# DIO1281
# Over-Voltage Protection Load Switch

## Features

- Surge Protection
  - IEC 61000-4-5: >100V
- Over-Voltage Protection (OVP)
- Over-Temperature Protection (OTP)
- ESD Protection
  - IEC 61000-4-2 Air Discharge: >15kV
  - IEC 61000-4-2 Contact Discharge: >8kV
- +/- 100V EOS Protection
- Negative Voltage Protection(-30V)

## Applications

- Mobile Handsets and Tablets
- Portable Media Players
- MP3 Players

## Descriptions

The DIO1281 features a low-RON internal FET and an operating range of 2.5 $V_{DC}$ to 25 $V_{DC}$ (absolute maximum of 30$V_{DC}$). An internal clamp is capable of shunting surge voltages>100V, protecting downstream components and enhancing system robustness. The DIO1281 features over-voltage protection that powers down the internal FET if the input voltage exceeds the OVP threshold. The OVP threshold is adjustable with optional external resistors. Over-temperature protection also powers down the device at 130℃ (typical). Exceptionally low off-state current (<1μA maximum) facilitates compliance with standby power requirements.

The DIO1281 is available in a fully "green" compliant 1.3mm x 1.8mm Wafer-Level Chip-Scale Package (WLCSP) with backside laminate.

## Function Block Diagram

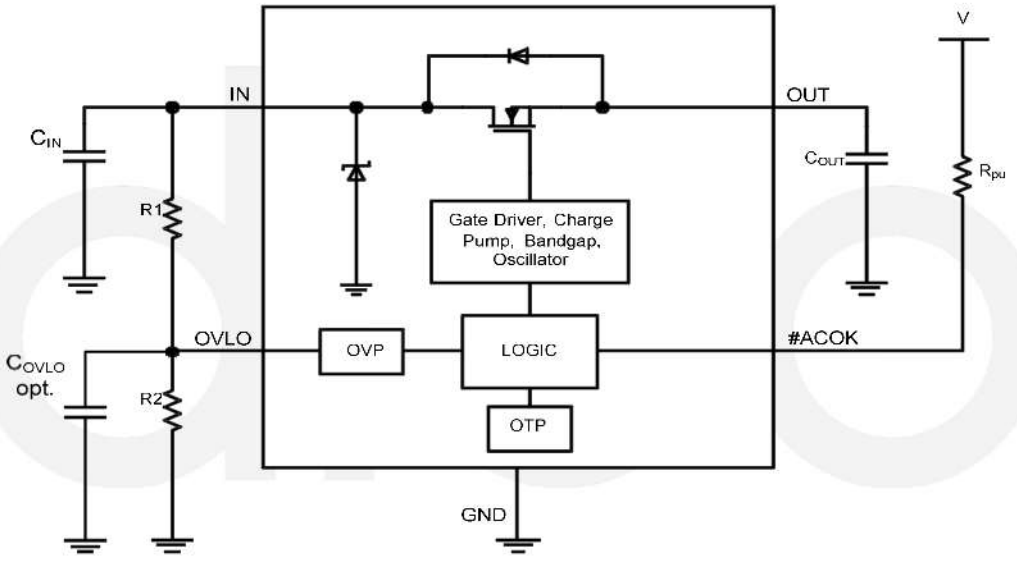
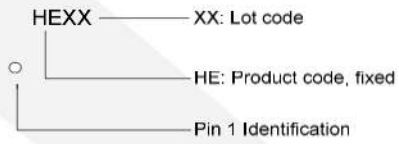



**Figure 1 Functional Block Diagram**

## Ordering Information

| Order Part Number | Top Marking | | $T_A$ | Package | |
|---|---|---|---|---|---|
| DIO1281WL12 | HEXX | Green | -40 to +85°C | WLCSP-12 0.4mm pitch | Tape & Reel, 3000 |

