STR-Y6753 and STR-Y6754

Off-Line Quasi-Resonant Switching Regulators

Features and Benefits

- TO–220F–7L package
- Lead (Pb) free compliance
- The built-in startup circuit reduces the number of external components and lowers standby power consumption
- Multi-mode control allows high efficiency operation across the full range of loads
- Auto burst oscillation mode for standby mode, for improving low standby power at no load: input power < 30 mW at 100 VAC and < 50 mW at 230 VAC
- Bottom-skip mode minimizes switching loss at medium to low loads
- Internal MOSFET V_{DSS}(min) is 650 V
- Internal MOSFET $R_{DS(on)}$(max) 1.9 Ω (STR-Y6753) or 1.4 Ω (STR-Y6754)
- Built-in soft start function reduces stress applied to the incorporated power MOSFET and peripheral components
- Step-on burst oscillation minimizes transformer audible noise
- Built-in leading edge blanking (LEB) function eliminates

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Package: 7-Pin TO-220F

Not to scale

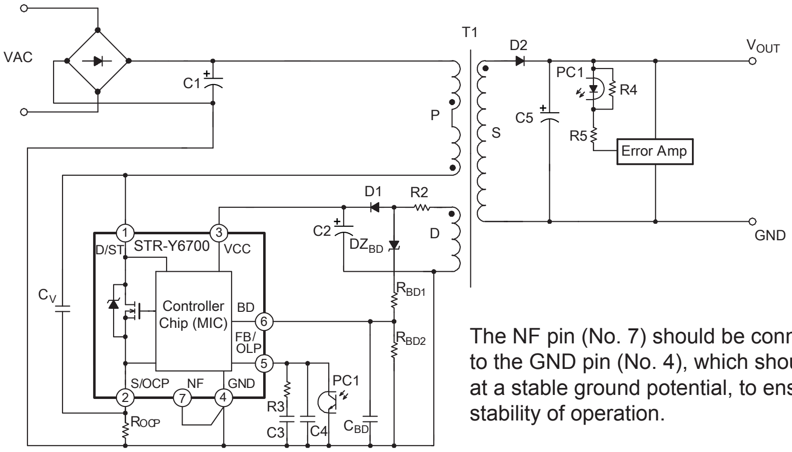
Description

The STR-Y6753 and STR-Y6754 each comprise a power MOSFET and a multi-functional monolithic integrated circuit (MIC) controller designed for controlling switch mode power supplies. The quasi-resonant mode of operation, coupled with the bottom-skip function, allows high efficiency and low noise at low to high operational levels, while burst oscillation mode ensures minimum power consumption at standby.

In order to sustain low power consumption under low load and in standby mode, the controller has built-in startup and standby circuits. This enables output power for the STR-Y6753 up to 60 W with universal input or 100 W with a 380 VDC input, and for the STR-Y6754 up to 67 W with universal input or 120 W with a 380 VDC input.

The compact 7-pin full mold package (TO220F-7L) reduces board space by requiring a minimum of external components, thus simplifying circuit design. This IC, including various protection functions, is an excellent choice for standardized, compact power supplies.

Typical Application



The NF pin (No. 7) should be connected to the GND pin (No. 4), which should be at a stable ground potential, to ensure stability of operation.

Features and Benefits (continued)

external filter components
- Built-in Bias Assist function enables stable startup operation
- V_{CC} operational range expanded
- Internal power MOSFET is avalanche energy guaranteed; two-chip structure
- Protection functions
  - ▫ Overcurrent protection (OCP): pulse by pulse basis, low dependence on input voltage
  - ▫ Overload protection (OLP): latched shutoff*
  - ▫ Overvoltage protection (OVP): latched shutoff*
  - ▫ Maximum on-time limitation
  - ▫ Thermal shutdown protection (TSD): latched shutoff*

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*Latched shutoff means the output is kept in a shutoff mode for protection, until reset.

