

# SP6CA1 – 1200V SP6LI Core Adapter Board

Designed for use with the 2ASC-12A1HP SiC Driver Core

## Overview

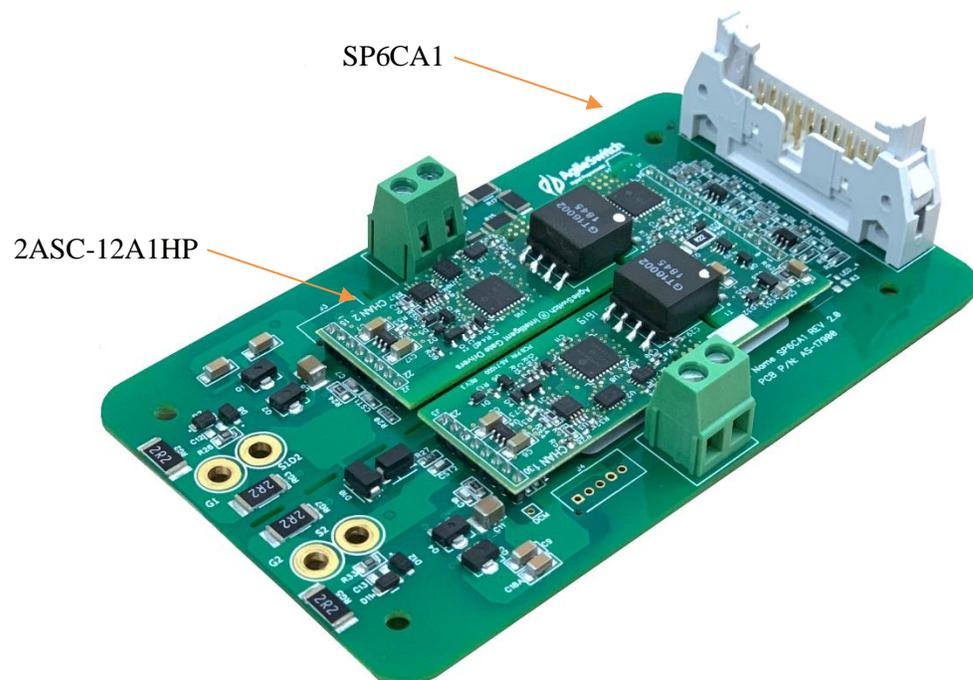
The AgileSwitch SP6CA1 – 1200V SP6LI Core Adapter Board is an evaluation tool designed to work with the the 2ASC-12A1HP SiC Driver Core. The combination can be used with the Microchip SP6LI SiC Power Modules.

## Key Adapter Board Features

- UL Compliant - 1200V SiC MOSFET Modules
- Dual-Channel
- Robust High-Noise-Immunity Design
- Plug & Play for SP6 or SP6LI SiC Modules from Microchip

## Applications

- Evaluation Tool



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## System Overview

The basic topology of the driver core is shown in Figure 1.

