Edit 01-16-18

AMADA MIYACHI AMERICA, INC.

Laser Solutions for Advanced Manufacturing
1820 South Myrtle Ave, PO Box 5033, Monrovia, CA 91017-7133 (626) 303-5676 FAX: (626) 599-9636

E13: Deionize Trouble
E54: Deionize Caution

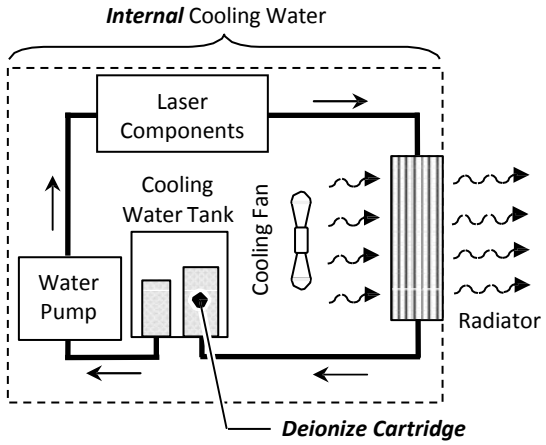
Troubleshooting Deionize Errors

The "**E13 – Deionize Trouble**" and "**E54 – Deionize Caution**" alarms indicate that the resistivity (ρ) of the Lasers *internal* cooling water is *low*. Resistivity is an intrinsic property that defines the quality of the *internal* cooling water. The higher the quality, the less conductive. For stability, the flashlamp (located in the oscillator chamber) is submersed in the internal cooling water to allow for optimized cooling. Therefore in order for proper Laser operation, the water resistivity[1] must be > 2MΩ·cm in order for the flashlamp to ignite when high-voltage is applied. If the resistivity is too low, the high-voltage will find an alternate path through the water rather than through the flashlamp. Low resistivity may also produce an **E14: Simmer Trouble** error.

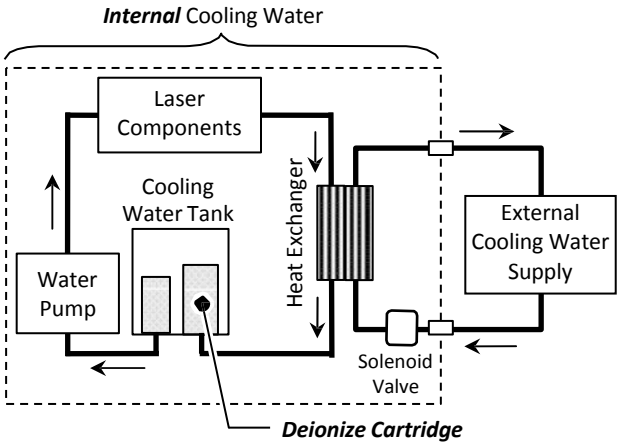
E13	Deionize Trouble	ρ ≤ 2MΩ·cm
E54	Deionize Caution	2MΩ·cm < ρ ≤ 3MΩ·cm

To ensure that the *internal* cooling water maintains a high resistivity, Steam-Distilled Water and a Deionize Cartridge (filled with deionize resin) is used. As the *internal* cooling water is circulated through the Laser, it passes through the Deionize Cartridge (located inside the Cooling Water Tank[2]) which removes ions from the water via an ion exchange process. Basic layouts of the air-cooled and water-cooled systems are shown below for convenience.

Note 1: The resistivity of water is dramatically affected by temperature (typically 10% / °C).
The operational resistivity value is specified at the Lasers normal operating temperature.
Note 2: The LW500A/600A Laser contains two Deionize Cartridges.



Air-Cooled Lasers
LW5A(M)/15A/25A/50AC/70AC/2AG/5AG



Water-Cooled Lasers
LW50A/70A/150A/300A/400A/500A/600A

The term "Deionize" and DI will be used interchangeably throughout this document. The meanings are the same.

An **E13: Deionize Trouble** and **E54: Deionize Caution** error can be caused by many things including:

1. Laser Not Ready
2. Expired Deionize Resin
3. Contaminated / Incorrect type of Water
4. Faulty Power Supply
5. Faulty Connection
6. Faulty Resistivity Sensor
7. Faulty Main PCB

1. Laser Not Ready

When the Laser is first turned on, the resistivity of the water will be too low for Laser operation. Once the Laser passes all of its initial tests, the water pump will turn on and circulate the internal cooling water through the DI Cartridge. When the resistivity of the water falls within an acceptable range, the Laser will be ready for operation (once all other tests have passed). If an **E13** or **E54** error appears during start-up, press the **Trouble Reset** button and allow more time for the ion exchange process to occur. The **Trouble Reset** button must be pressed in order to activate the water pump. If the water isn't cycled through the DI Cartridge, the resistivity will never increase. If the resistivity has not increased to an acceptable range (as noted by the value on the LCD Display) after 30 minutes, continue with the next troubleshooting step.

