High Voltage, Rail-to-Rail Output Operational Amplifiers

Features

- AEC-Q100 qualified
  - Device ambient temperature: -40°C ≤ T_A ≤ 125°C
  - Device junction temperature: -40°C ≤ T_J ≤ 150°C
- Supply voltage range: 4.5 V to 36 V
- High gain-bandwidth product of 3.5 MHz
- High slew rate of 2.5 V/µs
- Low supply current
  - 0.95 mA per channel at V_S = 36 V
  - 0.75 mA per channel at V_S = 4.5 V
- Settling time to 0.1% with 2 V step: 0.9 µs
- Common mode input range: -0.1 V to (+V_S - 1.5 V)
- Rail-to-rail output: -V_S to +V_S
- Low input voltage noise density of 32 nV/√Hz
- Low offset voltage of 3.5 mV (max)

Applications

- Body electronics and lighting
- Automotive head unit, T-Box
- BMS, traction inverter and OBC
- ADAS domain controller
- Passive safety: brake system

Package Information

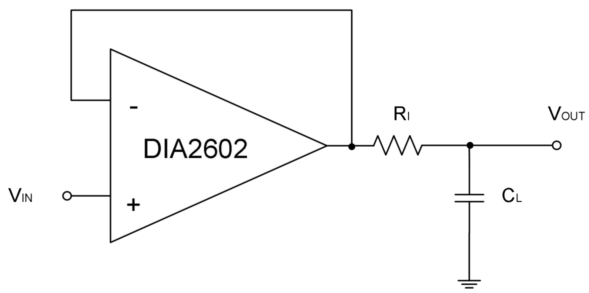
Part Number	Package	Body Size
DIA2602	SOIC-8	4.9 mm × 3.9 mm

Description

The DIA2602 is a dual-channel 36 V amplifier with high speed, low power and low noise. The DIA2602 has a high gain-bandwidth product of 3.5 MHz and a slew rate of 2.5 V/µs. These two outstanding specs allows the DIA2602 to amplify signals more accurately and handle high-frequency signals better, improving the accuracy of the circuit. In addition, the DIA2602 also offers a low supply current of 0.75 mA per channel at 4.5 V.

The good noise performance also makes the DIA2602 very suitable for low noise systems. Its low input offset voltage of 3.5 mV max, wide common mode input range and rail-to-rail output provides excellent user experience.

Simplified Schematic



Ordering Information

Ordering Part No.	Top Marking	MSL	RoHS	T_A	Package	
DIA2602SO8	DIA62AH	1	Green	-40 to 125°C	SOIC-8	Tape & Reel, 2500

If you encounter any issue in the process of using the device, please contact our customer service at marketing@dioo.com or phone us at (+86)-21-62116882. If you have any improvement suggestions regarding the datasheet, we encourage you to contact our technical writing team at docs@dioo.com. Your feedback is invaluable for us to provide a better user experience.

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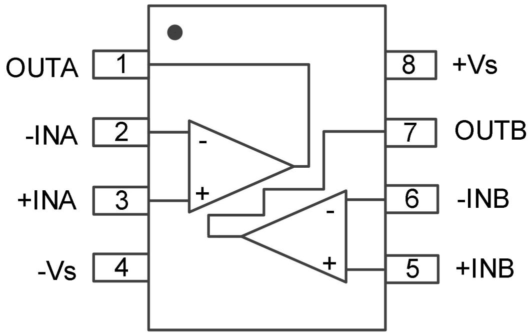


SOIC-8
Top view

Pin No.	Pin name	Description
8	$+V_S$	Positive supply
4	$-V_S$	Negative supply
3, 5	+IN (+INA / +INB)	Positive input (channel A / B)
2, 6	-IN (-INA / -INB)	Negative input (channel A / B)
1, 7	OUT (OUTA / OUTB)	Output (channel A / B)

2. Absolute Maximum Ratings

Exceeding the maximum ratings listed under Absolute Maximum Ratings when designing is likely to damage the device permanently. Do not design to the maximum limits because long-time exposure to them might impact the device's reliability. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Rating	Unit
V_S	Supply voltage	40	V
V_{IN}	Input voltage	$(-V_S - 0.3)$ to $(+V_S + 0.3)$	V
T_{STG}	Storage temperature range	-65 to 150	°C
T_J	Junction temperature	150	°C
T_L	Lead temperature range	260	°C

3. Recommended Operating Conditions

Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. The ratings are obtained over an operating free-air temperature range unless otherwise specified.

