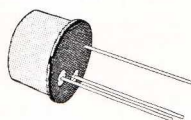


HIGH SPEED SWITCHES

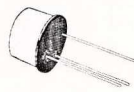
DESCRIPTION

The 2N2218A, 2N2219A, 2N2221A and 2N2222A are silicon planar epitaxial NPN transistors in Jedec TO-39 (for 2N2218A and 2N2219A) and in Jedec TO-18 (for 2N2221A and 2N2222A) metal cases. They are designed for high-speed switching applications at collector currents up to 500 mA, and feature useful current gain over a wide range of collector current, low leakage currents and low saturation voltages.

☞ 2N2218A/2N2219A approved to CECC 50002-100, 2N2221A/2N2222A approved to CECC 50002-101 available on request.

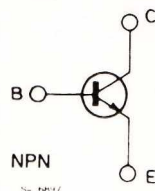


TO-39



TO-18

INTERNAL SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CBO}	Collector-base Voltage ($I_E = 0$)	75	V
V_{CEO}	Collector-emitter Voltage ($I_B = 0$)	40	V
V_{EBO}	Emitter-base Voltage ($I_C = 0$)	6	V
I_C	Collector Current	0.8	A
P_{tot}	Total Power Dissipation at $T_{amb} \leq 25^\circ\text{C}$		
	for 2N2218A and 2N2219A	0.8	W
	for 2N2221A and 2N2222A	0.5	W
	at $T_{case} \leq 25^\circ\text{C}$		
	for 2N2218A and 2N2219A	3	W
	for 2N2221A and 2N2222A	1.8	W
T_{stg}	Storage Temperature	- 65 to 200	$^\circ\text{C}$
T_j	Junction Temperature	175	$^\circ\text{C}$

THERMAL DATA

			2N2218A 2N2219A	2N2221A 2N2222A
$R_{th\ j-case}$	Thermal Resistance Junction-case	Max	50 °C/W	83.3 °C/W
$R_{th\ j-amb}$	Thermal Resistance Junction-ambient	Max	187.5 °C/W	300 °C/W

ELECTRICAL CHARACTERISTICS ($T_{amb} = 25\text{ °C}$ unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
I_{CBO}	Collector Cutoff Current ($I_E = 0$)	$V_{CB} = 60\text{ V}$ $V_{CB} = 60\text{ V}$ $T_{amb} = 150\text{ °C}$			10 10	nA μA
I_{CEX}	Collector Cutoff Current ($V_{BE} = -3\text{ V}$)	$V_{CE} = 60\text{ V}$			10	nA
I_{EBO}	Emitter Cutoff Current ($I_C = 0$)	$V_{EB} = 3\text{ V}$			10	nA
I_{BEX}	Base Cutoff Current ($V_{BE} = -3\text{ V}$)	$V_{CE} = 60\text{ V}$			20	nA
$V_{(BR)\ CBO}$	Collector-base Breakdown Voltage ($I_E = 0$)	$I_C = 10\text{ }\mu\text{A}$	75			V
$V_{(BR)\ CEO}^*$	Collector-emitter Breakdown Voltage ($I_B = 0$)	$I_C = 10\text{ mA}$	40			V
$V_{(BR)\ EBO}$	Emitter-base Breakdown Voltage ($I_C = 0$)	$I_E = 10\text{ }\mu\text{A}$	6			V
$V_{CE(sat)}^*$	Collector-emitter Saturation Voltage	$I_C = 150\text{ mA}$ $I_B = 15\text{ mA}$ $I_C = 500\text{ mA}$ $I_B = 50\text{ mA}$			0.3 1	V V
$V_{BE(sat)}^*$	Base-emitter Saturation Voltage	$I_C = 150\text{ mA}$ $I_B = 15\text{ mA}$ $I_C = 500\text{ mA}$ $I_B = 50\text{ mA}$	0.6		1.2 2	V V
h_{FE}^*	DC Current Gain	for 2N2218A and 2N2221A $I_C = 0.1\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 1\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}$ $V_{CE} = 1\text{ V}$ $I_C = 10\text{ mA}$ $V_{CE} = 10\text{ V}$ $T_{amb} = -55\text{ °C}$	20 25 35 40 25 20 15		120	
h_{FE}^*	DC Current Gain	for 2N2219A and 2N2222A $I_C = 0.1\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 1\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 10\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 500\text{ mA}$ $V_{CE} = 10\text{ V}$ $I_C = 150\text{ mA}$ $V_{CE} = 1\text{ V}$ $I_C = 10\text{ mA}$ $V_{CE} = 10\text{ V}$ $T_{amb} = -55\text{ °C}$	35 50 75 100 40 50 35		300	

* Pulsed : pulse duration = 300 μs , duty cycle = 1 %.

