No. 34,014A

SPRAGUE
THE MARK OF RELIABILITY

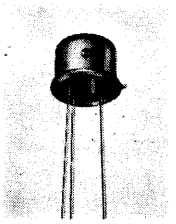
Engineering Bulletin

2N1024
2N1026

TYPE 2N1024 and 2N1026 SEPT® TRANSISTORS

—— PNP Silicon Planar Epitaxial Series

DESIGNED for low-level audio frequency and general purpose switching and amplifier applications, Type 2N1024 and 2N1026 SEPT Transistors provide outstanding low cost performance, both for new design and as economy replacements for many older silicon and germanium transistors.



TO-5 CASE

ABSOLUTE MAXIMUM RATINGS[1]

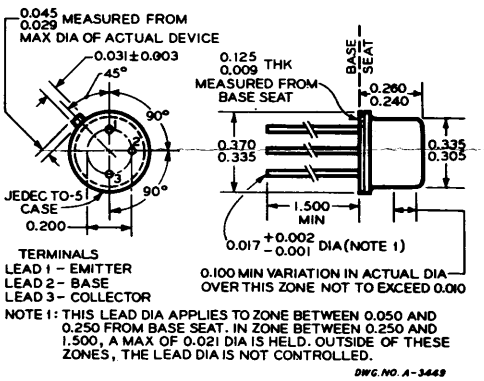
Collector-Base Voltage, V_{CBO}
- 2N1024 . . . −18 volts
- 2N1026 . . . −40 volts

Emitter-Base Voltage, V_{EBO}
- 2N1024 . . . −18 volts
- 2N1026 . . . −40 volts

Collector-Emitter Voltage, V_{CEO}
- 2N1024 . . . −15 volts
- 2N1026 . . . −35 volts

Collector Current, I_C . . . . . 100 mA
Total Device Dissipation at 25C . . . . . 250 mW
Derating Factor . . . . . 1.66 mW/°C
Lead Temperature (1/16" from case for 10 sec.) . . 230 C
Storage Temperature . . . . . −65C to +175C

MECHANICAL SPECIFICATIONS



NOTE 1: THIS LEAD DIA APPLIES TO ZONE BETWEEN 0.050 AND 0.250 FROM BASE SEAT. IN ZONE BETWEEN 0.250 AND 1.500, A MAX OF 0.021 DIA IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIA IS NOT CONTROLLED.

DWG. NO. A-3449

[1]The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The breakdown voltages may be far above the maximum voltage ratings. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

ELECTRICAL CHARACTERISTICS at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS		MIN.	TYP.	MAX.	UNITS
		D - C CHARACTERISTICS					
I_{CBO}	Collector Cutoff Current	At rated voltage		—	—	0.025	μA
I_{EBO}	Emitter Cutoff Current	At rated voltage		—	—	0.025	μA
I_{CBO}	Collector Cutoff Current	V_{CB} = −10V, T_A = 150C	2N1024	—	—	100	μA
		V_{CB} = −35V, T_A = 150C	2N1026	—	—	50	μA
		HIGH FREQUENCY CHARACTERISTICS					
h_{fe}	Forward Current Gain	I_E = 1mA, V_{CB} = −6V	2N1024	9	—	—	—
			2N1026	18	—	44	—
h_{ib}	Input Resistance			—	35	—	Ohms
h_{rb}	Voltage Derision Ratio			—	0.001	—	—
h_{ob}	Output Conductance			—	1.4	—	μmhos
$f_{\alpha b}$	Alpha Cutoff Frequency		2N1024	1	—	—	Mc
			2N1026	2	—	—	Mc
C_{ob}	Output Capacitance			—	7	—	pF
N.F.	Noise Figure	Center Frequency = 1000 cps Equiv. Noise Bandwidth = 1 cps R_G = 1000Ω		—	8	25	db

SPRAGUE ENGINEERING BULLETIN 34,014A

No. 31,137A

SPRAGUE
THE MARK OF RELIABILITY

Engineering Bulletin

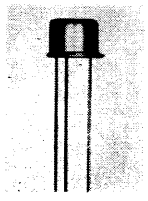
2N2162

TYPE 2N2162 SILICON P-N-P CHOPPER TRANSISTORS

FOR USE IN low-level chopper applications, the Type 2N2162 P-N-P Silicon Surface Precision Alloy Transistors feature guaranteed 30-volt ratings regardless of operating configuration, low offset voltage, and low dynamic resistance.

