INIVEN

DIVISION OF CONOLOG CORP.

INSTRUCTION MANUAL

I/O 40T AND I/O 40R
TRANSMITTER AND RECEIVER ANALOG I/O MODULES

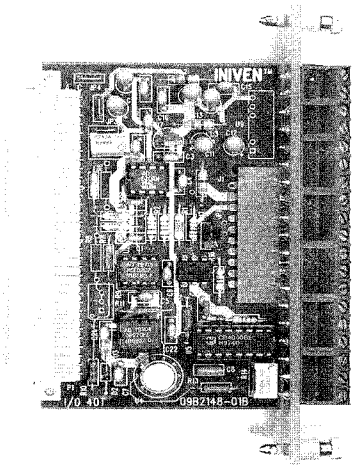

Fig. 1A. I/O 40T

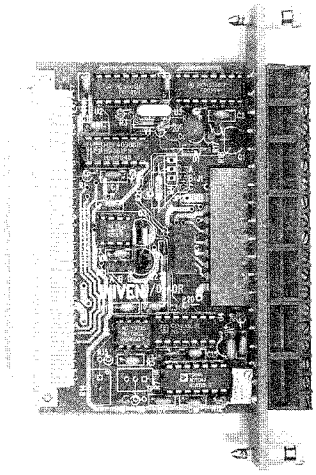

Fig. 1B. I/O 40R

DESCRIPTION: The I/O 40T is an accurate and stable voltage (or current) to frequency converters. The I/O 40T when used in conjunction with INIVEN's 98 Series FSK transmitter, is the transmitting side of an analog telemetry system.

Various inputs to the unit can be accommodated. Bi-polar and uni-polar voltage or current inputs can be accepted.

The output of the I/O module is a square wave which modulates an FSK tone transmitter alternately between mark and space frequencies at a rate within a 5-30Hz range. Standard ranges are 5-25Hz, 10-30Hz and 18-30Hz.

DESCRIPTION: The I/O 40R is an accurate and stable frequency to voltage (or current) converters. The I/O 40R when used in conjunction with INIVEN's 98 Series FSK receiver, is the receiving side of an analog telemetry system.

Various inputs to the unit from the FSK receiver can be accommodated. The square wave from the FSK receiver's mark and space outputs may be in a range of 5-30Hz. Standard ranges are 5-25Hz, 10-30Hz and 18-30Hz.

Bi-polar and uni-polar voltage or current outputs can be accommodated.

FEATURES:

- Uni-polar or bi-polar inputs and outputs.
- Wide range of inputs and outputs.
- High accuracy, stability and linearity.
- Differential input for ground loop noise rejection.
- Form C relay output for loss of telemetry.
- 12 year warranty.

SPECIFICATIONS:

GENERAL:

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:
+15 Vdc 15 mA (I/O 40T & I/O 40R)
-15 Vdc 7 mA (I/O 40T), 5ma (I/O 40R)

Accuracy: Setable to .1% of span

Linearity: <0.1% of span

Drift:
<0.005% per degree C
<0.2% over 6 months
<0.1% per volt of supply voltage change
<30 micro volts per degree C input offset

Physical:
Weight: .5lbs (.23 Kg)
Dimensions: 1.0" (25.4 mm) W
5.04" (128 mm) H
3.30" (83.8 mm) D

TRANSMITTER (I/O 40T):

Input DC Voltage Range: ±50mV to ±5V

Input DC Current Range: ±0.1mA to ±50mA

Input Common Mode Rejection: >45db with up to 3V peak common mode noise

Input Resistance: >1 MΩ for voltage input

Output Frequency Range: 5-25Hz, 10-30Hz & 18-30Hz standard (call factory for specials)

Output Voltage: >10V peak-to-peak square wave

RECEIVER:

Input Frequency Range: 5-25Hz, 10-30Hz and 18-30Hz standard (call factory for specials)

Input Voltage: >10V peak-to-peak square wave

Output Voltage Range: ±50mV to ±10V (6V with 12V supply)

