

DESCRIPTION

The MP18024 is a high-frequency, 100V, half-bridge, N-channel, power MOSFET driver. Its low-side and high-side driver channels are independently controlled and matched with less than 5ns in time delay. Under-voltage lockout on both high-side and low-side supplies force their outputs low in case of insufficient supply. The integrated bootstrap diode reduces external component count.

FEATURES

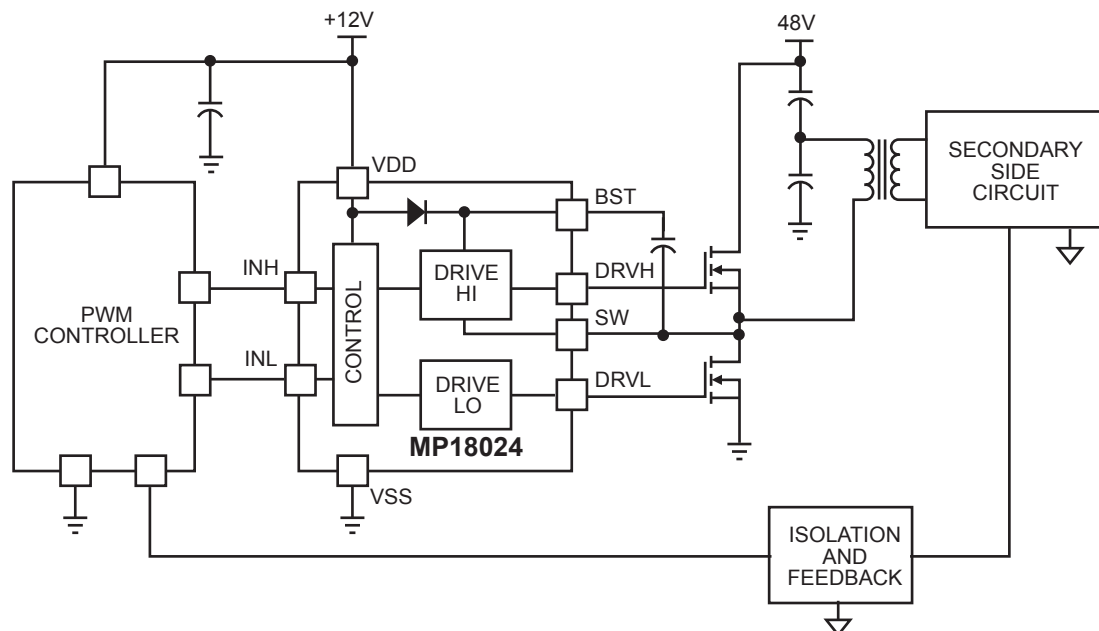
- Drives an N-Channel MOSFET Half Bridge
- 100V V_{BST} Voltage Range
- On-Chip Bootstrap Diode
- Typical Propagation Delay of 20ns
- Gate Drive Matching Of Less Than 5ns
- Drives A 2.2nf Load with 15nm Rise Time and 12ns Fall Time at 12v VDD
- TTL-Compatible Input
- Quiescent Current of Less Than 150 μ A
- UVLO for Both High Side and Low Side
- SOIC8E Package

APPLICATIONS

- Telecom Half-Bridge Power Supplies
- Avionics DC-DC Converters
- Two-Switch Forward Converters
- Active-Clamp Forward Converters

For MPS green status, please visit MPS website under Quality Assurance. "MPS" and "The Future of Analog IC Technology" are Registered Trademarks of Monolithic Power Systems, Inc.

TYPICAL APPLICATION



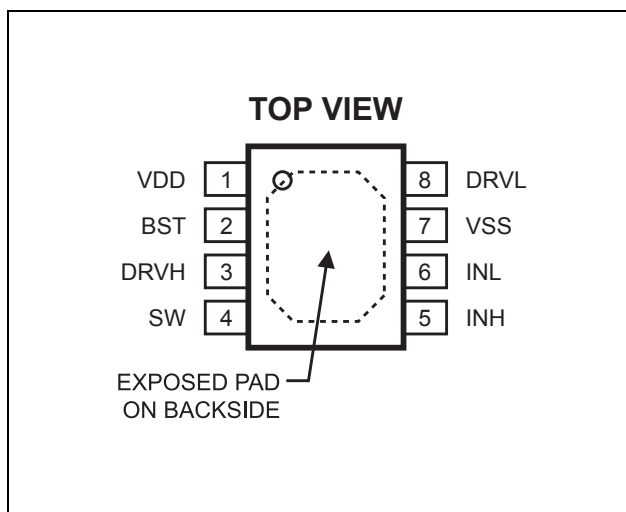
ORDERING INFORMATION

Part Number*	Package	Top Marking
MP18024HN	SOIC8E	MP18024HN

* For Tape & Reel, add suffix -Z (e.g. MP18024HN-Z);

For RoHS compliant packaging, add suffix -LF; (e.g. MP18024HN-LF-Z)