2. Expired Deionize Resin

As the DI Resin ages, it will take longer to raise the resistivity until it is no longer able to deionize the cooling water sufficiently. The typical operational life for the DI Resin is approximately 6 months. Note that the DI Resin is light sensitive and its effectiveness will decrease if allowed to be exposed to light for long periods of time. The **E13** error means that the DI Resin is no longer able to deionize the water sufficiently. The **E54** error means that the DI Resin is approaching its useful life. In both cases the DI Resin (and possibly the DI Cartridge) should be replaced. The DI Cartridge is used to hold the Resin and should be replaced approximately every 3 Resin changes.

The Deionize cartridge assembly consists of two parts; the DI Resin and the DI Cartridge. The DI Resin and DI Cartridge are available separately but can also be purchased as a kit (with both parts included). Instructions on how to replace the DI Resin are described in the Maintenance section of the appropriate Operator's Manual. Refer to the table below to identify the correct parts for your Laser. For convenience, both the Amada Miyachi America (AMYA) and Amada Miyachi Japan (AMY) parts numbers are provided.

Laser Model	Operator Manual	DI Resin		DI Cartridge		DI Kit (Resin + Cartridge)	
		AMYA	AMY	AMYA	AMY	**AMYA**	**AMY**
LW2AG	990-544	318-023	MLF-0020	318-022	MLF-0022	318-024	MLF-0024
LW5AG	990-558						
LW5A(M)/15A/25A	990-534						
LW50A/70A/150A	990-535	318-026	MLF-0021	318-025	MLF-0023	318-027	MLF-0025
LW300A(H)/400A	990-538						
LW500A/600A (x2)	990-539						

If changing the DI Resin and/or Cartridge does not eliminate the **E13** or **E54** errors, continue with the next troubleshooting step.

3. Contaminated / Incorrect type of Water

Using the wrong type of water can also greatly affect the deionization process. Since tap water contains an abundance of ions (Na^{+}, Ca^{2+}, Fe^{2+}, Cu^{2+}), the DI Resin may not have the capacity to remove enough ions to make the water useful inside the Laser. Likewise deionized water has virtually no ions but can be corrosive to the internal components of the Laser. In both of these cases, the use of Tap Water or deionized water is not recommended.

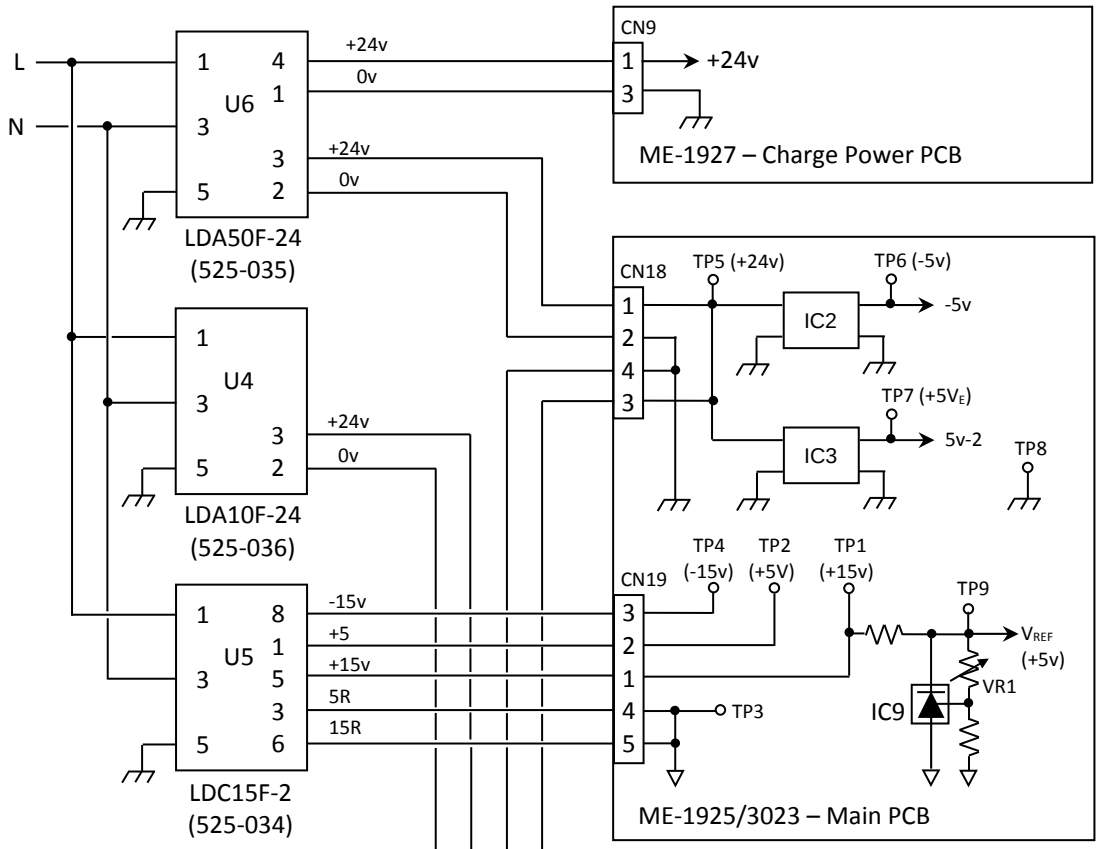
Amada Miyachi America uses and recommends Steam-Distilled water for all A-Series Lasers. Steam-Distilled water is made by boiling water and collecting the steam (distillation process). Steam-Distilled water is very clean and works well in all A-Series Lasers. If you are unable to source steam-distilled water locally, it is available through Amada Miyachi America, Pt # 900-241.

