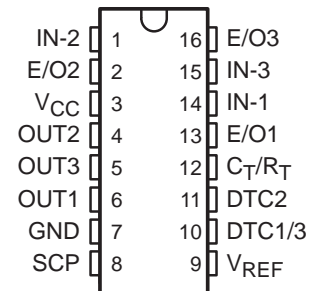


# TPS5100 TRIPLE-CHANNEL PWM CONTROL CIRCUITS

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- Low Voltage Operation . . . 2.5 V to 7 V
- Low Power . . . 3.5 mA  
(f = 500 kHz, Duty = 50%)
- Internal Undervoltage Lockout Protection
- Internal Short Circuit Protection
- Wide Operating Frequency . . . 50 kHz to 1 MHz
- Internal Precision Reference . . . 1.25 V  $\pm$ 1%  
(25°C)
- On/Off Switch for CH1/3 Pair and Ch2 (see Function Table)
- 0 to 100% Dead Time Control
- Totem Pole Output Stage
- Small I Package . . . 16 Pin TSSOP

PW PACKAGE  
(TOP VIEW)



## description

The TPS5100 is a triple PWM control circuit, primarily designed to compose the power supply for LCD display. Each PWM channel has own error amplifier, PWM comparator, dead-time control and output driver. The trimmed voltage reference, oscillator, undervoltage lockout and short circuit protection are common for all channels.

This device includes two boost exclusive circuits (ch1,3) and a buck-boost exclusive circuit (ch2). The operating frequency is set with external resistor and capacitor, and dead time is continuously adjustable from 0% to 100% duty cycle with resistive divider network. Soft start function can be implemented by adding a capacitor to dead time divider network. Two dead time control inputs are assigned for ch1,3 pair and ch2 individually and each dead time control input can be used to control on/off operation. TPS5100 can operate from 2.5 V supply voltage and ch1,3 pair and ch2 operate with reverse phase switching each other to achieve efficient operation in low power and battery powered system.

The TPS5100 is characterized for operation from  $-20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

FUNCTION TABLE

CONDITION	OUTPUT		
	CH-1	CH-2	CH-3
DTC1/3 > 0.3 V, DTC2 > 0.3 V	ON H	ON L	ON H
DTC1/3 > 0.3 V, DTC2 < 0.2 V	ON H	OFF H	ON H
DTC1/3 < 0.2 V, DTC2 > 0.3 V	OFF L	ON L	OFF L
DTC1/3 < 0.2 V, DTC2 < 0.2 V	OFF L	OFF H	OFF L

AVAILABLE OPTIONS

T <sub>A</sub>	PACKAGE
	TSSOP (PW)
$-20^{\circ}\text{C}$ to $85^{\circ}\text{C}$	TPS5100PW



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

 **TEXAS  
INSTRUMENTS**

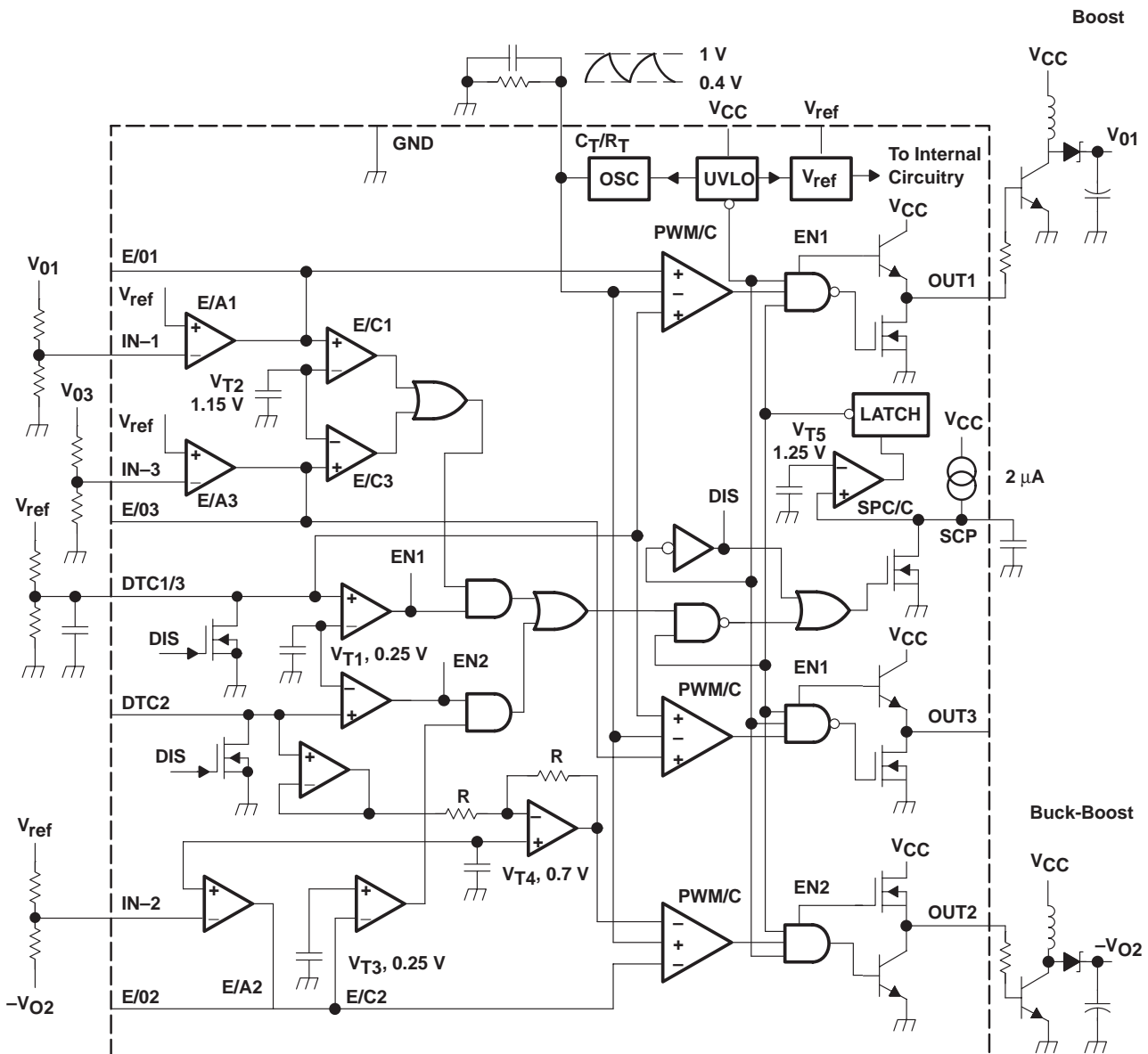
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# TPS5100 TRIPLE-CHANNEL PWM CONTROL CIRCUITS

