

RMC150 Hardware Evaluation

**TESTING RMC150 HARDWARE
IN THE EVENT OF A FAILURE**

Version 1.0

May, 2017

Overview

Use this procedure when you suspect that any of the modules in the RMC150E motion controller may have a hardware failure.

If the hardware fails any part of this procedure:

1. Use the checklist at the end to report which items failed. Describe the problem symptoms and test results in as much detail as possible.
2. Contact Delta Technical Support
 - support@deltamotion.com
 - +1 360-254-8688

If the hardware passes this procedure:

The problem is likely caused by something else. Items to check are:

1. The power supply.
2. Wiring.
3. Transducers.

On rare occasions, the problem may still be the RMC, even if it passes this simple test procedure. Intermittent hardware problems (such as a loose pin) or temperature-related problems may not appear in a simple test. However, you can modify the procedures to take these things into account, which will increase the chance of correctly determining whether the hardware has failed.

Required Equipment

1. **Multi-meter**
To measure voltage, current, and resistance.
2. **24 VDC power supply**
For powering the RMC.
3. **Variable-voltage power supply (0-10 V)**
If a variable-voltage power supply is not available, the Drive output can be used instead, which will slightly modify some of the tests.
4. **Wires and terminal blocks**
5. **Ethernet cable**
For the RMC100 Ethernet module or the RMC150E.
6. **PROFIBUS device**
Only for testing PROFIBUS. This must be a device such as a PLC that can act as a PROFIBUS master.
7. **SSI Transducer or Encoder**
For testing the S module only.
8. **Encoder**
For testing the QUAD module only. The encoder should ideally have 5V differential (RS-422 driver) outputs A+, A-, B+, B-, Z+, Z-.
9. **Resolver**
For testing the Resolver module only. The encoder should ideally have 5V differential (RS-422 driver) outputs A+, A-, B+, B-, Z+, Z-.

General Procedure

To test the entire RMC module, complete all the procedures. If you suspect a certain portion of the RMC, go to that specific procedure.

1. Disconnect all wiring from the RMC before beginning.
2. Apply 24 VDC to power the RMC on.
3. In RMCTools, make sure:
 - a. The axes are not in simulate mode.
 - b. The RMC is in Program mode.
 - c. All the hardware is assigned to axes.
4. Perform the procedures, and use the **checklist** at the end of the document to record the results.
5. After completing the procedures, open the saved project file and download it to the RMC.

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CPU Modules

RMC150E CPU

1. Apply 24 VDC power.
 - a. Measure the voltage across **+24V** and **24 Cmn**.
If the voltage is very low (such as below 5 V), the tranzorb has likely failed. This is usually caused by applying a voltage that is too high.
 - b. Measure how much current the RMC draws. This can be done with a multi-meter or a variable voltage power supply with a current readout. The current should be:

# of Modules	RMC150E
3	< 300 mA
4	< 400 mA
5	< 500 mA
6	< 600 mA

2. Check the **CPU** LED.

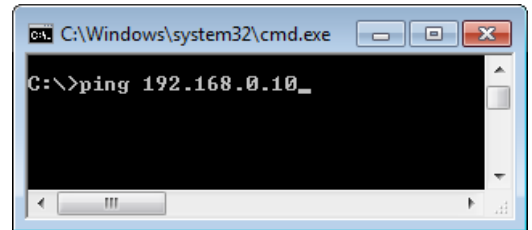
CPU LED State	Indicates	Action
Off	No Power	Check power supply. Verify polarity on connector.
Steady Green	Run Mode	OK
Flashing Green	Program Mode	OK
Alternating Red/Green	A power glitch occurred	Check power supply and continue test.
Flashing Red	The RMC is in the Loader	Update firmware with RMCTools. If firmware update fails, contact Delta.
Steady Red	Major Fault	Contact Delta.

