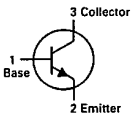
T-29-15

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}	40	Vdc
Collector-Base Voltage	V_{CBO}	50	Vdc
Emitter-Base Voltage	V_{EBO}	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°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°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°C unless otherwise noted.)

Characteristic		Symbol	Min	Max	Unit
OFF CHARACTERISTICS					
Collector Cutoff Current (V_{CB} = 40 Vdc, I_E = 0)		I_{CBO}	—	100	nAdc
Emitter Cutoff Current (V_{EB} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	100	nAdc
ON CHARACTERISTICS					
DC Current Gain (I_C = 1.0 mAdc, V_{CE} = 6.0 Vdc)	MMBC1623L3	h_{FE}	60	120	—
	MMBC1623L4		90	180	
	MMBC1623L5		135	270	
	MMBC1623L6		200	400	
	MMBC1623L7		300	600	
Collector-Emitter Saturation Voltage (I_C = 100 mAdc, I_B = 10 mAdc)		$V_{CE(sat)}$	—	0.3	Vdc
Base-Emitter Saturation Voltage (I_C = 100 mA, I_B = 10 mAdc)		$V_{BE(sat)}$	—	1.0	Vdc
Base-Emitter On Voltage (I_C = 1.0 mAdc, V_{CE} = 6.0 Vdc)		$V_{BE(on)}$	.60	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Current-Gain — Bandwidth Product (V_{CE} = 6.0 Vdc, I_E = 10 mAdc, f = 100 MHz)		f_T	200	—	MHz

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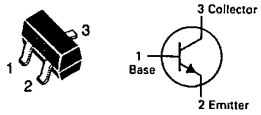
MMBC1653N2,3,4

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_{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°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°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

MMBC1653N2 = N2; MMBC1653N3 = N3; MMBC1653N4 = N4

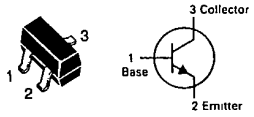
ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector Cutoff Current (V_{CB} = 100 Vdc, I_E = 0)		I_{CBO}	—	—	0.1	μAdc
Emitter Cutoff Current (V_{EB} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	—	0.1	μAdc
ON CHARACTERISTICS						
DC Current Gain (V_{CE} = 3.0 Vdc, I_C = 15 mAdc)	MMBC1653N2 MMBC1653N3 MMBC1653N4	h_{FE}	 50 100 150	 — — —	 130 220 330	—
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)		$V_{CE(sat)}$	—	—	0.5	Vdc
Base-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)		$V_{BE(sat)}$	—	—	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (V_{CE} = 10 Vdc, I_E = 10 mAdc, f = 100 MHz)		f_T	—	150	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	—	4.5	—	pF

T-29-15

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
Collector-Emitter Voltage	V_{CEO}	160	Vdc
Collector-Base Voltage	V_{CBO}	180	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°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°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

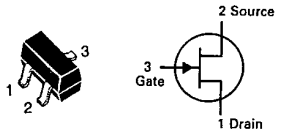
MMBC1654N5 = N5; MMBC1654N6 = N6; MMBC1654N7 = N7

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic		Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector Cutoff Current (V_{CB} = 100 V, I_E = 0)		I_{CBO}	—	—	0.1	μAdc
Emitter Cutoff Current (V_{EB} = 5.0 Vdc, I_C = 0)		I_{EBO}	—	—	0.1	μAdc
ON CHARACTERISTICS						
DC Current Gain (V_{CE} = 3.0 V, I_C = 15 mAdc)	MMBC1654N5 MMBC1654N6 MMBC1654N7	h_{FE}	50 100 150	— — —	130 220 330	—
Collector-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)		$V_{CE(sat)}$	—	—	0.5	Vdc
Base-Emitter Saturation Voltage (I_C = 10 mAdc, I_B = 1.0 mAdc)		$V_{BE(sat)}$	—	—	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS						
Current-Gain — Bandwidth Product (V_{CE} = 10 Vdc, I_F = 10 mAdc, f = 100 MHz)		f_T	—	150	—	MHz
Output Capacitance (V_{CB} = 10 Vdc, I_E = 0, f = 1.0 MHz)		C_{obo}	—	4.5	—	pF

MMBF4416

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



JFET
VHF/UHF AMPLIFIER TRANSISTOR
N-CHANNEL

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°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°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