PACKAGE REFERENCE

ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

Supply Voltage (V_{DD})	-0.3V to +18V
SW Voltage (V_{SW})	-5.0V to +105V
BST Voltage (V_{BST})	-0.3V to +118V
BST to SW	-0.3V to +18V
DRVH to SW	-0.3V to (BST-SW) + 0.3V
DRVL to VSS	-0.3V to (V_{DD} + 0.3V)
All Other Pins	-0.3V to (V_{DD} + 0.3V)
Continuous Power Dissipation ($T_A = 25^\circ\text{C}$) ⁽²⁾	2.6W
Junction Temperature	150°C
Lead Temperature	260°C
Storage Temperature	-65°C to +150°C

Recommended Operating Conditions ⁽³⁾

Supply Voltage V_{DD}	9.0V to 16.0V
SW Voltage (V_{SW})	-1.0V to 100V
SW Slew Rate	<50V/ns
Operating Junction Temp. (T_J)	-40°C to +125°C

Thermal Resistance ⁽⁴⁾	θ_{JA}	θ_{JC}
SOIC8E	48	10... °C/W

Notes:

- Exceeding these ratings may damage the device.
- The maximum allowable power dissipation is a function of the maximum junction temperature $T_J(\text{MAX})$, the junction-to-ambient thermal resistance θ_{JA} , and the ambient temperature T_A . The maximum allowable continuous power dissipation at any ambient temperature is calculated by $P_D(\text{MAX}) = (T_J(\text{MAX}) - T_A) / \theta_{JA}$. Exceeding the maximum allowable power dissipation will cause excessive die temperature, and the regulator will go into thermal shutdown. Internal thermal shutdown circuitry protects the device from permanent damage.
- The device is not guaranteed to function outside of its operating conditions.
- Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

$V_{DD} = V_{BST} - V_{SW} = 12V$, $V_{SS} = V_{SW} = 0V$, No load at DRVH and DRVL, $T_A = +25^\circ C$, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Supply Currents						
VDD quiescent current	I _{DDQ}	INL = INH = 0		100	150	μA
VDD operating current	I _{DDO}	fsw = 500kHz		9		mA
Floating driver quiescent current	I _{BSTQ}	INL = INH = 0		60	90	μA
Floating driver operating current	I _{BSTO}	fsw = 500kHz		7.5		mA
Leakage current	I _{LK}	BST = SW = 100V		0.05	1	μA
Inputs						
INL/INH High				2	2.4	V
INL/INH Low			1	1.4		V
INL/INH internal pull-down resistance	R _{IN}			185		kΩ
Under Voltage Protection						
VDD rising threshold	V _{DDR}		8.1	8.4	8.8	V
VDD hysteresis	V _{DDH}			0.5		V
(BST-SW) rising threshold	V _{BSTR}		6.9	7.3	7.7	V
(BST-SW) hysteresis	V _{BSTH}			0.55		V
Bootstrap Diode						
Bootstrap diode VF @ 100μA	V _{F1}			0.5		V
Bootstrap diode VF @ 100mA	V _{F2}			0.95		V
Bootstrap diode dynamic R	R _D	@ 100mA		2		Ω
Low Side Gate Driver						
Low level output voltage	V _{OLL}	I _O = 100mA		0.08		V
High level output voltage to rail	V _{OHL}	I _O = -100mA		0.23		V
Peak pull-up current	I _{OHL}	V _{DRVL} = 0V, V _{DD} = 12V		3		A
		V _{DRVL} = 0V, V _{DD} = 16V		4.7		A
Peak pull-down current	I _{OLL}	V _{DRVL} = V _{DD} = 12V		4.5		A
		V _{DRVL} = V _{DD} = 16V		6		A
Floating Gate Driver						
Low level output voltage	V _{OLH}	I _O = 100mA		0.08		V
High level output voltage to rail	V _{OHH}	I _O = -100mA		0.23		V
Peak pull-up current	I _{OHH}	V _{DRVH} = 0V, V _{DD} = 12V		2.6		A
		V _{DRVH} = 0V, V _{DD} = 16V		4		A
Peak pull-down current	I _{OLH}	V _{DRVH} = V _{DD} = 12V		4.5		A
		V _{DRVH} = V _{DD} = 16V		5.9		A

ELECTRICAL CHARACTERISTICS *(continued)*

$V_{DD} = V_{BST} - V_{SW} = 12V$, $V_{SS} = V_{SW} = 0V$, No load at DRVH and DRVL, $T_A = 25^\circ C$, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Switching Spec. --- Low Side Gate Driver						
Turn-off propagation delay INL falling to DRVL falling	T_{DLFF}			20		ns
Turn-on propagation delay INL rising to DRVL rising	T_{DLRR}			20		
DRVL rise time		$C_L = 2.2nF$		15		ns
DRVL fall time		$C_L = 2.2nF$		9		ns
Switching Spec. --- Floating Gate Driver						
Turn-off propagation delay INL falling to DRVH falling	T_{DHFF}			20		ns
Turn-on propagation delay INL rising to DRVH rising	T_{DHRR}			20		ns
DRVH rise time		$C_L = 2.2nF$		15		ns
DRVH fall time		$C_L = 2.2nF$		12		ns
Switching Spec. --- Matching						
Floating driver turn-off to low side drive turn-on	T_{MON}			1	5	ns
Low side driver turn-off to floating driver turn-on	T_{MOFF}			1	5	ns
Minimum input pulse width that changes the output	T_{PW}				50 ⁽⁵⁾	ns
Bootstrap diode turn-on or turn- off time	T_{BS}			10 ⁽⁵⁾		ns
Thermal shutdown				150		$^\circ C$
Thermal shutdown hysteresis				25		$^\circ C$

Note:

5) Guaranteed by design.

