Current Mode Control PWM Regulator IC For Switching Power Supplies

Features and Benefits

- Small DIP8 package with 8 to 24 W power output 230 VAC
- Current Mode PWM control with 67 kHz switching frequency
- Built-in Random Switching function, reducing EMI noise, and simplifying EMI filters, and therefore reducing cost
- Built-in Slope Compensation function, avoiding subharmonic oscillation
- Built-in Auto Standby function (Input Power, P_{IN} < 25 mW at no load)
  - Normal operation: PWM mode
  - Light load operation: Standby mode (burst oscillation)
- Built-in Audible Noise Suppression function during Standby mode
- Built-in Startup Circuit, reducing power consumption in standby operation, and eliminating external components.
- Bias-Assist function, improving startup operation, suppressing V_{CC} voltage drop in operation, and allowing use of smaller V_{CC} capacitor

Continued on the next page…

Package: 8-pin DIP

Not to scale

Description

The STR-A60xxM series are power ICs for switching power supplies, incorporating a power MOSFET and a current mode PWM controller IC. Including a startup circuit and a standby function in the controller, the product achieves low power consumption, low standby power, and high cost-effectiveness power supply systems with few external components.

The STR-A60xxM internal MOSFET has a V_{DSS} of 650 V(min) or 800 V(min), and an $R_{DS(on)}$ of 1.9 to 19.2 Ω with a frequency of 67 kHz. Power output is rated at 8 to 24 W at 230 VAC input and 5 to 20 W at wide input range (85 to 265 VAC).

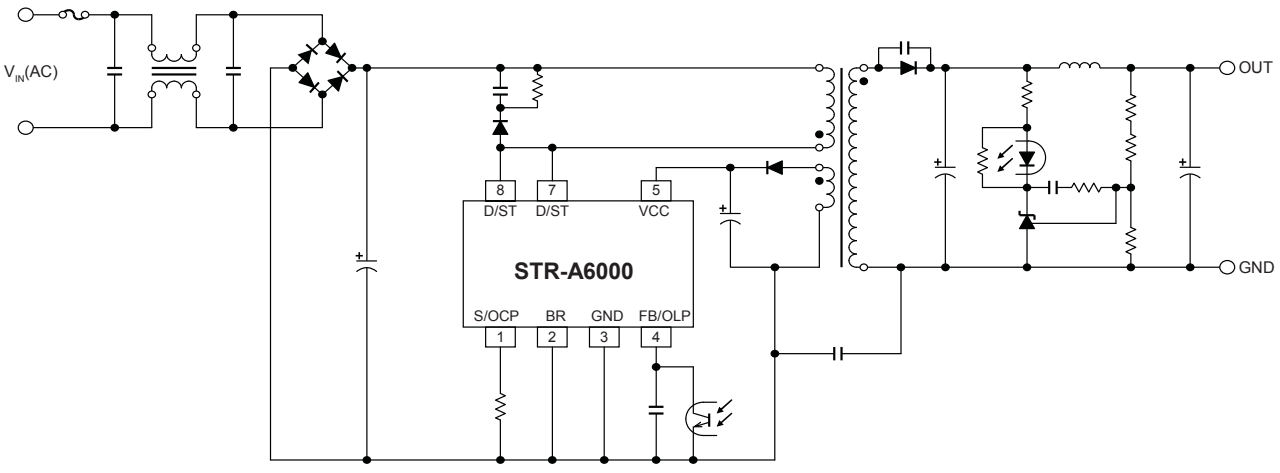
The device is provided in an industry-standard DIP-8 package, with pin 6 removed for increased isolation.

Applications:

For switching power supplies used in:

- Battery chargers for cell phones, digital cameras, video cameras, shavers, emergency lights
- Stand-by power for LCD TVs, desktop PCs, LB Printers, audio equipment
- Small switched-mode power supplies for inkjet printers, DVD/CD players, set-top boxes
- Auxiliary power supplies for A/C, refrigerators, washers, dish washers, and other white goods

Typical Application



Features and Benefits (continued)

- Built-in Leading Edge Blanking function
- Built-in High Speed Latch Release function, releasing the latch shutdown immediately at turning off AC supply
- Two-chip structure, with a controller and a power MOSFET with guaranteed avalanche energy available to simplify surge absorber circuits
- Protection functions:
  - Brown-In and Brown-Out Protection function: auto-restart, prevention of excess input current and heat rise at low input voltage
  - Overcurrent Protection function (OCP): pulse-by-pulse built-in compensation circuit to minimize OCP point variation on AC input voltage
  - Overload Protection function (OLP): auto-restart, built-in timer, reduces heat during overload condition, and no external components required
  - Overvoltage Protection function (OVP): latched shutdown
  - Thermal Shutdown Protection function (TSD): shutdown latches device off to prevent continuous oscillation

Selection Guide

Part Number	f_{OSC} (kHz)	MOSFET V_{DSS}(min) (V)	$R_{DS(on)}$ (max) (Ω)	P_{OUT}* (W)		Package	Packing
				230 V	Wide		
STR-A6051M	67	650	3.95	16	12	DIP8 with pin 6 removed	50 pieces per tube
STR-A6052M			2.8	20	16		
STR-A6053M			1.9	24	20		
STR-A6079M		800	19.2	8	5		

