HMCAD1511 Gain & DC Offset Measurements

Product Application Note

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1 Introduction

For the HMCAD15xx series, the typical FSR, the differential input full scale range, is 2 Vpp. This range can be varied by using the Full-Scale Control function and also by a coarse and fine programmable gain function.

The Full-Scale Control is adjusted by an internal 6 bit DAC. The adjustment is an analog one to the input of all four converters. The maximum range adjustment is ~ ± 10%.

The Programmable Gain is a digital function and has both coarse and fine settings. The coarse gain of each channel can be individually set using a 4 bit code and can be varied from 0 dB to 12 dB in 1 dB steps. The fine gain function is implemented for each ADC branch to adjust the fine gain errors between the branches. The fine gain can be varied from -0.0670 dB to 0.0665 dB in approximately 0.001 dB steps.

These gains and also the DC offset will be affected by both the supply voltage and by the ambient temperature. The following data table and graphs quantify this effect. The data was taken using the EVAL01-HMCAD1511board but will be applicable to the HMCAD1520 and HMCAD1510 as well.

2 HMCAD1511 Gain and DC Offset Measurement Data

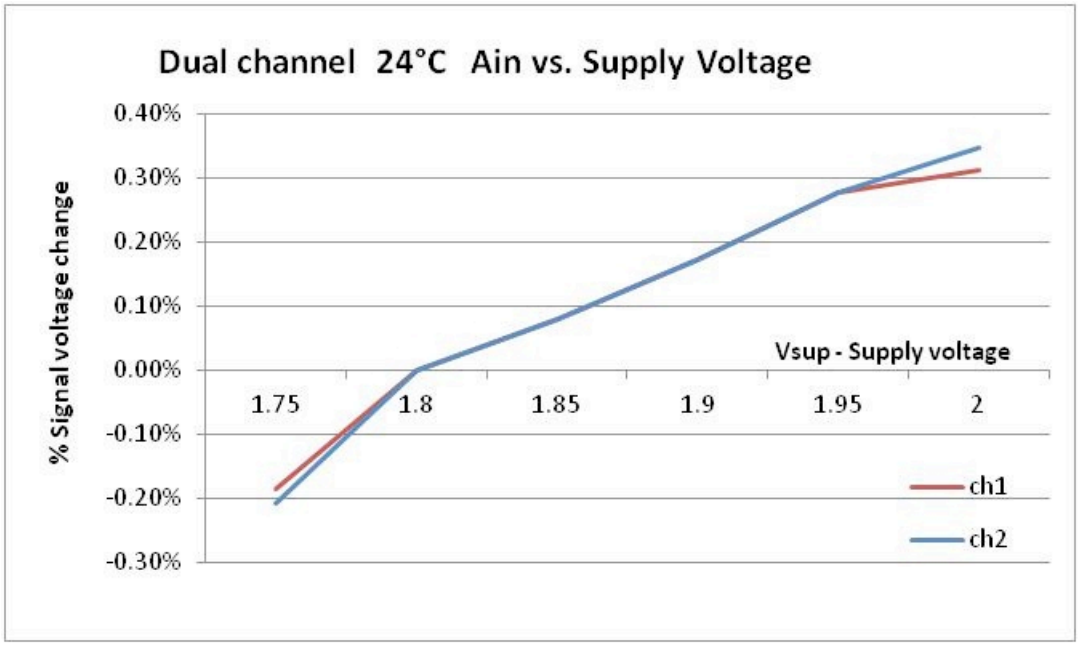

Figure 1 Dual channel @24°C – Ain vs. Supply Voltage

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		[MHz]	[MHz]	[DegC]	[Volt]	[dBFS]		[% of 1,8v]	Center value [max=4096]	[# diff LSB] Differential	[% fullscale]
		Fs	Fin	temp	Vsup	Ain	Ain	Ain	DC-offset	DC-offset	DC-offset
1ch		500	8.123	24	1.75	-1.050	0.886	1.51%	2047.2022	0.2022	0.0049 %
			8.123	24	1.8	-1.180	0.873	0.00%	2047.5637	0.5637	0.0138 %
			8.123	24	1.85	-1.220	0.869	-0.46%	2047.6185	0.6185	0.0151 %
			8.123	24	1.9	-1.240	0.867	-0.69%	2047.7394	0.7394	0.0181 %
			8.123	24	1.95	-1.260	0.865	-0.92%	2047.8156	0.8156	0.0199 %
