

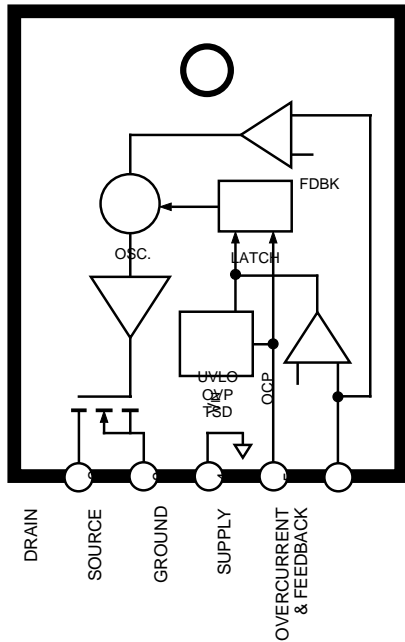
STR-G6653

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**

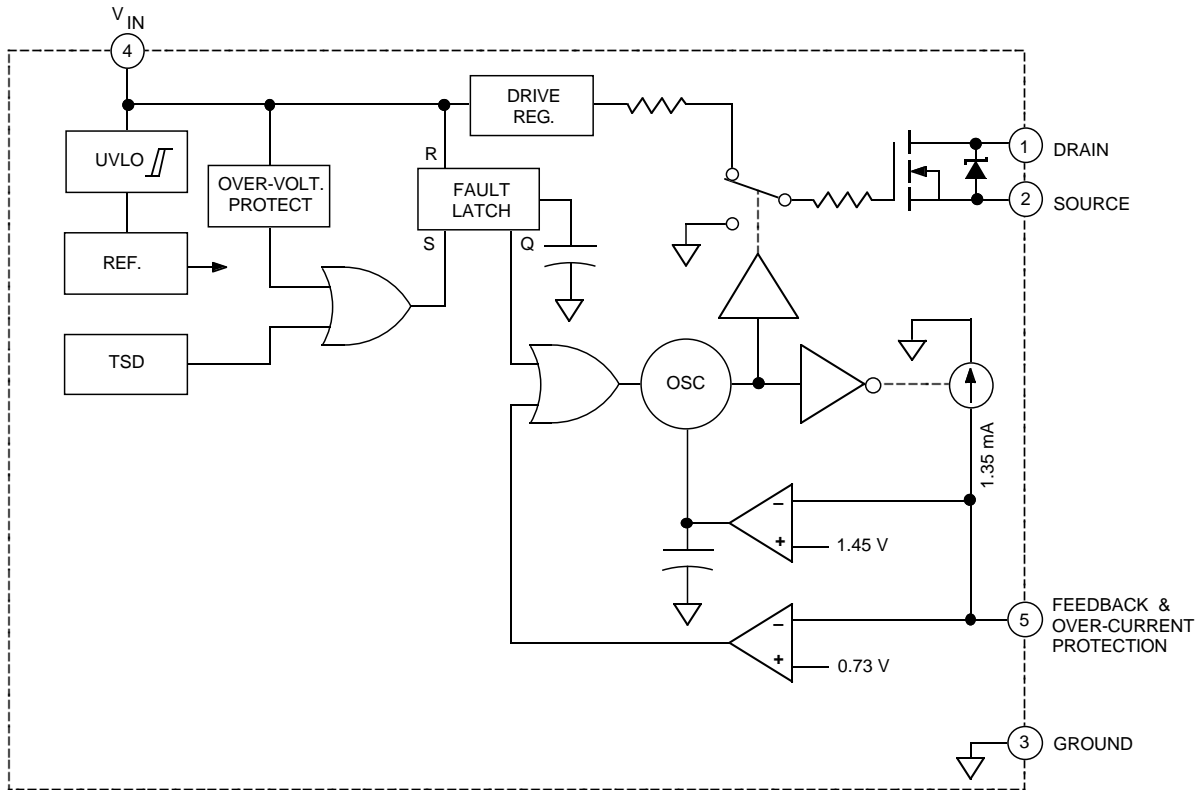
STR-G6653

OFF-LINE

QUASI-RESONANT FLYBACK

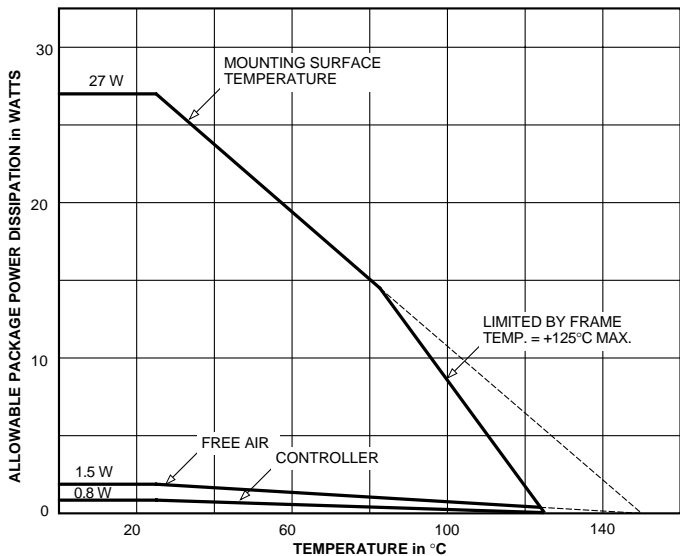
SWITCHING REGULATOR

FUNCTIONAL BLOCK DIAGRAM



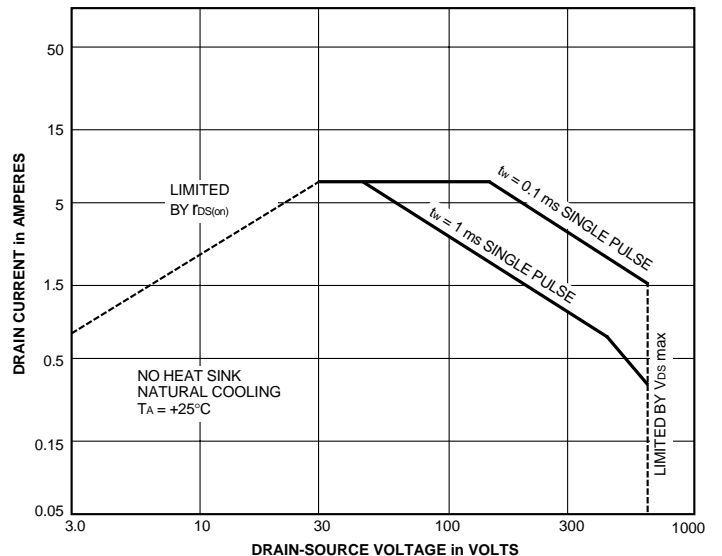
Dwg. FK-002-5

ALLOWABLE PACKAGE POWER DISSIPATION



Dwg. GK-003-4

MAXIMUM SAFE OPERATING AREA



Dwg. GK-004-5



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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 | μA |
| 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 | Ω |
| Maximum OFF Time | t_{off} | Drain waveform high | 45 | – | 55 | μs |
| Minimum Pulse Duration for Input of Quasi-Resonant Signals | $t_{w(th)}$ | Drain waveform high ¹ | – | – | 1.0 | μs |
| Minimum OFF Time | t_{off} | Drain waveform high ¹ | – | – | 1.5 | μs |
| Feedback Threshold Voltage | V_{FDBK} | Drain waveform low to high ¹ | 0.68 | 0.73 | 0.78 | V |
| | | Oscillation synchronized ² | 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 ³ | – | – | 30 | mA |
| | $I_{IN(OFF)}$ | Increasing V_{IN} prior to oscillation | – | – | 100 | μA |
| 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.

