Edit 01-16-18

AMADA MIYACHI AMERICA, INC.

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

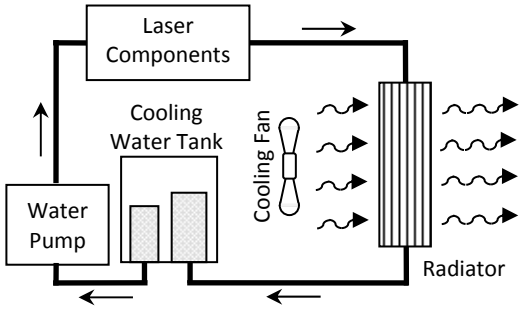
E11: Low Temperature of Coolant

Troubleshooting Water Temperature Errors

An "**E11 – Low Temperature of Coolant**" alarm indicates that the water temperature in the Laser is below the minimum operating temperature. In order to maintain proper Laser function, the operating temperature must be maintained within a specific operating temperature range.

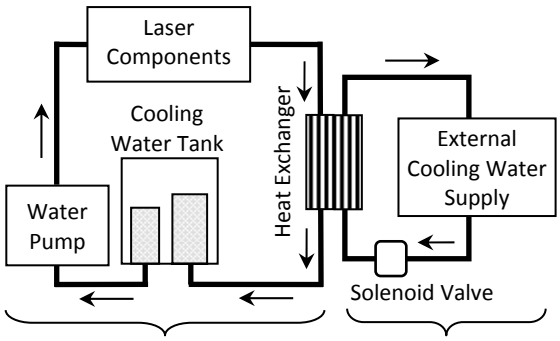
Air-Cooled Lasers – LW5A / 5AM / 15A / 25A / 50AC / 70AC / LW2AG / LW5AG

In the smaller A-Series Lasers, the operating temperature is maintained through the use of forced-air convection and a closed-loop water system. Variable speed fans are used to keep the Laser electronics cool and to provide air-flow for the cooling water system. As the cooling water cycles through the Laser, heat is drawn from the internal components and then passed through a radiator. Then through forced-air convection, air is drawn through the radiator where the internal heat is removed.



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

In the larger Lasers (LW50A-600A), the operating temperature is maintained through the use of forced-air convection and two independent water systems; (1) a secondary cooling water system and (2) a primary cooling water system. Variable speed fans are used to keep the Laser electronics cool through forced-air convection. The water from the secondary cooling water system cycles through the Laser, heat is drawn from the internal components and then passed through a heat exchanger. The primary cooling water system is a (customer supplied) external cooling water supply whose flow is regulated by the Laser through the use of a solenoid valve. When the solenoid valve is open, the primary cooling water flows through the heat exchanger where the internal heat is removed. In addition to cooling capabilities, a submersible heater is also present inside the Cooling Water Tank used to raise the operating temperature of the secondary cooling water when the Laser is used in colder environments.



An **E11: Low Temperature of Coolant** error can be caused by many things including:

1. Low Ambient Temperature
2. Incorrect Water Hook-up (LW50A-600A)
3. Dirty Solenoid Valve (LW50A-600A)
4. Faulty Connection
5. Incorrect Setting
6. Faulty Power Supply
7. Faulty Solenoid Valve (LW50A-600A)
8. Faulty RTD Sensor
9. Faulty Cooling Fan Control (Air-Cooled Lasers)
10. Faulty Heater / Heater Control (LW50A-600A)
11. Faulty Heat Exchanger (LW50A-600A)

1. Low Ambient Temperature

In order for the Laser to function properly, the ambient temperature surrounding the Laser must be greater than the minimum temperature set-point. Any temperature below this set-point will create an **E11** alarm condition.

Laser Model	Minimum Temperature (Alarm set-point)
LW2AG/5AG	> 20°C
LW5A(M)/15A/25A	> 20°C
LW50A(C)/70A(C)/150A	> 25°C
LW300A(H)/400A/500A/600A	> 25°C

When the Laser is first turned on, the water temperature in the cooling tank is measured. If the water temperature is below the minimum temperature set-point, the Laser will sit idle and wait for the water temperature to increase. If 30 minutes has lapsed and the temperature has not reached the minimum temperature set-point, an **E11** alarm will be produced. If the water temperature is increasing but is slow, press the *Trouble Reset* button on the Laser Controller and allow more time for the water temperature to increase. If the water temperature never reaches the minimum temperature set-point, it will not operate. In this case move the Laser to an area with a higher ambient temperature. In all cases, the performance and stability of the Laser is optimal when the water temperature is 30°C.

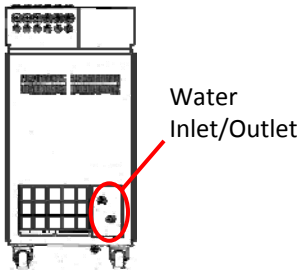
The larger water-cooled Lasers (LW50A-600A) have a submersible heater inside the cooling water tank. The heater is active when the cooling water temperature is ≤ 25°C. Once the temperature reaches 25°C, the heater turns off. The Laser can be used once the minimum operating temperature is reached.

The performance of the smaller air-cooled Lasers (LW5A(M)/15A/25A, LW2AG/5AG) are directly affected by the ambient temperature. If the ambient temperature cannot be raised to the minimum temperature set-point, the Laser will not operate. Unlike the larger Lasers, there is no submersible heater in the cooling water tank. The Laser can be used once the minimum operating temperature is reached.

2. Incorrect Water Hook-up (*LW50A-600A only*)

The water-cooled Lasers (LW50A-600A) regulate the operating temperature by allowing the (external) primary cooling water supply into the Laser through a solenoid valve. The most common cause for the **E11** alarm is due to an incorrect connection of the primary cooling water system.

First verify that the water Inlet and Outlet connections are correct. If these connections are reversed, the back pressure may not allow the solenoid valve to close. Refer to the Operator Manual to identify which connection is the Inlet and Outlet.



Second, verify the water pressure on the Inlet is ≤ 42.6 psi (294 kPa). If the pressure is too high, the solenoid valve may not close.

3. Dirty Solenoid Valve (*LW50A-600A only*)

The water-cooled Lasers (LW50A-600A) regulate the operating temperature by allowing the (external) primary cooling water supply into the Laser through a solenoid valve. If the solenoid valve is dirty or has contamination on the valve seal, it may not properly close. If the solenoid valve stays open, the secondary cooling water temperature cannot be regulated and will approach the chiller set-point.

