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Certification Exhibit

FCC ID: YKD-25TWD3000

FCC Rule Part: CFR 47 Part 90, DA 09-2482

ACS Report Number: 10-0003.W03.11.A

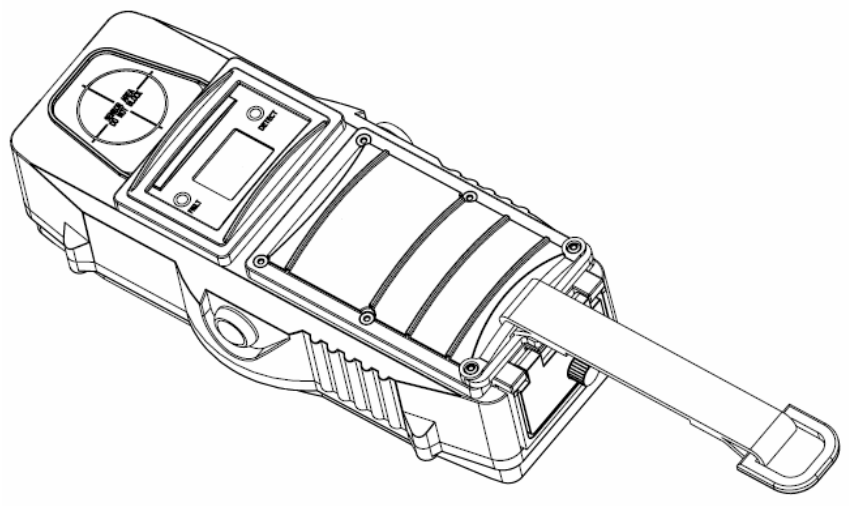
Applicant: L-3 Communications CyTerra
Model: RANGE-R

Manual

MAN-0001 Rev C

OPERATOR'S MANUAL

RANGE-R™



This RANGE-R Handheld Through Wall Radar is controlled under the U.S. International Traffic in Arms Regulations (ITAR) and may not be exported without proper authorization by the U.S. Department of State.

SAFETY SUMMARY

WARNINGS

When the degraded breather detection indicator is illuminated on the display, only large body movements will be detected. Small body movements such as respirations may not be detected. This should be taken into account when making mission oriented operational decisions. Failure to follow this warning could result in death or injury.

To avoid possible wall blockage scenarios, an operator must observe the building material to avoid scanning through metal or absorptive material. The building material should be taken into account when making mission oriented operational decisions. Failure to follow this warning could result in death or injury.

The RANGE-R™ system's best detection performance occurs directly in front of the unit and extends out ±80 degrees in a conical pattern. Outside of this area the detection performance rapidly degrades. This should be taken into account when making mission oriented operational decisions. When possible, the operator should perform scans at different locations along the wall surface to maximize coverage of the target area. Failure to follow this warning could result in death or injury.

There is a region above the display marked "Sensor Area – Do Not Block." This region should not be covered by the operator's hand. This region houses an antenna used to sense and reject nuisance detections that may arise from operator-side motion. Failure to do so could result in false alarms and degraded detection performance.

SAFETY SUMMARY

WARNINGS

Inserting the batteries into the unit in the wrong orientation may cause the batteries to overheat or explode. Care should be taken to insert the batteries correctly. Failure to follow the appropriate procedure may cause damage to the equipment.

The battery compartment is not internally watertight, thus care should be exercised when the battery door is open to ensure liquids do not enter the compartment where it is possible for them to leak into the internal electronics. Failure to follow this caution may cause damage to the equipment.

If the RANGE-R™ system is placed in the case with a side facing up, the scan buttons may be pressed when the case is closed, causing the unit to transmit. This will drain the batteries and may cause the system to overheat. This may possibly damage the device.

This RANGE-R Handheld Through Wall Radar is controlled under the U.S. International Traffic in Arms Regulations (ITAR) and may not be exported without proper authorization by the U.S. Department of State.

FCC COMPLIANCE

WARNING

Do not open the unit. There are no user serviceable parts contained within the unit, and opening or tampering with it will void the FCC certification and the manufacturer's warranty.