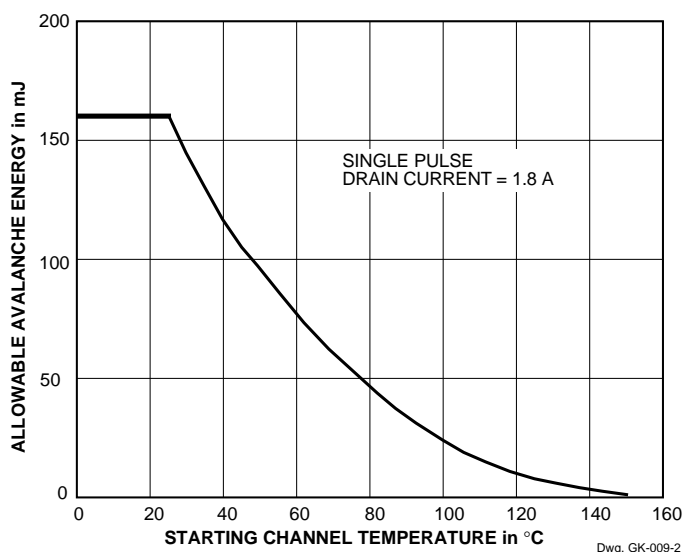
1. Feedback is square wave, $V_{IM} = 2.2\text{ V}$, $t_h = 1\ \mu\text{s}$, $t_l = 35\ \mu\text{s}$

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, $V_{IM} = 2.2\text{ V}$, $t_h = 4\ \mu\text{s}$, $t_l = 1\ \mu\text{s}$

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OFF-LINE
QUASI-RESONANT FLYBACK
SWITCHING REGULATOR

ALLOWABLE AVALANCHE ENERGY



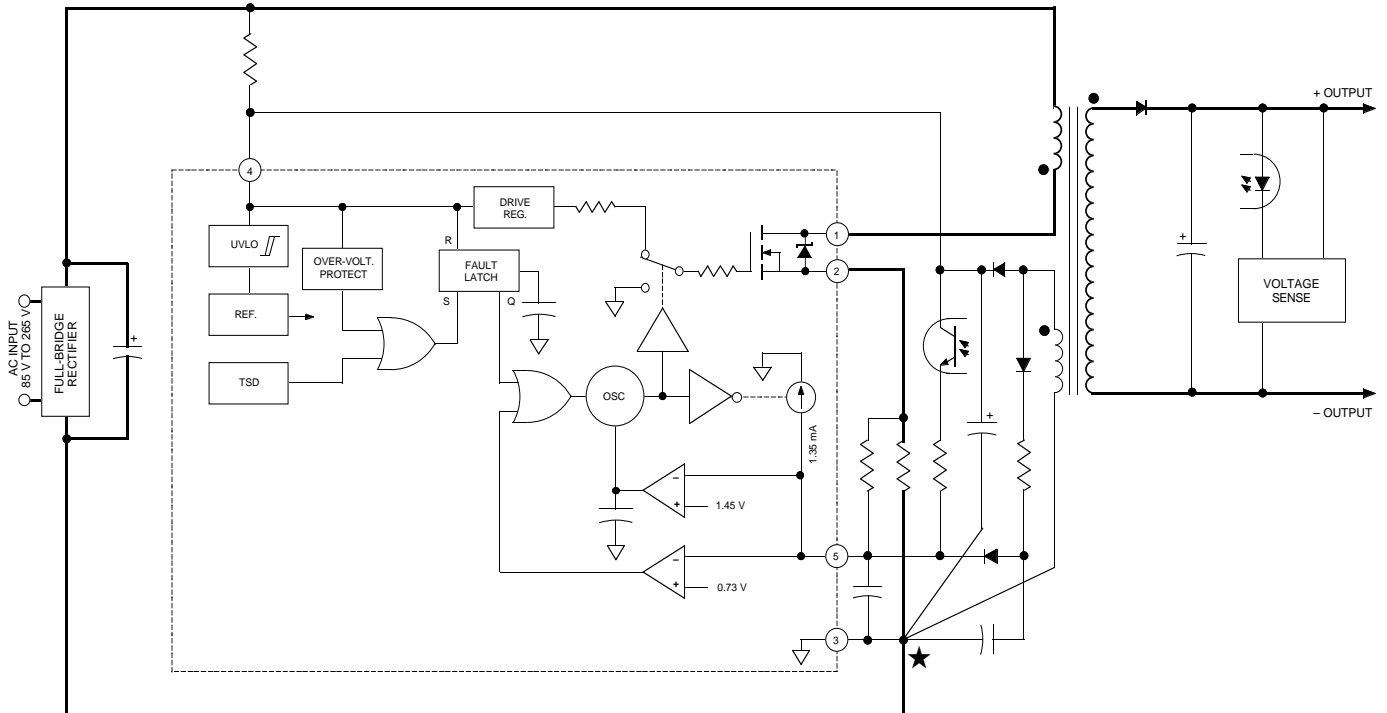
STR-G6600 Series

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

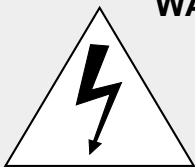
STR-G6653 OFF-LINE QUASI-RESONANT FLYBACK SWITCHING REGULATOR

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:

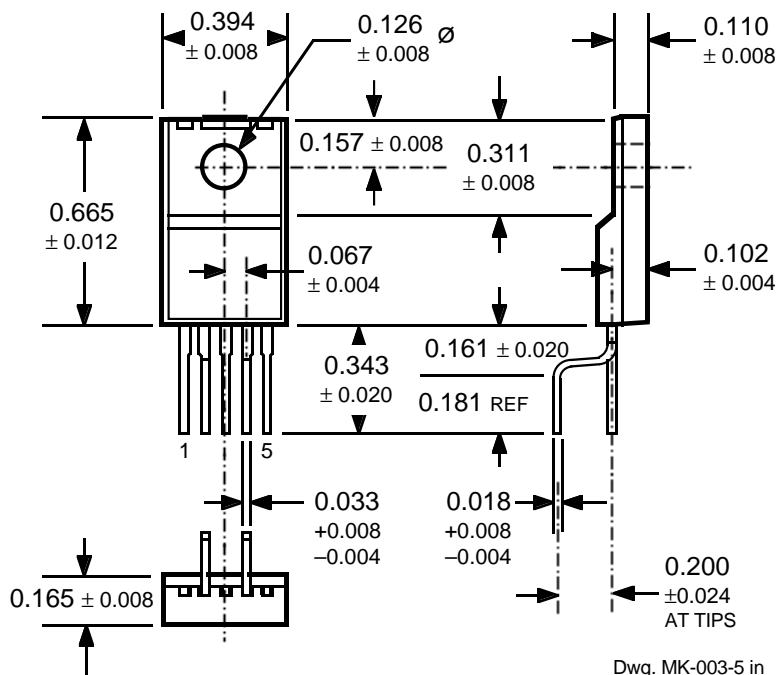
4.34 - 5.79 lbf•ft (6 - 8 kg•cm or 0.588 - 0.784 Nm).

Recommended silicone grease:

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

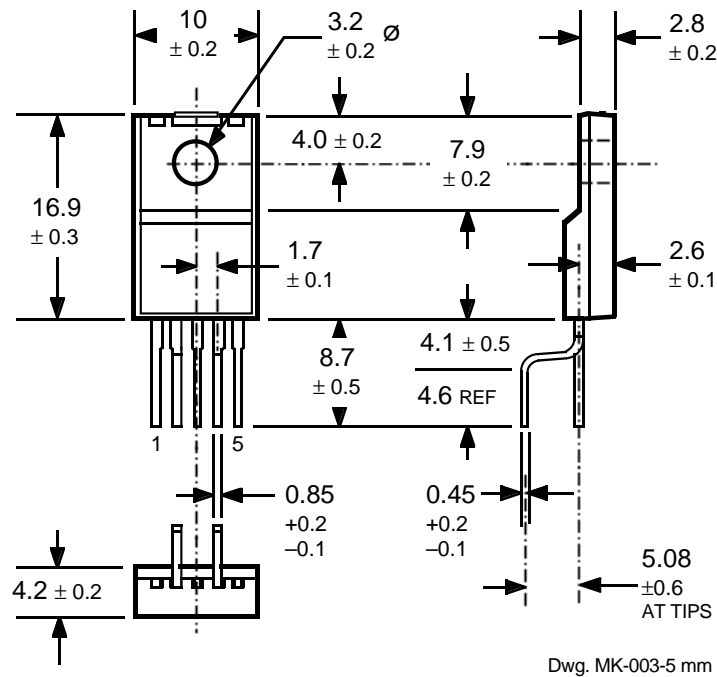
STR-G6653
OFF-LINE
QUASI-RESONANT FLYBACK
SWITCHING REGULATOR

Dimensions in Inches
 (for reference only)



STR-G6653
OFF-LINE
QUASI-RESONANT FLYBACK
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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 _I | Max P _O | | 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.