

Revisiting the amp that gave "*Solid-State*" a bad name: the

# Fender Solid-State Twin Reverb

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## Part 1

### Introduction, appearance, build & serviceability



Preface by author T.Z.:

When I first got interested in playing guitar around 1970, no one around me had a clue about guitar amps and guitar sounds. The main business most of the musical-instrument shops was still accordions and gut-string guitars and trumpets etc., so no help there either. In the big city I did find a few different shops, though, and it was there where I first saw guitars made by Fender and Gibson, and Fender and Marshall amps (all at prices far beyond my reach). I was quite nerdy then and did not dare ask any questions to the cool dudes hanging around there ... but I did find a shelf offering various brochures - among them a 1969 Fender catalog that I took. This became the object of many hours of study (although many of the scenes depicted in the photos even to me were clearly rather unrealistic). With my 100-\$-kind-of-Strat-copy plugged into an old radio, I could not get a sound anywhere near to what I heard on my Stones-w/Mick Taylor-, Purple- and Ten-Years-After-records (I had precious few - they were expensive ...), and my complete lack of playing skills made things only (much) worse. Of course, I explained the lack of success with the lack of availability of decent equipment, and dreamt of having the guitars and amps shown in the Fender catalog. In terms of pure numbers and features, one amp caught my eye in particular: the 105-Watt-Solid-State Twin Reverb. No other amp in that catalog had that kind of power (allegedly 350 Watt peak power, no less!), and on top of that it sported a "Style-Switch" apparently guaranteeing instant Rock&Roll sound ... I needed that! The associated picture however showed a really un-cool setting that cast some doubt in my very naive mind as to who would use this amp.



In any case, I could not afford any of the offerings in the catalog to begin with. Within a year or so my playing had improved a bit, I had made some contact with the "cool dudes", after all, and I had learned from them that I needed to replace my home-made, rather horribly sounding amps with good a tube amp. In 1974 I got a summer job and could buy a brand-new Twin-Reverb (Silverface, Push-Pull-Master-Volume). Regardless of what the image of that amp is today, it gave me a very decent sound, and was the first of many good amps I have owned over the years. Still, that Solid-State Twin-Reverb in the catalog with its "Style-Switch" always remained in the back of my mind....

## 1. Introduction

Everybody who is into guitar amps is aware that transistor- (or solid-state-) amps had - and in many ways still have - a hard time being accepted as means of amplification by guitar players. Transistor amps started to show up in the early 1960's - and to the engineer, they had considerable advantages over tube amps in terms of weight, efficiency/power-consumption, durability, and maintenance. However, musicians - and especially guitar players - were not convinced, despite the fact that some famous amp manufacturers issued solid-state amp models.

VOX did that, to some success, but the company was not doing very well in general in the late 1960's, and after a first series of transistor amps VOX faded out of the spotlight for a period, to some extent, at least. Their claim to fame was - and still is - the AC-30 tube amp, and the VOX-transistor amps were not talked about that much - for better or worse. In other words, they were neither a disaster nor very highly regarded. VOX transistor amps do not have much of a reputation either way. The same can be said for the Rickenbacker Transonic amps and the solid state amps made by Custom (both amp lines rather cool-looking, though!).

The Fender company (at the time freshly owned by CBS), on the other hand, fared quite differently. It was highly successful throughout the 1960's and continued to be so for many years to come. Their (tube-) amps were (still are!) very highly regarded, although this image had suffered some since the CBS-takeover due to small but noticeable changes in the circuits of some amplifiers. For their 1966 offering, it was decided to issue a line of transistor amplifiers, and within a very short time, these amps developed such catastrophically bad reputation, that not only were they dropped unceremoniously after just a few years, but they single-handedly ensured that - at least in the realm of the electric guitar - the words "transistor" and "solid state" would be associated with failure, disaster, and bad sound. A distinct no-go area for guitarists had been created, thanks to Fender's original solid-state series.

The classic Fender Twin-Reverb amp has an iconic (**good**) reputation as a reference-setting, great sounding, reliable workhorse. It seems that the Solid-State Twin-Reverb, in its disappointing failure to live up to the expectations associated with the label "Twin-Reverb", has thus had a particularly strong effect on establishing the (**bad**) reputation for solid-state amps. It would indeed appear to be the main "culprit" in giving the term "solid-state" generally a bad name for guitar amplifiers, and as such would be of special interest to anybody looking into the history of the guitar amplifier.

