

5370A problems:

Self test out of range error

My 5370A stopped working after being unpowered for a couple of months. When measuring the delay between the START and STOP channels with the rear panel connected to both the START and STOP inputs (front panel switch to START COM) the counter displayed an out of range error as though the STOP signal wasn't occurring. Indeed the rear panel STOP output was stuck at 0V whilst the rear panel START output produced pulses with the expected -0.6V amplitude.

After removing the top and bottom covers and tipping the 5370A on its side to facilitate probing, I discovered that:

- 1) The START and STOP input amplifiers were behaving normally and produced START and STOP signals.
- 2) The inputs and outputs of the arming assembly (A22) START flipflop (A22U17) were behaving as expected with logic levels of 0V and -0.6V for the 2 logic states.
- 3) The inputs and outputs of the arming assembly (A22) STOP flipflop (A22U21) were abnormal with logic levels of -0.6V and -1.2V for the 2 input logic states and the Q output was stuck at 0V.

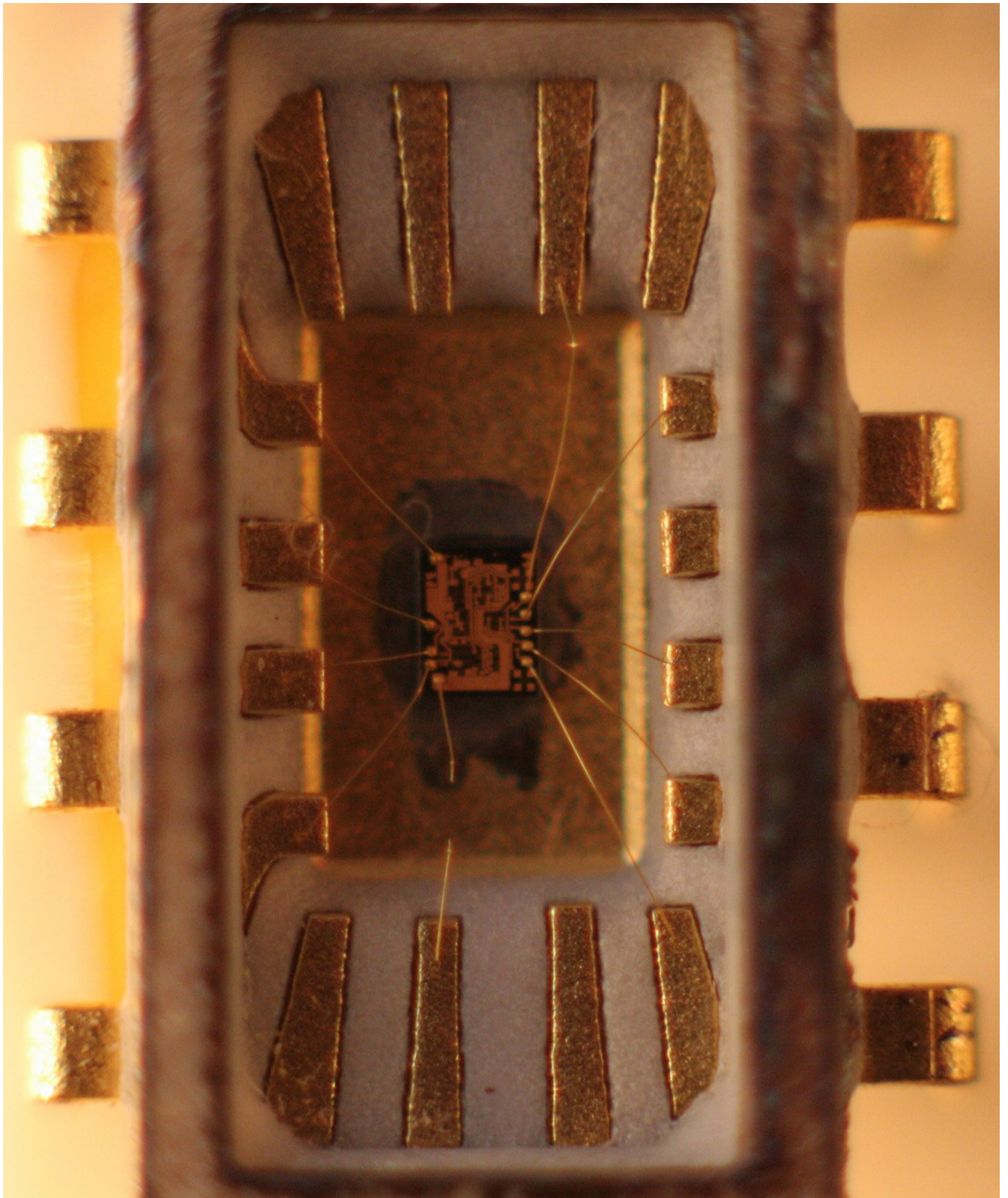
Since the outputs of the EECL logic involved are actually open collector switched current (12mA) sources with external 50 ohm load resistors connected to ground, it appeared that the inputs of U17 were sinking excessive current. Since the inputs are actually npn emitter followers the input current should be relatively small ($< 1\text{mA}$).

Fortunately there are external series resistors between the load resistors terminating the transmission lines (microstrip or coax) connecting the EECL driver chip outputs and the inputs of the START and STOP flipflops. When these resistors were disconnected from the STOP flipflop clock and data input pins the logic levels across the 50 ohm load resistors were restored to the expected 0V and -0.6V levels.

Since all the input pins (including the undocumented ones) of the STOP flipflop exhibited this behaviour it was likely that there was a common cause. The most likely cause (since a DVM showed that there was at least one operational pn junction between each chip input and the -5.2V supply pin) was that the internal IC ground bond wire was open circuit.

The STOP flipflop IC (A22U21) was removed from the circuit and its top goldplated Kovar cover was removed with the aid of a propane torch. The internal gases in the chip mounting cavity expanded and popped the lid off.

Using a 10x magnifying glass it was clear that the open ground gold bond wire had a small gap in it. This gap is clearly visible in the image shown below.



Capturing the chip image

Equipment

Camera: Canon EOS20Da

Lens: Zeiss 55mm Contax F/1.7 with 70mm of extension tubes.

Lens aperture:

The lens aperture was set at F/2.8 (according to the engraved markings on the lens barrel). In reality the image space F/number was closer to F/6.3 and the object space F/No closer to F/5. Image magnification was about 1.27 (determined largely by the 70mm total length of the extension tubes)

Camera settings:

Camera mode set to P (programmed automatic exposure) Since a Zeiss lens is used the camera cannot vary the aperture for the exposure, it can only vary the exposure time.

Imaging process:

The lens was focused slightly beyond the chip surface and a sequence of exposures taken with the distance from the chip to the lens decreased by 0.001" (micrometer graduations on 3 axis stage) between successive exposures for a total of 74 exposures. The exposure which best showed the bond wire detail being selected.

Exposure time for chip Image capture: 1/400 sec.

Illumination source:

The rays of the setting sun coming through a conservatory window were used to illuminate the chip

Camera Mount:

Camera mounted on a 4" long standard 1/2" optical post held in the 4 axis (tilt, tip, Y, Z) as shown below:

Chip mount:

The chip was stuck to surface of a small aluminium block with double sided foam tape. This block in turn sat on top of a short length of HDPE rod which in turn sat on a 3 axis mount (X, Y, Z) as shown below:

Stable base for imaging setup:

The 2 positioners sat on a piece of 30mm x 300mm x 600mm polished granite as shown below:

