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TITLE
MANUAL FOR MODEL XPS50P50

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INSTRUCTION MANUAL

For

XPS50P50

HIGH VOLTAGE POWER SUPPLY

FOR X-RAY TUBE APPLICATIONS

FILAMENT DEPEND ON BEAM

WITH SLOW START AT 240 SECOND

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Table of Contents

1. Introduction

1.1 DEFINITION OF SYMBOLS

Direct Current

Protective Conductor Terminal

Caution (refer to accompanying documents)

Caution, risk of electric shock

1.2 DESCRIPTION OF THE XPS50P50

The XPS50P50 high voltage power supply represents an advanced approach to X-ray generator power requirements. This power supply provides all of the power, control, and support functions required for practically all X-ray applications. The XPS50P50 provides high voltage, high current outputs with very low ripple. Stable voltage and current output result in significant performance improvements. Low output ripple provides higher intensity levels, with no increase in tube loading.

All of these advancements are possible only by CPS's long history in High Voltage power systems. This power supply utilizes extremely advanced switching conversion techniques, along with sophisticated control technology.

The XPS50P50 is designed for X-ray tube applications where the high voltage is a positive polarity, and the filament circuits are referenced to cathode ground potential (grounded filament).

The X-ray tube voltage and tube emission current are all continuously adjustable. Constant emission current operation is available.

The power supply operates from +24Vdc and is convection cooled for 0 to 50W models. Custom designed units for single use or OEM applications are available.

1.3 XPS50P50 SPECIFICATIONS

Output Control: Voltage and current are adjustable via a twenty-turn potentiometer.

Input Voltage: 24VDC ± 1V
Input Current: maximum 4.5 A with filament and HV output at full load.

Beam Voltage:
0 to +50kV DC
Load regulation: 0.01% of full voltage for a no load to full load change.
Line regulation: 0.01% of full voltage over specified input voltage range.

Beam Current:
0 to 1mA
Load regulation: 0.01% of full current from 0 to rated voltage.

Line regulation: 0.01% of full current over specified input voltage range.

Ripple: 0.1% p-p of maximum output voltage.

Filament: 4 A, 6.6V maximum

Stability: 0.05% per 7 hours after ½ hour warm up.

Temperature Coefficient: 0.01% per °C. Higher stability models are available on special orders.

Ambient Temperature: 0°C to 50°C operating, -20°C to 85°C storage.

Weight: <11.5 lb (5.2 kg)

Size: 3.937"H x 6.3"W x 10.0"D (10x16x25.4cm)

1.4 STANDARD AND OPTIONAL FEATURES

1.4.1. Local Standard Operating Features

The XPS50P50 incorporates several standard features designed to optimize user's satisfaction and safety.

Emission (beam) current set point ramp: This feature provides for a gradual rise for mA. Ramp rate is approximately 240 seconds. This ramp condition is started at the initial INTERLOCK CLOSED control signal.

INDICATOR LEDS: HIGH VOLTAGE OFF, HIGH VOLTAGE ON and POWER ON indicators.

OUTPUT CABLE: The XPS50P50 model is provided with a 1 meter shielded high voltage output cable. The cable is designed with a plug arrangement so that they can be easily removed from the mating receptacle located on the front of the chassis.

1.4.2. Remote Standard Operating Features

REMOTE MONITOR: Allows remote monitoring of the tube voltage and tube emission current.

EXTERNAL INTERLOCK: Interlock connections are provided on J1-4 on the front of the chassis for connection to a safety switch. The unit will not operate unless the interlock circuit is closed through a 12V lamp rated for 0.5W to 0.8W. During high voltage operation, opening the interlock circuit will cause the High Voltage and the Filament to shut off. This option should be used for safety interlock circuits. The lamp can be replaced with a wire if fail-safe interlocking of the X-ray ON is not required.

1.4.3. Optional Operating Features

DIFFERENT OUTPUT VOLTAGES: The following optional output ratings are available:

- 0 – 20 kV at 2.5 mA **Option 20A**
- 0 – 30 kV at 1.67 mA **Option 30A**
- 0 – 40 kV at 1.25 mA **Option 40A**
- 0 – 65 kV at 0.67 mA **Option 65A**

2. INSPECTION & INSTALLATION

Initial inspection and preliminary checkout procedures are recommended. For safe operation, please follow the step-by-step procedures described in Chapter 3, Operating Instructions.