3. Check USB (🔌) Communications
 - a. Connect a USB cable from the RMC to the PC.
 - b. In RMCTools, start a new project, go online, and upload all from the controller.
 - i. If RMCTools does not go online, unplug the USB cable, plug it in again, then attempt to go online again.
 - ii. If RMCTools still does not go online, unplug the USB cable, re-install RMCTools, connect the USB cable again, then attempt to go online again.
 - iii. If RMCTools still does not go online, check to make sure other devices can connect to the PC with the same USB port. If they do, and RMCTools still does not go online, then the RMC's USB port has likely failed.

- c. After uploading all from the RMC, save the project. This backup may be useful, since you may change some of the parameters in the RMC during this test procedure.
4. Check Ethernet (10/100 ENET) Communications
 - a. Set the RMC's IP address so it is compatible with the PC.
 - b. Connect an Ethernet cable from the RMC to the PC.
 - c. In RMCTools, change the connection path to Ethernet and go online with the RMC.

If RMCTools does not go online, try to ping the RMC:

- i. In Windows, open the DOS command prompt.
- ii. Type "ping *IP address*", where *IP address* is something like 192.168.0.10.
- iii. If the RMC returns a reply, then the Ethernet is working.



If the RMC does not return a reply, then there may be an Ethernet setup problem or the cable may be faulty. If you determine that the Ethernet is set up correctly and the cable is functional, then the RMC's Ethernet may have failed.

- d. Check the **Link** and **Net** LEDs.
 - i. The **Link** LED should be solid green or flashing green. If it is off, the physical Ethernet link is down. Check the port the RMC is connected to. If it works with other Ethernet devices, then the RMC's Ethernet may have failed.
 - ii. The **Net** LED should be flashing green. If it is RED, there is another device on the network with the same IP address. This is not a problem with the RMC. Make sure all devices on the network have unique IP addresses.

Modules

Drive Output (S, M, Q, A, H, G, R)

Do this for each control output (drive output).

1. Make sure the control output is assigned to an axis.
2. In the **Axis Parameters**, uncheck the **Invert Output Polarity**.
3. In the **Axis Parameters**, set the Output Bias to zero.
4. For each of the voltages [-10, -5, 0, 5, 10], do the following:
 - a. Send a **Direct Output (9)** command with the voltage. Use a large ramp rate, such as 100.
 - b. Measure the voltage between the **Drv** and **Drv Cmn** pins (on the Q module, pins 12 and 13, respectively) and verify that the voltage is within 0.1 V of the commanded voltage.

Analog Feedback (A, H, G, UI/O)

Do this for each analog input:

1. Make sure the input is assigned to an axis.
2. In the **Axis Parameters**, on the **Setup** tab:
 - a. Set the Scale to 1.0 and the Offset to 0.
 - b. Set the **Positive Travel Limit** to 100 and the **Negative Travel Limit** to -100.
3. With no wiring connected to the axis, the corresponding Axis LED should be solid red or flashing red.
4. Check Voltage
 - a. In the **Axis Parameters**, set the **Input Type** to **±10V**.
 - b. Install a wire jumper between **-In** and **Input Cmn (Anlg Cmn for U I/O)**.
 - c. For each of the voltages [-9.9, -5, 5, 9.9], do the following:
 - i. Apply the voltage across the **+In** and **-In** pins.
 - ii. With a volt meter, measure the voltage between **+In** and **-In**.
 - iii. In the **Axis Status Registers**, on the **All** tab, make sure the **Actual Voltage** register is within 0.1 V of the measured voltage.
 - d. Remove the applied voltage, then install a wire jumper between the **+In** and the **-In** pins (this will force the input to 0 V). Make sure to leave the jumper between **-In** and **Cmn** installed.
 - e. In the **Axis Status Registers**, on the **All** tab, make sure the **Actual Voltage** register is between -0.1 and +0.1 V.
 - f. Send a **Clear Faults (4)** command and verify that the Axis LED is now solid green or flashing green.
 - g. Remove the jumper between the **+In** and the **-In** pins (do not remove the jumper between **-In** and **Cmn**).

If the voltage readings are significantly out of spec, contact Delta.

