A. INTRODUCTION

The following data are submitted in connection with this request for Type Certification of the KG506-40D25K transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The KG506-40D25K is a multi-bandwidth, UHF, frequency modulated transceiver intended for applications in the 440 - 475 MHz band. It operates from a 13.8 volt vehicle supply. Rated output power rating is 1 to 30 watts. Both 25 kHz and 12.5 kHz channel operation is provided.

B. GENERAL INFORMATION REQUIRED FOR TYPE CERTIFICATION (Paragraph 2.983 of the Rules)

1. Name of applicant: Kyodo West

2. Identification of equipment: FCC ID: IOJKG50640

   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. 16k0F3E; 11k0F3E emission
   b. Frequency range: 440-475 MHz.
   c. Operating power of transmitter is fixed at the factory at 30 watts and can be reduced to 1 watt under software control.
   d. Maximum power permitted under Part 90 of the FCC is 350 watts, and the KG506-40D25K fully complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 9.9 Vdc
      Collector current: 7.1 A

   f. Function of each active semiconductor device: See Appendix 1.
   g. Complete circuit diagram in included as a separate exhibit.
   h. A draft instruction book is submitted as a separate exhibit.

B. GENERAL INFORMATION...(Continued)

i. The transmitter tune-up procedure is included as a separate exhibit.
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 2.985 through 2.997 follow this section.

C. RF POWER OUTPUT (Paragraph 2.985(a) of the Rules)

RF power output was measured with a Bird 4421 RF power meter and a Bird 8325 attenuator as a 50 ohm dummy load. Maximum power measured was 33 watts; and with software programming minimum power was 1.5 watt. (The transmitter was tuned by the factory.)

D. 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 a Audio Precision System One TRMS voltmeter and tracking generator.

2. Modulation limiting curves are shown in Figures 2a and 2b for wide or narrow channel operation respectively, using a Boonton 8220 modulation meter. Signal level was established with a Audio Precision System One TRMS voltmeter. The curves show compliance with paragraphs 2.987(b), and 90.211(c).

3. Figure 3 is a graph of the post-limiter low pass filter which meets the requirements of paragraph 90.211(d)(1) in providing 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 selective voltmeter on the Boonton 8220 modulation meter audio output.

D. MODULATION CHARACTERISTICS

4. Occupied_Bandwidth
(Paragraphs 2.989(c), 90.209(b)(4) and 90.210(d) of the Rules)

Figures 4a, 4b, 4c and 4d are plots of the sideband envelope of the transmitter for both 1.5 and 33 watt output taken with a TEK 494P or Advantest R3361A 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 2996 Hz, the frequency of maximum response. Measured modulation under these conditions was 4.9 kHz, or 2.4 kHz for 25 or 12.5 kHz channelization respectively.

For the 12.5 kHz channelization, RBW was 100 Hz, VBW 100 Hz, max hold, multiple scan per 90.210(d)(4).

All plots have unmodulated carrier as 0 dBm reference.

Emission Designators:

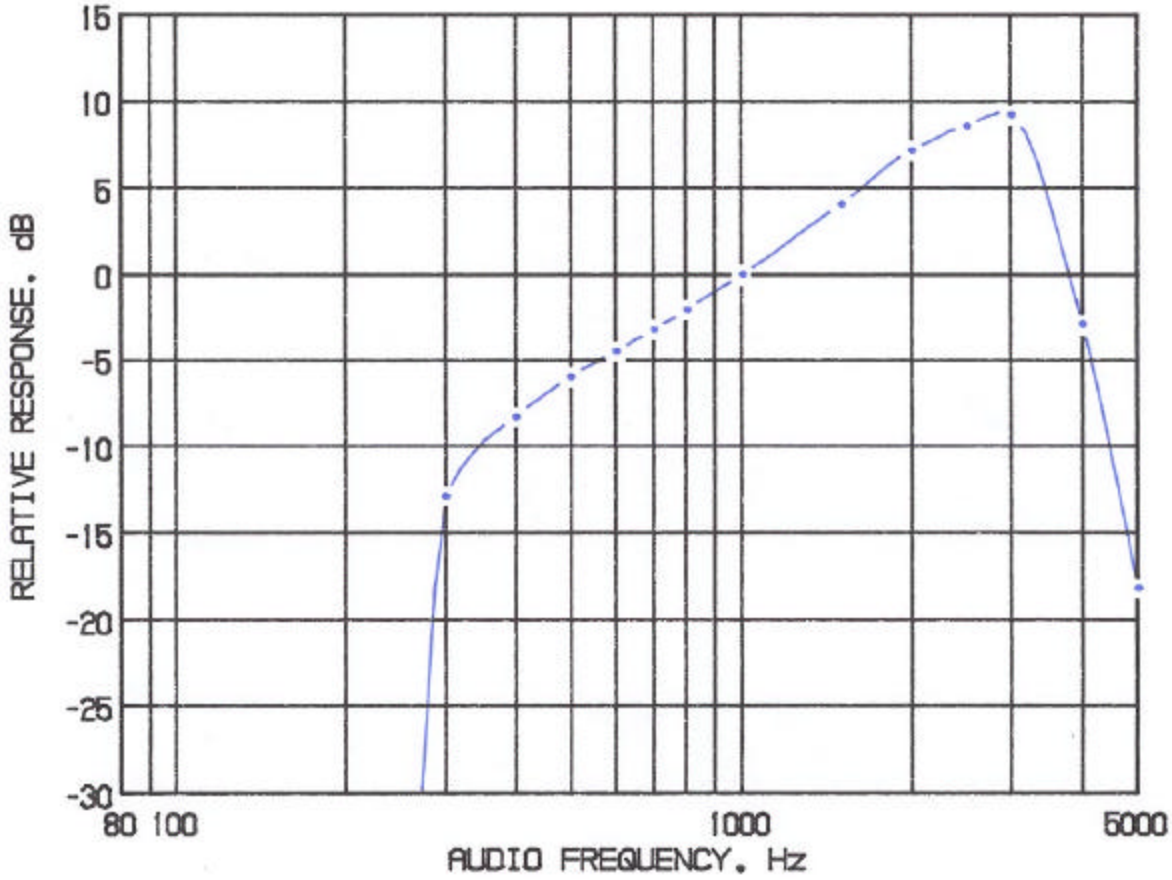
Carson’s = (2K + 2F)

