

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CE}	40	Vdc
Collector-Base Voltage	V_{CB}	50	Vdc
Emitter-Base Voltage	V_{EB}	5.0	Vdc
Collector Current — Continuous	I_C	100	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225 1.8	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	°C/mW
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300 2.4	mW mW/°C
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	°C/mW
Junction and Storage Temperature	T_J, T_{stg}	150	°C

*FR-5 = 1.0 x 0.75 x 0.62 in.

**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

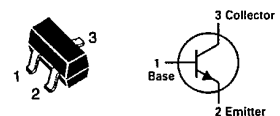
MMBC1623L3 = L3; MMBC1623L4 = L4; MMBC1623L5 = L5;
MMBC1623L6 = L6; MMBC1623L7 = L7

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

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector Cutoff Current ($V_{CB} = 40\text{ Vdc}, I_E = 0$)	I_{CBO}	—	100	nAdc
Emitter Cutoff Current ($V_{EB} = 5.0\text{ Vdc}, I_C = 0$)	I_{EBO}	—	100	nAdc
ON CHARACTERISTICS				
DC Current Gain ($I_C = 1.0\text{ mAdc}, V_{CE} = 6.0\text{ Vdc}$)	h_{FE}	60 90 135 200 300	120 180 270 400 600	—
Collector-Emitter Saturation Voltage ($I_C = 100\text{ mAdc}, I_B = 10\text{ mAdc}$)	$V_{CE(sat)}$	—	0.3	Vdc
Base-Emitter Saturation Voltage ($I_C = 100\text{ mA}, I_B = 10\text{ mAdc}$)	$V_{BE(sat)}$	—	1.0	Vdc
Base-Emitter On Voltage ($I_C = 1.0\text{ mAdc}, V_{CE} = 6.0\text{ Vdc}$)	$V_{BE(on)}$	.60	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Current-Gain — Bandwidth Product ($V_{CE} = 6.0\text{ Vdc}, I_E = 10\text{ mAdc}, f = 100\text{ MHz}$)	f_T	200	—	MHz

T-29-15
MMBC1623L3,4,5,6,7

CASE 318-02/03, STYLE 6
SOT-23 (TO-236AA/AB)



AMPLIFIER TRANSISTOR

NPN SILICON

Refer to MPS3904 for graphs.

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CEO}	130	Vdc
Collector-Base Voltage	V_{CBO}	150	Vdc
Emitter-Base Voltage	V_{EBO}	5.0	Vdc
Collector Current — Continuous	I_C	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
		1.8	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
		2.4	mW/ $^\circ\text{C}$
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{mW}$
Junction and Storage Temperature	T_J, T_{stg}	150	$^\circ\text{C}$

*FR-5 = 1.0 x 0.75 x 0.62 in.

**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MMBC1653N2 = N2; MMBC1653N3 = N3; MMBC1653N4 = N4

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

Characteristic	Symbol	Min	Typ	Max	Unit
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OFF CHARACTERISTICS

Collector Cutoff Current ($V_{CB} = 100\text{ Vdc}, I_E = 0$)	I_{CBO}	—	—	0.1	μAdc
Emitter Cutoff Current ($V_{EB} = 5.0\text{ Vdc}, I_C = 0$)	I_{EBO}	—	—	0.1	μAdc

ON CHARACTERISTICS

DC Current Gain ($V_{CE} = 3.0\text{ Vdc}, I_C = 15\text{ mAdc}$)	h_{FE}	50 100 150	— — —	130 220 330	—
Collector-Emitter Saturation Voltage ($I_C = 10\text{ mAdc}, I_B = 1.0\text{ mAdc}$)	$V_{CE(sat)}$	—	—	0.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 10\text{ mAdc}, I_B = 1.0\text{ mAdc}$)	$V_{BE(sat)}$	—	—	1.0	Vdc

