



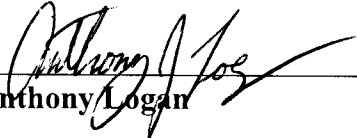
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Gravity Probe B Relativity Mission
Gas Management Assembly Flight Monitors

S0753, Rev.-

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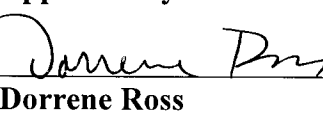
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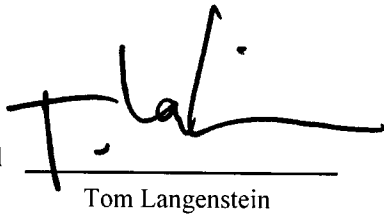
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3/13/03

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ITAR Assessment Performed


Tom Langenstein

ITAR Control Req'd? ☐ Yes ☒ No

3/13/02

Purpose:

This document verifies the PLSE-12 #3.7.8.9 *GMA Instrumentation* requirement by providing a summary of the Flight Monitors and a snapshot of the data from the monitors. The GMA flight monitors are used on orbit to measure the health and functionality of the GMA.

Introduction:

During the Space Vehicle Thermal Vacuum and Payload E-28 Tests the flight monitors were used to determine the health and functionality of the GMA. As a result, these tests demonstrated the capability of the GMA to provide telemetry to the ECU, which was operated through POD-G. POD-G has the same interface capabilities as the flight Mission Operations Center (MOC). The data files acquired through POD-G are in the format designed for the Space Vehicle & MOC and are presented in this document with only cosmetic changes. The document S0776 “15.10.1 GMA Flow Test Analysis” presents an analysis of the GMA telemetry data and places it into functional context. This document simply lists the monitors and provides an example of the telemetry data. To understand how this data is used to evaluate the performance of the GMA refer to S0776.

Requirement

PLSE-12 Requirement

Para	Title	Requirement	Method
3.7.8.9	GMA Instrumentation	The GMA shall provide instrumentation for evaluating performance.	D

Acronyms and Abbreviations

ECU –	Experiment Control Unit
EGSE –	Electrical Ground Support Equipment
GP-B –	Gravity Probe B
GSE –	Ground Support Equipment
LM –	Lockheed Martin (by various current and old names)
MOC –	Mission Operations Center
SU –	Stanford University

GMA Flight Monitors

Table 1 – provides a list of the monitors and a description of their function and generally where they are located on the GMA pallet.

Table 1- GMA Flight Monitors

Monitor Name	Subsys	Description	Display
Valve Control Monitors			
BE_GMASEL_ECHOA	ECU	GMA valve select and optical switch	ECU_ADC_Data
			ECU_Evt_190_1900
			ECU_GMA_1
BE_GMASELOPCLDA	ECU	GMA valve select and optical switch	ECU_ADC_Data
			ECU_PrtMon_UV
Power Monitors			
BP_GMPWR_A_Stat	ECU	ECU-A GMA Power Status	ECU_PseudoMntrs
BP_GMPWR_B_Stat	ECU	ECU-B GMA Power Status	ECU_PseudoMntrs
Pressure Transducer Monitors			
DE_GMA_GP1	ECU	GMA Tank Pressure, GP1	ECU_GMA_A
DE_GMA_GP2	ECU	GMA Pre-Regulator Pressure A, GP2	ECU_GMA_A
DE_GMA_GP3	ECU	GMA Pre-Regulator Pressure B, GP3	ECU_GMA_A
DE_GMA_GP4	ECU	GMA Post Regulator Pressure A, GP4	ECU_GMA_A
DE_GMA_GP5	ECU	GMA Post-Regulator Pressure B, GP5	ECU_GMA_A
DE_GMA_GP6	ECU	GMA Post Regulator Orifice, GP6	ECU_GMA_A
DE_GMA_GP7	ECU	GMA Inlet Pressure Gyro 1 A, GP7	ECU_GMA_A
DE_GMA_GP8	ECU	GMA Input to Gyro 1 B, GP8	ECU_GMA_A
DE_GMA_GP9	ECU	GMA Inlet Pressure Gyro 2 B, GP9	ECU_GMA_A
DE_GMA_GP10	ECU	GMA Inlet Pressure Gyro 2 A, GP10	ECU_GMA_A
DE_GMA_GP11	ECU	GMA Inlet Pressure Gyro 3 A, GP11	ECU_GMA_A
DE_GMA_GP12	ECU	GMA Inlet Pressure Gyro 4 B, GP12	ECU_GMA_A
DE_GMA_GP13	ECU	GMA Inlet Pressure Gyro 4 A, GP13	ECU_GMA_A
DE_GMA_GP14	ECU	GMA Vent Outlet Pressure, GP14	ECU_GMA_A
Temperature Sensors			
TE_ECU_Aft_SDT1	ECU	Aft ECU1 Board SDT/a	ECU_Critical_3
			TCS_Box_AFT_bays
TE_ECU_AFT_SDT2	ECU	Aft ECU2 Board SDT/b	ECU_Critical_2
			TCS_Box_AFT_bays
TE_GMA_SDT_1A	ECU	GMA #1A Pressure Bottle SDT/a	ECU_Critical_3
			ECU_GMA_1
TE_GMA_SDT_1B	ECU	GMA #1B Pressure Bottle SDT/b	ECU_Critical_3
			ECU_GMA_1
TE_GMA_SDT_2A	ECU	GMA #2A Pressure Transducer SDT/a	ECU_Critical_3
			ECU_GMA_1
TE_GMA_SDT_2B	ECU	GMA #2B Pressure Transducer SDT/b	ECU_Critical_3
			ECU_GMA_1
TE_GMA_SDT_3A	ECU	GMA #3A SDT/a Valve Side 1 SDT	ECU_Critical_3
			ECU_GMA_1
TE_GMA_SDT_3B	ECU	GMA #3B SDT/b Valve Side 2 SDT	ECU_Critical_3
			ECU_GMA_1

