OPERATION MANUAL
MODEL 886 AM EBS SYSTEM
MODEL 887 FM EBS SYSTEM

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**TFT OPERATION MANUAL ADDENDUM**

**MODEL 886/887**

**MANUAL P/N 5004-0886/0887 Rev. B**

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**IMPORTANT MANUAL CHANGES**

1. **AM LOOP ANTENNA FOR MODEL 886 EBS AM RECEIVER**

   A tuneable loop antenna for AM reception has been tested by TFT and found to be an effective device for use in conjunction with the TFT Model 886, EBS AM Receiver. This loop antenna is used indoors to optimized RF gain and selectivity.

   This antenna is also available through: Edmund Scientific
   101 E. Gloucester Pike
   Barrington, NJ 08007-1380
   (609) 573-6250

   Trade Name: Super Select-a-tenna
   Part No. : 72147

   If higher RF signal level to the Model 886 is required an outdoor antenna can be used. See the diagram below for installation and connections.

   ![Diagram of AM Loop Antenna]

2. **Model 887 FM Antenna Installation**

   a. Replace page 2.5
   b. Add Fig. 2.3 after Fig. 2.2

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TFT Form No. 5300-0268C
2-26-90
h. For remote control usage, connect the REMOTE ACTIVATION (ON AIR) terminals, pins 8 (ground) and 9 of J3 on the 887 rear panel, and the REMOTE RESET terminals, pins 10 (ground) and 11 of J3, to momentary-to-ground switches. Grounding these lines activates the functions.

i. If the 887 will be used to activate a station alarm, connect the alarm device to the EBS ALARM RELAY terminals, pins 1 thru 6 of J1 on the 887 rear panel. See Figure 2-1, Model 886/887 Wiring Diagram, at the back of this section for relay configuration.

j. Ac power is applied through the rear panel ac connector. Connect the line cord to an appropriate outlet. The 887 should now be on.

2.6 AM Antenna Installation

If a local AM antenna is not available, an end-fed long wire antenna (approximately 250 ft.) can be used. One end of the long wire should be connected to the ANT 75Ω connector.

For moderately strong signal areas, an alternative to the long-wire antenna connection can be used. Refer to Figure 2-2, AM Antenna Installation Diagram, at the back of this section.

2.7 FM Antenna Installation

For indoor and moderate strong area, the supplied FM indoor antenna and 300Ω to 75Ω matching transformer can be used. Refer to Figure 2-3 FM antenna matching installation diagram at the back of this section for connection.
# Model 886 AM EBS System
# Model 887 FM EBS System

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SECTION 1
GENERAL INFORMATION

1.1 General Description

The Models 886 and 887 EBS Systems are designed for broadcasters to meet Parts 73.940, 73.941, and 73.942 of the FCC Rules and Regulations.

The 886 AM Receiver uses a frequency-synthesized local oscillator which is phase-locked to a 5 MHz crystal oscillator. It is tunable across the AM broadcast band in 10 kHz increments via a 3-digit front panel pushbutton switch. The 886 Receiver's stability is ±500 Hz per year.

In addition to broadcast station use, the AM Receiver provides low cost EBS monitoring for emergency services such as police, fire, hospitals, and Civil Defense agencies listening to EBS-participating stations during an emergency.

The 887 FM Receiver is a high performance, tunable receiver. It uses a 3-digit front panel pushbutton switch that tunes in 100 kHz increments. This receiver is ideally suited to FM inter-city relay networks, key links in the EBS alerting procedure, thus allowing pickup and rebroadcast of emergency programming without degradation of signal quality.

Both EBS Systems have a built-in, two-tone decoder for the 853 Hz and 960 Hz EBS signaling tones from demodulated outputs. Stable piezoelectric tuning fork filters are used to achieve a bandwidth of ±5 Hz from each tone frequency.

This integral two-tone EBS generator, which uses individual crystal oscillators, produces the 853 Hz and 960 Hz tones simultaneously, with an accuracy of ±0.25 Hz. Tone amplitudes may be observed and adjusted individually. Test and on-air transmission switches are provided on the front panel.

There are two 2-digit LED displays on the front panel of both systems. These displays show the number of days (up to 12) since EBS test transmissions were last received and/or sent. Two LED bar graph displays are also provided for audio and RF level observations.

A speaker is provided on the front panel for audio monitoring. This speaker works in conjunction with the rear panel volume control, which also adjusts the volume of an external speaker when connected to a rear panel phone jack.

Both receivers are configured at the factory to operate from a 117 Vac, 50 Hz or 60 Hz power source.
1.2 Specifications

AM Receiver

Frequency Range ........................................... 540 kHz to 1750 kHz

Local Oscillator Stability .................................. ±500 Hz per year

Tuning Method ........................................... Pushbutton stepswitch in 10 kHz increments

Antenna Input ........................................... 75Ω nominal, unbalanced

Sensitivity ........................................... 30 μV for 20 dB signal-to-noise at 30% modulation

Image Rejection ........................................... 25 dB

AGC ........................................... 60 dB

IF Bandwidth, 6 dB ........................................... ±5 kHz

Harmonic Distortion ........................................... Less than 3% at 75% modulation

Noise ........................................... 45 dB or greater below 75% modulation with 10 mV/meter RF signal level

Audio Outputs (600Ω) ........................................... Balanced: +8 dBm

.............................................................. Unbalanced: 1 Vrms

Carrier-off Output ........................................... Active pull-up to 10 V, 10 mA

FM Receiver

Frequency Range ........................................... 88 MHz to 108 MHz

Tuning Method ........................................... Pushbutton stepswitch in 100 kHz increments

Antenna Input ........................................... 75Ω nominal, unbalanced
Sensitivity................................................ 2 \( \mu \)V for 20 dB quieting
IF Bandwidth, 6 dB........................................ +150 kHz
Image Rejection.......................................... 40 dB
AGC.......................................................... 80 dB
Audio Frequency Response................................ +1 dB, 50 Hz to 15 kHz
Harmonic Distortion.................................... 1% at 33% modulation
Signal-to-noise Ratio (SNR)............................ 60 dB or greater below 100% modulation at 50 \( \mu \)V RF input
De-emphasis.............................................. 75 \( \mu \)sec
Audio Outputs (600\( \Omega \))............................ Balanced: +8 dBm
....................................................... Unbalanced: 1 Vrms
Carrier-off Output...................................... Active pull-up to 10 V, 10 mA

Decoder (AM and FM)
Decoder Input Level..................................... 100 mV into 600\( \Omega \)
Bandwidth.................................................. ±5 Hz
Frequency Stability..................................... ±0.25 Hz, crystal-controlled
Audio Output Level..................................... 250 mW, internal speaker
Generator Output Level (600\( \Omega \)).............. Balanced: +8 dBm
....................................................... Unbalanced: 1 Vrms
AM and FM EBS Systems

Harmonic Distortion ....................................... Less than 2%

Tone Duration ............................................... 6, 12, or 24 seconds, adjustable

Tone Level Adjust .......................................... Internal

Time Delay for De-muting ............................... Adjustable to 2, 4, or 8 seconds

External Alarm Contacts ............................... SPDT relay contacts to rear panel strip

Front Panel

Day Display .................................................. Two 12-day digital displays to record number of days since last transmission and/or reception of two-tone transmission. Automatic reset.

ON/STANDBY Switch ....................................... 3-position, spring-loaded toggle switch. In the ON mode, the speaker is demuted. In the STANDBY mode, the speaker is muted until an EBS alert is received.

RESET Switch ............................................. Resets (mutes) the speaker after receipt of EBS transmission.

TEST/RESET Switch ....................................... 3-position, spring-loaded toggle switch. In the TEST position, the 886/887 performs a self-test of the decoder. In the RESET position, it interrupts on-air transmission or a self-test.

ON AIR Switches ......................................... Two 3-position, spring-loaded toggle switches. Must be held in opposing positions. Used to prevent accidental test transmission.

853 Hz/960 Hz OPERATE Switch ....................... 3-position, spring-loaded toggle switch. Tests individual tones and connects both tones to an output for test operations.
Mechanical and Environmental

Receiver Input Power ........................................ 117 Vac, ±15%, 50 Hz or 60 Hz, 20 W maximum

Operating Temperature ..................................... 0°C to +50°C (32°F to 122°F)

Dimensions .................................................. 1 3/4" (4.4 cm) H x 19" (48.3 cm) W x 10" (25.4 cm) D

Weight ....................................................... 6 lbs. (2.7 kg)

1.3 Warranty

TFT, Inc., warrants each of its manufactured instruments to meet the specifications when delivered to the BUYER and to be free from defects in material and workmanship. TFT will repair or replace, at its expense, for a period of one year from the date of delivery of equipment, all parts which are defective from faulty material or poor workmanship.

