ENGINEERING STATEMENT

For Type Certification of

Ranger Communications (M) SDN. BHD.

Model No: TR-286GX

FCC ID: M38-TR-286

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 Ranger Communications, to make type certification measurements on the TR-286GX transceiver. These tests were made by me or under my supervision in our Springfield laboratory.

Test data and documentation required by the FCC for type certification are included in this report. It is submitted that the above-mentioned transceiver meets all applicable FCC requirements.

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Rowland S. Johnson

Dated: November 24, 1999

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the TR-286GX transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The TR-286GX is both double-sideband amplitude modulated and

single-sideband-suppressed-carrier transmitter/receiver combination intended for operation in the citizens radio service. The transmitter has 40-channel capability in the 26.965 - 27.405 MHz band utilizing phase locked loop (PLL) technology.

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

1. Name of applicant: Ranger Communications (M) SDN. BHD.

2. Identification of equipment: FCC ID: M38-TR-286

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. 6k00A3E or 4k00J3E emission
b. Frequency range: 26.965 - 27.406 MHz
c. Operating power of transmitter is fixed at the factory at less than 4 watts, AM; and 12 watts PEP.
d. Maximum power rating under 95.635(c) of the Rules is 4 watts, AM and 12 watts PEP.
e. The dc voltage and dc currents at final amplifier:

Collector voltage: 12.6 V
Collector current: 710 mA @ 13.8 Vdc input.

f. Function of each active semiconductor device: See Appendix 1.
g. Complete circuit diagram is submitted as a separate exhibit.

h. A user instruction book is submitted as a separate exhibit.
i. The transmitter tune-up procedure is submitted as a separate exhibit.
j. A description of circuits for stabilizing frequency is included in Appendix 3.
k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 4.
l. Not applicable.

B. GENERAL INFORMATION...(Continued)

5. Data for 2.985 through 2.997 follow this section.

6. RF Power Output (Paragraph 2.985(a),(b)(1) of the Rules)

RF power output in the AM mode was measured with a Bird 4421 RF power meter and a Narda 765-20 50 ohm dummy load. SSB power was measured with a Bird Model 43 wattmeter with peak power option 4300-400. See plot shown in Figure 1. Power was measured with a supply voltage of 13.8 volts, and indicated:

Channel	Power, watts			
	HI	LO	PEP	
	AM		LSB	USB
1	3.8	0.7	11.8	11.8
21	3.9	0.8	11.9	11.9
40	3.9	0.8	11.9	11.9

C. MODULATION CHARACTERISTICS

NOTE: All audio data were taken with “mic gain” fully CW.

1. AF Frequency Response

A curve showing frequency response of the transmitter is shown in Figure 2. Reference level was taken as a 1 kHz tone with 50% modulation, as measured on a Datatech 209 modulation meter, using a Audio Precision TRMS voltmeter and tracking generator.

2. Modulation Limiting

Curves of AM modulation limiting for both positive and negative peaks are shown in Figures 3a and 3b, respectively. Characteristics at 300, 2500, and 3069 Hz are shown using a Datatech 209 modulation meter. Signal level was established with a Audio Precision TRMS voltmeter and tracking generator. The curves show compliance with Paragraph 95.633(d) of the Rules.

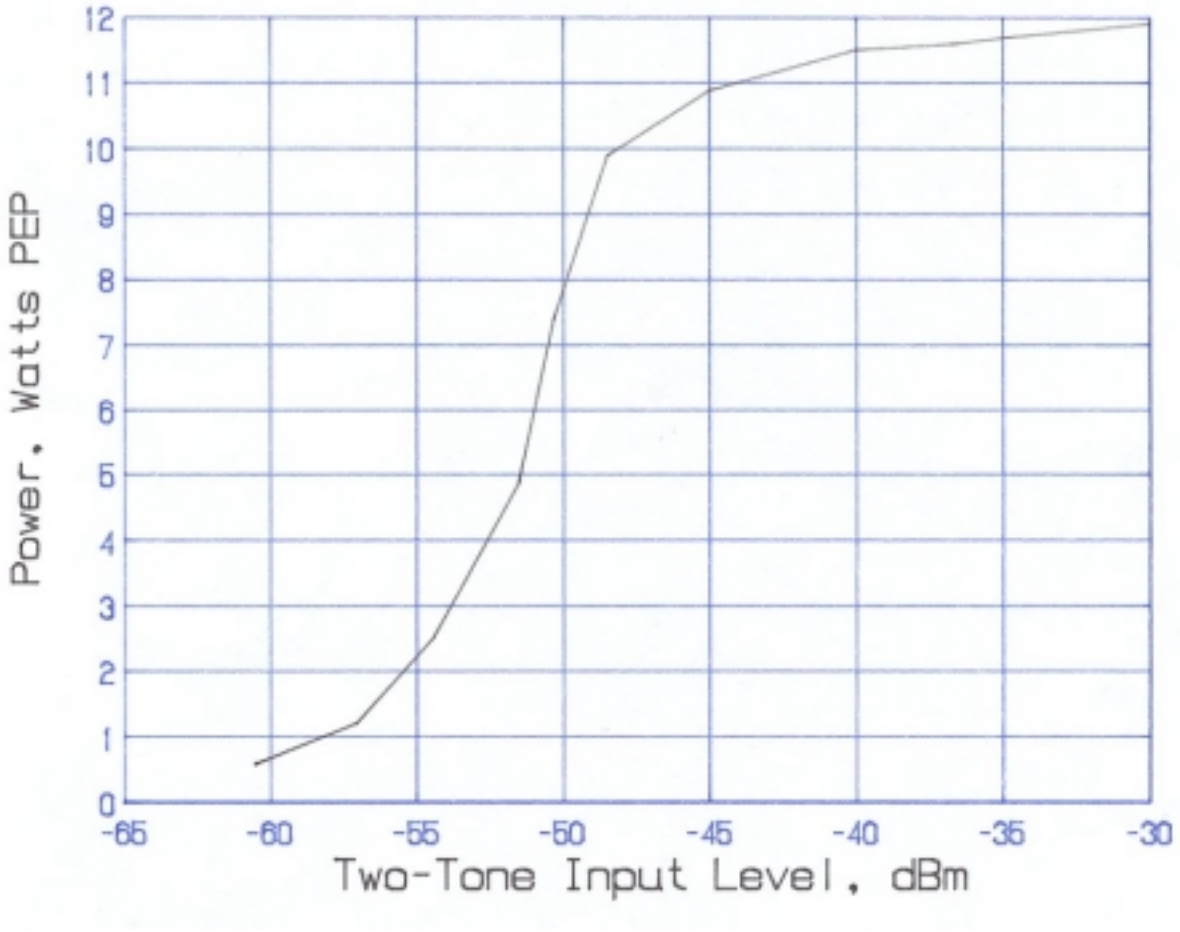
3. Modulation Limiter Attack Time

Modulation limiter attack time was measured by applying to the microphone input terminals a pulsed tone at 2500 Hz, 16 dB above the level required for 50% modulation at the frequency of maximum response, 3069 Hz. The spectrum analyzer was tuned to upper and lower fourth-order sidebands in the time domain. Horizontal sweep of the analyzer was triggered in synchronism with the tone turn-on. Sweep speed was 500 milliseconds per

division. Plots are included as Figures 4a and 4b. Any transients observed in excess of 33 dB attenuation as referenced to the carrier were less than 20 ms in duration.

