The documentation and process conversion measures necessary to comply with this revision shall be completed by 7 February 2004.

INCH-POUND

MIL-PRF-19500/408F
7 November 2003
SUPERSEDING
MIL-PRF-19500/408E
25 November 1997

PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-POWER
TYPES 2N3715 AND 2N3716 JAN, JANTX, JANTXV AND JANS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for NPN, silicon, high-power transistors. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, similar to TO-3.

* 1.3 Maximum ratings. Unless otherwise specified, T_C = +25°C.

Types	P_T (1) T_A = +25°C	P_T (2) T_C = +25°C	V_{CBO}	V_{CEO}	V_{EBO}	I_B	I_C	T_J and T_{STG}	$R_{\theta JC}$ (3)
	W	W	V dc	V dc	V dc	A dc	A dc	°C	°C/W max
2N3715	5.0	117	80	60	7.0	4.0	10	-65 to +200	1.5
2N3716	5.0	117	100	80	7.0	4.0	10	-65 to +200	1.5

(1) Derate linearly 28.57 mW/°C above T_A = +25°C.
(2) See figure 2 for temperature-power derating curves.
(3) See figure 3, transient thermal impedance graph.

1.4 Primary electrical characteristics. Unless otherwise specified, T_C = +25°C.

Limit	h_{FE1} (1) V_{CE} = 2.0 V dc I_C = 3.0 A dc	h_{FE4} (1) V_{CE} = 4.0 V dc I_C = 10 A dc	$V_{BE(SAT)1}$ (1) I_C = 5.0 A dc I_B = 0.5 A dc	$V_{CE(SAT)1}$ (1) I_C = 5.0 A dc I_B = 0.5 A dc	C_{obo} V_{CB} = 10 V dc I_E = 0 f = 1 MHz	$\|h_{fe}\|$ V_{CE} = 10 V dc I_C = 0.5 A dc f = 1 MHz
			V dc	V dc	pF	
Min	30	5.0				4.0
Max	120		1.5	1.0	500	20

(1) Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAC, Post Office Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5961

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 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 documents cited in sections 3 and 4 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 listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

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

STANDARD

DEPARTMENT OF DEFENSE

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, 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

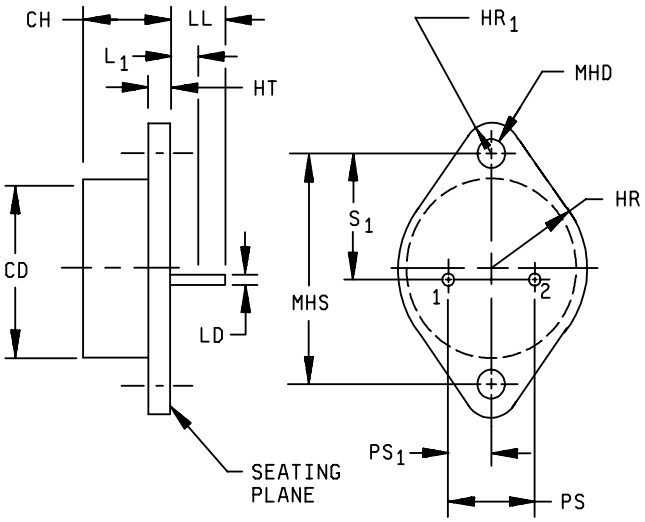
* 3.1 General. The individual item requirements shall be as specified in MIL-PRF-19500 and as modified herein.

* 3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

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

3.4 Interface and physical dimensions. Interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1.

3.4.1 Lead finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		.875		22.22	
CH	.270	.380	6.86	9.65	
HT	.060	.055	1.52	1.40	
HR	.495	.525	12.57	13.3	
HR_1	.131	.188	3.33	4.78	
LD	.038	.043	0.97	1.09	7
LL	.312	.500	7.92	12.70	
L_1		.050		1.27	
MHD	.151	.165	3.84	4.19	
MHS	1.177	1.197	29.90	30.40	
PS	.420	.440	10.67	11.18	4
PS_1	.205	.225	.521	5.72	4
s_1	.655	.675	16.64	17.15	

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Terminal 1, emitter; terminal 2, base; case, collector.
4. These dimensions should be measured at points .050-.055 inch (1.27-1.40 mm) below seating plane. When gauge is not used, measurement will be made at the seating plane.
5. The seating plane of the header shall be flat within .004 inch (0.10 mm) concave to .004 inch (0.10 mm) convex inside a .930 inch (23.62 mm) diameter circle on the center of the header and flat within .006 inch (0.15 mm) concave to .006 inch (0.15 mm) convex overall.
6. Collector shall be electrically connected to the case.
7. LD applies between L_1 and LL. Diameter is uncontrolled in L_1.
8. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

* FIGURE 1. Physical dimensions of transistor types 2N3715 and 2N3716 (TO-3).

* 3.5 Marking. Marking shall be in accordance with MIL-PRF-19500.

* 3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I.

* 3.7 Electrical test requirements. The electrical test requirements shall be as specified in table I and table II.

* 3.8 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

4. VERIFICATION

* 4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3)

c. Conformance inspection (see 4.4 and tables I, II, and III).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500.

