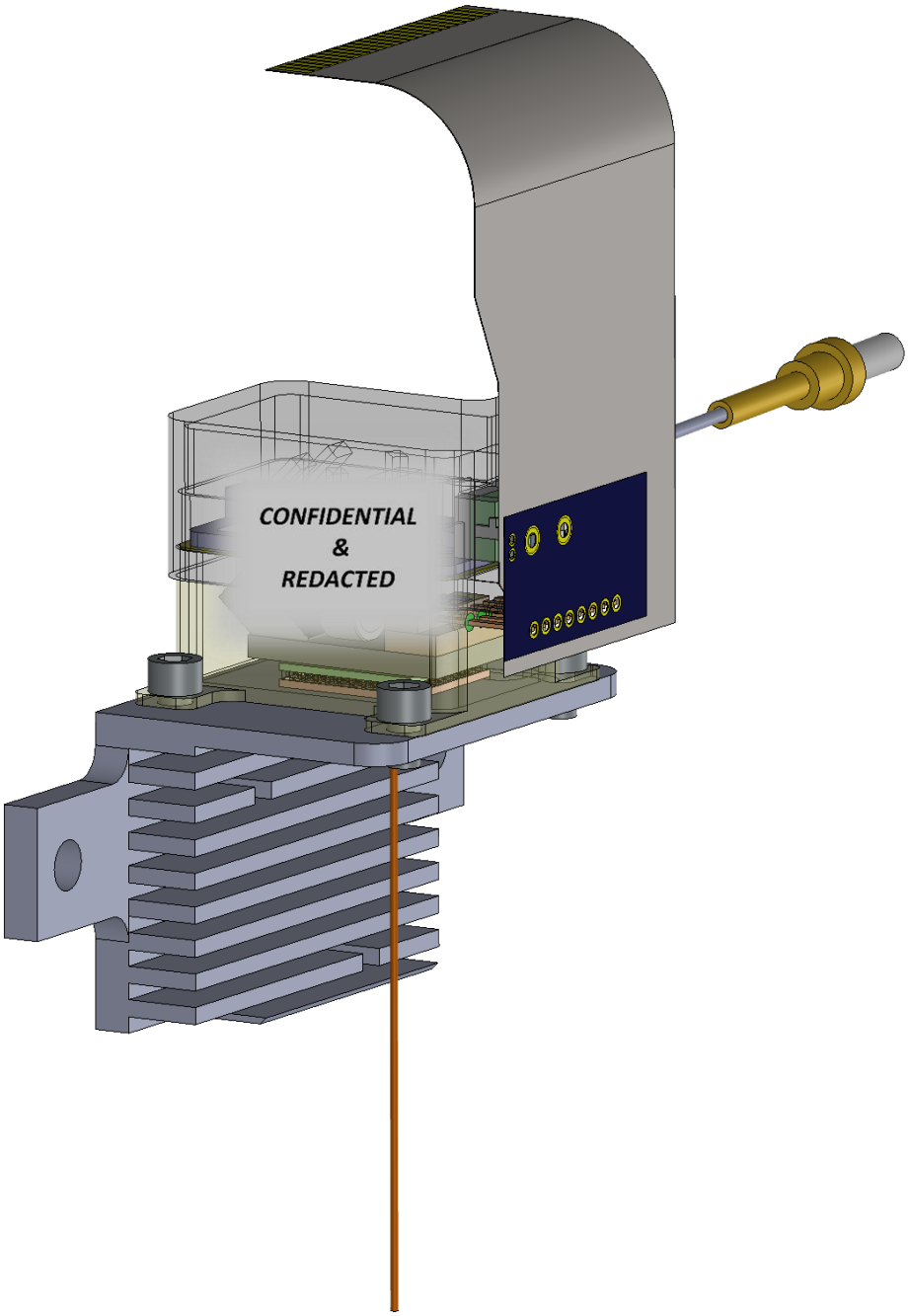
Document Title:	Part # Part Name Manufacture & QA Work Instructions



REVISION HISTORY

Revision	Date	ECO #	Description
01	18-MAY-2015	ECO-0087	Initial release authored by REDACTED.
02	01-OCT-2015	ECO-0090	Updated document to use additional electrically-set adhesive when REDACTED
03	12-OCT-2016	ECO-0094	Updated for new automated program.
D	21-OCT-2016	ECO-0103	Corrected motion direction in instructions for placing third reflector. Corrected Image text in reflector description. Change to lower-level lens and grating curing procedure. Change to ferrule attachment procedure and design. Change to final folding mirror alignment procedure.
E	17-DEC-2016	ECO-0117	Added ENKN measurement, added thermocycle and report generation, updated part numbers and figures
F	17-MAR-2018	n/a	Releasing Rev F in an as-is state for document preservation prior to overwriting with new draft to begin full rewrite. *Brian Okum*
G	07-OCT-2018	none	Complete rewrite of this document based on REDACTED. *Brian Okum*
H	*TBD*	*none*	*Pending updates:* • *Addition of global and procedure-level MBOM diagrams* • *Addition of Process Flow* • *Addition of new images* • *Steps to follow along with the traveler* • *Diagrams for **Error! Reference source not found.**, **Error! Reference source not found.**, **Error! Reference source not found.*** • *Addition of procedure to create laser chip wire bonds* • *Specification tables for ceramic node adhesion procedure* *Brian Okum*

CONTENTS

FIGURES

1.0 Specifications

Part Information	
Name	PART NAME
F/K/A	*FORMER PART NAME*
Part Number	PART#
Revision / Release	"D" released on 22 JUNE 2018
Engineering Name	FULL ENGINEERING NAME FROM SOLIDWORKS OR FUSION360

Refer to the following documents for specifications not explicit in this document:

Document Number	Document Title	Contents
FRM-00XX	FinalQC Form	Final quality specifications
QC-00XX	QC-000000-00, REDACTED	REDACTED performance specifications
QC-00XX	000000-00, REDACTED	Pertinent to 'REDACTED' i.e., the manufacture of REDACTED
QC-00XX	General Manufacturing Torque Specifications	Torque specifications
QC-00XX	Incoming Inspection Parts List	Critical measurements

2.0 Purpose

(A) To establish work instructions for the production floor technician(s) responsible for the assembly of PART#, the PART NAME.

(B) To document and preserve manufacturing knowledge of PART#, including necessary materials, parts, and procedures.

3.0 Scope

This document provides instruction for the manufacturing of PART#, the REDACTED. It contains all instructions for "Stage 2" i.e., the top-level assembly beginning with completed PART#, PART NAME and ending with the completion of PART#, PART NAME) and excludes instructions for "Stage 1" i.e., the lower-level assembly MO.

(A) Refer to WI-00XX for Stage 1 assembly instructions.
(B) Refer to WI-00XX for Stage 1 QC instructions.
(C) Refer to WI-00XX to manufacture PART#, the PART NAME.

4.0 Roles & Responsibilities

Role	Responsibility

5.0 Required Equipment & Materials

5.1 AC POWERED EQUIPMENT

Name Used in Document	Description & Specification	Manufacturer & Model

5.2 ADDITIONAL TOOLS & EQUIPMENT

Name Used in Document	Description & Specification	Manufacturer & Model

5.3 CONSUMABLE TOOLS & MATERIALS

Name Used in Document	Description and/or Model Number	Manufacturer

5.4 REFERENCED & SUPPORTING RESOURCES

5.4.1 DOCUMENTS.

Document Number	Document Title
DWG-000000-00	*redacted*
DWG-000000-00	*redacted*
WI-0000	*redacted*
WI-0000	*redacted*
WI-0000	*redacted*
TRV-0000	*redacted*
FRM-0000.00	*redacted*
QC-0000	*redacted*
QC-0000	*redacted*
QC-0000	*redacted*
QC-0000	*redacted*

5.4.2 COMPUTER PROGRAMS.

Computer Program	Description & Version
redacted	*redacted*
redacted	*redacted*
redacted	*redacted*

6.0 Glossaries

6.1 ACRONYMS

Acronym or Term	Definition or Meaning
AWG	
BOM	
CMD	
DAQ	
DDL	
DWG	
EBOM	
G	
IPA	
IR	
L1, L2	
LD	
LIV	
LPD	
MBOM	
MO	
NOA	
P0, P1	
QC	
RTV	
TEC	
UV	
WI	
λ	

6.2 TERMINOLOGY

Term	Definition
Aberration	A disruption/imperfection visible in parabolic data. A/k/a “clipping”
remainder of list redacted	

7.0 BOM & Process Flow

7.1 BOM LIST & NOMENCLATURE

Complete list of MBOM parts used and referenced and a cross-reference between the given names in the engineering domain and the abridged names used within this document and often in production.

7.1.1 FINAL PRODUCT FROM MANUFACTURING PROCESS.

Name Used in Work Instructions	Engineering Name/Description	Part #
PART NAME	ENGINEERING NAME	PART#

7.1.2 **MANUFACTURING BOM LIST.** Needed to manufacture PART#.

	Name Used in WI	Engineering Name/Description	Part #
Subassembly #1	PART NAME	ENGINEERING NAME	Top-Level PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	Lowest-Level PART#
Subassembly #2	PART NAME	ENGINEERING NAME	Top-Level PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	Lowest-Level PART#
Subassembly #3	PART NAME	ENGINEERING NAME	Top-Level PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	PART#
	PART NAME	ENGINEERING NAME	Lowest-Level PART#
REMAINDER OF LIST REDACTED			

7.1.3 **REFERENCED ONLY.** (Not an MBOM item for the SUBASSEMBLY manufacturing process).

Name Used in WI	Engineering Name/Description	Part #
REMAINDER OF LIST REDACTED		

7.2 WORKING GLOSSARY

These terms refer to partially completed assemblies during the work process or else to unique test assemblies that naturally do not have part numbers. The terminology is typically only used in work instructions documents and not in the engineering domain.

Name Used in WI	Part Numbers
REDACTED Subassembly	PART#, PART#, PART#, PART#
REDACTED Subassembly	PART#, PART#, PART#
REDACTED Subassembly	PART#, PART#, PART#, PART#, PART#, PART#
REDACTED	PART#, PART#
REDACTED[1]	PART#, PART#

[1] Soldering PART# to PART# to create the thermistor (PART#) is currently performed by a third party.

7.3 GLOBAL MBOM DIAGRAM

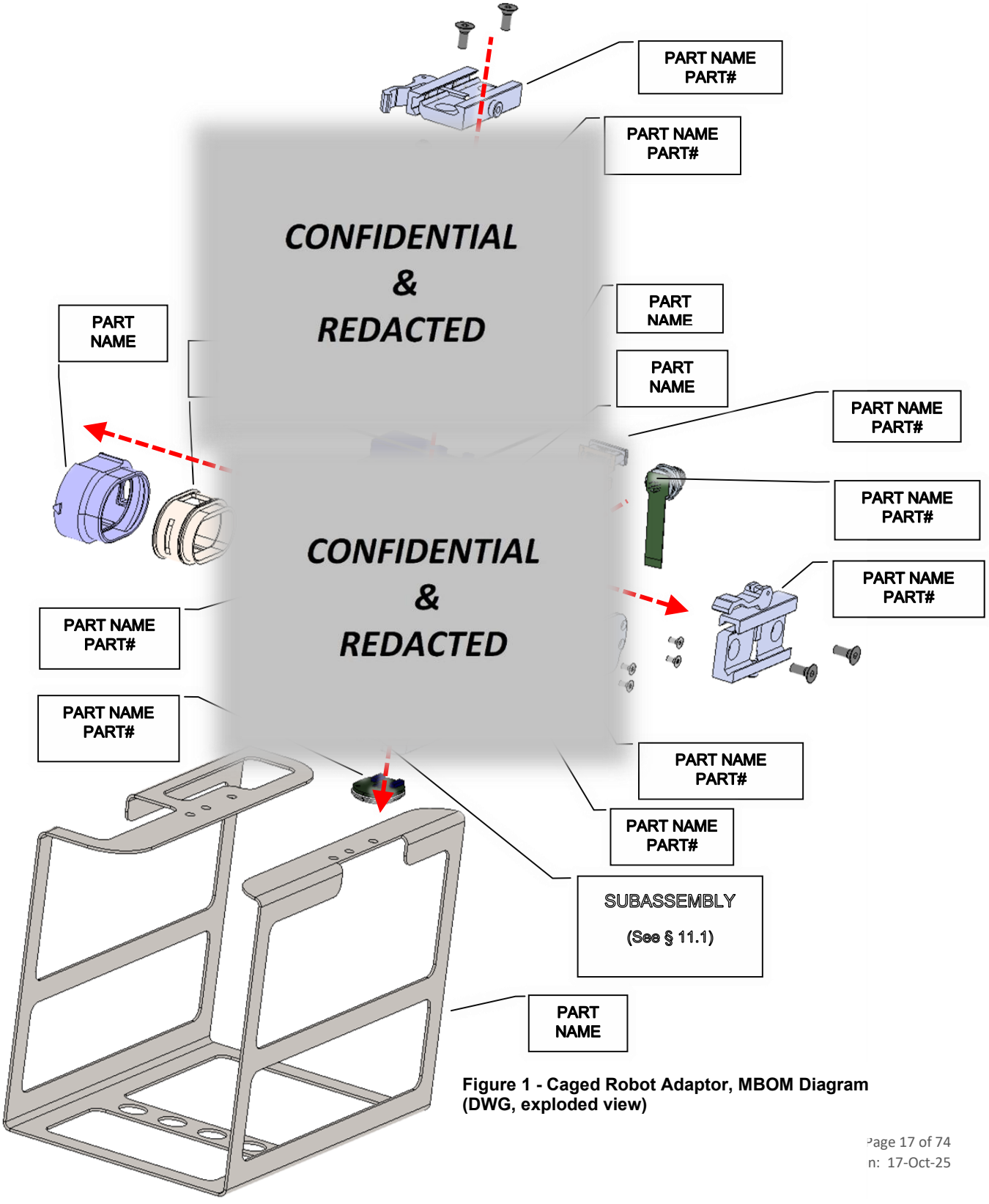


Figure 1 - Caged Robot Adaptor, MBOM Diagram (DWG, exploded view)

