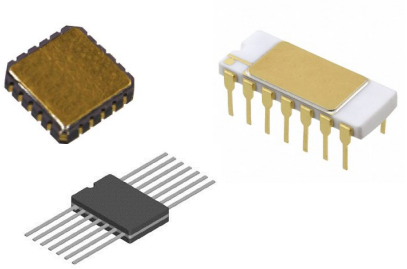
2N6987, 2N6987U, 2N6988

Multiple (Quad) PNP Silicon Dual In-Line And Flatpack Switching Transistor

Rev. V2

Features

- Available in JAN, JANTX, JANTXV and JANS per MIL-PRF-19500/558
- TO-116, 20 PIN Leadless (U) and 14 PIN Flat Pack package types
- Radiation Tolerant Levels M, D, P, L, and R



Electrical Characteristics

Parameter	Test Conditions	Symbol	Units	Min.	Max.
Off Characteristics					
Collector - Emitter Breakdown Voltage	I_C = 10 mA dc	$V_{(BR)CEO}$	V dc	60	—
Collector - Base Cutoff Current	V_{CB} = 60 V dc V_{CB} = 50 V dc	I_{CBO1} I_{CBO2}	µA dc nA dc	—	10 10
Emitter - Base Cutoff Current	V_{BE} = 5.0 V dc V_{EB} = 4.0 V dc	I_{EBO1} I_{EBO2}	µA dc nA dc	—	10 50
On Characteristics[1]					
Forward Current Transfer Ratio	V_{CE} = 10 V dc; I_C = 0.1 mA dc V_{CE} = 10 V dc; I_C = 1.0 mA dc V_{CE} = 10 V dc; I_C = 10 mA dc V_{CE} = 10 V dc; I_C = 150 mA dc V_{CE} = 10 V dc; I_C = 500 mA dc	h_{FE}	-	75 100 100 100 50	 450 300
Collector - Emitter Saturation Voltage	I_C = 150 mA dc; I_B = 15 mA dc I_C = 500 mA dc, I_B = 50 mA dc	$V_{CE(SAT)1}$ $V_{CE(SAT)2}$	V dc	—	0.4 1.6
Base - Emitter Saturation Voltage	I_C = 150 mA dc; I_B = 15 mA dc I_C = 500 mA dc; I_B = 50 mA dc	$V_{BE(SAT)1}$ $V_{BE(SAT)2}$	V dc		1.3 2.6
Dynamic Characteristics					
Magnitude of Common Small-Signal Short-Circuit Forward Current Transfer Ratio	V_{CE} = 20 V dc; I_C = 50 mA dc; f = 100 MHz	$\lvert h_{FE} \rvert$	-	2.0	8
Small-Signal Short Circuit Forward Current Transfer Ratio	V_{CE} = 10 V dc; I_C = 1.0 mA dc; f = 1 kHz	h_{fe}	-	100	—
Open Circuit Output Capacitance	V_{CB} = 10 V dc; I_E = 0; 100 kHz ≤ f ≤ 1 MHz	C_{obo}	pF	—	8.0
Input Capacitance (Output Open-Circuited)	V_{EB} = 2.0 V dc; I_C = 0; 100 kHz ≤ f ≤ 1 MHz	C_{ibo}	pF	—	30

Electrical Characteristics (T_A = +25°C unless otherwise specified)

Parameter	Test Conditions	Symbol	Units	Min.	Max.
Collector - Base Cutoff Current	T_A = +150°C V_{CB} = 50 V dc	I_{CBO3}	µA dc	—	10
Forward-Current Transfer Ratio	T_A = -55°C V_{CE} = 10 V dc; I_C = 1.0 mA dc	h_{FE6}		50	
Transistor to Transistor Resistance	$\lvert V_{T-T} \rvert$ = 500 V dc	R_{T-T}	ohms	10^{10}	—
Switching Characteristics					
Turn-On Time (saturated)	See figure 13 of MIL-PRF-19500/559	t_{on}	ns	—	45
Turn-Off Time (saturated)	See figure 14 of MIL-PRF-19500/559	t_{off}	ns	—	300

