

features

- DC-DC Synchronous Buck Controller
- Switching Frequency, 200 kHz (Typ)
- Programmable Output Voltage, 1 V to 2.5 V $\pm 2\%$
- Power Good Function (PWRGD)
- Input Voltage, 12 V $\pm 5\%$
- Drive High Load Current With External Components

applications

- PC Motherboard, Voltage Regulation for System Power
- DDR Memory Supply (V_{DDQ} or V_{TT})
- RDRAM Memory Supply (V_{DDQ})
- General Purpose Synchronous Switch Mode Controller

description

The TPPM0115 is a synchronous buck controller capable of driving two external power FETs 180° out of phase. The device requires a minimum of external standard filter components and switching FETs to regulate the desired output voltage. This is achieved with an internal switching frequency of 200 kHz (typical).

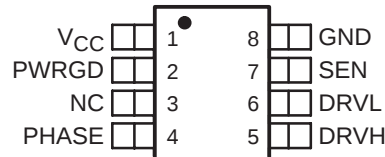
The TPPM0115 switch mode controller and associated circuitry provide efficient voltage regulation of greater than 85%. The output voltage is set by two external resistors. During power up, when the output voltage reaches 90% of the desired value, the power good (PWRGD) output is transitioned high after a short delay of 1 ms to 5 ms. During power down, when the output voltage falls below 90% of the set value, the PWRGD output is pulled low without any delay.

In the event the set output is in an over-voltage condition due to a system fault, the drive to the lower FET turns on to correct the fault. There is a dead time between switching one FET ON while the other FET is switching OFF to prevent cross conduction.

The TPPM0115 is capable of driving high static load currents with minimal ripple on the output ($<2\%$). The phase sense input is used to sense the flow of current through the inductor during flyback to minimize ripple on the output.

To optimize output filter capacitance, the voltage mode control is based on a fixed ON time during the start of the cycle and hysteretic control during load transients. This allows the device to respond and maintain the set regulation voltage.

SO (D) PACKAGE
(TOP VIEW)



NC – No internal connection



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

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**

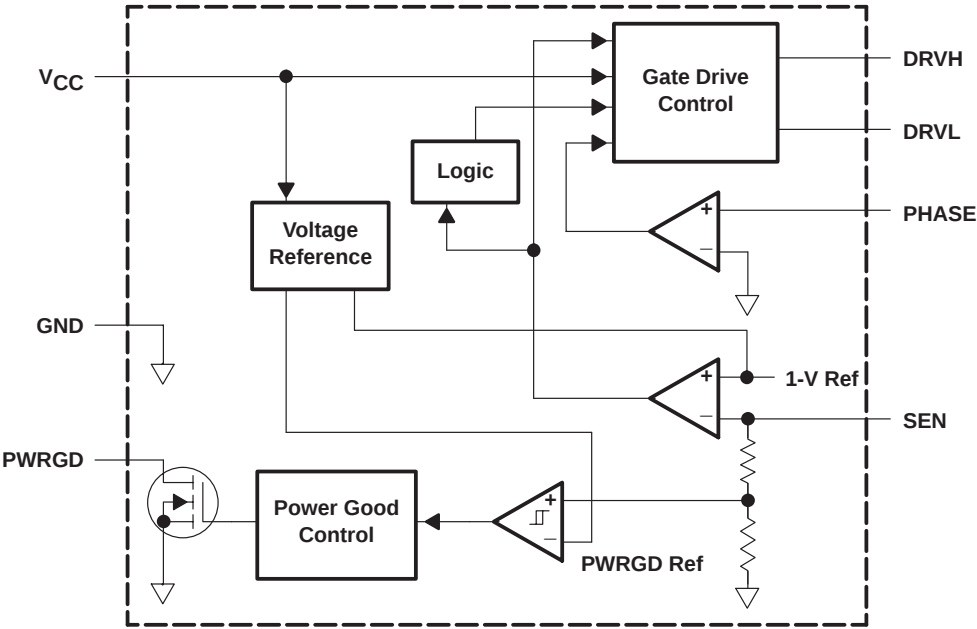
POST OFFICE BOX 655303 • DALLAS, TEXAS 75265

Copyright © 2001, Texas Instruments Incorporated

TPPM0115
SWITCH MODE SYNCHRONOUS BUCK CONTROLLER

SLVS371A- MARCH 2001 – REVISED JUNE 2001

functional block diagram



Terminal Functions

TERMINAL NAME	NO.	I/O	DESCRIPTION
DRVH	5	O	Output for upper FET gate drive
DRVL	6	O	Output for lower FET gate drive
GND	8	O	Ground
NC/TEST	3	O	No connection, used for test purpose only
PHASE	4	I	Phase sense input
PWRGD	2	O	Open-drain output for power good function
SEN	7	I	Sense input
VCC	1	I	Input voltage

TPPM0115

SWITCH MODE SYNCHRONOUS BUCK CONTROLLER

SLVS371A– MARCH 2001 – REVISED JUNE 2001

absolute maximum ratings over operating free-air temperature (unless otherwise noted)[†]

