

Wärtsilä Motion Reference Unit

Motion Reference Units for the Marine Industry



The Motion Reference Unit (MRU) utilizes the latest developments in Micro Electro Mechanical Systems (MEMS) technology to provide accurate determination of Pitch, Roll, and Heave for any vessel on which it is mounted. MRUs are suitable for a wide range of marine applications including vessels with dynamic positioning.



Benefits

- 0.08 deg RMS Pitch & Roll dynamic accuracy
- 5cm RMS Heave accuracy
- 0.005m/sec² linear acceleration accuracy
- NMEA 0183, TSS1 output data formats
- HYPACK software compatibility
- Environmentally sealed (IP67), compact design

Typical applications

Four variants of MRU available:

- •GMRU-H (Heave only)
- •GMRU-PR (Pitch and Roll only)
- •GMRU-PRH (Pitch, Roll and Heave)
- •GMRU-E (Pitch, Roll, Heave and Heading)

MRUs are suitable for a wide range of marine applications including vessels with dynamic positioning.



Measured Parameters	GMRU-H	GMRU-PR	GMRU-PRH	GMRU-E
Heave	\checkmark		✓	\checkmark
Pitch & Roll		✓	✓	✓
Heading				\checkmark

Main data

Devenueter	1 Jan Mar	MRU				
Parameter	Units	GMRU-H	GMRU-PR	GMRU-PRH	GMRU-E	
Output signals	-		Heave, Pitch & Roll, Heading,	, Accelerations, Angular rates	4	
Update rate	Hz	1 200 (user settable)				
Start-up time	sec		` <	:1		
Full Accuracy Data (Warm-up Time)	sec	10				
Heave	Units					
Measurement range	metres	+300		+300	+300	
Pesolution	metres	0.01	-	0.01	0.01	
Acouracy	(motroe) PMS	0.01 E (0.0E)		5 (0.05)	5 (0.05)	
Accuracy	% (metres) Kivis	5 (0.05)	-	5 (0.05)	5 (0.05)	
Heave rate accuracy	m/s RMS	0.07		0.07	0.07	
Pitch and Roll	Units					
Range: Pitch, Roll	deg	-	±90, ±180	±90, ±180	±90, ±180	
Angular Resolution	deg	-	0.01	0.01	0.01	
Static Accuracy in whole Temperature Range	deg	-	0.05	0.05	0.05	
Dynamic Accuracy	deg RMS	-	0.08	0.08	0.08	
Post processing accuracy (1)	deg RMS	-	0.03	0.03	0.03	
Heading	Units					
Range	deg	-	-	-	0 to 360	
Angular Resolution	deg	-		-	0.01	
Static Accuracy in whole Temperature Range	dea	-		_	0.2	
Dynamic Accuracy	deg RMS	-	-	-	0.4	
Post processing accuracy (1)	deg RMS			-	0.1	
Positions Velocity and Timestomes					0.1	
	Units					
Horizontal position accuracy (GPS LT), RMS	inetres	-		-	-	
Horizontal position accuracy (SBAS), RMS	metres	-	-	-	-	
Horizontal position accuracy (DGPS), RMS	metres	-	-	-	-	
Horizontal position accuracy (post processing) (1)	metres			-	-	
Velocity accuracy, RMS	metres/sec	-	-	-	-	
GNSS raw data rate	Hz	-	-	-	-	
Timestamps accuracy	milliseconds		<	:5		
Gyroscopes	Units					
Measurement range	deg/sec		±4	.50		
Measurement range Bias in-run stability (RMS, Allan Variance)	deg/sec deg/hr		±4	50 1		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density	deg/sec deg/hr deg/sec√Hz		±4 0.0	50 1 004		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers	deg/sec deg/hr deg/sec√Hz Units		±4 0.0	50 1 004		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range	deg/sec deg/hr deg/sec√Hz Units g		±4 	50 1)04 .8		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance)	deg/sec deg/hr deg/sec√Hz Units g ma		±4 0.0 ±	50 1 104 8 105		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density	deg/sec deg/hr deg/sec√Hz Units g mg mg		±4 0.0 ± 0.0	50 1 104 8 8 205 215		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers	deg/sec deg/hr deg/sec√Hz Units g mg mg Hz		±4 0.0 ± 0.0 0.0	50 1 104 8 8 105 115		
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss		±4 0.0 ± 0.0 0.0	50 1)04 .8 .005 .115	+16	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in run stability, PMS	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss	-	±4 0.0 ± 0.0 0.0 0.0	50 1)04 .8 .005 .115 -	±1.6	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS	deg/sec deg/hr deg/sec√Hz Units g mg Mg√Hz Units Gauss nT pTr/t i=	-	±4 0.0 ± 0.0 0.0 0.0	50 1 204 8 8 205 205 205 - - -	±1.6 0.2	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT/Hz	- - - -	+4 0.0 + - - -	50 1 1004 8 8 105 115 - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units	-	+4 0.0 + - - -	50 1)04 .8 .005 .115 	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units		±4 0.0 ± 0.0 0.0 0.0 - - 300 –	50 1 1004 88 005 015 - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance)	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa	-	±4 0.0 ± 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	50 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa/√Hz	- - - -	±4 0.0 ± 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0 0 0	50 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa/√Hz Units	- - - -	±4 0.0 ± 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	50 1 1004 88 1005 1015 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa Pa/√Hz Units deg C		±4	50 1 1 1004 	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa/√Hz Units deg C deg C		±4 0.0 ± 0.0 0.0 0.0 0.0 0.0 0 - 2 0 0 - 40 to -50 to	50 1 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa/√Hz Units deg C deg C hours		+4 	50 1 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature MTBF	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa Pa/\Hz Units deg C deg C deg C hours		±4 0.0 ± 0.0 0.0 0.0 0.0 0.0 0.0	50 1 1 1 1 1 1 1 1 1 1 1 1 1	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature MTBF Vibrationv	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa Pa Hz Units deg C deg C hours - Units		+4 	50 1 1 1 1 1 1 1 1 1 1 1 1 1	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature MTBF Vibrationv Electrical	deg/sec deg/sec Units g mg mg\Hz Units Gauss nT nT\Hz Units Alpha Pa Pa Pa/\Hz deg C deg C hours - Units V DC		+4 	50 1 1 1 1 1 1 1 1 1 1 1 1 1	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage	deg/sec deg/sec Units g mg mg\Hz Units Gauss nT nT\Hz Units Alpha Pa Pa/\Hz Units deg C deg C hours - Units V DC Watts		±4	50 1 1 1004 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption	deg/sec deg/sec Units g mg mg\Hz Units Gauss nT NT\Hz Units Qauss nT Nty Qauss nT Nty Qauss nT Nty Units Qaust Qaust Nours - Units VDC Watts		±4	50 1 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption Output Interface	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa/√Hz Units deg C deg C deg C hours - Units V DC Watts		±4	50 1 1 1004 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption Output Interface Output data format	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa/√Hz Units deg C deg C hours - Units V DC Watts - -		±4	50 1 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption Output Interface Output data format Compliance to EMCD, immunity/emission	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa/√Hz Units deg C deg C deg C deg C hours - Units V DC Watts - -		±4	50 1 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption Output Interface Output data format Compliance to EMCD, immunity/emission	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT∨Hz Units hPa Pa Pa/√Hz Units deg C deg C deg C deg C hours - Units V DC Watts - Units		±4	50 1 1 104 8 8 105 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature Urbrationv Electrical Supply voltage Power consumption Output Interface Output data format Compliance to EMCD, immunity/emission Connector ⁽²⁾	deg/sec deg/hr deg/sec√Hz Units 9 mg mg√Hz Units Gauss nT nT\Hz Units hPa Pa Pa/\Hz Units deg C deg C deg C deg C deg C i Units V DC V DC V DC V DC V DC V atts - - - Units N N N N N N N N N N N N N		±4	50 1 1 1004 8 8 105 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption Output Interface Output data format Compliance to EMCD, immunity/emission Connector ^(a) Physical	deg/sec deg/hr deg/sec√Hz Units g mg mg√Hz Units Gauss nT nT\Hz Units hPa Pa Pa Pa/\Hz Units deg C deg C deg C deg C hours - Units V DC V DC V DC V Matts - Units mm		±4	50 1 1 1004 8 8 1005 115 - - - - - - - - - - - - -	±1.6 0.2 0.3	
Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Accelerometers Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Magnetometers Measurement range Bias in-run stability, RMS Noise density, PSD Pressure Measurement range Bias in-run stability (RMS, Allan Variance) Noise density Environment Operating temperature Storage temperature Storage temperature MTBF Vibrationv Electrical Supply voltage Power consumption Output Interface Output data format Compliance to EMCD, immunity/emission Connector ⁽²⁾ Physical Size Weight	deg/sec deg/hr deg/sec√Hz Units g g mg√Hz Units Gauss nT nT√Hz Units hPa Pa Pa Pa Pa Hz Units Units Units C deg C deg C deg C deg C hours - Units		±4	50 1 1 1 1 1 1 1 1 1 1 1 1 1	±1.6 0.2 0.3 1.4	

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