GMA Monitor Data (Flight Configuration)

The following tables are actual 1 Hz telemetry data taken from the Space Vehicle from Pod G, which was stored in a database. The data presented does not represent any GSE instrumentation.

Table 2 – GMA Monitors for Valve Control, Power, and Pressure Sensor GP1

2 FSW SF_VEH_TIME1 F I12	2 FSW PF_10S_INTRVL F I12	2 FSW SF_FRAME_CO UNT F I12	BE_GMASEL_EC HOA F I12	BE_GMASEL_OP CLDA F I12	BP_GMPWR_A_ STAT F I12	BP_GMPWR_B_ STAT F I12	DE_GMA_ GP1 ANY F E14.7
53044000	0	21	0	0	0	0	0
53044010	53044000	21	0	0	1	1	104
53044020	53044010	21	0	0	1	1	104
53044030	53044020	21	0	0	1	1	104
53044040	53044030	21	0	0	1	1	104
53044050	53044040	21	0	0	1	1	104
53044060	53044050	21	0	0	1	1	104
53044070	53044060	21	0	0	1	1	104
53044080	53044070	21	0	0	1	1	104
53044090	53044080	21	0	0	1	1	104
53044100	53044090	21	0	0	1	1	104
53044110	53044100	21	0	0	1	1	104
53044120	53044110	21	0	0	1	1	104
53044130	53044120	21	0	0	1	1	104
53044140	53044130	21	0	0	1	1	104
53044150	53044140	21	0	0	1	1	104
53044160	53044150	21	0	0	1	1	104
53044170	53044160	21	0	0	1	1	104
53044180	53044170	21	0	0	1	1	104
53044190	53044180	21	0	0	1	1	104
53044200	53044190	21	0	0	1	1	104
53044210	53044200	21	0	0	1	1	104
53044220	53044210	21	0	0	1	1	104
53044230	53044220	21	0	0	1	1	104
53044240	53044230	21	0	0	1	1	104
53044250	53044240	21	0	0	1	1	104
53044260	53044250	21	0	0	1	1	104
53044270	53044260	21	0	0	1	1	104
53044280	53044270	21	0	0	1	1	104
53044290	53044280	21	0	0	1	1	104
53044300	53044290	21	0	0	1	1	104
53044310	53044300	21	0	0	1	1	104
53044320	53044310	21	0	0	1	1	104
53044330	53044320	21	0	0	1	1	104
53044340	53044330	21	0	0	1	1	104
53044350	53044340	21	0	0	1	1	104
53044360	53044350	21	0	0	1	1	104
53044370	53044360	21	0	0	1	1	104
53044380	53044370	21	0	0	1	1	104
53044390	53044380	21	0	0	1	1	104
53044400	53044390	21	0	0	1	1	104
53044410	53044400	21	0	0	1	1	104
53044420	53044410	21	0	0	1	1	104
53044430	53044420	21	0	0	1	1	104
53044440	53044430	21	0	0	1	1	104
53044450	53044440	21	0	0	1	1	104
53044460	53044450	21	0	0	1	1	104

