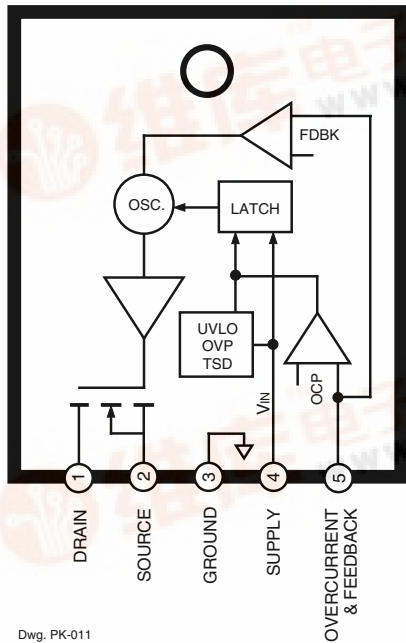


# STR-G6651

## OFF-LINE QUASI-RESONANT FLYBACK SWITCHING REGULATOR



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,                   |                 |
| .....  | -40°C to +125°C |

The STR-G6651 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. Two lead forms are available (with and without the suffix '-LF') to accommodate printed wiring board layout or mechanical constraints.

Proven in substantial volumes, the STR-G6651 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.

### FEATURES

- Quasi-Resonant Operation
- Output Power to 66 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-G6651**