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## functional block diagram



NOTE A: All voltages and currents listed are nominal.

# TPS5100

## TRIPLE-CHANNEL PWM CONTROL CIRCUITS

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**electrical characteristics over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V}$  (unless otherwise noted) (see Note 1)**

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{REF}$	Reference voltage	$I_{REF} = -1\text{ mA}$ , $T_A = 25^\circ\text{C}$	1.237	1.250	1.263	V
$V_{REF(dev)}$	Reference voltage change with $T_A$	$I_{REF} = -1\text{ mA}$ , See Note 2		15	25	mV
REGIN	Input regulation	$I_{REF} = -1\text{ mA}$ , $V_{CC} = 2.5\text{ V to }7\text{ V}$		2	5	mV
REGL	Output regulation	$I_{REF} = -0.1\text{ mA to }-1\text{ mA}$		1	5	mV
$I_{OS}$	Short-circuit output current	$V_{REF} = 0$	-2	-10	-30	mA

NOTES: 1. Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .  
 2. The deviation parameter  $V_{REF(dev)}$  is defined as the difference between the maximum and minimum values obtained over the recommended free-air temperature range ( $-20^\circ\text{C}$  to  $85^\circ\text{C}$ ).

### undervoltage lockout section

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{TH}$	Upper threshold voltage	$T_A = 25^\circ\text{C}$	2.2	2.3	2.4	V
$V_{TL}$	Lower threshold voltage	$T_A = 25^\circ\text{C}$	2	2.1	2.2	V
$V_{hys}$	Hysteresis ( $V_{TH} - V_{TL}$ )	$T_A = 25^\circ\text{C}$	0.1	0.2	0.3	V

NOTE 1: Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .

### protection control section

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{SCP}$	Input terminal source current		-1.4	-2	-2.6	$\mu\text{A}$
$V_{T2}$	Input threshold voltage	CH-1, 3	1.10	1.15	1.20	V
$V_{T3}$		CH-2	0.20	0.25	0.30	
$V_R$	Latch reset threshold voltage	$T_A = 25^\circ\text{C}$	0.8	1.5		V
$V_{T5}$	Threshold voltage		1.20	1.25	1.30	V

NOTE 1: Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .

### oscillator section

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$f_{OSC}$	Frequency	$C_T = 130\text{ pF}$ , $R_T = 7\text{ k}\Omega$	400	500	600	kHz
$f_{dV}$	Frequency change with $V_{CC}$	$V_{CC} = 2.5\text{ V}$ , $T_A = 25^\circ\text{C}$ , $C_T = 130\text{ pF}$ , $R_T = 7\text{ k}\Omega$		1%	2%	
$f_{dT}$	Frequency change with $T_A$	$C_T = 130\text{ pF}$ , $R_T = 7\text{ k}\Omega$		5%	10%	
$I_{CT/RT}$	Output source current		-180	-200	-220	$\mu\text{A}$
$V_{OSCH}$	H level output voltage		0.95	1	1.05	V
$V_{OSCL}$	L level output voltage		0.35	0.40	0.45	V

NOTE 1: Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .

### dead time control section

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$I_{BDT1/3}$	Input bias current	$V_{DTC1/3} = 0.35\text{ V to }1.05\text{ V}$			200	nA
$I_{BDT2}$		$V_{DTC2} = 0.35\text{ V to }1.05\text{ V}$		$\pm 2$	$\pm 20$	
$V_{T1}$	Comparator threshold voltage		0.2	0.25	0.3	V
$V_{T0(DTC1/3)}$	Input threshold voltage (DTC1/3) (see Note 3)	Duty = 0%	0.3	0.4	0.5	V
$V_{T100(DTC1/3)}$		Duty = 100%				
$V_{T0(DTC2)}$	Input threshold voltage (DTC2) (see Note 3)	Duty = 0%	0.3	0.4	0.5	V
$V_{T100(DTC2)}$		Duty = 100%				

NOTES: 1. Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .  
 3. These specifications are not production tested. They are specified as ensured values on circuit design.