The high frequency response, f_T typically 20 Mc, allows high chopping rates while the low diode capacitance insures minimum distortion of chopped waveforms.

Matched pairs of the Type 2N2162 are available.



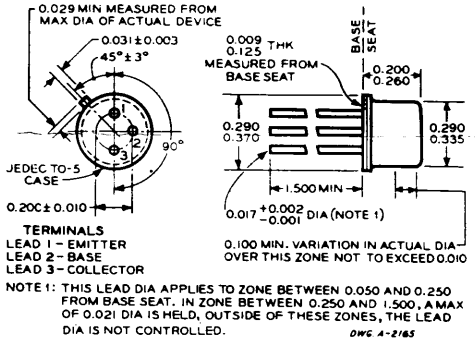
ACTUAL SIZE

ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature	−65 to +140 C
Collector Voltage, V_{CB}	30 volts
Emitter Voltage, V_{EB}	30 volts
Emitter Voltage, V_{ECO}	30 volts
Device Dissipation at 25 C Ambient	150 mW
Derating Factor	1.3 mW/° C

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The diode breakdown and punchthrough voltages may be far above the maximum collector voltage rating. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

MECHANICAL SPECIFICATIONS



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DWG A-2165

ELECTRICAL CHARACTERISTICS[2] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN	TYP.	MAX	UNITS
	D-C CHARACTERISTICS					
BV_{CBO}	Collector Breakdown Voltage	$I_C = -50\ \mu A$	30	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	30	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	30	—	—	volts
I_{CBO}	Collector Cutoff Current	$V_{CB} = -10$ V	—	.001	.010	μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = -10$ V	—	.001	.010	μA
I_{ECO}	Emitter Cutoff Current	$V_{EC} = -10$ V	—	.001	.010	μA
	CHOPPER CHARACTERISTICS					
V_{OFF}	Offset Voltage	$I_B = -1$ mA	—	1.4	2.0	mV
r_S	Dynamic Resistance	$I_B = -1$ mA	—	10	20	ohms
	SMALL SIGNAL PARAMETERS					
h_{fe}	Current Transfer Ratio	$V_{CE} = -3$V, $I_E = 1$mA, f = 1Kc	20	35	—	—
h_{fe}	Current Transfer Ratio	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	3.5	5	—	—
f_T	Gain Bandwidth Product	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	14	20	—	Mc
C_{ob}	Output Capacitance	$V_{CB} = -6$V, $I_E = 1$mA, f = 4Mc	—	6.0	10	pF
C_{ib}	Inverted Output Capacitance	$V_{EB} = -6$V, $I_C = 1$mA, f = 4Mc	—	6.0	10	pF

[2] Typical values are for engineering guidance only.

SPRAGUE ENGINEERING BULLETIN 31,137A

SPRAGUE®
THE MARK OF RELIABILITY

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□ □ □

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P. O. Box 14289
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*Airconditioning and Refrigeration Components Only.

In the construction of the components described, the full intent of the specification will be met. The Sprague Electric Company, however, reserves the right to make, from time to time, such departures from the detail specifications as may be required to permit improvements in the design of its products. Components made under military approvals will be in accordance with the approval requirements.

LITHO IN U.S. AMER.

ISSUE OF JUNE, 1962

No. 31,140A

SPRAGUE
THE MARK OF RELIABILITY

Engineering Bulletin

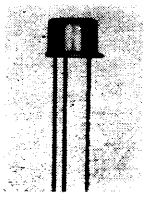
2N2163

TYPE 2N2163 SILICON P-N-P CHOPPER TRANSISTORS

GUARANTEED VOLTAGE operation at 15 volts, low offset voltage, low dynamic resistance and high frequency response are the prime characteristics of Type 2N2163 P-N-P Silicon Surface Alloy Transistors, designed for use in low-level chopper applications.

The high frequency response, typically 20 Mc, allows high chopping rates while the low diode capacitance insures minimum distortion of chopped waveforms.

Matched pairs of Type 2N2163 Transistors are available.



