



## An Ultra-small 1.4 mm<sup>2</sup>, 18 mΩ, 2.0 A Integrated Power Switch with Discharge

### General Description

The SLG59M1720V is a high performance 18 mΩ, 2.0 A single-channel nFET integrated power switch which can operate with a 2.5 V to 3.6 V V<sub>DD</sub> supply to switch power rails from as low as 0.85 V up to the supply voltage. The SLG59M1720V incorporates two-level overload current protection, thermal shutdown protection, fast output discharge, and in-rush current control which can easily be adjusted by a small external capacitor.

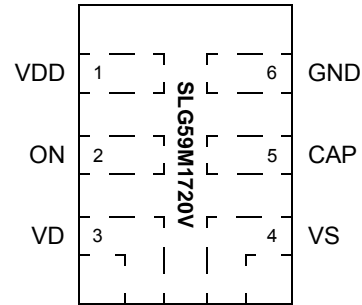
Using a proprietary MOSFET design, the SLG59M1720V achieves a stable 18 mΩ R<sub>DS(ON)</sub> across a wide input voltage range and over temperature. In addition, the SLG59M1720V's package also exhibits low thermal resistance for high-current operation using Silego's proprietary CuFET technology.

Fully specified over the -40 °C to 85 °C temperature range, the SLG59M1720V is packaged in a space-efficient, low thermal resistance, RoHS-compliant 1.0 mm x 1.4 mm STDFN package.

### Features

- Low R<sub>DS(ON)</sub> nFET: 18 mΩ
- Steady-state Operating Current: Up to 2.0 A
- Supply Voltage: 2.5 V ≤ V<sub>DD</sub> ≤ 3.6 V
- Wide Input Voltage Range: 0.85 V ≤ V<sub>D</sub> ≤ V<sub>DD</sub>
- Capacitor-programmable Start-up and Inrush Current Control
- Two-stage Overcurrent Protection:
  - Fixed 2.6 A Active Current Limit
  - Fixed 0.5 A Short-circuit Current Limit
- Thermal Shutdown Protection
- Fast V<sub>OUT</sub> Discharge
- Operating Temperature: -40 °C to 85 °C
- Low θ<sub>JA</sub>, 6-pin 1.0 mm x 1.4 mm STDFN Packaging
  - Pb-Free / Halogen-Free / RoHS compliant

### Pin Configuration

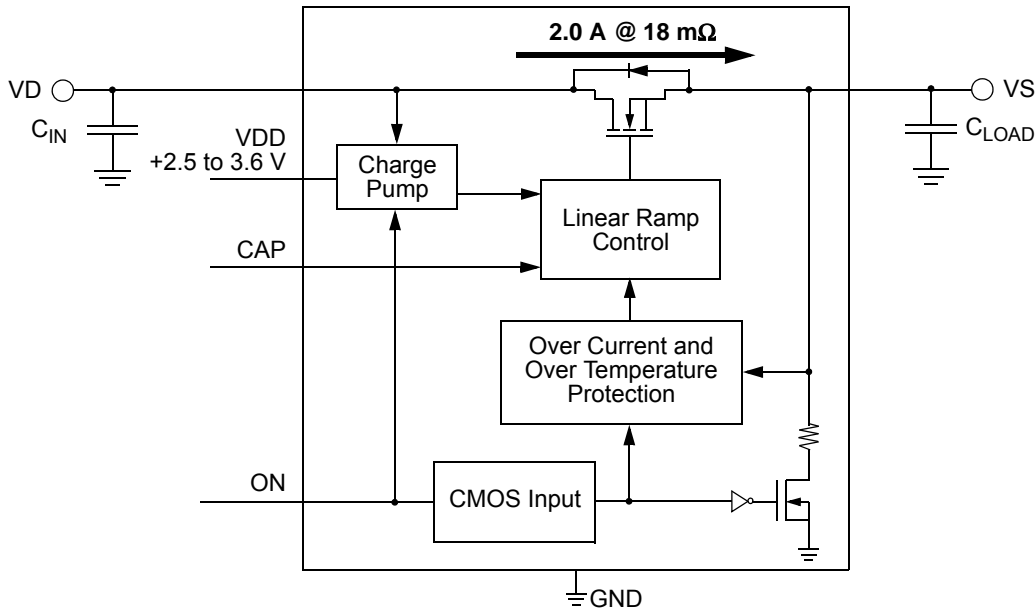


6-pin STDFN (Top View)

### Applications

- GPS Devices
- Notebook & Tablet PCs
- Smartphones
- Portable Consumer Electronics
- Portable Bar-Code Scanners
- Portable POS Terminals

