

## NPN SILICON PLANAR SWITCHING TRANSISTORS

**2N2221A**

**2N2222A**



TO-18

**TO-18**

**Metal Can Package**

**RoHS compliant**

### FEATURE:

1. This product is available in AEC-Q101 Compliant and PPAP Capable also.

**Note:** For AEC-Q101 compliant products, please use suffix -AQ in the part number while ordering.

**APPLICATION:** Switching And Linear Application DC And VHF Amplifier Applications

### ABSOLUTE MAXIMUM RATINGS (Ta = 25 °C Unless otherwise specified)

PARAMETER	SYMBOL	VALUE		UNIT
		2N2221A	2N2222A	
Collector -Emitter Voltage	$V_{CEO}$	40		V
Collector -Base Voltage	$V_{CBO}$	75		V
Emitter -Base Voltage	$V_{EBO}$	6.0		V
Collector Current Continuous	$I_C$	800		mA
Power Dissipation @ $T_a=25^{\circ}C$	$P_D$	500		mW
Derate Above 25°C		2.28		mW/°C
Power Dissipation @ $T_c=25^{\circ}C$	$P_D$	1.2		W
Derate Above 25°C		6.85		mW/°C
Operating And Storage Junction Temperature Range	$T_j, T_{stg}$	-65 to +200		°C

### ELECTRICAL CHARACTERISTICS at (Ta = 25 °C Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN	MAX	UNIT
Collector -Emitter Voltage	$V_{CEO}$	$I_C=10mA, I_B=0$	40	--	V
Collector -Base Voltage	$V_{CBO}$	$I_C=10\mu A, I_E=0$	75	--	V
Emitter-Base Voltage	$V_{EBO}$	$I_E=10\mu A, I_C=0$	6.0	--	V
Collector-Cut off Current	$I_{CBO}$	$V_{CB}=60V, I_E=0$	--	10	nA
		$V_{CB}=60V, I_E=0, T_a=150^{\circ}C$	--	10	$\mu A$
Collector-Cut off Current	$I_{CEX}$	$V_{CE}=60V, V_{EB}=3V$	--	10	nA
Emitter-Cut off Current	$I_{EBO}$	$V_{EB}=3V, I_C=0$	--	10	nA
Base-Cut off Current	$I_{BL}$	$V_{CE}=60V, V_{EB}=3V$	--	20	nA
Collector Emitter Saturation Voltage	$V_{CE(Sat)}^1$	$I_C=150mA, I_B=15mA$	--	0.3	V
		$I_C=500mA, I_B=50mA$	--	1.0	V
Base Emitter Saturation Voltage	$V_{BE(Sat)}^1$	$I_C=150mA, I_B=15mA$	--	0.6-1.2	V
		$I_C=500mA, I_B=50mA$	--	2.0	V

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**ELECTRICAL CHARACTERISTICS at** (Ta = 25 °C Unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION		2N2221A	2N2222A	UNIT
DC Current Gain	h <sub>FE</sub>	I <sub>C</sub> =0.1mA, V <sub>CE</sub> =10V	Min	20	35	
		I <sub>C</sub> =1mA, V <sub>CE</sub> =10V	Min	25	50	
		I <sub>C</sub> =10mA, V <sub>CE</sub> =10V	Min	35	75	
		I <sub>C</sub> =10mA, V <sub>CE</sub> =10V Ta=55°C	Min	15	35	
		I <sub>C</sub> =150mA, V <sub>CE</sub> =10V		40-120	100-300	
		I <sub>C</sub> =150mA, V <sub>CE</sub> =1V	Min	20	50	
		I <sub>C</sub> =500mA, V <sub>CE</sub> =10V	Min	25	40	