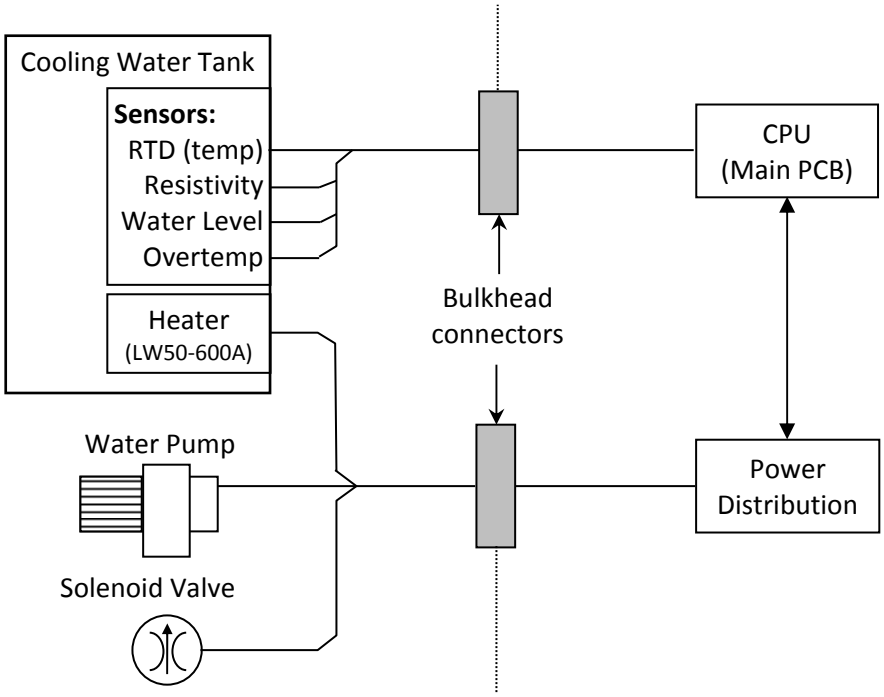
Refer to the *Maintenance Section* of the appropriate Operator's Manual for instructions on how to clean the solenoid valve. If the solenoid valve needs to frequently be cleaned, then a water filter should be added to the external water supply to prevent contaminants from entering the Laser.

Laser Model	Operator Manual
LW50A/70A/150A	990-535
LW300A(H)/400A	990-538
LW500A/600A	990-539

If there are algae in the primary cooling water system, it may clog the solenoid valve. Flush cooling water system and use the **AMYA # 900-349** corrosion inhibitor to prevent algae contamination. Once the solenoid valve is clean, verify operation or continue with the next troubleshooting step.

4. Faulty Connection

Occasionally a connection problem may arise between the cooling components and the CPU (Main PCB) / Power distribution PCB(s). All primary sensors / components responsible for maintaining the normal operating temperature are physically located in or near the Cooling Water Tank. All of these sensor / component connections are wired to bulkhead Molex style connectors that are physically mounted near the water pump assembly. Sometimes these bulkhead connectors get corroded (especially in harsh operating environments). 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, but they can be found by following the wiring harnesses to the appropriate bulkhead connector.



If these bulkhead connections cannot be verified, continue with this troubleshooting procedure in order to test each sensor / component section. The results of the tests below will verify these bulkhead connections.

5. Incorrect Laser Setting

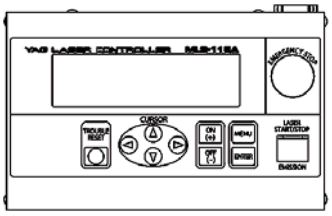
Laser performance is directly affected by the operating temperature. In order to maintain the ideal operating temperature, the laser is programmed with user-defined temperature parameters. These parameters affect the cooling water temperature / cooling fan speeds and are programmed in the Initialization Screen. Verify the parameters as defined below. DO NOT set the values to anything other than the values specified below:

Water Temperature Settings:

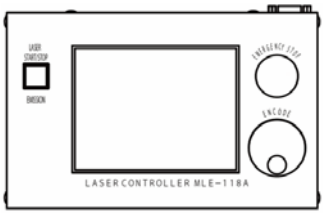
Laser Welder Model	Reference Temperature (Temp Cont)	Alarm Setting	
		Alarm "L"	Alarm "H"
LW2AG/5AG	30°C (unused)	20°C	40°C
LW5A(M)/15A/25A			
LW50A(C)/70A(C)/150A	30°C	25°C	40°C
LW300A(H)/400A			
LW500A/600A			

Cooling Fan Speed Settings (LW50A(C)/70A(C)/150A/300A(H)/400A/500A/600A):

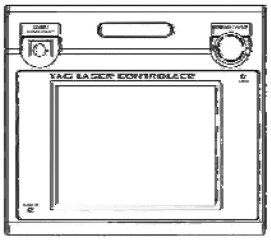
Laser Controller Setting (Initialization Settings)			Value
MLE-115A	MLE-118A	MLE-116A	
B	High ON	Medium ON	50%
D	High OFF	Medium OFF	50%
A	Low ON	Low ON	20%
C	Low OFF	Low OFF	80%