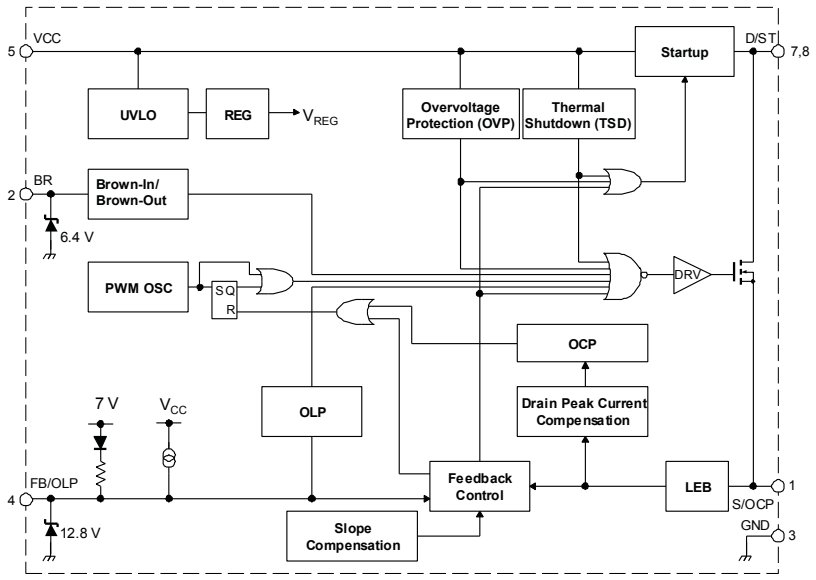
* The listed output power is based on the package thermal ratings, and the peak output power can be 120% to 140% of the value stated here. At low output voltage and short duty cycle, the output power may be less than the value stated here.

Absolute Maximum Ratings[1] Valid at T_A = 25°C, unless otherwise specified

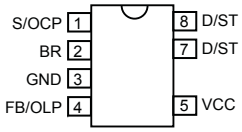
Characteristic	Symbol	Notes		Terminals	Rating	Unit
Drain Current[2]	I_{Dpeak}	Single pulse	STR-A6051M	8 – 1	2.5	A
			STR-A6052M	8 – 1	3.0	A
			STR-A6053M	8 – 1	4.0	A
			STR-A6079M	8 – 1	1.2	A
Single Pulse Avalanche Energy[3]	E_{AS}	Single pulse, V_{DD} = 99 V, L = 20 mH	STR-A6051M	8 – 1	47	mJ
			STR-A6052M	8 – 1	62	mJ
			STR-A6053M	8 – 1	86	mJ
			STR-A6079M	8 – 1	7	mJ
	I_{Lpeak}	Single pulse, V_{DD} = 99 V, L = 20 mH	STR-A6051M	8 – 1	2.0	A
			STR-A6052M	8 – 1	2.3	A
			STR-A6053M	8 – 1	2.7	A
			STR-A6079M	8 – 1	1.2	A
S/OCP Terminal Voltage	V_{OCP}			1 – 3	–2 to 6	V
Controller IC (MIC) Supply Input Voltage	V_{CC}			5 – 3	32	V
FB/OLP Terminal Voltage	V_{FB}			4 – 3	–0.3 to 14	V
FB/OLP Terminal Sink Current	I_{FB}			4 – 3	1.0	mA
BR Terminal Voltage	V_{BR}			2 – 3	–0.3 to 7	V
BR Terminal Sink Current	I_{BR}			2 – 3	1.0	mA
MOSFET Power Dissipation[4]	P_{D1}	Mounted on a 15 mm × 15 mm PCB		8 – 1	1.35	W
Controller IC (MIC) Power Dissipation	P_{D2}			5 – 3	1.2	W
Operating Ambient Temperature	T_{OP}	Maximum recommended internal leadframe temperature, T_F(max) = 115°C		–	–20 to 125	°C
Storage Temperature	T_{stg}			–	–40 to 125	°C
Channel Temperature	T_{ch}			–	150	°C

[1]Current characteristics are defined based on IC as sink (+), or source (–).
[2]Refer to MOSFET Safe Operating Area Curve.
[3]Refer to MOSFET Avalanche Energy Derating Coefficient Curve.
[4]Refer to MOSFET Temperature versus Power Dissipation Curve.

Functional Block Diagram



Pin-out Diagram



Terminal List Table

Number	Name	Function
1	S/OCP	MOSFET source, and input for Overcurrent Protection detection signal
2	BR	Input for Brown-In and Brown-Out Protection detection voltage
3	GND	Ground
4	FB/OLP	Input for constant voltage control signal, and input for Overload Protection signal
5	VCC	Input for power supply for control circuit
6	–	(Pin removed)
7, 8	D/ST	MOSFET drain, and input for startup current

Electrical Characteristics[1] Valid at V_{CC} = 18 V, T_A = 25°C, unless otherwise specified

