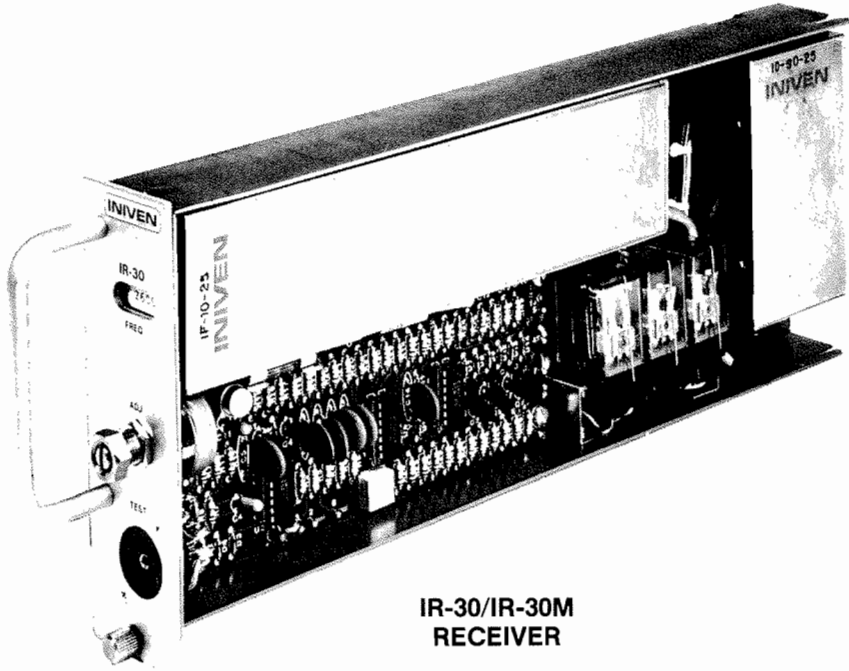


INIVEN™

IR-30/IR-30M
FSK TONE
RECEIVER

INSTRUCTION MANUAL



IR-30/IR-30M
RECEIVER

1. DESCRIPTION

1.1 The IR-30 is a frequency-shift-keyed (FSK) tone receiver intended for remote supervisory control, telemetry, and data transmission applications. In response to a received MARK, SPACE or CENTER tone within its specified pass-band, the IR-30 produces output contact closures (via relays) or voltage level shifts (via voltage output adapters.)

1.2 Receiver operating frequency and pass-band are determined by a plug-in filter module (IF-10)* and a plug-in discriminator (ID-30). The IF-10* bears a number denoting its center frequency (in Hertz). This number appears in a front-panel cutout when the filter module is installed.

1.3 When an IR-30 receiver is used in conjunction with an IT-30-3 FSK transmitter, it is modified to slow the release time of the MARK and SPACE output relays. This is necessary because when the MARK and/or SPACE functions of the IT-30-3 are keyed, the resultant output voltage is a series of pulses rather than a continuously keyed voltage. In order to keep the receiver relays energized during the "off" intervals between the pulses being received, 250 μ f capacitors are connected directly across the coil windings of the MARK and SPACE relays. This modified version of the IR-30 receiver is the model IR-30M.

2. SPECIFICATIONS

Sensitivity: Continuously adjustable to -45 DBM

Input Impedance: 600 ohms nominal in passband with rising characteristics out of band.

Output: Contact closure or logic level of 9 to 12 volts

Output Devices:

Relay Contacts— 5 A @ 29 VDC (non-inductive)
2 A @ 117 VAC (non-inductive)

Voltage Adapters—

IA-10: Inverted, 150 mA @ 12 V, inductive load
IA-11: Non-inverted, 40 mA @ 10 V, inductive load
IA-20: Inverted, 40 mA @ 10 V
IA-23: Non-inverted, 50 mA @ 12 V,
(35 VDC max with external power supply)
IA-30: Non-inverted, filtered, 40 mA @ 10 V
IA-66: Inverted, logic output, squared up
IDY-1: Time delay, 1-10 sec., non-inverted,
75 mA @ 12 V (other timing available)
IOA-1: Inverted or non-inverted, optically isolated,
100 mA @ 20 V

*Only Iniven's unique filter designs reject adjacent channel band-edge transmission frequencies by a minimum of 40 DB, providing maximum attenuation of mid-points between adjacent channels. (See figure for typical filter curves.)