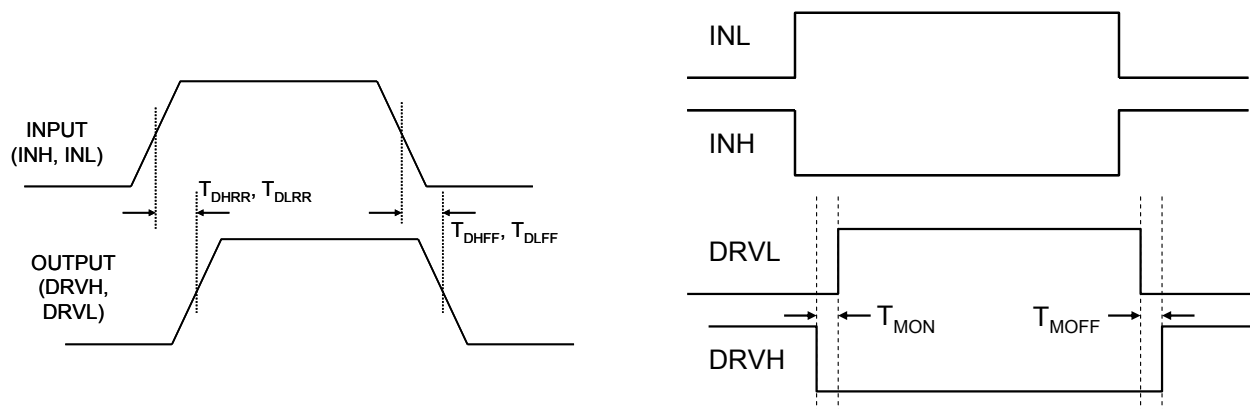


Figure 1—Timing Diagram

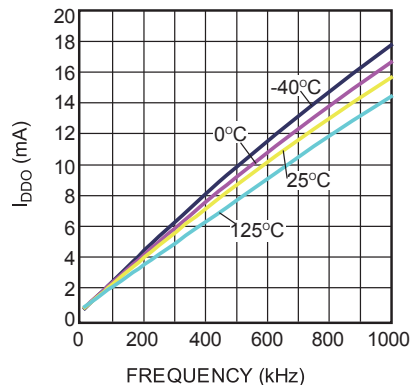
PIN FUNCTIONS

Pin #	Name	Description
1	VDD	Supply input. This pin supplies power to all the internal circuitry. Place a decoupling capacitor to ground close to this pin to ensure stable and clean supply.
2	BST	Bootstrap. This is the positive power supply for the internal floating high-side MOSFET driver. Connect a bypass capacitor between this pin and SW pin.
3	DRVH	Floating driver output.
4	SW	Switching node.
5	INH	Control signal input for the floating driver.
6	INL	Control signal input for the low side driver.
7	VSS, exposed pad	Chip ground. Connect exposed pad to VSS for proper thermal operation.
8	DRVL	Low side driver output.

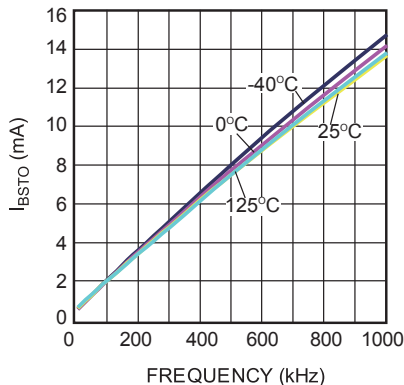
TYPICAL PERFORMANCE CHARACTERISTICS

$V_{DD} = 12V$, $V_{SS} = V_{SW} = 0V$, $T_A = 25^\circ C$, unless otherwise noted.

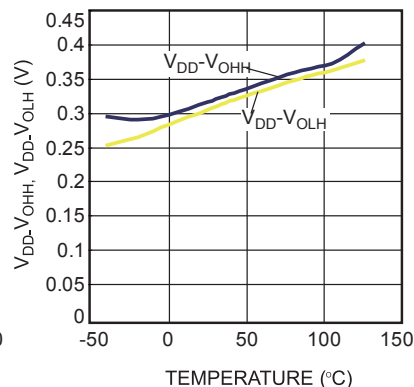
I_{DDQ} Operation Current vs. Frequency



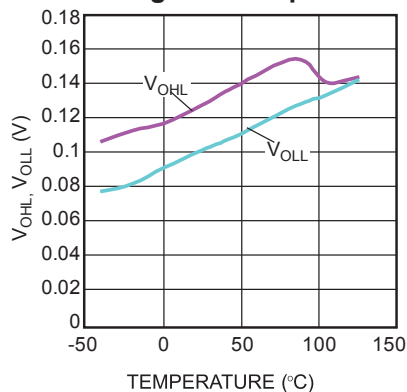
I_{BSTQ} Operation Current vs. Frequency



