INSTALLATION AND OPERATION INSTRUCTIONS

MICROWAVE PROTECTION SYSTEM MODEL 14000

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THE EDGE AND BEYOND

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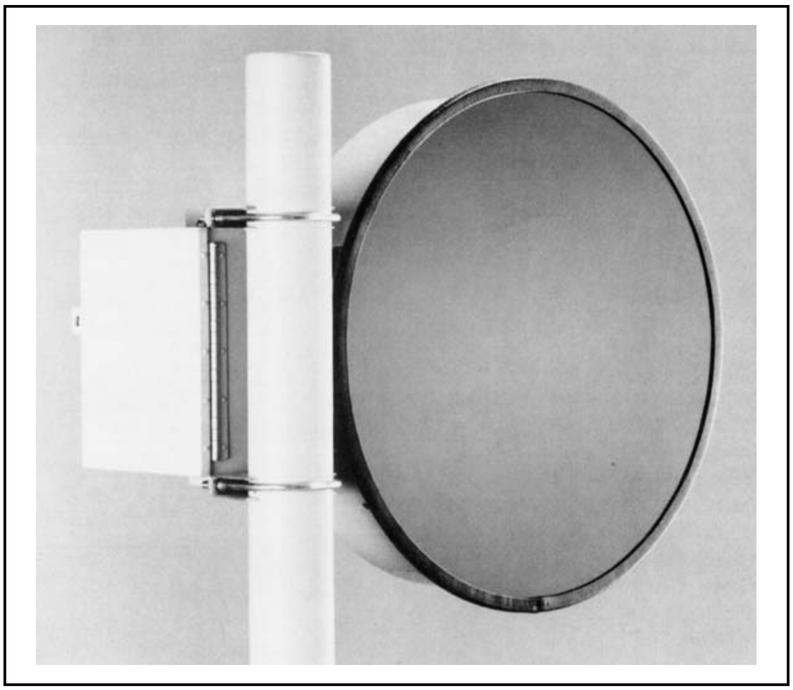

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I. INTRODUCTION

A. Preface
This manual covers the theory of operation, installation, alignment. maintenance and troubleshooting procedures for the PPi Model 14000 Microwave Security System. Please read this manual carefully before attempting installation or purchasing accessory equipment. Proper installation and a working knowledge of the system is vital for reliable operation. For special system applications, contact our Technical Services Department or our authorized representative.

B. FCC Certification
The PPi Model 14000 transmitter assembly complies with and is certified by the Federal Communication Commission under Part 15, Subpart F, Rules and Regulations covering Field Disturbance Sensor Equipment. **No installation license is required for operation.**

Governmental approvals have been obtained in many foreign countries. For specific operating frequencies and approval, contact the factory.

C. Description of Equipment Operation
The Model 14000 consists of a transmitter unit and a receiver unit. The microwave transmission principle used in this system provides effective long range detection in a wide variety of outdoor environments. Internal circuitry automatically compensates for atmospheric changes due to fog, rain, snow, etc. The transmitted microwave carrier is modulated with one of four field-selectable frequencies (3, 5. 8 or 13 KHz); the corresponding channel is also selected at the receiver, so the resultant transmitter-receiver link provides reliable operation that is free of co-channel interference Intrusion detection is accomplished at the receiver by:

1. Beam Break, resulting from a sudden decrease in received signal.
2. Jamming, resulting from a sudden increase in received signal.
3. Multipath detection, resulting from a changing microwave pattern produced by a person moving in the protected zone between transmitter and receiver. Multipath is defined as the propagation phenomenon of signals reaching a receiving antenna by more than one path. This is the same phenomenon that causes distortion in radio reception and ghost images in television.
4. Tampering, resulting from opening the electronics enclosure.

II. SPECIFICATIONS OF EQUIPMENT

A. Specifications of the Model 14000-01 are listed below. Specifications for other models of the 14000 are also listed.

14000-01 Transmitter
Frequency: 10.525 GHz ± 25 MHz
FCC Certified: Part 15. FCC license not required.
Microwave Output: Less than .25v/meter at 30m
Antenna Pattern: Single lobe, approximately 3.5° horizontal and vertical.
Antenna Polarization: E plane vertical.
Modulation: Class A2.
Modulation Frequencies. 3, 5, 8 or 13 KHz, field selectable.
Operating Temperature: -30° C to + 60° C (-22° F to + 140° F).
Power on Indicator: Light Emitting Diode (LED).
Class 2 Power Input: 16.5VAC, 60 Hz, 20VA minimum.
Power Consumption: 1.2A max from 16.5VAC line (during battery charge) .5A normally.
Battery Charger: Internal circuitry. Voltage regulated taper current float charger.
Tamper Circuit: Disables transmitter. May be cheated for installation/testing purposes. Normally closed (N/C) circuit, open on Tamper.
Size: 31" x 24" x 11" approximately (79cm x 61cm x 28cm).
Weight: 21 pounds (9.5kg)
Mounting: Designed for 3 1/2" O.D. pipe.

14000-01 Receiver
Frequency: 10.525 GHz ± 25 MHz.
FCC Certified: Not required.
Antenna Pattern: Single lobe, approximately 3.5° horizontal and vertical.
Antenna Polarization: E plane vertical.
Demodulation: Class A2, phase-lock-loop; 3, 5, 8 or 13KHz, field selectable.
"ON CHANNEL" Indicator: Light Emitting Diode (LED).
Detection Sensitivity: Field adjustable.
Alarm Circuit Output: Hermetically sealed reed relay, "dry" contacts, rated 1A max at 28VDC normally closed (N/C), open on alarm. Normally open (N/O), close on alarm optional.
Alarm Duration: Field adjustable, 1 sec. to 10 seconds ± 500ms.
Tamper Circuit: "Dry" contacts rated 1A max at 28VDC normally closed (N/C), open on tamper.
Class 2 Power Input: 16.5VAC,60 Hz, 20 VA minimum.
Power Consumption: 1.2 max from 16.5VAC line (during battery charge); .2A normally.
Battery Charger: Internal circuitry. Voltage regulated taper current float charger.
Size: 31" x 24" x 11" (79cm x 61cm x 28cm)
Weight: 21 pounds (9.5kg).
Mounting: Designed for 3 1/2" O.D. pipe.

B. Accessories
The following accessories are furnished with all dash numbers of the 14000. The next section lists additional accessories furnished with specific dash numbers.
2 each - battery, standby, 12V 2.5AH
2 each - transformer, step-down, 110VAC/16.5VAC (or 220VAC/16.5VAC if required).
2 each - mounting hardware sets.
1 each - installation and operation manual.

C. Specifications for Other Models
The specifications of these models differ from the standard specifications, as listed:

14004
Operating Temperature: Individually tested and certified to operate from -40° C to +70° C (-40° F to 158° F). Certification sheets are furnished with each unit.
Alarm Circuit Output: Hermetically sealed reed relay, "dry" contacts, rated 1A max. at 28V DC, normally closed (N/C).
Additional Accessories: 2 each conducted line filters, 2 each battery disconnect modules and 1 each relay kit

The Model 14004 is a high-reliability system that provides certified crawl detection up to 120m (400') separation when the perimeter security system has been designed and installed.

14005
Operating Temperature: Individually tested and certified to operate from -40° C to +70° C (-22° F to 140° F). Certification sheets are furnished with each unit.
Alarm Circuit: Hermetically sealed, normally open, (N/O) relay, "dry" contacts rated 1A @ 28VDC.
Additional Accessories: 2 each conducted line filters, 2 each battery disconnect modules and 1 each relay kit

The model 14005 is identical to the model 14004 except for the alarm circuit output.

14007
Maximum System Range: 750'
Transmitter & Receiver Frequency: 9.47 GHz
Transmitted Power Output: Per FTZ
Additional Accessories:
2 each conducted line filters and 2 each flexible conduit assemblies.
The model 14007 is an export version of our basic Model 14001.

14032
BISS-approved sensor. Same operating temperature and alarm circut as 14005.
Accessories: 2 each 115/16.5VAC transformers, 2 each 10-line RFI line filters and 1 each transmitter MSI Interface Cable.
NOTE: Standby batteries are not furnished with this model.

III. APPLICATION OF EQUIPMENT

A. General
The satisfactory performance of the Model 14000 is contingent on the following:
1. An accurate threat assessment that results in a statement of the level of protection that will be required.
2. Selection of the proper sensors.
3. Site selection and preparation.
4. Proper installation.
5. Accurate alignment.

B. Threat Assessment
The type of required protection will determine the physical parameters of the protection zone. High security applications require much more stringent zone specifications than do applications where only a beam break alarm is required. Table 1 should be used to determine the type of installation required.

TABLE 1

Application	Requirements
High Security	Detection of intruder stomach-crawling parallel to the beam.
Medium Security	Detection of intruder crawling on hands & knees.
Low Security	Beam break alarm only — detection of a walking intruder, vehicles, etc.

C. Site Selection and Preparation

1. Choosing a Site.
The bistatic microwave sensors (consisting of a separate receiver and transmitter) work best in a long, flat, narrow detection zone. Typical applications include prisons, high-security buildings and areas, power substations, storage yards and warehouses, etc. Virtually any site can be adapted to the use of the system if the following information is kept in mind:
a. There must be a clear direct line-of-sight between receiver and transmitter at all times.
b. The detection zone should not include any body of water such as lakes, streams, or ponds. Movement of the water will result in nuisance alarms.
c. Drainage ditches and gullies should either be avoided or filled in — not only will the periodic water flow cause nuisance alarms, but also the depression could allow the undetected access by an intruder.
d. Trees, bushes, shrubs, and tall grass within the detection zone will have an adverse effect on the nuisance alarm rate and on the probability of detection, especially when this vegetation is wet with rain or dew.
e. The presence of wildlife in the detection zone (rabbits, cats, dogs, deer, cows, etc.) may result in unwanted alarms, depending on the level of security to which the system is designed and adjusted.
f. Sharp discontinuities in the terrain under the line-of-sight may result in "holes" in the detection zone resulting from phasing inconsistencies. In addition, these

discontinuities may produce a detection "shadow" that may allow the undetected entry of an intruder.

g. The motion of semi-rigid objects (metal buildings, material or fences) that are outside of the intended protection zone may produce nuisance alarms if the objects are illuminated by the transmitted microwave signal.

2. Preliminary Survey of the Site.

Preparatory to designing a recommended microwave sensor system, a physical examination of the site is essential. During this survey, all salient physical features of the site should be noted, as follows:

a. Make accurate distance measurements of the area to be protected, and draw a rough sketch.

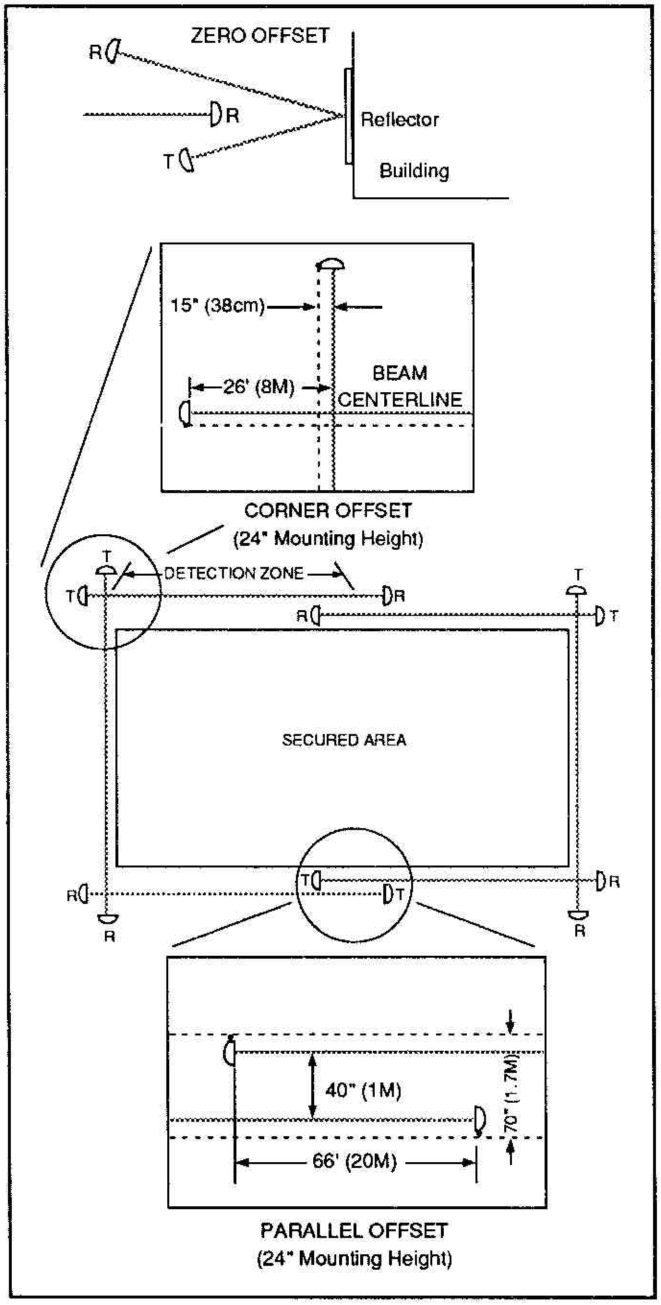


Figure 1: Offset Arrangements in Typical High Security Installations

b. Note the location of trees, poles, bushes, fire hydrants, buildings, fences, etc.

c. Walk the entire area to be protected and note the location of any gullies, ditches, low spots (which may accumulate water during rainstorms), high spots (which may interfere with line-of-sight or proper phasing), etc.

d. Pictures taken during this survey would be a valuable aid when making the detailed drawings.