Instruments found to be defective during the warranty period shall be returned to the factory with transportation charges prepaid by the BUYER. It is expressly agreed that replacement and repair shall be the sole remedy of BUYER with respect to any non-conforming equipment and parts thereof, and shall be in lieu of any other remedy available by applicable law. All returns to the factory must be authorized by the SELLER prior to such returns. Upon examination by the factory, if any instrument is found to be defective, the unit will be repaired and returned to the BUYER, with transportation charges prepaid by the SELLER.

Transportation charges for instruments found to be defective within the first 30 days of the warranty period will be paid both ways by the SELLER.

Transportation charges for warranty returns wherein failure is found not to be the fault of the SELLER shall be paid both ways by the BUYER.

NO OTHER WARRANTY IS EXPRESSED OR IMPLIED. TFT IS NOT LIABLE FOR CONSEQUENTIAL DAMAGES.
1.4 Claim for Damage in Shipment

Your instrument should be inspected and tested as soon as it is received. The instrument is insured for safe delivery. If the instrument is damaged in any way or fails to operate properly due to transportation damage, file a claim with the carrier or, if insured separately, with the insurance company.

WE SINCERELY PLEDGE OUR IMMEDIATE AND FULLEST COOPERATION TO ALL USERS OF OUR PRECISION ELECTRONIC INSTRUMENTS.

PLEASE ADVISE US IF WE CAN ASSIST YOU IN ANY MANNER.

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FAX (408) 727-5942
SECTION 2
INSTALLATION

2.1 Unpacking and Inspection

Upon receiving the instrument, inspect the packing box and instrument for signs of possible shipping damage. After installation, operate the instrument in accordance with the procedures in Part A, Section 3, Operation, of this manual. If the instrument is damaged or fails to operate properly due to transportation damage, file a claim with the transportation company or, if insured separately, with the insurance company.

2.2 Power Requirements

Both AM and FM EBS Systems are factory-wired to operate from 117 Vac. The line frequency must be either 50 Hz or 60 Hz. To select either 50 Hz or 60 Hz, jumpers (supplied) must be placed at the appropriate pins at both P1 and P2 on the Main Board. For 50 Hz, pins 3 and 4 must be jumpered; for 60 Hz, pins 1 and 2 must be jumpered. Refer to the exploded view of P1 and P2 below for pin locations. Maximum power required is 20 watts.

![Diagram of EBS Main Board]

Front Panel
Model 886/887

Note: Pin 1 of P1 and P2 is the squared hole. From the front panel view, the pins are numbered 1-4 from right to left.
2.3 Pre-installation DIP Switch Settings

There are two DIP switches located on the Main Board. They can be used to set the duration for the dual-tone signal and to set the de-muting time delay. These switches are shown in the figure for Paragraph 2.2 above.

SW9 is used to set the tone duration for the dual-tone signal for either 6, 12, or 24 seconds. This switch is set for 24 seconds at the factory.

SW10 is used to set the time delay for the de-muting circuit. It can be set for either 2, 4, or 8 seconds. SW10 is set for 8 seconds at the factory.

To change these DIP switches for other than the times set at the factory, perform the following:

a. Remove the EBS top cover.

b. To change the dual-tone duration, depress the switch position on SW9 for the desired time according to the following list. The remaining switch positions should be in the OPEN position.

   Position 2 = 6 seconds

   Position 3 = 12 seconds

   Position 4 = 24 seconds

   Position 1 = Unused and should be in the OPEN position

c. To change the time delay, depress the switch position on SW10 for the desired time according to the following list. The remaining switch positions should be in the OPEN position.

   Position 2 = 2 seconds

   Position 3 = 4 seconds

   Position 4 = 8 seconds

   Position 1 = Unused and should be in the OPEN position

d. Replace the EBS top cover and continue with the installation procedure below.
2.4 AM System Installation

The Model 886 is calibrated and ready for installation into an equipment rack for immediate use. Ensure proper environmental conditions exist as specified in Section 1, Paragraph 1.2 of this manual. The operating temperature for this unit is between 0°C and 50°C (32°F and 122°F). To install the 886, perform the following:

a. Mount the Model 886 in the equipment rack and secure.

b. If an AM receiver is installed, connect a 75Ω coaxial cable from the antenna to the ANT 75Ω connector on the rear panel of the 886. If a 75Ω coaxial cable is unavailable, an alternative antenna can be used. See Paragraph 2.6 below for further installation instructions.

c. If desired, the RX AUDIO UNBALANCED terminals, pins 9 (ground) and 10 of J1 on the rear panel of the 886, can be connected to a monitor or other external device.

d. The RX AUDIO BALANCED terminals at J1, pins 11 and 12 on the rear panel of the 886, can be connected to a monitor or other external device. The output at these terminals is +8 dBm into 600Ω.

e. If a remote indication of carrier failure is to be provided, connect the CARRIER FAIL terminals, pins 7 (ground) and 8 of J1 on the rear panel of the 886, to the remote indicator. The output 10 V at 10 mA for carrier loss.

f. Connect the program output to the AUDIO LOOP THRU RIGHT CH BALANCED INPUT terminals, pins 4 and 5 of J2 on the 886 rear panel. Connect the monaural program output line to the AUDIO LOOP THRU RIGHT CH BALANCED OUTPUT terminals, pins 1 and 2 of J2 on the 886 rear panel.

g. For remote control usage, connect the REMOTE ACTIVATION (ON AIR) terminals, pins 8 (ground) and 9 of J3, and the REMOTE RESET terminals, pins 10 (ground) and 11 of J3, to momentary-to-ground switches. Grounding these lines activates the functions.

h. If the 886 will be used to activate a station alarm, connect the alarm device to the EBS ALARM RELAY terminals, pins 1 thru 6 of J1 on the 886 rear panel. See Figure 2-, Model 886/887 Wiring Diagram, at the back of this section for relay configuration.

i. AC power is applied through the rear panel ac connector. Connect the line cord to an appropriate outlet. The 886 should now be on.
2.5 FM System Installation

The Model 887 is calibrated and ready for installation into an equipment rack for immediate use. Ensure proper environmental conditions exist as specified in Section 1, Paragraph 1.2 of this manual. The operating temperature for this unit is between 0°C and 50°C (32°F and 122°F). To install the 887, perform the following:

a. Mount the Model 887 in the equipment rack and secure.

b. If an FM receiver is installed, connect a 75Ω coaxial cable from the antenna to the ANT 75Ω connector on the rear panel of the 887. If a local FM antenna is not available, a conventional FM or TV antenna is satisfactory.

c. If desired, the RX AUDIO UNBALANCED terminals, pins 9 (ground) and 10 of J1 on the rear panel of the 887, can be connected to a monitor or other external device.

d. The RX AUDIO BALANCED terminals at J1, pins 11 and 12 on the rear panel of the 887, can be connected to a monitor or other external device. The output at these terminals is +8 dBm into 600Ω.

e. If a remote indication of carrier failure is to be provided, connect the CARRIER FAIL terminals, pins 7 (ground) and 8 of J1 on the rear panel of the 887, to the remote indicator. The output is 10 V at 10 mA for carrier loss.

f. To connect the right channel loop thru configuration, connect the program right channel balanced output to the AUDIO LOOP THRU RIGHT CH BALANCED INPUT terminals, pins 4 and 5 of J2 on the 887 rear panel. Connect the stereo generator right channel input line to the AUDIO LOOP THRU RIGHT CH BALANCED OUTPUT terminals, pins 1 and 2 of J2 on the 887 rear panel. See the wiring diagram for these connections, Figure 2-1 (Model 886/887 Wiring Diagram), at the back of this section.

To connect the left channel loop thru configuration, connect the program left channel balanced output to the AUDIO LOOP THRU LEFT CH BALANCED INPUT terminals, pins 9 and 10 of J2 on the 887 rear panel. Connect the stereo generator left channel input line to the AUDIO LOOP THRU LEFT CH BALANCED OUTPUT terminals, pins 6 and 7 of J2 on the 887 rear panel. See Figure 2-1, Model 886/887 Wiring Diagram, at the back of this section.

g. To use the composite loop thru configuration, connect the stereo generator output or composite output to the COMPOSITE LOOP THRU IN connector. Connect the COMPOSITE LOOP THRU OUT connector to the exciter modulation input. See Figure 2-1, Model 886/887 Wiring Diagram, at the back of this section for wiring connections.
h. For remote control usage, connect the REMOTE ACTIVATION (ON AIR) terminals, pins 8 (ground) and 9 of J3 on the 887 rear panel, and the REMOTE RESET terminals, pins 10 (ground) and 11 of J3, to momentary-to-ground switches. Grounding these lines activates the functions.

i. If the 887 will be used to activate a station alarm, connect the alarm device to the EBS ALARM RELAY terminals, pins 1 thru 6 of J1 on the 887 rear panel. See Figure 2-1, Model 886/887 Wiring Diagram, at the back of this section for relay configuration.

j. Ac power is applied through the rear panel ac connector. Connect the line cord to an appropriate outlet. The 887 should now be on.

2.6 AM Antenna Installation

If a local AM antenna is not available, an end-fed long wire antenna (approximately 250 ft.) can be used. One end of the long wire should be connected to the ANT 75Ω connector.

