

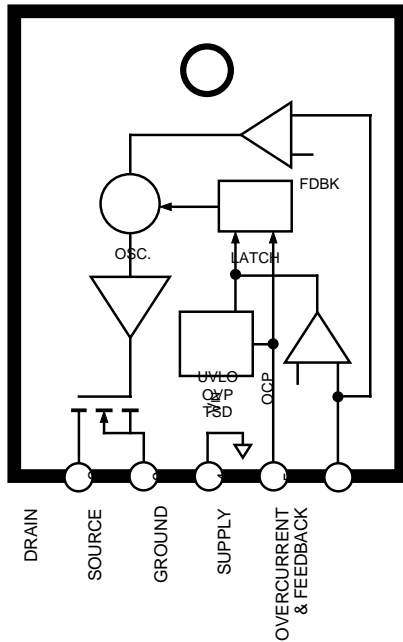
# STR-G6653

## OFF-LINE QUASI-RESONANT FLYBACK SWITCHING REGULATOR

The STR-G6653 is specifically designed to satisfy the requirements for increased integration and reliability in off-line quasi-resonant flyback converters. This device incorporates the primary control and drive circuit with a discrete avalanche-rated power MOSFET.

Cycle-by-cycle current limiting, under-voltage lockout with hysteresis, over-voltage protection, and thermal shutdown protects the power supply during the normal overload and fault conditions. Over-voltage protection and thermal shutdown are latched after a short delay. The latch may be reset by cycling the input supply. Low-current startup and a low-power standby mode selected from the secondary circuit completes a comprehensive suite of features. The device is provided in a five-pin over-molded TO-220 style package, affording dielectric isolation without compromising thermal characteristics.

Proven in substantial volumes, the STR-G6653 is a robust low-risk solution for off-line power supplies particularly where management of EMI at the source is a significant element of the system design.



Dwg. PK-011

### ABSOLUTE MAXIMUM RATINGS at $T_A = +25^\circ\text{C}$

Control Supply Voltage, $V_{IN}$ .....	35 V
Drain-Source Voltage, $V_{DS}$ .....	650 V
Drain Current, $I_D$	
continuous .....	2.7 A
single-pulse, $t_w \leq 1 \text{ ms}$ .....	7.2 A
Avalanche Energy, $E_{AS}$	
single-pulse .....	158 mJ
Over-Current Protection Voltage Range,	
$V_{OCP}$ .....	-0.3 V to +6 V
Insulation RMS Voltage,	
$V_{WM(RMS)}$ .....	2000 V
Package Power Dissipation, $P_D$	
control ( $V_{IN} \times I_{IN(ON)}$ ) .....	0.8 W
total .....	See Graph
FET Channel Temperature, $T_J$ ...	+150°C
Internal Frame Temperature, $T_F$ ...	+125°C
Operating Temperature Range,	
$T_A$ .....	-20°C to +125°C
Storage Temperature Range,	
$T_S$ .....	-40°C to +125°C

### FEATURES

- Quasi-Resonant Operation
- Output Power to 120 W
- Low-Loss, Pulse-Ratio-Control Standby Mode
- Temperature-Compensated Pulse-by-Pulse Over-Current Protection
- Latched Over-Voltage and Thermal Protection
- Under-Voltage Lockout with Hysteresis
- Active Low-Pass Filter for Enhanced Light-Load Stability
- Switched Attenuation of Leading-Edge Current-Sensing Signal
- Regulated Soft Gate Drive
- Adjustable Switching Speed for EMI Control
- Overmolded Five-Pin Package