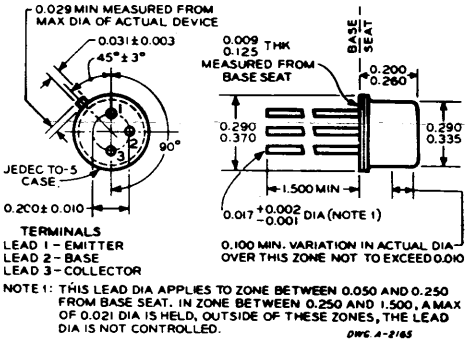
ACTUAL SIZE

ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature	−65 to +140 C
Collector Voltage, V_{CB}	15 volts
Emitter Voltage, V_{EB}	15 volts
Emitter Voltage, V_{ECO}	15 volts
Device Dissipation at 25 C Ambient	150 mW
Derating Factor	1.3 mw/° C

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The diode breakdown and punchthrough voltages may be far above the maximum collector voltage rating. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

MECHANICAL SPECIFICATIONS



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DWG. A-2165

ELECTRICAL CHARACTERISTICS[2] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
	D-C CHARACTERISTICS					
BV_{CBO}	Collector Breakdown Voltage	$I_C = -50\ \mu A$	15	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	15	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	15	—	—	volts
I_{CBO}	Collector Cutoff Current	$V_{CB} = -4.5$ V	—	.001	.010	μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = -4.5$ V	—	.001	.010	μA
I_{ECO}	Emitter Cutoff Current	$V_{EC} = -4.5$ V	—	.001	.010	μA
	CHOPPER CHARACTERISTICS					
V_{OFF}	Offset Voltage	$I_B = -1$mA	—	1.4	2.0	mV
r_S	Dynamic Resistance	$I_B = -1$mA	—	10	20	ohms
	SMALL SIGNAL PARAMETERS					
h_{fe}	Current Transfer Ratio	$V_{CE} = -3$V, $I_E = 1$mA, f = 1Kc	20	35	—	—
h_{fe}	Current Transfer Ratio	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	3.5	5	—	—
f_T	Gain Bandwidth Product	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	14	20	—	Mc
C_{ob}	Output Capacitance	$V_{CB} = -6$V, $I_E = 1$mA, f = 4Mc	—	6.0	10	pF
C_{ib}	Inverted Output Capacitance	$V_{EB} = -6$V, $I_C = 1$mA, f = 4Mc	—	6.0	10	pF

[2] Typical values are for engineering guidance only.

SPRAGUE ENGINEERING BULLETIN 31,140A

No. 31,143A

SPRAGUE
THE MARK OF RELIABILITY

Engineering Bulletin

TYPE
2N2164

TYPE 2N2164 SILICON P-N-P CHOPPER TRANSISTORS

SPECIFICALLY DESIGNED for use in low-level chopper applications requiring low offset voltage and dynamic resistance, the Type 2N2164 P-N-P Silicon Precision Alloy Transistors have a high f_T, typically 44Mc. Their low diode capacitance permits high chopping rates with low distortion of the chopped waveforms.

Matched pairs of Type 2N2164 Transistors are available.

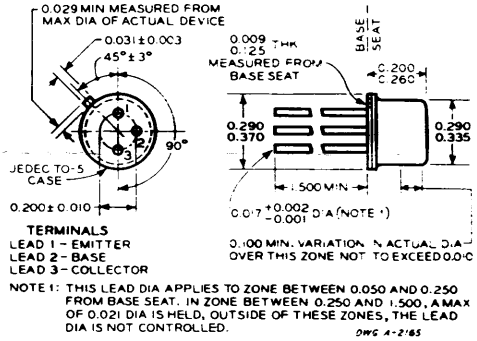
ACTUAL SIZE

ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature	−65 to +140 C
Collector Voltage, V_{CB}	12 volts
Emitter Voltage, V_{EB}	12 volts
Emitter Voltage, V_{ECO}	8 volts
Device Dissipation at 25 C Ambient	150 mW
Derating Factor	1.3 mW/° C

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The diode breakdown and punchthrough voltages may be far above the maximum collector voltage rating. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

