The documentation process conversion measures necessary to comply with this revision shall be completed by 10 March 1998

INCH-POUND

MIL-PRF-19500/608A
10 December 1997
SUPERSEDING
MIL-S-19500/608
22 April 1993

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICE, DIODE, SILICON, SCHOTTKY, POWER RECTIFIER, COMMON CATHODE OR COMMON ANODE CENTER TAP, TYPES 1N6660 AND 1N6660R 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 a silicon, schottky, power rectifier diodes. Four levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1 (T0-254AA isolated).

1.3 Maximum ratings.

Type	V_R 1/	V_{RWM} 1/	I_O 1/ 2/ 3/	I_{FSM} 1/	C_J 1/	T_{STG} and T_J
			$T_J = T_C = +100°C$	$T_C = +25°C$ $t_p = 8.3$ ms	at 5 V	
	V	V	A dc	A(pk)	pF	°C
1N6660, 1N6660R	45	45	15	300	2,000	-65 to +150

1/ Each individual diode.
2/ Derate linearly at 300 mA/°C from $T_J = T_C = +100°C$ to +150°C. 300 mA/°C times 50°C = 15 A, the device rating.
3/ Total package current is limited to 30 A dc.

1.4 Primary electrical characteristics. $R_{\theta JC} = 1.65°C/W$ maximum, $R_{\theta JA} = 40°C/W$ maximum, each individual diode.

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

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

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

MILITARY

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

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available 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 (except for related associated specifications or 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 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

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

3.3 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-254AA) herein. Methods used for electrical isolation of the terminal feedthroughs shall employ materials that contain a minimum of 90 percent AL_2O_3 (ceramic). Examples of such construction techniques are metallized ceramic eyelets or ceramic walled packages. The US government preferred system of measurement is the metric SI system. However, since this item was originally designed using inch-pound units of measurement, in the event of conflict between the metric and inch-pound units, the inch-pound units shall take precedence.

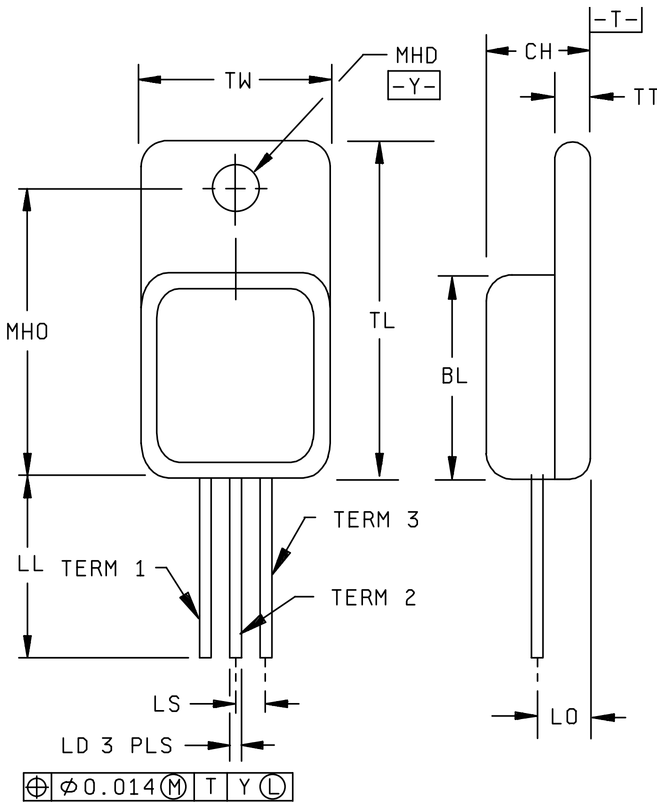
3.3.1 Lead formation and finish. Lead finish shall be solderable as defined in MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish or formation is desired, it shall be specified in the acquisition requirements (see 6.2

3.3.2 Polarity. Polarity and terminal configuration shall be in accordance with figure 1 herein.

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

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

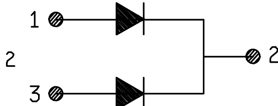
3.6 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3 herein.



