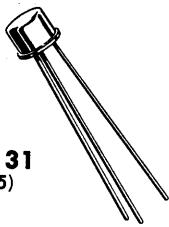


# 2N2410 (SILICON)



CASE 31  
(TO-5)

NPN silicon annular transistor designed for high-speed, medium-power saturated switching applications.

Collector connected to case

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	30	Vdc
Collector-Emitter Voltage $R_{BE} = 10 \text{ ohms}$	$V_{CER}$	40	Vdc
Collector-Base Voltage	$V_{CB}$	60	Vdc
Emitter-Base Voltage	$V_{EB}$	5	Vdc
Collector Current	$I_C$	800	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	800 4.57	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	2.5 14.3	Watts mW/ $^\circ\text{C}$
Operating Junction Temperature Range	$T_J$	200	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65 to +200	$^\circ\text{C}$

# 2N2410 (continued)

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage* ( $I_C = 30 \text{ mA}_\text{dc}$ , $I_B = 0$ )	$BV_{CEO} \text{ (sus)*}$	30	—	Vdc
Collector-Emitter Breakdown Voltage* ( $I_C = 30 \text{ mA}_\text{dc}$ , $R_{BE} = 10 \text{ ohms}$ )	$BV_{CER}^*$	40	—	Vdc
Collector-Base Breakdown Voltage ( $I_C = 0.1 \text{ mA}_\text{dc}$ , $I_E = 0$ )	$BV_{CBO}$	60	—	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 0.1 \text{ mA}_\text{dc}$ , $I_C = 0$ )	$BV_{EBO}$	5.0	—	Vdc
Collector-Cutoff Current ( $V_{CE} = 30 \text{ Vdc}$ , $V_{BE} = 0$ ) ( $V_{CE} = 30 \text{ Vdc}$ , $V_{BE} = 0$ , $T_A = 150^\circ\text{C}$ )	$I_{CES}$	—	0.3 350	$\mu\text{A}_\text{dc}$
Collector Cutoff Current ( $V_{CB} = 30 \text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	—	0.3	$\mu\text{A}_\text{dc}$
Emitter Cutoff Current ( $V_{BE} = 4 \text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	—	0.3	$\mu\text{Vdc}$

## ON CHARACTERISTICS

DC Current Gain* ( $I_C = 10 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ ) ( $I_C = 150 \text{ mA}_\text{dc}$ , $V_{CE} = 1 \text{ Vdc}$ ) ( $I_C = 150 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ ) ( $I_C = 500 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ )	$h_{FE}^*$	30 15 30 25	120 — 120 100	—
Collector-Emitter Saturation Voltage* ( $I_C = 150 \text{ mA}_\text{dc}$ , $I_B = 15 \text{ mA}_\text{dc}$ ) ( $I_C = 500 \text{ mA}_\text{dc}$ , $I_B = 50 \text{ mA}_\text{dc}$ )	$V_{CE(\text{sat})}^*$	— —	0.45 1.3	Vdc
Base-Emitter Saturation Voltage* ( $I_C = 150 \text{ mA}_\text{dc}$ , $I_B = 15 \text{ mA}_\text{dc}$ ) ( $I_C = 500 \text{ mA}_\text{dc}$ , $I_B = 50 \text{ mA}_\text{dc}$ )	$V_{BE(\text{sat})}^*$	— —	1.2 1.6	Vdc

## DYNAMIC CHARACTERISTICS

Current-Gain-Bandwidth Product ( $I_C = 50 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 100 \text{ MHz}$ )	$f_T$	200	—	MHz
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f = 1 \text{ MHz}$ )	$C_{ob}$	—	11	pF
Input Capacitance ( $V_{BE} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1 \text{ MHz}$ )	$C_{ib}$	—	50	pF
Turn-On Time ( $t_d + t_r$ ) ( $I_C = 150 \text{ mA}_\text{dc}$ , Figure 1) ( $I_C = 500 \text{ mA}_\text{dc}$ , Figure 2)	$t_{on}$	— —	65 65	ns
Turn-Off Time ( $t_s + t_f$ ) ( $I_C = 150 \text{ mA}_\text{dc}$ , Figure 1) ( $I_C = 500 \text{ mA}_\text{dc}$ , Figure 2)	$t_{off}$	— —	55 65	ns
Storage Time ( $I_C = 150 \text{ mA}_\text{dc}$ , Figure 1)	$t_s$	—	40	ns
Fall Time ( $I_C = 150 \text{ mA}_\text{dc}$ , Figure 1)	$t_f$	—	30	ns

