FLUKE networks™

LS-1310/1550
Laser Source

Service Information Sheet

Introduction

This *Service Information Sheet* provides the following service information for the LS-1310/1550 Laser Source (hereafter referred to as "the laser source").

- Precautions and safety information
- Parts and service information
- Specifications
- Cleaning procedures
- Required equipment
- Performance tests
- Calibration adjustments
- Diagrams showing calibration measurement and adjustment points
- Parts and accessories lists

For operating instructions, refer to the *LS-1310/1550 Laser Source Instruction Sheet*.

Precautions and Safety Information

- Always clean the fiber optic connectors before use.
- Before testing, let the laser source stabilize for 2 minutes after you turn it on.

⚠ Warning: Class I Laser Product

To avoid injury, do not service the source unless you are qualified to do so.

To avoid possible exposure to hazardous laser radiation and to prevent eye damage

Never look directly into the source connector. Though the laser radiation is invisible, it can damage your eyes.

Do not modify the source.

Do not magnify or otherwise modify the laser output. Use only approved connectors and adapters.

Do not use controls, adjustments, or procedures not documented or approved by Fluke Corporation.

Caution

While servicing the laser source, always follow guidelines for preventing electrostatic discharge (ESD). Otherwise, ESD can damage sensitive components, causing immediate or delayed failure of the source.

Parts and Service

The source is warranted to be free from defects in material and workmanship for one year, while under normal use. Parts and repairs are warranted for 90 days. Refer to the laser source instruction sheet for the complete warranty statement.

To order parts, or for warranty service, contact Fluke as follows:

U.S.A.: 1-888-993-5853
Canada: 1-800-363-5853
Europe: +31-402-675-200
Japan: +81-3-3434-0181
Singapore: +65-738-5655
Anywhere in the world: +1-425-446-4519

For operating assistance in the USA, call 1-800-283-5853.

Visit the Fluke Networks web site at **www.flukenetworks.com**.

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Specifications

Accuracy is specified for a period of one year after calibration, at 18 °C to 28 °C (64 °F to 82 °F) with relative humidity to 90%. Specifications are shown in Table 1.

Table 1. Specifications

Emitter Type	Laser
Laser Classification	Class 1
Safety	Complies with ANSI/ISA S82.01-1994, CSA C22.2 No. 1010.1-92, EN61010.1: 1993
Output Wavelengths	1310 nm ±20 nm 1550 nm ±30 nm
Output Connector	Singlemode ST
Output Power (CW)	-10 dBm (100 µW) adjustable
Output Level Stability	At 25 °C after a 15-minute warm-up: ±0.2 dB over 1 hour ±0.4 dB over 8 hours
Temperature Range	Operating: 0 °C to 40 °C Storage: -10 °C to +60 °C
Power Source	9 V battery
Size	17.4 cm x 7.6 cm x 3.8 cm (6.9 in x 3.0 in x 1.5 in)
Weight	266 g (9.38 oz)
Battery Life	16 hours typical (alkaline)
Indicators	SOURCE ACTIVE (power on) LED LOW BATTERY LED

Cleaning the Optical Connector

Most problems with optical sources result from contaminated connectors. Therefore, always clean the connector before troubleshooting or calibration.

To clean the source connector, wipe it gently with an optical-grade tissue or swab dampened with optical-grade alcohol. To remove loose dirt and dust from the connector, use filtered, compressed air.

Always cover the connector with a dust cap when the unit is not in use.

Required Equipment

The following equipment is required for performance tests and calibration adjustments:

- Fiber optic power meter calibrated at 1310 nm and 1550 nm
- 0-10 V dc adjustable power supply with a minimum output of 500 mA and a current-limit adjustment
- Fluke 187 DMM (digital multimeter), equivalent, or better
- 20 MHz digital or analog oscilloscope, equivalent, or better
- Optical power meter (OPM) traceable to local national standards
- ST/ST singlemode fiber patch cable

Note

Using a multimode fiber patch cable will cause calibration errors.

Performance Tests

Use the performance tests to confirm that the source is working properly. If the source fails any of these tests, clean the fiber connectors, verify that the connections are solid, then retest the laser source. If the source still fails a test, it needs calibration adjustments or repair.