Interestingly, although the books on Fender-amp history discuss the first solid-state series, and despite the fact that in Internet forums on the topic, the bad reputation of these amps is reiterated and underlined, it appears that very few people have actually heard or played one of these "failures". Of course, given just that reputation, it only makes sense that not many of these amps are still around 50 years later. Nevertheless, as engineers and scientists, the authors are reluctant to trust pure hearsay in this matter.



As overwhelming as this hearsay may be, we have long asked ourselves what - from a technical point of view went wrong with that first Fender transistor amp series. Literature does give some indications (manufacturing blunders in /3/ and bad serviceability in /4/) but nothing can replace getting one's hands on the actual amp when it comes to assessing its qualities (or deficiencies, as it were).

First-generation Fender transistor amps nowadays seem to be really "rare birds" even in the US. The situation in Europe is still much more drastic. It appears that the failure of the Fender solid-state amps became evident early enough so that the production of the export version of those amps was never really ramped up very far. In Europe, they are VERY scarce. Neither of the authors had seen - let alone heard or played - such an amp "in the flesh", and we believed them to be too close to non-existent or extinct in Germany or even in all of Europe.

To our big surprise, a Fender Solid-State Twin-Reverb turned up on ebay in autumn 2017. It was acquired sight unseen. We now have a specimen of this infamous amp available and undertook some analysis and testing, the objective being to

- 1. understand what "went wrong" with these amps and
- 2. newly evaluate the amp as far as possible in the light of today's approach to amplifiers.

This project also fits perfectly well with the mission of GITEC, the organization authors TH and MZ are involved in. Check out the [GITEC website](https://gitec-forum.de/wp/en/) (https://gitec-forum.de/wp/en/) to find out more.

This following article seeks to document our findings in three parts:

- In this first part we will give an introduction, and then concentrate on appearance, handling, build quality, and serviceability.
- The second part will deal with circuit design.
- Finally, the third part will discuss playability and sound.

There will also be an appendix with access to sound samples.



## 2. Our SS Twin-Reverb specimen, SR2100X, Ser. No. 2474

Upon arrival, the amp (probably built in 1968) turned out to be cosmetically in very reasonable shape (**Fig 1**). The front panel had some wear but was decent, and two of the original control knobs had been lost (with very similar looking replacements installed). According to the previous owner (who had bought the amp second-hand in 1974), the original speakers (presumably Oxfords) had suffered from ripped membranes already in the early 1970's, and two 12" Visaton speakers were installed as replacement.

The amp-electronics seemed factory-original, but there were a few issues:

- the Vibrato effect did not work
- the Normal-channel showed some very uneven distortion pointing to contact problems (pots, switches, jacks)
- the "Style-Switch" in the Vibrato-channel was inoperative
- one of the Bright-switches did not work.

There was a lot of sawdust in the amp (some of it had attached itself onto the heat sink of the power amp) - we could not determine where that came from.

All these defects could be repaired:

- the Vibrato effect required a new LDR (we will get back to this later)
- the Normal-channel had a bad solder connection (easily re-soldered)
- the "Style-Switch" in the Vibrato-channel was inoperative (required reconnecting to the printed circuit board - we will get back to this later)
- one of the Bright-switches had corroded contacts that could be cleaned.

The amplifier is therefore now in complete working order.



**Fig. 1:** The Solid-State Twin-Reverb specimen under scrutiny. Note the various angles of speaker- and control-panels, and the additional handle on the side.

### 3. Mechanical design and construction

#### 3.1 Cabinet

Cosmetically, the SS Twin Reverb is a complete departure from the design that Fender (and most other amplifier manufacturers) had employed before. While all previous Fender combos had a horizontally oriented design and layout, the SS TR is vertically oriented - it stands upright and even the controls of the two channels are in two rows above each other rather than arranged in a single row. The control knobs and switches (**Fig. 2**) are very different in design and feel compared to the tube amps - they represent a further step towards a "silvery" approach going even beyond what the silver-faced tube amps had received compared to the black-faced Fender era.

The new design is not without merits: with the amp set on the floor, the controls are much easier to reach, and arranging the speakers vertically rather than horizontally does provide for a different sound radiation pattern causing a somewhat more even sound distribution horizontally (i.e. across the audience). Whether specifically this sound distribution is desirable for a guitar amp, and whether the effect is very strong is debatable, though. We can anyway only speculate whether such acoustical thinking factored in the design - it is likely that these new amps simply were supposed to look different to set them apart from the "old-fashioned" tube amps and match them to "modern times" i.e. to the "space-age". Indeed, these amps would not have looked out-of-place in the "Jetsons"-cartoons!



