

INIVENTM

INSTRUCTION MANUAL

IR-98DSP AND IR-98DSP-1U PROGRAMMABLE FSK TONE RECEIVERS

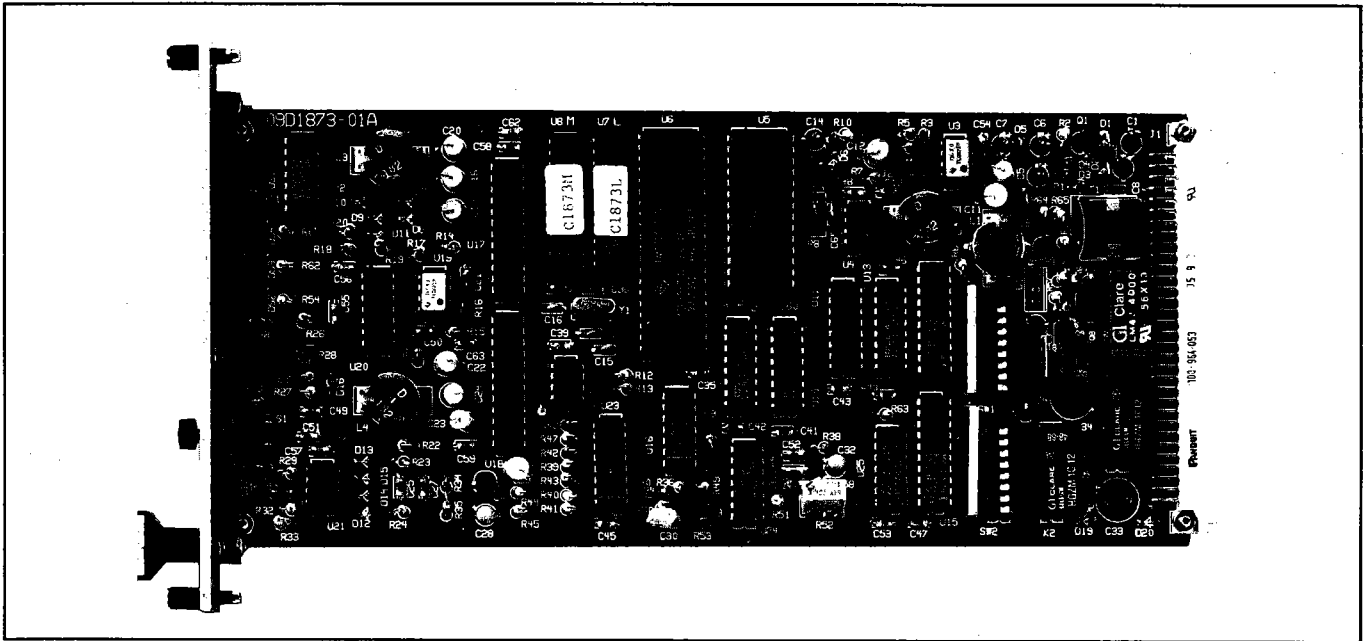


Fig. 1. IR-98DSP FSK TONE RECEIVER

DESCRIPTION: The IR-98DSP and IR-98DSP-1U are programmable frequency shift keyed (FSK) tone receivers intended for use on the receiving end of a communication channel in supervisory control, telemetry, and data transmission applications. A transmitter/receiver combination may be used over voice grade circuits including carrier, wire line, fiber optics, and microwave.

Utilizing state of the art design and crystal controlled DSP (Digital Signal Processing) tech-

niques provides for improved performance, flexibility, and reliability.

Each receiver module is field programmable for a specific center frequency and frequency shift (bandwidth/ baud rate) via dip switches. Operational modes include two-frequency (2F) or three-frequency (3F), carrier detector, and in conjunction with the mating transmitter inverted outputs and flasher (receipt of both mark and space simultaneously).

FEATURES:

- Voltage or relay outputs standard (Mercury relays optional).
- Front panel sensitivity adjustment.
- Dip switch programmable - - no need for external equipment to change frequency, bandwidth, or mode of operation.
- Cost saving design while maintaining reliability and quality.
- Life Time Warranty.

SPECIFICATIONS:

Input Sensitivity: Adjustable from -45 to +13 dBm..

Input Impedance: 30 k ohm minimum, isolated and balanced.

Frequency Stability: 0.02% of room temperature center frequency over full temperature range and power supply variation.

Outputs: Mark, Space, and Carrier Detect (CD).
Open-collector PNP Transistors (standard) 50 ma @ 15 Vdc.
Open-collector NPN Transistors 50 ma @ 30 Vdc, optional 1 amp @ 150 Vdc.

Relays: Form C, SPDT

Contacts: 2 amperes resistive @ 28 Vdc

Standard 100 Vdc switching voltage, 1 A switching current or 150 Vdc @ .5 A.

Mercury 150 Vdc switching voltage, 1 A switching current. Optional 350 Vdc @ .75 A available.

Operating Frequency Range: 200-3800 Hz. (See programming charts)

Operating Bandwidths: 50, 60, 85, 120, 170, 240,

300, or 600 Hz. Standard.

Indicators: Front panel mounted for mark, space, CD/carrier detector, and overload (OVL).

Bias distortion: Less than 7% with channel keyed in accordance to programmed bandwidth. Back to back Transmitter/Receiver.

Environmental Requirements:

Temperature Range: -30 to +70 C (-22 to +158 F)

Relative Humidity: 95% maximum, non condensing at 40 C (104 F).

Power Requirements:

+5 Vdc +/- 5% (4.75 to 5.25 Vdc) 130 ma @ 5 V

+12 Vdc +/- 35% (7.8 to 16.2 Vdc)

with CD relay 85 ma @ 15 V

with CD and mark or space relay 136 ma @ 15 V

-12 Vdc +/- 35% (7.8 to 16.2 Vdc) 46 ma @ 15 V

Physical

Weight: .5 lbs. (.23 Kg)

Dimensions: .999" (25.4 mm) Wide by 5.04" (128 mm) High by 9.76" (248 mm) Deep.

Note: IT-98DSP-1U has a special front panel and is intended for use in the 1U chassis only.