\*Pulse Test: Pulse Width = 300  $\mu\text{s}$ ; Duty Cycle = 2%

## SWITCHING TIME EQUIVALENT TEST CIRCUITS

FIGURE 1 —  $I_C = 150 \text{ mA}$

$t_d \leq 1 \text{ ns}$ , PULSE WIDTH  $\geq 300 \text{ ns}$

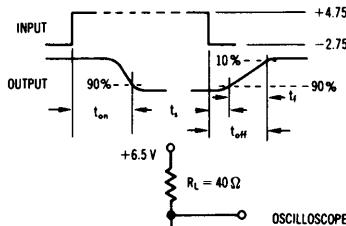
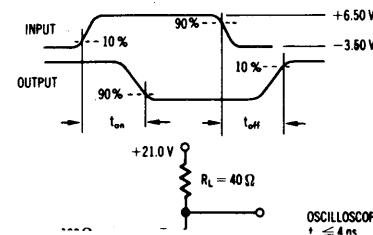


FIGURE 2 —  $I_C = 500 \text{ mA}$

$t_d \leq 12 \text{ ns}$ ,  $t_f \leq 12 \text{ ns}$ , PULSE WIDTH =  $1.5 \mu\text{s} \pm 0.5 \mu\text{s}$ , PRR  $\leq 500 \text{ Hz}$



**2N2415 (GERMANIUM)**

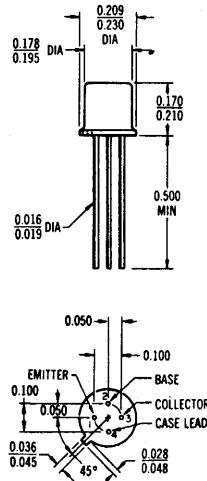
**2N2416**

### GERMANIUM ULTRA-HIGH-FREQUENCY TRANSISTORS

... for very low-noise, high-gain amplifiers, oscillators, mixers, and frequency multipliers.

- High Maximum Frequency of Oscillation  
 $f_{max} = 2000$  MHz typ
- Low Noise Figure  
 $NF = 3.0$  dB max at 200 MHz (2N2415)
- High Maximum Available Gain  
 $MAG = 14$  dB typ at 500 MHz for 2N2415  
 $MAG = 12.5$  dB typ at 500 MHz for 2N2416
- High Breakdown Voltages  
 $BV_{CEO} = 25$  Volts typ  
 $BV_{CBO} = 15$  Volts typ
- Low Output Capacitance  
 $C_{ob} = 0.9$  pF typ

### AMPLIFIER TRANSISTORS GERMANIUM PNP EPITAXIAL MESA DIFFUSED BASE



TO-72 PACKAGE

CASE 20

### MAXIMUM RATINGS\*

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	$V_{CEO}$	10	Vdc
Collector-Base Voltage	$V_{CB}$	15	Vdc
Emitter-Base Voltage	$V_{EB}$	0.3	Vdc
Collector Current	$I_C$	20	mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	75 1.0	mW mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	$T_J$ $T_{stg}$	-65 to +100	$^\circ\text{C}$

\* The maximum rating is that value above which device operation may be impaired from the viewpoint of life or performance.

