2N7000

Siliconix

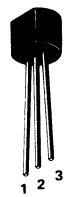
N-Channel Enhancement Mode
MOSPOWER FETlington™

APPLICATIONS

- CMOS or TTL Logic Compatible
- Bipolar Darlington Replacement
- Lamp, Relay Driver or Buffer
- Analog Signal Switching

PIN 1 – Source
PIN 2 – Gate
PIN 3 – Drain

TO–92



PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7000	60	5	TO–92

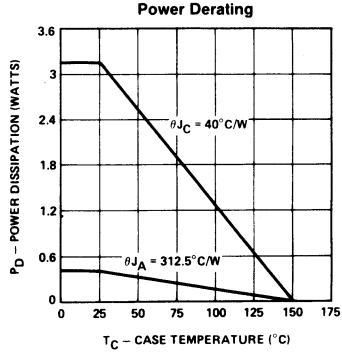
NEW
LOGIC-TO-LOAD
DESIGN
5 Volts in-100 mA out

ABSOLUTE MAXIMUM RATINGS (T_C = 25° C unless otherwise noted)

	Parameter	2N7000	Units
V_{DS}	Drain-Source Voltage	60	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	60	V
I_D @ T_C = 25° C	Continuous Drain Current	±200	mA
I_D @ T_C = 100° C	Continuous Drain Current	±123	mA
I	Pulsed Drain Current[1]	±500	mA
V_{GS}	Gate-Source Voltage	±40	V
P_D	Max. Continuous Power Dissipation	400	mW
P_D	Max. Pulsed Power Dissipation[2]	3.125	W
Junction to Case	Linear Derating Factor	25	mW/° C
Junction to Ambient	Linear Derating Factor	3.2	mW/° C
T_J Tstg	Operating and Storage Temperature Range	–55 To +150	° C
Lead Temperature	(1/16" from case for 10 secs.)	300	° C

1 **Pulse Test:** Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%
2 One Second Single, Power Pulse

Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7000	60	80		V	V_{GS} = 0, I_D = 10 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7000	0.8	1.8	3	V	V_{DS} = V_{GS}, I_D = 1 mA
I_{GSSF}	Gate-Body Leakage Forward	2N7000		1	10	nA	V_{GS} = +15V
I_{GSSR}	Gate-Body Leakage Reverse	2N7000		−1	−10	nA	V_{GS} = −15V
I_{DSS}	Zero Gate Voltage Drain Current	2N7000		0.1	1	μA	V_{DS} = 48V , V_{GS} = 0
		2N7000		0.1	1	mA	V_{DS} = 48V , V_{GS} = 0, T_C = 125°C
$I_{D(on)}$	On-State Drain Current[1]	2N7000	75	100		mA	V_{GS} = 4.5V , V_{DS} = 10V
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7000		1.2	2.5	V	V_{GS} = 10V , I_D = 0.5A
		2N7000			0.40	V	V_{GS} = 4.5V , I_D = 75 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7000		2.4	5	Ω	V_{GS} = 10V , I_D = 0.5A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7000		4.3	9	Ω	V_{GS} = 10V, I_D = 0.5A, T_C C

DYNAMIC

g_{fs}	Forward Transductance[1]	2N7000	100	200		mS(℧)	V_{DS} = 10V, I_D = 0.2A
C_{iss}	Input Capacitance	2N7000		30	60	pF	V_{GS} = 0 , V_{DS} = 25V, f = 1 MHz
C_{oss}	Output Capacitance	2N7000		14	25	pF	
C_{rss}	Reverse Transfer Capacitance	2N7000		2	5	pF	
$t_{(ON)}$	Turn-On Time	2N7000		6	10	ns	V_{DD} = 15V , I_D ≅ 0.50A, R_g = 25Ω , R_L = 25Ω
$t_{(OFF)}$	Turn-Off Time	2N7000		6	10	ns	(MOSFET switching times are essentially independent of operating temperature.)

THERMAL RESISTANCE

R_{thJC}	Junction-to-Case	2N7000		33	40	°C/W	
R_{thJA}	Junction-to-Ambient	2N7000			312.5	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7000			−0.2	A	Modified MOSPOWER symbol showing the integral P-N Junction rectifier 
I_{SM}	Source Current[1] (Body Diode)	2N7000			−0.5	A	
V_{SD}	Diode Forward Voltage[1]	2N7000		−0.85		V	T_C=25°C, I_S=−0.2A, V_{GS} = 0

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

18341

2N7001

Siliconix
PRELIMINARY

N-Channel Enhancement Mode
MOSPOWER FETlington™

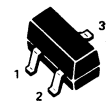
APPLICATIONS
- General Purpose Switch
- Hybrid Assemblies
- Instrumentation
- Automatic Test Equipment

FEATURES
- Surface Mount Package
- ıll In–Package Testability
- ndustry Standard–SOT-23
- Duramos® 40V Gate Rating

PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7001	240	45	SOT–23

Symbolized '701'



PIN 1 – Gate
PIN 2 – Source
PIN 3 – Drain

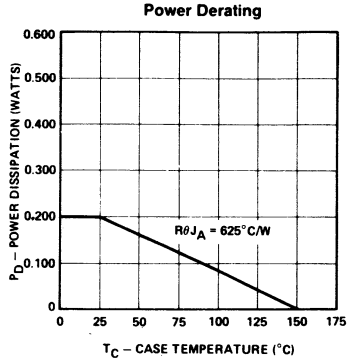
SOT–23
TO–236AA

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

	Parameter	2N7001	Units
V_{DS}	Drain-Source Voltage	240	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	240	V
I_D @ T_C = 25° C	Continuous Drain Current	±45	mA
I_D @ T_C = 100° C	Continuous Drain Current	±30	mA
I_{DM}	Pulsed Drain Current[1]	±210	mA
V_{GS}	Gate-Source Voltage	±40V	V
P_D @ T_C = 25° C	Max. Power Dissipation	200	mW
P_D @ T_C = 100°C	Max. Power Dissipation	80	mW
Junction to Ambient	Linear Derating Factor	0.16	mW/°C
T_J Tstg	Operating and Storage Temperature Range	−55 To 150	°C
Lead Temperature	(1/16" from case for 10 secs.)	300	°C