MECHANICAL SPECIFICATIONS



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DWG A-2165

ELECTRICAL CHARACTERISTICS[2] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN	TYP.	MAX	UNITS
	D-C CHARACTERISTICS					
BV_{CBO}	Collector Breakdown Voltage	$I_C = -50\ \mu A$	12	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	12	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	8	—	—	volts
I_{CBO}	Collector Cutoff Current	$V_{CB} = -4.5$ V	—	.002	.020	μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = -4.5$ V	—	.002	.020	μA
	CHOPPER CHARACTERISTICS					
V_{OFF}	Offset Voltage	$I_B = -1$mA	—	0.9	1.5	mV
V_{OFF}	Offset Voltage	$I_B = -0.25$ mA	—	0.6	1.0	mV
r_S	Dynamic Resistance	$I_B = -1$mA	—	10	20	ohms
	SMALL SIGNAL PARAMETERS					
h_{fe}	Current Transfer Ratio	$V_{CE} = -3$V, $I_E = 1$mA, f = 1Kc	25	40	—	—
h_{fe}	Current Transfer Ratio	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	6.0	11	—	—
f_T	Gain Bandwidth Product	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	24	44	—	Mc
C_{ob}	Output Capacitance	$V_{CB} = -6$V, $I_E = 1$mA, f = 4Mc	—	6.0	10	pF
C_{ib}	Inverted Output Capacitance	$V_{EB} = -6$V, $I_C = 1$mA, f = 4Mc	—	6.0	10	pF

[2] Typical values are for engineering guidance only.

SPRAGUE ENGINEERING BULLETIN 31,143A

No. 31,146A

SPRAGUE
THE MARK OF RELIABILITY

Engineering Bulletin

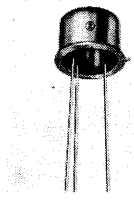
TYPE
2N2165

TYPE 2N2165 SILICON P-N-P CHOPPER TRANSISTORS

FOR USE IN low-level chopper applications, the Type 2N2165 P-N-P Silicon Surface Precision Alloy Transistors feature guaranteed 30-volt ratings regardless of operating configuration, low offset voltage, and low dynamic resistance.

The high frequency response, f_T typically 18Mc, allows high chopping rates, while the low diode capacitance insures minimum distortion of chopped waveforms.

Matched pairs of Type 2N2165 Transistors are available.



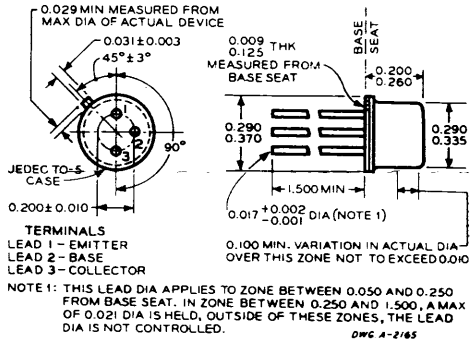
ACTUAL SIZE

ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature	−65 to +140 C
Collector Voltage, V_{CB}	30 volts
Emitter Voltage, V_{EB}	30 volts
Emitter Voltage, V_{ECO}	30 volts
Device Dissipation at 25 C Ambient	150 mW
Derating Factor	1.3 mW/° C

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The diode breakdown and punchthrough voltages may be far above the maximum collector voltage rating. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

MECHANICAL SPECIFICATIONS



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DWG A-2165

ELECTRICAL CHARACTERISTICS[2] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN	TYP.	MAX	UNITS
	D-C CHARACTERISTICS					
BV_{CBO}	Collector Breakdown Voltage	$I_C = -50\,\mu A$	30	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	$I_E = -50\,\mu A$	30	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	$I_E = -50\,\mu A$	30	—	—	volts
I_{CBO}	Collector Cutoff Current	$V_{CB} = -10$ V	—	—	.020	μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = -10$ V	—	—	.020	μA
	CHOPPER CHARACTERISTICS					
V_{OFF}	Offset Voltage	$I_B = -1$ mA	—	1.6	3.0	mV
r_S	Dynamic Resistance	$I_B = -1$ mA	—	20	20	ohms
	SMALL SIGNAL PARAMETERS					
h_{fe}	Current Transfer Ratio	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	2.5	4.5	—	—
f_T	Gain Bandwidth Product	$V_{CE} = -6$V, $I_E = 1$mA, f = 4Mc	10	18	—	Mc
C_{ob}	Output Capacitance	$V_{CB} = -6$V, $I_E = 1$mA, f = 4Mc	—	6.0	10	pF
C_{ib}	Inverted Output Capacitance	$V_{EB} = -6$V, $I_C = 1$mA, f = 4Mc	—	6.0	10	pF

[2] Typical values are for engineering guidance only.