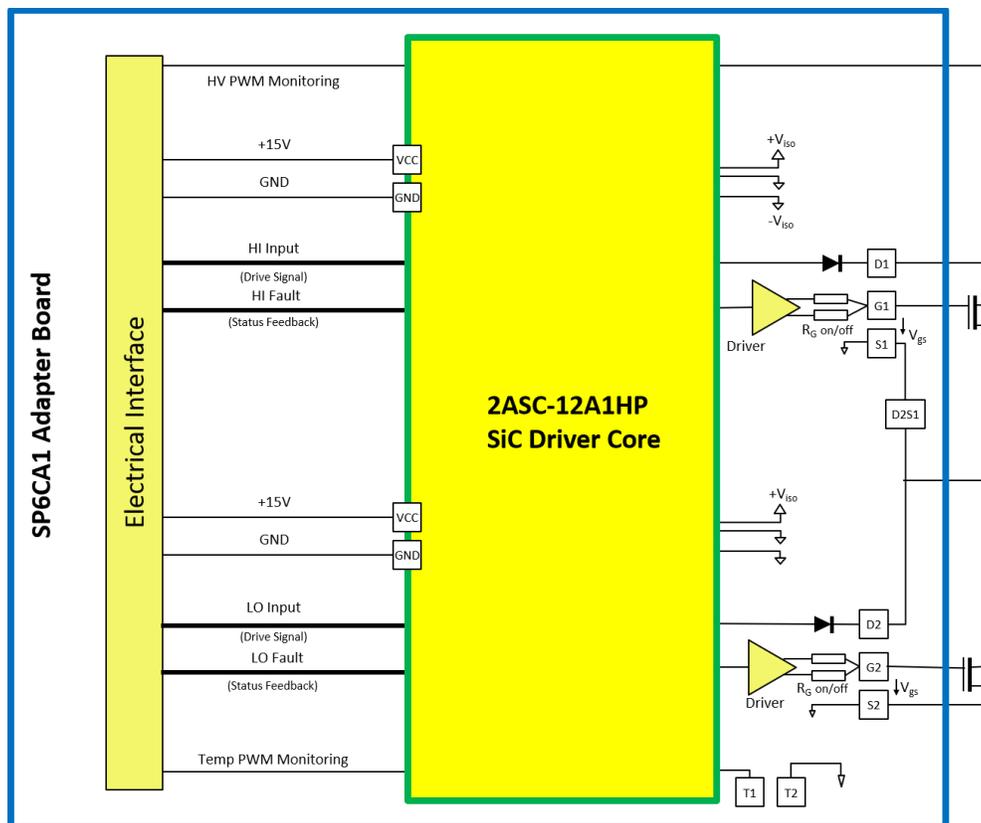


Figure 1 SP6CA1 Adapter Board Basic Topology

## Absolute Maximum Ratings

Interaction of maximum ratings is dependent on operating conditions

Parameter	Description	Min	Max	Unit
Supply Voltage	VCC to GND	0	16.5	V
Peak Gate Current	Note 1	-20	20	A
Input Logic Levels	To GND	-0.5	15	V
Switching Frequency	Note 2		100	kHz
Working Voltage	Primary to Secondary, Secondary to Secondary		1200	V
Creepage Distance	Primary to Secondary Side	8		mm
dV/dt	Rate of change input to output	100		kV/ $\mu$ s
Operating Temperature	Ambient Operating Temperature	-40	+85	$^{\circ}$ C
Storage Temperature		-40	+90	$^{\circ}$ C

## Electrical Characteristics

Conditions:  $V_{SUP} = +15.0\text{ V}$ ,  $V_{IN\_LOGIC} = 5\text{ V}$ , MOSFET ( $C_{iss} = 36.24\text{ nF}$ ;  $Q_g = 2784\text{ nC}$ )

Power Supply	Description	Min	Typ	Max	Unit
Supply Voltage	VCC to GND	14	15	16	V
Supply Current	Without Load		86		mA
Supply Current	With Load, Note 3		366		mA
Signal I/O	Description	Min	Typ	Max	Unit
Input Impedance	5V - Hi and Lo side input		100		$\Omega$
	15V – Hi & Lo side input		2000		$\Omega$
	5V Differential – Hi & Lo side input		240		$\Omega$
$V_{IN}$ Low	5V - Turn-off threshold			1.25	V
	15V – Turn-off threshold			4	V
$V_{IN}$ High	5V – Turn-on threshold	3.5			V
	15V – Turn-on threshold	10			V
$V_{IN}$ (differential option)	Difference between $V_{IN+}$ to $V_{IN-}$	2			V
Fault Output Voltage	Fault lines are open collect with 5mA load	0.3		24	V
Fault Output Current	Note 4			10	mA
Switching Frequency	Note 2			100	kHz

**Note 1:** Input signal should not be activated until 20 ms after power is applied to allow on board DC-DC converter to stabilize.

**Note 2:** Actual maximum switching speed is a function of gate capacitance.

**Note 3:** SiC MOSFET dependant, conditions listed above assume a MOSFET with  $C_{iss} = 36.24$  &  $Q_g = 2584\text{ nC}$  operating at 50kHz

**Note 4:** Fault lines are open collector and require a pull-up resistor, 2K $\Omega$  recommended

## Interconnects

### Controller/Power to SP6CA1 Connectors

Connector	Type	Ref	Manufacturer Part Number
Driver Board	20 Pin	J1	FCI 71918-220LF
Cable Assembly	20 Pin		FCI 71600-120LF

Recommended Cable for High Noise Environments: Flat Ribbon Cable, Twisted Pair, Shielded ([3M 1785/20 Series](#))

### Master to Slave Driver Connectors (Optional – Standard is DNP)

Connector	Type	Ref	Manufacturer Part Number
Driver Board	5 Pin	J3	JST B05B-PASK-1
Cable Assembly	5 Pin		JST PAP-05V-S
Driver Board	4 Pin	J4	JST B04B-PASK-1
Cable Assembly	4 Pin		JST PAP-04V-S

### Thermistor Connector (Optional – Standard is DNP)

Connector	Type	Ref	Manufacturer Part Number
Driver Board	2pos terminal block	NTC	Phoenix 1729018

Standard part is a vertical 2 pin header. Right-angle 2 pin header available upon request (P/N: JST S02B-PASK-2)

### MOSFET Terminals

Ref ID	Type	Manufacturer Part Number
G1, G2, S2, S1D2	2.8mm Quick Fit	Keystone 3534
D1*	2pos terminal block	Phoenix 1729018

\*Recommended Mate for D1 – [Keystone 8291](#) (Female Fully Insulated Quick Fit Terminal)

\*D1 Quick Fit terminal on gate driver must be connected to the D1 terminal on the SiC MOSFET module.

