June 2003

LM2724A
High Speed 3A Synchronous MOSFET Driver

General Description

The LM2724A is a dual N-channel MOSFET driver which can drive both the top and bottom MOSFETs in a push-pull structure simultaneously. The LM2724A takes a logic input and splits it into two complimentary signals with a typical 20ns dead time in between. The built-in cross-conduction protection circuitry prevents the top and bottom MOSFETs from turning on simultaneously. With a bias voltage of 5V, the peak sourcing and sinking current for each driver of the LM2724A is about 3A. Input UVLO (Under-Voltage-Lock-Out) ensures that all the driver outputs stay low until the supply rail exceeds the power-on threshold during system power on, or after the supply rail drops below power-on threshold by a specified hysteresis during system power down. The cross-conduction protection circuitry detects both driver outputs and will not turn on a driver until the other driver output is low. The top gate voltage needed by the top MOSFET is obtained through an external boot-strap structure. When not switching, the LM2724A only draws up to 195µA from the 5V rail. The synchronization operation of the bottom MOSFET can be disabled by pulling the SYNC pin to ground.

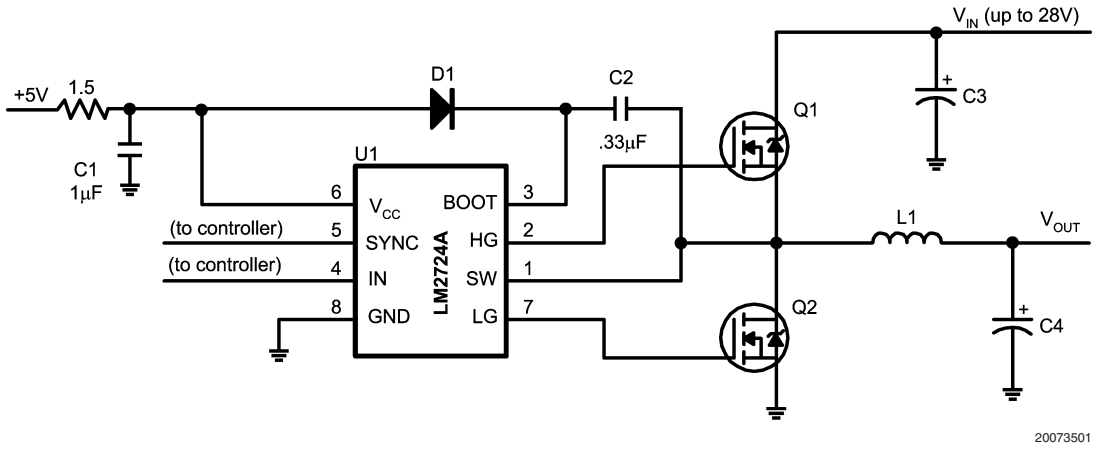
Features

- Shoot-through protection
- Input Under-Voltage-Lock-Out
- 3A peak driving current
- 195µA quiescent current
- 28V input voltage in buck configuration
- SO-8 and LLP packages

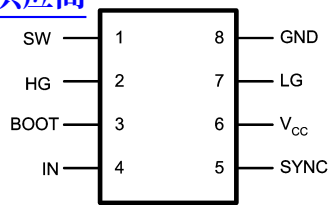
Applications

- High Current DC/DC Power Supplies
- High Input Voltage Switching Regulators
- Fast Transient Microprocessors
- Notebook Computers

