

2ASC-12A1HP – 1200V Dual-Channel Augmented High Performance SiC Core 1

Optimized for Silicon Carbide (SiC) MOSFET Modules

Overview

The AgileSwitch 2ASC-12A1HP – 1200V Dual-Channel Augmented High Performance SiC Core 1 enables better control and protection of most SiC MOSFET-based power systems. The 2ASC-12A1HP provides up to 10A of peak current at an operating frequency of 100kHz. The high CMTI gate drive core includes an isolated DC/DC converter and low capacitance isolation barrier for PWMs and fault feedback. The Intelligent Configuration Tool will allow users to appropriately configure the Gate Driver Parameters to their application without having to worry about changing hardware.

Software Programmable Features

- Augmented Turn-Off™ (ATOff) (Patented)
- $\pm V_{GS}$ Gate Voltages
- Power supply under-voltage lockout (UVLO)
- Power supply over-voltage lockout (OVLO)
- Desaturation detection settings
- Dead time
- Fault lockout settings
- Automatic Reset settings

Key Switch Driver Features

- UL Complaint - 1200V & 1700V SiC
- Dual Channel
- Robust High-Noise-Immunity Design
- Isolated Temperature Monitoring, PWM
- Isolated High Voltage Monitoring, PWM
- Compact 40x60mm form factor
- 2 X 10W output power
- RoHs compliant
- Up to 7 Unique Fault Conditions

Applications

- Heavy Duty Vehicles
- Induction Heating
- Auxiliary Power Units
- Battery Storage
- Inverters
- Wireless Charging



