OPERATOR MANUAL FOR

303 Series 2 High Voltage

POWER SUPPLY

Document: 83489011 Rev E

TDK-LAMBDA AMERICAS

405 Essex Road, Neptune, NJ 07753

Tel: (732) 795-4100

Fax: (732) 922-1441

Web: us.tdk-lambda.com/hp

ONE YEAR WARRANTY

TDK-Lambda Americas, Inc. (405 Essex Road, Neptune, N.J. 07753), warrants that the unit is free from defects in material or workmanship for a period of ONE YEAR from the date of initial shipment. TDK-Lambda Americas Inc. will service and, at its option, repair or replace parts which prove to be defective. This will be done free of charge during the stated warranty period. This warranty excludes defects resulting from misuse, unauthorized modification, operation outside the environmental or safety specifications of the power supply, or improper site preparation or maintenance. The customer shall contact TDK-Lambda Americas Inc., for warranty service or repair as described in the RETURNING EQUIPMENT section. The customer shall prepay shipping charges. If the unit is covered under the foregoing warranty, then TDK-Lambda Americas Inc. shall pay the return shipping charges.

The "WARRANTY", "CLAIM FOR DAMAGE IN SHIPMENT", and "RETURNING EQUIPMENT" information applies to equipment purchased directly from TDK-Lambda Americas Inc. End users receiving equipment from a third party should consult the appropriate service organization for assistance with these issues.

THIS LIMITED WARRANTY IS IN LIEU OF, AND TDK-LAMBDA AMERICAS INC. DISCLAIMS AND EXCLUDES, ALL OTHER WARRANTIES, STATUTORY, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, OR OF CONFORMITY TO MODELS OR SAMPLES.

CERTIFICATION

All test and measuring equipment used by TDK-Lambda Americas Inc. for Final Acceptance Testing are traceable to primary standards certified by the National Institute of Standards and Technology.



LETHAL VOLTAGES PRESENT!



All power supplies contain hazardous voltage and energy. The power supply must only be operated by qualified personnel who have read this operator's manual and are familiar with the operation, hazards and application of the power supply. Proper care and judgment must always be observed.

1. Before connecting input AC power, ensure all covers are in place and securely fastened. Ensure the required safety ground to chassis is installed and sufficient cooling is supplied.
2. Proper grounding from the input AC power is required to reduce the risk of electric shock, and to comply with safety agency and code requirements.
3. Use extreme caution when connecting input AC power. Only apply the input voltage specified on the rating label.
4. Use extreme caution when connecting any high voltage cables. Never handle any output cables when the power supply is operating.
5. After a power supply is switched OFF, its output section will retain a charge which may be lethal. Allow sufficient time for self-discharge before handling anything connected to the output. The discharge time specified in the Safety Notes does *NOT* include extra time required to discharge the energy stored in the user's load.
6. When user serviceable fuses are present, always replace fuses with the same type and Volt/Amp rating.
7. Never attempt to operate the power supply in any manner not described in this manual.
8. Never remove DANGER or WARNING labels from the power supply. Replace lost or damaged labels immediately. Contact TDK-Lambda Americas Customer Service for replacement labels.
9. The power supply may be serviced only by TDK-Lambda Americas Inc. factory qualified service personnel. Breaking the warranty seal will void the warranty. Prior to opening the power supply, contact TDK-Lambda Americas Inc. Customer Service for a written Service Waiver and a replacement warranty seal.

TDK-Lambda

MANUFACTURER'S PRODUCT DECLARATION

INTENDED PURPOSE (USE)

The Power Supplies described by this manual are defined by TDK-Lambda Americas Inc. as a component for use in the composition of an apparatus as defined in Article 1 (1) of the EMC Directive (89/336/EEC). These products, as individual components, do not perform in themselves a direct function for the user of the end product. They are not intended to be placed on the market with a direct function to a final user! As such, the products described by this manual are not subject to the provisions of the EMC Directive (89/336/EEC, with amendment 92/31/EEC).

The products described by this manual are intended for incorporation into a final product by a professional assembler. It is the responsibility of the assembler to ensure that the final apparatus or system incorporating our products complies with all relevant EMC standards for that final product.

OPERATING ENVIRONMENT

The operating environment as defined by TDK-Lambda Americas Inc., for the products described by this manual is stated as follows:

The Power Supplies described by this manual are intended for use in a protected industrial environment or in proximity to industrial power installations. These locations are often referred to as industrial locations containing establishments that are not connected to the low voltage public mains network.

Industrial locations are characterized by the existence of one or more of the following conditions:

1) industrial, scientific and medical (ISM) apparatus are present;
2) heavy inductive or capacitive loads are frequently switched;
3) currents and associated magnetic fields are high;
4) location supplied by their own transformer.

These components are not intended for connection to a public mains network, but are intended to be connected to a power network supplied from a high or medium-voltage transformer dedicated for the supply of an installation feeding manufacturing or similar operations. They are suitable for use in all establishments other than domestic and those directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

TDK-Lambda

Description of symbols used in product labeling

SYMBOL	PUBLICATION	DESCRIPTION
	EC Council Directive 93/68/EEC	European Community Conformity Assessment Product Mark
	IEC 348	Attention, consult Accompanying documents
	IEC 60417-1-5036	Dangerous voltage
	IEC 60417-1-5019	Protective earth (e.g. power line earth ground)
	IEC 60417-1-5017	Functional earth (e.g. chassis ground)
	IEC 60417-1-5134	Electrostatic Discharge (ESD) Sensitive Device

ELECTRICAL STANDARDS

All company primary standards are either certified or are traceable to certification by the National Institute of Standards and Technology.

CLAIM FOR DAMAGE IN SHIPMENT

This instrument received comprehensive mechanical and electrical inspection before shipment. Immediately upon receipt from the carrier, and before operation, this instrument should be inspected visually for damage caused in shipment. If such inspection reveals damage in any way, a claim should be filed with the carrier. A full report of damage should be obtained by the claim agent and this report should be forwarded to us. We will then provide a disposition of the equipment and arrange for repair or replacement.

When referring to this equipment, always include the model and serial numbers.

The "WARRANTY", "CLAIM FOR DAMAGE IN SHIPMENT", and "RETURNING EQUIPMENT" information applies to equipment purchased directly from TDK-Lambda Americas Inc. End users receiving equipment from a third party should consult the appropriate service organization for assistance with these issues.

RETURNING EQUIPMENT

Before returning any equipment to the factory, the following steps shall be taken.

1. Notify TDK-Lambda Americas Inc. at (732) 795-4100 or follow the instructions at US.TDK-Lambda.com/HP/service.htm. Give a full description of the difficulty including the model and serial number of the unit in question. Upon receipt of this information, we will assign a Return Material Authorization (RMA) number and provide shipping instructions.
2. The customer shall prepay shipping charges. Equipment returned to us must be packed in a manner to reach us without damage. The shipping container must be marked with the RMA number in an area approximate to the shipping label with numbers that are easy to read. All returned units that do not show the RMA number on the outside of the container will be refused.

   If the equipment is repaired within the warranty agreement, than TDK-Lambda Americas Inc. shall pay for the return shipping to the customer.
3. For non-warranty repairs, we will submit a cost estimate for your approval prior to proceeding. The customer shall pay return shipping charges.

MECHANICAL INSTALLATION

Most power supplies are heavy and, when rack mounted, they should be supported by rails along the sides of the supply from front to rear. The rails must adequately support the unit and not block airflow. Do not support the power supply from the front panel only.

Table of Contents

1. GENERAL INFORMATION 1-1
1.1 INTRODUCTION 1-1
1.2 203 and 303 OVERVIEW 1-1
1.2.1 FEATURES 1-1
1.2.2 BENEFITS 1-1
1.2.3 APPLICATIONS: 1-1
1.3 CAPACITOR CHARGING TECHNOLOGY 1-2
1.4 CONTINUOUS DC OPERATION 1-2
1.5 ADDITIONAL FEATURES: 1-2
1.6 SAFETY PRECAUTIONS 1-3
1.7 SCOPE OF THIS MANUAL 1-4
1.8 MODEL NUMBER FORMAT 1-4

2. SPECIFICATIONS 2-7
2.1 Output Power 2-7
2.2 Polarity 2-7
2.3 H.V. Return 2-7
2.4 Pulse to Pulse Repeatability 2-7
2.5 Rep Rate 2-7
2.6 Protection 2-7
2.7 Input Power: 2-8
2.8 Phase Configuration 2-8
2.9 Power Factor 2-8
2.10 Efficiency 2-8
2.11 AC Line Filtering 2-8
2.12 Inrush Current 2-8
2.13 Max. Discharge 2-8
2.14 Physical Specifications 2-8
2.15 Cooling Water 2-8
2.16 Water Fittings 2-9
2.17 Weight 2-9
2.18 Shock and Vibration 2-9
2.19 Shipping 2-9
2.20 Air Temperature Range 2-9
2.21 Humidity 2-9
2.22 Altitude 2-9

3. OUT-OF-BOX-INSPECTION 3-11
3.1 VISUAL INSPECTION 3-11
3.2 ELECTRICAL INSPECTION 3-11
3.2.1 TEST 1 3-11
3.2.2 TEST 2 3-11
3.3 CONTACTING TDK-LAMBDA AMERICAS CUSTOMER SERVICE 3-12
3.4 RETURNING DEFECTIVE UNITS 3-12

4. INSTALLATION 4-13
4.1 19-INCH RACK MOUNTING 4-13
4.2 VENTILATION REQUIREMENTS 4-14
4.3 WATER COOLING REQUIREMENTS 4-14
4.4 ORIENTATION 4-14
4.5 AC POWER CONNECTION 4-15

4.6 CONNECTING THE HIGH VOLTAGE OUTPUT 4-16

5. CONTROLS, INDICATORS, CONNECTORS 5-1

5.1 FRONT PANEL LAYOUT (L Model) 5-1
5.2 HV ON (Ref 1) 5-2
5.3 OUTPUT STATUS LEDs (Ref 2) 5-2
5.3.1 HV ON LED 5-3
5.3.2 HV OFF LED 5-3
5.3.3 INHIBIT LED 5-3
5.3.4 END OF CHARGE LED 5-3
5.3.5 INTERLOCK OPEN LED 5-3
5.3.6 LOAD FAULT LED 5-3
5.3.7 OVERTEMP LED 5-3
5.4 LOCAL VOLTAGE CONTROL (Ref 3) 5-3
5.5 VOLTAGE BAR GRAPH (Ref 4) 5-4
5.6 VOLTAGE DISPLAY (Ref 5) 5-4
5.7 CURRENT DISPLAY (Ref 6) 5-4
5.8 HV OFF/RESET (Ref 7) 5-4
5.9 OFF/LOCAL/REMOTE KEYSWITCH (Ref 8) 5-4
5.10 POWER SUPPLY STATUS LEDs (Ref 9) 5-4
5.10.1 STATUS LED GROUP 5-4
5.10.1.1 ENABLE 5-4
5.10.1.2 INHIBIT 5-4
5.10.1.3 AUTOINHIBIT (Normally OFF) 5-5
5.10.1.4 SUMMARY FAULT (Normally OFF) 5-5
5.10.1.5 LOAD FAULT (Normally OFF) 5-5
5.10.1.6 LINE FAULT (Normally OFF) 5-5
5.10.2 HIGH VOLTAGE LED GROUP 5-5
5.10.2.1 HV ON 5-5
5.10.2.2 HV OFF 5-5
5.10.2.3 END OF CHARGE (Normally OFF) 5-5
5.10.2.4 EXCESS REVERSAL (Normally OFF) 5-6
5.10.2.5 INTERNAL ARC (Normally OFF) 5-6
5.10.2.6 CLAMP (Normally OFF) 5-6
5.10.3 COOLANT LED GROUP 5-6
5.10.3.1 FULL (Normally ON) 5-6
5.10.3.2 WARNING (Normally OFF) 5-6
5.10.4 FAULT (Normally OFF) 5-6
5.10.4.1 OVERTEMP (Normally OFF) 5-6
5.10.4.2 PURGE VALVE (Normally OFF) 5-7
5.10.4.3 OVER PRESSURE (Normally OFF) 5-7
5.10.5 INPUT POWER LED GROUP (External Faults) 5-7
5.10.5.1 HIGH LINE (Normally OFF) 5-7
5.10.5.2 LOW LINE (Normally OFF) 5-7
5.10.5.3 IMBALANCE (Normally OFF) 5-8
5.10.5.4 INTERLOCK OPEN (Normally OFF) 5-8
5.10.5.5 BIAS FAULT (Normally OFF) 5-8
5.10.5.6 FAN FAIL (Normally OFF) 5-8
5.11 VIEW SET push button (Ref 10) 5-8
5.12 CURRENT BAR GRAPH (Ref 11) 5-8
5.13 AC POWER (Ref 12) 5-8
5.14 FRONT PANEL LAYOUT (S Model) 5-10
5.15 REAR PANEL LAYOUT (L Models) 5-11
5.15.1 INHIBIT BNC (Ref 1) 5-12
5.15.2 Coolant Water Inlet/Outlet (Ref 2/4) 5-12
5.15.3 HV Output Connector 5-12

5.15.4 Cooling Fan 5-12
5.15.5 Interlock/Power On Terminal strip 5-12
5.15.6 Remote connector 5-12
5.15.7 Slave connector 5-12
5.15.8 Tank pressure gauge 5-13
5.15.9 Safety ground 5-13
5.15.10 AC input terminal 5-13
5.15.11 Coolant service valve 5-13
5.16 REAR PANEL LAYOUT (S Models) 5-13

6. OPTIONAL FEATURES 6-14
6.1 LOW ENABLE OPTION (-EN) 6-14
6.2 5V PROGRAMMING OPTION (-5V) 6-14
6.3 LATCHING OVERLOAD PROTECTION OPTION (-LP) 6-14
6.4 CONTINUOUS DC OPTION (-DC) 6-14
6.5 REMOTE SENSE (-RS) 6-15
6.6 CURRENT PROGRAMMING (-CP) 6-15
6.7 LONG CHARGE OPERATION (-LCA) 6-15

7. OPERATING INSTRUCTIONS 7-17
7.1 LOCAL OPERATION (203/303L only) 7-17
7.2 REMOTE OPERATION (All models) 7-18
7.2.1 Remote Control Signals 7-19
7.2.2 Remote Operation with AUTOINHIBIT 7-19
7.2.3 Remote Operation with INHIBIT 7-21
7.3 Parallel Operation 7-22
7.3.1 Parallel system comprising 203/303L supplies 7-22
7.3.2 Parallel system comprising both 203/303L and 203/303S supplies 7-23
7.3.3 Parallel system comprising 203/303S supplies 7-23

8. APPLICATION NOTES 8-25

List of Figures

FIGURE 4-1 203/303L FRONT VIEW 4-13
FIGURE 4-2 203/303 REAR VIEW 4-14
FIGURE 4-3. AC INPUT TERMINAL BLOCK 4-15
FIGURE 4-4 TYPICAL LOAD CIRCUIT CONNECTION 4-17
FIGURE 5-1. 203/303L FRONT PANEL CONTROLS AND INDICATORS 5-1
FIGURE 5-2 203/303S FRONT PANEL CONTROLS AND INDICATORS 5-10
FIGURE 5-3 203/303L REAR PANEL CONNECTIONS 5-11
FIGURE 5-4 203/303S REAR PANEL 5-13
FIGURE 7-1. EXTERNAL REMOTE INTERFACE CIRCUIT. 7-20
FIGURE 7-2 REMOTE INTERFACE WAVEFORMS FOR 303 OPERATED WITH AUTOINHIBIT 7-21
FIGURE 7-3 REMOTE INTERFACE WAVEFORMS FOR 303 OPERATED WITH INHIBIT 7-22
FIGURE 7-4 PARALLEL OPERATION CONNECTIONS 7-23

List of Tables

TABLE 1-1 MODEL DESCRIPTION FORMAT 1-5
TABLE 4-1 RECOMMENDED AC INPUT CABLE 4-16
TABLE 5-1 FRONT PANEL CONTROLS AND INDICATORS (L MODEL) 5-2
TABLE 5-3 FRONT PANEL CONTROLS AND INDICATORS (S MODEL) 5-10
TABLE 5-4 203/303L REAR PANEL FUNCTIONS 5-12
TABLE 6-1 203/303 REMOTE INTERFACE DESCRIPTION 7-19

1. GENERAL INFORMATION

1.1 INTRODUCTION

TDK-Lambda's ALE series 203 and 303 are state of the art switch mode high voltage power supplies, designed primarily for capacitor charging applications such as laser systems, modulators, and pulse forming networks. They can also be used in many continuous DC applications including beam power for magnetrons, gyrotrons, klystrons and electron beam loads.

The 203L and 303L Models are fully instrumented with front panel meters displaying output voltage and current, status LEDs, a key switch for OFF, LOCAL or REMOTE operation, HV ON/OFF push-button switches, and a control for output voltage adjustment. The rear panel features external interlock, external inhibit, remote control and slave (parallel operation) control connections.

The 203S and 303S Models can only be operated by remote control and feature only front panel status LEDs. The "S" Models have been designed to operate as a slave unit to the "L" Models or in systems where local control is not a requirement. As many 203 or 303 supplies as required, can be connected in parallel to provide greater output power.

1.2 203 and 303 OVERVIEW

1.2.1 FEATURES

- 203 - 20kJ/sec capacitor charging power, 30kW in continuous DC.
- 303 - 30kJ/sec capacitor charging power, 50kW in continuous DC.
- Output voltages from 0-1kV to 0-50kV.
- Rep rates from single shot to several hundred hertz.
- Local or remote operation (L Model) with comprehensive control interface.
- Parallel operation (master/slave) for high power applications.
- Water-cooling for major means of excess heat removal.
- State of the art "Heat Pipe Cooling" system.

1.2.2 BENEFITS

- Smallest package size available in this power range (50kW in 12.25" package).
- Highest power available in a single package.
- Low EMI/RFI.
- Low ambient heating and quiet operation.
- Lightweight switch mode design.
- Rack mount chassis configuration.
- Low stored energy provides greater safety.
- Immunity to external EMI.

1.2.3 APPLICATIONS:

- Charging capacitors and capacitor banks.
- Powering pulse forming networks/modulators.

- Powering lasers: Excimer, flashlamp pumped dye, Yag, CO_2, etc.
- Line type modulators for RF generation and pulse discharge applications in research.
- Continuous power for RF tubes – magnetron, gyrotron, TWT, klystron etc.
- Electron beam applications.
- DC power source for pulsed hard-tube and solid state modulators.

1.3 CAPACITOR CHARGING TECHNOLOGY

Capacitor charging applications require a power supply designed specifically for the task. The Series 203 and 303 supplies allow capacitors to be charged in pulse forming networks and modulators in a very fast, efficient and controllable manner.

The units are compact high power constant current sources that can linearly and rapidly charge a capacitive load to high voltage. Once the load capacitor is charged to the programmed voltage, the supply will switch over to a voltage regulation mode and maintain the load voltage at the programmed level until the load is discharged.

The flexible design of the 203 and 303 allow the units to be ordered with (L model) or without (S model) the front panel controls and meters. The front panel controls are ideal in applications where local control and readbacks are necessary, such as R&D, laboratory use and diagnostics. All front panel controls and indicator signals are available at the rear panel remote control connector regardless which front panel option (L or S) is selected. The S models feature only front panel status indicators and remote controls and are a cost effective solution for applications where local controls are unnecessary.

The unit is self-contained, requiring only AC power and water for cooling. Several units may be connected in parallel for higher power operation. There is no theoretical limit to the number of units that may be paralleled. Typically one master unit and one or more slave units may be used to obtain as much output power as necessary. **Consult the factory before connecting parallel units in continuous or DC applications.**

The 203 and 303 are also ideally suited to charge reservoir capacitors in resonant charging circuits where high rep rates (several kilohertz) are required, such as in metal vapor lasers or solid-state modulators.

1.4 CONTINUOUS DC OPERATION

Although the 203 and 303 series has been designed for capacitor charging applications, they can also be used as a continuous DC High Power Source for RF tubes such as klystrons, TWTs, or other DC loads such as DC-DC converters. The DC option must be specified when ordering, and the supply will be factory setup and tested with a continuous DC load. When 203/303 supplies are operated in continuous DC applications it is necessary to add an external capacitor between the load and ground to improve the ripple performance of the unit. Our online Application Note 505 describes operating capacitor charging supplies in DC applications, and gives guidance in determining the size of any additional external filter capacitance required.

App Note 505 can be found at:

http://us.tdk-lambda.com/hp/pdfs/application%20notes/93008505rC.pdf

1.5 ADDITIONAL FEATURES:

- Internal contactor and fuses for AC disconnect and protection.
- Standard AC power and control connectors.

- Documentation Manual Including -
  - Installation
  - Check out
  - Block diagram
  - Suggested remote interfaces and control circuits
- 10 ft (3m). output cable is standard, other lengths are optional.

NOTE: *This manual contains information, instructions and diagrams which apply to standard constructions. If special features or modifications have been installed, the instructions specific to that modification are contained in Addenda and take precedence if conflicts exist. Please take care to refer to the correct information for your unit.*

1.6 SAFETY PRECAUTIONS



All 203 and 303 power supplies are designed to minimize the risk of fire or shock hazard. This instrument received comprehensive mechanical and electrical inspection prior to shipment. Nevertheless, certain safety precautions must be observed. Only TECHNICALLY QUALIFIED SERVICE PERSONNEL familiar with the principles of electrical safety should operate this supply. The power supply SHOULD NOT BE EXPOSED TO WATER (EXCEPT COOLING CONNECTIONS) OR MOISTURE OR DUSTY ENVIRONMENTS. Electrical safety must be maintained at all times.

Lethal voltages are developed within the power supply's enclosure and at the output cable. Therefore, the cover may not be removed by the user (see Warranty in preamble section for variance). Also, the large capacitors in the supply may store power even after the AC input line is removed. ALLOW AT LEAST 40 SECONDS DISCHARGE TIME between removing the AC input line and opening the cover. ALSO, ALLOW AT LEAST 40 SECONDS between switching the AC power off and switching it on again.