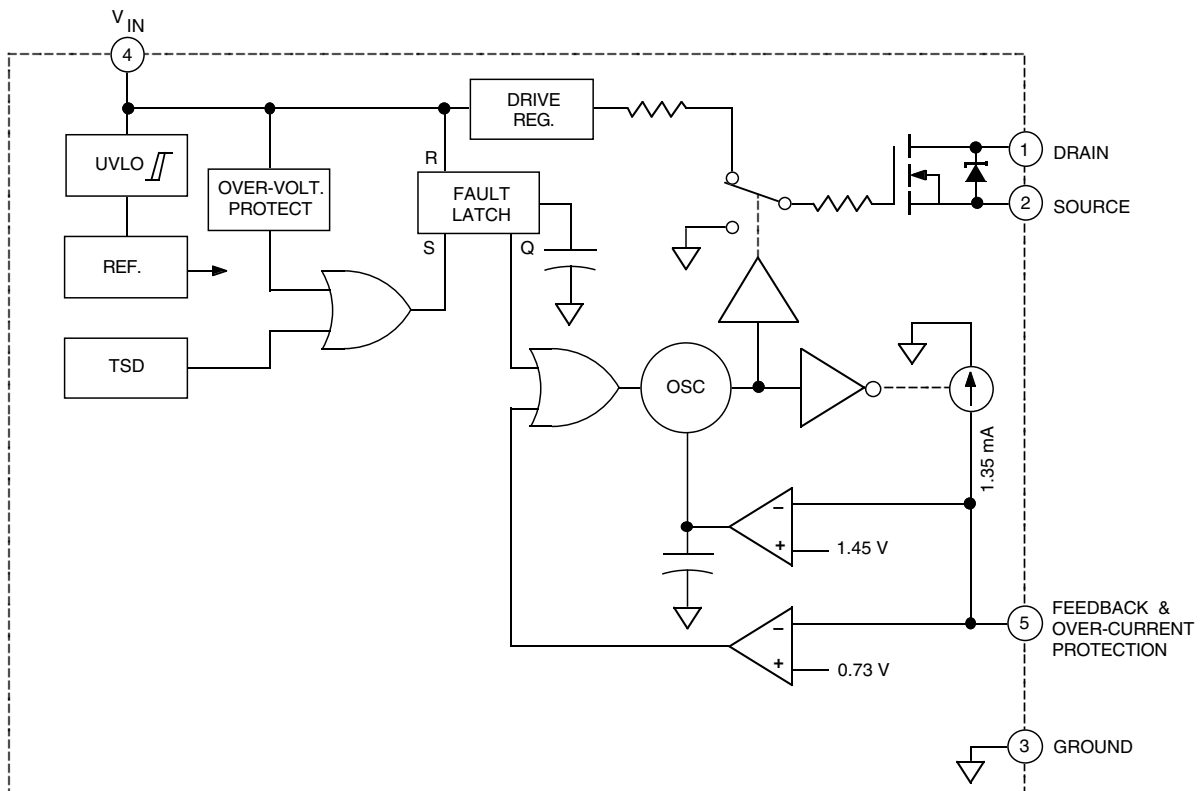
# STR-G6651

## OFF-LINE

### QUASI-RESONANT FLYBACK

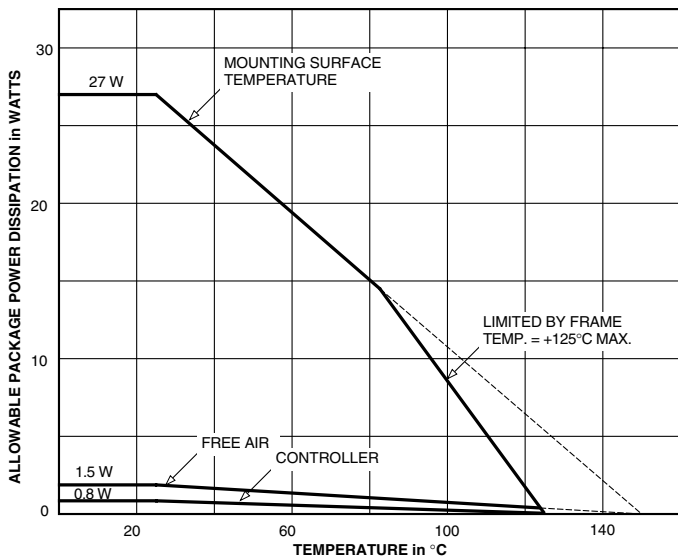
### SWITCHING REGULATOR

### FUNCTIONAL BLOCK DIAGRAM



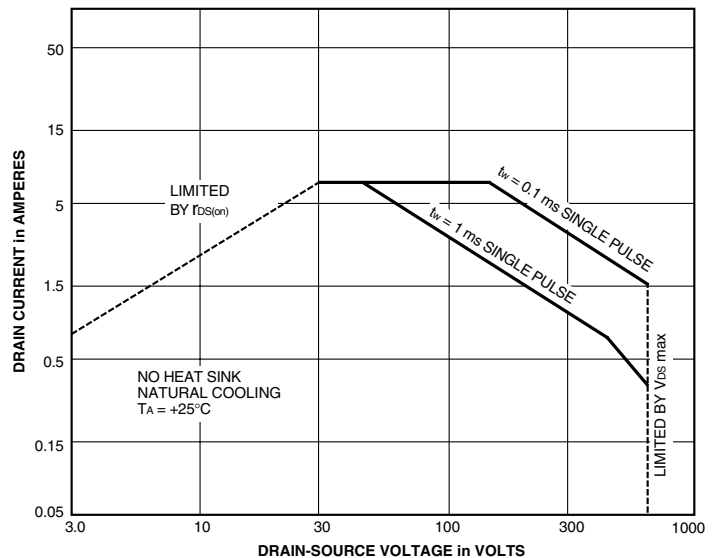
Dwg. FK-002-5

### ALLOWABLE PACKAGE POWER DISSIPATION



Dwg. GK-003-4

### MAXIMUM SAFE OPERATING AREA



Dwg. GK-004-5

**STR-G6651**  
**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 |      |      |                    |
|--|-----------------|--|--------|------|------|--------------------|
|  |                 |  | Min.   | Typ. | Max. | Units              |
| 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  | $r_{DS(on)}$    | $V_S = 10\text{ V}$ , $I_D = 0.9\text{ A}$ , $T_J = +25^\circ\text{C}$ | –      | –    | 3.95 | $\Omega$           |
| 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.