For moderately strong signal areas, an alternative to the long-wire antenna connection can be used. Refer to Figure 2-2, AM Antenna Installation Diagram, at the back of this section.
Figure 2-2. AM Antenna Installation Diagram

If a local AM antenna is not available, an end-fed long wire antenna (approximately 250 ft.) can be used. One end of the long wire should be connected to the 886 rear panel ANT 75Ω connector.

For moderately strong signal areas, an alternative to the long-wire antenna connection, shown above, can be used.
SECTION 3
OPERATION

3.1 General Discussion

The Model 886 AM Receiver uses a frequency-synthesized local oscillator which is phase-locked to a 5 MHz crystal oscillator. It is tunable across the AM broadcast band in 10 kHz increments via a 3-digit front panel pushbutton switch.

In addition to broadcast station use, the 886 provides low cost EBS monitoring for emergency services such as police, fire, hospitals, and Civil Defense agencies listening to EBS-participating stations during an emergency.

The Model 887 FM Receiver is a high performance, tunable receiver. It uses a 3-digit front panel pushbutton switch that tunes in 100 kHz increments. This receiver is ideally suited to FM inter-city relay networks, key links in the EBS alerting procedure, thus allowing pickup and rebroadcast of emergency programming without degradation of signal quality.

Both EBS Systems have a built-in, two-tone decoder for the 853 Hz and 960 Hz EBS signaling tones from demodulated outputs. Stable piezoelectric tuning fork filters are used to achieve a bandwidth of ±5 Hz from each tone frequency.

This integral two-tone EBS generator produces the 853 Hz and 960 Hz tones simultaneously with an accuracy of ±0.25 Hz. Tone amplitudes may be observed and adjusted individually.

The front panel of both systems contains both test and on-air transmission switches, two 2-digit LED displays (which show the number of days, up to 12, since EBS test transmissions were last received and/or sent), and two LED bar graph displays for audio and RF level observations.

Also on the front panel of both systems is a speaker for audio monitoring. This speaker works in conjunction with the rear panel volume control, which also controls an external speaker when connected to the rear panel phone jack.

3.2 Turn-on and Warm-up

The Models 886 and 887 EBS Systems are configured at the factory to operate from a 117 Vac, 50 or 60 Hz power source. Note: Ensure the proper jumpers for either 50 Hz or 60 Hz are installed at P1 and P2 on the Main Board before applying power to the EBS System. Refer to Paragraph 2.2, Power Requirements, and the exploded view of P1 and P2 on Page 2-1 of this manual for the proper installation of these jumpers. To turn on
the 886/887, connect the ac line cord to an appropriate outlet. No warm-up is required. The 886/887 is now ready for use.

3.3 Controls, Connectors, and Indicators

The following summary descriptions refer to the front and rear panel controls, connectors, and indicators of both 886 and 887 EBS Systems. Numerals in parentheses, ( ), refer to the reference numbers in Figure 3-1, Model 886 Front and Rear Panel Illustration, and Figure 3-2, Model 887 Front and Rear Panel Illustration, at the back of this section.

**Note:** The only difference in descriptions between the AM and FM Systems is reference number 15, the FREQUENCY X10 kHz (Model 886) and FREQUENCY MHz (Model 887) pushbutton switches. Each system has its own summary description for these switches.

**Front Panel**

<table>
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<tr>
<th>Ref. No.</th>
<th>Designation</th>
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<tr>
<td>1</td>
<td>GENERATOR RESET/TEST momentary switch</td>
</tr>
<tr>
<td>2</td>
<td>GENERATOR 853 Hz/960 Hz OPERATE momentary switch</td>
</tr>
<tr>
<td>3</td>
<td>GENERATOR ON AIR momentary switches</td>
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**Function**

1. **GENERATOR RESET/TEST momentary switch**
   - Used to test the operation of the two-tone generator without interrupting normal programming. In the TEST position, the speaker is on and there will be no delay. If, however, the SPEAKER ON/STANDBY switch is in the STANDBY position you will experience a delay. The delay is dependent on switch positions of DIP switch SW10, the Time Delay for De-muting switch on the EBS Main Board. Refer to Section 2, Paragraph 2.3 of this manual for pre-installation switch position information.
   - In the RESET position, the unit resets ON AIR or TEST during the dual-tone transmission activated by either of these positions.

2. **GENERATOR 853 Hz/960 Hz OPERATE momentary switch**
   - 3-position, spring-loaded momentary switch used to test the two tones — either 853 or 960 — separately. The specific tone will be heard on the speaker as long as the switch is in the corresponding position with the SPEAKER ON/STANDBY switch (5) in the ON position.

3. **GENERATOR ON AIR momentary switches**
   - Used to transmit the dual-tone audio signal. These two switches must be placed in opposite directions, as indicated by the arrows on the front panel, at the same time. When ON AIR is
activated, pins 1 & 2 and pins 6 & 7 of J2 on the rear panel of the unit (normally used for the loop thru and program) will switch to the internal dual-tone output. The program will be interrupted for the duration of the dual-tone, which is dependent on the switch settings of SW9 on the Main Board. After the dual-tone signal, the unit will switch back to the program.

Lights when ON AIR is activated by placing the GENERATOR ON AIR momentary switches in opposite directions at the same time.

3-position, spring-loaded momentary switch. In the ON position, this switch turns on the speaker; in the STANDBY position, it mutes the speaker. In the STANDBY position, the speaker will automatically turn on when one of the following conditions exists after the de-muting delay set by SW10 on the Main Board (refer to Section 2, Paragraph 2.3 of this manual for switch position information): 1) the GENERATOR RESET/TEST switch is in the TEST position; 2) the GENERATOR ON AIR switches are placed in opposing directions (as indicated by the positions of the arrows on the front panel), or; 3) the receiver receives a dual-tone signal.

3-position, spring-loaded momentary switch that resets the EBS RECEIVED SET LED (7) on the front panel and the EBS Alarm Relay, K1, on the rear panel. After receiving a dual-tone signal from another transmitter and acknowledging reception of the signal, this switch is used to reset the flashing EBS RECEIVED SET LED (7). Resetting this indicator will prepare it for the next reception of a dual-tone signal.

Flashes on when the 886/887 receives a dual-tone signal from another transmitter. The LED will flash until reset with the EBS RECEIVED RESET switch (6).
8 EBS RECEIVED
SET pushbutton
switch

Used to set the calendar display after a power
outage affecting the days since the last
dual-tone signal was received.

9 DAYS SINCE LAST
RECEPTION
calendar display

LED displaying the number of days since the
886/887 received a dual-tone audio signal. Upon
receipt of a dual-tone signal, this display resets
to 0 (zero) and will increase by 1 each day after
receiving the signal. If the 886/887 EBS System
has not received a dual-tone signal by day 12,
this display will begin flashing. If flashing
occurs, either a dual-tone signal has not been
received within the last 12 days or the unit may
be faulty.

10 CLK LED

Flashes at 1 second intervals (1 Hz) to indicate
that the Model 886/887 internal clock is correct.

11 TRANSMISSION
SET pushbutton
switch

Used to set the calendar display after a power
outage affecting the days since the last
dual-tone signal was transmitted.

12 DAYS SINCE LAST
TRANSMISSION
calendar display

LED displaying the number of days since the
886/887 was used to transmit a dual-tone signal.
It resets to 0 (zero) after transmitting the
dual-tone signal. It will increase by 1 each day
after transmitting the dual-tone signal. On day
12, the display will begin flashing. If flashing
occurs, either a dual-tone signal has not been
issued within the last 11 days or the unit may be
faulty. To test if the unit is functioning properly,
reset the display by setting the RESET/TEST
switch (1) to the TEST position. The calendar
display should reset to 0 (zero), indicating a
good unit. If the unit is working properly, reset
the display back to its flashing mode. Using the
TRANSMISSION SET pushbutton switch (11),
set the display back to 12 and it will begin
flashing again.

13 AUDIO LEVEL bar
graph display

Displays the audio level of the received program.

14 RF LEVEL bar
graph display

Displays the RF level of the received program.
15 AM EBS System,
FREQUENCY
X10 kHz pushbutton
switches

For the AM EBS System, indicates the
frequency of the station being received. The
station frequency is equal to the numerals
indicated on the switches times 10 kHz.

15 FM EBS System,
FREQUENCY MHz
pushbutton switches

For the FM EBS System, indicates the frequency
(in MHz) of the station being received. The
frequency is read directly off these switches.

16 Speaker

For listening to received program, received
dual-tone signal, or transmitted dual-tone signal.

Rear Panel (AM and FM Systems)

17 EXT SPK JACK

Used to connect an external speaker to the
Model 886/887.

18 COMPOSITE
LOOP THRU OUT
connector

Connects to the exciter or transmitter
modulation input.

19 COMPOSITE
LOOP THRU IN
connector

Connects to the stereo generator output. When
the EBS ON AIR is activated, the composite
output switches to the dual-tone circuit. After
the dual-tone signal, the unit will switch back to
the program.

