

DynaCube™ – DC40-GD, TACTICAL GRADE

FEATURES

- Tacticle grade MEMS sensor employed (bias stability for gyro better than 5 deg/h; for accelerometer better than 1mg)
- Dual antenna to guarantee heading accuracy over 0.1°
- 0.05° RMS 3D attitude accuracy
- Embedded with MotionCore® Mini AHRS/IMU
- Embedded with a high performance dual band / dual SAT system satellite receiver (GPS L1 C/A, L2C, L2P(Y); GLONASS L1/L2; Galileo E1; WAAS / EGNOS / MSAS)
- High data rate up to 100Hz for position / velocity / attitude (roll, pitch, yaw) and other auxiliary inertial sensor signals
- Loosely coupled sensor fusion software based on proprietary EKF algorithm
- Low power consumption (< 3W)
- Rugged designed for harsh environment, IP66 waterproof
- Each unit fully compensated for temperature, non orthogonality, soft & hard iron and cross axis coupling errors



APPLICATIONS

- Aviation control system (UAV / Fixed-wing / Rotor, etc.)
- Ground vehicle control system (UGV, etc.)
- Surface vehicle control system (USV, etc.)
- Other applicable situations

GENERAL DESCRIPTION

DynaCube™ DC40-GD Mini GPS/INS is a highly sophisticated system measuring a rigid body's inertial properties, including position, speed, altitude (pitch, roll, yaw) and also the complete set of dynamic parameters (acceleration / angular speed). Its sensing principle is based on the state of MEMS technology (MEMS: Micro Electro Mechanical System). As a result of batch processing and standardization of MEMS technology, cost of the system has been significantly lowered compared to its counterpart using optical fiber technology while the performance is not being compromised.

The system is equipped with a powerful sensing unit core called MotionCore™. This core unit, with both all the MEMS

sensors & micro processor integrated into a ultra small form factor hardware platform, is running an embedded sensor fusion software based on Senlution’s proprietary EKF algorithm (EKF: Enhanced Kalman Filter).

DynaCube™ DC40 employs the top of the line MEMS inertial sensors. Particularly for the gyroscope and accelerometer, the performance level has reached the highest limit within the MEMS sensor domain, and it can be classified as “tactile grade”, a term which traditionally only applies to high end, very costly inertial sensors based on optical technology.

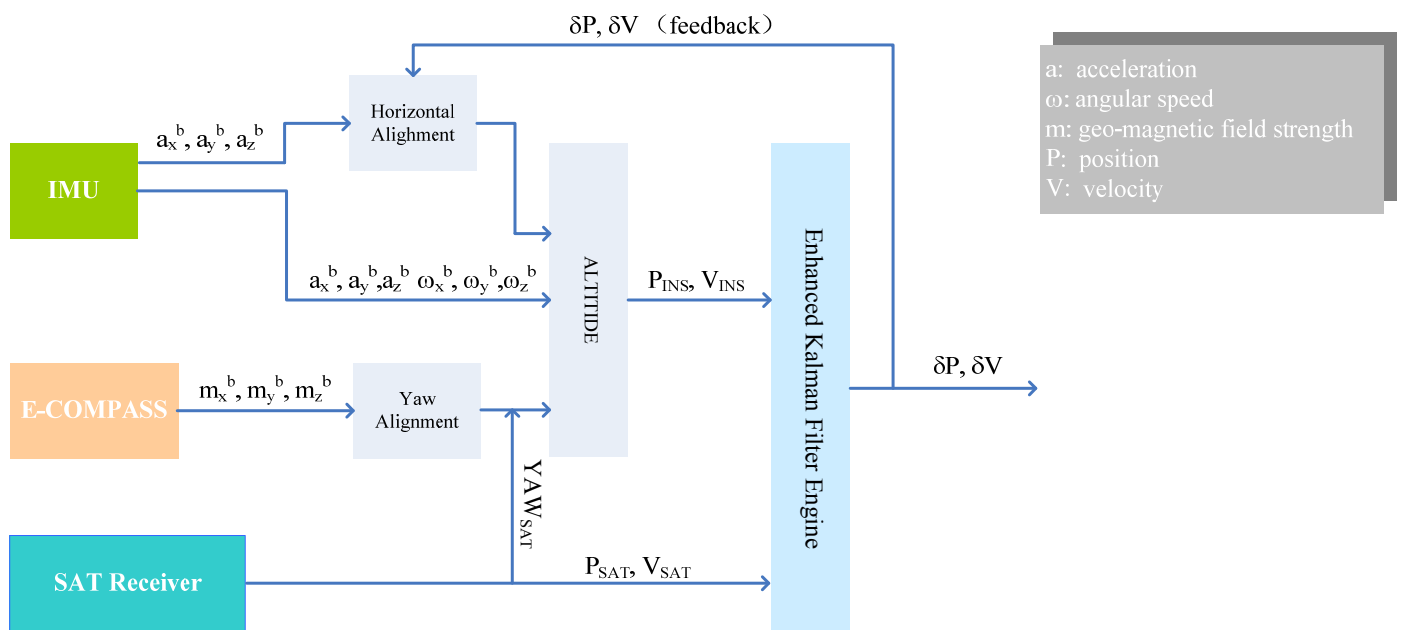
The system is also embedded with a highly accurate, highly reliable satellite receiver. This receiver unit works under both L1 and L2 frequency and is compatible with GPS or GLONASS dual system (GPS L1 C/A, L2C, L2P(Y); GLONASS L1/L2; Galileo E1; WAAS / EGNOS / MSAS). It has 226 channels and supports sub-meter level of accuracy using DGPS and even sub-millimeter level of accuracy using RTK. This receiver has been certified for MIL-STD810F and is highly resistant to EMC / vibration and shock up to 30G. A dual antenna hardware platform enables the system to achieve heading accuracy better than 0.1°.

