

MILITARY SPECIFICATION

**CV 7479**

SEMICONDUCTOR DEVICE, TRANSISTOR  
 2N2060

Description:- This specification covers the detail requirements for a six terminal device, containing two isolated high gain NPN Silicon Planar transistors and is in accordance with K1007, Issue 3, except as otherwise stated.

Mechanical Dimensions and Outlines:- See drawing Fig. 2  
 Page 13.

Connections:- See drawing Fig. 3 Page 13.

Absolute Maximum Ratings:-

Rating	V <sub>CB</sub>	V <sub>EB</sub>	V <sub>CER</sub>	V <sub>CEO</sub>	T <sub>stg</sub>	T <sub>j</sub>	Shock	Vibration
Unit	V	V	V	V	°C	°C	g	g
Min	-	-	-	-	-65	-	-	-
Max	100	7.0	80	60	+200	+200	1500	20
Notes			A				B	

Rating	P <sub>tot</sub> (Watts)					
	T <sub>case</sub> = 25°C		T <sub>case</sub> = 100°C		T <sub>amb</sub> = 25°C	
	One Side only	Both sides	One side only	Both sides	One side only	Both sides
Min						
Max	1.5	3.0	0.86	1.7	0.5	0.6
Notes	C		C			

See Page 2 for Notes

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Notes A.  $R_{BE} \leq 10$  ohms

B. Duration 0.5 mS.

C. See Fig. 1. Page 12.

## Primary Electrical Characteristics:-

Characteristic		$h_{FE}$	$h_{FE}$	$h_{FE}$	$h_{FE}$	$h_{fe}$	$C_{ob}$	$C_{TE}$	$V_{CE}$ (sat)
Unit							pF	pF	V
Min		25	30	40	50	3.0	-	-	-
Max		75	90	120	150		15	85	1.2
CONDITIONS	$T_{amb}$ °C	25	25	25	25	25	25	25	25
	$I_C$ mA	.01	0.1	1.0	10	50		0	50
	$I_B$ mA								5.0
	$V_{CE}$ V	5	5	5	5	10			
	$f$ Mc/s					20			
	$V_{CB}$ V						10		
	$V_{EB}$ V							0.5	
	$I_E$ mA						0		

Characteristic		$V_{BE}$ (sat)	$h_{fe}$	$h_{ib}$	$h_{ie}$	$h_{oe}$	Wide band	Narrow band
Unit		V		ohms	ohms	$\mu$ hos	db	db
Min		-	50	20	1000	4	-	-
Max		0.9	150	30	4000	16	8	8
CONDITIONS	$T_{case}$ °C	25	25	25	25	25	25	25
	$V_{CE}$ V		5.0	5.0	5.0	5.0	10	10
	$I_C$ mA	50	1.0	1.0	1.0	1.0	300 $\mu$ A	300 $\mu$ A
	$I_B$ mA	5						

Reliability Assurance Requirements:-

Under discussion

Requirements:

Abbreviations and Symbols: In addition to the symbols and abbreviations specified in K1007, the following shall apply:-

$V_{CER}$ (sust)	Sustaining voltage
$C_{TE}$	The emitter transition capacity
$\frac{h_{FE1}}{h_{FE2}}$	Current Gain ratio. The lowest of the two $h_{FE}$ readings is $h_{FE1}$

Marking: The device shall be marked as K1007. Section B.1.3.4. Minimum requirements are 1.3.4.1 (a) and (c).

Quality Assurance Provisions:

Destructive Tests: The tests listed in Table 2, Group B Inspection, Sub Groups 2, 3 and 4 are considered destructive.

Group C Inspection This inspection shall be conducted on the initial lot, and thereafter every ninety days or every fifth lot, whichever occurs first.

Preparation for Delivery:

Packaging: The device shall be packed according to K1007, Issue 3, Section A. 1.2.(c).

Joint Service Catalogue Number: 5960-99-037-3689

This specification has been prepared by, and the Qualification Approval Authority is:-  
Ministry of Aviation, Royal Radar Establishment, Malvern, Worcs. England.

20th January, 1964.

