"Wide-Range"!?

A discussion of the

Fender Humbucking Pickup

Original, Clones & Competition

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Part 2

Build and Measurements: Clones & Competition

Introductory note: this article does not only seek to give information, but is also meant to open a discussion. There are several questions that we raise here but cannot directly answer - any input the reader might have is therefore highly welcome. Also, due to the complexity of the matter and not always fully available historic information, we may have gotten some details wrong. If any reader finds a corresponding issue, we would be most grateful if we were informed about this via dr.t@gitec-forum-eng.de. Thanks a lot in advance for any support!

B1. Introduction

Having led more of a niche-existence, the Fender Humbucking Pickup has never enjoyed the same popularity and fame (and fortune) that accompanied the (various) Gibson humbuckers over the years, let alone the almost mythical statue of the original Gibson PAF humbucker. Still, with the pickup being something special and providing both quality sound and kind of an attractive "uniqueness", there is sufficient interest that some pickup companies offer "clones". This is despite the inherent issue that the original magnet material is difficult to come by and that therefore the product will be on the costly side or will require additional thoughts in order to get close to the characteristics of the originals.

B2. Some "clones" of the original Fender Humbucking Pickup

B2.1 Available pickups

We had available a number of clones of the Fender Humbucking Pickup. 4 specimen were made by Creamery in the UK (2 each for bridge and neck position) and 2 specimen made by Lollar in the US (1 each for bridge and neck position).

Fig. 2.1: Wide-Range Humbuckers: The Creamery (left, pic by H. Lemme), Lollar (right)

B2.2 Construction

Because the packaging of the Creamery pickups is very tight (possibly a solid filling of rather hard wax), and since we felt that what would have been a rather forceful removal of the cover could have risked damage, we did not open up these pickups. Due to time constraints we did not open the Lollar pickups, either. However, from the way the magnetic field is distributed above the visible screw-heads, it is clear that both the Lollar and the Creamery pickups indeed have magnets within the coils - i.e. the construction is highly similar to the original CuNiFe-pickups. We do not know, however, which specific material is used of for the threaded magnets with the attached/integrated screw-head. The two pairs of Creameries seemed to be from different production runs. One neck/bridge-pair had 4-conductor (plus shield) wiring while the other pair had a connector cable with an external braided shielded and a single internal wire. The housing of the Creameries is made of very thin brass sheets, contributing to low damping of pickup signal.

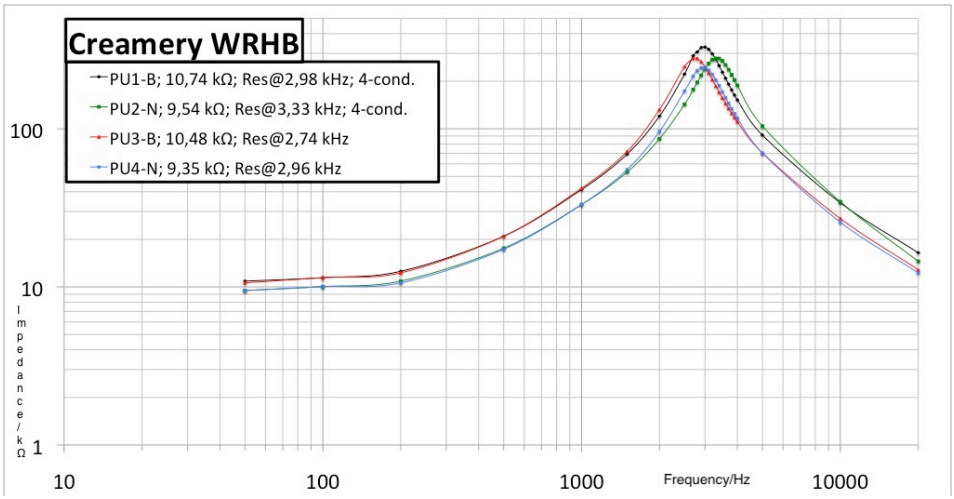
B2.3 Frequency responses of the pickup impedances

Measurements were carried out using the exact same setup as described in section A4 (in the first part of this series of articles on the "Wide Range" humbucker), and the basic consideration elaborated there also hold below. To compare between pickups measured in the framework of these articles, we use a "3-dB-down" bandwidth of the frequency response of the impedance, and calculate a "Q_{3dB}-Factor" from this referring to the peak frequency of the impedance plot. This special Q-factor should be treated as such – any comparisons to Q-factors established elsewhere should be done with great caution and in consideration of various possible definitions of the Q-factor (see the article on this topic published on the GITEC website).

