

24-30

Remote Base Controller

Version 1.01

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SPECIFICATIONS

Input voltage	15 Vdc @ 600mA 15Watt Wall Transformer 2.1 x 5.5mm barrel conn. Center (-)
Current consumption @ 15Vdc	205 mA (TX) 500 mA (RX) Vol. max 175 mA (Standby)
Standby voltage	12 - 15 Vdc **
Temperature range	0 to +60 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	-60 dB (ref. +0 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	-47 dB (ref 0dBm)
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 7.5 dB.
Tx Compression	With an audio increase of 30 dB beyond the start of compression the output increases 17.5 dB.
Line control	2 or 4 wire audio
Notch filter depth	> 42 dB (RX) > 44 dB (TX)
Weight	4 lb.
Dimensions	3.5" x 8" x 10.5" (handset version) 3.5" x 8" x 7.5" (desk mic version)

1.0 GENERAL DESCRIPTION

1.1 Description

The 24-30 series of remote controllers is used to remotely control repeaters and base station radios. Tone sequences are used by the 24-30 to control the remote repeater or base station radio. The 24-30 requires an appropriate panel in the repeater or at the base station for correct operation. The operating characteristics of the 24-30 can be selected and changed through jumper selections.

The 24-30 Tone remote uses standard function tones to control the repeater or base station. The 24-30 is available with either a handset or a desk microphone and can operate with either a 2-wire or a 4-wire line. A 12 V power cable is also available which allows the 24-30 to be operated from a 12 Vdc source.

1.2 Capabilities and Features

- ◆ Tone signaling
- ◆ 2 wire or 4 wire operation
- ◆ Handset or desk microphone
- ◆ Desk or wall mount
- ◆ Up to 4 channel capability
- ◆ Operation from 12 Vdc source
- ◆ Full duplex operation
- ◆ Intercom
- ◆ Line audio activity indicator

2.0 INSTALLATION

2.1 Line Connection

The 24-30 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 24-30 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 24-30 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 connector is found on the back of the 24-30. The line should be a standard 2 or 4 wire cable that is available anywhere that telephone accessories are sold. Refer also to the 24-30 installation diagram in the back of this manual.

2.2 Proper Grounding Practices

The surge protection varistors on the 15VDC power line, the two wire audio lines, and the four wire audio lines protect the 24-30 from line transients. It is imperative that a good earth ground be used 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. To properly ground the unit, attach an EXTERNAL EARTH GROUND lead to the circuit board mounting screw marked EARTH GROUND.

The surge protection varistors are of little value without this earth ground and **EXTREME CAUTION** must be observed when servicing the 24-30 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.

2.3 Parallel Detect Option

When the parallel detect option is installed in the field, it is necessary to open the 24-30 and plug the option board into P2 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.

3.0 ADJUSTMENT PROCEDURES

The following will explain the adjustment procedure for all potentiometers in the 24-30. 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 R24 - 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 R24 so that the output of U6 is 13.8 Vdc.

3.2 R25 - 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 U11. If needed, adjust R25 so that the output of U11 is 5 Vdc.

3.3 R52 - 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 J6-1. Place the 24-30 into intercom mode and begin transmitting by grounding J6-4. Connect a 600 ohm load to the output terminals J6-3 and J6-4. Adjust R52 so that 0 dBm (.77 Vrms) appears across the 600 ohm load.

Field adjustment procedure - 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 R52 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 24-30 is located and also upon the user of the desk microphone and how close and/or loud the user speaks.

3.5 R119 and R130 - 2175 Hz Notch Filter Adjust

With the handset or desk microphone removed, select INTERCOM and inject a 2175 Hz tone at 1 Vrms into the microphone input J7-5. Begin transmitting by grounding J7-4 and adjust R119 and R130 for a minimum reading at J6-3 and J6-4. Going back and forth between the two potentiometers will result in the best adjustment.

3.6 R79 - Receive Line Compensation

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

Field adjustment procedure - This adjustment should normally not need to be adjusted in the field. However, if levels coming into the 24-30 are greater than +10 dBm (2.45 Vrms) or there is excessive line noise, R79 should be turned down.

3.7 R70 - Speaker Level

Factory adjustment procedure – R79 must be set properly before making this adjustment. With the volume control at maximum, adjust R70 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 R70 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.

