

Application Note AN-02

Noise Equivalent Rates, Noise Equivalent Angles, Voltage Effects and Power Spectral Densities (PSD's) for MHD Angular Rate Sensors.

The following information is representative data for MHD sensors used in the measurement of vibration and small motion amplitudes. This data can be used to determine the best sensor for a given application, and also shows the effect of supply voltage on the range of the sensor. Values are based on standard sensor configurations, and will be proportionally different for custom scale factor and ranges. Three axis packages such as the Dynacube™, Dynapak and triaxial products are multi-axes arrays of the individual sensor and the individual sensor data applies to these products.

Table 1 shows the Noise Equivalent Rate for various MHD Angular Rate Sensors as a function of frequency in four bands within the sensor frequency response. The sensors low-end frequency response can be extended to below 0.1 Hz by use of digital filtering techniques as described in Application Note AN-01, "Extending the Frequency response of MHD Sensors". The upper limits of the frequency response may be extended higher to 2k Hz or above, or may be set to a lower frequency cut-off by the use of different electronic components at the time of manufacture. Generally, the rejection of high frequencies not of use in a particular measurement application will result in lower noise floor for the frequency range of interest.

Table 1. Noise Equivalent Rate in microradians/sec rms for three frequency bands within the standard frequency response range of the ARS-01, ARS-03, ARS-04, ARS-09 and ARS-12 MHD sensors. The sensors are ordered from highest noise rate to lowest noise rate. The column on the right shows the integrated bandwidth from 1 to 1000 Hz in microradians/sec rss*.

Frequency Band	1-10 Hz rms	10-100 Hz rms	100-1000 Hz rms	1-1000 Hz rss*
ARS-04	5,768.0	11,400.0	33,218.0	35,590.00
ARS-09	1,136.0	2,248.0	6,534.0	7,011.00
ARS-01	874.0	1,729.0	5,033.0	5,393.00
ARS-12	1.3	2.0	5.6	6.09

*root sum squared

Table 2. Noise Equivalent Angle (Angular Displacement) in microradians rms for three frequency ranges and for the standard total frequency range of MHD Angular Rate Sensors models ARS-01, ARS-03, ARS-04, ARS-09 and ARS-12. Sensors are shown in order of decreasing noise. For vibration measurements, the sensor should generally be at least a factor of 10 (20 dB) below the values being measured.

Sensor	1-10 Hz	10 -100 Hz	100-1000 Hz	1-1000 Hz
ARS-04	393.400	62.700	17.200	398.700
ARS-09	77.500	12.300	3.400	78.500
ARS-01	59.600	9.500	2.600	60.400
ARS-12	0.070	0.011	0.003	0.071

Table 3. Nominal Scale Factor and Range vs. Supply Voltages. The models ARS-01, ARS-03, ARS-04, ARS-09 and ARS-12 will operate with dual supplies with an input supply voltage range of ± 5 to ± 15 VDC. This table shows the effect of voltage input on the range of the sensor. There is generally a 1.5 volt drop between input and maximum output. For voltages between the values shown, the range can be calculated by dividing the input voltages in millivolts less 1.5 volts by the scale factor. For example, an ARS-01 at ± 7.5 volts input would have a range of $(7500 \text{ mV} - 1500 \text{ mV}) / 50 \text{ mV} = 100 \text{ rad/sec}$.

Sensor Model	Nominal Scale Factor mV/(rad/sec)	Range for ± 5 VDC Supply \pm radians/sec zero to peak	Range for ± 10 VDC Supply \pm radians/sec zero to peak	Range for ± 15 VDC Supply \pm radians/sec zero to peak
ARS-01	50	70.00	170.00	270.00
ARS-04	100	35.00	85.00	135.00
ARS-09	5,700	0.60	1.50	2.40
ARS-12	57,000	0.06	0.15	0.24

The following pages show the noise PSD curves for the same set of MHD sensors with the Angular Rate Noise values in $(\text{radians/sec})^2/\text{Hz}$ and Angular Displacement Noise in $(\text{radians})^2/\text{Hz}$ plotted as a function of frequency. For further information on these products or assistance in using this data, please contact ATA Sensors technical support at (505) 823-1320 or email your questions to CustomerService@aptec.com. Application notes and sensor data will be updated on our web sites as changes occur and are downloadable and printable from the Adobe Acrobat .pdf format. For more information visit ATA Sensors.com located at <http://www.atasensors.com>.

