REVISIONS			
SYMBOL	DESCRIPTION	DATE	APPROVAL
—	Initial Release	10/9/97	

SHEET REVISION STATUS

SH	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
REV	—	—	—	—	—	—	—	—	—	—	—									
SH	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
REV																				

ORIGINATOR: Antonio Reyes/Fairchild	DATE 9/22/97	**FSC: 5905**
APPROVED: J. A. Brusse/Unisys	9/30/97	Resistor, Fixed, Foil (Manganin), Chip, Power, Current Sensing, Surface Mount
CODE 311 APPROVAL: Michael Sampson	10/3/97	
CODE 311 SUPERVISORY APPROVAL: Ronald Chinnapongse	10/8/97	
ADDITIONAL APPROVAL: Karen Castell		**S-311-S-821**

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

CAGE CODE: 25306

1. SCOPE

1.1 Scope This specification covers the screening requirements for a fixed, manganin foil, precision, current sensing resistor in a surface mounted package. This chip resistor is intended for use in space flight hardware by the NASA Goddard Space Flight Center/MIDEX project.

1.2 Goddard part number. Parts screened to this specification shall be identified by a Goddard part number of the following form.

G311S821	-1R000	-1
Goddard Designator (See 1.3)	Resistance Value (See 1.4)	Tolerance (See 1.5)

1.3 Goddard designator. The designator denotes resistors as specified in Figure 1, Table 1 and Table 2 and 6.2 herein.

1.4 Resistance value. The nominal resistance value in ohms is specified by five characters. The letter R is used to signify the decimal point as in the following examples:

examples: 1R000 = 1.0 Ω
R0010 = 1.0 mΩ

The resistance value may be any value within the resistance range listed in Table 1.

1.5 Resistance tolerance. The resistance tolerance is identified by a dash number in accordance with Table 2.

2. APPLICABLE DOCUMENTS

2.1 Documents. The following documents, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

STANDARDS
MIL-STD- 202 Test Methods for Electronic and Electrical Component Parts

MIL-STD- 883 Test Methods and Procedures for Microelectronics

2.2 Order of precedence. In the event of any conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. However, nothing in this text shall supersede applicable laws and regulations unless a specific exemption has been obtained.

2.3 Copies of documents. Copies of federal and military documents can be obtained from the procuring activity.

3. REQUIREMENTS
Devices supplied to this specification shall meet the screening and qualification requirements specified herein.

3.1 Design and construction. Resistors shall be of the design and construction and dimensions depicted in Figure 1. The construction is based on an etched manganin foil resistor element laminated to an aluminum or copper base with an electrically isolating but thermally conductive adhesive. The manganin foil is connected to two massive copper terminals and encapsulated in a plastic package.

3.2 Package outline. This device shall conform to the package outline shown in figure 1.

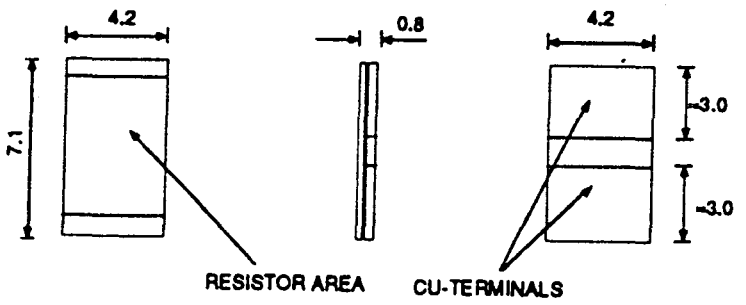
3.3 Pin-out configuration. The pin-out configuration for the device is as shown in figure 1.

3.4 Electrical Performance Characteristics. The electrical performance characteristics, shall be as specified in Table 1 herein and shall apply over the full operating temperature range.

3.4.1 Operating temperature range. The operating temperature range is -55 °C to 125 °C ambient.

3.4.2 Power rating. The power rating is based on continuous full load operation, not exceeding the maximum working current in free air at a rated ambient temperature of +25 °C (see Table 1). For higher temperatures, derating shall be in accordance with Figure 2.

