ATLAS Muon MDT

MROD Module:

MROD-X Second Pre-Production Series Test Report

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Abstract

Due to errors in the assembly of the pre-production series modules, it was decided to produce a **second pre-production series** of ten modules (**serial numbers 25-34**). This document describes the issues found during testing.

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Table 0 Document Change Record

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Table of Contents

1 Introduction

Due to errors in the assembly of the pre-production series modules (see the document "MROD-X Pre-Production Series Test Report" 07-Dec-2006), it was decided to produce a second pre-production series of 10 modules.

Both pre-production series were produced at PCB Technologies LTD, Israel. All MROD-X modules were of the type "6 channel without SHARC-B".

The 10 MROD-X modules of the second pre-production series have been given serial numbers 25-34.

It appears that most (but unfortunately not all) of the errors encountered with the first pre-production series have been solved.

Some items that were okay on the first pre-production series are wrong for the second pre-production series

The overall quality of the Printed Circuit Board and the quality of the soldering joints for the first pre-production series was very good. For the second pre-production series the quality is even better. The first pre-production series had eight soldering joint malfunctions whereas the second pre-production series had two.

Again all BGA devices on the ten modules were mounted correctly!

2 First inspection

2.1 Packaging

The 10 modules arrived in 2 boxes (figure 1). The modules were packed in special boxes that were ordered in Great-Britain (figure 2).

Figure 1: Arrival of the boxes in Amsterdam

Figure 2: One of the boxes was just opened

Still packaging needs improvement as can be seen in figure 3 and 4. The front panel handles bumped through the module boxes because they push directly on the bottom of the outer box without any protection. A buffer (plenty of foam, bubble-foil or chips etc.) must be placed between the bottom of the outer box and the inner boxes.

Luckily the modules had no damage due to shipment.

Figure 3: The front panel handles bumped through the module boxes…

Figure 4: … into the bottom of the outer box

2.2 Use an anti-static bag

Figure 5 shows how the modules where unpacked from their special boxes.

Figure 5: One of the modules just being unpacked after arrival

The boards were not packaged in anti-static bags. This needs to be done for the series. Without such a bag the components mounted on the board scrape parts of the foam, which get all over the module. Figure 6 shows how it was expected that the modules would arrive.

Figure 6: Use an anti-static bag to package the modules into the special boxes.

Anti-static bags will be sent from Amsterdam to PCB Technologies so the production series can be properly packaged.

2.3 Front Panel LEMO connector missing

The front panel “ROD Busy” LEMO connector (J25) is one of the items that were properly assembled on the first pre-production series but were not placed on the second pre-production series (see figure 7).

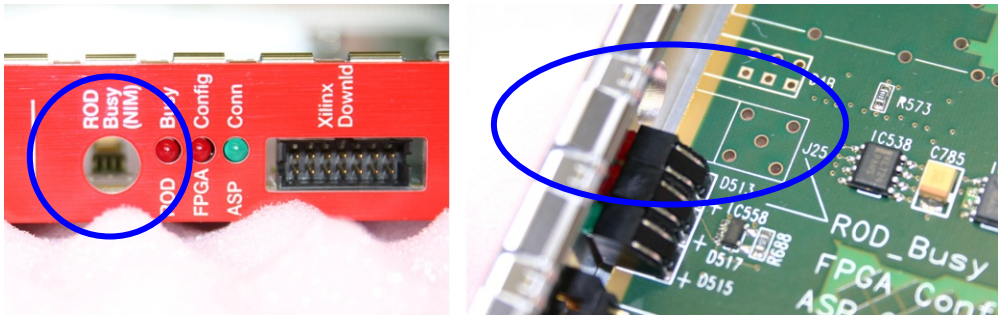

Figure 7: ROD Busy LEMO connector (J25) was not assembled

Apparently components had been swapped with other CERN projects since there were ten “RJ45” connectors (figure 8) separately packed. According to PCB-Technologies “these connectors didn’t fit the LEMO connector on the MROD module”. The text on the bag in figure 8 shows “item-29”. By mistake this item was swapped for the MROD project item-29 which is the ROD Busy LEMO connector.