Output DC Current Range: ±0.5mA to ±25mA

Note: *The IO 40T-1U and the I/O 40R-1U has a different terminal block board and is intended for use in the INIVEN 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 telemetry transmit I/O takes a voltage or current input and converts it to a square wave output at a specific frequency. An example would be a unit with a 4-20mA input at a 10-30Hz Rate. On a scale of 0 to 100, 4mA is 0 and 20ma is 100. That same scale applies to the output of 10-30Hz. 10Hz represents 0 while 30Hz is 100. When the 4mA input from a transducer or other source is present at the transmit I/O module (I/O 40T), the output of the I/O module is 10Hz. Any increase in the input current has an equal percentage increase on the frequency of the output. The lowest frequency in the range is commonly referred to as "Left Scale" and the highest, "Right Scale".
The square wave output from the I/O 40T modulates a FSK transmitter (IT-98DSP) operating in 2 frequency mode at the appropriate rate to match the input current (or voltage).

The FSK receiver (IR-98DSP) receives the output from the FSK transmitter and produces a square wave output at the same modulated rate from that of the transmitter. The I/O 40R converts the modulated frequency to a current (or voltage) output. **It is not required that the transmitter input and the receiver output current (or voltage) be the same.**

I/O 40T (TRANSMIT I/O):

U1 is a precision, differential amplifier. The DC input signal is applied to the (+) and (-) input terminals. If the input signal is a current, then shunt resistor R1 is supplied to convert the input current to a voltage. Noise is filtered by R2, R3, R18, R19, C1 and C2. In millivolt applications the gain of the differential amplifier can be increased by including R4.

U3B and associated circuitry form an inverting, summing DC amplifier. The output voltage is positive and drives U4 voltage to frequency converter. U4's input voltage, R13, R14 and C8 control the output frequency which is a few thousand Hertz at right scale. The high frequency allows use of small, temperature compensated frequency determining components.

U4's output is divided down to the desired frequency by U5 (12 stage counter/divider). The output of U5 is buffered by U6. This signal is used to key the FSK transmitter between Mark & Space.

U2 is a precision +5VDC reference voltage generator which supplies the source for the calibration voltage divider. The reference voltage is inverted by U3A to provide a negative reference.

The (+) and (-) reference voltages are used for offset and bias.

A bias signal is required if the output frequency ratio is not equal to the input ratio. No bias is required if 1-5V or 4-20mA is to produce a 5-25Hz output because the in/out ratios are the same. However, as an example, if ±1V input is to produce a 10-30Hz output, then 0.816V must be applied to U4 when the input is –1V and 2.45V applied when the input is +1V. U3B is the summing amplifier that combines the output of U3A with a reference bias to convert the ratios. Span is controlled by R5 and bias by R9.

ANALOG ISOLATION OPTION: U8 is a DC to DC converter which provides isolation for the +15 and –15 voltages. This isolation is rated at 1000VDC from input to output.

I/O 40R (RECEIVE I/O):

The incoming square wave from the FSK receiver output is applied to R1 and buffer U1A. U1A's output is applied to U1B and delay circuit R2 and C1. This circuit will pulse high twice per input cycle. If the incoming signal is 10Hz, the output of U1B will be 20 pulses per second. Y1 is a 2MHz crystal which controls the oscillator circuit U2C, R3, R4 and C2. U2C is applied to timer U3 that runs the clock. U2A is used to reset the clock every 1/2 cycle. When the clock times out, then U3 signals to U2B that it is finished. U2A is also used to start U4 (FET switch).

The generated wave form controls the FET gates of U4 which alternately switch a precision reference voltage on and off. The switched reference voltage drives averaging filters R9, R10, C5, C6 and U6C. The output of U6C is a DC voltage in the 0.5 to 2.5V range and is precisely proportional to the incoming telemetry frequency signal.

U5 is a precision 5V reference. R5, R6 and U6D give a negative 5V reference to the summing amp circuit R7, R8, R11, R12, R13 and U6A.

At this point the signal enters the voltage to current circuit. If current is not required it acts as an inverting buffer circuit which consists of U7, Q2, Q3, R19, R20 and U6B.

An optional 4-20mA current buffer circuit for loop supplies is performed through Q4 and R21.