Figure 1. Package Outline.



All dimensions are shown in millimeters

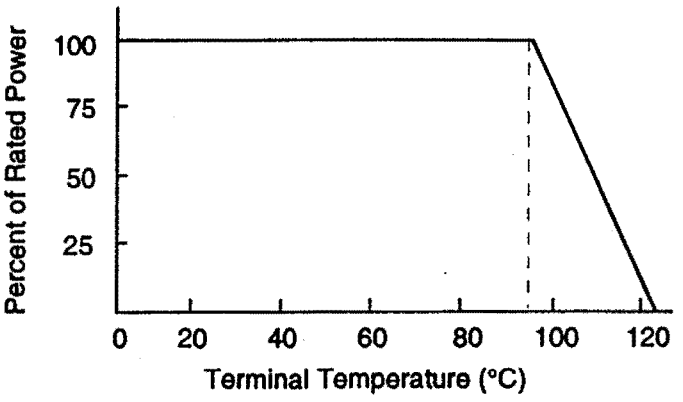
Table 1. Specification

Parameters	Range
Resistance Range	1 mΩ to 1.0 Ω
Temperature Coefficient of Resistance (20 °C to 60 °C)	< 50 ppm/°C
Power Rating	2 W
Dielectric Withstanding Voltage	50 VAC
Inductance	< 10 nH
Thermal Resistance to Ambiance	Rth < 15 °C/W
Stability (Nominal load @70 °C) after 2000 hrs	Deviation < 0.5%
Operating Temperature Range	-55 °C to 125 °C

Table 2. Resistance Tolerance

Resistance Tolerance	Dash Number
± 1.0%	-1
± 2.0%	-2

Figure 2. Derating



3.4.3 Voltage rating. Each resistor shall have a rated direct current (dc) continuous working voltage, or an approximate sine wave root-mean-square (rms) continuous working voltage at commercial line frequency and waveform, corresponding to the power rating as determined from the following formula:

$$E = \sqrt{PR}, \text{ where:}$$

E = rated dc or rms continuous working voltage
P = power rating (see 3.4.2)
R = nominal resistance (see Table 1)

3.5 DC resistance. When resistors are tested as specified in 4.5.2, the DC resistance shall be within the specified tolerance of the nominal resistance.

3.6 Thermal shock. When resistors are tested as specified in 4.5.3, there shall be no evidence of mechanical damage, and the change in resistance shall not exceed ±0.5%.

3.7 Temperature characteristic of resistance (TCR). When resistors are tested as specified in 4.5.4, the resistance temperature characteristic shall meet the requirement of Table 1.

3.8 Resistance to soldering heat. When resistors are tested as specified in 4.5.5, there shall be no evidence of mechanical damage, and the change in resistance shall not exceed ±0.5%

3.9 Solderability. When resistors are tested as specified in 4.5.6, the criteria for wire-lead terminal evaluation that is contained in the referenced test method shall be met.

3.10 Life. When resistors are tested as specified in 4.5.7, there shall be no evidence of mechanical damage, and the change in resistance shall not exceed ±0.75% (0 to 1000 hours).

3.11 Marking. The resistors which successfully complete all test and inspection, as defined by the Goddard part number and the applicable tables herein, shall be permanently marked with the Goddard part number in accordance with the following:

a. Marking shall in no way interfere with or obscure any of the original manufacturer's marking.
b. The number of lines shall be at discretion of the test facility or laboratory.
c. Marking shall be placed in such a manner to afford the most ready identification when the device is installed in its normal mounting configuration.

When space limitation prohibit the marking of the full Goddard part number as specified in 1.2, resistors shall then be individually packaged in suitable conductive bag(s) or container(s) for ESD control. The individual package shall display the full marking and shall include as a minimum:

a. The complete Goddard part number as specified in 1.2.
b. Manufacturer's identification.
c. Seal date code or inspection identification.

