BUX32, BUX32A, BUX32B

File Number **1285**

6-A SwitchMax Power Transistors

High-Voltage N-P-N Types for 240 V Off-Line Power Supplies and Other High-Voltage Switching Applications

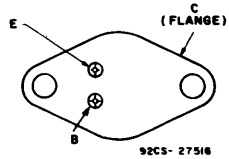
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* V_{CEX} = *450 V — 550 V*
- *Low* V_{CE} *(sat) at* I_C = *6 A*
- *Steel hermetic TO-204AA package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204AA
(200 mil diameter pin isolation)

The BUX32 SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The BUX32-series transistors are supplied in steel JEDEC TO-204AA hermetic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX32	BUX32A	BUX32B	
V_{CEV}				
V_{BE}=-1.5 V	800	900	1000	V
V_{CER} $R_{BE} \leq 10\ \Omega$	800	900	1000	V
V_{CEX} (Clamped)				
V_{BE}=-1.5 V	450	500	550	V
V_{CEO}	400	450	500	V
V_{EBO}	8			V
I_C(sat)	6			A
I_C	8			A
I_{CM}	10			A
I_B	4			A
P_T				
T_C up to 25°C	150			W
T_C above 25°C, derate linearly	1.0			W/°C
T_J	-65 to 175			°C
T_{stg}	-65 to 200			°C
T_L				
At distance ≧ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235			°C

BUX32, BUX32A, BUX32B

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS VOLTAGE V dc V_{CE}	V_{BE}	CURRENT A dc I_C	I_B	LIMITS BUX32 Min.	BUX32 Max.	BUX32A Min.	BUX32A Max.	BUX32B Min.	BUX32B Max.	UNITS
T_C=25°C											
I_{CEV}	800	-1.5			—	0.1	—	—	—	—	mA
	900	-1.5			—	—	—	0.1	—	—	
	1000	-1.5			—	—	—	—	—	0.1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	0.2	—	—	—	—	
	900				—	—	—	0.2	—	—	
	1000				—	—	—	—	—	0.2	
I_{EBO}		-8	0		—	2	—	2	—	2	
$V_{CEO(sus)}$[b]			0.2[a]	0	400	—	450	—	500	—	V
h_{FE}	3		6		8	40	8	40	8	40	
$V_{BE(sat)}$			6	1.2	—	1.3	—	1.3	—	1.3	V
$V_{CE(sat)}$			6	1.2	—	1	—	1	—	1	
			8	2	—	2	—	2	—	2	
V_{CEX}[b] (Clamped $E_{S/b}$) L=170 μH		-5	6	1.2[e]	450	—	500	—	550	—	
$I_{S/b}$	30		5		1	—	1	—	1	—	s
$\|h_{fe}\|$ f=5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
C_{obo} f=0.1 MHz	10[c]				50	250	50	250	50	250	pF
t_d[d]			6	1.2	—	0.1	—	0.1	—	0.1	μs
t_r[d]			6	1.2	—	0.45	—	0.45	—	0.45	
t_s[d]			6	1.2[e]	—	3.0	—	3.0	—	3.0	
t_f[d]			6	1.2[e]	—	0.4	—	0.4	—	0.4	
t_c V_{CC}=250 V, L=170 μH, R_C=50 Ω Collector clamped to V_{CEX}			6	1.2[e]	—	0.4	—	0.4	—	0.4	
T_C=100°C											
I_{CEV}	800	-1.5			—	1	—	—	—	—	mA
	900	-1.5			—	—	—	1	—	—	
	1000	-1.5			—	—	—	—	—	1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	3	—	—	—	—	
	900				—	—	—	3	—	—	
	1000				—	—	—	—	—	3	
$V_{CE(sat)}$			6	1.2	—	1.5	—	1.5	—	1.5	V
t_i[d]			6	1.2	—	0.6	—	0.6	—	0.6	μs
t_s[d]			6	1.2[e]	—	4	—	4	—	4	
t_f[d]			6	1.2[e]	—	0.7	—	0.7	—	0.7	
t_c V_{CC}=250 V, L=170 μH, R_C=50 Ω Collector clamped to V_{CEX}			6	1.2[e]	—	0.8	—	0.8	—	0.8	

BUX32, BUX32A, BUX32B

ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		BUX32		BUX32A		BUX32B		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
$R_{\theta JC}$	10	5			—	1.0	—	1.0	—	1.0	°C/W

[a]Pulsed; pulse duration=300 μs, duty factor ≤ 2%.

[b]CAUTION: The sustaining voltage $V_{CEO}(sus)$ and V_{CEX} MUST NOT be measured on a curve tracer.

[c]V_{CB} value.

[d]V_{CC}=250 V, t_p=20 μs.

[e]I_{B_1}=-I_{B_2}.

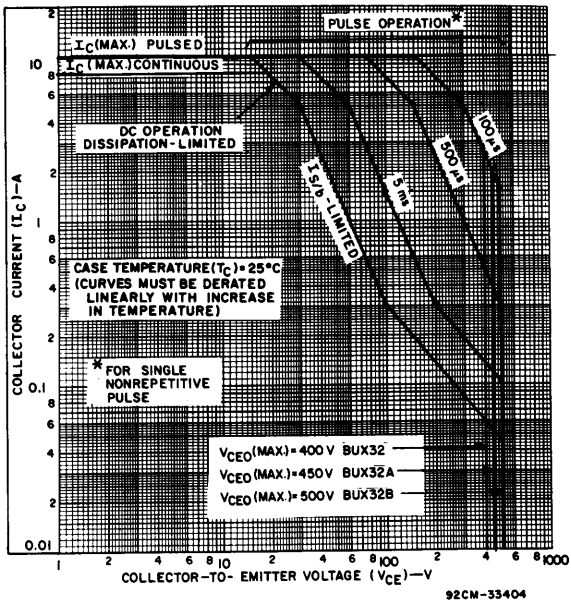


Fig. 1 — Maximum operating areas for all types (T_C).