K = rated system deviation, kHz
F = maximum modulation frequency, kHz

16k0F3E: 2x5+2x3 = 16
11k0F3E: 2x2.5+2x3 = 11

FIGURE 1

MODULATION FREQUENCY RESPONSE

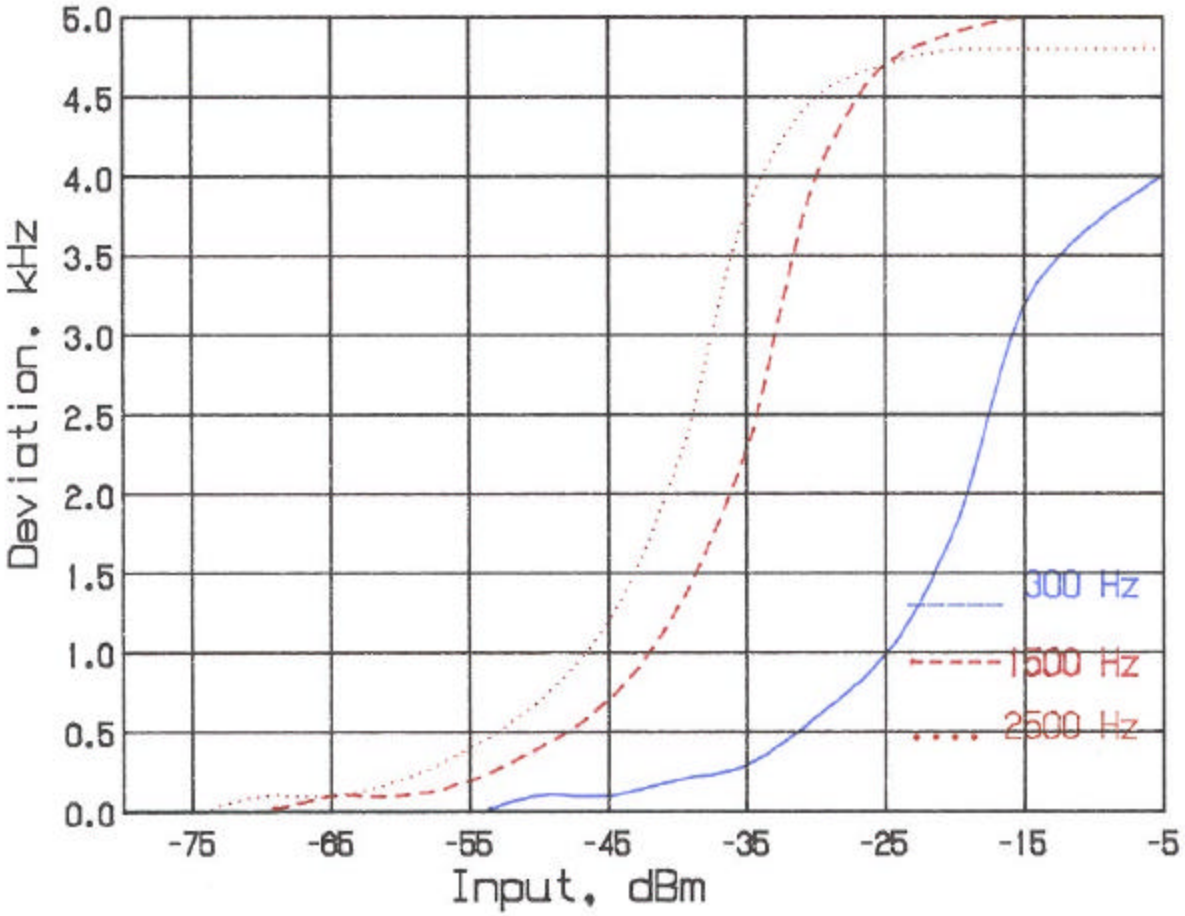


MODULATION FREQUENCY RESPONSE
FCC ID: IOJKG50640

FIGURE 1

FIGURE 2a

AUDIO LIMITER CHARACTERISTICS



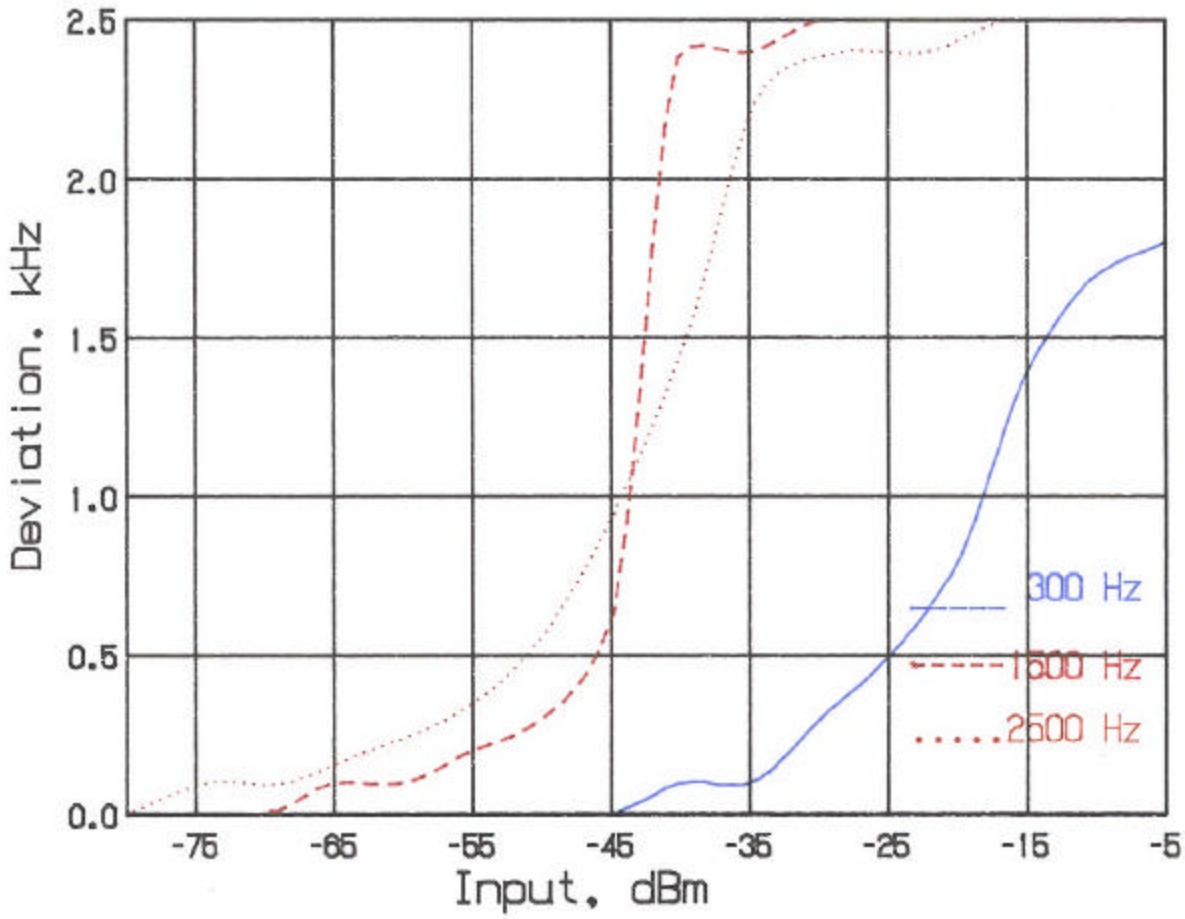
NOTE: Deviation did not exceed 5.0 kHz.