FIGURE 1

RF POWER OUTPUT VS AUDIO INPUT VOLTAGE
Two-Tone: 2400 + 500 Hz

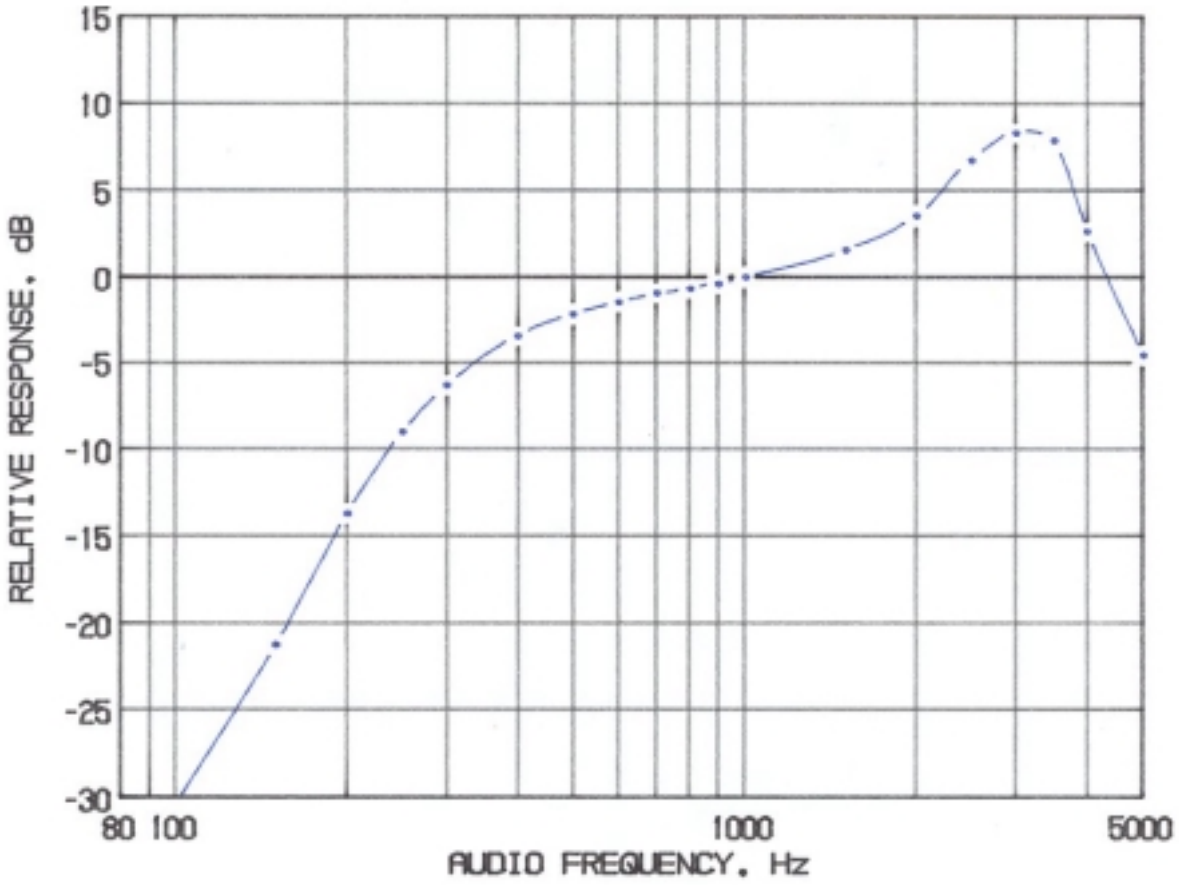


SIDEBAND MODE
RF POWER OUTPUT VS AUDIO INPUT
FCC ID: M38-TR-286

FIGURE 1

FIGURE 2

TRANSMITTER FREQUENCY RESPONSE

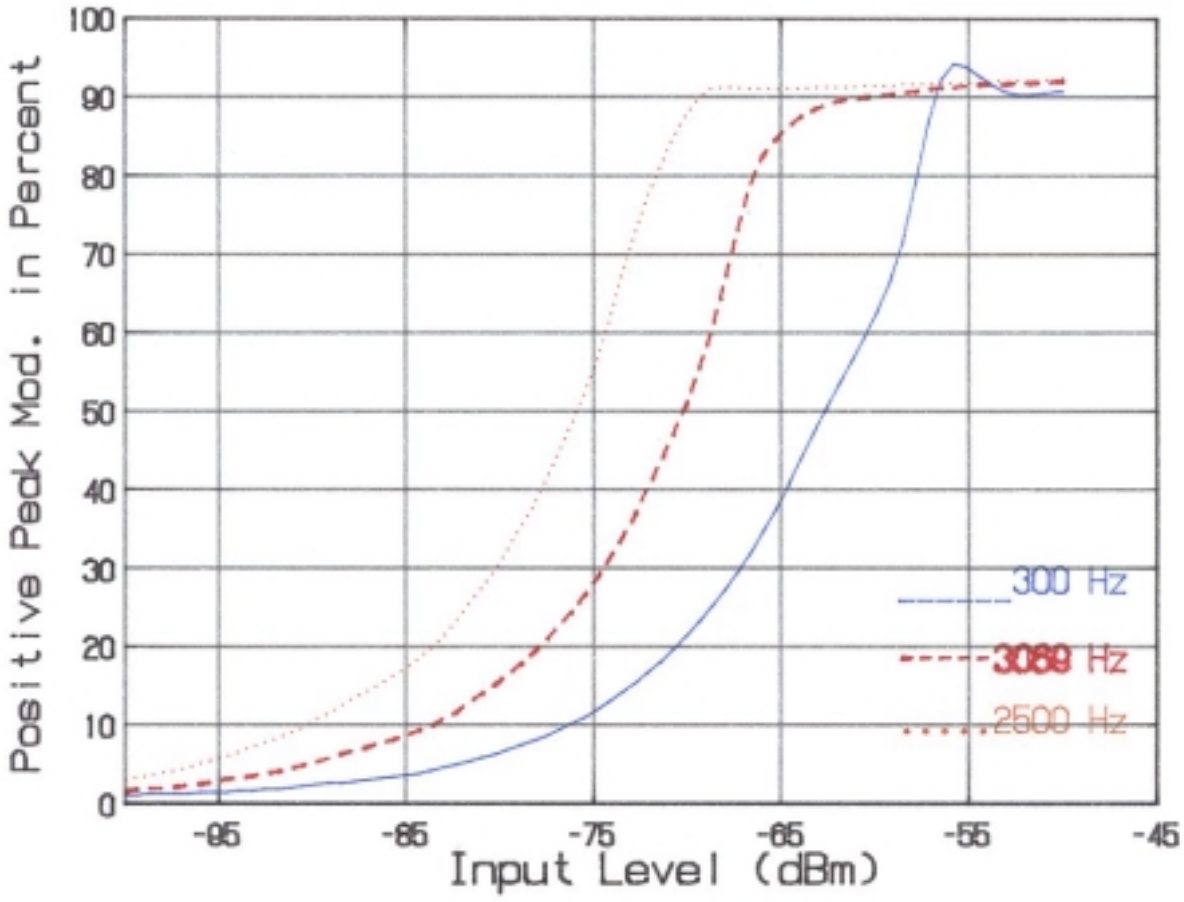


TRANSMITTER FREQUENCY RESPONSE
FCC ID: M38-TR-286

FIGURE 2

FIGURE 3a

AM MODULATION LIMITING - POSITIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

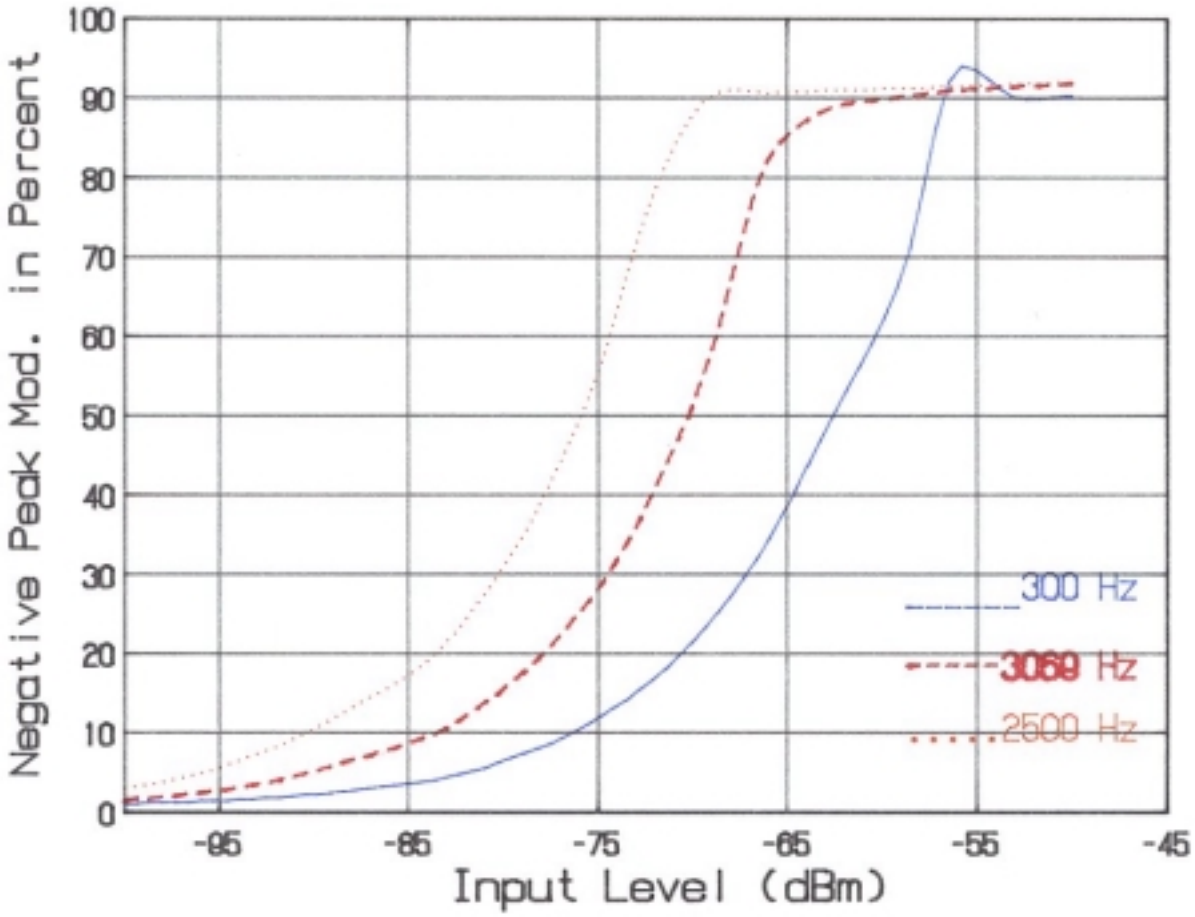
Percent modulation as a function of input level at microphone jack in dBm for 300 Hz, 2500 Hz, and 3069 Hz tones.

MODULATION LIMITING POSITIVE PEAKS
FCC ID: M38-TR-286

FIGURE 3a

FIGURE 3b

AM MODULATION LIMITING - NEGATIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

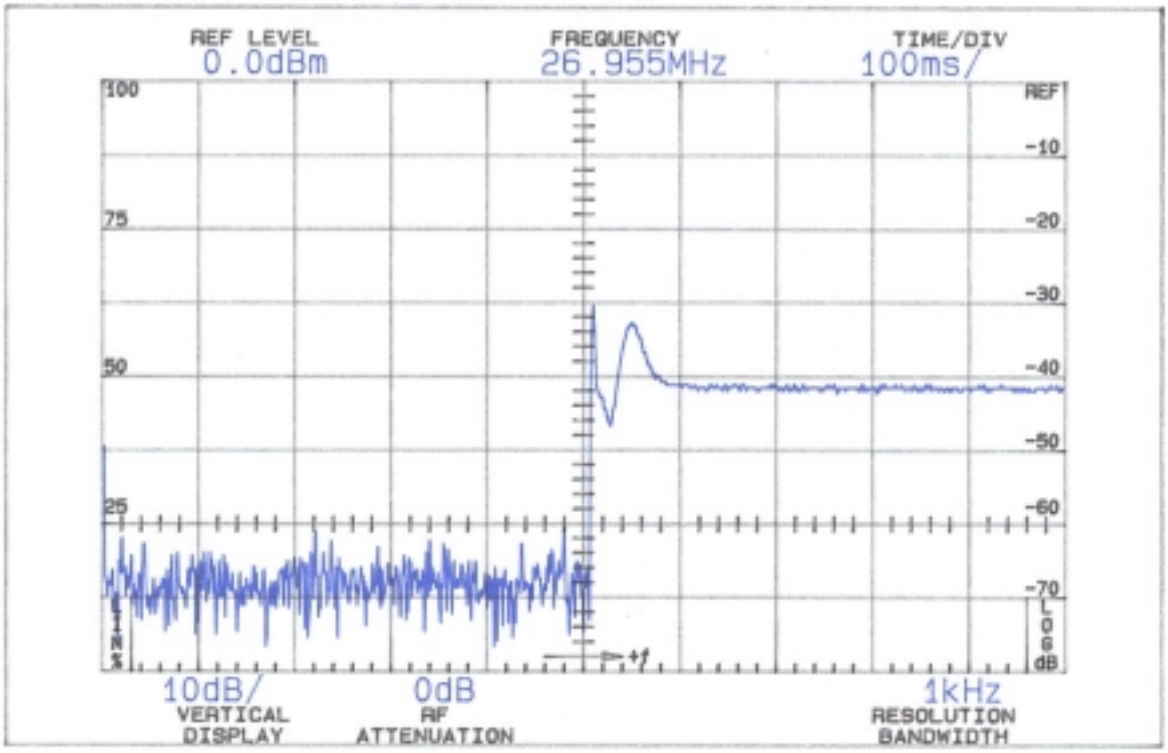
Percent modulation as a function of input level at microphone jack in dBm for 300 Hz, 2500 Hz, and 3069 Hz tones.