1. This product is designed for Indoor use.
2. This product is designed for pollution degree 2.
3. This product is designed for Transient Overvoltage Category II.
4. Ensure all covers are in place and securely fastened before switching ON the AC power.
5. Proper grounding from the input AC power is required to reduce the risk of electric shock. Ensure that the AC Protective Earth Ground connection has at least the same gauge wire as the supply leads shown in Table 4-1.
6. Where high leakage exists and there is a warning label on the rear panel, the Protective Earth Ground must be connected. (Symbol for protective earth ground ⏚).
7. Use extreme caution when connecting AC input power, and never apply the incorrect input voltage, refer to ratings label.
8. Use extreme caution when connecting the high voltage output cable to the load.
9. Ensure all load capacitors are completely discharged prior to connection. Never handle the output cable when the power supply is operating.
10. Never attempt to operate the power supply in any manner not described in this manual.

11. Never remove DANGER and WARNING labels from the power supply. Replace lost or damaged labels immediately.
12. The power supply should only be serviced by TDK-Lambda Americas factory authorized personnel.
13. No user maintenance is required.
14. No cleaning is required.

1.7 SCOPE OF THIS MANUAL

This manual is used for installing and operating the 203 and 303 Series 2 Power Supply with a revised front panel layout shown in Figure 4-1. For older model 303 supplies refer to manual part number 83489009 which can be found on our web site. Suggestions and requirements for connecting AC power, load cables and signal cables are given. Various operating modes and programming modes are described.

1.8 MODEL NUMBER FORMAT

The model numbering system for the 203 and 303 Series power supply includes symbols for features and options. They are separated by dashes.

Examples are: 303L-10KV-POS-3P400 and 203S-20KV-POS-DC-3P480.

The 203 and 303 are available with two basic front panel configurations, the L, and S. The choice of panel configuration is dependent upon the installation and system requirements. See section 5 for further details.

Table 1-1 shows a partial listing of the model description format for the 203/303 Power Supply family. For additional options, the customer may contact the Sales Department at TDK-Lambda Americas. Special options are typically shown as a four-digit suffix to the model number.

203/303(model) - (voltage) - (polarity) - (mode) - (input) - (options)

Model (L, or S)

Output Voltage Range kV

POS or NEG Polarity

Mode		
Standard	Capacitor Charging	Blank
DC	Continuous DC Operation	DC

AC INPUT VOLTAGE(1)		
	Input	Suffix
480VAC	432-528 VAC, 50-60 Hz 3ϕ (88A Max)	3P480
400VAC Option	360-440 VAC, 50-60 Hz 3ϕ (100A Max)	3P400
208VAC Option	180-264 VAC, 50-60 Hz 3ϕ (95A Max)	3P208

OPTIONS	
5V Programming	5V
Low Enable	EN
Custom cable length	xxxx
Other options	xxxx

Note 1. For 203/303 models shipped prior to August, 2017 the input voltage values are listed on the model numbers as follows:

480VAC: Blank

400VAC: 400VAC

208VAC: 208VAC

Note 2. See Input power table specification section 4.5 for more details.

Table 1-1 Model Description Format

NOTES:

2. SPECIFICATIONS

2.1 Output Power

AC INPUT VOLTAGE	MODE	MAXIMUM OUTPUT POWER RATING	
		MODEL 203	MODEL 303
432-528 VAC, 50-60 Hz, 3ϕ	Cap Charging	20kJ/sec av, 25kJ/sec pk	30kJ/sec av, 37.5kJ/sec pk
	Continuous DC	30kW	50kW
360-440 VAC, 50-60 Hz, 3ϕ	Cap Charging	20kJ/sec av, 25kJ/sec pk	25kJ/sec av, 32.5kJ/sec pk
	Continuous DC	30kW	40kW
180-264 VAC, 50-60 Hz, 3ϕ	Cap Charging	20kJ/sec av, 25kJ/sec pk	Not Available
	Continuous DC	20kW	Not Available

2.2 Polarity

Fixed positive or negative (specify when ordering).

2.3 H.V. Return

Ground through H.V. output cable shield to chassis, and through separate safety ground cable.

2.4 Pulse to Pulse Repeatability

± 0.5% full load range and input voltage range into minimum capacitance (value dependent on minimum voltage range).

2.5 Rep Rate

Single shot to 200 Hz. Lower regulation for 200Hz to 1 kHz rates.

2.6 Protection

Open circuit at turn on

Output over voltage

Output short circuit

AC input power failure

AC input power out of range

Excess voltage

Over and under temp

2.7 Input Power:

AC INPUT VOLTAGE	MAXIMUM INPUT CURRENT (1)	
	MODEL 203	MODEL 303
432-528 VAC, 50-60 Hz, 3ϕ	40A/Phase (Cap charging)	60A/Phase (Cap charging)
	60A/Phase (Continuous DC)	98A/Phase (Continuous DC)
360-440 VAC, 50-60 Hz, 3ϕ	47A/Phase (Cap charging)	71A/Phase (Cap charging)
	71A/Phase (Continuous DC)	94A/Phase (Continuous DC)
180-264 VAC, 50-60 Hz, 3ϕ	94A/Phase (Cap charging)	Not Available
	94A/Phase (Continuous DC)	Not Available

Note (1): Refer to section 2.1 for output power rating.

2.8 Phase Configuration

Wye or Delta, any rotation, separate ground.

2.9 Power Factor

0.9 at full load and nominal AC line.

2.10 Efficiency

85% at full load and nominal AC line.

2.11 AC Line Filtering

Passive power factor correction and EMI filters included.

2.12 Inrush Current

Limited to below full power level.

2.13 Max. Discharge

15 seconds to safe output level at output cable without external load consideration.

2.14 Physical Specifications

Size: 19" (483 mm) Rackmount standard front panel
17" (432 mm) chassis width
12.25" (311 mm) High
22" (559 mm) Deep + 5" (127 mm) for cables

2.15 Cooling Water

Maximum exit temperature for cooling water at approximately 2.0 US gpm (7.6 L/min) is 35°C Minimum exit temperature for cooling water at approximately 2.0 US gpm (7.6 L/min) is 15°C (Higher temperature water requires greater flow). All water paths are at ground potential and are copper or brass.

2.16 Water Fittings

1/4 inch NPT male threaded pipes.

2.17 Weight

190 lbs. (86.4 kg) approx.

2.18 Shock and Vibration

Unboxed 0.5 g.
Factory packing 2.0 g.

2.19 Shipping

Gross weight with packing material: 305 lbs. (140 kg) approx.
Size: 27"W X 21" H X 30"D (686 mm X 535 mm X 762 mm).

2.20 Air Temperature Range

Operating:	0°C to 55°C ambient air
Storage:	-55°C to 70°C

2.21 Humidity

Operating:	0% to 90% (Non-condensing)
Storage:	0% to 90%

2.22 Altitude

Operating:	12,000 ft. (3658 m)
Storage:	30,000 ft. (9144 m) at 25°C or less

NOTES:

3. OUT-OF-BOX-INSPECTION

3.1 VISUAL INSPECTION

Prior to shipment, this instrument was inspected and found to be free of mechanical and electrical defects. As soon as the unit is unpacked, inspect for any damage that may have occurred in transit. Verify the following:

A. Check the operation of the front panel control (knob should rotate smoothly).

B. Confirm that there are no dents or scratches on the panel surfaces.

C. Check front panel meters and LEDs for any broken or cracked lenses.

If any damage is found, follow the instructions in Section 3.3 and in the "Returning Equipment" instructions in the preamble section of this manual.

3.2 ELECTRICAL INSPECTION

Before the power supply is installed in a system, verify that no internal damage occurred during shipping. A simple preliminary electrical test should be performed. These tests are described below. **Note:** The sequences described are for L models, for S models the corresponding signals must be applied and monitored through the remote control interface.

3.2.1 TEST 1

Purpose: Verify general logic operation and generate maximum output current and check overload protection circuits. With AC power "OFF" and disconnected, short the H.V. output by connecting the center conductor of the output cable to its return shield (braid). This dead short will allow the unit to generate full output current at zero voltage.

1. Set the output voltage control to zero. Connect the AC power to the unit. Turn "ON" the AC power front panel switch.
2. Turn the front panel keyswitch to the LOCAL position (if applicable). Press the H.V. "ON" button and turn up the H.V. control until the power supply is generating output current into the dead short. The current meter will indicate max. current. The voltage meter will read zero and the power supply will intermittently turn on and off indicating the "overload" condition. The unit should continue to cycle in this mode with a 1 sec. repetition rate indefinitely. (The power supply will go into overload when max. current is drawn for more than half a second).
3. Turn off the H.V. and A.C. power switches.

This test indicates the inverter section is generating maximum current and the logic and overload circuitry works correctly.

3.2.2 TEST 2

Purpose: Verify that the power supply generates maximum rated voltage, and the regulation and feedback circuits are functioning.

1. With AC power OFF and disconnected, connect an appropriate load capacitor to the power supply output cable.
2. Prepare to charge the capacitor. NOTE: Operating a 203 or 303 power supply into an open circuit (no load operation) will instantly damage the power supply's H.V. output diodes. Make sure the load (capacitor) is connected and the H.V. output cable is securely inserted and connected.

3. For L models turn the voltage control on the front panel turned all the way down to zero (counter clockwise), apply AC power and press the HV ON button. By turning up the H.V. control knob the capacitor will charge to the voltage indicated on the front panel voltmeter. The power supply may be turned all the way up to its max. output voltage provided the load capacitor is sufficiently rated.
4. By turning the voltage control down or depressing the H.V. OFF button, the capacitor will "bleed" down through the internal voltage divider resistors used for regulation feedback.

Test #2 indicates the H.V. section is working correctly. Tests 1 and 2 generally indicate the unit is functioning as designed. Although 100% power had not been generated, these two tests give greater than 90% confidence that the unit is not damaged.

If any inconsistency from the above test procedure is noted, do not hesitate to call TDK-Lambda Americas Customer Service for assistance.

The supply and the coolant filled HV assembly should not be opened unless advised by TDK-Lambda Americas personnel. The coolant filled HV tank has been cleaned and the hermetically sealed at the factory, opening the supply or the assembly will void the factory warranty, and may compromise performance.

3.3 CONTACTING TDK-LAMBDA AMERICAS CUSTOMER SERVICE

When contacting customer service locate the product description, part number and serial number from the label located on the rear of the unit, and have this information available.

Phone: (732) 795-4100 E-mail: hp.service@us.tdk-lambda.com

Fax: (732) 922-1441

Customer Service, or an approved Service Center, should be contacted if:

- The power supply is mechanically or electrically damaged.
- The power supply requires on-site calibration, or replacement warning decals.
- The customer has questions about a special application that is not described in this manual.

Normally, the customer may *NOT* open any chassis covers that have a warranty seal. Breaking a seal will void the warranty.

At the discretion of TDK-Lambda Americas, the customer may be granted permission to break the warranty seal and open the chassis covers. Customer Service shall confirm the permission by sending a replacement seal. Once the unit has been serviced, the customer shall close the cover and apply the replacement seal adjacent to (not on top of) the broken seal.

3.4 RETURNING DEFECTIVE UNITS

The procedure for returning defective products is given in section 3.3 of this manual.

4. INSTALLATION

4.1 19-INCH RACK MOUNTING

This power supply is intended for mounting in a conventional 19-inch rack. It's 12.25 inch height makes it a "7U" size instrument. The rack should enclose the sides, top and back to protect the operator from electrical shock and protect the supply from environmental contamination.

Never install the 203 or 303 so only the front panel screws support its weight!

The 203/303 must never be installed without support in the back or sides of the unit. The 203/303 should be mounted on heavy-duty chassis slides –such as General Devices CTS-124- or on a suitable shelf or supports inside the rack.

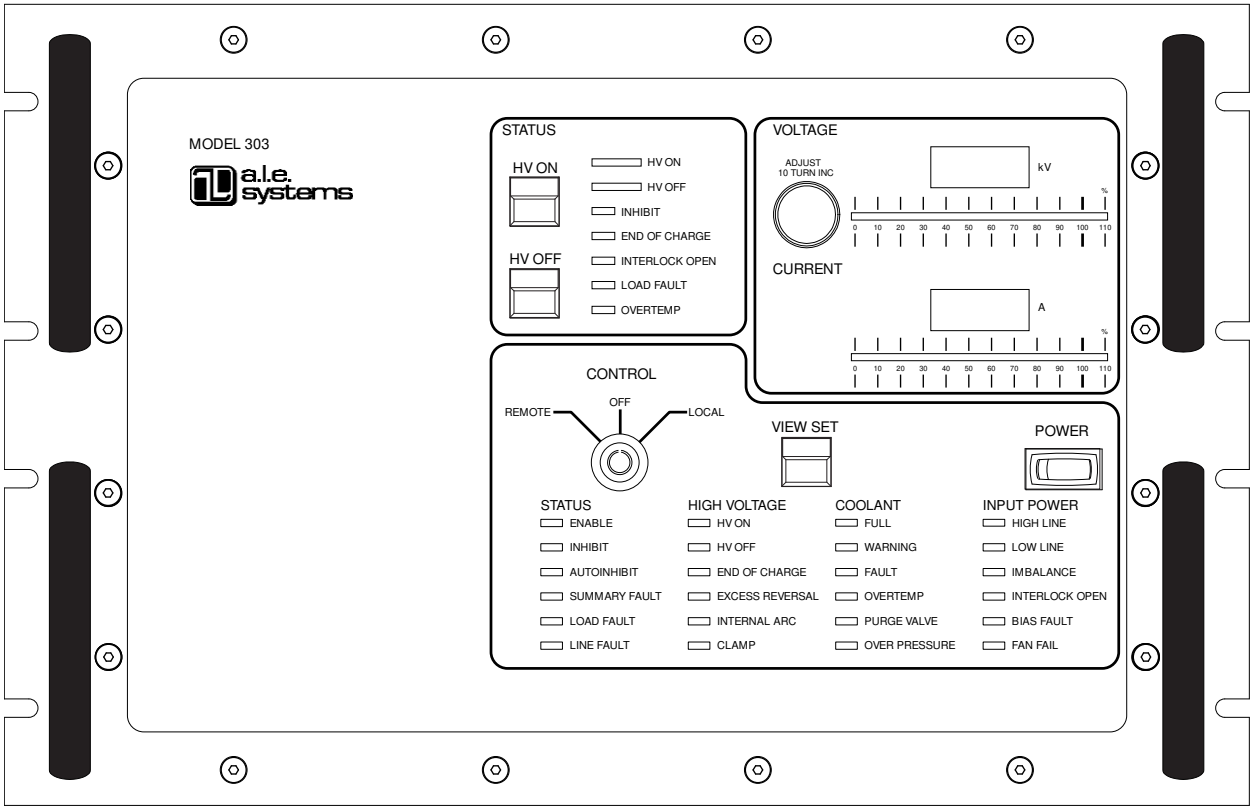


Figure 4-1 203/303L Front View

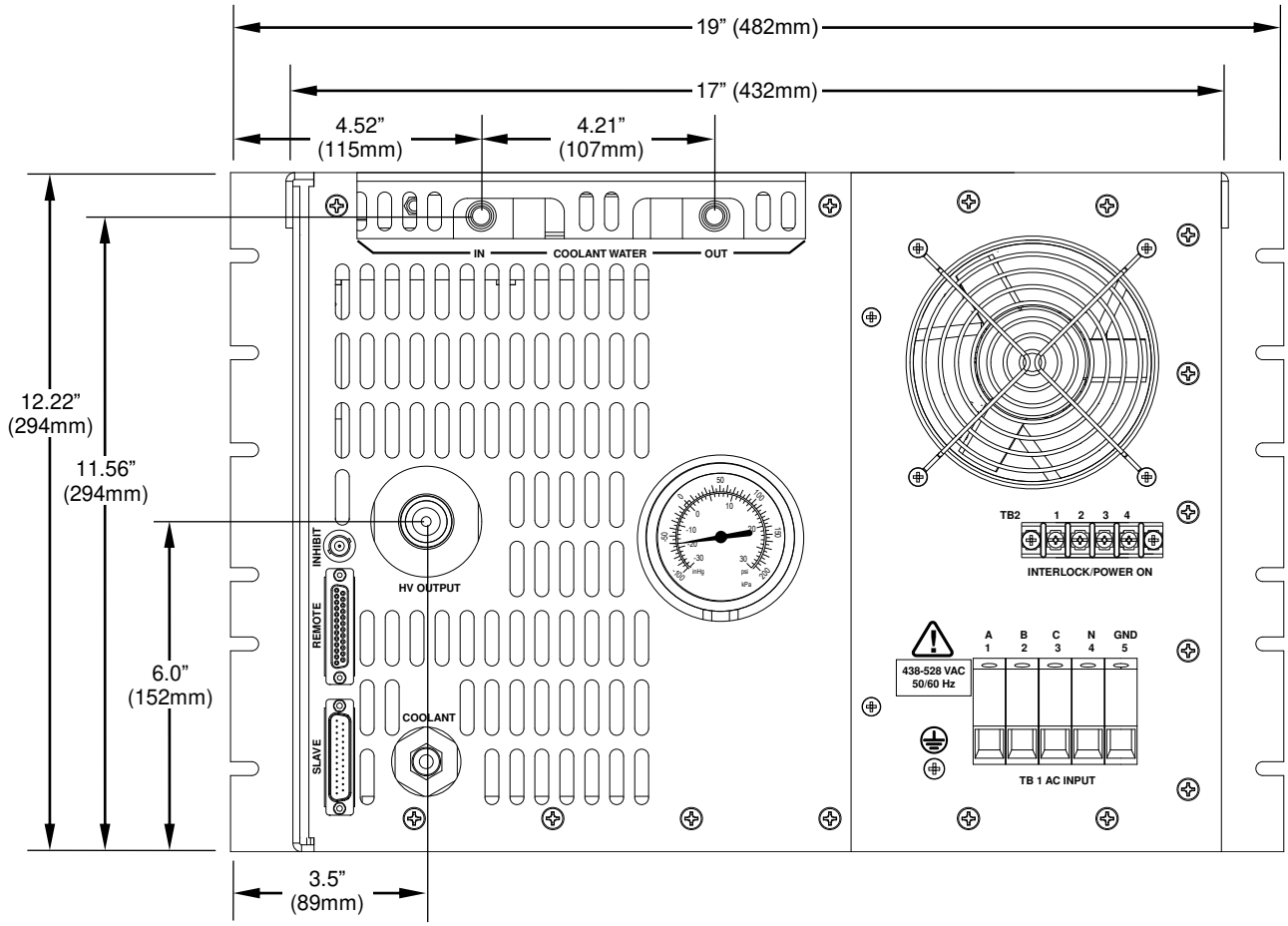


Figure 4-2 203/303 Rear View

4.2 VENTILATION REQUIREMENTS

Ensure there is at least 5 inches (12.5 cm) of clearance at the rear of the unit for airflow, cables and water lines. If the power supply is to be installed in an enclosed system, care must be taken to ensure the ambient inlet air to the power supply does not exceed the maximum operating temperature of 55°C.

4.3 WATER COOLING REQUIREMENTS

Water with a flow rate at 2 US gallons per minute (7.6litres/min) having an exit temperature of 15 to 35°C is required to cool the instrument. This is required to maintain the allowable tank temperature range of 15 to 48°C. Chilled water should not be used. (⚠ - If the supply is to be stored at temperatures below 4°C, the user should ensure all water is blown out of the coolant pipes).

4.4 ORIENTATION

The power supply must be operated in a level horizontal orientation. More than a quarter of an inch (6.25mm) difference in height in any direction could potentially cause an arcing condition and/or coolant fault in the high voltage tank and should be avoided.

4.5 AC POWER CONNECTION

The maximum voltage allowed between any two AC input terminals is 550VAC. If this voltage is exceeded, catastrophic damage will result, that is not covered by TDK-Lambda Americas standard warranty.

The customer's AC power line connects to the 203/303 via a UL/CSA approved 5 position terminal block on the rear panel of the unit (see Figure 4-3). Only use a power cable with the correct voltage and current rating (see Table 4-1). The ground wire must be equal to or larger than the recommended gauge. Proper grounding from the input AC power is required to reduce the risk of electric shock. The metal chassis of the power supply is grounded through the earth wire at the input AC power terminal block. Use extreme caution when connecting input AC power and never apply the incorrect input power.

The Protective Earth Ground ⏚ must be connected before applying AC Line Power to the 203/303.

Connect the three lines of the input power to the L1, L2, L3 terminals and the earth ground to the terminal marked with the ground symbol (⏚). No neutral connection is required for the 480, 400, or 208VAC configuration. The power connections are not phase rotation sensitive, so any phase can be connected to any of the AC inputs. The recommended torque for the AC input terminals is 35in-lb.

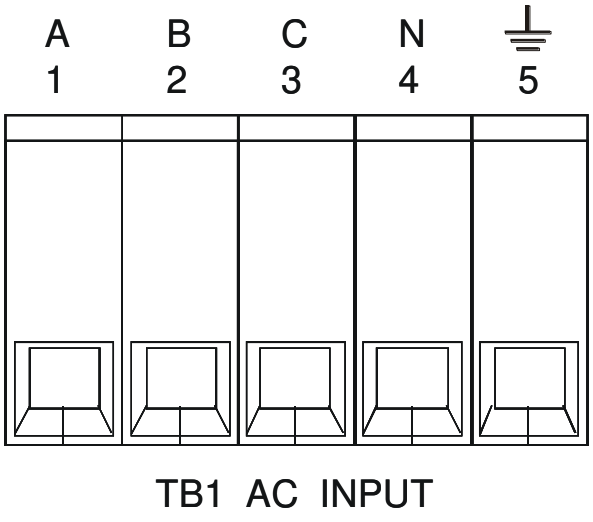


Figure 4-3. AC Input Terminal Block

AC INPUT VOLTAGE	MODE	RECCOMENDED AC INPUT CABLE SIZE	
		MODEL 203	MODEL 303
432-528 VAC, 50-60 Hz, 3ϕ	Cap Charging	5 AWG	4 AWG
	Continuous DC	4 AWG	3 AWG
360-440 VAC, 50-60 Hz, 3ϕ	Cap Charging	5 AWG	4 AWG
	Continuous DC	4 AWG	3 AWG
180-264 VAC, 50-60 Hz, 3ϕ	Cap Charging	3 AWG	Not Available
	Continuous DC	3 AWG	Not Available

Table 4-1 Recommended AC Input Cable

The AC input rating is marked on the rear terminal of the power supply. The rating is also part of the unit's model description shown in Table 1-1.

4.6 CONNECTING THE HIGH VOLTAGE OUTPUT

Voltage reversal at the output of this power supply can potentially cause damage to the high voltage section if reverse current is not limited. Refer to Application Note 517 (available from the factory or at us.tdk-lambda.com/hp) for more information.



