

# GC-TQ Reference

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# Table of Contents

- Troubleshooting Common Failures..... 3
  - Power-On and Communication ..... 3
    - Power Switch Not Working – TQ Always On..... 3
  - Pump and Vacuum..... 3
    - Rough Pump Not Turning On ..... 3
    - Turbo Pump Not Turning On or Not Reaching 100% Speed ..... 3
  - PCA RF Dipping..... 3
    - Quad Driver Unable to Dip Within Range ..... 3
    - Collision Cell Driver Unable to Dip Within Range ..... 4
  - Autotune ..... 4
    - Autotune Failure – Abundance, Mass Axis, and/or Peak Width..... 4
    - Autotune Failure – Gain ..... 5
    - Front Tailing on Peaks During Scan..... 5
  - Dark Current Test..... 6
  - Air and Water Check ..... 6
    - High Air Level ..... 6
    - High Water Level..... 7
  - Chemical Test..... 7
    - EI & EIEX Signal-to-Noise (SNR)..... 7
    - EIEX Relative Standard Deviation (RSD)..... 8
  - Faults..... 8
    - 1.1 Repeller driver cannot maintain the requested voltage..... 8
    - 1.2 Ion body driver cannot maintain the requested voltage..... 8
    - 3.0 L13 (Q1 shroud) lens driver cannot maintain the requested voltage..... 8
    - 3.2 Collision cell hexapole DC driver cannot maintain the requested voltage..... 8
    - 3.3 L16 (Iris) lens driver cannot maintain the requested voltage..... 9
- Appendix ..... 10
  - Faults..... 10
    - Mainboard 1, Fault Register 1..... 10
    - Mainboard 1, Fault Register 2..... 11
    - Mainboard 2, Fault Register 3..... 13
    - Mainboard 2, Fault Register 4..... 14
    - Fault Masks ..... 16

## Troubleshooting Common Failures

### Power-On and Communication

#### Power Switch Not Working – TQ Always On

|       |  |
|-------|--|
| Issue | The TQ powers on when the power cord is connected and the power switch cannot control. |
| Fix   | Replace 0950-4826 E-Module power supply.   |

### Pump and Vacuum

#### Rough Pump Not Turning On

|       |  |
|-------|--|
| Issue | The rough pump will not power on.  |
| Fix   | Try the following fixes starting from the top and working down the list until the issue is resolved. <ol style="list-style-type: none"><li>1. Verify rough pump power cord is connected to E-Module.</li><li>2. Connect rough pump directly to wall outlet and try to power on. If rough pump does not turn on, try the following:<ol style="list-style-type: none"><li>a. Check rough pump oil level and fill if low.</li><li>b. Replace rough pump.</li></ol></li><li>3. Check E-Module fuses and replace if blown.</li><li>4. Replace E-Module.</li></ol> |

#### Turbo Pump Not Turning On or Not Reaching 100% Speed

|       |   |
|-------|---|
| Issue | The turbo pump will not power on or not reach 100% speed.   |
| Fix   | Try the following fixes starting from the top and working down the list until the issue is resolved. <ol style="list-style-type: none"><li>1. Verify rough pump powers on and hose is properly connected to turbo pump.</li><li>2. When the TQ is powered on, verify a vacuum is pulled on the manifold. If not, there is a large leak. Common leak locations are: pump hose, analyzer door (front analyzer may require a light force to help vacuum catch), collision cell cover, transferline, CI flow module interface, and EI calibrant/vent valve.</li><li>3. Verify rough vacuum gauge is properly connected. Gauge may be defective and require replacement.</li></ol> |

### PCA RF Dipping

#### Quad Driver Unable to Dip Within Range

|       |   |
|-------|---|
| Issue | Unable to dip quad driver PCA within the specification.   |
| Fix   | Try the following fixes starting from the top and working down the list until the issue is resolved. <ol style="list-style-type: none"><li>1. Check to see if a fault is raised. Any fault in the system will prevent the quad driver electronics from turning on.</li><li>2. Verify quad driver PCA is powered on. The green “+21V” LED near the fan connectors should be on. If not, try the following:</li></ol> |