System Overview

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

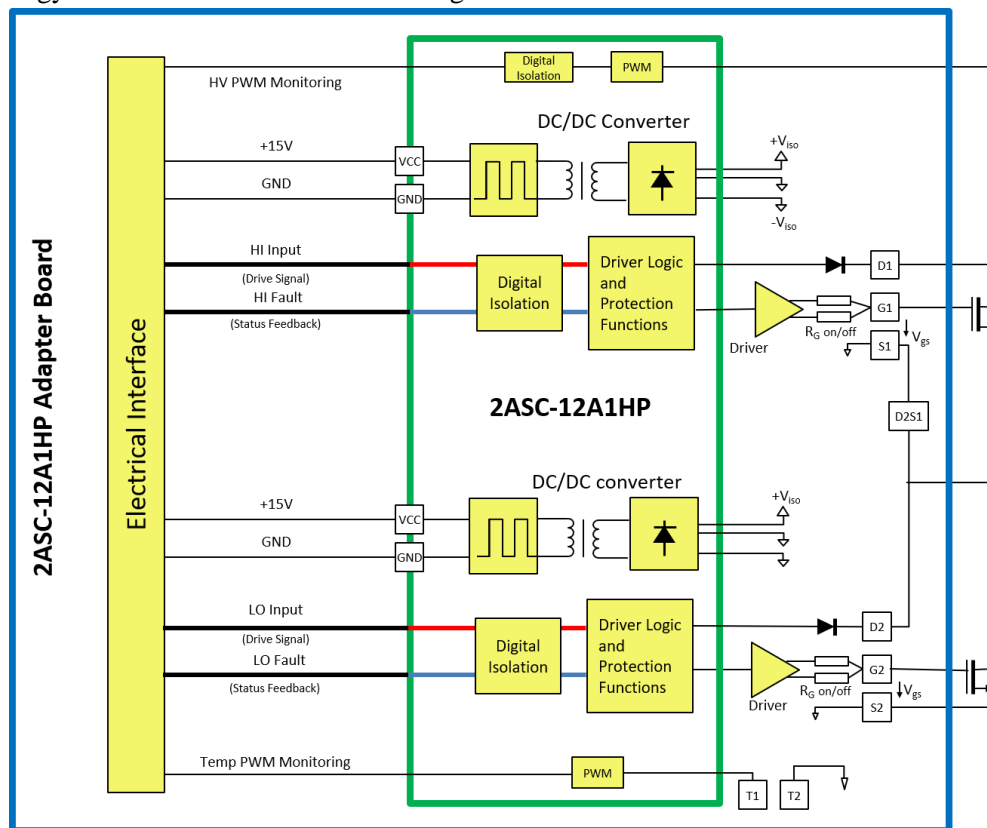


Figure 1 2ASC-12A1HP Block Diagram

Absolute Maximum Ratings

Interaction of maximum ratings is dependent on operating conditions

Parameter	Description	Min	Max	Unit
Supply Voltage	VCC to GND	0	18	V
Peak Gate Current	Note 1	-10	10	A
Input Logic Levels	To GND	-0.5	5	V
Output Power per Gate			3	W
Switching Frequency	Note 2		100	kHz
Isolation Voltage	Primary to Secondary VAC RMS 1 min		3750	V
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/ μ s
Operating Temperature	Ambient Operating Temperature	-40	+85	°C
Storage Temperature		-40	+90	°C

Electrical Characteristics

Conditions: $V_{SUP} = +15.0\text{ V}$, $V_{IN_LOGIC} = 5\text{ V}$, MOSFET = CAS300M12BM2

Power Supply	Description	Min	Typ	Max	Unit
Supply Voltage	VCC to GND	14	15	16	V
Supply Current	Without Load		110		mA
Supply Current	With Load, Note 3		250		mA
UVLO Level-HI and LO*	Primary Side low voltage detect fault level	13.5	14		V
UVLO Level-HI and LO*	Secondary Side low voltage detect fault level, Note 3	13			V
OVLO Level-HI and LO*	Primary Side high voltage detect fault level		16	16.5	V
OVLO Level-HI & LO*	Secondary Side high voltage fault detect level, Note 3	17		23	V
Signal I/O	Description	Min	Typ	Max	Unit
Input Impedance	5V - HI and LO side input	1			MΩ
$V_{IN\ Low}$	5V - Turn-off threshold			1.25	V
$V_{IN\ High}$	5V – Turn-on Threshold	3.5			V
Gate Output Voltage Low*	Note 3	-6		-4	V
Gate Output Voltage High*	Note 3	+17		+21	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			TBD	kHz
DC Link & Temp Monitoring	High Voltage (HV) & Temp Monitoring Output	0		5	V
DC Link & Temp Monitoring	PWM Frequency		31.5		kHz
DC Link & Temp Monitoring	Output Impedance, User defined on Adapter Board		50 1%		Ω
DC Link Voltage		880		920	V
Temperature Trip			125		°C
MOSFET Short Protection	Description	Min	Typ	Max	Unit
Desat Monitor Voltage*	Between Drain and Sink of MOSFET, Note 3		4.5		V
T_{DSAT}^*	Activation after MOSFET Turn on		1.5		μs
Response Time after Fault				200	ns

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 CAS300M12BM2 operating at 50kHz

Note 4: Fault lines are open collector and require a pull-up resistor, 2KΩ recommended

* Software configurable parameter

Interconnects

Module Adapter to Driver Core Connectors

Ref	Connector	Type	Manufacturer Part Number
J1	Input	14 Pin, 2mm pitch spacing	NRPN141PAEN-RC
J2, J3	Ch 1, Ch 2	8 Pin, 2mm pitch spacing	NRPN081PAEN-RC