20 ANT 75Ω connector

For connecting an antenna to the 886/887.

21 Label

Label for J1, J2, and J3 pin connections.

22 VOLUME adjust

Adjusts the program or audio signal volume.
Works in conjunction with the front panel
speaker and the external speaker, if connected.

23 J1, 12-pin connector

Used to connect the following:

J1, pins 1-6, EBS ALARM RELAY: Connects
the internal relay, K1 (1 A, 12 V), to these pins
for the external studio alarm or control device.
Normally, pins 1 and 2 and pins 4 and 5 are
open; pins 2 and 3 and pins 5 and 6 are closed.
When a dual-tone signal is received, pins 1 and 2
and pins 4 and 5 are closed; pins 2 and 3 and
pins 5 and 6 are open. When a dual-tone signal
is received, K1 is energized. There is no

3-5
de-muting delay. To reset the normal condition, place the EBS RECEIVED RESET switch (6) to the RESET position.

**J1, pins 7 and 8, CARRIER FAIL:** Used for indicating when no RF carrier is coming into the 886/887. If the carrier is off, pin 8 is high. Pin 7 is ground.

**J1, pins 9 and 10, RX AUDIO UNBALANCED:** Receiver unbalanced audio signal output; 600Ω output impedance. Used for connecting an external device. Pin 9 is ground.

**J1, pins 11 and 12, RX AUDIO BALANCED:** Receiver balanced audio signal output; 8 dBm into 600Ω output impedance. Used for connecting an external device.

Used to connect the following:

**J2, pins 1 and 2, AUDIO LOOP THRU RIGHT CH BALANCED OUTPUT:** Audio program output normally connected to the transmitter or exciter audio balanced input. When EBS ON AIR is activated, the internal relay disconnects the external audio program from pins 1 and 2 and allows the dual-tone signal to the transmitter. When the dual-tone is over, the loop-thru is reconfigured in order to connect the audio program signal.

**J2, pin 3:** Ground.

**J2, pins 4 and 5, AUDIO LOOP THRU RIGHT CH BALANCED INPUT:** Balanced audio input connected to the external audio program balanced output. Normally, the external audio program with loop-thru pins 4 and 5 are connected to pins 1 and 2, respectively, of J2. These are connected to the outside transmitter balanced input. When EBS ON AIR is activated, the internal relay disconnects the external audio program from pins 4 and 4 and allows the dual-tone signal to the transmitter. When the dual-tone is over, the
loop-thru is reconfigured in order to connect the audio program signal.

**J2, pins 6 and 7, AUDIO LOOP THRU LEFT CH BALANCED OUTPUT:** Audio program output normally connected to the transmitter audio balanced input. When EBS ON AIR is activated, the internal relay disconnects the external audio program from pins 6 and 7 and allows the dual-tone signal to the transmitter. When the dual-tone is over, the loop-thru is reconfigured in order to connect the audio program signal.

**J2, pin 8:** Ground.

**J2, pins 9 and 10, AUDIO LOOP THRU LEFT CH BALANCED INPUT:** Balanced audio input connected to the external audio program balanced output. Normally, the external audio program with loop-thru pins 9 and 10 are connected to pins 6 and 7, respectively, of J2. These are connected to the outside transmitter balanced input. When EBS ON AIR is activated, the internal relay disconnects the external audio program and allows the dual-tone signal to the transmitter. When the dual-tone is over, the loop-thru is reconfigured in order to connect the audio program signal.

**J2, pins 11 and 12:** No connections. Used to connect the following:

**J3, pins 1-2, ONE SECOND PULSE END OF DUAL TONE ACTIVATION:** After the dual-tone signal is transmitted during TEST or ON AIR mode, K2 is energized and pin switches from pin 2 to pin 1 for 1 second. You can use this 1 second to trigger peripheral equipment.

**J3, pin 4:** No connection.
3.4 System Operation

The following paragraphs describe the operation of the 886 and 887 EBS Systems both as receivers and transmitters of the dual-tone emergency signal. On power-up, the EBS unit is in the STANDBY position and ready for immediate use.

3.4.1 Operation of the AM Receiver

To use the 886 as a receiver, perform the following:

a. Select the audio program by depressing the front panel FREQUENCY X10 kHz pushbutton switches (15) for the desired station. The actual station frequency is 10 kHz times what is displayed on these switches. For example, the switch positions for a 540 kHz station are 054.
b. Upon power-up, an internal muting circuit mutes the speaker. To turn the speaker on, place the SPEAKER ON/STANDBY switch (5) to the ON position. The audio program will be on the speaker.

c. Tune the speaker for optimum listening by adjusting the rear panel VOLUME control (22).

3.4.2 Operation of the FM Receiver

To use the 887 as a receiver, perform the following:

a. Select the audio program by depressing the FREQUENCY MHz pushbutton switches (15) for the desired station. The frequency is read directly off these switches, contains four digits, and is read in MHz. The first digit is actually the combination of two switches; this digit can be set from 8 - 10 only. For example, the switch positions for a 100.1 MHz station are 1001.

b. Upon power-up, an internal muting circuit mutes the speaker. To turn the speaker on, place the SPEAKER ON/STANDBY switch (5) to the ON position. The audio program will be on the speaker.

c. Tune the speaker for optimum listening by adjusting the rear panel VOLUME control (22).

3.4.3 Operation of the Two-tone Generator (AM and FM)

To transmit a dual-tone signal, perform the following:

a. Place the two GENERATOR ON AIR switches (3) in opposite directions at the same time. (The directions are indicated by arrows on the front panel.)

b. To restore to normal programming, place the GENERATOR RESET/TEST switch (1) to the RESET position.

c. To test the two-tone generator without interrupting normal programming, place the RESET/TEST switch (1) to the TEST position. The two-tone signal will be present at the speaker.

d. To test the tones separately, place the OPERATE 853 Hz/960 Hz switch (2) to the desired tone position. The tone corresponding to the selected switch position will be on the speaker as long as the switch is held in that position.
SECTION 4
THEORY OF OPERATION

4.1 General Discussion (Block Diagram, Figure 6-1)

Dual-tone generation takes place on the Main Board. When the RESET/TEST switch, SW1, is in the TEST position, the dual-tone signal is generated in the dual-tone generator circuit. The output, DUAL TONE OUTPUT, goes to operational amplifier U15-4. U15-4 separates the dual tone into the 960 Hz and 850 Hz signals, which are then routed to their corresponding filter circuits.

The 960 Hz signal is amplified by U16-1 and routed to U16-3, where a dc level is detected. This dc, a high logic level, is then sent to the demuting circuit via A1. The 853 Hz signal is amplified by U16-2. U16-4, the dc detector, detects the dc level and routes it to the demuting circuit via A2.

When A1 and A2 are high at the same time, during a self-test, the demuting circuit recognizes either the 2, 4, or 8-second time delay before turning on the speaker.

SW2, the 853 Hz/960 Hz switch, selects a single tone. In the TS2 position, the 960 Hz signal tone is selected. The dual tone generator circuit sends this signal to the 960 Hz filter. When the CR6 LED on the Main Board is on, the 960 Hz filter circuit is operating properly. With SW2 in the TS3 position, the 853 Hz tone is selected and sent to its corresponding filter. When the CR7 LED on the Main Board is on, the 853 Hz filter circuit is operating properly. With the speaker enabled, either tone can be heard.

The ON AIR switches, SW3 and SW4, work together to produce a dual test tone. With these switches in opposing positions at the same time, the dual-tone signal is generated and fed to the DUAL TONE OUTPUT line from the dual-tone generator circuit. This output has three available paths.

The first path is to U15-4, the two-tone filter that separates the 960 and 853 signal tones. After filtering by U16, the two signals are routed to A1, A2, and then the demuting circuit. A high level at A1 and A2 at the same time to the demuting circuit drives Q6, which in turn activates loop-thru relays K3 and K4. This activation changes the loop-thru configuration in order to let the dual-tone signal to the transmitter.

The second path is through R74 to amplifiers U17-3 and U17-4. The result is a balanced dual tone output that is sent to 886/887 rear panel connector, J3, pins 6 and 7, for dual-tone test purposes. The U17 output is also fed through the isolation transformer, T2, to the loop-thru K3/K4 configuration and to the transmitter.
The third path after on-air activation is via the audio power amplifier U18. At the same time the ON AIR switches are placed in opposing directions, the dual-tone signal is fed to the demuting circuit. U18 is activated after the delay set by the internal TIME DELAY DIP switches in the demuting circuit on the Main Board. (This time can be set for either 2, 4, or 8 seconds.) The dual test tone goes through U18 and out to the speaker.

The opto-coupler at J3, pin 9 on the rear panel is used to connect a momentary-to-ground switch in order to remotely control on-air activation. This configuration is used in place of SW3 and SW4 for on-air activation.

The length of time the test tone is on depends on the TONE DURATION DIP switches on the Main Board. The time can be set for either 6, 12, or 24 seconds.

