Built-in Auto Standby Function, Input Power, P_{IN} < 40 mW at no load
PRC Off-Line Switching Regulators

STR-A6131M/51M/59M

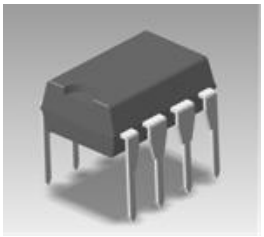
Sep. 25, 2013

General Description

The STR-A6131M/51M/59M is power ICs for switching power supplies, incorporating a power MOSFET and a current mode PRC controller IC. PRC stands for Pulse Ratio Control (on-pulse-width control with fixed off-time) 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.

Package

DIP8



Features and Benefits

- Current mode PRC control
- Built-in Auto Standby Function
  (Input Power, P_{IN} < 40mW at no load)
  In normal operation --------- PRC mode
  In standby operation (at light load) ------Standby mode
  (burst oscillation operation)
- Built-in Startup Function
- Built-in Leading Edge Blanking function
- Protection features
  - Overcurrent protection (OCP): pulse-by-pulse
  - Overvoltage protection (OVP): latched shutdown
  - Overload protection (OLP): Auto restart
  - Thermal shutdown(TSD): latched shutdown

Electrical Characteristics

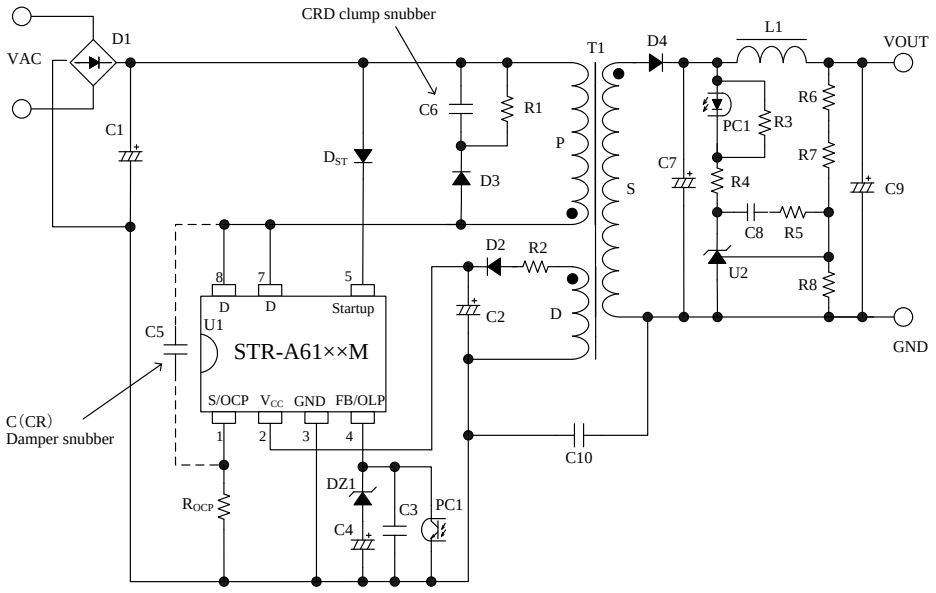
- Maxium OFF Time, $t_{OFF(MAX)}$(typ.) = 11.5 µs
- MOSFET Rating and Output Power, P_{OUT}

Product name	MOSFET		P_{OUT}	
	V_{DSS} (min.)	$R_{DS(ON)}$ (max.)	AC220V	Universal
STR-A6131M	500V	3.95Ω	13W (AC100V)	15W (AC120V)
STR-A6151M	650V	3.95Ω	15W	13W
STR-A6159M	650V	6Ω	13W	10W

Applications

- Battery charger
  Mobile phone, Electronic camera, Camcorder, Electrical shaver, emergency light, Guide light, etc.
- Stand-by power supply
  LCD television, PDP television, Desktop PC, LBP, Audeo, etc.
- Small switched-mode power supply (SMPS)
  Bubble jet printer, BD/DVD/CD player, Set-top box, etc
- Auxiliary power supply for controler
  Air conditioner, Refrigerator, Washer, Dishwasher, etc.

Typical Application Circuit



Absolute maximum ratings (1) Valid at Ta = 25°C, unless otherwise specified

Characteristic	Pins	Symbol	Conditions	Rating	Unit	Notes
Drain Current (2)	8 − 3	I_{DPEAK}	Single pulse	3.2	A	STR-A6131M
				2.5	A	STR-A6151M
				1.8	A	STR-A6159M
Maximum switching current (2)	8 − 3	I_{DMAX}	V_{1-3}=0.96V Ta=−20 to +125°C	3.2	A	STR-A6131M
			V_{1-3}=0.96V Ta=−20 to +125°C	2.5	A	STR-A6151M
			V_{1-3}=0.86V Ta=−20 to +125°C	1.8	A	STR-A6159M
Single Pulse Avalanche Energy (3)	8 − 3	E_{AS}	Single pulse V_{DD}=99V,L=20mH I_L= 2.1A	32	mJ	STR-A6131M
			Single pulse V_{DD}=99V,L=20mH I_L= 2.5A	72	mJ	STR-A6151M
			Single pulse V_{DD}=99V,L=20mH I_L= 1.8A	24	mJ	STR-A6159M
OCP Pin Voltage	1 − 3	V_{OCP}		−0.5 to 6	V	
V_{CC} Pin Voltage	2 − 3	V_{CC}		35	V	
FB/OLP Pin Voltage	4 − 3	$V_{FB/OLP}$		−0.5 to 10	V	
Startup Pin Voltage	5 − 3	$V_{STARTUP}$		−0.3 to 600	V	
Allowable Power Dissipation of MOSFET (4)	8 − 3	P_{D1}	(6)	1.35	W	
Allowable Power Dissipation of MIC (5)	2 − 3	P_{D2}		0.15	W	
Operating Internal Frame Temperature	—	T_F		−20 to +125	°C	Recommended operating temperature T_F = 115 °C (max.)
Operating Ambient Temperature	—	T_{OP}		−20 to +125	°C	
Storage Temperature	—	T_{stg}		−40 to +125	°C	
Channel Temperature	—	T_{ch}		+150	°C	

