# Ultra-low Resistance with Quick Rising Time Load Switch

## General Description

The EM5201A is a small, ultra-low RON, single channel load switch with controlled turn on. The device contains an N-channel MOSFET that can operate over an input voltage range of 0.6V to 5V and can support a maximum continuous current of 8A.

The combination of ultra-low RON and high current capability of the device makes it ideal for driving processor rails with very tight voltage dropout tolerances. The EM5201A is available in a small, space-saving DFN 33-08L with integrated thermal pad allowing for high power dissipation.

## Ordering Information

| Part Number | Package | Ron |
|---|---|---|
| EM5201AV | DFN3.0X3.0-08 | 6.5m |

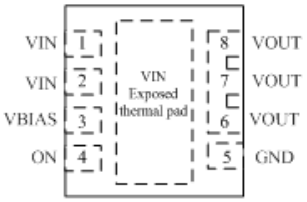
## Features

- VBIAS Voltage Range : 3V to 5.5V
- VIN Voltage Range : 0.8V to 5.5V
- Low Ron Internal NMOS: Ron=6.5mohm for 8A at Vin=1.05V(VBIAS=3V to 5.5V)
- 8A Continuous Current
- Low Quiescent Current (20uA at VBIAS=5V)
- Low Shutdown Current (1uA at VBIAS=5V)
- Quick Output Discharge
- DFN3.0X3.0-08 with Thermal PAD

## Applications

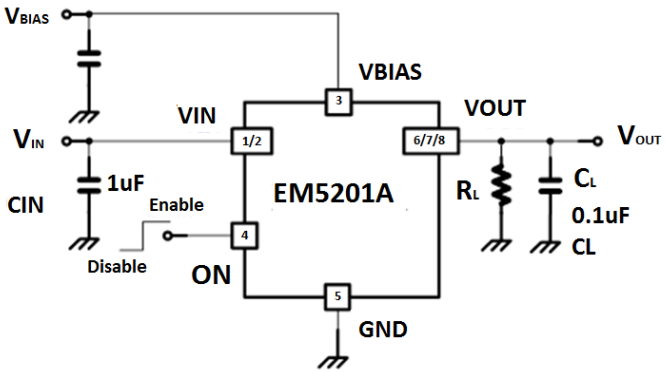
- Notebook & Netbook & MB
- Desktops
- Tablet PC

## Pin Configuration




TOP VIEW

## Typical Application Circuit

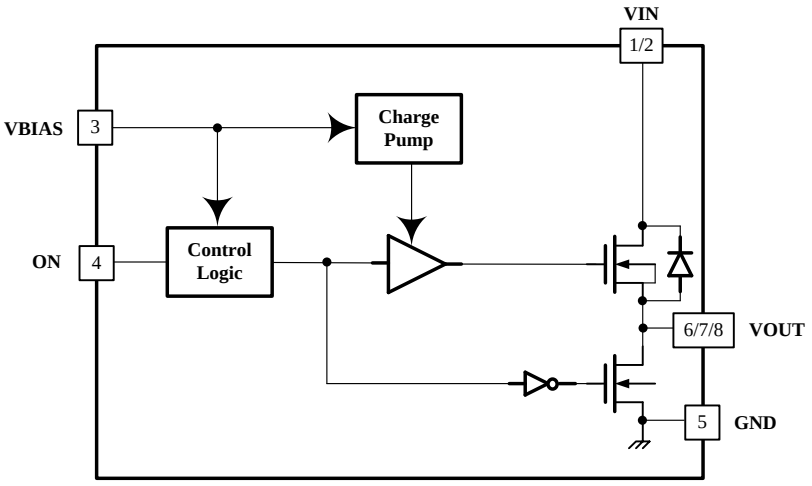



*CIN>10 CL is recommended.

## Pin Assignment

| Pin Name | Pin No. | Pin Function |
|---|---|---|
| **VIN** | 1,2 | Switch input. Place ceramic bypass capacitor(s) between this terminal and GND. |
| **VBIAS** | 3 | Bias voltage. Power supply to the device. |
| **ON** | 4 | Chip Enable Input |
| **GND** | 5 | GND |
| **VOUT** | 6,7,8 | Output Voltage. |

## Function Block Diagram




## Absolute Maximum Ratings (Note1)

- $V_{IN}$ ---------- 0.8V to 5.5 V
- Other Pins----------5.5V
- Power Dissipation, $P_D$ @ $T_A$ = 25°C, DFN3.0X3.0-08 ---------- 1.67 W
- Package Thermal Resistance, $\theta_{JA}$, DFN3.0X3.0-08 (Note 2)----------60°C/W
- Junction Temperature---------- 150°C
- Lead Temperature (Soldering, 10 sec.)---------- 260°C
- Storage Temperature ---------- –65°C to 150°C
- ESD susceptibility (Note3)
  HBM (Human Body Mode)---------- 2KV
  MM (Machine Mode)---------- 200V

## Recommended Operating Conditions (Note4)

- Supply Input Voltage, $V_{IN}$ ---------- 0.8V to VBIAS-2V
- Bias Input Voltage, VBIAS ---------- 3V to 5.5V
- Junction Temperature ---------- –40°C to 125°C
- Ambient Temperature ---------- -40°C to 85°C

## Electrical Characteristics

$V_{BIAS}$= $V_{ON}$ =3V to 5.5V, VIN=VBIAS-2V, $T_A$=25℃, unless otherwise specified

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Power Supplies and Currents Section** | | | | | | |
| Input supply voltage | $V_{IN}$ | $V_{ON}$ = 5V | 0.8 | | $V_{BIAS}$-2 | V |
| $V_{BIAS}$ Supply Voltage | $V_{BIAS}$ | | 3 | | 5.5 | V |
| Maximum continuous current | $I_D$ | $V_{ON}$ = 5V | | 8 | | A |
| $V_{BIAS}$ quiescent current | $I_{Q\text{-}BAIAS}$ | $I_{OUT}$ = 0, $V_{IN}$ = 3V | | 20 | | uA |
| $V_{BIAS}$ shutdown current | $I_{SD\text{-}BAIAS}$ | $V_{ON}$ = 0V；$V_{OUT}$ = 0V | | 1 | | uA |
| $V_{IN}$ shutdown current | $I_{SD\text{-}IN}$ | $V_{ON}$ = 0V；$V_{OUT}$ = 0V | | 1 | | uA |
| High-level input voltage | $v_{ON\text{-}H}$ | | 1.2 | | | V |
| Low-level input voltage | $v_{ON\text{-}L}$ | | | | 0.6 | V |
| ON pin leakage current | $I_{ON}$ | $V_{ON}$ = 5.5V | | 1 | | uA |
| **Resistance Section** | | | | | | |
| ON-state Resistance | $R_{ON}$ | Io=1A,<br>VBIAS = 3V to 5.5V<br>VIN=VBIAS-1.5V | | 6.5 | 7.8 | mΩ |
| Output Pull-down Resistance | $R_{PD}$ | $V_{IN}$ = 5.0V, $V_{ON}$ = 0V, $I_{OUT}$ = 5mA | | 250 | 350 | Ω |

