

## TPS22998 5.5V、10A、オン抵抗 4mΩ、ロード・スイッチ

### 1 特長

- 動作入力電圧範囲 ( $V_{IN}$ ): 0.2V~5.5V
- バイアス電圧範囲: 2.2V~5.5V
- 最大連続電流: 10A
- オン抵抗 ( $R_{ON}$ ): 4mΩ (標準値)
- トライステート・ピンによりスルー・レートを調整可能
- クイック出力放電 (QOD): 50Ω
- サーマル・シャットダウン
- 低い消費電力:
  - オン状態 ( $I_Q$ ): 15μA (標準値)
  - オフ状態 ( $I_{SD}$ ): 3μA (標準値)

### 2 アプリケーション

- ソリッド・ステート・ドライブ (SSD)
- PC とノート PC
- 産業用 PC
- 光学モジュール

### 3 概要

TPS22998 は、シングル・チャンネルのロード・スイッチで、立ち上がり時間を設定して突入電流を最小化できます。このデバイスは、0.2V~5.5V の入力電圧範囲で動作できる N チャンネル MOSFET を内蔵し、最大 10A の連続電流をサポートします。

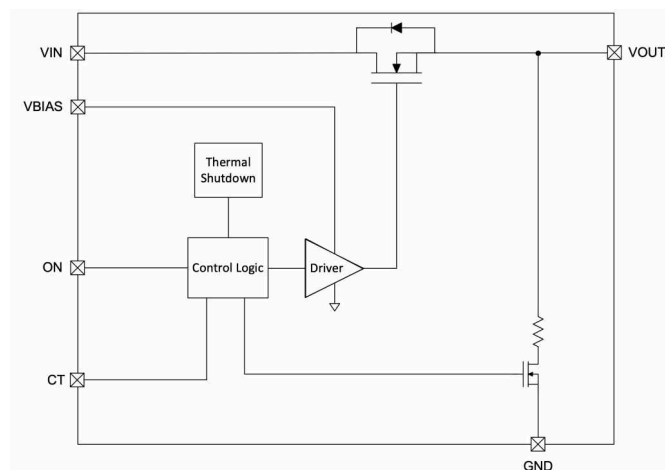
スイッチは、オン・オフ入力 (ON) で制御されます。この入力ピンは、低電圧の制御信号 ( $V_{IH} = 0.9V$ ) と直接接続できます。TPS22998 は、スイッチがオフになるときに働く固定のクイック出力放電を備えており、出力をグラウンドにプルダウンします。

TPS22998 は、1.5 × 2.0mm、0.5mm ピッチの 10 ピン WQFN パッケージ (RYZ) で供給され、-40°C~+105°C の周囲温度範囲で動作するように設計されています。

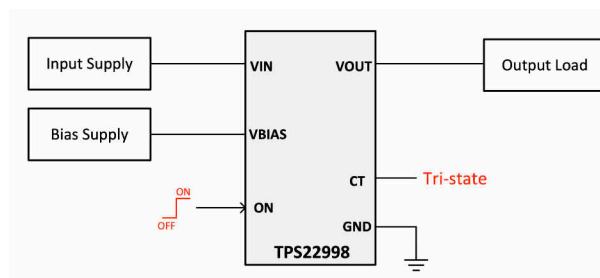
#### 製品情報

部品番号	パッケージ <sup>(1)</sup>	本体サイズ (公称)
TPS22998	WQFN (10)	1.5 × 2.0mm

- (1) 利用可能なすべてのパッケージについては、このデータシートの末尾にある注文情報を参照してください。



TPS22998 のブロック図



TPS22998 の代表的なアプリケーション



## Table of Contents

<b>1 特長</b> .....	1	7.2 Functional Block Diagram.....	11
<b>2 アプリケーション</b> .....	1	7.3 Feature Description.....	11
<b>3 概要</b> .....	1	7.4 Device Functional Modes.....	12
<b>4 Revision History</b> .....	2	<b>8 Application and Implementation</b> .....	13
<b>5 Pin Configuration and Functions</b> .....	3	8.1 Application Information.....	13
<b>6 Specifications</b> .....	4	8.2 Typical Application.....	13
6.1 Absolute Maximum Ratings.....	4	<b>9 Power Supply Recommendations</b> .....	15
6.2 ESD Ratings.....	4	<b>10 Layout</b> .....	15
6.3 Recommended Operating Conditions.....	4	10.1 Layout Guidelines.....	15
6.4 Thermal Information.....	4	10.2 Layout Example.....	15
6.5 Electrical Characteristics (VBIAS = 5 V).....	5	<b>11 Device and Documentation Support</b> .....	16
6.6 Electrical Characteristics (VBIAS = 3.3 V).....	5	11.1 Receiving Notification of Documentation Updates..	16
6.7 Electrical Characteristics (VBIAS = 2.2 V).....	6	11.2 サポート・リソース.....	16
6.8 Switching Characteristics (VBIAS = 2.2 V to 5 V).....	7	11.3 Trademarks.....	16
6.9 Timing Diagram.....	8	11.4 Electrostatic Discharge Caution.....	16
6.10 Typical Characteristics.....	9	11.5 Glossary.....	16
<b>7 Detailed Description</b> .....	11	<b>12 Mechanical, Packaging, and Orderable Information</b> .....	17
7.1 Overview.....	11		

## 4 Revision History

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

<b>Changes from Revision * (October 2021) to Revision A (December 2021)</b>	<b>Page</b>
• データシートのステータスを「事前情報」から「量産データ」に変更.....	1

## 5 Pin Configuration and Functions

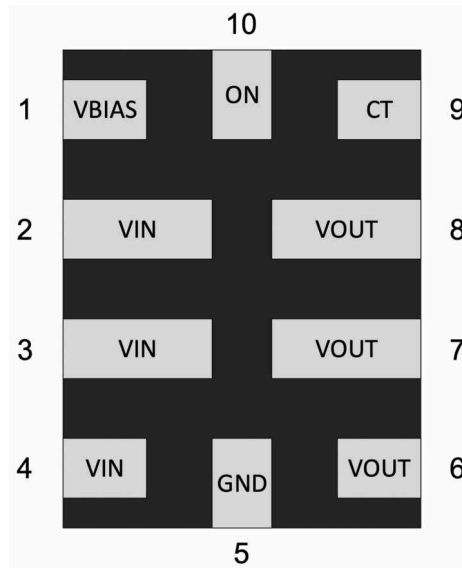


图 5-1. TPS22998 RYZ Package, 10-Pin WQFN (Top View)

表 5-1. Pin Functions

PIN		I/O <sup>(1)</sup>	DESCRIPTION
NAME	NO.		
VBIAS	1	I	Device bias supply
VIN	2, 3, 4	I	Switch input
GND	5	G	Device ground
VOUT	6, 7, 8	O	Switch output
CT	9	I	Slew rate control – can be pulled up, left floating, or tie to ground
ON	10	I	Enable pin

(1) I = Input, O = Output, I/O = Input or Output, G = Ground, P = Power.

