AEROFLEX

2975
Radio Test Set

LTR® Option Manual

OPERATION MANUAL

LTR® OPTION

2975

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PREFACE

SCOPE

This manual contains information to install and operate the 2975 LTR® Option. This manual is provided as an addition to the 2975 Operation Manual.

Refer to the 2975 Operation Manual for operational descriptions of items other than LTR®.

ORGANIZATION

The LTR® Option Manual is composed of the following sections:

SECTION 1 - DESCRIPTION

Contains general information regarding the 2975 LTR® functions, capabilities and descriptions.

SECTION 2 - OPERATION

Contains function descriptions explaining how to operate the 2975 LTR® Option.

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TABLE OF CONTENTS

APPENDIX A - TERMS / ACRONYMS

APPENDIX B - AEROFLEX CONTACT INFORMATION

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SECTION 1 - DESCRIPTION

1-1   FUNCTIONS AND CAPABILITIES

The 2975 LTR® Option provides powerful test features for LTR® radios and systems.

Included within the LTR® Option is:

- the ability to emulate repeater station operation;

- the ability to emulate mobile radio operation;

- the ability to monitor a LTR® repeater or radio channel;

- the ability to perform parametric tests and measurements.

1-2   LTR® SYSTEM OVERVIEW

LTR® is an acronym for Logic Trunked Radio. LTR® was created by the E.F. Johnson Company to address the need for a more spectrum efficient two-way radio system. The term trunking, or trunked radio, is the process used for sharing channel frequencies within a repeater system.

The LTR® trunking system is composed of up to 20 repeater channels, each having the ability to assign up to 250 separate **Group-ID** codes. Trunking is based on the assumption that a mobile, with access to one of several common channels, has a low probability of being blocked from transmitting. Practically speaking, individuals use the radio resources for only a small percentage of the time and a large number of subscribers do not use the system simultaneously.

Each mobile within an LTR® trunking system is assigned a **Home** repeater which receives digital, sub-audible control information. Mobiles monitor this data from its **Home** repeater to determine listening channels, to determine if it is being addressed by another mobile, or to determine which repeater channel to use if it needs to transmit.

In the United States, the FCC has allocated several duplex frequency pairs blocks of spectrum for use as trunked radio. Each repeater channel in a system uses only one frequency pair to communicate to subscriber mobiles. When mobiles are instructed to use another repeater, a different frequency pair is employed. A **Home** repeater can only exchange information with mobiles that have **Group-ID** numbers assigned to that **Home** repeater. **Home** repeaters ignore foreign mobiles unless the mobile has been given permission by another repeater in the system to access the repeater. All repeaters in an LTR® trunking system are physically connected to maintain information pertaining to the LTR® community activity of repeater accesses and repeater handoffs.

Mobiles in a system work in a simplex or push-to-talk (PTT) manner. Mobiles can only listen to audio messages through a repeater from a mobile with the same **Group-ID** code; likewise, mobiles can only communicate with other mobiles, through a repeater, that belongs to the same **Group-ID**. Only one mobile at a time is allowed, by logic lockout in the mobile, to transmit to mobiles in its group.

Mobiles can change their **Group-ID** numbers to either listen or talk to several groups, subgroups or individual mobiles. Mobiles change their **Group-ID** numbers either with manual controls or as the result of scanning operations. The organization of mobiles is arbitrary and is performed according to the particular radio manufacturer.

Signaling between mobiles and repeaters occurs by use of a sub-audible data stream, simultaneously and continuously, with the voice-audio of the transmission. The repeaters update mobiles on which channel is available or if another mobile is calling.

Before a mobile can access the system, a data handshake with the repeater must be accomplished. When the mobile push-to-talk is pressed, the mobile uses the **Home** repeater transmitted data packet to determine if there is a **Free** repeater available. If a **Free** channel exists, the mobile transmitter is enabled and the mobile transmits a data packet to the repeater containing the **Group-ID** code for broadcast. The mobile then waits for a repeater response for the permission to transmit. When this handshake is received, mobile transmission is enabled. All listening mobiles in the same group detect their **Group-ID** being transmitted, set their receiver to the designated **In-use** receive frequency and un-squelch the audio to receive the voice transmission.