With SW1 to the TEST position, the TEST output line from the dual tone generator circuit will be low. This low level goes to the demuting circuit via TS5. This switch can also be used to reset the EBS RECEIVED LED on the front panel.

The dual tone generator MU (mute) output is high when (1) SW1 is in the TEST position; (2) SW2 is in either the TS2 or TS3 position or; (3) SW3 and SW4 are placed in opposing directions. When this output is high, Q17 is on, thus muting the receiver audio signal to the filter circuit.

The 1/S CLOCK comes in to the dual tone generator circuit from the time base circuit on the Main Board. It uses the ac power line frequency, either 50 or 60 Hz, as a reference. Place a jumper at either the 50 Hz PRESET or 60 Hz PRESET location. A jumper in the appropriate frequency location selects the corresponding frequency for use with the 886/887.

Dual-tone generator 1/S PULSE END OF DUAL TONE output drives the K2 relay. At the end of the dual-tone after on-air activation, the dual-tone generator circuit sends a signal at the rate of 1 pulse/second to drive peripheral studio equipment, if connected at J3, pins 1-3.

The SEND output to the demuting circuit should be a high level. From demuting it goes to Q6 to drive K3/K4 and change the loop-thru configuration. This level also goes out as the SEND/RESET output line to the DAYS SINCE LAST RECEPTION Counter to reset the front panel calendar display to 0 (zero).

From the demuting circuit, the OA high level output lights the ON AIR LED. When the ON AIR switches are in opposite positions, this indicator is lit.

When the 886/887 receiver circuit receives a program signal, it changes to the dual tone. The AUDIO LEVEL output goes to U15-4 via R29. From U15-4, the program signal goes to the filter circuit, whose output is a high level at A1 and A2. This automatically turns on the speaker. The SPK ON/OFF line into U18 should also be high. This high
turns the DAYS SINCE LAST RECEPTION Counter to 0 via the EBS/RECV'D line from the demuting circuit.

When a program signal is received, the front panel EBS RECV'D LED, CR1, should also be lit. When the ON AIR switches are placed in opposite positions or the RESET/TEST switch is in the TEST position, this LED should be extinguished.

When the 886/887 receives a two-tone signal from another station, the AUDIO LEVEL line will also activate K1 (EBS ALARM) on rear panel connector J1, pins 1-6, when an external alarm is connected.

The receiver circuit AUDIO LEVEL output is also fed to rear panel connector J1 via U17. The outputs from U17 are the balanced and unbalanced outputs connected to J1, pins 1-3, used to monitor reception conditions.

Receiver AUDIO LEVEL output line also goes to the front panel AUDIO LEVEL bar graph display for monitoring the program audio level.

Demuting circuit RF LEVEL output line goes to the front panel RF LEVEL bar graph display for monitoring the program RF level.

SW5 is the SPEAKER ON/STANDBY switch, which is connected to the demuting circuit. When SW5 is in the SPK EN position, the SPK ON/OFF output is enabled and the speaker is on. With SW5 in the SPK DIS position, the SPK ON/OFF output is disabled and the speaker is off.

The EBS ALARM RESET switch, SW6, resets K1 (EBS ALARM).

REC COUNTER SET is the front panel pushbutton switch used to advance the Reception Counter.

TRANS COUNTER SET is the front panel pushbutton switch used to advance the Transmission Counter.

The CLOCK LED, CR2, is the front panel CLK LED that flashes at 1-second intervals to indicate that the 886/887 internal clock is functioning correctly.

The phone jack is used to connect an external speaker.

The power supply circuit is located on the Main Board. The transformer takes the ac line voltage, rectifies it, and regulates it to get an unregulated +20 Vdc and two regulated voltages, +12 Vdc and +5 Vdc. These voltages are distributed to those circuits requiring them.
4.2 Main Board (Figure 6-2)

EBS tones (single and dual), control and display signals, and PC board voltages for the EBS System are generated on the Main Board. The following paragraphs discuss these functions.

4.2.1 Tone Generation

The dual-tone signal is generated on the Main Board either by placing the RESET/TEST switch to the TEST position or by placing the ON AIR switches in opposite positions at the same time.

SW1 is the GENERATOR RESET/TEST momentary switch on the front panel. With SW1 in the TEST position, U2, pin 5 will be high. This logic high level output goes through a series of gates. The high level goes to U5, pins 1 and 5; the output of U5, at pins 3 and 4, will also go high. These outputs are fed to U7, with the outputs at pins 4 and 10 going high. These outputs are then routed to U9. The resulting output levels are high at U9, pins 3 and 4.

The high levels from U9, pins 3 and 4 go to U12, pin 2 and U14, pin 2, respectively. The high input levels at these ICs enable each to generate a single tone signal: U12 generates the 960 Hz and U14 generates the 853 Hz. The single tone signals each are fed to different sections of U15, where the signals are amplified. The outputs go to U15, pin 9. At U15, both signals are mixed. The resulting output is a dual-tone signal at U15, pin 8.

Length of the dual-tone signal is dependent on the 1-second timebase generated at U32. This timebase goes to U10, pin 9 where it is divided by 3 to get a 1/3-second pulse. This pulse is fed to U10, pin 1, the programmable counter, where the position of switch SW9 controls the duration of the dual-tone signal for either 6, 12, or 24 seconds. This counter controls U2. At the end of the dual-tone signal, U2 is cleared and, consequently, turns off the two signal generators, U12 and U14.

Also at the end of the dual-tone signal, U11, pin 5 goes high. At the same time, a 1-second input at U11, pin 11 forces a high output at U11, pin 9. After 1 second, this high will clear U11 and a 1-second pulse will be present at U11, pin 5. This pulse goes to R61 to drive Q4 in order to control relay K2 on rear panel connector J3.

When the two-tone generators are on (either by placing SW1 to TEST or the ON AIR switches in opposing positions), they can be turned off by setting SW1 to the RESET position. With SW1 in the RESET position, U2 and U10 are cleared, thus clearing the tone generation circuit.

SW2 is the GENERATOR 853 Hz/960 Hz momentary switch on the EBS System front panel. With SW2 in the 960 Hz position (TS2), U5, pin 6 is high, causing U7, pin 4 to go high. This logic level high goes to U9, pin 1 and forces the output at U9, pin 3 to go high. This high turns on tone generator U12, which generates the 960 Hz tone.
With SW2 in the 853 Hz position (TS3), U1, pin 8 is high. The high level goes to U5 where the resulting output at U5, pin 4 is also high. This high goes to U7 and the output at U7, pin 10 is high, which causes U9, pin 4 also to go high. The high at U9, pin 4 turns on tone generation at U14, thus generating the 853 Hz tone.

Front panel switches SW3 and SW4 are the GENERATOR ON AIR switches. They must be placed in opposing directions at the same time to generate the dual tone. With these switches in opposite positions, U2, pin 9 will be high. This level goes to gate U9. U9, pins 3 and 4 will go high, thus turning on the tone generators, U12 and U14. Their individual tones are then mixed in U15 with the resulting dual-tone signal generated at U15, pin 8.

When remote activation — connected to the rear panel at J3, pins 8 (ground) and 9 — is low, it drives the opto-coupler U54. U54 will turn on the ON AIR switch function as described above.

When remote reset — connected to the rear panel at J3, pins 10 (ground) and 11 — is low, the opto-coupler U53 will be high. This high turns on Q15, which in turn sends a high to U1, pin 1. This will clear U2 and act as a reset function identical to that of SW1 in the RESET position.

The dual-tone output at U15, pin 8 is fed to three different paths. First, the signal goes to amplifier U15, pin 13 via R22 and C21. The dual-tone signal is amplified here with an output at U15, pin 14. This output is fed to filters, FL1 and FL2. The tones are separated by the filtering process. FL1 filters out the 960 Hz; FL2 filters out the 853 Hz.

The 960 Hz out of FL1 goes to U16, pin 2 and out at U16, pin 1. This output is fed to CR2 and C32, which rectify the signal, and turn on Q2. Comparator U16, pin 8 will then go high and turn on CR6, LED1. When CR6 is on, it is a visual indication that the 960 Hz is present in the circuit.

The 853 Hz out of FL2 is routed to U16, pin 6 and out at U16, pin 7. This output is rectified by C30 and CR3 and turns on Q3. Comparator U16, pin 14 will go high and turn on CR7, LED2. When CR7 is on, it is a visual indication that the 853 Hz signal is present in the circuit.

The second dual-tone signal path from U15, pin 8 is through R23, C22, R58, and R59 to the audio power amplifier, U1. U18 drives the internal loudspeaker. This audio path is another method used to check the tones.