|  |   |
|--|---|
|  | <ol style="list-style-type: none"> <li>a. Check connector and pins on main cable harness. Rework or replace G7000-60826 main cable harness.</li> <li>b. Verify with a voltmeter that 24V is being supplied through the quad driver power connector yellow pins. If not, replace this cable on the inside of the E-Module or G7000-61008 bus PCA or the entire E-Module assembly.</li> </ol> <ol style="list-style-type: none"> <li>3. Make sure both quad driver coil slugs are even.</li> <li>4. Verify the bias voltage with a voltmeter. On the quad driver PCA, probe TP11 “Bias Monitor” (next to the +21V LED). It should measure 110mV +/- 5mV. If not with the instrument power on, reset the bias by adjusting R201 and R202 potentiometers fully counter-clockwise. Then adjust R201 clockwise until TP11 measures 55mV. Finally adjust R202 clockwise until TP11 measures 110mV.</li> <li>5. Disconnect ribbon cable from E-Module to quad driver PCA. Verify all pins within connectors are straight and none are missing. Reseat ribbon cable.</li> <li>6. Replace G7000-61015 quad driver PCA.</li> <li>7. Verify quad bridges are connected and aligned properly without shorting.</li> <li>8. Verify quad is defect free and good electrical contact is made when installed. Fix by reseating or replacing G7000-60155 quadrupole.</li> </ol> |
|--|---|

#### [Collision Cell Driver Unable to Dip Within Range](#)

|       |   |
|-------|---|
| Issue | Unable to dip collision cell driver PCA within the specification.   |
| Fix   | <p>Try the following fixes starting from the top and working down the list until the issue is resolved.</p> <ol style="list-style-type: none"> <li>1. Check to see if a fault is raised. Any fault in the system will prevent the quad driver electronics from turning on.</li> <li>2. Disconnect ribbon cable from E-Module to collision cell driver PCA. Verify all pins within connectors are straight and none are missing. Reseat ribbon cable.</li> <li>3. Replace G7000-61005 collision cell driver PCA.</li> <li>4. Verify all internal wires to collision cell are properly connected.</li> <li>5. Verify there are no obstructions inside the collision cell that may be shorting the rods.</li> <li>6. Replace G7000-60262 collision cell assembly.</li> </ol> |

### [Autotune](#)

#### [Autotune Failure – Abundance, Mass Axis, and/or Peak Width](#)

|       |  |
|-------|--|
| Issue | Autotune failed with one of the following messages: “Check Abundance failed”, “Adjust Mass Axis failed”, or “Adjust Peak Width failed”.  |
| Fix   | <p>Try the following fixes starting from the top and working down the list until the issue is resolved.</p> <ol style="list-style-type: none"> <li>1. Check calibrant level, make sure calibrant bulb is free of cracks, and verify calibrant valve cable is connected.</li> <li>2. For CI, make sure reagent gas flow is on and flow readback is correct.</li> <li>3. Tighten transferline nut.</li> <li>4. Check quad driver dip level at 1000 AMU is less than 73.3%.</li> <li>5. Verify all internal detector wires are connected (HED, EMV, Red Signal).</li> </ol> |