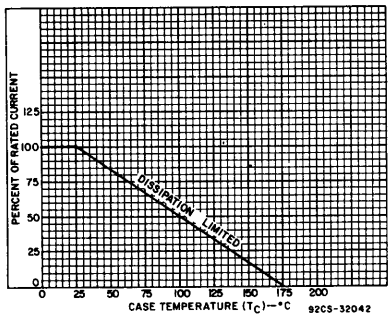


Fig. 2 — Dissipation derating curve for all types.

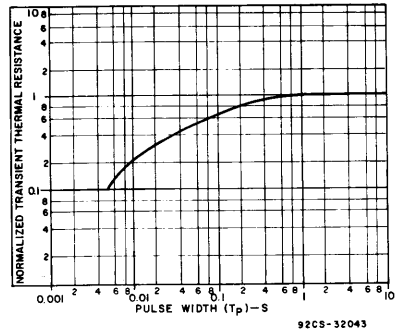


Fig. 3 — Typical thermal-response characteristic for all types.

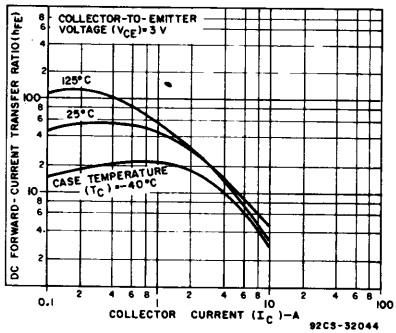


Fig. 4 — Typical dc beta characteristics for all types.

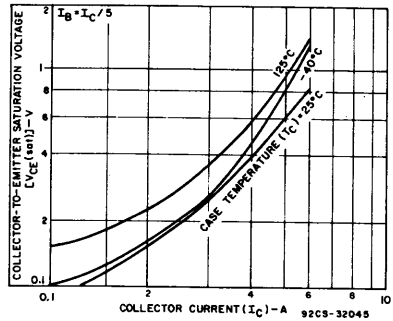


Fig. 5 — Typical collector-to-emitter saturation voltage as a function of collector current for all types.

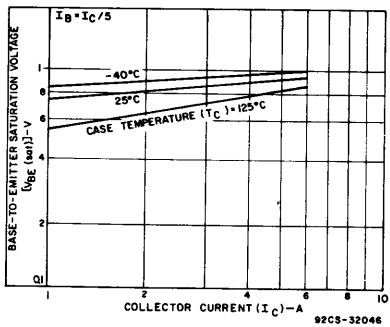


Fig. 6 — Typical base-to-emitter saturation voltage as a function of collector current for all types.

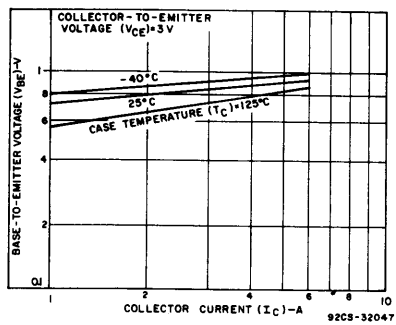


Fig. 7 — Typical base-to-emitter voltage as a function of collector current for all types.

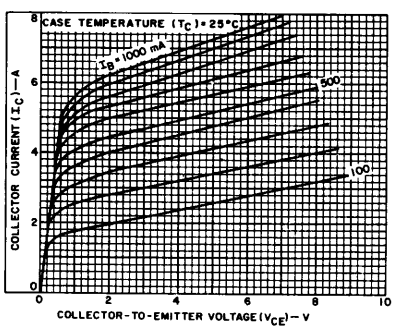


Fig. 8 — Typical output characteristics for all types.

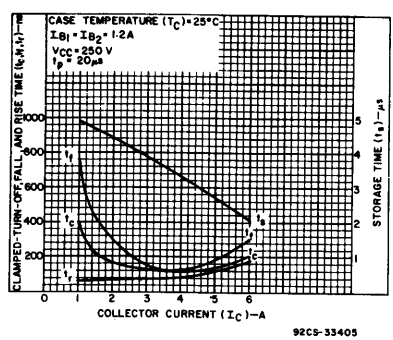


Fig. 9 — Typical saturated switching time characteristics for all types.

BUX32, BUX32A, BUX32B

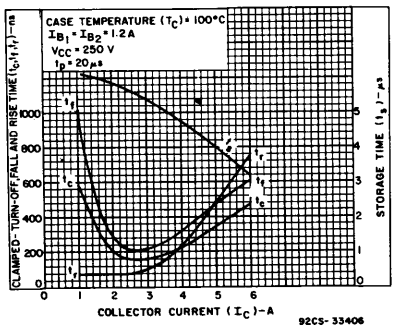


Fig. 10 — Typical saturated switching time characteristics for all types.

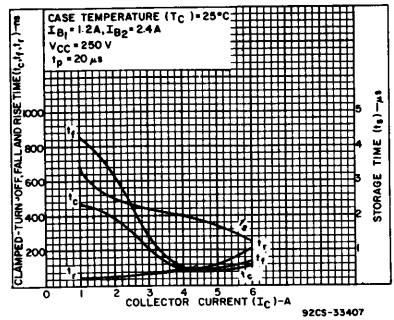


Fig. 11 — Typical saturated switching time characteristics for all types.

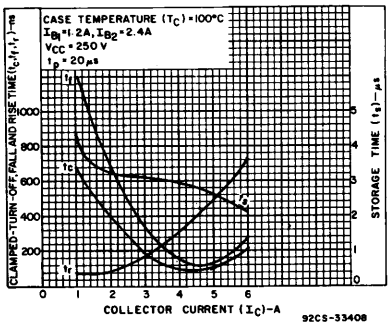


Fig. 12 — Typical saturated switching time characteristics for all types.