This device is approved for use by the FCC under FCC Order DA 09-2482, FCC ID YKD-25TWD3000.

Warning: Changes or modifications to this device not expressly approved by **L-3 CyTerra** could void the user's authority to operate the equipment.

"This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter."

"NOTE: 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. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:"

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For any questions related to FCC compliance contact L-3 CyTerra Technical Support.

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CHAPTER 1
INTRODUCTION
SECTION I - GENERAL INFORMATION

1.1 SCOPE.

This manual provides instructions for operating and service information for the RANGE-R™ (Electro-Magnetic Motion Detection and Ranging) system. It includes a description of the hardware, its controls and indicators, and operating procedures. To obtain the best performance and margin of safety, it is imperative that the operator familiarize themselves with the contents of this manual and train with the system on a regular basis in order to fully understand the system's capabilities and limitations.

1.2 LIST OF ACRONYMS/ABBREVIATIONS.

Acronym/Abbreviation	Definition
Br	Breather
BIT	Built-in-Test
C	Celsius
CBIT	Continuous Built-in-Test
cm	centimeter
DSP	Digital Signal Processor
F	Fahrenheit
ft	Foot
in	Inch
kg	Kilogram
lb	Pound
LED	Light Emitting Diode
MOV	Mover
PLL	Phase Locked Loop
PMCS	Preventative Maintenance Checks and Services

1.2 LIST OF ACRONYMS/ABBREVIATIONS (Continued).

Acronym/Abbreviation	Definition
RF	Radio Frequency
RMA	Return Material Authorization
sec	Second
SFCW	Stepped Frequency Continuous Wave
Tx	Transmit
VDC	Volts Direct Current

SECTION II - EQUIPMENT DESCRIPTION AND DATA

1.3 EQUIPMENT CHARACTERISTICS, CAPABILITIES, and FEATURES.

The RANGE-R™ system is a highly sensitive, portable, handheld, battery operated system. It is designed to detect moving and near stationary personnel through walls constructed of common building materials. Anticipated uses of the RANGE-R™ system include room clearance operations and victim location by search and rescue personnel engaged in disaster recovery efforts.

The system is comprised of a stepped-frequency continuous wave (SFCW) radar transceiver, digital signal processor (DSP), display and power supply electronics enclosed in a rugged, water-resistant, light-weight plastic housing. The operator controls consist solely of the two momentary pushbutton switches located on the sides of the unit. Target detection information and system status are shown on a graphics display and two LED indicator lights on the front of the unit. Batteries used to power the unit are accessed through a hinged door located on the bottom of the unit that is secured by a thumb screw.

1.4 LOCATION AND DESCRIPTION OF MAJOR COMPONENTS

The major features of the RANGE-R™ system are: Rear Looking Antenna; Fault LED, Detect LED, Graphics Display, Scan Button (2), Battery Door with Thumb Screw, and Serial Number Plate.

