CR-203636

Report 10458
Revised
August 1995

GENCORP
AEROJET

Earth Observing System/ Advanced Microwave Sounding Unit-A (EOS/AMSU-A) Firmware Requirements

Contract No: NAS 5-32314
CDRL: 306-2b

Submitted to:

National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771

Submitted by:

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Section 1

INTRODUCTION

1.1 Identification

This is the *Firmware Requirements Document* for the firmware to be used in the Earth Observing System (EOS) Advanced Microwave Sounding Unit-A (AMSU-A) instrument.. This document is submitted in response to Contract NAS 5-32314 as CDRL 306-2b. (CDRL 306-2a is the companion "Software Requirements document.")

1.2 Scope

This document describes the firmware requirements for the EOS/AMSU-A instrument.

1.3 Purpose and Objectives

The purpose of the *Firmware Requirements Document* is to specify the functional, performance, and interface requirements of the firmware. It also specifies the major characteristics, implementation constraints, and design goals of the firmware.

1.4 Document Status and Schedule

This is the revised submittal of the EOS/AMSU-A *Firmware Requirements Document*. A final version will be submitted prior to the Software Acceptance Review.

1.5 Document Organization

The EOS/AMSU-A Software Documentation Tree is as shown in Figure 1.

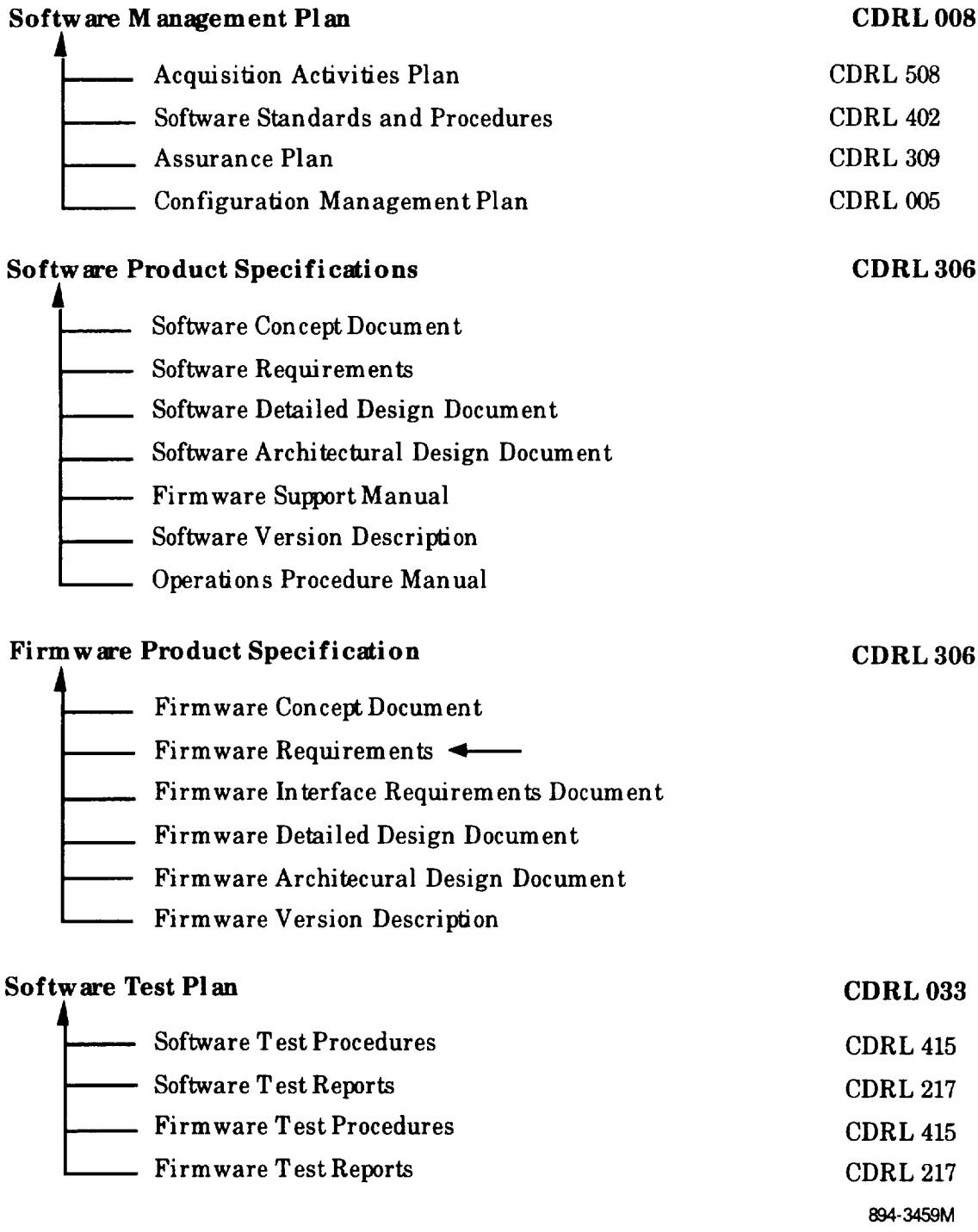

Figure 1 EOS/AMSU-A Software Documentation Tree

Section 2

RELATED DOCUMENTATION

2.1 Parent Documents

None.

2.2 Applicable Documents

The following documents are referenced or applicable to this report. Unless otherwise specified, the latest issue is in effect.

National Aeronautics and Space Administration

NASA-DID-999	Requirements Data Item Description.
GSFC 422-10-04	Earth Observing System (EOS) Instrument Project Software Acquisition Management Plan
GSFC 422-11-12-01	General Interface Requirements Document (GIRD)

2.3 Information Documents

None.