If the condition/type of the water is not known or if the DI Resin has been replaced and the Laser Welder still displays the **E13** or **E54** errors, replace the water. Refer to the appropriate Operator's Manual for instructions. If the water is replaced and still displays the **E13** or **E54** errors, continue with the next troubleshooting step.

4. Faulty Power Supply

An **E13** or **E54** error can also be caused by faulty Power Supply voltage. Typically a power supply fault will also yield other error messages as well. Using a DMM, measure the power supply voltages on the **CPU** (Main PCB) at the appropriate test points (see tables below for a list of test points and expected voltages). If all voltages test OK, continue with the next step. If there is a problem with one or more of the power supply voltages, isolate the failure based on the schematics below. Refer to the AMYA Support site (www.amyasupport.com/lsd) under "Service" for more information on component / test point locations.

LW5A(M)/15A/25A/2AG/5AG Laser Welders (8-xxx-01-xx)
with ME-1925/ME-3023 Main PCB – Power Distribution for Single E-Stop/Interlock Lasers



ME-1925/3023 Test Points:

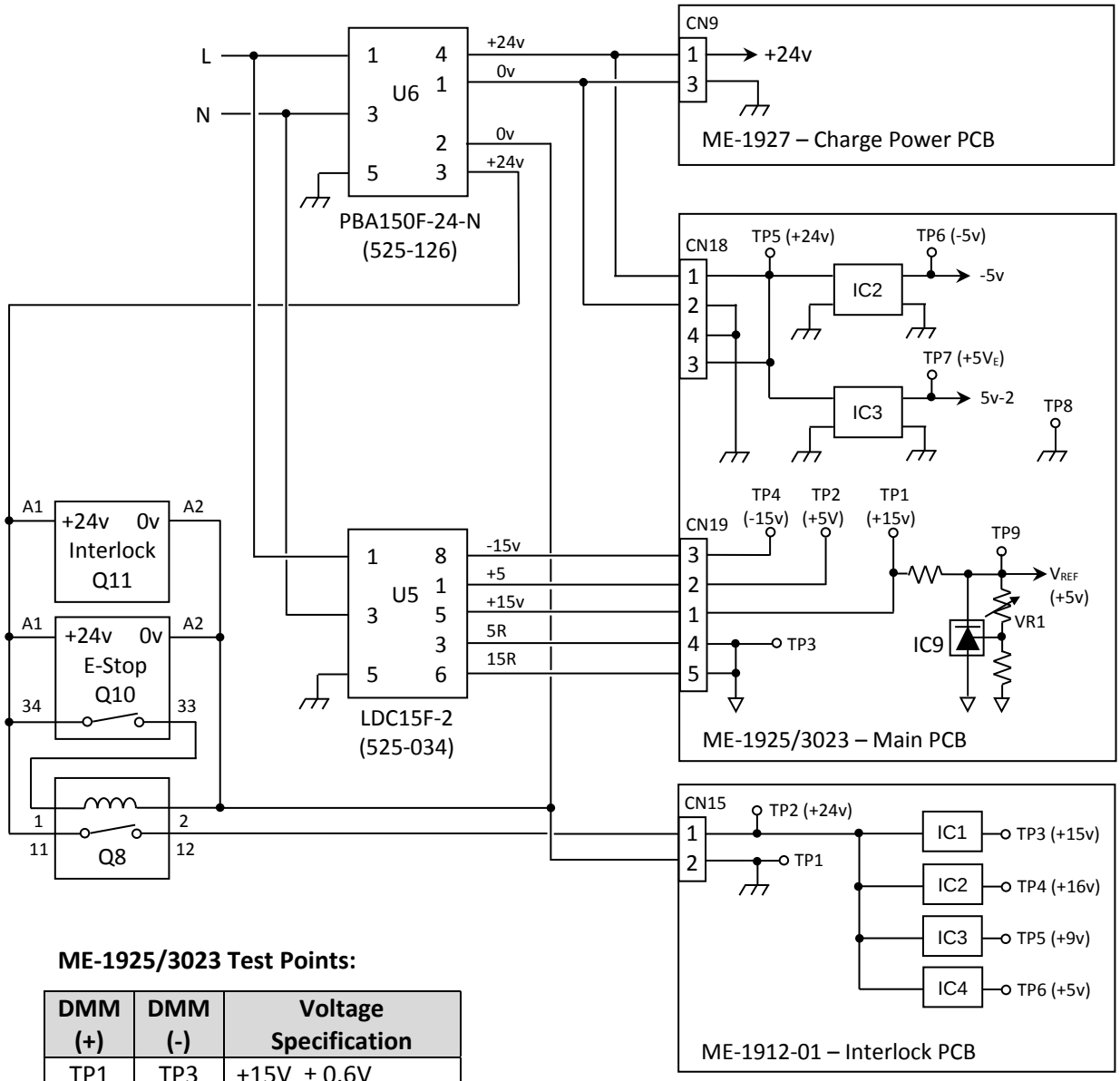
DMM (+)	DMM (-)	Voltage Specification
TP1	TP3	+15V ± 0.6V
TP2	TP3	+5V ± 0.2V
TP4	TP3	–15V ± 0.6V
TP9	TP3	+5V$_R$ ± 0.01V
TP5	TP8	+24V ± 0.5V
TP6	TP8	-5V ± 0.2V
TP7	TP8	+5V$_E$ ± 0.2V

Note: +5V$_R$ is adjusted by VR1 on Main PCB

Fuse F1: 218.002P (AMYA # 330-198)

U4, U5 and U6 are mounted to the inside chassis wall behind the Main PCB and Interlock PCB.