1. Turn on the optical power meter (OPM).
2. Set the laser source's power switch to 1310 nm. Verify that the LOW BATTERY LED flashes briefly before the SOURCE ACTIVE LED turns on. Let the laser source stabilize for 5 minutes.
3. Using a singlemode fiber patch cable, connect the laser source to the OPM.
4. Set the OPM to measure 1310 nm. Set the laser source's CW/MOD switch to CW.
5. Verify that the power reading is -10.00 dBm ±0.5 dB.
6. Set the laser source's CW/MOD switch to MOD. Verify that the power reading increases by 0.6 dBm ±0.3 dB.
7. Set the laser source's CW/MOD switch to CW; set the power switch to 1550 nm. Set the OPM to measure 1550 nm.
8. Repeat steps 5, 6, and 7.
9. Turn off the laser source. Disconnect the fiber patch cable; then install the dust caps on the source.

Calibration Adjustments for Serial Numbers < 79130000

(for later serial numbers, see page 6)

To ensure that the laser source performs to specifications, calibrate it annually using the procedure that follows.

Always perform the complete calibration adjustment procedure.

Step 1: Preparing for Calibration

Before you start the calibration procedures described in this sheet, do the following (refer to Figure 1 for locations of components on the circuit board):

1-1. Turn off the laser source.

1-2. Remove the battery door and the 9 V battery.

1-3. Remove the four Phillips screws from the back of the source. Remove the top case.

1-4. Unscrew the external retaining nuts from the source's power switch and CW/MOD switch.

1-5. Carefully remove the laser source circuit board from the bottom case. Take care to not strain the fiber that connects the circuit board to the ST connector mounted in the bottom case.

1-6. Before applying power to the source, do the following:

a. Remove the jumpers from J2 and J4.

b. Adjust the internal potentiometers R4 and R14 to their full counterclockwise positions. You will hear a faint click at the full counterclockwise position.

c. Adjust the external OUTPUT ADJUST potentiometers (R24 and R35) to their full clockwise positions. You will hear a faint click at the full clockwise position.

1-7. Adjust the dc power supply to 10 V ±0.25 V with the output current limited to 250 mA. Connect the power supply's positive lead to BT1 on the source; connect the negative lead to BT2.

1-8. Set the laser source's CW/MOD switch to the CW position.

1-9. Set the laser source's power switch to either the 1310 nm or 1550 nm position. Verify that the laser source LOW BATTERY LED is off and the SOURCE ACTIVE LED is on.

Step 2: Checking the Laser Drive Voltage

Use the following procedure to check the drive voltage for the laser diodes and to verify that the laser source's low battery detection circuit is operating properly.

2-1. Set up the DMM to measure dc voltage. Connect the DMM to the laser drive voltage between J2-6 and J2-4 (Gnd). Verify that the voltage is between 3.2 V dc and 3.5 V dc. Record this measurement for use in the next step.

Note

To avoid overshooting the target voltage in the next step, slow the adjustment rate on the power supply as the voltage approaches 7 V.

2-2. Decrease the power supply voltage just until the laser source's LOW BATTERY LED lights. Verify the following:

a. The power supply voltage is between 5.4 V dc and 6.2 V dc.

b. The DMM reading has changed less than 0.3 V dc from the reading you recorded in step 1.

2-3. Connect the DMM's positive lead to U3-5. Verify the reading to be < 500 mV dc.

2-4. Turn off the laser source and the power supply. Remove the power supply leads from the laser source's battery terminals.

2-5. Reassemble the bottom case, as follows:

a. Verify that the star washers are in place at the bases of the laser source switches; then carefully reinstall the PCA into the bottom case. Ensure that the fiber connecting the circuit board to the ST connector is not pinched between the board and the case.

b. Reinstall the external retaining nuts on the laser source's power switch and CW/MOD switch.