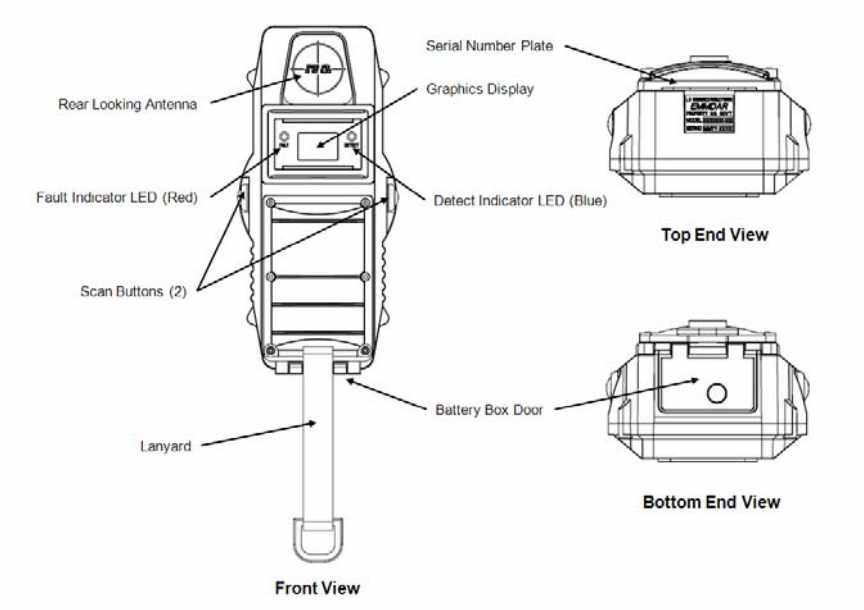


Figure 1-1. RANGE-R™ Components

1.5 EQUIPMENT DATA

System Dimensions and Weight:

Length……..... 8.9 in (22.16 cm)

Width…… 4.0 in (10.16 cm)

Height…….. 2.7 in (6.86 cm)

Weight…….. 1.2 lbs (0.55 kg)

Battery:

Type…….....4 each AA sized lithium batteries

Battery Life…… >400 uses

Temperature

Operational Temperature Range……0°F(-20°C) to 125°F (40°C)

SECTION III - THEORY OF OPERATION

1.6 TECHNICAL PRINCIPLES OF OPERATION.

The RANGE-R™ system uses safe levels of electro-magnetic radiation in the form of radar signals to detect and measure the range to moving or near stationary personnel through walls constructed of common building materials. The system is very sensitive and can detect coarse body movements such as walking or fast head and arm movements, as well as fine body motion such as chest movement caused by respirations.

The RANGE-R™ system contains three (3) mounted antennas. Two of the antennas, a transmit antenna and a receive antenna, face towards the target area. The third antenna is a rear-looking antenna that faces the operator of the system and is used in reducing the false alarm rate from movement of the user or behind the user.

When the RANGE-R™ system is in scan mode, radar waves are transmitted by the transmit antenna through the wall and into the adjacent room/structure or area. The radar waves travel until they strike an irregularity and are reflected back to the receive antenna. The return signal is analyzed by a signal processing algorithm. If a target is detected, the alert results are indicated on the graphics display and illumination of the blue LED indicator light.

CHAPTER 2
OPERATOR INSTRUCTIONS
SECTION I - DESCRIPTION AND USE OF OPERATOR CONTROLS AND INDICATORS

2.1 OPERATOR CONTROLS AND INDICATORS.

It is important to know the location and function of all controls associated with the RANGE-R™ system prior to use to ensure proper and safe operation. The controls used to operate the RANGE-R™ are located on each side and the indicators are located on the front of the system (see Figure 2-1). The function of each item is listed on Table 2-1.

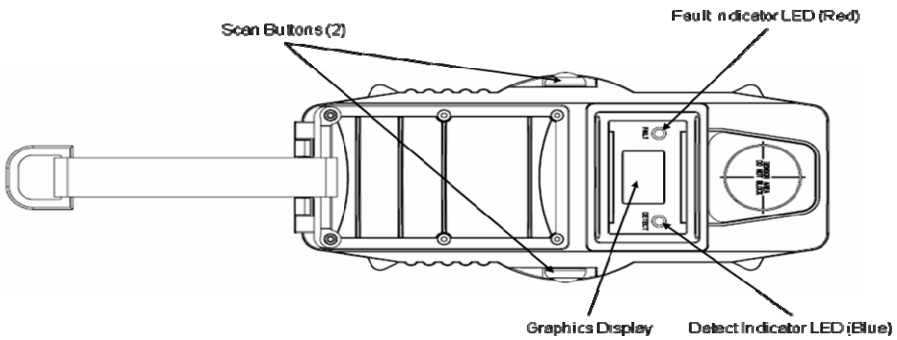


Figure 2-1. RANGE-R™ – Controls and Indicators

ITEM	COMPONENT	FUNCTION
Scan Buttons (2)	Momentary Switch	Mode Selection/ Scan
Graphics Display	LCD Screen	Display detection information / BIT functions
Fault Indicator	Red LED	BIT Fault
Detect Indicator	Blue LED	Positive Detection

Table 2-1. RANGE-R™ – Control and Indicator Functions

SECTION II - SYSTEM OPERATION

2.2 PREPARATION FOR USE.

WARNING

Inserting the batteries into the unit in the wrong orientation may cause the batteries to overheat or explode. Care should be taken to insert the batteries correctly. Failure to follow the appropriate procedure may cause damage to the equipment.

