AD8422 DS Changes Summary

Qadier Jilluh

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Output Voltage Noise, 1kHz

Old Datasheet vs New Datasheet

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

Data Sheet AD8422

SPECIFICATIONS

SOIC PACKAGE

V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, R_L = 2 kΩ, unless otherwise noted.

Table 1.

Parameter	Test Conditions/ Comments	AD8422ARZ Min	AD8422ARZ Typ	AD8422ARZ Max	AD8422BRZ Min	AD8422BRZ Typ	AD8422BRZ Max	Unit
NOISE[1]								
Voltage Noise, 1 kHz								
Input Voltage Noise, e_{NI}	V_{IN+}, V_{IN-}, V_{REF} = 0 V			8			8	nV/√Hz
Output Voltage Noise, e_{NO}				80			80	nV/√Hz
Peak to Peak, RTI	f = 0.1 Hz to 10 Hz							
G = 1			2			2		µV p-p
G = 10			0.5			0.5		µV p-p
G = 100 to 1000			0.15			0.15		µV p-p
Current Noise	f = 1 kHz		90			90	110	fA/√Hz
	f = 0.1 Hz to 10 Hz		8			8		pA p-p

MSOP PACKAGE

V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, R_L = 2 kΩ, unless otherwise noted.

Table 2.

Parameter	Test Conditions/ Comments	AD8422ARMZ Min	AD8422ARMZ Typ	AD8422ARMZ Max	AD8422BRMZ Min	AD8422BRMZ Typ	AD8422BRMZ Max	Unit
NOISE[1]								
Voltage Noise, 1 kHz								
Input Voltage Noise, e_{NI}	V_{IN+}, V_{IN-}, V_{REF} = 0 V			8			8	nV/√Hz
Output Voltage Noise, e_{NO}				80			80	nV/√Hz
Peak to Peak, RTI	f = 0.1 Hz to 10 Hz							
G = 1			2			2		µV p-p
G = 10			0.5			0.5		µV p-p
G = 100 to 1000			0.15			0.15		µV p-p
Current Noise	f = 1 kHz		90			90	110	fA/√Hz
	f = 0.1 Hz to 10 Hz		8			8		pA p-p

Preliminary Technical Data AD8422

SPECIFICATIONS

SOIC_N

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Voltage Noise, 1 kHz								
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Output Voltage Noise, e_{NO}			80			80		nV/√Hz
Peak to Peak, RTI	f = 0.1 Hz to 10 Hz							
G = 1			2			2		µV p-p
G = 10			0.5			0.5		µV p-p
G = 100 to 1000			0.15			0.15		µV p-p
Current Noise	f = 1 kHz		90			90	110	fA/√Hz
	f = 0.1 Hz to 10 Hz		8			8		pA p-p

MSOP

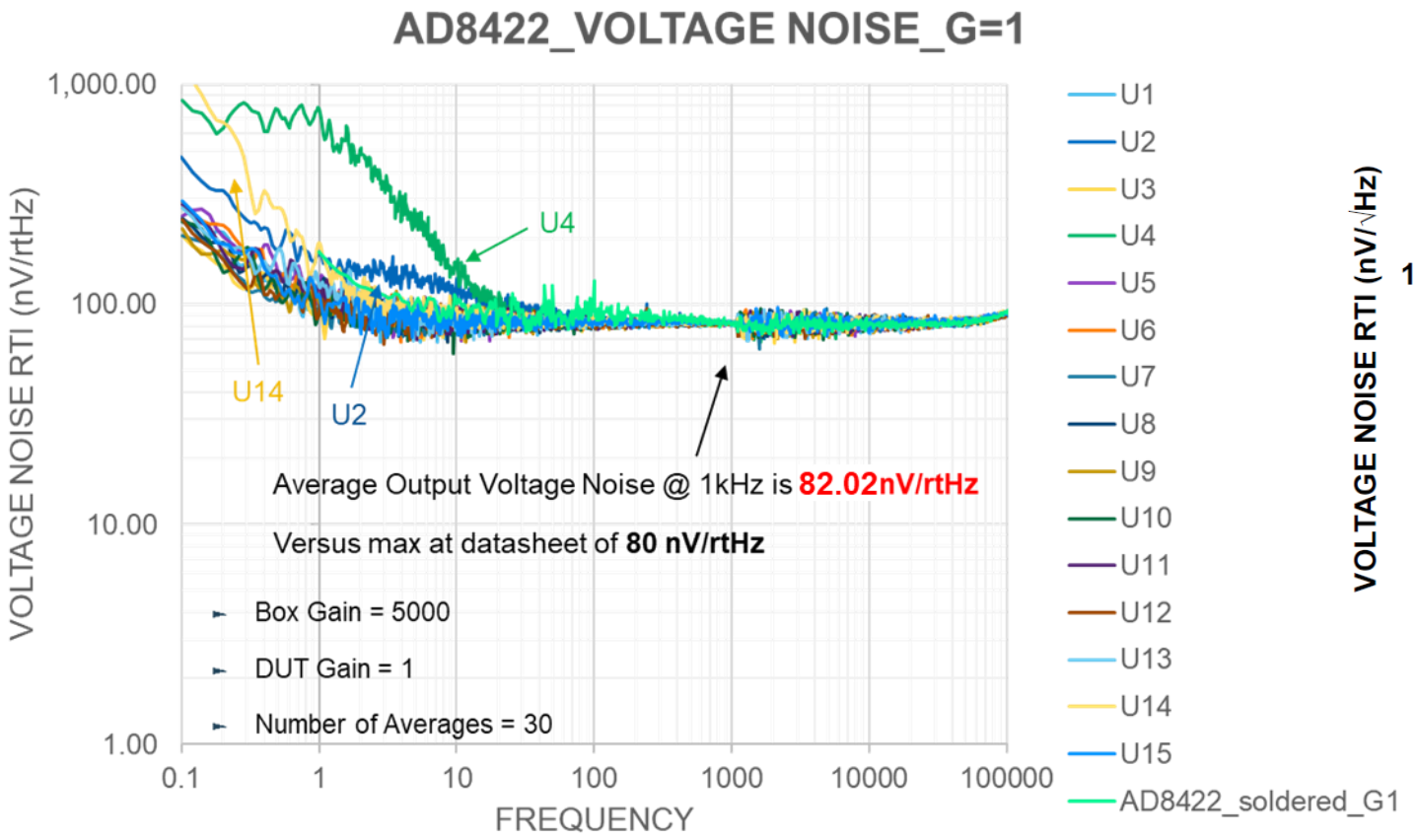
V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, and R_L = 2 kΩ, unless otherwise noted.

