24-66

Remote Base Controller

Version 1.22

Printings:

Version 1.00: 2/12/98
Version 1.10: 7/21/98
Version 1.20: 10/20/99
Version 1.21: 7/19/00
Version 1.22: 4/16/02

TABLE OF CONTENTS

SPECIFICATIONS **1**

1.0 GENERAL DESCRIPTION **2**
1.1 Description 2
1.2 Capabilities and Features 2

2.0 INSTALLATION **3**
2.1 Line Connection 3
2.2 Proper Grounding Practices 3
2.3 Dip Switch Settings - Tone Control Option 4
2.4 Dip Switch Settings - MSK Control Option 5
2.5 Parallel Detect Option 6
2.6 Remote Control Applications 7

3.0 ADJUSTMENT PROCEDURES **13**
3.1 R79 - 13.8 Vdc Adjust 13
3.2 R80 - 5 Vdc Adjust 13
3.3 R50 - Microphone To Line Level 13
3.4 Desk Microphone Output Sensitivity 13
3.5 R19 - Internal Microphone Level 14
3.6 R42 and R54 - 2175 Hz Notch Filter Adjust 14
3.7 R74 - Tone Encode Level 14
3.8 R1 - MSK Encode Level (MSK Control Option) 14
3.9 R2 - DTMF Encode Level (MSK Control Option) 15
3.10 R16 - Receive Line Compensation 15
3.11 R111 - Summed Audio Level 15
3.12 R60 - Speaker Level 15
3.13 R15 - Earpiece Level 16
3.14 R7 and R8 - 2175 Hz Notch Filter Adjust (Parallel Detect Option) 16
3.15 R16 and R17 - Guard/Hold Tone Detect (Parallel Detect Option) 16

4.0 CIRCUIT DESCRIPTION **17**
4.1 Power Supply 17
4.2 Line Interface 17
4.3 Two Wire, No Supervisory, No Alternate Line 17
4.4 Two Wire With Supervisory 18
4.5 Two Wire With Alternate Line 18
4.6 Four Wire, No Supervisory, No Alternate Line 18
4.7 Four Wire With Supervisory 19
4.8 Four Wire With Alternate Line 19
4.9 Two Wire With Alternate Line Summed Audio 19
4.10 Combined Two Wire and Four Wire (for use with 20-88) 20
4.11 Receive Audio 20
4.12 Transmit Audio 21
4.13 Digital Control Section 22
4.14 MSK Interface Board 24
4.15 Parallel Detect Option Board 24
4.16 Keypad Board 25

4.17 Clock Option 26
4.18 VU Meter Option 26
4.19 LCD Option 26
4.20 Programming Cable 26
4.21 FCC Part 15.105 (B) Option 27

5.0 TROUBLESHOOTING 29
5.1 Microphone Audio Doesn't Reach the Line 29
5.2 VU Meter Doesn't Function 29
5.3 Control/Alert Tones Do Not Reach the Line 30
5.4 Control Tones Have No Effect on the Panel 30
5.5 Line Audio Doesn't Reach the Speaker 30
5.6 Earpiece Audio is Not Loud Enough or No Sound 31
5.7 A Constant Hum is Present in the Speaker 31
5.8 Background Tone (2175 Hz) Present in Receive Audio 31
5.9 Parallel TX Indicator Intermittent or Stuck On 32
5.10 One or More Keys Stuck On or Off 32
5.11 Faceplate Keys and All LEDs Inoperative 32
5.12 Microprocessor Functioning Improperly 32
5.13 Voltage Level Tables 33
5.14 Status Messages 34

PARTS LIST 36

INSTALLATION DIAGRAMS 47

ADJUSTMENT LOCATOR DIAGRAM 49

SCHEMATICS 50

SPECIFICATIONS

Input voltage	117/230 Vac ±20% 50/60 Hz
Standby voltage	12 - 15 Vdc
Standby current @ 13.8 Vdc	287 mA (TX) 645 mA (RX) 267 mA (Standby)
Input power (max)	8.5 W (TX) 20 W (RX) 8.5 W (Standby)
Temperature range with LCD	0 to +60 deg C 0 to +50 deg C
Relative humidity	90% at 50 deg C
Line impedance	600 ohms (4-wire RX) 600 or > 5k ohms (4-wire TX or 2-wire)
Line audio output	-20 dBm to +10 dBm into a 600 ohm load
Tx hum & noise	-55 dB (ref. +10 dBm)
Threshold of compression (line to speaker audio)	-20 dBm adjustable
Speaker audio output	3 W into 4 ohms
Distortion (at rated speaker output)	< 3%
RX hum & noise	-55 dB
Frequency response	+1, -3 dB (300 to 3000 Hz except at notch frequency)
Rx Compression	With an audio increase of 30 dB beyond the start of compression the output increases less than 3 dB.
Tx Compression	With an audio increase of 30 dB beyond the start of compression the output increases 15 to 17 dB.
Line control	2 or 4 wire audio
Notch filter depth	> 45 dB (RX) > 45 dB (TX)
Weight	5 lb.
Dimensions	4.75" x 10" x 8"

1.0 GENERAL DESCRIPTION

1.1 Description

The 24-66 series of remote controllers is used to remotely control repeaters and base station radios. Tone sequences are used by the 24-66 to control the remote repeater or base station radio. The 24-66 requires an appropriate panel in the repeater or at the base station for correct operation. The operating characteristics of the 24-66 can be selected and changed with the programming software which runs on a standard personal computer.

The 24-66 is available with either tone signaling or MSK signaling. The 24-66 Tone remote uses function tones from 1050 to 2050 Hz to control the repeater or base station radio while the 24-66 MSK remote uses an MSK modem for control. The 24-66 is available with either a handset or a desk microphone and can operate with either a 2-wire or a 4-wire line. The 24-66 provides parallel detect as well as alternate line and supervisory modes of operation. The 24-66 is available with clock and VU meter display and can be set on a desk or wall mounted. A 12 V power cable is also available which allows the 24-66 to be operated from a 12 Vdc source.

1.2 Capabilities and Features

- Tone or MSK signaling
- 2 wire or 4 wire operation
- Handset or desk microphone
- Desk or wall mount
- PC programmable
- Non-volatile memory
- 8 or 99 channels for 24-66 Tone remote
- 99 channels or up to 32 systems for 24-66 MSK remote
- Operation from 12 Vdc source
- Parallel remote update
- Full duplex operation
- Intercom
- Alert tone
- Supervisory option
- Alternate line with or without summed audio option
- Clock option
- VU meter option
- LCD option

2.0 INSTALLATION

2.1 Line Connection

The 24-66 allows either 2-wire or 4-wire lines to be used. The choice of which one of these to use should be based upon cost, availability, performance, and the conditions that the 24-66 is to operate within. Two wire lines have one voice grade pair that is used for both the transmit and receive audio. They are simple to install and, depending upon local service, may be more economical. Four wire lines provide two voice grade pairs, one for transmit audio and the other for receive audio. This provides full duplex operation allowing the 24-66 to transmit and receive at the same time. Cost may be a factor since two voice grade pairs are required. Four wire lines would be used with customer owned multiplex microwave systems and with leased lines that do not use hybrids in the transmission paths.

The line connectors are found on the back of the 24-66. Connector J5 is the primary connector and is marked with one notch in the plastic case. Connector J6 is the secondary connector and is marked with two notches in the plastic case. The line should be a standard 2 or 4 wire cable that is available anywhere that telephone accessories are sold. With more than one remote in the system and no alternate line or supervisory option installed, J5 is used for the line from the base station and J6 is used to connect the line to additional remotes. With the supervisory option installed, J6 is used for the line from the base station and J5 connects to the remotes under supervisory control. If the 24-66 has the alternate line option installed, J5 is used for the primary line and J6 is used for the alternate line. Section **2.6 Remote Control Applications** describes the 24-66 setup and line connections for numerous different remote control applications. Refer also to the 24-66 installation diagrams in the back of this manual.

2.2 Proper Grounding Practices

The surge protection varistors on the 110 Vac power line, the two wire audio lines, and the four wire audio lines protect the 24-66 from line transients. It is imperative that a good earth ground be used on the ground conductor of the power cord or a **SERIOUS SHOCK HAZARD** could develop if lightning were to strike the power line or the audio lines. In order to protect the operator to the highest possible degree, obtain a good earth ground for the ground conductor on the 110 Vac power cord.

The surge protection varistors are of little value without this earth ground and **EXTREME CAUTION** must be observed when servicing the 24-66 in the presence of a local lightning storm. In addition, the internal circuits can be damaged when a good earth ground is not used and lightning strikes the power line or the audio lines.

If Class B Option is installed refer to section 4.21 for the required earth ground connection.

2.3 Dip Switch Settings - Tone Control Option

This section describes the function of the individual switches of dip switch SW1 which is located on the bottom of the 24-66 Tone remote. After changes are made to the switches, the 24-66 Tone remote should be powered off and then back on so that the new switch settings will be read.

SW1-1, 2, 3: These switches are used to set the operating mode of the 24-66 Tone remote as follows:

1	2	3	Mode
OFF	OFF	OFF	1 - Factory initialized internal EEPROM
ON	OFF	OFF	2 - IDA standard 24-20
OFF	ON	OFF	3 - GE standard RCN1000
ON	ON	ON	4 - Test Mode

Mode 1 - In this mode, the operating characteristics of the 24-66 Tone remote are stored in an internal EEPROM. This EEPROM can be programmed with the Tone Programming Software.

Mode 2 - In this mode, the 24-66 Tone remote emulates a standard IDA 24-20. This mode allows for two frequency operation as described in the following table. There are three keys active: F-SEL, MON, and INTCOM. A desk microphone should not be used with this mode.

Frequency	Control Tone	
	TX	MON
F1	1950 Hz	2050 Hz
F2	1850 Hz	1750 Hz

Mode 3 - In this mode, the 24-66 Tone remote emulates the GE RCN1000. This mode allows only single frequency operation as given in the table below. Only the MON key is active. A desk microphone should not be used with this mode.

Frequency	Control Tone	
	TX	MON
F1	1950 Hz	2050 Hz

2.3 Dip Switch Settings - Tone Control Option (cont.)

Mode 4 - The test mode allows different functions of the 24-66 Tone remote to be tested for proper operation. When the 24-66 Tone remote is powered up in test mode, all LED's will flash on and off 4 times and then a series of tones will be sent to the speaker. Two different character strings will be sent to the LCD display if the 24-66 Tone remote contains this option. The 24-66 Tone remote will then operate normally with one exception. If any key which sends function tones to the line is pressed, including PTT, the following will happen: The 2175 Hz guard tone will be sent to the line continuously until another key is pressed on the keypad. The guard tone will be followed by each of the tones normally associated with the original key that was pressed being sent to the line until another key is pressed.

SW1-4: This switch is used to change the line impedance of the 24-66 Tone remote. When this switch is off, the 4-wire transmit pair line impedance or the 2-wire line impedance is greater than 5k ohms. When this switch is on, the 4-wire transmit pair line impedance or the 2-wire line impedance is about 600 ohms. The 4-wire receive pair line impedance is always about 600 ohms. If there are several remotes in parallel on the system, it is recommended that all remotes except for one be in the high impedance state. This will minimize loading on the system.

2.4 Dip Switch Settings - MSK Control Option

This section describes the function of the individual switches of dip switch SW1 which is located on the bottom of the 24-66 MSK remote. After changes are made to the switches, the 24-66 MSK remote should be powered off and then back on so that the new switch settings will be read.

SW1-1: This switch is not used and should be left off.

SW1-2, 3: These switches are used to set the operating mode of the 24-66 MSK remote as follows:

2	3	Mode
OFF	OFF	1 - Factory initialized internal EEPROM
ON	ON	2 - Test Mode

Mode 1 - In this mode, the operating characteristics of the 24-66 MSK remote are stored in an internal EEPROM. This EEPROM can be programmed with the MSK Programming Software.

2.4 Dip Switch Settings - MSK Control Option (cont.)

Mode 2 - The test mode allows different functions of the 24-66 MSK remote to be tested for proper operation. When the 24-66 MSK remote is powered up in test mode, all LED's will flash on and off 4 times. The LCD will also display all 8's four times if the 24-66 MSK remote contains this option. A series of tones will then be sent to the speaker and to the handset earpiece if a handset is being used. The 24-66 MSK remote will then start sending 2175 Hz guard tone to the line. As keys on the keypad are pressed, the 24-66 MSK remote will switch to sending an MSK test tone to the line, then to sending 2175 Hz hold tone to the line, and then back to sending guard tone to the line. The 24-66 MSK remote will continue to switch between sending guard tone, MSK test tone, and hold tone as keys are pressed to allow their levels to be adjusted.

SW1-4: This switch is used to change the line impedance of the 24-66 MSK remote. When this switch is off, the 4-wire transmit pair line impedance or the 2-wire line impedance is greater than 5k ohms. When this switch is on, the 4-wire transmit pair line impedance or the 2-wire line impedance is about 600 ohms. The 4-wire receive pair line impedance is always about 600 ohms. If there are several remotes in parallel on the system, it is recommended that all remotes except for one be in the high impedance state. This will minimize loading on the system.

2.5 Parallel Detect Option

When the parallel detect option is installed in the field, it is necessary to open the 24-66 and plug the option board into P4 on the main board. All adjustments on the option board have been factory preset and should not need to be adjusted. Refer to section **3.0 Adjustment Procedures** if adjustment is needed.

2.6 Remote Control Applications

There are numerous remote control applications that can be provided by the 24-66. Each application requires a specific jumper configuration and specific line connections. Certain 24-66 options are also required for each application. The following is a description of each of the remote control applications.

Application 1 - Two wire, no supervisory, no alternate line: This application provides basic 2-wire operation. The base station is connected to J5 and additional parallel remotes are connected to J6.