MODULATION LIMITING NEGATIVE PEAKS
FCC ID: M38-TR-286

FIGURE 3b

FIGURE 4a

MODULATION LIMITER ATTACK TIME



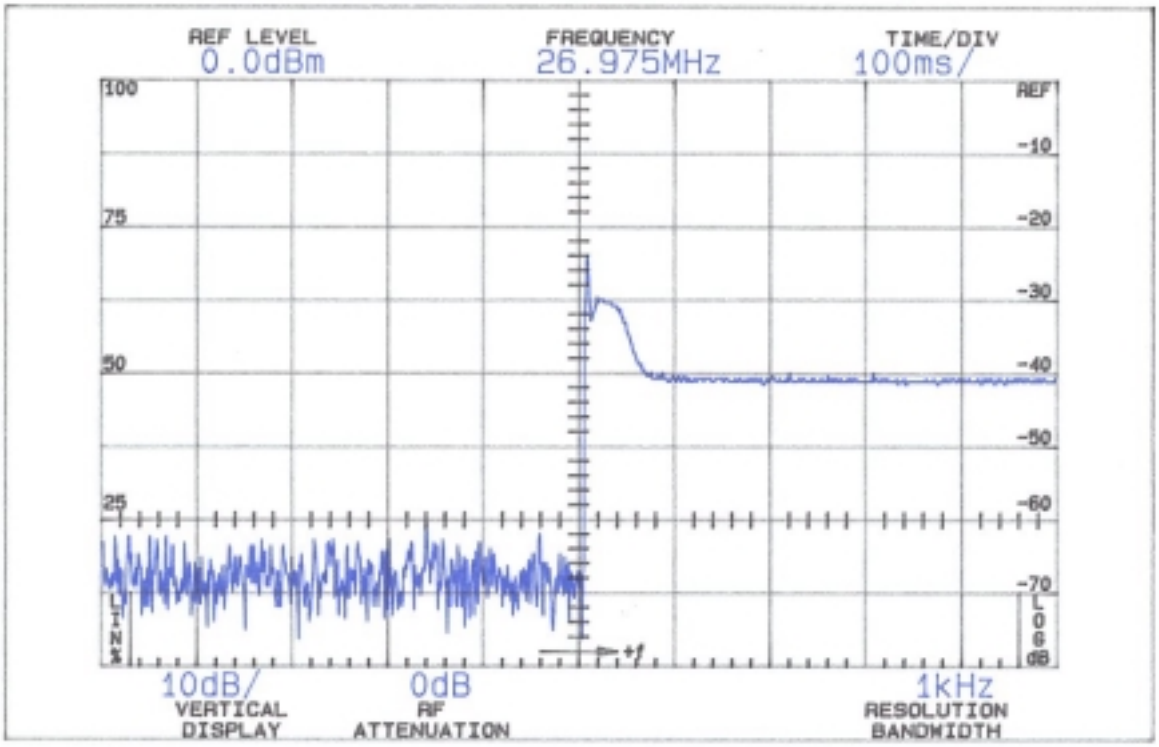
Measurement Conditions: 16 dB over 50% modulation level at 3069 Hz with 2500 Hz tone, upper fourth order sideband; horizontal scale 100 ms/div.

UPPER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: M38-TR-286

FIGURE 4a

FIGURE 4b

MODULATION LIMITER ATTACK TIME



Measurement Conditions: 16 dB over 50% modulation level at 3069 Hz with 2500 Hz tone, lower fourth order sideband; horizontal scale 100 ms/div.

LOWER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: M38-TR-286

FIGURE 4b

C. MODULATION CHARACTERISTICS (Continued)

4. Occupied Bandwidth - AM(Para. 2.989(c) of the Rules)

Figure 5a is a plot of the sideband envelope of the transmitter taken from a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(a) and consisted of 2500 Hz tone at an

input level 16 dB greater than that necessary to produce 50% modulation at 3069 Hz, the frequency of maximum response. Measured modulation under these conditions was 85% (Pos); 88% (Neg).

Figure 5b is a plot under the above conditions for 0.7 watt output.

The plots are within the limits imposed by Paragraph 95.631(b)(1,3) for double sideband AM 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.

5. Occupied Bandwidth - SSB

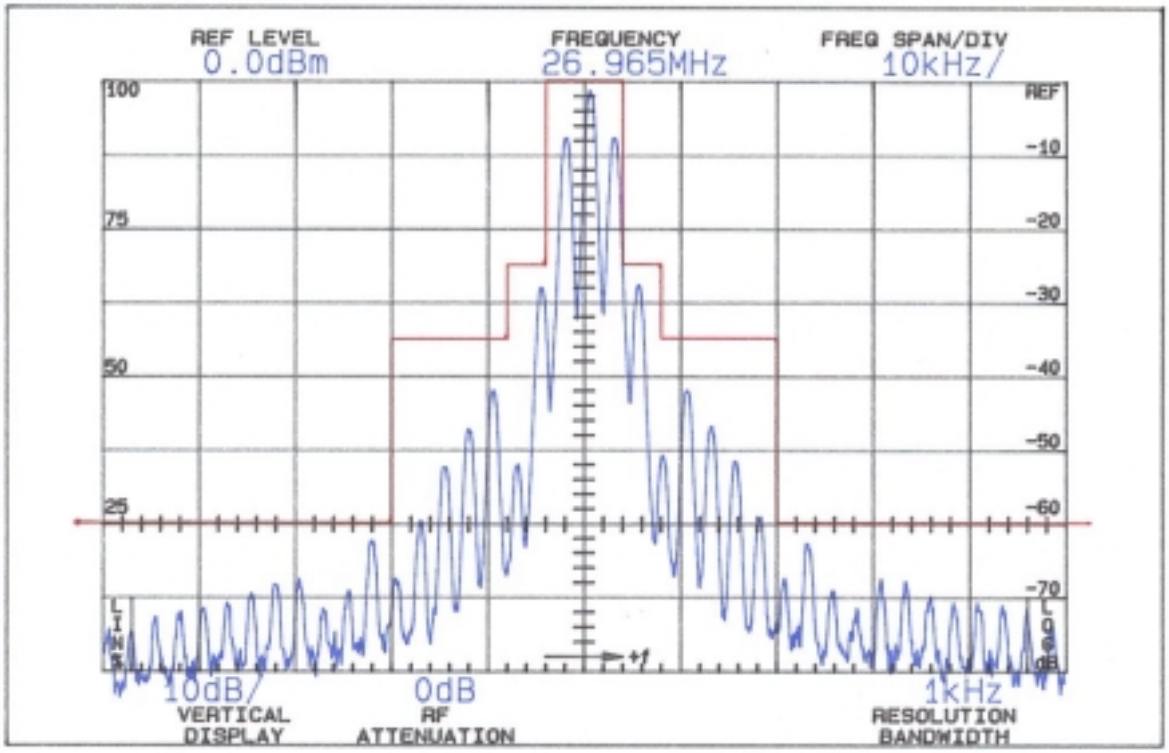
Figures 6a and 6b are plots of the sideband envelopes of the transmitter for USB/LSB taken from an Advantest P3361A spectrum analyzer. Modulation corresponded to an input level 10 dB above reference modulation per 2.989(c). The modulation is two tones at frequencies of 500 Hz and 2400 Hz applied simultaneously at levels to produce equal magnitude sidebands before the onset of limiting per 2.989(c)(2). The reference modulation level to produce reference peak envelope power was established per OCE 43.

Each sideband is 3 dB below 0 dB reference.

The plots are within the limits imposed by Paragraphs 95.631(b)(2,4) for single sideband modulation. The horizontal scale, frequency, is 4 kHz per division and the vertical scale, amplitude, is 10 dB per division. (The center of the display is tuned to the reference "assigned center frequency" of plus or minus 2000 Hz from suppressed carrier channel frequency.)

