



VN770K

QUAD SMART POWER SOLID STATE RELAY FOR COMPLETE H BRIDGE CONFIGURATIONS

| TYPE | R _{DS(on)} | I _{OUT} | V _{CC} |
|--------|---------------------|------------------|-----------------|
| VN770K | 220mΩ (*) | 9A (**) | 36V |

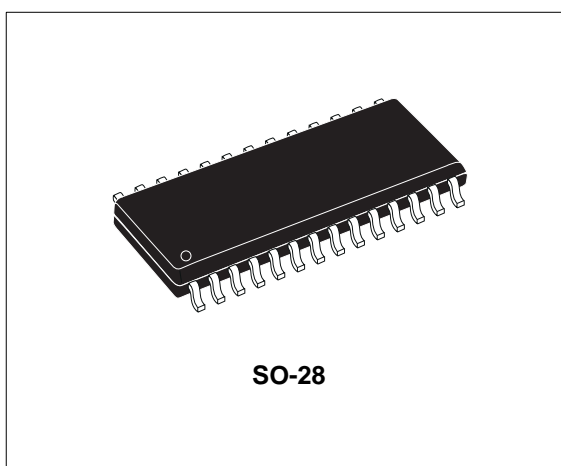
(*) Total resistance of one side in bridge configuration

(**) Typical current limitation value

- SUITED AS LOW VOLTAGE BRIDGE
- LINEAR CURRENT LIMITATION
- VERY LOW STAND-BY POWER DISSIPATION
- SHORT CIRCUIT PROTECTED
- STATUS FLAG DIAGNOSTIC (OPEN DRAIN)
- INTEGRATED CLAMPING CIRCUITS
- UNDERVOLTAGE PROTECTION
- ESD PROTECTION

DESCRIPTION

The VN770K is a device formed by three monolithic chips housed in a standard SO-28 package: a double high side and two low side switches. Both the double high side and low side switches are made using STMicroelectronics VIPower™ M0-3 Technology. This device is suitable to drive a DC motor in a bridge configuration as well as to be used as a quad switch for any low voltage application. The dual high side switches have built-in thermal shutdown

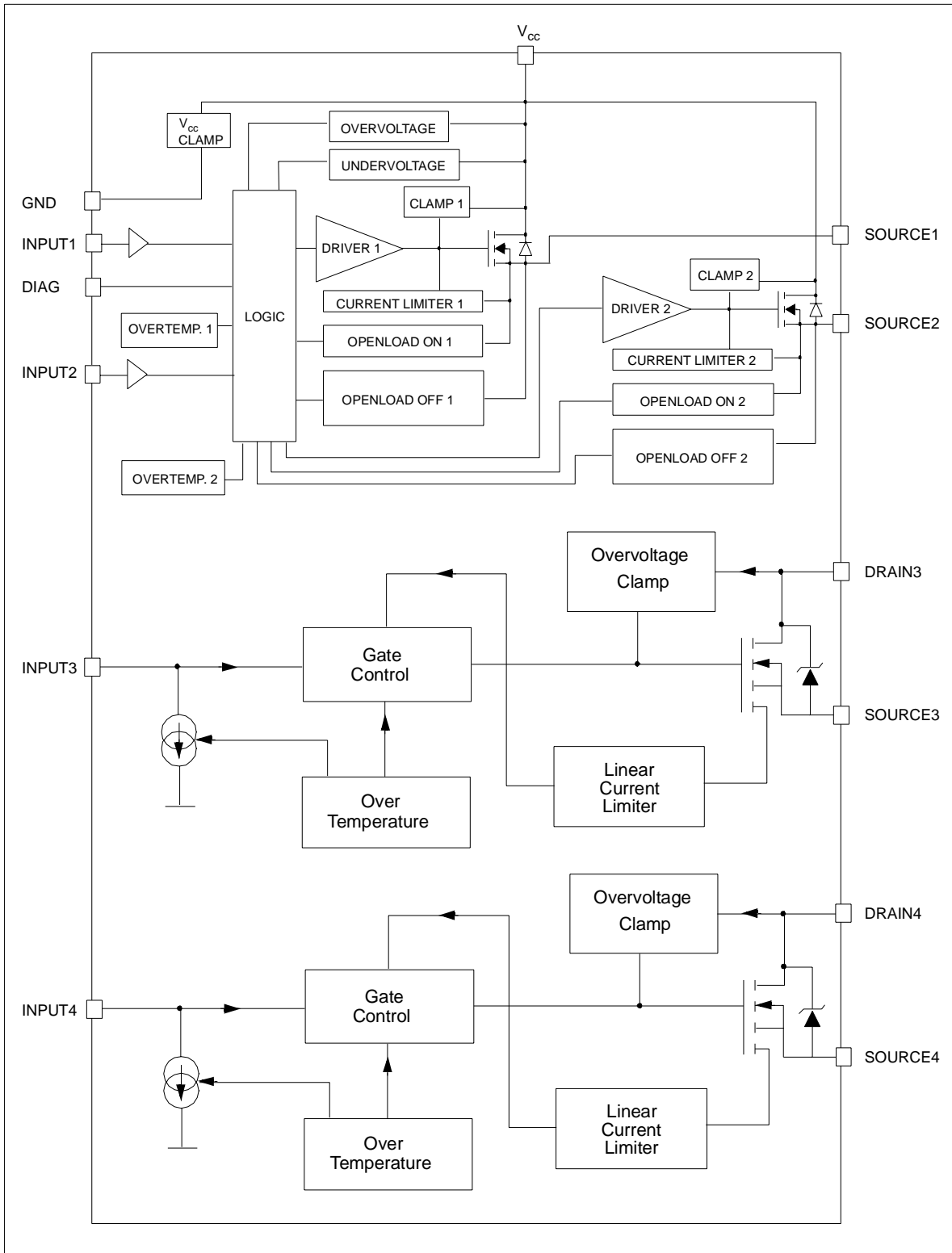


to protect the chips from overtemperature and current limiter blocks to protect the device from short circuit. Status output is provided to indicate open load in off and on state and overtemperature. The low side switches are two OMNIFET II types (fully autoprotected Power MOSFET in VIPower™ technology). They have built-in thermal shutdown, linear current limitation and overvoltage clamping. Fault feedback for thermal intervention can be detected by monitoring the voltage at the input pin.

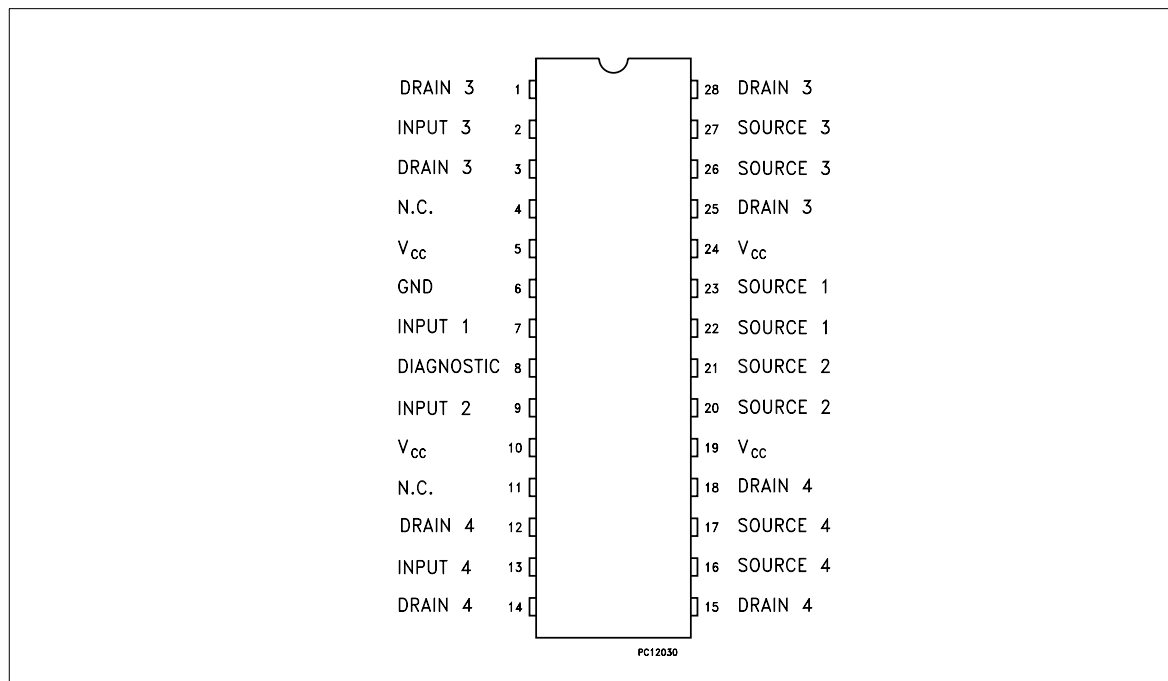
PIN FUNCTION

| No | NAME | FUNCTION |
|----------------|-----------------|---|
| 1, 3, 25, 28 | DRAIN 3 | Drain of Switch 3 (low-side switch) |
| 2 | INPUT 3 | Input of Switch 3 (low-side switch) |
| 4, 11 | N.C. | Not Connected |
| 5, 10, 19, 24 | V _{CC} | Drain of Switches 1 and 2 (high-side switches) and Power Supply Voltage |
| 6 | GND | Ground of Switches 1 and 2 (high-side switches) |
| 7 | INPUT 1 | Input of Switch 1 (high-side switches) |
| 8 | DIAGNOSTIC | Diagnostic of Switches 1 and 2 (high-side switches) |
| 9 | INPUT 2 | Input of Switch 2 (high-side switch) |
| 12, 14, 15, 18 | DRAIN 4 | Drain of switch 4 (low-side switch) |
| 13 | INPUT 4 | Input of Switch 4 (low-side switch) |
| 16, 17 | SOURCE 4 | Source of Switch 4 (low-side switch) |
| 20, 21 | SOURCE 2 | Source of Switch 2 (high-side switch) |
| 22, 23 | SOURCE 1 | Source of Switch 1 (high-side switch) |
| 26, 27 | SOURCE 3 | Source of Switch 3 (low-side switch) |

