

ENGINEERING STATEMENT  
For Type Certification of  
MIDLAND CONSUMER RADIO

Model No: 77-104XL

FCC ID: MMA77104XL

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 Midland Consumer Radio to make type certification measurements on the 77-104XL 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: April 12, 2000

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the 77-104XL transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 77-104XL is a double-sideband amplitude modulated transmitter/receiver combination intended for mobile 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 ACCEPTANCE  
(Paragraph 2.983 of the Rules)

1. Name of applicant: Midland Consumer Radio
2. Identification of equipment: FCC ID: MMA77104XL
  - a. The equipment identification label is submitted as a separate exhibit.  
Photographs of the equipment are submitted as a separate exhibit.
3. Quantity production is planned.
4. Technical description:
  - a. 6k00A3E emission
  - b. Frequency range: 26.965 - 27.405 MHz
  - c. Operating power of transmitter is fixed at the factory at less than 4 watts, AM.
  - d. Maximum power rating under 95.635(c) of the Rules is 4 watts.
  - e. The dc voltage and dc currents at final amplifier:  
  
Collector voltage: 13.7 V  
Collector current: 611 mA @ 13.8 Vdc.
  - f. Function of each active semiconductor device:  
See Appendix 1.
  - g. Complete circuit diagram is submitted as a separate exhibit.  
A draft instruction book is submitted as a separate exhibit.  
The transmitter tune-up procedure is submitted 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.

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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. (The transmitter was tuned by the factory.) Power was measured with a supply voltage of 13.8 Vdc and indicated:

| Channel | Power, watts |
|---------|--------------|
| 1       | 4.0          |
| 21      | 4.0          |
| 40      | 4.0          |

B. MODULATION CHARACTERISTICS

1. AF\_Frequency\_Response

A curve showing frequency response of the transmitter is shown in Figure 1. 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 2a and 2b, respectively. Characteristics at 300, 830, and 2500 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

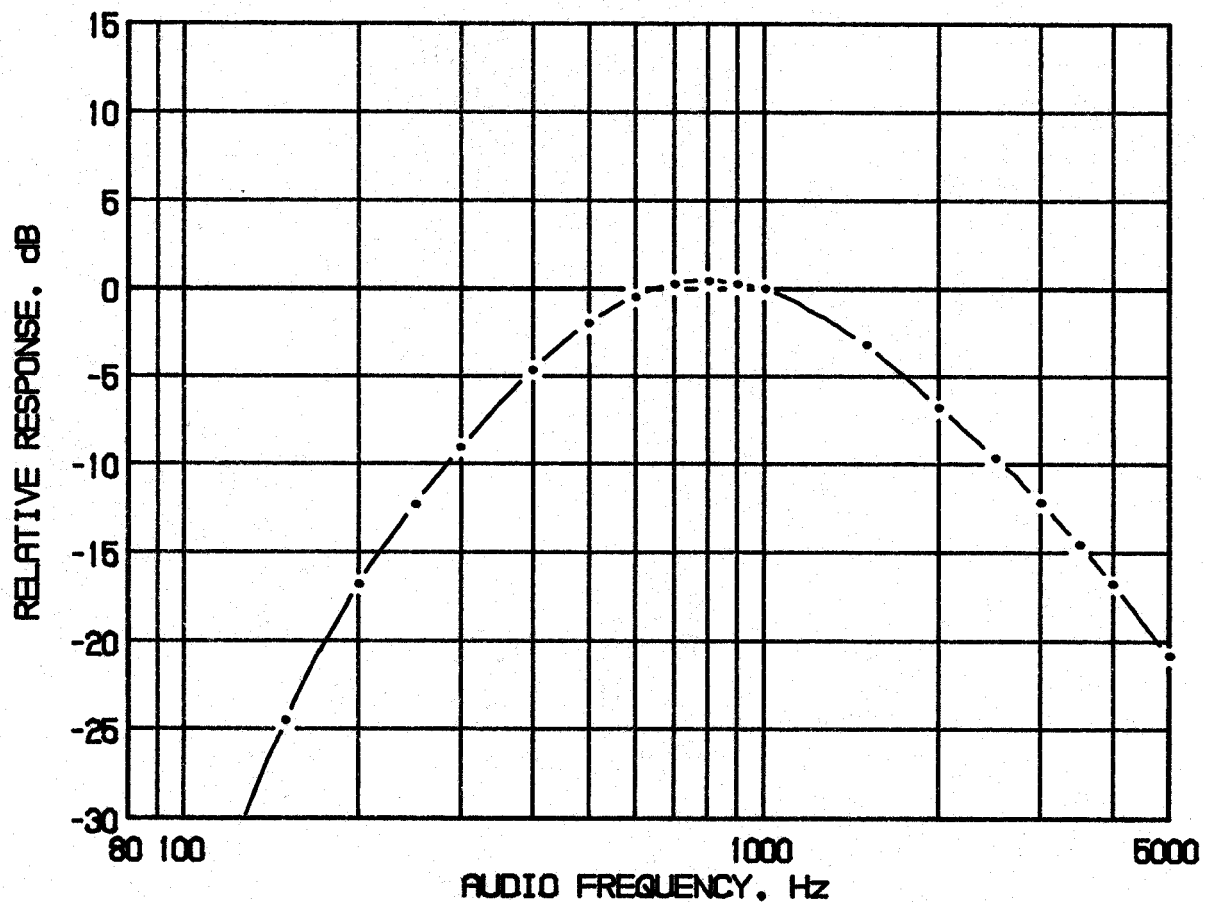
Modulation limiter attack time was measured by applying to the microphone input terminals a pulsed tone at 2500

Hz, 16 dB above the level required for 50% modulation at the frequency of maximum response, 830 Hz. The spectrum analyzer was tuned to upper and lower fourth-order sidebands in the time domain. Sweep speed was 100 milliseconds per division. Plots are included as Figures 3a and 3b. Any transients observed in excess of 33 dB attenuation as referenced to the carrier were less than 20 ms in duration.

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FIGURE 1

TRANSMITTER FREQUENCY RESPONSE



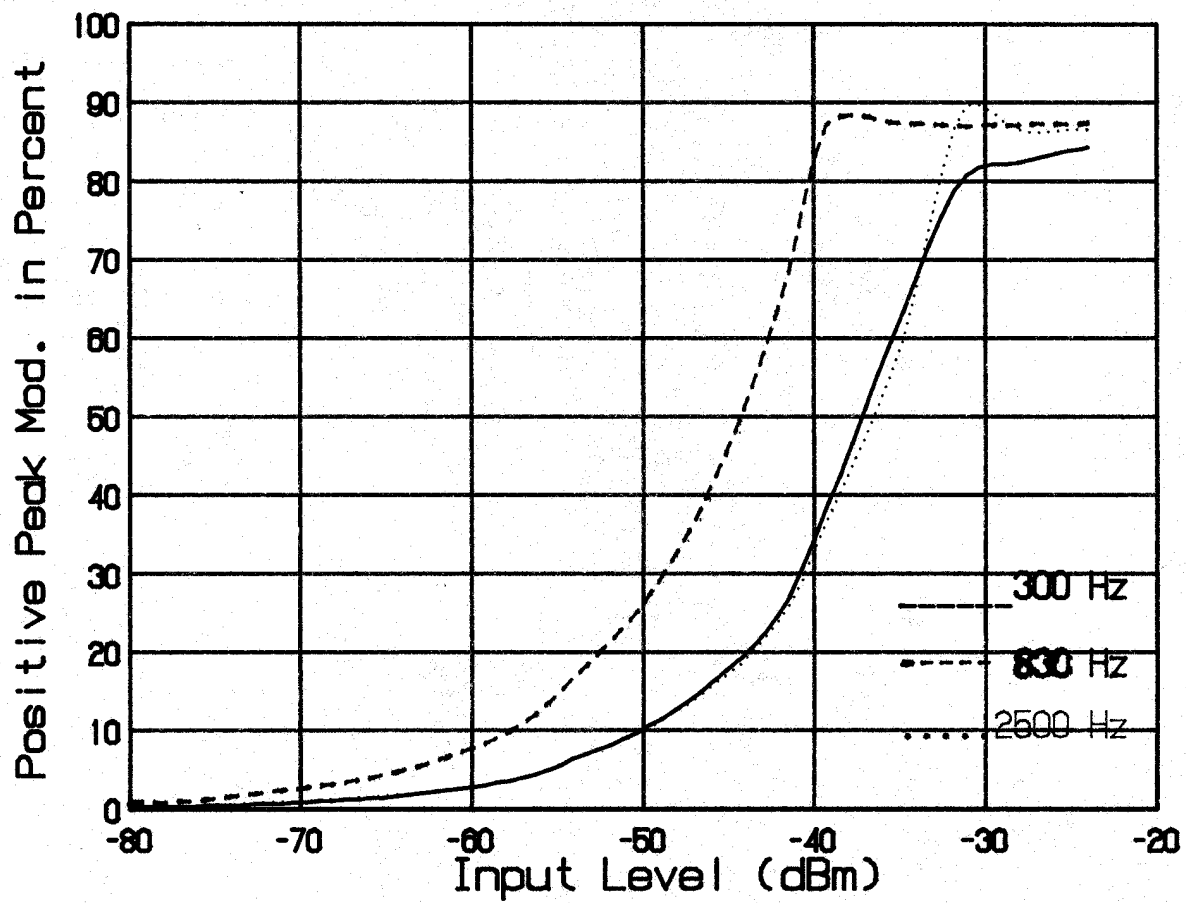
TRANSMITTER FREQUENCY RESPONSE  
FCC ID: MMA77104XL

FIGURE 1

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FIGURE 2a

AM MODULATION LIMITING - POSITIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

Percent modulation as a function of input level  
at microphone jack in dBm for 300 Hz, 830 Hz, and  
2500 Hz tones.

MODULATION LIMITING POSITIVE  
PEAKS

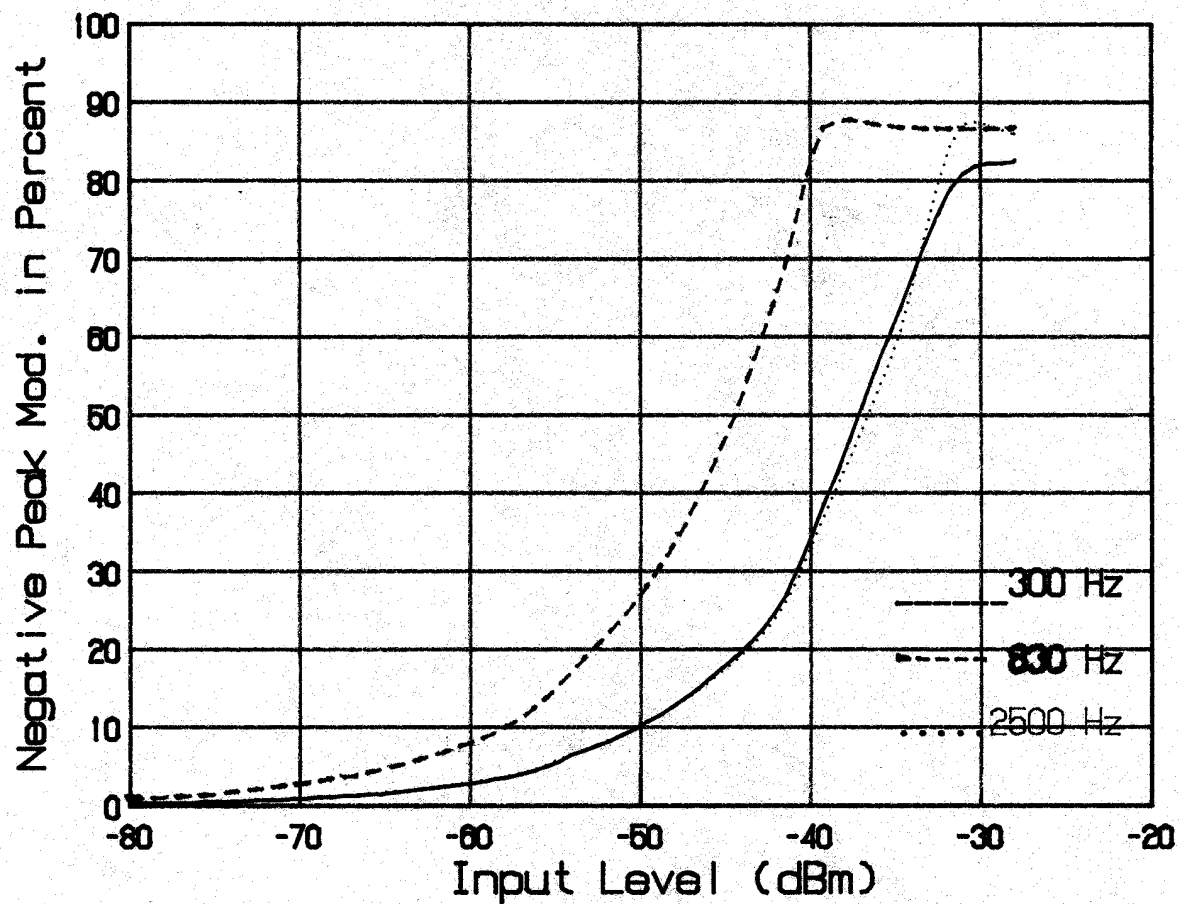
FCC ID: MMA77104XL

FIGURE 2a

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FIGURE 2b

AM MODULATION LIMITING - NEGATIVE PEAKS



## MODULATION LIMITING CHARACTERISTICS

Percent modulation as a function of input level  
at microphone jack in dBm for 300 Hz, 830 Hz, and  
2500 Hz tones.

