

## Description

AP22966 is an integrated dual N-channel load switch which features an adjustable slew rate that can be set using an external capacitor independently for each channel. The N-Channel MOSFETs have a typical  $R_{ON}$  of 18m $\Omega$ , enabling current handling capability of up to 6A. Both channels can independently be controlled with low voltage logic signals.

AP22966 is designed to operate from 0.8V to 5.5V. The low quiescent supply current makes it ideal for use in battery powered distribution systems where power consumption is a concern.

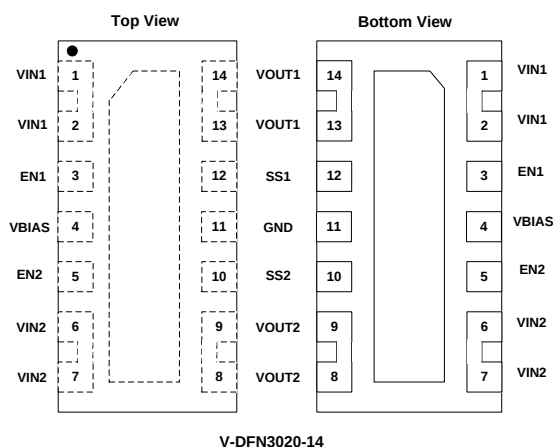
AP22966 is available in a standard Green V-DFN3020-14 package with exposed PAD for improved thermal performance and is RoHS compliant.

## Features

- Integrated Dual Channel Load Switch
- 0.8V to 5.5V Input Voltage Range
- Low Typical  $R_{ON}$  of 18m $\Omega$  ( $V_{BIAS} = 5V$ )
- 6A Maximum Continuous Current per Channel
- Very Low Quiescent Current
  - 60 $\mu$ A (Both Channels)
  - 45 $\mu$ A (Single Channel)
- Per Channel Adjustable Slew Rate
- Internal Quick Output Discharge (QOD)
- Low Voltage Logic Enable
  - 1.2/1.8/2.5/3.3V Logic
- Small Form Factor Package V-DFN3020-14 – footprint of just 6mm<sup>2</sup>
- Thermally Efficient Low Profile Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

- Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS) & 2011/65/EU (RoHS 2) compliant.
  2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
  3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

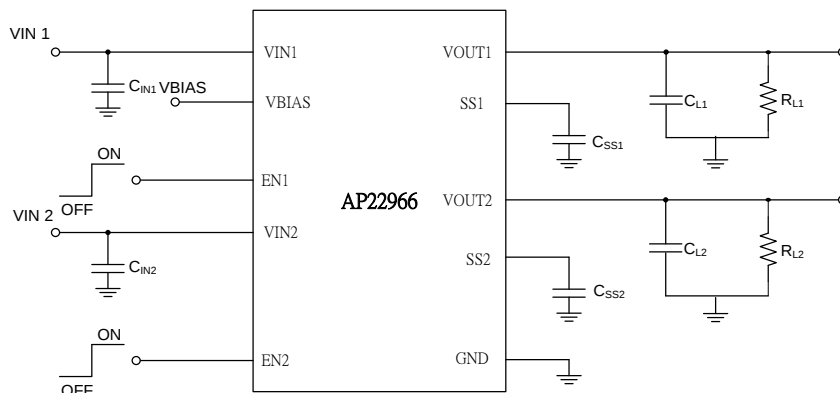
## Pin Assignments



## Applications

- Ultrabooks
- Notebooks
- Netbooks
- SetTop Boxes
- SSD (Solid State Drives)
- Consumer Electronics
- Tablet PC
- Telecom Systems

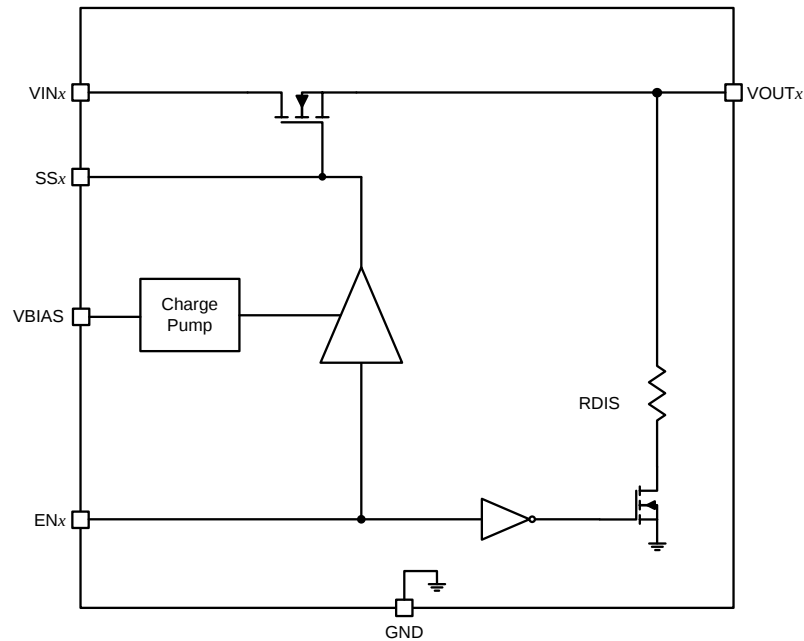
## Typical Applications Circuit



## Pin Descriptions

| Pin Name | Pin Number | Function                                                                                                                                                                                                                   |
|----------|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| VIN1     | 1, 2       | Channel 1 input. Recommended voltage range for this pin for optimal $R_{ON}$ performance from 0.8V to $V_{BIAS}$ . Place an optional decoupling capacitor between this pin and GND for reduce $V_{IN}$ dip during turn on. |
| EN1      | 3          | Active High Channel 1 enable input                                                                                                                                                                                         |
| VBIAS    | 4          | $V_{BIAS}$ Voltage. Recommended voltage range from 2.5V to 5.5V.                                                                                                                                                           |
| EN2      | 5          | Active High Channel 2 enable input                                                                                                                                                                                         |
| VIN2     | 6, 7       | Channel 2 input. Recommended voltage range for this pin for optimal $R_{ON}$ performance from 0.8V to $V_{BIAS}$ . Place an optional decoupling capacitor between this pin and GND for reduce $V_{IN}$ dip during turn on. |
| VOUT2    | 8, 9       | Channel 2 output<br>This pin connects to the Source of the 2 <sup>nd</sup> N-channel MOSFET.                                                                                                                               |
| SS2      | 10         | Channel 2 slew rate control<br>An external capacitor connected to this pin will set the ramp-up time for Channel 2 output.                                                                                                 |
| GND      | 11/PAD     | Ground<br>Connect Pin 11 and PAD together to system ground.                                                                                                                                                                |
| SS1      | 12         | Channel 1 slew rate control<br>An external capacitor connected to this pin will set the ramp-up time for Channel 1 output.                                                                                                 |
| VOUT1    | 13, 14     | Channel 1 output<br>This pin connects to the Source of the 1 <sup>st</sup> N-channel MOSFET                                                                                                                                |

## Functional Block Diagram



where x is the channel number (1 or 2)