2.1 INITIAL INSPECTION

Inspect the package exterior for evidence of damage due to handling in transit. Notify the carrier and CPS immediately if damage is evident. Do not destroy or remove any of the packing material used in a damaged shipment. After unpacking, inspect he panel and chassis for visible damage.

2.2 MECHANICAL INSTALLATION

The XPS50P50 has a mounting pattern on the top and side of the chassis. The unit is fully enclosed and is suitable for bench or tabletop operation. Standard unit dimensions are shown in Figure 2.1.

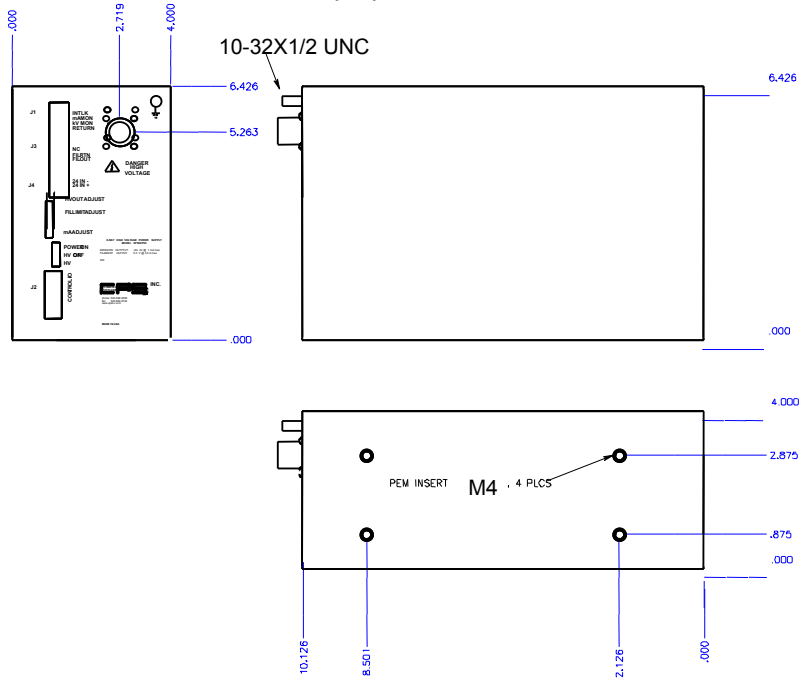


FIGURE 2.1 XPS50P50 STANDARD DIMENSIONS

3. OPERATING INSTRUCTIONS

3.1 OPERATION

WARNING!

THIS EQUIPMENT GENERATES DANGEROUS VOLTAGE THAT MAY BE FATAL. PROPER GROUNDING OF ALL HIGH VOLTAGE EQUIPMENT IS ESSENTIAL.
Failure to follow these procedures may void the warranty.

LOCAL PROGRAMING: Allows local adjustment of the output voltage and current. Jumpers are installed on connector J2 in the front of the chassis between J2-6 and J2-7 for voltage control and between J2-3 and J2-4 for current control figure 3.4.

A) Check the input voltage rating on the nameplate of the supply and make certain that this is the rating of the available power source. CPS units operate on 24VDC unless ordered with a different input voltage.

B) PROPER GROUNDING TECHNIQUE:
The chassis of high voltage power supplies must be grounded, preferably to an earth system ground using copper pipe or other earth ground using the connection terminal on the front of the unit. See Figure 3.1 for a typical operating set-up.

The return line from the load should be connected to the stud on the front panel. Using a separate external ground at the load is not recommended.

C) Attach the output cable to the load.

D) Plug the high-voltage output cable into the front of the supply and hand tighten the knurled collar.

E) For initial turn-on, rotate the HV OUT ADJUST and mA ADJUST (in the front panel) control fully counter-clockwise to the zero voltage and current position.

F) The input power may now be connected.

G) Close the INTERLOCK J1_1 to J1_4, figure 3.3. The LED inside should light up and the output will slow start to the preset level output voltage and /or output current.

H) TO SET THE FILAMENT LIMIT, connect a 2.5Ω 10W filament resistive load in series with an AMP METER to J3. Ramp beam voltage up to 30kV. Adjust mA ADJUST clockwise to turn on the FILAMENT, adjust FIL LIMIT ADJUST in the front panel counter-clockwise to lower the current limit vice-verse. The filament current should be at approximately 3 A.