### 2ASC-12A1HP Connection Sockets

Connector	Type	Ref	Manufacturer Part Number
Input	14 Pin	C-J1	NPPN141BFCN-RC or similar
Ch 1, Ch 2	8 Pin	C-J2, C-J3	NPPN081BFCN-RC or similar

Note: The 2ASC-12A1HP can be mounted to the adapter board using sockets or by soldering.

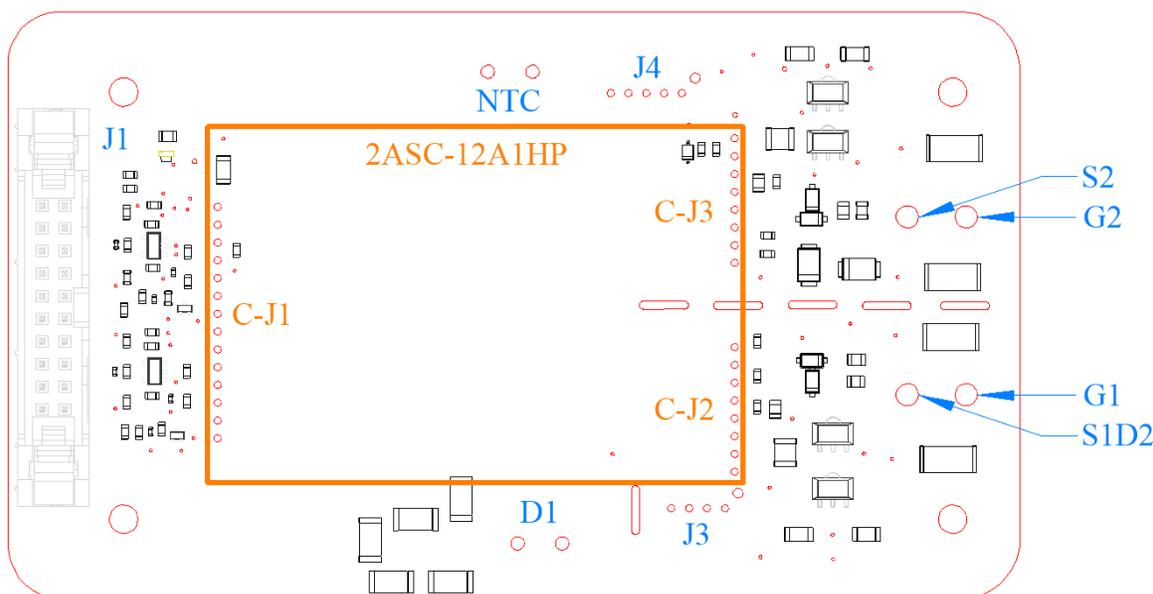


Figure 2 SP6CA1 Interconnects on Adapter Board

## Mounting of Core Assembly on Adapter Board

### Method 1 – Soldering

2ASC-12A1HP can be directly soldered onto an Adapter Board without the need for additional support.

### Method 2 – Socket

2ASC-12A1HP can be plugged into female sockets on an Adapter Board.

### Recommended Sockets

Ref	Connector	Type	Manufacturer Part Number
C-J1	Input	14 Pin, 2mm pitch spacing	NPPN141BFCN-RC
C-J2, C- J3	Ch 1, Ch 2	8 Pin, 2mm pitch spacing	NPPN081BFCN-RC