FIGURE 5a

OCCUPIED BANDWIDTH – AM



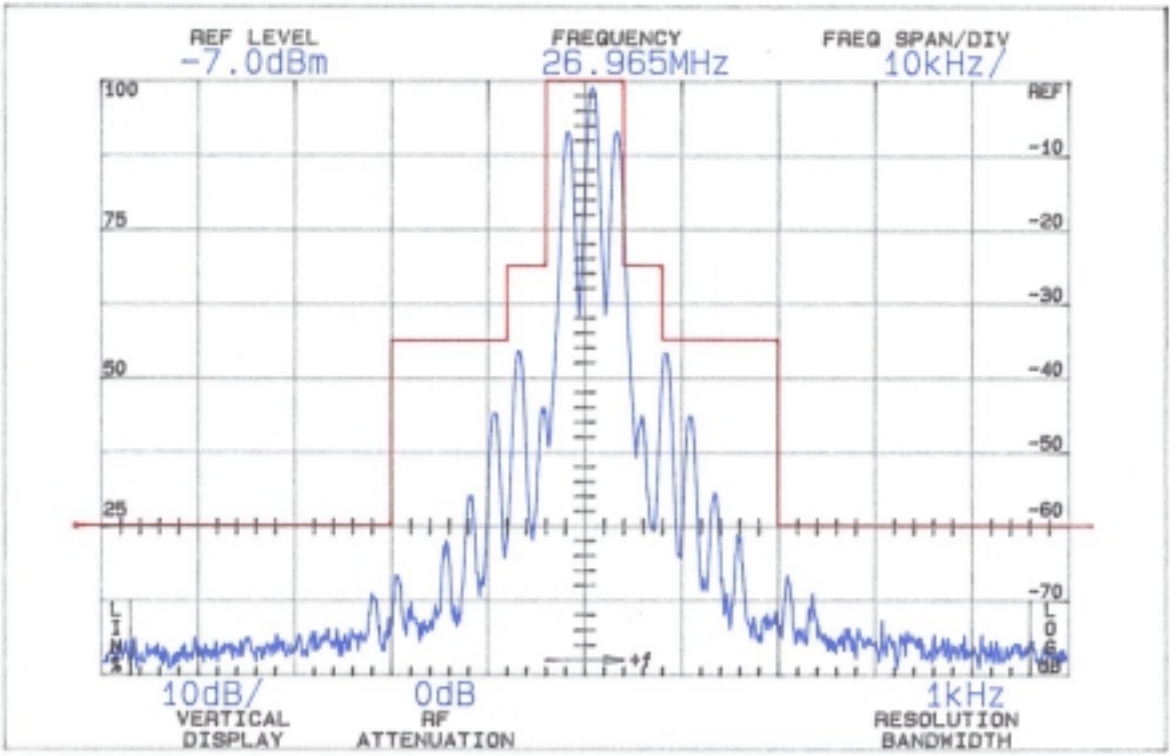
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 8kHz (4-8kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (8-20kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth	60

OCCUPIED BANDWIDTH - AM
FCC ID: M38-TR-286

FIGURE 5a

FIGURE 5b

OCCUPIED BANDWIDTH – AM



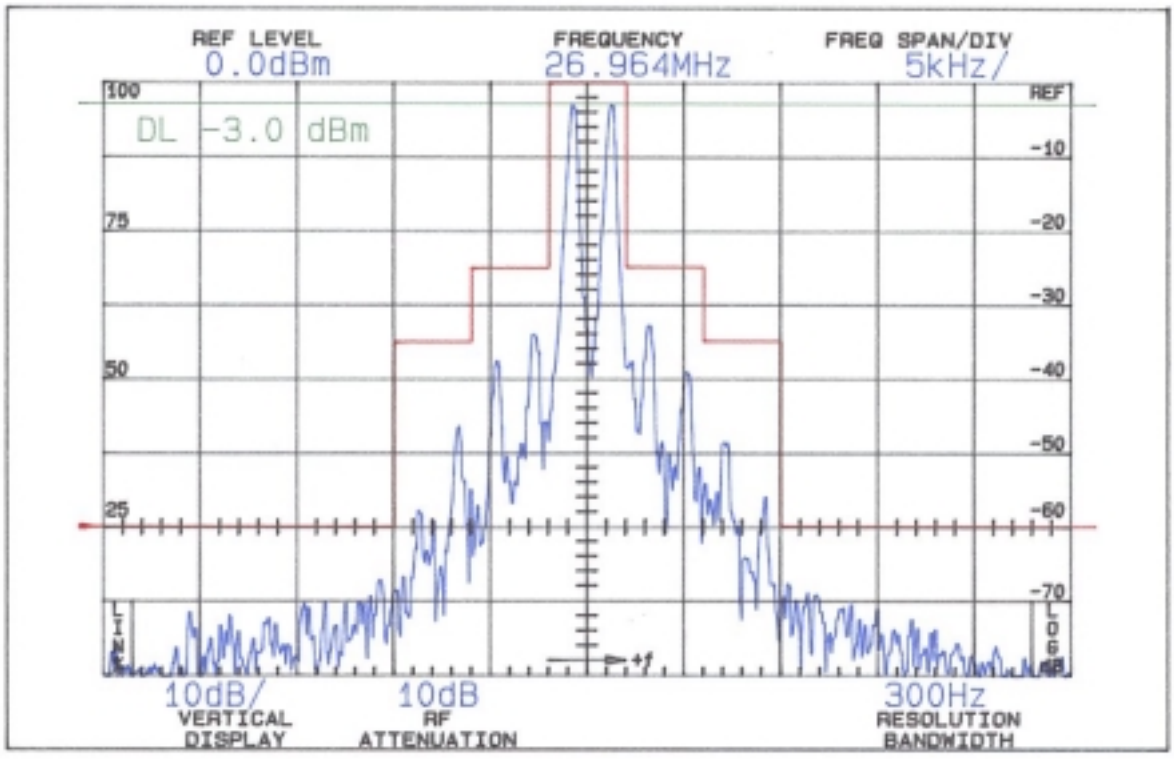
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 8kHz (4-8kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (8-20kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth	60

OCCUPIED BANDWIDTH - AM
FCC ID: M38-TR-286

FIGURE 5b

FIGURE 6a

OCCUPIED BANDWIDTH – LSB



ATTENUATION IN dB BELOW
MEAN OUTPUT POWER
Required

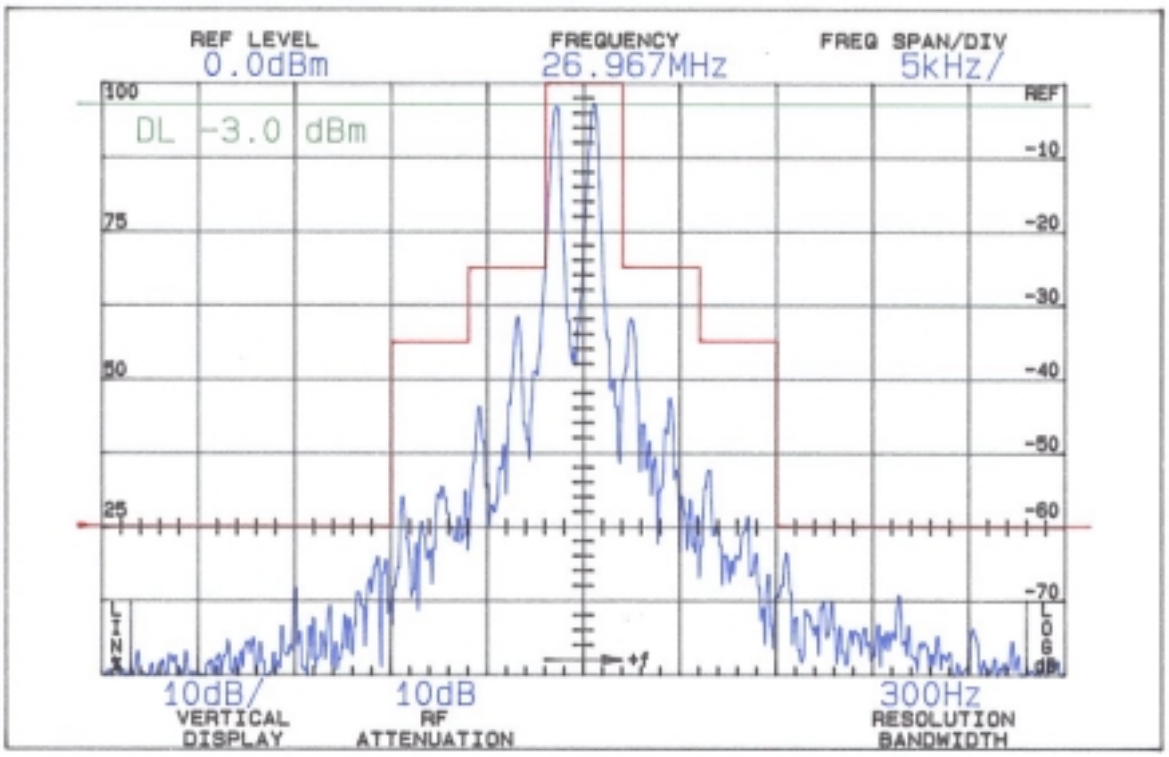
On any frequency more than 50% up to and including 150% from the center of the authorized bandwidth, 4 kHz (2-6 kHz)	25
On any frequency more than 150%, up to and including 250% from the center of the authorized bandwidth, 4 kHz (6-10 kHz)	35
On any frequency more than 250% from the center of the authorized bandwidth 4 kHz (>10 kHz)	60

OCCUPIED BANDWIDTH - LSB
FCC ID: M38-TR-286

FIGURE 6a

FIGURE 6b

OCCUPIED BANDWIDTH – USB



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 150% from the center of the authorized bandwidth, 4 kHz (2-6 kHz)	25
On any frequency more than 150%, up to and including 250% from the center of the authorized bandwidth, 4 kHz (6-10 kHz)	35
On any frequency more than 250% from the center of the authorized bandwidth 4 kHz (>10 kHz)	60

OCCUPIED BANDWIDTH - USB
FCC ID: M38-TR-286

FIGURE 6b

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

The TR-286GX 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% modulation at 3069 Hz, the frequency of highest sensitivity.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through Narda 765-20 50 ohm power attenuation.

In order to improve measurement system dynamic range, a series trap tuned to the carrier frequency was used on the Narda attenuator output. The trap, which had negligible shunt attenuation at the second harmonic and high frequencies, provided 26 dB attenuation of the fundamental. The trap was not used during close-in (within 10 MHz of the carrier) spurious measurements.

Measurements were repeated for the SSB mode.

During the tests, the transmitter was terminated in the Narda 765-20 dummy load. Power was monitored on a Bird 43 Thru-Line wattmeter; dc supply was 13.8 Vdc throughout the tests.

