REVISIONS			
LTR	**DESCRIPTION**	**DATE**	**APPROVED**
A	Add pure tin prohibition, manufacturer eligibility, and tin whisker paragraphs. Editorial changes throughout.	31 MAR 10	M. Radecki

Prepared in accordance with ASME Y14.100

Source control drawing

REV STATUS OF PAGES																		
	REV	A	A	A	A	A	A	A	A	A	A	A	A					
	PAGES	1	2	3	4	5	6	7	8	9	10	11	12					

PMIC N/A	**PREPARED BY** Jesus V. Garcia III	**DEFENSE SUPPLY CENTER, COLUMBUS** **COLUMBUS, OH**
Original date of drawing 3 October 2002	**CHECKED BY** Andrew Ernst	**TITLE** **RESISTORS, VARIABLE, NONWIRE WOUND (ADJUSTMENT TYPE, LEAD-SCREW ACTUATED) 1/2" RECTANGULAR, 0.3 WATTS**
	APPROVED BY Kendall A. Cottongim	
	SIZE A / **CODE IDENT. NO.** 037Z3	**DWG NO.** 02005
	REV A	**PAGE** 1 **OF** 12

1. SCOPE

1.1 Scope. This drawing describes the requirements for a 0.3 Watt, lead screw actuated, nonwire wound variable resistor.

1.2 Part or Identifying Number (PIN). The complete PIN is as follows:

02005	-	XXX
Drawing number		Resistance (see 3.3.1.1)

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-202	-	Test Method Standard Electronic and Electrical Components Parts.
MIL-STD-1285	-	Marking of Electrical and Electronic Parts.

* (Copies of these documents are available online at https://assist.daps.dla.mil/quicksearch/ or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

* 2.2 Order of precedence. Unless otherwise noted herein or in the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

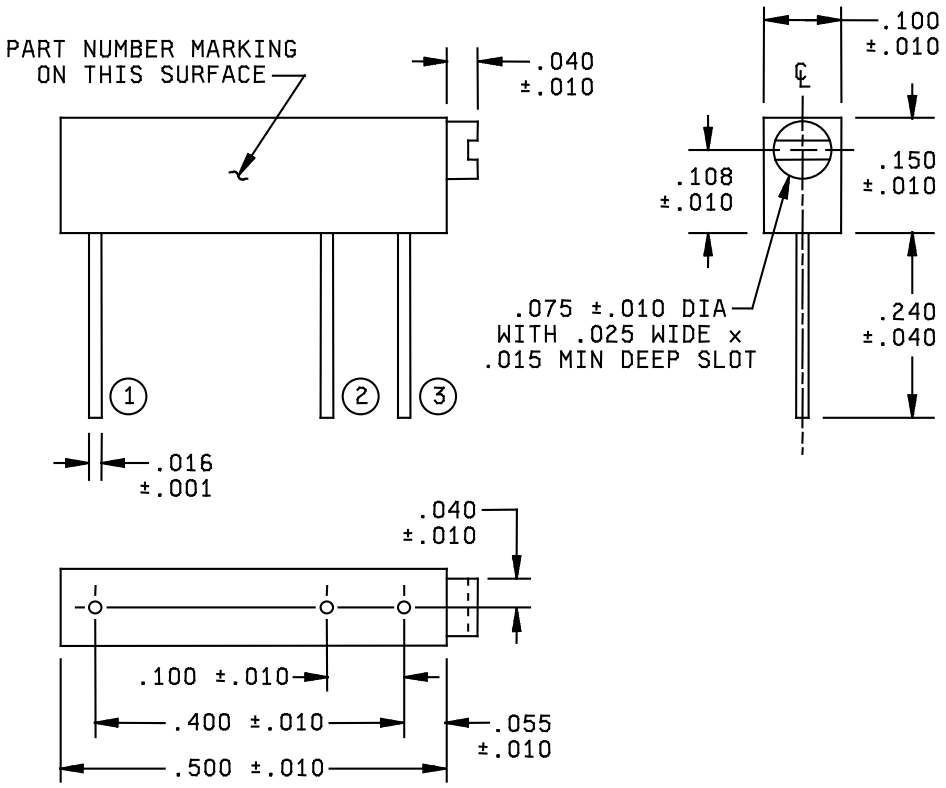
3. REQUIREMENTS

3.1 Item requirements. The individual item requirements shall be as specified herein.

3.2 Interface and physical dimensions. The resistor shall meet the interface and physical dimensions as specified herein (see figure 1).