Unregulated input voltage, V_{CC} (see Notes 1 and 2)	24 V
Drive output voltage, $V_{(DRVH)}$ and $V_{(DRVL)}$ (see Notes 1 and 3)	12.6 V
Power good voltage, $V_{(PWRGD)}$ (see Notes 1 and 2)	7 V
Feedback voltage, $V_{(SEN)}$ (see Notes 1 and 2)	7 V
Phase sense voltage, $V_{(PHASE)}$ (see Note 3)	7 V
Continuous power dissipation, P_D	0.4 W
Electrostatic discharge susceptibility, $V_{(HBMESD)}$ (see Note 4)	2 kV
Operating ambient temperature range, T_A	0°C to 70°C
Storage temperature range, T_{Stg}	–65°C to 150°C
Lead temperature (soldering, 10 sec) T_{LEAD}	260°C

[†] Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

- NOTES:
1. All voltage values are with respect to GND.
 2. Absolute negative voltage values on these terminals should not be below –0.5 V.
 3. Absolute negative voltage values on these terminals should not be below –1 V.
 4. The human body model is a 100-pF capacitor discharged through a 1.5-k Ω resistor into each terminal.

recommended operating conditions

	MIN	NOM	MAX	UNIT
Unregulated input voltage, V_{CC}	11.4		12.6	V
Drive output current, $I_{(DRVH)}$ and $I_{(DRVL)}$		500		mA
Power good voltage, $V_{(PWRGD)}$		5		V
Feedback voltage, $V_{(SEN)}$		1		V
Phase sense voltage, $V_{(PHASE)}$		0		V
Continuous power dissipation, P_D		100		mW
Operating ambient temperature, T_A		55		°C



TPPM0115

SWITCH MODE SYNCHRONOUS BUCK CONTROLLER

SLVS371A– MARCH 2001 – REVISED JUNE 2001

dc electrical characteristics, $T_A = 0^\circ\text{C}$ to 55°C , $V_{CC} = 12\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
V_{OUT} Output voltage	$V_{CC} = 11.4\text{ V}$ to 12.6 V , $I_L = 5\text{ A}$ to 10 A , See Figure 8 for external components, $R_1 = 0$, R_2 is not present	1			V
η Efficiency	$I_L = 10\text{ A}$, See Figure 8	86%			
I_Q Quiescent current	$V_{(SEN)} = <1\text{ V}$ or $>1.3\text{ V}$, $V_{OUT} = 1\text{ V}$ to 1.3 V		2		mA
$\Delta V_O(\Delta I_O)$ Load regulation	See Figure 8	-1%		1%	
$\Delta V_O(\Delta V_I)$ Line regulation					
Temperature regulation					
$V_{OH}(\text{DRVH})$	Upper drive output voltage	$V_{(SEN)} = 0.9\text{ V}$, $I_{OH} = 200\text{ mA}$	$V_{CC}-3\text{ V}$	1	V
$V_{OL}(\text{DRVH})$					
$V_{OH}(\text{DRVL})$	Lower drive output voltage	$V_{(SEN)} = 1.2\text{ V}$, $V_{(PHASE)} < 0\text{ V}$, $I_{OH} = 200\text{ mA}$	5	1	V
$V_{OL}(\text{DRVL})$					
I_{IH}	Phase input current	$V_{(SEN)} = 0.9\text{ V}$, $V_{(PHASE)} = 5\text{ V}$	100		μA
I_{IL}		$V_{(SEN)} = 1.2\text{ V}$, $V_{(PHASE)} = -0.3\text{ V}$	-50		
$V_{(PWRGD)}$ Sense output voltage for PWRGD detection range	Ramp up sense input until PWRGD transition to high	V_{OUT}^* 0.86		V_{OUT}^* 0.96	V
	Ramp down sense input until PWRGD transition to low	V_{OUT}^* 0.63		V_{OUT}^* 0.71	
I_{BIAS} Sense feedback bias current	$V_{(SEN)} = 1.08\text{ V}$			5	μA

ac electrical characteristics, $T_A = 0^\circ\text{C}$ to 55°C , $V_{CC} = 12\text{ V}$ (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
f_{SW} Switching frequency	Measured at DRVH terminal		200		kHz
t_r Output rise time for both DRVH and DRVL	$V_{(DRVH)} \rightarrow 0\text{ V}$ to 8 V , $V_{(SEN)} \rightarrow 1.1\text{ V}$ to 0.9 V		50		ns
	$V_{(DRVL)} \rightarrow 0\text{ V}$ to 8 V , $V_{(SEN)} \rightarrow 0.9\text{ V}$ to 1.1 V		50		
t_f Output fall time for both DRVH and DRVL	$V_{(DRVH)} \rightarrow 8\text{ V}$ to 0 V , $V_{(SEN)} \rightarrow 0.9\text{ V}$ to 1.1 V		50		ns
	$V_{(DRVL)} \rightarrow 8\text{ V}$ to 0 V , $V_{(SEN)} \rightarrow 1.1\text{ V}$ to 0.9 V		50		
t_d Power good signal delay	Delay time for $V_{(SEN)} > V_{(PWRGD)}$ to PWRGD transitioning high	1		5	ms
t_{dt} Dead time between DRVH and DRVL switch conduction	$V_{(SEN)} \rightarrow 1.1\text{ V}$ to 0.9 V , Delay between $V_{(DRVL)}$ at 0 V and $V_{(DRVH)} = 1.5\text{ V}$		50		ns
	$V_{(SEN)} \rightarrow 0.9\text{ V}$ to 1.1 V , Delay between $V_{(DRVH)}$ at 0 V and $V_{(DRVL)} = 1.5\text{ V}$		50		