LOSS OF TELEMETRY: Buffer U1D accepts a signal from input signal buffer U1A. U1D outputs to holding circuit R16, R17, R18 D1 and C9. This circuit turns on Q1 which turns on RL1 when the telemetry signal is present.

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's I/O's (inputs/outputs) to the rear of the chassis is via an I/O module such as the I/O 40T and the I/O 40R. To facilitate the 98 Series equipment's ability to work in almost all applications, several types of I/O's are available and are purchased separately. This section of the manual covers the most commonly supplied methods. Separate instructions will accompany equipment not covered in this manual.

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 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 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) Each I/O module is shipped with two Card Guides which are to be mounted in the chassis (some INIVEN chassis' may have the Card Guides already mounted). Viewing the chassis from the front, the recommended arrangement is a power supply on the extreme left, followed by transmit and or receive modules working towards the right of the chassis. Locate the desired position within the chassis for which the module is to be placed. Remove any existing blank panels. From the front of the chassis and with the boss (rounded) side facing to the right, press the lower card guide into the holes provided. Repeat this procedure for the upper card guide.

The I/O 40T and the I/O 40R are made up of two boards, the I/O 40 itself and the terminal block board. These two boards are connected at right angles. Disconnect the two boards for mounting.

The I/O 40 modules are installed from the front of the chassis by connecting it to the appropriate tone module (i.e. the IT-98DSP for the I/O 40T or the IR-98DSP for the I/O 4OR). The connection between the I/O module and the tone module is secured using 4 screws mounted through the existing holes in the connectors that mate the two modules.

Install the combined I/O 40 board and tone module by sliding it into the front of the chassis using the same Card Guides. Once the module is firmly seated, use the flat blade screwdriver to turn the two quarter turn screws clockwise on the front panel.

The I/O's terminal block board must be mounted from the rear of the chassis. Align the terminal block board with the I/O 40 and firmly mate the boards. To secure the board in place, turn the two quarter turn screws clockwise using a flat blade screwdriver.

INDIVIDUAL CHASSIS: The chassis is 1 or 3 rack units high and have two mounting brackets for either mounting on a wall or a standard 19" rack. All brackets and hardware are included with the chassis with the exception of the mounting screws for the brackets to be attached to a wall or rack. Spacing of the holes on the brackets are compliant with EIA and DIN standards. Slide the equipment into the rack or cabinet and secure it with proper screws for the mating hardware being used. Tighten all screws.

INTERCONNECTED CHASSIS: (or equipment mounted on shipping rails) This equipment should be mounted similarly 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 modules 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. When supplied, external wiring should be in accordance with the "as supplied" drawing. See figures 2A and 2B for wiring connections.

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

Methods of making the wiring connections to the terminal blocks vary and are 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 block. Module power and tone lines may be daisychained should the application require.