1 **Pulse Test:** Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%

Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7001	240	250		V	V_{GS} = 0 I_D = 100 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7001	1		2.5	V	V_{DS} = V_{GS}, I_D = 250 μA
I_{GSSF}	Gate-Body Leakage Forward	2N7001			10	nA	V_{GS} = +20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7001			−10	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7001		10	100	nA	V_{DS} = 120V, V_{GS} = 0
		2N7001		0.8	1	μA	V_{DS} = 120V, V_{GS} = 0 T_C = 125°C
$I_{D(on)}$	On-State Drain Current[1]	2N7001	100	200		mA	$V_{DS} \geq 2V_{DS(ON)}$, V_{GS} = 10V
		2N7001	35	75		mA	$V_{DS} \geq 2V_{DS(ON)}$, V_{GS} = 4.5V
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7001		1.95	2.25	V	V_{GS} = 10V, I_D = 50 mA
		2N7001		0.8	0.9	V	V_{GS} = 4.5V, I_D = 20 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7001		39	45	Ω	V_{GS} = 10V, I_D = 50 mA
		2N7001		39	45	Ω	V_{GS} = 4.5V, I_D = 20 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7001		74	85	Ω	V_{GS}=10V, I_D=50mA, T_C=125°C
		2N7001		74	85	Ω	V_{GS}=4.5V, I_D=20mA, T_C=125°C

DYNAMIC

g_{fs}	Forward Transductance[1]	2N7001	30	40		mS(℧)	$V_{DS} \geq 2V_{DS(ON)}$, I_D = 50 mA
C_{iss}	Input Capacitance	2N7001		20	30	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7001		8	15	pF	
C_{rss}	Reverse Transfer Capacitance	2N7001		4	10	pF	
$t_{(on)}$	Turn-On Time	2N7001		15	30	ns	V_{DD} = 60V, $I_D \cong$ 50 mA R_g = 25Ω, R_L = 1.2 KΩ (MOSFET switching times are essentially independent of operating temperature.)
$t_{(off)}$	Turn-Off Time	2N7001		10	20	ns	

THERMAL RESISTANCE

R_{thJA}	Junction-to-Ambient	2N7001			625	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7001			−45	mA	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
							
I_{SM}	Source Current[1] (Body Diode)	2N7001			−210	mA	
V_{SD}	Diode Forward Voltage[1]	2N7001			−1.2	V	T_C=25°C, I_S=−45mA, V_{GS} = 0

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Data Sheet Curves: VNDN24
Expiration Date: 12/31/85

2N7002

Siliconix
PRELIMINARY

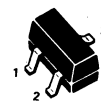
N-Channel Enhancement Mode
MOSPOWER FETlington™

APPLICATIONS
- General Purpose Switch
- Hybrid Assemblies
- Instrumentation

FEATURES
- Ultra Miniature, Light Weight
- Surface Mount Package
- Full In Package Testability
- Industry Standard—SOT—23
- Duramos® 40V Gate Rating

PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7002	60	7.5	SOT—23



PIN 1 — Gate
PIN 2 — Source
PIN 3 — Drain

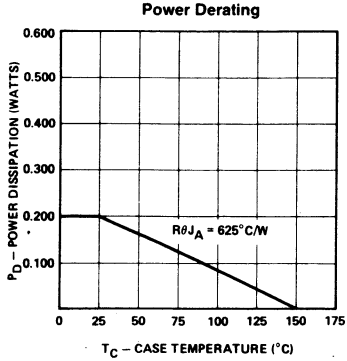
SOT—23
Symbolized '702'

ABSOLUTE MAXIMUM RATINGS (T_C = 25° C unless otherwise noted)

	Parameter	2N7002	Units
V_{DS}	Drain-Source Voltage	60	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	60	V
I_D @ T_C = 25° C	Continuous Drain Current	±115	mA
I_D @ T_C = 100° C	Continuous Drain Current	±75	mA
I_{DM}	Pulsed Drain Current[1]	±800	mA
V_{GS}	Gate-Source Voltage	±40	V
P_D @ 25°C	Max. Power Dissipation	200	mW
P_D @ 100°C	Max. Power Dissipation	80	mW
Junction to Ambient	Linear Derating Factor	0.16	mW/°C
T_J Tstg	Operating and Storage Temperature Range	−55 To 150	°C
Lead Temperature	(1/16" from case for 10 secs.)	300	°C

1 **Pulse Test:** Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%

Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7002	60	75		V	V_{GS} = 0 I_D = 10 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7002	1	2	2.5	V	V_{DS} = V_{GS}, I_D = 250 μA
I_{GSSF}	Gate-Body Leakage Forward	2N7002		5	100	nA	V_{GS} = 20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7002		−5	−100	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7002		0.1	1	μA	V_{DS} = Max. Rating, V_{GS} = 0
		2N7002		5	500	μA	V_{DS} = Max. Rating, V_{GS} = 0 T_C = 125°C
$I_{D(on)}$	On-State Drain Current[1]	2N7002	500			mA	$V_{DS} \geq 2V_{DS(ON)}$, V_{GS} =
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7002		2.5	3.75	V	V_{GS} = 10V, I_D = 500 mA
		2N7002		0.9	1.5	V	V_{GS} = 5V, I_D = 50 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7002		5	7.5	Ω	V_{GS} = 10V, I_D = 500 mA
		2N7002		4.5	7.5	Ω	V_{GS} = 5V, I_D = 50 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7002		9	13.5	Ω	V_{GS}=10V, I_D=500mA, T_C=125°C
		2N7002		8.1	13.5	Ω	V_{GS} =5V, I_D =50mA, T_C =125°C

DYNAMIC

g_{fs}	Forward Transductance[1]	2N7002	80	100		mS(℧)	$V_{DS} \geq 2V_{DS(ON)}$, I_D = 200mA
C_{iss}	Input Capacitance	2N7002		24	50	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7002		12	25	pF	
C_{rss}	Reverse Transfer Capacitance	2N7002		2	5	pF	
$t_{(on)}$	Turn-On Time	2N7002		8	20	ns	V_{DD} = 30V, $I_D \cong$ 200 mA R_g = 25Ω, R_L = 150Ω (MOSFET switching times are essentially independent of operating temperature.)
$t_{(off)}$	Turn-Off Time	2N7002		8	20	ns	