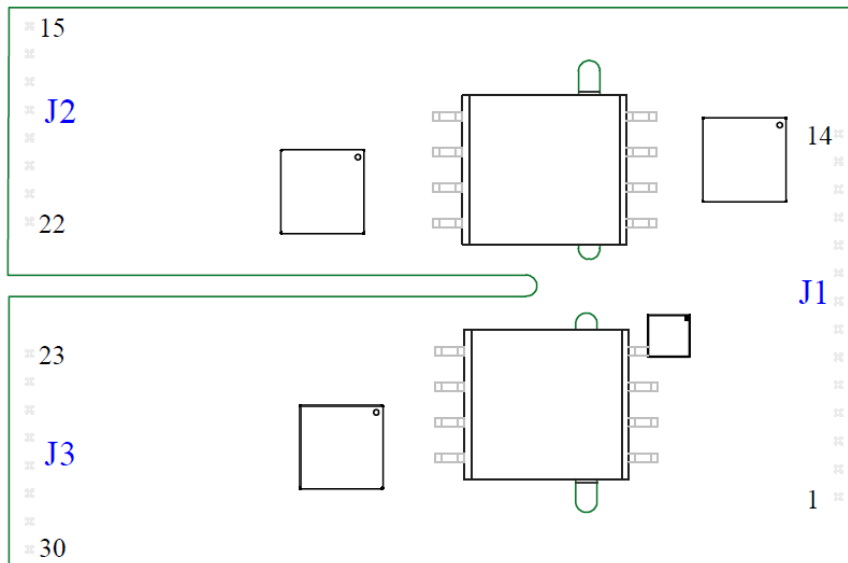


Figure 3: Interconnect Locations on PCB

Pinout – Controller/Power to Driver Connection

14 PIN – J1

Pin No	Signal
1	VCC – +15V Supply Voltage
2	VCC – +15V Supply Voltage
3	+5V Out
4	AL-F – All Faults (Low when CH1-F or CH2-F)
5	CH2-F – Channel 2 Fault Output
6	CH2-Trig – Channel 2 Trigger Input
7	CH1-F – Channel 1 Fault Output
8	CH1-Trig – Channel 1 Trigger Input
9	TE-P – Temperature Monitoring
10	HV-F - DC Link Voltage Fault
11	TE-F - Temperature Fault
12	F-RS – Fault Reset (Auto Reset Optional)
13	GND
14	GND

8 PIN – J2 – Channel 1 (CH1)

Pin No	Signal
1	CH1 DSAT
2	CH1 – (-)V_Unreg
3	GND
4	CH1_Sink
5	CH1_Source
6	CH1 – (+)V_Unreg
7	CH1_DC Link Monitor
8	CH1_Temperature Monitor

8 PIN – J3 – Channel 2 (CH2)

Pin No	Signal
1	CH2 DSAT
2	CH2 – (-)V_Unreg
3	GND
4	CH2_Sink
5	CH2_Source
6	CH2 – (+)V_Unreg
7	CH2_DC Link Monitor
8	CH2_Temperature Monitor

Recommended Interface Circuitry

TBD (See Manual)