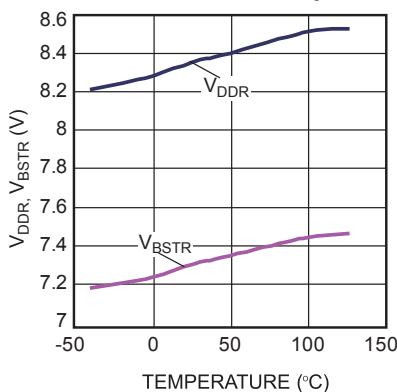
High Level Output Voltage vs. Temperature



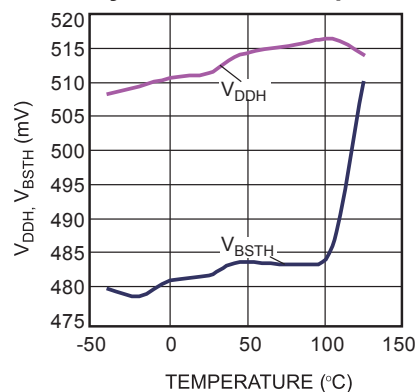
Low Level Output Voltage vs. Temperature



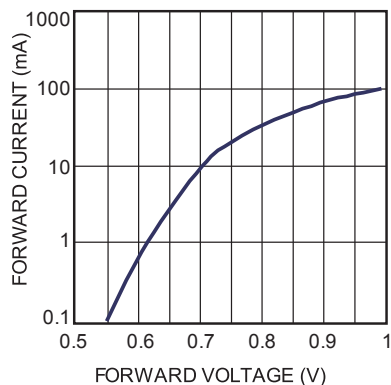
Undervoltage Lockout Threshold vs. Temperature



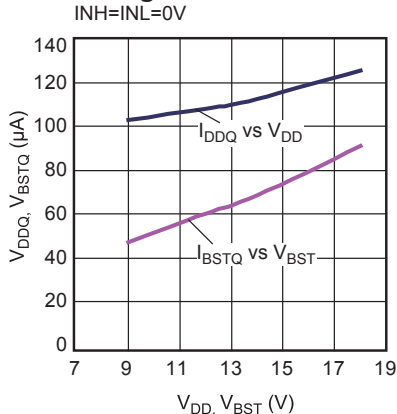
Undervoltage Lockout Hysteresis vs. Temperature



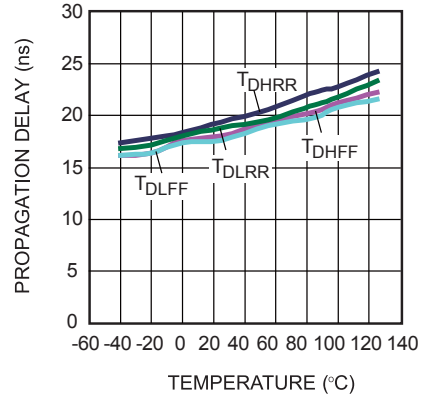
Bootstrap Diode I-V Characteristic



Quiescent Current vs. Voltage



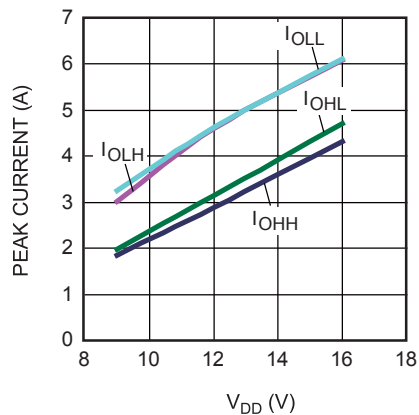
Propagation Delay vs. Temperature



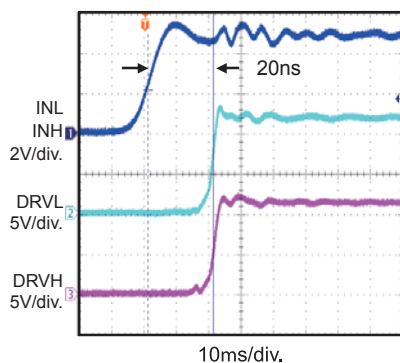
TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

$V_{DD} = 12V$, $V_{SS} = V_{SW} = 0V$, $T_A = 25^\circ C$, unless otherwise noted.