**Fig. 2:** The control panel up-close. The controls on the left are the "style-switches": Pop-Normal-RR/CW. The tremolo-control knobs are not original, and the little label below the designation is the sticker of the shop (in a small provincial town in the south east of Germany) that sold the amp. (N.B.: that shop still does business - not a bad feat, either!).



The speaker panel is angled a bit so that the speakers radiate upwards - again, not necessarily a bad thing: it makes for a possibly more desirable sound distribution although of course it is far less effective (and less adaptive) than the tilt-back-leg arrangement found in the higher-power Fender tube amps. The recess created by the angled speaker panel at the top allows for the amplifier section of the SS TR to be two-way slanted (**Fig. 3a**), with slits in the panels allowing for airflow supposed to cool the transistors when driven hard. Compared to the tube amps, the control panel of the SS TF seems much more (even overly) emphasized with more area, and the large knobs do their part here, as well.



**Fig. 3:** a) left: the angled front panel arrangement with cooling slits. Could they have pointed out any more strongly that transistors were at the heart of this amp ... b) right: with the upper rear cover panel removed, the modular arrangement of power-amp/supply and preamp becomes visible. At some point, the original fender speaker plug was replaced by a larger plug necessitating the small cutout in the cover.

Where the new design actually fails is in transport. Although quite lightweight, the amp is too tall (**Fig. 3b**) to comfortably carry it with the top handle ... it continues to bump into the floor and one needs to lift it to a muscle-straining, tiring height. In fact, the top handle may be only useful to turn the amp on its side where there is a second handle that makes for a much better carrying process. On the opposite side of the second handle, the amp has 4 "feet" so it can be set down on its side without damage to the covering. It seems the transport issue was detected early and solutions provided - although the additional handle and feet add to the peculiar overall appearance. In comparison, a (85 Watt) blackface Twin Reverb is heavier but still not more difficult to handle due to the orientation of the cabinet and the more compact arrangement.



In terms of "luggage space", the SS TR offers a generous compartment in the back to haul along cables, effects boxes, food, etc. - the extent of lower back cover makes for more space than is available in the tube TW, plus with the reverb pan is not located down there but on the side panel. Of course, all this transport capacity is only theoretical because as you turn the amp on its side for easier transport (with the second handle), the goods in the back are not safe anymore and will fall out sooner or later.

At first glance, the build quality of the SS TR does not seem to be that bad although it may not be as good as the build quality during earlier Fender periods. The fact that the amp has survived all this time (some of which including heavy gigging as stated by the previous owner) in such a reasonable shape speaks for itself.

In any case, the amp looks and feels (in appearance) very "different" - in the amp world, this aspect of it could at best become something of an acquired taste. That the words "Solid State" are prominently displayed in red color on the speaker panel would not help the image of transistors, as it turned out.

### 3.2 Electronics

Fender amps traditionally were easy to service - getting to the electronic components was simple. For the old tweed style, it was merely one back panel that needed removal, and the circuit was directly accessible. For the subsequent "Tolex"-amps, this changed somewhat since the amp chassis – hung in the cabinet with 4 bolts – had to be taken out to access the circuit. With the mains transformer sometimes severely obstructing one of the nuts of these bolts, this could be a bit of a challenge. However once the chassis was out, service was easy.

In the SS TR, Fender (now CBS) went a completely different way in that the electronics were modular. While the power supply and the power amp sits in a chassis mounted to a horizontal board below the top of the amp (**Fig. 4**), the preamp electronics and all controls are located in a second module that is directly screwed to the front panel from underneath. Both modules are interconnected by a short multi-core-cable with a multi-pin-connector on the amplifier-module side. The pilot light is also connected with a (separate) plug-in cable.



**Fig. 4:** view of the power module from the rear. It features (from left to right): a voltage selector (it is an export model, after all) with included fuse holder, a single on/off-switch (solid-state!), the input and output jacks to connect the reverb spring, the regular speaker jack, and the jack for an extension speaker. Above the upper right-hand corner sits a fuse-holder for the fuse incorporated in the speaker output.

