

LSP2916 16-Channel, High-Voltage Driver

Features

- 16 amplifier channels available in one package.
- Outputs from 0 V to –298 V per channel.
- Programmable output current limit (50 μ A to 300 μ A).
- Fixed gain set by internal resistors. (The fixed gain for version A is –32 V/V, and –66 V/V for version B.)
- Minimal external components.

Applications

- Optical crosspoint switches.
- Optical microelectromechanical systems (MEMS) components.

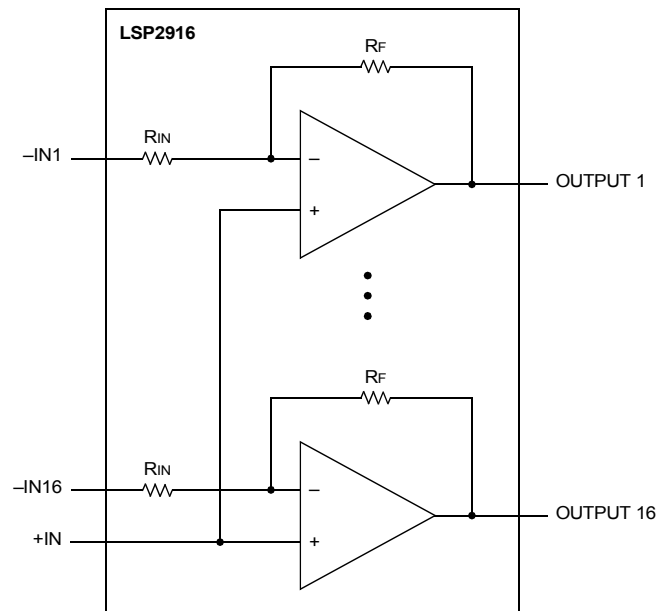
Description

This LSP2916 16-channel, high-voltage (HV) driver is targeted for microoptomechanical systems. Each device contains 16 high-voltage amplifiers with an output voltage range of 0 V to –298 V. Internal gain-setting resistors provide a fixed gain of –32 V/V, thereby minimizing external component count. Each amplifier can output up to 300 μ A, ideal for deflection and control of optical MEMS mirrors. Output current limit is programmed by an external resistor. Additionally, careful attention was paid to minimizing offset drift and gain variation over temperature. The internal block diagram is shown in Figure 1. There are two versions, version A (LSP2916A) and version B (LSP2916B). For version A, $R_F = 8 \text{ M}\Omega$ and $R_{IN} = 250 \text{ k}\Omega$; and for version B, $R_F = 8.25 \text{ M}\Omega$ and $R_{IN} = 125 \text{ k}\Omega$. So LSP2916A has the fixed gain of –32 V/V and LSP2916B has the fixed gain of –66 V/V.

The LSP2916 requires one negative high-voltage power supply (V_{HN}) and one positive 5 V analog power supply (V_{LP}). Corresponding to the 16 channels, there are 16 negative input voltage pins, –IN $_x$ ($x = 1, 2, \dots, 16$), and the corresponding 16 output pins, OUTPUT $_x$ ($x = 1, 2, \dots, 16$).

+IN is the noninverting input for all 16 amplifiers, which means all the amplifiers share the same noninverting input. +IN should be connected to GND for typical applications. IBIAS pin will set the current limit for the amplifiers by connecting it to an external resistor. The LSP2916 is available in a leaded surface-mount 64-pin MQFP package.

