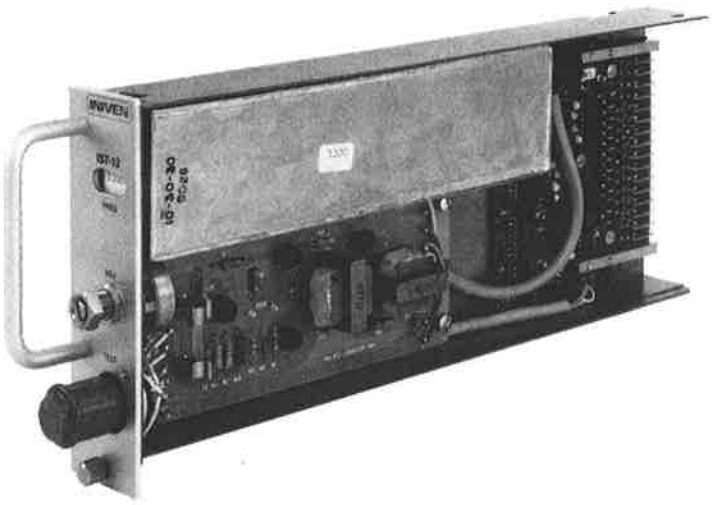
INIVEN™

Model IST-12 SCANNER/ FSK TRANSMITTER

INSTRUCTION MANUAL



IST-12 Scanner/FSK Transmitter

1. DESCRIPTION (See Figure 1)

1.1 The INIVEN™ IST-12 Scanner/FSK Transmitter is a 12-point, time division, multiplexing scanner capable of monitoring up to 12 inputs. The IST-12 serializes status data, converts it to FSK tone, and transmits this information to a remote companion ISR-12 Scanner and IR-30 FKS Receiver. The transmission path is via a single 2-wire pair, such as a leased telephone line.

1.2 The IST-12 is housed within a standard IT-30 Transmitter chassis. Opto-isolators are used for all status inputs to allow a wide choice of voltage or current sources to activate the inputs with electrical isolation.

2. SPECIFICATIONS

Output Level: +5DBM maximum, continuously adjustable

Output Impedance: 600 ohms nominal with rising characteristics outside the pass-band.

Transmission Speed: 15, 20, 25, 30, and 40 data-bits per second (approximately 60 percent of baud rate).

Transmission Mode: Serial asynchronous 12 bits plus 1 bit sync period. Three state, return-to-zero code format.

Output: Open-collector to +12Vdc bus to key FSK.

Status Inputs

Number: 12 maximum. 11 when using isolated power supply for input.

Keying Options: Dry contact when inputs powered from 12Vdc IP-23 or isolated power supply. Voltage inputs from solid-state equipment.

Keying Voltage: AC or DC voltages; 12 to 48 volts standard, 5 volts or 48 to 130 volts on special order. AC or pulsating DC voltages to be 30 Hz minimum.

Frequency Range: Refer to Table 8-2.

Coupling: Optical isolator (1000 Vac/1500Vdc minimum isolation when separate power supply is used)

Operating Temperature: −30°C to +60°C (−22° to +140°F)

Operating Humidity: 0 to 95% non-condensing

Power Requirements:
Input Voltage 12Vdc
Input Current 75 mA maximum

Dimensions: See Figure 6

3. FEATURES

3.1 Output Level Adjustment — an output level adjustment (ADJ) control is accessible on the front panel of the IST-12. This control allows the transmitter output level to be adjusted up to a maximum of +5 DBM.

3.2 Test Socket — A TEST socket is located on the transmitter front panel. For normal operation, a plug is installed in this socket. When the plug is removed for testing, the transmitter output is disconnected from terminals 3 and 4 of the terminal block. The TEST socket provides access to the following functions:

PIN NUMBER	FUNCTION
1 and 2	Tone output
3	Positive side of 12 Vdc power supply input
4	Negative side of 12 Vdc power supply input
5 and 3	Mark keying input
6 and 3	Space keying input
7 and 3	Carrier keying input

3.3 Transmitting Speed. Transmitting speed (baud rate) is determined by a potentiometer adjustment. Refer to Optional Operation Adjustments in section 5.

3.4 8-Point Scan. Optional 8-point scan operation is available by etch-cut and jumper addition. Refer to Optional Operation Adjustments in section 5.

4. THEORY OF OPERATION

4.1 The IST-12 Scanner Transmitter consists of a FSK Transmitter and a 12-Point Scanner. The Scanner circuits monitor up to 12 discrete inputs and transfers status of these inputs to the transmitter as Mark or Space keying signals. The transmitter transmits these signals in a three-frequency mode.

4.2 Twelve Point Scanner. (See Figures 1 and 2)

4.3 The scanner portion of the IST-12 consists of the input isolation and filter circuits, input multiplexer, control circuits, clock circuit, and associated circuitry.

