ENGINEERING STATEMENT

For Class II Permissive Change

Radio Shack, a Division of Tandy Corporation

Model No: 21-1859A
FCC ID: AAO2101825

I am an Electronics Engineer, a principal in the firm of Hyak Laboratories, Inc., Springfield, Virginia. My education and experience are a matter of record with the Federal Communications Commission.

Hyak Laboratories, Inc. has been authorized by Radio Shack, a Division of Tandy Corporation, to make measurements on a modified model 21-1825 transceiver (modified transceiver identified as Model 21-1859A). These tests were made by me or under my supervision in our Springfield laboratory.

The data verifies that the above mentioned transceiver continues to meet FCC requirements and a Class II Permissive Change applies.

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Rowland S. Johnson

Dated: July 26, 2001

A. INTRODUCTION

The following data are submitted in connection with continued compliance of the 21-1859A transceiver in accordance with Part 2,

Subpart J of the FCC Rules.

The 21-1859A is a portable, battery operated, UHF, frequency modulated transceiver intended for 12.5 kHz channel family radio service applications in the 462.5625-467.7125 MHz band. It operates from a nominal 4.5 Vdc battery supply. MFR rated output power is 0.3 watts ERP.

A change from the previously type certified model 21-1825 consists of:

1. MCU IC is changed from MC68HC05L1 to uPD789405 with its relevant component modification. The function of IC is same as before with different brand and type only.

2. IC302 and IC304 have been changed from NJM3403 to be LM324V with its relevant component modification. These two type Ics have the same function and can be interchangeable.

3. Added data control on cystal frequency to guarantee its stability within the required limits as well and the change of MCU.

A revised schematic diagram and Function of Devices exhibit is filed in a separate exhibit.

The above changes involve modification to the PLL reference crystal and audio circuits. Accordingly the following data are included:

1. Frequency stability as a function of temperature; temperature as a function of supply voltage. (See Tables 1 and 2.)

2. Audio frequency response (figure 1); low pass filter response (figure 2); audio limiter characteristics (figure 3) and occupied bandwidth (figure 4).

B. MODULATION CHARACTERISTICS

1. A curve showing frequency response of the transmitter is shown in Figure 1. Reference level was audio signal output from a Boonton 8220 modulation meter with one kHz deviation. Audio output was measured with an Audio Precision System One integrated test system.

2. Modulation limiting curves are shown in Figure 2, using a Boonton 8220 modulation meter. Signal level was established with a Audio Precision System One integrated test system. The curves show compliance with paragraphs 2.987(b).