Ensure that the power supply is off and disconnected from the AC input power and that all load capacitors are discharged and shorted to ground before making any connections. Never handle the HV cable while the supply is operating. Never operate the supply without a load capacitor connected.

Always use the HV connector and cable provided with the power supply or an equivalent substitute provided by TDK-Lambda Americas. Fully insert the connector end of the HV cable and tighten the locking nut only "hand tight".

When operating above 20kV or 200Hz rep rate a silicone grease (such as Dow Corning DC-4) must be applied to the HV cable before insertion into the HV connector. The grease is used to displace air in the connector and reduce long-term corona effects. A cable greasing procedure is available for download from the TDK-Lambda Americas web site.

The load ground must be connected to the chassis ground through a separate safety ground cable with a suggested minimum wire size of 6 AWG in addition to the H.V. output cable shield (see Figure 4-4).

Some peak current will flow out of the power supply during discharge and return through the HV return and system chassis. This current comes from voltage reversal in under-

damped systems and from normal discharge of filter and cable capacitance. The path for this current should not parallel control signal returns since the resulting voltages could interfere with normal system operation.

Currents due to voltage reversal at high rep. rates could damage the power supply. Generally, a resistor in series with the HV output can be added to limit this current to an acceptable level. Refer to Application Note 517 (available from the factory or at us.tdk-lambda.com/hp) for more information.

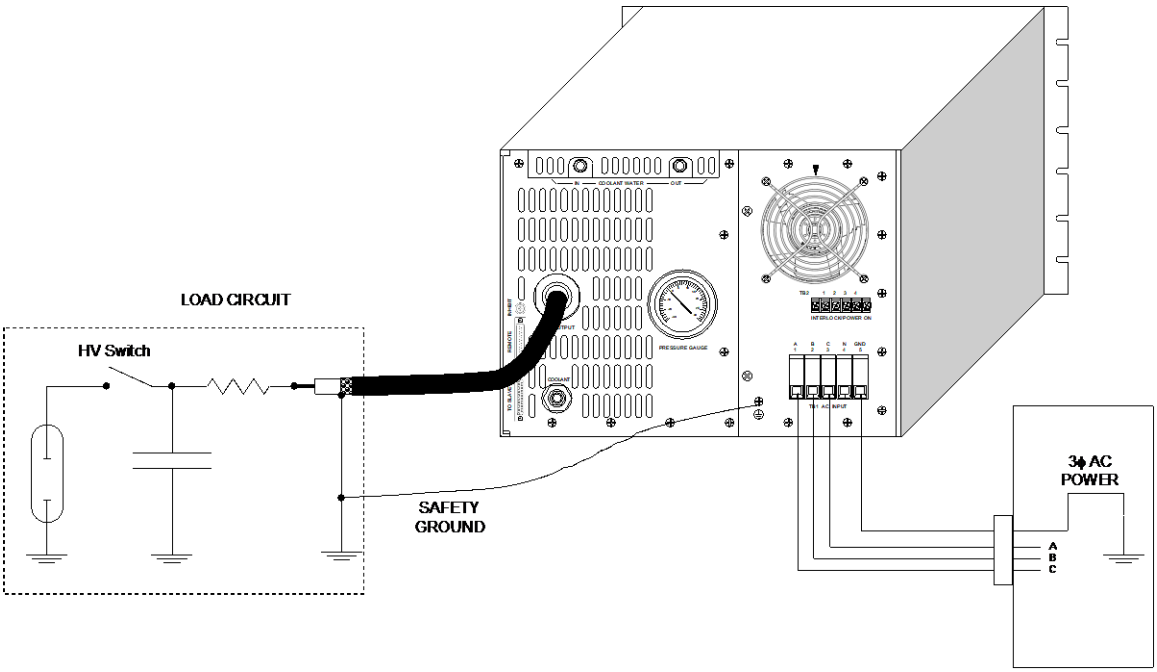


Figure 4-4 Typical Load Circuit Connection

Dress the high voltage cable creating a gentle curve making sure there are no sharp bends as this will tend to reduce the cable's insulation strength. Strain relieve the load end of the high voltage cable to prevent breaking of the center conductor. Keep the HV cables as distant as possible from the input power and the control signals.

To connect the HV cable to the load it is necessary to remove the cable jacket, shield, and any semiconducting layer that remains on the cable insulation after removing the shield.

The cable outer jacket should be removed to reveal the cable shield. At least 12” or 300mm of outer jacket should be removed for suitable voltage hold-off. The exposed shield should be trimmed to an appropriate length and terminated with a ground connection. With the shield removed, the black semiconducting layer is exposed. This layer should be very carefully removed using a sharp craft knife, and a peeling action. Once the semiconducting layer is removed the exposed EPR insulation should be cleaned with IPA or an equivalent solvent. If any of the semiconducting layer remains on the HV cable insulation it may cause the cable termination to fail.

NOTES:

5. CONTROLS, INDICATORS, CONNECTORS

5.1 FRONT PANEL LAYOUT (L Model)

The 203/303L series power supply is equipped with a fully instrumented front panel featuring output voltage control, voltage and current metering, and comprehensive status LEDs, along with local/remote mode keyswitch, and power on switch. The 203/303L can be operated locally from the front panel or remotely via the control connector located on the rear panel (see Section 7.2).

Figure 5-1 below shows the front panel layout of the 203/303L power supply.

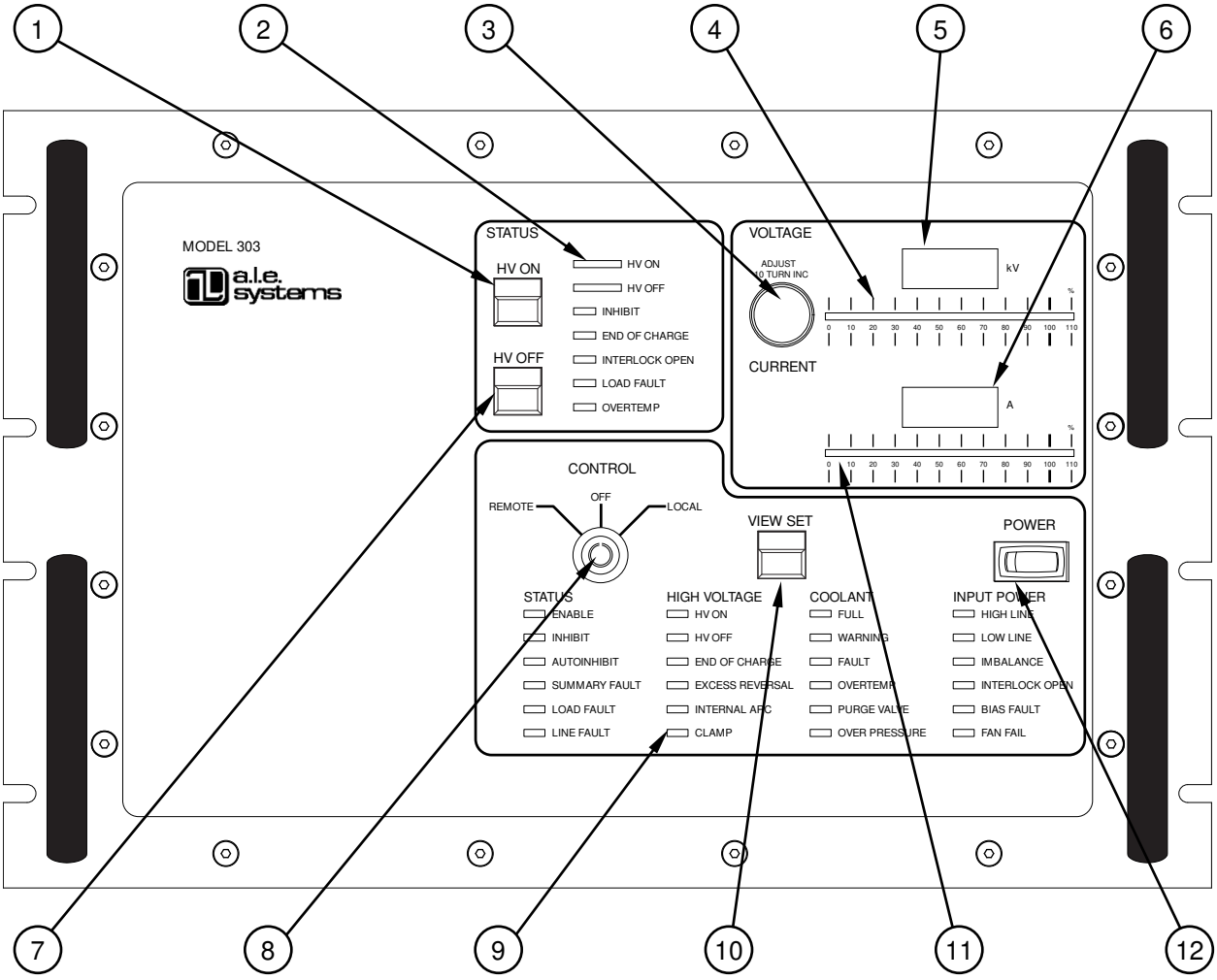


Figure 5-1. 203/303L Front Panel Controls and Indicators

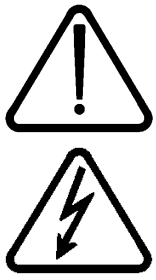
The function of each numbered item is outlined in Table 5-1

REF	DESCRIPTION	NOTE	SECTION
1	HV ON Push Button	Turns ON HV output	5.2
2	Output Status	Output Status LEDs	5.3
3	Local Voltage Set	10 turn pot for setting output voltage in local mode	5.4
4	Voltage Bar Graph	Analog bar graph showing output voltage (%)	5.5
5	Voltage Display	Digital display of output or set voltage	5.6
6	Current Display	Digital display of average output current	5.7
7	HV OFF Push Button	Turns OFF HV output and resets latching faults	5.8
8	Local/Remote Keyswitch	Switches control between remote, local, and off modes	5.9
9	Status LEDs	Detailed status LED displaying showing operating condition and any faults	5.10
10	View set push button	Push to view the output voltage set point in local mode	5.11
11	Current Bar Graph	Analog bar graph showing output current (%)	5.12
12	Power switch	Turns on/off power to auxiliary circuits	5.13

Table 5-1 Front Panel Controls and Indicators (L Model)

The front panel controls/indicators are described in detail in the following sections.

5.2 HV ON (Ref 1)



DO NOT DEPRESS THE HV ON PUSH-BUTTON UNLESS A SUITABLE CAPACITIVE LOAD IS CONNECTED TO THE POWER SUPPLY'S OUTPUT CABLE, AND THE LOAD IS CORRECTLY GROUNDED.

The HV ON push button turns ON the high voltage output when depressed only after all interlocks are closed, self checks are completed and the unit is switched to the LOCAL mode. HIGH VOLTAGE will be generated immediately when the HV ON is depressed and the HV ON LED will illuminate and remain illuminated while the HV is ON. The supply will charge the load to the voltage determined by the HV LEVEL ADJUST 10 turn pot. It is good practice to turn the LOCAL VOLTAGE CONTROL pot fully counterclockwise (to zero) before pushing the HV ON button when first using this power supply. Later on during system usage, the LOCAL VOLTAGE CONTROL may be left set at the desired level.

If a fault is present when the HV ON push-button is depressed, the SUMMARY FAULT LED will illuminate.

5.3 OUTPUT STATUS LEDs (Ref 2)

There are 6 output status LEDs on the front panel, indicating the state of the HV Output circuit and some of the fault detection circuits in the control system.

5.3.1 HV ON LED

The HV ON LED indicates that the HV output circuit is enabled and the supply will deliver output current if it is not inhibited by an external inhibit input. HV ON LED is active in local and remote modes.

5.3.2 HV OFF LED

The HV OFF LED indicates that the HV output circuit is disabled and the supply cannot deliver output current. HV OFF LED is active in local and remote modes.

5.3.3 INHIBIT LED

If the Inhibit LED is illuminated it indicates the presence of an active inhibit signal, and the supply will not deliver charging current after the HV ON button is pushed. Inhibit is applied either via the rear panel mounted BNC connector or via the remote control connector, do not use both inputs at the same time. Inhibit LED is active in local and remote modes.

5.3.4 END OF CHARGE LED

The END OF CHARGE indicator will illuminate when the load capacitor is charged to the programmed output voltage. The END OF CHARGE indicator will be extinguished when the high voltage is OFF or during load charging. END OF CHARGE may illuminate if the output voltage is programmed to zero.

5.3.5 INTERLOCK OPEN LED

The INTERLOCK OPEN LED illuminates if the safety interlock circuit is not closed. The power supply cannot be turned on if the interlock loop is open. If the interlock loop is opened when the unit is running (ie when HV in ON), the unit will turn off with a latching fault, requiring an HV ON/OFF reset cycle before it can be restarted. Interlock Open LED is active in local and remote modes.

5.3.6 LOAD FAULT LED

The LOAD FAULT LED indicates the presence of a fault in the load circuit due to a short circuit or large external capacitor. LOAD FAULT is activated if the charge voltage does not meet the programmed voltage within 500milliseconds. The fault automatically clears and the unit will restart charging after a further 500milliseconds unless the Latching Protection (LP) option is specified. Load Fault LED is active in local and remote modes.

5.3.7 OVERTEMP LED

The OVERTEMP LED indicates an overtemperature condition internal to the supply. The temp fault will clear once the temperature is below the fault threshold, but the unit will not restart without a reset cycle. Overtemp LED is active in local and remote modes.

5.4 LOCAL VOLTAGE CONTROL (Ref 3)

The LOCAL VOLTAGE CONTROL is a 10 turn potentiometer that adjusts the output voltage between zero and 100% of rated voltage. The set point can be viewed on the VOLTAGE DISPLAY by pushing the VIEW SET button. The output voltage can be set at the desired level by turning the control to the required output voltage before depressing the HV ON push button. It is good practice to turn the control fully counter clockwise after operating the supply. The local voltage control has no effect when the supply is operate in remote mode.

5.5 VOLTAGE BAR GRAPH (Ref 4)

The voltage bar graph is a 'quick view' analog percentage indication of the voltage measured at the power supply output. Bar graph is active in local and remote modes.

5.6 VOLTAGE DISPLAY (Ref 5)

The Voltage Display is a 4 digit LED indicator showing the voltage measured at the power supply output. This display momentarily shows the output program voltage after the View Set button is depressed. Voltage Display is active in local and remote modes.

5.7 CURRENT DISPLAY (Ref 6)

The Current Display is a 4 digit LED indicator showing the average current delivered by the power supply output. Current display is active in local and remote modes.

5.8 HV OFF/RESET (Ref 7)

The HV OFF push button is a momentary switch that when depressed turns off HV output. If the power supply shuts off with a summary fault (indicated by SUMMART FAULT LED illuminating), then this condition can be reset by pushing the HV OFF button. If the supply is operated in remote mode the HV OFF push button will still function.

5.9 OFF/LOCAL/REMOTE KEYSWITCH (Ref 8)



DO NOT MOVE THE KEYSWITCH POSITION FROM OFF TO LOCAL OR REMOTE UNLESS A SUITABLE CAPACITIVE LOAD IS CONNECTED TO THE POWER SUPPLY'S OUTPUT CABLE, AND THE LOAD IS CORRECTLY GROUNDED.

The OFF/LOCA/REMOTE Keyswitch switches the power supply operating modes between OFF, LOCAL, and REMOTE. The key can be removed in the OFF position to prevent unauthorized use. If the switch is in the LOCAL position the supply will operate from the front panel. In the REMOTE position the supply can only be operated via the remote control interface. An L model supply can simulate an S model with the key in the REMOTE position.

5.10 POWER SUPPLY STATUS LEDs (Ref 9)

There are four distinct sets of status LEDs on the 203/303L/S front panel. Each group indicates the status of a specific section of the power supply.

5.10.1 STATUS LED GROUP

5.10.1.1 ENABLE

Indicates the HV output circuitry is Enabled and HV may be present at the power supply output.

5.10.1.2 INHIBIT

The INHIBIT indicator displays the logical OR of all the internal and external signals that prevent HV output current, including EOC, AUTOINHIBIT, EXTERNAL INHIBIT, OVERLOAD, and any fault. If the INHIBIT indicator is OFF and the unit is not delivering charge current, there is an internal power supply failure that may require servicing by authorized service personnel. If an inhibit signal (HIGH) is applied at the rear panel BNC connector, the INHIBIT indicator will illuminate and output current cannot be delivered.

5.10.1.3 AUTOINHIBIT (Normally OFF)

The AUTOINHIBIT feature shuts OFF or inhibits the output current when the capacitive load is discharged. This feature allows the HV switch in the external load circuit (if applicable) to better recover after a load switching event.

The AUTOINHIBIT feature overcomes the need for the external inhibit signal in most cases. The AUTOINHIBIT circuit automatically creates an internal inhibit of approximately 1ms after the circuit detects high dv/dt at the output. The AUTOINHIBIT function will only work if the output voltage falls by approximated 30% of the rated voltage of the unit. The AUTOINHIBIT period can be programmed via a 0-10 VDC signal applied to the AUTOINHIBIT input on the rear panel remote interface connector. 0V input gives an AUTOINHIBIT period of approximately 500μs, 10V gives an AUTOINHIBIT period of 10ms.

5.10.1.4 SUMMARY FAULT (Normally OFF)

SUMMARY FAULT LED indicates any internal or external fault condition that prevents the power supply from operating. This condition can be cleared by pushing the HV OFF button to reset the fault.

5.10.1.5 LOAD FAULT (Normally OFF)

The LOAD FAULT LED indicates the presence of a fault in the load circuit due to a short circuit or large external capacitor. LOAD FAULT is activated if the charge voltage does not meet the programmed voltage within 500milliseconds. The fault automatically clears and the unit will restart charging after a further 500milliseconds unless the Latching Protection (LP) option is specified. Load Fault LED is active in local and remote modes.

5.10.1.6 LINE FAULT (Normally OFF)

The LINE FAULT LED illuminates when an input power fault occurs. The LINE FAULT indicator will remain ON (latch ON) after the specific external fault condition detected has cleared (the specific indicator goes OFF). The LINE FAULT LED will turn off the power supply output and under certain conditions will open the main AC power contactor. The LINE FAULT indicator may be reset by depressing the HV OFF push-button on the front panel.

5.10.2 HIGH VOLTAGE LED GROUP

5.10.2.1 HV ON

The HV ON LED indicates that the HV output circuit is enabled and the supply will deliver output current if it is not inhibited by an external inhibit input. HV ON LED is active in local and remote modes.

5.10.2.2 HV OFF

The HV OFF LED indicates that the HV output circuit is disabled and the supply cannot deliver output current. HV OFF LED is active in local and remote modes.

5.10.2.3 END OF CHARGE (Normally OFF)

The END OF CHARGE indicator will illuminate when the load capacitor is charged to the programmed output voltage. The END OF CHARGE indicator will be extinguished when the high voltage is OFF or during load charging. END OF CHARGE may illuminate if the output voltage is programmed to zero.

5.10.2.4 EXCESS REVERSAL (Normally OFF)

This indicator will illuminate if excess voltage reversal is detected at the HV output. A large reversal would cause damage to the power supply by drawing too much current through the output diode rectifiers. While the EXCESS REVERSAL sense circuit does not directly protect the diodes, it will stop the power supply from continuing to run in the case where reversal may be building up and could cause damage if left unchecked.

This protection circuit will reset automatically after three (3) seconds and restart the power supply. Repeated operation of this circuit indicates the presence of a persistent problem that must be corrected by some form of protection, clipper circuit or series resistor. Refer to Application Note 517 (available from the factory or at us.tdk-lambda.com/hp) for more information.

5.10.2.5 INTERNAL ARC (Normally OFF)

When illuminated, the INTERNAL ARC indicator signals a major fault internal to the high voltage tank of the power supply. This type of fault may be reset if the POWER is cycled; however, if it recurs, the unit should not be used any further because the output may be uncontrolled if present and could cause further damage to the supply or its load. The power supply should then be serviced by qualified personnel.

5.10.2.6 CLAMP (Normally OFF)

The CLAMP indicator illuminates when an overvoltage condition is detected on the output. The CLAMP indicator will also illuminate if the unit is being programmed to a higher voltage than it is rated for. The power supply will turn OFF the high voltage output (inhibited) and may be reset by depressing the HV OFF push-button on the front panel when the overvoltage condition is no longer present.

5.10.3 COOLANT LED GROUP

In the event of any coolant faults the user should verify installation orientation is in accordance with Section 4.4 prior to contacting TDK-Lambda Americas.

5.10.3.1 FULL (Normally ON)

When illuminated, this indicator signals that the high voltage tank in filled to the correct level with coolant. This indicator may be extinguished if the unit is cold.

5.10.3.2 WARNING (Normally OFF)

This indicator will FLASH if the coolant drops below its safe operation level, indicating that the coolant may be leaking (there are no environmental or safety hazards from this coolant leaking. It will evaporate before it collects). The unit should be serviced if the coolant is low.

5.10.4 FAULT (Normally OFF)

The FAULT indicator when illuminated indicates the coolant level is below the allowable level to safely operate the power supply. The FAULT indicator will turn OFF the high voltage output and it cannot be reset until the coolant level is corrected. The unit must be serviced by authorized service personnel.

5.10.4.1 OVERTEMP (Normally OFF)

The OVER TEMP LED Illuminates if the HV tank temperature is outside of its operating limits. The fixed operating limits have minimum low temperature and a maximum high temperature. When illuminated, the TEMP indicator will turn OFF the high voltage out-

put. When the internal temperature returns to a normal level, the output may be switched back on.

The Cooling fluid has a wide operating temperature range and is controlled and stabilized by the cooling water flowing through the high voltage tank. The maximum allowable tank temperature is 70°C, and the minimum is 15°C.

This temperature range can be maintained by running normal tap water through the power module at a rate of 2 gallons per minute (7.58 L/min). Chilled water should not be used, it can cause the lower operating temperature limit to be reached, as well as causing condensation to form which should always be avoided. Condensation in the power module could cause damage and the warranty will be void.

