

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

**MIL-S-19500/447 has been cancelled.
This drawing may be used as a substitute.**

Prepared in accordance with ASME-14.100

Selected item drawing

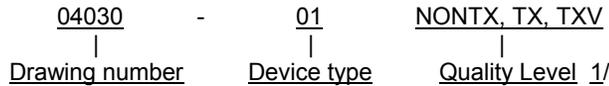
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PMIC N/A	PREPARED BY Roger Kissel	DEFENSE SUPPLY CENTER, COLUMBUS COLUMBUS, OH http://www.dsccl.dla.mil/programs/milspec/docsearch.asp	
Original date of drawing 14 March 2005	CHECKED BY Alan Barone	TITLE SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH POWER TYPE 2N5926	
	APPROVED BY Thomas Hess		
	SIZE A	CODE IDENT. NO. 037Z3	DWG NO. 04030
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1. SCOPE

1.1 Scope. This drawing describes the requirements for NPN, silicon, high-power transistors.

1.2 Part or Identifying Number (PIN). The complete PIN shall be as shown in the following example:



1.2.1 Device types. The device types identify the quality assurance level of the devices as follows:

<u>Device type</u> 1/	<u>Figure number</u>	<u>Package</u>
04030-01	1	Stud
04030-01TX	1	Stud
04030-01TXV	1	Stud

1.3 Maximum rating. $T_C = +25^\circ\text{C}$ unless otherwise specified.

PT (1) $T_C = +25^\circ\text{C}$	PT (1) $T_C = +100^\circ\text{C}$	V_{CEO}	V_{CBO}	V_{EBO}	I_C (2)	I_B	T_J and T_{STG}	$R_{\theta JC}$
<u>W</u>	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>°C</u>	<u>°C/W</u>
350	200	120	150	10	50	20	-65 to +200	0.5

- (1) Between $T_C = +25^\circ\text{C}$ and $T_C = +200^\circ\text{C}$, linear derating factor (average) = $2.0\text{W}/^\circ\text{C}$.
 (2) Pulsed (see 4.4.1) = 90A.

1.4 Primary electrical characteristics.

h_{FE} (1)			V_{BE} (1)		$V_{CE(sat)}$ (1)	
$I_C = 20\text{ A dc}$ $V_{CE} = 2\text{ V dc}$	$I_C = 50\text{ A dc}$ $V_{CE} = 2\text{ V dc}$	$I_C = 90\text{ A dc}$ $V_{CE} = 4\text{ V dc}$	$I_C = 50\text{ A dc}$ $V_{CE} = 2\text{ V dc}$	$I_C = 90\text{ A dc}$ $V_{CE} = 4\text{ V dc}$	$I_C = 50\text{ A dc}$ $I_B = 5\text{ A dc}$	$I_C = 90\text{ A dc}$ $I_B = 18\text{ A dc}$
Min 20 Max 80	Min 10 Max 40	Min 5	Max 1.2	Max 2.5	Max 0.6 V dc	Max 1.5 V dc

(1) Pulsed (see 4.4.1).

Limits	$R_{\theta JC}$	$ h_{fe} $ $V_{CE} = 10\text{ V dc}$ $I_C = 5\text{ A dc}$ $f = 100\text{ KHz}$	t_{on}	t_s	t_f
	<u>°C/W</u>		$I_C = 50\text{ A dc}$		
Min Max	.5	5 20	7.0 μs	4.0 μs	6.0 μs

1/ Quality level: non-TX (-01, no suffix), -01TX, and -01TXV levels correspond to JAN, JANTX, and JANTXV equivalent quality requirements in MIL-PRF-19500.

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2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 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 SPECIFICATIONS

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-750 - Test Methods for Semiconductor Devices.

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

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, 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 in accordance with MIL-PRF-19500 and as specified herein.