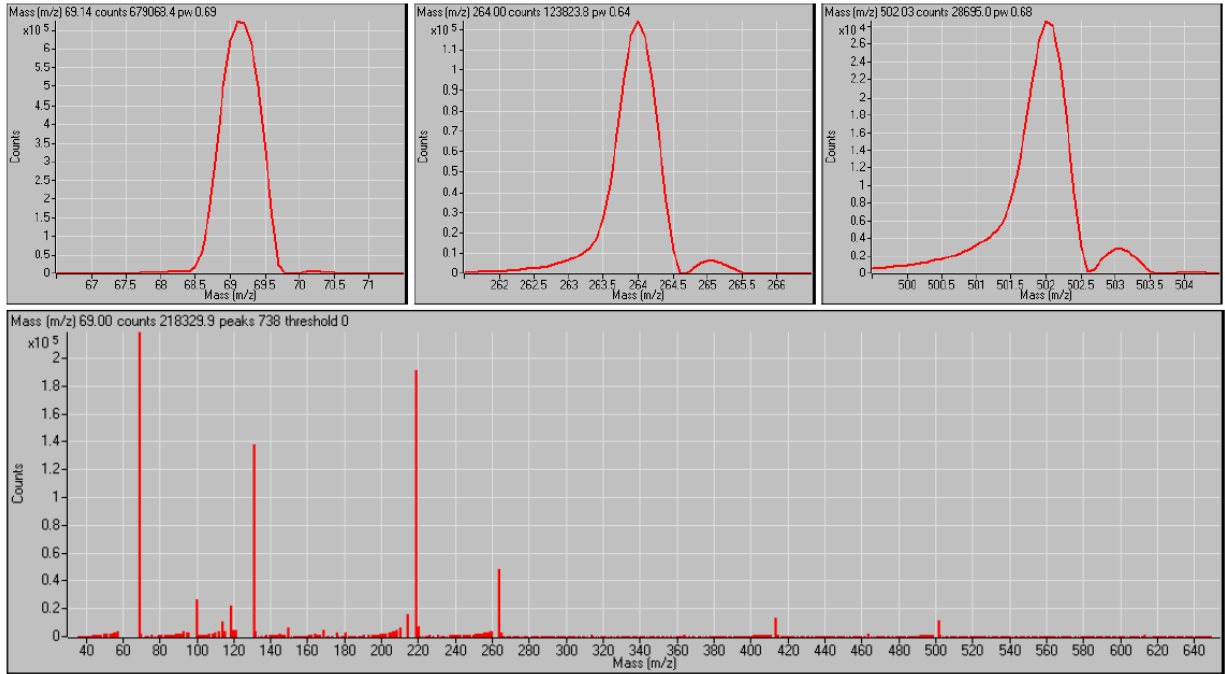
|  |  |
|--|--|
|  | 6. For CI, check filament wire straightness. Replace G1999-80070 CI filament if warped. Also, make sure the source lens stack is tight.<br>7. Replace G7000-61015 quad driver PCA.<br>8. Replace G7000-60155 quadrupole. |
|--|--|

[Autotune Failure – Gain](#)

|       |   |
|-------|---|
| Issue | Autotune failed with the following message: “Adjusting gain failed, insufficient valid data points”.  |
| Fix   | <p>Run Dark Current Check against the following specifications.</p> <ul style="list-style-type: none"> <li>• Baseline average &lt;= 60.0</li> <li>• Baseline threshold &lt;= 50.0</li> <li>• Pulse count with HED on &lt;= 50.0</li> <li>• Pulse count with HED off &lt;= 25.0</li> </ul> <p>Try the following fixes starting from the top and working down the list until the issue is resolved.</p> <ol style="list-style-type: none"> <li>1. Reseat all detector external cables and internal wires (HED, EMV, Signal). Check MS2 heater wire and make sure there is a minimum of 2mm clearance between all metal parts.</li> <li>2. Replace G2571-60806 signal cable.</li> <li>3. From where tune left off, rerun gain curve using a different mass. For too few pulses, decrement mass by 1. For too many pulses, increment mass by 1.</li> <li>4. Clean face of HED, horn of EM, and crevices of structure.</li> <li>5. Replace G7000-80102 detector assembly.</li> </ol> |

[Front Tailing on Peaks During Scan](#)

|       |   |
|-------|---|
| Issue | Front tailing on peaks during scan.     |
| Fix   | Replace Collision Cell PCA G7000-61005. |



## Dark Current Test

|       |  |
|-------|--|
| Issue | Dark Current Check fails any of the following specifications. <ul style="list-style-type: none"> <li>• Baseline average <math>\leq 60.0</math></li> <li>• Baseline threshold <math>\leq 50.0</math></li> <li>• Pulse count with HED on <math>\leq 50.0</math></li> <li>• Pulse count with HED off <math>\leq 25.0</math></li> </ul>  |
| Fix   | Try the following fixes starting from the top and working down the list until the issue is resolved. <ol style="list-style-type: none"> <li>1. Reseat all detector external cables and internal wires (HED, EMV, Signal). Check MS2 heater wire and make sure there is a minimum of 2mm clearance between all metal parts.</li> <li>2. Replace G2571-60806 signal cable.</li> <li>3. Clean face of HED, horn of EM, and crevices of structure.</li> <li>4. Replace G7000-80102 detector assembly.</li> </ol> |

