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DOCUMENT NUMBER: ENG-PRT-446

DOCUMENT TITLE: Mega Power Motherboard Transistor Change Verification

DOCUMENT NOTES:

## Document Information

| | |
|---|---|
| Revision: 001 | Vault: MEG-Rel |
| Status: Release | Document Type: ENG-PRT |

## Date Information

| | |
|---|---|
| Effective Date: 10 Nov 2017 | Expiration Date: |
| Release Date: 10 Nov 2017 | Next Review Date: |

## Control Information

| | |
|---|---|
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| Previous Number: | Change Number: 2017-ENG-DCO-121 |

# Signature Manifest

**Document Number:** ENG-PRT-446 **Revision:** 001
**Title:** Mega Power Motherboard Transistor Change Verification

All dates and times are in Mountain Standard Time.

## Mega Power Transistor Protocol

### Change Request

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Lucy Richards (LRICHARDS) | | 26 Oct 2017, 10:52:32 AM | Approved |

### Collaboration

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Stuart Taylor (STAYLOR) | Sr. Quality Engineer | 06 Nov 2017, 09:35:42 AM | Complete |
| Paul Borgmeier (PBORGMEIER) | | 07 Nov 2017, 04:22:44 PM | Complete |
| Darlene Hull (DHULL) | Regulatory | 08 Nov 2017, 02:51:49 PM | Complete |
| Mark Glassett (MGLASSETT) | | 08 Nov 2017, 03:40:35 PM | Complete |

### Document Review

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Lucy Richards (LRICHARDS) | | 09 Nov 2017, 07:42:01 AM | Complete |

### RA-Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Darlene Hull (DHULL) | Regulatory | 09 Nov 2017, 03:02:45 PM | Approved |

### QA-Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Stuart Taylor (STAYLOR) | Sr. Quality Engineer | 09 Nov 2017, 05:14:52 PM | Approved |

### ENG-Approval

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Paul Borgmeier (PBORGMEIER) | | 10 Nov 2017, 08:33:01 AM | Approved |

### Training Review

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Lucy Richards (LRICHARDS) | | 10 Nov 2017, 08:44:23 AM | Approved |

### Final Release

| Name/Signature | Title | Date | Meaning/Reason |
|---|---|---|---|
| Lucy Richards (LRICHARDS) | | 10 Nov 2017, 08:44:35 AM | Approved |

Printed on: 22 Jan 2020, 04:54:09 am; Printed by: .

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## 1. REFERENCES

| | |
|---|---|
| 4010301-01 | Assembly, PCB, Motherboard ROHS |
| 4010302-01 | Detail, PCB, Motherboard ROHS |
| 4010060-02 | Detail, PCB, Foot Control |
| 4010059-01 | Assembly, PCB, Foot Control |

## 2. SCOPE

This protocol pertains to the 4010301-01 Assembly, PCB, Motherboard ROHS and 4010059-02 Assembly, PCB, Foot Control ROHS.

## 3. PURPOSE

The purpose of this test protocol is to specify the verification for a change to the 4010301-01 Assembly, PCB, Motherboard ROHS and 4010059-02 Assembly, PCB, Foot Control ROHS. The change is to allow use of alternate transistor at line item 62 on BOM 4010301-01 Assembly, PCB, Motherboard and line 25 on BOM 4010059-02 Assembly, PCB Foot Control respectively. This alternate transistor, Fairchild PN2222ABU, has a different pin out from the previous transistor, ON Semiconductor PN2222AG. The transistors are three pin devices and the polarity is reversed on the PN2222ABU compared to the PN2222AG.

## 4. BACKGROUND

Motherboard Assembly 4010301-01 and Foot control assembly 4010059-02 have been using transistor PN2222AG from ON Semiconductor. This component has gone end of life and the manufacturer is no longer producing it. There is an alternate on the BOM but it has a different pin out. The difference to the pin out is that pin 1 and pin 3 are reversed. Since pin 1 and pin 3 are reversed for this alternate component the PCB assembly drawings must be revised. The revision is to add a note to the drawing to specify that when using the Fairchild PN2222ABU to reverse the polarity.