**DYNAMIC CHARACTERISTICS**

Small Signal Current Gain	h <sub>fe</sub>	I <sub>C</sub> =1mA, V <sub>CE</sub> =10V f=1kHz		30-150	50-300	
		I <sub>C</sub> =10mA, V <sub>CE</sub> =10V f=1kHz		50-300	75-375	
Input Impedance	h <sub>ie</sub>	I <sub>C</sub> =1mA, V <sub>CE</sub> =10V f=1kHz		1.0-3.5	2.0-8.0	kohms
		I <sub>C</sub> =10mA, V <sub>CE</sub> =10V f=1kHz		0.2-1.0	0.25-1.25	
Voltage Feedback Ratio	h <sub>re</sub>	I <sub>C</sub> =1mA, V <sub>CE</sub> =10V f=1kHz	Max	5.0	8.0	x <sup>10-4</sup>
		I <sub>C</sub> =10mA, V <sub>CE</sub> =10V f=1kHz	Max	2.5	4.0	
Out put Admittance	h <sub>oe</sub>	I <sub>C</sub> =1mA, V <sub>CE</sub> =10V f=1kHz		3.0-15	5.0-35	umhos
		I <sub>C</sub> =10mA, V <sub>CE</sub> =10V f=1kHz		10-100	25-200	
Collector Base Time Constant	rb'Cc	I <sub>E</sub> =20mA, V <sub>CB</sub> =20V f=31.8MHz	Max	150	1150	ps
Real Part Common-Emitter High Frequency Input Impedance	Re(hie)	I <sub>C</sub> =20mA, V <sub>CE</sub> =20V f=300MHz	Max	60	60	ohms
Noise Figure	NF	I <sub>C</sub> =100uA, V <sub>CE</sub> =10V Rs=1kohms, f=1kHz	Max	--	4.0	dB

**DYNAMIC CHARACTERISTICS**

Transistors Frequency	f <sub>t</sub>	I <sub>C</sub> =20mA, V <sub>CE</sub> =20V f=100MHz	Min	250	300	MHz
Out-Put Capacitance	C <sub>ob</sub>	V <sub>CB</sub> =10V, I <sub>E</sub> =0 f=100kHz	Max	8.0	8.0	pF
Input Capacitance	C <sub>ib</sub>	V <sub>EB</sub> =0.5V, I <sub>C</sub> =0 f=100kHz	Max	25	25	pF

**SWITCHING TIME**

Delay time	t <sub>d</sub>	I <sub>C</sub> =150mA, I <sub>B1</sub> =15mA	Max	10	--	ns
Rise time	t <sub>r</sub>	V <sub>CC</sub> =30V, V <sub>BE</sub> =0.5V	Max	25	--	ns
Storage time	t <sub>s</sub>	I <sub>C</sub> =150mA, I <sub>B1</sub>	Max	225	--	ns
Fall time	t <sub>f</sub>	I <sub>B2</sub> =15mA, V <sub>CC</sub> =30V	Max	60	--	ns

**Note:**

1. Pulse Condition: Pulse Width=300us, Duty Cycle=2%

### Recommended Reflow Solder Profiles

The recommended reflow solder profiles for Pb and Pb-free devices are shown below.

Figure 1 shows the recommended solder profile for devices that have Pb-free terminal plating, and where a Pb-free solder is used.

Figure 2 shows the recommended solder profile for devices with Pb-free terminal plating used with leaded solder, or for devices with leaded terminal plating used with a leaded solder.

