MID6W2424A

6W, 24Vin Isolated Power Module for IGBT/SiC Bias Supply

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

DESCRIPTION

The MID6W2424A is an 6W, 24Vin, 3kVrms isolated DC to DC power module with an integrated transformer. This solution is ideal for being used as an isolated power supply for biasing power transistors such as silicon carbide (SiC), silicon FETs, and IGBTs. It supports up to 6W output power with 24V input voltage, and -40°C to 105°C operating ambient temperature.

The MID6W2424A simplifies the design of an isolated bias supply by integrating the control, switching power stage, protection circuitry, the transformer, and other passive components in one package. This module provides a small solution size and higher reliability operation compared to a traditional system in package (SIP) isolated power module.

MID6W2424A features different protection features such as over voltage (OVP), over current (OCP), and over temperature protection (OTP). This device uses a soft switching topology for improved EMI performance.

The MID6W2424A requires a minimal number of readily available, standard external components. It is available in a low profile 4.8 mm tall LGA 10x10mm package.

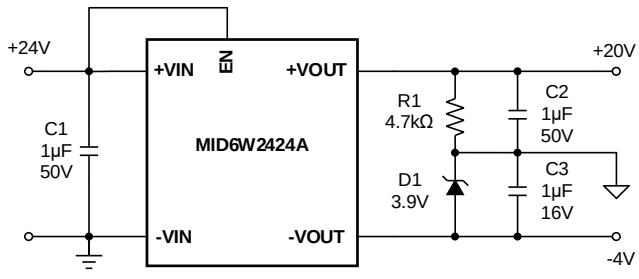
FEATURES

- Optimized for 24V±10% Input Voltage
- 1:1 Input/Output Voltage Ratio
- Up to 6W Output Power
- 500kHz Switching Frequency
- 3kVrms Isolation Test Voltage ‘Hi-Pot Test’
- Soft Start, OCP, Input OVP, OTP
- Operating Ambient Temperature: -40°C to 105°C
- EN62368-1 Compliant

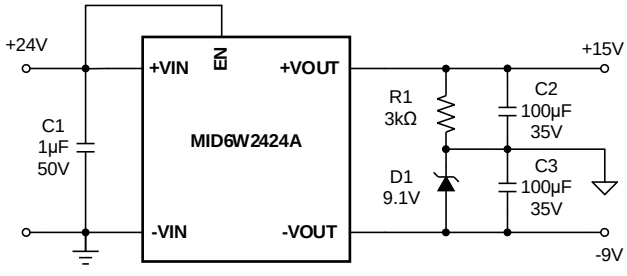
APPLICATIONS

- Isolated Gate Driver

TYPICAL APPLICATION



SIC GATE DRIVER POWER SUPPLY



IGBT GATE DRIVER POWER SUPPLY

ORDERING INFORMATION

Part Number*	Package	Top Marking	MSL Rating
MID6W2424AGO-3U	LGA-6 (10mm x 10mm)	*See below*	3

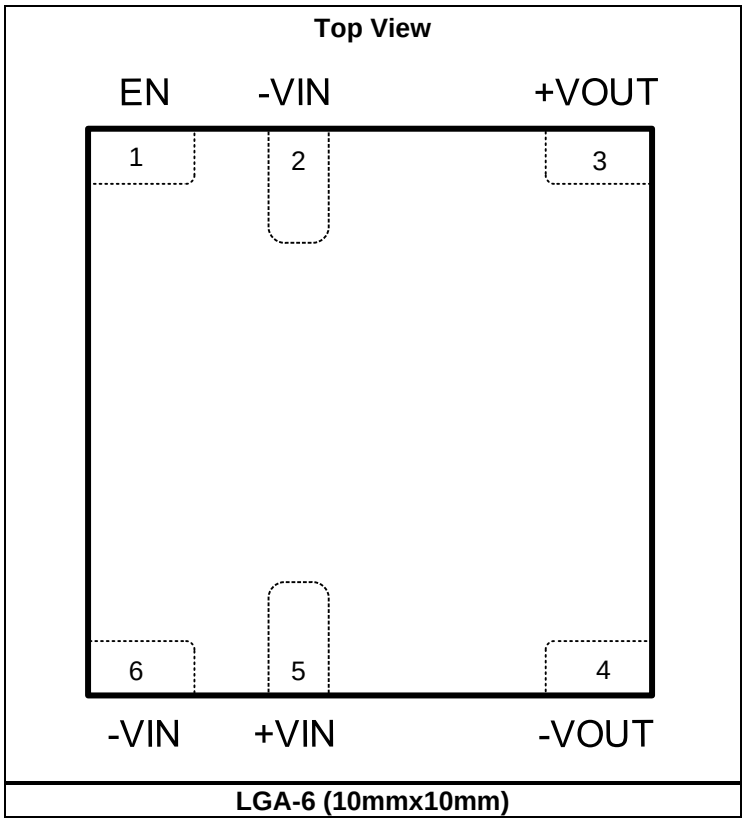
* For Tray, add suffix -T (e.g., MID6W2424AGO-3U-T).