SAFETY

Standard safety precautions must be followed at all times when installing, operating, servicing, and repairing this equipment. INIVEN/CONOLOG CORP. assumes no liability for failure to observe standard or specifically noted safety requirements or to use this equipment for purposes other than intended.

GROUNDING:

A suitable ground is required to reduce the hazard of shock. Refer to the enclosed module, chassis, and/or cabinet wiring diagram for ground connection locations.

ENVIRONMENT:

Operation of any electrical equipment in any area containing gases, fumes, wet, or damp is a potential safety hazard. Necessary precautions should be taken.

MANUAL:

Operators and maintenance personnel should read this manual before installing the equipment and placing it in service. Only properly trained personnel with proper tools and equipment should operate, maintain, repair, or service this equipment.

SHOCK:

Potentially dangerous electrical shock can occur whenever working on this product. Protective measures and safety procedures should be observed at all times.

THEORY OF OPERATION:

GENERAL: The unit accepts an audio tone which changes frequency when the associated transmitter input is keyed. The outputs are referred to as mark and space. In the two frequency mode the audio tone input is at a frequency plus or minus the shift (programmable) of the programmed center frequency. Upon receipt of a change in frequency the output of the receiver changes state accordingly. In a two-frequency system the carrier or center frequency is not produced.

In a three-frequency unit the center frequency is normally generated and neither mark or space output is present. When the transmitter is keyed to the space frequency the receiver space output is activated and when the transmitter is keyed to the mark frequency the receiver mark output is activated (space is deactivated and visa versa). Only one keying input is to be on at one given time unless the transmitter Flasher option is used which allows the transmitter to shift between mark and space frequencies when both inputs are keyed. This allows the mark and space outputs, through added built in delays, to remain energized.

The carrier detect (CD) output is activated whenever a signal is received within the programmed frequency bandwidth at a minimum level. This output may be used as a loss of signal alarm, in data terminal and other applications.

PROGRAMMING: Upon applying power to the unit the digital signal processor DSP (U6) reviews the program information of octal inverting buffers (U14 & U15) which have been set by switches SW1 and SW2.

INPUT: Signals from the line are coupled to the receiver via transformer T1. Operational ampli-

fier (U3) amplifies the incoming signal in accordance with the gain setting of jumper J2.

L1, L2, C10-12 form a lowpass filter to remove all out of band signals present on the line.

U3B detect the amount of signal at the input to the analog to digital converter (U5) illuminating LED DS1 when an overload condition of the analog to digital converter occurs,

U5 converts the analog signal to a binary word.

DSP: The microprocessor (U6) operating parameters are determined by the two EPROM's (4 k X 8-bit) U7 & U8. All bandpass filtering and discriminating information is processed in (U6).

U19 and U20 amplify the output and apply the signal to phase detectors U22 and U23. The phase is compared in (U24) which delivers a mark or space to the output section of the receiver.

The carrier detector (CD) is controlled by R28, U21, & Q3. Signal level is measured and compared to a pre-set threshold level.

WATCH DOG TIMER: (U12) is a watch dog timer which recycles the microprocessor should its software sequence fail to perform as required. The timer effectively restarts the program to eliminate having to re-initiate power up of the module.

OUTPUT: Mark, space, and carrier detect pass through (U25) and are sent to the relay drivers or voltage output ports, (Open collector PNP or NPN, dry contacts, or mercury wet relays

Refer to Figure 2, Block diagram and Figure 6, Schematic.