SPRAGUE ENGINEERING BULLETIN 31,146A

No. 31,149A
Supersedes No. 31,149

SPRAGUE the mark of reliability

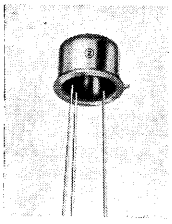
Engineering Bulletin

TYPE 2N2166

TYPE 2N2166 SILICON P-N-P CHOPPER TRANSISTORS

GUARANTEED VOLTAGE operation at 15 volts, low offset voltage, low dynamic resistance and high frequency response are the prime characteristics of Type 2N2166 P-N-P Silicon Surface Alloy Transistors, designed for use in low-level chopper applications.

Matched pairs of Type 2N2166 Transistors are available.



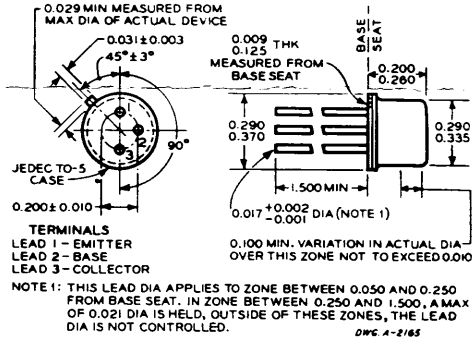
ACTUAL SIZE

ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature	−65 to +140 C
Collector Voltage, V_{CB}	15 volts
Emitter Voltage, V_{EB}	15 volts
Emitter Voltage, V_{ECO}	15 volts
Device Dissipation at 25 C Ambient	150 mW
Derating Factor	1.3 mw/° C

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The diode breakdown and punchthrough voltages may be far above the maximum collector voltage rating. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

MECHANICAL SPECIFICATIONS



NOTE 1: THIS LEAD DIA APPLIES TO ZONE BETWEEN 0.050 AND 0.250 FROM BASE SEAT. IN ZONE BETWEEN 0.250 AND 1.500, A MAX OF 0.021 DIA IS HELD, OUTSIDE OF THESE ZONES, THE LEAD DIA IS NOT CONTROLLED.

DWG. A-2165

ELECTRICAL CHARACTERISTICS[4] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN	TYP.	MAX	UNITS
	D-C CHARACTERISTICS					
BV_{CBO}	Collector Breakdown Voltage	$I_C = -50\ \mu A$	15	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	15	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	15	—	—	volts
I_{CBO}	Collector Cutoff Current	$V_{CB} = -4.5$ V	—	—	.020	μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = -4.5$ V	—	—	.020	μA
	CHOPPER CHARACTERISTICS					
V_{OFF}	Offset Voltage	$I_B = -1$ mA	—	1.6	3.0	mV
r_S	Dynamic Resistance	$I_B = -1$ mA	—	12	30	ohms
	SMALL SIGNAL PARAMETERS					
h_{fe}	Current Transfer Ratio	$V_{CE} = -6$V, $I_E = 1$mA, f = 4 Mc	2.5	4.5	—	—
f_T	Gain Bandwidth Product	$V_{CE} = -6$V, $I_E = 1$mA, f = 4 Mc	10	18	—	Mc
C_{ob}	Output Capacitance	$V_{CB} = -6$V, $I_E = 1$mA, f = 4 Mc	—	6.0	10	pF
C_{ib}	Inverted Output Capacitance	$V_{EB} = -6$V, $I_C = 1$mA, f = 4 Mc	—	6.0	10	pF

[4] Typical values are for engineering guidance only.

SPRAGUE ENGINEERING BULLETIN 31,149A

No. 31,152B

SPRAGUE THE MARK OF RELIABILITY

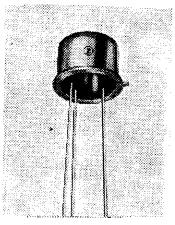
Engineering Bulletin

TYPE 2N2167

TYPE 2N2167 SILICON P-N-P CHOPPER TRANSISTORS

SPECIFICALLY DESIGNED for use in low-level chopper applications requiring low offset voltage and dynamic resistance, the Type 2N2167 P-N-P Silicon Precision Alloy Transistors have a high f_T, typically 36Mc. Their low diode capacitance permits high chopping rates with low distortion of the chopped waveforms.