Timing Diagrams

Normal Operation

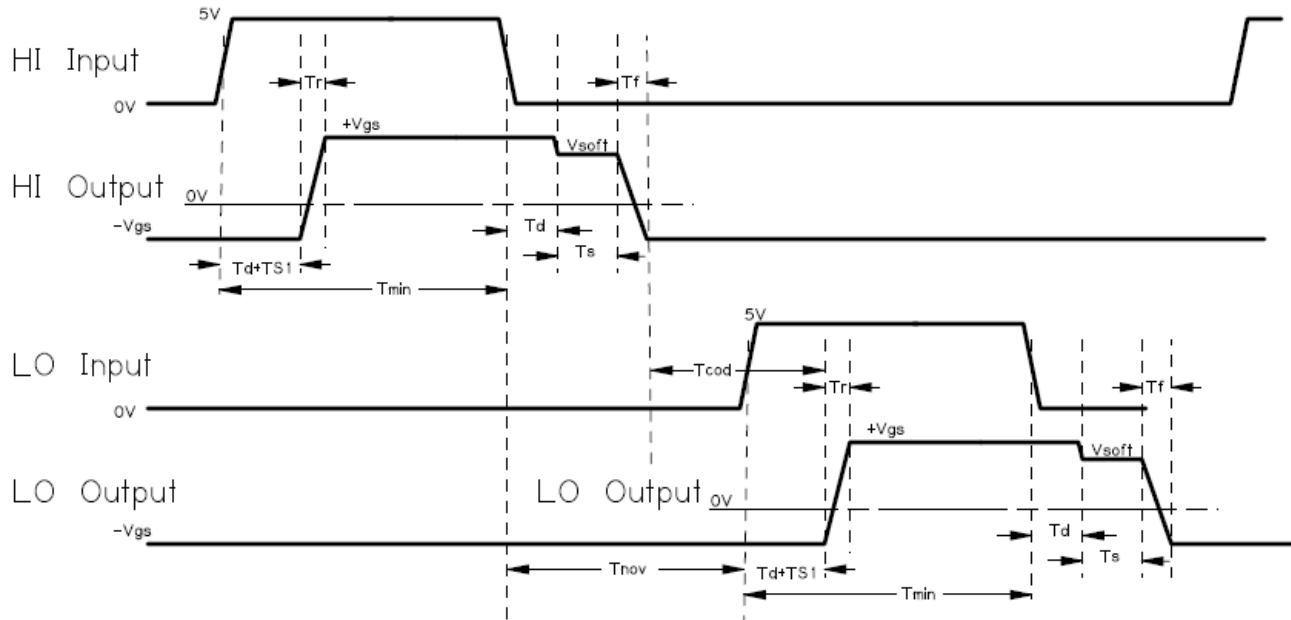


Figure 8: Signal input and output timing diagram.

Desat Fault Timing

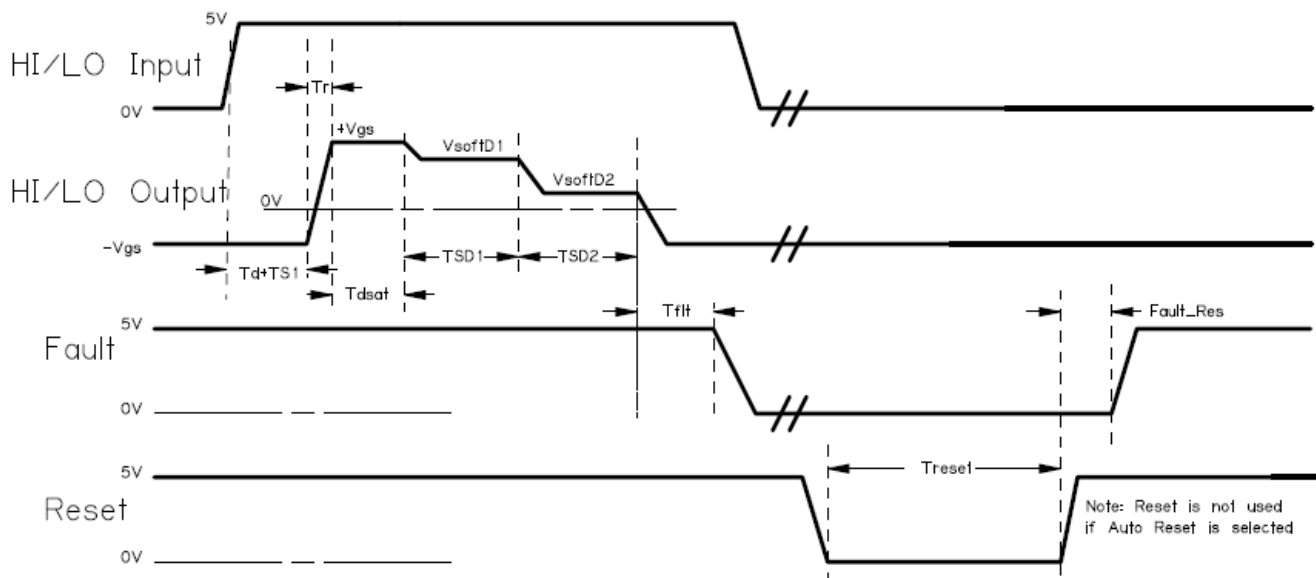


Figure 9: Signal desaturation and fault timing diagram.