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TABLE 1 GROUP A INSPECTION

Examination or Test	TEST CONDITIONS		AQL %	Insp. Level	Sym-bol	LIMITS		Units
	K1007/NATO Ref.	SPECIFIC CONDITIONS				Min.	Max.	
<u>SUB GROUP 1</u> Visual and Mechanical Inspection	5.1	Excluding Physical Dimensions	0.65	I				
<u>SUB GROUP 2</u> Ratio of Static-Forward Current Transfer ratio	7.3.4	$I_C = 100 \mu A$ $V_{CE} = 5.0V$	0.65	II	$\frac{h_{FE1}}{h_{FE2}}$	0.9	1.0	
Base-Emitter voltage differential	7.3.2	$I_C = 100 \mu A$ $V_{CE} = 5.0V$			$V_{BE1}$ $V_{BE2}$	-	5.0	mV
<u>SUB GROUP 3</u> Collector-Emitter Sustaining Voltage	7.2.2.2	$R_{BE} = 10 \text{ ohms}$ $tp < 300 \mu S < 2\% \text{ duty cycle}$ $I_C = 100mA$	4.0	I	$V_{CER}$ (sust)	80	-	V
Collector-Emitter Sustaining Voltage	7.2.2.2	$I_C = 30mA$ $I_B = 0$ $tp < 300 \mu S < 2\% \text{ duty cycle}$			$V_{CEO}$ (sust)	60	-	V
Collector-Base breakdown voltage	7.2.1	$I_E = 0$ $I_C = 100 \mu A$			BV CBO	100	-	V
Collector-Base Cut-off Current (1)	7.2.5.1	$V_{CB} = 80V$ $I_E = 0$			$I_{CBO}$	-	2.0	nA

TABLE 1 GROUP A INSPECTION (Cont'd)

Examination or Test	K1007/NATO Ref.	TEST CONDITIONS		AQL %	Insp. level	Sym- bol	LIMITS		Units
		Specific Conditions					Min.	Max.	
Emitter-Base Cut-off current	7.2.6	$V_{EB} = 5.0V$				$I_{EBO}$	-	2.0	nA
Emitter-Base breakdown voltage	7.2.3	$I_C = 0$ $I_E = 100 \mu A$				$V_{EBO}$	7	-	V
Collector Emitter Saturation Voltage	7.3.3	$I_C = 50mA$ $I_B = 5mA$				$V_{CE (sat)}$	-	1.2	V
Static Forward Current	7.3.4	$I_C = 1.0mA$				$h_{FE}$	40	120	
Transfer ratio (1)		$V_{CE} = 5.0V$							
Static Forward Current	7.3.4	$I_C = 0.1mA$				$h_{FE}$	30	90	
Transfer ratio (2)		$V_{CE} = 5.0V$							
<u>SUB GROUP 4</u>				6.5	IA				
Static Forward Current	7.3.4	$I_C = 10 \mu A$				$h_{FE}$	25	75	
Transfer ratio (3)		$V_{CE} = 5.0V$							
Transition Frequency	7.5.2	$I_C = 50 mA$ $V_{CE} = 10V$ $f = 20 Mc/s.$				$f_T$	60		Mc/s

TABLE 1 GROUP A INSPECTION (Cont'd)

Examination or Test	TEST CONDITIONS		AQL %	Insp. Level	Sym-bol	LIMITS		Units
	K1007/NATO Ref.	Specific Conditions				Min.	Max.	
Base-emitter saturation voltage	7.3.1	$I_C = 50\text{mA}$ $I_B = 5\text{mA}$			$V_{BE}$ (sat)	-	0.9	V
Collector-Base cut off current (2)	7.2.5.1	$T = 150^\circ\text{C} \pm 3^\circ\text{C}$ $V_{CB} = 80\text{V}$ $I_E = 0$			$I_{CBO}$	-	10	$\mu\text{A}$
Output capacitance	7.4.8	$I_C = 0$ $V_{CB} = 10\text{V}$			$C_{ob}$	-	15	$\mu\text{uF}$
Emitter Transition Capacitance		$I_C = 0$ $V_{EB} = +0.5\text{V}$			$C_{TE}$	-	85	$\mu\text{uF}$
Noise Figure Narrow Band	7.6.3	$I_C = 0.3\text{mA}$ $V_{CE} = 10\text{V}$ $f = 1\text{kc}$ $R_g = 510 \text{ ohms}$ 200 c/s bandwidth			F	-	8	db
Wide Band		$I_C = 0.3\text{mA}$ $V_{CE} = 10\text{V}$ $R_g = 1 \text{ Kohm}$ Bandwidth 15.7 kc/s.			F	-	8	db

