

### FEATURES

#### Stable Over Time and Temperature

0.5% initial accuracy

1% accuracy over the full temp range

#### For Type II or Type III compensation networks

Reference voltage 1.225V

Compatible with DOSA

Low power operation: <7 mA total

#### Wide Supply Voltage Range

$V_{DD1}$  – 3V to 20V

$V_{DD2}$  – 3V to 20V

Bandwidth – 400kHz

#### Isolation Voltage

5.0kVrms reinforced

#### Wide temperature range:

-40°C to 125°C ambient operation

150°C maximum junction temperature

### APPLICATIONS

Linear Power Supplies

Inverters

UPS

DOSA Compatible Modules

Voltage Monitor

### GENERAL DESCRIPTION

The ADuM4190 is an isolated error amplifier based on Analog Devices, Inc. *iCoupler*® technology. The ADuM4190 is ideal for linear feedback power supplies with primary side controllers enabling improvements in transient response, power density and stability as compared to commonly used optocoupler and shunt regulator solutions.

Unlike optocoupler-based solutions, which have an uncertain current-transfer-ratio over lifetime and at high temperatures, the ADuM4190 transfer function does not change over lifetime and is stable over a wide temperature range of -40°C to 125°C.

Included is a wide band operational amplifier which can be used to set up a variety of commonly used power supply loop compensation techniques. The ADuM4190 is fast enough to allow a feedback loop to react to fast transient conditions and over current conditions. Also, included is a high accuracy 1.225V reference to compare with the supply output set point.

The ADuM4190 is packaged in a wide body SO-16 package for reinforced 5kVrms isolation rating.

### FUNCTIONAL BLOCK DIAGRAM

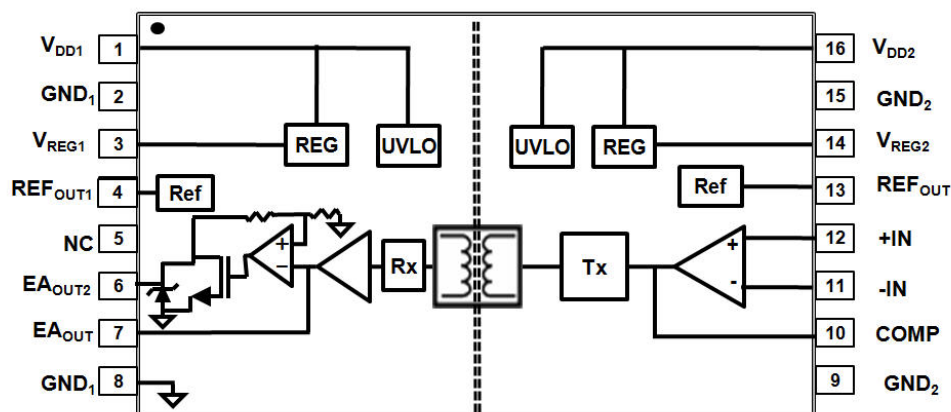


Figure 1. ADuM4190

<sup>1</sup> Protected by U.S. Patents 5,952,849, 6,873,065 and 7,075,329. Other patents pending.

#### Rev. PrA

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**SPECIFICATIONS WITH  $V_{DD1} = V_{DD2} = 3\text{ V TO }20\text{ V}$ ,  $T_A = T_{MIN}\text{ TO }T_{MAX}$**

Table 1. All typical specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{DD1} = V_{DD2} = 5\text{V}$ .