Application 2 - Two wire with supervisory: This application provides 2-wire operation with supervisory control. The base station is connected to J6 and the parallel remotes under supervisory control are connected to J5.

Application 3 - Two wire with alternate line: This application provides 2-wire operation with alternate line selection. The primary line is connected to J5 and the alternate line is connected to J6.

Application 4 - Four wire, no supervisory, no alternate line: This application provides basic 4-wire operation. The base station is connected to J5 and additional parallel remotes are connected to J6.

Application 5 - Four wire with supervisory: This application provides 4-wire operation with supervisory control. The base station is connected to J6 and the parallel remotes under supervisory control are connected to J5.

Application 6 - Four wire with alternate line: This application provides 4-wire operation with alternate line selection. The primary line is connected to J5 and the alternate line is connected to J6.

Application 7 - Two wire with alternate line summed audio: This application provides 2-wire operation with alternate line selection. Audio from the alternate line is also summed with audio from the primary line. The primary line is connected to J5 and the alternate line is connected to J6.

Application 8 - Combined two wire and four wire (for use with 20-88): This application allows operation with an IDA 20-88 that is interfaced to both 2-wire and 4-wire lines. The selected line from the 20-88 is connected to J5. J6 is not used.

2.6 Remote Control Applications (cont.)

The following chart details the required jumper configuration for each remote control application.

Application #

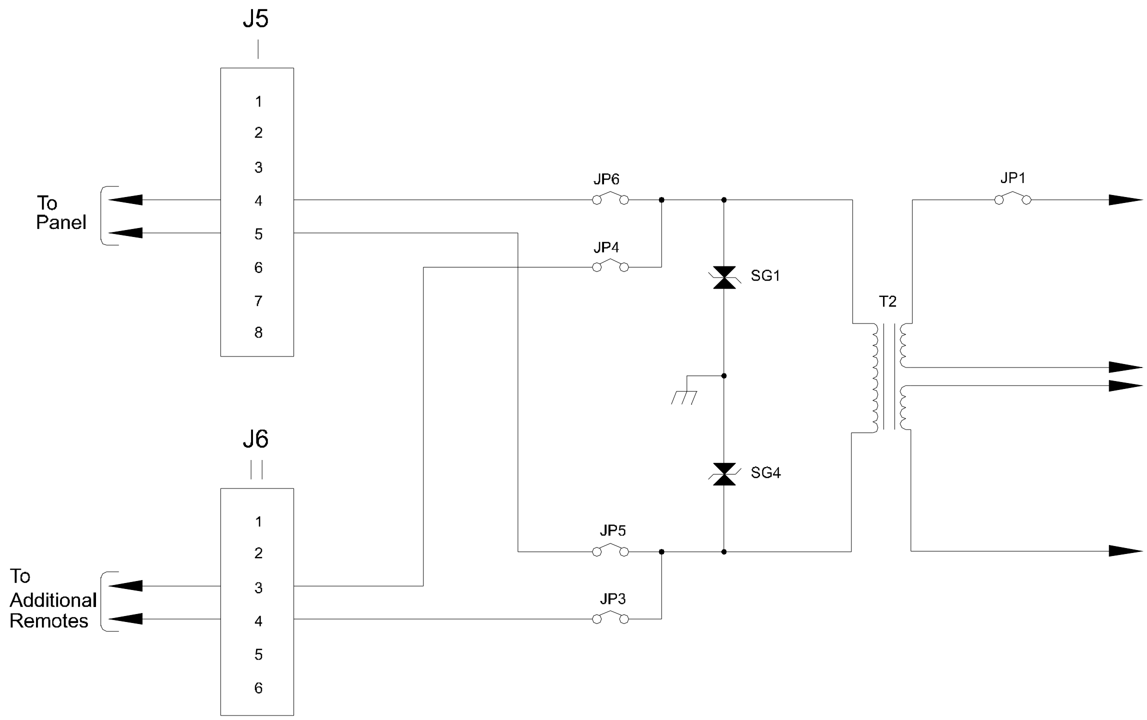
	1	2	3	4	5	6	7	8
JP1	•	•	•					
JP3	•	•		•	•			
JP4	•	•		•	•			
JP5	•			•				•
JP6	•			•				•
JP7				•	•			
JP8				•	•			
JP9				•				•
JP10				•				•
JP12							•	
JP13							•	
JP14							•	
JP15							•	

• - Jumper installed

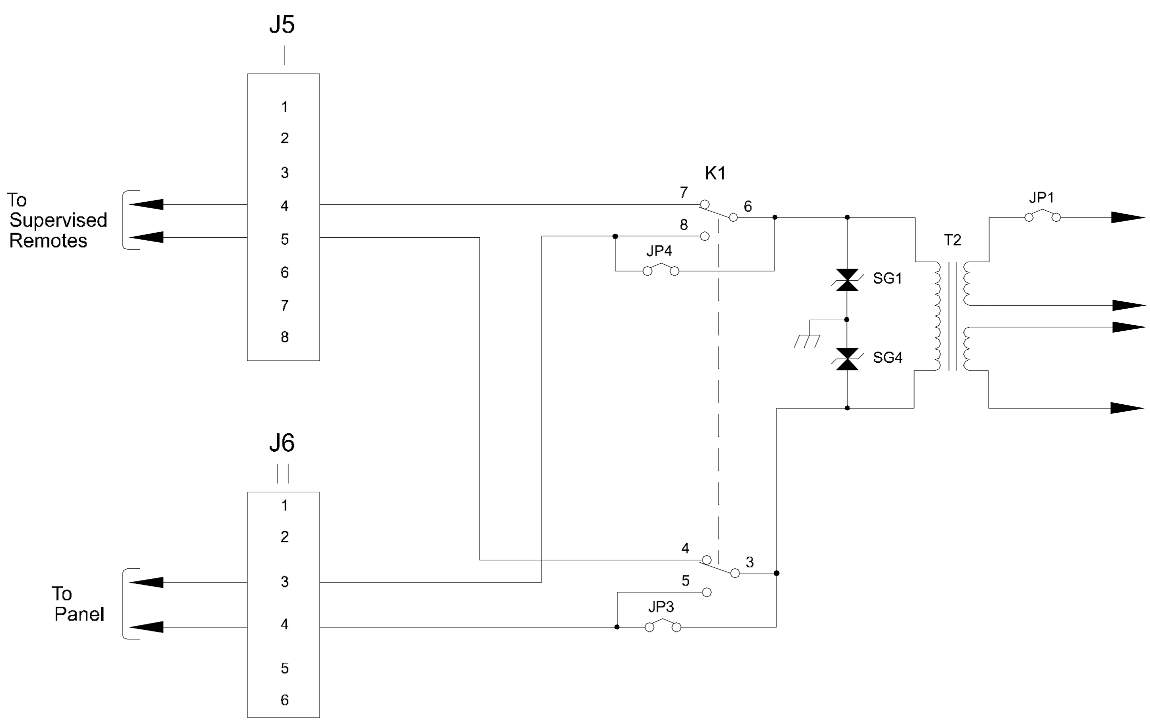
Note: Jumper JP2 should always be installed. Jumper JP11 is normally installed and should be removed only when the external encode/decode cable option is being used. Jumper JP16 should be installed in the 24-66 Tone remote and not installed in the 24-66 MSK remote. JP17 should be jumpered to A-B for 120 Vac operation, and to B-C for 220 Vac operation.

The following diagrams detail the line connections required for each remote control application and can be used as an aid when installing, troubleshooting and/or configuring a 24-66.