(1) The polarity value for current specifies a sink as "+ ," and a source as "−," referencing the IC
(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
(5) Refer to MIC Temperature versus Power Dissipation Curve
(6) When embedding this hybrid IC onto the printed circuit board (cupper area in a 15mm×15mm)

Electrical characteristics in Control Part [1] Valid at V_{CC}= 20 V, Ta = 25°C, unless otherwise specified

Characteristic	Pins	Symbol	Min.	Typ.	Max.	Unit	Notes
Operation Start Voltage	2 − 3	$V_{CC(ON)}$	16	17.5	19.2	V	
Operation Stop Voltage	2 − 3	$V_{CC(OFF)}$	9	10	11	V	
Circuit Current in Operation	2 − 3	$I_{CC(ON)}$	—	—	4	mA	
Circuit Current in Non-operation	2 − 3	$I_{CC(OFF)}$	—	—	50	µA	V_{CC}= 14V
Maximum OFF Time	8 − 3	$t_{OFF(MAX)}$	10.5	11.5	12.5	µs	
OCP Threshold Voltage	1 − 3	$V_{OCP(TH)}$	0.96	1.13	1.28	V	
Leading Edge Blanking Time	8 − 3	t_{BW}	200	320	480	ns	
Burst Threshold Voltage	4 − 3	V_{BURST}	0.66	0.75	0.84	V	
OLP Threshold Voltage	4 − 3	V_{OLP}	6.5	7.2	7.9	V	
FB/OLP Pin Current at OLP Operation	4 − 3	I_{OLP}	−35	−26	−18	µA	STR-A6131M
			−34.1	−26	−18.2	µA	STR-A6151M STR-A6159M
Maximum FB/OLP Pin Current	4 − 3	$I_{FB(MAX)}$	−390	−300	−220	µA	
Start-Up Current	5 − 3	$I_{STARTUP}$	−1230	−790	−340	µA	V_{CC}= 15V
Start-Up Circuit Leakage Current	5 − 3	$I_{START(leak)}$	−30	—	—	µA	
V_{CC} Pin OVP Threshold Voltage	2 − 3	$V_{CC(OVP)}$	28.7	31.2	34.1	V	
OVP/TSD Latch Sustaining Current [2]	2 − 3	$I_{CC(H)}$	—	—	200	µA	
OVP/TSD Latch Release Voltage [2]	2 − 3	$V_{CC(La.OFF)}$	6.6	7.3	8.0	V	
Thermal Shutdown Operating Temperature	—	$T_{j(TSD)}$	135	—	—	°C	

[1] The polarity value for current specifies a sink as "+ ," and a source as "−," referencing the IC
[2] A latch circuit is a circuit operated with Overvoltage Protection (OVP) and/or Thermal Shutdown Protection (TSD) in operation.

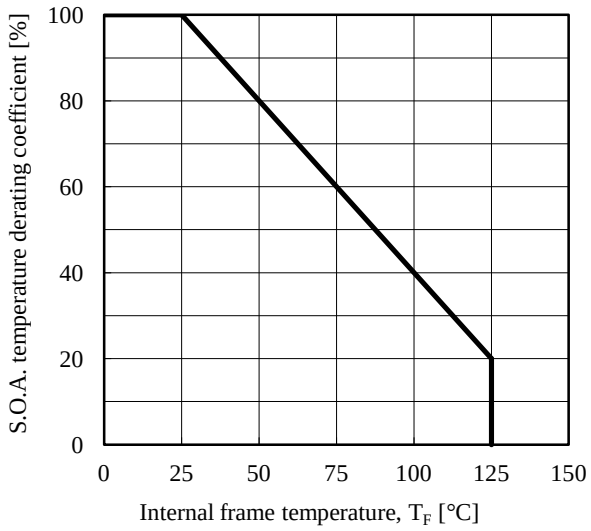
MOSFET Electrical Characteristics[1] Ta= 25°C, unless otherwise specified

Characteristic	Pins	Symbol	Min.	Typ.	Max.	Unit	Notes
Drain-to-Source Breakdown Voltage Drain Leakage Current	8 – 1	V_{DSS}	500	—	—	V	STR-A6131M
			650	—	—	V	STR-A6151M STR-A6159M
On-Resistance	8 – 1	I_{DSS}	—	—	300	µA	
Switching Time	8 – 1	$R_{DS(ON)}$	—	—	3.95	Ω	STR-A6131M STR-A6151M
			—	—	6	Ω	STR-A6159M
Drain-to-Source Breakdown Voltage	8 – 3	t_f	—	—	250	ns	
Drain Leakage Current [2]	—	θ_{ch-F}	—	—	52	°C/W	

[1] The polarity value for current specifies a sink as "+ ," and a source as "−," referencing the IC
[2] The thermal resistance between the channels of the MOSFET and the case.
T_C measured at the center of the case top surface.