### MODULATION LIMITING NEGATIVE PEAKS

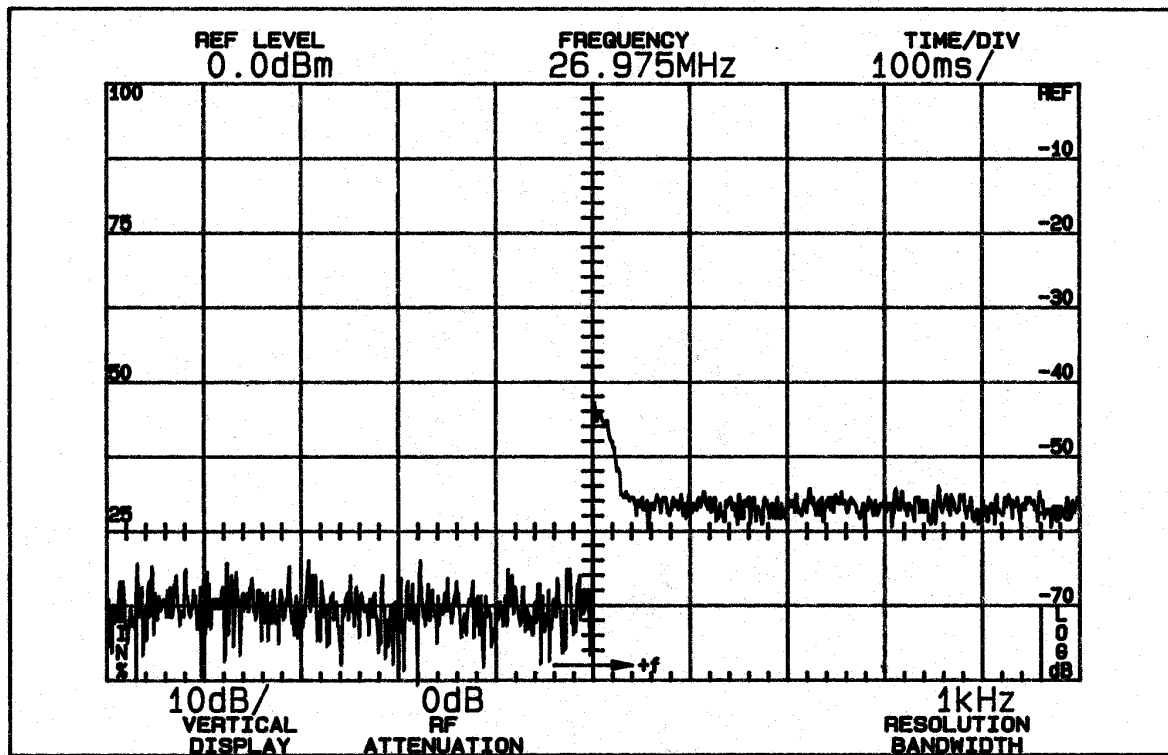
FCC ID: MMA77104XL

FIGURE 2b

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FIGURE 3a

### MODULATION LIMITER ATTACK TIME



Measurement\_Conditions: 16 dB over 50% modulation level at 830 Hz with 2500 Hz tone, upper fourth order sideband; horizontal scale 100 ms/div.

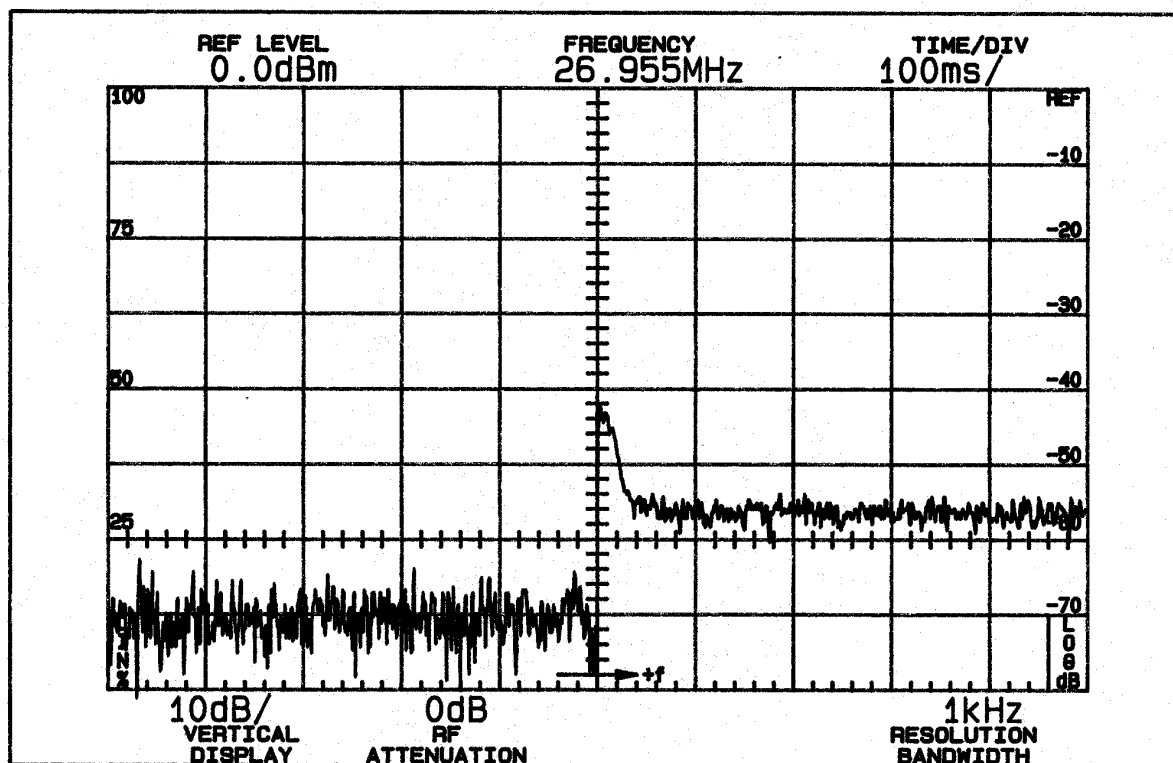
UPPER FOURTH-ORDER SIDEBAND  
LIMITER ATTACK TIME  
FCC ID: MMA77104XL

FIGURE 3a

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FIGURE 3b

MODULATION LIMITER ATTACK TIME





Measurement\_Conditions: 16 dB over 50% modulation level at 830 Hz with 2500 Hz tone, lower fourth order sideband; horizontal scale 100 ms/div.

LOWER FOURTH-ORDER SIDEBAND  
LIMITER ATTACK TIME  
FCC ID: MMA77104XL

FIGURE 3b

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C. MODULATION CHARACTERISTICS (Continued)

4. Occupied\_Bandwidth\_ - \_AM

(Paragraph 2.989(c) of the Rules)

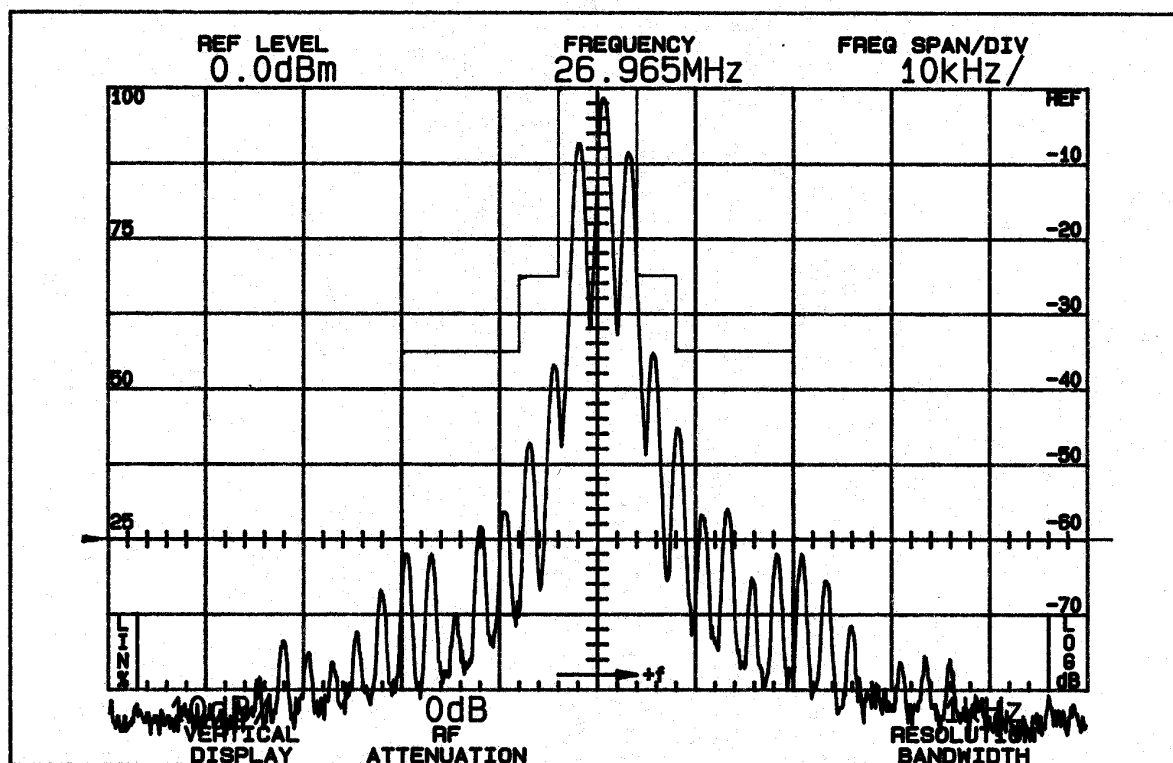
Figure 4 is a plot of the sideband envelope of the transmitter taken from a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(a) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 830 Hz, the frequency of maximum response. Measured modulation at 1150 Hz was 85% positive, 86% negative.

The plot is 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.

**Reference carrier was set to 0 dB.**

FIGURE 4

OCCUPIED BANDWIDTH - AM



ATTENUATION IN dB BELOW

MEAN OUTPUT POWER  
Required

|                                                                                                          |    |
|----------------------------------------------------------------------------------------------------------|----|
| On any frequency more than 50%<br>up to and including 100% of the<br>authorized bandwidth, 8kHz (4-8kHz) | 25 |
| On any frequency more than 100%,<br>up to and including 250% of the<br>authorized bandwidth (8-20kHz)    | 35 |
| On any frequency removed from the<br>assigned frequency by more than<br>250% of the authorized bandwidth | 60 |

OCCUPIED BANDWIDTH - AM  
FCC ID: MMA77104XL

FIGURE 4

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

The 77-104XL 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 830 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.

During the tests, the transmitter was terminated in the Narda 765-20 dummy load. Power was monitored on a Bird 43 Thru-Line wattmeter; 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 noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

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TABLE 1

TRANSMITTER CONDUCTED SPURIOUS

| <u>Channel</u> | <u>Spurious Frequency<br/>MHz</u> | <u>dB Below Unmod<br/>Carrier_Ref._</u> |
|----------------|-----------------------------------|-----------------------------------------|
| 1              | 53.930                            | 68                                      |
| 1              | 80.895                            | 90                                      |
| 1              | 107.860                           | 89                                      |
| 1              | 134.825                           | 106                                     |
| 1              | 161.790                           | 90                                      |
| 1              | 188.755                           | 105                                     |
| 1              | 215.720                           | 104                                     |
| 1              | 242.685                           | 95                                      |
| 1              | 269.650                           | 101                                     |
| 21             | 54.430                            | 70                                      |
| 21             | 81.645                            | 90                                      |
| 21             | 108.860                           | 89                                      |
| 21             | 136.075                           | 100                                     |
| 21             | 163.290                           | 90                                      |
| 21             | 190.505                           | 108                                     |
| 21             | 217.720                           | 99                                      |
| 21             | 244.935                           | 92                                      |
| 21             | 272.150                           | 96                                      |

|           |         |     |
|-----------|---------|-----|
| 40        | 54.810  | 71  |
| 40        | 82.215  | 92  |
| 40        | 109.620 | 90  |
| 40        | 137.025 | 107 |
| 40        | 164.430 | 93  |
| 40        | 191.835 | 108 |
| 40        | 219.240 | 103 |
| 40        | 246.645 | 94  |
| 40        | 274.405 | 104 |
| Required: |         | 60  |

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

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### 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 77-104XL 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 4.0 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 4.0 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<sub>t</sub> = transmitter power in watts

R = distance in meters

$$\text{for this case } E = \frac{(49.2 \times 4.0)^{1/2}}{3} = 4.7 \text{ V/m}$$

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

$$4.7 \text{ volts/meter} = 4.7 \times 10^6 \text{ uV/m}$$

$$\text{dBu/m} = 20 \text{ Log}_{10}(4.7 \times 10^6)$$

$$= 133 \text{ dBu/m}$$

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

$$133 - 107 = 26 \text{ dBm}$$

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.

