Vintage Test Gear and Workshop Equipment For discussions about vintage test gear and workshop equipment such as coil winders.

Closed

9th Jun 2020, 11:04 pm #1

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Bradley oscilloscope calibrator type 192 restoration

Hello,
after some kind advice from forum members on how to approach the calibration of my Telequipment oscilloscopes, I managed to buy a Bradley 192 oscilloscope calibrator on ebay. I was quite pricey, but many times cheaper as a Tek TG503 power frame with SG501, TG503 and PG506 modules. The unit seemed to be in somewhat mediocre condition, optically and technically, but all in all I had the impression that it might be repairable.

Upon arrival, I first did a little check up to identify obvious issues.

1. The whole unit was in dire need of a complete cleanup.
2. C4 (10uF, 400V) on the voltage calibrator board had exploded and barfed its contents on the PCB.
3. Several of the board retaining clamps were broken and missing.
4. Various solder joints on internal cables, going to the front panel sockets were bad or broken.
5. A bit of rust on one of the chrome clamps, holding the handles.
6. The volts/div board was reported by the previous owner to not work properly.

So, the first thing I did, was giving the case and the interior a thorough clean-up. Unfortunately, the side panels were painted aluminum and the paint had come off on many parts. Also, one of the side panel inlays had to be glued in again. On the aluminum front panel there were a few stains left I could not get rid of without risking damage to the surface finish. While disassembling the front panel, I also noticed that there were several 6BA 1/4" Allen grub screws with cup shaped tips missing. In addition to that some of the case screws need a replacement. Should be possible to get a few matching ones somewhere.

Regarding the exploded C4, I removed it and cleaned up the board in that area. Quite fiddly to get off the little black cable, securing the capacitor, without damaging it. Untying 45 year old knots is hard. While I was at it, I measured the remaining electrolytic capacitors and found all to be well in specifications. Then I cautiously removed the interior of C4 to prepare it for restoration by stuffing a new matching capacitor inside. I will make a little report on that later. Until then, I replaced C4 with a matching but ugly modern capacitor.

To my great surprise, I discovered that the broken two part board retainers are called NYLATCH and are still produced by a company named Southco. I took measurements on one of the broken parts and used the available datasheet to determine the exact part numbers. I think these are NY-5P-54-1-50 plungers and NY-5G-54-20 grommets. There seem to be a few industrial suppliers who still sell those but, do not ship to private customers and have horrendous shipping costs. I still have to find a way to get some of these, since 3D printing using FDM and SLA printers did not work here (stability issues). So, If anyone knows a source where a private customer can buy some new ones, please let me know.

Fixing the bad and broken solder joints on the cables was comparatively easy. I just needed to shorten several cables to get rid of some previous very unprofessional soldering attempts. Figuring out, which solder joints had been tampered with was very easy, since all solder joints which were not produced by wave soldering in the unit have been factory-painted with pink paint. This paint will get destroyed upon soldering, marking any redone soldering joints.

Unfortunately, I could not remove several rust spots on one of the handle chrome clamps. It had already eaten through the whole chrome layer. At the moment, I am not sure if I can do something about it because letting someone re-chrome parts like this can get quite expensive.

As the next step, I carefully examined the volts/div switch. At first, I could not spot anything suspicious and the contacts appeared to be clean. Then I discovered that one of the rotary switch wafers had kind of critical damage. The wafer contains a two segment rotating brass ring attached to the center axle. Each segment has one notch that connects to one of the outer wafer contacts for each switch position. On each half there is one elongated contact that permanently connects to the inner part of the two brass ring segments. One of the contacts that connect to the notches on the brass ring is heavily bent. As a result, one of the two brass notches on the ring has been cut off by the outer wafer contact. The second notch already has severe grinding damage and will come off in the near future. In addition to that, one of the brass ring segments is no longer properly attached to the rotating part on the axle. The two brass segments are fixed on the rotating part on the axle by several molten plastic pins. On the defective half, all except of one plastic pins are broken. This means that the brass ring half can swing freely around this pin and will cause further damage to the wafer contacts when operating the switch. I am afraid that this part of the repair will be very complicated. Although I managed to find two manufactures that still produce similar rotary switch wafers, namely Blore Edwards and NSF Controls, those seem to have different dimensions and wafer configurations than the defective wafer in my 192. An alternative option could be to correct the bent wafer contact, produce two replacement brass ring segments and somehow install those on behalf of the original ones. Especially making a durable, non-flexible connection of the replacement parts to the axle will be challenging, if possible at all. In every case, the rotary switch has to be disassembled to extract the defective wafer, which I assume to be a delicate operation. Any helpful advice on this would be appreciated.

