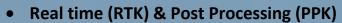


Dual Antenna, GPS-Aided Inertial Navigation Systems

INS-D-OEM
INS-DL-OEM



- Position accuracy = 0.5 cm (PPK) / 1 cm (RTK)
- Heading accuracy = 0.03 deg (PPK) / 0.05 deg (RTK)
- Pitch & Roll accuracy = 0.006 deg (PPK) / 0.08 deg (RTK)
- High precision dual antenna GNSS receiver
- Ideal solution for accurate point clouds
- Small Size, light weight
- Affordable price
- Compatible with LIDAR, Optical camera
- Applications: flight control, remote sensing, photogrammetry





GPS-Aided INS-D/DL-OEM Datasheet Rev. 3.8

The **Inertial Labs GPS-Aided Inertial Navigation System (INS-D/DL-OEM)** is OEM version of new generation, dual GNSS antenna, fully-integrated, combined GPS, GLONASS, GALILEO and BEIDOU GNSS and high-performance strapdown system, that determines position, velocity and absolute orientation (Heading, Pitch and Roll) for any device on which it is mounted. Horizontal and Vertical Position, Velocity, Dual Antenna Heading, Pitch & Roll are determined with high accuracy for both motionless and dynamic applications.



The Inertial Labs **INS-D/DL-OEM** utilizes advanced dual antenna GNSS receiver, 3-axes each of calibrated in full operational temperature range Advanced MEMS Accelerometers and new generation of tactical grade MEMS Gyroscopes to provide accurate Position, Velocity, Heading, Pitch and Roll of the device under measure.

INS-D/DL-OEM contains Inertial Labs new on-board sensors fusion filter, state of the art navigation and guidance algorithms and calibration software.

KEY FEATURES, BENEFITS & FUNCTIONALITY

- Commercially exportable Dual Antenna GPS-Aided Inertial Navigation System
- 85.5 x 47.7 x 40 mm size and 174 (or 184) grams in mass. Full temperature calibration of all sensing elements
- Industrial & Tactical-grade IMU (1 3 deg/hr gyroscopes Bias in-run stability)
- GPS, GLONASS, BEIDOU, SBAS, DGPS, RTK supported signals
- Up to 0.05 deg Heading and 0.08 deg Pitch & Roll accuracy
- Compatibility with LiDARs and Optical Cameras for remote sensing applications
- Up to 200 Hz INS, up to 2000 Hz IMU, up to 100 Hz GNSS positions and GNSS measurements data rate
- Advanced, extendable, embedded Kalman Filter based sensor fusion algorithms
- State-of-the-art algorithms for different dynamic motions of Vessels, Ships, Helicopters, UAV, UUV, UGV, AGV, ROV, Gimbals and Land Vehicles
- Implemented ZUPT, GNSS tracking angle features

INS-D-OEM and INS-DL-OEM performance during GNSS outages

Model	Outage duration	Mode	Position (meters	accuracy s, RMS)	Velocity a (meters/se		Attitude accuracy (degree, RMS)			
	uuration		Horizontal	Vertical	Horizontal	Vertical	Pitch, Roll	Heading*		
		RTK	0.01 + 1ppm	0.02 + 1ppm	0.02	0.01	0.015	0.05		
\sqsubseteq	0 sec	SP	1.2	1.0	0.03	0.02	0.08	0.08		
INS-D-OEM		PP	0.005	0.01	0.02	0.01	0.006	0.03		
	60 sec	RTK	7	2	0.3	0.1	0.05	0.08		
		SP	8	3	0.3	0.1	0.1	0.1		
		PP	0.3	0.2	0.03	0.05	0.01	0.05		
-DL- :M	0 sec	RTK	0.01 + 1ppm	0.02 + 1ppm	0.05	0.05	0.09	0.2		
	U SEC	SP	1.2	1.0	0.06	0.06	0.1	0.3		
INS-DL OEM	60 sec	RTK	8	3	0.5	0.4	0.06	0.3		
I	oo sec	SP	9	4	0.6	0.5	0.15	0.4		