MLE-115A



MLE-118A



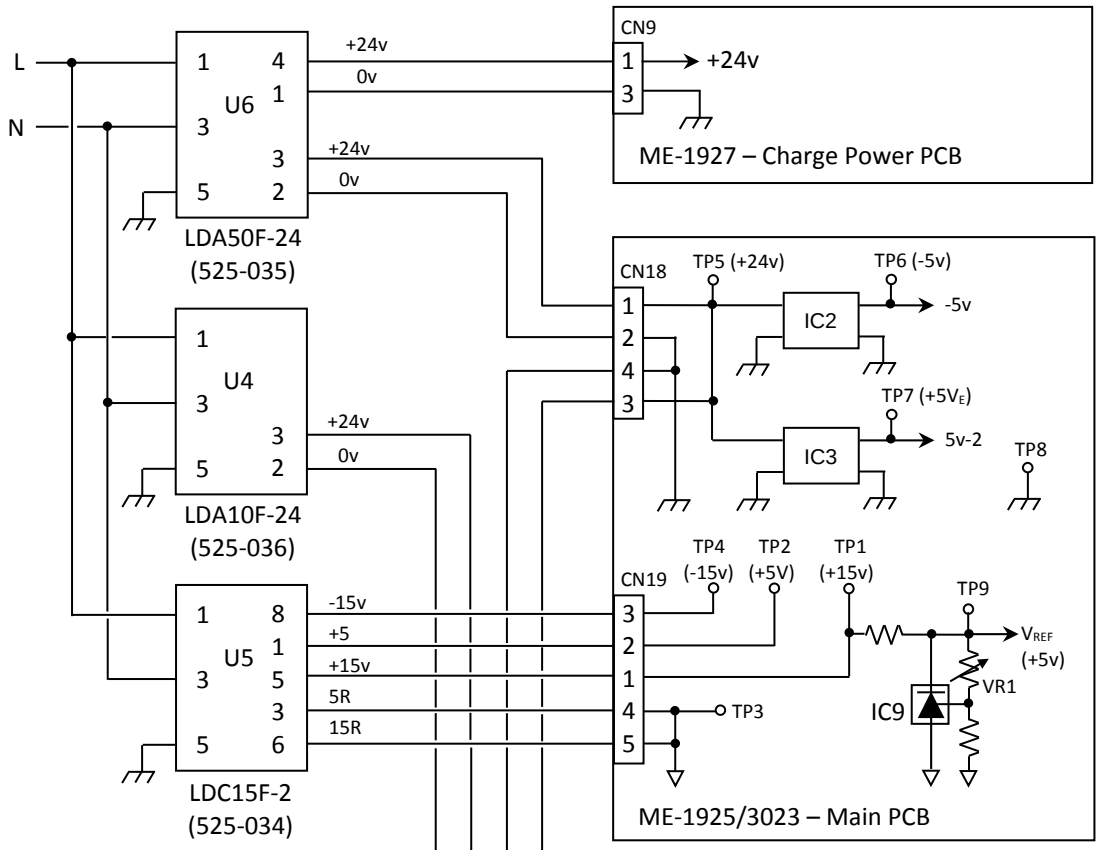
MLE-116A

6. Faulty Power Supply

An **E11** 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:

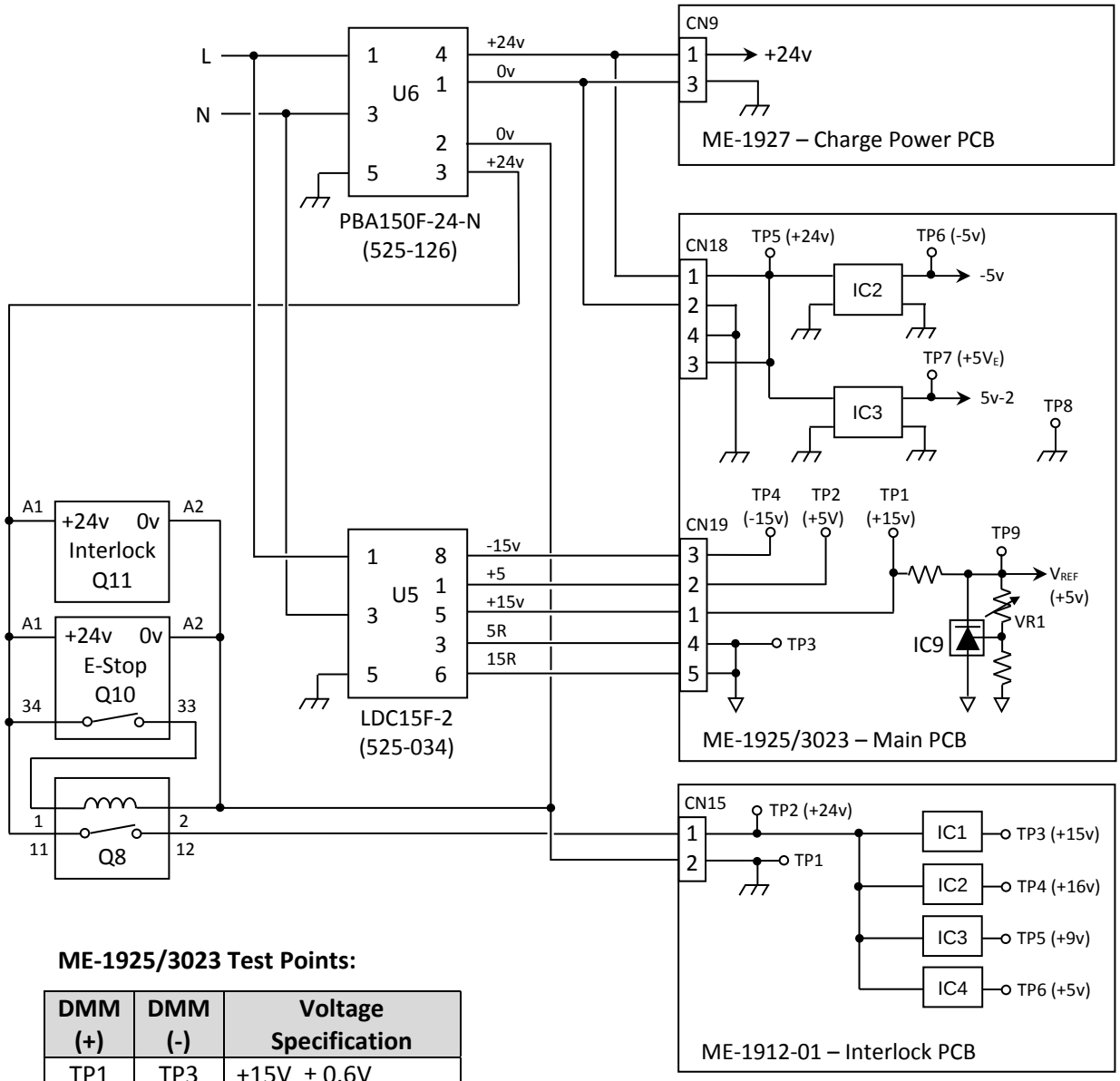
DMM (+)	DMM (-)	Voltage Specification
TP1	TP3	+15V ± 0.6V
TP2	TP3	+5V ± 0.2V
TP4	TP3	–15V ± 0.6V
TP9	TP3	+5V_R ± 0.01V
TP5	TP8	+24V ± 0.5V
TP6	TP8	-5V ± 0.2V
TP7	TP8	+5V_E ± 0.2V