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

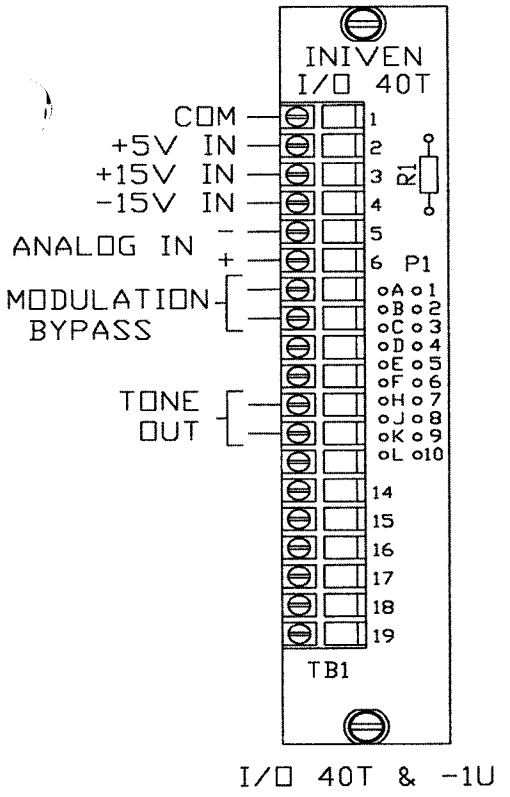

Fig. 2A. I/O 40T

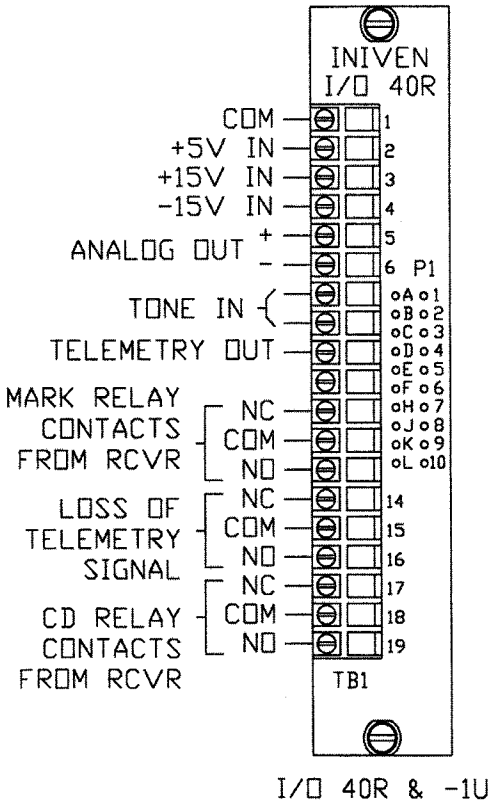

Fig. 2B. I/O 40R

If no external loop supply is used, use Table 1 for current output and maximum allowable resistances.

MAXIMUM ALLOWABLE RESISTANCE	
CURRENT OUTPUT (mA)	MAXIMUM RESISTANCE (Ω)
20	500
10	1,100
5	2,300
2.5	4,700
1	11,900

Table 1. I/O 40R Current Output

EXTERNAL LOOP SUPPLY: The external loop supply option must be used with a uni-polar current and a loop supply of no more then 50V. Q4 and R21 must be added and jumper JP2 must be removed in order to use the buffer option.

When an external loop supply for a uni-polar output range is being used (i.e. 4-20mA), the buffered output option is necessary. See Figure 3 below.

EXTERNAL LOOP HOOK-UP

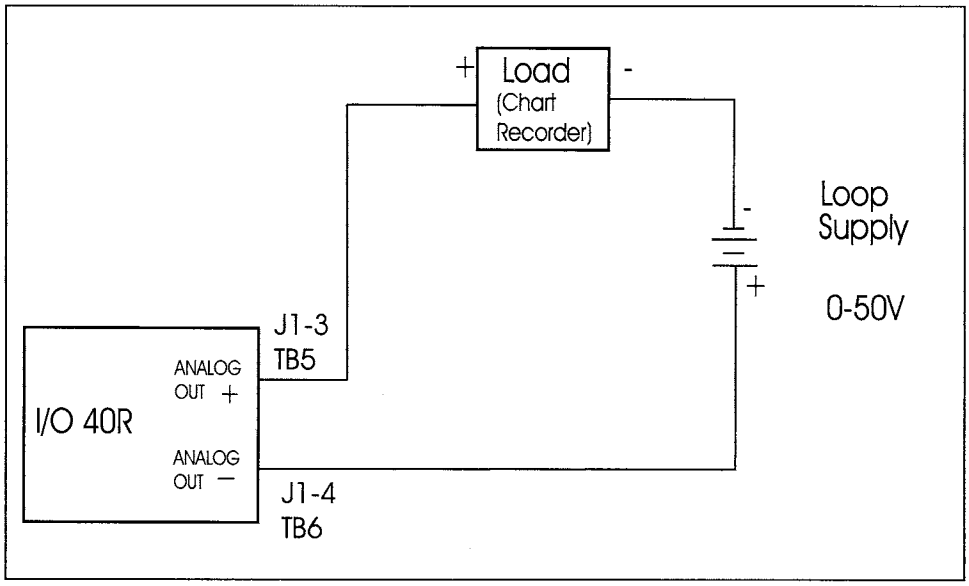

Fig. 3. I/O 40R. External Loop Hook-up

INITIAL START-UP & LEVEL CHECKS:

GENERAL:

To verify readings it is suggested the entire system be checked from the input process being measured to the output indicator or recording device.