I) In the front panel, adjust HV OUT ADJUST clockwise for the High Voltage from 0V to 50kV max, then adjust mA ADJUST clockwise to get your desire **Emission (beam) current**.

NOTE: The XPS50P50 is equipped with a slow start circuit that ramps the output up to its maximum setting in approximately 240 seconds after the INTERLOCK is closed.

J) To terminate the generation of output power, open the INTERLOCK. In the HIGH VOLTAGE OFF mode, the power supply's interface circuits are still active.

K) To turn off the power supply, disconnect the power.

WARNING!
AFTER TURNOFF, DO NOT HANDLE THE LOAD UNTIL
THE CAPACITANCE HAS BEEN DISCHARGED!

LOAD CAPACITANCE MAY BE DISCHARGED BY SHORTING TO GROUND.

3.2 STANDARD FEATURES

Whenever possible, electrical isolation should be provided when interfacing with any high voltage power supply. For power control signals such as EXTERNAL INTERLOCK, HIGH VOLTAGE OFF and HIGH VOLTAGE ON isolated relay contacts should be used. If possible, analog programming and monitoring signals should be isolated via analog isolation amplifiers. CPS application engineers are available to assist in interface circuitry design. All interface cables should be properly shielded. All power supply signals should be referenced to the power supplies signal ground on J1-1, J4-1, J2-8 or J2-9.

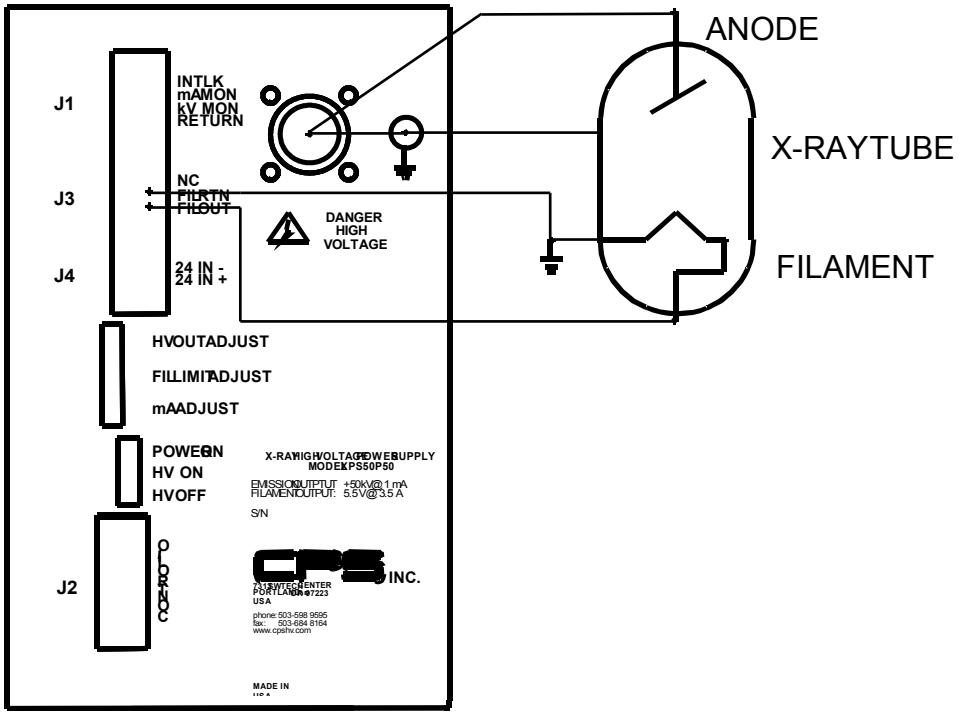
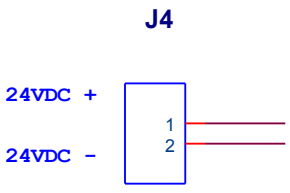
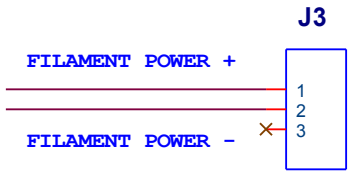


