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# Remotely Monitored Seal Array (RMSA)

## User's Manual

SFG-MAN-001
Revision: 1.7

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# Preface

## Inside This Manual

This document describes all of the procedures necessary to operate the Remotely Monitored Seal Array system including the Seals, their supporting Translators, and communications subsystems. The User is expected to be familiar with the basic PC and MS/DOS procedures.

This document is divided into the following five chapters:

***Chapter 1*** **RMSA System Description** - This section includes an RMSA system overview and theory of operation and describes the Seal, Translator and Remote Review Application software.

***Chapter 2*** **RMSA System Set-Up** - This section provides step-by-step instructions for setting up each of the RMSA System components.

***Chapter 3*** **RMSA Key Generation** - This section contains the procedures for generating cryptographic keys that will be loaded into the Seal.

***Chapter 4*** **RMSA Security** - This section discusses RMSA Security via encryption, authentication, and default keys for a specific Seal.

***Chapter 5*** **Remote Review of Seal Data** - This section demonstrates the Remote Review of Seal Data.

# Safety Guidelines

⚠ **Caution** – Do not operate this unit in a manner not specified in this document.

⚠ **Caution** – Only use this unit with the manufacturer provided input power cable.

# FCC Compliance

*Compliance Statement (Part 15.19)*

The enclosed hardware device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received including interference that may cause undesired operation.

*Warning (Part 15.21)*

Changes or modifications not expressly approved by Canberra Industries could void the user's authority to operate the equipment. Manufacturer is not responsible for any radio or TV interference caused by unauthorized modifications to this equipment.

*Compliance Statement (Part 15.105(b))*

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

**Industry Canada (IC) regulatory information**
This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie
Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

*Class B digital device notice*
This Class B digital apparatus complies with Canadian
ICES-003, RSS-Gen and RSS-210.
Cet appareil numérique de la classe B est conforme à
la norme NMB-003, CNR-Gen et CNR-210 du Canada.

- The system antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20cm from all the persons and must not be co-located or operating in conjunction with any other antenna or transmitter, except in accordance with FCC and Industry Canada multi-transmitter product procedures.
- The system antenna(s) used for this module must not exceed 10dBi (CDMA BC0) and 9.31dBi (CDMA BC1) for mobile and fixed operating configurations. Users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

# Translator Input Power

**Voltage:** 100-240 VAC, 50-60Hz

**Power Consumption:** .75A

# Prepared by:

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Chapter

1

# Introduction

Welcome to the Remotely Monitored Seal Array (RMSA) system provided by Canberra and Sandia National Labs. RMSA was designed to meet the needs of a large base of Users who require more data storage features, better RF performance, longer battery life, enhanced security and other more powerful functions. Figure 1 provides a pictorial representation of how the RMSA System fits within the Secure Sensor Platform (SSP) product family constellation in terms of its complexity and shared capabilities.

The RMSA Seal monitors a fiber optic loop, records tamper events, provides autonomous and requested State of Health via encrypted and authenticated messages. This information is stored in the Seal, remotely via the RMSA Translator and reviewed through the Remote Review Application. The Authenticated Switch version of the Seal includes magnetic sensors and activating magnets such that a pair of Authenticate Switch Seals can be used to create a balanced magnetic switch suitable for monitoring doors, containers and other articles where one surface moves away from another under authorized conditions.

## 1.1 RMSA System Overview

The RMSA system consists of Seals, a Translator, a Programming Card interface as well as the Remote Review Application. The RMSA system provides the following features:

- Offers a low cost solution for monitoring Sealed components
- Incorporates high reliability
- It is inexpensive compared to earlier RF Seals
- Ensures surveillance capabilities available for a long duration
- Provides requested or periodic state of health updates
- Monitors and records date and time of any Seal tamper or other events
- Secures Seal data with encryption and authentication techniques
- Allows remote review of Seals
- Can receive messages from multiple Seals while polling for data via Remote Review
- Requires no license for its low power 900 MHz ISM band RF communication

Each of these features will be discussed in this RMSA User Guide.

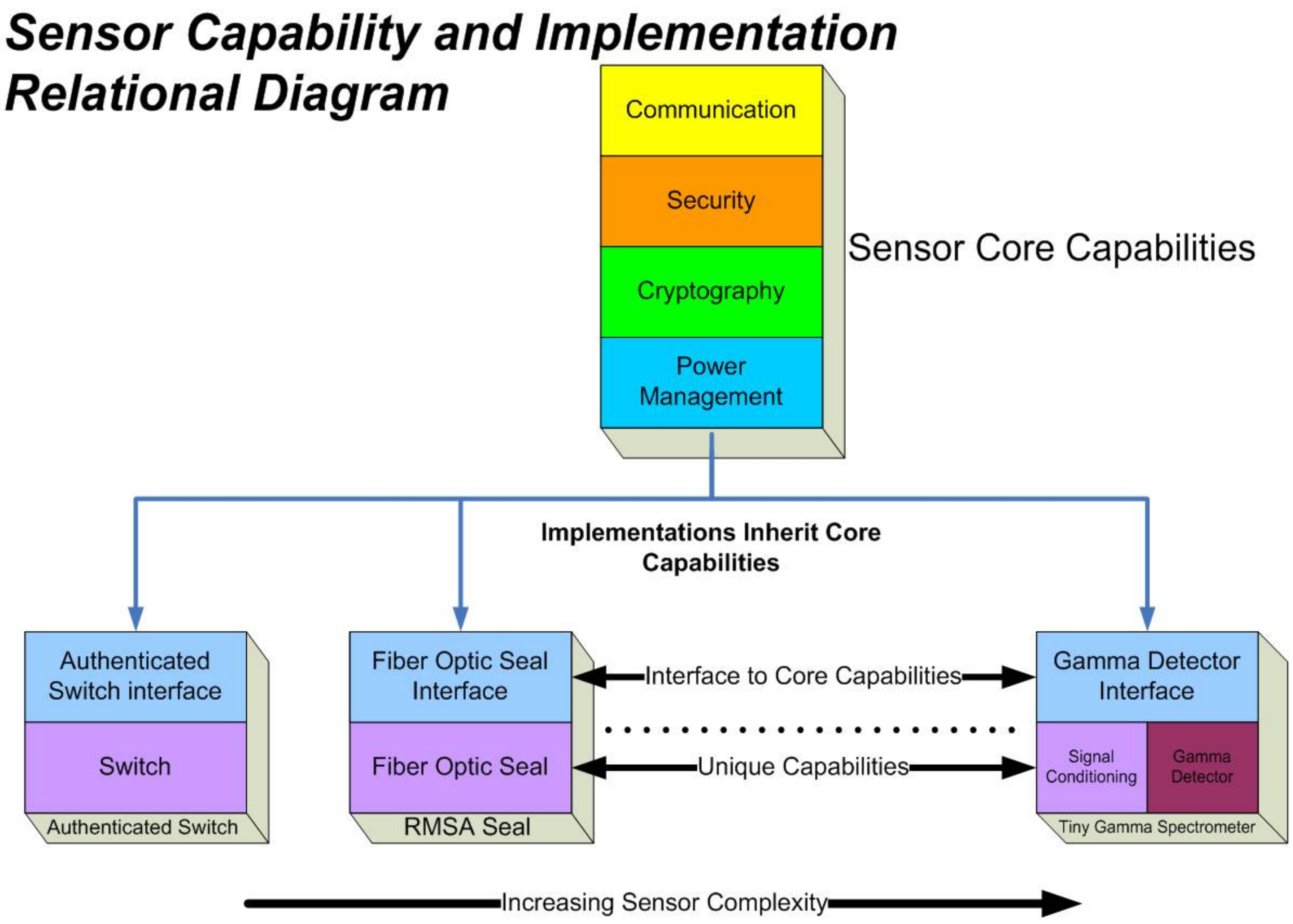


Figure 1 Capability and Implementation Relational Diagram

## 1.2 Theory of Operation

The RMSA allows for monitoring of a fiber optic or authenticated switch sensor as a Seal. See Figure 2 for an overview of the RMSA system configuration. Seal data is collected with an RMSA Translator with Translator/Seal communications via a no-license, low power RF communications channel. Seal data is encrypted, authenticated, and stored before transfer to the Translator as the Translator is an unsecure device. A Microsoft Windows (XP-based) Remote Review Application host can decrypt and authenticate the data stored on the Translator for inspector analysis. A TCP/IP (Ethernet) connection between the Translator and the Remote Review Application host facilitates the transfer of data from the Translator to the Remote Review Application. In addition to remote review, this network connection is used to allow the inspector to interrogate specific Seals for state-of-health or to request re-send of a specific Seal message.

The RMSA system is capable of supporting three configuration modes of operation. These three modes are designated standalone mode, local host supported mode and remote monitoring mode. In the standalone configuration the system hardware may consist of many active Seals and one Translator, which sits unmonitored for long periods of time. The local host supported configuration is via an Ethernet interface connected directly to a local host computer. The remote monitoring mode is similar to the local host mode but is via the internet to allow monitoring by a host computer of the RMSA system over the internet.

The Programming Card has several functions. It is used to provide power via an external power supply, a USB interface or from a Microchip compatible programming device. It also converts the Microchip RJ12 connector 6-wire programming cable to the RMSA 8-wire interface cable. The RMSA interface cable is used to program the microcontroller code and Seal personality information that is unique to each Seal. It also provides the interface between an external USB device, such as a PC, and the UART on the Seal, for personality programming and debugging.

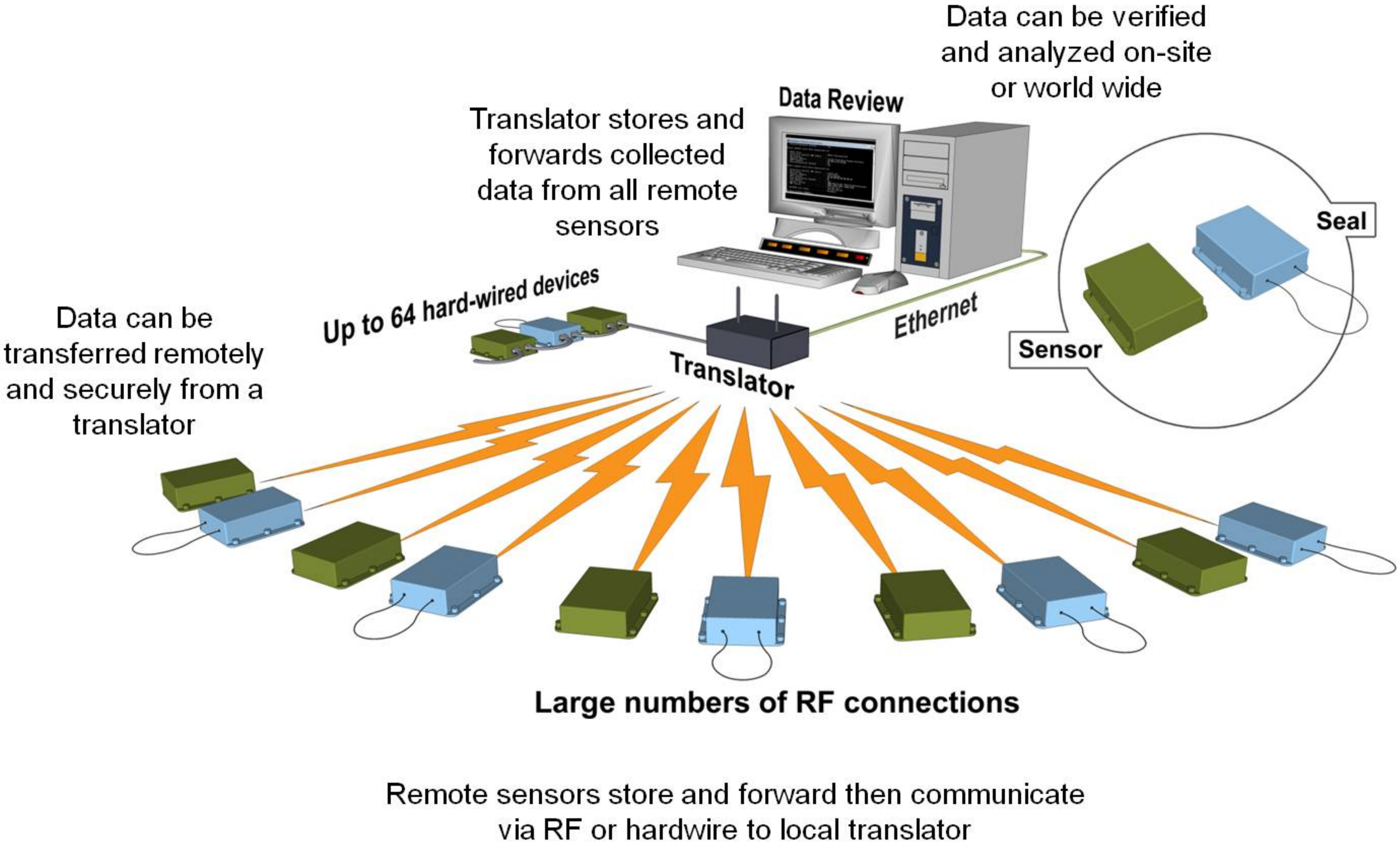

Data can be verified and analyzed on-site or world wide
Data Review
Translator stores and forwards collected data from all remote sensors
Seal
Up to 64 hard-wired devices
Data can be transferred remotely and securely from a translator
Ethernet
Sensor
Translator
Large numbers of RF connections
Remote sensors store and forward then communicate via RF or hardwire to local translator

Figure 2 RMSA System Configuration

## 1.3 Seal

The Seal's design is rugged and resistant to tampering. Its electronics are in a tamper indicating plastic housing. See Figure 3 for a picture of the prototype version of Seal in its case. A pair of tamper switches is used to detect any opening of the Seal housing. The Seal housing may be opened to replace the internal batteries. Openings are recorded as tamper events. The Seal is contained in either a white PVC or a blue and white swirl polycarbonate plastic overlapping two piece case that contains an O-ring Sealing system for environmental protection. The Plastic Optical Fiber (POF) cable connectors have special Delrin® plastic ferules along with O-ring Sealing gaskets.

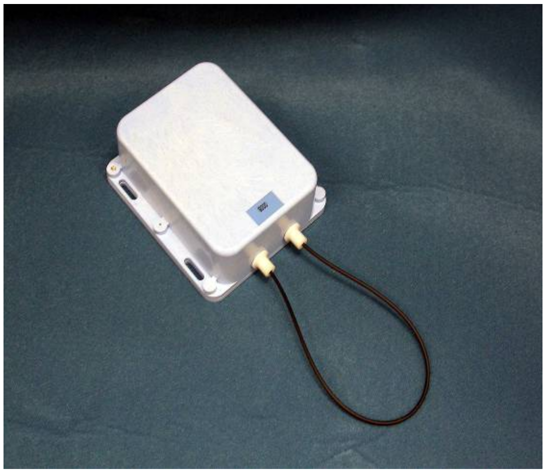


Figure 3 Seal in Case

Advantages of using the RMSA Seal include the following:

- Can be reused indefinitely
- Can be read in situ without removal from the Sealed item
- No external power required, battery operated
- Provides intrinsic tamper indication
- Easily installed
- One or multiple Seals can be read remotely

The Seal stores data and then forwards this data securely to a local Translator via low power RF communication. As many as 2000 normal State of Health messages are stored locally in the Seal in a non-volatile circular memory buffer. This locally stored Seal data can be retrieved manually by the User by using the Send Message Protocol should RF transmission be interrupted during normal operation.

The Seal is comprised of the following major components: the Fiber Optic Cable, a Fiber Optic Emitter and a Fiber Optic Receiver, a Microcontroller, Memory, an RF Transceiver and Real Time Clock. Other inherent components include the Battery Pack, Personality and Security Key programming, and the Programming Interface. See Figure 4 for a block diagram of the Seal.

Authenticated Switch Seals contain all of the components in the Seal, and additionally have a complementary set of magnetic switches, one operating as normally closed and the other operating as normally open. There is also a strong magnet installed in the housing such that when two Authenticated Switch modules are installed face to face, the magnet from one activates the magnetic switches on the other module.

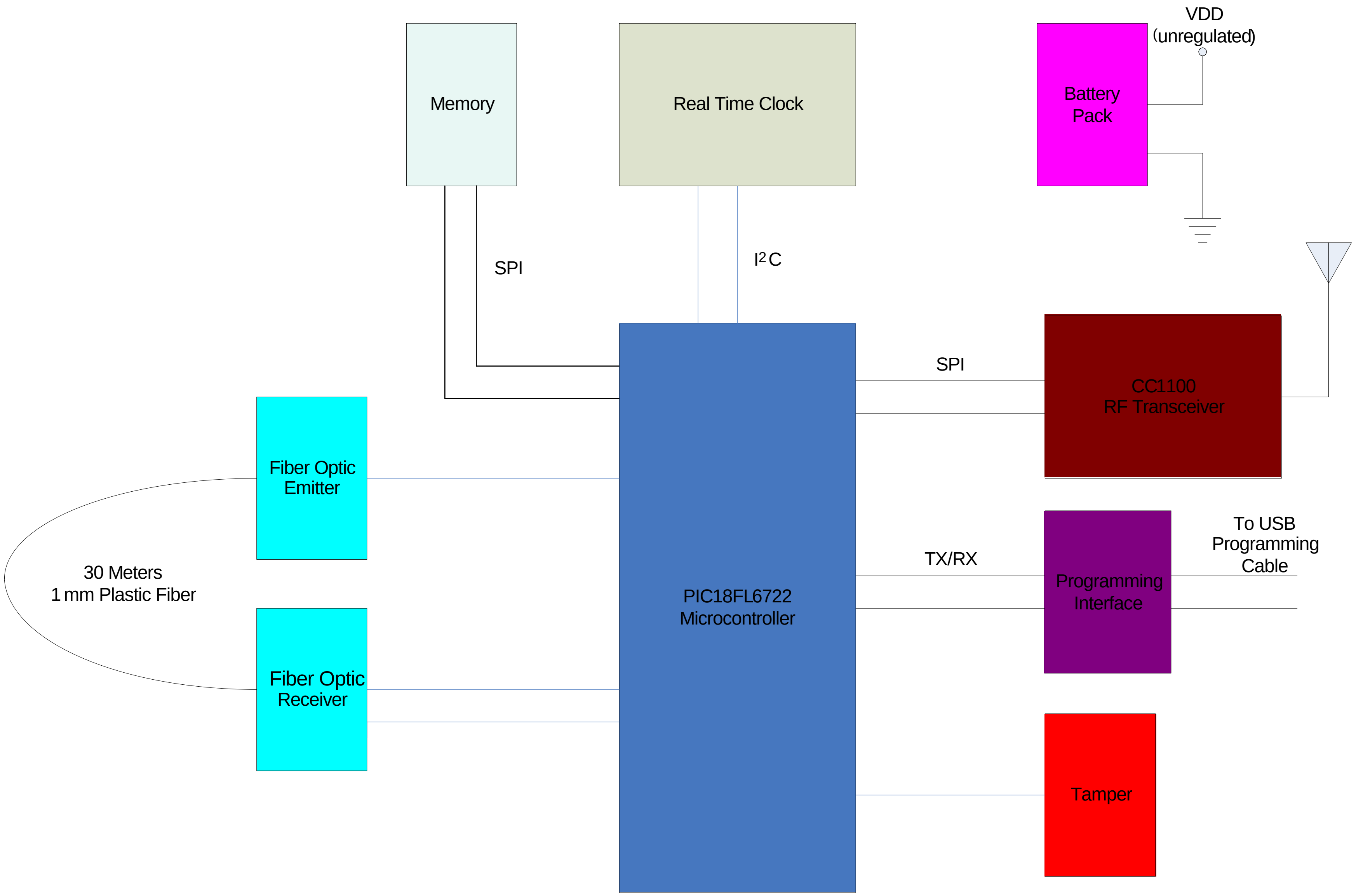


Figure 4 Block Diagram of the Seal

A parametric measure of the light intensity through the Fiber Cable Monitor is monitored electronically by the Seal. The fiber optic loop may be as short as 1 meter and as long as 30 meters in length.

Dates and times of opening or closing the loop, tampering, out of boundary conditions and interrogation are stored in the Seal. Each Seal has a unique ID number that is programmed before deployment in non-volatile memory internally. A new Seal received from the manufacturer does not contain any personality information such as encryption or authentication keys. For the Seal initialization and configuration process, refer to Section 2.1.

For tamper resistance, a pair of tamper switches along with a special pin attached to the case top are used together to detect opening of the Seal case. Once the case is opened, the time of this tamper is recorded for later review. Additionally, the encryption and authentication keys are automatically destroyed and a default key is used from that point forward to do both the encryption and authentication for any further messages.

The Seal contains the following components:

- Quartz crystal based timer (real-time clock) to ensure high precision in time/date generation
- Microchip low power microcontroller with 128 Kbyte Flash memory to control the Seal functions, encryption, and transmit information
- Non-volatile Flash memory to store up to 2000 normal SOH messages
- Case switches for tamper detection
- Fiber optic circuits to emit and receive light pulses traveling through the optical fiber loop
- Serial interface for data exchange between the Seal and the Personality Programming device
- Two AA 3.6V, 2100 mA-H Lithium Batteries
- Temperature monitor circuit
- Programmable RF transceiver for the 900 MHz ISM band
- Magnasphere magnetic switches (Authenticated Switch only)
- Cylindrical magnet (Authenticated Switch only)

The microprocessor is activated by any of the following events:

- Tampering attempt on the case switch
- Fiber optic (FO) loop event
- Valid request for communication (interrogation, initialization, etc.)

- Magnetic switch activation (Authenticated Switch only)

The plastic optical fiber (POF) cable is a 200-micron single fiber in a 1000 micron (1mm) plastic jacket. At each end is a removable plastic ferrule for connecting the POF into the Seal body. There is a 1 mm hole in the ferrule to allow the POF to pass through and insert into the Seal case opening to allow light from the POF to either enter or exit.