Always order by complete part number: **STR-G6653**

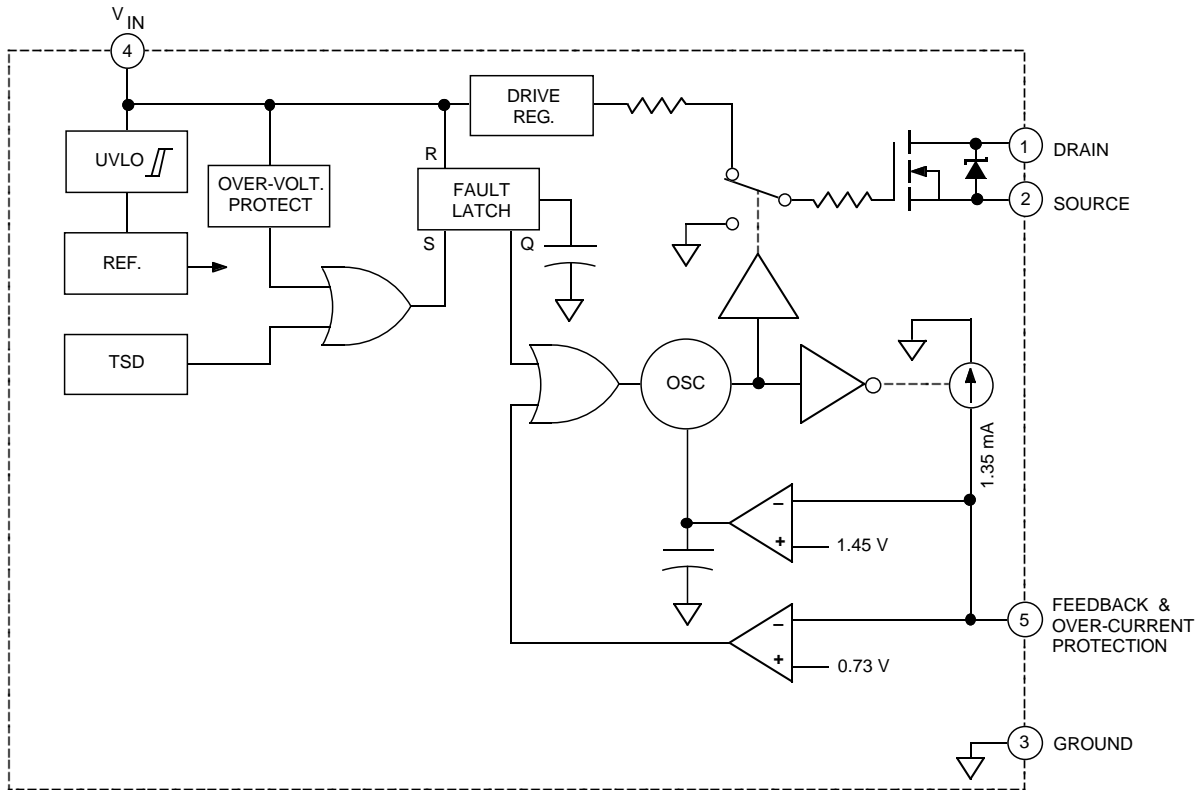
# STR-G6653

## OFF-LINE

### QUASI-RESONANT FLYBACK

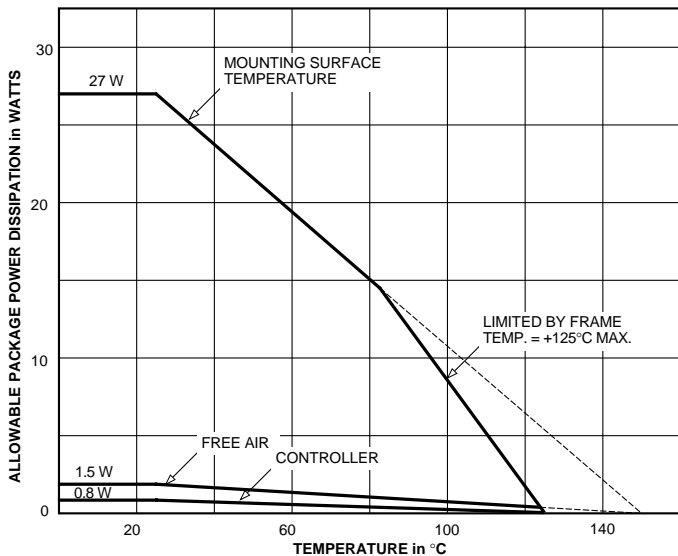
### SWITCHING REGULATOR

#### FUNCTIONAL BLOCK DIAGRAM



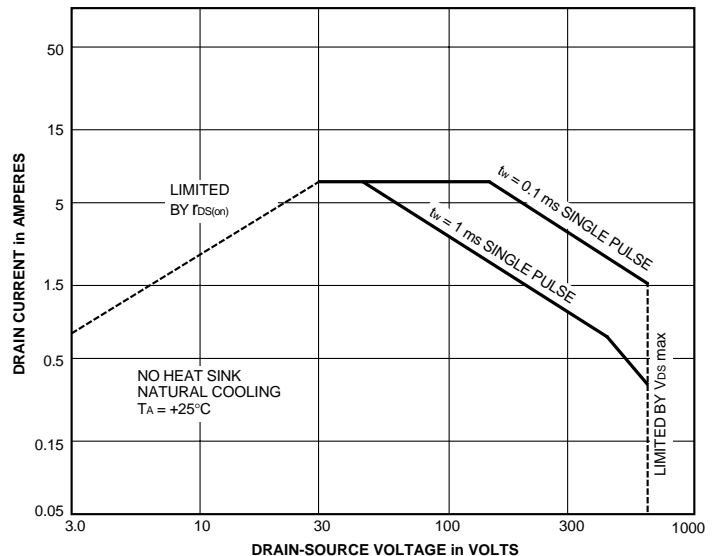
Dwg. FK-002-5

#### ALLOWABLE PACKAGE POWER DISSIPATION



Dwg. GK-003-4

#### MAXIMUM SAFE OPERATING AREA



Dwg. GK-004-5



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**STR-G6653**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**ELECTRICAL CHARACTERISTICS** at  $T_A = +25^\circ\text{C}$ ,  $V_{IN} = 18\text{ V}$ ,  $V_{DD} = 10\text{ V}$ ,  $V_S = 0$ , voltage measurements are referenced to ground terminal (unless otherwise specified).

Characteristic	Symbol	Test Conditions	Limits			Units
			Min.	Typ.	Max.	
On-State Voltage	$V_{INT}$	Turn-on, increasing $V_{IN}$	14.4	16	17.6	V
Under-Voltage Lockout	$V_{INQ}$	Turn-off, decreasing $V_{IN}$	9.0	10	11	V
Over-Voltage Threshold	$V_{OVP(th)}$	Turn-off, increasing $V_{IN}$	20.5	22.5	24.5	V
Drain-Source Breakdown Voltage	$V_{(BR)DSS}$	$I_D = 300\ \mu\text{A}$	650	–	–	V
Drain Leakage Current	$I_{DSS}$	$V_{DS} = 650\text{ V}$	–	–	300	$\mu\text{A}$
On-State Resistance	$r_{DS(on)}$	$V_S = 10\text{ V}$ , $I_D = 0.9\text{ A}$ , $T_J = +25^\circ\text{C}$	–	–	1.9	$\Omega$