LW5A(M)/15A/25A/2AG/5AG Laser Welders (8-xxx-02-xx)
with ME-1925/ME-3023 Main PCB – Power Distribution for Dual E-Stop/Interlock Lasers



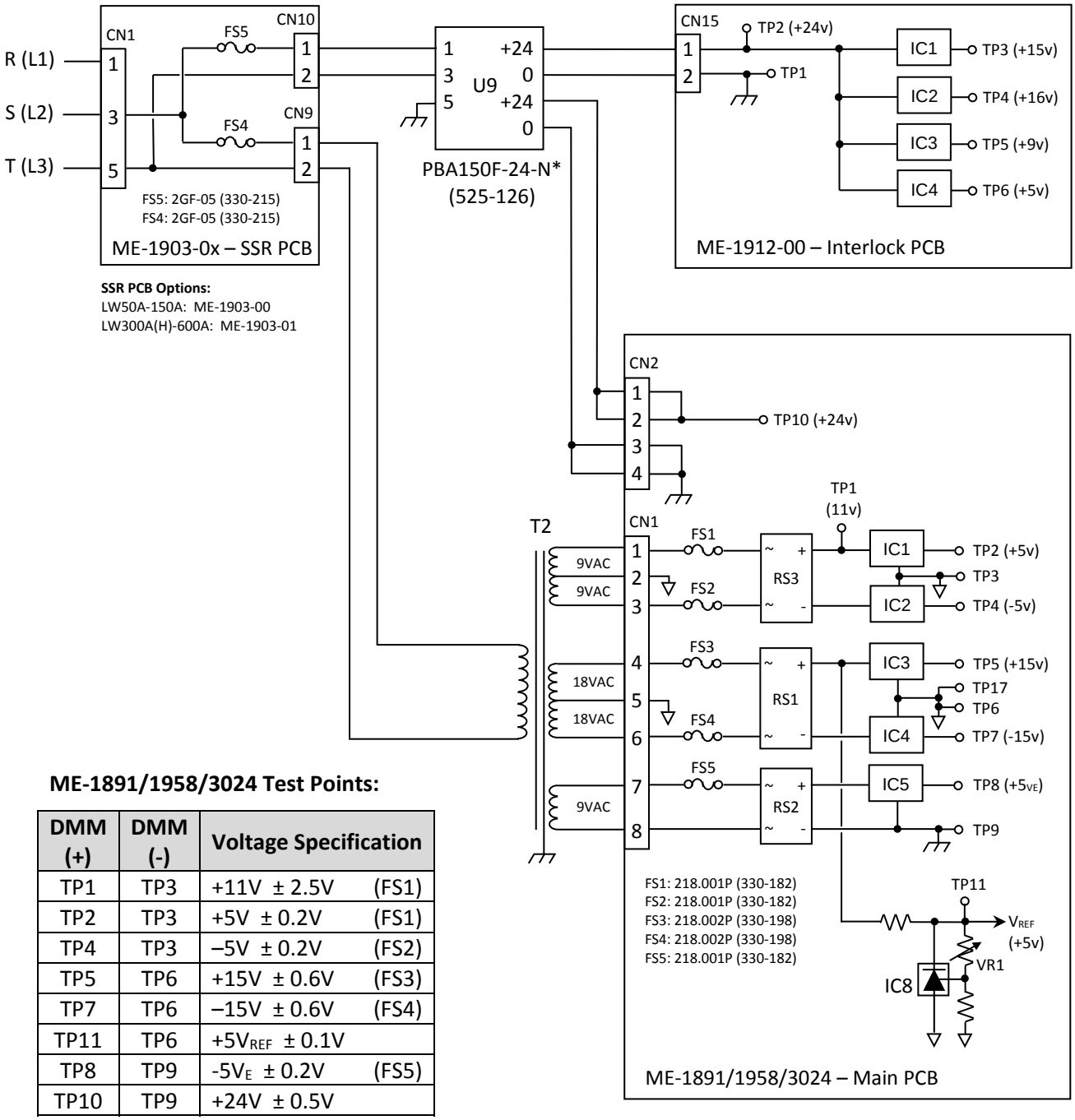
ME-1925/3023 Test Points:

DMM (+)	DMM (-)	Voltage Specification
TP1	TP3	+15V ± 0.6V
TP2	TP3	+5V ± 0.2V
TP4	TP3	–15V ± 0.6V
TP9	TP3	+5V$_R$ ± 0.01V
TP5	TP8	+24V ± 0.5V
TP6	TP8	-5V ± 0.2V
TP7	TP8	+5V$_E$ ± 0.2V

Note: +5V$_R$ is adjusted by VR1 on Main PCB

Power Supplies U5 & U6 are mounted to the inside chassis wall behind the Main PCB and Interlock PCB. Safety Relays Q10 / Q11 and relay Q8 are mounted on the chassis wall just below the Main PCB.