## Recommended Interface Circuitry

### Primary

#### Block Diagram

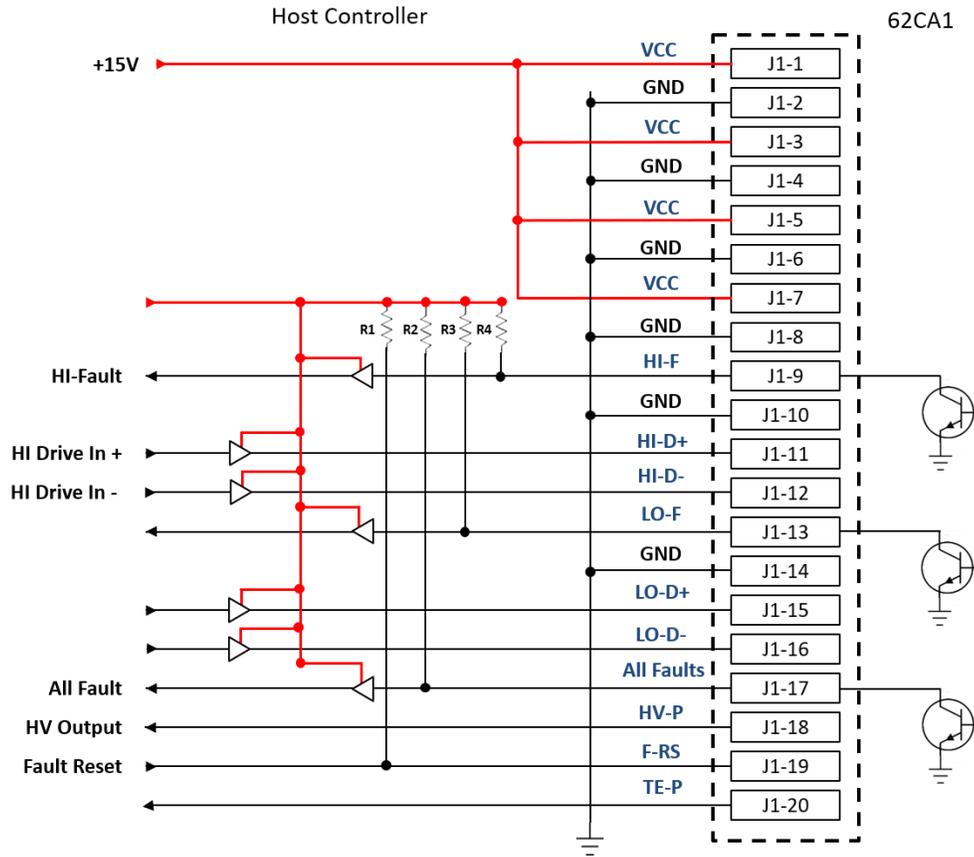


Figure 3 SP6CA1 Recommended Interface Circuitry

## Temperature and High Voltage PWM Monitoring

The AgileSwitch 2ASC-12A1HP Driver provides two 31.5 kHz, 5.0V PWM output signals that monitor the thermistor temperature (isolated or non-isolated) and the DC Link Voltage (High Side drain to Low Side source) of the SiC MOSFET power module. The PWM signals have an output impedance of 510Ω. When combined with an external low pass filter, these signals represent a real time voltage for both High Voltage and Thermistor Temperature. A Sallen-Key active low pass filter can be used with these outputs as shown below with a 2 kHz cut-off frequency. The cut-off frequency can be optimized for your application. For simplicity, a simple RC low pass filter with 100 Hz cut-off frequency can also be used.