## 5. REQUIRED EQUIPMENT, TOOLS, AND MATERIALS

Refer to ENG-WI-013

## 6. RISK ASSESSMENT

6.1. A review of Risk Analysis Document ENG-RMF-018 identifies risks associated with component failure in the circuits where these transistors are present on Motherboard 4010301-01. There are eight of these transistors on the Motherboard, they are at locations Q1, Q2, Q3, Q4, Q5, Q6, Q7 and Q8. The

severity for these single fault failures is scored in the range of 3 to 10. The lines items that are scored severity 10 are as follows:

| Line | Failure Mode | Cause | Mitigation | Verification |
|---|---|---|---|---|
| 105 | Loss of power regulation | Failure of voltage and current feedback network | Perform diagnostic test on every unit | Every unit is tested per OPER-WI-027 |
| 106 | Loss of power regulation | Failure of voltage and current feedback network | Software algorithm monitors feedback | Software Verification report ENG-RPT-281 |
| 107 | Loss of power regulation | Failure of voltage and current feedback network | WD microcontroller has redundant feedback | Software Verification report ENG-RPT-281 |
| 116 | CQM Fails to operate | Component failure in CQM Circuit | Software monitoring of CAM | Software Verification report ENG-RPT-281 |

For the transistor Q1 on Foot Control 4010059-02, there are no FMEA entries with severity scores greater than 1. Therefore the risk of the foot control PCB not working is low and will not be addressed.

## 7. SAMPLE SIZE JUSTIFICATION:

7.1. Printed Circuit Boards are assembled at an outside contractor. That contractor is responsible for proper assembly and test of the PCB assemblies. Each PCB assembly is 100% tested in the process to insure that PCB is working properly. Therefore, a small sampling of 5 PCB assemblies will be used for this verification. As part of the verification, the transistor data sheets will be compared by electrical engineer or technician to verify that the two transistors are significantly equivalent and interchangeable with each other.

## 8. PROCEDURE

8.1. Comparison of the Data Sheets

8.1.1. This comparison will be done by an Electrical Engineer or Electrical Technician.

8.1.2. Compare the data sheets of the ON Semiconductor PN2222AG with the Fairchild PN2222ABU. If any differences are noted, describe the difference and write justification why the difference is not significant to the Mega Power design. Show this explanation in the test report.

8.2. Assembly verification.

8.2.1. Engineering will create preproduction "X" number drawings for use by the supplier. Purchasing will buy five each of assembly Part Numbers X4010301-01 and X4010059-02.

8.2.2. The supplier will build and test each of the five assemblies of the two part numbers. The supplier will follow all of their standard processes with exception of placing the subject transistors per the "X" drawing.

8.2.3. Upon receipt of the PCB's at Megadyne, the PCBs will be received, lot numbered and inspected per SOP.

8.2.4. Megadyne Operations will build the PCB's into Mega Power 1000 Generators on standard work orders. Note on the traveler that the generators were built per this protocol.

8.2.5. Upon completion of the five generators, test per the work instruction and notify Quality Engineer that they are complete. If there are any failures of these five generators, hold for engineering evaluation.

8.2.6. After successful completion of this protocol, and assembly and test of the Mega Power generators, hold the generators until the DCO for revising the following drawings is complete, reference this DCO on the traveler.

4010059-01 Rev 007
4010301-01 Rev 004

## 9. ACCEPTANCE CRITERIA

9.1. The transistor data sheet comparison shall be completed and the engineer or technician shall verify that the replacement transistor is an acceptable alternate for the application. Document in the test report.

9.2. The five Mega Power generators shall pass all assembly and test requirements. Note that any test failure that is determined to be caused by means other than the transistor shall not be cause for rejecting the protocol results.