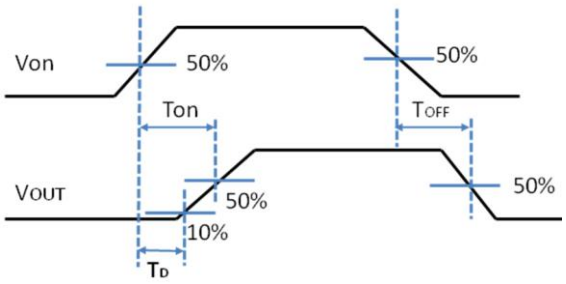
**Note 1.** Stresses listed as the above “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

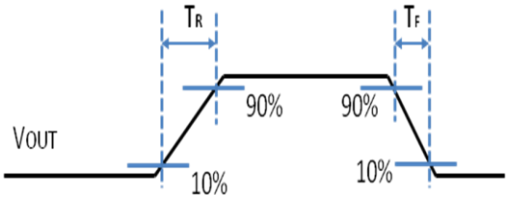
**Note 2.** $\theta_{JA}$ is measured in the natural convection at $T_A$=25°C on a low effective thermal conductivity test board (Single layout, 1S) of JEDEC 51-3 thermal measurement standard.

**Note 3.** Devices are ESD sensitive. Handling precaution is recommended.

**Note 4.** The device is not guaranteed to function outside its operating conditions.

## Switching Timing Diagrams



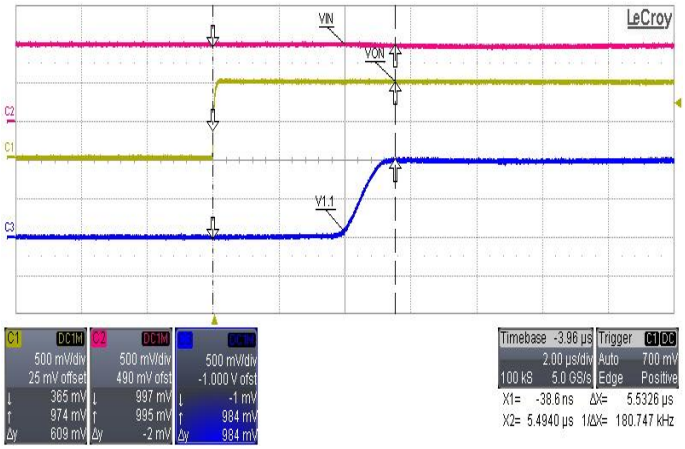

Switching characteristics

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **$V_{IN}$=2.5V；$V_{ON}$=$V_{BIAS}$=5V； $T_A$=25℃** | | | | | | |
| Turn-on time | $T_{ON}$ | $R_L$=10Ω；$C_L$=0.1uF | | 12 | | uS |
| Turn-off time | $T_{OFF}$ | | | 2 | | uS |
| Vout Rising time | $T_R$ | | | 19 | | uS |
| Vout falling time | $T_F$ | | | 2 | | uS |
| ON Delay time | $T_D$ | | | 7 | | uS |
| **$V_{IN}$=1.05V；$V_{ON}$=$V_{BIAS}$=5V； $T_A$=25℃** | | | | | | |
| Turn-on time | $T_{ON}$ | $R_L$=10Ω；$C_L$=0.1uF | 8 | 11 | 35 | uS |
| Turn-off time | $T_{OFF}$ | | 2 | 4 | 20 | uS |
| Vout Rising time | $T_R$ | | 7 | 9 | 12.5 | uS |
| Vout falling time | $T_F$ | | 1 | 2 | 10 | uS |
| ON Delay time | $T_D$ | | 5 | 7 | 25 | uS |
| **$V_{IN}$=1.05V；$V_{ON}$=$V_{BIAS}$=3.3V； $T_A$=25℃** | | | | | | |
| Turn-on time | $T_{ON}$ | $R_L$=10Ω；$C_L$=0.1uF | | 21 | | uS |
| Turn-off time | $T_{OFF}$ | | | 4 | | uS |
| Vout Rising time | $T_R$ | | | 20 | | uS |
| Vout falling time | $T_F$ | | | 2 | | uS |
| ON Delay time | $T_D$ | | | 13 | | uS |

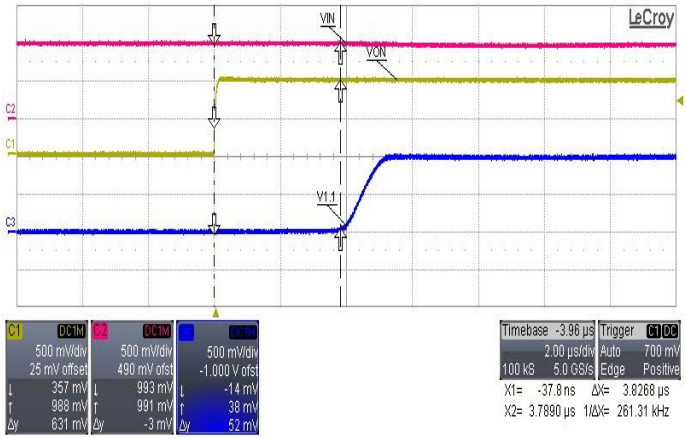
## Typical Operating Characteristics

CIN=1u, Co=0.1u, CL=10Ω, VIN=VBIAS-2V

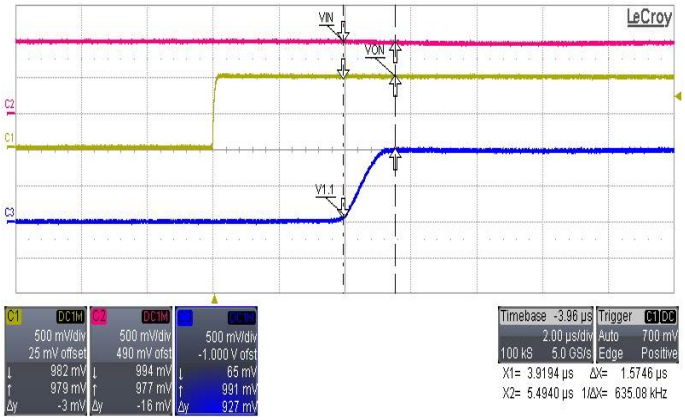
**Von to Vo Ready, VIN=1.05V, VBIAS=5V.**
**CH1:VON, CH2:VIN, CH3:Vo**