THERMAL RESISTANCE

R_{thJA}	Junction-to-Ambient	2N7002			625	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7002			−115	mA	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
I_{SM}	Source Current[1] (Body Diode)	2N7002			−800	mA	
V_{SD}	Diode Forward Voltage[1]	2N7002			−1.5	V	T_C=25°C, I_S=−115mA, V_{GS} = 0

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Expiration Date: 12/31/85

2N7003

Siliconix
PRELIMINARY

N-Channel Enhancement Mode
MOSPOWER FETlington™

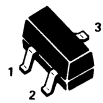
APPLICATIONS
- Hybrid Assemblies
- Instrumentation
- Automatic Test Equipment
- High Voltage Level Shifter

FEATURES
- Surface Mount Package
- Full In Package Testability
- Industry Standard—SOT—23
- Duramos® 40V Gate Rating

PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7003	500	300	SOT—23

Symbolized '703'



PIN 1 — Gate
PIN 2 — Source
PIN 3 — Drain

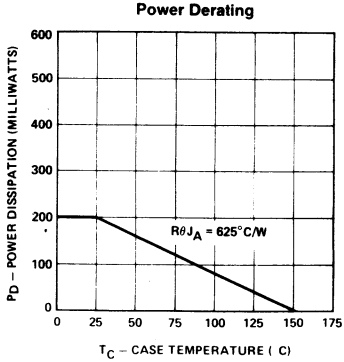
SOT—23
TO—236AA

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

	Parameter	2N7003	Units
V_{DS}	Drain-Source Voltage	500	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	500	V
I_D @ T_C = 25° C	Continuous Drain Current	±15	mA
I_D @ T_C = 100° C	Continuous Drain Current	±10	mA
I_{DM}	Pulsed Drain Current[1]	±50	mA
V_{GS}	Gate-Source Voltage	±40	V
P_D @ 25°C	Max. Power Dissipation	200	mW
P_D @ 100°C	Max. Power Dissipation	80	mW
Junction to Ambient	Linear Derating Factor	0.16	mW/°C
T_J Tstg	Operating and Storage Temperature Range	−55 To 150	°C
Lead Temperature	(1/16" from case for 10 secs.)	300	°C

1 **Pulse Test:** Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%

Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

	Parameter	Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7003	500	510		V	V_{GS} = 0 I_D = 10 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7003	1.5	3	4.5	V	V_{DS} = V_{GS}, I_D = 10 μA
I_{GSSF}	Gate-Body Leakage Forward	2N7003		10	100	nA	V_{GS} = +20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7003		−10	−100	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7003		5	50	nA	V_{DS} = 400V, V_{GS} = 0
		2N7003		50	500	nA	V_{DS} = 400V, V_{GS} = 0 T_C = 125°C
$I_{D(on)}$	On-State Drain Current[1]	2N7003	15			mA	$V_{DS} \geq 2V_{DS(ON)}$, V_{GS} = V
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7003		2.8	3	V	V_{GS} = 10V, I_D = 10 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7003		280	300	Ω	V_{GS} = 10V, I_D = 10 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7003		580	620	Ω	V_{GS} = 10V, I_D = 5mA, T_C = 125°C

DYNAMIC

g_{fs}	Forward Transductance[1]	2N7003	6	7		mS(℧)	$V_{DS} \geq 2V_{DS(ON)}$, I_D = 10 mA
C_{iss}	Input Capacitance	2N7003		10	20	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7003		4	10	pF	
C_{rss}	Reverse Transfer Capacitance	2N7003		1	5	pF	
$t_{(on)}$	Turn-On Time	2N7003		10	20	ns	V_{DD} = 50V, $I_D \cong$ 50 mA R_g = 25Ω, R_L = 1 KΩ (MOSFET switching times are essentially independent of operating temperature.)
$t_{(off)}$	Turn-Off Time	2N7003		12	25	ns	

THERMAL RESISTANCE

R_{thJA}	Junction-to-Ambient	2N7003			625	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7003			−15	mA	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
I_{SM}	Source Current[1] (Body Diode)	2N7003			−50	mA	
V_{SD}	Diode Forward Voltage[1]	2N7003			−1.5	V	T_C = 25°C, I_S = −15mA, V_{GS} = 0

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Data Sheet Curves: VNDO50
Expiration Date: 12/31/85

18/341

2N7006

N-Channel Enhancement Mode
MOSPOWER FETlington™

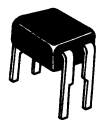
Siliconix
ADVANCE INFORMATION

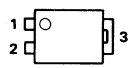
APPLICATIONS
- Small Motor Controls
- Line Voltage Suppression
- Switch Mode Power Supplies

FEATURES
- Duramos® Processing For 40V Gate Rating
- Auto Insertable — Low Production Costs
- End Stackable — Multiple Devices
- Fast Switching — MOS Technology
- Very High Pulsed Power Capability
- Improve Pin—Replacement For IRFD313

PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7006	350	5	4–Pin FETDIP





1 – Gate
2 – Source
3 – Drain

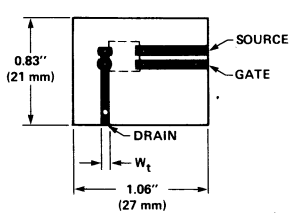
4 Pin FETDIP Package
(Top View)

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

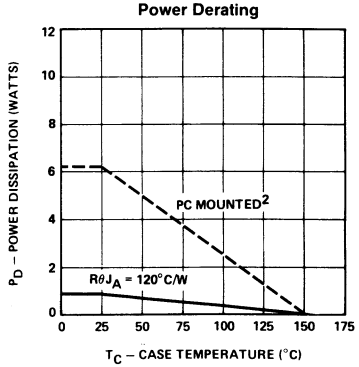
	Parameter	2N7006	Units
V_{DS}	Drain-Source Voltage	350	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	350	V
I_D @ T_C = 25° C	Continuous Drain Current	0.32	A
I_D @ T_C = 100° C	Continuous Drain Current	0.19	A
I_{DM}	Pulsed Drain Current[1]	1.2	A
V_{GS}	Gate-Source Voltage	±40	V
P_D @ T_C = 25° C	Max. Power Dissipation[2]	6.25	W
Junction to Ambient	Linear Derating Factor	0.0083	W/° C
T_J Tstg	Operating and Storage Temperature Range	−55 To 150	° C
Lead Temperature	(1/16" from case for 10 secs.)	300	° C