To communicate with the Seal, the Seal is connected to a PC USB port through the Programming Card. The Seal's two replaceable AA 3.6V lithium batteries may provide a source of power for over four years, although it is recommended that they be replaced sooner if there is more RF transmitting activity than normal.

## 1.4 Translator

The Translator is the device used to read the Seal data in situ. The Translator collects, stores, and then forwards data from Seals upon request, local or remote. All data is encrypted by the Seals before transmission, though some portions of the data frame such as Seal ID is sent in the clear (no encryption). An authentication signature is part of the overall Seal message. The Translator can then transfer this pre-encrypted Seal data via its Ethernet link as it does not decrypt the data nor authenticate nor does not contain such functionality. The Translator sends on the encrypted Seal messages as well as non-encrypted information regarding the Seal address, the number of bytes in the encrypted messages, received signal strength as seen by the Translator, and other information. Data can then be verified and analyzed on-site or remotely worldwide.

When a message is transmitted the source device expects an acknowledge response from the destination device. If an acknowledge message is not received the source device retransmits the message after a random stand-off period of time. This RF "hand-shake" is an affirmative action and has been shown to cut down the amount of RF traffic used by other types of Seals. The Seal will only try to wait for this acknowledgement of successful data reception by the Translator up to three times before stopping any further attempts for that particular message. The Translator stores the messages chronologically in non-volatile memory.

For physical security, the Translator is housed in a tamper-indicating enclosure with openings for RF antenna and an Ethernet cable. The Translator consists of an ARM9 based single board computer (SBC) with a specially designed PC/104 daughter card called the Translator Communication Card (TCC), a universal 115/230V, 50/60Hz AC to 5VDC power supply, two external vertical swivel antennas and a tamper switch. See Figure 5 for a block diagram of the Translator. The SBC runs Debian Linux and contains the Operating System and RMSA application on a removable 4 GB SD card. There are 128 MB of DDR RAM, 512MB of NAND Flash, USB ports, Gigabit Ethernet, a serial port and several other items which are not used on the SBC. The Translator may be powered by Power Over Ethernet (POE) if desired. Total power consumption is around 5 watts.

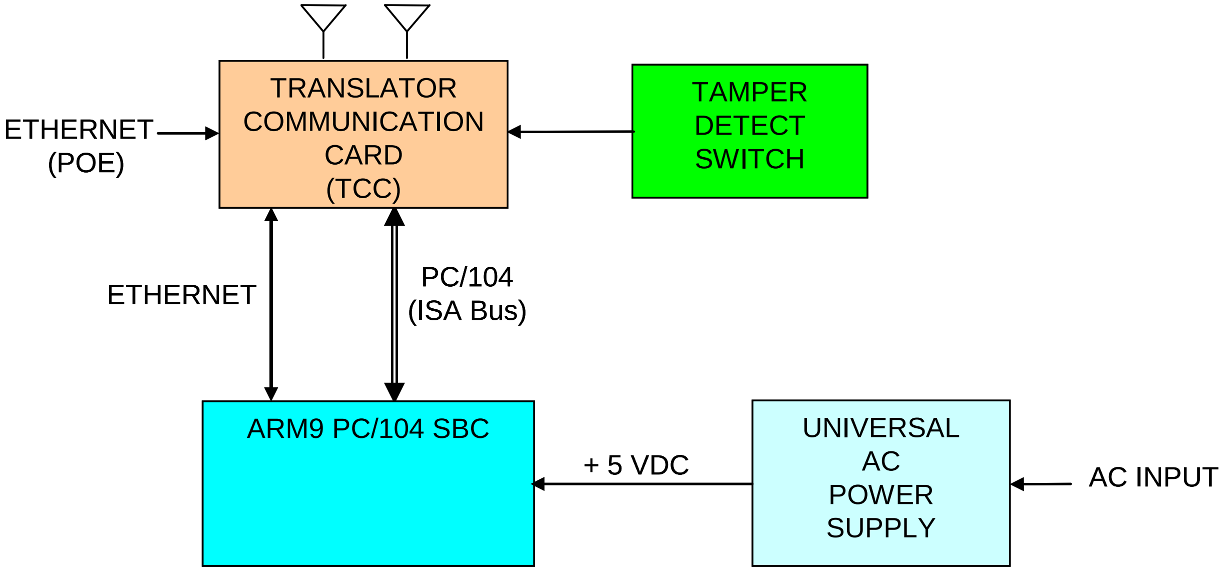


Figure 5 Translator Block Diagram

The Translator base system stores the encrypted Type Length Value (TLVs) messages in day files. The log file name consists of a date stamp and 4 digit counter. At midnight, the current day file is closed and a new file is opened with the new date stamp. To minimize Linux resource issues while stress testing, a maximum number of records per log file is imposed. When this maximum record count is reached, the current day file is closed and a new one is open with the same date stamp but incremented counter. Multi-part messages are reassembled and stored as a single day file entry for ease of retrieval. Remote command pass-through sends the State of Health of the Seals, the Message ID and includes an initiation of Wake on Radio sequence to the Seal. In addition, the day files also contain basic Translator State of Health data such as the following:

- Translator up-time and RMSA application start / stop time.
- Date and time that messages are received by the Translator timebase (though not necessarily the date and time the message was created by the Seal timebase).
- Number of successful and unsuccessful TLVs received from this Seal (based only on properly formatted TLV Header information). See Figure 6 for a breakdown of the TLV information and its proper formatting.
- Receive Signal Strength Indication (RSSI) / Link Quality Indication (LQI) based on messages.

The Translator is considered a non-secure device as any stored seal data is encrypted at the seal source before being collected by the Translator. However, Translator security features are available including:

- Password protection for upload of Translator log files to a review host via Samba.

- Translator log files are placed on a separate disk partition so problems with the root partition will have no effect on the logs.

- An “rmsadeploy” script on the Translator that disables user access including console/serial port access, ftp, ssh, etc. In deployed mode, the Translator’s SD card (firmware) would have to be replaced to regain access.

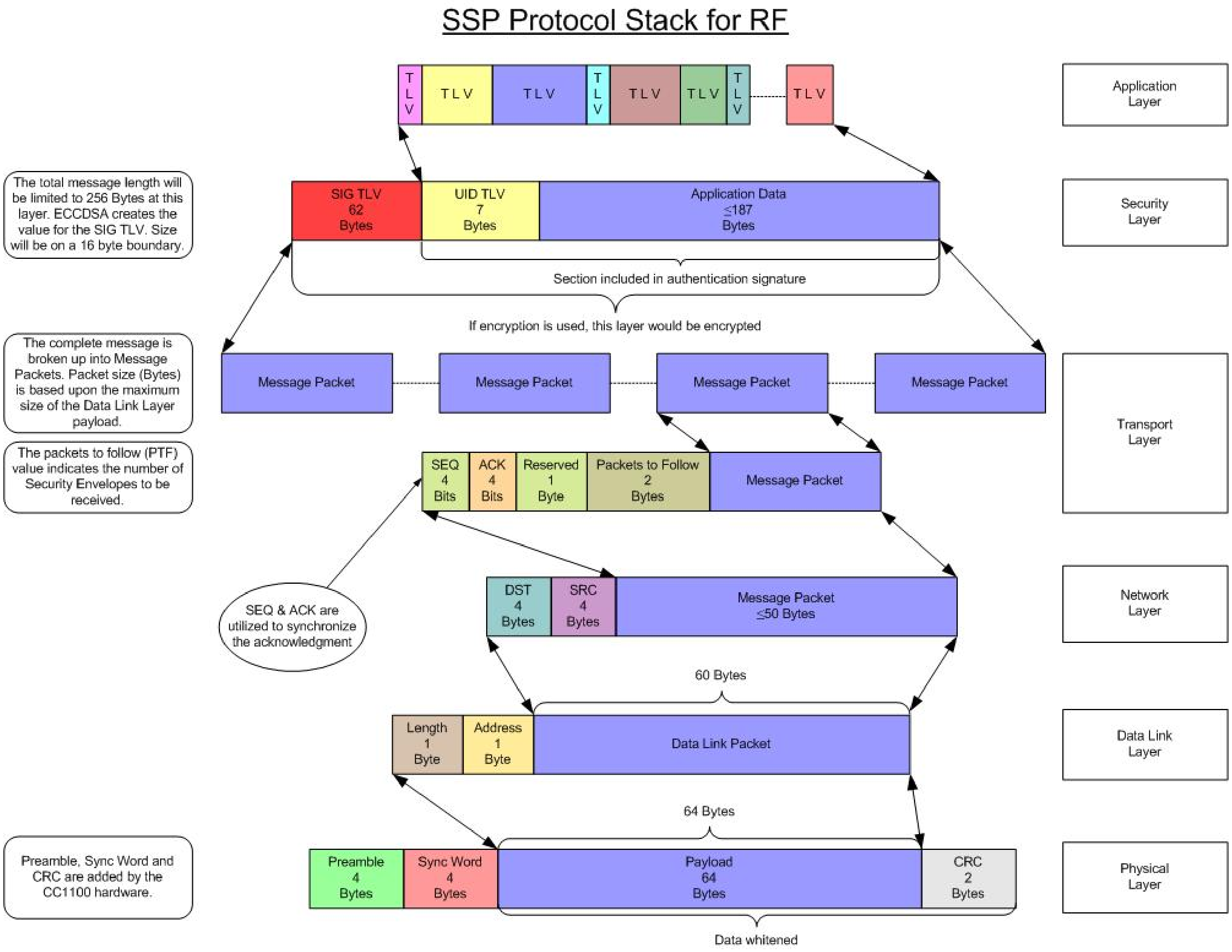
- Improperly encrypted and authenticated data will be flagged by the Remote Review GUI as “corrupt”.

Refer to Chapter 4 of this User’s Guide for more details on Translator operational deployment.

During RF transmissions, badly formatted TLV packets will be noted during the Translator’s data review of the packets sent. All transmitted message data is stored on the Seal as well. Interruption of network operations will not affect the Translator’s RF data store operations. Network operations are only necessary during inspector download and review events.

Figure 6 shows the TLV message construction from the Physical Layer all the way up to the Application Layer. The TLV message format is very flexible as it allows for new message types to be created at some future point in time while allowing all previous message types previously created to be fully backwards compatible.

The TLV format is set up with a Message Type Field (this it the “T”), followed by the Length Field (this is the “L”) and then followed by the Value Field (this is the “V”). The Type and Length fields are fixed in the number of bytes, but can be modified for future growth. The Value field can be as long as feasible, depending on the Message Type.



The total message length will be limited to 256 Bytes at this layer. ECCDSA creates the value for the SIG TLV. Size will be on a 16 byte boundary.

The complete message is broken up into Message Packets. Packet size (Bytes) is based upon the maximum size of the Data Link Layer payload.

The packets to follow (PTF) value indicates the number of Security Envelopes to be received.

SEQ & ACK are utilized to synchronize the acknowledgment

Preamble, Sync Word and CRC are added by the CC1100 hardware.

Figure 6 Type Length Value (TLV) Format

## 1.5 RMSA Review GUI

The RMSA Review GUI application runs under Microsoft WindowsXP. The Review application includes the ability to decrypt and authenticate Seal data and facilitates remote review of data both in a batch processing mode and in a live update mode. Decryption and authentication of the Seal data messages is provided as is handling of incorrectly formatted TLVs and batch processing of multiple input files.

The RMSA Review GUI includes an Inspector Mode that provides a Main Batch Review Screen and a Demand Data Screen. Within the Main Batch processing, a simplified view of the data, a full view of the data, or a custom view may be set up by the inspector. The batch processing of an RMSA day file(s) is only allowed with a password-protected Samba file share. Figure 7 provides a diagram of how the Review Application Software may be used.

Should live data updates or Seal data queries be needed, a TCP/IP port connection to the Translator is required. Query functions include either a request to acquire a specific Seal message via a send message demand or a request for status via a State-of Health demand.

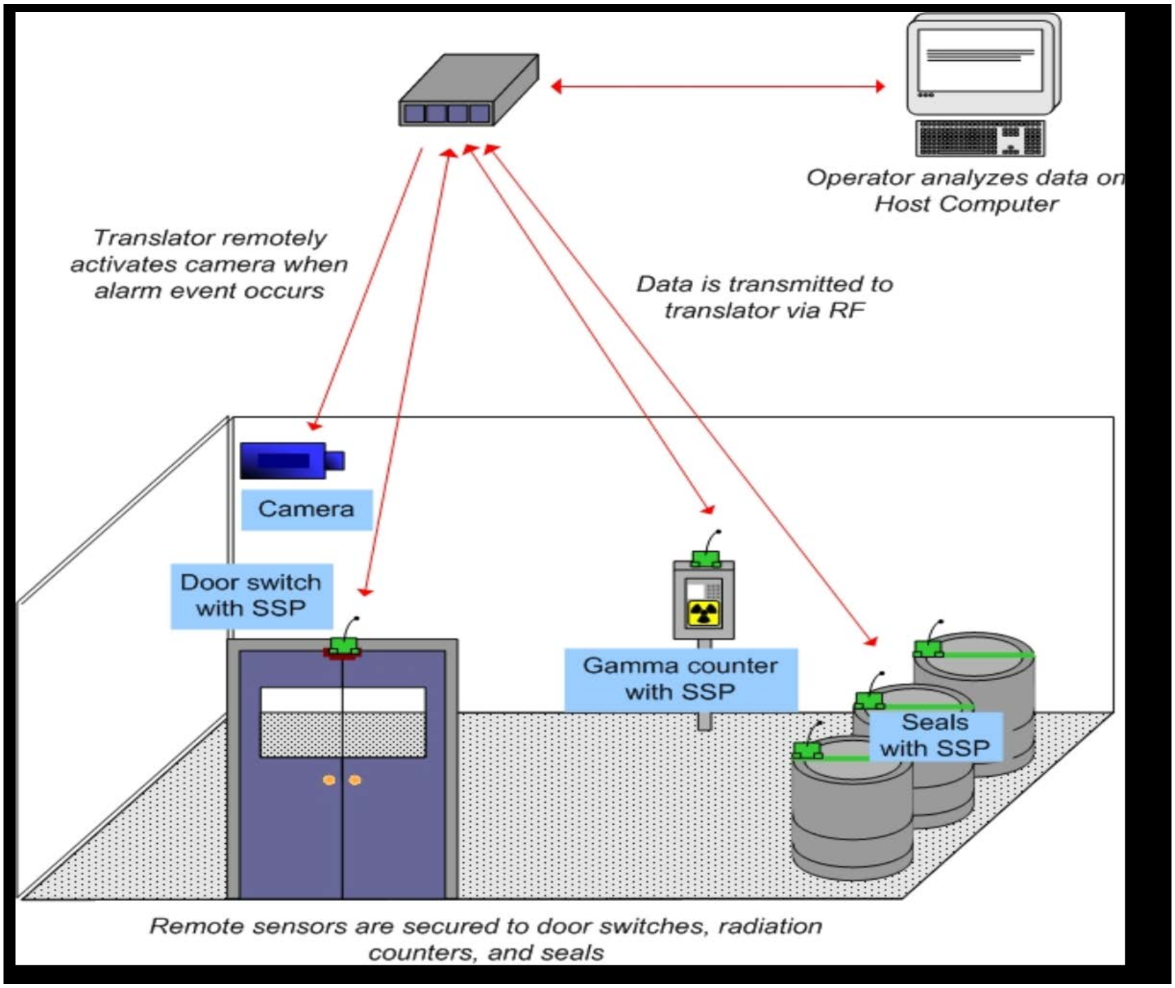


Figure 7 Example RMSA System Installation

Chapter

2

# RMSA Set-Up

*This chapter details the set-up steps for the RMSA system.*

## 2.1 RMSA Seal Programming and Configuring

Ensure that the Seal has fresh batteries with the following instructions.

### 2.1.1 Changing the Seal Batteries

- Open the Seal case. See Figure 8 below, which just shows the Seal circuit card assembly.

- The two 3.6-volt Lithium AA batteries are on the top of the board in battery holders.

- Remove old batteries and insert two fresh batteries. Note that the battery positive terminal must align with where the arrows are pointing. There are also battery orientation symbols in the battery holders.

- **NOTE:** The prototype Seal has a power switch which must be turned on (slide away from the end of the board with the fiber optic cable ferrules) to enter the command interface for personality programming.

- Reprogram the Seal personality, close the Seal case and install a fiber loop.

- Confirm proper start-up by verifying that the red LED visible through the bottom of the Seal case flashes 5 times and then turns off.

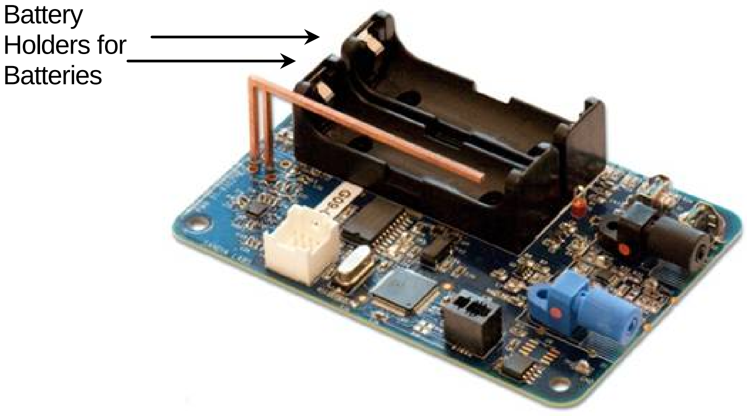


Figure 8 Battery Holders (Seal Not in Case)

### 2.1.2 Programming the Seal

The picture below illustrates the hardware set-up for the Seal programming phase. In Figure 9 the Programming Card and Seal are outside of their respective cases while Figure 10 shows the Programming inside its case. The hardware shown are the RMSA Programmer with USB cable, an 8-pin cable to support the Seal console and a PICKit2 Programming Dongle with USB-mini cable to support Seal microcontroller programming. The connections are the same if an MPLAB ICD3 Programming and Emulation module is used instead of the PICKit 2. Both USB cables (one from the PICKit 2 or ICD3 and one from the Programmer) are attached to the host PC. The set-up for the Windows terminal program such as HyperTerm or TeraTerm to be used with the Programmer Card is as follows: 8 data bits, No parity, 1 stop bit, 19.2 KBaud, no flow control. Once the Seal has been properly configured and programmed, all dongle connections may be removed and the Seal can operate stand-alone.

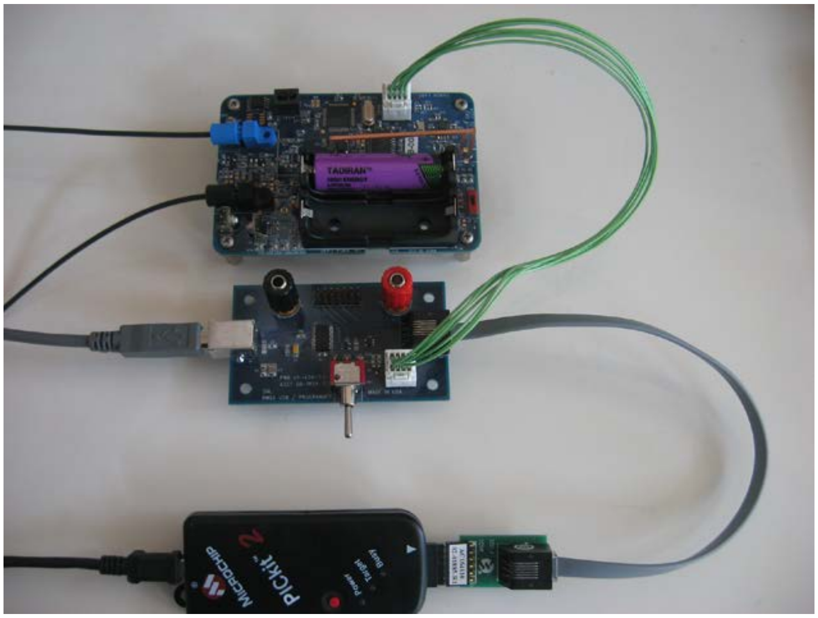


Figure 9 Out of Case Seal and Programmer Set -up

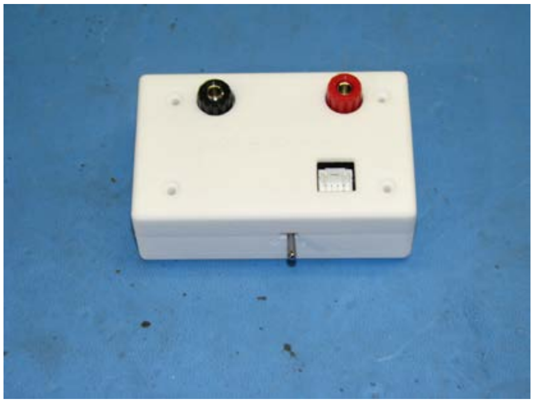


Figure 10 Seal Programmer Inside Case

Note that support files have been packaged for the User in a folder called RMSA_USER_Files in the support and documentation package provided with the RMSA system. The folder will be referred to as the RMSA USER file repository in the remainder of this User Guide.

Seal programming requires access to MPLAB IDE version 8.43 or later and PICKit 2 version 2.61 or later. If programming is being performed using the MPLAB ICD3, the ICD3 is fully supported by the MPLAB IDE. Both are available as free downloads from the Microchip website at www.microchip.com. The MPLAB IDE is used to create the Seal hex code with embedded Seal ID and then the PICKit 2 is used to write the hex file to the Seal. Each process is described below along with the process to configure a Seal with the appropriate date and encryption keys.