3.8 R92 - Earpiece Level

Factory adjustment procedure – R79 must be set properly before making this adjustment. With a handset or a 150 ohm load connected from J6-6 to ground, adjust R92 for 150 mV across the load while receiving a 1 kHz tone at +10 dBm (2.45 Vrms). The volume control should be set to maximum.

Field adjustment procedure - The earpiece and the base speaker are both controlled by the volume control. 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 R92 for a comfortable listening level with the volume control potentiometer at maximum.

3.9 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 J6-3 and J6-4. 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.

3.10 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 J6-3 and J6-4. 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.

3.11 Main Board Jumper Configuration

The main board has several jumper options. If 4-wire operation is desired, JP 1 should be removed and JP 16 should be installed. JP 3 is used to set the TX line impedance. It should be removed if high impedance is desired. JP 9 is removed if full duplex operation is required. JP10, 11, and 12 have to do with selecting handset or a desk mic. If a handset is used, JP10 is installed and JP 11 and 12 are removed. If a desk mic is used, JP 10 is removed and JP 11 and 12 are installed. When there is incoming audio on the line, the TX LED is illuminated. JP 15 can be removed to disable the line activity indicator if this feature is not desired.

JP 2,4,5,6,7,8,13,14 are for selecting the required transmit and monitor frequencies. They are used in conjunction with the F1 through F4 jumpers on the keypad board.

For **24-20 emulation** (F1 TX 1950, F2 TX 1850, F1 Mon 2050, F2 Mon 1750), the jumpers should be set as follows:

JP2 IN
JP4 OUT
JP5 OUT
JP6 OUT
JP7 IN
JP8 OUT
JP13 1-2
JP14 2-3

For **GE / MOTO operation** up to four frequency (F1 TX 1950, F2 TX 1850, F3 TX 1350, F4 TX 1250, Monitor always 2050), the jumpers should be set as follows:

JP2 IN
JP4 IN
JP5 IN
JP6 IN
JP7 OUT
JP8 IN
JP13 2-3
JP14 2-3

3.12 Tone Control Section Alignment

The alignment of the function tones and timers has been done at the factory and does not normally require field tuning. These adjustments are critical and care must be used when these adjustments are made. If the alignment is not done properly, the unit may not activate the interface panel at the radio / base station. If tuning is required, follow the instructions below:

Put JP13, 14 in the 2-3 position. Also, make sure that all frequency select buttons are enabled by installing jumpers JP2,3,4,5 on the KEYPAD BOARD.

Also, set the unit up for GE / MOTO configuration (4 freq. Tx , Mon = 2050). This application is described in section 3.11 .

Connect a 600 OHM load to the line connector. Connect a DVM, frequency counter, and an oscilloscope to the load.

Select F1 on the keypad. Set the Oscilloscope to trigger upon the activation of the PTT. Set the Time/Division to 20mS.

Press the PTT and note the duration of the Guard and Function tones.

Repeatedly key the PTT and set the following timers.

Adjust R9 so that the initial Guard tone is 120mS long.

Adjust R1 so that the Function tone is 40m/s long.

G.E. / MOTOROLA Emulation Alignment:

Apply 13.8V to test point TP3 then key and hold the PTT on the MIC.

Adjust R15 for +10 dBm (2.45V RMS, 6.93V p-p) to the Line.

Remove the 13.8V from TP3 and connect 13.8V to TP4 and hold the PTT.

Adjust R6 for 0 dBm (.77V RMS, 2.19V p-p) to the line.

Remove the 13.8V from TP4 and hold the PTT.

Adjust R29 for -20 dBm (.077V RMS, .219V p-p) to the line.

Apply 13.8V to TP3 and hold the PTT.

Adjust R27 for 2175Hz to the line using an accurate frequency counter.

Attach TP2 to ground (TP1 is ground. Do not use earth ground)

Apply 13.8V to TP3.

Select F1 from the keypad, hold PTT and adjust R57 for 1950Hz to the line.

Select F2 from the keypad, hold PTT and adjust R47 for 1850Hz to the line.

Select F3 from the keypad, hold PTT and adjust R40 for 1350Hz to the line.

Select F4 from the keypad, hold PTT and adjust R62 for 1250Hz to the line.

Push and hold the MON button on the keypad and adjust R35 for 2050Hz.