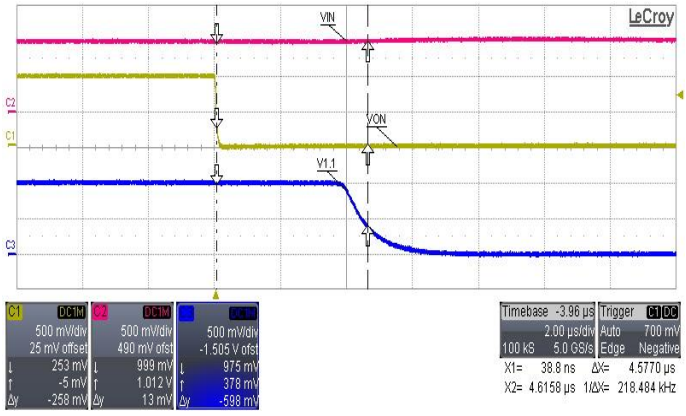

**Von to Vo TD, VIN=1.05V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:Vo**




**Rising time TR, VIN=1.05V, VBIAS=5V.**
**CH1:VON, CH2:VIN, CH3:VO**




**Turn off TOFF from VON, VIN=1.05V, VBIAS=5V**
**CH1:VIN, CH2:VON, CH3:VO**

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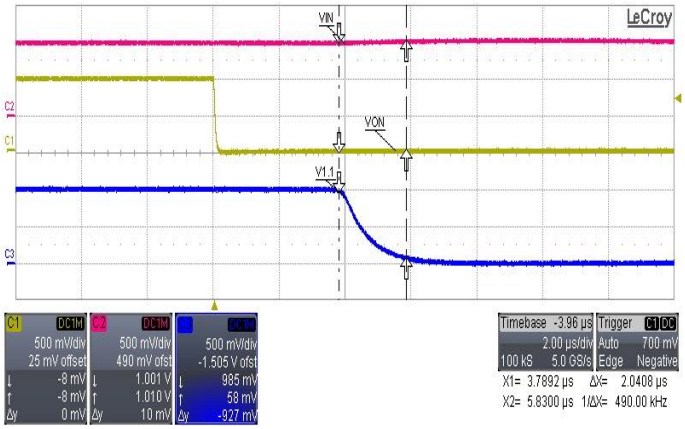
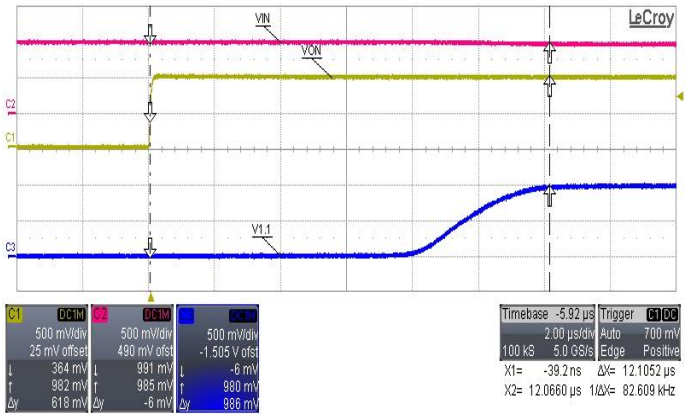
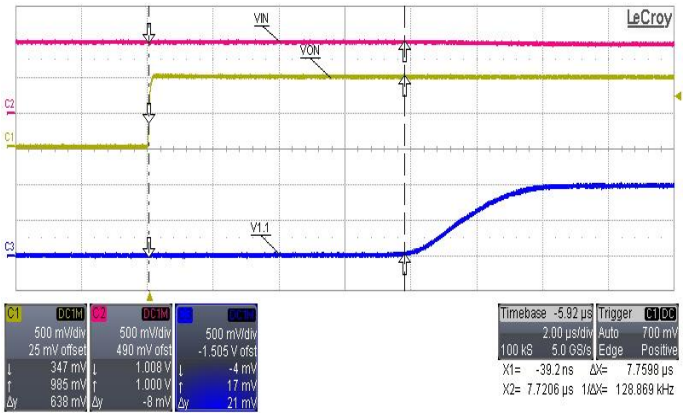


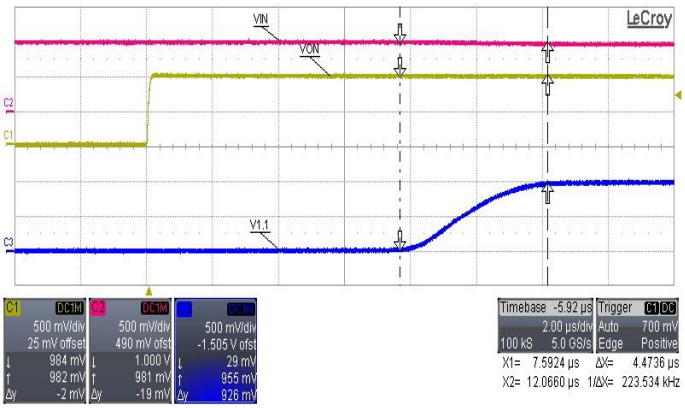

**Von to Vo Ready, VIN=1.05V, VBIAS=3.3V.**
**CH1:VON, CH2:VIN, CH3:Vo**



**Von to Vo TD, VIN=1.05V, VBIAS=3.3V**
**CH1:VON, CH2:VIN, CH3:Vo**




**Rising time TR, VIN=1.05V, VBIAS=3.3V**
**CH1:VON, CH2:VIN, CH3:VO**

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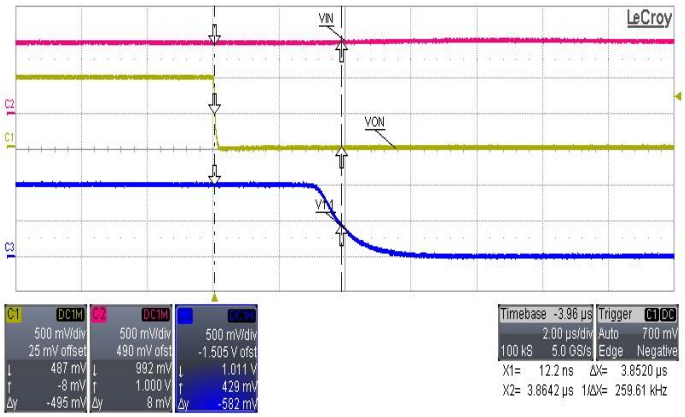
**CH1:VIN, CH2:VON, CH3:VO**