3. Figure 3 is a graph of the post-limiter low pass filter which provides a roll-off of 60Logf/3 dB where f is

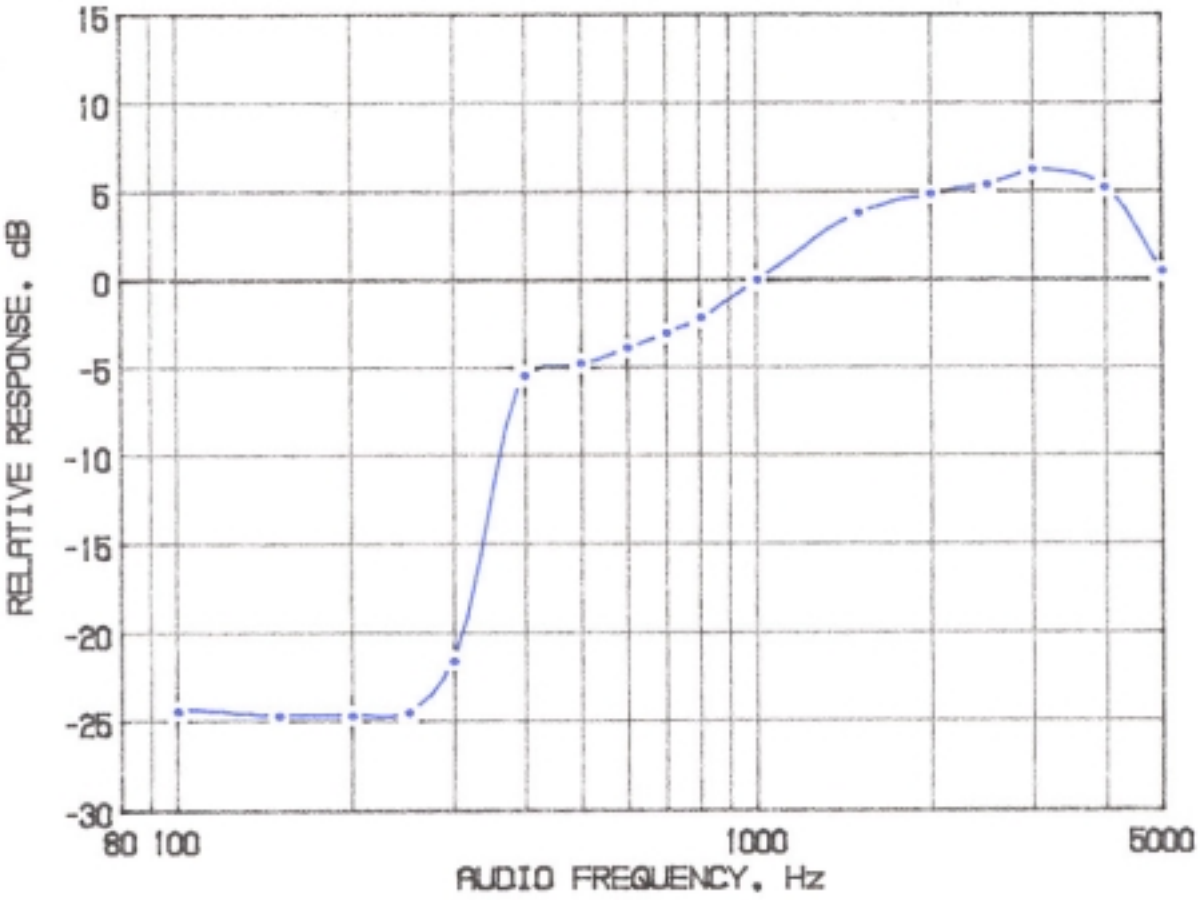
audio frequency in kHz. Measurements were made following EIA RS-152B with an Audio Precision System One integrated test system on the Boonton 8220 modulation meter audio output.

4. Occupied Bandwidth
(Paragraphs 2.989(c) of the Rules)

Figure 4 is a plot of the sideband envelope of the transmitter output taken with a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2926 Hz, the frequency of maximum response. Measured modulation under these conditions was 2.0 kHz.