**Marking Definition**




## Pin Configuration

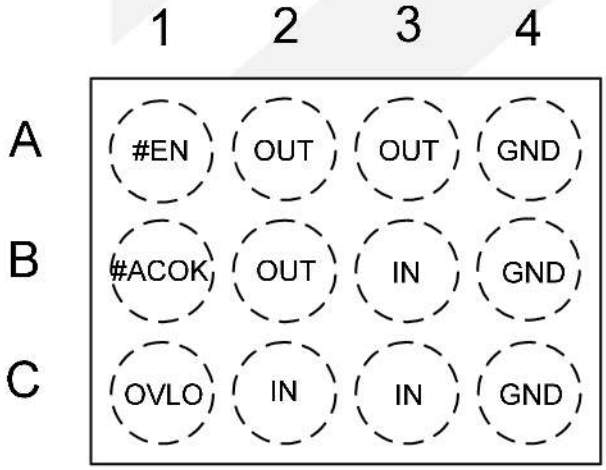



**Figure 2 Pin Assignment (Top View)**

## Pin Definitions

| Name | Bump | Type | Description | | |
|---|---|---|---|---|---|
| IN | B3,C2,C3 | Input/Supply | Switch Input and Device Supply | | |
| OUT | A2,A3,B2 | Output | Switch Output to Load | | |
| #ACOK | B1 | Output | Power Good | 1 | $V_{IN}<V_{IN\_min}$ or $V_{IN}\geq V_{OVLO}$ |
| | | | | 0 | Voltage Stable |
| #EN | A1 | Input | Device Enable | | |
| OVLO | C1 | Input | Over-Voltage Lockout Adjustment Pin | | |
| GND | A4,B4,C4 | Supply | Device Ground | | |

## Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Rating" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maxim rating conditions for extended periods may affect device reliability.

| Symbol | Parameter | | Rating | Unit |
|---|---|---|---|---|
| $V_{IN}$ | V_IN to GND & V_IN to V_OUT = GND or Float | | -0.3 to +30 | V |
| $V_{OUT}$ | V_OUT to GND | | -0.3 to $V_{IN}$+0.3 | V |
| $V_{OVLO}$ | OVLO to GND | | -0.3 to 30 | V |
| $V_{\#EN\_ACOK}$ | Maximum DC Voltage Allowed on #EN or ACOK Pin | | 6 | V |
| $I_{IN}$ | Switch I/O Current (Continuous) | | 4.5 | A |
| $I_{IK}$ | Input Clamp Diode Current (All Pins Except $V_{IN}$) | | -50 | mA |
| tPD | Total Power Dissipation at $T_A$=25°C | | 1.55 | mW |
| $T_{STG}$ | Storage Temperature Range | | -65 to +150 | °C |
| $T_J$ | Maximum Junction Temperature | | +150 | °C |
| $T_L$ | Lead Temperature (Soldering, 10 Seconds) | | +260 | °C |
| $\theta_{JA}$ | Thermal Resistance,Junction-to-Ambient | | 84.1 | °C/W |
| ESD | IEC 61000-4-2 System ESD | Air Gap | 15.0 | kV |
| | | Contact | 8.0 | |
| Surge | IEC 61000-4-5, Surge Protection | VIN | 100 | V |

## Recommended Operating Conditions

| Symbol | Parameter | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|
| $V_{IN}$ | Supply Voltage | 2.5 | | 20.0 | V |
| $T_A$ | Operating Temperature | -40 | | +85 | °C |
| $I_{OUT}$ | Output Current | | | 3 | A |