			8.123	24	2	-1.260	0.865	-0.92%	2047.8802	0.8802	0.0215 %
2ch	ch1	250	8.123	24	1.75	-0.211	0.976	-0.18%	2046.9416	-0.0584	-0.0014 %
			8.123	24	1.8	-0.195	0.978	0.00%	2047.0692	0.0692	0.0017 %
			8.123	24	1.85	-0.188	0.979	0.08%	2047.1177	0.1177	0.0029 %
			8.123	24	1.9	-0.180	0.979	0.17%	2047.1911	0.1911	0.0047 %
			8.123	24	1.95	-0.171	0.981	0.28%	2047.2632	0.2632	0.0064 %
			8.123	24	2	-0.168	0.981	0.31%	2047.3980	0.3980	0.0097 %
2ch	ch2	250	8.123	24	1.75	-0.218	0.975	-0.21%	2047.5575	0.5575	0.0136 %
			8.123	24	1.8	-0.200	0.977	0.00%	2047.5883	0.5883	0.0144 %
			8.123	24	1.85	-0.193	0.978	0.08%	2047.6047	0.6047	0.0148 %
			8.123	24	1.9	-0.185	0.979	0.17%	2047.6708	0.6708	0.0164 %
			8.123	24	1.95	-0.176	0.980	0.28%	2047.7287	0.7287	0.0178 %
			8.123	24	2	-0.170	0.981	0.35%	2047.6833	0.6833	0.0167 %
1ch		500	8.123	48	1.75	-1.000	0.891	2.33%	2046.8435	-0.1565	-0.0038 %
			8.123	48	1.8	-1.200	0.871	0.00%	2047.0718	0.0718	0.0018 %
			8.123	48	1.85	-1.250	0.866	-0.57%	2047.2250	0.2250	0.0055 %
			8.123	48	1.9	-1.310	0.860	-1.26%	2047.3614	0.3614	0.0088 %
			8.123	48	1.95	-1.350	0.856	-1.71%	2047.4398	0.4398	0.0107 %
			8.123	48	2	-1.360	0.855	-1.83%	2047.5069	0.5069	0.0124 %
2ch	ch1	250	8.123	48	1.75	-0.344	0.961	-0.15%	2047.1287	0.1287	0.0031 %
			8.123	48	1.8	-0.331	0.963	0.00%	2047.2125	0.2125	0.0052 %
			8.123	48	1.85	-0.324	0.963	0.08%	2047.2869	0.2869	0.0070 %
			8.123	48	1.9	-0.318	0.964	0.15%	2047.3755	0.3755	0.0092 %
			8.123	48	1.95	-0.302	0.966	0.33%	2047.3660	0.3660	0.0089 %
			8.123	48	2	-0.294	0.967	0.43%	2047.5184	0.5184	0.0127 %
2ch	ch2	250	8.123	48	1.75	-0.324	0.963	-0.18%	2047.3228	0.3228	0.0079 %
			8.123	48	1.8	-0.308	0.965	0.00%	2047.3439	0.3439	0.0084 %
			8.123	48	1.85	-0.303	0.966	0.06%	2047.4375	0.4375	0.0107 %
			8.123	48	1.9	-0.291	0.967	0.20%	2047.4549	0.4549	0.0111 %
			8.123	48	1.95	-0.284	0.968	0.28%	2047.5363	0.5363	0.0131 %
			8.123	48	2	-0.278	0.969	0.35%	2047.5999	0.5999	0.0146 %

