

JET PROPULSION LABORATORY**INTEROFFICE MEMORANDUM**

TO: Distribution S & I DFM 96-014
FROM: Tim Schofield 18th December 1996
SUBJECT: AIP data conversion expressions - Revision B.

REFERENCE(S): (1) AIP data conversion expressions, S & I DFM 96-013, 12th November 1996.

This memo corrects reference (1) for mis-assignments of W identifier number in the Aeroshell Instrumentation Package (AIP) platinum resistance thermometer (PRT) temperature sensors.

The cause of these mis-assignments is still not understood. They were originally noted during ASI/MET electrical interface testing on 20th June 1996, and these results were verified by the spacecraft temperature distribution observed during the first ASI/MET cruise health check on 16th December 1996. The assignment changes are as follows:

Identifier Was	Is
W - 2044	PRT1 (Backshell) PRT2 (Heatshield, Ref. for TC1-6)
W - 2045	PRT2 (Heatshield, Ref. for TC1-6) PRT3 (BIP, Ref. for TC7-9)
W - 2046	PRT3 (BIP, Ref. for TC7-9) PRT1 (Backshell)

where BIP stands for backshell interface plate.

The following GDS processing changes must be made to correct for scrambling noted above.

1. Rename W - 2044, W - 2045, and W - 2046, mnemonics in DMD displays.
2. Reassign W identifiers used in thermocouple engineering unit conversions.
3. The engineering conversions associated with each W identifier do not change.

The remainder of this memo is a corrected duplicate of reference (1).

Count to ADC Voltage conversion.

John Genofsky's conversions express physical parameters in terms of the ASI-MET 14 bit analog to digital converter (ADC) input voltage range of ± 3 Volts for each channel. Nominally, the relationship between counts and this voltage is given by the following expressions.

$$\text{Volts} = \text{Counts} \times 6/2^{14} \quad (\text{Counts } 8191)$$

$$\text{Volts} = \text{Counts} \times 6/2^{14} - 6 \quad (\text{Counts } 8192)$$

Counts must therefore be converted first into voltage and then into physical parameters using the expressions tabulated on the following page.

Parameter ADC Voltage to physical parameter conversion.

These expressions convert ADC input volts (V_{ADC}) to physical parameters for each ASI-MET channel.

Parameter 1 - TC1 - Heatshield Thermocouple 1 (W-2035)

The conversion from ADC volts to temperature for the thermocouples proceeds in four stages.

- a. Convert ADC input volts to thermocouple hot minus cold junction output voltage (V_{H-C}).

$$V_{H-C} \text{ (millivolts)} = 21.328 - 11.50 V_{ADC} \text{ (Volts)}$$

- b. Calculate thermocouple cold junction voltage (V_C) corresponding to T_{PRT2} , the temperature in °C measured by PRT2 (Parameter 10 - W-2044), using a polynomial fit to the nominal Type K (Chromel/Alumel) thermocouple temperature versus voltage curve.

$$V_C \text{ (millivolts)} = 2.91846 \times 10^{-2} + 3.93105 \times 10^{-2} T_{PRT2} + 5.97095 \times 10^{-6} T_{PRT2}^2 - 4.02608 \times 10^{-9} T_{PRT2}^3$$

- c. Calculate thermocouple hot junction voltage V_H by adding the measured voltage to V_C .

$$V_H \text{ (millivolts)} = V_C + V_{H-C}$$

- d. Calculate hot junction temperature corresponding to V_H , using a polynomial fit to the nominal Type K thermocouple temperature versus voltage curve.

$$T_H \text{ (}^\circ\text{C)} = -8.39166 \times 10^{-1} + 2.55089 \times 10^1 V_H - 9.45586 \times 10^{-2} V_H^2 + 1.55364 \times 10^{-3} V_H^3$$

Convert this temperature from °C to K by adding 273.15.

Parameter 2 - TC2 - Heatshield Thermocouple 2 (W-2036)

Identical to Parameter 1.

Parameter 3 - TC3 - Heatshield Thermocouple 3 (W-2037)

Identical to Parameter 1.

Parameter 4 - TC4 - Heatshield Thermocouple 4 (W-2038)

Identical to Parameter 1.

Parameter 5 - TC5 - Heatshield Thermocouple 5 (W-2039)

Identical to Parameter 1.

Parameter 6 - TC6 - Heatshield Thermocouple 6 (W-2040)

Identical to Parameter 1.

Parameter 7 - TC7 - BIP Thermocouple 1 (W-2041)

Identical to Parameter 1, but PRT3 (Parameter 11 - W-2045) substituted for PRT2 (Parameter 10 - W-2044) in step 1b.

Parameter 8 - TC8 - BIP Thermocouple 2 (W-2042).

Identical to parameter 7.

Parameter 9 - TC9 - BIP Thermocouple 3 (W-2043).

Identical to parameter 7.

Parameter 10 - PRT2 - Heatshield PRT (W-2044).

Two stage conversion; a. volts to sensor resistance, b. sensor resistance to temperature.

$$R(\text{Ohms}) = 699.3007 + 93.0233 V_{\text{ADC}}$$

$$\text{Temperature } (^\circ\text{C}) = -238.9485 + 0.44648 R + 7.45434 \times 10^{-5} R^2 - 2.34165 \times 10^{-8} R^3$$

The conversion includes nominal amplifier gain and offset plus a cubic fit to the PRT temperature v resistance calibration curves. Currently, the same calibration curve is used for all PRTs. Temperature should be converted to K by adding 273.15.

Parameter 11 - PRT 3 - BIP PRT (W-2045).

Two stage conversion; a. volts to sensor resistance, b. sensor resistance to temperature.

$$R(\text{Ohms}) = 606.0606 + 63.2911 V_{\text{ADC}}$$

$$\text{Temperature } (^\circ\text{C}) = -238.9485 + 0.44648 R + 7.45434 \times 10^{-5} R^2 - 2.34165 \times 10^{-8} R^3$$

The conversion includes nominal amplifier gain and offset plus a cubic fit to the PRT temperature v resistance calibration curves. Currently, the same calibration curve is used for all PRTs. Temperature should be converted to K by adding 273.15.

Parameter 12 - PRT1 - Backshell PRT (W-2046).

Identical to parameter 11, as variations between PRTs are currently being ignored.

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