AUDIO LIMITER CHARACTERISTICS
FCC ID: IOJKG50640

FIGURE 2a Wideband (5 kHz)

FIGURE 2b

AUDIO LIMITER CHARACTERISTICS



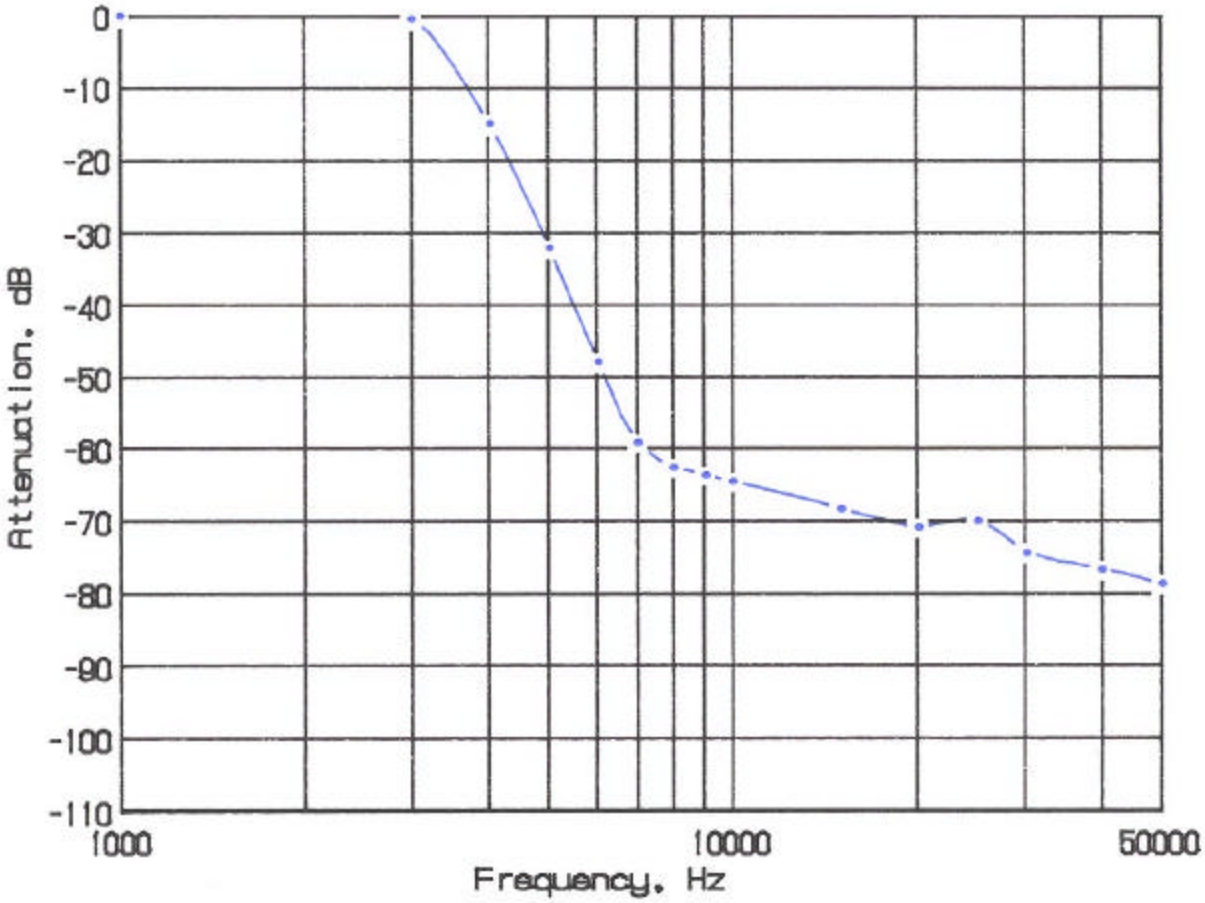
NOTE: Deviation did not exceed 2.5 kHz.

