Analog Technologies

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IMU/VG/AH/MINS

Digital Protocol

V3.0

Protocol

1 Data frame format : (8 data bits , 1 stop bit , No verification , Default rate 9600)

Identifier (1 byte)	Data length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (X byte)	Checksum (1 byte)
0×77					

Data format:
Hexadecimal
number Identifier:
fixed at 77
Data length: the length from data length to checksum (including data length and checksum) Address code: the address of the acquisition module, the default is 00
Data field: According to the different content and length of the command word, it changes accordingly. Checksum: The cumulative sum of data length, address code, command word and data field in hexadecimal notation (if there is a carry, only the last two digits are taken).
Note: When the command word or data field changes, the checksum will change. When you change the data field, please change the checksum.

2 Command format :

2.1 Read PITCH Pitch angle Send Command : 77 04 00 01 05

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0×77	0×04		0x01		0x05

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (3 byte)	Checksum (1 byte)
0×77	0×07		0x81	SXXX.YY	

Note: The data field is a 3-byte return angle value, which is a compressed BCD code, S is the sign bit (0 positive, 1 negative), XXX is a three-digit integer value, and YY is a two-digit decimal value.
If the return value is 77 07 00 81 10 34 63 2F, the pitch angle data is "10 34 63", which means "-34.63 degrees".

2.2 Read ROLL angle send command : 77 04 00 02 06

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0×77	0×04		0x02		0x06

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0x07		0x82	SXXX.YY	

Note: The data field is a 3-byte return angle value, which is a compressed BCD code, S is the sign bit (0 positive, 1 negative), XXX is a three-digit integer value, and YY is a two-digit decimal value.
If the return value is 77 07 00 82 01 23 57 04, the roll angle data is "01 23 57", which means "123.57 degrees".

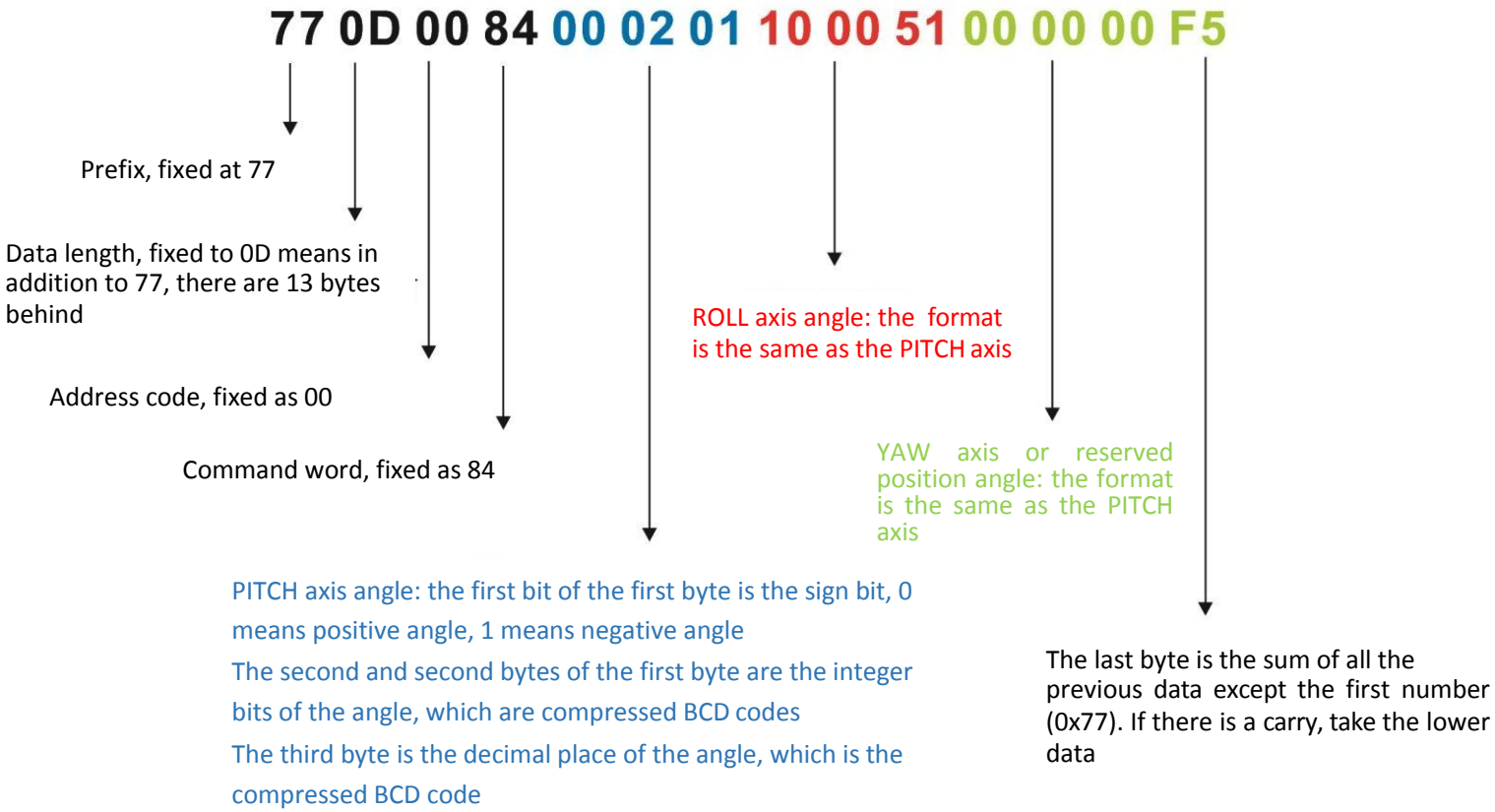
2.3 Read PITCH、ROLL Axis angle Send command：77 04 00 04 08