Parameter	Conditions	Min	Typ	Max	Unit
Accuracy	$= (1.225\text{V} - EA_{OUT})/1.225\text{V}$ Refer to Figure 2				
Initial Error	$T_A = 25^\circ\text{C}$		0.25%	0.5%	V/V
Total Error	$T_A = T_{MIN}\text{ to }T_{MAX}$		0.5%	1%	V/V
Op Amp					
Offset Error		-5	+/-2.5	5	mV
Open Loop Gain		66	80		dB
Input Common-mode Range		0.35		1.5	V
Gain Bandwidth Product			10		MHz
Common-mode rejection			72		dB
Input Capacitance			2		pF
Output Voltage Range	COMP pin	0.2		2.7	V
Input bias current			0.01		$\mu\text{A}$
Reference					
Output Voltage	at $25^\circ\text{C}$ , 0 to 1mA load, $C_{REFOUT} = 15\text{pF}$	1.220	1.225	1.230	V
	$-40^\circ$ to $125^\circ\text{C}$ , 0 to 1mA load, $C_{REFOUT} = 15\text{pF}$	1.213	1.225	1.237	V
Output Current	$C_{REFOUT} = 15\text{pF}$	2.0			mA
UVLO					
Positive Going Threshold			2.8		V
Negative Going Threshold			2.6		V
$EA_{OUT}$ Impedance	$V_{DD2} < \text{UVLO threshold}$ or $V_{DD1} < \text{UVLO threshold}$		High Z		Ohms
OUTPUT CHARACTERISTICS					
Output Gain	From Comp to $EA_{OUT}$ , DC, 0.3 to 2.4V	0.9	1.0	1.1	V/V
	From Comp to $EA_{OUT2}$ , DC, 0.4 to 5.0V	2.24	2.6	2.86	V/V
Output -3dB Bandwidth	From Comp to $EA_{OUT}$ , 0.3 to 2.4V, +/- 3mA				
	From Comp to $EA_{OUT2}$ , 0.4 to 5.0V, +/- 1mA				
A and S Grade		100	200		kHz
B and T Grade		250	400		kHz
Output Voltage, $EA_{OUT}$ Low	+/- 3mA output			0.4	V
Output Voltage, $EA_{OUT}$ High	+/- 3mA output	2.4	2.5		V
Output Voltage, $EA_{OUT2}$ Low	$V_{DD1} = 4.5\text{V}$ to $5.5\text{V}$ , +/- 1mA output		0.2	0.6	V
Output Voltage, $EA_{OUT2}$ High	$V_{DD1} = 4.5\text{V}$ to $5.5\text{V}$ , +/- 1mA output	4.8	4.9		V
Output Voltage, $EA_{OUT2}$ Low	$V_{DD1} = 10$ to $20\text{V}$ , +/- 1mA output		0.2	0.6	V
Output Voltage, $EA_{OUT2}$ High	$V_{DD1} = 10$ to $20\text{V}$ , +/- 1mA output	5.0	5.4		V
Output Voltage Noise	Figure 2		1.7		$\text{mV}_{RMS}$
POWER SUPPLY					
Operating Range	$V_{DD1}$	3.0		20	V
Operating Range	$V_{DD2}$	3.0		20	V
Power Supply Rejection	DC, $V_{DD1} = V_{DD2} = 3\text{V}$ to $20\text{V}$	60			dB
Supply Current	$I_{DD1}$		1.4	2.0	mA
	$I_{DD2}$		2.9	5.0	mA