Selection Guide

Part Number	V_{DSS}(min) (V)	$R_{DS(on)}$(max) (Ω)	Package	Packing
STR-Y6753	650	1.9	TO-220F	50 pieces per tube
STR-Y6754		1.4		

Absolute Maximum Ratings Unless specifically noted, T_A = 25°C and V_{CC} = 20 V

Characteristic	Symbol	Notes		Pins	Rating	Unit
Drain Current[1]	I_{DPEAK}	STR-Y6753	Single pulse	1 – 2	9.2	A
		STR-Y6754			11.0	A
Maximum Switching Current	I_{DMAX}	STR-Y6753	T_A = −20°C to 125°C	1 – 2	9.2	A
		STR-Y6754			11.0	A
Single Pulse Avalanche Energy[2]	E_{AS}	STR-Y6753	Single pulse, V_{DD} = 99 V, L= 20 mH, I_{LPEAK}= 2.9 A	1 – 2	99	mJ
		STR-Y6754	Single pulse, V_{DD} = 99 V, L= 20 mH, I_{LPEAK}= 4.1 A		198	mJ
Input Voltage in Control Part (MIC)	V_{CC}			3 – 4	35	V
Startup (D/ST) Pin Voltage	$V_{STARTUP}$			1 – 4	−1.0 to V_{DSS}	V
OCP Pin Voltage	V_{OCP}			2 – 4	−2.0 to 6.0	V
FB Pin Voltage	V_{FB}			5 – 4	−0.3 to 7.0	V
FB Pin Sink Current[3]	I_{FB}			5 – 4	10.0	mA
BD Pin Voltage	V_{BD}			6 – 4	−6.0 to 6.0	V
Power Dissipation in MOSFET[4]	P_{D1}	STR-Y6753	With an infinite heatsink	1 – 2	20.2	W
		STR-Y6754			21.5	W
		Without heatsink		1 – 2	1.8	W
Power Dissipation in Control Part (MIC)	P_{D2}			–	0.8	W
Internal Frame Temperature in Operation	T_F	Recommended internal frame temperature is T_F = 105°C (max).		–	−20 to 115	°C
Operating Ambient Temperature	T_{OP}			–	−20 to 115	°C
Storage Temperature	T_{stg}			–	−40 to 125	°C
Channel Temperature	T_{ch}			–	150	°C

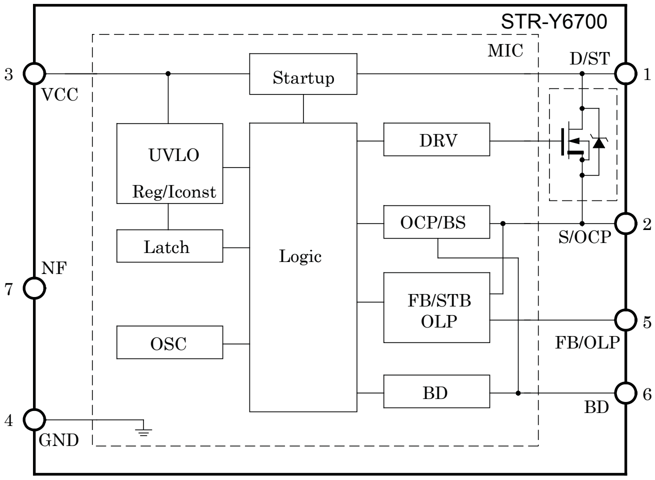
[1] Refer to MOSFET Safe Operating Area Curve.

[2] Refer to MOSFET Avalanche Energy Derating Coefficient Curve.

[3] The polarity value for current specifies a sink as "+ ," and a source as “−,” referencing the IC.

[4] Refer to MOSFET Temperature versus Power Dissipation Curve.

Functional Block Diagram



Pin List Table

Name	Number	Function
1	D/ST	MOSFET drain and Startup circuit input
2	S/OCP	MOSFET source and overcurrent detection signal input
3	VCC	Control circuit power supply input
4	GND	Ground
5	FB/OLP	Constant Voltage Control signal input, Standby control, and overload detection signal input
6B	D	Bottom Detection signal input, Input Compensation detection signal input
7N	F	For stable operation, connect to GND pin, using the shortest possible path

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All performance characteristics given are typical values for circuit or system baseline design only and are at the nominal operating voltage and an ambient temperature, T_A, of 25°C, unless otherwise stated.