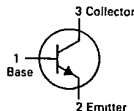
SMALL-SIGNAL CHARACTERISTICS

Current-Gain — Bandwidth Product ($V_{CE} = 10\text{ Vdc}, I_F = 10\text{ mAdc}, f = 100\text{ MHz}$)	f_T	—	150	—	MHz
Output Capacitance ($V_{CB} = 10\text{ Vdc}, I_E = 0, f = 1.0\text{ MHz}$)	C_{obo}	—	4.5	—	pF

T-29-15

MMBC1653N2,3,4

CASE 318-02/03, STYLE 6
SOT-23 (TO-236AA/AB)



HIGH VOLTAGE TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CE}	160	Vdc
Collector-Base Voltage	V_{CB}	180	Vdc
Emitter-Base Voltage	V_{EB}	5.0	Vdc
Collector Current — Continuous	I_C	50	mA

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	1.8	$^\circ\text{C}/\text{mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	2.4	$^\circ\text{C}/\text{mW}$
Junction and Storage Temperature	T_J, T_{stg}	150	$^\circ\text{C}$

*FR-5 = $1.0 \times 0.75 \times 0.62$ in.

**Alumina = $0.4 \times 0.3 \times 0.024$ in. 99.5% alumina.

DEVICE MARKING

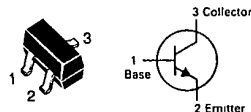
MMBC1654N5 = N5; MMBC1654N6 = N6; MMBC1654N7 = N7

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

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Collector Cutoff Current ($V_{CB} = 100\text{ V}, I_E = 0$)	I_{CBO}	—	—	0.1	μA
Emitter Cutoff Current ($V_{EB} = 5.0\text{ Vdc}, I_C = 0$)	I_{EBO}	—	—	0.1	μA
ON CHARACTERISTICS					
DC Current Gain ($V_{CE} = 3.0\text{ V}, I_C = 15\text{ mA}$)	h_{FE}	50 100 150	— — —	130 220 330	—
Collector-Emitter Saturation Voltage ($I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$)	$V_{CE(sat)}$	—	—	0.5	Vdc
Base-Emitter Saturation Voltage ($I_C = 10\text{ mA}, I_B = 1.0\text{ mA}$)	$V_{BE(sat)}$	—	—	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product ($V_{CE} = 10\text{ Vdc}, I_F = 10\text{ mA}, f = 100\text{ MHz}$)	f_T	—	150	—	MHz
Output Capacitance ($V_{CB} = 10\text{ Vdc}, I_E = 0, f = 1.0\text{ MHz}$)	C_{obo}	—	4.5	—	pF

MMBC1654N5,6,7

**CASE 318-02/03, STYLE 6
SOT-23 (TO-236AA/AB)**



HIGH VOLTAGE TRANSISTOR

NPN SILICON

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	30	Vdc
Drain-Gate Voltage	V_{DG}	30	Vdc
Gate-Source Voltage	V_{GS}	30	Vdc
Gate Current	I_G	10	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	225	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^\circ\text{C}/\text{mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	300	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^\circ\text{C}/\text{mW}$
Junction and Storage Temperature	T_J, T_{stg}	150	$^\circ\text{C}$

*FR-5 = 1.0 x 0.75 x 0.62 in.

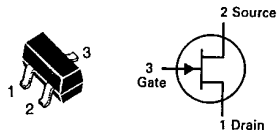
**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MMBF4416 = 6A

MMBF4416

CASE 318-02/03, STYLE 10
SOT-23 (TO-236AA/AB)



JFET
VHF/UHF AMPLIFIER TRANSISTOR
N-CHANNEL

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Gate-Source Breakdown Voltage ($I_G = 1.0 \mu\text{Adc}$, $V_{DS} = 0$)	$V_{(BR)GSS}$	30	—	Vdc
Gate Reverse Current ($V_{GS} = 20 \text{ Vdc}$, $V_{DS} = 0$) ($V_{GS} = 20 \text{ Vdc}$, $V_{DS} = 0$, $T_A = 150^\circ\text{C}$)	I_{GSS}	— —	1.0 200	nAdc nAdc
Gate Source Cutoff Voltage ($I_D = 1.0 \text{ mAdc}$, $V_{DS} = 15 \text{ Vdc}$)	$V_{GS(off)}$	—	6.0	Vdc
Gate Source Voltage ($I_D = 0.5 \text{ mAdc}$, $V_{DS} = 15 \text{ Vdc}$)	V_{GS}	1.0	5.5	Vdc