1 Pulse Test: Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%
2 P.C. Board as Below

a) P.C. Board Mounted
b) Package Mounted On Solder Side Of Board
c) FR–4 P.C. Board; 0.062" (1.5 mm)
d) Copper Trace Width = W_t = 0.100" (2.5 mm)
e) Power Applied Time ≤ 1 Second



Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25° C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7006	350	400		V	V_{GS} = 0 I_D = 250 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7006	2	3	4	V	V_{DS} = V_{GS}, I_D = 1 mA
I_{GSSF}	Gate-Body Leakage Forward	2N7006		10	500	nA	V_{GS} = 20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7006		−10	−500	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7006		0.1	0.25	mA	V_{DS} = Max. Rating, V_{GS} = 0
		2N7006		0.6	1	mA	V_{DS} = Max. Rating, V_{GS} = 0 T_C = 125°C
$I_{D(on)}$	On-State Drain Current[1]	2N7006	0.32			A	$V_{DS} \geq 2V_{DS(ON)}$, V_{GS} = 10V
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7006		1.35	1.5	V	V_{GS} = 10V, I_D = 0.3A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7006		4.5	5	Ω	V_{GS} = 10V, I_D = 0.3A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7006		8.4	9.3	Ω	V_{GS} = 10V, I_D = 0.3A, T_C = 125°C

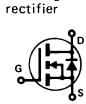
DYNAMIC

g_{fs}	Forward Transductance[1]	2N7006	0.5			S (℧)	$V_{DS} \geq 2V_{DS(ON)}$, I_D = 0.3A
C_{iss}	Input Capacitance	2N7006		180	220	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7006		30	50	pF	
C_{rss}	Reverse Transfer Capacitance	2N7006		10	20	pF	
$t_{d(on)}$	Turn-On Delay Time	2N7006		10	15	ns	V_{DD} = 200, $I_D \cong$ 0.3A R_g = 25Ω, R_L = 680Ω (MOSFET switching times are essentially independent of operating temperature.)
t_r	Rise Time	2N7006		10	20	ns	
$t_{d(off)}$	Turn-Off Delay Time	2N7006		10	15	ns	
t_f	Fall Time	2N7006		10	20	ns	

THERMAL RESISTANCE

R_{thJA}	Junction to Ambient	2N7006			120	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7006			−0.32	A	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
I_{SM}	Source Current[1] (Body Diode)	2N7006			−1.2	A	
V_{SD}	Diode Forward Voltage[1]	2N7006			−1.5	V	T_C = 25°C, I_S = −0.3A, V_{GS} = 0
t_{rr}	Reverse Recovery Time	2N7006		380		ns	T_J = 150°C, I_F = I_S dI_F/ds = 100 A/μs

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Data Sheet Curves: VNDL40

18/34

2N7009

Siliconix
PRELIMINARY

N-Channel Enhancement Mode
MOSPOWER FETlington™

APPLICATIONS
- Video Drives
- Instrumentation
- Automatic Test Equipment
- High Voltage Level Shifter

PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7009	500	300	TO–92

FEATURES
- Lower Cost Alternative To Bipolar Darlington Devices
- TO–92 Version Of SOT–23 2N7003, SMD Prototype
- Automatic Insertable
- High Voltage TO–92
- Duramos® 40V Gate Rating

PIN 1 – Source
PIN 2 – Gate
PIN 3 – Drain

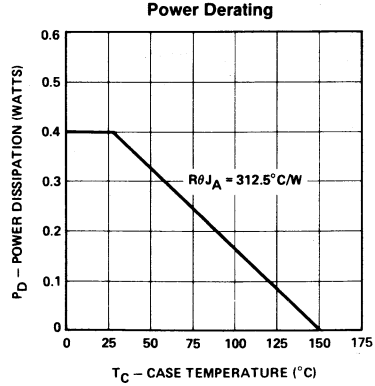
TO–92

ABSOLUTE MAXIMUM RATINGS (T_C = 25° C unless otherwise noted)

	Parameter	2N7009	Units
V_{DS}	Drain-Source Voltage	500	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	500	V
I_D @ T_C = 25° C	Continuous Drain Current	±20	mA
I_D @ T_C = 100° C	Continuous Drain Current	±15	mA
I_{DM}	Pulsed Drain Current[1]	±75	mA
V_{GS}	Gate-Source Voltage	±40	V
P_D @ T_C = 25° C	Max. Power Dissipation	400	mW
P_D @ T_C = 100° C	Max. Power Dissipation	160	mW
Junction to Ambient	Linear Derating Factor	0.32	mW/° C
T_J Tstg	Operating and Storage Temperature Range	–55 To 150	° C
Lead Temperature	(1/16" from case for 10 secs.)	300	° C

1 Pulse Test: Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%

Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25° C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7009	500	510		V	V_{GS} = 0 I_D = 10 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7009	1.5	3	4.5	V	V_{DS} = V_{GS}, I_D = 10 μA
I_{GSSF}	Gate-Body Leakage Forward	2N7009		10	100	nA	V_{GS} = +20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7009		−10	−100	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7009		10	50	nA	V_{DS} = 400V, V_{GS} = 0
		2N7009		100	500	nA	V_{DS} = 400V, V_{GS} = 0 T_C = 125° C
$I_{D(on)}$	On-State Drain Current[1]	2N7009	20			mA	$V_{DS} \geq 2V_{DS(ON)}$, V_{GS} = 10V
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7009		2.8	3	V	V_{GS} = 10V, I_D = 10 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7009		280	300	Ω	V_{GS} = 10V, I_D = 10 mA
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7009		580	620	Ω	V_{GS} = 10V, I_D =5mA, T_C = 125°C