Symbol	Parameter	Rating	Unit
V_S	Supply voltage	4.5 to 36	V
V_{IN}	Input voltage	-0.1 to (+V_S - 1.5)	V
T_A	Operating temperature range	-40 to 125	°C

4. ESD Ratings

When a statically-charged person or object touches an electrostatic discharge sensitive device, the electrostatic charge might be drained through sensitive circuitry in the device. If the electrostatic discharge possesses sufficient energy, damage might occur to the device due to localized overheating.

Model	Condition	Value	Unit
HBM	AEC Q100-002	±2000	V
CDM	AEC Q100-011	±500	V

5. Electrical Characteristics

Typical value: T_A = 25°C, $+V_S$ = 30 V, $-V_S$ = 0 V, R_L = 10 kΩ, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Power supply						
V_S	Supply voltage range		4.5		36	V
PSRR	Power supply rejection ratio			120		dB
I_Q	Supply current per channel/amplifier	V_S = 4.5 V, -40°C ≤ T_A ≤ 125°C	0.45	0.75	1.03	mA
		V_S = 36 V, -40°C ≤ T_A ≤ 125°C	0.48	0.95	1.41	mA
Input characteristics						
V_{OS}	Input offset voltage	V_{CM} = $+V_S$ / 2, -40°C ≤ T_A ≤ 125°C	-3.5		3.5	mV
I_B	Input bias current			100		pA
I_{OS}	Input offset current			100		pA
V_{CM}	Common mode voltage range	-40°C ≤ T_A ≤ 125°C	-0.1		$+V_S$ - 1.5	V
CMRR	Common mode rejection ratio	-40°C ≤ T_A ≤ 125°C, $+V_S$ = 36 V, V_{CM} = 0.5 V to 28 V		90		dB
A_{OL}[1]	Open loop voltage gain	R_L = 10 kΩ		155		dB
V_O	Output swing high from supply rail	$+V_S$ = 2.5 V, $-V_S$ = -2.5 V, R_L = 10k to 0 V		8	15	mV
		$+V_S$ = 15 V, $-V_S$ = -15 V, R_L = 10k to 0 V		30	40	mV
	Output swing low from supply rail	$+V_S$ = 2.5 V, $-V_S$ = -2.5 V, R_L = 10k to 0 V		5	10	mV
		$+V_S$ = 15 V, $-V_S$ = -15 V, R_L = 10k to 0 V		30	45	mV
$\Delta V_{OS}/\Delta T$	Input offset voltage drift	-40°C ≤ T_A ≤ 125°C		5		µV/°C
Output characteristics						
I_{SC}	Output short-circuit current	Sink current	7.5	14.2	21.9	mA
		Source current	9.3	16.5	24.7	mA
Dynamic performance						
GBP	Gain bandwidth product	f = 1 kHz		3.5		MHz
SR	Slew rate	A_V = 1, 10 V step		2.5		V/µs
t_S	Settling time	A_V = -1, 2 V step, 0.1%		0.9		µs
		A_V = -1, 2 V step, 0.01%		1.2		µs