3. Sensor System Siting Design.

The detailed site design drawings for the microwave sensor system should be prepared as soon as possible after the site survey. Dimensions and elevations should be shown on these drawings, as well as the location of the physical objects noted during the on-site survey. After the site drawings have been completed, the next step is to plot each microwave zone. A working knowledge of the following data is essential to the design of a reliable microwave sensor zone and system.

a. Ideal Zone. As stated previously, the level of security desired largely determines the physical parameters of the detection zone. An ideal protection zone utilizing the PPi Model 14004, designed to detect intruders belly-crawling parallel to the beam line-of-sight, is no longer than 400' (120m), graded level to grade ± 3" (7.6cm), paved or finished with crushed rock no larger than 1" (3cm) to a depth of 4", completely void of vegetation, and in which the equipment is mounted about 24" (60cm) high (beam centerline to the ground). The system capabilities are de-rated when the physical properties of the zone are not within these parameters.

b. Offsets. Offsets must be provided to prevent the possibility of crawling under or jumping over a unit to gain undetected access to the protected area. The offset distances illustrated in Figure 1 are based on the 14004 mounted at a height of 24", beam centerline to ground. Higher mounting heights require longer offsets. An optional short offset kit is available that reduces the offset to about 16' (4.8m).

c. Zone Length. The optimum length of each zone depends on several factors, i.e., level of security required, terrain, perimeter dimensions, space available for the protection zone width, etc. For short zones (railroad crossings, gate openings, etc.) use of the Model 16000 should be considered.

d. Zone Placement (fences, buildings, etc.). The sensors must be placed so that there is a clear, unobstructed line of sight between them. The suggested minimum distance between beam centerline and any object that may move (fences, trees, bushes, shrubs, etc.) is shown in Table 2.

TABLE 2
RACON 14000

Detection Zone Length	Suggested Minimum Distance Beam Centerline to Movable Object
300' (91m)	5' (152cm)
400' (121m)	5' (152cm)
500' (152m)	7' (212cm)
800' (243m)	11' (334cm)
1000' (304m)	14' (425cm)
1200' (364m)	16' (486cm)

e. Reflectors. As illustrated in Figure 1, reflectors can be used to provide a zero offset in order to protect the ends of zones that abut buildings. Reflectors can also be used to reduce the number of units required for complete protection of short perimeters. Reflectors must be large enough to intercept about 1/2 of the transmitted microwave power, and must be rigidly mounted and cross-braced to preclude movement caused by wind. The use of reflectors should be the exception rather than the rule, and it is recommended that reflector applications be discussed with the Technical Service Department.

f. Defining Site Work. After the site and zone plans have been developed, all of the work required to prepare the site for the microwave zone should be defined — grading, filling, elimination of trees or bushes. installation of drainage pipes, trenching for the power/ signal lines, etc.

IV. INSTALLATION AND INITIAL ALIGNMENT

A. Equipment Required

1. The following equipment is required for installation and initial alignment:

   9/16" open-end wrench

   1/2" open-end wrench

   1/4" flat-tip screwdriver

   Small trimpot screwdriver

   #2 Phillips screwdriver

   Voltmeter, high impedance digital
   (Fluke 8020 or equivalent)

2. The following equipment is optional, but highly recommended for use in high and medium security applications:

   Oscilloscope, portable, Tektronix 221
   or equivalent.

B. Installation

1. Power

Each Model 14000 receiver and transmitter is powered by 16.5VAC, 60 Hz. Two plug-in, step-down transformers (120VAC/16.5VAC, 20 VA for domestic applications) are furnished with each 14000 system; each unit draws a maximum of 1.2 amp from the 16.5VAC line. We recommend bringing 120VAC to the base of each post and terminating it in a duplex outlet receptacle that is enclosed in a weather proof box attached to the unit mounting post (see Figure 2). The 16.5VAC line is then run to the receiver or transmitter through flexible conduit. This box can also be used as a junction box for alarm/tamper signal lines. Insure placement of the box does not restrict full vertical movement of the unit, and that it does not block any of the microwave energy.

CAUTION

The use of one transformer for each receiver or transmitter preserves circuit isolation and eliminates the possibilities of circulating ground currents that cause erratic and undependable operation. **Failure to use one transformer for each system half will void the warranty.**

The 120VAC power line should be run underground in conduit.

2. Signal Wiring

a. Transmitter (see Figure 3). Normally signal wires from the transmitter to the alarm reporting panel are not required; the tamper circuit is factory wired to disable the transmitter (thereby putting the receiver in alarm) whenever the enclosure is opened. In those installations where separate tamper reporting is required, a twisted, shielded pair of wires must be run from the transmitter back to the alarm reporting panel. This signal wire should be shielded; the wire size is determined by the amount of current flowing through the wire and the total length of wire.

b. Receiver (see Figure 4). If separate tamper reporting is required, two twisted, shielded pair of signal lines are required from the receiver to the alarm reporting panel. If a separate tamper indication is not required, one pair of wires can be used to indicate either an alarm or a tamper. Alarm and tamper signal wires must be twisted, shielded pairs to prevent the induction of noise on these lines.

3. Mechanical Installation

a. Each receiver and transmitter must be rigidly mounted to prevent movement of the units during windy conditions. They have been designed to mount on a 3 1/2" O.D. post; typically,the posts are 8' long, 3' of which is buried in a concrete footing that is about 3' deep and 2' in diameter (see Figure 2).

b. Install the receiver and transmitter on their respective posts, using the pipe clamps and hardware provided. Mount the units at the approximate height above the ground indicated by the height chart (Figure 5); physically point them toward each other, and slightly tighten the clamp nuts so the unit will not fall. Slightly loosen the four antenna mounting bolts that secure the parabolic to the enclosure, and again point the units towards each other. This is a preliminary effort only; a more detailed mechanical alignment will be accomplished as part of the alignment procedure.

The height chart (Fig. 5) is used to determine the optimum (theoretical) mounting height (measured from the center of the antenna to ground). Mounting height versus distance plots that fall on one of the inphase node curves (N1, N2, N3 and N4) are preferred because they will result in higher signal strength at the receiver (lower AGC, hence a wider fade margin). As an example, suppose the distance between the transmitter and receiver is 400 ft., using the height chart, the best mounting heights are 38" or less (N1 curve and below), 63" (N2 curve), 82" (N3 curve) or 99". Areas between the node

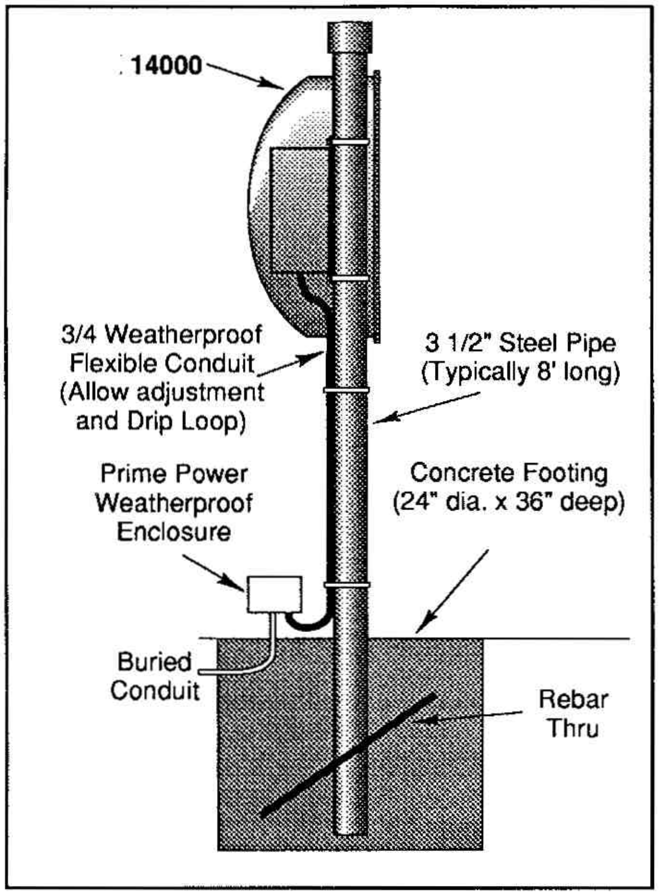


Figure 2: Mounting Post Installation

curves should be avoided. Remember that the height chart is intended to furnish a preliminary mounting height only; the operating height will be determined during mechanical alignment and final adjustment. In high security installations, mounting height is about 24" centerline to ground and the height chart is disregarded.

c. Install the 3/4" flexible conduit from the electronic enclosure on the units to the weatherproof enclosure containing the 16.5VAC transformers. Use watertight connectors, and allow sufficient slack in the flexible conduit to provide for a drip loop and for vertical adjustments of approximately ± 18".

d. Remove the protective paper covering from the face of the antenna; this will preclude any difficulty in removal after extended exposure to the elements.

4. Electrical Installation

a. Connect the 16.5VAC power lines to the receiver and transmitter. DO NOT PLUG IN TRANSFORMERS AT THIS TIME. Connect alarm and tamper wires to the receiver unit Connect the tamper signal lines (if used) to the transmitter.

b. Check all wiring and connections. Install a battery in each unit, and connect each battery to the mating connector on the printed circuit board (or on the battery disconnect module, if applicable).

CAUTION

If system installation is delayed and continuous AC power will not be available, **DO NOT** connect batteries at this time.

c. Plug the transformer for each unit into the 120V outlet. Verify that there is a minimum of 15VAC between terminals 1 and 2 of both the transmitter and receiver terminal board.

d. With the batteries connected and AC supplied, measure the DC voltage between terminals 3 (+) and 8 (ground) at both the receiver and transmitter; it should be 14.05 ± 1.5VDC ("cheat" the transmitter tamper switch). A lower voltage indicates that the batteries are undercharged — allow them to charge to the 14V level before proceeding with the alignment.

C. Initial Alignment

1. Preliminary

a. Each transmitter and receiver pair must transmit and receive on the same operating channel (A, B, C, or D). This channel is selected at the transmitter and receiver by connecting the channel jumper (red wire with spade lug) to the appropriate terminal. The receiver has an additional channel selection jumper, located above

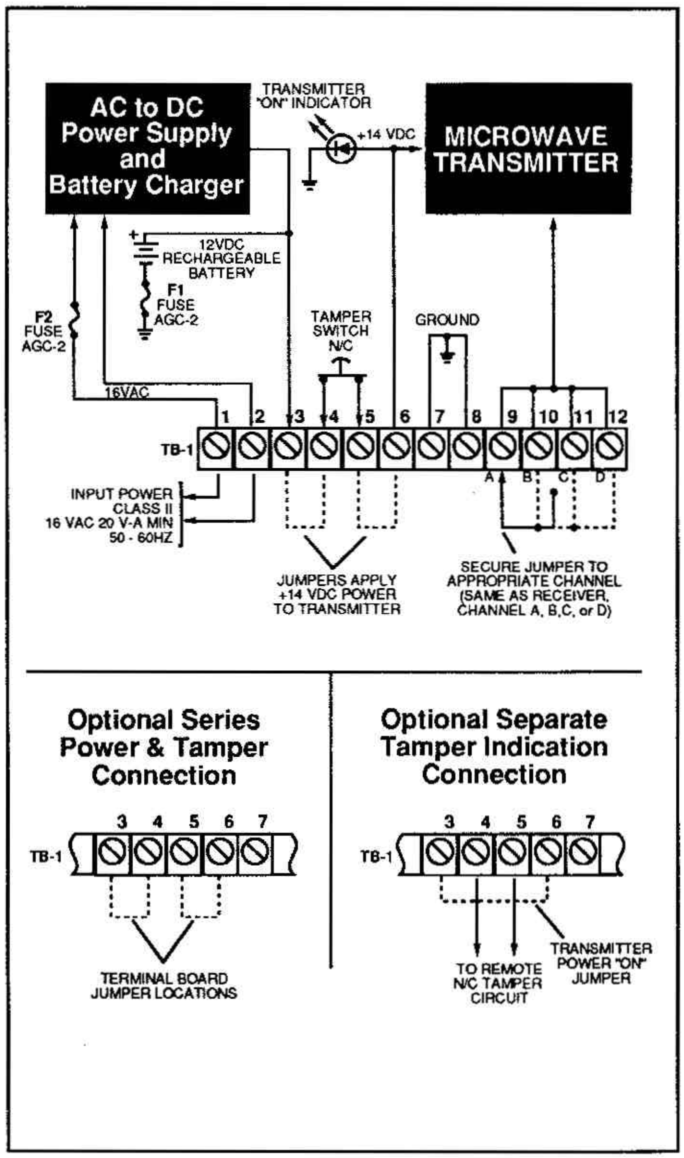


Figure 3: Transmitter Interconnection

and slightly to the right of the "ON CHANNEL" LED (see figures 8, 9 & 10). This jumper must also be set on the same channel as was selected at the transmitter.

b. Regulated Voltage and Battery Check

1) On the transmitter, pull the tamper switch out and verify that the "ON" TRANSMITTER LED is lit. The receiver is powered when the battery is connected and/or when AC is applied.