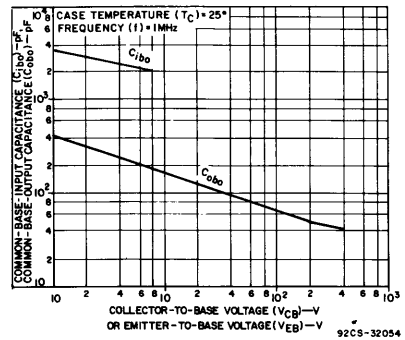


Fig. 13 — Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

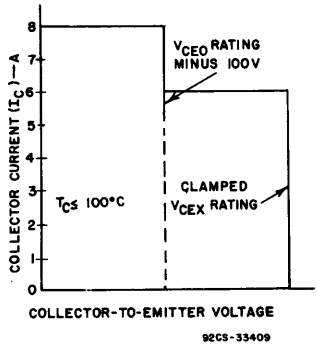


Fig. 14 — Maximum operating conditions for switching between saturation and cutoff.

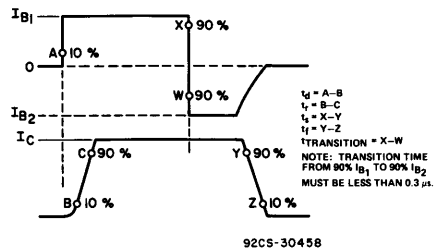


Fig. 15 — Phase relationship between input and output current showing reference points for specification of switching times.

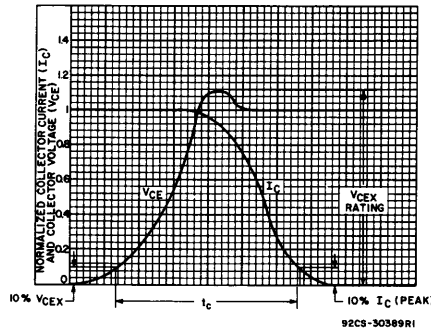


Fig. 16 — Oscilloscope display for measurement of clamped induction switching time (t_c).

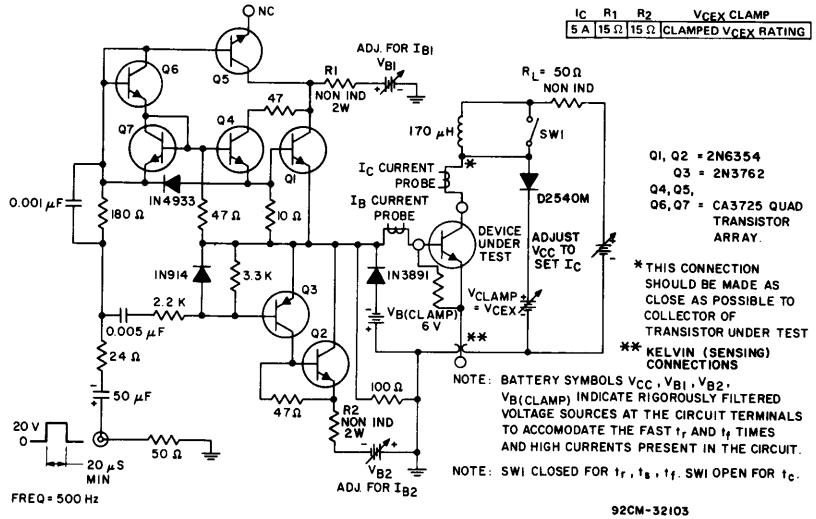


Fig. 17 — Circuit for measuring switching times.

BUX33, BUX33A, BUX33B

File Number **1354**

8-A *SwitchMax* Power Transistors

High-Voltage N-P-N Types for 240 V Off-Line Power Supplies and Other High-Voltage Switching Applications

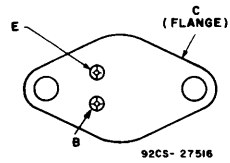
Features:

- *High-temperature parameters guaranteed*
- *Fast switching speed*
- *High voltage ratings:* V_{CEX} *= 450 V — 550 V*
- *Low* V_{CE} *(sat) at* I_C *= 8 A*
- *Steel hermetic TO-204AA package*

Applications:

- *Off-line power supplies*
- *High-voltage inverters*
- *Switching regulators*

TERMINAL DESIGNATIONS



JEDEC TO-204AA

(200 mil diameter pin isolation)

The BUX33 SwitchMax series of silicon n-p-n power transistors feature high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. They are specially designed for use in off-line power supplies and are also well suited for use in a side range of inverter or converter circuits and pulse-width-modulated regulators. These high-voltage, high-speed transistors are 100-per-cent tested for parameters that are essential to the design of industrial high-power switching circuits. Switching times, including inductive turn-off time, and saturation voltages are guaranteed at 100°C to provide information necessary for worst-case design.

The BUX33-series transistors are supplied in steel JEDEC TO-204AA hermetic packages.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX33	BUX33A	BUX33B	
V_{CEV}				
V_{BE} = 1.5 V	800	900	1000	V
V_{CER} $R_{BE} \leq 10\ \Omega$	800	900	1000	V
V_{CEX} (Clamped)				
V_{BE} = −1.5 V	450	500	550	V
V_{CEO}	400	450	500	V
V_{EBO}	8			V
I_C(sat)	8			A
I_C	12			A
I_{CM}	15			A
I_B	4			A
P_T				
T_C up to 25°C	150			W
T_C above 25°C, derate linearly	1.0			W/°C
T_J	−65 to 175			°C
T_{stg}	−65 to 200			°C
T_L				
At distance ≧ 1/16 in. (1.58 mm) from seating plane for 10 s max.	235			°C