LW50A(C)/70A(C)/150A/300A(H)/400A/500A/600A Laser Welders (8-xxx-01-xx)
with ME-1891/ME-1958/ME-3024 Main PCB – Power Distribution for Single E-Stop/Interlock Lasers



ME-1891/1958/3024 Test Points:

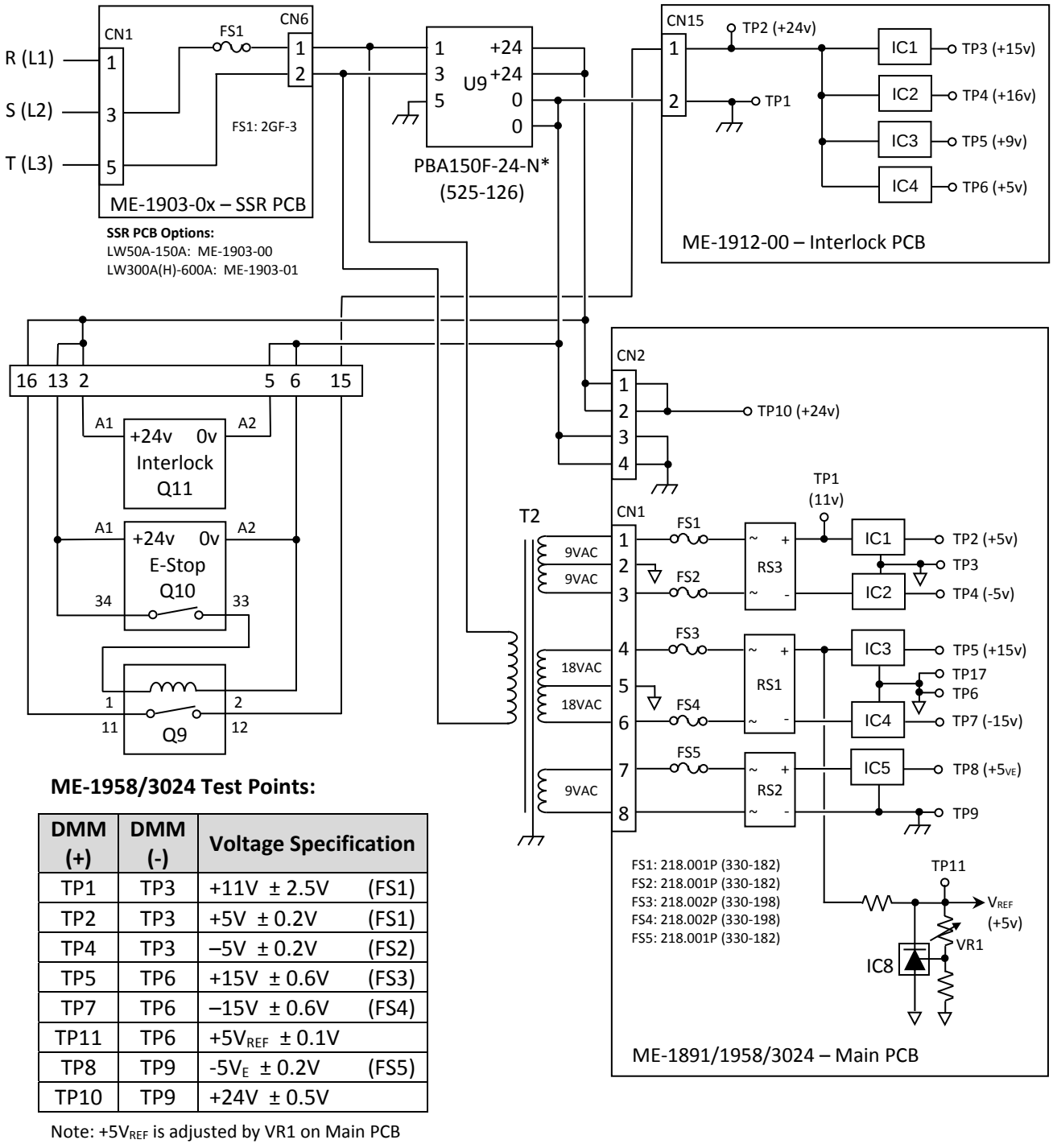
DMM (+)	DMM (-)	Voltage Specification	
TP1	TP3	+11V ± 2.5V	(FS1)
TP2	TP3	+5V ± 0.2V	(FS1)
TP4	TP3	–5V ± 0.2V	(FS2)
TP5	TP6	+15V ± 0.6V	(FS3)
TP7	TP6	–15V ± 0.6V	(FS4)
TP11	TP6	$+5V_{REF}$ ± 0.1V	
TP8	TP9	$-5V_E$ ± 0.2V	(FS5)
TP10	TP9	+24V ± 0.5V	

Note: $+5V_{REF}$ is adjusted by VR1 on Main PCB

The simplified schematic shown above highlights all important power supply connections and does not show all discrete components.