# 2N2415, 2N2416 (continued)

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Collector-Emitter Breakdown Voltage* ( $I_C = 2.0 \text{ mA}_\text{dc}$ , $I_B = 0$ )	$BV_{CEO}^*$	10	15	-	V <sub>dc</sub>
Collector-Base Breakdown Voltage ( $I_C = 100 \mu\text{A}_\text{dc}$ , $I_E = 0$ )	$BV_{CBO}$	15	25	-	V <sub>dc</sub>
Collector Cutoff Current ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	-	1.0	5.0	$\mu\text{A}_\text{dc}$
Emitter Cutoff Current ( $V_{BE} = 0.3 \text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	-	-	100	$\mu\text{A}_\text{dc}$

## ON CHARACTERISTICS

DC Current Gain ( $I_C = 2.0 \text{ mA}_\text{dc}$ , $V_{CE} = 6.0 \text{ Vdc}$ )	2N2415 2N2416	$h_{FE}$	10 8.0	-	200 200	-
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## DYNAMIC CHARACTERISTICS

Current-Gain-Bandwidth Product ( $I_C = 2.0 \text{ mA}_\text{dc}$ , $V_{CE} = 6.0 \text{ Vdc}$ , $f = 200 \text{ MHz}$ )	2N2415 2N2416	$f_T$	500 400	-	-	MHz
Output Capacitance ( $V_{CB} = 6.0 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )		$C_{ob}$	-	0.9	2.0	pF
Small-Signal Current Gain ( $I_C = 2.0 \text{ mA}_\text{dc}$ , $V_{CE} = 6.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	2N2415 2N2416	$h_{fe}$	15 10	-	300 300	-
Collector-Base Time Constant** ( $I_E = 2.0 \text{ mA}_\text{dc}$ , $V_{CB} = 6.0 \text{ Vdc}$ , $f = 79.8 \text{ MHz}$ )	2N2415 2N2416	$r_b' C_c^{**}$	-	-	8.0 10	ps
Noise Figure ( $V_{CB} = 6.0 \text{ Vdc}$ , $I_E = 1.5 \text{ mA}_\text{dc}$ , $R_S = 75 \text{ ohms}$ , $f = 200 \text{ MHz}$ )	2N2415 2N2416	NF	-	2.4 3.4	3.0 4.0	dB

## FUNCTIONAL TESTS

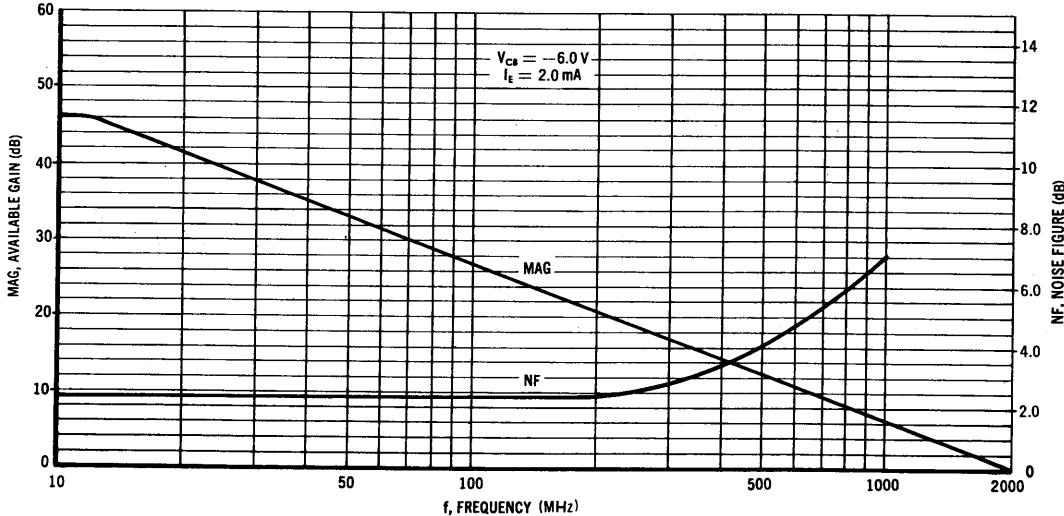
Maximum Available Gain# ( $V_{CB} = 6.0 \text{ Vdc}$ , $I_E = 2.0 \text{ mA}_\text{dc}$ , $f = 500 \text{ MHz}$ )	2N2415 2N2416	MAG#	-	14 12.5	-	dB
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\* Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

\*\* Direct Collector-Emitter header capacitance balanced out to give true device capability.