The repeaters and mobiles communicate through the use of sub-audible data packets. These data packets are composed of a **Sync code**, an **Area** bit, **In-use** or **Go-to** field, **Home** channel field, **Group-ID** code and **Free** channel field, as well as synchronization and error checking information. The packets for both the repeater and mobile are structured in a similar fashion.

The **Sync code** is used to detect the beginning of a data packet. LTR® standards specify the sync code to be 158 (hexadecimal), however, some non-standard systems use other sync codes. This field value can range from 000 to 1 FF.

The **Area** bit is used to distinguish between repeater systems that are in close proximity, using the same frequency pairs. This bit field is set to either one (1) or zero (0).

The **In-use** or **GOTO** field represents the current repeater channel being used or the repeater channel to select for transmission. This field must be the same number, from one to twenty, as assigned to the repeater for data acceptance for a mobile-to-repeater message. For a repeater-to-mobile message, this is the number of the repeater to use. The mobile translates this number, using a lookup table, to a FCC channel frequency pair. A value of "31" found in this slot is the turn off code, indicating end of transmission by either a repeater or mobile.

The **Home** field is used for system accounting. This field is the **Home** repeater number assigned to a mobile for the current group selection. For a repeater-to-mobile message, this contains the **Home** repeater number for the mobile initiating the transmission.

The **Group-ID** field contains a value (1 through 250) indicating the group being used for broadcast. In repeater-to-mobile transfer, mobiles listening to the LTR® data packets use this **Group-ID** to determine when to un-squelch their audio.

A repeater uses the **Free** field to identify which repeater channel frequency pair is available for use. This value can be the same number of the **Home** repeater, the same number of another repeater or zero (0) if all repeaters are busy. The mobile always sets this field value to 31.

SECTION 2 - OPERATION

The 2975 LTR® Option operates within the 2975 to provide new protocol and test capabilities.

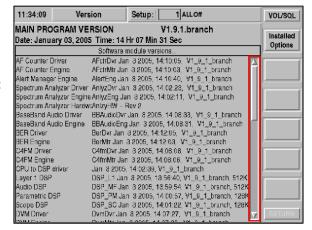Refer to the 2975 Operation Manual for details regarding general operation of the 2975.

2-1   LTR® OPTION SETUP

CHECKING LTR® OPTION INSTALLATION

The 2975 Option Control System permits the addition of new software options and for checking the status of the installed options.

The LTR® Option may be installed at the factory, or it may be customer-installed in the 2975 ONLY with Software Versions 1.8 and on.

To check whether the LTR® Option is installed in the 2975, select the **VERSION** screen (**[MODE]**, **[7]**, **[3]**) and then press the **Installed Options** Soft Key to go to the **Installed Options** screen.
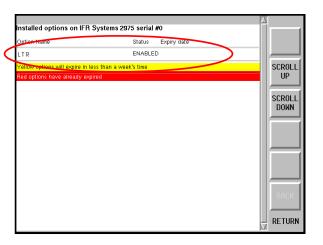
The **Installed Options** screen shows the 2975 serial number and the options that are installed.

If the LTR® Option Status displays **ENABLED** or **LEASED**, the option is installed and the 2975 is set up and ready to use.

If the LTR® Option (**LTR**) is NOT listed or is NOT shown as **ENABLED**, the option is not installed.

To install the LTR® Option, proceed to the next section, "INSTALLING LTR® OPTION."

If you wish to purchase the LTR® Option, contact information is shown in **APPENDIX B**.

INSTALLING LTR® OPTION

If you have received the LTR® Option from Aeroflex, you will need to install the Option into the 2975 before it is accessible.

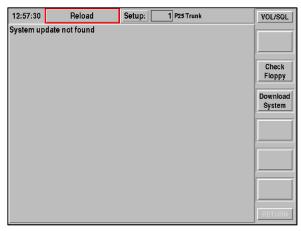*If the LTR® Option is already installed, you may skip this section.*

For customers who have 2975 Software Version 1.8 and on, the 2975 LTR® Option File ("**options.new**") is distributed by Aeroflex via email, floppy disk or CD-ROM.

The LTR® Option File ("**options.new**") must be placed onto a blank, formatted floppy disk (if received by email or CD-ROM) for installation into the 2975. Use a PC to copy the file onto a blank floppy disk.

The LTR® Option File ("**options.new**") is 2975 serial number specific, so label the disk (if not already labeled) for the particular 9-digit serial number for which it is made and *KEEP IT IN A SAFE PLACE*.