## Air and Water Check

### High Air Level

|       |  |
|-------|--|
| Issue | Air and Water Check failed with ratio $N_2$ to m/z 69 $> 10\%$   |
| Fix   | Generally, the air level decreases quickly over time so if this is the case, wait longer for the high temperatures and vacuum to remove remaining nitrogen.<br><br>In atmospheric air, the ratio of $O_2$ to $N_2$ is about 27%. If close to this ratio exists within the system, there is likely an air leak. Try the following fixes starting from the top and working down the list until the issue is resolved. <ol style="list-style-type: none"> <li>1. Verify collision cell <math>N_2</math> was off and allotted time to pump out before recording</li> </ol> |

|  |  |
|--|--|
|  | <p>abundances.</p> <ol style="list-style-type: none"> <li>2. Verify proper tune abundances for m/z 69 (&gt;200,000 for EI, &gt;400,000 for EIEX). If too low, there may be an issue with the EI calibrant valve.</li> <li>3. Use a can of compressed air and start MS1 profile on the target mass (ie Aeroduster is m/z 83). Spray air slowly at different areas of the system including transferline, CI flow module if applicable, front window, EI calibrant valve, edges of analyzer doors, feed-through on analyzer doors and manifold, collision cell cover and tubing, rear cover, and turbo pump.</li> <li>4. If a leak is not found on the TQ, perform the same leak checking on the GC and gas tubing.</li> <li>5. Replace collision cell EPC module.</li> </ol> |
|--|--|

### High Water Level

|       |  |
|-------|--|
| Issue | Air and Water Check failed with ratio H <sub>2</sub> O to m/z 69 > 16%   |
| Fix   | <p>Generally, the water level decreases over time so if this is the case, wait longer for the high temperatures and vacuum to remove water.</p> <p>If the water level is not decreasing over time or is taking longer than expected, try the following fixes starting from the top and working down the list until the issue is resolved.</p> <ol style="list-style-type: none"> <li>1. Verify GC heater zones are turned on.</li> <li>2. Bake and purge the system. Set TQ temperatures to 300/180/180. Set GC temperatures to 250/150/250, GC column flow to 2mL/min, and GC collision cell gases to 2mL/min N<sub>2</sub> and 3mL/min He. Allow the system to sit for at least 1 hour then return to normal operating setpoints.</li> <li>3. Inject a large volume of solvent to flush the system.</li> </ol> |

### Chemical Test

#### EI & EIEX Signal-to-Noise (SNR)

|       |   |
|-------|---|
| Issue | Failing EI SNR < 100:1 or EIEX SNR < 500:1 using the checkout method with 3 MRM transitions and gain of 100.  |
| Fix   | <p>Most new systems require some conditioning prior to achieving the required results. This may include high GC temperatures, high column flow, and/or large volume injections.</p> <p>If you have run 4 or more injections and still fail, check to see if the results show an improving trend. If so, continue to inject until passing or until leveling off.</p> <p>For little to no peak, try the following:</p> <ol style="list-style-type: none"> <li>1. Verify the correct tune file is selected. Verify the calibrant peaks are valid for the selected tune.</li> <li>2. Verify the correct sample is installed in the correct vial position.</li> </ol> <p>For high noise, try the following:</p> <ol style="list-style-type: none"> <li>1. Use a different noise region.</li> </ol> |

|  |   |
|--|---|
|  | <ol style="list-style-type: none"> <li>2. Follow <b>Dark Current Test</b> troubleshooting instructions for detector noise issues.</li> <li>3. Follow <b>High Air Level</b> troubleshooting instructions for leak issues.</li> </ol> <p>For low signal, try the following:</p> <ol style="list-style-type: none"> <li>1. Perform GC check and maintenance. <ol style="list-style-type: none"> <li>a. Verify thermal nut is tight.</li> <li>b. Verify column is inserted the correct length into the inlet and transferline. Verify there is a perpendicular, obstruction-free cut of each end of the column.</li> <li>c. Verify septum is intact and sealed properly.</li> <li>d. Verify the syringe is installed properly and has a smooth range of motion.</li> </ol> </li> <li>2. For high tune EM voltage or low tune abundance, follow <b>Dark Current Test</b> troubleshooting instructions for detector noise issues.</li> <li>3. Follow <b>High Air Level</b> troubleshooting instructions for leak issues.</li> </ol> |
|--|---|

