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Engineering Telemetry Conversions ICD

MIT Center for Space Research

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1.0 Introduction

This document defines the conversion of externally read ACIS engineering telemetry into engineering units. All of these measurements are performed by the spacecraft Remote Command and Telemetry Unit (RCTU) and placed into the data stream independent of actions taken by the ACIS instrument itself, and are available in Formats 1 and 2.

2.0 Reference

Part Number	Version	Title
52100.200.063		Instrumentation Program and Command List (IP&CL)
D17387		AXAF-I Users' Guide to Remote Command and Telemetry Unit (RCTU)

3.0 Active and Passive Analog Telemetry

3.1 Items

Passive temperature transducers are read by the RCTU as voltages after the application of a 1.0ma current and converted to an 8 bit value with a scale factor of 20mv/bit. The active test points are read directly as voltages with the same scale factor.

TABLE 1.

Mnemonic	Description	Conversion Type	Constants	Units	Special Case?
1CB[AB]T	Camera Body Temperature	RTD		C	
1CR[AB]T	Cold Radiator Temperature	RTD		C	
1DACT[AB]T	Collimator Temperature	RTD		C	
1DAH[AB]VO	DA Heater Bus Voltage	Linear	a = 0.156 b = 0	V	
1DAH[AB]CU	DA Heater Output Current	Linear	a = 0.0200 b = 0	V	

TABLE 1.

Mnemonic	Description	Conversion Type	Constants	Units	Special Case?
1DAH[AB]T	DA Heater Control Status	Discrete			yes
1DAH[AB]VO	DA Heater Output Voltage	Linear	a = 0.1198 b = 0	V	
1DE28[AB]VO	DEA Input Voltage	Linear	a = 0.138 b = 0	V	
1DEAMZT	DEA -Z Temperature	ACIS thermistor		C	
1DEIC[AB]CU	DEA Input Current	Linear	a = -0.0704 b = 18.09	A	yes
1DEN0[AB]VO	DEA -6v Out	Linear	a = -0.0301 b = 0	V	
1DEN1[AB]VO	DEA -15v Out	Linear	a = -0.0769 b = 0	V	
1DEP0[AB]VO	DEA +6v Out	Linear	a = 0.0300 b = 0	V	
1DEP1[AB]VO	DEA +15v Out	Linear	a = 0.0781 b = 0	V	
1DEP2[AB]VO	DEA +24v Out	Linear	a = 0.120 b = 0	V	
1DEP3[AB]VO	DEA +28v Out	Linear	a = 0.150 b = 0	V	
1DP28[AB]VO	DPA Input Voltage	Linear	a = 0.138 b = 0	V	
1DPAMYT	DPA -Y Temperature	ACIS thermistor		C	
1DPAMZT	DPA -Z Temperature	ACIS thermistor		C	
1DPIC[AB]CU	DPA Input Current	Linear	a = 0.0101 b = 0	A	
1DPP0[AB]VO	DPA +5v Out	Linear	a = 0.022 b = 0	V	
1HOPRAPR	Differential Pressure	Linear	a = 0.284 b = -21.13	torr	
1HOPRBPR	Differential Pressure	Linear	a = 0.284 b = -19.10	torr	
1MAHC[AB]T	Door Close Actuator Temperature	PSMC thermistor		C	
1MAHO[AB]T	Door Open Actuator Temperature	PSMC thermistor		C	
1OAH[AB]T	Starsys Housing Temperature	RTD		C	
1PDEA[AB]T	PSMC DEA Pwb Temperature	RTD		C	
1PIN1AT	PSMC Lid Temperature	RTD		C	yes
1SSMYT	SS -Y (DPA) Temperature	ACIS thermistor		C	

TABLE 1.

Mnemonic	Description	Conversion Type	Constants	Units	Special Case?
1SSPYT	SS +Y (DEA) Temperature	ACIS thermistor		C	
1VAHC[AB]T	Vent Close Actuator Temperature	PSMC thermistor		C	
1VAHO[AB]T	Vent Open Actuator Temperature	PSMC thermistor		C	
1WR[AB]T	Warm Radiator Temperature	RTD		C	

TABLE 2.

Mnemonic	Special Case
1DAH[AB]T	See DA Heater Control Status below
1DEIC[AB]CU	If (1DEP3[AB]VO <= 10) a = 0, b = 0
1PIN1AT	Divide count by 1.99 before converting.

3.2 Conversions

Within this section the term *count* represents the value that the RCTU reads. It ranges from 0 to 255. The term *EU* represents the value converted to the appropriate engineering units.