ON CHARACTERISTICS

Zero-Gate-Voltage Drain ($V_{GS} = 15 \text{ Vdc}$, $V_{GS} = 0$)	I_{DSS}	5.0	15	mAdc
Gate-Source Forward Voltage ($I_G = 1.0 \text{ mAdc}$, $V_{DS} = 0$)	$V_{GS(f)}$	—	1.0	Vdc

SMALL-SIGNAL CHARACTERISTICS

Forward Transfer Admittance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 1.0 \text{ kHz}$)	$ Y_{fs} $	4500	7500	μmhos
Output Admittance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 1.0 \text{ kHz}$)	$ Y_{os} $	—	50	μmhos
Input Capacitance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 1.0 \text{ MHz}$)	C_{iss}	—	4.0	pF
Reverse Transfer Capacitance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 1.0 \text{ MHz}$)	C_{rss}	—	0.8	pF
Output Capacitance ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$, $f = 1.0 \text{ MHz}$)	C_{oss}	—	2.0	pF

FUNCTIONAL CHARACTERISTICS

Noise Figure ($V_{DS} = 15 \text{ Vdc}$, $I_D = 5.0 \text{ mAdc}$, $R_g \approx 1000 \Omega$, $f = 100 \text{ MHz}$) ($V_{DS} = 15 \text{ Vdc}$, $I_D = 5.0 \text{ mAdc}$, $R_g = 1000 \Omega$, $f = 400 \text{ MHz}$)	NF	— —	2.0 4.0	dB
Common Source Power Gain ($V_{DS} = 15 \text{ Vdc}$, $I_D = 5.0 \text{ mAdc}$, $f = 100 \text{ MHz}$) ($V_{DS} = 15 \text{ Vdc}$, $I_D = 5.0 \text{ mAdc}$, $f = 400 \text{ MHz}$)	G_{ps}	18 10	— —	dB

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Drain-Source Voltage	V_{DS}	30	Vdc
Drain-Gate Voltage	V_{DG}	30	Vdc
Reverse Gate-Source Voltage	$V_{GS(r)}$	30	Vdc
Forward Gate Current	$I_{G(f)}$	50	mAdc

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation FR-5 Board,* $T_A = 25^{\circ}\text{C}$ Derate above 25°C	P_D	225	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	556	$^{\circ}\text{C}/\text{mW}$
Total Device Dissipation Alumina Substrate,** $T_A = 25^{\circ}\text{C}$ Derate above 25°C	P_D	300	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	417	$^{\circ}\text{C}/\text{mW}$
Junction and Storage Temperature	T_J, T_{stg}	150	$^{\circ}\text{C}$

*FR-5 = 1.0 x 0.75 x 0.62 in.

**Alumina = 0.4 x 0.3 x 0.024 in. 99.5% alumina.

DEVICE MARKING

MMBF4860 = 6F

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

Characteristic	Symbol	Min	Max	Unit
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OFF CHARACTERISTICS

Gate-Source Breakdown Voltage ($I_G = 1.0 \mu\text{Adc}$, $V_{DS} = 0$)	$V_{(BR)GSS}$	30	—	Vdc
Gate Reverse Current ($V_{GS} = 15 \text{ Vdc}$, $V_{DS} = 0$) ($V_{GS} = 15 \text{ Vdc}$, $V_{DS} = 0$, $T_A = 150^{\circ}\text{C}$)	I_{GSS}	—	0.5 2.0	nAdc μAdc
Gate Source Cutoff Voltage ($V_{DS} = 15 \text{ Vdc}$, $I_D = 0.5 \text{ nAdc}$)	$V_{GS(off)}$	2.0	6.0	Vdc