Electrical Characteristics of Control Part (MIC) Unless specifically noted, T_A = 25°C and V_{CC} = 20 V

Characteristic	Symbol	Test Conditions	Pins	Min.	Typ.	Max.	Unit
Power Supply Startup Operation							
Operation Start Voltage	$V_{CC(ON)}$		3 – 4	13.8	15.1	17.3	V
Operation Stop Voltage[1]	$V_{CC(OFF)}$		3 – 4	8.4	9.4	10.7	V
Circuit Current in Operation	$I_{CC(ON)}$		3 – 4	–	1.3	3.7	mA
Circuit Current in Non-Operation	$I_{CC(OFF)}$	V_{CC} = 13 V	3 – 4	–	4.5	50	μA
Startup Circuit Operation Voltage	$V_{START(ON)}$		1 – 4	42	57	72	V
Startup Current	$I_{CC(STARTUP)}$	V_{CC} = 13 V	3 – 4	−4.5	−3.1	−1.0	mA
Startup Current Supply Threshold Voltage[1]	$V_{CC(BIAS)}$		3 – 4	9.5	11.0	12.5	V
Operation Frequency	f_{OSC}		1 – 4	18.4	21.0	24.4	kHz
Soft Start Operation Duration	t_{SS}		1 – 4	–	6.05	–	ms
Normal Operation							
Bottom-Skip Operation Threshold Voltage 1	$V_{OCP(BS1)}$		2 – 4	0.487	0.572	0.665	V
Bottom-Skip Operation Threshold Voltage 2	$V_{OCP(BS2)}$		2 – 4	0.200	0.289	0.380	V
Quasi-Resonant Operation Threshold Voltage 1[2]	$V_{BD(TH1)}$		6 – 4	0.14	0.24	0.34	V
Quasi-Resonant Operation Threshold Voltage 2[2]	$V_{BD(TH2)}$		6 – 4	–	0.17	–	V
Maximum Feedback Current	$I_{FB(MAX)}$		5 – 4	−320	−205	−120	μA
Stand-by Operation							
Standby Operation Threshold Voltage	$V_{FB(STBOP)}$		5 – 4	0.45	0.80	1.15	V
Protected Operation							
Maximum On-Time	$t_{ON(MAX)}$		1 – 4	30.0	40.0	50.0	μs
Leading Edge Blanking Time	$t_{ON(LEB)}$	STR-Y6753	1 – 4	–	470	–	ns
		STR-Y6754		–	455	–	ns
Overcurrent Detection Threshold Voltage (Normal Operation)	$V_{OCP(H)}$	V_{BD} = 0 V	2 – 4	0.820	0.910	1.000	V
Overcurrent Detection Threshold Voltage (Input Compensation in Operation)	$V_{OCP(L)}$	V_{BD} = –3 V	2 – 4	0.560	0.660	0.760	V
Overcurrent Detection Threshold Voltage (Latched shutoff)[3]	$V_{OCP(La.OFF)}$		2 – 4	1.65	1.83	2.01	V

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Electrical Characteristics of Control Part (MIC) (Continued) Unless specifically noted, T_A = 25°C and V_{CC} = 20 V

Characteristic	Symbol	Test Conditions	Pins	Min.	Typ.	Max.	Unit
BD Pin Source Current	$I_{BD(O)}$		6 – 4	−250	−83	−30	µA
OLP Bias Current	$I_{FB(OLP)}$		5 – 4	−15	−10	−5	µA
OLP Threshold Voltage	$V_{FB(OLP)}$		5 – 4	5.50	5.96	6.40	V
OVP Threshold Voltage	$V_{CC(OVP)}$		3 – 4	28.5	31.5	34.0	V
FB Pin Maximum Voltage in Feedback Operation	$V_{FB(MAX)}$		5 – 4	3.70	4.05	4.40	V
Thermal Shut Down Temperature	$T_{J(TSD)}$		–	135	–	–	°C

Note: The polarity value for current specifies a sink as "+ ," and a source as "−," referencing the IC.

[1] The relation of $V_{CC(BIAS)} > V_{CC(OFF)}$ is maintained.

[2] The relation of $V_{BD(TH1)} > V_{BD(TH2)}$ is maintained in each product.