7.4 MIRRORS & LENSES DIAGRAMS

Produced in Manufacture Process Part II

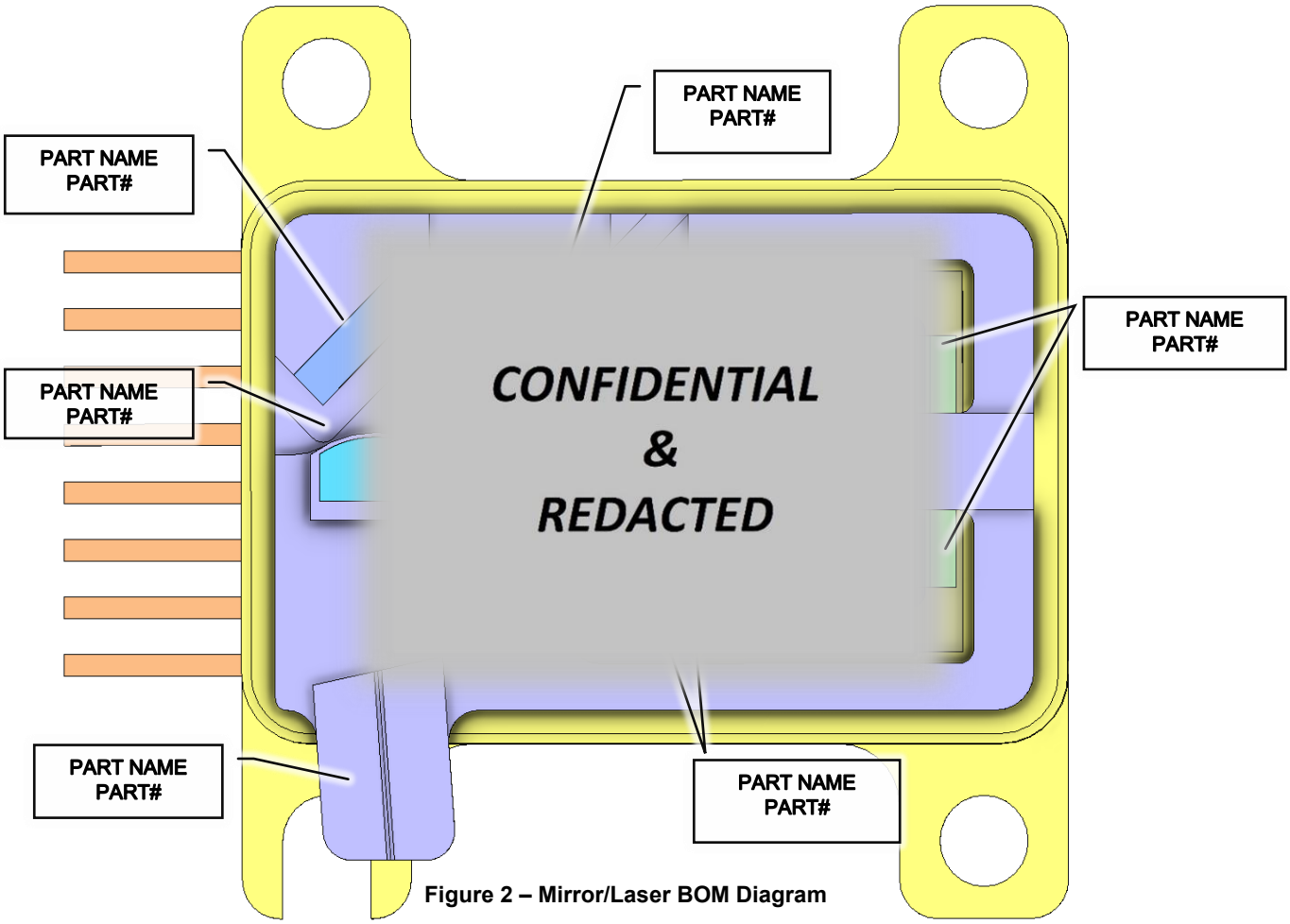


Figure 2 – Mirror/Laser BOM Diagram

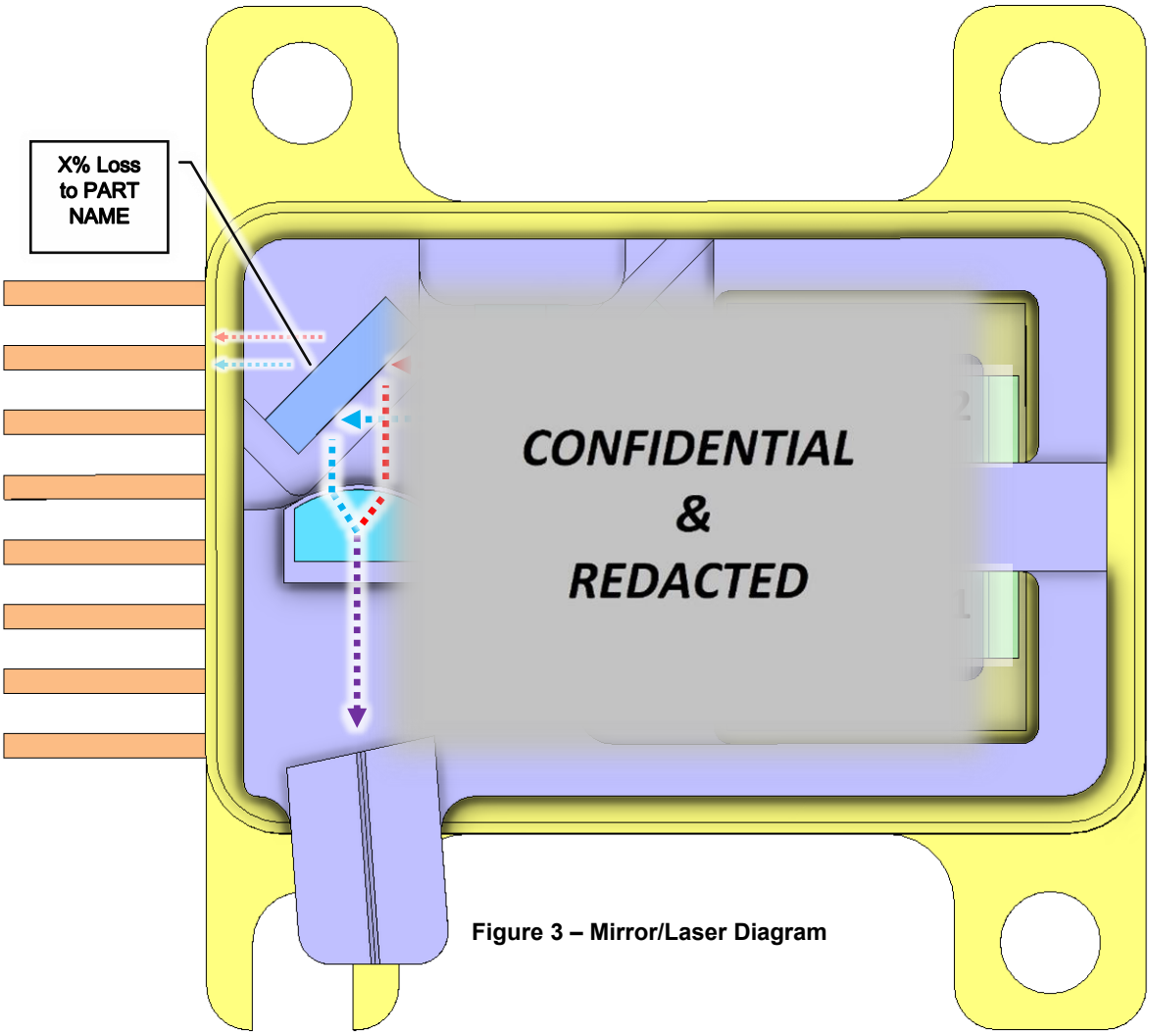


Figure 3 – Mirror/Laser Diagram

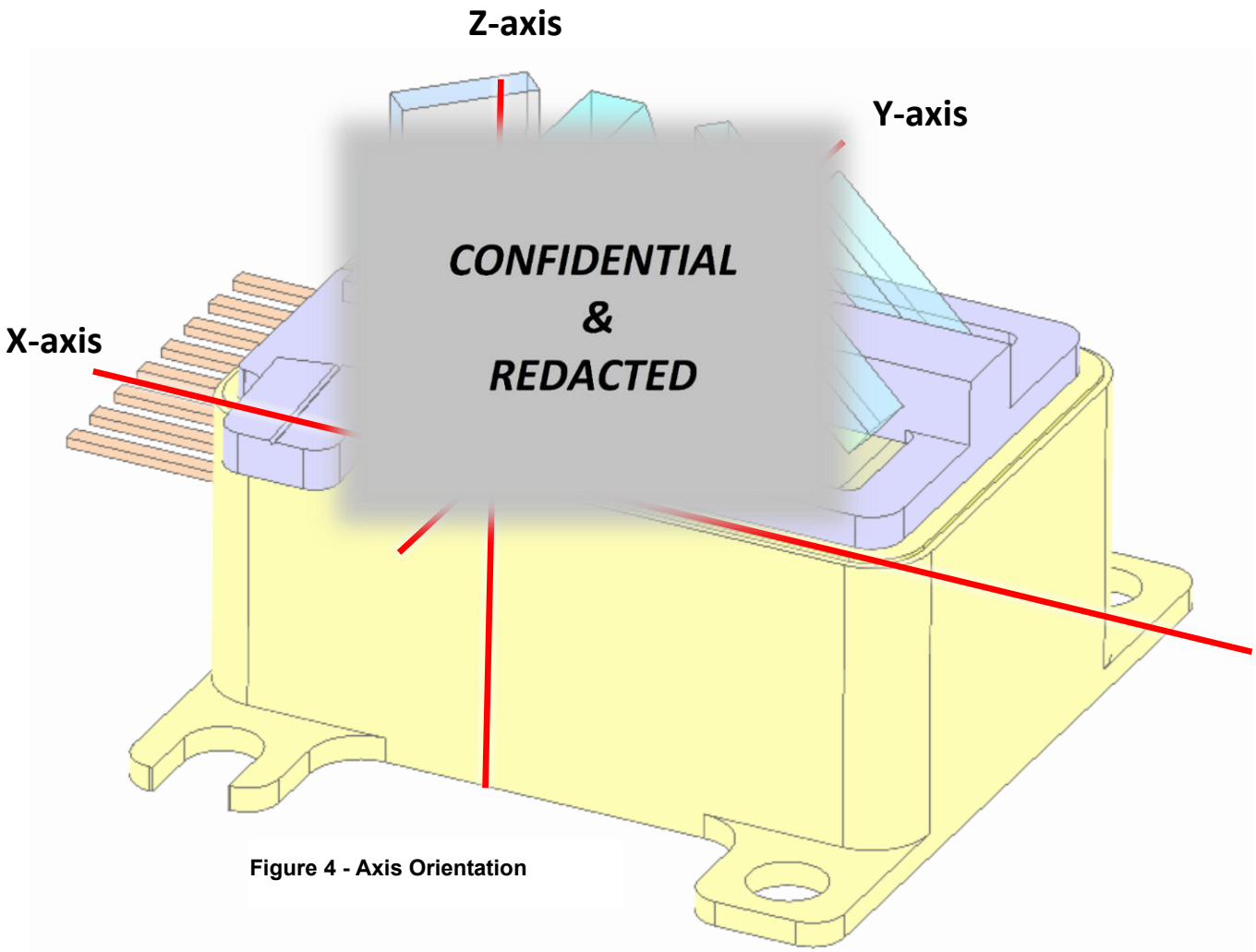


Figure 4 - Axis Orientation

7.5 PROCESS FLOW

(ADDITIONAL PROCESS FLOWS REDACTED)

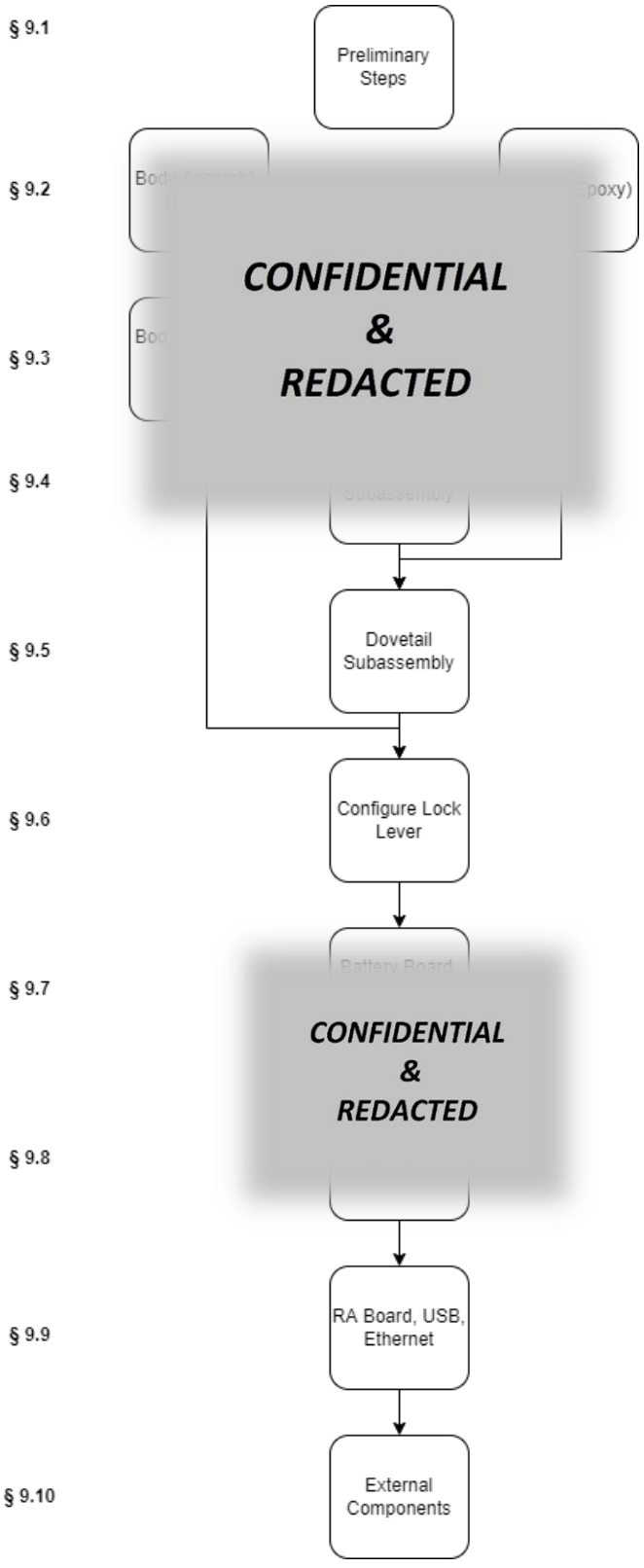


Figure 5 - 000000-00 Manufacture Process Part I Flow

8.0 Cautions, Warnings & General Practices

8.1 CAUTIONS & WARNINGS

- Laser safety glasses must be worn when operating the UV lamp and during open laser emission.
- Never stand downstream of an active laser emission (regardless of whether laser safety glasses are worn).
- A grounded ESD / anti-static wrist strap must be worn when handling circuited parts, flex cables and other wired subassemblies.

8.2 GENERAL PRACTICES

- Use USB microscopes when manipulating laser assemblies with the precision gripper.
- Circuited parts should only be placed on clean, electrically nonconductive surfaces. If there is epoxy, grease, or debris on the workstation then it is not suitable and a storage bag or other clean, non-electrically conductive surface should be used.
- REMAINDER REDACTED

9.0 Manufacture Process: Part I

Total Estimated Time: 8.5 Hours

Part I of the manufacture process ends with the completion of the 'PART NAME' and the 'PART NAME Subassembly'. Complete all procedures at the Stage 2 Laser Station in Production Room 1 except where specified otherwise. Estimated completion times and BOM lists assume an MO calling for 10 completed assemblies (PART#).

9.1 PRELIMINARY STEPS

Estimated Time: 1 Hour

Necessary steps prior to assembly procedures.

9.1.1 **GATHER PARTS & MATERIALS.** The following two tables list BOM parts and non-BOM tools and materials needed for this procedure.

Part	QTY.	Part Number
PART NAME	X	000000-00
PART NAME	X	000000-00

Non-BOM Material or Tool
25G Syringe Tip
Acetone (100% Purity)
Chemical Wipes
remainder of list redacted

⚠ *Wear nitrile gloves during this procedure. Oils from fingerprints left on the parts in this procedure may cause the completed unit to malfunction.*

9.1.2 **PARTS KIT.** Obtain a parts kit and picklist for the MO for PART#, PART NAME. Ensure all items and quantities represented on the picklist are present. See Operations if anything is missing.

9.1.3 **TRAVELER.**

9.1.3.1 Open the traveler with the corresponding serial number from the following pathway. If a traveler does not exist for this unit, then the cell lead must create one before proceeding. Do not create one yourself.

D:\Production\ (REMAINDER REDACTED).....

9.1.3.2 Complete the “Header” and “Manufacture Order” information sections.

9.1.4 **574-1 EPOXY SETUP.**

9.1.4.1 Retrieve a syringe of 574-1 epoxy from the laboratory freezer.

9.1.4.2 Attach a 25G tip to the syringe.

9.1.4.3 Attach the syringe to the pneumatic unit.

9.1.4.4 Set the pneumatic unit to the ‘dispense’ setting.

9.1.4.5 Set the unit dispense time to 0.2 second intervals.

9.1.4.6 Set the unit to dispense at 35psi.

Parameter	Specification
Epoxy Type	574-1
Syringe Tip Size	25G
Dispense Interval	0.2s
Pressure	35psi

9.1.4.7 Allow the epoxy to thaw for at least 15 minutes before dispensing any epoxy.

9.1.5 **CLEAN ALL PARTS (000000-00).**

9.1.5.1 Clean the inside walls and floor surface of each kovar box with cotton swabs and acetone.

9.1.5.2 Use the pneumatic dispenser as an air duster on the inside of each PART NAME to blow away any dust or cotton particles.

9.1.6 **CLEAN ALL TECS (000000-00).** Clean the sides of all PART NAMES with acetone and cotton swabs.

9.2 BATTERY BOARD & WIRE SOLDERING

Estimated Time: 3 Hours

Procedure to (1) install 000000-00, the Battery Board to the Adaptor Body and (2) solder wiring from the Part Subassembly to the Battery Board.

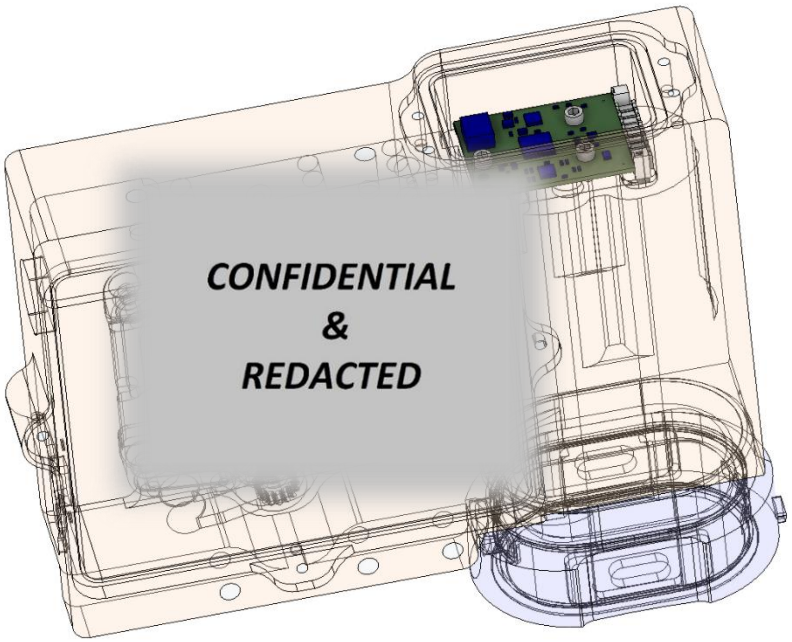


Figure 6 - Battery Board in Body (DWG)

9.2.1 **GATHER PARTS & MATERIALS.** The following two tables list BOM parts and non-BOM tools and materials needed for the procedure.

BOM Part	QTY	Part Number
Part	X	*From § 9.6*
Part PCB	X	000000-00
Screw (*specs redacted*)	X	000000-00

Non-BOM Material or Tool
Anti-static Wrist Strap
IPA
Cotton Swabs
Nitrile Gloves (recommended)
Loctite 222
Weighing Dish
English Allen Wrench Set
Wire Cutters
Wire Strippers
Needle Nose Pliers
Soldering Iron
Solder (0.3mm)
Flux

⚠ *Only use the lightweight tabletop vice for this procedure. Avoid using a mounted bench vice as it may scratch or damage the board or plastic parts.*

9.2.2 **INSERT BATTERY BOARD TO BODY.** Insert the battery board in the opening in the body as seen in Figure 6. Orient the battery board so that (A) the pin connector is on the 'outside' side of the body and (B) the female end of the connector faces down into the body as seen in Figure 7. Do not fasten the board down with screws yet.

