

## SGR2N60UFD

### Ultra-Fast IGBT

#### General Description

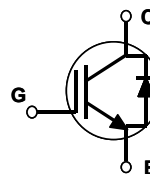
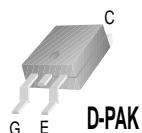
Fairchild's UFD series of Insulated Gate Bipolar Transistors (IGBTs) provides low conduction and switching losses. The UFD series is designed for applications such as motor control and general inverters where high speed switching is a required feature.

#### Features

- High speed switching
- Low saturation voltage :  $V_{CE(sat)} = 2.1 \text{ V @ } I_C = 1.2\text{A}$
- High input impedance
- CO-PAK, IGBT with FRD :  $t_{rr} = 45\text{ns (typ.)}$

#### Applications

AC & DC motor controls, general purpose inverters, robotics, and servo controls.



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

Symbol	Description	SGR2N60UFD	Units
$V_{CES}$	Collector-Emitter Voltage	600	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 20$	V
$I_C$	Collector Current @ $T_C = 25^\circ\text{C}$	2.4	A
	Collector Current @ $T_C = 100^\circ\text{C}$	1.2	A
$I_{CM(1)}$	Pulsed Collector Current	10	A
$I_F$	Diode Continuous Forward Current @ $T_C = 100^\circ\text{C}$	1.5	A
$I_{FM}$	Diode Maximum Forward Current	12	A
$P_D$	Maximum Power Dissipation @ $T_C = 25^\circ\text{C}$	25	W
	Maximum Power Dissipation @ $T_C = 100^\circ\text{C}$	10	W
$T_J$	Operating Junction Temperature	-55 to +150	$^\circ\text{C}$
$T_{stg}$	Storage Temperature Range	-55 to +150	$^\circ\text{C}$
$T_L$	Maximum Lead Temp. for Soldering Purposes, 1/8" from Case for 5 Seconds	300	$^\circ\text{C}$

**Notes :**

(1) Repetitive rating : Pulse width limited by max. junction temperature

#### Thermal Characteristics

Symbol	Parameter	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance, Junction-to-Case	--	5.0	$^\circ\text{C/W}$
$R_{\theta JC}$ (DIODE)	Thermal Resistance, Junction-to-Case	--	5.0	$^\circ\text{C/W}$
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (PCB Mount) (2)	--	50	$^\circ\text{C/W}$

**Notes :**

(2) Mounted on 1" square PCB (FR4 or G-10 Material)

**Electrical Characteristics of the IGBT**  $T_C = 25^\circ\text{C}$  unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
<b>Off Characteristics</b>						
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE} = 0V, I_C = 250\mu A$	600	--	--	V
$\Delta BV_{CES}/\Delta T_J$	Temperature Coefficient of Breakdown Voltage	$V_{GE} = 0V, I_C = 1mA$	--	0.6	--	$V/^\circ C$
$I_{CES}$	Collector Cut-Off Current	$V_{CE} = V_{CES}, V_{GE} = 0V$	--	--	250	$\mu A$
$I_{GES}$	G-E Leakage Current	$V_{GE} = V_{GES}, V_{CE} = 0V$	--	--	$\pm 100$	nA

**On Characteristics**

$V_{GE(th)}$	G-E Threshold Voltage	$I_C = 1.2mA, V_{CE} = V_{GE}$	3.5	4.5	6.5	V
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C = 1.2A, V_{GE} = 15V$	--	2.1	2.6	V
		$I_C = 2.4A, V_{GE} = 15V$	--	2.6	--	V

**Dynamic Characteristics**

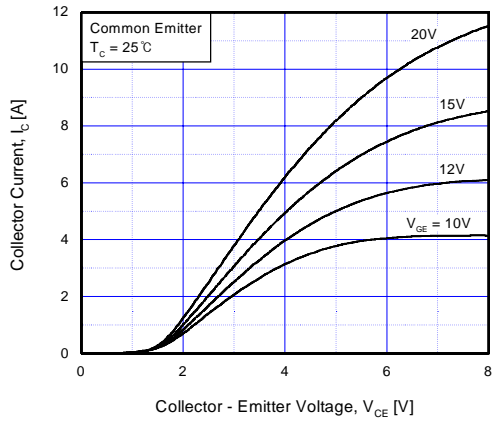
$C_{ies}$	Input Capacitance	$V_{CE} = 30V, V_{GE} = 0V,$ $f = 1MHz$	--	98	--	pF
$C_{oes}$	Output Capacitance		--	18	--	pF
$C_{res}$	Reverse Transfer Capacitance		--	4	--	pF