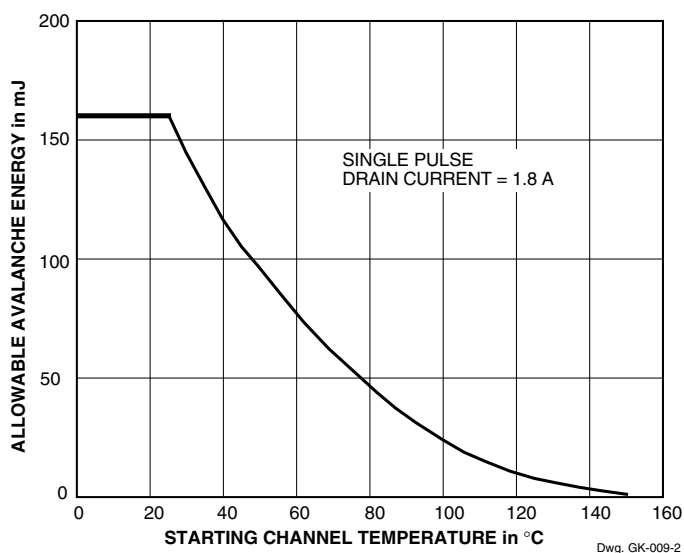
1. Feedback is square wave,  $V_{IM} = 2.2\text{ V}$ ,  $t_h = 1\ \mu\text{s}$ ,  $t_l = 35\ \mu\text{s}$

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-G6651**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**ALLOWABLE AVALANCHE ENERGY**



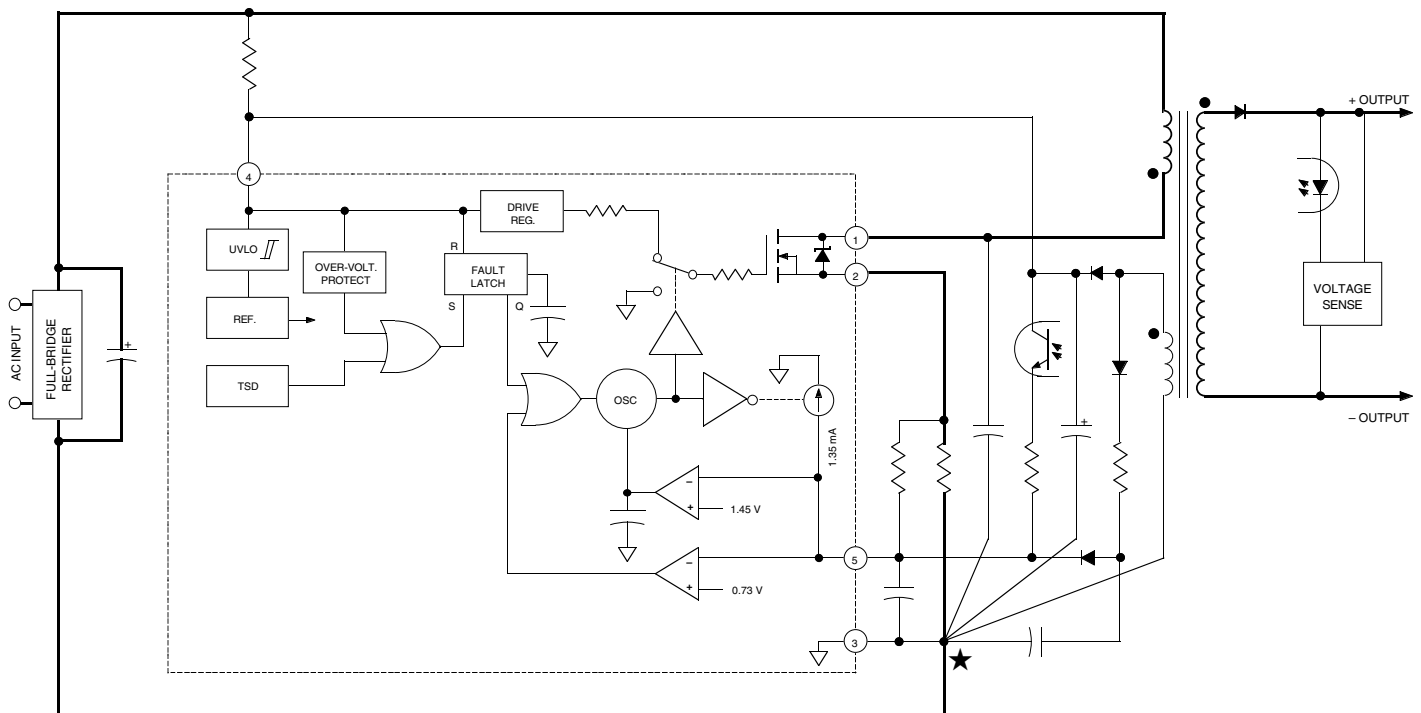
**STR-G6600 Series**

| Part Number                   | Drain-Source Output Breakdown Voltage at $I_D = 300 \mu\text{A}$<br>$V_{(BR)DS}$ , Minimum | Drain-Source ON Resistance at $I_D = 0.9 \text{ A}$<br>$r_{DS(on)}$ , 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        |