## Electrical Characteristics

$T_A$=-40℃ to 85℃, unless otherwise specified. Typical values are $V_{IN}$=5.0V, $I_{IN}$≤3A, $C_{IN}$=0.1μF and $T_A$=25℃.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IN\_CLAMP}$ | Input Clamping Voltage | $I_{IN}$=10mA | | 35 | | V |
| $I_Q$ | Input Quiescent Current | $V_{IN}$=5V, #EN=0V | | 58 | 100 | μA |
| $I_{IN\_Q}$ | OVLO Supply Current | $V_{OVLO}$=3V, $V_{IN}$=5V. $V_{OUT}$=0V | | 52 | 100 | μA |
| $V_{IN\_OVLO}$ | Internal Over-Voltage Trip Level | $V_{IN}$ Rising | 13.6 | 14.0 | 14.4 | V |
| | | $V_{IN}$ Falling | 13.0 | | | V |
| $V_{OVLO\_TH}$ | OVLO Set Threshold | $V_{IN}$=2.5V to $V_{OVLO}$ | 1.12 | 1.20 | 1.24 | |
| $V_{OVLO\_RNG}$ | Adjustable OVLO Threshold Range | $V_{IN}$=2.5V to $V_{OVLO}$ | 4 | | 20 | V |
| $V_{OVLO\_SELECT}$ | External OVLO Select Threshold | | | 0.30 | 0.28 | V |
| $R_{ON}$ | Resistance from $V_{IN}$ to $V_{OUT}$ | $V_{IN}$=5V, $I_{OUT}$=1A, $T_A$=25℃ | | 20 | 39 | mΩ |
| $C_{OUT}$ | OUT Load Capacitance | $V_{IN}$=5V | | | 1000 | μF |
| $I_{OLVO}$ | OVLO Input Leakage Current | $V_{OVLO}$=$V_{OVLO\_TH}$ | -100 | | 100 | nA |
| $T_{SDN}$ | Thermal Shutdown | | | 130 | | ℃ |
| $T_{SDN\_HYS}$ | Thermal Shutdown Hysteresis | | | 20 | | ℃ |
| **Digital Signals** | | | | | | |
| $V_{OL}$ | #ACOK Output Low Voltage | $I_{SINK}$=1mA | | | 0.4 | V |
| VIH_#EN | Enable HIGH Voltage | $V_{IN}$=2.5V to $V_{OVLO}$ | 1.2 | | | V |
| VIL_#EN | Enable LOW Voltage | $V_{IN}$=2.5V to $V_{OVLO}$ | | | 0.5 | V |
| $I_{ACOK\_LEAK}$ | #ACOK Leakage Current | $V_{ACOK}$=3V, #ACOK Deasserted | -0.5 | | 0.5 | μA |
| #EN_Leak | #EN Leakage Current | $V_{IN}$=5.0V, $V_{OUT}$=Float | -1.0 | | 1.0 | μA |
| **Timing Characteristics** | | | | | | |
| $t_{DEB}$ | Debounce Time | Time from 2.5V<$V_{IN}$<$V_{IN\_OVLO}$ to $V_{OUT}$=0.1 x $V_{IN}$ | | 15 | | ms |
| $t_{START}$ | Soft-Start Time | Time from $V_{IN}$=$V_{IN\_min}$ to 0.2 x #ACOK, $V_{IO}$=1.8V with 10kΩ Pull-up Resistor | | 30 | | ms |
| $t_{ON}$ | Switch Turn-On Time | $R_L$=100Ω, $C_L$=22μF, $V_{OUT}$ from 0.1 x $V_{IN}$ to 0.9 x $V_{IN}$ | | 2 | | ms |
| $t_{OFF}$ | Switch Turn-Off Time | $R_L$=100Ω, $C_L$=0μF, $V_{IN}$>$V_{OVLO}$ to $V_{OUT}$=0.8 x $V_{IN}$ | | 125 | | ns |

Specifications subject to change without notice.

