

**INSTALLATION AND OPERATING
INSTRUCTIONS FOR THE**

rad-D™

RADIATION DETECTION SYSTEM



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1 Introduction

The Rad-D is a security and inspection system that detects emissions from radioactive material. The Rad-D system can inspect large numbers of packages, vehicles, or personnel, and can be used to guard doorways and driveways, to scan conveyor belts of luggage or packages, or to provide radiation detection on existing X-ray scanning machines.

The Rad-D can operate completely stand-alone, providing the user with information via the Rad-D Alarm Display Panel, or it can be integrated into a computer network, allowing for real-time display and monitoring of multiple Rad-D systems, as well as integration with security command and control systems.

2 System Components

A Rad-D system consists of one to four detectors (Figure 1) and an Alarm Display Panel (Figure 2). There are two types of detectors: gamma and neutron. The gamma detector detects gamma radiation and high-energy X-rays emitted from radioactive materials. Gamma detectors come in two varieties: a narrow-field of view detector and an omni-directional detector. The neutron detector detects neutrons emitted from a small number of very important radioactive materials. Any combination of one to four gamma and/or neutron detectors can be installed and monitored by a single Alarm Display Panel.



Figure 1. Each Rad-D detector is 17.5” in length and 5” in diameter.

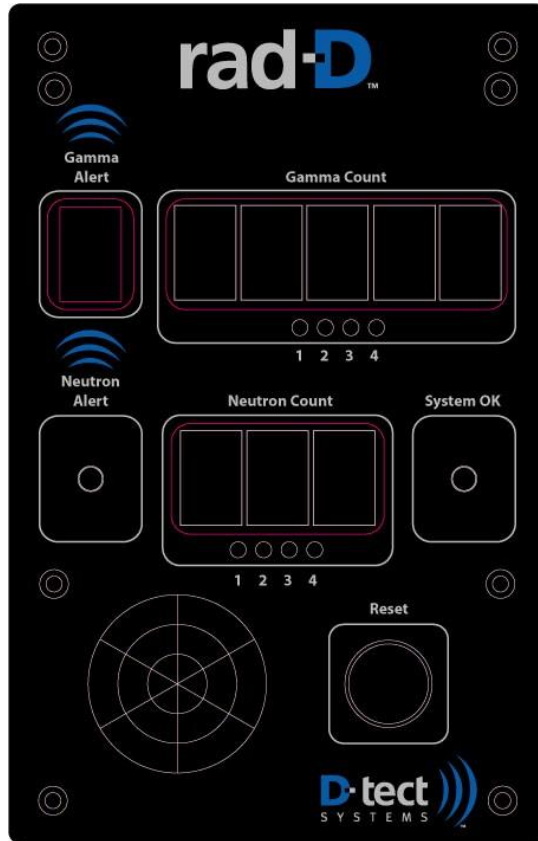


Figure 2. The Alarm Display Panel displays data from up to four different detectors

3 System Installation

General Installation:

Physically mount the detectors in accordance with the guidelines discussed below for each type of detector. A detector can be up to 50 feet away from the Alarm Display Panel. Connect the cable from each detector into any one of four detector ports on the Alarm Display Panel. The Rad-D will automatically know which type of detector has been connected to the Alarm Display Panel. Connect the power cable to the Alarm Display Panel. When all cables are connected, plug the power cable into a wall plug.

When power is applied, the Rad-D begins a 90 second warm-up sequence. During this time the Rad-D is performing self-tests and calibrating to the natural radiation background environment. At the end of this phase, the Alarm Display Panel will begin showing radiation counts from the gamma and/or neutron detectors.

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60 Hz and 50 Hz power

The Rad-D can operate on both 60 Hz/110 VAC (United States) and 50 Hz/208 VAC (most of the rest of the world) power. The Rad-D comes with a plug configured for U.S. power sockets. To use in a 50 Hz environment, attach a wall plug converter to convert the Rad-D U.S. wall plug to the local country plug standard. The Rad-D will automatically adjust to the power supplied.

Alarm Display Panel:

Locate the Alarm Display Panel near the operator or where it can be read easily, unless your Rad-D is going to be read remotely via PC. The Alarm Display Panel must be within reach of a power plug and within 50 feet of all detectors.