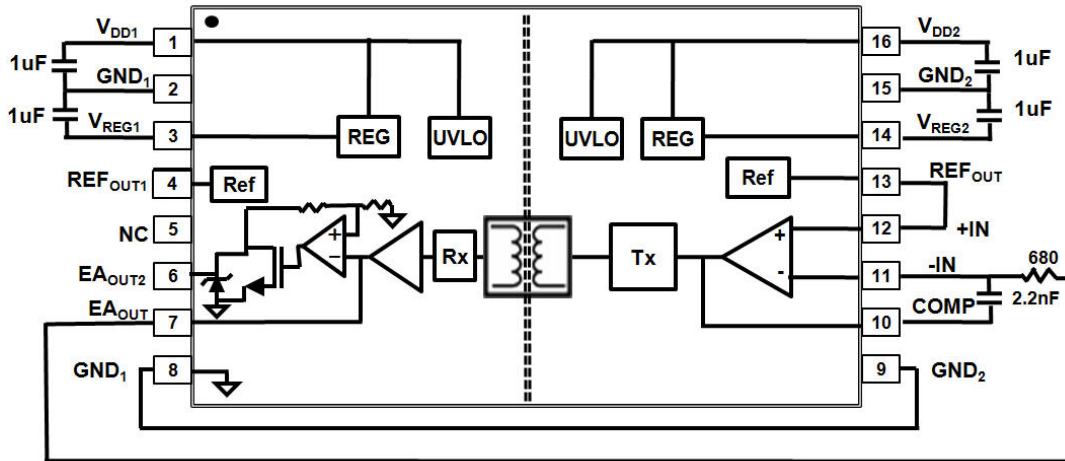


Figure 2. ADuM4190 Test Circuit 1

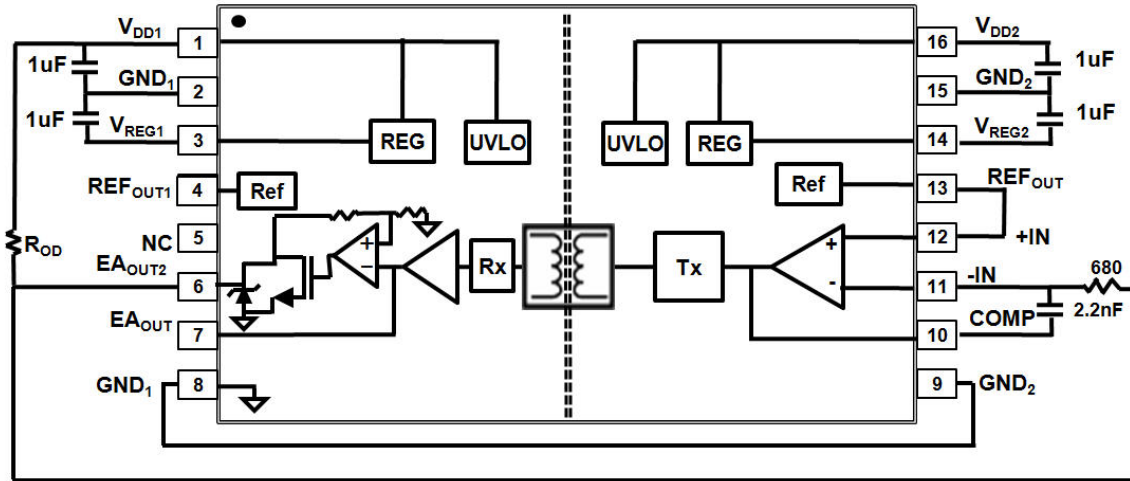


Figure 3. ADuM4190 Test Circuit 2

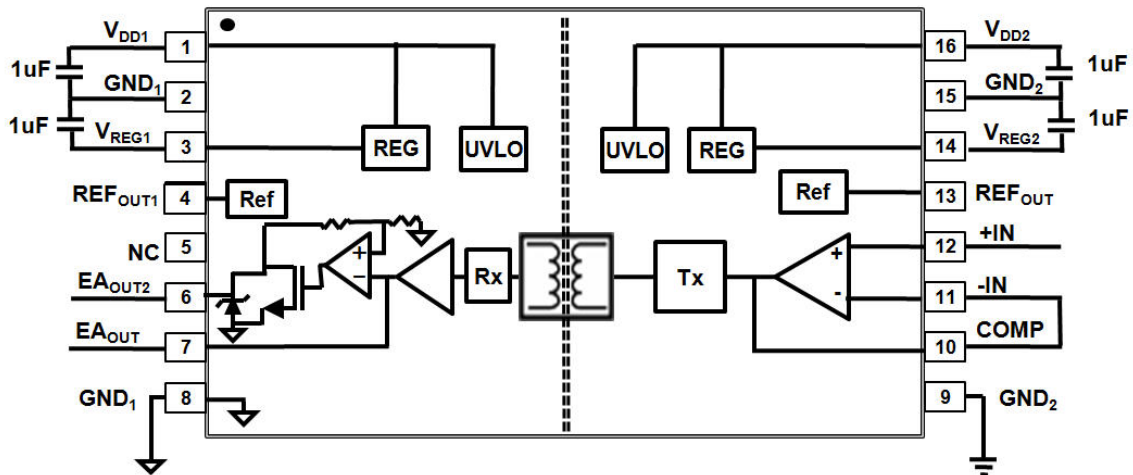


Figure 4. ADuM4190 Test Circuit 3

**PACKAGE CHARACTERISTICS**

Table 2.

Parameter	Symbol	Min	Typ	Max	Unit	Test Conditions
Resistance (Input-to-Output) <sup>1</sup>	R <sub>I-O</sub>		10 <sup>13</sup>		Ω	f = 1 MHz
Capacitance (Input-to-Output) <sup>1</sup>	C <sub>I-O</sub>		2.2		pF	
Input Capacitance <sup>2</sup>	C <sub>I</sub>		4.0		pF	Thermocouple located at center of package underside
IC Junction-to-Ambient Thermal Resistance						
16-Lead SOIC_IC	θ <sub>JA</sub>		45		°C/W	

<sup>1</sup> The device is considered a 2-terminal device; Pin 1 through Pin 8 are shorted together, and Pin 9 through Pin 16 are shorted together.

<sup>2</sup> Input capacitance is from any input data pin to ground.

**REGULATORY INFORMATION**

1

The ADuM4190 will be approved by the organizations listed in Table3. See Table 5 and the section for recommended maximum working voltages for specific cross-isolation waveforms and insulation levels.

Table 3.