Maximum OFF Time	$t_{off}$	Drain waveform high	45	–	55	$\mu\text{s}$
Minimum Pulse Duration for Input of Quasi-Resonant Signals	$t_{w(th)}$	Drain waveform high <sup>1</sup>	–	–	1.0	$\mu\text{s}$
Minimum OFF Time	$t_{off}$	Drain waveform high <sup>1</sup>	–	–	1.5	$\mu\text{s}$
Feedback Threshold Voltage	$V_{FDBK}$	Drain waveform low to high <sup>1</sup>	0.68	0.73	0.78	V
		Oscillation synchronized <sup>2</sup>	1.3	1.45	1.6	V
Over-Current Protection/Feedback Sink Current	$I_{OCP/FB}$	$V_{OCP/FB} = 1.0\text{ V}$	1.2	1.35	1.5	mA
Latch Holding Current	$I_{IN(OVP)}$	$V_{IN}$ reduced from 24.5 V to 8.5 V	–	–	400	mA
Latch Release Voltage	$V_{IN}$	$I_{IN} \leq 20\ \mu\text{A}$ , $V_{IN}$ reduced from 24.5 V	6.6	–	8.4	V
Switching Time	$t_f$	$V_{DD} = 200\text{ V}$ , $I_D = 0.9\text{ A}$	–	–	250	ns
Supply Current	$I_{IN(ON)}$	Operating <sup>3</sup>	–	–	30	mA
	$I_{IN(OFF)}$	Increasing $V_{IN}$ prior to oscillation	–	–	100	$\mu\text{A}$
Insulation RMS Voltage	$V_{WM(RMS)}$	All terminals simultaneous reference metal plate against backside	2000	–	–	V
Thermal Shutdown	$T_J$		140	–	–	$^\circ\text{C}$
Thermal Resistance	$R_{\theta JM}$	Output junction-to-mounting frame	–	–	1.63	$^\circ\text{C/W}$

Notes: Typical Data is for design information only.