2) The regulated voltage between terminals 3 and 8 (receiver and transmitter) is 14.05±1.5 VDC. Measure and verify this voltage with AC power on.

3) Leave the voltmeter connected to terminals 3 & 8; temporarily disconnect the AC power to the unit, and observe the voltage dropping towards 12V. If the voltage drops rapidly below 12VDC, the battery is not charged. Reconnect the AC power and allow the battery to fully charge before proceeding with the alignment.

2. Mechanical Alignment

a. Insure all three channel select jumpers (one in transmitter, two in receiver) are on the same channel.

b. Insure the "ON" TRANSMITTER LED (in the transmitter) is on, and that the "ON" CHANNEL LED (in the receiver) is on. NOTE: It takes 10-15 minutes after the initial application of power for the receiver AGC to rise to a level sufficient to allow the phase lock-loop circuit to operate.

c. Connect a voltmeter to the receiver AGC (Automatic Gain Control) test points, A (+) and B (ground). The voltage should read between about 4VDC and 6.2VDC. OPTIMUM ALIGNMENT IS INDICATED BY THE LOWEST AGC VOLTAGE THAT CAN BE OBTAINED WITH HEAD-TO-HEAD ALIGNMENT.

d. While monitoring the AGC voltage, slowly move the transmitter unit up and down the pole, then from left to right, until a minimum AGC voltage is obtained. Tilt the parabolic up and down, again adjusting for a minimum AGC **with head-to-head alignment.**

e. Continue to monitor the receiver AGC voltage and move the receiver up and down the pole, then from left to right, until the AGC voltage is minimum. Tilt the parabolic up and down, again adjusting for a minimum AGC with head-to-head alignment.

f. Go back to the transmitter, and move the unit slightly in all three axis until the AGC is as low as possible. Secure mounting clamps and parabolic to enclosure bolts — insure the AGC remains low as the unit is tightened to the post and enclosure.

g. Make the final mechanical adjustments to the receiver, again obtaining the lowest possible AGC reading. Because of discontinuities in the protection zone, the final mechanical position required for the lowest AGC may be slightly off head-to-head alignment; however, in no case should the units be aimed at the ground. Normal final AGC voltage is between 4.0 and 6.2 VDC.

3. Final Adjustment

a. Connect the digital voltmeter between TP-C (in the receiver) and ground. This is the alarm threshold voltage, and will normally be about +7.75VDC when there is no movement in the zone.

b. Walk test the detection zone, watching the indication on the voltmeter. As the receiver detects motion, the voltage on TP-C will decrease in proportion to the amount of motion and to the distance between the source of motion and the beam centerline. The receiver goes into alarm when this voltage decreases to about +3V.

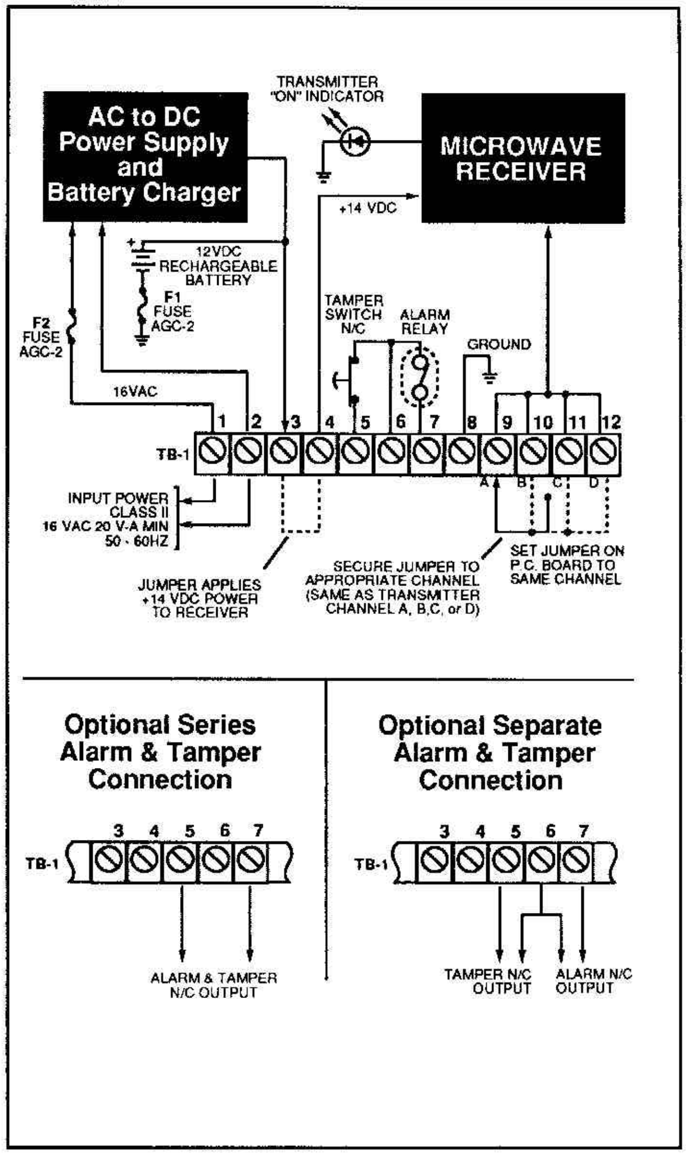


Figure 4: Receiver Interconnection

c. If an oscilloscope is available, connect it to TP-K (in the receiver) and ground. The waveform displayed will be about 2V peak-to-peak at the frequency selected at the transmitter. When the receiver begins to detect motion, the amplitude will momentarily increase and/ or decrease; when an object momentarily interrupts the line-of-sight between transmitter and receiver, the amplitude will decrease sharply and the receiver will go into alarm. Use the oscilloscope indication to define the boundaries of the detection zone.

d. The detection sensitivity can be adjusted with R53 (see Figure 9), as follows:

1) Connect the digital voltmeter to TP-C (in the receiver) and ground. With no motion in the detection zone, this voltage will stabilize at over +7VDC. Excessive variation in this voltage (1 volt or greater) is caused by an object moving in the zone. This object must be removed, and

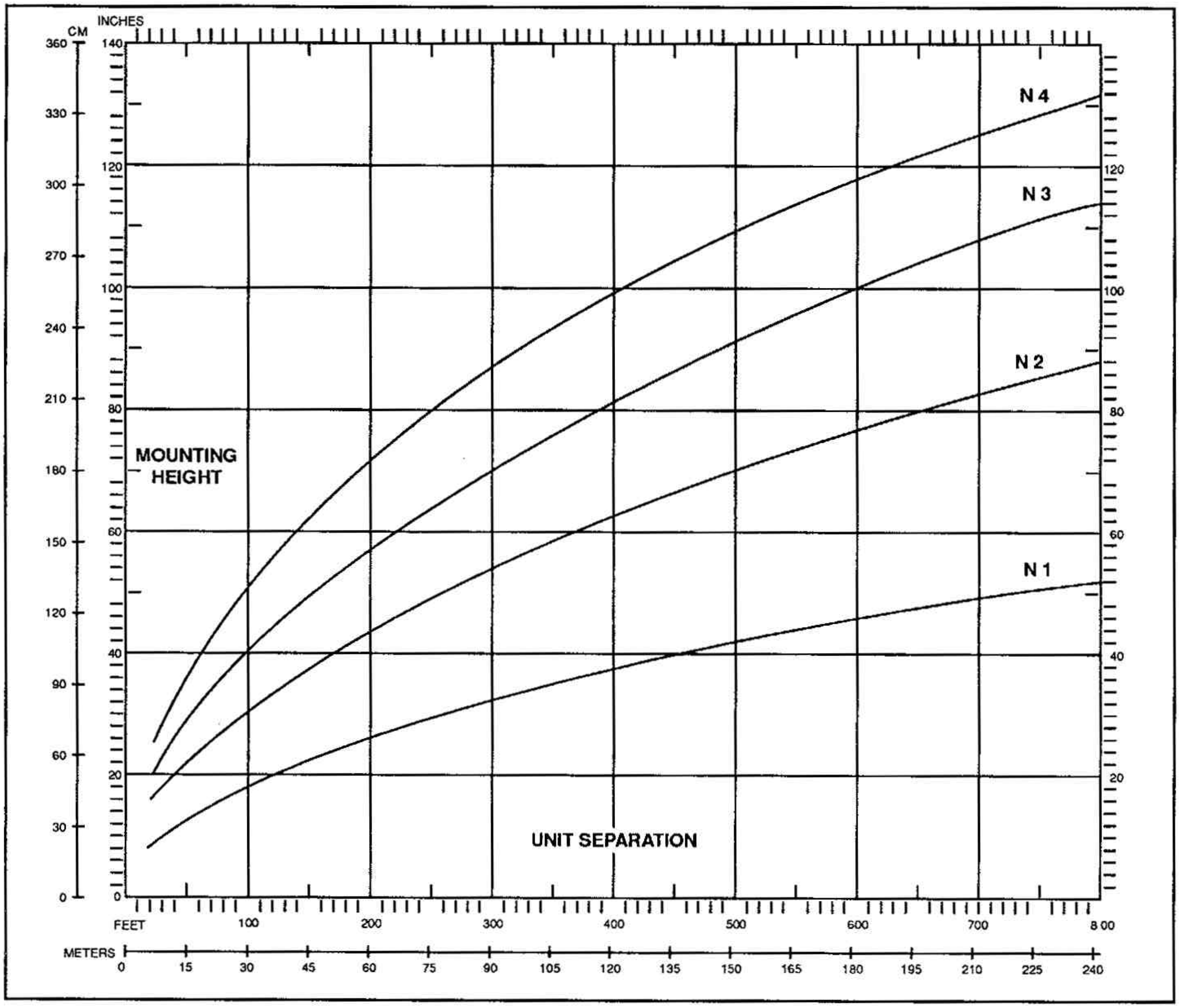


Figure 5: In-Phase Installation Mounting Height.

the voltage allowed to stabilize, before proceeding.

2) While making repeated walk tests of the zone, adjust R53 for the desired detection zone width and sensitivity. Allow the voltage at TP-C to stabilize after each penetration and alarm. The final voltage reading at TP-C should be as high as possible commensurate with the desired protection.

e. The detection zone can be altered somewhat by intentionally misaligning both transmitter and receiver as follows:

1) Connect a voltmeter to TP-A and ground (receiver AGC Test points).

2) Misalign the transmitter until the AGC increases by .25V. Misalign the receiver in the same direction until the AGC again increases by .25V. Walk test the zone; if detection is adequate, secure the units. If it is not adequate, repeat the procedure. In no case should more than 1 volt AGC be lost due to intentional misalignment.

3) The final AGC voltage must be no higher than 6.2 volts D.C.

f. Final Check

1) Connect an ohmmeter across the alarm relay contacts, terminals 6 and 7 in the receiver. The ohmmeter will indicate zero resistance when the unit is "armed", and infinite resistance when it is in alarm.

2) Connect an ohmmeter across the tamper switch contacts, terminals 5 and 6 in the receiver. Push the tamper switch all the way in; the ohmmeter should indicate zero resistance. With the switch in mid-position, the ohmmeter will indicate infinite resistance. There is zero resistance when the tamper is "cheated" (pulled all the way out).

3) Insure the unit is tight on the mounting post and that the four bolts holding the parabolic to the enclosure are tight.

4) Secure the covers of the units electronic enclosure and of the weatherproof power box (if used). Secure the flexible conduit to the mounting posts.