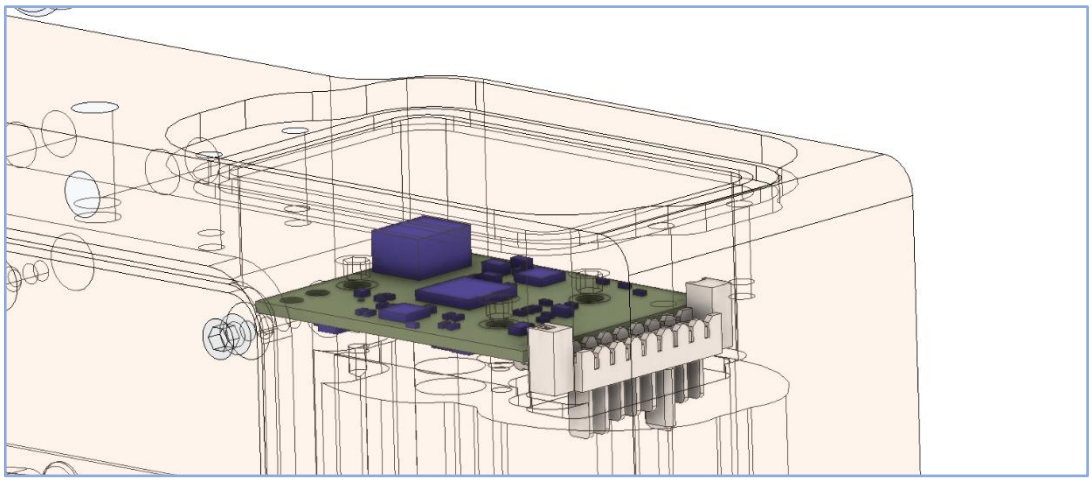


Figure 7 - Battery Board (000000-00), Orientation (DWG)

9.2.3 **ORIENT & TRIM WIRES.**

9.2.3.1 Bend and shape all four wires as seen in Figure 8 so that they all travel against the two walls in the body to reach the slot in the corner with the battery board

9.2.3.2 The red and black wires are likely longer than necessary. They must reach the larger through-hole solder joints on the battery board without tension (approximately where the dashed line is in the figure). The wires cannot be under tension; They should all have a degree of slack once soldered to the battery board. Use wire cutters to cut the red and black wire to length accordingly.

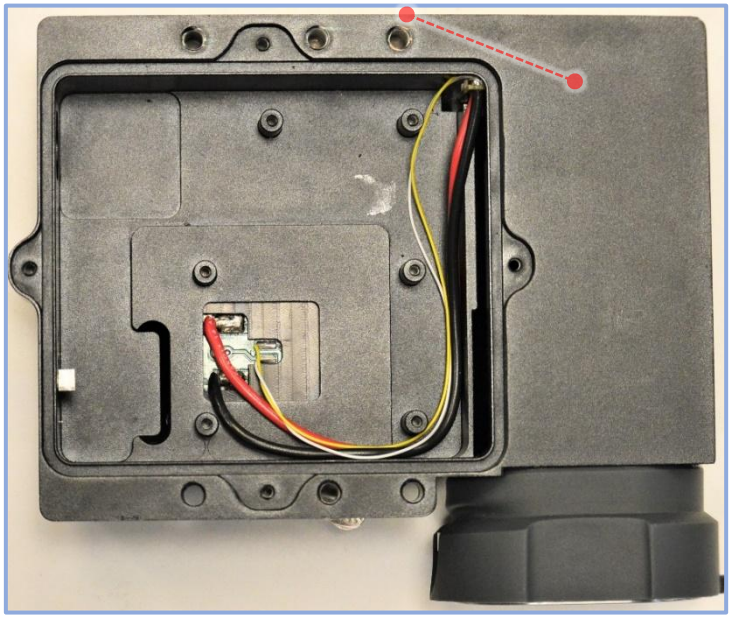


Figure 8 - Wires Oriented Around Body Standoffs

9.2.3.3 Use wire strippers to remove ~4mm insulation from the ends of the red and black wires.

9.2.4 SOLDER RED & BLACK 16 AWG TO BATTERY BOARD.

9.2.4.1 Feed the red and black wires through the two larger through-hole joints from the **bottom** of the battery board. From an overhead perspective the black wire must be fed through the left joint and the red through the right joint; Refer to Figure 9.

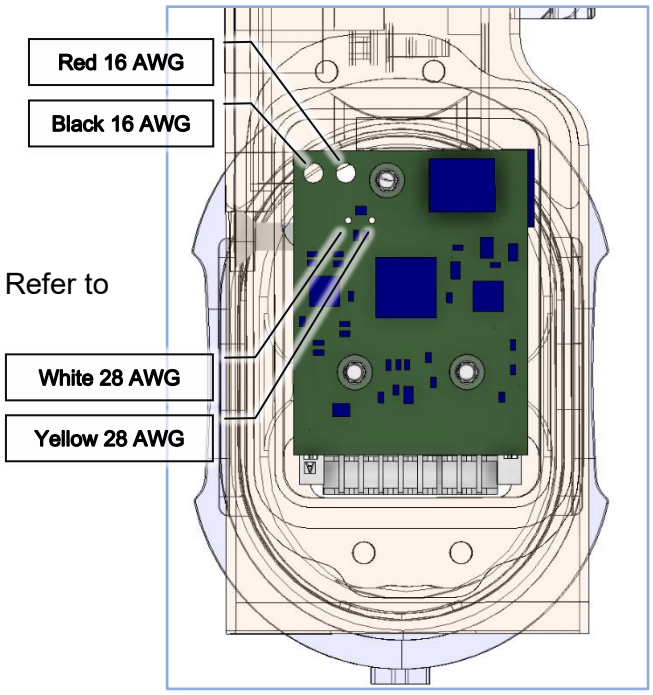
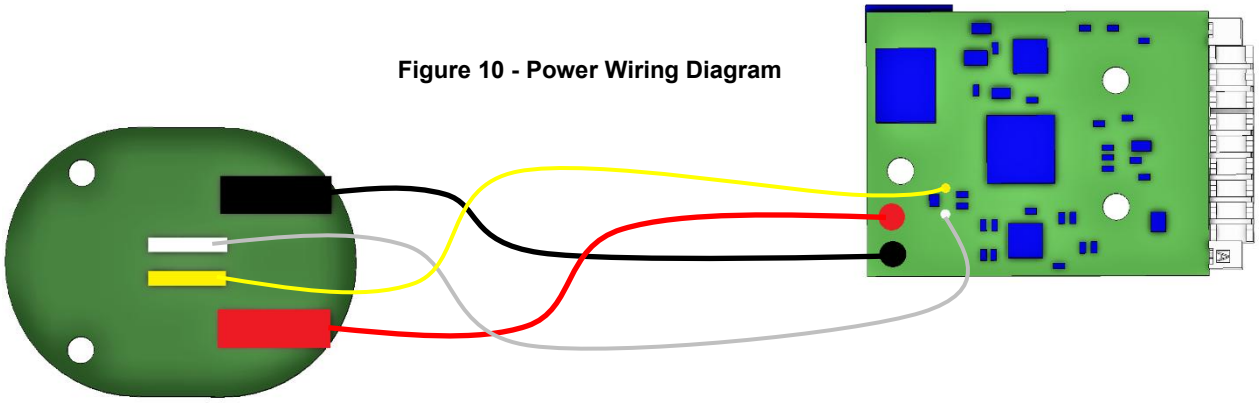


Figure 9 - Battery Board, Wire Diagram (DWG)

9.2.4.2 Start with the red wire; With the insulation against the bottom of the battery board as seen in Figure 11, use diagonal wire cutters to remove excess stripped wire so that it is flush with the battery board.

Figure 10 - Power Wiring Diagram



9.2.4.3 Apply flux to the red wire end.

9.2.4.4 Solder the red 16 AWG wire to the joint.

9.2.4.5 Repeat previous steps to solder the black 16 AWG wire to the other through-hole joint.

9.2.5 **SOLDER YELLOW & WHITE WIRE TO BATTERY BOARD.** Repeat steps used for the 16 AWG wires under § 9.7.4 to solder the 28 AWG wires. Solder the yellow wire first, and then the white wire. These wires are also fed from the bottom of the board.

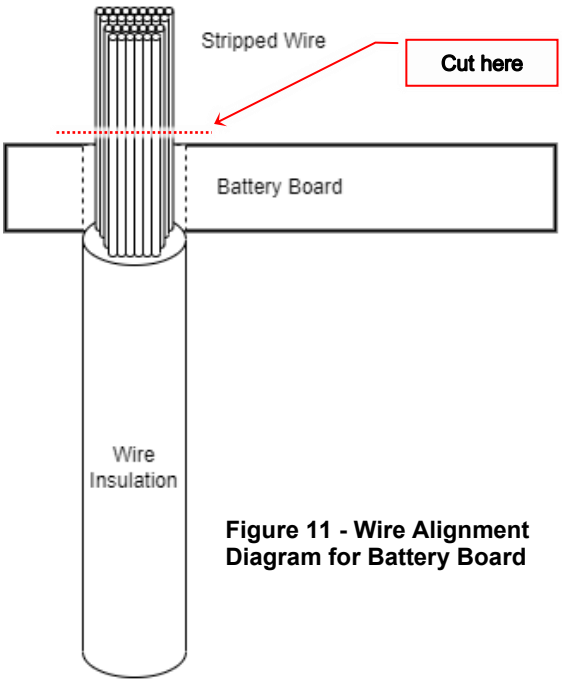


Figure 11 - Wire Alignment Diagram for Battery Board

9.2.6 **CLEAN FLUX & DEBRIS.**

9.2.6.1 Hold the battery board in place and then hold the entire adaptor unit upside down to shake away cut stripped wire or other debris.

9.2.6.2 Use cotton swabs and IPA to clean excess flux from the surface of the battery board.

9.2.7 **SECURE BATTERY BOARD.** Fasten the battery board to the body with three 2-56 screws (000000-00). These screws are highlighted in Figure 12.

9.2.8 Repeat all steps from § 9.7.2 up to this point for the remaining adaptor bodies and battery boards.

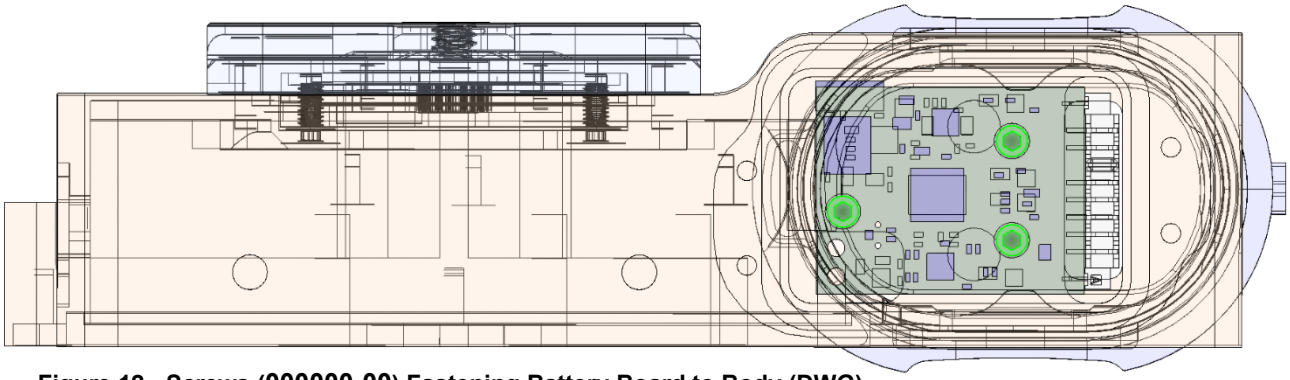


Figure 12 - Screws (000000-00) Fastening Battery Board to Body (DWG)

9.3 TEST UNIT CIRCUITRY

Procedure to test 000000-00 for any electrical & PCB related issues.

Estimated Time:
1 Hour

PROCEDURE REDACTED

9.4 EXTERNAL COMPONENTS

Procedure to attach external components including the Label, Part Clamps (x2), the Mounting Plate, and the Cage.

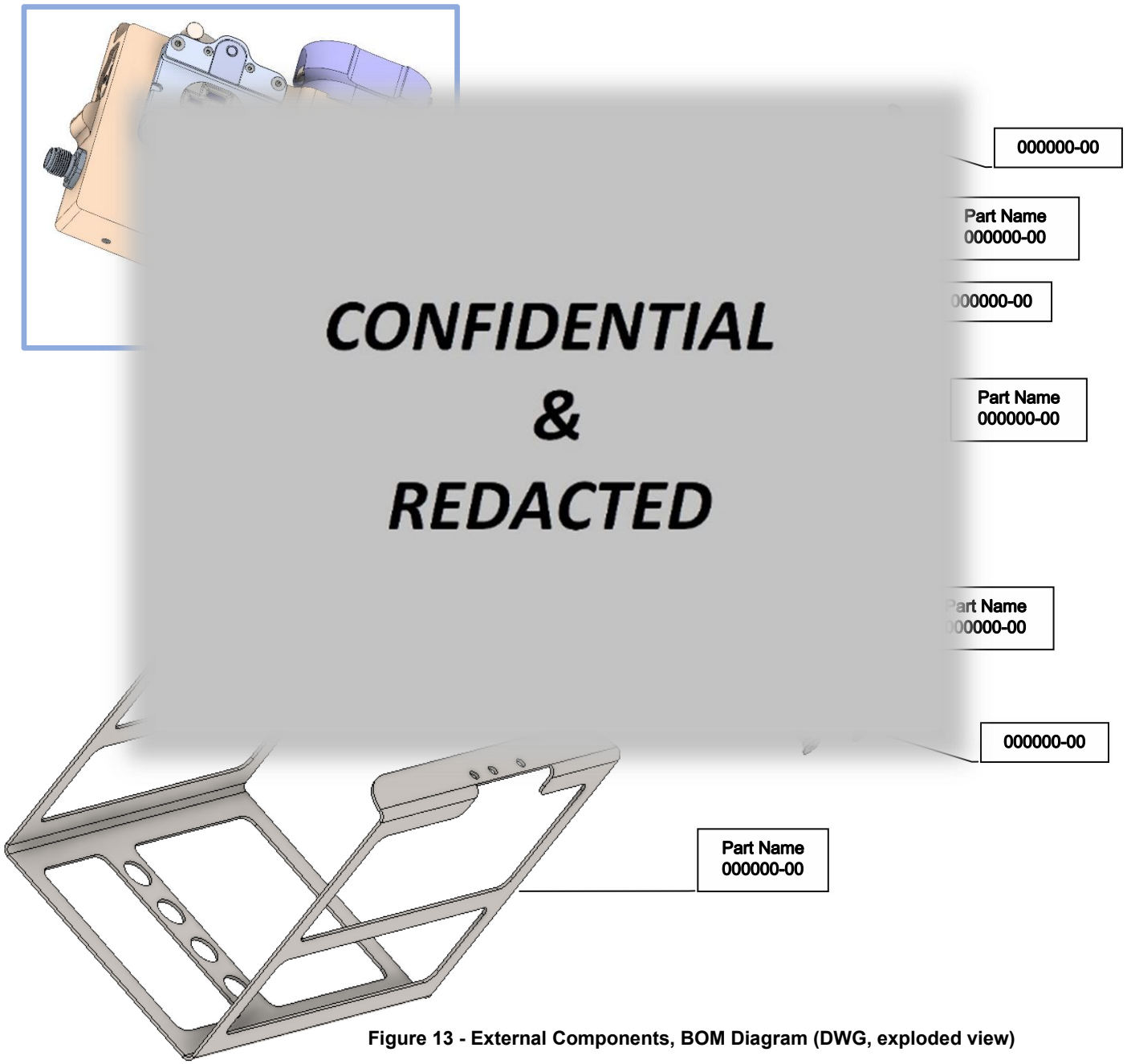


Figure 13 - External Components, BOM Diagram (DWG, exploded view)

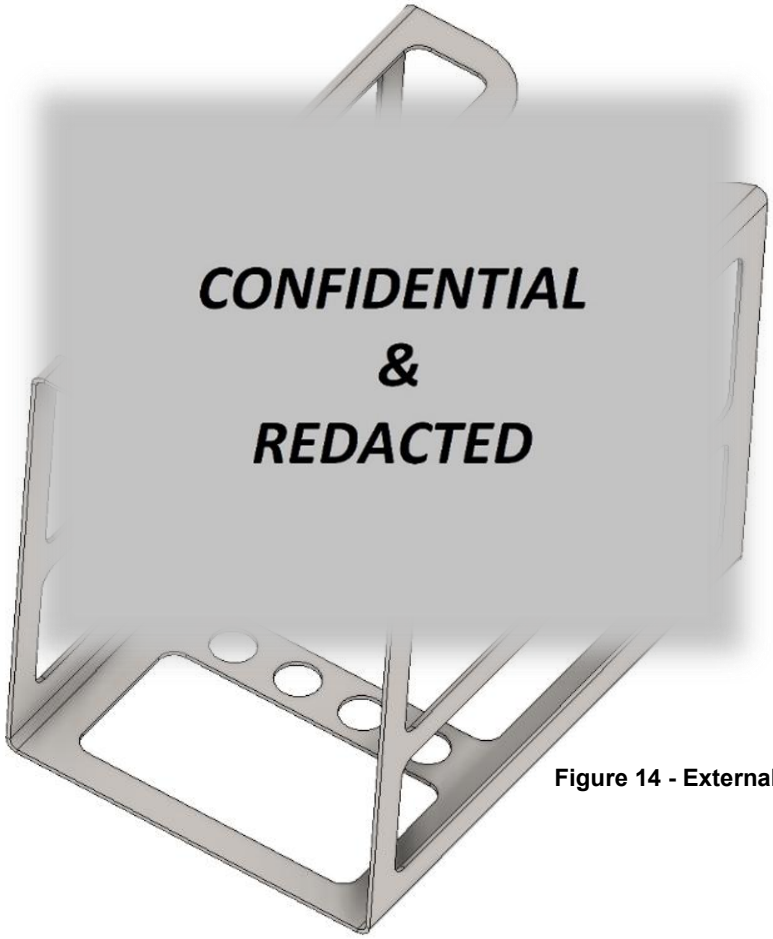


Figure 14 - External Components (DWG)

9.4.1 **GATHER PARTS & MATERIALS.** The following two tables list BOM parts and non-BOM tools and materials needed for the procedure.