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



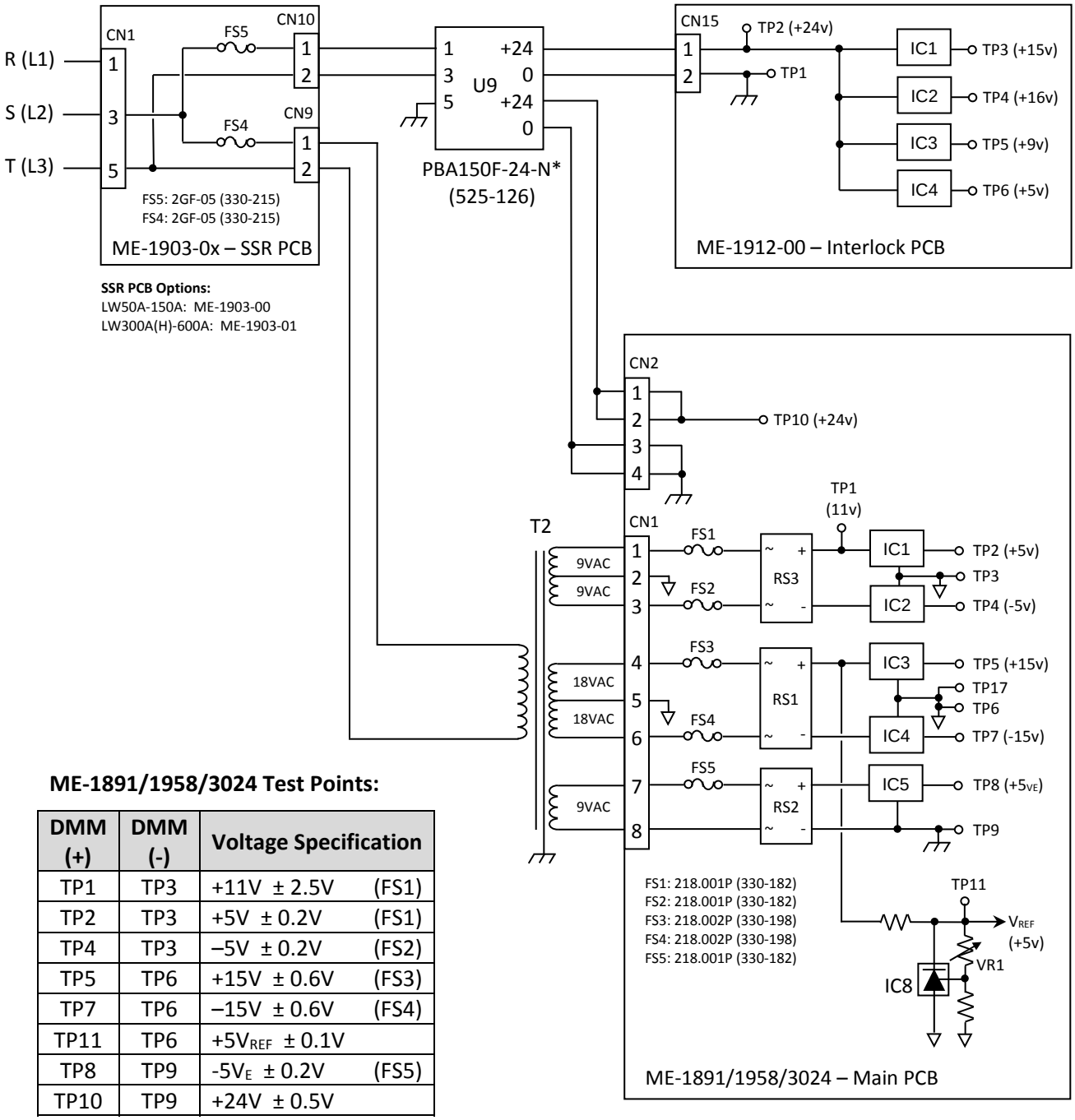
ME-1925/3023 Test Points:

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:

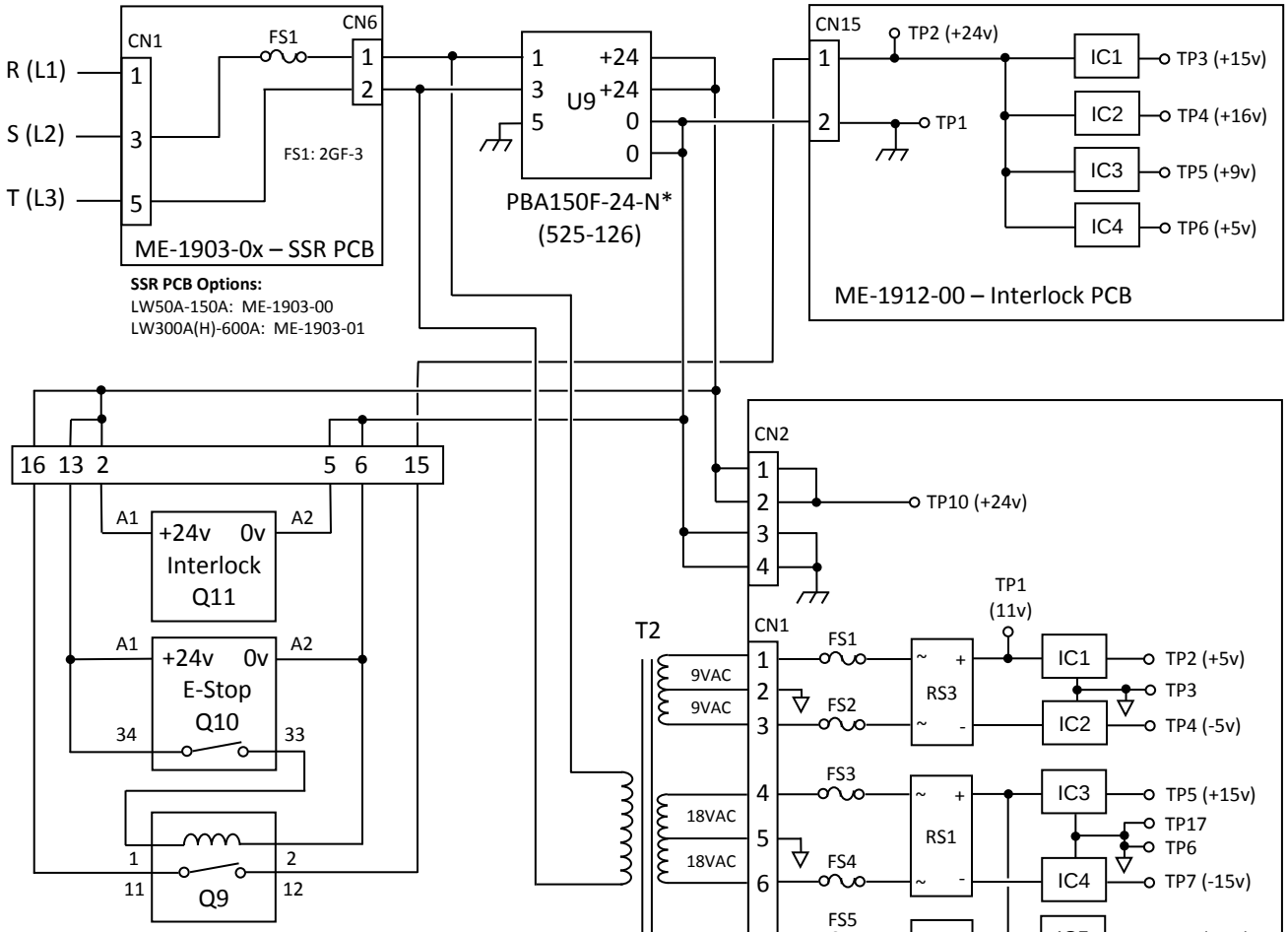
DMM (+)	DMM (-)	Voltage Specification	
TP1	TP3	+11V ± 2.5V	(FS1)
TP2	TP3	+5V ± 0.2V	(FS1)
TP4	TP3	–5V ± 0.2V	(FS2)
TP5	TP6	+15V ± 0.6V	(FS3)
TP7	TP6	–15V ± 0.6V	(FS4)
TP11	TP6	$+5V_{REF}$ ± 0.1V	
TP8	TP9	$-5V_E$ ± 0.2V	(FS5)
TP10	TP9	+24V ± 0.5V	