This approach is of course not necessarily a bad one, however, as we try to get to the electronics, we run into a few snags:

- while the power-module (amp and supply) is loosened easily enough by unfastening 4 screws, it is not possible to take it out further because of a ground connection wire bolted on one side to the power module (via a screw that also holds the transformer of the driver amp in place), and on the other side fastened to the preamp-module via a butterfly nut. The idea with the butterfly nut is not bad since in theory it would be possible to loosen it without any tool – however, the preamp-board design is such that after a few turns of loosening the nut, it is not possible to turn it further. It turned out to be easiest to de-solder the grounding wire. After that, the power-module is easily fully removed.

### 3.2.1 Power Module (power amp and power supply)

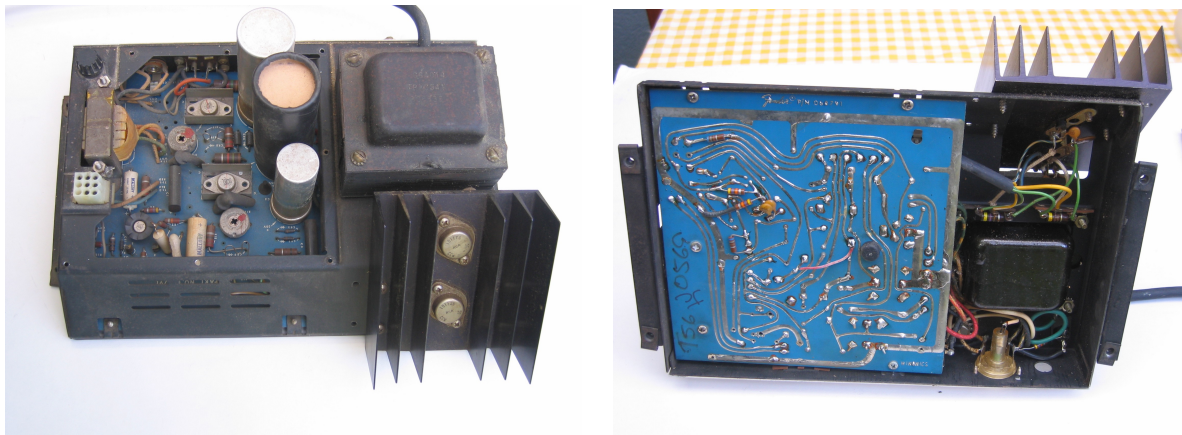
The power module (**Fig. 5**) is compact and, compared to a tube amp, relatively lightweight. On the exterior, the most prominent features are the power transformer, three large filter capacitor units (one containing two capacitors), the small transformer of the driver amp, and the power transistors with their heat sink. The latter is mounted on an angle and snugly fits into the slanted recess created in the correspondingly angled front panel. The slits in the panel allow for air to flow across the heat sink in order to provide cooling.



**Fig. 5:** power module from the top. Note the special, custom made rubber "gasket" surrounding the capacitors to avoid extra mechanical loading on components and printed circuit board.

On the power module there is another removable panel through which the filter capacitors extend. To protect the caps and the printed circuit board to which the caps are soldered from mechanical strain that might occur due to vibrations while playing or transporting the amp, a rubber "gasket" surrounding the caps is installed in this panel. To get to the potentiometers setting the operating point of the power amp, the panel needs to be removed - and this turns out to be another issue because the tightly fitting "gasket" is quite difficult to work-with, and in effect causes quite a bit of mechanical strain to the caps - at least when a service is called for!

Once the panel is off (**Fig. 6a**), (most of) the components of the power-amp and -supply become accessible. They are mounted on a printed circuit board the reverse (solder-) side of which is fully accessible from the bottom of the module (**Fig. 6b**).



**Fig. 6:** The power module with the access panel removed (left); view from the bottom (right)

Interestingly, a number of components (4 resistors, 3 capacitors and a connecting line) are mounted on the solder-side of the board. They seem to be factory-installed and are included in the circuit diagram we have. There could be any number of reasons why these components are not included in the regular layout (in any case it was labor- and therefore cost-intensive to install them this way).