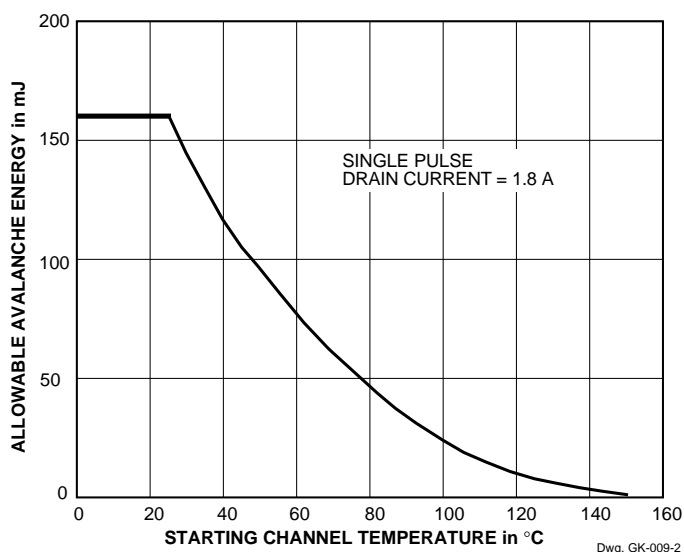
1. Feedback is square wave,  $V_{IM} = 2.2\text{ V}$ ,  $t_h = 1\ \mu\text{s}$ ,  $t_l = 35\ \mu\text{s}$