Spurious emission was measured on Channels 1, 21, and 40 throughout the RF spectrum from 10 to 300 MHz. Any emissions that were between the 60 dB attenuation required and the 92 dB noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

NOTE: No significant variation was noted for high/low power levels during SSB modes.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS

PEP		-AM-		-SSB-	
Channel	Spurious Frequency MHz	dB Below Unmod Carrier Ref. Hi	Lo	dB Below Ref. LSB	USB
1	53.930	65	60	63	63
1	80.895	76	81	76	77
1	107.860	90	82	91	91
1	134.825	86	87	85	84
1	161.790	97	98	96	98

1	188.755	92	95	91	89
1	215.720	102	103	>100	>100
1	242.685	88	97	85	86
1	269.650	88	96	89	88
21	54.430	63	60	65	64
21	81.645	76	84	78	77
21	108.860	89	82	87	88
21	136.075	86	85	86	88
21	163.290	95	100	96	97
21	190.505	93	93	92	91
21	217.720	104	106	>100	>100
21	244.935	86	92	86	86
21	272.150	86	93	89	88
40	54.810	61	57	64	63
40	82.215	76	86	76	74
40	109.620	90	84	90	90
40	137.025	86	86	86	85
40	164.430	94	100	93	92
40	191.835	92	93	90	92
40	219.240	104	106	>100	>100
40	246.645	82	89	83	84
40	274.050	87	92	89	88
	Required:	60		60	60

All other spurious were over 20 dB below required 60 dB suppression.

NOTE: Attenuation in low power SSB was essentially same as AM mode data.

E. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION (Paragraph 2.993(a)(b,2) of the Rules)

Field intensity measurements of radiated spurious emissions from the TR-286GX transmitter were made with a Tektronix 494P spectrum analyzer and dummy load located in an open field 3 meters from the test antenna. Output power was 3.8 watts. The supply voltage was 13.8 Vdc. The transmitter and test antennae were arranged according to OCE 42 to maximize pickup. The unit has no accessory jacks. Both vertical and horizontal test antenna polarization were employed.

Measurements were made from 10 MHz to 10 times the maximum operating frequency of 26.965 or 270 MHz. Reference level for the spurious radiations was taken as an ideal dipole excited by 3.8 watts, the output power of the transmitter according to the following relationship:*

$$E = \frac{(49.2 \times P_t)^{1/2}}{R}$$

where E = electric-field intensity in volts/meter

P_t = transmitter power in watts

R = distance in meters

for this case $E = \frac{(49.2 \times 3.8)^{1/2}}{3} = 4.6 V/m$

Since the spectrum analyzer is calibrated in decibels above one milliwatt (dBm):

4.6 volts/meter = 4.6×10^6 uV/m

dBu/m = $20 \text{ Log}_{10}(4.6 \times 10^6)$

= 133 dBu/m

Since 1 uV/m = -107 dBm, the reference becomes

133 - 107 = 26 dBm

Representing a conversion for convenience, from dBu to dBm. The measurement system was capable of detecting signals 100 dB or more below the carrier reference level. Data, including antenna factor and line loss corrections, are shown in Table 2.

*Reference Data for Radio Engineers, International Telephone and Telegraph Corporation, Sixth Edition.

F. FIELD STRENGTH MEASUREMENTS (Continued)

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS
Channel 1, 26.965 MHz; 3.8 watts; 13.8 Vdc

	dB Below Carrier Reference			
	With Accessories		Without Accessories	
Frequency, MHz	Vertical	Horizontal	Vertical	Horizontal
53.930	84	76	91	75
80.895	75	72	85	88
107.860	83	94	89	91
134.825	97	88	99	99
161.790	98	97	101	99
188.755	96	101	96	104
215.720	98	99	104	106
242.685	99	100	103	107
269.650	98	100	101	102
FCC Limit:	60	60	60	60

Unlisted spurious were more than 80 below carrier reference from 10 to 270 MHz.

F. FREQUENCY STABILITY

(Paragraph 2.995(a)(1) of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°C to 50°C in 10°C increments. At each temperature, the unit was exposed to the test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within ±2° of the desired test temperature. Following a 30 minutes 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. The transmitter output stage was terminated in a dummy load. Primary supply was 13.8 vac. Frequency was measured with a HP 5385A digital frequency counter connected to the transmitter through a power attenuator. Measurements were made on Channel 9, 27.065 MHz. No transient keying effects were observed. Data are shown in Table 3.

G. FREQUENCY STABILITY (Continued)

TABLE 3

Temperature	Output Frequency, MHz
-29.8	27.064381
-19.6	27.064554
-10.0	27.064785
0.0	27.064947
10.0	27.065054
19.8	27.065128
30.0	27.065239
39.9	27.065344
50.4	27.065475
Maximum frequency error:	27.064381
	27.065000
	- .000619 MHz

FCC Rule 95.625(b) specifies .005% or a maximum of ± .001353 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 digital frequency counter as supply voltage was varied from ±15% above the nominal 13.8 Vdc rating. A Keithley 177 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient. (See Table 4).

TABLE 4

Supply Voltage	Output Frequency, MHz
15.87	27.065130
15.18	27.065129
14.49	27.065129

13.80	27.065128
13.11	27.065128
12.42	27.065128
11.73	27.065125

Maximum frequency error:

27.065130
27.065000
+ .000130 MHz

FCC Rule 95.625(b) specifies .005% or a maximum of ±.0001353 MHz. No effects on frequency related to keying the unit were observed.

H. ADDITIONAL REQUIREMENTS FOR TYPE CERTIFICATION (Paragraph 95.665 of the Rules)

The TR-286GX meets the applicable provision of 95.665(a).

External controls are limited to the following per 95.665(a):

1. Primary power connection
2. Microphone jack
3. RF output power connection
4. External earphone/mike jacks
5. On-off switch (combined with receiver volume control
6. Upper/lower sideband selector
7. Not applicable, no R3E emission
8. Transmitting frequency selector
9. Transmit-receive switch
10. Meter for monitoring transmitter performance
11. Meter/pilot lamp for RF output indication

The serial number of each unit will be implemented in accordance with 95.667.

A copy of Part 5, Subpart D, of the FCC rules for the Citizens Band Radio Service, current at the time of packing of the transmitter, must be furnished with each CB transmitter marketed per 95.669.

I. PLL RESTRICTIONS(Per Public Notice of April 27, 1978)

The TR-286GX meets the following conditions specified in the April 27, 1978 notice:

1. All frequency-determining elements, including crystals, PLL integrated circuits and channel selector switches Are permanently sired and soldered in place.

2. The PLL integrated circuit division ratio selection BCD coded. All the 40 channels are mask programmed into the CPU and can not be changed.

3. Channel selection is controlled by the masked program of the CPU and has only 40 positions for use in the United States.

3. All the undedicated leads in the CPU and PLL integrated circuits are disabled, and are not serviceable by the user.

5. A copy of the PLL data sheet is shown in Appendix 4.

J. FINAL AMPLIFIER DATA

1. A copy of the final RF amplifier data sheet is included in Appendix 5.

APPENDIX 1

FUNCTION OF DEVICES

TR-286GX

Reference	Type	Function
TR39	2SC1973	Pre Driver
TR38	2SC2166	Driver
TR36	2SC1969	Final RF Amp
TR41	2SD1135	AM Power Regulator
TR24	2SC945	Mike Level Attenuator
TR23	2SC458	Mike Amp
TR22	2SC945	Mike Amp
TR34	2SC1675	ALC
TR25	2SA733	ALC
IC1	MB8719	PLL
IC2	UHIC070	VCO

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

All 40 channels of transmitting, and receiving, frequencies are provided by PLL (Phase Locked Loop) circuitry.

The purpose of the PLL is to provide a multiple number of frequencies from a VCO (Voltage Controlled Oscillator) with quartz crystal accuracy and stability locked to crystal oscillator reference frequency.

The reference crystal oscillator frequency is 10.24 MHz.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
FCC ID: M38-TR-286

APPENDIX 2

APPENDIX 3

A. Circuits For Suppression Of Spurious Radiation

The tuning circuit between the output of final amp TR36 and antenna, 4-stage "Pi" network associated with L38, L37, L36 and L34 serves as a spurious radiation suppressor. This network also serves to match the impedance between TX power amp and the antenna.

B. Circuits For Limiting Modulation

Input from the microphone is controlled by the Mic-Gain potentiometer and amplified by TR23. The amplified signal is used to drive the AM Modulator circuit consists of TR49 & 51.

There are two signals at the base of TR49, the DC voltage controlled by RF Power Level Adjust, and the AF level from pin 1 of IC4. The DC bias controls the operating point of the Darlington pair transistors TR24 & 25 to provide power supply to the RF Power transistors TR21 & 22, which controls the RF Carrier Power output of the radio. The AF signal is amplified and superimposed on the DC bias to create high level AM Modulation in TR43 & 44.

When the modulator overmodulates, AC voltages at emitter of TR26 will increase, and TR26 will conduct more during the negative cycle of the modulation signal, which increases the collector current of TR26 and turn TR24/TR25 on. The audio signal is shunted, input to the modulator decreases until it reaches the Modulation Limit set point.

C. Circuits For Limiting Power

The DSBSC signal is routed by the switching diodes to the 10.695 MHz crystal filter, the unwanted sideband is filtered off, and the processed SSB signal is sent for mixing with the VCO output to obtain the final transmitting frequency.

The high level modulator is bypassed during SSB operation. The RF Power amplifiers are biased to class B operation to preserve the envelope of the low-level modulated SSB signal. Since the SSB RF output is directly proportional to the level of audio signal driving the balanced modulator, the RF output is sampled which provides negative feedback to the audio ALC circuit (to limit the maximum SSB power output.

