

Keithley 2001 repair - Bug #652

Fix AC input mains curcuitry, replace electrolytic capacitors, replace transformer

12/27/2012 02:51 PM - tin

Status:	Closed	Start date:	12/27/2012
Priority:	Normal	Due date:	12/31/2012
Assignee:	tin	% Done:	70%
Category:		Estimated time:	0.00 hour
Target version:	Keithley 2001 #6		

Description

Initial inspection results:

Damaged enclosure
Cut earth wiring
Blown SMD resistors
Blown front panel current input fuse
Electrolyte on PCB near FE autozero and mains curcuitry
Damaged 555 generator SO8

To do:

Test digital board
Test controls and front panel display
Recover firmware

History

#1 - 12/30/2012 11:03 AM - tin

- Due date changed from 12/28/2012 to 12/30/2012

- Status changed from New to In Progress

#2 - 12/30/2012 01:21 PM - tin

- Due date changed from 12/30/2012 to 12/31/2012

- % Done changed from 0 to 10

Digital board work fine
Front panel/display work fine

Analog board visible inspection:

Q101, VR101, R100, R123, R250 damaged/burnt
Whole AC area side covered in electrolyte/dust from bad C106
S100, Q528 damaged?

#3 - 12/30/2012 01:48 PM - tin

C106, C114, C115, C116, C117 electrolyte leakage -> replaced
C104, C101 leakage -> to be replaced

#4 - 01/02/2013 06:42 PM - tin

- File *_TIM0043.JPG* added

- File *kei7.jpg* added

Schematics recovery for mains input

kei7.jpg
Purpose? :)

#5 - 01/02/2013 11:37 PM - lzerg

Paper draws? :)
Проверь, не перепутал ли коллектор - база Q101
Схема похожа на синхронизацию с сетью, вернее детектор нуля, но до конца не уверен - проверь транзистор, я подумую как правильно такое перерисовать чтоб смысл был :)

#6 - 01/02/2013 11:39 PM - lzerg

и что - то ты не дорисовал, проверь куда еще идут резисторы 102 и 103.

#7 - 01/04/2013 01:31 AM - tin

- % Done changed from 10 to 30

2.10.2 Power supply circuit theory

The following information provides some basic circuit theory that can be used as an aide to troubleshoot the power supply.

Pre-regulator circuit

The pre-regulator circuit regulates power to the transformer. When power is applied to the instrument, a power transformer secondary voltage (pins 12 and 13) is rectified (CR622), doubled (C624, C630, CR624 and CR625) and applied to U619 which is a +5V regulator. This +5V (+5V_C) is used for the pre-regulator circuit. The pre-regulator circuit monitors the voltage level on C611 using an integrator (U627). The voltage on C611 (typically around 7.5V) is divided by three through R712 and R713 and applied to the inverting input (pin 2) of the integrator. The +5V (+5V_C) is divided by two through R706 and R708. This 2.5V reference is applied to the non-inverting input (pin 3) of the integrator. When the voltage on the inverting input of the integrator is less than the 2.5V reference on the non-inverting input, the integrator output ramps in the positive direction. This positive ramp turns on Q608 which pulls the CONT line low to digital common. With CONT connected to common, current flows through the photodiode of U100 and generates a positive voltage at the gate of FET Q528. As Q528 turns on, the 470W resistor (R100) becomes shunted and results in less effective resistance to the transformer. The resultant increase in current (power) will increase the voltage on C611. Conversely, when the voltage on the inverting input of the integrator is more than the 2.5V reference, the integrator output ramps in the negative direction and begins to turn Q608 off. This will decrease current through U100, decrease the positive voltage on Q528 and thus, increase the effective resistance to the transformer. The resultant decrease in current (power) will decrease the voltage of C611. This constant regulation of effective resistance in series with the transformer regulates the power delivered to the instrument.

Line voltage (110V/220V) selection circuit

This circuit automatically selects the proper power line voltage setting for the instrument. The line selection circuit derives its power from the AC1 and AC2 lines on the primary side of the transformer. Rectifier CR101 applies approximately +18V to regulator U103. The output of U103 provides the +8V for the line voltage selection circuit and the HI/LO voltage control circuit. U106 is a comparator that has a +4V reference (via voltage divider R125 and R126) applied to its non-inverting input. The inverting input monitors the voltage on C111.

When the voltage at the inverting input is greater than 4V, the output of U106 goes low and turns on FET Q103. With Q103 on, +8V will be applied to the +RELAY1 line which energizes relay K101 to select the 110V setting. Conversely, when the voltage at the inverting input is less than 4V, the output of U106 goes high and turns off Q103. With Q103 off, the +8V is removed from K101 and thus, the line voltage setting defaults to 220V.