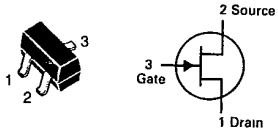
MMBF4416 = 6A

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Gate-Source Breakdown Voltage (I_G = 1.0 μAdc, V_{DS} = 0)	$V_{(BR)GSS}$	30	—	Vdc
Gate Reverse Current (V_{GS} = 20 Vdc, V_{DS} = 0) (V_{GS} = 20 Vdc, V_{DS} = 0, T_A = 150°C)	I_{GSS}	— —	1.0 200	nAdc nAdc
Gate Source Cutoff Voltage (I_D = 1.0 nAdc, V_{DS} = 15 Vdc)	$V_{GS(off)}$	—	6.0	Vdc
Gate Source Voltage (I_D = 0.5 mAdc, V_{DS} = 15 Vdc)	V_{GS}	1.0	5.5	Vdc
ON CHARACTERISTICS				
Zero-Gate-Voltage Drain (V_{GS} = 15 Vdc, V_{GS} = 0)	I_{DSS}	5.0	15	mAdc
Gate-Source Forward Voltage (I_G = 1.0 mAdc, V_{DS} = 0)	$V_{GS(f)}$	—	1.0	Vdc
SMALL-SIGNAL CHARACTERISTICS				
Forward Transfer Admittance (V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 kHz)	$\|Y_{fs}\|$	4500	7500	μmhos
Output Admittance (V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 kHz)	$\|Y_{os}\|$	—	50	μmhos
Input Capacitance (V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{iss}	—	4.0	pF
Reverse Transfer Capacitance (V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{rss}	—	0.8	pF
Output Capacitance (V_{DS} = 15 Vdc, V_{GS} = 0, f = 1.0 MHz)	C_{oss}	—	2.0	pF
FUNCTIONAL CHARACTERISTICS				
Noise Figure (V_{DS} = 15 Vdc, I_D = 5.0 mAdc, $R_g \approx$ 1000 Ω, f = 100 MHz) (V_{DS} = 15 Vdc, I_D = 5.0 mAdc, $R_g \approx$ 1000 Ω, f = 400 MHz)	NF	— —	2.0 4.0	dB
Common Source Power Gain (V_{DS} = 15 Vdc, I_D = 5.0 mAdc, f = 100 MHz) (V_{DS} = 15 Vdc, I_D = 5.0 mAdc, f = 400 MHz)	G_{ps}	18 10	— —	dB

MMBF4860

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



JFET
SWITCHING TRANSISTOR

N-CHANNEL

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°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°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

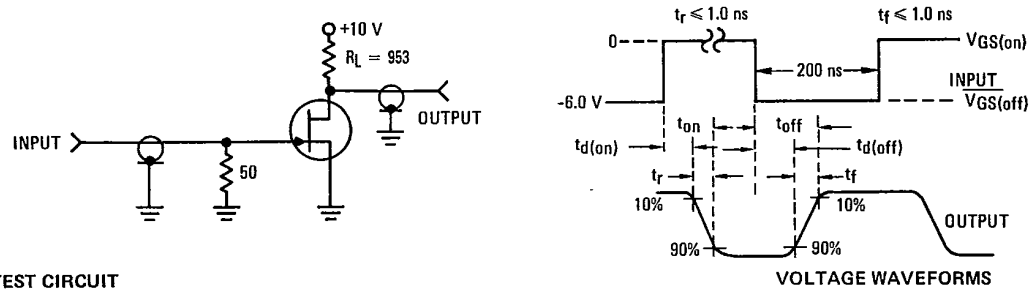
MMBF4860 = 6F

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted.)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Gate-Source Breakdown Voltage (I_G = 1.0 μAdc, V_{DS} = 0)	$V_{(BR)GSS}$	30	—	Vdc
Gate Reverse Current (V_{GS} = 15 Vdc, V_{DS} = 0) (V_{GS} = 15 Vdc, V_{DS} = 0, T_A = 150°C)	I_{GSS}	 — —	 0.5 2.0	 nAdc μAdc
Gate Source Cutoff Voltage (V_{DS} = 15 Vdc, I_D = 0.5 nAdc)	$V_{GS(off)}$	2.0	6.0	Vdc
ON CHARACTERISTICS				
Zero-Gate-Voltage Drain(1) (V_{DS} = 15 Vdc, V_{GS} = 0)	I_{DSS}	20	100	mAdc
Drain Cutoff Current (V_{DS} = 15 Vdc, V_{GS} = 10 Vdc) (V_{DS} = 15 Vdc, V_{GS} = 10 Vdc, T_A = 150°C)	$I_{D(off)}$	 — —	 0.25 0.5	 nAdc μAdc
Drain-Source On-Voltage (I_D = 10 mAdc, V_{GS} = 0)	$V_{DS(on)}$	—	0.5	Vdc
Static Drain-Source On Resistance (V_{GS} = 0, I_D = 0, f = 1.0 kHz)	$r_{DS(on)}$	—	40	Ohms
Input Capacitance (V_{DS} = 0, V_{GS} = 10 Vdc, f = 1.0 MHz)	C_{iss}	—	18	pF
Reverse Transfer Capacitance (V_{DS} = 0, V_{GS} = 10 Vdc, f = 1.0 MHz)	C_{rss}	—	8.0	pF
SWITCHING CHARACTERISTICS				
Delay Time (V_{DD} = 10 Vdc, $I_{D(on)}$ = 20 mAdc) ($V_{G(on)}$ = 0, $V_{GS(off)}$ = 10 Vdc)	t_d	—	6.0	ns
Rise Time (V_{DD} = 10 Vdc, $I_{D(on)}$ = 10 mAdc) ($V_{GS(on)}$ = 0, $V_{GS(off)}$ = 6.0 Vdc) (Figure 1)	t_r	—	4.0	ns
Turn-Off Time (V_{DD} = 10 Vdc, $I_{D(on)}$ = 5.0 mAdc) ($V_{GS(on)}$ = 0, $V_{GS(off)}$ = 4.0 Vdc) (Figure 1)	t_{off}	—	50	ns

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

FIGURE 1 — SWITCHING TIMES TEST CIRCUIT



TEST CIRCUIT

VOLTAGE WAVEFORMS

NOTES: 1. The input waveforms are supplied by a generator with the following characteristics:
Z_{out} = 50 ohms, Duty Cycle ≈ 2.0%
2. Waveforms are monitored on an oscilloscope with the following characteristics:
$t_r \leq 0.75$ ns, $R_{in} \geq 1.0$ megohm, $C_{in} \leq 2.5$ pF.