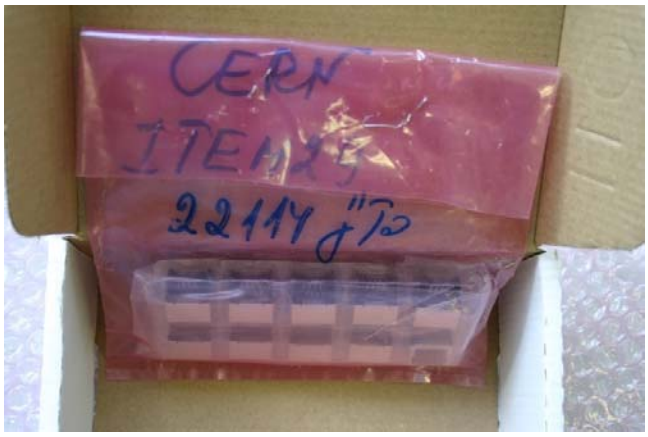

Figure 8: Item-29 of another CERN project

2.4 EMC Gasket

For the second pre-production series it was asked **not** to place the EMC Gaskets (RITTAL number 3686979) since they were found to be of inferior quality on the first pre-production series. However, all second pre-production modules had the EMC Gasket assembled (see figure 9). This figure also shows why the gaskets are of inferior quality; the springs sometimes get deformed which can cause damage on the components that are mounted on neighbouring modules when boards are put into or taken out of a VME Crate.

Do not place the EMC-Gasket. We now have better ones that we will mount in Amsterdam.

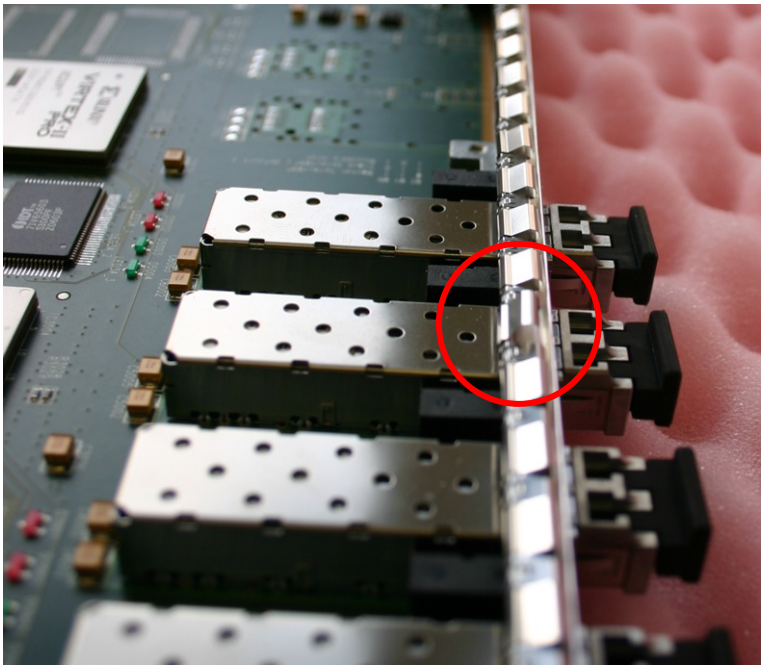

Figure 9: Inferior EMC Gasket was assembled. Encircled is a deformed spring.

2.5 Mechanically mounting of P1, P2 and P3

Connectors P1, P2 and P3 were mechanically fixed with M2x12 bolts (figure 10). For the series M2.5x10 should be used. There are two reasons to change to M2.5x10.

First, the holes in the connector and on the PCB are made for M2.5 bolt and thus a M2 bolt has clearance which can lead to a misalignment during the soldering of the connector.

Second, the M2x12 is unnecessary long. To keep maximum clearance to the neighbouring boards M2.5x10 is sufficient.

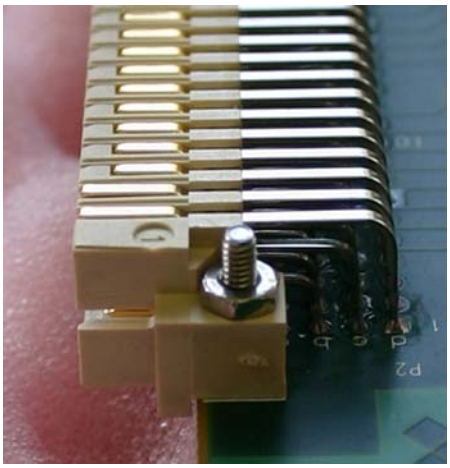

Figure 10: M2x12 was used to mechanically fix P1, P2 and P3. Use M2.5x10 instead.