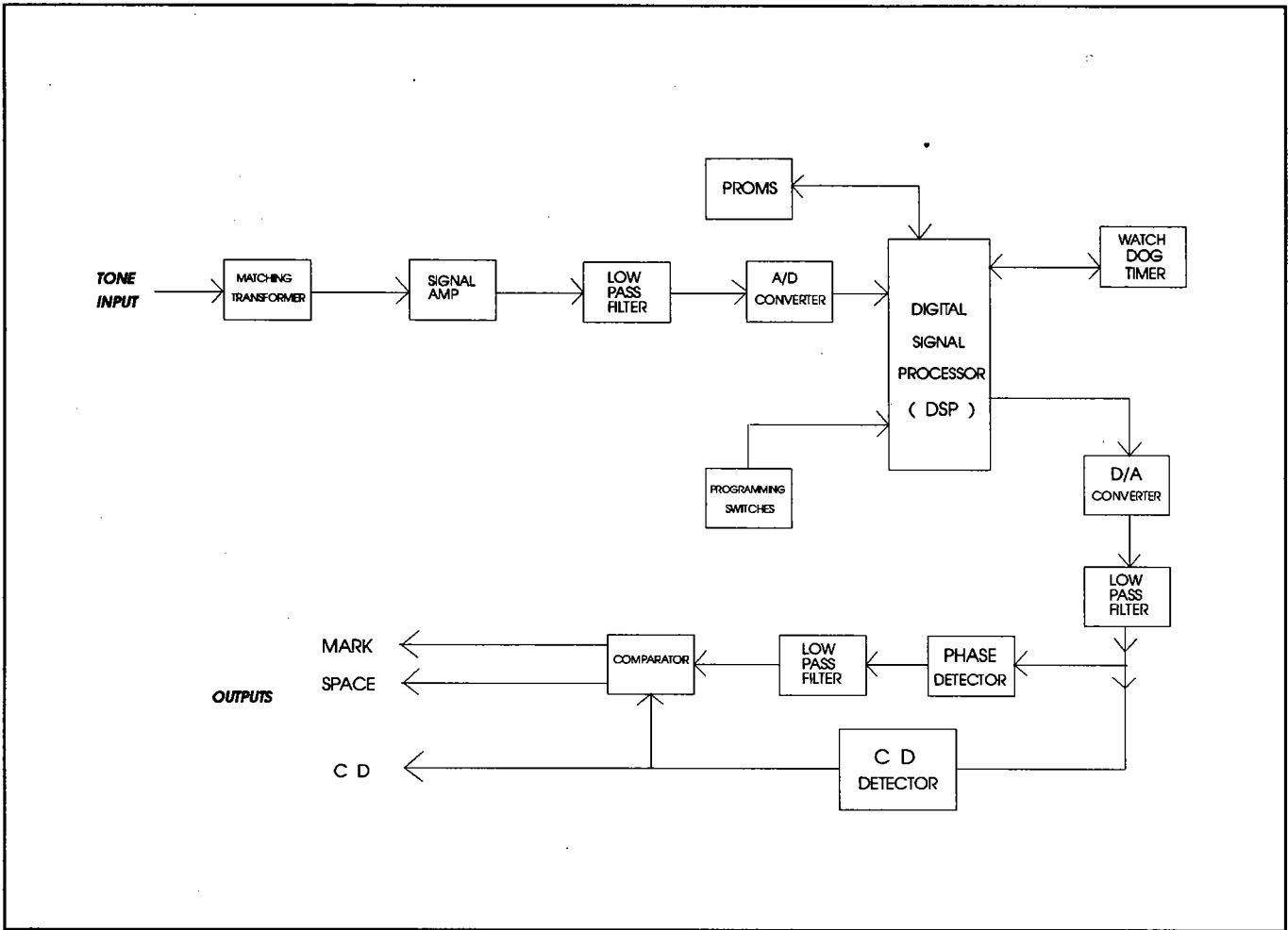


Fig. 2 Block Diagram

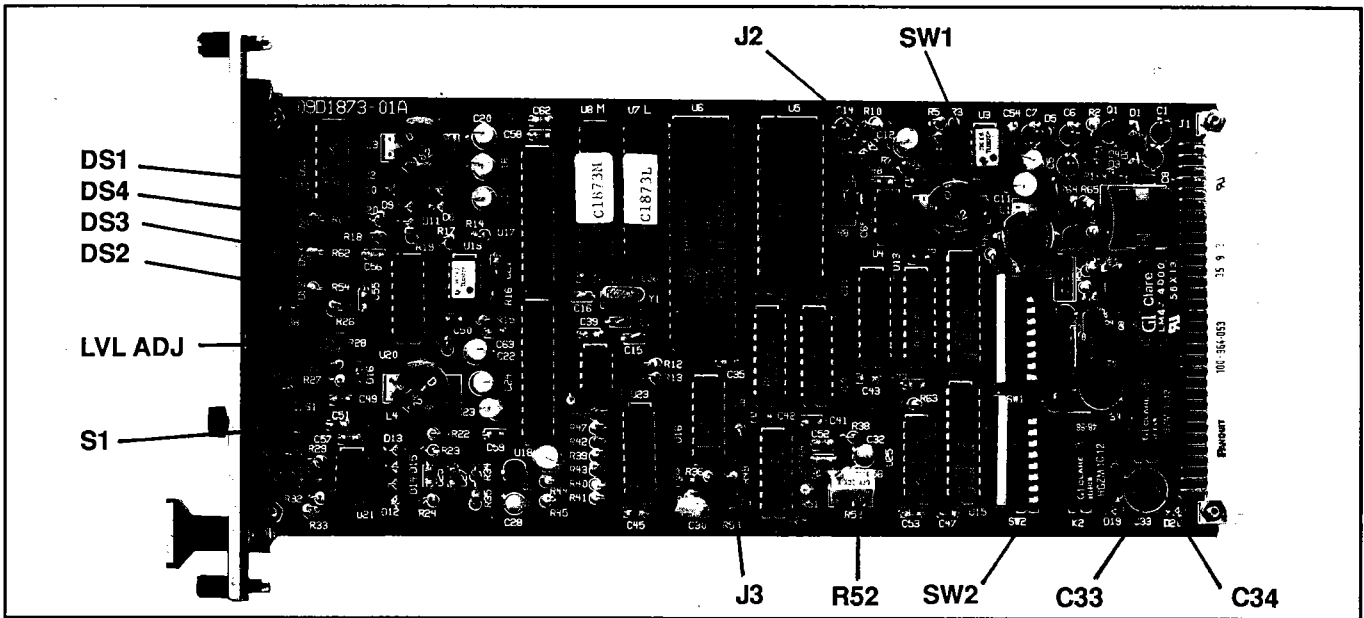


Fig. 3. Controls & Indicators

Table 1 Controls and Indicators

DS1	Indicator, (OVL), overload lights when excessive receive signal is received.
DS2	Indicator, (CD), carrier detect lights when carrier is received within the preset range.
DS3	Indicator, Space, lights when space output is on.
DS4	Indicator, Mark, lights when mark output is on.
R28	Variable resistor, receive tone level adjustment.
R52	Variable resistor, bias adjustment.
SW1	Switch, Programs frequency shift (see chart)
SW2	Switch, programs center frequency (see chart)
S1	Switch, used with R28 to set receive tone level range.
C33,34	Flasher option capacitors
J2	Jumper, receiver gain.
J3	Jumper, cancel carrier.

INSTALLATION:

GENERAL: Series 98 equipment is supplied in various forms depending on the application and system purchased. When supplied loose the module must be installed in a chassis and interwired. The method of bringing out the module inputs/outputs to the rear of the chassis is via an I/O connector (input/output). The I/O's are available in various styles, depending on application, and are purchased separate from the module. This section of the manual covers the most common supplied methods. Separate instructions will accompany equipment not covered herein.

UNPACKING: This equipment may be supplied loose, mounted in an individual chassis, stacked interconnected chassis, or as part of a rack or cabinet. Follow the procedure for the type of system supplied.

Loose and/or equipment mounted in an individual chassis will be packed in its own shipping carton. Inspect the carton for possible damage in transit. Open each carton carefully and remove the contents. Inspect the equipment for possible damage. Verify all items of value have been removed prior to discarding any packing material. **NOTE:** It is suggested the carton be retained for possible onward shipment.

Interconnected chassis or equipment supplied in racks or cabinets will be supplied in special boxes, wood crates, or if shipped via air-ride van without any case. Inspect the crate or other packing for possible damage in transit. Carefully remove the equipment from the container and inspect it for possible damage. Verify all items of value have been removed from the crate prior to

discarding any packing material and refer to the note above.

Should transit damage be found please notify INIVEN immediately.

MOUNTING: After unpacking follow the appropriate mounting procedure.