^{* 2} meters baseline

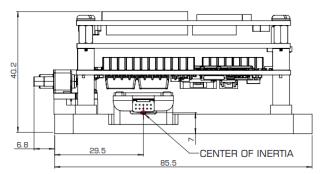
Specifications

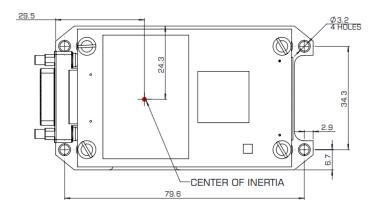
	Parameter	Units	Lov	INS-DL-OEM cost dual ante	enna	High	INS-D-OEM precision dual an	tenna	
General	Input signals		Marine application: DVL (Doppler Velocity Log) Land application: Odometer, Wheel sensor, Encoder, DMI Aerial application: Wind sensor, Air Speed Sensor, Doppler shift from locator (for long-term GPS denied) All: External Stand-Alone Magnetic Compass (SAMC/AHRS)						
	Output signals		Horizontal and Vertical Positions, Heading, Pitch & Roll, Velocity, Accelerations, Angular rates Barometric data, PPS Direct AT_ITINS message with Position, Heading, Pitch & Roll to COBHAM AVIATOR UAV 200 Direct Navigation Support for Pixhawk Flight Controllers as NMEA messages					,	
Ge	Main features		Du	Affordable price al antenna Head cm RTK position	ing	High precision dual antenna Heading, 1 cm RTK position, Tactical-grade IMU			
	Data rate (INS)	Hz	Up	to 200 (user setta	able)	Up to 200 (user settable)			
	Data rate (IMU)	Hz	Up to 2000 (user settable)			Up to 2000 (user settable)			
	Start-up time	sec		<1			<1		
	Positions, Velocity and Timestamps	Units		INS-DL-OEM		INS-D-OEM			
	Horizontal position accuracy (SP, L1), RMS	meters		1.5		1.5			
l	Horizontal position accuracy (SP, L1/L2), RMS Horizontal position accuracy (SBAS), RMS (1)	meters		1.2 0.6		1.2 0.6			
Ē	Horizontal position accuracy (DGPS), RMS	meters		n/a			0.4		
.2	Horizontal position accuracy (TerraStar-L) (2)	meters	n/a				0.4		
at	Horizontal position accuracy (TerraStar-C PRO) (2)	meters		n/a			0.025		
Navigation	Horizontal position accuracy (TerraStar-X) (2) Horizontal position accuracy (post processing) (3)	meters meters		n/a 0.005			0.02 0.005		
>	Horizontal position accuracy (post processing) (Fig. 4)	meters		0.003 0.01 + 1 ppm CE	P		0.01 + 1 ppm		
ž	Vertical position accuracy (SP), RMS	meters	<2				<1		
_	Vertical position accuracy (RTK), RMS	meters	0.02 + 1 ppm CEP				0.02 + 1 ppm		
Ų	Velocity accuracy, RMS PPS timestamps accuracy	meters/sec	0.05				0.02 20		
		nano sec							
	Heading	Units	INS-DL-OEM			INS-D-OEM			
_	Range Static Accuracy (4)	deg	0 to 360			0 to 360 0.15 (1 meter base line)			
6	Dynamic accuracy (GNSS) (7)	deg RMS, 1σ deg RMS, 1σ	0.4 (1 meter base line) 0.2 (2 meters baseline)			0.15 (1 meter base line) 0.08 (2 meters baseline)			
#	Post processing accuracy (3)	deg RMS, 1σ	0.1			0.03 (2 meters baseline)			
Orientation	Pitch and Roll	Units	INS-DL-OEM			INS-D-OEM			
i i	Range: Pitch, Roll	deg	±90, ±180			±90, ±180 0.01			
<u>¥</u> .	Angular Resolution Static Accuracy in whole Temperature Range	deg deg		0.01		0.01			
ō	Dynamic Accuracy (7)	deg RMS		0.04		0.03			
	Post processing accuracy (3)	deg RMS		0.01		0.006			
	GNSS receiver	Units		uBlox			NovAtel		
	Number of GNSS Antennas			Dual			Dual		
S			CDC L1C/A L2	C. GLO L10F L20	OF, GAL E1B/C		, L2C, L2P, L5; GLC	NASS L1 C/A, L2 , B2I, B2a, B3I;	
S	Supported GNSS signals & corrections (optional)		E5b, BDS B	11 B2I, QZSS L1C, AAS, EGNOS, MS		Galileo E1, E5 A L5; SBAS L1, L5	tBOC, E5a, E5b, E6; ; QZSS L1 C/A, L1C	C, L2C, L5, L6; L-	
SSN	Channel configuration (5)		E5b, BDS B L1C/A: W	11 B2I, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er	AS, GAGAN	Galileo E1, E5 A L5; SBAS L1, L5	ItBOC, E5a, E5b, E6; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels	C, L2C, L5, L6; L-	
GNSS	Channel configuration ⁽⁵⁾ GNSS Positions data rate ⁽⁶⁾	Hz	E5b, BDS B L1C/A: W	1l B2l, QZSS L1C, AAS, EGNOS, MSA channels – F9 er 10, 20 (10)	AS, GAGAN	Galileo E1, E5 A L5; SBAS L1, L5 Band	ItBOC, E5a, E5b, E6 ; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100	C, L2C, L5, L6; L- DGPS;	
