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## Space Communications and Navigation (SCaN) Testbed Project

National Aeronautics and Space Administration  
John H. Glenn Research Center at Lewis Field, OH 44135

# SCaN TESTBED PROJECT

## GIU Operational Guidelines

AUTHORIZED by CM when under FORMAL Configuration Control	
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## **PREFACE**

National Aeronautics and Space Administration (NASA) is developing an on-orbit, adaptable, Software Defined Radio (SDR)/Space Telecommunications Radio System (STRS)-based testbed facility to conduct a suite of experiments to advance technologies, reduce risk, and enable future mission capabilities on the International Space Station (ISS). The Space Communications and Navigation (SCaN) Testbed Project will provide NASA, industry, other Government agencies, and academic partners the opportunity to develop and field communications, navigation, and networking technologies in the laboratory and space environment based on reconfigurable, software defined radio platforms and the STRS Architecture. The project was previously known as the Communications, Navigation, and Networking reConfigurable Testbed (CoNNeCT). Also included are the required support efforts for Mission Integration and Operations, consisting of a ground system and the Glenn Telescience Support Center (GRC TSC). This document has been prepared in accordance with NASA Glenn’s Configuration Management Procedural Requirements GLPR 8040.1 and applies to the SCaN Testbed configuration management activities performed at NASA’s Glenn Research Center (GRC). This document is consistent with the requirements of SSP 41170, Configuration Management Requirements, International Space Station, and GLPR 7120.5.30 Space Assurance Requirements (SAR).

The purpose of this plan is to provide the preferred approach and project controls which will be used when operating the SCaN Testbed Ground Integration Unit (GIU).



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## 1.0 INTRODUCTION

### 1.1 Purpose

The purpose of this plan is to provide the preferred approach and project controls which will be used when operating the SCaN Testbed Ground Integration Unit (GIU). As such, it contains the guidelines to follow when performing developmental testing, troubleshooting, verification testing and training operations on the GIU. These guidelines include the following:

- Release level needed for the operating procedures.
- Review of Software Defined Radio (SDR) Waveform Code Review prior to installation and testing.
- When Quality Assurance (QA) presence is required to observe the operations.
- Checklist of minimum required steps to be included in all operating procedures written for the GIU.
- Certification and Calibration requirements for the Ground Support Equipment (GSE) and Test Support Equipment (TSE) used for the operations.
- Minimum required information to be entered into the GIU Log database for all GIU Operations Sessions.

### 1.2 Scope

The scope of this plan is limited to those items explicitly specified in **Section 1.1**. This plan does not cover how to generate the Manufacturing Work Order<sup>1</sup> (MWO) needed for using the GIU, generating the GIU Operating Procedures, how the GIU will be used and how to operate the GIU.

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<sup>1</sup> A Manufacturing Work Order (MWO) is an online form which will be filled out, printed and the appropriate signatures obtained. **The GIU Lead will be responsible for the aforementioned actions.** On this form, the operations to be performed, the procedures to be used and who is performing the operations will be entered. It provides an official means of gaining project permission to perform the operations. A MWO does not take the place of the GIU Log Book which also must be filled out as per this document.

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## 2.0 APPLICABLE DOCUMENTS

This section lists the NASA/Government and non-NASA/Government specifications, standards, guidelines, handbooks, or other special publications applicable to this document.

### 2.1 Applicable Documents

Applicable documents are those documents that form a part of this document. These documents carry the same weight as if they were stated within the body of this document.

**Table 1—Applicable Documents**

Document Number	Applicable Document
GRC-CONN-PLAN-0004	CoNNeCT Project Plan
GRC-CONN-PLAN-0006	CoNNeCT Product Assurance Plan
GRC-CONN-PLAN-0140	CoNNeCT Component and Software Management Plan
GRC-CONN-OPS-0371	NASA GRC Ground Systems Description and GIU Users Manual
GRC-CONN-OPS-0894	GIU Operation Procedures
ZIN F09014	ZIN Technologies Manufacturing Work Order Form and Kit List
ZIN P09014	ZIN Technologies Manufacturing Work Order Procedure
ZIN QM001	ZIN Technologies Quality Manual

### 2.2 Reference Documents

Reference documents are those documents that, though not a part of this document, serve to clarify the intent and contents of this document.