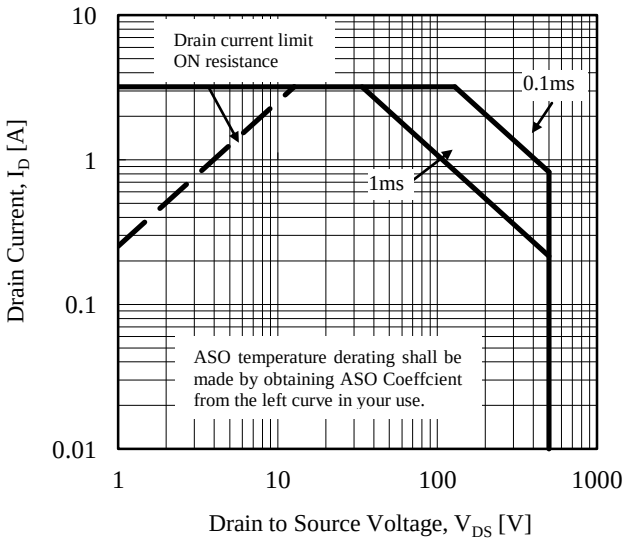
STR-A6131M MOSFET Performance Curves

S.O.A. temperature derating coefficient curve

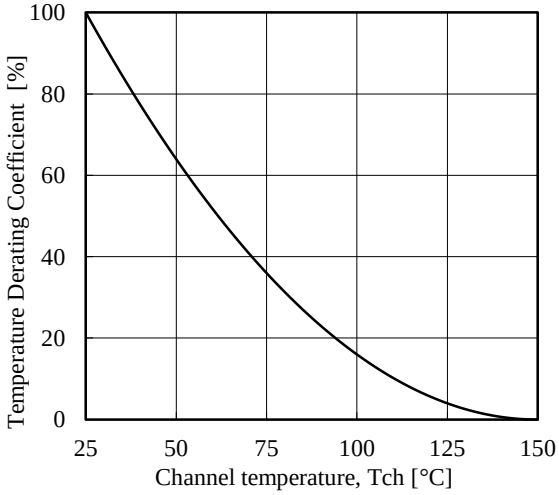


MOSFET Safe Operating Area Curve

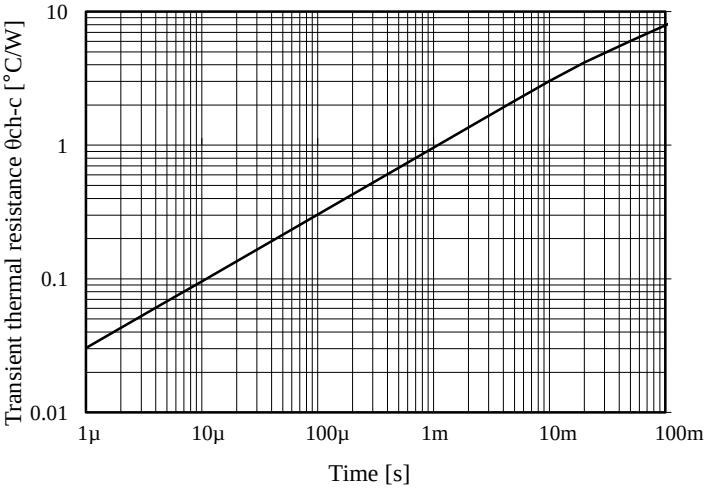
Ta=25°C Single pulse



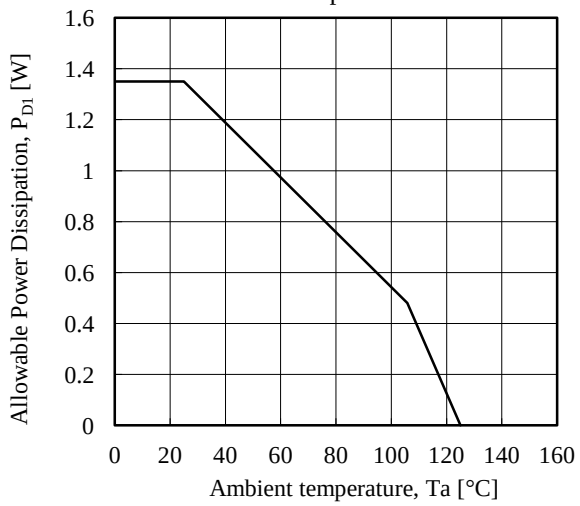
MOSFET Avalanche Energy Derating Coefficient Curve