The third dual-tone signal path is through R74, C44, and R77 to U17, pin 9. Two balanced outputs — U17, pins 8 and 14 — are fed to the secondary of T2. These balanced outputs go to pins 8 and 9 of K3 and K4 for the loop-thru configuration. The outputs, controlled by Q6, are routed to the rear panel of the EBS unit via J3, pins 5 and 7. The balanced outputs are 8 dBm into 600Ω for a single tone at these test points.
From the receiver, the audio program has three paths. First, the audio goes through R29, R129, R30, and C24 to U15, pin 13. If the audio program contains a dual-tone, the signal is amplified, filtered, separated, and rectified as discussed above. Each signal — the 853 Hz and 960 Hz — is used to turn on CR7 and CR6, respectively. If the audio program does not contain a dual-tone signal, the decoding circuit will not be activated and LEDs CR6 and CR7 will be off.

The second audio path is through R56 and R59 to the audio power amplifier. The user can monitor the audio program with the internal loudspeaker.

The final audio path is through R60, C39, and R63 to U17, pin 2. U17, pins 1 and 7 are balanced outputs which are fed to the rear panel at J1, pins 11 and 12. The only purpose of these outputs is to connect monitoring equipment. These outputs are 8 dBm into 600Ω per single tone.

The dual-tone is present when (1) the signal is received in an audio program, (2) the RESET/TEST switch has been placed in the TEST position, or (3) the ON AIR switches have been placed in opposite positions at the same time. When a dual-tone signal is present in the circuit, the output at U16, pin 8 and R54 and at U16, pin 14 and R55 will be high. U19, pins 1 and 2 will also be high; thus, pin 3 of U19 will be high. This high is connected to U19, pin 6; a 1-second pulse from U47, pin 4 is fed to U19, pin 5. C132 and R133 at U19, pin 5 differentiate the leading edge of this 1-second pulse to U19. This pulse triggers programmable counter U20, which is connected to the output of U19.

SW10 is a DIP switch at U20. This switch sets the demuting time to either 2, 4, or 8 seconds, depending on the switch position. The output from SW10 triggers U23 to force pin 5 high. This high is connected to U19 at pin 9 and forces U19, pin 10 to go high. This high output triggers U23, pin 9 high in order to turn on the audio power amplifier and have the dual-tone at the speaker.

### 4.2.2 Controls and Indicators

At U22, TEST/SEND inputs come from the EBS front panel RESET/TEST and ON AIR switches to pins 8 and 9 of U22. These pins are normally in a low logic state. U22, pin 10, also low, is inverted at U21 and fed to U24, pin 12.

When the EBS System receives an audio program that includes the dual-tone signal, the U20/U23 circuit will detect it. The clock at U24, pin 11 enables U24 to transfer the high logic level from pin 12 to pin 9. This high output indicates that the system has received the dual-tone signal. The high is fed to U19, pin 13 to generate 1-second pulses at its output, U19, pin 11. The pulses go through R106 to drive the front panel EBS RECEIVED LED, causing the indicator to flash.

The high output at U24, pin 9 is fed to R32 to turn on Q5. Q5 activates K1 on the EBS rear panel. This output may be used to connect a studio alarm.
At the same time, U24, pin 9 drives U25, pin 3. The resulting pulse to U46, pin 8 will reset the DAYS SINCE LAST RECEPTION calendar display to 0 (zero).

When U22, pin 9 is high, U22, pin 10 will go high and U21, pin 8 will be low. After a dual-tone signal has been received, the front panel EBS RECEIVED LED and the studio alarm, if connected, can be turned off by placing the RESET/TEST switch (SW1) in the TEST position or the ON AIR switches (SW3 and SW4) in opposing positions.

When the RESET/TEST switch is in the TEST position, the TEST path becomes high (from U7, pin 3). With the ON AIR switches in opposite directions, the SEND path is high (from U2, pin 9). In either case, a high level is present at U24, pin 2. The 1-second pulse will turn on U24; a high output will be present at U24, pin 5 and a low output will be present at U24, pin 6. The high at U24, pin 5 goes to R84, Q6, and then to the K3/K4 loop-thru relays.

The low output at U24, pin 6 goes to inverter U3, pin 11 to drive Q1 and force the ON AIR LED on the board to go on.

A high at U22, pin 8 is also fed to U25 and generates a pulse at pin 9 when the ON AIR switches are placed in opposite positions. Pin 9 of U25 is connected to U40, pin 6. The leading edge of this pulse is used to reset the DAYS SINCE LAST TRANSMISSION calendar display to 0 (zero).

SW5 is the front panel SPEAKER ON/STANDBY switch. In the ON position, a high is present at U23, pin 11 and at U23, pin 9, the output. This high output turns on the internal loudspeaker. The STANDBY position clears U23 and a low is present at U23, pin 9. In this case, the speaker will be off.

SW6 is the front panel EBS RECEIVED RESET switch. The ALARM/RESET position is connected to U24, pin 13 and is used to clear U24. If an alarm has been activated (for example, a studio alarm is connected and a dual-tone signal was received), this switch will reset the alarm.

SW7 is the front panel EBS RECEIVED SET momentary pushbutton switch used to advance the DAYS SINCE LAST RECEPTION calendar display by one, via U40, with each depression of the switch.

SW8 is the front panel SET momentary pushbutton switch used to advance the DAYS SINCE LAST TRANSMISSION calendar display by one, via U44, with each depression of the switch.

U51 is the receiver RF level comparator. Its output is fed to J1, pin 8 on the rear panel as the CARRIER FAIL terminal.
A remote control switch connected to REMOTE RESET, pin 11 of J3 on the rear panel, is used for overall resetting of the EBS System. With a low on this pin, U53 will go high and force Q12, Q13, and Q14, the latch circuit, to reset. This will reset the entire EBS unit — the alarm (if connected), displays, LED indicators, and speaker.

4.2.3 Calendar Displays

The timebase for the calendar displays comes from the power supply. For the transmitter calendar display, DAYS SINCE LAST TRANSMISSION, the timebase is programmed by the jumpers installed at the 50 Hz or 60 Hz setting at U32. U32 divides the line frequency either by 50 or 60 Hz, depending on the line frequency set by these jumpers. This division generates a 1-second output. The output goes to U47, pins 1, 3, and 5. Pin 6 of U47 drives the front panel CLK LED, which will flash every 1 second.

The 1-second output at U47, pin 4 is the 1-second input at U11, pin 11 and U24, pin 3. The 1-second output at U47, pin 2 goes through a series of inverters and gate U48 before being fed to U33 where it is divided by 60 to get 1 pulse/1 minute at U48, pin 4. This pulse is divided by 60 at U29 to get 1 pulse/1 hour.

The 1 pulse/1 hour output at gate U41, pin 10 is fed to U28 to be divided by 24. The output is 1 pulse/1 day and goes to gates U41 and U40 to reset U28. This 1 pulse/1 day also goes to U26, via a series of gates and inverters, to be divided by 30.

U26 has two counters. The first counter divides this pulse by 3, the other divides it by 10. The output of U26 goes to U34 and U35, then to the 7-segment drivers to drive the front panel DAYS SINCE LAST TRANSMISSION calendar display. U34 drives the tens digit; U35 drives the ones digit.

U26 resets when the EBS System transmits a dual-tone or after 30 days since the last time the system was used to transmit a dual-tone. U26 counts to 30 days by using counter A to count to 10 then advancing to counter B. Counter B then counts to 3.

U38 in the circuit detects when the counter is greater than 12 and will force U52, pin 5 high. With a modulated 1 pulse/1 second at U38, pin 13 and the high at U38, pin 12, U38 will drive Q7 and force the LEDs on the DAYS SINCE LAST TRANSMISSION calendar display (common-cathode) to flash.

The D1 RESET (SEND) path at U46, pin 13 comes from U25, pin 9 and is used to reset this DAYS SINCE LAST TRANSMISSION calendar display to 0 (zero).

For the receiver calendar display, DAYS SINCE LAST RECEPTION, the timebase is programmed at U32 as described above for the transmitter calendar display. U32 divides the line frequency either by 50 or 60 Hz, depending on the line frequency set by the jumpers at U32, in order to generate a 1-second output. The resulting 1 pulse/1 minute at U48, pin 4 from the division at U32 and U33 is fed to U31 to be divided by 60. The output of U31 is 1 pulse/1 hour.
At gate U41, pin 10, the 1 pulse/1 hour is fed to U30 to be divided by 24. The output is 1 pulse/1 day and goes to gates U45 and U44 to reset U30. This 1 pulse/1 day also goes to U27, via a series of gates and inverters, to be divided by 30.

U27 has two counters. The first counter divides this pulse by 3, the other divides it by 10. The output of U27 goes to U36 and U37, then to the 7-segment drivers to drive the front panel DAYS SINCE LAST RECEPTION calendar display. U36 drives the tens digit; U37 drives the ones digit.

U27 resets when the EBS System receives a dual-tone or after 30 days since the last time the system received a dual-tone signal. U27 counts to 30 days by using counter A to count to 10 and then advancing to counter B. Counter B then counts to 3.

U39 in the circuit detects when the counter is greater than 12. When more than 12 days pass since the last reception, U39 will force U52, pin 9 high. With a modulated 1 pulse/1 second at U39, pin 12 and the high at U39, pin 13, U39 will drive Q8 and force the LEDs on the DAYS SINCE LAST RECEPTION calendar display (common-cathode) to flash.