GNSS	Channel configuration ⁽⁵⁾ GNSS Positions data rate ⁽⁶⁾ RTK corrections		E5b, BDS B L1C/A: W	1l B2l, QZSS L1C, AAS, EGNOS, MSA channels – F9 er 10, 20 (10) RTCM 3	AS, GAGAN	Galileo E1, E5 A L5; SBAS L1, L5 Band	ItBOC, E5a, E5b, E6 ; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100 RTCM 2.1/2.3/3.0/3	C, L2C, L5, L6; L- DGPS;	
GNSS	Channel configuration ⁽⁵⁾ GNSS Positions data rate ⁽⁶⁾	Hz	E5b, BDS B L1C/A: W	1l B2l, QZSS L1C, AAS, EGNOS, MSA channels – F9 er 10, 20 (10)	AS, GAGAN	Galileo E1, E5 A L5; SBAS L1, L5 Band	ItBOC, E5a, E5b, E6 ; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100	C, L2C, L5, L6; L- DGPS;	
GNSS	Channel configuration ⁽⁵⁾ GNSS Positions data rate ⁽⁶⁾ RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time	Hz meters/sec Sec	E5b, BDS B L1C/A: W/	11 B2I, QZSS L1C, AAS, EGNOS, MS, channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (ho	AS, GAGAN agine	Galileo E1, E5 A L5; SBAS L1, L5 Band	ItBOC, E5a, E5b, E6; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot	., L2C, L5, L6; L ² DGPS; .1	
SSND	Channel configuration ⁽⁵⁾ GNSS Positions data rate ⁽⁶⁾ RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS	Hz meters/sec Sec nano sec	E5b, BDS B L1C/A: W/	11 B2I, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (ho	AS, GAGAN agine	Galileo E1, E5 A L5; SBAS L1, L5 Band	ItBOC, E5a, E5b, E6; ; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100 tTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot	., L2C, L5, L6; L- DGPS; .1	
GNSS	Channel configuration ⁽⁵⁾ GNSS Positions data rate ⁽⁶⁾ RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time	Hz meters/sec Sec	E5b, BDS B L1C/A: W/	11 B2I, QZSS L1C, AAS, EGNOS, MS, channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (ho	AS, GAGAN agine	Galileo E1, E5 A L5; SBAS L1, L5 Band	ItBOC, E5a, E5b, E6; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot	., L2C, L5, L6; L ² DGPS; .1	
GNSS	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type	Hz meters/sec Sec nano sec Units	E5b, BDS B L1C/A: W. 184 <29 (c	11 B2I, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade	as, GAGAN agine bt start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	itiBOC, E5a, E5b, E6 ; QZSS L1 C/A, L1c up to 5 channels; I 555 Channels Up to 100 ETCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade	.1 (12C, L5, L6; L-12C) .1 (12C) start)	
GNSS	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range	Hz meters/sec Sec nano sec Units	E5b, BDS B L1C/A: W. 184 <29 (c	11 B2I, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM	as, GAGAN agine bt start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	ItBOC, E5a, E5b, E6; ; QZSS L1 C/A, L1C up to 5 channels; I 555 Channels Up to 100 tTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM	.1 (2C, L5, L6; L-6) DGPS; .1 (start)	
GNSS	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RNS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance)	Hz meters/sec Sec nano sec Units deg/sec deg/hr	E5b, BDS B L1C/A: W. 184 <29 (c	11 BZI, QZSS L1C, AAS, EGNOS, MS, channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) Sold start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±20 3	as, GAGAN agine bt start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	ItBOC, E5a, E5b, E6; QZSS L1 C/A, L1C up to 5 channels; S55 Channels Up to 100 ctrow 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±200 1	.1 (2C, L5, L6; L-6) DGPS; .1 (start)	
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg//hr	E5b, BDS B L1C/A: W. 184 <29 (c	11 BZI, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-0EM Industrial-grade 450 / ±950 / ±2C 3 <50 <0.3	as, GAGAN agine bt start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 05 5 channels; 1 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±200 <0.2 <0.2	.1 L2C, L5, L6; L- DGPS; .1	