4.4 Input Isolation and Filter Circuit. The input isolation and filter circuit consists of resistors R7 through R18, diodes CR1 through CR12, dual opto-isolators U1 through U6, and a 12-channel filter composed of resistor packs R19 and R20 and capacitors C2 through C13.

4.5 Typically, an external switch circuit applies a potential (signal) via current-limiting resistor (R7-R18) to bias input light emitting diode of opto-isolator (U1-U6). This emission is sensed and amplified by its output photo-transistor to the input multiplexer circuit.

4.6 Input Multiplexer Circuit. The input multiplier circuit consists of the entirety of 8-channel multiplexer U8 and four channels of multiplexer U10.

4.7 Selection of the applied input signal which is output by the multiplexer circuit is controlled by the logic status of its address inputs A^3, A^2 and A^1 as represented octally. Signal A^4, is tied to the disable input of U8 and inverted to the disable input of U10. Since signal A^4 goes high (logic 1) at the 8-count of a 12-count scan, the addressed input signals from U8 are routed to the FSK keying circuit during counts 1 through 8 and via addressed inputs of U10 during counts 9 through 12.

4.8 FSK Keying Interface Circuit. The FSK keying circuit consists of 3-input positive logic function NAND gates U11-9 and U11-6, transistors Q1 and Q2, and associated circuitry. The inputs to pins 2 and 8 and pins 4 and 5 of gates U11-9 and U11-6 remain high during a 12 count scan period and their outputs are controlled by the data pulse signal received from the input multiplexer circuit. If the data pulse signal is low (logic O) then the output of gate U11-9 is high which biases transistor Q1 on to transmit a Mark signal. Conversely, a high data pulse signal results in a low output at U11-9 translated to a high output at U11-6, biasing transistor Q2 on to transmit a Space signal.

4.9 Clock Circuit. The clock circuit consists of positive function 2-input NAND gates U12-3 and U12-4 and counter-2 of dual 4-stage counter U7. The gates are arranged in a multivibrator configuration which oscillates over a frequency range of 160 to 640 Hz or 16 times the desired data rate. Frequency of the oscillator is adjustable via potentiometer VR1 in the multivibrator R-C network. The output of the multivibrator at U12-4 is routed to the clock input of U7. The output of U7-6 provides the basic clock signal at data-rate. The signal is routed to the control circuit and FSK keying circuit.

4.10 Control Circuit. The control circuit consists of counter-1 of dual 4-stage counter U7, positive function 2-input NAND gates U12-10 and U12-11, and flip-flops U9-1 and U9-13. The control circuit provides timing and control signals to regulate four functions.

a. Select which multiplexer (U8 and U10) is permitted to transfer data.

b. Address the multiplexer inputs.

c. Enable FSK keying interface during the scan count.

d. Reset the counter and disable the FSK keying circuit when the scan count is reached.

4.11 The clock signal is used to increment counter-1 of U7 during its negative transistion thereby causing its output stages to reflect the binary status of the scan count. Signals A^1 through A^3 address multiplexers U8 and U10. Signal A^4 disables either U8 or U10 as explained in paragraph 4.7.

4.12 When the scan count reaches 12 (T11, Figure 2), signals A^3, and A^4 go high to the inputs of NAND gate U12-11 resulting in a high output from gate U12-11 to reset flip-flops U9-1 and U9-13. With flip-flop U9-13 reset, its output at pin 12 goes high to initialize counter 1 of U7 and disable further counting until flip-flop U9-13 sets. The low output from gate U9-13 is routed to disable FSK keying gates U11-9 and U11-6 and inhibit transmission of Mark or Space signals, which is sensed by the companion receiver as a sync interval.