TOP MARKING

ww: yyxxx *
MPS
MIDxWxxxx

* ww: Week code
yy: Year code
xxx: Lot number

PACKAGE REFERENCE



LGA-6 (10mmx10mm)

PIN FUNCTIONS

LGA-6 Pin #	Name	Description
1	EN	**Enable.** Pull high to enable MID6W2424A, pull low to disable MID6W2424A. EN can be connected to +VIN directly for automatic start-up.
2,6	-VIN	**Ground to Input Voltage**
3	+VOUT	**Output Voltage**
4	-VOUT	**Ground to Output Voltage**
5	+VIN	**Input Voltage.** Place a 1uF ceramic capacitor close to Pin 5 and Pin 6 for good decoupling.

ABSOLUTE MAXIMUM RATINGS (1)

VIN, EN ..... -0.3V to 36V
Junction Temperature ..... 150°C
Lead Temperature ..... 260°C
Storage Temperature ..... -65°C to +150°C
Continuous Power Dissipation (T_A = +25°C) (2)
..... 1.2W

Recommended Operating Conditions (3)

Input Voltage VIN..... 10.8V to 26.4V
Ambient Temp. (T_A) ..... -40°C to +105°C

Thermal Resistance θ_{BA} (4)

MID6W2424A ..... 45.6 . °C/W
EV6W2424A-O-00A (5) ..... 32.6. °C/W

Notes:

1) Exceeding these ratings may damage the device.
2) The maximum allowable power dissipation is a function of the maximum junction temperature T_J (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 (MAX) = (T_J (MAX)-T_A)/θ_{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.
3) The device is not guaranteed to function outside of its operating conditions.
4) MID6W2424A module board-to-ambient thermal resistance, tested with still air.
5) Measured on EV6W2424A-O-00A, 2-layer PCB.

ELECTRICAL CHARACTERISTICS

V_{IN} = 24V, T_J = -40°C to +105°C, Typical value is tested at T_J = +25°C, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
Power Supply Transformer Driver						
Nominal Switching Frequency	F_S	Vin=24V, full load range		500		kHz
Input Over Voltage Protection Threshold	V_{OVP_T}	Rising	31	33	35	V
	V_{OVP_F}	Falling	28.5	30	32.5	V
Input OVP Hysteresis	V_{OVP_H}			3		V
EN Turn on Threshold	V_{EN_ON}	V_{EN} rising	1.0	1.1	1.2	V
EN Turn off Threshold	V_{EN_OFF}	V_{EN} falling	0.8	0.9	1.0	V
EN Hysteresis	V_{EN_HYS}			0.2		V
Soft-Start Time(6)	t_{SS}			20		ms
Thermal Shutdown(6)	T_{SD}			170		°C
Thermal Shutdown Hysteresis(6)	ΔT_{SD}			25		°C
System Level Parameters						
Nominal Input Voltage				24		V
Input Current at Rated Load				290		mA
No Load Input Current	I_Q	V_{IN}=24V, V_{EN} = 3.3V		10		mA
Efficiency		250mA load		86.6		%
Maximum Capacitive Load(6)		Capacitive load, module starts-up without entering OCP hiccup		470		µF
Load Regulation		From 10% load to full load		7	9	%
Line Regulation		Input voltage change ±1%		±1.1		%/%
No-Load Output Voltage		Tested on Typical Application Circuit		26		V
		Tested on Typical Application Circuit with Zener diode disconnected		31.5		
Voltage Set Point Accuracy		250mA load, $V_{OUT,NOM}$=24.5V	-0.9	-1.3	-1.8	%
OC Threshold			100%	125%	150%	Io
Product Temperature Rise above Ambient(6)		250mA load		58		°C
Operation with Temperature Rise				See derating graph		
Isolation Voltage		Pin 1-2 and 5-6 to Pin 3-4, qualified test with 3kVAC, 1min Production test with 3kVAC, 1s	3			kVrms
Isolation capacitance		Pin 1-2 and 5-6 to Pin 3-4, 1MHz/0.1V		4		pF
Isolation Resistance		Pin 1-2 and 5-6 to Pin 3-4, 500VDC	50			GΩ

ELECTRICAL CHARACTERISTICS *(continued)*

V_{IN} = 24V, T_J = -40°C to +105°C, Typical value is tested at T_J = +25°C, unless otherwise noted.