5) Questions concerning installation or alignment should be directed to Technical Services Dept.

V. THEORY OF OPERATION

A. Transmitter (refer to block diagram, Figure 6, and schematic diagram). For Gunn source and board, refer to Insert 13.

1. Power Supply

The Class 2 power, 16.5VAC, is connected to terminals 1 and 2 of TB-1. This AC power is applied to the full-wave bridge rectifier D7 through the 2 amp fuse F2. Varistor D12 is across the input line for surge and spike protection. The output of D7 is filtered by C11; the voltage across C11 (TP-D to ground) is between 18VDC (minimum) to 24VDC depending on the AC input voltage.

The +14VDC regulator circuit consists of M1, Q6, R14, R20, R21, R22, R23 and C7. R14 limits the current to about 750ma. Output voltage is factory set by selecting the proper value of R23. Diode D11 provides power supply isolation during standby battery operation and drops the regulated output voltage to 14.05 ± .5V on terminal 3 of TB-1.

The battery disconnect module (optional) is designed to prevent the deep discharge of the standby battery during the prolonged absence of AC input voltage; it electrically disconnects the battery when battery voltage is from approximately 8.5 to 9.5V, and automatically reconnects it to the charging circuit when AC power is restored. A 10.8VDC battery disconnect module is also optional.

The regulated 14VDC is brought to terminal 3, TB-1, and either routed through the tamper switch (terminals 4 and 5) or applied directly to terminal 6, TB-1 at the user's option From terminal 6, 14V is connected to the 10VDC regulator (Q7, R15, D5, D6 and C8); 10.25 ± .25V is measured from TP-C to ground (terminal 7 or 8, TB-1). D13, a Light Emitting Diode (LED) is lit when 14VDC is present. R16 is the current limiter for D13.

The 14VDC from terminal 6 is also connected to the primary of the DC inverter circuit consisting of the primary of T1, Q1, Q2, C1, C2, C3, C17, C18, C19, C20, R1, R2, R13, and R36. The signal at TP-H, measured with an oscilloscope, should be from 26-30V P-P, 10-40 KHz. The output from the secondary of T1 is rectified and doubled by D1, D2, C4, C5, R3 and R4. C14, C15, and C16 provide spike suppression and filtering. The unregulated voltage at TP-E is between 120 -140 VDC.

The impatt current regulator circuit (Q3, Q4, D3, R5, R6, and R33) provides the specific operating current required by each impatt diode D4. Resistors R5 and R6 are selected to provide this current. The voltage at TP-F is approximately 85VDC, and at TP-G about 83VDC. Resistor R8 (100 ohms) facilitates measurement of the impatt current; the voltage drop across this resistor should be from 1.5VDC to 3VDC, corresponding to an impatt current of between 15ma and 30ma DC.

2. Modulator

The microwave carrier is amplitude modulated with a field-selectable 3, 5, 8 or 13 KHz triangular waveform from tone oscillator M2. The operating channel is selected by connecting the jumper wire to TB-1 terminals 9, 10, 11, or 12. The tone oscillator is powered from the 10VDC power supply. The operating frequency is established by C10 and R17 in conjunction with R24, R25, R26-R27, R28-R29 or R30. Tone frequency is adjusted by R25, R27, R29 or R30 and can be measured with a frequency counter at pin 4 of M2.

Modulation of the impatt source is provided by the shunt modulator Q5 and R7, R9, R10, R11, R34 and C6. R9 and R11 are adjusted and sealed at the factory.

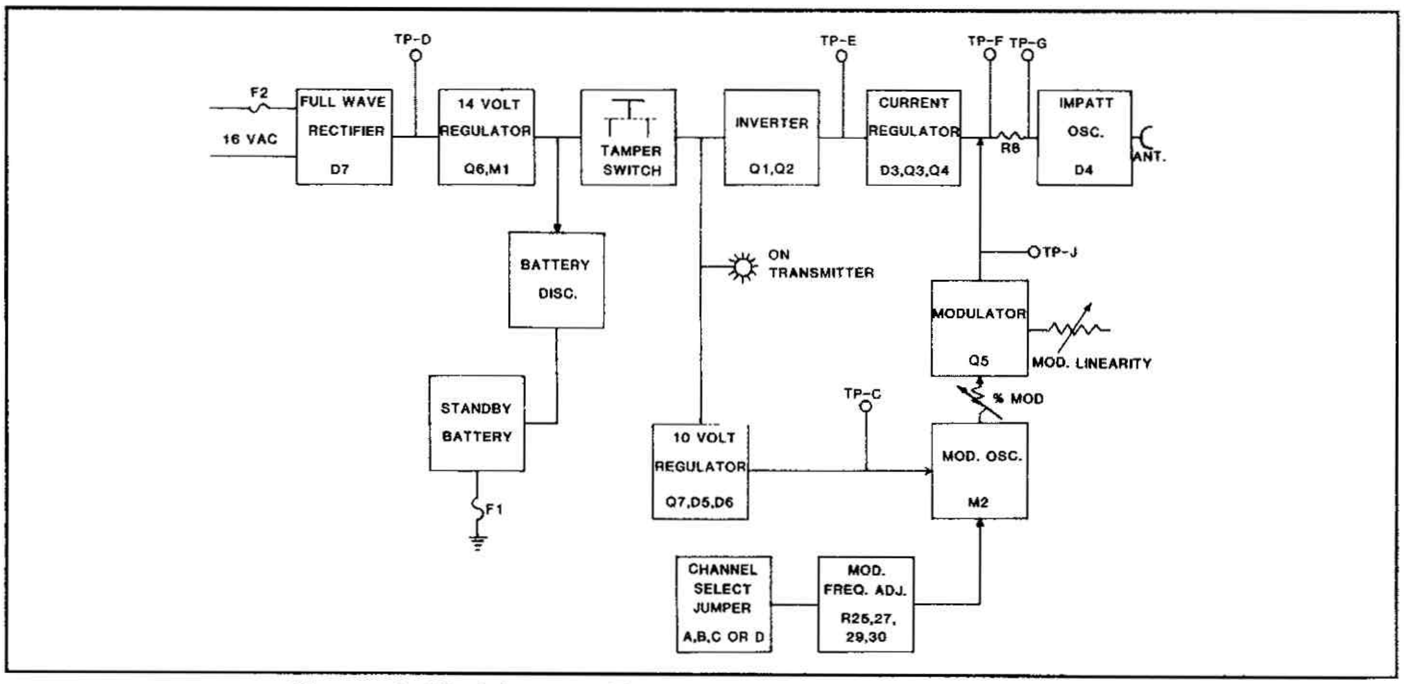


Figure 6: Model 14000 Transmitter (IMPATT) Block Diagram

B. Receiver
(Refer to block diagram, Figure 7, and schematic diagram)

1. Power Supply
The Class 2 power, 16.5VAC, is connected to terminals 1 and 2 of TB-1. This AC power is applied through fuse F2 (2A) to full-wave bridge rectifier D8. Varistor D13 is across the AC line for spike and surge protection. The output of D8 is filtered by C24; the voltage across this capacitor is between 18VDC (minimum) and 24VDC, depending on the AC input voltage.

The +14VDC regulator circuit consists of Q6, M2, R30, R31, R32, R33, R34, and C30. The output voltage is factory set by selecting the proper value of R34. Diode D12 provides power supply isolation during standby battery operation and drops the regulated output voltage at TB-1 terminal 3 to 14.05 ± 1.5VDC. The battery disconnect module (optional) is designed to prevent the deep discharge of the standby battery during the prolonged absence of AC input power; it electrically disconnects the battery when the battery voltage is from 8.5 to 9.5V and automatically reconnects it to the charging circuit when AC power is restored. A 10.8 battery disconnect is also available.

The regulated +14VDC is brought to TB-1 terminal 3 and applied to terminal 4 through the factory-supplied jumper. It is then used to operate the +9V regulator circuit consisting of Q1, M1, R1, R2, R3, R4, R5, C1, C2 and C32. Resistor R5 is factory selected to provide +9V ± .25VDC.

2. Amplifier and AGC
The microwave signal is detected by diode D1. The resulting audio frequency is amplified by Q2, Q3 (FETs), M3, M4, and associated circuitry. A passive filter set to the same channel as the transmitter is used between the output of M3 and the input of M4 to provide co-channel isolation in multiple zone use. The output of M4 (TP-K) is a 2V peak-to-peak signal of the same frequency as the transmitter modulation frequency.

The AGC circuitry provides a fast attack and slow decay AGC voltage that is applied to Q2 and Q3. The AGC circuit consists of Q4, Q5, D2, D3, C3, C15, C16, C36, C37, R8, R11, R24, R25, R26, R27, R28, R29, R35, R54, and R56. The AGC voltage at TP-A increases as the strength of the received signal decreases.

3. Phase-Lock-Loop (PLL) Detector
The amplified received signal is applied to the PLL detector M5 through the voltage divider R21-R22 and coupling capacitor C17. The PLL capture range is selected by connecting the jumper wire to TB-1 terminals 9, 10, 11, or 12. Variable resistors R40, R41, R44, and R45 are factory adjusted to center the capture range around the center frequency of 3, 5, 8, or 13 KHz. When the PLL circuit captures the incoming signal. pin 8 of M5 goes low and allows the ON CHANNEL indicator LED (D4) to light.

4. Multipath Amplifier/Detector
Upon capture of the incoming signal, M5 produces an amplitude detected output at pin 1. This amplitude variation, caused by motion in the multipath field, is amplified by M6 and associated circuitry. The detection sensitivity jumper (SLOW-MED-FAST) should be left in the MED position. The amplified signal variations are applied to the peak detector D5, D6, C21, and R36. R53 adjusts the quiescent voltage level at TP-C and pin 2 of M7.

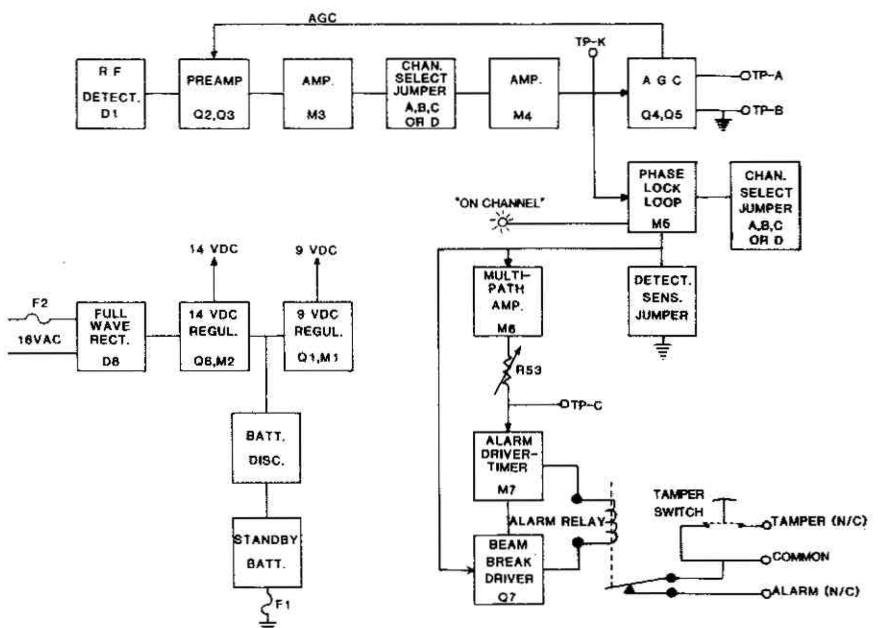


Figure 7: Model 14000 Receiver Block Diagram

5. Alarm Timer/Relay
The alarm relay is energized (closed relay contacts) when the ON CHANNEL indicator is lit and there is no motion in the multipath field. The alarm relay is de-energized when the beam is interrupted ("beam break" alarm) or when there is motion in the multipath field ("multipath" alarm). The "beam break" alarm duration is adjusted by R57.

6. Operation of Beam Break, Multipath and Alarm Circuits.
When the receiver is operating during quiescent conditions, the ON CHANNEL LED is lit, TP-C voltage is at the level set by R53 and not varying more than ±.5 volts, pin 3 of M7 is low (OV). D7 cathode is 9V, D7 anode is 4V, and the relay is energized.

a. Beam Break Alarm Path
When the line-of-sight path between receiver and transmitter is broken, the phase-lock-loop circuit (M5) is unlocked, pin 8 of M5 goes to OV, the LED goes out, and the voltage on the positive side of C10 goes from 8V to 12.5VDC. The cathode of D7 drops to OV, pin 3 of M7 remains low (OV) and the relay de-energizes.

b. Multipath Alarm
Motion in the detection zone causes amplitude variations at pin 1, M5; these variations are amplified by M6 and can be seen with an oscilloscope at TP-L. The peak variations are detected by D5 and D6, causing C21 to discharge; the voltage at TP-C (and pin 2 of M6) drops rapidly in proportion to the amount of movement in the zone. When the voltage at TP-C is about 3V, pin 3 of M7 goes high (9V), the cathode of D7 remains at 9V, and the alarm relay de-energizes, and stays de-energized for the period of time set by R57 (alarm duration) providing line-of-sight is restored.