t_{OR}	Positive overload recovery time	$+V_S$ = 18 V, $-V_S$ = -18 V, G = 10, R_L = 2 kΩ, C_L = 100 pF, V_{IN} = 3.8 Vpp at 1.9 V		1.4		μs
	Negative overload recovery time	$+V_S$ = 18 V, $-V_S$ = -18 V, G = 10, R_L = 2 kΩ, C_L = 100 pF, V_{IN} = 3.8 Vpp at -1.9 V		1		μs
Noise performance						
THD+N	Total harmonic distortion and noise	f = 1 kHz, A_V = 1 V, R_L = 2 kΩ, V_{OUT} = 3.5 V_{RMS}		0.0005		%
e_n	Input voltage noise density	f = 1 kHz		32		nV/√Hz
V_n	Input voltage noise	f = 0.1 Hz to 10 Hz		2.35		μV_{RMS}
X_{talk}	Channel separation	f = 1 kHz, R_L = 1 kΩ		-100		dB

Note:

(1) Guaranteed by design.

(2) Specifications subject to change without notice.

6. Typical Performance Characteristics

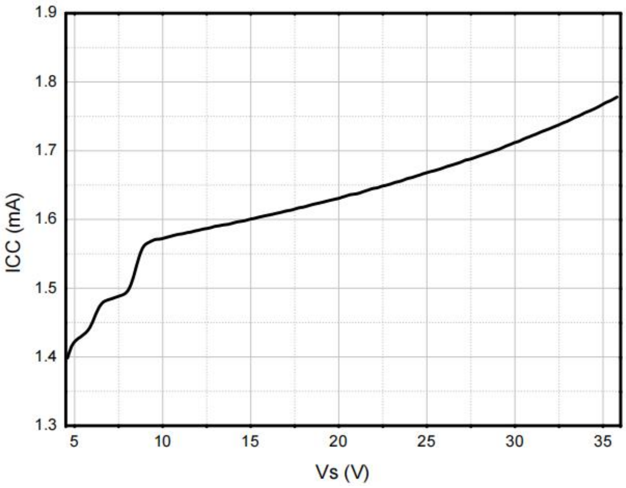


Figure 1. Quiescent current vs. Supply voltage

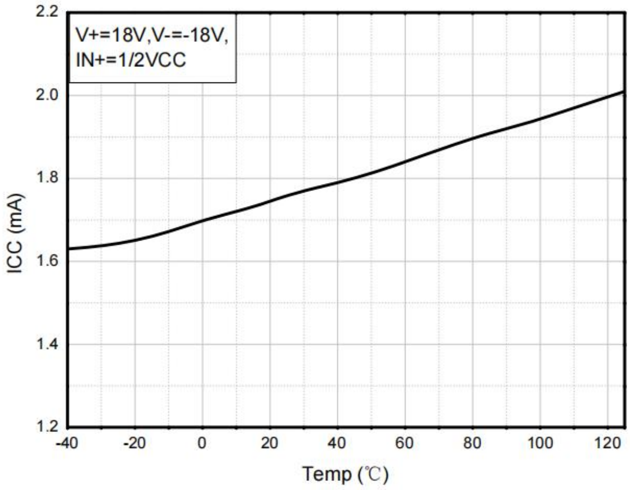


Figure 2. Quiescent current vs. Temperature

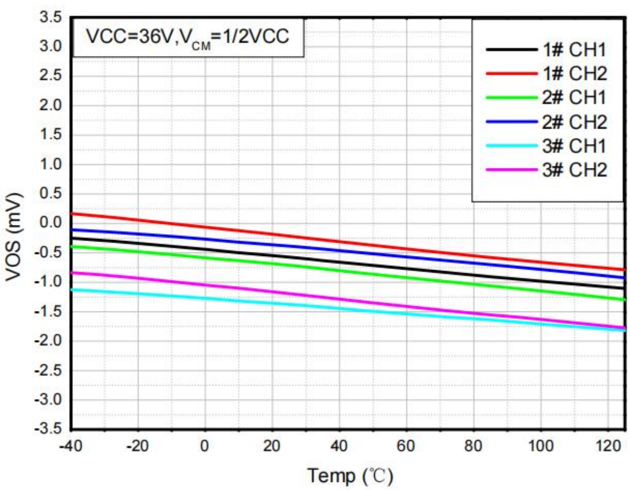


Figure 3. V_{OS} vs. Temperature

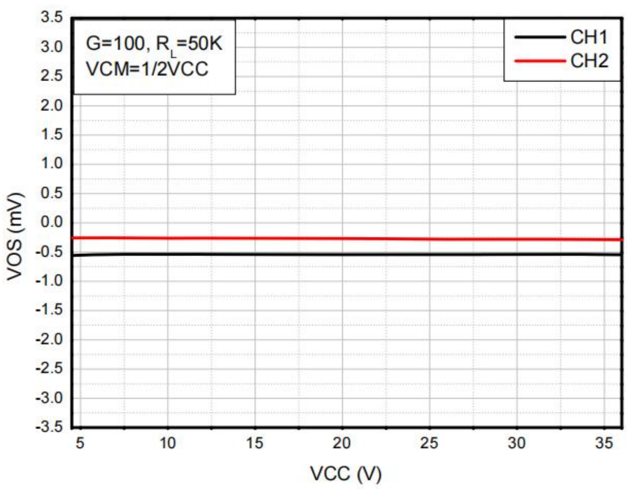
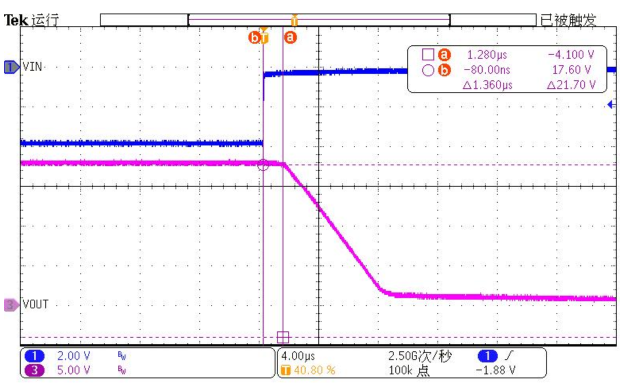


