# Engineering Measurements of KFTL-DT

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By

George F. Ledoux

Astre Systems Inc.
Modesto, California

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The following measurements were made at the KFTL-DT Stockton, California transmitter site within the Mount Diablo state Park just west of Stockton, CA.

Measurements were made by or under the direction of George F. Ledoux President of Astre Systems Inc., Modesto, CA.

The primary instrument used was a Tektronix RFA-300A Measurement Set for 8VSB. This instrument is known to be in calibration and operating in good order. Photos of the screen were taken to display the traces and measurements made by the RFA-300A and are included here. In all cases, the photo of the RFA-300A screen shows the FCC limits in Blue and the measured values in white.

## Power Measurement

RF output power was measured using a calibrated RF coupling port at the output of the mask filter. A Hewlett Packard model 437B power meter with a Hewlett Packard 8481A Power Sensor was used to measure the average power.

After correcting the 437B for the coupling value (-50.5 dB), the power meter measured 15 kilowatts average power output.

## Equipment Used

Tektronix model RFA-300A S/N B010103

Hewlett Packard model 437B Power Meter S/N 3737U26429

Hewlett Packard model 8481A Power Sensor S/N 2552A52607

Agilent 8753E Network Analyzer S/N 38161305

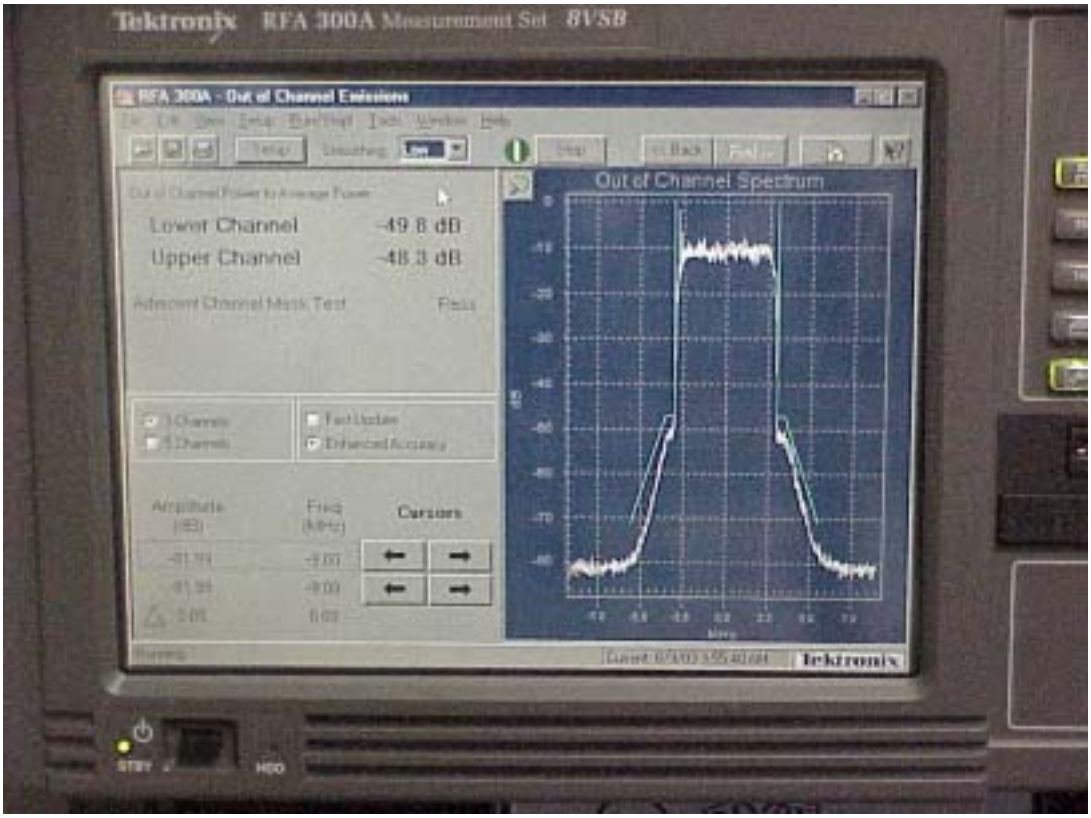
Tektronix MTG 200 MPEG Test Generator S/N 848283/038