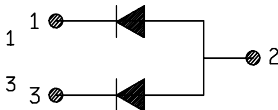
Ltr	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
BL	.535	.545	13.59	13.89
CH	.249	.260	6.32	6.60
LD	.035	.045	0.89	1.43
LL	1.195	1.235	30.35	31.37
LO	.150 BSC		3.81 BSC	
LS	.150 BSC		3.81 BSC	
MHD	.139	.149	3.53	3.78
MHO	.665	.685	16 89	17.40
TL	.790	.800	20.07	20.32
TT	.040	.050	1.02	1.27
TW	.535	.545	13.59	13.89

SCHEMATIC

1N6660 Term 1 = Anode 1
Term 2 = Cathode 2
Term 3 = Anode 3



1N6660R Term 1 = Cathode 1
Term 2 = Anode 2
Term 3 = Cathode 3



NOTES:
1. Dimensions are in inches
2. Metric equivalents are given for general information only.
3. All terminals are isolated from case.

FIGURE 1. Physical dimensions and configuration (T0-254AA).

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).

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

4.3 Screening (JANS, JANTX, and JANTXV levels only). Screening shall be in accordance with MIL-PRF-19500 (Appendix E, table IV), 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 1/	Method 3101 (see 4.3.2), Peak reverse energy test (see 4.3.3)	Method 3101 (see 4.3.2), Peak reverse energy test (see 4.3.3)
9 and 10	Not applicable	Not applicable
11	V_{F2} and I_{R1}	V_{F2} and I_{R1}
12	See 4.3.1, t = 240 hours	See 4.3.1, t = 48 hours
13	Subgroups 2 and 3 of table herein; $\Delta V_{F2} = \pm$ 50 mV; ΔI_{R1} = 100 percent of initial value or $\pm$ 250 μA dc, whichever is greater.	Subgroup 2 of table herein; $\Delta V_{F2} = \pm$ 50 mV; ΔI_{R1} = 100 percent of initial value or $\pm$ 250 μA dc, whichever is greater.

1/ Shall be performed anytime after screen 3.

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

MIL-STD-750 method 1038, test condition A. T_C = +125°C; V_R = 36 V dc.

4.3.2 Thermal impedance $Z_{\theta JX}$ measurements for screening. The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101. Test each die separately. The maximum limit and conditions for $Z_{\theta JX}$ in screening (appendix E, table IV of MIL-PRF-19500) shall be derived by each vendor by means of process control of actual measurements which characterizes the die attach process. When three lot date codes have exhibited control, the data from these three lots will be used to establish a fixed screening limit (not to exceed the group A limit). Once a fixed limit has been established, monitor all future sealing lots using a sample from each lot to be plotted on the applicable SPC chart.

4.3.2.1 Thermal impedance ($Z_{\theta JX}$ measurements) for initial qualification or requalification. The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750. Method 3101 (read and record date $Z_{\theta JX}$) derived conditions limits and thermal response curve shall be supplied to the qualifying activity on the qualification lot prior to qualification approval.

4.3.3 Peak reverse energy test. The peak reverse energy test is to be performed using the circuit as shown on figure 2 or equivalent. The Schottky rectifier under test must be capable of absorbing the reverse energy, as defined, below:

I_{RM} = 2 A minimum, V_{RSM} = 54 V minimum, L = 260 μH.

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. Electrical measurements (end points) and delta requirements shall be in accordance with the applicable steps of table III herein. The following test conditions shall be used for $Z_{\theta JX}$, group A inspection:

a. I_M measure current ....10 mA

b. I_H forward heating current ....15 - 50 A

c. t_M heating time...50 ms

d. t_{MS} measurement delay time ....100 μs minimum

The maximum limit for $Z_{\theta JX}$ under these test conditions are $Z_{\theta JX}$(max) = 1.55°C/W.

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 VIb (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 III herein.

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

a. Subgroup 4: Condition for intermittent operation life for each diode are as follows:

   I_F or I_O = 2 A (minimum); $\Delta T_J \geq$ 85°C, +15°C, -5°C for 2,000 cycles minimum.

b. Subgroups 5: Condition for steady-state operation life (accelerated) is as follows:

   Method 1038, condition A, $T_J = T_C$ = +150°C, V_R = 36 V dc.

c. Subgroup 6: Limit for thermal resistance is $R_{\theta JC}$ = 1.65°C/W maximum for each die.

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

a. Subgroup 3: Condition for intermittent operation life for each diode are as follows:

   I_F or I_O = 2 A (minimum); $\Delta T_J \geq$ 85°C, +15°C, -5°C for 2,000 cycles minimum.