thermal characteristics

	MIN	TYP	MAX	UNIT
$R_{\theta JC}$ Thermal impedance, junction-to-case			50	$^\circ\text{C/W}$
$R_{\theta JA}$ Thermal impedance, junction-to-ambient			178	$^\circ\text{C/W}$



TYPICAL CHARACTERISTICS

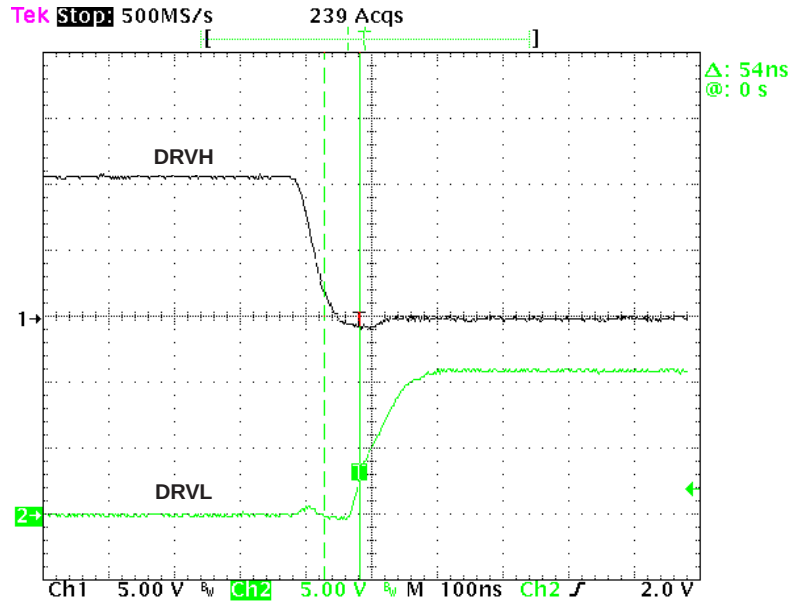


Figure 1. Dead Time Between Gate Drives Upper Switching OFF and Lower Switching ON

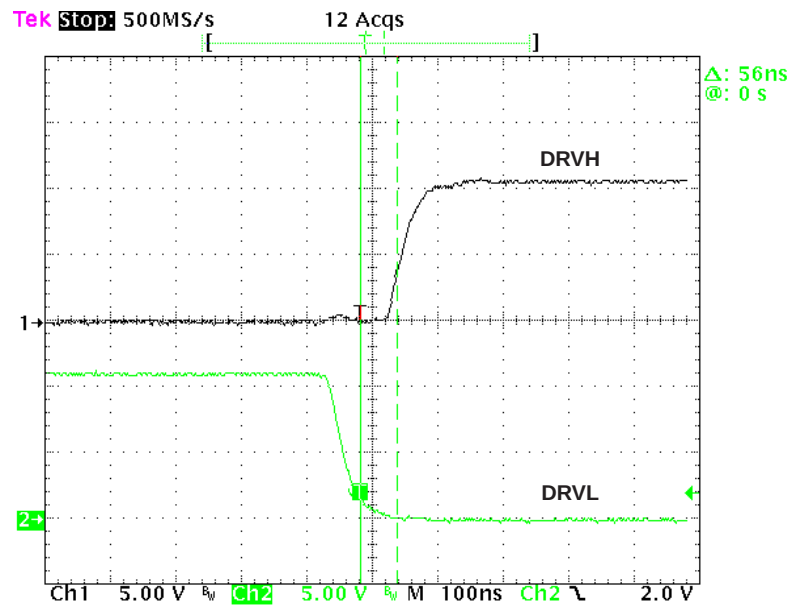


Figure 2. Dead Time Between Gate Drives Upper Switching ON and Lower Switching OFF