EXAMPLE: If a transducer is measuring pressure, check it with a separate accurate pressure gauge and compare the readings with the output at the receiving station indicator.

RECEIVER: The telemetry frequency input to the receive I/O must be as close to a symmetrical square wave as possible. If the FSK tone receiver (i.e. IR-98DSP) is equipped with Mark and Space relays they must be removed. Adjust the receiver bias control for a square wave following the instructions for the particular I/O 40 module being used.

TRANSMITTER: When the I/O 40T is in use with the IT-98DSP, the IT-98DSP is operating in the Space hold mode. Therefore on the front panel of the IT-98DSP, under normal operating conditions the Space LED will not be lit and the Mark LED will be turning on and off relative to the keying frequency being used (example: 10 times per second for 10Hz).

CALIBRATION:

Note: The I/O 40T and I/O 40R have been calibrated at the factory before shipment and should not require any further adjustment. Field adjustments to these units are not recommended. The following procedures are made available for units in which accuracy associated components have been field changed.

Span is defined as the entire range for which the unit is set. An example is a range of ±1V. The Span of this *range is 2 volts. Bias is defined as the adjustment that can offset the Span along the scale. Using the above example, the Bias permits the adjustment of the 2V Span down the scale to –1.1V to +0.9V or up the scale to* –0.8V to +1.2V and so on.

Note: *The sample range of ±1V @ 10-30Hz will be used in the following calibration procedure as an example.*

ALIGNMENT OF I/O 40T:

The following equipment is recommended to align the transmit end in a test environment with the I/O 40T removed from service:

1. Precision voltage or current source as required for the input range purchased.
2. Digital voltmeter that can resolve 100 micro volts (DVM).
3. Frequency counter with 10 period averaging.
4. Flat blade screwdriver with 1/8 inch wide tip or potentiometer adjustment tool.
5. Test power supply to power the I/O 40T.

Calibration is performed by adjusting two potentiometers, R5 for Span and R9 for Bias.

STEP 1: Apply the highest voltage or current in the range of the I/O 40T to the positive analog input TB-5 and to negative analog input TB-6. For the example of ±1V @ 10-30Hz, +1V would be applied.

STEP 2: Connect a frequency counter to the square wave output TB-8 (or JP1 pin B if an extender board is being used) and square wave common output TB-1. Note the reading.

STEP 3: Apply the lowest voltage or current in the range of the I/O 40T to the analog input TB-5 and to negative analog input TB-6. For the example of ±1V @ 10-30Hz, -1V would be applied. Note the reading on the frequency counter. The Span (the first reading minus the second reading) should for this example equal 20Hz for frequency and 2V for voltage.

STEP 4: If the Span is less than it should be, adjust R5 counterclockwise. If the Span is greater than it should be adjust R5, clockwise until you have reached the desired Span.

Note: *It may be easier to adjust R5 in small increments while repeating STEPS 1-4 until the desired Span is obtained.*

Once the correct Span (in this example 20Hz) has been set then the Bias can be adjusted.

STEP 5: Repeat STEPS 1 & 2 and note the reading from the frequency counter. For the example of ±1V @ 10-30Hz, the reading should be 30Hz. If the reading is higher then it should be, adjust R9 counterclockwise or clockwise if it is less then it should be.

STEP 6: Once the upper frequency has been set (30Hz in this example) repeat STEP 4 to verify that the lower frequency in the range is correct (10Hz in this example). If the lower frequency is not accurate, the Span may need to be fine tuned and the entire procedure should be repeated to ensure accuracy.

Note: *It may be easier to adjust R9 in small increments while repeating the adjustment procedure.*

IMPORTANT: When R5 or R9 are adjusted, it is important to allow the new setting settle before making any further adjustments.