UL	CSA	VDE
Recognized under UL 1577 Component Recognition Program <sup>1</sup>	Approved under CSA Component Acceptance Notice #5A	Certified according to DIN V VDE V 0884-10 (VDE V 0884-10): 2006-12 <sup>1</sup>
Single 5000 V rms Isolation Voltage	Reinforced insulation per CSA 60950-1-03 and IEC 60950-1, 400 V rms (565 V peak) maximum working voltage Basic insulation per CSA 60950-1-03 and IEC 60950-1, 800 V rms(1131 V peak) maximum working voltage	Reinforced insulation, 849 V peak
File E214100	File 205078	File 2471900-4880-0001

In accordance with UL 1577, each ADuM4190 is proof tested by applying an insulation test voltage ≥ 6000 V rms for 1 second (current leakage detection limit = 10 μA).

<sup>1</sup> In accordance with DIN V VDE V 0884-10, each ADuM4190 is proof tested by applying an insulation test voltage ≥ 1590 V peak for 1 second (partial discharge detection limit = 5 pC). An asterisk (\*) marking branded on the component designates DIN V VDE V 0884-10 approval.

**INSULATION AND SAFETY-RELATED SPECIFICATIONS**

Table 4 ADuM4190.

Parameter	Symbol	Value	Unit	Conditions
Rated Dielectric Insulation Voltage		5000	V rms	1 minute duration
Minimum External Air Gap (Clearance)	L(I01)	8.0 min	mm	Measured from input terminals to output terminals, shortest distance through air
Minimum External Tracking (Creepage)	L(I02)	7.6 min	mm	Measured from input terminals to output terminals, shortest distance path along body
Minimum Internal Gap (Internal Clearance)		0.017 min	mm	Insulation distance through insulation
Tracking Resistance (Comparative Tracking Index)	CTI	>175	V	DIN IEC 112/VDE 0303 Part 1
Isolation Group		IIIa		Material Group (DIN VDE 0110, 1/89, Table 1)

Table 5. Maximum Continuous Working Voltage<sup>1</sup>

Parameter	Max	Unit	Constraint
AC Voltage, Bipolar Waveform	560	V peak	50-year minimum lifetime
AC Voltage, Unipolar Waveform	1131	V peak	50-year minimum lifetime
DC Voltage	1131	V peak	50-year minimum lifetime

<sup>1</sup> Refers to continuous voltage magnitude imposed across the isolation barrier. See the Applications section for more details.

**RECOMMENDED OPERATING CONDITIONS**

Table 6.

Parameter	Symbol	Min	Max	Unit
Operating Temperature	$T_A$			
ADuM4190A/ADuM4190B		-40	+85	°C
ADuM4190S/ADuM4190T		-40	+125	°C
Supply Voltages <sup>1</sup>	$V_{DD1}, V_{DD2}$	3.0	20	V
Input Signal Rise and Fall Times			1.0	ms

## ABSOLUTE MAXIMUM RATINGS

T<sub>A</sub> = 25°C, unless otherwise noted.

Table 7.

Parameter	Rating
Storage Temperature (T <sub>ST</sub> ) Range	-65°C to +150°C
Ambient Operating Temperature (T <sub>A</sub> ) Range	-40°C to +125°C
Junction Temperature	-40°C to +150°C
Supply Voltages (V <sub>DD1</sub> , V <sub>DD2</sub> ) <sup>1</sup>	-0.5 V to +24 V
Supply Voltages (V <sub>REG1</sub> , V <sub>REG2</sub> ) <sup>1</sup>	-0.5 V to +3.6V
Input Voltages (+IN, -IN)	-0.5 V to +3.6V
Output Voltages (REF <sub>OUT</sub> , Comp)	-0.5 V to +3.6V
Output Voltages (REF <sub>OUT1</sub> , EA <sub>OUT</sub> ) EA <sub>OUT2</sub>	-0.5 V to +5.5V
Average Output Current per Output Pin	-11 mA to + 11 mA
Common-Mode Transients <sup>4</sup>	-100 kV/μs to +100 kV/μs

<sup>1</sup> All voltages are relative to their respective ground.

<sup>2</sup> V<sub>DD1</sub> and V<sub>DD2</sub> refer to the supply voltages on the input and output sides of a given channel, respectively. See the Applications section.

<sup>3</sup> See Regulatory Information for maximum rated current values for various temperatures.

<sup>4</sup> Refers to common-mode transients across the insulation barrier. Common-mode transients exceeding the absolute maximum ratings may cause latch-up or permanent damage.

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

<sup>1</sup> All voltages are relative to their respective ground. See the Applications section for information on immunity to external magnetic fields.