Transient thermal resistance curve

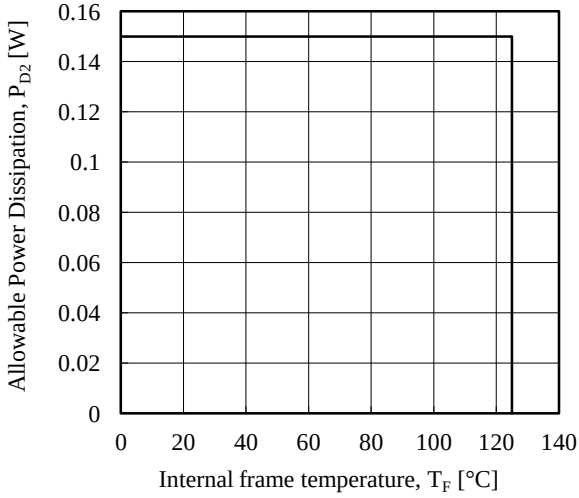


P_{D1}=1.35 [W] T Temperature versus Power Dissipation Curve 1



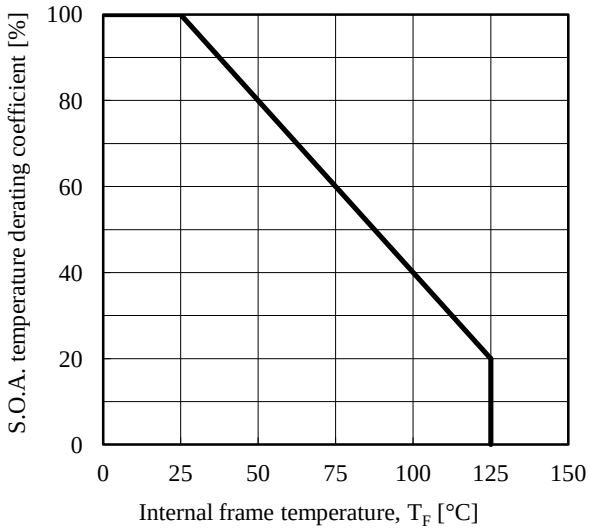
MIC Temperature versus

P_{D2}=0.15 [W] ıtion Curve 2



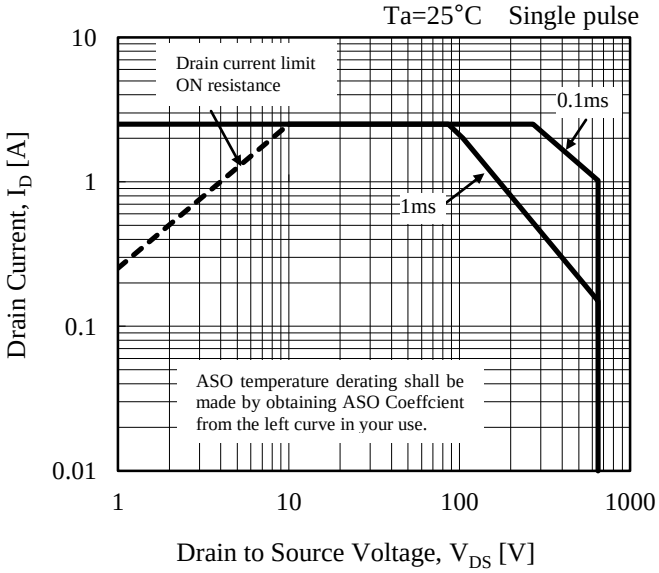
STR-A6151M MOSFET Performance Curves

S.O.A. temperature derating coefficient curve

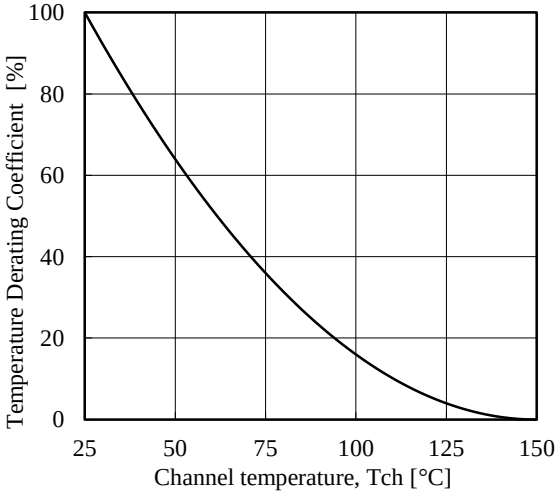


MOSFET Safe Operating Area Curve

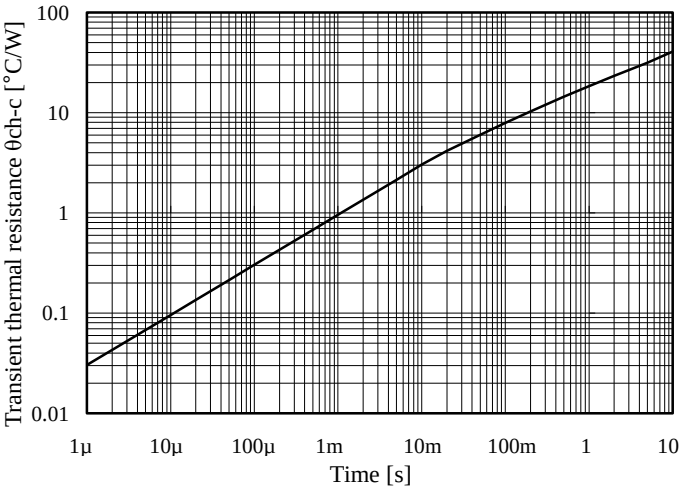
Ta=25°C Single pulse



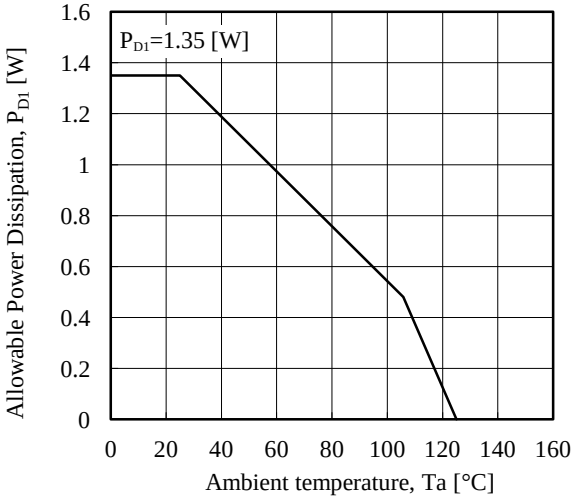
MOSFET Avalanche Energy Derating Coefficient Curve