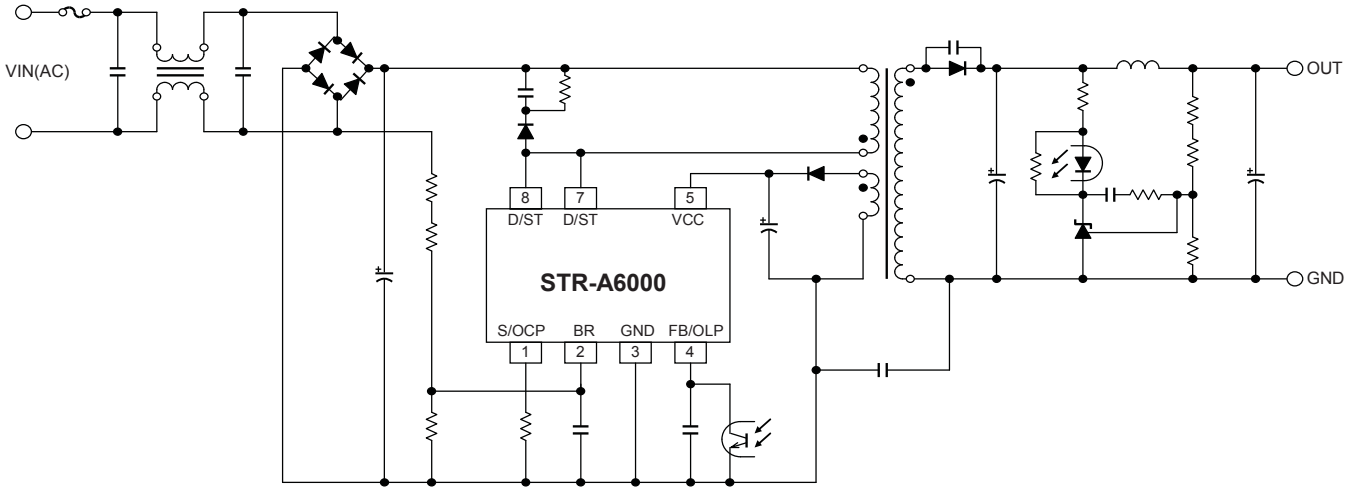
Characteristic	Symbol	Terminal	Min.	Typ.	Max.	Unit
Operation Start Voltage	$V_{CC(ON)}$	5 – 3	13.8	15.3	16.8	V
Operation Stop Voltage[2]	$V_{CC(OFF)}$	5 – 3	7.3	8.1	8.9	V
Circuit Current in Operation	$I_{CC(ON)}$	5 – 3	–	–	2.5	mA
Minimum Startup Voltage	$V_{ST(ON)}$	5 – 3	–	38	–	V
Startup Current	$I_{STARTUP}$	5 – 3	–3.7	–2.5	–1.5	mA
Startup Current Supply Threshold Voltage[2]	$V_{CC(BIAS)}$	5 – 3	8.5	9.5	10.5	V
Average Switching Frequency	$f_{OSC(av)}$	8 – 3	60	67	74	kHz
Switching Frequency Variance Range	Δf	8 – 3	–	5	–	kHz
Maximum Duty Cycle	D_{MAX}	8 – 3	77	83	89	%
Minimum On-Time	$t_{ON(MIN)}$	–	–	540	–	ns
Leading Edge Blanking Time	t_{BW}	–	–	340	–	ns
OCP Compensation Coefficient	D_{PC}	–	–	22	–	mV/µs
Maximum Duty Cycle for OCP Compensation	D_{DPC}	–	–	36	–	%
OCP Threshold Voltage at Zero Duty Cycle	$V_{OCP(L)}$	1 – 3	0.70	0.78	0.86	V
OCP Threshold Voltage at 36% Duty Cycle	$V_{OCP(H)}$	1 – 3	0.81	0.9	0.99	V
Maximum Feedback Current	$I_{FB(MAX)}$	4 – 3	–340	–230	–150	µA
Minimum Feedback Current	$I_{FB(MIN)}$	4 – 3	–30	–15	–7	µA
Oscillation Stop FB/OLP Voltage	$V_{FB(OFF)}$	4 – 3	0.85	0.95	1.05	V
OLP Threshold Voltage	$V_{FB(OLP)}$	4 – 3	7.3	8.1	8.9	V
OLP Delay Time	t_{OLP}	4 – 3	54	68	82	ms
Operation Current After OLP	$I_{CC(OLP)}$	5 – 3	–	300	600	µA
FB/OLP Terminal Clamp Voltage	$V_{FB(CLAMP)}$	4 – 3	11	12.8	14	V
Brown-In Threshold Voltage	$V_{BR(IN)}$	2 – 3	5.2	5.6	6	V
Brown-Out Threshold Voltage	$V_{BR(OUT)}$	2 – 3	4.45	4.8	5.15	V
BR Terminal Clamp Voltage	$V_{BR(CLAMP)}$	2 – 3	6	6.4	7	V
BR Function Disabling Threshold	$V_{BR(DIS)}$	2 – 3	0.3	0.48	0.7	V
OVP Threshold Voltage	$V_{CC(OVP)}$	5 – 3	26	29	32	V
Latch Circuits Sustaining Current[3]	$I_{CC(LATCH)}$	5 – 3	–	700	–	µA
Thermal Shutdown Operating Temperature	$T_{J(TSD)}$	5 – 3	135	–	–	°C

[1]Current characteristics are defined based on IC as sink (+), or source (–).
[2]$V_{CC(BIAS)} > V_{CC(OFF)}$.
[3]A latch circuit is a circuit operated with Overvoltage Protection (OVP) and/or Thermal Shutdown Protection (TSD) in operation.

MOSFET Electrical Characteristics Valid at T_A = 25°C, unless otherwise specified

Characteristic	Symbol	Device	Terminal	Min.	Typ.	Max.	Unit
Drain-to-Source Breakdown Voltage	V_{DSS}	STR-A6051M	8 – 1	650	–	–	V
		STR-A6052M	8 – 1	650	–	–	V
		STR-A6053M	8 – 1	650	–	–	V
		STR-A6079M	8 – 1	800	–	–	V
Drain Leakage Current	I_{DSS}	–	8 – 1	–	–	300	μA
On-Resistance	$R_{DS(on)}$	STR-A6051M	8 – 1	–	–	3.95	Ω
		STR-A6052M	8 – 1	–	–	2.8	Ω
		STR-A6053M	8 – 1	–	–	1.9	Ω
		STR-A6079M	8 – 1	–	–	19.2	Ω
Switching Time	t_f	STR-A6051M	8 – 1	–	–	250	ns
		STR-A6052M	8 – 1	–	–	250	ns
		STR-A6053M	8 – 1	–	–	400	ns
		STR-A6079M	8 – 1	–	–	250	ns
Thermal Resistance*	$R_{\theta chC}$	$R_{\theta chC}$	–	–	–	22	°C/W