WARNING

The battery compartment is not internally watertight, thus care should be exercised when the battery door is open to ensure liquids do not enter the compartment where it is possible for them to leak into the internal electronics. Failure to follow this caution may cause damage to the equipment.

Prior to operation, batteries need to be installed into the RANGE-R™ system. The RANGE-R™ is designed to operate on four standard “AA” sized lithium batteries. Alkaline AA batteries should not be used in the system. The following procedure is to be used when installing the batteries into the RANGE-R™ system.

a. Open the battery door by unscrewing the thumbscrew located at the bottom end of the unit.

b. Insert all batteries with the positive end first into the battery compartment.

c. Close the battery door and secure it by hand-tightening the thumbscrew.

2.3 POWERING THE SYSTEM ON.

Powering on the RANGE-R™ system will bring the unit into STANDBY Mode (see Figure 2-2. In this mode, the radar is not active and target detection is not possible. The following procedure is to be used to power on the RANGE-R™ system.

a. Depress both Scan buttons simultaneously and release.

b. As the unit powers on, first the Fault Indicator LED (Red) and then the Detect Indicator LED (Blue) will momentarily turn on. This allows the operator to know that the LEDs are functioning properly. The unit will show STANDBY on the display as shown in Figure 2-2 when it is ready for operation.

c. If the unit is not used within one minute, the system will power down to conserve battery life.

Figure 2-2. Standby Mode Display

2.4 BRIGHTNESS ADJUSTMENT.

After powering on the RANGE-R™ system, it may be necessary to adjust the brightness of the graphic display and LED indicators for specific operational and environmental conditions.

a. Press and hold either of the Scan buttons for two seconds to enter ADJUST BRIGHTNESS Mode (see Figure 2-3).

b. Adjust the brightness by pressing the left-side scan button to decrease the brightness or the right-side button to increase the brightness.

c. To return to STANDBY Mode, press and release both scan buttons simultaneously. The selected brightness level is stored in flash memory and will be used again at the next power-on.

Figure 2-3. Adjust Brightness Display

2.5 SCAN MODE.

WARNING

When the degraded breather detection indicator is illuminated on the display, only large body movements will be detected. Small body movements such as respirations may not be detected. This should be taken into account when making mission oriented operational decisions. Failure to follow this warning could result in death or injury.

WARNING

It is essential that the operator remain as still as possible when performing scanning operations in order to achieve the best overall detection performance. Failure to follow this caution could result in false alarms and degraded detection performance.

WARNING

There is a region above the display marked “Sensor Area – Do Not Block.” This region should not be covered by the operator’s hand. This region houses an antenna used to sense and reject nuisance detections that may arise from operator-side motion. Failure to do so could result in false alarms and degraded detection performance.

a. Follow the steps below when performing scanning operations with the RANGE-R™ system.

b. With the unit in STANDBY Mode, place the black, backside surface firmly against the wall to be scanned.

c. Squeeze-and-hold both scan buttons to initiate SCAN Mode.

d. Allow three seconds for the signal processing algorithms to assess the ambient conditions of the room being scanned.

e. Continue to maintain both scan buttons depressed and the system maintained with the black backside surface firmly against the wall. A scan indicator located in the upper left corner of the display provides a visual cue to the operator when the three-second initialization period has ended and full performance scanning has begun. During the initialization period, the scan indicator shows only the word “SCAN.” Thereafter, scan bars are added, slowly cycling through zero, one, two, three, and four bars (see Figure 2-4).

f. When a target is detected, the two horizontal bars in the range field will be replaced with the range to the target which is displayed to the nearest foot along with the target classification: “Mov” (Mover) or “Br” (Breather). The blue DETECT light is also illuminated for the duration of the detection (see Figure 2-4).

g. Releasing the two Scan buttons will return the system to STANDBY Mode.