Table 3 – GMA Monitors for Pressure Sensors GP2 – GP8

2 FSW SF_VEH_TIME1 F 112	DE_GMA____G P2 ANY F E14.7	DE_GMA____G P3 ANY F E14.7	DE_GMA____G P4 ANY F E14.7	DE_GMA____G P5 ANY F E14.7	DE_GMA____G P6 ANY F E14.7	DE_GMA____G P7 ANY F E14.7	DE_GMA____G P8 ANY F E14.7
53044000	0	0	0	0	0	0	0
53044010	1786	75	187	183	25	25	1993
53044020	1786	75	187	183	25	25	1993
53044030	1786	75	187	183	25	25	1993
53044040	1786	75	187	183	25	25	1993
53044050	1786	75	187	183	25	25	1993
53044060	1786	75	187	183	25	25	1993
53044070	1786	75	187	183	25	25	1993
53044080	1786	75	187	183	25	25	1993
53044090	1786	75	187	183	25	25	1993
53044100	1786	75	187	183	25	25	1993
53044110	1785	75	187	183	25	25	1993
53044120	1786	75	187	183	25	25	1993
53044130	1786	75	187	183	25	25	1993
53044140	1786	75	187	183	25	25	1993
53044150	1786	75	187	183	25	25	1993
53044160	1786	75	187	183	25	25	1993
53044170	1786	75	187	183	25	25	1993
53044180	1786	75	187	183	25	25	1993
53044190	1786	75	187	183	25	25	1993
53044200	1786	75	187	183	25	25	1993
53044210	1785	75	187	183	25	25	1993
53044220	1786	75	187	183	25	25	1993
53044230	1786	75	187	183	25	25	1993
53044240	1786	75	187	183	25	25	1993
53044250	1786	75	187	183	25	25	1993
53044260	1786	75	187	183	25	25	1993
53044270	1786	75	187	183	25	25	1993
53044280	1786	75	187	183	25	25	1993
53044290	1786	75	187	183	25	25	1993
53044300	1786	75	187	183	25	25	1993
53044310	1786	75	187	183	25	25	1993
53044320	1786	75	187	183	25	25	1993
53044330	1786	75	187	183	25	25	1993
53044340	1786	75	187	183	25	25	1993
53044350	1786	75	187	183	25	25	1993
53044360	1786	75	187	183	25	25	1993
53044370	1786	75	187	183	25	25	1993
53044380	1786	75	187	183	25	25	1993
53044390	1786	75	187	183	25	25	1993
53044400	1786	75	187	183	25	25	1993
53044410	1786	75	187	183	25	25	1993
53044420	1786	75	187	183	25	25	1993
53044430	1786	75	187	183	25	25	1993
53044440	1786	75	187	183	25	25	1993
53044450	1786	75	187	183	25	25	1993
53044460	1786	75	187	183	25	25	1993

Table 4 – GMA Monitors for Pressure Sensors GP9 – GP14 and ECU Reference Temperature T1