## 6 Specifications

### 6.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)<sup>(1)</sup>

		MIN	MAX	UNIT
V <sub>IN</sub>	Input Voltage	−0.3	6	V
V <sub>BIAS</sub>	Bias Voltage	−0.3	6	V
V <sub>ON, VCT</sub>	Control Pin Voltage	−0.3	6	V
I <sub>MAX</sub>	Maximum Current		10	A
T <sub>J</sub>	Junction temperature		Internally Limited	°C
T <sub>stg</sub>	Storage temperature	−65	150	°C

- (1) Operation outside the Absolute Maximum Ratings may cause permanent device damage. Absolute Maximum Ratings do not imply functional operation of the device at these or any other conditions beyond those listed under Recommended Operating Conditions. If used outside the Recommended Operating Conditions but within the Absolute Maximum Ratings, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

### 6.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/ JEDEC JS-001 <sup>(1)</sup>	±2000	V
		Charged device model (CDM), per ANSI/ESDA/ JEDEC JS-002 <sup>(2)</sup>	±1000	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.  
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V <sub>IN</sub>	Input Voltage	0.2		5.5	V
V <sub>BIAS</sub>	Bias Voltage	2.2		5.5	V
V <sub>CT</sub>	Control Pin Voltage	0		5.5	V
T <sub>A</sub>	Ambient Temperature	−40		105	°C

### 6.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		TPS22998	UNIT
		RYZ (WQFN)	
		10 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	84.1	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	77.5	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	16.6	°C/W
Ψ <sub>JT</sub>	Junction-to-top characterization parameter	4.0	°C/W
Y <sub>JB</sub>	Junction-to-board characterization parameter	16.0	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 6.5 Electrical Characteristics (VBIAS = 5 V)

Over operating free-air temperature range (unless otherwise noted). Typical values are at  $T_A = 25^\circ\text{C}$ .

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
<b>Power Consumption</b>							
$I_{SD,VBIAS}$	VBIAS Shutdown Current	ON = 0 V	25°C	3			µA
			-40°C to 85°C			5	µA
			-40°C to 105°C			6	µA
$I_{Q,VBIAS}$	VBIAS Quiescent Current	ON > $V_{IH}$	25°C	15			µA
			-40°C to 85°C			20	µA
			-40°C to 105°C			20	µA
$I_{SD,VIN}$	VIN Shutdown Current	ON = 0 V	25°C	0.1			µA
			-40°C to 85°C			1	µA
			-40°C to 105°C			2	µA
$I_{ON}$	ON pin leakage	ON = VBIAS	-40°C to 105°C	0.1			µA
<b>Performance</b>							
$R_{ON}$	On-Resistance	VIN = 0.2 V to 5 V	25°C	4			mΩ
			-40°C to 85°C			6	mΩ
			-40°C to 105°C			7	mΩ
$V_{IH}$	Turn on threshold, rising		-40°C to 105°C	0.765	0.9	1.035	V
$V_{IL}$	Turn off threshold, falling		-40°C to 105°C	0.595	0.7	0.805	V
$V_{ON,HYST}$	ON pin hysteresis		-40°C to 105°C	0.2			V
$t_{ON,DEGLITCH}$	On pin deglitch time		-40°C to 105°C	2	5	7	µs
$R_{QOD}$	QOD Resistance	VOUT = VIN	25°C	50			Ω
			-40°C to 105°C	40	60		Ω
<b>Protection</b>							
TSD	Thermal Shutdown		-	130	150	180	°C
TSD <sub>HYS</sub>	Thermal Shutdown Hysteresis		-	20			°C

## 6.6 Electrical Characteristics (VBIAS = 3.3 V)

Over operating free-air temperature range (unless otherwise noted). Typical values are at  $T_A = 25^\circ\text{C}$ .

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
<b>Power Consumption</b>							
$I_{SD,VBIAS}$	VBIAS Shutdown Current	ON = 0 V	25°C	3			µA
			-40°C to 85°C			5	µA
			-40°C to 105°C			5	µA
$I_{Q,VBIAS}$	VBIAS Quiescent Current	ON > $V_{IH}$	25°C	15			µA
			-40°C to 85°C			20	µA
			-40°C to 105°C			20	µA
$I_{SD,VIN}$	VIN Shutdown Current	ON = 0 V	25°C	0.1			µA
			-40°C to 85°C			1	µA
			-40°C to 105°C			3	µA
$I_{ON}$	ON pin leakage	ON = VBIAS	-40°C to 105°C	0.1		1	µA
<b>Performance</b>							

## 6.6 Electrical Characteristics (VBIAS = 3.3 V) (continued)

Over operating free-air temperature range (unless otherwise noted). Typical values are at  $T_A = 25^\circ\text{C}$ .

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
$R_{ON}$	On-Resistance	$V_{IN} = 0.2\text{ V to }3.3\text{ V}$	$25^\circ\text{C}$	4			m $\Omega$
			$-40^\circ\text{C to }85^\circ\text{C}$	7			m $\Omega$
			$-40^\circ\text{C to }105^\circ\text{C}$	7			m $\Omega$
$V_{IH}$	ON pin turn on threshold, rising		$-40^\circ\text{C to }105^\circ\text{C}$	0.765	0.9	1.035	V
$V_{IL}$	ON pin turn off threshold, falling		$-40^\circ\text{C to }105^\circ\text{C}$	0.595	0.7	0.805	V
$V_{ON, HYST}$	ON pin hysteresis		$-40^\circ\text{C to }105^\circ\text{C}$	0.2			V
$t_{ON, DEGLITCH}$	On pin deglitch time		$-40^\circ\text{C to }105^\circ\text{C}$	2	5	6.5	us
$R_{QOD}$	QOD Resistance	$V_{OUT} = V_{IN}$	$25^\circ\text{C}$	50			$\Omega$
			$-40^\circ\text{C to }105^\circ\text{C}$	40	60		$\Omega$
<b>Protection</b>							
TSD	Thermal Shutdown		-	130	150	180	$^\circ\text{C}$
TSD <sub>HYS</sub>	Thermal Shutdown Hysteresis		-	20			$^\circ\text{C}$

## 6.7 Electrical Characteristics (VBIAS = 2.2 V)

Over operating free-air temperature range (unless otherwise noted). Typical values are at  $T_A = 25^\circ\text{C}$ .

PARAMETER		TEST CONDITIONS	$T_A$	MIN	TYP	MAX	UNIT
<b>Power Consumption</b>							
$I_{SD, VBIAS}$	VBIAS Shutdown Current	$ON = 0\text{ V}$	$25^\circ\text{C}$	3			$\mu\text{A}$
			$-40^\circ\text{C to }85^\circ\text{C}$	5			$\mu\text{A}$
			$-40^\circ\text{C to }105^\circ\text{C}$	5			$\mu\text{A}$
$I_{Q, VBIAS}$	VBIAS Quiescent Current	$ON > V_{IH}$	$25^\circ\text{C}$	15			$\mu\text{A}$
			$-40^\circ\text{C to }85^\circ\text{C}$	20			$\mu\text{A}$
			$-40^\circ\text{C to }105^\circ\text{C}$	20			$\mu\text{A}$
$I_{SD, VIN}$	VIN Shutdown Current	$ON = 0\text{ V}$	$25^\circ\text{C}$	0.1			$\mu\text{A}$
			$-40^\circ\text{C to }85^\circ\text{C}$	1			$\mu\text{A}$
			$-40^\circ\text{C to }105^\circ\text{C}$	3			$\mu\text{A}$
$I_{ON}$	ON pin leakage	$ON = V_{BIAS}$	$-40^\circ\text{C to }105^\circ\text{C}$	0.1		1	$\mu\text{A}$
<b>Performance</b>							
$R_{ON}$	On-Resistance	$V_{IN} = 0.2\text{ V to }2.2\text{ V}$	$25^\circ\text{C}$	4.3			m $\Omega$
			$-40^\circ\text{C to }85^\circ\text{C}$	7			m $\Omega$
			$-40^\circ\text{C to }105^\circ\text{C}$	7			m $\Omega$
$V_{IH}$	ON pin turn on threshold, rising		$-40^\circ\text{C to }105^\circ\text{C}$	0.765	0.9	1.035	V
$V_{IL}$	ON pin turn off threshold, falling		$-40^\circ\text{C to }105^\circ\text{C}$	0.595	0.7	0.805	V
$V_{ON, HYST}$	ON pin hysteresis		$-40^\circ\text{C to }105^\circ\text{C}$	0.2			V
$t_{ON, DEGLITCH}$	On pin deglitch time		$-40^\circ\text{C to }105^\circ\text{C}$	2	4.5	6.5	us
$R_{QOD}$	QOD Resistance	$V_{OUT} = V_{IN}$	$25^\circ\text{C}$	50			$\Omega$
			$-40^\circ\text{C to }105^\circ\text{C}$	40	60		$\Omega$
<b>Protection</b>							
TSD	Thermal Shutdown		-	130	150	180	$^\circ\text{C}$
TSD <sub>HYS</sub>	Thermal Shutdown Hysteresis		-	20			$^\circ\text{C}$