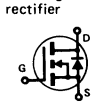
DYNAMIC

g_{fs}	Forward Transductance[1]	2N7009	6	8		mS(℧)	$V_{DS} \geq 2V_{DS(ON)}$, I_D = 10mA
C_{iss}	Input Capacitance	2N7009		10	20	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7009		4	10	pF	
C_{rss}	Reverse Transfer Capacitance	2N7009		1	5	pF	
$t_{(on)}$	Turn-On Time	2N7009		10	20	ns	V_{DD} = 50V, $I_D \cong$ 50 mA R_g = 25Ω, R_L = 1 KΩ (MOSFET switching times are essentially independent of operating temperature.)
$t_{(off)}$	Turn-Off Time	2N7009		12	25	ns	

THERMAL RESISTANCE

R_{thJA}	Junction-to-Ambient	2N7009			312.5	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7009			−20	mA	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
							
I_{SM}	Source Current[1] (Body Diode)	2N7009			−75	mA	
V_{SD}	Diode Forward Voltage[1]	2N7009			−1.5	V	T_C = 25°C, I_S =−20mA, V_{GS} = 0

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Data Sheet Curves: VNDO50
Expiration Date: 12/31/85

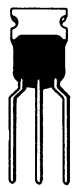
2N7010 ■ 2N7011

Siliconix
PRELIMINARY

N-Channel Enhancement Mode
MOSPOWER FETlington™

APPLICATIONS
- Small Motor Control
- Solenoid Drives
- Switch Mode Power Supplies
- Low-Profile, TO–220 Replacement

FEATURES
- Duramos® Processing
- Gate Transient Protected
- Thermally Efficient TO–237, TO–220 In-Out Lead Form



PIN 1 – Gate
PIN 2 & TAB – Drain
PIN 3 – Source

TO–237
*Modified
(Conforms To TO–220 Lead Form Pattern)

PRODUCT SUMMARY

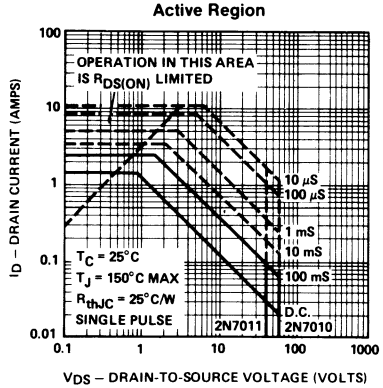
Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7010	60V	0.35	TO–237*
2N7011	40V	0.35	TO–237*

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

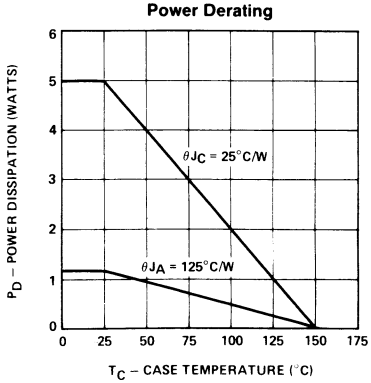
	Parameter	2N7010	2N7011	Units
V_{DS}	Drain-Source Voltage	60	40	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	60	40	V
I_D @ T_C = 25° C	Continuous Drain Current	±1.3	±1.3	A
I_D @ T_C = 100° C	Continuous Drain Current	±0.8	±0.8	A
I_{DM}	Pulsed Drain Current[1]	±8	±8	A
V_{GS}	Gate-Source Voltage	±40	±40	V
P_D @ T_C = 25° C	Max. Continuous Power Dissipation	1.2	1.2	W
P_D @ T_A = 25°C	Max. Pulse[2] Power Dissipation	5	5	W
Junction to Case	Linear Derating Factor	0.04	0.04	W/° C
Junction to Ambient	Linear Derating Factor	0.01	0.01	W/° C
T_J Tstg	Operating and Storage Temperature Range	–55 To +150	–55 To +150	° C
Lead Temperature	(1/16" from case for 10 secs.)	300	300	° C

1 Pulse Test: Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%
2 1 Sec Continuous Power Single Pulse

Active Region



Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7010	60	70		V	V_{GS} = 0 I_D = 250 μA
		2N7011	40	50		V	
$V_{GS(th)}$	Gate-Threshold Voltage	All	1	2	4	V	V_{DS} = V_{GS}, I_D = 250 μA
I_{GSSF}	Gate-Body Leakage Forward	All			100	nA	V_{GS} = +20V, V_{DS} = 0
I_{GSSR}	Gate-Body Leakage Reverse	All			−100	nA	V_{GS} = −20V, V_{DS} = 0
I_{DSS}	Zero Gate Voltage Drain Current	All		0.1	0.25	mA	V_{DS} = Max. Rating, V_{GS} = 0
		All		0.7	1	mA	V_{DS} = 0.8x8V_{DSS}, V_{GS} = 0 T_C = 125°C
$I_{D(on)}$	On-State Drain Current[1]	All	8			A	V_{DS}≥2$V_{DS(ON)}$, V_{GS} = 10V
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	All		1.2	1.4	V	V_{GS} = 10V, I_D = 4A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	All		0.3	0.35	Ω	V_{GS} = 10V, I_D = 4A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	All		0.55	0.64	Ω	V_{GS} = 10V, I_D = 2A, T_C = 125°C

DYNAMIC

g_{fs}	Forward Transductance[1]	All	1.2	1.7		S (℧)	V_{DS}≥2$V_{DS(ON)}$, I_D = 2A
C_{iss}	Input Capacitance	All		240	300	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	All		120	200	pF	
C_{rss}	Reverse Transfer Capacitance	All		30	100	pF	
$t_{d(on)}$	Turn-On Delay Time	All		7	20	ns	V_{DD} = 30V, I_D ≅ 2A R_g = 25Ω, R_L = 15Ω (MOSFET switching times are essentially independent of operating temperature.)
t_r	Rise Time	All		15	30	ns	
$t_{d(off)}$	Turn-Off Delay Time	All		15	30	ns	
t_f	Fall Time	All		13	25	ns	

THERMAL RESISTANCE

R_{thJC}	Junction-to-Case	All			25	°C/W	
R_{thJA}	Junction-to-Ambient	All			100	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	All			−1.3	A	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
							