Parameter	Symbol	Condition	Min	Typ	Max	Units
CMTI		V_{cm}=650V	100			kV/µs
Ripple & Noise		Peak to peak value, 250mA load, tested on Typical Application Circuit(7)		140		mV
MTTF		MIL 217		64		kyr
Safety Regulation						
ESD		IEC/EN61000-4-2		±4		kV
Electrical Fast Transient (EFT) / Burst Transients		IEC/EN61000-4-4		±2		kV
Surge Immunity		IEC/EN61000-4-5, Input to Output		±2		kV

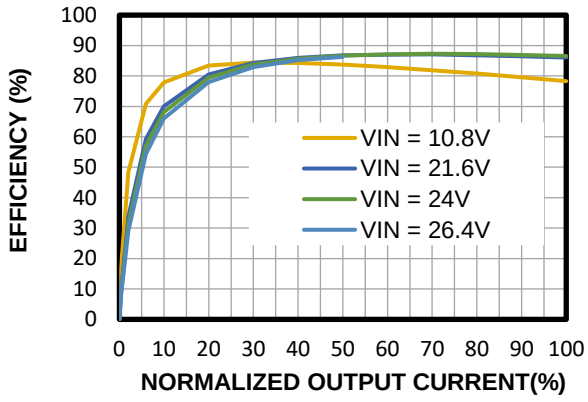
Notes:

6) Tested by bench characterization only
7) Refer to Figure 2.

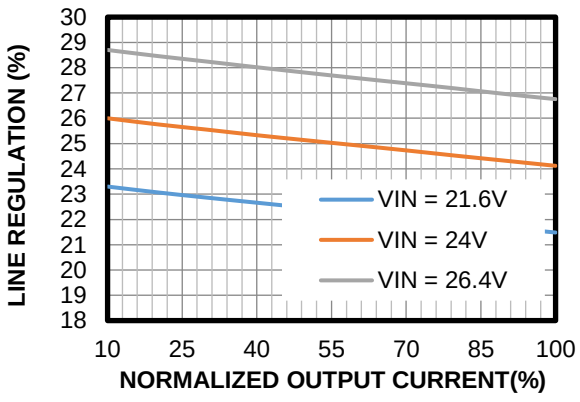
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 24V, I_{OUT} = 0.25A, T_A = -40°C to +105°C, Typical value is tested at T_A = +25°C, unless otherwise noted.

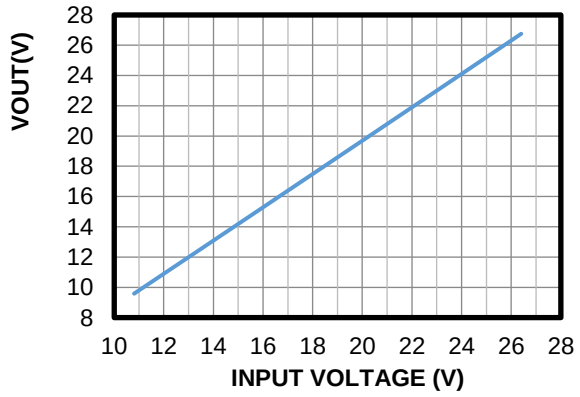
Efficiency vs. Load Current



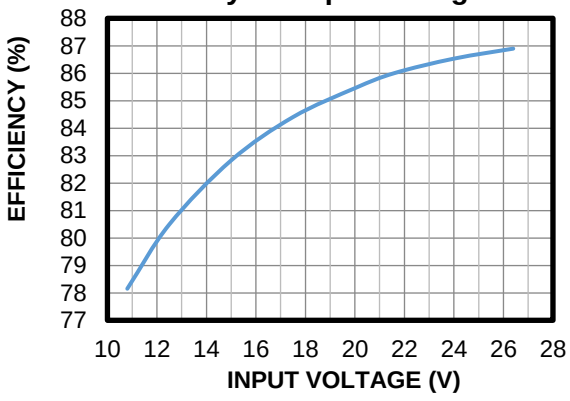
Output Voltage vs. Load Current



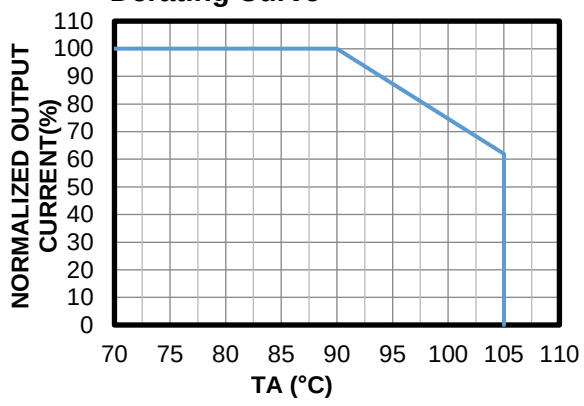
Output Voltage vs. Input Voltage



Efficiency vs. Input Voltage



Derating Curve

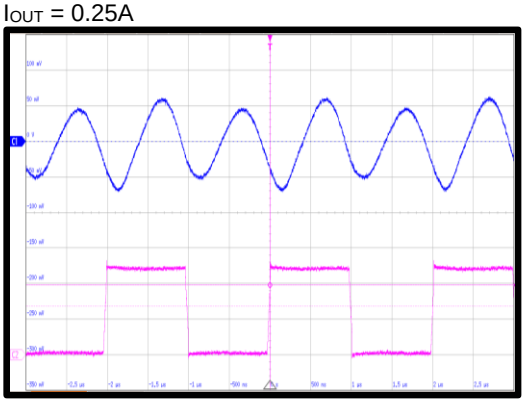


TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 24V, I_{OUT} = 0.25A, T_A = +25°C, unless otherwise noted.