BOM Part	QTY	Part Number
Part Subassembly	X	*From § 9.5*
Part Name	X	000000-00
Part Name	X	000000-00
Part Name	X	000000-00
Part Name	X	000000-00
Screw (Specs)	XX	000000-00
Screw (Specs)	XX	000000-00

Non-BOM Material or Tool
English Allen Wrench Set
Metric Allen Wrench Set
Tweezers

⚠ *Do not use Loctite on any screws in this procedure.*
These components are intended to be removable by the consumer.

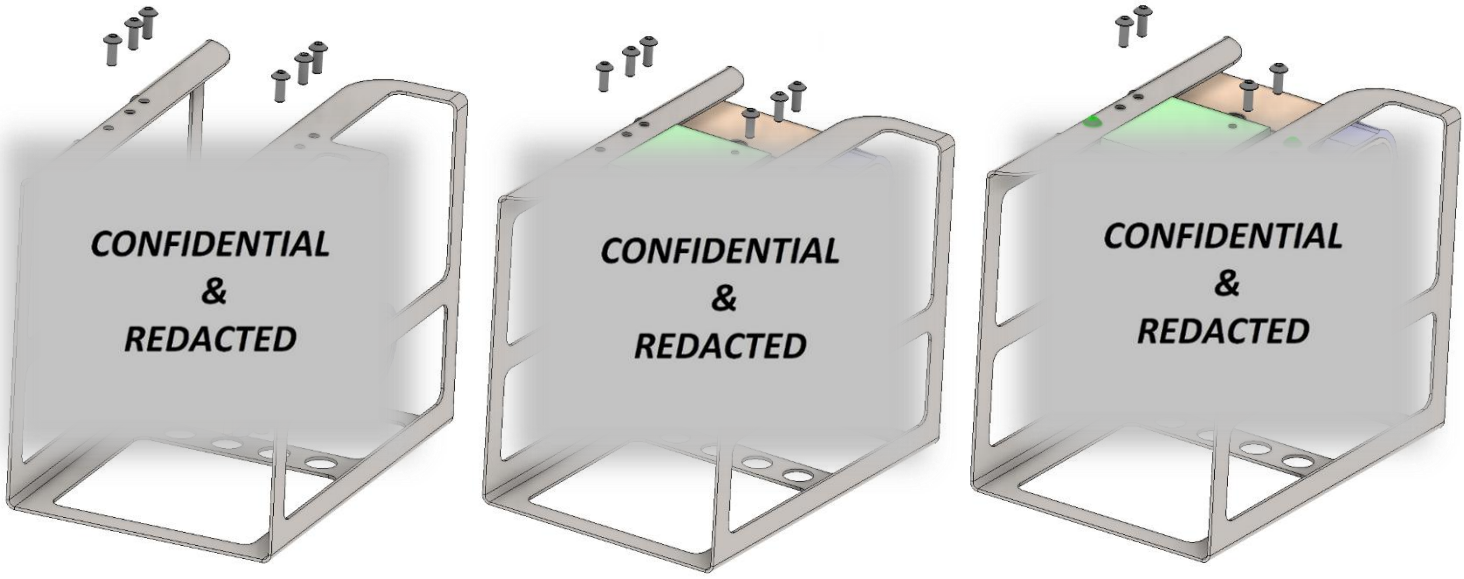


Figure 15 - Attaching Part and Part to Part (DWG)

9.4.2 **PART + PART SUBPART + PART.** Attach the mounting plate (000000-00) to the body and then the cage to the mounting plate as follows. Refer to Figure 15 and Figure 16.

9.4.2.1 Orient the cage as seen in the figure.

9.4.2.2 Place the mounting plate on top of the body cover on the adaptor body, oriented as shown in the figure. Note that the mounting plate is not symmetrical – there are two screw inserts off to one side. This side must be nearer to the boot and cartridge slot on the adaptor body. Refer to Figure 16 to ensure all parts are oriented correctly.

9.4.2.3 Hold the body and mounting plate under the two brackets on the cage as seen in the second image in the figure. Align the screw inserts among the parts.

9.4.2.4 Fasten two 10-32 screws (000000-00) finger-tight to diagonal corners of the cage (as seen in the third image in the figure) to hold the assembly in place. Do not use Loctite on any of these screws.

9.4.2.5 Fasten the other four 12-30 screws (000000-00) finger-tight to the other four inserts.

9.4.2.6 Use an English driver to tighten all six screws. There should be no play between the body, mounting plate nor the cage.

Figure 16 - Orientation of Assembly, Part, & Part (DWG)

9.4.3 **CONFIGURE PICATINNY CLAMPS.** The picatinny clamps should be pre-assembled in third-party packaging in the parts kit. They must be configured prior to being attached. Refer to WI-0000 subsection 12.4.11 for details.

REMAINDER OF PROCEDURE REDACTED

Estimated Time:
1.5 Hours

9.5 RA BOARD, USB & ETHERNET

Procedure to install (1) 000000-00, the PLK Adaptor Board, a/k/a the "RA" Board, (2) 000000-00, the Part Flex Subassembly, and (3) 000000-00, the Part Flex Assembly to the adaptor body containing other components from previous procedures.[2]

PROCEDURE REDACTED

[2] Note that DWG images may not capture the correct orientation of the flex cables.

Estimated Time:
30 Minutes

9.6 PART (000000-00) & PART (000000-00)

Procedure to attach 000000-00, the Part to 000000-00, the Part. Complete this procedure at a workstation with a microscope in Production Room 1. See DWG-000000-00 and DWG-000000-00.

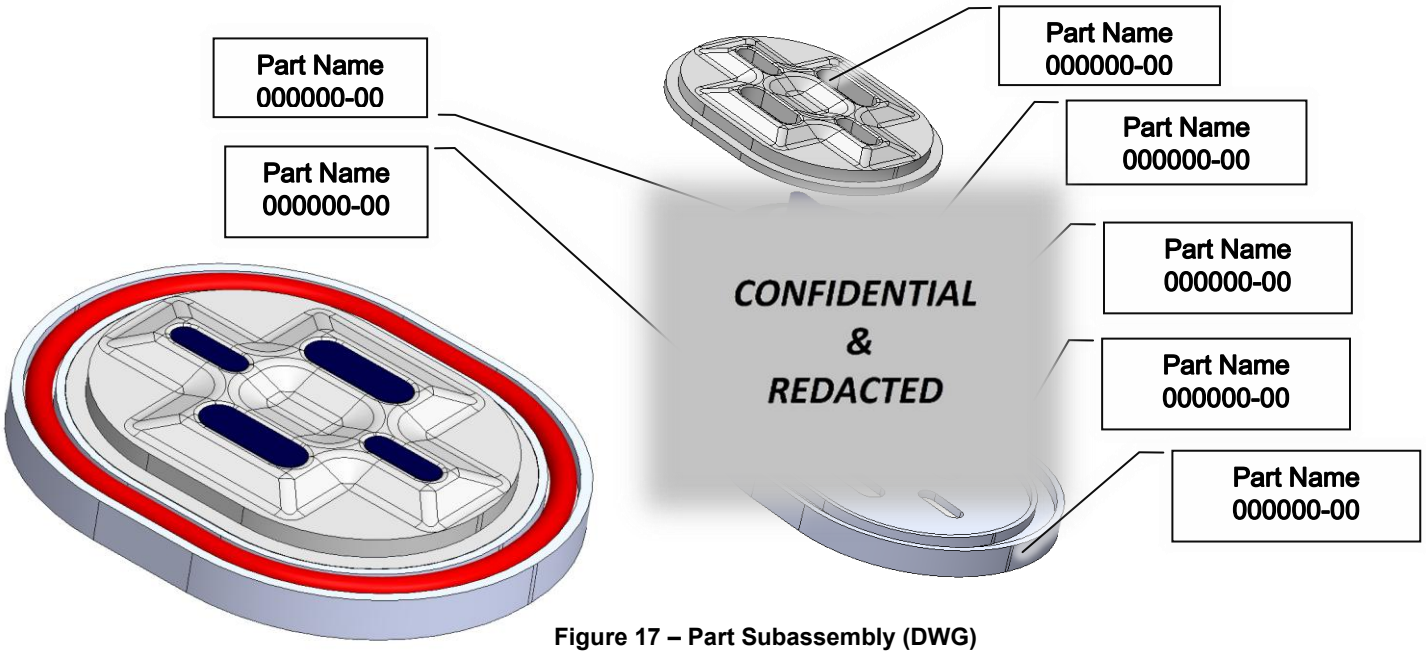


Figure 17 – Part Subassembly (DWG)

9.6.1 **GATHER PARTS & MATERIALS.** The following two tables list BOM parts and non-BOM tools and materials needed for this procedure.

Part	QTY.	Part Number
PART NAME	X	000000-00
PART NAME	X	000000-00
PART NAME	X	000000-00
PART NAME	X	000000-00
PART NAME	X	000000-00
PART NAME	X	000000-00
PART NAME	X	000000-00
PART NAME	X	000000-00

Non-BOM Material or Tool
25G Syringe Tip
Acetone (100% Purity)
Chemical Wipes
REMAINDER OF LIST REDACTED

⚠ *Wear nitrile gloves during this procedure. Oils from fingerprints left on the parts in this procedure may cause the completed unit to malfunction.*

9.6.2 **493-3 EPOXY SETUP.** Use the same epoxy from the previous procedure. Refer to § 9.1.4 if setup instructions are needed.

Parameter	Specification
Epoxy Type	574-1
Syringe Tip Size	25G
Dispense Interval	0.2s
Pressure	35psi

9.6.3 **ATTACH PART TO PART FIXTURE.** The two sides of the TEC (000000-00) are visibly identical with only one exception. Figure 19 identifies this difference: the wires are soldered to one side.

9.6.3.1 Peel back the double-sided tape on the back of the TEC.

9.6.3.2 Adhere the Part to the double-sided tape. Orient the Part as seen in Figure 19:

(A) The TEC wires are on the same side as the gold pins on the fixture.
(B) The side of the TEC that the wires are soldered to is facing down i.e., away from the fixture.

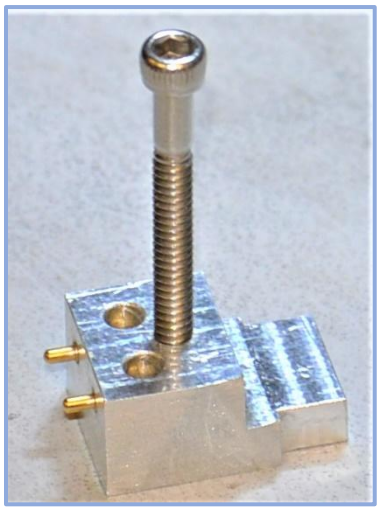


Figure 18 - TEC Fixture

⚠ IF THE TEC IS NOT ORIENTED CORRECTLY, THE ENTIRE PART ASSEMBLY WILL NOT WORK.

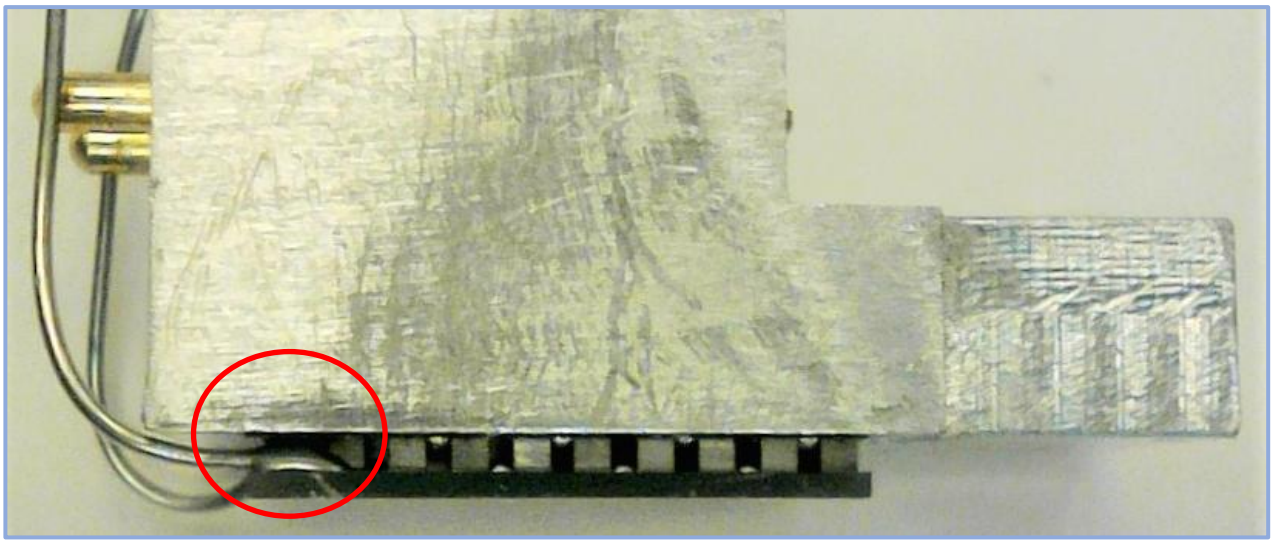


Figure 19 - TEC Orientation in Fixture

9.6.4 EPOXY PART TO PART.

9.6.4.1 Dispense several beads of epoxy onto a chemical wipe to flush out any debris or dried epoxy in the syringe or tip.

9.6.4.2 *APPLY EPOXY.* Apply 12 evenly spaced beads of epoxy on the bottom surface of the TEC. Apply them in four rows of three as seen in the Figure 20.

9.6.4.3 *PLACE TEC IN KOVAR BOX.* Place the TEC fixture in the kovar box (000000-00), epoxy-side down. Orient it so that the fixture pins face the header pins coming off the box as seen in the Figure 21.

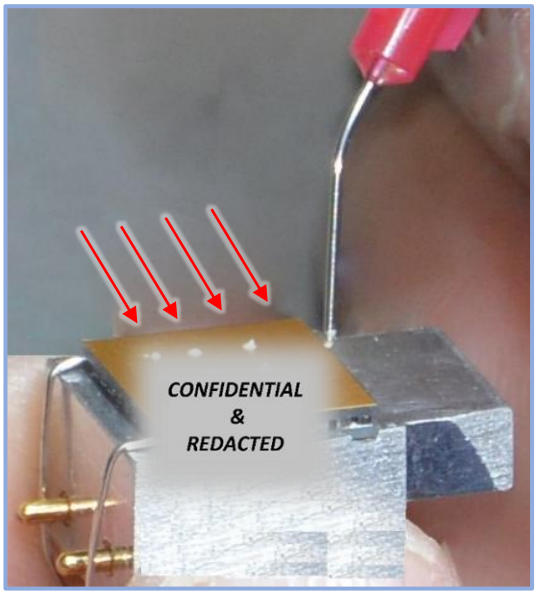
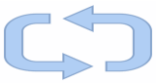


Figure 20 - Epoxy Application to TECs

9.6.4.4 Slide the fixture forward in the box (compressing the fixture pins slightly) to spread the epoxy, and then re-align the fixture tight against the back wall of the kovar box.