The EKF based sensor fusion algorithm loosely couples data from satellite receiver and MotionCore™. In this way, errors introduced into the system by the inertial measurement sensors can be compensated, while reciprocally, the position / velocity can also be calculated only based on the inertial measurement during a short duration of satellite signal loss.

DynaCube™ DC40-GD is furnished with a standard RS-232 cable for data collection. The metal shell provides users with 6 alignment holes for installation and for electrically grounding.

DynaCube™ DC40-GD is suitable for applications ranging from aeronautics, aerospace , surface vessels, ground vehicles to other military or civil adaptations.

The following diagrams shows the basic hardware / software functions blocks and principles:



SPECIFICATIONS

1. Operating Conditions

Electrical	
Voltage Supply	9 – 18V
Current	≈ 600mA (when external antenna is connected)
Data Protocol	
Default	RS232
Optional	RS422; 10/100 Ethernet;
Update Rate	5Hz (uptown 100Hz)
Environment	
Temperature	-40 to +85°C
Water Proof Level	IP66
Mechanical	
Size	152mm X 152mm X 67mm
Weight	400g
Power Connector 1	ODU AMC SERIES 4PIN FEMALE (ODU PART#: G80YAR-P04WFG0-000L)
Data Connector 2	ODU AMC SERIES 7PIN FEMALE (ODU PART#: G80YAR-P07WCD0-000L)
Ant. Connector	ODU AMC SERIES SMA FEMALE (ODU PART#: G80YAR-FK1XJH0-00UL)
	Quantity: 2

2. Inertial Sensors Specifications:

	Accelerometer	Gyroscope	Magnetic Sensor
Principle	MEMS, Capacitive	MEMS, Vibrational	MEMS, AMR
Range	+/- 2g – 10g selectable	+/- 800 deg/s	+/- 2 Gauss
Noise (RMS)	0.2 mg	0.3 deg/s	0.5 mGauss
Offset Initial Error	< 0.8 mg	< 200 deg/hour	< 2 mGauss
Bias Stability	1 mg	5 deg/hour	
Non-linearity (%)	0.05	0.05	0.1
Bandwidth (Hz)	100	80	50