IR-30 and IR-30M

Receiver Filter IF-10* (see figure curves)

Channel Spacing (Hz)	Passband 3 DB Bandwidth	Adjacent 40-45 DB Channel Rejection
100	52	75
120	64	180
170	87	254
240	127	360
340	175	514

Pulse Rate:

- 30 PPS max @ 100 Hz spacing
- 40 PPS max @ 170 Hz spacing

Power Requirement: 12 VDC \pm 10%; 102 mA with carrier output,
140 mA at MARK or SPACE

Temperature Range: -30°C to $+60^{\circ}\text{C}$

Protection: 0.5 A fuse located internally (on printed circuit board)

A1); protects against excessive current drain within receiver module

Weight: 5 lb approx. (2.2 Kg)

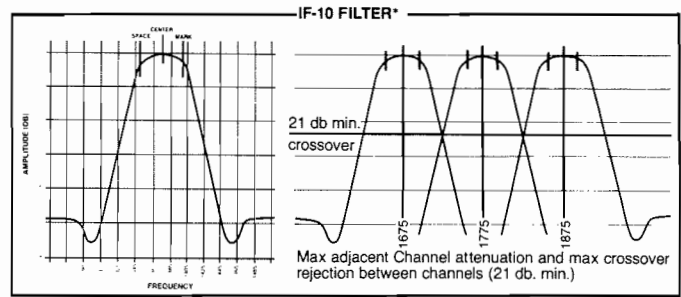
3. FEATURES

3.1 Sensitivity Adjustment; a sensitivity adjustment (ADJ) control is accessible on the front panel of the IR-30 and IR-30M. This control allows the receiver to be operated with a wide range of input signal levels.

3.2 Test Socket: a TEST socket is located on the front panel of the receiver. The TEST socket provides access to the following functions:

PIN NUMBER	FUNCTION
1 and 2	Tone input
3	Positive side of 12 VDC power supply input
4	Negative side of 12 VDC power supply input
5 and 3	Output of IA-10 voltage adapter (MARK) — when used
6 and 3	CARRIER detector output voltage
7 and 3	Output of IA-10 voltage adapter (SPACE) — when used
8 and 4	MARK DC amplifier output
9 and 4	SPACE DC amplifier output

3.3 Noise Protection — an integrating capacitor (C_{INT}) can be connected externally into the carrier detector circuit to ensure fast relay dropout on channel failure and slow relay pull-in on recovery of a failed channel. Slow pull-in protects against false operation of the carrier detector relay due to noise on a failed channel.



*Only Iniven's unique filter designs reject adjacent channel band-edge transmission frequencies by a minimum of 40 DB, providing maximum attenuation of mid-points between adjacent channels.
(See figure for typical filter curves.)

4. THEORY OF OPERATION (See Figure 1)

4.1 The IR-30 consists of an input bandpass filter, a preamplifier-limiter, discriminator, phase detector (SPACE and MARK), active lowpass filter, lost carrier circuit, three output DC amplifiers and a voltage regulator.

4.2 Tone input from the communication line is applied to the IF-10 (Bandpass) filter, a frequency-selective network which passes only the desired frequencies and rejects all other tone signals on the same communication line. This filter typically has 40db adjacent channel rejection.

4.3 The filter output signal appears across the level adjustment potentiometer R1 which is located on the front panel. A portion of the input signal is amplified by the U2-3 and diodes limiter U2-1.

