Meter reading Transmission Unit with Receiver

Model 9945

FCC ID: LLB9945

Frequency Stability Test report:

a. Frequency Stability vs. Temperature;
b. Frequency Stability vs. Supply Voltage
c. Transient Stability

Hexagram, Inc.
October 10, 2006

Lazar Feldman
Principal Engineer
216-896-8635 lfeldman@hexagram.com

INTRODUCTION

The Hexagram Model 9845 transceiver is a designed to provide remote meter reading capability with the Landis & Gyr "S-4" family of electric meters. The transceiver is connected to the meter circuitry and mounts within the meter enclosure. An on-board battery provides power when AC power is not available. The transmitter provides a very short, intermittent radio frequency transmission to provide a remote reading of the meter. A microprocessor provides timing, control and data processing functions. The built in antenna is inaccessible to the user and no provision is made for an external antenna. The receiver can be used to request a meter reading or other options available in the system. One transmitter was tested and this report presents the data obtained in support of an application for certification.

FREQUENCY STABILITY VS. TEMPERATURE

The temperature stability of the frequency generating components of the transmitter was observed. The transmitter was placed in a temperature chamber with the battery-powered transmitter set to transmit at intervals of about 2 minutes. A receiving antenna outside the chamber picked up the transmitted signal, which was fed to the real-time spectrum analyzer.

With the transmitter programmed to transmit at 462 MHz, the chamber temperature was set to 20° C. After reaching the set temperature, the transmitter was allowed to stabilize for about 10 minutes or more. The transmission signal was captured by the real-time spectrum analyzer and the frequency was determined and considered the "reference" frequency. The temperature in the chamber was then increased 85° C. At each temperature, time was allowed for stabilization of the transmitter, a transmission was made and the frequency determined. The temperature was decreased to 80° C, and then in 10° steps to -30° C, again stabilizing at each 10° interval before a reading was made.

The frequency at each temperature was recorded, compared to the "reference" frequency, and is recorded in Table 1. It can be seen from the table that all readings are within the deviation limit of ±2.5 ppm or 1155 Hz at 462 MHz.

TABLE 1
FREQUENCY STABILITY VS. TEMPERATURE

Temperature ° C	Measured Frequency MHz	Dev. Hz	Dev. ppm
+20	462.001872*	0	0
+85	462.002185	+313	+0.68
+80	462.001872	0	0
+70	462.001872	0	0
+60	462.001872	0	0
+50	462.001872	0	0
+40	462.001872	0	0
+30	462.001872	-0	0
+20	462.001872	0	0
+10	462.002185	+313	0
-0-	462.002185	+313	0.68
-10	462.002310	+438	++0.95
-20	462.001997	+125	+0.27
-30	462.002310	+438	+0.68

* = “reference frequency”

FREQUENCY STABILITY VS. SUPPLY VOLTAGE

As the primary power source for the transmitter is the AC line that powers the electric meter, the frequency stability of the transmitted signal was measured at the nominal 115 Volt level as well as at 115% and 85% of that level. In the event of a power outage, the on-board battery provides power to the transmitter. Because of this, the transmitter was also checked with no AC applied and the DC voltage at a nominal 3.6 V as well as at 85% of that value.

For the AC frequency stability test, a variable voltage AC supply was connected to the AC input of the transmitter. The transmitted frequency was checked at the nominal 115 V level. The frequency was also measured at 115% (132.3 V) and at 85% (97.8 V) of the nominal value.

For the DC test, the AC power was removed and the battery replaced by a variable DC supply. The frequency was measured at both the nominal 3.60 V of the battery and at the 85% level or 3.06 V.

With the voltage set to a measurement point, the transmitted signal was captured by the real-time spectrum analyzer and the frequency value determined. The frequencies are compared to the "reference" frequency obtained at the nominal operating voltage. All data for these measurements are found in Table 2. Again, it can be seen that all values obtained are within the deviation limit of ±2.5 ppm or 1150 Hz at the 460 MHz test frequency.

