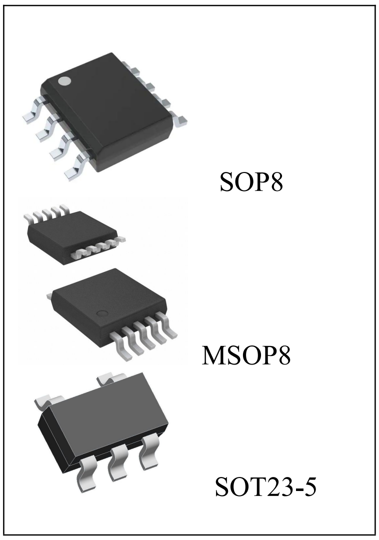
Silicore 芯谷科技

D721/D722

970μA,9MHz,Rail-to-Rail I/O CMOS Operational Amplifier

General Description

The D722 (dual)/D721(single) is low noise, low voltage, and low power operational amplifiers, that can be designed into a wide range of applications. The D721/2 has a high Gain- Bandwidth Product of 9MHz, a slew rate of 8.5V/μs, and a quiescent current of 0.97mA/amplifier at 5V.



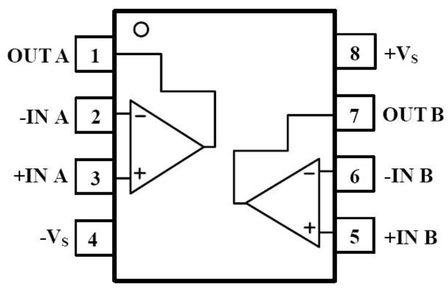
The D721/2 is designed to provide optimal performance in low voltage and low noise systems. It provides rail-to-rail output swing into heavy loads. The input common-mode voltage range includes ground, and the maximum input offset voltage is 4mV for D721/2. It is specified over the extended industrial temperature range (−40°C to +125°C). The operating range is from 2.5V to 5.5V.

The single version D721 is available in SOT23-5 package and dual version D722 is available in SOP8 or MSOP8 packages.

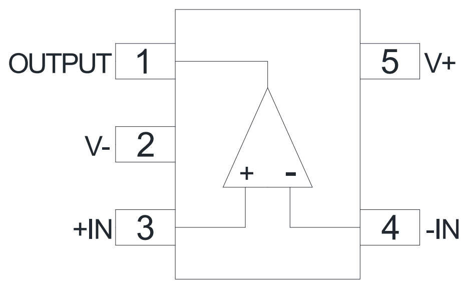
FEATURES

- Rail-to-Rail Input and Output: 1mV Typical V_{OS}
- High Gain-Bandwidth Product: 9MHz
- High Slew Rate: 8.5V/μs
- Settling Time to 0.1% with 2V Step: 0.36 μs
- Overload Recovery Time: 0.4μs
- Low Noise : 8 nV/$\sqrt{\text{Hz}}$
- Operates on 2.5 V to 5.5V Supplies
- Input Voltage Range = - 0.1 V to +5.6 V with VS = 5.5 V
- Low Power: 0.65 mA/Amplifier Typical Supply Current

PIN CONFIGURATION



D722(SOP8/MSOP8)



D721(SOT23-5)

Applications

- Sensors
- Audio
- Active Filters
- A/D Converters
- Communications
- Test Equipment
- Cellular and Cordless Phones
- Laptops and PDAs
- Photodiode Amplification
- Battery-Powered Instrumentation

Absolute Maximum Ratings (Ta=25℃) *

Characteristic		Limit	Unit
Supply voltage		7.5	V
Common-mode input voltage		(-Vs)-0.5 ~ (+Vs)+0.5	V
Storage temperature range		-65 ~ +150	℃
Junction temperature		160	℃
Operation temperature range		-55 ~ +150	℃
Thermal resistance @ Ta=25℃	SOP8	125	℃/W
	MSOP8	216	℃/W
	SOT23-5	250	℃/W
Lead temperature range(soldering 10 sec)		260	℃
ESD susceptibility	HBM	1500	V
	MM	400	V

*: 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.