* 4.2.1 Group E qualification. Group E inspection shall be performed for qualification or re-qualification only. In case qualification was awarded to a prior revision of the associated specification that did not request the performance of table III tests, the tests specified in table III herein shall be performed by the first inspection lot of this revision to maintain qualification.

* 4.3 Screening (JANS, JANTX and JANTXV levels only). Screening shall be in accordance with table IV of MIL-PRF-19500 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 appendix E, table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTX and JANTXV levels
3c	Thermal impedance (transient), method 3131 of MIL-STD-750 (see 4.3.2) (1)	Thermal impedance (transient), method 3131 of MIL-STD-750 (see 4.3.2) (1)
9	I_{CES1} and h_{FE2}	I_{CES1}
11	I_{CES1} and h_{FE2}; ΔI_{CES1} = 100 percent of initial value or 1 μA dc, whichever is greater. $\Delta h_{FE2} = \pm$ 15 percent of initial value.	I_{CES1} and h_{FE2}; ΔI_{CES1} = 100 percent of initial value or 1 μA dc, whichever is greater.
12	See 4.3.1	See 4.3.1
13	ΔI_{CES1} = 100 percent of initial value or 1 μA dc, whichever is greater; $\Delta h_{FE2} = \pm$ 15 percent of initial value; subgroup 2 of table I herein	ΔI_{CES1} = 100 percent of initial value or 1 μA dc, whichever is greater; $\Delta h_{FE2} = \pm$ 20 percent of initial value; subgroup 2 of table I herein

(1) Thermal impedance limits ($Z_{\theta JC}$) shall not exceed the thermal impedance curve on figure 3.

* 4.3.1 Power burn-in conditions. Power burn-in conditions are as follows:

$T_J = 187.5 \pm 12.5^{\circ}C$; $V_{CE} = 25 \pm 5$ V dc; $T_A \leq 35^{\circ}C$.

4.3.2 Thermal impedance (ΔV_{BE}) measurements. The ΔV_{BE} measurements shall be performed in accordance with method 3131 of MIL-STD-750. The ΔV_{BE} conditions (I_H and V_H) and maximum limit shall be derived by each vendor. The chosen ΔV_{BE} measurement and conditions for each device in the qualification lot shall be submitted in the qualification report and a thermal response curve shall be plotted. The chosen V_{BE} shall be plotted. The chosen V_{BE} shall be considered final after the manufacturer has had the opportunity to test five consecutive lots. One hundred percent safe operating area (SOA) testing may be performed in lieu of thermal response testing herein provided that the appropriate conditions of temperature, time, current, and voltage to achieve die attach integrity are submitted to the qualifying activity. The following parameter measurements shall apply:

a. I_M ..... 10 mA.

b. V_{CE} measurement voltage..... 20 V (same as V_H).

c. I_H collector heating current ..... 4 A (minimum).

d. V_H collector-emitter heating voltage..... 20 V (minimum).

e. t_H heating time..... 100 ms.

f. t_{MD} measurement delay time..... 50 µs to 80 µs.

g. t_{SW} sample window time..... 10 µs (maximum).

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V of MIL-PRF-19500 and table I herein.

4.4.2 Group B inspection . Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VIa (JANS) and table Vib (JAN, JANTX and JANTXV) of MIL-PRF-19500, and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

Subgroup	Method	Conditions
B4	1037	V_{CB} = 30 V dc, P_T = 4 W at T_A = +25°C ± 3°C, t_{on} = t_{off} = 3 minutes minimum for 2,000 cycles. No heat sink or forced air on the device shall be permitted. A separate sample may be pulled for each test.
B5	1027	V_{CB} = 30 V dc, T_A = +125°C ± 25°C for 96 hours; P_T = 4 W at T_A = +100°C or adjusted as required by the chosen T_A to give an average lot T_J = +225°C. Marking legibility requirement shall not apply.
B6	3131	See 4.5.2.

4.4.2.2 Group B inspection, table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B3	1037	$V_{CB} \geq 10$ V dc; ΔT_J between cycles $\geq 100°C$; $t_{on} = t_{off} \geq 1$ minute for 2,000 cycles. No heat sink or forced air cooling on the device shall be permitted.
B5	3131	See 4.5.2.
B6	1032	$T_A = +200°C$.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) and delta requirements shall be in accordance with the applicable steps of table II herein.

Subgroup	Method	Conditions
C2	1056	Test condition B.
C2	2036	Test condition A, weight = 10 lbs, application time = 15 seconds.
C6	1037	$V_{CB} \geq 10$ V dc; ΔT_J between cycles $\geq 100°C$, $t_{on} = t_{off} \geq 1$ minute for 6,000 cycles. No heat sink or forced air cooling on the device shall be permitted.

* 4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in table IX of MIL-PRF-19500 and herein. Electrical measurements (end-points) shall be in accordance with table I, subgroup 2 herein.

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

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

* 4.5.2 Thermal resistance. Thermal resistance measurements shall be conducted in accordance with test method 3131 of MIL-STD-750. The following details shall apply.

a. Collector current magnitude during power application shall be 1.0 A dc.

b. Collector to emitter voltage magnitude shall be 10 V dc.

c. Reference temperature measuring point shall be the case.

d. Reference temperature measuring point shall be within the range $+25°C \leq T_R \leq +75°C$ and recorded before the test is started.

e. Mounting arrangement shall be with heat sink to header.

f. Maximum limit of $R_{\theta JC} = 1.5°C/W$ and shall be in accordance with figure 3, thermal impedance graph.

* TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical examination	2071					
Subgroup 2						
Collector-emitter breakdown voltage	3011	Bias condition D; I_C = 10 mA dc; pulsed (see 4.5.1)	$V_{(BR)CEO}$			
2N3715				60		V dc
2N3716				80		V dc
Collector-base cutoff current	3036	Base condition D	I_{CBO}			
2N3715		V_{CB} = 80 V dc			10	μA dc
2N3716		V_{CB} = 100 V dc			10	μA dc
Emitter-base cutoff current	3061	Base condition D; V_{EB} = 7 V dc	I_{EBO}		1.0	mA dc
Collector-emitter cutoff current	3041	Bias condition A	I_{CEX1}			
2N3715		V_{BE} = 1.5 V dc, V_{CE} = 60 V dc			1.0	mA dc
2N3716		V_{BE} = 1.5 V dc, V_{CE} = 80 V dc			1.0	mA dc
Collector-emitter cutoff current	3041	Bias condition C	I_{CES1}			
2N3715		V_{CE} = 60 V dc			1.0	mA dc
2N3716		V_{CE} = 80 V dc			1.0	mA dc
Base-emitter saturated voltage	3066	Test condition A; I_C = 5 A dc; I_B = 0.5 A dc; pulsed (see 4.5.1)	$V_{BE(SAT)1}$		1.5	V dc
Base-emitter saturated voltage	3066	Test condition A; I_C = 10 A dc; I_B = 2 A dc; pulsed (see 4.5.1)	$V_{BE(SAT)2}$		3.0	V dc
Collector-emitter saturated voltage	3071	I_C = 5 A dc; I_B = 0.5 A dc; pulsed (see 4.5.1)	$V_{CE(SAT)1}$		1.0	V dc
Collector-emitter saturated voltage	3071	I_C = 10 A dc; I_B = 2 A dc; pulsed (see 4.5.1)	$V_{CE(SAT)2}$		2.5	V dc
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 1.0 A dc; pulsed (see 4.5.1)	h_{FE1}	50	150	
Forward current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 3.0 A dc; pulsed (see 4.5.1)	h_{FE2}	30	120	

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 2 - Continued						
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 5 A dc; pulsed (see 4.5.1)	h_{FE3}	10		
Forward-current transfer ratio	3076	V_{CE} = 4.0 V dc; I_C = 10 A dc; pulsed (see 4.5.1)	h_{FE4}	5		
Subgroup 3						
High temperature operation:		T_A = +150°C				
Collector to emitter cutoff current	3041	Bias condition C	I_{CES2}			
2N3715		V_{CE} = 50 V dc			5.0	mA dc
2N3716		V_{CE} = 70 V dc			5.0	mA dc
Low temperature operation:		T_A = -55°C				
Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 3.0 A dc; pulsed (see 4.5.1)	h_{FE5}			
Subgroup 4						
Switching parameters						
Pulse delay time		See figure 4	t_d		0.2	ns
Pulse rise time		See figure 4	t_r		1.3	ns
Pulse storage time		See figure 4	t_s		1.2	ns
Pulse fall time		See figure 4	t_f		1.2	ns
t_{off}		$t_s + t_f$			2.0	µs
Small-signal short-circuit forward-current transfer ratio	3206	V_{CE} = 10 V dc; I_C = 0.5 A dc; f = 1 kHz	h_{fe}	30	300	
Magnitude of small-signal short-circuit forward current transfer ratio	3306	V_{CE} = 10 V dc; I_C = 0.5 A dc; f = 1 MHz	$\|h_{fe}\|$	4.0	20	
Open circuit output capacitance	3236	V_{CB} = 10 V dc; I_E = 0; f = 1 MHz	C_{obo}		500	pF

See footnote at end of table.

* TABLE I. Group A inspection - Continued.

Inspection 1/	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 5						
Safe operating area (continuous dc)	3051	T_C = +25°C; t ≥ 1 s; 1 cycle; (see figure 5)				
Test 1		V_{CE} = 15 V dc; I_C = 10 A dc				
Test 2		V_{CE} = 40 V dc; I_C = 3.75 A dc				
Test 3						
2N3715		V_{CE} = 55 V dc; I_C = 0.9 A dc				
2N3716		V_{CE} = 65 V dc; I_C = 0.9 A dc				
Safe operating area (clamped inductive)		T_A = +25°C; I_C = 10 A dc; V_{CC} = 15 V dc; (see figures 6 and 7)				
2N3715		Clamp voltage = 60 V dc				
2N3716		Clamp voltage = 80 V dc				
Test 1		t_p approximately 1.0 ms (vary to obtain I_C); R_{BB1} = 5Ω; V_{BB1} = 8 V dc; R_{BB2} = 4; V_{BB2} = 0; V_{CC} = 15 V dc; I_C = 5 A dc; L = 4 mH; Q ≥ 100 at 1 kHz; .05 ohms, 20 A dc; (Stanford Miller CK-20 or equivalent)				
Test 2		t_p approximately 2.2 ms (vary to obtain I_C); R_{BB1} = 5Ω; V_{BB1} = 8 V dc; R_{BB2} = 4; V_{BB2} = 0; V_{CC} = 15 V dc; I_C = 2.2 A dc; L = 20 mH; Q ≥ 6000 at 10 kHz; 0.22 ohms, 12.5 A dc; (Two Stancor C-2688 in series or equivalent)				
Electrical measurements		See table II, steps 1 and 4.				
Subgroups 6 and 7						
Not applicable						