# Absolute Maximum Ratings (@ $T_A = +25^{\circ}\text{C}$ , unless otherwise specified.) (Note 4)

| Symbol          | Parameter                                                                           |                       | Ratings     | Units                |
|-----------------|-------------------------------------------------------------------------------------|-----------------------|-------------|----------------------|
| ESD HBM         | Human Body ESD Protection                                                           |                       | 4000        | V                    |
| ESD MM          | Machine Model ESD Protection                                                        |                       | 300         | V                    |
| ESD CDM         | Charged Device Model ESD Protection                                                 |                       | 1000        | V                    |
| $V_{IN}$        | Input Voltage at VIN1, VIN2 Pin                                                     |                       | -0.3 to +6  | V                    |
| $V_{BIAS}$      | Bias Supply Voltage                                                                 |                       | -0.3 to +6  | V                    |
| $V_{OUT}$       | Output Voltage at VOUT1, VOUT2 Pin                                                  |                       | -0.3 to +6  | V                    |
| $V_{EN}$        | Enable Voltage at EN1, EN2 Pin                                                      |                       | -0.3 to +6  | V                    |
| $I_L$           | Load Current per channel                                                            |                       | 6           | A                    |
| $I_{PLS}$       | Maximum pulsed switch current per channel, pulse <300 $\mu\text{s}$ , 2% duty cycle |                       | 8           | A                    |
| $T_{J(max)}$    | Maximum Junction Temperature                                                        |                       | +125        | $^{\circ}\text{C}$   |
| $T_{ST}$        | Storage Temperature                                                                 |                       | -65 to +150 | $^{\circ}\text{C}$   |
| $P_D$           | Power Dissipation                                                                   | (Note 5) V-DFN3020-14 | 2.7         | W                    |
| $R_{\theta JA}$ | Thermal Resistance, Junction to Ambient                                             | (Note 5) V-DFN3020-14 | 46.5        | $^{\circ}\text{C/W}$ |
|                 |                                                                                     | (Note 5) V-DFN3020-14 | 8           |                      |
| $R_{\theta JL}$ | Thermal Resistance, Junction to Leads                                               | (Note 6) V-DFN3020-14 | 300         | $^{\circ}\text{C/W}$ |

Notes:

- Stresses greater than the 'Absolute Maximum Ratings' specified above may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.
- Device mounted on 2"x2" FR-4 substrate PCB, 2oz copper, with minimum recommended pad layout
- Thermal resistance from junction to solder-point

# Recommended Operating Conditions (For each channel)

| Symbol       | Parameter                             | Min | Max        | Units              |
|--------------|---------------------------------------|-----|------------|--------------------|
| $V_{IN}$     | Input Voltage Range at VIN1, VIN2 Pin | 0.8 | $V_{BIAS}$ | V                  |
| $V_{BIAS}$   | Bias Supply Voltage Range             | 2.5 | 5.5        | V                  |
| $V_{EN}$     | Enable Voltage Range at EN1, EN2 Pin  | 0   | 5.5        | V                  |
| $V_{OUT}$    | Output Voltage at VOUT1, VOUT2 Pin    | –   | $V_{IN}$   | V                  |
| $T_A$        | Operating Ambient Temperature         | -40 | +85        | $^{\circ}\text{C}$ |
| $C_{IN}$     | Input Capacitor                       | 1   | –          | $\mu\text{F}$      |
| $V_{IH\_EN}$ | EN Input Logic High Voltage           | 1.2 | 5.5        | V                  |
| $V_{IL\_EN}$ | EN Input Logic Low Voltage            | 0   | 0.5        | V                  |

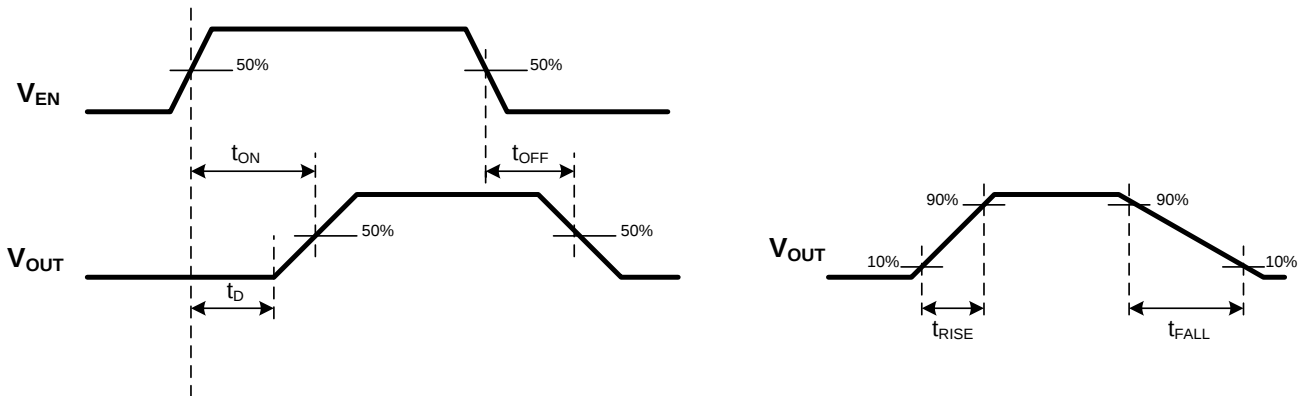
**Electrical Characteristics** (For each channel @  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{IN} = 0.8\text{V}$  to  $5.5\text{V}$ ,  $V_{BIAS} = 5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 100\text{nF}$ , typical values are at  $T_A = +25^{\circ}\text{C}$ , unless otherwise specified.)

| Symbol                | Parameters                                | Conditions                                                                                                | Min                    | Typ | Max  | Unit |    |
|-----------------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------|-----|------|------|----|
| I <sub>BIAS_Q</sub>   | VBIAS Quiescent Current (both channels)   | V <sub>EN</sub> = V <sub>IN</sub> = V <sub>BIAS</sub> = 5V, I <sub>OUT</sub> = 0A                         | –                      | 60  | 110  | μA   |    |
| I <sub>BIAS_Q</sub>   | VBIAS Quiescent Current (single channels) | V <sub>EN1</sub> = V <sub>IN</sub> = V <sub>BIAS</sub> = 5V, V <sub>EN2</sub> = 0V, I <sub>OUT</sub> = 0A | –                      | 45  | –    | μA   |    |
| I <sub>BIAS_OFF</sub> | VBIAS Off Supply Current                  | V <sub>EN</sub> = 0V, V <sub>OUT</sub> = 0V                                                               | –                      | –   | 2    | μA   |    |
| I <sub>IN_SD</sub>    | Input Shutdown Current (per channel)      | V <sub>EN</sub> = 0V<br>V <sub>OUT</sub> = 0V                                                             | V <sub>IN</sub> = 5V   | –   | 0.5  | 17   | μA |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 3.3V | –   | 0.1  | 6    | μA |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.8V | –   | 0.07 | 3    | μA |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 0.8V | –   | 0.04 | 2    | μA |
| R <sub>ON</sub>       | Load Switch On-Resistance                 | V <sub>EN</sub> = V <sub>BIAS</sub> ,<br>I <sub>OUT</sub> = 200mA<br>T <sub>A</sub> = +25°C               | V <sub>IN</sub> = 5V   | –   | 17   | 24   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 3.3V | –   | 17   | 24   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.8V | –   | 17   | 24   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.5V | –   | 17   | 24   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.2V | –   | 17   | 24   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 0.8V | –   | 17   | 24   | mΩ |
| R <sub>ON</sub>       | Load Switch On-Resistance                 | V <sub>EN</sub> = V <sub>BIAS</sub> ,<br>I <sub>OUT</sub> = 200mA<br>T <sub>A</sub> = -40°C to +85°C      | V <sub>IN</sub> = 5V   | –   | –    | 26   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 3.3V | –   | –    | 26   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.8V | –   | –    | 26   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.5V | –   | –    | 26   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 1.2V | –   | –    | 26   | mΩ |
|                       |                                           |                                                                                                           | V <sub>IN</sub> = 0.8V | –   | –    | 26   | mΩ |
| I <sub>LEAK_EN</sub>  | EN Input Leakage                          | V <sub>EN</sub> = 5.5V                                                                                    | –                      | –   | 1    | μA   |    |
| R <sub>DIS</sub>      | Discharge FET On-Resistance               | V <sub>EN</sub> = 0V, I <sub>DIS</sub> = 10mA, T <sub>A</sub> = +25°C                                     | –                      | 220 | 300  | Ω    |    |

**Electrical Characteristics** (For each channel @  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{IN} = 0.8\text{V}$  to  $5.5\text{V}$ ,  $V_{BIAS} = 2.5\text{V}$ ,  $C_{IN} = 1\mu\text{F}$ ,  $C_L = 100\text{nF}$ , typical values are at  $T_A = +25^{\circ}\text{C}$ , unless otherwise specified.)