## 6.8 Switching Characteristics (VBIAS = 2.2 V to 5 V)

Over operating free-air temperature range (unless otherwise noted), C<sub>IN</sub>=47uF. Typical values are at T<sub>A</sub> = 25°C, C<sub>L</sub> = 0.1μF, and a current load of 1mA.

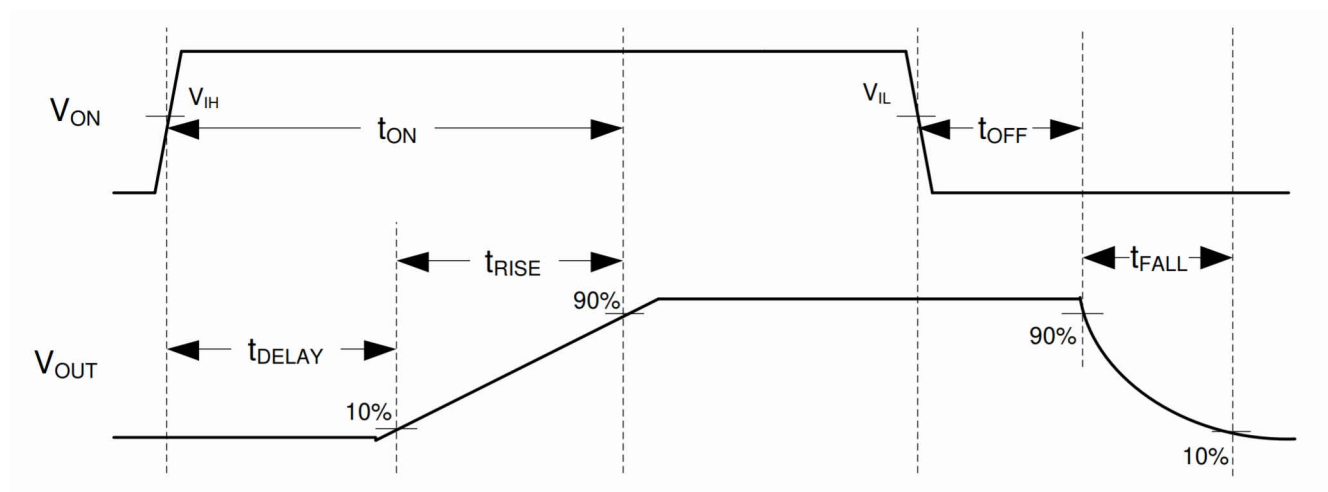
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>VIN = 5 V</b>						
t <sub>ON</sub>	Turn ON time	CT = Open		250		us
t <sub>ON</sub>	Turn ON time	CT = V <sub>BIAS</sub>		1870		us
t <sub>ON</sub>	Turn ON time	CT = GND		3728		us
t <sub>RISE</sub>	Rise time	CT = Open		225		us
t <sub>RISE</sub>	Rise time	CT = V <sub>BIAS</sub>		1838		us
t <sub>RISE</sub>	Rise time	CT = GND		3697		us
t <sub>D</sub>	Delay time	CT = Open		26		us
t <sub>D</sub>	Delay time	CT = V <sub>BIAS</sub>		31		us
t <sub>D</sub>	Delay time	CT = GND		31		us
t <sub>FALL</sub>	Fall time	CT = Open		11		us
t <sub>OFF</sub>	Turn OFF time	CT = Open		3		us
<b>VIN = 3.3 V</b>						
t <sub>ON</sub>	Turn ON time	CT = Open		175		us
t <sub>ON</sub>	Turn ON time	CT = V <sub>BIAS</sub>		1261		us
t <sub>ON</sub>	Turn ON time	CT = GND		3586		us
t <sub>RISE</sub>	Rise time	CT = Open		150		us
t <sub>RISE</sub>	Rise time	CT = V <sub>BIAS</sub>		1232		us
t <sub>RISE</sub>	Rise time	CT = GND		2478		us
t <sub>D</sub>	Delay time	CT = Open		26		us
t <sub>D</sub>	Delay time	CT = V <sub>BIAS</sub>		29		us
t <sub>D</sub>	Delay time	CT = GND		29		us
t <sub>FALL</sub>	Fall time	CT = Open		11		us
t <sub>OFF</sub>	Turn OFF time	CT = Open		3		us
<b>VIN = 1.8 V</b>						
t <sub>ON</sub>	Turn ON time	CT = Open		102		us
t <sub>ON</sub>	Turn ON time	CT = V <sub>BIAS</sub>		664		us
t <sub>ON</sub>	Turn ON time	CT = GND		1302		us
t <sub>RISE</sub>	Rise time	CT = Open		75		us
t <sub>RISE</sub>	Rise time	CT = V <sub>BIAS</sub>		634		us
t <sub>RISE</sub>	Rise time	CT = GND		1272		us
t <sub>D</sub>	Delay time	CT = Open		27		us
t <sub>D</sub>	Delay time	CT = V <sub>BIAS</sub>		29		us
t <sub>D</sub>	Delay time	CT = GND		30		us
t <sub>FALL</sub>	Fall time	CT = Open		11		us
t <sub>OFF</sub>	Turn OFF time	CT = Open		3		us
<b>VIN = 0.6 V</b>						
t <sub>ON</sub>	Turn ON time	CT = Open		51		us
t <sub>ON</sub>	Turn ON time	CT = V <sub>BIAS</sub>		213		us
t <sub>ON</sub>	Turn ON time	CT = GND		393		us
t <sub>RISE</sub>	Rise time	CT = Open		23		us
t <sub>RISE</sub>	Rise time	CT = V <sub>BIAS</sub>		183		us
t <sub>RISE</sub>	Rise time	CT = GND		365		us

## 6.8 Switching Characteristics (VBIAS = 2.2 V to 5 V) (continued)

Over operating free-air temperature range (unless otherwise noted), C<sub>IN</sub>=47uF. Typical values are at T<sub>A</sub> = 25°C, C<sub>L</sub> = 0.1μF, and a current load of 1mA.

