

Introducing new SILK S-325 SE Output Transformer



Frequency response surpasses 100KHz by 50KHz!

It is very difficult to believe that we can surpass the remarkable performance of our previous SILK S-325. (internal code name "S") After hundreds of testing models and countless of listening and testing hours, we are confident that our new SILK S-325 (internal code name "Fi") is one of the best Output Transformer for medium power single-ended amplifier in the market. It is specially designed to best working with circuit employing tubes like; 300B, 2A3, 6B4G, PX-25 and the like. New S-325 also works well with ultra-linear connected circuit with tubes like; EL34, 6L6, 6550, or KT88.

SILK S-325 incorporates SILK winding technique on special heat treatment core. We have developed new proprietary winding arrangement to increase magnetic coupling between primary and secondary with lowest insertion loss.

This generates power bandwidth from 13Hz to more than 150,000Hz at -3.0dB. This wideband characteristic must also provide low THD at low frequency that why we do not adopt small cut core since they process very high THD in low frequency range. This figure arrives from actual working condition run with SE300B tube without NFB at its full power.

Test report

We set up the test for frequency response, THD and FFT analysis under actual working condition of the transformer; that's running with DC unbalance and driven by 300B tube without the aid of NFB.

List of test equipment

HP 8903A audio analyzer as low THD signal generator and distortion analyzer

HP 3478A multi-meter

Instek GDS-806S digital storage oscilloscope with FFT math analyzer

Hameg HM-504 analog oscilloscope

Escort EFG-3210 function generator (for square wave and sine wave below 20Hz and above 100KHz)

Kikusui FAE-2000 FFT spectrum analyzer

Our test drive circuit is based on 6SN7 (SRPP) input, C-coupling to 6V6 (triode connected) R-C coupling to 300B running at +350V at 78mA.

Center frequency is 1,000Hz

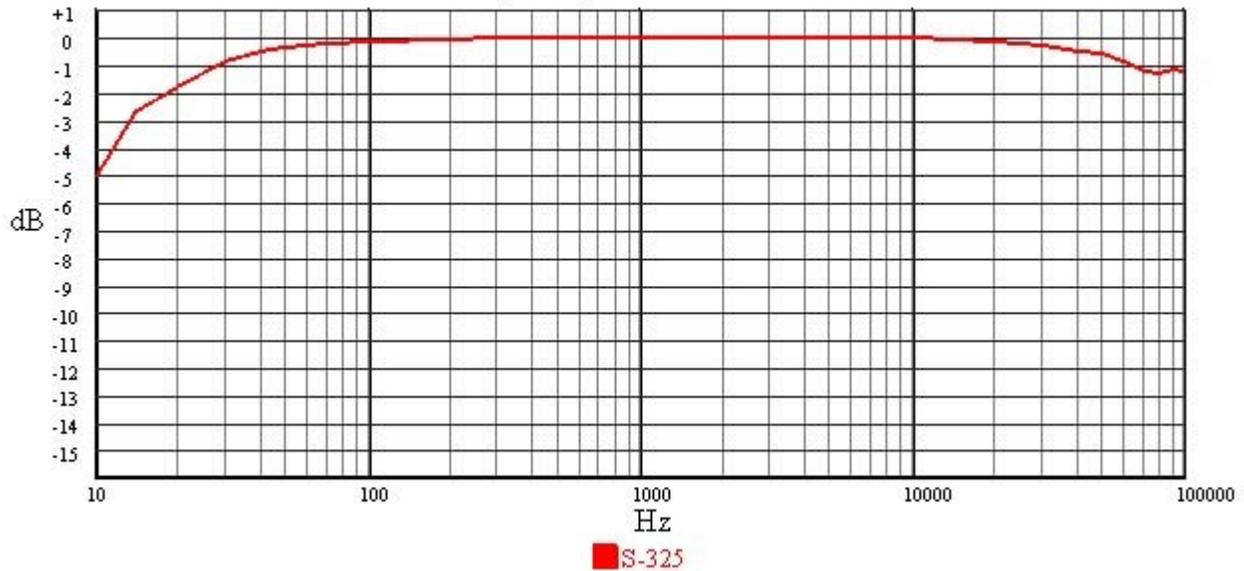
Reference level (0.0dB) is 20.0V p-p into 8 ohm load (17.2dBVrms)