Figure 3.1 TYPICAL OPERATING SETUP XPS50P50



INPUT POWER



FILAMENT OUTPUT

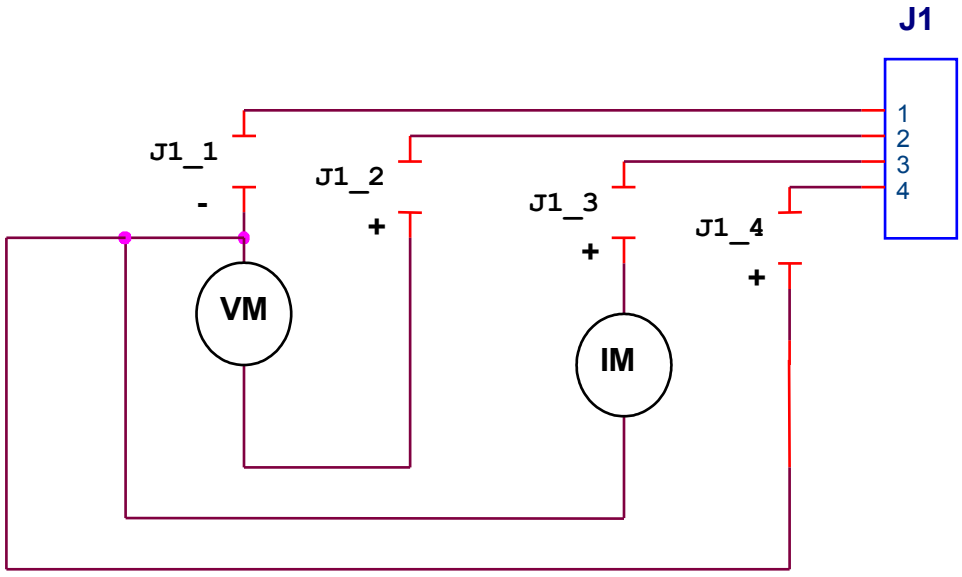
Figure 3.2 DC INPUT & FILAMENT CONNECTIONS

REMOTE PROGRAMMING: Allows remote adjustment of the output voltage and current via an external voltage source. For remote programming, the jumpers are removed and a positive voltage source, from 0 to 10 volts is applied to the appropriate terminals. Programming signals should be referenced to J2-8 or J2-9 signal ground. By adjusting the voltage source from 0 volt (zero output) to 10 volts (full rated output) the desired output can be selected. See Figure 3.4 for wiring and specification.

An alternate method of controlling the output remotely is by using external resistance, such as a potentiometer or a resistor network. For remote control the jumpers are removed and the desired resistor configuration installed. See figure 3.4 for wiring diagram.

REMOTE MONITOR: Test points are made available at J1 on the front of the chassis for monitoring the beam voltage and beam current output. The test points are always positive regardless of the output polarity where 0-10 volts equals 0-100% of output. Test points have output impedance of <100 ohms. See Figure 3.3 for test point designations.

EXTERNAL INTERLOCK: Interlock connections are provided on J1-4 on the front of the chassis for connection to a safety switch. The unit will not operate unless the interlock circuit is closed. During high voltage operation, opening the interlock circuit will cause the unit to revert to the HIGH VOLTAGE OFF mode. See Figure 3.3 on for the recommended interface circuit.



VM – VOLTAGE MONITOR (DVM), IM – CURRENT MONITOR (DVM)