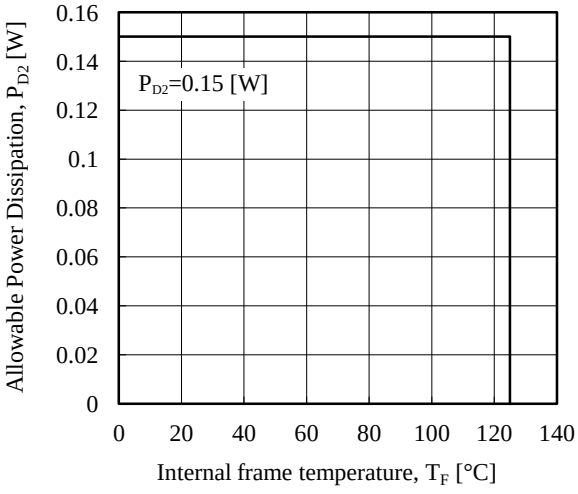
Transient thermal resistance curve



MOSFET Temperature versus Power Dissipation Curve 1

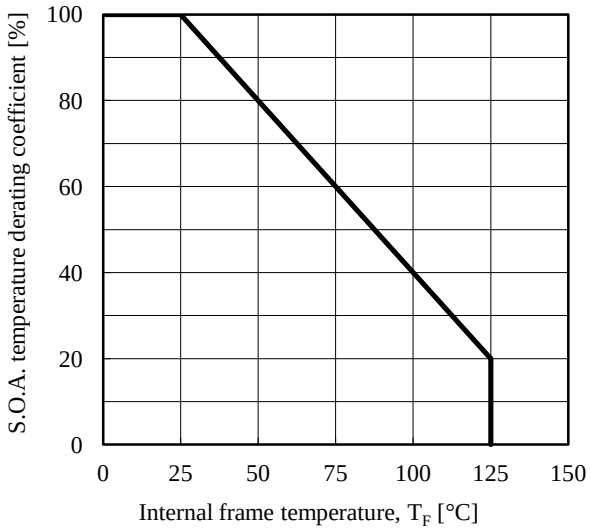


MIC Temperature versus Power Dissipation Curve 2

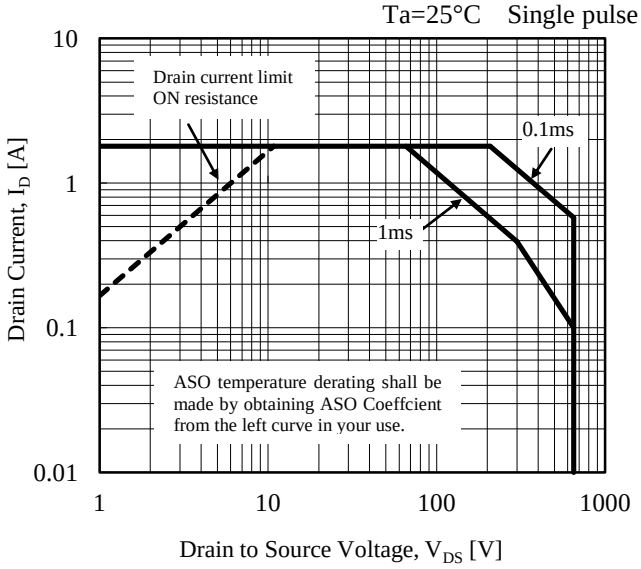


STR-A6159M MOSFET Performance Curves

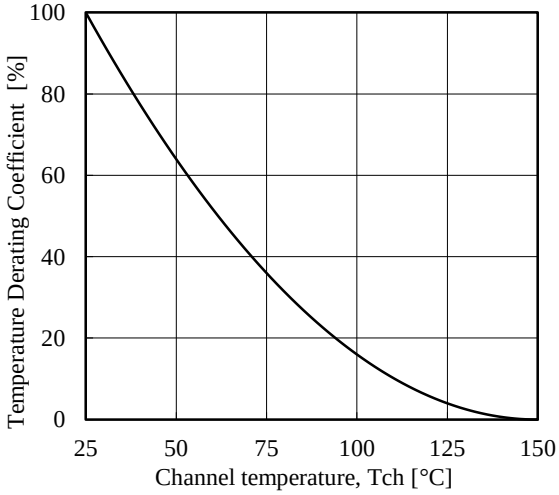
S.O.A. temperature derating coefficient curve