Steady State

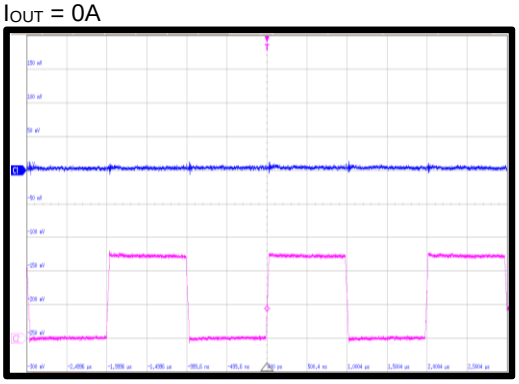
I_{OUT} = 0.25A



500ns/div.

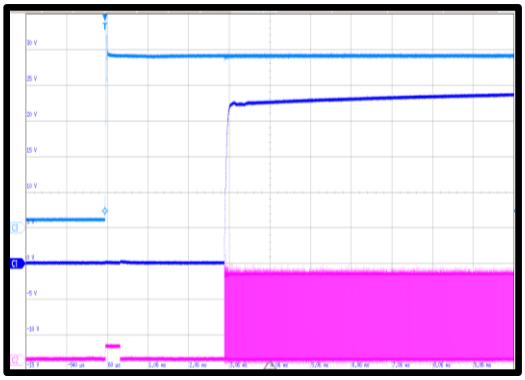
Steady State

I_{OUT} = 0A



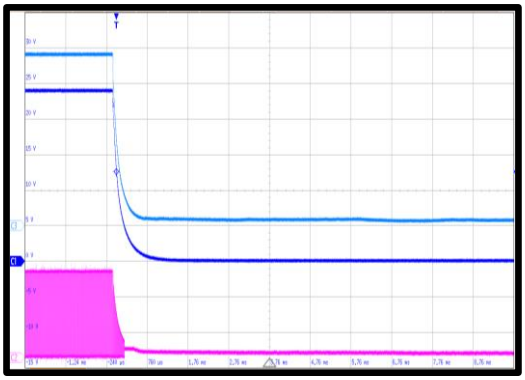
500ns/div.

Start-Up through V_{IN}



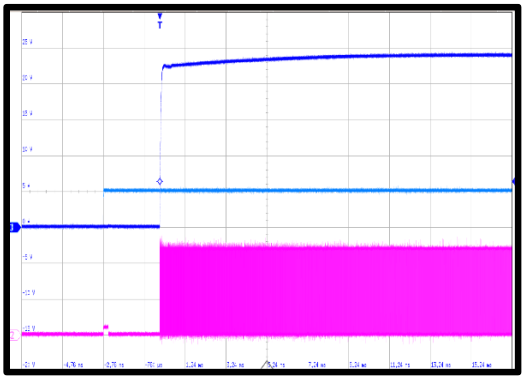
1ms/div.

Shutdown through V_{IN}



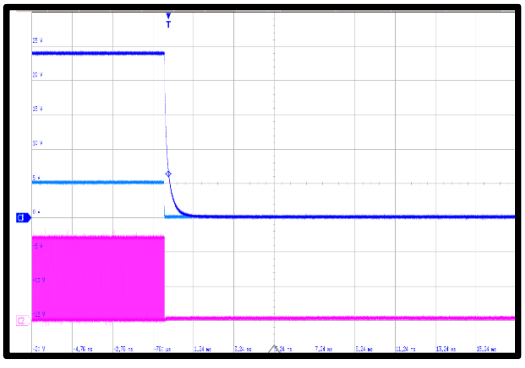
1ms/div.

Start-Up through EN



2ms/div.

Shutdown through EN



2ms/div.

TYPICAL PERFORMANCE CHARACTERISTICS *(continued)*

V_{IN} = 24V, I_{OUT} = 0.25A, T_A = +25°C, unless otherwise noted.

SCP Entry

Load switched from 250mA to SHORT

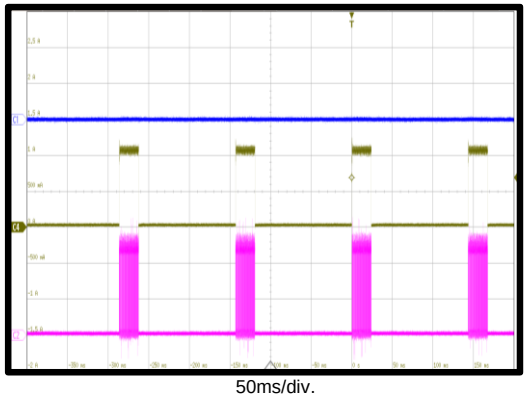
50ms/div.