9.6.4.5 Place the assembly in a weighing dish and place the dish on an aluminum baking tray.

9.6.4.6 Repeat all steps above for all TEC fixtures and kovar boxes.



9.6.5 OVEN CURE EPOXY.

9.6.5.1 Place the tray of weighing dishes with epoxied assemblies in the XX°C oven for at least six hours.

9.6.5.2 Remove the tip from the epoxy syringe and place the syringe back in the lab freezer.

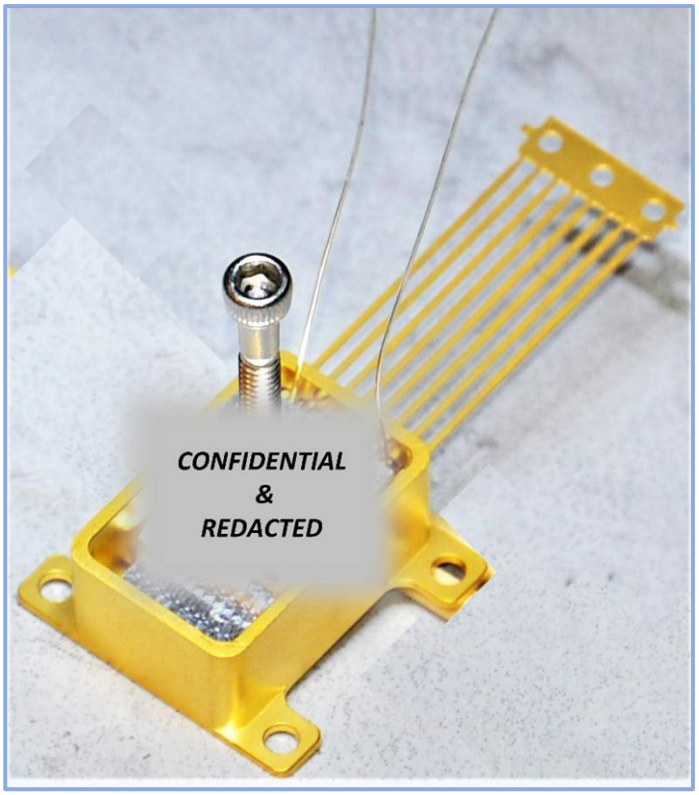


Figure 21 - TEC / Fixture in Part

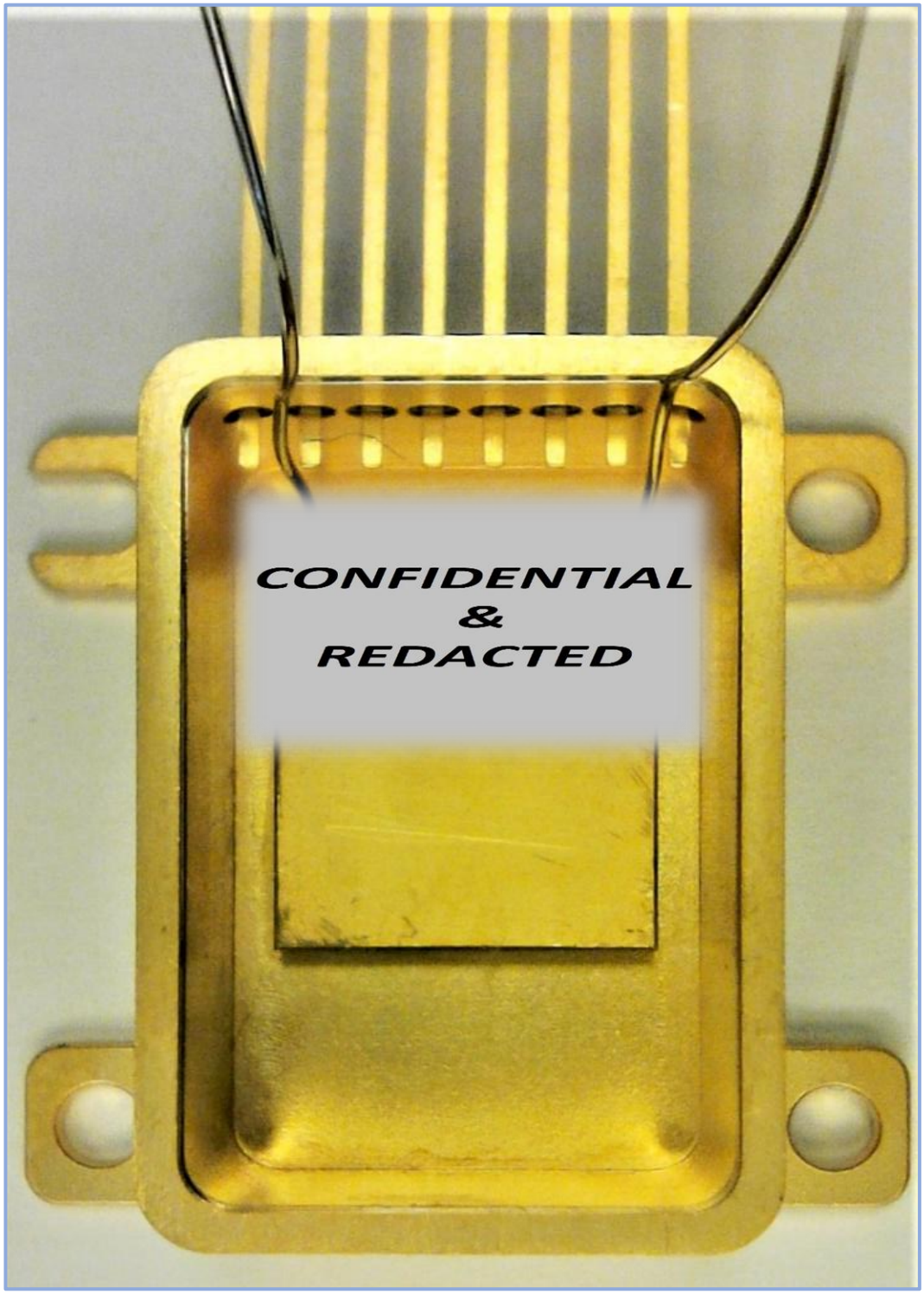
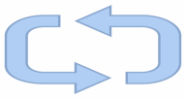


Figure 22 – Part (00000-00) Epoxied to Part

9.6.5.3 Apply a continuous bead of epoxy around the cutout on the first cover. Apply it so that it hugs the edge of the window area, leaving space between the epoxy and cutout only as wide (or less so) than the bead of epoxy. Refer to Figure 23 and Figure 24.

9.6.5.4 Repeat the last step to apply epoxy to all covers in the fixture.



9.6.5.5 Use tweezers to remove a window from the Gel-Pak. Inspect it under the microscope for any scuff marks. Remove any scuff marks with a cotton swab and acetone.

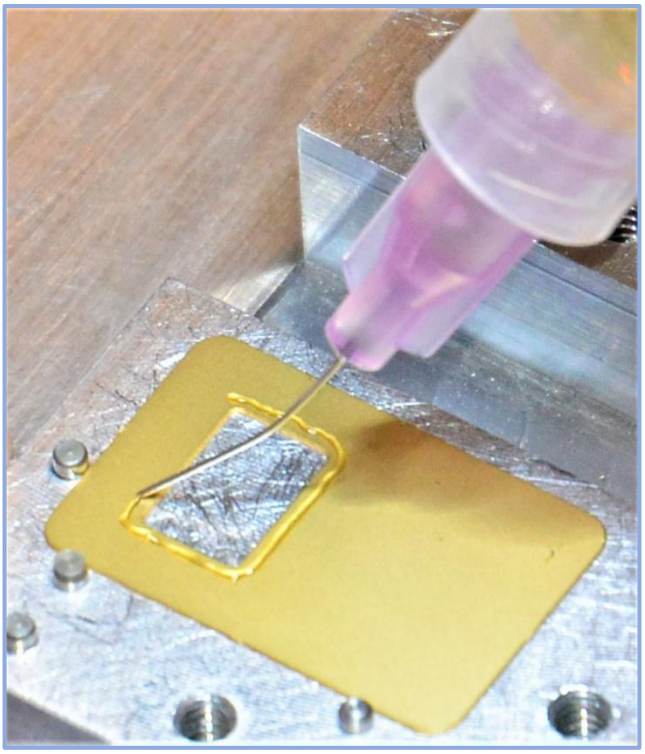


Figure 23 - Application of Epoxy to Cover

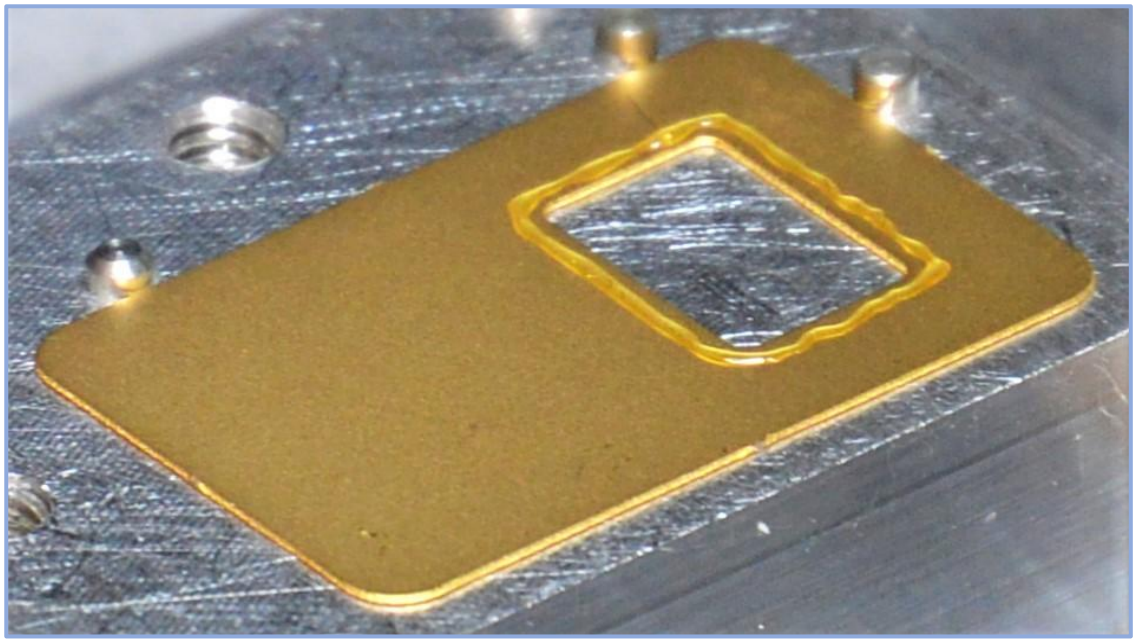


Figure 24 - Cover with Epoxy for Window

9.6.5.6 Use the microscope or magnification glasses to check the alignment of the window over the cutout area. Regard the silver pins on the fixture as a guide only (They sometimes do not provide a perfectly squared alignment). Use tweezers to shift the window so that it is aligned symmetrically over the cutout area on the cover, i.e., (A) the amount of window on each side of the cutout must be the same and (B) the window must be square with the cover. (Figure 25).

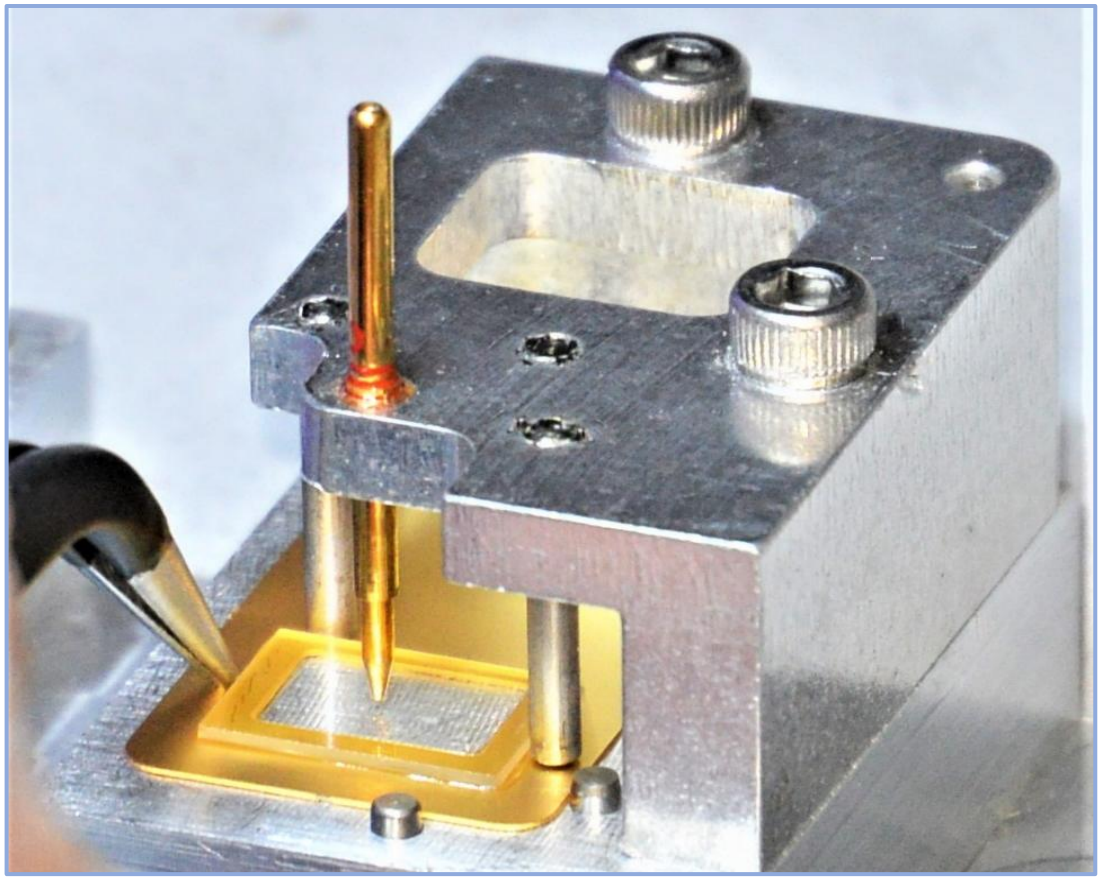
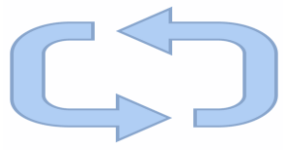


Figure 25 - Manipulating Cover/Window in Fixture

9.6.5.7 Tighten the fixture screws with a 3/32 driver to secure the part in place. Do not overtighten them as the gold pin will crack the window under excess tension. Tighten the fixture only until the window cannot be pushed around freely with tweezers.

9.6.5.8 Repeat all steps from § 9.6.5.5 up to this point for the remaining windows.



9.6.6 **INSPECT ALIGNMENT.**

9.6.6.1 After all parts are secured in the fixture, use the microscope or magnification glasses to examine each in turn for alignment to make sure than none shifted while others were installed.

9.6.6.2 Use tweezers to double-check that all parts are firmly held in place.

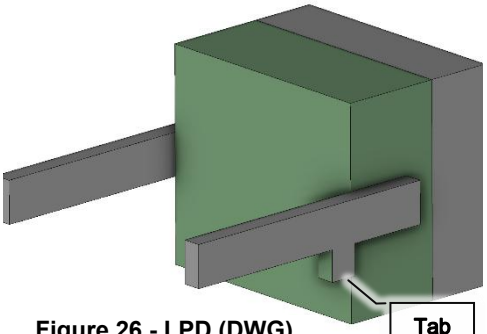


Figure 26 - LPD (DWG)

9.6.7 **OVEN CURE EPOXY.** Place the fixture in the XX°C oven for at least two hours to cure the epoxy.

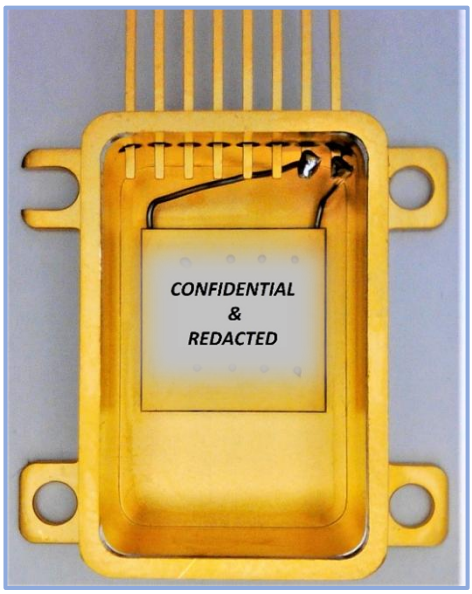


Figure 27 - Epoxy Applied to TEC for Q-Mount Subassembly

Figure 28 - Q-Mount Subassembly on TEC

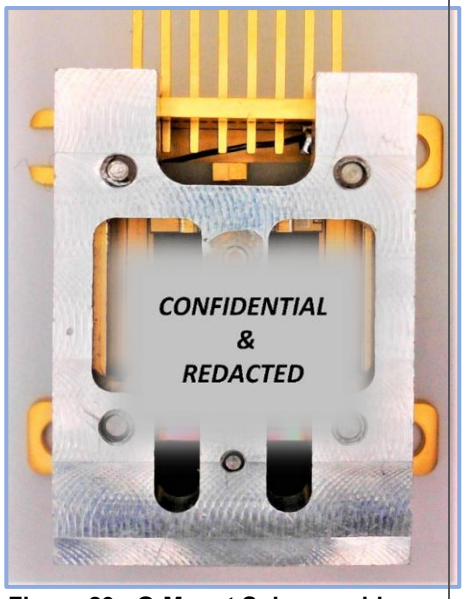


Figure 29 - Q-Mount Subassembly Fixture

Estimated Time:
15 Minutes

9.7 PHOTODIODE (LPD)

Procedure to assemble the Laser Photodiode (LPD) with 000000-00, a Part and 000000-00 a Part Sensor.

PROCEDURE REDACTED

Estimated Time:
2 Hours

9.8 PART SUBASSEMBLY (000000-00)

Procedure to attach the Part Subassembly (000000-00) to the TEC within the Part.

PROCEDURE REDACTED

9.9 PART & LPD (000000-00)

Estimated Time:
45 Minutes

Procedure to attach the Laser Photodiode to 000000-00, the Part.

PROCEDURE REDACTED

Estimated Time:
30 Minutes

9.10 PART & PART

Procedure to outfit 300629-00, the Laser Heatsink with 400376-00, the Laser Heatsink Thermistor.

PROCEDURE REDACTED

Estimated Time:
4 Hours

9.11 INTERNAL WIRE BONDS

Procedure to create the internal wiring that joins the Part Subassembly to the Part Subassembly. Complete this procedure at the microchip electronics workstation in Production Room I.

PROCEDURE REDACTED

Estimated Time:
30 Minutes

9.12 V3 COMPONENTS & PART PLATFORM

Procedure to (A) solder the V3 Spec. PCB to the header pins on the Part, (B) solder the LPD Part to the LPD, and (C) attach the Part Platform to the Part.