Table 1 (Above) Gain and DC Offset vs. Supply Voltage and Temperature

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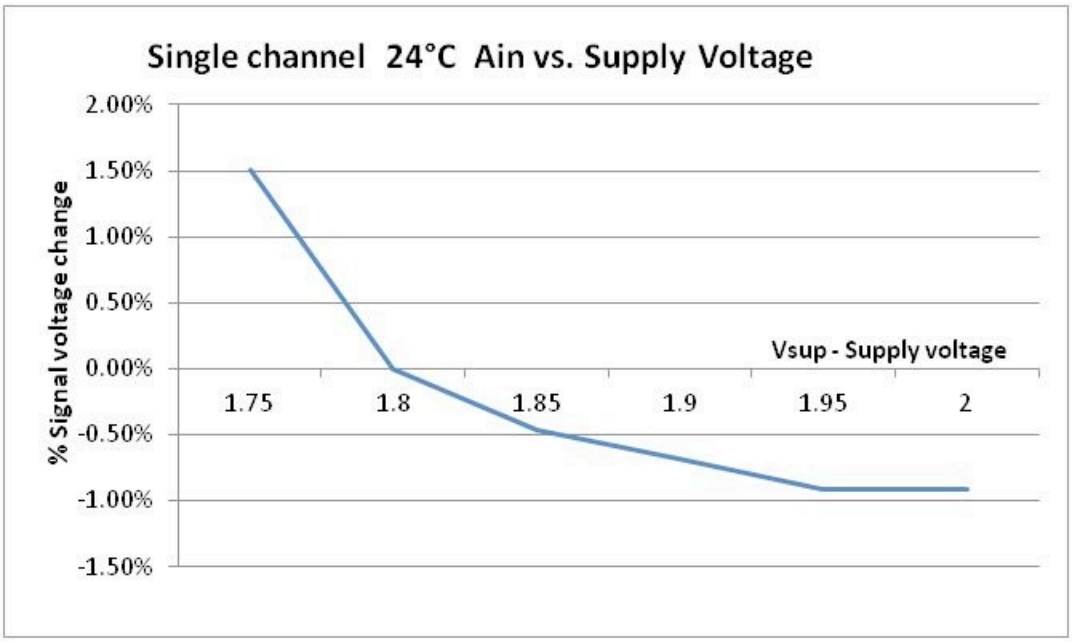

