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National Aeronautics and
Space Administration

NASA-CR-167436

Lyndon B. Johnson Space Center
Houston, Texas 77058

JSC-17634

REQUIREMENTS DOCUMENT

FOR

MINI SYSTEM TEST UNIT

Job Order 48-519

Prepared By

Lockheed Engineering and Management Services Company

Houston, Texas

Contract NAS 9-15800
For
EXPERIMENT SYSTEMS DIVISION

August 1981

LEMSCO-17199

JSC-17634

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1. INTRODUCTION

This document defines the basic requirements for the Mini System Test Unit (STU) for the Trace Gas Analyzer (TGA) and defines the interface signals of the components used to implement the STU. The mini STU will be primarily used to support pre-flight ground test operations at Kennedy Space Center (KSC).

2. APPLICABLE DOCUMENTS

The listed documents in current revision on the date of this specification shall form a part of the specification to the extent referenced herein. In the event of differences between the requirements of this specification and the listed documents, the requirements of this specification shall have precedence.

1.	ED82-SH-1731	Statement of Work for Shuttle Trace Gas Analyzer System
2.	ED82-SH-1732	Shuttle TGA System Performance Specification
3.	ED82-SH-1733	System Integration Specification for Shuttle Trace Gas Analyzer System
4.	ED83-SH-1734	Shuttle TGA Product Support Specification
5.	ED82-SH-1735	Shuttle TGA Interface Requirement Specification
6.	ICD-SL-3005	Trace Gas Analyzer/Spacelab Interface Control Document
7.	SPO #30027	Specification for TGA STU

8.	C70-1509	OEX Ground Station
9.	JSC-16666	Orbiter Experiments System Requirements
10.	CDR-4	RID OEX Ground Station and TGA
11.	SLP-2104	Spacelab Payload Accommodations Handbook
12.	SW-E-0002 REB	GSE Requirement at KSC

3. MINI SYSTEM TEST UNIT DEFINITION

3.1 MINI-SYSTEM TEST UNIT FUNCTIONS

The Mini System Test Unit (STU) will be designed to test the operation of the TGA. To test the TGA, the Mini STU must simulate some of the electrical and electronic interfaces such as: Primary and essential power, and GMT control. An indication of TGA operation (organic and carbon monoxide analyses) and the ability to monitor gas chromtograph and mass spectrometer test signals will be included.

3.2 MINI STU APPLICATIONS AT KSC

The Mini STU will be used at field sites for a number of applications in support of the TGA project. These applications are summarized below:

- For engineering evaluation of the ETU at KSC.
- For operational Checkout of flight TGA units prior to installation into Spacelab.
- For minor troubleshooting TGA malfunctions.
- For replenishment of consumables such as carrier and cal-gases.
- Storage when TGA is out of the Spacelab.

4. HARDWARE REQUIREMENTS

4.1 GENERAL

The Mini STU will provide a panel for connecting desired test equipment to monitor essential TGA signals. A blower will also be included to provide cooling air to the TGA. All required cabling for the Mini STU to interfaces with both the TGA and OEX ground station will be provided. A conceptual layout of the Mini STU is shown in Figure 4-1.

4.2 ACCOMMODATION FOR THE TGA

A cabinet simulating the Spacelab rack mounting in accordance with SLP-2104 will be provided to hold the TGA. No requirement exists for duplicating the Spacelab rack interface, but the rack should be sufficiently similar to allow verification of ground handling procedures.

4.3 BLOWER

A blower will provide the air cooling interface for TGA. It will supply forced air at 40 Kg/hr, simulating the sucking stub ducting and nozzle interface with the TGA as provided by Spacelab.