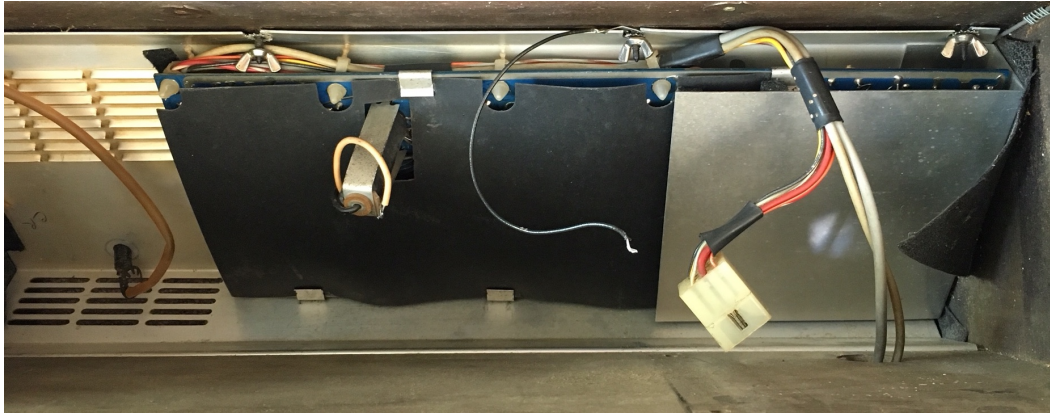
The printed circuit board does not give the impression of being a result of high-volume production with flow-soldering as it had just been introduced at Fender when production of the solid-state amps started (see /3/). It in fact looks more like it was soldered by hand.

Again, the build quality seen in the power-module does not seem to be that bad. While the authors have seen better quality in the Fender amplifiers from up to 1966 and also later than 1972, it is still clear that a lot of thinking went into the mechanical design to make it roadworthy. Serviceability is not as good as it was with even the "Tolex" tube amplifiers because more panels had to be opened to get to the components, plus a number of components (especially including some mounted to the heat sink) remain quite inaccessible and are difficult and time consuming to replace, if need be.

### 3.2.2 Preamplifier Module (incl. tremolo and reverb circuits)

Removing the preamp module for repairs or inspection is another step up. First, the butterfly nuts holding the assembly in place need to be unfastened – a cumbersome process because access is not very good and the wiring and the circuit board get in the way of turning the nuts (**Fig. 7**). Still, the use of butterfly nuts is a great idea given the circumstances; regular nuts would have been even more problematic.





**Fig. 7:** The back of the preamp module (still in place). Note the butterfly nuts, and the opto-coupler arrangement sticking out of the preamp-board.