TPPM0115

SWITCH MODE SYNCHRONOUS BUCK CONTROLLER

SLVS371A– MARCH 2001 – REVISED JUNE 2001

TYPICAL CHARACTERISTICS

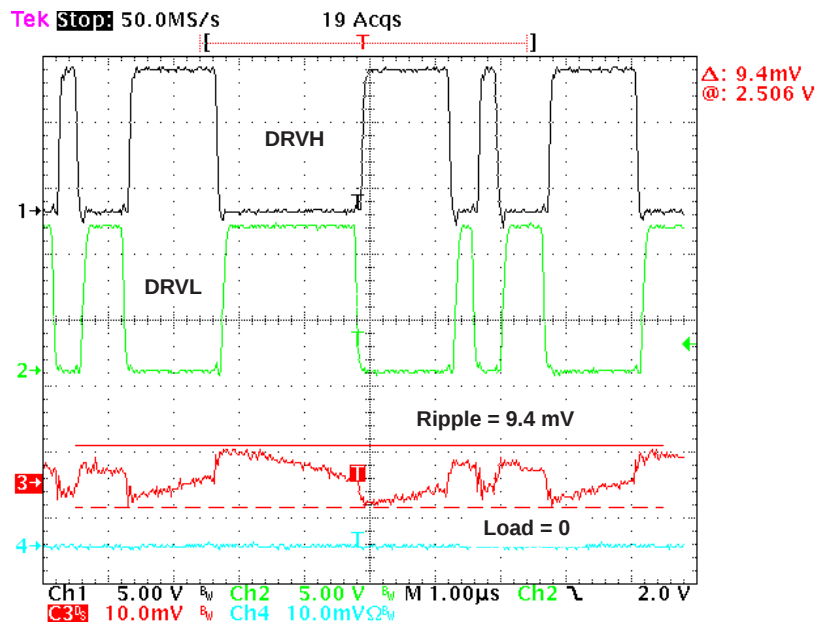


Figure 3. Output Voltage Ripple (Offset = 2.5 V) With NO Load

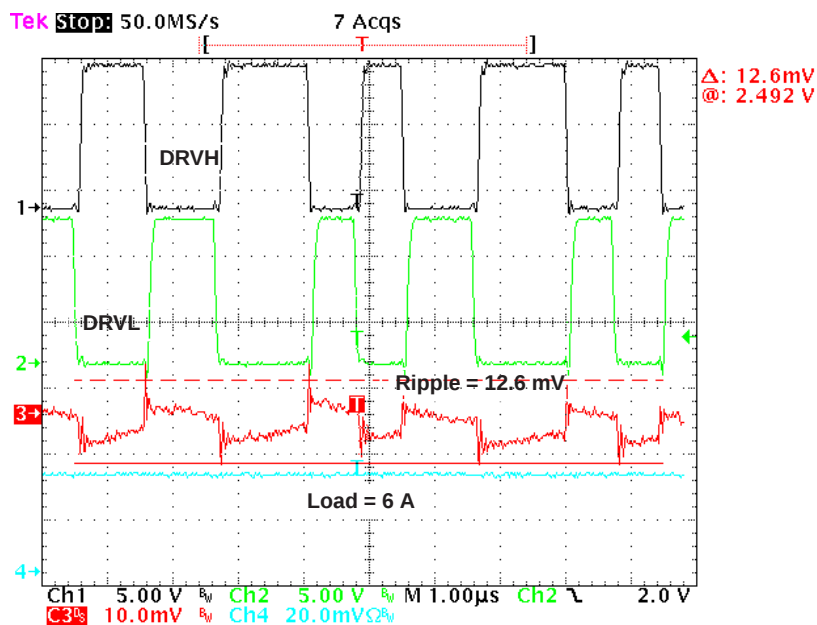


Figure 4. Output Voltage Ripple (Offset = 2.5 V) With 6 A Load

TYPICAL CHARACTERISTICS

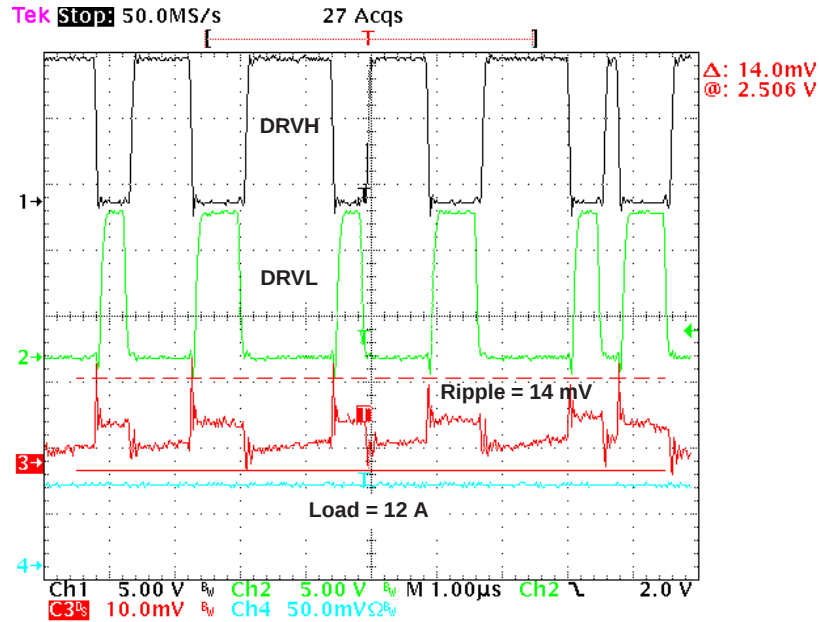