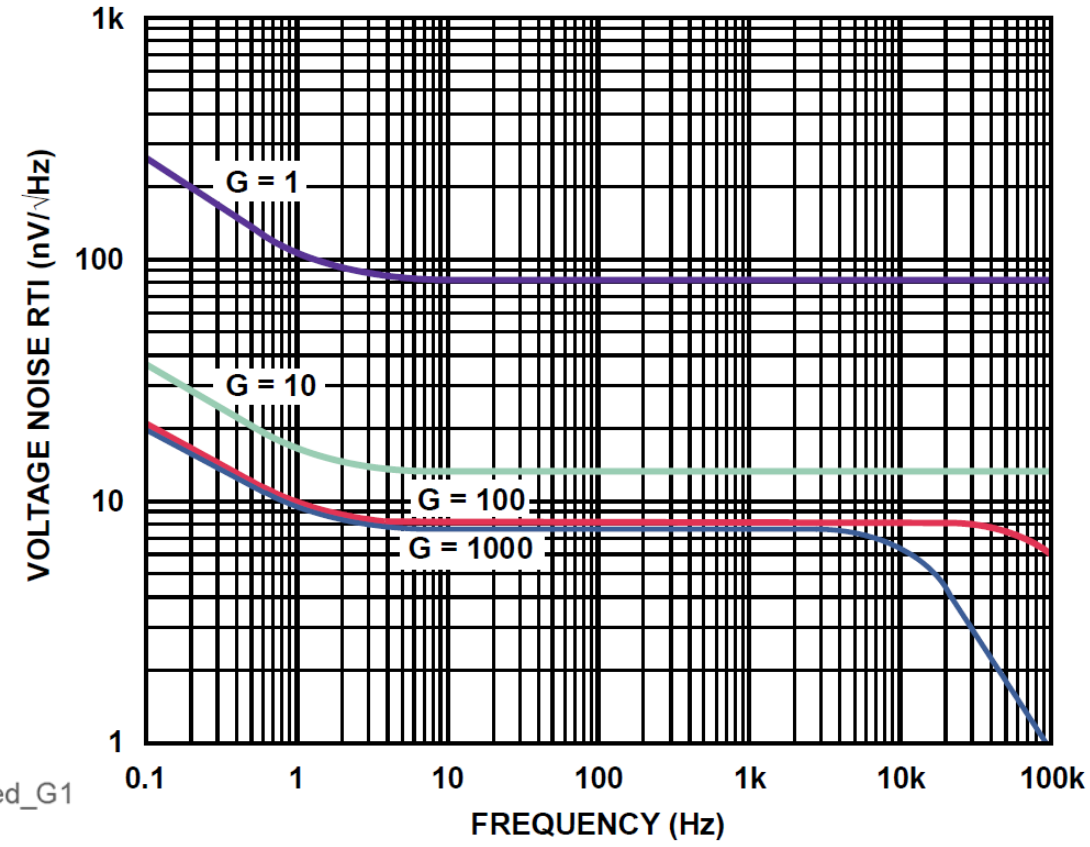
Table 2.

Parameter	Test Conditions/ Comments	AD8422ARMZ Min	AD8422ARMZ Typ	AD8422ARMZ Max	AD8422BRMZ Min	AD8422BRMZ Typ	AD8422BRMZ Max	Unit
NOISE[1]								
Voltage Noise, 1 kHz								
Input Voltage Noise, e_{NI}	V_{IN+}, V_{IN-}, V_{REF} = 0 V			8			8	nV/√Hz
Output Voltage Noise, e_{NO}			80			80		nV/√Hz
Peak to Peak, RTI	f = 0.1 Hz to 10 Hz							
G = 1			2			2		µV p-p
G = 10			0.5			0.5		µV p-p
G = 100 to 1000			0.15			0.15		µV p-p
Current Noise	f = 1 kHz		90			90	110	fA/√Hz
	f = 0.1 Hz to 10 Hz		8			8		pA p-p