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 III herein.

4.4.3.1 Group C inspection, appendix E, table VII of MIL-PRF-19500.

a. Subgroup 2: Condition for terminal strength are as follows:

Tension: Test condition A, weight = 10 lbs, t = 15 seconds.

b. Subgroup 3: Condition for constant acceleration are as follows:

X_1, Y_1, Z_1, and Z_2 axis.

c. Subgroup 6: I_F or I_O = 2 A (minimum); $\Delta T_J \geq 85^\circ C$, $+15^\circ C$, $-5^\circ C$ for 6,000 cycles minimum.

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

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

4.5.2 Thermal resistance. Thermal resistance shall be measured as follow in accordance with method 3101 or 5081. Each diode leg shall be measured.

a. I_M .... 10 mA

b. I_H .... 15 - 50 A

c. t_{Md} .... 100 μs maximum

d. $R_{\theta JC}$ .... 1.65°C/W

TABLE I. Group A inspection. 1/ 2/

Inspection	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Thermal impedance 3/	3101	See 4.4.1	$Z_{\theta JX}$		1.55	°C/W
Forward voltage	4011	I_F = 5 A (pk) pulsed (see 4.5.1)	V_{F1}		0.55	V dc
		I_F = 15 A (pk) pulsed (see 4.5.1)	V_{F2}		0.75	V dc
		I_F = 30 A (pk) pulsed (see 4.5.1)	V_{F3}		1.0	V dc
Reverse current	4016	DC method, V_R = 45 V dc, (see 4.5.1)	I_{R1}		1.0	mA dc
Subgroup 3						
High temperature operation:		T_A = +125°C				
Reverse current leakage	4016	DC method, pulsed (see 4.5.1) V_R = 45 V (pk)	I_{R2}		40	mA dc
Low temperature operation:		T_A = -55°C				
Forward voltage	4011	Pulsed (see 4.5.1) I_F = 15 A (pk)	V_{F4}		0.8	V dc
Subgroup 4						
Junction capacitance	4001	V_R = 5 V dc; f = 1 MHz V_{SIG} = 50 mV (p-p) (max)	C_J		2,000	pF
Subgroup 5						
Dielectric withstand	1016	V_R = 500 V dc; All leads shorted; V measure from leads to case; Sample is n = 116, c = 0.	DWV		10	μA
Subgroup 6 and 7						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.
2/ Each individual diode.
3/ If 4.4.1 test conditions are performed in 100 percent screening, this test need not be performed in group A.

TABLE II. Group E inspection (all quality levels) for qualification only.

Inspection	MIL-STD-750		Qualification inspection
	Method	Conditions	
Subgroup 1			38 devices, c = 0
Thermal shock (temperature cycling)	1051	500 cycles	
Hermetic seal	1071		
Electrical measurements		See table III, steps 1, 2, and 5	
Subgroup 2			38 devices, c = 0
Steady-state blocking life	1048	t = 1,000 hours, T_C = +125°C; V_R = 36	
Electrical measurements		See table III, steps 1 and 2	
Subgroup 3			
Not applicable			
Subgroup 4			10 devices, c = 0
Thermal resistance	3101	See 4.5.2, $R_{\theta JC}$ = 1.65°C/W	
Subgroup 5 1/			22 devices, c = 0
Surge	4066	Condition B; T_A = +25°C; I_{FSM} = 300 A, 100 surges	
Electrical measurements		See table III, steps 1 and 2.	

1/ For each diode.

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

Step	Inspection	MIL-STD-750		Symbol	Limits		Unit
		Method	Conditions		Min	Max	
1.	Forward voltage	4011	I_F = 15 A (pk), pulsed (see 4.5.1)	V_{F2}		0.75	V dc
2.	Reverse current leakage	4016	V_R = 45 V dc, pulsed (see 4.5.1) DC method	I_{R1}		1.0	mA dc
3.	Forward voltage	4011	I_F = 15 A (pk), pulsed (see 4.5.1)	ΔV_{F2}	± 50 mV dc from initial reading.		
4.	Reverse current	4016	V_R = 45 V dc, pulsed (see 4.5.1) DC method	ΔI_{R1}	± 250 :A dc or 100 percent from initial reading, whichever is greater.		
5.	Thermal impedance	3101	See 4.4.1	$Z_{\theta JX}$		1.55	°C/W

1/ Each individual diode.

