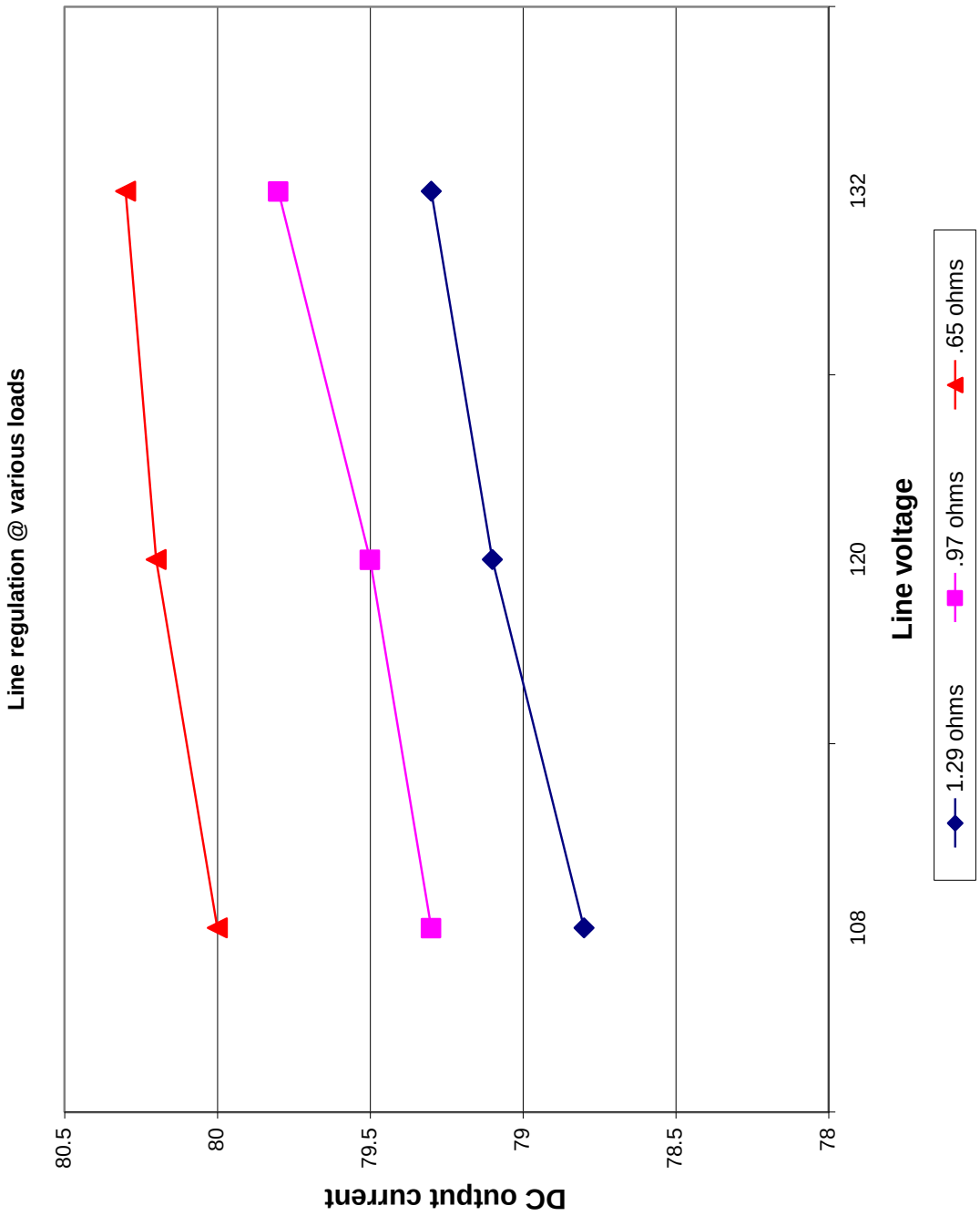


Figure 6-4: Line / Load Regulation at 120 Volts



6.2. WATT LOSS

M3506 units are 93% efficient, or better.