Block Diagram

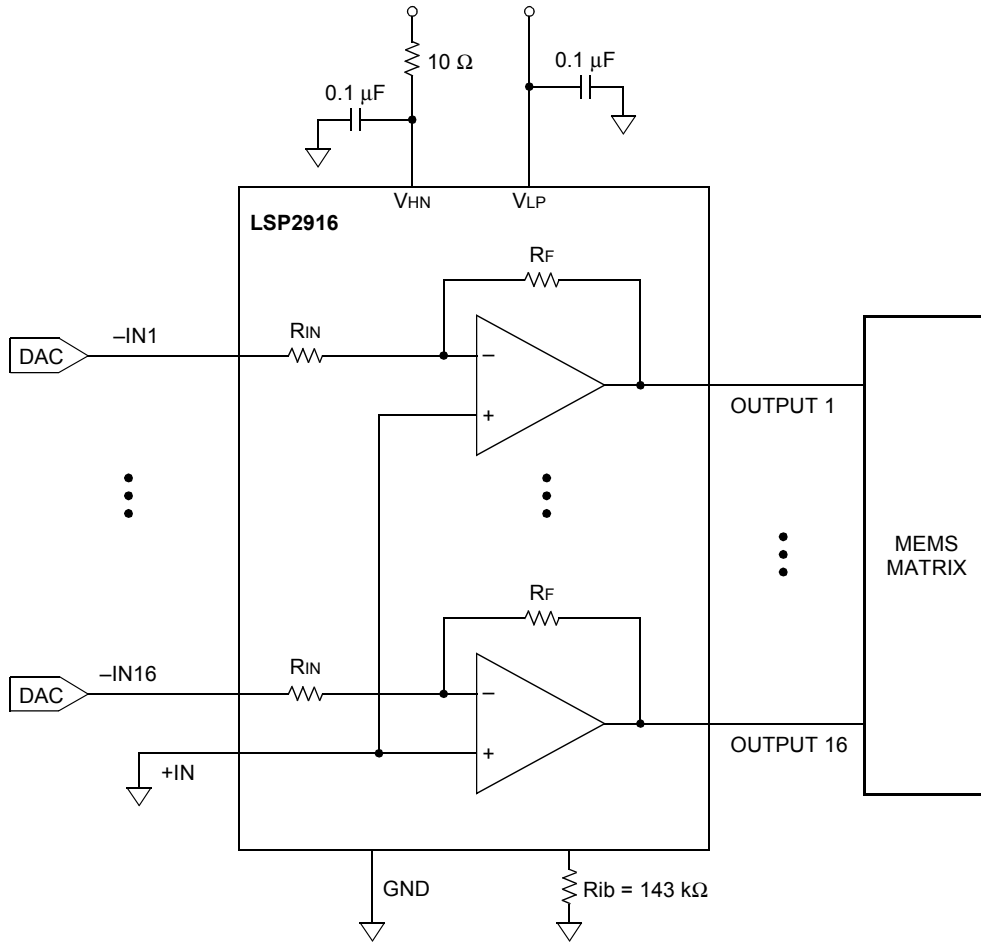


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Figure 1. LSP2916 Internal Functional Block Diagram

Description (continued)

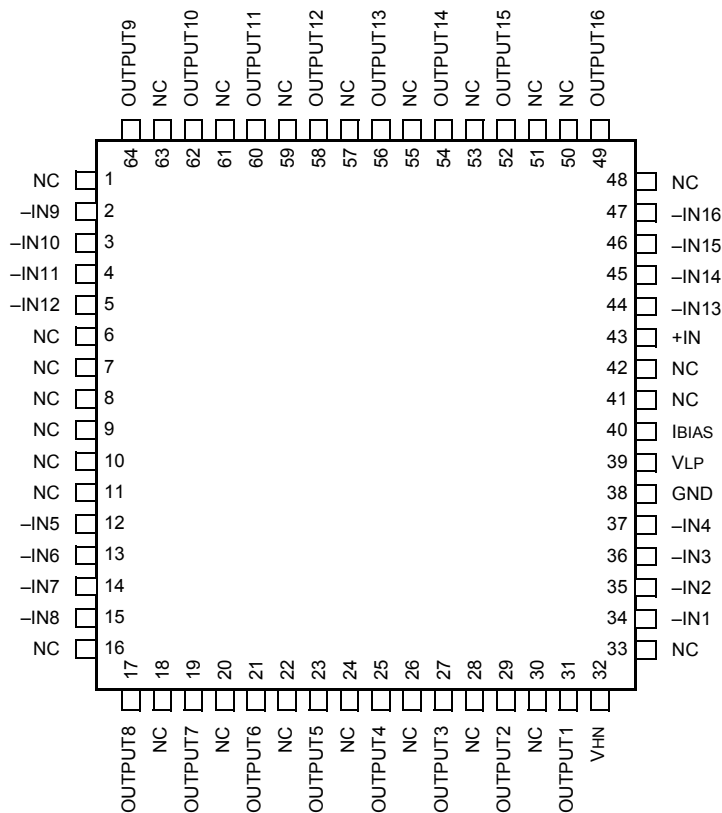
Typical Application Circuit



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Figure 2. Typical Application Circuit