5.10.4.2 PURGE VALVE (Normally OFF)

The PURGE indicator illuminates when the purge valve opens. The STP vapor pressure of the coolant used in the High Voltage tank is below atmospheric pressure, hence a small leak in this enclosure will cause outside air to leak in. The coolant vapor is much heavier than air so this remains at the top of the tank. The effect of this air is to increase the temperature of the top of the liquid relative to the bottom. This temperature difference is sensed by the power supply control circuits and if out of range a valve is opened to allow purging of the air from the top of the sealed assembly. There is a check value in line with this value so flow will only occur when the HV tank internal pressure is above prevailing atmospheric pressure. Purging will continue until the correct temperature difference is established and then the valve closes. To cause the internal pressure to be above atmospheric the supply must be running hot enough to raise the internal pressure above atmospheric which at the recommended flows and temperatures may require reducing or temporarily stopping the water flow. It may take several purge cycles for this condition to fully correct itself.

5.10.4.3 OVER PRESSURE (Normally OFF)

It indicates the presence of an OVER PRESSURE condition in the HV tank. Can be reset by depressing the HV OFF button, after the condition has cleared. Repeated OVER PRESSURE faults are an indication of a problem in the HV tank. Contact the factory for service.

5.10.5 INPUT POWER LED GROUP (External Faults)

5.10.5.1 HIGH LINE (Normally OFF)

The HIGH LINE LED illuminates when the external AC input voltage is above the maximum limit (typically 10% above nominal). Damage can result if the AC input exceeds the rating and so the supply disconnects itself from the line by opening the contactor.

When the HIGH LINE condition is removed the indicator extinguishes and the power supply can be reset by operating the HV OFF push-button.

5.10.5.2 LOW LINE (Normally OFF)

The LOW LINE LED will illuminate if the AC input voltage drops below approximately 85% of the nominal nameplate level. The power supply will continue to deliver output current unless the AC input voltage dip is too great (either low voltage or for a long time). The power supply will shut down the output until the AC line is restored. The line fault resets the power supply automatically.

5.10.5.3 IMBALANCE (Normally OFF)

The IMBALANCE LED illuminates if an internal power imbalance occurs, which could happen under abnormal power conditions. The fault will automatically reset when the condition corrects itself.

The AC contactor is opened and the FAULT indicator is illuminated which may be reset using the push-button after the IMBALANCE LED extinguishes. This does not indicate an AC line to line imbalance.

5.10.5.4 INTERLOCK OPEN (Normally OFF)

INTERLOCK OPEN illuminates when the interlock loop on rear panel is opened. If the interlock is opened while the supply is operating, the main AC line contactor will be opened, disconnecting AC power from the HV circuitry. The INTERLOCK OPEN LED indication is reset automatically when the interlock circuit is closed (LED extinguished), but before power can be generated the fault condition must be reset by pushing the HV OFF push-button.

5.10.5.5 BIAS FAULT (Normally OFF)

When illuminated indicates the internal DC control voltage is low, or out of range.

5.10.5.6 FAN FAIL (Normally OFF)

Indicates failure of the auxiliary cooling fan. The power supply should be removed for service if this indicator is illuminated.

5.11 VIEW SET push button (Ref 10)

The view set push button changes the reading on the digital voltage display from the power supply output voltage, to the programmed voltage set on the local voltage set potentiometer. After pushing this button the set voltage is displayed for approximately 3 seconds.

5.12 CURRENT BAR GRAPH (Ref 11)

The current bar graph is a 'quick view' analog percentage indication of the current measured at the power supply output. Bar graph is active in local and remote modes.

5.13 AC POWER (Ref 12)

The front panel POWER switch controls the main input power to the unit. When closed, AC power is applied to the control logic, and if no faults are present the AC input contactor will also close. The POWER switch only controls a low voltage signal, and is not directly connected to the main AC line. This low voltage control signal is wired in series with two terminals on the rear panel. (4 position barrier strip) marked as INTERLOCK/POWER ON (see Figure 5-3).

The INTERLOCK/POWER ON terminals at the rear of the unit must be jumpered or wired to a remote switch or contactor. Both the remote contacts and the front panel switch must be closed for the unit to turn on.

Once the unit is turned on using the front panel POWER switch, the internal control logic begins a complete check of all operational circuits. The check includes all functions displayed on the front panel LED indicator lights. The check sequence begins with a tests of all the lights by switching them all on for about one second to let the operator know that all the LED's and the associated drivers are working, and that the power is applied to the logic circuit and the internal self checks are underway.

Within approximated 10 or 11 seconds of the POWER switch being closed the self check sequence and, all power on tests are completed and the AC contactor automatically closes (a loud ‘thunk’ will be heard) which applies AC power to the main power circuits, placing the power supply in the READY state (FAULT LED is not illuminated). When READY the power supply is considered to be armed and could be generating high voltage.

5.14 FRONT PANEL LAYOUT (S Model)

The 303S series power supply is equipped with a partially instrumented front panel featuring comprehensive status LEDs, and a power on switch. The 303S can only be operated remotely via the control connector located on the rear panel (see Section 7.2).

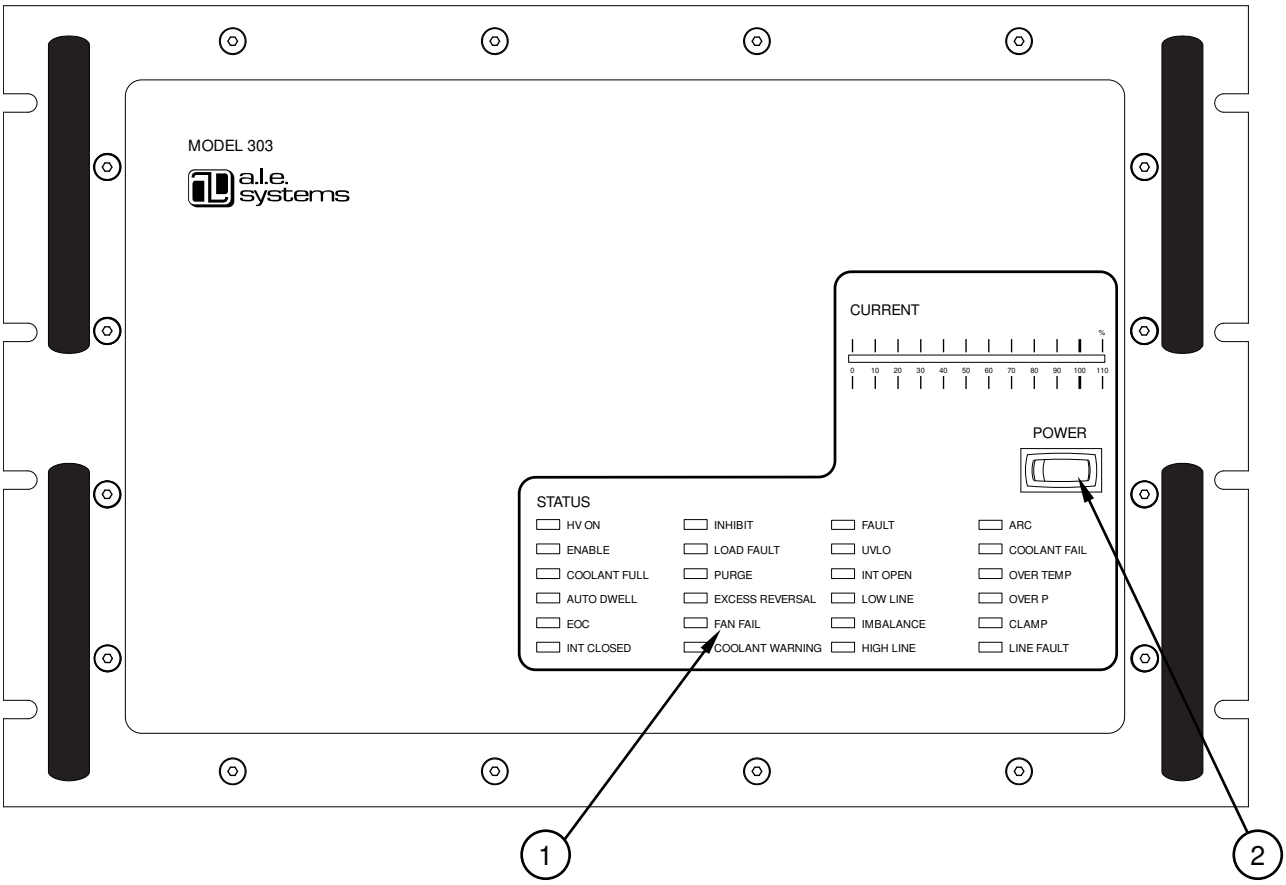


Figure 5-2 203/303S Front Panel Controls and Indicators

REF	DESCRIPTION	NOTE	SECTION
1	Status LEDs	Indicates the status of the power supply	5.10
2	Power switch	Turns on/off power to auxiliary circuits	5.13

Table 5-2 Front Panel Controls and Indicators (S Model)

A description of the function of the LEDs and the power switch are given in sections 5.10 and 5.13 respectively.

5.15 REAR PANEL LAYOUT (L Models)

All of the interconnect and service connections for the 203/303L are located on the power supply rear panel. Figure 5-3 shows the rear panel layout and location of the various connectors.

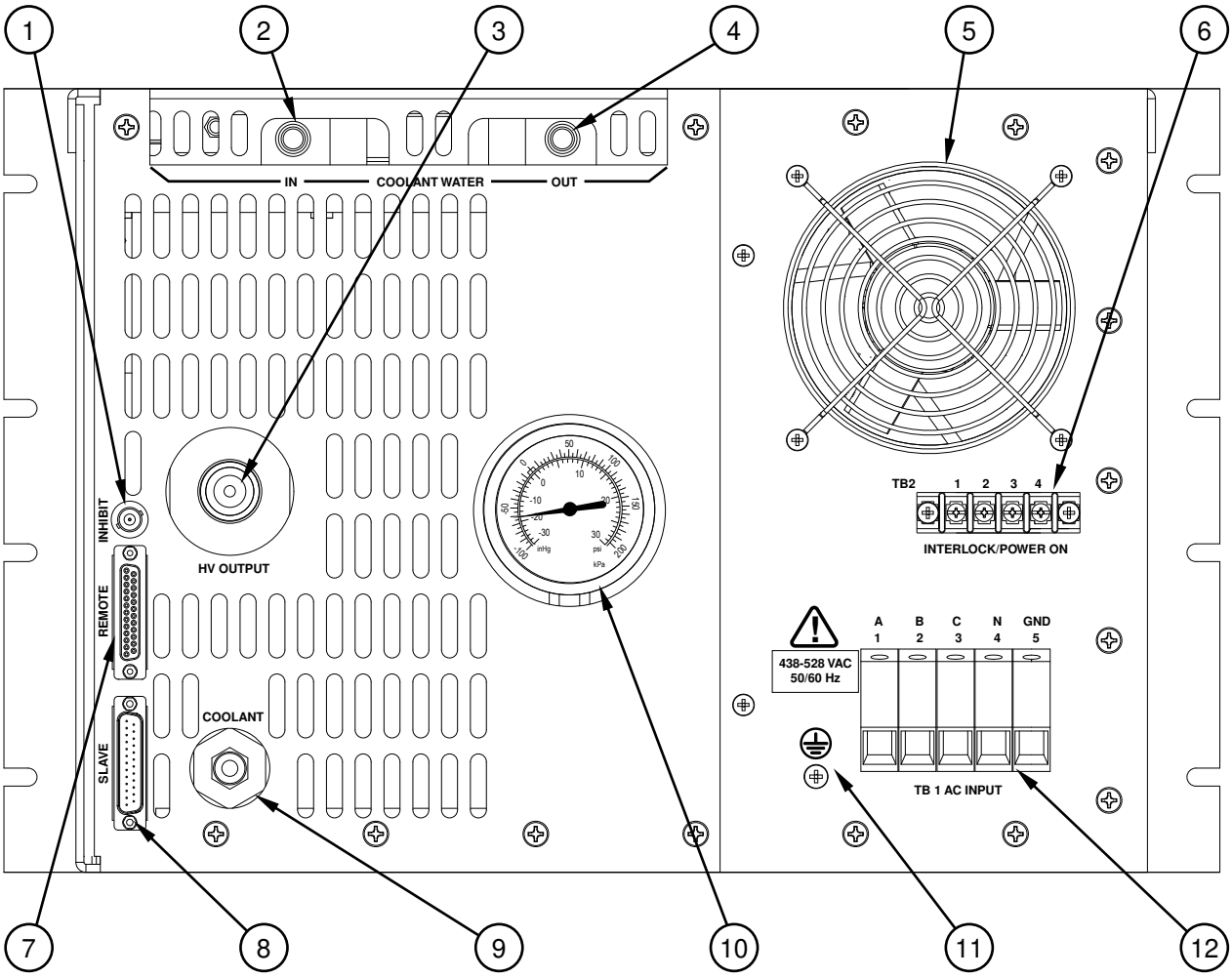


Figure 5-3 203/303L Rear Panel Connections

REF	DESCRIPTION	NOTE	SECTION
1	Inhibit BNC	BNC socket for external inhibit signal	5.15.1
2	Coolant Water Inlet	¼ NPT male threaded coolant inlet pipe	5.15.2
3	HV Output Connector	HV output connector	5.15.3
4	Coolant Water Out	¼ NPT male threaded coolant outlet pipe	5.15.2
5	Cooling Fan	Input section cooling fan	5.15.4
6	Interlock/Power On Terminal strip	External interlock and remote power on terminals	5.15.5

REF	DESCRIPTION	NOTE	SECTION
7	Remote connector	Remote control interface 25 pin D-sub plug	5.15.6
8	Slave connector	Slave interface 25 pin D-sub socket	5.15.7
9	Coolant service valve	Coolant valve to allow external tank fill	5.15.11
10	Tank pressure gauge	HV tank pressure gauge	5.15.8
11	Safety ground	10-32 safety ground connection	5.15.9
12	AC input terminal	AC input terminal block	5.15.10

Table 5-3 203/303L Rear panel Functions

The function of each item in Table 5-3 is described in the following sections.

5.15.1 INHIBIT BNC (Ref 1)

The inhibit BNC input is a standard BNC socket that allows an external connection to a pulse generator or control system and gives the user control of the power supply output current. A logic 1 (10-15V) input will inhibit the supply (shuts off the output current) and a logic 0 (ground or open) allows the supply to operate.

5.15.2 Coolant Water Inlet/Outlet (Ref 2/4)

¼ NPT male threaded pipe connection for external cooling water supply.

5.15.3 HV Output Connector

Connector socket for mating HV cable supplied with unit. The connector should be kept clean and free from debris at all times.

5.15.4 Cooling Fan

Although the supply is water cooled a small cooling fan is used to cool the AC input circuitry. Allow at least 5 inches of clearance and do not obstruct clear air flow around the fan.

5.15.5 Interlock/Power On Terminal strip

Provides an external connection for the customer to allow both interlock and remote power on functions to be controlled. The interlock terminals should be connected to any safety interlock circuitry in the power supply installation. The remote power on terminals are wired in series with the front panel ON switch, and can be used as a remote ON/OFF switch if the front panel switch is left in the ON position. **Note: The Interlock/remote power on terminals are connected to floating chassis referenced 24VAC circuits and should never be connected to ground. Solid state relays should not be used to control interlock or remote power on terminals.**

5.15.6 Remote connector

A 25 pin D-sub female connector that allows remote operation and monitoring of all power supply functions when the unit is operated in REMOTE mode.

5.15.7 Slave connector

A 25 pin D-sub male connector that allows connection of a slave supply for increased power operation. Coolant service valve.

5.15.8 Tank pressure gauge

The tank pressure gauge indicates the pressure inside the coolant filled HV assembly. With the power supply non operating at room temperature the gauge should show a vacuum between 10 and 15in Hg. With the supply operating at full power the gauge should read between 10 and 15PSI.

5.15.9 Safety ground

10-32 safety ground screw installed in chassis. Should be used for additional safety ground cable between supply and load circuit.

5.15.10 AC input terminal

Main AC input power terminal block see section 4.5 for further details.

5.15.11 Coolant service valve

External valve to allow topping up of the HV tank with coolant without the need for removing the top cover. Do not undertake this procedure without contacting the factory.

5.16 REAR PANEL LAYOUT (S Models)

The 303S rear panel is almost identical to the 303L except these is no SLAVE or INHIBIT BNC connector. If a number of units are to be connected in parallel, a daisy chain type ribbon cable should be used to connect the supplies together. See section 7.3 for more details. Note: The numbers in Figure 5-4 refer to Table 5-3.

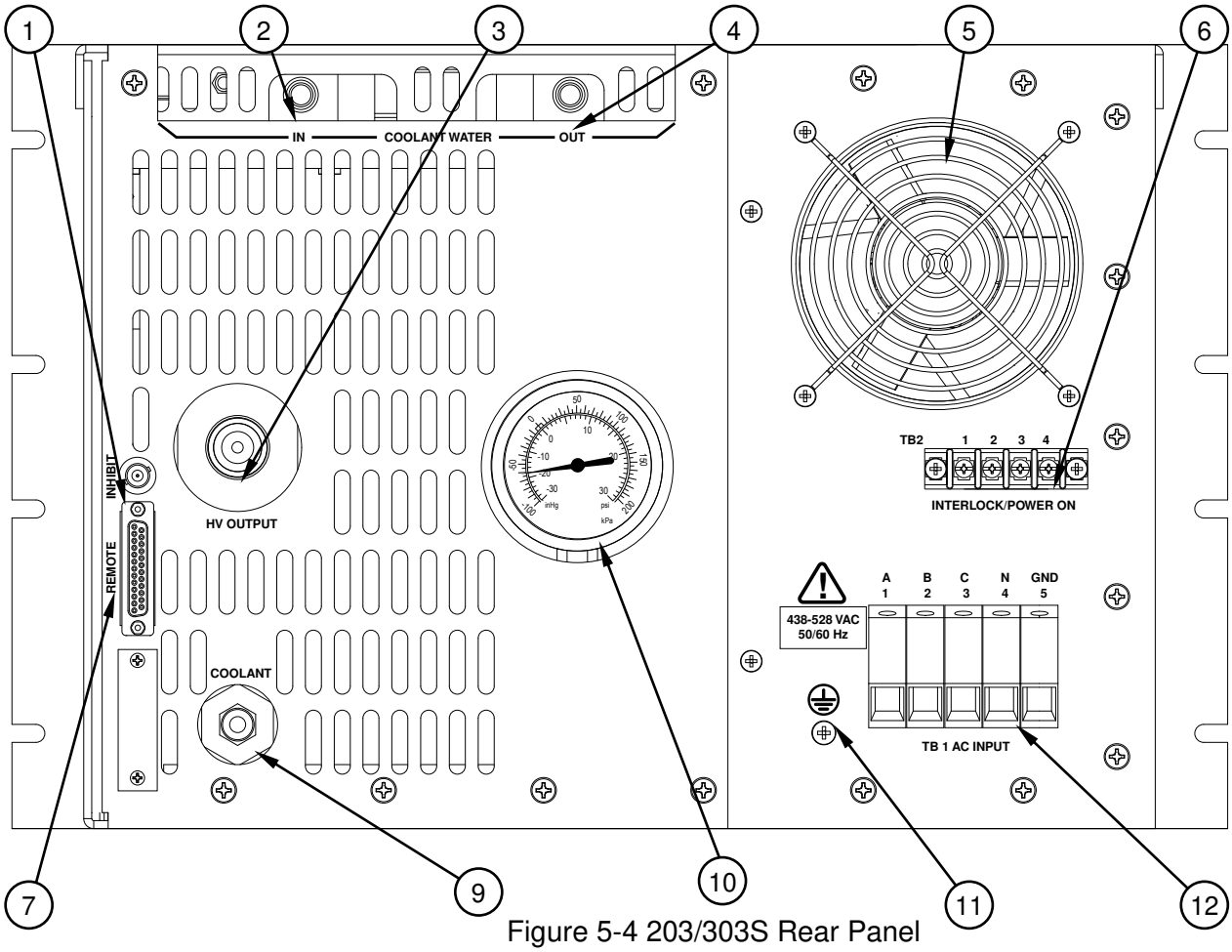


Figure 5-4 203/303S Rear Panel

6. OPTIONAL FEATURES

The 203/303 series power supplies can be ordered with a number of optional features which are explained in the following paragraphs.

6.1 LOW ENABLE OPTION (-EN)

All model 203/303 power supplies are equipped with an Enable or HV ON/OFF signal as part of the remote interface. The standard ENABLE logic is a 12-15V signal turns HV ON and 0V or open turns HV OFF. The EN option replaces the standard logic levels with 12-15V = HV OFF and 0V or Open = HV ON.

6.2 5V PROGRAMMING OPTION (-5V)

All model 203/303 power supplies are equipped with an Analog output voltage program signal ($V_{program}$) as part of the remote interface. The program level is 0-10V input is equal to 0 to 100% of rated output voltage. The -5V option replaces the standard programming so that 0-5V input delivers 0-100% of rated voltage at the output. Note that the Analog Out and Voltage M Out signals remain scaled at 0-10V with 5V option installed.

6.3 LATCHING OVERLOAD PROTECTION OPTION (-LP)

Standard model 203 and 303 series capacitor charging supplies are equipped with a Load Fault or Overload protection circuit. This circuit causes the power supply to shut down and indicate a LOAD FAULT condition if the output voltage does not reach the programmed voltage within 500ms. The LOAD FAULT condition automatically clears after a further 500ms, and the supply continues charging the load in 500ms intervals until the programmed voltage is reached.

If the LP option is installed, the power supply still shuts down if the output voltage does not reach the programmed voltage within 500ms, and the unit stays latched OFF indicating a LOAD FAULT, which requires a reset signal before it will restart.

6.4 CONTINUOUS DC OPTION (-DC)

Model 203 or 303 power supplies equipped with the DC option should not be operated in parallel without first contacting the factory.

The DC option is specified when a 203 or 303 series power supply is used to power a continuous DC load such as an RF tube, amplifier, DC-DC converter, or similar load where the output voltage and current is continuously on.

All model 203 and 303 power supplies equipped with the DC option have –DC in the product description, for example – 303L-50KV-POS-DC-3P480, 203L-7KV-POS-DC-3P400.

203 and 303 -DC supplies are factory modified to have the OVERLOAD function defeated, the output current adjusted for the appropriate power level (see power ratings in Section 2.1), and a different final test procedure is employed.

When operating a model 203 or 303 power supply in a DC application, the customer must add an external filter capacitor to the load circuit to ensure the output ripple is suitable for the application. Model 203 and 303-DC power supplies must never be operated into a resistive or other load without an external filter capacitor, otherwise damage may occur to the High Voltage Output. For more details on continuous DC operation and filter capacitor sizing and selection, please refer to our online App Note 505 which can be downloaded at:

http://us.tdk-lambda.com/hp/pdfs/application%20notes/93008505rC.pdf

Some examples of DC loads are;

- Tetrode Amplifiers
- X-ray Tube Burn-In
- DC-DC Converters
- Hard Tube Modulators
- Klystrons
- Gyrotrons
- Radar Systems

6.5 REMOTE SENSE (-RS)

The remote sense option can be specified when the output voltage accuracy or stability requirements of the application cannot be met by the internal voltage sensing components. It allows the power supply's output voltage sense signal to be provided by an external voltage divider.