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	

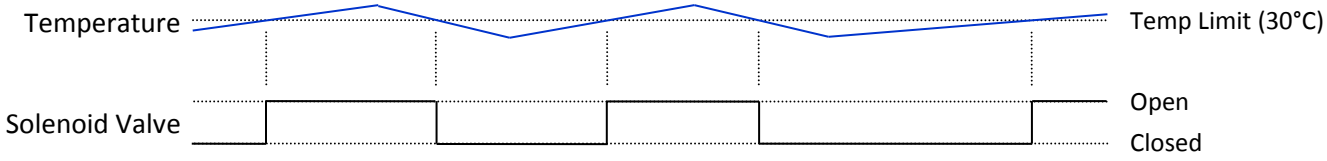
Note: $+5V_{REF}$ is adjusted by VR1 on Main PCB

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.

7. Faulty Solenoid Valve (LW50A-600A)

The water-cooled Lasers (LW50A-600A) regulate the operating temperature by allowing the (external) primary cooling water supply into the Laser through a solenoid valve. When the temperature of the secondary cooling water reaches 30°C, the solenoid valve opens allowing the Laser to cool. Likewise, when the temperature of the secondary cooling water falls below 30°C, the solenoid valve closes.

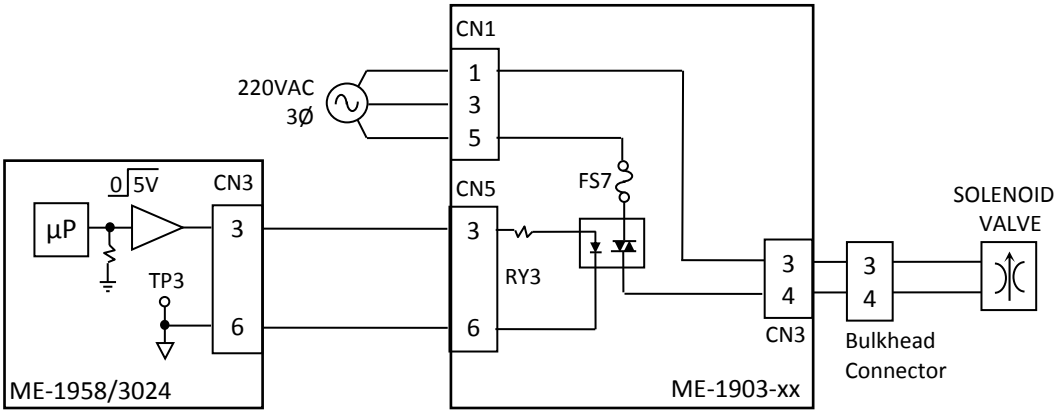


As noted previously in this troubleshooting procedure, the solenoid valve may not function properly if dirty or plugged. If the solenoid valve is clean, and the Laser cannot cool down enough to maintain normal operating temperature, the solenoid valve may be faulty. Using a DMM verify the operation of the solenoid valve. Using a thermometer in the cooling water tank may help determine when the solenoid valve should be energized. In addition the solenoid valve makes an audible "click" when opening and closing. If the solenoid valve is found to be defective, replace with the proper solenoid as noted in the table below. If the solenoid valve is operational, continue with the next troubleshooting step.

Laser Model	Solenoid Valve	
	Mfg P/N	AMYA #
LW50A/70A/150A	RSV-15A-210W-2G211-AC200V	720-133
LW300A(H)/400A		
LW500A/600A	RSV-25A-210W-2G211-AC200V	720-193

Fuse Replacement (FS7) – *common with Heater circuit*:

SSR PCB	Mfg P/N	AMYA #
ME-1903-00	FA-Ubon 2GF-5	330-216
ME-1903-01	Littelfuse 313 005	330-016
ME-1903-02	Littelfuse 313 005	330-016

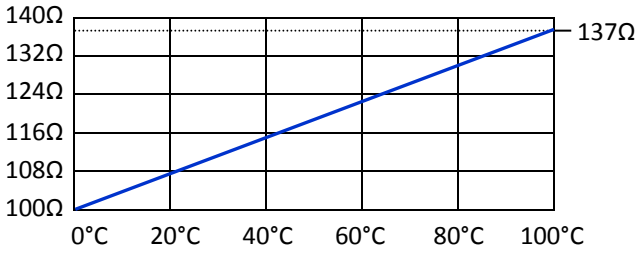


8. Faulty RTD Temperature Sensor

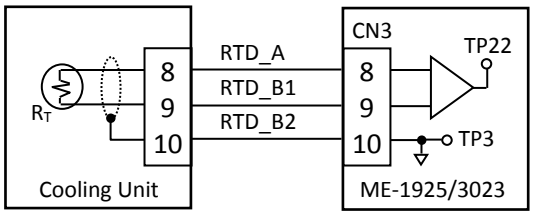
The first step in determining if the RTD sensor is bad is to use a thermometer to measure the cooling tank water temperature and compare this value to the reported temperature value on the Laser Controller. If the

temperature is correct (within ± 1°C), continue with the next troubleshooting step. If the reported temperature is grossly incorrect, continue testing the RTD Sensor. If the reported temperature is close in magnitude but not accurate, then the temperature sensor circuit may need to be calibrated.