### EIEX Relative Standard Deviation (RSD)

|       |  |
|-------|--|
| Issue | Failing EIEX RSD > 8% of 8 sequential injections using the checkout method with 3 MRM transitions and gain of 100.   |
| Fix   | <p>Look through the individual areas of each injection. Determine if one or two injections are outliers and if so continue to run sequential injections until these are purged out of the 8 that are used for RSD.</p> <p>For a downward trend throughout the sequence, bake and purge the GC column as well as the TQ source for a couple hours.</p> <p>For erratic results, check the peak shape. If the top of the peaks are being missed, it may be due to an issue with the method. For tailing, perform a column cut on the inlet end.</p> <p>Otherwise, follow similar troubleshooting from <u>EI &amp; EIEX Signal-to-Noise (SNR)</u>.</p> |

### Faults

- 1.1 Repeller driver cannot maintain the requested voltage.
  - CI – Filament gold screw washer is shorted to the repeller block.
- 1.2 Ion body driver cannot maintain the requested voltage.
  - Bare heater wire is shorted to source radiator.
  - CI – Filament gold screw washer is shorted to the repeller block.
- 3.0 L13 (Q1 shroud) lens driver cannot maintain the requested voltage.
  - Q1 heater block is shorted to the radiator mount.
  - Metal burr is shorting Q1 shroud to source radiator.
  - O-ring between Q1 shroud and mount was positioned incorrectly causing a short.
- 3.2 Collision cell hexapole DC driver cannot maintain the requested voltage.
  - Replace G7000-61005 collision cell driver PCA.



3.3 L16 (Iris) lens driver cannot maintain the requested voltage.

- End of clip that holds EM is shorting to iris lens.
- An insulator is missing from the iris lens.
- Metal shavings inside iris lens gold screw hole.

## Appendix

### Faults

#### Mainboard 1, Fault Register 1

| Fault Number | Fault Name         | Fault Description   |
|--------------|--------------------|---|
| 1.0          | L1                 | Electron energy driver cannot maintain the requested voltage.   |
| 1.1          | L2                 | Repeller driver cannot maintain the requested voltage.  |
| 1.2          | L3                 | Ion body driver cannot maintain the requested voltage.  |
| 1.3          | L4                 | Drawout driver cannot maintain the requested voltage.   |
| 1.4          | L5                 | Ion focus driver cannot maintain the requested voltage.   |
| 1.5          | L6                 | Entrance lens driver cannot maintain the requested voltage.   |
| 1.6          | L7                 | MS1 post filter driver cannot maintain the requested voltage.   |
| 1.7          | L8                 | DIF driver cannot maintain the requested voltage.<br>Not connected, should be masked.   |
| 1.8          | L9                 | masked  |
| 1.9          | L10                | masked  |
| 1.10         | L11                | masked  |
| 1.11         | L12                | masked  |
| 1.12         | n/a                | masked  |
| 1.13         | n/a                | masked  |
| 1.14         | n/a                | masked  |
| 1.15         | U- Driver          | MS1 U- driver cannot maintain the requested mass setting.   |
| 1.16         | U+ Driver          | MS1 U+ driver cannot maintain the requested mass setting.   |
| 1.17         | RFPA               | MS1 RF driver cannot maintain the requested mass setting.   |
| 1.18         | U+/U- Rail         | masked  |
| 1.19         | Low Vac Pumpdown   | Instrument cannot achieve proper rough pump vacuum in a fixed amount of time. Vent and power cycle is needed to clear condition.                        |
| 1.20         | n/a                | masked  |
| 1.21         | n/a                | masked  |
| 1.22         | n/a                | masked  |
| 1.23         | High Vac Not Ready | Vacuum system is not ready. This is typical during a pump down cycle or when the high vacuum pump is turned off during a vent cycle or fault condition. |
| 1.24         | HED                | HED power supply senses a fault condition.  |
| 1.25         | EMV                | EMV power supply senses a fault condition.  |
| 1.26         | masked             | masked  |
| 1.27         | masked             | masked  |
| 1.28         | masked             | masked  |
| 1.29         | Pump Fan           | masked  |
| 1.30         | EMOD Fan           | Electronics module fan has failed.  |
| 1.31         | Leak               | masked  |