## Timing Diagrams:

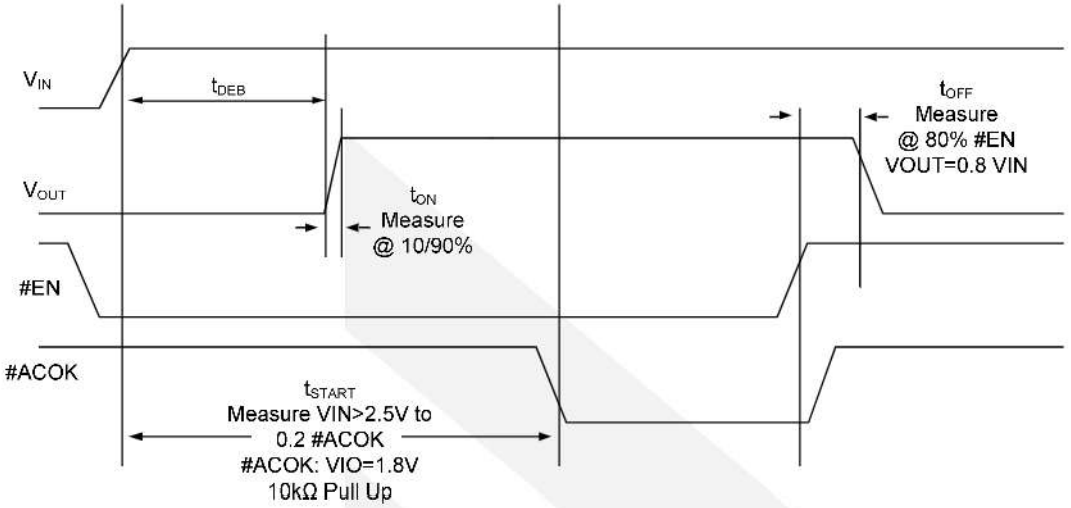



**Figure 3 Timing for Power Up and Normal Operation**

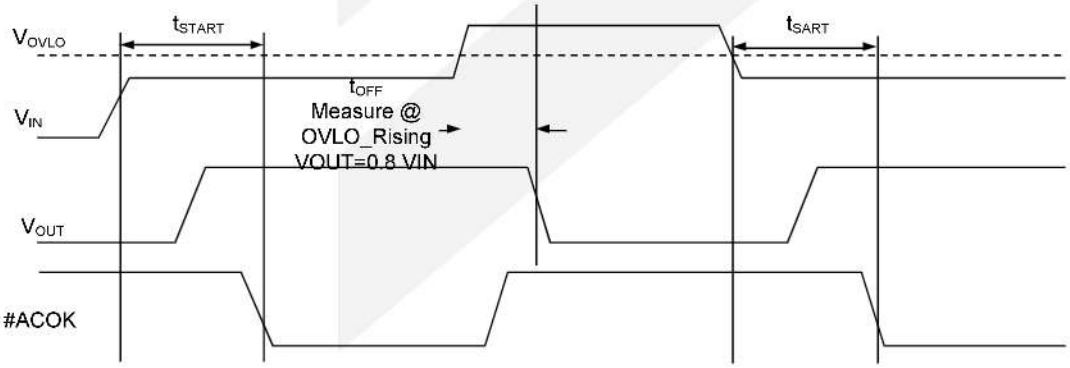
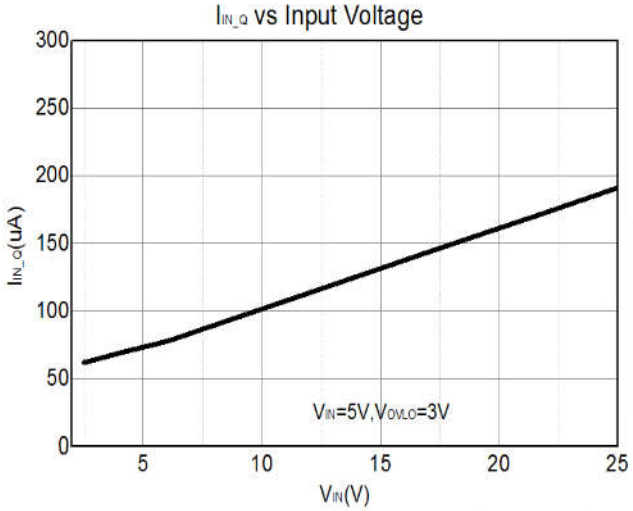