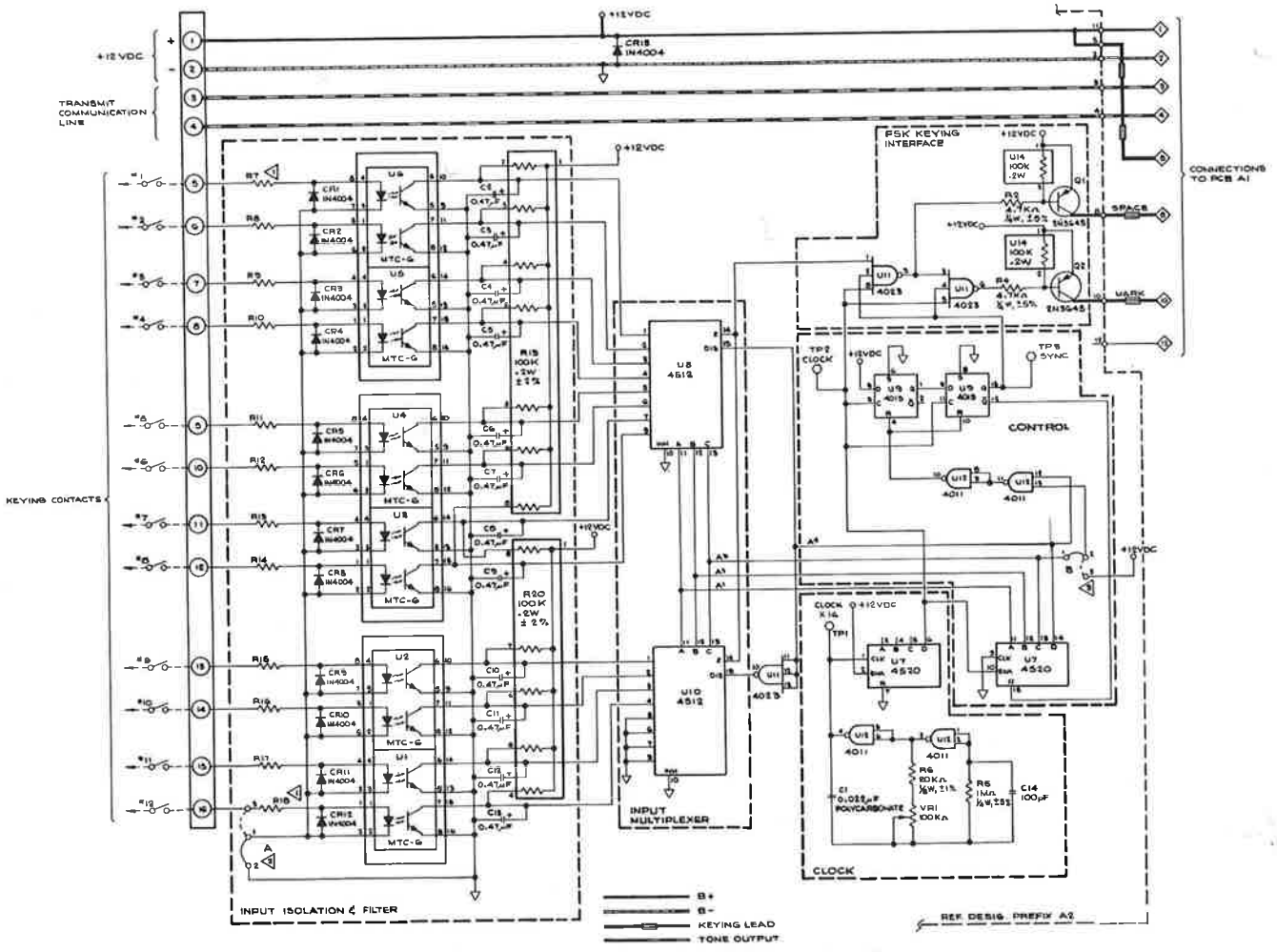


Figure 1. Twelve Point Scanner-Schematic Diagram

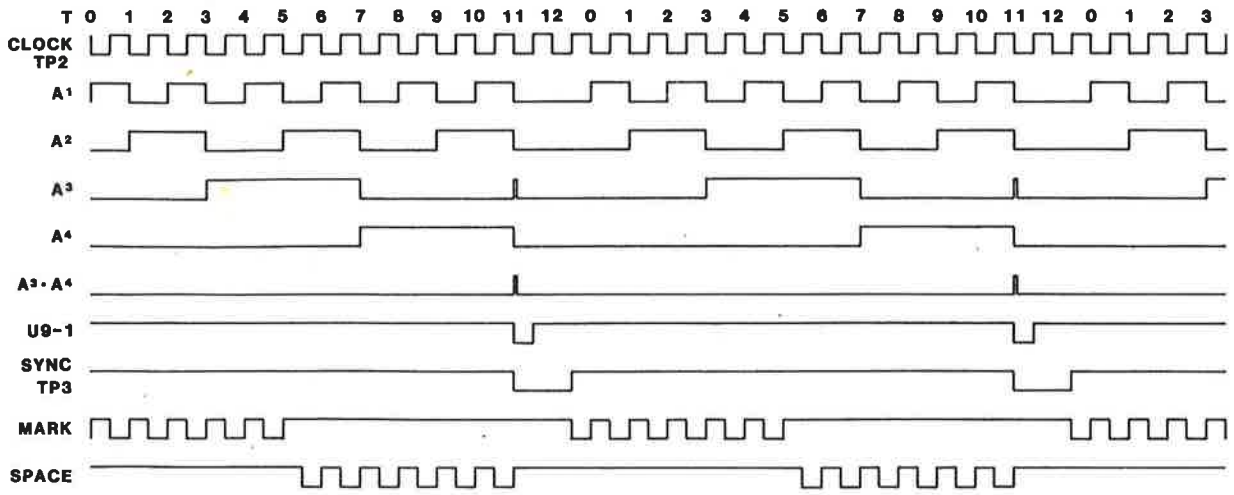


Figure 2. Twelve Point Scanner - Timing Diagram

4.13 The disable period lasts only 1½ clock cycles because as the counter is reset, signals A3 and A4, which initiated the cycle, go low removing the reset signal from control flip-flops U12. On the next positive transition of clock (T11-5) flip-flop U9-1 sets to provide a high clock input to flip-flop U9-13. At the next positive transition of CLOCK (T12-5) U9-13 sets and removes the disable from the FSK keying gates U11 and its output at pin 12 goes low to remove the disable from Counter-1. Counter-1 will increment at the next negative transition clock (TO) and initiate the next scan count.