BLOCK DIAGRAM



CONNECTION DIAGRAM



THERMAL DATA

| Symbol | Parameter | Value | Unit |
|----------------|---|-------|---------|
| $R_{thj-case}$ | Thermal Resistance Junction-case (High-side switch) | MAX | 20 °C/W |
| $R_{thj-case}$ | Thermal Resistance Junction-case (Low-side switch) | MAX | 20 °C/W |
| $R_{thj-amb}$ | Thermal Resistance Junction-ambient | MAX | 60 °C/W |

ABSOLUTE MAXIMUM RATING

DUAL HIGH SIDE SWITCH

| Symbol | Parameter | Value | Unit |
|------------|---|--------------------|------|
| V_{CC} | DC Supply Voltage | 41 | V |
| $-V_{CC}$ | Reverse DC Supply Voltage | - 0.3 | V |
| $-I_{GND}$ | DC Reverse Ground Pin Current | - 200 | mA |
| I_{OUT} | DC Output Current | Internally Limited | A |
| $-I_{OUT}$ | Reverse DC Output Current | - 6 | A |
| I_{IN} | DC Input Current | +/- 10 | mA |
| I_{stat} | DC Status Current | +/- 10 | mA |
| V_{ESD} | Electrostatic Discharge (Human Body Model: $R=1.5K\Omega$; $C=100pF$) | | |
| | - INPUT | 4000 | V |
| | - STATUS | 4000 | V |
| | - OUTPUT | 5000 | V |
| | - V_{CC} | 5000 | V |
| P_{tot} | Power Dissipation ($T_C=25^\circ C$) | 6 | W |
| T_j | Junction Operating Temperature | Internally Limited | °C |
| T_C | Case Operating Temperature | - 40 to 150 | °C |
| T_{stg} | Storage Temperature | - 55 to 150 | °C |

VN770K

ABSOLUTE MAXIMUM RATING (continued)

LOW SIDE SWITCH

| Symbol | Parameter | Value | Unit |
|---------------|--|--------------------|------------|
| V_{DS} | Drain-source Voltage ($V_{IN}=0V$) | Internally Clamped | V |
| V_{IN} | Input Voltage | Internally Clamped | V |
| I_{IN} | Input Current | +/-20 | mA |
| $R_{IN\ MIN}$ | Minimum Input Series Impedance | 150 | Ω |
| I_D | Drain Current | Internally Limited | A |
| I_R | Reverse DC Output Current | -10.5 | A |
| V_{ESD1} | Electrostatic Discharge ($R=1.5K\Omega$, $C=100pF$) | 4000 | V |
| V_{ESD2} | Electrostatic Discharge on output pin only ($R=330\Omega$, $C=150pF$) | 16500 | V |
| P_{tot} | Power Dissipation ($T_C=25^\circ C$) | 6 | W |
| T_j | Operating Junction Temperature | Internally limited | $^\circ C$ |
| T_c | Case Operating Temperature | Internally limited | $^\circ C$ |
| T_{stg} | Storage Temperature | -55 to 150 | $^\circ C$ |

ELECTRICAL CHARACTERISTICS FOR DUAL HIGH SIDE SWITCH

($8V < V_{CC} < 36V$; $-40^\circ C < T_j < 150^\circ C$, unless otherwise specified)

POWER OUTPUTS (Per each channel)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|------------------|--------------------------|---|-----|-----|-----|-----------|
| $V_{CC}^{(**)}$ | Operating Supply Voltage | | 5.5 | 13 | 36 | V |
| $V_{USD}^{(**)}$ | Undervoltage Shut-down | | 3 | 4 | 5.5 | V |
| $V_{OV}^{(**)}$ | Overvoltage Shut-down | | 36 | | | V |
| R_{ON} | On State Resistance | $I_{OUT}=1A$; $T_j=25^\circ C$ | | | 160 | $m\Omega$ |
| | | $I_{OUT}=1A$; $V_{CC}>8V$ | | | 320 | $m\Omega$ |
| $I_S^{(**)}$ | Supply Current | Off State; $V_{CC}=13V$; $V_{IN}=V_{OUT}=0V$ | | 12 | 40 | μA |
| | | Off State; $V_{CC}=13V$; $V_{IN}=V_{OUT}=0V$; $T_j=25^\circ C$ | | 12 | 25 | μA |
| | | On State; $V_{CC}=13V$; $V_{IN}=5V$; $I_{OUT}=0A$ | | 5 | 7 | mA |
| $I_{L(off1)}$ | Off State Output Current | $V_{IN}=V_{OUT}=0V$ | 0 | | 50 | μA |
| $I_{L(off2)}$ | Off State Output Current | $V_{IN}=0V$; $V_{OUT}=3.5V$ | -75 | | 0 | μA |
| $I_{L(off3)}$ | Off State Output Current | $V_{IN}=V_{OUT}=0V$; $V_{CC}=13V$; $T_j=125^\circ C$ | | | 5 | μA |
| $I_{L(off4)}$ | Off State Output Current | $V_{IN}=V_{OUT}=0V$; $V_{CC}=13V$; $T_j=25^\circ C$ | | | 3 | μA |

(**) Per device

SWITCHING ($V_{CC}=13V$)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------------------------|------------------------|--|-----|----------------------|-----|-----------|
| $t_{d(on)}$ | Turn-on Delay Time | $R_L=13\Omega$ from V_{IN} rising edge to $V_{OUT}=1.3V$ | | 30 | | μs |
| $t_{d(off)}$ | Turn-off Delay Time | $R_L=13\Omega$ from V_{IN} falling edge to $V_{OUT}=11.7V$ | | 30 | | μs |
| $\frac{dV_{OUT}}{dt_{(on)}}$ | Turn-on Voltage Slope | $R_L=13\Omega$ from $V_{OUT}=1.3V$ to $V_{OUT}=10.4V$ | | See relative diagram | | $V/\mu s$ |
| $\frac{dV_{OUT}}{dt_{(off)}}$ | Turn-off Voltage Slope | $R_L=13\Omega$ from $V_{OUT}=11.7V$ to $V_{OUT}=1.3V$ | | See relative diagram | | $V/\mu s$ |

ELECTRICAL CHARACTERISTICS FOR DUAL HIGH SIDE SWITCH (continued)

LOGIC INPUT

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|------------|--------------------------|------------------|------|------|------|---------|
| V_{IL} | Input Low Level | | | | 1.25 | V |
| I_{IL} | Low Level Input Current | $V_{IN} = 1.25V$ | 1 | | | μA |
| V_{IH} | Input High Level | | 3.25 | | | V |
| I_{IH} | High Level Input Current | $V_{IN} = 3.25V$ | | | 10 | μA |
| V_{hyst} | Input Hysteresis Voltage | | 0.5 | | | V |
| V_{ICL} | Input Clamp Voltage | $I_{IN} = 1mA$ | 6 | 6.8 | 8 | V |
| | | $I_{IN} = -1mA$ | | -0.7 | | V |

STATUS PIN

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------|------------------------------|-----------------------------------|-----|------|-----|---------|
| V_{STAT} | Status Low Output Voltage | $I_{STAT} = 1.6 mA$ | | | 0.5 | V |
| I_{LSTAT} | Status Leakage Current | Normal Operation; $V_{STAT} = 5V$ | | | 10 | μA |
| C_{STAT} | Status Pin Input Capacitance | Normal Operation; $V_{STAT} = 5V$ | | | 100 | pF |
| V_{SCL} | Status Clamp Voltage | $I_{STAT} = 1mA$ | 6 | 6.8 | 8 | V |
| | | $I_{STAT} = -1mA$ | | -0.7 | | V |

PROTECTIONS

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------|-------------------------------------|---|---------------|---------------|---------------|-------------|
| T_{TSD} | Shut-down Temperature | | 150 | 175 | 200 | $^{\circ}C$ |
| T_R | Reset Temperature | | 135 | | | $^{\circ}C$ |
| T_{hyst} | Thermal Hysteresis | | 7 | 15 | | $^{\circ}C$ |
| t_{sdl} | Status Delay in Overload Conditions | $T_j > T_{TSD}$ | | | 20 | μs |
| I_{lim} | Current limitation | $T_j = 125^{\circ}C$ $5.5V < V_{CC} < 36V$ | 7 | 10 | 13 | A |
| | | | 8 | | 13 | A |
| | | | | | 13 | A |
| V_{demag} | Turn-off Output Clamp Voltage | $I_{OUT} = 1A; L = 6mH$ | $V_{CC} - 41$ | $V_{CC} - 48$ | $V_{CC} - 55$ | V |