Scanning Display

Mover Detection Display

Breather Detection Display

Figure 2-4. Scan Mode Displays

2.6 FACTORS AFFECTING DETECTION.

Several different factors and environmental conditions may inhibit or degrade the detection capabilities of the RANGE-R™ system. Operators should be familiar with these limitations prior to using the system.

2.6.1 INTERFERENCE.

WARNING

When the degraded breather detection indicator is illuminated on the display, only large body movements will be detected. Small body movements such as respirations may not be detected. This should be taken into account when making mission oriented operational decisions. Failure to follow this warning could result in death or injury.

Strong RF interference will degrade target detection performance. As Breather target signals are typically much smaller than Mover target signals, Breather detection

performance will be affected first. Signal processing algorithms are included to detect and alert the operator when these conditions exist.

While operating in Scan Mode and with strong interference detected, the display will show a dimly illuminated Breather symbol overlaid with a circle-cross out (see Figure 2-5). When the degraded detection performance indicator is illuminated, the operator and surrounding personnel should try scanning again while standing as still as possible, and if necessary, move to a different spot on the wall where the interference may be less intense.

2.6.2 Operator and Rearward Motion.

WARNING

When the degraded breather detection indicator is illuminated on the display, only large body movements will be detected. Small body movements such as respirations may not be detected. This should be taken into account when making mission oriented operational decisions. Failure to follow this warning could result in death or injury.

The RANGE-R™ system is highly sensitive to motion, whether it is by a person hiding in a building, or by the operator and his/her teammates. While the majority of radar energy is directed away from the operator side of the unit, some energy does bounce back off internal wall structures and is reflected by the operator and anyone else nearby which is in turn detected by the RANGE-R™ system. Because the operator is typically the closest person to the system, the radar energy reflected by the operator is potentially greater than the radar energy returning from a distant target. For this reason, the operator and his/her teammates must stand as still as possible during operations in the scan mode.
A rearward looking antenna is included in the design to detect operator motion and inhibit the resulting false target alerts. However, this does not reduce the strong interference from the operator that can obscure true target returns. Most of the degradation in detection performance will be associated with Breather targets as both the operator's and the target's breathing signatures are virtually identical.

While operating in Scan Mode and with operator interference detected, the display will show a dimly illuminated Breather symbol overlaid with a circle-cross out (see Figure 2-5). When the degraded detection performance indicator is illuminated, the operator and surrounding personnel should try scanning again while standing as still as possible, and if necessary, move to a different spot on the wall where the interference may be less intense.

Figure 2-5. Diminished Breather Detection Display

2.6.3 Wall Blockage.

WARNING

To avoid possible wall blockage scenarios, an operator must observe the building material to avoid scanning through metal or absorptive material. The building material should be taken into account when making mission oriented operational decisions. Failure to follow this warning could result in death or injury.

Wall blockage occurs when a large reflective object is within, or in close proximity to, the wall being scanned and obscures the view of the target area. The RANGE-R™ system contains signal processing algorithms that detect and alert the operator if such conditions exist. Since it is possible that the transmit signal is being blocked and not reaching potential targets, target detection is not possible when blockage is detected.

While operating in Scan Mode and with blockage detected, the red FAULT light will be illuminated and the word “Blocked” will be displayed (see Figure 2-6). If this occurs, the operator should release the scan buttons, move to a different spot on the wall, and try again.

In some situations, a blockage alert will not be indicated even though the signal is blocked. One possible is when the unit is held up directly against a metal door or wall. In this situation, the transmit signal is completely blocked and little to no energy reaches the receive antenna. Because the blockage signal power threshold will not be exceeded, no alert is generated. Another scenario occurs when the wall material is highly absorptive. Here, signal returns from the obscuring object are greatly reduced by losses in the wall. The blockage signal power threshold is not exceeded and no alert is generated.

Through training and frequent use in different scenarios with different wall types and materials, the operator will become aware of its limitations and proficient at adapting his/her tactics and procedures to reduce the risk of a missed detection.