Power supplies equipped with the remote sense option have an additional BNC connector located on the rear panel adjacent to remote/slave control connectors. The BNC connector is labeled HVS (High Voltage Sense).

The typical remote sense input is configured for a 1000:1 divide ratio external probe, and has a 1MΩ input impedance with a capacitance of 20-50pF. Other divide ratios and impedances can be configured upon request. Contact the factory to confirm the exact remote sense input requirements.

The remote sense input must be connected for correct operation of the power supply. If the supply is operated without the remote sense signal connected, the output will not be uncontrolled, but it will deliver approximately 10% higher output when set to the maximum programmed voltage.

6.6 CURRENT PROGRAMMING (-CP)

Power supplies equipped with the Current Programming option, allow the user to program the output current between approximately 10% and 100% of rated current. A model 203/303L equipped with the CP option has an addition control potentiometer located below the voltage control potentiometer, and a current program pin on the remote interface (Pin 18). A 203/303S equipped with this feature has the control signal on the remote interface only. This feature is useful in continuous DC units, but can also be specified in capacitor charging applications.

6.7 LONG CHARGE OPERATION (-LCA)

The long charger operation option should be specified if the 203/303 power supply is designed to be used to charge a large capacitive over a period of 1second or more. The LCA option controls the charger output current such that the load charges in fastest possible time without exceeding the average power rating of the unit. When this option is specified, the charge voltage curve will ramp in the conventional manner from 0 to 50% of rated voltage where the charge current is constant. Then at voltages above 50% of rated, the charge current is gradually reduced so the unit operates as a constant power source with a power limit equivalent to the average power rating of the unit.

With the LCA option installed, the Iprogram, and Current meter Output signals are not scaled at 0-10V=0-100%, please contact the factory for more details.

7. OPERATING INSTRUCTIONS

The 203/303 power supply is designed for operation in two modes. The first mode is local, where the power supply is operated using the front panel controls. Local operation is only possible with the L model supply. The second mode is remote, where control signals are passed via the 25pin remote connector. Remote operation is possible with all 203/303 model power supplies (L and S).

7.1 LOCAL OPERATION (203/303L only)

The model 203/303L has full front panel instrumentation and controls for use in laboratory, prototype or OEM systems. The front panel controls include power on/off, remote/local key switch, HV on/off push-buttons, output voltage adjust, digital voltage and current meters, and status indicators. An internal AC contactor is included which is controlled by the front panel power switch and the interlock terminals on the rear of the unit. A BNC connector is provided on the rear panel for easily connecting a pulsed INHIBIT signal when operating from the front panel. The model 203/303L can be operated as a "master" unit in parallel with several model 203/303S or "slave" units for increased output power. Refer to Section 7.3 Parallel Operation.

After all external AC input, cooling, and load connections have been correctly made and the high voltage cable properly terminated at the load, the power supply is ready to operate.

NOTE: The 203/303 series power supplies are not designed to operate into an open circuit load. Operating the supply with no external load capacitor could result in damage to the high voltage output section and would void the warranty.



CAUTION

HIGH VOLTAGES MAY POTENTIALLY EXIST FROM THIS POINT FORWARD



To operate the supply, follow the steps below:

1. Turn "HV Level Adjust" control fully CCW.
2. Ensure key switch is in the OFF position.
3. Turn on AC power, "POWER" switch.

   The fan should be running. The front panel LED's will light and reset. The INHIBIT and HV OFF LEDs should be illuminated. The END OF CHARGE LED may or may not be on at this time. The INTERLOCK OPEN LED should be extinguished.
4. Turn key switch to the LOCAL position. Push the HV ON button, slowly turn the high voltage adjust level to the desired output voltage. Note that at any point in stopping the adjustment, the end of charge light will illuminate.
5. When the desired output voltage is reached, the load switch should now operate and the power supply will begin charging the load at the rated power level.

After the load has been discharged the AUTOINHIBIT function will inhibit the output current for a short time before the load is re-charged. Alternatively an external inhibit signal can be connected to the rear panel mounted BNC connector.

To turn OFF the power supply depress the OFF button or use the INHIBIT input. Opening the interlock terminals will also cause the power supply to turn off. In this case the unit can only be turned back on after the interlock has been closed and the OFF button depressed to RESET the fault. Any other fault occurring in the internal protection circuitry will interrupt the power supply's operation causing it to turn OFF.

For a full explanation of each control and indicator refer to Section 5.

7.2 REMOTE OPERATION (All models)

All 203/303 models are easily controlled through the 25 pin sub D-type remote interface connector located on the rear panel. The minimum required signals for remote control operation are; HV ON/OFF, Vprogram and GND. The remaining signals are provided for status monitoring and fault diagnosis, or more sophisticated control methodologies. A description of each signal is shown in Table 7-1, with a schematic showing a suggested remote interface circuit shown in Figure 7-1.

Pin	Signal Name	I/O	Description
1	+15VDC	O	+15V 125mA max. May be used to power LEDs etc in a remote control circuit.
2	FAULT	O	Open collector. Low impedance when FAULT is present.
3	INBIHIT LED	O	Open collector. Low impedance when power supply is inhibited from charging.
4	END OF CHARGE LED	O	Open collector. Low impedance when power supply reaches End of Charge.
5	EXCESS REVERSAL	O	Open collector. Low impedance when EXCESS REVERSAL is sensed.
6	HV ON	O	Open collector. Low impedance when HV OUTPUT is ON.
7	OVER VOLTAGE	O	Open collector. Low impedance when output OVERVOLTAGE is sensed.
8	ARC	O	Open collector. Low impedance when ARC is detected in the HV tank.
9	AUTOINHIBIT	I	0-10V signal programs AUTOINHIBIT period between 500us and 10ms in range 1 (factory preset) or 50μs to 1ms in range 2.
10	HV ON/OFF	I	15V=On, ground or open =Off. Also used to reset most latching faults by cycling from On to Off. Input impedance >1MΩ.
11	Vprogram	I	0-10V = 0-100% of rated output voltage. Input impedance >1MΩ.
12	CURRENT METER OUTPUT	O	Output current , 0-10VDC = 0-100% of rated current.
13	ANALOG OUT	O	0-10V (±1%) Analog of output voltage waveform. Impedance 1kΩ.
14	INTERLOCK LED	O	Open collector. Low impedance when external interlock circuit is open or power supply top cover is removed.
15	INPUT POWER FAULT LED	O	Open collector. Low impedance when input power fault occurs (high, imbalance, interlock). When signal is activated the supply will latch off.
16	AUTOINHIBIT LED	O	Open collector. Low impedance when AUTOINHIBIT is activated.
17	LOAD FAULT LED	O	Open collector. Low impedance when LOAD FAULT condition occurs. Load fault is a non-latching fault and will self reset after approximately 500ms (for models without LP option).
18	Iprogram	I	0-10V signal programs the output current between 0 and 100% of rated current. This signal is not standard and is only operational on special models or units equipped with the Current Programming (CP) option. See 6.6 for more detail.

Pin	Signal Name	I/O	Description
19	COOLANT FAULT	O	Open collector. Low impedance when the internal over temperature sensor is activated. The power supply shuts off and will not restart until the unit has returned to normal operating temperature. On occasion the thermal sensor may be activated by residual heat after shut down. This is normal and will reset itself within one minute after re-application of power. This signal is logical OR connected with the COOLANT LOW and FAN FAIL LEDs.
20	PURGE VALVE	O	Open collector. Low impedance when PURGE VALVE is activated.
21	DIGITAL GROUND		Common ground connection for digital circuits.
22	INHIBIT INPUT	I	5-15V Inhibits unit, open or ground allows operation. Input impedance >10kΩ.
23	ANALOG GROUND		Common ground connection for analog circuits.
24	+11VDC	O	+11V 100mA max regulated for use with Vprogram and AUTOINHIBIT program inputs.
25	VOLTAGE METER OUT	O	+10VDC indicates max rated output voltage.

Table 7-1 203/303 Remote Interface Description

To operate an L model in remote mode the front panel key switch must be in the REMOTE position. Before operating either a 203/303L or S in remote mode it must first be connected to a master supply, or an appropriate control system.

7.2.1 Remote Control Signals

There are two recommended remote control signal arrangements for the 203/303 supply. The first utilizes the 203/303 inbuilt AUTOINHIBIT function, and the second utilizes a customer supplied INHIBIT signal. Each case is detailed in the following sections.

7.2.2 Remote Operation with AUTOINHIBIT

The simplest remote control for the 203/303 series power supplies required only an external HV ON/OFF signal (Pin 10), a Vprogram signal (Pin11), and ground (Pin 21/23). The Vprogram signal should be set to the appropriate analog level that corresponds to the desired output voltage. For any given model with standard 10V programming, the program voltage (in Volts) is given by:

$$\text{Vprogram} = \frac{\text{Vcharge} \times 10}{\text{Vrated}}$$

Note: The program voltage should never be greater than 10V.

Once the desired Vprogram signal has been set by the remote control system, the supply can be turned on. The first step is to turn on the AC power switch on the supply front panel, or close the remote power on the rear panel if it is being used.

With the supply AC power turned-on and the Vprogram set to the desired level, the HV ON signal can be asserted (Pin 10=15V). As soon as the HV ON signal is high the output of the supply is energized and the load will begin charging.

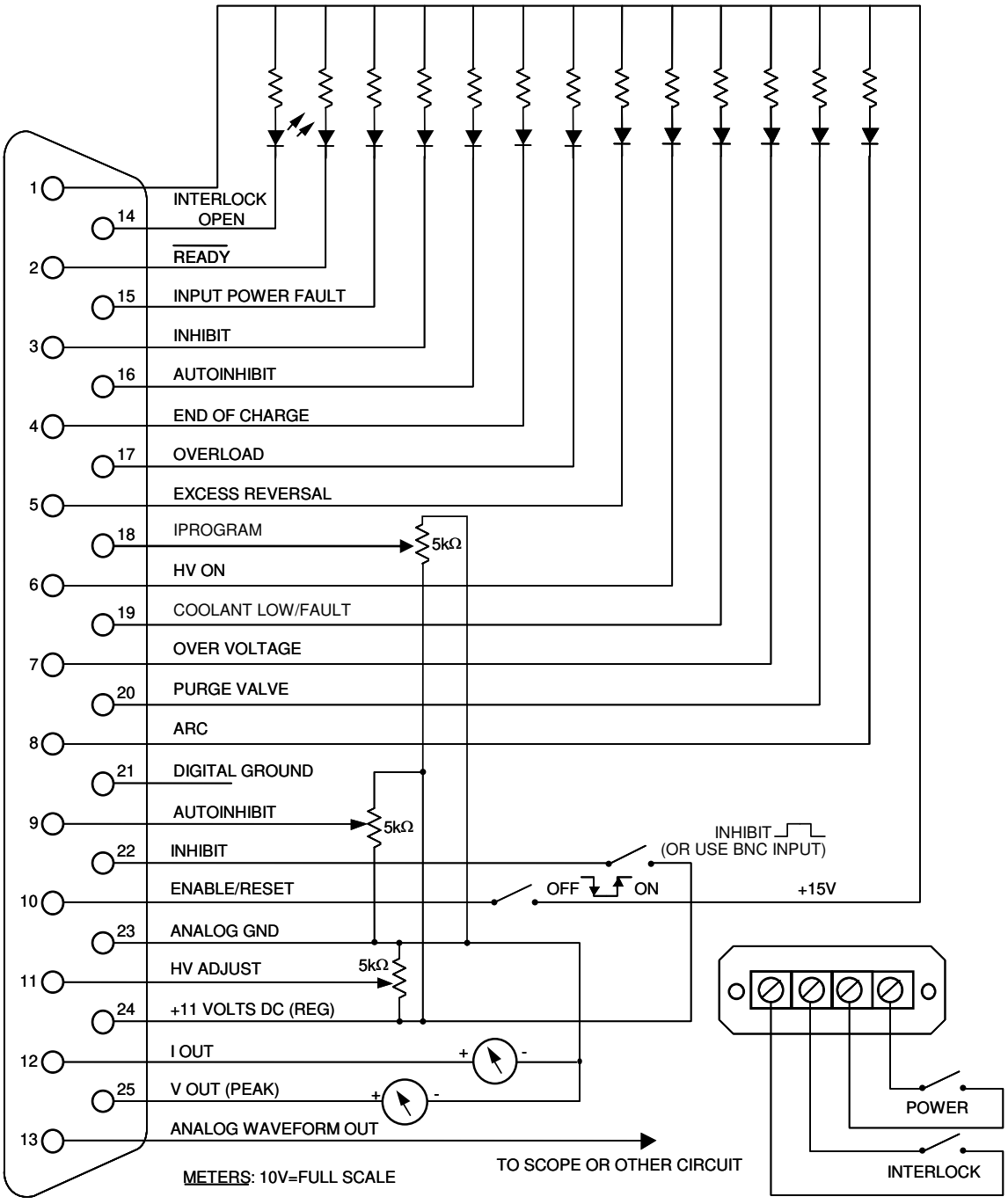
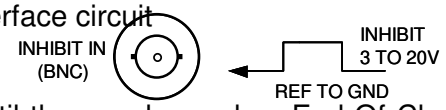


Figure 7-1. External remote interface circuit



The load will continue to charge at full current until the supply reaches End Of Charge (EOC - output voltage=program voltage). After the supply reaches EOC the load voltage is maintained at the programmed level by short bursts of charge current. When the load is discharged the AUTOINHIBIT circuit automatically creates an internal inhibit signal that shuts off the output current for a short period (1ms default). Note: the AUTOINHIBIT period is programmable between 500μs and 5ms via remote Pin 9. The AUTOINHIBIT circuit will only detect load discharge when the output voltage falls from

between 20% and 100% of rated voltage to zero. If the load is discharged at below 20% of rated voltage, the AUTOINHIBIT circuit will not activate and the supply will continue to deliver current.

When the AUTOINHIBIT period is over, the supply will begin to recharge the load and the cycle repeats. The supply will continue to operate in this manner until HV OFF is asserted (PIN 10=0V). See Figure 7-2 for typical remote interface waveforms.

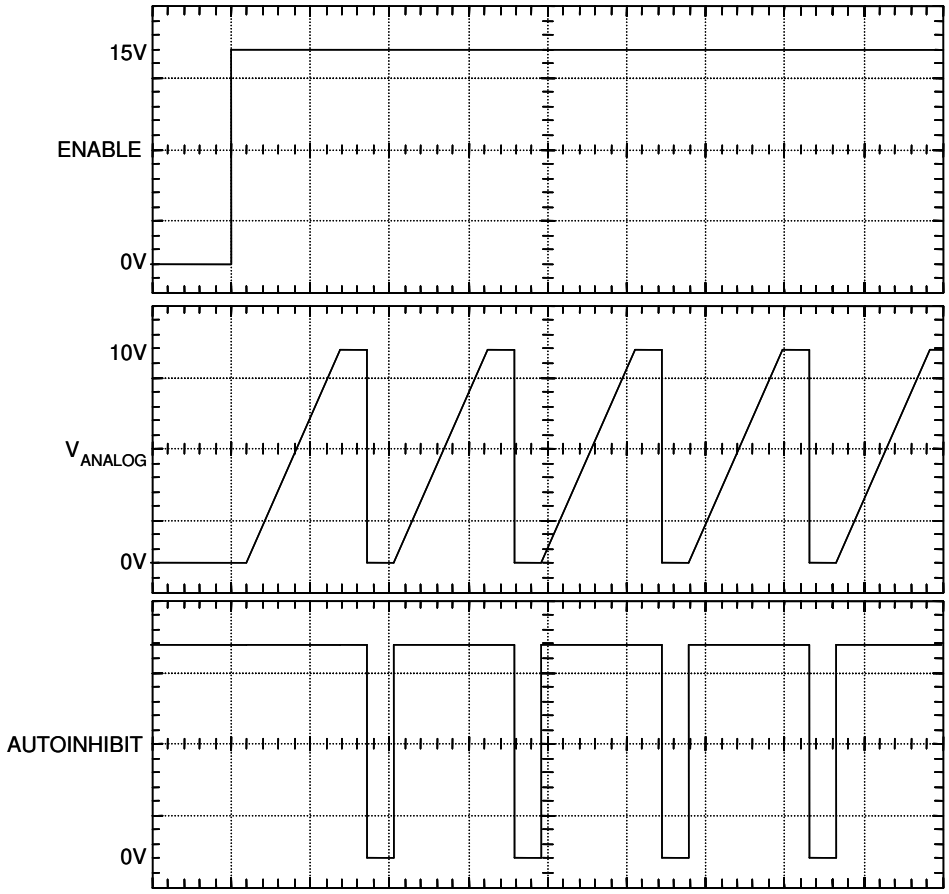


Figure 7-2 Remote Interface waveforms for 303 operated with AUTOINHIBIT

7.2.3 Remote Operation with INHIBIT

Although the AUTOINHIBIT signal offers the user the simplest remote programming method for the 203/303, the INHIBIT signal is commonly used to control the output current and offers greater flexibility, allowing the user to minimize the time at which the load capacitor remains at high voltage. The INHIBIT signal should be asserted (Pin 22=5-15V) prior to activating the HV ON signal. Once HV ON has been set, then INHIBIT can be removed (Pin 22=0V), and the supply will begin charging the load. A few 10s of microseconds before the load switch is triggered to close, the INHIBIT signal should be asserted to turn-off the output current, and aid in switch recovery. Once the load switch has recovered from the discharge event, INHIBIT can be removed and the load recharged. A typical set of remote control waveforms is shown in Figure 7-3.

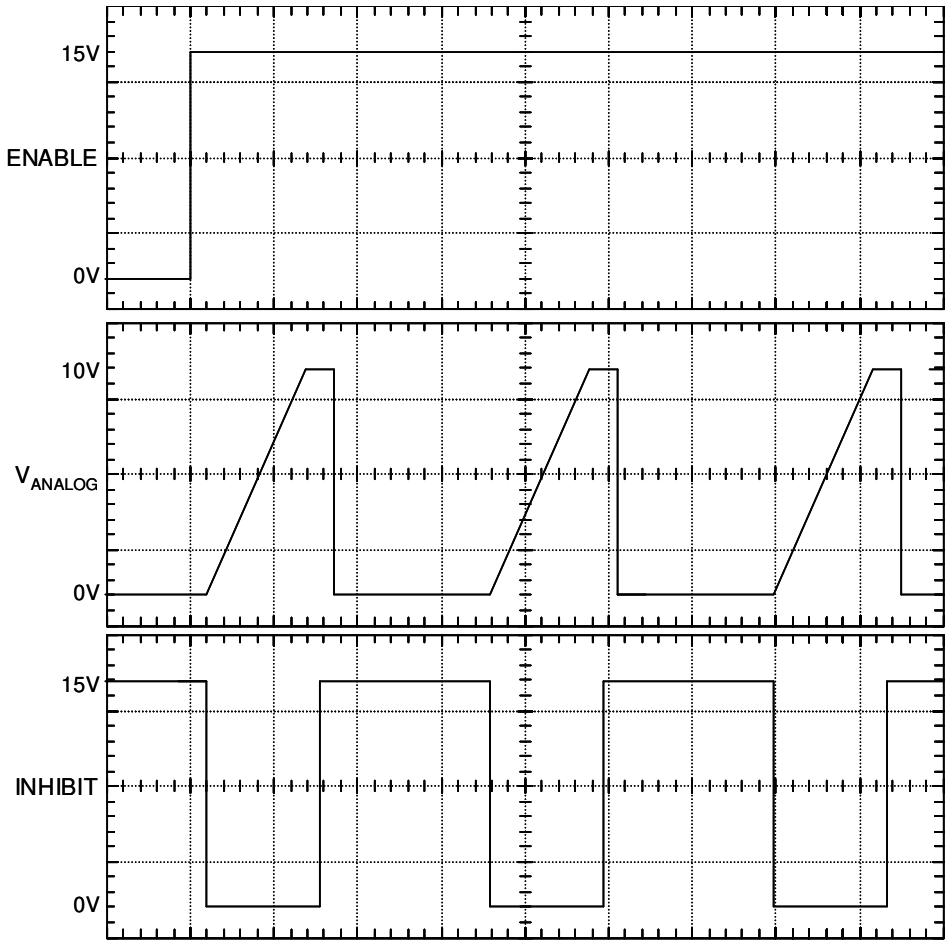


Figure 7-3 Remote Interface waveforms for 303 operated with INHIBIT

7.3 Parallel Operation

The 203/303 series capacitor charging power supplies are constant current sources, and can be connected in parallel for applications requiring increased power. To operate more than one unit in parallel all that is required is a parallel control cable, and to connect the HV output cables together at the load. Either model 203/303L or 203/303S or any combination of units can be operated in parallel. If at least one model 203/303L is connected in a parallel system then the system can be operated without an external controller by using the 203/303L as a master supply in local mode.

If status, voltage, and current displays/measurements are required individually for each supply in a parallel system then the 'daisy chain' control cable is not appropriate, and each unit must be individually connected to a remote control system.

7.3.1 Parallel system comprising 203/303L supplies

If all of the parallel units are L model supplies then one unit should be operated as the master supply in either local or remote mode. The other parallel supplies can be connected to the SLAVE 25-pin D-sub connector on the master unit rear panel (refer to Figure 7-4). The SLAVE control cable can be a pin-to-pin ribbon or other cable that is 'daisy chained' to the REMOTE connector on each of the SLAVE supplies. Note: The master 203/303L supply in a parallel system only displays the status, voltage, and current out-

put for that unit, not for the entire system. The slave supplies will also display the voltage and current only for that specific unit.

7.3.2 Parallel system comprising both 203/303L and 203/303S supplies

For a system comprising both 203/303L and S units, a single L model should be operated as a master in either local or remote mode. The other parallel supplies can be connected to the SLAVE 25-pin D-sub connector on the master unit rear panel (refer to Figure 7-4). The SLAVE control cable can be a pin-to-pin ribbon or other cable that is 'daisy chained' to the REMOTE connector on each of the SLAVE supplies.