**Figure 4 Timing for OVLO Trip**

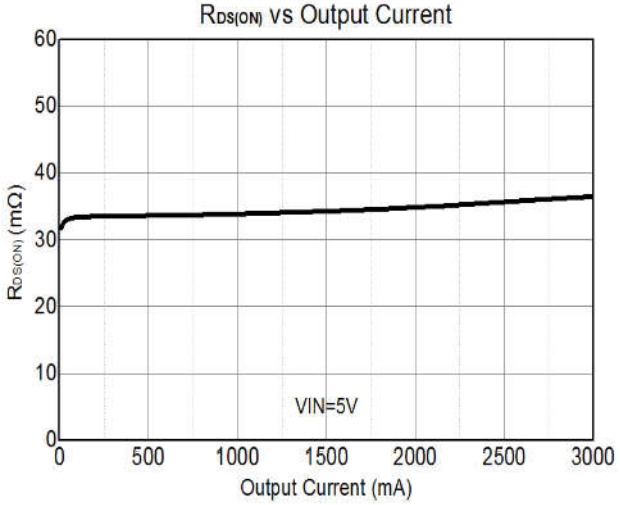
## Typical Performance Characteristics

Ambient temperature is 25°C, $V_{IN}$=5V, $I_{IN}$≤3A, $C_{IN}$ =1uF, $C_{OUT}$ =1μF, unless otherwise noted.