- Locate hex code files (will have a format such as NAME.hex) and Keys.dat in the RMSA file repository. Also, locate the Seal personality Blind Programmer executable in the RMSA file repository. (The default is typically C:\Program Files\Sandia National Laboratories\SSP Software)

- Identify the host PC COM Port associated with the RMSA USB dongle (e.g., COM5 or COM11). For the remainder of this User Guide, this COM port will be referred to as Comport.

### 2.1.3 Creating the Seal-Specific Hex File with MPLAB IDE

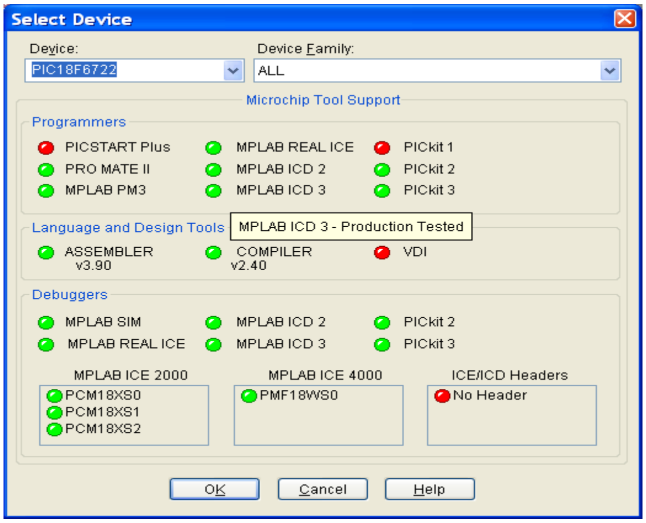
To create a Seal specific .hex file (with embedded Seal ID), perform the following steps:

- Launch the MPLAB IDE application.

- Using the Configure/Select Device option, ensure that the MPLAB tool is configured for device type PIC18F6722 as illustrated in the screen shot below:

Normal operation for the Seal should be 3.5 V, +/- 0.1 V. The Seal will operate between 3.0 and 3.6 volts.

**IMPORTANT INFORMATION! Do not apply any voltage greater than 3.7 volts to the Seal!**



Device: PIC18F6722

Device Family: ALL

Programmers:

- 🔴 PICSTART Plus
- 🟢 PRO MATE II
- 🟢 MPLAB PM3
- 🟢 MPLAB REAL ICE
- 🟢 MPLAB ICD 2
- 🟢 MPLAB ICD 3
- 🔴 PICkit 1
- 🟢 PICkit 2
- 🟢 PICkit 3

Language and Design Tools:

- 🟢 ASSEMBLER v3.90
- 🟢 COMPILER v2.40
- 🔴 VDI

Debuggers:

- 🟢 MPLAB SIM
- 🟢 MPLAB REAL ICE
- 🟢 MPLAB ICD 2
- 🟢 MPLAB ICD 3
- 🟢 PICkit 2
- 🟢 PICkit 3

MPLAB ICE 2000: 🟢 PCM18XS0, 🟢 PCM18XS1, 🟢 PCM18XS2

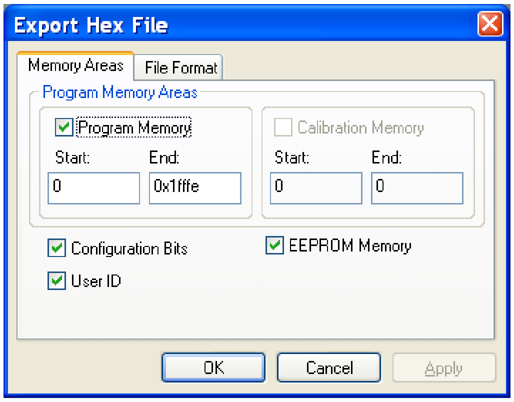
MPLAB ICE 4000: 🟢 PMF18WS0

ICE/ICD Headers: 🔴 No Header

- Under the File pull down, select Import. In the Open window, browse to the location of the RMSA User files and select file FullUser.hex.

- Select Configure, then ID Memory, then enter the Seal ID (**NOTE:** All ID's using 0xFF in the least significant byte of the ID are reserved for the Translator only and may not be used for Seal identification) in the User ID box, then press OK.

- Under the File pull down, select Export. Select the export defaults as illustrated below and click OK.



☑ Program Memory Start: 0 End: 0x1fffe

☐ Calibration Memory Start: 0 End: 0

☑ Configuration Bits

☑ EEPROM Memory

☑ User ID

- In the Save As window, browse to the User file location and save the Seal specific .hex file with a unique name. For example, if the new .hex file has embedded ID 6F, save the .hex file as FullUser_ID6F.hex.

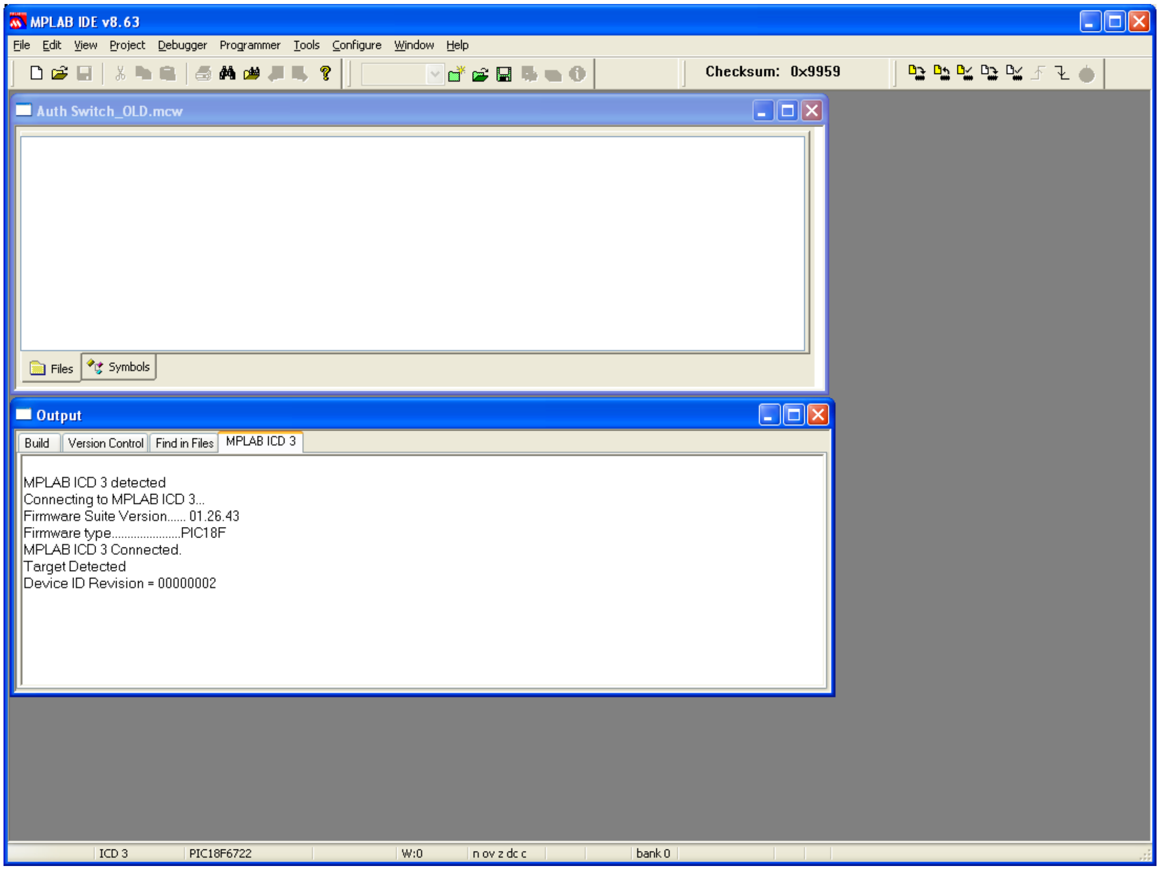
- If the Seal is to be programmed with the PICKit2 dongle, exit the MPLAB IDE application and use the Writing the Hex File to the Seal with PICKit2 section. Otherwise, remain in the MPLAB IDE and use the Writing the Hex File to the Seal with ICD3 section.

### 2.1.4 Writing the Hex File to the Seal with ICD3

Writing the .hex file to the Seal requires the RMSA USB/Programmer. To write the .hex file to a Seal, perform the following steps:

- Select a Seal, remove the enclosure and connect the RMSA USB/Programming dongle and ICD3 dongle shown in Section 2.1 of this User Guide.

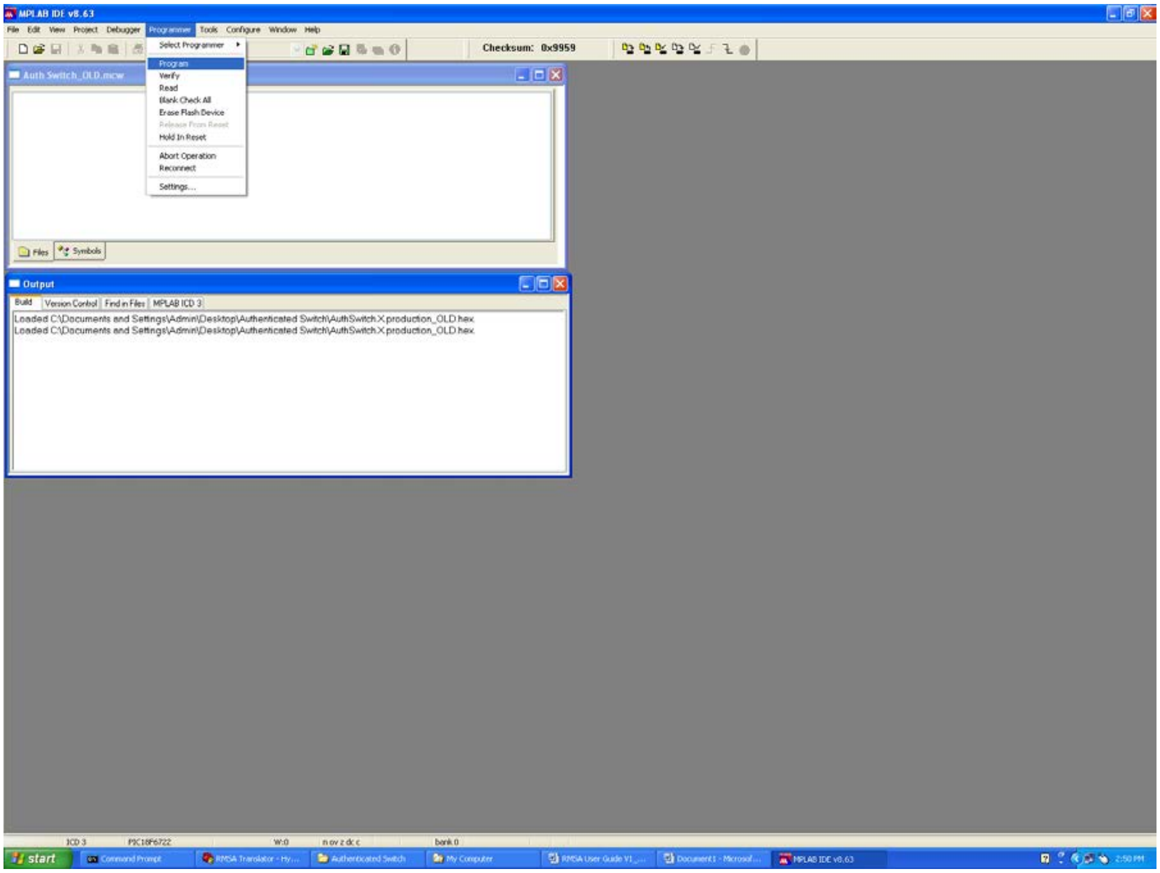
- Start the MPLAB Integrated Development Environment (IDE) if it is not already running. The program will confirm the existence of the ICD3 programming module and ask the user to confirm the correct power supply setting. When the initialization is complete, the prompt will indicate that the program is ready. If not, check dongle cabling (as shown in Section 2.1) and repeat this step until the connection is indicated.



```
MPLAB ICD 3 detected
Connecting to MPLAB ICD 3...
Firmware Suite Version...... 01.26.43
Firmware type....................PIC18F
MPLAB ICD 3 Connected.
Target Detected
Device ID Revision = 00000002
```

- Under the File pull down, select Import, browse to the Seal specific .hex file for the Seal and select Open.  The program will report the successful import of the hex file.

- Click Programmer from the top menu line and click on Program in the drop-down menu



```
Loaded C:\Documents and Settings\Admin\Desktop\Authenticated Switch\AuthSwitch.X.production_OLD.hex
Loaded C:\Documents and Settings\Admin\Desktop\Authenticated Switch\AuthSwitch.X.production_OLD.hex
```

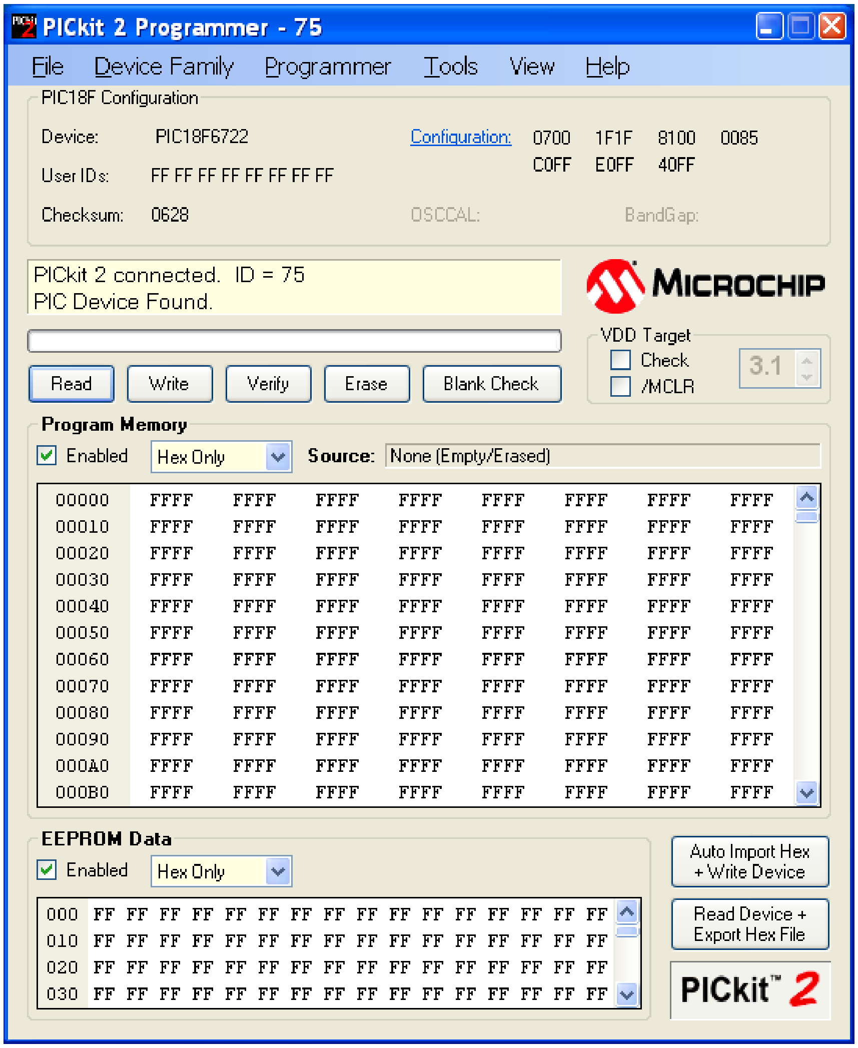
- The progress bar at the bottom of the screen will indicate that programming is in progress, and the screen will report “Programming/Verify Complete” when it is finished.  Exit the MPLAB IDE program.

### 2.1.4 Writing the Hex File to the Seal with PICKit2

Writing the .hex file to the Seal requires the RMSA USB/Programmer.  To write the .hex file to a Seal, perform the following steps:

- Select a Seal, remove the enclosure and connect the RMSA USB/Programming dongle and PICKit 2 dongle shown in Section 2.1 of this User Guide.

- Start the PICKit 2 application.  Once started, the PICKit 2 window should indicate that a PIC device was found.  If not, check dongle cabling (as shown in Section 2.1) and repeat this step until the connection is indicated.



PIC18F Configuration

Device: PIC18F6722

User IDs: FF FF FF FF FF FF FF FF

Checksum: 0628

Configuration: 0700 1F1F 8100 0085 C0FF E0FF 40FF

OSCCAL:

BandGap:

PICkit 2 connected. ID = 75
PIC Device Found.

□ Check

□ /MCLR

3.1

Program Memory

☑ Enabled Hex Only

Source: None (Empty/Erased)

```
00000   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00010   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00020   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00030   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00040   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00050   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00060   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00070   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00080   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
00090   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
000A0   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
000B0   FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF  FFFF
```

EEPROM Data

☑ Enabled Hex Only

```
000 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
010 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
020 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
030 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
```

- Under the File pull down, select Import Hex, browse to the Seal specific .hex file for the Seal and select Open. Note whether the program bytes appear in the Program Memory window and if the message that the Hex file has been successfully imported appears.

- Click the Write button. Writing the hex file to the Seal will take approximately 1 minute allowing erase of the device then programming of the new code. A successful outcome will cause the message box to be shaded green with the message Programming Successful.

Note: Should the User wish to Read the code back, click the Read button. The message “Reading Device: Program Memory” is displayed in the message box. After several seconds, the message box will indicate it is “Done.”. No program bytes are available in the Program Memory window (use ICD3 from Microchip).

### 2.1.5 The Key Files

Key files are used to load keys into the Seal with the Sandia National Laboratories Blind Programmer GUI. The key files are for creation and review of encrypted and authenticated Type Length Value (TLV) data. The key file is a table of comma-delimited records where each record contains the Seal ID followed by the default encryption key, encryption key and authentication key. Key generation is dictated by IAEA policy and, therefore, outside the scope of this User Guide. Example encryption keys for this step are obtained from key file keyfile.dat.

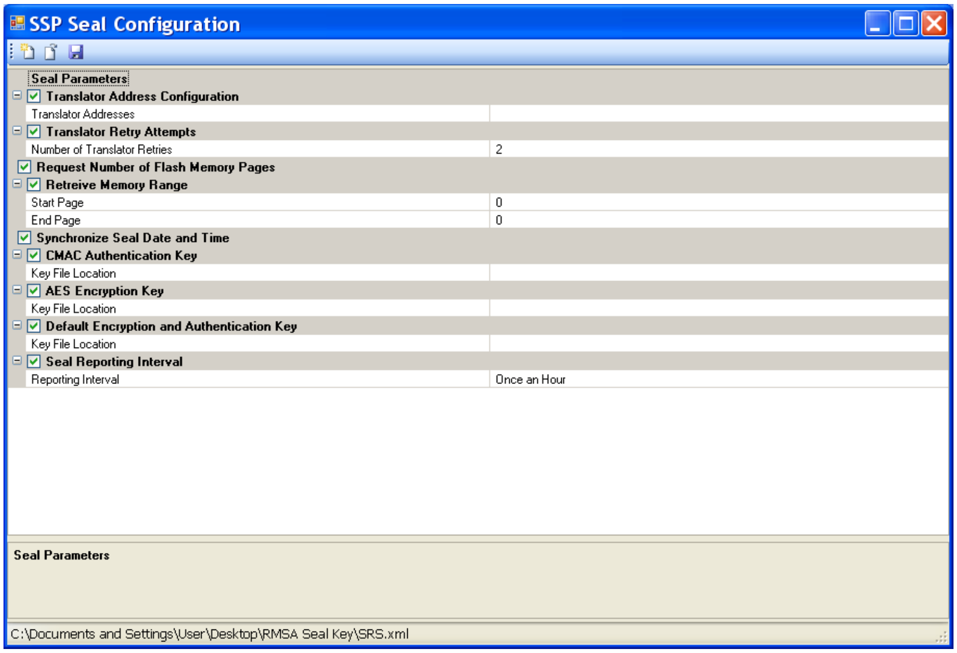
See Section 3.1 for information on how a Key file is generated for a series of RMSA Seal IDs.

### 2.1.6 Configuring the Seal Personality

Sandia National Laboratories provides software for configuring seal personality including the SSP Personality Profile Editor for creating an XML file to define SSP seal configuration and the SSP Personality Programmer for programming the personality defined in an XML file into a seal.  Use the RMSA Software.msi installer program to install the tools on a host PC running Windows XP.  Then, from Start->All Programs, choose SSP Software to create the personality XML file.  Once created, the personality XML file can be used to configure any number of seals.  The XML file creation and SSP Programmer steps are described in more detail below.

The instructions below assume that the key file for the seals has been generated and is in a known location.