I_{SM}	Source Current[1] (Body Diode)	All			−8	A	
V_{SD}	Diode Forward Voltage[1]	All		−1.6	−2	V	T_C=25°C, I_S=−1.3A, V_{GS} = 0
t_{rr}	Reverse Recovery Time	All		200		ns	T_J = 25°C , I_F = I_S, dI_F/dt = 100A/μs

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Data Sheet Curves: VNDK06
Expiration Date: 12/31/85

MP/1K-8/85

2N7014

Siliconix
PRELIMINARY

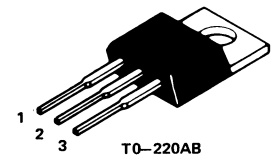
N-Channel Enhancement Mode
MOSPOWER FETlington™

APPLICATIONS
- CMOS Logic Compatible Switch
- Bipolar Darlington Replacement
- Lamp Relay Driver Or Buffer

PRODUCT SUMMARY

Part Number	BV_{DSS} Volts	$r_{DS(ON)}$ (ohms)	Package
2N7014	100	0.8	TO–220AB

FEATURES
- Low Threshold "On"—Voltage
- Nanosecond Switching Speeds
- MOS (Very High) Input Impedance, Low Drive Requirements
- Duramos® Construction—±40V Gate Capabilities



TO–220AB

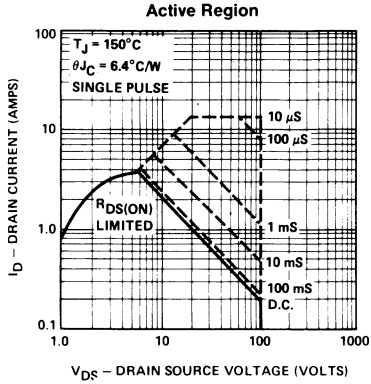
PIN 1 – Gate
PIN 2 & TAB – Drain
PIN 3 – Source

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

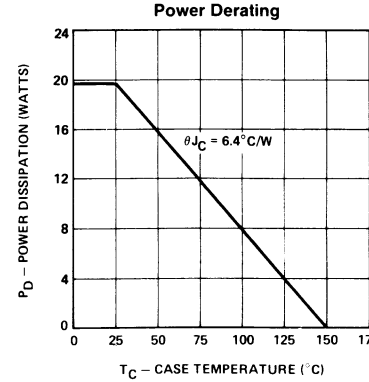
	Parameter	2N7014	Units
V_{DS}	Drain-Source Voltage	100	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	100	V
I_D @ T_C = 25° C	Continuous Drain Current	±3.5	A
I_D @ T_C = 100° C	Continuous Drain Current	±2	A
I_{DM}	Pulsed Drain Current[1]	±14	A
V_{GS}	Gate-Source Voltage	±40	V
P_D @ T_C = 25° C	Max. Power Dissipation	19.5	W
P_D @ T_C = 100°C	Max. Power Dissipation	8	W
Junction to Case	Linear Derating Factor	0.156	W/° C
Junction to Ambient	Linear Derating Factor	0.013	W/° C
T_J Tstg	Operating and Storage Temperature Range	−55 To +150	° C
Lead Temperature	(1/16" from case for 10 secs.)	300	° C

1 Pulse Test: Pulsewidth ≤ 300μsec, Duty Cycle ≤ 2%

Active Region



Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
BV_{DSS}	Drain-Source Breakdown Voltage	2N7014	100			V	V_{GS} = 0 I_D = 250 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7014	0.8		2.5	V	V_{DS} = V_{GS}, I_D = 1 mA
I_{GSSF}	Gate-Body Leakage Forward	2N7014			100	nA	V_{GS} = 20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7014			−100	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7014			0.25	mA	V_{DS} = Max. Rating, V_{GS} = 0
		2N7014			1	mA	V_{DS}=Max. Rating, V_{GS}=0, T_C=125°C
I_{DSV}	Gate-Bias Drain Current	2N7014		0.3	6	mA	V_{DS}=Max. Rating, V_{GS} = 0.5V
$I_{D(on)}$	On-State Drain Current[1]	2N7014	3	6		A	V_{DS} ≥2$V_{DS(ON)}$, V_{GS} = 10V
		2N7014	1.5	2.5		A	V_{DS} ≥2$V_{DS(ON)}$, V_{GS} = [illegible]
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7014		0.6	0.9	V	V_{GS} = 4.5V, I_D = 1A
		2N7014		0.5	0.8	V	V_{GS} = 10V, I_D = 1A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7014		0.6	0.9	Ω	V_{GS} = 4.5V, I_D = 1A
		2N7014		0.5	0.8	Ω	V_{GS} = 10V, I_D = 1A
$R_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7014		1	1.55	Ω	V_{GS}=4.5V, I_D=1A @ T_C = 125°C
		2N7014		0.85	1.36	Ω	V_{GS}=10V, I_D=1A @ T_C = 125°C

DYNAMIC

g_{fs}	Forward Transductance[1]	2N7014	0.75	1.5		S (℧)	V_{DS} ≥2$V_{DS(ON)}$, I_D = 2A
C_{iss}	Input Capacitance	2N7014		230	300	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7014		180	200	pF	
C_{rss}	Reverse Transfer Capacitance	2N7014		50	100	pF	
$t_{d(on)}$	Turn-On Delay Time	2N7014		10	20	ns	V_{DD} = 50V, I_D ≅ 2A R_g = 25Ω, R_L = 25Ω (MOSFET switching times are essentially independent of operating temperature.)
t_r	Rise Time	2N7014		20	40	ns	
$t_{d(off)}$	Turn-Off Delay Time	2N7014		45	90	ns	
t_f	Fall Time	2N7014		35	70	ns	

THERMAL RESISTANCE

R_{thJC}	Junction-to-Case	2N7014			6.4	°C/W	
R_{thJA}	Junction-to-Ambient	2N7014			80	°C/W	Free Air Operation

BODY-DRAIN DIODE RATINGS AND CHARACTERISTICS

I_S	Continuous Source Current (Body Diode)	2N7014			−3.5	A	Modified MOSPOWER symbol showing the integral P-N Junction rectifier
							
I_{SM}	Source Current[1] (Body Diode)	2N7014			−14	A	
V_{SD}	Diode Forward Voltage[1]	2N7014			−2	V	T_C = 25°C, I_S =−3.5A, V_{GS} = 0
t_{rr}	Reverse Recovery Time	2N7014		500		ns	T_C = 25°C, I_F = I_{SD}, Figure dI_F/ds = 100 A/μs