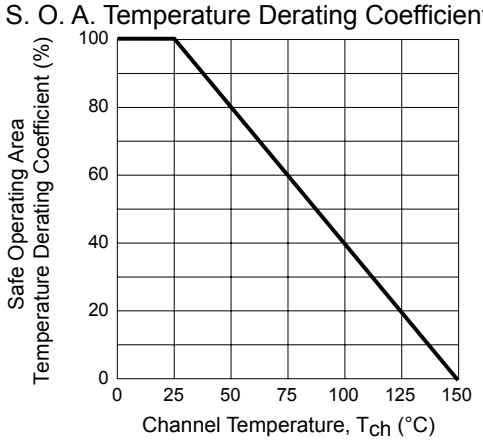
*Case temperature, T_C, is defined at the center of surface on the branded side of the package.



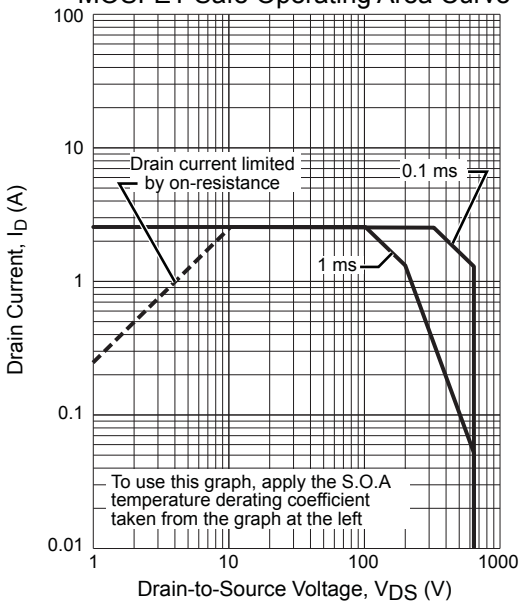
Typical application circuit example. Brown-in/Brown-out function enabled by connecting the BR terminal to a resistive divider

Characteristic Performance
STR-A6051M

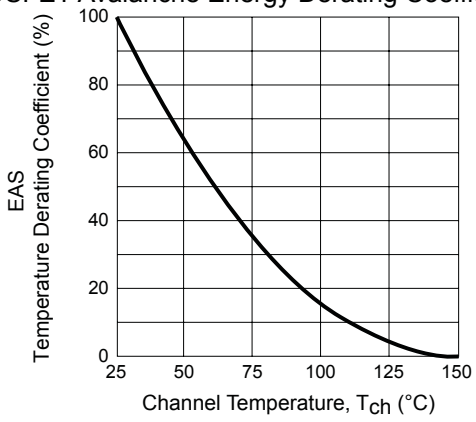
S. O. A. Temperature Derating Coefficient Curve



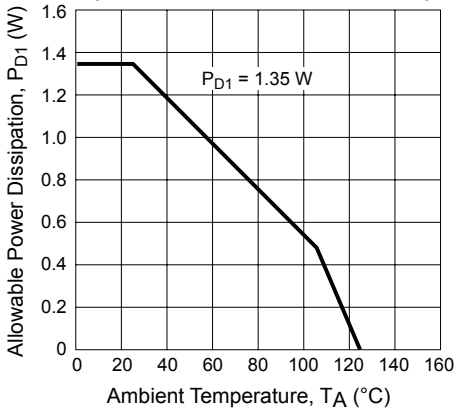
MOSFET Safe Operating Area Curve



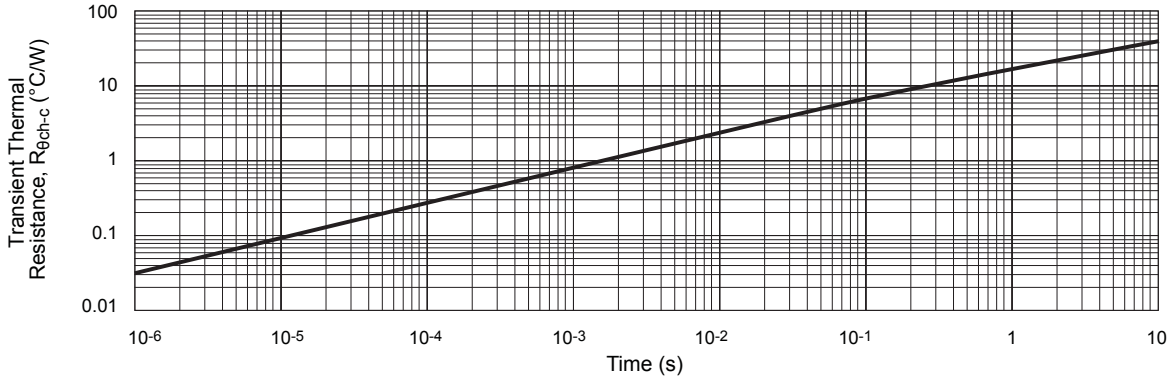
MOSFET Avalanche Energy Derating Coefficient Curve