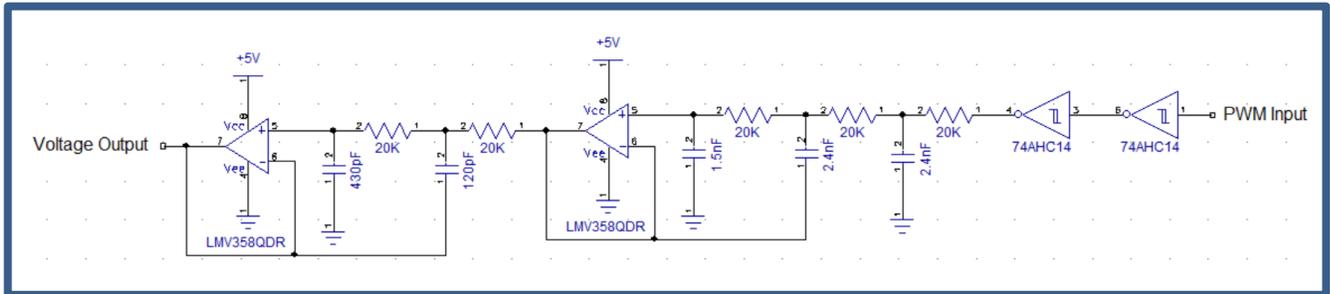
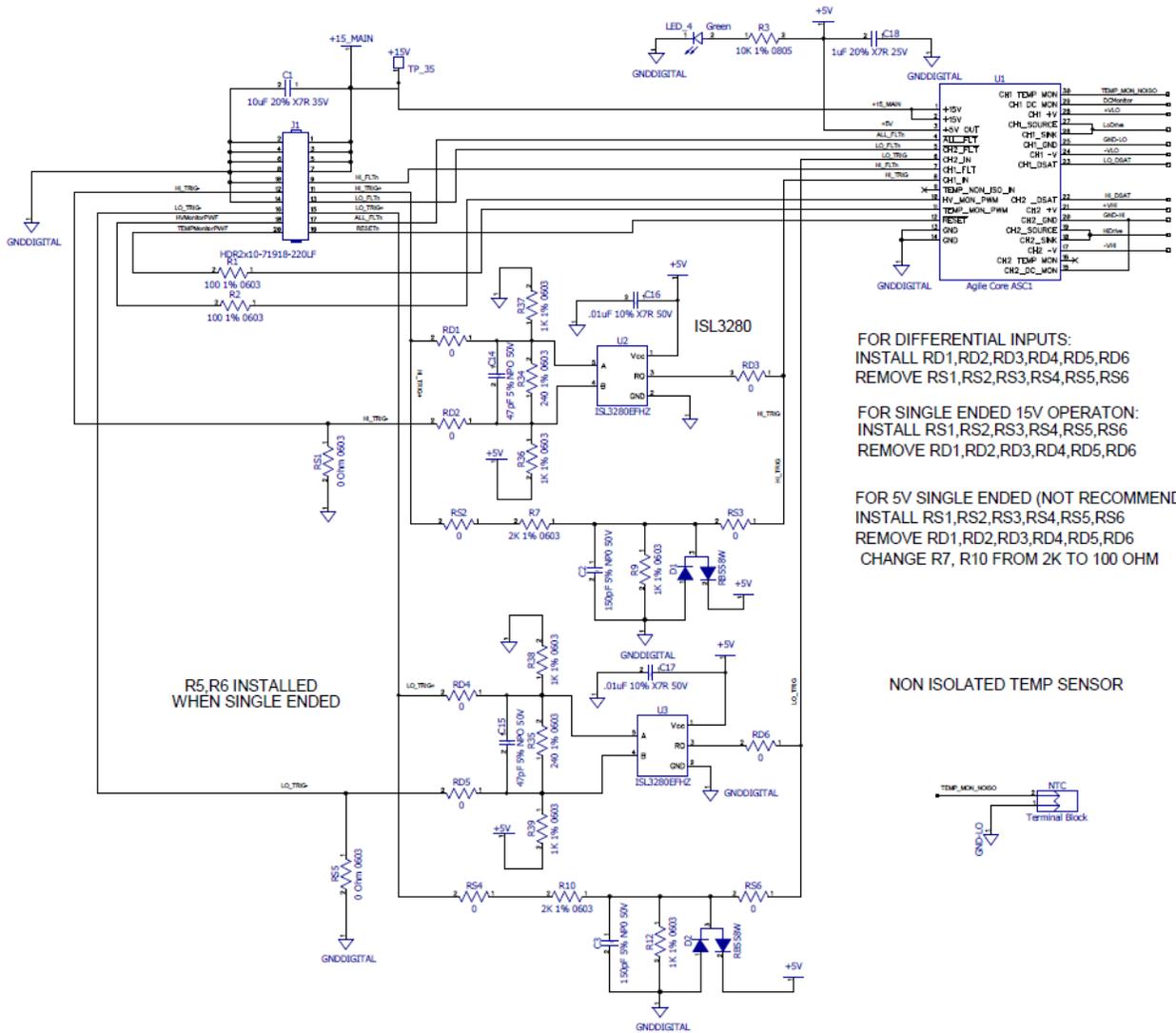
