Application Notes

Application Note 108

Locate bus shorts and loading faults with the TONEOHM 950's advanced bus fault finding ranges

Locating obscure loading faults and shorts on microprocessor buses on multi-layer circuit boards can seem a daunting task. Combining a multi-range shorts locator such as the Polar Instruments TONEOHM 950 with a systematic approach to the fault can help locate the toughest short.

Bus fault types

In this Application Note we discuss two types of bus faults - short circuits and excessive loads. How you set about locating obscure short circuits or loading faults on microprocessor based circuits built on multi-layer circuit boards will depend on the nature of the fault. Short circuits can be categorised as high resistance or low resistance (less than 200mOhm) and static (the fault is always present) or dynamic (the fault is only present when the board is powered). The accessibility of the short or load (some faults will be buried inside wiring harnesses or between board planes) will also determine how you go about finding it.

Low resistance shorts

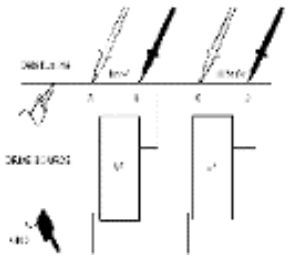
Shorts below approximately 200mOhm are usually caused by solder bridges between device leads or pins or land bridges between adjacent pcb tracks. For these shorts, making resistance measurements using the milliohm range will usually guide you to within a few millimeters of the short. For shorts between two bus lines select the 200mOhm range and place the probes across the tracks. Probe along the tracks at several points until the resistance reading indicates a minimum. (Very fine land bridges may still be invisible if the board is covered in solder resist. Use a sharp scalpel to cut between the tracks.)

Measuring track current

When a short is hidden (for example, inside an IC) the TONEOHM 950 can be used to locate the short by measuring the current flowing in a bus line or pcb track. The 950 measures current by measuring the voltage drop across lengths of pcb track. The method is appropriate for large track currents and is similar to measuring track voltage, described below.

Measuring track voltage

Current flowing in bus lines will normally be extremely small. In such cases and where tracks are wide (and therefore very low resistance) the current flowing in a track may be too small to be resolved with the current range. You can use the 950's track voltage ranges to measure very small voltage drops along bus lines. The Drive Source is connected across the shorted tracks and the current traced through to the short or excessive load using the millivolt ranges. Consider the circuit below with a static load problem on one of the data lines.



Tracing a load by measuring track voltage

In this circuit the databus line shown is being loaded by one of the ICs. Using the 950 Drive Source and the millivolt ranges, voltage between points A and B measures 1mV. Further along the track, voltage across points C and D measures 0.05mV. This suggests that U1 is loading the bus line, probably via blown input protection diodes.

Inaccessible shorts and loads

Measuring track current is not always possible - many shorts will occur inside wire harnesses, beneath conformal coating or in densely packed boards. In these cases the 950's non-contact current TRACE facility can help locate shorts under an IC or on an inner layer of a multi-layer pcb. The 950 Drive Source drives current between two

shorted tracks - the resulting magnetic field indicates the path of the current which can be easily followed with a current trace probe. To locate which device is causing a bus to stick low, connect one Drive Source lead as close to one end of the bus as possible, the other Drive Source lead to ground. Now trace along the bus line until the audible tone disappears - this point should be close to the device causing the "stuck at" fault. This method can be especially effective at locating which of several ICs is drawing excessive current.

Plane shorts
If the short is between two planes or between a plane and a bus line use the 950's PLANE SHORTS range. Most plane shorts are located at or near via holes so are accessible from the surface of the board. The 950 incorporates 4 Plane Stimulus leads which are connected to the outer corners of the plane, a Plane Clip connected to the bus line shorted to the plane and a Plane Probe to pin-point the short. As the Plane Probe is moved around the plane a system of direction arrows, meter readings and audible tones guides the operator to the area of the short. Once the general area of the short has been established the Plane Stimulus leads can be moved closer to the short to localise the fault still further. Note that although we have discussed data and address busses, all tracks connecting multiple points on a circuit (even power supply rails) are, in effect, busses. The 950 is equally effective at locating shorts on any type of node.

Polar Instruments Ltd
Garenne Park, St Sampson, Guernsey, Channel Islands GY2 4AF, UK

www.polarinstruments.com
mail@polarinstruments.com

Tel: +44 1481 253 081 Fax +44 1481 252 476