MOSFET Temperature versus Power Dissipation Curve

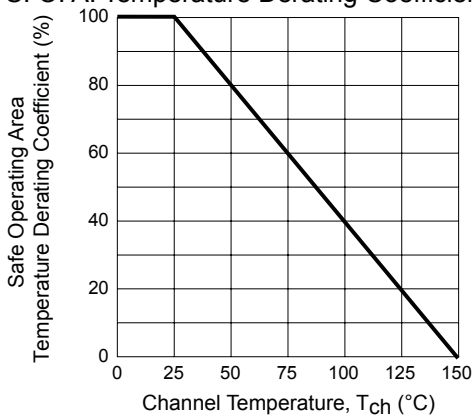


Transient Thermal Resistance Curve

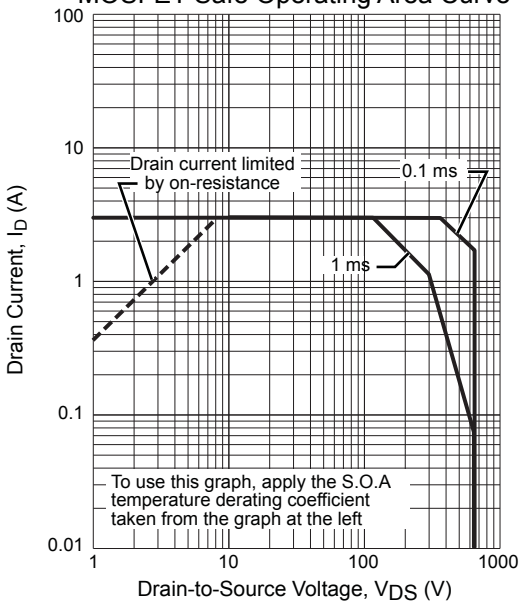


Characteristic Performance
STR-A6052M

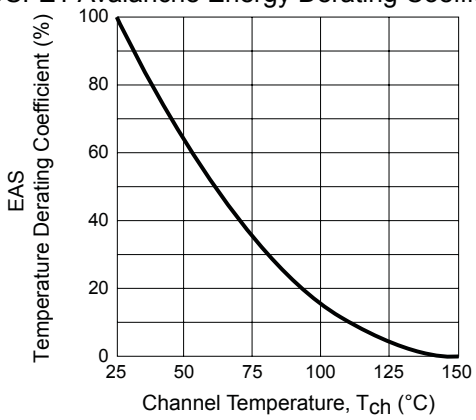
S. O. A. Temperature Derating Coefficient Curve



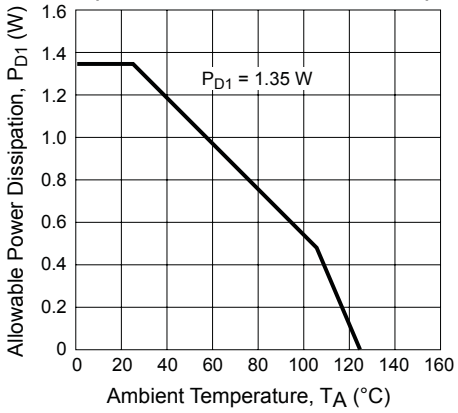
MOSFET Safe Operating Area Curve



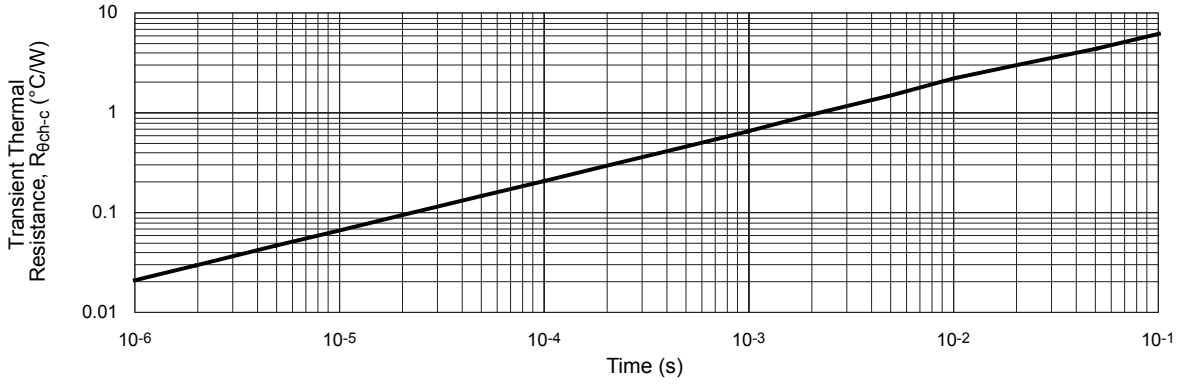
MOSFET Avalanche Energy Derating Coefficient Curve