- Start the SSP Personality Profile Editor from Start->All Programs->SSP Software. Just under the SSP Seal Configuration Title, click on the left most icon to create a new configuration file.  The configuration window should be similar to:



| | |
|---|---|
| Seal Parameters | |
| ☑ Translator Address Configuration | |
| Translator Addresses | |
| ☑ Translator Retry Attempts | |
| Number of Translator Retries | 2 |
| ☑ Request Number of Flash Memory Pages | |
| ☑ Retreive Memory Range | |
| Start Page | 0 |
| End Page | 0 |
| ☑ Synchronize Seal Date and Time | |
| ☑ CMAC Authentication Key | |
| Key File Location | |
| ☑ AES Encryption Key | |
| Key File Location | |
| ☑ Default Encryption and Authentication Key | |
| Key File Location | |
| ☑ Seal Reporting Interval | |
| Reporting Interval | Once an Hour |

Seal Parameters

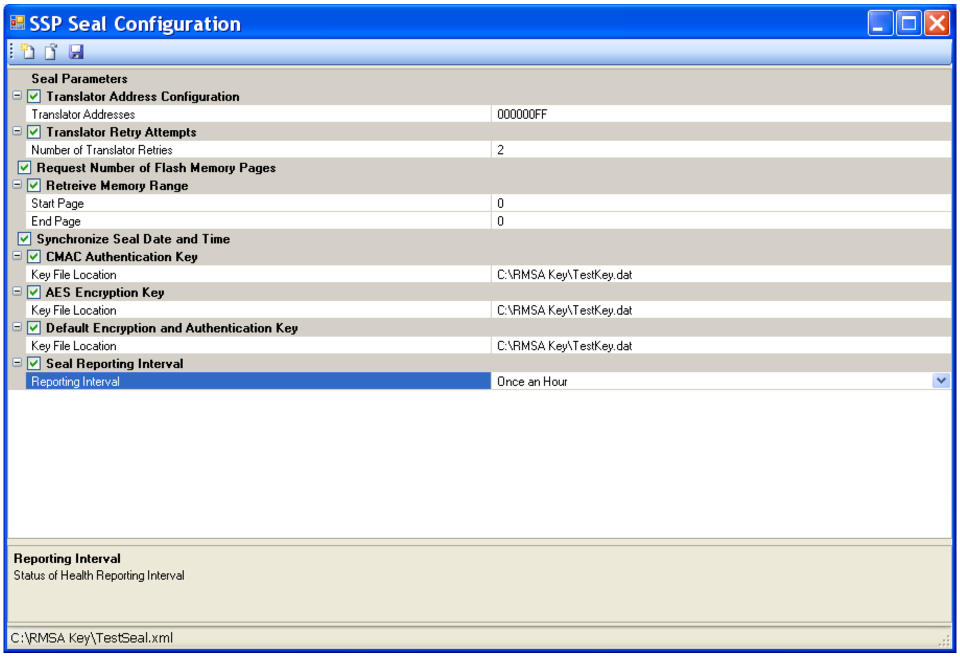
C:\Documents and Settings\User\Desktop\RMSA Seal Key\SRS.xml

- Click the empty cell in the right column next to "Translator Addresses".  Enter the default address 000000ff.

- Click anywhere on the "Key File Location" row for the CMAC Authentication Key then click on the "…" icon that appears to the right of this row.  Use the standard browser interface to select the key file for the seals.  Repeat this step for the "Key File Location" row for the AES Encryption Key and Default Encryption and Authentication Key.  Note that these keys may be loaded from the same file.

- Click on the cells to the right of the label "Reporting Interval".  (The default value of these cells is 30 seconds.)  Enter any value between 30 seconds and 24 hours.  This interval defines the period for normal State of Health reporting for the seal.

- At this point, the configuration window should appear similar to:



| Seal Parameters | |
|---|---|
| ☑ Translator Address Configuration | |
| Translator Addresses | 000000FF |
| ☑ Translator Retry Attempts | |
| Number of Translator Retries | 2 |
| ☑ Request Number of Flash Memory Pages | |
| ☑ Retreive Memory Range | |
| Start Page | 0 |
| End Page | 0 |
| ☑ Synchronize Seal Date and Time | |
| ☑ CMAC Authentication Key | |
| Key File Location | C:\RMSA Key\TestKey.dat |
| ☑ AES Encryption Key | |
| Key File Location | C:\RMSA Key\TestKey.dat |
| ☑ Default Encryption and Authentication Key | |
| Key File Location | C:\RMSA Key\TestKey.dat |
| ☑ Seal Reporting Interval | |
| Reporting Interval | Once an Hour |

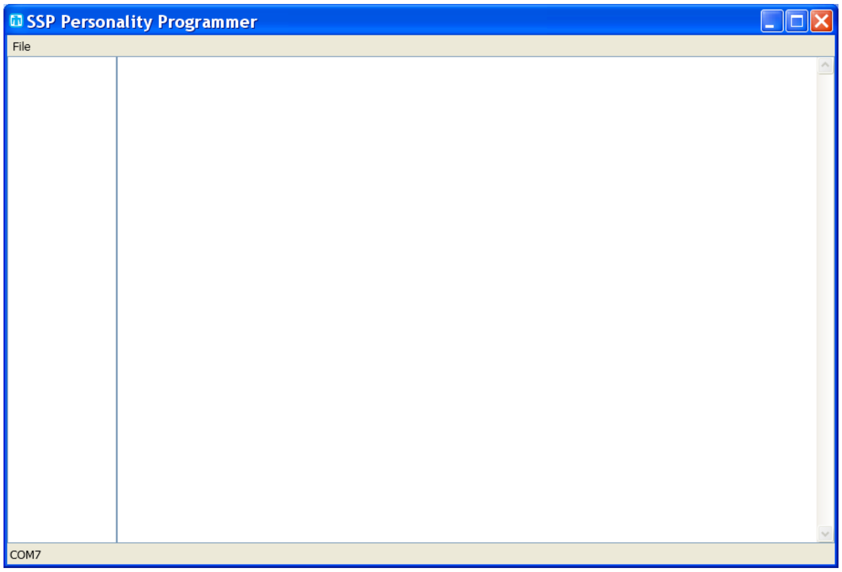
**Reporting Interval**
Status of Health Reporting Interval

C:\RMSA Key\TestSeal.xml

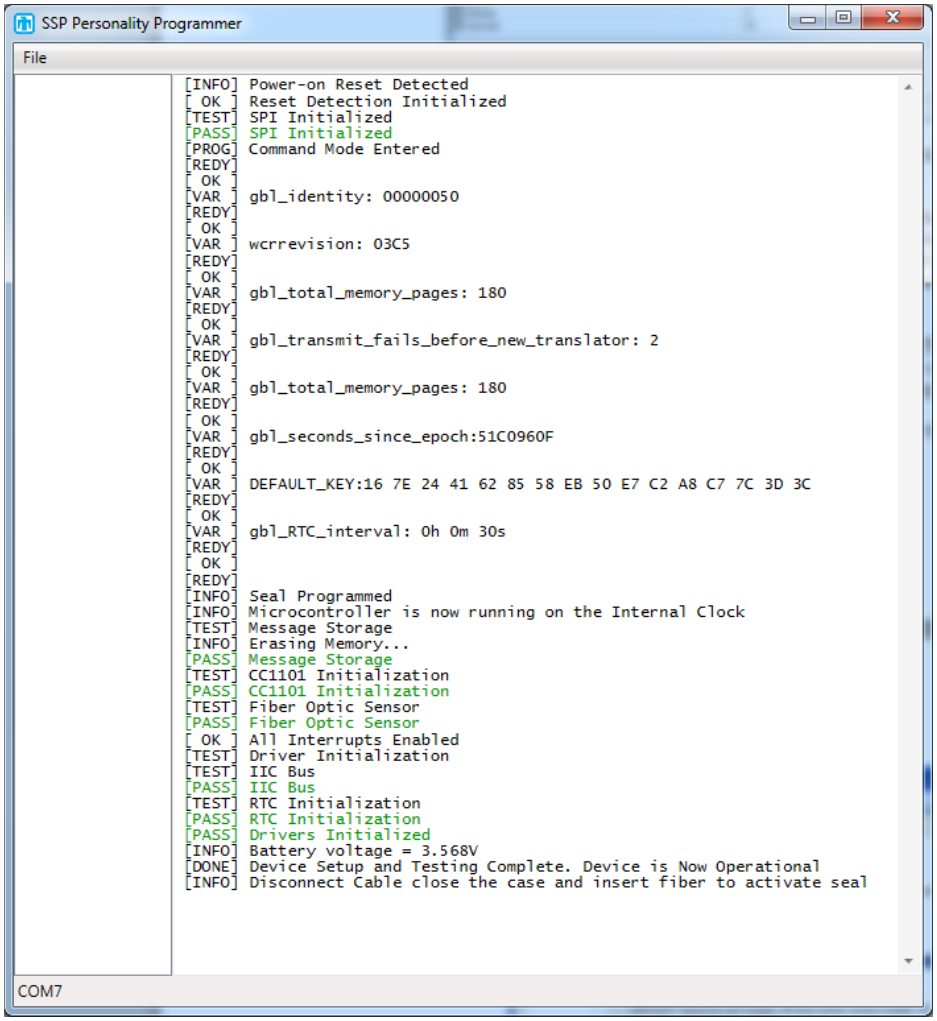
- Under the SSP Seal Configuration title, select the right-most icon to save the personality configuration using the provided standard browser interface. Once saved, exit the editor program.

- It is important that the RMSA programmer dongle be plugged into the host PC via a USB port before starting the RMSA Blind Programmer GUI so that the GUI selects the correct COM port for communications. Plug the RMSA Programmer dongle into the USB port of the PC host and the white 8-pin connector into the seal.

- Start the SSP Personality Programmer from Start->All Programs->SSP Software. In the browser interface that is presented at startup, navigate to the XML configuration file that you just saved. The SSP Programmer window will appear similar to:



- Open the seal that is to be configured. Cycle the power (red switch) to the VDD position. Message will appear in the Blind Programmer window reporting status of seal configuration similar to:



```
[INFO] Power-on Reset Detected
[ OK ] Reset Detection Initialized
[TEST] SPI Initialized
[PASS] SPI Initialized
[PROG] Command Mode Entered
[REDY]
[ OK ]
[VAR ] gbl_identity: 00000050
[REDY]
[ OK ]
[VAR ] wcrrevision: 03C5
[REDY]
[ OK ]
[VAR ] gbl_total_memory_pages: 180
[REDY]
[ OK ]
[VAR ] gbl_transmit_fails_before_new_translator: 2
[REDY]
[ OK ]
[VAR ] gbl_total_memory_pages: 180
[REDY]
[ OK ]
[VAR ] gbl_seconds_since_epoch:51C0960F
[REDY]
[ OK ]
[VAR ] DEFAULT_KEY:16 7E 24 41 62 85 58 EB 50 E7 C2 A8 C7 7C 3D 3C
[REDY]
[ OK ]
[VAR ] gbl_RTC_interval: 0h 0m 30s
[REDY]
[ OK ]
[REDY]
[INFO] Seal Programmed
[INFO] Microcontroller is now running on the Internal Clock
[TEST] Message Storage
[INFO] Erasing Memory...
[PASS] Message Storage
[TEST] CC1101 Initialization
[PASS] CC1101 Initialization
[TEST] Fiber Optic Sensor
[PASS] Fiber Optic Sensor
[ OK ] All Interrupts Enabled
[TEST] Driver Initialization
[TEST] IIC Bus
[PASS] IIC Bus
[TEST] RTC Initialization
[PASS] RTC Initialization
[PASS] Drivers Initialized
[INFO] Battery voltage = 3.568V
[DONE] Device Setup and Testing Complete. Device is Now Operational
[INFO] Disconnect Cable close the case and insert fiber to activate seal
```

- There should be no messages printed out in red font. Any such messages indicate errors in the personality programming and/or the hardware.

- Disconnect the 8-pin programming connector from the seal and install the cover.

- When configuring multiple seals repeat the SSP Personality Programmer steps above. ***(*The XML configuration file will need to be re-loaded for each seal.)***

- At this point, the seals have been loaded with the information from the XML configuration file:
  - Translator Address
  - Translator Retry Attempts
  - Date and Time
  - Authentication and Encryption Keys
  - Seal Reporting Interval

### 2.1.7 Verification of Seal Communications

Verification of seal communications requires an RMSA Translator. Refer to section 2.2.2 of this User's Guide.

## 2.2 RMSA Translator Set-up and Linux Bootstrap

The Translator is initially delivered in factory set-up mode. In factory set-up mode, the Translator is not yet installed in the tamper indicating enclosure and the User has access to the Translator via the console port or secure network communication such as ssh. Section 4.1 includes Translator deployment steps which put the Translator in the more secure "deployed" mode, eliminating console port access and auto-starting the RMSA application.

In factory set-up mode, an XP Windows PC can be used with a terminal emulator program such as TeraTerm or Hyperterm to create a console connection to the Translator via an RS-232 or USB port (with a USB-serial dongle). The console port should be configured with 115,200 baud, 8 bits, no parity, 1 stop bit and no flow control.

### 2.2.1 Translator Physical Configuration

To support the console port connection required for factory set-up mode, the Translator is initially used in an open case or on the bench top. The Translator board stack consists of an EmbeddedARM TS7800 SBC with Canberra's custom TCC daughter card. Physical configuration details for the Translator are as follows:

- TS7800 jumper JP1 is installed to initiate bootstrap from the SD card.

- TS7800 jumper JP3 is installed to run the CPU at 333MHz instead of 500MHz, saving power and increasing reliability in extreme thermal conditions.

- A serial port console connection requires a null modem connector. A cross-over Ethernet cable can be used to connect the Translator directly to the Windows-XP Remote Review Host (see below).

- Two RF antennas should be connected to the TCC card through cabling in the tamper-indicating enclosure.

- The tamper switch is connected to the Tamper port of the TCC card.

### 2.2.2 Creating a Translator SD Card

Translator initial factory set-up mode is achieved by creating a clone of a bootable Translator SD card as documented in the "Cloning Translator SD Cards" section of the "Building RMSA Software" document. This guideline contains a complete description of the cloning procedure. Create a bootable SD card for the Translator as described below in a brief summary:

- Insert an SD card in an SD appliance connected to a Linux development environment. These steps assume that the contents of the clonesd folder provided by Canberra is installed in the Linux development environment in /home/rmsa/clonesd. This folder should contain the tarclone.sh script, the tarballs for the RMSA root (root.tar.gz) and home (home.tar.gz) partitions and the dd files for the other partitions required by the

EmbeddedARM bootloader.

- Before proceeding, you must know the /dev file name for the inserted SD appliance. This can typically be obtained from the dmesg utility. Make sure the SD appliance is settled and available after insertion before continuing.

- From the shell prompt of the Linux development system, enter the following commands:

  ```
  cd /home/rmsa/clonesd
  ./tarclone.sh sdX
  ```

  where sdX represents the /dev file name of the SD card appliance (which can be determined from the dmesg utility).

- The disk clone procedure will take several minutes. Upon completion, dismount the SD card from the appliance.

### 2.2.3 Booting the Translator

With power removed from the Translator, insert the bootable SD card into the Translator's SD card slot then apply Translator power. Linux bootstrap messages appear in the Translator console window. The Translator is configured to auto-start the RMSA application. With no active seals, the Translator bootstrap messages will be similar to:

```
>> TS-BOOTROM - built Dec  4 2008
>> Copyright (c) 2008, Technologic Systems
>> Booting from SD card...
.
.
.
.
>> Booting to SD Card...
INIT: version 2.86 booting
Starting the hotplug events dispatcher: udevd.
Synthesizing the initial hotplug events...done.
Waiting for /dev to be fully populated...done.
Cleaning up ifupdown...done.
Loading kernel modules...done.
Checking all file systems...
fsck 1.37 (21-Mar-2005)
... done.
/dev/tssdcardb6 on /home type ext3 (rw,noexec,nosuid,nodev)
Setting up networking...done.
Setting up IP spoofing protection: rp_filter.
Enabling packet forwarding...done.
Configuring network interfaces...done.
Starting portmap daemon: portmap.
INIT: Entering runlevel: 3
Starting system log daemon: syslogd.
Starting kernel log daemon: klogd.
Starting  internet  superserver:  inetdJul  25  20:19:55  ts7800
kernel: Debian version TCC driver.
Jul 25 20:19:55 ts7800 kernel: Initializing TCCDriver: 0.0.1 @
IO base address 320
Jul   25   20:19:55   ts7800   kernel:   TCC   Card   Version:   -
(202D)<0>ID RT (5452)
Jul 25 20:19:55 ts7800 kernel: Registered device tcc, major #
```

```
62
Jul 25 20:19:55 ts7800 kernel: CC1100 INIT:  Success and ready
in RX mode.
Jul 25 20:19:55 ts7800 kernel: RxSyncLo = 91
Jul 25 20:19:55 ts7800 kernel: Verifying TCC Initial status:
<0> 02
Jul 25 20:19:55 ts7800 kernel: TCC driver successfully
initialized.
.
Starting Samba daemon......Samba daemon started!Starting
OpenBSD Secure Shell server: sshd.
Starting periodic command scheduler: cron.
main: Translator starting.  Verbosity Level = LOW.
rmsa: Initializing log file.
rmsa: Initializing TCC.
tccInit: Opening /dev/tcc.
tccInit: TranslatorId=ff
tccInit: Wake Interval = 12 msec, Wake Duration = 5 msec
tccInit: Initializing known device queue at 0x16610.
tccInit: SSPq ready. tccInit: radioCfg=0
tccInit: channel number = 0x0main: Ready to service TCC port.
rmsa: Initializing CC1100.
Jul 25 20:20:02 ts7800 kernel: CC1100 INIT:  Success and ready
in RX mode.
Kernel level CC1100 INIT returns 1.
Disable all TCC interrupts returns 1.
cc1100: Programming CC1100.
Setting cc1100Ready to 1
CC1100 programming successful.
        Flushing the RX FIFO returns 1.
        Flushing the TX FIFO returns 1.
        Calibrating.
        Calibration returns 1
        Entering RX Mode.
        RX mode returns 1
CC1100 Ready.
rmsa: Starting threads.
netCreateSocket: translator hostname: ts7800
netCreateSocket: Creating network socket ...
net create socket, sockfd = 7
netCreateSocket: Network socket ready. Bind=0
rmsa: Logging application start.
logTranslatorEvent:  Logging translator event 0.
rmsa: Enabling TCC interrupts.
rmsa: Radio channel number: 0x0
main: Translator successfully initialized.
Set process priority to -10
Calling tccServicePort with priority -10
```

### 2.2.4 Setting Translator Time

To configure the Translator system time, Login as User “root” with password “rmsa”. This can be done from the console port or via a ssh connection from a Linux host. If the console is required, we must first terminate the RMSA application. To do this, enter CTRL C on the console port. Within 7 seconds, you must enter the root user name and password then issue the command `wdoff`. If the `wdoff` command is not issued within 7 seconds, the watchdog timer will expire and the Translator will reboot.

From the shell prompt, issue the following command to set the Translator system time:

```
date –u MMDDhhmmCCYY.ss
```

Where –u is the command line argument that specifies UTC format and
*MM* represents the current month (01-12)
*DD* represents the current month day (01-31)
*hh* represents the current hour (01-23)
*mm* represents the current minute (01-59)
*CCYY* represents the current year (e.g. 2010)
and *ss* represents the seconds (01-59)

Repeat this step as often as necessary until satisfied with the new system date and time, the new date and time is repeated on the console without error and the shell prompt is re-displayed. For example:

```
# date –u 011208272010.45
Tue Jan 12 08:27:45 MST UTC 2010

#
```

If the RMSA application was terminated in order to use the Translator console, restart the RMSA application with the following command:

```
rmsa -v
```

Alternatively, the application can be restarted by rebooting the Translator.

### 2.2.5 Verification of Translator Operation

An operational Translator running the RMSA application will automatically collect and store the Seal messages. The Translator receives and stores Seal messages, and logs them chronologically (in the order received) in day files in a separate partition on the SD card from the root file system. The size of the storage for messages is 1.5GB or larger.

*Translator Implementation Note: All Translator statistics and message logs are stored in files on the Translator SD card. As disk files, the logs are non-volatile. Separate file partitions are provided for system and message logs. System status information is in the root partition. The size of the root /home partition depends on the size of the SD card. Approximately 512 MB are used for bootloader and root partitions. A 2GB SD card, for example, would have approximately 1.5GB available for the message log partition.*

In order to verify Translator operation, prepare at least 2 seals according to the instructions in Section 2.1 of this User's Guide and operate the Translator in factory configuration mode with a console cable attached. With the seals configured and installed, reboot the Translator and observe the bootstrap messages in the console window followed by the RMSA application initialization messages as described in section 2.2.3, above. If the seal period is set to one minute, then within one minute you should see messages similar to the following:

```
tccServicePort: Rcvd 63 bytes from 45 seq_ack 31
tccRegisterDevice: creating new SSPq entry for 45
sspReceive: ACKing 45 SSP with seq_ack byte 33
tccSend (14): 0D 45 00 00 00 45 00 00 00 FF 33 00 00 00
tccServicePort: Rcvd 43 bytes from 45 seq_ack 43
sspReceive: ACKing 45 SSP with seq_ack byte 44
```

```
tccSend (14): 0D 45 00 00 00 45 00 00 00 FF 44 00 00 00
Cleared 2 segments for device 45
```

Note: In this example, 45 is the Seal address that originated the message. Similar messages should appear for other Seals.

Verification of seal message logging can be accomplished by logging into the Translator. Once again, if the console must be used, it will be necessary to CTRL C, log on to the Translator as root and issue the `wdoff` command within 7 seconds. Alternatively, use an ssh network connection. From the shell prompt ("#") within the console window, issue the following commands:

```
cd /home/share
ls
```

Verify log file contents with the command:

```
cat  filename
```

where *filename* is a log file name such as `rmsa255_20100112.log`.

The log file will contain entries that look similar to the following example:

```
1, 2010 01 15 17:10:47, 00000051, 00000032, 00000000, 000000FF,
0 06:43:22,    1, ab(a9/ab), 00(00/00),   80, fb 1c a7 b5 55 a4
d1 69 22 f5 67 be 1c 09 c1 82 ec 79 59 ec de 6d a1 a2 32 44 22 8e
1b b2 34 62 7b 45 4c 35 e2 d2 1c 43 04 1b ba 1e 3b ce d4 dd fe 63
57 25 93 e2 3d b0 ea 95 35 a6 0f bc 24 ea 03 4d 02 e3 5e b7 3b c6
69 5d dc 40 c7 3d 5c 55
```

Highlights have been added to the example log entry above to facilitate understanding of this comma separated data file:

The green text is the log entry type. 1 indicates a message received. (Other log entry types indicate Translator start, Translator tamper, etc.)

The yellow text is the timestamp that the message was received. A review of the log file (using cat or similar linux tool) will show the entries in chronological order based on this time stamp.

The non-highlighted text contains a snapshot of key Translator statistics at the time the message was received.

The pink text is the number of message bytes received.