Note: *The sample range of ±1V @ 10-30Hz will be used in the following calibration procedure as an example.*

ALIGNMENT OF I/O 40R:

The following equipment is recommended to align the transmit end in a test environment with the I/O 40R removed from service:

1. Square wave frequency generator which can be set within .02% of input range frequency. Output voltage must swing between 0 and +15VDC.
2. Digital multimeter for current and voltage with 4 ½ digit accuracy.
3. Test power supply to power the I/O.

Calibration is performed by adjusting two potentiometers, R11 for Span and R7 for Bias.

STEP 1: Using the frequency generator, apply the highest frequency or right scale in the range of the I/O 40R to the Telemetry Signal input TB-9 and Square Wave common TB-1. For the example of ±1V @ 10-30Hz, 30Hz would be applied.

STEP 2: Connect the multimeter to the analog output of the I/O 40R, TB-5 for positive and TB-6 for negative. Note the reading.

STEP 3: Adjust the frequency generator to apply the lowest frequency or left scale in the range to TB-9 and TB-1. Note the reading. For the example of ±1V @ 10-30Hz, 10Hz would be applied. The Span (the first reading minus the second reading) should for this example equal 20Hz for frequency and 2V for voltage.

STEP 4: If the Span is less than it should be, adjust R11 counterclockwise. If the Span is greater than it should be adjust R11 clockwise until you have reached the desired Span.

Note: *It may be easier to adjust R11 in small increments while repeating STEPS 1-4 until the desired Span is obtained.*

Once the correct Span (in this example 20Hz) has been set then the Bias can be adjusted.

STEP 5: Repeat STEPS 1 & 2 and note the reading from the multimeter. For the example of ±1V @ 10-30Hz, the reading should be +1V. If the reading is higher then it should be, adjust R7 counterclockwise or clockwise if it is less then it should be.

STEP 6: Once the upper voltage or current has been set (+1V in this example) repeat STEP 3 to verify that the lower voltage or current (left scale) is correct (-1V in this example). If the lower voltage or current is not accurate, the Span may need to be fine tuned and the entire procedure should be repeated to ensure accuracy.

IMPORTANT: When R7 or R11 are adjusted, it is important to allow the new setting settle before making any further adjustments.

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 IN OR OUT OF SERVICE. ANY UNAUTHORIZED MODIFICATIONS TO THIS EQUIPMENT WILL VOID THE WARRANTY.

PREVENTIVE MAINTENANCE:

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:

1. Soft bristled brush with non-conductive handle or a source of low level compressed air.
2. Clean dry cloth
3. Flat blade screwdriver
4. Mild non-abrasive detergent solution.
5. Test equipment described in the Installation Section.

Preventive maintenance procedure:

a. Turn off the power switch on the power supply module and de-energize the power supply applied to the equipment.

b. Remove the modules from the chassis by using the screwdriver to turn the two quarter turn fasteners counterclockwise (note module location). Remove the modules by pulling on their handles.

c. Using a brush or low pressure compressed air, remove all dust from the modules and chassis.

d. Inspect modules for signs of visual damage such as overheating or corrosion. Correct the conditions prior to proceeding further.

e. Use the cloth and mild detergent to clean the front panel of each module and the front of the chassis. Insure all parts are dry prior to proceeding.

f. Replace all modules in their proper locations taking care to align each module to the Card Guides in the chassis. Once each card is firmly seated in its correct position, use the screwdriver to turn the two quarter turn screws on the front panel of each module clockwise.

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

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

MODULE REMOVAL:

Before removing a module always turn off the power supply first. To remove the I/O 40 board but not the terminal block board, turn the two quarter turn screws clockwise on the front panel of the tone module attached to the I/O 40 and pull the module firmly by the handle. The I/O 40 module is attached to the tone module and is removed from the front of the chassis. To remove the I/O 40 from the tone module (i.e. IT-98DSP) unscrew the two screws attached to the tone module. The connecting brackets should remain with the I/O 40T or I/O 40R.

To remove the Terminal Block board of the I/O 40T or I/O 40R remove the I/O 40 board according to the above instructions then unwire all connections to the board. Turn the two quarter turn screws clockwise on the rear panel of the I/O 40 terminal block board and remove the board.

