

MIL-S-19500/130C
~~11 February 1975~~
 SUPERSEDING
 MIL-S-19500/130B
 5 June 1970, and
 MIL-S-19500/129(SigC)
 20 July 1960

MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, DIODE, SILICON, MIXER
 TYPES 1N78C, 1N78CR, 1N78CM, 1N78CMR,
 1N78F, 1N78FR, 1N78FM, AND 1N78FMR

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 detail requirements for silicon point contact semiconductor diodes for use as a mixer in Ku-band equipment.

1.2 Ratings and characteristics.

	F_{om}		1/G	L	N	SWR
	1N78C	1N78F				
	<u>dB</u>	<u>dB</u>	<u>ohms</u>	<u>dB</u>	<u>ratio</u>	<u>ratio</u>
Min	---	---	400	---	---	---
Max	9.5	7.5	565	6.0	1.9	1.5

OPERATING AMBIENT TEMPERATURE: -65° to +150°C

STORAGE TEMPERATURE: -65° to +150°C

2. APPLICABLE DOCUMENTS

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

SPECIFICATION

MILITARY

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

STANDARD

MILITARY

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

DRAWINGS

Defense Electronics Supply Center

D65084 - Diode Test Holder, (Ku Band).

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements for semiconductor diodes shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations and symbols. The abbreviations and symbols used herein are defined in MIL-S-19500.

3.3 Design, construction, and dimensions. The semiconductor diode shall be of the design, construction, and physical dimensions specified in figure 1. Forward polarity units shall have the cathode connected to the center pin. Reverse polarity units shall have the anode connected to the center pin.

3.3.1 Plating. The diode shall be plated as specified in figure 1. If silver plating is used, a rhodium flash may be applied.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted at the option of the manufacturer:

- (a) Country of origin.
- (b) Manufacturer's identification.
- (c) Polarity.

3.5.1 Matched diodes. The "M" suffix for matched diodes shall be omitted in the type designation on each device. Matched diodes meeting the requirements of this specification shall be packaged with a statement to that effect.

3.6 Burnout by multiple RF pulses. At the end of manufacturing processes and prior to selecting samples for testing, all diodes shall be subjected to 100 percent burnout by exposure to a series of RF pulses with the test conditions as follows:

$P = 10 \text{ watts.}$
 $f = 16.5 \pm .5 \text{ GHz.}$
 $R_L = 100 \text{ ohms.}$
 $t_p = 6 \pm 3 \text{ nanoseconds,}$
 Exposure = 15,000 pulses minimum.
 Holder: Test data demonstrating that the holder used meets the requirement of figure 2, note 1 shall be made available to the government representative upon request.

After the burnout by multiple pulse, group A, subgroup 2 tests shall be performed on all devices in the lot. Any device which fails the end point test shall be eliminated from the lot.

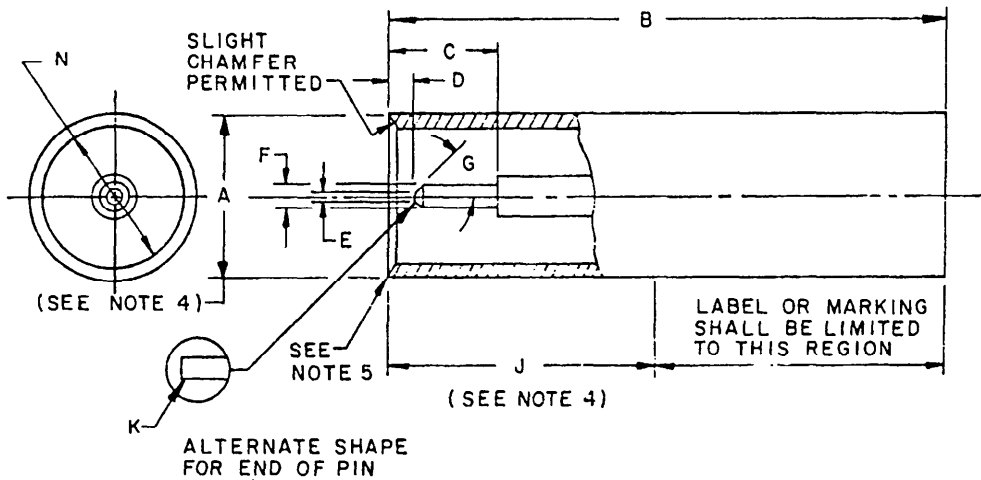
4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.1.1 Structurally similar device types. Types 1N78C and 1N78F are structurally similar devices. Type 1N78F shall be sampled for groups B and C inspections to qualify and accept all types for qualification inspection and quality conformance inspection.