5. Check Current (A and H modules only)
 - a. In the **Axis Parameters**, set the **Input Type** to **4-20 mA**.
 - b. Install a jumper between the **+In** and **Res (Jmpr for U I/O)** pins (do not remove the jumper between **-In** and **Cmn**).
 - c. Apply approximately 4.9 V across the **+In** and **-In** pins.
 - d. With a current meter, measure the current. It should be close to 20 mA.
 - e. In the **Axis Status Registers**, on the **All** tab, in the **Feedback** section, make sure the **Current** register is within 0.1 mA of the measured current.
 - f. Apply approximately 1.1 V across the **+In** and **-In** pins.
 - g. With a current meter, measure the current. It should be close to 4 mA.
 - h. In the **Axis Status Registers**, on the **All** tab, make sure the **Actual Current** register is within 0.1 mA of the measured current.

If the current readings are slightly out of spec, you can redo the axis Scale and Offset to compensate for the error. If the current readings are significantly out of spec, contact Delta.

6. Check 10V Exciter Output
 - a. Measure the voltage between **10V Exiter +** and **Cmn**. It should be between 9.98 and 10.02 volts.
7. Remove all wiring from the inputs.

MDT Feedback (M)

Do this for each input:

1. Make sure the input is assigned to an axis.
2. With no wiring connected to the axis, the corresponding Axis LED should be solid red or flashing red.
3. In the **Axis Parameters**, set the **MDT Type** to **PWM**.
4. Remove all wires from the MDT module.
5. Connect **+Int** to **+Ret**, and connect **-Int** to **-Ret**.
6. Send a **Clear Faults (4)** command and verify that the Axis LED is now solid green or flashing green.
7. In the **Axis Error Bits**, make sure the **No Transducer** and **Transducer Overflow** error bits are off.
8. In the **Axis Status Registers**, on the **All** tab, make sure the **Counts** value is between 30 and 40.
9. Disconnect **-Int** from **-Ret**.
10. Send the **Clear Faults (4)** command to the axis.
11. In the **Axis Error Bits**, make sure the **No Transducer** and **Transducer Overflow** error bits are off.

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12. In the **Axis Status Registers**, on the **All** tab, make sure the **Counts** value is between 30 and 40.
 13. Remove all wiring from the inputs.

If the count values are not within the specified range, the MDT module has failed.

SSI Feedback (S and UI/O)

Do this for each input:

1. With no wiring connected to the axis, the corresponding Axis LED should be solid red or flashing red.
2. Locate a known good SSI transducer and wire it to the **+Clk**, **-Clk**, **+Dat**, **-Dat** and **Cmn** pins.
3. In RMCTools, set the **Data Bits** and **Binary/Gray Code** axis parameters correctly.
4. Send a **Clear Faults (4)** command and verify that the Axis LED is now solid green or flashing green.
5. In the **Axis Status Registers**, on the **All** tab, look at the **Counts**.
6. Move the transducer in one direction, and make sure the counts change smoothly.
7. Move the transducer in the other direction, and make sure the counts change smoothly in the other direction.
8. Remove all wiring from the inputs.

Fault Input, Enable Output and Reg Input (Q)

Fault Input

Do this for each fault input:

1. In the **Axis Parameters**, on the **All** tab, in the **Output** section, make sure the **Fault Input Polarity** is set to **Active High**.
2. The **Axis** LED should be steady green or flashing green.
In the **Axis Tools**, the **Fault Input** status bit should be off.
3. Apply 24 V across the **Flt In+** (pin 21) and **Flt In-** (pin 20).
4. The **Axis** LED should be red.
In the **Axis Tools**, the **Fault Input** status bit should be on.

Enable Output

Do this for each enable output:

1. In the **Axis Parameters**, on the **All** tab, in the **Output** section, make sure the **Enable Output Polarity** is set to **Active Closed**.
2. Send the **Set Enable Output (67)** command to **Disable** the output.
The **Axis** LED should be flashing green.
In the **Axis Tools**, the **Enable Output** status bit should be off.

