A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the 21-1849 transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 21-1849 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 0.5 watts ERP.

B. GENERAL INFORMATION REQUIRED FOR TYPE CERTIFICATION (Section 2.1033 of the Rules)

1. Name of applicant: Radio Shack Corporation

2. Identification of equipment: FCC ID: AAO2101849

   a. The equipment identification label is submitted as a separate exhibit.
   b. Photographs of the equipment are submitted as a separate exhibit.

3. Quantity production is planned.

4. Technical description:

   a. 11k0F3E emission
   b. Frequency range: 462.5625 - 467.7125 MHz.
   c. Operating power of transmitter is fixed at the factory at less than 0.5 W ERP.
   d. Maximum power permitted is 0.5 watts, and the 21-1849 fully complied with that power limitation.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 4.4 Vdc
      Collector current: 0.52 A

   f. Function of each active semiconductor device: See Appendix 1.
   g. Complete schematic diagram is submitted as a separate exhibit.
   h. A draft instruction manual is submitted as a separate exhibit.
   i. The transmitter tune-up procedure is submitted as a separate exhibit.

B. GENERAL INFORMATION (continued)

   j. A description of circuits for stabilizing frequency is included in Appendix 2.

k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 3.

l. Not applicable.

5. Data for 2.1046 through 2.1057 follow this section.

C. RF Power Output (Section 2.1046 of the Rules)

The 21-1849 has a permanently attached built-in antenna without provisions for a coaxial connector.

RF power output was determined by substitution.

TABLE 1

Operating Freq., MHz	Power watts into a dipole antenna
462.5625	0.49

D. MODULATION CHARACTERISTICS (Section 2.1047 of the Rules)

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
(Section 2.1047 and 95.629(a)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 2.1049(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50%

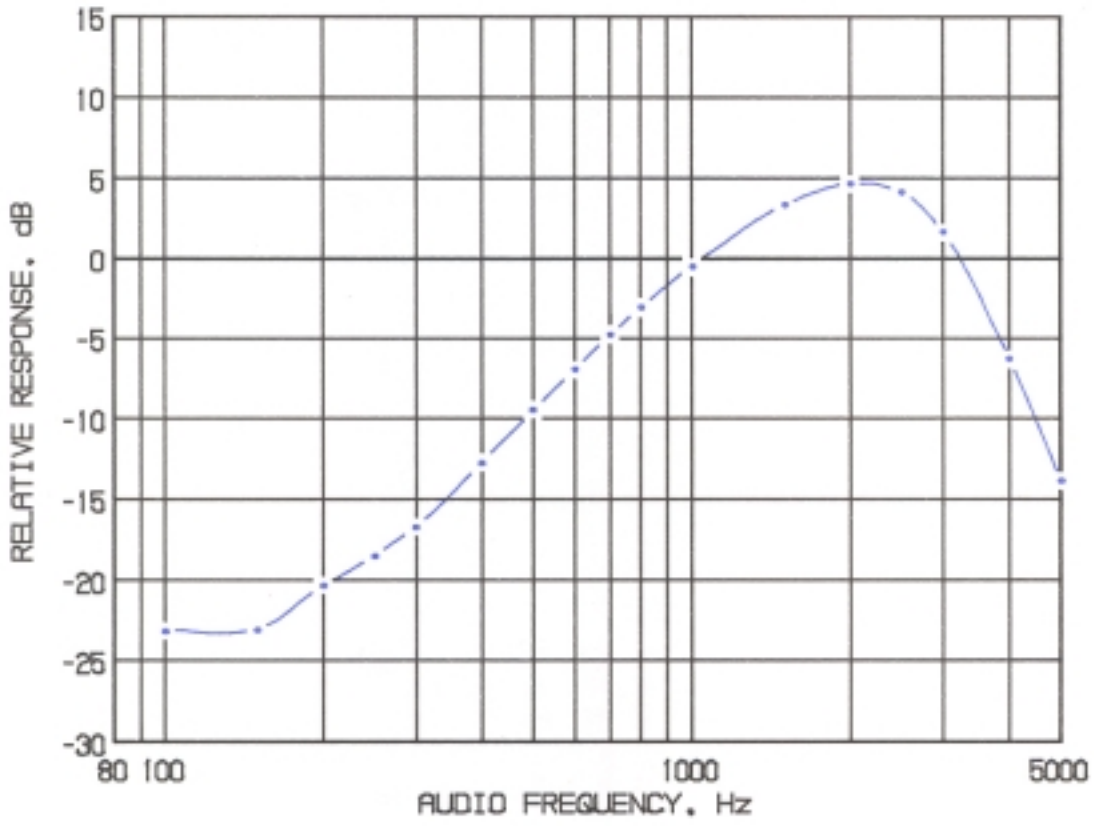
modulation at 1997 Hz, the frequency of maximum response.