The cyan text contains the actual as-received encrypted message bytes. The TLV contents are not available to the Translator in clear-text.

From the shell prompt, issue the following command to display Translator file partitions:

```
df
```

Results will be similar to:

```
Filesystem      1K-blocks  Used Available Use% Mounted on
tmpfs              63584    …    …           0%   /dev/shm
/dev/tssdcardb6  2855172    …    …           3%   /home
tmpfs              10240    …    …           1%   /dev
```

Note that /home is mounted as a separate file partition completely separating the storage for the RMSA log files from system information and statistics.

### 2.2.6 Translator Power-Over-Ethernet Operation

To configure the Power-Over-Ethernet option, disconnect the AC power cord from the Translator and connect POE enabled power supply or POE enabled Ethernet Router to the Translator with an Ethernet cable. To verify correct operations, apply Translator power and verify the bootstrap messages in the console window as described in section 2.2.3 of this User's Manual.

Note that the Translator can be powered simultaneously from either the POE interface or the AC interface without any issues.

### 2.2.7 Alternate Translator Configuration

The default Translator SSP address is 0xff and the default radio channel is 0. These settings should be adequate in most cases. Instructions are provided below for applications where these default settings must be modified.

The default radio frequency of the Translator is set correspond with the base of the proper allocated frequency band and to agree with the frequency that is programmed into the Seals. While the channel of the Translator may be changed, it must agree with the channel that the Seals are operating on to insure proper communication. The Translator channel should only be changed if the Seals have been programmed with an alternate channel. To change the default radio channel, edit the file /etc/rmsa/radioconfig and replace the 0 with the desired radio channel. The radio channel value may range from 0-30 hexadecimal.

To change the Translator's SSP address, edit the file /etc/rmsa/transid and replace the ff with the desired translator address. The Translator address may be any hexadecimal integer (4 bytes) where the last byte is either ff or 0.

Note that the /etc/rmsa folder contains 2 other files that should not be modified. The sdVersion file may be read to obtain the translator software version. The wakecfg file was used by developers to experiment with the command and acknowledge timing for demanding seal data and should not be changed.

### 2.2.8 Change Translator IP Address

To change the translator IP address, connect to the translator via the console port. The 4 steps below must be performed within 7 seconds or the watchdog will cause the system to reboot.

Type Ctrl + c

```
ts7800 login: root
Password: rmsa
root@ts7800:root# wdoff (enter)
```

At this point the `root@ts7800:root#` prompt should be displayed.

Edit the Hosts file

```
root@ts7800:root# cd /etc (enter)
root@ts7800:etc# vi hosts (enter)
```

The "hosts" file will be open for editing.

```
10.10.16.72 ts7800  <--Change to the desired IP address
127.0.0.1 ts7800
204.152.191.39 ftp.us.debian.org
130.225.242.102 ftp.sunsite.dk
10.10.16.71 yagoo

# The following lines are desirable for IPv6 capable hosts
# (added automatically by netbase upgrade)

::1     ip6-localhost ip6-loopback
fe00::0 ip6-localnet
ff00::0 ip6-mcastprefix
ff02::1 ip6-allnodes
ff02::2 ip6-allrouters
ff02::3 ip6-allhosts
~
```

To add new characters place the cursor under the character(s) that will be changed and press "i", type the desired character(s) and press "esc". To Delete old characters place the cursor under the characters(s) that need to be removed and press "x". When changes are complete press "shift+z+z" to close and save the file.

Edit the Interfaces file

```
root@ts7800:root# cd etc/network (enter)
root@ts7800:network# vi interfaces (enter)
```

The "interfaces" file will be open for editing.

```
        #Used by ifup(8) and ifdown(8). See the interfaces(5) manpage
or
        # /usr/share/doc/ifupdown/examples for more information.

        auto lo
        iface lo inet loopback

        auto eth0
        #iface eth0 inet dhcp
        iface eth0 inet static
              address 10.10.16.72  <--Change to the desired IP address
              network 10.10.16.0  <--Change to the desired network (if necessary)
              netmask 255.255.255.0
              broadcast 10.10.16.255
              gateway 10.10.16.72  <--Change to the desired gateway
        #       address 192.168.239.50
        #       network 192.168.239.0
        #       netmask 255.255.255.0
        #       broadcast 192.168.239.255
        #       gateway 192.168.239.1
        #iface eth0 inet static
        #       address 192.168.1.207
        #       network 192.168.1.0
        #       netmask 255.255.255.0
```

```
interfaces: unmodified: line 1
```

To add new characters place the cursor under the character(s) that will be changed and press "i", type the desired character(s) and press "esc". To Delete old characters place the cursor under the characters(s) that need to be removed and press "x". When changes are complete press "shift+z+z" to close and save the file.

When all changes are complete the system will need to be re-booted.

```
root@ts7800:network# reboot (enter)
```

Chapter

3

# RMSA Key Generation

*This chapter demonstrates key generation for the Seal.*

## 3.1. RMSA Key Generation

This step uses software that runs in a DOS box on a WindowsXP PC generating keys for one Seal. The resultant keys will be loaded into the Seal.

- Locate the file rmsakeyfilegen.exe in the RMSA file repository.
- Note that Help is available if needed in the following file:

  msakeyfilegenhelp.txt

- Start the key generation software by typing the following command line in the DOS box:

  ```
  rmsakeyfilegen.exe /start:0x00000001 /end:0x000000FF /keyfile:rmsakeys.dat
  ```

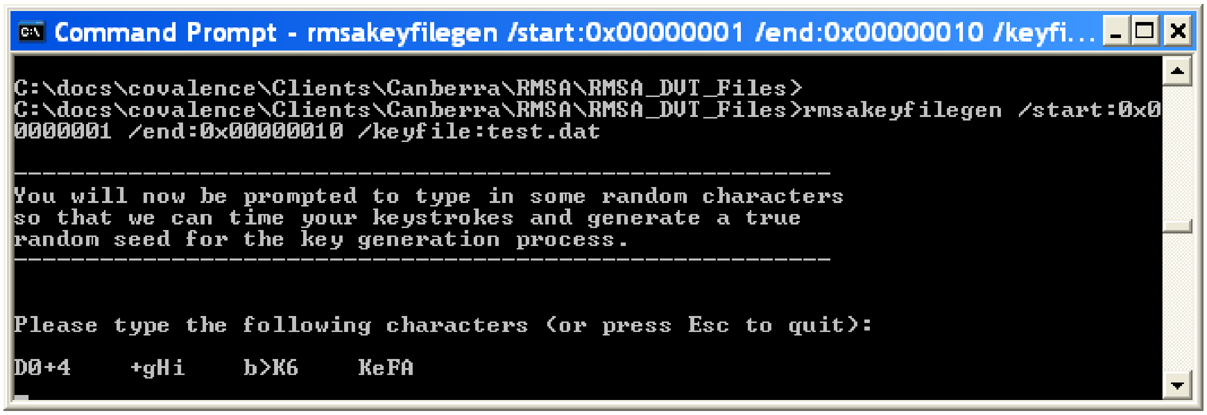
  /start tells the generator what the first RMSA Seal ID in the file will be. Additional Seal IDs will increment from this one.

  /end tells the generator what the last RMSA Seal ID in the file will be.

  /keyfile tells the generator the filename to write the keys to.

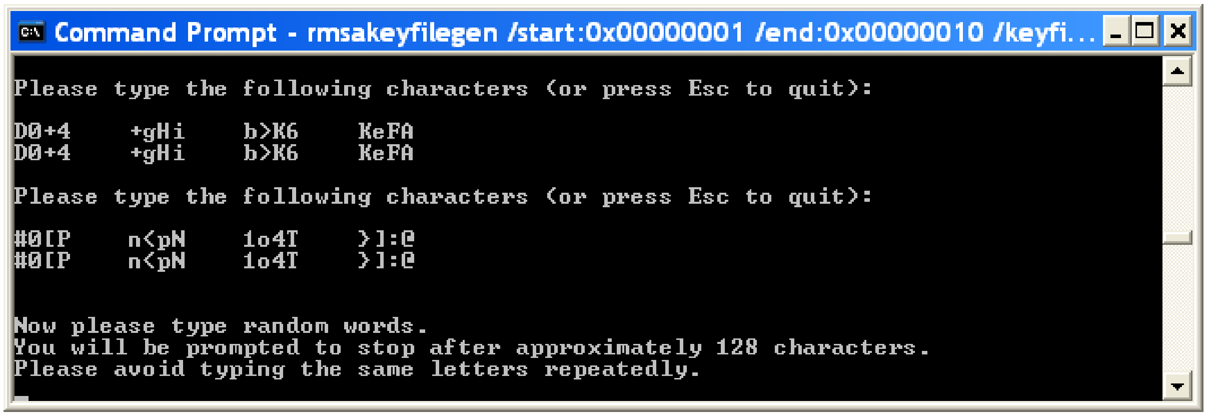
- You will be prompted to retype in a first set of specific random characters in the DOS box. Type in the first set of characters.
- You will be prompted to retype in second set of specific randomly characters in the DOS box. Type in the second set of characters
- You will be asked to type in 128 random key strokes. Type in 128 keystrokes.
- After the 128th keystroke, the program will ask the User to stop typing and will create the keyfile.

Starting the Key Generation Software


Command Prompt - rmsakeyfilegen /start:0x00000001 /end:0x00000010 /keyfi...

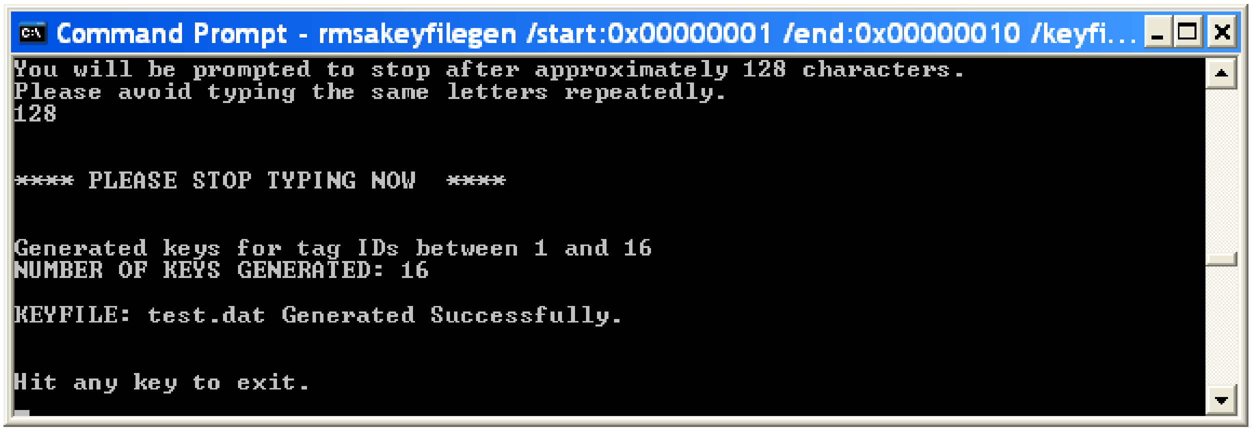
```
C:\docs\covalence\Clients\Canberra\RMSA\RMSA_DVT_Files>
C:\docs\covalence\Clients\Canberra\RMSA\RMSA_DVT_Files>rmsakeyfilegen /start:0x0
0000001 /end:0x00000010 /keyfile:test.dat

---------------------------------------------------------
You will now be prompted to type in some random characters
so that we can time your keystrokes and generate a true
random seed for the key generation process.
---------------------------------------------------------


Please type the following characters (or press Esc to quit):

D0+4    +gHi    b>K6    KeFA
```

After echoing 2 sets of characters by the key generation software


Command Prompt - rmsakeyfilegen /start:0x00000001 /end:0x00000010 /keyfi...

```
Please type the following characters (or press Esc to quit):

D0+4    +gHi    b>K6    KeFA
D0+4    +gHi    b>K6    KeFA

Please type the following characters (or press Esc to quit):

#0[P    n<pN    1o4T    >]:@
#0[P    n<pN    1o4T    >]:@


Now please type random words.
You will be prompted to stop after approximately 128 characters.
Please avoid typing the same letters repeatedly.
```

After entering 128 keystrokes


Command Prompt - rmsakeyfilegen /start:0x00000001 /end:0x00000010 /keyfi...

```
You will be prompted to stop after approximately 128 characters.
Please avoid typing the same letters repeatedly.
128


**** PLEASE STOP TYPING NOW  ****


Generated keys for tag IDs between 1 and 16
NUMBER OF KEYS GENERATED: 16

KEYFILE: test.dat Generated Successfully.


Hit any key to exit.
```

The keys have been generated in the named file.  You can close the DOS box.

Chapter

4

# RMSA Security

*This chapter demonstrates RMSA encryption, authentication and default keys as well as adding new fiber lengths to a Seal.*

## 4.1 Collect / Store Seal Messages with no Console Access

The Translator provides a script for deploying from factory set-up mode to operational mode. In operational mode, no further access to the Translator (via the physical console or secure network communications such as ssh or sftp) will be possible. To re-use the Translator in factory set-up mode, the User will have to configure a new bootable SD card as described in Section 2.2 of this User Guide.

To deploy a Translator into operational mode, from the shell prompt in the console window, issue the command:

```
rmsadeploy
```

Messages similar to the following will be displayed on the in the console window:

```
Cleaning files out of the /home/share directory ...
Cleaning debug statistics in /var/stat/rmsa ...
Disable root login...
Removing ssh service...
Remove unnecessary modules...
Disable root ftp access ...
Autostart RMSA application ...
Removing TTYs and console...
Deploy complete.
Rebooting Translator to implement security changes.
```

Remove the Translator console cable and install the enclosure cover.

## 4.2 Authentication and Encryption of Messages

Valid keys are necessary for decryption and signature verification. Key management procedures, including generation of keys and key file management, are the responsibility of the user.

Messages with invalid authentication keys will result in a “Bad signature” message status in the RMSA Review GUI. Messages with invalid encryption keys will result in a “Bad key” message status in the RMSA Review GUI and the decrypted data will not be available for review. Messages with a correct encryption and authentication key will be available for review in the

RMSA Review GUI.  When messages are properly decrypted and authenticated, all TLV data is displayed.

- Ensure that the RMSA Review Application is connected to the Translator by noting that the RMSA Review Application indicates it is connected and new messages from the Seals appear in the main display at a rate that has been configured by the User in Section 2.1.7.

- Open the key file keyfile.dat in the RMSA file repository.

- Note that for each Seal ID is defined 3 keys.  The first is the default key, the 2nd is the encryption key, the 3rd is the authentication key.  An example for a hypothetical entry for Seal ID 50 could show:

  Default key: FAAB136723F5DD237533C32A14879011
  Encryption key: 2086C23014C770D7411C039028740150
  Authentication key: 2B7E151628AED2A6ABF7158809CF4F50

- Quit (Don’t Save) the keyfile.dat file.

## 4.3 Fiber Lengths

This step is to demonstrate how to use various fiber lengths.  The User may add any User selected length of fiber, between 1 and 30 meters cut from a spool of fiber without any special tools.  However, it should be noted that the best way to ensure a good plastic optical fiber (POF) connection to the Seal would be to use a very sharp implement that will create a clean cut that is orthogonal to the cable.  Cuts that have angles, are ragged or are poorly terminated will affect the sensitivity measurements done by the Seal for the light intensity and can preclude proper operation if not enough light is coupled through the fiber.

After each fiber insertion or removal, the Seal will send a message that shows the state of the fiber link in the Seal (i.e., Open or Closed).

- Insert the fiber within the RMSA Seal ferrules and then screw down until Hand Tight. (**DO NOT OVER-TIGHTEN!**)

  o Push the POF into the opening until you feel it bottom out against the photodiode.  Hand-tighten the ferrule

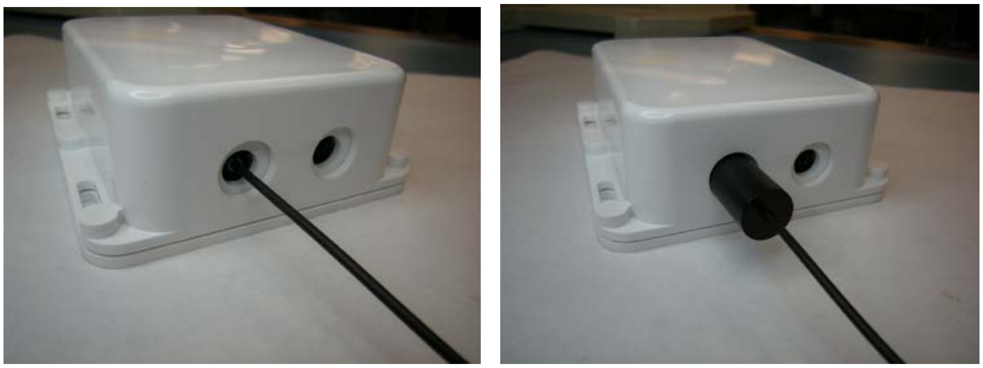


Figure 11 Installing Plastic Optical Fiber (POF)

  - Repeat the above sequence for the other end of the POF for the remaining fiber opening in the Seal.

  - To remove the POF, do the same set of operations but in reverse order.

- Ensure that the RMSA Review Application is connected to the Translator (see section 5.1) by noting that the RMSA Review Application indicates it is connected and new messages from the Seals appear in the main display at a rate of that has been configured by the User in Section 2.1.6.

- Remove one end of the POF from the seal.

- Within a few seconds, a message is displayed from that Seal indicating an alarm under the Source Tamper Status column, indicating that a fiber has been removed or inserted.

Chapter
5

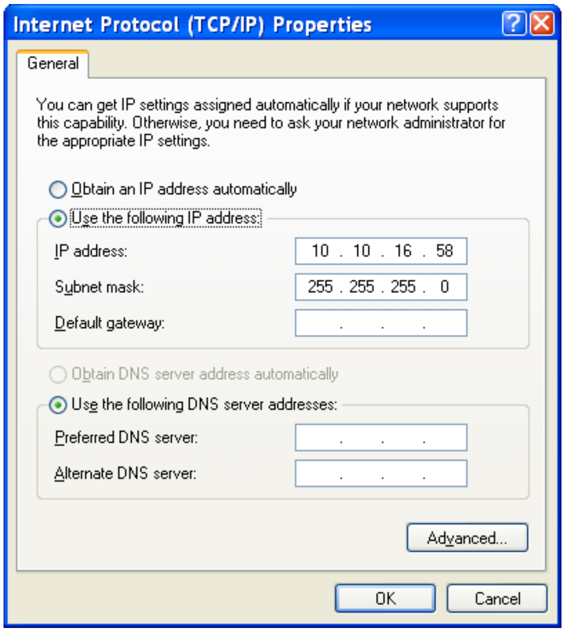
# Remote Review of Seal Data

*This chapter describes the installation, configuration and use of the demonstration RMSA Remote Review GUI provided by Canberra for the analysis of data collected by the Translator.*

## 5.1 RMSA Review GUI Installation and Configuration

The RMSA Review GUI installer is provided by Canberra in the RMSA repository. The demonstration GUI runs on a Windows XP PC. The default installation location of the GUI will be in c:\Program Files\RMSA. The GUI is based on the .NET framework which must be installed before installing the RMSA Review GUI. If required, a copy of the .NET framework is also provided by Canberra in the RMSA repository.

The demonstration RMSA Review GUI relies on a network connection from the Windows XP host to the Translator. This can be accomplished with an Ethernet crossover cable from the PC to the Translator with the PC LAN port configured as follows:

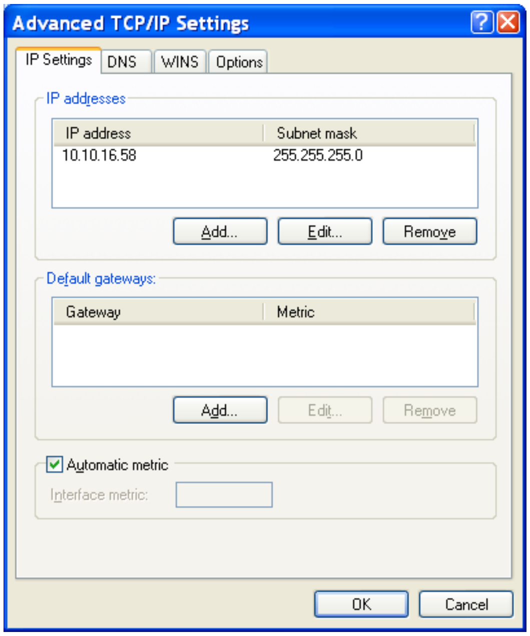

Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically
● Use the following IP address:
IP address: 10 . 10 . 16 . 58
Subnet mask: 255 . 255 . 255 . 0
Default gateway: . . .

○ Obtain DNS server address automatically
● Use the following DNS server addresses:
Preferred DNS server: . . .
Alternate DNS server: . . .


Advanced TCP/IP Settings

IP Settings | DNS | WINS | Options

IP addresses

| IP address | Subnet mask |
|---|---|
| 10.10.16.58 | 255.255.255.0 |

Default gateways:

| Gateway | Metric |
|---|---|

☑ Automatic metric
Interface metric:

Once the LAN is properly configured, it should be possible to ping the Translator (default IP 10.10.16.72) to confirm the network connection.

## 5.2 Loading Collected RMSA Data

The RMSA Review GUI is designed to work in two ways:

- In Remote Review Mode the GUI loads one or more day files from the Translator's Samba-mounted /home partition for review and analysis.

- In Local Host Mode an active network connection is made between the RMSA application running on the Translator and the Remote Review GUI. In this mode, as seal messages are received by the Translator and stored in a day file, the messages are also sent immediately to the GUI providing a "live" view of RMSA message activity. In local host mode, the GUI operator can also demand seal data by requesting an immediate State-of-Health (SOH) message or a resend of a previous seal message.