MOSFET Temperature versus Power Dissipation Curve

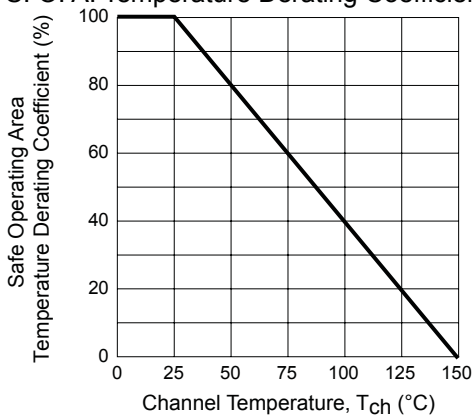


Transient Thermal Resistance Curve

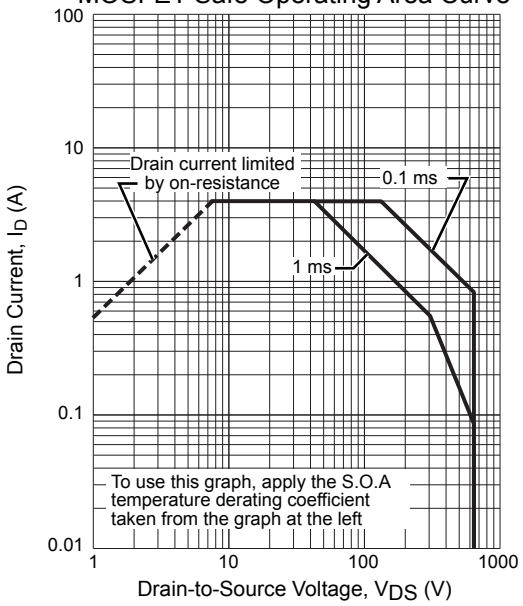


Characteristic Performance
STR-A6053M

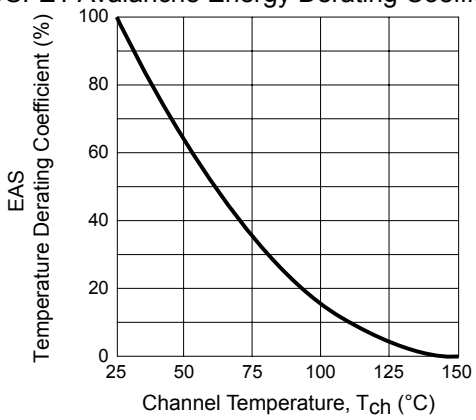
S. O. A. Temperature Derating Coefficient Curve



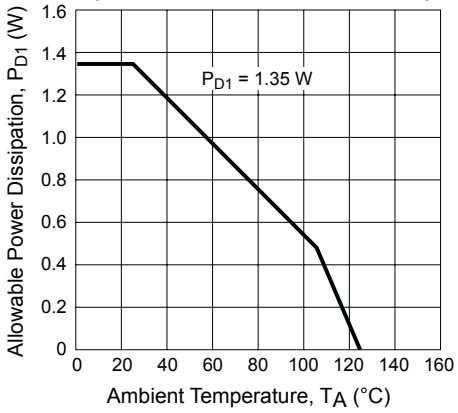
MOSFET Safe Operating Area Curve



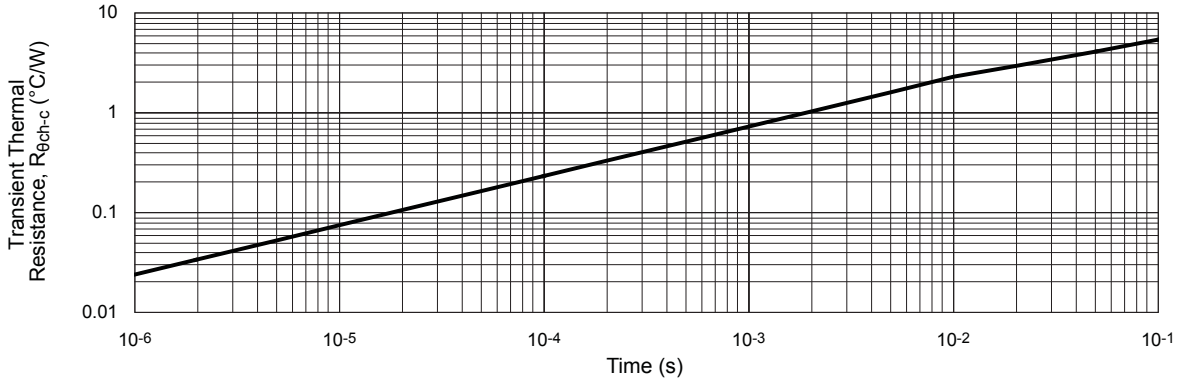
MOSFET Avalanche Energy Derating Coefficient Curve



MOSFET Temperature versus Power Dissipation Curve

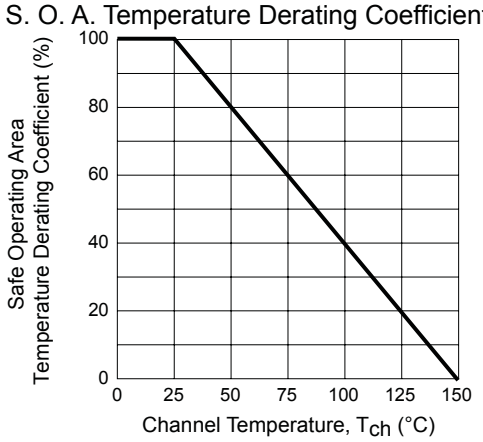


Transient Thermal Resistance Curve

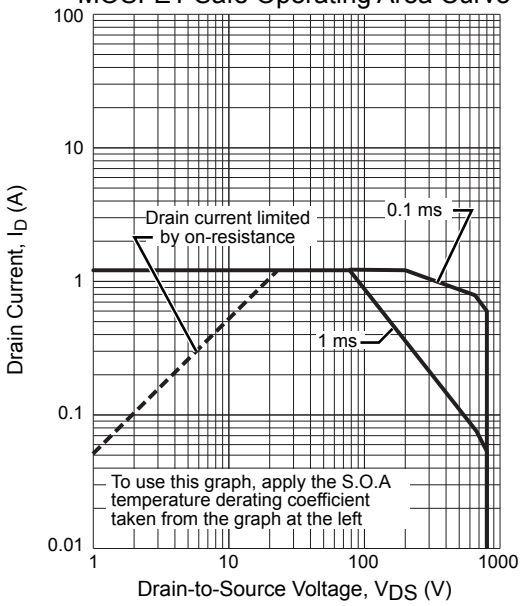


Characteristic Performance
STR-A6079M

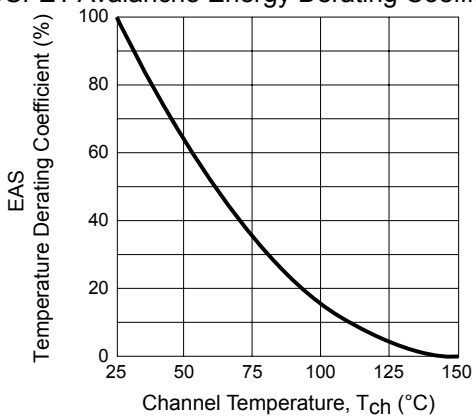
S. O. A. Temperature Derating Coefficient Curve