Section 3

REQUIREMENTS APPROACH AND TRADEOFFS

The AMSU-A Instrument Control Firmware requirements were determined by a Systems Engineering analysis of all the system requirements which resulted in an allocation of the requirements to the firmware. These allocations were based on what could be done most effectively in firmware as opposed to a total hardware solution.

A similar approach was taken in the selection of the MIL-STD-1553 hardware so as to maximize the use of integrated hardware devices, thus, minimizing the required firmware tasks in the command and Data Handling firmware. The firmware requirements were the result of the allocation of the General Interface Requirements document (GIRD) GSFC 422-121-12-01 requirements, that could not be accomplished in the hardware, to the firmware.

No further trade studies or requirements re-evaluations will be performed because the hardware selections have been made and the firmware requirements are completely defined.

Section 4

EXTERNAL INTERFACE REQUIREMENTS

The Instrument Control Firmware shall interface with the AMSU-A instrument through the use of Input/Output (I/O) ports and shall interface with the command and Data Handling (C&DH) firmware through a First In-First Out (FIFO) memory also interfaced through an I/O port. These I/O ports are each one byte (8 bits) in length and shall have bit allocations as shown in Figures 2 to 28 for AMSU-A1 and Figures 29 to 47 for AMSU-A2.

The Command and Data Handling (C&DH) firmware shall interface with the Instrument Control firmware through the FIFO memory through I/O ports and shall interface with the MIL-STD-1553 bus through a Random Access Memory (RAM). The I/O ports shall have bit allocations as shown in Figures 48 to 51.

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 00H Type Port: Input

Bit No.	Description
0	LSB MSP of Resolver for Antenna A1-1
1	MSP of Resolver for Antenna A1-1
2	MSP of Resolver for Antenna A1-1
3	MSP of Resolver for Antenna A1-1
4	MSP of Resolver for Antenna A1-1
5	MSP of Resolver for Antenna A1-1
6	MSP of Resolver for Antenna A1-1
7	MSB MSP of Resolver for Antenna A1-1

Notes: Logic active high

Figure 2 EOS/AMSU-A1 I/O Port Assignment Port 00H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 01H Type Port: Input

Bit No.	Description
0	Unused Connect to Gnd.
1	Unused Connect to Gnd.
2	LSB LSB of Resolver for Antenna A1-1
3	LSB of Resolver for Antenna A1-1
4	LSB of Resolver for Antenna A1-1
5	LSB of Resolver for Antenna A1-1
6	LSB of Resolver for Antenna A1-1
7	MSB LSB of Resolver for Antenna A1-1

Notes: Logic active high

Figure 3 EOS/AMSU-A1 I/O Port Assignment Port 01H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 02H Type Port: Input

Bit No.	Description
0	LSB MSP of Resolver for Antenna A1-2
1	MSP of Resolver for Antenna A1-2
2	MSP of Resolver for Antenna A1-2
3	MSP of Resolver for Antenna A1-2
4	MSP of Resolver for Antenna A1-2
5	MSP of Resolver for Antenna A1-2
6	MSP of Resolver for Antenna A1-2
7	MSB MSP of Resolver for Antenna A1-2

Notes: Logic active high

Figure 4 EOS/AMSU-A1 I/O Port Assignment Port 02H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 03H Type Port: Input

Bit No.	Description
0	Unused Connect to Gnd.
1	Unused Connect to Gnd.
2	LSB LSP of Resolver for Antenna A1-2
3	LSP of Resolver for Antenna A1-2
4	LSP of Resolver for Antenna A1-2
5	LSP of Resolver for Antenna A1-2
6	LSP of Resolver for Antenna A1-2
7	MSB LSP of Resolver for Antenna A1-2

Notes: Logic active high

Figure 5 EOS/AMSU-A1 I/O Port Assignment Port 03H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 04H Type Port: Input

Bit No.	Description
0	Spare Command Input.
1	PLL Power Cmd 0 = Use Redundant PLL 1 = Use Primary PLL
2	Module Totally Off Cmd 0 = Not Off 1 = Off
3	Scanner 1 Power Cmd 0 = Off 1 = On
4	Scanner 2 Power Cmd 0 = Off 1 = On
5	Cold Cal Position Cmd, LSB
6	Cold Cal Position Cmd, MSB
7	Spare Cmd Input

Notes:
For input signals
logic 0 = 10V, logic 1 = 0V at the input connector.
Signals are inverted prior to entering the computer.
Within the computer logic active high.

Figure 6 EOS/AMSU-A1 I/O Port Assignment Port 04H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 05H Type Port: Input

Bit No.	Description
0	Spare Cmd Input
1	Full Scan Mode Cmd 0 = Not Full Scan Mode 1 = Full Scan Mode
2	Warm Calibration Mode Cmd 0 = Not Warm Calibration Mode 1 = Warm Calibration Mode
3	Cold Calibration Mode Cmd 0 = Not Cold Calibration Mode 1 = Cold Calibration Mode
4	Nadir Mode Cmd 0 = Not Nadir Mode 1 = Nadir Mode
5	Spare Cmd Input
6	Spare
7	Spare Cmd Input

Notes:
For input signals
logic 0 = 10V, logic 1 = 0V at the input connector.
Signals are inverted prior to entering the computer.
Logic active high.

Figure 7 EOS/AMSU-A1 I/O Port Assignment Port 05H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 06H Type Port: Input

Bit No.	Description
0	LSB GSE Command
1	GSE Command
2	MSP GSE Command
3	Spare Command Input
4	Spare Command Input
5	Spare Command Input
6	Unused
7	Unused

Notes: For input signals logic 0 = 5V, logic 1 = 0V at the input connector.

Signals are inverted prior to entering the computer.