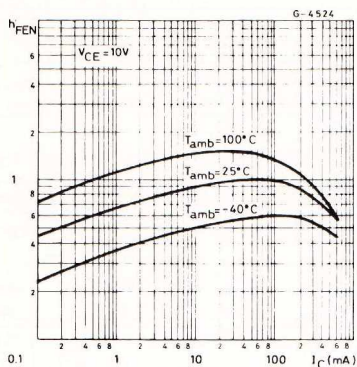
ELECTRICAL CHARACTERISTICS (continued)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
h_{ie}	Small Signal Current Gain	$I_C = 1 \text{ mA}$ $V_{CE} = 10 \text{ V}$ $f = 1 \text{ kHz}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A $I_C = 10 \text{ mA}$ $V_{CE} = 10 \text{ V}$ $f = 1 \text{ kHz}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A	30 50 50 75		150 300 300 375	
f_T	Transition Frequency	$I_C = 20 \text{ mA}$ $V_{CE} = 20 \text{ V}$ $f = 100 \text{ MHz}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A	250 300			MHz MHz
C_{EBO}	Emitter-base Capacitance	$I_C = 0$ $V_{EB} = 0.5 \text{ V}$ $f = 100 \text{ kHz}$			25	pF
C_{CBO}	Collector-base Capacitance	$I_E = 0$ $V_{CB} = 10 \text{ V}$ $f = 100 \text{ kHz}$			8	pF
$R_{e(hie)}$	Real Part of Input Impedance	$I_C = 20 \text{ mA}$ $V_{CE} = 20 \text{ V}$ $f = 300 \text{ MHz}$			60	Ω
NF	Noise Figure	$I_C = 100 \mu\text{A}$ $V_{CE} = 10 \text{ V}$ $R_g = 1 \text{ k}\Omega$ $f = 1 \text{ kHz}$		4		dB
h_{ie}^{**}	Input Impedance	$I_C = 1 \text{ mA}$ $V_{CE} = 10 \text{ V}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A $I_C = 10 \text{ mA}$ $V_{CE} = 10 \text{ V}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A	1 2 0.2 0.25		3.5 8 1 1.25	Ω Ω Ω Ω
h_{re}^{**}	Reverse Voltage Ratio	$I_C = 1 \text{ mA}$ $V_{CE} = 10 \text{ V}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A $I_C = 10 \text{ mA}$ $V_{CE} = 10 \text{ V}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A			5×10^{-4} 8×10^{-4} 2.5×10^{-4} 4×10^{-4}	
h_{oe}^{**}	Output Admittance	$I_C = 1 \text{ mA}$ $V_{CE} = 10 \text{ V}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A $I_C = 10 \text{ mA}$ $V_{CE} = 10 \text{ V}$ for 2N2218A and 2N2221A for 2N2219A and 2N2222A	3 5 10 25		15 35 100 200	μS μS μS μS
t_d^{***}	Delay Time	$I_C = 150 \text{ mA}$ $V_{CC} = 30 \text{ V}$ $I_{B1} = 15 \text{ mA}$ $V_{BB} = -0.5 \text{ V}$			10	ns
t_r^{***}	Rise Time	$I_C = 150 \text{ mA}$ $V_{CC} = 30 \text{ V}$ $I_{B1} = 15 \text{ mA}$ $V_{BB} = -0.5 \text{ V}$			25	ns
t_s^{***}	Storage Time	$I_C = 150 \text{ mA}$ $V_{CC} = 30 \text{ V}$ $I_{B1} = -I_{B2} = 15 \text{ mA}$			225	ns
t_f^{***}	Fall Time	$I_C = 150 \text{ mA}$ $V_{CC} = 30 \text{ V}$ $I_{B1} = -I_{B2} = 15 \text{ mA}$			60	ns
$r_{bb'} C_{D'C}$	Feedback Time Constant	$I_C = 20 \text{ mA}$ $V_{CE} = 20 \text{ V}$ $f = 31.8 \text{ MHz}$			150	ps

