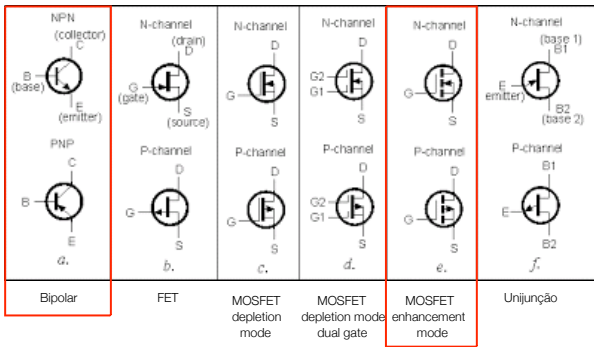


Interface com o mundo real

Jun Okamoto Jr.

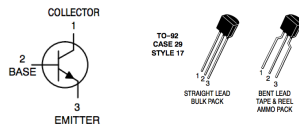
Transistores



Bipolar – NPN

BC337, BC337-25, BC337-40

Amplifier Transistors



MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector – Emitter Voltage	V_{CE0}	45	Vdc
Collector – Base Voltage	V_{CB0}	50	Vdc
Emitter – Base Voltage	V_{EB0}	5.0	Vdc
Collector Current – Continuous	I_C	800	mA dc
Total Device Dissipation @ $T_A = 25^\circ\text{C}$ Derate above 25°C	P_D	625 5.0	mW mW/ $^\circ\text{C}$
Total Device Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	1.5 12	W mW/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-55 to +150	$^\circ\text{C}$

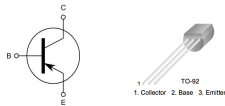
Bipolar — NPN

ON CHARACTERISTICS		Min.	Typ.	Max.	Units
DC Current Gain ($I_C = 100\text{ mA}$, $V_{CE} = 1.0\text{ V}$)	BC337	100	-	630	-
	BC337-25 BC337-40	160 250 60	- - -	400 630 -	-
Base-Emitter On Voltage ($I_C = 300\text{ mA}$, $V_{CE} = 1.0\text{ V}$)		$V_{BE(on)}$	-	1.2	Vdc
Collector-Emitter Saturation Voltage ($I_C = 500\text{ mA}$, $I_B = 50\text{ mA}$)		$V_{CE(sat)}$	-	0.7	Vdc
SMALL-SIGNAL CHARACTERISTICS					
Output Capacitance ($V_{CB} = 10\text{ V}$, $I_E = 0$, $f = 1.0\text{ MHz}$)		C_{ob}	-	15	pF
Current-Gain - Bandwidth Product ($I_C = 10\text{ mA}$, $V_{CE} = 5.0\text{ V}$, $f = 100\text{ MHz}$)		f_T	-	210	MHz

Bipolar — PNP



BC327/328



Switching and Amplifier Applications
 • Suitable for AP-Driver stages and low power output stages
 • Complement to BC337/BC338

Absolute Maximum Ratings $T_a = 25^\circ\text{C}$ unless otherwise noted

Symbol	Parameter	Value	Units
V_{CES}	Collector-Emitter Voltage : BC327 : BC328	-50 -30	V
V_{CEO}	Collector-Emitter Voltage : BC327 : BC328	-45 -25	V
V_{EBO}	Emitter-Base Voltage	-5	V
I_C	Collector Current (DC)	-800	mA
P_C	Collector Power Dissipation	625	mW
T_J	Junction Temperature	150	$^\circ\text{C}$
T_{STG}	Storage Temperature	-55 ~ 150	$^\circ\text{C}$

MOSFET — enhancement mode — N-channel

2N7002P

60 V, 360 mA N-channel Trench MOSFET
 Rev. 02 — 29 July 2010



Table 1. Quick reference data

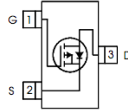
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DS}	drain-source voltage	$T_{amb} = 25^\circ\text{C}$	-	-	60	V
V_{GS}	gate-source voltage		-20	-	20	V
I_D	drain current	$V_{GS} = 10\text{ V}$; $T_{amb} = 25^\circ\text{C}$	[1]	-	360	mA
$R_{\theta son}$	drain-source on-state resistance	$V_{GS} = 10\text{ V}$; $I_D = 500\text{ mA}$; $T_J = 25^\circ\text{C}$; pulsed; $t_p \leq 300\text{ }\mu\text{s}$; $\delta \leq 0.01$	-	1	1.6	Ω

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for drain 1 cm².