AUDIO LIMITER CHARACTERISTICS
FCC ID: IOJKG50640

FIGURE 2b Narrow band (2.5 kHz)

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE



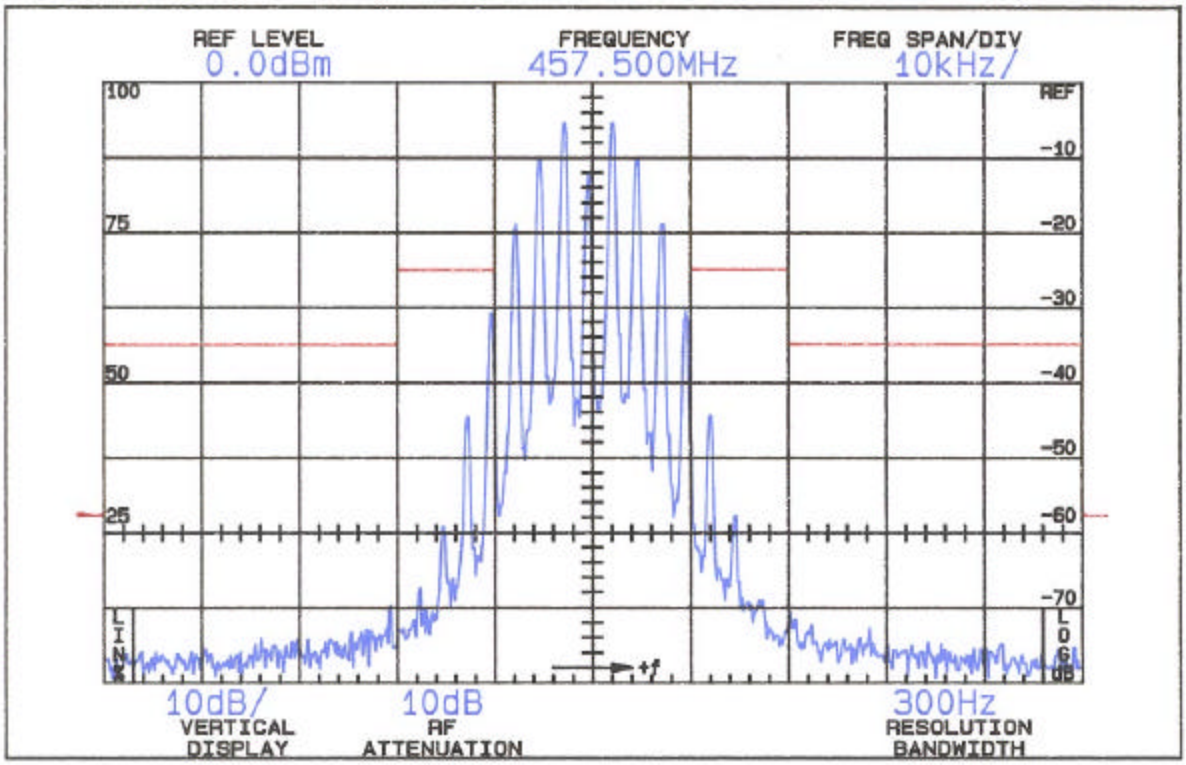
NOTE: Unusually high attenuation is result of digital signal processor.

AUDIO LOW PASS FILTER RESPONSE
FCC ID: IOJKG50640

FIGURE 3

FIGURE 4a

OCCUPIED BANDWIDTH



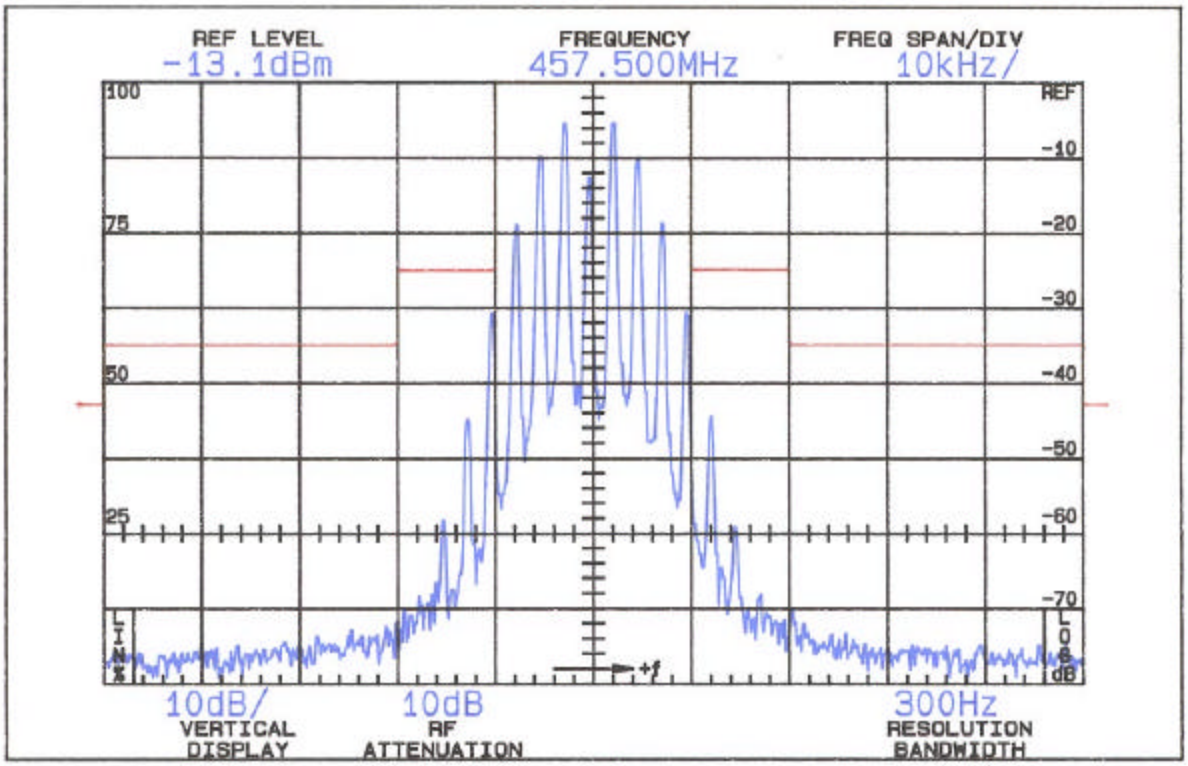
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 20 kHz (10-20 kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (20-50 kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth (over 50 kHz)	43+10LogP = 58

OCCUPIED BANDWIDTH (33 W)
FCC ID: IOJKG50640

FIGURE 4a (5 kHz)