## Transmitter description

The program data was supplied by a recently calibrated Tektronix MTG 200 MPEG Test Generator. This instrument provides data in the SMPTE-310M format. This signal is connected to and modulated by a Zenith model DTVMODV-30 8VSB modulator. The Zenith modulator output is at 44 MHz IF frequency and is frequency up-converted to the operating frequency. The Zenith Modulator and the up-converter are frequency and phase locked to a precision 10 MHz reference signal derived from a Spectracom model 8165 WWVB Receiver. This assures that the final operating frequency is within FCC specifications for the operating frequency. The signal is then amplified by a LDMOS Intermediate Power Amplifier to a sufficient level to drive the L-3 Corp. Constant Efficiency Amplifier (MSDC-IOT) output amplifier to 15 kW average power output. The signal is passed through a Myat low pass harmonic filter, then through a Myat mask filter, and on to the patch panel to be able to select the antenna or station load as required. The output signals are in conformance with the FCC Output Mask.

This transmitter complies with 47 C.F.R. Section 73.1660

George F. Ledoux
Astre Systems Inc.




Spectrum measurements

This test shows that this transmitter meets the FCC Mask requirements for out of channel emissions referenced to a 500kHz noise bandwidth. The measurement was made at the output of the mask filter. The noise floor of the Tektronix RFA-300 can be seen to be at approx -83db. The response of the mask filter when added to the response of the transmitter meets or exceeds the required -110 db at Fo +/-6 MHz.

This plot shows the mask filter insertion loss plus and minus 13 MHz of center frequency. This insertion loss when added to the response of the transmitter shown above shows out of channel emissions to be at or below -110 db as per FCC requirements.


Amplitude and Phase Error

In this measurement the amplitude error was measured at 0.23 dB. The phase error was measured at 1.4 degree.

These reading pass the Magnitude Error Mask test and Phase error Mask tests.

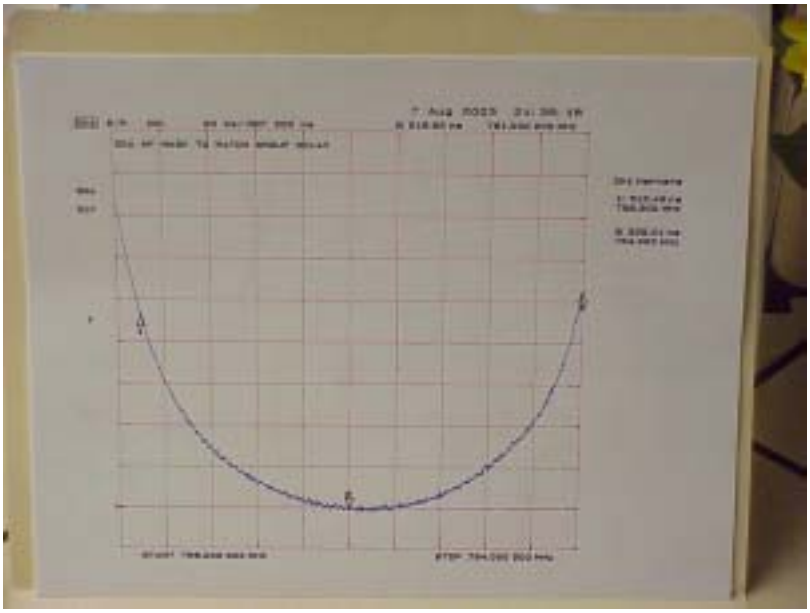
The blue traces are the FCC limits. The white traces are the measured results.

The measurements were made operating into the station load.