DEVICES AND CIRCUITS TO
SUPPRESS
SPURIOUS RADIATION; LIMIT
MODULATION AND POWER
FCC ID: M38-TR-286

APPENDIX 3

APPENDIX 4

PLL DATA SHEETS

COPY OF PLL DATA SHEETS
FCC ID: M38-TR-286

APPENDIX 4

RCI 8719/RCI 8734 DATA SHEET

DESCRIPTION :

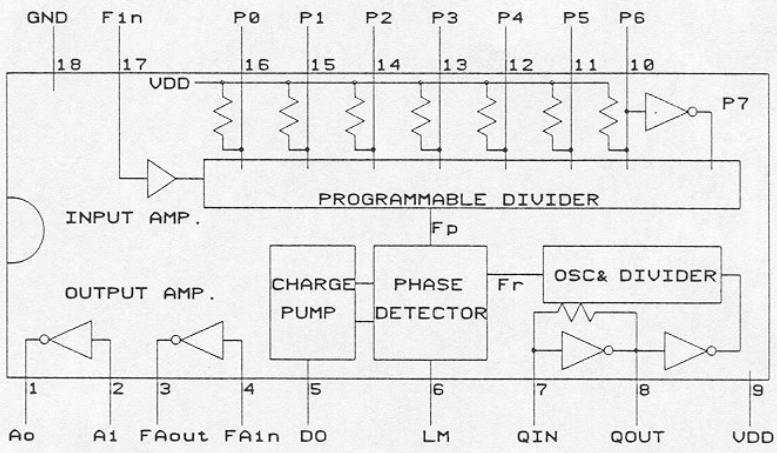
RCI 8719/RCI 8734 is a PLL frquency synthesizer in a 18-pin plastic dual-in-line package . The product is pin-to-pin compatiable to the MB8719 .

FEATURES :

The RCI 8719/RCI 8734 features a reference oscillator/amplifier , a 1024 reference divider chain , a parallel programmable 8-bit counter , phase detector , charge pump , and filter amplifier .

All parallel load inputs have internal pull-up circuit . Combined with a external VCO circuit each synthesizer block can provide all the remaining functions for a PLL frequency synthesizer .

BLOCK DIAGRAM :



Filter and Amplifier :

Pin 1..Pin 4 are two amplifiers . The output of DO is filtered and amplified to control the external V C O circuit .

ABSOLUTE MAXMUM RATINGS :

Parameter	Sym .	Range	Units
SUPPLY VOLTAGE	VDD	- 0.3 -- + 12.0	V
INPUT VOLTAGE	Vi	- 0.3 -- + VDD	V
OUTPUT VOLTAGE	Vo	- 0.3 -- + VDD	V
OUTPUT CURRENT	Io	± 10	mA
OPERATING TMP .	Topt	- 20 -- +80	°C
STORAGE TMP .	Tstg	- 65 -- +150	°C

ELECTRICAL CHARACTERISTICS :*

Parameter	Sym .	Condition	Min	Typ	Max	Unit
INPUT VOLTAGE P0-P6 ; FAin ; Ai ; Qin	Vih Vil		6.5		1.0	V
INPUT VOLTAGE Fin	Vf	peak to peak	0.3			V
OUTPUT VOLTAGE FAout ; Ao	Voh Vol	Ioh = - 0.5 mA Iol = 0.5mA	7.5		0.5	V
OSCILLATOR OUTPUT VOLTAGE Qout	Voh Vol	C1 = C2 = 60pF	6.5		1.0	V
SUPPLY VOLTAGE	VDD		7.8		8.2	V
OPERATE CURRENT	IDD	**		9.0		mA
INPUT FREQUENCY	Fmaxp	Fin (Pin 17)	4.0			MHZ
	Fmaxq	Qout (Pin 8)	11.0			MHZ

* @ VDD = 8.0 V T = 25°C

** FAin = Ai = 0 V ; Fin = 1 MHZ ; P0..P6 OPEN ; Qin-Qout CONNECT
10.24 MHZ CRYSTAL OSCILLATOR ; C1 = C2 = 60 pF

FUNCTION DESCRIPTION :

Programmable Counter :

Using mechanical switches or electronic circuitry program P0..P6 to define the division ratio (N *) as folllow :

P0	P1	P2	P3	P4	P5	P6	N
0 **	0	0	0	0	0	1	64
1	0	0	0	0	0	1	65
0	1	0	0	0	0	1	66
:							:
:							:
1	1	1	1	1	1	1	127
0	0	0	0	0	0	0	128
1	0	0	0	0	0	0	129
0	1	0	0	0	0	0	130
:							:
:							:
1	1	1	1	1	1	0	191

* FOR RCI 8719 $64 \leq N \leq 191$

RCI 8734 $64 \leq N \leq 127$

** ' 1 ' = OPEN

' 0 ' = GND

Divider :

The reference frequency (Fr) is divided by 1024 from oscillator input pin .

Phase Detector :

LM output 'H' when reference frequency (Fr) and programmed frequency (Fp) having phase error at falling edage .

Charge Pump :

DO is a tri-state output pin . It is dependent on Fr and Fp .

When Fr > Fp DO = 'H' (source current)

Fr = Fp DO = 'Z' (high impedance)

Fr < Fp DO = 'L' (sink current)

TYPE : RCI8719

TEST MODE / SAMPLE	I/P-VSS		I/P-VDD		I/P-O/P		O/P-VSS		O/P-VDD		VDD-VSS	
PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12
1							8000P	8000P	8000P	8000P		
2	8000P	8000P	8000P	8000P	4000	4500						
3							7000	8000P	-7500	8000P		
4	8000P	8000P	8000P	8000P	8000P	8000P						
5							-6500	-6000	8000P	8000P		
6							-5000	-5500	-7000	-7500		
7	8000P	8000P	8000P	8000P	-6500	-6500						
8	8000P	8000P	-5500	-4000	-6500	-6500						
9											4000	4000
10	8000P	8000P	8000P	8000P	8000P	8000P						
11	8000P	8000P	8000P	8000P	8000P	8000P						
12	8000P	8000P	8000P	8000P	8000P	8000P						
13	8000P	8000P	8000P	8000P	8000P	8000P						
14	8000P	8000P	8000P	8000P	8000P	8000P						
15	8000P	8000P	8000P	8000P	8000P	8000P						
16	8000P	8000P	8000P	8000P	8000P	8000P						
17	8000P	8000P	8000P	8000P	8000P	8000P						
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聯華電子股份有限公司 品質服務部可靠度測試實驗室
UNITED MICROELECTRONICS CORP. QUALITY SERVICE DEPARTMENT RELIABILITY TEST LABORATORY
新竹市科學工業園區創新一路13號
NO. 13 INNOVATION ROAD 1, SCIENCE-BASED
INDUSTRIAL PARK, HSIN-CHU CITY, TAIWAN R.O.C.
TEL : (035) 782258
FAX : (035) 782965

可靠性測試報告
RELIABILITY TEST REPORT

Date : 11/14/94
RA No.: 831106-015

申請者 Applicant: 李元宏 偉詮電子股份有限公司	
測試目的 Test Purpose: 廠商委託測試	
型號 Type No.: RCI8719	批號 Lot-No.: - -
包裝／腳數 Pkg Type/Pin Count: DIP 18	數量 Quantity: 12
申請日期 Date Of Application: 11/04/94	完成日期 Date of Finish: 11/14/94

項 目 : ESD

依 據 : MIL-STD-883D METHOD 3015.7

設 備 : IMCS-5000 #1

結 果 : 測試資料參考下頁

** 本實驗保證上述測試條件，並依規定保留三年測試數據備查。

實驗室負責人 RT MANAGER	權責主管 APPROVED BY	測試工程師 PREPARED BY
83.11.14	83.11.14	田秋美

※ 本報告僅對樣品負責且不得摘錄使用

LATCH - UP 測 試 資 料

1. 測 試 結 果(RCI8719)

1-1. 正負電壓 電流 TRIGGER 結果如下:

單位 : V　　單位 : mA

編號 / 電壓電流 / 腳數	+VT		-VT		+IT		-IT	
	1	2	3	4	5	6	7	8
1	30*	30*	30*	30*	200*	200*	200*	200*
2	30*	30*	30*	30*	200*	200*	200*	200*
3	30*	30*	30*	30*	200*	200*	200*	200*
4	30*	30*	30*	30*	200*	200*	200*	200*
5	30*	30*	30*	30*	200*	200*	200*	200*
6	30*	30*	30*	30*	200*	200*	200*	200*
7	30*	30*	30*	30*	200*	200*	200*	200*
8	30*	30*	30*	30*	200*	200*	200*	200*
9								
10	30*	30*	30*	30*	200*	200*	200*	200*
11	30*	30*	30*	30*	200*	200*	200*	200*
12	30*	30*	30*	30*	200*	200*	200*	200*
13	30*	30*	30*	30*	200*	200*	95	95
14	30*	30*	30*	30*	200*	200*	200*	200*
15	30*	30*	30*	30*	200*	200*	200*	200*
16	30*	30*	30*	30*	200*	200*	200*	200*
17	30*	30*	30*	30*	200*	200*	200*	200*
18								

* PASSED LATCH-UP TEST

聯華電子股份有限公司 品質服務部可靠度測試實驗室
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TEL : (035) 782258
FAX : (035) 782965

可靠性測試報告
RELIABILITY TEST REPORT

Date :11/07/94
RA No.: 831106-001

申請者 Applicant: 李元宏 · 偉詮電子股份有限公司	
測試目的 Test Purpose: 廠商委託測試	
型號 Type No.: RCI8719	批號 Lot-No.: - -
包裝／腳數 Pkg Type/Pin Count: DIP 18	數量 Quantity: 8
申請日期 Date Of Application: 11/04/94	完成日期 Date of Finish: 11/07/94

