PRELIMINARY

SA110

Fully Integrated Half-Bridge Module

RoHS COMPLIANT

FEATURES

- 20A continuous output current
  - 28A for A-grade
- ≥250kHz switching frequency
- 400V supply voltage
- Integrated gate drive with under-voltage lock-out and active Miller clamping
- 12-pin PSIP package

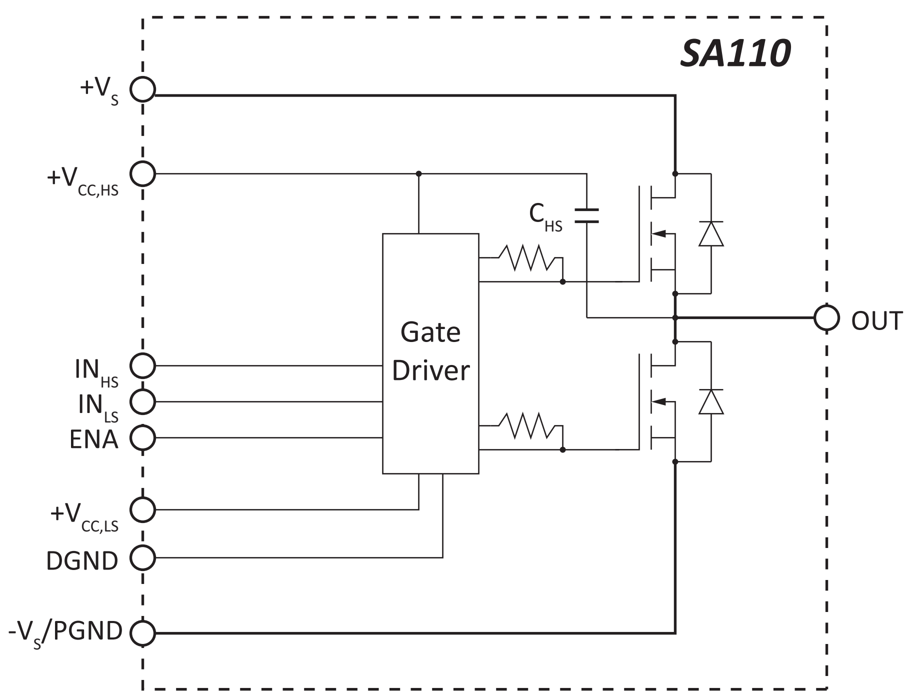
APPLICATIONS

- DC/AC or DC/DC converters
- Motor control

DESCRIPTION

The SA110 is a fully integrated switching amplifier based on Silicon Carbide technology. The half bridge provides up to 20A continuous output current with microcontroller or DSC control. Protection features include Under-voltage lockout (UVLO) function and active Miller clamping.

Figure 1: Module Block Diagram



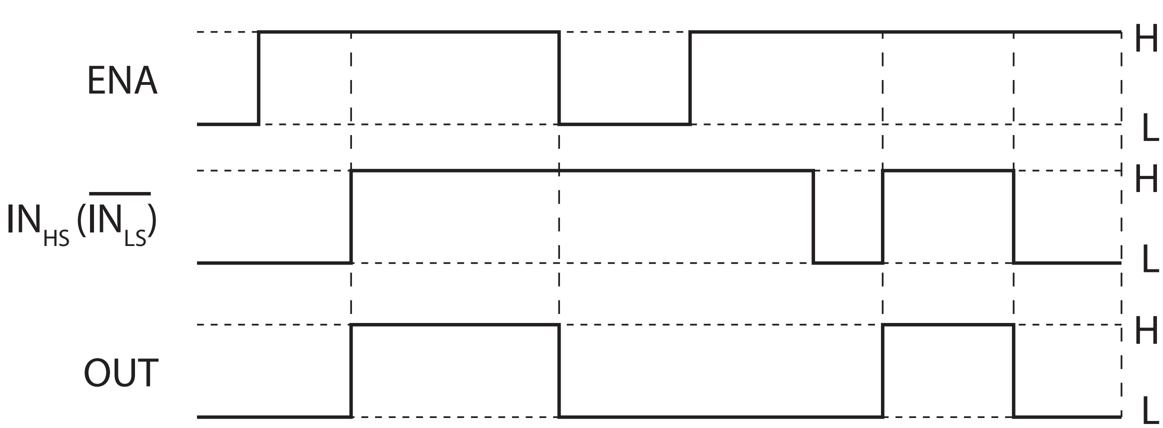
PIN DESCRIPTION TABLE (DP PACKAGE)