# TPS5100

## TRIPLE-CHANNEL PWM CONTROL CIRCUITS

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electrical characteristics over recommended operating free-air temperature range,  $V_{CC} = 3.3\text{ V}$  (unless otherwise noted) (see Note 1) (continued)

### error amplifier section

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{IO}$	Input offset voltage	CH1, 3,	$A_V = 1$			15	mV
$I_{IB}$	Input bias current	CH1, 3,	$V_I = -.95\text{ V to }1.55\text{ V}$		$\pm 10$	$\pm 20$	nA
		CH2,	$V_I = 0.4\text{ V to }1\text{ V}$		$\pm 10$	$\pm 20$	
$V_{IR}$	Input voltage range	CH1, 3,		0.95		1.55	V
		CH2		0.4		1	
$A_{VD}$	Open-loop voltage amplification	$R_{FB} = 200\text{ k}\Omega$			60		dB
$B_1$	Unity-gain bandwidth				1		MHz
$V_{OM+}$	Output voltage swing	$V_{ID} = 0.1\text{ V}$	$I_O = 60\text{ }\mu\text{A}$	1.2			V
$V_{OM-}$			$I_O = 0.2\text{ mA}$			0.2	
$I_{OM+}$	Output sink current	$V_{ID} = 0.1\text{ V}$ ,	$V_O = 0.2\text{ V}$	0.2	1		mA
$I_{OM-}$	Output source current	$V_{ID} = 0.1\text{ V}$ ,	$V_O = 1.2\text{ V}$	-60	-100		$\mu\text{A}$
$V_{T4}$	Input bias voltage	CH2,	$A_V = 1$ , $T_A = 25^\circ\text{C}$	678	700	722	mV
		CH2,	$A_V = 1$	665	700	735	

NOTE 1: Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .

### output section

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$V_{OH}$	High-level output voltage	$I_O = 20\text{ mA (CH2)}$		2.9	3.05		V
		$I_O = -40\text{ mA (CH1, 3)}$		1.9	2.2	2.6	
$V_{OL}$	Low-level output voltage	$I_O = 20\text{ mA (CH1, 3)}$			0.2	0.4	V
		$I_O = 40\text{ mA (CH2)}$		0.2	0.3	0.6	
$t_r$	Rise time	$CL = 1000\text{ pF}$			130		ns
$t_f$	Fall time	$I_O = 1000\text{ pF}$			50		ns

NOTE 1: Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .

### total device

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$I_{CC}$	Supply current	Output OFF state			2.5	4	mA
$I_{CCA}$	Average supply current	$F_{OSC} = 500\text{ kHz}$ , Duty = 50%, No load			3.5	5	mA

NOTE 1: Typical values of all parameters except for  $V_{REF(dev)}$  and  $f_{dT}$  are specified at  $T_A = 25^\circ\text{C}$ .