3.3 Electrical characteristics.

3.3.1 Resistance. The nominal resistance expressed in ohms is identified by a three-digit number; the first two digits represent significant figures and the last digit specifies the number of zeros to follow. When resistance values less than 10 ohms are required, the letter "R" is substituted for one of the significant digits to represent the decimal point. The resistance may be of any value, but it is preferred that the standard values be chosen from table I.



Inches	mm	Inches	mm	Inches	mm
.001	0.0254	.040	1.016	.150	3.810
.010	0.254	.055	1.397	.240	6.100
.015	0.381	.075	1.905	.400	10.160
.016	0.406	.100	2.540	.500	12.700
.025	0.635	.108	2.743		

NOTE:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. The picturization of the resistor above is a given representative of the envelope of the item. Slight deviations from the outline shown (which are contained within the envelope, and do not alter the functional aspects of the device) are acceptable.

FIGURE 1. Resistor variable nonwire wound.

3.3.1.1 Resistance range. The resistance values are as specified in table I.

TABLE I. Resistance values.

Resistance code	Resistance	Resistance code	Resistance
100	10	502	5,000
200	20	103	10,000
500	50	203	20,000
101	100	503	50,000
201	200	104	100,000
501	500	204	200,000
102	1,000	504	500,000
202	2,000		

3.3.2 Resistance tolerance. The resistance tolerance shall be ±10 percent.

3.3.3 Power rating. The power rating shall be 0.3 watts at 85°C, derated to zero at 150°C.

3.3.4 Operating temperature. The operating temperature shall be -65°C to +150°C.

3.4 Resistance temperature characteristic. The resistance temperature characteristic shall be ±100 ppm/°C.

* 3.5 Pure tin. The use of pure tin, as an underplate or final finish is prohibited both internally and externally. Tin content of resistor components and solder shall not exceed 97 percent, by mass. Tin shall be alloyed with a minimum of 3 percent lead, by mass (see 6.3).

3.6 Conditioning. When resistors are tested as specified in 4.4, there shall be no mechanical damage. The change in total resistance shall not exceed ±2 percent.

3.7 Contact resistance variation. When measured as specified in 4.5, the contact resistance variation shall not exceed ±3 percent or 3 ohms, which ever is greater.

3.8 DC resistance.

3.8.1 Total resistance. When measured as specified in 4.6.1, the total direct current (dc) resistance shall not deviate from the specified nominal resistance (see 3.1), by more than ±10 percent.

3.8.2 End resistance. When measured as specified in 4.6.2, the end resistance for all characteristics shall not exceed 2 ohms or ±2 percent of the total resistance, which ever is greater.

3.9 Immersion. When resistors are tested as specified in 4.7, no continuous stream of bubbles shall emanate from any concentrated point of the resistor. When resistors are subjected to the dye penetrant test, there shall be no evidence of dye in the internal cavities.

3.10 Actual effective electrical travel. When resistors are tested as specified in 4.8, the number of turns of the operating shaft necessary for the contact arm to traverse the resistance element shall be as specified (see 3.1).

3.11 Dielectric withstanding voltage. When resistors are tested as specified in 4.9, there shall be no evidence of damage, arcing, or breakdown. The leakage current shall not exceed one milliampere.

3.12 Insulation resistance. When resistors are tested as specified in 4.10, the dry insulation resistance shall not be less than 1,000 megohms.

3.13 Torque.

3.13.1 Operating. When resistors are tested as specified in 4.11.1, the minimum torque required to move the contact arm shall be 0.05 ounce-inch and the maximum torque required shall be as specified (see 3.1).

3.13.2 Clutch. When resistors are tested as specified in 4.11.2, the contact arm shall idle against the stop without electrical discontinuity or evidence of mechanical damage. The travel of the contact arm shall also be capable of reversing direction.

3.14 Thermal shock. When resistors are tested as specified in 4.12, the change in total resistance shall not exceed ±1 percent. The change in setting stability shall not exceed ±1 percent. There shall be no electrical discontinuity or evidence of mechanical damage.

3.15 Solderability. When resistors are tested as specified in 4.13, they shall meet the criteria for wire-lead terminal evaluation in the test method.