| Symbol                | Parameters                                | Conditions                                                                                                  | Min                    | Typ | Max  | Unit |    |
|-----------------------|-------------------------------------------|-------------------------------------------------------------------------------------------------------------|------------------------|-----|------|------|----|
| I <sub>BIAS_Q</sub>   | VBIAS Quiescent Current (both channels)   | V <sub>EN</sub> = V <sub>IN</sub> = V <sub>BIAS</sub> = 2.5V, I <sub>OUT</sub> = 0A                         | –                      | 28  | 46   | μA   |    |
| I <sub>BIAS_Q</sub>   | VBIAS Quiescent Current (single channels) | V <sub>EN1</sub> = V <sub>IN</sub> = V <sub>BIAS</sub> = 2.5V, V <sub>EN2</sub> = 0V, I <sub>OUT</sub> = 0A | –                      | 20  | –    | μA   |    |
| I <sub>BIAS_OFF</sub> | VBIAS Off Supply Current                  | V <sub>EN</sub> = 0V, V <sub>OUT</sub> = 0V                                                                 | –                      | –   | 2    | μA   |    |
| I <sub>IN_SD</sub>    | Input Shutdown Current                    | V <sub>EN</sub> = 0V<br>V <sub>OUT</sub> = 0V                                                               | V <sub>IN</sub> = 2.5V | –   | 0.13 | 4    | μA |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.8V | –   | 0.07 | 3    | μA |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.2V | –   | 0.05 | 2    | μA |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 0.8V | –   | 0.04 | 2    | μA |
| R <sub>ON</sub>       | Load Switch On-Resistance                 | V <sub>EN</sub> = V <sub>BIAS</sub> ,<br>I <sub>OUT</sub> = 200mA<br>T <sub>A</sub> = +25°C                 | V <sub>IN</sub> = 2.5V | –   | 19   | 25   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.8V | –   | 18   | 25   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.5V | –   | 18   | 25   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.2V | –   | 18   | 25   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 0.8V | –   | 18   | 25   | mΩ |
| R <sub>ON</sub>       | Load Switch On-Resistance                 | V <sub>EN</sub> = V <sub>BIAS</sub> ,<br>I <sub>OUT</sub> = 200mA<br>T <sub>A</sub> = -40°C to +85°C        | V <sub>IN</sub> = 2.5V | –   | –    | 27   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.8V | –   | –    | 27   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.5V | –   | –    | 27   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 1.2V | –   | –    | 27   | mΩ |
|                       |                                           |                                                                                                             | V <sub>IN</sub> = 0.8V | –   | –    | 27   | mΩ |
| I <sub>LEAK_EN</sub>  | EN Input Leakage                          | V <sub>EN</sub> = 5.5V                                                                                      | –                      | –   | 1    | μA   |    |
| R <sub>DIS</sub>      | Discharge FET On-Resistance               | V <sub>EN</sub> = 0V, I <sub>DIS</sub> = 10mA, T <sub>A</sub> = +25°C                                       | –                      | 220 | 300  | Ω    |    |

## Test Circuit and $t_{ON}/t_{OFF}$ Waveforms

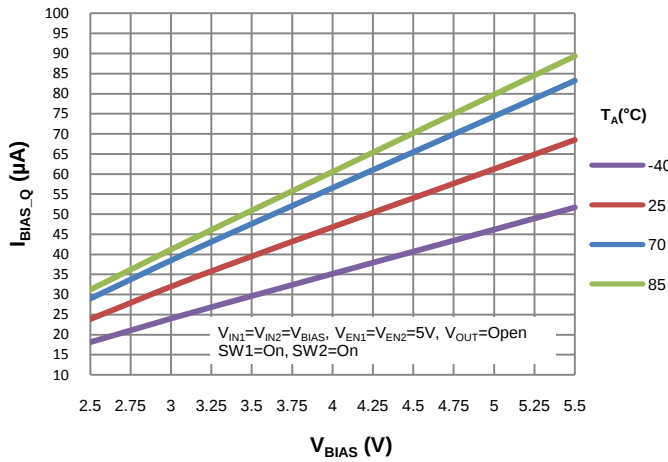


## Switching Characteristics

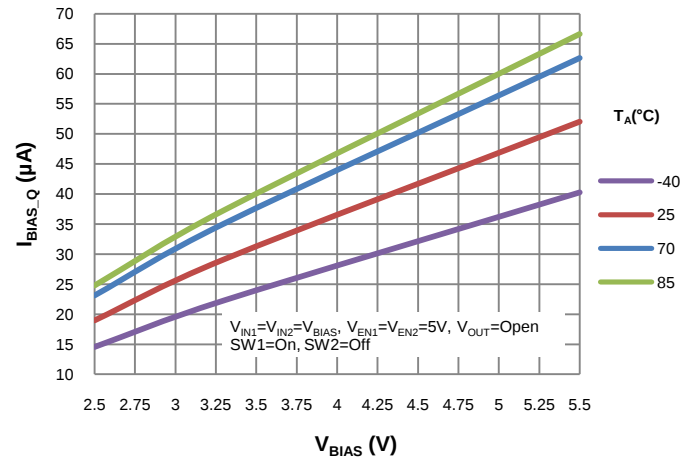
| Symbol                                                           | Parameters                 | Conditions                                        | Min | Typ  | Max | Unit    |
|------------------------------------------------------------------|----------------------------|---------------------------------------------------|-----|------|-----|---------|
| $V_{IN} = V_{EN} = V_{BIAS} = 5V, T_A = +25^\circ C$             |                            |                                                   |     |      |     |         |
| $t_{RISE}$                                                       | Output Rise-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 1720 | —   | $\mu s$ |
| $t_{ON}$                                                         | Output Turn-ON Delay Time  | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 1270 | —   | $\mu s$ |
| $t_{FALL}$                                                       | Output Fall-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 2.3  | —   | $\mu s$ |
| $t_{OFF}$                                                        | Output Turn-OFF Delay Time | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 9.6  | —   | $\mu s$ |
| $t_D$                                                            | Output Start Delay         | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 160  | —   | $\mu s$ |
| $V_{IN} = 0.8V, V_{EN} = V_{BIAS} = 5V, T_A = +25^\circ C$       |                            |                                                   |     |      |     |         |
| $t_{RISE}$                                                       | Output Rise-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 330  | —   | $\mu s$ |
| $t_{ON}$                                                         | Output Turn-ON Delay Time  | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 428  | —   | $\mu s$ |
| $t_{FALL}$                                                       | Output Fall-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 11   | —   | $\mu s$ |
| $t_{OFF}$                                                        | Output Turn-OFF Delay Time | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 146  | —   | $\mu s$ |
| $t_D$                                                            | Output Start Delay         | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 253  | —   | $\mu s$ |
| $V_{IN} = 2.5V, V_{EN} = 5V, V_{BIAS} = 2.5V, T_A = +25^\circ C$ |                            |                                                   |     |      |     |         |
| $t_{RISE}$                                                       | Output Rise-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 1488 | —   | $\mu s$ |
| $t_{ON}$                                                         | Output Turn-ON Delay Time  | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 1381 | —   | $\mu s$ |
| $t_{FALL}$                                                       | Output Fall-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 3    | —   | $\mu s$ |
| $t_{OFF}$                                                        | Output Turn-OFF Delay Time | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 11   | —   | $\mu s$ |
| $t_D$                                                            | Output Start Delay         | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 359  | —   | $\mu s$ |
| $V_{IN} = 0.8V, V_{EN} = 5V, V_{BIAS} = 2.5V, T_A = +25^\circ C$ |                            |                                                   |     |      |     |         |
| $t_{RISE}$                                                       | Output Rise-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 561  | —   | $\mu s$ |
| $t_{ON}$                                                         | Output Turn-ON Delay Time  | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 748  | —   | $\mu s$ |
| $t_{FALL}$                                                       | Output Fall-time           | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 11   | —   | $\mu s$ |
| $t_{OFF}$                                                        | Output Turn-OFF Delay Time | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 123  | —   | $\mu s$ |
| $t_D$                                                            | Output Start Delay         | $R_L = 10\Omega, C_{SS} = 1000pF, C_L = 0.1\mu F$ | —   | 415  | —   | $\mu s$ |

**Performance Characteristics** (@ $T_A = +25^\circ\text{C}$ ,  $V_{\text{BIAS}} = 5\text{V}$ , unless otherwise specified.)