**Table 2—Reference Documents**

Document Number	Reference Document
GRC-CONN-PLAN-0034	CoNNeCT Project Contamination Control Plan
GRC-CONN-PLAN-0145	CoNNeCT Project Electrostatic Discharge Control Plan

### 2.3 Order of Precedence for Documents

In the event of a conflict between this document and other documents specified herein, the requirements of this document shall apply. In the event of a conflict between this document and higher level documents, the higher level documents shall take precedence over this document.

All documents used are to be the approved versions released as of the CoNNeCT Project Plan (GRC-CONN-PLAN-0004) baseline date. All document changes issued after the baseline establishment shall be reviewed for impact on the scope of work. Nothing in this document supersedes applicable laws and regulations unless a specific exemption has been obtained.

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### **3.0 GIU DESCRIPTION**

The GIU is a ground based facsimile of the SCaN Testbed Flight System. Refer to GRC-CONN-OPS-0371, NASA GRC Ground Systems Description and GIU User's Manual for a detailed description of the GIU.

The primary purpose of the GIU, in conjunction with the ELC Suitcase Simulator and GIU TReK Workstation, is to provide a platform for the development, integration, and verification of both experiment software developed on the software defined radios or the avionics systems and Payload Avionics Software to be executed on the Flight System while on orbit.. The GIU also provides a platform for troubleshooting Flight System anomalies.

The GIU includes both a commercial TWTA and an LRO Flight Spare TWTA. Since the LRO Flight Spare TWTA is a limited life item, it will have more restrictive operational controls.

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## **4.0 GUIDANCE FOR GIU OPERATIONS**

At a minimum, written procedures<sup>2</sup> will be required for all GIU Operations. The exact checklist of items required for operation of the GIU is contained in **Table 3**.

If the planned use for the GIU does not fall within those areas listed, contact personnel in **Table 4** for direction.

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<sup>2</sup> In cases where CM Released Procedures are **NOT** needed, either redlined existing procedures, typed procedures in any format, handwritten procedures or any of the above can be used. For these cases, some form of written documentation of what was performed is necessary.

**Table 3—GIU Operational Checklist**

Operation	Log Book Annotated	MWO Required	CM Released Procedures Required	QA Witness Required	TPA, Code Review or Experiment Readiness Review Required
Formal Verification and Validation of Software	X	X	X	X	X
Operations involving the use of the Spare LRO TWTA <sup>3</sup>	X	X	X	X	
Characterization of GIU Hardware Operation (ie.:Performance, Timing, Bit Error Rates, etc.) <sup>4</sup>	X	X	X		
Development and Verification/Validation of the Flight System Operation Modules.	X				
Troubleshooting of GIU Hardware <sup>5</sup>	X	X	X	X	
Troubleshooting of anomalies encountered on the Flight System <sup>6</sup>	X	X	X	X	
Debugging of existing PAS and Developmental Testing of upgrades to the PAS	X				
Developmental and Integrated Testing of Avionics Experiment Software	X	X			X
Developmental and Integrated Testing of SDR Waveform Code	X	X			X
Update to TReK Workstation Software	X				
Operations Team Training	X		X		

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<sup>3</sup> Redlining of the procedures is permissible only if it is limited to the RF Drive Level to the TWTA. The RF Drive Level is controlled by the Variable Attenuator (See GRC-CONN-OPS-0894). Quality signoff (initials & date) will be required for all redlines.

<sup>4</sup> The CM Release Procedures can be redlined.

<sup>5</sup> For troubleshooting the GIU, CM Released Procedures will be used as a starting point. They can be redlined as needed to encompass the desired operations. Quality signoff (initials & date) will be required for all redlines.

<sup>6</sup> For troubleshooting the Flight System, CM Released Procedures will be used as a starting point. They can be redlined as needed to encompass the desired operations. Quality signoff (initials & date) will be required for all redlines.