4.4 U2-1 takes the input sine wave signal from U2-3 and converts it to a square wave. The output signal is fed to Q1 (emitter follower) which in turn drives the ID-30 (discriminator), U2-2 (hard limiter) and U2-4 amplifier for the carrier circuit. The outputs of U2-2 and ID-30 after being hard limited by U3-4 are applied to U4-1 (phase detection).

4.5 The discriminator is a two resonant circuit whose output will shift the phase linearly with respect to the input signal by a certain degree. When the CARRIER frequency is received, the discriminator shifts the phase of its input signal (center frequency) by 90 degrees. This signal is amplified by U3-4 and is applied to the U-4 phase detector with the signal from U2-2. The output signal of the center frequency being received is a twice-carrier symmetrical square wave whose average signal two is one-half signal swing.

4.6 When the SPACE frequency is received, the discriminator generates an output signal with a phase shift of less than 90 degrees. After amplification to a square wave by U3-4, this signal and the signal from U2-2 are applied to phase detector U4-1. The output signal is again twice the carrier frequency, but now the signal is a non-symmetrical square wave whose average signal is less than one-half signal swing.

5. INSTALLATION

5.1 Mechanical Installation

The IR-30 and IR-30M are shipped with modules Z1 and Z2 in place, and the terminal block assembly plugged into connector TB1. Four 6-32 screws are partially screwed into the terminal block.

The receiver is normally mounted in an IX-3 or IX-11 mounting frame, or in a cradle-type frame. To install the receiver into the frame, proceed as follows:

- (1) Remove four 6-32 screws from terminal block.
- (2) Push the receiver, with terminal block attached, into the frame.
- (3) Secure the receiver to the frame, using the knurled retaining screw on the front panel. Precautions must be taken when aligning the front panel screw with the hole in the frame to prevent damage to the front panel.
- (4) At the rear of the frame, use the 6-32 screws provided to fasten the terminal block assembly securely to the frame. The IR-30 or IR-30M can now be removed from (and installed into) the frame by using the front-panel knurled retaining screw.

5.2 Terminal Block Connections

All electrical connections are made to the terminal block at the rear of the frame (see Figures 1 and 2):

TERMINAL	FUNCTION
1	Positive (+) side of 12 VDC power supply input
2	Negative (-) side of 12 VDC power supply input
3 and 4	Tone input

NOTE

When using the IA-10 telemetering adapters in place of the output relays, outputs are taken from the terminals as follows:

- MARK 10 (-) 1 (+)
- SPACE 7 (-) 1 (+)
- CARRIER 15 (-) 1 (+)

Load resistance must be at least 80 ohms. (Terminal 16 is internally connected to terminal 1 when the IA-10 is plugged into the SPACE relay socket.)

When using the IA-11 telemetering adapters in place of the output relays, outputs are taken from the terminals as follows:

- MARK 9 (-) 8 (+)
- SPACE 6 (-) 5 (+)
- CARRIER 14 (-) 13 (+)

Output will be approximately 12 volts provided the external load is 430 ohms or greater. If the external load is less than 430 ohms, the output will be constant current 28 to 35 mA. Loads smaller than 200 ohms must not be used. (Terminals 9, 6 and 14 are internally connected to pin 2 when the adapters are plugged in.)

TERMINAL	FUNCTION
5	N.C. SPACE Output Relay Contacts
6	Common (Relay energizes only on SPACE frequency — refer to Note above)
7	N.O. frequency — refer to Note above)
8	N.C. MARK Output Relay Contacts
9	Common (Relay energizes only on MARK frequency — refer to Note above)
10	N.O. frequency — refer to Note above)
11	Common Neutral Output Relay Contacts (contact opens only on MARK or SPACE frequency)
12	N.C. CARRIER Output Relay Contacts
13	N.C. CARRIER Output Relay Contacts
14	Common (Relay is energized on MARK, SPACE and Neutral, drops out on Channel Failure — refer to Note above)
15	N.O. Neutral, drops out on Channel Failure — refer to Note above)
16	Negative (-) side of Integrating Capacitor (C _{INT}) (refer to para. 5.3)