Loose module: (The following is for new installations - replacement of an existing module will have the card guides already mounted, refer to **MODULE REPLACEMENT** in the maintenance section of this manual). Each I/O connector comes with two Card Guides which are to be mounted within the chassis (A one-rack unit high chassis is supplied with the card guides mounted). Locate the desired position within the chassis for which the module is to be placed. Remove blank panels if existing. Viewing the chassis from the front, the recommended arrangement is a power supply on the extreme left then followed by transmit and or receive modules working towards the right of the chassis. From the front of the chassis and with the boss side (rounded) facing to the right press the lower card guide into the holes provided for the desired location. Repeat this procedure for the upper card guide.

The I/O module, (provided separately) is installed from the rear of the chassis. Aligning the I/O with the appropriate desired location push the assembly into the chassis. Turn the two quarter turn screws (clockwise) using a flat blade screwdriver which will secure it in place.

Install the module by sliding it into the proper slot aligning to the card guides. Once the module is firmly seated use the flat blade screwdriver to turn the two quarter turn screws on the front panel (clockwise).

Individual Chassis: The chassis is a 1 or 3 rack unit high unit containing two mounting ears for 19" rack mounting. Two screws appropriate for the mating hardware are required for each mounting ear (total of four per chassis) and are not supplied with the chassis. Install the chassis in the desired location and securely tighten all four screws. Spacing on the mounting ear holes are compliant with EIA and DIN standards.

Interconnected Chassis or equipment mounted on shipping rails are to be mounted similar to an individual chassis. When shipping rails are provided the equipment is to be placed

near the desired location. Remove the screws holding the shipping rails and then remove the rails. Slide the equipment into the rack or cabinet and secure it with proper screws for the mating hardware being used. Tighten all screws.

Systems provided in a rack or cabinet from the factory must be secured to the floor or wall as required. Mounting hardware is not supplied due to the various surfaces and mounting methods.

CAUTION: EQUIPMENT MOUNTED IN SWING RACK TYPE CABINETS MUST BE SECURED TO THE MOUNTING SURFACE PRIOR TO OPENING THE SWING RACK TO PREVENT THE CABINET FROM FALLING.

VENTILATION: Proper ventilation is required for most electronic equipment. Enclosed cabinets or rooms where this equipment is mounted should be kept at temperatures within the limits of the equipment. Operation above these limits may affect reliability.

ELECTRICAL CONNECTIONS: User connections are made via the I/O on the rear of the chassis. Each unit in the 98 SERIES of equipment will contain these connections in the instruction manual for the specific individual module. On equipment supplied wired from the factory or on interwired chassis and cabinets an "as supplied" drawing will be included with the equipment. External wiring should be in accordance with the "as supplied" drawing when supplied.

The IR-98DSP and IR-98DSP-1U supplied loose may be interfaced with one of the I/O's shown herein. External wiring is to be in accordance with the appropriate I/O used and particular interface required for your application.

For safety reasons power on the leads to be connected to the unit are to be de-energized during installation.

Methods of making the wiring connections to the terminal blocks vary and based on local practice. It is suggested number 20 AWG size insulated wire, stripped portion tinned, be used. Approximately 1/4" of the insulation is to be removed and inserted in the terminal strip.

Module power and tone lines may be daisy-chained should the application require.

Tighten all connections and insure exposed wires do not touch each other or the chassis.

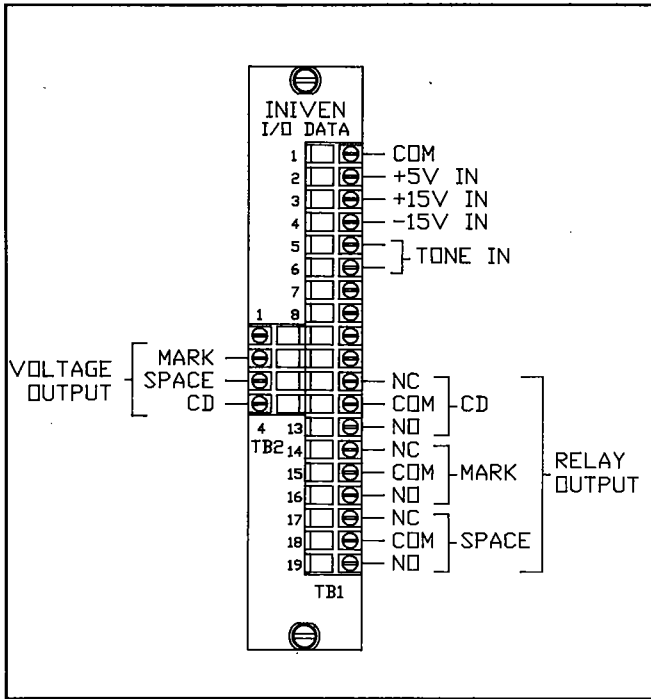


Figure 4. Standard I/O

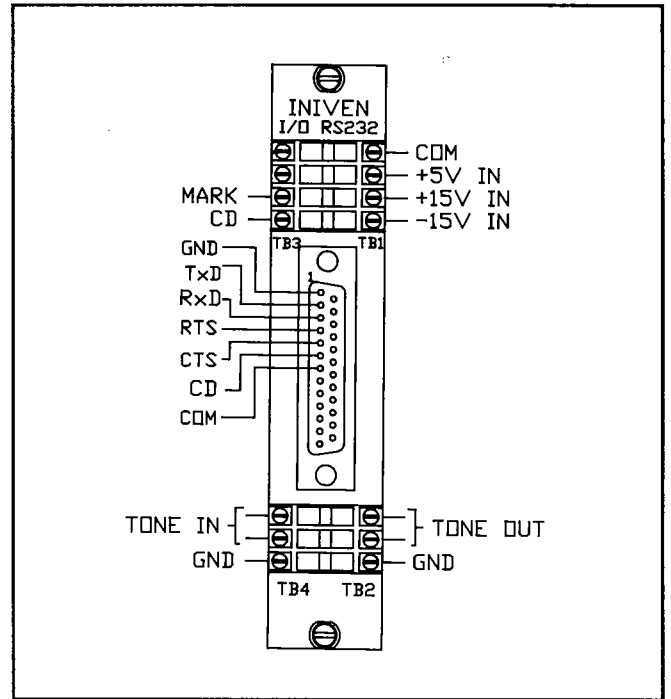


Figure 5. RS232 I/O

FREQUENCY SELECTION: With the module removed from the chassis. Select the desired bandwidth and center frequency from the enclosed charts. Refer to figure 3 for switch location.