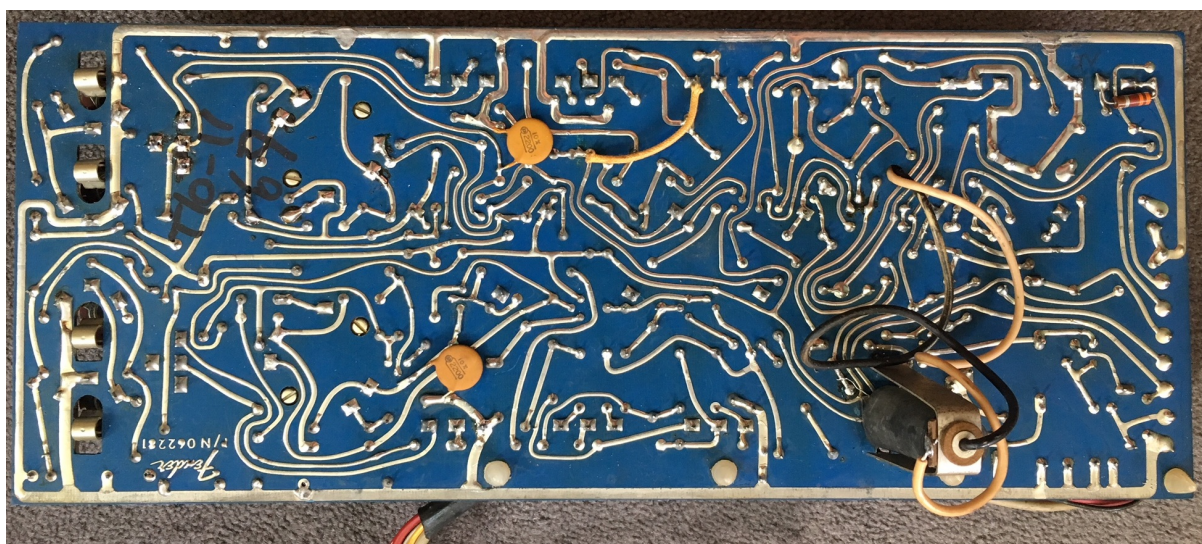
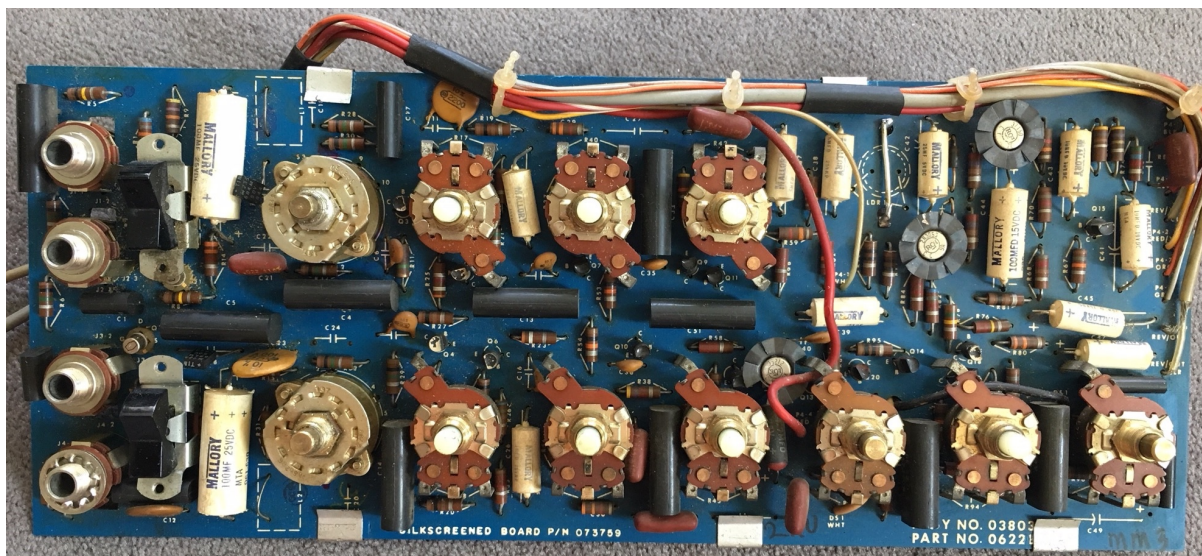
Once the nuts are off, the whole assembly-base (a relatively thin, flimsy-feeling sheet of aluminum bent into the angular shape) needs to be coaxed out of the groove (in the lower compartment-wall) it sits in (**Fig. 8**). That will work given a bit of courageous handling ... but one needs to be careful not rip off the rather delicate wire leading to the pilot light. This wire must not be forgotten and needs to be unscrewed from the cabinet wall first. At the same time, however, we realize that because of the connections to the reverb spring (which are not detachable at the preamp-board side), the reverb pan needs to be taken out by removing the associated further two screws and unpacking the pan to unplug the wiring on that end.



**Fig. 8:** Side view of the removed preamp module - the edge on the lower left sits in a groove in the lower panel of the amplifier compartment.

So now the preamp module is out – but there is still no way to get to the circuit. Ah, what fun: all eleven control knobs need to be removed, and all eleven potentiometer-nuts plus 4 nuts of the input jacks. Of course, the knobs may not be unfastened with a regular screwdriver (such as the knobs on Blackface and Silverface amps, as far as they are not just pressed onto the potentiometer shaft) – no, we need a miniature wrench of a type not usually at hand. We are by now really loving the person who designed the mechanical assembly of the amp, aren't we? Now, after unscrewing everything, the circuit board actually comes off!! Hurrah! Hurrah? No, not yet because the black cover on the reverse side of the board is fastened with 6 tightly-fitting clamps that put up some substantial resistance. Eventually, they yield and we have full access to the board, at last (**Fig. 9**).





**Fig. 9:** Component-side (top) and solder-side (bottom) of the preamplifier board. The black tube sticking out vertically is the opto-coupler for the tremolo. Why that would be such a behemoth compared to the "bugs" used in the Fender tube amps is anybody's guess.

Like on the power module, we find on the preamp module a few components (two capacitors and one resistor) installed on the solder side of the board. Again, they appear to be factory-installed and are included in the schematic.

The build-quality is in principle the same that we found in the power module. However, the soldering on the preamp module is very even and in fact might be the result of automated flow-soldering. That the Normal-channel had a bad solder connection is only noteworthy in that this SS TR is the only Fender amp in which we have seen such a fault, indicating that indeed the new manufacturing methods (in particular the flow-soldering) may have not sufficiently perfected yet.