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RNS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr	E5b, BDS B L1C/A: W. 184 <29 (c	11 BZI, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±20	ot start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	LtBOC, E5a, E5b, E6; ; QZSS L1 C/A, L1v pt o 5 channels; up to 5 channels; Up to 100 TO 100 TO 100 CO 30 Cold start), 20 (hot 20 TO 1NS-D-OEM Tactical-grade -450 / ±950 / ±200 1 CO 2 INS-D-OEM	.1 (2C, L5, L6; L-6) DGPS; .1 (start)	
IMU GNSS	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/r/hr Units	E5b, BDS B L1C/A: W. 184 <29 (c	11 BZI, QZSS L1C, AAS, EGNOS, MS, channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <0.3 INS-DL-OEM Industrial-grade INS-DL-OEM Industrial-grade INS-DL-OEM Industrial-grade INS-DL-OEM Industrial-grade INS-DL-OEM Industrial-grade Industrial-grade Industrial-grade Industrial-grade	AS, GAGAN Igine ot start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	(tBOC, E5a, E5b, E5 ; QZSS L1 C/A, L1C up to 5 channels; 1 555 Channels Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade: 450 / ±950 / ±200 <0.2 INS-D-OEM Tactical-grade:	, L2C, L5, L6; L- DGPS; .1 .start)	
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RNS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg//hr	E5b, BDS B L1C/A: W. 184 <29 (c	11 BZI, QZSS L1C, AAS, EGNOS, MS/ channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±20	ot start)	Galileo E1, E5 A L5; SBAS L1, L5 Band F	LtBOC, E5a, E5b, E6; ; QZSS L1 C/A, L1v pt o 5 channels; up to 5 channels; Up to 100 TO 100 TO 100 CO 30 Cold start), 20 (hot 20 TO 1NS-D-OEM Tactical-grade -450 / ±950 / ±200 1 CO 2 INS-D-OEM	.1 (12C, L5, L6; L-12C) .1 (12C) start)	
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (6) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Ressurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS)	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr deg/yhr Units g mg mg	= 8 g 0.01 0.7	11 BZI, QZSS L1C, AAS, EGNOS, MS, channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C <0.3 INS-DL-OEM Industrial-grade ±15 g 11 S Q 0.03 1.1	25, GAGAN Ingine Dot start) 2000 240 g 20.05 1.5	Galileo E1, E5 A L5; SBAS L1, L5 Band F 39 (c	itBOC, E5a, E5b, E5 ; q ZSS L1 C/A, L1C up to 5 channels; to 555 Channels up to 100 ctCM 2.1/2.3/3.0/3 Up to 100 ctCM 2.1/2.3/3.0/3 Up to 100 ctCM 2.003 cold start), 20 (hot 20 INS-D-OEM Tactical-grade c450 / ±950 / ±200 1 c30 c0.2 INS-D-OEM Tactical-grade ±15 g 0.02 0.7		
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range Measurement range Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/vhr Units g mg mg	±8 g 0.01 0.7 1.5	11 BZJ, QZSS L1C, AAS, EGNOS, MS/ Channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30) INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <50 <0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0	#40 g 0.05 1.5 2.5	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L1c up to 5 channels; 1 555 Channels Up to 100 ETCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±20c 1 <30 <0.2 INS-D-OEM Tactical-grade ±15 g 0.02 0.7 1.3		
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/vhr Units g mg mg mg m/s/v/hr	= 8 g 0.01 0.7	11 BZJ, QZSS L1C, AAS, EGNOS, MS/ Channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30) INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <50 <0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.11 2.0 0.045	25, GAGAN Ingine Dot start) 2000 240 g 20.05 1.5	Galileo E1, E5 A L5; SBAS L1, L5 Band F 39 (c	LtBOC, E5a, E5b, E5 ; QZSS L1 C/A, L1C up to 5 channels; 1 555 Channels Up to 100 <0.03 COM 20, 0.03 CM 2		