PROCEDURE REDACTED

10.0 Manufacture Process: Part II

Part II of the manufacture process begins with the completed Part Subassembly and includes the attachment of all L1 and L2 lenses and mirrors, as well as the fiber subassembly to the Part. Complete these procedures at the Stage 2 Part Station in Production Room 2 unless when specified otherwise. Estimated completion times and BOM lists assume an MO calling for XX completed assemblies

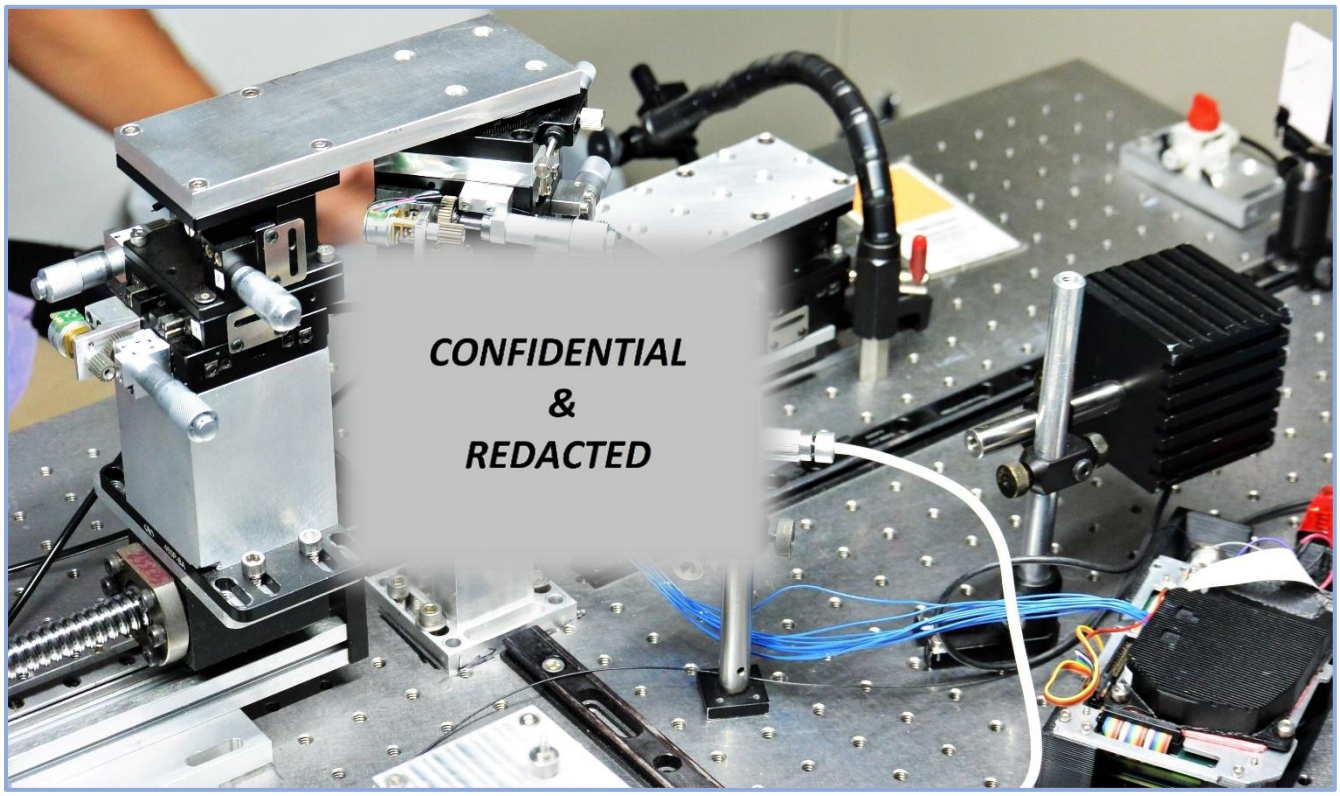


Figure 30 - Workstation Components for Part II

Estimated Time:
30 Minutes

10.1 PRELIMINARY STEPS

Necessary steps prior to assembly procedures.

PROCEDURE REDACTED

Estimated Time:
2 Hours

10.2 LIV TEST

Procedure to perform Live Indirect Voltage tests on L1 and L2 using the (redacted) computer program.

10.2.1 **POWER ON WORKSTATION UNITS.** Turn on the following four units at the at the workstation. *(The settings on these units should never change between MO cycles however it is important to verify them nonetheless).*

10.2.1.1 Turn on the laser diode controller unit. Verify that the TEC is preset to XXX0°C and the laser amperage should be set to XXXmA.

10.2.1.2 Turn on the laser diode driver unit. Verify that all values on the display screen read zero upon startup.

10.2.1.3 Turn on the pneumatic vacuum unit.

10.2.1.4 Turn on the optical multimeter unit. The laser wavelength should be set to XXXnm. The wattage should read approximately XXXµW.

Parameter	Specification
TEC	
Laser Amp.	
Laser Wavelength	
Optical Wattage	
Laser Diode (all)	

10.2.1.5 Turn on the (redacted) boardstack by flipping the switch under the red cover and then pressing the power button.

10.2.1.6 Turn on the desktop computer and open the (redacted) program.

10.2.2 **POWER HEAD.**

10.2.2.1 Activate the intended laser to be tested (typically redacted followed by redacted).

10.2.2.2 Set up the power head (Figure 31).

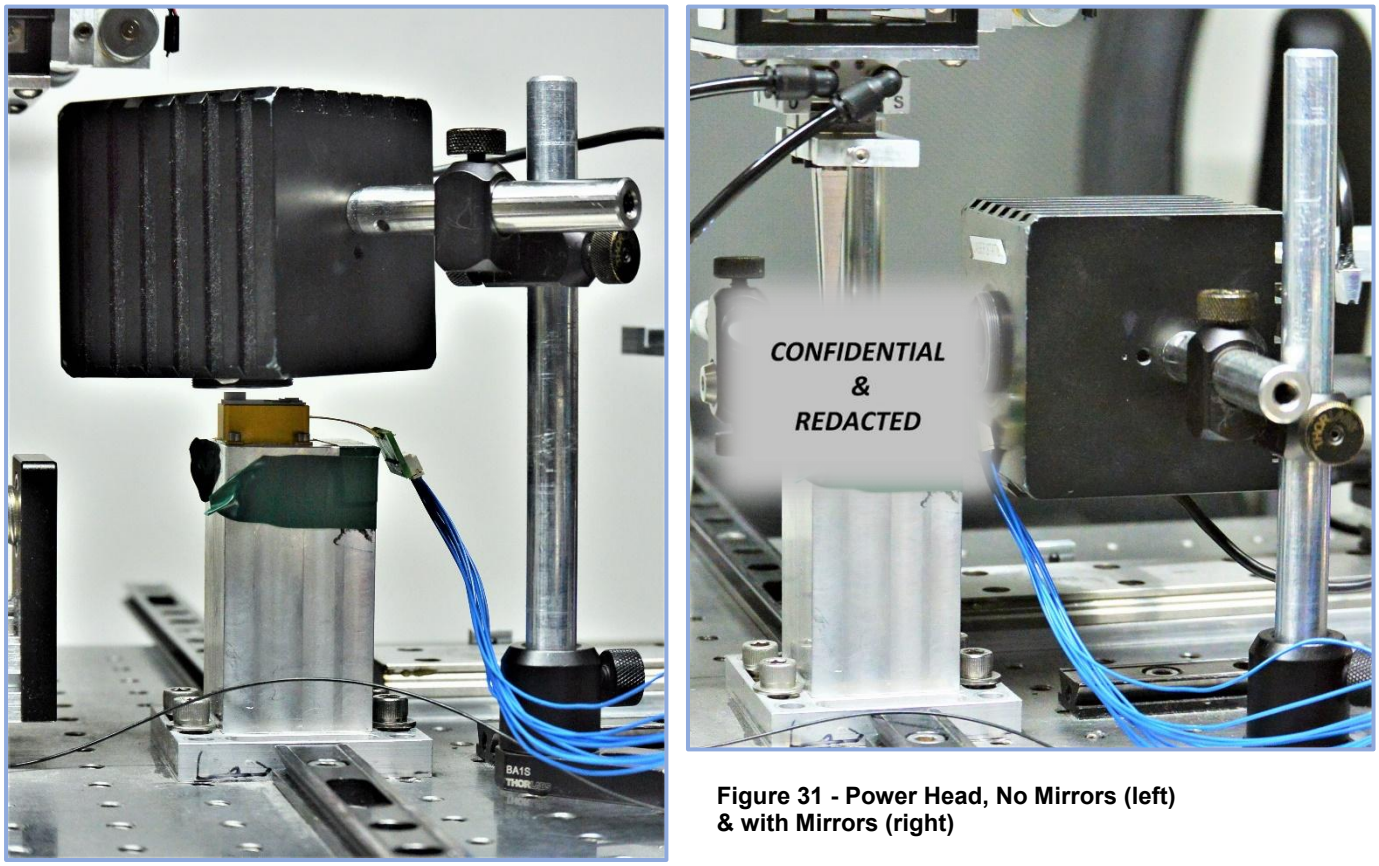


Figure 31 - Power Head, No Mirrors (left) & with Mirrors (right)

10.2.3 **DARK ENVIRONMENT.** Redacted

10.2.4 CONFIGURE COMPUTER APPLICATION.

10.2.4.1 Open the computer application (redacted computer program).

10.2.4.2 Click the arrow button in the upper left in the application window to run the application (Indicated by the yellow arrow in Figure 33).

10.2.4.3 Select 'Beam Muxing [Level 2]' from the popup window. See Figure 32.

10.2.4.4 The previous popup window closes, and a second popup window appears. Complete the three information fields in this popup. The DDL Serial # should match the serialized label on the side of the Part subassembly.

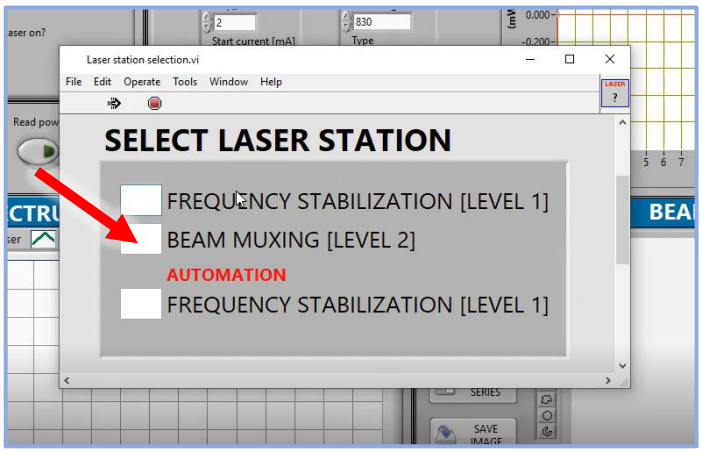


Figure 32 - Computer Application for LIV Test

10.2.4.5 Set the following parameters in the application. (Figure 33)

10.2.4.5.1 CURRENT. Set the current to XXXmA.

10.2.4.5.2 WAVELENGTH. Select the XXXnm for the wavelength from the dropdown menu in the computer application for L1. *(Later, XXXnm is selected for L2).*

10.2.4.5.3 TYPE. From the dropdown menu select the appropriate stage number.

10.2.4.5.4 STEP SIZE. Verify that 'Step size' is preset to XXX

10.2.4.5.5 START CURRENT. Verify that 'Start current is preset to XXX

10.2.4.5.6 STOP CURRENT. Verify that 'Stop current' is preset to XXX

10.2.4.5.7 SAVE. Select 'yes' from the dropdown menu for the field labeled 'Save?'.

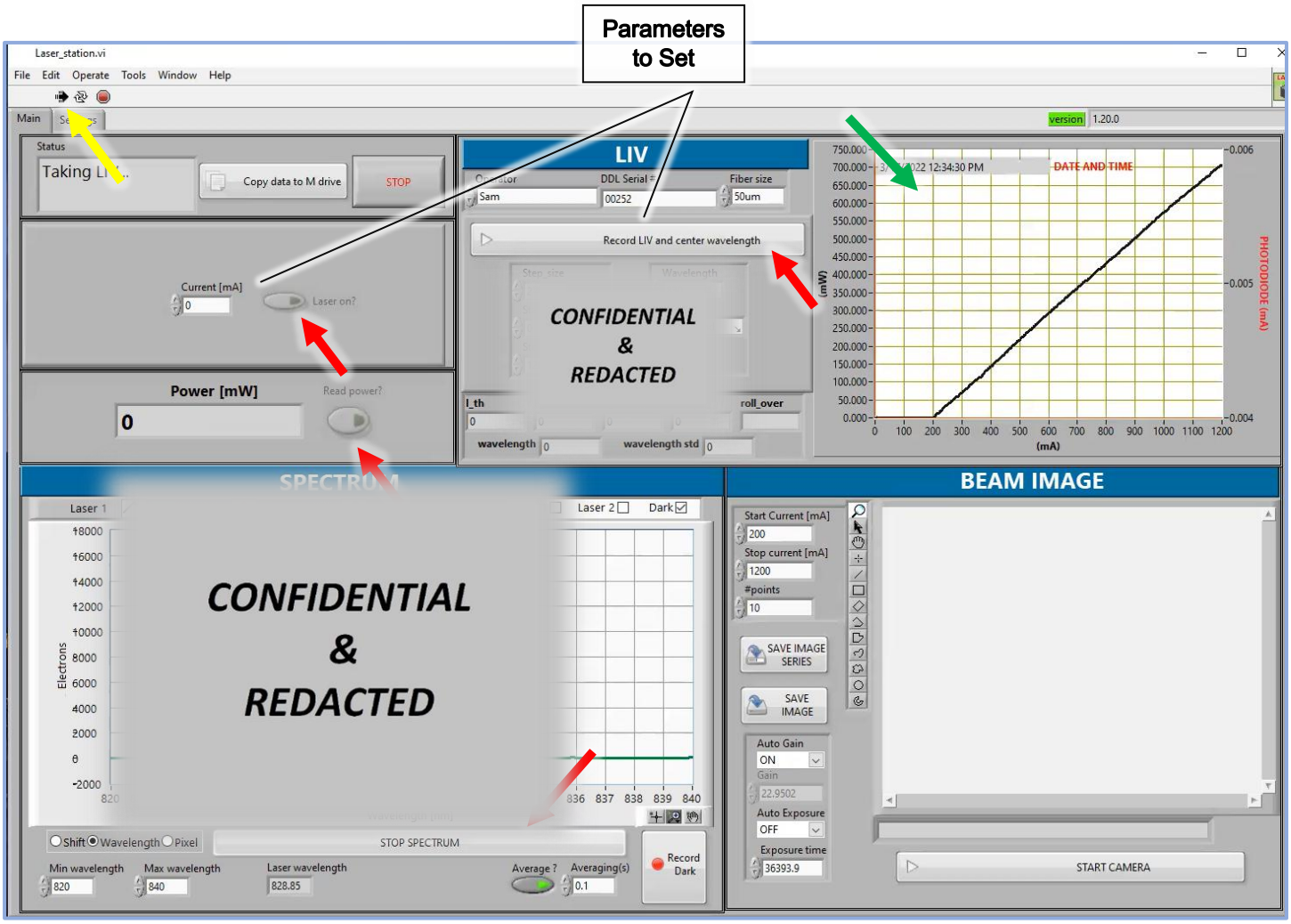


Figure 33 - Computer Application for LIV Test (laser.station.vi)

10.2.4.6 Click the button labeled Laser on? to enable the laser.

10.2.4.7 Click the button labeled Read power?.

10.2.4.8 Click the Start Spectrum button. This causes the peak wavelength to appear on the display.

10.2.5 **DETERMINE PEAK POWER.** Determine the peak power prior to initializing the LIV test by adjusting the power head (Figure 35) until the maximum peak power is found. The 'peak power' is the maximum power registered by the power head while the laser is emitted into it. The power registered by the power head changes slightly depending on the angle and location the laser beam enters the power head window. Power is indicated by the green arrow in Figure 35. The distance the beam travels until it reaches the power head also affects the registered power. Thus, 'peak power' is achieved by adjusting the power head until its window is receiving the laser beam from an optimum position. This is only found through trial and error each time, but as a rule, start by making sure that the power head is not tilted forward or backward, nor to one side or the other, and is approximately the distance from the reflective fixture as seen in the figure. If necessary, hold the IR sensor card in front of the power head window to find exactly where the beam is striking and go from there. The red arrows in Figure 35 depict the pathway of the laser beam as it is emitted from the Q-mount subassembly. Adjust the power head until the highest power (displayed in mW in the computer application as pointed out in Figure 34) is found.