2.6 Remote Control Applications (cont.)

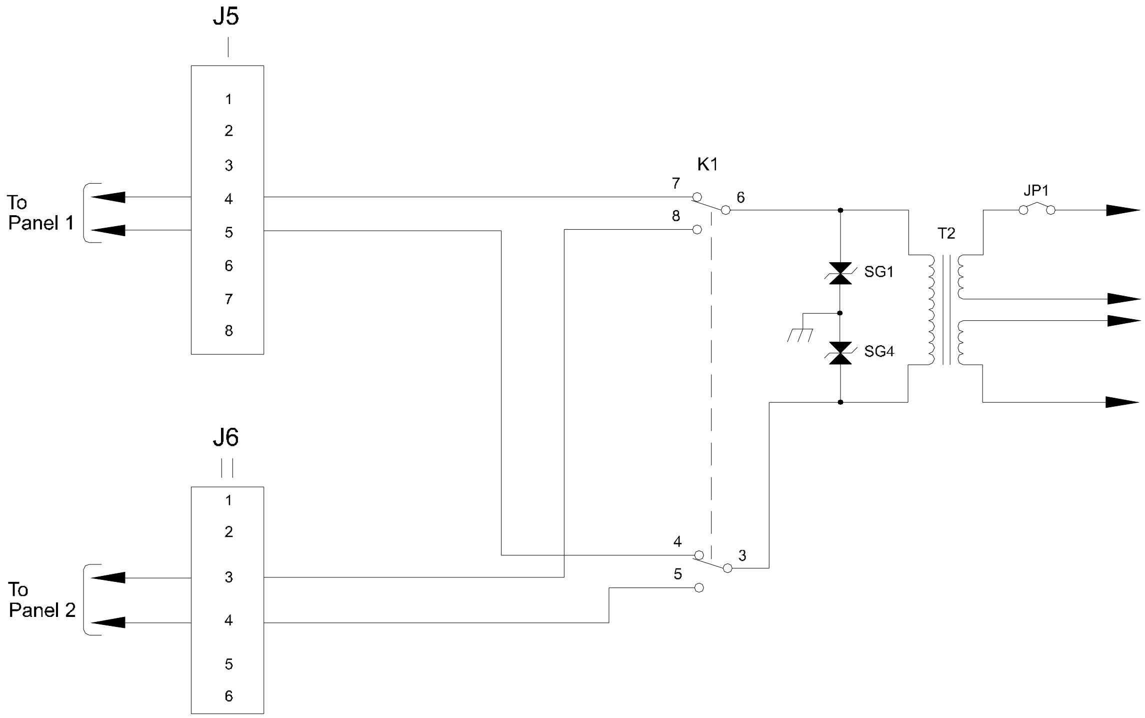


Application 1 - Two wire, no supervisory, no alternate line

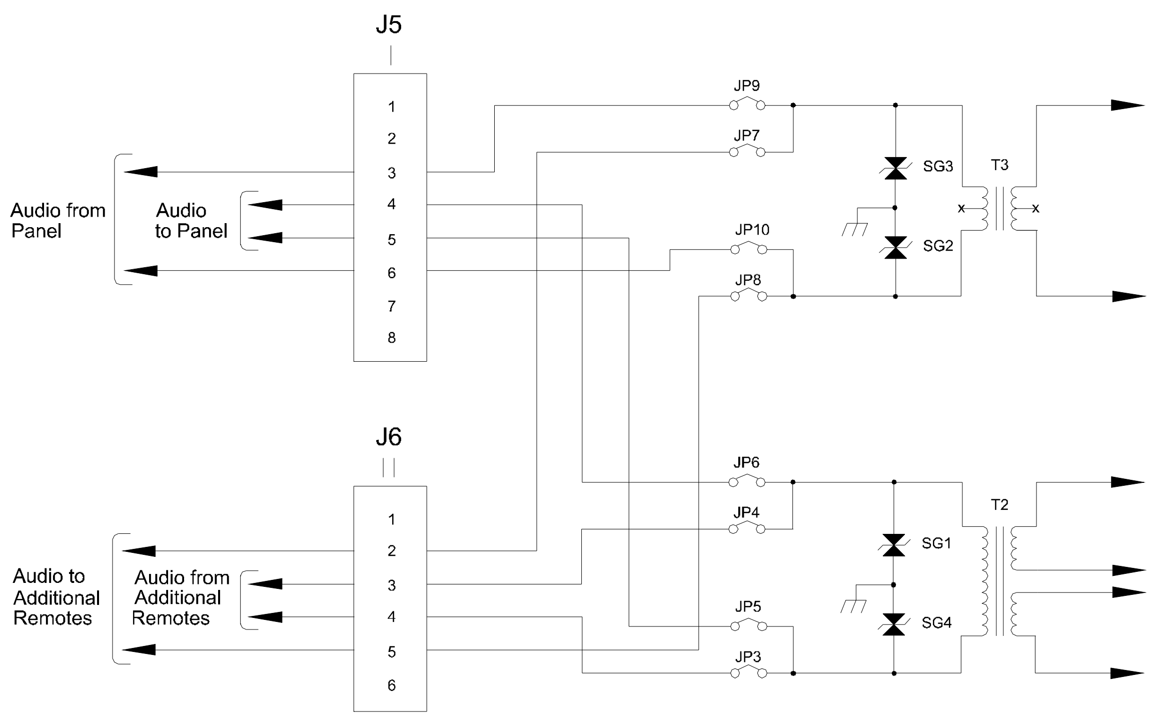


Application 2 - Two wire with supervisory

2.6 Remote Control Applications (cont.)

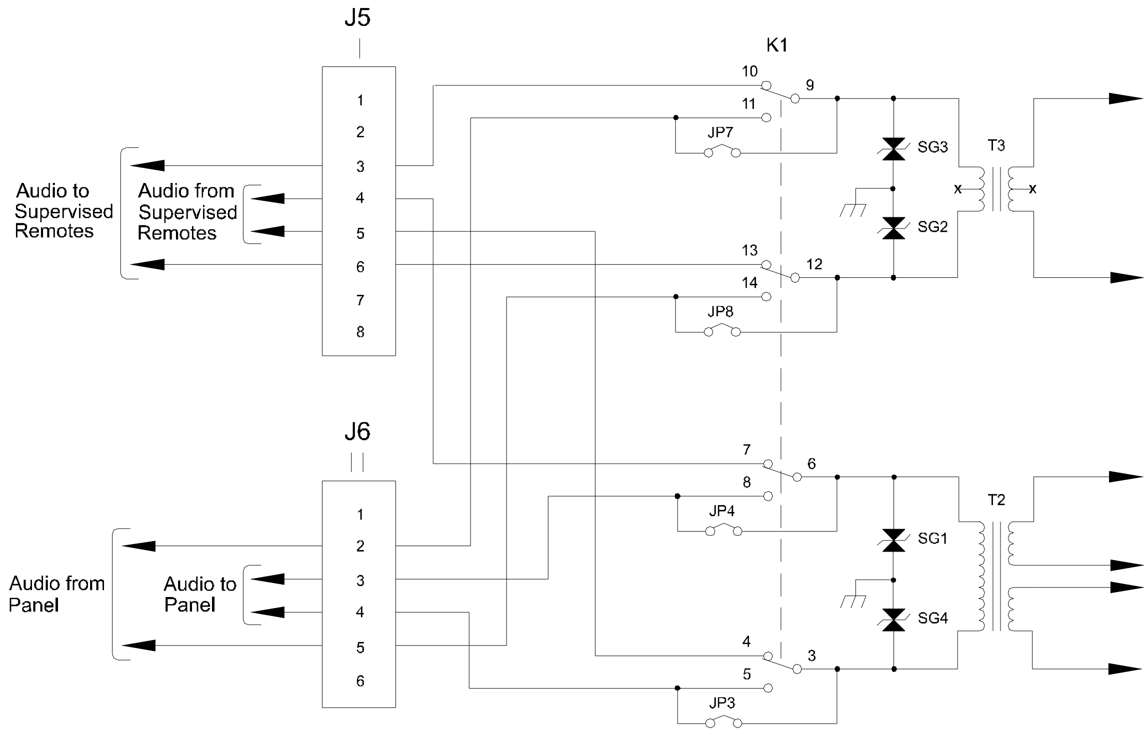


Application 3 - Two wire with alternate line

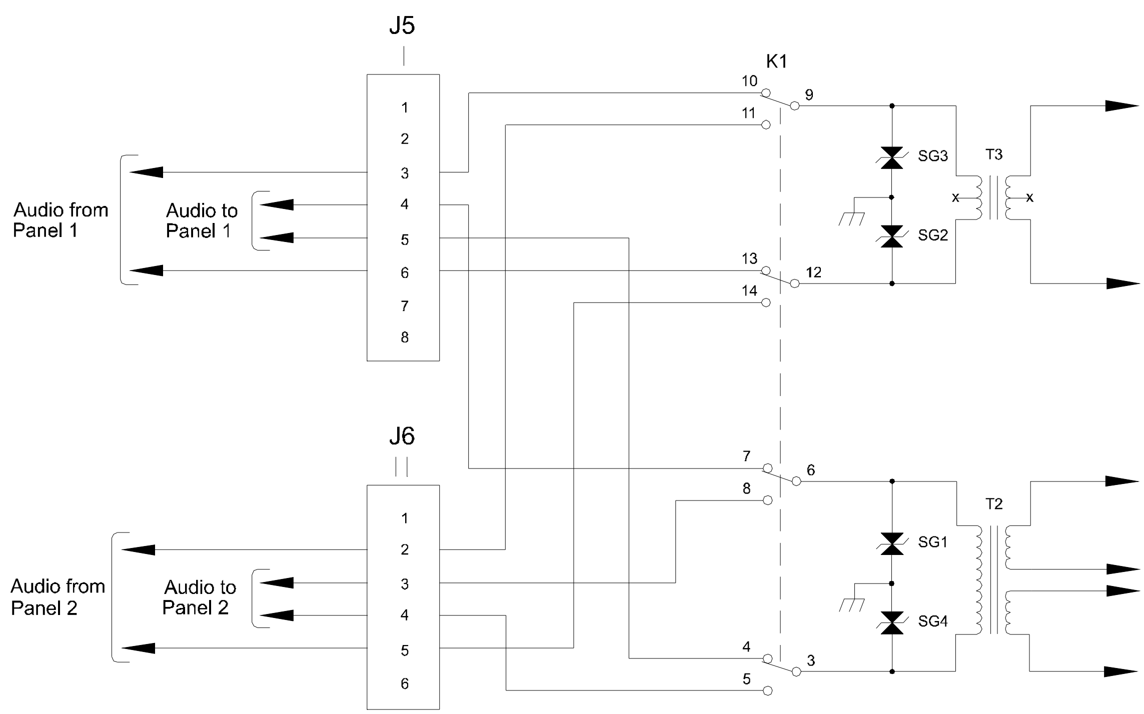


Application 4 - Four wire, no supervisory, no alternate line

2.6 Remote Control Applications (cont.)

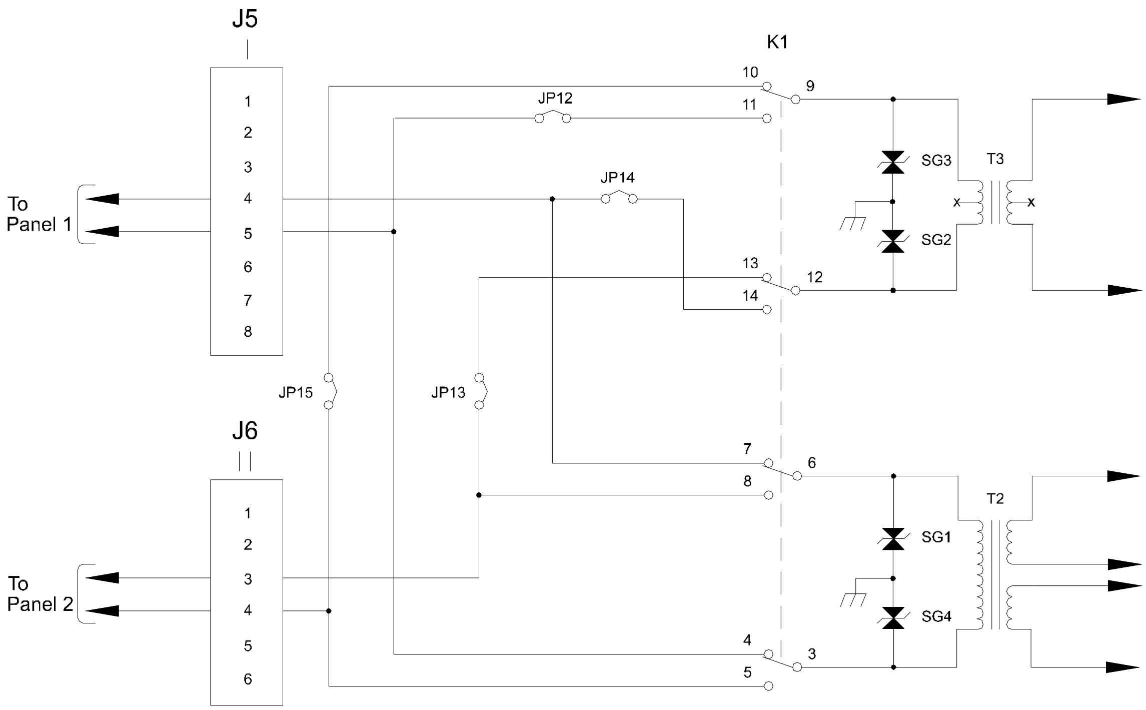


Application 5 - Four wire with supervisory

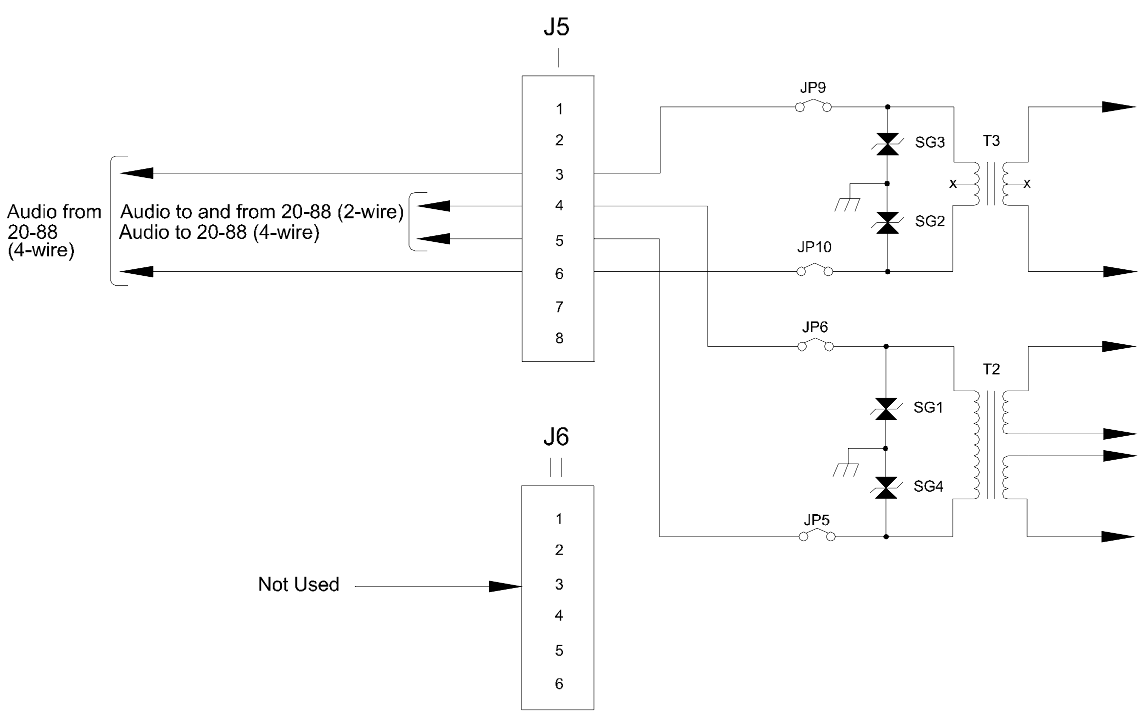


Application 6 - Four wire with alternate line

2.6 Remote Control Applications (cont.)



Application 7 - Two wire with alternate line summed audio



Application 8 - Combined two wire and four wire (for use with 20-88)

3.0 ADJUSTMENT PROCEDURES

The following will explain the adjustment procedure for all potentiometers in the 24-66. Most potentiometers are factory preset and will, in most cases, not need adjustment. The factory adjustment procedure and the recommended field adjustment procedure are given for most potentiometers. Refer to the adjustment locator diagram in the back of this manual for the location of the adjustment potentiometers.

3.1 R79 - 13.8 Vdc Adjust

This adjustment is a factory preset adjustment which should only need to be adjusted if repairing the power supply section or the potentiometer was inadvertently turned. If needed, adjust R79 so that the output of U9 is 13.8 Vdc.

3.2 R80 - 5 Vdc Adjust

This adjustment is a factory preset adjustment which should only need to be adjusted if repairing the power supply section or the potentiometer was inadvertently turned. Before making this adjustment check that 13.8 Vdc is present on the input of U13. If needed, adjust R80 so that the output of U13 is 5 Vdc.

3.3 R50 - Microphone To Line Level

Factory adjustment procedure - With the handset or desk microphone removed, inject a 1 kHz tone at 1 Vrms from a 600 ohm generator into the microphone input J7-4. Place the 24-66 into intercom mode and begin transmitting by grounding J7-3. Connect a 600 ohm load to the output terminals J5-4 and J5-5. Adjust R50 so that 0 dBm (.77 Vrms) appears across the 600 ohm load.

Field adjustment procedure - This adjustment can be made through the bottom of the 24-66 through a small hole labeled TX. While speaking into the handset or desk microphone, monitor the output of the base station or repeater transmitter with a service monitor or deviation meter and adjust R50 for proper transmitter deviation.

3.4 Desk Microphone Output Sensitivity

The audio output level of the desk microphone can be adjusted through a hole in the bottom of the desk microphone. A small jeweler's flat blade screwdriver will be needed. The adjustment may need to be made depending upon background noise in the environment where the 24-66 is located and also upon the user of the desk microphone and how close and/or loud the user speaks.

3.5 R19 - Internal Microphone Level

Factory adjustment procedure - R50 should be set properly before making this adjustment. Inject a 1 kHz tone at 1 Vrms from a 600 ohm generator into the internal microphone input at U8-4 (right side of R110). Connect a 600 ohm load across the output terminals J5-4 and J5-5 and begin transmitting by holding down the internal microphone PTT button. Adjust R19 so that 0 dBm (0.77 Vrms) appears across the 600 ohm load.

Field adjustment procedure - The internal microphone level can be adjusted by speaking into the microphone, monitoring the output, and adjusting R19 to the desired level.

3.6 R42 and R54 - 2175 Hz Notch Filter Adjust

With the handset or desk microphone removed, inject a 2175 Hz tone at 1 Vrms into the microphone input J7-4. Begin transmitting by grounding J7-3 and adjust R42 and R54 for a minimum reading across the output terminals J5-4 and J5-5. Going back and forth between the two potentiometers will result in the best adjustment.

3.7 R74 - Tone Encode Level

Factory adjustment procedure - Remove the handset or desk microphone and begin transmitting by grounding J7-3. Install a 600 ohm load across the output terminals J5-4 and J5-5 and measure the AC voltage across it. The 24-66 will be generating a 2175 Hz hold tone across the load. Adjust R74 so that -20 dBm (.08 Vrms) is across the load.

Field adjustment procedure - Turn R74 down so that the 24-66 will not key the base station or repeater panel. While keying the 24-66 several times, adjust R74 until it keys the base station or repeater panel reliably.

3.8 R1 - MSK Encode Level (MSK Control Option)

Factory adjustment procedure - Put the 24-66 MSK remote into test mode and press any button until the MSK test tone is being sent to the line. Install a 600 ohm load across the line and adjust potentiometer R1 on the MSK interface board for 0 dBm (.77 Vrms) across the load.