Figure 8 EOS/AMSU-A1 I/O Port Assignment Port 06H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 12H Type Port: Input

Bit No.	Description
0	FIFO Ready 0 = Ready to accept data 1 = Not ready to accept data
1	Scanner A1-1 Power * 0 = Off 1 = On
2	Scanner A1-2 Power * 0 = Off 1 = On
3	PLL Power * 0 = Redundant 1 = Primary
4	Survival Heater Power * 0 = Off 1 = On
5	Unused
6	Unused
7	Unused

Notes: Logic active high.

* Current digital "B" status as read from system.

Figure 9 EOS/AMSU-A1 I/O Port Assignment Port 12H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 15H Type Port: Input

Bit No.	Description
0	INTCMPL 0 = Integration period not complete 1 = Integration period complete
1	TSCMPL 0 = Timing sequence not complete 1 = Timing sequence complete
2	Unused
3	Unused
4	DACBSY 0 = Conversion complete 1= DAC busy
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 10 EOS/AMSU-A1 I/O Port Assignment Port 15H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 16H Type Port: Input

Bit No.	Description
0	Unused Connect to Ground
1	LSB LSP of A/D Converter Output
2	LSP of A/D Converter Output
3	LSP of A/D Converter Output
4	LSP of A/D Converter Output
5	LSP of A/D Converter Output
6	LSP of A/D Converter Output
7	MSB LSP of A/D Converter Output

Notes: Logic active high

Figure 11 EOS/AMSU-A1 I/O Port Assignment Port 16H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 17H Type Port: Input

Bit No.	Description
0	LSB MSP of A/D Converter Output
1	MSP of A/D Converter Output
2	MSP of A/D Converter Output
3	MSP of A/D Converter Output
4	MSP of A/D Converter Output
5	MSP of A/D Converter Output
6	MSP of A/D Converter Output
7	MSB MSP of A/D Converter Output

Notes: Logic active high

Figure 12 EOS/AMSU-A1 I/O Port Assignment Port 17H, Input

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 00H Type Port: Output

Bit No.	Description
0	LSB MSP of Antenna A1-1 Position
1	MSP of Antenna A1-1 Position
2	MSP of Antenna A1-1 Position
3	MSP of Antenna A1-1 Position
4	MSP of Antenna A1-1 Position
5	MSP of Antenna A1-1 Position
6	MSP of Antenna A1-1 Position
7	MSB MSP of Antenna A1-1 Position

Notes: Logic active high

Figure 13 EOS/AMSU-A1 I/O Port Assignment Port 00H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 01H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	LSB LSP of Antenna A1-1 Position
3	LSP of Antenna A1-1 Position
4	LSP of Antenna A1-1 Position
5	LSP of Antenna A1-1 Position
6	LSP of Antenna A1-1 Position
7	MSB LSP of Antenna A1-1 Position

Notes: Logic active high

Figure 14 EOS/AMSU-A1 I/O Port Assignment Port 01H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 02H Type Port: Output

Bit No.	Description
0	LSB MSP of Antenna A1-2 Position
1	MSP of Antenna A1-2 Position
2	MSP of Antenna A1-2 Position
3	MSP of Antenna A1-2 Position
4	MSP of Antenna A1-2 Position
5	MSP of Antenna A1-2 Position
6	MSP of Antenna A1-2 Position
7	MSB MSP of Antenna A1-2 Position

Notes: Logic active high

Figure 15 EOS/AMSU-A1 I/O Port Assignment Port 02H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 03H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	LSB LSP of Antenna A1-2 Position
3	LSP of Antenna A1-2 Position
4	LSP of Antenna A1-2 Position
5	LSP of Antenna A1-2 Position
6	LSP of Antenna A1-2 Position
7	MSB LSP of Antenna A1-2 Position

Notes: Logic active high

Figure 16 EOS/AMSU-A1 I/O Port Assignment Port 03H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 04H Type Port: Output

Bit No.	Description
0	On/Off Control * 0 = Off 1 = On
1	Unused
2	Scanner 1 Power Positive pulse to activate
3	Scanner 2 Power Positive pulse to activate
4	PLL Power Positive pulse to activate Off = Redundant, On = Primary PLL
5	Unused
6	Unused
7	Master Power Off 0 = No action 1 = Turn module (instrument) power Off

Notes: * This signal is used in conjunction with the Channel Power, Scanner Power, and PLL Power lines. In order to apply power to a particular system; i.e., Scanner PWR 1 the On/Off Control line will be set high (On) and a positive pulse applied to the system to be activated; i.e., Scanner 1. Logic active high.

Figure 17 EOS/AMSU-A1 I/O Port Assignment Port 04H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 05H Type Port: Output

Bit No.	Description
0	Unused
1	Antenna in Full Scan Mode 0 = Not Full Scan Mode 1 = Full Scan Mode
2	Antenna in Warm Calibration Mode 0 = Not in Warm Calibration Mode 1 = Warm Calibration Mode
3	Antenna in Warm Calibration Mode 0 = Not in Cold Calibration Mode 1 = Cold Calibration Mode
4	Antenna in Nadir Mode 0 = Not in Nadir Mode 1 = Nadir Mode
5	LSB Cold Calibration Position
6	MSB Cold Calibration Position
7	Unused

Notes: These lines connect to the Digital "B" housekeeping output lines.

Logic active high.