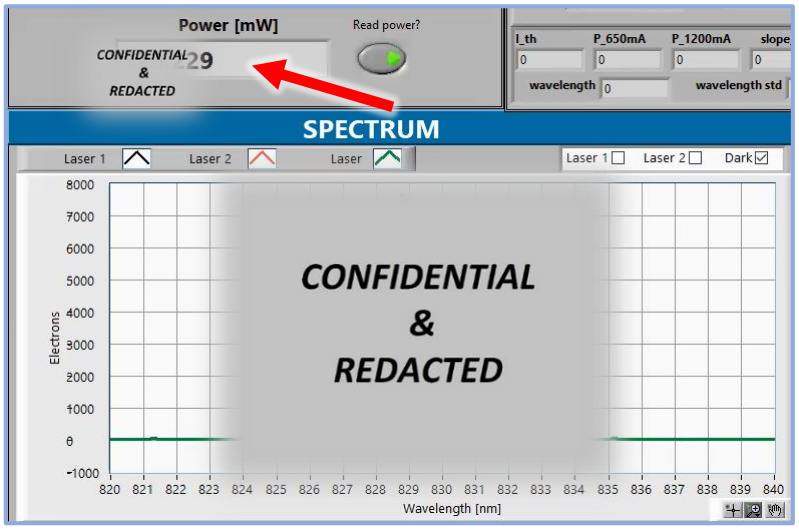


Figure 34 – Peak Power

⚠ *Note that the power head must be adjusted prior to every laser chip tested!*

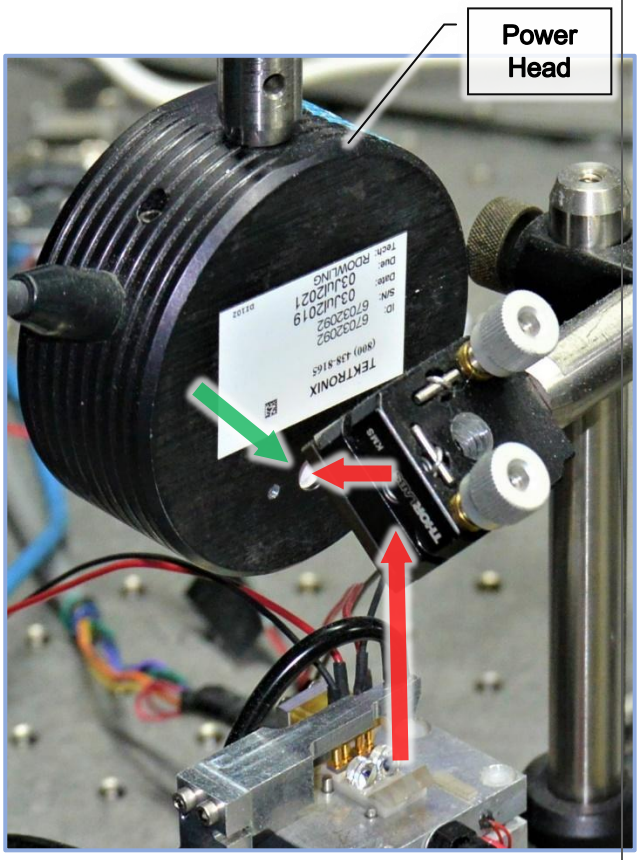


Figure 35 - Power Head (Type 2)

10.2.6 **ACTIVATE LIV TEST.** Click the Record LIV and Center Wavelength button pointed out in Figure 33 to initiate the LIV test. The test will continue for 2-3 minutes until the 'Stop current' (XXXmA) is reached. The data displayed in the LIV live data graph (indicated by the green arrow in the figure) should resemble the slope seen in the figure.

10.2.7 **CONCLUDING LIV TEST.** A few things occur upon completion of the test. Six fields (Figure 36) populate with data and illuminate either green or red upon the end of the LIV test. Green indicates that the laser passed that aspect of the test, and red means that the laser failed and that that value is outside of a normal, acceptable range. If there are any failures, verify that the correct wavelength was selected for the test, that the Part subassembly is aligned correctly on the LIV testing platform, and that the power head was properly aligned as these are common reasons for a 'false failure'. Re-run the LIV test if a false failure was found. Any true failures must be reviewed with the shop floor manager before proceeding.[3] Failures notwithstanding, perform the below steps once the test has concluded:

10.2.7.1 Click the Copy to X Drive button located at the top left of the computer application window. This creates a .txt document in the local pathway below containing data from the LIV test.[4]

(X:) > Production > redacted Build > redacted > redacted 30 micron > DDLXXXXX > DDLXXXXX-08 > 866

Figure 36 - LIV Te

[3] Interpretation of the cause of any failed aspect of the test can be done by reviewing data from the LIV test against data gathered from prior LIV tests. The pathway in § 10.2.7.1 contains not only data from the LIV test, but also .txt files containing data imported from the automation station. For example, the LIV test results shown in Figure 36 failed for the maximum mA achieved. In this instance, the technician reviewed the mA achieved before the Q-mount subassembly was oven cured.

[4] The 'XXXXX' in the pathway is the serial number for the Q-mount subassembly tested. The '830' folder in the folder contains data for the test on L1. The pathway for the .txt file for L2 will be in the same with the exception that the final folder containing it is labeled '828'.

10.2.7.2 Click the STOP button (also located at the top left of the window).

10.2.7.3 A popup window will appear asking if you want to 'power down'. Click 'NO'. *(Clicking 'YES' would power off the (redacted) boardstack, which we do not want to do until we are finished performing all LIV tests).*[5]

10.2.7.4 Turn off the LIV test platform pneumatic vacuum via the red knob.

10.2.7.5 Loosen the pogo pins holding the Q-mount subassembly, raise them, and resecure them.

10.2.7.6 Use tweezers to move the tested Q-mount subassembly back to its serialized weighing dish on the aluminum baking tray.

10.2.8 **TRAVELER.** Complete the section of the traveler for the LIV test for L1 *(and later, L2).* Document any failed aspects of the test in the comments section, as well as any dialogue about the test and/or the failure with the shop floor manager.

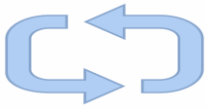
10.2.9 **PERFORM LIV TEST ON L2.**

10.2.9.1 Repeat all steps up to this point starting from § 19.2.4.5 to perform the LIV test on L2. The following changes should be made:

(A) Make sure to select XXX.3 from the dropdown menu from § 10.2.4.5.2

(B) Note that when performing § 10.2.5 the power head must be moved slightly to align with the L2 beam.

(C) Change the workstation connection from L1 to L2.



REMAINDER OF PROCEDURE REDACTED

[5] It is okay to turn on workstation and/or production room lights again after the test if necessary. However, they must be off when conducting further LIV tests.

Estimated Time:
1.5 Hours

10.3 ANGLED FOLDING MIRRORS

Procedure to attach 000000-00, the L1 & L2 Angled Folding Mirrors to the Part Platform on the Part Subassembly completed in Manufacturing Process Part I. The Angled Folding Mirrors are the first mirrors to intercept L1 & L2. They are called 'angled' mirrors because they are epoxied to the Part Platform at a ~XX°, contrary to the other mirrors and lenses.

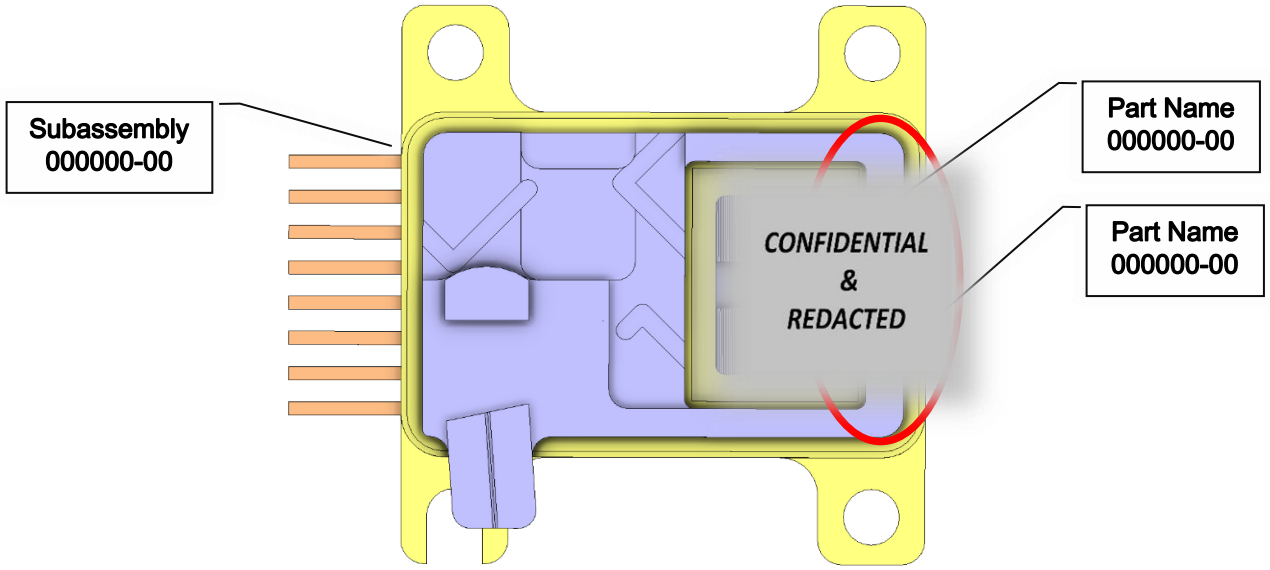


Figure 37 – Procedure Level MBOM Diagram (DWG)

10.3.1 **GATHER PARTS & MATERIALS.** The following two tables list BOM parts and non-BOM tools and materials needed for this procedure.

Part	QTY	Part Number
Part Subassembly	10	See § 9.0
Angled Folding Mirror	20	000000-00

Non-BOM Material or Tool
Tweezers
IR Sensor Card VRC4
Extra-fine Tip Pen
3408 UV Cured Epoxy Syringe w/ 25G Tip
Chemical Wipes
Magnification Glasses
Nitrile Gloves
Flashlight

⚠ *Wear nitrile gloves during this procedure. Oils from fingerprints left on the parts in this procedure may cause the completed X10 unit to malfunction.*

10.3.2 **PREP 3408 EPOXY.**

10.3.2.1 Retrieve a syringe of 3408 epoxy from the lab freezer.

10.3.2.2 Attach a 25G tip to the syringe.

10.3.2.3 Allow the epoxy to thaw while completing the following steps.

10.3.3 **IDENTIFY SIDES OF MIRRORS.** The two main sides of folding mirrors (including 000000-00, 000000-00 and 000000-00) are not identical. One side reflects orange at an angle and the other reflects green. The orange side is always the 'front', i.e., the side which the laser beam strikes and reflects off. Use a flashlight to identify these sides of a folding mirror before placing it on the platform.

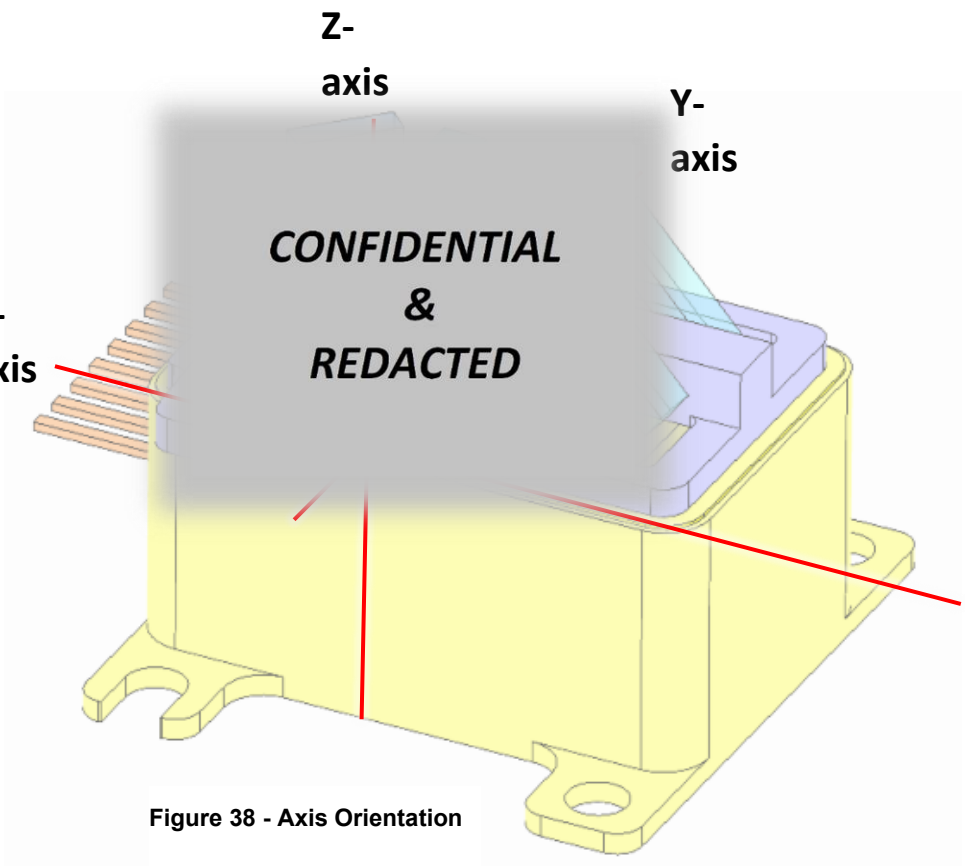


Figure 38 - Axis Orientation

10.3.4 **DETERMINE <u>APPROXIMATE</u> ROATIONAL POSITION VIA 'DRAG & DROP METHOD'.**
The goal of this step is to establish an approximate rotational position of the mirror.

10.3.4.1 Turn off workstation lights. Both lasers should be disabled.

10.3.4.2 Take one angled folding mirror (000000-00) with tweezers and place it on the L1 side of the macor platform in the location shown in Figure 39. Place it 1.5mm away from the center 'divider' on the macor platform

10.3.4.3 Pick up the mirror using the gripper. Grab it by a slight amount at the top - approximately 0.5mm of surface area as seen in Figure 40. Grabbing too much of the mirror results in the following steps being much more difficult to perform.

10.3.4.4 Raise the mirror vertically off the macor platform approximately 1mm.

10.3.4.5 Travel the mirror along the X-axis 2-4mm behind the assembly. (Figure 41).

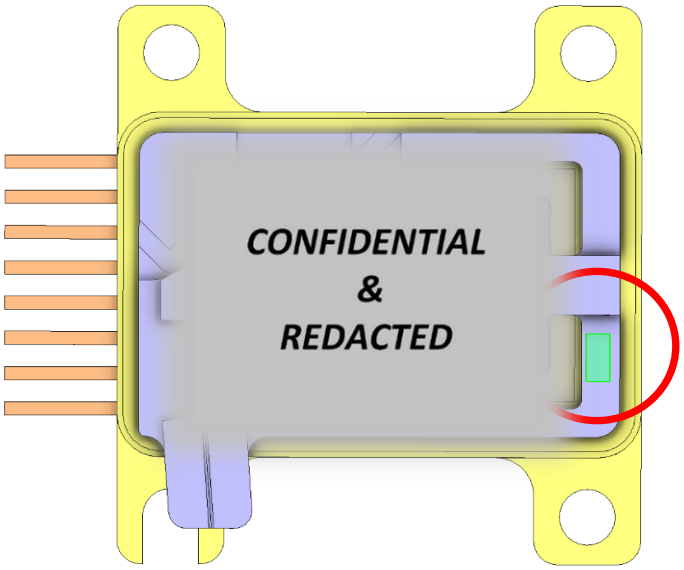


Figure 39 - L1 Angled Folding Mirror in Initial Position

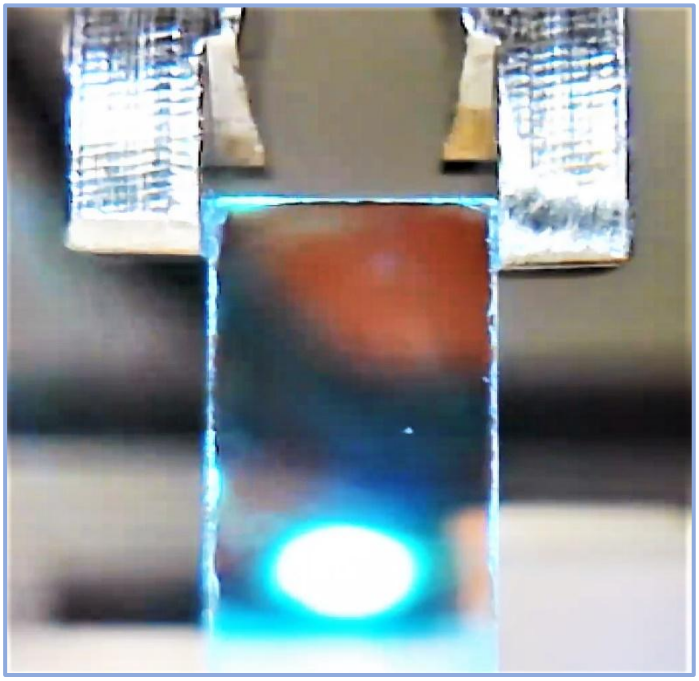


Figure 40 – Angled Folding Mirror (400326-00) Held in Precision Gripper

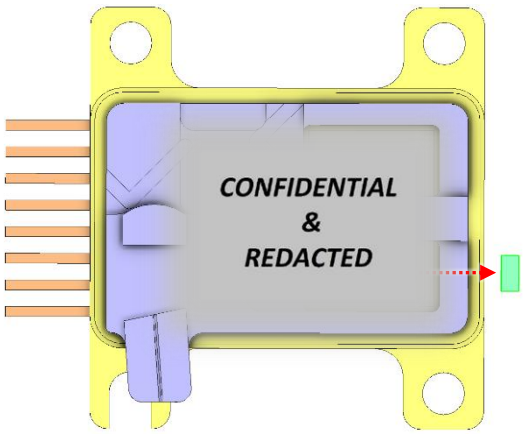


Figure 41 - L1 Angle Mirror, Position 2

REMAINDER OF PROCEDURE REDACTED

10.4 DICHROIC MIRROR

Estimated Time:
45 Minutes

Procedure to attach 000000-00, the Part (x1) to the Part Platform on the Part Subassembly. The Part redirects the L1 & L2 beams at a ~86 to the Symmetrical Lens.