Figure 3.3 MONITORS & INTERLOCK CONNECTIONS

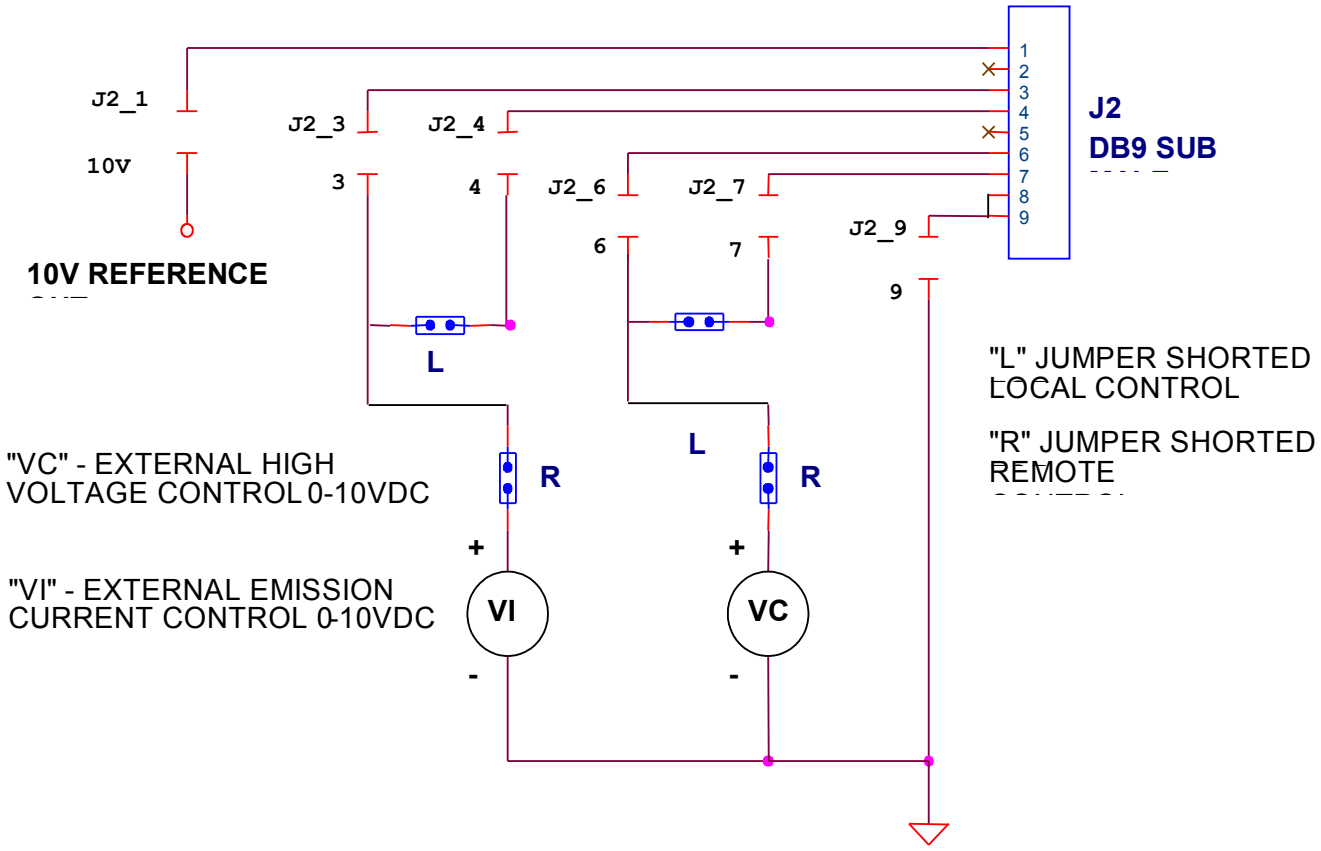


Figure 3.4 LOCAL/REMOTE CONTROL

4. PRINCIPLES OF OPERATION

The XPS50P50 high voltage power supply utilizes sophisticated power conversion technology. A variety of analog, and power conversion techniques are used throughout. The intention of the Principles of Operation is to introduce the basic function blocks that comprise the XPS50P50 power supply. For details on a specific circuit, consult CPS's Engineering Department.

The XPS50P50 power supply is basically a DC-to-DC power converter. Within a power supply, conversions of DC to high frequency AC then to high voltage DC take place. By reviewing further the sub-assemblies, a basic understanding of the process can be gained.

4.1 CHASSIS

The XPS50P50 is a compact, high efficiency, high voltage power supply. The power supply can supply up to 50 watts of DC power. (Output power capability may be higher or lower depending upon model ordered). Output voltages of up to 65 kV can be generated.

4.2 INVERTER

The inverter is a switch mode push-pull topology. A PWM scheme is used for regulating the power generated from the inverter. High-speed MOSFET switches are used to convert 24VDC to high frequency (~50kHz) AC signals. These devices provide high frequency switching to control the power flow.

4.3 HIGH VOLTAGE TRANSFORMER

The output of the High Frequency Switching Inverter is connected to the primary of the High Voltage Transformer. The High Voltage Transformer is a step up type. Typical secondary voltages are in the range of 6 kV peak-to-peak depending upon output voltage ratings.

4.4 HIGH VOLTAGE ASSEMBLY

The High Voltage Assembly will vary depending upon the model ordered. The circuitry typically consists of a half wave voltage multiplier. The higher voltage ranges utilize various series arrangements of a voltage doubler.