Mainboard 1, Fault Register 2

| Fault Number | Fault Name                          | Fault Description  |
|--------------|-------------------------------------|--|
| 2.0          | Lens Supply                         | Main board 1 lens driver power supply cannot maintain the voltage.   |
| 2.1          | Zone 1 Timeout                      | Zone1 controller cannot regulate the requested setting after a fixed amount of time. Power cycle is needed to clear condition.<br>Aux heater, not connected, should be masked. |
| 2.2          | Zone 2 Timeout                      | Source heater controller cannot regulate the requested setting after a fixed amount of time. Power cycle is needed to clear condition.   |
| 2.3          | Zone 3 Timeout                      | MS1 heater controller cannot regulate the requested setting after a fixed amount of time. Power cycle is needed to clear condition.  |
| 2.4          | Zone 4 Timeout                      | masked   |
| 2.5          | Zone 5 Timeout                      | Emission current controller cannot regulate the requested setting after a fixed amount of time.  |
| 2.6          | Zone 6 Timeout                      | masked   |
| 2.7          | Zone 7 Timeout                      | masked   |
| 2.8          | High Vacuum Gauge                   | High vacuum gauge is reading too high a pressure.  |
| 2.9          | Valve Cable Not Connected           | masked   |
| 2.10         | n/a                                 | masked   |
| 2.11         | RFPA Cable Not Connected            | Cable to the MS1 RFPA board is not connected. Turn off power to the electronics before connecting cable.   |
| 2.12         | n/a                                 | masked   |
| 2.13         | Flow Controller Cable Not Connected | Cable from Main Board 1 to the emission current controller board is not connected. Turn off power to the electronics before connecting cable.                                  |
| 2.14         | HED Cable Not Connected             | Cable to the HED supply is not connected. Turn off power to the electronics before connecting cable.   |
| 2.15         | Lens Cable Not Connected            | Cable from Main Board 1 to various lens elements is not connected. Turn off power to the electronics before connecting cable.  |
| 2.16         | Log AMP                             | Firmware timing problem: log amp is read before conversion is completed.   |
| 2.17         | n/a                                 | masked   |
| 2.18         | n/a                                 | masked   |
| 2.19         | n/a                                 | masked   |
| 2.20         | AC Line Zero Cross                  | AC line zero cross circuit has failed. Vent and power cycle is needed to clear condition.  |
| 2.21         | Turbo Pump                          | Turbo pump does not reach proper speed in a fixed amount of time. Vent and power cycle is needed to clear condition.   |
| 2.22         | n/a                                 | masked   |
| 2.23         | n/a                                 | masked   |
| 2.24         | Zone 1 Runaway                      | Zone1 heater has exceeded its maximum temperature. Power cycle is needed to clear condition.<br>Aux heater, not connected, should be masked.                                   |
| 2.25         | Zone 2 Runaway                      | Source heater has exceeded its maximum temperature. Power cycle  |

|      |                   |  |
|------|-------------------|--|
|      |                   | is needed to clear condition.  |
| 2.26 | Zone 3 Runaway    | MS1 heater has exceeded its maximum temperature. Power cycle is needed to clear condition. |
| 2.27 | n/a               | masked   |
| 2.28 | n/a               | masked   |
| 2.29 | n/a               | masked   |
| 2.30 | INTERNAL SHUTDOWN | masked   |
| 2.31 | SHUTDOWN          | masked   |

Mainboard 2, Fault Register 3

| Fault Number | Fault Name        | Fault Description  |
|--------------|-------------------|--|
| 3.0          | L13               | L13 lens driver cannot maintain the requested voltage.<br>Q1 Shroud  |
| 3.1          | L14               | Collision cell entrance DC driver cannot maintain the requested voltage.   |
| 3.2          | L15               | Collision cell hexapole DC driver cannot maintain the requested voltage.   |
| 3.3          | L16               | L16 lens driver cannot maintain the requested voltage.<br>Iris   |
| 3.4          | L17               | Collision cell exit DC driver cannot maintain the requested voltage.   |
| 3.5          | L18               | L18 lens driver cannot maintain the requested voltage.<br>CC Shroud shorted to CC Exit. L18 not connected, should be masked. |
| 3.6          | L19               | MS2 pre-filter DC driver cannot maintain the requested voltage.  |
| 3.7          | L20               | L20 lens driver cannot maintain the requested voltage.<br>Not connected, should be masked                                    |
| 3.8          | L21               | masked   |
| 3.9          | L22               | masked   |
| 3.10         | L23               | masked   |
| 3.11         | L24               | masked   |
| 3.12         | Collision Cell RF | Collision cell RF driver cannot maintain the requested RF peak voltage.  |
| 3.13         | n/a               | masked   |
| 3.14         | Delta V           | Delta voltage across the collision cell cannot maintain the requested drive.   |
| 3.15         | U- Driver         | MS2 U- driver cannot maintain the requested mass setting.  |
| 3.16         | U+ Driver         | MS2 U+ driver cannot maintain the requested mass setting.  |
| 3.17         | RFPA              | MS2 RF driver cannot maintain the requested mass setting.  |
| 3.18         | U+/U- Rail        | This bit is set if the U+/U- DC-to-DC converter supply (MS2) is not producing voltage or is over producing voltage.          |
| 3.19         | n/a               | masked   |
| 3.20         | n/a               | masked   |
| 3.21         | n/a               | masked   |
| 3.22         | n/a               | masked   |
| 3.23         | n/a               | masked   |
| 3.24         | n/a               | masked   |
| 3.25         | n/a               | masked   |
| 3.26         | n/a               | masked   |
| 3.27         | n/a               | masked   |
| 3.28         | n/a               | masked   |
| 3.29         | n/a               | masked   |
| 3.30         | n/a               | masked   |
| 3.31         | n/a               | masked   |