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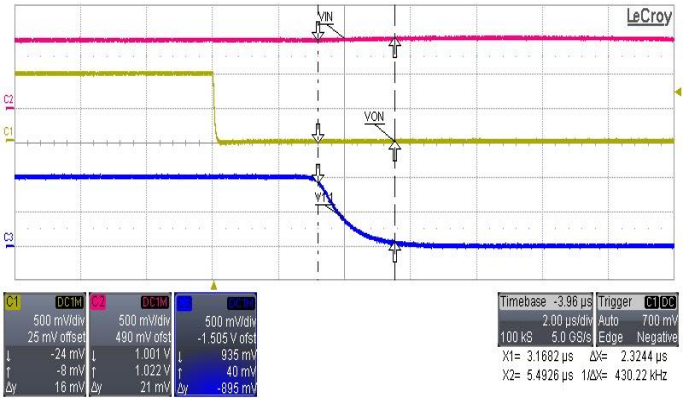
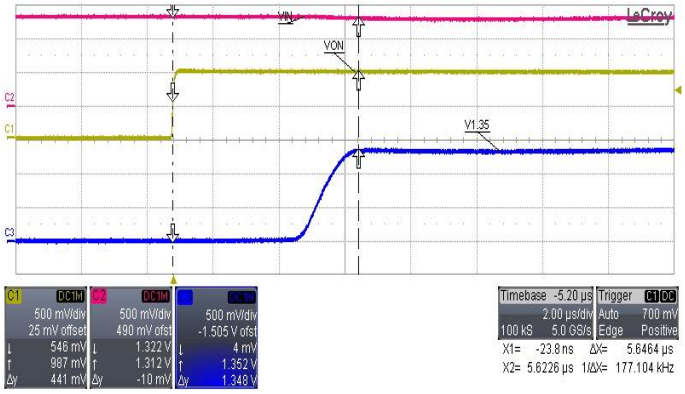



**Von to Vo Ready, VIN=1.35V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:Vo**

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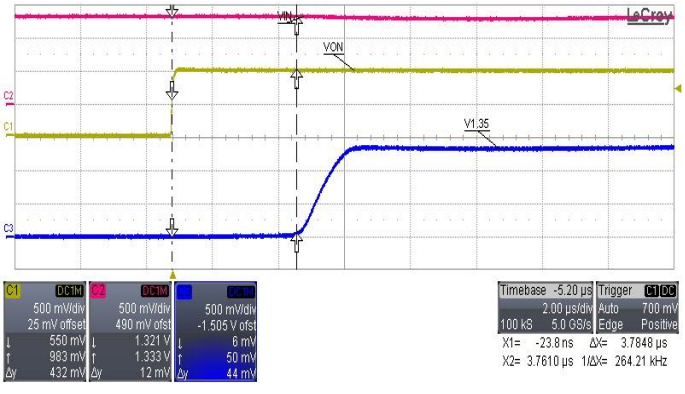
**CH1:VON, CH2:VIN, CH3:Vo**



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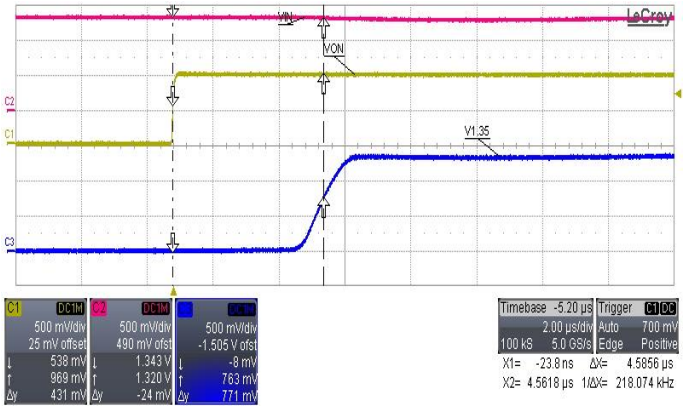
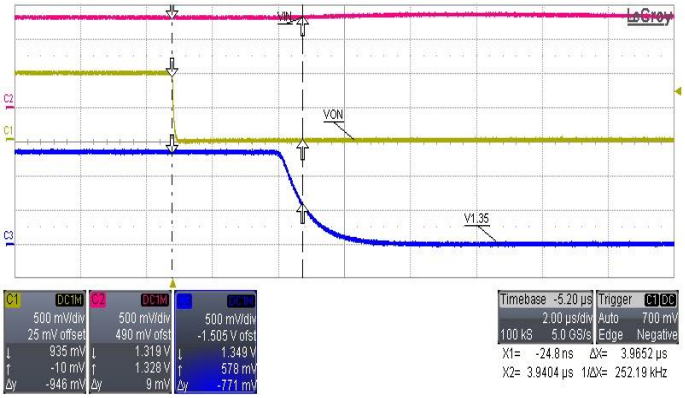
**CH1:VON, CH2:VIN, CH3:VO**




**Turn off TOFF from VON, VIN=1.35V, VBIAS=5V**
**CH1:VIN, CH2:VON, CH3:VO**

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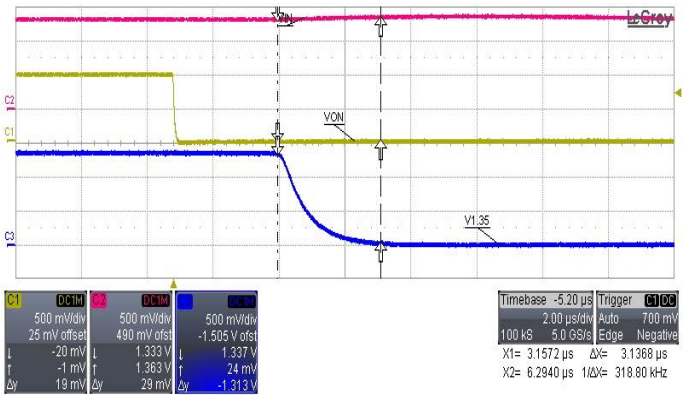