**Switching Characteristics**

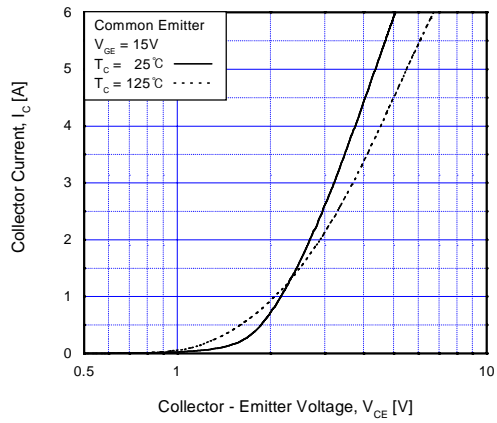
$t_{d(on)}$	Turn-On Delay Time	$V_{CC} = 300V, I_C = 1.2A,$ $R_G = 200\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 25^\circ C$	--	15	--	ns	
$t_r$	Rise Time		--	20	--	ns	
$t_{d(off)}$	Turn-Off Delay Time		--	80	130	ns	
$t_f$	Fall Time		--	95	160	ns	
$E_{on}$	Turn-On Switching Loss		--	30	--	$\mu J$	
$E_{off}$	Turn-Off Switching Loss		--	13	--	$\mu J$	
$E_{ts}$	Total Switching Loss		--	43	70	$\mu J$	
$t_{d(on)}$	Turn-On Delay Time		$V_{CC} = 300V, I_C = 1.2A,$ $R_G = 200\Omega, V_{GE} = 15V,$ Inductive Load, $T_C = 125^\circ C$	--	19	--	ns
$t_r$	Rise Time			--	24	--	ns
$t_{d(off)}$	Turn-Off Delay Time			--	115	200	ns
$t_f$	Fall Time	--		176	250	ns	
$E_{on}$	Turn-On Switching Loss	--		36	--	$\mu J$	
$E_{off}$	Turn-Off Switching Loss	--		27	--	$\mu J$	
$E_{ts}$	Total Switching Loss	--		63	100	$\mu J$	
$Q_g$	Total Gate Charge	$V_{CE} = 300V, I_C = 1.2A,$ $V_{GE} = 15V$		--	9	14	nC
$Q_{ge}$	Gate-Emitter Charge			--	3	5	nC
$Q_{gc}$	Gate-Collector Charge			--	1.5	3	nC
$L_e$	Internal Emitter Inductance	Measured 5mm from PKG	--	7.5	--	nH	

**Electrical Characteristics of DIODE**  $T_C = 25^\circ\text{C}$  unless otherwise noted

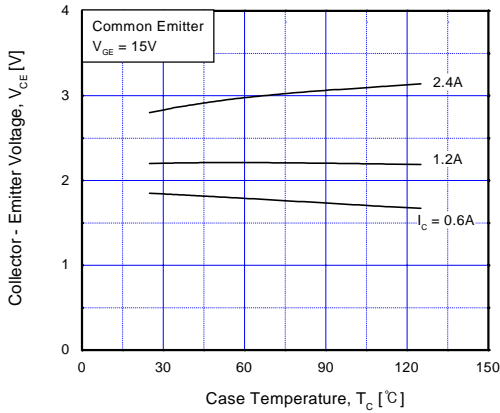
Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units	
$V_{FM}$	Diode Forward Voltage	$I_F = 2A$	$T_C = 25^\circ C$	--	1.4	1.7	V
			$T_C = 100^\circ C$	--	1.3	--	
$t_{rr}$	Diode Reverse Recovery Time	$I_F = 2A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	45	80	ns
			$T_C = 100^\circ C$	--	75	--	
$I_{rr}$	Diode Peak Reverse Recovery Current	$I_F = 2A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	1.5	3.0	A
			$T_C = 100^\circ C$	--	2.5	--	
$Q_{rr}$	Diode Reverse Recovery Charge	$I_F = 2A,$ $di/dt = 200A/\mu s$	$T_C = 25^\circ C$	--	60	135	nC
			$T_C = 100^\circ C$	--	120	--	