A sufficient number of M2.5x10 bolts and nuts will be sent from Amsterdam to PCB Technologies so the connectors on the production series can be properly fixed.

2.6 Front panel mounting

The front panel was properly assembled on the first pre-production series but wrong bolts were used for the second pre-production series (figure 11). The assembly list states on page 19, to use a “countersunk head M2.5x6 for mounting the front panel to the PCB holder”.

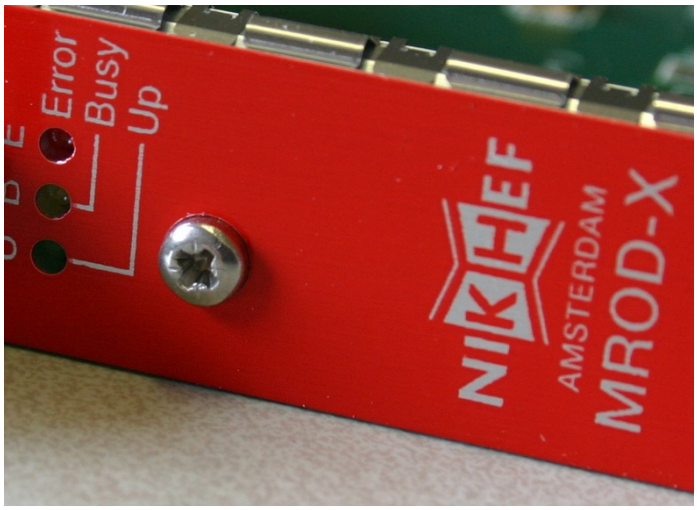

Figure 11: a countersunk head M2.5x6 must be used instead of a cheese head

A sufficient number of M2.5x6 countersunk head bolts will be sent from Amsterdam to PCB Technologies so the front panel on the production series can be properly fixed.

3 Closer inspection

A few critical SMD components were checked before a module was put into the VME crate for further testing. These components include special resistors that configure board 'settings' (6 or 8 channel module; yes/no SHARC-B present) and feedback resistors for the power supplies.

The SMD components which had special instructions due to inspection of the first pre-production series were checked as well. Many, but not all, instructions were followed.

3.1 Power supply feedback resistors

There are many (switched mode) power supplies on the board. The feedback resistors need to have the proper values to avoid over-voltage on the FPGAs or SHARC processors. Not all resistors had the proper value. It seems that there was a wrong tape placed on the machine since for all 100 ohm resistors, 10 ohm resistors were placed instead. This involves 15 resistors per module (R605, R608, R609, R610, R719, R720, R721, R1006, R2006, R3006, R4006, R5006, R6006, R7006, R8006)

The proper EIA-96 marking for a 100 ohm SMD resistor should read "01A". However 10 ohm resistors with marking "01X" were placed.

It should be noted that the same error was made in the first pre-production series!

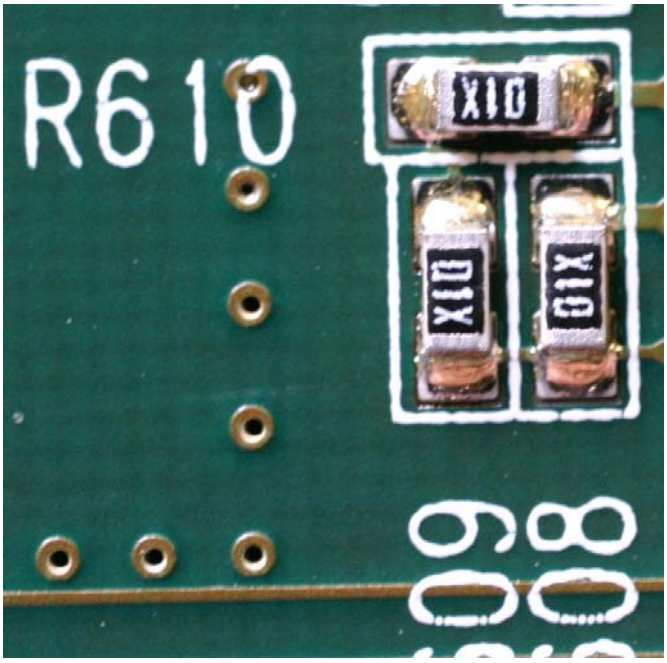

Figure 12: example of resistors with wrong values

3.2 Termination resistors R710, R712, R714 and R716

New insights from the first pre-production series led to the instruction **not** to place R710, R712, R714, R716. This instruction was not followed as can be seen in figure 13.