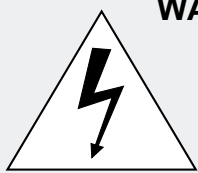
# STR-G6651 OFF-LINE QUASI-RESONANT FLYBACK SWITCHING REGULATOR

## TYPICAL QUASI-RESONANT FLYBACK CONVERSION USING STR-G6651

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



Dwg. EK-003-4A



**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).

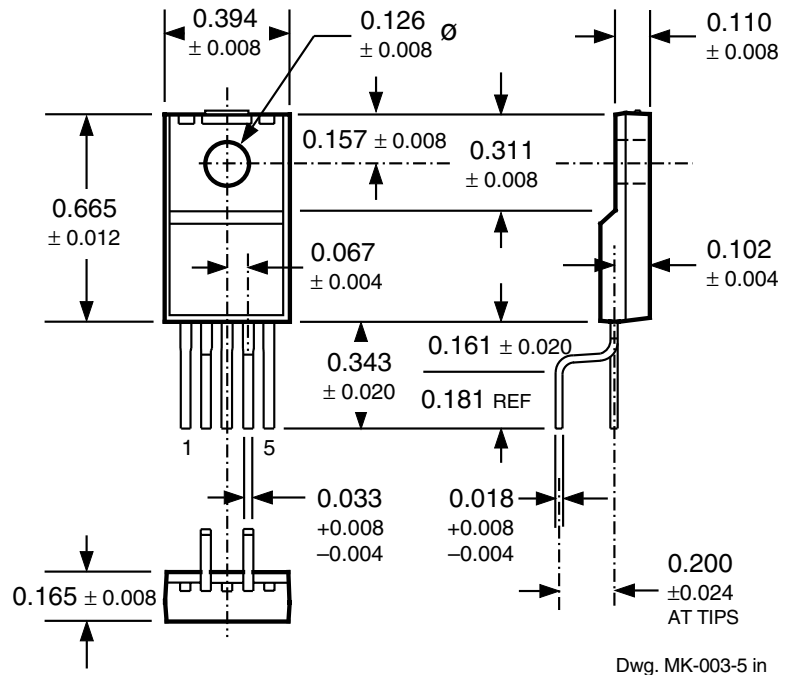
Recommended silicone grease:

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

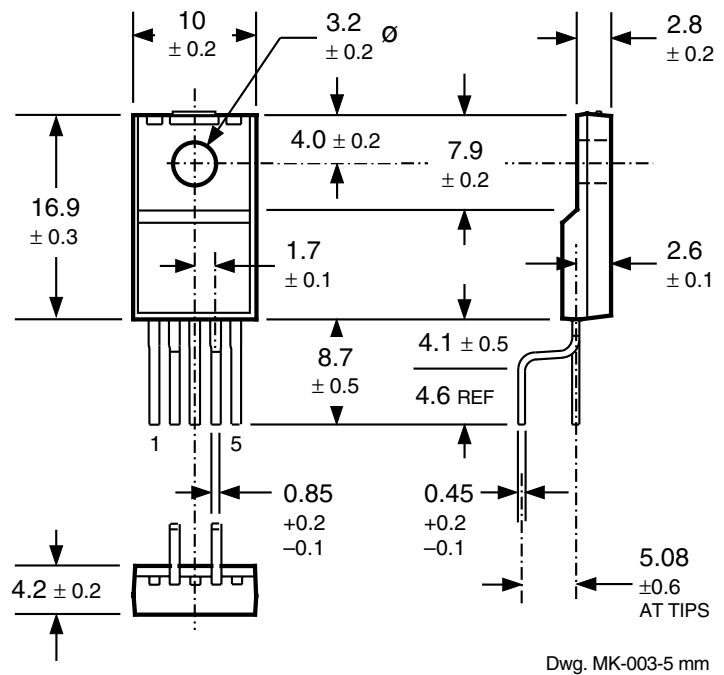
**STR-G6651**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**STR-G6651**  
(LF1129)