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (0 byte)	Checksum (1 byte)
0×77	0x04		0x04		

Answer Command：

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data field (1 byte)	Checksum (1 byte)
0×77	0x0D		0x84	3 groups SXXX.YY	

Pitch axis: +2.01°， ROLL axis: -0.51°，YAW axis: 0.00°



2.4 Set communication rate Send Command : 77 05 00 0B 02 12

Identifier (1 byte)	Date Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x0B	XX	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data Area (1 byte)	Checksum (1 byte)
0x77	0x05		0x8B	0x00: success 0xFF: failure	

Note: 0x00 means 2400, 0x01 means 4800, 0x02 means 9600, 0x03 means 19200, 0x04 means 115200, 0x05 means 38400, 0x06 means 57600, 0x07 means 460800, the default value is 0x02: 9600, each time the communication baud rate is successfully changed, the response command will be sent back at the original baud rate, and then the device communication baud rate will be changed immediately.
Note: If you need high frequency output, please set the baud rate to 115200 or 460800. Modifying the baud rate does not need to send a save command, it will take effect immediately.

2.5 Set module address Send command : 77 05 00 0F 01 15

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05	Correct address	0x0F	New address	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05	New address	0x8F	0x00: success 0xFF: failure	

Note: For example, the following command "77 05 00 0F 0A 1E" means to change the address of the product from hexadecimal address 00 to 0A.

2.6 Inquiry current address Send command : 77 04 00 1F 23

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04	0x00	0x1F		0x23

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05	Current address	0x1F	Current address	

Note: The query address command fixes this command.

2.7 Save setting send command : 77 04 00 0A 0E

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x0A		

Answer Command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x8A	0x00: success 0xFF: failure	

Note: Setting the baud rate does not need to save the settings, other setting items need to be sent to save the settings. The sensor save operation will last for 3-5 seconds, during which the power cannot be cut off.

2.8 Set zero type Send command : 77 05 00 05 01 0B

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x05	0x00: absolute zero point 0x01: Relative zero	

Answer Command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x85		

2.9 Inquiry zero type Send command : 77 04 00 0D 11

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x0D		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x8D	0x00: absolute zero point 0xFF: Relative zero	

2.10 Inquiry the value of gravity acceleration g Send command : 77 04 00 54 58

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x54		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (9 byte)	Checksum (1 byte)
0x77	0x0D		0x54	3 group SXXX.YY	

Note: The data field part is the g value of pitch, roll, and Z axis (vertical horizontal plane), which is composed of 1 sign bit + 1 integer bit + 4 decimal places.

If the return value is "77 0D 00 54 00 01 07 00 94 21 10 06 30 64", they are 0.0107g, 0.9421g, -0.0630g, respectively.

2.11 Inquiry angular velocity Send command : 77 04 00 50 54

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x50		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (9 byte)	Checksum (1 byte)
0x77	0x0D		0x50	3group SXXX.YY	

Note: The data field part is the angular velocity of pitch, roll, and Z axis (vertical horizontal plane), which is composed of 1 sign bit + 3 integer bits + 2 decimal places.

For example, the return value is "77 0D 00 50 10 93 76 14 98 87 00 14 03 C0", the data field part is respectively: pitch axis angular velocity: -93.76°/s,

Angular velocity of roll axis: -498.87°/s, angular velocity of Z axis: +14.03°/s.