TYPICAL CHARACTERISTICS

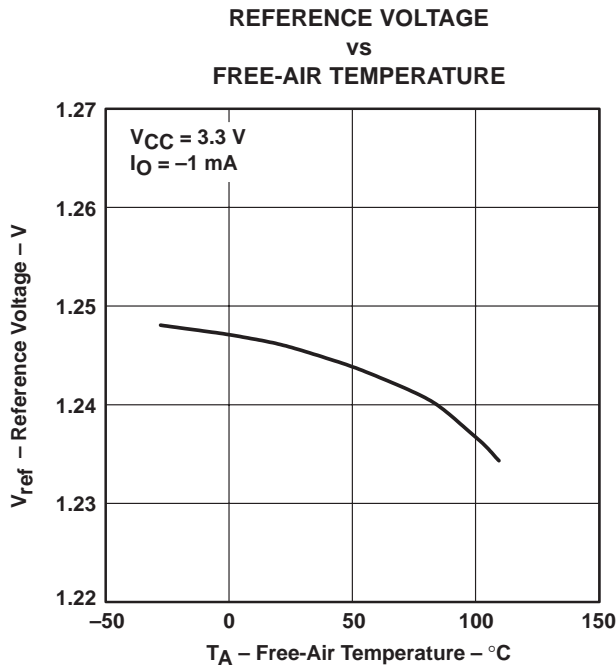


Figure 1

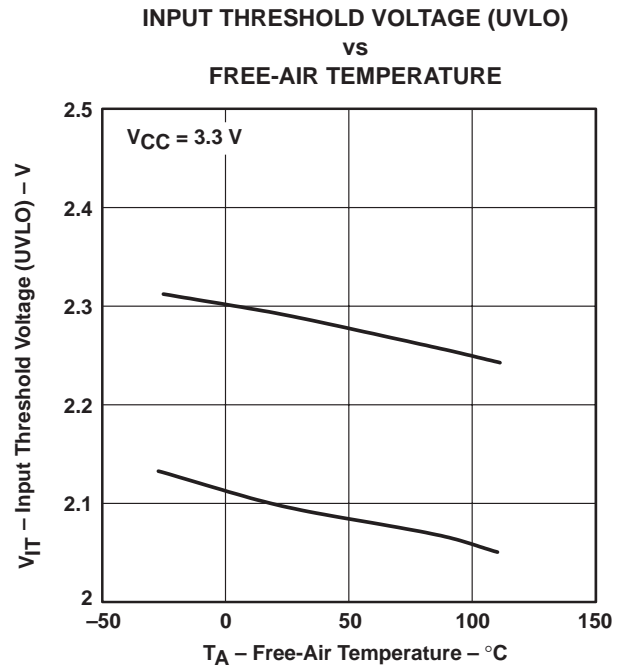


Figure 2

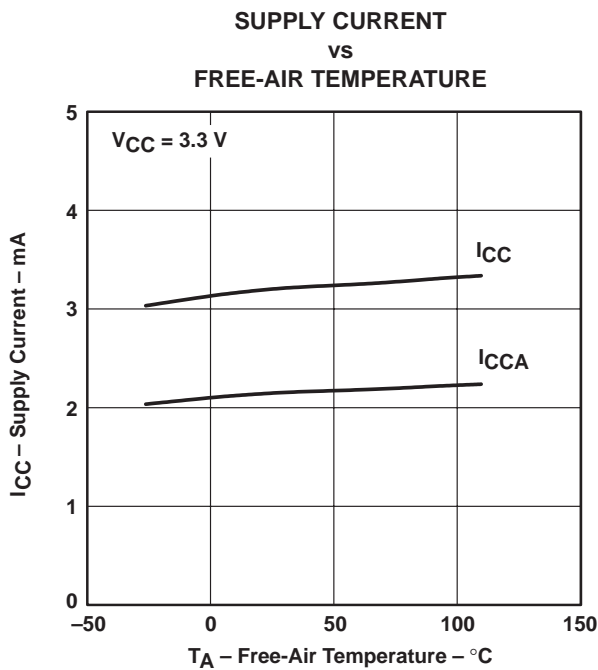


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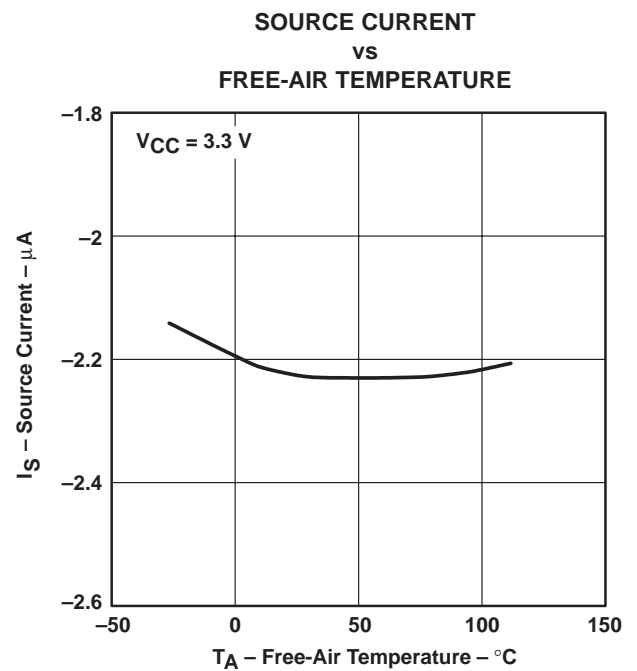