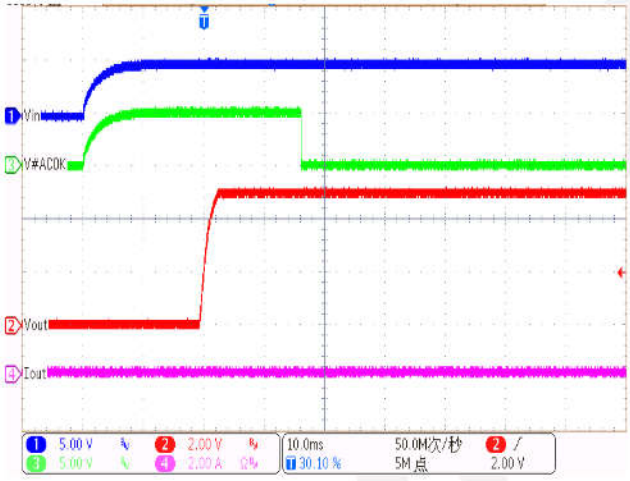
$I_{IN\_Q}$ vs Input Voltage



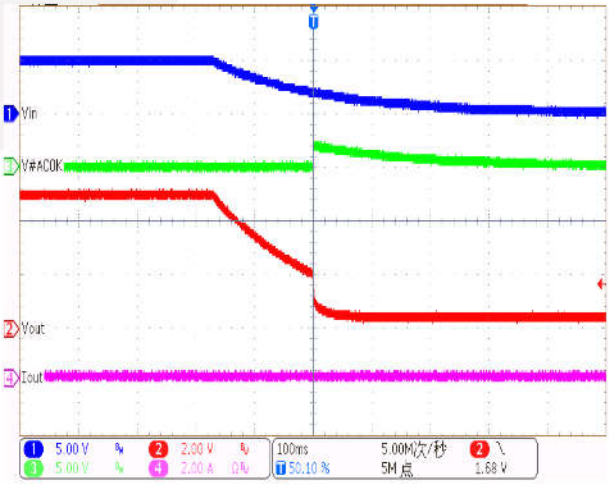

$R_{DS(ON)}$ vs Output Current



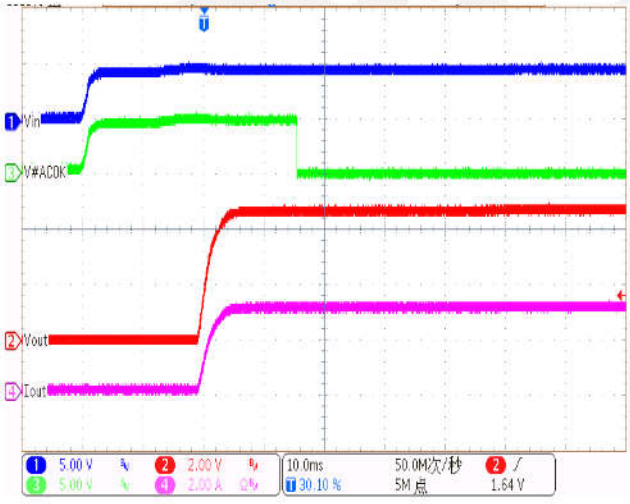

VIN Power ON ($V_{IN}$=5V, No Load)



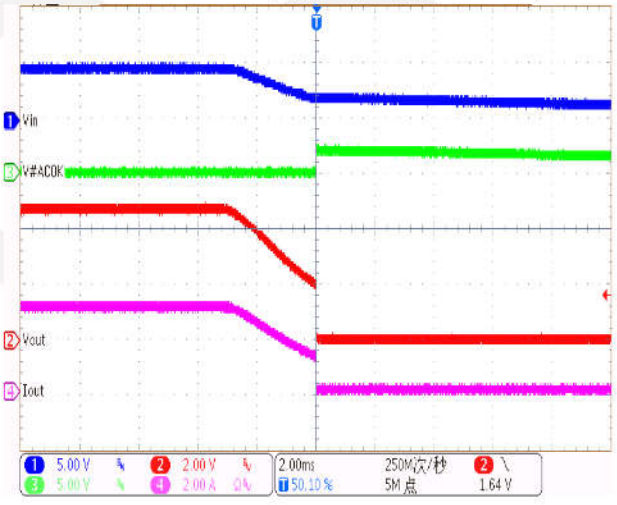

VIN Power OFF ($V_{IN}$=5V, No Load)



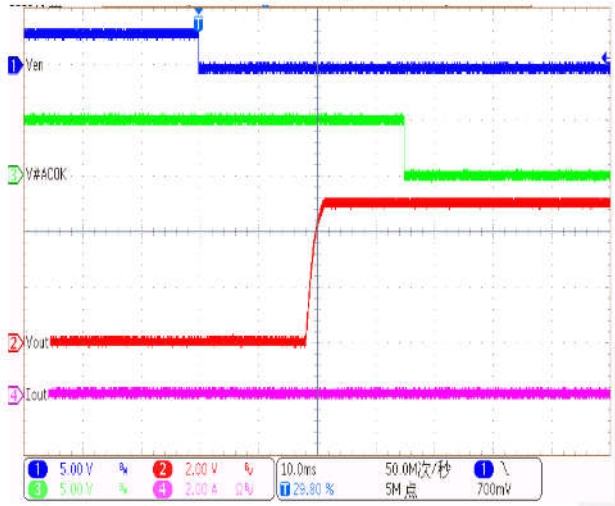

VIN Power ON ($V_{IN}$=5V, $R_{Load}$=1.6ohm)