Figure 1

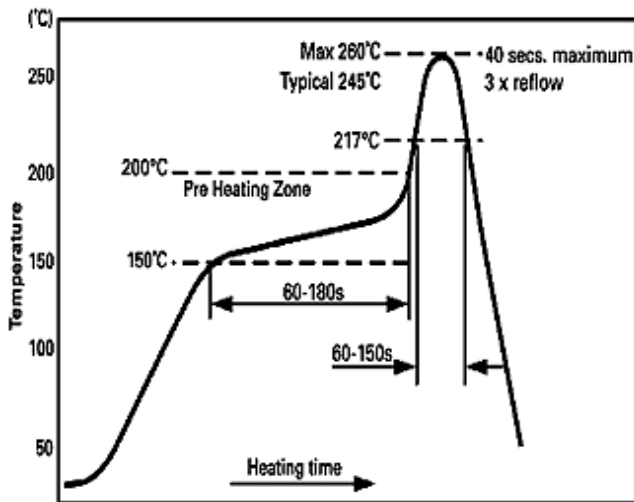
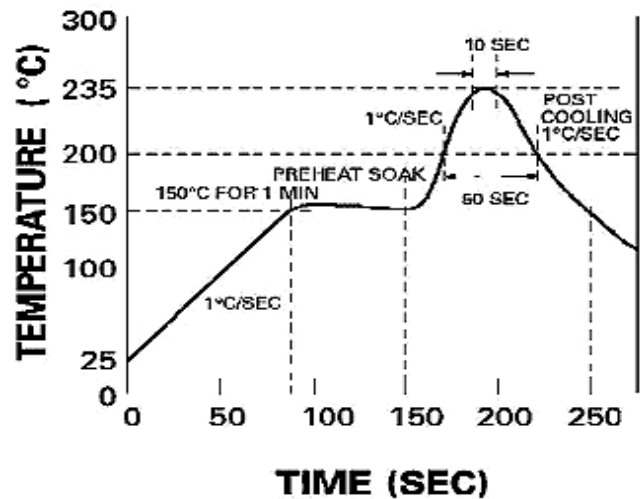


Figure 2



#### Reflow profiles in tabular form

Profile Feature	Sn-Pb System	Pb-Free System
Average Ramp-Up Rate	~3°C/second	~3°C/second
<b>Preheat</b>		
– Temperature Range	150-170°C	150-200°C
– Time	60-180 seconds	60-180 seconds
Time maintained above:		
– Temperature	200°C	217°C
– Time	30-50 seconds	60-150 seconds
Peak Temperature	235°C	260°C max.
Time within +0 -5°C of actual Peak	10 seconds	40 seconds
Ramp-Down Rate	3°C/second max.	6°C/second max.



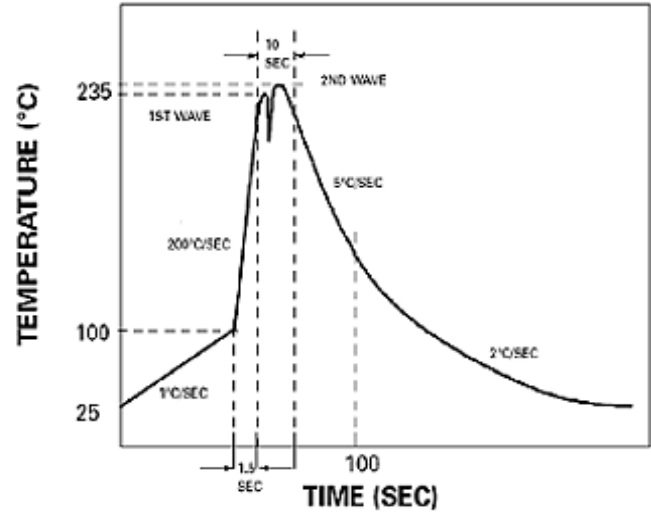
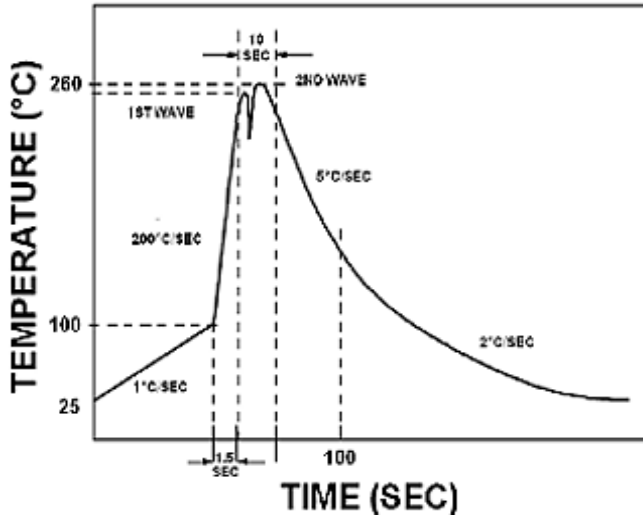
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**Recommended Wave Solder Profiles**