Figure 18 EOS/AMSU-A1 I/O Port Assignment Port 05H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 06H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 19 EOS/AMSU-A1 I/O Port Assignment Port 06H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 10H Type Port: Output

Bit No.	Description
0	LSB Data to FIFO, LSP
1	Data to FIFO, LSP
2	Data to FIFO, LSP
3	Data to FIFO, LSP
4	Data to FIFO, LSP
5	Data to FIFO, LSP
6	Data to FIFO, LSP
7	MSB Data to FIFO, LSP

Notes: Logic active high

Figure 20 EOS/AMSU-A1 I/O Port Assignment Port 10H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 11H Type Port: Output

Bit No.	Description
0	LSB Data to FIFO, MSP
1	Data to FIFO, MSP
2	Data to FIFO, MSP
3	Data to FIFO, MSP
4	Data to FIFO, MSP
5	Data to FIFO, MSP
6	Data to FIFO, MSP
7	MSB Data to FIFO, MSP

Notes: Logic active high

Figure 21 EOS/AMSU-A1 I/O Port Assignment Port 11H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 12H Type Port: Output

Bit No.	Description
0	FIFO write + pulse to write
1	FIFO reset + pulse to reset
2	
3	
4	
5	
6	
7	

Notes: Logic active high

Figure 22 EOS/AMSU-A1 I/O Port Assignment Port 12H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 13H Type Port: Output

Bit No.	Description
0	LSB Temp Sensor Mux Address
1	Temp Sensor Mux Address
2	Temp Sensor Mux Address
3	MSB Temp Sensor Mux Address
4	LSB Radiometer Mux Address
5	Radiometer Mux Address
6	Radiometer Mux Address
7	MSB Radiometer Mux Address

Notes: Logic active high

Figure 23 EOS/AMSU-A1 I/O Port Assignment Port 13H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 14H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Antenna Address Strobe (Antennas A1-1 and A1-2) 0 = Normal + pulse strobe antenna addr in data latch
5	Conv Negative pulse to start A/D conversion
6	INTCMD Positive pulse to start generation of I/H & Dump signals. Must be >0.125 msec.
7	Latch Resolver Data (Antennas A1-1 and A1-2) 0 = Normal 1 = Latched (Data does not follow pos.)

Notes: Logic active high

Figure 24 EOS/AMSU-A1 I/O Port Assignment Port 14H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 00H Type Port: Input

Bit No.	Description
0	LSB MSP of Resolver for Antenna A2
1	MSP of Resolver for Antenna A2
2	MSP of Resolver for Antenna A2
3	MSP of Resolver for Antenna A2
4	MSP of Resolver for Antenna A2
5	MSP of Resolver for Antenna A2
6	MSP of Resolver for Antenna A2
7	MSB MSP of Resolver for Antenna A2

Notes: Logic active high

Figure 25 EOS/AMSU-A2 I/O Port Assignment Port 00H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 01H Type Port: Input

Bit No.	Description
0	Unused Connect to Gnd.
1	Unused Connect to Gnd.
2	LSB LSP of Resolver for Antenna A2
3	LSP of Resolver for Antenna A2
4	LSP of Resolver for Antenna A2
5	LSP of Resolver for Antenna A2
6	LSP of Resolver for Antenna A2
7	MSB LSP of Resolver for Antenna A2

Notes: Logic active high

Figure 26 EOS/AMSU-A2 I/O Port Assignment Port 01H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 02H Type Port: Input

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 27 EOS/AMSU-A2 I/O Port Assignment Port 02H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 03H Type Port: Input

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	
4	
5	
6	
7	

Notes: Logic active high

Figure 28 EOS/AMSU-A2 I/O Port Assignment Port 03H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 04H Type Port: Input

Bit No.	Description
0	Spare Command Input.
1	Unused
2	Module Totally Off Cmd 0 = Not Off 1 = Off
3	Scanner 1 Power Cmd 0 = Off 1 = On
4	Unused
5	Cold Cal Position Cmd, LSB
6	Cold Cal Position Cmd, MSB
7	Spare Cmd Input

Notes:
For input signals
logic 0 = 10V, logic 1 = 0V at the input connector.
Signals are inverted prior to entering the computer.
Within the computer logic active high.

Figure 29 EOS/AMSU-A2 I/O Port Assignment Port 04H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 05H Type Port: Input

Bit No.	Description
0	Spare Cmd Input
1	Full Scan Mode Cmd 0 = Not Full Scan Mode 1 = Full Scan Mode
2	Warm Calibration Mode Cmd 0 = Not Warm Calibration Mode 1 = Warm Calibration Mode
3	Cold Calibration Mode Cmd 0 = Not Cold Calibration Mode 1 = Cold Calibration Mode
4	Nadir Mode Cmd 0 = Not Nadir Mode 1 = Nadir Mode
5	Spare Cmd Input
6	Spare
7	Spare Cmd Input

Notes:
For input signals
logic 0 = 10V, logic 1 = 0V at the input connector.
Signals are inverted prior to entering the computer.
Logic active high.

Figure 30 EOS/AMSU-A2 I/O Port Assignment Port 05H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 06H Type Port: Input

Bit No.	Description
0	LSB GSE Command
1	GSE Command
2	MSB GSE Command
3	Spare Command Input
4	Spare Command Input
5	Spare Command Input
6	Unused
7	Unused

Notes: For input signals logic 0 = 5V, logic 1 = 0V at the input connector.

Signals are inverted prior to entering the computer.

Figure 31 EOS/AMSU-A2 I/O Port Assignment Port 06H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 12H Type Port: Input

Bit No.	Description
0	FIFO Ready 0 = Ready to accept data 1 = Not ready to accept data
1	Scanner A2 Power 0 = Off 1 = On
2	Unused
3	Unused
4	Survival Heater Power 0 = Off 1 = On
5	Unused
6	Unused
7	Unused

Notes: Logic active high

* Current digital "B" status as read from system.