3.2.1 Thermistor in parallel with 5.05K, buffered inside PSMC; units of C

```
if ( count < 10 )
EU = "--"
```

```
if ( count > 176 )
EU = "Cold"
```

```
else
aa = ( 5050 * count ) / ( 6175 - count )
qq = log( ( 152 * aa ) / ( 152 - aa ) )
EU = 1 / ( 1.074e-7 * qq * qq * qq + 2.372e-4 * qq + 1.4733e-3 ) - 273.16 + 15.0
```

3.2.2 RTD at 2K nominal; units of C

```
if ( count < 10 )
EU = "Short"
```

```
if ( count > 150 )
EU = "Open"
```

```
else
EU = -count * count * count * 3.181e-6 + count * count * 2.009e-3 + count * 2.218 -
238.67
```

3.2.3 Thermistor in parallel with 5.23K (MIT) excited by 1ma; units of C

```
if ( count < 10 )
EU = "Short"
```

```
if ( count > 245 )
EU = "Open"
```

```
else
aa = ( count * 20 * 5.23e3 ) / ( 5.23e3 - 20 * count )
qq = log(aa)
EU = 1 / (1.074e-7 * qq * qq * qq + 2.372e-4 * qq + 1.4733e-3) - 273.16
```

3.2.4 Linear volts, current, temperature, or pressure according to aN + b formula

```
if ( count > 253 )
EU = "+Error"
```

```
else
EU = count * a + b
```

3.2.5 DA Heater Control Status

```
if ( count > 224 )
EU = "Cold"
```

```
if ( count < 32 )
EU = "Hot"
```

```
else
EU = "OK"
```

4.0 Bi-level Telemetry

ACIS uses 8 bits of bi-level telemetry to read out hardware (4 bits) and software (4 bits) status.

4.1 Hardware LED's

TABLE 3.

Mnemonic	Description	0 =	1 =
1STA4ST	Active BEP	A	B
1STA5ST	BEP is held in the reset state	Yes	No
1STA6ST	BEP FIFO is full	Yes	No
1STA7ST	BEP FIFO is empty	Yes	No

4.2 Software LED's

In the following, value = 1STA3ST * 8 + 1STA2ST * 4 + 1STA1ST * 2 + 1STA0ST * 1

TABLE 4.

Value	Software State
0	Watchdog Science active - Blink State A
1	Watchdog Science active - Blink State B
2	Watchdog Science idle - Blink State A
3	Watchdog Science idle - Blink State B
4	Science active - Blink State A
5	Science active - Blink State B
6	Science idle - Blink State A
7	Science idle - Blink State B
8	Initializing loaded code
9	About to patch up linked code
10	About to execute up linked code
11	Copying packets from up link
12	Waiting for first up link packet
13	Spare (formerly Ready to execute ROM code)
14	Spare (formerly Copying code from ROM to RAM)
15	BEP just reset

5.0 Serial Digital Telemetry

The ACIS Power Supply and Mechanism Controller (PSMC) supplies a 32 bit word to the RCTU to indicate the discrete status of various voltages and mechanism states.

TABLE 5.

Byte	Bit	Mnemonic	Description	1 =	0 =
1	1	1LVDB[AB]ON	Small Vent Valve Power	Enabled	Disabled
1	2	1DEPS[AB]EN	DEA Power Supply	Enabled	Disabled
1	3	1DEDB[AB]ON	DEA Power Supply	Ready	Off
1	4	1DPDB[AB]ON	DPA Power Supply	Ready	Off
1	5	1DPPS[AB]EN	DPA Power Supply	Enabled	Disabled
1	6	1DPPS[AB]ON	DPA Power Supply	On	Off
1	7	1DPCP[AB]OC	DPA Power Supply Over-Current Protection	Trip	Off
1	8	spare bit	always 1		

TABLE 5.

Byte	Bit	Mnemonic	Description	1 =	0 =
2	1	1DABO[AB]EN	DA Bake Out	Enabled	Disabled
2	2	1DAHT[AB]EN	DA Normal Mode Heater	Enabled	Disabled
2	3	1DAHT[AB]ON	DA Normal Mode Heater	On	Off
2	4	1DE28[AB]OC	DEA Power Supply +28v Over-Current Protection	Trip	Off
2	5	spare bit	always 0		
2	6	spare bit	always 0		
2	7	1DEPS[AB]ON	DEA Power Supply	On	Off
2	8	1DEMV[AB]OC	DEA Power Supply Multi-Volt Over-Current Protection	Trip	Off
3	1	1MCAT[AB]TR	Door Actuator Status N.B. Side B is always 0.	In transition	--
3	2	1MEOP[AB]OP	Door Open Latch	--	Engaged
3	3	1MCDR[AB]CL	Door Close Actuator	Powered	Off
3	4	1MODR[AB]OP	Door Open Actuator	Powered	Off
3	5	1MDBU[AB]ON	Door Mechanism Power	Enabled	Disabled
3	6	1MIPW[AB]ON	Door Input Power	Available	--
3	7	1VVCL[AB]CL	Vent Valve Close Latch	--	Engaged
3	8	1DABO[AB]ON	DA Bake Out	On	Off
4	1	spare bit	always 0		
4	2	1VVAT[AB]TR	Vent Valve Actuator Status N.B. Side B is always 0.	In Transition	--
4	3	1VVOP[AB]OP	Vent Valve Open Latch	--	Engaged
4	4	1VVCD[AB]CL	Vent Valve Close Actuator	Powered	Off
4	5	1VVOD[AB]OP	Vent Valve Open Actuator	Powered	Off
4	6	1PRDB[AB]ON	Pressure Transducer Power	On	Off
4	7	1VVDB[AB]ON	Vent Valve Power	Enabled	Disabled
4	8	1MECL[AB]CL	Door Close Latch	--	Engaged