3. Satellite Receiver Specifications

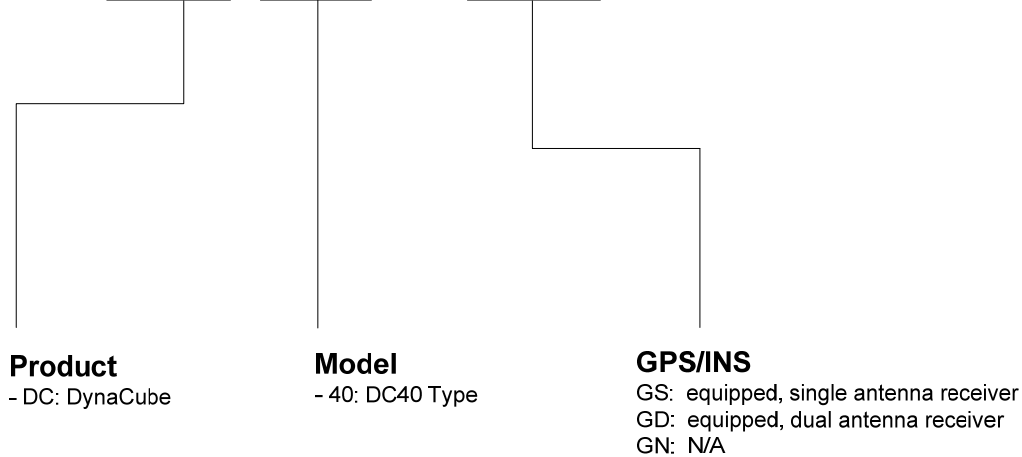
Satellite Tracking		
Channels		226
Signals	GPS	L1 C/A, L2C, L2 P(Y)
	GLONASS	L1 / L2
	SBAS	WAAS / MSAS / EGNOS
	Galileo	E1
Position Accuracy		
Autonomous L1/L2		horizontal: 1.2 m; vertical: 1.8m
DGPS		horizontal: 0.3 m; vertical: 0.5m
SBAS		horizontal: 0.8 m; vertical: 1.2m
RTK(Static)		horizontal: 1mm + 0.5ppm X baseline vertical: 2mm + 0.5ppm X baseline
RTK(Kinematic)		horizontal: 10mm + 1.0ppm X baseline vertical: 15mm + 1.0ppm X baseline
Ground Speed		0.02 m/sec
Timing		30 nsec
Electrical		
LNA Power		+4.75 to +5.10 VDC @ 0 - 140 mA
Environmental		
Vibration		4g sine wave(SAEJ1211); 7.7g random (MIL-STD 810F)

4. Altitude Computation Specifications :

Static Accuracy	
Pitch	$\pm 0.3^\circ$
Roll	$\pm 0.3^\circ$
Yaw	$\pm 0.1^\circ$ (sattellite attitude calculation valid)
Dynamic Accuracy	1.5° RMS
Resolution (RMS)	
Pitch	$\pm 0.05^\circ$
Roll	$\pm 0.05^\circ$
Yaw	$\pm 0.1^\circ$
Measurement Range	
Pitch	$\pm 90^\circ$
Roll	$\pm 180^\circ$
Yaw	$\pm 180^\circ$
Barometric Measurement	
Accuracy	100 Pa
Resolution	5 Pa
Range	0 – 110 kPa

ORDERING GUIDE

DC 40 - GD



The following products is now available from Senlution Technologies:

Model Name	SAT System	YAW from SAT	Band	Status
DC40-GN	N/A	N/A	N/A	Available
DC40-GS	GPS/GLONASS (BEIDOU Optional)	NO	L1 C/A, L2 C, L2 P(Y)	Available
DC40-GD	GPS/GLONASS (BEIDOU Optional)	YES (dual ant.)	L1 C/A, L2 C, L2 P(Y)	Q1, 2016 EDR

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Appendix 1 : Default RS232 Protocol (faster 100Hz BINARY data also available upon request)

Electrical Specifications:

- Baud Rate: 115200 / Data Bit: 8 / Stop Bit: 2 / Parity: none / Flow Control: none

Default Data Packet (Attn: do **NOT** send any data to the system after powering up)

NMEA0183- $\$$ GPHPD ASCII Message (non-standard and customized)

Format:

$\$$ GPHPD, GPSWeek, GPSTime, Heading, Pitch, Roll, Latitude, Longitude, Altitude, Speed, Track Angle, Position Status, Latitude-Base Station, Longitude-Base Station, Altitude-Base Station, Baseline, NSV1, NSV2*cs<CR><LF>