If the Rad-D is integrated as part of a computer network via its wireless Bluetooth interface, the receiving computer must be within 100 meters or less (depending on intervening walls) of the Alarm Display Panel. If the Rad-D is integrated as part of a computer network via its Serial Port interface, the receiving computer must be connected using a single serial cable. The PC network displays Rad-D information using the provided Rad-D software. The data format and structure of the interface is also available on request, allowing the user to use create their own monitoring software.

Detector Installation Guidelines:

All detectors are mounted using two ½” screws separated by 4”. The detectors can be mounted in any orientation. Each detector has unique placement requirements for maximum efficiency.

- **Gamma Detector, Omni-directional:** Place this detector as close to the traffic area as possible to maximize its sensitivity. It can be oriented in any direction. This detector weighs approximately 8 pounds.
- **Gamma Detector, Narrow Field-of-View:** Aim the front of the detector at the target inspection area. The front is the end opposite the cable interface. The front is composed of very thin aluminum, so care must be used to prevent dents or puncturing (neither, however, will degrade the operation of the unit, it just won't look as nice). The field-of-view is +/- 45° from the front. Ensure that the unit is as close as possible to the inspection area while still getting good coverage of the field-of-view. This detector weighs 30 lbs. Please take care when handling and mounting it to avoid injury to yourself or others. Always use safe lifting practices when moving heavy objects.
- **Neutron Detector:** To maximize neutron detection efficiency, place the detector as close as possible to the traffic area. It can be oriented in any direction. This detector weighs approximately 8 pounds.

Mounting on X-ray machines:

Typical Rad-D installation on X-ray machines consist of a single narrow field-of-view gamma detector and one-or-more neutron detectors. Because the X-ray machine can generate scatter that can be detected by the gamma detector, to avoid false alarms do not aim the front of the detector into the X-ray machine.

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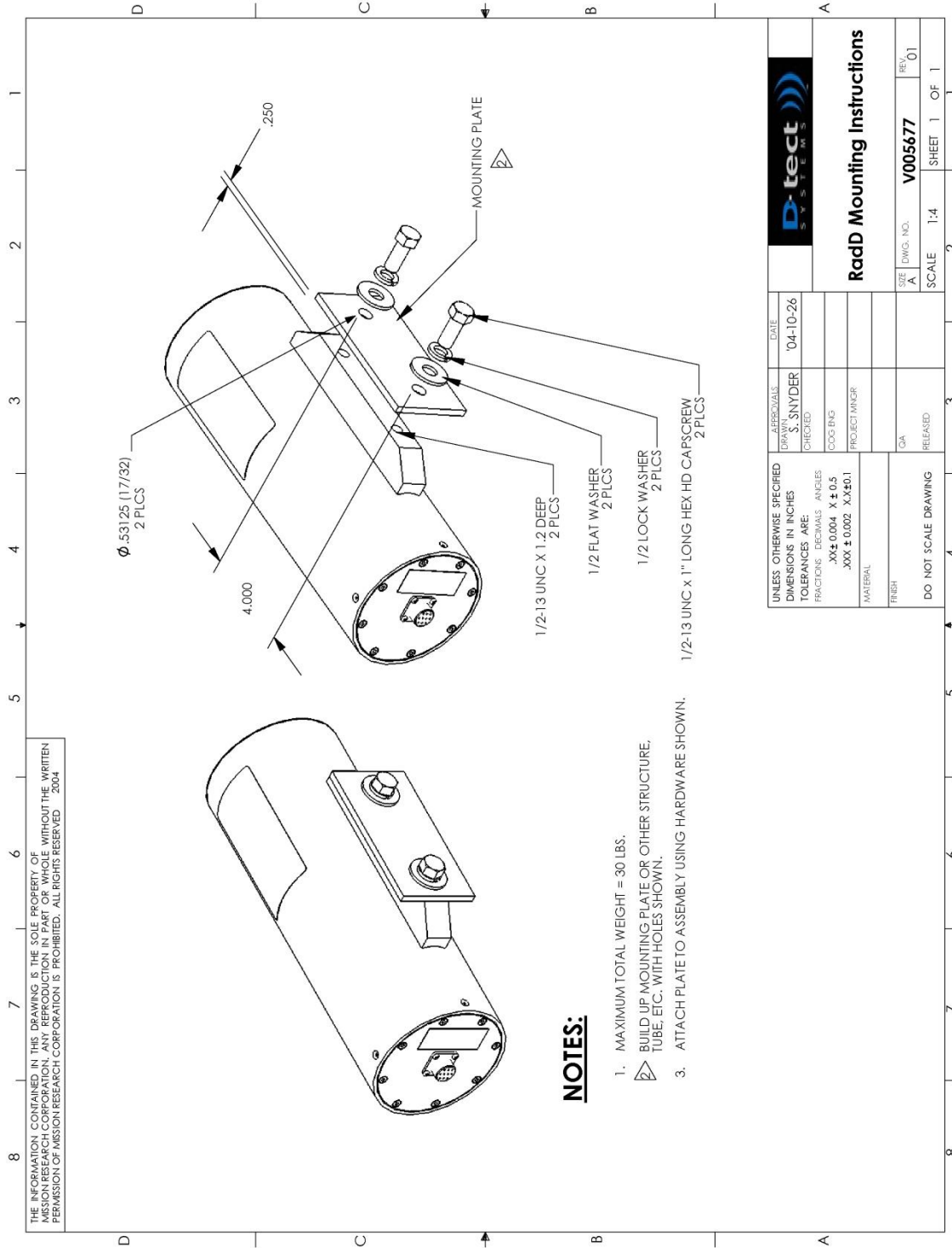
Either aim the gamma detector at the conveyor belt coming into the X-ray machine or leaving the X-ray machine. Depending on the relative radiation noise from the X-ray machine (older machines tend to be noisier), the Rad-D may have to be tuned with the X-ray machine in a one-time operation to eliminate false alarms. Inside the Alarm Display Panel is a 16-position switch that can be turned from position “0” to “15”. From the factory the unit is set to “0” unless requested otherwise.