OPTION INSTALLATION:

1. Power ON the 2975.

2. After the 2975 has booted, press **[MODE]**, **[7]** and **[4]** to display the RELOAD screen.

3. Insert the LTR® Option floppy disk for this 2975 (serial number specific) into the floppy drive.

4. Press the **CHECK FLOPPY** Soft Key.

5. The floppy disk is accessed and the **INSTALL OPTION FILE** Soft Key appears. Press the **INSTALL OPTION FILE** Soft Key.

6. When the red warning screen appears, press the **START INSTALL** Soft Key.

7. When installation is completed and the 2975 has been rebooted, go to the **VERSION** screen (**[MODE]**, **[7]** and **[3]**) to verify the LTR® Option is installed. Press the **INSTALLED OPTIONS** Soft Key to verify the LTR® Option is **ENABLED**.

Installation of the LTR® Option is only required once - it does not need to be reinstalled each time the system is upgraded with new software.

2-2   LTR® OPERATION MODES

The LTR® Option is accessible from the following screens:

Receiver screen (**[MODE]** and **[2]**)

Generator screen (**[MODE]** and **[1]**)

Duplex (**[MODE]** and **[3]**)

User screen (**[MODE]** and **[0]**) on the 2975

The Duplex Option selections show the LTR® Option selections:

LTR® Repeater Sim

LTR® Repeater Simulator

LTR® Radio Sim

LTR® Mobile Simulator

LTR® Monitor

LTR® System Monitor

Each LTR® screen occupies one-fourth of the total screen space.
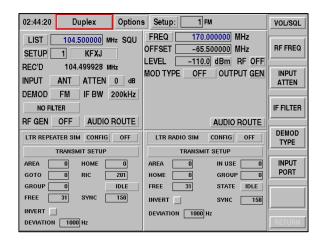
This permits one or two LTR® functions to be on-screen simultaneously, as the Duplex screen always has the Receiver (Tx Test) and Generator (Rx Test) screens present.

NOTE: The Repeater and Radio Simulator tiles can be displayed simultaneously; however, they can not be operated simultaneously.

LTR® REPEATER SIMULATOR

The LTR® Repeater Simulator screen displays current Control Channel parameters, and permits these parameters to be changed for the specific radio system being tested.

The 2975 uses these settings and controls while simulating the base station repeater.

FIELD DEFINITIONS

CONFIG

This button opens the channel to frequency screen to allow user to configure various parameters for each channel of the Repeater simulation.

ON/OFF

This button turns the Repeater simulator ON / OFF.

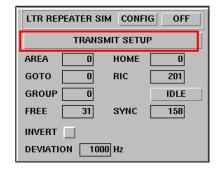### TRANSMIT SETUP / RECEIVED DATA

This toggle button switches Repeater Simulation screen between TRANSMIT SETUP (to permit entry of downlink data) or RECEIVED DATA (to permit viewing data received on the uplink).

TRANSMIT SETUP - AREA

Displays the present AREA value (0 or 1) of the Simulator output. AREA is used by the mobile to select which repeater to use (when two are within its range). This value should be set to match the value programmed in the mobile for AREA.

TRANSMIT SETUP - GOTO

Displays the present GOTO value (1 to 20) of the Simulator output. The GOTO channel indicates where active conversations are taking place. This parameter is only used when the simulator state is CONT.

TRANSMIT SETUP - GROUP

Displays the present GROUP value (0 to 250) of the Simulator output. The GROUP parameter is used by the mobile to determine if it should listen to a conversation that is assigned to that particular talk group.

TRANSMIT SETUP - FREE

The FREE channel parameter transmitted by the repeater is used to inform the mobile of an available channel if its HOME channel is busy. When a repeater channel is available, it transmits its own channel number as the FREE parameter. When the repeater channel is busy, it finds an available channel and transmits that number as the FREE channel. If all channels are busy, it transmits a ZERO as the FREE channel. This parameter is only used when the simulator state is "REP BUSY."

TRANSMIT SETUP - HOME

Displays the repeater channel (1 to 20) being simulated by the 2975. This value should be set to match the mobile HOME channel which is used by the mobile as the default control channel.