VI. TROUBLESHOOTING AND MAINTENANCE

A. Equipment Required
1. The following equipment is required for troubleshooting and maintaining the equipment:
   - 9/16" open end wrench
   - 1/2" open end wrench
   - Flat Blade screwdriver, 1/4" x 8"
   - 11/32" spin-tite
   - Low wattage soldering iron (Weller WTCP or equivalent)
   - .050 Allen wrench
   - #2 Phillips screwdriver, 6" long
   - Voltmeter, high impedance digital (Fluke 8020B or equivalent)
2. The following equipment is recommended for troubleshooting and maintenance:
   - Oscilloscope, portable, Tetronix 221 or equivalent
3. The following additional equipment is recommended for troubleshooting high-security perimeter systems where minimum system down time is essential:

Antenna, 18 Db, P/N 10021-207-01
Waveguide to BNC adapter, HPX281COpt013
Crystal Detector, HB8470BOpt012
or Model 13000-01, P/N 10021-001-01

The equipment listed above is used to determine whether the transmitter unit is actually transmitting. By using a 13000-01 system for troubleshooting, both the transmitter and receiver of the Model 14000 can be given an operational check in the field.

B. Recommended Spares
1. The quantity of spare subassemblies that should be on hand varies depending on the number of zones in the system and the level of security the system is designed to provide. Generally, one set of spare subassemblies per 10 systems should be sufficient to maintain system integrity. Subassembly part numbers are listed in the parts list, Section VII.
2. We recommend one complete 14000 system (as a spare) for every 25 systems.

