Ralph's Problem in Maintenance Lab

Fixing the Ikegami companion cameras. Cal pulse and ... overlaid.

Diagram 1. Relay is the coil/inductor. Called K1 in the relay (was labeled as UMD, was at +24VDC). Ralph suspected that relay wasn't closing, since it didn't change states when it told the cal pulse to change states.

How to diagnose this? Relays don't break down often, so historically not a problem. Diode could have shorted. Transistor could be problem; tend to short when fail. If diode had shorted, what would have happened to the transistor? Since diode reversed, might draw 5-6 amps through that little transistor and burn it out. Relay was always in one position (it was always closed); the cal pulse was always on the monitor.

Why is the diode in the circuit? Back-EMF. When remove 24V, what will happen at the relay coil? The voltage will spike, maybe to 100 volts. Diagram 2 shows the voltage at the coil when the relay closes. Diode allows 0.7 volts due to drop. It will short out the (negative) 100 volts and waste the power in IR losses running from one end of the relay coil to the other. This spike will only persist for a few microseconds.

Diode is more robust than transistor. Diode will always be in opposite polarity to the power supply voltage, else will short out the transistor by applying the full power supply voltage to the collector.

Sometimes relays have built-in diodes, but not often, since if reverse-wire the relay could blow out a nearby transistor.

When transistor in cut-off, no voltage drop across the inductor since no current flows, so relay not engaged. When transistor saturated, other side of inductor goes to ground, so there is 24 volts across the inductor.

How did Ralph solve the problem? Thinks of transistor as two diodes. Ralph redraws circuit – see diagram 3. Could have been transistor or diode. PNP transistor. Have two diodes in the transistor, each with the cathode at the base. Pulled off leads, found that one leg was shorted using the diode checker (pretty close to a dead short – had 5 ohms one way and 4 ohms the other way). The hardest thing about the transistor was determining which leads are which terminals (usually are EBC order).

Best to check the diode before putting in the new transistor, since a shorted diode could blow out the new transistor.

Typical parts failures: capacitors short, resistors open (carbon material conducts enough current to start burning some of it out, like a fuse), semiconductors short.

Josh's Problem in Maintenance Lab

Master sync generator kept blowing fuses. The fuses looked good, but tested bad. Generally means something pretty serious, and usually power supply related. There isn't anything in these things that can blow a fuse of that degree (2 amps). What in that circuit could draw 2 amps? The individual circuits fed by the power supply can't draw that much power individually.

Transformers are robust. Could be diode rectifiers or filter capacitors.

Diagram 4. If capacitor shorts, 15 volts goes right to ground. If 10:1 turns ratio, secondary current would be 20 amps to blow a 2 amp fuse. If diode shorted, AC would flow to capacitor.

Tricky to measure resistance in circuit since transformer secondary has low resistance. Can put a ohmmeter on the secondary and if capacitor is OK it will charge, so can see that with the voltmeter.

Can pull out one lead of diode and reapply power to circuit. If still blows fuse, suspect the transformer.

Handout 1

Constant current power supply. Most power supplies try to hold the voltage constant. Why have constant current for the RTS intercoms? Audio rides on the voltage. Audio would not survive if the power supply attempted to maintain a constant voltage. Notice the regulators (U1 U2 U3); they are integrated circuits LM 317K. Notice the adjust pin. On our power supplies, we put a resistor to ground. On this one, this looks at voltage across R1, a 1 ohm resistor. Very little voltage drop across R1 since so low of a resistance. This makes the value of the voltage the same as the value of the current. This results in the current being sampled and adjusted to.

Diagram 5. Voltage response to some sound. 30 VDC base voltage, 1 V peak-to-peak AC audio. How to take out the DC? Use a capacitor in line. How to take out the audio? Use a capacitor to ground.

Why is there a diode after the regulator? If put voltage on E18, and didn't have a voltage at E15, would burn out the regulator.

What about the other diode? If negative voltage on E18, CR2 would conduct, and the fuse would blow if that current exceeded 3 amps.

What about R2? Allow CR1 to conduct when nothing connected to it, required to bias CR1 and allow audio to pass through CR1 even if there is no power being drawn from the output. So, audio would appear on both sides of that diode.

Handout 2

Boxes are the power supplies on handout 1. This is for the source assign panel. Currently we have 9 channels available, so switches go from 0 to 9 (0 is ground). We can put any intercom unit to any channel we want (or channel pair in the case of belt packs or some user stations). We have to isolate all the channels from each other and put 30 volts on the audio. That's one benefit of the constant current power supplies, since they isolate the audio.

Handout 3

Block diagram. Put power on our switch buses (9 channels of them). Go out through external outputs into the BOP. What's the rectangle to the right of the BOP? A belt pack or other user station. Select two channels for this user station, send it to the breakout panel. Out of break out panel is 3 wire cable, so can use a microphone cable (XLR) with this. The circle between the BOP and the user station is the shield of the cable; normally connected to ground (pin 1 of XLR). Pin 2 is channel 1, pin 3 is channel 2. Regulator on channel 1, regulates the voltage down to 12 volts to power belt pack circuitry. Capacitor blocks DC, then go through channel selector switch. Bilateral current source – this is how we modulate the DC and also how demodulate the DC to obtain the audio. Customarily we have power on channel 1, and may have power on channel 2. Electronic switch is the microphone switch. Mechanical switch controls the electronic switch, since we have an always-on microphone switch as well as a push-to-talk microphone switch. Can control this switch from somewhere else.

VIE306 is camera isolation. Isolate so camera engineering can talk to camera operators without interfering with production or engineering.

Other side of page has schematic diagram. Drying. Two different syntaxes regarding audio: wet or dry. Wet has DC power on it, dry doesn't have DC power on it. Sometimes we have to dry the audio. Use a blocking capacitor to dry the audio. For example, don't want the DC to go to the transformer (DC would saturate the transformer and cause distortion). These transformers have very thin wire, so should not put DC on them; they won't handle that kind of current.

What's the difference between the sides of the transformer? Left side is balanced, right side is unbalanced. System interconnect does the conversion between balanced and unbalanced (between master stations and rest of system).

The alternatives are 200 ohm impedance and 400 ohm impedance. Switches are on the back of the power supplies. May have to change impedance depending on how much bad there is on the circuit.

Projects