24-20 Emulation Alignment:

For 24-20 emulation (F1 TX 1950, F2 TX 1850, F1 MON 2050, F2 MON 1750), set the main board jumpers as described in section 3.11 above for 24-20 emulation.

Also, remove JP4 and JP5 on the Keypad Board.

Attach TP2 to ground (TP1 is ground. Do not use earth ground)

Apply 13.8V to TP3.

Select F1 from the keypad, hold PTT and adjust R57 for 1950Hz to the line.

Select F2 from the keypad, hold PTT and adjust R47 for 1850Hz to the line.

Select F1 on the keypad, press and hold the MON button on the keypad and adjust R35 for 2050Hz.

Select F2 on the keypad, press and hold the MON button on the keypad and adjust R40 for 1750Hz.

After all tone frequencies are set, go back through them to verify and fine tune them as needed.

3.13 Keypad Board Jumper Configuration

The keypad board has several jumpers to configure various applications. Removing JP 10 disables the mute function. Removing JP 1 disables the intercom function.

Installing JP 2 through JP 5 enable frequency 1 through 4 respectively. JP 6 through JP 9 determine which frequency the 24-30 powers up in (normally F1).

JP 6 is F1, JP 7 is F2, JP 8 is F3, JP 9 is F4.

3.14 Default Jumper Settings

On the Keypad board, the following jumpers are installed at the factory:

JP1, 2, 3, 4, 5, 6, and 10 .

On the main board, the following jumpers are installed at the factory:

JP1, 2, 3, 4, 5, 6, 8, 9, 10, 13(2-3), 14(2-3), 15 .

4.0 CIRCUIT DESCRIPTION

4.1 Power Supply

Power is supplied to the 24-30 via the supplied 15VDC wall transformer. It is connected at J1 on the back of the 24-30. The polarity of the connector must be correct.

From J1 the power is routed through a 1 amp fuse F1. The power input is protected from power line surges by varistors SG1 and SG2. Power is fed into voltage regulator U6. The output voltage of U6 is set to 13.8 Vdc by the resistor divider consisting of R11, R20, and potentiometer R24. C9 is an output filter capacitor. This 13.8 Vdc drives the audio section of the 24-30. It is also fed into voltage regulator U11. The output voltage of U11 is set to 5 Vdc by the resistor divider network consisting of R12, R21, and potentiometer R25. C11 is an output filter capacitor. The 5 Vdc powers the digital section of the 24-30. The 13.8 Vdc is also fed to voltage regulator U10 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 24-30 can be operated from a 13.8 Vdc supply through connector J8. Diode D3 prevents a reverse polarity from harming the 24-30.

4.2 Receive Audio

Receive audio from the receive amplifier U4B in the line interface section is passed to the receive audio adjustment potentiometer R79. 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 U29A and U31A and their associated components. The AGC output is at pin 1 of U31A. The audio input on pin 3 of U29A 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 U29A. The attack time of the AGC is determined by C41 and the recovery time is determined by C47.

From pin 1 of U31A the audio signal goes to pin 8 of audio gate U27C. This gate is normally enabled unless the parallel detect option board is installed on P2. 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 U27C, the audio goes to pin 3 of U27B. This is the audio mute gate. This gate is normally enabled to allow audio to pass unattenuated to pin 3 of U34 which is the electronic potentiometer and its associated circuitry. Resistor R107 prevents the audio from being turned completely off by the volume control. However, when the MUTE button on the front panel is pressed, this gate will be disabled. This puts resistor R68 in series with the audio path which will mute the audio by about 20 dB. If it is desired to completely disable the audio instead of just reducing the level by 20 dB, remove R68.

The audio then passes out pin 5 of U34 and into the amplifier U30A. The audio goes to the earpiece level adjustment potentiometer R92. The audio is then fed to the earpiece driver U30B. The audio is passed to the handset earpiece at pin 6 of J6.

From the audio amplifier U30A, the audio also passes to pin 1 of U27A. This audio gate enables or disables the speaker output. The output of the speaker enable gate (pin 2 of U27A) is fed to the speaker level adjustment potentiometer R70. The audio is then fed into the speaker driver U28. U28 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 J5, the speaker connector. Jumper J4 is removed only if an external speaker is installed.