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

TABLE II. Groups A, B, and C electrical end-point inspection measurements. 1/ 2/ 3/ 4/

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Collector-emitter cutoff current 2N3715 2N3716	3041	Bias condition C V_{CE} = 50 V dc V_{CE} = 70 V dc	I_{CES1}		 10 10	 μA dc μA dc
2.	Collector-emitter (voltage saturated)	3071	I_C = 5 A dc; I_B = 0.5 A dc; pulsed (see 4.5.1)	$V_{CE(SAT)1}$		1.0	V dc
3.	Base-emitter voltage saturated	3066	Bias condition A; I_C = 5.0 A dc; I_B = 0.5 A dc; pulsed (see 4.5.1)	$V_{BE(SAT)1}$		1.5	V dc
4.	Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 3.0 A dc; pulsed (see 4.5.1)	h_{FE2}	30	120	
5.	Collector-emitter cutoff current 2N3715 2N3716	3041	Bias condition C V_{CE} = 50 V dc V_{CE} = 70 V dc	ΔI_{CES1} 5/	100 percent of initial value or 1 μA dc; whichever is greater.		
6.	Forward-current transfer ratio	3076	V_{CE} = 2.0 V dc; I_C = 3.0 A dc; pulsed (see 4.5.1)	Δh_{FE2} 5/	± 25 percent change from initial value		
7.	Collector-emitter (voltage saturated)	3071	I_C = 5 A dc; I_B = 0.5 A dc; pulsed (see 4.5.1)	$\Delta V_{CE(SAT)1}$ 5/	± 50 percent mV dc change from previously measured value.		
8.	Thermal impedance	3131	See 4.3.2	ΔV_{BE}			

See footnotes at end of table.

* TABLE II. Groups A, B, and C electrical end-point inspection measurements 1/ 2/ 3/ 4/ - Continued.

1/ The electrical measurements for table VIa (JANS) of MIL-PRF-19500 are as follows:
   a. Subgroup 3, see table II herein, steps 1, 2, 3, and 4.
   b. Subgroup 4, see table II herein, steps 1, 2, 3, 4, 7, and 8.
   c. Subgroup 5, see table II, steps 1, 2, 3, 4, 5, 6, and 7.

2/ The electrical measurements for table VIb (JAN, JANTX, and JANTXV) of MIL-PRF-19500 are as follows:
   a. Subgroup 2, see table II herein, steps 1, and 3.
   b. Subgroup 3, see table II herein, steps 1, 3, 4, 5, and 6.
   c. Subgroup 6, see table II herein, steps 1, 4, 5, and 6.

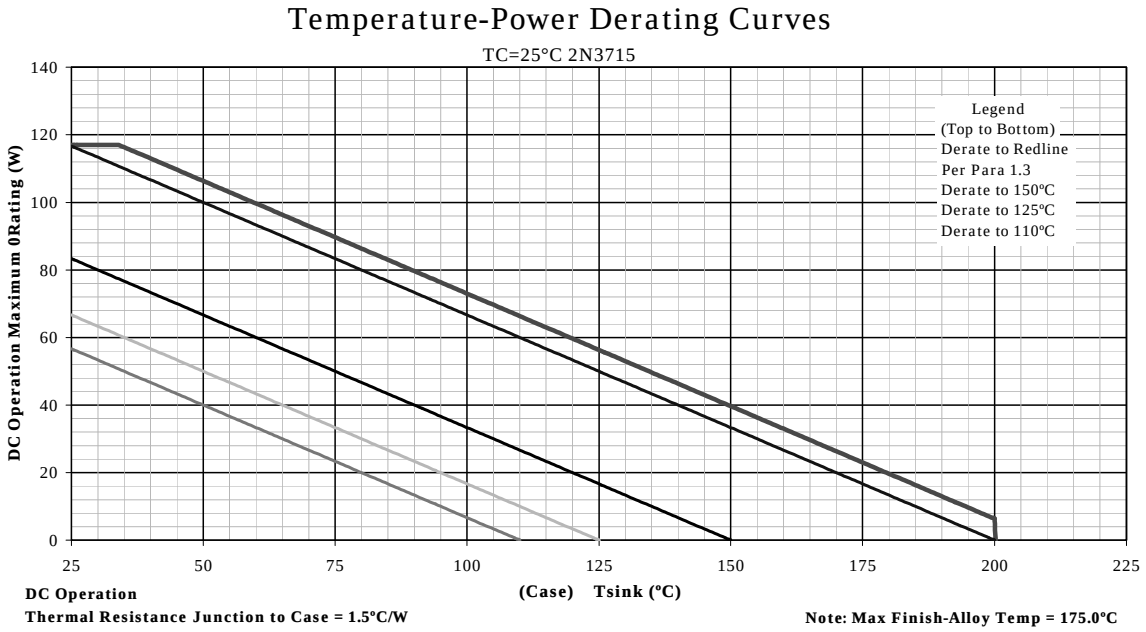
3/ The electrical measurements for table VII of MIL-PRF-19500 are as follows:
   a. Subgroup 2, see table II herein, steps 1, 2, 3, and 4 (JANS); and 1, 2, and 4 (JAN, JANTX, and JANTXV).
   b. Subgroup 3, see table II herein, steps 1, 2, 3, and 4 (JANS); and 1, 2, and 4 (JAN, JANTX, and JANTXV).
   c. Subgroup 6, see table II herein, steps 1, 2, 3, 4, 5, 6, 7, and 8 (JANS); and 1, 2, 3, 4, 5, and 6 (JAN, JANTX, and JANTXV).