Figure 4

TYPICAL CHARACTERISTICS

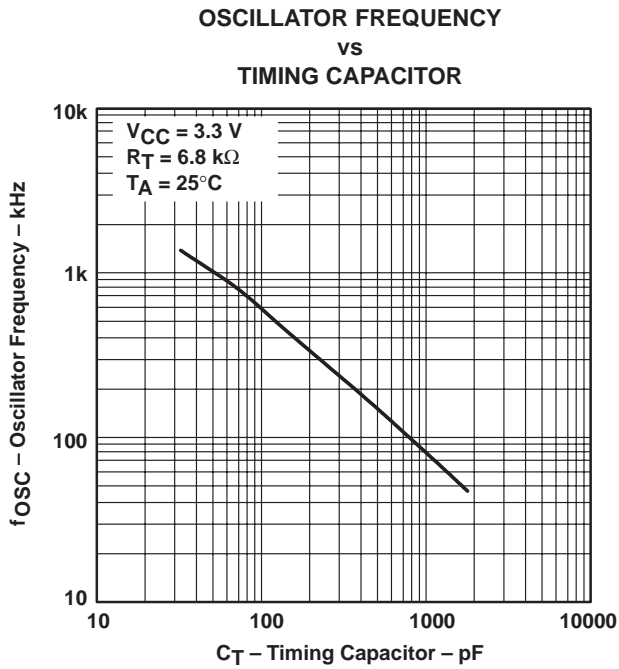


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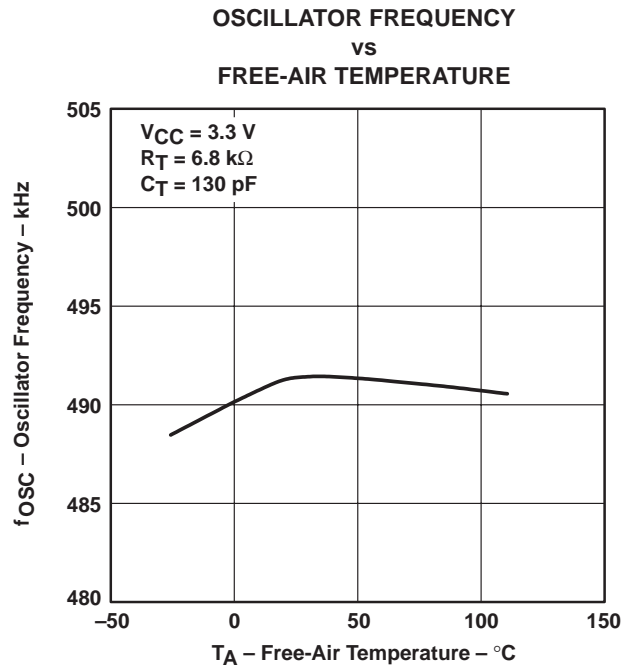


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