If the Rad-D, when mounted, is alarming as a response to the X-ray machine:

1. unplug the Rad-D
2. open the Alarm Display Panel
3. set the 16-position switch to a “1” using a small screwdriver
4. close the Alarm Display Panel
5. plug the Rad-D into the wall socket
6. check to see if the false alarm response from the X-ray machine has been eliminated.

Usually a setting of “1” is sufficient for modern X-ray machines. If there are still false alarms, adjust the switch to a “2” using the process described above. If there are still false alarms, increase the switch one setting using the process described until the Rad-D does not have a false alarm response to the X-ray machine.

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- NOTES:**
1. MAXIMUM TOTAL WEIGHT = 30 LBS.
 2. BUILD UP MOUNTING PLATE OR OTHER STRUCTURE, TUBE, ETC. WITH HOLES SHOWN.
 3. ATTACH PLATE TO ASSEMBLY USING HARDWARE SHOWN.

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		DATE	'04-10-26
DESIGNED BY	S. SNYDER	CHECKED	
COG-ENG		PROJECT MGR	
RadD Mounting Instructions		SIZE	A
		DWG. NO.	V005677
		REV.	01
		SCALE	1:4
		SHEET	1 OF 1
UNLESS OTHERWISE SPECIFIED DIMENSIONS IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES .XX ± 0.004 X ± 0.5 .XXX ± 0.002 X.X ± 0.1 MATERIAL FINISH		DO NOT SCALE DRAWING	