Field adjustment procedure - If the panel does not decode updates sent by the 24-66 MSK remote, adjust R1 on the MSK interface board until the panel decodes the updates reliably.

3.9 R2 - DTMF Encode Level (MSK Control Option)

Potentiometer R1 on the MSK interface board is used to adjust the level of DTMF tones sent to the line. R1 is factory set to its minimum level since the 24-66 MSK remote does not currently encode any DTMF tones.

3.10 R16 - Receive Line Compensation

Factory adjustment procedure - For 2-wire or 4-wire applications, this adjustment is set to maximum.

Field adjustment procedure - This adjustment can be made through the bottom of the 24-66 through a small hole labeled RX. This adjustment should normally not need to be adjusted in the field. However, if levels coming into the 24-66 are greater than +10 dBm (2.45 Vrms) or there is excessive line noise, R16 should be turned down.

3.11 R111 - Summed Audio Level

Factory adjustment procedure - Input a 2 kHz tone at 1 Vrms across J5-4 and J5-5 and input a 1 kHz tone at 1 Vrms across J6-3 and J6-4. Measure the output at P4-6 and adjust R111 so that the 1 kHz (alternate) signal is 20 dBm below the 2 kHz (primary) signal. When the alternate line button is depressed, the primary signal becomes the 1 kHz signal and the alternate signal becomes the 2 kHz signal. However, the alternate signal should remain 20 dBm below the primary signal.

Field adjustment procedure - When using the summed audio option, it may be necessary to adjust the alternate line audio. This can be done by opening the 24-66 and adjusting R111 to the desired level.

3.12 R60 - Speaker Level

Factory adjustment procedure - R16 must be set properly before making this adjustment. With the volume control potentiometer R105 at maximum, adjust R60 so that 3.45 Vrms appears across the speaker terminals while receiving a 1 kHz tone at +10 dBm (2.45 Vrms).

Field Adjustment procedure - While connected to the system and receiving audio from the highest level source, adjust R60 so that audio in the speaker is a comfortable listening level. Do not turn it up too high since this will cause distortion and clipping. The audio should not exceed 3.45 Vrms at the speaker terminals.

3.13 R15 - Earpiece Level

Factory adjustment procedure - R16 must be set properly before making this adjustment. With a handset or a 150 ohm load connected from J7-2 to ground, adjust R15 for 150 mV across the load while receiving a 1 kHz tone at +10 dBm (2.45 Vrms). The volume control potentiometer R105 should be set to maximum.

Field adjustment procedure - The earpiece and the base speaker are both controlled by the volume control potentiometer R105. It may be necessary in certain noisy environments to increase the level to the earpiece. While in the noisy environment and receiving audio from the source with the least level coming in, adjust R15 for a comfortable listening level with the volume control potentiometer at maximum.

3.14 R7 and R8 - 2175 Hz Notch Filter Adjust (Parallel Detect Option)

Factory adjustment procedure - Apply a 2175 Hz tone at +10 dBm (2.45 Vrms) across J5-4 and J5-5. Adjust R7 and R8 for a minimum reading across the speaker. Going back and forth between the two potentiometers will result in the best adjustment.

Field adjustment procedure - While receiving a 2175 Hz hold tone from a paralleled remote, adjust R7 and R8 until little or no hold tone is heard in the speaker. Going back and forth between the two potentiometers will result in the best adjustment.

3.15 R16 and R17 - Guard/Hold Tone Detect (Parallel Detect Option)

Factory adjustment procedure - Apply a 2175 Hz tone at +10 dBm (2.45 Vrms) across J5-4 and J5-5. On the option board, turn R16 approximately 12 turns clockwise from the bottom. Adjust R17 for a maximum level at TP2 and then adjust R16 for 2.5 Vrms at TP2. Reduce input level by 20 dB (to 0.24 Vrms) and check that the DC level at J4-2 has changed from 0 Vdc to 5 Vdc. Reduce input level by a total of 50 dB (to .008 Vrms) and check that the DC level at J4-1 has changed from 0 Vdc to 5 Vdc.

Field adjustment procedure - Adjust R17 as described in the factory adjustment procedure. Turn R16 counter-clockwise to the bottom. While a paralleled remote is being keyed several times, adjust R16 clockwise until the TX indicator comes on and follows the paralleled remote. It is best to use the paralleled remote that is the furthest away from the unit being setup or, in other words, the paralleled remote that has the most line loss. Check to be sure that all other paralleled remotes will make the TX indicator illuminate.

4.0 CIRCUIT DESCRIPTION

4.1 Power Supply

Power is supplied to the 24-66 through the power cord that is connected to tab connections P8-1 and P8-2. The black wire from the power cord should be connected to P8-1 and the neutral white wire should be connected to P8-2. For 120 Vac operation, JP17 should be jumpered to A-B. For 220 Vac operation, JP17 should be jumpered to B-C. The green earth ground is connected to the screw terminal P9.

From P8 the power is routed through a 3/8 amp fuse F1 and an optional EMI filter L1 to power transformer T1. This transformer steps down the input voltage to about 16 Vac. The 16 Vac goes to the full wave bridge consisting of diodes D13 - D16. The input of the bridge is protected from power line surges by varistors SG5 and SG6. The output of the bridge is filtered by C55 and fed into voltage regulator U9. The output voltage of U9 is set to 13.8 Vdc by the resistor divider consisting of R75, R76, and potentiometer R79. This 13.8 Vdc drives the audio section of the 24-66. It is also fed into voltage regulator U13. The output voltage of U13 is set to 5 Vdc by the resistor divider network consisting of R77, R78, and potentiometer R80. C58 is an output filter capacitor. The 5 Vdc powers the digital section of the 24-66. The 13.8 Vdc is also fed to voltage regulator U7 which generates a 6.9 Vdc reference voltage for the line driver and line receiver circuits. This 6.9 Vdc is used to help eliminate popping when the line driver is turned on and off.

The 24-66 can be operated from a 13.8 Vdc supply through connector P10. Diode D9 prevents a reverse polarity from harming the 24-66.

4.2 Line Interface

The line is connected to the 24-66 through the two back panel modular jacks, J5 and J6. The 24-66 can be configured in several different configurations. It can be 2-wire or 4-wire, 2-wire or 4-wire with supervisory control, and 2-wire or 4-wire with alternate line. The lines are protected from transients by surge arresters SG1 - SG4.

4.3 Two Wire, No Supervisory, No Alternate Line

In the basic two wire configuration, the 2-wire line from the base station is connected to J5-4 and J5-5. Jumpers JP5 and JP6 are installed so that audio to and from the base station is routed through transformer T2. With jumpers JP3 and JP4 installed, additional remotes may be connected in parallel to J6-3 and J6-4. Receive audio is coupled through transformer T2 and passes from pin 4 of T2 through jumper JP1 to the buffer amplifier U11B. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of T2 where it is coupled to the line.

4.4 Two Wire With Supervisory

In the two wire configuration with supervisory control, relay K1 is used for implementation of the supervisory mode. Only one user should have supervisor privileges. The 2-wire line from the base station is connected to J6-3 and J6-4. Additional remotes should be connected to J5-4 and J5-5. Jumpers JP3 and JP4 are installed so that audio to and from the base station is always routed through transformer T2. When the SUPER key is pressed, K1 is activated thus disconnecting any remotes connected to J5 from the line. Receive audio is coupled through transformer T2 and passes from pin 4 of T2 through jumper JP1 to the buffer amplifier U11B. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of T2 where it is coupled to the line.

4.5 Two Wire With Alternate Line

In the two wire configuration with alternate line, relay K1 is used to select the alternate line. The 2-wire line from the primary base station is connected to J5-4 and J5-5. The 2-wire line from the alternate base station is connected to J6-3 and J6-4. When the ALT key is pressed, K1 is activated thereby connecting the alternate line to transformer T2. Receive audio is coupled through transformer T2 and passes from pin 4 of T2 through jumper JP1 to the buffer amplifier U11B. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of T2 where it is coupled to the line.

4.6 Four Wire, No Supervisory, No Alternate Line

In the basic four wire configuration, the 4-wire line from the base station is connected to J5. Audio from the base station comes in on J5-3 and J5-6 and is passed through jumpers JP9 and JP10 to transformer T3. The audio is coupled through transformer T3 and passes from pin 6 of T3 to the buffer amplifier U11B. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of transformer T2. The audio is coupled through transformer T2 and passes through jumpers JP5 and JP6. The audio is then passed to the base station through J5-4 and J5-5.

Additional remotes may be connected in parallel to J6. Jumpers JP7 and JP8 pass audio from the base station to the parallel remotes through J6-2 and J6-5. Jumpers JP3 and JP4 pass audio from the parallel remotes to the base station through J6-3 and J6-4.

4.7 Four Wire With Supervisory

In the four wire configuration with supervisory control, relay K1 is used for implementation of the supervisory mode. Only one user should have supervisor privileges. The 4-wire line from the base station is connected to J6 with J6-2 and J6-5 used for audio from the base station and J6-3 and J6-4 used for audio to the base station. Additional remotes should be connected in parallel to J5 with J5-3 and J5-6 used for audio from the base station to the parallel remotes and J5-4 and J5-5 used for audio from the parallel remotes to the base station. When the SUPER key is pressed, K1 is activated thus disconnecting any remotes connected to J5 from the line. Jumpers JP7 and JP8 allow audio from the base station to always be coupled through transformer T3 and where it then passes from pin 6 of T3 to the buffer amplifier U11B. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of transformer T2. Jumpers JP3 and JP4 are installed so that audio coupled through transformer T2 is always passed to the base station.

4.8 Four Wire With Alternate Line

In the four wire configuration with alternate line, relay K1 is used to select the alternate line. The 4-wire line from the primary base station is connected to J5 with J5-3 and J5-6 used for audio from the base station and J5-4 and J5-5 used for audio to the base station. The 4-wire line from the alternate base station is connected to J6 with J6-2 and J6-5 used for audio from the base station and J6-3 and J6-4 used for audio to the base station. When the ALT key is pressed, K1 is activated thereby connecting the alternate line to transformers T2 and T3. Audio from the base station is coupled through transformer T3 and passes from pin 6 of T3 to the buffer amplifier U11B. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of transformer T2. The audio is coupled through transformer T2 and is then passed to the base station.

4.9 Two Wire With Alternate Line Summed Audio

In the two wire configuration with alternate line and summed audio, relay K1 is used to select the alternate line. The 2-wire line from the primary base station is connected to J5-4 and J5-5. The 2-wire line from the alternate base station is connected to J6-3 and J6-4. When the alternate line is not selected, the primary line is connected to transformer T2 and the alternate line is connected to transformer T3 through jumpers JP13 and JP15. When the ALT key is pressed, K1 is activated thereby selecting the alternate line and connecting it to transformer T2. The primary line is then connected to transformer T3 through jumpers JP12 and JP14. Receive audio from the selected line is coupled through transformer T2 and passes from pin 4 of T2 to the buffer amplifier U11B where it is summed with audio coupled through transformer T3 from the unselected line. Potentiometer R111 is used to control the level of audio received from the unselected line. Transmit audio coming from pins 5 and 8 of U4 goes to pins 2 and 5 of T2 where it is coupled to the selected line.

4.10 Combined Two Wire and Four Wire (for use with 20-88)

The 24-66 can be used with an IDA 20-88 to allow the 24-66 to control multiple base stations. The lines from the base stations are connected to the 20-88 which selects one of the lines and passes that line to the 24-66. This configuration allows both 2-wire and 4-wire lines to be connected to the 20-88 at the same time. The selected line from the 20-88 is connected to J5. J6 is not used. Jumpers JP5 and JP6 connect J5-4 and J5-5 to transformer T2 which couples transmit audio from U4 to the line for both 2-wire and 4-wire lines. Receive audio is also coupled through transformer T2 for 2-wire lines and passed to the buffer amplifier U11B. Jumpers JP9 and JP10 connect J5-3 and J5-6 to transformer T3. Receive audio from 4-wire lines is coupled through transformer T3 and passed to the buffer amplifier U11B. Potentiometer R111 is used to control the level of audio received from 4-wire lines and should be adjusted so that audio received from the 4-wire lines is at the same level as audio received from the 2-wire lines.

4.11 Receive Audio

Receive audio from the summing amplifier U11B in the line interface section is passed to the receive audio adjustment potentiometer R16. This potentiometer can be adjusted through the bottom of the case. The audio then goes to an automatic gain control (AGC) circuit. The AGC circuit provides for a constant output voltage over an input range of 30 dB. The AGC circuit is comprised of U1A and U2A and their associated components. The AGC output is at pin 1 of U2A. The audio input on pin 3 of U1A is rectified internally and is used to control the gain of the internal gain cell that is connected between pin 5 and pin 7 of U1A. The attack time of the AGC is determined by C3 and the recovery time is determined by C18.

From pin 1 of U2A the audio signal goes to pin 8 of audio gate U6C. This gate is normally enabled unless the parallel detect option board is installed on P4. If the option board is installed, this gate will be disabled and audio will be routed through the notch filter and parallel detect circuitry on the parallel detect option board.

From pin 9 of U6C, the audio goes to pin 10 of U6D. This audio gate is the audio mute gate. This gate is normally enabled to allow audio to pass unattenuated to amplifier U3A. However, when the MUTE button on the front panel is pressed, this gate will be disabled. This puts resistor R59 in series with the audio path which will mute the audio by about 20 dB. In the 24-66 MSK remote, the audio mute gate will also be disabled when a parallel transmission is received and mute on parallel detect is enabled. If it is desired to completely disable the audio instead of just reducing the level by 20 dB, remove R59.

