INIVEN

Power Supply
IP-23/IP-23R

INSTRUCTION MANUAL

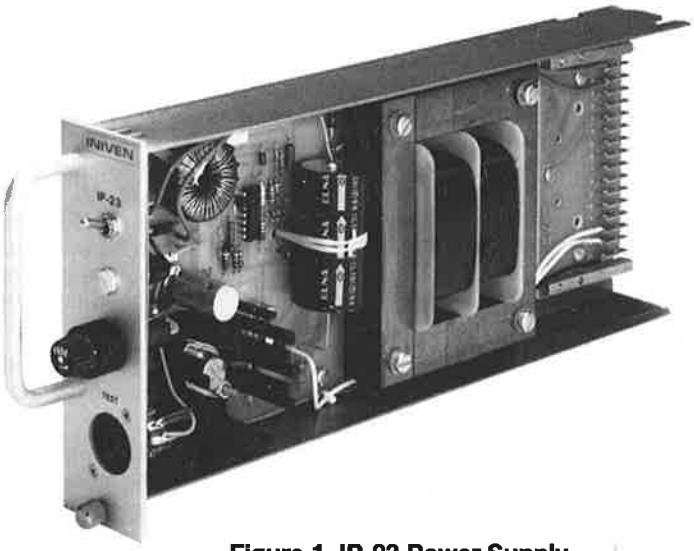

Figure 1. IP-23 Power Supply

DESCRIPTION

1.1 The INIVEN™ IP-23/IP-23R Power Supply (see Figure 1) is a "switching" type voltage regulated unit that delivers 12 Vdc at a maximum 2300mA. This unit is intended for use as a power supply for tone telemetry units.

1.2 Several features are incorporated into the IP-23 that provide ease of operation and test. Some of these features are listed in Table 1. The Model IP-23R features a power transfer relay that switches the load to an external battery and/or alarm if the IP-23R or ac power fails.

1.3 SPECIFICATIONS

Input Voltage: 105-135 Vac, 50-70 Hz
Input Current: 0.40 amperes maximum
Output Voltage: 11-13 Vdc Adjustable
Output Current: 2300 mA Maximum
Load Regulation: 150 mV maximum
(No load to Full Load)
Ripple: 50 mV maximum
Operating Temperature: −30 to +65°C
Temperature Co-efficient: 0.038% of output voltage C°
Primary Protection: 1 Amp Fused (Output current limited)
Weight: 5 lbs. (2.2 Kg)
Dimensions: (See Figure 3)

Table 1. Design Features

FEATURE	FUNCTION
Indicator Lamp	**A front panel mounted lamp that indicates status of the output dc voltage.**
Test Socket	**The socket is front panel mounted and facilitates measurement of the output dc voltage.**
On/Off Switch	**Switch is mounted on front panel for ease of system operation.**
Line Transient	**Supply is designed such that no measurable transients are generated when power is applied or removed.**
Power Dissipation	**A switching regulator is employed to insure that internal power dissipation is held to a very low level.**

2. INSTALLATION

2.1 Unpacking

2.2 Unpacking and handling of the IP-23/IP-23R Power Supply should be consistent with procedures used in handling electronic equipment.

2.3 Inspection

2.4 Visually inspect the power supply 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 that may have been jarred loose during shipment or handling.

2.5 Installation

2.6 The IP-23/IP-23R Power Supply is mounted in standard INIVEN™ tone frames.

2.7 Install the power supply as follows:

(1) Leave terminal block mounted, as shipped, on rear of each unit.
(2) Remove mounting screws from terminal blocks.
(3) Insert power supply into tone frame and secure with knurled retaining screw on front panel.
(4) Install and tighten mounting screws that hold terminal block to mounting frame.
(5) Power supply can now be removed, if desired.
(6) Connect power supply as shown in Figure 2.

3. FUNCTIONAL DESCRIPTION (See Figure 2).

3.1 Power is applied to the IP-23/IP-23R Power Supply through terminals 15 (neutral) and 16 (line). This ac line current is then applied through switch S1 and fuse F1 and stepped down in voltage by transformer T1. The current is then applied to a diode bridge consisting of CR1 through CR4 for full-wave rectification. The resulting dc output is filtered by capacitor C1 and is about 26 Vdc at nominal line voltage. This voltage is switched on an off at a rate of about 20 kHz by switching regulator U3. It is then filtered by choke L1 and capacitor C6 to provide a V_{out} of about 12 Vdc with respect to circuit common. U3 is driven by transistor Q1 and Q2 normally conducting. The rest of the circuit provides necessary pulse-width modulation for Q1 and overcurrent protection through Q2.

3.2 Power for these controlling elements is taken from U1, a three-terminal preregulator which drops the 26 volt unregulated dc to about 15 Vdc. A reference voltage of 5.1 Vdc, with respect to output common, is derived from the U1 output using zener diode CR5 in conjunction with R2. (Output common varies up to 0.23 volts more positive than circuit common because of the potential across current sensing resistor R20).