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#### F. FIELD STRENGTH MEASUREMENTS (Continued)

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS  
Channel 1, 26.965 MHz; 4.0 watts; 13.8 Vdc

| <u>Frequency, _MHz</u> | <u>dB_Below_Carrier_Reference</u> |                   |                            |                   |
|------------------------|-----------------------------------|-------------------|----------------------------|-------------------|
|                        | <u>With Accessories</u>           |                   | <u>Without Accessories</u> |                   |
|                        | <u>Vertical</u>                   | <u>Horizontal</u> | <u>Vertical</u>            | <u>Horizontal</u> |
| 53.930                 | 79                                | 81                | 83                         | 91                |
| 80.895                 | 73                                | 66                | 84                         | 84                |
| 107.860                | 88                                | 83                | 94                         | 95                |
| 134.825                | 75                                | 83                | 78                         | 94                |
| 161.790                | 80                                | 82                | 77                         | 95                |
| 188.755                | 85                                | 83                | 94                         | 105               |
| 215.720                | 86                                | 80                | 84                         | 76                |
| 242.685                | 75                                | 88                | 77                         | 80                |
| 269.650                | 74                                | 74                | 73                         | 74                |

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° 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 minute 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 Vdc. 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.

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G.    FREQUENCY STABILITY (Continued)

TABLE 3

| <u>Temperature</u>       | <u>Output_Frequency, _MHz</u> |
|--------------------------|-------------------------------|
| -29.2                    | 27.065635                     |
| -19.8                    | 27.065640                     |
| - 9.8                    | 27.065597                     |
| 0.0                      | 27.065499                     |
| 10.4                     | 27.065344                     |
| 19.9                     | 27.065243                     |
| 30.5                     | 27.065044                     |
| 40.4                     | 27.064885                     |
| 49.9                     | 27.064749                     |
| Maximum frequency error: | 27.065640                     |
|                          | <u>27.065000</u>              |
|                          | - .000640 MHz                 |

FCC Rule 95.625(b) specifies .005% or a maximum of  $\pm .001353$  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 provided by Heath SP-5220 variable ac power supply was varied from  $\pm 15\%$  above the nominal 13.8 Vdc. 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

| <u>Supply_Voltage</u> | <u>Output_Frequency, _MHz</u> |
|-----------------------|-------------------------------|
| 15.87                 | 27.065256                     |
| 15.18                 | 27.065252                     |
| 14.49                 | 27.065247                     |
| 13.80                 | 27.065243                     |
| 13.11                 | 27.065239                     |
| 12.42                 | 27.065236                     |
| 11.73                 | 27.065233                     |

|                          |                  |
|--------------------------|------------------|
| Maximum frequency error: | 27.065256        |
|                          | <u>27.065000</u> |
|                          | + .000256 MHz    |

FCC Rule 95.625(b) specifies .005% or a maximum of  $\pm .0001353$  MHz.

No effects on frequency related to keying the unit were observed.

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H. ADDITIONAL REQUIREMENTS FOR TYPE ACCEPTANCE  
(Paragraph 95.669 of the Rules)

The 77-104XL meets the applicable provision of 95.669(a).

External controls are limited to the following per 95.669(a):

1. Primary power connection
2. Microphone jack
3. RF output power connection
4. External speaker jacks
5. On-off switch (combined with receiver volume control)
6. Not applicable, AM only
7. Not applicable
8. Transmitting frequency selector
9. Transmit-receive switch
10. Meter for monitoring transmitter performance
11. Meter/pilot lamp for RF output indication



Other front panel controls and functions follow on pages 17 and 18, and are representative of functions approved on other submissions.

The serial number of each unit will be implemented in accordance with 95.971.

A copy of Part 95, 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 95.673.

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

The 77-104XL meets the following conditions specified:

1. All frequency-determining elements, including crystals, PLL integrated circuits and channel selector switches are permanently wired and soldered in place.
2. The PLL integrated circuit division ratio selection is 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 US.
4. All the undedicated leads in the CPU and PLL integrated circuits are disabled and 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.

FUNCTION OF DEVICES FOLLOWS THIS SHEET

FUNCTION OF DEVICES  
FCC ID: MMA77104XL

APPENDIX 1

## 1) IC

| Ref. No. | Description | Function   |            | Manufacturer |
|----------|-------------|------------|------------|--------------|
|          |             | RX         | TX         |              |
| IC1      | LC7185      | PLL IC     | PLL IC     | SANYO        |
| IC2      | NJM4558D    | Squelch    | Audio Amp. | JRC          |
| IC3      | TDA2003     | Audio Amp. | Audio Amp. | SGS          |

## 2) TR

| Ref. No. | Description | Function                 |                 | Manufacturer |
|----------|-------------|--------------------------|-----------------|--------------|
|          |             | RX                       | TX              |              |
| Q1       | KTA1267Y    | AGC                      | -               | K.E.C.       |
| Q2       | KTC3195Y    | RF Amp.                  | -               | K.E.C.       |
| Q3       | KTC3195Y    | RX 1 <sup>ST</sup> Mixer | -               | K.E.C.       |
| Q4       | KTC3195Y    | RX 2 <sup>ND</sup> Mixer |                 | K.E.C.       |
| Q5       | KTC3195Y    | IF Amp.                  | -               | K.E.C.       |
| Q6       | KTC3199Y    | IF Amp.                  | -               | K.E.C.       |
| Q7       | KTC3199Y    | ANL Clipping             | -               | K.E.C.       |
| Q8       | KTC3199Y    | -Audio switching         |                 | K.E.C.       |
| Q9       | KTC3199Y    | -                        | Audio switching | K.E.C.       |
| Q10      | KTC3199Y    | Squelch                  |                 | K.E.C.       |
| Q11      | KTC3199Y    | Squelch                  |                 | K.E.C.       |
| Q12      | KTA1267Y    |                          | Mic amp         | K.E.C.       |
| Q13      | KTC3199Y    |                          | ALC             | K.E.C.       |
| Q14      | KTC3199Y    |                          | ALC             | K.E.C.       |
| Q15      | KTC3198Y    | Regulator                | Regulator       | K.E.C.       |
| Q16      | KTC3875S    |                          | TX B+ Switching | K.E.C.       |
| Q17      | KTC3198Y    | RX B+ Switching          | -               | K.E.C.       |
| Q20      | KTC3195Y    | VCO                      | VCO             | K.E.C.       |
| Q21      | KTC3199Y    | VXO amp                  | VXO amp         | K.E.C.       |
| Q22      | KTC3199Y    | Buffer                   | buffer          | K.E.C.       |
| Q23      | KTC3199Y    |                          | Doubler amp     | K.E.C.       |
| Q24      | KTC3198Y    | -                        | PRE Amp.        | K.E.C.       |
| Q25      | KTC1006     | -                        | RF Driver Amp.  | K.E.C.       |
| Q26      | KTC2075A    | -                        | Power Amp.      | K.E.C.       |
| Q27      | KTA1267Y    | Display logic            | Display logic   | K.E.C.       |
| Q28      | KTA1267Y    | Display logic            | Display logic   |              |
| Q30      | KTC3199Y    | RX ind cont.             |                 |              |
| Q32      | KTC3198Y    | 6v. reg                  | 6v. reg         | K.E.C.       |
| Q35      | KTC3199Y    | Active filter            | Active filter   | K.E.C.       |
| Q36      | KTC3199Y    | Active filter            | Active filter   | K.E.C.       |

## 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 10.240 MHz.

APPENDIX 2

APPENDIX 3

1. Circuits\_For\_Suppression\_Of\_Spurious\_Radiation

The tuning circuit between frequency synthesizer and final AMP Q26 and 3-stage "PI" network, C110, C112, C113, C115 C116, L6, L7 and L8 in the Q26 output circuit serves to suppress spurious radiation. This network serves to impedance match Q26 to the antenna and to reduce spurious content to acceptable levels in the frequency synthesizer.

2. Circuits\_For\_Limiting\_Modulation

The mic input is fed to the mic amp IC2 (1/2) and then to the audio power amp IC3 which feeds the signal to the modulation transformer T6. The audio output at the top of T6 is fed in series with the B+ voltage through diode D11 to the collector of Q25 and the final Q26 to collector modulate at both stages.

A portion of the modulation voltage is fed to Q13 and Q14 and turn on and at the same time, Q14 attenuates the mic, in put to the mic amp IC2 (1/2). The resulting feedback loop keeps the modulation from exceeding 100% for input approximately 40 dB greater than that required to produce 50% modulation. The attack time is about 18 ms and the release time is about 300 ms.

3. Circuits For Limiting Power

During factory alignment, the series base resistor Q26 (R127) is selected to limit the available power to slightly less than 4 watts. The tuning is adjusted so that the actual power is from 3.6 to 4.0 watts; there are no other controls for adjusting power.

DEVICES AND CIRCUITS TO SUPPRESS  
SPURIOUS RADIATION; LIMIT  
MODULATION AND POWER  
FCC ID: MMA77104XL

APPENDIX 3

APPENDIX 4

PLL DATA SHEETS

TWELVE (12) PAGES FOR LC7185-8750 FOLLOW THIS SHEET

COPY OF PLL DATA SHEETS  
FCC ID: MMA77104XL

APPENDIX 4

Ordering number: EN 3356A

CMOS IC

**SANYO**

**LC7185-8750**

**CB Transceiver PLL Frequency Synthesizer  
and Controller**

## Overview

This 27 MHz band, PLL frequency synthesizer LSI chip is designed specifically for CB transceivers. The specifications are suited for use in U.S.A.(FCC).

## Functions

The LC7185-8750 incorporates PLL circuitry and a controller for CB applications on a single CMOS chip. The controller handles the PLL circuitry, frequency data ROM, channel preset/recall RAM, and LED display driver. It also supports channel scan, channel preset/recall, and emergency channel call.

## Features

1. A built-in programmable divider for the 16 MHz VCO
2. Transmission is inhibited when the PLL is unlocked (digital lock monitor).
3. Direct channel 9 or 19 selection (sliding switch)
4. A 7-segment, 2-character LED display
5. "PA" is displayed in public announcement mode.
6. Output beep-tone control circuitry
7. Up to 5 channel settings can be stored in memory.
8. 4 × 3 key matrix implementation

## Specifications

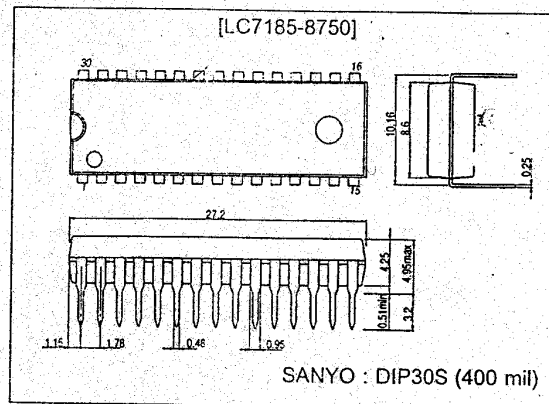
**Absolute Maximum Ratings at  $T_a = 25^\circ\text{C}$ ,  $V_{SS} = 0\text{ V}$**

| Parameter                   | Symbol               | Conditions                                 | Ratings                | Unit             |
|-----------------------------|----------------------|--------------------------------------------|------------------------|------------------|
| Maximum supply voltage      | $V_{DD\text{ max}}$  | Pin $V_{DD}$                               | -0.3 to +9.0           | V                |
| Input voltage               | $V_{IN1\text{ max}}$ | Pins HOI, D, TX                            | -0.3 to +15            | V                |
|                             | $V_{IN2\text{ max}}$ | Input pins other than $V_{IN1\text{ max}}$ | -0.3 to $V_{DD} + 0.3$ | V                |
| Output voltage              | $V_{O1\text{ max}}$  | Pins SA, SB, SC, SD, SE, SF, SG, D1, D2    | -0.3 to +15            | V                |
|                             | $V_{O2\text{ max}}$  | Pins UL, BEEP                              | -0.3 to +15            | V                |
|                             | $V_{O3\text{ max}}$  | Pin PD                                     | -0.3 to $V_{DD} + 0.3$ | V                |
|                             | $V_{O4\text{ max}}$  | Output pins other than mentioned above     | -0.3 to $V_{DD} + 0.3$ | V                |
| Output Current              | $I_{O1\text{ max}}$  | Pins SA, SB, SC, SD, SE, SF, SG            | 0 to +30               | mA               |
|                             | $I_{O2\text{ max}}$  | Pins D1, D2                                | 0 to +10               | mA               |
|                             | $I_{O3\text{ max}}$  | Pins UL                                    | 0 to +20               | mA               |
|                             | $I_{O4\text{ max}}$  | Pin BEEP                                   | 0 to +10               | mA               |
| Allowable power dissipation | $P_d\text{ max}$     | ( $T_a \leq 85^\circ\text{C}$ )            | 350                    | mW               |
| Operating temperature       | $T_{opr}$            |                                            | -40 to +85             | $^\circ\text{C}$ |
| Storage temperature         | $T_{stg}$            |                                            | -55 to +125            | $^\circ\text{C}$ |