AD8422 Voltage Noise Spectral Density

Gain of 1

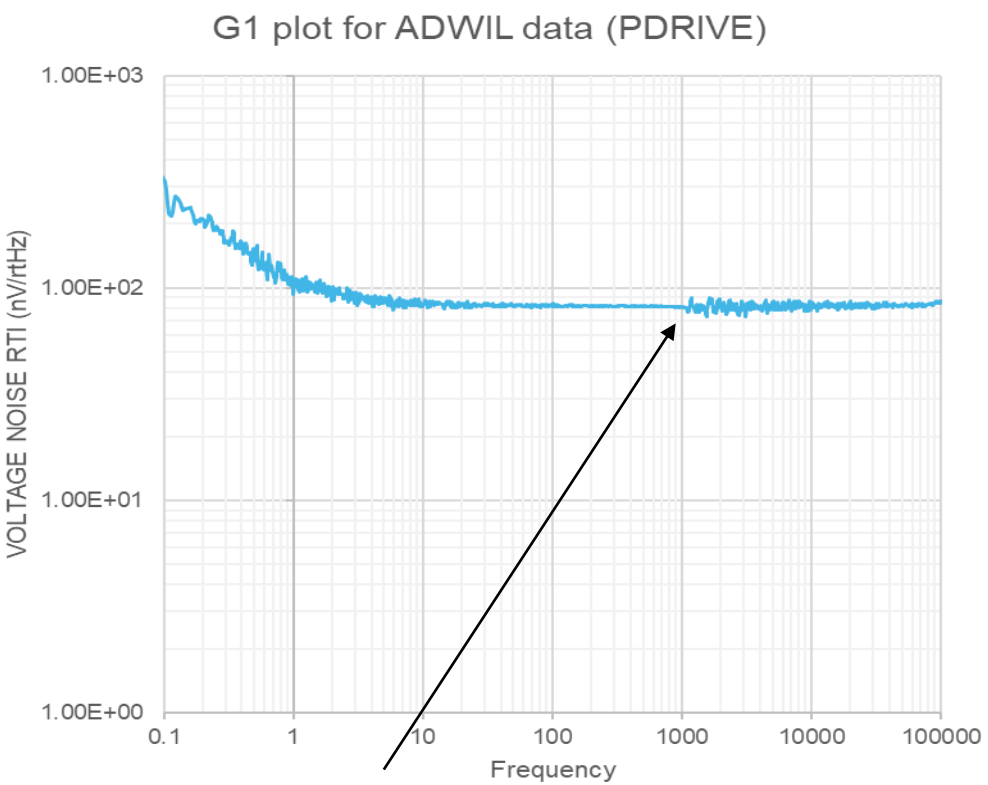




- Noisy units were identified for Bench to ATE correlation. 3 out of 15 units failed.
- Average output voltage noise @ 1kHz exceeded DS maximum limit.

AD8422 Voltage Noise Spectral Density

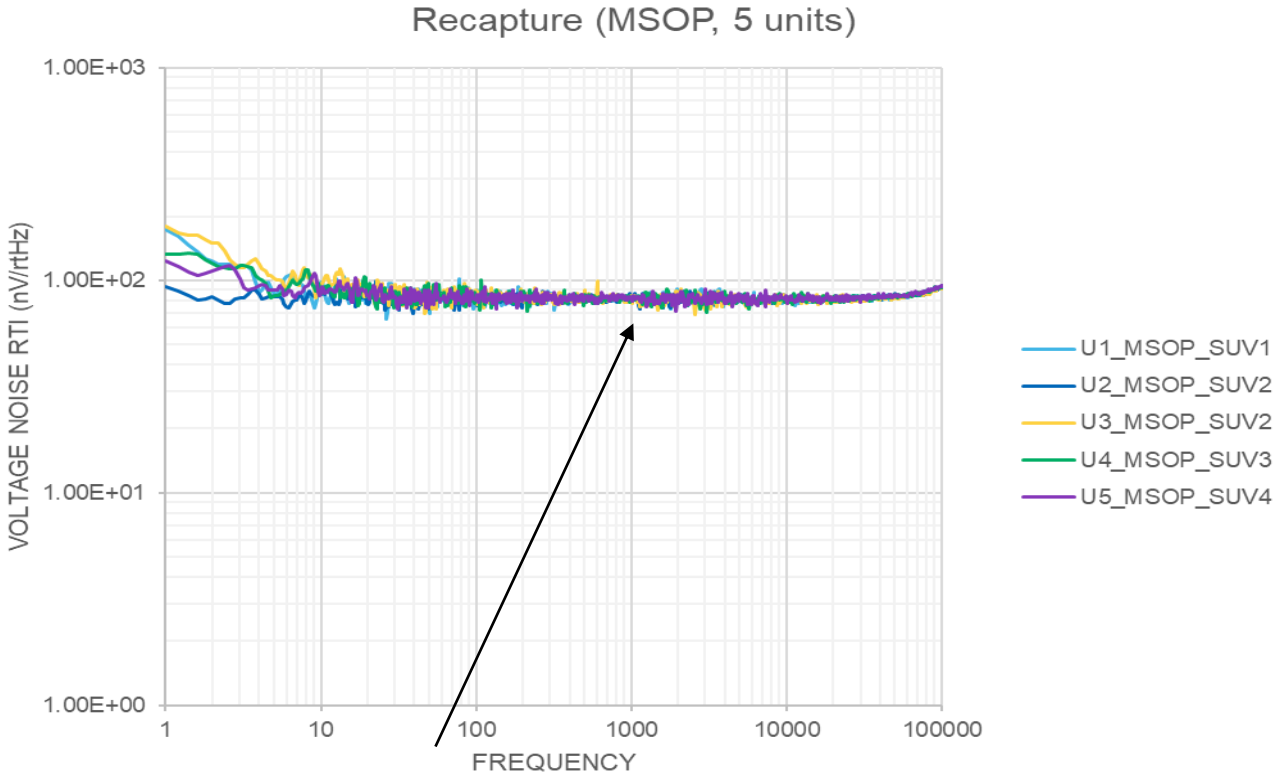
ADWIL data vs fresh verification of OLD MATERIAL (MSOP)



Raw data from ADWIL (50 averages):