7.3.3 Parallel system comprising 203/303S supplies

A system comprising only model 203/203S supplies must be operated from a control system. The control system should be connected using a pin-to-pin ribbon or other cable that is 'daisy chained' to the REMOTE connector on each of the 203/303S supplies in the system.

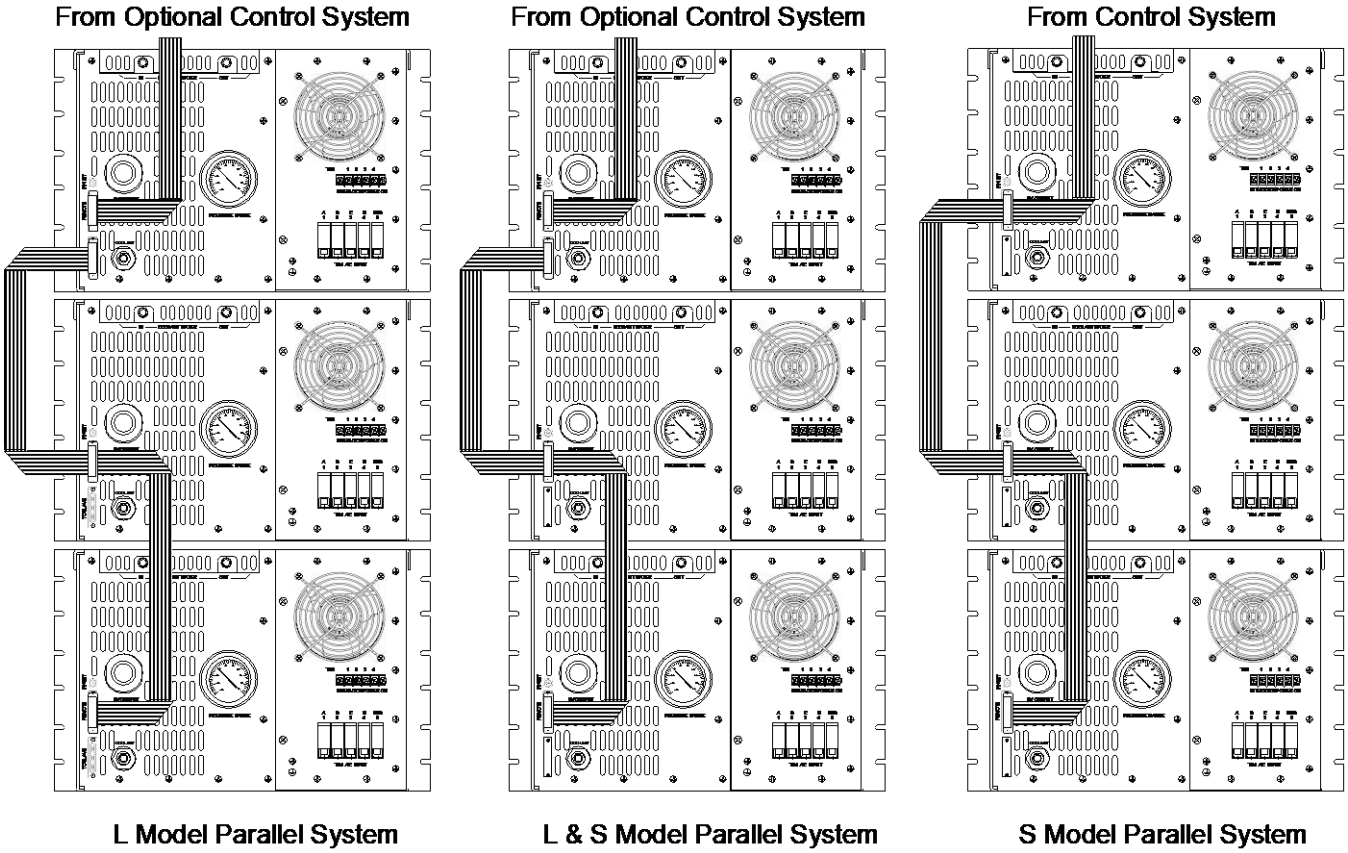


Figure 7-4 Parallel Operation Connections

NOTES:

8. APPLICATION NOTES

The 203/303 series power supplies are extremely powerful high voltage power sources and great care should be taken when connecting and operating these units. In order to aid installation design and number of application notes have been produced to aid the design engineer with certain load circuit component rating and selection. The latest versions of these application notes are available for download at the Lambda web site (http://us.tdk-lambda.com/hp/product_html/high_volt.htm).

The following App Notes were available at the time this manual was produced. These documents are continually being improved and expanded to always check for the latest revision on-line.

APP Note 500: Calculating Capacitor Charge Time.

APP Note 502: Calculating AC Line Currents.

APP Note 505: Charging units as Continuous Output DC Supplies.

APP Note 507: Charging Large Load Capacitors.

APP Note 509: What is Regulation and Repeatability?

APP Note 513: Power Factor Correction.

APP Note 517: Protection Against Voltage Reversal.

If there are any other application issues or questions that are not covered in these Application Notes, or elsewhere in this manual, please do not hesitate to contact the factory and our team of experienced HV application engineers.

Contact the Factory – We are here to help!

Tel: +1 732 795 4100

Fax: +1 732 922 1441

APPLICATIONS		
USED ON	NEXT ASSY	QTY

REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE
3	UPREVED TO TRACK PCB	DRP 4/10/12	GB 4/10/12
A	TG 016051-4	DRP 1/4/13	GB 1/4/13
B	ECO #26889	BM 4/08/15	AEH

VOLTAGE-FDBK — R33 10.0K 1% — R901 — R32 TBD — C20 TBD — R31 TBD — C19 TBD

VOLTAGE-PRGRM — R11 10.0K 1% — R10 47 — R12 100K — C7 .1uF — U5-B 324 — D5 1N4743A 13V

INHIBIT — Q3 VN2222LL

D4 1N4148 — R13 TBD

+15V — R15 10.0K 1% — U1-D 339 — R14 100 — VOLTAGE-MODE

INHIBIT — Q4 VN2222LL

+15V — R7 3.3K — R8 10.0K — U5-A 324 — TP3 — VM — R900 — −15V

+15V — R21 4.99K — R19 10.0K — R20 TBD — SP7 — D901 — R800 — D800 — R801

CURRENT-FDBK — SP1 — CURRENT-FDBK-REM — SP2 — CURRENT-FDBK-LOC — R18 6.04K 1%

R17 TBD — C9 TBD — R16 TBD — C8 TBD

CURRENT-PRGRM — R2 10.0K 1% — R1 47 — R3 100K — C1 .1uF — U5-D 324 — D2 1N4743A 13V

INHIBIT — Q1 VN2222LL

D1 1N4148 — R4 TBD

+15V — R6 10.0K 1% — U1-C 339 — R5 100 — CURRENT-MODE

INHIBIT — Q2 VN2222LL

01-048-1300
DIGITAL CONTROL

VOLTAGE-PRGRM — J1-1
CURRENT-PRGRM — J1-2
V-ACTUAL — J1-3
I-ACTUAL — J1-4
VMTR — J1-5
IMTR — J1-6
VM — J1-7
J1-8 FEEDFORWARD+
J1-9 FEEDFORWARD-
CURRENT-FDBK-LOC — J1-10
J1-11 SPARE
J1-12 SPARE
VOLTAGE-MODE — J1-13
CURRENT-MODE — J1-14
EOC — J1-15
HV-ON — J1-16
INHIBIT — J1-17
J1-18 SPARE
J1-19 SPARE
J1-20 SPARE
J1-21 SPARE
+15V — J1-22 SPARE
J1-23 SPARE
J1-24
J1-25
J1-26
−15V

+15V — C18 .1uF — U5-E 324 — C16 .1uF — U4-G 40106 — C42 .1uF — U10-C 358 — C5 .1uF — U2-E 339

+15V — C3 .1uF — U1-E 339 — C2 .1uF

LIFT U1-12 CON TO GND

+15V — C30 .1uF — U7-E 324 — C29 .1uF — −15V

+15V — U8-C 358 — C31 .1uF — C32 .1uF — −15V

U2-B 339 — U2-C 339 — U2-D 339 — U1-A 339 — U1-B 339

U8-A 358

U4-B 40106 — U4-C 40106 — U4-D 40106 — U4-E 40106 — U4-F 40106

H5 H4 H3 H2 H1 E1

+15V — SP24 — HV-ON — SP23 — R60 2.2K — CLK1 T1101AB — D9 — +15V — CLK1A 120PC — R61 TBD

NOTE:
1) SPLIT PAD CONFIGURATION CHANGES W/APPLICATION
2) COMPONENT VALUES CHANGE W/APPLICATION. REFER TO BOM OR ASSY DWG FOR DETAILS.

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	TDK-LAMBDA
	PRJ.MGR: A Hague 3/17/16	DWN: DRP 3/1/12	TITLE: 303 CONTROL ANALOG BOARD
	MFG: GS 3/2/16	CHK: B Huhn 3/16/16	
P/L:	DOC.REL: A Hague 3/17/16	ENG: GB 3/1/12	PCB: 21-048-1200 SHEET 1 OF 2
SCALE:		APP: A Hague 3/17/16	DRAWING NO: 01-048-1200 REV. B

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE

NOT USED

REMOTE VOLTAGE FDBK

REAR PANEL J7 — R58 10.0K 1% — SP20 — C39 1000PF — C38 1000PF — SP22 — SP21 — R57 1% 10.0K — R56 TBD — R54* 100K

REAR PANEL J6 — R52 10.0K 1% — SP17 — C36 1000PF — C35 1000PF — SP18 — SP19 — R51 1% 10.0K — R50 TBD — R44* 100K

R55 10.0K 1% — R53* 100K — C37 TBD

U9: 7 V+, 2 -IN, 1 RG, 8 RG, 3 +IN, VO 6, REF 5, V- 4

+15V — C33 .1uF — −15V — C34 .1uF

JMP U9-3 TO U9-6

NOT USED

INTERNAL VOLTAGE FDBK

− TANK J5 — R43 TBD — SP14 — C27 1000PF — C26 1000PF — SP16 — SP15 — R42 324K 1% — R41 100 — R39* 100K

+ TANK J4 — R37 1M 1% — SP11 — C24 TBD — C23 1000PF — SP12 — SP13 — R36 1M 1% — R35 49.9K — R34* 100K

R40 10.0K 1% — R38* 100K — C25 TBD

U6: 7 V+, 2 -IN, 1 RG, 8 RG, 3 +IN, VO 6, REF 5, V- 4

+15V — C21 .1uF — −15V — C22 .1uF

G=2

C41 — D8 1N4148 — U10-A (2, 3, 1) 358

C40 — D7 1N4148 — U10-B (6, 5, 7) 358

U8-B (6, 5, 7) 358

R59 7.5K

10V=FS

R45 1% 10.0K — U7-A (2, 3, 1) 324 — R46 100 — V-ACTUAL

VOLTAGE-FDBK

R49 1% 10.0K

DC MODE

R48 TBD

U5-C (10, 9, 8) 324 — D6 1N4148 — +15V — Q5 2N4400

R47 1M — C28 4.7uF

U7-B (6, 5, 7) 324 — TP6 — VMTR

VOLTAGE-PRGRM — 10.0K 1% R9 — TP2 — C4 TBD

U2-A (4, 5, 2) 339

+15V — R26 10.0K 1% — C15 .001uF

U4-A (1, 2) 40106 — TP4 — R27 100 — EOC

C6 .001uF — D3 1N4148 — SP3

NOT USED

REMOTE CURRENT FDBK

− REAR PANEL J3 — R22 1% 10.0K — SP10 — C12 .001uF — SP9 — SP8

+ REAR PANEL J2 — R23 1% 10.0K — SP4 — C13 .001uF — SP5 — SP6

R25 10.0K 1% — R24* 100K — C14 TBD

U3: 7 V+, 2 -IN, 1 RG, 8 RG, 3 +IN, VO 6, REF 5, V- 4

+15V — C10 .1uF — −15V — C11 .1uF

G=5 — TP1 — CURRENT-FDBK-REM — D900

CENTER OF BD — TP0

R30 10.0K 1% — U7-C (9, 10, 8) 324 — IMTR

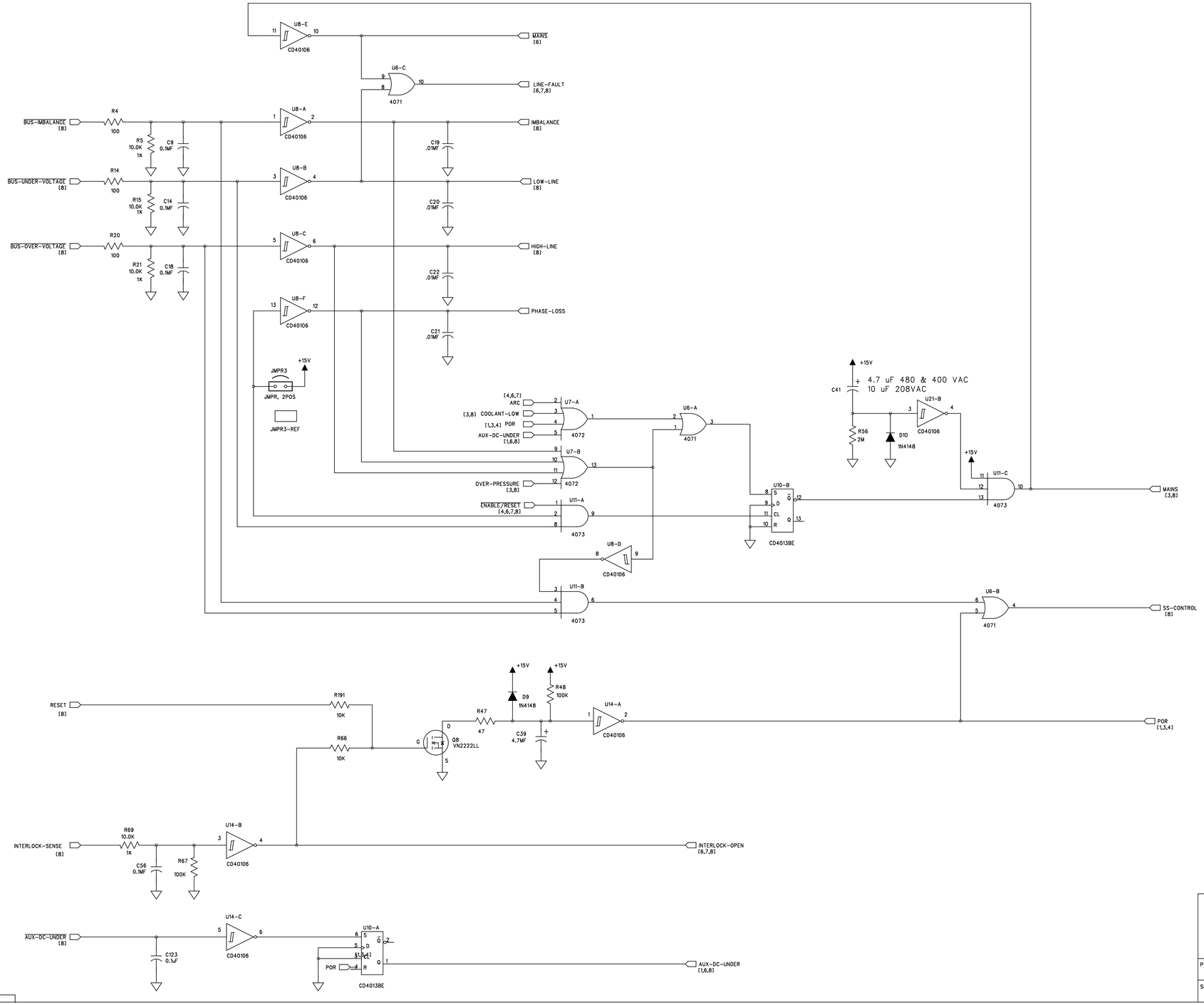
C17 NOT INSTALLED

CURRENT-FDBK — U7-D (12, 13, 14) 324 — R28 100 — R29 10.0K 1% — I-ACTUAL

NOTE:
1) SPLIT PAD CONFIGURATION CHANGES W/APPLICATION REFER TO BOM OR ASSY DWG FOR DETAILS.

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	TDK−LAMBDA
	PRJ.MGR: DATE:	DWN: DATE:	TITLE: 303 CONTROL ANALOG
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: DATE:	PCB: 21−048−1200 SHEET 2 OF 2
SCALE:		APP: DATE:	DRAWING NO: 01−048−1200 REV. B

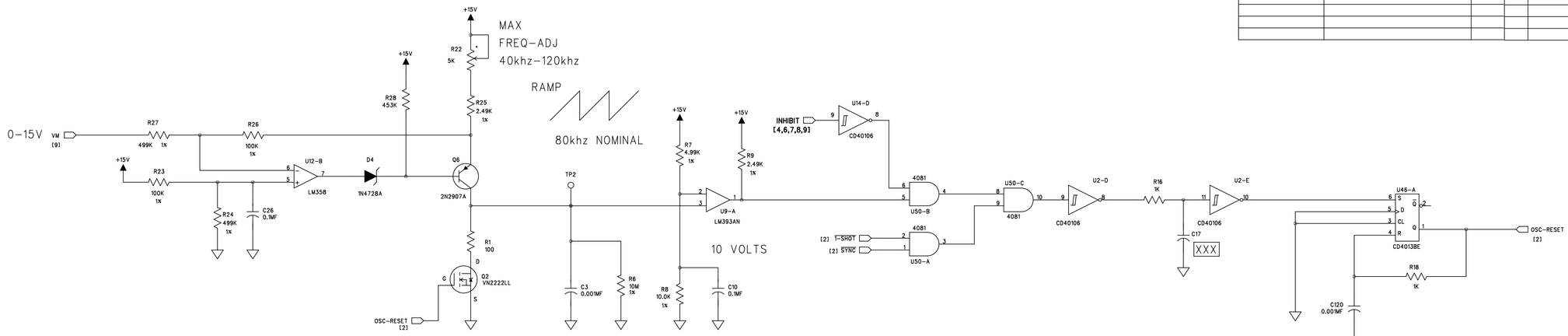
REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE
1	PROT RELEASE	GB 7/98	GB 7/98
2	REDESIGN	LS	1/19/12
3	RE-DO AFTER DEBUG	LS	1/19/12
4	REVISED PER ENG	LS	3/15/12
5	SWAPPED J3-5 & 8	LS	3/20/12
6	MISC VALUE CHANGES	DP 4/12	GB 4/12
7	REV TO TRACK PCB	DP 6/12	GB 6/12
A	TG 016051-4	DP 1/13	GB 1/13
B	ECO 26117	BM 10/13	GB 10/13
C	ECO 27859	DSF 3/17	AH 3/17

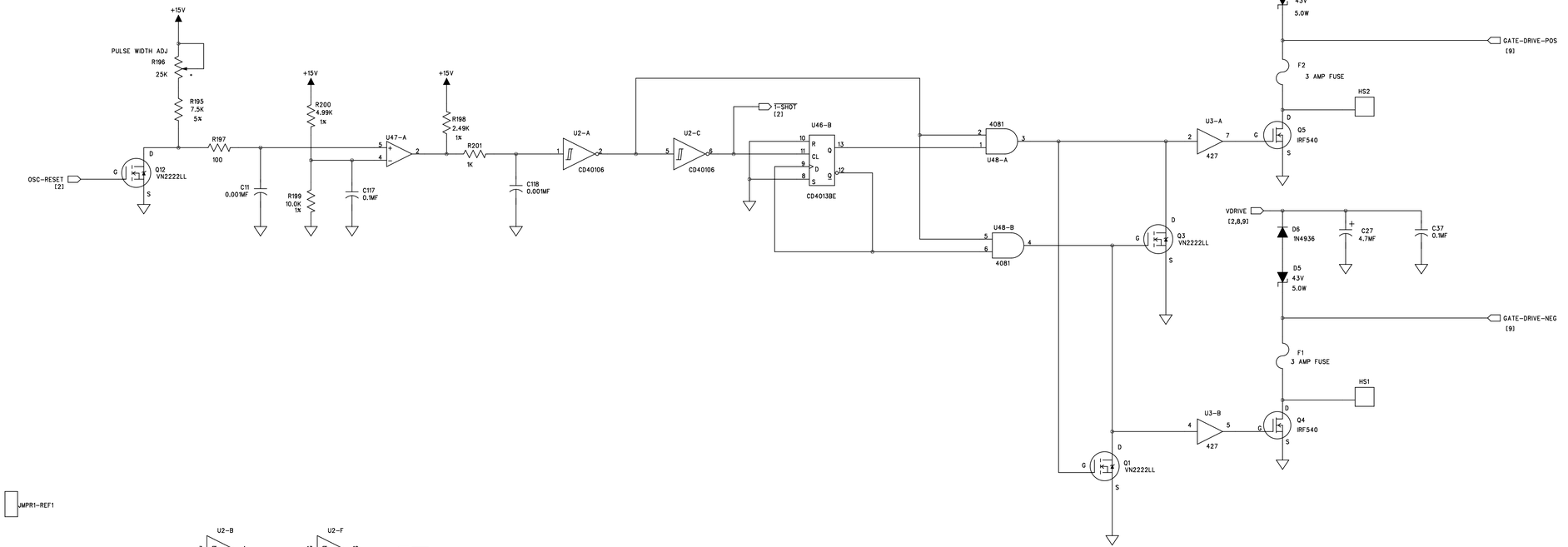


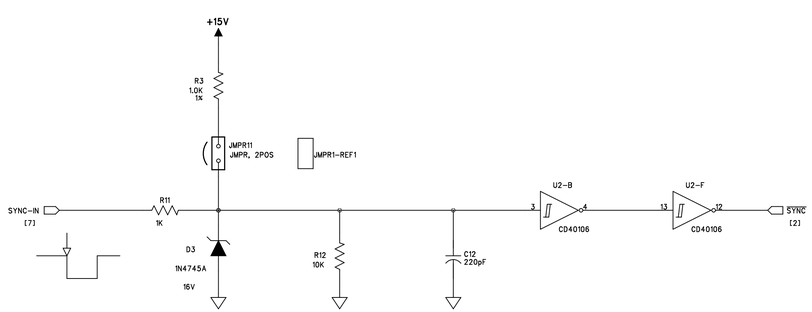
LINE SENSE

TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ale systems LAMBDA AMERICAS
	PRJ.MGR: DATE: A Hague 5/12/17	DWN: DSF 12/8/5	TITLE: DIGITAL PCB CONTROL 303X
	MFG: GS 3/31/17	CHK: DATE: B Huhn 4/24/17	
P/L:	DOC.REL: DATE: A Hague 5/12/17	ENG: GB/LS DATE: 12/6/5	PCB: 21-048-1300 SHEET OF 1 10
SCALE:		APP: DATE: A Hague 5/12/17	DRAWING NO: 01-048-1300 REV. C