## Package Dimensions

unit : mm

3061-DIP30S





# LC7185-8750

Allowable Operating Conditions at  $T_a = -40$  to  $+85^\circ\text{C}$ ,  $V_{SS} = 0\text{ V}$

| Parameter                      | Symbol     | Conditions                              | min         | typ   | max         | Unit |
|--------------------------------|------------|-----------------------------------------|-------------|-------|-------------|------|
| Supply voltage                 | $V_{DD}$   |                                         | 5.0         |       | 8.0         | V    |
| Input high-level voltage       | $V_{IH1}$  | Pins HOLD, TX                           | $0.7V_{DD}$ |       | 12          | V    |
|                                | $V_{IH2}$  | Pin INIT                                | 3.2         |       | $V_{DD}$    | V    |
|                                | $V_{IH3}$  | Pins K11, K12, K13, K14                 | $0.6V_{DD}$ |       | $V_{DD}$    | V    |
| Input low-level voltage        | $V_{IL1}$  | Pins HOLD, TX                           | 0           |       | $0.3V_{DD}$ | V    |
|                                | $V_{IL2}$  | Pin INIT                                | 0           |       | 1.3         | V    |
|                                | $V_{IL3}$  | Pins K11, K12, K13, K14                 | 0           |       | $0.4V_{DD}$ | V    |
| Output voltage                 | $V_{OUT1}$ | Pins SA, SB, SC, SD, SE, SF, SG, D1, D2 | 0           |       | 13          | V    |
|                                | $V_{OUT2}$ | Pins UL, BEEP                           | 0           |       | 8           | V    |
| Input frequency                | $f_{IN1}$  | Pin XIN (sine wave, capacitor coupled)  | 1.0         | 10.24 | 15          | MHz  |
|                                | $f_{IN2}$  | Pin PIN (sine wave, capacitor coupled)  | 10          |       | 30          | MHz  |
| Input amplitude                | $V_{IN1}$  | Pin XIN (sine wave, capacitor coupled)  | 0.5         |       | 1.5         | Vrms |
|                                | $V_{IN2}$  | Pin PIN (sine wave, capacitor coupled)  | 0.15        |       | 1.5         | Vrms |
| Required oscillating frequency | X'tal      | Pins XIN, XOUT ( $C1 \leq 50\ \Omega$ ) | 5.0         | 10.24 | 15          | MHz  |

Electrical Characteristics at under allowable operating conditions

| Parameter                           | Symbol     | Conditions                                                                         | min          | typ          | max          | Unit          |
|-------------------------------------|------------|------------------------------------------------------------------------------------|--------------|--------------|--------------|---------------|
| Internal feedback resistance        | Rf1        | Pin XIN                                                                            |              | 1.0          |              | M $\Omega$    |
|                                     | Rf2        | Pin PIN                                                                            |              | 500          |              | k $\Omega$    |
| Pull-down resistor                  | RpdN       | Pins K11, K12, K13, K14, TEST                                                      | 30           | 50           | 70           | k $\Omega$    |
| Input high-level current            | $I_{IH1}$  | Pins HOLD, TX $V_I = 12\text{ V}$                                                  |              |              | 5.0          | $\mu\text{A}$ |
|                                     | $I_{IH2}$  | Pin INIT $V_I = V_{DD}$                                                            |              |              | 5.0          | $\mu\text{A}$ |
|                                     | $I_{IH3}$  | Pin XIN $V_I = V_{DD}$                                                             |              |              | 25           | $\mu\text{A}$ |
|                                     | $I_{IH4}$  | Pin PIN $V_I = V_{DD}$                                                             |              |              | 50           | $\mu\text{A}$ |
| Input low-level current             | $I_{IL1}$  | Pins HOLD, TX $V_I = V_{SS}$                                                       |              |              | 5.0          | $\mu\text{A}$ |
|                                     | $I_{IL2}$  | Pin INIT $V_I = V_{SS}$                                                            |              |              | 5.0          | $\mu\text{A}$ |
|                                     | $I_{IL3}$  | Pin XIN $V_I = V_{SS}$                                                             |              |              | 25           | $\mu\text{A}$ |
|                                     | $I_{IL4}$  | Pin PIN $V_I = V_{SS}$                                                             |              |              | 50           | $\mu\text{A}$ |
| Output high-level voltage           | $V_{OH1}$  | Pins KO1, KO2, KO3 $I_O = 1\text{ mA}$                                             | $V_{DD}-2.0$ | $V_{DD}-1.0$ | $V_{DD}-0.5$ | V             |
|                                     | $V_{OH2}$  | Pin PD $I_O = 0.5\text{ mA}$                                                       | $V_{DD}-1.0$ |              |              | V             |
| Output low-level voltage            | $V_{OL1}$  | Pins KO1, KO2, KO3 $I_O = 20\ \mu\text{A}$                                         | 0.6          | 1.0          | 1.4          | V             |
|                                     | $V_{OL2}$  | Pin PD $I_O = 0.5\text{ mA}$                                                       |              |              | 1.0          | V             |
|                                     | $V_{OL3}$  | Pin BEEP $I_O = 2\text{ mA}$                                                       |              |              | 1.0          | V             |
|                                     | $V_{OL4}$  | Pins SA, SB, SC, SD, SE, SF, SG $I_O = 20\text{ mA}$                               |              |              | 1.0          | V             |
|                                     | $V_{OL5}$  | Pins D1, D2 $I_O = 5\text{ mA}$                                                    |              |              | 1.0          | V             |
|                                     | $V_{OL6}$  | Pin UL $I_O = 10\text{ mA}$                                                        |              |              | 1.0          | V             |
| Output leakage current              | $I_{OFF1}$ | Pins SA, SB, SC, SD, SE, SF, SG, D1, D2 $V_O = 13\text{ V}$                        |              |              | 5.0          | $\mu\text{A}$ |
|                                     | $I_{OFF2}$ | Pins UL, BEEP $V_O = 8\text{ V}$                                                   |              |              | 5.0          | $\mu\text{A}$ |
| High-level tristate leakage current | $I_{OFFH}$ | Pin PD $V_O = V_{DD}$                                                              |              | 0.01         | 10.0         | nA            |
| Low-level tristate leakage current  | $I_{OFFL}$ | Pin PD $V_O = V_{SS}$                                                              |              | 0.01         | 10.0         | nA            |
| Supply current                      | $I_{DD1}$  | Normal mode<br>*1 (PLL operates)                                                   |              | 5            | 10           | mA            |
|                                     | $I_{DD2}$  | Hold mode $V_{DD} = 3.2\text{ V}$<br>*2 (memory backup)<br>$V_{DD} = 8.0\text{ V}$ |              |              | 5            | $\mu\text{A}$ |

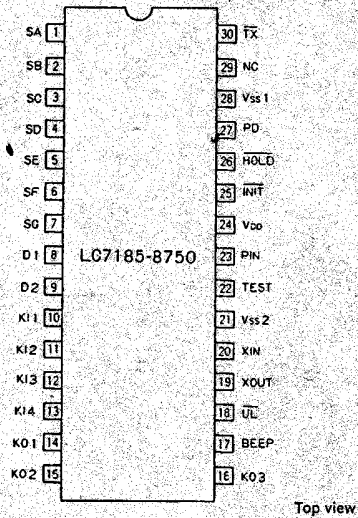
\*1:  $f_{IN2} = 20\text{ MHz}$  (PIN)  
 $V_{IN2} = 0.15\text{ Vrms}$   
 $X'tal = 10.240\text{ MHz}$   
 $\overline{TX} = \overline{HOLD} = \overline{INIT} = V_{DD}$   
 Other inputs =  $V_{SS}$   
 Other outputs = open

\*2:  $\overline{HOLD} = V_{SS}$   
 $\overline{TX} = \overline{INIT} = V_{DD}$   
 Other inputs =  $V_{SS}$   
 Other outputs = open

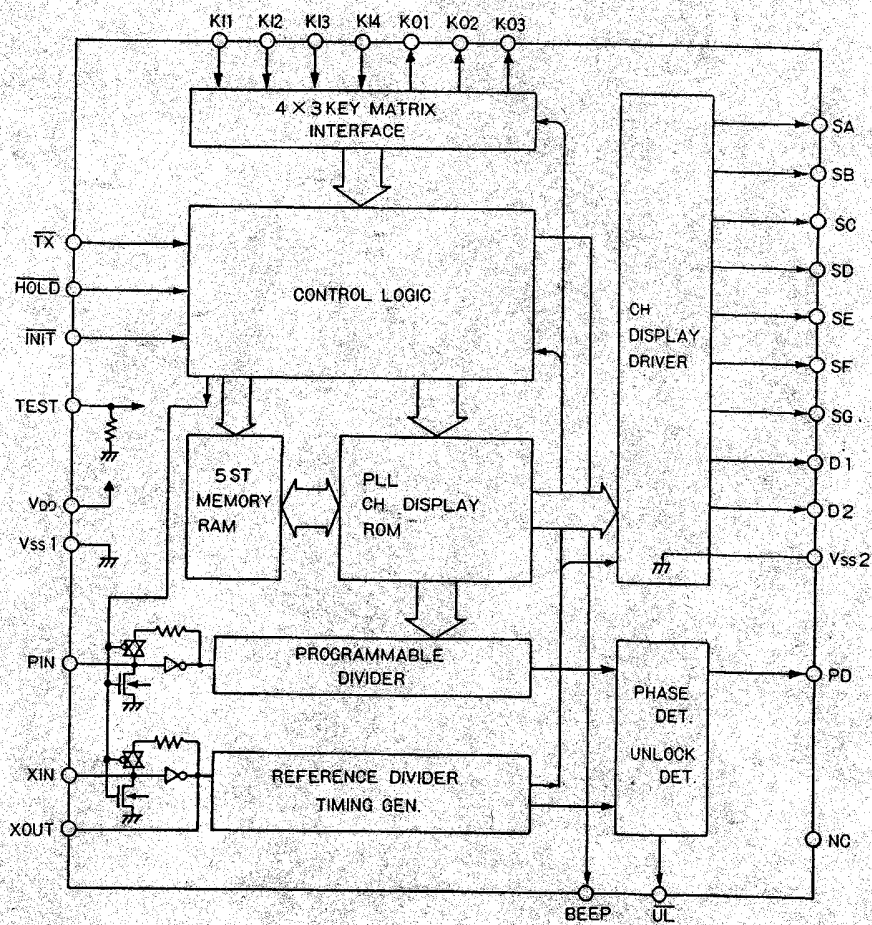
Note: Be careful that the dielectric strength of pins SA, SB, SC, SD, SE, SF, D1, D2, UL, BEEP are weak.