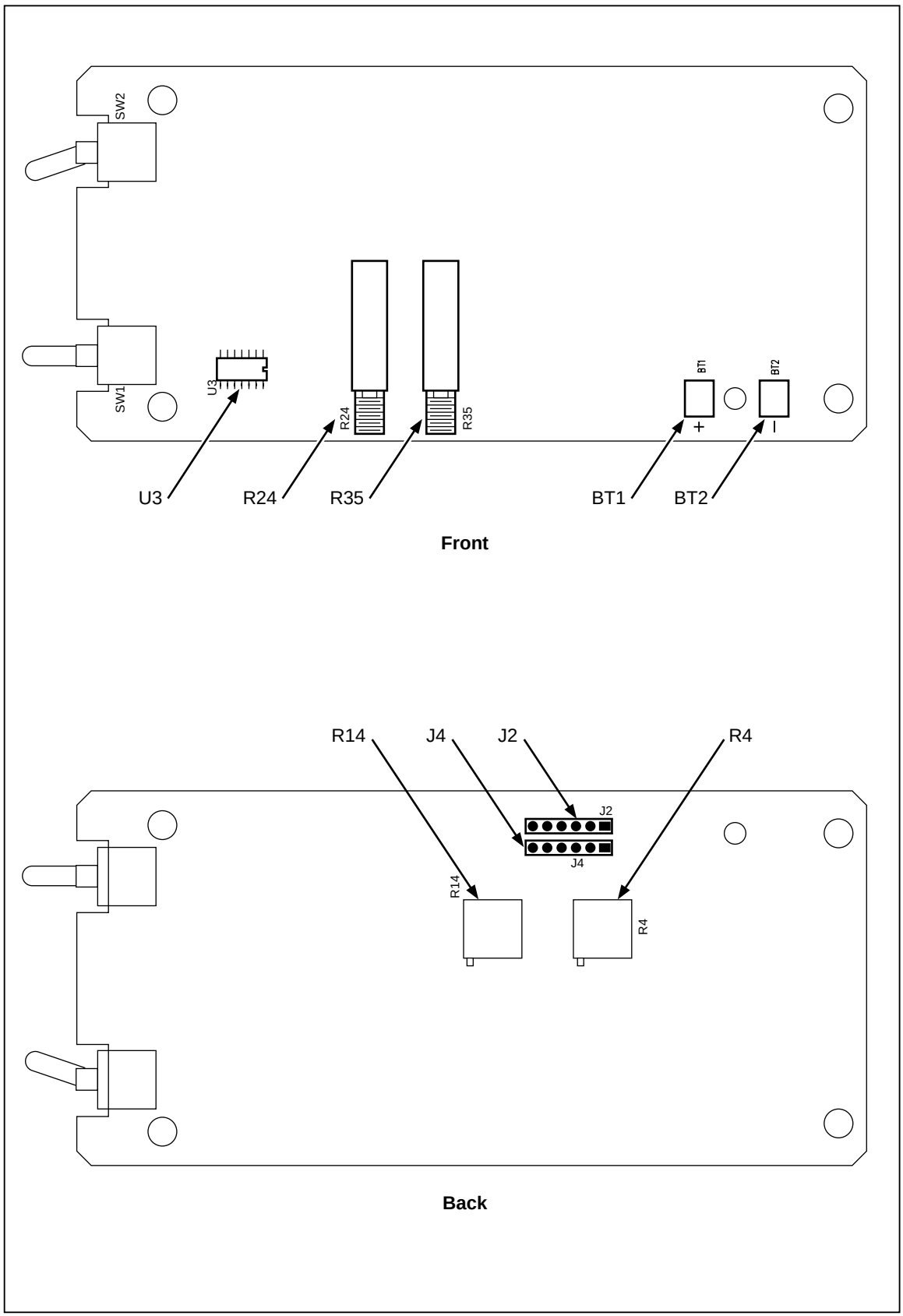

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Figure 1. Jumpers and Calibration Measurement and Adjustment Points for SN < 79130000

Step 3: Calibrating and Adjusting the 1310 nm Circuit

Use the following procedure to make calibration adjustments to the 1310 nm laser diode circuit and to calibrate the 1310 nm modulation circuit:

3-1. Adjust the dc power supply to 9 V dc ±0.25 V dc. Connect the supply's positive lead to BT1; connect the negative lead to BT2.

3-2. Set up the DMM to measure dc current less than 300 mA. Connect the DMM's positive lead to J4-1; connect the negative lead to J4-2.

3-3. Use a singlemode fiber patch cable to connect the laser source to the OPM. Set the OPM to measure 1310 nm.