項目： LATCH UP

依據： JEDEC STANDARD

設備：

- HP POWER SUPPLY
- TEKTRONIX SCOPE
- HP PULSE GENERATOR
- KEILTHLEY CURRENT SOURCE

條件：

電壓 TRIGGER 至 ± 30V

± 1V～ ± 30V,每個 STEP為 ± 0.1V

電流 TRIGGER 至 ± 200mA

± 20mA～ ± 100mA,每個 STEP為 ± 5mA

± 100mA～ ± 200mA,每個 STEP為 ± 10mA

結果： 測試資料參考下頁

** 本實驗保證上述測試條件,並依規定保留三年測試數據備查.

實驗室負責人 RT MANAGER	權責主管 APPROVED BY	測試工程師 PREPARED BY
黃國強 831107	蕭振宣 83.11.7	田秋美

※ 本報告僅對樣品負責且不得摘錄使用

APPENDIX 5

FINAL RF AMPLIFIER DATA SHEETS

FINAL RF AMP DATA SHEET
FCC ID: M38-TR-286

APPENDIX 5

三菱半導体〈トランジスタ

2SC1969

HF帯低電圧直線増幅用
シリコンNPNエピタキシャルプレーナ形

概　要

2SC1969は、シリコンNPNエピタキシャルプレーナ形トランジスタで、HF帯での低電圧直線増幅に性能を発揮します。

特　長

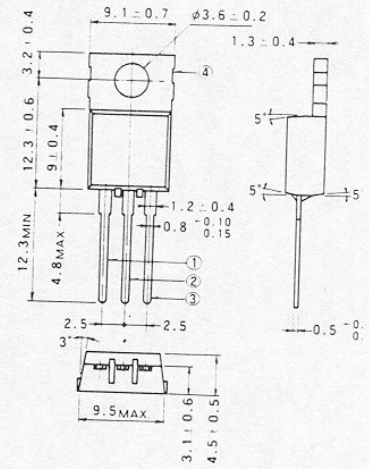
- 高利得：G_{pe}≧12dB（@f＝27MHz、V_{CC}＝12V、P_{in}＝1W）
- エミッタ安定化抵抗の採用
- 高破壊耐量：f＝27MHz、V_{CC}＝16V、P_O＝20Wでの無限大負荷VSWRに耐える
- 低ひずみ：3次IMD＝−30dB（@f＝27MHz、V_{CC}＝12V、P_O＝14W PEP）

用　途

HF帯低電圧直線増幅用、特に27MHz SSB12W CBトランシーバ送信段用

外形図

単位：



電極接続
①：ベース
②：コレクタ　　EIAJ：−
③：エミッタ　　JEDEC：−
④：コレクタ（放熱板）

（注1）公差指定のない寸法は代表値を示す。

最大定格（Tc＝25℃）

記号	項目		定格値	単位
V_{CBO}	コレクタ・ベース間電圧		60	V
V_{EBO}	エミッタ・ベース間電圧		5	V
V_{CEO}	コレクタ・エミッタ間電圧		25	V
I_C	コレクタ電流		6	A
P_C	コレクタ損失	Ta＝25℃	1.7	W
P_C		Tc＝25℃	20	W
T_j	接合部温度		150	℃
Tstg	保存温度		−55〜＋150	℃
Rth−a	熱抵抗（接合部—雰囲気間）		73.5	℃/W
Rth−c	熱抵抗（接合部—ケース間）		6.25	℃/W

電気的特性（Tc＝25℃）

記号	項目	測定条件	特性値 最小	標準	最大	単位
$V_{(BR)EBO}$	エミッタ・ベース降伏電圧	I_E＝5mA、I_C＝0	5			V
$V_{(BR)CBO}$	コレクタ・ベース降伏電圧	I_C＝1mA、I_E＝0	60			V
$V_{(BR)CEO}$	コレクタ・エミッタ降伏電圧	I_C＝10mA、R_{BE}＝∞	25			V
I_{CBO}	コレクタしゃ断電流	V_{CB}＝30V、I_E＝0			100	μA
I_{EBO}	エミッタしゃ断電流	V_{EB}＝4V、I_C＝0			100	μA
h_{FE} †	直流電流増幅率	V_{CE}＝12V、I_C＝10mA、パルス測定	10	50	180	—
P_O	出力電力	V_{CC}＝12V、f＝27MHz、P_{in}＝1W	16	18		W
η_C	コレクタ効率	V_{CC}＝12V、f＝27MHz、P_{in}＝1W	60	70		%

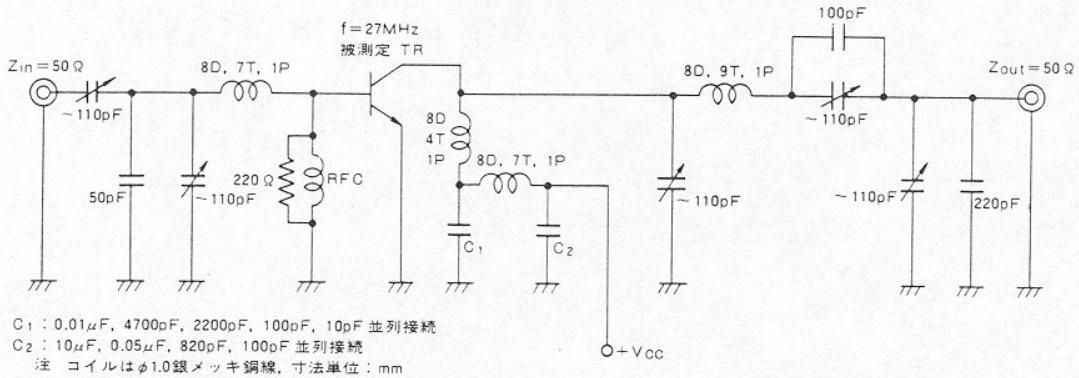
†：h_{FE}の値により右表のようにアイテム分類を行っています。

アイテム	X	A	B	C	D
h_{FE}	10〜25	20〜45	35〜70	55〜110	90〜180

2SC1969

HF帯低電圧直線増幅用
シリコンNPNエピタキシャルプレーナ形

出力電力測定回路

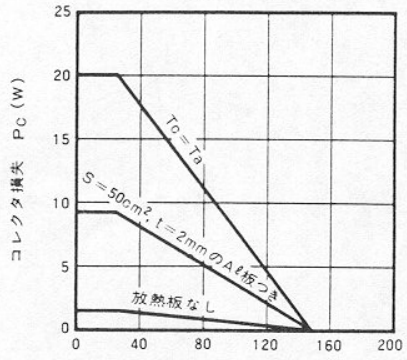


C1：0.01μF, 4700pF, 2200pF, 100pF, 10pF 並列接続
C2：10μF, 0.05μF, 820pF, 100pF 並列接続
注 コイルはφ1.0銀メッキ銅線，寸法単位：mm
D：コイルの内径，T：コイルの巻数，P：コイルのピッチ