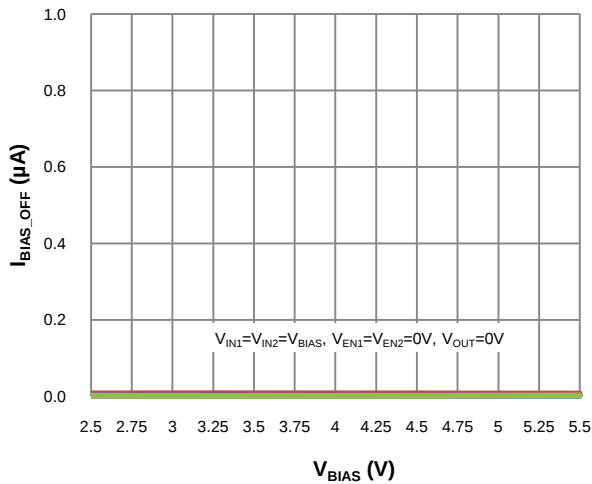
**$V_{\text{BIAS}}$  vs. QUIESCENT CURRENT (BOTH CHANNELS)**



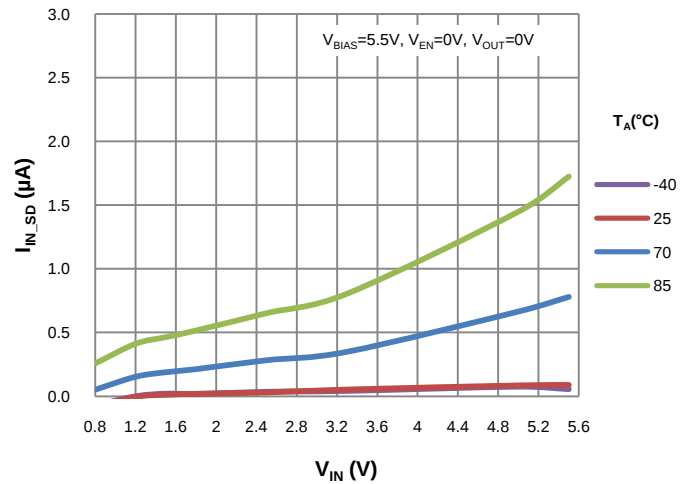
**$V_{\text{BIAS}}$  vs. QUIESCENT CURRENT (SINGLE CHANNEL)**



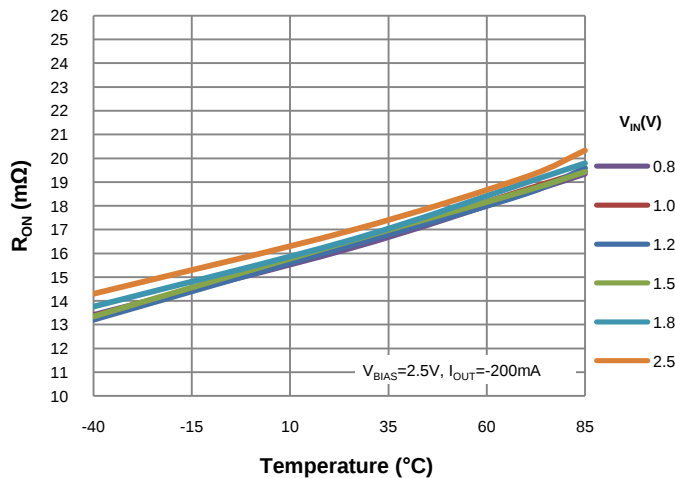
**$V_{\text{BIAS}}$  vs. SHUTDOWN CURRENT (BOTH CHANNELS)**



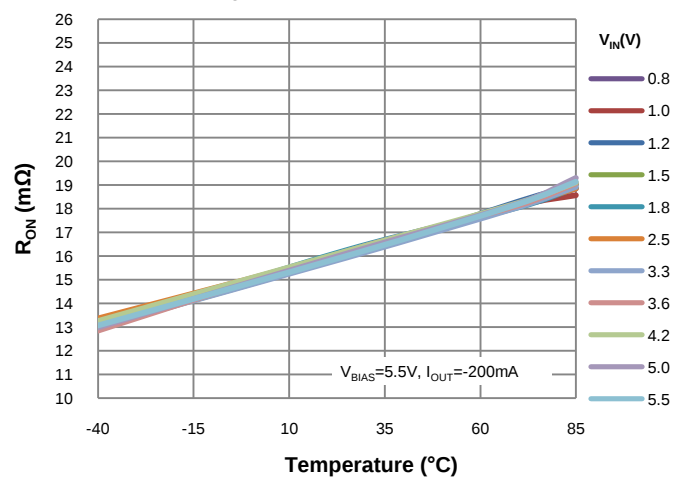
**$V_{\text{IN}}$  vs. OFF-STATE VIN CURRENT (SINGLE CHANNEL)**



**TEMPERATURE vs.  $R_{\text{ON}}$   
( $V_{\text{BIAS}}=2.5\text{V}$ , SINGLE CHANNEL)**



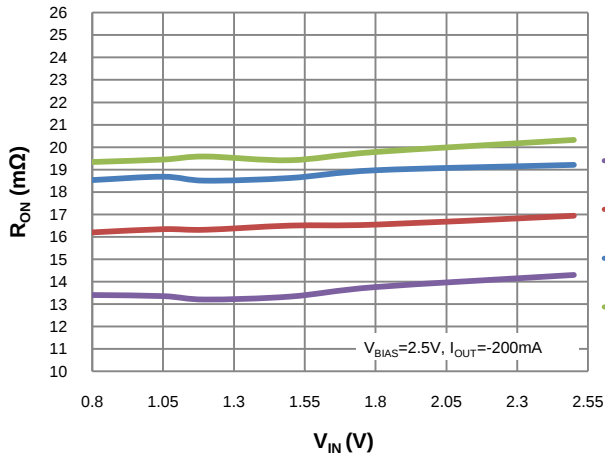
**TEMPERATURE vs.  $R_{\text{ON}}$   
( $V_{\text{BIAS}}=5.5\text{V}$ , SINGLE CHANNEL)**



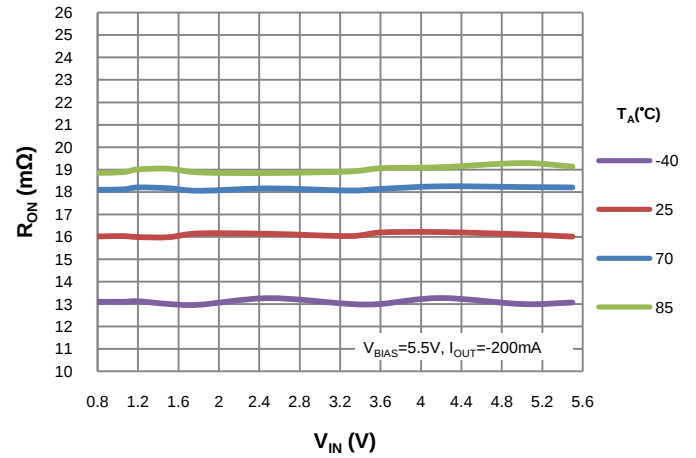
**Performance Characteristics** (cont.) (@ $T_A = +25^\circ\text{C}$ ,  $V_{\text{BIAS}} = 5\text{V}$ , unless otherwise specified.)