Mainboard 2, Fault Register 4

| Fault Number | Fault Name                          | Fault Description   |
|--------------|-------------------------------------|---|
| 4.0          | Lens Supply                         | Main board 2 lens driver power supply cannot maintain the voltage.  |
| 4.1          | Zone 9 Timeout                      | masked  |
| 4.2          | Zone 10 Timeout                     | masked  |
| 4.3          | Zone 11 Timeout                     | MS2 heater controller cannot regulate the requested setting after a fixed amount of time. Power cycle is needed to clear condition. |
| 4.4          | Zone 12 Timeout                     | masked  |
| 4.5          | Zone 13 Timeout                     | masked  |
| 4.6          | Zone 14 Timeout                     | masked  |
| 4.7          | Zone 15 Timeout                     | masked  |
| 4.8          | n/a                                 | masked  |
| 4.9          | n/a                                 | masked  |
| 4.10         | Collision Cell Cable Not Connected  | Cable to the collision cell board is not connected. Turn off power to the electronics before connecting cable.                      |
| 4.11         | RFPA Cable Not Connected            | Cable to the MS2 RFPA board is not connected. Turn off power to the electronics before connecting cable.                            |
| 4.12         | n/a                                 | masked  |
| 4.13         | Flow Controller Cable Not Connected | masked  |
| 4.14         | n/a                                 | masked  |
| 4.15         | Lens Cable not connected            | Cable from main board 2 to various lens elements is not connected. Turn off power to the electronics before connecting cable.       |
| 4.16         | n/a                                 | masked  |
| 4.17         | n/a                                 | masked  |
| 4.18         | n/a                                 | masked  |
| 4.19         | n/a                                 | masked  |
| 4.20         | AC Line Zero Cross                  | AC line zero cross circuit has failed. Vent and power cycle is needed to clear condition.   |
| 4.21         | n/a                                 | masked  |
| 4.22         | n/a                                 | masked  |
| 4.23         | n/a                                 | masked  |
| 4.24         | Zone 9 Runaway                      | Zone9 has exceeded its maximum temperature. Power cycle is needed to clear condition.<br>Not connected, should be masked            |
| 4.25         | Zone 10 Runaway                     | Zone10 has exceeded its maximum temperature. Power cycle is needed to clear condition.<br>Not connected, should be masked           |
| 4.26         | Zone 11 Runaway                     | MS2 heater has exceeded its maximum temperature. Power cycle is needed to clear condition.  |
| 4.27         | n/a                                 | masked  |
| 4.28         | n/a                                 | masked  |
| 4.29         | n/a                                 | masked  |
| 4.30         | INTERNAL                            | masked  |

|      |          |        |
|------|----------|--------|
|      | SHUTDOWN |        |
| 4.31 | SHUTDOWN | masked |

## Fault Masks

- Default fault mask, firmware build 37
  - Status 1        0x438B80FF
  - Status 2        0x0731E92F
  - Status 3        0x0003D0FF
  - Status 4        0x07108C09
- Updated fault mask, firmware build 37 + new QQQDefaultParms.txt
  - Status 1        0x438B807F
  - Status 2        0x0631E92D
  - Status 3        0x0003D05F
  - Status 4        0x04108C09