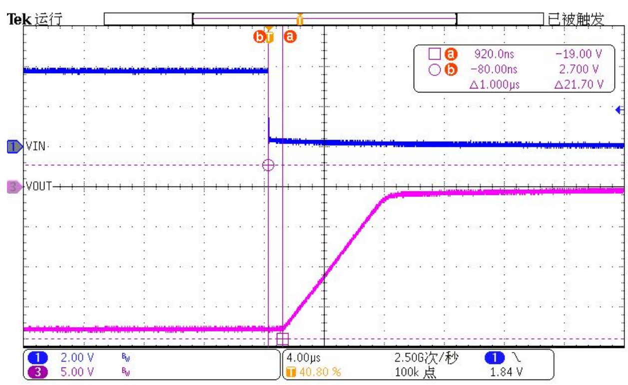
Figure 4. V_{OS} vs. V_{CC}



+V_S = 18 V, -V_S = -18 V, G = 10, R_L = 2 kΩ, C_L = 100 pF,

V_{IN} = 3.8 Vpp at 1.9 V

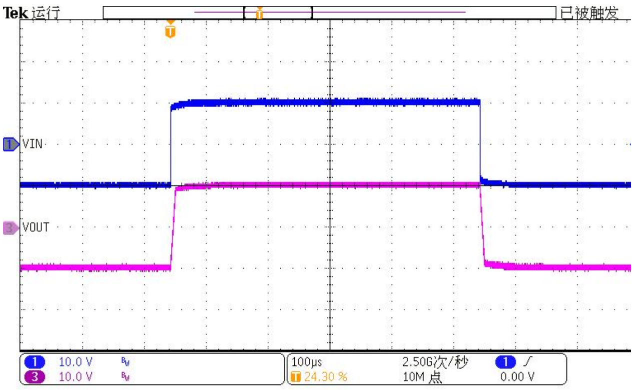
Figure 5. Positive overload recovery



+V_S = 18 V, -V_S = -18 V, G = 10, R_L = 2 kΩ, C_L = 100 pF,

V_{IN} = 3.8 Vpp at -1.9 V

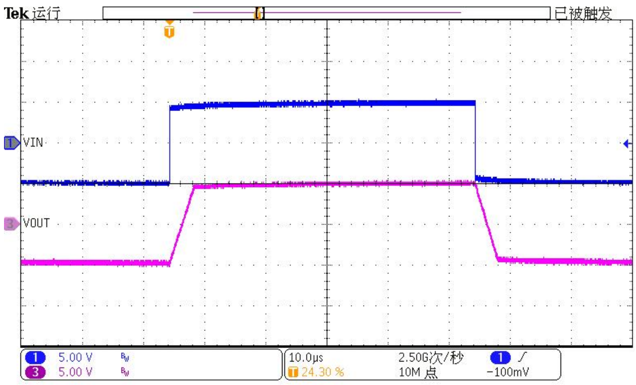
Figure 6. Negative overload recovery



+V_S = 18 V, -V_S = -18 V, G = 1, R_L = 2 kΩ, C_L = 100 pF

V_{IN} = 10 Vpp at 1 kHz, 0 V bias

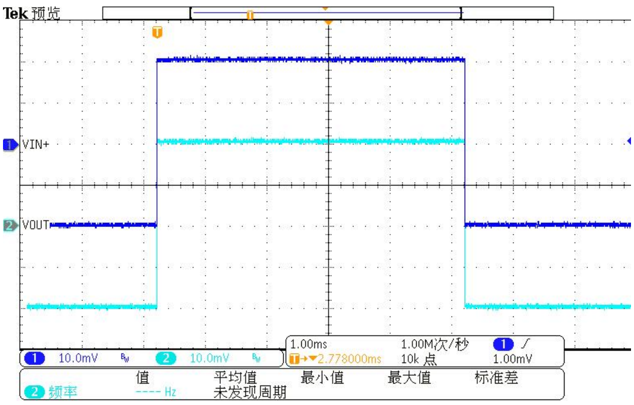
Figure 7. Signal step response



+V_S = 18 V, -V_S = -18 V, G = 1, R_L = 2 kΩ, C_L = 100 pF

V_{IN} = 10 Vpp at 10 kHz, 0 V bias

Figure 8. Signal step response



+V_S = 18 V, -V_S = -18 V, G = 1, C_L = 100 pF, R_L = 2 kΩ to GND,

V_{IN} = 40 mVpp at 100 Hz, 0 V bias,

Figure 9. Small-signal response

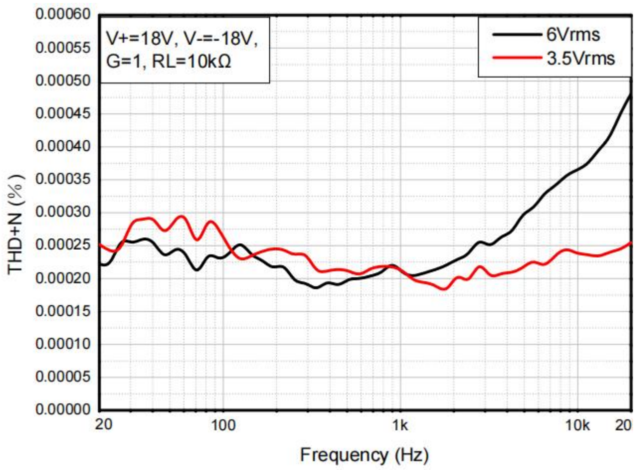


Figure 10. THD + N vs. Frequency