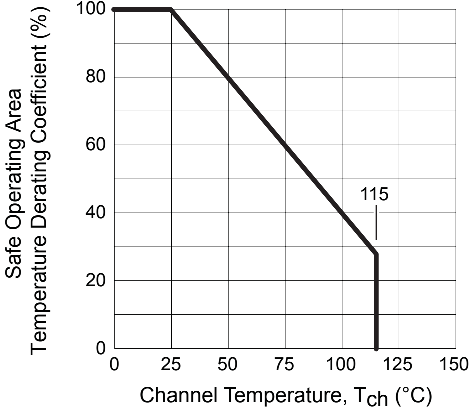
[2] The latch circuit means a circuit operated OVP, OLP, OCP (latch-off), or TSD.

Electrical Characteristics of MOSFET Unless specifically noted, T_A = 25°C and V_{CC} = 20 V

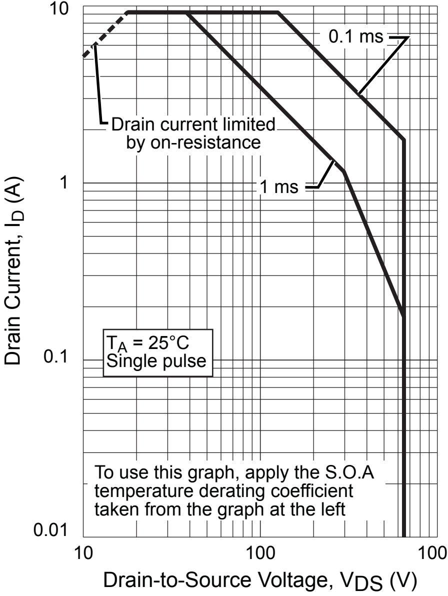
Characteristic	Symbol	Test Conditions		Pins	Min.	Typ.	Max.	Unit
Voltage Between Drain and Source	V_{DSS}			1 – 2	650	–	–	V
Drain Leakage Current	I_{DSS}			1 – 2	–	–	300	µA
On-Resistance	$R_{DS(on)}$	STR-Y6753		1 – 2	–	–	1.9	Ω
		STR-Y6754		1 – 2	–	–	1.4	Ω
Switching Time	t_f	STR-Y6753		1 – 2	–	–	250	ns
		STR-Y6754		1 – 2	–	–	300	ns
Thermal Resistance	$R_{\theta ch\text{-}F}$	STR-Y6753	Between a channel of the MOSFET and the internal leadframe	–	–	2.7	3.1	°C/W
		STR-Y6754		–	–	2.4	2.7	°C/W

Characteristic Performance (STR-Y6753)

S. O. A. Temperature Derating Coefficient Curve

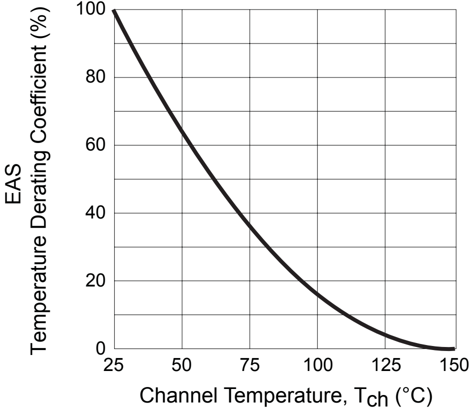


MOSFET Safe Operating Area Curve

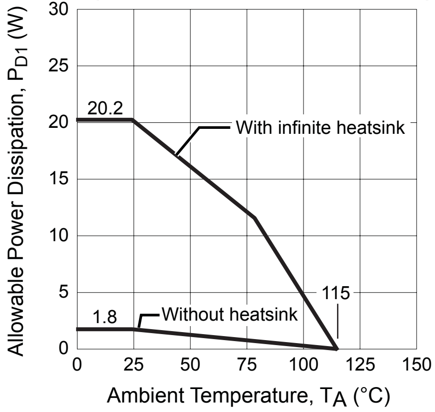


To use this graph, apply the S.O.A temperature derating coefficient taken from the graph at the left