# LC7185-8750

## Pin Assignment



## Block Diagram

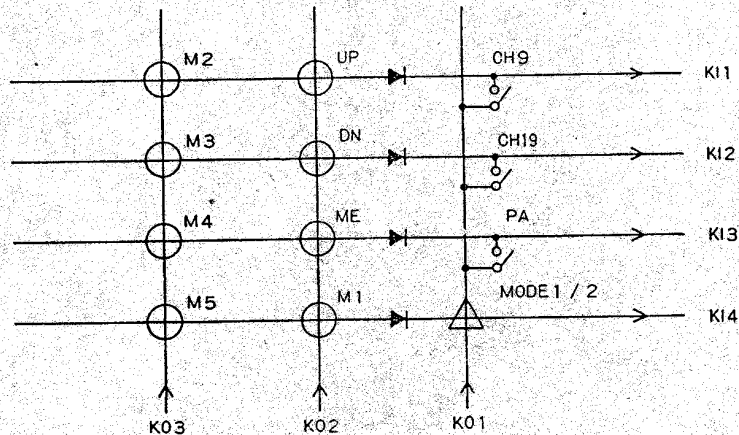


# LC7185-8750

## Pin Descriptions

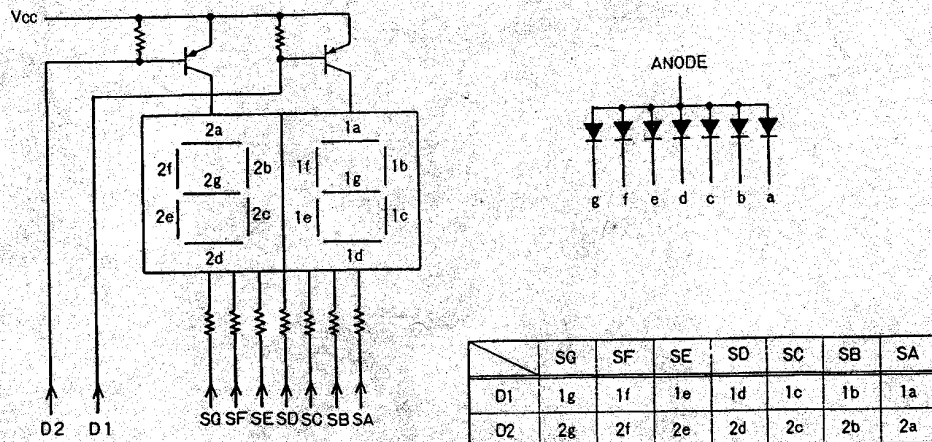
|                 |                                               |            |                              |
|-----------------|-----------------------------------------------|------------|------------------------------|
| TX              | Transmit/receive select                       | PD         | Charge pump output           |
| HOLD            | Hold mode select                              | NC         | NC pin                       |
| INIT            | Initial input                                 | SA to SG   | Segment driver (for display) |
| TEST            | Test point (input)                            | D1, D2     | Digit output (for display)   |
| VDD, VSS1, VSS2 | Power supply                                  | KI1 to KI4 | Key inputs                   |
| PIN             | Programmable divider input                    | KO1 to KO3 | Key scan outputs             |
| XIN, XOUT       | Crystal oscillator input, output (10.240 MHz) | BEEP       | Beep-tone control output     |
| UL              | Unlock detection signal output                |            |                              |

## Key Matrix



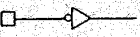
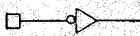
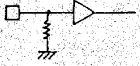
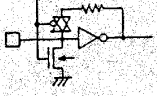
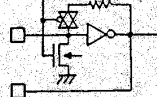
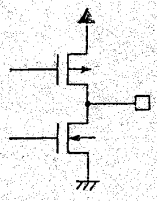
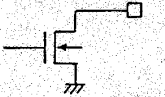
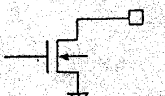
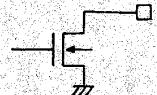
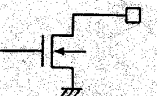
|          |                             |                  |                       |
|----------|-----------------------------|------------------|-----------------------|
| CH9      | Emergency CH9 recall        | ME               | Station Memory Enable |
| CH19     | Emergency CH19 recall       | M1 to M5         | Station Memory recall |
| PA       | Public announcement display | UP/DN/ME/M1 to 5 | Momentary SW          |
| MODE 1/2 | Display Mode                | CH9/CH19/PA      | Slide SW              |
| UP       | CH up/scan                  | MODE 1/2         | Diode                 |
| DN       | CH down/scan                |                  |                       |

## LED Display Configuration (Common anode/7 segment)



# LC7185-8750

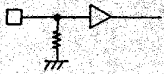
## Pin Description

| Pin Name                 | Pin No.  | Type                                                                                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|--------------------------|----------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $\overline{\text{TX}}$   | 30       |    | <ul style="list-style-type: none"> <li>Transmit/receive select</li> <li>TX = "0"...Transmit, TX = "1"...Receive</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| $\overline{\text{HOLD}}$ | 26       |    | <ul style="list-style-type: none"> <li>Hold mode select</li> <li>HOLD = "0"...Hold mode select</li> <li>HOLD = "1"...Normal mode select</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| $\overline{\text{INIT}}$ | 25       |    | <ul style="list-style-type: none"> <li>Reset line</li> <li>INIT = "0"...Reset</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| TEST                     | 22       |    | <ul style="list-style-type: none"> <li>Test point (input)</li> <li>Tie to ground or leave floating</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| V <sub>DD</sub>          | 24       |                                                                                     | <ul style="list-style-type: none"> <li>Power supply (+)</li> <li>Normal mode: 5.0 to 8.0 V</li> <li>Hold mode: <math>\geq 3.2</math> V</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| V <sub>SS2</sub>         | 21       |                                                                                     | <ul style="list-style-type: none"> <li>Channel display LED driver ground</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| PIN                      | 23       |    | <ul style="list-style-type: none"> <li>Programmable divider input</li> <li>150 mVrms min</li> <li>Hold mode: Programmable divider is disabled.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| XIN<br>XOUT              | 20<br>19 |    | <ul style="list-style-type: none"> <li>Crystal oscillator</li> <li>Frequency: 10.24 MHz</li> <li>Hold mode: Oscillator is disabled.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| PD                       | 27       |  | <ul style="list-style-type: none"> <li>Charge pump output from the phase comparator. If the frequency of f<sub>V</sub> (the signal obtained by dividing the PIN input by N) is higher than that of f<sub>R</sub> (the reference signal), or if the phase of f<sub>V</sub> leads that of f<sub>R</sub>, positive pulses are output on this pin. If the frequency is lower or the phase lags, negative pulses are output on this pin. If they match, the pin goes to high impedance.</li> <li>f<sub>V</sub> &gt; f<sub>R</sub> OR leading: Positive Pulses</li> <li>f<sub>V</sub> &lt; f<sub>R</sub> OR leading: Negative Pulses</li> <li>f<sub>V</sub> = f<sub>R</sub> and phase matched: High impedance</li> <li>Hold mode: High impedance</li> </ul> |
| V <sub>SS1</sub>         | 28       |                                                                                     | <ul style="list-style-type: none"> <li>PLL circuit and controller ground</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| NC                       | 29       |                                                                                     | <ul style="list-style-type: none"> <li>No-connection</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| $\overline{\text{UL}}$   | 18       |  | <ul style="list-style-type: none"> <li>Unlock detected output</li> <li>Fixed to low level when unlocked, when changing channels, in PA mode, or in hold mode.</li> <li>Open: Locked</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| BEEP                     | 17       |  | <ul style="list-style-type: none"> <li>Beep-tone control output</li> <li>During station memory operation</li> <li>During I/O on emergency channel</li> <li>When changing channels</li> <li>During reset</li> <li>During hold mode recovery</li> <li>Fixed to low level in hold mode</li> </ul> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;"> <p>NC</p> </div> <div style="border-left: 1px solid black; padding-left: 10px;"> <p>Transistor: Off (50 ms cycle)<br/>→ Open</p> </div> </div>                                                                                                                                                                                                                     |
| SA to SG                 | 1 to 7   |  | <ul style="list-style-type: none"> <li>Segment drivers for the display</li> <li>(Common anode/7 segments)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| D1<br>D2                 | 8<br>9   |  | <ul style="list-style-type: none"> <li>Digit output (150 Hz) for the display</li> <li>(common anode/7 segments)</li> <li>Hold mode: Transistor goes off.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

Continued on next page.

## LC7185-8750

Continued from preceding page.

| Pin Name   | Pin No.  | Type                                                                              | Description                                                                              |
|------------|----------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| KI1 to KI4 | 10 to 13 |  | • Key inputs<br>Input from the key matrix                                                |
| KO1 to KO3 | 14 to 16 |  | • Key scan output (75 Hz)<br>Output to the key matrix<br>Hold mode: Low (scanning stops) |

### Operation

#### (1) Channel Selection (up/down)

##### 1. Manual scanning (up/down)

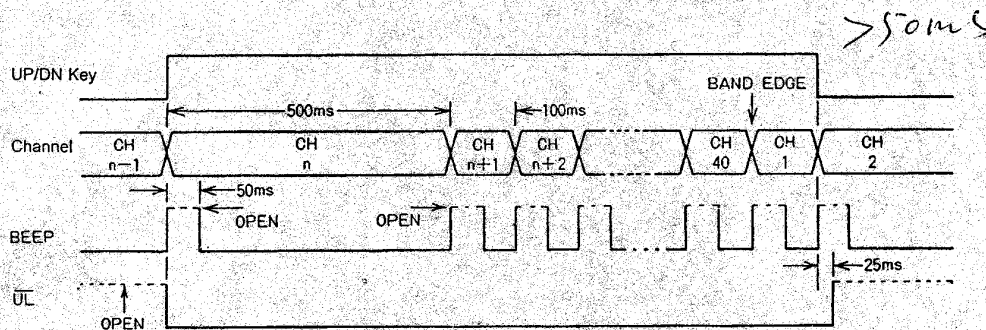
Pressing the UP key increments by one channel and pressing the DN key decrements by channel. When scanning reaches the end of the band, it automatically wraps around to the beginning.

##### 2. Auto scanning (up/down)

Holding the UP (or DN) key down for 500 ms or longer starts auto scanning. For both up and down scanning, each channel takes 100 ms to scan.

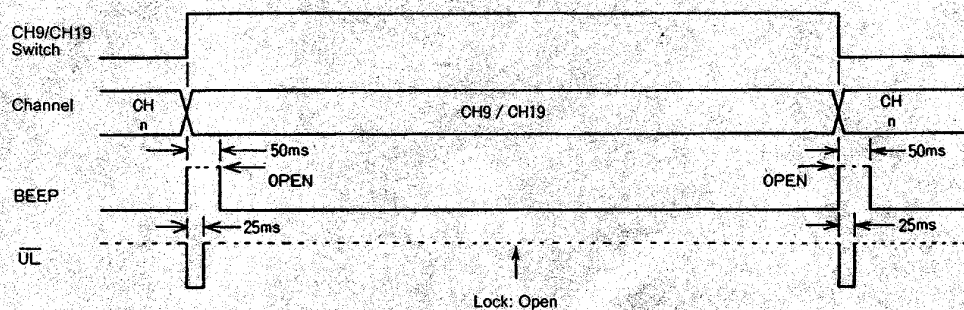
##### 3. The unlock detected line ( $\overline{UL}$ ) is asserted (low) when the UP (or DN) key is pressed and deactivated 25 ms after the key is released.

##### 4. The beep-tone control line (BEEP) is asserted (open) for 50 ms after each new channel is selected.



#### (2) Selecting an Emergency Channel (CH9/CH19)

- If the CH9 or CH19 switch is turned on, the LC7185 stores the value of the previous channel and asserts the beep-tone control line for 50 ms.
- While the CH9 or CH19 switch is turned on, the LC7185 disables all keys except  $\overline{TX}$  and PA (UP/DN, ME, and M1 to M5 switches).
- Even if the CH9 or CH19 switch is turned off while transmitting using the CH9 or CH19 switch, keep the emergency channel open until the LC7185 is in the receive mode.
- After the CH9 or CH19 switch is turned back off, the beep-tone control line is asserted for 50 ms and the LC7185 reopens the previous channel.
- Note the CH9 has a higher priority over CH19. As a result, if both switches are turned on, CH9 will be opened.
- The  $\overline{UL}$  line is asserted for 25 ms after the CH9 or CH19 switch is turned off or on.
- Causes either "9" or "19" to blink on the display.