Figure 32 EOS/AMSU-A2 I/O Port Assignment Port 12H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 15H Type Port: Input

Bit No.	Description
0	INTCMPL 0 = Integration period not complete 1 = Integration period complete
1	TSCMPL 0 = Timing sequence not complete 1 = Timing sequence complete
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 33 EOS/AMSU-A2 I/O Port Assignment Port 15H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 16H Type Port: Input

Bit No.	Description
0	Unused Connect to Ground
1	LSB LSP of A/D Converter Output
2	LSP of A/D Converter Output
3	LSP of A/D Converter Output
4	LSP of A/D Converter Output
5	LSP of A/D Converter Output
6	LSP of A/D Converter Output
7	MSB LSP of A/D Converter Output

Notes: Logic active high

Figure 34 EOS/AMSU-A2 I/O Port Assignment Port 16H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 17H Type Port: Input

Bit No.	Description
0	LSB MSP of A/D Converter Output
1	MSP of A/D Converter Output
2	MSP of A/D Converter Output
3	MSP of A/D Converter Output
4	MSP of A/D Converter Output
5	MSP of A/D Converter Output
6	MSP of A/D Converter Output
7	MSB MSP of A/D Converter Output

Notes: Logic active high

Figure 35 EOS/AMSU-A2 I/O Port Assignment Port 17H, Input

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 00H Type Port: Output

Bit No.	Description
0	LSB MSP of Antenna A2 Position
1	MSP of Antenna A2 Position
2	MSP of Antenna A2 Position
3	MSP of Antenna A2 Position
4	MSP of Antenna A2 Position
5	MSP of Antenna A2 Position
6	MSP of Antenna A2 Position
7	MSB MSP of Antenna A2 Position

Notes: Logic active high

Figure 36 EOS/AMSU-A2 I/O Port Assignment Port 00H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 01H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	LSB LSP of Antenna A2 Position
3	LSP of Antenna A2 Position
4	LSP of Antenna A2 Position
5	LSP of Antenna A2 Position
6	LSP of Antenna A2 Position
7	MSB LSP of Antenna A2 Position

Notes: Logic active high

Figure 37 EOS/AMSU-A2 I/O Port Assignment Port 01H, Output

EOS/AMSU-A1

I/O PORT ASSIGNMENTS

Port No: 02H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 38 EOS/AMSU-A2 I/O Port Assignment Port 02H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 03H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 39 EOS/AMSU-A2 I/O Port Assignment Port 03H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 04H Type Port: Output

Bit No.	Description
0	On/Off Control * 0 = Off 1 = On
1	Unused
2	Scanner 1 Power Positive pulse to activate
3	Unused
4	Unused
5	Unused
6	Unused
7	Master Power Off 0 = No action 1 = Turn module (instrument) power Off

Notes: * This signal is used in conjunction with the Channel Power, Scanner Power, and PLL Power lines. In order to apply power to a particular system; i.e., Scanner PWR 1, the On/Off control line will be set high (On) and a positive pulse applied to the system to be activated; i.e., Scanner 1. Logic active high.

Figure 40 EOS/AMSU-A2 I/O Port Assignment Port 04H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 05H Type Port: Output

Bit No.	Description
0	Unused
1	Antenna in Full Scan Mode 0 = Not Full Scan Mode 1 = Full Scan Mode
2	Antenna in Warm Calibration Mode 0 = Not in Warm Calibration Mode 1 = Warm Calibration Mode
3	Antenna in Cold Calibration Mode 0 = Not in Cold Calibration Mode 1 = Cold Calibration Mode
4	Antenna in Nadir Mode 0 = Not in Nadir Mode 1 = Nadir Mode
5	LSB Cold Calibration Position
6	MSB Cold Calibration Position
7	Unused

Notes: These lines connect to the Digital "B" housekeeping output lines.

Logic active high.

Figure 41 EOS/AMSU-A2 I/O Port Assignment Port 05H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 06H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Unused
5	Unused
6	Unused
7	Unused

Notes: Logic active high

Figure 42 EOS/AMSU-A2 I/O Port Assignment Port 06H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 10H Type Port: Output

Bit No.	Description
0	LSB Data to FIFO, LSP
1	Data to FIFO, LSP
2	Data to FIFO, LSP
3	Data to FIFO, LSP
4	Data to FIFO, LSP
5	Data to FIFO, LSP
6	Data to FIFO, LSP
7	MSB Data to FIFO, LSP

Notes: Logic active high

Figure 43 EOS/AMSU-A2 I/O Port Assignment Port 10H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 11H Type Port: Output

Bit No.	Description
0	LSB Data to FIFO, MSP
1	Data to FIFO, MSP
2	Data to FIFO, MSP
3	Data to FIFO, MSP
4	Data to FIFO, MSP
5	Data to FIFO, MSP
6	Data to FIFO, MSP
7	MSB Data to FIFO, MSP

Notes: Logic active high

Figure 44 EOS/AMSU-A2 I/O Port Assignment Port 11H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 12H Type Port: Output

Bit No.	Description
0	FIFO write + pulse to write
1	FIFO reset + pulse to reset
2	
3	
4	
5	
6	
7	

Notes: Logic active high

Figure 45 EOS/AMSU-A2 I/O Port Assignment Port 12H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 13H Type Port: Output

Bit No.	Description
0	LSB Temp Sensor Mux Address
1	Temp Sensor Mux Address
2	Temp Sensor Mux Address
3	MSB Temp Sensor Mux Address
4	LSB Radiometer Mux Address
5	Radiometer Mux Address
6	Radiometer Mux Address
7	MSB Radiometer Mux Address

Notes: Logic active high

Figure 46 EOS/AMSU-A2 I/O Port Assignment Port 13H, Output

EOS/AMSU-A2

I/O PORT ASSIGNMENTS

Port No: 14H Type Port: Output

Bit No.	Description
0	Unused
1	Unused
2	Unused
3	Unused
4	Antenna Address Strobe (Antenna A2) 0 = Normal + pulse strobe antenna addr in data latch
5	Conv Negative pulse to start A/D conversion
6	INTCMD Positive pulse to start generation of I/H & Dump signals. Must be >0.125 msec.
7	Latch Resolver Data (Antenna A2) 0 = Normal 1 = Latched (Data does not follow pos.)