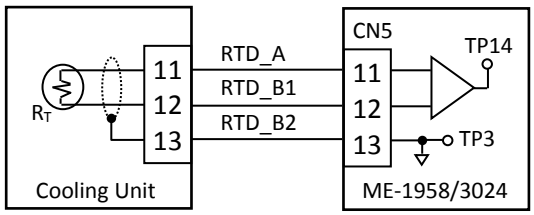
The temperature of the secondary cooling water is measured by an RTD (*Resistance Temperature Detector*) sensor located in the cooling water tank. The RTD sensor resistance is proportional to the temperature applied and its approximate response is shown on the right.



At 0°C the RTD resistance is ≈100 Ω and at 100°C the RTD resistance is ≈137 Ω. Depending on the CPU (Main PCB), disconnect the appropriate CN connector, then use a DMM to measure the RTD resistance.



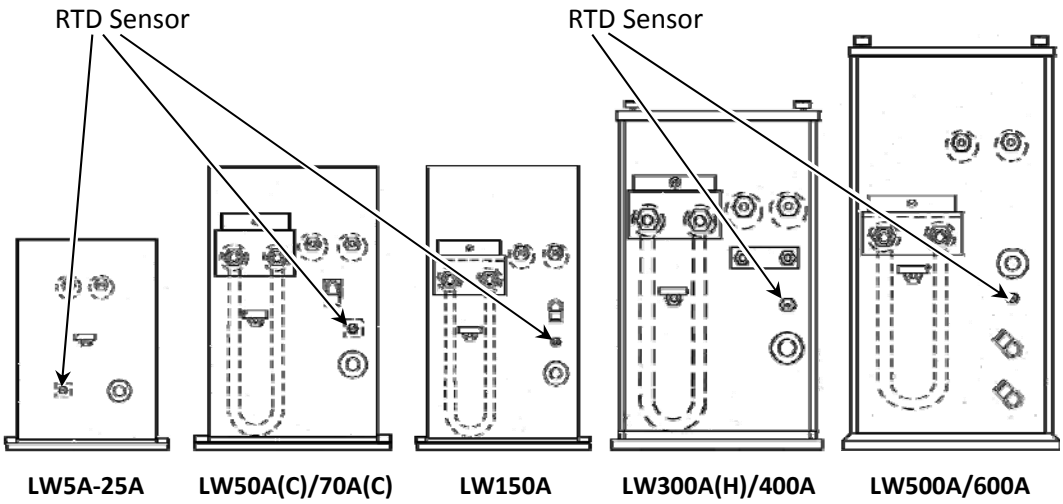
LW5A-25A/2AG/5AG



LW50A-600A

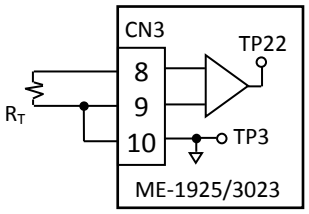
- ME-1925/3023 – Verify resistance (100 Ω ≤ R_T ≤ 137 Ω) between CN3-8 and CN3-9.
- ME-1958/3024 – Verify resistance (100 Ω ≤ R_T ≤ 137 Ω) between CN5-11 and CN5-12.

If the resistance is within the expected range, continue with the next troubleshooting step. If the resistance is either 0 Ω (short) or ∞ Ω (open), inspect the wiring harness, RTD sensor, or bulkhead connector. If it is determined that the RTD sensor is bad, replace the RTD sensor with **AMYA # 701-052**. The location of the RTD sensor varies among Laser models but is always fastened to the cooling water tank as shown below:

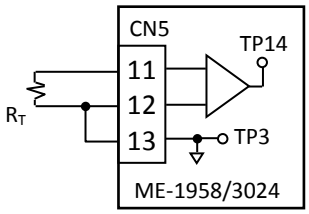


9. RTD Sensor Circuit Calibration

If the reported temperature is close in magnitude to the temperature measured by the thermometer, the temperature sensor circuit on the Main PCB may need adjustment. Before starting this calibration procedure, all power supply voltages should be verified. In order to properly adjust the sensor circuit a 100Ω ± 0.1% and 137Ω ± 0.1% resistor will be required. Disconnect the RTD sensor harness from the CPU (Main PCB) and replace the RTD sensor with the 100Ω ± 0.1%. Adjust the VR potentiometer as noted in the table below to achieve 5mV. Replace resistor with 137Ω ± 0.1% and adjust the VR potentiometer as noted in the table below to achieve 4.88V. Repeat procedure until no further adjustments are required.



LW5A-25A/2AG/5AG



LW50A-600A

Main PCB	R_T Resistance	Equivalent Temperature	DMM (+)	DMM (–)	Procedure
ME-1925	100Ω	0°C	TP22	TP3	Adjust VR5 for 5mV (+15mV/-5mV)
ME-3023	137Ω	100°C			Adjust VR6 for 4.88V (± 0.03V)
ME-1958	100Ω	0°C	TP14	TP3	Adjust VR3 for 5mV (+15mV/-5mV)
ME-3024	137Ω	100°C			Adjust VR2 for 4.88V (± 0.03V)

10. Faulty Cooling Fan Control (Air-Cooled Lasers)

In the air-cooled Lasers (LW5AM/5A/15A/25A, LW2AG/5AG and LW50AC/70AC), the water temperature is maintained by forced-air convection. The cooling fans used to cool the Laser are pulse-width modulated (PWM) based on the ambient temperature. If the control circuit used to control the speed of the fans is faulty, the fans may constantly run at 100%, which may produce an E11 alarm. Verify fan operation as described below.