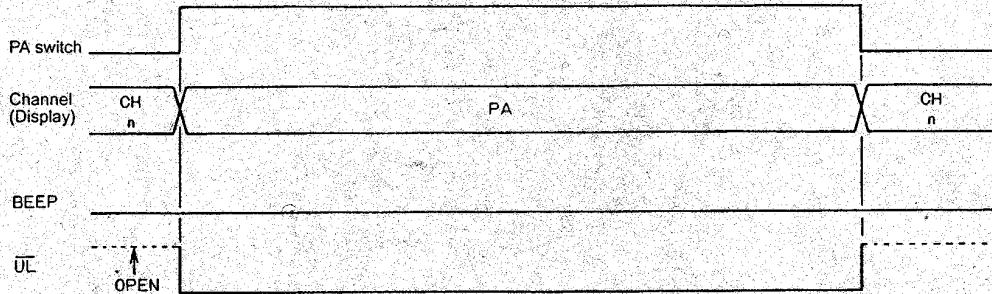




## LC7185-8750

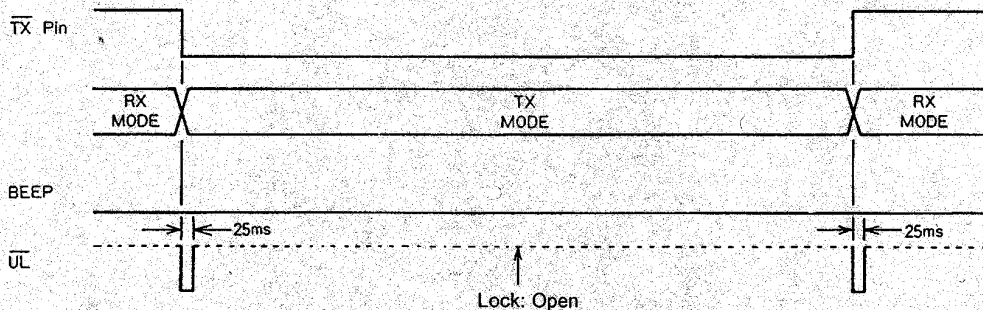
### (3) Public Announcement (PA) Mode

1. When the PA switch is turned on, the LC7185 stores the value of the previous channel and enters the PA mode.
2. While the PA switch is turned on, the LC7185 disables all keys (TX, CH9/CH19, UP/DN, ME, M1 to M5)
3. "PA" is displayed on the channel display.
4. When the PA switch is turned back off, the LC7185 enters the CB mode and reopens the previous channel.
5. The  $\overline{UL}$  line is asserted while the PA switch is turned on.



### (4) Transmit/Receive Selection

1. When the TX line is asserted, the LC7185 enters TX mode.
2. If the PA switch is turned on while the LC7185 is in TX mode, the device enters PA mode. However, if any other switch (other than the PA switch) or key (UP/DN, ME, M1 through M5, CH9, CH19) is pressed while the LC7185 is in TX mode, that switch or key has no effect.
3. The unlock detected signal is output each time the device switches between transmitting and receiving.



### (5) Channel Preset/Recall Facility

1. The LC7185 allows up to 5 channels to be preset (assigned to M1 to M5).
  - After a reset (when the power is turned on, etc.), M1 to M5 are assigned to CH33.
2. Recalling preset channels
  - A preset channel is recalled by pressing one of the preset memory keys (M1 to M5) to which the channel was previously assigned.
  - There are two different display modes as shown below.
 

**Mode 1 (without diode)**  
Each time a key is pressed (M1 to M5), the new channel is displayed.  
Example: Display 21 → 15  
key M1

**Mode 2 (with diode)**  
Each time a key is pressed (M1 to M5), a key mnemonic ("P1" to "P5") is displayed for 400 ms, then the new channel is displayed.  
Example: Display 21 → P1 → 15  
Key M1 400 ms

### 3. Presetting channels

- First select the channel to be preset, then hold down the ME key and press the preset memory key (M1 to M5) to which you would like to assign the current channel.

In the following cases, a channel will not be preset:

- M1 to M5 is pressed and in the memory preset mode.
- Emergency channels CH9 or CH19 are currently selected.
- The  $\overline{\text{TX}}$  line is asserted.
- The PA switch is turned on (PA mode).
- The  $\overline{\text{HOLD}}$  line is asserted (hold mode).

Even if the above key operations are not performed, the preset mode will be canceled automatically after 9 seconds.

- There are two different display modes as shown below.

#### Mode 1 (without diode)

The current channel is displayed throughout the preset process.

Example: Display 15  $\xrightarrow{\text{ME M1}}$  15

#### Mode 2 (with diode)

When the ME key is held down, "PE" is flashed on the display, indicating that presetting is possible. Once a preset memory key (M1 to M5) is pressed, the key mnemonic ("P1" to "P5") is displayed for 400 ms before the current channel is redisplayed.

Example: Display 15  $\rightarrow$  PE  $\rightarrow$  P1  $\rightarrow$  15  
400 ms

- Note that if two or more keys are pressed at the same time, priority is assigned as follows:  
M1 > M2 > M3 > M4 > M5

### (6) Beep-tone Control Output (BEEP pin)

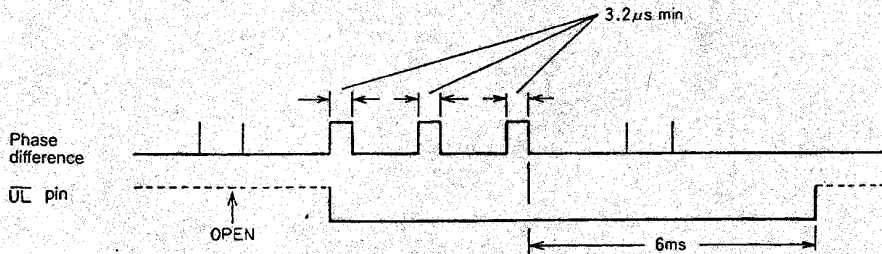
After each of the following events, the BEEP line is asserted for 50 ms:

- A reset, such as a battery replacement ( $\overline{\text{INIT}} = 0$ )
- Any key press associated with the channel memory
- Any emergency channel switch activation
- A new channel is selected
- Leaving hold mode

### (7) Unlock Detected Output ( $\overline{\text{UL}}$ pin)

In the following cases, the  $\overline{\text{UL}}$  line is asserted:

- When the phase difference between the programmable and reference divider outputs exceeds  $3.2 \mu\text{s}$ , the  $\overline{\text{UL}}$  line is held low for 6 ms after the last out-of-range phase sample is detected, as shown below.

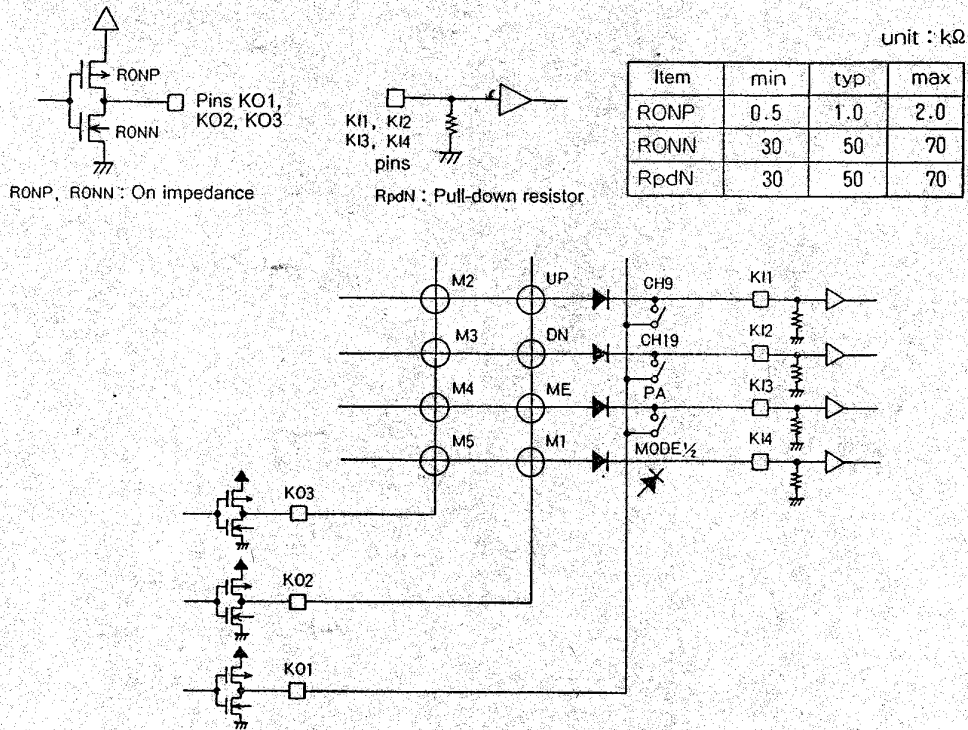


- After a new transmit/receive or channel selection, the  $\overline{\text{UL}}$  line is asserted for 25 ms.
- While the PA switch is turned on, the  $\overline{\text{UL}}$  line is asserted during PA mode.
- The  $\overline{\text{UL}}$  pin is open while the device is in the PLL LOCK state (when the phase difference is  $< 3.2 \mu\text{s}$ ).

## LC7185-8750

### (8) Key Matrix

It is normal to put diodes in series with the key scanning lines to avoid creating a short with the output lines. But KO1, KO2 and KO3 lines (key scan signal output) do not need diodes.



### Explanation Regarding Power On and Hold Mode

#### (1) Operation in hold mode

When in hold mode ( $\overline{\text{HOLD}} = 0$ ), the LC7185-8750 does not accept any operation other than the  $\overline{\text{INIT}}$  pin being asserted (reset). The primary function of hold mode is to maintain the contents of station memory.

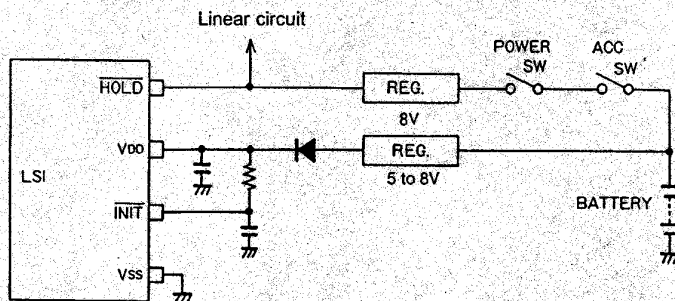
- In hold mode, the programmable divider, crystal oscillator and reference divider are all stopped.
- The PD pin (charge pump output) goes to high impedance. The  $\overline{\text{UL}}$  pin goes to  $V_{SS}$ .
- The channel display pins D1 and D2 go to high impedance.
- The BEEP pin goes to  $V_{SS}$ .
- The key scan signal outputs (KO1 to KO3) go to  $V_{SS}$ .

When the LC7185-8750 leaves hold mode, the previously selected channel is reopened.

#### (2) Initial state settings

The LC7185-8750 can be reset to its initial state settings (reset) after the battery has been replaced, etc., by setting  $\overline{\text{INIT}} = 0$ . The initial state that is established by an initial reset is as follows:

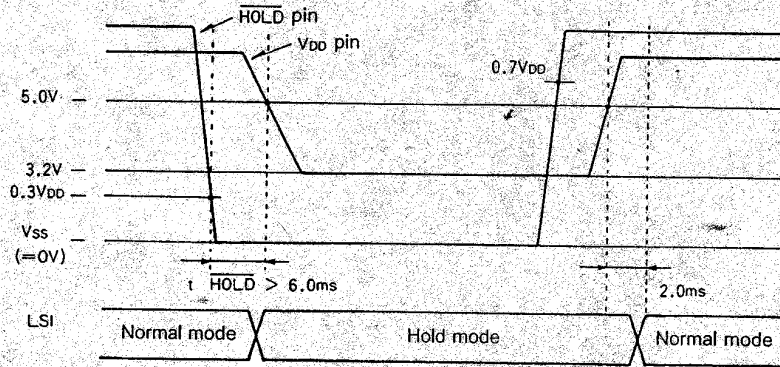
- When the  $V_{DD}$  pin turned on, CH9 or CH33 is selected.
- When the  $V_{DD}$  pin operate voltage already, CH9 is selected.
- All of station memory is set to CH33.





## LC7185-8750

### (3) Timing Requirements for Hold Mode



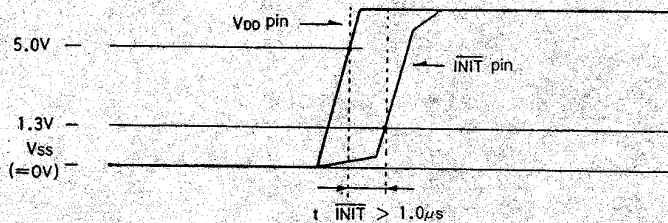
$V_{DD}$  must remain at 5.0 V or higher (crystal oscillator requirement) for 6.0 ms ( $t_{\text{HOLD}}$ ) after the  $\overline{\text{HOLD}}$  line is asserted ( $\overline{\text{HOLD}} = 0$  ( $< 0.3 V_{DD}$ )). After this,  $V_{DD}$  may go as low as 3.2 V.

There are no constraints on timing for the  $\overline{\text{HOLD}}$  and  $V_{DD}$  pins when the chip is leaving hold mode. The signal can be activated in one of two orders.

If  $\overline{\text{HOLD}}$  is already deactivated ( $> 0.7 V_{DD}$ ), the LC7185-8750 leaves hold mode within 2.0 ms after  $V_{DD}$  rises to  $> 5.0$  V. If  $V_{DD}$  is  $> 5.0$  V, the LC7185-8750 enters normal mode within 2.0 ms after  $\overline{\text{HOLD}}$  is deactivated.