Figure 2-6. Blocked Detection Display

2.6.4 Water and Moisture. Water is highly absorptive at the frequency band in which the RANGE-R™ system operates. This becomes a factor when the wall being scanned is made of a porous material such as exposed concrete or adobe and is saturated deep within from rain or some other source of moisture. In this case, significant radar energy may be lost due to attenuation through the wall and result in critical loss of detection performance. There is no system test available for this condition and thus the operator must be aware of this possibility and trained to recognize such conditions.

2.6.5 Blind Spots. The best detection performance when using the RANGE-R™ system occurs directly in front of the unit, and extends out ±80 degrees in a conical pattern (160 degree cone). Outside this region, detection performance rapidly falls off to a minimum at ±90 degrees. Because of this, there are blind spots in close proximity and at sharp angles from the system (see Figure 2-7). To compensate for blind spots, it is suggested that the operator perform scans through at different locations along the wall surface to maximize scan coverage of the target area.

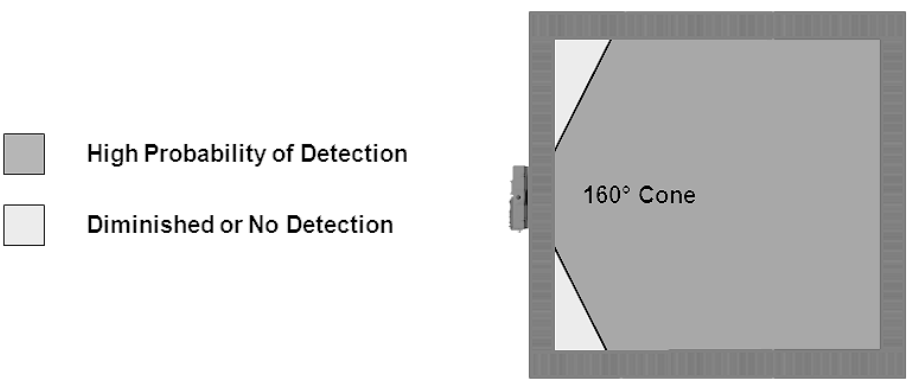


Figure 2-7. Blind Spots

2.6.6 False Range Indication. Specific building structures may cause the range to the target to appear farther away than the actual range to the target. This often occurs in buildings that have a mix of hard and soft walls on the interior, like concrete

block or brick and drywall, or half height walls. This may cause the radar to bounce multiple times and the range that is shown on the RANGE-R™ is then the sum of all of the reflections. When this happens it is likely that the range will alternate between the correct range and the incorrect range. In this case RANGE-R™ is still operating as it should and will continue to detect personnel targets properly.

2.6.7 Hollow Building Materials. Hollow concrete block and similar materials having hollow cavities present additional challenges to the system. Signal reflections off internal structures, being close to the radar, can produce strong returns that desensitize the receiver and degrade detection performance. It is also possible the return is large enough to be classified as blockage and be indicated as such on the display.

Reflections off internal wall structures also exaggerate the effects of interference from movement by the operator and others in close proximity. Higher false alarms, as well as degraded Breather detection performance due to operator-side movement, have been observed during operational testing. Minimizing movement on the operator side of the unit is imperative to achieving the best overall system performance.

2.7 FAULT AND STATUS MODES

Internal circuitry monitors the battery voltage whenever the RANGE-R™ system is powered on and the critical performance parameters while the unit is actively transmitting. When a failure occurs or the status changes, indicators are given to the operator as to the condition of the system.

2.7.1 Battery Status. While the system is powered on, internal circuitry measures the battery voltage and reports the status to the user. Three different battery status modes may be displayed:

FULL BATTERY – The battery voltage is sufficient to provide full operational performance. This state is indicated by a filled-in battery symbol located in the upper right-hand corner of the graphics display (see Figure 2-8).

LOW BATTERY CAUTION – The battery voltage is beginning to get low, but will continue to function normally. The operator should consider replacing the batteries as soon as possible. This state is indicated by an empty battery symbol located in the upper right-hand corner of the graphics display (see Figure 2-8).

LOW BATTERY WARNING – The battery voltage is too low to continue operation. The operator must replace the batteries. The words “Replace Battery” are displayed and the red FAULT light is illuminated.