3. Measure the resistance between the **+Enable Out** (pin 25) and **-Enable Out** (pin 24).
The resistance should be high (open circuit).
4. Send the **Set Enable Output (67)** command to **Enable** the output.
The **Axis** LED should be steady green.
In the **Axis Tools**, the **Enable Output** status bit should be on.

Measure the resistance between the **+Enable Out** (pin 25) and **-Enable Out** (pin 24).
The resistance should be between 5 and 50 Ohms.

Registration Inputs

1. In the **Axis Status Registers**, on the **All** tab, in the **Registration** section, the **RegX/PosLim Input** and **Reg Y/NegLim Input** should be off.
2. Apply 24 VDC across **RegX In+** (pin 9) and **RegX In-** (pin 8). Now the **RegX Input** status register should be on.
3. Apply 24 VDC across **RegY In+** (pin 7) and **RegY In-** (pin 6). Now the **RegY Input** status register should be on.

Quadrature Feedback (Q and UI/O)

Do this for each input:

9. With no wiring connected to the axis, the corresponding Axis LED (Q module only) should be solid red or flashing red.
10. Locate a known good encoder with 5V differential output (RS-422 driver), and wire it to the **A+**, **A-**, **B+**, **B-**, **Z+**, **Z-**, and **Cmn** pins (UI/O does not have Z+ and Z-).

Q module pin label	A-	A+	B-	B+	Z-	Z+
Pin #	1	2	3	4	14	15

11. Send a **Clear Faults (4)** command and verify that the Axis LED is now solid green or flashing green.
12. In the **Axis Status Registers**, on the **All** tab, look at the **Counts**.
13. Turn the encoder in one direction, and make sure the counts change smoothly.
14. Turn the encoder in the other direction, and make sure the counts change smoothly in the other direction.
15. Test the Z input (Q module only):
 - a. Send the **Arm Home (50)** command with the following parameters:
 - i. **Home Pos:** 0
 - ii. **Trigger Type:** Z
 - iii. **Repeat Mode:** Single
 - b. In the **Axis Status Registers**, on the **All** tab, in the **Home** section, **Home Armed** should be on.

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- c. Turn the encoder more than one revolution.
 - d. **Home Armed** should now be off, and **Home Latched** should be on. This means the Z input is working correctly.
16. Remove all wiring from the inputs.

If any step fails, the Q or U I/O module has failed.

Resolver Feedback (R)

Do this for each input:

1. With no wiring connected to the axis, the corresponding Axis LED should be solid red or flashing red.
2. Locate a known good resolver wire it to the R module.
3. In RMCTools, set the **Reference Amplitude**, **Reference Frequency** and **Resolver Resolution** axis parameters correctly.
4. Send a **Clear Faults (4)** command and verify that the Axis LED is now solid green or flashing green.
5. In the **Axis Status Registers**, on the **All** tab, look at the **Counts**.
6. Move the transducer in one direction, and make sure the counts change smoothly.
7. Move the transducer in the other direction, and make sure the counts change smoothly in the other direction.
8. Remove all wiring from the inputs.

PROFIBUS Module

1. Check the PROFIBUS communications
 - a. Connect a PROFIBUS communication device (PLC, etc.) to the PROFIBUS port, and properly configure the device to communicate with the RMC150.
 - b. Make sure the PROFIBUS LED is green. If it is not green, the PROFIBUS is either not configured properly, or the PROFIBUS port on the RMC failed.