Timing Diagram Values

Conditions: $V_{SUP} = +15.0\text{ V}$, Temp = $0\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$

Description	Symbol	Min	Typ	Max	Unit	Notes
Minimum Pulse Width	T_{MIN}	1000			ns	
Delay Time	T_D			250	ns	
De-Glitch Time			200		ns	Input signal de-glitch time
Rise Time	T_R		80		ns	Measured from 10% to 90% points on edge Measurement Point 1 – Fig. 10
Fall Time	T_F		90		ns	Measured from 10% to 90% points on edge Measurement Point 2 – Fig. 10
2-Level Turn-Off Time	T_{S1}		360		ns	Software configurable
2-Level Turn-Off Voltage	V_{soft}		1.5		V	Software configurable
Desaturation Time	T_{DSAT}	1400	1500	1600	ns	Software configurable
1 st DSAT V	$V_{soft\ D1}$		9		V	Multi-Level Turn-Off – First DSAT Step
First DSAT Time*	T_{SD1}		400		ns	First DSAT 2-level turn-off time
2 nd DSAT V	$V_{soft\ D2}$		5		V	Multi-Level Turn-Off – Second DSAT Step
Second DSAT Time*	T_{SD2}		200		ns	Second DSAT 2-level turn-off time
Fault Time Delay	T_{FLT}		5000		ns	
Fault Reset	$Fault_Res$		1000		ns	
Fault Response Time	T_{RESP}		200		ns	
Dead Time - Input	T_{NOV}		1000		ns	Recommended Minimum Time between Inputs
Dead Time – Driver	T_{cod}	1000			ns	Minimum Time between drive signals allowed by driver, software configurable
Reset Timing	T_{reset}	1000			ns	Minimum Reset Time
Automatic Reset (Optional)			5		ms	Standard setting of 5 ms

*Note 3

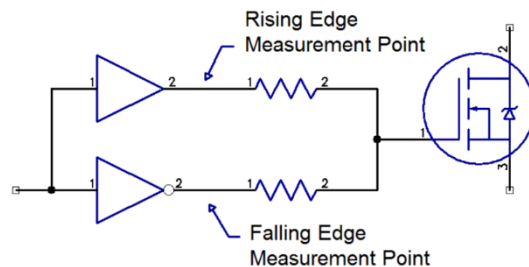


Figure 10: Measurement points for rise and fall time.

Temperature Monitor

The following table describes the correlation between the Thermistor Temperature and Temperature Monitor PWM Output with 2kHz 4 pole filter. This is based on an NTC thermistor that measures $5k\Omega @ 25^{\circ}\text{C}$. Recommended Thermistor P/N: TBD.

Output Voltage [V]	Temperature [$^{\circ}\text{C}$]
0.8	-3
1.6	25
2.2	41
2.8	57
3.1	67
3.3	74
3.4	80
3.7	94
4.0	108
4.1	122
4.3	138
4.4	154

DC Link Voltage Monitor – 1700V

TBD

Generic Sample Factory Settings

AgileSwitch drivers are designed to provide safe, secure and efficient operation of the SiC MOSFET power module, as well as to provide unparalleled information on the condition of the overall system.

Generic samples are set at the factory to perform certain actions (e.g. turn off the HI side or LO side of the SiC MOSFET) and to report that a fault occurred based on performance parameters that occur outside of default ranges.

The tables below show the generic configuration.

Performance & Interconnect Settings

Parameter	Generic Factory Setting	Value	Unit
Fault Reset	Auto	5	ms
DC Link Voltage Fault	Enabled	900	V
Temperature Fault	Enabled	125	°C
UVLO Primary	Enabled	13.2	V
OVLO Primary	Enabled	16.5	V