EXAMPLE: For an 85 baud channel at 1615 Hz center frequency, set SW1 position 3 to "ON" (only a single position within SW1 is to be "ON" at any one time). Set SW2 positions 1, 4, & 7 to "ON" (be sure all other positions on SW2 are "OFF").

FOR 50 BAUD OPERATION	
SET POSITION 1 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
365	4
465	1,4
565	2,4
665	1,2,4
765	3,4
865	1,3,4
965	2,3,4
1075	1,2,3,4
1175	5
1275	1,5
1375	2,5
1475	1,2,5
1575	3,5
1675	1,3,5
1775	2,3,5
1875	1,2,3,5
2000	4,5
2100	1,4,5
2200	2,4,5
2300	1,2,4,5
2400	3,4,5
2500	1,3,4,5
2600	2,3,4,5
2700	1,2,3,4,5
2800	6
2900	1,6
3000	2,6
3100	1,2,6
3200	3,6
3300	1,3,6
3400	2,3,6
3500	1,2,3,6

FOR 60 BAUD OPERATION	
SET POSITION 2 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
420	4,6
540	1,4,6
660	2,4,6
780	1,2,4,6
900	3,4,6
1020	1,3,4,6
1140	2,3,4,6
1260	1,2,3,4,6
1380	5,6
1500	1,5,6
1620	2,5,6
1740	1,2,5,6
1860	3,5,6
1980	1,3,5,6
2100	2,3,5,6
2220	1,2,3,5,6
2340	4,5,6
2460	1,4,5,6
2580	2,4,5,6
2700	1,2,4,5,6
2820	3,4,5,6
2940	1,3,4,5,6
3060	2,3,4,5,6
3180	1,2,3,4,5,6
3300	7
3420	1,7

FOR 85 BAUD OPERATION	
SET POSITION 3 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
425	2,7
595	1,2,7
765	3,7
935	1,3,7
1105	2,3,7
1275	1,2,3,7
1445	4,7
1615	1,4,7
1785	2,4,7
1955	1,2,4,7
2125	3,4,7
2295	1,3,4,7
2465	2,3,4,7
2635	1,2,3,4,7
2865	5,7
2975	1,5,7
3145	2,5,7
3315	1,2,5,7
3485	3,5,7

FOR 170 BAUD OPERATION	
SET POSITION 5 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
850	2,6,7
1190	1,2,6,7
1530	3,6,7
1870	1,3,6,7
2210	2,3,6,7
2550	1,2,3,6,7
2890	4,6,7
3230	1,4,6,7

FOR 240 BAUD OPERATION	
SET POSITION 6 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
600	2,4,6,7
1080	1,2,4,6,7
1560	3,4,6,7
2040	1,3,4,6,7
2520	2,3,4,6,7
3000	1,2,3,4,6,7

FOR 120 BAUD OPERATION	
SET POSITION 4 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
480	1,3,5,7
720	2,3,5,7
960	1,2,3,5,7
1200	4,5,7
1440	1,4,5,7
1680	2,4,5,7
1920	1,2,4,5,7
2160	3,4,5,7
2400	1,3,4,5,7
2640	2,3,4,5,7
2880	1,2,3,4,5,7
3120	6,7
3360	1,6,7

FOR 300 BAUD OPERATION	
SET POSITION 7 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
1020	5,6,7
1700	1,5,6,7
2380	2,5,6,7
3060	1,2,5,6,7

FOR 600 BAUD OPERATION	
SET POSITION 8 OF SW1 "ON"	
To Obtain Center Freq. Hz	Set Listed Positions of SW2 to "ON"
1360	3,5,6,7
2720	1,3,5,6,7

INITIAL START-UP & LEVEL CHECKS

ADJUSTMENTS: The transmitter contains a front panel LEVEL adjustment (R28), an on board bias adjustment (R52) and two jumpers, gain adjust (J2) and carrier cancel (J3) (see Fig. 3 for location). Each receiver is shipped from the factory with the jumpers and bias adjustments set for most applications.

The following equipment is recommended to perform the initial start-up and level checks:

1. Digital multimeter with dB readout function; Fluke 8010A or equivalent.
2. Flat-blade-screwdriver with 1/8 inch wide tip or potentiometer adjustment tool.
3. Oscilloscope, 100MHz, dual trace with probes; Tektronix Model 2235 or equivalent.
4. Optional - - Card Extender.

INITIAL SETTINGS:

NOTE: The OVL indicator on the front panel will illuminate when the received input signal is excessive. Setting of J2 may be required.

JUMPER J2: Determines the required gain of the receiver as compared to the received signal from the transmitting end. Jumper (J2) is shipped from the factory in positions B & C which provides for received signals in the +8 to -36 dBm range. For signals in the -1 to -45 dBm range, move the jumper to A & B, and remove the jumper altogether for a +13 to -31 dBm range.

To determine the receive level, connect the multimeter (dB mode) across the "tone in" on the I/O connector and measure the received signal. To avoid erroneous readings be sure only the mating transmitter is on line during this measurement. Note the reading obtained and then select the appropriate jumper setting. In many applications the factory set jumper position will be adequate.

LEVEL ADJUSTMENT: With the transmitter set at the operating level press the receiver front panel push-button (S1) and adjust the LVL ADJ counterclockwise using a screwdriver or adjustment tool until the front panel CD indicator is off. While still depressing the push-button turn the LVL ADJ clockwise until the CD indicator illuminates. The receiver is now set for a 7 dB operating margin.

NOTE: Jumper J2 may have to be changed if the level adjust does not perform as indicated or if the front panel OVL LED is illuminated.

JUMPER J3: Cancels out the carrier by reducing the transition time between mark and space on two-frequency channels. Jumper is to be in 2F and out for 3F.

BIAS ADJUSTMENT: R52 provides a bias adjustment for the mark/space ratio of the output. In on/off, relay output and slow speed applications this adjustment should not change. If the system requires equal or offset mark/space ratios the following method is offered.