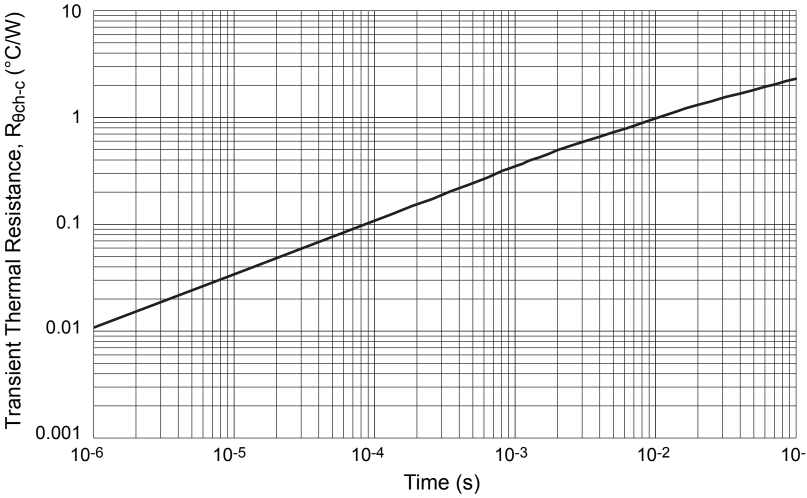
MOSFET Avalanche Energy Derating Coefficient Curve



MOSFET Temperature versus Power Dissipation Curve

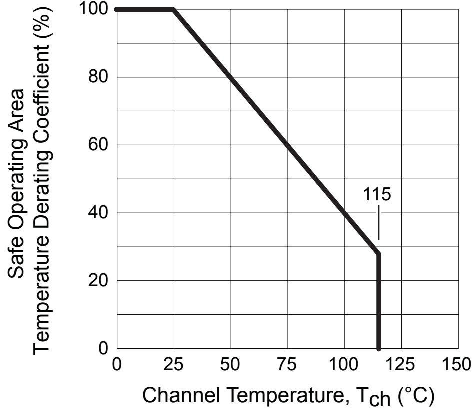


Transient Thermal Resistance Curve

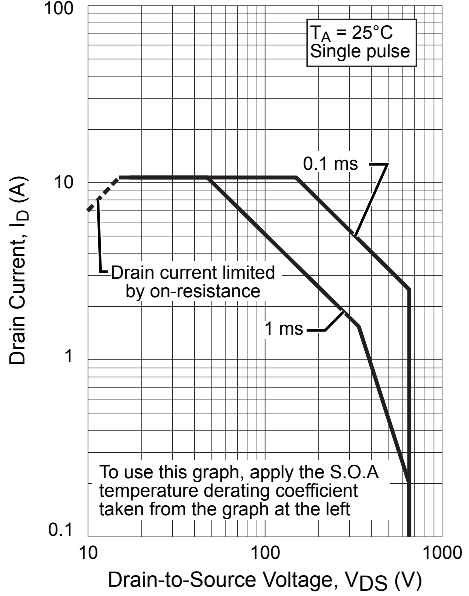


Characteristic Performance (STR-Y6754)

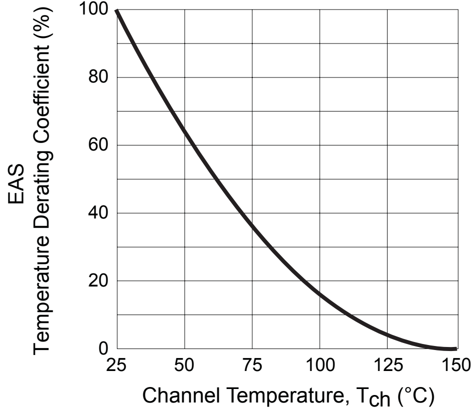
S. O. A. Temperature Derating Coefficient Curve