Voltage Noise @1kHz = **81.25** nV/rtHz also

Exceeded DS max limit of **80nV/rtHz**



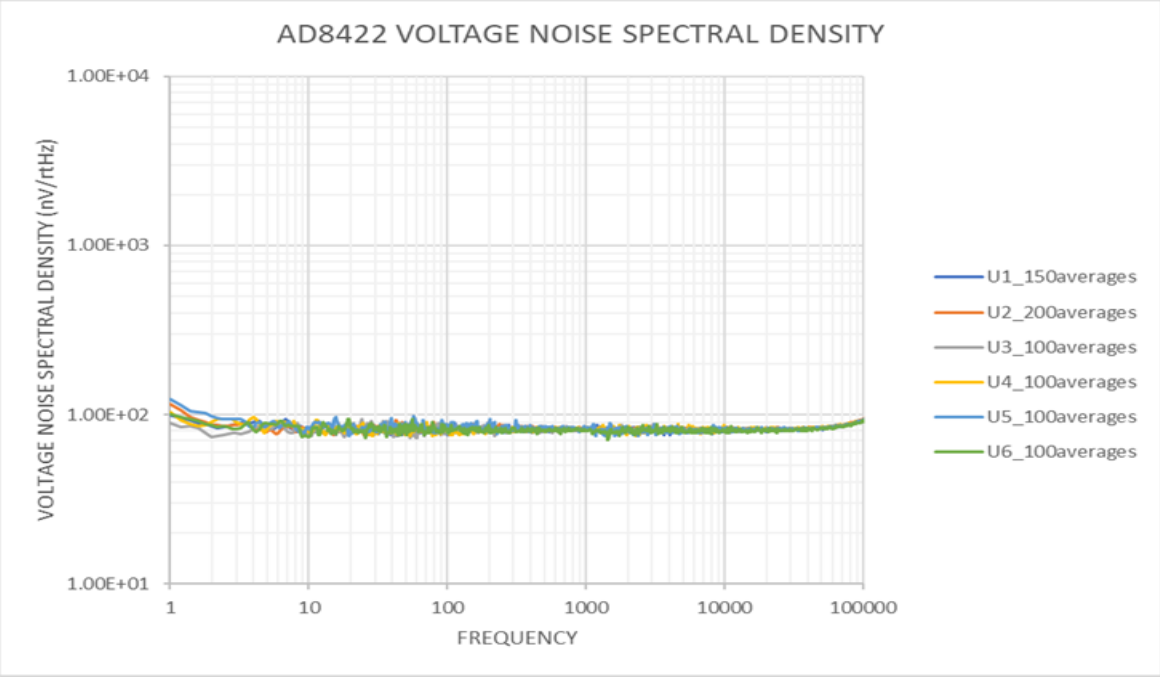
Fresh verification of **MSOP OLD MATERIAL** Voltage Noise

@ 1kHz average reading of **81.32** nV/rtHz

versus max at datasheet of **80 nV/rtHz**

AD8422 Voltage Noise Spectral Density

Supplementary Data: Enlarged Number of Averages (LFCSP)



- Added number of averages in testing Voltage Noise Spectral density of LFCSP.
- Bench lab results still obtained an average of 82nV/rtHz which is beyond datasheet's maximum limit of 80nV/rtHz.
- LFCSP measurements match that of old material MSOP, as well as ADWIL data.
- Test was performed during non-peak hours (6-9PM)

Freq	U1	U2	U3	U4	U5	U6
999.636037	81.56917	82.64996	83.63603	82.25006	81.39684	81.05697
1011.21128	82.70089	81.35978	83.99054	81.17039	81.74786	81.25681

Freq	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	U11	U12	U13	U14	U15
999.636037	80.45553	82.02134	79.39885	79.4521	79.40114	80.93648	81.67549	81.36813	81.90406	82.34547	82.93053	82.66912	82.43189	82.32592	82.08017
1011.21128	77.72738	80.48264	81.46638	83.1783	82.50804	79.17637	83.49232	83.51297	81.2212	82.1843	80.9732	80.5636	83.02696	83.06276	80.3562

Input Voltage Operating Range

Old Datasheet vs New Datasheet

ANALOG DEVICES
AHEAD OF WHAT'S POSSIBLE™

Data Sheet AD8422

SPECIFICATIONS

SOIC PACKAGE

V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, R_L = 2 kΩ, unless otherwise noted.

Table 1.

Parameter	Test Conditions/ Comments	AD8422ARZ Min	AD8422ARZ Typ	AD8422ARZ Max	AD8422BRZ Min	AD8422BRZ Typ	AD8422BRZ Max	Unit
INPUT								
Input Impedance								
Differential			200||2			200||2		GΩ||pF
Common Mode			200||2			200||2		GΩ||pF
Input Operating Voltage Range[4]	V_S = ±2.3 V to ±18 V	$-V_S$ + 1.2		$+V_S$ − 1.2	$-V_S$ + 1.2		$+V_S$ − 1.2	V
Over Temperature	T = −40°C to +85°C	$-V_S$ + 1.2		$+V_S$ − 1.3	$-V_S$ + 1.2		$+V_S$ − 1.3	V

MSOP PACKAGE

V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, R_L = 2 kΩ, unless otherwise noted.

Table 2.

Parameter	Test Conditions/ Comments	AD8422ARMZ Min	AD8422ARMZ Typ	AD8422ARMZ Max	AD8422BRMZ Min	AD8422BRMZ Typ	AD8422BRMZ Max	Unit
INPUT								
Input Impedance								
Differential			200||2			200||2		GΩ||pF
Common Mode			200||2			200||2		GΩ||pF
Input Operating Voltage Range[4]	V_S = ±2.3 V to ±18 V	$-V_S$ + 1.2		$+V_S$ − 1.2	$-V_S$ + 1.2		$+V_S$ − 1.2	V
Over Temperature	T = −40°C to +85°C	$-V_S$ + 1.2		$+V_S$ − 1.3	$-V_S$ + 1.2		$+V_S$ − 1.3	V

Preliminary Technical Data AD8422

SPECIFICATIONS

SOIC_N

V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, and R_L = 2 kΩ, unless otherwise noted.

Table 1.

Parameter	Test Conditions/ Comments	AD8422ARZ Min	AD8422ARZ Typ	AD8422ARZ Max	AD8422BRZ Min	AD8422BRZ Typ	AD8422BRZ Max	Unit
INPUT								
Input Impedance								
Differential			200||2			200||2		GΩ||pF
Common Mode			200||2			200||2		GΩ||pF
Input Operating Voltage Range[4,5]	V_S = ±2.3 V to ±18 V	$-V_S$ + 1.2		$+V_S$ − 1.5	$-V_S$ + 1.2		$+V_S$ − 1.5	V
Over Temperature	T = −40°C to +85°C	$-V_S$ + 1.2		$+V_S$ − 1.5	$-V_S$ + 1.2		$+V_S$ − 1.5	V

MSOP

V_S = ±15 V, V_{REF} = 0 V, V_{+IN} = 0 V, V_{-IN} = 0 V, T_A = 25°C, G = 1, and R_L = 2 kΩ, unless otherwise noted.

Table 2.