OPENLOAD DETECTION

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|----------------|--|-----------------|-----|-----|------|---------|
| I_{OL} | Openload ON State Detection Threshold | $V_{IN} = 5V$ | 20 | 40 | 80 | mA |
| $t_{DOL(on)}$ | Openload ON State Detection Delay | $I_{OUT} = 0A$ | | | 200 | μs |
| V_{OL} | Openload OFF State Voltage Detection Threshold | $V_{IN} = 0V$ | 1.5 | 2.5 | 3.5 | V |
| $t_{DOL(off)}$ | Openload Detection Delay at Turn Off | | | | 1000 | μs |

VN770K

ELECTRICAL CHARACTERISTICS FOR LOW SIDE SWITCHES

($-40^{\circ}\text{C} < T_j < 150^{\circ}\text{C}$, unless otherwise specified)

OFF

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|--------------------|--|--|-----------|-----|-----------|---------------|
| V_{CLAMP} | Drain-source Clamp Voltage | $V_{\text{IN}}=0\text{V}; I_{\text{D}}=3.5\text{A}$ | 40 | 45 | 55 | V |
| V_{CLTH} | Drain-source Clamp Threshold Voltage | $V_{\text{IN}}=0\text{V}; I_{\text{D}}=2\text{mA}$ | 36 | | | V |
| V_{INTH} | Input Threshold Voltage | $V_{\text{DS}}=V_{\text{IN}}; I_{\text{D}}=1\text{mA}$ | 0.5 | | 2.5 | V |
| I_{ISS} | Supply Current from Input Pin | $V_{\text{DS}}=0\text{V}; V_{\text{IN}}=5\text{V}$ | | 100 | 150 | μA |
| V_{INCL} | Input-Source Clamp Voltage | $I_{\text{IN}}=1\text{mA}$ $I_{\text{IN}}=-1\text{mA}$ | 6 -1.0 | 6.8 | 8 -0.3 | V |
| I_{DSS} | Zero Input Voltage Drain Current ($V_{\text{IN}}=0\text{V}$) | $V_{\text{DS}}=13\text{V}; V_{\text{IN}}=0\text{V}; T_j=25^{\circ}\text{C}$ $V_{\text{DS}}=25\text{V}; V_{\text{IN}}=0\text{V}$ | | | 30 75 | μA |

ON

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---------------------|-----------------------------------|--|-----|-----|-----------|------------------|
| $R_{\text{DS(on)}}$ | Static Drain-source On Resistance | $V_{\text{IN}}=5\text{V}; I_{\text{D}}=3.5\text{A}; T_j=25^{\circ}\text{C}$ $V_{\text{IN}}=5\text{V}; I_{\text{D}}=3.5\text{A}$ | | | 60 120 | $\text{m}\Omega$ |

($T_j=25^{\circ}\text{C}$, unless otherwise specified)

DYNAMIC

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-----------------------|--------------------------|--|-----|-----|-----|-------------|
| $g_{\text{fs}}^{(*)}$ | Forward Transconductance | $V_{\text{DD}}=13\text{V}; I_{\text{D}}=3.5\text{A}$ | | 9 | | S |
| C_{OSS} | Output Capacitance | $V_{\text{DS}}=13\text{V}; f=1\text{MHz}; V_{\text{IN}}=0\text{V}$ | | 220 | | pF |

SWITCHING

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-------------------------------------|-----------------------|--|-----|------|------|------------------------|
| $t_{\text{d(on)}}$ | Turn-on Delay Time | $V_{\text{DD}}=15\text{V}; I_{\text{D}}=3.5\text{A}$ $V_{\text{gen}}=5\text{V}; R_{\text{gen}}=R_{\text{IN MIN}}=150\Omega$ | | 100 | 300 | ns |
| t_{r} | Rise Time | | | 470 | 1500 | ns |
| $t_{\text{d(off)}}$ | Turn-off Delay Time | | | 500 | 1500 | ns |
| t_{f} | Fall Time | | | 350 | 1000 | ns |
| $t_{\text{d(on)}}$ | Turn-on Delay Time | $V_{\text{DD}}=15\text{V}; I_{\text{D}}=3.5\text{A}$ $V_{\text{gen}}=5\text{V}; R_{\text{gen}}=2.2\text{K}\Omega$ | | 0.75 | 2.3 | μs |
| t_{r} | Rise Time | | | 4.6 | 14.0 | μs |
| $t_{\text{d(off)}}$ | Turn-off Delay Time | | | 5.4 | 16.0 | μs |
| t_{f} | Fall Time | | | 3.6 | 11.0 | μs |
| $(\text{dI}/\text{dt})_{\text{on}}$ | Turn-on Current Slope | $V_{\text{DD}}=15\text{V}; I_{\text{D}}=3.5\text{A}$ $V_{\text{gen}}=5\text{V}; R_{\text{gen}}=R_{\text{IN MIN}}=150\Omega$ | | 6.5 | | $\text{A}/\mu\text{s}$ |
| Q_{i} | Total Input Charge | $V_{\text{DD}}=12\text{V}; I_{\text{D}}=3.5\text{A}; V_{\text{IN}}=5\text{V}$ $I_{\text{gen}}=2.13\text{mA}$ | | 18 | | nC |

SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|-----------------------|--------------------------|---|-----|------|-----|---------------|
| $V_{\text{SD}}^{(*)}$ | Forward On Voltage | $I_{\text{SD}}=3.5\text{A}; V_{\text{IN}}=0\text{V}$ | | 0.8 | | V |
| t_{rr} | Reverse Recovery Time | $I_{\text{SD}}=3.5\text{A}; \text{dI}/\text{dt}=20\text{A}/\mu\text{s}$ $V_{\text{DD}}=30\text{V}; L=200\mu\text{H}$ | | 220 | | ns |
| Q_{rr} | Reverse Recovery Charge | | | 0.28 | | μC |
| I_{RRM} | Reverse Recovery Current | | | 2.5 | | A |

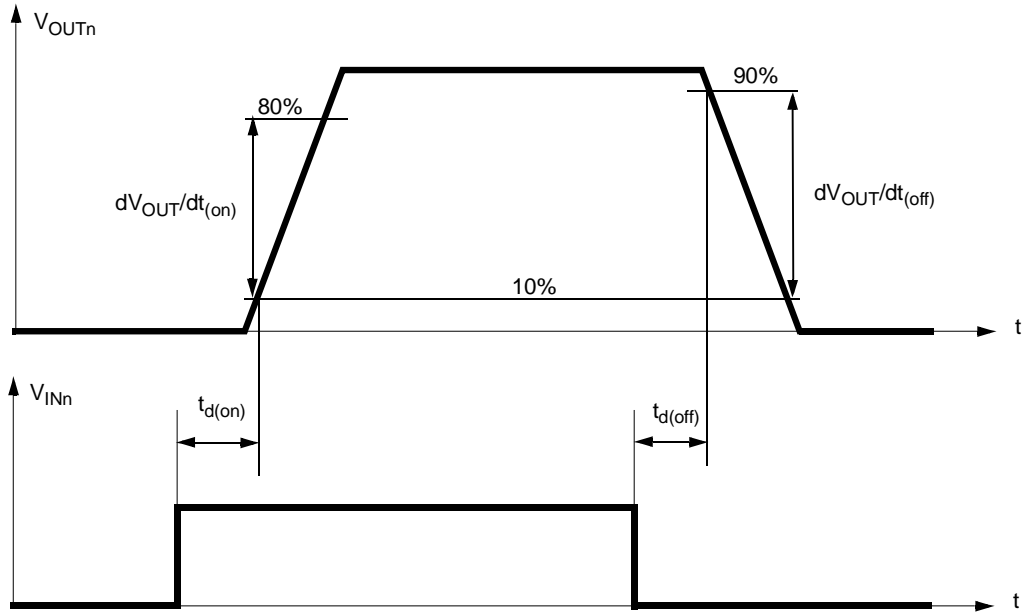
ELECTRICAL CHARACTERISTICS FOR LOW SIDE SWITCHES (continued)
PROTECTIONS ($-40^{\circ}\text{C} < T_j < 150^{\circ}\text{C}$, unless otherwise specified)

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|------------|-----------------------------|--|-----|-----|-----|--------------------|
| I_{lim} | Drain Current Limit | $V_{IN}=5\text{V}; V_{DS}=13\text{V}$ | 6 | 9 | 12 | A |
| | | $V_{IN}=5\text{V}; V_{DS}=13\text{V}; T_j=125^{\circ}\text{C}$ | 6.5 | | 12 | A |
| t_{dlim} | Step Response Current Limit | $V_{IN}=5\text{V}; V_{DS}=13\text{V}$ | | 4.0 | | μs |
| T_{jsh} | Overtemperature Shutdown | | 150 | 175 | | $^{\circ}\text{C}$ |
| T_{jrs} | Overtemperature Reset | | 135 | | | $^{\circ}\text{C}$ |
| I_{gf} | Fault Sink Current | $V_{IN}=5\text{V}; V_{DS}=13\text{V}; T_j=T_{jsh}$ | | 15 | | mA |
| E_{as} | Single Pulse | starting $T_j=25^{\circ}\text{C}; V_{DD}=24\text{V}$ | | | | |
| | Avalanche Energy | $V_{IN}=5\text{V}; R_{gen}=R_{IN\text{ MIN}}=150\Omega; L=24\text{mH}$ | 200 | | | mJ |