4.11 Receive Audio (cont.)

From the mute gate the audio goes to the summing amplifier U3A. The audio from the line is amplified by U3A and then passed to the volume control potentiometer R105. D1 and D2 are used to help protect the 24-66 from electrostatic discharges. Resistor R3 prevents the audio from being turned completely off. From the volume control potentiometer, the audio goes to the earpiece level adjustment potentiometer R15. The audio is then fed to the earpiece driver U3B. The output of U3B is passed to the earpiece enable gate U8C. If the 24-66 is equipped with a handset, this gate allows the audio to go to the earpiece in the handset. If the 24-66 is equipped with a desk microphone, the earpiece enable gate will be disabled. This allows pin 2 on J7 to be used as the monitor line from the desk microphone.

From the volume control potentiometer, the audio also passes to pin 1 of U6A. This audio gate enables or disables the speaker output. The output of the speaker enable gate is fed to the speaker level adjustment potentiometer R60. The audio is then fed into the speaker driver U10. U10 and its associated circuitry is a wide band audio amplifier set to have a gain of 36 dB. The output of the speaker driver goes to P11, the speaker connector. Jumper JP11 is removed only if an external encode/decode cable is installed.

4.12 Transmit Audio

Microphone audio from the handset or the desk microphone comes from pin 4 of J7. The microphone is biased by resistors R17 and R18. The microphone audio then passes through an electrostatic discharge protection circuit consisting of D5 and D6. The audio is then compressed by the compression circuit consisting of U1B and U2B and their associated components. The compression circuit output is at pin 7 of U2B. The audio signal fed back from pin 7 of U2B to pin 13 of U1B is rectified internally and controls the gain of the internal gain cell that is connected between pin 9 and pin 11 of U1B. The attack time is determined by C22 and the recovery time is determined by C19.

From pin 7 of U2B the signal goes to the 2175 Hz notch filter consisting of U5A and U5B and their associated components. Potentiometers R42 and R54 are used to tune the notch filter to 2175 Hz. This filter notches out any 2175 Hz component that is present in the microphone audio. The notch depth is greater than 45 dB. This helps prevent a user's voice from falsing any 2175 Hz detectors that are in a panel or another parallel remote.

The microphone audio then passes through the microphone mute audio gate U8A. This gate allows muting of the microphone audio when necessary to eliminate any audio feedback ringing. Pin 1 of U8A goes to the transmit audio adjustment potentiometer R50. This potentiometer can be adjusted through the bottom of the case.

4.12 Transmit Audio (cont.)

U12A is a summing amplifier that sums the transmit audio and the function tones. The function tones are generated by the digital to analog converter and are low pass filtered by U12B and its associated components. Potentiometer R74 is used to adjust the level of the function tones. The output of U12A goes to the line driver U4 which drives the line coupling transformer T2. Switch SW1-4 is used to change the 4-wire transmit pair line impedance or the 2-wire line impedance from about 600 ohms when SW1-4 is on to greater than 5k ohms when SW1-4 is off.

4.13 Digital Control Section

The 24-66 is controlled by U15 which is an 8-bit microprocessor. The control program for U15 is stored in U16 which is a 64KB CMOS EPROM. Address latch U17 latches the 8 low order address lines to U16 since these address lines are multiplexed with the 8-bit data bus. A program byte is fetched from U16 each time pin 29 of U15 goes low. R100 is a resistor network that is used to provide pull-ups on the 8-bit data bus.

Other inputs to U15 are SW1-2, SW1-3 and the monitor line from a desk microphone. Outputs from U15 are four I/O lines that go to the keypad board to allow U15 to control the display LEDs and the LCD. Another output from U15 is the internal microphone enable which enables audio from the internal microphone to be transmitted.

U14 is a CPU supervisor IC that functions as a watchdog for U15. While U15 is executing valid program instructions, pin 1 of U15 pulses pin 7 of U14. This causes pin 5 of U14 to stay low. If there are no pulses from U15 for a period of approximately 600ms, pin 5 of U14 will pulse high which will cause a reset pulse to be applied to pin 9 of U15. Pin 5 of U14 is also high whenever the 5 Vdc power supply is below 4.75 Vdc. This ensures that U15 is properly reset on power-up.

All of the programmable operating characteristics of the 24-66 are stored in U18 which is a serial EEPROM. The data on pin 5 of U18 is read from or written into U18 by the clock signal on pin 6 of U18. The data in U18 is checked on power-up to determine if it has been corrupted. If the data in U18 has been corrupted, an error indication will be given on the front panel display. The data stored in U18 is changed by using the programming cable and the programming software supplied by IDA.

4.13 Digital Control Section (cont.)

U19 is an 8-bit input latch. Three of the inputs are the column lines from the keypad board. The PTT input goes low any time the PTT button on the handset or desk microphone is pressed. The hookswitch input goes high when the handset is taken out of the cradle. The hold tone detect input goes low if the parallel detect option is installed and a hold tone is detected from the line. The guard tone detect input goes low if the parallel detect option is installed and a guard tone is detected from the line. For the 24-66 Tone remote, jumper JP16 is installed and the eighth input, pin 7 of U19, is connected to SW1-1 which is used to select the operating mode of the 24-66 Tone remote. For the 24-66 MSK remote, jumper JP16 is not installed and the eighth input is connected to the DTMF detect line from the MSK interface board and is used to signal when a DTMF digit has been detected.

U22 is an 8-bit output latch that is used to control various audio gates. Six of the outputs are connected to open collector gates in U21. These six outputs are used to disable the microphone audio, mute the speaker audio, enable audio to the speaker, enable audio to the earpiece, enable the monitor line from a desk microphone, and enable tones to the speaker. A seventh output is used to enable DTMF tones on the MSK interface board in the 24-66 MSK remote. An eighth output, pin 9 of U21, can be used for an external PTT to support a microwave link between the 24-66 and a base station panel. It outputs a high and the update tones can be delayed to allow the link to be established. The length of the delay is programmable in the 24-66 MSK remote and is set to 500 ms in the 24-66 Tone remote. The output has a drive capability of 6 mA. A recommended interface circuit is illustrated in the schematic section at the back of this manual.

U25 is also an 8-bit output latch. Six of the outputs are connected to open collector gates in U24. Four of these outputs are used to enable the keypad rows on the keypad board while the other two are used to enable the line driver and to control the alternate line/supervisory relay. A seventh output is used to disable the AGC. An eighth output is used to enable MSK tones on the MSK interface board in the 24-66 MSK remote.

U23 is an 8-bit digital to analog converter. Data written to it by U15 is converted to an analog voltage level. The amplitude and frequency of the output signal is controlled by the data written to it. U23 is used to generate the tones required by the 24-66 including the guard tone, hold tone, function tones, alert tone and various other tones.

J1 is the connection to the keypad board. There are two power pins, 5 Vdc and 13.8 Vdc, and a ground pin. There are four row outputs to the keypad matrix and three column inputs from the keypad matrix. There are the four I/O lines for controlling the display LEDs and the LCD. There is also the analog VU signal for the VU meter on the display.

4.14 MSK Interface Board

The MSK interface board is installed only in the 24-66 MSK remote. Connector J2 allows U3 to perform the same function as U17 on the base board while allowing the MSK interface board access to the data lines connected to U17. In the same way, connector J4 allows U1 to perform the same function as U20 on the base board while allowing the MSK interface board access to the data lines connected to U20. Connector J3 is used to provide access to additional data lines on the base board.

U7 is an MSK modem and is used to encode and decode the MSK data. Crystal X1 provides a 4 MHz clock to U7. The output of the AGC on the base board is fed to pin 2 of J1. This audio passes through the buffer stage U5D and is then passed to U7 which will decode MSK data from this audio. The decoded data is then read from U7 by the microprocessor. Data to be transmitted is written to U7 by the microprocessor. U7 converts this data to MSK tones which then appear on pin 2 of U7. The MSK tones pass through audio gate U6D when it is enabled and then to the summing amplifier U5C. Potentiometer R1 is used to control the gain of the MSK tones through the summing amplifier. The MSK tones are then passed to U12A on the base board where they are sent to the line driver and on to the line.

U2 is a DTMF transceiver that is used to encode and decode DTMF tones. Crystal X2 provides a 3.58 MHz clock to U2. Audio from pin 5 of P12 on the base board is fed to pin 3 of J1. Jumper JP2 determines if this audio is passed to U2 or if the output of the AGC on pin 1 of J1 is passed to U2. DTMF tones are decoded from the audio passed to U2 by jumper JP2. The decoded DTMF digits are then read from U2 by the microprocessor. Digits to be transmitted are written to U2 by the microprocessor. U2 converts these digits to DTMF tones which then appear on pin 8 of U2. The DTMF tones are passed to a lowpass filter which consists of U5B and its associated components. The DTMF tones pass through audio gate U6C when it is enabled and then are fed to the summing amplifier U5C. Potentiometer R2 is used to control the gain of the DTMF tones through the summing amplifier. The DTMF tones are then passed to U12A on the base board where they are sent to the line driver and on to the line.

4.15 Parallel Detect Option Board

Line audio enters the parallel detect option board through pin 6 of J4 and is passed into the 2175 Hz bandpass filter through potentiometer R16. R16 adjusts the level of audio into the bandpass filter and therefore into the guard and hold tone detect circuits. The bandpass filter is comprised of U2A, U2C, and U2D and their associated components. Potentiometer R17 is used to tune the bandpass filter to 2175 Hz.

4.15 Parallel Detect Option Board (cont.)

The 2175 Hz tones that come out of the bandpass filter are passed into the guard and hold tone detect circuits. For the guard tone detect circuit, audio passes through C11 to diodes D3 and D4. These diodes pass only the positive transitions of the 2175 Hz tones to capacitor C10 which causes C10 to charge up. During negative transitions, C10 is discharged through resistor R6. The transistor Q2 will be turned on when the charge on C10 is greater than the level required to turn Q2 on. When transistor Q2 is on, pin 2 of J4 will be pulled low which indicates that guard tone is being detected.

For the hold tone detect circuit, audio is passed to amplifier U2B which provides approximately 30 dB of gain. Diodes D1 and D2 pass only the positive transitions of the 2175 Hz tones to capacitor C1 which causes C1 to charge up. During negative transitions, C1 is discharged through resistor R5. The transistor Q1 will be turned on when the charge on C1 is greater than the level required to turn Q1 on. When transistor Q1 is on, pin 1 of J4 will be pulled low which indicates that hold tone is being detected.

Audio from the output of the AGC enters the parallel detect option board through pin 5 of J4 and is passed to the 2175 Hz notch filter. The notch filter is comprised of U1A and U1B and their associated components. Potentiometers R7 and R8 are used to tune the notch filter to 2175 Hz. The notch filter removes the 2175 Hz hold tone from the line audio to prevent it from being heard. The output of the notch filter is passed back to the base board through pin 4 of J4.

4.16 Keypad Board

The keypad board is mounted on the faceplate of the 24-66. It is connected to J1 on the base board by a ribbon cable that is soldered to J5 on the keypad board. The keypad board has the contacts for the front panel buttons etched on it, and provides a backplane for the front panel buttons. The rows and columns of the keypad are fed to the baseboard through connector J5. The microprocessor determines if a certain key is pressed by pulling the row input for that key low and then checking to see if the column output for that key also goes low.

LEDs are provided for each button and also for the TX indicator. These LEDs are driven by the LED display driver U1 which also drives the single digit 7-segment LED display D1 when D1 is installed. This driver has a serial interface to the microprocessor on the base board. Serial data coming from the baseboard on pin 1 is clocked into U1 by the clock signal on pin 13. When all the data is clocked in, pin 12 is pulsed to load the data into the drivers.

Also located on the keypad board are the mounting sockets for the clock, VU meter, and LCD options. The clock option plugs into J4 and the LCD option plugs into J3. The VU meter option plugs into either J1 or J2 depending on if the LCD option is installed.

4.17 Clock Option

The clock option plugs into J4 on the keypad board. It consists of a four digit 7-segment LED clock display module that is connected through J4 to the LED display driver U1 on the keypad board. This option is used to display the time of day and in some configurations is also used to display the frequency, channel, or system and group selected.

4.18 VU Meter Option

The VU meter option plugs into J1 on the keypad board when the LCD option is installed and into J2 when the LCD option is not installed. This option converts a DC signal level on pin 6 of J1 or J2 to a readout on an LED bar graph. This DC signal comes from the base board through the keypad board.

On the base board the transmit signal is fed to an amplifier consisting of U11A and its associated components. The output of the amplifier is then fed to a rectifier circuit consisting of C66, D11, D12, and C67. The resulting DC signal is then passed through a resistor divider network of R83 and R84 before being sent to the keypad board and the VU meter option board.