Full Battery in Standby Mode

Low Battery Caution in Standby Mode

Low Battery Warning

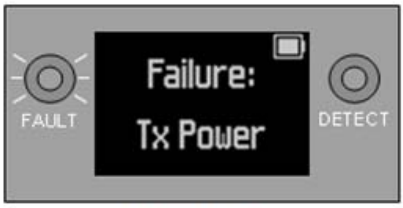
Figure 2-8. Battery Status Displays

2.7.2 Built-In-Test Failures. Continuous built-in-test (CBIT) circuitry monitors critical performance parameters while the unit is actively transmitting. These parameters include transmit (Tx) output power, phase locked loop (PLL) lock status, and software execution status. When these failures occur, the red FAULT light is illuminated and a description of the failure is shown on the display (see Figure 2-9).

When a PLL Lock failure or a Tx Power failure occurs, releasing the scan buttons and re-squeezing may solve the problem. If the failure continues after several cycles of releasing and re-squeezing the scan buttons, the unit should be considered inoperable.

If a software execution error occurs, the unit will be rebooted within 2 seconds, and the System Restarted warning will be displayed. The unit will then be in standby mode, and normal operation can resume.

PLL Lock Failure



Tx Power Failure

Software Execution Failure

Figure 2-9. Fault Displays

CHAPTER 3
MAINTENANCE AND SUPPORT
SECTION I - INSPECTIONS AND STORAGE

3.1 INSPECTIONS.

A proper inspection program that includes preventative checks and maintenance will help prevent damage and extend the service life of the RANGE-R™ system. Inspections should be performed both prior to operations and after the completion of operations.

3.1.1 Preoperational Checks. Prior to conduction operations, the following checks should be performed to ensure that the RANGE-R™ system is serviceable and mission ready.

a. Inspect the RANGE-R™ system's housing and graphics display for visible physical damage.

b. Ensure the batteries to be used contain a sufficient charge to last the duration of the mission.

c. Power on the RANGE-R™ system and ensure that both LED indicator lights illuminate and the graphics display functions properly.

d. Test the RANGE-R™ system on a wall in a safe area with a target at a known distance to ensure it is functioning properly.

3.1.2 Post Operational Checks. After the completion of an operation, the following checks and maintenance should be performed to maintain the operational readiness of the RANGE-R™ system.

a. Inspect the RANGE-R™ system's housing and graphics display for visible physical damage

b. Clean the RANGE-R™ housing using either a dry or slightly dampened cloth. Never use any cleaners or solvents.

c. Clean the graphics display using an approved lens cleaning cloth.

d. Remove the batteries from the system. The system should never be stored with batteries inserted into the system.

3.2 STORAGE.

WARNING

If the RANGE-R™ system is placed in the case with a side facing up, the scan buttons may be pressed when the case is closed, causing the unit to transmit. This will drain the batteries and may cause the system to overheat. This may possibly damage the device.

When not in use, the RANGE-R™ system should be stored in the storage case provided with the system to protect the system from accidental damage. The system should be stored with the graphics display facing up. The batteries should also be removed from the battery compartment to prevent possible damage from battery leakage.

SECTION II - SERVICE AND SUPPORT

3.3 SERVICE / WARRANTY.

The manufacturer warranty provided with the RANGE-R™ is for defects in materials and workmanship for a period of 12 months following delivery to the end user. Damage due to abuse, misuse, mishandling, or use other than specified in this user manual is not covered by the warranty. The RANGE-R™ batteries must be removed from the unit prior to storage. Damage to the RANGE-R™ from leaking batteries is not covered by the warranty. If your RANGE-R™ requires service, please contact a product support representative using the contact information listed below to obtain a Return Material Authorization (RMA) number and shipping instructions.

Service/Warranty Returns:

Phone: 407-517-6110

Email: RANGE-R.service@L-3com.com

3.4 TECHNICAL SUPPORT.

Technical support for the RANGE-R™ is available at anytime. Please feel free to contact a product support representative with any questions or concerns using the contact information listed below.

24/7 Technical Support:

Phone: 407-517-6167

Email: RANGE-R.techsupport@L-3com.com