(*) Pulsed: Pulse duration = 300 μs , duty cycle 1.5%

DUAL HIGH-SIDE SWITCH

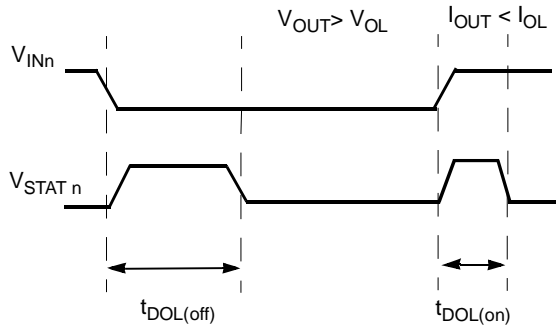
SWITCHING TIME WAVEFORMS



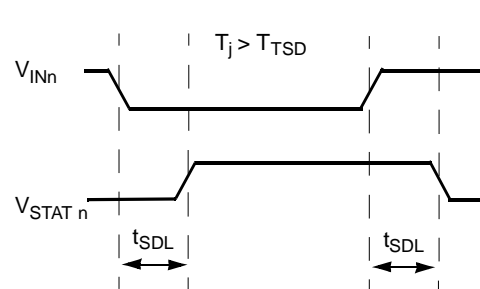
TRUTH TABLE

| CONDITIONS | INPUT | OUTPUT | STATUS |
|---------------------------|-------|--------|--|
| Normal Operation | L | L | H |
| | H | H | H |
| Current Limitation | L | L | H |
| | H | X | ($T_j < T_{TSD}$) H ($T_j > T_{TSD}$) L |
| Overtemperature | L | L | H |
| | H | L | L |
| Undervoltage | L | L | X |
| | H | L | X |
| Overvoltage | L | L | H |
| | H | L | H |
| Output Voltage $> V_{OL}$ | L | H | L |
| | H | H | H |
| Output Current $< I_{OL}$ | L | L | H |
| | H | H | L |

OPEN LOAD STATUS TIMING (with external pull-up)



OVER TEMP STATUS TIMING



TYPICAL APPLICATION DIAGRAM

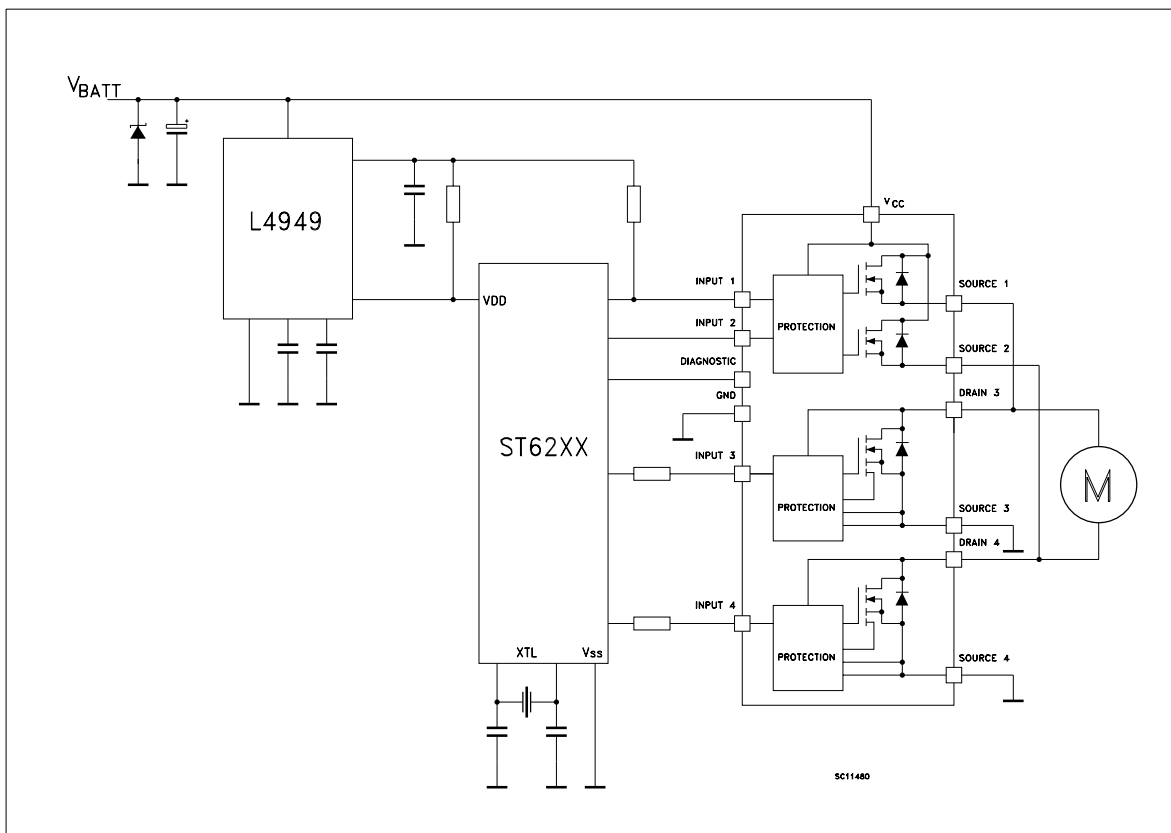
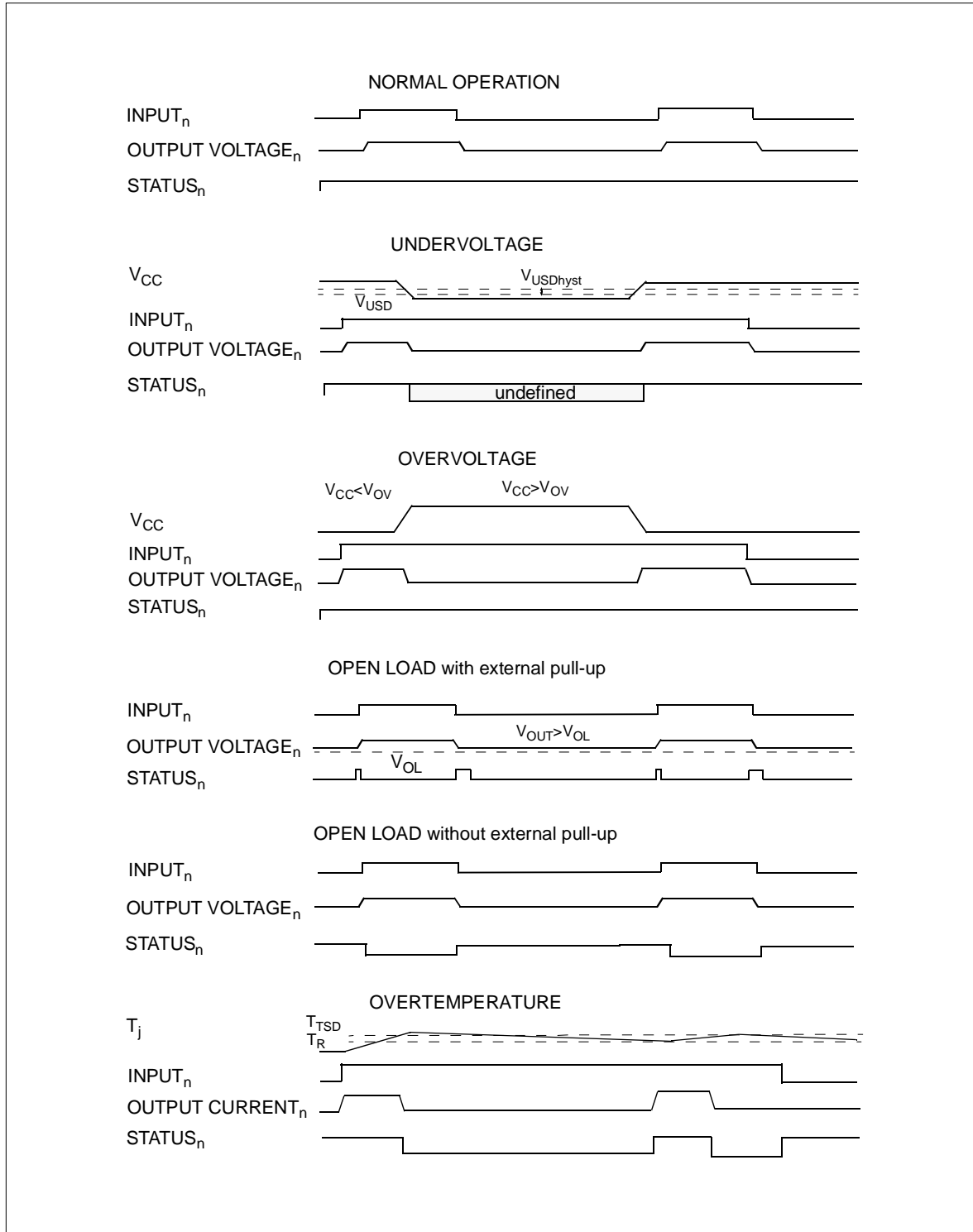
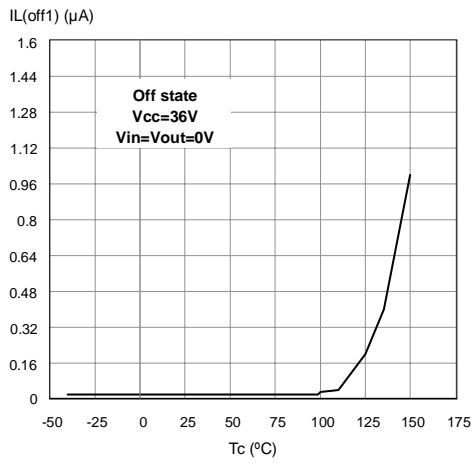