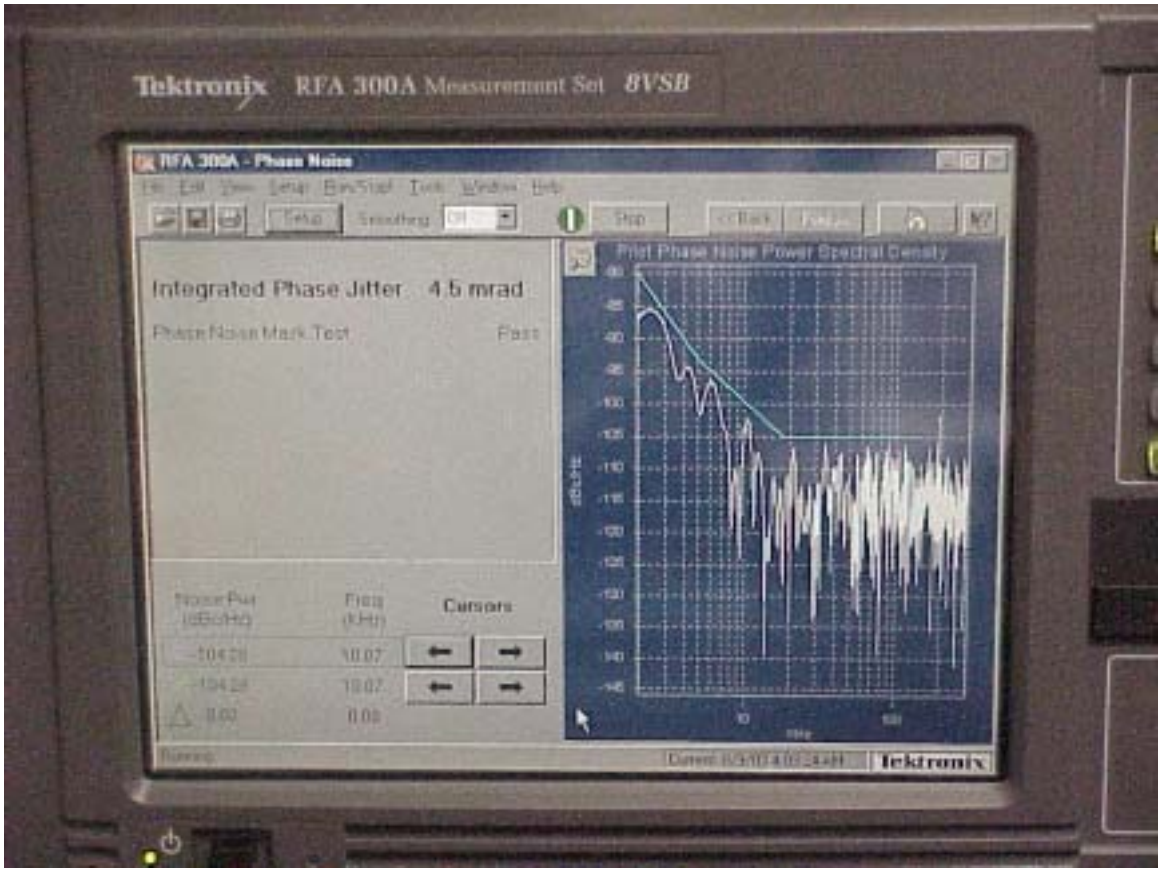

Frequency Response and Group Delay

The frequency response and group delay of the transmitter is shown above and is well within the FCC requirements. The measured frequency response peak to peak is 0.10 dB. The group delay, peak to peak measurement is shown to be 11.9 ns.

Both the frequency response and group delay mask tests pass FCC requirements.