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t <sub>D</sub>	Delay time	CT = Open		27		us
t <sub>D</sub>	Delay time	CT = V <sub>BIAS</sub>		29		us
t <sub>D</sub>	Delay time	CT = GND		29		us
t <sub>FALL</sub>	Fall time	CT = Open		10		us
t <sub>OFF</sub>	Turn OFF time	CT = Open		4		us
<b>VIN = 0.285 V</b>						
t <sub>ON</sub>	Turn ON time	CT = Open		37		us
t <sub>ON</sub>	Turn ON time	CT = V <sub>BIAS</sub>		96		us
t <sub>ON</sub>	Turn ON time	CT = GND		158		us
t <sub>RISE</sub>	Rise time	CT = Open		11		us
t <sub>RISE</sub>	Rise time	CT = V <sub>BIAS</sub>		66		us
t <sub>RISE</sub>	Rise time	CT = GND		128		us
t <sub>D</sub>	Delay time	CT = Open		27		us
t <sub>D</sub>	Delay time	CT = V <sub>BIAS</sub>		29		us
t <sub>D</sub>	Delay time	CT = GND		30		us
t <sub>FALL</sub>	Fall time	CT = Open		9		us
t <sub>OFF</sub>	Turn OFF time	CT = Open		4		us

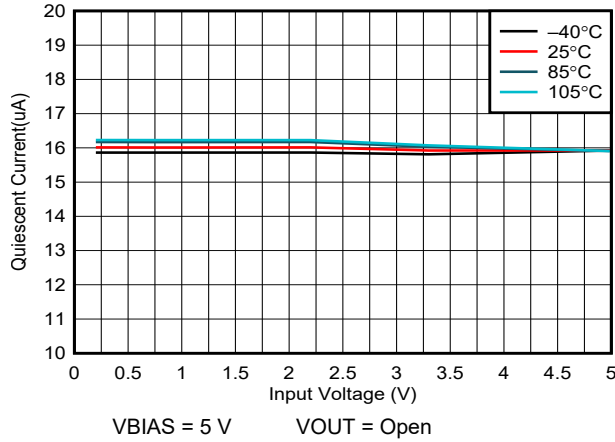
## 6.9 Timing Diagram



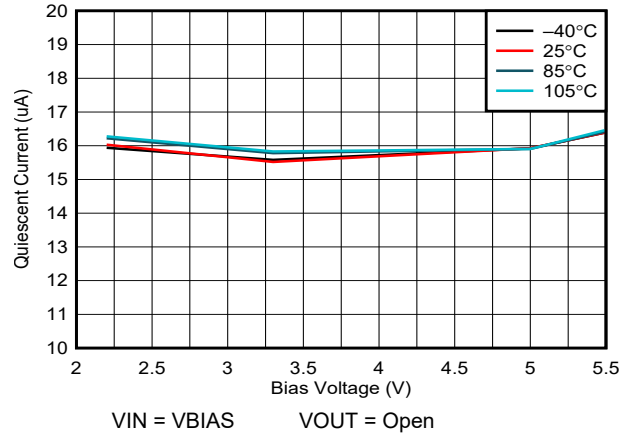
⊗ 6-1. TPS22998 Timing Diagram



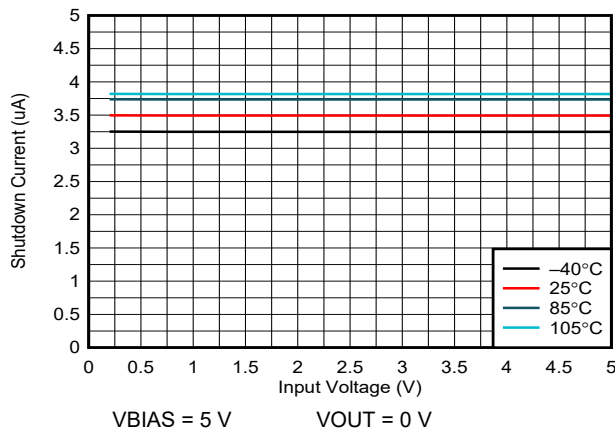
## 6.10 Typical Characteristics



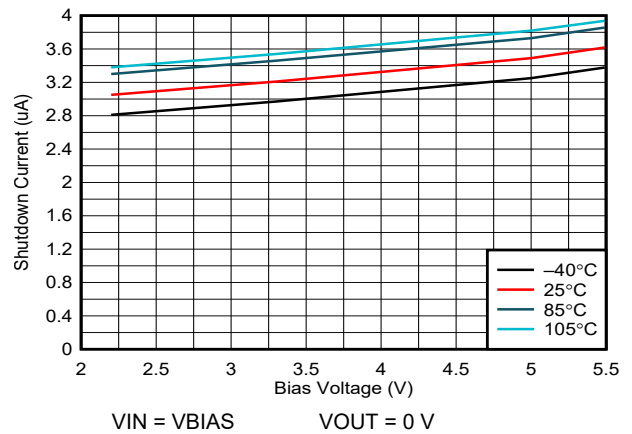
6-2. Quiescent Current vs Input Voltage



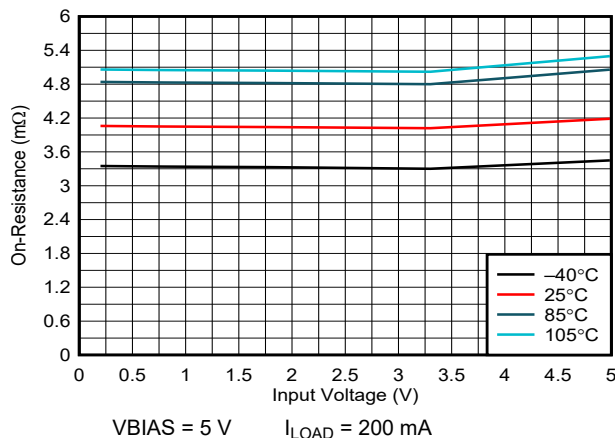
6-3. Quiescent Current vs Bias Voltage



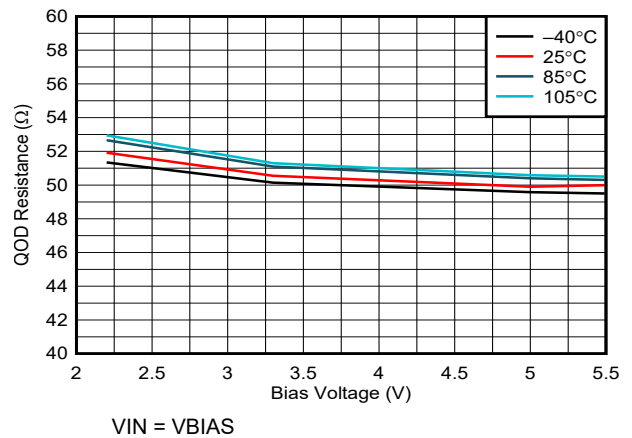
6-4. VBIAS Shutdown Current vs Input Voltage