ELECTRICAL CHARACTERISTICS

BUX33, BUX33A, BUX33B

CHARACTERISTIC	TEST CONDITIONS				LIMITS						UNITS
	VOLTAGE V dc		CURRENT A dc		BUX33		BUX33A		BUX33B		
	V_{CE}	V_{BE}	I_C	I_B	Min.	Max.	Min.	Max.	Min.	Max.	
$T_C = 25°C$											
I_{CEV}	800	−1.5			—	0.1	—	—	—	—	mA
	900	−1.5			—	—	—	0.1	—	—	
	1000	−1.5			—	—	—	—	—	0.1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	0.2	—	—	—	—	
	900				—	—	—	0.2	—	—	
	1000				—	—	—	—	—	0.2	
I_{EBO}		−8	0		—	2	—	2	—	2	
$V_{CEO(sus)}$[b]			0.2[a]	0	400	—	450	—	500	—	V
h_{FE}	3		8		6	40	6	40	6	40	
$V_{BE(sat)}$			8	2	—	1.3	—	1.3	—	1.3	
$V_{CE(sat)}$			8	2	—	1	—	1	—	1	V
			12	3	—	4	—	4	—	4	
V_{CEX}[b] (Clamped $E_{S/b}$) $L = 170\ \mu H$		−5	8	2	450	—	500	—	550	—	
$I_{S/b}$	30		5		1	—	1	—	1	—	s
$\|h_{fe}\|$ f = 5 MHz	10		0.2		3	12	3	12	3	12	
f_T	10		0.2		15	60	15	60	15	60	MHz
C_{obo} f = 0.1 MHz	10[c]				50	250	50	250	50	250	pF
t_d[d]			8	2	—	0.1	—	0.1	—	0.1	
t_r[d]			8	2	—	0.45	—	0.45	—	0.45	
t_s[d]			8	2[e]	—	3.0	—	3.0	—	3.0	
t_f[d]			8	2[e]	—	0.4	—	0.4	—	0.4	
t_c V_{CC} = 240 V, $L = 170\ \mu H$, $R_C = 30\ \Omega$ Collector clamped to V_{CEX}			8	2[e]	—	0.4	—	0.4	—	0.4	μs
$T_C = 100°C$											
I_{CEV}	800	−1.5			—	1	—	—	—	—	mA
	900	−1.5			—	—	—	1	—	—	
	1000	−1.5			—	—	—	—	—	1	
I_{CER} $R_{BE} \leq 10\ \Omega$	800				—	3	—	—	—	—	
	900				—	—	—	3	—	—	
	1000				—	—	—	—	—	3	
$V_{CE(sat)}$			8	2	—	1.5	—	1.5	—	1.5	V
t_d[d]			8	2	—	0.6	—	0.6	—	0.6	
t_s[d]			8	2[e]	—	4	—	4	—	4	
t_f[d]			8	2[e]	—	0.7	—	0.7	—	0.7	
t_c V_{CC} = 240 V, $L = 170\ \mu H$, $R_C = 30\ \Omega$ Collector clamped to V_{CEX}			8	2[e]	—	0.8	—	0.8	—	0.8	μs
$R\theta_{JC}$	10	5			—	1.0	—	1.0	—	1.0	°C/W

[a] Pulsed; pulse duration = 300 μs, duty factor ≤ 2%.
[b] CAUTION; The sustaining voltage $V_{CEO(sus)}$ and V_{CEX} MUST NOT be measured on a curve tracer.
[c] V_{CB} value.
[d] V_{CC} = 240 V, t_p = 20 μs.
[e] $I_{B1} = -I_{B2}$.

BUX33, BUX33A, BUX33B

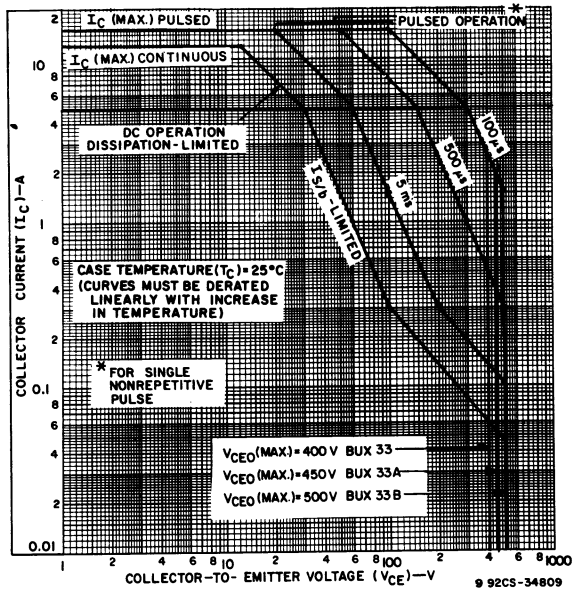


Fig. 1 — Maximum operating areas for all types (T_C).

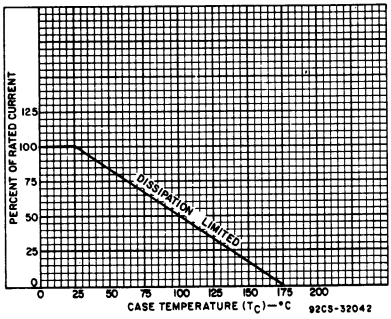


Fig. 2 — Dissipation derating curve for all types.

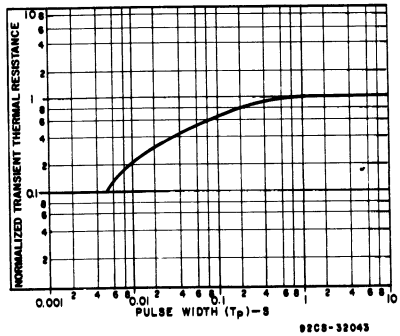


Fig. 3 — Typical thermal-response characteristic for all types.