4/ The electrical measurements for table IX of MIL-PRF-19500 are as follows: Subgroups 1 and 2, see table II herein, steps 1, 2, 3, and 4.

5/ Devices which exceed the group A limits for this test shall not be acceptable.

* TABLE III. Group E inspection (all quality levels) - for qualification and re-qualification only.

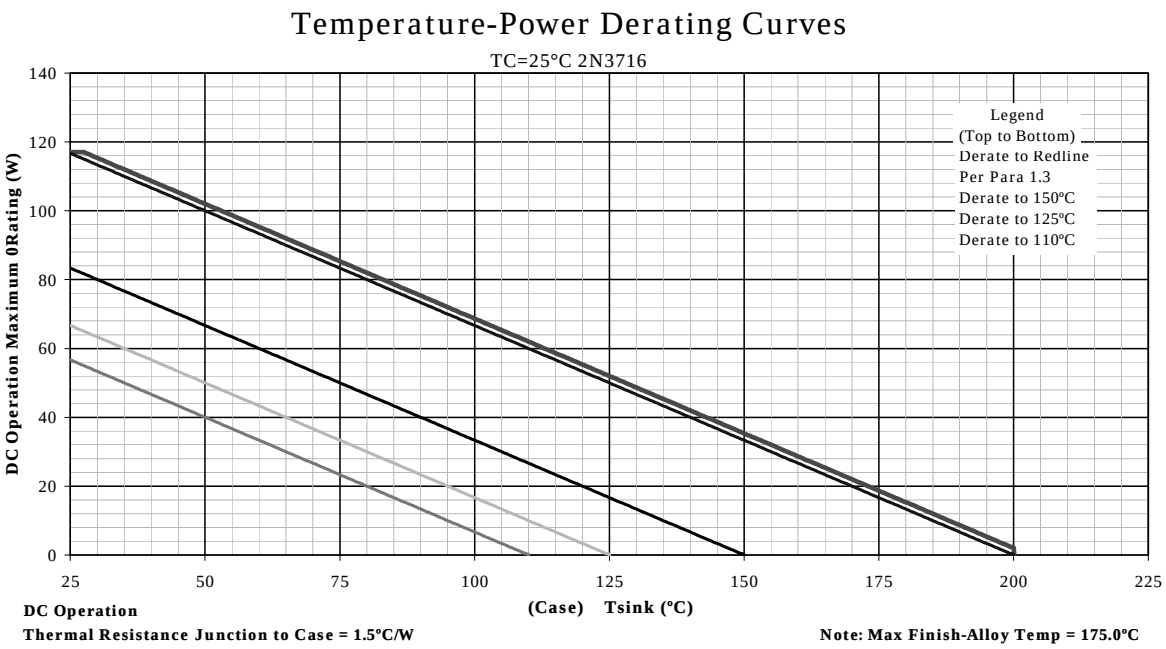
Inspection	MIL-STD-750		Qualification
	Method	Conditions	
Subgroup 1			45 devices c = 0
Temperature cycling	1051	500 cycles minimum	
Hermetic seal	1071		
Fine leak Gross leak			
Electrical measurements		See table II, steps 1 through 4.	
Subgroup 2			45 devices c = 0
Steady-state dc blocking life	1039 or 1049	Condition A; 1,000 hrs	
Electrical measurements		See table II, steps 1 through 4.	
Subgroup 3			3 devices c = 0
DPA	2102		
Subgroup 4			sample size N/A
Thermal impedance curves		Each supplier shall submit their (typical) design thermal impedance curves. In addition, test conditions and $Z_{\theta JX}$ limit shall be provided to the qualifying activity in the qualification report	
Subgroups 5 and 6			
Not applicable			
Subgroup 7			45 devices c = 0
Reverse stability	1033	Condition A for devices $\geq$ 400 V, condition B for devices < 400 V.	



NOTES:

1. Maximum theoretical derate design curve. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See paragraph 1.3)
3. Derate design curve chosen at $T_J \leq +150°C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125°C$, and $+110°C$ to show power rating where most users want to limit T_J in their application.