# MAG calculated from  $f_{max}$  as determined from actual amplifier circuits.

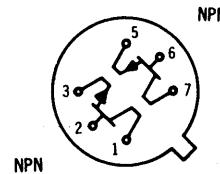
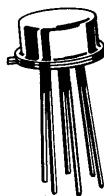
## TYPICAL MAG and NOISE FIGURE versus FREQUENCY



**2N3423 (SILICON)**

**2N3424**

Dual NPN silicon transistors designed for use as  
sense and high-frequency differential amplifiers.



**CASE 32 C**

PINS 4 AND 8 OMITTED  
Pin Connections Bottom View  
All Leads Electrically Isolated from Case

**MAXIMUM RATINGS** (each side) ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Rating	Symbol	Value		Unit
Collector-Emitter Voltage	$V_{CEO}$	15		Vdc
Collector-Base Voltage	$V_{CB}$	30		Vdc
Emitter-Base Voltage	$V_{EB}$	3.0		Vdc
Collector Current	$I_C$	50		mAdc
Operating & Storage Junction Temperature Range	$T_J, T_{stg}$	-65 to +200		°C
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	One Side	Both Sides	Watt mW/°C
		0.3	0.45	
		1.72	2.57	
Total Device Dissipation @ $T_C = 100^\circ\text{C}$ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	0.344	0.685	Watt
		0.6	1.2	Watt
		3.44	6.85	mW/°C

**2N3423, 2N3424 (continued)**
**ELECTRICAL CHARACTERISTICS** (each side) ( $T_A = 25^\circ\text{C}$  unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage* ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $I_B = 0$ )	$BV_{CEO(\text{sus})}^*$	15	-	Vdc
Collector-Base Breakdown Voltage ( $I_C = 1.0 \mu\text{A}_\text{dc}$ , $I_E = 0$ )	$BV_{CBO}$	30	-	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 10 \mu\text{A}_\text{dc}$ , $I_C = 0$ )	$BV_{EBO}$	3.0	-	Vdc
Collector Cutoff Current ( $V_{CB} = 15 \text{ Vdc}$ , $I_E = 0$ ) ( $V_{CB} = 15 \text{ Vdc}$ , $I_E = 0$ , $T_A = 150^\circ\text{C}$ )	$I_{CBO}$	- -	0.01 1.0	$\mu\text{A}_\text{dc}$
Emitter Cutoff Current ( $V_{EB} = 3.0 \text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	-	10	$\mu\text{A}_\text{dc}$
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 1.0 \text{ Vdc}$ ) ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ Vdc}$ )	$h_{FE}$	20 20	- 200	-
Collector-Emitter Saturation Voltage ( $I_C = 10 \text{ mA}_\text{dc}$ , $I_B = 1.0 \text{ mA}_\text{dc}$ )	$V_{CE(\text{sat})}$	-	0.4	Vdc
Base-Emitter Saturation Voltage ( $I_C = 10 \text{ mA}_\text{dc}$ , $I_B = 1.0 \text{ mA}_\text{dc}$ )	$V_{BE(\text{sat})}$	-	1.0	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Current-Gain - Bandwidth Product ( $I_C = 4.0 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 100 \text{ MHz}$ )	$f_T$	600	1200	MHz
Output Capacitance ( $V_{CB} = 0$ , $I_E = 0$ , $f = 140 \text{ kHz}$ ) ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f = 140 \text{ kHz}$ )	$C_{ob}$	- -	3.0 1.7	pF
Input Capacitance ( $V_{BE} = 0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 140 \text{ kHz}$ )	$C_{ib}$	-	2.0	pF
Real Part of Input Impedance ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ Vdc}$ , $f = 350 \text{ MHz}$ )	$Re(h_{ie})$	-	45	Ohm
<b>MATCHING CHARACTERISTICS</b>				
DC Current Gain Ratio** ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ Vdc}$ ) 2N3423 2N3424	$h_{FE1}/h_{FE2}^{**}$	0.8 0.9	1.0 1.0	--
Base Voltage Differential ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ Vdc}$ ) 2N3423 2N3424	$ V_{BE1} - V_{BE2} $	- -	10 5.0	mVdc
Base Voltage Differential Gradient ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ Vdc}$ , $T_{A1} = +25^\circ\text{C}$ , $T_{A2} = -55^\circ\text{C}$ ) 2N3423 2N3424  ( $I_C = 3.0 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ Vdc}$ , $T_{A1} = +25^\circ\text{C}$ , $T_{A2} = +125^\circ\text{C}$ ) 2N3423 2N3424	$\Delta(V_{BE1} - V_{BE2})$	- - - -	3.2 1.6 4.0 2.0	mVdc