FIGURE 1

MODULATION FREQUENCY RESPONSE



MODULATION FREQUENCY RESPONSE
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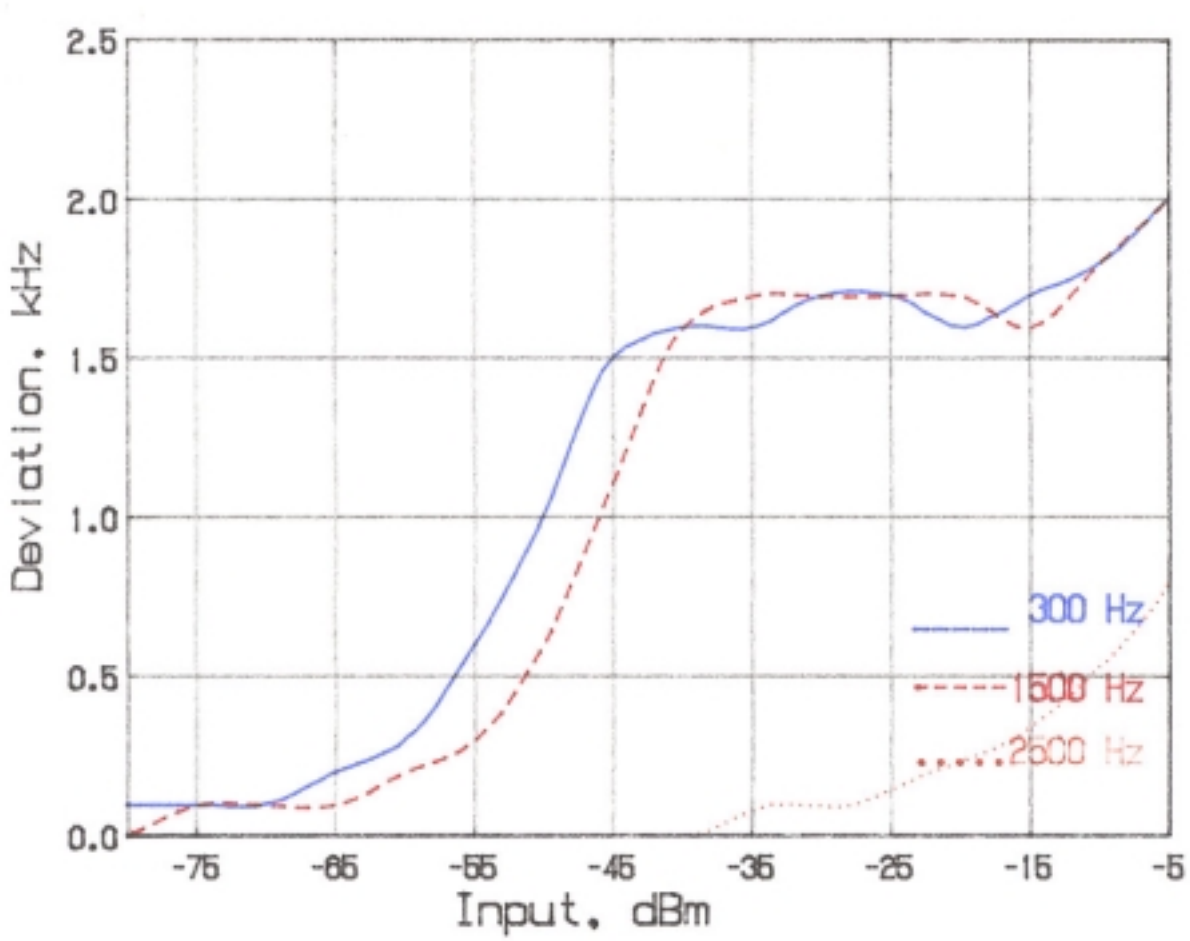
FIGURE 1