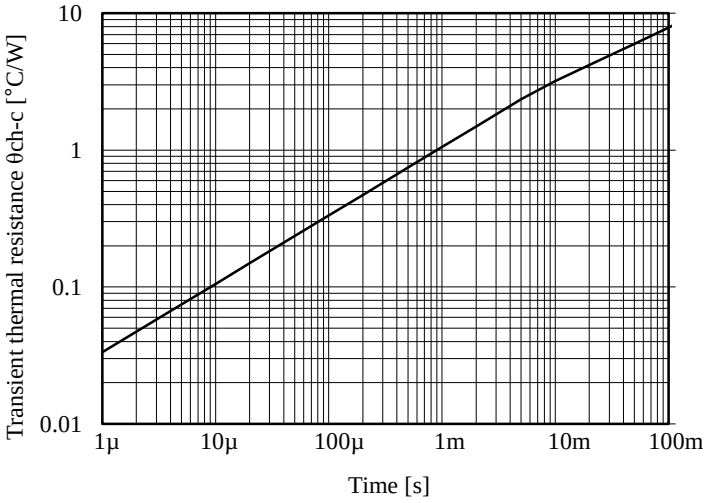
MOSFET Safe Operating Area Curve
Ta=25°C Single pulse



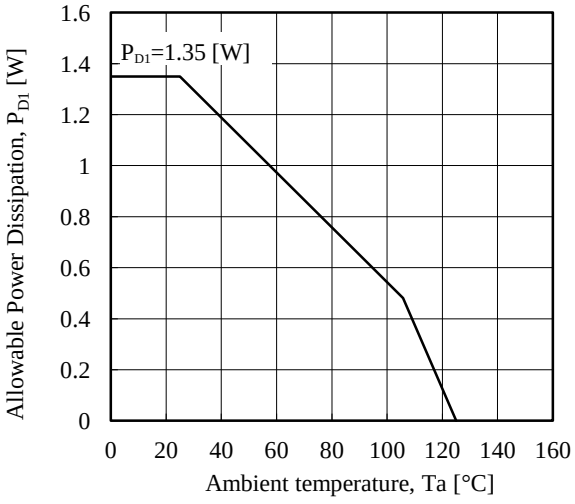
MOSFET Avalanche Energy Derating Coefficient Curve



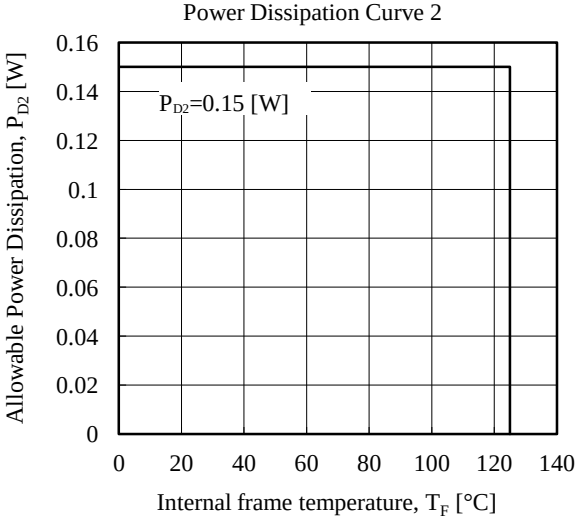
Transient thermal resistance curve



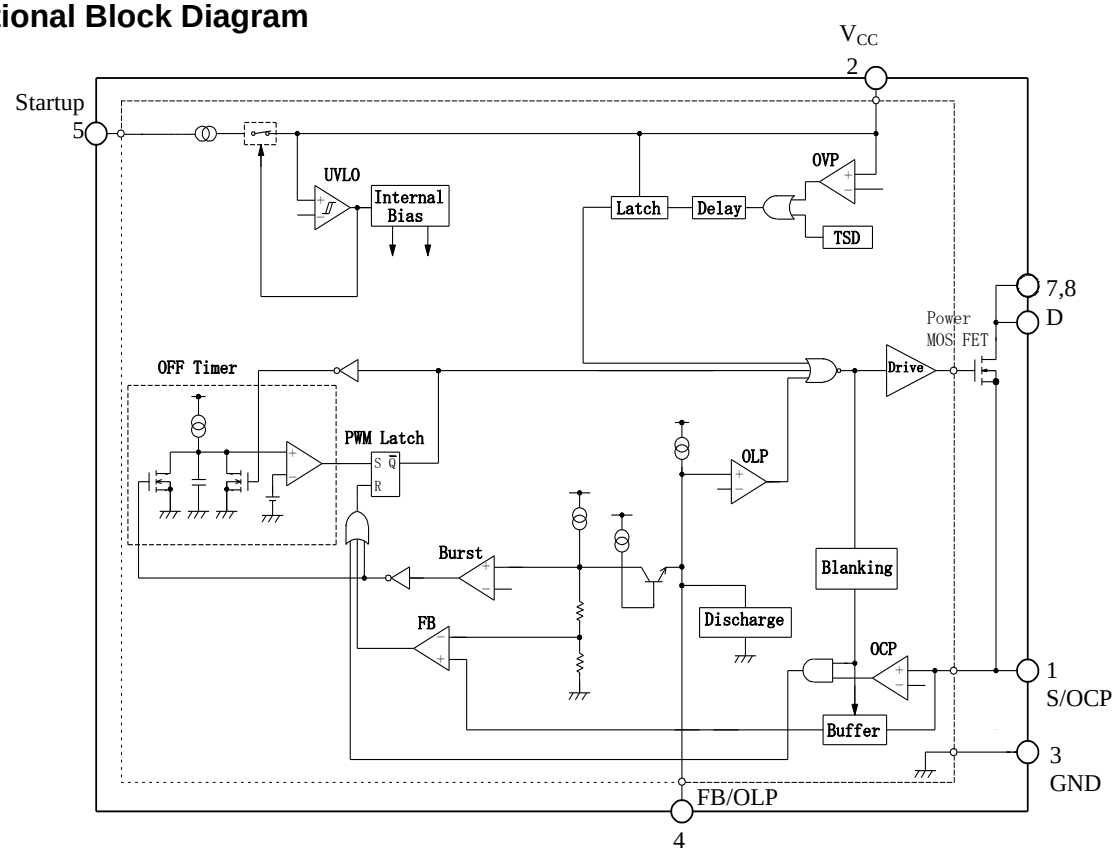
MOSFET Temperature versus Power Dissipation Curve 1