TRANSMIT SETUP - RIC

Displays the present Repeater Interconnect (RIC) code value (0 to 250) of the Simulator output. The RIC code is the group parameter transmitted by the mobile when it wants to make a phone call to a land telephone network.

TRANSMIT SETUP - STATE

Displays the current STATE of the Simulator output. The user can select from the following options to set the STATE:

- **IDLE** - This simulates the HOME channel being available to process calls. In this mode the GOTO and FREE channel settings are ignored, since the HOME channel functions both as the control and voice channels.

- **SYS BUSY** - This simulates the situation where ALL channels are busy and the mobile has to wait for access.

- **REP BUSY** - This simulates the situation where the HOME channel is busy with a call for radios on a different group number than the mobile. In this situation the FREE channel is used as the control and voice channels.

- **CONT** - This simulates a continuous message (or tone) being sent from another mobile in the group. In this mode the HOME channel is the control channel and the GOTO channel is the voice channel.

- **DISCON** - This is used to disconnect a CONT condition, simulating the effect of the transmitting radio unkeying.

Additional simulator states which are displayed but not user selectable:

- **R INIT** - This indicates that the user has pressed the mobile PTT.

- **RIC** - This indicates that a RIC call is in progress.

- **WAIT...** - This condition is highlighted to indicate that the 2975 is busy setting up the next test state. The time delay occurs because the 2975 has to shut down communication on one channel, switch to the HOME channel to broadcast control information, and then switch again to a new voice channel. If the radio is keyed during this transition, it may lose synchronization with the 2975. If this happens, set the state back to IDLE and wait a couple of seconds.

TRANSMIT SETUP - SYNC

The sync code is used to detect the start of a data packet. LTR® standards specify the sync code to be 158 (hexadecimal), however, some non-standard systems use other sync codes. This field ranges in value from 000 to 1 FF.

TRANSMIT SETUP - INVERT

Displays the inversion status for the transmitted data output. The user can click on this button to invert (red) the state of the data output, or maintain non-inverted (gray) status. Some LTR® systems use inverted transmit to further reduce interference from nearby systems. For example, one system is inverted, the other is non-inverted. The 2975 automatically determines whether or not the received signal is inverted.

The 2975's INVERTED setting must match the setting **expected** by the UUT. For example, if the mobile being tested is non-inverted, and it expects the repeater to be in an inverted state, then the Repeater Simulator must be set to INVERTED, regardless of whether or not the setting matches that of the mobile.

TRANSMIT SETUP - DEVIATION

Displays the transmit deviation of the transmitted data output. The user can enter a value into this field from 0 to 4000 Hz deviation (the default value is 1000 Hz).

RECEIVED DATA

The screen to the right shows the RECEIVED DATA screen for the LTR Repeater Simulator.

RECEIVE DATA - AREA

Displays the present AREA value received from the mobile under test. This field can not be edited by user.

RECEIVE DATA - HOME

Displays the present HOME value received from the mobile under test. This field can not be edited by user

RECEIVE DATA - FREE

Displays the present FREE value received from the mobile under test. This field can not be edited by user.

RECEIVE DATA - IN USE

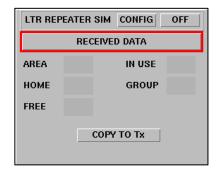Displays the present IN USE value received from the mobile under test. This field can not be edited by user.

RECEIVE DATA - GROUP

Displays the present GROUP value received from the mobile under test. This field can not be edited by user.

RECEIVE DATA - COPY TO Tx

The user can click on this button to copy the Repeater Simulator Receive Setup fields to the Transmit Data values for HOME, GROUP and AREA.

This feature can be used to configure the 2975 to match radio settings. Set the 2975 on the radio's home channel. Key the radio and the 2975 decodes the request received from the radio. Selecting **COPY TO Tx** configures the 2975 with the data received from the radio.

LTR® RADIO SIMULATOR

The LTR® Radio Simulator screen displays current Control Channel parameters, and permits these parameters to be changed for the specific radio system being tested.

The 2975 uses these settings and controls while simulating a mobile or portable radio.

FIELD DEFINITIONS

CONFIG

This button opens the channel configuration screen to allow user to configure various parameters for each channel of the Repeater simulation.

ON/OFF

This button turns the Radio simulator ON / OFF.