The other fault our SS TR had when we received it merits particular consideration: the faulty Style-switch in the Vibrato-channel. Here, we found that the rotary switch had failed to maintain contact with the circuit board not so much because of a sub-standard solder connection but because the connector-pins were too short to pass through the board to the extent necessary to establish a stable, sustainable solder connection - in particular when manufactured by flow-soldering. It seems the pins had originally made contact such that the switch worked, but regular use (i.e. operating the switch or putting a bit of mechanical load on the switch as it often can occur in transport) had stressed the small available solder-surface that made the contact too much so that it broke. This can be considered a systematic fault that will appear sooner or later in all amplifiers fitted with this kind of switch on this kind of circuit board. It is a true design fault because the wrong component was specified. Ordering a switch with slightly longer pins would have removed the fault.

We repaired the switch by carefully making sure that a much more voluminous solder point was created that extended further along the available pin of the switch - not something you could do in mass manufacture.

### 3.3 Re-assembly

Putting the amp back together after inspection (or repairs) is not really much of a picnic, either. Not only is it considerable work because of (in particular) the reassembly of all potentiometer nuts and knobs (with the dreaded mini-wrench being a true nuisance), but it involves pushing the control module in place in a way that puts strain on the circuit board. That made us feel rather uncomfortable – we were elated that the amp still fully worked when we were finished.

Some good news: incidentally, the pilot light had ceased working when we got the amp but sprang back into action after dis- and reassembly - not bad for a 50 year old lamp.



#### **4. A first assessment: appearance, handling, build quality, and serviceability.**

So what do we have so far? It indeed is not looking very good:

- the Solid State Twin Reverb **looks a bit awkward** (granted, that is a matter of taste), it seems to be **trying too much to look "modern" and "different"**;
- the amp is **relatively lightweight** but also **awkward to handle** due to the geometric design;
- the overall design approach does show **consideration for "roadability"** in principle and the **build quality is reasonable**; however **there are real design flaws** rendering less dependable - in any case less than the traditional Fender tube amps;
- compared to the traditional Fender amps, the amp is **difficult to service** if only because it is not easy to open it up - i.e. it turns out that Forrest White certainly had a point when he objected to the serviceability of this amp (he left Fender over this issue). The above mentioned care for "roadability" is put into question by the way the sub-assemblies need to be handled when repairs are necessary, leaving the impression of a bit of a **hodge-podge of approaches** represented in the overall design of the amp. Fender tube amps will give a feeling of massive, indestructible build - this is lost in this solid-state model that has a more **flimsy feel**.
- the criticism regarding the low degree of serviceability (at least compared to Fender tube amps would have been, in all likelihood, countered by the designers by mentioning that transistors amps, with a practically endless lifespan of the main components and the much longer lifespan of electrolytic capacitors (due to the much lower operating temperatures) will need considerably less service or none at all. While this is true, components still may need to be replaced (e.g. a control due to broken potentiometer axis), and – **given design flaws in both the pre-amp** (the short "style"-switch pins) **and the power amp – some repairs may in fact have been almost inevitable**. We will get to the issue of the power amp in part 2.

To be continued; in a second part of this article, we will look into the circuit design.

#### **Appendix 1: Literature:**

- /1/ Fender Amps - The first fifty years; John Teagle and John Sprung, Hal Leonard, 1995
- /2/ The Fender Amp Book; John Morrish, Balafon, 1995
- /3/ The Soul of Tone; Tom Wheeler, Hal Leonard, 2007
- /4/ Fender - The inside Story; Forrest White, Miller Freeman, 1994
- /5/ Electric Guitar - Sound Secrets and Technology, Helmut Lemme, Elektor, 2012
- /6/ Physik der Elektrogitarre Manfred Zollner,  
<https://gitec-forum.de/wp/gitec-community/buch/>;  
Translation:  
Physics of the Electric Guitar:  
<https://gitec-forum.de/wp/en/gitec-community/the-book/>
- /7/ Jim Marshall - The Father of Loud, Rich Maloof, United Entertainment Media, 2004
- /8/ Solid State Amplifier, and Control Panel Assembly incorporated therein, Paul Spranger (Inventor), Patent US-A-3 462 553A, 1969
- /9/ Fender Musical Instruments ... ON THE GO!, 1968 Catalog, Fender, 1967
- /10/ Fender lovin' care, 1969 Catalog, Fender, 1968