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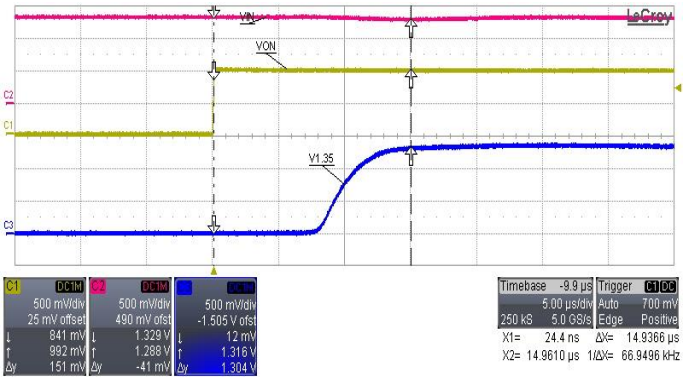
**CH1:VON, CH2:VIN, CH3:Vo**

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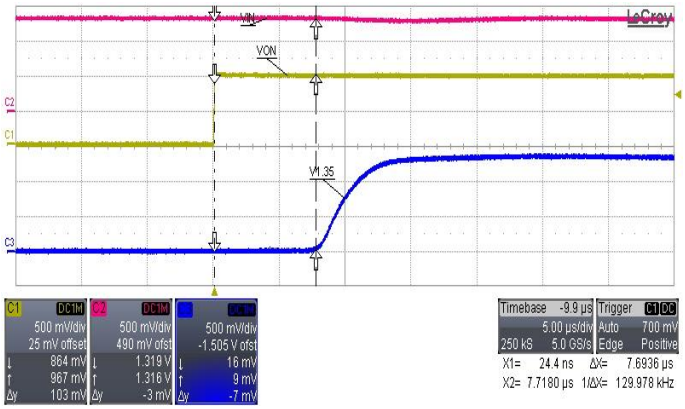
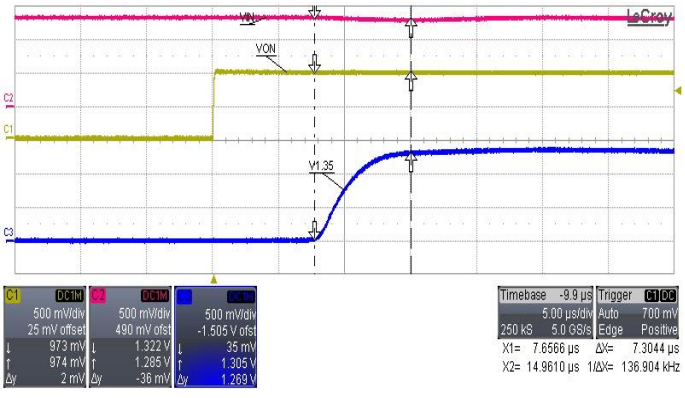
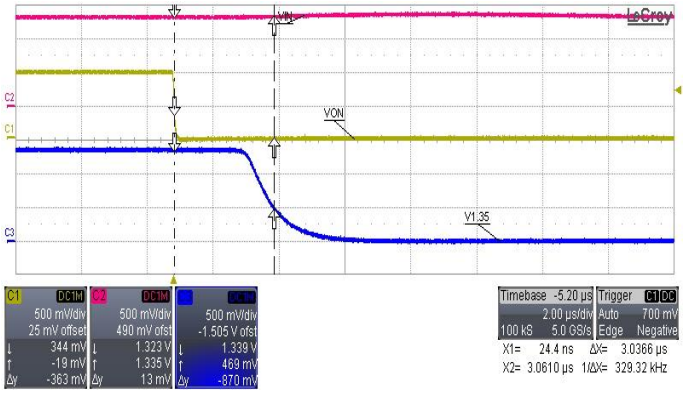
**CH1:VON, CH2:VIN, CH3:Vo**




**Rising time TR, VIN=1.35V, VBIAS=3.3V**
**CH1:VON, CH2:VIN, CH3:VO**



**Turn off TOFF from VON, VIN=1.35V, VBIAS=3.3V**
**CH1:VIN, CH2:VON, CH3:VO**

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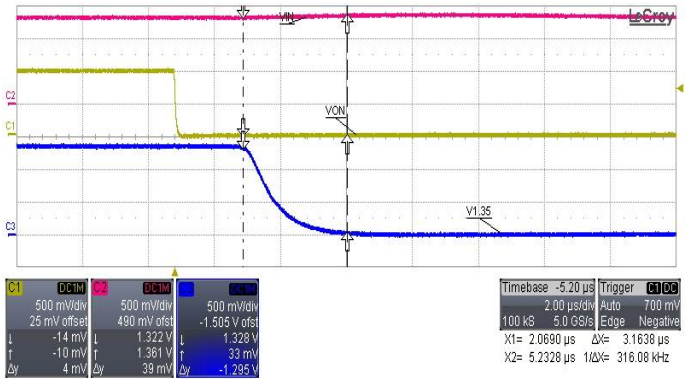
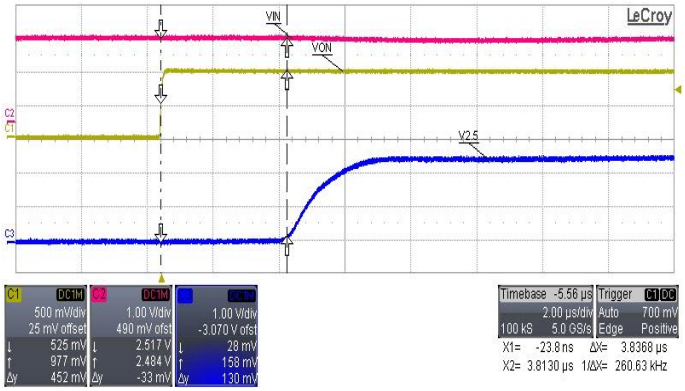
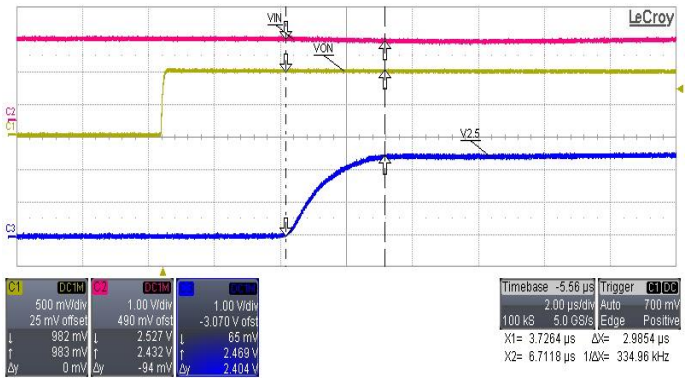
**CH1:VIN, CH2:VON, CH3:VO**