C. System Troubleshooting Data — See Table 3 and Insert 13

D. Board-level Troubleshooting Data — See Table 4 and Insert 13

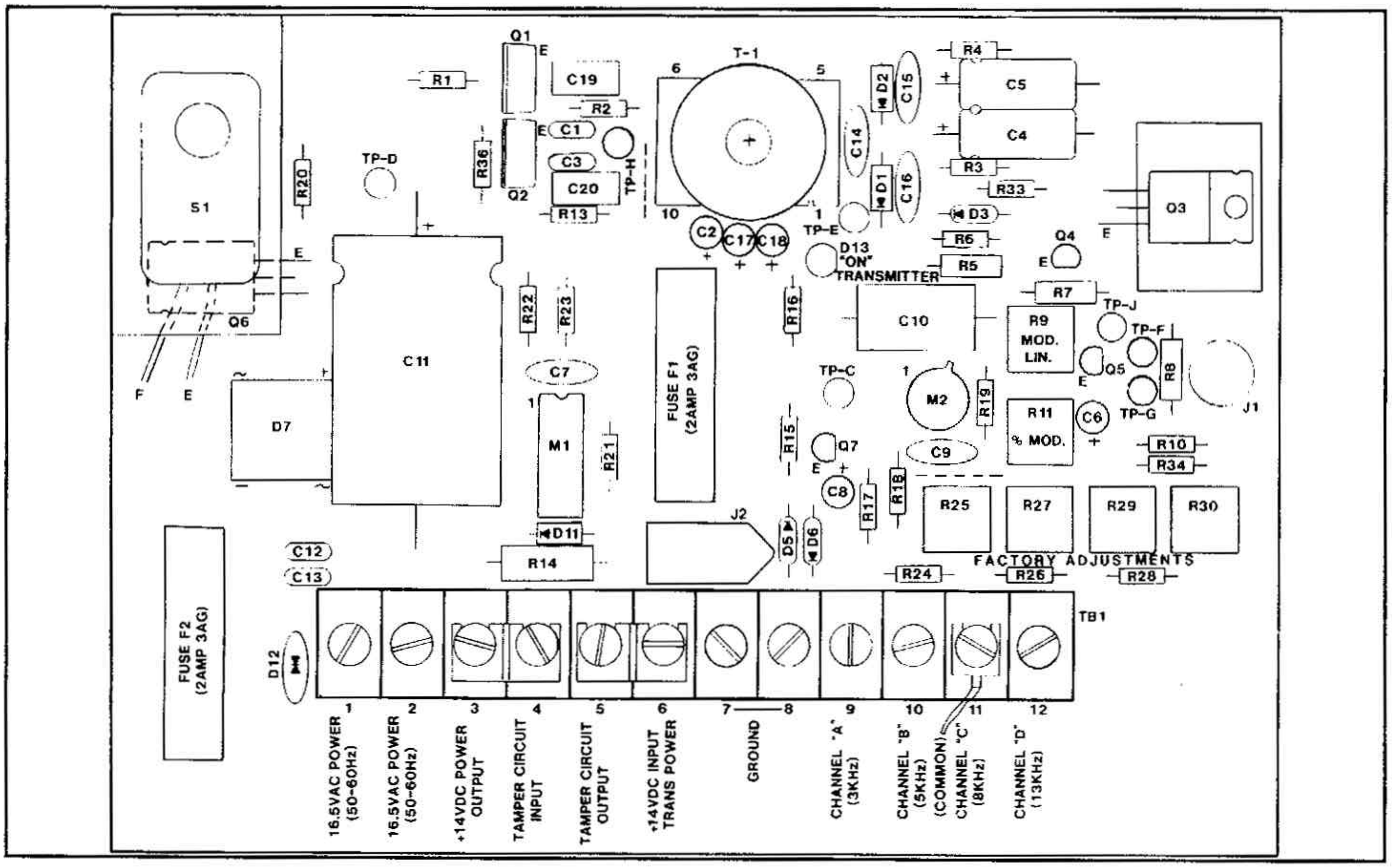


Figure 8: Transmitter (IMPATT) Component Locations

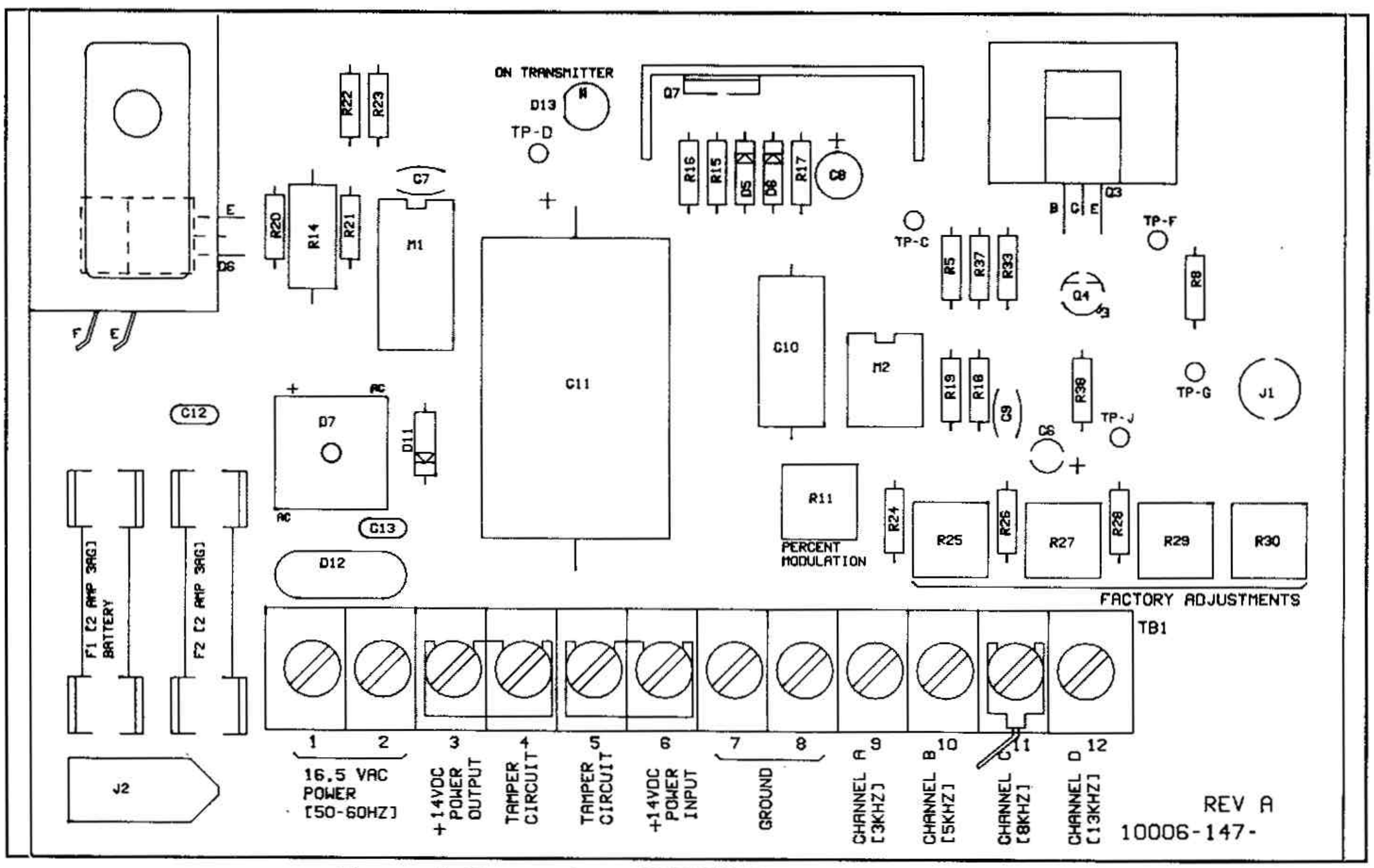


Figure 9: Transmitter (GUNN) Component Locations

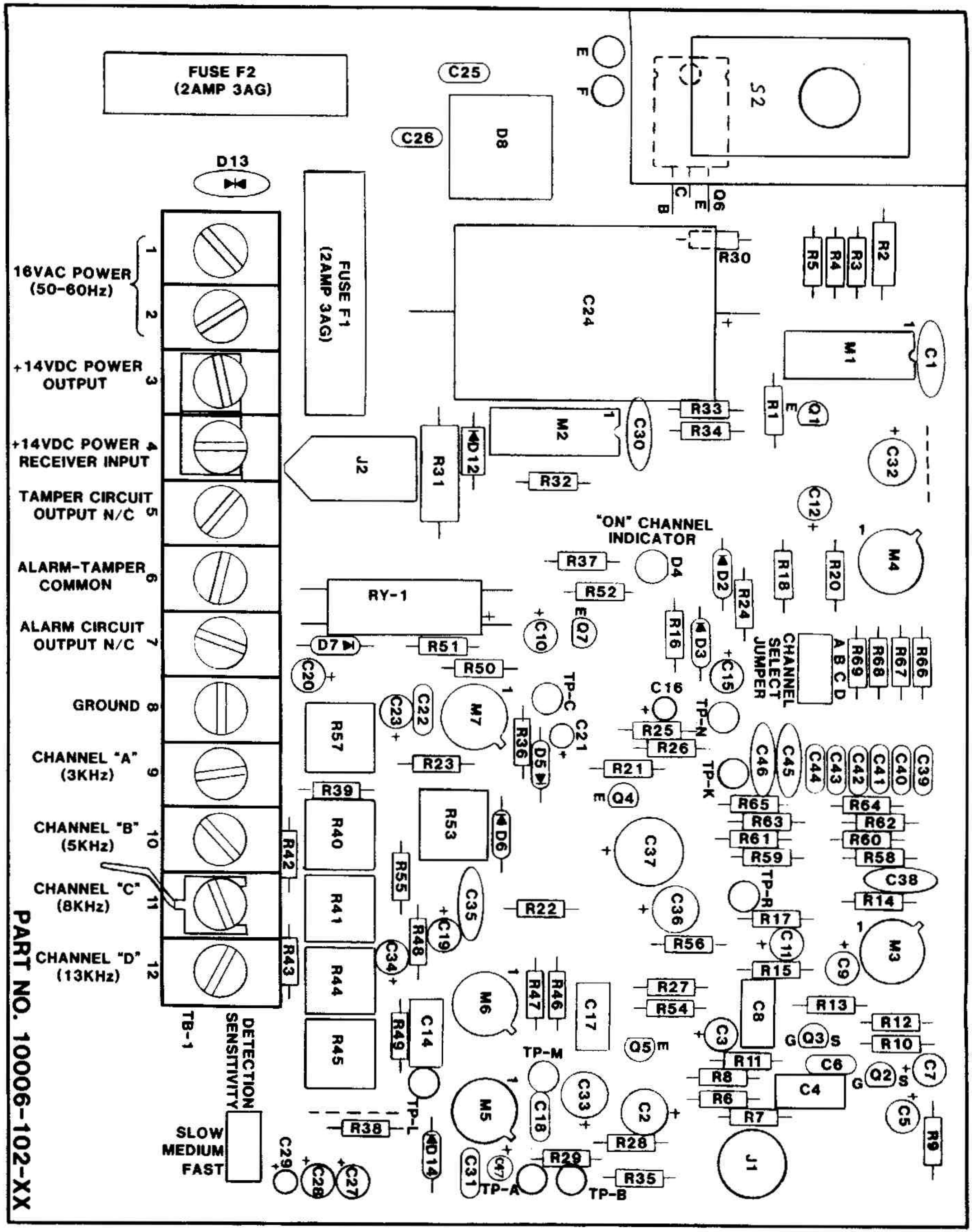


Figure 10: Receiver Component Locations

TABLE 3
MODEL 14000 TROUBLESHOOTING TABLE

Symptom	Go To	Check	Normal Indication	If Abnormal	If Normal
1. Continuous Alarm	1. Transmitter, with Impatt S/F assembly.	1. Pull tamper switch, check "Transmitter On" LED	LED lit	Go to transmitter check #2	Go to transmitter Check #3
		2. Measure voltage on TB-1 terminal 1 & 2	16.5 VAC ± 10%	Repair external wiring problems	Go to transmitter check #3
	See insert 13 for Gunn S/F assembly.	3. Measure voltage across R8 (100 ohm l/2W resistor by phono plug)	1.5 to 3.0VDC	Go to transmitter check #4	Go to transmitter check #5
		4. Remove all power. Disconnect coax cable at phono plug. Check res between center cond and shield of cable (use highest ohm scale)	Infinity. Reverse polarity approx. 4M	Repair coax or replace microwave assembly	Go to transmitter check #5
		5. Observe waveform on TP-J with AC-coupled oscilloscope	Approx. 40V P-P triangular wave, frequency as selected by jumper	Replace transmitter board	Go to receiver check #1
	2. Receiver	1. Check position of channel jumpers (2)	Both channel jumpers set to same channel as transmitter	Set channel jumpers to correct channel. Symptom should clear. If not, go to receiver check #2	Go to receiver check #2
		2. "On Channel" LED	LED lit	Go to receiver check #3	Go to receiver check #4
		3. Measure voltage between TB-1 terminal 4(+) and ground.	14.05 ± 1.5VDC	Check input power- if normal (16.5 VAC) replace receiver board	Go to receiver check #4
		4. Measure AGC voltage between test point A(+) and B (ground).	Between about 4.0 and 6.2 VDC	Replace receiver board	Go to receiver check #5
		5. Remove external connections on TB-1 term 6 and 7. Measure resistance	Less than .5 ohm resistance between 6 and 7	Replace receiver board	Repair external alarm circuits
2. Will not go into alarm with beam break	1. Receiver	1. Monitor AGC voltage (DC) at TP A(+) and TP B(-). Remove coax cable at phono plug	AGC voltage gradually rises to over 8VDC (approx. 10 minutes)	Replace receiver board	Go to check #2
		2. Remove External connection on TB-1 term 7	External circuits should indicate alarm condition	Repair external alarm circuits	Go to check #3
		3. Perform R53 adj. procedure	Unit alarms with beam break	Replace receiver board	Problem is cleared
3. High nuisance alarm rate	1. Receiver	1. Insure receiver is looking directly at transmitter, with no moveable objects in zone	Mechanical alignment is correct, zone is free of moveable obstructions, and height of units has not changed since initial installation	Realign system, clean up zone	Go to check #2
		2. Perform walk test as per initial alignment instructions	Voltage at TP-C (adjusted by R53) as high as possible consistent with desired protection (about 6.5VDC or higher)	Adjust R53 to a higher TP-C reading after successful walk test	Go to check #3

Symptom	Go To	Check	Normal Indication	If Abnormal	If Normal
3. High nuisance alarm rate (continued)	1. Receiver (continued)	3. Check position of both channel jumpers	Both channel jumpers set to same channel as transmitter jumper	Set jumpers to same channel	Go to check 4
		4. Change channel jumpers to different channel than original	No effect on nuisance alarm rate	Nuisance alarms reduced or eliminated indicates co-channel interference	Reset channel jumpers to original channel Go to check 5
		5. Remove power, check DC voltage between TB-1 term 3(+) and ground	11.8VDC minimum voltage	Replace battery with freshly charged one	Go to transmitter check #1
	2. Transmitter	1. Pull tamper to "cheat". Observe waveform at TP-J with AC coupled oscilloscope	Approximately 40V P-P triangular wave, clean, frequency as selected	Replace transmitter board	Go to transmitter check #2
		2. Remove power, check DC voltage between TB-1 term 3(+) and ground	11.8 VDC minimum	Replace battery with freshly charged one	See note below

NOTE: The possible causes for a high nuisance alarm rate are many; however, most can be attributed to physical problems within the protection zone. Mounting posts must be absolutely rigid. No movable objects can be in the zone. Nothing must be allowed to interfere with a direct line of sight between transmitter and receiver. Mounting height must be as specified in the installation manual. All connections to the terminal boards of the unit must be tight. If nuisance alarms persist, note time and conditions of each alarm — is the beam being reflected from a train, car or truck traffic, small animals, etc? False alarms attributed to the system are generally caused by a weak or intermittent receiver. Try changing receiver boards (be sure to walktest the system after installing a new board).

TABLE 4
BOARD-LEVEL TROUBLESHOOTING DATA

1. The following data is obtained under these conditions:
   a. AC (16.5V ± 10%) applied, batteries fully charged.
   b. Transmitter tamper "cheated."
   c. Microwave connected to phono plug on both receiver and transmitter.
   d. Receiver channel selection (2 places) same as transmitter channel.
   e. All measurements are to ground (terminal 8, TB-1) unless otherwise indicated.

2. TRANSMITTER, IMPATT (see also Insert 13 for GUNN Transmitter)

Test Point	Measuring Instrument	Normal Indication	Possible Causes for Abnormal Indication
D	DC Voltmeter	18VDC Min	1. Low line voltage 2. Fuse F2 blown 3. Rectifier circuit failure
Terminal 6, TB-1	DC Voltmeter	13.9-14.2VDC	1. Tamper switch open 2. Battery not fully charged 3. Jumpers missing (3 to 4, 5 to 6 on TB-1) 4. 14V regulator circuit failure
C	DC Voltmeter	10.0-10.5VDC	1. 10V regulator circuit failure 2. 14V regulator circuit failure 3. Tone oscillator circuit failure
E	DC Voltmeter	120-140VDC	1. Inverter secondary circuit failure 2. Inverter primary circuit failure 3. Current regulator/impatt failure
F	DC Voltmeter	80-90VDC	1. Inverter circuit failure 2. Current regulator circuit failure 3. Impatt Failure
F-G	DC Voltmeter	1.5-3.0VDC	1. High reading-current regulator 2. Zero reading-impatt open or R-8 open (impatt shorted)
G	DC Voltmeter	77-87VDC	1. Zero reading-impatt shorted, R-8 open 2. Low reading-current regulator
H	Oscilloscope	Square wave, 10-40 KHz, about 30VP-P	1. 14 volt regulator circuit failure 2. Inverter primary circuit failure 3. Inverter transformer failure
J	Oscilloscope	Triangular wave, about 40VP-P, frequency as selected on terminal board	1. Oscillator circuit failure 2. Modulation circuit failure

3. RECEIVER

Test Point	Measuring Instrument	Normal Indication	Possible Causes for Abnormal Indication
Across C24	DC Voltmeter	1 8VDC M i n	1. Low AC line voltage 2. F2 blown 3. Rectifier circuit failure
Terminal 4, TB- 1	DC Voltmeter	13.9-14.2VDC	1. Jumper missing (3 to 4) 2. Battery not fully charged 3. 14V regulator circuit failure
Pin 3, M1	DC Voltmeter	8.9-9.1VDC	1. 9V regulator circuit failure 2. 14V regulator circuit failure
TP-A	DC Voltmeter	4-6.2V	1. High reading a) poor Tx-Rx alignment b) weak or no signal from transmitter c) both receiver channel jumpers not same as transmitter d) receiver detector or amplifier failure 2. Low (less than 1V) reading a) Insufficient time allowed for AGC voltage to rise to quiescent level (10-15 minutes) b) Internal circuit failure
TP-C	DC Voltmeter	4.8-8 0V	1. Adjust R53 per alignment instructions 2. Circuit failure
TP-K	Oscilloscope	Clean 2V P-P sine wave at frequency selected on Tx & Rx	1. **No Signal** a) Channel jumper loose or missing b) Insufficient time for AGC to stabilize c) Weak or no signal from transmitter d) Circuit failure 2. **Sine wave not clean** a) Co-channel interference—change channel of transmitter and receiver b) Poor coax connection, board to microwave c) External RFI d) Circuit failure
TP-L TP-M	No field use No field use		

VII. PARTS LIST

Subassemblies, electronic for Model 14001

Transmitter:

Description	Part Number
Transmitter PCB Assembly for Impatt Source	10006-101-01
Transmitter PCB Assembly for Gunn Source	10006-147-01
Transmitter Source/Filter Assembly (Gunn)	10070-105-40
Transmitter PCB w/Matched Source (Gunn)	10006-147-40
Battery Disconnect Assy	10021-112-03

Receiver:

Description	Part Number
Receiver PCB Assembly	10006-102-01
Receiver Detector/Filter Assembly	10006-133-40
Receiver PCB w/Matched Detector Assembly	10006-102-40
Battery Disconnect Assy	10021-112-03

SUBASSEMBLIES FOR OTHER MODELS

Model	Description	Part Number
14005/14032	Receiver PCB Assembly	10006-102-05
	Transmitter PCB Assembly for Impatt Source	10006-101-03
	Transmitter PCB for Gunn Source	10006-147-04
	Receiver Detector/Filter Assembly	10006-133-40
	Transmitter Source/Filter Assembly (Gunn)	10070-105-40
	Transmitter PCB w/Matched Source (Gunn)	10006-147-60
	Receiver PCB w/Matched Detector Assembly	10006-102-61
14004	Receiver PCB Assembly	10006-102-04
	Transmitter PCB Assembly for Impatt Source	10006-101-03
	Transmitter PCB for Gunn Source	10006-147-04
	Receiver Detector/Filter Assembly	10006-133-40
	Transmitter Source/Filter Assembly (Gunn)	10070-105-40
	Transmitter PCB w/Matched Source (Gunn)	10006-147-60
	Receiver PCB w/Matched Detector Assembly	10006-102-61

ANTENNA & ENCLOSURE ASSEMBLY (RECEIVER & TRANSMITTER)

Description	Part Number
Antenna Parabolic Assy, Beige (1)	10006-248-02
Enclosure Assy. Beige (1)	10006-308-06
Cover. Antenna (lens 24") (1)	10006-207-01
Bracket mounting (2)	10021-216-03
U-Bolt	10021-217-02
Seal, lead	00021-002 02
Tape, vinyl foam, double-backed (6.5')	04000-002-01
Windlace, snap-on (6.5')	04005-001-02
R F. Cable Assy (Tx only) (1)	10006-113-01
R F Cable Assy (Rx only) (1)	10006-112-01

RECEIVER P.C. BOARD
(PN 10006-102-04 Ref. Fig. 9A)