Notes: Logic active high

Figure 47 EOS/AMSU-A2 I/O Port Assignment Port 14H, Output

C&DH

I/O PORT ASSIGNMENTS

Port No: 00H Type Port: Input

Bit No.	Description
0	LSB Data from digital processor
1	Data from digital processor
2	Data from digital processor
3	Data from digital processor
4	Data from digital processor
5	Data from digital processor
6	Data from digital processor
7	MSB Data from digital processor

Notes: Logic active high

Figure 48 C&DH I/O Port Assignment Port 00H, Input

C&DH

I/O PORT ASSIGNMENTS

Port No: 41H Type Port: Input

Bit No.	Description
0	FIFO Empty Flag 0 = Empty 1 = Not empty
1	
2	
3	
4	
5	
6	
7	

Notes: Logic active high

Figure 49 C&DH I/O Port Assignment Port 41H, Input

C&DH

I/O PORT ASSIGNMENTS

Port No: 42H Type Port: Output

Bit No.	Description
0	LSB Commands to digital processor
1	Commands to digital processor
2	Commands to digital processor
3	Commands to digital processor
4	Commands to digital processor
5	Commands to digital processor
6	Commands to digital processor
7	MSB Commands to digital processor

Notes: Logic active high

Figure 50 C&DH I/O Port Assignment Port 42H, Output

C&DH

I/O PORT ASSIGNMENTS

Port No: 43H Type Port: Output

Bit No.	Description
0	Command Strobe 1 + pulse to strobe command into digital processor port 04H
1	Command Strobe 2 + pulse to strobe command into digital processor port 05H
2	8-Second Sync Pulse
3	
4	
5	
6	
7	

Notes: Logic active high

Figure 51 C&DH I/O Port Assignment Port 43H, Output

Section 5

REQUIREMENTS SPECIFICATION

5.1 Process and Data Requirements

5.1.1 Instrument control Firmware for EOS/AMSU-A1

The Instrument Control Firmware shall read the following data from the EOS/AMSU-A1 instrument and C&DH interface through the corresponding I/O ports:

No.	Data Element	Number of Bits	I/O Port Location
1.	A1-1 Antenna Resolver	14	8 bits from Input Port #0 6 bits from Input Port #1
2.	A1-2 Antenna Resolver	14	8 bits from Input Port #2 6 bits from Input Port #3
3.	PLL Power Command	1	Input Port #4 bit #1
4.	Module Totally Off Command	1	Input Port #4 bit #2
5.	Scanner 1 Power Command	1	Input Port #4 bit #3
6.	Scanner 2 Power Command	1	Input Port #4 bit #4
7.	Cold Cal Position Command	2	Input Port #4 bits #5 & 6
8.	Sensor Mode Command	4	Input Port #5 bits #1 - 4
9.	GSE Mode Commands	3	Input Port #6 bits #0 - 2
10.	FIFO Ready Flag	1	Input Port #12H bit #0
11.	Scanner 1 Power Status	1	Input Port #12H bit #1
12.	Scanner 2 Power Status	1	Input Port #12H bit #2
13.	PLL Power Status	1	Input Port #12H bit #3
14.	Survival Heater Power Status	1	Input Port #12H bit #4
15.	Integration Complete Status	1	Input Port #15H bit #0
16.	Timing Sequence Complete Status	1	Input Port #15H bit #1
17.	Analog to Digital Conversion Status	1	Input Port #15H bit #4
18.	Analog to Digital Converter Output	15	7 bits from Input Port #16H 8 bits from Input Port #17H

The Instrument control firmware shall write the following data to the EOS/AMSU-A1 instrument and the FIFO memory through the corresponding I/O ports:

No.	Data Element	Number of Bits	I/O Port Location
1.	A1-1 Antenna Resolver	14	8 bits to Output Port #0 6 bits to Output Port #1
2.	A1-2 Antenna Resolver	14	8 bits to Output Port #2 6 bits to Output Port #3
3.	Power On/Off Control	1	Output Port #4 bit #0
4.	Scanner 1 Power	1	Output Port #4 bit #2
5.	Scanner 2 Power	1	Output Port #4 bit #3
6.	PLL Power	1	Output Port #4 bit #4
7.	Master Power	1	Output Port #4 bit #7
8.	Antenna Mode	4	Output Port #5 bits #1 - 4
9.	Cold Cal Position	2	Output Port #5 bits #5 & 6
10.	Output Data to FIFO	16	8 bits to Output Port #10H 8 bits to Output Port #11H
11.	FIFO Write Pulse	1	Output Port #12H bit #0
12.	FIFO Reset Pulse	1	Output Port #12H bit #1
13.	Temp Sensor Mux Address	4	Output Port #13H bits #0 - #3
14.	Radiometer Mux Address	4	Output Port #13H bits #4 - #7
15.	Antenna Address Strobe	1	Output Port #14H bit #4
16.	Analog to Digital Convert Pulse	1	Output Port #14H bit #5
17.	Integrate/Hold Dump Pulse	1	Output Port #14H bit #6
18.	Latch Resolver Data Flag	1	Output Port #14H bit #7

The Instrument control Firmware shall perform the following functions for both EOS/AMSU-A1 and EOS/AMSU-A2:

1. Upon power up, initialize the system by setting the FIFO memory to zero, set scanner power of, switch to primary PLL, and place the antennas in the warm cal position.

2. Upon receipt of an 8-second sync pulse interrupt, begin the processing sequence to operate the scanner and output the data. The individual tasks required are:

   a) Output a data header including instrument status to the FIFO memory.

   b) Operate the scanner:

      1) Determine mode from input command.

      2) Sequence the antenna based on mode (each sequence shall be completed prior to next 8-second sync pulse interrupt).