NEW PRODUCT

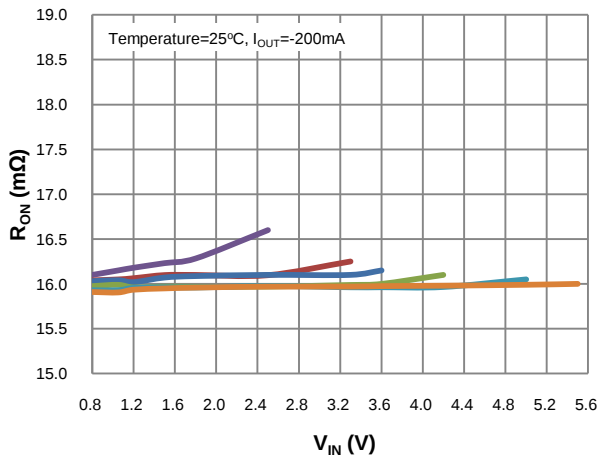
$V_{\text{IN}}$  vs.  $R_{\text{ON}}$  ( $V_{\text{BIAS}}=2.5\text{V}$ , SINGLE CHANNEL)



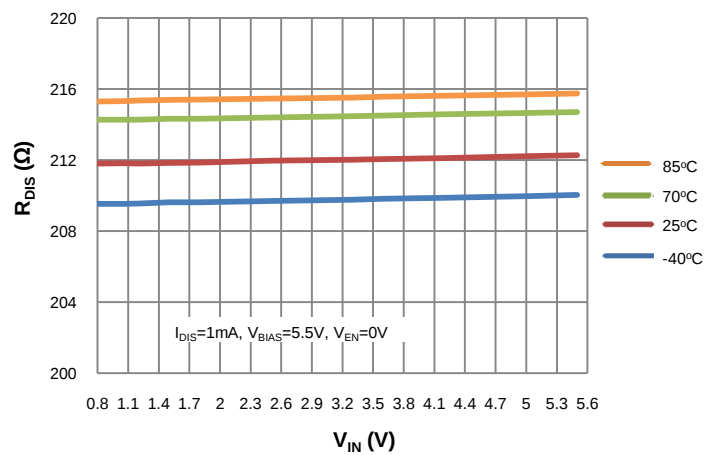
$V_{\text{IN}}$  vs.  $R_{\text{ON}}$  ( $V_{\text{BIAS}}=5.5\text{V}$ , SINGLE CHANNEL)



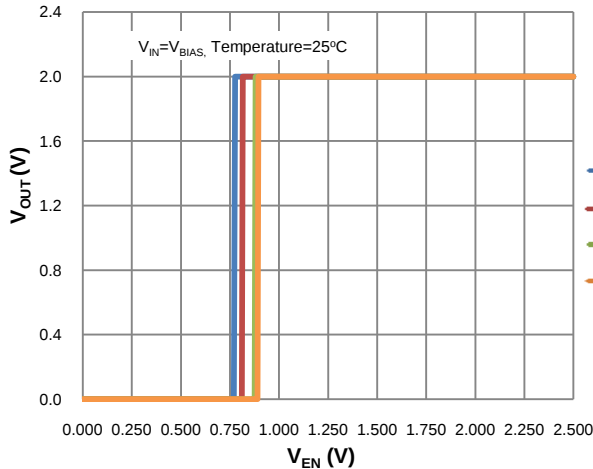
$V_{\text{IN}}$  vs.  $R_{\text{ON}}$  ( $T_A=25^\circ\text{C}$ , SINGLE CHANNEL)



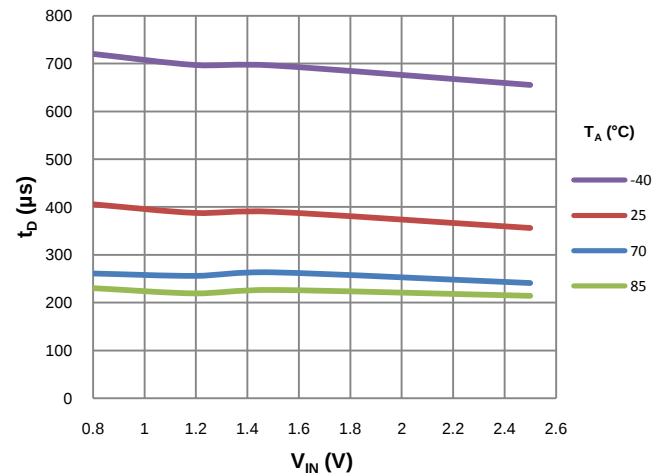
$V_{\text{IN}}$  vs.  $R_{\text{DIS}}$  ( $V_{\text{BIAS}}=5.5\text{V}$ , SINGLE CHANNEL)



$V_{\text{EN}}$  vs.  $V_{\text{OUT}}$  ( $T_A=25^\circ\text{C}$ , SINGLE CHANNEL)

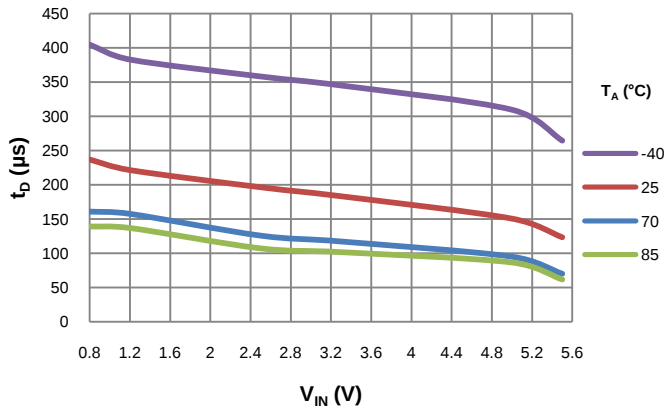


$t_D$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=2.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )

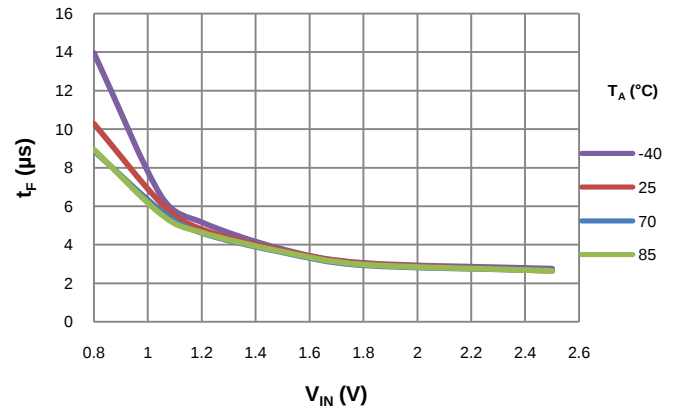


**Performance Characteristics** (cont.) (@ $T_A = +25^\circ\text{C}$ ,  $V_{\text{BIAS}} = 5\text{V}$ , unless otherwise specified.)

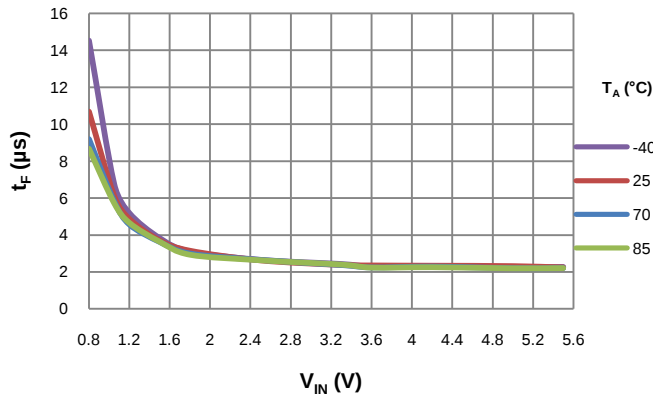
$t_D$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=5.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



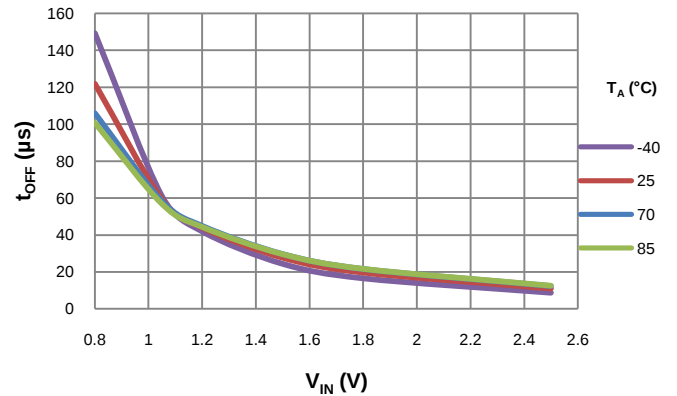
$t_F$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=2.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