4.2 Test conditions. Unless otherwise specified herein, the test conditions, when applicable, shall be as follows:

$P = 1.0 \text{ mW} \pm 5\%$
 $f = 16 \text{ GHz} \pm 20 \text{ MHz}$
 $\bar{F}_{is} \geq 1.5 \text{ dB}$
 $Z_L = 500 \pm 10 \text{ ohms; } \pm j0 \text{ ohms}$
 $R_L = 100 \pm 1 \text{ ohms}$
 Holder = D65084

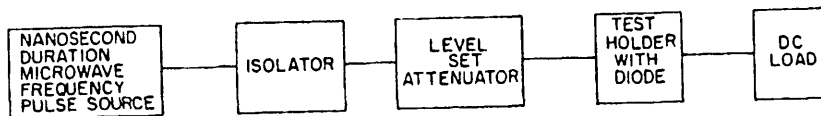


LTR	DIMENSIONS			
	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.215	.220	5.16	5.58
B	.734	.766	18.64	19.45
C	.147		3.73	
D	.011	.028	.28	.71
E	.007	.017	.18	.43
F	.031	.033	.78	.84
G	40°	50°		
J	.406		10.31	
K	.007	.017	.18	.43
N	.179	.189	4.55	4.80

NOTES:

1. Finish .0002 (.005 mm) tin plate over nickel flash, or .0001 (.003 mm) gold plate or .0001 (.003 mm) silver plate.
2. Axis of center conductor (pin) not to deviate from axis of outer conductor referred to its outside diameter more than .004 (.102 mm).
3. Forward polarity units shall have the cathode connected to the center pin. Reverse polarity units shall have the anode connected to the center pin.
4. Outside diameter, .215 (5.46 mm) to .220 (5.59 mm), applies for length of dimension J. Remainder of body diameter shall not exceed .225 (5.72 mm) max.
5. This device shall be free of sharp edges and burrs.

FIGURE 1. Semiconductor device, diode, types 1N78C, 1N78F, suffix R (reverse polarity), suffix M (matched forward pair), and suffix MR (matched forward and reverse).



NOTES:

1. The holder used with a diode mounted in it and terminated with 100 ohms and with an incident power of 1.0 mw to the holder shall have a 2.0 maximum VSWR over a minimum band width of $\frac{1}{\text{(pulse width used)}}$ on both sides of the RF burnout test frequency used.
2. A suitable circuit for generating nanosecond pulses of the required power is described in the 1969 IEEE-G-MTT International Microwave Symposium Conference Record. See figure 3.

FIGURE 2. Multiple RF pulse burnout circuit.

4.2.1 Holder. The diode holder specified in Drawing D65084, or equivalent, shall be used for all electrical test measurements.

4.3 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III, except the matched-pair requirements in subgroup 3, table I. Qualification testing of both polarities shall be required to obtain qualification approval.

4.4 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests specified in groups A, B, and C.

4.4.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

4.4.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.

4.4.3 Group C inspection. Group C inspection shall consist of the tests specified in table III, and shall be performed every 12 months.

4.5 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:

4.5.1 High-temperature operation. The semiconductor diode shall be placed in the mixer holder. The ambient temperature of the diode, with test conditions specified for the overall noise figure, shall be raised to +150°C and maintained at this temperature until equilibrium is reached. The F_{om} shall then be determined and shall be no greater than the specified maximum limit. The temperature shall then be returned to 25 ±3°C at which time F_{om} shall be no greater than the specified maximum limit.