3.13 Data requirements. Attribute data resulting from screening test (see 4.3) shall be traceable to each lot of resistors and lot date code and shall accompany each shipment of resistors delivered to Goddard. Resistors which have passed the screening test may be delivered prior to the completion of QCI testing (see 4.4), with prior approval by Goddard.

3.14 Certification of conformance. A certification of conformance in accordance with this specification shall be provided with each lot of resistors.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. The test facility is responsible for the performance of all inspection requirements, as specified herein, using his own or any other suitable facility acceptable to Goddard. Upon receipt of product, Goddard reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to verify conformance to prescribed requirements.

4.2 Classification of inspection. Inspection requirements specified herein are classified as follows:

a. Screening (see 4.3).
b. Quality conformance inspection (QCI) (see 4.4).

4.3 Screening inspection. All resistors supplied to this drawing shall be subjected to the tests and inspections specified in Table 3 herein and shall be performed in the order shown. Resistors failing any of the tests of Table 3 shall be removed from the lot and shall not be delivered to Goddard.

4.4 Quality conformance inspection (QCI). Quality conformance inspection tests shall be performed in accordance with Table 4 herein on samples units selected from the production lot of resistors to be delivered to Goddard. Samples tested for any given Subgroup should not be used for testing in any other Subgroup of Table 4.

4.4.1 Accept/reject criteria. Devices that do not meet the specified requirements for each test shall be rejected. Failure to meet the accept/reject requirements of any Subgroup of Table 4 shall be cause for rejection of the part lot.

4.4.2 Disposition of QCI samples. Sample units which have been subjected to QCI inspection shall be considered destroyed. Samples units shall be packaged to indicate non-flight quality and shall accompany the QCI test report to Goddard.

4.4.3 Failure analysis of failures. All catastrophic failures (open or shorted failure modes) occurring during acceptance inspection shall be subjected to a failure analysis to determine the cause of failure. Devices that exhibit significant shifts in electrical parameters shall be candidates for analysis. The analysis shall be accomplished in detail to the extent necessary so that corrective action can be implemented. A detailed report shall be submitted to Goddard for review and approval.

4.5 Methods of inspection.

4.5.1 Visual and mechanical inspection. Resistors shall be examined to verify that materials, external design and construction, physical dimensions and marking are as specified herein.

4.5.2 DC resistance. Resistors shall be tested in accordance with Method 303 of MIL-STD-202. The following details and exceptions shall apply:

a. Measuring apparatus: The same measuring apparatus shall be used for any one test, but not necessarily for all tests.
b. Test voltage: The test voltage shall not exceed 1% of the rated working voltage (see 3. 4.3).
c. Points of measurements: Resistance measurements shall be obtained using the current leads identified in Figure 1.

4.5.3 Thermal shock. Resistors shall be tested in accordance with Method 107 of MIL-STD-202 at Test Condition B except the minimum temperature extreme shall be -55 °C.

4.5.4 Temperature characteristic of resistance. Resistors shall be tested in accordance with Method 304 of MIL-STD-202 except as modified herein.

a. QCI: The series of standard test temperatures shall be limited to +20 °C, -20 °C, +20 °C, and +60 °C.

4.5.5 Resistance to soldering heat. Resistors shall be tested in accordance with Method 210 of MIL-STD-202. The following details and exceptions shall apply:

a. Measure DC resistance before test per 4.5.2.
b. Samples units shall not have been soldered during any previous tests.
c. Test condition C.
d. Measure DC resistance per 4.5.2 after 45 minutes cooling period.
e. Examine each part for evidence of mechanical damage.

4.5.6 Solderability. Resistors shall be tested in accordance with Method 208 of MIL-STD-202

4.5.7 Life test. Resistors may be mounted on a test board and shall be subjected to a continuous temperature of +95 °C ±4 °C. The load applied shall be the maximum rated power (free air) not to exceed maximum working voltage for a continuous duration of 1000 hours, 48 hours, -0 hours (These resistors dissipate most of their heat via the terminations, so test pads and fixturing must provide sufficient heat sinking to prevent overheating). DC resistance shall be measured and recorded prior to the beginning of the life test and at 250, 500, and 1000 hours. The change in resistance at any interval shall not exceed ±0.75%.