REQUIRES OPTIONAL CARD EXTENDER: With the power turned off to the module, loosen the two screws holding the front panel and remove the module from the chassis. Insert the extender in the chassis and then the module in the extender. For 2F systems, connect the test leads of the oscilloscope to GROUND (pin 32) and MARK (pin 16) of the connector (J1) located at the rear of module. Use the dual trace oscilloscope on GROUND (pin 32), MARK (pin 16) and SPACE (pin 17) for 3F systems.

Key the transmitter at the baud rate of the channel with continuous reversals. While monitoring the oscilloscope, adjust the bias control (R52) for equal output pulses. On 3F channels alternate the keying on the transmitter between the mark and space input in order to adjust mark and space outputs equally. An alternate method is to use a dc multimeter in place of the scope and adjust for zero bias as an average dc reading.

Turn off the power, remove the test leads, module, and card extender. Replace the module, tighten the front panel screws and turn on the power.

FLASHER: If the flasher option is to be used capacitor C33 and C34 are to be installed.

MAINTENANCE:

ALL SAFETY PROCEDURES ARE TO BE STRICTLY ADHERED TO AND ONLY QUALIFIED MAINTENANCE, OPERATORS, OR SERVICE PERSONNEL ARE TO PERFORM WORK ON THIS EQUIPMENT. LIFE THREATENING VOLTAGES AND CURRENTS ARE PRESENT WITHIN THIS EQUIPMENT. OBTAIN ALL REQUIRED APPROVALS PRIOR TO PLACING THIS EQUIPMENT IN OR OUT OF SERVICE.

PREVENTIVE MAINTENANCE is meant to reduce system downtime by locating and correcting potential problems prior to catastrophic failure. The following procedure is recommended to be performed on six month intervals. Equipment located in harsh environments may require more frequent maintenance. It is not the intent of this schedule to replace preventive maintenance procedures in place within any particular organization.

Items required to perform the following procedure:

Soft-bristled brush with non-conductive handle OR a source of low level compressed air.

Clean dry cloth(s)

Flat blade screwdriver with 1/8" wide tip.

Flat blade screwdriver with 1/4" wide tip.

Mild non-abrasive detergent solution.

Test equipment described in the Installation Section.

1. Turn off the power switch on the power supply module and de-energize the power applied to the equipment.
2. Remove the modules from the chassis by using a flat blade screwdriver to turn the two quarter turn fasteners (counterclockwise) on the front panel of each module (note module location). Then remove each module by pulling on its handle.
3. Using a brush or low pressure compressed air remove all dust from the module and chassis.
4. Inspect module for signs of visual damage such as overheating or corrosion. Correct the conditions prior to proceeding further.
5. Use the cloth and mild detergent to clean the front panels of each module and front of the chassis. Insure all parts are dry prior to proceeding.
6. Replace all modules in the proper location as noted in step 2 above aligning each to the card guides in the chassis. Once each card is firmly seated in its correct position use the flat blade screwdriver to turn the two quarter turn screws on the front panel of each module (clockwise).

7. Energize power to the equipment and turn "on" the power switch on the power supply.

8. Perform the initial startup procedure located in the installation section of this manual.

MODULE REMOVAL is accomplished by first turning off the power switch on the power supply. Turn the two quarter turn screws (counterclockwise) on the front panel of the module to be removed. Pull out the module by the handle.

MODULE REPLACEMENT is accomplished by first turning off the power supply and then sliding the module into the proper slot aligning to the card guides. Once the module is firmly seated use the flat blade screwdriver to turn the two quarter turn screws on the front panel clockwise. Turn the power supply switch to "ON".

Note: In the event a replacement module is being installed check all switch and jumper positions prior to installation. Comparison with the removed module is one convenient method.

The equipment has been designed to operate in an industrial environment and should provide years of trouble free operation. In the unlikely event a malfunction should occur standard troubleshooting techniques may be followed to resolve the problem. To assist you we have included schematics, and detailed information (including parts list) within this manual.

If factory assistance is required **INIVEN** has set up a **toll free number (1-800-526-3984)** for sales and service information. Should a module require repair please refer to our **life time warranty** in this manual.

Table 1. Replaceable parts IR-98DSP & IR98DSP-1U (1873-00)