⚠Caution

In the following steps, do not exceed the laser diode's maximum operating current of 60 mA. Doing so can damage the laser diode. If the current reaches 60 mA before the optical power reading reaches -9.2 dBm, clean the ST connectors or repair the laser source.

3-4. Set the laser source to 1310 nm. Verify that the laser diode current is less than 60 mA.

⚠Caution

In the next step, slow the adjustment rate on R4 as the optical power reading approaches -14 dBm. If you turn R4 too quickly, you might overshoot the -9.2 dBm target and exceed the laser diode's maximum current of 60 mA.

3-5. Adjust R4 clockwise until the either the power reading is -9.2 dBm ±0.1 dB or the current reaches 60 mA. A typical current value is 15 mA at -9.2 dBm. If the current reaches 60 mA before the power reading reaches -9.2 dBm, the laser source requires repair.

3-6. Turn off the laser source. Disconnect the current meter. Reinstall the jumper between J4-1 and J4-2.

3-7. With the laser source set to 1310 nm, verify that the power reading is -9.2 dBm ±0.1 dB.

3-8. Adjust the 1310 nm external potentiometer (R24) counterclockwise to verify that the laser source output is adjustable to -11.2 dBm ±0.1 dB.

3-9. Adjust R24 until the laser source output reads -10.0 dBm ±0.1 dB.

3-10. While the laser source is on, disconnect the power supply; then install a 9 V battery. Verify that the output is still at -10.0 dBm ±0.1 dB.

3-11. Connect an oscilloscope across J4-1 and J4-4 (Gnd). Set the laser source's CW/MOD switch to the MOD position.

3-12. Verify that the power reading is -10 dBm ±0.5 dB. Verify that the signal frequency is 2 kHz ±100 Hz with a duty cycle of 50% ±5%.

3-13. Set the laser source's CW/MOD switch to CW. Turn off the laser source. Remove the 9 V battery.

Step 4: Calibrating and Adjusting the 1550 nm Circuit

Use the following procedure to make calibration adjustments to the 1550 nm laser diode circuit and to calibrate the 1550 nm modulation circuit:

4-1. Adjust the dc power supply to 9 V dc ±0.25 V dc. Connect the supply's positive lead to BT1; connect the negative lead to BT2.

4-2. Set up the DMM to measure dc current less than 300 mA. Connect the DMM's positive lead to J2-1; connect the negative lead to J2-2.

4-3. Use a singlemode fiber patch cable to connect the laser source to the OPM. Set the OPM to measure 1550 nm.

⚠Caution

In the following steps, do not exceed the laser diode's maximum operating current of 60 mA. Doing so can damage the laser diode. If the current reaches 60 mA before the optical power reading reaches -9.2 dBm, clean the ST connectors or repair the laser source.

4-4. Set the laser source to 1550 nm. Verify that the laser diode current is less than 60 mA.

⚠Caution

In the next step, slow the adjustment rate on R14 as the optical power reading approaches -14 dBm. If you turn R14 too quickly, you might overshoot the -9.2 dBm target and exceed the laser diode's maximum current of 60 mA.

4-5. Adjust R14 clockwise until either the power reading is -9.2 dBm ±0.1 dB or the current reaches 60 mA. A typical current value is 25 mA at -9.2 dBm. If the current reaches 60 mA before the power reading reaches -9.2 dBm, the laser source requires repair.

4-6. Turn off the laser source. Disconnect the DMM. Reinstall the jumper between J2-1 and J2-2.

4-7. With the laser source set to 1550 nm, verify that the power reading is -9.2 dBm ±0.1 dB.

4-8. Adjust the 1550 nm external potentiometer (R35) counterclockwise to verify that the laser source output is adjustable to -11.2 dBm ±0.1 dB.

4-9. Adjust R35 until the laser source output reads -10.0 dBm ±0.1 dB.

4-10. While the laser source is on, disconnect the power supply; then install a 9 V battery. Verify that the output is still at -10.0 dBm ± 0.1 dB.

4-11. Connect an oscilloscope across J2-1 and J2-4 (Gnd). Set the laser source CW/MOD switch to the MOD position.

4-12. Verify that the power reading is -10 dBm ±0.5 dBm. Verify that the signal frequency is 2 kHz ±100 Hz with a duty cycle of 50% ±5%.

