Advantech AE Technical Share Document

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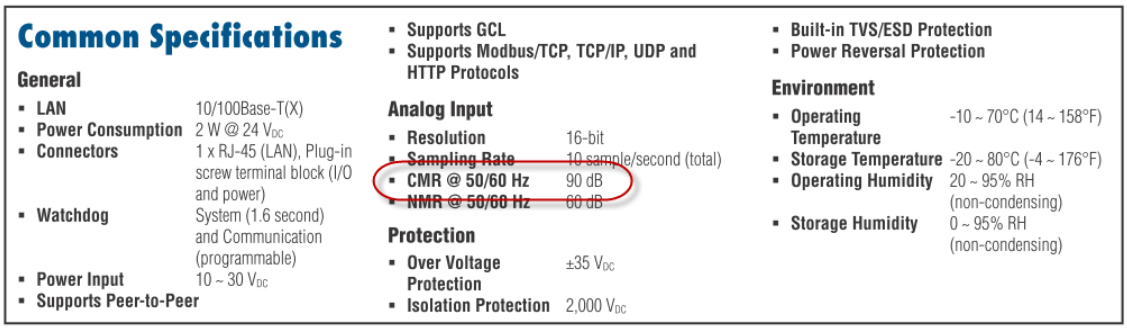
Category	■FAQ □SOP	**Related OS**	N/A
Abstract	ADAM-4000 and 6000, What's CMR of AI module		
Keyword	Analog input, Common-mode voltage, Differential-mode voltage, CMR		
Related Product	ADAM-4011, ADAM-4012, ADAM-4013, ADAM-4015, ADAM-4015T, ADAM-4016, ADAM-4017+, ADAM-4018+, ADAM-4019+, ADAM-4118, ADAM-6015, ADAM-6017, ADAM-6018, ADAM-6117, ADAM-6217, ADAM-6218		

■ Problem Description:

What's CMR definition and meaning for ADAM analog input module?(*Figure 1*)



Common Specifications

General

- LAN: 10/100Base-T(X)
- Power Consumption: 2 W @ 24 V_{DC}
- Connectors: 1 x RJ-45 (LAN), Plug-in screw terminal block (I/O and power)
- Watchdog: System (1.6 second) and Communication (programmable)
- Power Input: 10 ~ 30 V_{DC}
- Supports Peer-to-Peer
- Supports GCL
- Supports Modbus/TCP, TCP/IP, UDP and HTTP Protocols

Analog Input

- Resolution: 16-bit
- Sampling Rate: 10 sample/second (total)
- CMR @ 50/60 Hz: 90 dB
- NMR @ 50/60 Hz: 60 dB

Protection

- Over Voltage Protection: ±35 V_{DC}
- Isolation Protection: 2,000 V_{DC}
- Built-in TVS/ESD Protection
- Power Reversal Protection

Environment

- Operating Temperature: -10 ~ 70°C (14 ~ 158°F)
- Storage Temperature: -20 ~ 80°C (-4 ~ 176°F)
- Operating Humidity: 20 ~ 95% RH (non-condensing)
- Storage Humidity: 0 ~ 95% RH (non-condensing)

Figure 1

■ Answer:

The common-mode voltage is the same voltage signal passing through both ends of amplifier input channels. Although the purpose of the differential amplifier is to eliminate the common-mode voltage v_{Icm} and amplify the differential voltage of two input channelsv_{Id}, in practical there are still small output voltage result from the common-mode voltage. The output voltage v_0 of amplifier is given by *Equation 1*

$$v_0 = A_d v_{Id} + A_{cm} v_{Icm}$$

Equation 1

where A_d denoted the differential-mode gain and A_{cm} denoted the common-mode gain. Ideally, common-mode gain A_{cm} should be zero and then the output voltage can fully represent the times of differential voltages. The common-mode rejection ratio (CMRR) shows the efficacy of amplifier. It's defined as *Equation 2*

$$\text{CMRR} = \frac{|Ad|}{|Acm|}$$

Equation 2

It is the ratio of the common-mode gain to the differential-mode gain. Usually, common-mode gain is small. In order to represent the large value of the CMRR, the CMR is defined as *Equation 3*

$$\text{CMR} = 20 \log CMRR$$

Equation 3

Taking ADAM-4012 specification for the example (*Figure 2*),

CMR @ 50/60 Hz	150 dB

Figure 2

It means that the CRM is 150 dB when ADAM-4012 works in the 50/60 Hz ac environment and the CMRR is around 31,622,776. (*Figure 3*)

CMR(dB)	CMRR(A_{Id}/A_{Icm})
160	100,000,000
140	10,000,000
120	1,000,000
100	100,000
80	10,000
60	1,000
40	100
20	10
0	1

Figure 3