In both modes, the GUI controls the number of records loaded for review in order to avoid resource issues on the Host PC. Operating procedures for each mode are further described in the remainder of this section as is the procedure for configuring the maximum number of records available for viewing. Operating procedures for data analysis and for demand of seal data are provided in sections 5.3 and 5.4 of this chapter.

Both Remote Review and Local Host operations require the GUI operator to have access to the same key file(s) used to configure the seal personality in order to properly decrypt and authenticate the seal data.

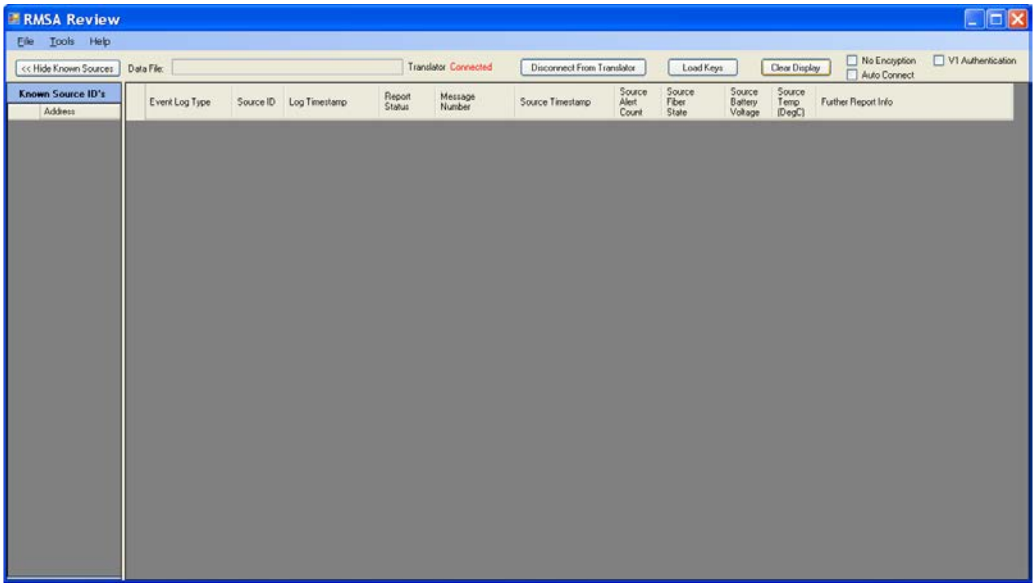
### 5.2.1 Remote Review Operation

Perform the following steps to operate the RMSA Review GUI in Remote Review mode:

- Ensure the Translator is operational and a PC LAN connection has been established between the Host PC and the Translator (refer to section 5.1, above).

- Establish the Samba connection between the Host PC and the Translator using the Tools->Map Network Drive function in an Explore window. The drive folder will be \\10.10.16.72\share. Click on Connect Using a Different Username and enter Username "smbuser" and password "asdfqwer". (Note that this factory default password can be changed by the user prior to Translator deployment.)

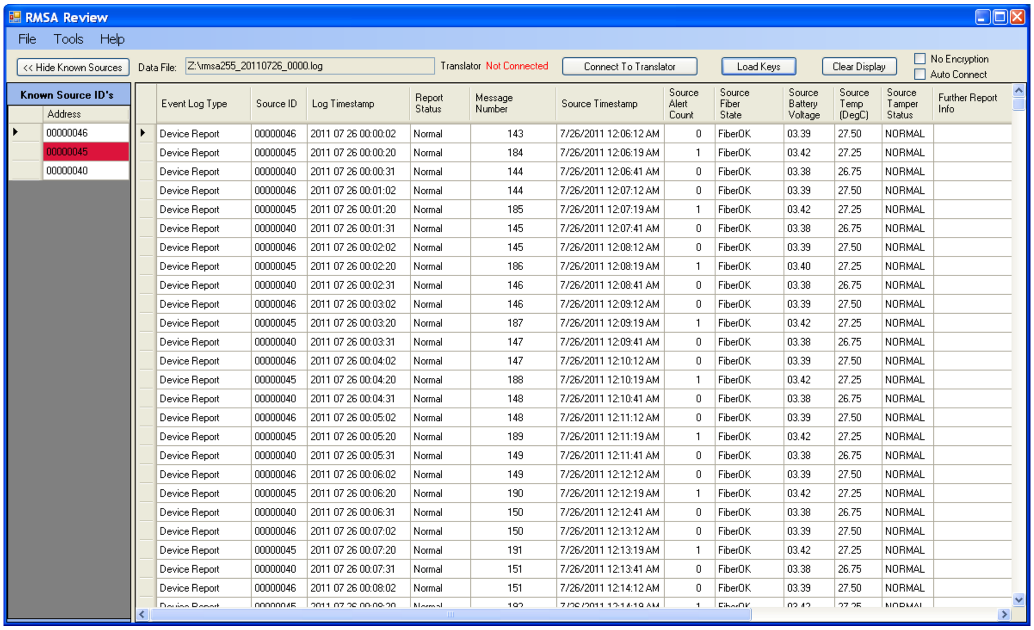
- Start the RMSA Review GUI via Start->All Programs->RMSA Review. A window similar to the following should appear:



- Click the Load Keys button, then browse for the appropriate key file. Double click the key file (keyfile.dat, for example) to load the keys. A message box will be displayed indicating that the key file was successfully loaded. Click OK to dismiss this message.

- Using the File pull-down in the toolbar (upper left corner), browse for a log file on the Translator's Samba-mounted drive. Double click on one or more day file to upload that day's data to the remote review GUI.

- Data is displayed in the GUI similar to the example below. Note the file name in the Data File text box at the top of the display. If more than one file is selected for loading, this text box will contain the name of the last file loaded but the main window will contain the data for all files.



Data File: Z:\rmsa255_20110726_0000.log

Translator Not Connected

| Known Source ID's |
|---|
| Address |
| 00000046 |
| 00000045 |
| 00000040 |

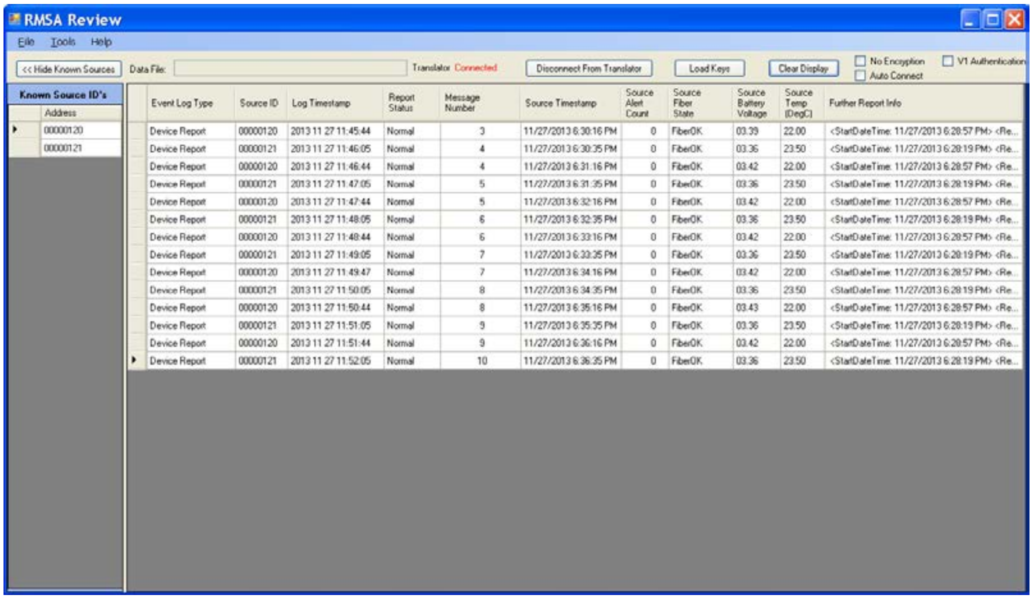
| Event Log Type | Source ID | Log Timestamp | Report Status | Message Number | Source Timestamp | Source Alert Count | Source Fiber State | Source Battery Voltage | Source Temp (DegC) | Source Tamper Status | Further Report Info |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Device Report | 00000046 | 2011 07 26 00:00:02 | Normal | 143 | 7/26/2011 12:06:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:00:20 | Normal | 184 | 7/26/2011 12:06:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:00:31 | Normal | 144 | 7/26/2011 12:06:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:01:02 | Normal | 144 | 7/26/2011 12:07:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:01:20 | Normal | 185 | 7/26/2011 12:07:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:01:31 | Normal | 145 | 7/26/2011 12:07:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:02:02 | Normal | 145 | 7/26/2011 12:08:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:02:20 | Normal | 186 | 7/26/2011 12:08:19 AM | 1 | FiberOK | 03.40 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:02:31 | Normal | 146 | 7/26/2011 12:08:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:03:02 | Normal | 146 | 7/26/2011 12:09:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:03:20 | Normal | 187 | 7/26/2011 12:09:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:03:31 | Normal | 147 | 7/26/2011 12:09:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:04:02 | Normal | 147 | 7/26/2011 12:10:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:04:20 | Normal | 188 | 7/26/2011 12:10:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:04:31 | Normal | 148 | 7/26/2011 12:10:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:05:02 | Normal | 148 | 7/26/2011 12:11:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:05:20 | Normal | 189 | 7/26/2011 12:11:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:05:31 | Normal | 149 | 7/26/2011 12:11:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:06:02 | Normal | 149 | 7/26/2011 12:12:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:06:20 | Normal | 190 | 7/26/2011 12:12:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:06:31 | Normal | 150 | 7/26/2011 12:12:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:07:02 | Normal | 150 | 7/26/2011 12:13:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:07:20 | Normal | 191 | 7/26/2011 12:13:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| Device Report | 00000040 | 2011 07 26 00:07:31 | Normal | 151 | 7/26/2011 12:13:41 AM | 0 | FiberOK | 03.38 | 26.75 | NORMAL | |
| Device Report | 00000046 | 2011 07 26 00:08:02 | Normal | 151 | 7/26/2011 12:14:12 AM | 0 | FiberOK | 03.39 | 27.50 | NORMAL | |
| Device Report | 00000045 | 2011 07 26 00:08:20 | Normal | 192 | 7/26/2011 12:14:19 AM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |

### 5.2.2 Local Host Operation

Perform the following steps to operate the RMSA Review GUI in Local Host mode:

- Repeat all steps for Remote Review operation up to the point of select day files with the File pull down. I.e., start the RMSA Review GUI and load keys.

- Click the Connect to Translator button. Within a few seconds, the Translator status should be changed from Disconnected to Connected and the button will be relabeled “Disconnect From Translator”. As seal messages are received by the Translator, they will be immediately sent to the GUI. Refer to the view below:



Data File:

Translator Connected

□ No Encryption
□ Auto Connect
□ V1 Authentication

| Known Source ID's |
|---|
| Address |
| 00000120 |
| 00000121 |

| Event Log Type | Source ID | Log Timestamp | Report Status | Message Number | Source Timestamp | Source Alert Count | Source Fiber State | Source Battery Voltage | Source Temp (DegC) | Further Report Info |
|---|---|---|---|---|---|---|---|---|---|---|
| Device Report | 00000120 | 2013 11 27 11:45:44 | Normal | 3 | 11/27/2013 6:30:16 PM | 0 | FiberOK | 03.39 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:46:05 | Normal | 4 | 11/27/2013 6:30:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:46:44 | Normal | 4 | 11/27/2013 6:31:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:47:05 | Normal | 5 | 11/27/2013 6:31:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:47:44 | Normal | 5 | 11/27/2013 6:32:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:48:05 | Normal | 6 | 11/27/2013 6:32:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:48:44 | Normal | 6 | 11/27/2013 6:33:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:49:05 | Normal | 7 | 11/27/2013 6:33:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:49:47 | Normal | 7 | 11/27/2013 6:34:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:50:05 | Normal | 8 | 11/27/2013 6:34:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:50:44 | Normal | 8 | 11/27/2013 6:35:16 PM | 0 | FiberOK | 03.43 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:51:05 | Normal | 9 | 11/27/2013 6:35:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:51:44 | Normal | 9 | 11/27/2013 6:36:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:52:05 | Normal | 10 | 11/27/2013 6:36:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |

To terminate the Local Host connection, click on the Disconnect From Translator button. For best synchronization of the network connection between the GUI and Translator, the connection should be disconnected before terminating the RMSA Review application. If not, it may take several minutes to re-establish the connection if the GUI restarted.

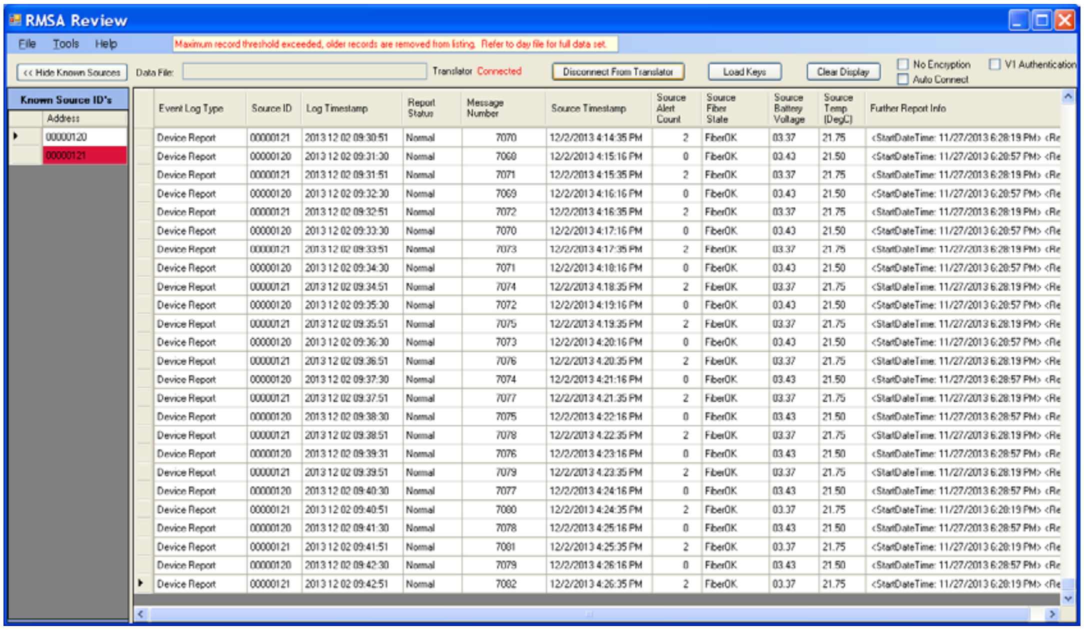
In Local Review mode, demanding seal data is available via the Tools pull down as described in section 5.4.

In Local Host mode, a TCP/IP connection heartbeat message is passed between the GUI and Translator. If loss of heartbeat is detected, the connection will be shutdown. If this occurs, the Translator status will change to Disconnected and the button will be relabeled “Connect to Translator.

Note the Auto Connect option near the upper right corner of the display. If this option is selected, the GUI will automatically attempt to establish GUI/Translator communications. Therefore, if a network disruption causes disconnection due to loss of heartbeat, the GUI will re-establish the connection within a minute once the network becomes available.

### 5.2.3 Maximum Record Display Threshold

If the number of total number of records for all day files exceeds the maximum record count for the RMSA Review Display, a warning will be printed at the top of the display indicating that the maximum record threshold has been exceed as illustrated below. Consider loading fewer day files to view the complete set of data. If a particular day file exceeds the maximum record count, consider raising the threshold or using an editor to break the day files into multiple parts.



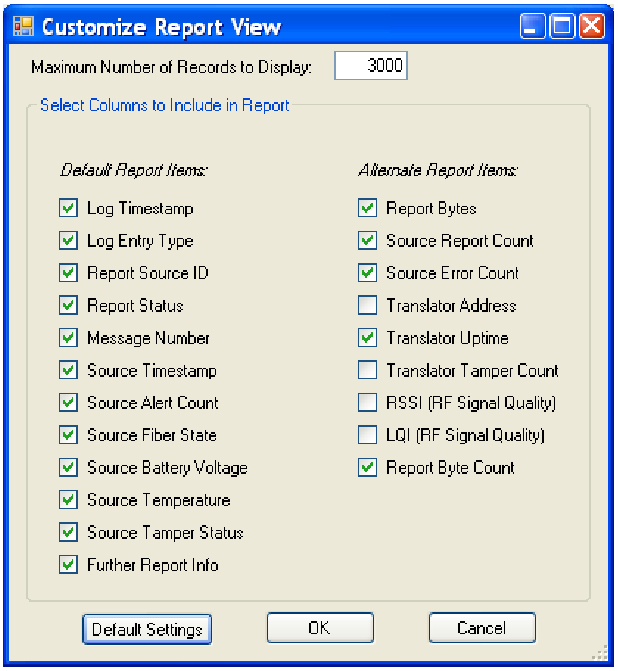
Maximum record threshold exceeded, older records are removed from listing. Refer to day file for full data set.

Translator Connected

| Known Source ID's<br>Address |
|---|
| 00000120 |
| 00000121 |

| Event Log Type | Source ID | Log Timestamp | Report Status | Message Number | Source Timestamp | Source Alert Count | Source Fiber State | Source Battery Voltage | Source Temp (DegC) | Further Report Info |
|---|---|---|---|---|---|---|---|---|---|---|
| Device Report | 00000121 | 2013 12 02 09:30:51 | Normal | 7070 | 12/2/2013 4:14:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:31:30 | Normal | 7068 | 12/2/2013 4:15:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:20:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:31:51 | Normal | 7071 | 12/2/2013 4:15:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:32:30 | Normal | 7069 | 12/2/2013 4:16:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:20:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:32:51 | Normal | 7072 | 12/2/2013 4:16:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:33:30 | Normal | 7070 | 12/2/2013 4:17:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:20:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:33:51 | Normal | 7073 | 12/2/2013 4:17:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:34:30 | Normal | 7071 | 12/2/2013 4:18:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:20:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:34:51 | Normal | 7074 | 12/2/2013 4:18:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:35:30 | Normal | 7072 | 12/2/2013 4:19:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:20:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:35:51 | Normal | 7075 | 12/2/2013 4:19:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:36:30 | Normal | 7073 | 12/2/2013 4:20:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:20:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:36:51 | Normal | 7076 | 12/2/2013 4:20:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:37:30 | Normal | 7074 | 12/2/2013 4:21:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:37:51 | Normal | 7077 | 12/2/2013 4:21:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:38:30 | Normal | 7075 | 12/2/2013 4:22:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:38:51 | Normal | 7078 | 12/2/2013 4:22:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:39:31 | Normal | 7076 | 12/2/2013 4:23:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:39:51 | Normal | 7079 | 12/2/2013 4:23:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:40:30 | Normal | 7077 | 12/2/2013 4:24:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:40:51 | Normal | 7080 | 12/2/2013 4:24:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:20:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:41:30 | Normal | 7078 | 12/2/2013 4:25:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:41:51 | Normal | 7081 | 12/2/2013 4:25:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:20:19 PM> <Re |
| Device Report | 00000120 | 2013 12 02 09:42:30 | Normal | 7079 | 12/2/2013 4:26:16 PM | 0 | FiberOK | 03.43 | 21.50 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re |
| Device Report | 00000121 | 2013 12 02 09:42:51 | Normal | 7082 | 12/2/2013 4:26:35 PM | 2 | FiberOK | 03.37 | 21.75 | <StartDateTime: 11/27/2013 6:20:19 PM> <Re |

To increase the threshold, select Tools->Customize Report View. The threshold setting is in the Maximum Number of Records to Display box at the top of the configuration menu (illustrated below). Change the setting as desired and click OK. Data will need to be reloaded (from the File pulldown) to load additional records. The default value of the threshold is 1000.



Maximum Number of Records to Display: 3000

Select Columns to Include in Report

*Default Report Items:*

- ☑ Log Timestamp
- ☑ Log Entry Type
- ☑ Report Source ID
- ☑ Report Status
- ☑ Message Number
- ☑ Source Timestamp
- ☑ Source Alert Count
- ☑ Source Fiber State
- ☑ Source Battery Voltage
- ☑ Source Temperature
- ☑ Source Tamper Status
- ☑ Further Report Info

*Alternate Report Items:*

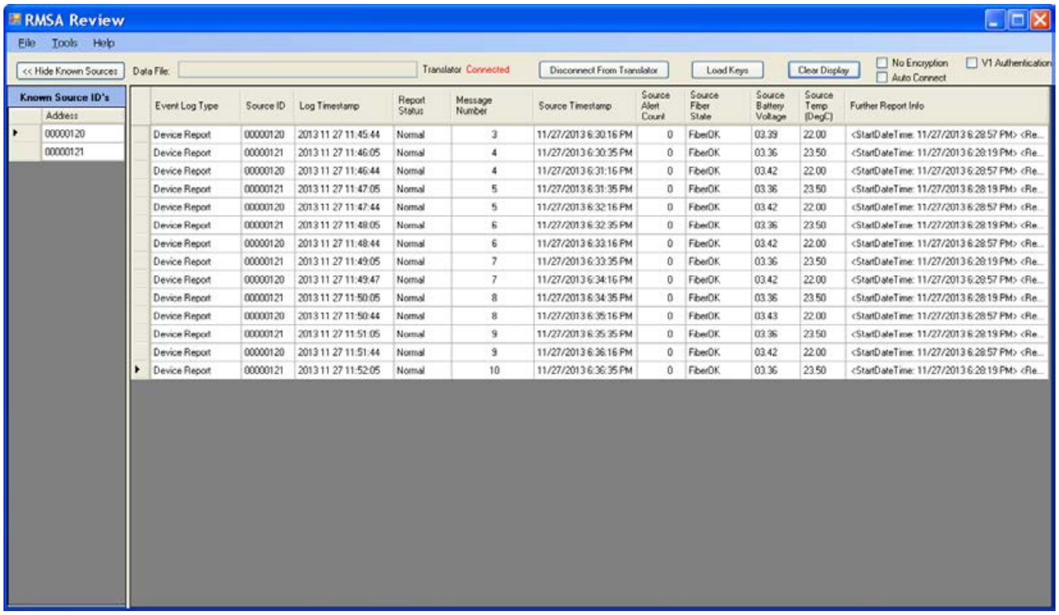
- ☑ Report Bytes
- ☑ Source Report Count
- ☑ Source Error Count
- □ Translator Address
- ☑ Translator Uptime
- □ Translator Tamper Count
- □ RSSI (RF Signal Quality)
- □ LQI (RF Signal Quality)
- ☑ Report Byte Count

## 5.3 Sorting and Analyzing RMSA Data

This section summarizes the methods available in the demonstration RMSA Review GUI for sorting data or generating alternate data view to assist with analysis. The details of the default data view, device-specific reports and data view customization are provided below.