3.16 Marking. Resistors shall be in accordance with MIL-STD-1285, except the resistors shall be marked with the PIN assigned herein, (see 1.2), manufacturer's identification (Commercial and Government Entity (CAGE) or logo), and date and lot codes.

3.17 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

* 3.18 Manufacturer eligibility. To be eligible for listing as an approved source of supply, a manufacturer shall perform the group A inspections specified herein on a sample agreed upon by the manufacturer and DSCC-VA.

* 3.18.1 Certificate of compliance. A certificate of compliance shall be required from manufacturers requesting to be listed as an approved source of supply.

3.19 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and parts shall be free from any defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Qualification inspection. Qualification inspection is not applicable to this document.

4.2 Conformance inspection.

4.2.1 Inspection of product for delivery. Inspection of product for delivery shall consist of the group A inspections.

4.2.1.1 Group A inspection. Group A inspection shall consist of the inspections specified in table II, and shall be made on the same set of sample units, in the order shown.

TABLE II. Group A inspection.

Inspection	Requirement paragraph	Test method paragraph	Sampling procedure
Subgroup 1 1/ 2/			
Conditioning	3.6	4.4	100 percent inspection
Contact resistance variation	3.7	4.5	
Total resistance 3/	3.8.1	4.6.1	
Immersion	3.9	4.7	
Subgroup 2 4/ 5/			
End resistance	3.8.2	4.6.2	4.3.2
Actual effective electrical travel	3.10	4.8	
Dielectric withstanding voltage	3.11	4.9	
Insulation resistance	3.12	4.10	
Torque	3.13	4.11	
Thermal shock	3.14	4.12	
Subgroup 3 4/ 6/			
Solderability	3.15	4.13	4.3.3

1/ 100 percent solder dip may be performed prior to immersion.
2/ At the manufacturer's option, the determination of resistance change may be by any method which is within the accuracy requirements of this specification.
3/ Resistors shall meet this specified initial resistance tolerance. The resistance measurement made upon completion of the power conditioning test may be used if a measurement was made which can, without conversion, be directly related to nominal resistance value and tolerance.
4/ At the option of the manufacturer, subgroup 2, and subgroup 3 may be performed concurrently with a separate set of samples.
5/ If the manufacturer can demonstrate that this test has been performed for 6 months with zero failures, the frequency of this test, with the approval of the qualifying activity, can be performed on an annual basis. If the design, material, construction, or processing of the part is changed, or if there are any quality problems or failures, the qualifying activity may require resumption of the original test frequency.
6/ The manufacturer may request the deletion of the subgroup 3 solderability test, provided an in-line or process control system for assessing and assuring the solderability of leads can be validated and approved by the qualifying activity. Deletion of the test does not relieve the manufacturer from meeting this test requirement in case of dispute. If the design, material, construction, or processing of the part is changed or if there are any quality problems, the qualifying activity may require resumption of the test.

4.3.1 Subgroup 1 Subgroup 1 tests shall be performed on 100 percent of the product supplied under this specification. Resistors that are out of resistance tolerance or which experience a change in resistance greater than that permitted for the tests of this subgroup shall be removed from the lot. Lots having more than 5 percent total rejects or one resistor, whichever is greater, due to exceeding the specified resistance change limit, shall not be furnished on the contract.

4.3.2 Subgroup 2. A sample of parts in accordance with table III shall be randomly selected, if one or more defects are found, the lot shall be rescreened and defects removed. A new sample of parts shall then be randomly selected. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied against this document.

TABLE III. Group A sampling plan.

Lot size	Sample size
1 to 8	100 percent
9 to 150	13
151 to 280	20
281 to 500	29
501 to 1,200	34
1,201 to 3,200	42
3,201 to 10,000	50
10,001 to 35,000	60
35,001 to 150,000	74
150,001 to 500,000	90
500,001 and over	102

4.3.3 Subgroup 3 (solderability). A sample of parts in accordance with table III shall be randomly selected, as an option, the manufacturer may use electrical rejects from subgroup I test for all or part of the sample. If there are one or more defects, the lot is rejected. The manufacturer may use the following for corrective action:

a. Each lot that was used to form the failed lot shall be individually submitted to the solderability test. Lots that pass the solderability test are available for shipment.

b. The failed lot is submitted to a 100 percent hot solder dip. A subsequent solderability test shall then be performed. If the lot passes, it is available for shipment; if the lot fails, the manufacturer may perform the hot solder dip one additional time. If the lot fails, the lot is considered rejected and shall not be supplied to this drawing.