T A B L E 2

FREQUENCY STABILITY VS. SUPPLY VOLTAGE

INPUT Volts	Measured Frequency MHz	Dev. Hz	Dev. ppm
97.8 VAC	460.002341	0	0
115 VAC	460.002341*	0	0
132.3 VAC	460.002341	0	0
3.60 VDC	460.002341*	0	0
3.06 VDC	460.002341	0	0

* = "reference frequency"

Note: Transmitter tuned to 460 MHz.

TEST EQUIPMENT USED

Real-Time Spectrum Analyzer : Tektronix / Sony Model 3086 s/n J300195

Antenna: EMCO 3146 LPA

DC Power Supply: TENMA, Laboratory DC Power Supply, Model 72-420

Thermometer: Cooper Electric Corp., Model SRH77A

AC Power Supply: Superio Electric, Type 1226 Powerstart

Temperature Chamber: TestEquity, Model 115

TRANSIENT STABILITY

The transient stability measurements indicate the variation in tuned frequency during the brief interval of time during the start of the transmission and at the end of the transmission.

The Model 9845 transmitter was tested for transient frequency behavior using the test method of TIA/EIA-603. A block diagram of the test setup is seen in Fig. 1.

A model DCU-1 receiver with an audio bandwidth of 16 kHz (low Pass) was used. The storage oscilloscope was triggered by the radiated signal from the transmitter. Appropriate delay was provided by the digital delay circuitry of the oscilloscope. The 1 kHz test signal was provided by the Marconi signal generator. The generator's output control was used to insure that the test signal was at least 50 dB below the received signal level from the 9845.

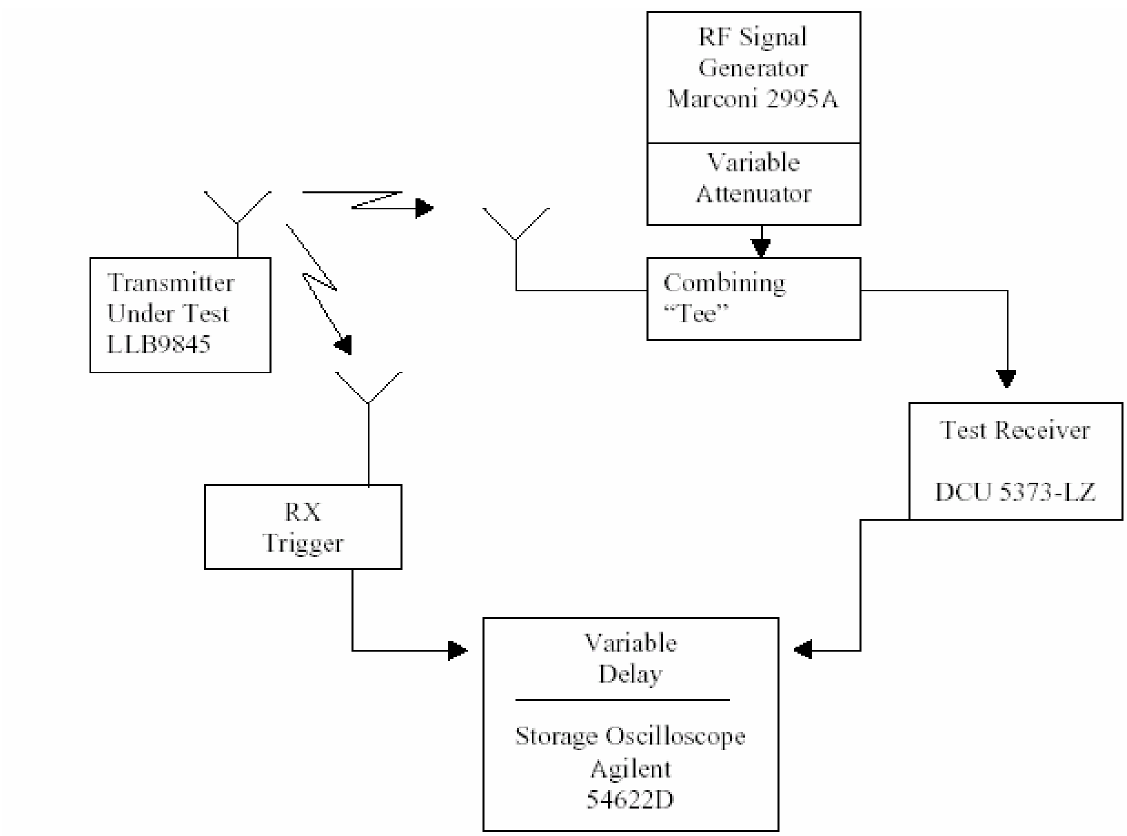

Fig.1
Transient Frequency Behavior
Test Setup

The test requirements per 90.214 are:

1. Frequency deviation during t_1 (10 ms duration after $_{ton)}$ may be greater than ±12,5 kHz because the output power is less than 6 Watts.

2. Frequency deviation during t_2 (25 ms duration after t_1) must be less than ±6.25 kHz.

3. Frequency deviation after t_2 must be less the ±2.5 ppm. or ±1150 Hz.

4. Frequency deviation during t_3 (10 ms duration after transmitter is turned off) may exceed ±12.5 kHz because output power is less than 6 Watts.

Test Data

Figures 2 through 6 show the Model 9845's transient frequency characteristics. The limit masks are indicated on each of the figures.

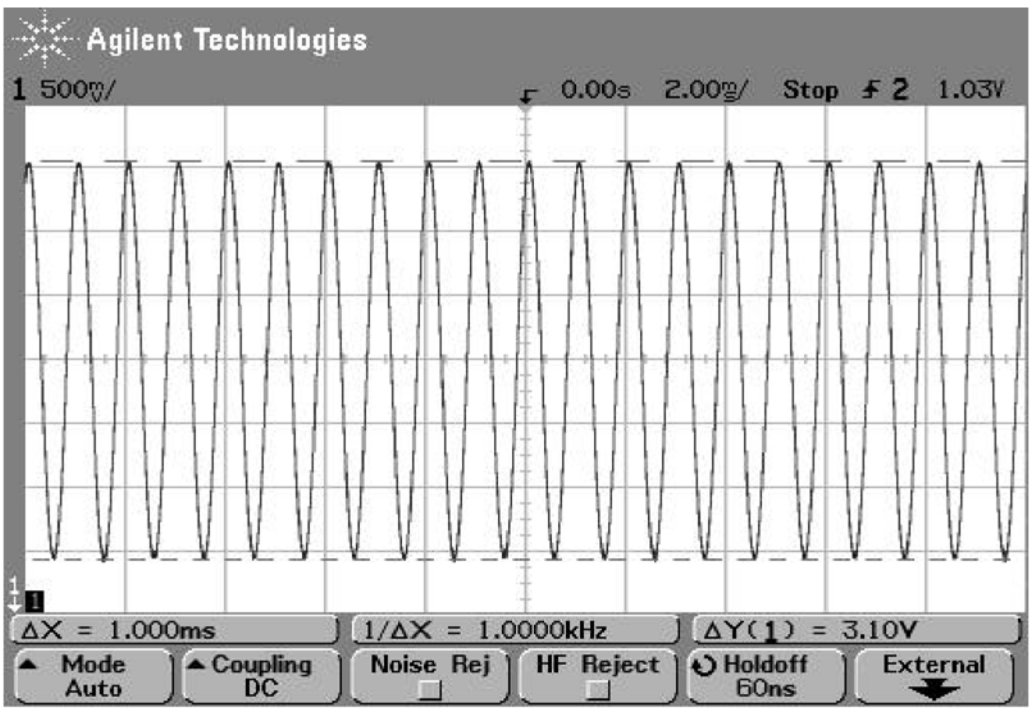

Fig. 2 ±12.5 kHz modulated test signal 25 kHz = 3.10 V.