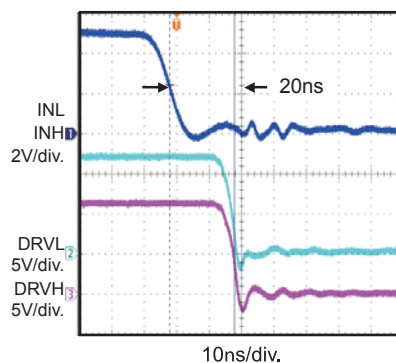
**Peak Current vs.
V_{DD} Voltage**



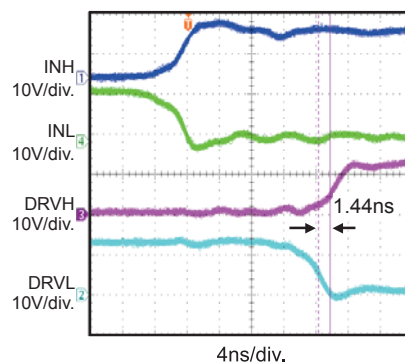
Turn-on Propagation Delay



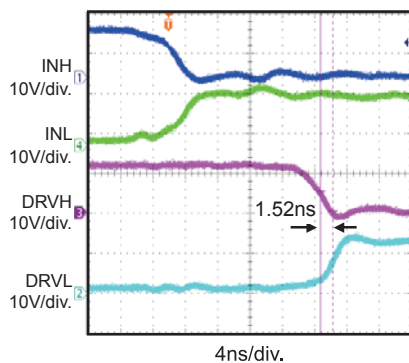
Turn-off Propagation Delay



Gate Drive Matching T_{MOFF}

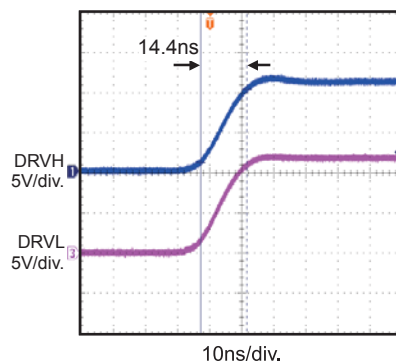


Gate Drive Matching T_{MON}



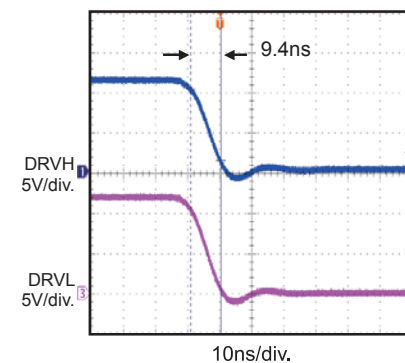
Drive Rise Time

2.2nF Load



Drive Fall Time

2.2nF Load



BLOCK DIAGRAM

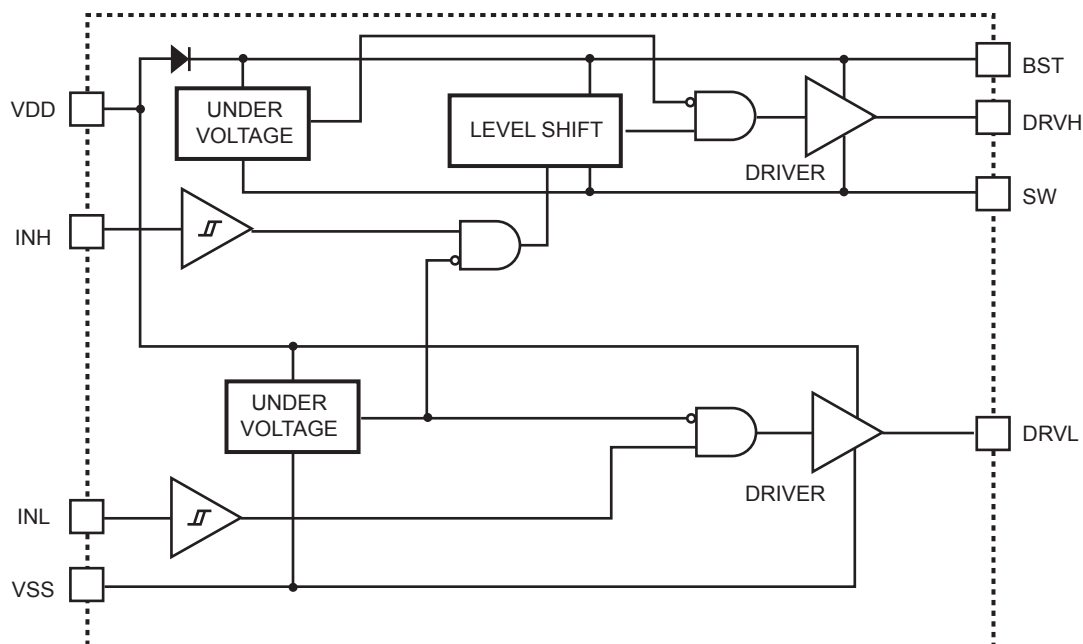


Figure 2—Function Block Diagram

APPLICATION

The input signals INH and INL can be controlled independently. If both INH and INL control the high-side MOSFET and low-side MOSFET of the same bridge, then users must avoid shoot through by

setting sufficient dead time between INH and INL low, and vice versa. See Figure 3 below. Dead time is defined as the time interval between INH low and INL low.