Figure 1: Waveforms

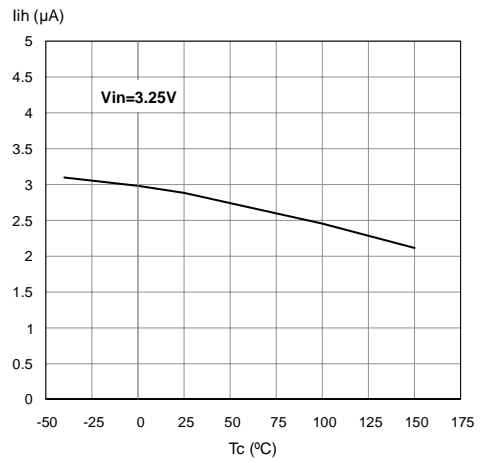


ELECTRICAL CHARACTERIZATION FOR DUAL HIGH SIDE SWITCH

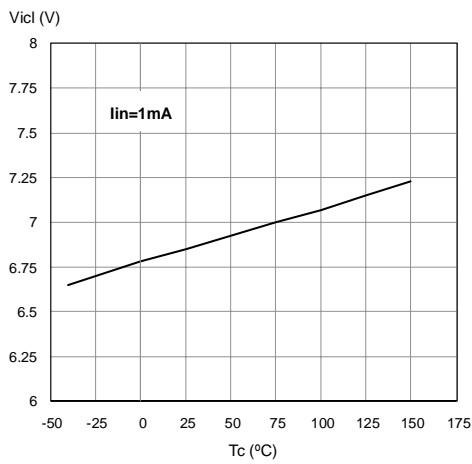
Off State Output Current



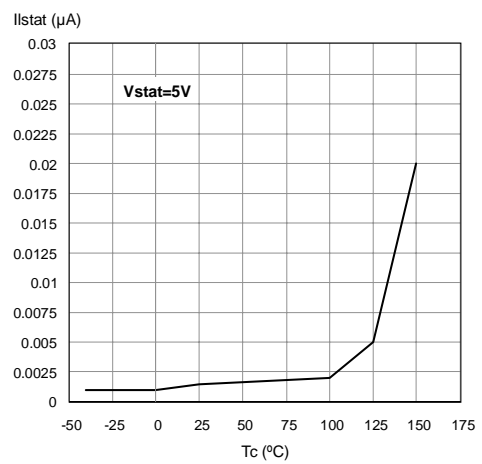
High Level Input Current



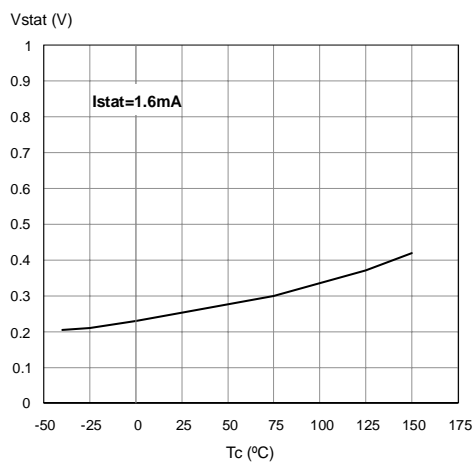
Input Clamp Voltage



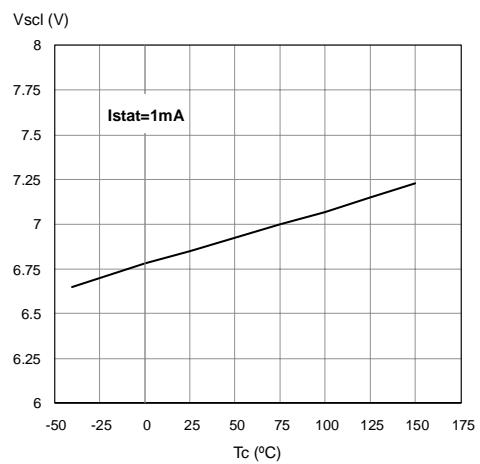
Status Leakage Current



Status Low Output Voltage

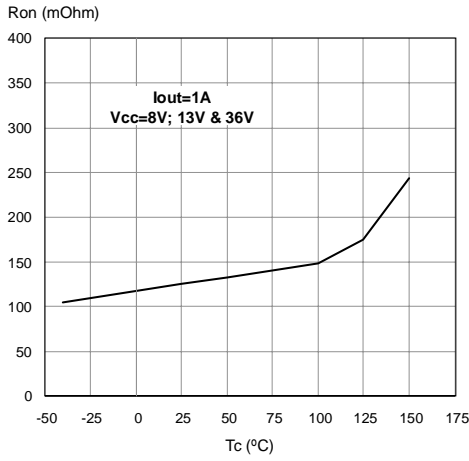


Status Clamp Voltage

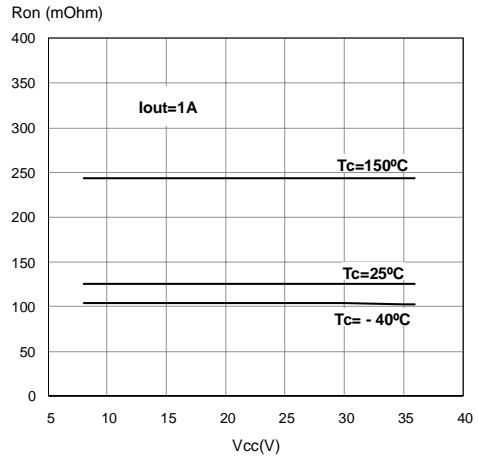


ELECTRICAL CHARACTERIZATION FOR DUAL HIGH SIDE SWITCH (continued)

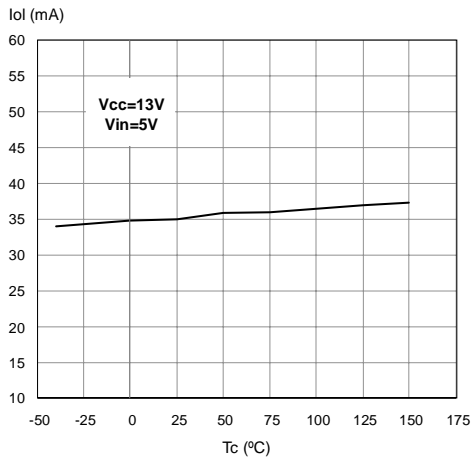
On State Resistance Vs T_{case}



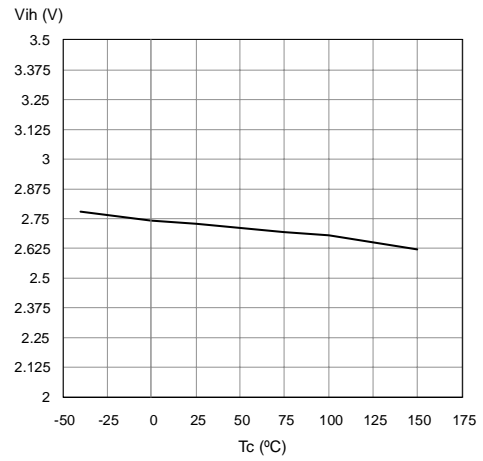
On State Resistance Vs V_{CC}



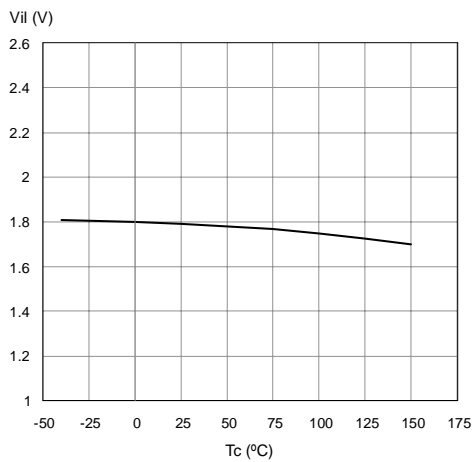
Openload On State Detection Threshold



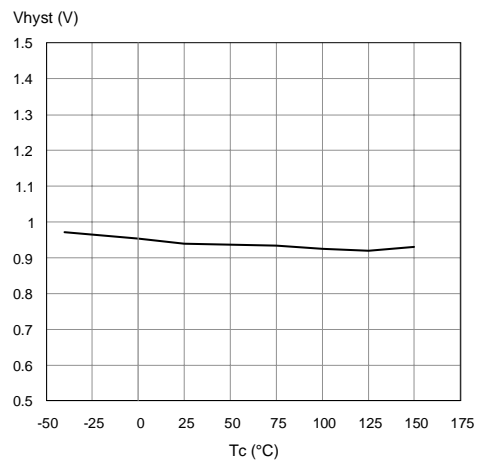
Input High Level



Input Low Level

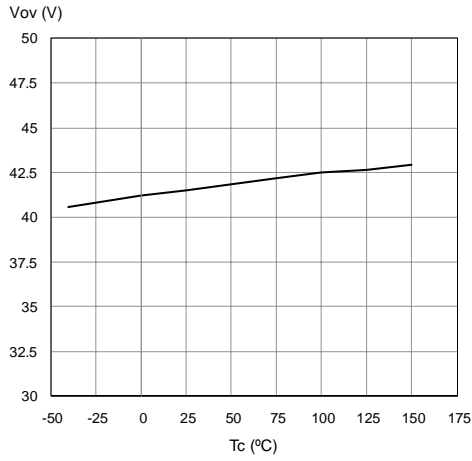


Input Hysteresis Voltage

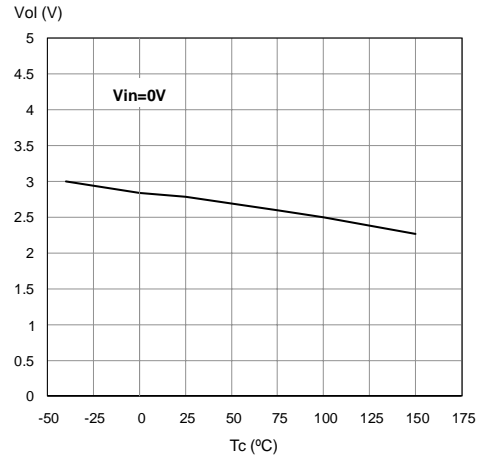


ELECTRICAL CHARACTERIZATION FOR DUAL HIGH SIDE SWITCH (continued)