FIGURE 4b

OCCUPIED BANDWIDTH



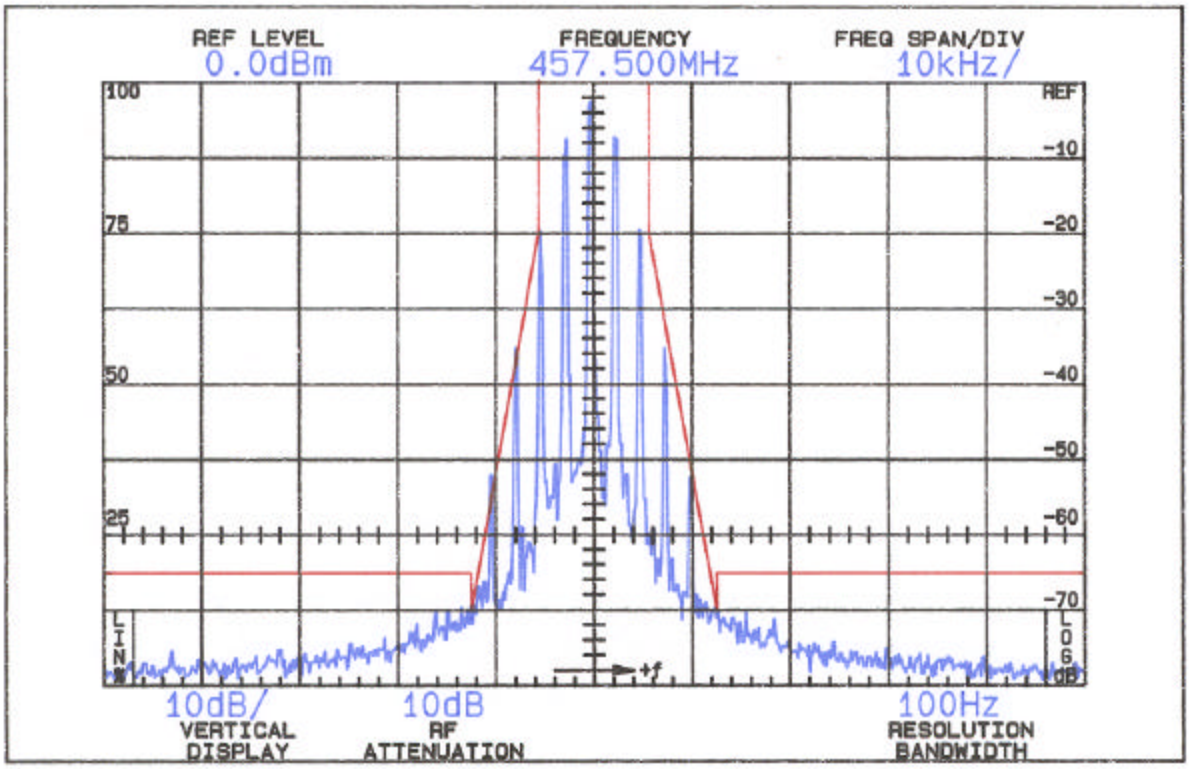
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 20 kHz (10-20 kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (20-50 kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth (over 50 kHz)	43+10LogP = 45

OCCUPIED BANDWIDTH (1.5 W)
FCC ID: IOJKG50640

FIGURE 4b (5 kHz)

FIGURE 4c

OCCUPIED BANDWIDTH



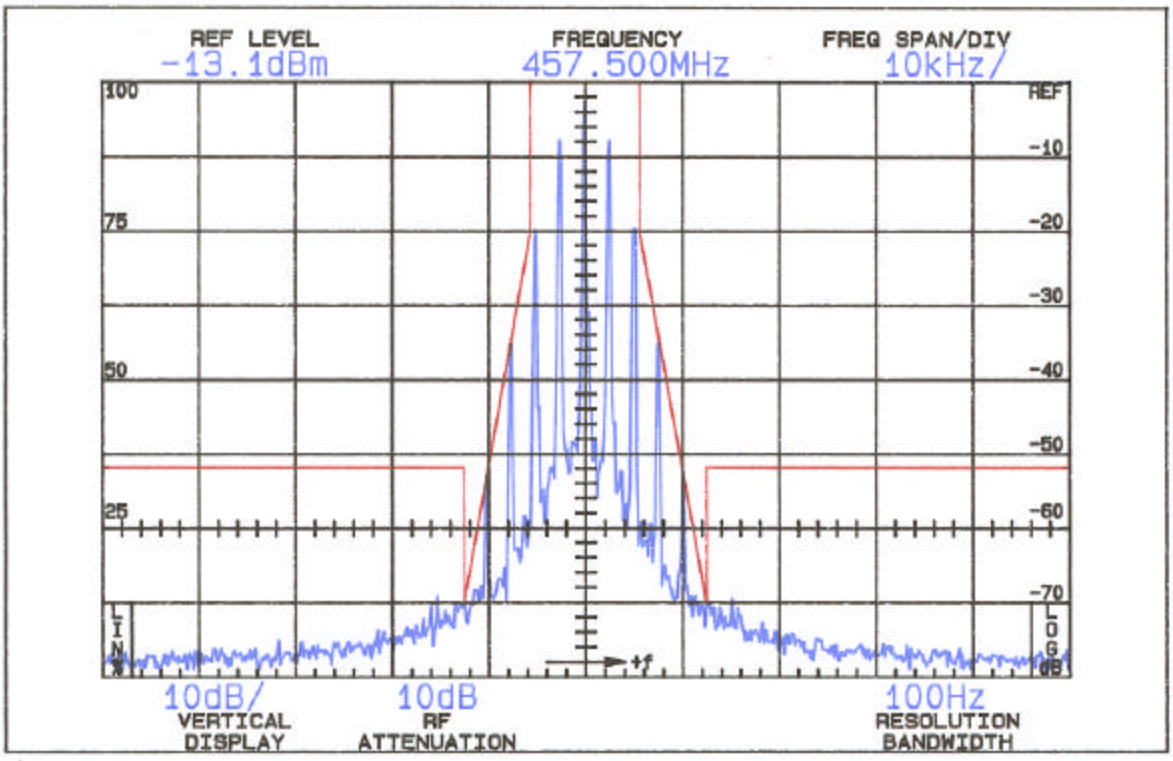
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o.	0 (>5.625 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27 (f_d - 2.88 kHz) dB.	70 (@ 12.5 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz.	50+10LogP = 65 (>12.5 kHz)

OCCUPIED BANDWIDTH (F3E 33W)
FCC ID: IOJKG50640

FIGURE 4c (2.5 kHz)

FIGURE 4d

OCCUPIED BANDWIDTH



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o.	0 (>5.625 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27 (f_d - 2.88 kHz) dB.	70 (@ 12.5 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz.	50+10LogP = 52 (>12.5 kHz)

OCCUPIED BANDWIDTH (F3E 1.5W)
FCC ID: IOJKG50640

FIGURE 4d (2.5 kHz)

D. MODULATION CHARACTERISTICS (Continued)

The plots are within the limits imposed by Paragraph 90.211(c) for frequency modulation. The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

Resolution bandwidth was 100 Hz; video bandwidth 1 kHz; max store display; 20 second scan time.