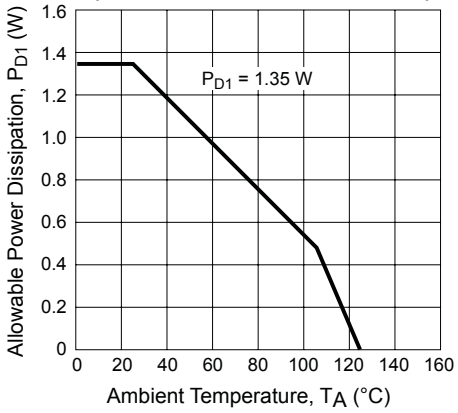
MOSFET Safe Operating Area Curve



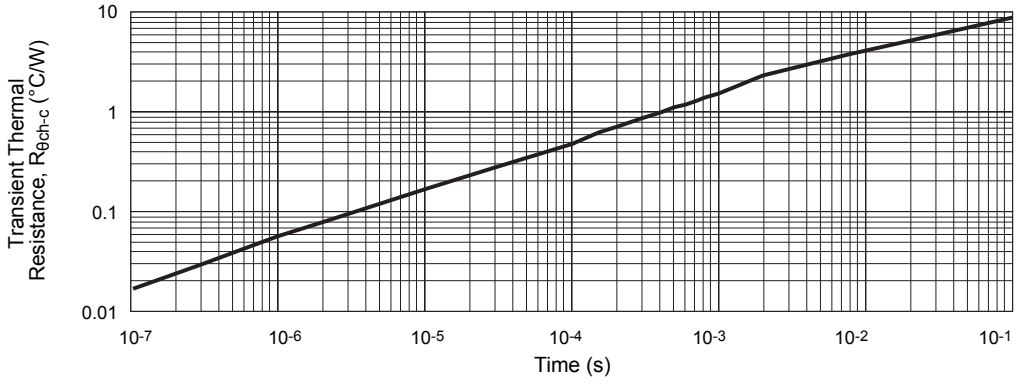
MOSFET Avalanche Energy Derating Coefficient Curve



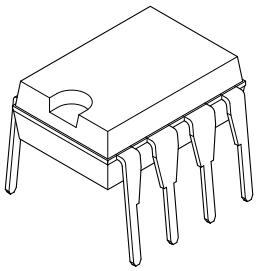
MOSFET Temperature versus Power Dissipation Curve



Transient Thermal Resistance Curve



Package Outline Drawing, DIP-8



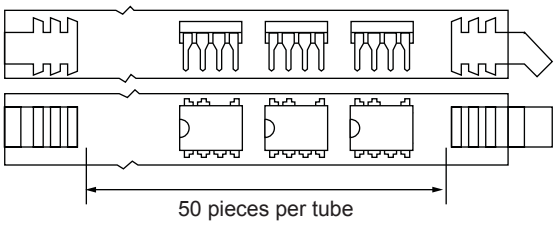
Material of terminal: Cu
Treatment of terminal: Solder plating (Pb-free)
Weight: Approximately 0.51 g
Unit: mm

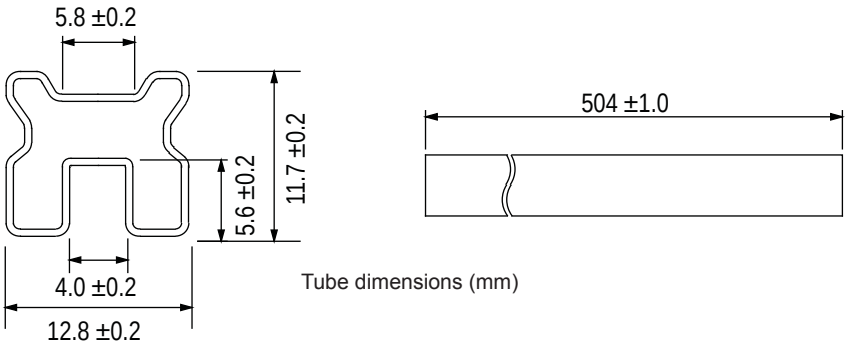
a. Type Number: A60**
b. Lot Number:
1st letter: Last digit of year
2nd letter: Month
1 to 9 for Jan. to Sept.
O for Oct.
N for Nov.
D for Dec.
3rd letter: Week
c. Sanken Registration Number

Appearance: The body shall be clean and shall not bear any stain, rust, or flaw.
Marking: The type number and lot number shall be clearly marked.

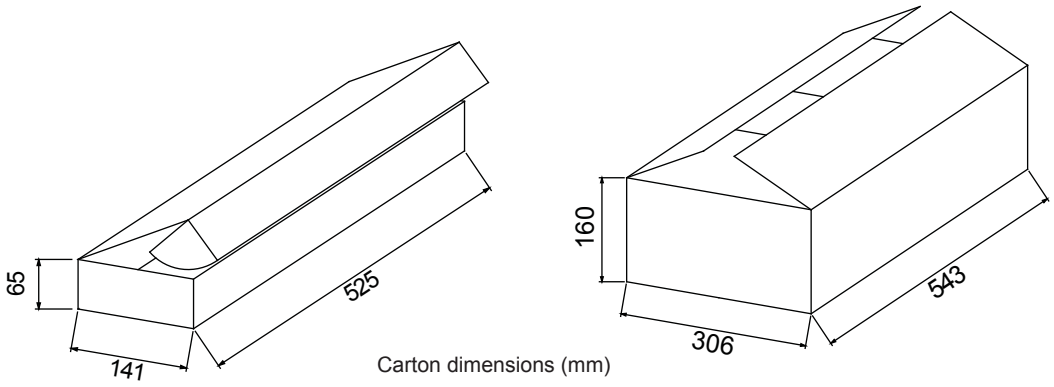
Leadframe plating Pb-free. Device composition compliant with the RoHS directive.