2.12 Quaternion Send command : 77 04 00 57 5B

Identifier (1 byte)	Data Length (1 byte)	Across code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x57		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Across code (1 byte)	Command word (1 byte)	Data area (16 byte)	Checksum (1 byte)
0x77	0x14		0x57	4 group SXYYYYYY	

Note: The data field contains 16 bytes, 4 bytes as a group, respectively quaternion q0, q1, q2, q3, compressed BCD code, the format is SX YY YY YY,
S is the sign bit (0 is positive, 1 is negative), X is 1 integer, and YYYYYY is 6 decimal places.
For example, the return command 77 14 00 57 00 99 99 96 00 00 02 90 10 00 26 73 10 00 00 01 7F, the quaternary data are:
Where q0 is 00 99 99 96, which means 0.999996
q1 is 00 00 02 90, which means 0.000290
q2 is 10 00 26 73, which means -0.002673
q3 is 10 00 00 01, which means -0.000001

2.13 Read gyroscope and accelerometer at the same time Send command (IMU Series) :77 04 00 59 5D

Identifier (1 byte)	Data Length (1 byte)	Across code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		59	-	

Send command :

Identifier (1 byte)	Data Length (1 byte)	Across code (1 byte)	Command word (1 byte)	Data area (18 byte)	Checksum (1 byte)
0x77	0x16		0x84	Data area	

The data field contains 18 bytes, which are angular velocity and acceleration respectively, which are compressed BCD codes, and 3 bytes are a group. For example, the return value is
"77 16 00 84 10 93 76 12 98 87 00 14 03 00 01 07 00 94 21 10 06 30 FE"
The data domain parts are: X-axis angular velocity: -93.76°/s, Y-axis angular velocity: -298.87°/s, Z-axis angular velocity: +14.03°/s, X-axis acceleration: 0.0107g, Y-axis acceleration: 0.9421g , Z-axis acceleration: -0.0630g.

2.14 Read angle, accelerometer, gyroscope, quaternion at the same time (MINS VG Series) Send command : 77 04 00 59 5D

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x59	-	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (43 byte)	Checksum (1 byte)
0x77	0x2F		0x59	Data area	

The data field contains 43 bytes, which are angle, gravitational acceleration g value, angular velocity, quaternion, which is compressed BCD code, quaternion is the last 16 bytes, 4 bytes are one group, 4 groups in total, The rest is a group of 3 bytes, and the representation method is shown in the return value of the corresponding parameter. For example, the return value is:

77 2F 00 59 10 00 60 10 03 06 00 00 00
10 01 07 10 05 43 01 01 54
10 00 13 10 00 04 00 00 09
10 87 06 35 00 01 76 91 00 02 06 94 00 49 11 75 5C
Then: the three axis angles are -0.6 degrees, -3.06 degrees, and 0 degrees respectively; The g values of the three axes are -0.0107g, -0.0543g, 1.0154g;
The angular velocities of the three axes are -0.13°/s, -0.04°/s, 0.09°/s; The four quaternions are -0.870635 , 0.017691 , 0.020694 , 0.491175。

2.15 Read angle, acceleration, angular velocity, magnetic field value and quaternion at the same time Send command (AH Series): 77 04 00 59 5D

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x59		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (52 byte)	Checksum (1 byte)
0x77	0x38		0x59	-	

Note: The data field part contains 52 bytes, which are angle, acceleration g value, angular velocity, magnetic field value, quaternion, which are compressed BCD codes, quaternion is the last 16 bytes of the data part, four words The section is a group, a total of 4 groups, and the rest is a group of 3 bytes. For specific analysis methods, see the data field of each individual query return value.

Such as the return value: 77 38 00 59 10 13 15 00 25 58 02 51 87
10 18 07 10 28 16 01 02 65
10 06 48 01 24 13 00 03 88
01 59 62 01 63 91 14 14 58
10 22 83 75 10 18 33 49 10 16 55 78 00 93 99 14 58

Then: the three axis angles are: -13.15°, +25.58°, +251.
The g values of the three axes are: -0.1807g, -0.2816g, +1.0265g; The three-axis angular velocities are: -6.48°/s, +124.13°/s, +3.88°/s;
The three-axis magnetic field values are: +0.15962, +0.16391, -0.41458;

The quaternions are: -0.228375, -0.183349, -0.165578, 0.939914.