3.3 Termination resistors R711, R713, R715 and R717

New insights from the first pre-production series led to the instruction to replace R711, R713, R715, R717 by a 51 ohm resistor. This instruction was indeed followed, however a **0603 SMD size must be used**, not a 0805 (see figure 13).

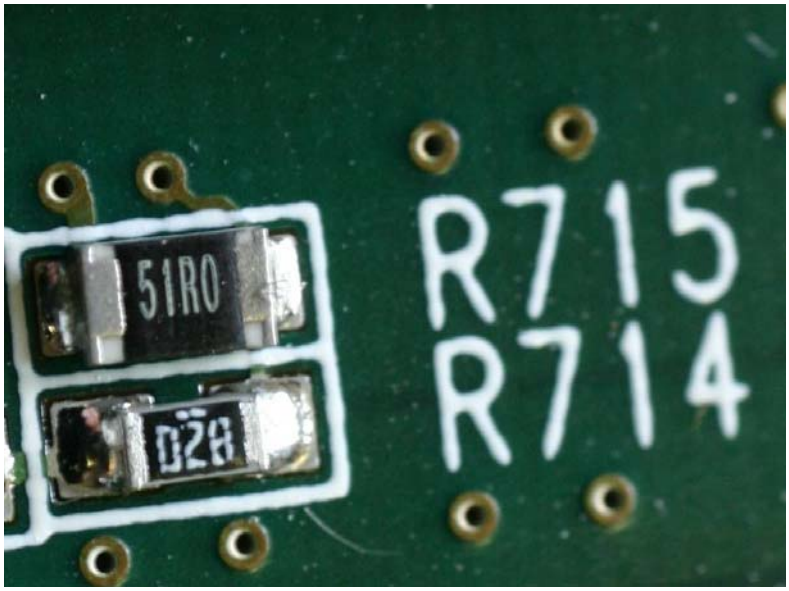

Figure 13: Example; R714 must **not** be placed, R715 must be a **0603** package, not a 0805 package

3.4 Fuses

One of the recommendations that followed the first pre-production series, was to pay extra attention to the soldering of the fuses. The second pre-production series had properly soldered fuses but unfortunately 5 (out of 20) were broken. This is probably due to the effect that when heating the fuses, the end-caps tend to be blown off by the expanding hot air inside the fuse. One need to find an optimum in reflowing the solder and trying to keep the end-caps in place.

It was already noted that these fuses are not made to be used as surface mount devices. In that sense this is not an assembly error.

It would help a great deal if the fuses are checked (with an ohm-meter) after soldering. When a broken fuse is found it can be replaced immediately.

4 Assembly errors found

4.1 General

In the second pre-production series (10 modules) we have found 2 individual assembly errors. This is a major improvement with respect to the first pre-production series (15 modules) were 8 individual assembly errors were found.

Below the failures that were encountered in the second pre-production series are shown. The pictures below are made with a microscope which is only capable to make pictures from a strait angle. These straight angle pictures might not look very convincing because in order to find solder joints that are not soldered properly it is absolutely necessary to view under an angle. Some pictures are therefore made with a mirror.

4.2 Module 30, J24 short between pins 56 and 58

This module did not pass the test and software soon pointed to connector J24 pins 56 and 58. It appeared that PCB technologies had done some rework on pins 52 to 64. After closer inspection with a tiny mirror, one can see that there is a short between pins 56 and 58 (see figure 14).