C1	180pf, 1KV, Cer Disc	01003-001-03
C2	100uf, 10V. Dipped Tant	01003-002-01
C3	6.8uf, 35V, Dipped Tant	01003-002-04
C4	.1uf, 100V, Poly film	01003-003-07
C5	6.8uf, 35V, Dipped Tant	01003-002-04
C6	.027uf, 100V, Poly film	01003-003-01
C7	6.8uf, 35V, Dipped Tant	01003-002-04
C8	.1uf, 100V, Poly film	01003-003-07
C9	6.8uf, 35V, Dipped Tant	01003-002-04
C10	6.8uf, 35V, Dipped Tant	01003-002-04
C11	22uf,16V. Dipped Tant	01003-002-03
C12	6.8uf, 35V, Dipped Tant	01003-002-04
C13	Not used	
C14	.1uf, 100V, Poly film	01003-003-07
C15	6.8uf, 35V, Dipped Tant	01003-002-04
C16	1uf, 35V, Dipped Tant	01003-002-02
C17	.1uf, 100V, Poly film	01003-003-07
C18	.047uf, 100V, Poly film	01003-003-02
C19	22uf,16V. Dipped Tant	01003-002-03
C20	22uf,16V. Dipped Tant	01003-002-03
C21	6.8uf, 35V, Dipped Tant	01003-002-04
C22	.027uf, 100V, Poly film	01003-003-01
C23	6.8uf, 35V, Dipped Tant	01003-002-04
C24	2200uf, 40V, Aluminum	01003-004-08
C25	.01 ,100V, Poly film	01003-003-04
C26	1uf, 35V, Dipped Tant	01003-002-02
C27	22uf,16V. Dipped Tant	01003-002-03
C28	6.8uf, 35V, Dipped Tant	01003-002-04
C29	1uf, 35V, Dipped Tant	01003-002-02
C30	180pf, 1KV, Cer Disc	01003-001-03
C31	.015uf, 100V, Poly film	01003-003-03
C32	100uf, 10V. Dipped Tant	01003-002-01
C33	100uf, 10V. Dipped Tant	01003-002-01
C34	6.8uf, 35V, Dipped Tant	01003-002-04
C35	100pf, IKV, cer disc	01003-001-05
C36	100uf, 10V. Dipped Tant	01003-002-01
C37	220uf, 10V, Dipped Tant	01003-002-07
C38	22pf, 1 KV, cer disc	01003-001-09
C39	.0056,100V, Poly Film	01003-003-05
C40	.0056,100V, Poly Film	01003-003-05
C41	.0047,100V, Poly film	01003-003-10
C42	.0047,100V, Poly film	01003-003-10
C43	.0022, IOOV, Poly film	01003-003-06
C44	.0022, IOOV, Poly film	01003-003-06
C45	680pf, IKV,cer disc	01003-001-04
C46	680pf, IKV,cer disc	01003-001-04
C47	1uf, 35V, Dipped Tant	01003-002-02
D1	Not used	
D2	Diode, 1N4148	01005-002-01
D3	Diode, 1N4148	01005-002-01
D4	Diode, LED, red	01004-004-01
D5	Diode, 1N4148	01005-002-01
D6	Diode, 1N4148	01005-002-01
D7	Diode, 1N4148	01005-002-01
D8	Diode, Bridge	01005-016-01
D9	Not used	
D10	Not used	
D11	Not used	
D12	Diode, 1N4005	01005-003-01
D13	Diode, Varistor	01015-006-01
D14	Diode, 1N5233B	01005-020-01
D15	Diode, 1N4148 (on detector end of coaxial cable)	01005-002-01
D16	Diode, 1N4148 (on detector end of coaxial cable)	01005-002-01

F1	Fuse, AGC-2	01010-001-02
F2	Fuse, AGC-2	01010-001-02
J1	Receptacle, phono plug	01013-003-07
J2	Receptacle, battery	01013-002-07
M1	IC, Volt Reg, RC723D	01007-006-01
M1	IC, Hi Rel, UA723F	01007-006-02
M2	IC, Volt Reg, RC723D	01007-006-01
M2	IC, Hi Rel, UA723F	01007-006-02
M3	IC, Amplifier, RC741DN	01007-001-01
M3	IC, Amplifier, Hi Rel, UA741MJG	01007-001-03
M4	IC, Amplifier, RC741DN	01007-001-01
M4	IC, Amplifier, Hi Rel, UA741MJG	01007-001-03
M5	IC, Tone Decoder, NE567V	01007-008-01
M5	IC, Tone Decoder, Hi Rel, LM567H	01007-008-02
M6	IC, Amplifier. LM308H	01007-014-01
M6	IC, Amplifier, Hi Rel, LM308H	01007-014-01
M7	IC, Timer, NE555V	01007-003-01
M7	IC, Timer, High Rel, SE555JG	01007-003-02
Q1	Transistor, 2N3638	01006-008-01
Q2	Transistor, 2N5953	01006-009-01
Q3	Transistor, 2N5953	01006-009-01
Q4	Transistor, 2N4916	01006-002-01
Q5	Transistor, 2N3565	01006-001-01
Q6	Transistor, TIP30	01006-006-01
Q7	Transistor, 2N4916	01006-002-01
R1	100 ohm, 1/4W, 10%	01001-101-01
R2	3.9 ohm,1/2W,5%carbon	01001-3-9-11
R3	5.6K, 1/4W, 5%	01001-562-01
R4	24K, 1/4W, 5%	01001-243-01
R5	Selected Value, 1/4W, 5%	
R6	470K, 1/4W, 5%	01001-474-01
R7	10K, 1/4W, 5%	01001-103-01
R8	10K, 1/4W, 5%	01001-103-01
R9	2.7K, 1/4W. 5%	01001-272-01
R10	100K 1/4W, 5%	01001-104-01
R11	10K, 1/4W, 5%	01001-103-01
R12	Same as R9	
R13	10K, 1/4W, 5%	01001-103-01
R14	270K, 1/4W, 5%	01001-274-01
R15	10K, 1/4W, 5%	01001-103-01
R16	1K, 1/4W, 5%	01001-102-01
R17	1K, 1/4W, 5%	01001-102-01
R18	10K, 1/4W, 5%	01001-103-01
R19	Not used	
R20	270K, 1/4W, 5%	01001-274-01
R21	3.9K, 1/4W, 5%	01001-392-01
R22	430 ohms, 1/4W, 5%	01001-431-01
R23	12K, 1/4W, 5%	01001-123-01
R24	1K, 1/4W, 5%	01001-102-01
R25	18K, 1/4W, 5%	01001-183-01
R26	180K, 1/4W, 5%	01001-184-01
R27	68K, 1/4W, 5%	01001-683-01
R28	1K, 1/4W, 5%	01001-102-01
R29	10K, 1/4W, 5%	01001-103-01
R30	100 ohm, 1/4W, 10%	01001-101-01
R31	.56 ohms, 2W, 5% Carbon	01001-056-21
R32	10K, 1/4W, 5%	01001-103-01
R33	12K, 1/4W, 5%	01001-123-01
R34	Selected value 1/4W, 5%	
R35	1K, 1/4W, 5%	01001-102-01
R36	1M, 1/4W, 5%	01001-105-01
R37	1K, 1/4W, 5%	01001-102-01
R38	Selected value 1/4W, 5%	01001-392-01
R39	12K, 1/4W, 5%	01001-123-01

R40 Pot, 10K	01002-103-01
R41 Pot, 5K	01002-502-01
R42 6.2K, 1/4W, 5%	01001-622-01
R43 2K, 1/4W, 5%	01001-202-01
R44 Pot, 5K	01002-502-01
R45 Pot, 2K	01002-202-02
R46 10K, 1/4W, 5%	01001-103-01
R47 15K, 1/4W, 5%	01001-153-01
R48 15K, 1/4W, 5%	01001-153-01
R49 1.3M, 1/4W, 5%	01001-135-01
R50 100K 1/4W, 5%	01001-104-01
R51 330 ohms, 1/4W, 5%	01001-331-01
R52 10K, 1/4W, 5%	01001-103-01
R53 Pot, 5K	01002-502-01
R54 15K, 1/4W, 5%	01001-153-01
R55 100 ohm, 1/4W, 10%	01001-101-01
R56 9.1M, 1/4W, 5%	01001-915-01
R57 Potentiometer, 1M	01002-105-01
R58 1.5K, 1/4W, 5%	01001-152-01
R59 2.7K. 1/4W. 5%	01001-272-01
R60 1.1K, 1/4W, 5%	01001-112-01
R61 1.8K, 1/4W, 5%	01001-182-01
R62 1.5K, 1/4W, 5%	01001-152-01
R63 2.2K, 1/4W, 5%	01001-222-01
R64 2.7K. 1/4W. 5%	01001-272-01
R65 4.7K, 1/4W, 5%	01001-472-01
R66 150K, 1/4W, 5%	01001-154-01
R67 91K, 1/4W, 5%	01001-913-01
R68 150K, 1/4W, 5%	01001-154-01
R69 560K, 1/4W, 5%	01001-564-01
S2 Switch, Tamper	01009-002-01
TB-1 Terminal Block	00007-002-01
RY-1 Relay, alarm	01012-002-01
Normally closed, open on alarm	
RY-1 Relay. alarm	01012-005-01
Normally open, closed on alarm	

MECHANICAL PARTS

Bracket, Tamper & Heat sink	10006-205-01
Clip, fuse	01010-101-02
Screw, 4-40 x 3/8 PHP (part of heat sink)	00002-004-63
Nut, hex 4-40 flat (part of heat sink)	00009-005-04
Washer, #4 split lock (part of heat sink	00004-003-05
Washer, nylon shoulder (part of heat sink)	00005-001-07
Washer, mica (part of heat sink)	00005-003-10
Terminal (used as test points)	00001-003-02
Spacer, nylon snap-in, 3/8"	00010-004-02
Header, straight, double row	01013-013-01
Connector, mini-jumper	01013-009-01
Socket, phono	01013-003-07
Receptacle, battery (Molex)	01013-002-07

TRANSMITTER P.C. BOARD, IMPATT

C1 .01uf, 100V, Poly Film	01003-003-04
C2 22uf, 35V, Dipped Tant	01003-002-09
C3 .01uf, 100V, Poly Film	01003-003-04
C4 3uf, 150V, Aluminum	01003-004-04
C5 3uf, 150V, Aluminum	01003-004-04
C6 22uf, 16V, Dipped Tant	01003-002-03
C7 180pf, IKV, Ceramic	01003-001-03
C8 22uf, 16V, Dipped Tant	01003-002-03
C9 680pf, 1KV, Ceramic Disc	01003-001-04
C10 0056, Poly + 5%	01003-009-01
C11 2200uf, 40V, Aluminum	01003-004-08
C12 .01uf, 100V, Poly Film	01003-003-04
C13 .01uf, 100V, Poly Film	01003-003-04
C14 680pf, 1KV, Ceramic Disc	01003-001-04
C15 680pf, 1KV, Ceramic Disc	01003-001-04
C16 680pf, 1KV, Ceramic Disc	01003-001-04
C17 Not used	
C18 Not used	
C19 .1uf, 100V, Poly film	01003-003-07
C20 .1uf, 100V, Poly film	01003-003-07
D1 1N4005	01005-003-01
D2 1N4005	01005-003-01
D3 1N5233B	01005-020-01
D4 Not used	
D5 1N5240	01005-007-01
D6 1N4148	01005-002-01
D7 Diode Bridge	01005-016-01
D8 Not used	
D9 Not used	
D10 Not used	
D11 1N4005	01005-003-01
D12 Varistor	01015-006-01
D13 LED, red	01004-004-01
F1 Fuse, 2A	01010-001-02
F2 Same as F1	
J1 Receptacle, phono plug	01013-003-07
J2 Receptacle, battery	01013-002-07
MI I.C., Voltage Regulator RC723CP	01007-006-01
M1 I.C. (high rel) UA723F	01007-006-02
M2 I.C., Tone Oscillator LM566CN	01007-007-01
Q1 Transistor, D44C6	01006-004-01
Q2 Transistor, D44C6	01006-004-01
Q3 Transistor, D44C6	01006-004-01
Q4 Transistor 2N4888	01006-003-01
Q5 Transistor 2N5550	01006-010-01
Q6 Transistor TIP-30	01006-006-01
Q7 Transistor 2N3568	01006-005-01
R1 3.3K, 1/4W, 5% CF	01001-332-01
R2 180 ohm, 1/4W, 5% CF	01001-181-01
R3 100K, 1/4W, 5% CF	01001-104-01
R4 100K, 1/4W, 5% CF	01001-104-01
R5 220 ohm, 1/2W, 5% CF	01001-221-11
R6 Selected value	
R7 3.9K, 1/2W, 5% CF	01001-392-11
R8 100 ohm, 1/2W, 5% CF	01001-101-11
R9 Potentiometer, 1M	01002-105-01
R10 150 ohm, 1/4W, 5% CF	01001-151-01
R11 Potentiometer, 5K	01002-502-01
R12 Not used	
R13 180 ohm, 1/4W, 5% CF	01001-181-01
R14 .56 ohm, 2W, 5% carbon	01001-056-21
R15 150 ohm, 1/4W, 5% CF	01001-151-01
R16 1 K, 1 /4W, 5% CF	01001-102-01
R17 1 K, 1 /4W, 5% CF	01001-102-01
R18 Selected value	
R19 1.5K, 1/4W, 5% CF	01001-152-01
R20 100 ohm, 1/4W, 5% CF	01001-101-01
R21 10K, 1/4W, 5% CF	01001-103-01
R22 12K, 1/4W, 5% CF	01001-123-01
R23 Selected value	
R24 18K, 1/4W, 5% CF	01001-183-01
R25 Potentiometer, 5K	01002-502-01
R26 Same as R21	
R27 Potentiometer, 5K	01002-502-01
R28 4.7K, 1/4W, 5% CF	01001-472-01