Figure 2 Single channel @24°C – Ain vs. Supply Voltage

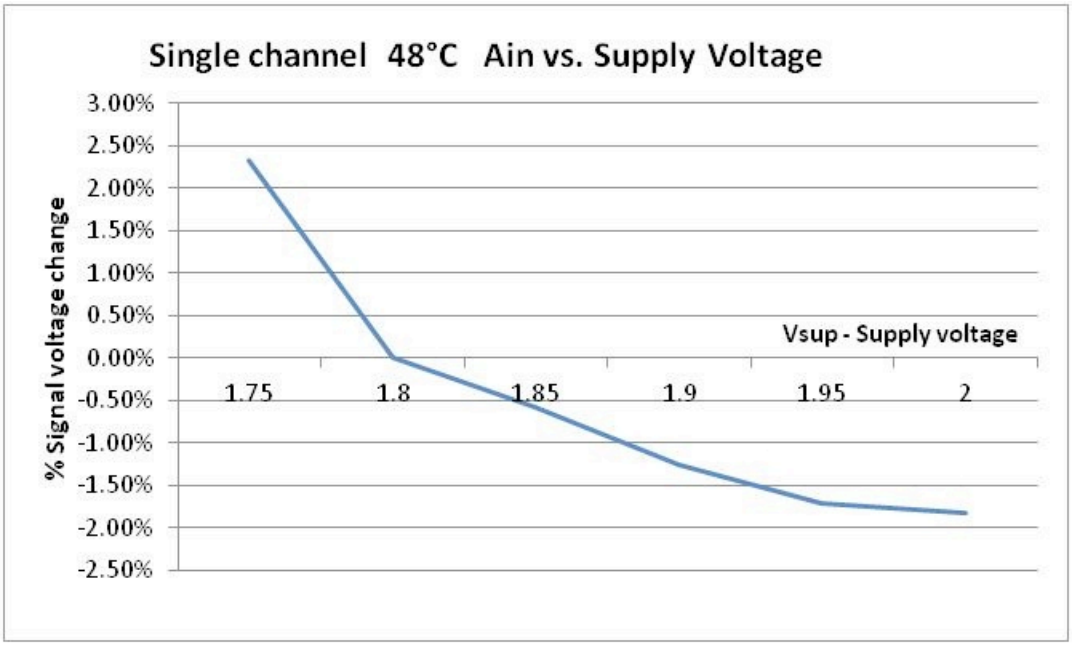

Figure 3 Single channel @48°C – Ain vs. Supply Voltage

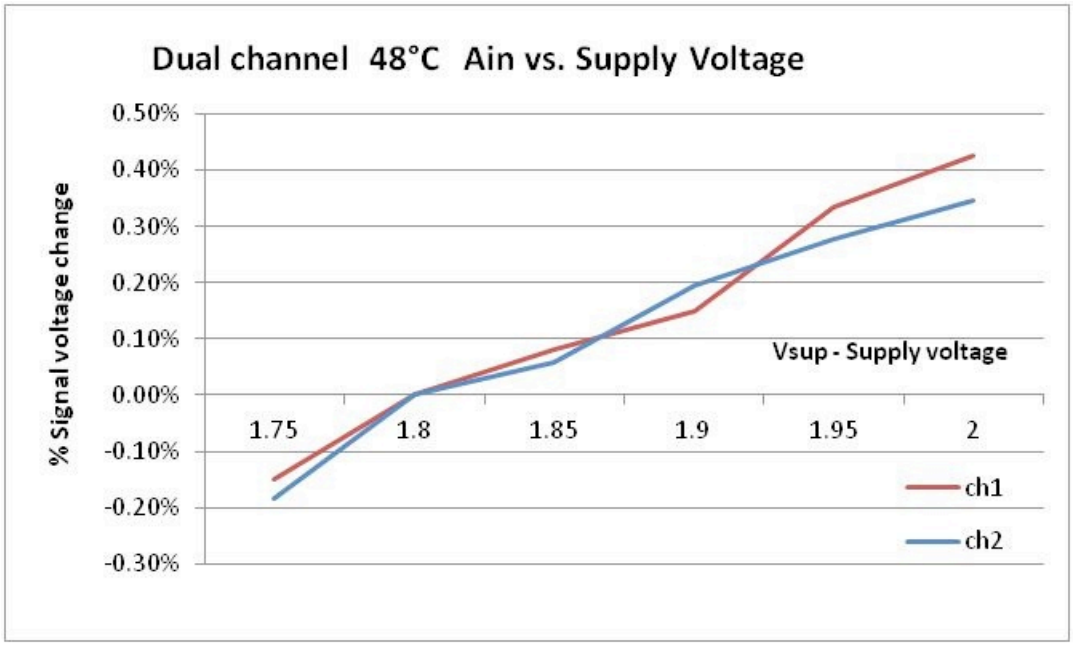

Figure 4 Dual channel @48°C – Ain vs. Supply Voltage

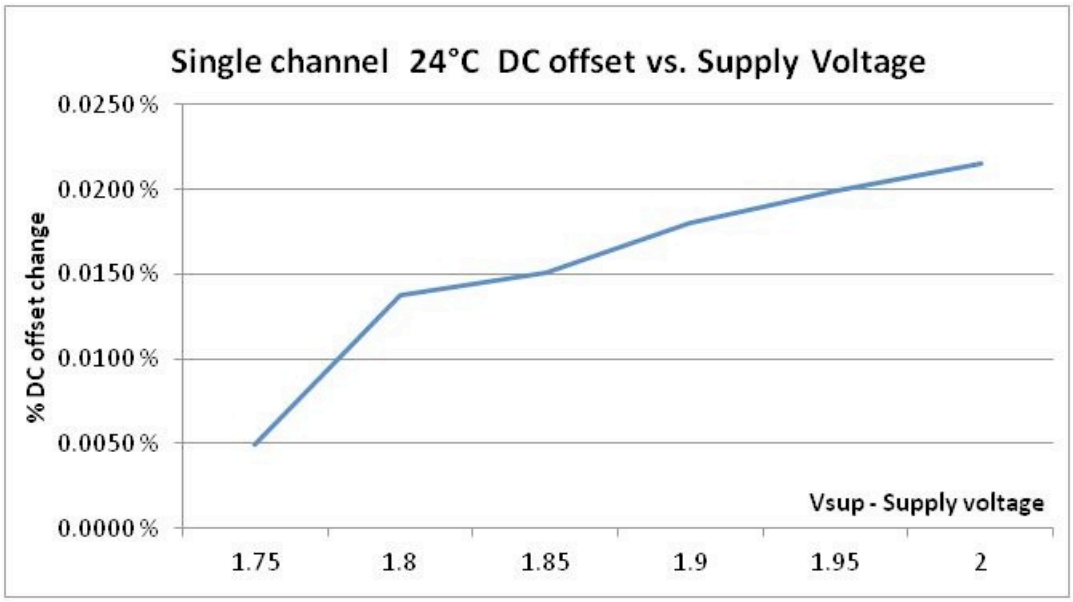

Figure 5 Single channel @24°C – DC offset vs. Supply Voltage

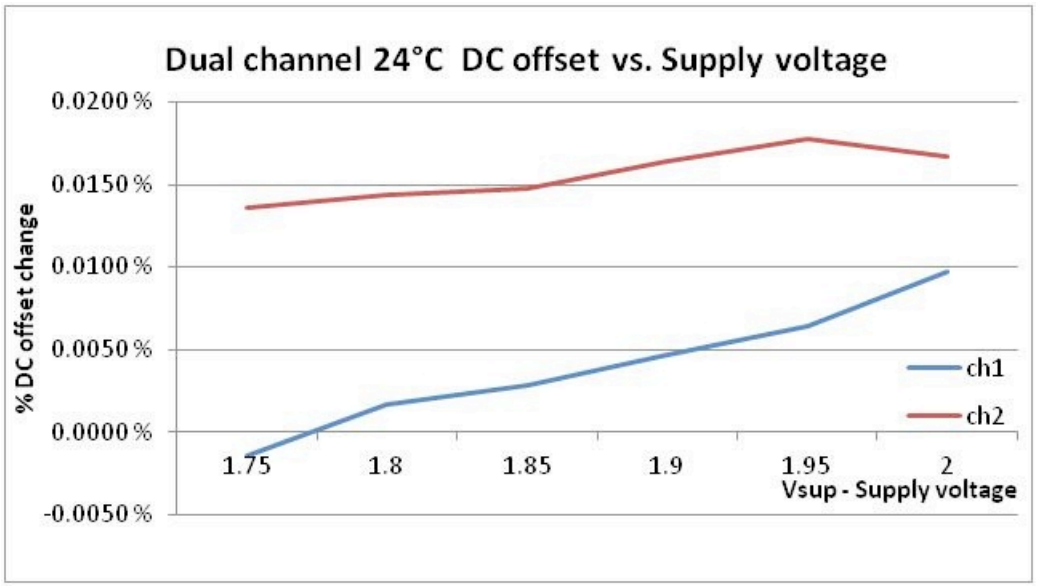

Figure 6 Dual channel @24°C – DC offset vs. Supply Voltage

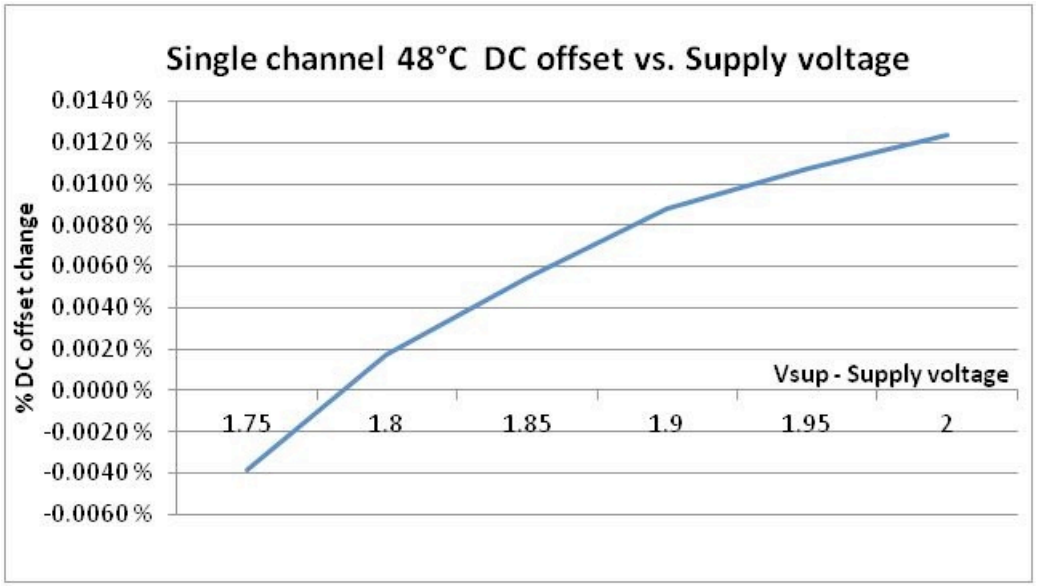

Figure 7 Single channel @48°C – DC offset vs. Supply Voltage