TRANSMIT SETUP / RECEIVED DATA

This toggle button switches Radio Simulation screen between TRANSMIT SETUP (to permit entry of downlink data) or RECEIVED DATA (to permit viewing data received on the uplink).

TRANSMIT SETUP - AREA

Displays the present AREA value (0 or 1) of the Simulator output. AREA is used by the mobile to select which repeater to use (when two are within its range). This value should be set to match the value programmed in the repeater for AREA.

TRANSMIT SETUP - IN USE

Displays the present IN USE value (1 to 20) of the Simulator output. The IN USE channel indicates where active conversations are taking place.

TRANSMIT SETUP - HOME

Displays the present HOME value (1 to 20) of the Simulator output. The mobile uses its HOME channel as its default control channel.

TRANSMIT SETUP - GROUP

Displays the present GROUP value (0 to 250) of the Simulator output. The GROUP parameter is used by the mobile to determine if it should listen to a conversation going on.
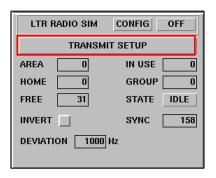
TRANSMIT SETUP - FREE

The FREE channel parameter is normally only used by the repeater and is set to 31 by the mobile.

TRANSMIT SETUP - STATE

Displays the current STATE of the Simulator output. The user can select from the following options to set the STATE:

- **IDLE** - This simulates the radio being available to process calls.
- **PTT** - This simulates the mobile radio press of the Push-To-Talk (PTT) switch.
- **LISTEN -** This indicates the radio simulation is receiving a call from another mobile within the group. This option is NOT user selectable.

2-7

TRANSMIT SETUP - INVERT

Displays the inversion status for the transmitted data output. The user can click on this button to invert (red) the state of the data output, or maintain non-inverted (gray) status. Some LTR® systems use inverted transmit to further reduce interference from nearby systems. For example, one system is inverted, the other is non-inverted. The 2975 automatically determines whether or not the received signal is inverted.

TRANSMIT SETUP - SYNC

The sync code is used to detect the start of a data packet. LTR® standards specify the sync code to be 158 (hexadecimal), however, some non-standard systems use other sync codes. This field ranges in value from 000 to 1 FF.

TRANSMIT SETUP - DEVIATION

Displays the transmit deviation of the transmitted data output. The user can enter a value into this field from 0 to 4000 Hz deviation.

RECEIVED DATA

The screen to the right shows the RECEIVED DATA selection for the LTR Radio Simulator.

RECEIVE DATA - AREA

Displays the present AREA value received from the repeater under test. This field can not be edited by user.

RECEIVE DATA - HOME

Displays the present HOME value received from the repeater under test. This field can not be edited by user.

RECEIVE DATA - FREE

Displays the present FREE value received from the repeater under test. This field can not be edited by user.

RECEIVE DATA - GOTO

Displays the present GOTO value received from the repeater under test. This field can not be edited by user.

RECEIVE DATA - GROUP

Displays the present GROUP value received from the repeater under test. This field can not be edited by user.

RECEIVE DATA - STATE

Displays the current STATE of the simulator output. Allows the user to select from the following options when setting the STATE:

- **IDLE** - This simulates the radio being available to process calls.

- **PTT** - This simulates the mobile radio press of the Push-To-Talk (PTT) switch.

- **LISTEN -** This indicates the radio simulation is receiving a call from another mobile within the group. This option is NOT user selectable.

LTR® MONITOR

The LTR® Monitor is a powerful tool used for capturing system data for analysis and troubleshooting.

The LTR® Monitor is set up with channel and word recognizer values, then started to CAPTURE data according to the set values.

FIELD DEFINITIONS

CONFIG

This button opens the channel configuration screen to allow user to view and edit parameters used during simulation.

MONITOR - OFF / REPEATER / RADIO

This button turns the LTR® Monitor OFF or monitors REPEATER or RADIO channels.

CHAN

This field displays the Channel number (1 to 20) to be monitored.

SYNC

This field displays the sync portion of the data that is currently being detected. Value is hexadecimal.

WORD

This field displays the raw data word data. Value is hexadecimal.

CHECKSUM

This field displays the check data word. Value is hexadecimal.

TIMESTAMP

This field displays a relative time stamp to show the message sequence timing in relation to other words.