6-5. VBIAS Shutdown Current vs Bias Voltage

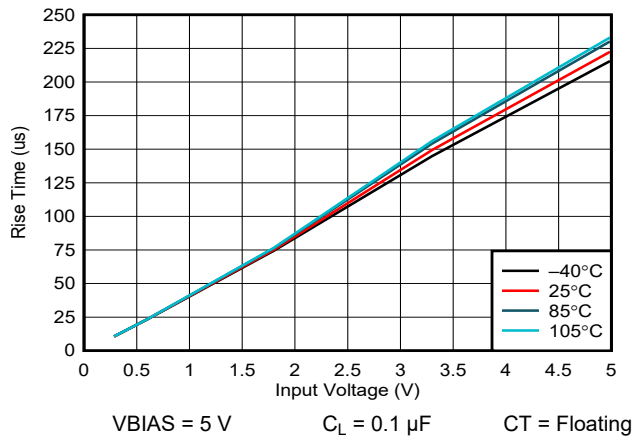


6-6. On-Resistance vs Input Voltage

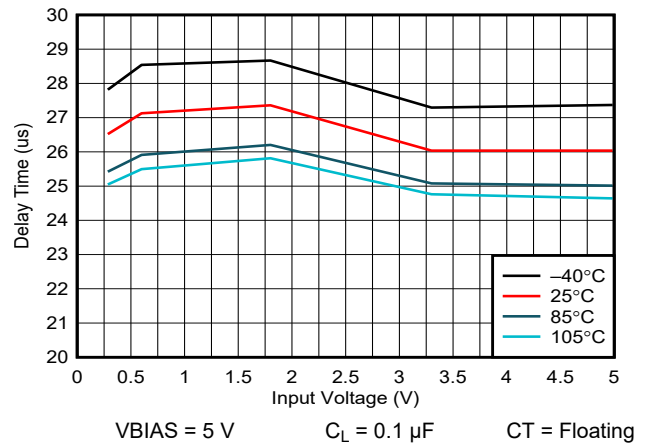


6-7. QOD Resistance vs Bias Voltage

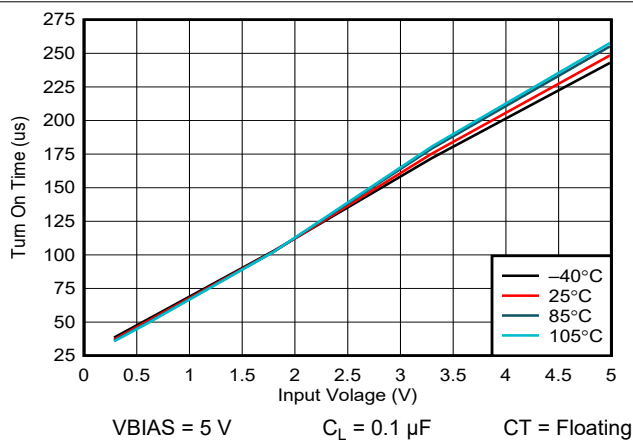
### 6.10 Typical Characteristics (continued)



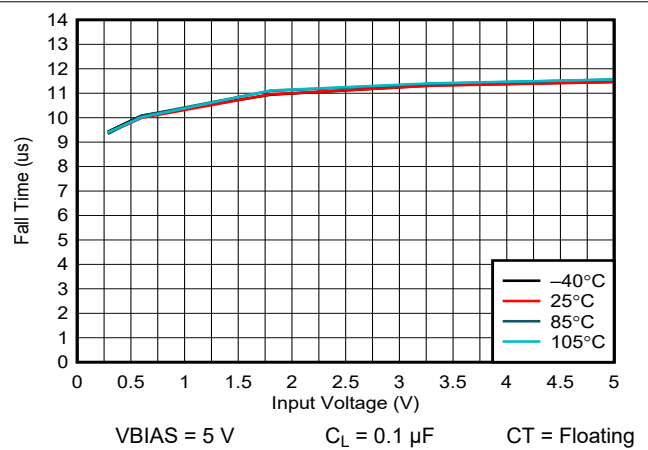
6-8. Rise Time vs Input Voltage



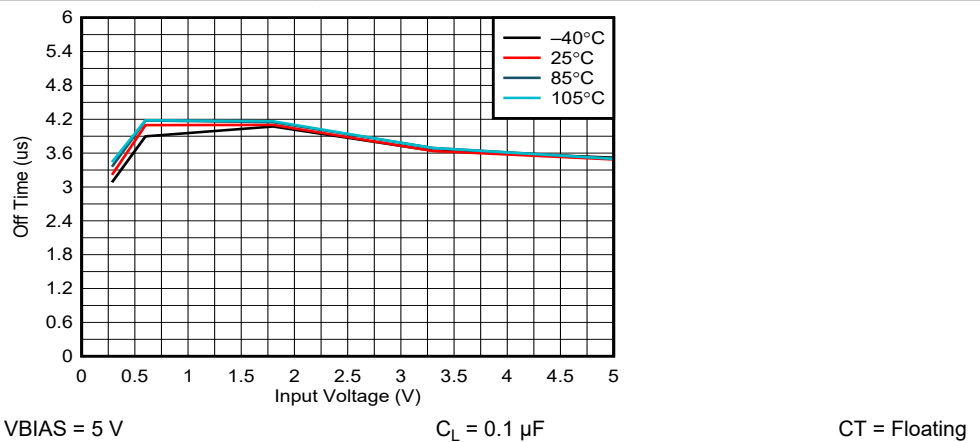
6-9. Delay Time vs Input Voltage



6-10. Turn-On Time vs Input Voltage



6-11. Fall Time vs Input Voltage



6-12. Off Time vs Input Voltage

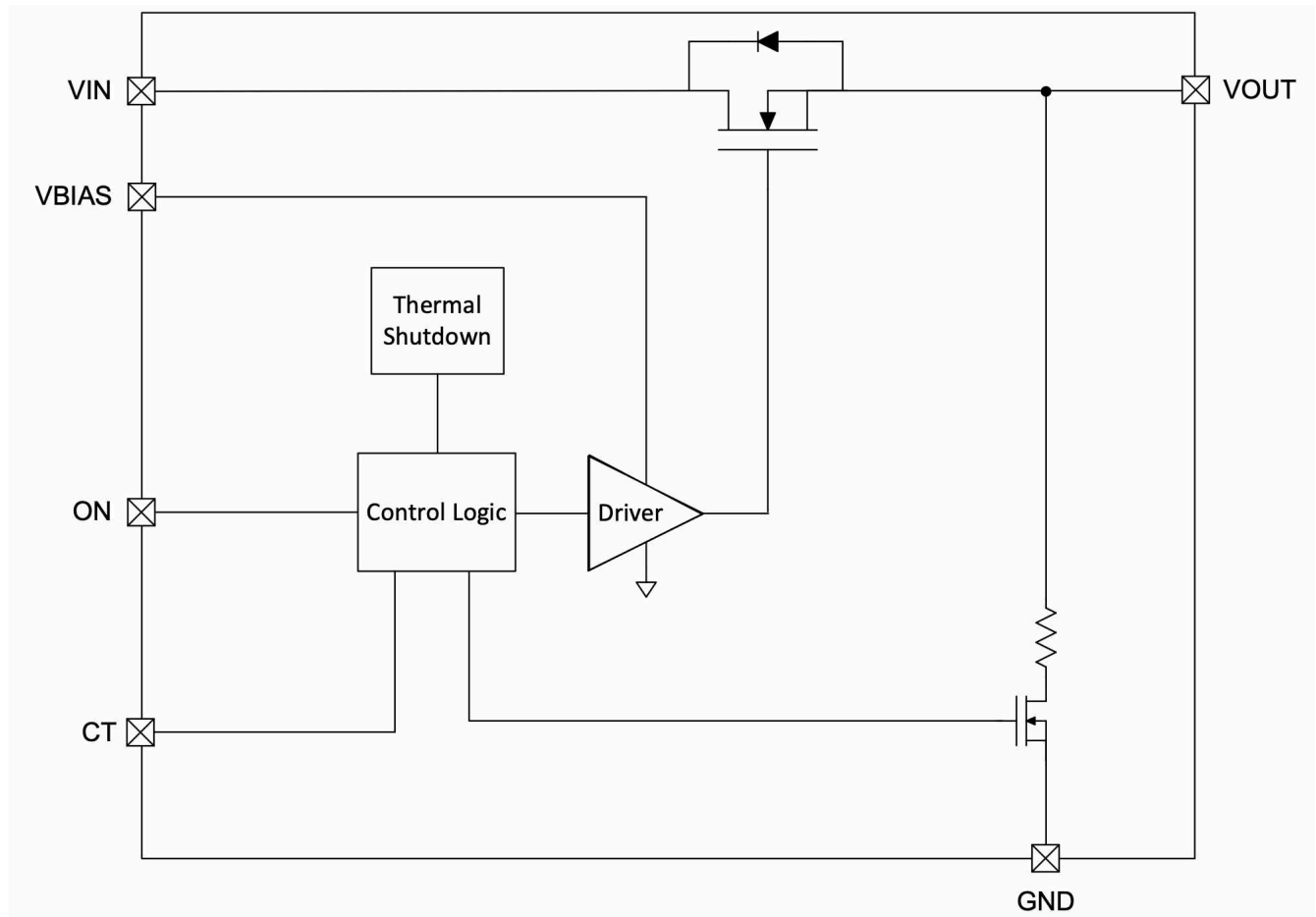
## 7 Detailed Description

### 7.1 Overview

The TPS22998 device is a single-channel load switch with a 4-m $\Omega$  power MOSFET designed to operate up to 10 A. The voltage range is 0.2 V to 5.5 V. A configurable rise time provides flexibility for power sequencing and minimizes inrush current for high capacitance loads.