### Block Diagram





### Pin Description

| Pin # | Pin Name | Type   | Pin Description  |
|-------|----------|--------|--|
| 1     | VDD      | Power  | With an internal 1.9V UVLO threshold, VDD supplies the power for the operation of the power switch and internal control circuitry. Bypass the VDD pin to GND with a 0.1 $\mu$ F (or larger) capacitor.   |
| 2     | ON       | Input  | A low-to-high transition on this pin initiates the operation of the SLG59M1720V's state machine. ON is an asserted HIGH, level-sensitive CMOS input with $V_{IL} < 0.3$ V and $V_{IH} > 0.85$ V. While there is an internal pull-down circuit to GND ( $\sim 4$ M $\Omega$ ), connect this pin directly to a general-purpose output (GPO) of a microcontroller, an application processor, or a system controller – do not allow this pin to be open-circuited. |
| 3     | VD       | MOSFET | Drain terminal connection of the n-channel FET. Connect a 10- $\mu$ F (or larger) low-ESR capacitor from this pin to ground. Capacitors used at VD should be rated at 10 V or higher.  |
| 4     | VS       | MOSFET | Source terminal connection of the n-channel FET. Connect a 10 $\mu$ F (or larger) low-ESR capacitor from this pin to ground. Capacitors used at VS should be rated at 10 V or higher. To speed up VS fall time on OFF, the SLG59M1720V includes a 220 $\Omega$ discharge path to GND.  |
| 5     | CAP      | Output | A low-ESR, stable dielectric, ceramic surface-mount capacitor connected from CAP pin to GND sets the VS slew rate and overall turn-on time of the SLG59M1720V. For best performance, the range for CAP values are $1$ nF $\leq$ CAP $\leq$ 22 nF. Capacitors used at CAP should be rated at 10 V or higher.  |
| 6     | GND      | GND    | Ground connection. Connect this pin to system analog or power ground plane.  |

### Ordering Information

| Part Number   | Type                     | Production Flow             |
|---------------|--------------------------|-----------------------------|
| SLG59M1720V   | STDFN 6L                 | Industrial, -40 °C to 85 °C |
| SLG59M1720VTR | STDFN 6L (Tape and Reel) | Industrial, -40 °C to 85 °C |



## Absolute Maximum Ratings

| Parameter                | Description                       | Conditions   | Min. | Typ. | Max. | Unit |
|--------------------------|-----------------------------------|--|------|------|------|------|
| V <sub>DD</sub>          | Power Supply                      |  | --   | --   | 4.5  | V    |
| T <sub>S</sub>           | Storage Temperature               |  | -65  | --   | 150  | °C   |
| ESD <sub>HBM</sub>       | ESD Protection                    | Human Body Model   | 2000 | --   | --   | V    |
| ESD <sub>CDM</sub>       | ESD Protection                    | Charged Device Model   | 1000 | --   | --   | V    |
| MSL                      | Moisture Sensitivity Level        |  | 1    |      |      |      |
| θ <sub>JA</sub>          | Thermal Resistance                | 1.0 x 1.4 mm 6L STDFN; Determined using 1 in <sup>2</sup> , 1 oz. copper pads under VD and VS terminals and FR4 pcb material | --   | 72   | --   | °C/W |
| W <sub>DIS</sub>         | Package Power Dissipation         |  | --   | --   | 0.4  | W    |
| MOSFET IDS <sub>PK</sub> | Peak Current from Drain to Source | Maximum pulsed switch current, pulse width < 1ms, 1% duty cycle  | --   | --   | 3    | A    |

Note: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

## Electrical Characteristics

T<sub>A</sub> = -40 °C to 85 °C (unless otherwise stated)

| Parameter              | Description                          | Conditions   | Min.                      | Typ. | Max.            | Unit |
|------------------------|--------------------------------------|--|---------------------------|------|-----------------|------|
| V <sub>DD</sub>        | Power Supply Voltage                 | -40 °C to 85 °C  | 2.5                       | --   | 3.6             | V    |
| I <sub>DD</sub>        | Power Supply Current (PIN 1)         | when OFF   | --                        | --   | 1               | μA   |
|                        |                                      | when ON, No load   | --                        | 85   | 100             | μA   |
| RDS <sub>ON</sub>      | Static Drain to Source ON Resistance | T <sub>A</sub> 25°C @ 100 mA   | --                        | 18   | 21              | mΩ   |
|                        |                                      | T <sub>A</sub> 85°C @ 100 mA   | --                        | 20   | 24              | mΩ   |
| IDS                    | Operating Current                    | V <sub>D</sub> = 1.0 V to 3.6 V  | --                        | --   | 2.0             | A    |
| I <sub>FET_OFF</sub>   | MOSFET OFF Leakage Current           | V <sub>D</sub> = 3.3 V, V <sub>S</sub> = 0 V; ON = LOW   | --                        | --   | 1               | μA   |
| V <sub>D</sub>         | Drain Voltage                        |  | 0.85                      | --   | V <sub>DD</sub> | V    |
| T <sub>ON_Delay</sub>  | ON pin Delay Time                    | 50% ON to Ramp Begin, R <sub>LOAD</sub> = 100 Ω, no C <sub>LOAD</sub>  | --                        | 450  | 650             | μs   |
| T <sub>Total_ON</sub>  | Total Turn On Time                   | 50% ON to 90% V <sub>S</sub>   | Configurable <sup>1</sup> |      |                 | ms   |
|                        |                                      | Example: CAP (PIN 5) = 4 nF, V <sub>DD</sub> = V <sub>D</sub> = 3.3 V, R <sub>LOAD</sub> = 100 Ω, C <sub>LOAD</sub> = 10 μF          | --                        | 1.4  | 1.7             | ms   |
| T <sub>SLEWRATE</sub>  | Slew Rate                            | 10% V <sub>S</sub> to 90% V <sub>S</sub>   | Configurable <sup>1</sup> |      |                 | V/ms |
|                        |                                      | Example: CAP (PIN 5) = 4 nF, V <sub>DD</sub> = V <sub>D</sub> = 3.3 V, R <sub>LOAD</sub> = 100 Ω, C <sub>LOAD</sub> = 10 μF          | 2.5                       | 3.0  | 3.5             | V/ms |
| T <sub>OFF_Delay</sub> | OFF Delay Time                       | 50% ON to V <sub>S</sub> Fall, V <sub>DD</sub> = V <sub>D</sub> = 3.3 V, R <sub>LOAD</sub> = 100 Ω, no C <sub>LOAD</sub>             | --                        | 3.2  | --              | μs   |
| T <sub>FALL</sub>      | V <sub>S</sub> Fall Time             | 90% V <sub>S</sub> to 10% V <sub>S</sub> , V <sub>DD</sub> = V <sub>D</sub> = 3.3 V, R <sub>LOAD</sub> = 100 Ω, no C <sub>LOAD</sub> | --                        | 0.5  | --              | μs   |
| C <sub>LOAD</sub>      | Output Load Capacitance              | C <sub>LOAD</sub> connected from V <sub>S</sub> to GND   | 10                        | 22   | 100             | μF   |
| R <sub>DIS</sub>       | Discharge Resistance                 |  | 150                       | 220  | 300             | Ω    |