 \*Pulse Test: Pulse Width  $\leq 300 \mu\text{s}$ ; Duty Cycle  $\leq 2\%$ 

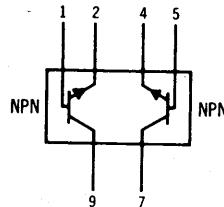
 \*\* Lowest of the two  $h_{FE}$  readings is taken as  $h_{FE1}$  for purposes of this ratio.

**2N3515 (SILICON)****2N3518**

Dual NPN silicon transistor for use as a differential amplifier.



**CASE 33**  
(TO-89)



Pin Connections,  
Bottom View

**MAXIMUM RATINGS** (each side) ( $T_A = 25^\circ\text{C}$ )

Rating	Symbol	2N3515	2N3518	Unit
Collector-Emitter Voltage	$V_{CEO}$	40	60	Vdc
Collector-Base Voltage	$V_{CB}$	80	100	Vdc
Emitter-Base Voltage	$V_{EB}$	5.0	7.0	Vdc
Collector Current	$I_C$	500		mAdc
Operating Junction Temperature Range	$T_J$	-65 to +175		°C
Storage Temperature Range	$T_{stg}$	-65 to +200		°C
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	One Side	Both Sides	mW
		250	350	
		1.67	2.33	$\text{mW}/^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	700	1,400	mW
		4.67	9.33	$\text{mW}/^\circ\text{C}$

# 2N3515, 2N3518 (continued)

ELECTRICAL CHARACTERISTICS (each side) ( $T_A = 25^\circ C$  unless otherwise noted)