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/vhr Units g mg mg mg m/s/v/hr Units	±8 g 0.01 0.7 1.5	11 BZJ, QZSS L1C, AAS, EGNOS, MS/ channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hd 30) INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <s0 0.03="" 0.045="" 1.1="" 2.0="" <0.3="" g="" industrial-grade="" ins-dl-oem="" ins-dl-oem<="" td="" ±15=""><td>#40 g 0.05 1.5 2.5</td><td>### ### ### ### ### ### ### ### ### ##</td><td>LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 0 5 channels; 1 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±20(1 <30 <0.2 INS-D-OEM Tactical-grade ±15 g 0.02 0.7 1.3 0.035 INS-D-OEM</td><td></td></s0>	#40 g 0.05 1.5 2.5	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 0 5 channels; 1 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±20(1 <30 <0.2 INS-D-OEM Tactical-grade ±15 g 0.02 0.7 1.3 0.035 INS-D-OEM		
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr deg/hr Units g mg mg mg mg tog ms/s/vhr Units deg C	±8 g 0.01 0.7 1.5	11 BZI, QZSS L1C, AAS, EGNOS, MS/ Channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <s50 0.03="" 0.045="" 1.1.1="" 2.0="" <0.3="" g="" industrial-grade="" ins-dl-oem="" ins-dl-oem<="" td="" ±15=""><td>#40 g 0.05 1.5 2.5</td><td>### ### ### ### ### ### ### ### ### ##</td><td>LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 05 5 channels; Up to 5 channels; Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 Cold start), 20 (hot 20 INS-D-OEM Tactical-grade +450 / ±950 / ±200 Tactical-grade ±15 9 0.02 0.7 1.3 0.035 INS-D-OEM Tactical-grade -440 to +75</td><td></td></s50>	#40 g 0.05 1.5 2.5	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 05 5 channels; Up to 5 channels; Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 Cold start), 20 (hot 20 INS-D-OEM Tactical-grade +450 / ±950 / ±200 Tactical-grade ±15 9 0.02 0.7 1.3 0.035 INS-D-OEM Tactical-grade -440 to +75		
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (6) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr deg/vhr Units g mg mg mg my // hr Units deg C deg C	±8 g 0.01 0.7 1.5	11 BZI, QZSS L1C, AAS, EGNOS, MS, channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 0.05 0.05 0.05 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 3 <50 <0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0 0.045 INS-DL-OEM	#40 g 0.05 1.5 2.5	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E5 Lt C/A, L1C up to 5 channels; 555 Channels Up to 100 < COMBINE Up to 100 COMBINE Up t		
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature MTBF	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr deg/hr Units g mg mg mg mg tog ms/s/vhr Units deg C	±8 g 0.01 0.7 1.5	11 BZI, QZSS L1C, AAS, EGNOS, MS/ Channels – F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <s50 0.03="" 0.045="" 1.1.1="" 2.0="" <0.3="" g="" industrial-grade="" ins-dl-oem="" ins-dl-oem<="" td="" ±15=""><td>#40 g 0.05 1.5 2.5</td><td>### ### ### ### ### ### ### ### ### ##</td><td>LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 05 5 channels; Up to 5 channels; Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 Cold start), 20 (hot 20 INS-D-OEM Tactical-grade ±15 9 0.02 0.7 1.3 0.035 INS-D-OEM Tactical-grade ±15 9 0.02 0.7 1.3 0.035 INS-D-OEM -40 to +75</td><td></td></s50>	#40 g 0.05 1.5 2.5	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 05 5 channels; Up to 5 channels; Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 <0.03 Cold start), 20 (hot 20 INS-D-OEM Tactical-grade ±15 9 0.02 0.7 1.3 0.035 INS-D-OEM Tactical-grade ±15 9 0.02 0.7 1.3 0.035 INS-D-OEM -40 to +75		
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature MTBF	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr Units g mg mg mg deg mg mg mg my John Units deg C deg C deg C hours V DC	±8 g 0.01 0.7 1.5 0.02	11 BZI, QZSS L1C, AAS, EGNOS, MS, channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 (±950 / ±2C 0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0 0.045 INS-DL-OEM INS-DL-OEM INS-DL-OEM INS-DL-OEM INS-DL-OEM INS-DL-OEM INS-DL-OEM INS-DL-OEM INS-DL-OEM 9-36	#40 g 0.05 1.5 2.5 0.06	#8 g 0.005 0.5 1.0 0.015	LEBOC, E5a, E5b, E6 , QZSS L1 C/A, L1C up to 5 channels; Up to 100 ETCM 2.1/2.3/3.0/3 Up to 100 ETCM 2.1/2.3/3.0/3 Up to 100 -0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±200 -30 -<0.2 INS-D-OEM Tactical-grade -15 g -0.02 -0.7 -1.3 -0.035 INS-D-OEM -40 to +75 -50 to +85 -55,500 INS-D-OEM -9 -36	.1	