### Electrical Characteristics (continued)

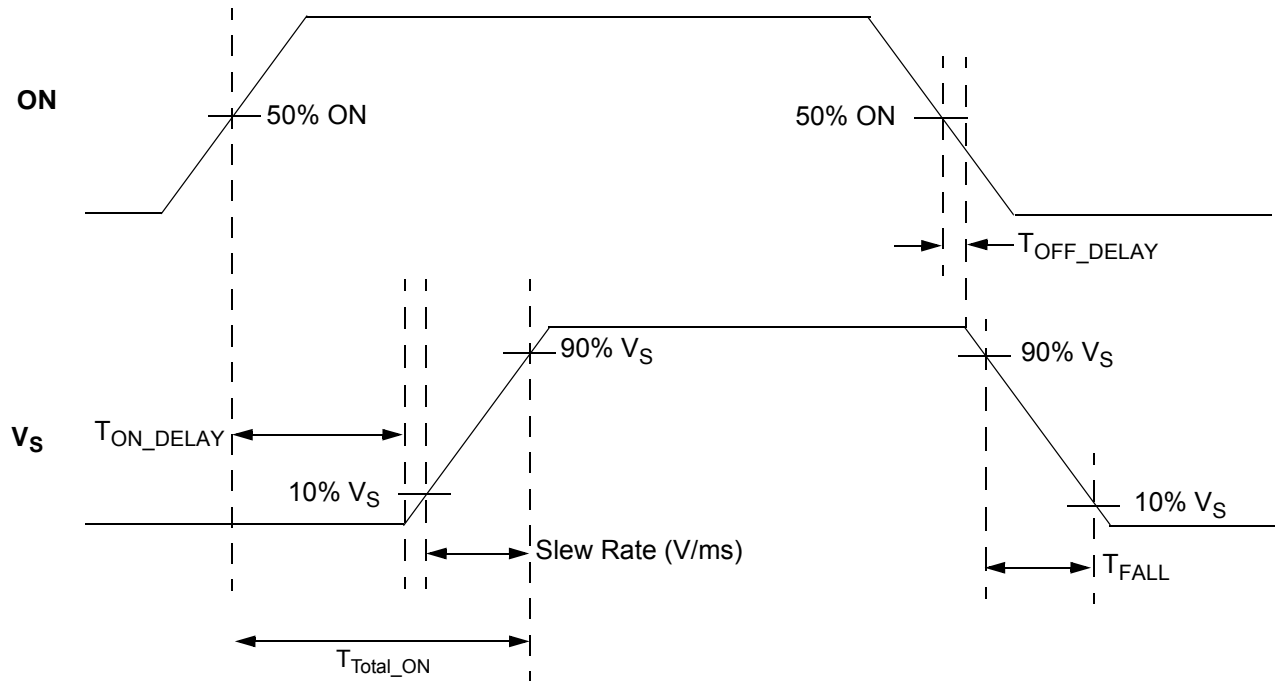
$T_A = -40\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$  (unless otherwise stated)

| Parameter             | Description                          | Conditions   | Min. | Typ. | Max.            | Unit               |
|-----------------------|--------------------------------------|--|------|------|-----------------|--------------------|
| ON_V <sub>IH</sub>    | High Input Voltage on ON pin         |  | 0.85 | --   | V <sub>DD</sub> | V                  |
| ON_V <sub>IL</sub>    | Low Input Voltage on ON pin          |  | -0.3 | 0    | 0.3             | V                  |
| I <sub>LIMIT</sub>    | Active Current Limit                 | MOSFET will automatically limit current when V <sub>S</sub> > 250 mV | 2.1  | 2.6  | 3.1             | A                  |
|                       | Short Circuit Current Limit          | MOSFET will automatically limit current when V <sub>S</sub> < 250 mV | --   | 0.5  | --              | A                  |
| THERM <sub>ON</sub>   | Thermal shutoff turn-on temperature  |  | --   | 135  | --              | $^{\circ}\text{C}$ |
| THERM <sub>OFF</sub>  | Thermal shutoff turn-off temperature |  | --   | 105  | --              | $^{\circ}\text{C}$ |
| THERM <sub>TIME</sub> | Thermal shutoff time                 |  | --   | --   | 1               | ms                 |