Matched pairs of Type 2N2167 Transistors are available.



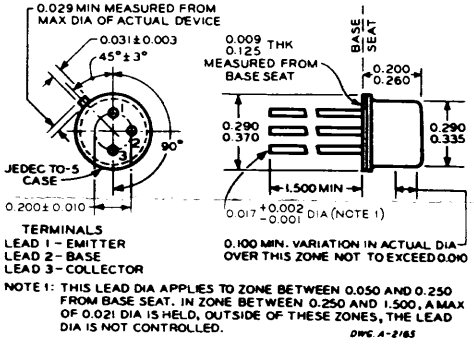
ACTUAL SIZE

ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature	−65 to +140 C
Collector Voltage, V_{CB}	12 volts
Emitter Voltage, V_{EB}	12 volts
Emitter Voltage, V_{ECO}	8 volts
Collector Current, I_C	−50 ma
Device Dissipation at 25 C Ambient	150 mw
Derating Factor	1.3mW/° C

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The diode breakdown and punchthrough voltages may be far above the maximum collector voltage rating. To avoid permanent damage to the transistor, do not attempt to measure these characteristics above the maximum ratings.

MECHANICAL SPECIFICATIONS



NOTE 1: THIS LEAD DIA APPLIES TO ZONE BETWEEN 0.050 AND 0.250 FROM BASE SEAT. IN ZONE BETWEEN 0.250 AND 1.500, A MAX OF 0.021 DIA IS HELD, OUTSIDE OF THESE ZONES, THE LEAD DIA IS NOT CONTROLLED.

DWG. A-2185

ELECTRICAL CHARACTERISTICS[2] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN	TYP.	MAX	UNITS
	D-C CHARACTERISTICS					
BV_{CBO}	Collector Breakdown Voltage	$I_C = -50\ \mu A$	12	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	12	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	$I_E = -50\ \mu A$	8	—	—	volts
I_{CBO}	Collector Cutoff Current	$V_{CB} = -4.5V$	—	.002	.020	μA
I_{EBO}	Emitter Cutoff Current	$V_{EB} = -4.5V$	—	.002	.020	μA
	CHOPPER CHARACTERISTICS					
V_{OFF}	Offset Voltage	$I_B = -1mA$	—	1.5	2.5	mV
V_{OFF}	Offset Voltage	$I_B = -0.25\ mA$	—	1.1	1.5	mV
r_S	Dynamic Resistance	$I_B = -1mA$	—	10	20	ohms
	SMALL SIGNAL PARAMETERS					
h_{fe}	Current Transfer Ratio	$V_{CE} = -6V$, $I_E = 1ma$, $f = 4Mc$	4.0	9.0	—	—
f_T	Gain Bandwidth Product	$V_{CE} = -6V$, $I_E = 1ma$, $f = 4Mc$	16	36	—	Mc
C_{ob}	Output Capacitance	$V_{CB} = -6V$, $I_E = 1ma$, $f = 4Mc$	—	6.0	10	pF
C_{ib}	Inverted Output Capacitance	$V_{EB} = -6V$, $I_C = 1ma$, $f = 4Mc$	—	6.0	10	pF

[2] Typical values are for engineering guidance only.

SPRAGUE ENGINEERING BULLETIN 31,152B

SPRAGUE
THE MARK OF RELIABILITY

Engineering Bulletin

TYPE
2N2185
2N2187

TYPE 2N2185 AND 2N2187 SILICON PRECISION-ALLOY TRANSISTORS

EXTREMELY LOW leakage current, low offset voltage, and uniquely low inverted dynamic saturation resistance are the prime characteristics of Type 2N2185 Silicon Precision-Alloy Transistors, designed for use in low-level chopper applications.

Type 2N2187 SPAT® identifies matched pairs of Type 2N2185 transistors with the offset voltage match guaranteed over the temperature range of +25 C to +85 C.