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## 5.0 GIU LOG BOOK

Whenever the GIU is used, the GIU Log Book Database shall be annotated with the following:

- Operator Name(s).
- Date of Operation.
- MWO Number for the Operation.
- Power On and Off Times for each GIU component (i.e.: Avionics, Software Defined Radio (SDR), Traveling Wave Tube Amplifier (TWTA) and Gimbal Control Electronics (GCE).
- Brief description of operations performed. When available the Procedure Numbers of the operations performed are to be included.
- GSE and TSE utilized for the operations.
- GIU Interfaces in which the GSE and TSE were connected.
- Results of the operations performed (i.e.: passed, failed, inconclusive, etc.).
- Anomalies encountered on the GIU during the operations. If an anomaly is encountered, the GIU Lead should be immediately notified. Refer to **Table 4** for contact information.

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## **6.0 EQUIPMENT USED WITH THE GIU**

GSE and TSE that were certified for use with the Flight System can be used with the GIU. All instruments contained in the GSE and TSE must be within their valid calibration dates. For all other equipment refer to **Table 4** for direction.

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## 7.0 PROCEDURE CHECKLIST

The following is a minimum checklist for GIU Operations that shall be incorporated into all test new procedures:

- Contact list of personnel to call if problems or anomalies arise. Refer to **Table 4** for contact information.
- Reference to document GRC-CONN-OPS-0894 GIU Operation Procedures. These provide the general operating procedures for the ELC Simulator and the GIU. Also contained are the settings for the Ka-Band Variable Attenuator when using either the Spare LRO or Commercial TWTAs.
- Reference to procedures for the retrieval of data and log files from the GIU.
- Requirement that all portable storage media (CDs, DVDs, Flash Drives, etc.) must be virus scanned prior to connection to either the GIU TReK Workstation, GIU Debug Terminal, TDRSS Simulators (TSIMs), Test Equipment Interface (TEI) Rack Computer or Power Acquisition System (PAS) Rack Computer.
- Verify that all the items in **Table 3** needed for the planned operations are in place.
- Verify that Ground Support Equipment (GSE) and Test Support Equipment (TSE) have acceptable certification and calibration stickers for date of testing.
- Verify RF energy is properly managed for the test procedure configuration. RF energy must always be contained in GSE, TSE or RF Loads. Radiated RF energy shall adhere to applicable safety permits.
- Verify RF Terminators are installed on all unused RF Test Ports.
- Verify the GIU Log Book Database is maintained.

## 8.0 CONTACTS

**Table 4** contains the key contacts for the SCaN Testbed. The Sustaining Engineering & Integration Lead may modify this list based on best testing practices and shall communicate the list to each discipline lead for incorporation into test procedures.

**Table 4—Scan Testbed Contacts**

Area	Contact	Office Phone #	Cell Phone #
GIU Lead	Allan Rybar	(440) 863-4383	(440) 334-7252
Systems Lead	Andrew Sexton	(440)-863-4386	(440) 225-0145
Systems Engineering & Integration Lead	Steve Hall	(216-433-3036	
Chief Engineer	Josh Freeh	(216) 433-5014	(216) 403-4253
Project Manager	Diane Malarik	N/A	(216) 978-8078

## **APPENDIX A    ACRONYMS AND ABBREVIATIONS**

### **A.1    Scope**

This appendix lists the acronyms and abbreviations used in this document.

### **A.2    List of Acronyms and Abbreviations**

**Table A-1—Acronyms**

CM	Configuration Management
GIU	Ground Integration Unit
GSE	Ground Support Equipment
LRO	Lunar Reconnaissance Orbiter
MWO	Manufacturing Work Order
QA	Quality Assurance
PAS	Power Acquisition System
RF	Radio Frequency
SDR	Software Defined Radio
SE & I	Systems Engineering and Integration
TEI	Test Equipment Interface
TPA	Test Preparation Assessment
TSE	Test Support Equipment
TSIM	TDRSS Simulator
TWTA	Traveling Wave Tube Amplifier