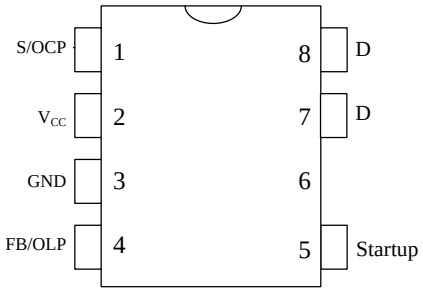
MIC Temperature versus Power Dissipation Curve 2



Functional Block Diagram

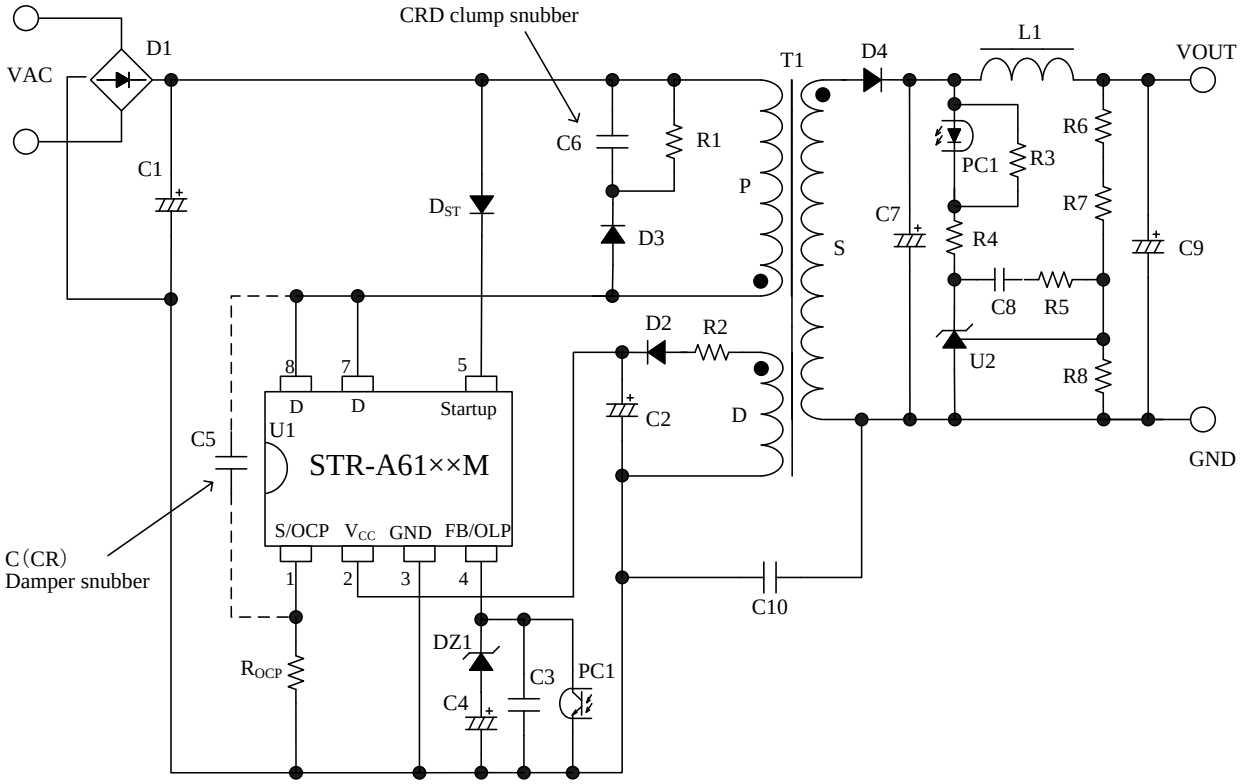


Pin List Table



Number	Name	Function
1	S/OCP	MOSFET source and Overcurrent Protection
2	V_{CC}	Supply voltage input and Overvoltage Protection signal input
3	GND	GND pin for the Controller chip
4	FB /OLP	Feedback compensation and Overload Protection signal input
5	Startup	Input of the startup current
6	—	Pin removed
7	D	MOSFET drain pin
8		