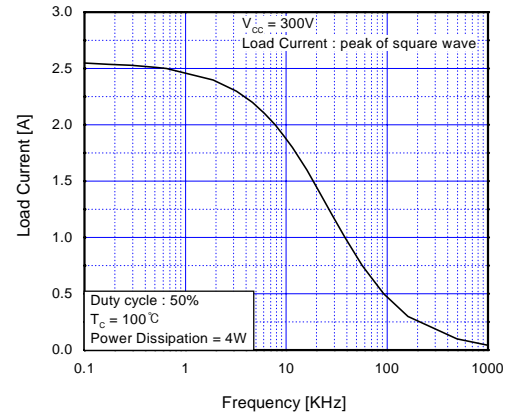
**Fig 1. Typical Output Characteristics**



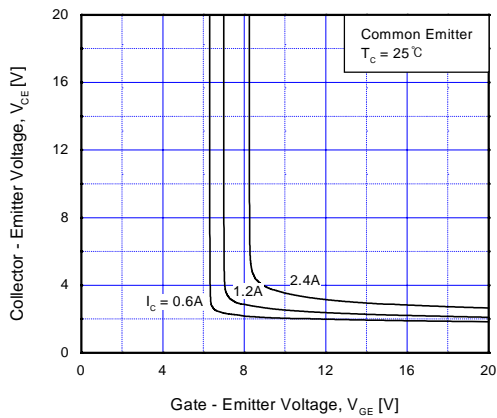
**Fig 2. Typical Saturation Voltage Characteristics**



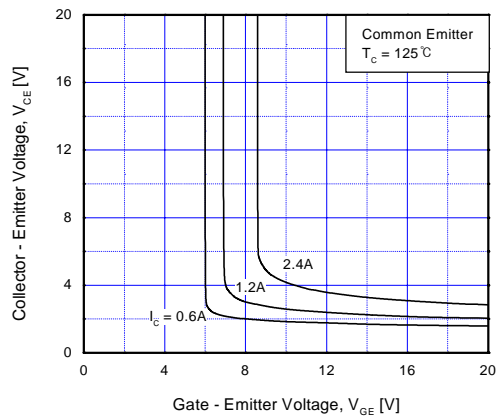
**Fig 3. Saturation Voltage vs. Case Temperature at Variant Current Level**



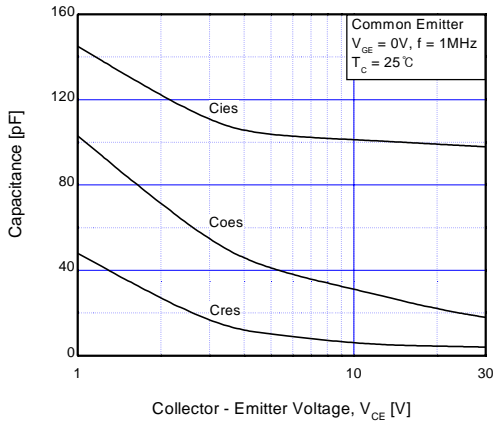
**Fig 4. Load Current vs. Frequency**



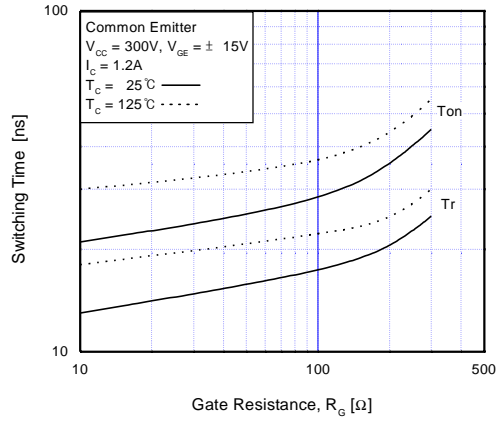
**Fig 5. Saturation Voltage vs.  $V_{GE}$**