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Absolute Maximum Ratings (T_A = 25°C unless otherwise specified) (1)

Ratings	Symbol	Value
Collector - Emitter Voltage	V_{CEO} (5)	60 Vdc
Collector - Base Voltage	V_{CBO} (5)	60 Vdc
Emitter - Base Voltage	V_{EBO} (5)	5.0 Vdc
Collector Current	I_C (3)	600 mAdc
Total Power Dissipation @ T_A = +25°C 2N6987 2N6987U 2N6988	P_T (2)	 1.5 W 1.0 W 1.0 W
Total Power Dissipation @ $T_{A(AM)}$ = +25°C 2N6988	P_T (2)	1.0 W
Operating & Storage Temperature Range	T_J, T_{STG}	-65°C to +200°C

Thermal Characteristics

Characteristics	Symbol	Max. Value
Thermal Resistance, Junction to Ambient 2N6987 2N6987U 2N6988	$R_{\theta JA}$ (3)	 85°C/W 160°C/W 175°C/W
Thermal Resistance, Junction to Ambient 2N6987 2N6987U 2N6988	$R_{\theta JA(AM)}$ (3) (4)	 N/A N/A 23°C/W

(1) Maximum voltage between transistors shall be ≥500 V dc
(2) For derating see figures 5, 6, 7 and 8 of MIL-PRF-19500/558
(3) For thermal impedance graphs, see figures 9, 10, 11 and 12 of MIL-PRF-19500/558.
(4) Thermally conductive adhesive mount to infinite heat sink
(5) Ratings apply to each transistor in the array