Figure 5. Output Voltage Ripple (Offset = 2.5 V) With 12 A Load

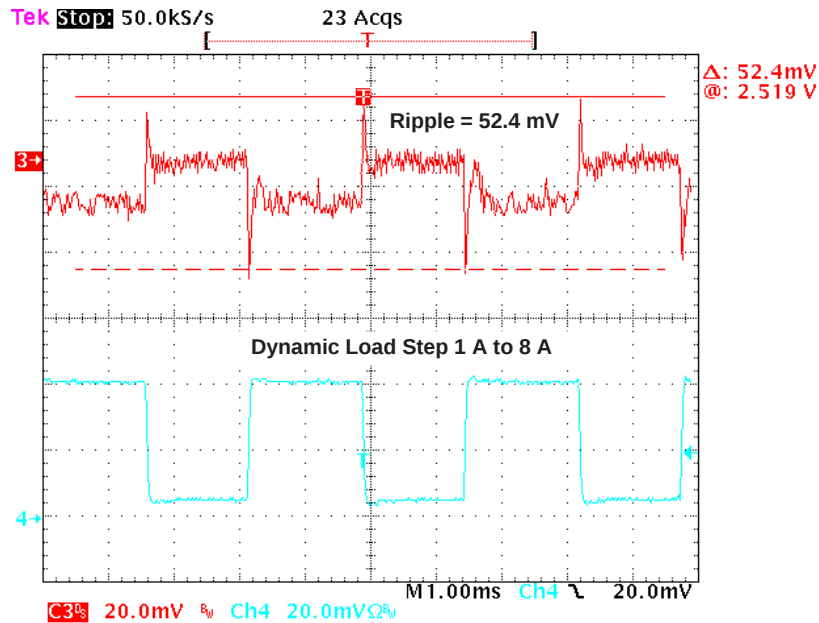


Figure 6. Output Voltage Ripple (Offset = 2.5 V) With Dynamic Load Switching (1 A to 8 A)

TPPM0115

SWITCH MODE SYNCHRONOUS BUCK CONTROLLER

SLVS371A- MARCH 2001 - REVISED JUNE 2001

TYPICAL CHARACTERISTICS

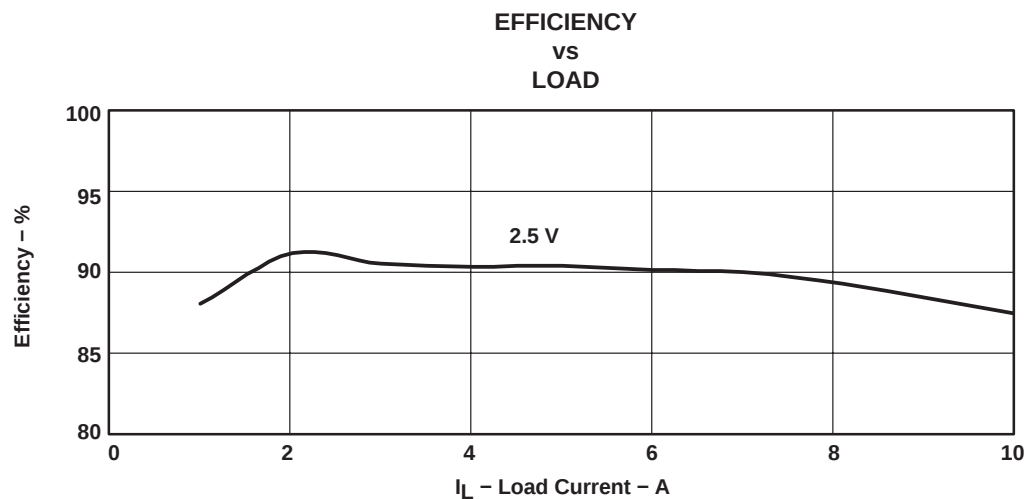
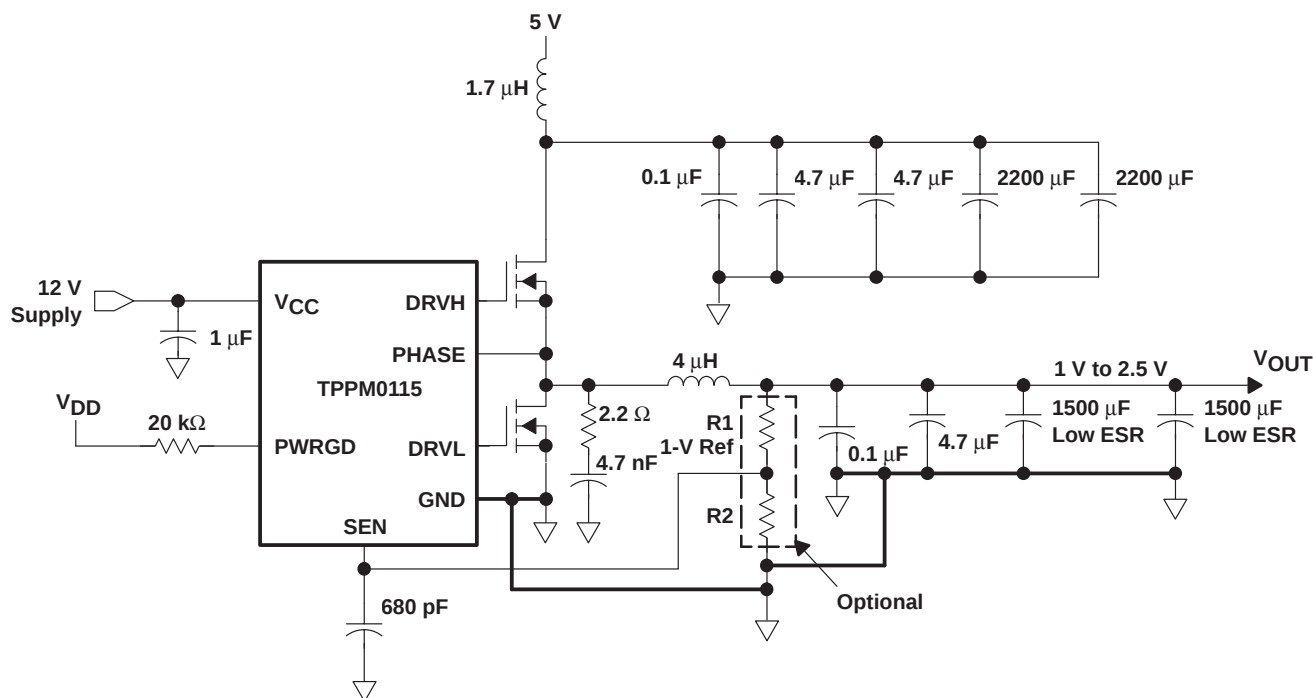