### 5.3.1 Default Data View

The RMSA Review default data view is illustrated below.



| Address |
|---|
| 00000120 |
| 00000121 |

| Event Log Type | Source ID | Log Timestamp | Report Status | Message Number | Source Timestamp | Source Alert Count | Source Fiber State | Source Battery Voltage | Source Temp (DegC) | Further Report Info |
|---|---|---|---|---|---|---|---|---|---|---|
| Device Report | 00000120 | 2013 11 27 11:45:44 | Normal | 3 | 11/27/2013 6:30:16 PM | 0 | FiberOK | 03.39 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:46:05 | Normal | 4 | 11/27/2013 6:30:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:46:44 | Normal | 4 | 11/27/2013 6:31:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:47:05 | Normal | 5 | 11/27/2013 6:31:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:47:44 | Normal | 5 | 11/27/2013 6:32:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:48:05 | Normal | 6 | 11/27/2013 6:32:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:48:44 | Normal | 6 | 11/27/2013 6:33:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:49:05 | Normal | 7 | 11/27/2013 6:33:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:49:47 | Normal | 7 | 11/27/2013 6:34:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:50:05 | Normal | 8 | 11/27/2013 6:34:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:50:44 | Normal | 8 | 11/27/2013 6:35:16 PM | 0 | FiberOK | 03.43 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:51:05 | Normal | 9 | 11/27/2013 6:35:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:51:44 | Normal | 9 | 11/27/2013 6:36:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:52:05 | Normal | 10 | 11/27/2013 6:36:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |

From the default view, note the following:

- Each row in the main display contains a Device Report row including a message counter, the Source Timestamp column contains the UNIX encoded time field and the Source Alert Count column contains the alert counter. These fields are included in every State of Health Message. The source timestamp should mirror the seal reporting period that was configured when programming the seal personality.

- The following Event Log Types may be included in the report:

  - Device Report: a TLV message from a seal

  - Translator Start: provides the timestamp of the start of the RMSA collection application on the Translator.

  - Cal Success: The Translator has detected conditions where the RF receiver needed to be recalibrated and has successfully performed this task.

  - Cal Failure: The Translator has detected conditions where the RF receiver needed to be recalibrated and failed to successfully perform this task.

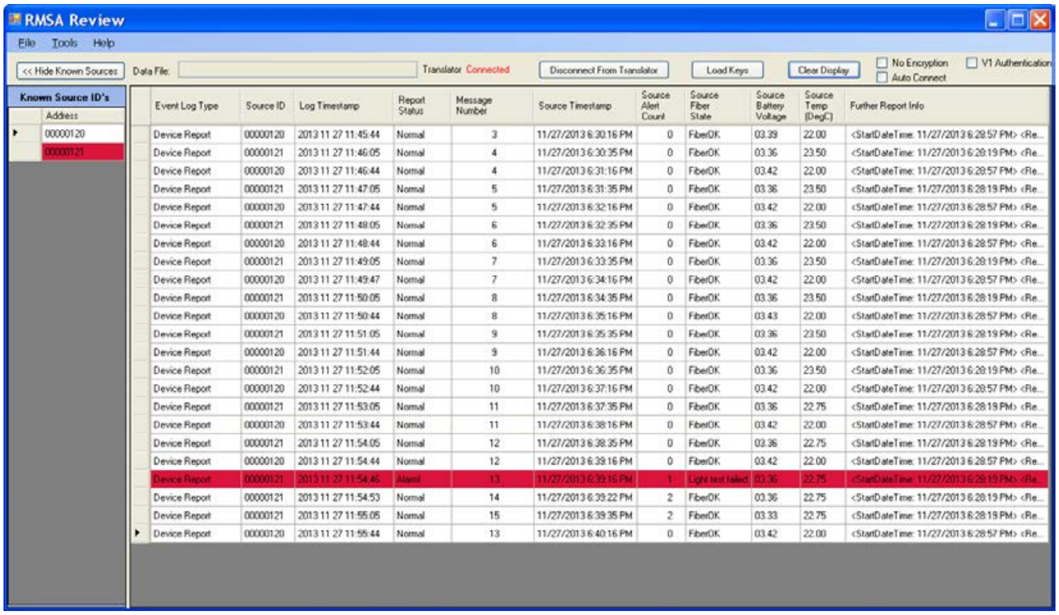
  - Translator Tamper: Indicates a tamper event in the Translator enclosure.

- In Device Report entries, the following fields are reported with a standard SOH message:

  - The Source ID is the address of the reporting seal.

  - The Log Timestamp is the time the seal report was logged by the Translator.

  - The Report Status will indicate Normal, Alarm, Warning or Bad Key if the message decryption fails. Alarm entries will be shaded red, Warning entries are shaded yellow, normal messages are not shaded. In the example below, seal 00000121 reported an Alarm in the SOH message due to a failed light test fiber status.



| Known Source ID's |
|---|
| Address |
| 00000120 |
| 00000121 |

| Event Log Type | Source ID | Log Timestamp | Report Status | Message Number | Source Timestamp | Source Alert Count | Source Fiber State | Source Battery Voltage | Source Temp (DegC) | Further Report Info |
|---|---|---|---|---|---|---|---|---|---|---|
| Device Report | 00000120 | 2013 11 27 11:45:44 | Normal | 3 | 11/27/2013 6:30:16 PM | 0 | FiberOK | 03.39 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:46:05 | Normal | 4 | 11/27/2013 6:30:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:46:44 | Normal | 4 | 11/27/2013 6:31:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:47:05 | Normal | 5 | 11/27/2013 6:31:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:47:44 | Normal | 5 | 11/27/2013 6:32:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:48:05 | Normal | 6 | 11/27/2013 6:32:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:48:44 | Normal | 6 | 11/27/2013 6:33:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:49:05 | Normal | 7 | 11/27/2013 6:33:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:49:47 | Normal | 7 | 11/27/2013 6:34:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:50:05 | Normal | 8 | 11/27/2013 6:34:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:50:44 | Normal | 8 | 11/27/2013 6:35:16 PM | 0 | FiberOK | 03.43 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:51:05 | Normal | 9 | 11/27/2013 6:35:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:51:44 | Normal | 9 | 11/27/2013 6:36:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:52:05 | Normal | 10 | 11/27/2013 6:36:35 PM | 0 | FiberOK | 03.36 | 23.50 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:52:44 | Normal | 10 | 11/27/2013 6:37:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:53:05 | Normal | 11 | 11/27/2013 6:37:35 PM | 0 | FiberOK | 03.36 | 22.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:53:44 | Normal | 11 | 11/27/2013 6:38:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:54:05 | Normal | 12 | 11/27/2013 6:38:35 PM | 0 | FiberOK | 03.36 | 22.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:54:44 | Normal | 12 | 11/27/2013 6:39:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:54:46 | Alarm | 13 | 11/27/2013 6:39:16 PM | 1 | Light test failed | 03.36 | 22.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:54:53 | Normal | 14 | 11/27/2013 6:39:22 PM | 2 | FiberOK | 03.36 | 22.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000121 | 2013 11 27 11:55:05 | Normal | 15 | 11/27/2013 6:39:35 PM | 2 | FiberOK | 03.33 | 22.75 | <StartDateTime: 11/27/2013 6:28:19 PM> <Re... |
| Device Report | 00000120 | 2013 11 27 11:55:44 | Normal | 13 | 11/27/2013 6:40:16 PM | 0 | FiberOK | 03.42 | 22.00 | <StartDateTime: 11/27/2013 6:28:57 PM> <Re... |

The seal logic includes a security feature that, under certain circumstances, will delete the encryption and authentication keys configured during personality programming and replace them with default keys. If the RMSA Review GUI fails to decrypt and authenticate using the standard keys, it will then try using the default keys. If the default key is required a “DK” code will be added to the Report Status field. So a “Normal – DK” status indicates that a normal SOH message has been received from the seal but a previous event caused the keys to be replaced with default keys.

- o The message number is the seals message count. The report should contain consecutive message numbers for each seal. However, in a busy situation where a number of seals are reporting at the same time, it is possible that the SSP ACK/Retry logic will time out and the message will be missed by the Translator. The message will be stored on the seal and can be recovered with the SNDM command as described in section 5.4.

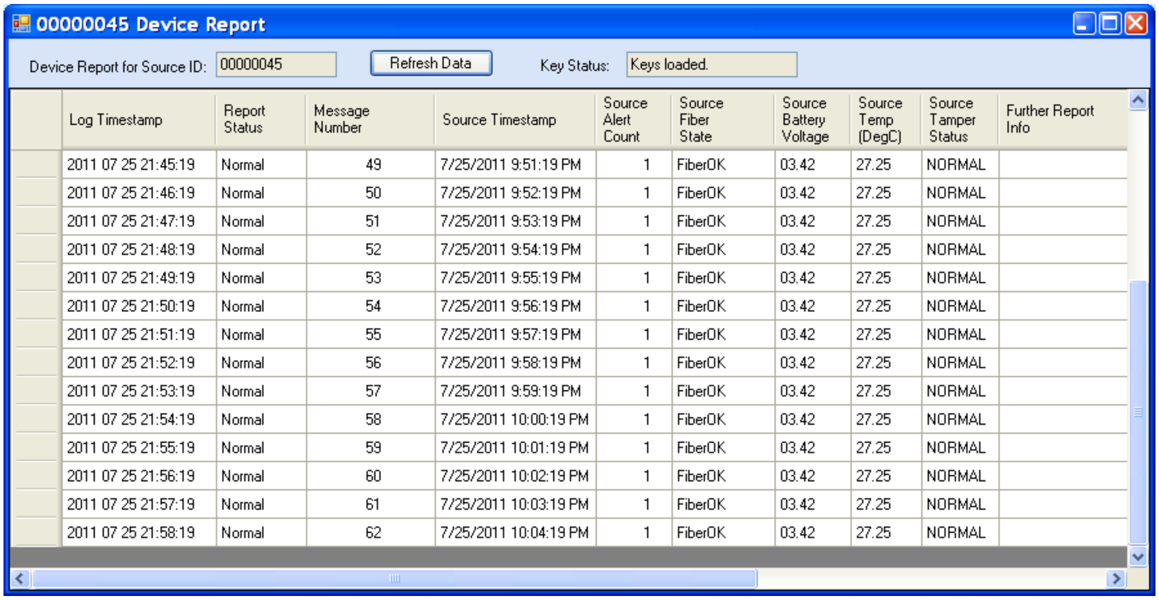
- o The Source Alert Count contains a cumulative alert count for the seal. Note in the figure above that the Source Alert Count for seal 45 changes from 0 to 1 when the fiber event is reported.

- o Other standard SOH fields include the battery voltage, temperature and tamper status of the seal at the time the SOH message was sent. The Further Report Info would be empty under normal circumstances but may contain additional TLV information in the case of an alert or warning.

- On the left side of the main display is a Known Device List. This list can be minimized with the Hide Known Devices button if more screen space is desired for a custom report view as described in section 5.3.3. The known device list can be used to create seal-specific reports as described in section 5.3.2. Within the known device list, the seal address is shaded by the highest noted alert level. I.e. if no problems have been reported, the seal address is not shaded. If the seal has ever reported a warning, the device address will be shaded red. If the seal has ever reported an alert, the address is shaded red.

### 5.3.2 Device-Specific Report

Double click on the address cell of any seal in the Known Source ID's list to get a pop-up report containing only messages for that seal as illustrated below.



00000045 Device Report

Device Report for Source ID: 00000045

Key Status: Keys loaded.

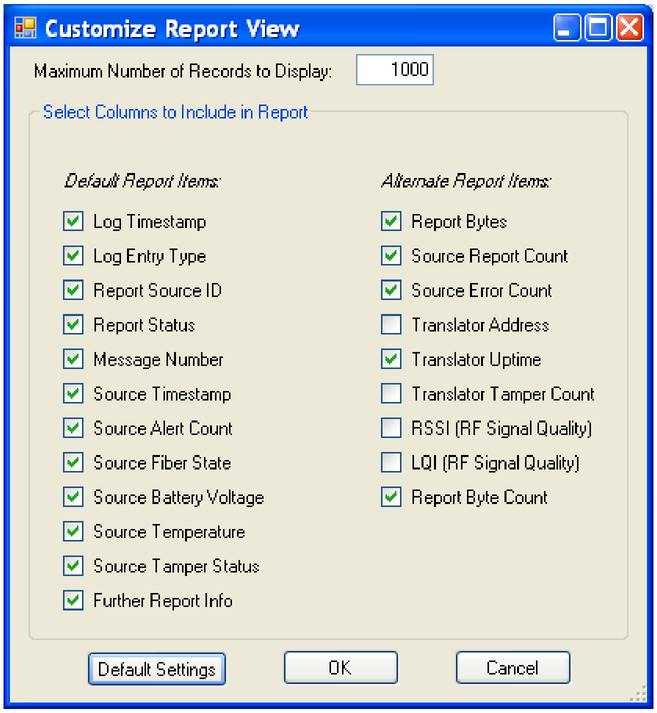
| Log Timestamp | Report Status | Message Number | Source Timestamp | Source Alert Count | Source Fiber State | Source Battery Voltage | Source Temp (DegC) | Source Tamper Status | Further Report Info |
|---|---|---|---|---|---|---|---|---|---|
| 2011 07 25 21:45:19 | Normal | 49 | 7/25/2011 9:51:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:46:19 | Normal | 50 | 7/25/2011 9:52:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:47:19 | Normal | 51 | 7/25/2011 9:53:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:48:19 | Normal | 52 | 7/25/2011 9:54:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:49:19 | Normal | 53 | 7/25/2011 9:55:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:50:19 | Normal | 54 | 7/25/2011 9:56:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:51:19 | Normal | 55 | 7/25/2011 9:57:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:52:19 | Normal | 56 | 7/25/2011 9:58:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:53:19 | Normal | 57 | 7/25/2011 9:59:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:54:19 | Normal | 58 | 7/25/2011 10:00:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:55:19 | Normal | 59 | 7/25/2011 10:01:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:56:19 | Normal | 60 | 7/25/2011 10:02:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:57:19 | Normal | 61 | 7/25/2011 10:03:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |
| 2011 07 25 21:58:19 | Normal | 62 | 7/25/2011 10:04:19 PM | 1 | FiberOK | 03.42 | 27.25 | NORMAL | |

As with the main data display, it is possible to click on any column header to sort by that data. Note that the device report is static – it is generated from the data available at the time it was created. In Local Host mode, where data is continually being added to the main display, it may be necessary to click the Refresh Data button to receive live updates.

With the Device-specific report, it is quite easy to note missing messages where the message numbers are not consecutive. There may be valid reasons for a missing message. For example, the ack/retry logic on the seal takes place in a relatively short amount of time to conserve seal battery. If multiple seals are reporting at once, the Translator may not meet the acknowledge time criteria for all seals and the message will not be received. However, the message should still be available on the seal and can be resent with the Send Message data request as described in section 5.4.

### 5.3.3 Customizing the Data View

Each Device Report log entry has more data available for forensics and detailed analysis than is probably desired during the initial data review. The RMSA Review GUI provides a tool to allow the operator to customize the data view. Under Tools, select Customize Report View. A window similar to the following will be displayed:



Customize Report View

Maximum Number of Records to Display: 1000

Select Columns to Include in Report

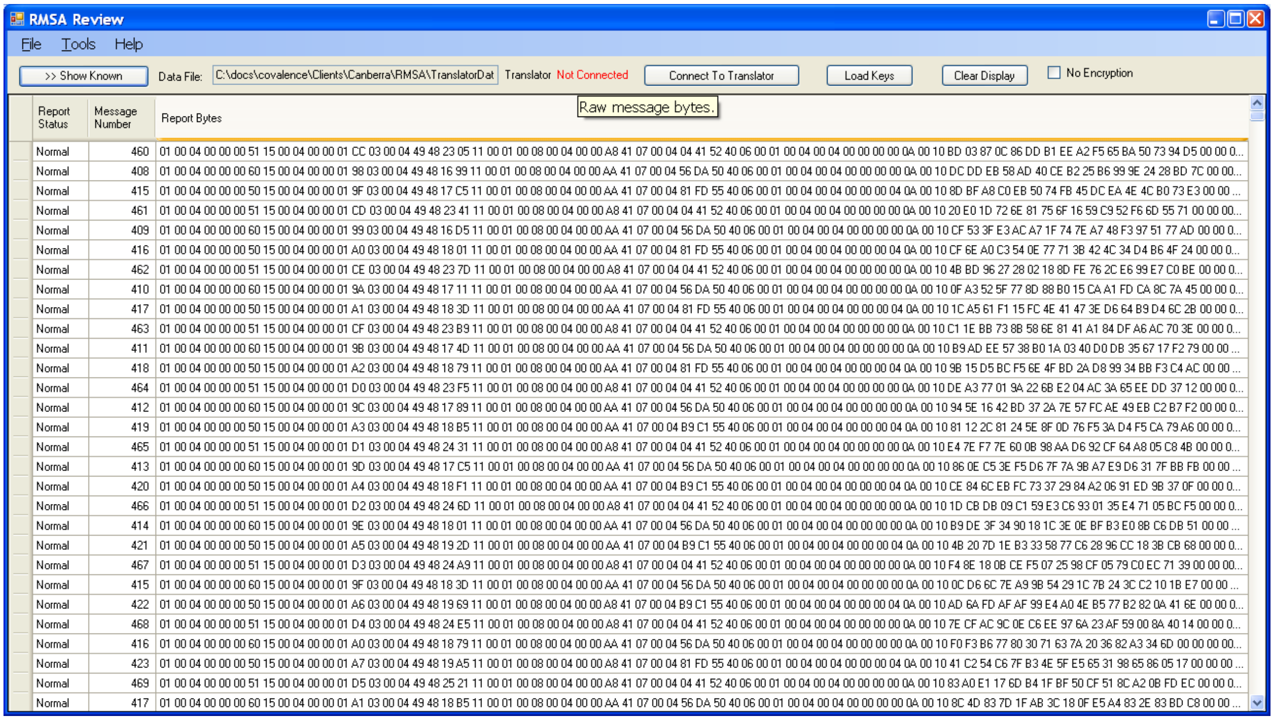
*Default Report Items:*

- ☑ Log Timestamp
- ☑ Log Entry Type
- ☑ Report Source ID
- ☑ Report Status
- ☑ Message Number
- ☑ Source Timestamp
- ☑ Source Alert Count
- ☑ Source Fiber State
- ☑ Source Battery Voltage
- ☑ Source Temperature
- ☑ Source Tamper Status
- ☑ Further Report Info

*Alternate Report Items:*

- ☑ Report Bytes
- ☑ Source Report Count
- ☑ Source Error Count
- ☐ Translator Address
- ☑ Translator Uptime
- ☐ Translator Tamper Count
- ☐ RSSI (RF Signal Quality)
- ☐ LQI (RF Signal Quality)
- ☑ Report Byte Count

The items listed on the left are default report items and can be restored by pressing the Default Settings button. Use the checkboxes for each of the default and alternate report items to select the items to be visible then click OK. In the following example, the operator selected Report Status, Message Number and Report Bytes. The Hide Known Sources button was clicked to maximize the data view. The resulting display can be used to forensically examine message bytes.