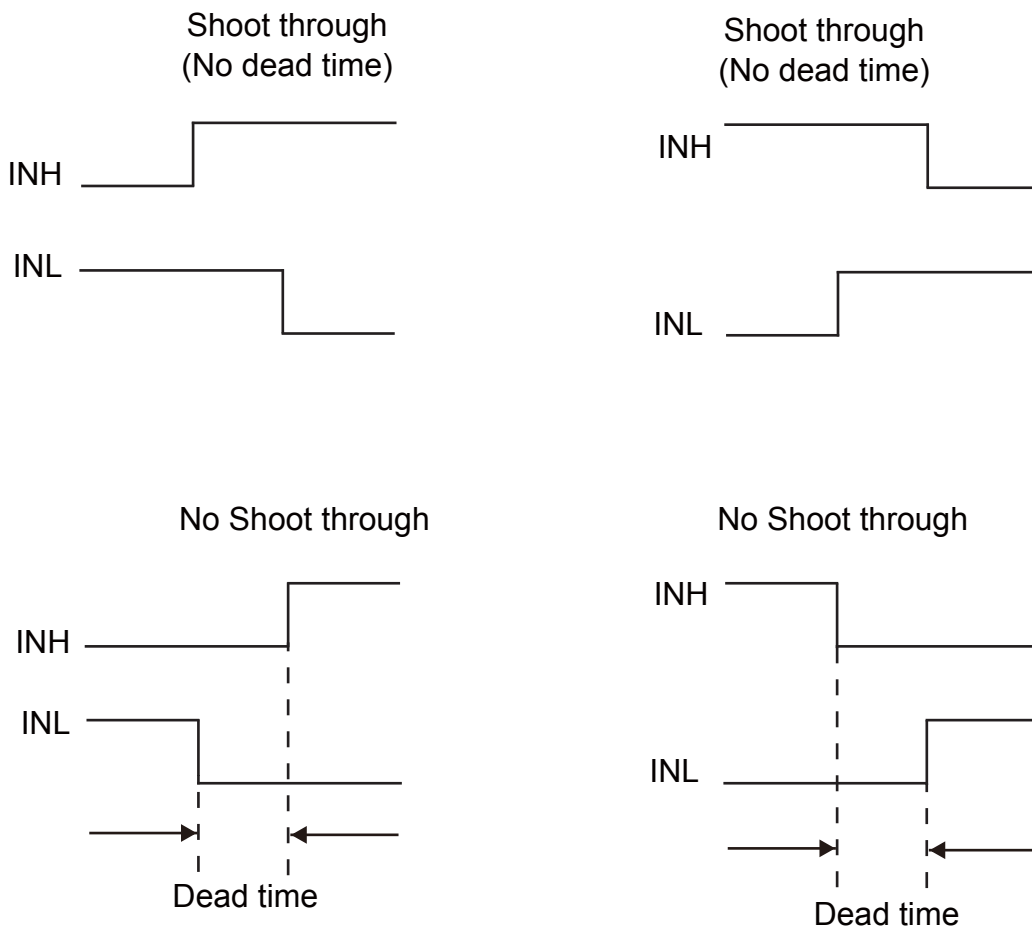


Figure 3—Shoot-Through Timing Diagram

REFERENCE DESIGN CIRCUITS

Half Bridge Converter

The MP18024 drives the MOSFETs with alternating signals (with dead time) in half-bridge converter topology. Therefore, from the PWM

controller drives INH and INL with alternating signals. The input voltage can go up to 100V.