3.3 Operational amplifier U2B is used with R3, R4, R5, and C2 to make up a free-running oscillator. Application of the 5.1 Vdc reference to this sub-circuit causes a 20 kHz, 4 volt peak-to-peak triangular wave, roughly symmetrical about the reference, to appear at the upper plate of C2.

3.4 U2A, with R9, R11, R12, and R13, acts as an error amplifier, generating an output at pin 3 which is proportional to the dc error difference between the reference voltage and the scaled V_{out}. R10 and C3 provide a reduced ac gain for this amplifier to suppress the effects of noise.

3.5 The error signal from U2A gates the triangular wave by means of U2C. When V_{out} is much lower than 12 volts, the error signal rises higher than any part of the triangular wave because of inversion at the error amplifier. Operational amplifier U2C, running open-loop, saturates positively turning Q1 on and permitting regulator U3 to pass the raw rectified dc unimpeded. Conversely, when V_{out} is slightly low, the relatively high error signal holds U2C in positive saturation during all but the positive peaks of the waveform. When these peaks occur, the output of U2C goes low. Thus, the on time of Q1 during each period of the wave is increased, causing U3 to pass the 26 volt raw dc a greater proportion of the time. A slightly high V_{out} causes less passage of the raw dc. V_{out} is thus maintained at its design value of 12.0 Vdc with respect to output common.

3.6 Amplifier U2D, with resistors R14 through R18 and R20, act to provide current overload protection. When the power supply load current causes a voltage drop across R20 greater than the deadband provided by positive feedback resistor R14, U2D slews positive, cutting off Q2. With the voltage of its emitter thus elevated, Q1 ceases to conduct, cutting off U3. V_{out} then diminishes to zero, locking the power supply in a disabled state. Restoration of V_{out} can be accomplished by removing the overload, then cycling switch S1 OFF, then ON. C4 serves to suppress noise in the overcurrent sensor. C5, R19, and CR6 turn on in negative saturation, its normal state.

3.7 Diode CR7 provides emergency overvoltage protection, conducting when V_{out} reaches 15 Vdc. The resulting effective short circuit blows F1.

3.8 Resistor R1 is used to discharge C1 quickly to permit rapid re-starting of the power supply such as when clearing an overload condition.