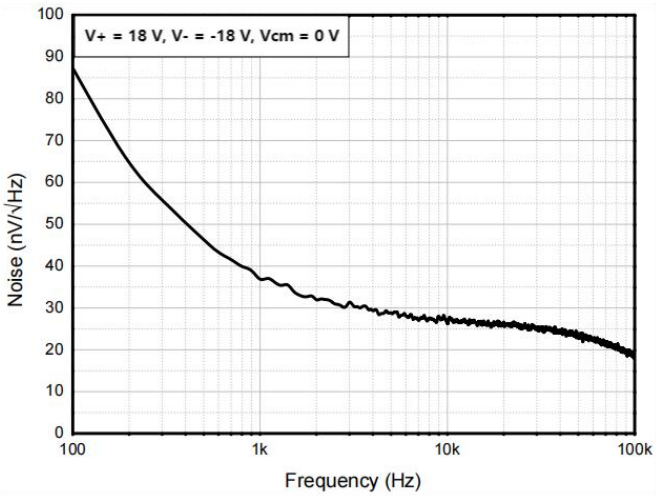


Figure 11. Voltage noise spectral density vs. Frequency

7. Application Information

Important notice: Validation and testing are the most reliable ways to confirm system functionality. The application information is not part of the specification and is for reference purposes only.

7.1. Application examples

A typical application of operational amplifiers is inverters. This amplifier applies positive voltage to the input and makes it a negative voltage of the same size. Similarly, it also makes negative voltage positive.

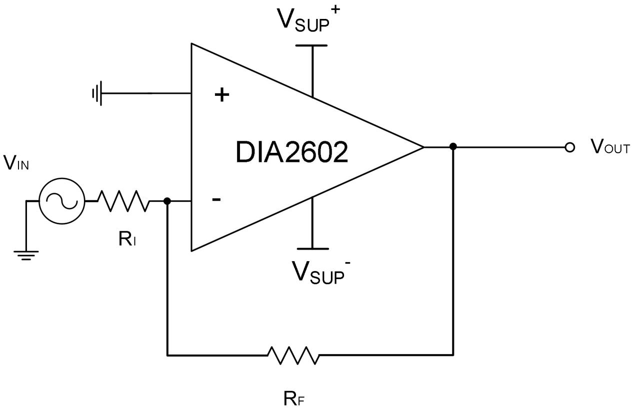


Figure 12. Application schematic (Equation 1)

$$A_V = -R_F / R_I \tag{1}$$

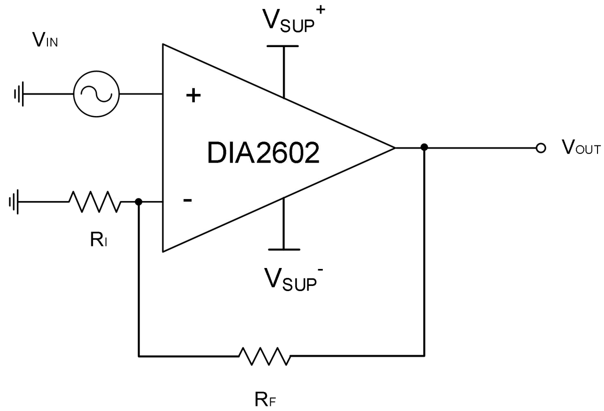


Figure 13. Application schematic (Equation 2)

$$A_V = R_F / R_I + 1 \tag{2}$$

7.2. Detailed design procedure

Use the following formulas to determine the required gain for the inverter amplifier:

$$A_V = V_{OUT} / V_{IN} \tag{3}$$

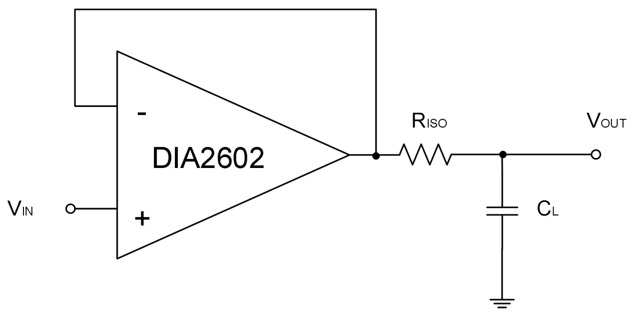


Figure 14. Indirectly driving heavy capacitive load

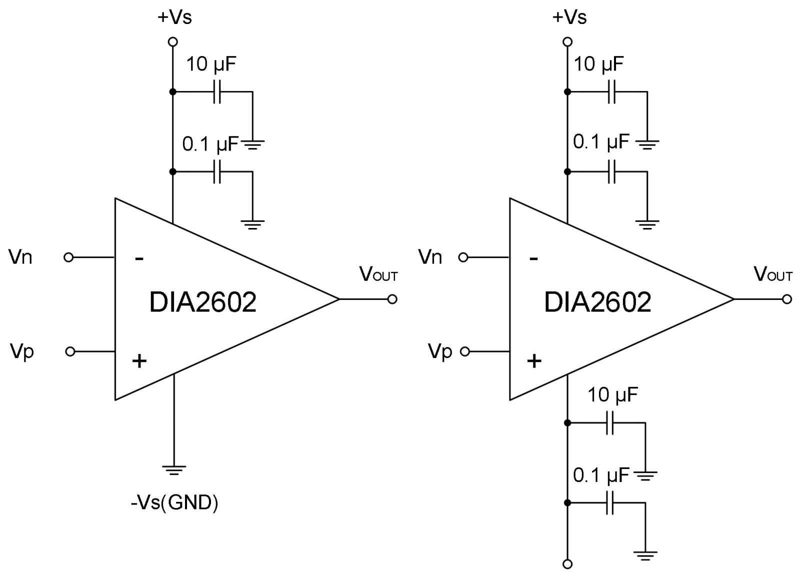


Figure 15. Indirectly driving heavy capacitive load with DC accuracy

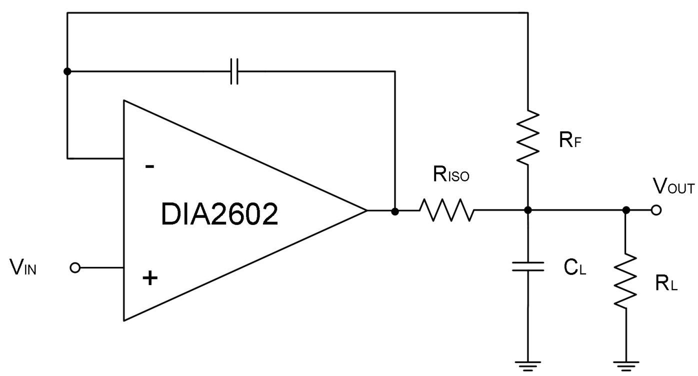


Figure 16. Amplifier with bypass capacitors

8. Feature Description

8.1. Overview

The DIA2602 is a high voltage, rail-to-rail output operational amplifier. The DIA2602 has a high gain-bandwidth product and low supply current. These characteristics, combined with low offset voltage and high slew rate, make this device ideal for automotive applications.

8.2. Gain-bandwidth product

The DIA2602 has a high gain-bandwidth which is typically rated at 3.5 MHz. The DIA2602 may be operated without greatly distorting the signal.

8.3. Slew rate

The slew rate of the DIA2602 is the rate can change its output when there is a change on the input. The DIA2602 has a 2.5 V/μs high slew rate.