### ESD CAUTION



**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

## PIN CONFIGURATIONS AND FUNCTION DESCRIPTIONS

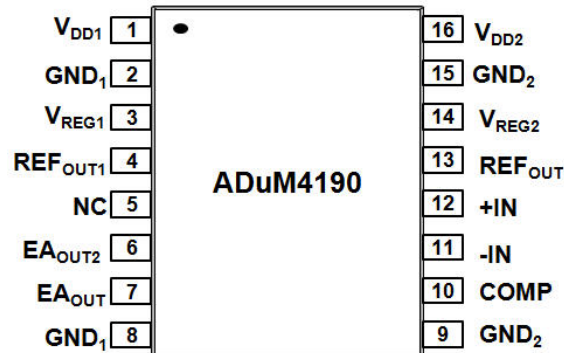


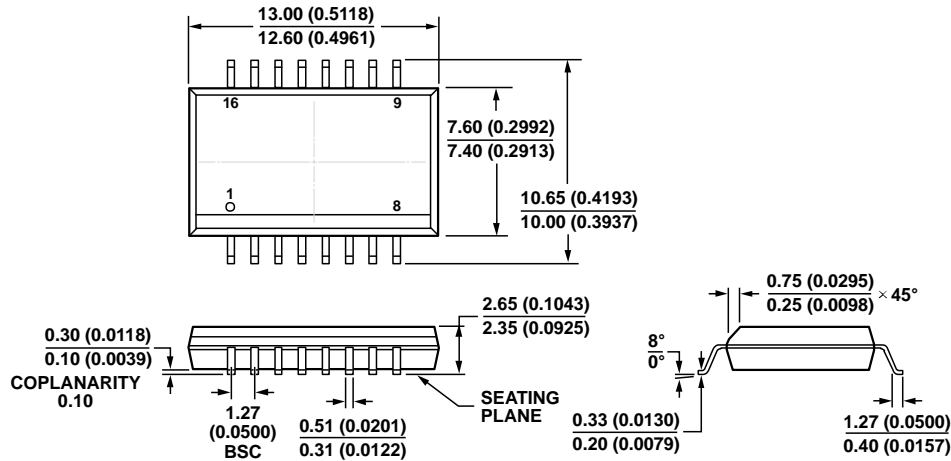
Figure 5. ADu41 90 Pin Configuration

Table 8. ADuM4190 Pin Functional Descriptions

Pin No.	Mnemonic	Description
1	V <sub>DD1</sub>	Supply Voltage for Side 1 (3.0V to 20 V)
2	GND <sub>1</sub>	Ground Reference for Side 1
3	V <sub>REG1</sub>	Internal Supply Voltage for Side 1. Connect a 1uF capacitor between V <sub>DD1</sub> and GND <sub>1</sub> .
4	REF <sub>OUT1</sub>	Reference Output Voltage for Side 1, maximum C <sub>REFOUT1</sub> = 15pF.
5	NC	No Connection, connect to GND <sub>1</sub> , do not leave floating.
6	EA <sub>OUT2</sub>	Isolated Output Voltage, Open Drain Output, select pull-up resistor for up to 1mA current.
7	EA <sub>OUT</sub>	Isolated Output Voltage
8	GND <sub>1</sub>	Ground Reference for Side 1
9	GND <sub>2</sub>	Ground Reference for Side 2
10	COMP	Output of the Op Amp. Loop compensation network may be connected between COMP and -IN pins.
11	-IN	Inverting Op Amp input. Connection for the power supply set point and compensation network.
12	+IN	Non-Inverting Op Amp input. May be used as reference Input.
13	REF <sub>OUT</sub>	Reference Output Voltage for Side 2, maximum C <sub>REFOUT</sub> = 15pF.
14	V <sub>REG2</sub>	Internal Supply Voltage for Side 2. Connect a 1uF capacitor between V <sub>DD2</sub> and GND <sub>2</sub> .
15	GND <sub>2</sub>	Ground Reference for Side 2
16	V <sub>DD2</sub>	Supply Voltage for Side 2 (3.0V to 20 V)



### OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-013-AC  
 CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS  
 (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR  
 REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN.

10-12-2010-A

Figure 6. 16-Lead Standard Small Outline Package, with Increased Creepage [SOIC\_IC]  
 Wide Body (RI-16-1)  
 Dimension shown in millimeters and (inches)

### ORDERING GUIDE

Model	Temperature Range	Bandwidth (typical)	Package Description	Package Option
ADuM4190ARIZ	-40°C to +85°C	200kHz	16-Lead SOIC_IC	RI-16-1
ADuM4190BRIZ	-40°C to +85°C	400kHz	16-Lead SOIC_IC	RI-16-1
ADuM4190SRIZ	-40°C to +125°C	200kHz	16-Lead SOIC_IC	RI-16-1
ADuM4190TRIZ	-40°C to +125°C	400kHz	16-Lead SOIC_IC	RI-16-1