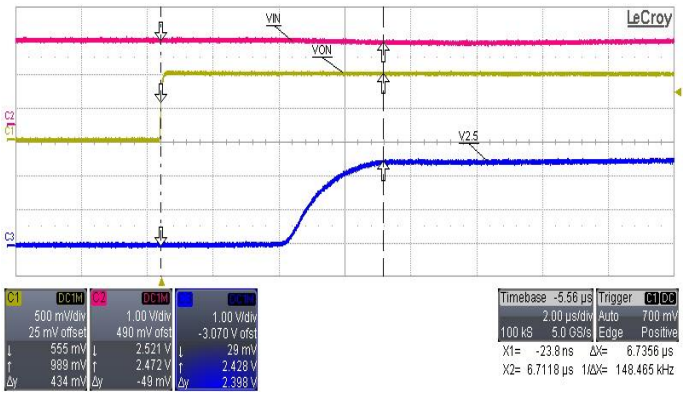

**Von to Vo TD, VIN=2.5V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:Vo**



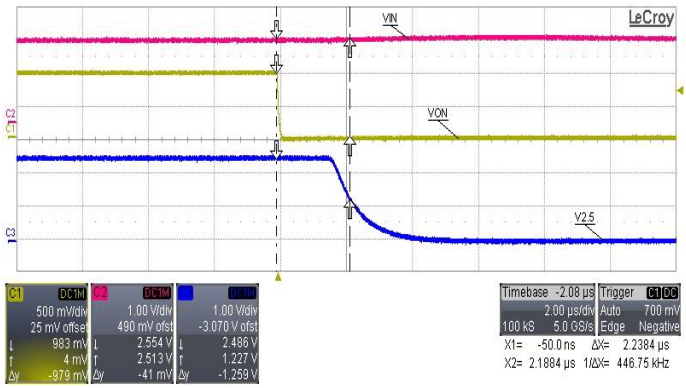

**Rising time TR, VIN=2.5V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:VO**



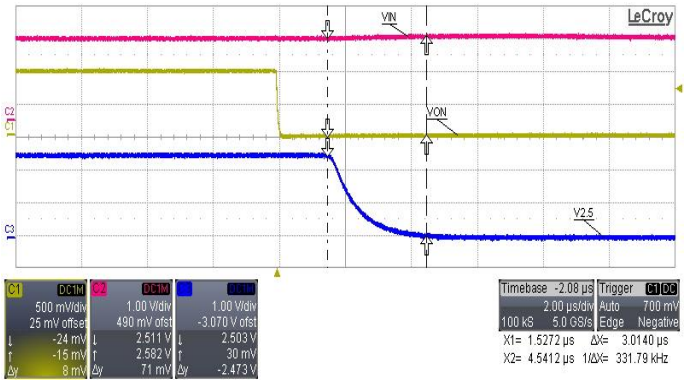

**Von to Vo Ready, VIN=2.5V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:Vo**



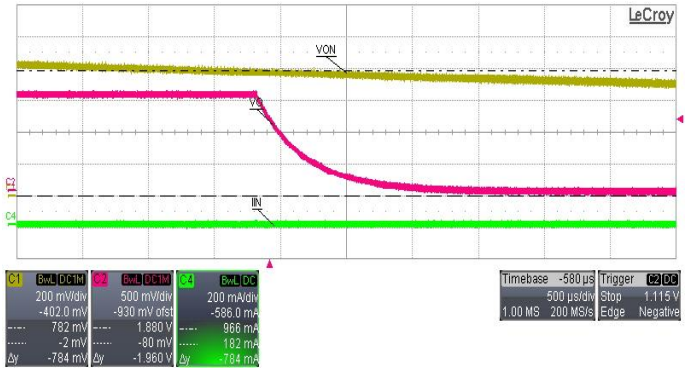

**Von to Vo TOFF, VIN=2.5V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:Vo**



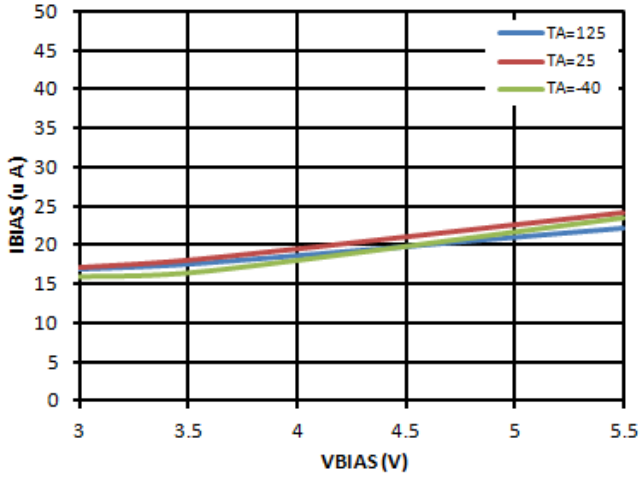
**Von to Vo TF, VIN=2.5V, VBIAS=5V**
**CH1:VON, CH2:VIN, CH3:Vo**