Frequency Response

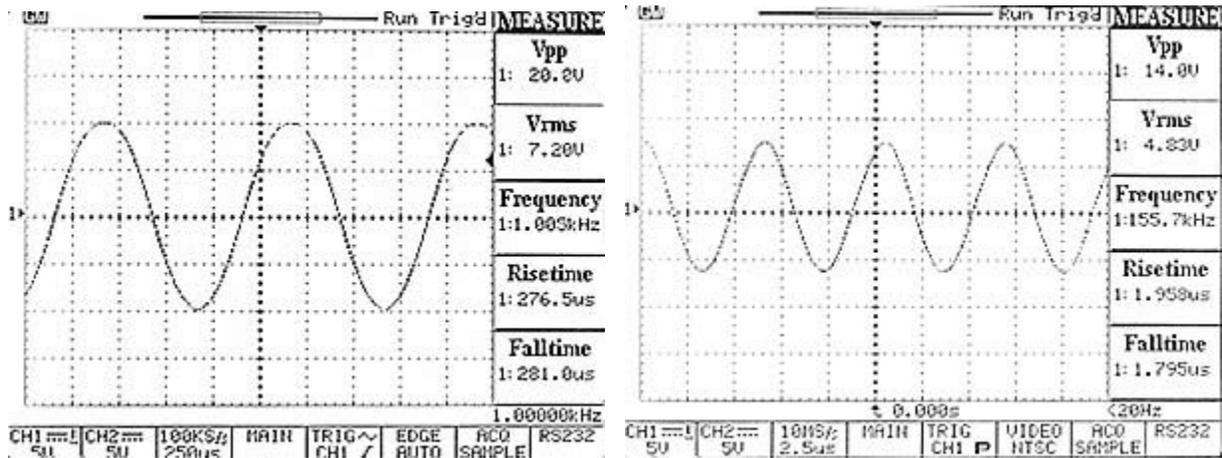
Frequency response is one of the most important aspects of output transformer. Although some might argue that this has no benefit since human is limited in hearing up to only 20KHz, wide bandwidth output transformer usually means that it can generate true upper harmonic that bring music reproduction closer to the real live performance.

Wide bandwidth characteristic with low THD is very difficult task that only comes from good design output transformers.