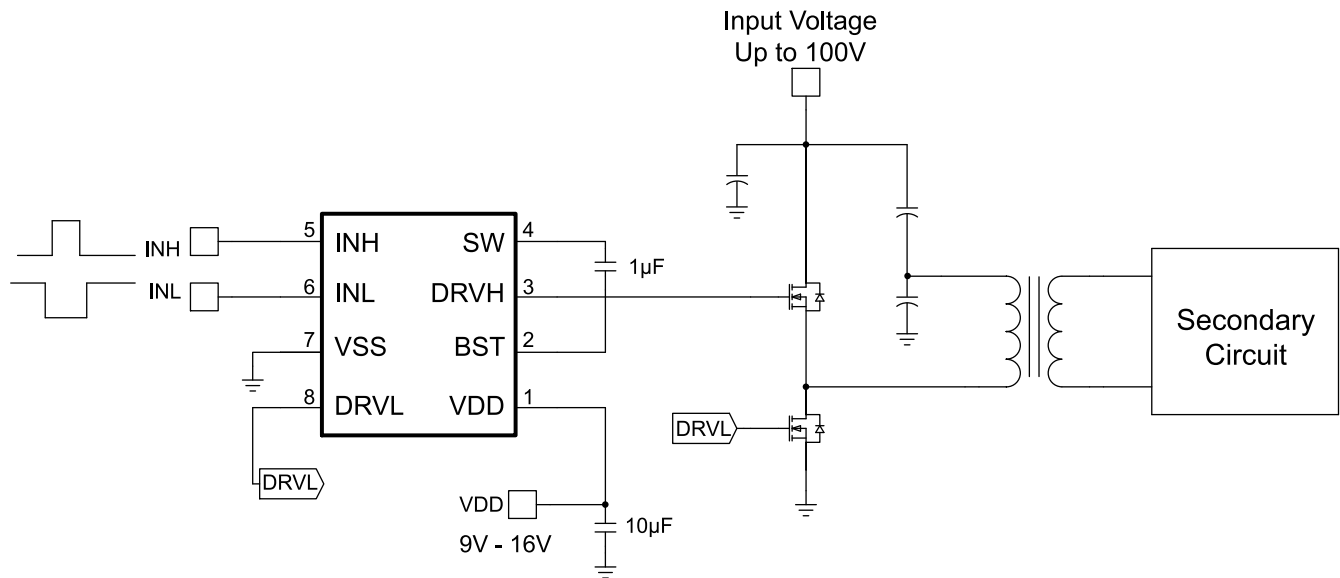


Figure 4—Half Bridge Converter

Two-Switch Forward Converter

In two-switch forward converter topology, both MOSFETs are turned on and off simultaneously. The input signal (INH and INL) comes from a PWM controller that senses the output voltage (and output current during current-mode control).

The Schottky diodes clamp the reverse swing of the power transformer and must be rated for the input voltage. The input voltage can go up to 100V.

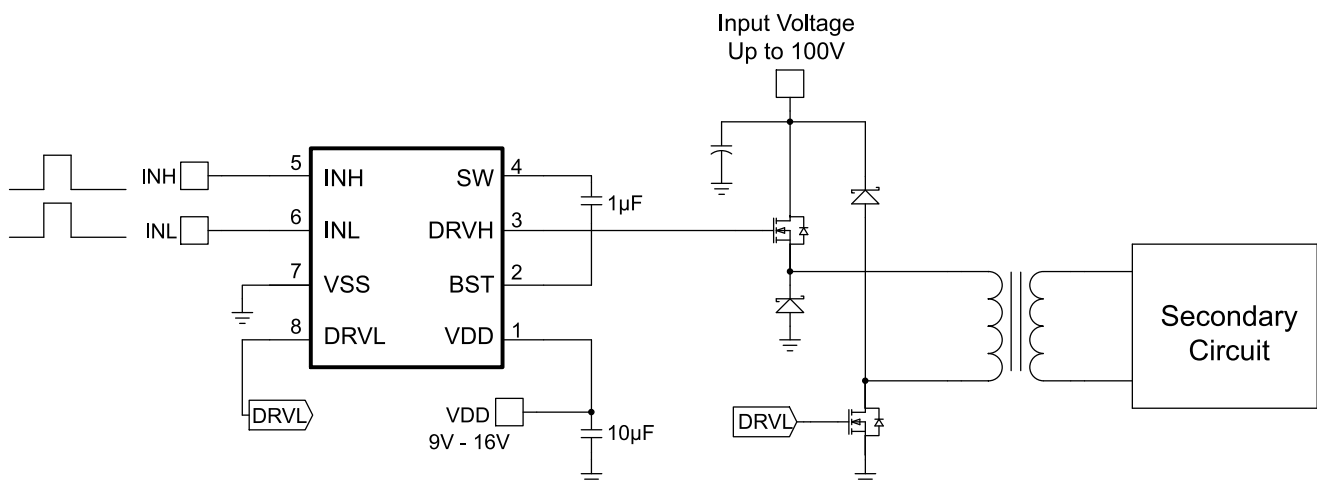


Figure 5—Two-Switch Forward Converter

Active-Clamp Forward Converter

In active-clamp-forward converter topology, the MP18024 drives the MOSFETs with alternating signals. The high-side MOSFET, in conjunction with Creset, is used to reset the power transformer in a lossless manner.

This topology lends itself well to run at duty cycles exceeding 50%. The device may not be able to run at 100V with this topology.