SCP Recovery

Load switched from SHORT to 250mA

50ms/div.

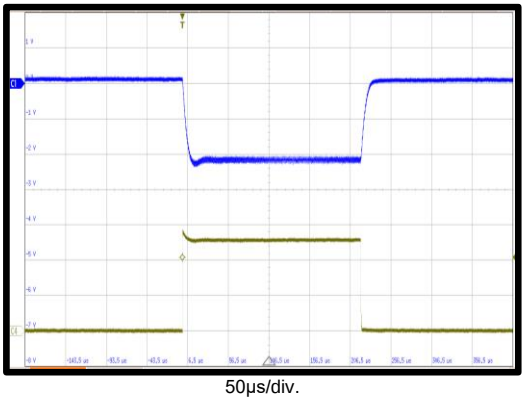
SCP Steady State



50ms/div.

Load Transient Response

I_{OUT} = 4mA <-> 0.25A



50µs/div.

OPERATION

Enable Control

The EN pin enables and disables the MID6W2424A power converter. When applying a voltage higher than the EN start up threshold the MID6W2424A is enabled and starts switching operation after a delay. The device is disabled when the EN voltage falls below the turn off threshold. EN pin is compatible with voltage up to 30V, for automatic start-up, connect EN pin to VIN pin directly.

Soft-Start of Power Converter

The MID6W2424A implements a soft start mechanism to limit the inrush current during start-up.

Over Current & Short Circuit Protection

In over current (OC) condition, the MID6W2424A will limit the transformer current to a constant value. If the OC condition persists for longer than 20ms, the part shuts down and auto-retries after a waiting time.

During an abrupt dead short, the inrush current may trigger short circuit protection. The part will immediately shut down and auto-retries after a waiting time.

Over Voltage Protection

When input voltage goes above the over voltage protection threshold, the converter immediately stops switching. After the input voltage falls below the OVP threshold (with hysteresis), the part restarts.

Over Temperature Protection

MID6W2424A constantly monitors the transformer driver temperature. When the transformer driver temperature goes over the thermal shutdown limit, the part shuts down. After the temperature falls back below thermal limit (with hysteresis), the part restarts.

APPLICATION INFORMATION

Start-up/Shut-down Threshold

For automatic start-up and shut-down the input voltage threshold can be set by connecting voltage divider between +VIN and -VIN. Referring to Figure 5, when the external EN control is left open, the turn-on and turn-off thresholds are set by the ratio of R4 to R3:

$$V_{IN\_ON(OFF)} = V_{EN\_ON(OFF)}\left(1 + \frac{R_4}{R_3}\right)$$

Set resistor values so that the load they present to +Vin is acceptable.

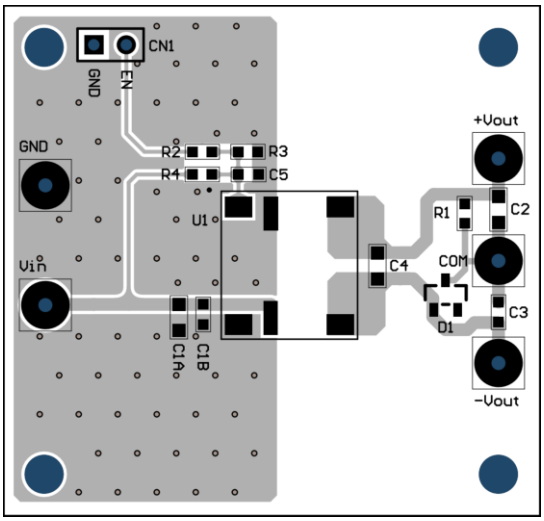
Filtering EN

Unless connected directly to +VIN, add 10nF capacitor between EN and -VIN pins to prevent any noise disturbing normal operation.

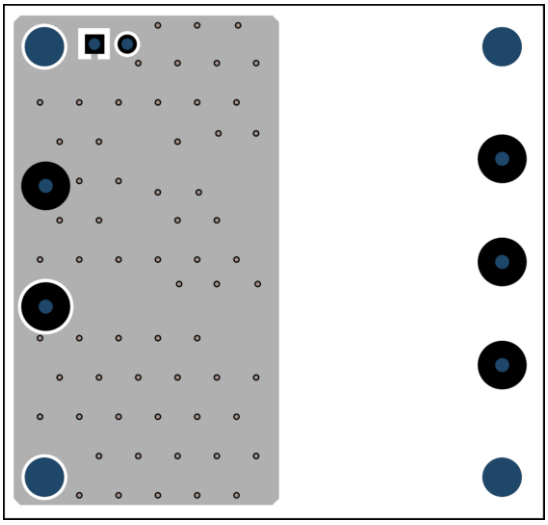
PC Board Layout

PCB layout is important for normal operation. Refer to Figure 1: Recommended Layout, Figure 5 and the PCB layout guidelines below.