LW5A(M)/15A/25A and LW2AG/5AG

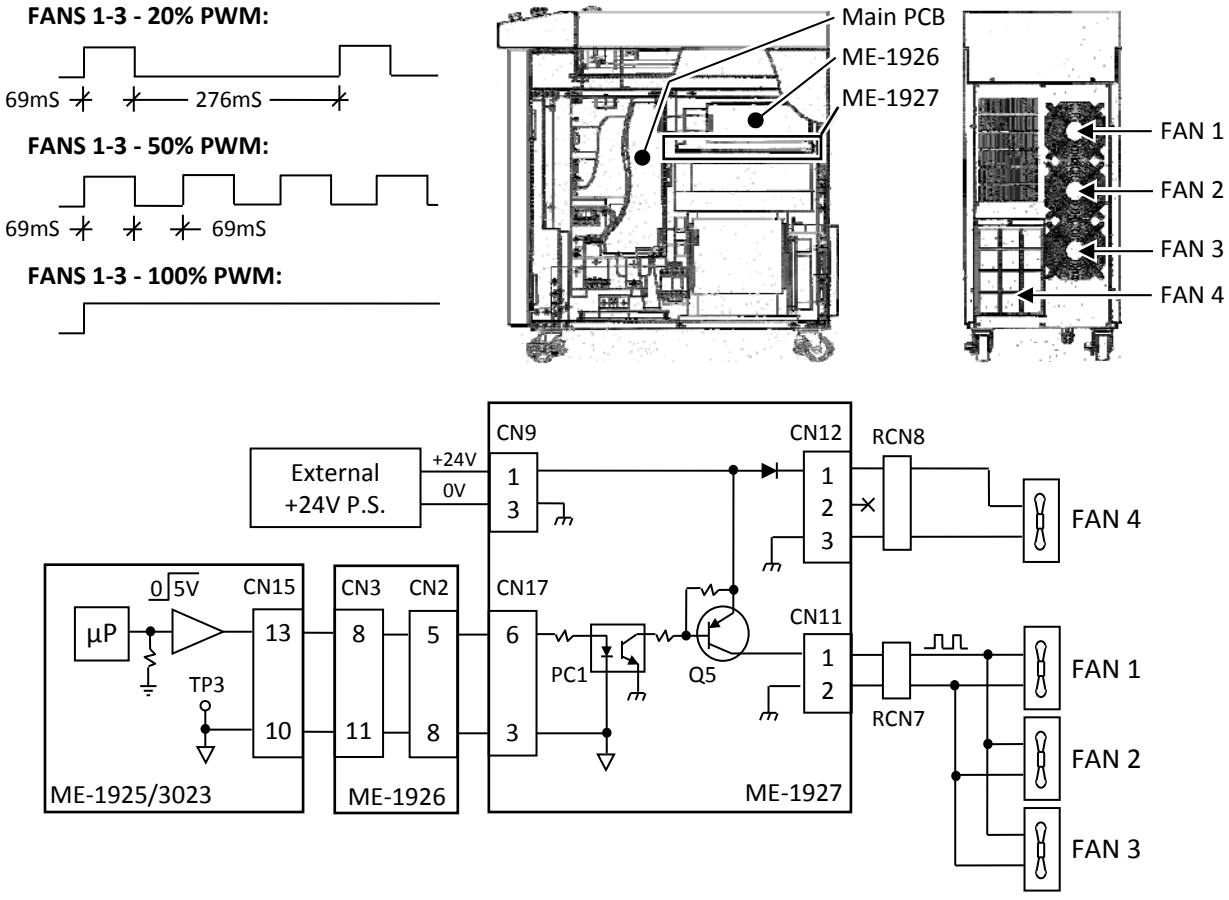
The Fan power in the LW5A(M)/15A/25A and LW2AG/5AG is produced by the ME-1927 Charge Power PCB (located in the Charge Unit). The ME-1927 sits horizontal just below the ME-1926 Charge Control PCB and is located behind the right side panel. FAN 4 is always "ON". FANS 1-3 are pulse width modulated (at +24V) based on the ambient temperature.

FAN 1-3 Operation:

Fan	Temp	PWM[1]
Sanyo Fan	≤ 29°C	20%
	30 - 34°C	50%
	≥ 35°C	100%

Fan	Temp	PWM[1]
Pelco Fan	≤ 34°C	50%
	≥ 35°C	100%

1. The PWM waveforms are shown below for reference:

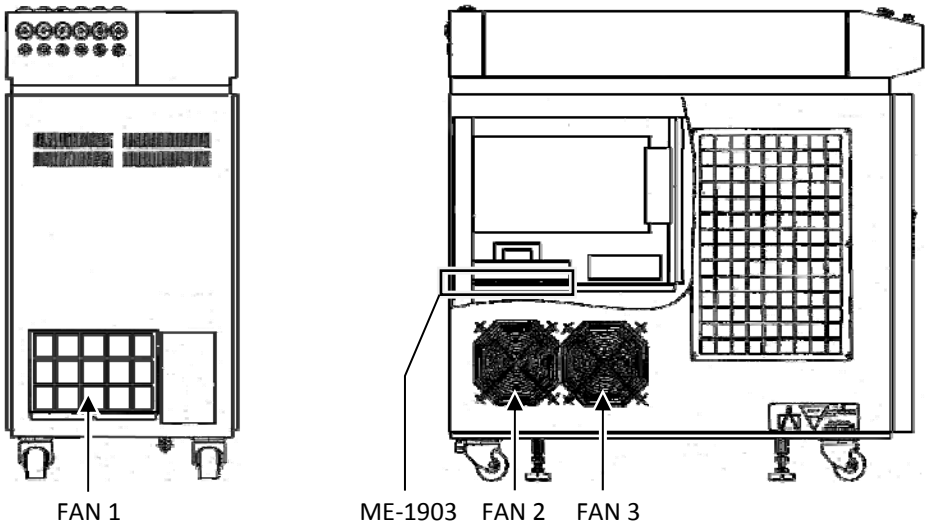


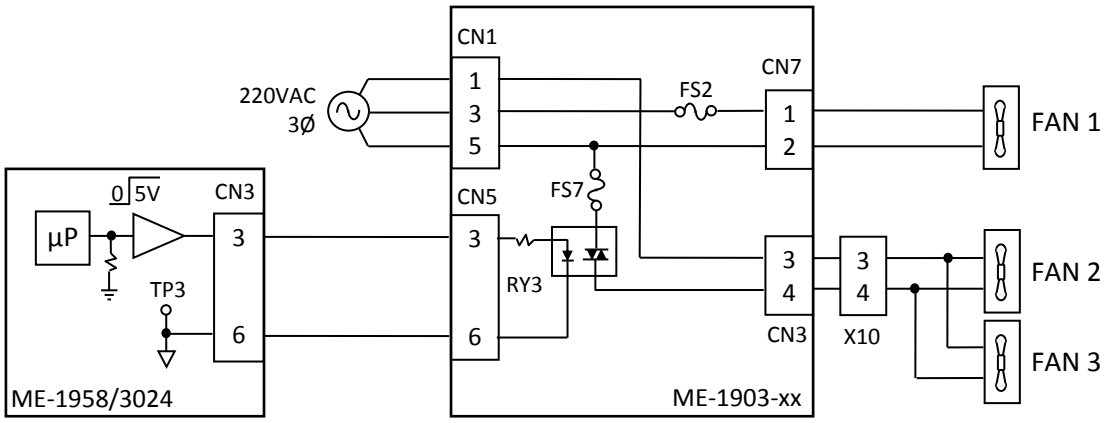
LW50AC/70AC

The Fan power in the LW50AC/70AC is produced by the ME-1903 SSR (Solid State Relay) PCB. There are two versions of the ME-1903 SSR PCB used, the ME-1903-00 and the ME-1903-02. The ME-1903-00 are used in the CDRH models (U.S. destination) and the ME-1903-02 are used in the CE Models. The ME-1903-xx is mounted horizontally just below the ME-1958/3024 (Main PCB) behind the left side panel. FAN 1 is always "ON". FANS 2-3 are pulse width modulated (at 200VAC) based on the ambient temperature.

