SUPPORT NOTE

SN-129

Replacement of Matrix and Node Relays

Introduction

Using Reedholm diagnostics software, it is relatively easy to isolate shorted relays, or ones with excessive resistance, on a crosspoint matrix or picoammeter module. It takes a few more steps to isolate relays on node extending modules in high pin count systems, but that can be done in a straight forward manner. Specific module tests are used to identify defective node relays on power supply and measurement modules.

By being very careful, Reedholm can repair defective modules so they meet the most stringent manufacturing specifications. Customers that replace defective node relays need to take that same care. If not, a module may be damaged to the point of causing the test system to fail its performance specifications.

Because of recent module damage by customers when replacing relays, this note is provided to identify potential pitfalls for customers that otherwise have the requisite skills in soldering and repair of printed circuit assemblies.

Removing Relays

Unless one has a desoldering tool that can apply heat to all pins at one time, the recommended method for removing multiple pin count devices such as integrated circuits is to cut the leads and separately remove each pin. That approach is not possible with the node relays illustrated in figure 1. Instead, solder needs to be removed from the through hole around each pin and the pin freed mechanically. The trick is to do that without lifting the pads or damaging the through hole.

That is not easy. Node relay pins are on 0.1" centers, so there is little pad material on either side of each pin, and it takes very little excess heat to pull away the pads. On the other hand, if not enough heat is applied, solder in the through hole is not adequately removed. Then the through hole plating will be pulled from the board when the relay is removed.

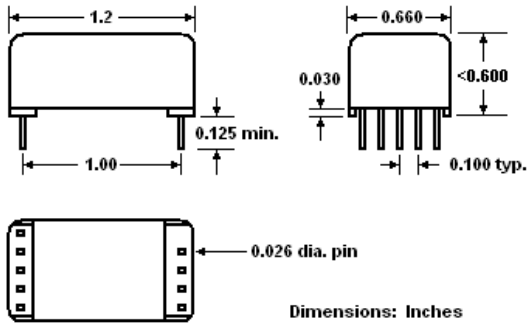

Figure 1 - Node Relay Dimensions

Damage Repair

Pad removal on the non-componentor bottom side of the module is not a big problems as long as the guard pad is not the one removed. Without that one intact, surface guarding of leakage currents is compromised. However, lifting of pads on the component side is difficult to repair regardless of pin function. Simply

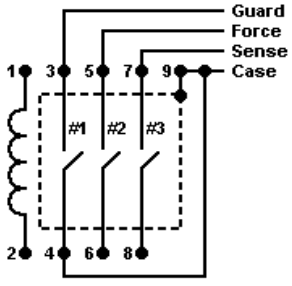

Figure 2 - Node Relay Connections

adding jumper wires does not work, even ones with Teflon insulation, because the force and sense wires need to be completely guarded. Figure 2 shows relay connections from the bottom side. The magnetic case is tied to the input side of the guard switch, and the guard lands completely enclose force and sense on both sides of the circuit board.

Repair and Hand Soldering

Module rework plus hand soldering is done at Reedholm with Kester 44 activated rosin cored wire. In the case of picoammeter assemblies, the residual flux is left on the assembly rather than risk spreading the flux to circuitry that have to perform to femtoampere levels. In some cases, flux has been on boards in use for >20years with no signs of degradation. That matches the claims in the Kester data sheets. Howerver, rosin flux residue is removed with virgin isopropyl alcohol for cosmetic reasons when doing repair work. After cleaning, several hours drying at 50°C is used to drive residual alcohol and water from the printed circuit board.

Kester 44 is an Sn63Pb37 alloy. If lead free solder has to be used, Kester 48 cored wire solder has a more active rosin flux for use with lead-free alloys. If used, the flux should be removed promptly as a precaution. Furthermore, if no lead solder is used, the higher desoldering and soldering temperatures could lead to printed circuit board and relay damage.

Problem with No-Clean Flux

Prior to replacing a batch of defective relays, Reedholm had not found a reason to outsource relay replacement. The company that did the replacement was the same one that stuffs the matrix boards and wave solders them. Surprisingly, there were severe current leakage failures even after extended time at 50°C. The same water soluble flux (Kester 2331-ZX), and the same cleaning process was used on the reworked modules as used when the modules were flow soldered.

Suspecting residual contamination from the water soluble flux, the boards were brought to acceptable quality by washing several times in hot water. In some cases, module were immersed in hot water with the thought of dissolving aborbed flux from the circuit board. Also, some relays had to be removed to completely flush the offending flux. That is with a flux advertized as " . . . does not . . . attack FR-4 epoxy-glass laminate." and ". . . is not detrimental to the surface insulation resistance . . . "

In conclusion, the flux used by the vendor worked well for flow soldering and probably was ok for most repairs. But it was a disaster for use on low current measurement modules. In hindsight, no amount of care could have kept the liquid flux from getting into the printed circuit board.

Customer Repairs

Reedholm sells node relays with the caveat that customer repaired assemblies might not be capable of performing to published specifications. That could happen even when taking the utmost care in replacing relays. Worst case, a functioning module could be destroyed.