Typical Application

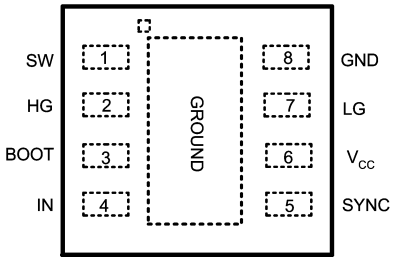


Connection Diagram



20073502

8-Lead SO (NS Package # M08A)
θ_{JA} = 172˚C/W



20073506

8-Lead LLP (NS Package # LDC08A)
θ_{JA} = 39˚C/W

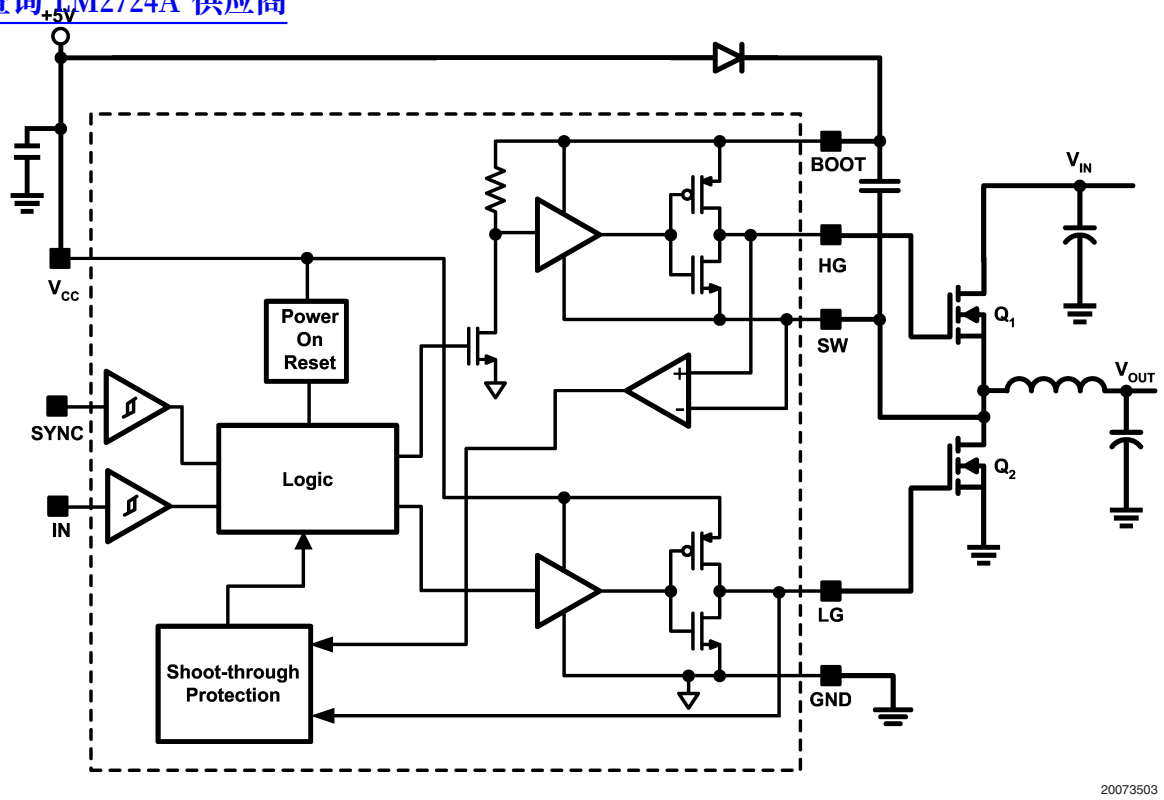
Ordering Information

Order Number	Size	NSC Package Drawing	Supplied As
LM2724AM	SO-8	M08A	95 Units/Rail
LM2724AMX			2500 Units/Reel
LM2724ALD	LDC08A	LDC08A	1000 Units/Rail
LM2724ALDX			4500 Units/Reel

Pin Descriptions

Pin	Name	Function
1	SW	Top driver return. Should be connected to the common node of top and bottom FETs
2	HG	Top gate drive output. Should be connected to the top FET gate.
3	BOOT	Bootstrap. Accepts a bootstrap voltage for powering the high-side driver
4	IN	Accepts a logic control signal
5	SYNC	Bottom gate enable
6	V_{CC}	Connect to +5V supply
7	LG	Bottom gate drive output. Should be connected to the bottom FET gate.
8	GND	Ground

Block Diagram



Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

V_{CC}	7V
BOOT to SW	7V
BOOT to GND (Note 2)	35V
SW to GND	30V
Junction Temperature	+150˚C
Power Dissipation	720mW (SO-8)
(Note 3)	3.2W (LLP-8)
Storage Temperature	−65˚C to 150˚C
ESD Susceptibility	
Human Body Model (Note 4)	2.0 kV
Soldering Time, Temperature	10sec., 300˚C

Operating Ratings (Note 1)

V_{CC}	4.3V to 6.8V
Junction Temperature Range	-40˚C to 125˚C

Electrical Characteristics LM2724A

V_{CC} = BOOT = SYNC = 5V, SW = GND = 0V, unless otherwise specified. Typicals and limits appearing in plain type apply for $T_A = T_J$ = +25˚C. Limits appearing in **boldface** type apply over the entire operating temperature range.