5.3 Noise Protection

To improve noise immunity of the receiver, an integrating capacitor (C_{INT}) may be connected between terminal 16 (-) and terminal 1 (B+) of the terminal block. This capacitor will introduce approximately 1.5 milliseconds of delay for each microfarad of capacitance. The capacitor should be rated at 6 volts. Polarity must be observed when installing the capacitor.

5.4 Sensitivity Level and Balance Adjustment

The IR-30 Receiver sensitivity and balance adjustment procedure uses two potentiometers. The ADJ potentiometer (see figure 3) for adjusting sensitivity and potentiometer A1R26 (see figure 4) setting MARK/SPACE balance. The sensitivity setting provides for a minimum of 6 DB dynamic range to offset any variations in transmission attenuation. The balance adjustment procedure provides for settings of equal MARK/SPACE amplitude under all maintained and most pulsing signal outputs.

It is required that a previously adjusted operating transmitter of the same frequency be used to provide the signal to make these adjustments. Refer to transmitter manual IM-2003 for methods of keying. If no matching transmitter is available, the transmitter must be simulated using an audio frequency signal generator, frequency counter and AC (dbm) voltmeter.

NOTE

Plug the matching transmitter into the frame at the transmitting site. With power applied CARRIER frequency is normally "on line."

The following equipment is required to set the balance and sensitivity of the IR-30 and IR-30M FSK Tone Receivers.

- Test Adapter INIVEN
- Extender Module INIVEN

Multimeter Simpson Model 260 (or equivalent)
 Transmitter INIVEN IT-30 (or equivalent)

5.5 Adjustment Procedure. Adjust the receiver sensitivity level and MARK/SPACE reception balance as follows:

NOTE

If Test Adapter is not available, take measurements directly from TEST socket.

- (1) Loosen captive retaining screw and remove receiver from frame.
- (2) Install Extender Module in space vacated by receiver.
- (3) Plug receiver into Extender Module.
- (4) Insert Test Adapter plug into receiver TEST socket.

NOTE

Be certain to observe polarity when obtaining voltage measurements.

- (5) Set Multimeter to 10 VDC scale and insert test leads into jacks 3(+) and 6(-) of Test Adapter.
- (6) While observing Multimeter, rotate the receiver ADJ potentiometer fully counterclockwise. Then slowly rotate the potentiometer clockwise until the Multimeter indication fails to increase proportionally with rotation of potentiometer. This is the sensitivity saturation point of the receiver. Rotate potentiometer approximately 1/8-turn counterclockwise below saturation point indication.
- (7) Set balance potentiometer A1R26 to mid-point of its rotational extremities.
- (8) Remove Multimeter test leads from Test Adapter.
- (9) Insert Multimeter test leads into jacks 4(-) and 8(+) of Test Adapter.
- (10) Key a MARK signal on the matching transmitter.

6. MAINTENANCE

This section contains corrective maintenance procedures that can be used in conjunction with the balance and sensitivity level adjustment procedures in Section 5.

6.1 The module you have purchased has been thoroughly inspected and tested in accordance with our specifications. The modules does not require preventive maintenance. However, it is recommended that signal levels be checked and adjusted every 6 months.

6.2 In-plant quality assurance procedures specify transmission levels that vary for "hardware" and "system" orders. Testing the modules, in either case, is over a transmission link simulating a telephone circuit (600 ohms impedance) with a loss of -25 dbm from origin to destination. The attenuation and

(11) While observing Multimeter, rotate ADJ potentiometer to obtain an indication of approximately 6 volts.

(12) Remove test lead(+) from jack 8 of Test Adapter and insert into jack 9(+).