4.3 Transmit Audio

Microphone audio from the handset or the desk microphone comes from pin 1 of J6. The microphone is biased by resistors R120 and R125. The microphone audio then passes through an electrostatic discharge protection circuit consisting of D34 and D35. The audio is then compressed by the compression circuit consisting of U29B and U31B and their associated components. The compression circuit output is at pin 7 of U31B. The audio signal fed back from pin 7 of U31B to pin 13 of U29B is rectified internally and controls the gain of the internal gain cell that is connected between pin 9 and pin 11 of U29B. The attack time is determined by C73 and the recovery time is determined by C67.

From pin 7 of U31B the signal goes to the 2175 Hz notch filter consisting of U36A and U36B and their associated components. Potentiometers R119 and R130 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 to the microphone mute audio gate pin 11 of U27D. This gate allows muting of the microphone audio when necessary to eliminate any audio interference with the keying and function tones. Pin 10 of U27D goes to the transmit audio adjustment potentiometer R52.

U4A is a summing amplifier that sums the transmit audio and the function tones. The function tones are generated by U3 and associated circuitry. The output of U4A goes to the line driver U8 which drives the line coupling transformer T2. JP3 is used to change the 4-wire transmit pair line impedance or the 2-wire line impedance from about 600 ohms when JP3 is installed to greater than 5k ohms when JP3 is removed.

4.4 Tone Control Section

Frequency selection is determined by the keypad board. The selection feeds into U9 and U13 AND Gates. U9 is used to control PTT and 13 is used to control the monitor function. After a frequency is selected and PTT is activated, the output of the appropriate gate of U9 goes high. This activates the corresponding gate of U22 which selects the correct resistor value for the required function tone frequency. As well as activating an input to U7B or U7C. The output of U7A goes high to start the tone timer sequence which is controlled by U2. U2A's output goes active for 140 mS (this can be seen at TP 3) turning on U1D to allow the +10dB guard tone (which is 2175Hz generated by U3) to be sent to the line for 140mS. U2B is then triggered by U2A's timer

expiring and it activates a 40mS pulse (TP 4) to turn on U1A and also directs U3 to generate the appropriate function tone. U1A allows the 0dB function tone to be sent to the line. At the end of the 40mS pulse, U1B is held on by U22F allowing the -20dB 2175Hz hold tone to be sent to the line as long as PTT is held. U22F also drives Q3 which is used to turn on the TX LED on the Keypad board.

When monitor is activated, the corresponding output of U13 goes high. This drives U5 and the same process goes on as above with the exception that U22F is not activated so there is no hold tone sent to the line.

4.5 Parallel Detect Option Board

Line audio enters the parallel detect option board through pin 6 of J2 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.

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.

4.6 Keypad Board

The keypad board has several jumpers to configure various applications. Removing JP 10 disables the mute function from the keypad. Removing JP 1 disables the intercom function. Installing JP 2 through JP 5 enable frequency 1 through 4 respectively. JP 6 through JP 9 determine which frequency the 24-30 powers up in. JP 6 is F1, JP 7 is F2, JP 8 is F3, JP 9 is F4.

With all features and frequencies enabled the basic operation is described below. Upon activation of a frequency select button, that selection is latched by U5 or U6 depending on what frequency was selected. At the same time, the previous frequency selection is cleared out of the latches. This is done by U2, 3, and 4. The output of the activated latch drives U1 which controls the LED indicator associated with the appropriate frequency selection. The latch also signals the main board as to what frequency has been selected via the 16 position connector J1. If intercom has been selected, all latches are cleared and U7 and U1 activate the intercom LED. As the mute button is activated and de-activated, the latch U8A activates the mute LED as well as signaling the main board to mute the speaker. The monitor and the transmit LED's are controlled by the main board. The monitor button and the volume control buttons connect directly to the main board.

4.7 Line Interface

The line is connected to the 24-30 through the back panel modular jack J2. The 24-30 can be configured in 2-wire or 4-wire. The lines are protected from transients by surge arresters SG3 – SG6.