Parameter	Test Conditions/ Comments	AD8422ARMZ Min	AD8422ARMZ Typ	AD8422ARMZ Max	AD8422BRMZ Min	AD8422BRMZ Typ	AD8422BRMZ Max	Unit
INPUT								
Input Impedance								
Differential			200||2			200||2		GΩ||pF
Common Mode			200||2			200||2		GΩ||pF
Input Operating Voltage Range[4,5]	V_S = ±2.3 V to ±18 V	$-V_S$ + 1.2		$+V_S$ − 1.5	$-V_S$ + 1.2		$+V_S$ − 1.5	V
Over Temperature	T = −40°C to +85°C	$-V_S$ + 1.2		$+V_S$ − 1.5	$-V_S$ + 1.2		$+V_S$ − 1.5	V

Input Voltage Operating Range

Parameter		Datasheet Limits			Ave. Bench Result		Units		Remarks
		Min	Typ	Max					
Input Voltage Range									
VS = ±2.3V to ±18V	VS = ±18V	-VS+1.2		+VS–1.2	-VS + 0.907	+VS – 1.303	V	X	Exceeded upper limit
	VS = ±15V				-VS + 0.908	+VS – 1.300	V	X	Exceeded upper limit
	VS = ±5V				-VS + 0.912	+VS – 1.308	V	X	Exceeded upper limit
	VS = ±2.3V				-VS + 0.915	+VS – 1.311	V	X	Exceeded upper limit
OLD MAT	VS = ±18V	-VS+1.2		+VS–1.2	-VS + 0.917	+VS – 1.329	V	X	Confirmation using OLD MAT (SOIC) shows similar results
	VS = ±15V				-VS + 0.927	+VS – 1.331	V	X	
	VS = ±5V				-VS + 0.928	+VS – 1.335	V	X	
	VS = ±2.3V				-VS + 0.935	+VS – 1.336	V	X	
	TA = -40℃	-VS+1.2		+VS–1.3	-VS + 0.991	+VS – 1.261	V	O	Performed at 18V
OLD MAT					-VS + 0.971	+VS – 1.276	V	O	Performed using OLD MAT (SOIC)
	TA = 125℃	-VS+1.2 ※At 85℃		+VS–1.3 ※At 85℃	-VS + 0.916	+VS – 1.413	V	X	Exceeded upper limit
OLD MAT					-VS + 0.913	+VS – 1.423	V	X	Performed using OLD MAT (SOIC)

TPC Measurements

- Both upper and lower limits of IVR were tested at Vs = ±2.3V, ±5V, ±15V and ±18V

AD8422	VS	Upper Range (distance from +Vs)					Lower Range (distance from -Vs)				
		U1	U2	U6	U7	AVE	U1	U2	U6	U7	AVE
-40℃	18	1.282	1.235	1.224	1.227	**1.242**	-0.992	-0.986	-0.966	-0.958	**-0.976**
	15	1.277	1.270	1.242	1.237	**1.256**	-1.008	-0.992	-0.976	-0.970	**-0.986**
	5	1.265	1.240	1.221	1.235	**1.240**	-1.005	-1.002	-0.984	-0.979	**-0.992**
	2.3	1.251	1.227	1.222	1.232	**1.233**	-0.994	-1.011	-0.990	-0.984	**-0.995**
25℃	18	1.292	1.302	1.273	1.279	**1.286**	-0.914	-0.892	-0.930	-0.906	**-0.911**
	15	1.286	1.290	1.286	1.278	**1.285**	-0.910	-0.894	-0.911	-0.916	**-0.908**
	5	1.302	1.322	1.278	1.254	**1.289**	-0.889	-0.919	-0.897	-0.900	**-0.901**
	2.3	1.306	1.324	1.281	1.239	**1.288**	-0.918	-0.924	-0.876	-0.874	**-0.898**
85℃	18	1.403	1.416	1.418	1.414	**1.413**	-0.895	-0.914	-0.911	-0.930	**-0.913**
	15	1.418	1.418	1.411	1.418	**1.416**	-0.908	-0.906	-0.910	-0.924	**-0.912**
	5	1.414	1.422	1.414	1.416	**1.417**	-0.919	-0.905	-0.905	-0.921	**-0.912**
	2.3	1.422	1.422	1.411	1.411	**1.417**	-0.922	-0.908	-0.906	-0.914	**-0.913**
105℃	18	1.411	1.410	1.418	1.421	**1.415**	-0.921	-0.926	-0.922	-0.926	**-0.924**
	15	1.413	1.403	1.406	1.408	**1.408**	-0.908	-0.921	-0.916	-0.922	**-0.917**
	5	1.405	1.402	1.410	1.408	**1.406**	-0.908	-0.911	-0.906	-0.918	**-0.911**
	2.3	1.405	1.397	1.411	1.411	**1.406**	-0.908	-0.905	-0.921	-0.914	**-0.912**
125℃	18	1.411	1.408	1.418	1.418	**1.414**	-0.914	-0.916	-0.903	-0.906	**-0.910**
	15	1.419	1.406	1.408	1.406	**1.410**	-0.897	-0.892	-0.882	-0.889	**-0.890**
	5	1.414	1.405	1.406	1.390	**1.404**	-0.879	-0.874	-0.889	-0.873	**-0.879**
	2.3	1.410	1.395	1.408	1.395	**1.402**	-0.862	-0.858	-0.850	-0.860	**-0.858**

TPC Plots (Old TPC vs New TPC)