As a last step I checked the unit for obvious shorts and powered it on. Aside from the defective voltage calibrator switch everything seemed to work, aside from occasional contact problems on the switches which should disappear after some cleaning or even after just actuating the switches for some time. Simulating the actuation of the volts/div rotary switch by manually shorting the respective contacts revealed that the voltage calibrator also works, aside from possible calibration issues. So, the main task now is to find a replacement or repair method for the rotary switch wafer.

Attached Thumbnails





10th Jun 2020, 3:21 am #2

Chris55000
Octode

Join Date: Aug 2007
Location: Walsall Wood, Aldridge, Walsall, UK.
Posts: 1,924

Re: Bradley oscilloscope calibrator type 192 restoration

Hi!

Bradley 192 calibrators are hard to get and always come up stupid silly prices whatever condition they're in!

Bradley's method of drawing circuits is novel, to say the least of it and trying to fathom out the contact switching permutations on the "volts" and "time" switches isn't exactly one of the easier tasks the legendary Hercules had to do – me thinks I will have to redraw it!

Is this any help for the PCB fixings?

https://www.ebay.com/itm/362989918064

Damaged 21 position rotary wafer switches are a lot more of a headache because nearly all of the ones sold in the hobby/replacements sector are 12 position max. @ 30° indexing, whereas Calibrator and Oscilloscope TB switches are 24 position @ 15° indexing!

However, you can get 24 position @ 15° indexing two pole switches from here:–

https://www.don-audio.com/Rotary-Swi...AQAvD_BwE?mt=1

. . .if you don't mind a bit of investment in parts cost and time, you might find that if you buy two of these, you can use threaded spacers, studding and nuts, plus a spindle coupler to gang four wafers onto one mechanism, and then find a suitable combination of tag wiring to connect the appropriate resistors into circuit in each volts/div. position!

The other best place you're going to get a suitable replacement is either eBay or RS, if you can get some of the larger size blue "Maka–Switch" wafers n.o.s., you'll also have to get some m1.5 nuts and screws to fix replacement contacts to the old wafers, which will solve the mangled contact problems – if the centre wiper ring is damaged also, this will unfortunately add to the difficulty!

You'll also need a hand held battery drill to drill out the rivets securing the contacts to the wafer in order to fit new contacts, if you want to go down that route.

Another source you might try is an old TB switch off an Oscilloscope, these are usually 24 position with 15° indexing, you might get one with several wafers in combination that might make up the contact permutations you need, but it will need rearrangement of the resistors and interconnecting links on the wafers in order to get it to perform the correct function.

A Telequipment Timebase plugin, e.g., S2A, will have a 21/24 position 15° indexed rotary switch assembly you can perhaps salvage, and I think the Bradley knob might fit it directly if you remove the middle variable speed control from the assembly first!

I'll see if I can draw you an equivalent contact table over the next few days!

Chris Williams

_____
It's an enigma, that's what it is! This thing's not fixed because it doesn't want to be fixed!

Last edited by Chris55000; 10th Jun 2020 at 3:46 am.

10th Jun 2020, 5:06 am #3

Chris55000
Octode

Join Date: Aug 2007
Location: Walsall Wood, Aldridge, Walsall, UK.
Posts: 1,924

Re: Bradley oscilloscope calibrator type 192 restoration

Hi!

Bookwork if you need it!

Chris Williams

Attached Files
Bradley-192-OM-SM.pdf (1.75 MB, 126 views)
Ballantine 6125A (Bradley 192) Service Manual.pdf (1.85 MB, 90 views)

_____
It's an enigma, that's what it is! This thing's not fixed because it doesn't want to be fixed!

Last edited by Chris55000; 10th Jun 2020 at 5:17 am.

10th Jun 2020, 9:57 am #4

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Quote:

> Originally Posted by **Chris55000**
> *Hi!*
>
> *Bradley 192 calibrators are hard to get and always come up stupid silly prices whatever condition they're in!*

Hello Chris, thank you for your reply. You are right. I was recently overbid on a unit in nearly perfect condition located here in Germany that went for nearly 300 €.

Quote:

> Originally Posted by **Chris55000**
> *Bradley's method of drawing circuits is novel, to say the least of it and trying to fathom out the contact switching permutations on the "volts" and "time" switches isn't exactly one of the easier tasks the legendary Hercules had to do – me thinks I will have to redraw it!*

To be honest, I find both ways of depicting the rotary switches quite intuitive. I think, the one of the timebase switch is different, because the type of same-index-to-same-index-connection it makes on the duals sided wafers is quite simple.

