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Datasheet SCS2000_LiqHeLevel Slot Card

HW-Revision: A

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DESCRIPTION

The SCS2000_LiqHeLevel is a slot card being used with the SCS2000, SCS2001 and SCS3000 slow control systems.
It's a 2 channel liquid helium level detector. The sensor is supplied with a unipolar current source, delivering up 100mA (adjustable with 16Bit DAC). The sensor-feedback signal is measured differential with a resolution of 24Bits.

ELECTRICAL CHARACTERISTICS

CURRENT SOURCE

Parameter	Condition	Value			Unit
		Min	Typ	Max	
Output Voltage	Uout > 0	2.8V - 25*ILoad			V
Output Current Sourcing		0		100	mA
Maximum Load		2.8V/ILoad -25			Ω
Resolution			1,53		µA
Integral Linearity			±18.31	±97	µA
Differential Nonlinearity				±1.53	µA
Offset Error[1,3]			0,22	±2.76	mA
Gain Error[1,4]			0,35	1,64	%
Offset Temperature Coefficient[1,2,5]			±20.25		µA/°C
Gain Temperature Coefficient[1,2,6]			71	141,5	ppm/°C

Note 1: Gauss' law of error propagation assumed for typical values (not tested)
Note 2: Estimated values according datasheets (not tested)
Note 3: Most of the offset error due to offset bias current of OPA547
Note 4: Most Error due to precision of Resistors and DAC
Note 5: Most of failure due to temp. drift of OPA547
Note 6: Most failure due to temp. coefficient of resistors

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VOLTAGE INPUTS

Parameter	Condition	Value			Unit
		Min	Typ	Max	
Differential Input Voltage				±30	V
Common Mode Input Voltage				±30	V
Input Offset Voltage[1,2,4]	Input Referred		±3.65		mV
Integral Linearity	Input Referred		±4	±29.5	µV
Differential nonlinearity	Input Referred			±1.53	µA
Gain Error[1,3]			0,185	0,37	%
Offset Temperature Coefficient[1,2]			±0.4		µV/°C
Gain Temperature Coefficient[1,3]			38	74	ppm/°C
Analog Input Bandwidth			20		Hz

Note 1: Gauss' law of error propagation assumed for typical values (not tested)
Note 2: CHOP mode of AD7718 enabled
Note 3: See calculations below, errors of AD7718 neglected
Note 4: Offset due to AD8221 instrumentation amplifier and reference offset (IC 9)

MODULE IDENTIFICATION CODE

0x84

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ENGLISH

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CALCULACTIONS

Gain Error caused by resistor tolerance of input amplifier:

Voltage at positive input of Amplifier: $U_p = \frac{R_{11} \cdot Ue_p}{R_7 + R_{11}}$

Voltage at negative of Amplifier: $U_n = \frac{R_{10} \cdot Ue_n}{R6 + R10}$

Differential input Voltage of Amplifier: $U_{diff} = U_p - U_n$

Gain Error of differential input of Amplifier caused by 0.1% tolerance of

R6: $\left|\frac{dU_{diff}}{dR_6} \cdot \Delta R_6\right| = \left|\frac{R_{10}}{(R_6+R_{10})^2} \cdot \Delta R_6\right| = 70 \cdot 10^{-6}$

R10: $\left|\frac{dU_{diff}}{dR_6} \cdot \Delta R_6\right| = \left|\frac{-R_6}{(R_6+R_{10})^2} \cdot \Delta R_{10}\right| = 70 \cdot 10^{-6}$

R7: $\left|\frac{dU_{diff}}{dR_7} \cdot \Delta R_6\right| = \left|\frac{-R_{11}}{(R_7+R_{11})^2} \cdot \Delta R_7\right| = 70 \cdot 10^{-6}$

R11: $\left|\frac{dU_{diff}}{dR_7} \cdot \Delta R_{11}\right| = \left|\frac{R_7}{(R_7+R_{11})^2} \cdot \Delta R_{11}\right| = 70 \cdot 10^{-6}$

Typical gain error with 0.1% resistor toerance: $\sqrt{70 \cdot 10^{-6^2} + 70 \cdot 10^{-6^2} + 70 \cdot 10^{-6^2} + 70 \cdot 10^{-6^2}} = 140 \cdot 10^{-6}$
With a nominal gain of $75.78 \cdot 10^{-3}$ the gain error is typical **0.185%.**

The maximum gain error with 0.1% resistor tolerance is: $4 \cdot 70 \cdot 10^{-6} = 280 \cdot 10^{-6}$
The maximum gain error is **0.37%.**

Gain Drift caused by resistor temperature dependency of 15ppm/°C of

R6: $\left|\frac{dU_{diff}}{dR_6} \cdot \Delta R_6\right| = \left|\frac{R_{10}}{(R_6+R_{10})^2} \cdot \Delta R_6\right| = 1.75 \cdot 10^{-6}$

R10: $\left|\frac{dU_{diff}}{dR_6} \cdot \Delta R_6\right| = \left|\frac{-R_6}{(R_6+R_{10})^2} \cdot \Delta R_{10}\right| = 1.05 \cdot 10^{-6}$

R7: $\left|\frac{dU_{diff}}{dR_7} \cdot \Delta R_6\right| = \left|\frac{-R_{11}}{(R_7+R_{11})^2} \cdot \Delta R_7\right| = 1.75 \cdot 10^{-6}$

R11: $\left|\frac{dU_{diff}}{dR_7} \cdot \Delta R_{11}\right| = \left|\frac{R_7}{(R_7+R_{11})^2} \cdot \Delta R_{11}\right| = 1.05 \cdot 10^{-6}$

Typical gain drift resistor toerance: $\sqrt{1.75 \cdot 10^{-6^2} + 1.05 \cdot 10^{-6^2} + 1.75 \cdot 10^{-6^2} + 1.05 \cdot 10^{-6^2}} = 2.87 \cdot 10^{-6}$
With a nominal gain of $75.78 \cdot 10^{-3}$ the gain error is typical **38.1ppm/°C.**

The maximum gain drift with is: $2 \cdot 1.05 \cdot 10^{-6} + 2 \cdot 1.75 \cdot 10^{-6} = 5.6 \cdot 10^{-6}$
The maximum gain error is **73.9ppm/°C.**