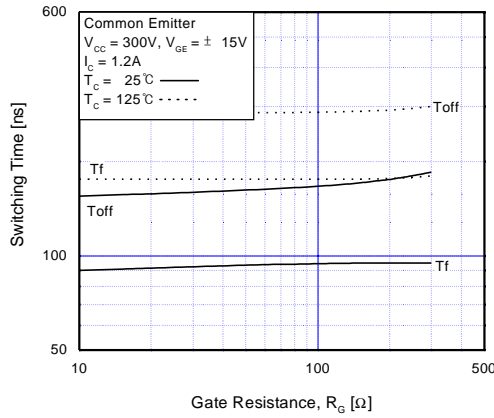
**Fig 6. Saturation Voltage vs.  $V_{GE}$**



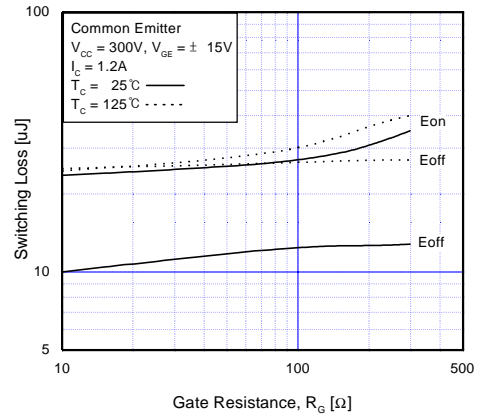
**Fig 7. Capacitance Characteristics**



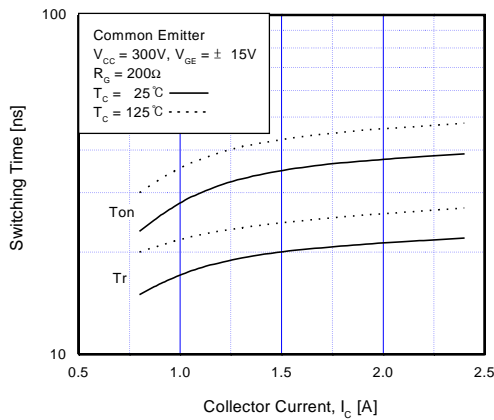
**Fig 8. Turn-On Characteristics vs. Gate Resistance**



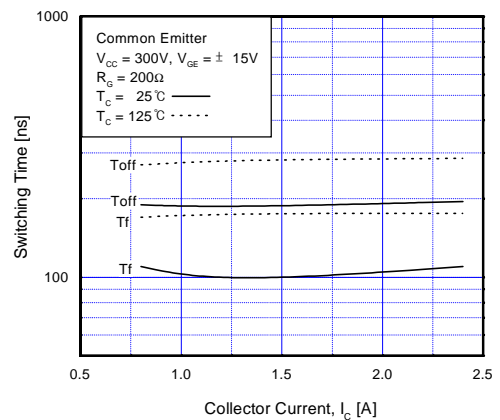
**Fig 9. Turn-Off Characteristics vs. Gate Resistance**