3.1.1 Device capability. The devices must be capable of meeting the following MIL-STD-750 test conditions:

<u>Step</u>	<u>Method</u>	<u>Condition</u>
1	3053	Load condition C (unclamped inductive load), $T_C = +25^\circ\text{C}$, single 10 ms pulse, $t_r = t_f \leq 1\mu\text{s}$, $R_{BB1} = 1\Omega$, $R_{BB2} = \infty$, $V_{BB1} = 6.2\text{ V dc}$, $V_{BB2} = 0\text{ V dc}$, $I_C = 50\text{ A dc}$, $V_{CC} = 25\text{ V dc}$, $L = 5\text{ mH}$. See 3.1.2. Endpoints: Group A, subgroup 2.
2	3053	Load condition B (clamped switching Destructive), $T_A = +25^\circ\text{C}$, single 2 ms pulse, $t_r = t_f \leq 1\mu\text{s}$, $R_{BB1} = 1\Omega$, $R_{BB2} = 20\Omega$, $V_{BB1} = 6.2\text{ V dc}$, $V_{BB2} = 3\text{ V dc}$, $I_C = 50\text{ A dc}$, $V_{CLAMP} = 125\text{ V dc}$, $L = 68\mu\text{H}$, $R_L = 0$, clamping diode – 2N5926 with emitter shorted to base. Device fails if clamp voltage is not reached. See 3.1.2. Endpoints: Group A, subgroup 2.
3	3051	$T_C = 100^\circ\text{C}$, $t = 1\text{ s}$, 1 cycle, see 3.1.2 and figure 2. Test 1 - $V_{CE} = 4\text{ V dc}$, $I_C = 50\text{ A dc}$ Test 2 - $V_{CE} = 50\text{ V dc}$, $I_C = 4\text{ A dc}$ Test 3 - $V_{CE} = 120\text{ V dc}$, $I_C = 850\text{ mA dc}$
4	3131	I_M measurement 10 mA. V_{CE} measurement voltage 25 V. I_H collector heating current 10 A. V_H collector-emitter heating voltage 20 V. t_H heating time steady-state (see method 3131 of MIL-STD-750 for definition). t_{MD} measurement delay time 20 μs maximum. t_{SW} sample window time 10 μs maximum.

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3.1.2 Safe Operating Area (DC Operation) test. Each transistor shall sustain the applicable test conditions and the following acceptance criteria shall apply:

- (a) I_C (for each transistor) shall not vary more than $\pm 10\%$ during the dc operation; and
- (b) All other specified end-point test(s) limits shall not be exceeded, after the dc-operation test.
- (c) Correlation note: satisfactory endurance of the transistors throughout tests 1, 2, and 3 respectively (paragraph 3.1.1, step 3) is directly associable with ascertainment of the safe operating area for the transistors as illustrated in the nomograph of figure 2.

3.2 Abbreviations, symbol, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.3 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and figure 1 herein.

3.3.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein.

3.3.2 Internal construction. Multiple chip construction shall not be permitted.

3.4 Marking. Marking shall be in accordance with MIL-PRF-19500.

3.5 Manufacturer eligibility. To be eligible to supply devices to this drawing, the manufacturer shall perform conformance inspection in accordance with the procuring activity's testing requirements as specified in 4.2 and 4.3 herein. Devices specified herein shall meet traceability as specified in MIL-PRF-19500. It is prohibited for a manufacturer not listed as an approved source to mark devices with this drawing number.

3.5.1 Certificate of compliance. A certificate of compliance shall be required from manufacturers requesting to be an approved source of supply.

3.5.2 Certificate of conformance. A certificate of conformance shall be provided with each lot of devices delivered in accordance with this drawing.

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

3.7 Workmanship. The semiconductor shall be uniform in quality and free from any defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Sampling and inspection. Unless otherwise specified, sampling and inspection procedures shall be performed in accordance with MIL-PRF-19500, and as specified herein.

4.2 Screening. All TX and TXV devices shall be screened in accordance with table IV of MIL-PRF-19500, as appropriate and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement
	TX and TXV levels
4	Optional
9	Not applicable
11	I_{CES1} and h_{FE1}
12	Burn-in (see 4.2.1).
13	ΔI_{CES1} = 100 percent of initial value, maximum, subgroup 2 of table I herein; Δh_{FE1} = ± 25 percent, maximum, subgroup 2 of table I herein.

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4.2.1 Power burn in. Power burn-in conditions are in accordance with method 1039 of MIL-STD-750, test condition B and as follows: $T_A = 30^{\circ}\text{C}, \pm 5^{\circ}\text{C}, V_{CE} \geq 4.5 \text{ V dc}, T_J = 187.5^{\circ}\text{C} \pm 12.5^{\circ}\text{C}$. NOTE: No heatsink or forced air cooling on the devices shall be permitted.

4.3 Conformance inspection. Conformance inspection shall consist of the inspections and tests specified in groups A and B herein.