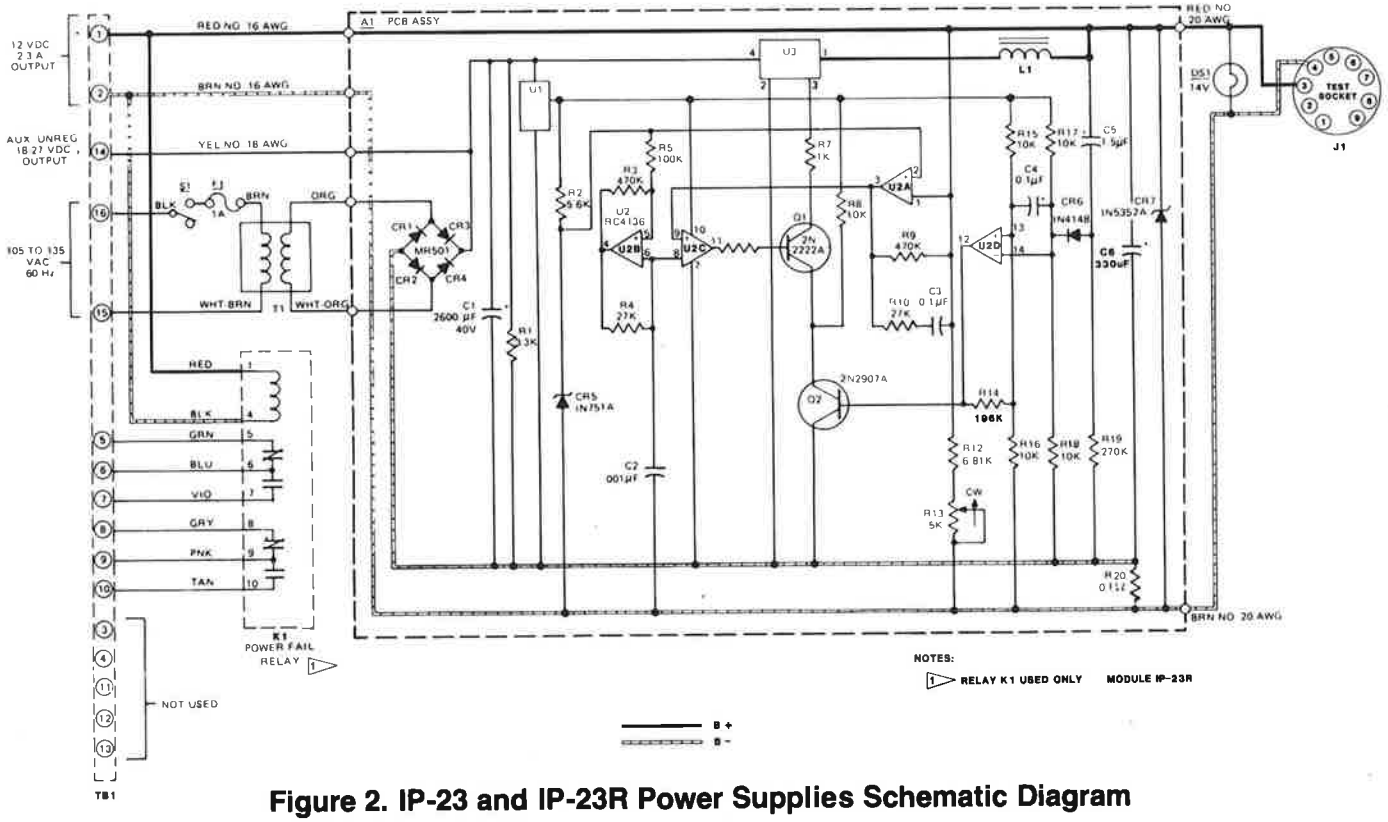

Figure 2. IP-23 and IP-23R Power Supplies Schematic Diagram

4. TROUBLE SHOOTING

4.1 Trouble shooting of the IP-23/IP-23R Power Supply can be accomplished by using the functional description of the unit and the system schematic. (See Figure 2).

5. PARTS LIST

The following parts list is included to facilitate maintenance of the IP-23/IP-23R Power Supply. All parts are listed in order of their reference designators, as applicable. Figure 3 exhibits the major components of the power supply. Figure 4 is a component diagram of printed circuit board A1.

5. IP-23/IP-23R Power Supply Assembly (see figure 3). The "Usable On Code" column identifies parts/assemblies which apply to only one particular power supply model. If the "Usable On Code" column is left blank, the part/assembly applies to all models.

MODEL	USABLE ON CODE
IP-23	A
IP-23R	B

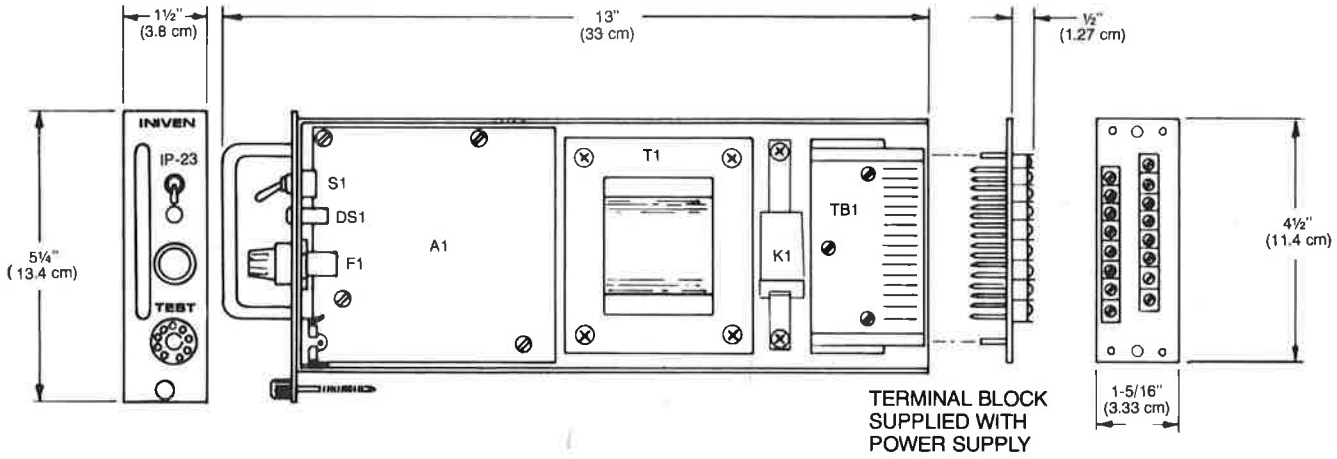

Figure 3. IP-23/IP-23R Power Supply — Dimensions and Component Identification.