Emission designator:

(2M + 2D) (2 x 3 kHz) + (2 x 2.5 kHz) = 11k0F3E

FIGURE 1

MODULATION FREQUENCY RESPONSE

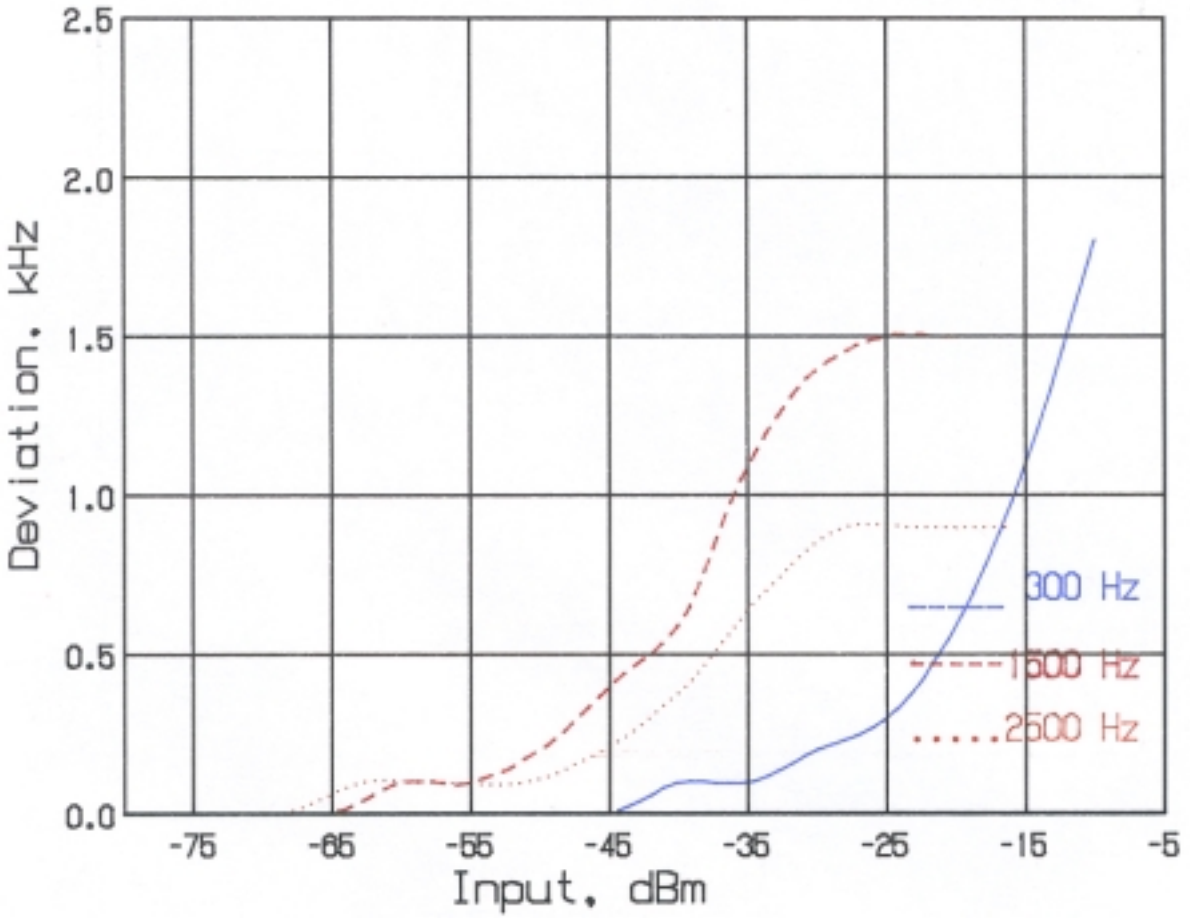


MODULATION FREQUENCY RESPONSE
FCC ID: AAO2101849

FIGURE 1

FIGURE 2

AUDIO LIMITER CHARACTERISTICS

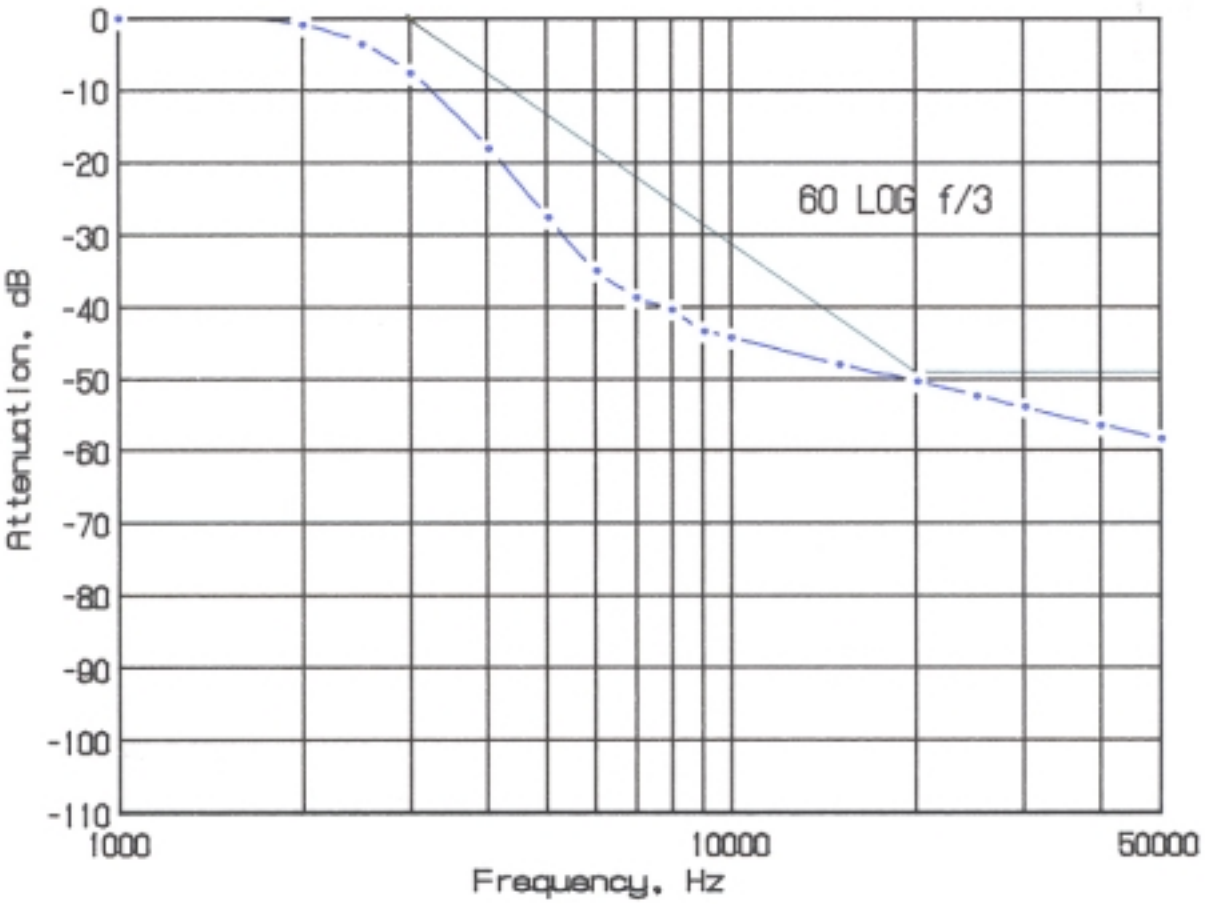


AUDIO LIMITER CHARACTERISTICS
FCC ID: AAO2101849

FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

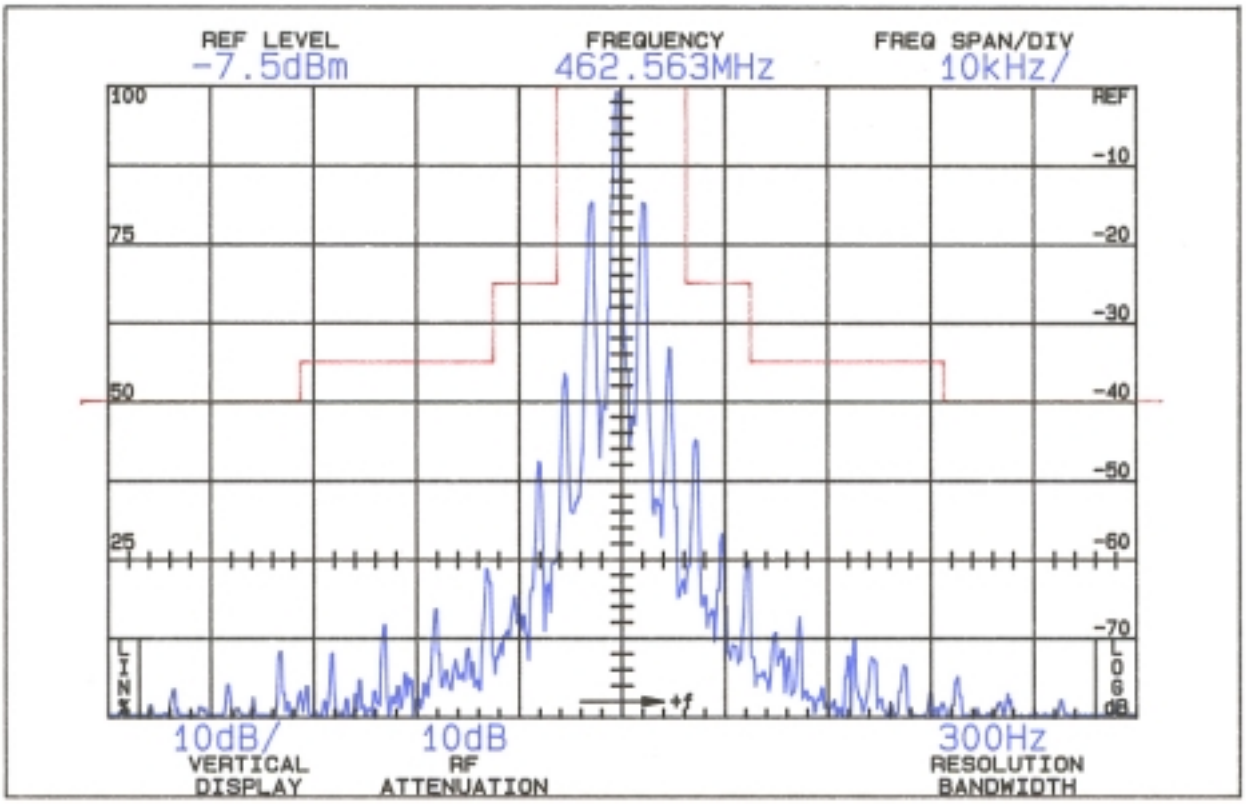


AUDIO LOW PASS FILTER
RESPONSE
FCC ID: AAO2101849

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 = 40 (P = 0.49)

OCCUPIED BANDWIDTH
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FIGURE 4

D. 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.

E. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

The 21-1849 has a permanently attached antenna. There is no connector for an external antenna. Therefore, no antenna terminal conducted measurements were made.

F. MEASUREMENTS OF SPURIOUS RADIATION
(Section 2.1053, 95.635(b)(7) of the Rules)

Measurements of radiated spurious emissions from the 21-1849 were made by substitution with a Tektronix 494P spectrum analyzer using Singer DM-105 for the measurements to 1 GHz, and EMCO 3115 horn to 4.8 GHz.

The transmitter was located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 4.5 Vdc.

The transmitter and test antennae were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

Measurements were made from the lowest frequency generated within the unit (10.25 MHz), to 10 times operating frequency. Data after application of antenna factors and line loss corrections are shown in Table 2.

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS

462.5625 MHz, 4.5 Vdc, 0.49 watts

Spurious Frequency	dB Below Carrier

MHz	Reference
462.563	0
925.127	53H
1387.693	53V
1850.251	54H
2312.811	49H
2775.376	50H
3237.936	45H
3700.498	54V
4163.058	55H
4625.623	57V

Required: 43+10 Log(P) = 40

All other spurious from 20.95 MHz to the tenth harmonic were 20 dB or more below FCC limit.