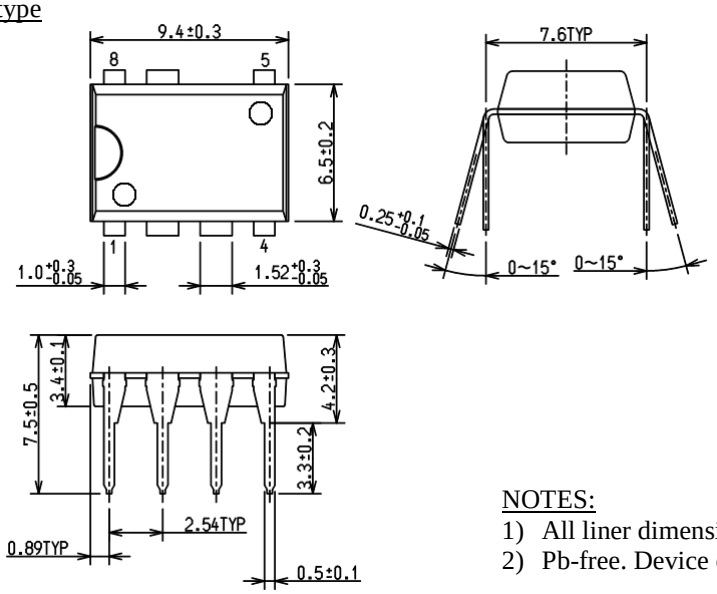
Typical application circuit



Package Outline

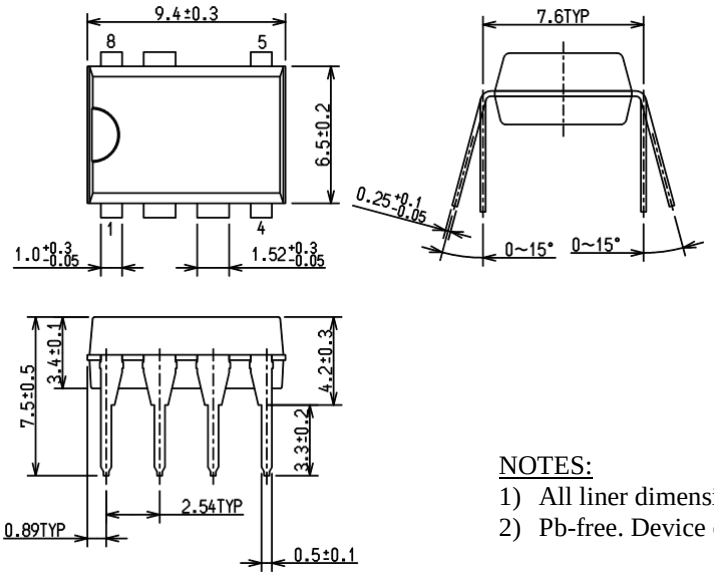
DIP8
There are two kinds of package, A type and B type

A type



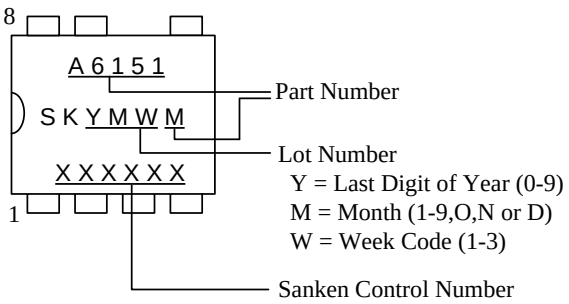
NOTES:
1) All liner dimensions are in millimeters
2) Pb-free. Device composition compliant with the RoHS directive

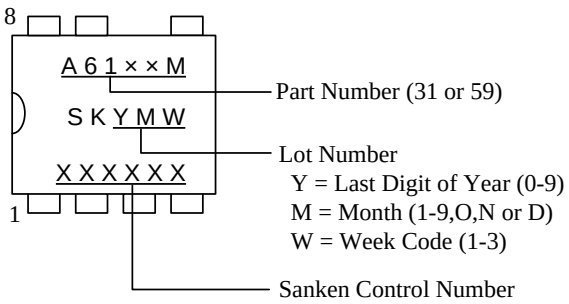
B type



NOTES:
1) All liner dimensions are in millimeters
2) Pb-free. Device composition compliant with the RoHS directive

Marking Diagram





OPERATING PRECAUTIONS

In the case that you use Sanken products or design your products by using Sanken products, the reliability largely depends on the degree of derating to be made to the rated values. Derating may be interpreted as a case that an operation range is set by derating the load from each rated value or surge voltage or noise is considered for derating in order to assure or improve the reliability. In general, derating factors include electric stresses such as electric voltage, electric current, electric power etc., environmental stresses such as ambient temperature, humidity etc. and thermal stress caused due to self-heating of semiconductor products. For these stresses, instantaneous values, maximum values and minimum values must be taken into consideration. In addition, it should be noted that since power devices or IC's including power devices have large self-heating value, the degree of derating of junction temperature affects the reliability significantly.

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 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 the 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. Ensure all test parameters are within the ratings specified by Sanken for the products.

Remarks About Using Silicone Grease with a Heatsink

- When silicone grease is used in mounting the products 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 greases with low consistency (hard grease) may cause cracks in the mold resin when screwing the products 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 Inc.
SC102	Dow Corning Toray Co., Ltd.

Soldering

- When soldering the products, please be sure to minimize the working time, within the following limits:
  - 260 ± 5 °C 10 ± 1 s (Flow, 2 times)
  - 380 ± 10 °C 3.5 ± 0.5 s (Soldering iron, 1 time)
- Soldering should be at a distance of at least 1.5 mm 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 1MΩ 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 order 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.

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  The use of Sanken products without the written consent of Sanken in the applications where extremely high reliability is required (aerospace equipment, nuclear power control systems, life support systems, etc.) is strictly prohibited.
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