Pin Information



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Figure 3. External Connections

Table 1. LSP2916 Pin Order

Pin Number	Symbol	Pin Number	Symbol	Pin Number	Symbol	Pin Number	Symbol
1	NC	17	OUTPUT8	33	NC	49	OUTPUT16
2	-IN9	18	NC	34	-IN1	50	NC
3	-IN10	19	OUTPUT7	35	-IN2	51	NC
4	-IN11	20	NC	36	-IN3	52	OUTPUT15
5	-IN12	21	OUTPUT6	37	-IN4	53	NC
6	NC	22	NC	38	GND	54	OUTPUT14
7	NC	23	OUTPUT5	39	VLP	55	NC
8	NC	24	NC	40	IBIAS	56	OUTPUT13
9	NC	25	OUTPUT4	41	NC	57	NC
10	NC	26	NC	42	NC	58	OUTPUT12
11	NC	27	OUTPUT3	43	+IN	59	NC
12	-IN5	28	NC	44	-IN13	60	OUTPUT11
13	-IN6	29	OUTPUT2	45	-IN14	61	NC
14	-IN7	30	NC	46	-IN15	62	OUTPUT10
15	-IN8	31	OUTPUT1	47	-IN16	63	NC
16	NC	32	VHN	48	NC	64	OUTPUT9

Pin Information (continued)**Table 2. LSP2916 Pin Description**

Pin Name	Function	Pin Total Counts	Description
VLP	Power Supply	1	5 V analog power supply.
GND	Ground	1	Analog ground.
VHN	$VHN < -298 V$	1	High-voltage negative supply.
IBIAS	Current Limit Control	1	Sets current limit with external resistor to GND.
+IN	Analog Input	1	Noninverting input for all channels.
-INx	Analog Input	16	Inverting input for each channel.
OUTPUTx	Analog Output	16	Output.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Table 3. Absolute Maximum Ratings

Parameter	Min	Typ	Max	Unit
Power Supply:				
VHN	0	-160.0	-298.0	V
VLP	4.5	5.0	5.5	V
Operating Temperature	-5	25	85	°C
Storage Temperature	-40	—	85	°C
Ambient Temperature	-5	25	70	°C

Handling Precautions

Although protection circuitry has been designed for this device, proper precautions should be taken to avoid exposure to electrostatic discharge (ESD) during handling and mounting. Agere Systems Inc. employs a human-body model (HMB) and charged-device model (CDM) for ESD-susceptibility testing and protection design evaluation. ESD voltage thresholds are dependent on the circuit parameters used in the defined model. No industry-wide standard has been adopted for CDM. However, a standard HBM (resistance = 1500 Ω , capacitance = 100 pF) is widely used, and therefore, can be used for comparison purposes. The HBM ESD threshold (>500 V) presented here was obtained by using these circuit parameters.

Application Notes

LSP2916 is recommended for MEMS optical systems. It features programmable current limit while the output can swing up to -298 V. With all the feedback resistors inside the chip, there is no more need for these resistors in the external circuit.

Safety Handling for the High-Voltage Device

LSP2916 is designed to operate up to 298 V negative power supply, so special care should be paid to safety issues.

Bypass Capacitors/Protection Series Resistor for the Power Supplies

To minimize noise coupling to the output, a 0.1 μ F bypass capacitor should be placed as close as possible to all power supply pins. Additionally, to avoid the possible degradation of the LSP2916 when VHN is hot switched, a 10 Ω series resistor between the VHN pin and the VHN power supply is required.