5. PACKAGING

5.1 Preservation and packaging. Resistors shall be clean, dry, and individually packaged in a manner that will afford adequate protection against corrosion, deterioration, and physical damage during shipment.

5.2 Packing. The packaged resistors shall be packaged in shipping containers in a manner that will afford adequate protection against damage during shipment to NASA Goddard Space Flight Center.

5.3 Marking. Each unit package and exterior container shall include, as a minimum, the following:

a. Name of the screening house or test laboratory.
b. Goddard part number.
c. Goddard work order or purchase order number.

6. NOTES

6.1 Intended use. Resistors described herein are intended for use in electronic circuits where high reliability and precision are required.

6.2 Approved source(s) of supply.

NASA/GSFC Control Number	Manufacturer's Part Number	Resistance Value	Manufacturer's Name and Address
G311S821-1R000-1	SMT-1R00-1	1.0 Ω - 1%	ISOTEK Corp.
G311S821-1R000-2	SMT-1R00-2	1.0 Ω - 2%	566 Wilbur Avenue Swansea, MA 02777

Table 3. 100% Screening

Step	Test/Inspection	MIL-STD-202 Method (1)	Requirements
1	External Visual Inspection	MIL-STD-883, Method 2009	3X magnification (minimum)
2	DC Resistance Measurement (DCR)	303	T_A = 25 °C, Read and record,
3	Thermal Shock	107, Condition B	10 cycles, T_A = -55 °C to 125 °C
4	DC Resistance Measurement (DCR)	303	T_A = 25 °C, Read and record, Calculate ΔDCR, ΔDCR ≤ 0.5%
5	PDA calculation (2)		Acceptable if ≤ 10%
6	External Visual Inspection	MIL-STD-883, Method 2009	3X magnification (minimum). Verify no evidence of mechanical damage

(1) Test methods, procedures and exceptions are defined in 4.5 herein.

(2) Marking and cosmetic defects shall not be counted for purposes of calculating PDA.

Table 4. Quality Conformance Inspection (QCI)

Test/Inspection	MIL-STD-202 Method (1)	Requirements
Subgroup 1		3 samples (0 failures)
Solderability	208	
External Visual Inspection	MIL-STD-883, Method 2009	3X magnification (minimum). Verify no evidence of mechanical damage
Subgroup 2		9 samples (0 failures)
Thermal Shock	107, Condition B	5 cycles, T_A = -55 °C to 125 °C
Temperature Characteristic of Resistance (TCR)	304	Test temp sequence: +20 °C (Reference temp.) -20 °C, +20 °C, +60 °C TCR < 50 ppm/°C (+20 °C to +60 °C). (-20 °C to +20 °C measurements are required for information only)
Subgroup 3		6 samples (0 failures)
Resistance to Soldering Heat	210, Condition C	
DC Resistance Measurement (DCR)	303	T_A = 25 °C, Read and record, Calculate ΔDCR, ΔDCR ≤ 0.5%
External Visual Inspection	MIL-STD-883, Method 2009	3X magnification (minimum). Verify no evidence of mechanical damage

Table 4. Quality Conformance Inspection (QCI) (Continued)

Test/Inspection	MIL-STD-202 Method (1)	Requirements
Subgroup 4		6 samples (0 failures)
Life	108	1000 hours, T_A = 95 °C, P = 2W
DC Resistance Measurement (DCR)	303	T_A = 25 °C, Read and record, Calculate ΔDCR, ΔDCR ≤ 0.75%
External Visual Inspection	MIL-STD-883, Method 2009	3X magnification (minimum). Verify no evidence of mechanical damage

(1) Test methods, procedures and exceptions are defined in 4.5 herein and MIL-STD-202