Output Data Rate: 5Hz

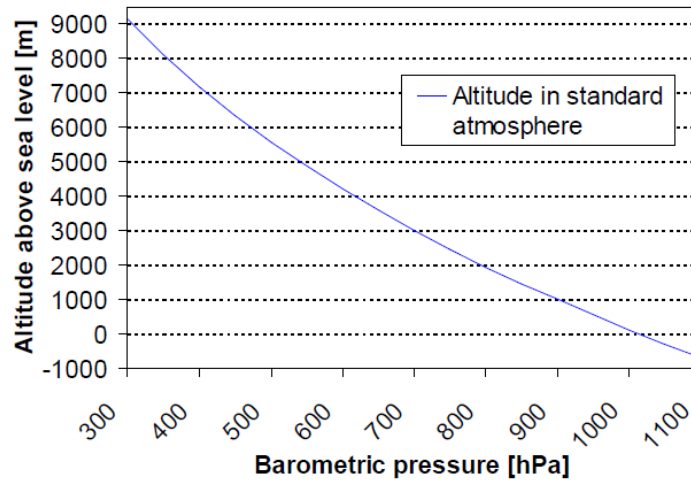
Name	Format	Example	Unit	Description
$\$$ GPHPD	string	$\$$ GPHPD		HPD message header
GPSWeek	numeric	1451		Number of weeks since 1980-01-06
GPSTime	numeric	368123.30	mSec	Current time within the current week
Heading	numeric	90.01	deg.	Yaw
Pitch	numeric	0.132	deg.	Pitch
Roll	numeric	90.11	deg.	Roll
Latitude	numeric	34.1966004	deg.	Latitude (WGS84)
Longitude	numeric	108.8551924	deg.	Longitude (WGS84)
Altitude	numeric	394.98	m	Elevation (WGS84)
Ve	numeric	-0.34	m/s	Speed towards the EAST
Vn	numeric	0.25	m/s	Speed towards the NORTH
Vu	numeric	-0.10	m/s	Speed towards the SKY
reserved				
reserved				
reserved				
Baseline	numeric	0.998	m	baseline length
NSV1	numeric	6		No. of available satellites
reserved		0		
cs	Hexadecimal	*0B		checksum
<CR> <LF>				

Appendix 2: Calculation of Altitude based on barometric sensor

DynaCube DC40-GD provides a “vent” hole which connects the inside air to the outside. When this feature is needed, user should uninstall the sealed screw so the inside barometric sensor is able to measure the atmosphere pressure directly. When the pressure reading is obtained, user may use the following equation to calculate the equivalent elevation:

$$\text{Altitude} = 44330 \times \left(1 - \left(\frac{p}{p_0} \right)^{\frac{1}{5.255}} \right)$$

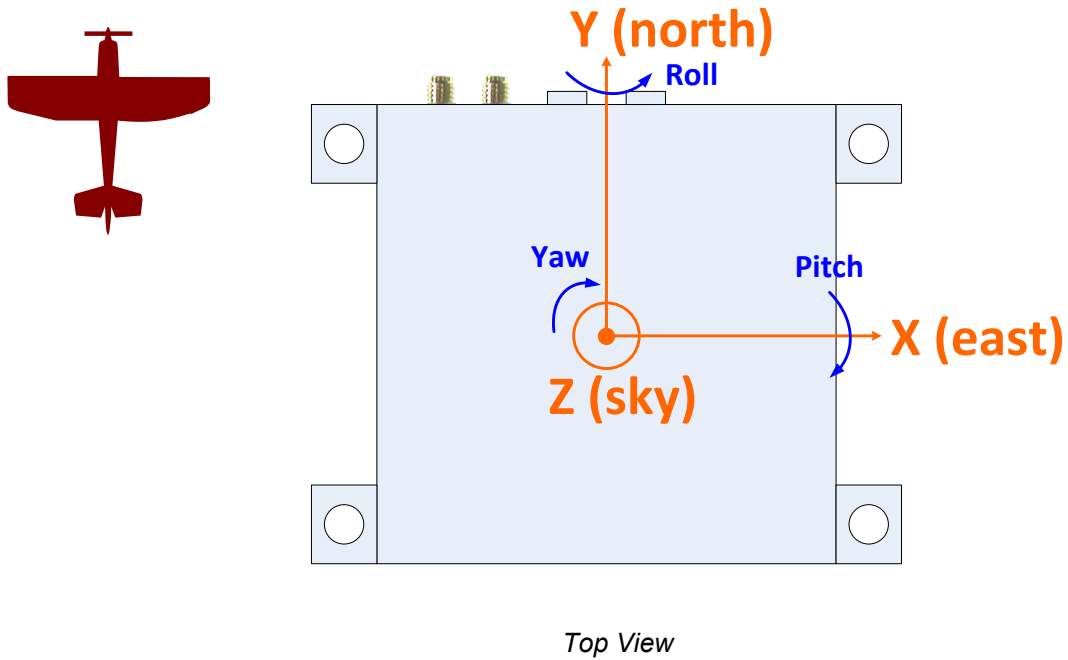
While p is the current pressure, in Pascal; p_0 is the sea level atmosphere pressure, equals 101325 Pascal.



Appendix 3: Coordinate Definition

The coordinate system used in DynaCube, is compatible with MotionCore product series, which follows the common “EAST, WEST, SKY” convention. The detailed orientation is as follows, the direction which the arrow shows is positive:

- Pitch: positive around +X axis (i.e. head-up is positive)
- Roll: positive around +Y axis (i.e. tilt right is positive)
- Yaw: positive around - Z axis (i.e. clockwise turning, looking from the top is positive)



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