FIGURE 2

AUDIO LIMITER CHARACTERISTICS



AUDIO LIMITER CHARACTERISTICS
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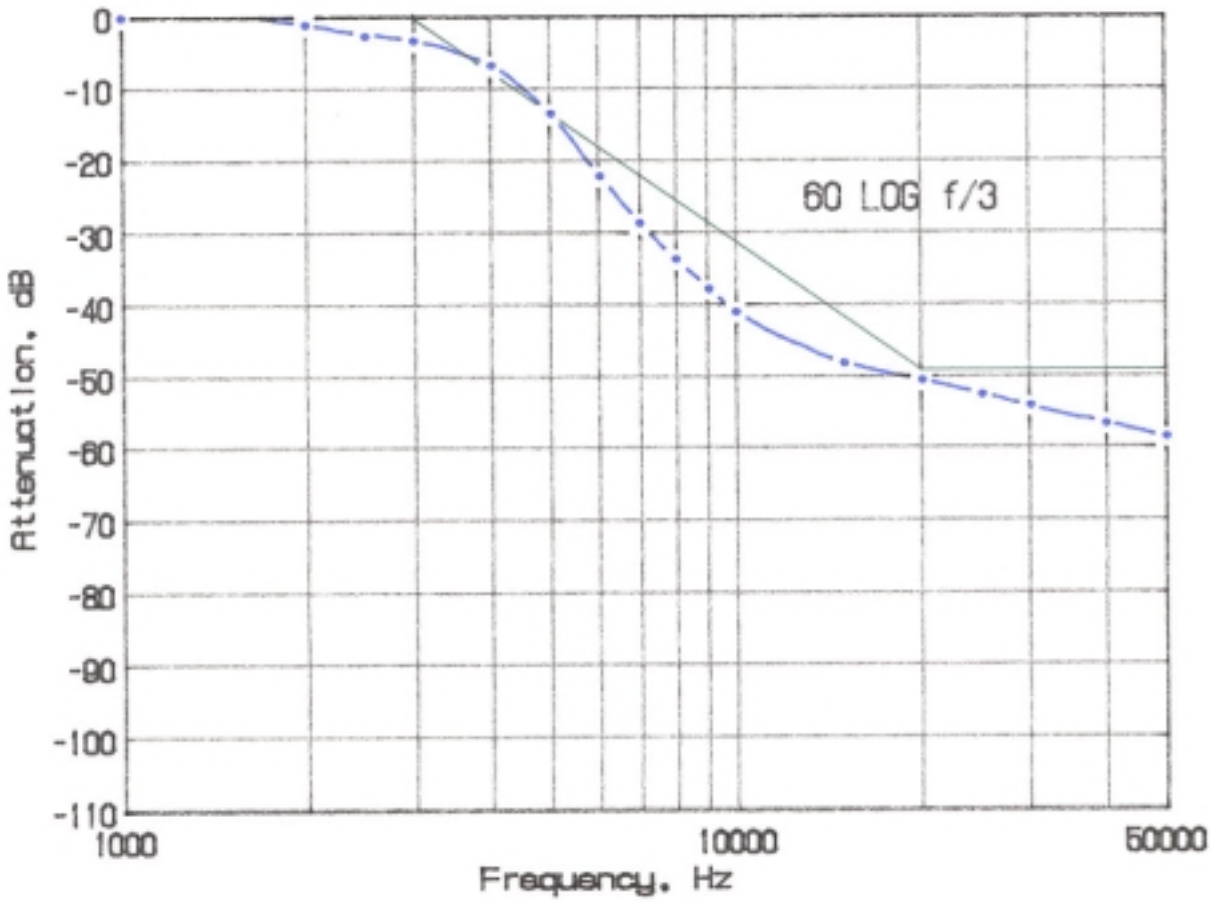
FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE



AUDIO LOW PASS FILTER
RESPONSE
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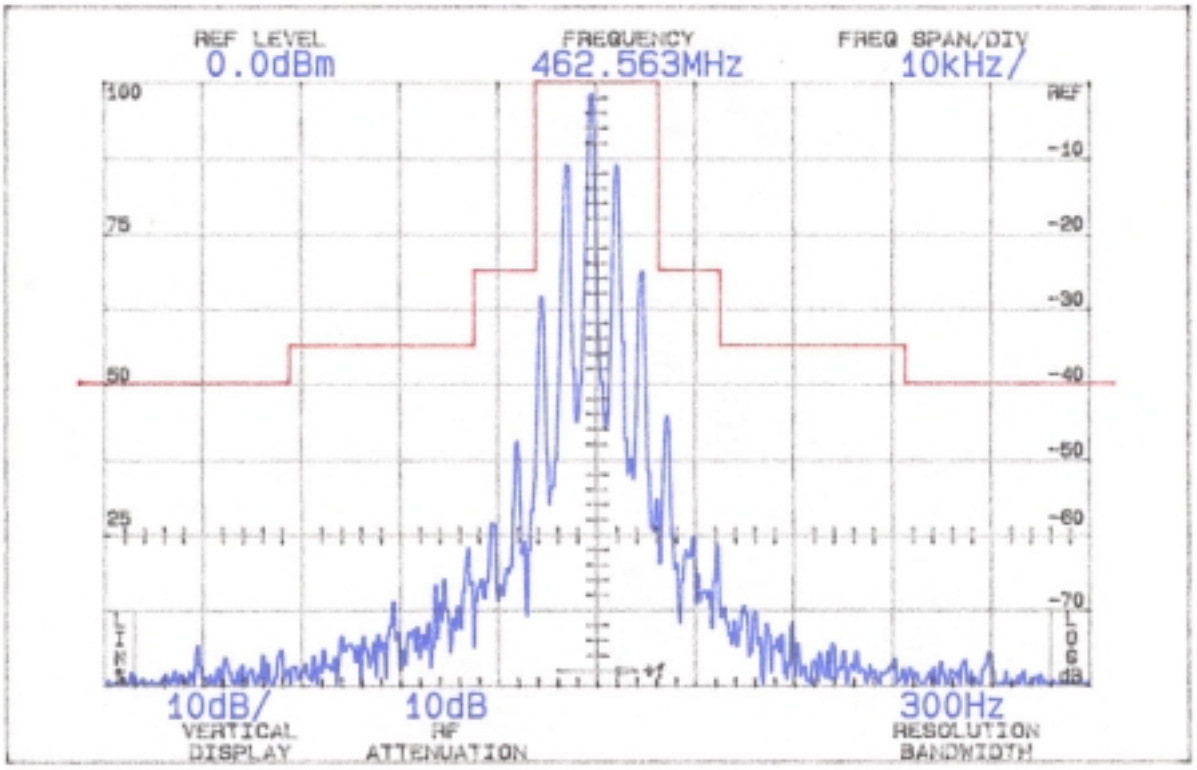
FIGURE 3