Notes:

1. Refer to table for configuration details.

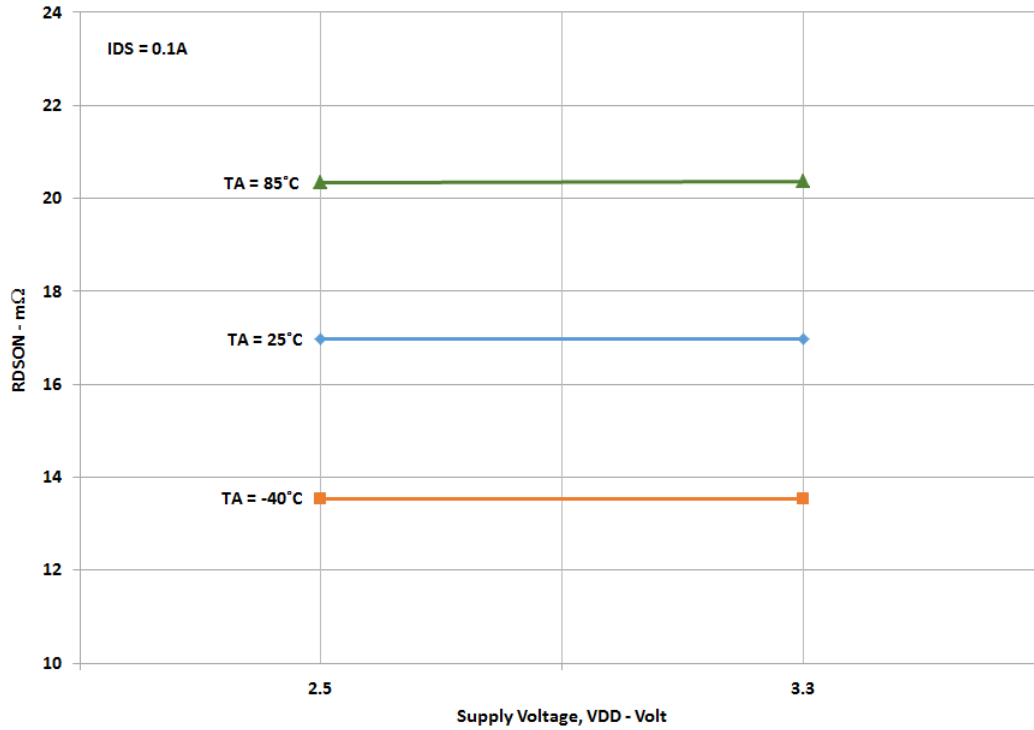
### T<sub>Total\_ON</sub>, T<sub>ON\_Delay</sub> and Slew Rate Measurement