* At the time of this document's publish date, Power Supply U9 shown above is typical for 220VAC U.S. LW50A/70A/150A Laser Models. However, depending on the Laser Model, Date of Manufacture and destination country, Power Supply U9 may be different than shown. If a faulty power supply is found, read the model number of the power supply itself in order to determine the correct replacement.

LW50A(C)/70A(C)/150A/300A(H)/400A/500A/600A Laser Welders (8-xxx-02-xx)
with ME-1958/ME-3024 Main PCB – Power Distribution for Dual E-Stop/Interlock Lasers



ME-1958/3024 Test Points:

DMM (+)	DMM (-)	Voltage Specification	
TP1	TP3	+11V ± 2.5V	(FS1)
TP2	TP3	+5V ± 0.2V	(FS1)
TP4	TP3	–5V ± 0.2V	(FS2)
TP5	TP6	+15V ± 0.6V	(FS3)
TP7	TP6	–15V ± 0.6V	(FS4)
TP11	TP6	$+5V_{REF}$ ± 0.1V	
TP8	TP9	$-5V_E$ ± 0.2V	(FS5)
TP10	TP9	+24V ± 0.5V	

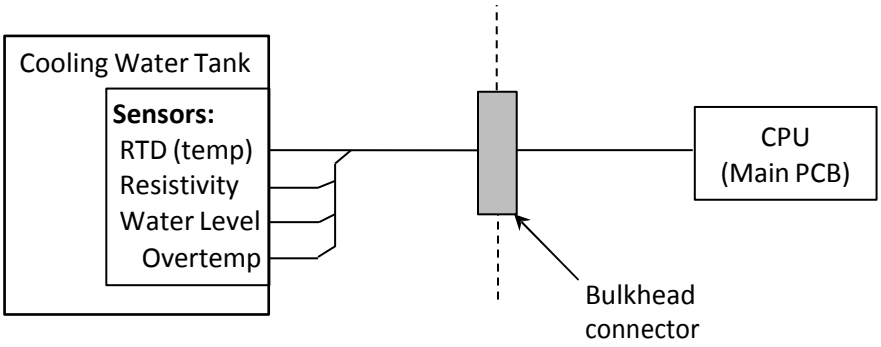
Note: $+5V_{REF}$ is adjusted by VR1 on Main PCB

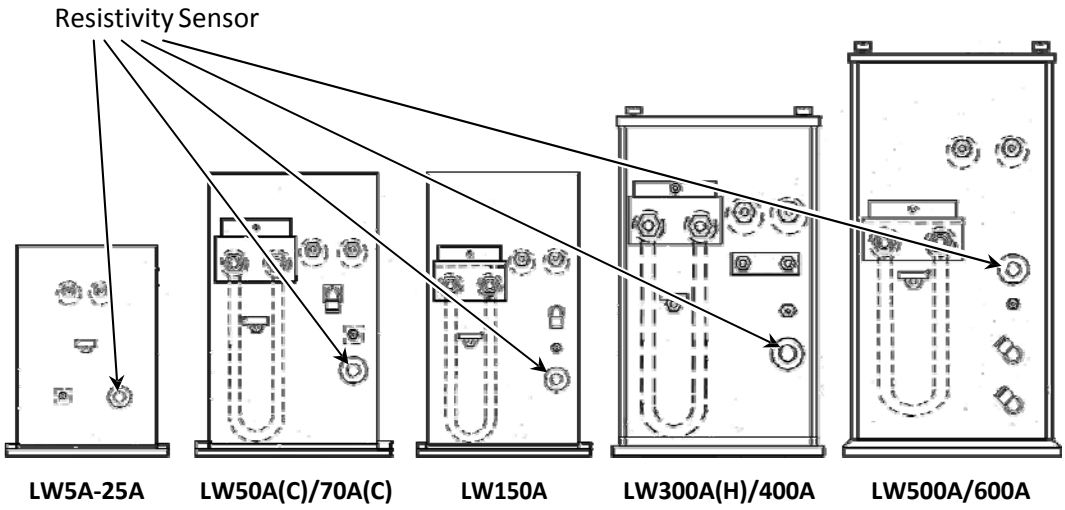
The simplified schematic shown above highlights all important power supply connections and does not show all discrete components.

* At the time of this document's publish date, Power Supply U9 shown above is typical for 220VAC U.S. LW50A/70A/150A Laser Models. However, depending on the Laser Model, Date of Manufacture and destination country, Power Supply U9 may be different than shown. If a faulty power supply is found, read the model number of the power supply itself in order to determine the correct replacement.

5. Faulty Connection

Occasionally a connection problem may arise between the resistivity sensor and the CPU (Main PCB). The resistivity sensor is physically located on the Cooling Water Tank. The resistivity sensor is wired to bulkhead Molex style connector that is mounted to the chassis near the water pump assembly. Sometimes the bulkhead connector gets corroded (especially in harsh operating environments). The bulkhead connector can be located by following the wires from the resistivity sensor to the bulkhead connector. If the bulkhead connector is corroded, the contacts can be cleaned with contact cleaner or simply repetitive connect/disconnects. The locations of the bulkhead connectors vary among Laser models.