4.19 LCD Option

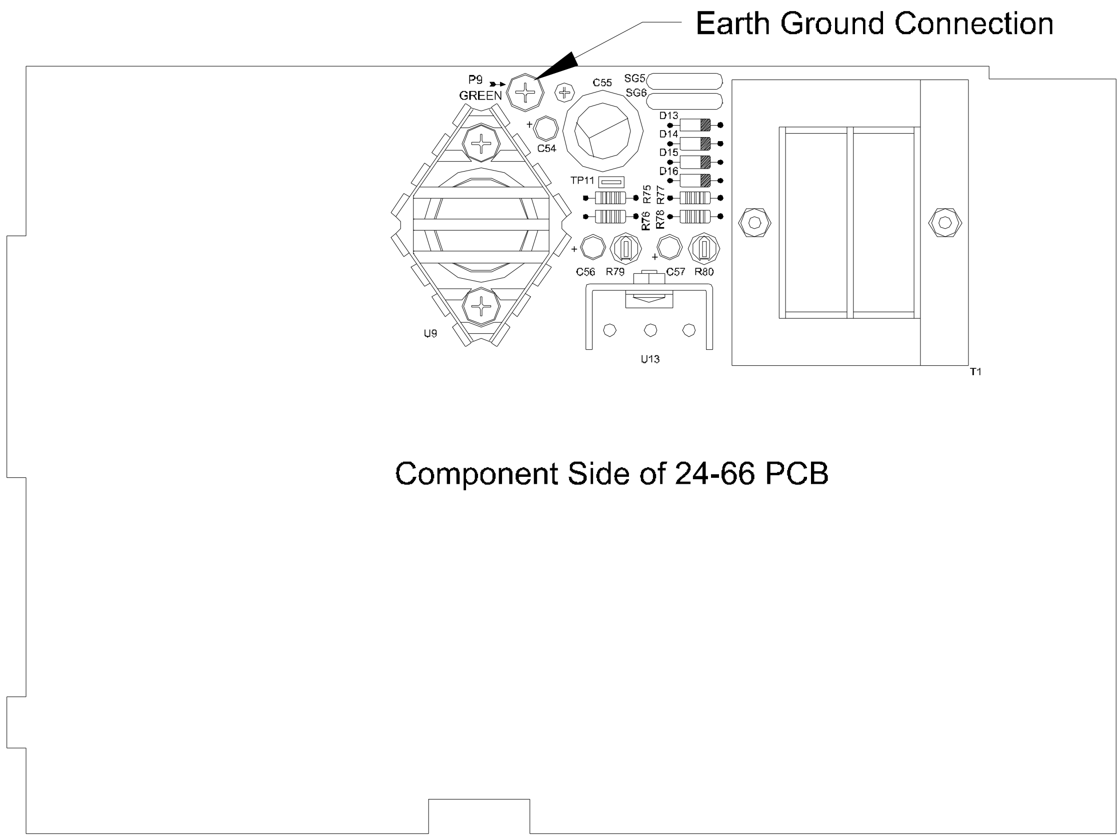
The LCD option includes a 32 character (two line) LCD module which plugs into J3 on the keypad board. Serial data from the microprocessor is transmitted to U2 on the keypad board which is an 8-bit serial input, parallel output latch. Serial data coming in on pin 14 is clocked into U2 by the clock signal on pin 11. Once all 8 bits have been clocked in, data is transferred to the LCD (pins 7 - 14 of J3) by a rising edge on pin 12 of U2. The contrast level of the LCD is adjusted using potentiometer R8 on the keypad board.

4.20 Programming Cable

The programming cable is used for programming the desired configuration into the 24-66. One end of the cable is an eight position modular connector that plugs into J5 on the 24-66. The other end is a DB-25 connector that connects to the serial port of the computer. Inside the housing of the DB-25 connector is a TTL to RS-232 converter. Four wires are used between the 24-66 and the converter. These are 5 Vdc, ground, RX data, and TX data. There are only three connections between the converter and the computer. These are ground, RX data, and TX data. If the computer has a DB-9 serial port, the DB-25 to DB-9 adapter will need to be used.

4.21 FCC Part 15.105 (B) Option

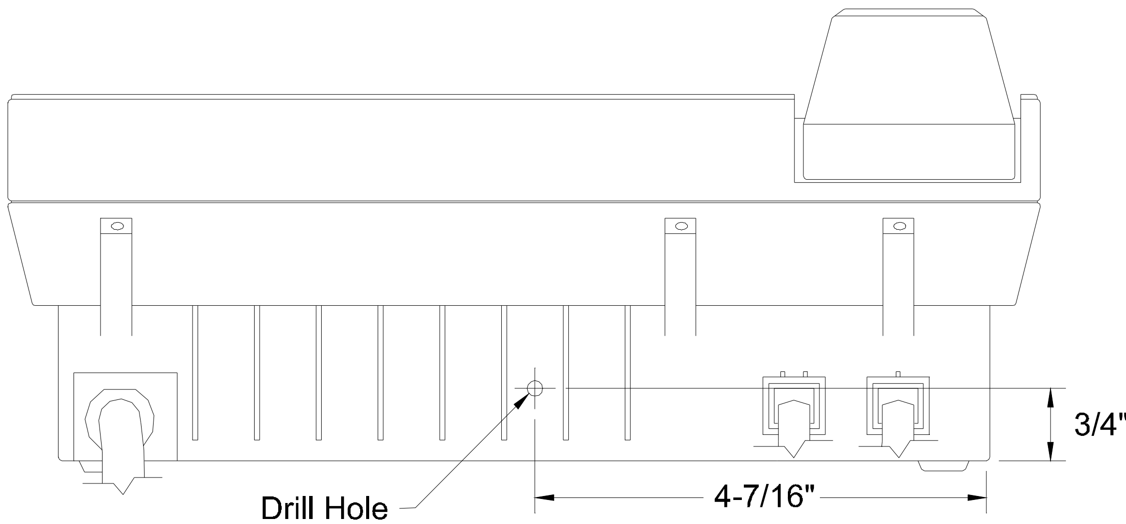
The power cord for the 24-66 with the Class B option does not contain a ground conductor due to the fact that it would act as an antenna and radiate an excessive amount of interference. The following grounding methods must be followed for proper lightning protection. External lighting protection is preferred or an earth ground wire must be attached to the earth ground post (P9) in the 24-66 as shown in the following diagram:



24-66 Class B Option Earth Ground Location

FCC Part 15.105 (B) Option (cont.)

On the 24-66 base cabinet, a hole needs to be made to allow the earth ground wire to exit the cabinet and be connected to an earth ground such as a water pipe or other suitable connection. Drill hole only through the plastic cabinet. Drill hole size will be determined by the gauge of wire used for the earth ground. 14awg (or heavier) stranded wire is recommended. Below is a diagram which shows the suggested hole location.



24-66 Remote Base Controller
(Rear View)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions contained in this manual, may cause harmful interference to radio communications. However there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

5.0 TROUBLESHOOTING

5.1 Microphone Audio Doesn't Reach the Line

1. The Push-to-Talk (PTT) button should be depressed fully so that the TX indicator is on. If the TX indicator does not turn on, check the handset or desk microphone cord and connector. Note: The Tx indicator will not turn on during intercom.

2. Check to see if pin 17 of U19 goes low (0.7 Vdc or lower) when the PTT switch is depressed. If it does go low and there is still no microphone audio, U19 may be faulty. Replace it with a known working part.

3. The output of the compressor circuit, U2-7, should be biased at 6.9 Vdc with the microphone audio riding on it.

4. The output of the 2175 Hz notch filter circuit, U5-1, should be biased at 6.9 Vdc with the microphone audio riding on it.

5. To allow microphone audio to pass, pin 13 of U8 needs to be high (13.8 Vdc). Audio will pass through U8 from pin 2 to pin 1.

6. The output of the summing amplifier, U12-1, should be biased at 6.9 Vdc with the microphone audio riding on it. If not, U12 may be faulty or the TX ADJ potentiometer R50 may be turned down too far.

7. The output of the line driver stage, U4-5 and U4-8, should be biased at 6.9 Vdc with the microphone audio riding on it. The line driver is turned on and off by the level present on U4-1. This level should be low (0.7 Vdc or less) when depressing PTT.

5.2 VU Meter Doesn't Function

1. This is a hardware option. Make sure the unit is equipped with it. If no audio appears on the line, refer to section 5.1.

2. Audio is amplified and buffered to the VU meter through U11. The output, U11-1, should be biased at 6.9 Vdc with microphone audio riding on it.

3. If VU audio is present on J1-9, the ribbon cable should be checked for an open.

5.3 Control/Alert Tones Do Not Reach the Line

1. All control tones and the alert tone are generated by the microprocessor through the digital to analog converter (U23). The tones will be present on U23 pins 14, 15, and 16 during times when tones are generated. If not, replace U23 or refer section 5.12.

2. The control tones and the alert tones are fed from the D to A converter to a low pass filter U12B. The output of the filter, U12-7, should be biased at 6.9 Vdc and should have tone(s) present during times when tones are being generated.

3. The tones pass through the tone adjust potentiometer R74. Check the adjustment to see if it is set properly. If tones are still not being sent to the line, turn the potentiometer fully clockwise. If tones are present on the wiper arm of R74 and they are still not reaching the line, then the problem is either in the summing amplifier stage U12A or the line driver stage U4. If so, refer to section 5.1 since microphone audio is probably not reaching the line either.

5.4 Control Tones Have No Effect on the Panel

1. See adjustment procedure for the proper setting of the tone levels.

2. Make sure the 24-66 configuration has been programmed to match what is expected by the panel.

5.5 Line Audio Doesn't Reach the Speaker

1. If a handset is being used, make sure the handset is properly seated in the cradle. Check the operation of the HUHS (Hang Up Hook Switch) by monitoring P11-2 with a DC voltmeter. If a desk microphone is being used, the speaker will remain on continually.

2. If the alternate line or supervisory option is installed make sure the line is connected to the appropriate modular receptacle and that the supervisory function is not selected. Also verify that the appropriate jumpers are installed or not installed.

3. If the parallel detect option is installed, remove power from the 24-66, open the top cover and pull the option board out. Apply power to the 24-66 and if the problem has gone away either replace or repair the option board.

4. While sending audio into the 24-66 from the line, monitor U2-1. This pin should be biased at 6.9 Vdc with the audio riding on it. If not, make sure the RX ADJ potentiometer R16 is set properly. If there is still no audio present on U2-1, U1 or U2 may be faulty.

5. Make sure audio will pass from U6-8 to U6-9 and from U6-10 to U6-11. With the parallel detect option board removed and the mute function off, the control pins on both audio gates should be high (13.8 Vdc present on U6-6 and U6-12).

5.5 Line Audio Doesn't Reach the Speaker (cont.)

6. While receiving audio from the line, U3-1 should be biased at 6.9 Vdc with the audio riding on it.

7. Check to be sure audio passes through the volume control potentiometer R105. After the volume control the audio splits into two paths: one for the speaker and the other for the earpiece. In the speaker path U6-13 should be high (13.8 Vdc) and audio should be present at U6 pins 1 and 2.

8. The speaker level adjustment R60 should be checked to see if it is properly set. U10 is the speaker driver and should have audio present on its output, pin 4. As a last step make sure JP11 is installed and the speaker connector is mated to P11.

5.6 Earpiece Audio is Not Loud Enough or No Sound

The following solutions assume that the speaker audio is working properly.

1. Check the earpiece level adjustment R15 for proper adjustment.

2. The output of the earpiece amplifier, U3-7, should be biased at 6.9 Vdc with audio riding on it.

3. Earpiece audio should pass from U8-8 to U8-9 while U8-6 is high (13.8 Vdc). At J7-2 there should be approximately 150 mVrms of audio with the handset plugged in.

4. U8-12 should be low (0.7 Vdc or less) when the 24-66 is configured for a handset. If it is high (13.8 Vdc), the 24-66 is configured for a desk microphone and will need to be reconfigured by using the programming software.

5.7 A Constant Hum is Present in the Speaker

1. Check the filter capacitors and voltage regulators in the power supply section. Look for AC ripple riding on the DC voltages.

2. One or more audio adjustments may be turned up too high. Check all applicable adjustments according to the adjustment procedure.

5.8 Background Tone (2175 Hz) Present in Receive Audio

1. Make sure the 24-66 is equipped with the parallel detect option. If not, tone present in the receive audio is normal.

2. Check the 2175 Hz notch filter on the parallel detect option board to see if it is set properly.

3. The 2175 Hz tone may be coming in at too high of a level. Check the levels coming from other parallel remotes.

5.9 Parallel TX Indicator Intermittent or Stuck On

1. The 2175 Hz hold tone arriving at the 24-66 is at too high of a level or the detection gain potentiometer R16 on the parallel detect option board is set improperly.

5.10 One or More Keys Stuck On or Off

1. Unplug the 24-66 and then plug it back in.

2. Check the ribbon cable between the keypad board and the base board.

3. Microprocessor may be functioning improperly. Refer to section 5.12.

5.11 Faceplate Keys and All LEDs Inoperative

1. Unplug the 24-66 and then plug it back in.

2. Check the ribbon cable between the keypad board and the base board.

3. Microprocessor may be functioning improperly. Refer to section 5.12.

5.12 Microprocessor Functioning Improperly

1. Check for 12 MHz clock frequency between pins 18 and 19 on the microprocessor (U15). Caution: Use a high impedance probe.

2. Make sure pin 9 of microprocessor (U15) is low (0.7 Vdc or less) at all times.

3. If pin 9 of the microprocessor (U15) is constantly pulsing, the watchdog (U14) is trying to cause a reset. This means that pin 1 of the microprocessor isn't writing to the watchdog (U14 pin 7) at least once every 600 ms.

4. Pin 30 of the microprocessor (U15) is used to latch the instruction address to the latch (U17). This line should be constantly pulsing.

5. The write control line (pin 16 of U15) should be pulsing.

5.13 Voltage Level Tables

As an aid to the service technician both a receive voltage table and a transmit voltage table are provided. The following conditions apply to both tables: 24-66 handset version with no options, low impedance (SW1-4 on), volume control at maximum, all faceplate LEDs off, adjustments are factory pre-set using IDA's test procedure. All voltages are with respect to ground (TP1).

Receive Voltage Table

	DC volts	AC volts (rms)	AC volts (p-p)
D13 cathode	18.2	.46	1.3
P4-6	6.9	1.16	3.3
U1-2	4.4	0	0
U2-1	7	.35	1
U2-2	2.5	0	0
U2-3	2.5	0	0
U3-1	6.8	1.5	4.2
U3-2	6.8	0	0
U3-3	6.8	0	0
U6-2	6.8	1.5	4.2
U6-13	13.8	0	0
U10-1	1.2	0	0
U10-2	.8	0	0
U10-4	6.5	3.7	10.4
U3-5	6.9	0	0
U3-6	6.9	0	0
U3-7	6.9	.28	.8
J7-2	0	0	0

Conditions of table: 1 kHz at 2.45 Vrms across J5-4 and J5-5 with R16 adjusted to maximum and R60 adjusted to provide 3.45 Vrms into a 4 ohm speaker load. The handset is on-hook.