The D2 RESET (RCVD) path at U46, pin 8 comes from U25, pin 5 and is used to reset the DAYS SINCE LAST RECEPTION calendar display to 0 (zero).

### 4.2.4 Power Supply Voltages

Power supply voltages used for the EBS System are generated on the Main Board. Ac comes from the ac line cord to the primary of T1. From the secondary of T1, the voltage goes to a bridge rectifier to get two unregulated dc voltages, 22 V and 11 V. The unregulated 11 Vdc goes to regulators U49 and U50. A regulated 5 Vdc is present at U50, pin 3; a regulated 12 Vdc is present at U49, pin 3. These voltages are distributed throughout the EBS System as needed.

### 4.3 Display Board (Figure 6-4)

Connector J1 on the Display Board is connected to J1 on the Main Board. The signals used to drive the two calendar displays, DAYS SINCE LAST RECEPTION and DAYS SINCE LAST TRANSMISSION, come from the Main Board into the Front Panel Board through J1, pins 3 thru 33. These signals are then applied to the four 7-segment displays, U1 thru U4.

U36 an U37 on the Main Board drive U1 and U2 on the Display Board. U1 is the tens digit and U2 is the ones digit on the DAYS SINCE LAST RECEPTION display.

U34 and U35 on the Main Board drive U3 and U4 on the Display Board. U3 is the tens digit and U4 is the ones digit on the DAYS SINCE LAST TRANSMISSION display.

The audio output level comes from the Receiver Board. This output is fed to the Main Board at J2, pin 5, routed to J1, pin 35 on the Main Board, and comes into the Display
Board via J1, pin 35. The audio goes to U7, the VU scale bar graph meter driver. This component is used to drive the bar graph LED, U5, to indicate the audio output level. R3 is used to adjust the bar graph LED to full scale.

RF level also comes from the Receiver Board and goes to J2, pin 1 on the Main Board. The RF from J2, pin 1 is routed to J1, pin 36 on the Main Board and comes into the Display Board through J1, pin 36. This level goes to the logarithmic bar graph driver, U8. This driver is used to drive the bar graph LED, U6, which indicates the RF level of the received signal at the antenna.

When an EBS dual-tone signal is received, the Main Board sends a signal to J1, pin 1 on the Display Board. This pin is connected to CR1 (LED1), located on the unit’s front panel. It is used to indicate that an EBS signal was received.

A signal from the Main Board is fed to J1, pin 2. This pin is connected to CR2 (LED2), the front panel CLK LED, and flashes at a 1 Hz rate to indicate the internal system clock is functioning correctly.

4.4 AM Receiver Board (Figure 6-6)

A 540-1740 kHz AM signal comes in to the AM EBS System via the rear panel ANT 75Ω connector and is routed to the tuned circuit consisting of C41, C60, and CR1-1. This circuit is used to change to the desired station. The AM signal is also routed to the secondary of transformer T1 and to U15, pin 4. In U15 the RF amplifier amplifies the AM signal.

C4, C5, and CR1-2 make up the local oscillator (L.O.) circuit. The signal from the L.O. goes to U15, pin 12. U11 and U12 make up the voltage-controlled-oscillator (VCO). These two circuits are part of the phase-locked-loop (PLL).

U15 mixes the amplified RF and the L.O. signals. The mixer output at U15, pin 1 is 455 kHz. This 455 kHz goes to the IF filter, L1 and FL1. The pure 455 kHz from FL1, pin 5 goes to U15, pin 3. Here, it is amplified by U15, the IF amplifier.

U15 also detects the audio signal. The audio is amplified in U15. The output of the audio amplifier is the audio program at U15, pin 6. This signal goes to amplifier U17 and out to J1, pin 6 to the Main Board.

The 5 MHz oscillator circuit consists of Y1, the 5 MHz oscillator and Q4. The 5 MHz goes to amplifier Q3 and then to U14, pin 1, where the signal is divided by 5. The resulting 1 MHz goes to U14, pin 15, where the signal is divided by 10. The output at U15, pin 9 goes to U13, pin 4, where it is divided by 10 again. The resulting output is 10 kHz at U13, pin 7. This 10 kHz signal goes to phase-comparator U12, pin 3. This is the reference signal that will be compared to the local frequency at U12 in the PLL.
The local frequency at U15, pin 10 goes to the Q1/Q2 amplifier where it is divided by N. N is controlled by the front panel FREQUENCY X10 kHz pushbutton switches plus 45. The divide-by-N circuit is made up of U1 thru U10. For example, if the incoming frequency is 1000 kHz, the L.O. frequency is 1450 kHz. The L.O. from U15, pin 10 goes to the Q1/Q2 circuit where it is divided by N, which is 100 (from the front panel FREQUENCY switches) plus 45. The resulting output frequency at U10, pin 6 is 10 kHz. This 10 kHz goes to U12, pin 1. At U12 it is compared to the 10 kHz reference at U12, pin 3. If the frequencies are the same, the PLL is locked.

If the front panel FREQUENCY switches are changed, a dc voltage is generated at U12, pin 13. This dc voltage goes to low pass filter U11 and back to R1 and R2 to control varactors CR1-1 and CR1-2. CR1-1 and CR1-2 will correct the local frequency for comparison to the 10 kHz reference at U12. The PLL circuit continues to correct until the local frequency is 10 kHz.

The dc voltage at U15, pin 9 indicates the RF level from the antenna. This voltage goes to amplifier U17, pin 10 and then through J1, pin 10 to the Main Board to drive the front panel RF LEVEL bar graph display.

### 4.5 FM Receiver Board (Figure 6-8)

The FM Receiver Board receives an 88 MHz-108 MHz FM program signal at the rear panel antenna connector. The signal is routed to Z1, the Front End Block consisting of a mixer, a voltage-controlled oscillator (VCO), and other components. A 10.7 MHz IF signal is generated at Z1 and sent out at Z1, pin 5. The signal is filtered at FL1 and sent to Q3 to be amplified. From Q3 the signal goes to FL2 to be filtered and then to the IF amplifier, U1, pin 1. U1 and quadrature detector L3 (located at U1, pin 9) take the IF signal and generate an audio output at U1, pin 6. This audio goes to R19, which sets the audio level, and to U2, where it is amplified before going out to the FM Receiver Board connector J1. The audio goes out to the Main Board via J1, pin 5.

The output at U1, pin 13 indicates the RF level of the input signal. This output goes to amplifier U2 and to J1, pin 1. From J1, pin 1, it is routed to the front panel RF LEVEL bar graph display via the Main Board. R63, at U2, pin 6 sets the reference for the RF level to the bar graph display.

U1, pin 12 is the muting output. This output goes to U2, pin 3, where it is compared with the level set by R29 at U2, pin 2. (R29 adjusts the muting point.) U2, pin 1 (the output of U2) drives CR3. When the muting level at U2, pin 3 is greater than the level set at U2, pin 2, CR3 is on. When the muting level at U2, pin 3 is less than the level at U2, pin 2, CR3 is off. When CR3 is on, there is a positive voltage drop at R27. This drop in voltage goes to CR1, R13, R11, R10, and U1, pin 5, which is the muting level input. This loop from U2 to U1 is the muting loop. Potentiometer R11 is set to its maximum setting.

U1, pin 15 is the AGC (automatic gain control) voltage output. This output goes to pin 2 of the Front End Block via R100 to perform the AGC function.
Q4 and Y1 make up the oscillator that generates a 5 MHz output. The 5 MHz out of the emitter of Q4 goes to R54, C58, and to the base of amplifier Q5. The output of Q5, the collector, is connected to U16, pin 1. The 5 MHz signal to U16, pin 1 is divided by 2 and output at U16, pin 5. This divided signal is routed to U16, pin 13 where it is divided by 2 again. The resulting signal is sent out at U16, pin 8 to U17, pin 9. At U17 the signal is divided by 100 to get 12.5 kHz. This 12.5 kHz signal is used as a reference at comparator U5, pin 3, where this signal will be compared with a signal originating from the Front End Block.

Pin 6 of the Front End Block is the L.O. output that goes to emitter-follower Q6. From Q6 the signal goes to C69 and then to the Q1/Q2 amplifier to U3, pin 1. Here the signal is divided by 2. The resulting signal is sent out of U3 at pin 5 and goes to U3, pin 13. The signal is divided by 2 at U13 and this output goes out at pin 8 to a divide-by-N circuit.

The divide-by-N circuit consists of U4, U13, U7, U8, U9, and U10. This divide-by circuit is programmed by U11, U12, U14, U15 and the front panel FREQUENCY switches of the unit. The resulting frequency after processing by this circuit is a 12.5 kHz signal at TP4. This 12.5 kHz signal goes to U5, pin 14 and compared with the 12.5 kHz reference signal at U5, pin 3. When the frequencies are the same, there will be no output at U5,13 and no input to U6, pin 2. With no input at pin 2, there will be no output at U6, pin 6, R43, R45, R48, R49, and to the Front End Block at pin 4, which is used to keep the VCO on frequency.
SECTION 5
MAINTENANCE

5.1 Periodic Maintenance

The Models 886 and 887 EBS Systems are calibrated and ready for immediate use. There are no calibrations; however, periodic performance checks and adjustments should be made. This section discusses those checks and adjustments required for optimum system performance.