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE



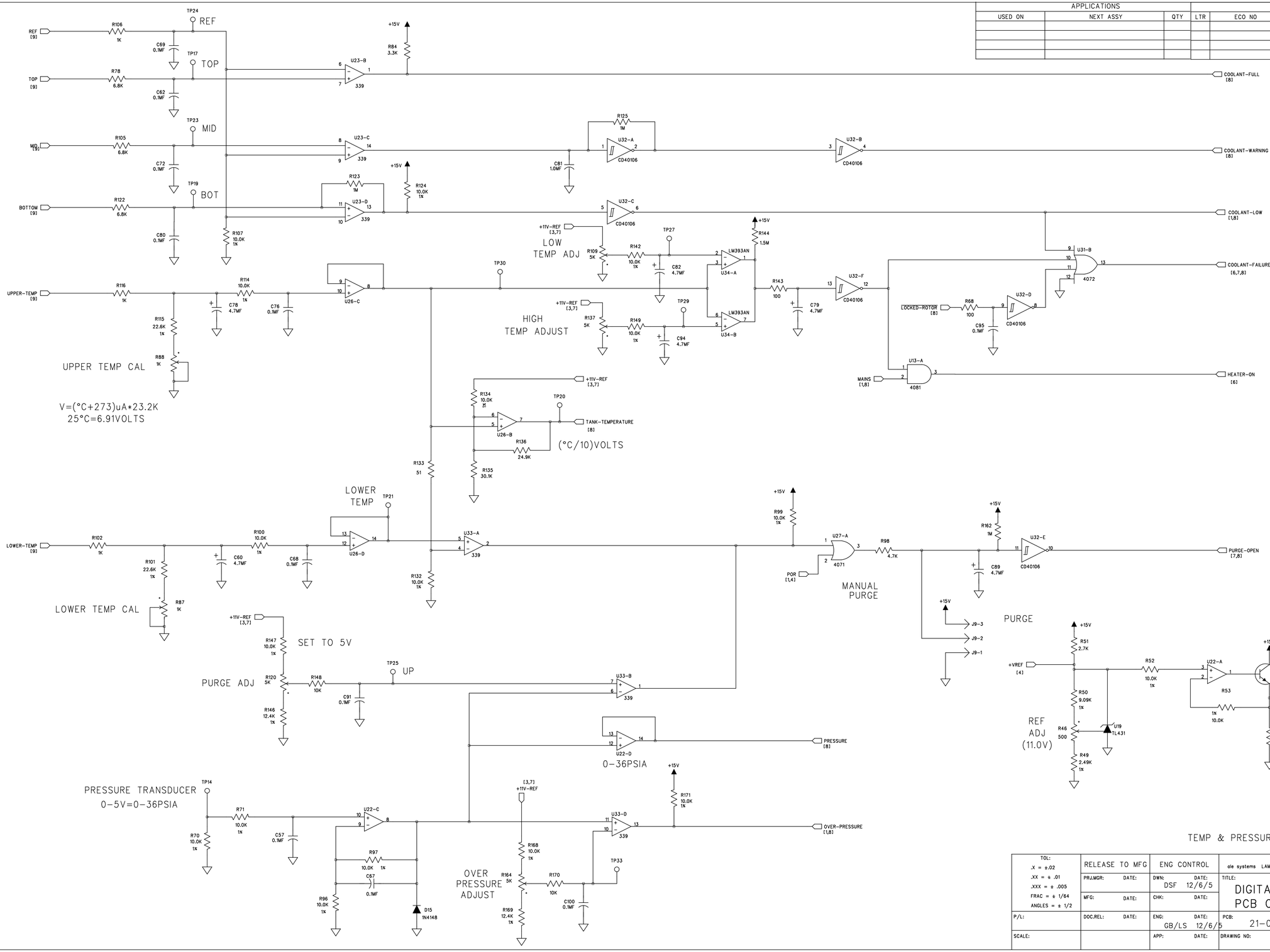




GATE DRIVE & OSC

TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ole systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DSF DATE: 12/6/5	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: GB/LS DATE: 12/6/5	PCB: 21-048-1300 SHEET OF 2 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

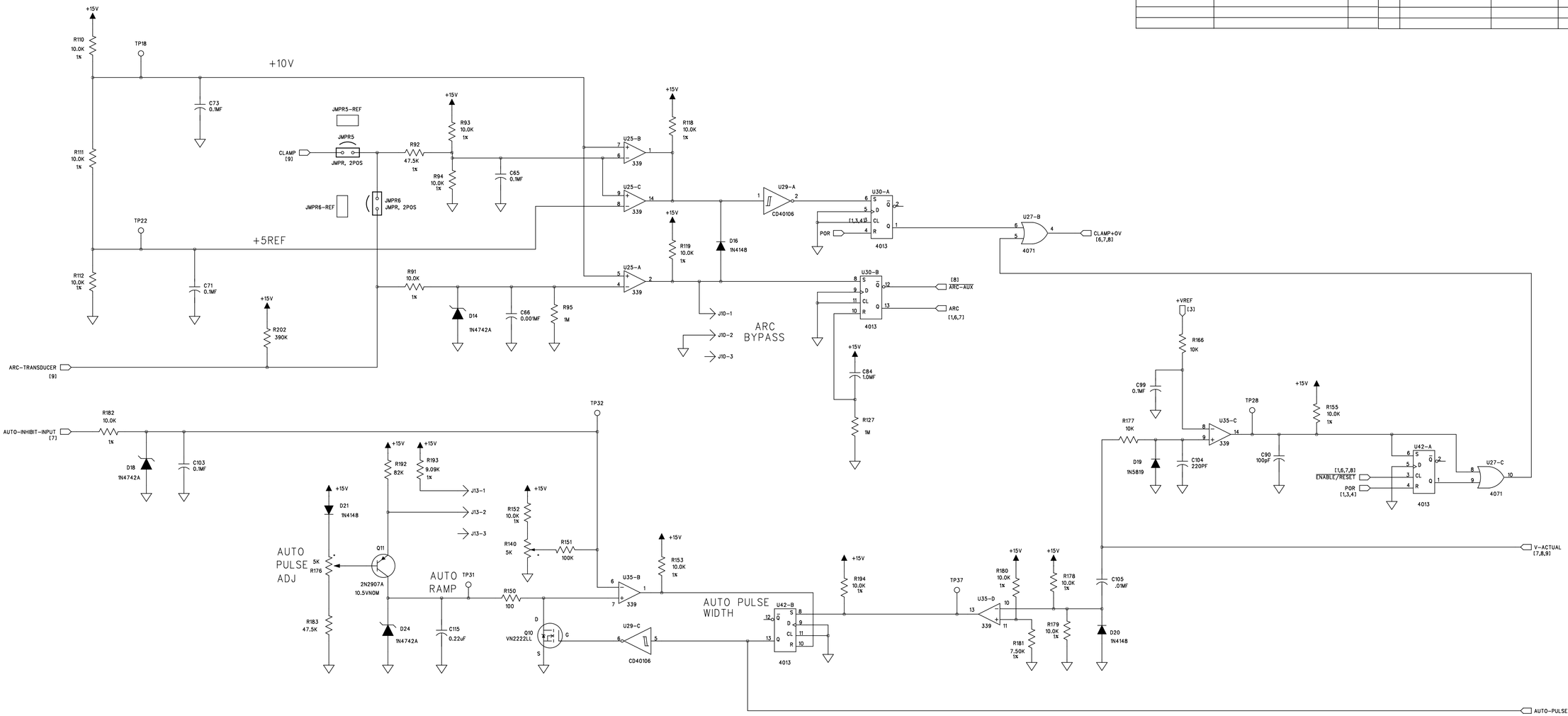
APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE



TEMP & PRESSURE MONITOR

TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ole systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DSF DATE: 12/6/5	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: GB/LS DATE: 12/6/5	PCB: 21-048-1300 SHEET OF 3 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

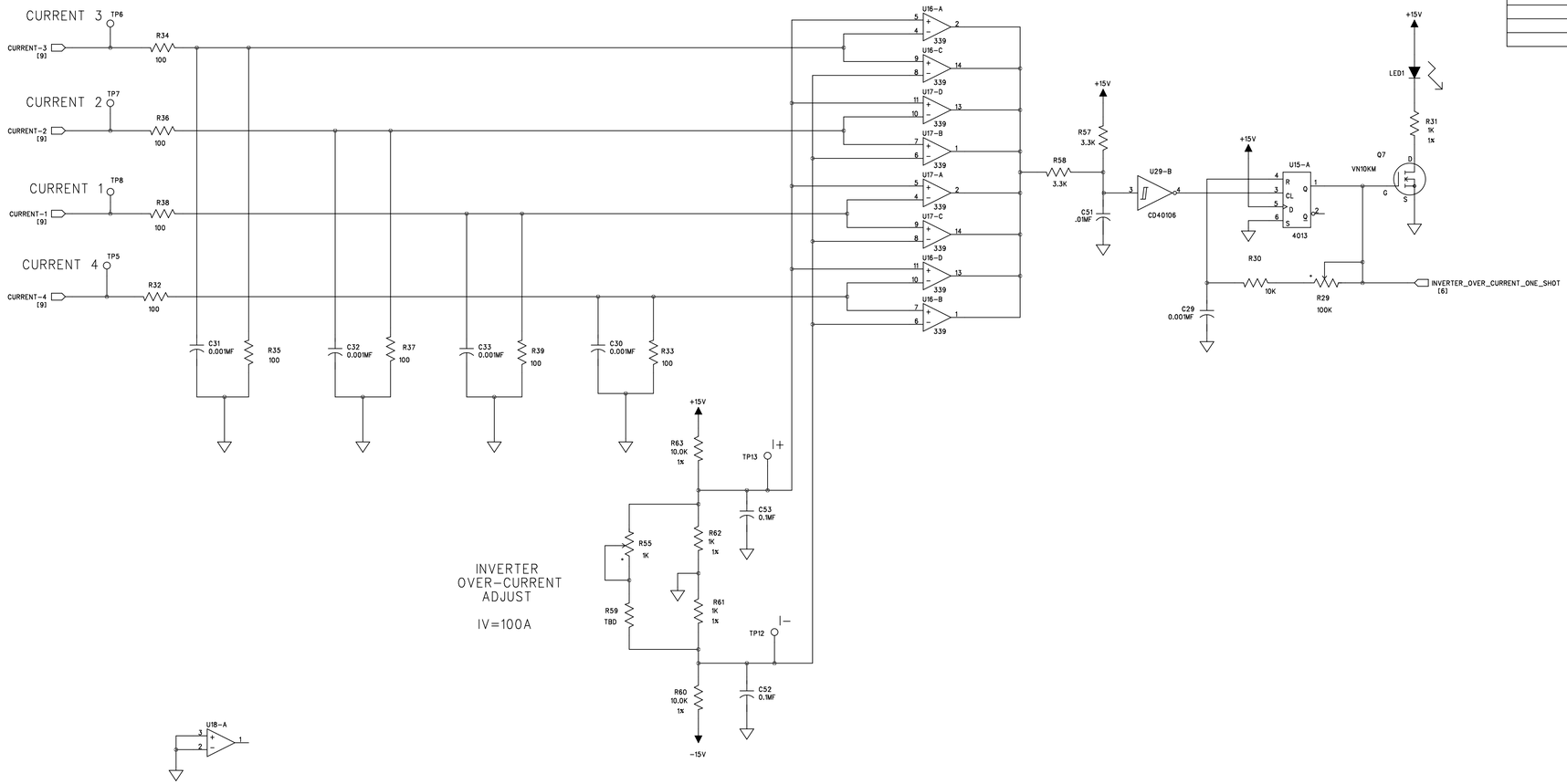
APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE

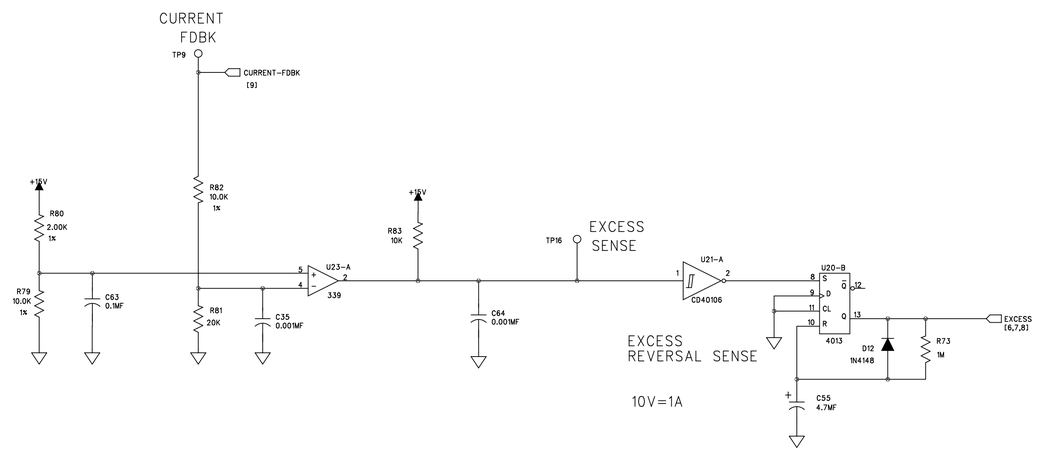


AUTO INHIBIT/OL

TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ale systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DSF DATE: 12/6/5	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: GB/LS DATE: 12/6/5	PCB: 21-048-1300 SHEET OF 4 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

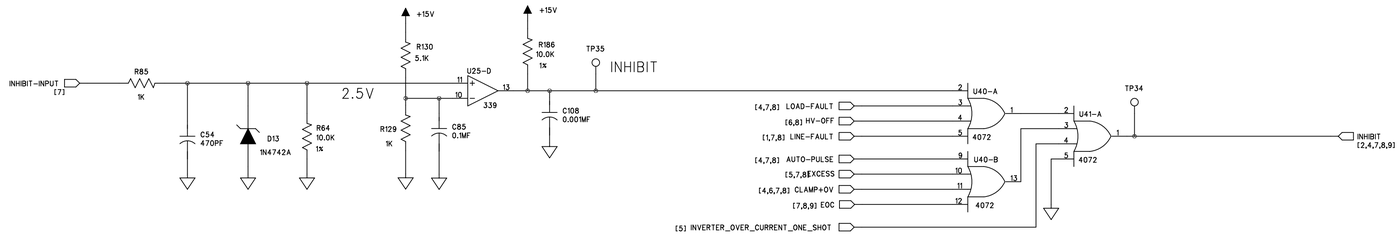
APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE

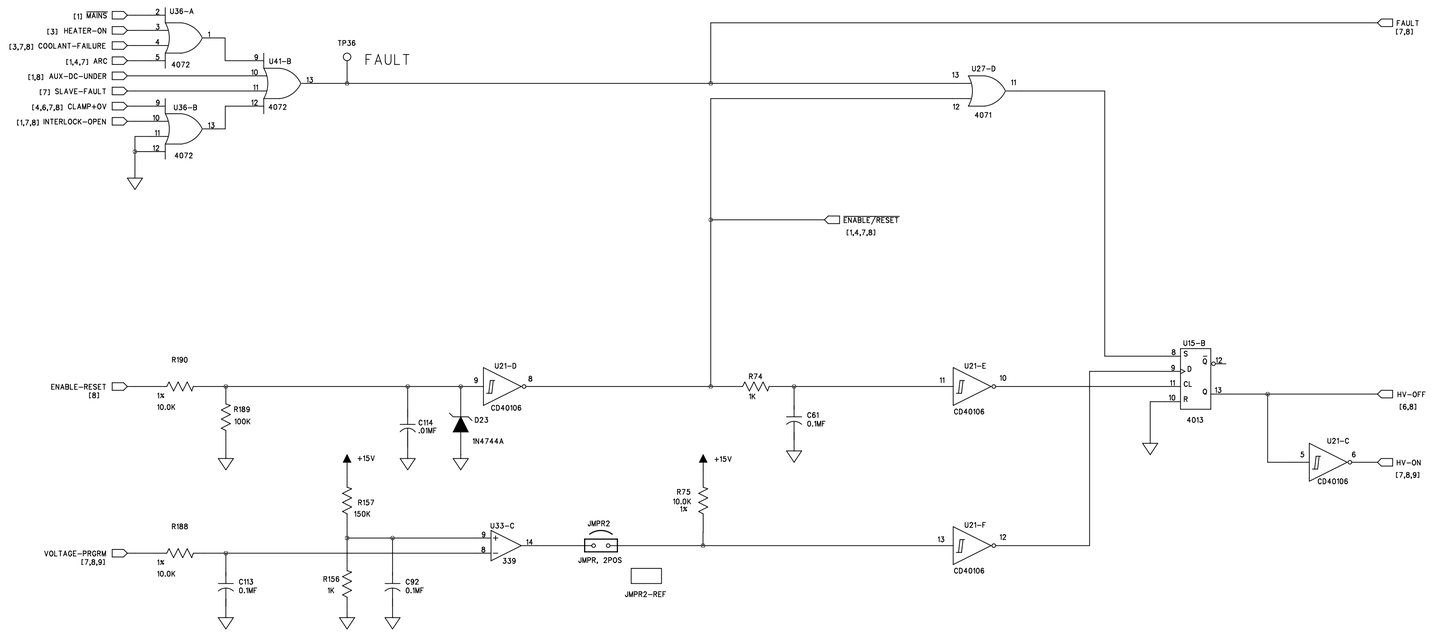




TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ole systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DSF 12/6/5 DATE:	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: GB/LS 12/6/5 DATE:	PCB: 21-048-1300 SHEET OF 5 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE

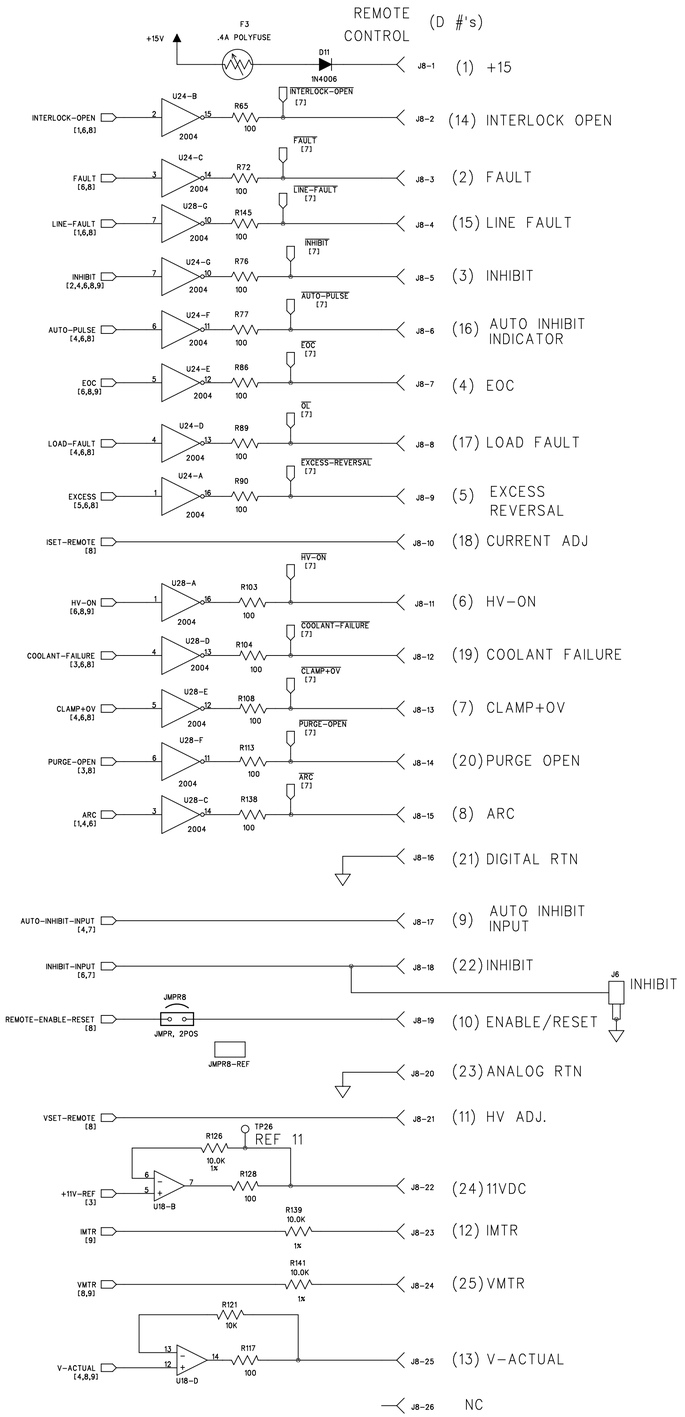


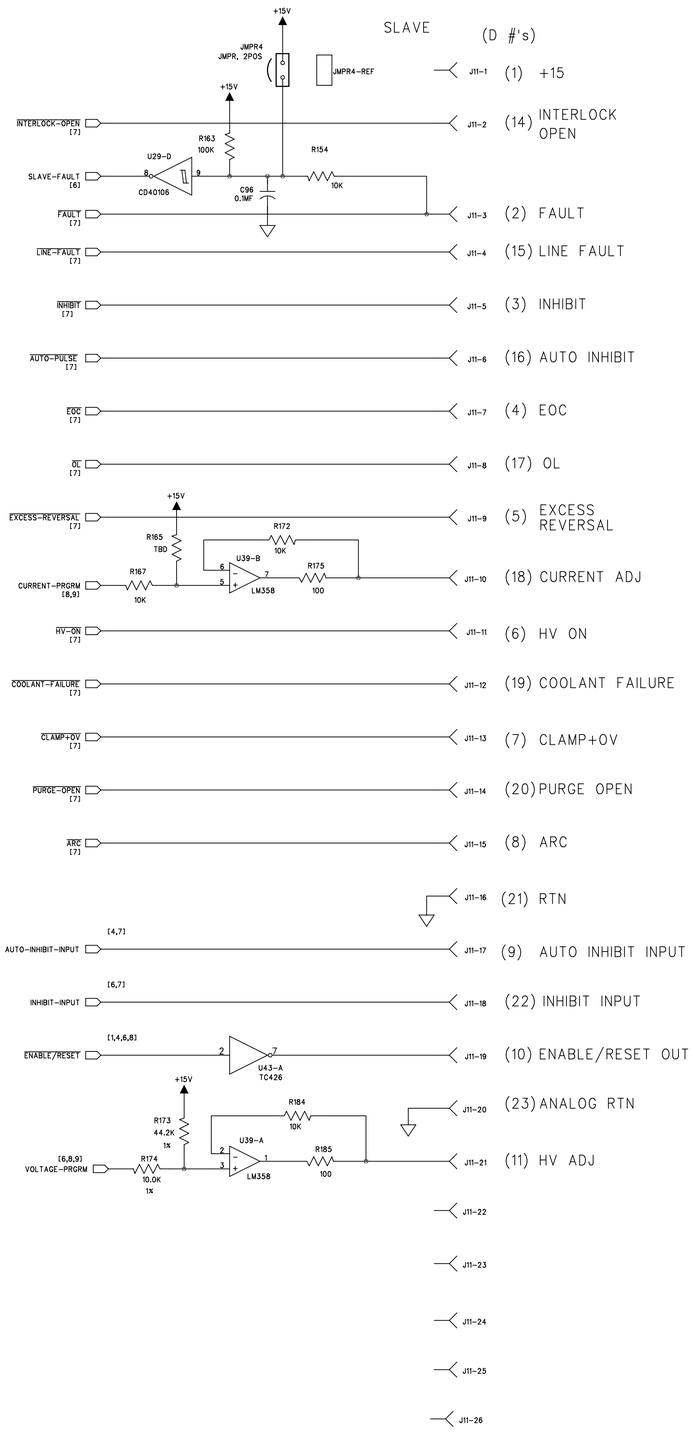


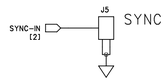
FAULT

TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ale systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DATE:	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: DATE:	PCB: 21-048-1300 SHEET OF 6 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE