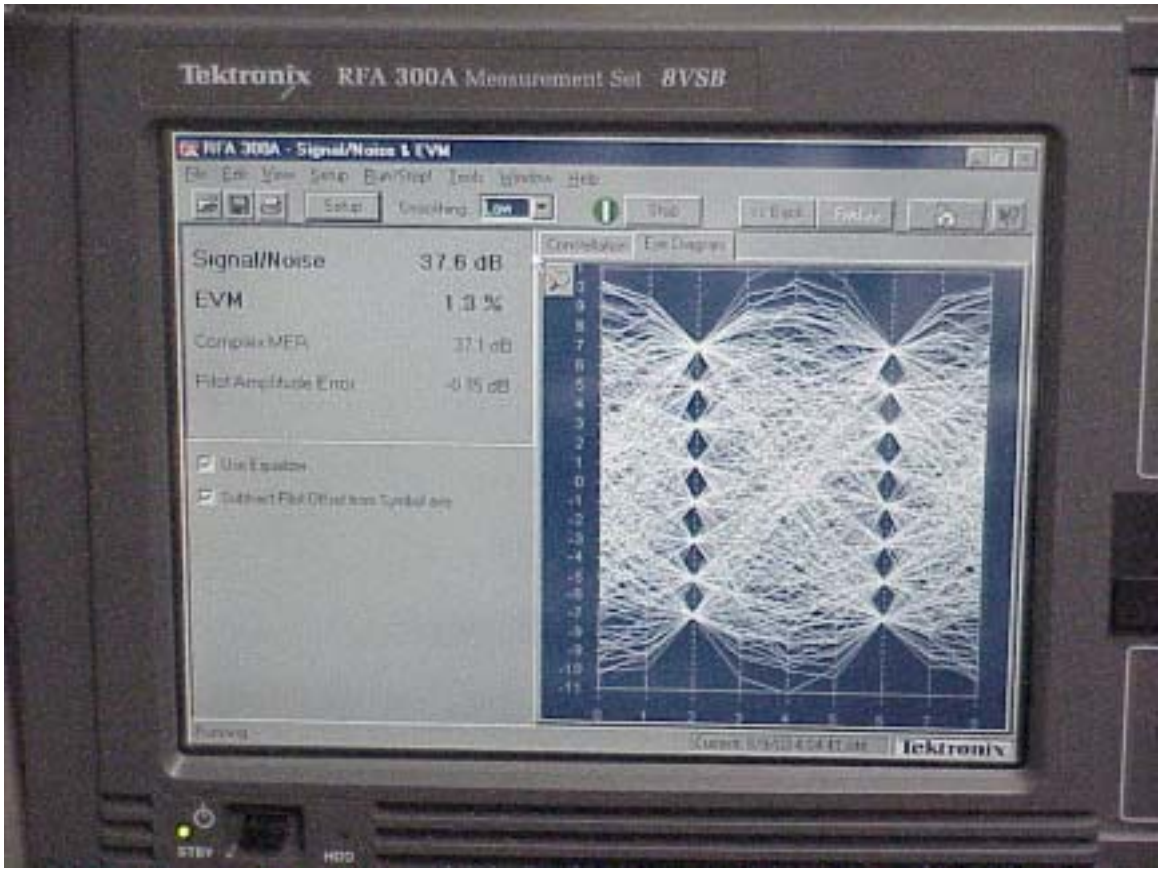
Plot of Group Delay of the mask filter.




