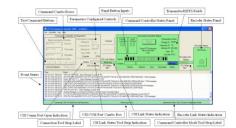




# Bourne Technologies, Inc.

### **EFTS Support and Capabilities** 2000-2011







## EFTS SUPPORT OVERVIEW

- Active on EFTS Program since 2000
- Roles:
  - Primary Supporting Technical Lead in the Development of the EFTS
  - Co-ordination with all Organizations (USAF, Army, Navy, NASA, NSA, Academia)
  - Development of Waveform and Prototyping by Cincinnati Electronics (Now L3-CE)
  - Managed Alternates to UHF approach (i.e. CDMA)
  - Supported NASA STARS Project
  - Development and Prototyping
  - Reports and Presentation on Activities
  - Documentation of Standards
  - Primary Responsibility for All Major EFTS Documents on EFTS Program [2000-2006]
    - Study Approach and Initial Design
    - Request for Program Resources
    - EFTS IRD
    - All Specs for RFQs (EFTS FTR, EFTS TDU, EFTS Encoder, EFTR Monitor)
    - AMRAAM Testing
    - EFTS CONOPS
- Supported other EFTS Documents and Activities not of primary responsibility
  - EFTS Key Management
  - RCC Specifications (RCC 319, 313 re-writes)
- Supported and Witnessed EFTS CTEIP Development As Government Representative
  - EFTS FTR, EFTS Encoder, EFTS TDU, EFTS Monitor

- Developed Project Support Devices/Systems
  - EFTS BOSS
  - EFTS Configuration ICD Tool
  - EFTS Command Controller for Encoder Validation
  - FTR CONFIGURATION TOOL (EFTS CCSI)
- Support For AMRAAM Demonstration of EFTS
  - Supported Conception and Goals Development
  - Build Interface between Encoder and Range Interface (CC-AMRAAM)
  - Implementation and Use of System at Eglin AFB and Tyndall AFB
  - Operated Devices During Testing and Managed other Operating Devices
  - Supported Development of AMRAAM Report
- Developed Initial EFTS Capability for NASA Dryden
  - Updated EFTS Command Controller to Operational Component
  - Build Windows Based Software for Operators
    - Command Controller
    - Monitor Software
  - DTMF Command Panel System
- Support For NASA Dryden on ACDS (still active WV development)
  - Developed Specification for NASA Dryden, Edwards AFB
  - Supporting Project Reviews and Development
- Developed Manual Testing Support Hardware
  - EFTS Test Case
  - EFTS Manual Test Jig
  - FATS and FATS 2 Software
  - Support Updated to 313
- Developed EFTS Devices in Support of NASA's Mission Needs
  - EFTS PODs (Key POD, Frequency POD, Mission POD, Status POD)
  - EFTS Parameter Management Tool
  - EFTS Integrated Command Modulator
- Currently Developing Automated EFTS FTR Test Set
  - 2 FTRs
  - Labview

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### **EFTS Automated FTR Test Set**

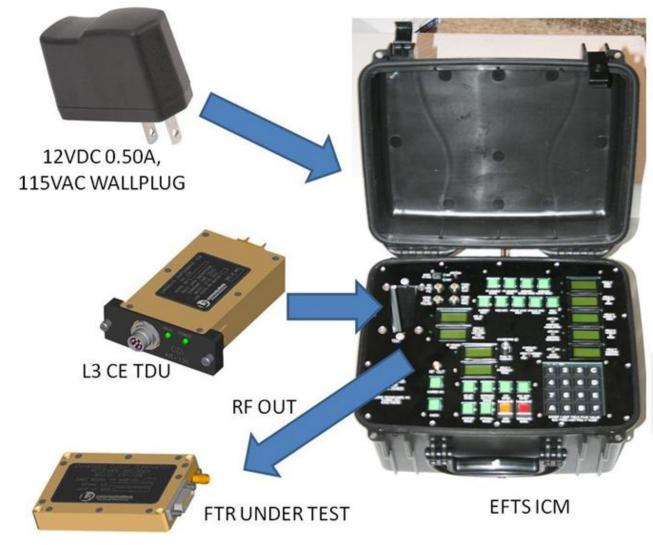


### **Automated Recertification of EFTS FTRs**

- 2 FTRS
- NI Labview based software
- NI PXI Components
- •28 Temperatures

Developed to Support NASA Automated FTR Testing Delivery: Q3/4 2011 Current Under Development