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

The KG506-40D25K transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a 2500 Hz signal, 16 dB above minimum input signal for 50% (2.5 kHz deviation) modulation at 2996 Hz, the frequency of highest sensitivity.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through a Bird 8325 power attenuator. A notch filter was used to attenuate the carrier.

During the tests, the transmitter was terminated in the 50 ohm attenuator. Power was monitored on a Bird 43 Thru-Line wattmeter; dc supply was 13.8 volts throughout the tests.

Spurious emissions were measured at 33 and 1.5 watts output throughout the RF spectrum from (lowest frequency generated in the transmitter is 14.95 MHz) to the tenth harmonic of the carrier.

Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS
457.500, 13.8 Vdc Input

Spurious Frequency ___MHz___	dB Below Carrier Reference	
33 W		
915.000	89	
1372.500	>100	
1830.000	98	
2287.500	>100	
2745.000	>100	
3202.500	>100	
3660.000	>100	
4117.500	>100	
4575.000	>100	
Required:	58	(65) 90.210(d)
1.5 W		
915.000	92	
1372.500	>100	
1830.000	>100	
2287.500	>100	
2745.000	>100	
3202.500	>100	
3660.000	>100	
4117.500	>100	
4575.000	>101	
Required:	45	(52) 90.210(d)

All other emissions to the tenth harmonic were 20 dB or more below FCC limit.

NOTE: Carrier notch filter used to increase dynamic range.

F. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Measurement of radiated spurious emissions from the KG506-40D25K were made by substitution with a Tektronix 494P spectrum analyzer using Singer DM-105A or Emco 3121 calibrated dipole antennas below 1 GHz, and Polarad CA-L, and CA-S or EMCO 3115 from 1-5.0 GHz based on the procedures of EIA/TIA 603 (1992).

The transmitter and dummy load were located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 13.8 Vdc.

Output power was 33 watts at 457.500 MHz operating frequency. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antennae polarization were employed.

Reference level for the spurious radiations was taken as 33 watts, the output power of the transmitter.

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 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

457.500 MHz, 13.8 Vdc, 33 watts

Spurious Frequency MHz	dB Below Carrier Reference[1]	
3328.5	85V*	
Required:	58	(65) 90.210(d)

[1]Worst-case polarization, H-Horizontal, V-Vertical.

*Worst case harmonic data for reference data only, 20 dB below FCC limit.

All other spurious to 4.7 GHz were 20 dB or more below FCC limit.

G. FREQUENCY STABILITY
(Paragraph 2.995(a)(2) and 90.213 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°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 -30°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 13.8 volts. Frequency was measured with a HP 5385A frequency counter connected to the transmitter through a power attenuator. Measurements were made at 457.500 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE
457.500 MHz; 13.8 Vdc; 33 W

Temperature, °C	Output Frequency, MHz	p.p.m.
-29.4	457.499193	-1.8
-19.6	457.499358	-1.4
-10.2	457.499820	-0.4
0.3	457.500117	0.3
9.9	457.500160	0.3
19.8	457.500026	0.1
30.2	457.499915	-0.2
40.1	457.499959	-0.1
49.9	457.500212	0.5

Maximum frequency error: 457.499193
457.500000

- .000807 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001144 MHz, which corresponds to:

High Limit	457.501144 MHz
Low Limit	457.498856 MHz

H. 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 13.8 volt rating. 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
457.500 MHz, 13.8 Volts Nominal, 33 W

%	Supply Voltage	Output Frequency, MHz	p.p.m.
115	15.87	457.500041	0.1
110	15.18	457.500037	0.1
105	14.49	457.500032	0.1
100	13.80	457.500026	0.1
95	13.11	457.500021	0.0
90	12.42	457.500017	0.0
85	11.73	457.500012	0.0

Maximum frequency error: 457.500041
457.500000

+ .000041 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001144 MHz, corresponding to:

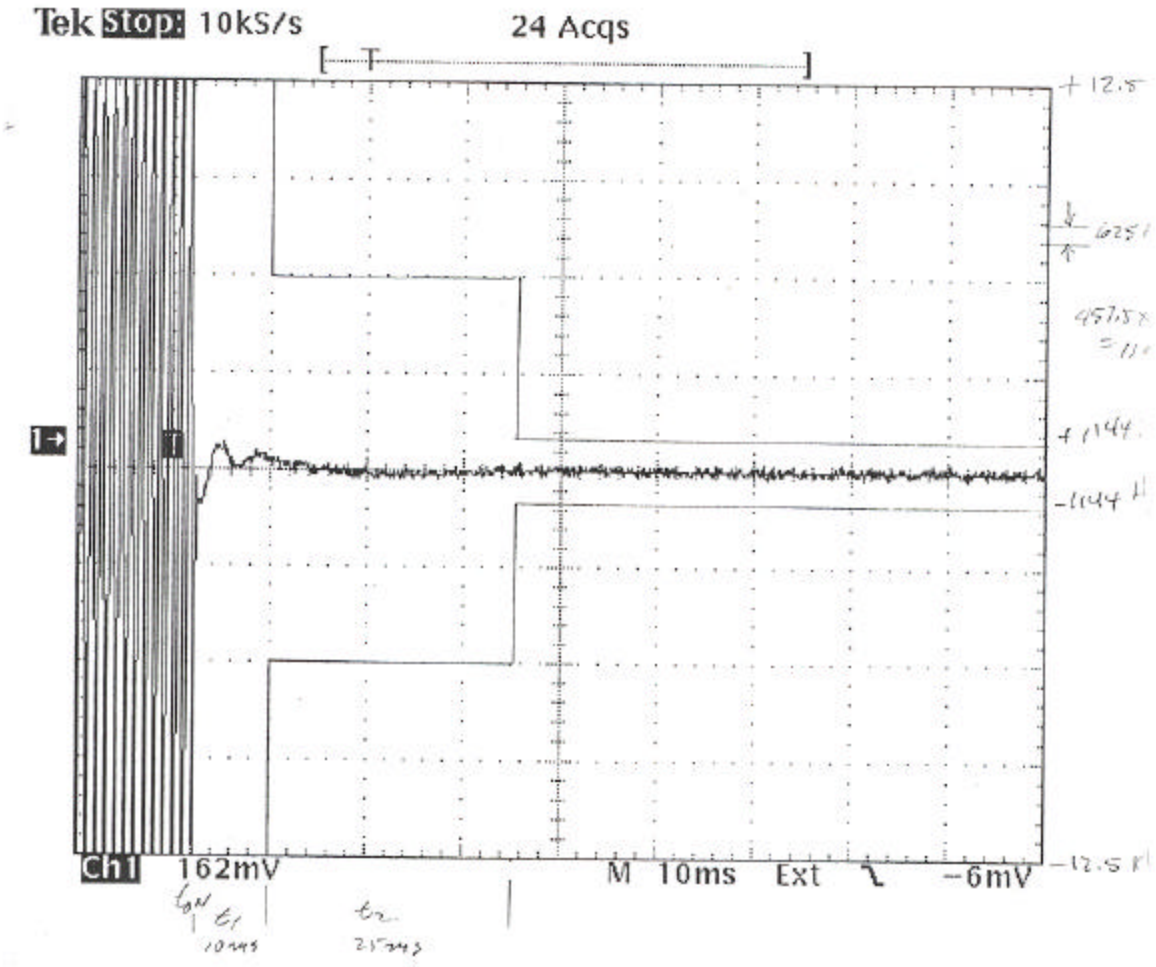
High Limit	457.501144 MHz
Low Limit	457.498856 MHz

J. TRANSIENT FREQUENCY BEHAVIOR
(Paragraph 90.214 of the Rules)

Plots identified as Figures 5 and 6 demonstrate TFB.

FIGURE 5

TRANSIENT FREQUENCY BEHAVIOR

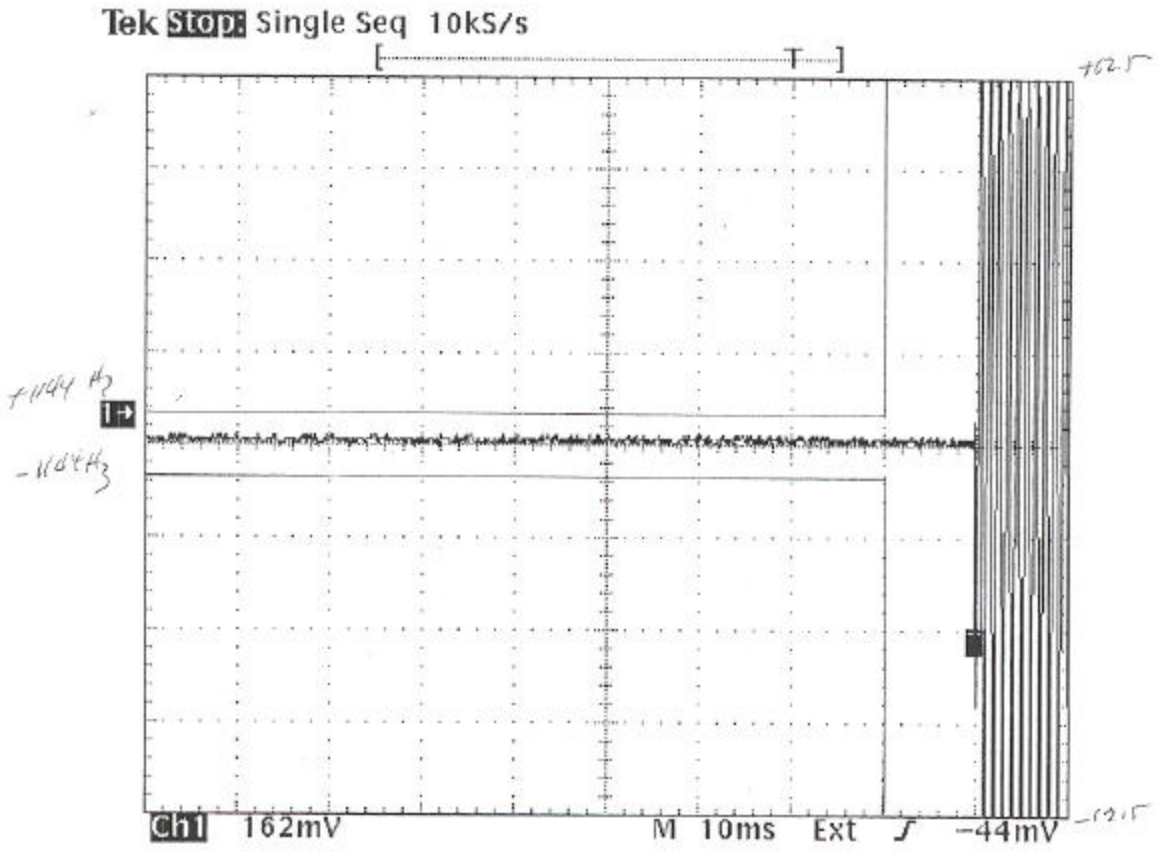


TRANSIENT FREQUENCY BEHAVIOR
FCC ID: IOJKG50640

FIGURE 5 (12.5 kHz Turn-on)

FIGURE 6

TRANSIENT FREQUENCY BEHAVIOR



TRANSIENT FREQUENCY BEHAVIOR
FCC ID: IOJKG50640

FIGURE 6 (12.5 kHz Turn-off)

APPENDIX 1

FUNCTION OF DEVICES
KG506-40D25K

List of Semiconductors Designations and Functions.