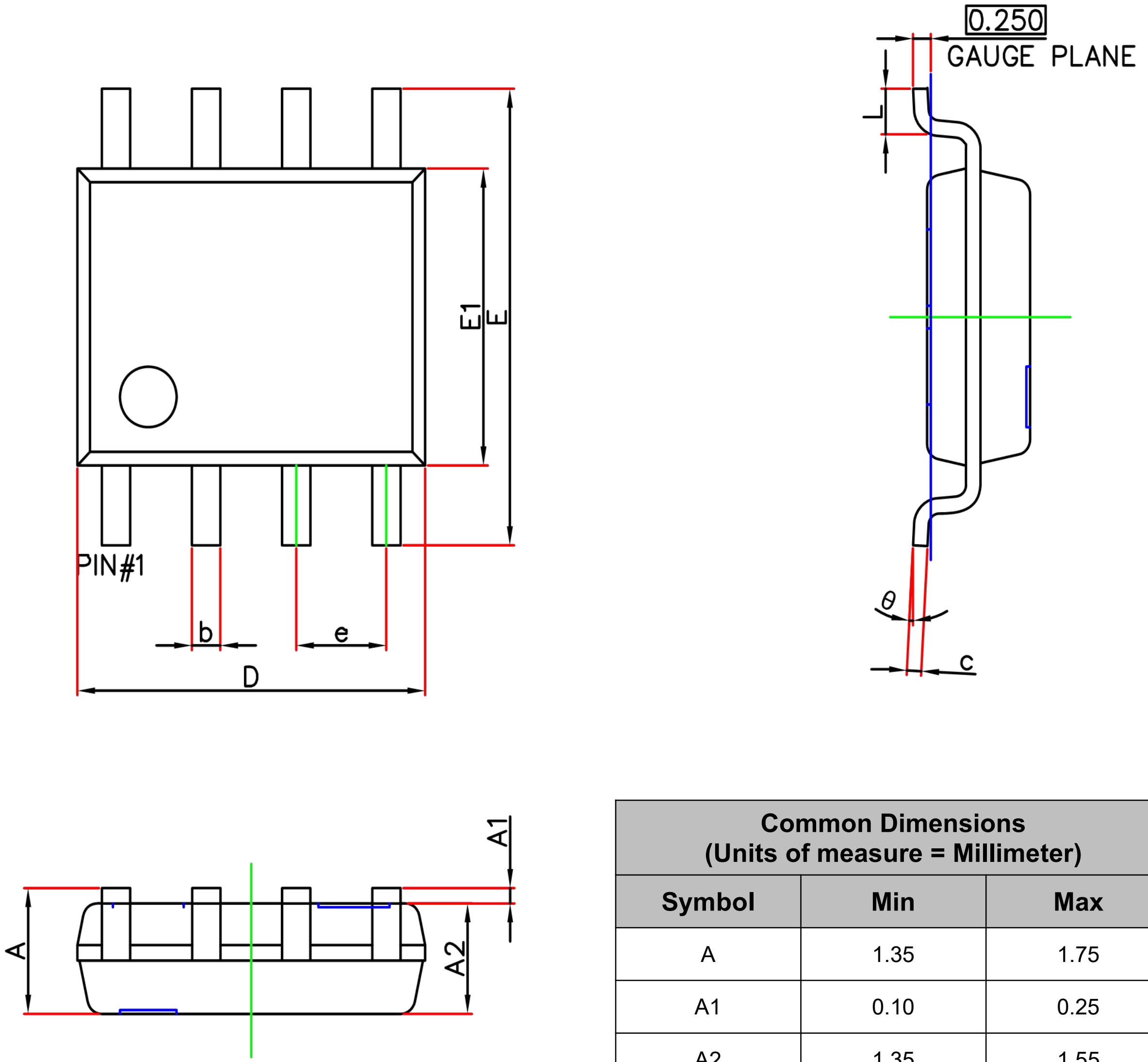
8.4. Input common mode range

The valid common mode range of DIA2602 is from -0.1 V to (+V_S - 1.5 V). Inputs may exceed V_S until maximum V_S without device damage. At least one input must be within a valid input commonality range in order for the output to achieve the correct phase.

8.5. Device functional modes

When the power supply is connected, these devices will be powered on. According to the application situation, the device can be operated as a single power operational amplifier or a dual power amplifier.

9. Physical Dimensions: SOIC-8



Common Dimensions (Units of measure = Millimeter)		
Symbol	**Min**	**Max**
A	1.35	1.75
A1	0.10	0.25
A2	1.35	1.55
b	0.33	0.51
c	0.17	0.25
c1	0.17	0.23
D	4.70	5.10
E	5.80	6.20
E1	3.80	4.00
e	1.27 BSC	
L	0.40	1.27
θ	0°	8°

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