4 System Operation

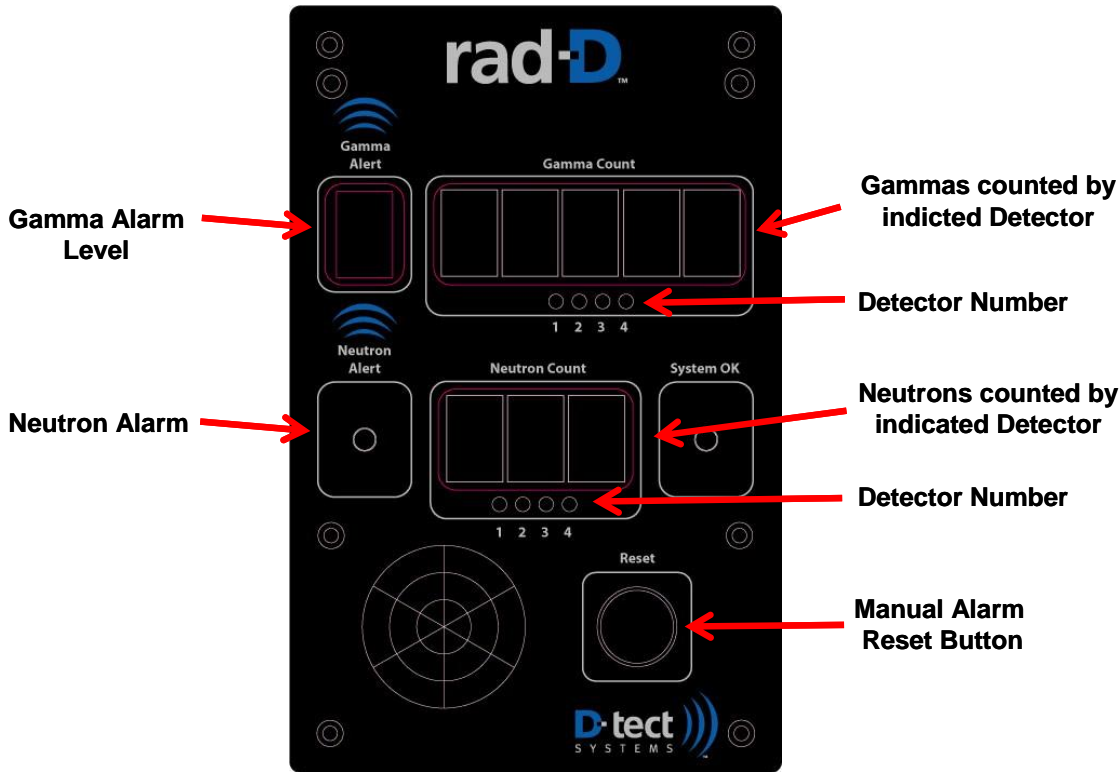
Non-Alarming

When not alarming, the Rad-D information panel displays the measured gamma counts per second and measured neutrons per second for each detector in a repeating display cycle. If your Rad-D system consists of four gamma detectors, the display would show the gammas/second from detector #1, indicated by the first LED light below the gamma count display being lit. Then the gammas/second from detector #2 would be shown (accompanied by the second LED light being lit). The cycle would continue with the gammas/second measured by detectors #3 and #4 being shown and then would begin again with detector #1. A similar cycle would be shown if there were four neutron detectors. If you have a mixed combination of gammas and neutron detectors, then the detectors would be cycled similarly to the previous examples, except split between the gamma and neutron displays.

Alarms

During an alarm, the non-alarming detectors are no longer displayed. Instead the gamma or neutron count of the alarming unit is displayed, with the specific detector identified by the detector number light. If more than one gamma or neutron detector is alarming, the display shifts between the two. Both the gamma and neutron counter displays are real-time. When the radiation source moves on, they will go back to displaying normal levels. The Alarm Display Panel also has persistent alarm displays for gamma and neutron alarms. These will not clear to normal levels until reset, either using the manual button on the Alarm Display or via computer. The persistent gamma alarm displays the highest alarm level (1 through 9) that a detector measured. The persistent neutron alarm indicates an alarm, but does not display a level (any neutron source above natural background requires investigation).

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5 Problems or Failure

Contact your distributor or D-tect Systems at www.dtectsystems.com.

6 Warnings

Do not open any Rad-D component while it is still plugged into a power source. Please use proper care and good practices when lifting heavy Rad-D components.

7 Notification

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC Rules.

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8 Testing

8.1 Test Procedure

8.1.1 Power On Test

1. Plug gamma and/or neutron detectors into controller box as shown in Figure 1. Detectors can be connected to any port in any order.



Figure 1. Rad-D Detector to Controller Box

2. Connect AC power cord to control box and plug in to AC-outlet. Power should be 100-240VAC, 50/60 Hz.



Figure 2. Controller Box in power-up mode



- a. Confirm that all LEDs light up as shown in Figure 2. Neutron Alert LED and System 'OK' LEDs should pulse briefly.
- b. Speaker will beep once.
- c. The green system 'OK' LED should flash once every second for one minute while the system stabilizes.
- d. After one minute, the system 'OK' LED should flash twice per second for 30 seconds while system detects background radiation levels.

NOTE: Exposing the detectors to radioactive materials during calibration will skew functioning of the detector. System must be powered off and on again to re-calibrate.