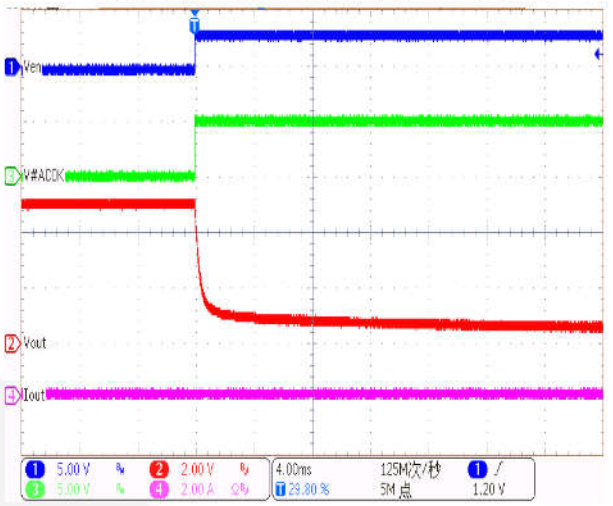

VIN Power OFF ($V_{IN}$=5V, $R_{Load}$=1.6ohm)



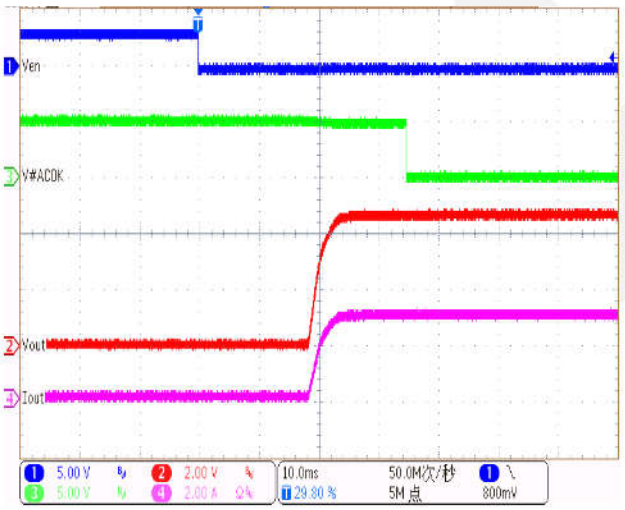
EN Power ON ($V_{IN}$=5V, No Load)



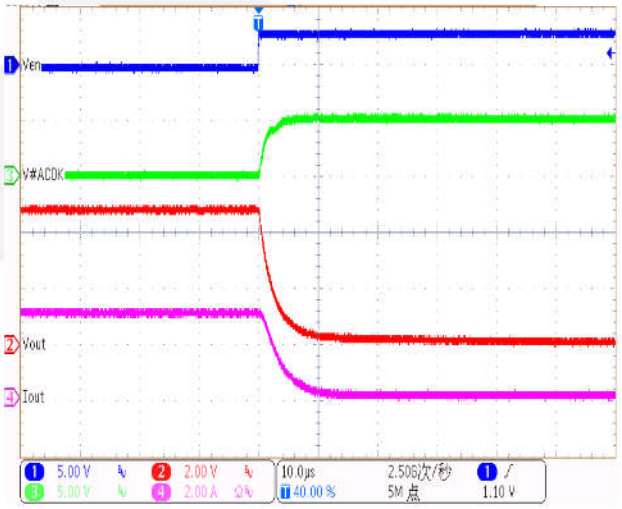

EN Power OFF ($V_{IN}$=5V, No Load)




EN Power ON ($V_{IN}$=5V, $R_{Load}$=1.6ohm)




EN Power OFF ($V_{IN}$=5V, $R_{Load}$=1.6ohm)




## Over-Voltage Lockout (OVLO) Calculation:

OVLO can be set externally and override default OVP. By connecting an external resistor-driver to the OVLO pin. Equation (1) can produce the desired trip voltage and resistor values.

$$V_{IN\_OVLO} = V_{OVLO\_TH} \cdot \left[1 + R1 / R2\right] \qquad (1)$$

Recommended minimum R1=820kΩ.

## CONTACT US

Dioo is a professional design and sales corporation for high-quality and performance analog semiconductors. The company focuses on industry markets, such as, cell phone, handheld products, laptop, and medical equipment and so on. Dioo's product families include analog signal processing and amplifying, LED drivers and charger IC. Go to http://www.dioo.com for a complete list of Dioo product families.

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