Discrete I/O (UI/O Module)

1. In RMCTools, configure all the discrete I/O on the UI/O module as **Outputs**.
2. Turn off all the discrete outputs on the UI/O module (use the DI/O Monitor).
3. Measure the resistance between **Output Cmn** and each **I/O** point. The resistance should be high (open circuit).
4. Turn on all the discrete outputs on the UI/O module (use the DI/O Monitor).
5. Measure the resistance between **Output Cmn** and each **I/O** point. The resistance should be approximately 20-50 Ohms (measuring resistance may be best done directly on the pins without a terminal block installed)

6. Configure all the discrete I/O on the UI/O module as **Inputs**.
7. Make sure the **I/O Monitor** in RMCTools indicates the inputs are all off.
8. For each I/O point, apply about 1 VDC between the **I/O** point and **Input Cmn**. Slowly increase the voltage until the input turns on. It should turn on between 3.5 and 7 volts, and remain on as the voltage is increased up to 24 VDC. If you do not have an adjustable power supply, just apply 24 VDC to the input.
When the input turns on, the I/O monitor should indicate it is on.

If any step fails, the UI/O module has failed.

Discrete I/O (RMC150E CPU)

1. Turn off both discrete outputs on the RMC150E (use the DI/O Monitor). Make sure the discrete output LEDs are all off.
2. Measure the resistance between **In+** and each **In-** for each input. The resistance should be high (open circuit).
3. Turn on both discrete outputs on the RMC150E module (use the DI/O Monitor). Make sure the discrete output LEDs are all green.
4. Measure the resistance between **In+** and each **In-** for each input. The resistance should be approximately 20-50 Ohms (measuring resistance may be best done directly on the pins without a terminal block installed)
5. Make sure all the I/O point LEDs are off when the voltage is applied, and make sure the **I/O Monitor** in RMCTools indicates the inputs are all off.
6. For each I/O point, apply about 1 VDC between the **I/O** point and **Input Cmn**. Slowly increase the voltage until the input turns on. It should turn on between 3.5 and 7 volts, and remain on as the voltage is increased up to 24 VDC. If you do not have an adjustable power supply, just apply 24 VDC to the input.
When the input turns on, the corresponding LED should be green.

If any step fails, the RMC150E module has failed.

Discrete I/O (DI/O)

1. Turn off all the discrete outputs on the DI/O module (use the DI/O Monitor).
2. Measure the resistance between **Output Cmn** and each discrete output. The resistance should be high (open circuit).
3. Turn on all the discrete outputs on the DI/O module (use the DI/O Monitor).

4. Measure the resistance between **Output Cmn** and each discrete output. The resistance should be approximately 20-50 Ohms (measuring resistance may be best done directly on the pins without a terminal block installed)
5. For each discrete input, apply about 1 VDC between the discrete input and **Input Cmn**. Slowly increase the voltage until the input turns on. It should turn on between 2 and 3 volts, and remain on as the voltage is increased up to 24 VDC. If you do not have an adjustable power supply, just apply 24 VDC to the input.
When the input turns on, the I/O monitor should indicate it is on.

If any step fails, the DI/O module has failed.

Checklist

P = pass, F = fail, N/A = does not apply

RMC150E CPU

P	F	N/A	Procedure	Notes
			Power Voltage and Current	
			CPU LED	
			USB Communications	
			Ethernet Communications	
			Discrete I/O	

H and G Modules

P	F	N/A	Procedure	Notes
			Drive Output	
			Voltage Input	
			Current Input	
			10V Exciter Output	

A Module

P	F	N/A	Procedure	Notes
			Voltage Input	
			Current Input	
			10V Exciter Output	

M Module

P	F	N/A	Procedure	Notes
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RMC150 Hardware Evaluation procedure

			Drive Output	
			MDT Feedback Input	

S Module

P	F	N/A	Procedure	Notes
			Drive Output	
			SSI Feedback Input	

Q Module

P	F	N/A	Procedure	Notes
			Fault Input	
			Enable Output	
			Drive Output	
			Quadrature Feedback	
			Registration Inputs	
			Z Input	

R Module

P	F	N/A	Procedure	Notes
			Drive Output	
			Resolver Feedback Input	

DI/O Module

P	F	N/A	Procedure	Notes
			Outputs 0-7	
			Inputs 0-17	

UI/O Module

P	F	N/A	Procedure	Notes
			Analog Feedback	
			Discrete I/O	
			MDT Feedback	
			Quadrature Feedback	