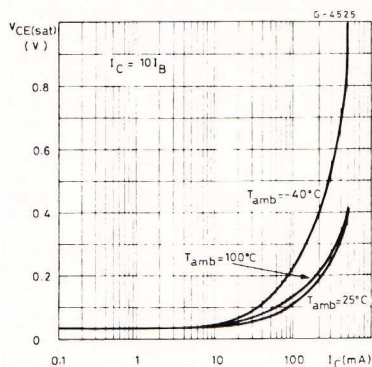
** $f = 1 \text{ kHz}$

*** see test circuit.

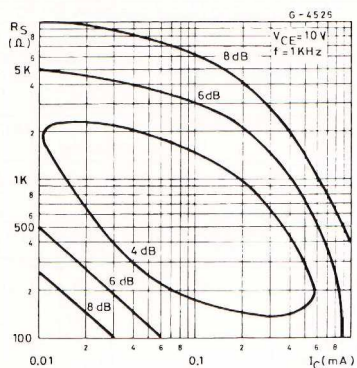
Normalized DC Current Gain.



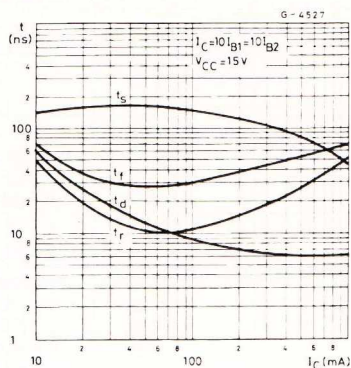
Collector-emitter Saturation Voltage.

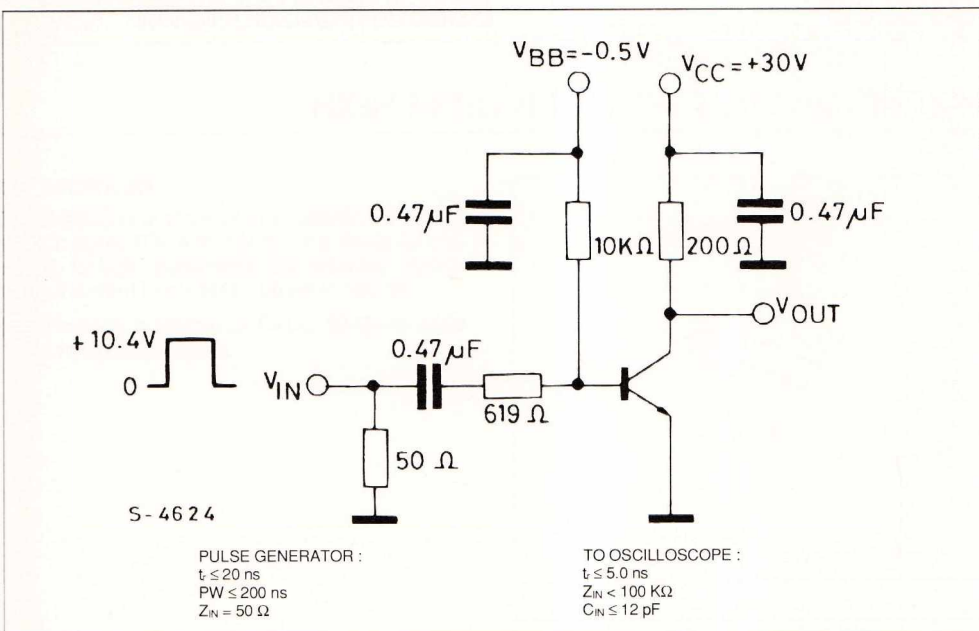


Contours of Constant Narrow Band Noise Figure.



Switching Time vs. Collector Current.



Test Circuit for t_d , t_r .Test Circuit for t_d , t_r .