Outline Drawing 2N6987

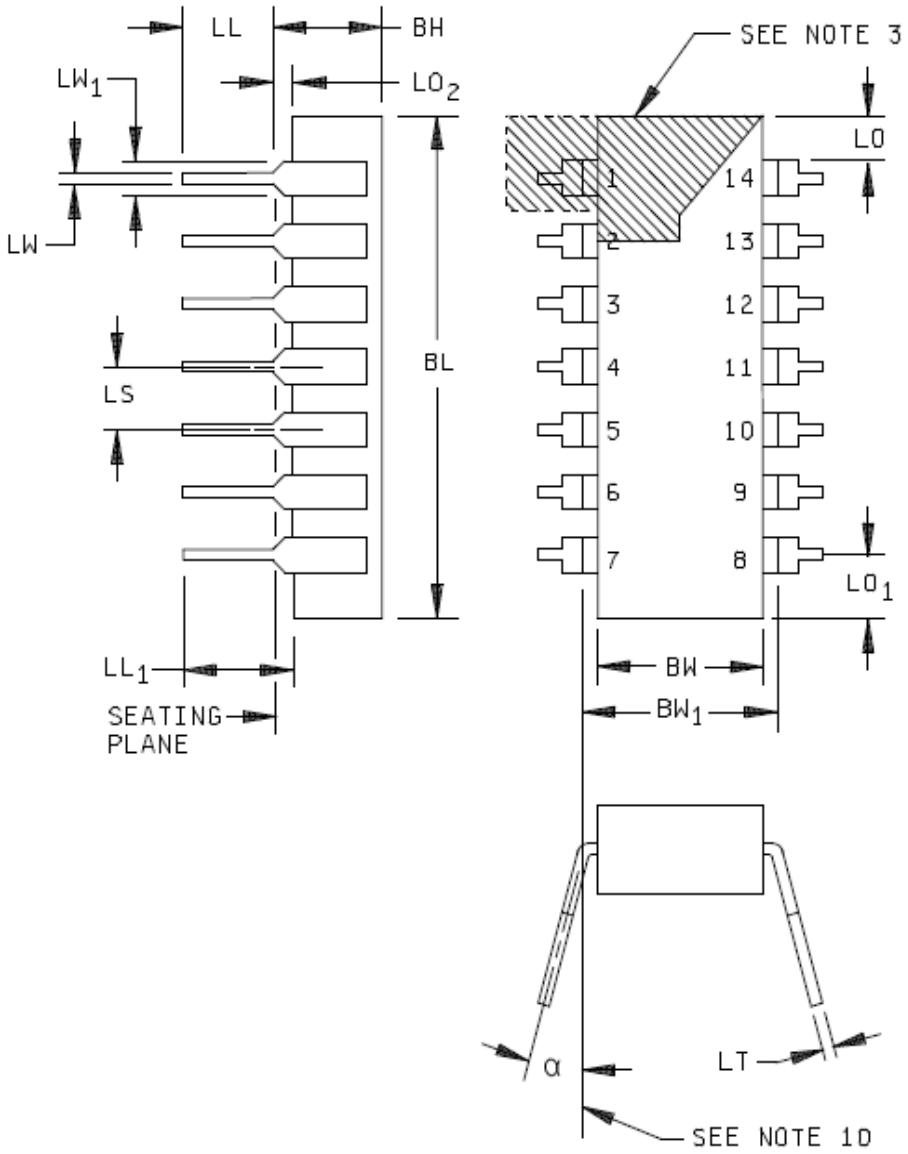

FIGURE 1. Dimensions and configuration for type 2N6987.

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Outline Dimensions 2N6987

Symbol	Inches		Millimeters		Notes
	Min	Max	Min	Max	
BH		.200		5.08	
LW	.014	.023	0.36	0.58	8
LW_1	.030	.070	0.76	1.78	4, 8
LT	.008	.015	0.20	0.38	8
BL		.785		19.94	4
BW	.220	.310	5.59	7.87	4
BW_1	.290	.320	7.37	8.13	7
LS	.100 BSC		2.54 BSC		5, 9
LL	.125	.200	3.18	5.08	
LL_1	.150		3.81		
LO_2	.015	.060	0.38	1.52	3
LO_1		.098		2.49	6
LO	.005		0.13		6
α	0°	15°	0°	15°	

NOTES:

1. Dimensions are in inches.
2. Millimeters are given for information only.
3. Index area; a notch or pin one identification mark shall be located adjacent to pin one and shall be located within the shaded area shown. The manufacturer's identification shall not be used as a pin one identification mark.
4. The minimum limit for dimension LW_1 may be .023 inch (0.58 mm) for lead numbers 1, 7, 8, and 14 only.
5. Dimension LO_2 shall be measured from the seating plane to the base plane.
6. This dimension allows for off-center lid, meniscus, and glass overrun.
7. The basic pin spacing is .100 inch (2.54 mm) between centerlines. Each pin centerline shall be located within ±.010 inch (±0.25 mm) of its exact longitudinal position relative to pins 1 and 14.
8. Applies to all four corners (lead numbers 1, 7, 8, and 14).
9. Lead center when α is 0 degrees. BW_1 shall be measured at the centerline of the leads.
10. All leads: Increase maximum limit by .003 inch (0.08 mm) measured at the center of the flat, when lead finish A is applied. Pointed or round lead ends are allowed.
11. Twelve spaces.
12. No organic or polymeric materials shall be molded to the bottom of the package to cover leads.
13. For terminal connections, see figure 4.
14. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 1. Dimensions and configuration for type 2N6987 - Continued.