**Fig 10. Switching Loss vs. Gate Resistance**



**Fig 11. Turn-On Characteristics vs. Collector Current**



**Fig 12. Turn-Off Characteristics vs. Collector Current**

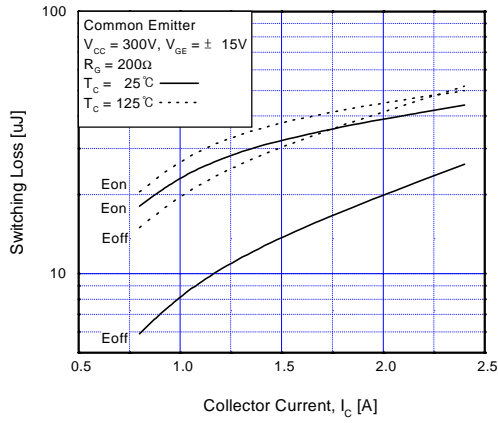


Fig 13. Switching Loss vs. Collector Current

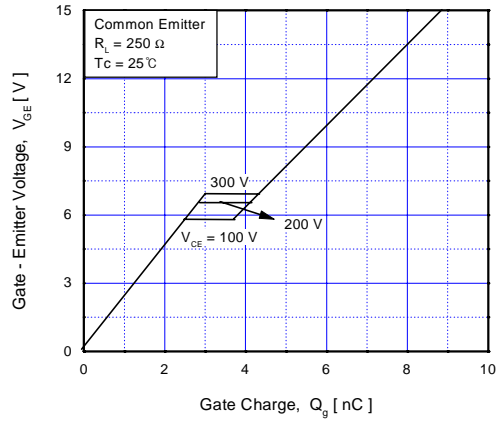


Fig 14. Gate Charge Characteristics

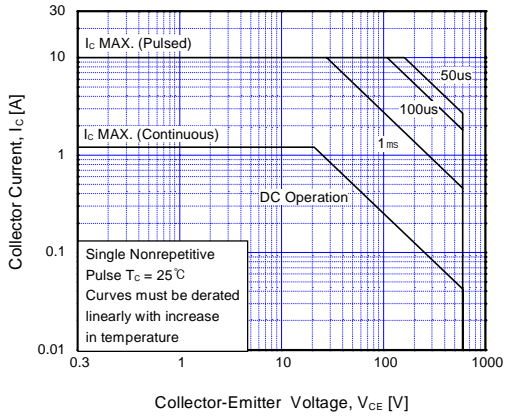


Fig 15. SOA Characteristics

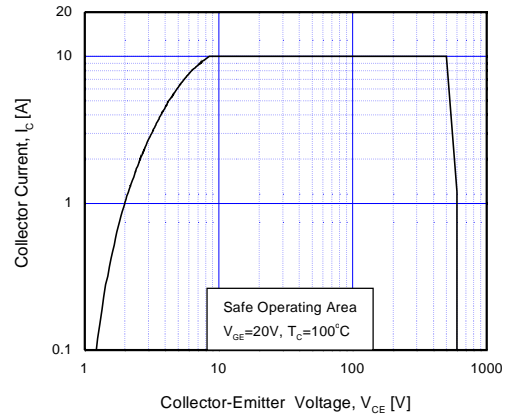


Fig 16. Turn-Off SOA Characteristics

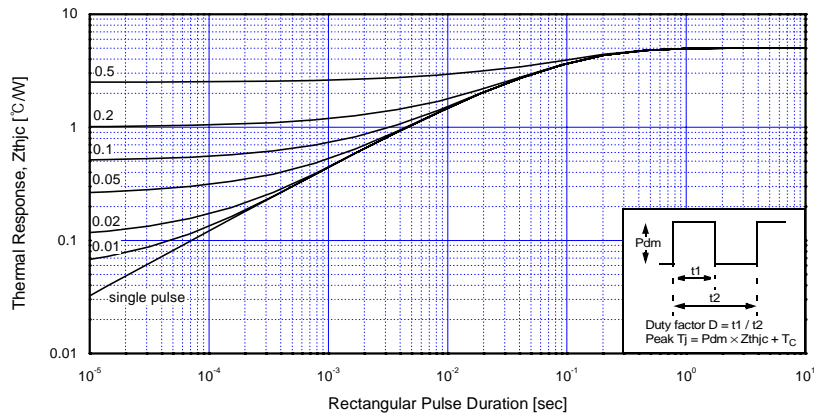


Fig 17. Transient Thermal Impedance of IGBT

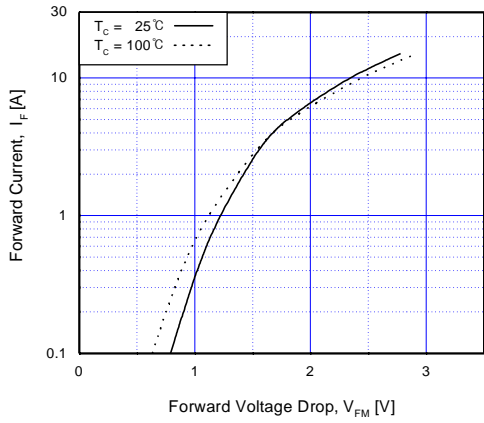


Fig 18. Forward Characteristics

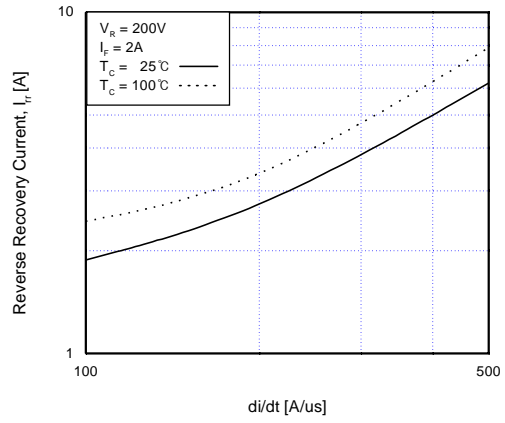


Fig 19. Reverse Recovery Current

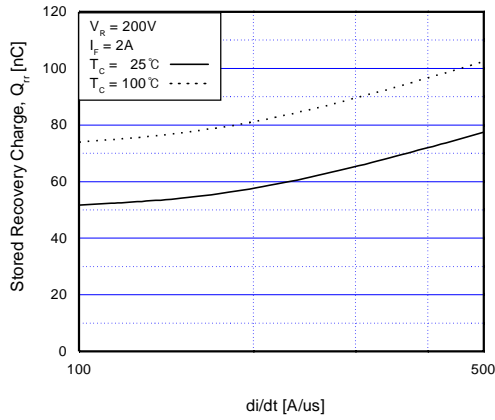


Fig 20. Stored Charge

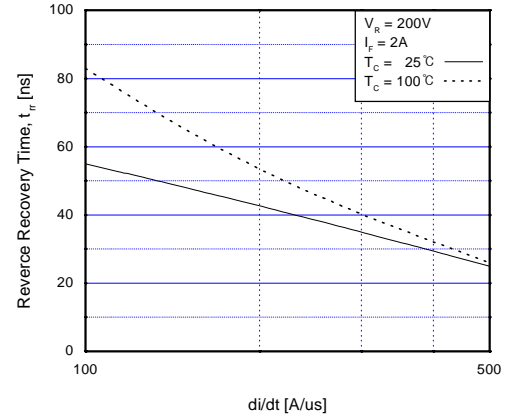


Fig 21. Reverse Recovery Time



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Datasheet Identification	Product Status	Definition
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No Identification Needed	Full Production	This datasheet contains final specifications. Fairchild Semiconductor reserves the right to make changes at any time without notice in order to improve design.
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## SGR2N60UFD

Discrete, High Performance IGBT with Diode