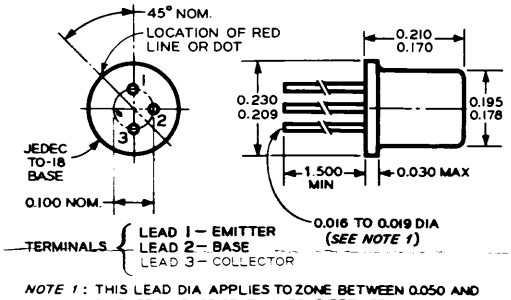
ABSOLUTE MAXIMUM RATINGS[1]

Storage Temperature . . . . . −65 C to + 140 C
Collector Voltage, V_{CBO} . . . . . −30 volts
Collector Voltage, V_{CEO} . . . . . −30 volts
Emitter Voltage, V_{EBO} . . . . . −30 volts
Emitter Voltage, V_{ECO} . . . . . −30 volts
Collector Current, I_C . . . . . −50 ma
Total Device Dissipation[2] at 25 C . . . . . 150 mw
Lead Temperature at 1/16" ± 1/32" from case . . . . . 230 C for 10 sec

[1] The maximum ratings are limiting absolute values above which the serviceability may be impaired from the viewpoint of life or satisfactory performance. The breakdown voltages may be far above the maximum voltage ratings. To avoid permanent damage to the transistors, do not attempt to measure these characteristics above the maximum ratings.

[2] Due to the nature of these transistors, the dissipation in the base emitter circuit may be appreciable under high base drive conditions and must be included in the total device dissipation. For temperatures above 25 C, derate by 1.3 mw/°C.

MECHANICAL SPECIFICATIONS



NOTE 1: THIS LEAD DIA APPLIES TO ZONE BETWEEN 0.050 AND 0.250 FROM BASE SEAT. IN ZONE BETWEEN 0.250 AND 0.050, A MAX OF 0.021 DIA IS HELD. OUTSIDE OF THESE ZONES, THE LEAD DIA IS NOT CONTROLLED.

DWG NO. A-3806

ELECTRICAL CHARACTERISTICS[3] at T = 25 C

	CHARACTERISTICS	TEST CONDITIONS	MIN.	TYP.	MAX.	UNITS
	D-C CHARACTERISTICS					
I_{CBO}	Collector Cutoff Current	V_{CB} = −10V	—	—	1	nA
I_{CBO}	Collector Cutoff Current	V_{CB} = −10V, T = +65C	—	—	15	nA
I_{EBO}	Emitter Cutoff Current	V_{EB} = −10V	—	—	1	nA
I_{EBO}	Emitter Cutoff Current	V_{EB} = −10V, T = +65C	—	—	15	nA
I_{ECO}	Emitter Current	V_{EC} = −10V	—	—	1	nA
BV_{CBO}	Collector Breakdown Voltage	I_C = −10nA	30	—	—	volts
BV_{CEO}	Collector Breakdown Voltage	I_C = −1μA	30	—	—	volts
BV_{EBO}	Emitter Breakdown Voltage	I_E = −10nA	30	—	—	volts
BV_{ECO}	Emitter Breakdown Voltage	I_E = −10nA	30	—	—	volts
V_{OFF}	Offset Voltage	I_B = −500μA	—	1	1.5	mV
V_{OFF}	Offset Voltage	I_B = −1mA	—	1.2	2.0	mV
V_{OFF}	Offset Voltage	I_B = −1.5mA	—	1.5	2.5	mV
	HIGH FREQUENCY CHARACTERISTICS					
r_s	Inverted Dynamic Saturation Resistance[4]	I_B = −1mA, I_E = 100μA	8	14	20	ohms
C_{ib}	Input Capacitance	V_{EB} = −6V, I_C = 0, f = 4mc	—	4	7	pF
C_{ob}	Output Capacitance	V_{CB} = −6V, I_E = 0, f = 4mc	—	6	9	pF
C_{eb}	Emitter Diode Capacitance[5]	I_E = 0.25μA, f = 10mc	—	12	16	pF
—	Emitter Diode Recovery Time[6]	I_B = −1mA nom.	—	6	15	μsec
f_T	Gain Bandwidth Product	V_{CE} = −6V, I_E = 1mA, f = 4mc	6.5	10	—	mc
	TYPE 2N2187 MATCHED PAIR DATA					
ΔV_{OFF}	Differential Offset Voltage[7]	I_B = −1mA, T_A = +25C to +85C	—	—	50	μV

[3] Typical values are for engineering guidance only.
[4] To be measured in circuit of Figure 1.
[5] To be measured in circuit of Figure 2.
[6] To be measured in circuit of Figure 3.
[7] To be measured in circuit of Figure 4.