To replace an I/O 40T or I/O 40R, follow the Loose Module installation instructions earlier in this manual.

REPAIR:

The I/O 40T and I/O 40R have been designed to operate in an industrial environment and should provide years of trouble free operation. In the unlikely event a malfunction should occur and factory assistance is required, a toll free number has been set up, 800-526-3984. Should a module require a repair please refer to our twelve year warranty on the back cover of this manual. All returns require a RMA number, which can be obtained by calling 800-526-3984.

RESISTOR VALUES FOR COMMON INPUT & OUTPUT RANGES:

FREQUENCY (Hz)		10-30	10-30	10-30	10-30	10-30	10-30	10-30	5-25	18-30	18-30
INPUT RANGE	CURRENT	+/-1mA	0-1mA		0-20mA	4-20mA			4-20mA	+/-1mA	+/-1mA
	VOLTAGE	+/-1V	+/-2V	+/-2.5V	+/-5V		+/-200mV	0-5V	+/-5V	0-5V	+/-50mV
COMPONENT	TYPE	VALUE (Ω)									
RESISTOR R1	CUR	1K	1K		100	100			1K	1K	1K
	VOLT										
RESISTOR R4	CUR										
	VOLT										1K
VAR. RESISTOR R5	CUR	1K	500		500	200			500	500	500
	VOLT	500	500	500	500		100	500	500	500	500
RESISTOR R6	CUR	14.4K	5.9K		8.45K	6.9K			9.53K	3.24K	4.87K
	VOLT	2.87K	5.76K	7.15K	14.7K		1.69K	10.1K	12K	12.1K	10K
RESISTOR R7	CUR	10K	10K		7.15K	7.15K			10K	3.4K	2.43K
	VOLT	2.43K	2.43K	2.43K	2.43K		7.15K	3.4K	2K	2.43K	2K
RESISTOR R8	CUR	29.4K	60.4K			86.6K				11.3K	6.04K
	VOLT	7.15K	7.15K	7.15K	7.15K		21.3K	20K	7.87K	8.06K	4.87K
VAR. RESISTOR R9	CUR	2K	2K			2K	1K			1K	500
	VOLT	500	500	500	500			2K	500	500	500

Note: *Resistors are metal film, 1/4W, .1%. Variable resistors are 3299X- type.*

Table 1. I/O 40T

FREQUENCY (Hz)		10-30	10-30	10-30	10-30	5-25	18-30	18-30
INPUT RANGE	CURRENT	+/-1mA	0-1mA	4-20mA		4-20	+/-1mA	0-1mA
	VOLTAGE	+/-10V	+/-2.5V	+/-5V	0-5V	+/-5V	+/-5V	
COMPONENT	TYPE	VALUE (Ω)						
VAR. RESISTOR R7	CUR	500	2K	500			500	1K
	VOLT	200	500	500	1K	500	500	
RESISTOR R8	CUR	24.9K	74.1K	42.2K			24.9K	33.2K
	VOLT	4.87K	6.9K	7.87K	19.1K	3K	4.75K	
VAR. RESISTOR R11	CUR	200	500	100		1K	200	200
	VOLT	100	200	200	200	200	500	
RESISTOR R12	CUR	8.06K	2K	3.4K		3.16K	9.76K	9.76K
	VOLT	1.58K	2.33K	2.55K	3.16K	3.16K	1.74K	
RESISTOR R13	CUR	1K	750	3.4K		3.4K	1K	1K
	VOLT	20K	7.15K	16.2K	10K	20K	20K	