Figure 7. System Efficiency With Load Current (2.5-V Output)

APPLICATION INFORMATION



- NOTES:
- A. The heavy lines must be kept short and connected to the ground plane construction for efficient results.
 - B. The feedback (sense) trace should be kept from the inductor flux.
 - C. The 1500-µF capacitor should have a low ESR to minimize output voltage ripple.
 - D. External FETs are MTD3302 or PHD55N03LT.
 - E. Set the resistor values on the SEN terminal using the following formulas:

$$V_{OUT} = \frac{V_{ref}(R1 + R2)}{R2}, \text{ where } V_{ref} = 1\text{ V}$$

- F. Maximum efficiency is dependent on proper selection of external components.
- G. Line and load regulation is dependent on proper selection of external components.

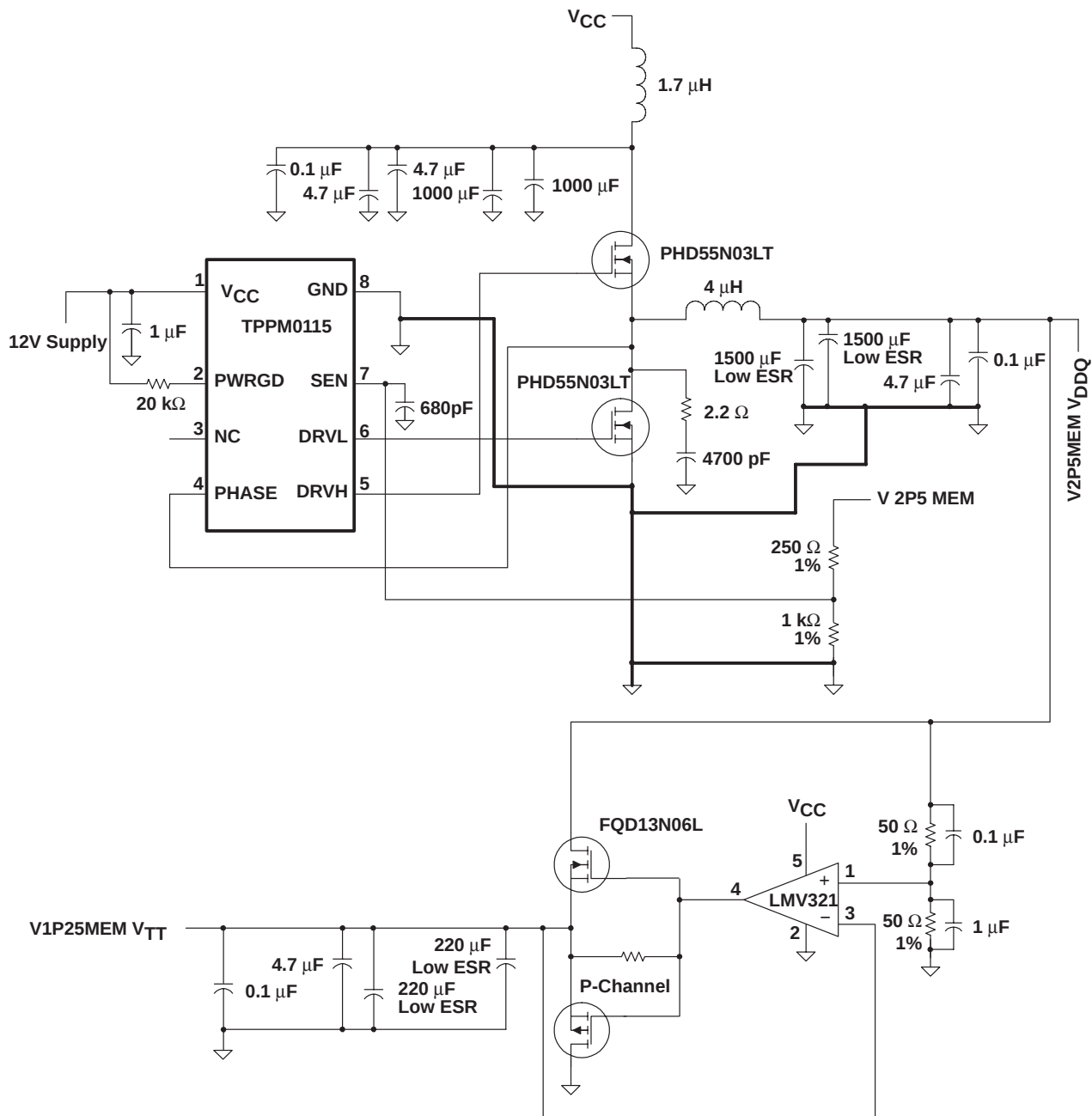
Optional: When resistor feedback network is not used, V_{OUT} must be connected directly to SEN input to provide output regulation at $V_{OUT} = V_{ref}$.