Quote:

> Originally Posted by **Chris55000**
> *Is this any help for the PCB fixings?*
>
> *https://www.ebay.com/itm/362989918064*

Unfortunately not. The reason is that the PCBs in the 192 are incredibly thick (over 4.1 mm). So you need a less-common version of the NYLATCH fasteners as can be seen in the Southco datasheet.

Quote:

> Originally Posted by **Chris55000**
>
> *Damaged 21 position rotary wafer switches are a lot more of a headache because nearly all of the ones sold in the hobby/replacements sector are 12 position max. @ 30° indexing, whereas Calibrator and Oscilloscope TB switches are 24 position @ 15° indexing!*
>
> *However, you can get 24 position @ 15° indexing two pole switches from here:–*
>
> *https://www.don-audio.com/Rotary-Swi...AQAvD_BwE?mt=1*
>
> *. . .if you don't mind a bit of investment in parts cost and time, you might find that if you buy two of these, you can use threaded spacers, studding and nuts, plus a spindle coupler to gang four wafers onto one mechanism, and then find a suitable combination of tag wiring to connect the appropriate resistors into circuit in each volts/div. position!*
>
> *The other best place you're going to get a suitable replacement is either eBay or RS, if you can get some of the larger size blue "Maka–Switch" wafers n.o.s., you'll also have to get some m1.5 nuts and screws to fix replacement contacts to the old wafers, which will solve the mangled contact problems – if the centre wiper ring is damaged also, this will unfortunately add to the difficulty!*
>
> *You'll also need a hand held battery drill to drill out the rivets securing the contacts to the wafer in order to fit new contacts, if you want to go down that route.*
>
> *Another source you might try is an old TB switch off an Oscilloscope, these are usually 24 position with 15° indexing, you might get one with several wafers in combination that might make up the contact permutations you need, but it will need rearrangement of the resistors and interconnecting links on the wafers in order to get it to perform the correct function.*
>
> *A Telequipment Timebase plugin, e.g., S2A, will have a 21/24 position 15° indexed rotary switch assembly you can perhaps salvage, and I think the Bradley knob might fit it directly if you remove the middle variable speed control from the assembly first!*

I think killing a TQ module for this would be a pitty. ;-)
Replacement options, I dug out until now are: The UB-MM range of NSF Controls. They might even fit the original shaft but I am not sure, if they have have the correct mounting hole distance of approximately 39.5 mm.
https://www.nsfcontrols.co.uk/produc...afer-switches/

The PZ Wafers of Blore Edwards can be bought at a reasonable price and are quite configurable. However, I still have to figure out what all of their naming schemes mean.
https://www.blore-ed.com/product-page/pz-wafer-kit

> Quote:
>
> Originally Posted by **Chris55000**
> *I'll see if I can draw you an equivalent contact table over the next few days!*

Thanks for the offer, but I find the original documentation quite intuitive. Be aware, however, that the circuit diagrams of the volts/div switch actually contain errors. I found that out, when I rebuilt parts of the switch in a circuit simulator, to understand how the circuit part of it works.

> Quote:
>
> Originally Posted by **Chris55000**
> *Hi!*
> *Bookwork if you need it!*
> *Chris Williams*

Thanks, I got one bad copy of the Bradley manual with the unit and managed to find the content wise nearly identical Ballantine one in a well hidden corner of the web.

10th Jun 2020, 1:27 pm #5

Chris55000
Octode

Join Date: Aug 2007
Location: Walsall Wood, Aldridge, Walsall, UK.
Posts: 1,924

Re: Bradley oscilloscope calibrator type 192 restoration

Afternoon Denis!

The point you have to watch about the voltage/div switches on your Calibrator is that one of them is stepped round about 4 positions, so simply using a standard 23 way wafer product won't work – what you'll have to do is to use a second wafer for the second pole of the switch, but 'step round" the shaft operating the back wafer about 4 positions, by sawing the switch shaft between wafer 1 and wafer 2, and joining the shaft parts with a coupler so that wafer 2 is moved the right distance round to match the offset rotation angle as per the original Bradley Diagram!

Alternatively if that's not possible, you might have to redesign the voltage attenuator circuit to enable a standard 23 way wafer product from one of the suppliers you linked, but it's still awkward as the original switches had quite a few "dummy" tags for anchoring resistors and capacitors, and some sections are break–before–make and make–before–break on one wafer, you'll have to design this with separate M.B.B. and B.B.M. wafers!