### INTEGRATED COMMAND MODULATOR



### **Complete Standalone EFTS Exciter**

- Houses EFTS TDU
- Exciter (Frequency 420-450 MHz)
- Nominal -10 to 0 dBm output
- Change EFTS Parameters
- Mission Lock Feature
- Command Button for All EFTS
   Commands
- Other Modes facilitate FTR Testing (Carrier Only, Frame Sync Only, Bit Sync Only, Invalid Command)

Developed to Support NASA Dryden Program Pre-Flight Testing Delivery: March 2011 (in use)

### **EFTS Parameter Management Tool**

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#### **Manage EFTS Parameters**

- Allows single EFTS Parameter Management System
- Saves to XML based Text file
- Integrates with FTR via Serial Port
- Integrates with EFTS FTR Mission POD via Serial POD (Mission POD holds 10 Missions)

Developed to Manage and Support All EFTS Parameters in a Centralized EFTS Environment Delivery: 2010-11 Current Operating Capability

#### MANUAL CONFIGURATION OF EFTS FTR

Download Parameter

to Mission PBD Location

Erase A Local

Ilser XX

SST0 Voltage X.X

Flash Writes Bemainin

### **EFTS PODS**

#### EFTS FTR Key POD Z01004

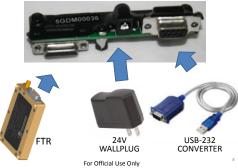
•Facilitates FTR Key Management without disturbing or viewing any other FTR Configuration Parameters •Provides Power to FTRs for loading of keys and key management. •VIEW FTR KEY IDENTIFIER •ZEROIZED FTR KEYS •Featurs



#### EFTS FTR Frequency POD P/N Z01009

•Provides FTR Frequency Configuration without disturbing or viewing any other FTR Configuration Parameters •View and change FTR Frequency







#### EFTS FTR Mission POD P/N Z01022:

Used with EFTS Parameter Management Tool to Store and Download up to 10 different FTR Missions (32 Configuration each Mission)
Download any of 10 Missions
View all FTR Parameters in real time





7 EFTS FTR Status POD P/N Z01028:

Allows Viewing of All FTR parameters in real Time.No ability to change FTR parameters.

Developed to support various compartmentalized capabilities at NASA Dryden Delivery: 2010-11 Current Operating Capability at NASA Dryden

# EFTS FTR TEST CASE (EFTC)

### EFTS FTR DATA INTERFACE CONNECTOR BREAKOUT

Interconnection with the Enhanced Flight Termination System (EFTS) Flight Termination Receiver (FTR)

#### **STANDALONE SOLUTION**

This portable test set provides power, configuration and status of all EFTS FTR signals: Discrete, Control and Status Interface (CSI), User Defined Port Interface, and Message Error Rate Testing. Integrated Volt meter allows validation of all signals

#### **THREE POWER SOURCES**

EFTC and FTR are powered from one of three sources:1) 4 AA Lithium Photo Batteries2) Provided AC/DC wall plug3) RED/BLACK Banana plugs (22-36V)

Developed to allow manual and portable testing of EFTS FTRs Delivery: 2008-Present Current Operating Capability at NASA Dryden



# MANUAL TEST BREAKOUT

### EFTS FTR DATA INTERFACE CONNECTOR BREAKOUT

Each Signal to Banana Jack and O-Scope clip Each Signal can have 10K termination switched in or disconnected with LEDs

### **Command Signals have LED indications**

- Check
- Monitor
- Optional
- Arm
- Terminate (x2)
- Pulsed Command Valid
- Failsafe

Developed to facilitate manual testing of EFTS FTRs in Lab Environment Delivery: 2010 Current Operating Capability at NASA Dryden