B2.3.1 The Creamery

The DC-resistance for the bridge pickups measured (4-conductor and external shield, resp.) about 10.7 kΩ and 10.5 kΩ; the neck pickups had 9.5 kΩ and 9.3 kΩ. As has been noted repeatedly by many sources, the DC-resistance is, however, no indicator for the sound (both in terms of tone and in terms of volume) of a pickup.

Looking at the (much more relevant) frequency responses of the impedance, pickups made by The Creamery show more significant scatter compared to e.g. the Mexico-made reissue pickups. Peak frequencies were 2.9 kHz and 2.7 kHz for the bridge pickups, and 3.3 kHz and 3 kHz for the neck pickups. The neck pickup of the pair with the external braided shield thus peaked out almost at the same frequency as the bridge pickup with the 4-conductor cable. The 3-dB-down bandwidth of the impedance plot is around 1 kHz for all four pickups possibly with a slight tendency to increase for the neck pickups (with their higher resonance frequency. Correspondingly, the Q_{3dB}-factor is around 3.



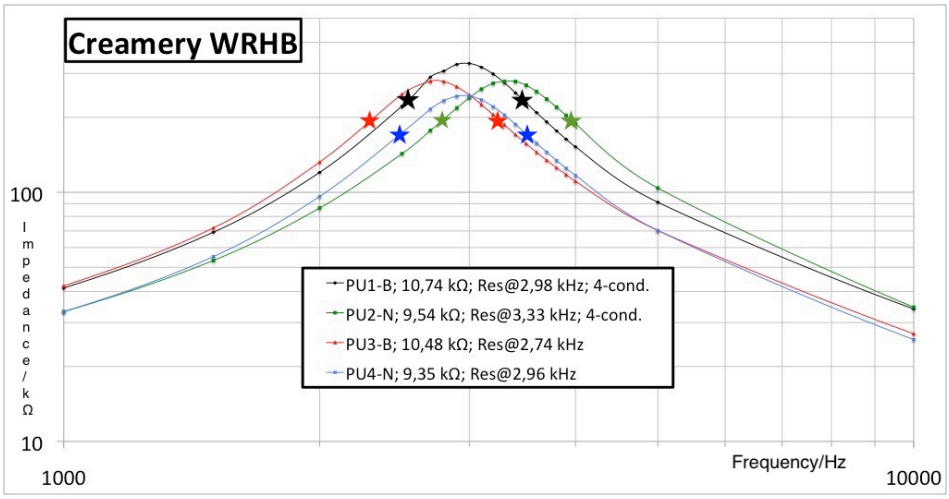


Fig 2.2: Creamery Wide-Range humbuckers - frequency response of impedance of 4 pickups (two each bridge- and neck-position).
Top: full frequency range. Bottom: smaller range around the peak frequency with black/red (bridge pickup) and green/blue (neck pickup) stars indicating 3-dB-down frequencies.

B2.3.2 Lollar

Both neck- and bridge-position Lollar pickups measured a DC-resistance of 10.8 kΩ. Interestingly (and again underlining the above statement about the DC-resistance) the neck pickup shows, at 3.1 kHz, a higher peak frequency on the impedance plot compared to the bridge pickup (peaking at 2.8 kHz). 3-dB-down bandwidths were around 800 Hz for the bridge pickup and around 650 Hz for the neck pickup, resulting in Q_{3dB}-factors of around 3,5 for the bridge pickup and close to 5 for the neck pickup.