Chris William

_____
It's an enigma, that's what it is! This thing's not fixed because it doesn't want to be fixed!

11th Jun 2020, 5:55 pm #6

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Today, I removed the attenuator switch from the case for better accessibility during examination. Unfortunately, the damage is more severe than I thought. The pre-selection wafer with the adjustable precision 1000x voltage divider seems to be in acceptable condition. This is kind of expected, since it has only three switch contacts and one wide outer section on the inner brass ring which reduces switch action. The two wafers of the 1-2-5 voltage attenuator, on the other hand, have two brass ring sections each with only a 1 mm wide switching finger on each section. As can be seen in the attached images, one brass finger on each wafer has been ground off by frequent switching action. The remaining ones are close to also being ground off. In addition to that, the brass ring segments on wafer 1 are no longer held in place by the transparent plastic pins since those are mostly gone. Wafer 1 also has three bent switching contacts.

So, a repair will be difficult. Bending back the brass contacts could be possible when working very cautious. The damaged brass rings have to be replaced or would need 4 new brass fingers and a new durable fixation on the shaft assembly. Soft-soldering on new brass fingers will probably not be durable enough and hard soldering will kill the brass rings. Maybe spot-welding via a shorted large capacitor could work, but I have no experience on that. Or I could use the existing brass ring segments to cut new ones from some brass sheets. However, I do not know the type of brass (bendable/non-bendable) used here and if non-plated brass will work.

Maybe NSF Controls can custom make some wafers. At least they make a big deal on their website of how configurable their wafers are.

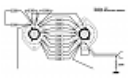
To exactly determine what kind of wafers I would need, I manually vectorized the wafer drawings from the manual. Then I checked, that all shaft rotations would work like expected. Of course they did not make the required connections for the attenuator to work. While comparing the circuit diagrams with reality, I found several errors in the drawings from the manual, the most important being that two fingers on the brass rings were drawn in the wrong positions. You can find a corrected version attached.

@Chris55000:
I think that just offsetting the wafers via the shaft will not work, since the brass fingers and the cut positions on the brass ring have different offsets. On the two 1-2-5 attenuator wafers, all contacts are break–before–make due to the small width of the brass fingers. Also, the difference between break–before–make and make–before–break contacts would be irrelevant here, since neighboring contacts on one wafer are always 30° apart except for the one with the inner contact finger. So there are no neighboring contacts where having one or the other would make a difference.

Denis

Attached Thumbnails





12th Jul 2020, 8:30 pm #7

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Just a small update on my first attempt of capacitor re-stuffing.

- I first disassembled the cap without breaking the negative aluminum strip contact and cleaned everything, as can be seen in the first image.
- The second step was drilling a centered hole through the positive contact aluminum assembly. This had to be done, since it was not possible to solder anything to the aluminum contact from the inside. I did not want to put a screw on the inside and solder the wire to the screw, because screws tend to have quite some contact resistance. So I drilled a hole, put a wire

through it and soldered it on the outside to the brass contact of the capacitor leg. Then I cut out a fitting rubber disc with a hole in it to fit around the positive contact assembly.
- The next step was to solder a tin blob to the negative aluminum strip contact. This was done by putting some sunflower oil onto the strip, then scraping off the aluminum oxide and while still under oil soldering a tin blob onto the strip. The oil prevents immediate oxidation of the aluminum and allows soldering. The soldering on the strip was done on a position outside the cap to not damage the original shrink wrapping. After that, I z-folded the strip back to the inside of the capacitor where the new capacitors negative contact would end.
- The new Panasonic cap was then attached via a wire to the positive assembly to leave enough room for soldering the negative contact with the new capacitor inserted into the old capacitor shell. The new capacitor was then inserted into the shell and soldered to the negative contact.
- As a last step, the rubber disk was inserted into the capacitor shell and the heat shrink tubing was given a little touch up.

The result looks better than I expected.

Attached Thumbnails





2nd Aug 2020, 10:25 pm #8

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Sorry for the lack of updates. I have worked out several possible solutions for the issue with the voltage attenuator with the two defective switch wafers.

For the first solution, I contacted NSF Controls. It turned out that the original wafers were indeed made by them and are from their MM range of wafers. So I created detailed technical drawings for the three switch wafers on the attenuator, and asked if they could custom make those specific designs. A very helpful technician confirmed that all designs could be made. However, the mounting post holes on the current wafers are no longer 6BA but M2.5. Since this could be fixed with a little post processing, I asked them to make me an offer for all three wafers. Unfortunately, the minimum order quantity seemed to be five and the price per custom wafer set of three turned out to be at nearly 130€, not including taxes and postage. Gold plating was even more expensive. Since, even the cheaper option would result in a total cost of approximately 800€, which you could get multiple 192s for, I discarded that technically nearly perfect solution. A subsequent request whether I could change something in the specification to achieve a significant price reduction or whether they offer 1 pole, 32 position default configuration wafers at a cheaper price was not answered.