An enable pin (ON) controls the switch, which is capable of interfacing directly with low voltage GPIO signals. The TPS22998 device uses quick output discharge when switch turns off, pulling the output down to 0 V through an internal 50- $\Omega$  resistor.

### 7.2 Functional Block Diagram



### 7.3 Feature Description

#### 7.3.1 ON and OFF Control

The ON pin controls the state of the switch. The ON pin is compatible with standard GPIO logic threshold so it can be used in a wide variety of applications. When the pin pull high, the device enables, and when it is low, the device disables.

#### 7.3.2 Adjustable Slew Rate

The CT pin is a tri-state pin, meaning that it has three different slew rates depending on the connection to the pin. The CT pin can be grounded, pulled high, or left floating. Floating defines as an effective resistance to GND or other pins greater than 10 M $\Omega$ .

### 7.3.3 Thermal Shutdown

When the device temperature reaches 150°C (typical), the device shuts itself off to prevent thermal damage. After it cools off by about 20°C, the device turns back on. If the device is kept in a thermally stressful environment, then the device oscillates between these two states until it can keep its temperature below the thermal shutdown point.

### 7.4 Device Functional Modes

The below table summarizes the device functional modes:

ON	Fault Condition	VOUT State
L	None	QOD to GND
H	None	Connected to VIN
H	Thermal shutdown	QOD to GND

## 8 Application and Implementation

### Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

### 8.1 Application Information

This section highlights some of the design considerations when implementing this device in various applications.

### 8.2 Typical Application

This typical application demonstrates how to use the TPS22998 device to limit startup inrush current.

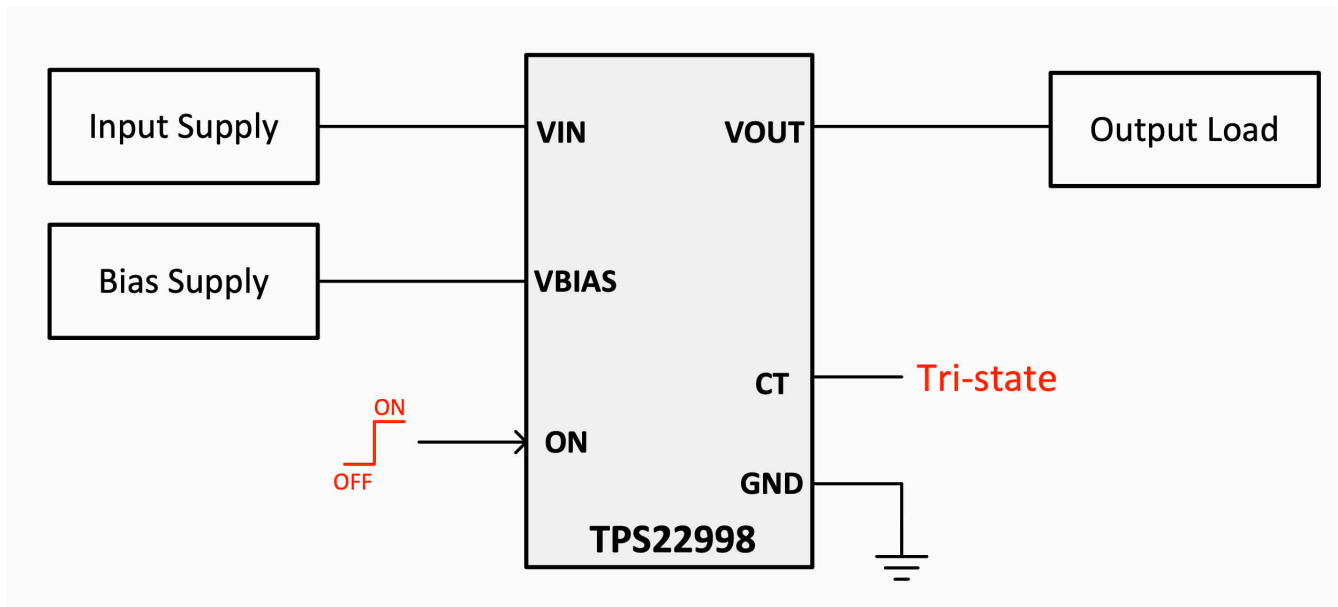


图 8-1. TPS22998 Basic Application

#### 8.2.1 Design Requirements

For this example, the values below are used as the design parameters.

表 8-1. Design Parameters

PARAMETER	VALUE
$V_{BIAS}$	3.3 V
$V_{IN}$	1.8 V
Load capacitance	470 $\mu$ F
Maximum inrush current	1 A

## 8.2.2 Detailed Design Procedure

When the switch enables, the charge up the output capacitance from 0 V to the set value (1.8 V in this example). This charge arrives in the form of inrush current. Calculate inrush current using 式 1.

$$\text{Inrush Current} = C_L \times dV_{\text{OUT}}/dt \quad (1)$$

Where:

- $C_L$  is the output capacitance.
- $dV_{\text{OUT}}$  is the change in  $V_{\text{OUT}}$  during the ramp up of the output voltage when device is enabled. Because rise time is 10% of  $V_{\text{OUT}}$  to 90% of  $V_{\text{OUT}}$ , this is 80% of the  $V_{\text{IN}}$  value.
- $dt$  is the rise time in  $V_{\text{OUT}}$  during the ramp up of the output voltage when the device is enabled.

The TPS22998 offers an adjustable rise time for  $V_{\text{OUT}}$ , allowing the user to control the inrush current during turn on. Calculate the appropriate rise time using the design requirements and the inrush current equation as shown below.

$$1A = 470 \mu\text{F} \times (1.8 \text{ V} \times 80\%) / dt \quad (2)$$

$$dt = 677 \mu\text{s} \quad (3)$$

To ensure an inrush current of less than 1 A, a  $C_T$  setting that yields a rise time of more than 677  $\mu\text{s}$  must be chosen. By pulling the  $C_T$  pin high, a rise time of 900  $\mu\text{s}$  is selected, limiting the inrush current to below 1 A.

## 8.2.3 Application Performance Plots

The below scope shot shows the TPS22998 turning on into a 470- $\mu\text{F}$  load with the  $C_T$  pin tied to  $V_{\text{BIAS}}$ .