(13) Key a SPACE signal on the matching transmitter and note voltage indication.

(14) If voltage indication obtained is approximately 6 volts the reception balance has been properly adjusted; if not, proceed to step (15).

(15) Repeat steps 9, 10, 12, and 13 as necessary to obtain approximately equal indications as a result of MARK and SPACE keying, then proceed to step (16).

(16) Remove Multimeter test leads from Test Adapter and insert test leads into jacks 3(+) and 6(-).

(17) Rotate receiver ADJ potentiometer clockwise to saturation point.

(18) Rotate ADJ potentiometer approximately 1/8-turn clockwise beyond sensitivity saturation point. Sensitivity level has been properly adjusted.

5.6 Electrical Grounding

To reduce ground loop interference effects, it is necessary that the chassis of each tone unit be grounded. When the tone unit is mounted in an IX-3, IX-11 or cradle-type frame, a good earth ground on the relay racks or other equipment on which the frame is installed is necessary. Station batteries or other power supplies with grounded negative or positive leads can be employed in place of regular INIVEN™ power supplies.

When individual tone receivers are operated out of the frame, the receiver chassis should be connected to the earth ground.

frequency response of the circuit is due to a number of factors which cannot be duplicated at the factory. The factors include:

- (1) Distance between stations.
- (2) Diameter and length of wire used in transmission circuit.
- (3) Actual impedance of transmission circuit.
- (4) Inductance and capacitance of transmission circuit.

6.3 Quick-Check — Table 6-1 contains quick-check procedures designed to isolate trouble in the majority of cases. When use of these procedures fails to locate the cause of the malfunction, refer to Section 4 for detailed theory of operation and the referenced schematics as an aid in signal tracing.

Table 6-1. Quick Check Malfunction Isolation

SYMPTOM	POSSIBLE CAUSE	REMEDY
SYSTEM CHECKS		
No operation.	Power failure of commercial power or IP power supply.	Check voltage.
	Transmission circuit failure.	Call telephone company or responsible agency.
Intermittent operation of some tone receivers.	Signal level shifted due to transmission circuit change.	Check all tone receivers to see if sensitivity has been affected. If so, notify responsible agency of change in circuit attenuation.
	Transmitter outputs set too high.	Check with telephone company or responsible agency for correct settings. For quick reference refer to Table 7-1.
Tone receivers in "off" condition exhibit erratic and unsteady symptoms when checked using multimeter and Test Adapter.	Telephone company circuit trouble.	Call telephone company and advise of problem.
	Grounded telephone company circuit or defective filter or oscillator.	Determine if ground is on telephone line or due to tone equipment by measuring each side of line to ground with line connected and then disconnected from equipment. If ground is on line, call telephone company. If ground is due to tone equipment, it may be caused by a defective oscillator or filter. Pull out each module in turn while monitoring ground with multimeter until absence of low resistance indication signifies module containing defective filter or oscillator.
IR-30/IR-30M CHECKS		
No sensitivity or detector voltage at pins 6 and 3 of TEST socket.	Fuse defective.	Replace fuse.
	Filter defective or discriminator defective.	If same frequency not available for either filter or discriminator, replace both with matched pair and check for output.
No MARK or SPACE output but CARRIER relay operates.	Q4 defective.	Replace transistor.
	Discriminator defective.	Replace with discriminator of same frequency. If not available replace both discriminator and filter with matched pair.
No MARK output (relay or adapter)	Q7, Relay or adapter defective.	Replace transistor, relay, or adapter.
No SPACE output (relay or adapter)	Q6, Relay or adapter defective.	Replace transistor, relay, or adapter.
No CARRIER Detector (relay or adapter)	Q5 or Relay defective.	Replace transistor, relay, or adapter.
MARK output with no tone input	Q7 defective.	Replace transistor.
SPACE output with no tone input	Q6 defective.	Replace transistor.
CARRIER Detector Output with no tone input	Q5 defective.	Replace transistor.
Insufficient voltage to energize MARK relay but SPACE operates or vice versa.	Balance potentiometer on printed circuit board improperly adjusted.	Adjust balance in accordance with procedures in Section 5.