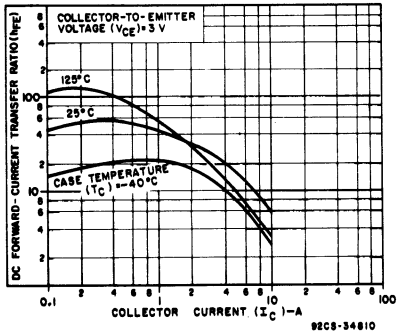


Fig. 4 — Typical dc beta characteristics for all types.

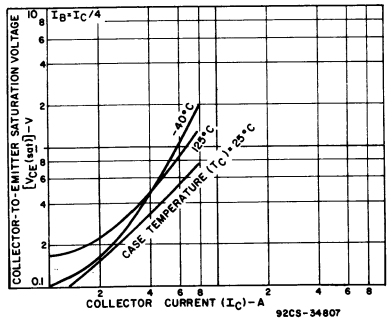


Fig. 5 — Typical collector-to-emitter saturation voltage for all types.

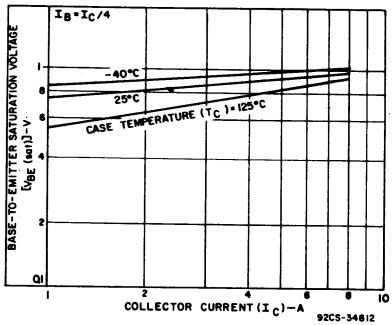


Fig. 6 — Typical base-to-emitter saturation voltage as a function of collector current for all types.

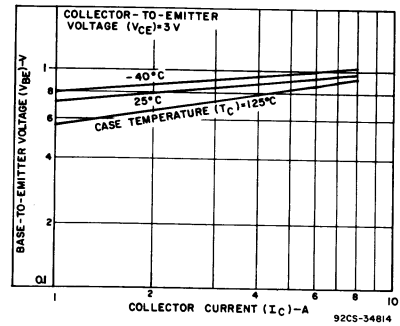


Fig. 7 — Typical base-to-emitter voltage as a function of collector current for all types.

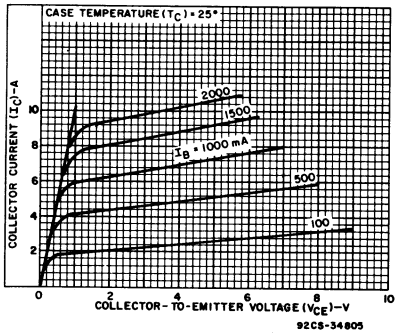


Fig. 8 — Typical output characteristics for all types.

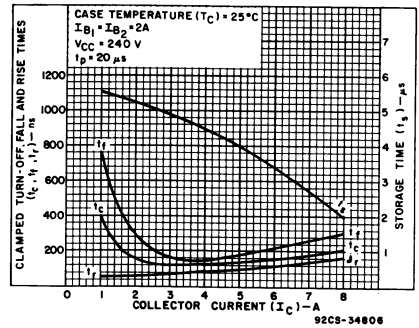


Fig. 9 — Typical saturated switching time characteristics for all types.

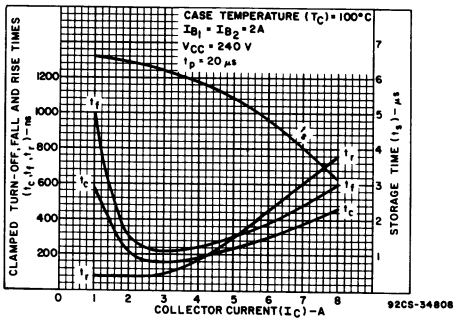


Fig. 10 — Typical saturated switching time characterics for all types.

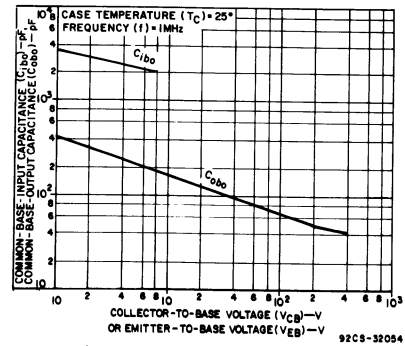


Fig. 11 — Typical common-base input or output capacitance characteristics as a function of collector-to-base voltage or emitter-to-base voltage for all types.

BUX33, BUX33A, BUX33B

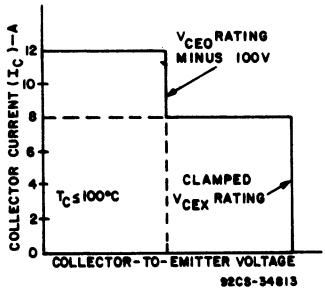


Fig. 12 — Maximum operating conditions for switching between saturation and cutoff.

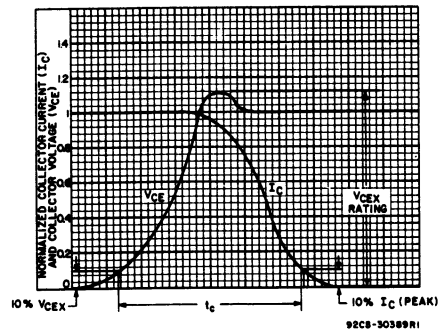


Fig. 13 — Oscilloscope display for measurement of clamped induction switching time (t_c).

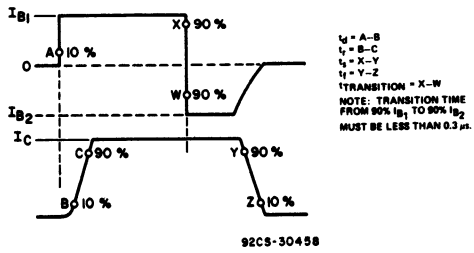


Fig. 14 — Phase relationship between input and output current showing reference points for specification of switching times.