4.14 FSK Transmitter (See Figure 3).

4.15 The FSK transmitter portion of the IST-12 consists of a stable audio oscillator, oscillator tank circuit, push-pull amplifier, and a line coupling network. The line-coupling network and oscillator tank circuit are contained within plug-in module Z1 (10-30).

4.16 The oscillator is composed of transistor Q1; biasing resistors R1, R2, and R3; and oscillator tank circuit Z1. The resonant frequency of the tank circuit can assume any one of three values depending upon the status of the keying inputs to the transmitter. When a Space is keyed, an additional capacitive element is switched into the tank circuit, thus decreasing its resonant frequency. Keying a Mark cuts off keying transistor Q4 which in turn removes a capacitive element from the tank circuit. This increases the resonant frequency of the tank circuit. When neither Space nor Mark is keyed, the oscillator operates at its nominal center frequency. As long as power is applied, the oscillator is in continuous operation.

4.17 The oscillator output signal appears across potentiometer VR1 and is applied to emitter follower Q5. The emitter follower isolates the oscillator circuit from load variations. Transformer T1, in the emitter circuit of Q5, couples the signal to the push-pull amplifier. The push-pull amplifier consists of transistors Q2 and Q3 (connected in a common-base configuration), output transformer T2, and biasing network CR2 and R8. Diode CR2 and R8 hold the bases of Q2 and Q3 slightly negative to eliminate crossover distortion. The amplifier is in operation only when the emitters of Q2 and Q1 are returned to B+. This voltage can be applied continuously or intermittently. The transmitter is configured for continuous operation (a jumper is connected across the carrier keying input terminals). For intermittent (keyed carrier) operation, this jumper is removed, and a key is connected to the carrier input keying terminals. The transmitter generates a tone only when the carrier input terminals are keyed.

4.18 The output of the push-pull amplifier is coupled to the line-coupling network by transformer T2. The line-coupling network isolates the transmitter from voltage variations on the transmission line and presents a 600-ohm output impedance to the line at the nominal frequency. Swamping resistor R9 ensures that a constant impedance is presented to the line-coupling network.