Pin Number	Name	Description
1	$+V_{CC,HS}$	High-side power supply pin
2	ENA	Enable pin. A low level puts the high-side and low-side MOSFETs in high-impedance state. See logic table for details.
3	IN_{HS}	Logic input for high-side SiC MOSFET control
4	IN_{LS}	Logic input for low-side SiCMOSFET control
5	$+V_{CC,LS}$	Low-side and input side power supply pin
6	DGND	Input side ground pin. This pin needs to be connected externally to the negative supply rail or the power ground
7, 8	$-V_S$/PGND	Negative supply rail or power ground (for single positive supply, $+V_S$) Connect externally to the DGND pin.
9, 10	OUT	PWM output
11, 12	$+V_S$	Positive supply rail

I/O CONDITION TABLE

ENA	IN_{HS}	IN_{LS}	OUT
L	X	X	High impedance
H	L	L	High impedance
H	H	L	$+V_S$
H	L	H	$-V_S$/PGND
H	H	H	High impedance

Figure 2: Input and Output Logic Timing Chart



DEVICE SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply Voltage, total	$+V_S$		400	V
Gate Driver Supply Voltage, relative to SiC MOSFET drain	$+V_{CC}$		22(rel.)	V
Output Current, source, sink, peak, within SOA			40	A
Output Current, continuous			28	A
Power Dissipation, internal, continuous, per MOSFET	P_D		75	W
Switching Frequency, per phase			400	kHz
Input Voltage, logic level			$+V_{CC,LS}$	V
Temperature, pin solder, 10s max.			260	°C
Temperature, junction, MOSFET	T_J		150	°C
Temperature Range, storage		-40	+105	°C
Operating Temperature Range, case	T_C	-40	+125	°C

POWER SUPPLY (SINGLE RAIL SUPPLY)

Parameter	Test Conditions	Min	Typ	Max	Unit
Low Side Supply Voltage, $+V_{CC,LS}$[1]		12	18	20	V
Supply Voltage, $+V_S$				400	V
High Side Supply Voltage, $+V_{CC,HS}$[2]		OUT+12	OUT+18	OUT+20	V
DGND			0		V

1. The maximum current might be limited at low temperatures when operating the device at V_{CC}<14V.
2. The high-side supply should be realized either as a floating voltage supply relative to the device output or as a boot-strap circuit (resistor and diode in series between $+V_{CC,LS}$ and $+V_{CC,HS}$).

POWER SUPPLY (DUAL RAIL SUPPLY)

Parameter	Test Conditions	Min	Typ	Max	Unit
Low Side Supply Voltage, $+V_{CC,LS}$[1]		$-V_S+12$	$-V_S+18$	$-V_S+20$	V
Total Supply Voltage, $+V_S-(-V_S)$				400	V
High Side Supply Voltage, $+V_{CC,HS}$[2]		OUT+12	OUT+18	OUT+20	V
DGND			$-V_S$		V

1. The maximum current might be limited at low temperatures when operating the device at V_{CC}<14V.
2. The high-side supply needs to be a floating supply relative to the device output (or a bootstrap circuit if suitable). The low-side supply voltage is relative to the negative supply rail.

INPUT

Parameter	Test Conditions	Min	Typ	Max	Unit
Logic High Level Input Voltage		DGND+2.0		$+V_{CC,LS}$	V
Logic Low Level Input Voltage		DGND		DGND+0.8	V
Isolation			450		V

OUTPUT

Parameter	Test Conditions	SA110			SA110A			Units
		Min	Typ	Max	Min	Typ	Max	
RDS(ON), per MOSFET[1]	I_D=27A, V_{CC}=18V, T_J=25C		30			*		mΩ
RDS(ON), per MOSFET[1]	I_D=27A, V_{CC}=18V, T_J=125C		39.6			*		mΩ
RDS(ON), (Including parasitics)	I_D=27A, V_{CC}=18V, T_J=25C		73					mΩ
Fall Time, per MOSFET			30			*		ns
Switching Frequency				400			*	kHz
Current, continuous, source/sink		20			28			A
Current, peak, source/sink				40			*	A
Current, continuous, body diode, per MOSFET		20			28			A
Current, peak, body diode, per MOSFET				40			*	A
Reverse Recovery Time, body diode, per MOSFET	V_S=300V, I_F=27A, di/dt=1100A/µs		26			*		ns