The AC power line is tied to C111 through CR104, R227 and R114 via control line ACL. When the AC power line voltage is less than approximately 135VAC, sufficient charge remains on C111 to keep the inverting input of U106 above 4V to ultimately energize K101 (110V setting). When the AC power line voltage is greater than approximately 18VAC, charge will be pulled from C111 dropping the voltage at the inverting input of the comparator to less than 4V. This will de-energize K101 (220V setting).

HI/LO voltage control circuit

Clipboard-1.png
This circuit automatically selects the appropriate HI/LO setting for the available power line voltage. During power-up, the line voltage is rectified (CR100), divided (R103 and R105, or R102 and R105) and applied to the base of Q101. If the voltage level at the base of Q101 is high (above zener VR101), the transistor will turn on and apply power to the ISO1+ and ISO1- lines. With power applied to ISO1+ and ISO1-, U105 will turn on and allow Q105 to be forward biased. With U105 and Q105 on, TRIG of U110 will be pulled low and allow its output (OUT) to latch at +8V which will turn on FET Q102. With Q102 on, the -RELAY2 line will be connected to common, and thus energize K100 (HI setting). If the power line voltage decreases to a low level, U105 will turn off, but the output of U110 will remain latched at +8V. However, the LOW line will be driven low turning on U109. With U109 and Q106 on, +8V will be applied to THR of U110 forcing its output (OUT) to reset to low. With the gate of Q102 low, the FET will turn off and open the relay coil circuit for K100 (LO setting). The LOW line is controlled by comparator U628.

The inverting input of the comparator is connected to the 2.5V reference. The non-inverting input monitors (via divider R709 and R711) C611. As previously explained, the typical power line voltage level will apply around 7.5V to C611. However, if the line voltage decreases such that the voltage on C611 becomes less than 6V, the voltage level on the non-inverting input of the comparator will drop below 2.5V causing its output (LOW line) to go low.

#8 - 01/04/2013 11:00 PM - tin

- File *Clipboard-1.png* added

#9 - 01/13/2013 02:06 PM - tin

Replaced Q101, VR100, VR101, K100, K101, R100, U105, U110, S100, R250, R123

Meter now power on ok, able to do measurements.

Self-diagnostics fail on codes:

401.1 Zero Cal Sw.
412.1 ACA switch

Test with Keithley 2400 SMU

2400 setting	2001 #7 mode	2001 #7 result
V 0.182020, 10.5mA, -9.07777mA	2w ohm, 20 range	20.000074, Isrc=9.0766mA, Vdroop 181.53 mV
V 0.192785, 1.05mA, -0.962675mA	2w ohm, 200 range	200.00348, Isrc=0.9626mA, Vdroop 192.53 mV
V 0.96280, 1.05mA, -0.962675mA	2w ohm, 2k range	1.0000436k, Isrc=0.9626mA, Vdroop 962.67 mV
V 0.87480, 100uA, -87.4499uA	2w ohm, 20k range	10.000137k, Isrc=87.460uA, Vdroop 874.62 mV
V 0.69530, 100uA, -6.95041uA	2w ohm, 200k range	100.00101k, Isrc=6.9508uA, Vdroop 695.08 mV
V 0.75755, 100uA, -0.75856uA	2w ohm, 2M range	1.0000826M, Isrc=757.29nA, Vdroop 757.35 mV
V 4.1950, 100uA, -0.004388uA	2w ohm, 2G range	1.0000368G, Isrc=4.1929nA, Vdroop 4.1930 V

Resistance 4W:

R592 0.1% 0.91 ohm = 2001 #7 result: 00.909108 ohm

To do:

Replaced C108 1000uF 50V to 470uF 50V, need buy proper one
Replace C101, C104 to new ones, 2200uF 35V
Replace cooling FAN, original is failed

#10 - 01/13/2013 02:17 PM - tin

CR305 failed?

#11 - 01/13/2013 03:12 PM - tin

- % Done changed from 30 to 70

#12 - 07/13/2014 01:37 AM - tin

- Target version changed from Keithley 2001 #7 to Keithley 2001 #6

#13 - 06/07/2016 01:10 AM - tin

- Status changed from In Progress to Closed

Files

_TIM0043.JPG	2.13 MB	01/02/2013	tin
kei7.jpg	46.4 KB	01/02/2013	tin
Clipboard-1.png	40.3 KB	01/04/2013	tin