7. PARTS LIST

The following parts list is included to facilitate maintenance of the IR-30 and IR-30M tone receivers. All parts are listed in the order of their reference designations, as applicable. Figure 3 depicts the parts for the major components of the receiver; Figure 4 exhibits parts for printed circuit board A1.

7.1 IR-30/IR-30M RECEIVER ASSEMBLY (See Figure 2)

The "Usable on Code" column identifies parts/assemblies which apply to only one particular receiver model. If the "Usable on Code" column is left blank, the part/assembly applies to all models.

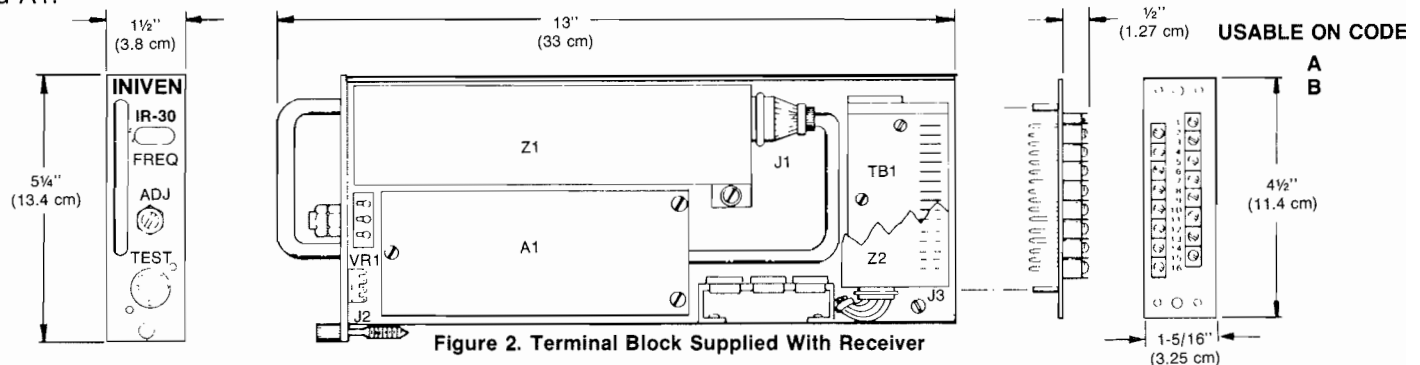


Figure 2. Terminal Block Supplied With Receiver

Figure 2. IR-30 and IR-30M FSK Receivers — Dimensions and Component Identification

REF DESIG	DESCRIPTION	QTY	USABLE ON CODE	PART NUMBER	MFR
	IR-30 RECEIVER ASSY		A	CC1091-00	INIVEN
	IR-30M RECEIVER ASSY		B	CC1109-00	INIVEN
	• HANDLE	1	A	230-18AL832C	Promptus Elec.
	• FACEPLATE	1	A	06B1091-OIN	INIVEN
	• FACEPLATE	1	B	06B1109-OIN	INIVEN
	• SCREW, Captive	1		08A1088-OIN	INIVEN
J1, J3	• CONNECTOR, Receptacle	2		401A2	Connector Corp.
	• BOOT, Socket	2		C860 w/o H	Methode
J2	• CONNECTOR, Receptacle	1		417A4	Connector Corp.
VR1	• RESISTOR, Variable, 250 ohm, 2W	1		380C2-250-Z	Clarostat
TB1	• CONNECTOR BOARD ASSY	1		CC1101-00	INIVEN
Z1	• FILTER ASSY	1		*IF-10-XXXX-YY	INIVEN
Z2	• DISCRIMINATOR ASSY	1		*ID-30-XXXX-YY	INIVEN
A1	• PRINTED CIRCUIT BOARD ASSY (See figure 4 for breakdown)	1	A	AD1091-OIN	INIVEN
A1	• PRINTED CIRCUIT BOARD ASSY (See Figure 4 for breakdown)	1	B	AD1109-OIN	INIVEN

*For complete ordering number substitute frequency for XXXX and substitute shift for YY.