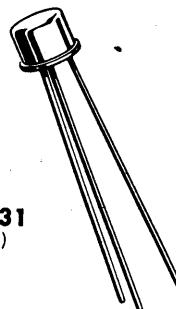
Characteristics	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage* ( $I_C = 20 \text{ mA}_\text{dc}$ , $I_B = 0$ )	$BV_{CEO}^*$	40 60	-	Vdc
2N3515 2N3518				
Collector-Base Breakdown Voltage ( $I_C = 50 \text{ nA}_\text{dc}$ , $I_E = 0$ )	$BV_{CBO}$	80	-	Vdc
( $I_C = 100 \mu\text{A}_\text{dc}$ , $I_E = 0$ )	2N3518	100	-	
Emitter-Base Breakdown Voltage ( $I_E = 50 \text{ nA}_\text{dc}$ , $I_C = 0$ )	$BV_{EBO}$	5.0	-	Vdc
( $I_E = 100 \mu\text{A}_\text{dc}$ , $I_C = 0$ )	2N3518	7.0	-	
Collector Cutoff Current ( $V_{CB} = 60 \text{ Vdc}$ , $I_E = 0$ )	$I_{CBO}$	-	0.02	$\mu\text{A}_\text{dc}$
( $V_{CB} = 30 \text{ Vdc}$ , $I_E = 0$ , $T_A = 150^\circ C$ )	2N3515	-	15	
( $V_{CB} = 50 \text{ Vdc}$ , $I_E = 0$ )	2N3518	-	0.002	
( $V_{CB} = 50 \text{ Vdc}$ , $I_E = 0$ , $T_A = 150^\circ C$ )	2N3518	-	10	
Emitter-Cutoff Current ( $V_{EB} = 5.0 \text{ Vdc}$ , $I_C = 0$ )	$I_{EBO}$	-	20	$\text{nA}_\text{dc}$
2N3515 2N3518		-	2.0	
<b>ON CHARACTERISTICS</b>				
DC Current Gain ( $I_C = 100 \mu\text{A}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	$h_{FE}$	35	-	-
( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )		50	200	
( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $T_A = -55^\circ C$ )	2N3518	15	-	
Collector-Emitter Saturation Voltage ( $I_C = 50 \text{ mA}_\text{dc}$ , $I_B = 5.0 \text{ mA}_\text{dc}$ )	$V_{CE(\text{sat})}$	-	1.2	Vdc
Base-Emitter Saturation Voltage ( $I_C = 50 \text{ mA}_\text{dc}$ , $I_B = 5.0 \text{ mA}_\text{dc}$ )	$V_{BE(\text{sat})}$	-	0.9	Vdc
<b>SMALL-SIGNAL CHARACTERISTICS</b>				
Current-Gain-Bandwidth Product ( $I_C = 50 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ , $f = 20 \text{ MHz}$ )	$f_T$	50 60	-	MHz
2N3515 2N3518				
Output Capacitance ( $V_{CB} = 10 \text{ Vdc}$ , $I_E = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{ob}$	-	18	pF
2N3515 2N3518		-	15	
Input Capacitance ( $V_{BE} = 0$ , $0.5 \text{ Vdc}$ , $I_C = 0$ , $f = 1.0 \text{ MHz}$ )	$C_{ib}$	-	85	pF
Input Impedance ( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CB} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{ib}$	20	35	ohms
Input Impedance ( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{ie}$	1.0 1.0	5.0 10.5	k ohms
Small-Signal Current Gain ( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{fe}$	50	300	-
Output Admittance ( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $f = 1.0 \text{ kHz}$ )	$h_{oe}$	4.0 4.0	16 50	$\mu\text{mhos}$
2N3515 2N3518				
Noise Figure ( $I_C = 0.3 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ Vdc}$ , $R_G = 510 \text{ ohms}$ , $B.W. = 1.0 \text{ Hz}$ , $f = 1.0 \text{ kHz}$ )	NF	-	8.0	dB
<b>MATCHING CHARACTERISTICS</b>				
DC Current Gain Ratio**	$h_{FE1}/h_{FE2}^{**}$	0.8 0.9 0.8 0.9	1.0 1.0 1.0 1.0	-
( $I_C = 100 \mu\text{A}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	2N3515			
( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	2N3518			
Base Voltage Differential ( $I_C = 100 \mu\text{A}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	$ V_{BE1} - V_{BE2} $	-	5.0	mVdc
2N3515 2N3518		-	3.0	
( $I_C = 1.0 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ )	2N3515 2N3518	-	5.0 3.0	
Base Voltage Differential Gradient ( $I_C = 100 \mu\text{A}_\text{dc}$ , $V_{CE} = 5.0 \text{ Vdc}$ , $T_A = -55$ to $+125^\circ C$ )	$\frac{\Delta(V_{BE1} - V_{BE2})}{\Delta T_A}$	-	15 10	$\mu\text{V}/^\circ C$
2N3515 2N3518				

\* Pulse Width  $\leq 300 \mu\text{s}$ , Duty Cycle  $\leq 2.0\%$ .

\*\* The lowest of the two  $h_{FE}$  readings is taken as  $h_{FE1}$  for the purpose of measurement.