Being at a seemingly dead end, I checked the web shop of Blore Edwards where they offer some very similar wafers in form of their PZ wafer kits. I asked them for a specification sheet of their PZ switch wafers and the only significant difference from the NSF Control wafers seemed to be the distance of the mounting holes, which is 41.3 mm instead of 39.825 mm. Mounting hole diameters are 6BA and the dimensions of the shaft hole at the center seem to be a perfect match. Seeing the very attractive prices, I simply ordered a set of two 1 pole, 23 position wafers with solder contacts and gold plating. Then I tried to find a method to repair the attenuator using PZ wafers in the most unintrusive way possible.

The solution I came up with can be build with one or two PZ wafers. The second wafer serves just as a mounting aid for the resistors and can be omitted, if money is tight. All original resistors can be used and the ones attached to the metal plate of the attenuator assembly can remain in their original places. You can find a drawing of the original wafer configuration in the first attached image. There, I have fixed a few errors of the previous versions, including the one depicted in the manual. The S104/2F wafer is the one located near the metal plate of the attenuator assembly and directly connected to the larger value resistors. The second image shows the new version I came up with. It is basically a simple attenuator design, where the resistors are mounted between consecutive wafer contacts with one intermediate stop at an unconnected solder contact of a second wafer. The first 9 contacts are just forwarded to the pins located 9 positions ahead (gray wires). This is because at switch position 10, the third switch wafer kicks in a 1000x attenuation, at which the resistor ladder is used again, including two extra steps at the end. In the original design, this mapping is realized via a complex setup using 2 poles with a custom tab position at each wafer to minimize the required wiring length. The new design requires additional forwarding wires at the back of the wafer and additional wiring for 7 resistors to go back to the next wafer contact. The latter can be avoided by not mounting the resistors in parallel between two wafers but bending the resistors wires to connect directly to two neighboring contacts of only one wafer. However, this could lead to space issues. The mounting points of the resistors to the second wafer are indicated by the dots on the wires.

Of course the additional wire length could lead to accuracy issues of the attenuator. So I did some calculations on that. The following will assume the use of enamelled copper wire with a diameter of 0.8 mm. This results in a cross section of 0.5027 mm². The total wire introduced is 4.3 cm for the

forward skipping (which can only occur once) and 7 * 2.5 cm = 21.8 cm additional wires between the resistors (the first three are mounted without additional wireing). The 4.3 cm wire introduces an additional 0.00146 Ohms and each 2.5 cm wire 0.00085 Ohms. So I put all of this into an attenuator calculation sheet in OpenOffice Calc and compared the resulting attenuator values to the original ones without additional wiring. The results can be seen in the third attached image, where the attenuator steps are shown on the x-axis and the error on the y-axis. With the maximum error being below 0.0085%, I think, the attenuator should still be within specification (voltage accuracy of the 192 is supposed to be 0.25%).

Now to the required modifications to the PZ wafers. Since the mounting holes are too far apart, the holes must be relocated using a file or a drill bit. This is a delicate operation because the material is hard and brittle. The risk of damaging the wafer with a rotary tool is very high. Therefore, I am still waiting for an ordered 2.8 mm diameter hardened round file to accomplish this. The next required modification concerns the rotation of the shaft mounting hole with respect to the tab position on the rotor. This needs to be done for the offset to the third attenuator wafer with the 1000x attenuation being correct and the starting position not interfering with the index spring on the wafer (needs 20 consecutive switch positions). In addition to that, the wafer rotation direction has to be matched. Some of this can be solved by flipping the wafer, but then all resistor positions must be changed. Luckily the Blore Edwards PZ wafers can be customized to a certain degree without damaging them. Unlike the NSF MM wafers, where the rotor is molded to the center piece, the rotor on the PZ wafers is fixed to the core via several bent metal strips. This fixation can be undone when working very careful and then the rotor can be rotated in steps of two with respect to the core. The third attached picture shows the result of this modification. There, the right wafer is in its factory default state and the left wafer is the one modified by me as required. On the left wafer, I also added the mounting hole modification with Photoshop to check if the remaining wall thickness is sufficient.

Any comments on this solution are welcome. Maybe you spot some errors I missed.

Attached Thumbnails

3rd Aug 2020, 11:34 am #9

Chris55000
Octode

Join Date: Aug 2007
Location: Walsall Wood, Aldridge, Walsall, UK.
Posts: 1,924

Re: Bradley oscilloscope calibrator type 192 restoration

Afternoon Denis!

I've had a look at your diagrams and it looks like your solution should sort your enigma out!

Just one thought tho' – do Blore Edwards offer those "dummy rings" where a circle of soldering tags is provided on a wafer–piece that has a much larger central hole with no rotor fitted?

If they do it might be a bit cheaper than a duplicate wafer!