OLD TPC

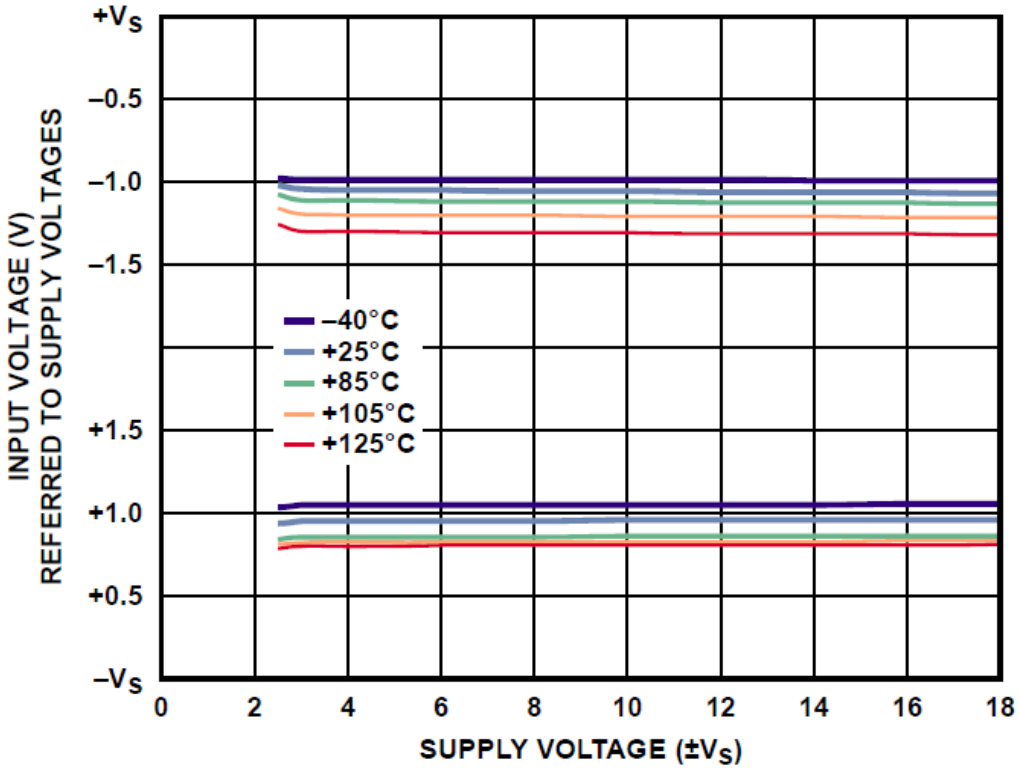
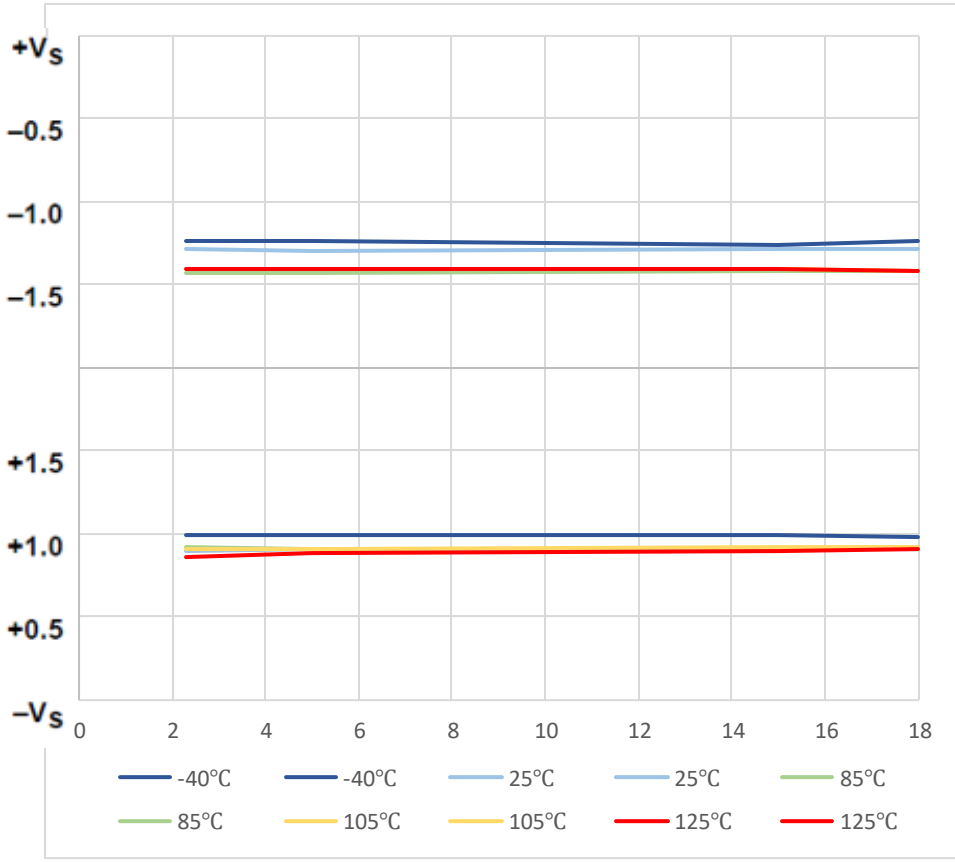


Figure 31. Input Voltage Limit vs. Supply Voltage

NEW TPC



- Plot for upper limit noticeably shifted in newly generated TPC.
- Plot for lower limit maintained a similar level but spread across temperatures noticeable lessened.

Update on Figure 32: Input Voltage vs Supply Voltage

TPC Measurements

- Both upper and lower limits of IVR were tested at Vs = ±2.3V, ±5V, ±15V and ±18V