ON CHARACTERISTICS

Zero-Gate-Voltage Drain(1) ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 0$)	I_{DSS}	20	100	mAdc
Drain Cutoff Current ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 10 \text{ Vdc}$) ($V_{DS} = 15 \text{ Vdc}$, $V_{GS} = 10 \text{ Vdc}$, $T_A = 150^{\circ}\text{C}$)	$I_{D(off)}$	—	0.25 0.5	nAdc μAdc
Drain-Source On-Voltage ($I_D = 10 \text{ mAdc}$, $V_{GS} = 0$)	$V_{DS(on)}$	—	0.5	Vdc
Static Drain-Source On Resistance ($V_{GS} = 0$, $I_D = 0$, $f = 1.0 \text{ kHz}$)	$r_{DS(on)}$	—	40	Ohms
Input Capacitance ($V_{DS} = 0$, $V_{GS} = 10 \text{ Vdc}$, $f = 1.0 \text{ MHz}$)	C_{iss}	—	18	pF
Reverse Transfer Capacitance ($V_{DS} = 0$, $V_{GS} = 10 \text{ Vdc}$, $f = 1.0 \text{ MHz}$)	C_{rss}	—	8.0	pF

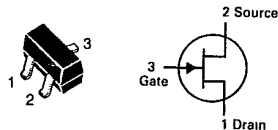
SWITCHING CHARACTERISTICS

Delay Time ($V_{DD} = 10 \text{ Vdc}$, $I_{D(on)} = 20 \text{ mAdc}$) ($V_{G(on)} = 0$, $V_{GS(off)} = 10 \text{ Vdc}$)	t_d	—	6.0	ns
Rise Time ($V_{DD} = 10 \text{ Vdc}$, $I_{D(on)} = 10 \text{ mAdc}$) ($V_{GS(on)} = 0$, $V_{GS(off)} = 6.0 \text{ Vdc}$) (Figure 1)	t_r	—	4.0	ns
Turn-Off Time ($V_{DD} = 10 \text{ Vdc}$, $I_{D(on)} = 5.0 \text{ mAdc}$) ($V_{GS(on)} = 0$, $V_{GS(off)} = 4.0 \text{ Vdc}$) (Figure 1)	t_{off}	—	50	ns

(1) Pulse Test: Pulse Width = 100 ms, Duty Cycle $\leq 10\%$.

MMBF4860

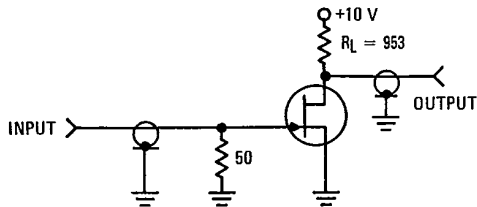
CASE 318-02/03, STYLE 10
SOT-23 (TO-236AA/AB)



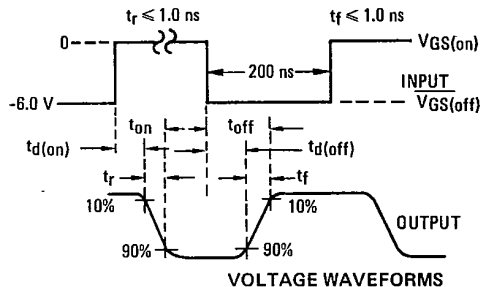
JFET
SWITCHING TRANSISTOR

N-CHANNEL

FIGURE 1 — SWITCHING TIMES TEST CIRCUIT



TEST CIRCUIT



NOTES: 1. The input waveforms are supplied by a generator with the following characteristics:

$Z_{out} = 50 \text{ ohms}$, Duty Cycle $\approx 2.0\%$

2. Waveforms are monitored on an oscilloscope with the following characteristics:

$t_r \leq 0.75 \text{ ns}$, $R_{in} \geq 1.0 \text{ megohm}$, $C_{in} \leq 2.5 \text{ pF}$.