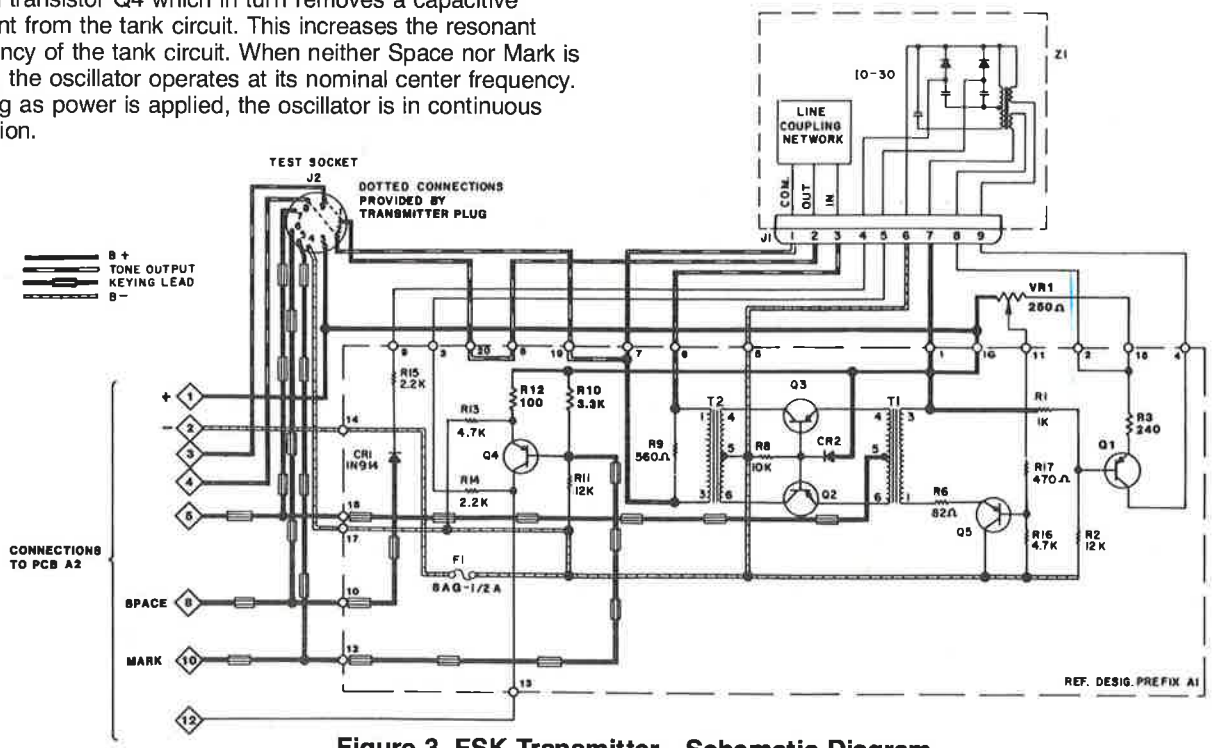


Figure 3. FSK Transmitter - Schematic Diagram

5. INSTALLATION

5.1 Unpacking. Unpacking and handling of the IST-12 Scanner Transmitter should be consistent with procedures used in handling electronic equipment.

5.2 Inspection. Visually inspect the scanner transmitter for damage from rough-handling and faulty packing. Visually inspect for:

(1) Loose Wires

(2) Deformation in the frame

(3) Faceplate damage

(4) Evidence of moisture or condensation within the units.

(5) Loose hardware or parts which evidence improper handling.

5.3 Mechanical Installation. The IST-12 is shipped with module Z1 in place, and the terminal block plugged in and secured to the rear of each unit by four 6-32 screws. The IST-12 Scanner Transmitter is normally mounted in standard INIVENTM Tone Frames.

5.4 Install the IST-12 as follows:

(1) Leave terminal block plugged in, as shipped, on rear of unit.

(2) Remove four 6-32 screws from terminal block.

(3) While inserting IST-12 into tone frame align captive screw at bottom of face-plate with mounting hole in frame.

(4) Secure IST-12 to frame using captive screw on faceplate.

(5) At rear of frame, use 6-32 screws removed in step (2) to secure terminal block to tone frame.

IST-12 can now be removed and re-installed in frame using the front panel captive screw.

5.5 Electrical Installation. All electrical connections are made to the terminal block at the rear of the frame (see figure 4 and table 5.1).

Table 5-1 Terminal Block Connections

TERMINAL	FUNCTION
1	Positive (+) side of 12 Vdc power supply input.
2	Negative (–) side of 12Vdc power supply input.
3 and 4	Tone Output
5 through 15	Monitor points 1 through 11
16	Monitor point 12 when used with internal power supply or external common when used with isolated power supply.

5.6 Electrical Grounding. It is recommended that the chassis of each tone unit is grounded to reduce ground loop interference effects. When the tone unit is housed in a standard INIVENTM Tone frame, a good earth-ground to the rack or other equipment, in which the frame is installed, is sufficient. When the individual tone units are operated out of the frame, each tone unit chassis should be connected to earth-ground.

5.7 Station batteries or other power supplies with grounded negative or positive leads can be employed in place of standard INIVENTM Power Supplies.

5.8 Operational Test — Output Level Adjustment

The following equipment is required to test the operation and set the output level of IST12 Scanner/FSK Transmitter.

Test Adapter **INIVEN**
Multimeter **Simpson Model 260 (or Equivalent)**

5.9 Preparation for Adjustment. Prepare the IST-12 for output level adjustment as follows:

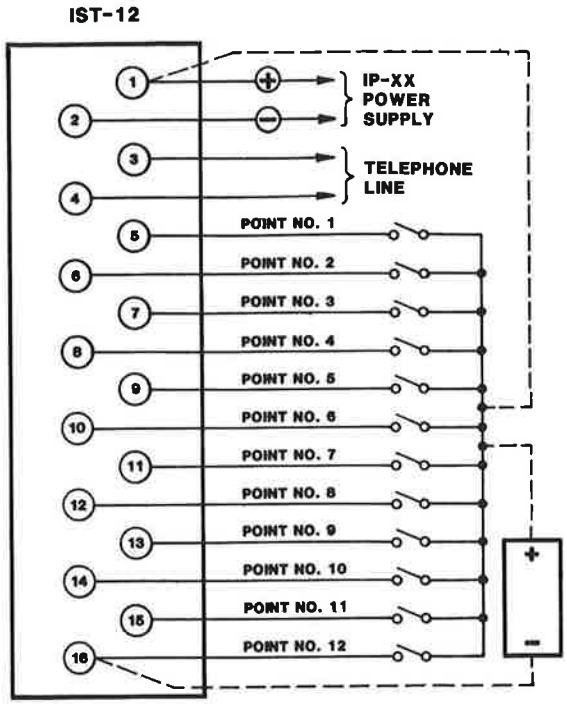


Figure 4. Electrical Installation

NOTE

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

(1) Disconnect transmitter plug from TEST socket.