BUX33, BUX33A, BUX33B

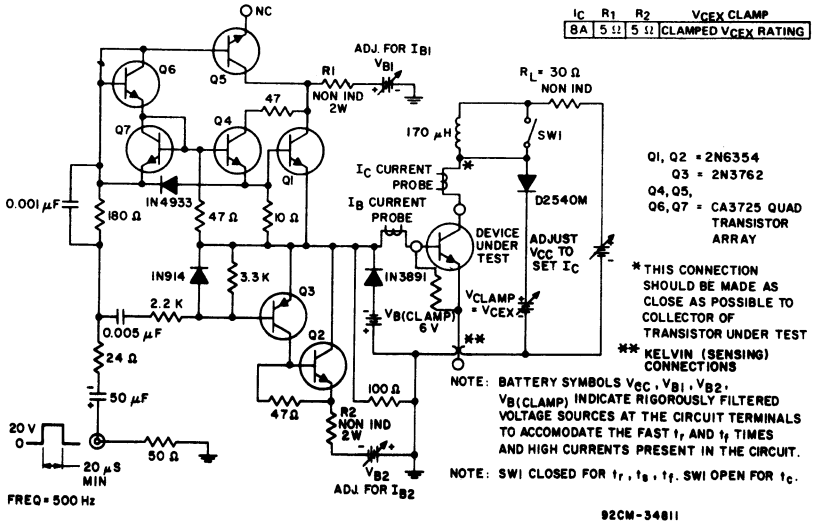


Fig. 15 — Circuit for measuring switching times.

BUX39 File Number **1211**

High-Current, High-Speed, High-Power Silicon N-P-N Planar Transistors

For Switching and Amplifier Applications in Industrial and Commercial Service

Features:

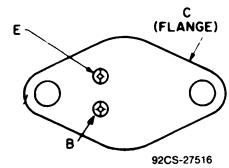
- *Maximum area-of-operation curves for dc and pulse operation - $I_{s/b}$ limit begins at 25 V*
- *Fast turn-on time - 1 μs at I_C = 15 A*
- *High-current capability - h_{FE}, $V_{CE}(sat)$, $V_{BE}(sat)$ measured at I_C = 10 A*

The RCA BUX39 is an epitaxial silicon n-p-n planar transistor that has high current and high power handling capability and fast switching speed.

This device is especially suitable for switching-control amplifiers, power gates, switching regulators, power-switching circuits converters, inverters, control circuits. Other recommended applications include dc-rf amplifiers, and power oscillators.

The BUX39 is supplied in a steel JEDEC TO-204AA hermetic package.

TERMINAL DESIGNATIONS



JEDEC TO-204AA

MAXIMUM RATINGS, *Absolute-Maximum Values:*

V_{CBO}	120 V
V_{CEX}	
V_{BE} = -1.5 V	120 V
V_{CER}	
R_{BE} = 100 Ω	110 V
$V_{CEO}(sus)$	90 V
V_{EBO}	7 V
I_C	30 A
I_{CM}	40 A
I_B	6 A
P_T	
$T_C \leq 25°C$	120 W
$T_C \geq 25°C$, derate linearly	0.68 W/°C
T_{stg}, T_J	-65 to 100°C
T_L	
At distance ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	230°C

BUX39

ELECTRICAL CHARACTERISTICS, *At Case Temperature (T_C) = 25°C unless otherwise specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS			UNITS
	VOLTAGE V dc		CURRENT A dc					
	V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	
I_{CEO}	70				—	—	1	mA
I_{CEX}	120	−1.5			—	—	1	
T_C = 125 °C	120	−1.5			—	—	5	
I_{EBO}		−5	0		—	—	1	
V_{CEO}(sus)[a] L = 25 mH			0.2[b]	0	90	—	—	V
$V_{(BR)EBO}$ I_E = 50 mA			0		7	—	—	
h_{FE}	4		12[b]		15	—	45	
	4		20[b]		8	—	—	
$V_{BE(sat)}$			20[b]	2.5	—	2.1	2.5	V
$V_{CE(sat)}$			12[b]	1.2	—	0.7	1.2	
			20[b]	2.5	—	1.25	1.6	
$I_{S/b}$ t = 1 s	45				1	—	—	A
	30				4	—	—	
f_T	15		1		8	—	—	MHz
t_{ON} $t_d + t_r$	V_{CC} =		20	2.5	—	0.8	1.5	μS
t_s	30 V		20	2.5[c]	—	0.55	1	
t_f			20	2.5[c]		0.15	0.3	
$R_{\theta JC}$					—	—	1.46	°C/W

A CAUTION: The sustaining voltage V_{CEO}(sus) *MUST NOT* be measured on a curve tracer.

b Pulsed; pulse duration ≤ 300 μS, duty factor ≤ 2%.

c $I_{B_1} = -I_{B_2}$.

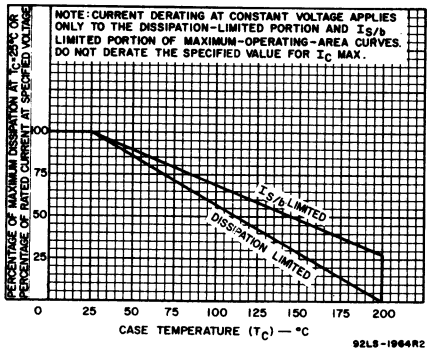


Fig. 1 - Derating curves.

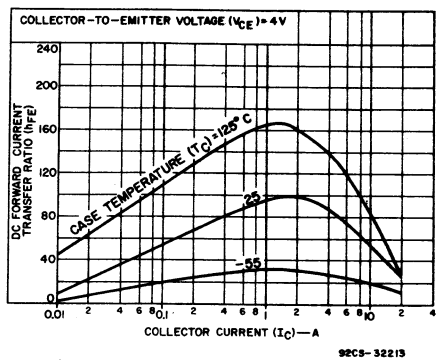


Fig. 2 - Typical DC beta characteristics.