Outline Drawing 2N6988

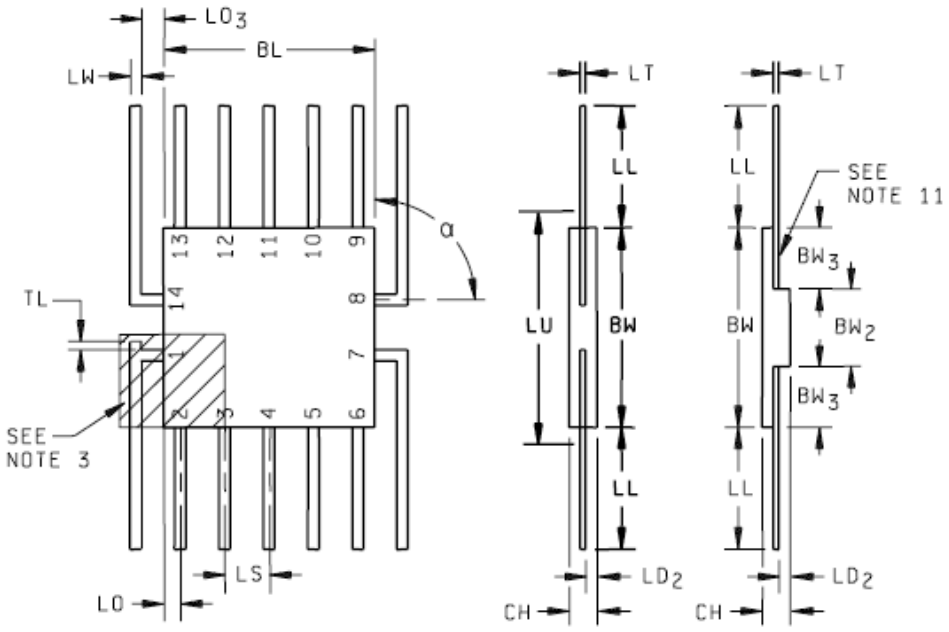


FIGURE 2. Physical dimensions for type 2N6988.

Outline Dimension 2N6988

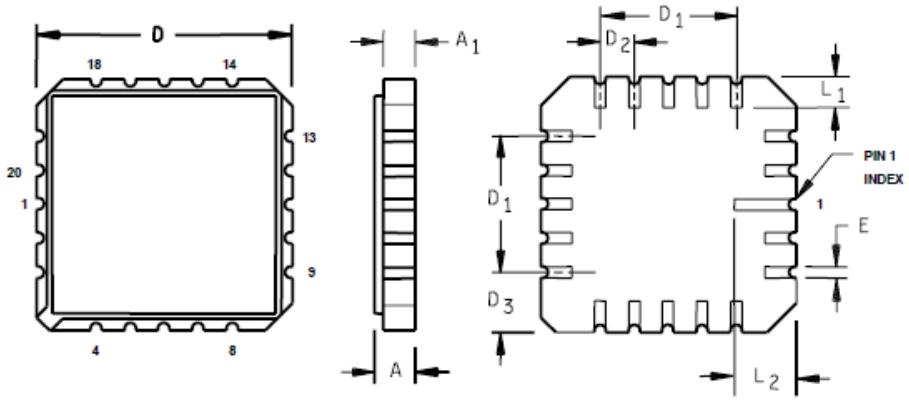
Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CH	.030	.115	0.76	2.92	
LW	.010	.019	0.25	0.48	7
TL	.008	.015	0.20	0.38	12
BL		.280		7.11	5
BW	.240	.260	6.10	6.60	
LU		.290		7.37	5
BW_2	.125		3.18		

Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
BW_3	.030		0.76		
LS	.050 BSC		1.27 BSC		6, 8
LT	.003	.006	0.076	0.152	7
LL	.250	.370	6.35	9.40	
LD_2	.005	.040	0.13	1.02	4
LO	.005		0.13		9, 10
LO_3	.004		0.10		13
α	30°	90°	30°	90°	14