4.5.2 Matched pair, "M" suffix (forward polarity). The matched pair ("M" suffix) shall consist of two diodes, tested to requirements of subgroup 3, table I, and shall have the cathode connected to the center pin.

4.5.3 Matched pair, "MR" suffix (forward and reverse polarity). The matched forward and reverse pair ("MR" suffix) shall consist of two diodes, tested to requirements of subgroup 3, table I; one diode shall have the cathode connected to the center pin (forward polarity) and the second diode shall have the anode connected to the center pin (reverse polarity).

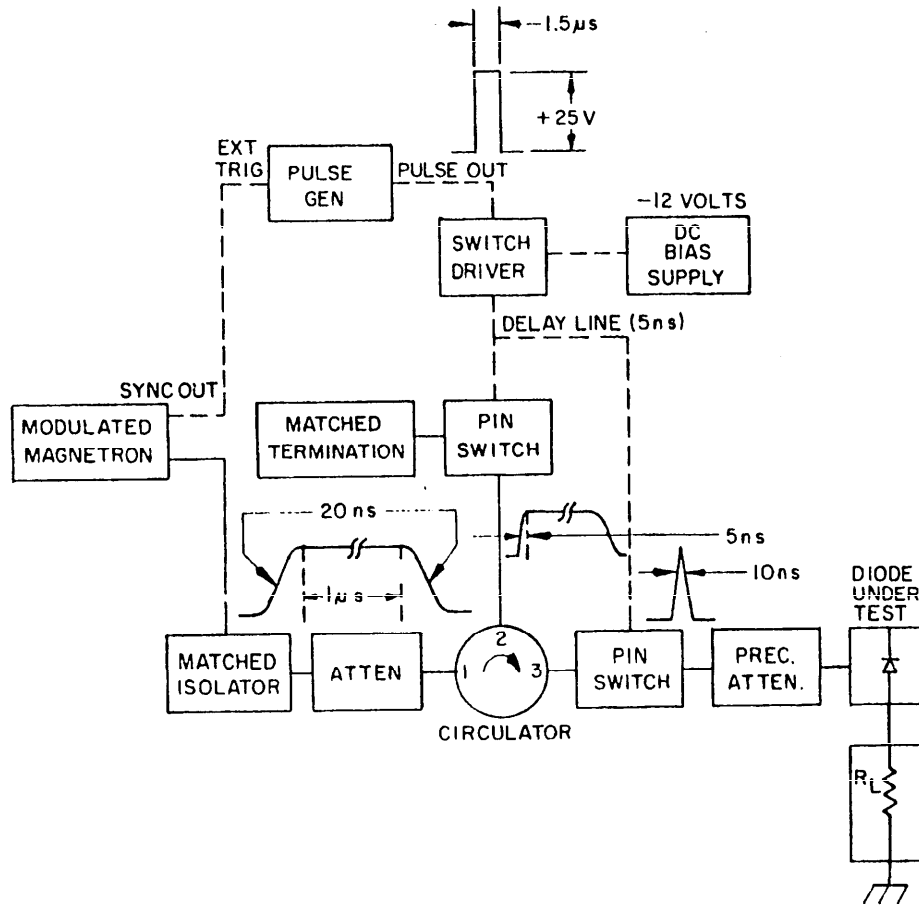


FIGURE 3. RF pulse burnout block diagram.