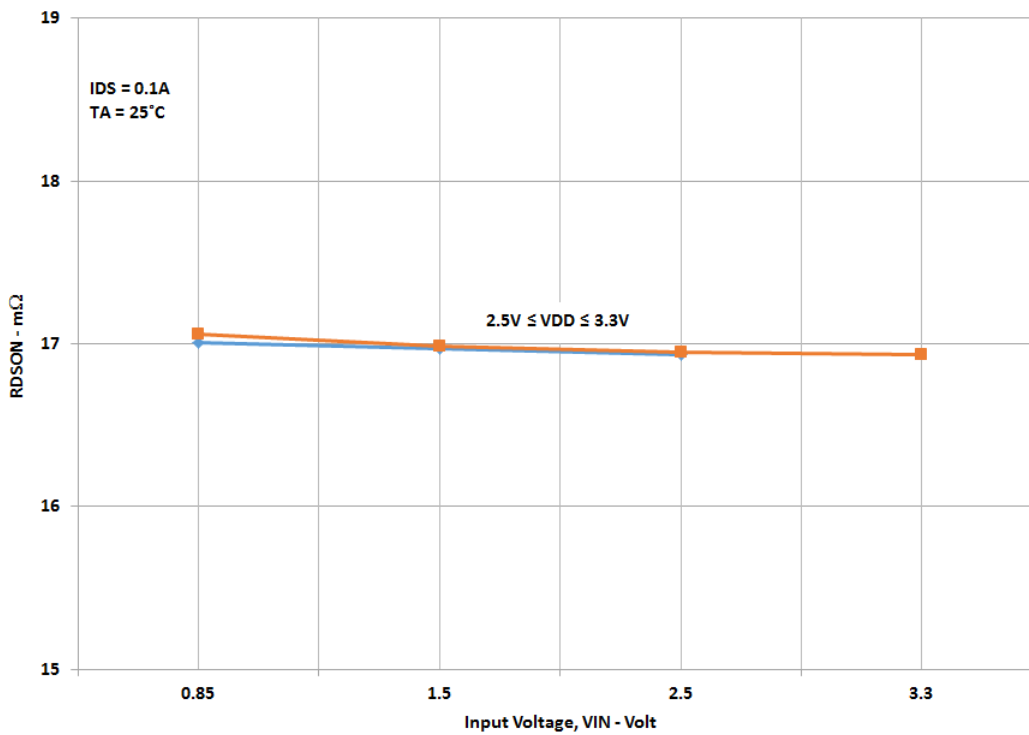


### Typical Performance Characteristics

#### RDS<sub>ON</sub> vs. V<sub>DD</sub>, and Temperature

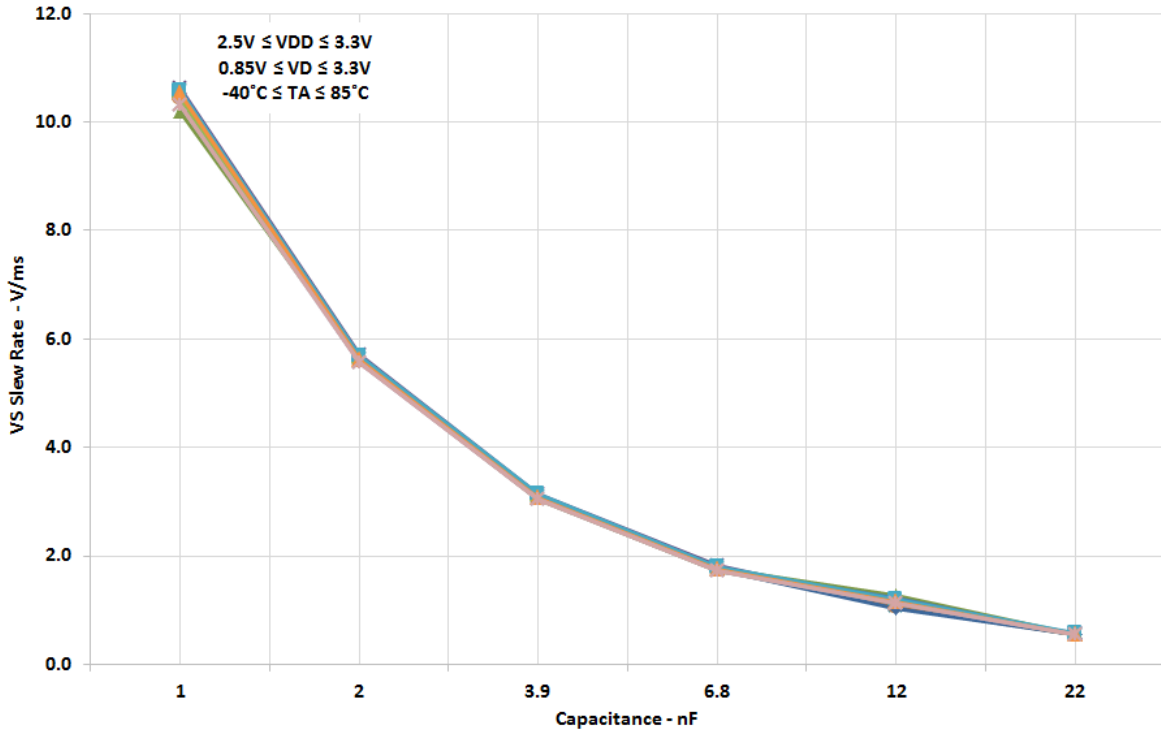


#### RDS<sub>ON</sub> vs. V<sub>D</sub> and V<sub>DD</sub>

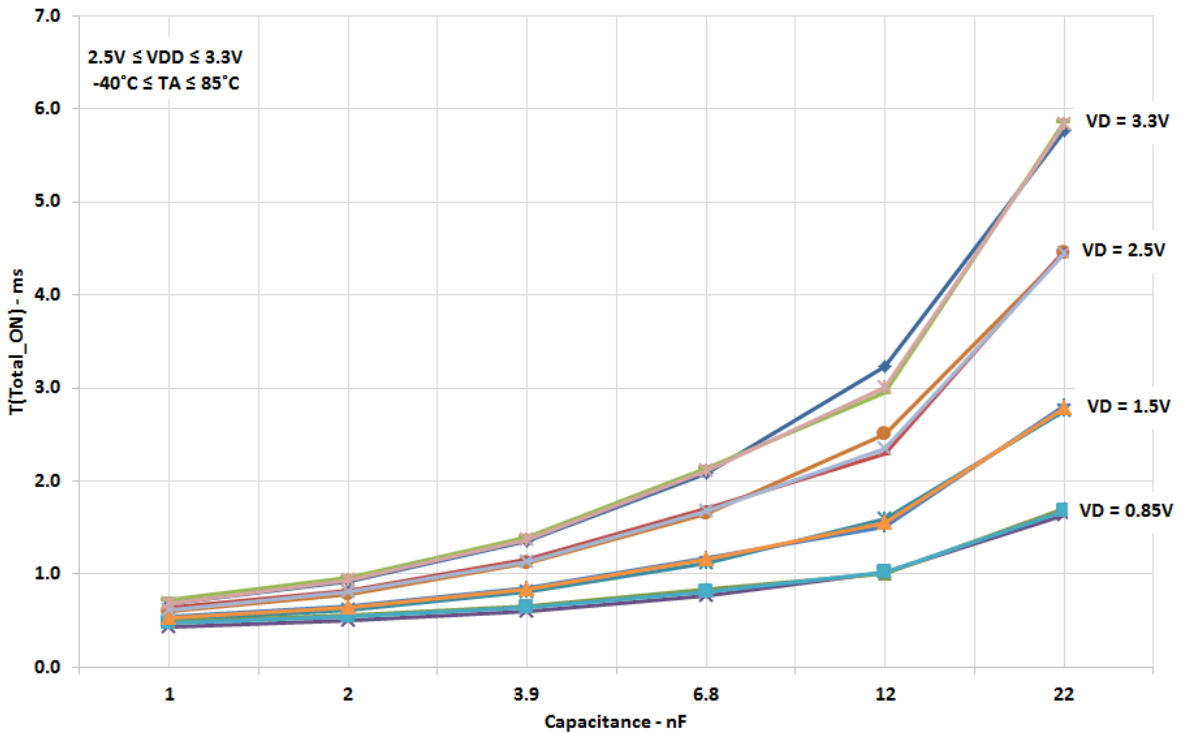




### $T_{SLEW}$ vs. CAP, $V_D$ , $V_{DD}$ , and Temperature



### $T_{Total\_ON}$ vs. CAP, $V_D$ , $V_{DD}$ , and Temperature





### SLG59M1720V Power-Up/Power-Down Sequence Considerations

A nominal power-up sequence is to apply  $V_{DD}$  first, followed by  $V_D$  only after  $V_{DD}$  is  $> 1.9$  V, and finally toggling the ON pin LOW-to-HIGH after  $V_D$  is at least 90% of its final value.

A nominal power-down sequence is the power-up sequence in reverse order. It is important that the SLG59M1720V's ON pin is toggled HIGH only after  $V_{DD}$  and  $V_D$  have reached their steady-state values; otherwise, the power switch will spend an undesirable amount of time in high-resistance mode while powering up, heating up, and possibly reaching its thermal shutdown before ever fully turning on.

If  $V_{DD}$  and  $V_D$  are applied at the same time, a voltage glitch may appear on the output pin at  $V_S$ . To prevent glitches at the output, it is recommended to connect a 10  $\mu$ F capacitor from the  $V_S$  pin to GND and to keep the  $V_{DD}$  &  $V_D$  ramp times less than 2 ms.

The  $V_S$  output follows a linear ramp when the power switch is turned on, provided that the  $V_S$  slew time set by CAP is less than the RC time constant formed by the  $R_{DS_{ON}}$  of the power switch and load capacitance  $C_{LOAD}$ .

### SLG59M1720V Current Limiting Operation

The SLG59M1720V has two types of current limiting triggered by the output  $V_S$  pin voltage.