      3) Test Antenna position and set error bit true or false.

      4) Read and place antenna position data into FIFO memory.

      5) Read and place radiometer data into FIFO memory.

   c) Read housekeeping data and place into FIFO memory.

   d) Read the commands from the input ports.

   e) For hardware control commands, send the appropriate pulse or level to the output ports.

   f) Read instrument power commands from the input port and turn on or off appropriate scanner, PLL, and main power as indicated.

5.1.2 Instrument Control Firmware for EOS/AMSU-A2

The Instrument Control Firmware shall read the following data from the EOS/AMSU-A2 instrument and the C&DH interface through the corresponding I/O ports.

No.	Data Element	Number of Bits	I/O Port Location
1.	Antenna Resolver	14	8 bits from Input Port #0 6 bits from Input Port #1
2.	Module Totally Off Command	1	Input Port #4 bit #2
3.	Scanner Power Command	1	Input Port #4 bit #3
4.	Cold Cal Position Command	1	Input Port #4 bits #5 & #6
5.	Scanner Mode Command	4	Input Port #5 bits #1 - #4
6.	GSE Commands	3	Input Port #6 bits #0 - #2
7.	FIFO Ready Flag	1	Input Port #12H bit #0
8.	Scanner Power Status	1	Input Port #12H bit #1
9.	Survival Heater Power Status	1	Input Port #12H bit #4
10.	Integration Complete Status	1	Input Port #15H bit #0
11.	Timing Sequence Complete Status	1	Input Port #15H bit #1
12.	Analog to Digital Converter Output	15	7 bits from Input Port #16H 8 bits from Input Port #17H

The Instrument Control Firmware shall write the following data to the EOS/AMSU-A2 instrument and the FIFO memory through the corresponding I/O ports:

No.	Data Element	Number of Bits	I/O Port Location
1.	A2 Antenna Position	14	8 bits to Output Port #0 6 bits to Output Port #1
2.	Power On/Off Control	1	Output Port #4 bit #0
3.	Scanner Power	1	Output Port #4 bit #2
4.	Master Power	1	Output Port #4 bit #7
5.	Antenna Mode	4	Output Port #5 bits #1 - #4
6.	Cold Cal Position	2	Output Port #5 bits #5 & #6
7.	Output Data to FIFO	16	8 bits to Output Port #10H 8 bits to Output Port #11H
8.	FIFO Write Pulse	1	Output Port #12H bit #0
9.	FIFO Reset Pulse	1	Output Port #12H bit #1
10.	Temp Sensor Mux Address	4	Output Port #13H bits #0 - #3
11.	Radiometer Mux Address	4	Output Port #13H bits #4 - #7
12.	Antenna Address Strobe	1	Output Port #14H bit #4
13.	Analog to Digital Convert Pulse	1	Output Port #14H bit #5
14.	Integrate/Hold/Dump Pulse	1	Output Port #14H bit #6
15.	Latch Resolver Data Flag	1	Output Port #14H bit #7

The instrument Control Firmware shall provide identical functions for EOS/AMSU-A2 as for EOS/AMSU-A1. These functions are described above in Paragraph 5.1.1.

5.1.3 Command and Data Handling Firmware

The Command and Data Handling Firmware will be identical for both EOS/AMSU-A1 and EOS/AMSU-A2. The input data shall come from two sources, the EOS/AMSU-A instrument and the MIL-STD-1553 interface to the spacecraft and the out put data shall go to the same 2 destinations. The input data form the MIL-STD-1533 interface will be memory mapped into a Random Access Memory (RAM) by the interface hardware. The EOS/AMSU-A instrument data will be placed in a FIFO Memory by the Instrument Control firmware.

The Command and Data Handling firmware shall read the FIFO data and the FIFO status through Input/Output ports:

No.	Data Element	Number of Bits	I/O Port Location
1.	AMSU-A Instrument Data	8	8 bits from Input Port #0
2.	FIFO Status	1	Input Port #41H bit #0

The output data to the MIL-STD-1553 interface will be memory mapped to the same RAM that is used as input from the MIL-STD-1553 interface. The EOS/AMSU-A instrument command and control output will be directed to Input Ports associated with the instrument and Data Handling firmware. This output will be routed through Input/Output ports:

No.	Data Element	Number of Bits	I/O Port Location
1.	AMSU-A Instrument Data	8	8 bits from Output Port #42H
2.	Command Strobe 1	1	Output Port #43H bit #0
3.	Command Strobe 2	1	Output Port #43H bit #1
4.	8-Second Sync Pulse	1	Output Port #43H bit #2

The command bit locations shall match the bit locations shown for commands located in Instrument Control Firmware Input Ports #4 and 5 and shall be sent 8 bits at a time controlled by Command Strobe 1 for LSP bits and Command Strobe 2 for MSP bits.

The command data handling firmware shall perform the following functions as the interface between the EOS/AMSU-A instrument and the MIL-STD-1553 bus:

1. Upon receipt of an instrument command, the firmware shall read the CCSDS header to verify a valid AMSU-A command input, and read the command word. If it is a valid input, restructure the bits of the command to match the input port 4 and 5 configuration of the Instrument control firmware and output this bit pattern.

2. Upon receipt of Synchronize with Data Time Mark command interrupt, the firmware shall read the low-order three its of the data word and, if this value equal 7, output the bit pattern that will generate the 8-second sync pulse to the Instrument Control firmware. This shall also be used to initiate all data output functions of the C&DH firmware.

3. Read Subaddress #28 and #29 to determine if previous data have been taken from the Shared RAM and new data may be moved from the instrument FIFO memory to Shared RAM.

4. Create the CCSDS header for the low-rate science data and place this header into the RAM location assigned for output transmission of low-rate science data.

5. Create the CCSDS header for the engineering data and place this header into the RAM location assigned for output transmission of engineering data.