Table 7-2. List of Available Frequencies

Channel Center Frequency (Hz)					
Series Half Band Width	25	30	35 or 42	60	85
Channel Spacing (Hz)	100	120	170	240	340
Baud Rate	50	60	80	120	170
Channel No. -01	365	420	425	480	850
-02	465	540	595	720	1190
-03	565	660	765	960	1530
-04	665	780	935	1200	1870
-05	765	900	1105	1440	2210
-06	865	1020	1275	1680	2550
-07	965	1140	1445	1920	2890
-08	1075	1260	1615	2160	3230
-09	1175	1380	1785	2400	
-10	1275	1500	1955	2640	
-11	1375	1620	2125	2880	
-12	1475	1740	2295	3120	
-13	1575	1860	2465	3360	
-14	1675	1980	2635		
-15	1775	2100	2865		
-16	1875	2220	2975		
-17	2000	2340	3145		
-18	2100	2460	3315		
-19	2200	2580	3485		
-20	2300	2700			
-21	2400	2820			
-22	2500	2940			
-23	2600	3060			
-24	2700	3180			
-25	2800	3300			
-26	2900	3420			
-27	3000				
-28	3100				
-29	3200				
-30	3300				
-31	3400				
-32	3500				

7.2 Ordering Information

When ordering please specify:

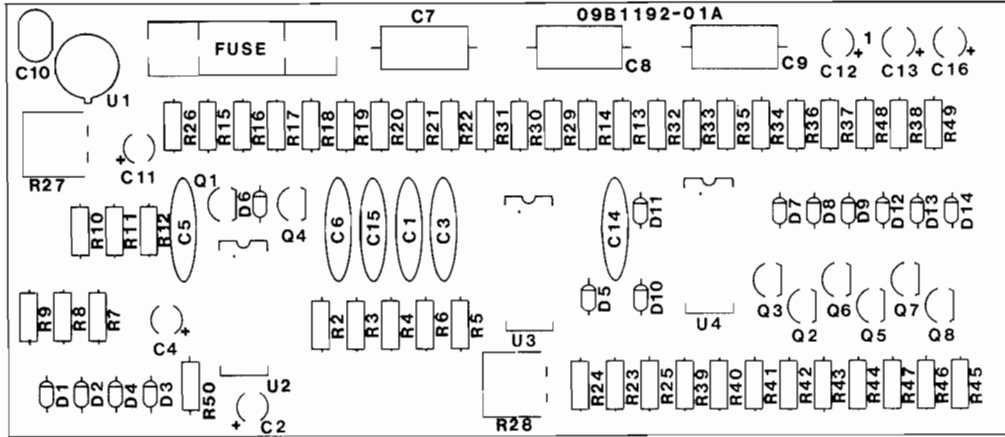
(1) Model Number — Center Frequency — Shift, i.e. IR-30-1775-25 would specify a Model IR-30 receiving at the center frequency of 1775 Hz with a shift to 1800 Hz to receive MARK and a shift to 1750 Hz to receive SPACE.

(2) Special Features or Options

7.3 Refer to Table 7-2 for a complete list of available frequencies.

Table 7-1. Suggested Multiple Tone Transmitter Output Levels

WHEN INFORMATION IS NOT AVAILABLE FROM TELEPHONE CO.	
NUMBER OF TONE CHANNELS ON LINE	RECOMMENDED LEVELS
	DBM
	RMS VOLTS (600Ω)
1	0
2	-3
3	-5
4	-6
5	-7
6 to 7	-8
8 to 10	-10
12 to 16	-12
17 to 25	-13
	0.78
	0.55
	0.45
	0.40
	0.35
	0.30
	0.25
	0.20
	0.17



7.4

Figure 3.