## Contents

[General description](#) | [Features](#) | [Applications](#) | [Product status/pricing/packaging](#) | [Models](#)

## General description

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[back to top](#)

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- High Input Impedance
- CO-PAK, IGBT with FRD :  $t_{rr} = 45$ ns (typ.)

[back to top](#)

## Applications

AC &DC Motor controls, General Purpose Inverters, Robotics, Servo Controls

[back to top](#)[Product status/pricing/packaging](#)

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[Request samples](#)[Dotted line](#)[How to order products](#)[Dotted line](#)[Product Change Notices](#)[\(PCNs\)](#)[Dotted line](#)[Support](#)[Dotted line](#)[Distributor and field sales](#)[representatives](#)[Dotted line](#)[Quality and reliability](#)[Dotted line](#)[Design tools](#)

## Datasheet

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Product	Product status	Pricing*	Package type	Leads	Packing method
SGR2N60UFDTF	Full Production	\$0.68	TO-252(DPAK)	2	TAPE REEL
SGR2N60UFDTM	Full Production	\$0.68	TO-252(DPAK)	2	TAPE REEL

\* 1,000 piece Budgetary Pricing

[back to top](#)

Models

Package & leads	Condition	Temperature range	Software version	Revision date
PSPICE				
TO-252(DPAK)-2	<a href="#">Electrical</a>	25°C	9.2	Jun 28, 2002

[back to top](#)

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