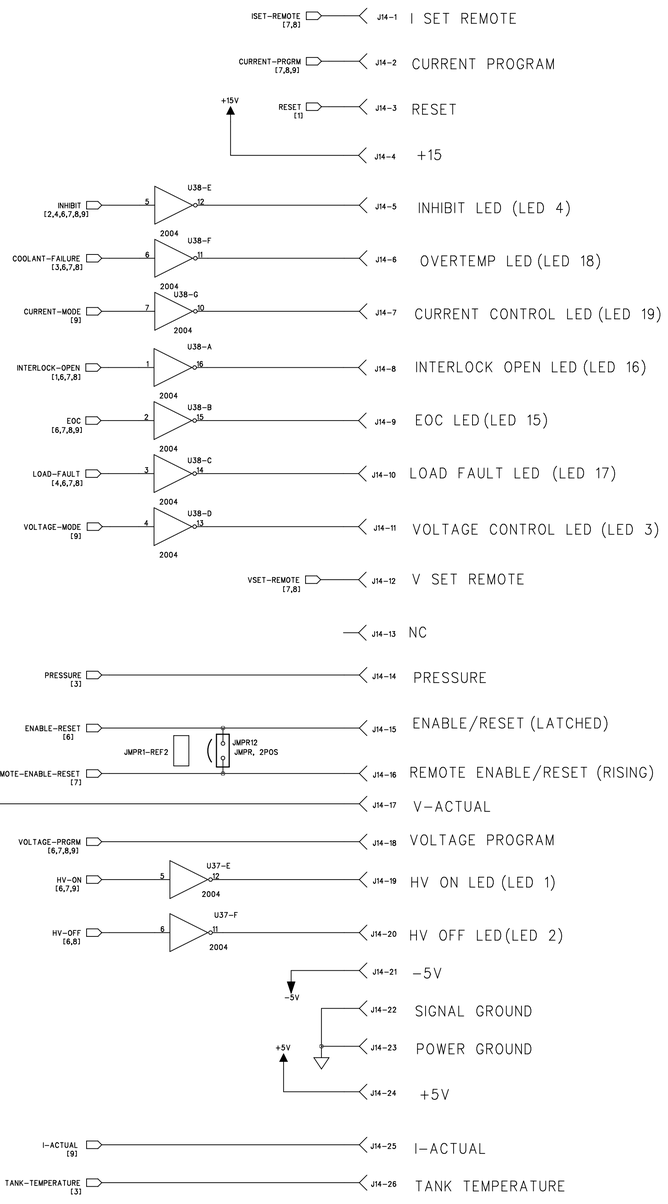


REAR-PANEL CONNECTORS

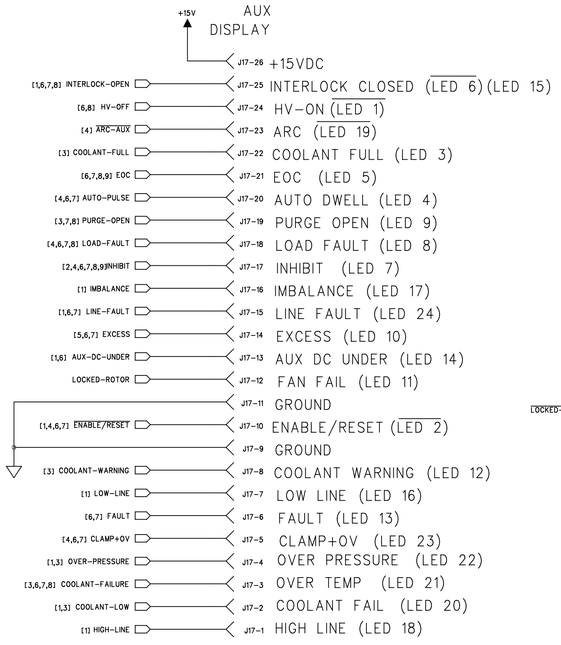
TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ole systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DATE:	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: DATE:	PCB: 21-048-1300 SHEET OF 7 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE

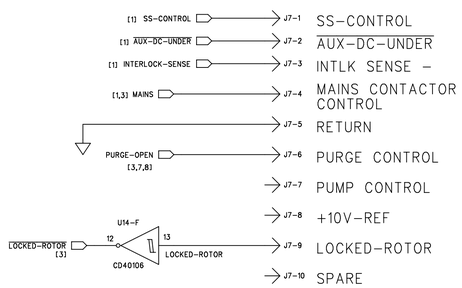
01-045-600
1202 DISPLAY

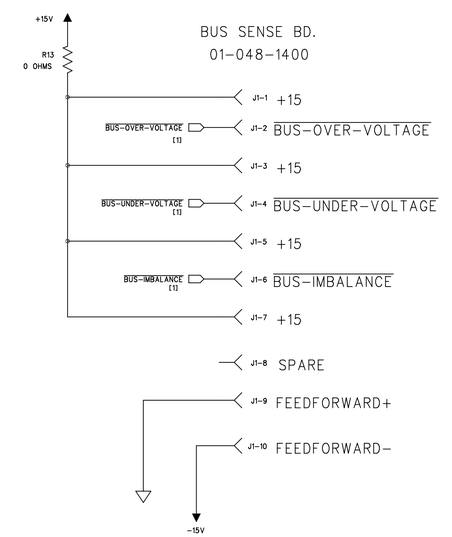


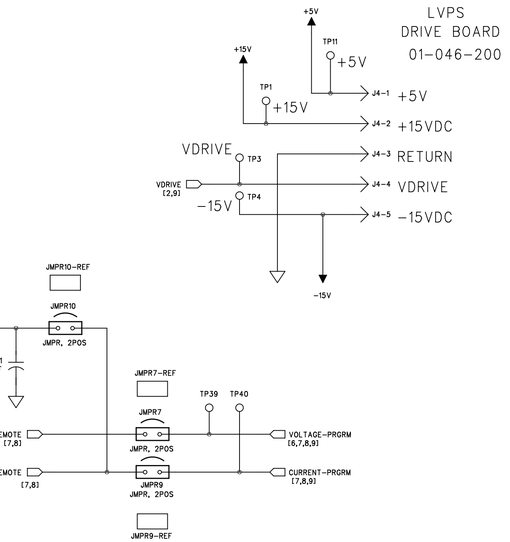
01-046-100
AUX DISPLAY



LVPS RELAY DRIVER BOARD
01-046-200





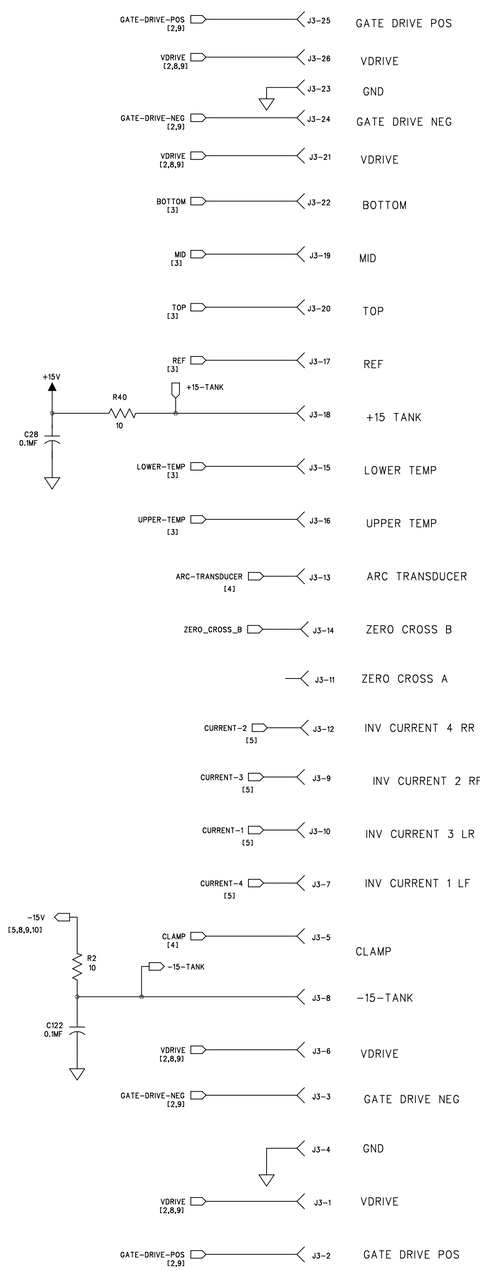


CONNECTORS

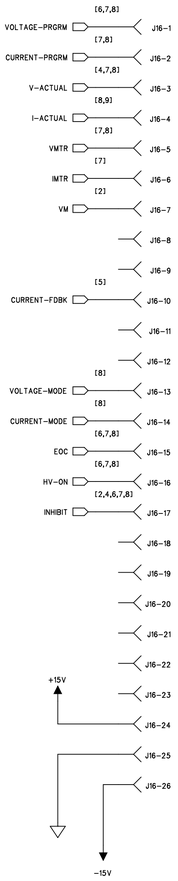
TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ole systems LAMBDA AMERICAS	
	PRJ.MGR: DATE:	DWN: DATE:	TITLE: DIGITAL PCB CONTROL 303X	
	MFG: DATE:	CHK: DATE:		
P/L:	DOC.REL: DATE:	ENG: DATE:	PCB: 21-048-1300	SHEET OF 8 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300	REV. C

APPLICATIONS			REVISIONS			
USED ON	NEXT ASSY	QTY	LTR	ECO NO	BY/DATE	APP/DATE

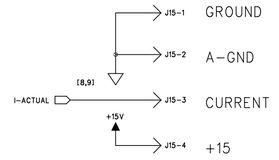
HEADER FEED THRU
TANK CONN



ANALOG CONTROL BD
01-048-1200



BAR GRAPH DISPLAY BD
01-047-1700

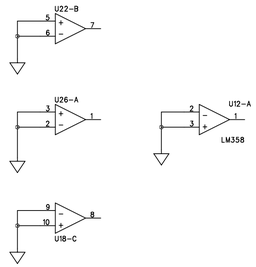


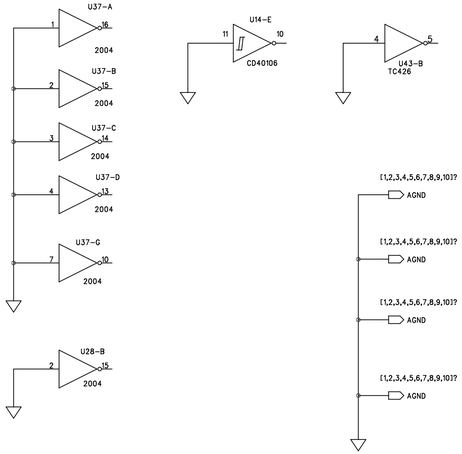
TANK CONNECTOR

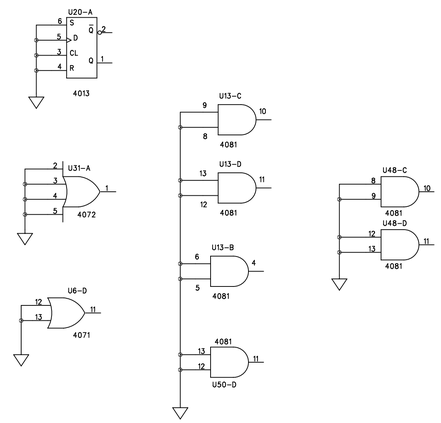
TOL: .X = ±.02, .XX = ± .01, .XXX = ± .005, FRAC = ± 1/64, ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ole systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DATE:	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: DATE:	PCB: 21-048-1300 SHEET OF 9 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

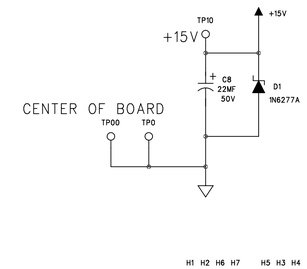
APPLICATIONS		
USED ON	NEXT ASSY	QTY

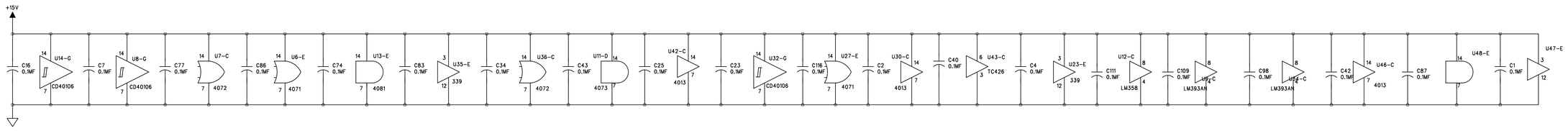
REVISIONS			
LTR	ECO NO	BY/DATE	APP/DATE

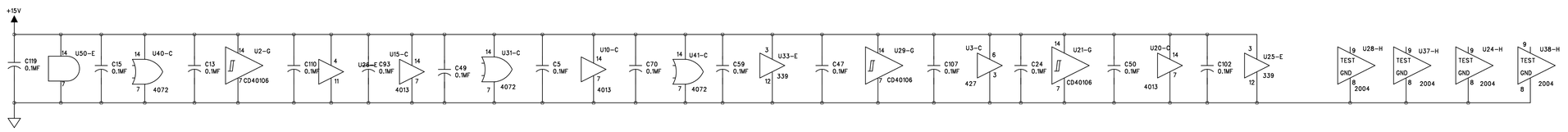


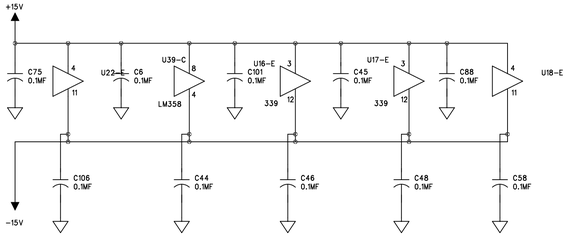


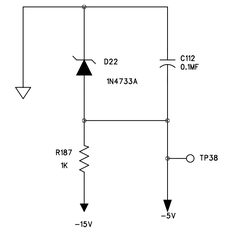












SPARE GATES

TOL: .X = ±.02 .XX = ± .01 .XXX = ± .005 FRAC = ± 1/64 ANGLES = ± 1/2	RELEASE TO MFG	ENG CONTROL	ale systems LAMBDA AMERICAS
	PRJ.MGR: DATE:	DWN: DATE:	TITLE: DIGITAL PCB CONTROL 303X
	MFG: DATE:	CHK: DATE:	
P/L:	DOC.REL: DATE:	ENG: DATE:	PCB: 21-048-1300 SHEET OF 10 10
SCALE:		APP: DATE:	DRAWING NO: 01-048-1300 REV. C

THIS IS A COMPUTER GENERATED DWG.
NO MANUAL REVISIONS ARE PERMITTED.

LTR	E.C.O. NO.	BY	APP.
1	INIT REL HPS020696 11/13/12	AEH	
A	REL TO PROD 3/16/16	AEH	AEH

BAR GRPH BD
20-047-1700
01-047-1700

LED BD
20-046-500
01-046-101

FRNT PNL
BD
26-045-65X
01-045-600

ASSY FP
26-609-XXX
ON/OFF
SWITCH

CONTROL BD
20-048-13XX
01-048-13XX

ANALOG INT BD
20-048-12XX
01-048-12XX

BUS SENSE BOARD
20-048-13XX
01-048-13XX

HV TANK ASSY
26-573-XXX
TANK SIGNAL CONNECTOR
VOLTAGE FEEDBACK
CURRENT FEEDBACK
UNRA+
UNRA-
UNRB+
INVERTER RETURN A
INVERTER RETURN B

C1 C2 C3 C4 C5 C6
R3A 20K 11W
R3B 20K 11W
FB2 F6 100A 300V
FB3 F9 100A 300V

L1 125uH 100A
L2 125uH 100A

AI 001-0036 LINE RECTIFIER

K2 10A 240VAC 124-0011 INRUSH RELAY

K1 124-0008 MAIN CONTACTOR 110A 600VAC

C7 25uF 440VAC
R1 330K 1W
C8 25uF 440VAC
R2 330K 1W

26-595-XXX
REAR PANEL
ASSY
REMOTE CONN.
SLAVE CONN.
INHIBIT BNC
TB1
INTERLOCK LOOP
POWER ON

LVPS
20-046-200
01-046-200
PURGE
RECTIFIER
+24VDC
DC RETURN
RP FAN
M1

FB1
F1 100A
F2 100A
F3 100A
VR1 VR2 VR3 VR4 VR5 VR6

J1
400 or 480VAC
3Ø

CHASSIS GROUND

INRUSH COIL
MAIN CONTACTOR COIL

SS1 SF1 SS2 SF2
T1 T2
S1 F1 S2 F2

F4 5.0A 600VAC 2X F5
FB2

DO NOT SCALE DWG.

SHEET 1 OF 2

MTL: N/A	TOL: .X = ± .02" .XX = ± .01" .XXX = ± .005" FRAC. = ± 1/64" ANGLES = ± 1/2°	REL. TO MFG. PRJ. ENG. DATE: AEH 11/13/12	ENG. CTL. DWN: DATE: AEH 11/13/12	TDK-Lambda
		MFG: GS 3/23/16 DATE:	B Huhn 3/29/16	TITLE: SCHEMATIC SYSTEM 303 SERIES 2 (400/480V)
FIN: N/A	P/L: 489	DOC. REL. DATE: A Hague 3/31/16	ENG: DATE: AEH 11/13/12	
	SCALE: N/A	CHK: DATE:	APP: DATE: A Hague 3/31/16	DWG. NO. 01-489-100 REV. A

THIS IS A COMPUTER GENERATED DWG.
NO MANUAL REVISIONS ARE PERMITTED.

APPLICATION			LTR	E.C.O. NO.	BY	APP.
USED ON	NEXT ASSY.	QTY.		SEE SHT 1		

MAIN CONTROL BOARD 303 S2
20-048-13XX
01-048-13XX

HV TANK WITH HEADER FEEDTHROUGH

HV TANK WITH PCB FEEDTHROUGH

REMOTE CONNECTOR

SLAVE CONNECTOR

26 PIN RIBBON

J3 J2 J8 J11

PIN 1 OF J2

PIN 1 OF J3

J3 J2

TO CONTROL BOARD?

2 PIN J8

ANALOG CTL
20-048-12XX
01-048-12XX

26 PIN RIBBON J16 — 26 PIN RIBBON J1

REMOTE VOLTAGE FEEDBACK

INTERNAL VOLTAGE FEEDBACK

CURRENT FEEDBACK

BNC J7 BNC J6 BNC J5 BNC J4 BNC J3 BNC J2

LVPS
20-046-200
01-046-200

10 PIN RIBBON J7 — 10 PIN RIBBON J13

5 PIN MOLEX J4 — 5 PIN MOLEX J6

BUS SENSE BOARD
20-048-13XX
01-048-13XX

10 PIN RIBBON J2 — 10 PIN RIBBON J1

BNC J3 — 6 PIN AMP J1

TO CONTROL BOARD

TO DC BUS

26 PIN RIBBON J17

26 PIN RIBBON J1

ACTUAL SIGS

ACTUAL LEDS

303 LED DISPLAY BOARD
20-046-101
01-046-100

26 PIN RIBBON J16 — 26 PIN RIBBON J1

303 FRONT PANEL
20-045-651 (GRN)
20-045-652 (RED)
20-045-650
01-045-600
(NEW-RELAY)

4 PIN J15 — 4 PIN J15

LED BAR GRAPH
20-047-1700
01-047-1700

4 PIN J2 — 10 PIN MOLEX J5 — 10 PIN MOLEX J1 — 2 PIN J15 — 2 PIN J3 — 2 PIN J4 — 3 PIN J16

RECTIFIER ON PANEL

LEGACY CTL BOARD

RP INTERLOCK

RP ON/OFF

CONTACTOR

SOFT START

RP FAN

FP ON/OFF

SPARE FAN

24VAC XFMR

PURGE

SHEET 2 OF 2

MTL:	TOL:	REL. TO MFG.	ENG. CTL.	TDK-Lambda
N/A	.X = ± .02"	PRJ. ENG. DATE:	DWN: DATE: SEE SHT 1	
	.XX = ± .01"			TITLE: CTL INTERCONNECT 303 S2 CONTROL BD
	.XXX = ± .005"	MFG: DATE:	CHK: DATE:	
FIN: N/A	FRAC. = ± 1/64" ANGLES = ± 1/2°	P/L: 489	DOC. REL. DATE:	ENG: DATE:
		SCALE: NONE	CHK: DATE:	APP: DATE:
				DWG. NO. 01-489-100 REV. 1