Packing Specifications





Tube dimensions (mm)



Carton dimensions (mm)

50 tubes per inner carton (maximum)
2500 pieces maximum per inner carton

4 inner cartons per outer carton (maximum)
10,000 pieces maximum per outer carton

Because reliability can be affected adversely by improper storage environments and handling methods, please observe the following cautions.

Cautions for Storage

- Ensure that storage conditions comply with the standard temperature (5°C to 35°C) and the standard relative humidity (around 40% to 75%); avoid storage locations that experience extreme changes in temperature or humidity.
- Avoid locations where dust or harmful gases are present and avoid direct sunlight.
- Reinspect for rust on leads and solderability of products that have been stored for a long time.

Cautions for Testing and Handling

When tests are carried out during inspection testing and other standard test periods, protect the products from power surges from the testing device, shorts between the product pins, and wrong connections.

Remarks About Using Silicone Grease with a Heatsink

- When silicone grease is used in mounting this product on a heatsink, it shall be applied evenly and thinly. If more silicone grease than required is applied, it may produce excess stress.
- Volatile-type silicone greases may crack after long periods of time, resulting in reduced heat radiation effect. Silicone grease with low consistency (hard grease) may cause cracks in the mold resin when screwing the product to a heatsink.
- Our recommended silicone greases for heat radiation purposes, which will not cause any adverse effect on the product life, are indicated below:

Type	Suppliers
G746	Shin-Etsu Chemical Co., Ltd.
YG6260	Momentive Performance Materials Holding, Inc.
SC102	Dow Corning Toray Co., Ltd.

Soldering

- Leadframe temperature, T_F, should not exceed 115°(max)
- When soldering the products, please be sure to minimize the working time, within the following limits:
  260±5°C 10 s
  350±5°C 3 s (solder iron)
- To avoid internal chip damage, soldering on each of the lead-pins should be at a distance of at least 1.5 mm away from the body of the products.

Electrostatic Discharge

- When handling the products, the operator must be grounded. Grounded wrist straps worn should have at least 1 MΩ of resistance from the operator to ground to prevent shock hazard, and it should be placed near the operator.
- Workbenches where the products are handled should be grounded and be provided with conductive table and floor mats.
- When using measuring equipment such as a curve tracer, the equipment should be grounded.
- When soldering the products, the head of soldering irons or the solder bath must be grounded in other to prevent leak voltages generated by them from being applied to the products.
- The products should always be stored and transported in Sanken shipping containers or conductive containers, or be wrapped in aluminum foil.

The products described herein are manufactured in Japan by Sanken Electric Co., Ltd. for sale by Allegro MicroSystems, Inc.

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Worldwide Contacts

Asia-Pacific

China

Sanken Electric Hong Kong Co., Ltd.
Suite 1026, Ocean Centre
Canton Road, Tsimshatsui
Kowloon, Hong Kong
Tel: 852-2735-5262, Fax: 852-2735-5494

Sanken Electric (Shanghai) Co., Ltd.
Room 3202, Maxdo Centre
Xingyi Road 8, Changning District
Shanghai, China
Tel: 86-21-5208-1177, Fax: 86-21-5208-1757

Sanken Electric (Shanghai) Co., Ltd.
Shenzhen Office
Room 1013, Xinhua Insurance Building
Mintian Road, Futian District
Shenzhen City, Guangdong, China
Tel: 86-755-3391-9356/9358, Fax: 86-755-3391-9368

Taiwan Sanken Electric Co., Ltd.
Room 1801, 18th Floor
88 Jung Shiau East Road, Sec. 2
Taipei 100, Taiwan R.O.C.
Tel: 886-2-2356-8161, Fax: 886-2-2356-8261

Japan

Sanken Electric Co., Ltd.
Overseas Sales Headquarters
Metropolitan Plaza Building
1-11-1 Nishi-Ikebukuro, Toshima-ku
Tokyo 171-0021, Japan
Tel: 81-3-3986-6164, Fax: 81-3-3986-8637

Korea

Sanken Electric Korea Co., Ltd.
Samsung Life Yeouido Building 16F
23-10, Yeouido-Dong, Yeongdeungpo-gu
Seoul 150-734, Korea
Tel: 82-2-714-3700, Fax: 82-2-3272-2145

Singapore

Sanken Electric Singapore Pte. Ltd.
152 Beach Road, #10-06 The Gateway East
Singapore 189721
Tel: 65-6291-4755, Fax: 65-6297-1744

Europe

Sanken Power Systems (UK) Limited
Pencoed Technology Park
Pencoed, Bridgend CF35 5HY, United Kingdom
Tel: 44-1656-869-100, Fax: 44-1656-869-162

North America

United States

Allegro MicroSystems, Inc.
115 Northeast Cutoff
Worcester, Massachusetts 01606, U.S.A.
Tel: 1-508-853-5000, Fax: 1-508-853-7895

Allegro MicroSystems, Inc.
14 Hughes Street, Suite B105
Irvine, California 92618, U.S.A.
Tel: 1-949-460-2003, Fax: 1-949-460-7837