#### 1. Standard Current Limiting Mode (with Thermal Shutdown Protection)

When the  $V_S$  pin voltage  $> 250$  mV, the output current is initially limited to the Active Current Limit (ACL) specification listed in the Electrical Characteristics table. The ACL monitor's response time is very fast and is triggered within a few microseconds to sudden (transient) changes in load current. When a load current overload is detected, the ACL monitor increases the FET resistance to keep the current from exceeding the power switch's ACL threshold.

However, if a load-current overload condition persists where the die temperature rises because of the increased FET resistance, the power switch's internal Thermal Shutdown Protection circuit can be activated. If the die temperature exceeds the listed  $THERM_{ON}$  specification, the FET is shut OFF completely, thereby allowing the die to cool. When the die cools to the listed  $THERM_{OFF}$  temperature threshold, the FET is allowed to turn back on. This process may repeat as long as the output current overload condition persists.

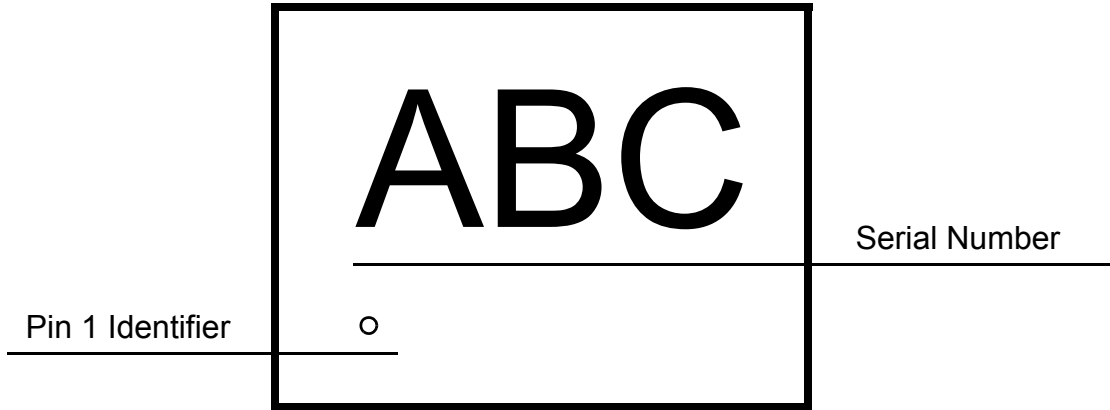
#### 2. Short Circuit Current Limiting Mode (with Thermal Shutdown Protection)

When the  $V_S$  pin voltage  $< 250$  mV (which is the case with a hard short, such as a solder bridge on the power rail), the power switch's internal Short-circuit Current Limit (SCL) monitor limits the FET current to approximately 500 mA (the SCL threshold). While the internal Thermal Shutdown Protection circuit remains enabled and since the SCL threshold is much lower than the ACL threshold, thermal shutdown protection may become activated only at higher ambient temperatures.