- e. Confirm system enters normal operation mode. The counter displays will be active if the associated detector type is connected to the control box, with the port light lit for each detector attached. (Figure 3 depicts a system with a gamma detector in port 3, and a neutron detector in port 4.)
- f. While detecting, the system displays are updated each second. Counts above background level are displayed. If multiple detectors of one type are connected, the display cycles through display of each detector, with the associated port light active, as detailed in this manual. Over the course of about a minute, confirm that each detector has both zero and non-zero counts displayed.

NOTE: Testing the gamma detector can be accomplished by using several controlled sources; however, the Neutron acceptance can only be verified by detecting neutrons. Therefore acceptance for the neutron detector is simply accomplished by the controller box detecting 1 or 2 counts, from background radiation, as displayed by the neutron count.

A Rad-D neutron detector can be sent to a qualified facility for testing and detecting neutrons.

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Figure 3. System 'OK' LED flashing green and gamma/neutron counts

3. If a radioactive sample is available, the inspector may expose each gamma detector to the sample and confirm an associated elevated count/alarm level displayed. Directional gamma detectors (contain lead and are heavy) should be exposed at the front end, as shown in Figure 4. Omni-directional gamma detectors (do not contain lead) may be exposed from side or end.



Figure 4. Radioactive source at the Detector and detecting level/counts.

4. Gamma and neutron alerts maintain their highest alert levels, with their associated port lights flashing, until the controller box is reset. Reset the system by pressing the red Reset button.



Note: Pressing the Reset button only clears past alerts, but does not clear active alerts, nor does it re-calibrate the system.

8.1.2 Communications Test

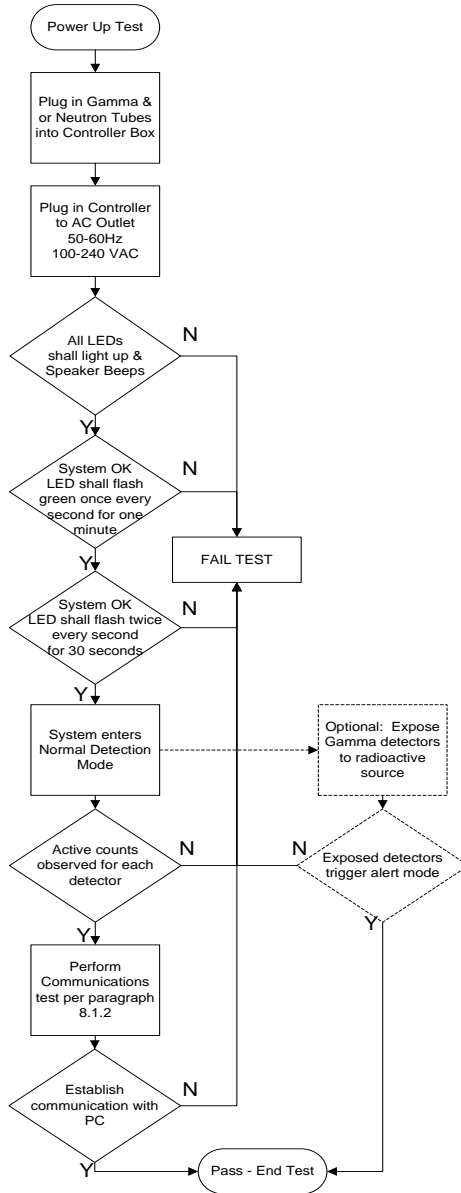
1. Connect the Rad-D controller to a PC. This can be done in one of two ways.
 - a. Connect a serial cable between the PC serial port and the serial port on the top of the Rad-D controller.
 - b. If your controller is Bluetooth equipped, establish a serial connection through a Bluetooth device on the PC. This can be done through 'My BlueTooth Places' in WindowsXP.
2. Start the Rad-D software.

Note: Program setup is explained in the readme.txt file found on the Rad-D GUI installation CD.

3. Press the Connect button in the Rad-D GUI computer program.
4. Confirm that data is displayed on the PC screen and actively changes for each detector connected to the controller ports.