Fault and Monitoring Conditions

Fault Condition/Action	Generic Sample Default Trigger Values	Action on IGBT if Active (Default Setting)	HI Fault	LO Fault	All Faults
NO FAULTS			HIGH	HIGH	HIGH
DSAT/UVLO – HI	See Electrical Characteristics	Turn Off HI & LO Side	LOW	HIGH	LOW
DSAT/UVLO – LO	See Electrical Characteristics	Turn Off HI & LO Side	HIGH	LOW	LOW
OVLO	See Electrical Characteristics	Turn Off HI & LO Side	HIGH	HIGH	LOW
Temperature Fault	125 °C Thermistor Monitor	No Action	HIGH	HIGH	LOW
DC Link Voltage Fault	DC Link Voltage above or below setting	Turn Off HI & LO Side	HIGH	HIGH	LOW
Power On Configuration Fault*	Failure to Configure Gate drivers	Turn Off HI & LO Side	LOW	LOW	LOW

*After power up, if all Fault lines are LOW, then either there is a real fault (UVLO/DSAT) on both the HI and LO sides or there has been a software configuration failure.

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

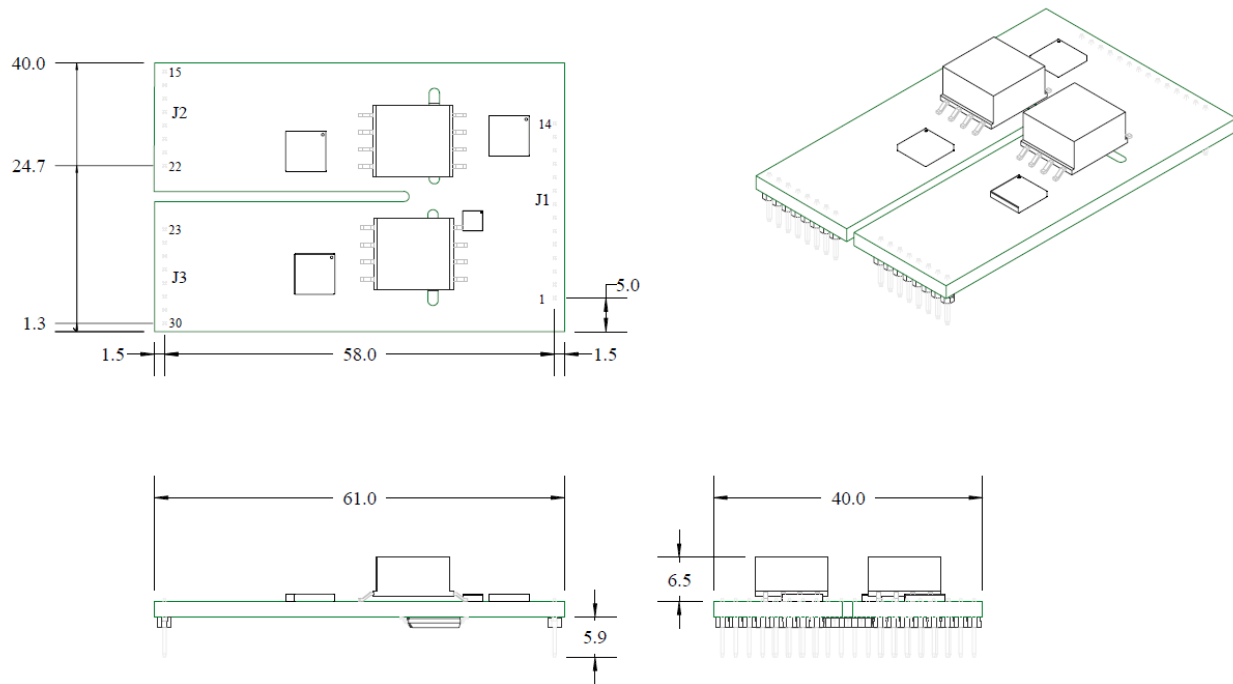


Figure 11: Dimensions of the 2ASC-12A1HP Core (+/- 0.1mm)

Dimensions are in mm.

Download the full drawing and model for additional details. Not all components are shown.

Revisions

Prepared By	Approved By	Version	Date	Description
N. Satheesh A. Fender		01	8/31/2018	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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