"SPAT" is a registered trademark of the Philco Corp.

SPRAGUE ENGINEERING BULLETIN 31,155A

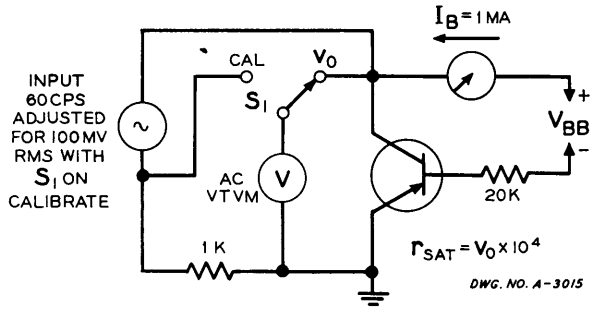


FIGURE 1
INVERTED DYNAMIC r_s TEST CIRCUIT

The inverted dynamic saturation resistance, which is the slope of the V_{OFF}, I_E characteristic at a specified base current, is measured in the circuit shown in Figure 1. The circuit reads r_s directly as the ratio of the a-c collector voltage, V_o to a calibrated a-c collector current.

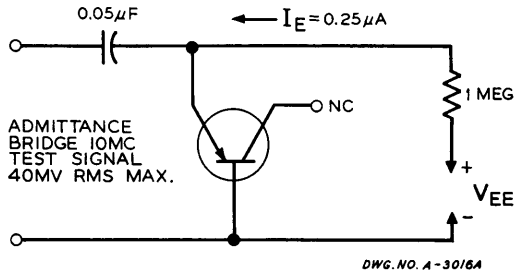


FIGURE 2
EMITTER DIODE CAPACITANCE TEST CIRCUIT

Figure 2 shows the test circuit for the measurement of the emitter diode capacitance, C_{eb}. The measurement is made with the emitter diode slightly forward biased (I_E = 0.25μA). The 10 MC test signal from the admittance bridge should be less than 40 MV RMS.

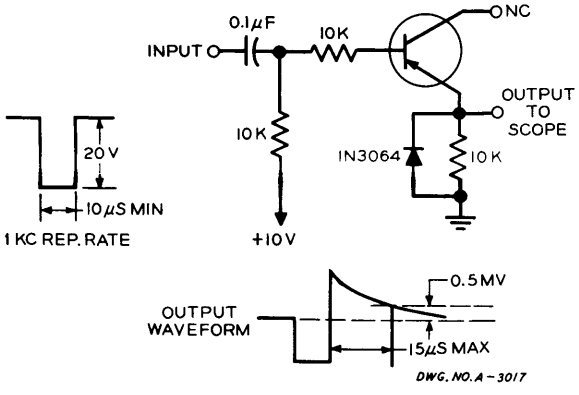


FIGURE 3
RECOVERY TIME TEST CIRCUIT

The emitter diode reverse recovery time, a measure of the transient response of the chopper, is measured in the circuit of Figure 3. The measurement is made as the time for the emitter current to recover from a specified forward value to a specified reverse value. The IN3064 diode across the 10K emitter resistance serves to clamp the emitter potential to reduce the output voltage change to a convenient level.

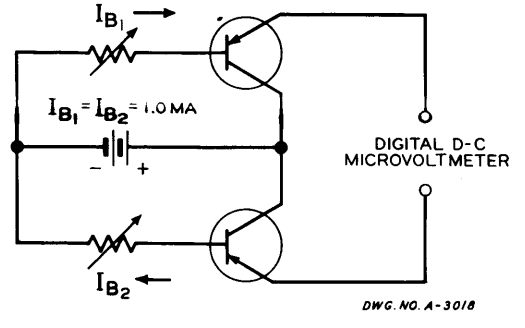


FIGURE 4
MATCHED OFFSET VOLTAGE TEST CIRCUIT

The offset voltage match, ΔV_{OFF}, is measured in the circuit of Figure 4. The difference in the offset voltage at the specified base current is measured with a digital voltmeter.

ISSUE OF JUNE, 1964

LITHO IN U. S. AMER.