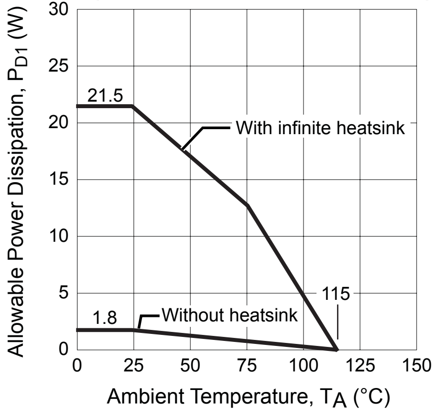
MOSFET Safe Operating Area Curve



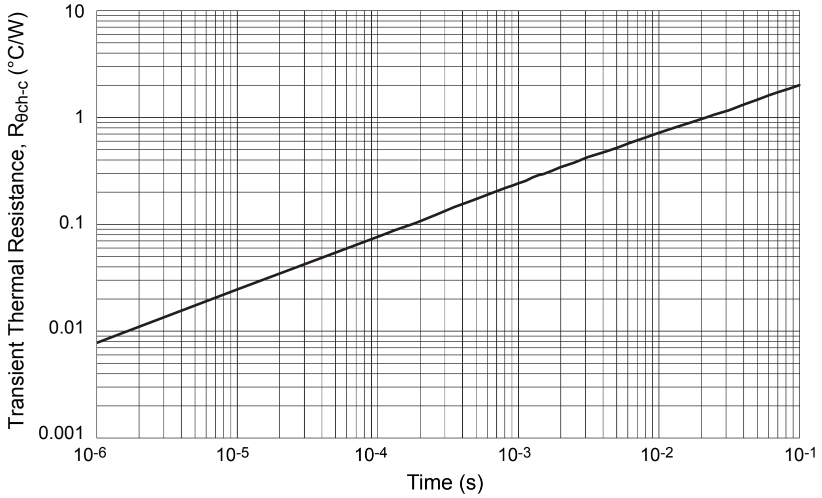
MOSFET Avalanche Energy Derating Coefficient Curve



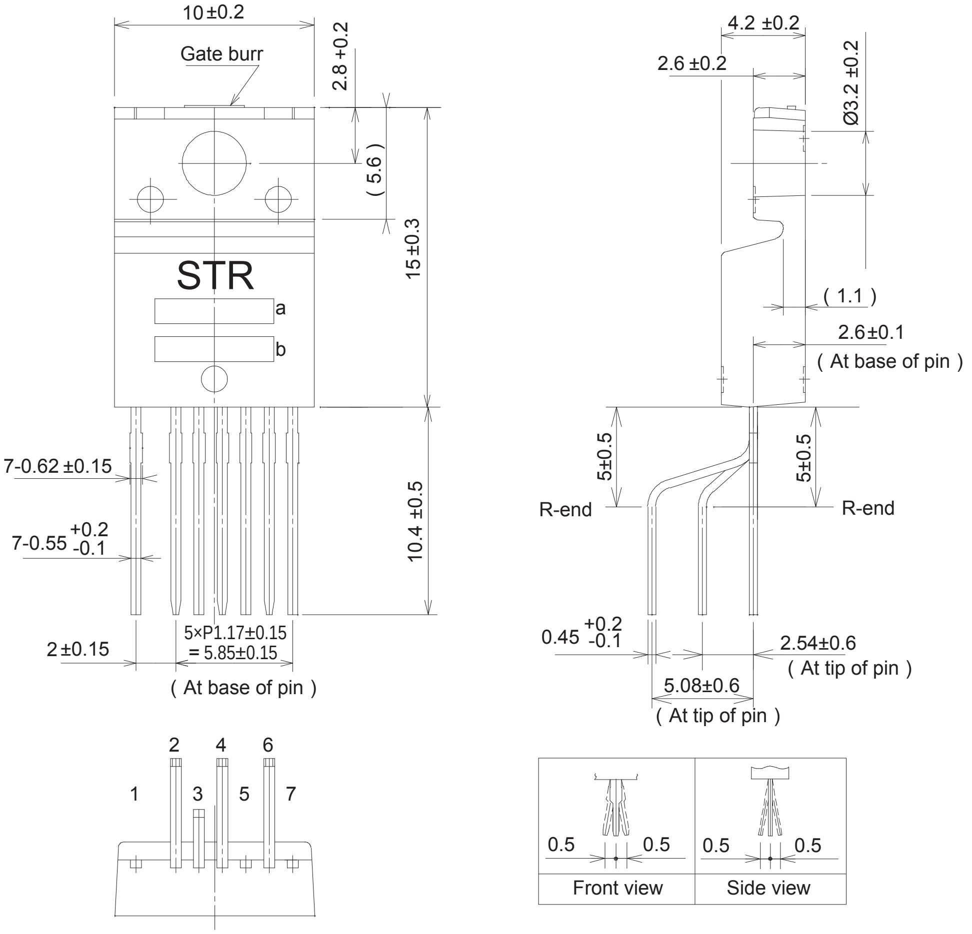
MOSFET Temperature versus Power Dissipation Curve