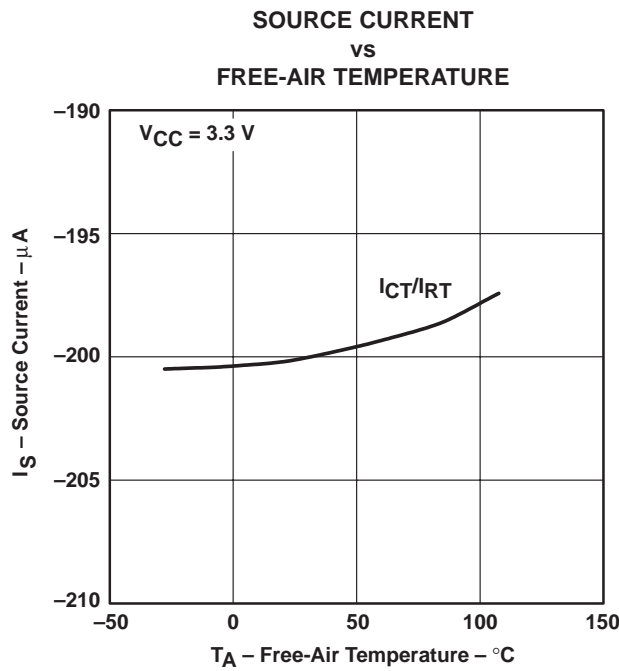
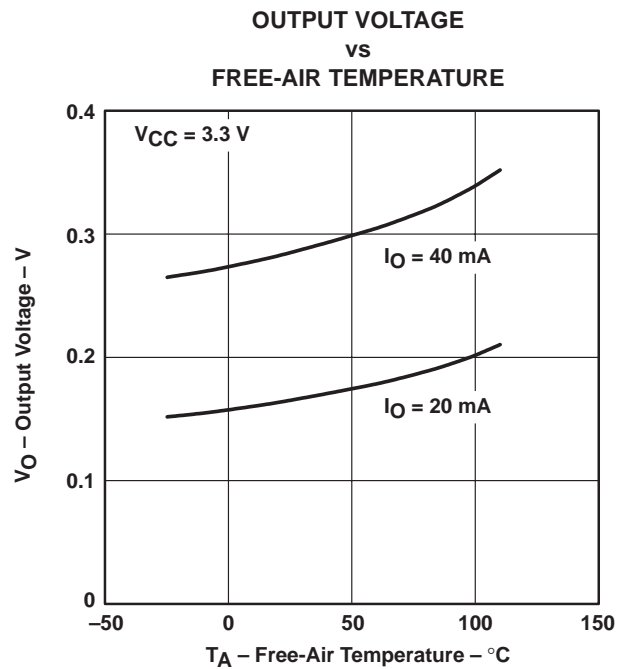
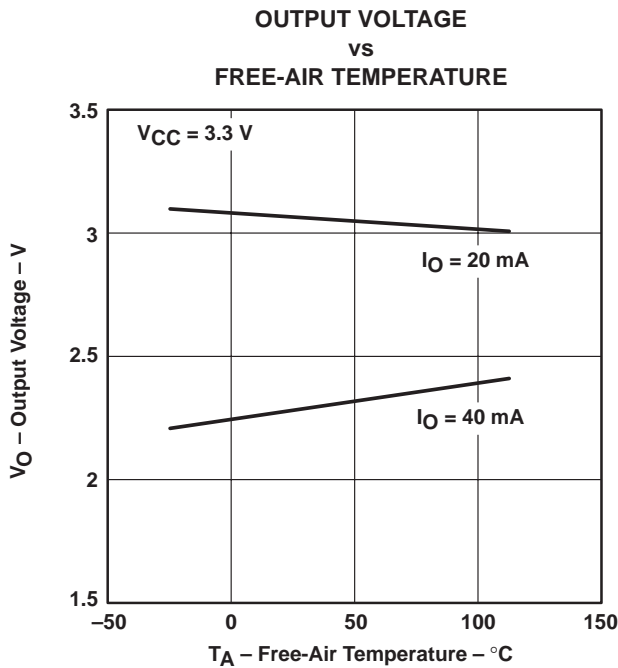
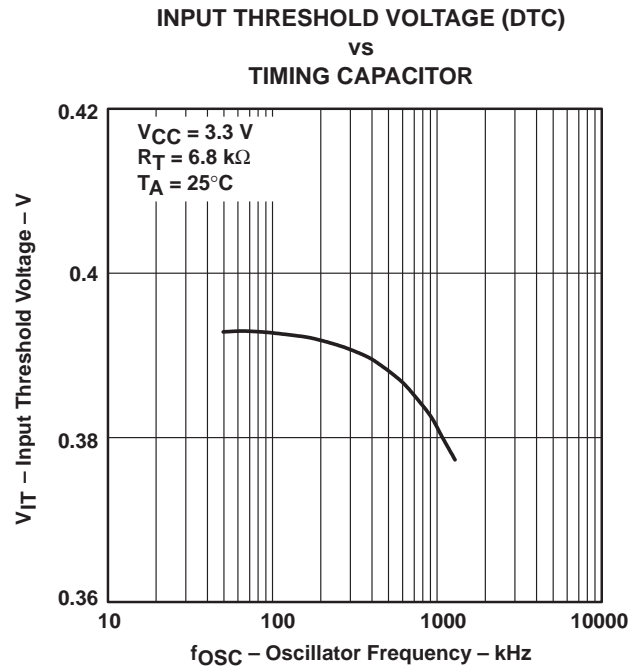
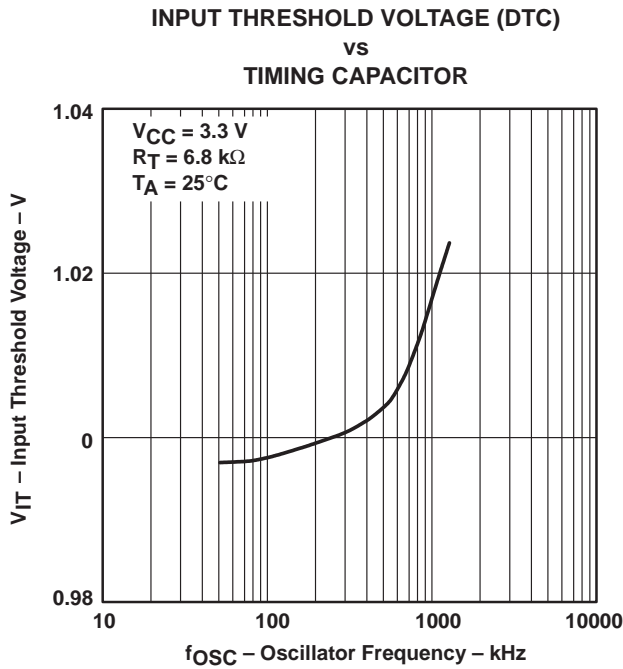