4-13. Set the laser source CW/MOD switch to CW. Turn off the laser source.

Step 5: Reassembly and Final Test

5-1. Remove the singlemode cable from the laser source. Put the dust cap onto the laser source optical ST connector.

5-2. Apply insulating varnish, such as red GLPT, to all potentiometers adjusted.

5-3. Put the board back in the case. Put the case halves together and install the four Phillips screws. Reinstall the lock washers and nuts to the CW/MOD and 1550/1310 switches. Install a 9 V battery and the battery door.

5-4. Run the performance tests as described in the earlier section "Performance Tests".

Calibration Adjustments for Serial Numbers ≥ 79130000

(For earlier serial numbers, see page 3)

To ensure that the laser source performs to specifications, calibrate it annually using the procedure that follows.

Always perform the complete calibration adjustment procedure.

Step 1: Preparing for Calibration

Before you start the calibration procedures described in this sheet, do the following (refer to Figure 2 for locations of components on the circuit board):

1-1. Turn off the laser source.

1-2. Remove the battery door and the 9 V battery.

1-3. Remove the four Phillips screws from the back of the laser source. Remove the top case.

1-4. Unscrew the external retaining nuts from the laser source's power switch and CW/MOD switch.

1-5. Carefully remove the laser source circuit board from the bottom case. Take care to not strain the fiber that connects the circuit board to the ST connector mounted in the bottom case.

1-6. Before applying power to the laser source, do the following:

   a. Adjust the internal potentiometers R39 and R40 to their full counterclockwise positions. You will hear a faint click at the full counterclockwise position.

   b. Adjust the external OUTPUT ADJUST potentiometers (R12 and R31) to their full counterclockwise positions. You will hear a faint click at the full counterclockwise position.

1-7. Adjust the dc power supply to 9 V ±0.25 V with the output current limited to 250 mA. Connect the power supply's positive lead to BT1+ on the laser source, connect the negative lead to BT1-.

1-8. Set the laser source's CW/MOD switch to the CW position.

1-9. Set the laser source's power switch to either the 1310 nm or 1550 nm position. Verify that the laser source LOW BATTERY LED is off and the SOURCE ACTIVE LED is on.

Step 2: Checking the Laser Drive Voltage

Use the following procedure to check the drive voltage for the laser diodes and to verify that the laser source's low battery detection circuit is operating properly.

2-1. Connect negative probe of DMM to TP2 (Gnd).

2-2. Turn laser source to either 1310 nm or 1550 nm, set the CW/MOD switch to the CW position.

2-3. With the DMM verify the voltage of Z5 pin 8 is 1.23 V ±0.04 V.

2-4. Check the voltage on the plus (+) side of C13, verify it is 5 V ±0.2 V.

2-5. Decrease the power supply voltage just until the laser source's LOW BATTERY LED is lit.

2-6. Verify the power supply voltage is 5.9 V ±0.2 V.

2-7. Reverify voltage on plus (+) side of C13 is 5 V ±0.2 V.

Step 3: Calibrating and Adjusting the 1310 nm Circuit

Use the following procedure to make calibration adjustments to the 1310 nm laser diode circuit:

3-1. Adjust the dc power supply to 9 V ±0.25 V with the output current limited to 250 mA. Connect the power supply's positive lead to BT1+; connect the negative lead to BT1-.

3-2. Set up the DMM to measure dc volts less than 2 V. Connect the negative probe to TP2 (Gnd) and the positive to the side of R20 furthest from Z2. To calculate current in the 1310 nm laser drive use the equation I = V/22.

3-3. Use a singlemode fiber patch cable to connect the laser source to the OPM. Set the OPM to measure 1310 nm.

⚠Caution

In the following steps, do not exceed the laser diode's maximum operating current of 60 mA. Doing so can damage the laser diode. If the current reaches 60 mA before the optical power reading reaches -9.2 dBm, clean the ST connectors or repair the laser source.

3-4. Set the laser source to 1310 nm. Turn R12 to full clockwise position.

⚠Caution

In the next step, slow the adjustment rate on R39 as the optical power reading approaches -14 dBm. If you turn R39 too quickly, you might overshoot the -9.2 dBm target and exceed the laser diode's maximum current of 60 mA.