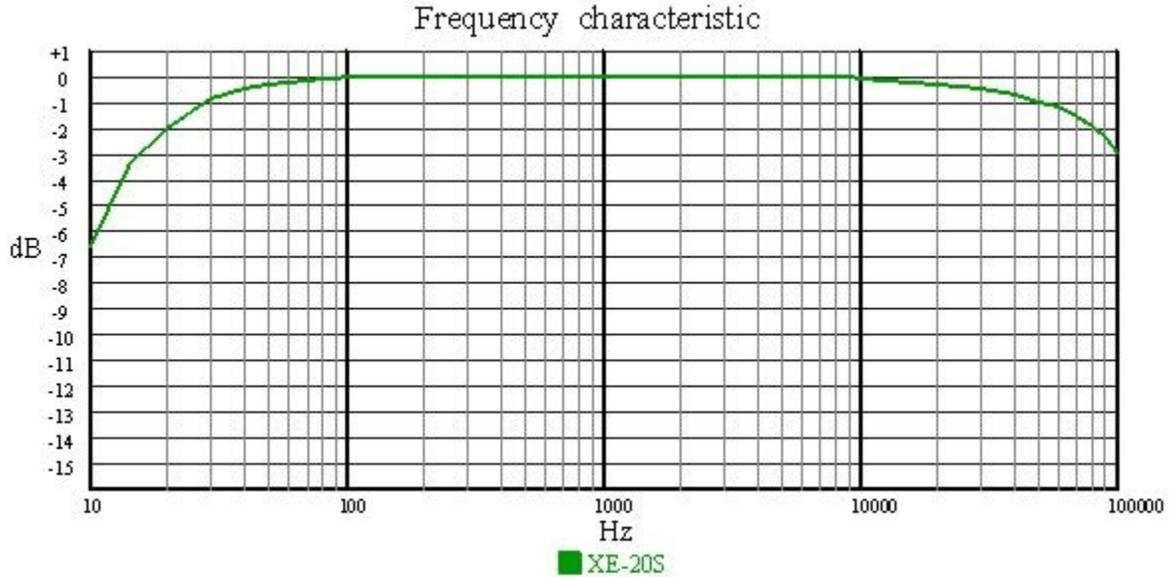
Frequency characteristic



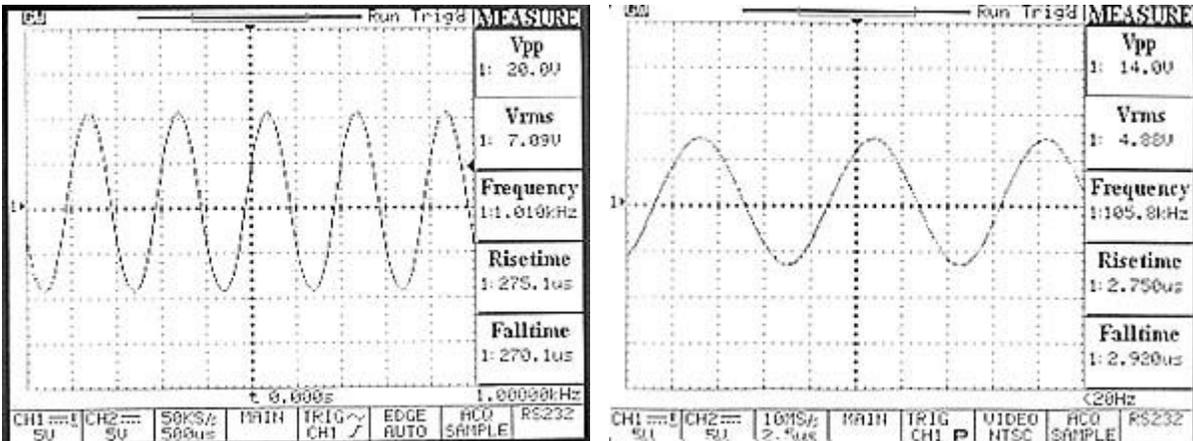
The above figure is frequency characteristic of our new SILK S-325. This is tremendous bandwidth for actual working transformer. -3.0dB point is below 15Hz to above 155,000Hz with no peak and dip.



Left figure illustrates the testing condition at center frequency of 1,000Hz at 20.0Vp-p level. This is 7.20V rms into 8 ohm load that means around 6.5 watt RMS. Right figure illustrates the -3.0dB point or when the output is drop to 14.0Vp-p level. It reads at 155.70KHz. (-3.0dB can be found using formular $\text{dB} = 20 \times \log(\text{Vout}/\text{Vin})$)



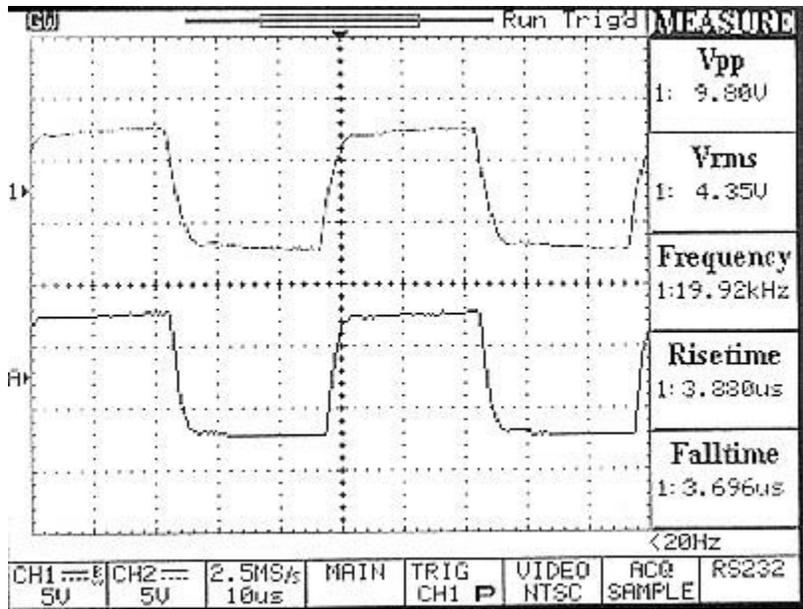
The above figure illustrates frequency characteristic of Tango XE-20S. (at 3.5K primary load) XE-20S processes very wide bandwidth of around 17Hz to 105KHz at -3.0dB.