Circuit Symbol	Description	INIVEN Part Number
CAPACITORS:		
C1-7,14	Capacitor,tantalum dipped,1uF,20V,+/-10%,DT20V105K or equiv.	DT20V105K
C9	Capacitor,ceramic molded,1000 pF,100V,+/-5% CM-NPO-E-102J or equiv.	CM-NPO-E-102J
C10	Capacitor,metalized polycarbonate,.022uF,100V,+/-3%,MPC32E223H or equiv.	MPC32E223H
C11	Capacitor,metalized polycarbonate,.015uF,100V,+/-3%,MPC32E153H or equiv.	MPC32E153H
C12	Capacitor,metalized polycarbonate,.018uF,100V,+/-3%,MPC32E183H or equiv.	MPC32E183H
C13,21,25,27,31	Capacitor,ceramic,.1uF,100V,+/-10%,CM-X7R-E-104-K or equiv.	CM-X7R-E-104-K
C15-17	Capacitor,ceramic,18pF,100V,+/-5%,CM-NPO-E-180-J or equiv.	CM-NPO-E-180-J
C26	Capacitor,ceramic,.02uF,100V,+/-10%,CM-X7R-E-203-K or equiv.	CM-X7R-E-203-K
C20,24	Capacitor,metalized polycarbonate,.0082uF,100V,+/-2%,MPC32E822G or equiv.	MPC32E822G
C32	Capacitor,tantalum,4.7uF,35V,+/-10%,DT35V475K or equiv.	DT35V475K
C35-64	Capacitor,ceramic,.1uF,50V,+/-20%,CM-Z5U-D-104-M or equiv.	CM-Z5U-D-104-M
C18,22	Capacitor,metalized polycarbonate,.0068uF,100V,+/-2%,MPC32E682G or equiv.	MPC32E682G
C19,23	Capacitor,metalized polycarbonate,.0015uF,100V,+/-2%,MPC32E152G or equiv.	MPC32E152G
C29	Capacitor,metalized polycarbonate,.068uF,100V,+/-5%,MPC32E683G or equiv.	MPC32E683G
C30	Capacitor,metalized polycarbonate,.12uF,100V,+/-5%,MPC32E124J or equiv.	MPC32E124J
C28	Capacitor,tantalum dipped,15uF,20V,+/-10%,DT20V156K or equiv.	DT20V156K
C33,34	Capacitor,electrolytic,radial,220uF,25V,+/-10% ER25V227M or equiv.	ER25V227M
C65	Capacitor,ceramic molded,.01uF,100V,+/-5% CM-NPO-E-103-J or equiv.	CM-NPO-E-103-J
C8	NOT USED in standard applications.	
RESISTORS:		
R1	Resistor,carbon,1.0K,1/4 watt,+/- 5%. or equiv.	RCF07J102
R11	Resistor,carbon,680 ohms,1/4 watt,+/- 5%. or equiv.	RCF07J681
R2	Resistor,carbon,5.6K,1/4 watt,+/- 5%. or equiv.	RCF07J562
R3	Resistor,carbon,20K,1/4 watt,+/- 5%. or equiv.	RCF07J203
R7	Resistor,carbon,150K,1/4 watt,+/- 5%. or equiv.	RCF07J154
R8	Resistor,carbon,390K,1/4 watt,+/- 5%. or equiv.	RCF07J394
R12	Resistor,carbon,3.9K,1/4 watt,+/- 5%. or equiv.	RCF07J392
R13,17,18,24,25	Resistor,carbon,4.7K,1/4 watt,+/- 5%. or equiv.	RCF07J472
R15,22,56	Resistor,carbon,10K,1/4 watt,+/- 5%. or equiv.	RCF07J103
R16,23,53,58,63	Resistor,carbon,15K,1/4 watt,+/- 5%. or equiv.	RCF07J153
R20,27,32	Resistor,carbon,27K,1/4 watt,+/- 5%. or equiv.	RCF07J273
R34,38	Resistor,carbon,220K,1/4 watt,+/- 5%. or equiv.	RCF07J224
R49	Resistor,carbon,33K,1/4 watt,+/- 5%. or equiv.	RCF07J333
R10	Resistor,carbon,2.2K,1/4 watt,+/- 5%. or equiv.	RCF07J222

Table 1. Replaceable parts (continued)

Circuit Symbol	Description	INIVEN Part Number
RESISTORS (continued)		
R19,26	Resistor,carbon,470K,1/4 watt,+/- 5%. or equiv.	RCF07J474
R35	Resistor,carbon,2.2K,1/4 watt,+/- 5%. or equiv.	RCF07J512
R39,43-45	Resistor,carbon,51K,1/4 watt,+/- 5%. or equiv.	RCF07J513
R40,46	Resistor,carbon,22K,1/4 watt,+/- 5%. or equiv.	RCF07J223
R41,47	Resistor,carbon,12K,1/4 watt,+/- 1%. or equiv.	RCF07J123
R50,55	Resistor,carbon,3.6K,1/4 watt,+/- 1%. or equiv.	RCF07J362
R51	Resistor,carbon,1.8K,1/4 watt,+/- 1%. or equiv.	RCF07J182
R54,62,67	Resistor,carbon,2.0K,1/4 watt,+/- 1%. or equiv.	RCF07J202
R57,61,66	Resistor,carbon,3.9K,1/4 watt,+/- 1%. or equiv.	RCF07J3R9
R59,64	Resistor,carbon,2.4K,1/4 watt,+/- 1%. or equiv.	RCF07J242
R60,65	Resistor,carbon,9.1K,1/4 watt,+/- 1%. or equiv.	RCF07J912
R42-48	Resistor,carbon,6.2K,1/4 watt,+/- 1%. or equiv.	RCF07J622
R4	Resistor,metal film,4.9K,1/4 watt,+/- 1%. or equiv.	RN55D4491F
R5	Resistor,metal film,24.3K,1/4 watt,+/- 1%. or equiv.	RN55D2432F
R6	Resistor,metal film,1.6K,1/4 watt,+/- 1%. or equiv.	RN55D1601F
R14,21	Resistor,metal film,3.09K,1/4 watt,+/- 1%. or equiv.	RN55D3091F
R29	Resistor,metal film,750 ohms,1/4 watt,+/- 1%. or equiv.	RN55D7500F
R30	Resistor,metal film,27.4K,1/4 watt,+/- 1%. or equiv.	RN55D2742F
R31	Resistor,metal film,31.6K,1/4 watt,+/- 1%. or equiv.	RN55D3162F
R36	Resistor,metal film,2K,1/4 watt,+/- 1%. or equiv.	RN55D2001F
R37	Resistor,metal film,1K,1/4 watt,+/- 1%. or equiv.	RN55D1001F
R28	Resistor,variable,10K,3/4 watt,10 turn or equiv.	3006P-1-103
R52	Potentiometer,20K,1/2watt or equiv.	3299W-1-203
SEMICONDUCTORS		
D1,2,	Diode,avalanche,400V,1A,1N4004 or equiv.	1N4004
D5	Diode,Zener,5.6V,1N752A or equiv.	1N752A
D3,4,6-20	Diode,general purpose,1N914 or equiv.	1N914
DS1-4	LED,Red,Dialight 550-1106 or equiv.	550-1106-RED
Q1-5,7	Transistor,NPN 2N4401 or equiv.	2N4401
Q6,8	Transistor,PNP 2N4403 or equiv.	2N4403
U1	NOT USED IN STANDARD APPLICATIONS	
U2	Negative voltage regulator,-5 Vdc,Motorola MC79M05CT or equiv.	MC79M05CT
U3,19	Dual operational amplifier,Texas Instrument TL0821P or equiv.	TL0821P

Table 1. Replaceable parts (continued)