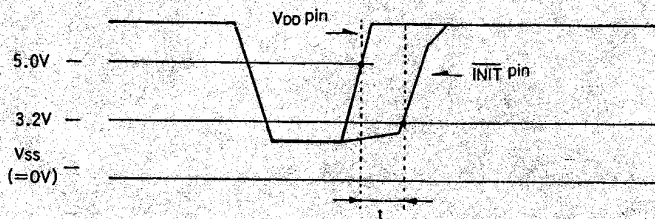
### (4) Reset Timing

#### 1. Reset timing (e.g. battery replacement)



Note:  $t_{\text{INIT}}$  should be greater than 1.0  $\mu\text{s}$ .

#### 2. Reset caused by a sudden voltage ( $V_{DD}$ ) drop



If  $V_{DD}$  drops momentarily down to less than 3.2 V and rises up to more than 5.0 V  $t > t_{\text{INIT}}$  ( $t > 1.0 \mu\text{s}$ ), a reset may be generated.

# LC7185-8750

Frequency Table (U.S.A.: LC7185-8750)

*Ref 2.5*

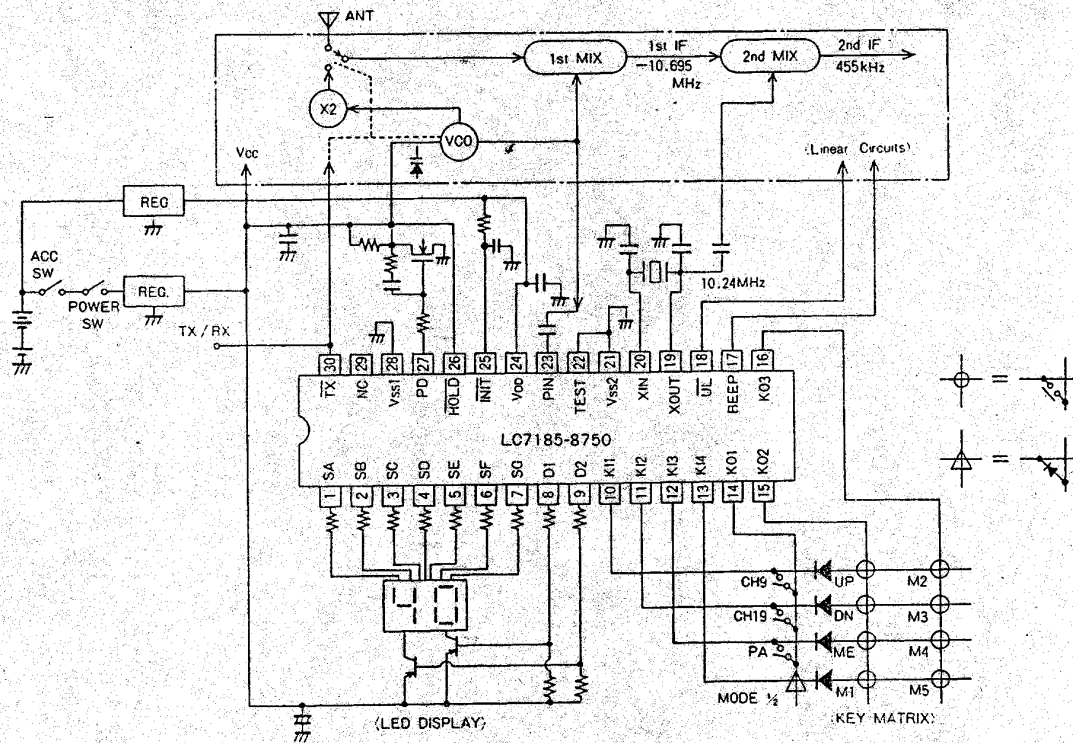
| CHANNEL | FREQUENCY<br>(MHz) | RX (TX = 1) |              | TX (TX = 0) |                           |
|---------|--------------------|-------------|--------------|-------------|---------------------------|
|         |                    | N           | Fvco         | N           | Fvco                      |
| 1       | 26.965             | 6508        | <u>16.27</u> | 5393        | <u>13.4825</u> $\times 2$ |
| 2       | 26.975             | 6512        | 16.28        | 5395        | 13.4875                   |
| 3       | 26.985             | 6516        | 16.29        | 5397        | 13.4925                   |
| 4       | 27.005             | 6524        | 16.31        | 5401        | 13.5025                   |
| 5       | 27.015             | 6528        | 16.32        | 5403        | 13.5075                   |
| 6       | 27.025             | 6532        | 16.33        | 5405        | 13.5125                   |
| 7       | 27.035             | 6536        | 16.34        | 5407        | 13.5175                   |
| 8       | 27.055             | 6544        | 16.36        | 5411        | 13.5275                   |
| 9       | 27.065             | 6548        | 16.37        | 5413        | 13.5325                   |
| 10      | 27.075             | 6552        | 16.38        | 5415        | 13.5375                   |
| 11      | 27.085             | 6556        | 16.39        | 5417        | 13.5425                   |
| 12      | 27.105             | 6564        | 16.41        | 5421        | 13.5525                   |
| 13      | 27.115             | 6568        | 16.42        | 5423        | 13.5575                   |
| 14      | 27.125             | 6572        | 16.43        | 5425        | 13.5625                   |
| 15      | 27.135             | 6576        | 16.44        | 5427        | 13.5675                   |
| 16      | 27.155             | 6584        | 16.46        | 5431        | 13.5775                   |
| 17      | 27.165             | 6588        | 16.47        | 5433        | 13.5825                   |
| 18      | 27.175             | 6592        | 16.48        | 5435        | 13.5875                   |
| 19      | 27.185             | 6596        | 16.49        | 5437        | 13.5925                   |
| 20      | 27.205             | 6604        | 16.51        | 5441        | 13.6025                   |
| 21      | 27.215             | 6608        | 16.52        | 5443        | 13.6075                   |
| 22      | 27.225             | 6612        | 16.53        | 5445        | 13.6125                   |
| 23      | 27.255             | 6624        | 16.56        | 5451        | 13.6275                   |
| 24      | 27.235             | 6616        | 16.54        | 5447        | 13.6175                   |
| 25      | 27.245             | 6620        | 16.55        | 5449        | 13.6225                   |
| 26      | 27.265             | 6628        | 16.57        | 5453        | 13.6325                   |
| 27      | 27.275             | 6632        | 16.58        | 5455        | 13.6375                   |
| 28      | 27.285             | 6636        | 16.59        | 5457        | 13.6425                   |
| 29      | 27.295             | 6640        | 16.60        | 5459        | 13.6475                   |
| 30      | 27.305             | 6644        | 16.61        | 5461        | 13.6525                   |
| 31      | 27.315             | 6648        | 16.62        | 5463        | 13.6575                   |
| 32      | 27.325             | 6652        | 16.63        | 5465        | 13.6625                   |
| 33      | 27.335             | 6656        | 16.64        | 5467        | 13.6675                   |
| 34      | 27.345             | 6660        | 16.65        | 5469        | 13.6725                   |
| 35      | 27.355             | 6664        | 16.66        | 5471        | 13.6775                   |
| 36      | 27.365             | 6668        | 16.67        | 5473        | 13.6825                   |
| 37      | 27.375             | 6672        | 16.68        | 5475        | 13.6875                   |
| 38      | 27.385             | 6676        | 16.69        | 5477        | 13.6925                   |
| 39      | 27.395             | 6680        | 16.70        | 5479        | 13.6975                   |
| 40      | 27.405             | 6684        | <u>16.71</u> | 5481        | 13.7025                   |

$$V_{CO} (TX) = RF + 2$$

$$V_{CO} (RX) = RF - 10.695 \text{ MHz (IF)}$$

$$\text{CH1: } V_{CO} (TX) = 26.965 + 2 = 13.4825$$

$$V_{CO} (RX) = 26.965 - 10.695 = 16.27$$



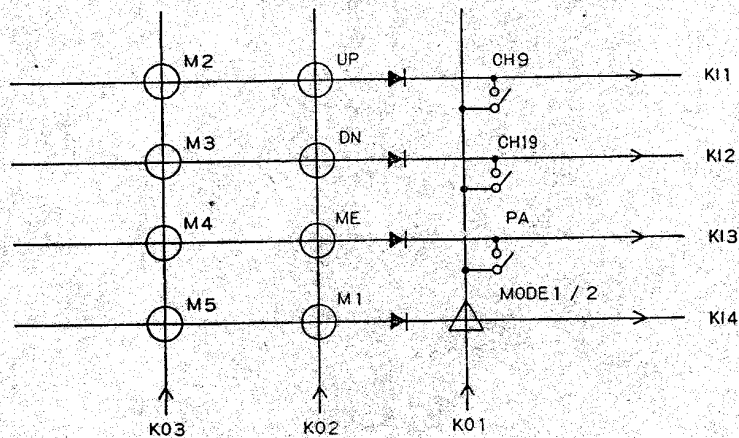
- This catalog provides information as of July, 1998. Specifications and information herein are subject to change without notice.

## LC7185-8750

### Pin Descriptions

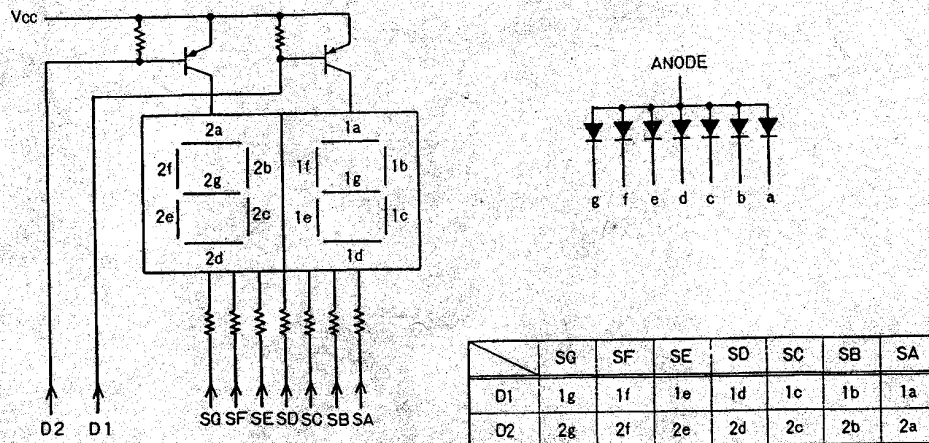
|                                                       |                                               |            |                              |
|-------------------------------------------------------|-----------------------------------------------|------------|------------------------------|
| TX                                                    | Transmit/receive select                       | PD         | Charge pump output           |
| HOLD                                                  | Hold mode select                              | NC         | NC pin                       |
| INIT                                                  | Initial input                                 | SA to SG   | Segment driver (for display) |
| TEST                                                  | Test point (input)                            | D1, D2     | Digit output (for display)   |
| V <sub>DD</sub> , V <sub>SS1</sub> , V <sub>SS2</sub> | Power supply                                  | KI1 to KI4 | Key inputs                   |
| PIN                                                   | Programmable divider input                    | KO1 to KO3 | Key scan outputs             |
| XIN, XOUT                                             | Crystal oscillator input, output (10.240 MHz) | BEEP       | Beep-tone control output     |
| UL                                                    | Unlock, detection signal output               |            |                              |

### Key Matrix



|          |                             |                  |                       |
|----------|-----------------------------|------------------|-----------------------|
| CH9      | Emergency CH9 recall        | ME               | Station Memory Enable |
| CH19     | Emergency CH19 recall       | M1 to M5         | Station Memory recall |
| PA       | Public announcement display | UP/DN/ME/M1 to 5 | Momentary SW          |
| MODE 1/2 | Display Mode                | CH9/CH19/PA      | Slide SW              |
| UP       | CH up/scan                  | MODE 1/2         | Diode                 |
| DN       | CH down/scan                |                  |                       |

### LED Display Configuration (Common anode/7 segment)



APPENDIX 5

FINAL RF AMPLIFIER DATA SHEETS

FOUR(4) PAGES FOR KTC2075 FOLLOW THIS SHEET

FINAL RF AMP DATA SHEET  
FCC ID: MMA77104XL

APPENDIX 5



# SILICON NPN TRANSISTOR EPITAXIAL PLANAR TYPE (PCT PROCESS)

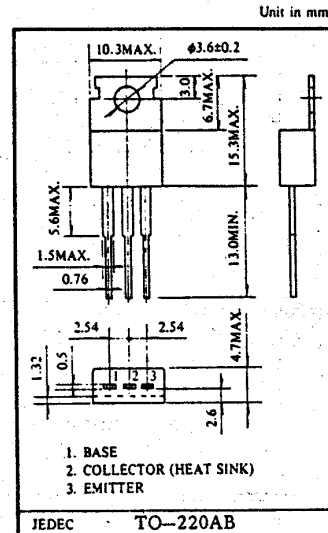
# KTC2075

## APPLICATIONS

- 27MHz Power Amplifier Applications.