Symbol	Parameter	Condition	Min	Typ	Max	Units
POWER SUPPLY						
I_{q_op}	Operating Quiescent Current	IN = 0V		145	**195**	µA
TOP DRIVER						
	Peak Pull-Up Current			3.0		A
	Pull-Up Rds_on	I_{BOOT} = I_{HG} = 0.3A		1.2		Ω
	Peak Pull-down Current			−3.2		A
	Pull-down Rds_on	I_{SW} = I_{HG} = 0.3A		0.5		Ω
t_4	Rise Time	Timing Diagram, C_{LOAD} = 3.3nF		17		ns
t_6	Fall Time			12		ns
t_3	Pull-Up Dead Time	Timing Diagram		19		ns
t_5	Pull-Down Delay	Timing Diagram, from IN Falling Edge		27		ns
BOTTOM DRIVER						
	Peak Pull-Up Current			3.2		A
	Pull-up Rds_on	I_{VCC} = I_{LG} = 0.3A		1.1		Ω
	Peak Pull-down Current			3.2		A
	Pull-down Rds_on	I_{GND} = I_{LG} = 0.3A		0.6		Ω
t_8	Rise Time	Timing Diagram, C_{LOAD} = 3.3nF		17		ns
t_2	Fall Time			14		ns
t_7	Pull-up Dead Time	Timing Diagram		22		ns
t_1	Pull-down Delay	Timing Diagram		13		ns
LOGIC						
V_{uvlo_up}	V_{CC} Under-Voltage-Lock-Out Upper Threshold	V_{CC} rises from 0V toward 5V			**4**	V
V_{uvlo_dn}	V_{CC} Under-Voltage-Lock-Out Lower Threshold	VCC falls from 5V toward 0V	**2.5**			V
V_{uvlo_hys}	V_{CC} Under-Voltage-Lock-Out Hysteresis	V_{CC} falls from 5V toward 0V		0.8		V
V_{IH_SYNC}	SYNC Pin High Input		**55%**			V_{CC}
V_{IL_SYNC}	SYNC Pin Low Input				**25%**	V_{CC}
I_{leak_SYNC}	SYNC Pin Leakage Current	SYNC = 5V, Sink Current			**2**	µA
		SYNC = 0V, Source Current			**10**	µA

Electrical Characteristics

LM2724A (Continued)

V_{CC} = BOOT = SYNC = 5V, SW = GND = 0V, unless otherwise specified. Typicals and limits appearing in plain type apply for $T_A = T_J$ = +25˚C. Limits appearing in **boldface** type apply over the entire operating temperature range.

Symbol	Parameter	Condition	Min	Typ	Max	Units
I_{leak_IN}	IN Pin Leakage Current	IN = 0V, Source Current			**2**	µA
		IN = 5V, Sink Current			**10**	
t_{on_min1}	Minimum Positive Pulse Width at IN Pin (Note 5)			160		ns
t_{on_min2}	Minimum Positive Pulse Width at IN Pin for HG to Respond (Note 6)			45		
t_{on_min3}	Minimum Positive Pulse Width at IN Pin for LG to Respond (Note 7)			10		
t_{off_min1}	Minimum Negative Pulse Width at IN Pin for LG to Respond (Note 8)			40		
t_{off_min2}	Minimum Negative Pulse Width at IN Pin for HG to Respond (Note 9)			5		
V_{IH_IN}	IN High Level Input Voltage	When IN pin goes high from 0V	**55%**			V_{CC}
V_{IL_IN}	IN Low Level Input Voltage	When IN pin goes low from 5V			**25%**	

Note 1: Absolute Maximum Ratings are limits beyond which damage to the device may occur. **Operating ratings** are conditions under which the device operates correctly. The gaurnteed specifications apply only for the listed test conditions. Some performance characteristics may degrade when the part is not operated under listed conditions.

Note 2: If BOOT voltage exceeds this value, the ESD structure will degrade.

Note 3: Maximum allowable power dissipation is a function of the maximum junction temperature, T_{JMAX}, the junction-to-ambient thermal resistance, θ_{JA}, and the ambient temperature, T_A. The maximum allowable power dissipation at any ambient temperature is calculated using: $P_{MAX} = (T_{JMAX}-T_A) / \theta_{JA}$. The junction-to-ambient thermal resistance, θ_{JA}, for LM2724A is 172˚C/W. For a T_{JMAX} of 150˚C and T_A of 25˚C, the maximum allowable power dissipation is 0.7W. The θ_{JA}, for LM2724A LLP package is 39˚C/W. For a T_{JMAX} of 150˚C and T_A of 25˚C, the maximum allowable power dissipation is 3.2W.