Caution

This integrated circuit can be damaged by ESD. Silicore recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

Electrical Characteristics

(unless otherwise specified: Vcc+ = +5V with Vcc- = 0 V, Vicm = Vcc/2, R_L connected to Vcc/2, full temperature range)*1

Characteristics	Symbol	Test conditions	Min	Typ	Max	Unit
DC Performance						
Offset Voltage	Vio	Top = 25°C Tmin < Top < Tmax		1.0	4.5 7.5	mV
Input Offset Voltage Drift	Dvio/DT			5		μV/°C
Input Offset Current *2	Iio	Top = 25°C Tmin < Top < Tmax		1	10 100	pA
Input Bias Current *2	Iib			1	10 100	pA
Common Mode Rejection Ratio 20 log (Δ Vic/ Δ vio)	CMR	0V to 5V, Vout = 2.5V Tmin < Top < Tmax	64 55	86		dB
Supply Voltage Rejection Ratio 20 log (Δ Vic/ Δ vio)	SVR	Vcc=2.5 ~ 5V	70	86		dB
Large Signal Voltage Gain	Avd	R_L= 10kΩ, Vout= 0.5V to 4.5V, T= 25°C Tmin < Top < Tmax	80 75	91		dB
High Level Output Voltage	Vcc-V_{OH}	R_L = 10kΩ Tmin < Top < Tmax R_L = 600Ω Tmin < Top < Tmax		15 100	40 40 150 150	mV
Low Level Output Voltage	V_{OL}	R_L = 10kΩ Tmin < Top < Tmax R_L = 600Ω Tmin < Top < Tmax		15 100	40 40 150 150	mV
Isink	Iout	Vo = 5V, Top = 25°C Tmin < Top < Tmax	40 30	50		mA
Isource		Vo = 0V, Top = 25°C Tmin < Top < Tmax	40 30	50		
Supply Current (per operator)	Icc	No load, Vout=2.5V Tmin < Top < Tmax		0.92	1.2 1.2	mA
AC Performance						
Gain Bandwidth Product	GBP	R_L= 2kΩ, C_L=100pF, f =100kHz,Top = 25°C		9		MHz
Unity Gain Frequency	Fu	R_L= 2kΩ, C_L= 100pF, Top = 25°C		8.5		MHz
Phase Margin	Φm	R_L= 2kΩ, C_L= 100pF, Top = 25°C		45		Degree
Gain Margin	Gm	R_L= 2kΩ, C_L= 100pF, Top = 25°C		8		dB
Slew Rate	SR	R_L= 2kΩ, C_L=100pF, Av=1, Top = 25°C		4.8		V/μs
Equivalent Input Noise Voltage	e_n	f= 1kHz, T = 25°C f= 10kHz, Top = 25°C		27 21		$\frac{nV}{\sqrt{Hz}}$
Total Harmonic Distortion	THD+ e_n	G=1, f=1kHz, R_L=2kΩ, Bw= 22kHz, Top =25°C, Vicm=(V_{CC}+1)/2, Vout=3.6Vpp		0.0004		%

*1. All parameter limits at temperatures other than 25°C are guaranteed by correlation.

*2. Guaranteed by design.

Application Information

Driving Capacitive Loads

The D721/2 can directly drive 4700pF in unity-gain without oscillation. The unity-gain follower (buffer) is the most sensitive configuration to capacitive loading. Direct capacitive loading reduces the phase margin of amplifiers and this results in ringing or even oscillation. Applications that require greater capacitive drive capability should use an isolation resistor between the output and the capacitive load like the circuit in Fig1. The isolation resistor R_{ISO} and the load capacitor C_L form a zero to increase stability. The bigger the R_{ISO} resistor value, the more stable V_{OUT} will be. Note that this method results in a loss of gain accuracy because R_{ISO} forms a voltage divider with the R_{LOAD}.

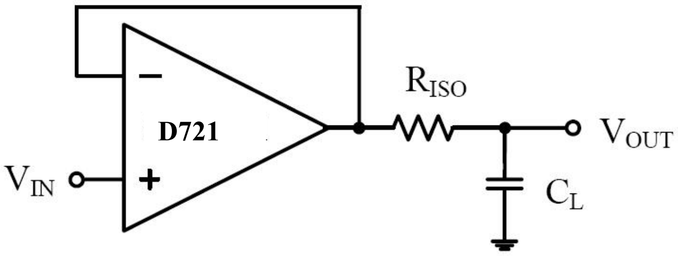


Fig 1. Indirectly Driving Heavy Capacitive Load

An improvement circuit is shown in Fig2. It provides DC accuracy as well as AC stability. RF provides the DC accuracy by connecting the inverting signal with the output. CF and RIso serve to counteract the loss of phase margin by feeding the high frequency component of the output signal back to the amplifier’s inverting input, thereby preserving phase margin in the overall feedback loop.