AD8422	VS	Upper Range (distance from +Vs)					Lower Range (distance from -Vs)				
		U1	U2	U6	U7	AVE	U1	U2	U6	U7	AVE
-40℃	18	1.282	1.235	1.224	1.227	**1.242**	-0.992	-0.986	-0.966	-0.958	**-0.976**
	15	1.277	1.270	1.242	1.237	**1.256**	-1.008	-0.992	-0.976	-0.970	**-0.986**
	5	1.265	1.240	1.221	1.235	**1.240**	-1.005	-1.002	-0.984	-0.979	**-0.992**
	2.3	1.251	1.227	1.222	1.232	**1.233**	-0.994	-1.011	-0.990	-0.984	**-0.995**
25℃	18	1.292	1.302	1.273	1.279	**1.286**	-0.914	-0.892	-0.930	-0.906	**-0.911**
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	5	1.302	1.322	1.278	1.254	**1.289**	-0.889	-0.919	-0.897	-0.900	**-0.901**
	2.3	1.306	1.324	1.281	1.239	**1.288**	-0.918	-0.924	-0.876	-0.874	**-0.898**
85℃	18	1.403	1.416	1.418	1.414	**1.413**	-0.895	-0.914	-0.911	-0.930	**-0.913**
	15	1.418	1.418	1.411	1.418	**1.416**	-0.908	-0.906	-0.910	-0.924	**-0.912**
	5	1.414	1.422	1.414	1.416	**1.417**	-0.919	-0.905	-0.905	-0.921	**-0.912**
	2.3	1.422	1.422	1.411	1.411	**1.417**	-0.922	-0.908	-0.906	-0.914	**-0.913**
105℃	18	1.411	1.410	1.418	1.421	**1.415**	-0.921	-0.926	-0.922	-0.926	**-0.924**
	15	1.413	1.403	1.406	1.408	**1.408**	-0.908	-0.921	-0.916	-0.922	**-0.917**
	5	1.405	1.402	1.410	1.408	**1.406**	-0.908	-0.911	-0.906	-0.918	**-0.911**
	2.3	1.405	1.397	1.411	1.411	**1.406**	-0.908	-0.905	-0.921	-0.914	**-0.912**
125℃	18	1.411	1.408	1.418	1.418	**1.414**	-0.914	-0.916	-0.903	-0.906	**-0.910**
	15	1.419	1.406	1.408	1.406	**1.410**	-0.897	-0.892	-0.882	-0.889	**-0.890**
	5	1.414	1.405	1.406	1.390	**1.404**	-0.879	-0.874	-0.889	-0.873	**-0.879**
	2.3	1.410	1.395	1.408	1.395	**1.402**	-0.862	-0.858	-0.850	-0.860	**-0.858**