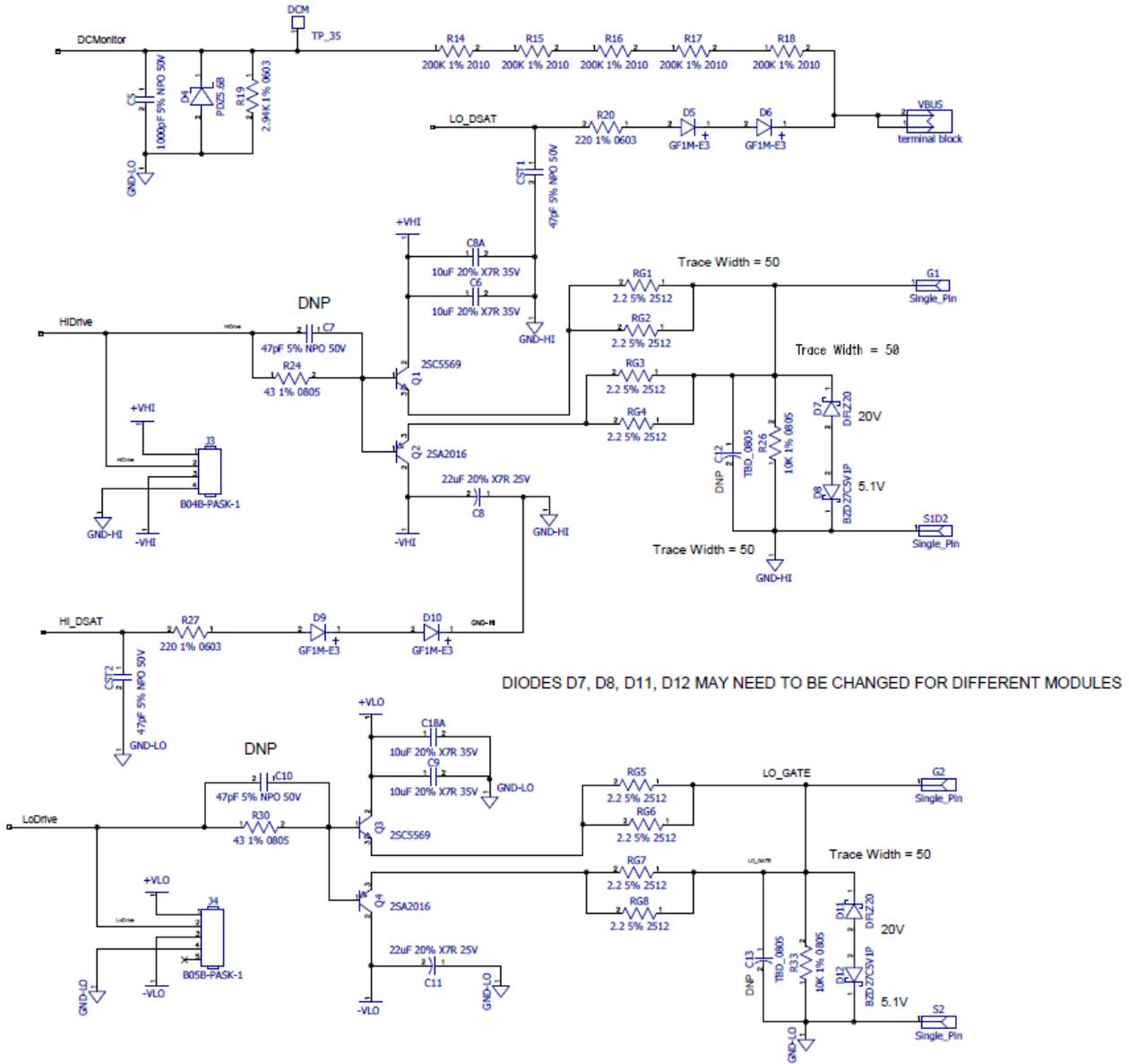