6.25 kHz = 775 mV
1.15 kHz = 143 mV

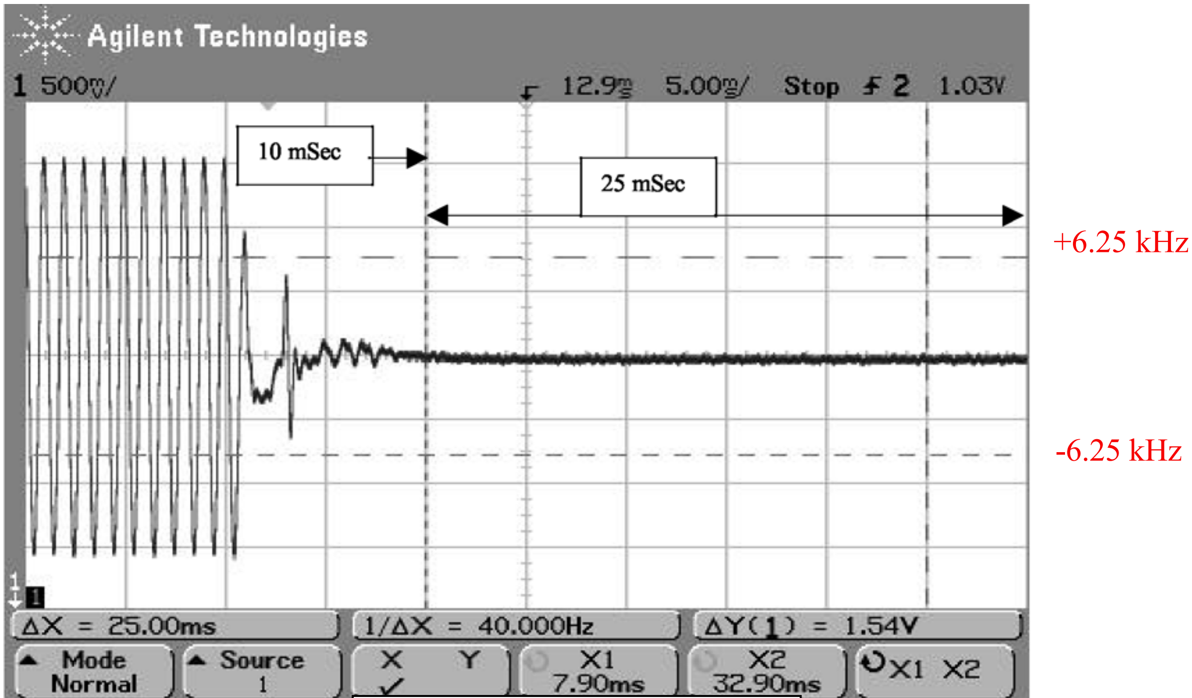

Fig. 3 Start of Transmission

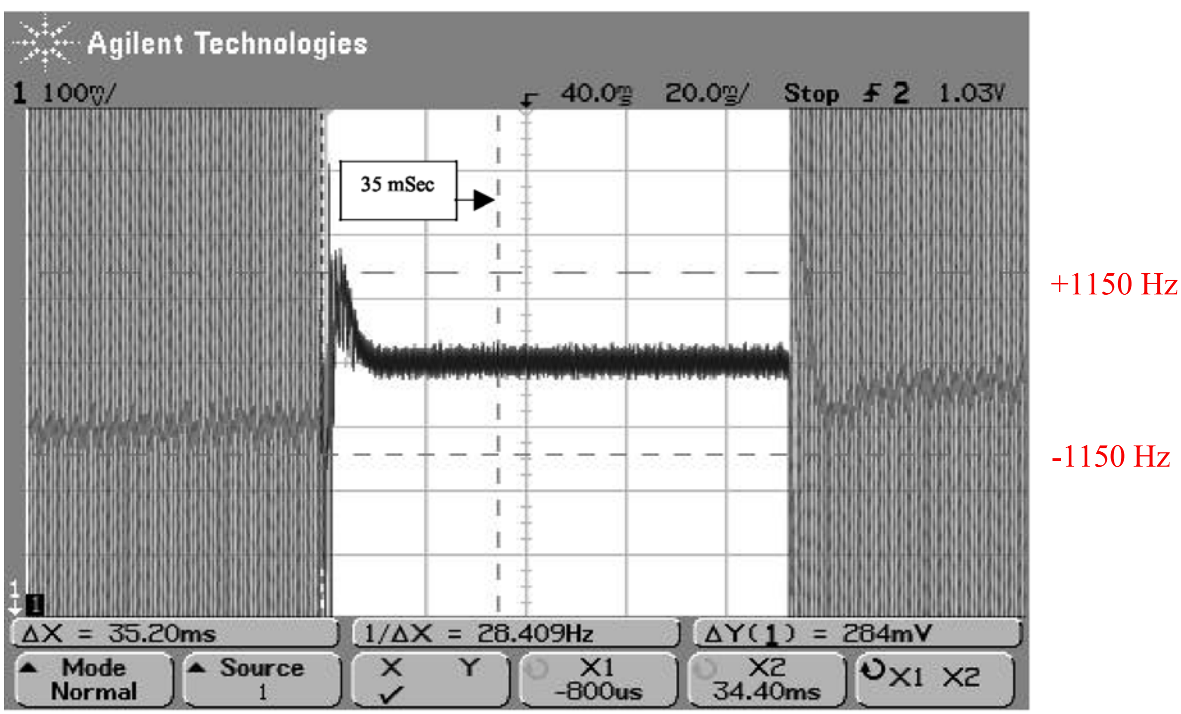

Fig. 4 Full Transmission

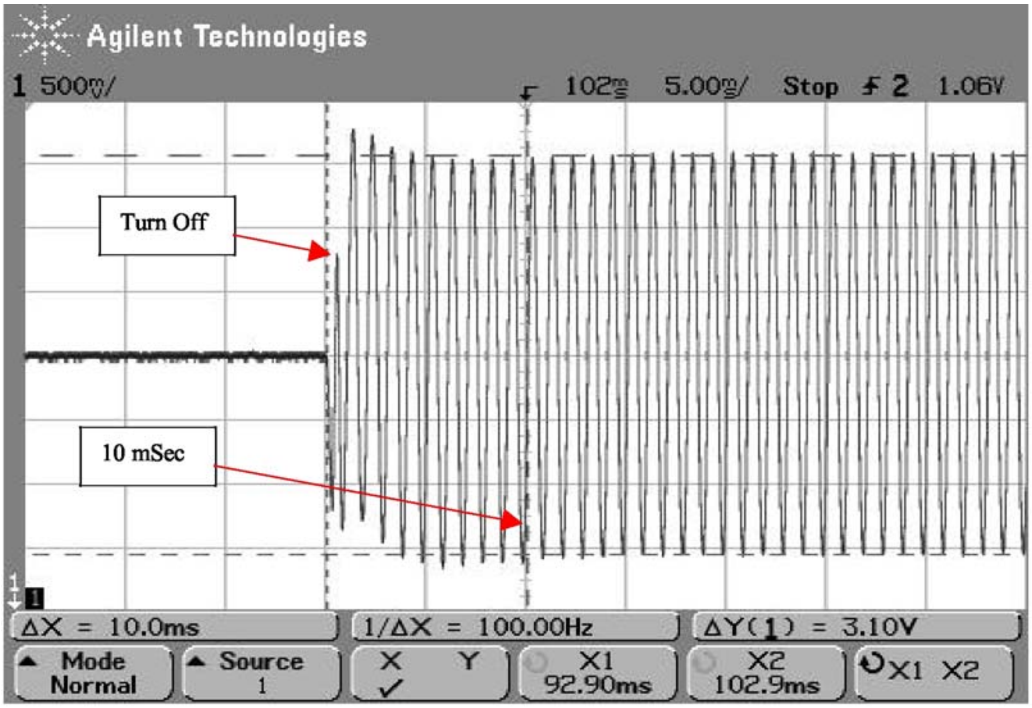

Fig. 5 Turn Off Transient

The modulated signal appears well within the allowed 10 ms and does not exceed ±12.5 kHz beyond 10 ms.

<u>Test Equipment Used</u>

Signal Generator:
Marconi, Model 2955A

Test Receiver:
Hexagram DCU-I (Modified)

Oscilloscope:
Agilent, Model 54622D
s/n MY 40006228

RF Trigger:
Hexagram Detector Circuit