(2) Insert plug of Test Adapter into TEST socket of transmitter.

(3) Install a 600 ohm resistor between terminals 3 and 4 of the Test Adapter.

5.10 Adjustment Procedure. Adjust the output level of the transmitter as follows:

(1) Set Multimeter to 2.5 VAC scale and insert test leads into jacks 3 and 4 of Test Adapter.

(2) Rotate ADJ potentiometer, on front panel of IST-12 to obtain an indication in accordance with Table 8-1.

NOTE

Continuous pulsing indication signifies scanner operation.

(3) Remove test probes and unplug Test Adapter from IST-12 TEST socket.

(4) Reinstall transmitter plug in IST-12 TEST socket.

5.11 Clock Adjustment

The following equipment is required to set the clock rate of the IST-12 Scanner/FSK Transmitter:

Frequency Counter **Fluke Model 1900A (or equivalent)**
Extender Module **INIVEN IE-5**

NOTE

The clock output at TP2 should indicate the same as the desired baud rate.

5.12 Adjustment Procedure. Adjust the clock rate as follows:

(1) Loosen captive retaining screw and remove IST-12 from frame.

(2) Plug IST-12 into Extender Module

(3) Install Extender Module in space vacated by IST-12.

(4) Ground Frequency Counter to terminal 2 of connector on printed circuit board A2 (see figure 7) and connect test probe to TP2.

(5) Frequency Counter should indicate a frequency at the baud rate, if not proceed to step 6).

(6) Rotate adjustment screw on potentiometer A2VR1 to obtain desired indication on the Frequency Counter.

(7) Disconnect Frequency Counter from test point.

(8) Unplug IST-12 from Extender Module and remove Extender Module from frame.

5.13 Optional Operation Adjustments

5.14 Eight-Point Scan Option. The IST-12 can be modified to operate as an eight-point scanner. To accomplish this modification, cut the etch on the printed circuit board A2 (Figure 7) between B-1 and B-2 and install a jumper from B-2 to B-3. The IST-12 will now monitor points 1 through 8 connected to terminal block connections 5 through 12. Points 9 through 12 will not be transmitted.

5.15 External Isolated Power Supply Option. The IST-12 can be modified to accommodate an external isolated power supply. This modification reduces the number of usable inputs to 11 instead of 12 as connection #16 of the terminal block is used as negative common for the external power supply. To accomplish this modification, proceed as follows:

CAUTION

Units modified for external power supply should not be used in system with units using a common power supply.

(1) Cut etch on printed circuit board A2 (Figure 7) between A-1 and A-2.

(2) Install a jumper from A-1 to A-3.

(3) Connect the isolated power supply as shown in Figure 4.

5.16 Keying Voltage Option. The IST-12 is standardly configured to accept keying voltages within the 12 to 48 Volt range and can be modified to accommodate keying voltages within the 48 to 130 Volt range or a nominal 5 Volt. To accomplish this modification to accept keying voltages in the 48 to 120 Volt range or nominal 5 volts, replace resistors R7 through R18 on printed circuit board A2 in accordance with parts list of Figure 7.

6. MAINTENANCE

This section contains corrective maintenance procedures that can be used in conjunction with the operation test and output 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 module 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 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.

Any references to transmit levels in the manual is a factory setting and must be rest in the field in accordance with the output level adjustment procedures in paragraphs 5.8 through 5.11 and Table 8.1.

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 System Checks

SYMPTOM	POSSIBLE CAUSE	REMEDY
	SYSTEM CHECKS	
No inputs or outputs at control station.	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 at master station.	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.
Tone receivers in "off" condition exhibit erratic and unsteady symptoms when checked using multimeter and Test Adapter.	Transmitter outputs set too high.	Check with telephone company or responsible agency for correct settings. For quick reference refer to Table 8-1.
	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.

SYMPTOM	POSSIBLE CAUSE	REMEDY
	IST-12 CHECKS	
No tone output (Mark, Center, or Space)	Transmitter plug not in socket	Replace test plug or jumper 1 to 9 and 2 to 8 of TEST socket.
	Fuse defective	Replace fuse.
	Q1 defective	Replace transistor.
	Q5 defective	Replace transistor.
	10-30 defective	Replace with 10-30 of same or different frequency and check for output.
Maximum output reduced (less than 1 Vac or +2 dbm)	A1Q2 or A1Q3 defective	Replace transistors, one at a time.
No Mark output	A1Q4 defective	Replace transistor.
	10-30 oscillator defective	Replace with 10-30 of same or different frequency and check for output.
No Space output	10-30 defective	Same as above.
Space on continuously	10-30 defective	Same as above.
Mark on continuously	A1Q4 defective	Replace transistor.

7. PARTS LIST

The following parts list is included to facilitate maintenance of the IST-12 Scanner/FSK Transmitter. All parts are listed in order of their reference designators, as applicable. Figure 5 depicts the parts for the major components of the IST-12. Figures 6 and 7 exhibit the parts for printed circuit board assemblies A1 and A2, respectively.