Figure 4 Example of a Low Pass Filter for DC Link PWM output

## Schematic

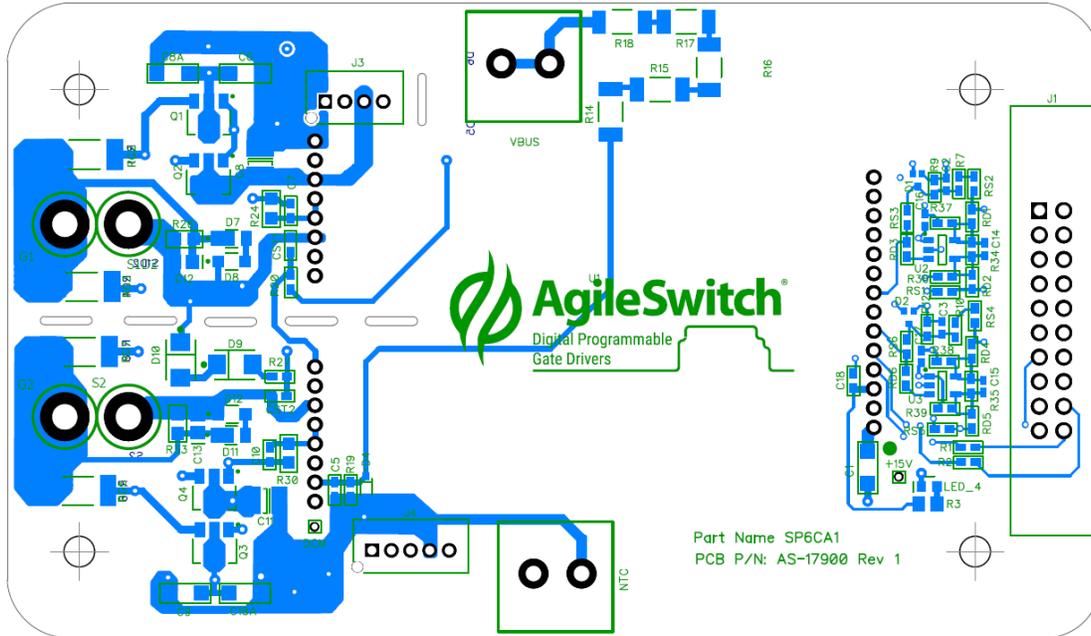
### Control I/O – Sheet 1 of 2



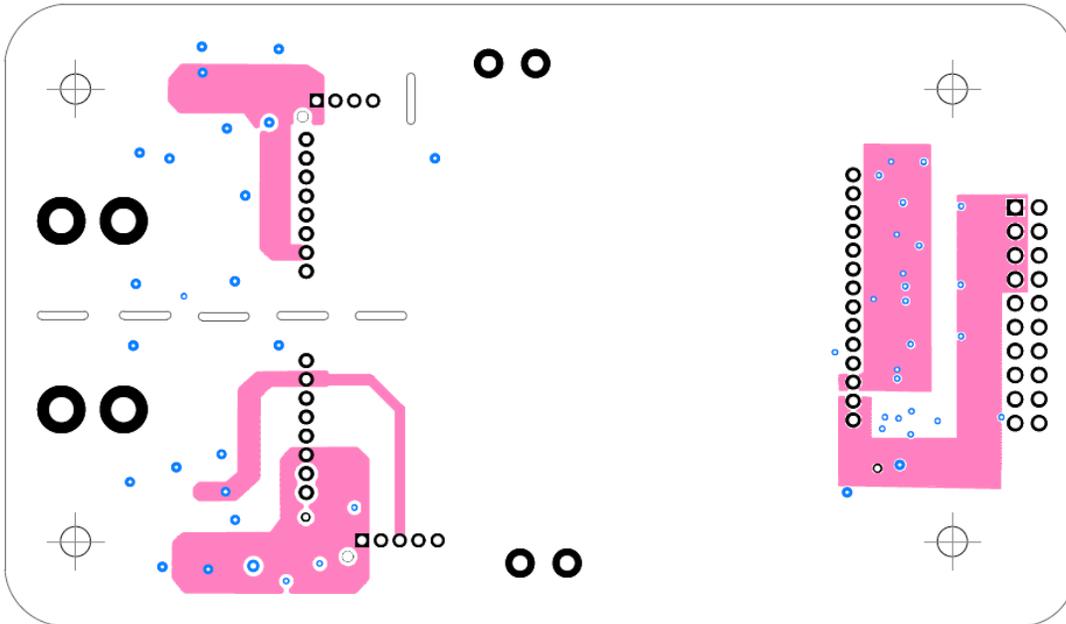
*HI & LO Side Drivers – Sheet 2 of 2*


## Layout

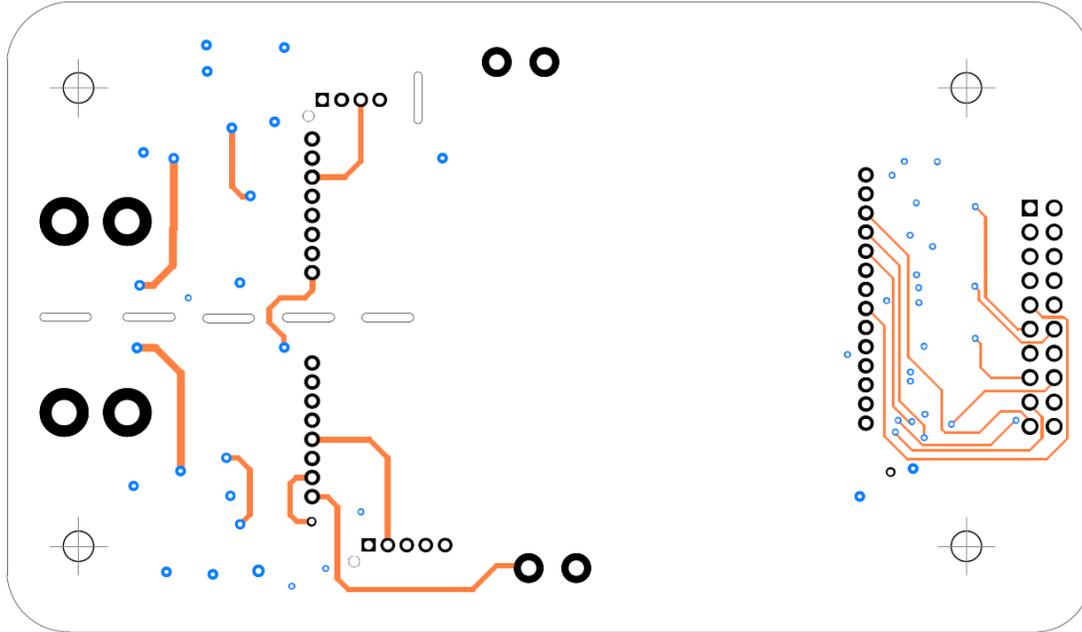
### Layer 1 - Top



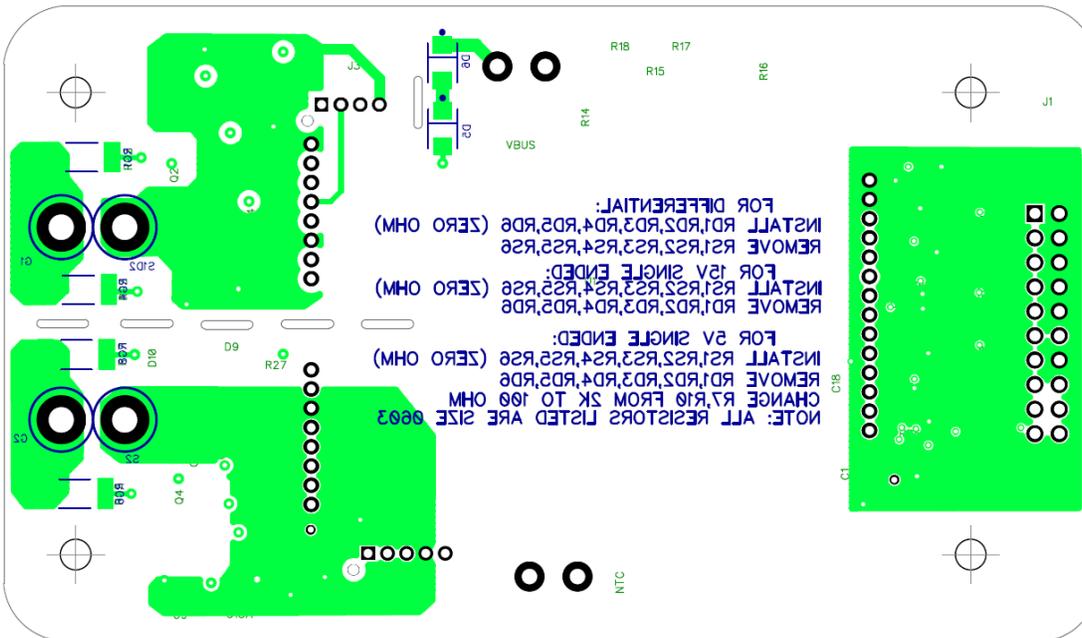
### Layer 2 - Voltage



### Layer 3 – Signals



### Layer 4 – Bottom\_GND



## Design Files

The Schematic, Layout and Bill of Materials for the SP6CA1 are publicly available for download.

Please visit AgileSwitch.com for access to these files.

<http://www.agileswitch.com/module-adapter-boards>

## Important Precautions

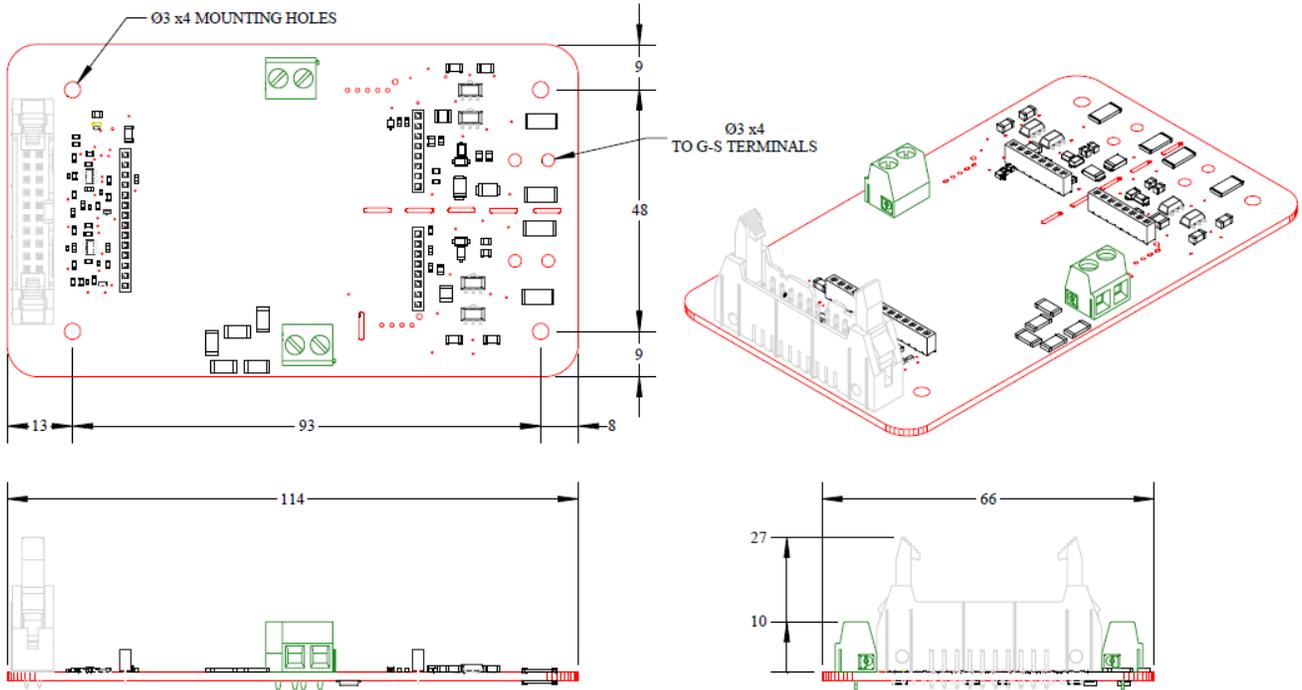


**Caution: Handling devices with high voltages involves risk to life. It is imperative to comply with all respective precautions and safety regulations.**

**When installing the core and adapter board, please make sure that power is turned off. Hot swapping may cause damage to the IC components on the board.**

**AgileSwitch assumes that the core and adapter board have been mounted on the SiC MOSFET prior to start-up testing. It is recommended that the user checks that the SiC MOSFET power modules are operating inside the Specified Operating Area (SOA) as specified by the module manufacturer including short circuit testing under very low load conditions.**

## Mechanical Dimensions



Dimensions are in mm.

## Revisions

Prepared By	Approved By	Version	Date	Description
N. Satheesh A. Fender		1	3/16/2020	Preliminary Release

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### Patent Notices

Offering	Issued U.S. Patent Numbers
AgileStack™ Power Stack	8,984,197
Gate Drivers for WBG Power Semiconductors	9,490,798
Additional Patents Pending	

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