<p>The Recommended solder Profile For Devices with Pb-free terminal plating where a Pb-free solder is used</p>	<p>The Recommended solder Profile For Devices with Pb-free terminal plating used with leaded solder, or for devices with leaded terminal plating used with leaded solder</p>
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**Wave Profiles in Tabular Form**

Profile Feature	Sn-Pb System	Pb-Free System
Average Ramp-Up Rate	~200°C/second	~200°C/second
Heating rate during preheat	Typical 1-2, Max 4°C/sec	Typical 1-2, Max 4°C/Sec
Final preheat Temperature	Within 125°C of Solder Temp	Within 125°C of Solder Temp
Peak Temperature	235°C	260°C max.
Time within +0 -5°C of actual Peak	10 seconds	10 seconds
Ramp-Down Rate	5°C/second max.	5°C/second max

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## TYPICAL CHARACTERISTICS CURVES

Fig 1: DC Current Gain vs Collector-Cut off Current

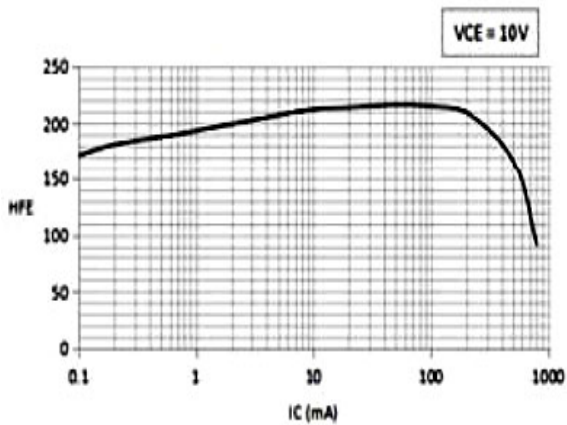


Fig 2: Collector Emitter Saturation Voltage vs Collector-Cut off Current

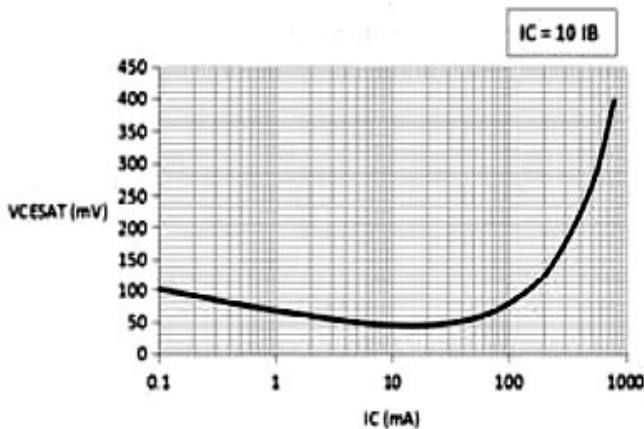


Fig 3: DC Current Gain vs Collector-Cut off Current

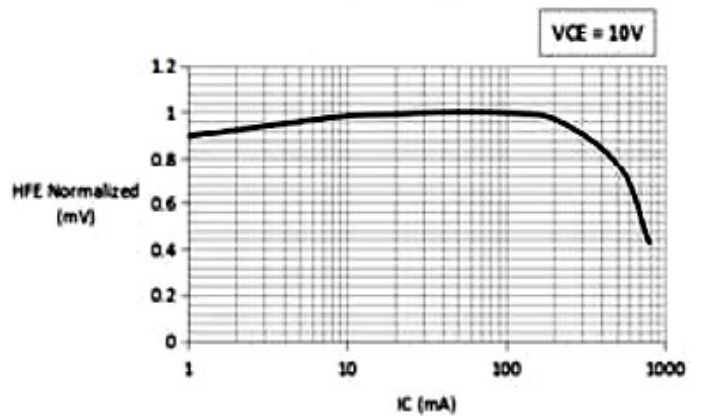


Fig 4: Base Emitter Saturation Voltage vs Collector-Cut off Current

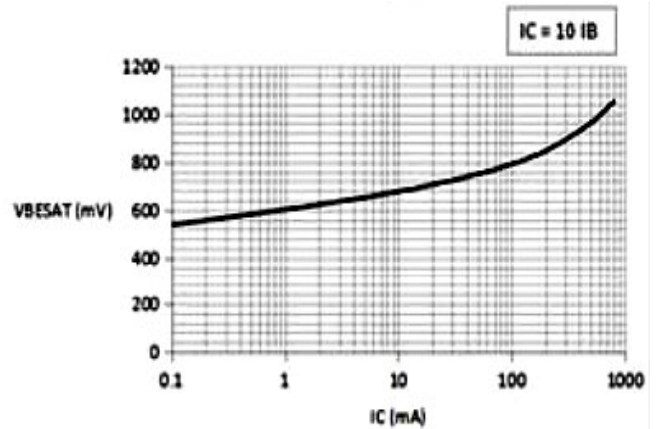
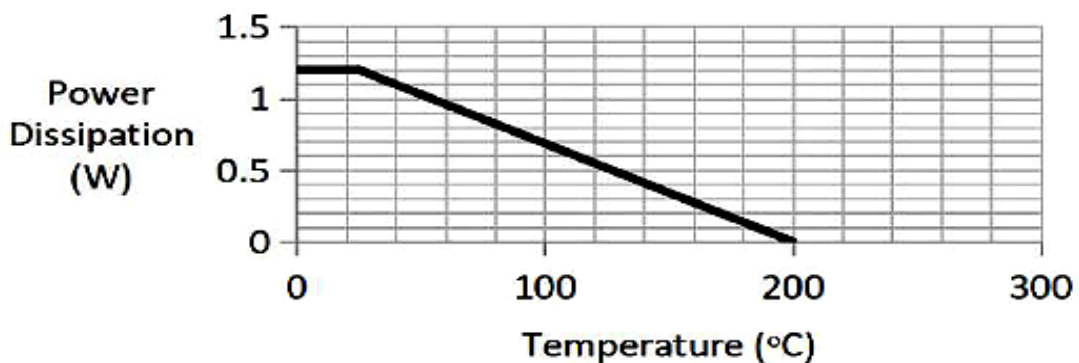
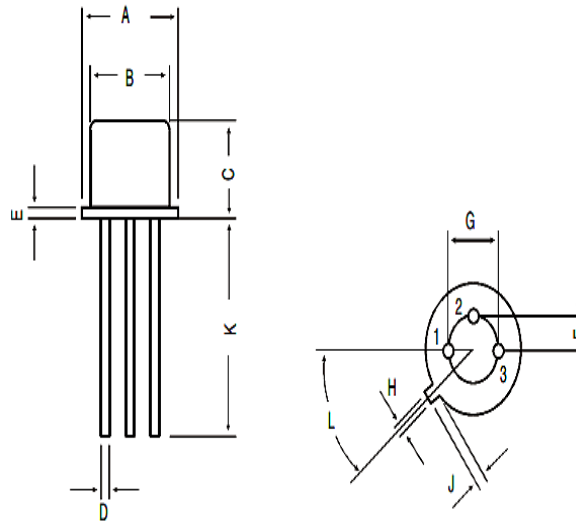