1. To comply with isolation and safety requirements, primary side and secondary side must be physically separated. The creepage and clearance distances must meet the safety standard applicable for the application.
2. In order to leverage CMTI performance of the module, minimize capacitive coupling between primary and secondary side. In this respect, it is best to keep the region defined by the creepage distance, free of any metal objects on any PCB layers.
3. To minimize loop of the input ripple current, use low ESR MLCC type capacitors for local decoupling, placed close to the +VIN and -VIN pins. The smaller value capacitor (C1B) should be placed closer to the pins than the one of larger capacitance (C1B).
4. One must be careful with using large area of copper connected to any net on the isolated side, as it contributes to increased level of common-mode current and radiated emission. Even in high voltage applications, the contribution to the overall system noise can become non-negligible if isolated side copper area gets large with respect to the rest of the system.
5. Adding an LC input filter (not shown) at a distance from the module or put on the BOT side (shielded by the TOP ground plane copper) can help reduce EMI.
6. In applications where high CMTI rating is not a must, EMI performance can be improved by connecting a Y-capacitor across the isolation barrier, which provides low impedance return path for the common-mode noise component. Small value Y-capacitor can also be built by overlapping primary and secondary side copper layers. Care must be taken however, not to violate the required isolation rating.



Top Layer



Bottom Layer

Figure 1: Recommended Layout

TYPICAL APPLICATION CIRCUITS

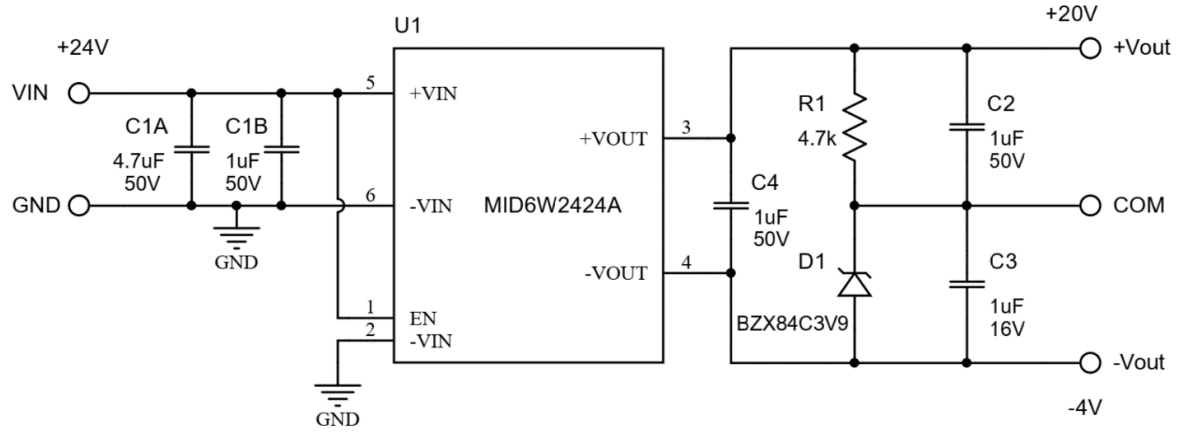


Figure 2: VIN=24V, Vo=+20V/-4V/250mA, automatic start-up

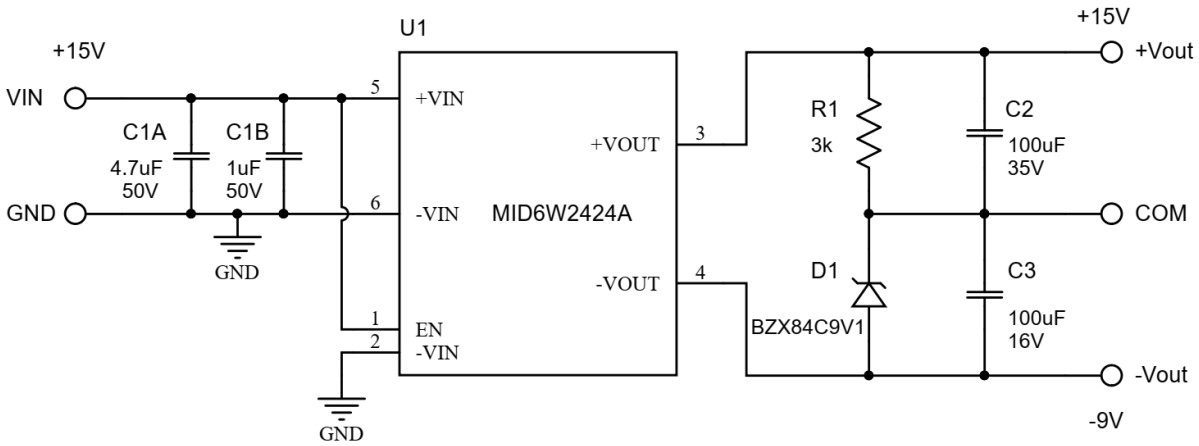


Figure 3: VIN=24V, Vo=+15V/-9V/250mA, automatic start-up

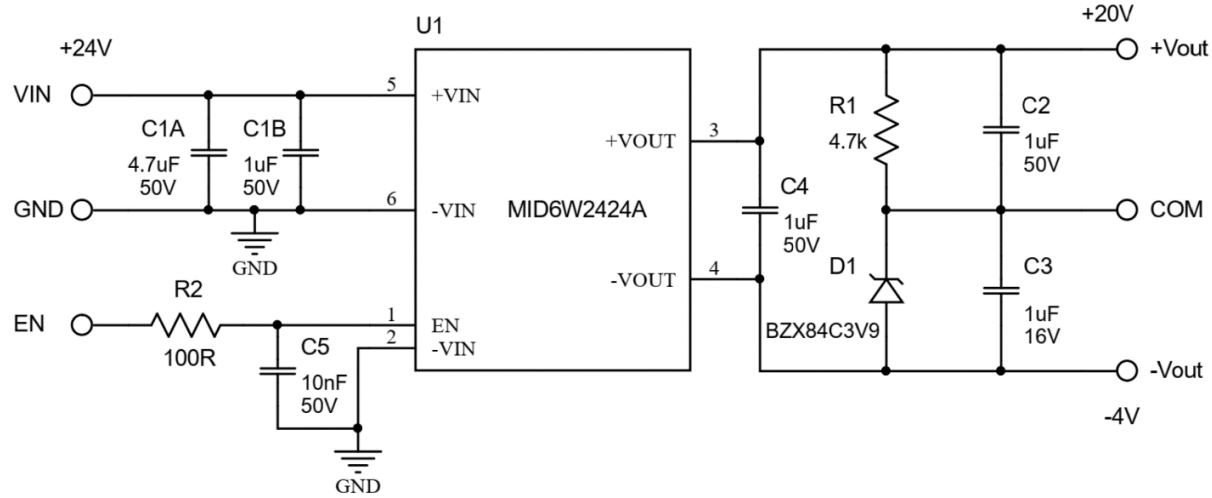


Figure 4: VIN=24V, Vo=+20V/-4V/250mA, pull EN high to start operation

TYPICAL APPLICATION CIRCUITS *(continued)*

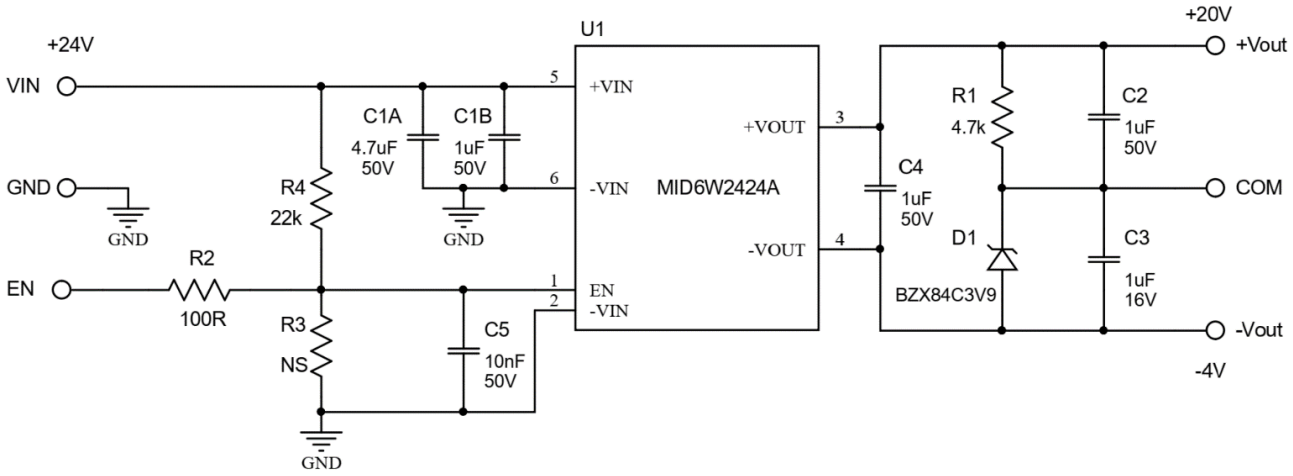
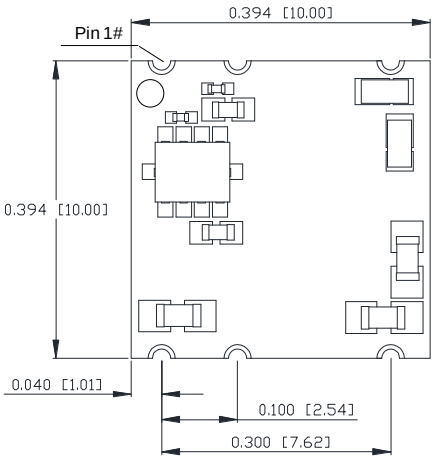