BUX39

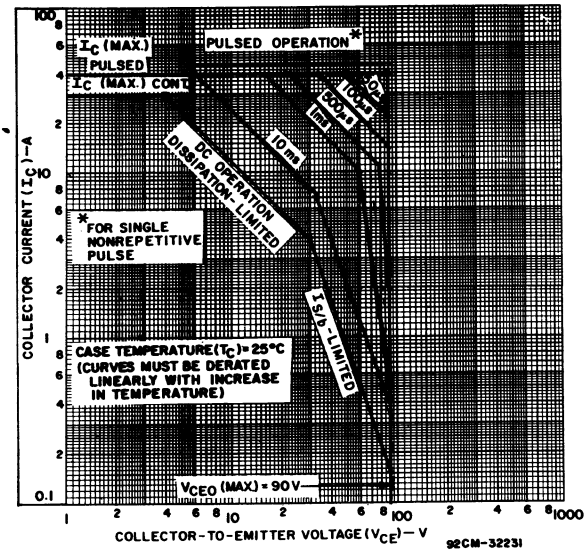


Fig. 3 - Maximum operating areas.

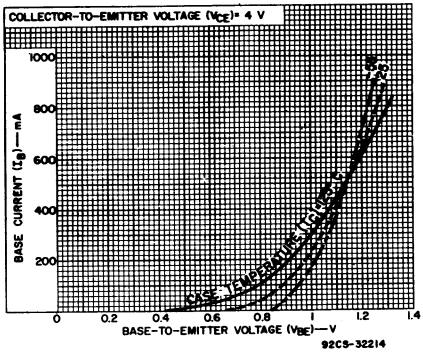


Fig. 4 - Typical input characteristics.

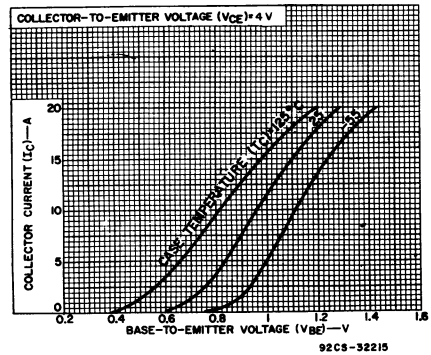


Fig. 5 - Typical transfer characteristics.

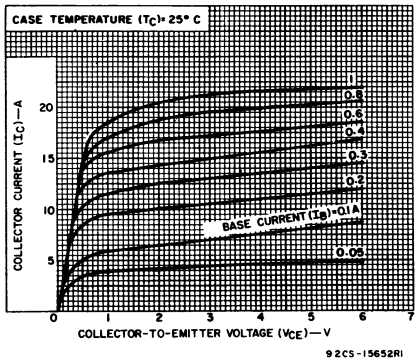


Fig. 6 - Typical output characteristics.

File Number **1231**

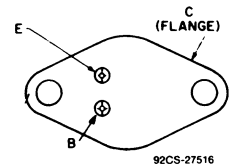
BUX45

High-Voltage, High-Power Silicon N-P-N Power-Switching Transistors

Features:

- V_{CEO} — 500V
- I_C — 5A
- P_T — 120W

TERMINAL DESIGNATIONS



JEDEC TO-204AA

The RCA-BUX45 is an epitaxial-base silicon n-p-n transistor having high-voltage capability, fast switching speeds, and low saturation voltages, together with high safe-operating-area (SOA) ratings. It is specially designed for use in off-line power supplies and is also well suited for use in a wide range of inverter or converter circuits and pulse-width-modulated regulators.

The RCA-BUX45 is supplied in a steel JEDEC TO-204AA hermetic package.

MAXIMUM RATINGS, *Absolute-Maximum Values:*

	BUX45	
V_{CBO}	500	V
V_{CER}		
R_{BE} = 100Ω	500	V
V_{CEO}	500	V
V_{CEX}		
V_{BE} = -1.5V	500	V
V_{EBO}	7	V
I_C	5	A
I_{CM}	7	A
I_B	1	A
P_T		
$I_C \leq 25°C$	120	W
$T_C > 25°C$ derate linearly	0.69	W/°C
T_{stg}, T_J	-65 to +200	°C
T_L		
At distances ≥ 1/32 in. (0.8 mm) from seating plane for 10 s max.	235	°C

BUX45

ELECTRICAL CHARACTERISTICS, *Case Temperature (T_C) = 25°C Unless Otherwise Specified*

CHARACTERISTIC	TEST CONDITIONS				LIMITS			UNITS
	VOLTAGE V dc		CURRENT A dc		BUX45			
	V_{CE}	V_{BE}	I_C	I_B	Min.	Typ.	Max.	
I_{CEO}	400			0	—	—	1	mA
I_{CEX}	500	—1.5			—	—	1	
T_C = 125°C	500	—1.5			—	—	5	
I_{EBO}		—5	0		—	—	1	
$V_{CEO(sus)}$[b]			0.2[a]	0	500	—	—	V
$V_{(BR)EBO}$ I_E = 50 mA			0		7	—	—	
h_{FE}	4		1[a]		15	—	45	
	4		2[a]		8	—	—	
$V_{BE(sat)}$			2[a]	0.4	—	0.8	2	V
$V_{CE(sat)}$			1[a]	0.125	—	0.15	1	
			2[a]	0.4	—	0.15	2	
f_T	15		1		8	—	—	MHz
$I_{S/b}$	135				0.15	—	—	A
t = 1s, nonrepetitive	30				4	—	—	
t_{ON}	V_{CC}		2	0.4	—	0.4	1	μs
t_s $I_{B1} = I_{B2}$	=		2	0.4	—	3.5	5	
t_f $I_{B1} = I_{B2}$	100 V		2	0.4	—	0.6	1.2	
$R_{\theta JC}$					—	—	1.46	°C/W

[a] Pulsed; pulse duration = 300 μs, duty factor ≤ 2%.