5.0 PARTS LISTS

24-30 Main Board

101-2430M

Item	Reference	Description	Part No.	Qty
1	C1,2,6,13,17,19,21,27,29,30, 31,32,35,37,41,45,46,51,53, 60,63,64,71	Cap Mono .1uF	372-5104	23
2	C3,4,7,16,24,25,42,48,52,59, 66,68,69,81	Cap Tant 1uF 16V	392-2105	14
3	C5,12,15,18,20,26,36,43,56, 65,75,80	Cap Tant 10uF 16V	394-2106	12
4	C8,28,34,70	Cap Tant 2.2uF 16V	393-2225	4
5	C9,11	Cap Tant 22uF 16V	395-2226	2
6	C10	Cap Elec 2200uF 35V	360-0009	1
7	C14	Cap Mono .015 ulst	378-5153R	1
8	C22,33	Cap Elec 1000uF 16V	360-0012	2
9	C23,50,58,62	Cap Mono .001uF	372-5102	4
10	C38	Cap Elec 470uF 16V	360-2477	1
11	C39,40,44,49,54,61,73,79	Cap Mono .47uF	372-2474	8
12	C47,67	Cap Tant 33uF 16V	395-3336	2
13	C57	Cap Mono .022uF	372-5223	1
14	C72,74,76,77	Cap Mono .01uF ulst	371-5103	4
15	C78	Cap Mono 100pF	372-5101	1
16	D3	Diode 1N4003 Horiz	110-0002	1
17	D14,15	Diode Zener 1N5428 18V	111-0019	2
18	D16	Diode Zener 1N5226 3.3V	111-0015	1
19	D18	Diode Zener 1N5235 6.8V	111-0012	1
20	D23,24,25,26,27,28,29,30,31, 32,33, 34,35	Diode MMBD4148 SMT	110-0018	13
21	F1	Fuse 1 Amp PC Mnt Slow	290-0011	1
22	J1	Swichcraft Pwr Jack RA	234-0114	1
23	J2,6	Jack Modular 6 Loaded	234-0066U	2
24	J3	16 Pos DIP Socket	220-0001	1
25	J4	Jumper Post 2 Pin	231-1002	1
26	J5	Conn 2 pos Lock Hdr	234-0019	1
27	J7	Conn 5Pos 1 Lock Hdr	233-0034	1
28	J8	2 Pin .156 Header	231-1067	1
29	JP1,2,3,4,5,6,7,8,9,10,11,12,15, 16	Jumper Post 2 Pin	231-1002	14
30	JP13,14	Jumper Post 3 Pin	231-1003	2

31	P2	CONN .156 Lock Hdr	231-0043	1
32	Q1,2,3,4,5,6,7,9	Trnstr MMUN2211 SMT	180-0040	8
33	Q8,10	Trnstr MMUN2111 SMT	180-0042	2
34	R1,6,9,15,29	Pot 50K 22 Turn Top	352-0002	5
35	R2,16	Surface MT 5.1K Res	321-1512	2
36	R3,4,8,19,33,45,84,87,107,120	Surface MT 1K Res	321-1102	10
37	R5	Surface MT 75K Res	321-1753	1
38	R7	Surface MT 27K Res	321-1273	1
39	R10,90,99,112	Surface MT 100K Res	321-1104	4
40	R11,12	Surface MT 243 1% Res	320-2431	2
41	R13,32,125	Surface MT 620 Res	321-1621	3
42	R14,18,28,37,38,42,53,54,55, 58,59,63,65,69,72,76,81,85,86, 88,98,102,103,104,105,109,110, 111,115,122,123,127,137	Surface MT 10K Res	321-1103	33
43	R17	Surface MT 200 Res	321-1201	1
44	R20	Surface MT 2.32K 1% Res	320-2322	1
45	R21	Surface MT 604 1% Res	320-6044	1
46	R22,80	Surface MT 6.2K Res	321-1622	2
47	R23	Surface MT 560ohm Res	321-1561	1
48	R24,25	Pot 200 1 Turn	351-1251	2
49	R26,34,56	Surface MT 29.4K Res	320-2942	3
50	R27,35,40,47,57	Pot 5K 22 Turn Top	352-0001	5
51	R30,49,50,83,95,121,126,131, 135	Surface MT 47K Res	321-1473	9
52	R31,93	Surface MT 330 Res	321-1331	2
53	R36	Surface MT 365 1% Res	320-3651	1
54	R39,46	Surface MT 33.2K 1% Res	320-3322	2
55	R41	Surface MT 274 1% Res	320-2741	1
56	R43,96	Surface MT 3.3K Res	321-1332	2
57	R44	Surface MT 8.2K Res	321-1822	1
58	R48,100,101,133,134	Surface MT 12K Res	321-1123	5
59	R51	Surface MT 1.24K 1% Res	320-1241	1
60	R52	Pot 100K 1 Turn Top	351-1104	1
61	R60	Surface MT 2.2K Res	321-1222	1
62	R61	Surface MT 39K Res	321-1393	1
63	R62	Pot 10K 22T Top	352-1103	1
64	R64,82,136	Surface MT 47.5K 1% Res	320-4752	3
65	R66,89	Surface MT 45.3K 1% Res	320-4532	2
66	R67	Surface MT 220 Res	321-1221	1
67	R68,108	Surface MT 33K Res	321-1333	2
68	R70,92	Pot 2K 1 Turn Mini Top	351-1202	2
69	R71,74	Surface MT 2.2 Res	321-1226	2
70	R73	Surface MT 47 Res	321-1470	1
71	R75,114	Surface MT 3.9K Res	321-1392	2
72	R77	Surface MT 470K Res	321-1474	1