5.13 Voltage Level Tables (cont.)

Transmit Voltage Table

	DC volts	AC volts (rms)	AC volts(p-p)
U1-14	1.8	0	0
U2-5	2.5	0	0
U2-6	2.5	0	0
U2-7	3.8	.212	.6
U5-1	6.9	.212	.6
U5-2	6.9	.212	.6
U5-3	6.8	.212	.6
U5-5	6.6	.204	.58
U5-6	6.6	.204	.58
U5-7	6.6	.204	.58
U12-1	6.9	.45	1.3
U12-2	6.9	0	0
U12-3	6.9	0	0
U4-1	0	0	0
U4-3	6.7	0	0
U4-4	6.7	0	0
U4-5	6.7	1.1	3.1
U4-8	6.7	1.1	3.1
U11-1	6.9	1.8	5.1
U11-2	6.9	0	0
U11-3	6.9	0	0
D11 cathode	3.9	.07	.2

Conditions of table: 1 kHz at 1 Vrms applied to J7-4 with handset removed and 24-66 in intercom mode. J7-3 tied low and R50 adjusted to provide 2.45 Vrms into a 600 ohm load across the line.

5.14 Status Messages

The display on the 24-66 is used for displaying the selected frequency, channel, or system and group information. In addition, different status messages are also displayed. The appearance of the different status messages varies depending upon if the 24-66 has the Tone Control option or the MSK Control option and upon the type of display being used (either an LED or an LCD display). Each of the status messages are described below.

5.14 Status Messages (cont.)

24-66 Tone Remote

32 character LCD	LED	Description
"LOCK"	"L"	This indicates the current channel is locked out.
"PROGRAM"	"P"	This is displayed while the 24-66 Tone remote is being programmed.
"CHECKSUM"	"C"	If this is displayed on power-up, the code EPROM U16 has become corrupted and should be replaced.
"ERROR"	"E"	If this is displayed on power-up, the EEPROM U18 has become corrupted and should be replaced.
"888..." "TEST..."	"88:88"	This is displayed once (LCD) or four times (LED) when the 24-66 Tone remote is powered-up in test mode to verify that the display is functional.

24-66 MSK Remote

32 character LCD	LED	Description
"DISABLED"	"-d"	This is displayed when an update has been received for a disabled channel or system and group.
"LCK"	"-"	This indicates the current channel or system and group is locked out.
"NOT PROGRAMMED"	"-U"	This indicates that the EEPROM is uninitialized and needs to be programmed.
"PROGRAMMING"	"-P"	This is displayed while the 24-66 MSK remote is being programmed.
"CODE ERROR"	"-C"	If this is displayed on power-up, the code EPROM U16 has become corrupted and should be replaced.
"EEPROM ERROR"	"-E"	If this is displayed on power-up, the EEPROM U18 has become corrupted and should be replaced.
"888..."	"88:88-"	This is displayed four times when the 24-66 MSK remote is powered-up in test mode to verify that the display is functional.
"GUARD"	"-1"	In test mode, this is displayed when guard tone is being encoded and sent to the line.
"MSK"	"-2"	In test mode, this is displayed when the MSK test tone is being encoded and sent to the line.
"HOLD"	"-3"	In test mode, this is displayed when hold tone is being encoded and sent to the line.

PARTS LIST

24-66 Base Board
101-0211

Item	Reference	Description	Part No.	Qty.
1	C1,2,10,17,22,27,63	.47uF MONO CAP	362-0002	7
2	C3,4,11,13,15,16,31, 32,41,47,49,50,51,52, 59,60,67,68,69,70,71, 72,73,76,77,78,79,80	.1uF MONO CAP	362-0001	28
3	C5,45	.001 MONO CAP	362-0006	2
4	C6,8,12,21,26,35,37	1uF 35V TANT CAP	390-0003	7
5	C7,14,20,24,29,33,36, 42	10uF 16V TANT CAP	390-0010	8
6	C9,23,53	2.2uF 35V TANT CAP	390-0005	3
7	C18,19	33uF 16V TANT CAP	390-2336	2
8	C25,46	100pF MONO CAP	362-0016	2
9	C28,48	1000uF 16V ELEC CAP	360-0012	2
10	C30,38,39,40	.01 50V/ULTRA MONO CAP	362-0019	4
11	C34	NOT INSTALLED	000-0002	1
12	C43	470uF 16V ELEC CAP	360-2477	1
13	C44,66	.22uF 35V TANT CAP	390-0001	2
14	C54,56	10uF 16V ELEC CAP	360-0004	2
15	C55	2200uF 35V ELEC CAP	360-0009	1
16	C57,58	22uF 16V ELEC CAP	360-0002	2
17	C61,62	.01uF MONO CAP	362-0003	2
18	C74,75	18pF CER CAP	370-0019	2
19	D1,2	1N5248 18V ZENER DIODE	111-0019	2
20	D3	1N5226 3.3V ZENER DIODE	111-0015	1
21	D4,7,8	1N5235 6.8V ZENER DIODE	111-0012	3
22	D5,6,11,12	1N914 DIODE	110-0001	4
23	D9,13,14,15,16	1N4003 DIODE	110-0002	5
24	F1	FUSE .400 AMP	290-0021	1
25	F1	FUSE HOLDER	291-0007	1
26	F1	FUSE COVER	291-0008	1
27	J1	16 PIN DIP SOCKET	220-0001	1
28	J2,3,4,8	NOT INSTALLED	000-0002	4
29	J5	UNIVERSAL 8 to 6 JACK	231-0007	1
30	J6	MODULE, JACK	234-0066	1
31	J7	4 POS MODULE, JACK	231-0021	1
32	JP1,2	STAPLE JUMPER	265-0016	2
33	JP3,4,5,6,7,8,9,10,12, 13,14,15	2 POS GOLD POST	231-1002	12
34	JP11	4 POS CONN	234-0019	1
35	JP16	NOT INSTALLED	000-0002	1
36	JP17	JUMPER WIRE .4 x .25	265-0004	1
37	JP5,6,9,10,11	SHORTING PLUG	234-0046	5

38	P1,2,3,5,6,7	NOT INSTALLED	000-0002	6
39	P4	HEADER .156 LOCK MOLEX	231-0043	1
40	P8	MALE DISCONNECT .25”	233-0014	2
41	P9	#6 X 1/2” SPACER	199-0045	1
42	P10	2 POS .156 POST	231-1067	1
43	P11	4 POS CONN LOCKING	234-0014	1
44	P12	5 POS CONN LOCKING	233-0034	1
45	R1,2,39,45,48,109, 110,113,114	NOT INSTALLED	000-0002	9
46	R3	6.8K 5% 1/4 W RES	312-0018	1
47	R4,25	3.9K 5% 1/4 W RES	312-0070	2
48	R5	470K 5% 1/4 W RES	312-0046	1
49	R6	6.2K 5% 1/4 W RES	312-0041	1
50	R7	13.7K 1% 1/4 W RES	311-1372	1
51	R8,17,96,98,104	1K 5% 1/4 W RES	312-0019	5
52	R9,10,27,28,71	12K 5% 1/4 W RES	312-0021	5
53	R11,20,29,30,40,62, 69,70	47K 5% 1/4 W RES	312-0020	8
54	R12,26,33,34,35,36, 52,53,58,67,68,85,86, 92,93,94,95,97,102, 103,107	10K 5% 1/4 W RES	312-0011	21
55	R13	10 5% 1/4 W RES	312-0038	1
56	R14	4.7K 5% 1/4 W RES	312-0040	1
57	R15,60	2K 1 TURN POT	351-1202	2
58	R16	25K 1 TURN POT	351-0013	1
59	R18	620 5% 1/4 W RES	312-0045	1
60	R19,74	100K 1 TURN POT	351-1104	2
61	R21	365 1% 1/4 W RES	311-3650	1
62	R22	3K 5% 1/4 W RES	312-0023	1
63	R23	330K 5% 1/4 W RES	312-1334	1
64	R24	6.8M 5% 1/4 W RES	312-0016	1
65	R31	43K 5% 1/4 W RES	312-0027	1
66	R32,73	47.5K 1% 1/4 W RES	311-4752	2
67	R37	22K 5% 1/4 W RES	312-0015	1
68	R38	8.2K 5% 1/4 W RES	312-0036	1
69	R39,45,48,122	470 5% 1/4 W RES	312-0028	4
70	R41,43	46.4K 1% 1/4 W RES	311-4642	2
71	R42,54	2K 22 TURN POT	352-0004	2
72	R44	1.78K 1% 1/4 W RES	311-1781	1
73	R46	274 1% 1/4 W RES	311-0016	1
74	R47	1.24K 1% 1/4 W RES	311-1241	1
75	R49	3.3K 5% 1/4 W RES	312-0035	1
76	R50	100K 1 TURN POT	351-0014	1
77	R51	2.2K 5% 1/4 W RES	312-0007	1
78	R55	2.67K 1% 1/4 W RES	311-0017	1
79	R56,112	6.81K 1% 1/4 W RES	311-6811	2
80	R57	7.32K 1% 1/4 W RES	311-7321	1
81	R59	33K 5% 1/4 W RES	312-0014	1
82	R61	45.3K 1% 1/4 W RES	311-4532	1

83	R63	220 5% W RES	312-0052	1
84	R64,72	2.2 5% 1/4 W RES	312-1229	2
85	R65	30K 5% 1/4 W RES	312-1303	1
86	R66	51K 5% 1/4 W RES	312-0032	1
87	R75,77	243 1% 1/4 W RES	311-0010	2
88	R76	2.32K 1% 1/4 W RES	311-2321	1
89	R78	604 1% 1/4 W RES	311-0006	1
90	R79,80	200 1 TURN POT	351-1251	2
91	R83,84	75K 5% 1/4 W RES	312-0055	2
92	R87	5.90K 1% 1/4 W RES	311-5901	1
93	R88	21.5K 1% 1/4 W RES	311-2152	1
94	R89	23.7K 1% 1/4 W RES	311-2372	1
95	R90	220K 5% 1/4 W RES	312-0012	1
96	R91	5.36K 1% 1/4 W RES	311-5361	1
97	R99	10K 9 ELE RES NET	316-1103	1
98	R100	47K 9 ELE RES NET	316-0001	1
99	R101	1M 5% 1/4 W RES	312-0047	1
100	R105	50K SLIDE POT	340-0003	1
101	R106	100K 5% 1/4 W RES	312-0003	1
102	R108	24K 5% 1/4 W RES	312-0064	1
103	R111	JUMPER WIRE	265-0018	1
104	R115,116	470 3 ELE RES NET	316-4703	2
105	R117	470 5 ELE RES NET	316-4705	1
106	R118,119,120,121,123	470 4 ELE RES NET	316-4704	5
107	RESET	2 PIN JUMPER POST	231-1002	1
108	SG1,4,5,6	SPACER	200-0045	4
109	SG1,4,5,6	30V VARISTOR	300-0005	4
110	SG2,3	NOT INSTALLED	000-0002	2
111	SW1	4 POS DIP SWITCH	613-0032	1
112	T1	4-40 HEX NUT	199-0010	2
113	T1	#4 STAR WASHER	199-2001	2
114	T1	NYLON WASHER	199-2110	2
115	T1	4-40 X 1 3/8” SCREW	199-3067	2
116	T1	POWER TRANSFORMER	420-0006	1
117	T2	AUDIO TRANSFORMER	410-0011	1
118	T3	NOT INSTALLED	000-0002	1
119	TP1	TEST POINT STAPLE	265-0016	1
120	U1	NE572, IC	130-0240	1
121	U2	CA3260E, IC	130-0229	1
122	U3,5,11,12	TL062CP, IC	130-0120	4
123	U4	MC34119, IC	130-0352	1
124	U6,8	4066, IC	130-0067	2
125	U7	LM317LZ, IC	130-0236	1
126	U9	LM317KC, IC	130-0247	1
127	U10	TDA2003V, IC	130-0248	1
128	U13	LM317T, IC	130-0237	1
129	U14	DS1232, IC	130-0263	1
130	U15	P80C32, IC	130-0285	1
131	U16	27C512 EPROM, IC	130-0319	1
132	U17,20	NOT INSTALLED	000-0002	1

133	U18	24LC16, IC	130-0359	1
134	U19	74HC373, IC	130-0218	1
135	U21,24	DM7406, IC	130-0099	2
136	U22,25	74HC374, IC	130-0228	2
137	U23	AD557JN/AD558JN, IC	130-0119	1
138	U9	6-32 X 5/16” SCREW	199-4032	2
139	U9	1/8” THREADED SPACER	200-0068	2
140	U9	5015B HEAT SINK	210-0010	1
141	U9	5423U HEAT SINK	210-0012	1
142	U9	TO3 INSULATOR	210-0100	1
143	U10,13	6-32 HEX NUT	199-0020	2
144	U10,13	#6 STAR WASHER	199-2002	2
145	U10,13	6-32 X 1/4” SCREW	199-3070	2
146	U10,13	5630B HEAT SINK	210-0009	2
147	U10,13	TO220 INSULATOR	210-0103	2
148	U1,23	16 PIN DIP SOCKET	220-0001	2
149	U2,3,4,5,11,12,14,18	8 PIN DIP SOCKET	220-0003	8
150	U6,8,21,24	14 PIN DIP SOCKET	220-0002	4
151	U15	40 PIN DIP SOCKET	220-0007	1
152	U16	28 PIN DIP SOCKET	220-0008	1
153	U19,22,25	20 PIN DIP SOCKET	220-0009	3
154	X1	12MHz CRYSTAL	305-0015	1
155	X1	CRYSTAL INSULATOR	210-0106	1
156		24-66 BASE PC BOARD	900-0211	1