REF DESIG	DESCRIPTION	QTY	USABLE ON CODE	PART NUMBER	MFR.
	IP-23 POWER SUPPLY		A	D210003	INIVEN
	IP-23R POWER SUPPLY		B	D210004	INIVEN
F1	• FUSE	1		3AG-1AMP	Littlefuse
J1	• CONNECTOR, Receptacle	1		417A4	Connector Corp.
	• HANDLE	1		230-18AL832C	Promptus Elec.
	• SCREW, Captive	1		A210301	INIVEN
	• INDICATOR, Cartridge	1		CML540285	Chicago Miniature
K1	• RELAY	1	B	T154X179	Allied
	• CLIP, Relay	1	B	30040-1	Allied
S1	• SWITCH, Toggle, SPDT	1		7101SYZB	C & C
	• FACEPLATE	1	A	B210151	INIVEN
	• FACEPLATE	1	B	B210152	INIVEN
T1	• TRANSFORMER	1		B210266	INIVEN
A1	• PRINTED CIRCUIT BOARD ASSY (See figure 4 for breakdown)	1		210005	INIVEN

5.2 Printed Circuit Board Assembly A1 (See figure 4)

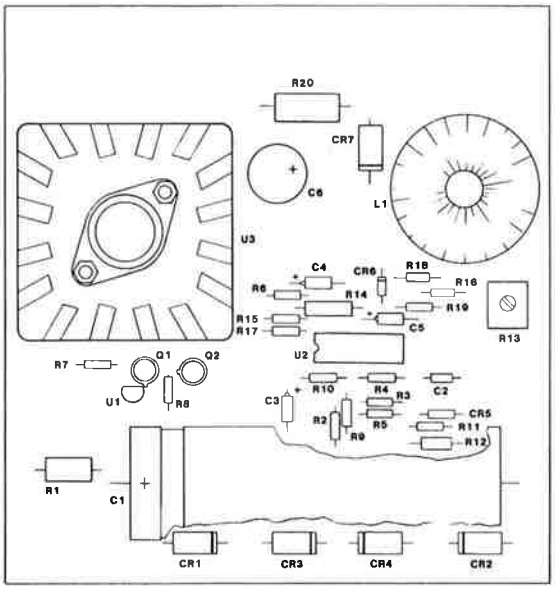

Figure 4. Printed Circuit Board Assembly A1

REF DESIG	DESCRIPTION	QTY	PART NUMBER	MFR.
	PRINTED CIRCUIT BOARD ASSY		D210005	INIVEN
C1	• CAPACITOR, 3300 uf, 50V, Electrolytic	1	50TL3300	Elna
C2	• CAPACITOR, 100 pf, 100V, 10%	1	C1f4C102K1X5CA	Kemet
C3, C4	• CAPACITOR, 0.1 uf, 35V, Tant	2	35SC0.1	Elna
C5	• CAPACITOR, 1.5 uf, 25V, Tant.	1	25SC1.5	Elna
C6	• CAPACITOR, 270 uf, 25V, Electrolytic	1	672D277H025DM5C	Sprague
CR1-CR4	• DIODE	4	MR501	Motorola
CR5	• DIODE	1	1N751A	
CR6	• DIODE	1	1N4148	
CR7	• DIODE	1	1N5353B	
L1	• COIL, Toroidal	1	B210267	INIVEN
Q1	• TRANSISTOR	1	2N2222A	
Q2	• TRANSISTOR	1	2N2907A	
R1	• RESISTOR, 3.3K, ½W, 5%	1	EB3325	Allen Bradley Co.
R2	• RESISTOR, 5.6K, ¼W, 5%	1	CB5625	Allen Bradley Co.
R3	• RESISTOR, 47K, ¼W, 5%	1	CB4735	Allen Bradley Co.
R4	• RESISTOR, 27K, ¼W, 5%	1	CB2735	Allen Bradley Co.
R5	• RESISTOR, 100K, ¼W, 5%	1	CB1045	Allen Bradley Co.
R6	• RESISTOR, 1.5K, ¼W, 5%	1	CB1525	Allen Bradley Co.
R7	• RESISTOR, 1K, ¼W, 5%	1	CB1025	Allen Bradley Co.
R8, R15-R18	• RESISTOR, 10K, ¼W, 5%	5	CB1035	Allen Bradley Co.
R9	• RESISTOR, 470K, ¼W, 5%	1	CB4745	Allen Bradley Co.
R10	• RESISTOR, 56K, ¼W, 5%	1	CB5635	Allen Bradley Co.
R11	• RESISTOR, 15K, ¼W, 5%	1	CB1535	Allen Bradley Co.
R12	• RESISTOR, 7.5K, ¼W, 1%	1	RN60D7501F	
R13	• RESISTOR, Variable	1	3386P-1-502	Bourns
R14	• RESISTOR, 196K, Factory selected	1		
R19	• RESISTOR, 270K, ¼W, 5%	1	CB2745	Allen Bradley Co.
R20	• RESISTOR, 0.1 ohm, 2W, 5%	1	HB01G5	Allen Bradley Co.
U1	• REGULATOR, Voltage	1	MC78L15ACP	Motorola
U2	• AMPLIFIER, Operational	1	RC4136DB	Raytheon
U3	• REGULATOR	1	PIC600	Unitrode