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



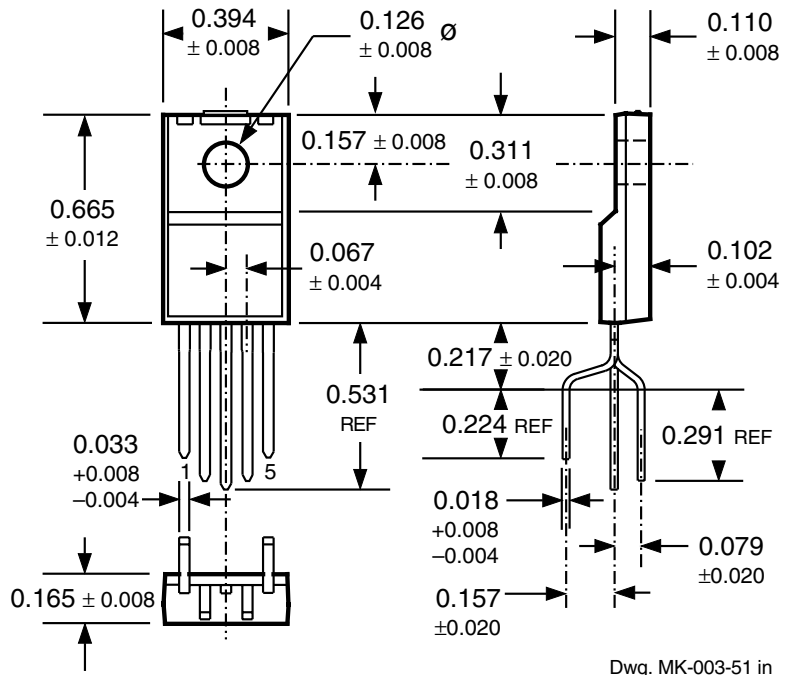
**Dimensions in Millimeters**  
(controlling dimensions)



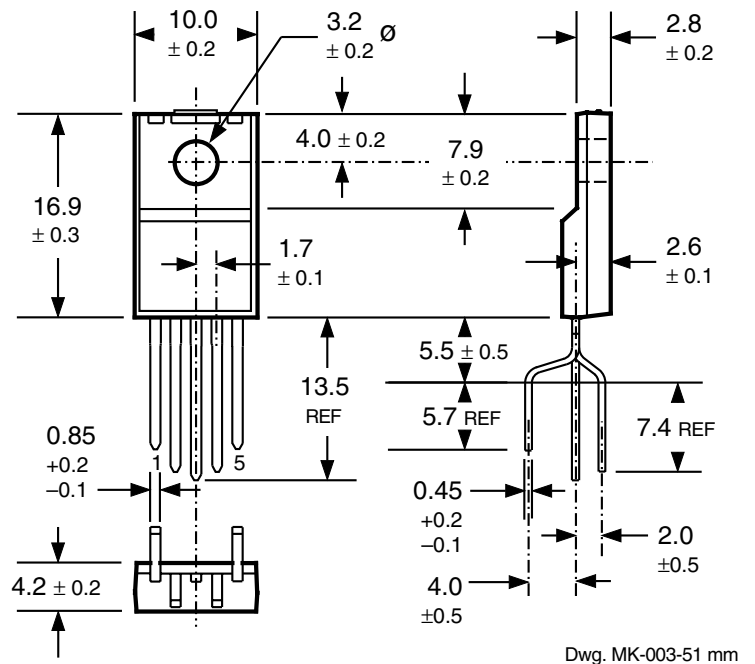
**STR-G6651**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

**STR-G6651-LF**  
(LF1128)

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



**Dimensions in Millimeters**  
(controlling dimensions)



**STR-G6651**  
**OFF-LINE**  
**QUASI-RESONANT FLYBACK**  
**SWITCHING REGULATOR**

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