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature MTBF	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr deg//hr Units g mg mg mg mg complete the second se	±8 g 0.01 0.7 1.5 0.02	11 BZJ, QZSS L1C, AAS, EGNOS, MS/ Channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 3 <50 <0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0 0.045 INS-DL-OEM -40 to +75 -50 to +85 55,500 INS-DL-OEM 9 - 36 (6 with data logq	#40 g 0.05 1.15 2.5 0.06	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E5 Lt (7A, L1c y to 5 channels; 1 555 Channels Up to 100 TCM 2.1/2.3/3.0/3 Up to 100 <.0.03 cold start), 20 (hot 20 INS-D-OEM Tactical-grade ±15 g 0.02 INS-D-OEM Tactical-grade ±15 g 0.02 0.7 1.3 0.035 INS-D-OEM Tactical-grade -40 to +75 -50 to +85 55,500 INS-D-OEM 9 - 36 (6 with data logge		
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature MTBF	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr Units g mg mg mg deg mg mg mg my John Units deg C deg C deg C hours V DC	±8 g 0.01 0.7 1.5 0.02	11 BZJ, QZSS L1C, AAS, EGNOS, MS/ Channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <50 <0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0 0.045 INS-DL-OEM -40 to +75 -50 to +85 55,500 INS-DL-OEM 9 - 36 (6 with data logg 2-23 or RS-422, K	#40 g 0.05 1.5 2.5 0.06	### ### ### ### ### ### ### ### ### ##	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 0 5 channels; l pt 0 5 channels; l 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 C0.03 Cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±200 Tactical-grade -450 / ±950 / ±200 INS-D-OEM Tactical-grade -410 / 500 Tactical-grade -420 / 500 Tacti		
IMU	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature MTBF	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr Units g mg mg mg complete the complete	±8 g 0.01 0.7 1.5 0.02	11 BZI, QZSS L1C, AAS, EGNOS, MS, channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 010 start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 (±950 / ±2C 0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0 0.045 INS-DL-OEM 9-36 (6 with data logg, c232 or RS-422,	#40 g 0.05 1.5 2.5 0.06	#8 g 0.005 0.015	(180C, E5a, E5b, E6 (20	±40 g 0.03 1.2 1.5 0.045	
	Channel configuration (5) GNSS Positions data rate (6) RTK corrections RTK corrections GNSS Measurements (raw) data rate Velocity accuracy, RMS Initialization time Time accuracy (dock drift) (8) Gyroscopes Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Angular Random Walk Accelerometers Type Measurement range Measurement range Measurement range (RMS) Angular Random Walk Accelerometers Type Measurement range Bias in-run stability (RMS, Allan Variance) Bias error over temperature range (RMS) Bias one-year repeatability Velocity Random Walk Environment Operating temperature Storage temperature MTBF	Hz meters/sec Sec nano sec Units deg/sec deg/hr deg/hr Units g mg mg mg mg deg mg mg ms/s/Vhr Units deg C deg C hours V DC Watts	±8 g 0.01 0.7 1.5 0.02	11 BZJ, QZSS L1C, AAS, EGNOS, MS/ Channels — F9 er 10, 20 (10) RTCM 3 10, 20 (10) 0.05 old start), <1 (hc 30 INS-DL-OEM Industrial-grade 450 / ±950 / ±2C 3 <50 <0.3 INS-DL-OEM Industrial-grade ±15 g 0.03 1.1 2.0 0.045 INS-DL-OEM -40 to +75 -50 to +85 55,500 INS-DL-OEM 9 - 36 (6 with data logg 2-23 or RS-422, K	±40 g 0.05 1.5 2.5 0.06	#8 g 0.005 0.015	LtBOC, E5a, E5b, E6 ; QZSS L1 C/A, L10 pt 0 5 channels; l pt 0 5 channels; l 555 Channels Up to 100 CTCM 2.1/2.3/3.0/3 Up to 100 C0.03 Cold start), 20 (hot 20 INS-D-OEM Tactical-grade -450 / ±950 / ±200 Tactical-grade -450 / ±950 / ±200 INS-D-OEM Tactical-grade -410 / 500 Tactical-grade -420 / 500 Tacti	±40 g 0.03 1.2 1.5 0.045	