Note: Numerals in parentheses, ( ), refer to reference numbers in Figure 3-1, Model 886 Front and Rear Panel Illustration, and Figure 3-2, Model 887 Front and Rear Panel Illustration, at the back of Section 3 in this manual.

Performance checks and adjustments in this section require specific test equipment. The following is a list of equipment suggested for the procedures in this section.

Test Equipment

1. Digital multimeter, accurate to within ±0.1%
2. Distortion analyzer
3. Frequency counter, up to 1 GHz
4. Oscilloscope with 100 MHz or better bandwidth
5. RF signal generator, 50Ω impedance with 88-108 MHz FM, 500-1700 kHz AM output

5.2 AM Receiver Performance Checks

The Model 886 AM Receiver’s sensitivity and AGC range should be checked periodically. The following paragraphs discuss the procedures for making these checks using the equipment listed in Paragraph 5.1 above.

5.2.1 AM Receiver Sensitivity

To check the AM Receiver sensitivity, perform the following:

a. Connect a signal generator to the ANT 75Ω connector (20) on the 886 rear panel.

b. Set the signal generator output for 30% modulation at a 1 kHz rate. Set the output level to 30 μV output.

c. Connect an oscilloscope and distortion analyzer in parallel to the RX AUDIO BALANCED terminals, pins 11 and 12 of J1, on the 886 rear panel.
d. Note the reading on the meter, then set the distortion analyzer to 0 dB and turn off the modulation. Read the meter. The difference in the readings with modulation on and with it off should be greater than 20 dB.

e. Observe the oscilloscope. The waveform should still be present on the scope.

f. Set the signal generator output to 540 kHz and AM modulation to 50% at a 1 kHz rate. Set the output level to 10 μV.

g. Connect a multimeter to the CARRIER FAIL terminals, pins 7 and 8 of J1, on the 886 rear panel.

h. Set the FREQUENCY X10 kHz pushbutton switches (15) to read 540 kHz.

i. Slowly increase the RF level of the signal generator to approximately 30 mV. The voltage on the multimeter at the CARRIER FAIL terminals should indicate a change from 0 V to 10 Vdc.

5.2.2 AM Receiver AGC Range

To check the AM Receiver AGC range, perform the following:

a. Ensure the signal generator is connected to the ANT 75Ω connector (20) on the 886 rear panel and its output is set to 540 kHz and AM modulation to 50% at a 1 kHz rate. Set the output level to 10 μV.

b. Connect an oscilloscope to the RX AUDIO BALANCED terminals, pins 11 and 12 of J1, on the 886 rear panel.

c. Increase the signal generator level to 30 mV. The 1 kHz sine wave on the oscilloscope should remain undistorted.

d. Repeat steps a and b above for 1030 kHz and 1600 kHz input signals.

5.3 FM Receiver Performance Checks

The Model 887 FM Receiver's sensitivity and AGC range should be checked periodically. The following paragraphs discuss the procedures for making these checks using the equipment listed in Paragraph 5.1 above.

5.3.1 FM Receiver Sensitivity

To check the FM Receiver sensitivity, perform the following:

a. Connect a signal generator to the ANT 75Ω connector (20) on the 887 rear panel.
b. Set the signal generator output to the receiver’s channel frequency (set by the front panel FREQUENCY MHz switches) and the frequency deviation for ±75 kHz at a 1 kHz rate. Set the output level to 2 μV.

c. Connect an oscilloscope and distortion analyzer in parallel to the RX AUDIO BALANCED terminals, pins 11 and 12 of J1, on the 887 rear panel.

d. Note the reading on the meter, then set the distortion analyzer to 0 dB and turn off the modulation. Read the meter. The difference in the readings with modulation on and with it off should be greater than 20 dB.

e. Observe the oscilloscope. The waveform should still be present on the scope.

f. Set the signal generator output level to 1 μV.

g. Connect a multimeter to the CARRIER FAIL terminals, pins 7 and 8 of J1, on the 887 rear panel.

f. Slowly increase the RF level of the signal generator to approximately 2 μV. The voltage on the multimeter at the CARRIER FAIL terminals should indicate a change from 0 V to 10 Vdc.

5.3.2 FM Receiver AGC Range

To check the FM Receiver AGC range, perform the following:

a. Ensure a signal generator is connected to the ANT 75Ω connector (20) on the 887 rear panel.

b. Using the FREQUENCY MHz pushbutton switches (15), set the 887 for the desired channel frequency.

c. Set the signal generator to the receiver’s channel frequency and the frequency deviation for ±75 kHz at a 1 kHz rate. Set the output level to 1 μV.

d. Connect an oscilloscope to the RX AUDIO BALANCED terminals, pins 11 and 12 of J1, on the 887 rear panel.

e. Increase the signal generator level to 20 mV. The 1 kHz sine wave on the oscilloscope should remain undistorted.

5.4 Dual-tone Level Adjust (AM and FM)

To adjust the dual-tone level, perform the following:

a. Remove the EBS System top cover.

b. On the Main Board, connect an oscilloscope to U15, pin 8.
AM and FM EBS Systems

c. Place and hold the 853 Hz/960 Hz OPERATE switch (2) to the 853 Hz position while observing the scope. Adjust R16 on the Main Board until the output at U15, pin 8 is 4 V peak-to-peak.

d. With the scope at U15, pin 8, place and hold the 853Hz/960 Hz OPERATE switch (2) to the 960 Hz position. Adjust R9 on the Main Board for a 4 V peak-to-peak output at this pin.

e. Connect a distortion analyzer to J3, pins 5 and 7 on the EBS rear panel.

f. While observing the meter on the distortion analyzer at J3, adjust R74 on the Main Board for 8 dBm into 600Ω load.

g. Replace the top cover.

5.5 Calendar Display Adjust (AM and FM)

To adjust either EBS front panel calendar display — DAYS SINCE LAST RECEPTION or DAYS SINCE LAST TRANSMISSION — simply take a thin, insulated instrument and depress the corresponding SET pushbutton switch (8 for DAYS SINCE LAST RECEPTION SET switch or 11 for DAYS SINCE LAST TRANSMISSION SET switch) on the 886/887 front panel.

5.6 Receiver Audio Output Adjust

The EBS receiver audio output adjustment procedures for both AM and FM Receivers are described in the following Paragraphs 5.6.1 and 5.6.2 below.

5.6.1 AM Receiver Audio Output Adjust

To adjust the AM Receiver audio output, perform the following:

a. Remove the 886 top cover.

b. Connect a 600Ω load and the balanced output of a distortion analyzer to the RX AUDIO BALANCED terminals, pins 11 and 12 of J1, on the AM EBS System rear panel.

c. Connect a signal generator with a 600 kHz carrier, modulated at 1 kHz with 90% modulation, to the ANT 75Ω connector (20) on the 886 rear panel. Set the signal strength for 100 µV.

d. While observing the meter on the distortion analyzer, adjust R6 on the Main Board for 8 dBm.

e. Replace the top cover.
5.6.2 FM Receiver Audio Output Adjust

To adjust the FM Receiver audio output, perform the following:

a. Remove the 887 top cover.

b. Connect a 600Ω load and the balanced output of a distortion analyzer to the RX AUDIO BALANCED terminals, pins 11 and 12 of J1, on the FM EBS System rear panel.

c. Connect a signal generator with an 88 MHz carrier, modulated at 1 kHz with ±75 kHz deviation, to the ANT 75Ω connector (20) on the 887 rear panel. Set the signal strength for 100 µV.

d. While observing the meter on the distortion analyzer, adjust R6 on the Main Board for 8 dBm.

e. Replace the top cover.

5.7 Receiver Audio Signal versus Dual-tone Signal (AM and FM)

It is suggested that a 1:1 ratio exist between the receiver audio signal and the dual-tone signal for both AM and FM EBS Systems. To adjust for this 1:1 ratio, perform the following:

a. Remove the 886/887 top cover and locate R56 on the Main Board.

b. Ensure you are receiving a program signal from any station. You should hear the program on the speaker.

c. Place the RESET/TEST switch (1) to the TEST position. You can now hear the dual-tone and the program at the same time on the speaker.

d. Adjust R56 on the Main Board so that the program signal and the dual-tone signal are of equal strength.
SECTION 6

DIAGRAMS AND SCHEMATICS
SECTION 6

DIAGRAMS AND SCHEMATICS
Pi MISTAKED ON CIRCUIT

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Page 1 of 4
NOTE A: trace should be cut on PCB
FIG. 6-11

NOTES:
1. COMPONENTS LOADED ON FAR SIDE.

CIRCUIT SIDE

CUT TRACE AS SHOWN