[b] **CAUTION:** The sustaining voltage V_{CEO}(sus) *MUST NOT* be measured on a curve tracer.

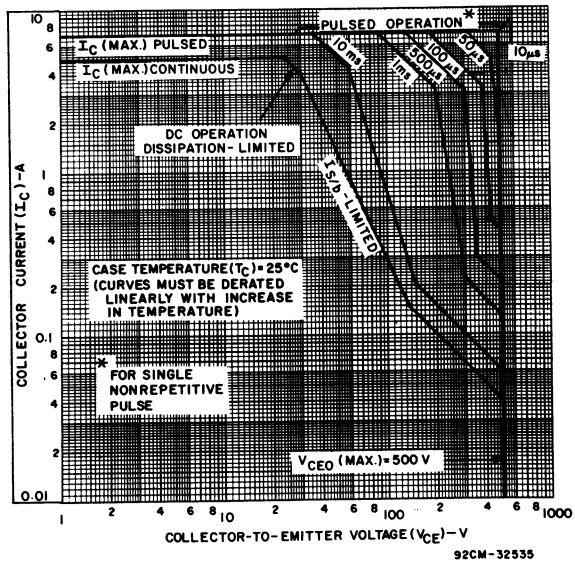


Fig. 1 — Maximum safe-operating areas (T_C =25°C).

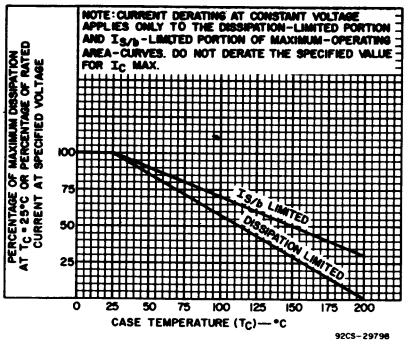


Fig. 2 — Derating curves for $I_{S/b}$ and dissipation.

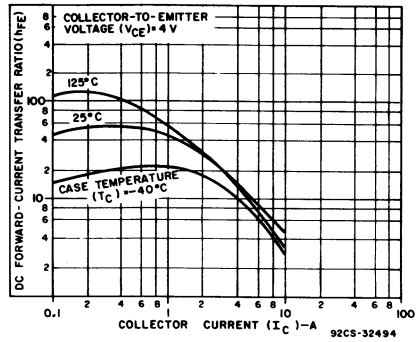


Fig. 3 — Typical dc beta characteristics.

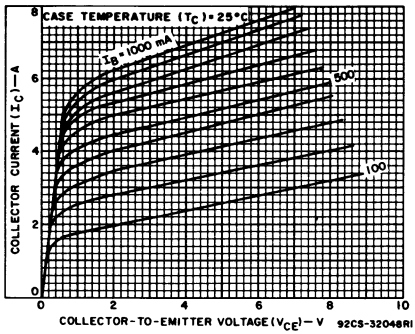


Fig. 4 — Typical output characteristics.

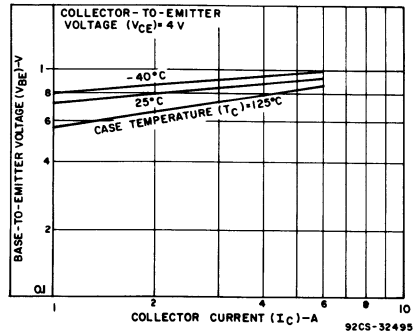


Fig. 5 — Typical base-to-emitter voltage as a function of collector current.

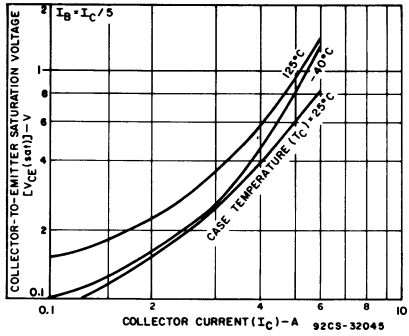


Fig. 6 — Typical collector-to-emitter saturation voltage as a function of collector current.

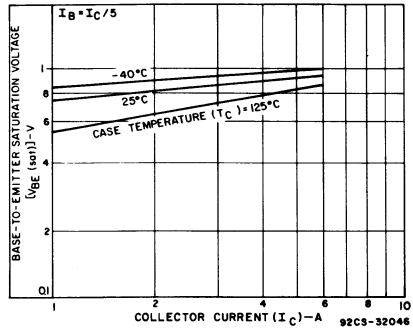


Fig. 7 — Typical base-to-emitter saturation voltage as a function of collector current.

BUX45

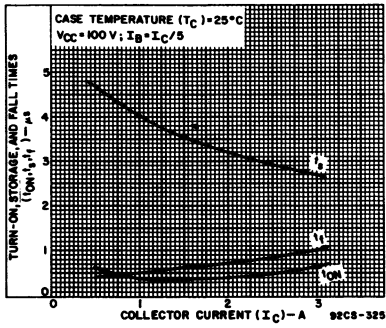


Fig. 8 — Typical saturated-switching times as a function of collector current.

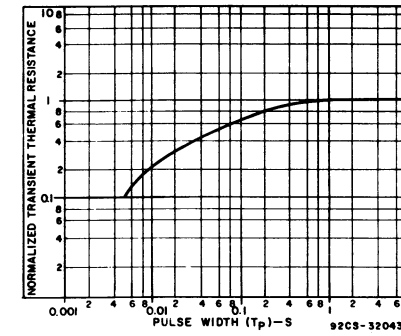


Fig. 9 — Typical thermal-response characteristic.