3-5. Adjust R39 clockwise until either the power reading is -9.2 dBm ±0.1 dB or the current reaches 60 mA. A typical current value is 15 mA at -9.2 dBm. If the current reaches 60 mA before the power reading reaches -9.2 dBm, the laser source requires repair.

3-6. With the laser source set to 1310 nm, verify that the power reading is -9.2 dBm ±0.1 dB.

3-7. Adjust the 1310 nm external potentiometer (R12) counterclockwise to verify that the laser source output is adjustable to -11.2 dBm ±0.1 dB.

3-8. Adjust R12 until the laser source output reads -10.0 dBm ±0.1 dB.

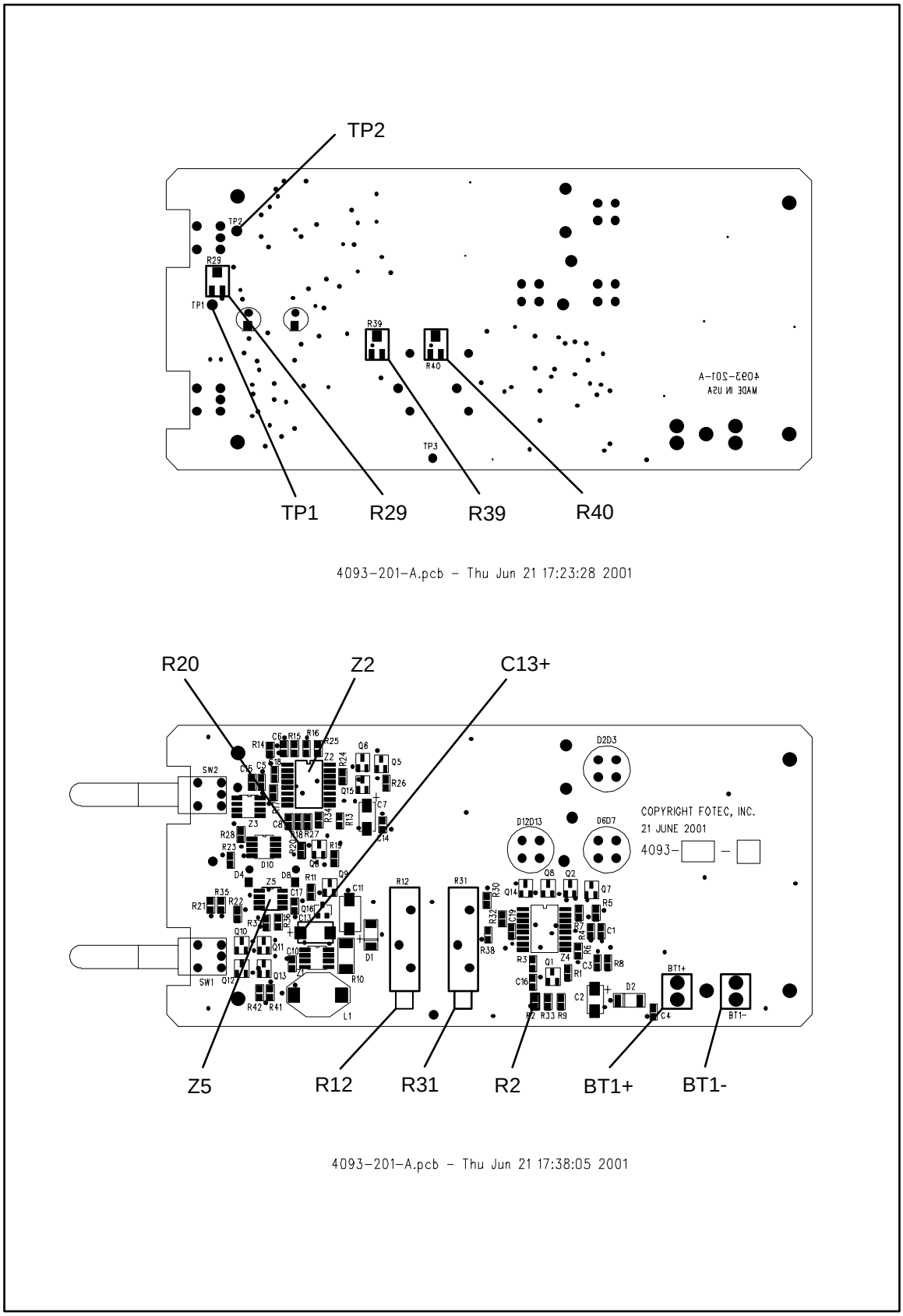

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Figure 2. Calibration Measurement and Adjustment Points for SN ≥ 79130000