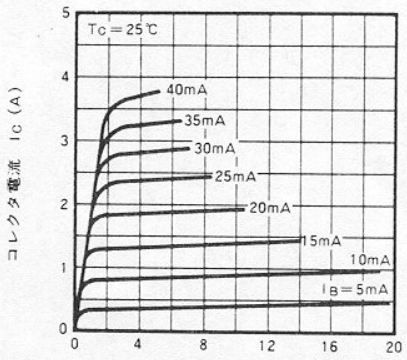
4

標準特性

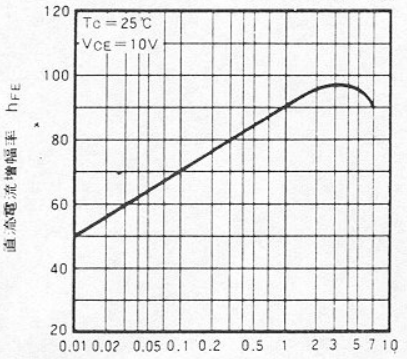
コレクタ損失—周囲温度特性



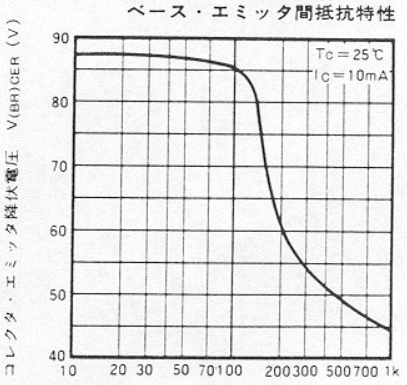
エミッタ接地出力特性



直流電流増幅率—コレクタ電流特性



コレクタ・エミッタ降伏電圧—
ベース・エミッタ間抵抗特性

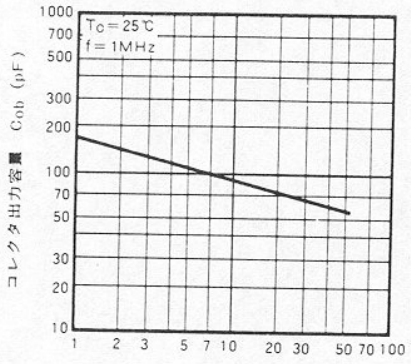


三菱半導体〈トランジスタ〉

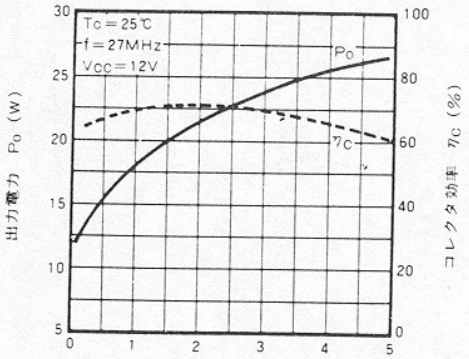
2SC1969

HF帯低電圧直線増幅用
シリコンNPNエピタキシャルプレーナ形

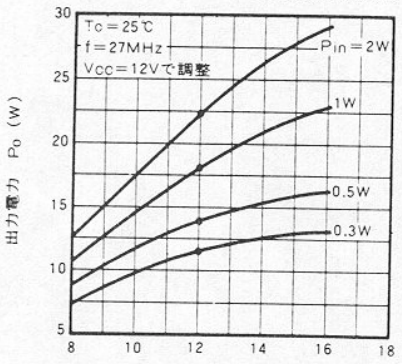
コレクタ出力容量—
コレクタ・ベース間電圧特性



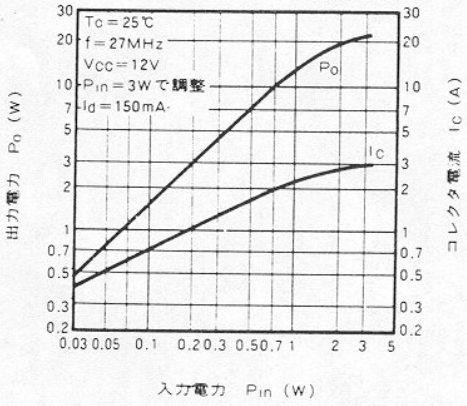
出力電力，コレクタ効率—入力電力特性



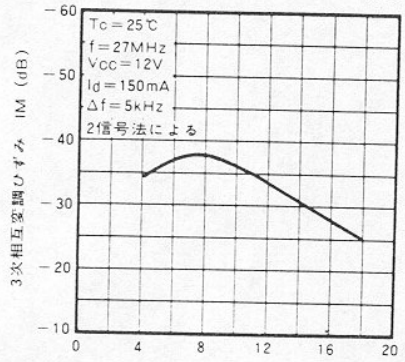
出力電力—コレクタ供給電圧変動特性



AB級出力電力・コレクタ電流—
入力電力特性



3次相互変調ひずみ—出力レベル特性



三菱半導体〈トランジスタ〉

2SC2166

27MHz帯トランシーバ用
シリコンNPNエピタキシャルプレーナ形

概　要

2SC2166は、シリコンNPNエピタキシャルプレーナ形トランジスタで、27MHz帯での高周波電力増幅用として性能を発揮します。

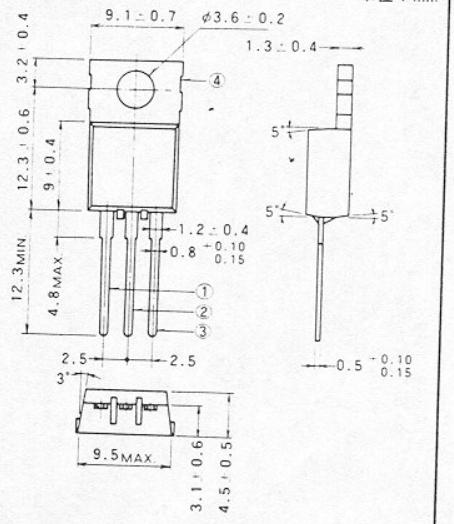
特　長

- 高利得：$G_{pe} \geqq 13.8$dB（@ $V_{CC}=12$V、f＝27MHz、$P_{in}=0.25$W）
- フレームリードシリコンモールドパッケージの採用
- エミッタ安定化抵抗の採用

用　途

27MHz C.B.トランシーバ
4W AM送信部出力段
12W SSB送信部励振段

外形図　単位：mm



電極接続
①：ベース
②：コレクタ　　EIAJ：—
③：エミッタ　　JEDEC：—
④：コレクタ（放熱板）

（注1）公差指定のない寸法は代表値を示す。

最大定格（Tc＝25℃）

記　号	項　　目		定　格　値	単　位
V_{CBO}	コレクタ-ベース間電圧		75	V
V_{EBO}	エミッタ-ベース間電圧		5	V
V_{CER} †	コレクタ-エミッタ間電圧		75	V
I_C	コレクタ電流		4	A
P_C	コレクタ損失	Ta＝25℃	1.5	W
P_C		Tc＝25℃	12.5	W
T_j	接合部温度		150	℃
Tstg	保存温度		−55～＋150	℃
Rth−a	熱抵抗（接合部—雰囲気間）		83	℃/W
Rth−c	熱抵抗（接合部—ケース間）		10	℃/W

†：$R_{BE}=10\Omega$

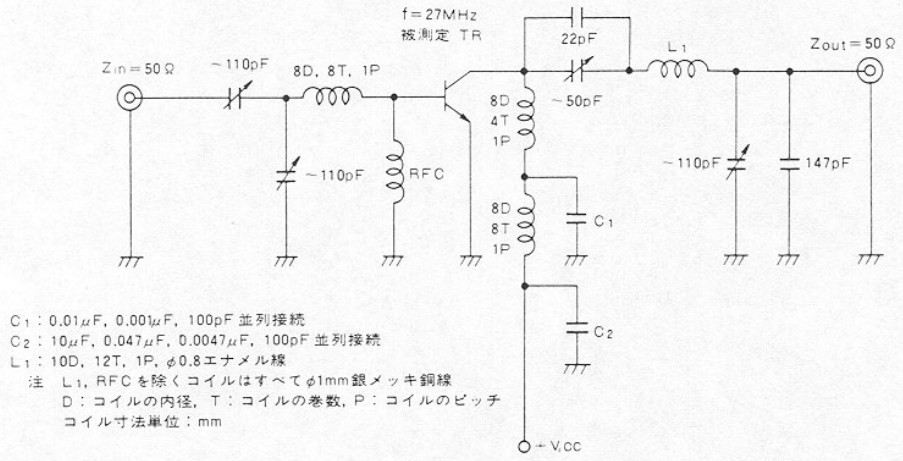
電気的特性（Tc＝25℃）

記　号	項　　目	測　定　条　件	特　性　値			単　位
			最　小	標　準	最　大	
$V_{(BR)EBO}$	エミッタ-ベース降伏電圧	$I_E=1$mA, $I_C=0$	5			V
$V_{(BR)CBO}$	コレクタ-ベース降伏電圧	$I_C=1$mA, $I_E=0$	75			V
$V_{(BR)CER}$	コレクタ-エミッタ降伏電圧	$I_C=10$mA, $R_{BE}=10\Omega$	75			V
I_{CBO}	コレクタしゃ断電流	$V_{CB}=30$V, $I_E=0$			100	μA
I_{EBO}	エミッタしゃ断電流	$V_{EB}=3$V, $I_C=0$			100	μA
h_{FE}	直流電流増幅率	$V_{CE}=10$V, $I_C=0.1$A, パルス測定	35	70	180	—
P_O	出力電力	$V_{CC}=12$V, f＝27MHz, $P_{in}=0.25$W	6	7.5		W
η_C	コレクタ効率	$V_{CC}=12$V, f＝27MHz, $P_{in}=0.25$W	55	60		%

2SC2166

27MHz帯トランシーバ用
シリコンNPNエピタキシャルプレーナ形

出力電力測定回路

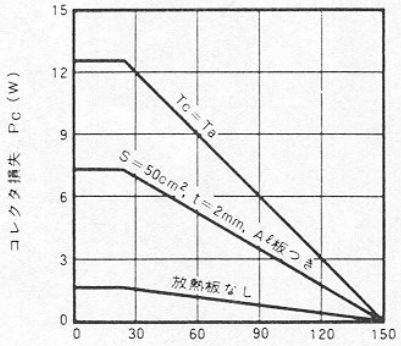


C1：0.01μF, 0.001μF, 100pF 並列接続
C2：10μF, 0.047μF, 0.0047μF, 100pF 並列接続
L1：10D, 12T, 1P, φ0.8エナメル線
注　L1, RFCを除くコイルはすべてφ1mm銀メッキ銅線
　　D：コイルの内径, T：コイルの巻数, P：コイルのピッチ
　　コイル寸法単位：mm

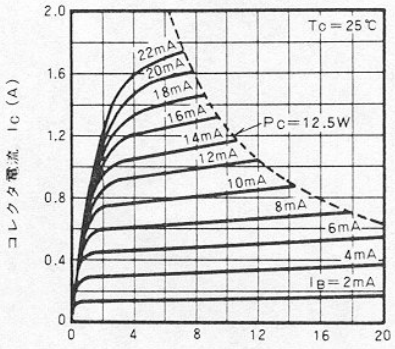
4

標準特性

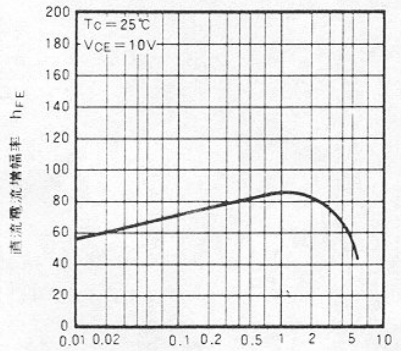
コレクタ損失—周囲温度特性



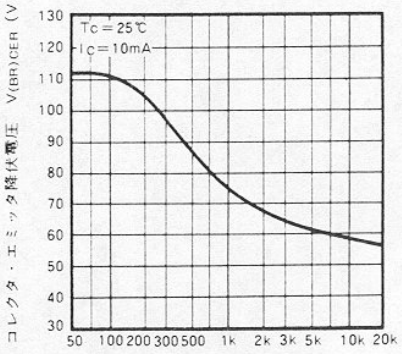
エミッタ接地出力特性



直流電流増幅率—コレクタ電流特性



コレクタ・エミッタ降伏電圧—
ベース・エミッタ間抵抗特性

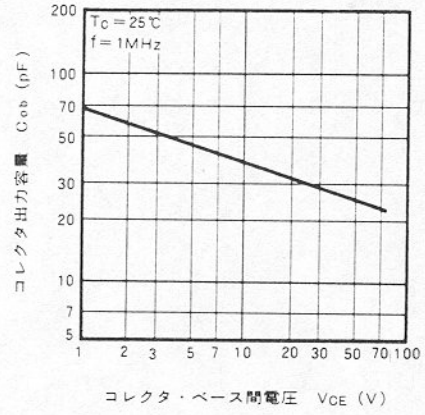


三菱半導体〈トランジスタ〉

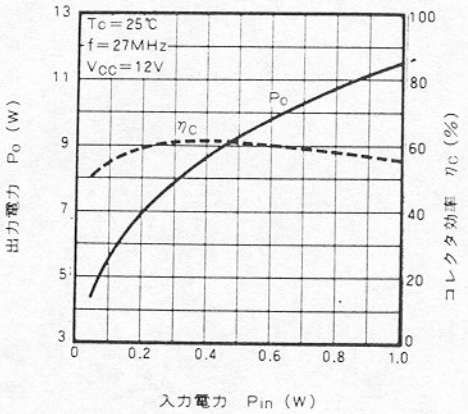
2SC2166

27MHz帯トランシーバ用
シリコンNPNエピタキシャルプレーナ形

コレクタ出力容量—
コレクタ・ベース間電圧特性



出力電力，コレクタ効率—入力電力特性



出力電力—コレクタ供給電圧変動特性