4.4 SYSTEM CONTROL PANEL

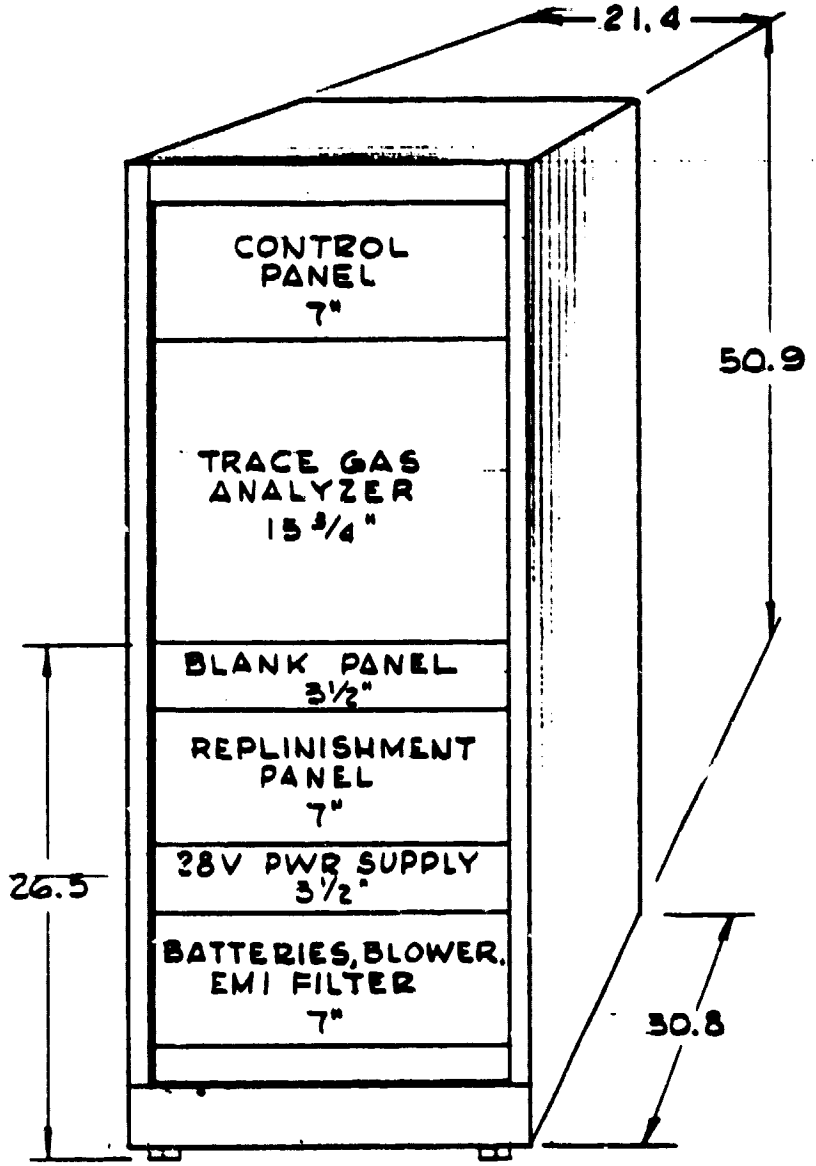
This panel will provide selected indicators which show Gas Chromatograph (GC) functions such as: CO analysis operation and organic analysis operation, Mass Spectrometer (MS) function status indicators for ion pum, high voltage, HRM output and clock, and essential power ON-OFF switch.

4.5 POWER SUPPLIES

All necessary power supplies (including backup batteries and battery charger) will be provided to assure proper operation of the TGA.

4.6 REPLENISHMENT PANEL

This panel is to be supplied by Perkin-Elmer from the existing STU.



MINI SYSTEMS TEST UNIT

Figure 4-1 Conceptual Layout of the Mini STU

4.7 ANALOG MONITORING PANEL

This panel will provide a panel DVM that will display selected TGA signals listed on Tables I and II, four BNC outputs for Visicorder monitoring labeled RIC, TIC, SCAN VOLTS and EXT, and an Elapsed Time Display.

TABLE I

Signal Pin	Return	Function	Source	Definition
3	19	S-VSCAN	TGA	Mass marker voltage with a dynamic range of -5V to +5V and a frequency of .25 Hz. This signal will be monitored with a scope and/or a Visicorder.
4	19	S-MAGTEMP	TGA	Magnet temperature monitor voltage ranging from ØV to +5V. This voltage will be monitored with a voltmeter.
5	19	S-TICM	TGA	TIC monitor voltage ranging from ØV to +5V. This voltage will be monitored with a voltmeter.
6	19	S-RICM	TGA	Smoothed RIC monitor voltage ranging from -5V to +5V with a maximum frequency of 450 Hz. This signal will be monitored with a scope and/or a Visicorder.

TABLE I (Continued)

Signal Pin	Return	Function	Source	Definition
16	17	S-IPE	TGA	IPE voltage ranging from ØV to +5V. This voltage will be monitored with a voltmeter.
8	19	S-IONSORT	TGA	IONSORT monitor voltage ranging from Ø to +5V. This voltage will be monitored with a voltmeter.
17	-	IP GND		Return for IPE
19	-	MS SHIELD		Common tie point at STU connector for MS signal shields.
10	19	S-HPD	TGA	High TIC level discriminator signal. High TTL output indicates high TIC monitor voltage. To be indicated with a LED.
11	19	S-RATD	TGA	TIC rate discriminator signal. High TTL output indicates excessive rate of change of TIC monitor voltage to be indicated with a LED.
13	19	S-IPE	TGA	Sink for LED on STU to indicate the ion pump current level (LED on) is low enough.
14	19	S-ISHE	TGA	Sink for LED on STU to indicate the ion source heater in enabled (LED on).
15	19	S-MSE	TGA	Sink for LED on STU to indicate MS electronics are (LED on).