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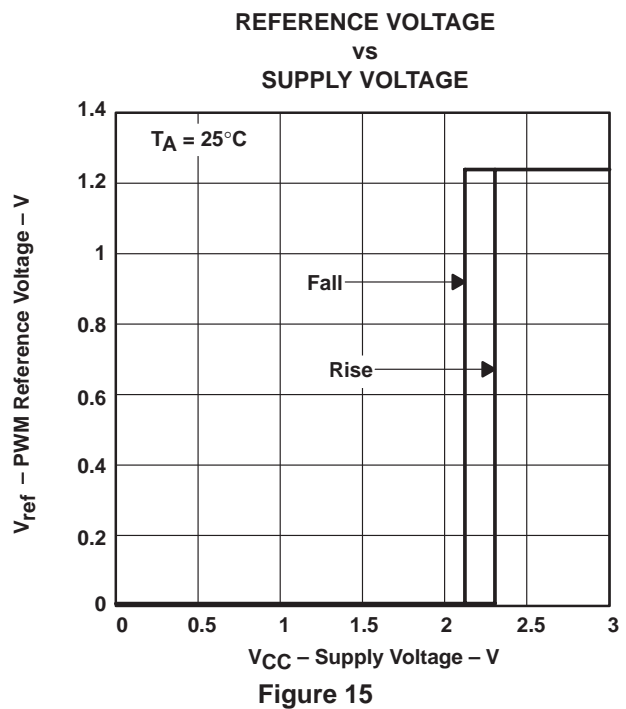
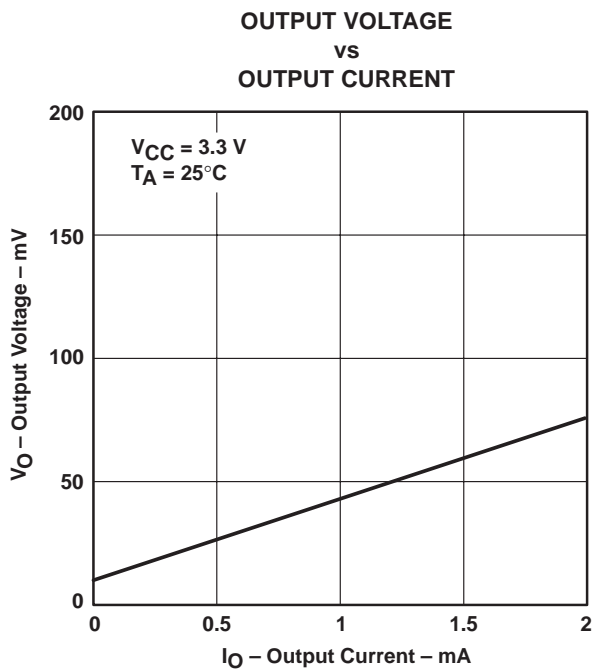
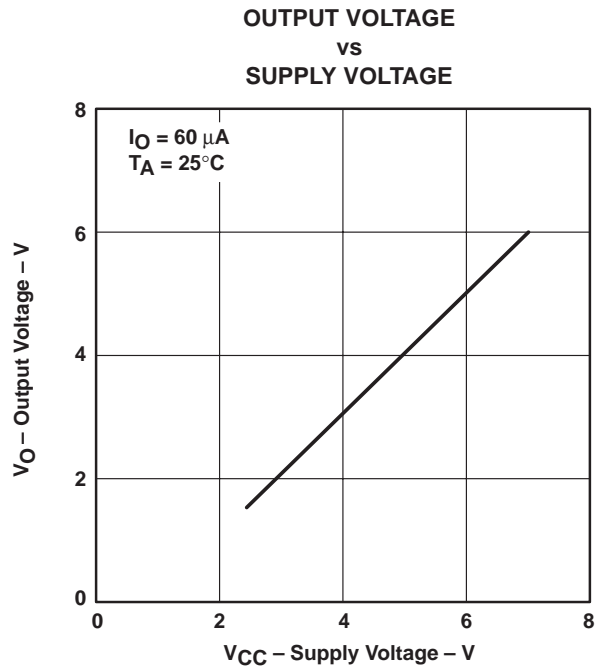
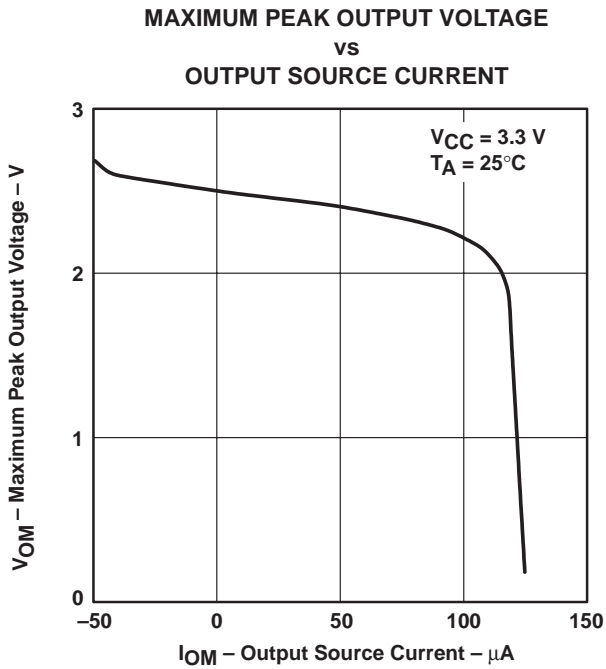
TYPICAL CHARACTERISTICS