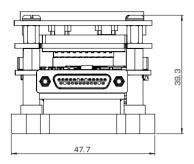
⁽¹⁾ GPS only; (2) Requires a subscription to a TerraStar data service; (3) RMS, incremental error growth from steady state accuracy. Post-processing results using third party software; (4) 2 meters base line between two GNSS antennas; (5) tracks up to 60 L1/L2 satellites; (8) 50 Hz while tracking up to 20 satellites. 20 Hz position update rate for Basic model of INS; (7) dynamic accuracy may depend on type of motion; (8) time accuracy does not include biases due to RF or antenna delay; (9) Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware. In bracket shown weight for a device in standard configuration with internal datalogger; (10) if tracking GPS only.



INS-D-OEM mechanical interface drawing (standard configuration)





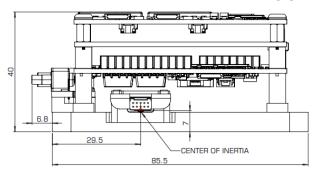


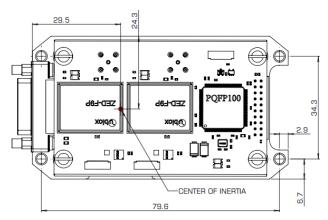
Device side: 25-pin connector MDSM-25PE-Z10-VR17

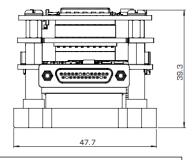
Notes:

- 1. All dimensions are in millimeters.
- 2. All dimensions within this drawing are subject to change without notice.
- Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.
- Please contact Inertial Labs, Inc. if you need the INS unit to be delivered in a custom configuration with customized connector and output data.

INS-DL-OEM mechanical interface drawing (standard configuration)







Device side: 25-pin connector MDSM-25PE-Z10-VR17

Notes:

- 1. All dimensions are in millimeters.
- 2. All dimensions within this drawing are subject to change without notice.
- 3. Weight and size are PN dependent. Customers should obtain the most recent 2D/3D files before designing any interface hardware.
- Please contact Inertial Labs, Inc. if you need the INS unit to be delivered in a custom configuration with customized connector and output data.