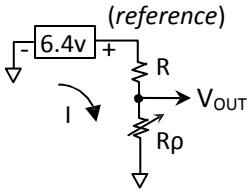


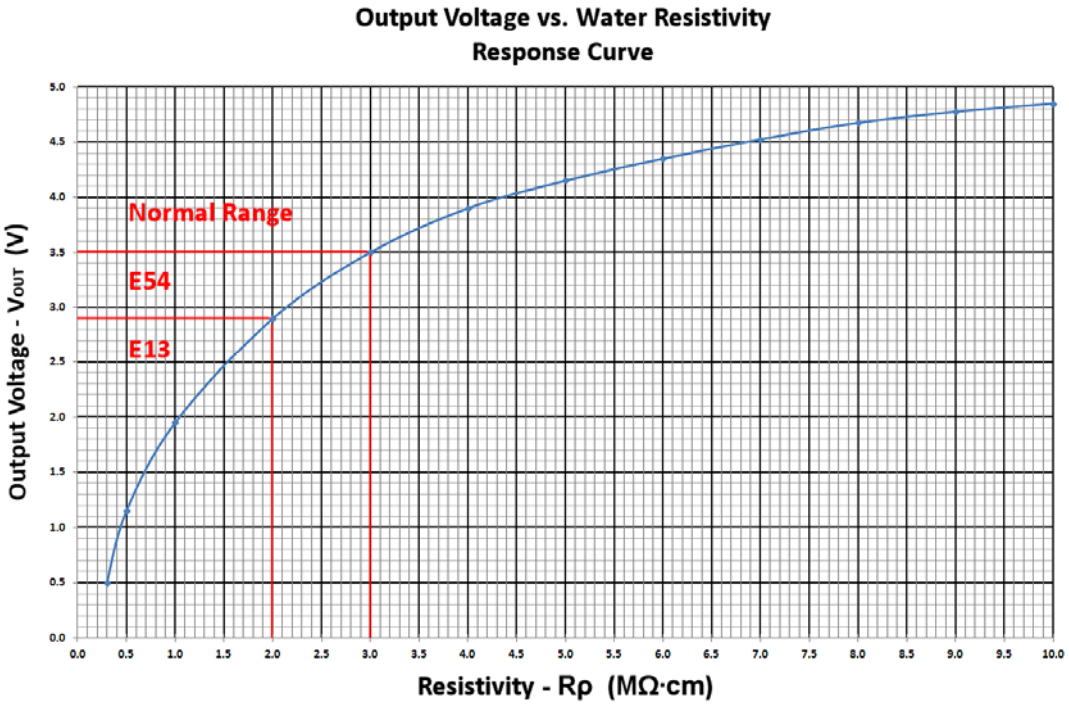


If the bulkhead connection cannot be verified, continue with the next troubleshooting step in order to test the resistivity sensor connections. The results of the next step will verify the bulkhead connection.

6. Faulty Resistivity Sensor

It is very rare for a Resistivity Sensor to go bad. In order to rule out a faulty sensor, this section describes "how to test it". The Resistivity Sensor circuit is a simple voltage divider that works by applying a small current between two probes physically spaced 2mm apart and using the water as the conductive medium (Rρ). As the resistivity of the water increases, the voltage divider output (V_{OUT}) also increases. This output voltage (V_{OUT}) is then measured by the µP (microprocessor) on the Main PCB and the resistivity value is then calculated and displayed on the LCD screen. The response of the Resistivity Sensor is shown below.



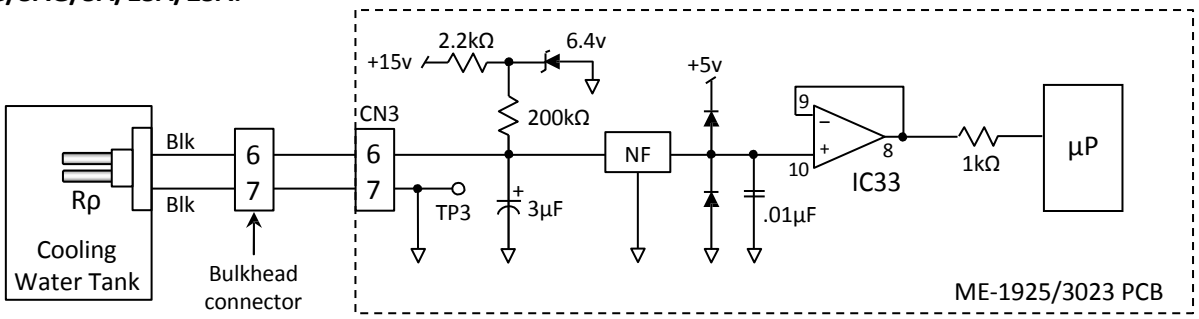


Using a DMM, measure the voltage on the Main PCB at the locations indicated in the table below. Take care when making these measurements, as a slip of the DMM lead may damage the Main PCB.