Figure 8. Typical Application Schematic

TPPM0115

SLVS371A- MARCH 2001 – REVISED JUNE 2001

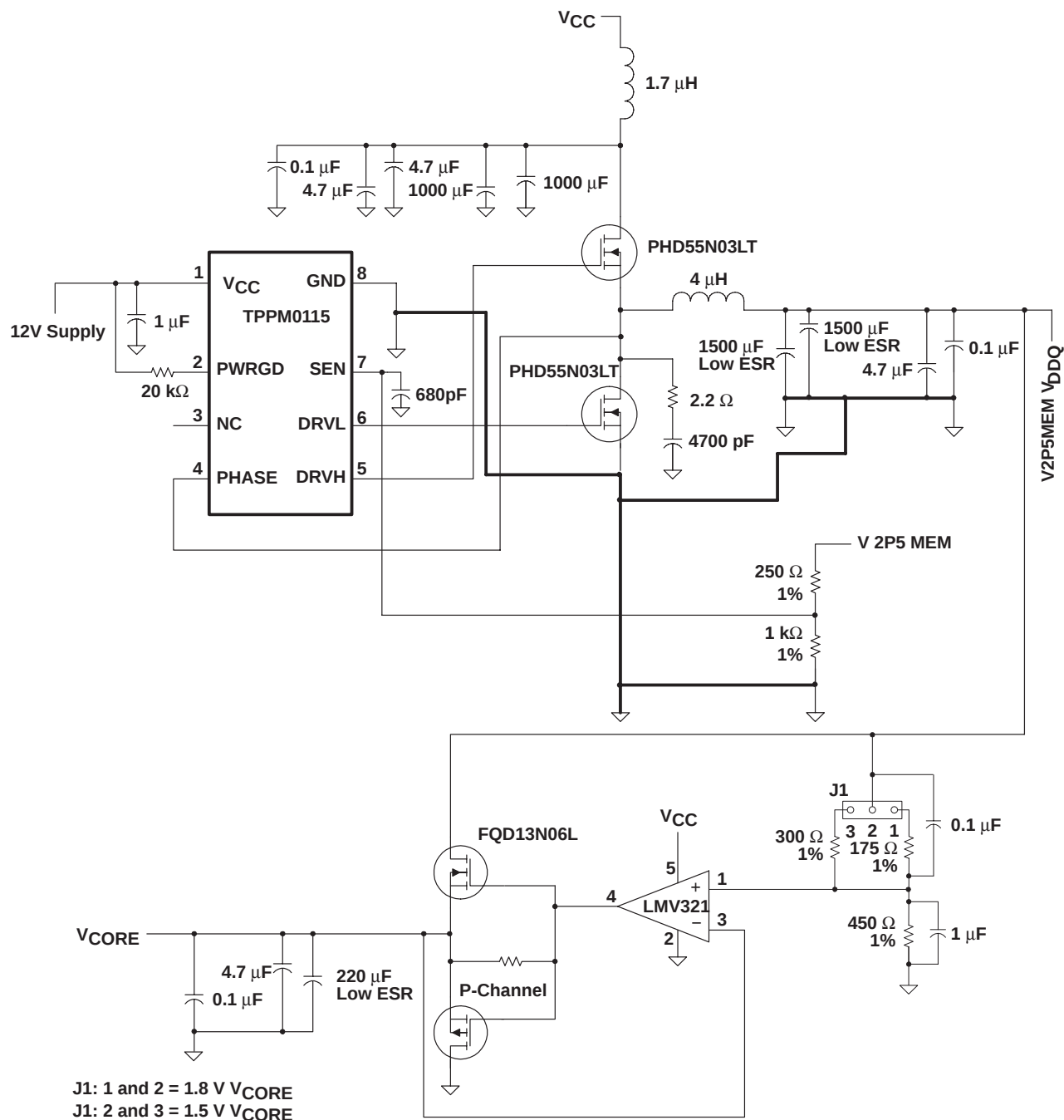
APPLICATION INFORMATION



NOTES: A. The heavy lines must be kept short and connected to the ground plane construction for efficient results.
B. The performance of the regulator depends on the proper selection of the external components for the application.