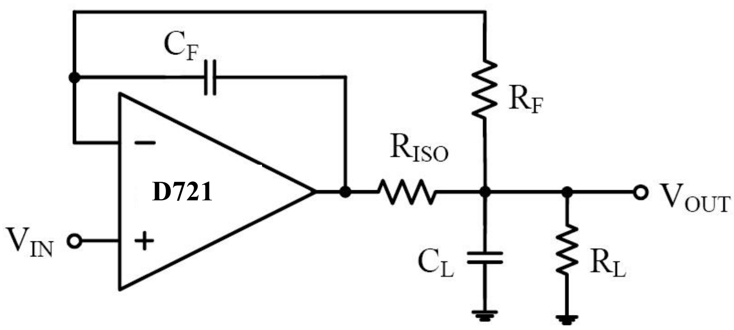


Fig2. Indirectly Driving Heavy Capacitive Load with DC Accuracy

For no-buffer configuration, there are two others ways to increase the phase margin: (a) by increasing the amplifier’s gain or (b) by placing a capacitor in parallel with the feedback resistor to counteract the parasitic capacitance associated with inverting node.

Power-Supply Bypassing and Layout

The D721/2 operates from either a single +2.5V to+5.5V supply or dual ±1.25V to ±2.75V supplies. For single-supply operation, bypass the power supply V_{DD} with a 0.1μF ceramic capacitor which should be placed close to the V_{DD} pin. For dual-supply operation, both the V_{DD} and the V_{SS} supplies should be bypassed to ground with separate 0.1μF ceramic capacitors. 2.2μF tantalum capacitor can be added for better performance.

Good PC board layout techniques optimize performance by decreasing the amount of stray capacitance at the op amp's inputs and output. To decrease stray capacitance, minimize trace lengths and widths by placing external components as close to the device as possible. Use surface-mount components whenever possible.

For the operational amplifier, soldering the part to the board directly is strongly recommended. Try to keep the high frequency big current loop area small to minimize the EMI (electromagnetic interfacing).

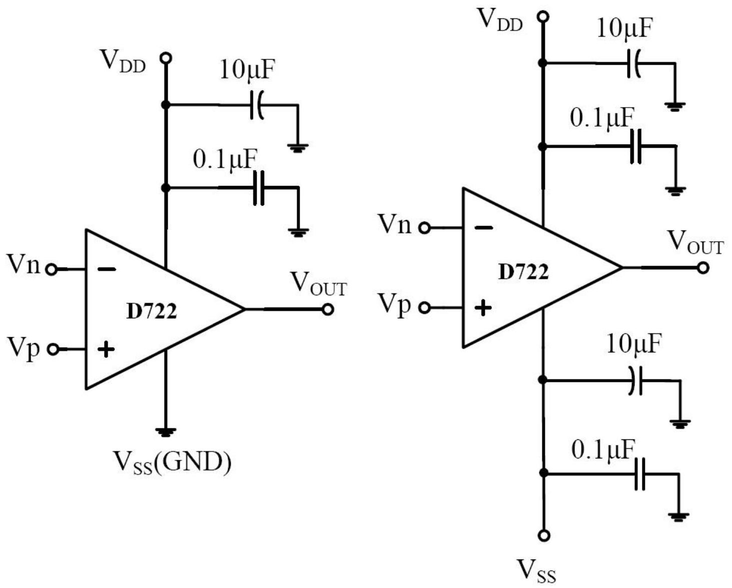


Fig3. Amplifier with Bypass Capacitors Grounding

Grounding

A ground plane layer is important for D721/2 circuit design. The length of the current path speed currents in an inductive ground return will create an unwanted voltage noise. Broad ground plane areas will reduce the parasitic inductance.

Input-to-Output Coupling

To minimize capacitive coupling, the input and output signal traces should not be parallel. This helps reduce unwanted positive feedback.

Differential Amplifier

The circuit shown in Fig.4 performs the difference function. If the resistors ratios are equal (R4 / R3 = R2 / R1), then V_{OUT} = (Vp – Vn) × R2 / R1 + Vref.

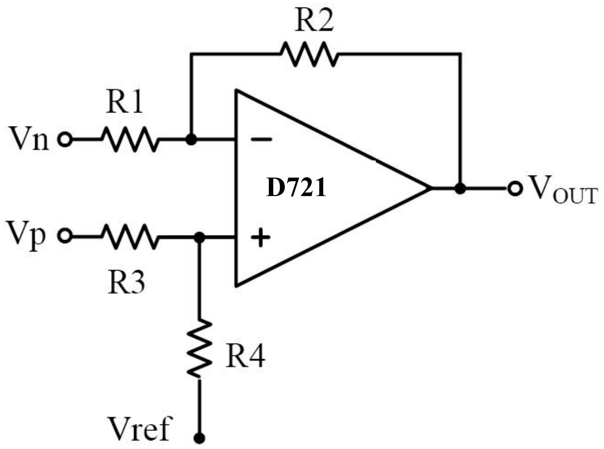


Fig4. Differential Amplifier

Instrumentation Amplifier

The circuit in Fig.5 performs the same function as that in Fig.4 but with the high input impedance.