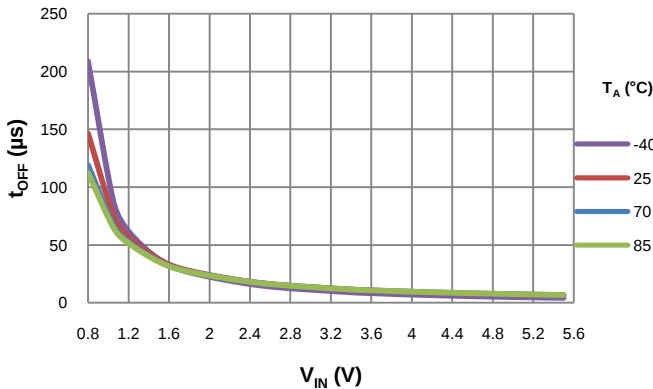
$t_F$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=5.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



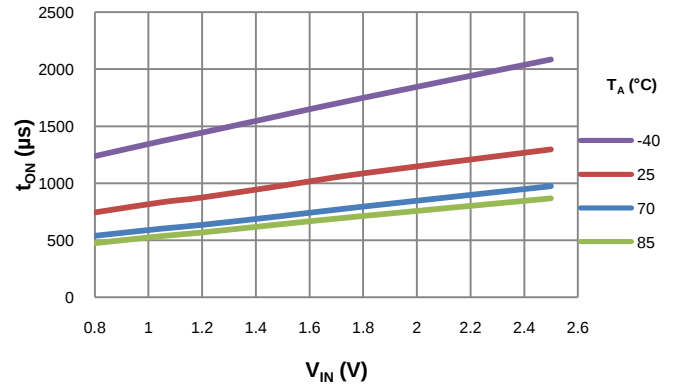
$t_{\text{OFF}}$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=2.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



$t_{\text{OFF}}$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=5.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )

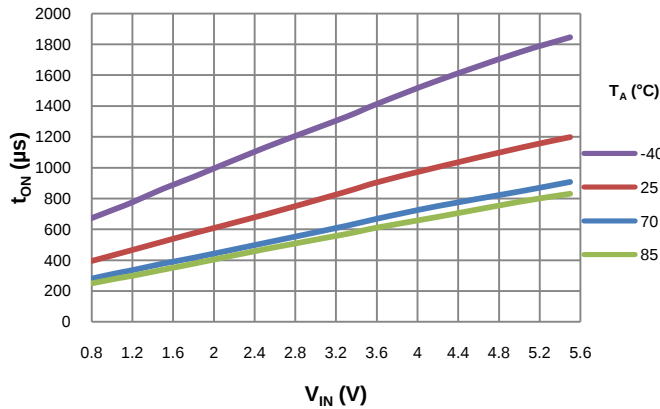


$t_{\text{ON}}$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=2.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )

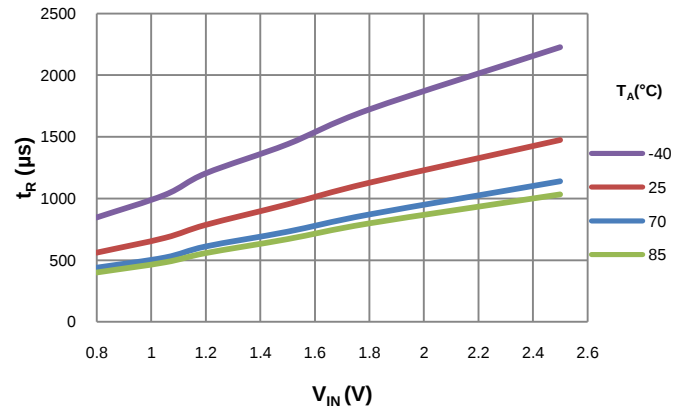


**Performance Characteristics** (cont.) (@ $T_A = +25^\circ\text{C}$ ,  $V_{\text{BIAS}} = 5\text{V}$ , unless otherwise specified.)

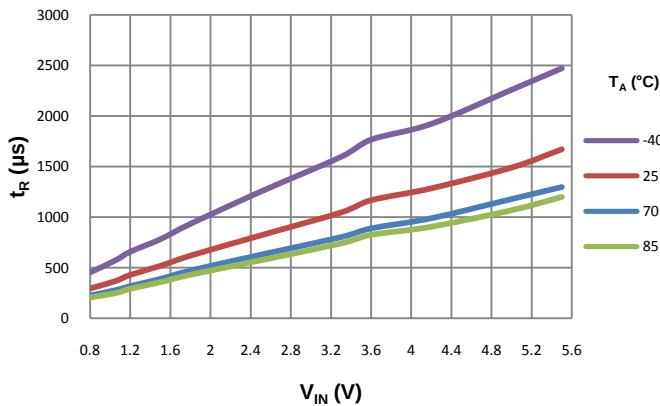
$t_{\text{ON}}$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=5.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



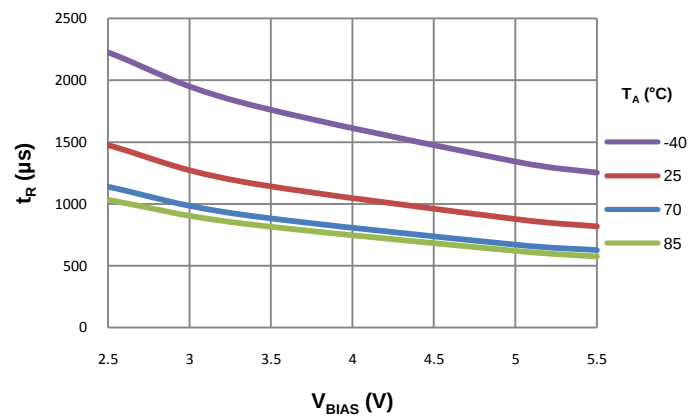
$t_{\text{R}}$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=2.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



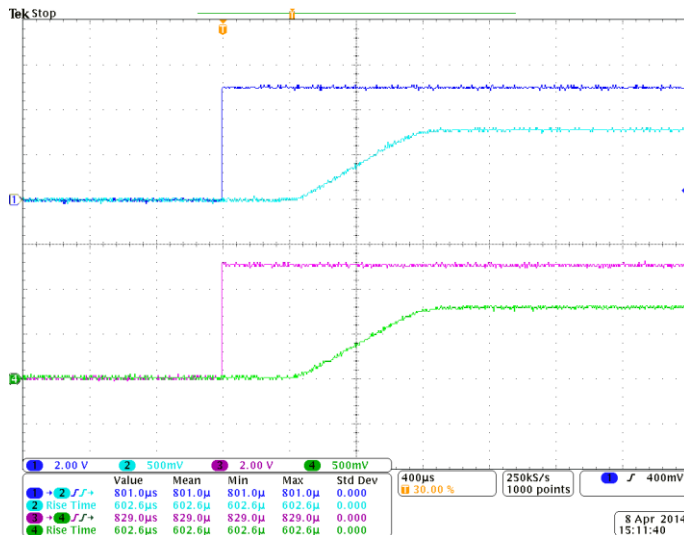
$t_{\text{R}}$  vs  $V_{\text{IN}}$ ,  $V_{\text{BIAS}}=5.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