10.4.1 **GATHER PARTS & MATERIALS.** The following two tables list BOM parts and non-BOM tools and materials needed for this procedure.

Part	QTY	Part Number
Part Subassembly	10	From § 10.4
Part	10	000000-00

Non-BOM Material or Tool
Tweezers (Curved Tip)
IR Sensor Card VRL9
4833 UV Cured Epoxy Syringe w/ 21G Tip
Chemical Wipes
Magnification Glasses
Nitrile Gloves
Dichroic Mirror Alignment Fixture

10.4.2 **PLACE MIRROR ON PLATFORM.** Note that the mirrors sides are not identical – one side reflects orange under light and the other reflects purple. See § 10.3.3.

10.4.2.1 Use tweezers to place the dichroic mirror (000000-00) on the macor platform with the front/orange side facing the other mirrors on the platform. Place it so that it aligns on the inside of the L-shaped ridge on the platform.

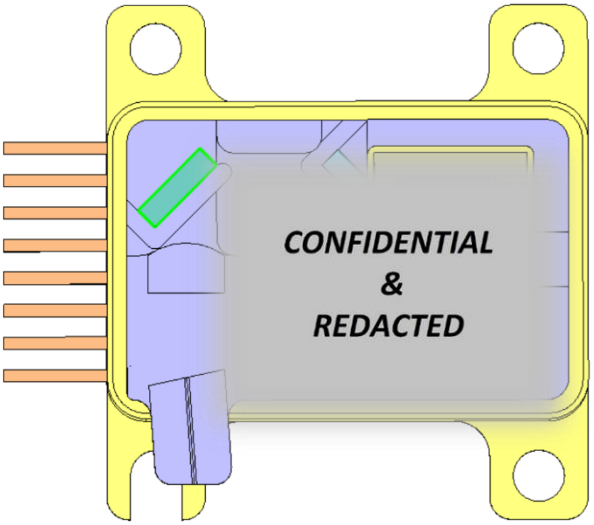


Figure 42 - Dichroic Mirror (400328-00)

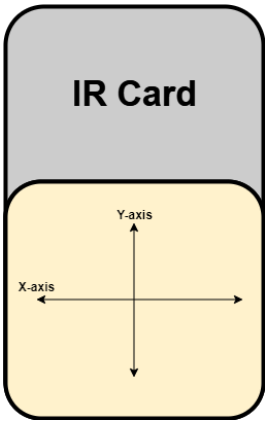


Figure 43 - Axis Orientation for IR Cards

10.4.2.2 Turn off workstation lights and position/enable the USB microscope(s).

10.4.2.3 Pick up the mirror using the gripper. Grab it by a slight amount at the top - approximately 0.5mm of surface area (Figure 40 for reference). Grabbing too much of the mirror results in the following steps being much more difficult to perform.

10.4.2.4 Raise the mirror vertically off the macor platform approximately 0.5mm.

10.4.2.5 Use the USB microscope from multiple angles to verify that the mirror is still aligned above the two edges of the L-shaped ridge.

10.4.3 **PERFORM DOT METHOD ON L1 TO POSITION DICHROIC MIRROR.** Workstation lights must be off.

10.4.3.1 Enable L1.

10.4.3.2 Refer to § 10.3.5 to use the 'dot method' to align the dichroic mirror on Adjust the mirror along the X-axis.

10.4.3.3 Disable L1.

10.4.4 **PERFORM SYMMETRY METHOD TO ALIGN L1 & L2 BEAMS ON X-AXIS.**

10.4.4.1 Set up the dichroic mirror alignment fixture on the edge of the platform as seen in F fixture in the lip o platform.

10.4.4.2 Turn off

10.4.4.3 One ca which w the dich camera camera the das

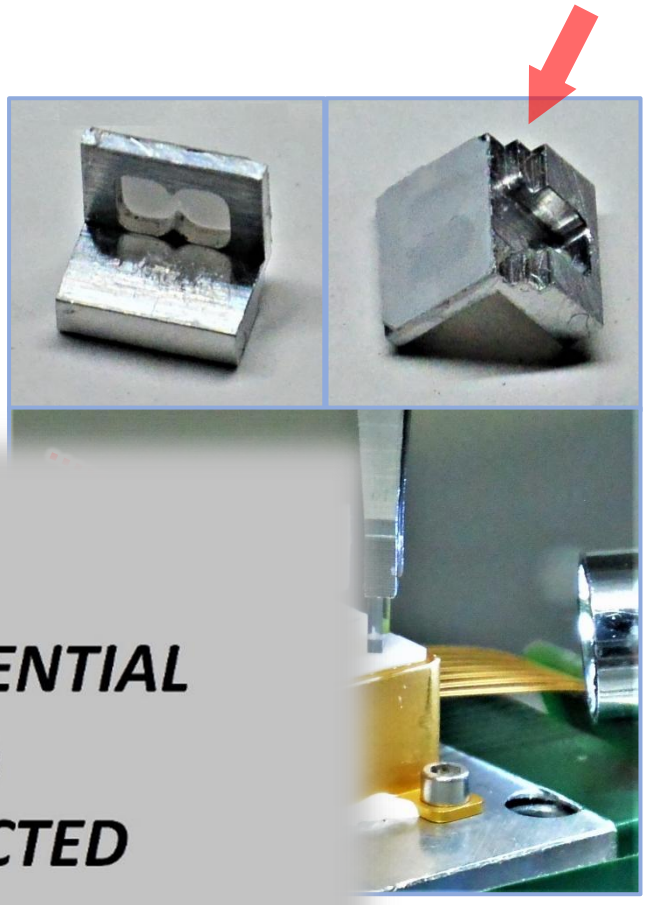


Figure 44 - Dichroic Mirror Alignment Fixture

CONFIDENTIAL
&
REDACTED

10.4.4.4 Move and focus the second USB camera so that its field of capture is entirely on the backside of the fixture. The backside of the fixture must fill the full frame of the computer monitor. See Figure 48 as an example.

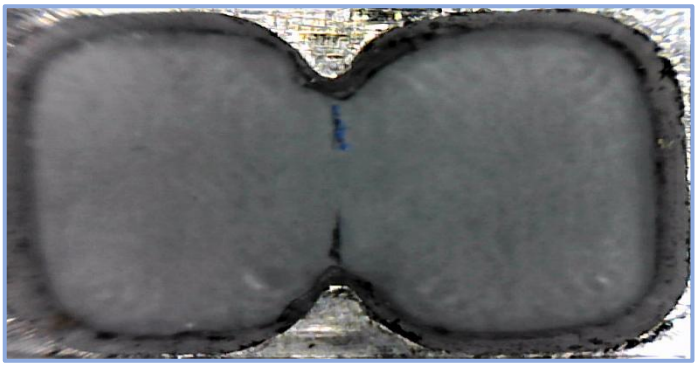


Figure 45 – USB Camera View of Alignment Fixture

10.4.4.5 Set L1 and L2 to XXXmA in the laser station application.

10.4.4.6 Enable L1.

10.4.4.7 Adjust L1 mA in marginal increments until optimal visibility of the beam pattern on the desktop monitor is achieved. See Figure 49. The beam must be highly visible yet not over-saturated. Note how:

(A) The center of the beam in the figure is a solid white,

(B) The surrounding area of the beam is NOT saturated white but is instead a scattered violet, and

(C) The beam pattern extends from the bottom of the fixture to the top. The beam in Figure 49 constitutes 'optimal visibility'.[6]

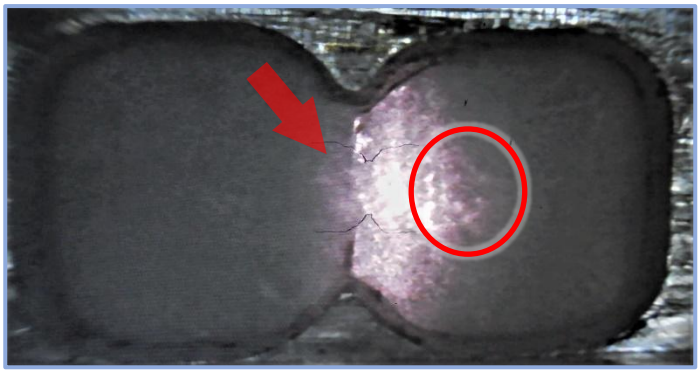


Figure 46 - Blinking Method, L2 Beam at 130mA

10.4.4.8 Disable L1.

10.4.4.9 Enable L2.

10.4.4.10 Adjust L2 mA per § 10.4.4.7.

[6] In the examples to follow, optimal visibility of L1 was found at 110mA and L2 was found at 130mA. These numbers are not always equivalent nor are they the same across different kovar subassemblies.

10.4.4.11 *L1 & L2 ALIGNMENT.* The goal is to make the laser beams as symmetrical as possible on the X-axis as seen on the desktop monitor. Small tic marks exist on the fixture screen as seen in Figure 48. These m… la… a… a… m… is o… s in… c… e o… r perfectly spaced as to align both exactly on the center line. The L1 beam seen in Figure 51 *(the same beam in Figure 50)* is aligned despite the small scattering of violet seen on the right side of the center line. Moving the beam left to move more o… w… re… ne… e. Th… te… hat w… een tr… e si… amount of dead space between the beam and the center – the choice is typically to eliminate all or most of the dead space so that the bulk of the beam is directly against the center line. And (B), in this example and often the case, moving the L1 beam further left would have moved a significant portion of the L2 beam across the center line. Note how in Figure 49 the 'sides' of the L2 beam visible in the monitor are not as clean as the sides of the L1 beam in Figure 51.

CONFIDENTIAL & REDACTED

CONFIDENTIAL & REDACTED

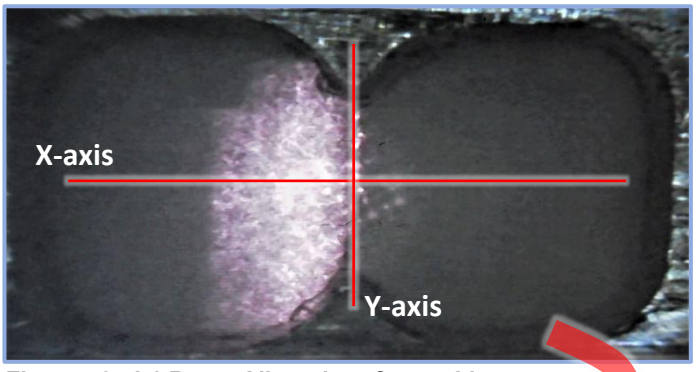


Figure 48 - L1 Beam Aligned on Center Line

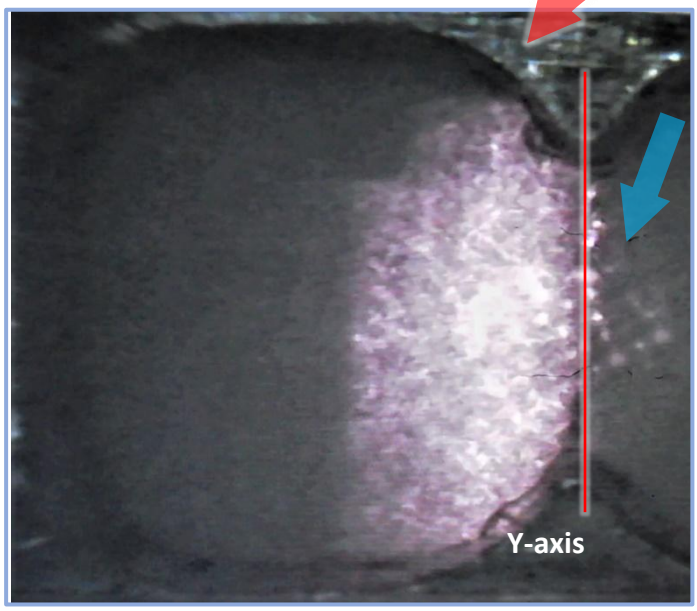


Figure 47 – Beam Symmetry

10.4.5 VERIFY L1 ALIGNMENT VIA DOT METHOD.

REDACTED

10.5 FOCUS LENSES & FIBER

Procedure to attach 000000-00 and 000000-00, the Vertical and Horizontal Part Lenses, and 000000-00 the Part Subassembly to the Part Platform on the Part Subassembly. Part of this procedure is completed at a workstation with a microscope in Production Room 1.

Estimated Time: 2 Hours

PROCEDURE REDACTED

11.0 Manufacture Process: Part III

Part III of the manufacture process concludes the production of PART#. Complete these procedures at a workstation with a microscope in Production Room 1. Estimated completion times and BOM lists assume an MO calling for 10 completed assemblies.[7]

Total Estimated Time: 16.5 Hours

Estimated Time: 15 Minutes

11.1 PRELIMINARY STEPS

PROCEDURE REDACTED

[7] Total estimated time needed includes a substantial amount of time (approx. 45 minutes per unit) at the QC workstation, where these labor hours/minutes do not wholly require the Technician to be present while QC tests commence.

Estimated Time:
1 Hour

11.2 PART ASSEMBLY (000000-00)

Procedure to attach the Part with Part (previously assembled) to the (incomplete) Part Assembly from Manufacturing Process Part II.

PROCEDURE REDACTED

Estimated Time:
2 Hours

11.3 FLEX CABLE SOLDERING

Procedure to replace the V3 Part PCB from the Part with 000000-00, the Part Flex Cable.

PROCEDURE REDACTED

Estimated Time:
9.5 Hours

11.4 QUALIFICATION CALIBRATION

Procedure to perform a Qualification Calibration on the Dual Laser Assembly (200235-00). This is the final testing performed before the unit assembly is completed and the unit is inventoried. Perform this procedure at the Laser & MEMS QC Workstation in Production Room I.

PROCEDURE REDACTED

11.4.1 REPORT & QC SHEET.

11.4.1.1 Open the Pendar X10 Report application.

11.4.1.2 Click Both Laser Report.

11.4.1.3 Select the folder matching the DDL number of the laser.

11.4.1.4 Open the QC sheet and complete the LIV #7 section.

11.4.1.5 Notify the Quality Engineer that the report is ready for review.

11.5 PART INSTALLATION

Estimated Time:
4 Hours

Procedure to attach the Part with Part (from Manufacture Process Part I) to the bottom of the Part (from Manufacture Process Part II) to complete the Part Assembly (PART#).

PROCEDURE REDACTED

12.0 Troubleshooting

12.1 POWER CONTACT PCB FIT TO FIXTURE

PROCEDURE REDACTED

12.2 POWER CONTACT ASSEMBLY SOLDERING

If the solder job does not meet criteria from § 11.3.1 then attempt to further solder the power contact assembly outside of the solder fixture by holding the PCB with either tweezers or needle nose pliers and using the soldering iron from the bottom as seen in Figure 58. Make sure to hold the PCB level so that the contact does not shift on the PCB.

This remedy has a low chance of success if solder crept up the side of the power contact; Typically, the contact (and PCB as well) are no longer usable if this occurs. If the opposite occurred – If solder did not creep up the side at all and failed to encircle and adhere to the base of the power contact all the way around – this resoldering method has greater success (see Figure 58). Do not add additional solder anywhere but do apply additional flux to the seam area where the solder did not create a joint.

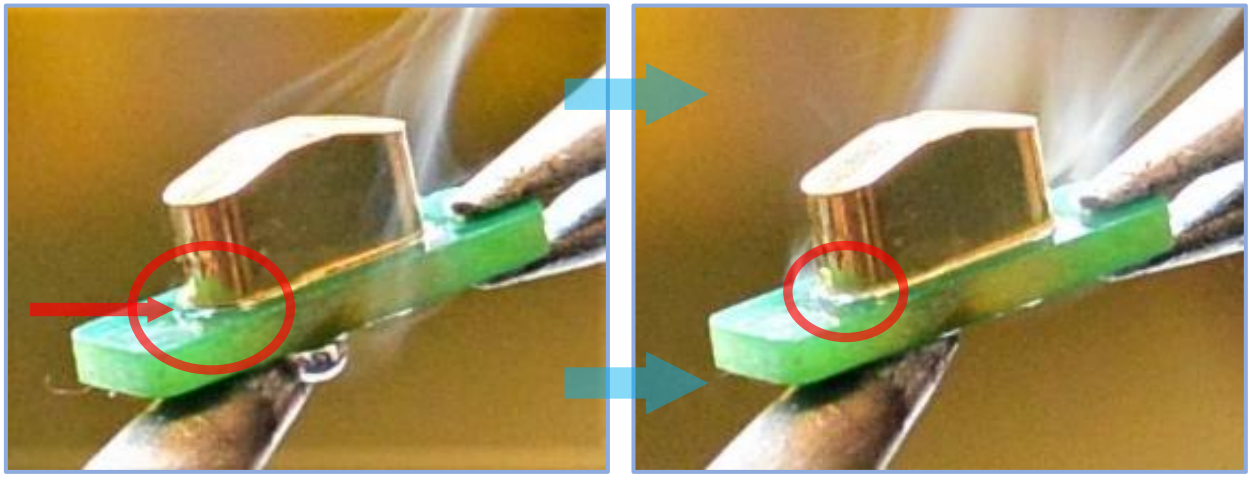


Figure 49 - Power Contact, Solder Correction Strategy

12.3 TECHNICAL DRAWINGS

The following pages contain the technical drawings in the table below.

Ref. Number	Description
DWG-000000-00	ENGINEERING NAME
DWG-000000-00	ENGINEERING NAME
DWG-000000-00	ENGINEERING NAME
DWG-000000-00	ENGINEERING NAME

PAGES REDACTED