1. MOSFET only. Does not consider resistance due to layout/routing.

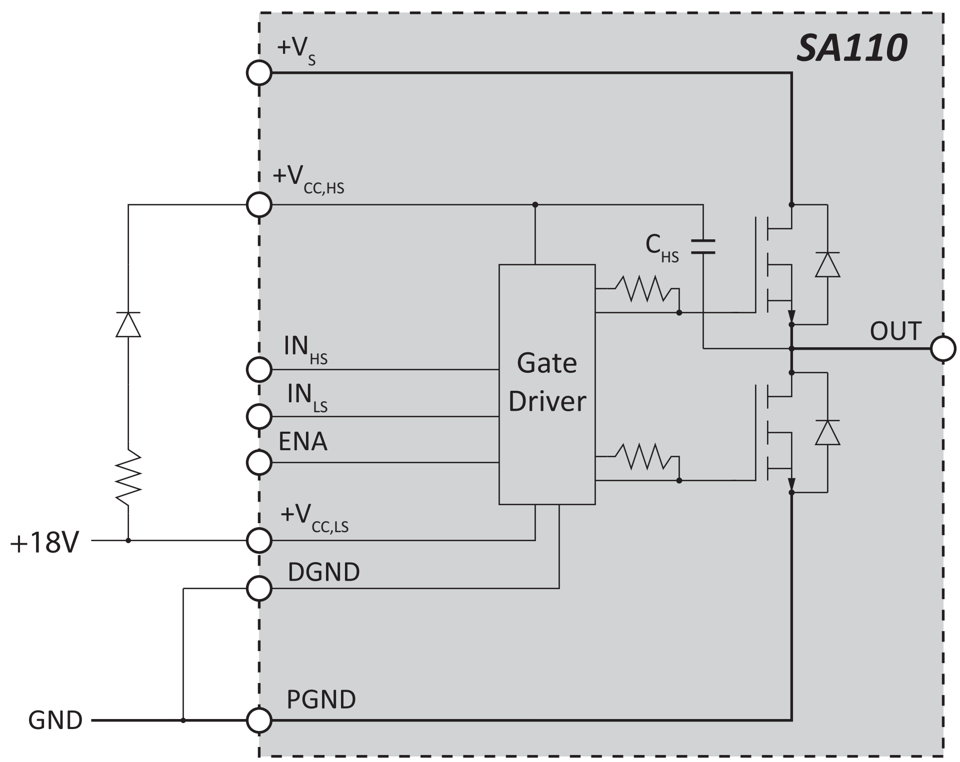
GENERAL

Please read Application Note 1 "General Operating Considerations" which covers stability, supplies, heat sinking, mounting, current limit, SOA interpretation, and specification interpretation. Visit www.apexanalog.com for Apex Microtechnology's complete Application Notes library, Technical Seminar Workbook, and Evaluation Kits.

BOOTSTRAP CIRCUIT

When operating the device with Single Supply Rail, the high-side supply voltage ($V_{CC,HS}$) can be realized through a bootstrap circuit if operating the device under 100% duty cycle is not required. Figure 3 illustrates the components required for the bootstrap circuit. The high-side supply voltage is connected to the low-side supply voltage through a resistor and a diode that are put in series.

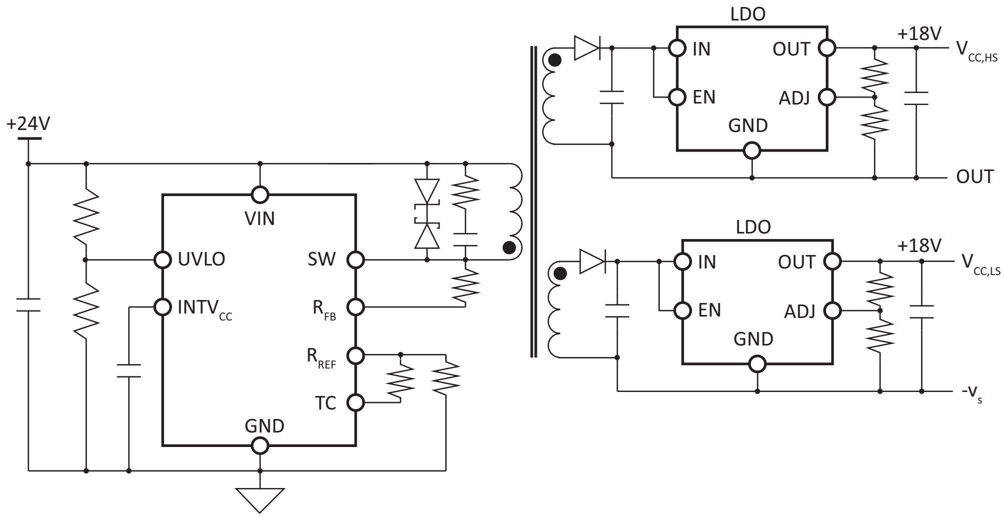
Figure 3: Bootstrap Circuit for Single Supply Rail Operation



POWER SUPPLY FOR DUAL RAIL MODE

In dual rail mode, the low-side gate driver is operating relative to the negative supply rail, which is in Dual Rail mode and not ground, but $-V_S$. Dual rail mode is typically used when you switch only one side (high side or low side) during each half period of an output sine wave, so a bootstrap circuit for the high-side is also not suitable. Figure 4 shows a simplified power supply for such condition. It is a fly-back converter circuit with two windings on the secondary side of the transformer.