1 Pulse Test: Pulse Width ≤ 300 μsec, Duty Cycle ≤ 2%

Data Sheet Curves: VNDG10
Expiration Date: 12/31/85

MP/1K-8/85

18/341

2N7059

N-Channel Enhancement Mode
MOSPOWER

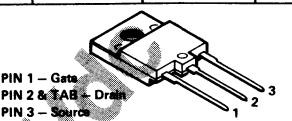
Siliconix
July 1986

APPLICATIONS
- Power Supplies
- Motor Controls
- Power Conversion
- Industrial Switching

DESIGN BENEFITS
- MOSPOWER-6™ Technology
- Electrically Isolated Package
- JEDEC Registered Specifications
- Upgrade Existing Circuit Performance

PRODUCT SUMMARY

Part Number	$V_{(BR)DSS}$ (VOLTS)	$r_{DS(ON)}$ (OHMS)	I_D (AMPS)
2N7059	500	0.45	8



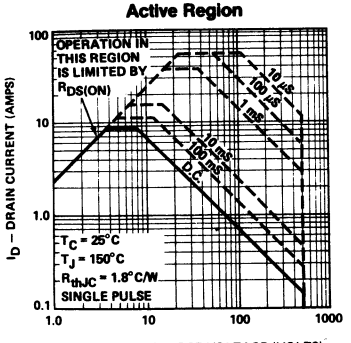
ISOWATT218
(PACKAGE TYPE 5475)

ABSOLUTE MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

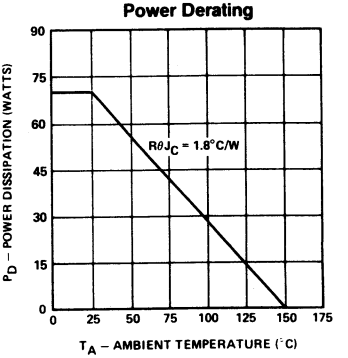
	Parameter	2N7059	Units
V_{DS}	Drain-Source Voltage	500*	V
V_{DGR}	Drain-Gate Voltage (R_{GS} = 1 MΩ)	500*	V
V_{GS}	Gate-Source Voltage	±40*	V
I_D @ T_C = 25°C	Continuous Drain Current	±8*	A
I_D @ T_C = 100°C	Continuous Drain Current	±5*	A
I_{DM}	Pulsed Drain Current[1]	±52*	A
I_S	Continuous Source Current	8*	A
I_{SM}	Pulsed Source Current[1]	52	A
P_D @ T_C = 25°C	Max. Power Dissipation	70*	W
P_D @ T_C = 100°C	Max. Power Dissipation	28*	W
Junction to Case	Linear Derating Factor	0.56*	W/°C
Junction to Ambient	Linear Derating Factor	0.029	W/°C
T_J, Tstg	Operating & Storage Temp. Range	–55 To 150*	°C
Lead Temperature	(1/16" from case for 10 secs.)	300*	°C

1 Pulse Test: Pulsewidth ≤ 300 μsec, Duty Cycle ≤ 2%
* JEDEC Registered Values

Active Region



Power Derating



ELECTRICAL CHARACTERISTICS (T_C = 25°C unless otherwise noted)

STATIC

Parameter		Type	Min.	Typ.	Max.	Units	Test Conditions
$V_{(BR)DSS}$	Drain-Source Breakdown Voltage	2N7059	500*			V	V_{GS} = 0 I_D = 250 μA
$V_{GS(th)}$	Gate-Threshold Voltage	2N7059	2*		4*	V	V_{DS} = V_{GS}, I_D = 1 mA
I_{GSSF}	Gate-Body Leakage Forward	2N7059			100*	nA	V_{GS} = 20V
I_{GSSR}	Gate-Body Leakage Reverse	2N7059			−100*	nA	V_{GS} = −20V
I_{DSS}	Zero Gate Voltage Drain Current	2N7059		0.1	0.25*	mA	V_{DS} = 500V, V_{GS} = 0
		2N7059		0.2	1*		V_{DS} = 400V, V_{GS} = 0, T_C °C
$V_{DS(on)}$	Static Drain-Source On-State Voltage[1]	2N7059		2.66	3.15*	V	V_{GS} = 10V, I_D = 7A
		2N7059		1.52	1.8*		V_{GS} = 10V, I_D = 4A
$r_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7059		0.38	0.45*	Ω	V_{GS} = 10V, I_D = 7A
		2N7059		0.38	0.45*		V_{GS} = 10V, I_D = 4A
$r_{DS(on)}$	Static Drain-Source On-State Resistance[1]	2N7059		0.72	0.86*	Ω	V_{GS} = 10V, I_D = 4A, T_C = 125°C
		2N7059		0.72	0.86*		V_{GS} = 10V, I_D = 3A, T_C = 125°C
G_{fs}	Forward Transconductance[1]	2N7059	6*	7.2		S (℧)	V_{DS} ≥ $2V_{DS(ON)}$, I_D = 7A
V_{SD}	Diode Forward Voltage[1]	2N7059		1.2	1.5*	V	I_S = 12A, V_{GS} = 0

DYNAMIC

C_{iss}	Input Capacitance	2N7059		2400	3300*	pF	V_{GS} = 0, V_{DS} = 25V f = 1 MHz
C_{oss}	Output Capacitance	2N7059		400	700*	pF	
C_{rss}	Reverse Transfer Capacitance	2N7059		120	300*	pF	
C_{D-HS}	Drain–Heatsink Capacitance	2N7059		19		pF	V_{D-HS} = 25V, f = 1 MHz
$t_{d(on)}$	Turn-On Delay Time	2N7059		25	40*	ns	V_{DD} = 210V, R_L = 30Ω, I A V_{GEN} = 10V, R_G = 5Ω (MOSFET switching times are essentially independent of operating temperature)
t_r	Rise Time	2N7059		25	50*	ns	
$t_{d(off)}$	Turn-Off Delay Time	2N7059		75	150*	ns	
t_f	Fall Time	2N7059		31	70*	ns	
t_{rr}	Reverse Recovery Time	2N7059		400	600*	ns	I_F=8A,di/dt=100A/μs