TX VCO

Q301,	2SK508	Oscillator
Q302,	2SC4325	Amplifier
Q303,	2SC3583	VCO output amplifier
Q304,	DTA124EKA	Switch
Q305,	2SC2351	B+ Filter
Q306,	DTYA124EKA	B+ Switch
IC301,	uPC1688	Amplifier

TX MAIN UNIT (Driver)

Q201,	DTC124EKA	PTT Buffer
Q202,	FMG9A	Switch
Q203,	UMC2	Switch
Q205,	2SD2351	B+ Filter
Q206,	2SK3018	Charge pump
Q207,	2SJ166	Charge pump
Q208,	2SK3018	Charge pump
Q209,	UMC2N	Switch
Q210,	FMG2A	Switch
Q211,	FMG2A	Switch
Q212,	2SB1184TL	Reg.
Q214,	IMX1	TX Power Adj.
Q215,	2SC3357	RF Amplifier
Q216,	2SC2131	RF Amplifier
Q217,	2SK209	Modulation Switch W/N
IC201,	AN78L05M	5V Reg.
IC202,	TA78M05F	5V Reg.
IC203,	TS272CD	Mod LF Amp
IC204,	TA75S01F	Mod Amp
IC205,	MB1511	PLL
IC206,	NJU7662M	Control
IC207,	BU4S66	LPF, loop
IC208,	M5337ML	DC-DC Inverter, 15 VDC
IC209-A,	NJM2904	Power Control
IC209-B,	"	Error Amp

TX POWER AMPLIFIER UNIT

Q502,	**2SK3018**	**Switch**
Q503,	MCH3306	B+ Switch
IC501-A,	BAM4558F	Power Control
IC501-B,	"	Error Amp
IC502,	TA75601F	Power Control
IC504,	AN78L05M	5V Reg.
PM510,	RA30H4452M	Power Output Module

RX VCO UNIT

Q301,	2SK508	Oscillator
Q302,	2SC4325	Amplifier
Q303,	2SC3583	VCO output amplifier
Q304,	DTA124EKA	Switch
Q305,	2SC2351	B+ Filter
Q306,	DTYA124EKA	B+ Switch
IC301,	uPC1688	Amplifier

RX MAIN UNIT

Q101,	3SK177	RF Amp
Q102,	3SK177	RF Amp, Optional second RF circuit, Simplex
Q103,	2SK508	1st Hi IF Amp.
Q104,	DTB143EK	B+ Switch, RF Amp 1
Q105,	DTB143EK	B+ Switch, RF Amp 2
Q107,	2SD2351	Control
Q108,	2SJ166	Charge pump
Q109,	2SK3018	Charge pump
Q110,	2SK3018	Charge pump
Q111,	UMC2N	Switch
Q112,	"	Switch
Q113,	2SC4250	2nd Hi IF Amp
Q114,	DTC314TK	W/N Switch
Q115,	2SK209	W/N Switch
Q116,	2SK209	W/N Switch
Q117,	DTA144EUA	Switch
Q118,	DTE143EK	Switch
Q119,	DTC144EKA	RX Switch
Q120,	2SK3018	RX Switch
Q127	2SK3018	W/N Switch

RX MAIN UNIT (cont.)

IC101,	MB1511	PLL
IC102,	NJU7662M	DC-DC Inverter, 15 VDC
IC103,	UB4S66	LPF, loop
IC104,	AN78L05M	5V Reg.
IC105,	TA75S01F	VCO Error Amp.
IC106,	TK10487M	Lo IF/Osc./Det.
IC107,	TA75558F	AF Amp.
IC108,	TA78M05F	5V Reg.

LOGIC UNIT

Q1,	2SSD2351	DTMF Beep Switch
Q2,	DTC124EKA	Decode Switch for horn
Q3,	2SK880	RX AF Switch
Q4,	2SK209	Repeat AF Switch
Q6,	RN6001	Switch for horn
Q7,	DTC314TU	Low Power Switch
Q8,	2SK880	RX AF Switch
Q9,	2SK3018	Beep Switch
Q10,	2SD2219	AF Voltage Regulator
Q13,	UMH8N	LED Driver
Q14,	"	" "
IC1,	uPD78F0058Y	CPU
IC2,	AK2344	TX Audio Processor, BPF, pre-emphasis,
IC3,	AK2344	RX Audio Processor, BPF, de-emphasis,
IC4,	AN78L05M	5V Reg.
IC5,	"	" "
IC6,	NJM2405	Voltage detector
IC7,	HN58C65	EE ROM, Channel data
IC8,	TC74HC373AF	Data latch
IC9,	RN5VL22N	Reset
IC10,	TA75S01F	TX-on sensor
IC11,	BU4S81	Simplex control
IC12,	BU4S01	Repeat LED Switch
IC13,	M62551GP	LPF for TX audio
IC14,	M62551GP	Low Battery Sense
IC15,	BU4S81	BUSY Buffer
IC16,	NJM2073	AF Line Amp.
IC17,	BU4S69F	Clock Osc. TX & RX AF Processors
IC18,	TC7W74FU	½ divider
IC19,	M5222PF	AF attenuator
IC20,	N62551GP	Volume control
IC21,	"	Squelch control
IC22,	TA8201AK	AF Output power amplifier
IC23,	BA12ST	12V Switch and regulator

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

The transmitter uses a TCVXO (temperature and voltage controlled crystal oscillator) to generate the 12.0 MHz reference frequency for the transmitter PLL and VCO circuits. The oscillator is accurate to less than +/- .0002% over the range of –30 to +60 C.

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY
FCC ID: IOJKG50640

APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION,
LIMIT MODULATION AND CONTROL POWER

A multiple pole Low Pass Filter is sued after the final power amplifier stage. It is designed to sharply attenuate spurious and harmonic frequencies above the highest frequency in the sub-band of the radio.

Modulation limiting is performed by TX Audio Procesor, IC2, AK2344 located in the Logic Unit. Internal limiting/compression amplifiers provide excellent limiting with minimum distortion.

In addition to modulation limiting, this device contains all circuitry to perform pre-emphases, band-pass shaping, CTCSS encode and voice inversion scrambling.

CIRCUITS TO SUPPRESS SPURIOUS
RADIATION, LIMIT MODULATION-
AND CONTROL POWER

FCC ID: IOJKG50640

APPENDIX 3

APPENDIX 4

TRANSIENT FREQUENCY BEHAVIOR (90.214) TEST PROCEDURE

Para. 2.995(a)(b)(d) Frequency stability

90.214 (continued) Transient Frequency Behavior