For more information on Silego GreenFET3 integrated power switch features, please visit our [Application Notes](#) page at our website and see [App Note "AN-1068 GreenFET3 Integrated Power Switch Basics"](#).



Package Top Marking System Definition



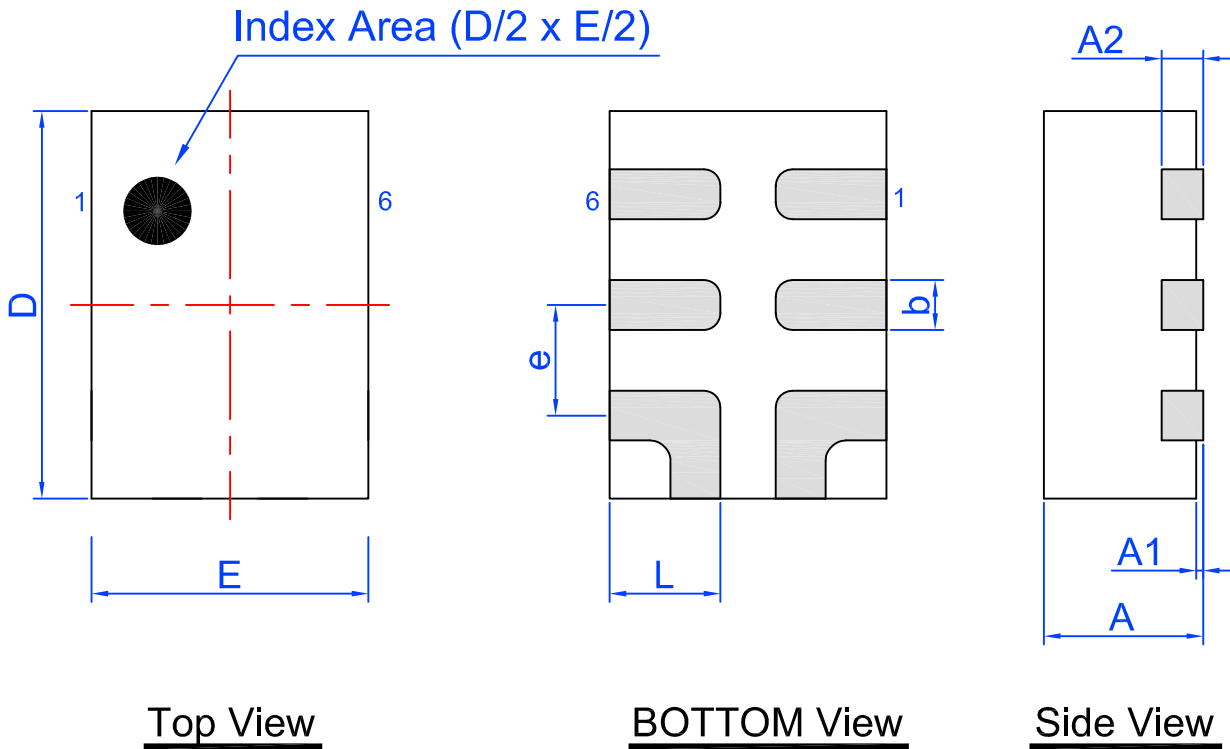
ABC - Part Serial Number Field  
each A, B, and C character can be A-Z and 0-9





### Package Drawing and Dimensions

6 Lead STDFN Package 1.0 x 1.4 mm

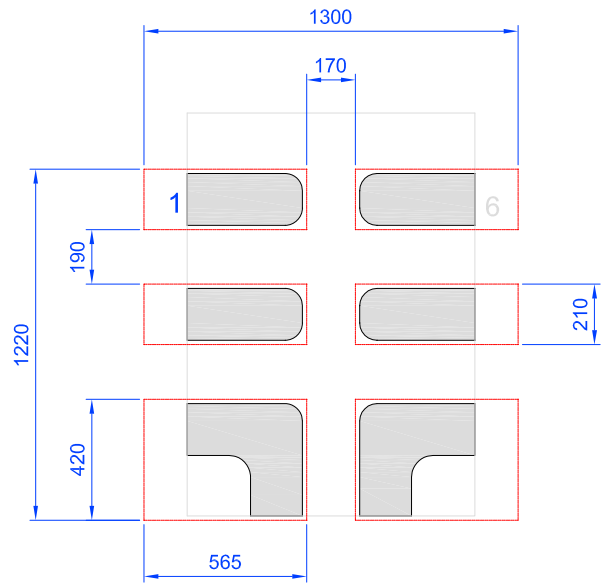
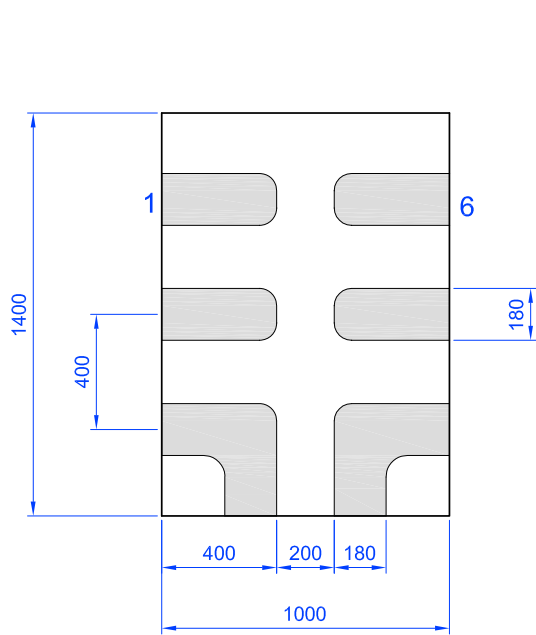