REF DESIGN	DESCRIPTION	QTY	USABLE ON CODE	PART NUMBER	MFG.
	PRINTED CIRCUIT BOARD ASSY A1		A	AB1192-01A	INIVEN
	PRINTED CIRCUIT BOARD ASSY A1		B	AB1255-01N	INIVEN
C1,3,5,6,14,15	CAPACITOR .1uf, 50V, 20%, CER	6		CGZ5F-104M	
C2,11	CAPACITOR 4.7uf, 10V, 20%, TANT	2		DT10V475M	
C4,12,13,16	CAPACITOR 1uf, 35V, 20%, TANT	4	A	DT35V105M	
C12,13	CAPACITOR 220uf, 25V, Electrolytic	2	B	ER25V227M	
C7	CAPACITOR .02uf, 100V, 5%, PC	1		PC32E203J	
C8	CAPACITOR .039uf, 100V, 5%, PC	1		PC32E393J	
C9	CAPACITOR .018uf, 100V, 5%, PC	1		PC32E183J	
C10	CAPACITOR 110 pf, 100V, 5%, MIC	1		DM05E111J	
D1-D14	DIODE	14		IN914	
R27,28	RESISTOR, VAR, 20K 1/2W20%	2		72PXR20K	
R2,17,18,19	RESISTOR 27K, 1/4W, 5%	4		RCF07J273	
R3,5	RESISTOR 33K, 1/4W, 5%	2		RCF07J333	
R4,35,42	RESISTOR 20K, 1/4W, 5%	3		RCF07J203	
R6,30	RESISTOR 3.6K, 1/4W, 5%	2		RCF07J362	
R7,9,10,11,32,39	RESISTOR 10K, 1/4W, 5%	6		RCF07J103	
R8	RESISTOR 4.7K, 1/4W, 5%	1		RCF07J472	
R12	RESISTOR 15 ohms, 1/4W, 5%	1		RCF07J150	
R13,21	RESISTOR 1K, 1/4W, 5%	2		RCF07J102	
R14	RESISTOR 390K, 1/4W, 5%	1		RCF07J394	
R15	RESISTOR 47K, 1/4W, 5%	1		RCF07J473	
R16,20	RESISTOR 220K, 1/4W, 5%	2		RCF07J224	
R22,33,40,46	RESISTOR 5.1K, 1/4W, 5%	4		RCF07J512	
R23,24	RESISTOR 51K, 1/4W, 5%	2		RCF07J513	
R25	RESISTOR 100K, 1/4W, 5%	1		RCF07J104	
R26	RESISTOR 33 ohms, 1/4W, 5%	1		RCF07J330	
R29,37,44,48	RESISTOR 9.1K, 1/4W, 5%	4		RCF07J912	
R31	RESISTOR 3.9K, 1/4W, 5%	1		RCF07J392	
R34,36,41,43	RESISTOR 2.4K, 1/4W, 5%	4		RCF07J242	
R38,45,49	RESISTOR 3.9 ohms, 1/4W, 5%	3		RCF07J3R9	
R47	RESISTOR 1.8K, 1/4W, 5%	1		RCF07J182	
R50	RESISTOR 68 ohms, 1/4W, 5%	1		RCF07J680	
Q1-Q5	TRANSISTOR	5		2N4401	
Q6-Q8	TRANSISTOR	3		2N4403	
U1	INTEGRATED CIRCUIT	1		CA3085A	
U2,U3	INTEGRATED CIRCUIT	2		LM324N	
U4	INTEGRATED CIRCUIT	1		CD070BCN	
FUSE	FUSE 8AG-1/2AMP	1		8AG-1/2AMP	