R29	Potentiometer, 5K	01002-502-01
R30	Potentiometer, 5K	01002-502-01
R31	Not used	
R32	Not used	
R33	100K, 1/4W, 5% CF	01001-104-01
R34	18K, 1/4W, 5% CF	01001-183-01
R35	Not used	
R36	3.3K, 1/4W, 5% CF	01001-332-01
S1	Switch Tamper SPDT	01009-002-01
TB1	Terminal Block	00007-002-01
T1	Transformer, inverter	01008-008-01
NA	Transformer, 115/16.5VAC	01008-004-04

TRANSMITTER P.C. BOARD, GUNN

C6	1uf, 16V, Dipped Tant	01003-002-01
C7	180pf, IKV, Ceramic	01003-001-03
C8	22uf, 16V, Dipped Tant	01003-002-03
C9	680pf, 1KV, Ceramic Disc	01003-001-04
C10	0056, Poly + 5%	01003-009-01
C11	2200uf, 40V, Aluminum	01003-004-08
C12	.01uf, 100V, Poly Film	01003-003-04
C13	.01uf, 100V, Poly Film	01003-003-04
D5	1N5240	01005-007-01
D6	1N4148	01005-002-01
D7	Diode Bridge	01005-016-01
D8	Not used	
D9	Not used	
D10	Not used	
D11	1N4005	01005-003-01
D12	Varistor	01015-006-01
D13	LED, red	01004-004-01
F1	Fuse, 2A	01010-001-02
F2	Same as F1	
J1	Receptacle, phono plug	01013-003-07
J2	Receptacle, battery	01013-002-07
MI	I.C., Voltage Regulator RC723CP	01007-006-01
M1	I.C. (high rel) UA723F	01007-006-02
M2	I.C., Tone Oscillator LM566CN	01007-007-01
Q3	Transistor, D44C6	01006-004-01
Q4	Transistor 2N4888	01006-003-01
Q6	Transistor TIP-30	01006-006-01
Q7	Transistor 2N3568	01006-005-01
R1	Not Used	
R2	180 ohm, 1/4W, 5% CF	01001-181-01
R3	Not Used	
R4	Not Used	
R5	10 ohm, 1/4W, 5%	01001-100-01
R6	Not Used	
R7	Not Used	
R8	10 ohm, 1/4W, 5%	01001-100-01
R9	Not Used	
R10	Not Used	
R11	Potentiometer, 5K	01002-502-01
R12	Not used	
R13	Not Used	
R14	.56 ohm, 2W, 5% carbon	01001-056-21
R15	150 ohm, 1/4W, 5% CF	01001-151-01
R16	1 K, 1 /4W, 5% CF	01001-102-01
R17	1 K, 1 /4W, 5% CF	01001-102-01
R18	9.1K, 1/4W, 5% CF	01001-912-01
R19	1.5K, 1/4W, 5% CF	01001-152-01
R20	100 ohm, 1/4W, 5% CF	01001-101-01
R21	10K, 1/4W, 5% CF	01001-103-01
R22	12K, 1/4W, 5% CF	01001-123-01
R23	Selected value	
R24	18K, 1/4W, 5% CF	01001-183-01
R25	Potentiometer, 5K	01002-502-01
R26	Same as R21	
R27	Potentiometer, 5K	01002-502-01
R28	4.7K, 1/4W, 5% CF	01001-472-01
R29	Potentiometer, 5K	01002-502-01
R30	Potentiometer, 5K	01002-502-01
R31	Not used	
R32	Not used	
R35	Not used	
R37	100K, 1/4W, 5% CF	01001-104-01
R38	2K 1/4W, 5% CF	01001-202-01
S1	Switch Tamper SPDT	01009-002-01
TB1	Terminal Block	00007-002-01
NA	Transformer, 115/16.5VAC	01008-004-04

MECHANICAL PARTS

Bracket, Tamper & Heat Sink	10006-205-01
Clip, Fuse	01010-101-02
Heat Sink	00018-003-01
Terminal (used as Test Points)	00001-003-02
Nut, 4-40 hex (part of heat sink)	00009-005-04
Washer, #4 split (part of heat sink)	00004-003-05
Screw, 4-40 x 3/8 PHP (part of heat sink)	00002-004-63
Washer, nylon, shoulder (part of heat sink)	00005-001-07
Washer, mica (part of heat sink)	00005-003-10
Spacer, nylon, 3/8"	00010-004-02
Socket, phono	01013-003-07
Receptacle, battery (Molex)	01013-002-07

Insert 13, model 14000xx manual

This insert provides information on the Transmitter Gunn Source/Filter assembly and the Gunn Transmitter Printed Circuit Board. References here are to Sections, paragraphs, figures, etc in the basic manual.

III. THEORY OF OPERATION

A. Transmitter.

There are several important differences between the older IMPATT Source/Filter Assembly and the new Gunn Source/Filter Assembly, as follows:

A. The Gunn source requires a much lower operating voltage than the IMPATT.

B. The Gunn source is modulated by a symmetrical square wave; the IMPATT is modulated with a triangular wave.

C. The Gunn source is not a current-sensitive device; therefore, the Gunn Transmitter Circuit Board does not have to be matched to the Gunn Source/ Filter Assembly.

1. Power Supply

The Class 2 power, 16.5VAC , is connected to terminals 1 and 2 of TB-1. This AC power is applied to the full-wave bridge rectifier D7 through the 2 ampere fuse F2. Varistor D12 is across the input line for surge and spike protection. The output of D7 is filtered by C11; the voltage across C11 (TP-D to ground) is between 18VDC (minimum) to about 24VDC, depending on the AC input voltage.

The +14VDC regulator circuit consists of M1, Q6, R14, R20, R21, R22, R23 and C7. R14 limits the current to about 750ma. Output voltage is factory set by selecting the proper value of R23. Diode D11 provides power supply isolation during standby battery operation and drops the regulated output voltage to 14VDC on terminal 3 of TB-I. The optional battery disconnect circuit is designed to prevent the deep discharge of the standby battery during the prolonged absence of AC input voltage; it electrically disconnects the battery when the battery voltage is about 9VDC, and automatically reconnects it to the charging circuit when AC power is restored.

The regulated 14VDC is brought to terminal 3, TB-1, and either routed through the tamper switch (terminals 4 and 5) or applied directly to terminal 6, TB-1 at the users option. From terminal 6, 14VDC is connected to the +10VDC regulator circuit (Q7, R15, D5, D6 and C8). The output of the regulator circuit is measured from TP-C (+) to ground. The "ON TRANSMITTER" LED (D13) is illuminated when 14VDC is present. R16 is the current limiter for the LED.

2. Modulator

The microwave carrier is amplitude modulated with a field selectable 3, 5, 8 or 13KHz symmetrical waveform from tone oscillator M2. The operating channel is selected by connecting the jumper wire to TB-1 terminals 9, 10, 11 or 12. The tone oscillator is powered from the 10VDC power supply. The operating frequency of M2 is established by C10 and R17 in conjunction with R24-R25, R26-R27, R28-R29 or R30 and can be measured at pin 3 or 4 of M2 or at TP-J. Percent of modulation is measured with an oscilloscope at TP-G and adjusted with R11; this adjustment is normally made at the factory and the adjustment is sealed with QC laquer.

ADDENDUM TO TABLE 3, MODEL 14000 TROUBLESHOOTING TABLE

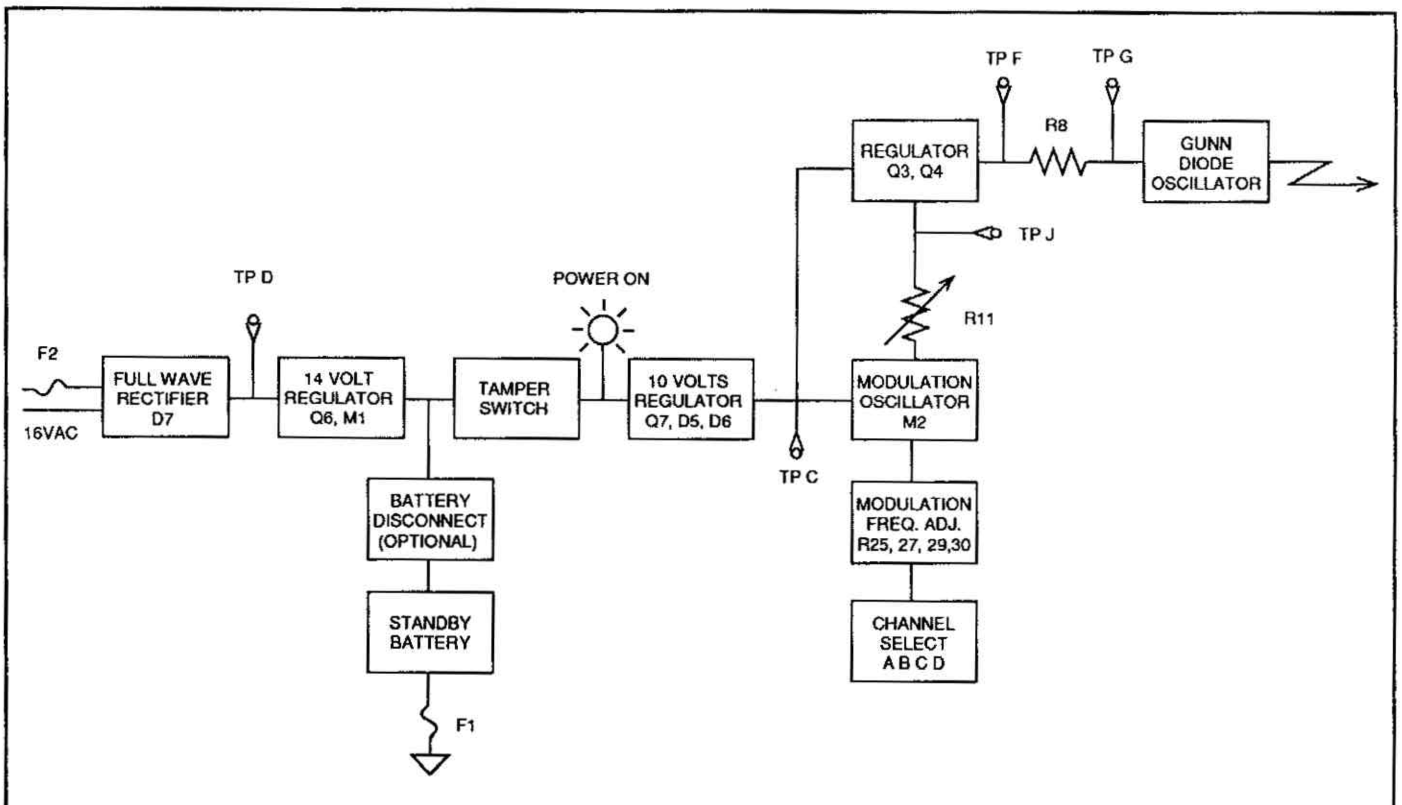
1. If the unit is in continuous alarm, check Transmitter PCB to insure operating power is present (Pull tamper switch to "cheat" position):

Measuring Instrument	Test Point	Normal Indication
Digital Multimeter	TB-1	3.8 to 14.3VDC
Digital Multimeter	TP-C	9.75 to 10.75VDC
Oscilloscope	TP-G	Square Wave, 6.5vp-p ± 1.5V
Scope, horn, detect.	Face of transmitter	Square Wave about 50mv p-p, clean

If the above tests are satisfactory, the transmitter is operational and the problem is in the receiver.

ADDENDUM TO TABLE 4, BOARD—LEVEL TROUBLESHOOTING DATA

Test Point	Measuring Instrument	Normal Indication	Abnormal? Possible cause
D	DMM	18VDC Minimum	1. Low line voltage 2. Fuse F2 blown 3. Rectifier circuit failure
Term 6, TB-1	DMM	13.8-14.3VDC	1. Tamper switch 2. Battery not charged 3. Jumpers missing 4. 14V regulator failure
C	DMM	9.75-10.75VDC	1. 10V regulator failure 2. Tone oscillator failure 3. 14V regulator failure
F	DMM	No Modulation 14VDC Specific 0 Mod 4.25 - 5.0VDC	1. 10V regulator failure 1. D3 or D4 failure 2. Tone Oscillator failure
F - G	DMM	No Modulation 1.14VDC Modulation .65VDC	1. Open Gunn 2. Open Coax
G	No Field Use		
J	Frequency Counter	Mod. Frequency	1. Tone Oscillator Failure 2. Modulation circuit failure
J	Oscilloscope	Square Wave 2.5V p-p	1. Tone Oscillator Failure 2. Modulation Circuit Failure
J	DMM	No Modulation 8.31VDC Full Modulation 10.2VDC Specified Modulation 8.5VDC	10V Supply Failure Tone Oscillator Failure % modulation pot R11



Transmitter (GUNN) Block Diagram

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