NOTES:
1. Dimensions are in inches.
2. Millimeters are given for general information only.
3. Index area: A notch or pin one identification mark shall be located adjacent to pin one and shall be located within the shaded area shown. The manufacturer's identification shall not be used as a pin one identification mark. Alternatively, a tab (dim TL) may be used to identify pin one.
4. Dimension LD_2 shall be measured at the point of exit of the lead from the body.
5. This dimension allows for off-center lid, meniscus, and glass overrun.
6. The basic pin spacing is .050 inch (1.27 mm) between centerlines. Each pin centerline shall be located within ±.005 inch (0.13 mm) of its exact longitudinal position relative to pins 1 and 14.
7. All leads: Increase maximum limit by .003 inch (0.08 mm) measured at the center of the flat when the lead finish is solder.
8. Twelve spaces.
9. Applies to all four corners (leads number 2, 6, 9, and 13).
10. Dimension LO may be .000 inch (0.00 mm if leads number 2, 6, 9, and 13) bend toward the cavity of the package within one lead width from the point of entry of the lead into the body or if the leads are brazed to the metallized ceramic body.
11. No organic or polymeric materials shall be molded to the bottom of the package to cover the leads.
12. Optional, see note 1. If a pin one identification mark is used in addition to this tab, the minimum limit of dimension TL does not apply.
13. Applies to leads number 1, 7, 8, and 14.
14. Lead configuration is optional within dimension BW except dimensions LW and LT apply.
15. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.
16. Pins 1, 7, 8, and 14 are collectors.
17. Pins 2, 6, 9, and 13 are bases.
18. Pins 3, 5, 10, and 12 are emitters.
19. Pins 4 and 11 are no contacts.

FIGURE 2. Physical dimensions for type 2N6988 - Continued.

Outline Drawing 2N6987U

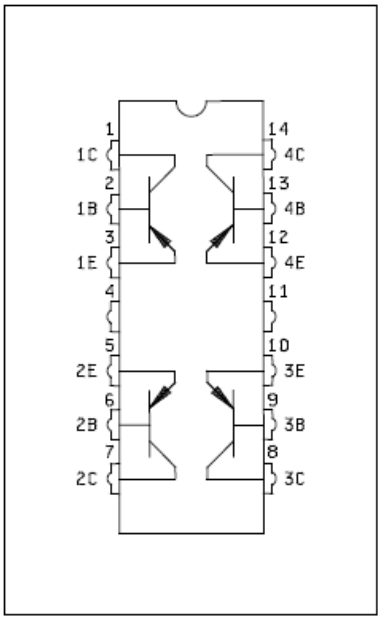


Symbol	Dimensions			
	Inches		Millimeters	
	Min	Max	Min	Max
A	.073	.085	1.85	2.16
A_1	.063	.075	1.60	1.90
D	.345	.355	8.76	9.02
D_1	.195	.205	4.95	5.21
D_2	.050 TYP		1.27 TYP	
D_3	.070	.080	1.76	2.03
E	.025 REF		0.64 REF	
L_1	.050 REF		1.27 REF	
L_2	.080	.090	2.03	2.28

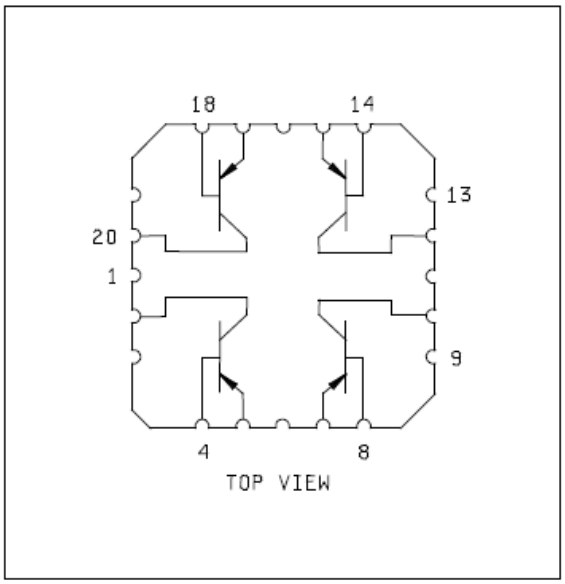
NOTES:
1. Dimensions are in inches.
2. Millimeters equivalents are given for general information only.
3. Unless otherwise specified, tolerance is ±.005 inch (0.13 mm).
4. For terminal connections, see figure 4.
5. In accordance with ASME Y14.5M, diameters are equivalent to ϕx symbology.

FIGURE 3. Physical dimensions for type 2N6987U.

Outline Drawing



14-lead flat-package or dual-in-line (top view)



20 pin leadless chip carrier (top view).

FIGURE 4. Schematic and terminal connections.