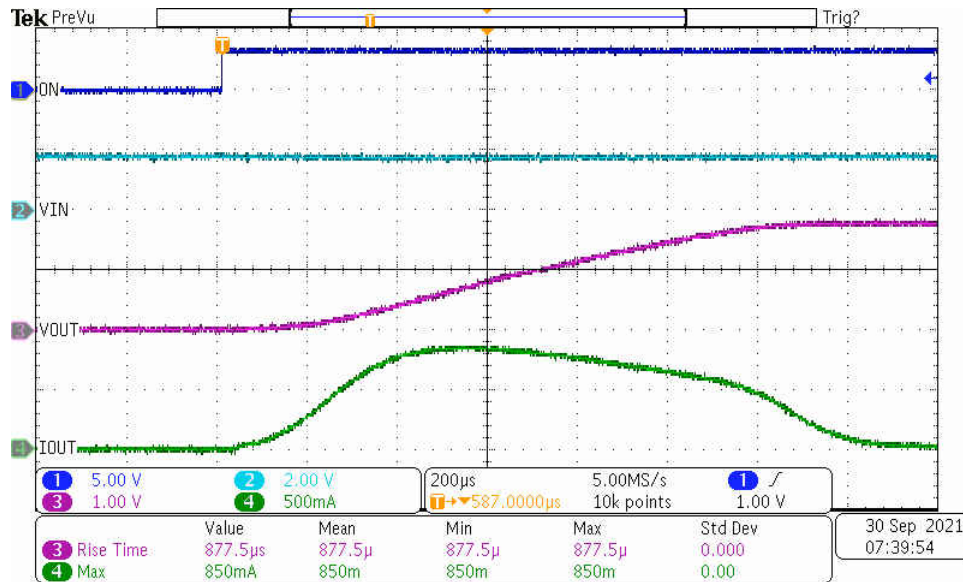


图 8-2. TPS22998 Turn-On into 470  $\mu\text{F}$  ( $C_T = V_{\text{BIAS}}$ )

## 9 Power Supply Recommendations

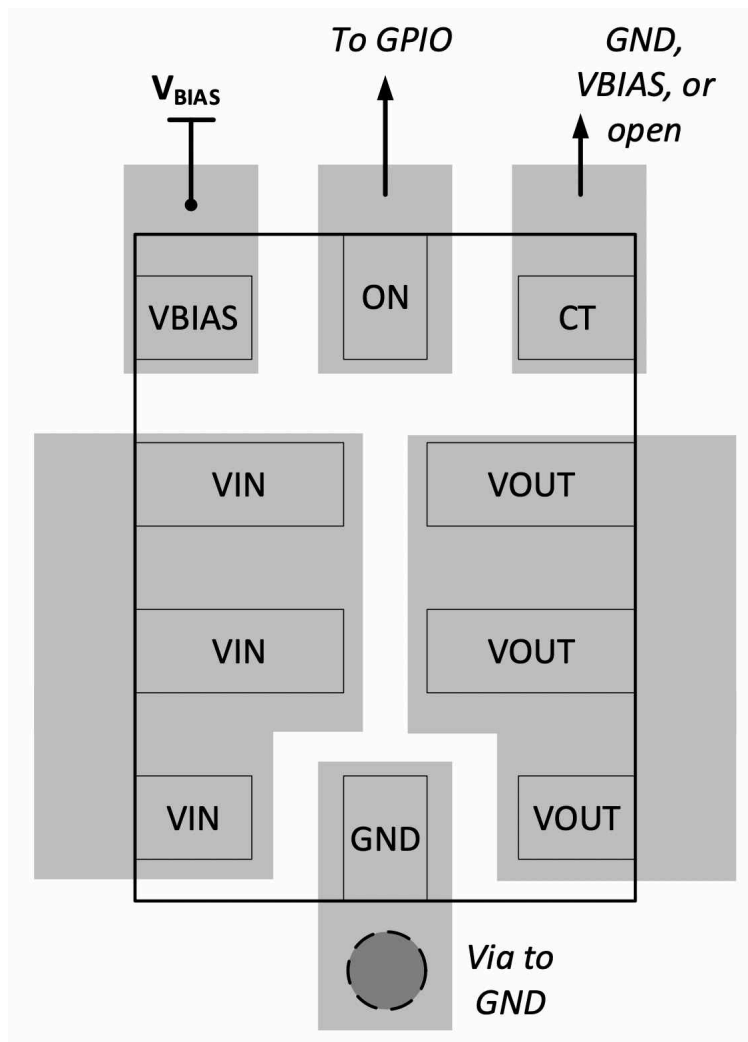
The TPS22998 device is designed to operate with a  $V_{IN}$  range of 0.2 V to 5.5 V. Regulate the  $V_{IN}$  power supply well and place as close to the device terminal as possible. The power supply must be able to withstand all transient load current steps. In most situations, using an input capacitance ( $C_{IN}$ ) of 1  $\mu\text{F}$  is sufficient to prevent the supply voltage from dipping when the switch is turned on. In cases where the power supply is slow to respond to a large transient current or large load current step, additional bulk capacitance can be required on the input.


## 10 Layout

### 10.1 Layout Guidelines

For best performance, all traces must be as short as possible. To be most effective, place the input and output capacitors close to the device to minimize the effects that parasitic trace inductances can have on normal operation. Using wide traces for  $V_{IN}$ ,  $V_{OUT}$ , and GND helps minimize the parasitic electrical effects.

### 10.2 Layout Example




**10-1. TPS22998 Layout Example**

## 11 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

### 11.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.ti.com). Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 11.2 サポート・リソース

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### 11.4 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

### 11.5 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.



## 12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS22998RYZR	ACTIVE	WQFN-HR	RYZ	10	3000	RoHS & Green	SN	Level-2-260C-1 YEAR	-40 to 105	1LF	Samples

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

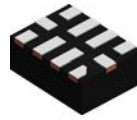
(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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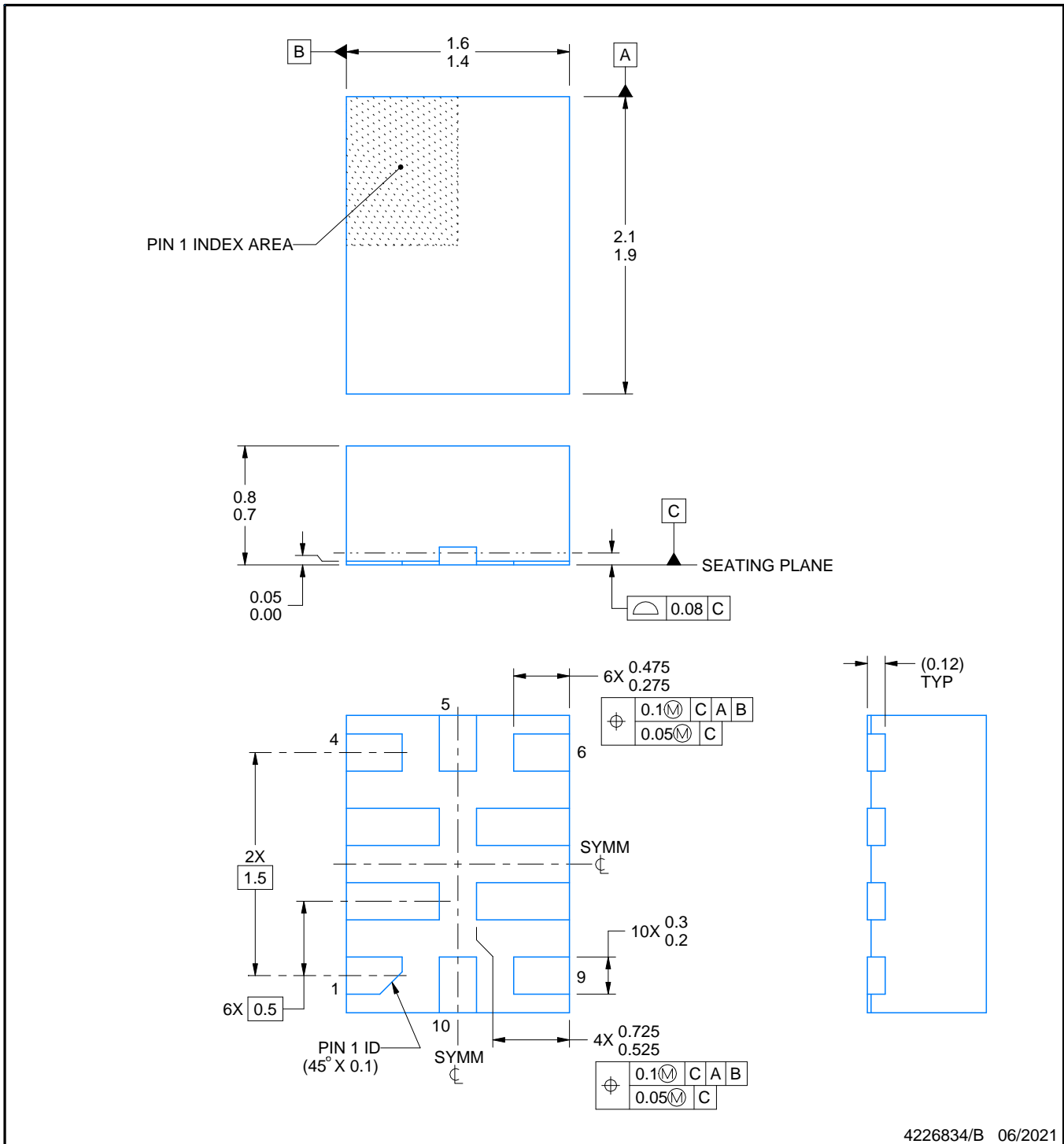
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**RYZ0010A**