TABLE 2. GROUP B INSPECTION  
See Page 3 Quality Assurance Provisions, Destructive Tests.

Examination or Test	TEST CONDITIONS		AQL %	Insp. Level	Sym- bol	LIMITS		Units
	K1007/NATO Ref.	Specific Conditions				Min.	Max.	
<u>SUB GROUP 1</u> Physical Dimensions	5.1	According to drawings	6.5	IA				
<u>SUB GROUP 2</u> Solderability	5.13		4.0	IA				
Temperature Cycling Cycling	5.5	-65°C + 150°C						
Thermal Shock	5.6.2	0°C and 100°C						
Moisture Resistance	5.3							
<u>SUB GROUP 3</u> Vibration Fatigue	5.15		4.0	I Note 1				
<u>SUB GROUP 4</u> Lead Fatigue	5.10.2	3 cycles	6.5	IA				
<u>SUB GROUP 5</u> Omitted								
<u>SUB GROUP 6</u> Omitted								
<u>SUB GROUP 7</u> High Temperature Life (non-operating)	6.2.1	Tstg = 200°C ± 10°C Duration 1000 hrs.	4.0	I Note 1				

TABLE 2 GROUP B INSPECTION (Cont'd)

Examination or Test	TEST CONDITIONS		AQL %	Insp. Level	Sym-bol	LIMITS		Units
	K1007/NATO Ref.	Specific Conditions				Min.	Max.	
<u>SUB GROUP 8</u> Operating Life	6.3	$T_{amb} = 25^{\circ}C$ $V_{CB} = 40V$ $P_C = 300mW$ each side, $600mW$ total $I_C = 15mA$ . total	4.0	IA				
<u>Post Test End Points for Sub Groups 2, 3 &amp; 4</u> Collector-Base Cut-off Current	7.2.5.1	$V_{CB} = 80V$ $I_E = 0$			$I_{CBO}$	-	0.02	$\mu A$
Collector-Emitter Saturation Voltage	7.3.3	$I_C = 50mA$ $I_B = 5mA$			$V_{CE (sat)}$	-	1.32	V
Base-Emitter Saturation Voltage	7.3.2	$I_C = 50mA$ $I_B = 5mA$			$V_{BE (sat)}$	-	0.99	V
<u>Post Test End Points for Sub Groups 7 &amp; 8</u> Collector-Base Cut-off Current	7.2.5.1	$V_{CB} = 80V$ $I_E = 0$			$I_{CBO}$	-	0.02	$\mu A$



TABLE 2 GROUP B INSPECTION (Cont'd)

Examination or Test	TEST CONDITIONS		AQL %	Insp. Level	Sym- bol	LIMITS		Units
	K1007/NATO Ref.	Specific Conditions				Min.	Max.	
Static Forward Current Transfer Ratio (4)	7.3.4	$I_C = 10\text{mA}$ $V_{CE} = 5.0\text{V}$ $t_p = 300\text{ }\mu\text{s.} < 2\% \text{ duty cycle}$			$h_{FE}$	45	165	
Ratio of Statio-Forward Current Transfer Ratio	7.3.4	$I_C = 100\text{ }\mu\text{A.}$ $V_{CE} = 5.0\text{V}$			$\frac{h_{FE1}}{h_{FE2}}$	0.85	1.0	
Base Emitter Voltage Differential Change	7.3.2	$I_C = 100\text{ }\mu\text{A}$ $V_{CE} = 5\text{V}$			$V_{BE1}$ $V_{BE2}$	-	10	mV