Electrical Characteristics

Table 4. Electrical Characteristics

T_A = 25 °C, V_LP = 5 V, V_HN = -200 V, noninverting input +IN = 0 V, I_{BIAS} resistor = 143 kΩ.

Parameters	Symbol	Condition	Min		Typ		Max		Unit
			2916A	2916B	2916A	2916B	2916A	2916B	
Input Characteristics									
Input Resistance	R	-IN = 5 V	125		200		500		kΩ
Input Offset Voltage*	—	-IN = 0 V	-20		0		20		mV
Input Offset Voltage Drift	—	-IN = 0 V 0 °C—70 °C	—		4		—		μV/°C
Input Noise	—	f ≤ 10 kHz C = 150 pF R = 10 MΩ	—		10.3		—		μVrms
Input Bias Current	I(-IN _x)	-IN = 5 V	12.5		25		50		μA
Input Bias Current	I(+IN)	-IN = 5 V	-40		0		40		nA
Power Supply Rejection Ratio	PSRR	VHN	—		85		—		dB
		VLP	—		52		—		dB
Input Range	-IN	—	-0.5		—		10		V
Gain									
Voltage Gain	G	-IN = 3 mV	30.4	63.0	32.0	66.0	33.6	69.0	V/V
Gain Temperature Coefficient	GTC	—	—		-1.25 x 10 ⁻⁵		—		—
Channel-to-Channel Gain Match	—	—	—		2		—		%
Amplifier Output Characteristics									
Output Resistance	—	—	10		90		125		kΩ
Amplifier Current Limit	—	R _{ib} = 143 kΩ	85		100		115		μA
Output Voltage	—	—	V _H N + 2.5 V [†]		—		V _L P - 3 V [‡]		V
Dynamics Characteristics									
-3 dB Bandwidth	—	—	—		6.5		—		kHz
Slew Rate	—	Input pulse = 0 V—4 V C = 150 pF and R = 10 MΩ	Rising	—	0.62		—		V/μs
			Falling	—	0.54		—		V/μs
Settling Time	—	Input pulse = 0 V—4 V C = 150 pF and R = 10 MΩ	Rising	—	277		—		μs
			Falling	—	309		—		μs
Crosstalk [§]	—	C = 150 pF f = 1 kHz R = 16 MΩ	Adjacent Channel	—	-71		—		dB
			Nonadjacent Channel	—	-80		—		dB

* Input offset voltage = (V_{OFFSET} voltage/gain), the test condition is for the offset output voltage.

† -IN = 10 V.

‡ -IN = -0.25 V.

§ Using an OP27 as buffer, test measurement was taken at the output of OP27.

Electrical Characteristics (continued)**Table 4. Electrical Characteristics** (continued)

$T_A = 25\text{ }^\circ\text{C}$, $V_{LP} = 5\text{ V}$, $V_{HN} = -200\text{ V}$, noninverting input $+IN = 0\text{ V}$, I_{BIAS} resistor = $143\text{ k}\Omega$.

Parameters	Symbol	Condition	Min		Typ		Max		Unit
			2916A	2916B	2916A	2916B	2916A	2916B	
Power Supply Currents at Room Temperature									
Quiescent Current	I(VHN)	VHN = -160.0 V VLP = 5.0 V	1.30		1.55		1.80		mA
	I(VLPA)		1.36		1.60		1.85		mA
Power Consumption	P	VHN = -160.0 V VLP = 5.0 V	—		256		—		mW

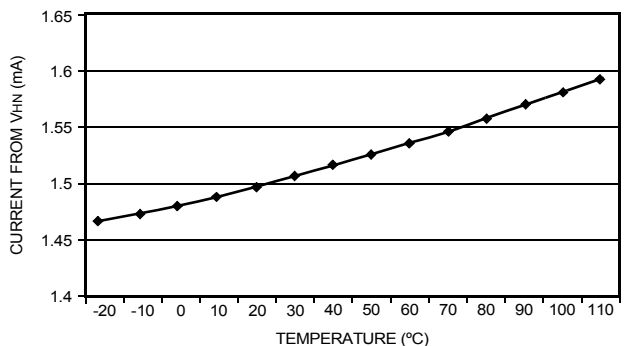
* Input offset voltage = (V_{OFFSET} voltage/gain), the test condition is for the offset output voltage.