**2N3722 (SILICON)**

**2N3723**



NPN silicon annular transistors designed for medium-current, high-speed, high-voltage switching and driver applications.

**CASE 31  
(TO-5)**

Collector connected to case

### MAXIMUM RATINGS

Rating	Symbol	2N3722	2N3723	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	80	Vdc
Collector-Base Voltage	$V_{CB}$	80	100	Vdc
Emitter-Base Voltage	$V_{EB}$	6.0		Vdc
Collector Current - Continuous	$I_C$	500		mAdc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	0.8 4.56	Watt mW/ $^\circ\text{C}$	
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$	4.0 22.8	Watts mW/ $^\circ\text{C}$	
Operating and Storage Junction Temperature Range	$T_J$ , $T_{stg}$	-65 to +200		$^\circ\text{C}$

### ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Breakdown Voltage* ( $I_C = 10 \text{ mA}, I_B = 0$ )	$BV_{CEO}^*$	60 80	-	Vdc
( $I_C = 100 \mu\text{A}, V_{BE} = 0$ )	$BV_{CES}$	80 100	-	Vdc
Collector-Base Breakdown Voltage ( $I_C = 100 \mu\text{A}, I_E = 0$ )	$BV_{CBO}$	80 100	-	Vdc
Emitter-Base Breakdown Voltage ( $I_E = 100 \mu\text{A}, I_C = 0$ )	$BV_{EBO}$	6.0	-	Vdc
Collector Cutoff Current ( $V_{CE} = 40 \text{ Vdc}, V_{BE} = 0$ ) ( $V_{CE} = 50 \text{ Vdc}, V_{BE} = 0$ )	$I_{CES}$	-	0.5 0.5	$\mu\text{Adc}$
( $V_{CE} = 40 \text{ Vdc}, V_{BE} = 0, T_A = +125^\circ\text{C}$ ) ( $V_{CE} = 50 \text{ Vdc}, V_{BE} = 0, T_A = +125^\circ\text{C}$ )		-	70 70	
Base Current ( $V_{CE} = 40 \text{ Vdc}, V_{BE} = 0$ ) ( $V_{CE} = 50 \text{ Vdc}, V_{BE} = 0$ )	$I_B$	-	0.5 0.5	$\mu\text{Adc}$

\* Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 1.0%.