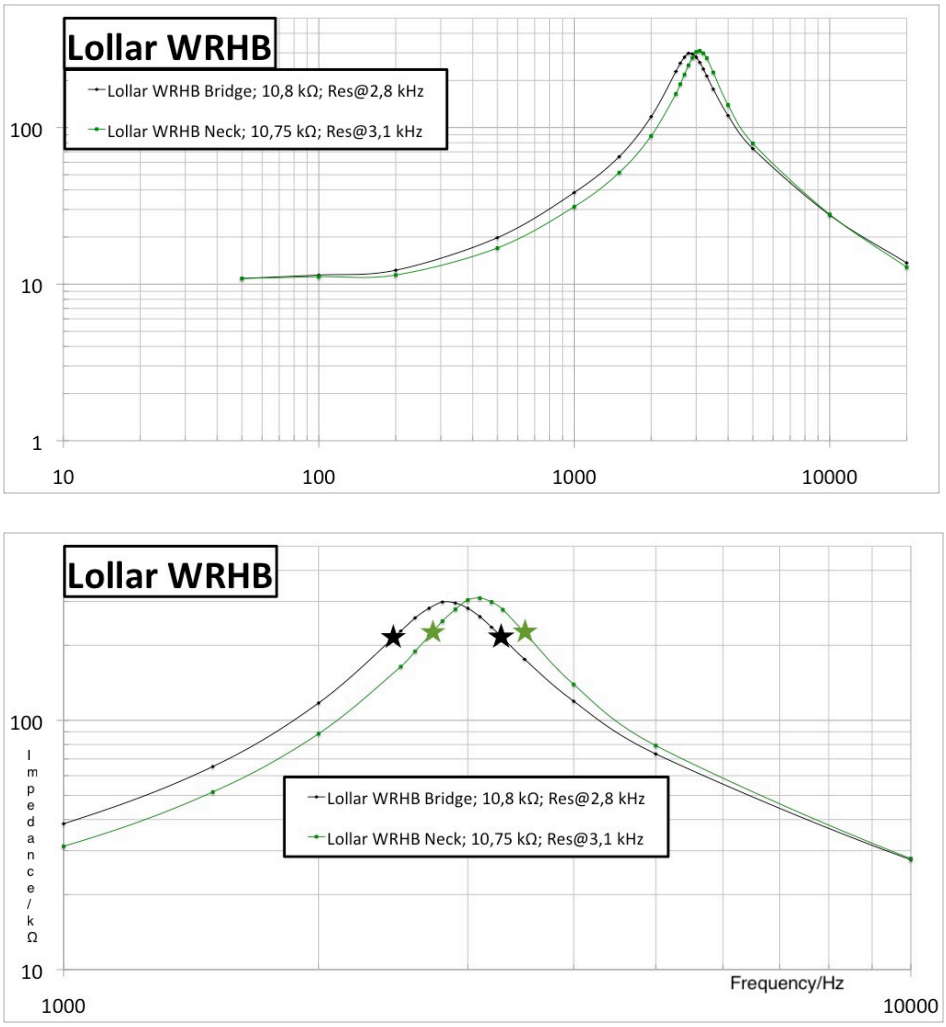


Fig 2.3: Lollar Wide-Range humbuckers - frequency resp. of impedance of 2 pickups (bridge- and neck-position).
Top: complete frequency range. Bottom: smaller range around the peak frequency with black (bridge pickup) and green (neck pickup) stars indicating the 3-dB-down frequencies.

B2.4 Discussion of the measurement results

Comparing the measurements results obtained from the Creamery and Lollar clones of the Wide-range humbucker with those of the genuine Fender products (70's CuNiFe's, or Mexico or Squire reissues as elaborated on in the first part of this series of articles), the following can be summarized:

- in terms of the frequency response of the impedance, i.e. both with regard to peak frequency and Q_{3dB}-factor, the Lollar neck-position pickup is a rather perfect clone of the original 1970's CuNiFe-Fender pickups.

- the Lollar bridge-position pickup seems geared towards the modern approach that the bridge pickup should work well with a lot of overdrive, and give associated sounds. This typically entails a somewhat lower peak frequency in the frequency response of the impedance, and possibly a lower Q_{3dB}-factor. Still, the Lollar bridge pickup remains pretty close to the CuNiFe's.

- the Creamery pickups (again categorized into neck- and bridge-position specimen as customary today) seem to tread some kind of middle ground between the original CuNiFe-pickups and the reissue bar-magnet pickups. The have a Q_{3dB}-factor only slightly larger than the reissues but a peak frequency closer to the original CuNiFe's.