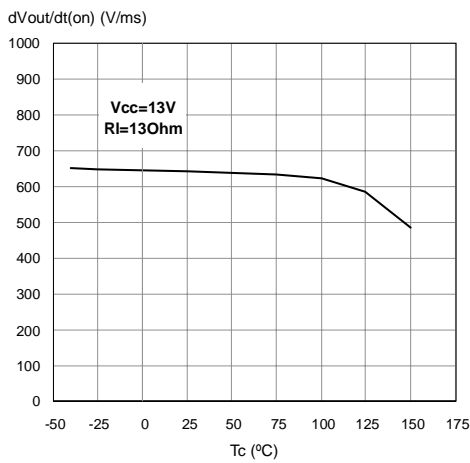
Overvoltage Shutdown



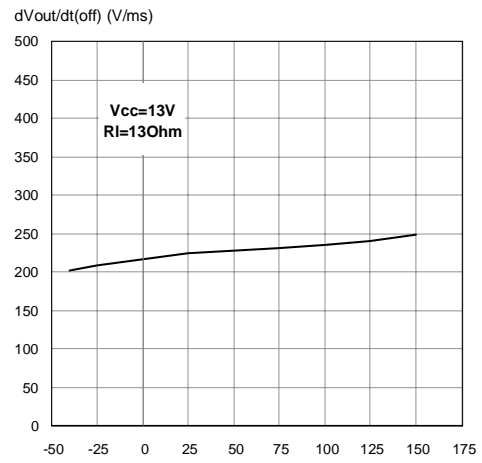
Openload Off State Voltage Detection Threshold



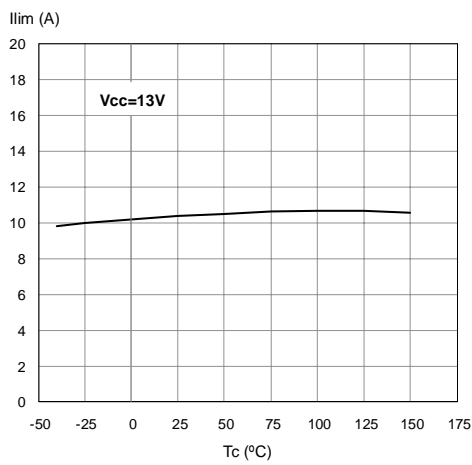
Turn-on Voltage Slope



Turn-off Voltage Slope

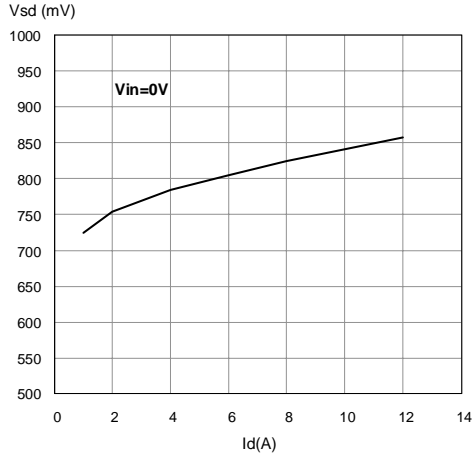


I_{LIM} Vs T_{case}

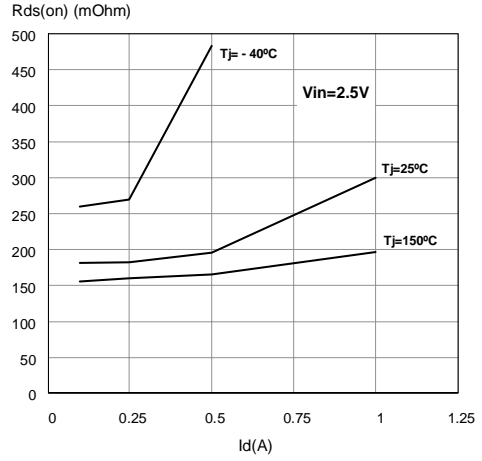


ELECTRICAL CHARACTERIZATION FOR LOW SIDE SWITCHES

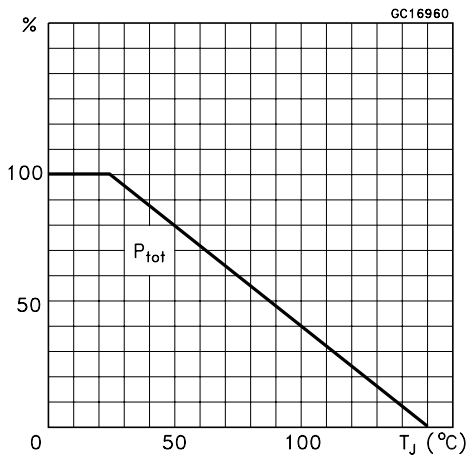
Source-Drain Diode Forward Characteristics



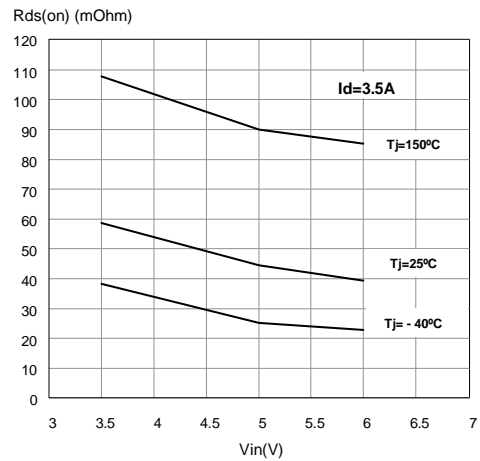
Static Drain Source On Resistance



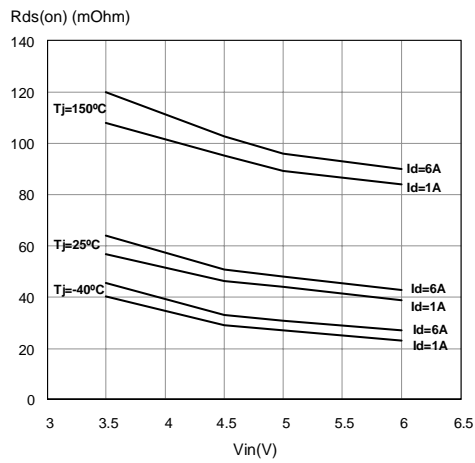
Derating Curve



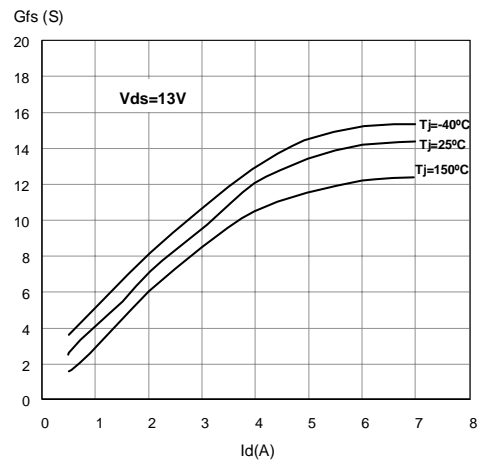
Static Drain-Source On resistance Vs. Input Voltage



Static Drain-Source On resistance Vs. Input Voltage

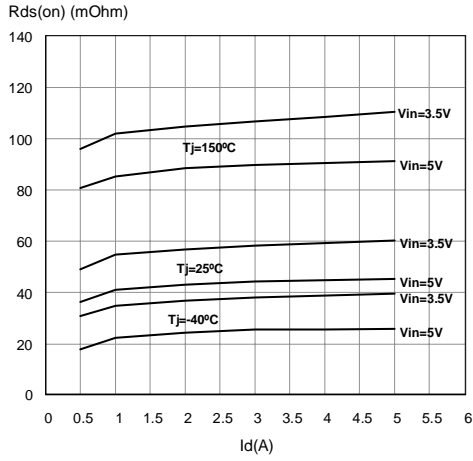


Transconductance

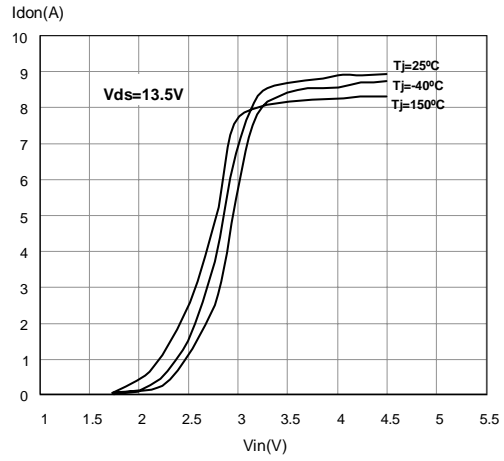


ELECTRICAL CHARACTERIZATION FOR LOW SIDE SWITCHES (continued)