## FEATURES

- Recommended for Output Stage Application of AM 4W Transmitter.
- High Power Gain.
- Wide Area of Stage Operation.



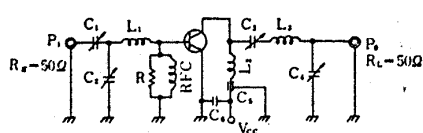
## ■ MAXIMUM RATINGS (Ta=25°C)

| CHARACTERISTIC                                  | SYMBOL    | RATING | UNT | CHARACTERISTIC                                   | SYMBOL    | RATING  | UNT        |
|-------------------------------------------------|-----------|--------|-----|--------------------------------------------------|-----------|---------|------------|
| Collector-Base Voltage                          | $V_{CBO}$ | 80     | V   | Emitter Current                                  | $I_E$     | -4      | A          |
| Collector-Emitter Voltage ( $R_{BE}=50\Omega$ ) | $V_{CER}$ | 80     | V   | Collector Power Dissipation ( $T_C=25^\circ C$ ) | $P_C$     | 10      | W          |
| Emitter-Base Voltage                            | $V_{EBO}$ | 4      | V   | Junction Temperature                             | $T_J$     | 150     | $^\circ C$ |
| Collector Current                               | $I_C$     | 4      | A   | Storage Temperature Range                        | $T_{STG}$ | -55~150 | $^\circ C$ |

## ■ ELECTRICAL CHARACTERISTICS (Ta=25°C)

| CHARACTERISTIC                       | SYMBOL            | TEST CONDITION                  | MIN. | TYP. | MAX. | UNT     |
|--------------------------------------|-------------------|---------------------------------|------|------|------|---------|
| Collector Cut-off Current            | $I_{CBO}$         | $V_{CB}=30V, I_E=0$             | -    | -    | 10   | $\mu A$ |
| Breakdown Voltage                    | Collector-Emitter | $I_C=10mA, R_{BE}=50\Omega$     | 80   | -    | -    | V       |
|                                      | Emitter-Base      | $I_E=1.0mA, I_C=0$              | 4.0  | -    | -    | V       |
| DC Current Gain                      | $h_{FE(1)}$       | $V_{CE}=5V, I_C=0.5A$           | 25   | -    | -    |         |
|                                      | $h_{FE(2)}$       | $V_{CE}=2V, I_C=3A$             | 15   | -    | -    |         |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$     | $I_C=3A, I_B=0.3A$              | -    | -    | 1.5  | V       |
| Transition Frequency                 | $f_T$             | $V_{CE}=5V, I_C=500mA$          | -    | 100  | -    | MHz     |
| Collector Output Capacitance         | $C_{ob}$          | $V_{CE}=10V, I_E=0, f=1MHz$     | -    | 40   | -    | pF      |
| Output Power (Fig. 1)                | $P_o$             | $V_{CC}=12V, P_i=0.3W, f=27MHz$ | 3.5  | -    | -    | W       |

Fig. 1  $P_o$  TEST CIRCUIT



$C_1 : \sim 100pF, C_2, C_3 : \sim 150pF, C_4 : \sim 300pF, C_5 : 1000pF$   
 $C_6 : 0.01\mu F$   $R : 250\Omega$   
 $L_1 : 0.8mm\phi$  UEW, 7T, 8mm I.D.  $L_2 : 0.8mm\phi$  UEW, 5T, 8mm I.D.  
 $L_3 : 0.8mm\phi$  UEW, 10T, 8mm I.D. RFC : 0.35mm $\phi$  UEW, 17T, 5mm I.D.

# KTC 2075

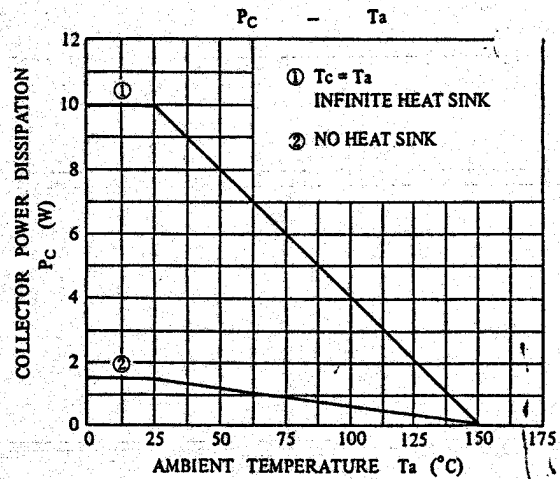
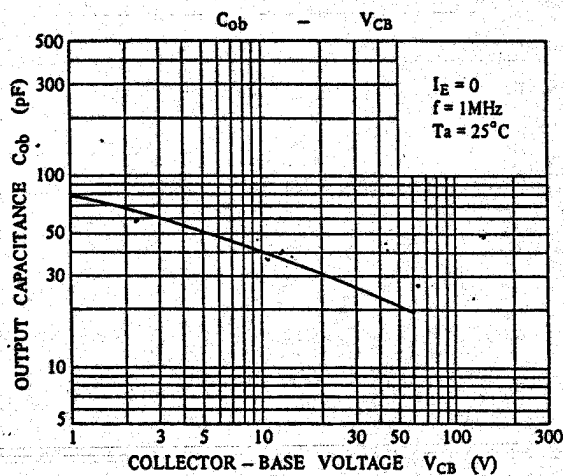
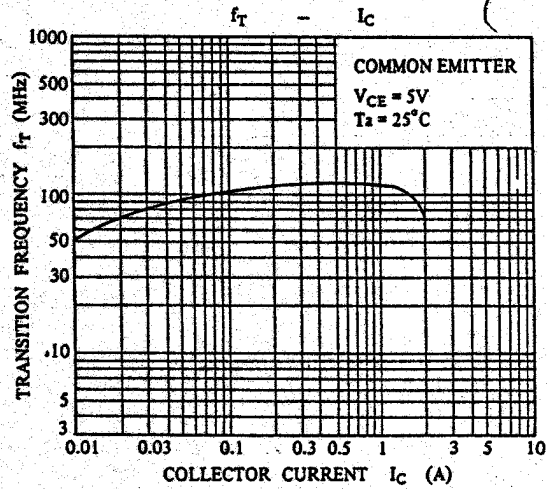
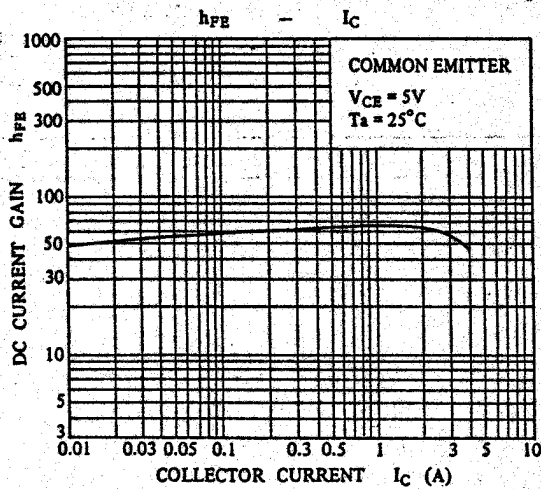
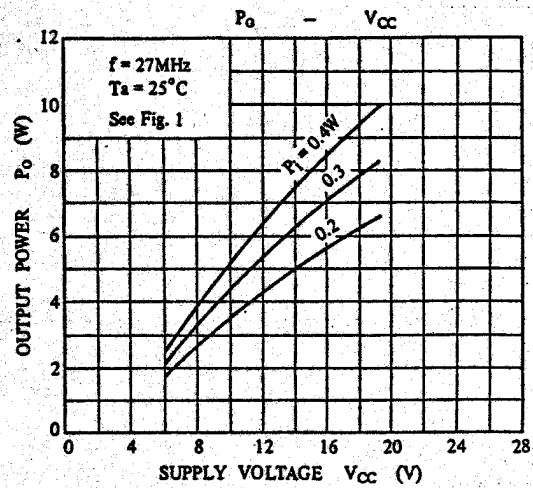
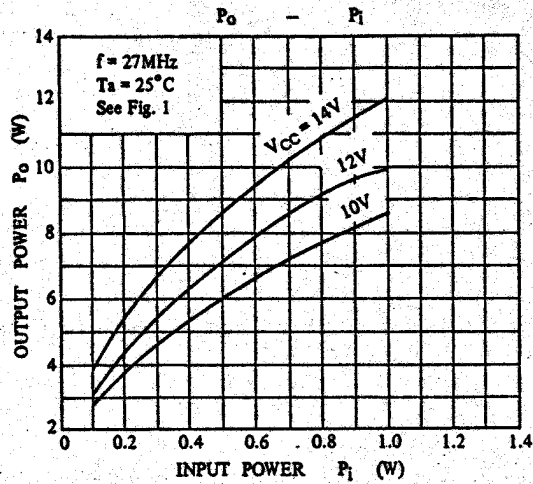
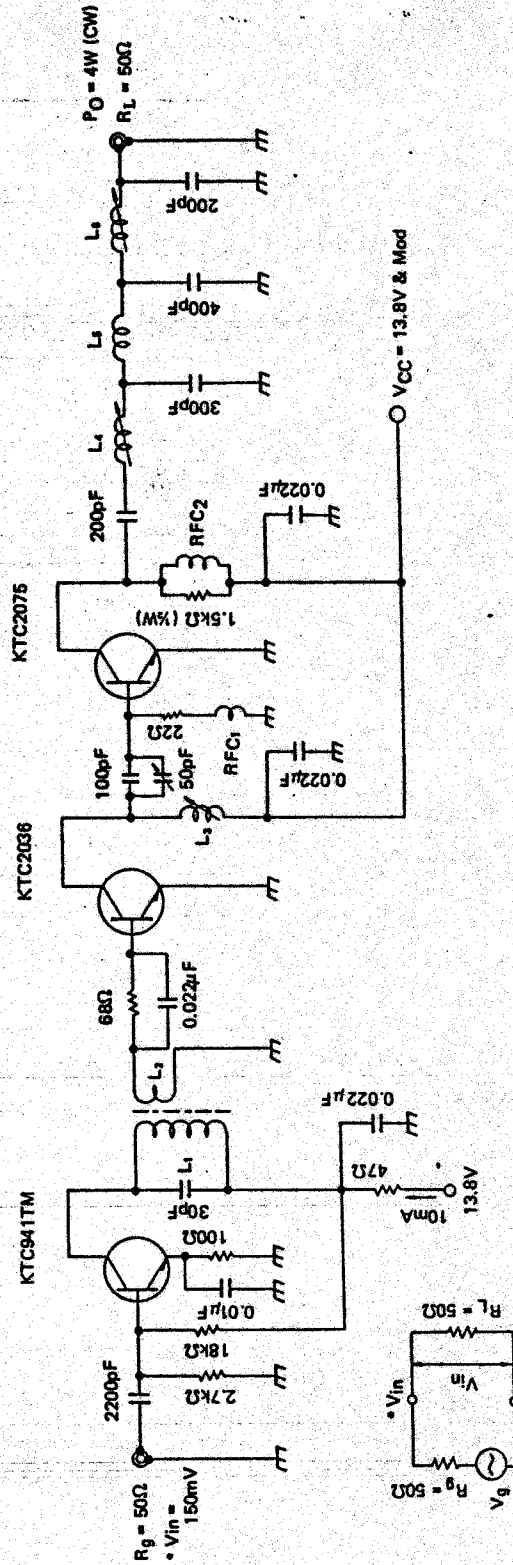




Fig. 2. 27MHz 4W Output AM Transceiver Circuit



- $L_1$  : 4mm $\phi$  BOBBIN WITH FERRITE CORE, 0.08mm $\phi$  UEW, 8 TURNS
- $L_2$  : 4mm $\phi$  BOBBIN WITH FERRITE CORE, 0.08mm $\phi$  UEW, 2 TURNS
- $L_3, L_4$  : 6.5mm $\phi$  BOBBIN WITH FERRITE CORE, 0.6mm $\phi$  Sn PLATED COPPER WIRE 6 $\frac{1}{2}$  TURNS
- $L_4$  : 6.5mm $\phi$  BOBBIN WITH FERRITE CORE, 0.6mm $\phi$  Sn PLATED COPPER WIRE 8 $\frac{1}{2}$  TURNS
- $L_4$  : 0.6mm $\phi$  Sn PLATED COPPER WIRE, 6.5mm I.D, 8 $\frac{1}{2}$  TURNS
- RFC<sub>1</sub> : 47 $\mu$  H, 7BA-480k (TOKO)
- RFC<sub>2</sub> : 0.2mm $\phi$  UEW, 30 TURNS

RESISTER :  $\frac{1}{2}W$  CARBON  
 CAPACITER : CERAMIC

# KTC 2075

## APPLICATION CIRCUIT CHARACTERISTIC