Phase Noise

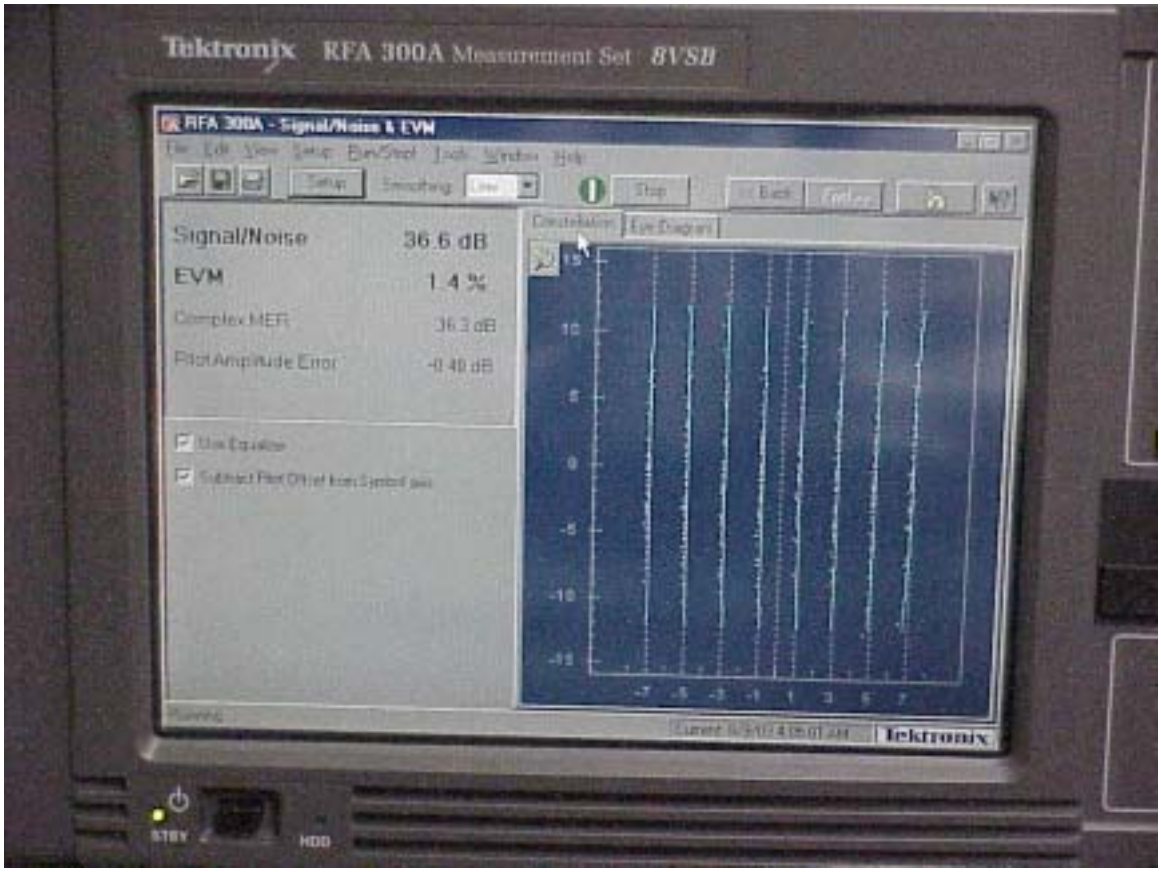
Integrated Phase Noise is a single figure of merit describing the phase variation that the transmitters frequency synthesizer adds to the digital modulation process.

The measurement made is within the parameters set forth by the FCC .