Low Pass Active Filter

The low pass filter shown in Figure 6 has a DC gain of (-R2/R1) and the –3dB corner frequency is $1/2\pi R2C$. Make sure the filter is within the bandwidth of the amplifier. The Large values of feedback resistors can couple with parasitic capacitance and cause undesired effects such as ringing or oscillation in high-speed amplifiers. Keep resistors value as low as possible and consistent with output loading consideration.

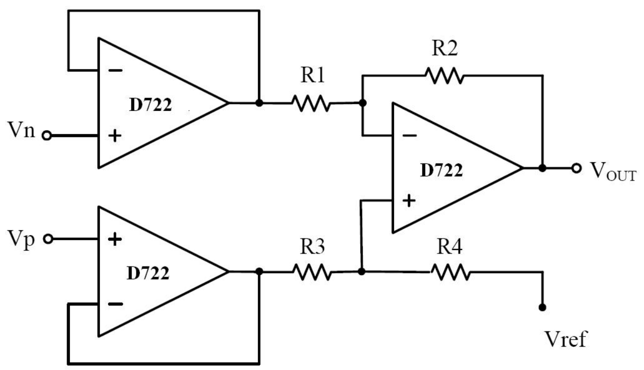


Fig5. Instrumentation Amplifier

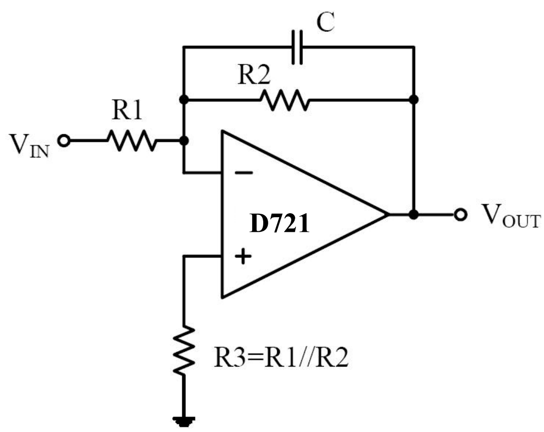
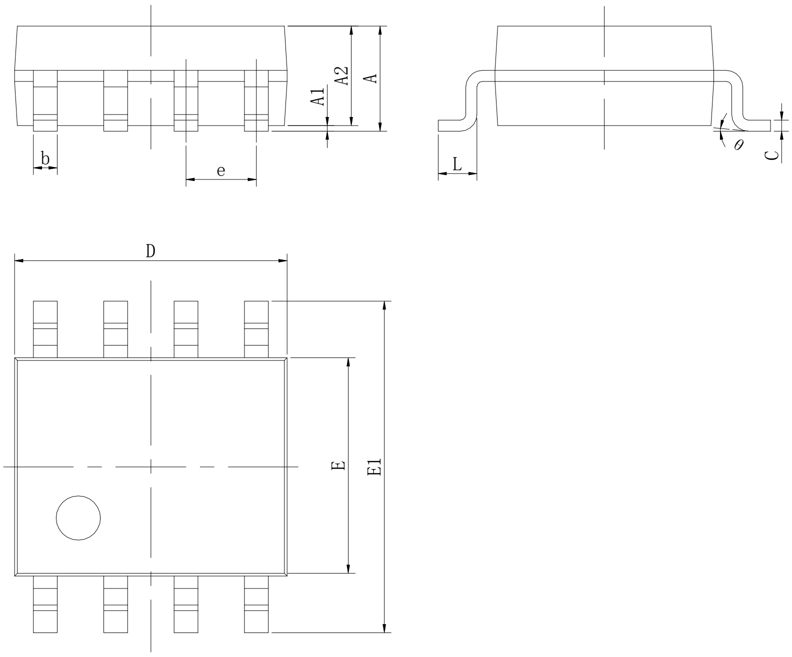