Left figure shows same testing as for SILK S-325 which is 1,000Hz at 20Vp-p as center frequency. Right figure shows -3.0dB point (14.0Vp-p) at 105.8KHz.

Square Wave behavior

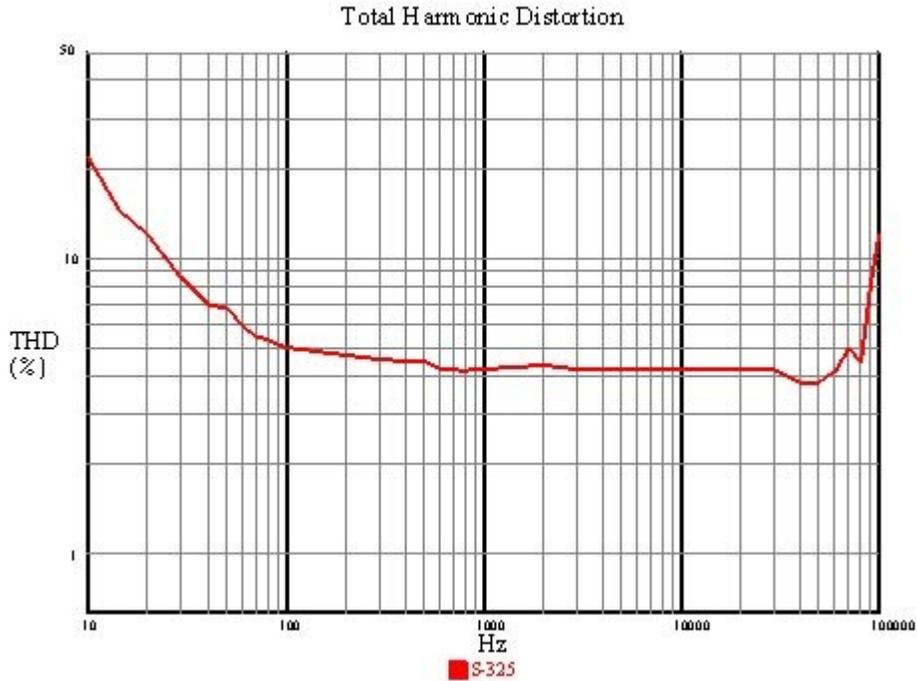
Good output transformer must not only process wide bandwidth, but also generate uniform high frequency response that can be observed by assigning square waveform of some frequencies. The shape of square waveform will distort if non linear in high frequency response exist. Raise time, fall time and ringing time which becomes the "Signature" of each transformer. This test confirms the remarkable uniform high frequency response of SILK S-325.