INVERTED

This field indicates whether or not data was transmitted with the polarity of 1 or 0. "1" indicates that the word is inverted and "0" indicates the word is non-inverted. This corresponds to the Invert fields of the radio and repeater simulator.

CAPTURE ON / OFF

This button controls whether or not the 2975 monitors data.

DATA LOG ON / OFF

This button controls whether or not captured data is saved to a file.

DATA

The DATA display area shows current captured data. The scroll bar on the right side permits moving the DATA display window to view the information.
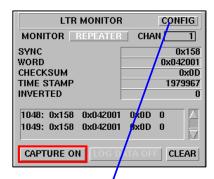
CLEAR

Clears captured data from DATA display field.

LTR® CHANNEL CONFIGURATION

The Channel Configuration screen allows users to configure up to twenty (20) channels by assigning parameters to each channel. Editing fields in the top row of data updates the corresponding data in the display fields below. User must enter a value in the CHAN field to select the row to be edited.

This feature is available with LTR® Repeater Simulator, LTR® Radio Simulator and LTR® Monitor options.

FIELD DEFINITIONS

CHAN

This field displays the present channel (row of data) being configured.

BAND

This field displays the band of each channel being configured. User may edit field to define this value.

MOBILE Rx

This field displays the receive frequency of the channel being configured. User may edit field to define this value.

MOBILE Tx

This field displays the transmit frequency of the channel being configured. User may edit field to define this value.

FCC CH#

This field displays the FCC reference of the channel being configured. User may edit field to define this value, which changes both transmit and receive frequencies to standard values related to the FCC reference number for the present BAND and Border Bit value.

BORDER BIT

This field displays the Border Bit value of the channel being configured. User can enter a 1 or 0 in this field to set this value, which changes both transmit and receive frequencies to standard values related to the FCC reference number for the present BAND and Border Bit value.

RESTORE DEFAULTS

Selecting this button resets all configuration values back to predefined values.
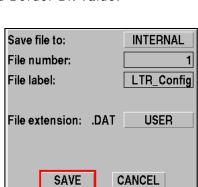
SAVE

Selecting this button saves the configuration values for all channels to a file. A file save dialogue is displayed to allow user to define various file parameters.

RECALL

Selecting this button recalls configuration values from a previously saved file.

CLOSE

This button closes the channel configuration screen.

APPENDIX A - TERMS / ACRONYMS

AREA BIT   An information element that is used to distinguish between repeater systems that are in close proximity to one another.

BW   Bandwidth

FM   Frequency Modulation

FREE   A data field from the repeater identifying that a channel is available for use.

GOTO   The repeater channel to use for transmission.

GROUP CALL   A call to all mobiles of the same GROUP SELECT.

GROUP-ID   ID codes that are always decoded by the radio regardless of the group select.

HOME REPEATER   LTR® mobile transceivers have one of the site repeaters assigned as their "Home" repeater. This repeater is monitored to receive calls and for information needed to place calls, such as which repeaters are free. In addition, the home repeater/ID code number identifies the mobile or group of mobiles being called. Each LTR® system can be programmed with a different home repeater.

ID   Identification

IN-USE   The current repeater channel being used.

LTR®   Logic Trunked Radio

PSTN   Public Switch Telephone Network

PTT   Push-to-Talk

RIC   Repeater Interconnect Code

RX   Receive

SYNC   Synchronization code

TX   Transmit

UHF   Ultra High Frequency

UUT   Unit Under Test

VHF   Very High Frequency

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APPENDIX B - AEROFLEX CONTACT INFORMATION

For issues relating to **Software or Option Loading**, contact our Sales Support Department:

CONTACT: Aeroflex
Sales Support Department
10200 West York Street
Wichita, Kansas 67215

Telephone: (800) 835-2352 (Dial Option 4)
FAX: (316) 524-2623
Email: techsupport@aeroflex.com

For issues related to **Hardware Problems or General Issues,** contact our Customer Service Department**:**

CONTACT: Aeroflex
Customer Service Department
10200 West York Street
Wichita, Kansas 67215

Telephone: (800) 835-2350
FAX: (316) 524-2623
Email: americas.service@aeroflex.com

On-Line Return Authorization: *http://www.aeroflex.com/services/rma.htm*

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AEROFLEX

1002-4203-3P0

Our passion for performance is defined by three
attributes represented by these three icons:
solution-minded, performance-driven, customer-focused.