73	R79	Pot 25K 1 Turn Mini Top	351-1253	1
74	R91	Surface MT 390K Res	321-1394	1
75	R94	Surface MT 13.7K 1% Res	320-1372	1
76	R97,106	Surface MT 4.7K Res	321-1472	2
77	R113	Surface MT 330K Res	321-1334	1
78	R116	Surface MT 6.8M Res	321-1685	1
79	R117	Surface MT 7.32K 1% Res	320-7321	1
80	R118	Surface MT 6.81K 1% Res	320-6811	1
81	R119,130	Pot 2K 22 Turn Top	352-0004	2
82	R124	Surface MT 1.78K 1% Res	320-1781	1
83	R128,132	Surface MT 46.4K 1% Res	320-4642	2
84	R129	Surface MT 2.67K 1% Res	320-2672	1
85	SG1,2,3,4,5,6	Varistor 30V	300-0005	6
86	T1	Transformer 600 Ohm Audio	410-0005	1
87	T2	Transf 600P 600/600S	410-0011	1
88	TP1,2,3,4,5,6,7,8,9,10,11	Test Point Loop	200-0013	11
89	U1,14,27	IC 4066 SMT	131-1028	3
90	U2	IC 4528 SMT	131-1036	1
91	U3	IC 2206 SMT	131-1037	1
92	U4,30,36	IC TL082 SMT	131-1007	3
93	U5,7	IC 74HC32 SMT	131-1031	2
94	U6	IC LM317K	130-0247	1
95	U8	IC 34119 SMT	131-1039	1
96	U9,13	IC 74HC08 SMT	131-1034	2
97	U10	IC LM317LZ	130-0236	1
98	U11	IC LM317T	130-0237	1
99	U22	IC 7404 SMT	131-1025	1
100	U28	IC TDA2003	130-0248	1
101	U29	IC 572 SMT	131-1038	1
102	U31	IC CA3260E SUPOP AMP	130-0229	1
103	U32	IC 74HC14 SMT	131-1048	1
104	U33	IC 555 SMT	131-1041	1
105	U34	IC X9C103P	130-0243	1

**24-30 Keypad Board
101-2430K**

Item	Reference	Description	Part No.	Qty.
1	C1,2,3,4,5,6,7,9,11,12,13	Cap Mono .1uF	372-5104	11
2	C8	Cap Tant 1uF 16V	392-2105	1
3	C10	Cap Tant 10uF 16V	394-2106	1
4	D1,2,3,4,5,6,7,9,10,11	Diode LED Red Vert T-1 pkg.	112-0012	10
5	D8	Diode LED Red Rectangle	112-0016	1
6	J1	16 Pos Cable Assy.	222-0025	1
7	JP1,2,3,4,5,6,10	JMPR WR .1 X .25	265-0018	7
8	Q2	Trnstr MMUN2111 SMT	180-0042	1
9	Q3,4	Trnstr MMUN2211 SMT	180-0040	2
10	R1,2,3,4,6,12	Surface MT 330 Res	321-1331	6
11	R7,8,9,10,11,13,14,15	Surface MT 10K Res	321-1103	8
12	U1	IC 7404 SMT	131-1025	1
13	U2,3,4	IC 74HC08 SMT	131-1034	3
14	U5,6,8	IC 74HC74 SMT	131-1033	3
15	U7	IC 74HC32 SMT	131-1031	1
16	U9	IC 74HC14 SMT	131-1048	1