Note 4: ESD machine model susceptibility is 200V.

Note 5: If the positive pulse width at IN pin is below this value but above t_{on_min2}, the pulse is internally stretched to t_{on_min1}, so the HG width will be a constant value.

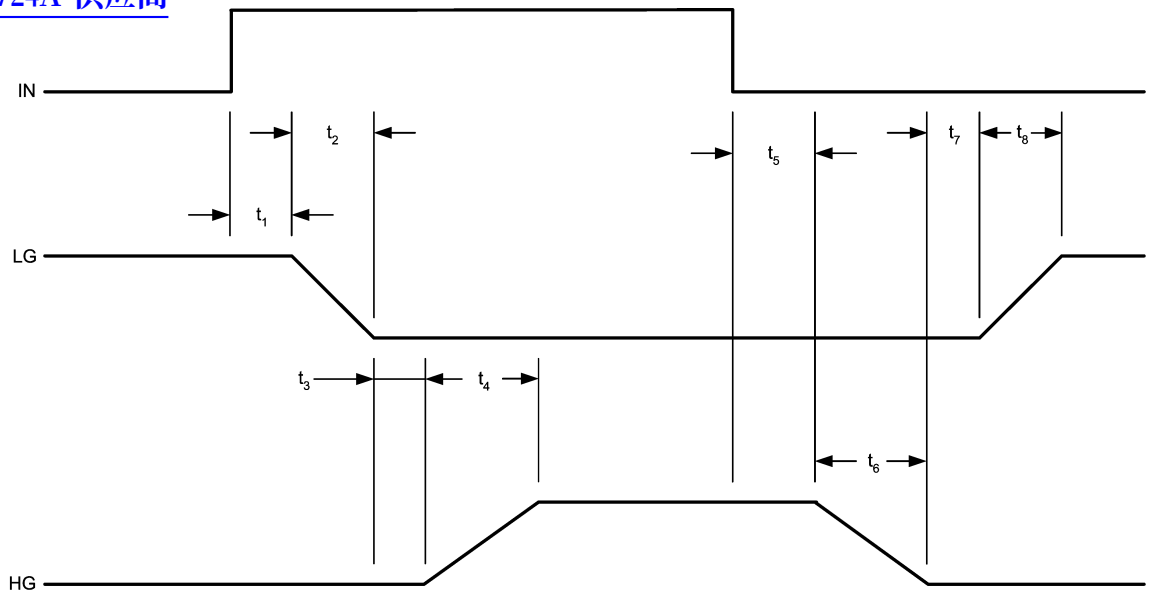
Note 6: If the positive pulse width at IN pin is below this value but above t_{on_min3}, then HG stops responding while LG still responds to the pulse.

Note 7: If the positive pulse width at IN pin is below this value, the pulse will be completely ignored. Neither HG or LG will respond to it.

Note 8: If the negative pulse width at IN pin is below this value but above t_{off_min2}, then LG stops responding while HG still responds.

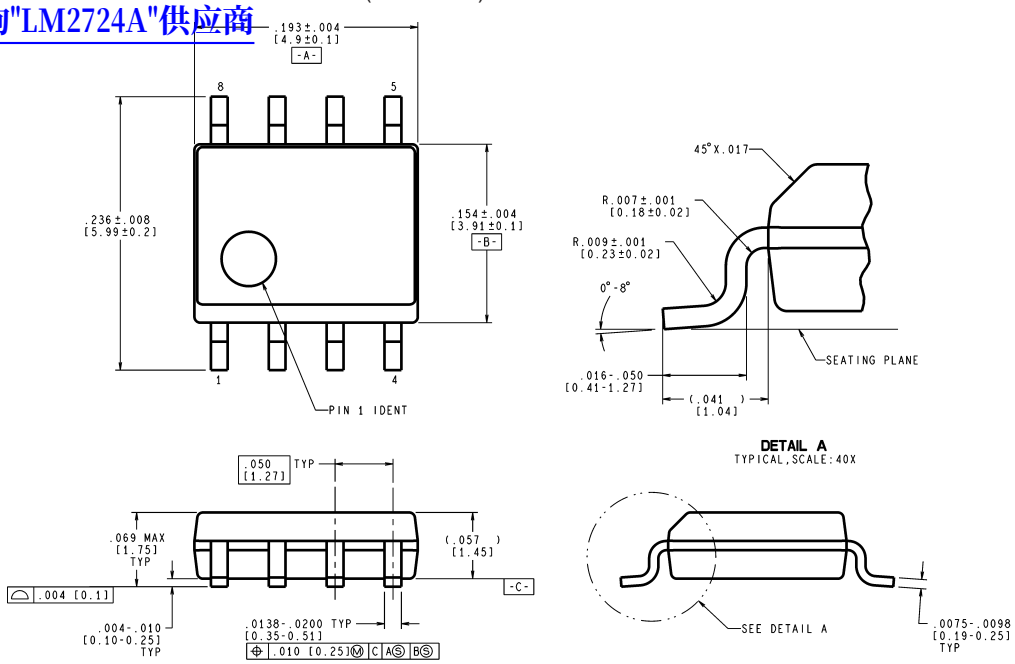
Note 9: If the negative pulse width at IN pin is below this value, the pulse will be completely ignored. Neither HG or LG will respond to it.