7.1 IST-12 SCANNER/FSK TRANSMITTER ASSEMBLY. (See Figure 5)

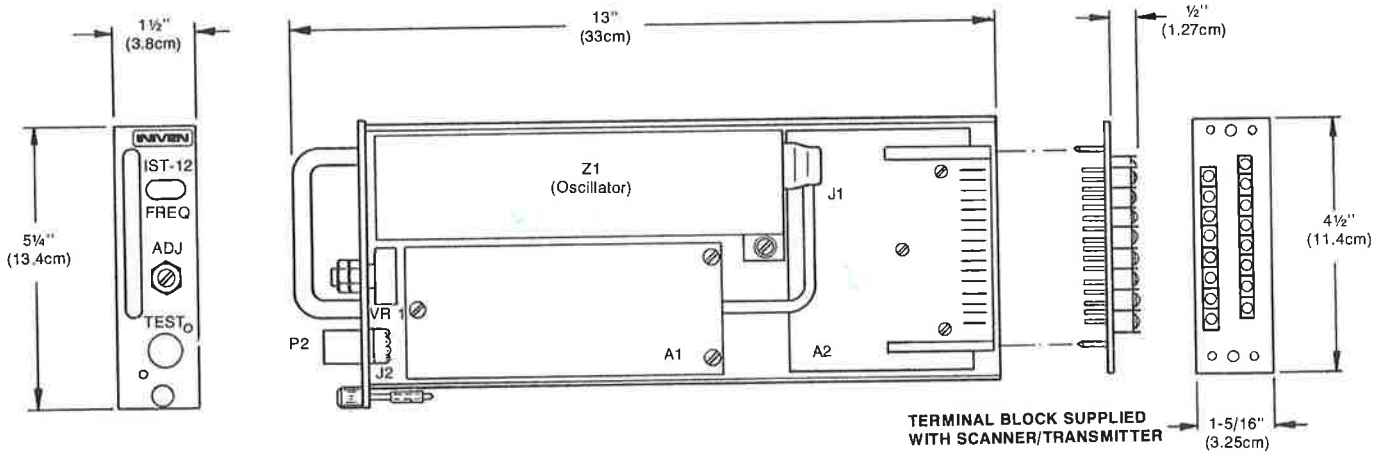


Figure 5. IST-12 Scanner/FSK Transmitter - Dimensions and Component Identification

REF DESIG	DESCRIPTION	QTY	PART NUMBER	MFR
	IST-12 SCANNER/FSK TRANSMITTER ASSY		CC1153-00	INIVEN
J1	• CONNECTOR, Socket	1	401A2	Connector Corp.
	• BOOT, Socket	1	C-860 w/o H	Methode
	• HANDLE	1	230-18AL832C	Promptus Elec.
	• FACEPLATE	1	06B1153-OIN	INIVEN
	• SCREW, Captive	1	0841088-OIN	INIVEN
J2	• CONNECTOR, Socket	1	417A4	Connector Corp.
P2	• PLUG, Transmitter	1	CMS1603-M9X	
VR1	• RESISTOR, Variable, 250 ohm, 2W	1	380C2-250-Z	Clarostat
A1	• PRINTED CIRCUIT BOARD ASSY (see figure 7 for breakdown)	1	AD1088-OIN	INIVEN
A2	• PRINTED CIRCUIT BOARD ASSY (see figure 8 for breakdown)	1	AD1153-OIN	INIVEN
Z1	• OSCILLATOR ASSY.	1	*10-30-XXXX-YY	INIVEN