GPS-Aided INS-D/DL-OEM Datasheet Rev. 3.8

Product Code Structure:

Model	Gyroscope	Accel	Calibration	Connector	SAMC	Encoder	Data Logger	GNSS receiver	Version	Interface
INS-D-OEM	G450	A8	TGA	C4	SAMC (option)	E (option)	S64	07720	VD4	1
·	G950	A15	TMGA (Option)	C6				ZD9P	VD42	2
	G2000	A40		C8				WOR	VD43	3
			= '		-				VD44	4
									VD49	5
									VD9	11
										22
										145
										125
										245

Model	Gyroscope	Accel	Calibration	Connector	SAMC	Encoder	Data Logger	GNSS receiver	Version	Interface
INS-DL-OEM	G450	A8	TGA	C4	SAMC (option)	E (option)	S64	B482 (Obsolete)	VD9	1
	G950	A15	TMGA (Option)	C6				ZD9P		2
	G2000	A40		C8				WOR		3
			="		_					4
										5
										11
										22
										145
										125
										245

Product code details:

- INS-D-OEM: Dual Antenna GPS-Aided Inertial Navigation System
- INS-DL-OEM: Low cost Dual Antenna GPS-Aided Inertial Navigation System
- G450: Gyroscopes measurement range = ±450 deg/sec
- G950: Gyroscopes measurement range = ±950 deg/sec
- G2000: Gyroscopes measurement range = ±2000 deg/sec
- A8: Accelerometers measurement range = ±8 g -> recommended for applications with low level of operational vibrations
- A15: Accelerometers measurement range ±15 g -> recommended for applications with medium level of operational vibrations
- A40: Accelerometers measurement range ±40 g -> recommended for high dynamic applications or/and with high level of vibration
- TGA: Gyroscopes and Accelerometers
- TMGA: Magnetometers, Gyroscopes and Accelerometers
- C4: Aluminum Base Plate 26 pin header and ribbon cable (20021121-00026T4LF by Amphenol) (with available interfaces of: RS-232, RS-422, Ethernet and CAN)
- C6: Aluminum Base Plate 14 pin screw-lock connector (M80-5401442 by Harwin) (with available interfaces of: RS-232 and CAN, RS-422 and CAN, or Ethernet and CAN)
- C8: Aluminum Base Plate 25-pin micro D-SUB connector with screw lock (MDSM-25PE-Z10-VR17 by ITT Cannon) (with available interfaces of: RS-232, RS-422, Ethernet and CAN)
- SAMC: support of external Stand Alone Magnetic Compass (for RS-232; or RS-422; or RS-232 & RS-422 interfaces)
- E: Encoder support
- S64: 64GB embedded Data Logger (optional)
- O7720: Novatel OEM7720 dual antenna GNSS receiver (INS-D-OEM only)
- B482: Inertial Labs B482 dual antenna GNSS receiver (INS-DL-OEM only) OBSOLETE
- ZD9P: Dual ZED-F9P, Dual-Frequency, Multi-Constellation, RTK Capable GNSS Receiver
- · WOR: without GNSS receiver
- VD4: GPS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD42: GPS L1/L2, GLONASS L1/L2, Dual GNSS Heading, SBAS, DGPS, RTK, 20 Hz measurements, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD43: GPS L1/L2, GLONASS L1/L2, Dual antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD44: GPS L1/L2, GLONASS L1/L2, GALILEO E1B/C E5b Dual antenna Heading, SBAS, DGPS, 20 Hz positions (NovAtel Dual Antenna GNSS Receiver only)
- VD49: GPS L1/L2, GLONASS L1/L2, NavIC (IRNSS), Dual antenna Heading, SBAS, DGPS, 20 Hz positions; 20 Hz GNSS measurements (NovAtel Dual Antenna GNSS Receiver only)
- VD9: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2, GALILEO E1/E5, QZSS L1/L5, DGPS, RTK, Dual GNSS Heading, GNSS measurements, GNSS positions (Dual Antenna GNSS Receiver only)
- .1: RS-232 interface
- .2: RS-422 interface
- .3: RS-485 interface (temporary is not available)
- .4: CAN interface
- .5: Ethernet interface
- .11: two RS-232 interfaces (only available for C4 and C8 connectors)
- .22: two RS-422 interfaces (only available for C4 and C8 connectors)
- . .145: RS-232, CAN and Ethernet interfaces (with optional Encoder support) (only available for C4 and C8 connectors)
- . 125: RS-232, RS-422 and Ethernet interfaces (without optional Encoder support) (only available for C8 connectors)
- 245: RS-422, CAN and Ethernet interfaces (without Encoder support) (only available for C4 and C8 connectors)