Fig 5: Power Derating Curve



## PACKAGE DETAILS

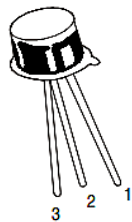
TO-18 Metal Can Package



DIM	MIN	MAX
A	5.24	5.84
B	4.52	4.97
C	4.31	5.33
D	0.40	0.53
E	--	0.76
F	--	1.27
G	--	2.97
H	0.91	1.17
J	0.71	1.21
K	12.70	--
L	45°	

## PIN CONFIGURATION

1. EMITTER
2. BASE
3. COLLECTOR



## Packing Detail

PACKAGE	STANDARD PACK		INNER CARTON BOX		OUTER CARTON BOX		
	Details	Net Weight/Qty	Size	Qty	Size	Qty	Gr Wt
TO-18	1K/polybag	350 gm/1K pcs	3" x 7.5" x 7.5"	5.0K	17" x 15" x 13.5"	80.0K	34 kgs



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## Recommended Product Storage Environment for Discrete Semiconductor Devices

This storage environment assumes that the Diodes and transistors are packed properly inside the original packing supplied by CDIL.

- Temperature 5 °C to 30 °C
- Humidity between 40 to 70 %RH
- Air should be clean.
- Avoid harmful gas or dust.
- Avoid outdoor exposure or storage in areas subject to rain or water spraying .
- Avoid storage in areas subject to corrosive gas or dust. Product shall not be stored in areas exposed to direct sunlight.
- Avoid rapid change of temperature.
- Avoid condensation.
- Mechanical stress such as vibration and impact shall be avoided.
- The product shall not be placed directly on the floor.
- The product shall be stored on a plane area. They should not be turned upside down. They should not be placed against the wall.

### Shelf Life of CDIL Products

The shelf life of products is the period from product manufacture to shipment to customers. The product can be unconditionally shipped within this period. The period is defined as 2 years.

If products are stored longer than the shelf life of 2 years the products shall be subjected to quality check as per CDIL quality procedure.

The products are further warranted for another one year after the date of shipment subject to the above conditions in CDIL original packing.

### Floor Life of CDIL Products and MSL Level

When the products are opened from the original packing, the floor life will start.

For this, the following JEDEC table may be referred:

JEDEC MSL Level		
Level	Time	Condition
1	Unlimited	≤30 °C / 85% RH
2	1 Year	≤30 °C / 60% RH
2a	4 Weeks	≤30 °C / 60% RH
3	168 Hours	≤30 °C / 60% RH
4	72 Hours	≤30 °C / 60% RH
5	48 Hours	≤30 °C / 60% RH
5a	24 Hours	≤30 °C / 60% RH
6	Time on Label(TOL)	≤30 °C / 60% RH



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## Customer Notes

### Component Disposal Instructions

1. CDIL Semiconductor Devices are RoHS compliant, customers are requested to please dispose as per prevailing Environmental Legislation of their Country.
2. In Europe, please dispose as per EU Directive 2002/96/EC on Waste Electrical and Electronic Equipment (WEEE).

### Disclaimer

The product information and the selection guides facilitate selection of the CDIL's Semiconductor Device(s) best suited for application in your product(s) as per your requirement. It is recommended that you completely review our Data Sheet(s) so as to confirm that the Device(s) meet functionality parameters for your application. The information furnished in the Data Sheet and on the CDIL Web Site/CD are believed to be accurate and reliable. CDIL however, does not assume responsibility for inaccuracies or incomplete information. Furthermore, CDIL does not assume liability whatsoever, arising out of the application or use of any CDIL product; neither does it convey any license under its patent rights nor rights of others. These products are not designed for use in life saving/support appliances or systems. CDIL customers selling these products (either as individual Semiconductor Devices or incorporated in their end products), in any life saving/support appliances or systems or applications do so at their own risk and CDIL will not be responsible for any damages resulting from such sale(s).

CDIL strives for continuous improvement and reserves the right to change the specifications of its products without prior notice.



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