FAN 2-3 Operation (PWM operation):

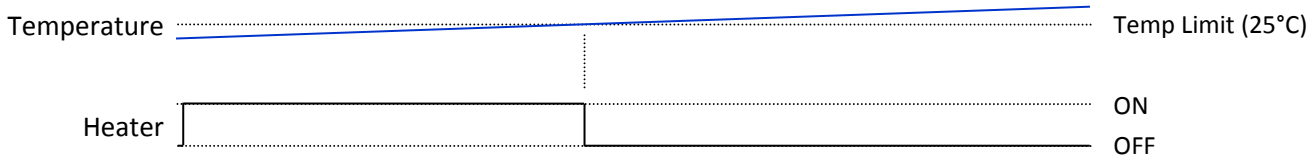
Temp	PWM	Reference Notes
< 27°C	0%	< (Low + 2°C)
27°C - 29°C	20%	(Low + 2°C) - (Ref – 1°C)
30°C - 34°C	50%	(Ref) - (High – 6°C)
≥ 35°C	100%	≥ (High – 5°C)





11. Faulty Heater / Heater Control (LW50A-600A)

In the water-cooled Lasers, a heater is placed in the cooling water tank to help raise the temperature of the cooling water when operating in cooler ambient temperatures. When the temperature of the secondary cooling water is below 25°C, the heater turns ON allowing the secondary cooling water temperature to increase. Once the secondary cooling water reaches 25°C, the heater is turned OFF. If the heater or heater drive circuit is faulty, the water in the cooling tank may never reach the minimum operating temperature when used in colder environments. Using a DMM verify 200VAC at the heater terminals, when the heater is enabled.

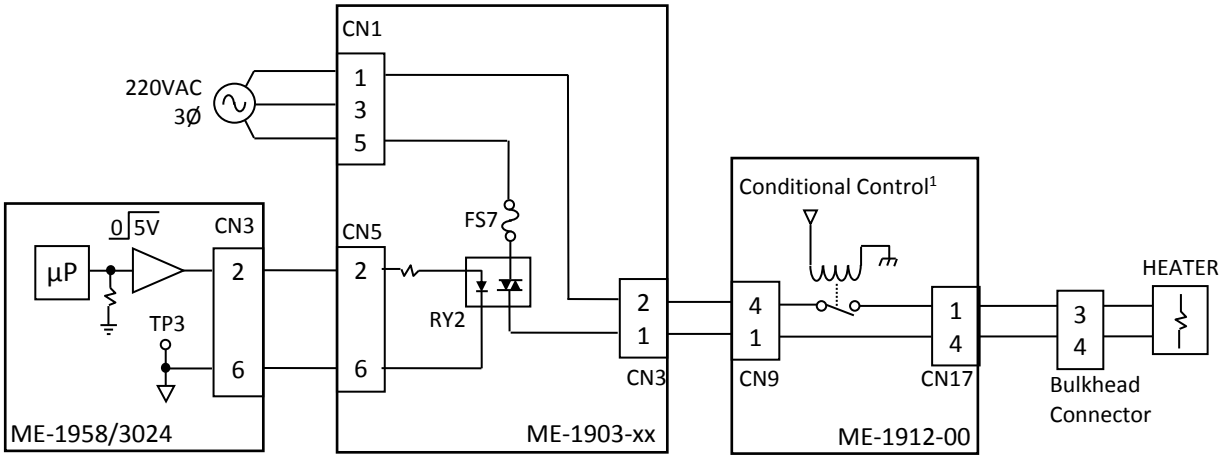


Using a DMM verify the operation of the heater circuit. Using a thermometer in the cooling water tank may help determine when the heater should be energized. If the heater or drive circuit is found to be defective, replace appropriate parts as noted in the tables below.

Laser Model	Heater		
	Mfg P/N	AMYA #	Capacity
LW50A/70A/150A	Nippon Heater LU-205	*Special order*	500W
LW300A(H)/400A			
LW500A/600A	Nippon Heater UU-1K	*Special order*	1,000W

Fuse Replacement (FS7) – *common with Solenoid Valve circuit:*

SSR PCB	Mfg P/N	AMYA #
ME-1903-00	FA-Ubon 2GF-5	330-216
ME-1903-01	Littelfuse 313 005	330-016
ME-1903-02	Littelfuse 313 005	330-016



1. Conditional Control - Heater enabled when the following conditions are met:
   Pump thermal switch OK + Shutter thermal switch OK + Coolant Thermal Switch OK + Coolant level OK + Head Cover Switch OK + Pump Cover switch OK.

12. Faulty Heat Exchanger / Radiator

When all possible causes have been eliminated, the next step is to examine the Heat Exchanger / Radiator. A faulty Heat Exchanger / Radiator can have a leak.

If the Heat Exchanger / Radiator is leaking, the Laser will constantly need the secondary cooling water re-filled. A leak may also be indicated by an **E04: Coolant Low Level** alarm. To test for leaks, drain the cooling tank, remove the hoses from the heat exchanger / radiator and then fill the heat exchanger / radiator with water while plugging the opposite end. If it is determined that there is a leak, replace the heat exchanger / radiator.

LW5A(M)/15A/25A

Component	AMYA #
Radiator	Z-0211
Radiator (obsolete)	Z-00731-001
Radiator Plug	M-5P
Hose Clamps	SNP-14

LW50A/70A

Component	AMYA #
Heat Exchanger	BXC-024-NU-20
Heat Exchanger (obs)	BXN-005-P-14
Hose Clamps	SNP-24

LW150A

Component	AMYA #
Heat Exchanger	BXN-005-P-26
Hose Clamps	SNP-24

LW50AC/70AC

Component	AMYA #
Radiator	Z-01633-002
Heat Exchanger	BXC-024-NU-20
Hose Clamps	SNP-24

LW300A(H)/400A

Component	AMYA #
Heat Exchanger	BXN-005-P-40
Hose Clamps	SNP-24

LW500A/600A

Component	AMYA #
Heat Exchanger	BHE-015-P-26
Hose Clamps	SNP-24

End of Document