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

7.2 Printed Circuit Board Assembly A1.
(See Figure 6)

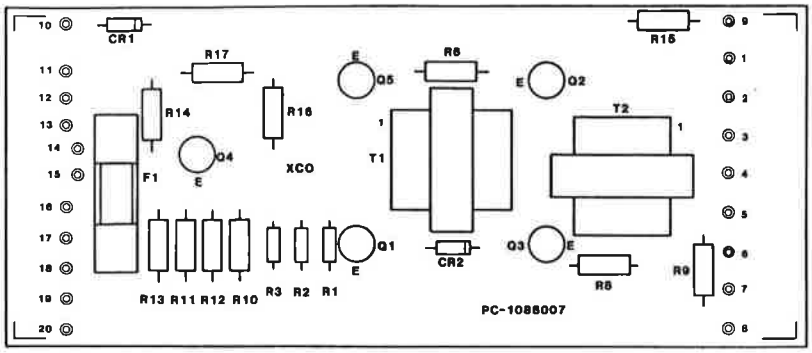


Figure 6. Printed Circuit Board Assembly A1

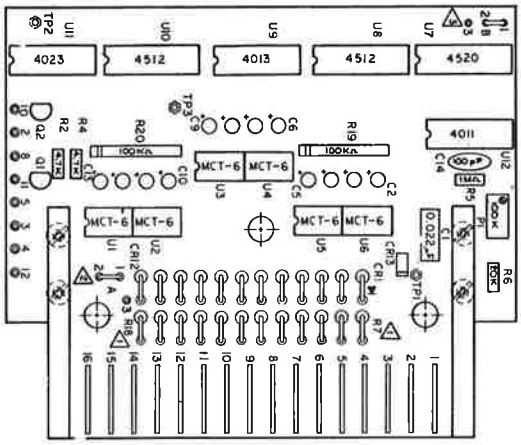


Figure 7. Printed Circuit Board Assembly A2

REF DESIG	DESCRIPTION	QTY	PART NUMBER	MFR.
	PRINTED CIRCUIT BOARD ASSY. A1		AD1088-OIN	INIVEN
CR1, CR2	• DIODE	2	IN914	
F1	• FUSE	1	8AG-½AMP	
Q1-Q5	• TRANSISTOR	5	2N3645	
	• SOCKET, TRANSISTOR	5	3-LPS-B	Cinch
R1	• RESISTOR, 1K, ¼W, 5%	1	RCF07J102	
R2	• RESISTOR, 12K, ¼W, 5%	1	RCF07J123	
R3	• RESISTOR, 240 ohm, ¼W, 5%	1	RCF07J241	
R6	• RESISTOR, 82 ohm, ½W, 5%	1	RCF20J820	
R8	• RESISTOR, 10K, ½W, 5%	1	RCF20J103	
R9	• RESISTOR, 560 ohm, ½W, 5%	1	RCF20J561	
R10	• RESISTOR, 3.3K, ½W, 5%	1	RCF20J332	
R11	• RESISTOR, 12K, ½W, 5%	1	RCF20J101	
R12	• RESISTOR, 100 ohm, ½W, 5%	2	RCF20J472	
R13, R16	• RESISTOR, 4.7K, ½W, 5%	2	RCF20J222	
R14, R15	• RESISTOR, 2.2K, ½W, 5%	1	RCF20J471	
R17	• RESISTOR, 470 ohm, ½W, 5%	1	CC1070-00	INIVEN
T1	• TRANSFORMER	1	CC1019-00	INIVEN
T2	• TRANSFORMER			

7.3 Printed Circuit Board Assembly A2. (See Figure 7)

REF DESIG	DESCRIPTION	QTY	PART NUMBER	MFR.
	PRINTED CIRCUIT BOARD ASSY. A2		AD1153-OIN	INIVEN
C1	• CAPACITOR, 0.022uf, 50V, Polycarb	1	MPC32D223J	
C2-C13	• CAPACITOR, 0.47 uf, 35V, 10%	12	DT35V474K	
C14	• CAPACITOR, 100 pf, 50V, 10%	1	CG53N101K	
D1-D13	• DIODE, Slicon, 1 Amp, 400V	12	IN4004	Motorola
Q1, Q2	• TRANSISTOR	2	2N3645-T092	Fairchild
R2, R4	• RESISTOR, 4.7K, ¼W, 5%	2	RCF07J472	
R5	• RESISTOR, 1 Meg ohm, ¼W, 5%	1	RCF07J105	
R6	• RESISTOR, 20K, ⅛W, 1%	1	RN55F2002	
R7-R18	• RESISTOR, ½W, 5%	12	RCF20J363	
R19, R20	• RESISTOR PACK, 8-Pin SIP, 100K, 0.2W, 2%	2	4308R101-104	Bourns
U1-U6	• OPTO-ISOLATOR, Dual	6	MCT6	Monsanto
U7	• COUNTER, Dual Binary	1	MC14520BCP	Motorola
U8, U10	• DATA SELECTOR, 8-Channel	2	MC14512BCP	Motorola
U9	• FLIP-FLOP, Dual D	1	MC14013BCP	Motorola
U11	• NAND GATE, 3-Input, Triple	1	CD4023CN	National
U12	• NAND GATE, 2-Input, Quad	1	MC14011BCP	Motorola
VR1	• RESISTOR, Variable, 100K	1	64Y104	Spectrol

8. ORDERING INFORMATION

8.1 When ordering please specify:

1. Model Number — Center Frequency — Shift, i.e. IST-12-1775-25 would specify a Model IST-12 transmitting at the center frequency of 1775 Hz with a shift to 1800 Hz to transmit Mark and a shift to 1750 Hz to transmit space.
2. Special Features or Options

8.2 Refer to Table 8-2 for a complete list of available frequencies.

Table 8-1. 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	0.78
2	−3	0.55
3	−5	0.45
4	−6	0.40
5	−7	0.35
6 to 7	−8	0.30
8 to 10	−10	0.25
12 to 16	−12	0.20
17 to 25	−13	0.17

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				

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