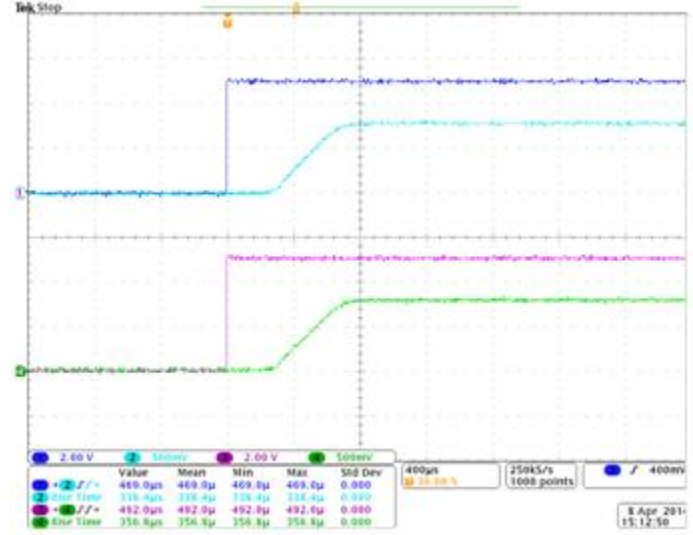
$t_{\text{R}}$  vs  $V_{\text{BIAS}}$ ,  $V_{\text{IN}}=2.5\text{V}$   
( $C_{\text{IN}}=1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$ ,  $C_L=0.1\mu\text{F}$ )



**Turn ON Response Time**  
 $V_{\text{IN}}=0.8\text{V}$ ,  $V_{\text{BIAS}}=2.5\text{V}$ ,  $C_{\text{IN}}=1\mu\text{F}$ ,  $C_L=0.1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$



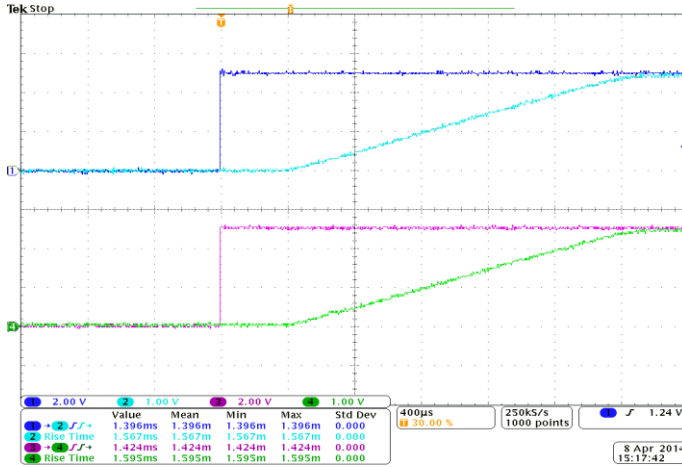
**Turn ON Response Time**  
 $V_{\text{IN}}=0.8\text{V}$ ,  $V_{\text{BIAS}}=5\text{V}$ ,  $C_{\text{IN}}=1\mu\text{F}$ ,  $C_L=0.1\mu\text{F}$ ,  $C_{\text{SS}}=1\text{nF}$ ,  $R_L=10\Omega$



**Performance Characteristics** (cont.) (@T<sub>A</sub> = +25°C, V<sub>BIAS</sub> = 5V, unless otherwise specified.)

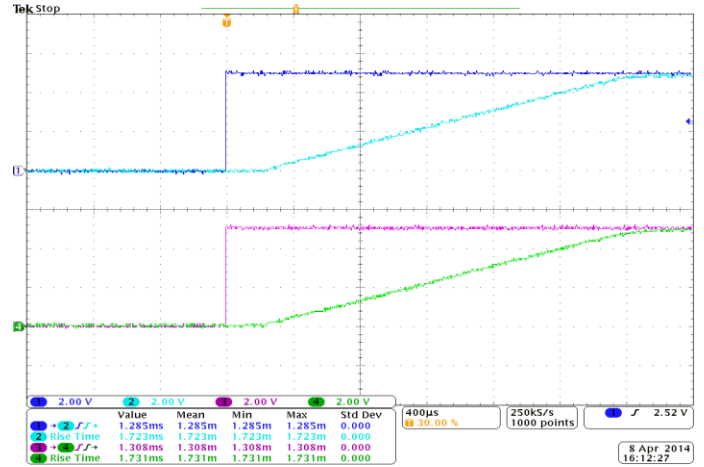
**Turn ON Response Time**

V<sub>IN</sub>=2.5V, V<sub>BIAS</sub>=2.5V, C<sub>IN</sub>=1μF, C<sub>L</sub>=0.1μF, C<sub>SS</sub>=1nF, R<sub>L</sub>=10Ω



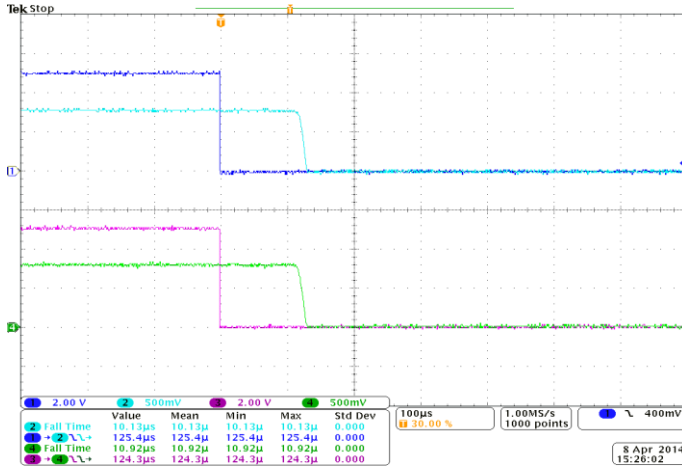
**Turn ON Response Time**

V<sub>IN</sub>=5V, V<sub>BIAS</sub>=5V, C<sub>IN</sub>=1μF, C<sub>L</sub>=0.1μF, C<sub>SS</sub>=1nF, R<sub>L</sub>=10Ω



**Turn OFF Response Time**

V<sub>IN</sub>=0.8V, V<sub>BIAS</sub>=2.5V, C<sub>IN</sub>=1μF, C<sub>L</sub>=0.1μF, C<sub>SS</sub>=1nF, R<sub>L</sub>=10Ω



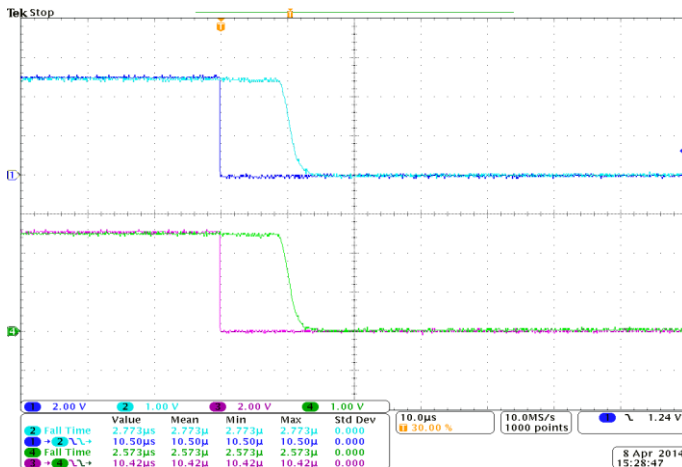
**Turn OFF Response Time**

V<sub>IN</sub>=0.8V, V<sub>BIAS</sub>=5V, C<sub>IN</sub>=1μF, C<sub>L</sub>=0.1μF, C<sub>SS</sub>=1nF, R<sub>L</sub>=10Ω



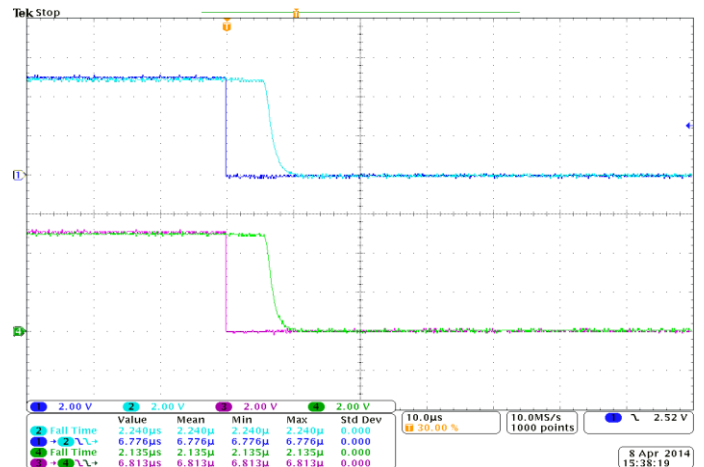
**Turn OFF Response Time**

V<sub>IN</sub>=2.5V, V<sub>BIAS</sub>=2.5V, C<sub>IN</sub>=1μF, C<sub>L</sub>=0.1μF, C<sub>SS</sub>=1nF, R<sub>L</sub>=10Ω



**Turn OFF Response Time**

V<sub>IN</sub>=5V, V<sub>BIAS</sub>=5V, C<sub>IN</sub>=1μF, C<sub>L</sub>=0.1μF, C<sub>SS</sub>=1nF, R<sub>L</sub>=10Ω



## Application Information

### Enable/Disable CONTROL

The EN pins control the state of the two switches. AP22966 is enabled when the EN pins are asserted high, and, the device is disabled when EN pins are asserted low. The EN input is compatible with both TTL and CMOS logic. This pin cannot be left floating and must be tied either high or low for proper functionality.