24-66 MSK Control Option
106-MSKRMOPT

Item	Reference	Description	Part No.	Qty.
1	J8	6 POS SOCKET	234-0097	1
2	P1	5 POS 1.5mm HEADER	231-1505	1
3	R2	47K 5% 1/4 W RES	312-0020	1
4	U17	20 POS SOCKET	234-0099	1
5	U20	14 POS SOCKET	234-0098	1
6		4-40 X 1/4” SCREW	199-3055	1
7		4-40 X 1/2” SPACER	200-0304	1

24-66 MSK Control Option Interface Board
101-0270

Item	Reference	Description	Part No.	Qty.
1	C1,2	1uF/50V ELEC CAP	360-0001	2
2	C3,4,5,6,7,8,9,11,15, 16,18,19,20,21,22,23, 24	.1uF 50V 10% X7R CAP	372-5104	17
3	C10,17	1000pF 50V 5% NPO CAP	372-5102	2
4	C12	.01uF 50V 10% X7R CAP	372-5103	1
5	C13,14	33pF 50V 5% NPO CAP	372-5330	2
6	J1	5 POS CABLE ASSEMBLY	222-1505	1
7	J2	20 POS HEADER .1 X .1	231-1082	1
8	J3	6 POS HEADER .1 X .1	231-1081	1
9	J4	14 POS HEADER .1 X .1	231-1076	1
10	JP1	NOT INSTALLED	000-0002	1
11	JP2	3 POS GOLD POST CONN	231-1003	1
12	JP2	SHORTING PLUG	234-0046	1
13	Q1,2	MMUN2211LT1 TRANS	180-0040	2
14	R1,2	50K 1 TURN POT	351-0010	2
15	R3,4,18	100K 5% 1/8 W RES	321-1104	3
16	R5,6,8,9,15,17,19,20, 21,25	10K 5% 1/8 W RES	321-1103	10
17	R7	390K 5% 1/8 W RES	321-1394	1
18	R10,12	220K 5% 1/8 W RES	321-1224	2
19	R11	2M 5% 1/8 W RES	321-1205	1
20	R13	68K 5% 1/8 W RES	321-1683	1
21	R14,22	39K 5% 1/8 W RES	321-1393	2
22	R16	1M 5% 1/8 W RES	321-1105	1
23	R23,24	22K 5% 1/8 W RES	321-1223	2
24	TP1,2	TEST POINT PC MOUNT	200-0013	2
25	U1	74HC32, IC	131-1031	1
26	U2	8888, IC	131-1027	1
27	U3	74HC373, IC	131-1022	1
28	U4	74HCT00, IC	131-1026	1
29	U5	TL084ID, IC	131-1001	1
30	U6	4066, IC	131-1028	1
31	U7	MX429, IC	131-3003	1
32	X1	4MHz CRYSTAL	305-0007	1
33	X2	3.57954MHz CRYSTAL	305-0001	1
34		MSK INTERFACE PC BOARD	900-0270	1

24-66 Tone Control Option
106-TNREMOPT

Item	Reference	Description	Part No.	Qty.
1	JP16	STAPLE JUMPER	265-0016	1
2	U17	74HC373, IC	130-0218	1
3	U20	74HCT32, IC	130-0337	1
4	U17	20 PIN DIP SOCKET	220-0009	1
5	U20	14 PIN DIP SOCKET	220-0002	1

Parallel Detect Option
431-RBC-613

Item	Reference	Description	Part No.	Qty.
1	C1,3,9,10,11,12,15	.1uF MONO CAP	362-0001	7
2	C2	10uF 16V ELEC CAP	360-0004	1
3	C4,5,7,8,13,14,16	.01uF 50V MONO CAP	362-0019	7
4	C6	.47uF MONO CAP	362-0002	1
5	D1,2,3,4	1N914 DIODE	110-0001	4
6	J4	8 POS RECEPTACLE	231-0042	1
7	Q1,2	MPS8098 TRANSISTOR	180-0009	2
8	R1	1.78K 1% 1/4 W RES	311-1781	1
9	R2,10	46.4K 1% 1/4 W RES	311-4624	2
10	R3	6.81K 1% 1/4 W RES	311-6811	1
11	R4	7.32K 1% 1/4 W RES	311-7321	1
12	R5,6,19	1K 5% 1/4 W RES	312-0019	3
13	R7,8,17	2K 22 TURN POT	352-0050	3
14	R9	2.67K 1% 1/4 W RES	311-0017	1
15	R11	2.26K 1% 1/4 W RES	311-2261	1
16	R12	15.8K 1% 1/4 W RES	311-1582	1
17	R13,21	7.15K 1% 1/4 W RES	311-7151	2
18	R14,22,23	10K 5% 1/4 W RES	312-0011	3
19	R15	523K 1% 1/4 W RES	311-5233	1
20	R16	100K 22 TURN POT	352-0050	1
21	R18	220K 5% 1/4 W RES	312-0012	1
22	R20	147K 1% 1/4 W RES	311-1473	1
23	TP1,2	STAPLE JUMPER	265-0016	2
24	U1	TL062, IC	130-0120	1
25	U2	TL064, IC	130-0251	1
26	U1	8 PIN DIP SOCKET	220-0003	1
27	U2	14 PIN DIP SOCKET	220-0002	1
28		PARALLEL OPT PC BOARD	900-0214	1

24-66 EMI CLASS B with FILTER

Item	Reference	Description	Part No.	Qty.
1	L1	125/250VAC 1 FILTER	306-0014	2

24-66 EMI with out CLASS B

Item	Reference	Description	Part No.	Qty.
1	L1	JUMPER WIRE .75 x .25	265-0013	1
2	L1	JUMPER WIRE 1.5 x .25	265-0014	1

4 Wire Option
431-RBC-611

Item	Reference	Description	Part No.	Qty.
1	R1	620 5% 1/4 W RES	312-0045	1
2	SG2,3	30V VARISTOR	300-0005	2
3	T3	AUDIO TRANSFORMER	410-0005	1

Supervisory/Alternate Line Option
431-RBC-612

Item	Reference	Description	Part No.	Qty.
1	D10	1N914 DIODE	110-0001	1
2	K1	4PDT RELAY	700-0001	1

Internal Mic Option

Item	Reference	Description	Part No.	Qty.
1	R109,110,114	10K 5% 1/4 W RES	312-0011	3
2	Q1	MPS8098 TRANSISTOR	180-0009	1
3		MIC ELEMENT	901-0014	1
4		RUBBER ELEMENT HOLDER	901-0011	1

Summed Audio Option

Item	Reference	Description	Part No.	Qty.
1	JP12,13,14,15	SHORTING PLUG	224-0046	4
2	R113	10K 5% 1/4 W RES	312-0011	1
3	R111	100K 1 TURN POT	351-1104	1

Keypad Board

101-0209

Item	Reference	Description	Part No.	Qty.
1	C1,2	10uF 16V ELEC CAP	360-0004	2
2	C3	10uF 16V TANT CAP	390-0010	1
3	C4,6	NOT INSTALLED	000-0002	2
4	C5	.1uF 50V 10% MONO CAP	365-5104	1
5	D1	NOT INSTALLED	000-0002	1
6	D2,3,4,5,6,7,8,9,10, 11,12,13	LED, T-1 RED	112-0012	12
7	D14	LED, RED HIGH INTENSITY	112-0024	1
8	J1,2,3,4	NOT INSTALLED	000-0002	4
9	J5	16 POS CABLE 8”	222-0025	1
10	JP1,2	STAPLE JUMPER	265-0016	2
11	R1,6	220 1 W RES	314-1224	2
12	R2	1.2K 5% 1/4 W RES	312-0034	1
13	R3,5,7	10K 5% 1/4 W RES	312-0011	3
14	R4	33K 5% 1/4 W RES	312-0014	1
15	R8	NOT INSTALLED	000-0002	1
16	U1	MAX7219, IC	130-0287	1
17	U2	NOT INSTALLED	000-0002	1
18		KEYPAD PC BOARD	900-0209	1

VU Meter Option (New)

Item	Reference	Description	Part No.	Qty.
1	D1,2	10 SEGMENT BAR LED	112-0027	2
2	P1	12 POS HEADER POST	231-3315	1
3	U2	LM3915 IC	130-0372	1
4		PLASTIC STANDOFF .125"	200-0388	2
5		VU METER PC BOARD	900-0281	1

VU Meter Option (Old)

Item	Reference	Description	Part No.	Qty.
6	J1 (J2)	12 POS HEADER POST	231-3315	1
7	J1 (J2)	NSM3916 V/U MODULE	130-0244	1
8	J1 (J2)	PLASTIC STANDOFF .25"	200-0387	2

Clock Option

Item	Reference	Description	Part No.	Qty.
1	J4	24 PIN DIP SOCKET	220-0019	1
2	J4	LED CLOCK DISPLAY	113-0098	1

Frequency Display Option

Item	Reference	Description	Part No.	Qty.
1	D1	7 SEG RED, DISPLAY	113-0099	1
2	D1	14 PIN DIP SOCKET	220-0002	1
3	J2	6 POS BOTTOM ENTRY CON	231-1116	2

LCD Option

Item	Reference	Description	Part No.	Qty.
1	C4,6	.1uF 50V 10% MONO CAP	365-5104	2
2	J1	6 POS RECEPTACLE	231-1116	2
3	J3	8 POS RECEPTACLE	231-3008	2
4	R8	10K 1 TURN POT	351-1103	1
5	U2	74HC595, IC	130-0350	1
6		LCD 32 CHARACTER	113-0104	1
7		PLASTIC STAND OFF 3/16”	200-0385	4
8		16 POS HEADER POST	231-3116	1

DC Power Cable Option

Item	Description	Part No.	Qty.
1	2 POS .156 RECEPTACLE	233-0024	1
2	CABLE TIE (SHORT)	200-0081	1
3	2 COND. 20ga. CABLE	800-1106	5’

External Encode/Decode Cable Option

Item	Description	Part No.	Qty.
1	CABLE TIE (SHORT)	200-0081	1
2	9 COND. 22ga. CABLE	222-0034	3’
3	5 POS .1” RECEPTACLE	233-0024	1
4	2 POS .1” RECEPTACLE	234-0033	1

Phone Cable Option

Item	Description	Part No.	Qty.
1	6 POS. MODULAR PLUG	231-0008	2
2	WIRE 6 CON, TELE. FLAT	800-1003	10’

Programming Cable Option
431-RBC-003

Item	Reference	Description	Part No.	Qty.
1	C1,2,3,4	10uF TANT CAP	390-9106	4
2	J1	IDC PC MOUNT PIN	231-0041	4
3	J2	DB25 W/FEMALE PIN	231-0022	1
4	U1	MAX232, IC	130-0235	1
5		DB25 HOOD COVER	231-0046	1
6		CABLE ASSEMBLY	800-2027	1
7		PROGRAMMING CABLE PCB	900-0215	1

Desk Mic Option

Item	Description	Part No.	Qty.
1	DESK MIC	900-0399	1
2	CRYSTAL PROGRAMMABLE	900-0725	1
3	CABINET TOP for LED	900-0721	1
4	CABINET TOP for LCD	900-0750	1

Hand Set Option

Item	Description	Part No.	Qty.
1	HOLE COVER	199-6137	1
2	CABLE TIE (SHORT)	200-0081	2
3	SENSOR SWITCH	611-0027	1
4	HAND SET	900-0020	1
5	CABINET TOP for LED	900-0723	1
6	CABINET TOP for LCD	900-0751	1

DTMF Pad Option

Item	Description	Part No.	Qty.
1	5 POS RECEPTACLE	233-0035	1
2	DTMF KEYPAD	903-0006	1

Wall Mount Option

Item	Description	Part No.	Qty.
1	#6 X 1/4” SF THRD SCREW	199-4039	4
2	#6 X 1” WALL SCREW	199-4011	4
3	WALL ANCHOR	199-4012	4
4	WALL MOUNT BRACKET	900-5112A	1

24-66 Base Cabinet
900-0751

Item	Description	Part No.	Qty.
1	NUT PAL	199-0040	4
2	#6 STAR WASHER	199-2002	1
3	6-32 X 1/4” SCREW	199-3070	1
4	#4 X 1/4” TAP SCREW	199-4029	9
5	#6 X 3/8” TAP SCREW	199-4038	7
6	#6 X 1/4” TAP SCREW	199-4039	6
7	IDA SERIAL LABEL	199-6135	1
8	IDA CAUTION LABEL	199-6136	1
9	IDA FCC LABEL CLASS B EMI	199-6140	1
10	6 KEY, KEYPAD	203-0026	1
11	3 KEY, KEYPAD	203-0027	2
12	3/8” FOOT	203-1053	4
13	STRAIN RELIEF	203-1107	1
14	STRAIN RELIEF for CLASS B	203-1110	1
15	22 AWG WIRE GREEN	222-0016	6”
16	22 AWG WIRE YELLOW	222-0018	6”
17	RING TERM #10	231-0044	1
18	CONN DIS TAB F 18-22	233-0016	2
19	4 POS RECEPTACLE	233-0045	1
20	POWER CORD	260-0009	1
21	POWER CORD for Class B	260-0034	1
22	REMOTE BUTTON	900-0718	12
23	12 KEY PANEL SCREENED	900-0722S	1
24	BOTTOM CABINET	900-0724	1
25	3W 4ohm SPEAKER	901-0004	1
26	CRYSTAL for TONE PLAIN	900-0726	1
27	CRYSTAL for CLOCK/VU	900-0728	1
28	CRYSTAL for CHANNEL	900-0730	1
29	CRYSTAL for SYS/GRP	900-0731	1
30	CRYSTAL for LCD	900-0732	1

INSTALLATION DIAGRAMS

Insert

24-66 Installation Diagram

here

Insert

24-66 Installation Diagram with Supervisory Control

here

ADJUSTMENT LOCATOR DIAGRAM

Insert

Adjustment Locator Diagram

here

SCHEMATICS

Insert

Schematics

here