4.3.1 Group A inspection. Group A inspection shall be conducted in accordance with the conditions specified for subgroup testing in table I herein.

4.3.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 and table II herein. Electrical measurements (end-points) and delta requirements shall be table I, subgroup 2 herein.

4.3.2.1 Group B sample selection. Samples selected from group B inspection shall meet all of the following requirements.

- a. Must be chosen from an inspection lot that has been submitted to and passed table I, subgroup 2, conformance inspection. When the final lead finish is solder or any plating prone to oxidation at high temperature, the samples for life test (group B for non-TX, TX, and TXV) may be pulled prior to the application of final lead finish.

4.4 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.4.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

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TABLE I. Group A inspection. 1/

Inspection 1/	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Breakdown voltage, collector to emitter	3011	Bias condition D; $I_C = 200$ mA dc; pulsed (see 4.4.1)	$V_{(BR)CEO}$	120		V dc
Collector to base cutoff current	3041	Bias condition C; $V_{BE} = 0$ V dc; $V_{CE} = 150$ V dc	I_{CES1}		2	mA dc
Emitter to base current	3061	Bias condition D; $V_{EB} = 10$ V dc	I_{EBO}		1	mA dc
Base emitter voltage	3066	Test condition B, $I_C = 50$ A dc, $V_{CE} = 2$ V dc, pulsed (see 4.4.1)	V_{BE1}		1.2	V dc
Base emitter voltage	3066	Test condition B, $I_C = 90$ A dc, $V_{CE} = 4$ V dc, pulsed (see 4.4.1)	V_{BE2}		2.5	V dc
Saturation voltage and resistance	3071	$I_C = 50$ A dc; $I_B = 5$ A dc; pulsed (see 4.4.1)	$V_{CE(SAT)1}$		0.6	V dc
Saturation voltage and resistance	3071	$I_C = 90$ A dc; $I_B = 18$ A dc; pulsed (see 4.4.1)	$V_{CE(SAT)2}$		1.5	V dc
Forward-current transfer ratio	3076	$V_{CE} = 2$ V dc; $I_C = 20$ A dc pulsed (see 4.4.1)	h_{FE1}	20	80	
Forward-current transfer ratio	3076	$V_{CE} = 4$ V dc; $I_C = 90$ A dc pulsed (see 4.4.1)	h_{FE2}	5		
Forward-current transfer ratio	3076	$V_{CE} = 2$ V dc; $I_C = 50$ A dc pulsed (see 4.4.1)	h_{FE3}	10	40	
<u>Subgroup 3</u>						
High-temperature operation		$T_A = +150^\circ\text{C}$; $n = 15$, $c = 0$				
Collector-base cutoff current	3041	Bias condition C; $V_{CE} = 100$ V dc, $V_{BE} = 0$ V dc	I_{CES2}		10	mA dc
Low-temperature operation		$T_A = -65^\circ\text{C}$				
Forward-current transfer ratio	3076	$V_{CE} = 2$ V dc; $I_C = 50$ A dc; pulsed (see 4.4.1)	h_{FE4}	10		

See footnote at end of table.

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TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limit		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 4</u>						
Pulse response	3251	Test condition B, $V_{CC} = 50$ V dc, $R_C = 1 \Omega$, $V_{BE1} = 11.2$ V dc, $R_B = 2 \Omega$, $V_{BE2} = 10$ V dc; $n = 15$, $c = 0$				
Turn-on time			t_{on}		7.0	μs
Storage time			t_s		4.0	μs
Fall time			t_f		6.0	μs
Magnitude of common emitter small signal short-circuit forward-current transfer ratio	3306	$V_{CE} = 10$ V dc; $I_C = 5$ A dc; $f = 100$ kHz	$ h_{fe} $	5	20	
<u>Subgroups 5, 6 and 7</u>						
Not applicable						

1/ See MIL-PRF-19500 for sampling plan.