Step 4: Calibrating and Adjusting the 1550 nm Circuit

Use the following procedure to make calibration adjustments to the 1550 nm laser diode circuit.

4-1. Adjust the dc power supply to 9 V ±0.25 V. Connect the supply's positive lead to BT1+; connect the negative lead to BT1-.

4-2. Set up the DMM to measure dc volts less than 2 V. Connect the negative probe to TP2 (Gnd) and the positive to the side of R2 furthest from the board edge. To calculate current in the 1550 nm laser drive use the equation I = V/22.

4-3. Use a singlemode fiber patch cable to connect the laser source to the OPM. Set the OPM to measure 1550 nm.

⚠Caution

In the following steps, do not exceed the laser diode's maximum operating current of 60 mA. Doing so can damage the laser diode. If the current reaches 60 mA before the optical power reading reaches -9.2 dBm, clean the ST connectors or repair the laser source.

4-4. Set the laser source to 1550 nm. Turn R31 to the full clockwise position.

⚠Caution

In the next step, slow the adjustment rate on R40 as the optical power reading approaches -14 dBm. If you turn R40 too quickly, you might overshoot the -9.2 dBm target and exceed the laser diode's maximum current of 60 mA.

4-5. Adjust R40 clockwise until either the power reading is -9.2 dBm ±0.1 dB or the current reaches 60 mA. A typical current value is 15 mA at -9.2 dBm. If the current reaches 60 mA before the power reading reaches -9.2 dBm, the laser source requires repair.

4-6. With the laser source set to 1550 nm, verify that the power reading is -9.2 dBm ±0.1 dB.

4-7. Adjust the 1550 nm external potentiometer (R31) counterclockwise to verify that the laser source output is adjustable to -11.2 dBm ±0.1 dB.

4-8. Adjust R31 until the laser source output reads -10.0 dBm ± 0.1 dB.

Step 5: Adjusting the 2 kHz Modulated Signal

5-1. Connect an oscilloscope across TP1 and TP2 (Gnd).

5-2. Set the laser source CW/MOD switch to the MOD position. Set the 1550/1310 switch to 1310.

5-3. Verify that the signal frequency is 2 kHz ±100 Hz with a duty cycle of 50% ±5%. Adjust R29 as necessary.

5-4. Set the 1550/1310 switch to 1550 and reverify signal frequency is 2 kHz ±100 Hz with a duty cycle of 50% ±5%.

Step 6: Reassembly and Final Test

6-1. Remove the singlemode cable from the laser source. Put the dust cap onto the laser source optical ST connector.

6-2. Apply insulating varnish, such as red GLPT, to all potentiometers adjusted.

6-3. Put the board back in the case. Put the case halves together and install the four Phillips screws. Reinstall the lock washers and nuts to the CW/MOD and 1550/1310 switches. Install a 9 V battery and the battery door.

6-4. Run the performance tests as described in the earlier section "Performance Tests".

Parts and Accessories

Tables 2 and 3 show the replacement parts and accessories available from Fluke for the LS-1310/1550 Laser Source.

Table 2. Replacement Parts

Description	Fluke Part Number
Battery cover assembly	662632
Top case	625837
Bottom case	625829
Fiber optic cable assembly, ST/ST, singlemode	662368
Fiber optic adapter, ST/ST, singlemode	625928
9 V battery	614487
LS-1310/1550 Laser Source Instruction Sheet	687290

Table 3. Accessories

Description	Fluke Model Number
Fiber optic cable assembly, ST/ST, singlemode	NF100SM
Fiber optic cable assembly, ST/SC, singlemode	NF110SM
Fiber optic cable assembly, ST/FC, singlemode	NF120SM
Fiber optic adapter, ST/ST, singlemode	NF300SM