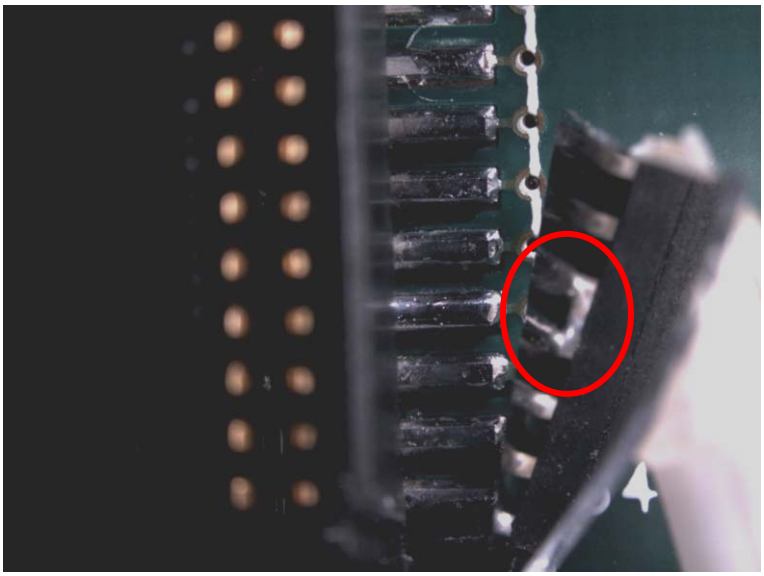

Figure 14: J24 pins 56 and 58 are shorted

4.3 Module 31, IC588 pin 1 and 5 not soldered properly

This fault is caused by the package of the NC7SZ00P5X which is not really flat on the PCB thus causing the pins to stand off from the PCB surface (see figure 15).

This problem area was already noticed while testing the first pre-production series and it was recommended to pay extra attention to IC588. This fault proves that extra attention for IC588 is indeed necessary!

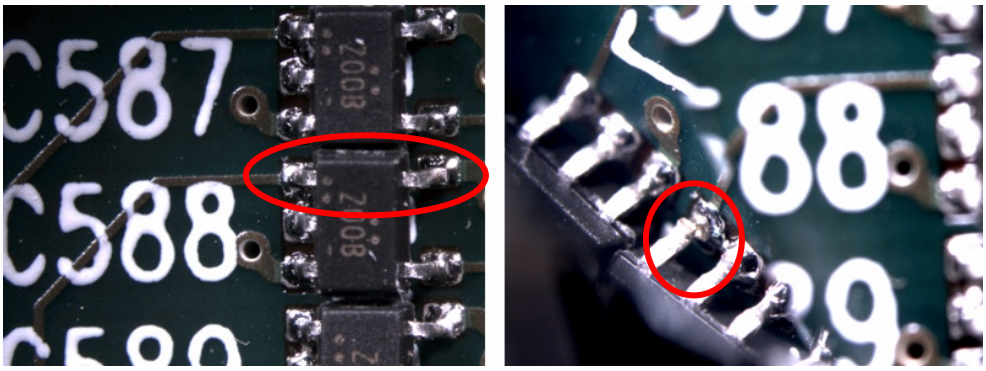

Figure 15: IC588 pin 1 and 5 above the PCB and not soldered

4.4 Conclusions

In the second pre-production series 2 individual assembly errors were found. For 10 modules this gives a yield of some 80% which is much better than the first pre-production series were the yield was about 50%.

With respect to the enormous amount of components that were soldered properly this is really a major achievement! On the other hand, care should be taken to keep this high standard.

Appendix A: Assembly instruction summary

The most important list of this report:

Use an **anti-static bag** before the module is packed into the special module box.

Improve packaging; put **plenty of foam, bubble-foil or chips** between the bottom of the outer box and the inner boxes.

Assemble J25 (ROD Busy LEMO)

Do **not** assemble the EMC Gaskets (RITTAL Number 3686979)

Mechanically fix P1, P2 and P3 before soldering with **M2.5x10**

Use a **countersunk head M2.5x6** for mounting the front panel to the PCB holder

R605, R608, R609, R610, R719, R720, R721, R1006, R2006, R3006, R4006, R5006, R6006, R7006, R8006 **must be 100 Ω** (not 10 Ω)

Don't place R710, R712, R714, R716

Place R711, R713, R715, R717 = **51 Ω** (not 130 Ω) **in 0603 package**

Carefully solder the Fuses. Try to keep the end-caps in place while reflowing the solder. Measure the fuses with an ohm-meter after soldering and repair when necessary

Keep paying special attention to IC588 area

Don't forget to pay attention to the instructions and recommendations that were done after the first pre-production series!

Appendix B: Items that will be supplied

300	Anti-static bags
1200	M2.5x10 bolts cheese head + 1500 nuts (for mounting P1, P2 and P3)
1000	M2.5x8 bolts cheese head (for mounting stiffening bar and PCB holder)
400	M2.5x6 bolts cheese head (for mounting the keying-pin)
400	M2.5x6 bolts countersunk head (for mounting the front panel to the PCB holder)
1	Example MROD-X module

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