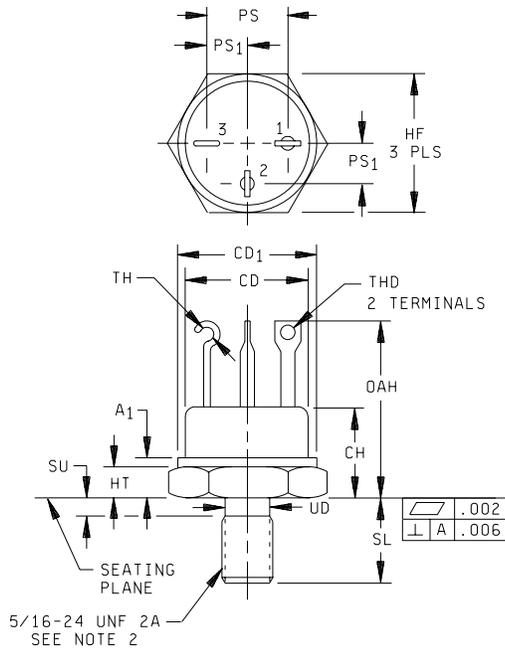
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TABLE II. Group B inspection for TX and TXV.

Inspection ^{1/}	MIL-STD-750		Small lot CI
	Method	Conditions	
<u>Subgroup 1</u>			
Solderability	2026		
Resistance to solvents	1022		n = 3, c = 0
<u>Subgroup 2</u>			
Temperature cycling (air to air)	1051	Test condition C	n = 6, c = 0
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table I, subgroup 2 herein	
<u>Subgroup 3</u>			
Steady state operation life	1027	T _A = +30°C ± 5°C, V _{CE} = 4.5 V dc, T _J = 187.5°C, ±12.5°C, t = 168 hours minimum	n = 12, c = 0
Electrical measurements	3041 3076	ΔI _{CES1} = +100% of initial value, maximum Δh _{FE1} ±25 percent change of initial value, maximum	
<u>Subgroup 4</u>			
Decap internal visual (design verification)	2075		n = 1, c = 0
<u>Subgroup 5</u>			
Thermal resistance	3131	R _{θJC} = .5°C/W; see 3.1.1	n = 6, c = 0
<u>Subgroup 6</u>			
High-temperature life (nonoperating)	1032	t = 168 hours minimum, T = +200°C	n = 12, c = 0
Electrical measurements		See table I, subgroup 2 herein	

^{1/} For sampling plan, see MIL-PRF-19500.

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Ltr	Dimension				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
A ₁		.300		7.62	
CD	.745	.775	18.92	19.69	
CD ₁	.775	.875	19.69	22.23	
CH	.480	.535	12.19	13.59	
HF	.847	.875	21.51	22.23	
HT	.090	.167	2.29	4.24	
OAH	.937	1.03	23.80	26.16	
PS	.480	.500	12.19	12.70	3, 4, 5
PS ₁	.240	.250	6.10	6.35	3, 4, 5
SL	.460	.495	11.68	12.57	
SU		.105		2.66	
THD	.060	.105	1.52	2.67	
TH	.060	.105	1.52	2.67	
UD	.278	.312	7.06	7.92	

NOTES:

1. Dimensions are in inches, millimeters are given for general information only.
2. See NSB Handbook H28, "Screw-Thread Standards for Federal Services".
3. Angular orientation of terminals with respect to hex flats is optional.
4. Terminal spacing measured at the base seat only.
5. This dimension applies to the location of the center line of the terminals.
6. Terminal 1 - emitter, 2 - base, 3 - collector. All leads are isolated from the case.
7. Maximum pitch diameter of plated thread shall be basic pitch diameter.

FIGURE 1 Physical dimensions.