† $-IN = 10\text{ V}$.

‡ $-IN = -0.25\text{ V}$.

§ Using an OP27 as buffer, test measurement was taken at the output of OP27.

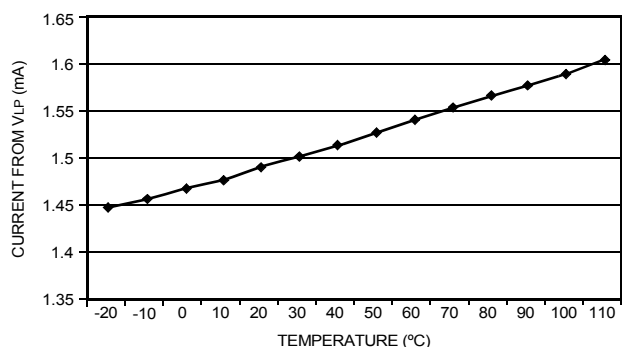
Electrical Characteristics (continued)



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Note: Test conditions for the LSP2916A are: VHN = -200 V, VLP = 5 V, Rib = 144 kΩ.

Figure 4. Current from VHN vs. Temperature



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Note: Test conditions for the LSP2916A are: VHN = -200 V, VLP = 5 V, Rib = 144 kΩ.

Figure 5. Current from VLP vs. Temperature

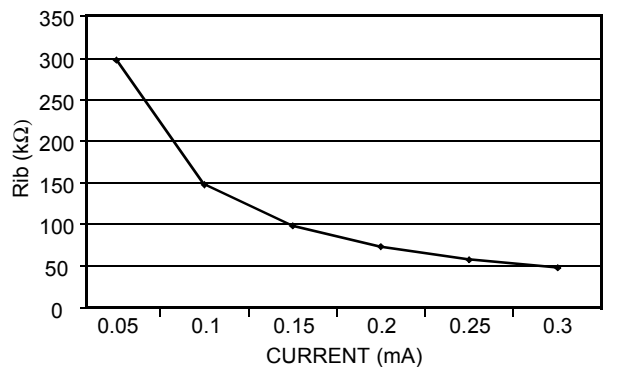
Output Current Range at Different Resistance on Pin IBIAS

Figure 6 shows the output current range when different resistances are applied to pin IBIAS.

Test condition: maximum current limit is 300 μA.

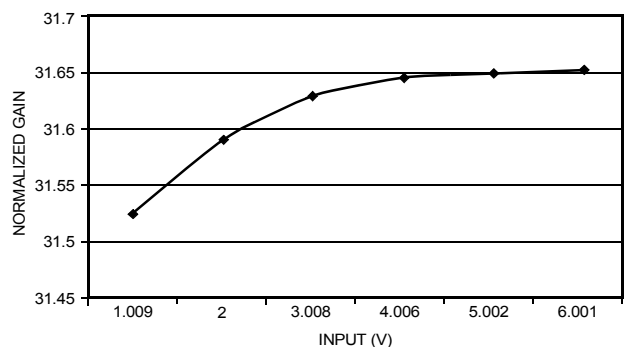
Table 5. Output Current Range at Different Resistances on IBIAS

Resistance on IBIAS	Min	Typ	Max	Unit
143 kΩ	85	100	115	μA
70.3 kΩ	170	200	230	μA
45.2 kΩ	255	300	345	μA



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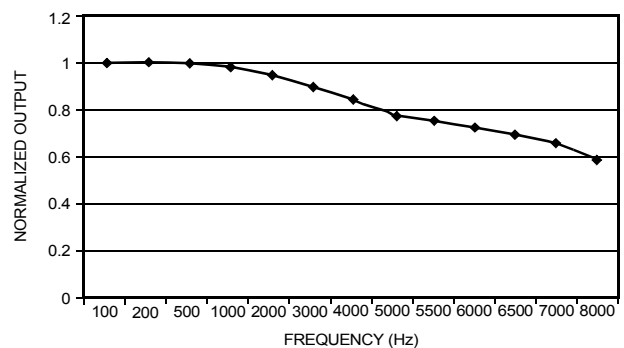
Figure 6. Resistor (Rib) vs. Output Current Limit



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Note: Test conditions for the LSP2916A are: VHN = -200 V, VLP = 5 V, Rib = 144 kΩ.