TABLE 3 GROUP C INSPECTION

See Page 3. Quality Assurance Provisions, Group C Inspection

Examination or Test	K1007/NATO Ref.	TEST CONDITIONS		AQL %	Insp. Level	Sym- bol	LIMITS		Units	
		Specific Conditions					Min.	Max.		
<b>SUB GROUP 1</b> Small Signal Forward Current Transfer Ratio Static Forward Current Transfer ratio (4)	7.4.2	$I_C = 1 \text{ mA}$ $V_{CE} = 5V$ $f = 1 \text{ kc.}$	Specific Conditions  $I_C = 10 \text{ mA}$ $V_C = 5.0V$ $t_p = 300 \mu\text{S } 2\% \text{ duty cycle}$	2.5	IA	$h_{fe}$	50	150		
	7.3.4	$I_C = 10 \text{ mA}$ $V_C = 5.0V$ $t_p = 300 \mu\text{S } 2\% \text{ duty cycle}$					$h_{FE}$	50	150	
	7.4.1	$I_C = 1 \text{ mA}$ $V_{CE} = 5V$ $f = 1 \text{ kc.}$					$h_{ie}$	1000	4000	ohms.
	7.4.4	$I_C = 1 \text{ mA}$ $V_{CE} = 5V$ $f = 1 \text{ kc.}$					$h_{oe}$	4	16	$\mu\text{mho}$
<b>SUB GROUP 2</b> Shock (non operating)	5.17	5 blows in each of three mutually perpendicular directions								

TABLE 3 GROUP C INSPECTION (Cont'd)

Examination or Test	K1007/NATO Ref.	TEST CONDITIONS		AQL %	Insp. Level	Sym- bol	LIMITS		Units
		Specific Conditions					Min.	Max.	
<u>Post Test End Points for Sub Group 2</u>									
Collector-Base Cut-off Current (1)	7.2.5.1	$V_{CB} = 80V$ $I_E = 0$				$I_{CBO}$	-	0.02	$\mu A$
Collector Saturation Voltage	7.3.3	$I_C = 50 \text{ mA.}$ $I_B = 5 \text{ mA.}$				$V_{CE} \text{ (sat)}$	-	1.32	V
Base-Emitter Saturation Voltage	7.3.1	$I_C = 50 \text{ mA.}$ $I_B = 5 \text{ mA.}$				$V_{BE} \text{ (sat)}$	-	0.99	V