4.3.3.1 Disposition of samples. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.

4.4 Conditioning (see 3.6). Resistors shall be conditioned in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of mounting: Supported by their terminals (resistors not mounted on life test chassis). Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no circulation of air over the resistors other than that caused by the heat of the resistors.

b. Temperature and tolerance: 25°C, +10°C, -5°C.

c. Initial measurements: Initial total resistance shall be measured at 25°C, +10°C, -5°C after mounting as specified in 4.6.1. This initial measurement shall be used as the reference temperature for all subsequent measurements.

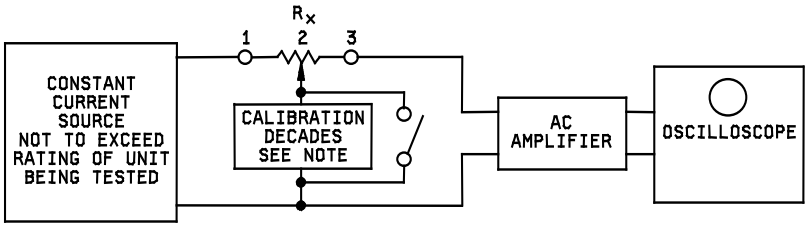
d. Operating condition: DC continuous working voltage or a continuous working voltage from an ac supply at commercial line frequency and waveform equivalent to 1.5 times the specified wattage (see 3.1), shall be applied between the end terminals intermittently 1.5 hours "on" and 0.5 hour "off" for a minimum of 50 hours +8 hours, -0 hours, at a temperature of 25°C, +10°C, -5°C. Each resistor shall dissipate 1.5 times the rated wattage, but not to exceed the maximum voltage specified for each style (see 3.1).

e. Measurement after conditioning: Total resistance shall be measured at the end of the 50 hours +8 hours, -0 hours as specified in 4.6.1 after load has been removed and the resistors stabilized.

f. Examination after conditioning: Resistors shall be examined for evidence of mechanical damage.

g. Test duration: 50 hours +8 hours, -0 hours.

4.5 Contact resistance variation (see 3.7). Contact resistance variation shall be measured with the measuring circuit shown on figure 2, or its equivalent. The operating shaft shall be rotated in both directions through 90 percent of the actual effective-electrical travel for a total of 6 cycles. If the product passes on any one of the first three cycles, then the product is acceptable. Only the last 3 cycles shall count in determining whether or not a contact resistance variation is observed at least twice in the same location, exclusive of the roll-on or roll-off points where the contact arm moves from the termination, on or off, the resistance element. Group A, subgroup 1, product acceptance may be determined based on one cycle minimum where compliance to the specification is demonstrated. The rate of rotation of the operating shaft shall be such that the wiper completes 1 cycle in 5 seconds, minimum, to 2 minutes, maximum.



Rx: Test specimen:
Oscilloscope bandwidth: 100 Hz to 50 kHz.
Minimum input impedance: At least 10 times the nominal resistance being tested.

NOTE: At the calibration of the decade, terminals 1 and 2 must be coincident. Calibration decade is to be set for the contact-resistance (CRV) level of the specified nominal resistance being tested.

FIGURE 2. Contact resistance variation measuring circuit.

4.6 DC resistance (see 3.8). Resistors shall be tested in accordance with method 303 of MIL-STD-202. The following details shall apply:

a. Measuring apparatus: Different types of measuring test equipment (multimeters, bridges, or equivalent) are permitted to be used, provided the equipment is the same model, or if it can be shown that the performance of the equipment is equivalent to or better.

b. Test voltage: Measurements of resistance shall be made by using the test voltages specified in table IV. The test voltage chosen, whether it be the maximum or a lower voltage which would still provide the sensitivity required, shall be applied across the terminals of the resistor. This same voltage shall be used whenever a subsequent resistance measurement is made.

TABLE IV. DC resistance test voltage. 1/

Total resistance, nominal	Maximum test voltage
Ohms	Volts
10 to 100 incl.	1.0
Over 100 to 1,000 incl.	3.0
Over 1,000 to 10,000 incl.	10
Over 10,000 to 500,000 incl.	30

1/ The critical resistance value is the maximum standard resistance value which will dissipate full wattage when the maximum continuous working voltage is applied.