2/ The electrical measurements for appendix E, table VIa (JANS) of MIL-PRF-19500 are as follows:

a. Subgroup 3, see table III herein, steps 1 and 2.

b. Subgroup 4, see table III herein, steps 1, 2, 3, 4, and 5.

c. Subgroup 5, see table III herein, steps 1, 2, 3, and 4.

3/ The electrical measurements for appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500 are as follows:

a. Subgroup 2, see table III herein, steps 1 and 2.

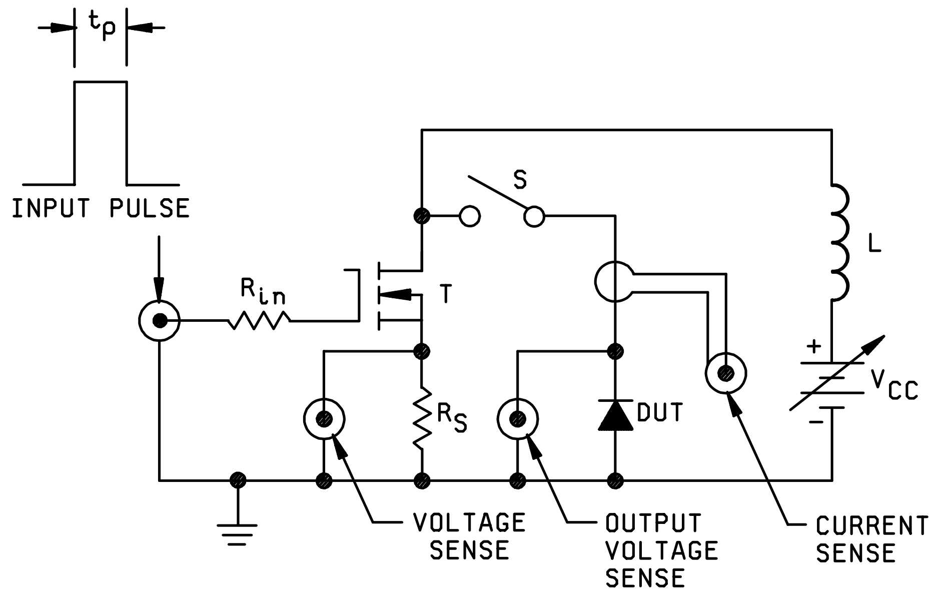
b. Subgroup 3, see table III herein, steps 1, 2, and 5.

c. Subgroup 6, see table III herein, steps 1 and 2.

4/ The electrical measurements for appendix E, table VII of MIL-PRF-19500 are as follows:

a. Subgroups 2 and 3, see table III herein, steps 1 and 2 for all levels.

b. Subgroup 6, see table III herein, steps 1, 2, and 5 for all levels.



Input pulse	Rin = 50 ohms, 1 watt
V_G = 10 Volts	R_S = 0.1 ohms, 1 watt
R_G = 50 ohms	$V_{CC} \approx$ 10 volts
P.W.$\approx$ 30 μs	L = 260 μH
Duty cycle $\leq$ 1 percent	T = IRF130/2N6756 or equivalent

PROCEDURES:

1. With S open, adjust pulse width to test current of 2 amps across R_S.
2. Close S, verify test current with current sense.
3. Read peak output voltage (see 4.3.3).

FIGURE 2. Peak reverse energy test circuit.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material 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 Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6. NOTES

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

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. See MIL- PRF-19500.

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 Products List QPL No.19500 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 purchase 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, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

Custodians:
Army - CR
Navy - EC
Air Force - 17
NASA - NA

Review activities:
Army - AR, MI, SM
Navy - AS, CG, MC, OS
Air Force - 13, 19, 85, 99

Preparing activity:
DLA - CC

(Project 5961-1791)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-PRF-19500/608A	2. DOCUMENT DATE (YYMMDD) 971210

3. DOCUMENT TITLE SEMICONDUCTOR DEVICE, DIODE, SILICON, SCHOTTKY, POWER RECTIFIER, COMMON CATHODE OR COMMON ANODE CENTER TAP TYPES 1N6660 AND 1N6660R JAN, JANTX, JANTXV, AND JANS

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

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME Alan Barone	b. TELEPHONE (Include Area Code) (1) Commercial (614)692-0510 (2) AUTOVON 850-0510
c. ADDRESS (Include Zip Code) Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340