NOTES

Note 1. Maximum sample size is 125

FIG 1

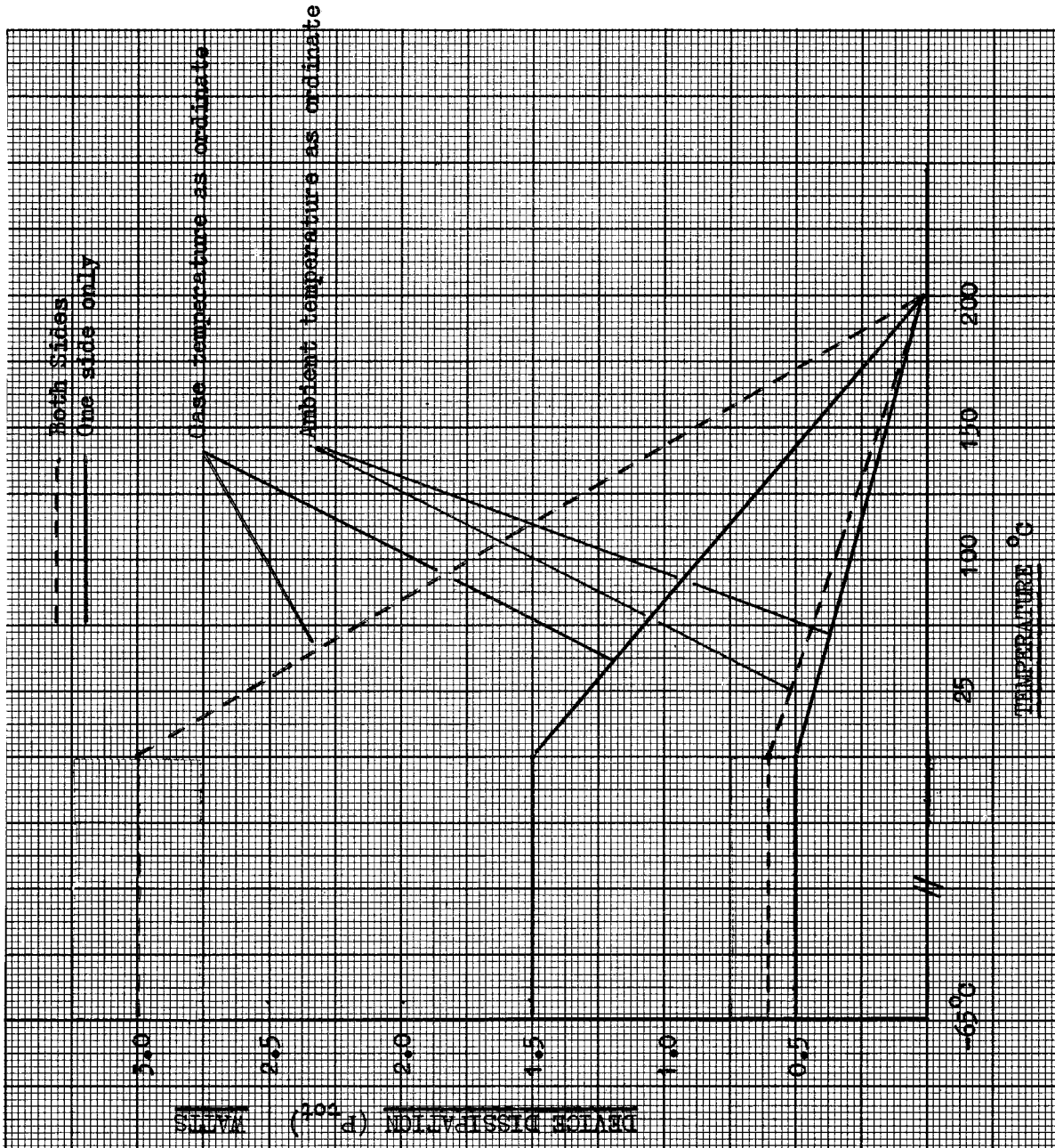


FIG. 2.  
PHYSICAL DIMENSIONS IN INCHES

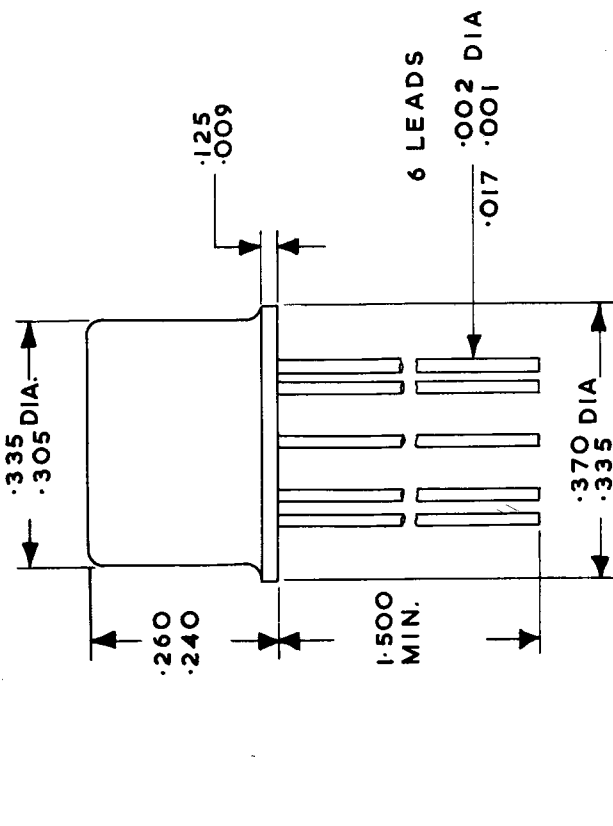


FIG. 3.  
CONNECTION DIAGRAM