Eye Diagram

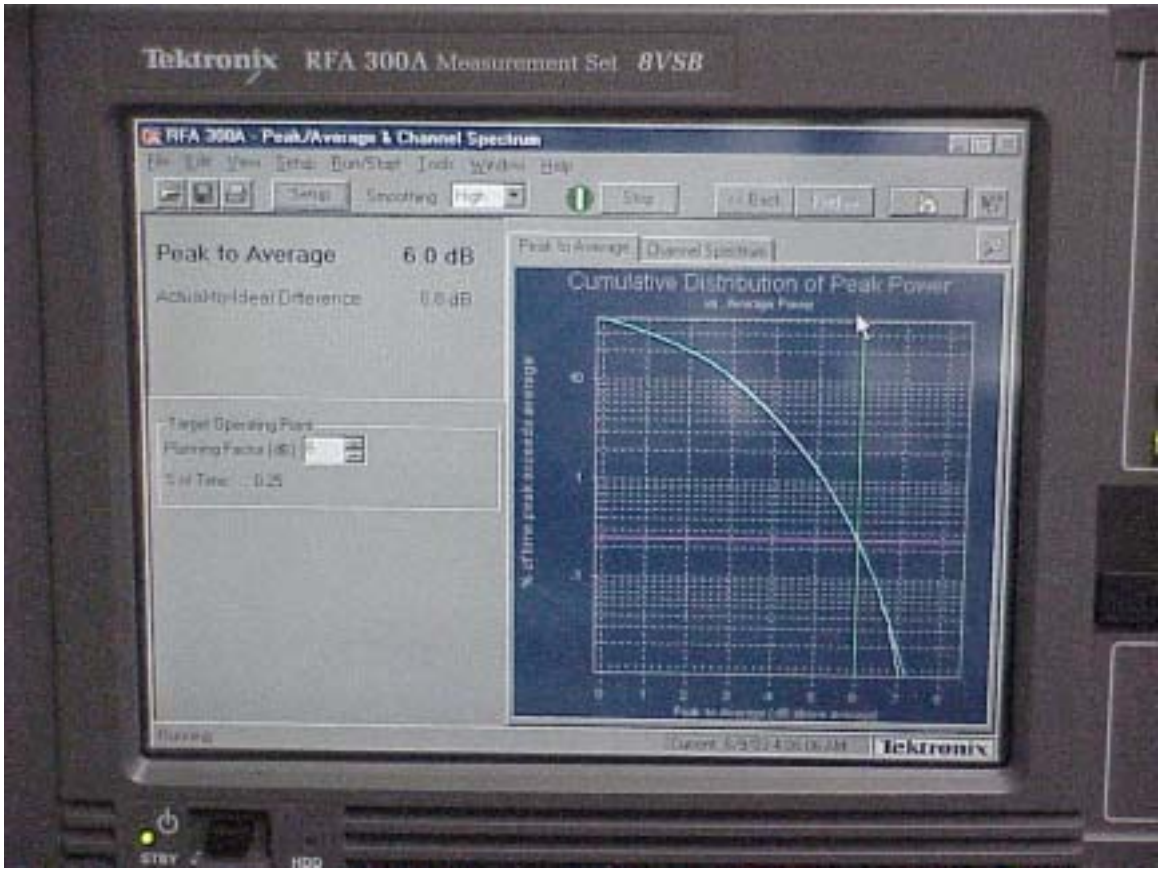
The Eye Diagram demonstrates the signal noise ratio of the transmitted signal. As measured here at 37.6 dB. The EVM is 1.3% The Pilot amplitude error is -0.35dB




Constellation Display

The constellation display plots the relationship between the carrier amplitude and phase of each data symbol. It provides a visual health check of the 8VSB transmitter.

In 8VSB we are concerned with the amplitude of the signal which represents the symbol values. The phase of the carrier varies in order to suppress the lower sideband. The eight amplitude levels are recovered by sampling the in-phase (I-channel) only. On the 8VSB constellation diagram, the I-channel data is displayed along the x-axis (real axis) while the Quadrature (Q-channel) follows the y-axis (imaginary axis). The photo above displays the result.




Peak to Average Power

A transmitter should spend a certain percentage of its time at various power levels ranging from its average to its peak. The Peak to Average Power is the ratio of the peak transient power to the average envelope power. The peak transient power is the maximum value of envelope power occasionally reached by the digitally modulated signal. This is plotted as a statistical distribution of carrier power over time using a Cumulative Distribution Function.

The percentage of the time the signal is greater than the average amplitude in dB is plotted and compared with the ideal. A properly operating transmitter will track the ideal curve. Using power amplifiers beyond their capability can cause compression of peaks. This distorts the signal, causing out of channel emissions and lower signal to noise ratio (S/N). Compression can cause the actual curve to fall below the ideal curve.

The measurement shown above displays that this transmitter is not in compression, and is operating within design parameters, and FCC regulations.


Picture from Station Demodulator

The picture shown above was the output of the Sencore model IRD 3384 demodulator connected to the Samsung monitor. The picture shown is a test pattern and station identification as received “off air”.