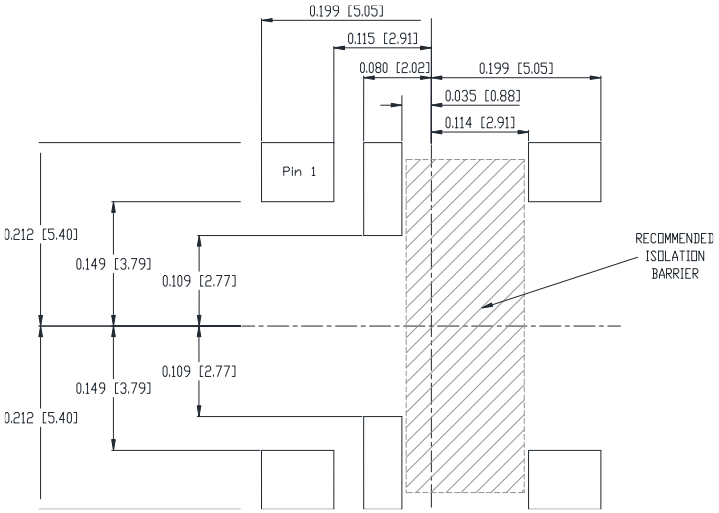
Figure 5: VIN=24V, Vo=+20V/-4V/250mA; start device either by applying power or controlling EN

PACKAGE INFORMATION

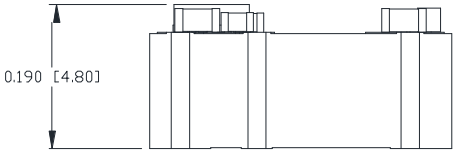
LGA-6 (10mmx10mmx5mm)



TOP VIEW



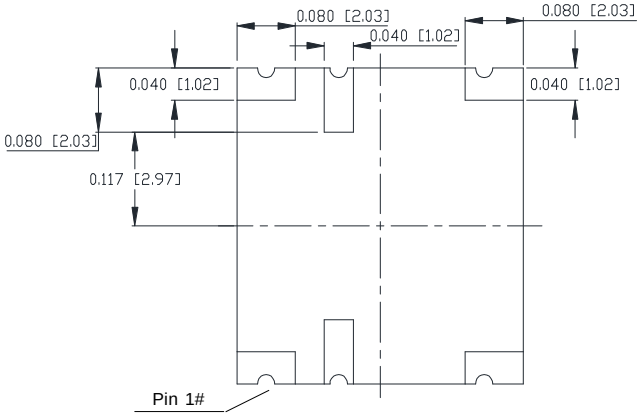
RECOMMENDED LAND PATTERN



SIDE VIEW

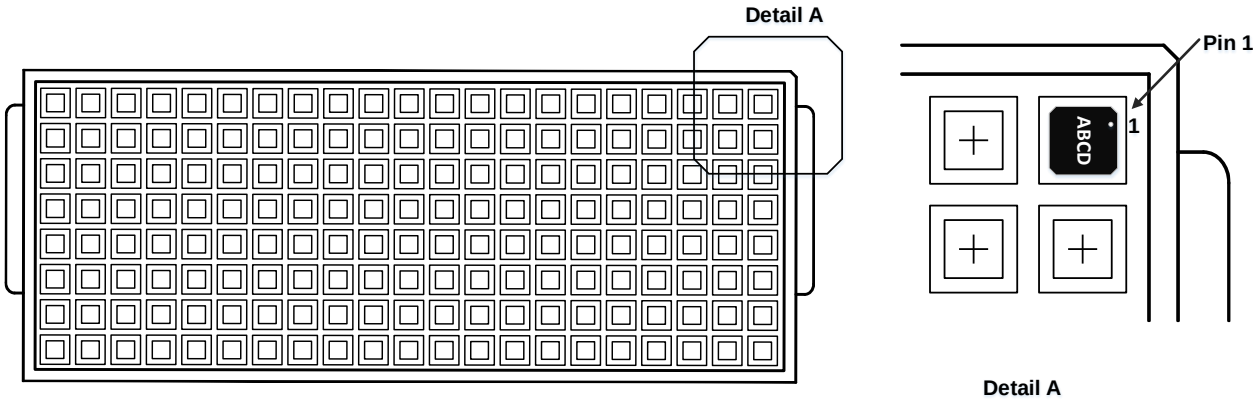
NOTE:

1) THE LEAD SIDE IS WETTABLE.
2) ALL DIMENSIONS ARE IN INCHES [MILLIMETERS].
3) DRAWING IS NOT TO SCALE.



BOTTOM VIEW

CARRIER INFORMATION



Note:
This is a schematic diagram of Tray. Different packages correspond to different trays with different length, width and height

Part Number	Package Description	Quantity/ Reel	Quantity/ Tube	Quantity/ Tray	Reel Diameter	Carrier Tape Width	Carrier Tape Pitch
MID6W2424AGO-3U-T	LGA-6 (10mmx10mm x5mm)	N/A	N/A	152	N/A	N/A	N/A