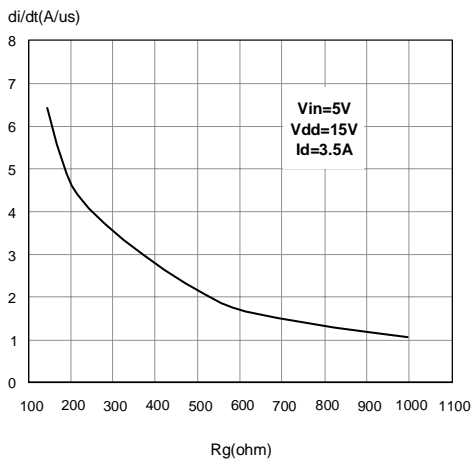
Static Drain-Source On Resistance Vs. Id



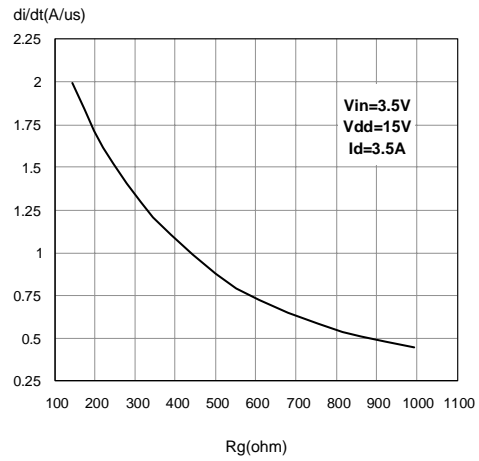
Transfer Characteristics



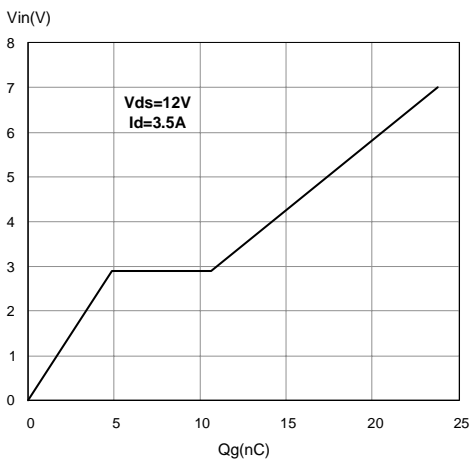
Turn On Current Slope



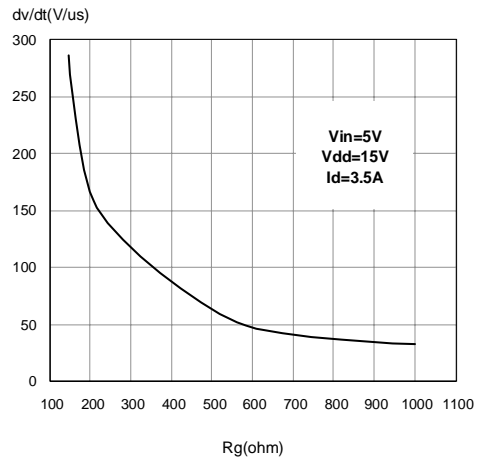
Turn On Current Slope



Input Voltage Vs. Input Charge

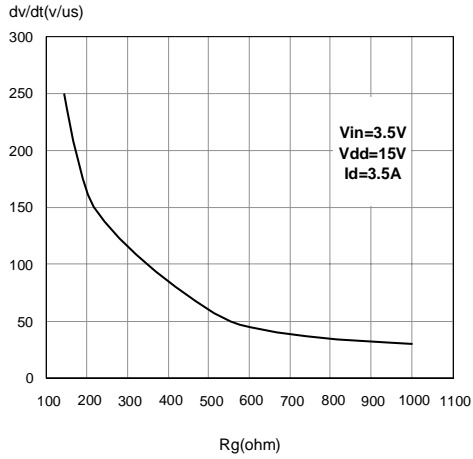


Turn off drain source voltage slope

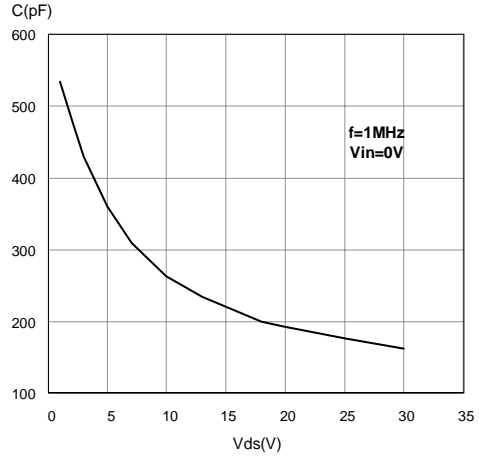


ELECTRICAL CHARACTERIZATION FOR LOW SIDE SWITCHES (continued)

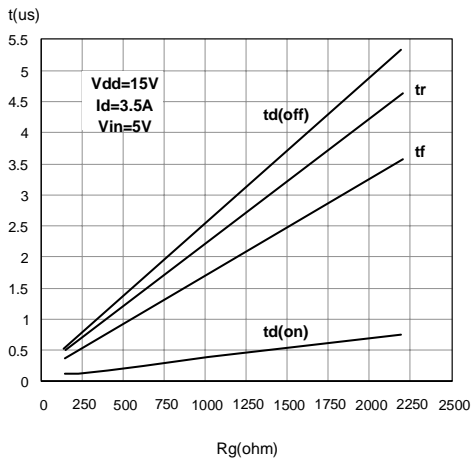
Turn Off Drain-Source Voltage Slope



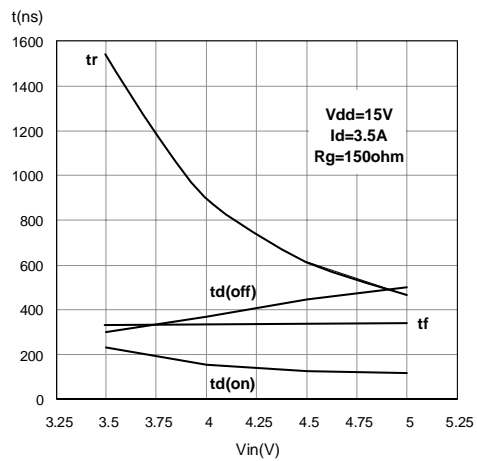
Capacitance Variations



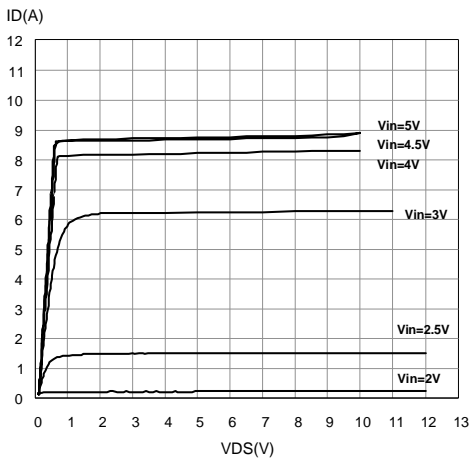
Switching Time Resistive Load



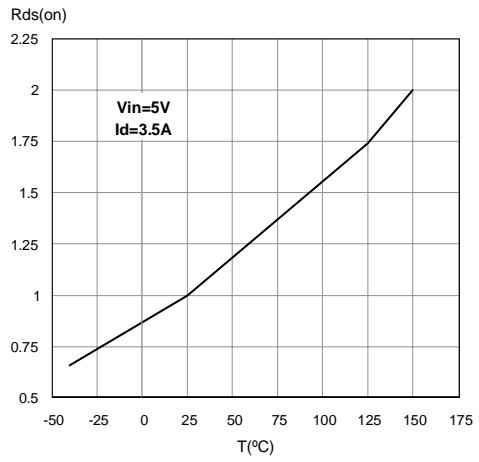
Switching Time Resistive Load



Output Characteristics

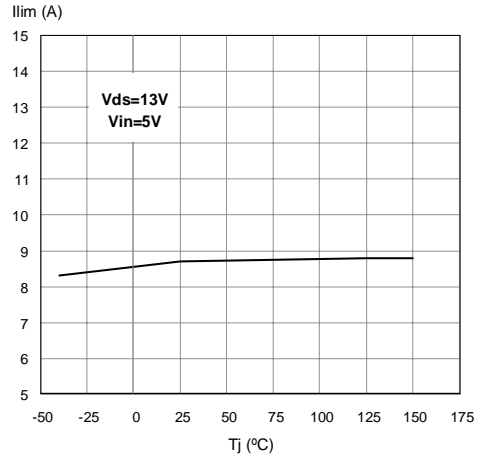
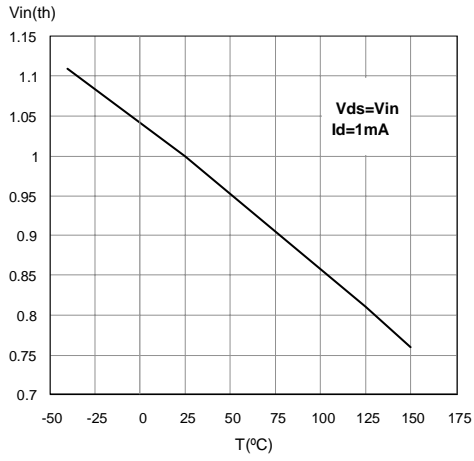