Output filtering is typically provided by an R-C type filter. Voltage feedback for regulation and monitoring is provided by a high bandwidth resistive/capacitive divider. Current feedback for regulation and monitoring is provided by a sense resistor connected at the low voltage end of the High Voltage Rectifier/Multiplier Circuit.

4.5 CONTROL PCB

The majority of control circuits for power supply are located on the CONTROL/POWER PCB.

Auxiliary voltages: +15VDC, -15VDC, and +10VDC are generated on the CONTROL/POWER PCB. High voltage On/Off control is accomplished by relay and its associated circuitry. Interlock control is provided by K1.

Program voltages are typically ramped up to set level by the slow start circuits.

4.6 FILAMENT SUPPLY

The filament inverter provides the power for the X-ray tube filament. The filament inverter is a high frequency switch mode inverter. The inverter provides regulated current to the primary of the filament transformer. The filament transformer secondary is then connected to the output connector. The filament supply is a highly regulated, stable current source.

SAFETY

5.1 OPERATIONAL SAFETY

THIS POWER SUPPLY GENERATES VOLTAGES THAT ARE DANGEROUS AND MAY BE FATAL. OBSERVE EXTREME CAUTION WHEN WORKING WITH THIS EQUIPMENT.

High voltage power supplies must always be grounded.

Do not touch connections unless equipment is off and the capacitances of both the load and power supply are discharged.

Do not ground yourself or work under wet or damp conditions.

5.2 SERVICING SAFETY

Maintenance may require removing the instrument cover with the power on.

Servicing should only be done by qualified personnel aware of the electrical hazards.

“WARNING” notes in the text call attention to hazards in the operation of these units that could lead to possible injury or death.

“CAUTION” notes in the text indicate procedures to be followed to avoid possible damage to equipment.

Technical and safety assistance can be obtained from:

Bill Tanner / Frank Feng
7313 SW Tech Center Dr
Portland, OR 97223, USA

Phone: 503-598 9595
Fax: 503-684-8164
e-mail: Piotr@cpshv.com
Frank@cpshv.com

WARNING!

IF THE EQUIPMENT IS USED IN ANY MANNER NOT SPECIFIED BY THE CPS, INC. (MANUFACTURER), THE PROTECTION PROVIDED IN THE POWER SUPPLY MAY BE IMPAIRED CAUSING EQUIPMENT DAMAGE.

WARRANTY

Seller (CPS, Inc.) warrants equipment of its manufacture against defective materials or workmanship for a period of one year from date of shipment.

The liability of Seller under this warranty is limited, at Seller’s option, solely to repair, replacement with equivalent CPS equipment, or an appropriate credit adjustment not to exceed the original equipment sales price, of equipment returned to the Seller provided that (a) Seller is promptly notified in writing by Buyer upon discovery of defects, (b) the defective equipment is returned to Seller, transportation charges prepaid by Buyer, and (c) Sellers’ examination of such equipment disclosed to its satisfaction that defects were not caused by negligence, misuse, improper installation, accident or unauthorized repair or alteration by Buyer.

This warranty is applicable to the original Buyer only and constitutes the sole and exclusive warranty of Seller. No other warranty is made, expressed or implied.

FINAL INSPECTION
TEST DATA SHEET

CPS
7313 SW TECH CENTER DR
PORTLAND, OR 97223
USA

MODEL No. XPS50P50 REV B
SERIAL No. 4041
DATE: 16 JAN 04

BURN-IN 100 HRS ☑
STABILITY ☑ %/8 hrs

INPUT VOLTAGE 24 V DC + -5%

INPUT CURRENT 4.5 A MAX

OUTPUT VOLTAGE SWING 0 KV to 50 KV

OUTPUT + 50 KV

LINE REG <.01 %

DROP OUT <.01 %

SHORT CKT ☑

I LIMIT 1mA ☑

ACCURACY ☑ %

RIPPLE .05% Vp-p

LOAD REGULATION <.01 %

ARC TEST ☑

RECOVERY ☑

V METER 10 V @ 50 KV

I METER 10 V @ 1 mA

OUTPUT VOLTAGE CURRENT	.5mA EMISSION INPUT CURRENT	1mA EMISSION INPUT
50KV	2.07 A	3.32 A
40KV	1.95 A	3.06 A
30KV	1.72 A	2.73 A

CUSTOMER AUSTIN AL
SALES ORDER No. 3514

TESTED BY VQD
Q.C.

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