### INPUT CAPACITOR

To limit the voltage drop on the input supply when the switch turns on into a discharged load capacitor resulting in a transient inrush current, a capacitor needs to be placed between VIN and GND. Use 1μF capacitor or a larger value for high-current applications. Place the capacitor close to the VIN pins.

### OUTPUT CAPACITOR

The recommended output capacitor value is 0.1μF when switching lighter loads. For heavier loads close to 6A, it is recommended that the VIN and VOUT trace lengths be kept to a minimum. In addition, a bulk capacitor ( $\geq 10\mu\text{F}$ ) may also be placed close to the VOUT pins. If using a bulk capacitor on VOUT, it is important to control the inrush current by choosing an appropriate soft-start time in order to minimize the droop on the input supply.

### SOFT-START TIME

A capacitor on the SS pins (to GND) sets the slew rate for each channel. To ensure desired performance, a capacitor with a minimum voltage rating of 25V should be placed on the SS pins. The input inrush current can be controlled by choosing an appropriate soft-start time. The table below shows the rise-time (10% to 90%) on VOUT for a variety of VIN and CSS conditions.

| CSS(pF) | Soft-start Time (μs) 10% - 90%, VBIAS = 5V, CL = 0.1μF, CIN = 1μF, RL = 10Ω, Typical Values are at TA=+25°C |      |      |      |      |       |      |
|---------|-------------------------------------------------------------------------------------------------------------|------|------|------|------|-------|------|
|         | 5V                                                                                                          | 3.3V | 1.8V | 1.5V | 1.2V | 1.05V | 0.8V |
| 0       | 129                                                                                                         | 93   | 67   | 61   | 59   | 57    | 47   |
| 220     | 452                                                                                                         | 310  | 177  | 148  | 125  | 112   | 96   |
| 470     | 898                                                                                                         | 610  | 351  | 290  | 241  | 210   | 166  |
| 1000    | 1609                                                                                                        | 1130 | 661  | 557  | 454  | 397   | 315  |
| 2200    | 3453                                                                                                        | 2371 | 1483 | 1224 | 1019 | 870   | 710  |
| 4700    | 7202                                                                                                        | 4978 | 2900 | 2394 | 2014 | 1728  | 1430 |
| 10000   | 13673                                                                                                       | 9774 | 5728 | 4778 | 3982 | 3370  | 2762 |

### THERMAL CONSIDERATOIN

The maximum junction temperature should be restricted to +125°C under normal operating conditions. The maximum allowable power dissipation PD(MAX) can be calculated as:

$$P_{D(MAX)} = (T_{J(MAX)} - T_A) / \theta_{JA}$$

where,

TJ(MAX) is the maximum operating junction temperature. For AP22966, TJ(MAX) = 125°C

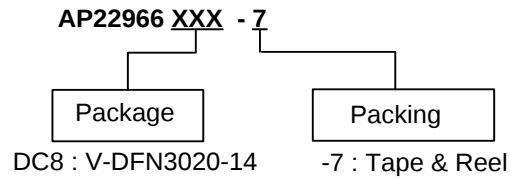
TA is the ambient temperature of the device

θJA is the junction-to-air thermal impedance

### BOARD LAYOUT

Good PCB layout is important for improving the thermal performance of the device. All trace lengths should be kept as short as possible. Place input and output capacitors close to the device to minimize the effects of parasitic inductance. The input and output PCB traces should be as wide as possible. Use a ground plane to enhance the power dissipation capability of the device.

## Ordering Information

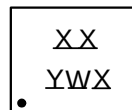


| Part Number  | Package Code | Packaging    | 7" Tape and Reel |                    |
|--------------|--------------|--------------|------------------|--------------------|
|              |              |              | Quantity         | Part Number Suffix |
| AP22966DC8-7 | DC8          | V-DFN3020-14 | 3000/Tape & Reel | -7                 |

## Marking Information

V-DFN3020-14

( Top View )



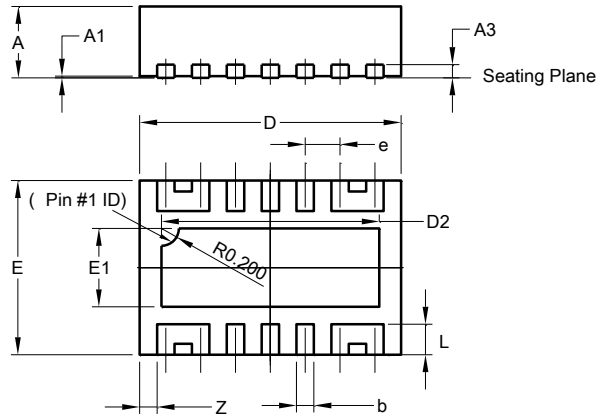
XX : Identification Code  
 Y : Year : 0~9  
 W : Week : A~Z : 1~26 week;  
       a~z : 27~52 week; z represents  
       52 and 53 week  
 X : Internal Code

| Part Number  | Package      | Identification Code |
|--------------|--------------|---------------------|
| AP22966DC8-7 | V-DFN3020-14 | WE                  |

## Package Outline Dimensions

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

### V-DFN3020-14

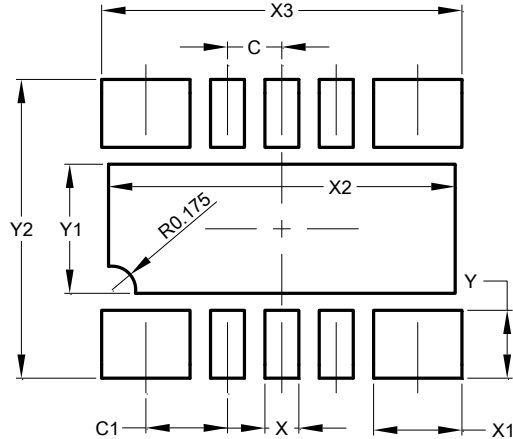


| V-DFN3020-14         |      |      |      |
|----------------------|------|------|------|
| Dim                  | Min  | Max  | Typ  |
| A                    | 0.77 | 0.83 | 0.80 |
| A1                   | 0    | 0.05 | 0.02 |
| A3                   | -    | -    | 0.15 |
| b                    | 0.15 | 0.25 | 0.20 |
| D                    | 2.95 | 3.05 | 3.00 |
| D2                   | 2.40 | 2.60 | 2.50 |
| E                    | 1.95 | 2.05 | 2.00 |
| E1                   | 0.80 | 1.00 | 0.90 |
| e                    | -    | -    | 0.40 |
| L                    | 0.30 | 0.40 | 0.35 |
| Z                    | -    | -    | 0.20 |
| All Dimensions in mm |      |      |      |

## Suggested Pad Layout

Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

### V-DFN3020-14



| Dimensions | Value (in mm) |
|------------|---------------|
| C          | 0.400         |
| C1         | 0.600         |
| X          | 0.250         |
| X1         | 0.650         |
| X2         | 2.550         |
| X3         | 2.650         |
| Y          | 0.500         |
| Y1         | 0.950         |
| Y2         | 2.200         |

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