Unit: mm

| Symbol | Min   | Nom. | Max   | Symbol | Min      | Nom. | Max  |
|--------|-------|------|-------|--------|----------|------|------|
| A      | 0.50  | 0.55 | 0.60  | D      | 1.35     | 1.40 | 1.45 |
| A1     | 0.005 | -    | 0.060 | E      | 0.95     | 1.00 | 1.05 |
| A2     | 0.10  | 0.15 | 0.20  | L      | 0.35     | 0.40 | 0.45 |
| b      | 0.13  | 0.18 | 0.23  | e      | 0.40 BSC |      |      |



**Recommended Land Pattern**



Unit: um

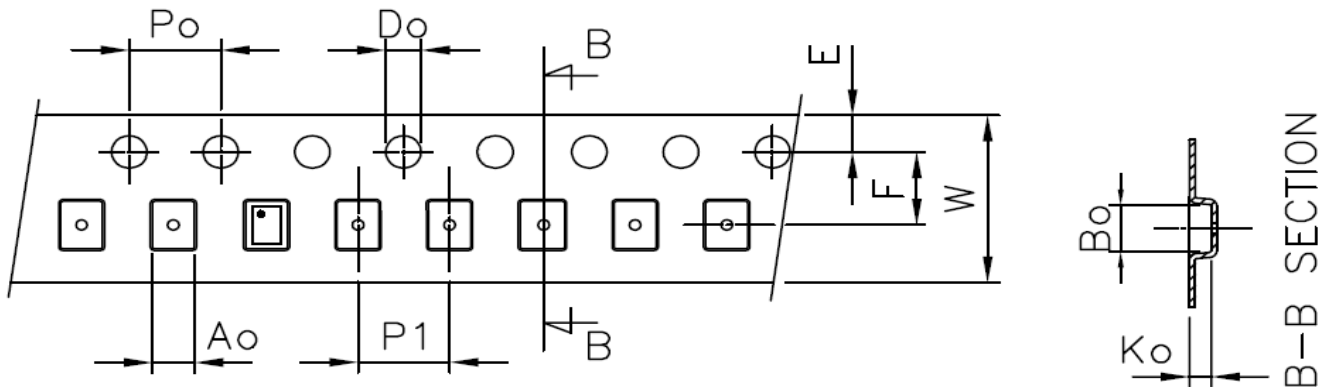


**Tape and Reel Specifications**

| Package Type                            | # of Pins | Nominal Package Size [mm] | Max Units |         | Reel & Hub Size [mm] | Leader (min) |             | Trailer (min) |             | Tape Width [mm] | Part Pitch [mm] |
|---|-----------|---------------------------|-----------|---------|----------------------|--------------|-------------|---------------|-------------|-----------------|-----------------|
|   |           |                           | per Reel  | per Box |                      | Pockets      | Length [mm] | Pockets       | Length [mm] |                 |                 |
| STDFN 6L<br>1x1.4mm<br>0.4P FC<br>Green | 6         | 1.0 x 1.4 x 0.55          | 3,000     | 3,000   | 178 / 60             | 100          | 400         | 100           | 400         | 8               | 4               |

**Carrier Tape Drawing and Dimensions**

| Package Type                            | Pocket BTM Length | Pocket BTM Width | Pocket Depth | Index Hole Pitch | Pocket Pitch | Index Hole Diameter | Index Hole to Tape Edge | Index Hole to Pocket Center | Tape Width |
|---|-------------------|------------------|--------------|------------------|--------------|---------------------|-------------------------|-----------------------------|------------|
|   | A0                | B0               | K0           | P0               | P1           | D0                  | E                       | F                           | W          |
| STDFN 6L<br>1x1.4mm<br>0.4P FC<br>Green | 1.21              | 1.62             | 0.75         | 4                | 4            | 1.5                 | 1.75                    | 3.5                         | 8          |



Refer to EIA-481 specification

**Recommended Reflow Soldering Profile**

Please see IPC/JEDEC J-STD-020: latest revision for reflow profile based on package volume of 0.77 mm<sup>3</sup> (nominal). More information can be found at [www.jedec.org](http://www.jedec.org).



**Revision History**

| Date      | Version | Change             |
|-----------|---------|--------------------|
| 2/23/2017 | 1.00    | Production Release |