Figure 4: Power Supply for Dual Rail Mode (Simplified)

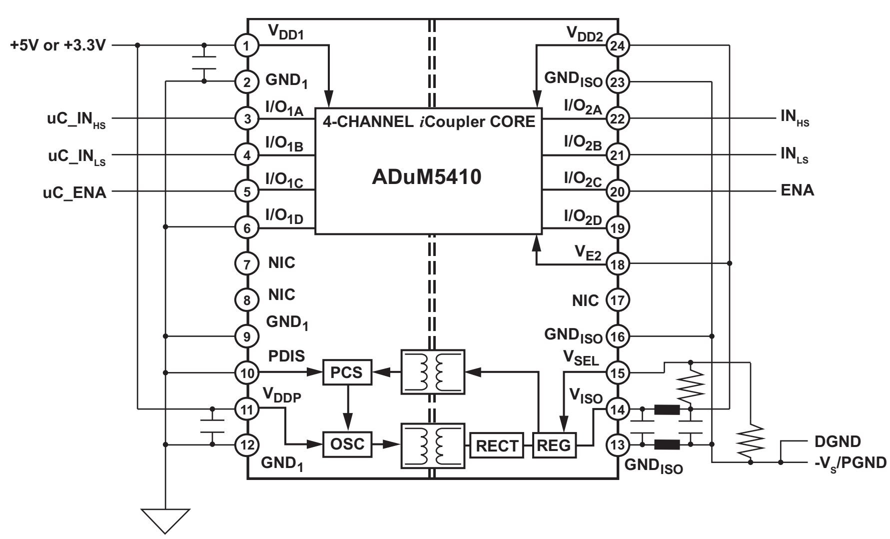


INPUT SIGNAL ISOLATION

When using dual rail mode, the input signals (which are referenced to the system ground) need to be level shifted relative to the $-V_S$ supply. The isoPower devices from Analog Devices are well suited to do that level shifting.

The same circuit also can be used when full isolation of the input signals to the SA110 is desired.

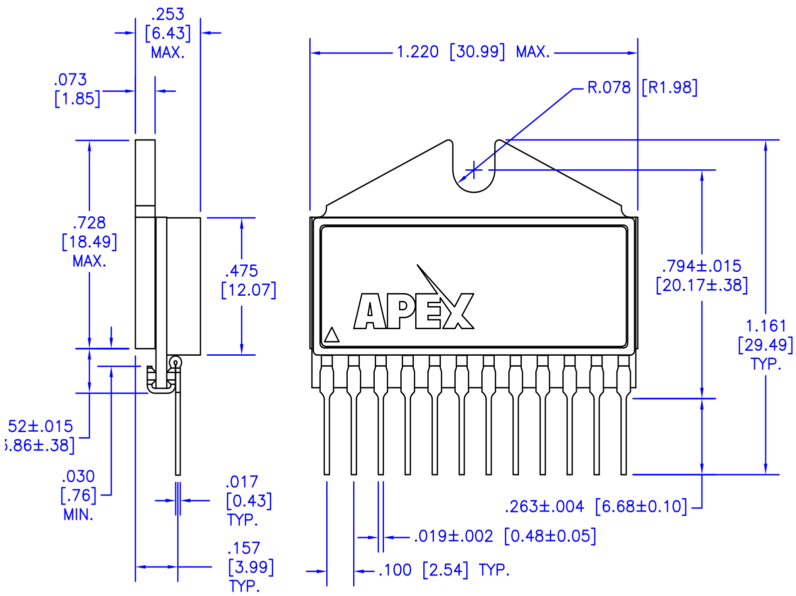
Figure 5: Input Signal Isolation (Example using ADuM5410)

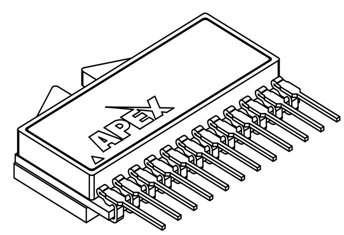


PACKAGE OPTIONS

Part Number	Apex Package Style	Description
SA110DP	DP	12 Pin Power SIP
SA110DPA	DP	12 Pin Power SIP

12-Pin Power SIP DP





NOTES:

1. Dimensions are inches & [mm].
2. Triangle on lid denotes pin 1.
3. Pins: CDA 510 phosphor bronze with tin–lead solder finish
4. Package: Vectra liquid crystal polymer, black
5. Epoxy–sealed & ultrasonically welded non–hermetic package.
6. Package weight: .367 oz. [11.41 g]

Please talk to your Apex representative for package options with bent leads.

NEED TECHNICAL HELP? CONTACT APEX SUPPORT!

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