G. FREQUENCY STABILITY
(Section 2.1055 and 95.621(b) of the Rules))

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 3, starting with -20°C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital thermometer. 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 3

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE
462.5625 MHz, 4.5 Vdc, 0.49 W

Temperature, °C	Output Frequency, MHz	p.p.m.
-20.4	462.562895	0.9
-11.1	462.562941	1.0
1.2	462.562997	1.1
10.8	462.562938	0.9
20.1	462.562587	0.2
30.1	462.562265	-0.5
40.1	462.561995	-1.1
49.5	462.561980	-1.1
Maximum frequency error:	462.561980	
	462.562500	
	- .000520 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

H. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE
(Section 2.1055 and 95.621(b) 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 4

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE

462.5625 MHz, 4.5 Vdc Nominal; 0.49W

Supply Voltage		Output Frequency, MHz	p.p.m.
5.17	115%	462.562773	0.6
4.95	110%	462.562711	0.5
4.73	105%	462.562644	0.3
4.50	100%	462.562587	0.2
4.28	95%	462.562540	0.1
4.05	90%	462.562504	0.0
3.83	85%	**	n/a
3.60*	80%	**	n/a

Maximum frequency error: 462.562773
462.562500

+ .000273 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

*Battery end point.
**No RF output, CPU shut-down

APPENDIX 1

FUNCTION OF DEVICES

SEMICONDUCTORS AND FUNCTIONS

QS1	KRA105S	K.E.C	RX B+ SWITCHING
QS2	KRA105S	K.E.C	POWER SAVEING SWITCHING
QS3	KRA110S	K.E.C	BACK LIGHT LED CONTROL
QS4	KRA105S	K.E.C	TX B+ SWITCHING
QS5	KRA104S	K.E.C	CPU VDD CINTROL

QS6	KRC104S	K.E.C	TX B+ SWITCHING
QS7	KRA101S	K.E.C	PTT INPUT DET.
QB1	KTC3875S	K.E.C	LOW BATT. DET.
QB2	KTC3875S	K.E.C	TX POWER CONTROL
QF1	2SC4226	N.E.C	RX LOCAL OUTPUT
QF2	KRC104S	K.E.C	TX SWITCHING
QR1	2SC4226	N.E.C	RX RF AMP.
QR2	2SC4226	N.E.C	1'ST MIXER
QR3	KTC3880S	K.E.C	1'ST IF AMP.
QR4	KTC3875S	K.E.C	AUDIO MUTE
QR5	KRC104S	K.E.C	AUDIO AMP. B+ CONTROL
QR6	KRA226S	K.E.C	AUDIO AMP. B+ CONTROL
QT1	2SC4226	N.E.C	TX BUFFER
QT2	2SC4226	N.E.C	TX POWER DRIVE AMP.
QT3	DRF1401	PARTSNIC	TX POWER FINAL AMP.
QM1	KTC3875S	K.E.C	TX AUDIO AMP
QM2	KTC3875S	K.E.C	TX AUDIO AMP.
QM3	KTC3875S	K.E.C	TX AUDIO AMP.
QC1	KRC104S	K.E.C	CALL MUTE
QV1	KRC104S	K.E.C	RX/TX MOD. SWITCHING
QV2	2SC4226	N.E.C	O.S.C

IC1	TK83361	TOKO	2'nd MIXER,IF,AND FM DETECTOR CPU
IC2	NJM2070	J.R.C	AUDIO POWER AMP.
IC3	TMP87C807U	TOSHIBA	CPU
IC4	TB31202FN	TOSHIBA	PLL FREQUENCY SYNTHESIZER
IC5	TK11228CMCL	TOKO	

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

The PLL synthesizer of the 21-1849 consists of the signal loop PLL circuit with the reference of 12.5KHz. The IC4 PLL IC includes all the functions such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider.

At the reference oscillator, the 10.25MHz TCXO of the CTX1 is connected to the pin 11 of the IC4 to oscillate the frequency of 10.25MHz. The TCXO(10.25 MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -20∝.

The phase detector sends out the output power to the loop filter through 3 pin of the IC4. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector sends out the output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector sends out the output power in negative pulse. Therefore, the VCO can maintain the frequency set.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
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APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION
AND LIMIT MODULATION

The transmitted signal of approximately 7mW, combined at the PLL module is supplied to the base of the QT3 amplifier. The transmitted signal amplified to 0.5 Watts here passes the TX LPF of the 2nd characteristic of the LT4 and the LT5, and RX/TX switching takes place by the DT2. After this, the signal is provided to the antenna the TX LPF of the 1st characteristics,

consisted of the LT6.

The voice signal input from the microphone is pre-emphasized at the QM1. The signal which comes out of the QM2 is limited to a certain amplitude for the voice signal not to exceed the allowable band width assigned for transmission.

CIRCUITS TO SUPPRESS SPURIOUS
RADIATION AND LIMIT MODULATION
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APPENDIX 3