MOSFET — enhancement mode — P-channel

IRLML6401PbF

HEXFET® Power MOSFET



Absolute Maximum Ratings

Parameter	Max.	Units
V_{DS}	-12	V
I_D @ $T_A = 25^\circ\text{C}$	-4.3	A
I_D @ $T_A = 70^\circ\text{C}$	-3.4	A
I_{DM}	-34	A
P_D @ $T_A = 25^\circ\text{C}$	1.3	W
P_D @ $T_A = 70^\circ\text{C}$	0.8	W
Linear Derating Factor	0.01	W/°C
E_{AS}	33	mJ
V_{GS}	± 8.0	V
T_J, T_{STG}	-55 to +150	°C

MOSFET — enhancement mode — P-channel

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)DSS}$	-12	—	—	V	$V_{GS} = 0V, I_D = -250\mu\text{A}$
$\Delta V_{(BR)DSS}/\Delta T$	-0.007	—	—	V/°C	Reference to $25^\circ\text{C}, I_D = -1\text{mA}$
$R_{DS(on)}$	—	0.050	—	Ω	$V_{GS} = -4.5V, I_D = -2.5A$ Ⓞ
	—	0.085	—	Ω	$V_{GS} = -2.5V, I_D = -2.5A$ Ⓞ
	—	0.125	—	Ω	$V_{GS} = -1.8V, I_D = -2.0A$ Ⓞ
$V_{GS(th)}$	-0.40	-0.55	-0.95	V	$V_{DS} = V_{GS}, I_D = -250\mu\text{A}$
g_{fs}	8.6	—	—	S	$V_{DS} = -10V, I_D = -4.3A$
I_{DSS}	—	-1.0	—	μA	$V_{DS} = -12V, V_{GS} = 0V$
	—	-25	—	μA	$V_{DS} = -9.6V, V_{GS} = 0V, T_J = 55^\circ\text{C}$
I_{GSS}	—	-100	—	nA	$V_{GS} = -8.0V$
	—	100	—	nA	$V_{GS} = 8.0V$

MOSFET — enhancement mode — N-channel (2A)

MCH3481

Power MOSFET
20V, 104m Ω , 2A, Single N-Channel

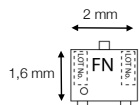
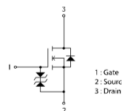
SPECIFICATIONS

ABSOLUTE MAXIMUM RATING at $T_A = 25^\circ\text{C}$ (Note 1)

Parameter	Symbol	Value	Unit
Drain to Source Voltage	V_{DS}	20	V
Gate to Source Voltage	V_{GS}	± 9	V
Drain Current (DC)	I_D	2	A
Drain Current (Pulse)	I_{DP}	8	A
Power Dissipation When mounted on ceramic substrate (900mm ² × 0.8mm)	P_D	0.8	W
Junction Temperature	T_J	150	°C
Storage Temperature	T_{stg}	-55 to +150	°C

Note 1: Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

ELECTRICAL CONNECTION N-Channel



MOSFET — enhancement mode — N-channel (2A)

ELECTRICAL CHARACTERISTICS at Ta = 25 °C (Note 2)

Parameter	Symbol	Conditions	Value			Unit
			min	typ	max	
Drain to Source Breakdown Voltage	$V_{(BR)DSS}$	$I_D=1mA, V_{GS}=0V$	20			V
Zero-Gate Voltage Drain Current	I_{DSS}	$V_{DS}=20V, V_{GS}=0V$			1	μA
Gate to Source Leakage Current	I_{GSS}	$V_{GS}=7.2V, V_{DS}=0V$			± 10	μA
Gate Threshold Voltage	$V_{GS(th)}$	$V_{DS}=10V, I_D=1mA$	0.3		0.9	V
Forward Transconductance	g_{FS}	$V_{DS}=10V, I_D=1A$		2.4		S
	$R_{DS(on)1}$	$I_D=1A, V_{GS}=4.5V$		80	104	m Ω
Static Drain to Source On-State Resistance	$R_{DS(on)2}$	$I_D=0.5A, V_{GS}=2.5V$		105	147	m Ω
	$R_{DS(on)3}$	$I_D=0.3A, V_{GS}=1.8V$		135	203	m Ω
	$R_{DS(on)4}$	$I_D=0.1A, V_{GS}=1.2V$		270	540	m Ω
	C_{iss}			175		pF
Input Capacitance	C_{iss}	$V_{DS}=10V, f=1MHz$		30		pF
Output Capacitance	C_{oss}			25		pF
Reverse Transfer Capacitance	C_{rss}			6.6		ns
Turn-ON Delay Time	$t_{d(on)}$	See specified Test Circuit		27		ns
Rise Time	t_r			28		ns
Turn-OFF Delay Time	$t_{d(off)}$			19		ns
Fall Time	t_f			2.9		nC
Total Gate Charge	Q_g	$V_{DS}=10V, V_{GS}=4.5V, I_D=2A$		0.46		nC
Gate to Source Charge	Q_{gs}			0.53		nC
Gate to Drain "Miller" Charge	Q_{gd}			0.85	1.2	V
Forward Diode Voltage	V_{SD}	$I_D=2A, V_{GS}=0V$				

Note 2: Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

MOSFET — enhancement mode — N-channel (2A)

- Sistema para caracterização dos motores de PMR3404
- Acionamento PWM do motor do PI-7

MCH3481