Figure 7. Gain vs. Output Voltage (VHN = -160 V)

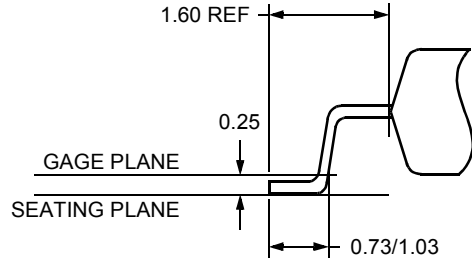
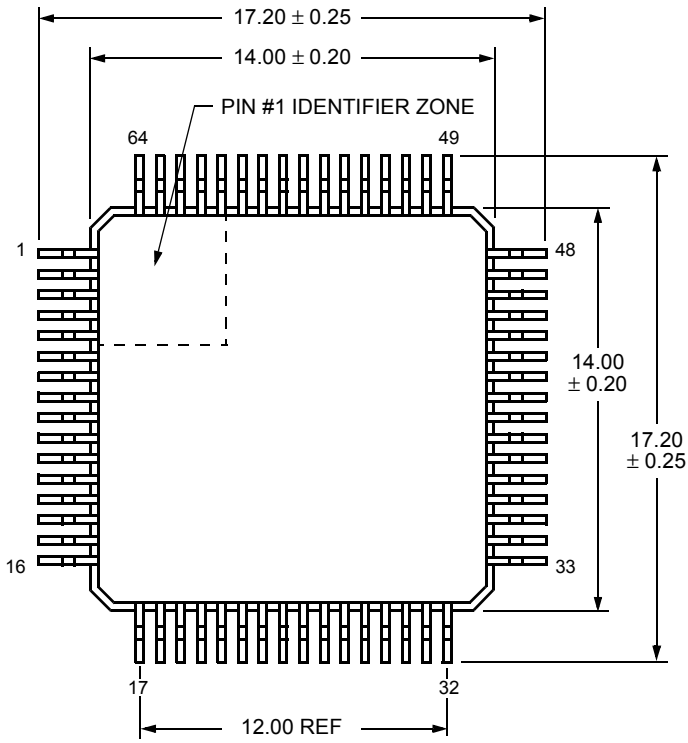


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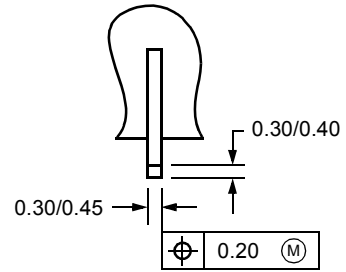
Note: Test conditions for the LSP2916A are: VHN = -200 V, VLP = 5 V, Rib = 144 kΩ.

Figure 8. -3 dB Plot

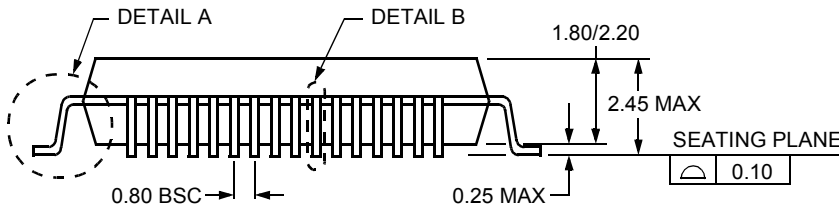
LSP2916AHA/LSP2916BHA Package Diagram



DETAIL A



DETAIL B



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Ordering Information

Version	Device Code	Temperature Range	Package
LSP2916A	LSP2916AHA	0 °C—70 °C	64 MQFP
LSP2916B	LSP2916BHA	0 °C—70 °C	64 MQFP

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