It never ceases to amaze me that OEMs insist on making all sorts of convoluted switching and contact arrangements on their rotary switch assemblies when, in many cases like you've found, the same electrical arrangement of contacts can be done with standard products, allbeit at the cost of a little more interconnecting wiring!

Chris Williams

_____
It's an enigma, that's what it is! This thing's not fixed because it doesn't want to be fixed!

3rd Aug 2020, 5:21 pm #10

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Quote:

> Originally Posted by **Chris55000**
> *Just one thought tho' – do Blore Edwards offer those "dummy rings" where a circle of soldering tags is provided on a wafer–piece that has a much larger central hole with no rotor fitted?*
>
> *If they do it might be a bit cheaper than a duplicate wafer!*

I think, their price of 7.31£ for one wafer is already cheap enough and every penny I give to them will support the good service they provide for the vintage repair community. In addition to that, cautiously disassembling the rotor core on the second ring will give you a spare rotor to mount on

the first wafer if its rotor should ever go defective. Since those dummy rings were used in the Telequipment CT71 curve tracer (TQ used Blore Edwards style wafers), they might have made those in the past, but they are not among the options in the web shop.

> Quote:
> Originally Posted by **Chris55000**
> *It never ceases to amaze me that OEMs insist on making all sorts of convoluted switching and contact arrangements on their rotary switch assemblies when, in many cases like you've found, the same electrical arrangement of contacts can be done with standard products, allbeit at the cost of a little more interconnecting wiring!*

This might not be a matter of costs but a matter of avoiding wires for better attenuation precision. Also mounting the forwarding wires on the wafer will get quite ugly, because they will stack at one point up to 7.2 mm.

3rd Aug 2020, 6:00 pm #11

Chris55000
Octode

Join Date: Aug 2007
Location: Walsall Wood, Aldridge, Walsall, UK.
Posts: 1,924

Re: Bradley oscilloscope calibrator type 192 restoration

Evening Denis!

Thanks for the tip about the TQ CT71 – I thought this would have had NSF wafers – I bought a nice example of one of these for testing my growing collection of oscilloscopes with t.d. triggers!

The little hints and tips you include in your posts are greatly appreciated Denis!

Chris Williams

_____
It's an enigma, that's what it is! This thing's not fixed because it doesn't want to be fixed!

16th Aug 2020, 8:04 pm #12

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

I just started working on the attenuator again and have several hints for anyone, trying to work on those.

Adapting the Blore-Edwards PZ wafers to the different mounting stud distance of the NSF wafers is possible by using a high quality hardened and not too rough file. I used a round 2.8 mm diameter needle file with a swiss pattern number 2 cut which worked like a charm.

Removing the wafers from the shaft is a delicate process, since they are tightly press fit onto the central shaft. Thus, even moving the wafers on the shaft slightly requires significant force. If this force is applied at a position, different from the rotor core, you are guaranteed to break something. This is because the brass rotors mechanically lock the rotor cores in the wafer. Applying force to the outside of the wafers will apply stress to that connection and break it. The very tight fit onto the shaft does not only apply to the original NSF MM wafers, but also to the replacement wafers I am going to use, now made by Blore-Edwards.

To remove the wafers and disassemble the attenuator I identified two ways:
Method 1: Desolder everything from the wafers and then remove the wafers one at a time, starting with the back-most wafer. To do that, remove the potentiometer at the back. To remove a wafer, make sure that the wafer can move without any friction on the two mounting rods. Then apply force to the rotor core, maybe by using lever action with a screw-driver, to carefully remove each wafer. Make sure, the wafer cores do not tilt on the shaft by working from different directions.

Method 2: If for some reason you want to remove the shaft and switch assembly without desoldering anything, this is also possible. However, it is far more risky and very time-consuming, since all wafers have to be processed quasi simultaneously by taking turns. The trick is, to remove the potentiometer at the back and then put the shaft with its back pointing down on a metal rod. The metal rod should rest on hard solid ground so it can support the whole attenuator assembly on it and take impacts. Then you can start working the wafers via lever action or put a small wrench on the top of the wafer cores and cautiously hammer the wrench with a small hammer or other hard object to move all wafers down the shaft. Make sure the wrench touches only the wafer core (and maybe the shaft) and ensure the wafer cores do not tilt on the shaft by working from different directions. Only move a wafer core a tinzy winzy bit and then work on the other cores first. It may take an hour to separate the shaft assembly and the wafers this way, but it can be done without damaging anything.

All in all I would recommend method 1, since it introduces far less stress on the wafers.