RMSA Review

Data File: C:\docs\covalence\Clients\Canberra\RMSA\TranslatorDat

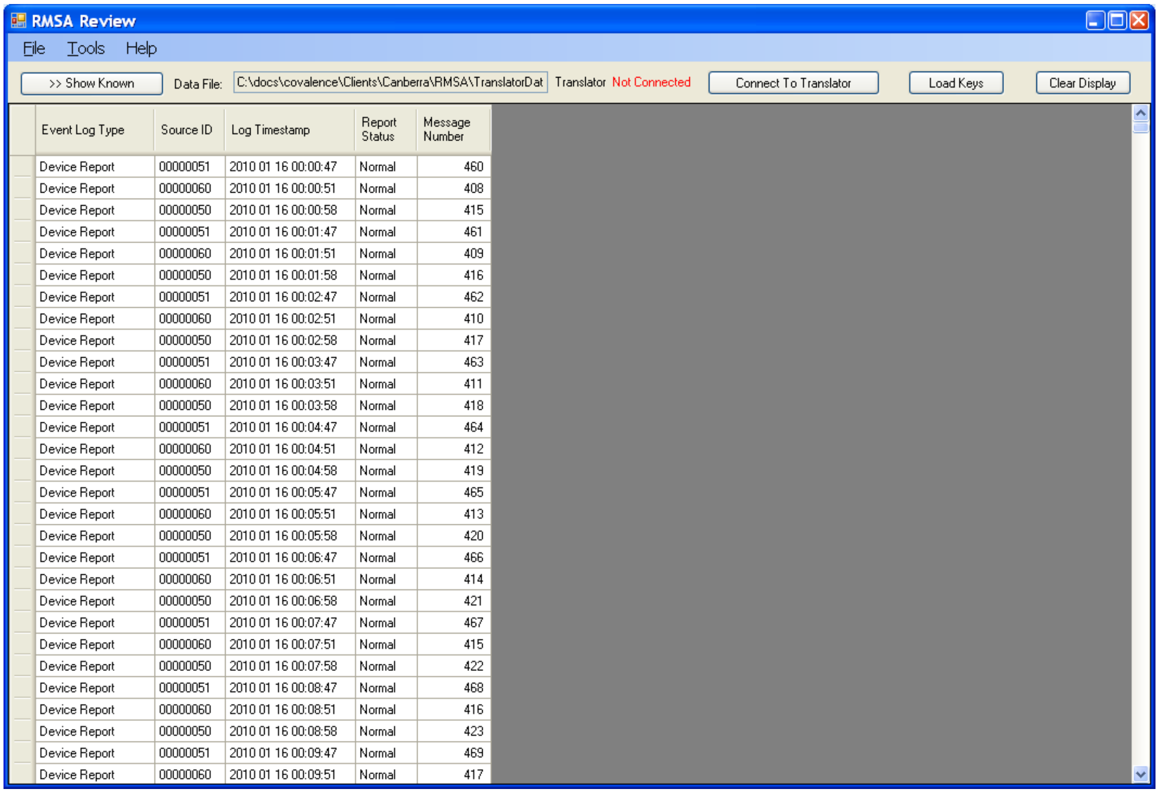
Translator Not Connected

☐ No Encryption

Raw message bytes.

| Report Status | Message Number | Report Bytes |
|---|---|---|
| Normal | 460 | 01 00 04 00 00 00 51 15 00 04 00 00 01 CC 03 00 04 49 48 23 05 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 BD 03 87 0C 86 DD B1 EE A2 F5 65 BA 50 73 94 D5 00 00 0... |
| Normal | 408 | 01 00 04 00 00 00 60 15 00 04 00 00 01 98 03 00 04 49 48 16 99 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 DC DD EB 58 AD 40 CE B2 25 B6 99 9E 24 28 BD 7C 00 00... |
| Normal | 415 | 01 00 04 00 00 00 50 15 00 04 00 00 01 9F 03 00 04 49 48 17 C5 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 81 FD 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 8D BF A8 C0 EB 50 74 FB 45 DC EA 4E 4C B0 73 E3 00 00 ... |
| Normal | 461 | 01 00 04 00 00 00 51 15 00 04 00 00 01 CD 03 00 04 49 48 23 41 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 20 E0 1D 72 6E 81 75 6F 16 59 C9 52 F6 6D 55 71 00 00 00... |
| Normal | 409 | 01 00 04 00 00 00 60 15 00 04 00 00 01 99 03 00 04 49 48 16 D5 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 CF 53 3F E3 AC A7 1F 74 7E A7 48 F3 97 51 77 AD 00 00 0... |
| Normal | 416 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A0 03 00 04 49 48 18 01 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 81 FD 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 CF 6E A0 C3 54 0E 77 71 3B 42 4C 34 D4 B6 4F 24 00 00 0... |
| Normal | 462 | 01 00 04 00 00 00 51 15 00 04 00 00 01 CE 03 00 04 49 48 23 7D 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 4B BD 96 27 28 02 18 8D FE 76 2C E6 99 E7 C0 BE 00 00 0... |
| Normal | 410 | 01 00 04 00 00 00 60 15 00 04 00 00 01 9A 03 00 04 49 48 17 11 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 0F A3 52 5F 77 8D 88 B0 15 CA A1 FD CA 8C 7A 45 00 00 0... |
| Normal | 417 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A1 03 00 04 49 48 18 3D 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 81 FD 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 1C A5 61 F1 15 FC 4E 41 47 3E D6 64 B9 D4 6C 2B 00 00 0... |
| Normal | 463 | 01 00 04 00 00 00 51 15 00 04 00 00 01 CF 03 00 04 49 48 23 B9 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 C1 1E BB 73 8B 58 6E 81 41 A1 84 DF A6 AC 70 3E 00 00 0... |
| Normal | 411 | 01 00 04 00 00 00 60 15 00 04 00 00 01 9B 03 00 04 49 48 17 4D 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 B9 AD EE 57 38 B0 1A 03 40 D0 DB 35 67 17 F2 79 00 00 ... |
| Normal | 418 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A2 03 00 04 49 48 18 79 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 81 FD 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 9B 15 D5 BC F5 6E 4F BD 2A D8 99 34 BB F3 C4 AC 00 00 ... |
| Normal | 464 | 01 00 04 00 00 00 51 15 00 04 00 00 01 D0 03 00 04 49 48 23 F5 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 DE A3 77 01 9A 22 6B E2 04 AC 3A 65 EE DD 37 12 00 00 0... |
| Normal | 412 | 01 00 04 00 00 00 60 15 00 04 00 00 01 9C 03 00 04 49 48 17 89 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 94 5E 16 42 BD 37 2A 7E 57 FC AE 49 EB C2 B7 F2 00 00 0... |
| Normal | 419 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A3 03 00 04 49 48 18 B5 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 B9 C1 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 81 12 2C 81 24 5E 8F 0D 76 F5 3A D4 F5 CA 79 A6 00 00 0... |
| Normal | 465 | 01 00 04 00 00 00 51 15 00 04 00 00 01 D1 03 00 04 49 48 24 31 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 E4 7E F7 7E 60 0B 98 AA D6 92 CF 64 A8 05 C8 4B 00 00 0... |
| Normal | 413 | 01 00 04 00 00 00 60 15 00 04 00 00 01 9D 03 00 04 49 48 17 C5 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 86 0E C5 3E F5 D6 7F 7A 9B A7 E9 D6 31 7F BB FB 00 00 ... |
| Normal | 420 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A4 03 00 04 49 48 18 F1 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 B9 C1 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 CE 84 6C EB FC 73 37 29 84 A2 06 91 ED 9B 37 0F 00 00 0... |
| Normal | 466 | 01 00 04 00 00 00 51 15 00 04 00 00 01 D2 03 00 04 49 48 24 6D 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 1D CB DB 09 C1 59 E3 C6 93 01 35 E4 71 05 BC F5 00 00 0... |
| Normal | 414 | 01 00 04 00 00 00 60 15 00 04 00 00 01 9E 03 00 04 49 48 18 01 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 B9 DE 3F 34 90 18 1C 3E 0E BF B3 E0 8B C6 DB 51 00 00 ... |
| Normal | 421 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A5 03 00 04 49 48 19 2D 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 B9 C1 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 4B 20 7D 1E B3 33 58 77 C6 28 96 CC 18 3B CB 68 00 00 0... |
| Normal | 467 | 01 00 04 00 00 00 51 15 00 04 00 00 01 D3 03 00 04 49 48 24 A9 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 F4 8E 18 0B CE F5 07 25 98 CF 05 79 C0 EC 71 39 00 00 00... |
| Normal | 415 | 01 00 04 00 00 00 60 15 00 04 00 00 01 9F 03 00 04 49 48 18 3D 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 0C D6 6C 7E A9 9B 54 29 1C 7B 24 3C C2 10 1B E7 00 00 ... |
| Normal | 422 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A6 03 00 04 49 48 19 69 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 B9 C1 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 AD 6A FD AF AF 99 E4 A0 4E B5 77 B2 82 0A 41 6E 00 00 0... |
| Normal | 468 | 01 00 04 00 00 00 51 15 00 04 00 00 01 D4 03 00 04 49 48 24 E5 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 7E CF AC 9C 0E C6 EE 97 6A 23 AF 59 00 8A 40 14 00 00 0... |
| Normal | 416 | 01 00 04 00 00 00 60 15 00 04 00 00 01 A0 03 00 04 49 48 18 79 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 F0 F3 B6 77 80 30 71 63 7A 20 36 82 A3 34 6D 00 00 00 00... |
| Normal | 423 | 01 00 04 00 00 00 50 15 00 04 00 00 01 A7 03 00 04 49 48 19 A5 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 81 FD 55 40 06 00 01 00 04 00 04 00 00 00 04 0A 00 10 41 C2 54 C6 7F B3 4E 5F E5 65 31 98 65 86 05 17 00 00 00 ... |
| Normal | 469 | 01 00 04 00 00 00 51 15 00 04 00 00 01 D5 03 00 04 49 48 25 21 11 00 01 00 08 00 04 00 00 A8 41 07 00 04 04 41 52 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 83 A0 E1 17 6D B4 1F BF 50 CF 51 8C A2 0B FD EC 00 00 0... |
| Normal | 417 | 01 00 04 00 00 00 60 15 00 04 00 00 01 A1 03 00 04 49 48 18 B5 11 00 01 00 08 00 04 00 00 AA 41 07 00 04 56 DA 50 40 06 00 01 00 04 00 04 00 00 00 00 0A 00 10 8C 4D 83 7D 1F AB 3C 18 0F E5 A4 83 2E 83 BD C8 00 00 ... |

In the next example, the report view was customized to include only the Event Log Type, Source ID, Log Timestamp, Report Status and Message Number. The resulting minimal display could be used to quickly scan for Alarm or Warning conditions:



Data File: C:\docs\covalence\Clients\Canberra\RMSA\TranslatorDat

Translator Not Connected

| Event Log Type | Source ID | Log Timestamp | Report Status | Message Number |
|---|---|---|---|---|
| Device Report | 00000051 | 2010 01 16 00:00:47 | Normal | 460 |
| Device Report | 00000060 | 2010 01 16 00:00:51 | Normal | 408 |
| Device Report | 00000050 | 2010 01 16 00:00:58 | Normal | 415 |
| Device Report | 00000051 | 2010 01 16 00:01:47 | Normal | 461 |
| Device Report | 00000060 | 2010 01 16 00:01:51 | Normal | 409 |
| Device Report | 00000050 | 2010 01 16 00:01:58 | Normal | 416 |
| Device Report | 00000051 | 2010 01 16 00:02:47 | Normal | 462 |
| Device Report | 00000060 | 2010 01 16 00:02:51 | Normal | 410 |
| Device Report | 00000050 | 2010 01 16 00:02:58 | Normal | 417 |
| Device Report | 00000051 | 2010 01 16 00:03:47 | Normal | 463 |
| Device Report | 00000060 | 2010 01 16 00:03:51 | Normal | 411 |
| Device Report | 00000050 | 2010 01 16 00:03:58 | Normal | 418 |
| Device Report | 00000051 | 2010 01 16 00:04:47 | Normal | 464 |
| Device Report | 00000060 | 2010 01 16 00:04:51 | Normal | 412 |
| Device Report | 00000050 | 2010 01 16 00:04:58 | Normal | 419 |
| Device Report | 00000051 | 2010 01 16 00:05:47 | Normal | 465 |
| Device Report | 00000060 | 2010 01 16 00:05:51 | Normal | 413 |
| Device Report | 00000050 | 2010 01 16 00:05:58 | Normal | 420 |
| Device Report | 00000051 | 2010 01 16 00:06:47 | Normal | 466 |
| Device Report | 00000060 | 2010 01 16 00:06:51 | Normal | 414 |
| Device Report | 00000050 | 2010 01 16 00:06:58 | Normal | 421 |
| Device Report | 00000051 | 2010 01 16 00:07:47 | Normal | 467 |
| Device Report | 00000060 | 2010 01 16 00:07:51 | Normal | 415 |
| Device Report | 00000050 | 2010 01 16 00:07:58 | Normal | 422 |
| Device Report | 00000051 | 2010 01 16 00:08:47 | Normal | 468 |
| Device Report | 00000060 | 2010 01 16 00:08:51 | Normal | 416 |
| Device Report | 00000050 | 2010 01 16 00:08:58 | Normal | 423 |
| Device Report | 00000051 | 2010 01 16 00:09:47 | Normal | 469 |
| Device Report | 00000060 | 2010 01 16 00:09:51 | Normal | 417 |

It is important to note that all data exists at all times within the GUI. Customizing the report view only determines which data will be displayed. In other words, customizing the report view does not cause the GUI to reload data from the translator.

The following table has a complete list of available Device Report data items:

| Column Label | Description of Contents |
|---|---|
| Event Log Type | Describes the type of report – refer to section 5.3.1, above, for further details. This column should always contain data and is included in the default report view. |
| Source ID | Contains the seal address that originated a Device Report and is empty for all other Event Log Types. This column is included in the default report view. |
| Log Timestamp | Contains the timestamp that the log entry was created on the translator in the format MM/DD/YYYY hh.mm.ss. This column should always contain data and is included in the default report view. |

| Column Label | Description of Contents |
|---|---|
| Report Status | Some analysis of message data is performed by the GUI to categorize each report as Normal, Warning or Alarm. Normal reports have no background shading, Warning reports are shaded yellow and Alarm reports are shaded red. In the case of a Normal report, the Report Status is Normal. Warning or Alarm reports may have a Report Status of Warning or Alarm or may further indicate the Warning or Alarm source (such as “Bad key.”). This column should always contain data and is included in the default report view. |
| Message Number | Contains the seal message number for a Device Report in decimal format. This column is included in the default report view. |
| Source Timestamp | Contains the seal timestamp for a Device Report indicating the time that the seal generated the report. This column is included in the default report view. |
| Source Alert Count | Contains the seal’s cumulative alert count for a Device Report in decimal format. This column is included in the default report view. |
| Source Fiber State | Contains the seal’s fiber optic state for a Device Report. A fiber state reading is interpreted by the seal into one of the following possible fiber states:<br>• FiberOK<br>• Dark test failed<br>• Light test failed<br>• Measured light exceeds upper limit<br>• Measured light exceeds lower limit<br>• Positive threshold exceeds upper limit<br>• Negative threshold exceeds lower limit<br>• Measured light exceeds positive threshold<br>• Measured light exceeds negative threshold<br>• Unknown fiber state<br>A reported state of FiberOK is considered “Normal” all others are considered an “Alarm”. This column is included in the default report view. |
| Source Battery Voltage | Contains the seal’s battery voltage reading for a Device Report. This column is included in the default report view. |
| Source Temp | Contains the seal’s temperature reading for a Device Report in Degrees Celsius. This column is included in the default report view. |
| Source Tamper Status | Contains the seal’s tamper status reading for a Device Report. The case tamper reading is analyzed by the seal and reported as either Normal or Alarm. If “Alarm” is reported, the report is classified as an Alarm report and shaded red. This column is included in the default report view. |

| Column Label | Description of Contents |
|---|---|
| Further Report Info | Contains information as necessary to support the log entry. In the case of a Translator Tamper report, this column will contain further information on the nature of the tamper. For Device Report log entries, the column is used to report a Bad TLV or invalid TLV format. It may also be used to report information from TLVs that are not normally reported in a SOH message and do not, therefore, have a dedicated column. This column is included in the default report view. |
| Report Bytes | Contains a list of the raw report bytes (in hexadecimal) for a Device Report. If the report bytes were successfully decrypted, the decrypted report bytes are reported. Note that this column can be quite wide. To examine the report bytes of a single entry, roll the mouse over the cell for a 5-second pop-up of the complete contents. Alternative, customize the report view to remove other columns, then expand the Report Bytes column width. Report bytes will typically not be of interest for inspection outside of forensic investigations. Therefore, this column is not included in the default report view. See Customizing Report View, below for more information. |
| Source Report Count | The number of reports received by the translator from the seal source address of this Device Report. This column is not included in the default report view. |
| Source Error Count | The number of errors logged by the translator for reports from the seal source address of this Device Report. For example, RF payloads with invalid SSP header information are ignored (not processed and logged), but a error counter is incremented. This column is not included in the default report view. |
| Translator Address | The translator address extracted from the SSP header for the Device Report. In most cases, the Translator Address will be 0xff – unless the translator device address has been modified during translator set-up/configuration or corruption of the RF payload has occurred. This column is not included in the default report view. |
| Translator Uptime | The translator uptime (time since last boot) at the time the Device Report was processed and logged. The uptime can be used as a forensic indicator that the translator was unavailable for a period of time. This column is not included in the default report view. |
| Translator Tamper Count | The cumulative count of translator case tampers at the time the Device Report was processed and logged. This column is not included in the default report view. |
| RSSI (RF Signal Quality) | The RSSI value is an indicator of RF signal quality and can be used forensically by an RF expert to determine if there were problems with the RF. This column is not included in the default report view. |
| LQI (RF Signal Quality) | The LQI value is an indicator of RF signal quality and can be used forensically by an RF expert to determine if there were problems with the RF. This column is not included in the default report view. |
| Report Byte Count | The number of bytes included in a Device Report. The raw bytes are viewable in the Report Bytes column. This column is not included in the default report view. |

## 5.4 Requesting RMSA Seal Data

In Local Host Operation mode (refer to section 5.2.2) the RMSA Review GUI provides an interface to request immediate data from the RMSA seals via Tools->Request Device Data. Six types of data request are supported(refer to sections 5.4.1 thru 5.4.5).

Because the translator cannot access the contents of incoming TLV messages from seals (due to encryption), the translator has no way of assigning a particular incoming message to a particular request. A response message will be delivered to the GUI for evaluation of TLV contents as with any autonomous SOH or alarm.

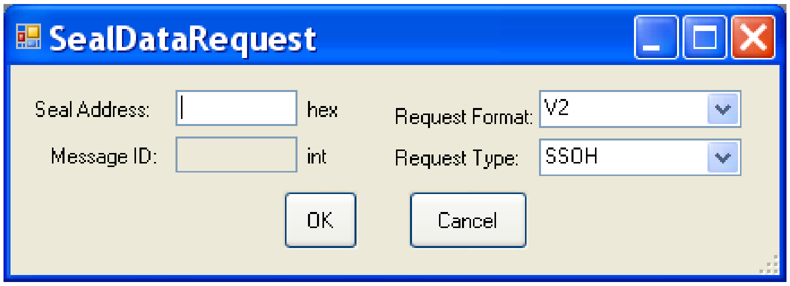
Further, seal response is not guaranteed. All commands sent to a seal require an acknowledgement to the Translator. If the Translator does not detect an acknowledgement within an adequate time period, the request will time out and the translator will retry up to 3 times. (Further data requests are locked out until the current data request completes, so a finite number of attempts is necessary.) Data requests can be interrupted by autonomous SOH or alarm messages from any seal resulting in a delayed acknowledge for the request. Testing has shown that the translator's three automatic retries are adequate in most cases, but occasional misses still happen.

The GUI operator can watch the main display for the requested report from the seal address specified in the request. If the report from the specified seal does not appear within 15 seconds, the GUI operator should repeat the request.

Procedures for each of the three requests are detailed below.

### 5.4.1 State of Health (SSOH) Request

To demand a SOH message from a seal, select Tools->Request Device Data. The following pop-up will appear:



Seal Address: hex

Message ID: int

Request Format: V2

Request Type: SSOH

If necessary, click on the down arrow for the Request Type and select SSOH. (SSOH is the default request type but the GUI will remember the last request type.) Enter the hexadecimal address of the seal (from 1 to FFFFFFFF) in the Seal Address text box then press OK. Within 15 seconds, a SOH report from the specified seal, using the next available message number, should appear in the GUI's main display.

### 5.4.2 Extended State of Health (ESOH) Request

For an extended SOH request, enter the hexadecimal seal address (from 1 to FFFFFFFF) and use the Request Type down arrow to select ESOH. The message ID text box is not activated as a message number is not required for an ESOH request. Once the seal address has been entered, click OK to continue. Click Cancel to abort the request.

Within 15 seconds, an extended SOH report from the specified seal, using the next available message number, should appear in the GUI's main display. The extended SOH report includes entries in the Further Information column for the number of watchdog resets and the transmission count for the seal.0

### 5.4.3 Send Message (SNDM) Request

To request a particular archived message, enter the hexadecimal seal address (from 1 to FFFFFFFF) and use the Request Type down arrow to select SNDM. Once the SNDM request type is selected, the Message ID text box is activated. Enter a valid message number for this seal as a decimal value.

Message numbers start with 1. The maximum valid message number should be available in the main display within the most recent autonomous State of Health message.

Click OK to send the request. Click Cancel to abort the request.

Within 15 seconds, the requested message number from the requested seal should appear within the GUI window. Note that in default review mode, messages are sorted chronologically in order of the log timestamp on the translator. Since the translator has no access to the TLV contents of the message (due to encryption), it has no way of inserting the data in a day file log based on the message number or time it was originally sent. Therefore, if interrogating a seal that has been running for some time for message ID 1, the translator will log the event in the current day file, not in the day file of the original transmission attempt. Similarly, the GUI will present the new message (Message Number 1) at the end of the currently displayed data set.

### 5.4.4 Send Fiber History (HIST) Request

To request a history of all fiber optic event messages generated (up to a limit of ~383), enter the hexadecimal seal address (from 1 to FFFFFFF) and use the Request Type down arrow to select HIST. Once the seal address has been entered, click OK to continue. Click Cancel to abort the request.

Within 15 seconds, a list of the seal's fiber optic event messages should appear in the GUI's main display.

### 5.4.5 Send RMSA To Translator Associate(RTTA) and RMSA To Translator Disassociate(RTTD) Request

The RMSA To Translator Associate (RTTA) and Disassociate (RTTD) commands were created for seals that do not provide translator addresses during personality programming. The address of the Translator that is connected to the GUI will be used by the seal after successfully sending this message. Before receiving the RTTA command, the seal will buffer but not transmit messages. Upon receiving RTTA command, the seal will check a list of all messages buffered and send those to the associated translator all at once. Upon receiving the RTTD command, the seal will once again no longer transmit, but buffer messages in flash memory. Messages will continue being buffered until a new RTTA command is received. Note that these commands only work when translator addresses are not downloaded during personality programming.

The message number is not required for a RTTA or RTTD command. Enter the hexadecimal seal address (from 1 to FFFFFFFF) then click OK to continue or Cancel to abort the request. Within 15 seconds, buffered messages should begin to appear in the GUI's main display.

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