THERMAL RESISTANCE

R_{thJC}	Junction-to-Case	2N7059			1.8*	°C/W	
R_{thJA}	Junction-to-Ambient	2N7059			35	°C/W	Free Air Operation

1 Pulse Test: Pulse Width ≤300 μsec, Duty Cycle ≤2%

* JEDEC Registered Values

TYPICAL PERFORMANCE CURVES (25°C unless otherwise noted)

2N7059

FIGURE 1. Ohmic Region

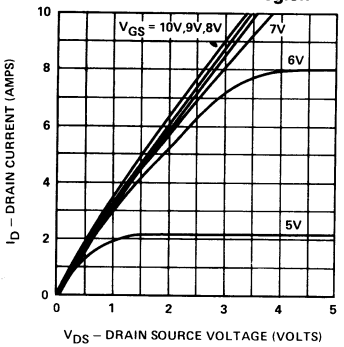


FIGURE 2. Transfer Characteristics

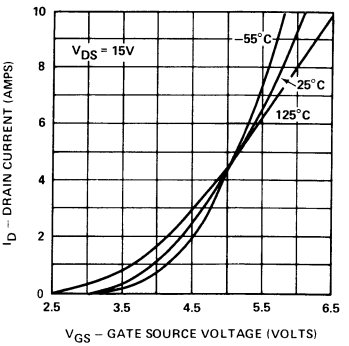


FIGURE 3. Temperature Effects on $r_{DS(on)}$

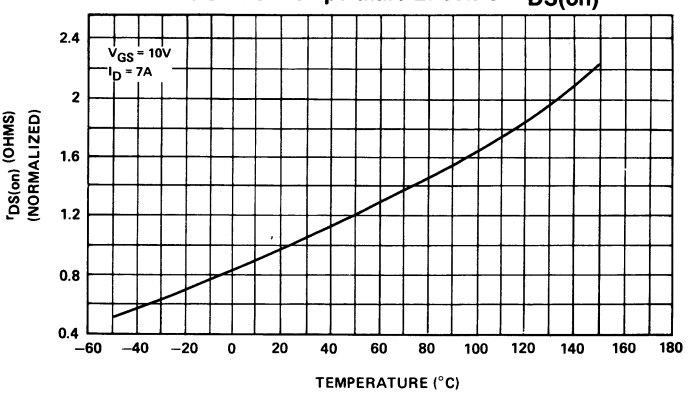


FIGURE 4. Output Characteristics

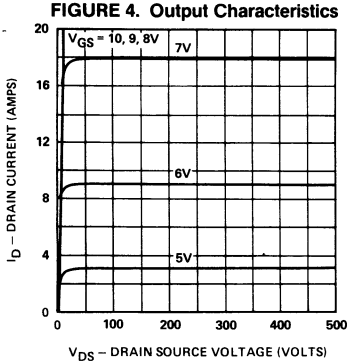
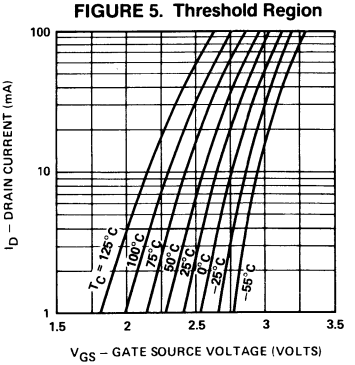


FIGURE 5. Threshold Region



TYPICAL PERFORMANCE CURVES—Continued

2N7059

FIGURE 6. Capacitance

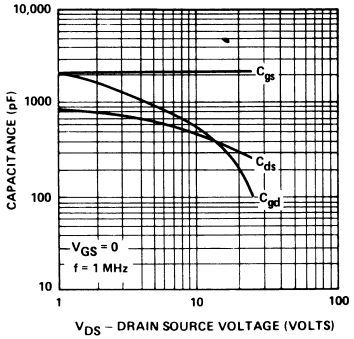


FIGURE 7. Turn-on Charge

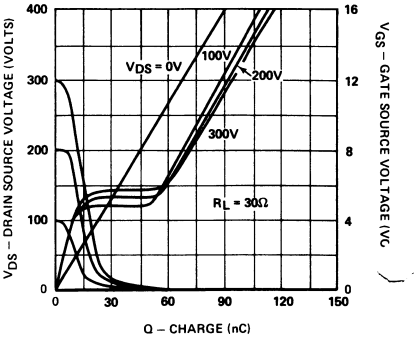
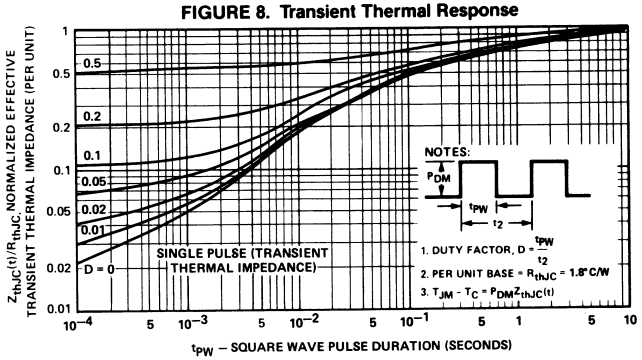
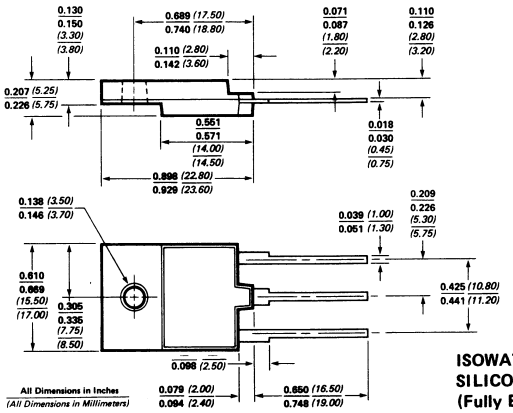


FIGURE 8. Transient Thermal Response



PACKAGE DIMENSIONS



ISOWATT218
SILICONIX PACKAGE TYPE 5475
(Fully Electrically Isolated)