2.16 Automatic output data type selection Send command : 77 05 00 56 00 5B

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x56	XX	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x56	00	

Product Series	Output mode	Output data	Data form
VG MINS	0x00	Three-axis angle	Reference format2.3
	0x01	Three-axis acceleration	Reference format2.10
	0x02	Three-axis angular velocity	Reference format2.11
	0x03	Three-axis angle	Reference format2.3
	0x04	Quaternion	Reference format2.12
	0x05	Angle, acceleration, angular velocity, quaternion	Reference format2.14
IMU	0x00	Three-axis angular velocity	Reference format2.11
	0x01	Three-axis acceleration	Reference format2.10
	0x02	Angular velocity, acceleration	Reference format2.13
AH (Other modes are consistent with VG)	0x03	Triaxial magnetic field	Reference format2.23
	0x05	Angle, acceleration, angular velocity, magnetic field, quaternion	Reference format2.15

2.17 Set output frequency Send command : 77 05 00 0C 00 11

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x0C	XX	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x8C	0x00	

Note: The sent data field XX is an option of automatic output frequency:
00 means answer mode (default)
01 means 5Hz automatic output data 02 means 10Hz automatic output data 03 means 20Hz automatic output data 04 means 25Hz automatic output data 05 means 50Hz automatic output data 06 means 100Hz automatic output data
07 means 200Hz automatic output data 08 means 500Hz automatic output data
The automatic output data type is determined by the following data type selection command, and the default is to automatically output the three-axis angle.

2.18 Gyro calibration Send command : 77 04 00 52 56

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x52		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0xA5	0x01	

Note: When the sensor performs poorly in a dynamic environment or the angular velocity of the gyroscope is not at zero when it is stationary, this command can be sent to correct the gyroscope's zero offset.
This command can only be used when the sensor is absolutely stationary to obtain the best calibration effect.

2.19 Clear heading angle Send command : 77 04 00 82 86 (MINS series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x82	-	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0 byte)	Checksum (1 byte)
0x77	0x04		0x82	-	

Note: The program uses a manual command to clear the azimuth angle. After the command is sent, the program starts to recalculate the azimuth angle. The real-time calculated angle can be read by

the host computer.。

2.20 Relative angle setting Send command : 77 07 00 84 01 00 00 8C (MINS Series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (3 byte)	Checksum (1 byte)
0x77	0x07		0x84	-	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (3 byte)	Checksum (1 byte)
0x77	0x07		0x84	-	

Note: SX XX YY in the command is the BCD code, S is the sign bit (0 is positive, 1 is negative), XXX is three integer digits, and YY is two decimal places.
For example, the starting point of the sensor heading angle needs to be set to 100, then SX XX YY is 01 00 00. The corresponding complete command is 77 07 00 84 01 00 00 8C

2.21 Set magnetic declination Send command : 77 06 00 06 02 08 16 (AH Series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (2byte)	Checksum (1 byte)
0x77	0x06		0x06	SX XY	

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (2 byte)	Checksum (1 byte)
0x77	0x06		0x86	00	

nea ns X n in
Y means decimal. For example, 02 08 means +20.8°

2.22 Read magnetic declination Send command : 77 04 00 07 0B (AH series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x07		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (2 byte)	Checksum (1 byte)
0x77	0x06		0x87	SX XY	

Note: S means sign, 0 means positive and 1 means negative, XX means two-digit integer, and Y means decimal. For example, 02 08 means +20.8°

2.23 Read magnetic fields send command : 77 04 00 55 59 (AH series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x55		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (9 byte)	Checksum (1 byte)
0x77	0x0D		0x55	3group SYYYYY	

Note: S means sign, 0 means positive and 1 means negative; Y means decimal places, and the unit is Gauss.
For example, the return value is 77 0D 00 55 11 55 25 00 34 52 13 46 16 E2 represents: X axis: -0.15525, Y axis: 0.03452, Z axis: -0.34616.

2.24 Clear magnetic calibration data Send command : 77 04 00 10 14 (AH Series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x10		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x90	0x00	

Note: This command is used to clear the magnetic calibration data performed by the user.。

2.25 Start plane circumference calibration Send command : 77 04 00 11 15 (AH Series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x11		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x91	0x00	

Note: This command is used to clear the magnetic calibration data performed by the user.

2.26 Finish plane circumference calibration Send command : 77 04 00 12 16 (AH Series)

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (0byte)	Checksum (1 byte)
0x77	0x04		0x12		

Answer command :

Identifier (1 byte)	Data Length (1 byte)	Address code (1 byte)	Command word (1 byte)	Data area (1 byte)	Checksum (1 byte)
0x77	0x05		0x92	0x00	

Note: This command is used to clear the magnetic calibration data performed by the user.