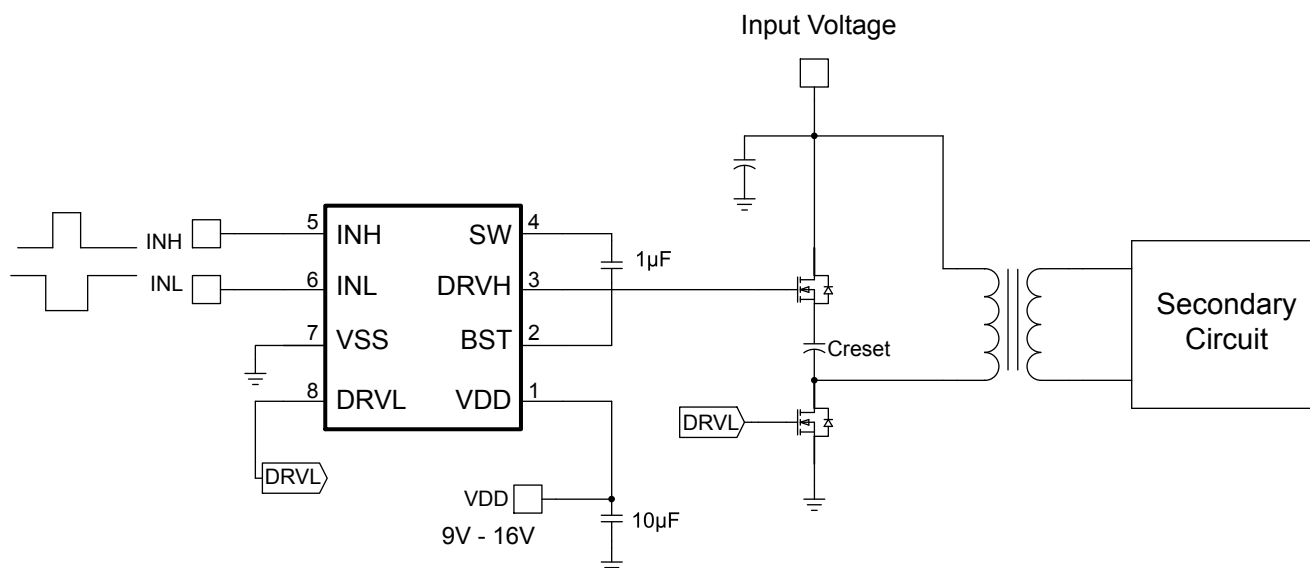
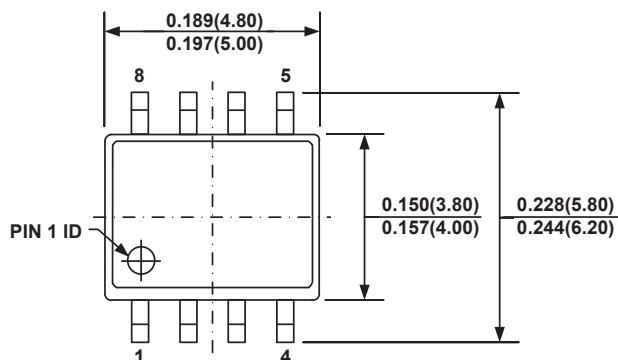


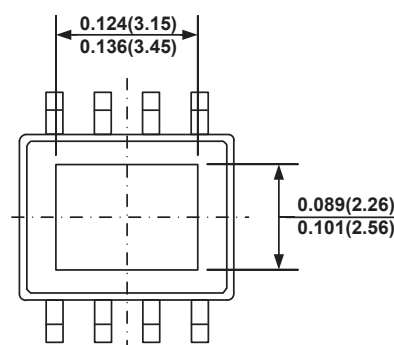
Figure 6—Active-Clamp Forward Converter

PACKAGE INFORMATION

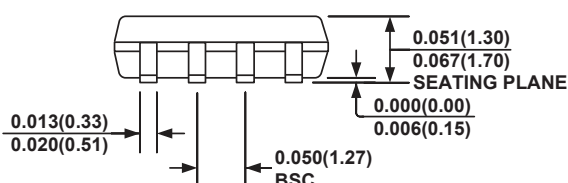
SOIC8E



TOP VIEW

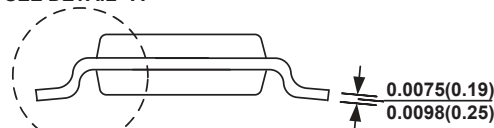


BOTTOM VIEW

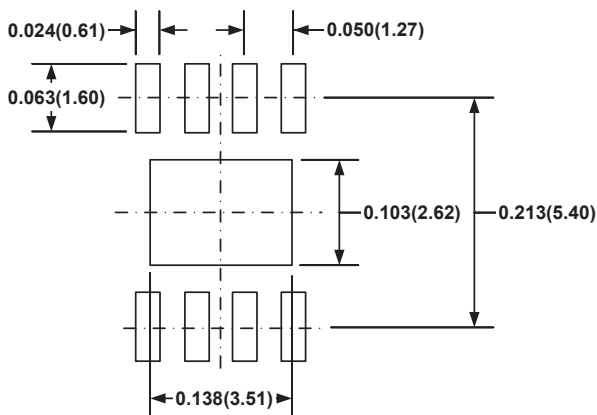


FRONT VIEW

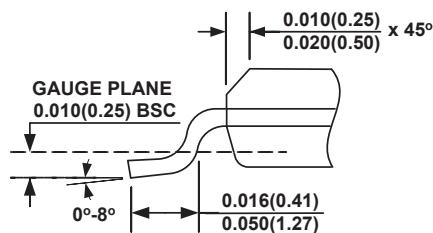
SEE DETAIL "A"



SIDE VIEW



RECOMMENDED LAND PATTERN



DETAIL "A"

NOTE:

- 1) CONTROL DIMENSION IS IN INCHES. DIMENSION IN BRACKET IS IN MILLIMETERS.
- 2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
- 3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
- 4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.004" INCHES MAX.
- 5) DRAWING CONFORMS TO JEDEC MS-012, VARIATION BA.
- 6) DRAWING IS NOT TO SCALE.

NOTICE: The information in this document is subject to change without notice. Users should warrant and guarantee that third party Intellectual Property rights are not infringed upon when integrating MPS products into any application. MPS will not assume any legal responsibility for any said applications.