Normalized On Resistance Vs. Temperature

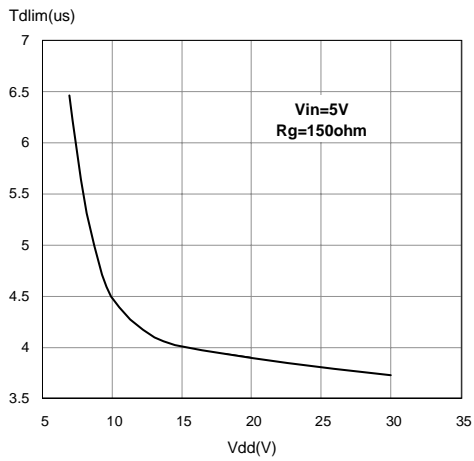


ELECTRICAL CHARACTERIZATION FOR LOW SIDE SWITCHES (continued)

Normalized Input Threshold Voltage Vs. Current Limit Vs. Junction Temperature

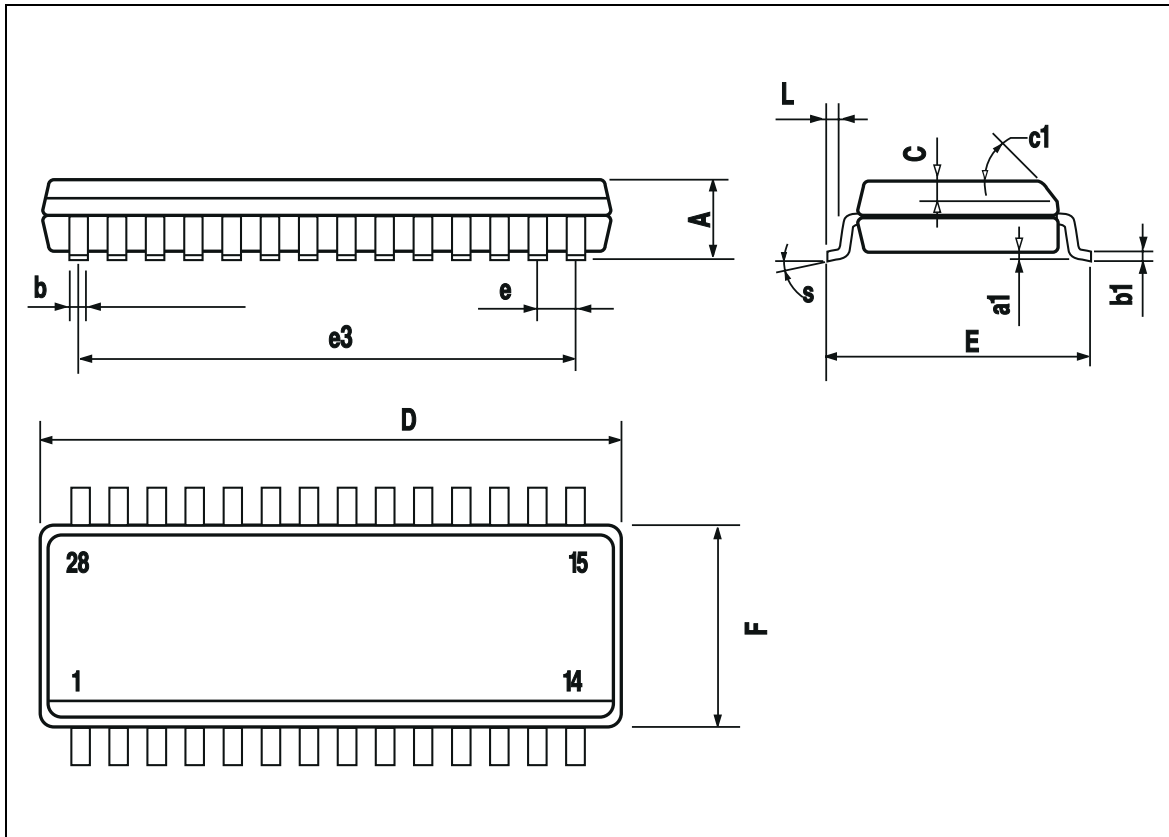


Step Response Current Limit

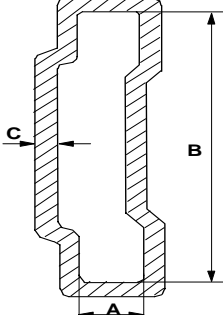


SO-28 MECHANICAL DATA

| DIM. | mm. | | | inch | | |
|------|-----------|-------|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | | | 2.65 | | | 0.104 |
| a1 | 0.10 | | 0.30 | 0.004 | | 0.012 |
| b | 0.35 | | 0.49 | 0.013 | | 0.019 |
| b1 | 0.23 | | 0.32 | 0.009 | | 0.012 |
| C | | 0.50 | | | 0.020 | |
| c1 | 45 (typ.) | | | | | |
| D | 17.7 | | 18.1 | 0.697 | | 0.713 |
| E | 10.00 | | 10.65 | 0.393 | | 0.419 |
| e | | 1.27 | | | 0.050 | |
| e3 | | 16.51 | | | 0.650 | |
| F | 7.40 | | 7.60 | 0.291 | | 0.299 |
| L | 0.40 | | 1.27 | 0.016 | | 0.050 |
| S | 8 (max.) | | | | | |



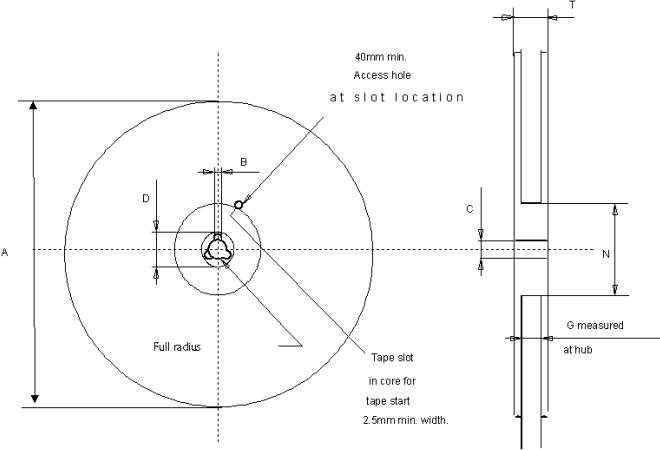
SO-28 TUBE SHIPMENT (no suffix)



| | |
|---|------|
| Base Q.ty | 28 |
| Bulk Q.ty | 700 |
| Tube length (± 0.5) | 532 |
| A | 3.5 |
| B | 13.8 |
| C (± 0.1) | 0.6 |

All dimensions are in mm.

TAPE AND REEL SHIPMENT (suffix "13TR")

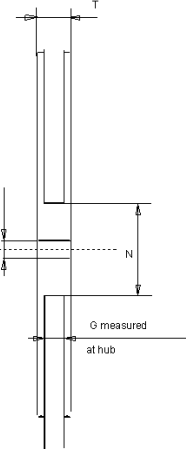


| | |
|---------------------------------|------|
| Base Q.ty | 1000 |
| Bulk Q.ty | 1000 |
| A (max) | 330 |
| B (min) | 1.5 |
| C (± 0.2) | 13 |
| F | 20.2 |
| G (+ 2 / - 0) | 16.4 |
| N (min) | 60 |
| T (max) | 22.4 |

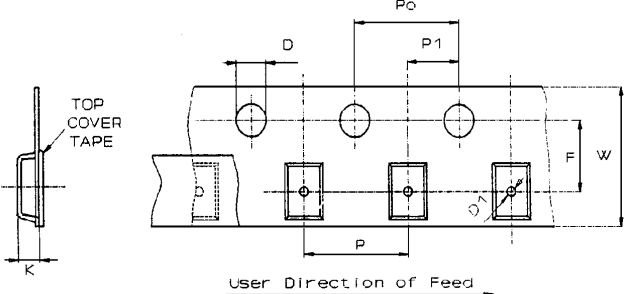
TAPE DIMENSIONS

According to Electronic Industries Association (EIA) Standard 481 rev. A, Feb 1986

| | | |
|--------------------------|------------------------------------|-----|
| Tape width | W | 16 |
| Tape Hole Spacing | P0 (± 0.1) | 4 |
| Component Spacing | P | 12 |
| Hole Diameter | D ($\pm 0.1/-0$) | 1.5 |
| Hole Diameter | D1 (min) | 1.5 |
| Hole Position | F (± 0.05) | 7.5 |
| Compartment Depth | K (max) | 6.5 |
| Hole Spacing | P1 (± 0.1) | 2 |



All dimensions are in mm.



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.
The ST logo is a trademark of STMicroelectronics

© 2002 STMicroelectronics - Printed in ITALY- All Rights Reserved.

STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia -
Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - U.S.A.

<http://www.st.com>