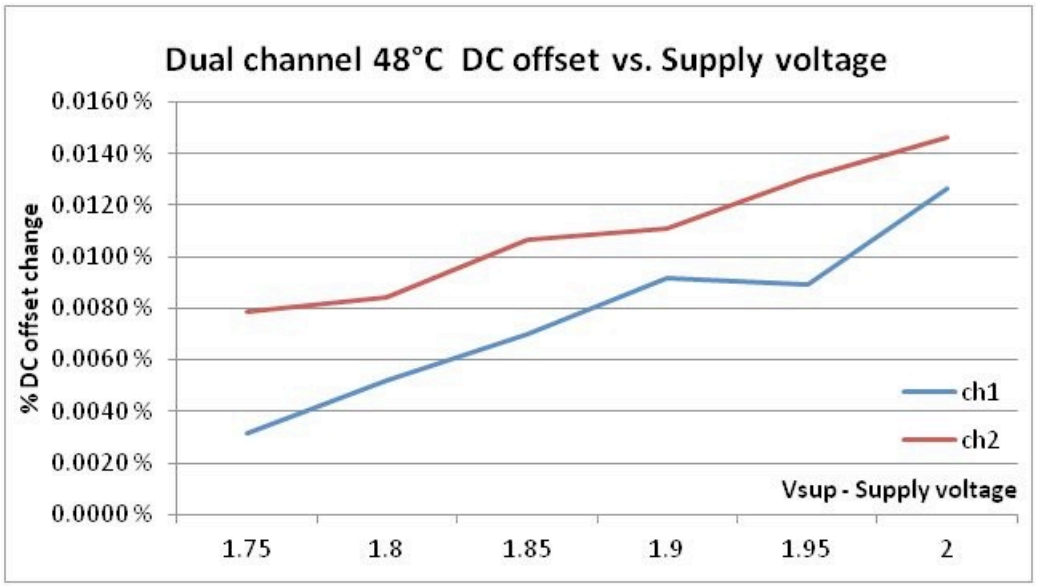

Figure 8 Dual channel @48°C – DC offset vs. Supply Voltage

3 Calculation of temperature dependency

The following data was extracted for the temperature dependency at V supply = 1.8V. The maximum 12 bit signal amplitude value of 4096 equals 2 Vpp.

								(1)			(2)
								%Ai change	Center value	[# diff LSB]	[# diff LSB]
		[MHz]	[MHz]	[DegC]	[Volt]	[dBFS]	(FS=1,00)	per °C	[max=4096]	Differential	per °C
		Fs	Fin	temp	Vsup	Ain	Ain	Ain%/°C	DC-offset	DC-offset	DC-off/°C
1ch		500	8.123	24	1.8	-1.180	0.873		2047.5637	0.5637	
1ch		500	8.123	48	1.8	-1.200	0.871	-0.00837 %	2047.0718	0.0718	-0.0204958
2ch	ch1	250	8.123	24	1.8	-0.195	0.978		2047.0692	0.0692	
2ch	ch1	250	8.123	48	1.8	-0.331	0.963	-0.06329 %	2047.2125	0.2125	0.0059708
2ch	ch2	250	8.123	24	1.8	-0.200	0.977		2047.5883	0.5883	
2ch	ch2	250	8.123	48	1.8	-0.308	0.965	-0.05032 %	2047.3439	0.3439	-0.0101833

(1) Comment: This is the % change of the measured input signal amplitude per degree Centigrade
(2) Comment: This is the change of DC value, measured in unit of LSB, per degree Centigrade

Table 2 Calculation of temperature dependency