## FATS SOFTWARE

File View He Check	NO-OP	Monitor	Optional	Arm	Terminate	UNLATCH	Format	PORT COM
CHECK	Test	CC Clear	FS Enable	FS Disable	WIRELESS	WIRELESS	C Only Counter Decimal	Connect
ARM 0x31		<u> </u>	01	About EFTS FATS	ENABLE		□ □ Immediate Mode Send Next Step	-1 -1 CCC 1023
Step	Command	Range ID	Transmit ID	Copyright 2004-201	0, Bourne Technologies, Ir	Chec	k Active Command Outputs	
1	No-Op-0E	00001	01	ALL RIG	HTS RESERVED	Off	V	
2	Monitor-23	00001	01	10		Off	V, M	
3	No-Op-0E	00001	01	16 N	ovember 2010	Off	V	
4	Optional-2D	00001	01	Г	ок	Off	V,O	
5	No-Op-0E	00001	01			Off	V,O	
6	Cmd Unlatch-00	00001	01	U		Off Off	ν,	
- Time		Event					•••	
11/24/2010	12:46:56.559	Started Applicatio	on					

### Works with L3 CE Encoder to Develop 64 bit EFTS Waveform

Windows 7 based application Uses Serial Port Allows sending all EFTS Commands Allows simple testing of all EFTS "Logic Step Table" Developed to facilitate manual testing of EFTS FTRs in Lab Environment Delivery: 2010 Current Operating Capability at NASA Dryden

## FATS 2 SOFTWARE

EFTS FATS2-SSTO Test Ap	plication									EE
og Help										
Center Frequency Step Increment Step Dwell Time -107 Power Level -1 Image Testing Image1 Imag 691.400 670.1 Image3 Imag 446.400 111.1	20 kHz 100 ms 106.5 dBm 3 57 ge2 000 MHz ge4	Band1 🖗 Band2 🖗 Band3 Г Band4 Г Band5 Г Band6 Г	10.000 to 425.275 to 1435.000 to 1755.000 to 2200.000 to 5700.000 to		020737	Col FTR S/N	omalies Port  C HPID ADDR	COM1 18	Start Test Voltage Sensor C Labjack © USB-1608FS	
FREQ= 0010.100N		P to V F	424.965 to └ Verb	425.035 ose Mode	Time		at -107dBm= Anoma Description of A	liles		
4/30/2010 12:04:33:500	Started App	ication								

### Works with stand test equipment to validate FTR performance

Windows 7 based application Uses IEEE-488 with standard RF Generator Uses USB Based DAQ Card Validates FTR performance (SSTO) for various tests and Image response (Auto Sweep and validation) ProWides Saved Output Reports in Text Format

Developed to facilitate manual testing of EFTS FTRs in Lab Environment Delivery: 2010 Current Operating Capability at NASA Dryden

# NASA Dryden-Initial Operating Capability Progression

- EFTS Side by Side with Existing PC System (Quad Redundant)
  - Required moving Cables when switching between EFTS and IRIG based Missions
- Development of EFTS DTMF CPS (Quad Redundant)
  - DTMF LCP incorporated front panel switches to allows selection of system type (EFTS or IRIG) from front panel
- Split of System into Two Dual Systems
  - Quad Redundant System split into two dual systems to support 2 missions (at 2 different frequencies) simultaneously.

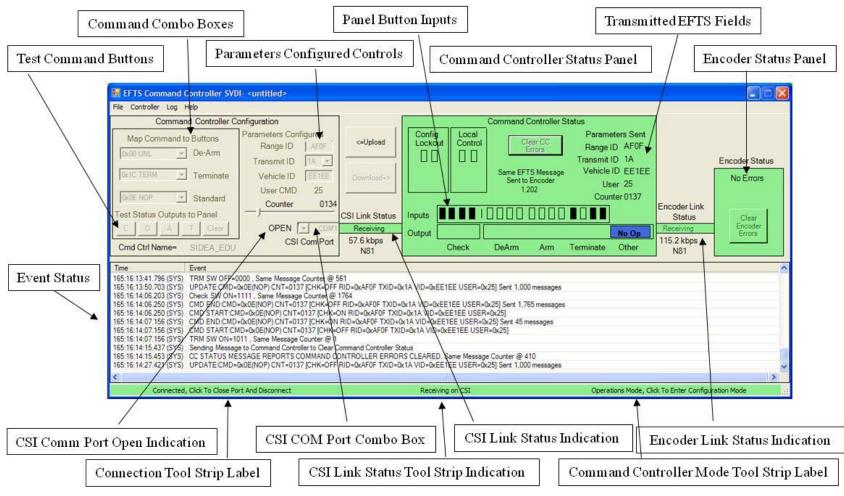
## EFTS CC SVDI (Dual)