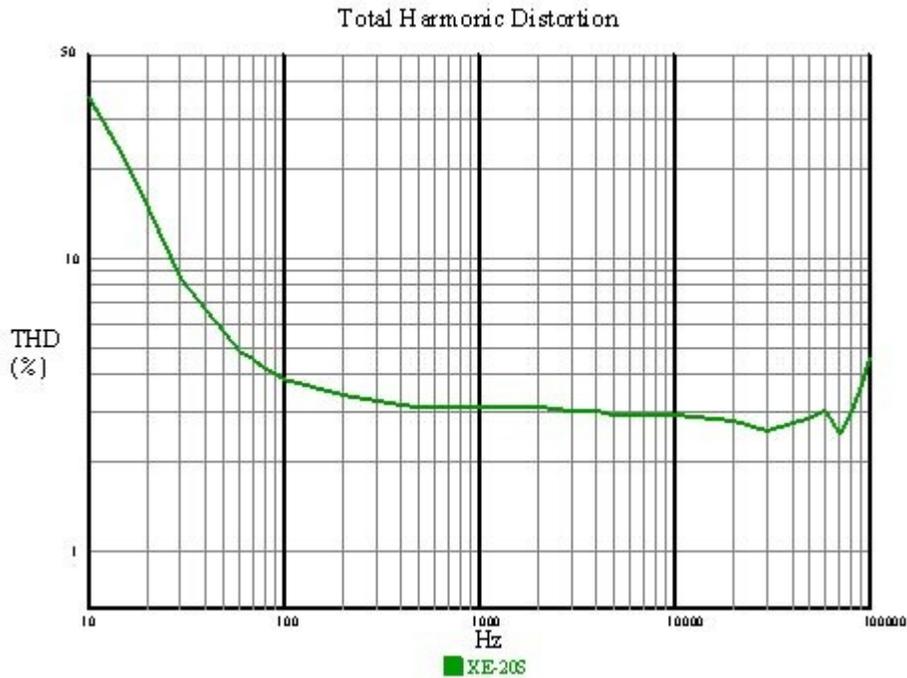
Above figure demonstrates square waveform test at high power level (10Vp-p duty cycle almost at 50%) at very high frequency of 20KHz. Top trace shown result from XE-20S which has very good square wave. Its risetime of 3.88uS is very fast; however, the bottom trace shown result from SILK S-325 which has better square wave with its faster risetime of only 2.62uS.

Total Harmonic Distortion (THD)

THD is good measurement in performance of output transformer. It will reveal the added distortion that output transformer generate though this has to deal with impedance of driving tube and primary impedance of output transformer. In low frequency, high THD usually means that the core is saturate and weak inductance.



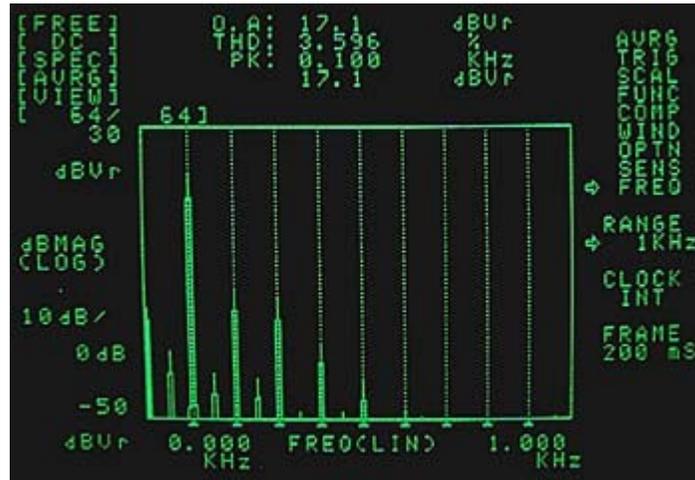
SILK S-325 with 3.0K primary performs as well as 3.5K of XE-20S. Below 100Hz SILK S-325 yields much lower in THD than XE-20S since it has much more inductance. This proves that SILK generates better bass response with deep, precise and well define bass. Note that THD goes up very rapidly above 70KHz since the output level is not drop like XE-20S and most THD come from driving circuit through output transformer.



THD figure above is taken from XE-20S. With 3.5K primary impedance, XE-20S has advantage in offering lower THD figure in mid range but due to its small inductance, it generates severe distortion in bass region when directly compare with SILK S-325

Fast Fourier Transform Analysis (Spectrum analysis)

FFT analysis will enable see through distortion in frequency domain of each test signal that THD only able to give the total figure. Researchers suggested that the higher odd harmonic (5th, 7th, 9th and so on) usually has more perceptible effect than equivalent lower even harmonic (2nd and 4th) thus THD figure of 0.1% which consists of 7th, 9th, 11th harmonic may sound worse than THD figure of 0.5% which consists of purely 2nd harmonic.



Spectrum analysis as illustrated above is from SILK S-325 runing at 17.1dBVrms or around 20.0Vp-p at center frequency of 1,000Hz. THD value of 3.596% is the sum of 64 input samples that being average out by Kikusui FAE2000. Harmonic up to only 5th order is evident with very small amount. Basically the 2nd harmonic and 3rd are dominate.