Figure 9. Application Schematic for DDR Memory V_{DDQ} and V_{TT} Supplies

APPLICATION INFORMATION



TPPM0115
SWITCH MODE SYNCHRONOUS BUCK CONTROLLER

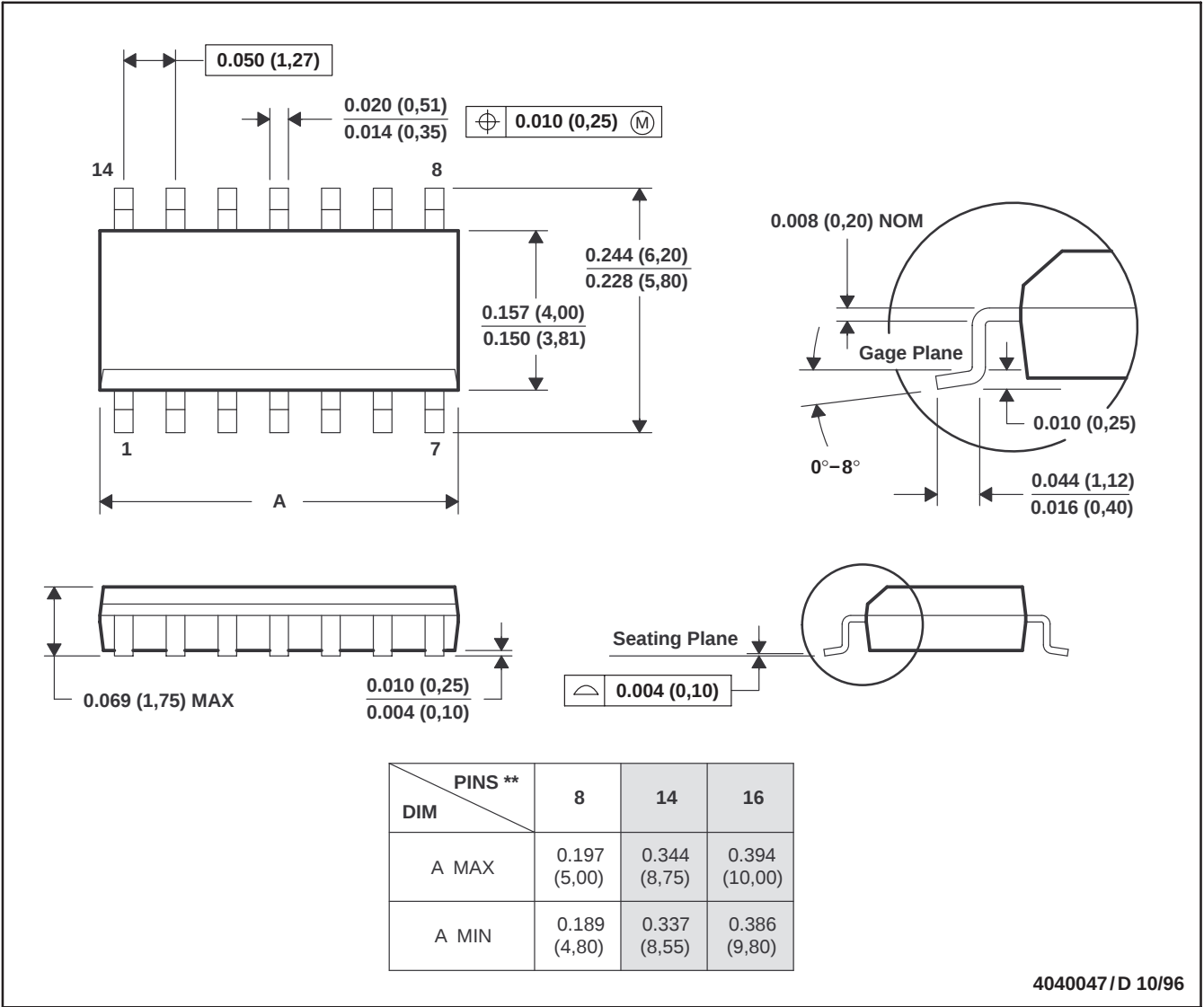
SLVS371A- MARCH 2001 – REVISED JUNE 2001

MECHANICAL DATA

D (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



- NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion, not to exceed 0.006 (0,15).
D. Falls within JEDEC MS-012

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
RF/IF and ZigBee® Solutions	www.ti.com/lprf

Applications

Audio	www.ti.com/audio
Automotive	www.ti.com/automotive
Broadband	www.ti.com/broadband
Digital Control	www.ti.com/digitalcontrol
Medical	www.ti.com/medical
Military	www.ti.com/military
Optical Networking	www.ti.com/opticalnetwork
Security	www.ti.com/security
Telephony	www.ti.com/telephony
Video & Imaging	www.ti.com/video
Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2008, Texas Instruments Incorporated