17th Oct 2020, 11:11 am #13

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

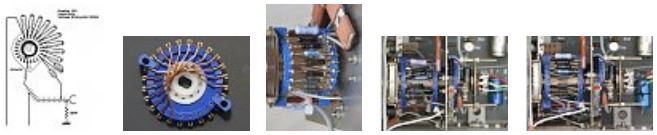
Re: Bradley oscilloscope calibrator type 192 restoration

Yesterday, I finally found time to finish the repair of the rotary switch. For the extra wiring needed for my design in image 1, I used enameled 0.8mm wire to have the maximum wire diameter with a minimum of space wasted for sufficient insulation. The result looked quite artsy as can be see in image 2. It was quite a paint to disassemble the old switch wafers and resistors, since Bradley opted for not only soldering the resistors to the wafers, but tying wire knots wherever possible. The new design is made so that replacement of components is much easier. It took some time to fiddle this together but the result looks quite nice, especially compared to the old wiring that can be seen in the fourth image for comparison. Now, the switch seems to work perfectly and uses only one switch wafer with a core. The remaining wafer core can be used for future repairs.

A first functional test using my DMM and my D75 and D755 scopes indicated that the calibrator is working fine now. However both scopes still have some occasional stability issues. For a full functional check, I think I need to hook up the 192 to some better test equipment. Although I can do most testing with my 40000 counts DMM and my 20000 counts LCR-Meter, they are not quite up to the task.

Next thing to do is to find a source for the damaged Southco Nylatch fasteners, from which I can get a full set of fasteners from as a non-commercial customer.

Attached Thumbnails



Last edited by Pinörkel; 17th Oct 2020 at 11:21 am.

18th Oct 2020, 9:35 pm #14

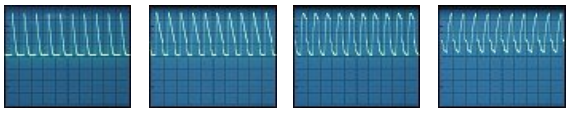
Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Just did additional function testing on the unit and I have a question for other 192 owners:
When using the time calibration function at the 1 µs multiplier setting, I noticed that the time maker signal gets distorted for the fastest three speed settings of 0.5 µs, 0.2 µs, and 0.1 µs. I have attached four screenshots from my D75 at for the 1 µs, 0.5 µs, 0.2 µs, and 0.1 µs signals. Looks like the sawtooth spike generator cannot keep up with the speed. Is this expected behavior, or indicative of a fault?

Attached Thumbnails



19th Oct 2020, 8:20 pm #15

Chris55000
Octode

Join Date: Aug 2007
Location: Walsall Wood, Aldridge, Walsall, UK.
Posts: 1,924

Re: Bradley oscilloscope calibrator type 192 restoration

Evening Denis!

I would say it's probably normal due to the capacitance of the connecting cable and probe from the 192 to your Oscilloscope – if I'm not mistaken, Tek used to specify a special very low–capacitance direct coupling adapter between the output of the calibration unit and the 'scope itself precisely to minimise effects like you observed!

Unfortunately I've discovered my 192 also needs switch and main PCB repairs, so alas to say I can't offer comparison waveforms I'm afraid – sorry Denis!

However, I would run yourself off a printout of the "Risetime/Fast Trigger" circuit, FIG. 2, and work through the transistors TR813 to TR850 against the diagram along with the associated resistors in this circuit, as this section of the calibrator provides the 100ns, 200ns and 500ns fast–rise pulses separately at SK800, and any grotty transistors or resistors wandered too far up or down from their specified values will have deleterious effects on the quality of the fast rise–time pulses!

Chris Williams

_____

It's an enigma, that's what it is! This thing's not fixed because it doesn't want to be fixed!

Last edited by Chris55000; 19th Oct 2020 at 8:35 pm.

19th Oct 2020, 10:34 pm #16

dave cox
Octode

Join Date: Jan 2009
Location: Bristol, UK.
Posts: 1,728

Re: Bradley oscilloscope calibrator type 192 restoration

I think Chris W is right.
If I were testing this I would use a 50ohm through terminator, straight on the output, and a X10 probe with BNC adaptor on the probe into a normal 1M input.

Very neat work with the switch, I wish I could do 1/4 as good as that!

dc

20th Oct 2020, 12:38 am #17

Pinörkel
Pentode

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Re: Bradley oscilloscope calibrator type 192 restoration

Thank you both for hinting out the cables. I often forget about that. Just did some testing with a shorter cable and 50 ohm termination. The shapes of the 0.2 µs and 0.1 µs signal changed indeed. Now the 0.2 µs signal looks more like a crappy square wave and the 0.1 µs signal like a sine wave. The cut-off sawtooth shape of the 0.5 µs signal stayed the same. I would have made some screenshots, but my TQ D75 suffered a strong drop-off in brightness during testing. I immediately suspected one of the 10K carbon resistors in the HV-section and bingo! Apparently, R322 has gone high. Need to fix that before doing further testing (if that is the only problem). Those old scopes always keep their owners busy.