Note: *Resistors are metal film, 1/4W, .1%. Variable resistors are 3299X- type.*

Table 1. I/O 40R

Table 4. Replaceable parts IO-40T

Circuit Symbol	Description	INIVEN Part Number
	CAPACITORS:	
C1, 2	Capacitor, ceramic, 100pF, 100V, +/-5	CM-NPO-E-101-J
C3-7, 10, 15, 16, 19-22	Capacitor, ceramic, 1uF, 100V, I /-5%	CM-X7R-E-104-J
C8	Capacitor, ceramic, .0068uF, 100V, +/-5%	CM-NPO-E-682-J
C9	Capacitor, tantalum, 1uF, 35V, +/-10%	DT35V105K
C11-14, 17, 18	Capacitor, tantalum, 10uF, 35V, +/-10%	DT35V106K
	RESISTORS:	
R2, 3	Resistor, carbon, 2.2M, 1/4 watt, +/-5%	RCF07J225
R10	Resistor, metal film, 10K, 1/4 watt, +/-1%	RN55D1002F
R11, 12	Resistor, metal film, 10K, 1/4 watt, +/-.01%	RN55E1002F
R13	Resistor, metal film, 4.22K, 1/4 watt, +/-1%	RN55C4221F
R14	Resistor, potentiometer, 500Ω	3299W-1-501
R15, 16	Resistor, carbon, 4.7K, 1/4 watt, +/-5%	RCF07J472
R17	Resistor, carbon, 10K, 1/4 watt, +/-5%	RCF07J103
	SEMICONDUCTORS	
D1	Diode, general purpose	HP5082
U1	Op-Amp, low power instrumentation	AD620AN
U2	Precision voltage reference	AD537JH
U3	Op-Amp, very low noise precision	OP-270FZ
U4	IC, voltage to frequency converter	AD537JH
U5	IC, CMOS, 12 stage counter/divider	CD4040B
U6	Optical isolator	4N36
U7	Positive voltage regulator, +10VDC	MC78L10ACP
U8	DC/DC converter	HPR117
	MISCELLANEOUS COMPONENTS:	
L1-3	Inductor, 560uH, +/-10%	ADF-08

Table 5. Replaceable parts IO-40R

Circuit Symbol	Description	INIVEN Part Number
	CAPACITORS:	
C1	Capacitor, ceramic, .001uF, 50V, +/-10%	CM-X7R-D-102-K
C2	Capacitor, ceramic, 47pF, 100V, +/-5%	CM-NPO-E-470-J
C3, 4, 10-16	Capacitor, ceramic, .1uF, 50V, +/-20%	CM-Z5U-D-104-M
C5	Capacitor, ceramic, .47uF, 50V, +/-10%	CM-X7R-D-474-K
C6	Capacitor, tantalum, 1uF, 35V, +/-20%	DT35V105M
C9	Capacitor, tantalum, 47uF, 35V, +/-20%	DT35V476M
	RESISTORS:	
R1, 2	Resistor, carbon, 4.7K, 1/4 watt, +/-5%	RCF07J472
R3	Resistor, carbon, 4.7M, 1/4 watt, +/-5%	RCF07J475
R4, 17, 21	Resistor, carbon, 2.2K, 1/4 watt, +/-5%	RCF07J222
R5, 6	Resistor, metal film, 10K, 1/4 watt, +/-.1%	RN55E1002B
R9, 10	Resistor, carbon, 510K, 1/4 watt, +/-5%	RCF07J514
R16	Resistor, carbon, 2.2M, 1/4 watt, +/-5%	RCF07J225
R18	Resistor, carbon, 220K, 1/4 watt, +/-5%	RCF07J224
R19	Resistor, metal film, 100Ω, 1/4 watt, +/-.1%	RN55E1000B
R20	Resistor, carbon, 27K, 1/4 watt, +/-5%	RCF07J273
	SEMICONDUCTORS	
D1, 2	Diode, fast switching	1N914
Q1	Transistor, NPN	2N4401
Q2	Transistor, NPN	BDB01C
Q3	Transistor, PNP	BDB02C
U1	IC, CMOS, quad exclusive OR gate	CD4030B
U2	IC, CMOS, quad 2 input NOR gate	CD4001B
U3	IC	MC14536B
U4	IC, CMOS, quad bilateral switch	CD4066B
U5	Precision voltage reference	REF-02CZ
U6	Op-Amp, bi-polar quad pA input current	AD704JN
U7	Differential amplifier, precision	AMP-03GP
	MISCELLANEOUS COMPONENTS:	
Y1	Crystal, quartz, 2MHz	SE020-AS
RL1	Relay	TN2E-12V

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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