6.3. CERTIFICATIONS

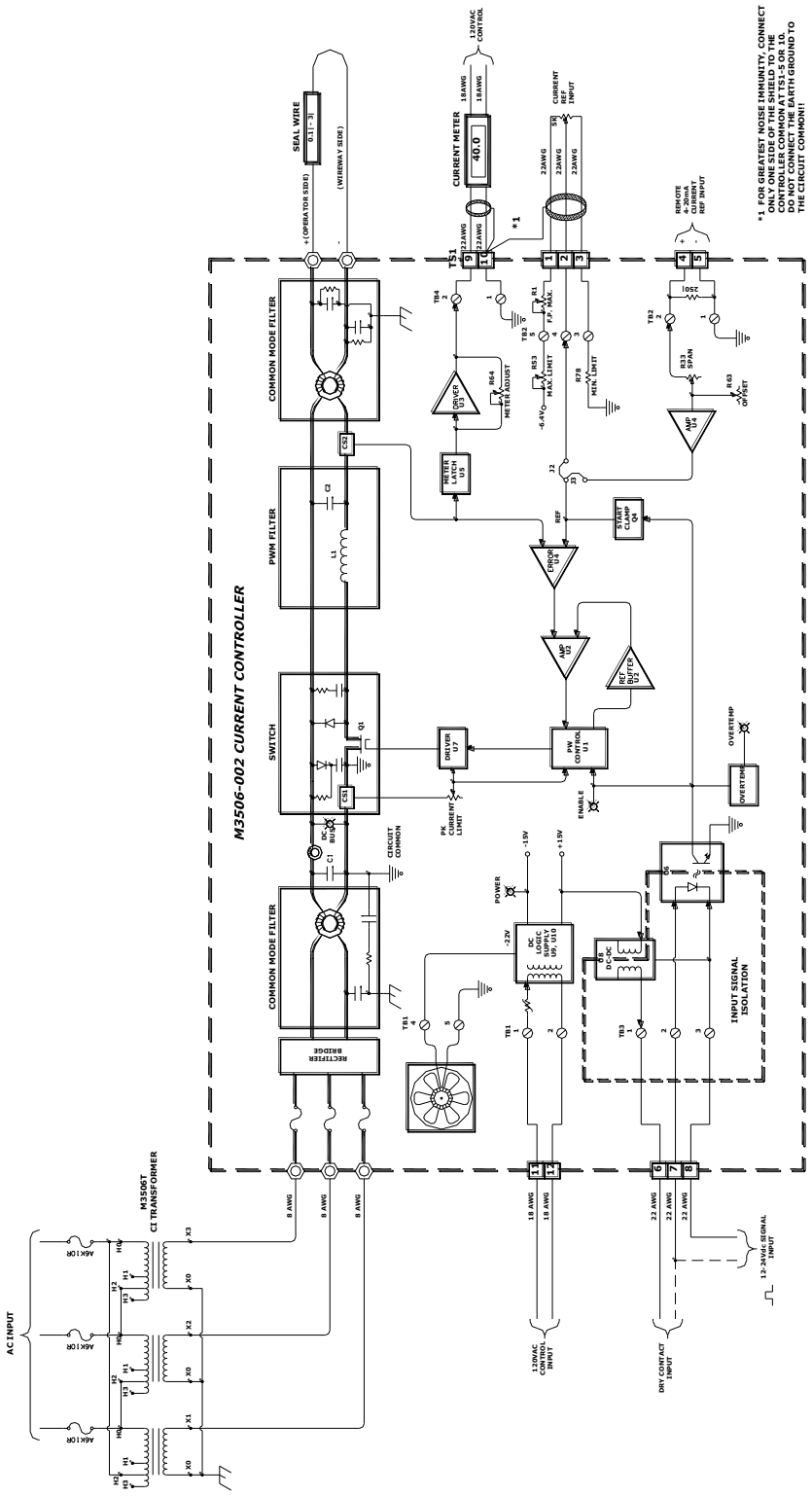
None.

6.4. FUSE/CIRCUIT BREAKER SIZING AND RATING

CURRENT RATING	RECOMMENDED AC INPUT FUSE	DESCRIPTION
50 amp	FWH-60	60A, 600V fuse
80 amp	FWH-80	80A, 600V fuse

6.5. BLOCK DIAGRAM

Figure 6-5: Current Controller Kit Block Diagram



6.6. PARTS LIST

PART NUMBER	DESCRIPTION	M3506-U050-C6	M3506-U080-K6
FS FWH-60	60A, 600V Fuse	3	-
PLP 3506-FC	Clear Fuse Cover	1	-
TS ST14-FT	Feed-thru Terminal (1/4" Stud)	8	-

6.7. RECOMMENDED SPARE PARTS

For 50A Unit: FWH-60 Amp fuses

NOTES

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