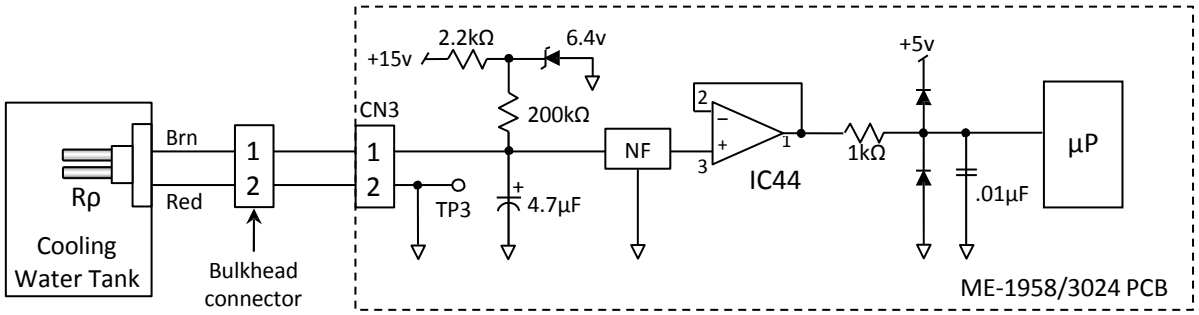
Laser Model	DMM		EXPECTED RESULTS
	(+)	(–)	
LW2AG + LW5AG	ME-1925/3023 – IC33 pin 8	ME-1925/3023 – TP3	Normal ≈ ≥ 3.5v 2.9v ≤ E54 < 3.5v E13 < 2.9v
LW5A(M)/15A/25A	ME-1925/3023 – IC33 pin 8	ME-1925/3023 – TP3	
LW50A(C)/70A(C)/150A	ME-1958/3024 – IC44 pin 1	ME-1958/3023 – TP3	
LW300A(H)/400A	ME-1958/3024 – IC44 pin 1	ME-1958/3023 – TP3	
LW500A/600A	ME-1958/3024 – IC44 pin 1	ME-1958/3023 – TP3	
LW50A/70A (obsolete)	ME-1891 – IC73 pin 1	ME-1891 – TP4	
LW300A/400A (obsolete)	ME-1891 – IC73 pin 1	ME-1891 – TP4	

If the DMM measures 0 v at all times, then look for a short between the Resistivity Sensor and the Main PCB.
If the DMM measures > 4.6 v at all times, then look for an open between the Resistivity Sensor and the Main PCB.
For convenience, the schematics for both the ME-1925/3023 and ME-1958/3024 Main PCB's are shown below for reference.

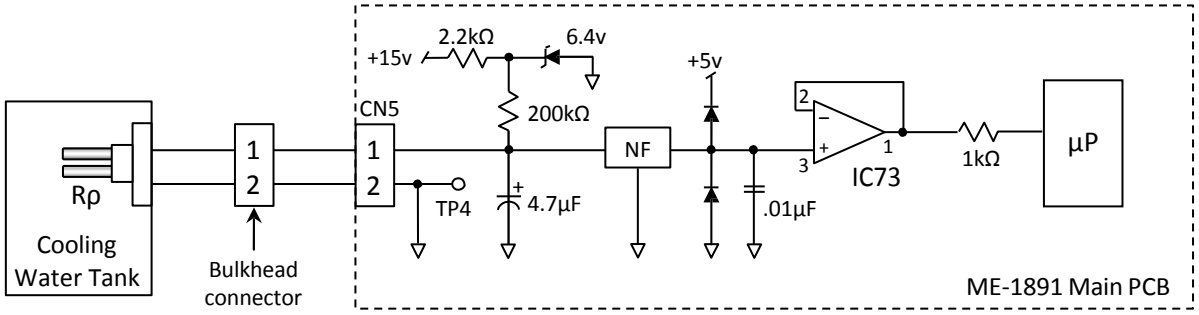
LW2AG/5AG/5A/15A/25A:



LW50A(C)/70A(C)/150A/300A(H)/400A/500A/600A:

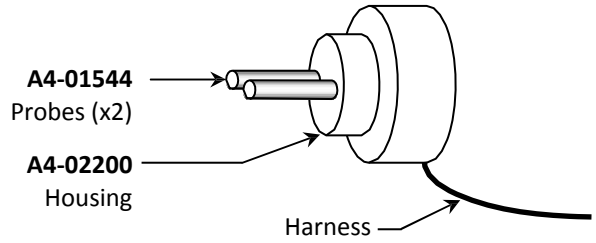


LW50A/70A/300A/400A with obsolete ME-1891 Main PCB:



If the Resistivity Sensor is determined bad, then it would be easiest to replace the complete Resistivity Sensor assembly (harness + sensor probes + housing). Refer to the table below for the correct replacement part numbers. Please note that the majority of these parts are not normally stocked and will be special order.

Laser Model	Harness	Sensor Probe	Housing	Adhesive
LW2AG + LW5AG	A-03906-001	A4-01544 (*2 required*)	A4-02200	Threebond Type 2212B Epoxy
LW5A(M)/15A/25A	A-03906-001			
LW50A(C)/70A(C)/150A	A-03504-003			
LW300A(H)/400A	A-03504-002			
LW500A/600A	A-04522-001			



7. Faulty Main PCB

If all likely causes for the **E13** and **E54** errors have been eliminated, then the Main PCB is most likely faulty. Replace the Main PCB and re-test.

End of Document