# TPS5100 TRIPLE-CHANNEL PWM CONTROL CIRCUITS

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## TYPICAL CHARACTERISTICS





TYPICAL CHARACTERISTICS

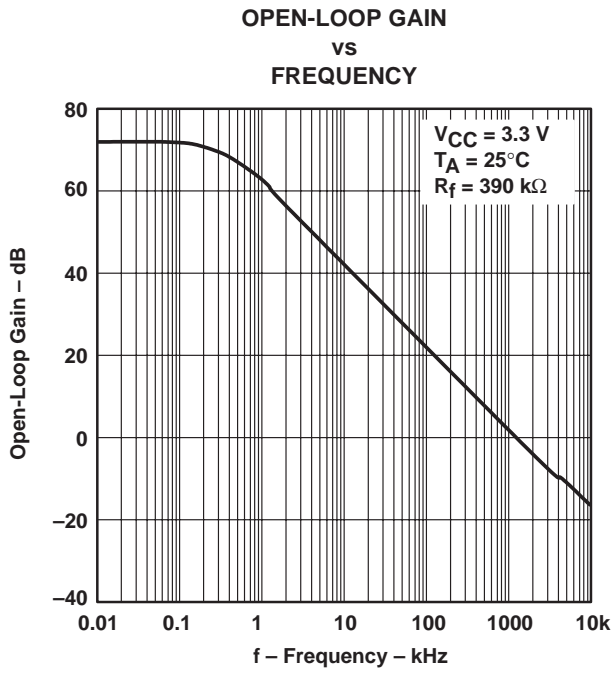


Figure 16

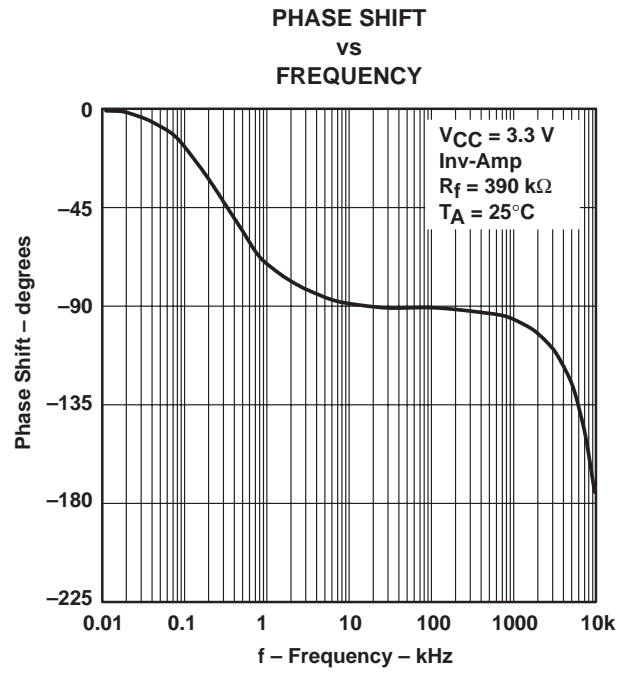


Figure 17

# TPS5100 TRIPLE-CHANNEL PWM CONTROL CIRCUITS

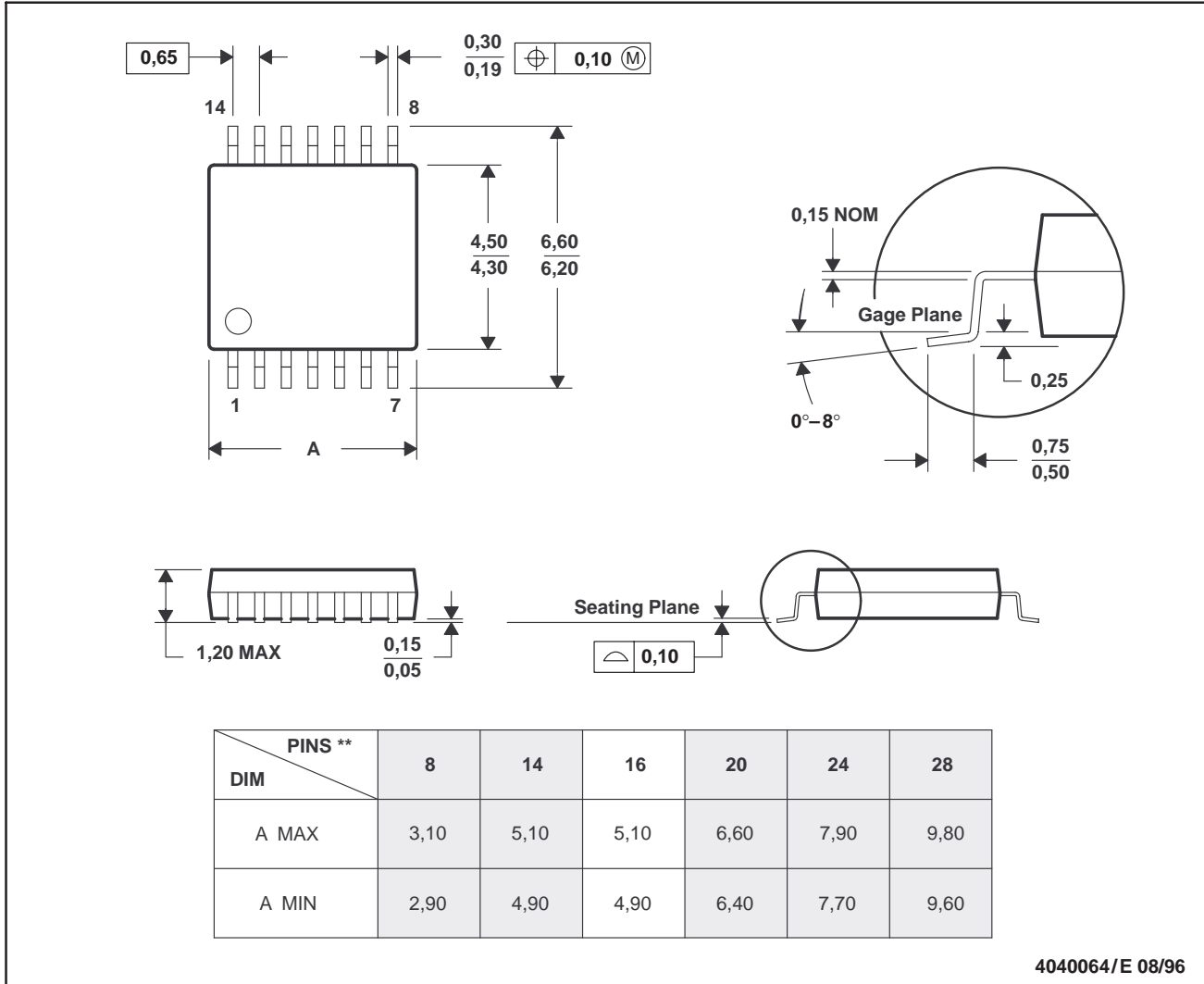
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## MECHANICAL DATA

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PIN SHOWN



4040064/E 08/96

- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
  - D. Falls within JEDEC MO-153

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