- Develops 64 bit EFTS Message
- Interface to existing Range Infrastructure
- Communicates with L3 CE Encoder

Delivery: 2008 Current Operating Capability at NASA Dryden

## SVDI USER INTERFACE



Developed as Initial Operating Capability for NASA Dryden Delivery: 2008, 2010 Current Operating Capability at NASA Dryden

## EFTS MONITOR GUI

EFTS Monitor GUI-TEST:	1.mcf			
File Log Help				
DATA VALID		Valid Data		Valid Data
COMMAND		0x0E NO OP		NO-OP 0x0E
CHECK		OFF		CHECK=OFF
USER		25		25 User
RANGE ID				9999 Range ID
VEHICLE ID		EE1DE		EE1DE Vehicle ID
TX ID		10		1D Transmit ID
COUNTER		0100		0100 Counter
StripChart 153:13:03:0	03.148 Same Messages Received= 7,768	153:13:03:33.148	< 6 sec>	153:13:04:03.148 Full Time Span
Deactivate 4	12.07.270			► 60 sec -
Time	Event			^ ^
153:13:01:25:853 (SYS) 153:13:01:25:853 (SYS)	CSI FRAME SYNC ERROR [02][6C]15 CSI FRAME SYNC ERROR [02][73]13			
153:13:01:25.946 (SYS)	CSI FRAME SYNC ERROR [02][73]19			
153:13:01:25.946 (SYS) 153:13:01:25.946 (SYS)	CSI FRAME SYNC ERROR [02][73]17 CSI FRAME SYNC ERROR [02][73]15			
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153:13:01:27.818 (SYS)	MESSAGE DISPLAT LIST DISABLED TO MAINT MESSAGE MESSAGE DISPLAY LIST RE-ENABLED!	D TO UDPLAT		
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•		m		•
	Connected, Click To Close Port And Disconnect	Click to Hide Events		

- Interface to L3 CE EFTS Monitor, Post Decryption Output
- Displays all commands in strip chart format

Developed as Initial Operating Capability for NASA Dryden Delivery: 2008, 2010 Current Operating Capability at NASA Dryden

# DTMF COMMAND PANEL SYSTEM



- Dual Tone Multi-Frequency (DTMF)
- No Software or Firmware
- RSO Panel (Top)
- Local Panel (Bottom)
- User Interface at NASA Dryden
- Communicates with existing IRIG and EFTS CC SVDI

20 May 2011

Developed as Replacement of E&M based panels at NASA Dryden Delivery: 2009-Present Current Operating Capability at NASA Dryden

### FTR CONFIGURATION AND STATUS INTERFACE

- WINDOW BASED
- C#, .NET 2.0

Developed to support FTR Configuration Initial Delivery:2005 Updated: 2006-2008 Used by Edwards AFB and NASA Dryden during FTR Testing

FTR Computer Configuration and S	tatus Interface (CCSI)	_ D ×
Port Selection Com1  Close Com Port	Set Status Mode	eyID Request KeyID Zeroize
FTR Configuration Parameters		
	est All ? Key Valid ? Key Zero	Fill All TXID Fields with Zero
T×ID Enabled       00       16         00       16       0         01       17       0         02       18       Range ID         03       19       0         04       20       Vehicle ID         05       21       0         06       22       CC ON         07       23       0         08       24       0         09       25       0         10       26       1         11       27       Config to Change         12       28       ✓         13       29       Set Config         14       30       Parameters         15       31       0	Set Current Config Current Config ID Pulsed Output ? Wireless Config Used ?Failsafe Used LOC FSD LOP FSV Center Freq Set Global Parameters	TXID CC         00       16         01       17         02       18         03       19         04       20         05       21         06       22         07       23         08       24         09       25         11       27         12       28         13       29         14       30
Most Received Valid Comman Range ID Vehicle ID TXID XXXX XXXX XX	nd Command Counter Use XX XXX XX	er SSTO
	Exit	