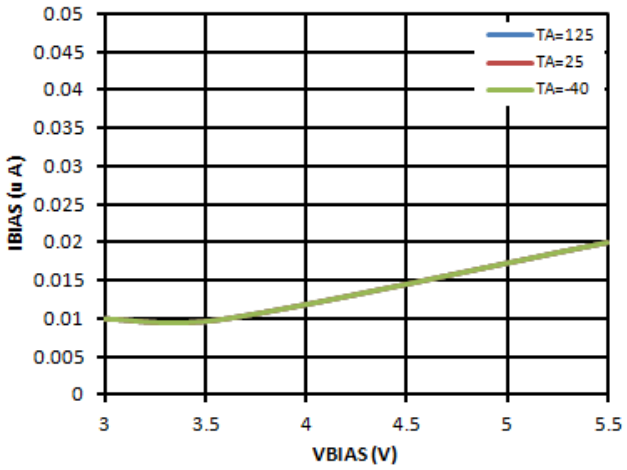

**Turn off when no load**
**CH1:VON, CH2:VIN, CH3:IN**



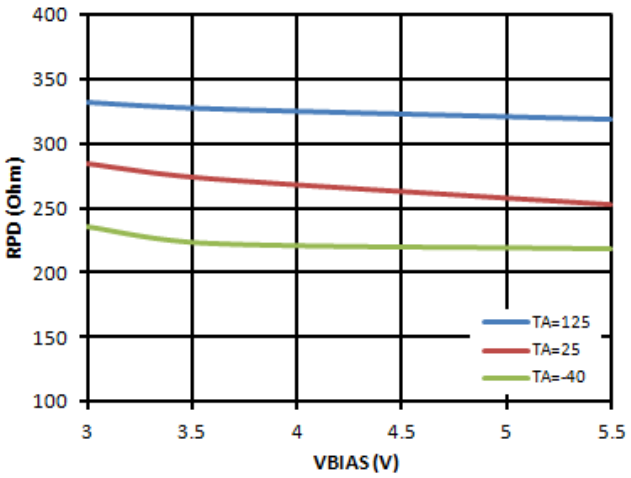

**BIAS Supply Current VS. Temperature**
**VIN=1V, VBIAS=3V to 5.5V**



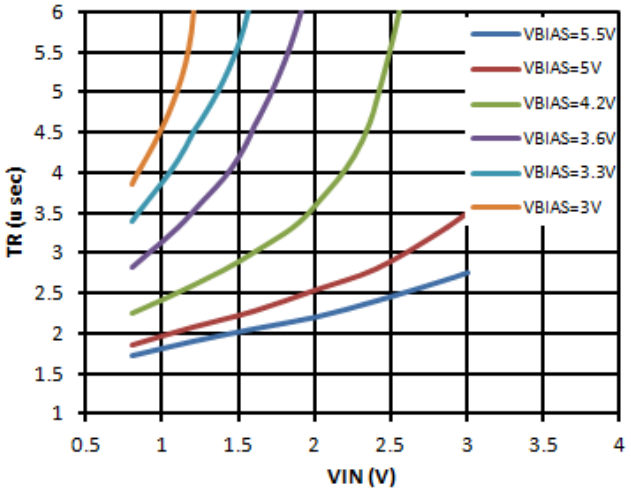

**BIAS Shunt down Current VS. Temperature**
**VIN=1V, VBIAS=3V to 5.5V**




**RPD Performance VS. Temperature**
**VIN=1V, VBIAS=3V to 5.5V**



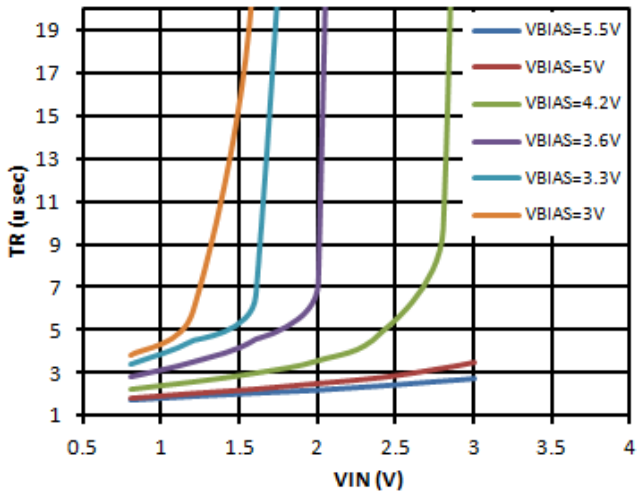

**Output Rising Time VS. VIN VS. VBIAS**
**VIN=0.8V to 3V, VBIAS=3V to 5.5V**



## Functional Description

### VIN and VBIAS Voltage Range

The MOSFET gate voltage in the EM5201A is driven by an internal charge pump. The output voltage of the charge pump is dependent on the voltage on VBIAS pin. Care must be taken to ensure a sufficient VBIAS is used to keep the desired output rising time when given the anticipated input voltage. For quickly output rising requirement that may be under 60usec, make sure $V_{IN} \leq (V_{BIAS} - 2V)$ is highly recommended. For example, in order to have VIN=3V, VBIAS must be 5V. The Ron of EM5201A will still be keep constant if $V_{IN} > (V_{BIAS} - 2V)$ but it will exhibit slowly output rising time. See figure as below.




### ON/OFF Control

EM5201A is enabled if the voltage of the Von pin is greater than logic high level and the VBIAS voltage has an adequate applied. If the voltage of the EN pin is less than logic low level, the device will be disabled.

### Input Capacitor CIN

The EM5201A do not require an input capacitor. In order to limit the voltage drop on the input supply caused by transient inrush current, an input bypass capacitor is recommended. A 1uF ceramic capacitor should be placed as closed as possible to the VIN pin. Higher values capacitor can help to further reduce the voltage drop.

### Output Capacitor Co

Due to the integrated body diode in the NMOS switch, the CIN greater than Co is highly recommended. A CIN to Co ratio of 10 to 1 is recommended for minimizing VIN drop caused by inrush during startup. It also helps to prevent parasitic inductance forces Vo below GND when switching off. A 0.1uF ceramic capacitor should be placed as closed as possible to the Vo pin.

### Thermal and Layout Consideration

EM5201A is designed to maintain a constant output load current. Due to physical limitations of the chip layout and assembly of the device the continuous current is 8A. All copper traces for the VIN and Vo pin should be widely and short to carry the maximum continuous current and obtain the best effect. The input and output capacitor should be close to the device as possible to minimize the parasitic trace inductances and prevents the voltage drop when load transient.