Figure 32: Input Voltage vs Supply Voltage

Old TPC vs New TPC

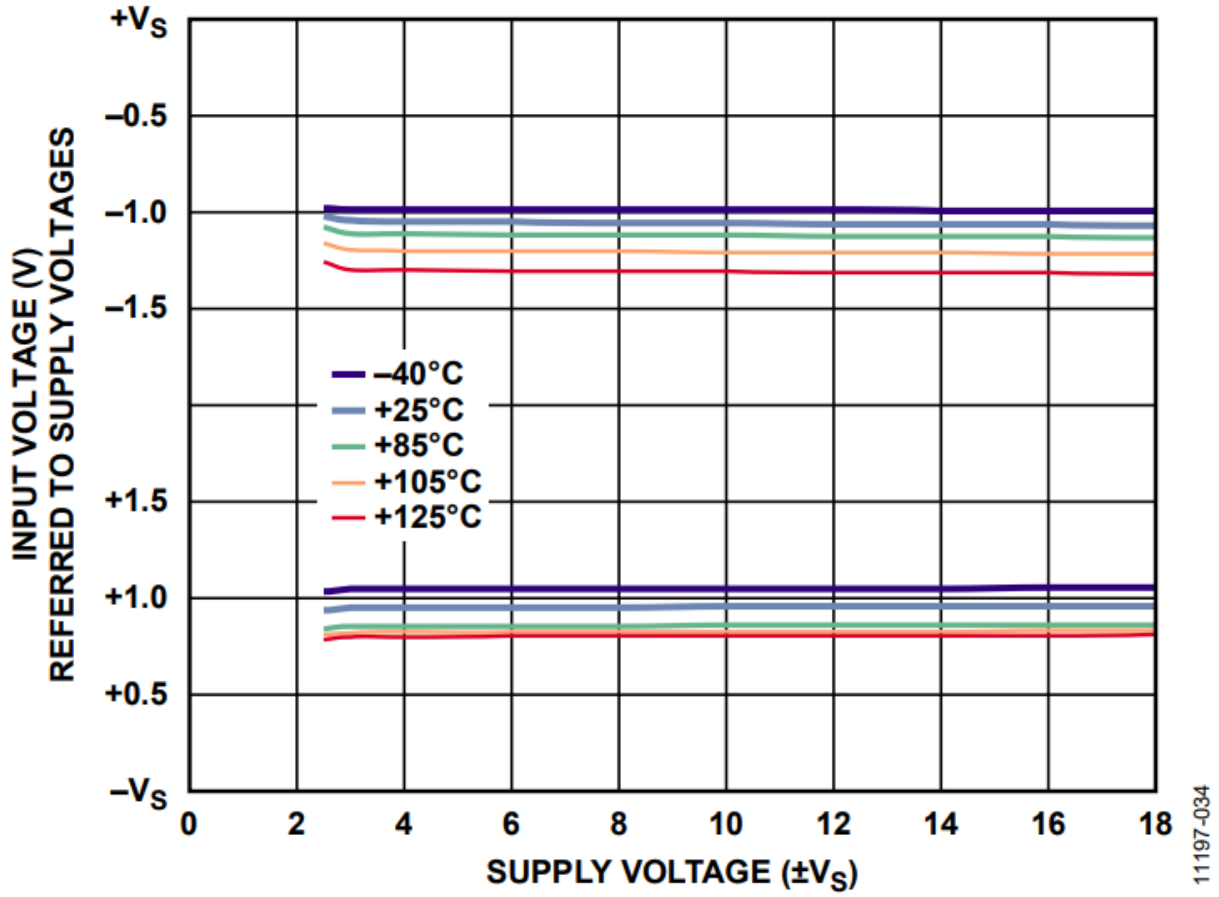

Figure 31. Input Voltage Limit vs. Supply Voltage

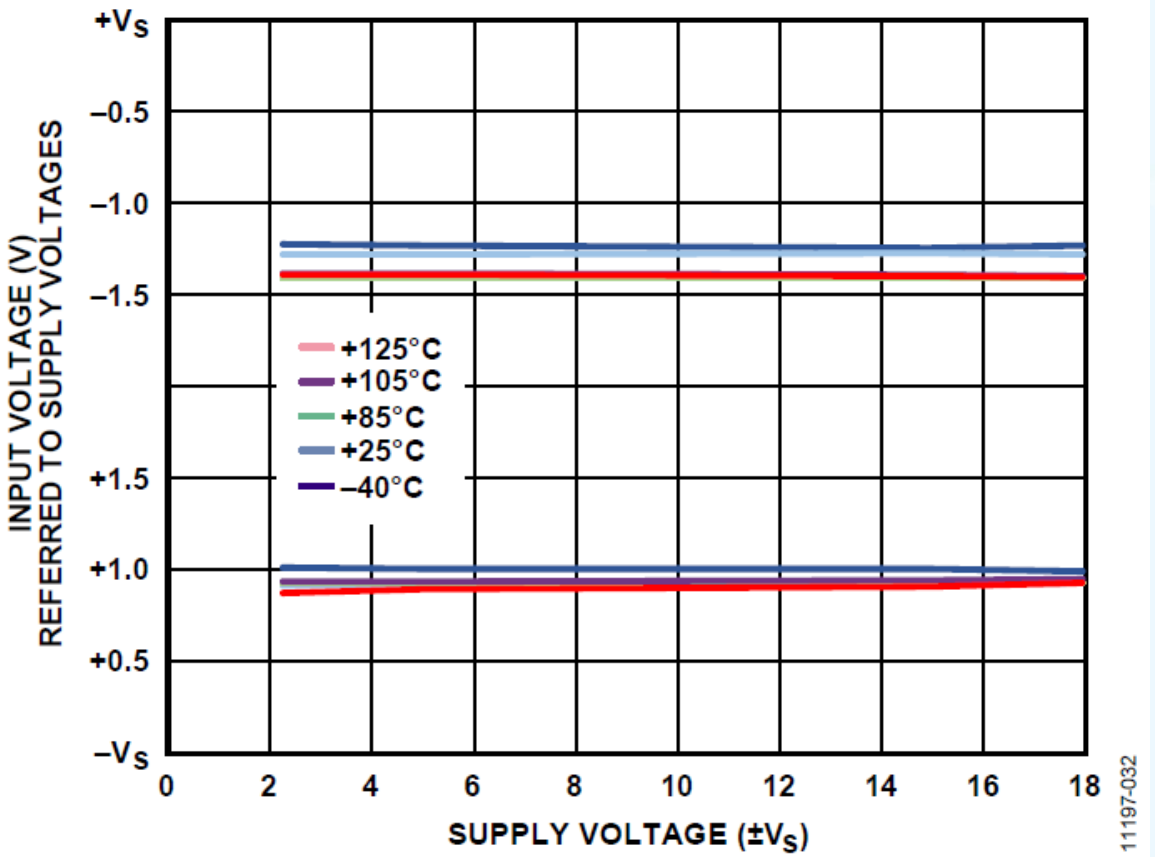

Figure 32. Input Voltage vs. Supply Voltage

Thermal Resistance spec update

Summary of changes to Theta JA/JC

ANALOG DEVICES
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AD8422 Data Sheet

ABSOLUTE MAXIMUM RATINGS

Table 3.

Parameter	Rating
Supply Voltage	±2.3 V to ±18 V
Output Short-Circuit Current Duration	Indefinite
Maximum Voltage at –IN or +IN[1]	$-V_S + 40$ V
Minimum Voltage at –IN or +IN	$+V_S - 40$ V
Maximum Voltage at REF	$\pm V_S \pm 0.3$ V
Storage Temperature Range	–65°C to +150°C
Operating Temperature Range	–40°C to +125°C
Maximum Junction Temperature	150°C
ESD	
Human Body Model	2.5 kV
Charge Device Model	1.25 kV
Machine Model	100 V

[1] For voltages beyond these limits, use input protection resistors. See the Theory of Operation section for more information.

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

THERMAL RESISTANCE

θ_{JA} is specified for a device in free air using a 4-layer JEDEC printed circuit board (PCB).

Table 4.

Package	θ_{JA}	Unit
8-Lead SOIC	100	°C/W
8-Lead MSOP	162	°C/W

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.

AD8422 Preliminary Technical Data

ABSOLUTE MAXIMUM RATINGS

Table 4.

Parameter	Rating
Supply Voltage	±2.3 V to ±18 V
Output Short-Circuit Current Duration	Indefinite
Maximum Voltage at –IN or +IN[1]	$-V_S + 40$ V
Minimum Voltage at –IN or +IN	$+V_S - 40$ V
Maximum Voltage at REF	$\pm V_S \pm 0.3$ V
Temperature	
Storage Range	–65°C to +150°C
Operating Range	–40°C to +125°C
Maximum Junction	150°C

[1] For voltages beyond these limits, use input protection resistors. See the Theory of Operation section for more information.

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

THERMAL RESISTANCE

Thermal performance is directly linked to printed circuit board (PCB) design and operating environment. Careful attention to PCB thermal design is required.

θ_{JA} is the junction to ambient thermal resistance, and θ_{JC} is the junction to case thermal resistance.

Table 5. Thermal Resistance

Package	θ_{JA}[1]	θ_{JC}	Unit
R-8	113	51	°C/W
RM-8	151	59	°C/W
CP-8-19	55	59	°C/W

[1] θ_{JA} is specified for a device in free air using a 4-layer JEDEC PCB.

ELECTROSTATIC DISCHARGE (ESD) RATINGS

The following ESD information is provided for handling of ESD sensitive devices in an ESD protected area only.

Human body model (HBM) per ESDA/JEDEC JS-001-2011.

Charged device model (CDM) per JESD22-C101.

Machine model (MM) per JESD22-A115. MM voltage values are for characterization only.

ESD Ratings for AD8422

Table 6. AD8422, 8-Lead SOIC_N, 8-Lead MSOP, and 8-Lead LFCSP

ESD Model	Withstand Threshold	Class
HBM	2.5 kV	2
CDM	1.25 kV	IV
MM	100 V	Not applicable

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