N.B.: in his recent publication /11/, Helmuth Lemme has measured the output signal strength of the Creamery pickups. This turns out to be considerably higher than both the CuNiFe's and the reissues. It would therefore appear that despite the build that is very close to the CuNiFe-pickup, the Creamery pickups are based on a somewhat different philosophy towards achievement of tone.

B3. The old "Competition" of the Fender Humbucking Pickup: measurements

With all these measurements dedicated to the Wide-Range humbucker, it seems high time to take into consideration its classic competition. This will enable us to make comparisons to sound that we are highly familiar with.

B3.1 Stratocaster-type pickup

The build of the Fender Stratocaster pickup has been discussed in section A3.1 in the first of this series of articles. We had a number of modern Strat pickups available, specifically the Texas Special, TexMex and Yosemite pickup sets. However, we chose a Seymour Duncan Antiquity (early series) as a more vintage-oriented example. These pickups are said to be extremely close in build and sound to original 1950's Stratocaster pickups, especially considering the rather extended scatter that the old pickups were subjected to in terms of number of windings, winding density and magnet strengths. Also, a quick comparison of the peak frequencies of all available Strat pickups showed a range between 3.3 kHz and 4.4 kHz, i.e. the Duncan – with 3.9 kHz – sat comfortably in the middle of that range and therefore could well serve as an example.

The frequency response of the Antiquity Strat pickup is depicted in Fig. 2.4. Given a 3-dB-down bandwidth of about 650 Hz, the Q_{3dB}-factor amounts to about 6.

Of course, the Fender Stratocaster pickup was never actually a competition to the Fender Humbucking Pickup. The latter was meant to complement the line of pickups offered by Fender while retaining certain characteristics the company saw in their pickups.