2 FSW SF_VEH_TIME1 F I12	DE_GMA _____ G P9 ANY F E14.7	DE_GMA _____ G P10 ANY F E14.7	DE_GMA _____ G P11 ANY F E14.7	DE_GMA _____ G P12 ANY F E14.7	DE_GMA _____ G P13 ANY F E14.7	DE_GMA _____ G P14 ANY F E14.7	TE_ECU_AFT SDT1 ANY F E14.7
53044000	0	0	0	0	0	0	0
53044010	25	299	25	25	299	299	308
53044020	25	299	25	25	299	299	308
53044030	25	299	25	25	299	299	308
53044040	25	299	25	25	299	299	308
53044050	25	299	25	25	299	299	308
53044060	25	299	25	25	299	299	308
53044070	25	299	25	25	299	299	308
53044080	25	299	25	25	299	299	308
53044090	25	299	25	25	299	299	308
53044100	25	299	25	25	299	299	308
53044110	25	299	25	25	299	299	308
53044120	25	299	25	25	299	299	308
53044130	25	299	25	25	299	299	308
53044140	25	299	25	25	299	299	308
53044150	25	299	25	25	299	299	308
53044160	25	299	25	25	299	299	308
53044170	25	299	25	25	299	299	308
53044180	25	299	25	25	299	299	308
53044190	25	299	25	25	299	299	308
53044200	25	299	25	25	299	299	308
53044210	25	299	25	25	299	299	308
53044220	25	299	25	25	299	299	308
53044230	25	299	25	25	299	299	308
53044240	25	299	25	25	299	299	308
53044250	25	299	25	25	299	299	308
53044260	25	299	25	25	299	299	308
53044270	25	299	25	25	299	299	308
53044280	25	299	25	25	299	299	308
53044290	25	299	25	25	299	299	308
53044300	25	299	25	25	299	299	308
53044310	25	299	25	25	299	299	308
53044320	25	299	25	25	299	299	308
53044330	25	299	25	25	299	299	308
53044340	25	299	25	25	299	299	308
53044350	25	299	25	25	299	299	308
53044360	25	299	25	25	299	299	308
53044370	25	299	25	25	299	299	308
53044380	25	299	25	25	299	299	308
53044390	25	299	25	25	299	299	308
53044400	25	299	25	25	299	299	308
53044410	25	299	25	25	299	299	308
53044420	25	299	25	25	299	299	308
53044430	25	299	25	25	299	299	308
53044440	25	299	25	25	299	299	308
53044450	25	299	25	25	299	299	308
53044460	25	299	25	25	299	299	308

Table 5 – GMA Monitors for Temperature Sensors ECU T2 and GMA 1A – 3B

2 FSW SF_VEH_TIME1 F112	TE_ECU_AFT SDT2 ANY F E14.7	TE_GMA_SDT_1 A ANY F E14.7	TE_GMA_SDT_1 B ANY F E14.7	TE_GMA_SDT_2 A ANY F E14.7	TE_GMA_SDT_2 B ANY F E14.7	TE_GMA_SDT_3 A ANY F E14.7	TE_GMA_SDT_3 B ANY F E14.7
53044000	0	0	0	0	0	0	0
53044010	307	298	300	299	298	298	298
53044020	307	298	300	299	298	299	298
53044030	307	298	300	299	298	298	297
53044040	307	298	300	299	298	299	298
53044050	307	298	300	299	298	298	298
53044060	307	298	300	299	298	299	298
53044070	306	298	300	299	298	298	298
53044080	307	298	300	299	299	298	298
53044090	307	298	300	299	299	299	298
53044100	309	298	300	299	298	298	298
53044110	307	298	300	299	298	299	298
53044120	307	298	299	299	298	298	297
53044130	307	298	300	299	298	298	298
53044140	307	298	300	299	298	298	297
53044150	307	298	300	299	298	298	298
53044160	307	299	300	299	298	298	298
53044170	307	298	300	299	298	298	298
53044180	307	298	300	299	299	299	297
53044190	307	298	300	299	298	299	297
53044200	307	298	300	299	298	298	298
53044210	307	298	299	299	299	298	298
53044220	309	299	300	299	298	299	298
53044230	307	299	300	299	298	298	298
53044240	307	298	300	299	299	298	297
53044250	307	298	300	299	298	298	298
53044260	307	298	300	299	298	298	297
53044270	307	298	300	299	299	298	298
53044280	307	298	300	299	299	299	298
53044290	307	298	300	299	298	299	297
53044300	307	298	300	299	298	298	297
53044310	307	298	300	299	298	298	298
53044320	307	298	300	299	298	298	298
53044330	307	298	301	299	298	299	298
53044340	307	298	300	299	298	298	297
53044350	307	298	300	299	298	298	298
53044360	307	298	300	299	298	299	297
53044370	307	298	301	299	299	298	297
53044380	307	298	300	299	298	299	297
53044390	307	298	300	299	298	298	298
53044400	307	298	301	299	298	299	297
53044410	309	298	300	299	298	298	298
53044420	309	298	300	299	298	298	298
53044430	307	298	300	299	298	298	298
53044440	307	298	300	299	299	299	298
53044450	307	298	300	299	298	298	297
53044460	307	298	300	299	299	298	298

Conclusion:

The GMA instrumentation clearly demonstrates that it provides temperature and pressure telemetry that is sufficient for evaluating the performance of the GMA in the flight configuration.