Fig6. Low Pass Active Filter

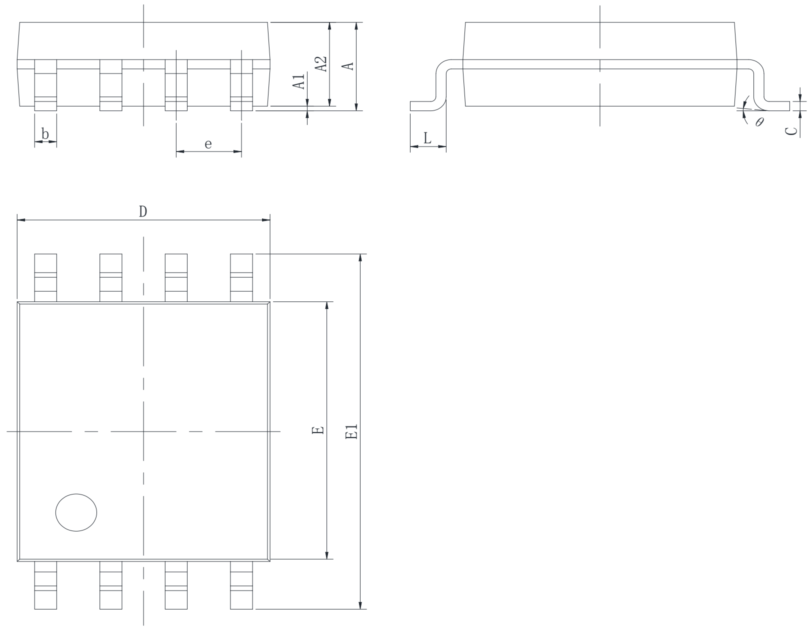
Outline Drawing

SOP8 Unit:mm



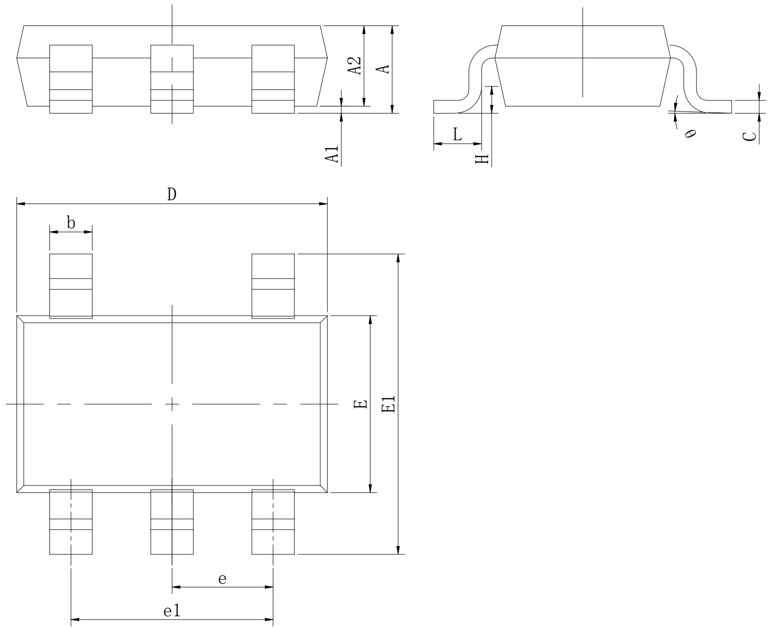
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

MSOP8 Unit:mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.820	1.100	0.032	0.043
A1	0.020	0.150	0.001	0.006
A2	0.750	0.950	0.030	0.037
b	0.250	0.380	0.010	0.015
c	0.090	0.230	0.004	0.009
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
E1	4.750	5.050	0.187	0.199
e	0.650(BSC)		0.026(BSC)	
L	0.400	0.800	0.016	0.031
θ	0°	6°	0°	6°

SOT23-5 Unit:mm



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	**Max**	**Min**	**Max**
A	0.700	0.900	0.028	0.035
A1	0.000	0.100	0.000	0.004
A2	0.700	0.800	0.028	0.031
b	0.350	0.500	0.014	0.020
c	0.080	0.200	0.003	0.008
D	2.820	3.020	0.111	0.119
E	1.600	1.700	0.063	0.067
E1	2.650	2.950	0.104	0.116
e	0.95（BSC）		0.037(BSC)	
e1	1.90（BSC）		0.075(BSC)	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Statements

- Silicore Technology reserves the right to make changes without further notice to any products or specifications herein. Before customers place an order, customers need to confirm whether datasheet obtained is the latest version, and to verify the integrity of the relevant information.

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- The product upgrades without end, Silicore Technology will wholeheartedly provide customers integrated circuits that have better performance and better quality.