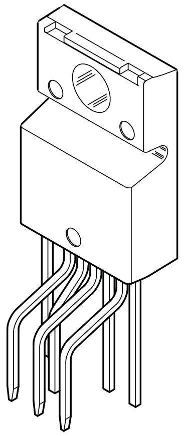


Transient Thermal Resistance Curve



Package Outline Drawing





Unit: mm

Package: TO-220F

(Sanken leadform #3051)

Leadframe material: Cu

Pin treatment: Solder dip

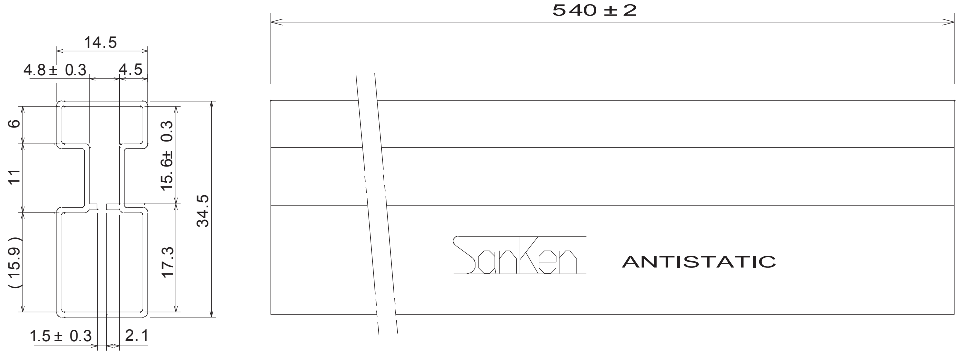
Weight: Approximately 1.45 g

"Gate Burr" shows area where 0.3 mm (max) gate burr may be present

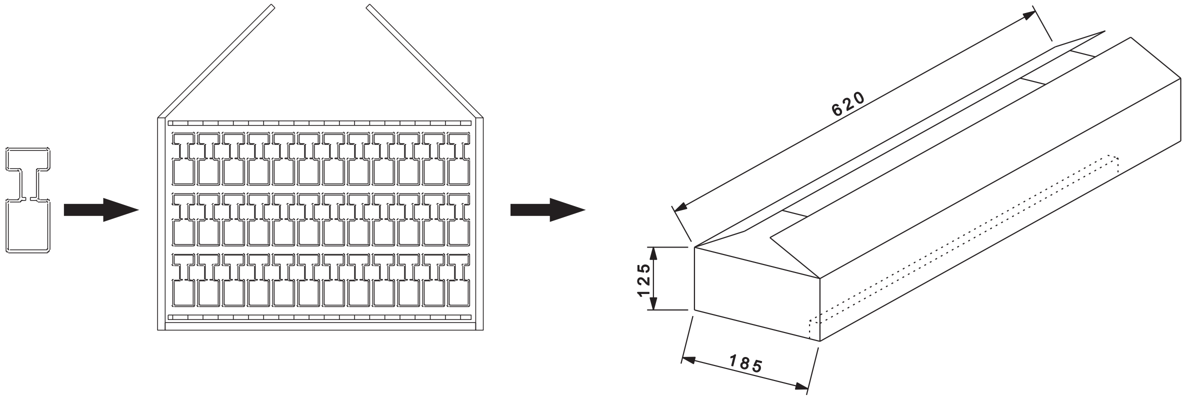
a: Part # Y6753 [or Y6754]
b: Lot number
  1st letter: Last digit of year
  2nd letter: Month
    Jan to September: Numeric
    October: O
    November: N
    December: D
  3rd and 4th letter: Date
    01 to 31: Numeric
  5th letter: Internal use control number

Pin treatment Pb-free. Device composition compliant with the RoHS directive.

Packing Specifications



Tube dimensions (mm)
50 pieces per tube



Carton dimensions (mm)

36 tubes per carton (maximum)
1800 pieces maximum per 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, Inc.
SC102	Dow Corning Toray Co., Ltd.

Heatsink Assembly

- Attachment torque should be in the range 0.588 to 0.785 N•m (6 to 8 kgf•cm).

Soldering

- The leadframe temperature should never exceed T_F = 105°C(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)
- Soldering iron should be at a distance of at least 2.0 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 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.

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