TABLE I (Continued)

Singal Pin	Return	Function	Source	Definition
12	19	S-LPD	TGA	Low TIC level discriminator signal. High TTL output indicates low TIC monitor voltage. To be indicated with a LED.
7	19	IPV		Sink for LED on STU to indicate Ion Pump high voltage is high enough. LED on at $\geq$ 2.5 KV.
56	19	$\overline{\text{TCRST}}$	TGA	Logic signal from TGA. Low level resets the TGA's elapsed time counts. Used in STU's elapsed time counter.

TABLE II

Signal Pin	Signal	Function	Orgin: GC-J6
24	OCT	Organic Column Temperature	
25	TZT	T-Zone Temperature	C
26	COCT	CO Column Temperature	R
27	THT	Through Heater Temperature	E
28	STT	Small Trap Temperature	F
29	LTT	Large Trap Temperature	D
30	SCM	Separator Current	G
31	CGLP (LTNKP)	Carrier Gas Low Pressure	P
32	CGTP (HTNKP)	Carrier Gas Tank Pressure	T
33	CALP (CTNKP)	Calibration Gas Tank Pressure	T
34	SVT	Sample Valve Temperature	A
35	GCSSG	GCS Signal Ground	I
37	ORRUN	Organic Ramp On (Logic)	Y
38	ORSCN	Organic Ramp at Macimum (Logic)	V
39	ORHP	Organic Heater Power (Logic)	N
41	CORUN	CO Ramp on (Logic)	X
42	COSCN	CO Ramp at Maximum (Logic)	W
43	OHP	CO Heater power	L
44	VREF	Separator reference voltage	M
45	PNRTN	Return for $\pm$ 12V Power	O
46	P5RTN	Return for +5V Power	K
47	SVD	Sample Valve Driver	S
48	GCSPF	GD Supply Power Floating	Q
49	GC Shield	Shield for GC signals - common to PNRTN	O

5. MINI STU SIGNAL DEFINITIONS

All TTL outputs signals will be capable of supplying 400 microamperes minimum source current at the high logic level of 2.4 volts and will be capable of sinking a minimum of 4 milliamperes at low logic level of +0.4 volts.

All TTL signal inputs are high at +2.4 volts with a maximum source current requirement of 80 microamperes. Each signal's input is low at +0.8 volts with a maximum sink current requirement of 800 microamperes.

The mating connectors on the TGA for the PRI PWR (Primary Power), ESS PWR (Essential Power), RAU, HRM, and STU on the bottom of the TGA in the connector box.

These connectors mate with the TGA connectors:

(1) RAU Interface Connector - MS27473 - T12F35SB
(2) HRM Interface Connector - MS27473 - T12F35SA
(3) PRI PWR Interface Connector - M83723 - 23R2015N
(4) ESS PWR Interface connector - NBO#12 - 3SNT
(5) STU Interface Connector - MS27473 - T18F35S

All signals between the TGA and the Mini STU will be interfaced through the above connectors.

5.1 TGA POWER DEFINITIONS

Table III defines the power requirements of the TGA to be supplied by the Mini STU. The ESS PWR and PRI PWR are interfaced to the TGA with individual connectors as defined in Section 5.

TABLE III -- POWER REQUIREMENTS

Function	Source	Definition
PRI PWR	STU	28 VDC ±4V. Implemented by a variable power supply with a minimum power rating of 450 watts. PRI PWR can be switched off without interfering with ESS PWR. Meter to be included.
ESS PWR	STU	ESS PWR can be switched off without interfering with PRI PWR. Implemented by batteries.

5.2 RAU SIGNAL DEFINITIONS

TABLE IV – RAU SIGNAL DEFINITIONS

Function	Source	Definition
DOWNLINK	STU	Logic signal to Downlink. High level when DUMP INHIBIT is high instructs executive processor to Downlink.
DUMP INHIBIT	STU	Logic signal to instruct executive processor to Standby for Downlink signal.

5.3 HRM SIGNAL DEFINITIONS

TABLE V – HRM SIGNAL DEFINITIONS

Function	Source	Definition
HRM DATA	TGA	Format of the HRM DATA is as described in DFM No. TGA (PE) 0122/80. HRM DATA will be clocked at 48 kHz.
HRM CLK	TGA	48 kHz clock supplied with HRM DATA. Clock levels will be TTL compatible.