FIGURE 4

OCCUPIED BANDWIDTH



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 12.5 kHz (6.25-12.5 kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (12.5-31.25 kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth (over 31.25 kHz)	43+10LogP = 38 (P = 0.29W)

OCCUPIED BANDWIDTH
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FIGURE 4

C. MODULATION CHARACTERISTICS (Continued)

The plots are within FCC limits. The horizontal scale frequency) is 10 kHz per division and the vertical scale amplitude) is a logarithmic presentation equal to 10 dB per

division.

D. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS
(Paragraph 2.991 of the Rules)

The 21-1859A has a permanently attached antenna. There is no connector for an external antenna. Therefore, no antenna terminal conducted measurements were made.

E. DESCRIPTION OF RADIATED SPURIOUS MEASUREMENT FACILITIES

A description of the Hyak Laboratories' radiation test facility is a matter of record with the FCC. The facility was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

F. FREQUENCY STABILITY
(Paragraph 2.995(a)(2))

Measurement of frequency stability versus temperature was made at temperatures from -20°C to +50°C. At each temperature, the unit was exposed to test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within ±2° of the desired test temperature. Following the 1 hour soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes. Test temperature was sequenced in the order shown in Table 1, starting with -20°C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital thermometer. The transmitter output stage was terminated in a dummy load. Primary supply was 4.5 volts. Frequency was measured with a HP 5385A frequency counter connected to the transmitter through a power attenuator. Measurements were made at 462.5625 MHz. No transient keying effects were observed.

TABLE 1

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE
462.5625 MHz, 4.5 Vdc, 0.29 W

Temperature, °C	Output Frequency, MHz	p.p.m.

-2-.4	462.562593	2.2
-10.1	462.562565	0.1
-0.9	462.562759	0.6
10.1	462.562803	0.7
20.3	462.562559	0.1
29.3	462.562656	0.3
39.8	462.562595	0.2
50.9	462.562455	-0.1

Maximum frequency error: 462.562803
462.562500

\+ .000303 MHz

FCC Rule 95.627(b) specifies .00025% (2.5 p.p.m.) or a maximum of ±0.001156 MHz, which corresponds to:

High Limit	462.563656 MHz
Low Limit	462.561344 MHz

G. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE
(Paragraph 2.995(d)(2) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with a HP 5385A frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied from

±15% above the nominal 4.5 volt rating to below the battery end point. A Fluke 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 2

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE

462.5625 MHz, 4.5 Vdc Nominal; 0.29W

Supply Voltage		Output Frequency, MHz	p.p.m.
5.17	115%	462.562745	0.5
4.95	110%	462.562673	0.4
4.73	105%	462.562563	0.1
4.50	100%	462.562559	0.1
4.28	95%	462.562547	0.1
4.05	90%	462.562426	-0.2
3.83	85%	462.562475	-0.1
3.60	80%	462.562597	-1.0

Maximum frequency error: 462.562597
462.562500

\- .000472 MHz

FCC Rule 95.627(b) specifies .00025% (2.5 p.p.m. or a maximum of ±0.001156 MHz, corresponding to:

High Limit	462.563656 MHz
Low Limit	462.561344 MHz