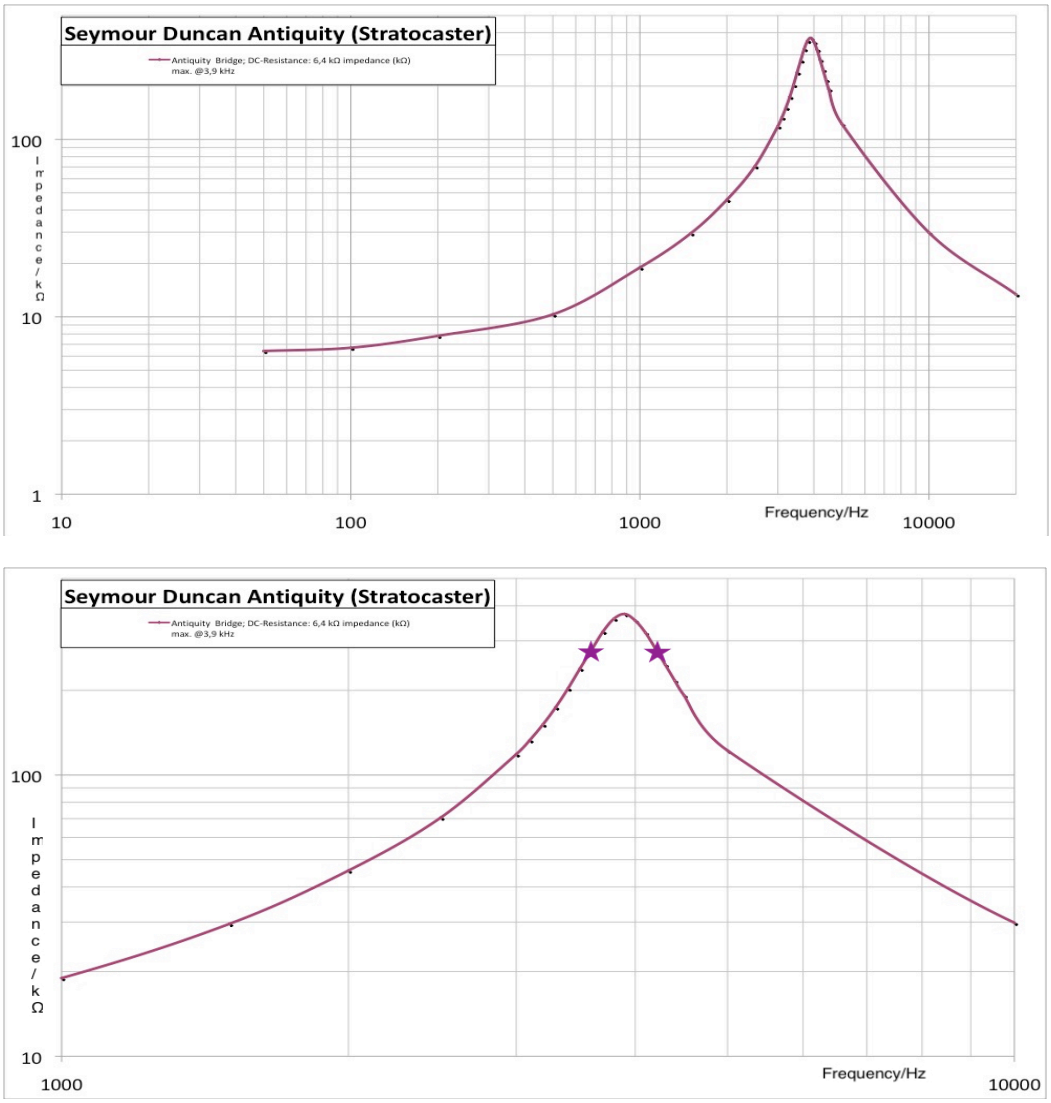


Fig 2.4: Seymour Duncan Antiquity Stratocaster Pickups - frequency response of impedance. Top: complete frequency range. Bottom: smaller range around the peak frequency with stars indicating the 3-dB-down frequencies. The somewhat "too straight" upper slope is a (graphic) artifact due to fewer measurement points in that range.

B3.2 Gibson Humbucking & P-90 pickups

Probably the most important member of the group of competitors to Fender was Gibson, with a long tradition in electric guitars. First marketed on 1946, their P-90 single coil pickup looked back on quite a number of years of honorable service, and with the introduction of the Humbucking Pickup, in particular in the original form of the "PAF" ("patent applied for", in 1956), Gibson had created what was to become a most legendary component option in the arsenal of the "electric guitarist".

Our measurements were done with a modern version 490T version of the Gibson humbucker (the bridge position specimen). Incidentally, we also had a Gibson P-94 lying around and did measurements on this pickup, as well. (Note: the P94 is sold by Gibson as a version of the famous P-90 that has the geometry of a Gibson humbucking pickup, i.e. it can directly replace a standard Gibson humbucker.)

Fig. 2.5 indicates that both the P-94 and the 490T pickups have a 3-dB-down bandwidth of about 1kHz and a peak frequency of 3 kHz, i.e. a Q_{3dB}-factor of about 3.