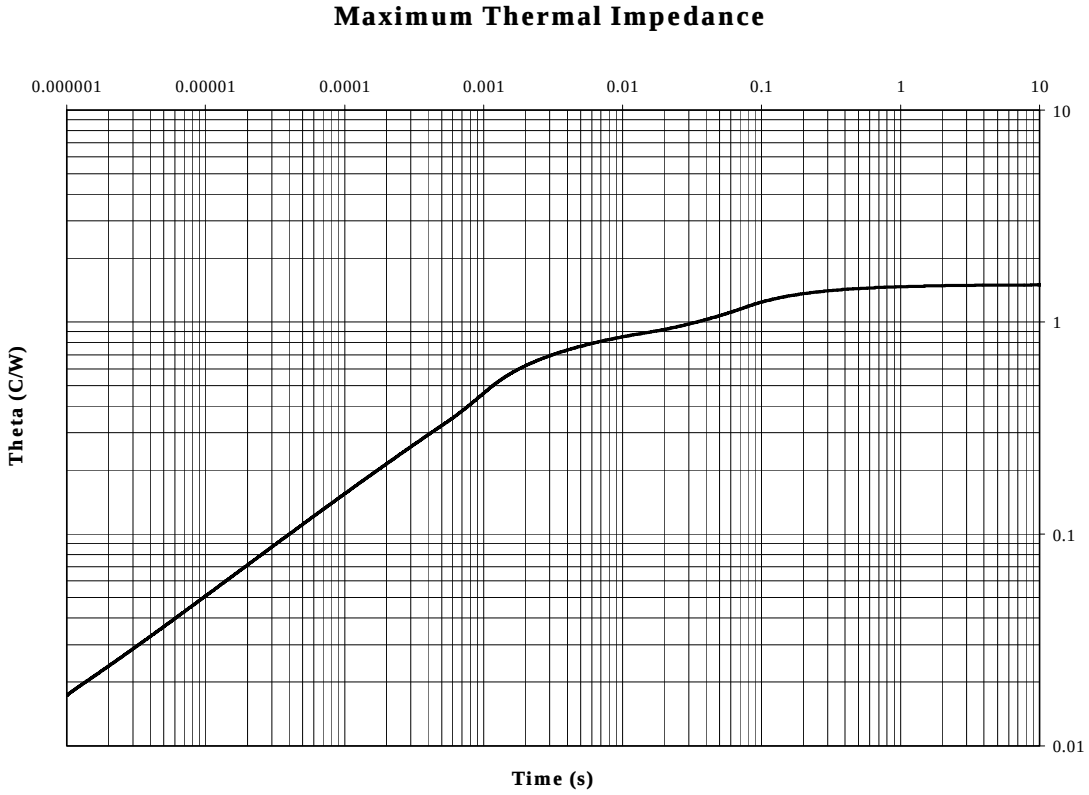
* FIGURE 2. Temperature derating graphs (TO-3).



NOTES:

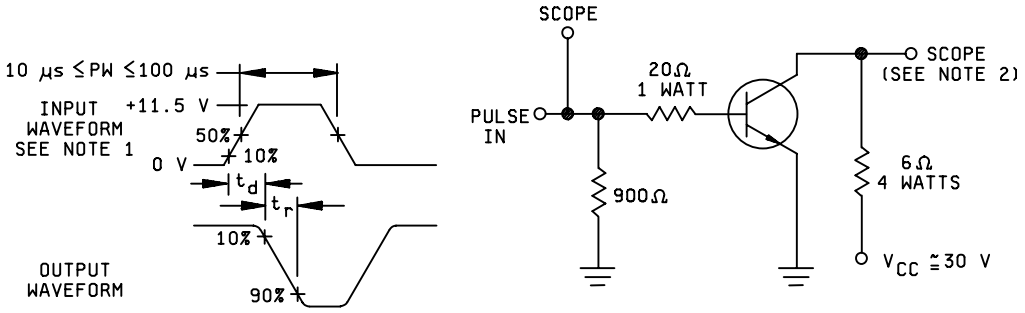
1. Maximum theoretical derate design curve. This is the true inverse of the worst case thermal resistance value. All devices are capable of operating at $\leq T_J$ specified on this curve. Any parallel line to this curve will intersect the appropriate power for the desired maximum T_J allowed.
2. Derate design curve constrained by the maximum junction temperatures and power rating specified. (See paragraph 1.3)
3. Derate design curve chosen at $T_J \leq +150^{\circ}C$, where the maximum temperature of electrical test is performed.
4. Derate design curve chosen at $T_J \leq +125^{\circ}C$, and $+110^{\circ}C$ to show power rating where most users want to limit T_J in their application.

* FIGURE 2. Temperature derating graphs (TO-3) - Continued.

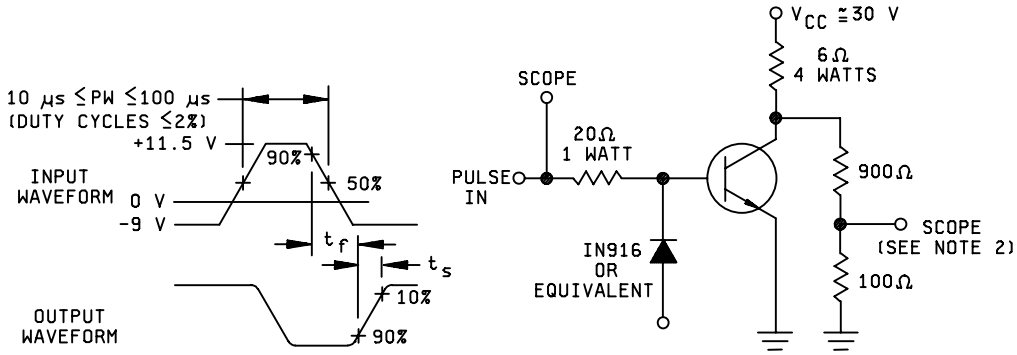


T_C = +25C. Thermal resistance = 1.5◦C/W.