# EFTS CONFIGURATION ICD TOOL

- WINDOW BASED
- C#, .NET 2.0

Developed to support FTR Vendor Compliance with Configuration ICD Initial Delivery:2005 Provided to L3 CE and Herley During FTR and Ground System Development

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EET_MODE         (022)								
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### **Baseband Output Signal Simulator (BOSS)**

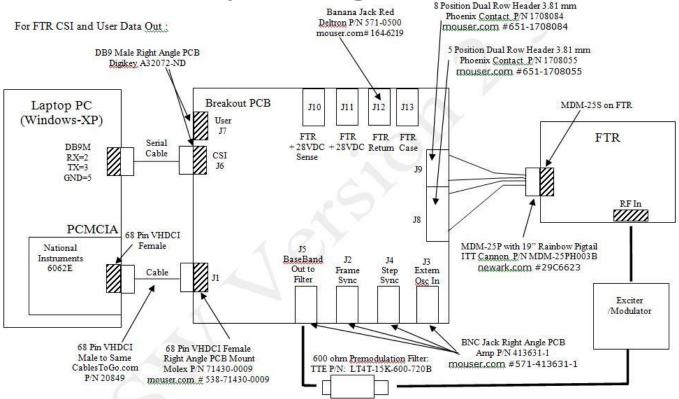
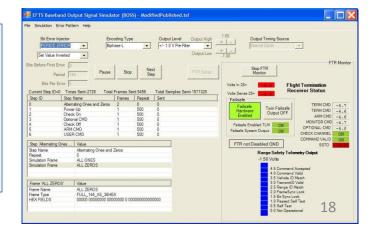




Figure 1, BOSS Block Diagram Developed to support FTR Vendor Compliance with EFTS Interface Requirements Document (IRD) Initial Delivery:2004 Updated: 2006 Provided to L3 CE and Herley During FTR Development

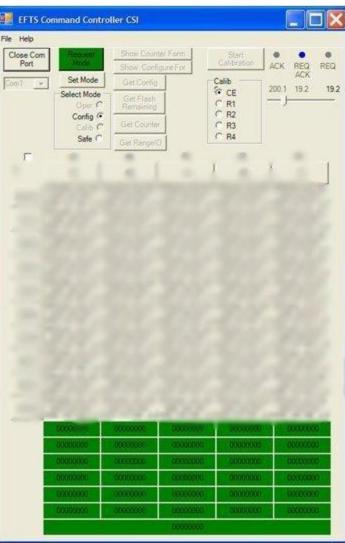


### EFTS Command Controller (AMRAAM)

- Dual EFTS Command Controller
- Up to 10 Vehicles and Use of L3 CE Encoder with up to 5 remote encoders.



Developed to support EFTS Encoder Validation and AMRAAM Support Initial Delivery:2006 Used during L3 CE Encoder Validation and AMRAAM



# **Support Devices**

- FTR Data Simulator (2 Versions)
  - All Signals (Shown)
  - Circuit and POD Version Also
- Monitor Simulator
  - Circuit Card Version
- Encoder Simulator (2 Versions)
  - PC Version
  - Circuit Card Version
- TDU Simulator
  - Circuit Card
- CC SVDI Test Set
  - All signals
- DTMF CPS Test Set
  - All Signals





Circuit Card Version of simulators





# **Technical Software Tools**

- Subversion/Tortoise-SVN-
  - Configuration Management/Document Mgmt
- MS Visual Studio- C# Language
  - Windows Applications
- IAR Embedded Workstation/Seggar J-Flash
  - Embedded Software, C based programming
  - Has MISRA "C" COMPLIANCE CHECKER BUILT-IN
- National Instruments Labview
  - Automatic Test Set
- DIPTrace
  - PWB Design
- Bourne Technologies MyProductionLibrary
  - Manufacturing/ERP