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8.1.3 Test Flow





9 Appendix A: Limited Warranty for D-tect System Products

1. What this Warranty Covers and for How Long

D-tect Systems ("D-tect Systems") warrants this device (the "Product") against defects in materials and workmanship under normal use for a period of two years from the date of purchase. This warranty extends to the first end-user purchaser only, and is not transferable. This warranty does not extend to other ancillary and/or consumable products including but not limited to batteries, calibration sources, straps, and shipping cases. D-tect Systems, at its option, will at no charge either repair, replace or refund the purchase price of any Products that do not conform with this warranty. Repair may include the replacement of parts with functionally equivalent reconditioned or new parts. Replacement may include providing a functionally equivalent Certified Reconditioned/Pre-owned or a new Product. Products that have been repaired or replaced are warranted for the balance of the original warranty period or for 90 days from the date that the repaired or replaced Product is received by you, whichever is longer. All Products for which replacements have been provided will become D-tect Systems property.

2. Other Warranty Conditions

This warranty is D-tect Systems' complete warranty for the Product. D-tect Systems assumes no obligation or liability for changes to this warranty unless made in writing and signed by an officer of D-tect Systems.

If D-tect Systems agrees to perform services requested and approved by the customer that are not included in either the Limited or Extended Warranty, these services will be billed to the customer at D-tect Systems' standard prices and terms.

D-tect Systems does not warrant any installation, maintenance, or service that it did not perform. SERVICE WORK PERFORMED BY SERVICE CENTERS NOT AUTHORIZED BY D-TECT SYSTEMS TO PERFORM SUCH WORK WILL VOID THIS WARRANTY.

3. What This Warranty Does Not Cover

- a. Defects or damage resulting from: collision of the Product with hard surfaces, contact with water, rain or extreme humidity, contact with sand, dirt or the like, contact with extreme heat or cold, spills of food or liquid, improper testing, operation, maintenance, installation, adjustment; or any alteration or modification of any kind.
- b. Normal "wear and tear" of the Product such as scratches, scuffs, and marks on the LCD, case and other external features.
- c. Cracked or broken displays, buttons, or damage to other externally exposed parts caused by abnormal use and/or abuse of the Product.
- d. Products disassembled or repaired in such a manner as to adversely affect performance or prevent adequate inspection and testing to verify any warranty claim.
- e. Products on which serial numbers or date tags have been removed, altered or obliterated.

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4. How to Get Warranty Service

To get warranty service, please contact your distributor or D-tect Systems at www.dtectsystems.com.

You will receive directions on how to mail the Product to D-tect Systems. All Products shipped to D-tect Systems must be shipped with freight and insurance prepaid. Along with the Product you must include a receipt, bill of sale, or some other comparable proof of purchase, a written description of the problem and, most importantly, your address and telephone number. If additional information is needed, please contact D-tect Systems at the web address indicated above.

5. General Provisions

THIS IS THE COMPLETE WARRANTY FOR THIS PRODUCT BY D-TECT SYSTEMS AND SETS FORTH YOUR EXCLUSIVE REMEDIES. THIS WARRANTY IS GIVEN IN LIEU OF ALL OTHER EXPRESS WARRANTIES. IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE GIVEN ONLY IF SPECIFICALLY REQUIRED BY APPLICABLE LAW. OTHERWISE, THEY ARE SPECIFICALLY EXCLUDED. IN NO EVENT SHALL D-TECT SYSTEMS BE LIABLE FOR DAMAGES IN EXCESS OF THE PURCHASE PRICE OF THE PRODUCT OR FOR ANY INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT, TO THE FULL EXTENT THESE DAMAGES MAY BE DISCLAIMED BY LAW.

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D-tect Systems will defend at its own expense, any suit brought against you to the extent that it is based on a claim that the Products infringe a United States patent. D-tect Systems will pay those costs and damages finally awarded against you in any such suit which is attributable to any such claim. The defense and payments by D-tect Systems are conditioned on the following: (a) that you will notify D-tect Systems promptly in writing any notice of the claim; and (b) that D-tect Systems will have sole control of the defense of the suit and all negotiations for its settlement or compromise; and (c) should the Products become, or in D-tect System's opinion be likely to become, the subject of a claim of infringement of a United States patent, that you will permit D-tect Systems, at its option and expense, either: to procure for you the right to continue using the Products or parts; to replace or modify them so that they become non-infringing; or to grant you a credit for such Products or parts as depreciated and accept their return. The depreciation will be an equal amount per year over the lifetime of the Products, accessories, battery or parts as established by D-tect Systems.

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