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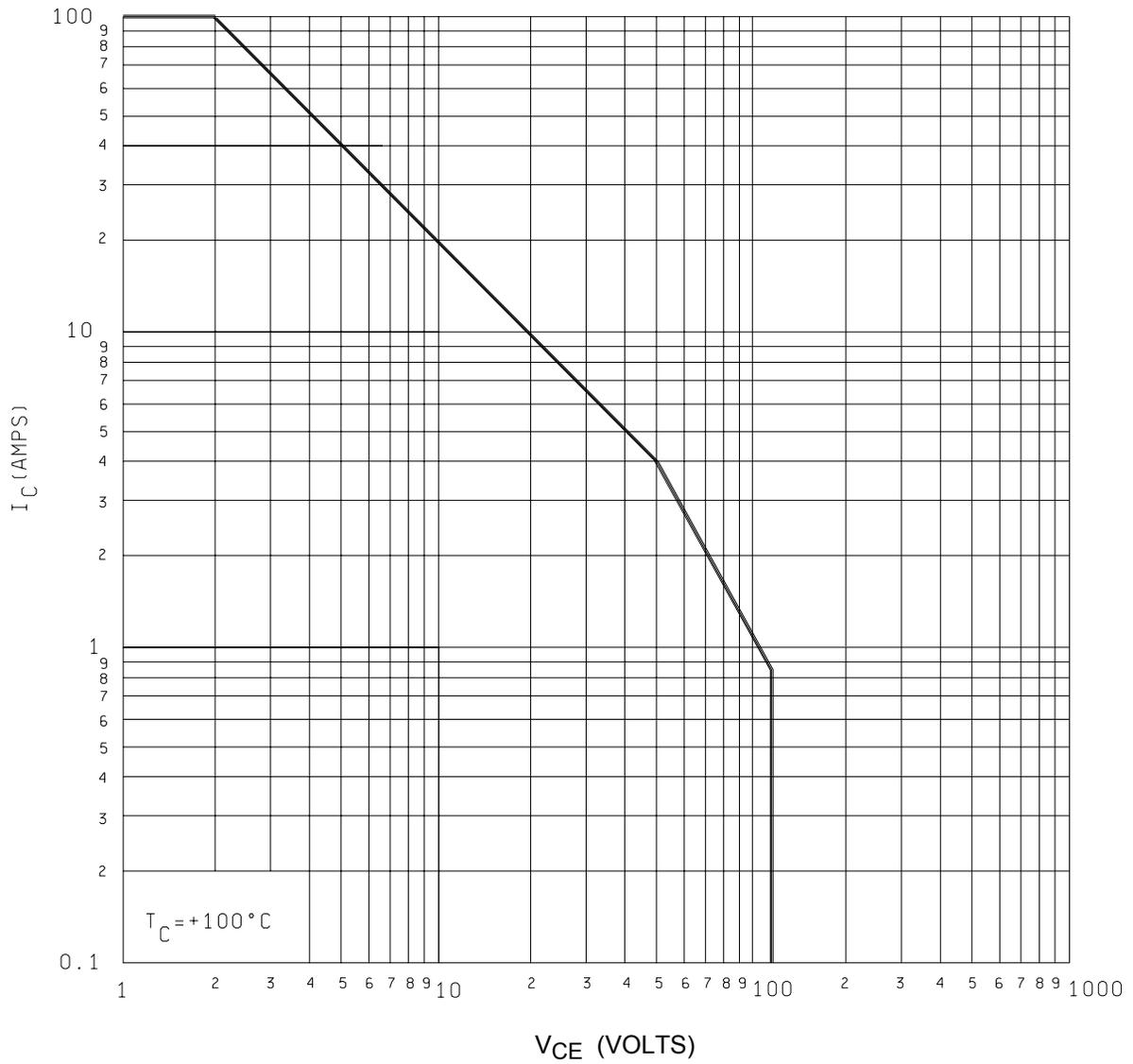


FIGURE 2. Maximum safe operating graph (continuous dc).

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5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual 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

6.1 Intended use. Devices 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 OEM application. This drawing is intended exclusively to prevent the proliferation of unnecessary duplicate specifications, drawings, and stock catalog listings. When a product covered by this drawing has been listed on QML-19500, this drawing will be inactivated and will not be used for new design. The QML 19500 products shall be the preferred item for all applications.

6.2 Acquisition requirements. The acquisition requirements should specify the following:

- a. Complete PIN (see 1.2).
- b. Requirements for delivery of one copy of the conformance inspection data or certificate of compliance that parts have passed conformance inspection with each shipment of parts by the manufacturer.
- c. Requirements for packaging and packing.

6.3 Replaceability. Devices covered by this drawing replace the same device covered by specification sheet MIL-S-19500/447, which has been cancelled.

6.4 Comments. Comments on this drawing should be directed to Defense Supply Center Columbus, ATTN: DSCC-VAC, P.O. Box 3990, Columbus, OH 43218-3990, e-mail Semiconductor@dsc.dla.mil, or telephone (614) 692-0510.

6.5 Approved sources of supply. Approved sources of supply are listed herein. Additional sources will be added as they become available. The vendors listed herein have passed the requirements of section 4 herein and have submitted a certificate of compliance to DSCC-VAC.

DSCC drawing PIN (1)	JEDEC numbers	Vendor CAGE code	Vendor name and address
04030-01 04030-01TX 04030-01TXV	2N5926 2N5926 2N5926	32953	Power Tech Incorporated 0-02 Fair Lawn Avenue Fair Lawn NJ 07410-1281

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

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