6. Read the time code data from the RAM memory addresses associated with subaddress #6 and place the time data into the low-rate science header and the engineering data header.

7. Acquire the data from the EOS/AMSU-A instrument FIFO memory and place then into the RAM memory following the low-rate science data header.

8. Place the instrument data allocated to the engineering data output stream into the RAM memory following the engineering data header.

9. When a full block of data has been created in RAM memory, the ready flag shall be incremented in the corresponding subaddress memory location; subaddress #28 for engineering data, #29 for science data.

10. Upon receipt of the last data word for a full scan from the AMSU-A instrument is read, a checksum shall be placed in the engineering data stream and in the low-rate science data stream.

5.2 Performance and Quality Engineering Requirements

1. Each of the three CSCI shall not exceed 4096 bytes to reside in Programmable Read Only Memory (PROM) and not utilize more than 4096 bytes of RAM.

2. The Instrument Control Firmware CSCI shall be capable of completing all their required tasks within the 8 seconds between the 8-second sync pulse interrupts. The Command and Data Handling firmware CSCI shall be capable of receiving all sensor data within the same 8-second time frame, and capable of outputting the data at the required 3.2 kbps minimum data rate and receiving command data at the 3.2 kbps minimum rate.

3. The Instrument Control firmware shall be capable of recovering from any data error condition by restarting with each 8-second sync pulse interrupt. The Command and Data Handling Firmware shall validate all incoming data packets by their headers and reject any invalid packets.

5.3 Safety Requirements

Not applicable to embedded firmware.

5.4 Security and Privacy Requirements

Not applicable to embedded firmware.

5.5 Implementation Constraints

Each of the three CSCI shall be developed using an HP 64000 UX development system, or equivalent, utilizing 8085 assembler language. The two Instrument Control firmware CSCI shall be modified versions of existing firmware developed for the NOAA/AMSU-A program.

5.6 Site Adaptation

Not applicable for embedded firmware.

5.7 Design Goals

1. The three CSCI shall be designed to operate autonomously without error for the life of the EOS/AMSU-A instruments and, since they are burned into PROM memory, shall have no maintainability or portability requirements.

Section 6

TRACEABILITY TO PARENTS DESIGN

All requirements for the Command and Data Handling firmware were derived from the General Interface Requirements Document (GIRD) GSFC 422-11-12-01 Section 6.5. The allocation of the GIRD requirements to the firmware requirements are shown in Table X.

Table X Requirements Traceability

GIRD Requirements	GIRD Paragraph	Requirements Paragraph
Instrument Commands	6.5.6	5.1.3 (1)
Time Mark Transfer	6.5.7.1	5.1.3 (2)
Low-Rate Science Data Packetization	6.5.9.3	5.1.3 (3)
Engineering Data Packetization	6.5.8.2	5.1.3 (4)
Low-Rate Science Data Transfer	6.5.9.5	5.1.3 (5) & (7)
Engineering Data Transfer	6.5.6.4	5.1.3 (6) & (7)
Arithmetic Checksum	Figure 6-4	5.1.3 (8)
Time Code Transfer	6.5.7.2	5.1.3 (9)

Section 7

PARTITIONING FOR PHASED DELIVERY

The firmware will not be developed in stages, therefore this paragraph is not applicable.

Section 8

ABBREVIATIONS AND ACRONYMS

None.

Section 9

GLOSSARY

None.

Section 10

NOTES

None.

Section 11

APPENDIX

None.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (*Leave blank*)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED

4. TITLE AND SUBTITLE
Earth Observing System/Advanced Microwave Sounding Unit (EOS/AMSU-A), Firmware Requirements Document

5. FUNDING NUMBERS
NAS 5-32314

6. AUTHOR(S)
Robert Schwantje

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Aerojet
1100 W. Hollyvale
Azusa, CA 91702

8. PERFORMING ORGANIZATION REPORT NUMBER
CDRL 306-2b
10458
August 1995

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
NASA
Goddard Space Flight Center
Greenbelt, Maryland 20771

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
---

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

12b. DISTRIBUTION CODE
---

13. ABSTRACT (*Maximum 200 words*)

This Firmware Requirements Document specifies the functional, performance, and interface requirements of the firmware. It also specifies the major characteristics, implementation constraints, and design goals of the firmware.

14. SUBJECT TERMS
EOS
Microwave System

15. NUMBER OF PAGES
70

16. PRICE CODE
---

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std 239-18
298-102

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Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
---	---	---

4. Title and Subtitle	5. Report Date
Earth Observing System/Advanced Microwave Sounding Unit -A (AMSU-A), Firmware Requirements	August 1995
	6. Performing Organization Code: ---
7. Author(s): Robert Schwantje	8. Performing Organization Report No.: 10458, August 1995
	10. Work Unit No.: ---
9. Performing Organization Name and Address: Aerojet, 1100 W. Hollyvale, Azusa, CA 91702	11. Contract or Grant No.: NAS 5-32314
12. Sponsoring Agency Name and Address: NASA, Goddard Space Flight Center, Greenbelt, Maryland 20771	13. Type of Report and Period Covered: Final
	14. Sponsoring Agency Code: ---

15. Supplementary Notes

---

16. ABSTRACT (*Maximum 200 words*)

This Firmware Requirements Document specifies the functional, performance, and interface requirements of the firmware. It also specifies the major characteristics, implementation constraints, and design goals of the firmware.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
EOS Microwave System	Unclassified — Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of pages	22. Price
Unclassified	Unclassified	76	---

NASA FORM 1626 OCT 86

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Block 11. Contract or Grant No. Provide when applicable.

Block 12. Sponsoring Agency Name and Address. National Aeronautics and Space Administration, Washington, D.C. 20546-0001. If contractor report, add NASA installation or HQ program office.

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