# 2N3722, 2N3723 (continued)

## ELECTRICAL CHARACTERISTICS (continued)

Characteristic	Symbol	Min	Max	Unit	
<b>ON CHARACTERISTICS</b>					
DC Current Gain ( $I_C = 10 \text{ mA}_\text{dc}$ , $V_{CE} = 1.0 \text{ V}_\text{dc}$ )	2N3722, 2N3723	$h_{FE}^*$	25	-	
( $I_C = 100 \text{ mA}_\text{dc}$ , $V_{CE} = 1.0 \text{ V}_\text{dc}$ )	2N3722, 2N3723		40	150	
( $I_C = 300 \text{ mA}_\text{dc}$ , $V_{CE} = 2.0 \text{ V}_\text{dc}$ )	2N3722 2N3723		20 15	-	
( $I_C = 500 \text{ mA}_\text{dc}$ , $V_{CE} = 2.0 \text{ V}_\text{dc}$ )	2N3722		15	-	
( $I_C = 500 \text{ mA}_\text{dc}$ , $V_{CE} = 3.0 \text{ V}_\text{dc}$ )	2N3723		15	-	
( $I_C = 800 \text{ mA}_\text{dc}$ , $V_{CE} = 5.0 \text{ V}_\text{dc}$ )	2N3722, 2N3723		12	-	
( $I_C = 100 \text{ mA}_\text{dc}$ , $V_{CE} = 1.0 \text{ V}_\text{dc}$ , $T_A = -55^\circ\text{C}$ )	2N3722, 2N3723		15	-	
( $I_C = 200 \text{ mA}_\text{dc}$ , $V_{CE} = 2.0 \text{ V}_\text{dc}$ , $T_A = -55^\circ\text{C}$ )	2N3722, 2N3723		20	-	
Collector-Emitter Saturation Voltage* ( $I_C = 10 \text{ mA}_\text{dc}$ , $I_B = 1.0 \text{ mA}_\text{dc}$ )	2N3722 2N3723	$V_{CE(\text{sat})}^*$	-	0.22	
( $I_C = 100 \text{ mA}_\text{dc}$ , $I_B = 10 \text{ mA}_\text{dc}$ )	2N3722 2N3723		-	0.25	
( $I_C = 300 \text{ mA}_\text{dc}$ , $I_B = 30 \text{ mA}_\text{dc}$ )	2N3722 2N3723		-	0.28	
( $I_C = 500 \text{ mA}_\text{dc}$ , $I_B = 50 \text{ mA}_\text{dc}$ )	2N3722 2N3723		-	0.37	
( $I_C = 800 \text{ mA}_\text{dc}$ , $I_B = 80 \text{ mA}_\text{dc}$ )	2N3722		-	0.44	
Base-Emitter Saturation Voltage ( $I_C = 10 \text{ mA}_\text{dc}$ , $I_B = 1.0 \text{ mA}_\text{dc}$ )	2N3722, 2N3723	$V_{BE(\text{sat})}^*$	-	0.75	
( $I_C = 100 \text{ mA}_\text{dc}$ , $I_B = 10 \text{ mA}_\text{dc}$ )	2N3722, 2N3723		-	0.85	
( $I_C = 300 \text{ mA}_\text{dc}$ , $I_B = 30 \text{ mA}_\text{dc}$ )	2N3722, 2N3723		-	1.1	
( $I_C = 500 \text{ mA}_\text{dc}$ , $I_B = 50 \text{ mA}_\text{dc}$ )	2N3722, 2N3723		0.86	1.2	
( $I_C = 800 \text{ mA}_\text{dc}$ , $I_B = 80 \text{ mA}_\text{dc}$ )	2N3722		-	1.5	
<b>DYNAMIC CHARACTERISTICS</b>					
Current-Gain-Bandwidth Product ( $I_C = 50 \text{ mA}_\text{dc}$ , $V_{CE} = 10 \text{ V}_\text{dc}$ , $f = 100 \text{ MHz}$ )	$f_T$	300	-	MHz	
Output Capacitance ( $V_{CB} = 10 \text{ V}_\text{dc}$ , $I_E = 0$ , $f = 100 \text{ kHz}$ )	$C_{ob}$	-	10 9.0	pF	
Input Capacitance ( $V_{BE} = 0.5 \text{ V}_\text{dc}$ , $I_C = 0$ , $f = 100 \text{ kHz}$ )	$C_{ib}$	-	65	pF	
<b>SWITCHING CHARACTERISTICS</b>					
Turn-On Time	2N3722 2N3723	$t_{on}$	-	50 70	ns
Delay Time	( $V_{CC} = 30 \text{ V}_\text{dc}$ , $V_{BE(\text{off})} = 3.8 \text{ V}_\text{dc}$ , $I_C = 500 \text{ mA}_\text{dc}$ , $I_{B1} = 50 \text{ mA}_\text{dc}$ )	$t_d$	-	12 15	ns
Rise Time	2N3722 2N3723 (See Figure 1)	$t_r$	-	50 70	ns
Turn-Off Time	2N3722 2N3723	$t_{off}$	-	100 130	ns
Storage Time	( $V_{CC} = 30 \text{ V}_\text{dc}$ , $I_C = 500 \text{ mA}_\text{dc}$ , $I_{B1} = I_{B2} = 50 \text{ mA}_\text{dc}$ )	$t_s$	-	85 110	ns
Fall Time	2N3722 2N3723 (See Figure 1)	$t_f$	-	45 50	ns

\* Pulse Test: Pulse Width = 300  $\mu\text{s}$ , Duty Cycle = 1.0%.

FIGURE 1 – SWITCHING TIMES TEST CIRCUIT