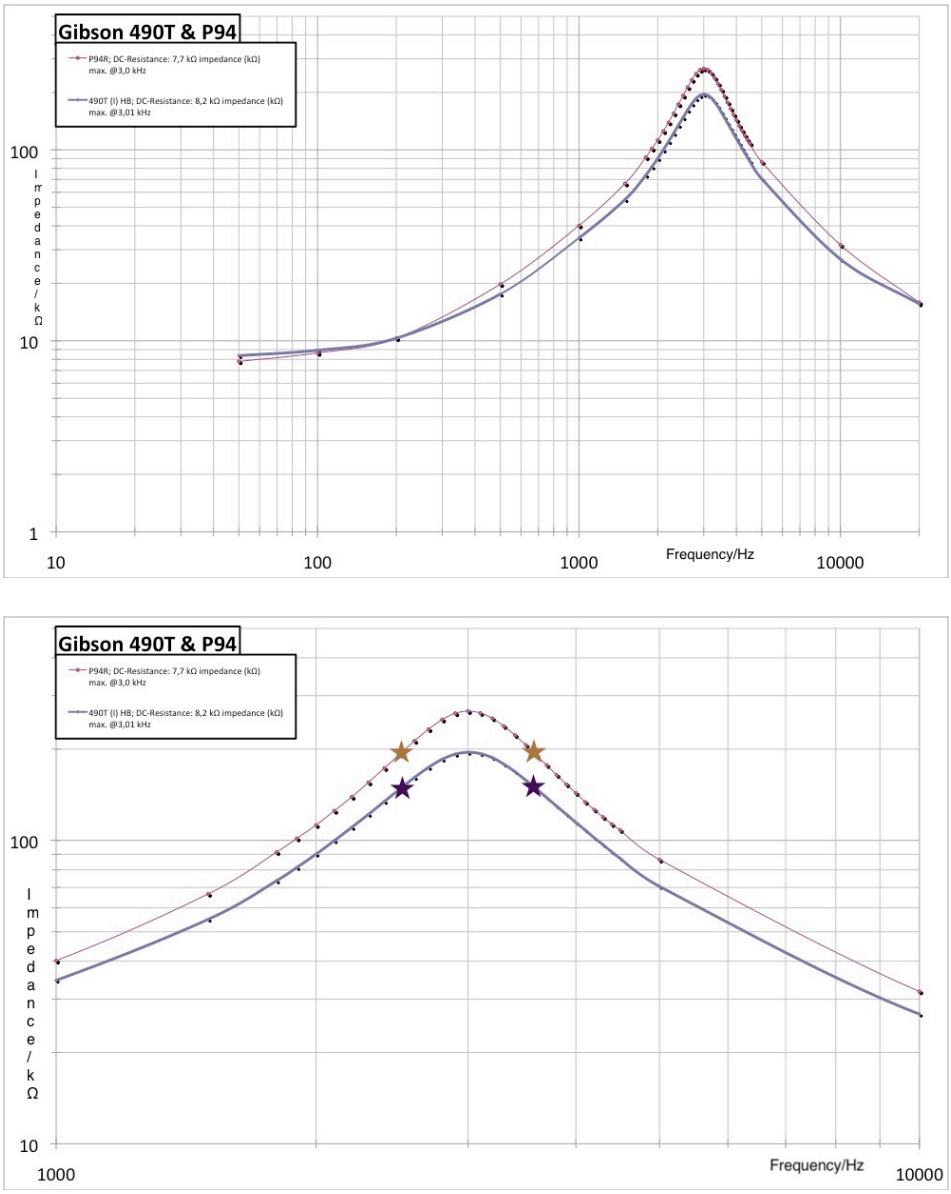


Fig 2.5: Gibson P94 single coil (brown) and 490T humbucker (blue) pickups - frequency response.
Top: complete frequency range. Bottom: smaller range around the peak frequency with brown (P94) and blue (490T) stars indicating the 3-dB-down frequencies.

B3.3 Discussion of measurement results

Clearly, our measurements confirm the fundamental difference between the approaches that the Fender and Gibson companies have traditionally taken to achieve "their" respective sound. Fender prefers a pronounced peak in the frequency response of the impedance at a higher peak frequency, while Gibson goes for a less "focused" peak at a lower frequency.

This matches well with the almost cliché association that Fender guitars give a bright, more piercing sound in contrast to Gibsons having a more singing, round tone. Measurements found in literature (e.g. /5/, /9/) agree quite well with the present findings.

The Gibson P-94 pickup deserves a dedicated paragraph. According to our measurements, this pickup shows only marginally different data compared to the Gibson humbucker. This would contradict the generally held opinion that the P-90 (for which the P-94 pickup is supposed to be a humbucker-sized match) sounds brighter and more "single-coil-y". On the other hand, data from literature point towards the Gibson P-90 and the Gibson humbucker being more alike than different, with the P-90 having only a slightly higher Q-factor than the humbucker, and a peak frequency that may even be lower than that of the humbucker. It would seem that this topic of how in fact the Gibson P-90 actually sounds different than the Gibson humbucker would merit a separate in-depth discussion. Interestingly, when designing the Gibson humbucker, designer Seth Lover sought to achieve the same sound as the P-90 had it (interview in /12/).

B4. Outlook

In the third part of this series of article, we will look into how the data found in the first and second parts manifest themselves perceptionally. The plan is to record test sounds of the different pickups mounted on one and the same guitar (or at least on guitars as similar as possible), and make A/B-comparisons using automated channel-switching on a DAW.

... i.e.: to be continued further ... stay tuned!

Appendix: Literature

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- /4/ Electric Guitar - Sound Secrets and Technology; Helmut Lemme, Elektor, 2012, p. 89 - 91
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