The maximum IC junction temperature should be restricted to 125℃ under normal operating conditions. To calculate the maximum allowable dissipation, PD(MAX) for a given output current and ambient temperature, used the following equation:

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

Where:

PD(MAX)=Maximum allowable power dissipation

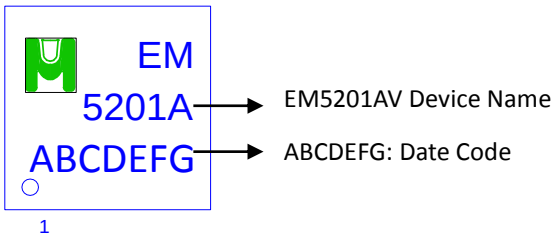
TJ(MAX)=Maximum allowable junction temperature (125 ℃ for the EM5201A)

TA=Ambient Temperature of the device

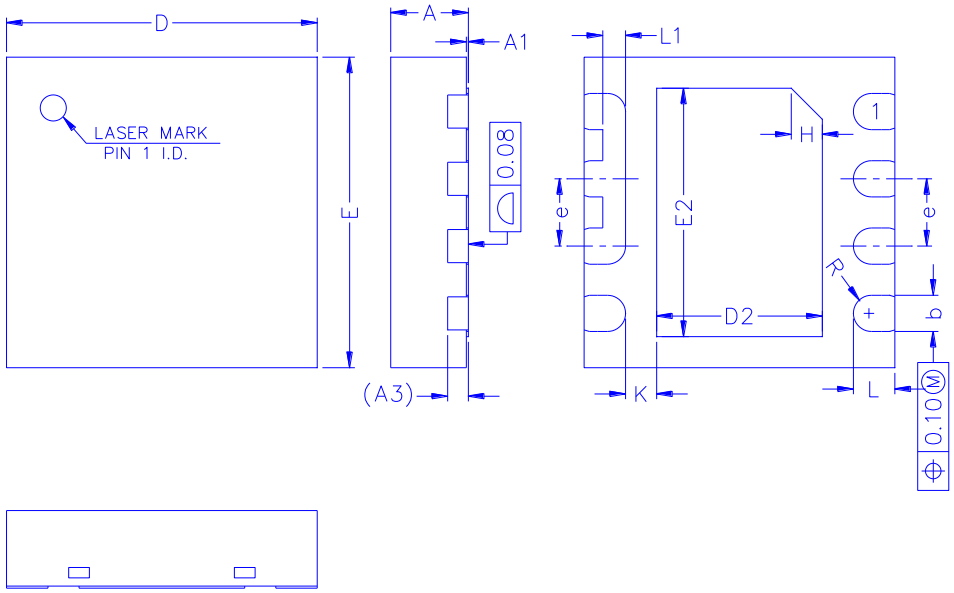
ΘJA= Junction to air thermal impedance. This parameter is also dependent upon PCB layput.

## Ordering & Marking Information

Device Name: EM5201AV for DFN3.0X3.0-08



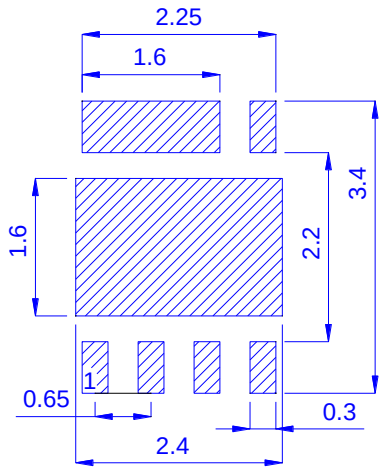

## Outline Drawing



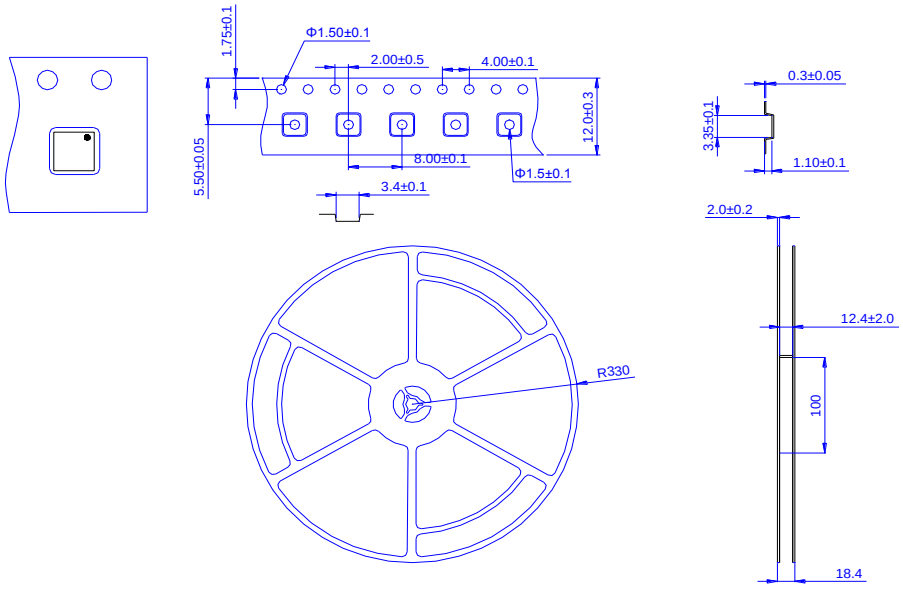

Dimension in mm

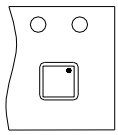
| Dimension | A | A1 | A3 | b | D | E | D2 | E2 | e | H | K | L | L1 | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Min. | 0.7 | 0.00 | | 0.3 | 2.9 | 2.9 | 1.5 | 2.3 | 0.55 | | 0.2 | 0.3 | 0.12 | 0.16 |
| Typ. | 0.75 | 0.02 | 0.2 REF | 0.35 | 3.0 | 3.0 | 1.6 | 2.4 | 0.65 | 0.3REF | 0.3 | 0.4 | 0.22 | |
| Max. | 0.8 | 0.05 | | 0.4 | 3.1 | 3.1 | 1.7 | 2.5 | 0.75 | | 0.4 | 0.5 | 0.32 | |

Recommended minimum pads



Tape&Reel Information: 5000pcs/Reel




| | |
|---|---|
| 產品別 | DFN3.0X3.0-08 |
| Reel 尺寸 | 13” |
| 編帶方式 |  |
| 前空格 | 50 |
| 後空格 | 50 |
| 裝箱數 | |
| 滿捲數量 | 5K |
| 捲/內盒比 | 1 : 1 |
| 內盒滿箱數 | 5K |
| 內/外箱比 | 10 : 1 |
| 外箱滿箱數 | 50K |
| 包裝材料規格 | |
| 導電袋(mm) | 500 * 375 * 0.1 |
| 保護帶(mm) | 108 ± 1* 1.6 ± 0.05 * 0.1 ± 0.01 |
| 內盒尺寸(mm) | 351 * 339 * 31 |
| 外箱尺寸(mm) | 384 * 360 * 360 |