2. For quasi-resonant operation, the input signal must be longer than  $t_{w(th)}$  and greater than  $V_{FDBK}$

3. Feedback is square wave,  $V_{IM} = 2.2\text{ V}$ ,  $t_h = 4\ \mu\text{s}$ ,  $t_l = 1\ \mu\text{s}$

**STR-G6653**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**ALLOWABLE AVALANCHE ENERGY**



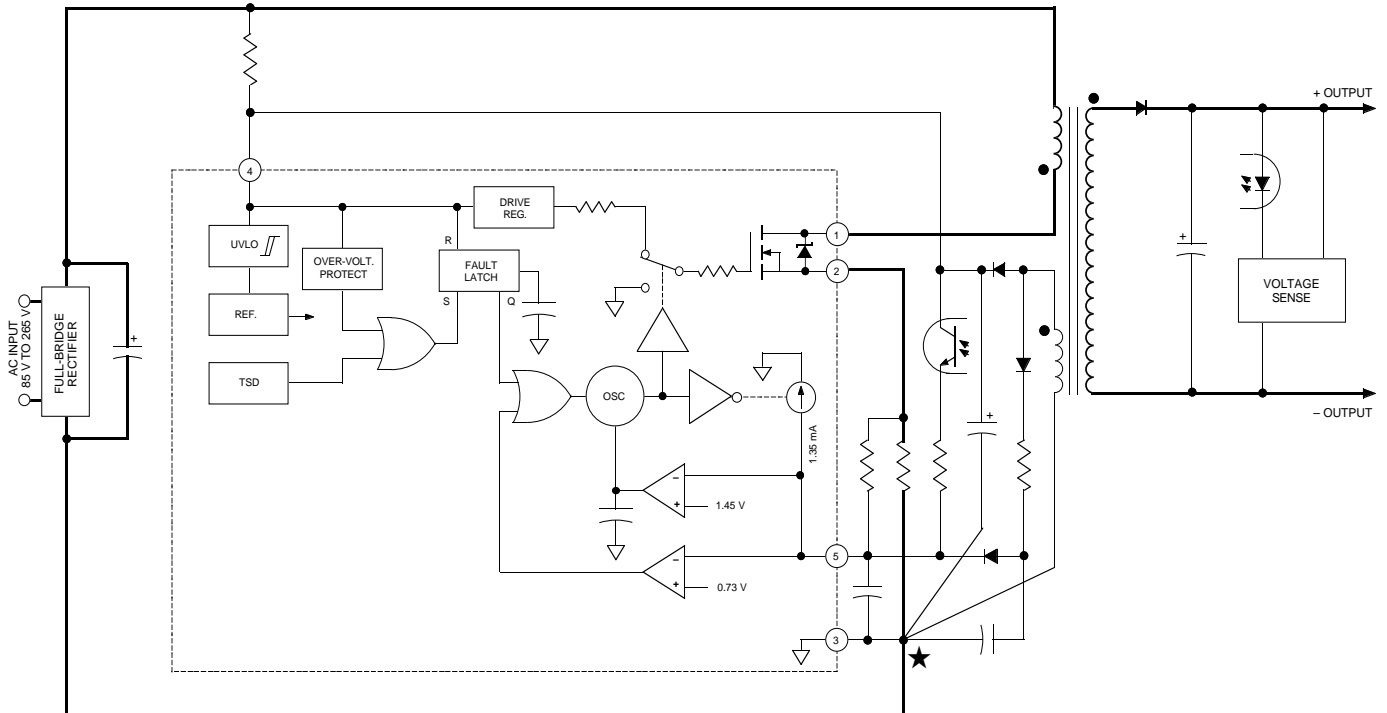
**STR-G6600 Series**

Part Number	Drain-Source Output Breakdown Voltage at $I_D = 300 \mu\text{A}$ $V_{(BR)DS}$ , Minimum	Drain-Source ON Resistance at $I_D = 0.9 \text{ A}$ $r_{DS(on)}$ , Maximum	Output Power
<b>For 100/120 V AC Input</b>			
STR-G6622	450 V	2.18 $\Omega$	44 W – 60 W
STR-G6624	450 V	0.92 $\Omega$	98 W – 130 W
<b>For 110/120 V AC Input</b>			
STR-G6632	500 V	2.62 $\Omega$	36 W – 50 W
<b>For 200/220 V AC Input</b>			
STR-G6651	650 V	3.95 $\Omega$	66 W
STR-G6652	650 V	2.80 $\Omega$	86 W
STR-G6653	650 V	1.95 $\Omega$	120 W

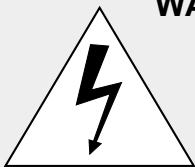
# STR-G6653 OFF-LINE QUASI-RESONANT FLYBACK SWITCHING REGULATOR

## TYPICAL QUASI-RESONANT FLYBACK CONVERSION USING STR-G6653

**WARNING:** lethal potentials are present. See text.



Dwg. EK-003-4



**WARNING** — These devices are designed to be operated at lethal voltages and energy levels. Circuit designs that embody these components must conform with applicable safety requirements. Precautions must be taken to prevent accidental contact with power-line potentials. Do not connect grounded test equipment.

The use of an isolation transformer is recommended during circuit development and breadboarding.

Recommended mounting hardware torque:

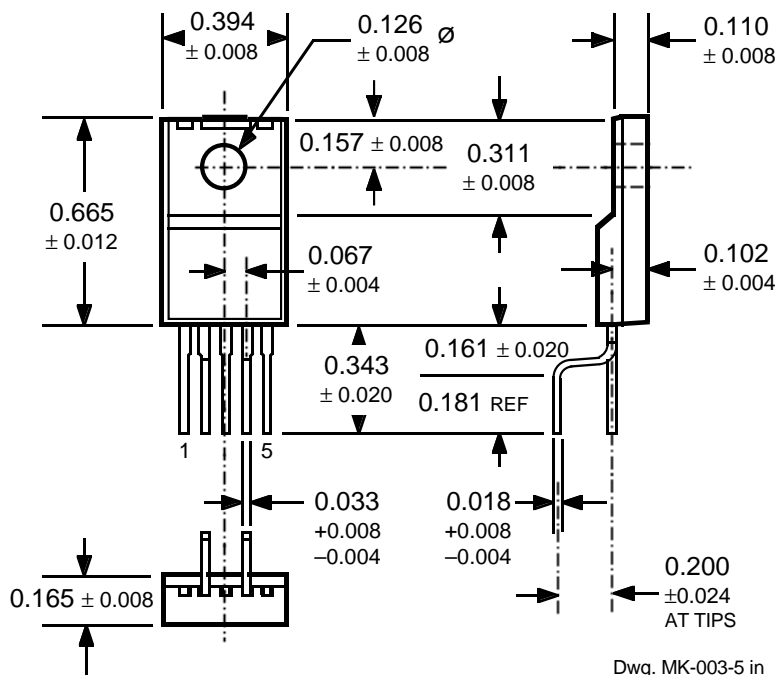
4.34 - 5.79 lbf•ft (6 - 8 kg•cm or 0.588 - 0.784 Nm).

Recommended silicone grease:

Dow Corning SC102, Toshiba YG6260, Shin-Etsu G746., or equivalent

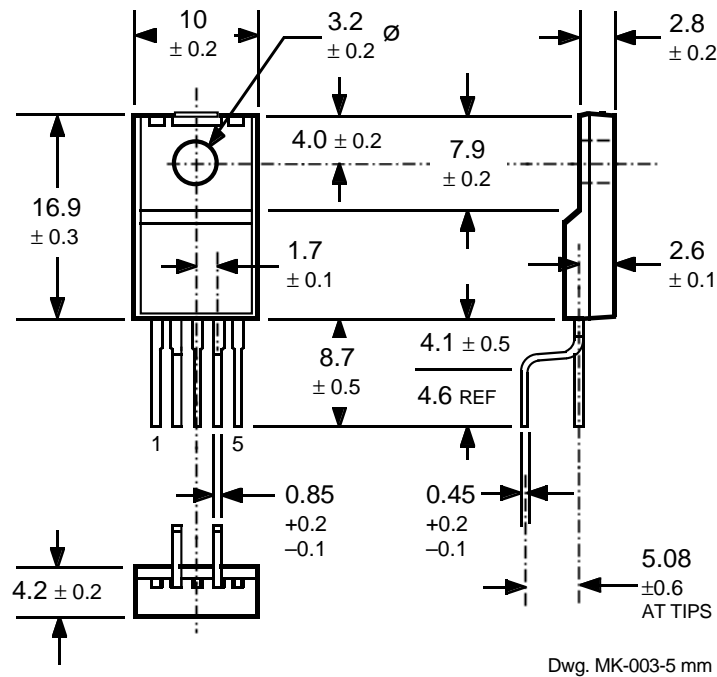
**STR-G6653**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**Dimensions in Inches**  
 (for reference only)



**STR-G6653**  
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**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**Dimensions in Millimeters**  
(controlling dimensions)



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**STR-G6653**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**POWER CONVERSION/POWER MANAGEMENT**  
**SELECTION GUIDES**

**SWITCHING REGULATOR PMCMs**

Part Number*	Application	V <sub>I</sub>	Max P <sub>O</sub>		Power Switch	
3002M	5 V switching regulator and a 9 V switching regulator†	7.0-33 V	–	–	500 mA 400 mA	bipolar bipolar
3004M	5 V switching regulator and Dual 9 V switching regulator	7.0-33 V	–	–	500 mA 2 x 400 mA	bipolar bipolar
S5703	Quasi-resonant flyback converter	110/120 V	140 W	500 V	6 A	bipolar
S5707	Quasi-resonant flyback converter	85-265 V 220/240V	90 W 140 W	850 V	6 A	bipolar
S5708	Quasi-resonant flyback converter	85-265 V 220/240 V	120 W 180 W	850 V	7.5 A	bipolar
F6624	Quasi-resonant flyback converter	100/120 V	130 W	450 V	0.92 Ω	MOSFET
F6626	Quasi-resonant flyback converter	100/120 V	190 W	450 V	0.58 Ω	MOSFET
F6628	Quasi-resonant flyback converter	100/120 V	290 W	450 V	0.35 Ω	MOSFET
G6651	Quasi-resonant flyback converter	85-265 V	30 W	650 V	3.95 Ω	MOSFET
F6652	Quasi-resonant flyback converter	85-265 V	40 W	650 V	2.8 Ω	MOSFET
F6653	Quasi-resonant flyback converter	85-265 V	58 W	650 V	1.95 Ω	MOSFET
F6654	Quasi-resonant flyback converter	85-265 V	92 W	650 V	1.15 Ω	MOSFET
F6656	Quasi-resonant flyback converter	85-265 V	150 W	650 V	0.71 Ω	MOSFET
F6672	Quasi-resonant flyback converter	85-265 V	25 W‡	900 V	7.7 Ω	MOSFET
F6674	Quasi-resonant flyback converter	85-265 V	28 W	900 V	4.49 Ω	MOSFET
F6676	Quasi-resonant flyback converter	85-265 V	44 W	900 V	2.81 Ω	MOSFET
S6703	Quasi-resonant flyback converter	110/120V	140 W	500 V	6 A	bipolar
S6704	Quasi-resonant flyback converter	110/120 V	100 W	500 V	5 A	bipolar
S6707	Quasi-resonant flyback converter	85-265 V 220/240 V	90 W 140 W	850 V	6 A	bipolar
S6708	Quasi-resonant flyback converter	85-265 V 220/240 V	120 W 180 W	850 V	7.5 A	bipolar
S6709	Quasi-resonant flyback converter	85-265 V 220/240 V	160 W 220 W	850 V	10 A	bipolar
8033S	3.3 V switching regulator	5.5-28 V	–	–	3 A	bipolar
8050S	5.0 V switching regulator	7.0-40 V	–	–	3 A	bipolar
8090S	9.0 V switching regulator	12-40V	–	–	3 A	bipolar
8120S	12 V switching regulator	15-40 V	–	–	3 A	bipolar
8150S	15 V switching regulator	18-40 V	–	–	3 A	bipolar

\* Complete part number includes additional characters to indicate operating temperature range and/or package style.

† Also includes linear regulator output for 15.7 V at 1.0 A.

‡ Without heat sink.



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