Timing Diagram



20073504

Physical Dimensions inches (millimeters) unless otherwise noted

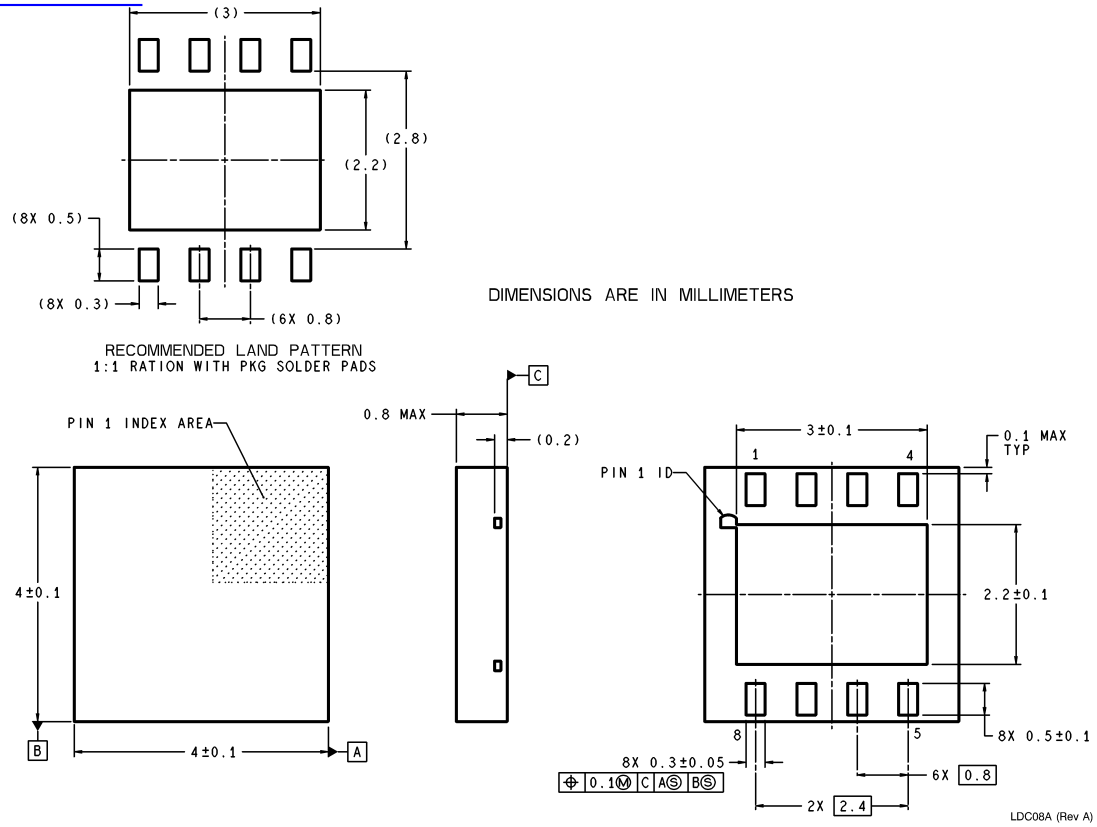


CONTROLLING DIMENSION IS INCH
VALUES IN [ ] ARE MILLIMETERS

M08A (Rev J)

8-Lead Small Outline Package
Order Number LM2724AM, LM2724AMX
NS Package Number M08A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



8-Lead LLP Package
Order Number LM2724ALD, LM2724ALDX
NS Package Number LDC08A

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

www.national.com

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560