4.6.1 Total resistance. Total resistance shall be measured as specified in 4.6, between the resistance-element end terminals (terminals 1 and 3 on figure 3), with contact arm positioned against a stop. The positioning of the contact arm and terminal shall be the same for all subsequent measurements of the total resistance on the same specimen (see 3.8.1).

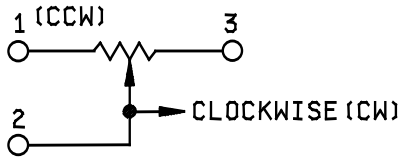


FIGURE 3. Circuit Diagram.

4.6.2 End resistance. The contact arm shall be positioned at the extreme counterclockwise limit of mechanical travel, and the resistance shall be measured as specified in 4.6 between the contact arm and the corresponding end terminal. The contact arm shall then be positioned at the extreme clockwise limit of the mechanical travel, and the resistance shall be measured as specified in 4.6 between the contact arm and the corresponding end terminal. During this test, precaution shall be taken to insure that rated current of the resistance element is not exceeded. Clockwise signifies the direction of rotation of the operating shaft when the resistor is viewed from the shaft end (see 3.8.2).

4.7 Immersion (see 3.9). The surface shall be cleaned of any foreign matter immediately before immersion.

a. Precondition: The resistors shall be preconditioned in an oven at 125°C ±5°C for 13 minutes ±2 minutes, or use a fluorocarbon bath maintained at 125°C ±5°C for a period of 1.5 minutes ±0.5 minutes. Upon completion of precondition, allow resistors to stabilize to room temperature for approximately 13 minutes ±2 minutes.

b. Immersion: The resistors shall be immersed (not to exceed 30 samples) into a bath of fluorocarbon held at 85°C +5°C, -0°C for a period of 60 seconds ±5 seconds. The resistor shall be completely submerged in the bath, with no part at a depth of less than 1 inch. Resistors shall be shaken for a maximum of 5 seconds and shall remain in the bath for a period of 1 minute ±5 seconds. Visually examine resistors for inadequate seals, as evidence by a continuous stream of bubbles emanating from any concentrated point on the resistor.

c. Dye penetrant verification: A five-piece sample of the product exhibiting inconclusive evidence of compliance to immersion requirements (see 3.9), shall be preconditioned in an oven stabilized at 125°C ±5°C for 13 minutes ±2 minutes, or preconditioned in a fluorocarbon bath maintained at 125°C ±5°C for 1 minute ±5 seconds and immediately upon removal (within 5 seconds), shall be submerged in a dye penetrant solution for 30 seconds minimum. The dye penetrant solution shall consist of 0.1 grams per liter, or equivalent, of a soluble stain dye such as crystal violet dissolved in deionized water maintained at room ambient. Upon removal from the dye solution, the sample shall be held at room temperature until external surfaces are dry. The sample shall be carefully opened and examined under 10X to 30X for evidence of dye penetration into the sealed cavity. Evidence of such penetration verifies loss of immersion seal, and lack of such evidence verifies compliance to the requirements.

4.8 Actual effective electrical travel (see 3.10). The actual effective electrical travel shall be measured by placing the resistor in a suitable device and circuit that will indicate both angular position of the operating shaft and voltage output. The actual effective electrical travel will be the number of turns or degrees of the operating shaft in which a change in contact-arm position gives a measurable change in voltage output.

4.9 Dielectric withstanding voltage (see 3.11).

4.9.1 Atmospheric pressure. The resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details shall apply:

a. Special preparations: The resistors shall be mounted on metal plates of sufficient size to extend beyond the resistor extremities, and in such a manner that measurements can be made between the terminals tied together and any other external metal parts.

b. Magnitude of test voltage: As specified in table IV.

c. Nature of potential: From an alternating-current (ac) supply at commercial-line frequency and waveform. This potential shall be applied for 1 minute.

d. Points of application of test voltage: Between the terminals connected together and all external metal portions of the resistors and metal-mounting plate.

e. Examinations and measurements: During the tests, the leakage current shall be monitored and the resistors examined for evidence of arcing and breakdown. At the conclusion of the test, resistors shall be examined for evidence of damage.