Circuit Symbol	Description	INIVEN Part Number
SEMICONDUCTORS (continued)		
U4	Operational amplifier, Analog Devices ADOP-27EN or equiv.	ADOP-27EN
U7,8	EPROM, 4K x 8-bit, WS57C43B-45T or equiv.	WS57C43B-45
U5	Analog to Digital converter, Analog Devices AD7871JN or equiv.	AD7871JN
U6	Digital Signal Processor (DSP), Texas Instruments TMS320C10NL or equiv.	TMS320C10NL
U9,10	Counter, Binary Resettable SYNC/ASYNC, National Semiconductor MM74HC161N or equiv.	MM74HC161N
U11	3 line to 8 line decoder/demultiplexer, National Semiconductor MM74HC138N or equiv.	MM74HC138N
U12	Watchdog Timer, Dallas Semiconductor DS1232 or equiv.	DS1232
U13	Flip flop quad, National Semiconductor MM74HC175N or equiv.	MM74HC175N
U14,15	Octal inverting buffer, 3 state, National Semiconductor MM74HC240N or equiv.	MM74HC240N
U16	Quad 2-input nand schmidt trigger, National Semiconductor MM74HC132N or equiv.	MM74HC132N
U17,18	14-bit DAC	AD7840JN
U20,24	Quad operational amplifier, Texas Instruments TL084CP or equiv.	TL084CP
U21	Dual amplifier, Texas Instruments TL081CT or equiv.	TL081CT
U22	CMOS Quad Exclusive-or Gate CD4030B or equiv.	CD4030B
U23	Dual 4 channel multiplexer, National Semiconductor MM74HC4052N or equiv.	MM74HC4052N
U25	Quad 2 input AND gate MM74C08N or equiv.	MM74C08N
MISCELLANEOUS COMPONENTS:		
T1	Transformer, INIVEN	CC1992-00
SW1,2	Switch, DIP 8 position, Alcoswitch or equiv.	ADF-08
S1	Switch, Push Button, C&K Components or equiv.	ADF-04
Y1	Crystal, quartz, 20 MHz. or equiv.	SE200-AS
K1-K3	Relay DPDT, Clare LM44D00 or equiv.	LM44D00

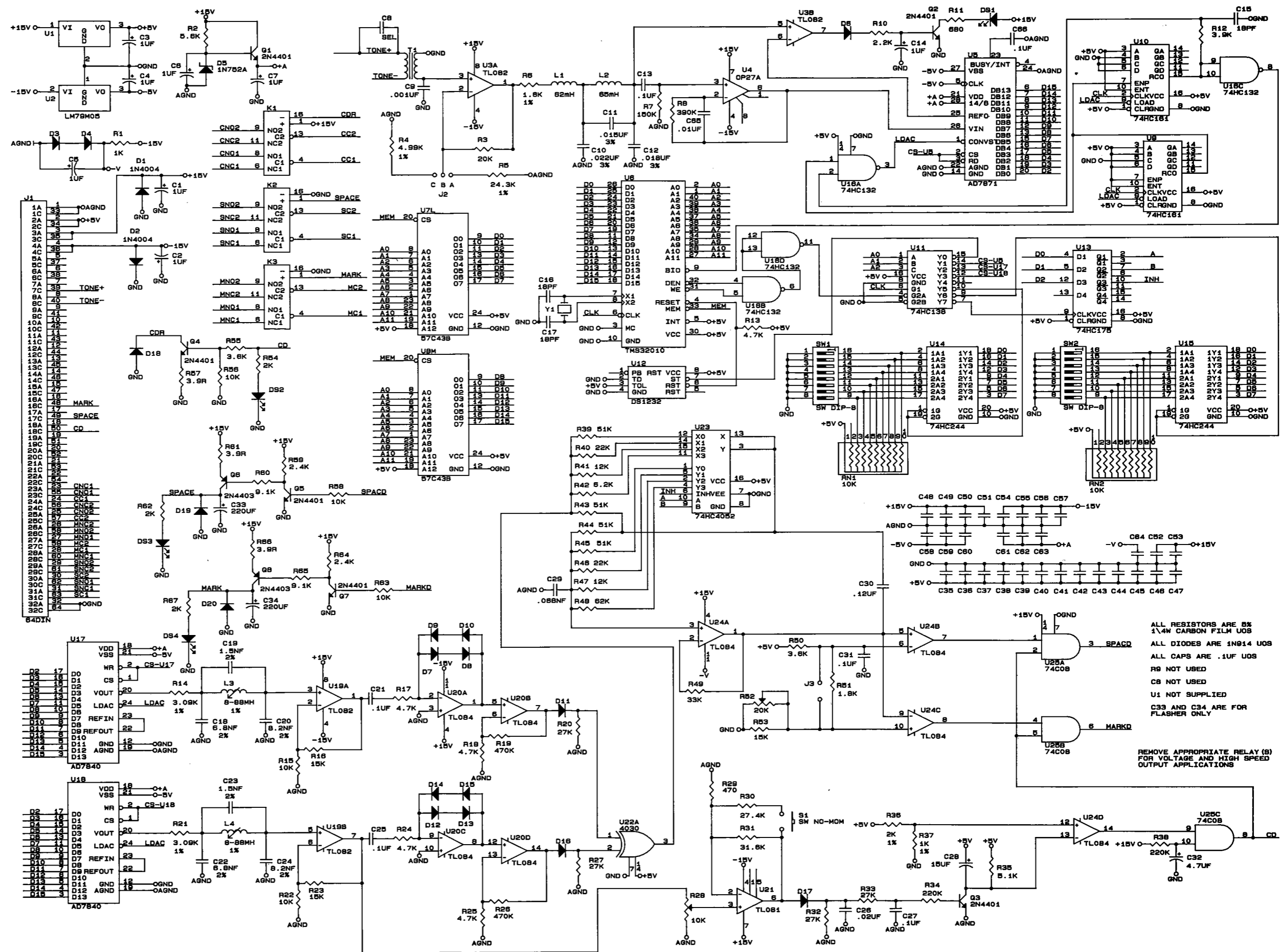


Figure 6, Schematic.

WARRANTY AGREEMENT

We hereby certify that the INIVEN product line carries a warranty for any part which fails during normal operation or service for 12 Years. A defective part should be returned to the factory, shipping charges prepaid, for repair f.o.b. Somerville, New Jersey. In case INIVEN cannot promptly return the unit to you, it will endeavor to provide a loaner until the repair or replacement is returned to you. Any unauthorized repairs or modifications will void the warranty. This warranty is contingent upon the commercial availability of parts as purchased by INIVEN. However, in the event that failure is less than two years from the date of delivery of the product, INIVEN will accept full responsibility.

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