**PACKAGE OUTLINE**  
**WQFN-HR - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



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**NOTES:**

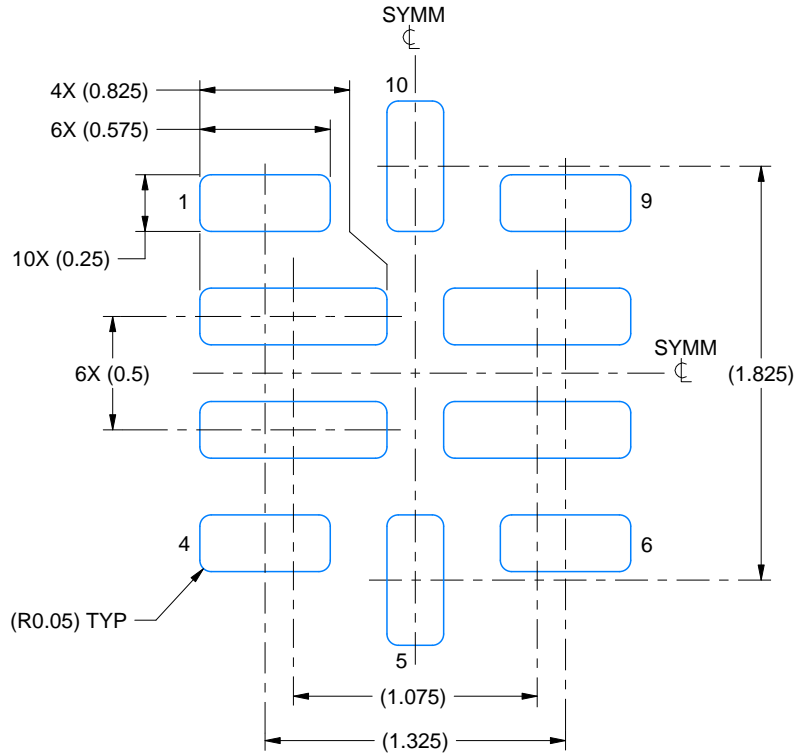
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

# EXAMPLE BOARD LAYOUT

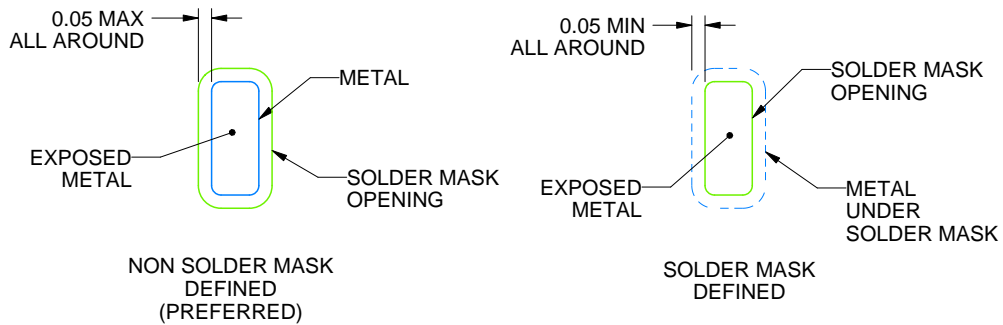
**RYZ0010A**

**WQFN-HR - 0.8 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



**LAND PATTERN EXAMPLE**  
EXPOSED METAL SHOWN  
SCALE:30X



**SOLDER MASK DETAILS**  
NOT TO SCALE

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NOTES: (continued)

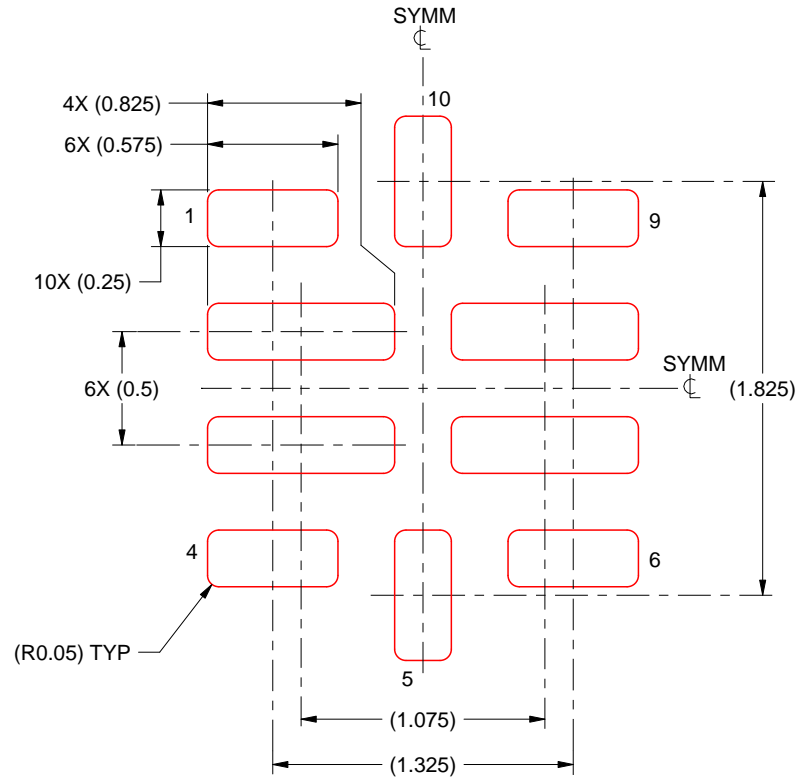
3. For more information, see Texas Instruments literature number SLUA271 ([www.ti.com/lit/slua271](http://www.ti.com/lit/slua271)).

# EXAMPLE STENCIL DESIGN

RYZ0010A

WQFN-HR - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
BASED ON 0.1 mm THICKNESS  
SCALE: 30X

4226834/B 06/2021

NOTES: (continued)

5. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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