4.9.2 Barometric pressure. Resistors shall be tested in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of mounting: As specified in 4.9.1a.

b. Test condition: C.

c. Period of time at reduced pressure prior to application of potential: 1 minute.

d. Test during subjection to reduced pressure: Voltage from an ac supply at commercial line frequency and waveform shall be applied for 1 minute.

e. Points of application: As specified in 4.9.1d.

f. Examinations and measurements: As specified in 4.9.1e.

4.10 Insulation resistance (see 3.12). Resistors shall be tested in accordance with method 302 of MIL-STD-202. The following details shall apply:

a. Test condition: A or B, whichever is more practicable.

b. Special preparation: As specified in 4.9.1a.

c. Points of measurement: As specified in 4.9.1d.

4.11 Torque.

4.11.1 Operating. The torque required to move the contact arm on the resistance element shall be determined at approximately 10, 50, and 90 percent of actual effective-electrical travel by the torque-wrench method or by any other method acceptable to the Government (see 3.13.1).

4.11.2 Clutch. The contact arm shall be adjusted to each extreme limit of mechanical travel, and sufficient torque shall be applied to the lead-screw actuator to permit the contact arm to idle for 25 complete mechanical turns of the lead-screw actuator. During idle, a suitable electrical indicating device connected between the contact-arm terminal and the adjacent end terminal shall be observed for electrical continuity. After idle, the operating shaft shall be rotated in the opposite direction and the indicating device observed to determine if the contact arm reversed direction (see 3.13.2).

4.11.3 Stop (when applicable). Resistors shall be mounted by their normal mounting means. The contact arm shall then be rotated to each extreme limit of mechanical rotation, and the specified torque, applied through the operating shaft to the stop.

4.12 Thermal shock (see 3.14). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition: F.

b. Measurements before cycling: Total resistance and setting stability shall be in as specified in 4.6.1.

c. Measurements after cycling: Setting stability, total resistance, and continuity shall be measured as specified in 4.6.1. Continuity of the contact arm shall be verified by connecting a vacuum-tube voltmeter or suitable indicating device, between the contact arm terminal and the counterclockwise end terminal. The applied voltage shall be in accordance with table IV.

d. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.13 Solderability (see 3.15). Resistors shall be tested in accordance with method 208 of MIL-STD-202. All pin terminals of each resistor shall be tested.

5. PACKAGING

* 5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature which may be helpful, but is not mandatory.)

6.1 Intended use. Resistors conforming to this drawing are intended for use when military specifications do not exist and qualified military devices that will perform the required function are not available for the OEM application.

6.2 Ordering data. The contract or purchase order should specify the following:

a. Complete PIN (see 1.2).

b. Requirements for delivery: One copy of the conformance inspection data with each shipment of parts by the manufacturer.

c. Requirements for packaging and packing.

* 6.3 Tin whisker growth. The use of alloys with tin content greater than 97 percent, by mass, may exhibit tin whisker growth problems after manufacture. Tin whiskers may occur anytime from a day to years after manufacture and can develop under typical operating conditions, on products that use such materials. Conformal coatings applied over top of a whisker-prone surface will not prevent the formation of tin whiskers. Alloys of 3 percent lead, by mass, have shown to inhibit the growth of tin whiskers. For additional information on this matter, refer to ASTM-B545 (Standard Specification for Electrodeposited Coatings of Tin).

* 6.4 User of record. Coordination of this document for future revisions is coordinated only with the approved source of supply and the users of record of this document. Requests to be added as a recorded user of this drawing may be achieved online at resistor@dla.mil or in writing to: DSCC-VAT, Post Office Box 3990, Columbus, OH 43218-3990 or by telephone (614) 692-0552 or DSN 850-0552.

* 6.5 Approved source of supply. Approved source of supply is listed herein. Additional sources will be added as they become available. Assistance in the use of this drawing may be obtained online at resistor@dla.mil or contact DSCC-VAT, Post Office Box 3990, Columbus, OH 43218-3990 or by telephone (614) 692-0552 or DSN 850-0552.

DSCC drawing PIN	Vendor similar designation or type number 1/	Vendor CAGE	Vendor name and address
02005-XXX	3082P-EE1-XXX	32997	Bourns Trimpot, Inc. 1200 Columbia Ave Riverside, CA 92507-2114

1/ Parts must be purchased to this DSCC PIN to assure that all performance requirements and tests are met.