TABLE I. Group A inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u>			7				
Visual and mechanical examination	2071			---	---	---	---
<u>Subgroup 2</u>			5				
Standing wave ratio (see 4.2)	4136	Test method A or B (optional)		SWR	---	1.5	ratio
Intermediate frequency impedance (see 4.2)	4116	f = 60 - 2,000 Hz		1/G	400	565	ohms
Overall (average) noise figure (see 4.2)	4126	Test method A		$\overline{F}_{om}$			
1N78C					---	9.5	dB
1N78F					---	7.5	dB
<u>Subgroup 3</u>			5				
Matched pair requirements: (see 4.5.2 and 4.5.3)							
Conversion loss unbalance	4101	Test method A		ΔL	---	0.3	dB
Intermediate frequency impedance unbalance	4116			ΔG	---	25	ohms

TABLE II. Group B inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u>			10				
Physical dimensions	2066	(See figure 1)		---	---	---	---
<u>Subgroup 2</u>			10				
Thermal shock (temperature cycling)	1051	Test condition F		---	---	---	---
Moisture resistance	1021	Omit initial conditioning		---	---	---	---

TABLE II. Group B inspection - Continued.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 2 - Continued</u>			10				
End points:							
Overall (average) noise figure (see 4.2)	4126			$\bar{F}_{om}$			
1N78C					---	10.5	dB
1N78F					---	8.5	dB
<u>Subgroup 3</u>			10				
Shock	2016	Nonoperating; 500 G; t = 1.0 ms; 5 blows in each orientation: X ₁ , Y ₁ , and Y ₂		---	---	---	---
Vibration, variable frequency	2056	Nonoperating; 15 G, 60 to 2,000 Hz		---	---	---	---
End points:							
(Same as subgroup 2)							
<u>Subgroup 4</u>			10				
High-temperature operation: (see 4.5.1)	---	T _A = 150°C		---	---	---	---
Overall (average) noise figure (see 4.2)	4126			$\bar{F}_{om}$			
1N78C					---	12.5	dB
1N78F					---	10.5	dB
Overall (average) noise figure (see 4.2)	4126	T _A = 25°C		$\bar{F}_{om}$			
1N78C					---	10.5	dB
1N78F					---	8.5	dB

TABLE II. Group B inspection - Continued.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 5</u> High-temperature life (nonopera- ting) End points: (Same as sub- group 2)	1031	$T_A = 150^\circ\text{C}$	$\lambda=10$	---	---	---	---

TABLE III. Group C inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
<u>Subgroup 1</u> Conversion loss (see 4.2)	4101		10	L	---	6.0	dB
Output noise ratio (see 4.2)	4121	$R_e = 400 \text{ ohms}$		N	---	1.9	ratio

NOTE: L and N may be determined by any suitable combination of measured parameters selected from among the following: L, N, and $\bar{F}_{om}$. A measurement of L or N but not both is required.

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-19500.

6. NOTES

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

6.2 Superseded diode type. Type 1N78B formerly covered in MIL-S-19500/129(SigC) is replaced by type 1N78C.

Custodians:

Army - EL
 Navy - EC
 Air Force - 17

Preparing activity:

Army - EL

Agent:

DSA - ES

Review activities:

Army - MI, MU
 Air Force - 11, 19, 80, 85
 DSA - ES
 NASA - NA

(Project 5961-0524)

User activities:

Army - SM
 Navy - MC, CG, AS, OS, SH

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SPECIFICATION ANALYSIS SHEET		Form Approved Budget Bureau No. 22-R255
INSTRUCTIONS: This sheet is to be filled out by personnel, either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity. Comments and suggestions submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or serve to amend contractual requirements.		
SPECIFICATION MIL-3-12500/1300 SEMICONDUCTOR DEVICE, DIODE, SILICON, MIXER TYPES 2N73C, 1N78CR, 1N78CH, 1N78CMR, 1N78F, 1N78FR, 1N78FM, AND 1N78FMR		
ORGANIZATION		
CITY AND STATE		CONTRACT NUMBER
MATERIAL PROCURED UNDER A ☐ DIRECT GOVERNMENT CONTRACT ☐ SUBCONTRACT		
1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE? A. GIVE PARAGRAPH NUMBER AND WORDING.		
B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES		
2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID		
3. IS THE SPECIFICATION RESTRICTIVE? ☐ YES ☐ NO (If "yes", in what way?)		
4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)		
SUBMITTED BY (Printed or typed name and activity - Optional)		DATE

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