* FIGURE 3. Transient thermal impedance graph.



TEST CIRCUIT A

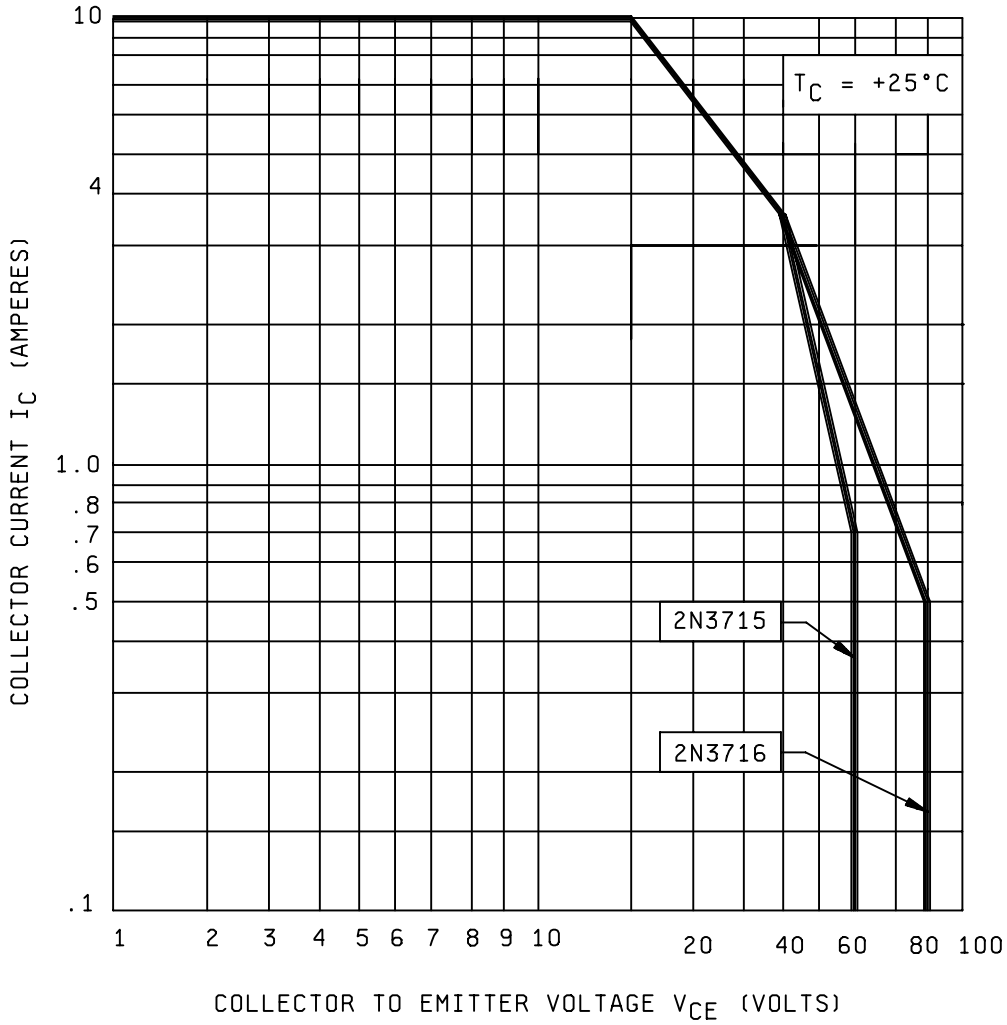


TEST CIRCUIT B

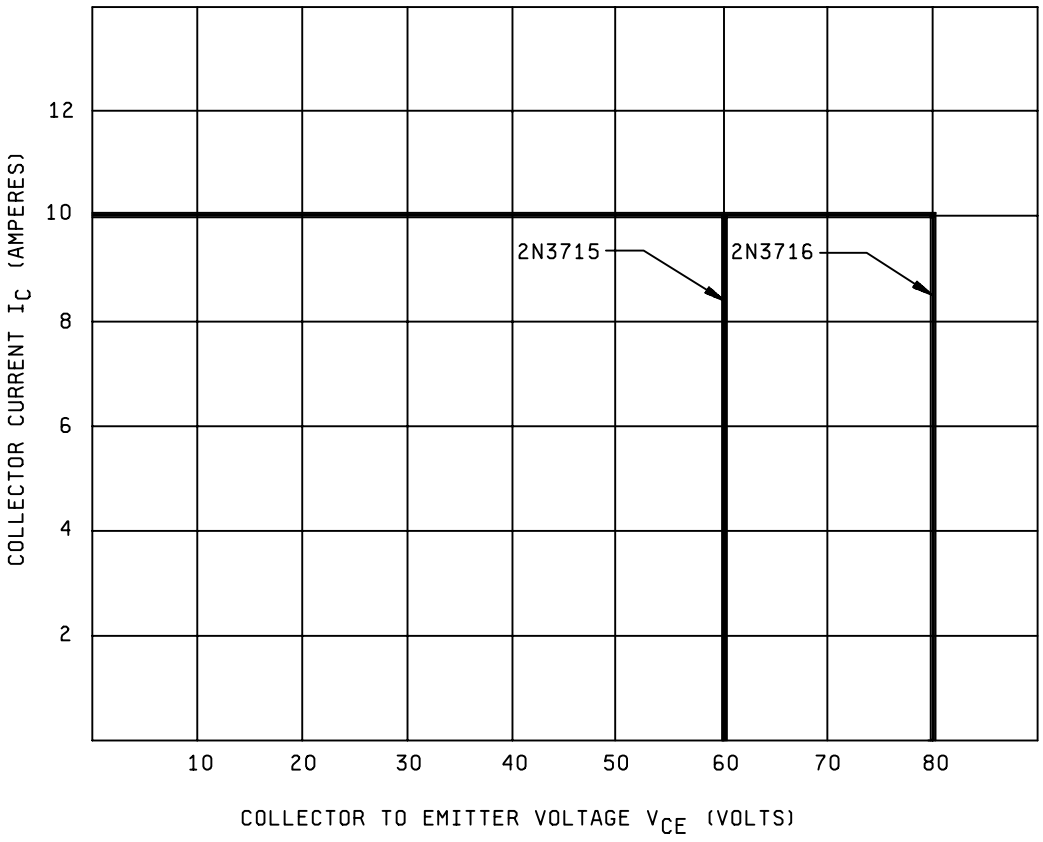
NOTES:

1. The input waveform is supplied by a pulse generator with the following characteristics: $t_r \leq 20.0$ ns, $t_f \leq 1$ µs, 10 µs $\leq$ PW $\leq$ 100 µs, $Z_{OUT} = 50\Omega$, duty cycle $\leq$ 2 percent.
2. Output waveforms are monitored on an oscilloscope with the following characteristics: $t_r \leq 5$ ns, $Z_{IN} \geq 100$ kΩ, $C_{IN} \leq 12$ pF.
3. Test circuit A for t_d and t_r; test circuit B for t_s and t_f.

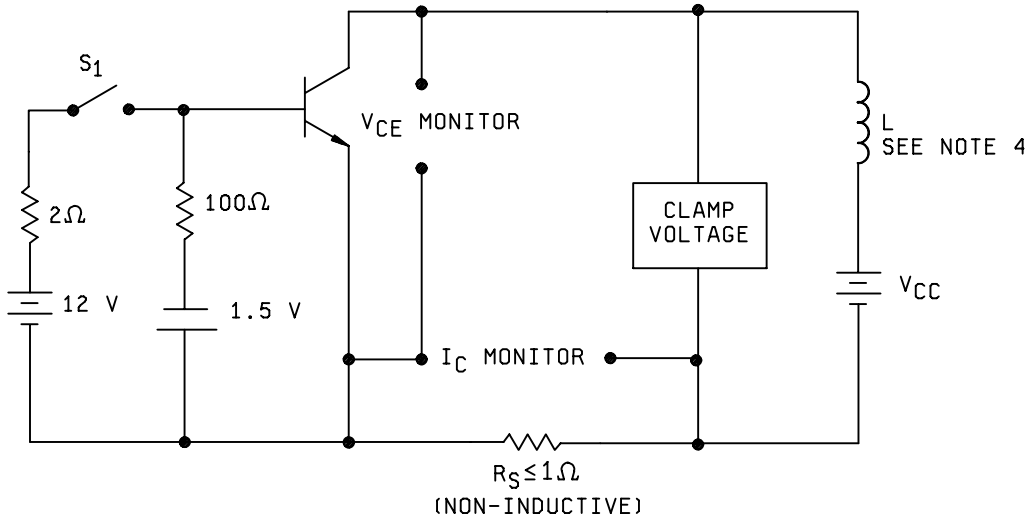
* FIGURE 4. Pulse response test circuits.



* FIGURE 5. Maximum safe operating graph (dc).



* FIGURE 6. Safe operating area for switching between saturation and cutoff (clamped inductive load).



Procedure:

1. With switch S1 closed, set the specified test conditions.
2. Open S1. Device fails if clamp voltage not reached.
3. Perform specified end-point tests.
4. L = 4.0 mH, 0.05Ω, 20 A, Q ≥ 100 at 1 kHz, (Sanford Miller CK-20 or equivalent).

* FIGURE 7. Clamp inductive sweep test circuit.

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 personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. 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 that may be helpful, but is not mandatory.)

* 6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

* 6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.

b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).

c. Packaging requirements (see 5.1).

d. Lead finish (see 3.4.1).

e. Type designation and product assurance level.

* 6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Interchangeability information. MIL-PRF-19500/621 is a TO-254 package version of MIL-PRF-19500/379, which is a TO-3 package version. The military 2N7369 contains the same die as the military 2N3792. The MIL-PRF-19500/621 is preferred over the MIL-PRF-19500/379 whenever interchangeability is not a problem. For new design use 2N7369. The 2N2792 is inactive for new design.

* 6.5 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, TRANSISTOR, NPN, SILICON, HIGH-POWER TYPES 2N3715 AND 2N3716 JAN, JANTX, JANTXV AND JANS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

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8. PREPARING ACTIVITY

a. Point of Contact Alan Barone	b. TELEPHONE Commercial 614-692-0510	DSN 850-0510	FAX 614-692-6939	EMAIL alan.barone@.dla.mil
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