@Chris: I'll have a look into FIG. 2 and will try to understand how the fast risetime circuit is used for the three fastest time marker signals. As far as I remember, that section of the board is populated with quite some suspicious carbon composition resistors.

20th Oct 2020, 5:44 pm #18

WME_bill
Octode

Join Date: Oct 2007
Location: Exeter, Devon, UK.
Posts: 1,423

Re: Bradley oscilloscope calibrator type 192 restoration

Bradley 192.
I have got out my 192 with a 100Mhz Tek 2230 scope. The results at the four fastest time/division speeds you were worrying about were almost the same as you found.
So I think you do not need to worry about the performance.
I also checked with and without a 50ohm termination at the scope. The output & cable is 50 ohm. Slight improvement in the shape on the 100ns setting, giving a "pointed" top to the wave with the termination, as against a flat top and some slight ringing when direct into the scope high impedance input.
I am afraid my sampling scope is awaiting attention, so I can't report upon that ringing.
My manual warns to expect degradation of pulse shape on the highest speeds in para 3.12.3, and the pictures of the display on page 14 show closely what I get on mine. Very similar to your results.

I also looked at the wave shape on the HF nsecs output of 10ns,20ns,50ns. That comes from the three separate RF oscillators to give sine waves to 100Mhz and seemed fine.

I fear Chris55000 is confusing the fast risetime parts of the circuit on Fig2 which has a separate output socket with the fastest settings of the main calibration time circuit. I have looked at the rise time pulse on my scope and it seems fine at what ever pulse width I set it at. It gives a huge peak ring without the 50ohm through termination, but a nice square top with the termination. The observed rise time does not alter.

Congratulations upon your work upon that switch. The results look very successful.
I have some pictures of the waveshapes I obtained if you are interested.
wme_bill

20th Oct 2020, 7:49 pm #19

Pinörkel
Pentode

Re: Bradley oscilloscope calibrator type 192 restoration

Join Date: Jun 2019
Location: Dortmund, Germany
Posts: 140

Quote:

> Originally Posted by **WME_bill**
> *Bradley 192.*
> *I have got out my 192 with a 100Mhz Tek 2230 scope. The results at the four fastest time/division speeds you were worrying about were almost the same as you found.*
> *So I think you do not need to worry about the performance.*
> *I also checked with and without a 50ohm termination at the scope. The output & cable is 50 ohm. Slight improvement in the shape on the 100ns setting, giving a "pointed" top to the wave with the termination, as against a flat top and some slight ringing when direct into the scope high impedance input.*
> *I am afraid my sampling scope is awaiting attention, so I can't report upon that ringing.*
> *My manual warns to expect degradation of pulse shape on the highest speeds in para 3.12.3, and the pictures of the display on page 14 show closely what I get on mine. Very similar to your results.*

Thank you very much for taking the time to compare my signals with your unit. So it is very likely the default behavior. I just looked at the signals again using my D755 and observed the following: For every spike, the sawtooth time signal seems to consist of a very fast rise and a slower linear drop-down phase, which both have the same slope for at least the fastest five speed settings. The spikes just move closer together. However, if the drop-down phase at the three fastest settings would behave the same as at the other settings, the signal would not come down to zero and the resulting spikes would not have the same height. I suspect there is a part of the circuit that forces the drop-down to zero in these cases and consequently causes the waveform distortion as a compromise to maintain the signal ampliude. The remaining bumpiness of the signal is probably due to signal reflections in the cable, because it changes with different cables.

Quote:

> Originally Posted by **WME_bill**
> *Congratulations upon your work upon that switch. The results look very successful.*

Thank you for the compliment. It took a lot of time to disassemble the switch. Luckily, the components required for the repair turned out to be comparatively cheap. Mostly, because I changed the design and could replace the custom NSF Controls wafers with standard Blore Edwards ones.

30th Oct 2020, 6:15 pm #20

chriswood1900
Octode

Join Date: Jan 2007
Location: Bristol, UK.
Posts: 1,194

Re: Bradley oscilloscope calibrator type 192 restoration

Whilst looking for something else I was looking through my 192 manual and noticed in one edition it has a fault finding guide with images of the correct wave forms at the higher speed settings. I have abstracted the image below, I can also confirm that my 192 gives exactly those images as in post 14.

Attached Thumbnails

Chris Wood
BVWS Member

Closed

Page 1 of 2 **1** 2 >

« Previous Thread | Next Thread »

All times are GMT. The time now is 2:50 pm.