**24-30 Cabinet Parts
101-2430C**

Item	Description	Part No.	Qty.
1	REMOTE BASE TOP	900-0523	1
2	REMOTE BASE BOTTOM	900-0524	1
3	12 HOLE PANEL FACE	900-0522AS	1
4	CRYSTAL BEZEL	900-0519E	1
5	BUTTON F1	900-0518T	1
6	BUTTON F2	900-0518U	1
7	BUTTON F3	900-0518V	1
8	BUTTON F4	900-0518W	1
9	BUTTON MON	900-0518O	1
10	BUTTON MUTE	900-0518J	1
11	BUTTON INTCM	900-0518D	1
12	BUTTON VOL UP/DN	900-0518B	2
13	BUTTON PLAIN	900-0518	3
14	KEYPAD 10 POS	203-0020	1
15	KEYPAD VOL UP/DN	203-0018	1
16	SPEAKER 3" 4OHM	901-0013	1
17	WIRE 22GA. GRN	222-0016	2
18	RECEPT 2 POS.	234-0033	1
19	RUBBER FEET	203-1054	4
20	INSERT 6-32 x 1/4	200-0069	19
21	SCREW #4 x 1/4 tap	199-4029	21
22	SCREW #6-32 x 1/4 black	199-3080	6
23	SCREW #6-32 x 3/8 slot	199-3071	2
24	PAL NUT	199-0040	4
25	WALL TRANSFORMER	902-0014	1
26	LOGO EMBLEM		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

**Handset Option
101-2430H**

Item	Reference	Description	Part No.	Qty.
1		24-30 HANDSET PCB	900-0288	1
2	C1	.001uF MONO CAP	362-0006	1
3	C2	.0047uF MONO CAP	362-0008	1
4	C3	1uF / 35V TANT CAP	390-0003	1
5	C4	47uF /16V TANT CAP	390-2476	1
6	J1	3/8 HEAT SHRINK TUBE	199-6099	1
7	J1	6 POS MODULAR JACK	234-0066	1
8	J1	COIL CORD 6 POS MOD	260-0023	1
9	J3	ALPHA CABLE	800-0037	1
10	J3	DH-32 EARPIECE ELEM	901-0009	1
11	J3	SPEAKER CLOTH	901-0016	1
12	MK1	SCREW 2x1/4 PHL P	199-1002	2
13	MK1	RUBBER SHOCK MOUNT	901-0011	1
14	MK1	EM-60 MIC ELEMENT	901-0014	1
15	Q1,Q2	MPS 8098 TRANS	180-0009	2
16	R1	180 OHM 5% 1/4W RES	312-0025H	1
17	R2	15 OHM 5% 1/4W RES	312-0009H	1
18	R3	10K OHM 1 TURN MINI POT	351-1103	1
19	R4	470 OHM 5% ¼ W RES	312-0028H	1
20	R5	2.2K OHM 5% 1/4W RES	312-0007H	1
21	R6	1K OHM 5% 1/4W RES	312-0019H	1
22	R7	10 OHM 5% 1/4W RES	312-0038H	1
23	S1	PTT SWITCH	611-0031	1
24	S2	REED SWITCH	611-0030	1
25		HANDSET TOP	900-0514	1
26		HANDSET BOTTOM	900-0515	1
27		PTT BUTTON	900-0516	1
28		HANDSET RETAINER	900-0517	2
29		HANDSET WEIGHT	900-5006	1
30		HANDSET STYRO	201-0063	1
31		SCREW #4 x ½ TAP	199-4027	4
32		HANDSET CRADLE	900-0525	2
33		MAGNET, HUHS	200-0094	1
34		SCREW #6-32 x ¼ PH BLK	199-3080	4

Desk Mic Option

Item	Description	Part No.	Qty.
1	DESK MIC	900-0399	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'

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

Wall Mount Option

Item	Description	Part No.	Qty.
1	WALL BRACKET	900-5104A	1
2	6 x ½" SHEET MTL SCREW	199-4010	4
3	6 x 1" SHEET MTL SCREW	199-4011	4
4	WALL ANCHOR	199-4012	4