IMU06

What is the IMU06?

The IMU06 is a compact 6 degree of freedom inertial measurement unit. It provides 3 axis acceleration (maximum 10G) and angular velocities (maximum 300 degrees/s) on both CAN and RS232 at user configurable data rates of up to 100Hz. The unit can also provide a timing pulse to indicate the moment at which the sample has been taken for data alignment purposes. It is available as both IP67 (IMU06WP) and IP55 (IMU06).

Figure 1: IMU06 general arrangement

Figure 2: IMU06WP general arrangement

Who is the IMU06 designed for?

The IMU06 is designed for vehicle dynamics testing applications, particularly for suspension or braking testing. It can also find application in a number of other position sensing applications such as stability control.

How does the IMU06 integrate in to an existing data logging system?

There are two output formats available on the IMU06, RS232 and CAN data. The RS232 data is formatted using the Race Technology data format, detailed in Appendix A. This data can be fed directly in to a Race Technology data logger such as the DL1 or DL2, alternatively it can be viewed directly on a PC or Race Technology display product.

The CAN data can be user configured to use any two CAN channel IDs. This data is transmitted at selectable rates of up to 100Hz.

Ordering information

IP55 version: IMU06
IP67 version: IMU06WP

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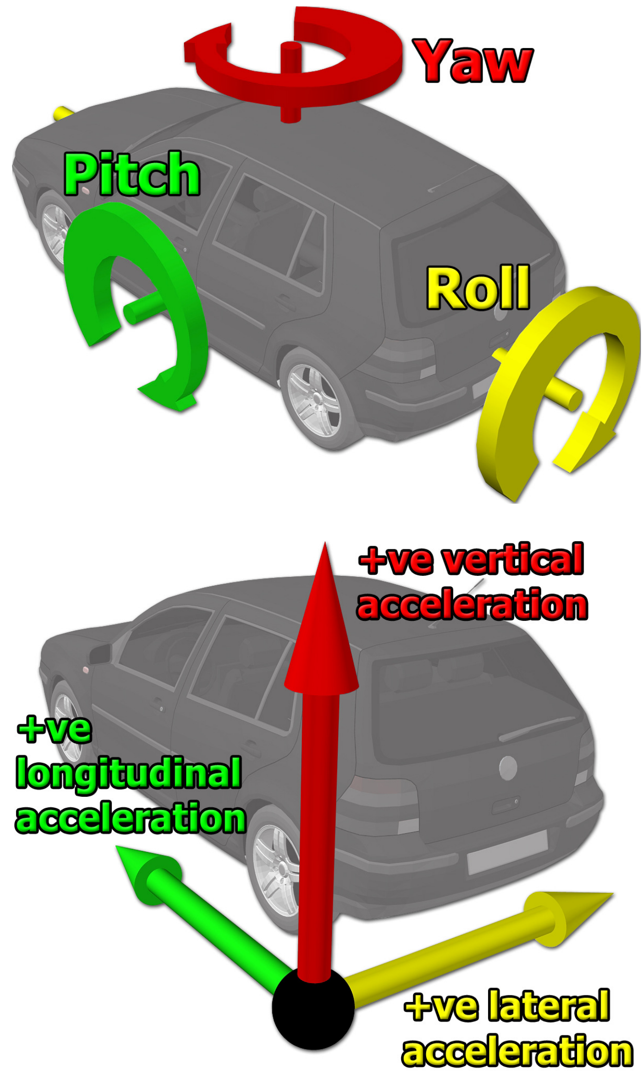
General Specification	IMU06	IMU06WP
Power requirements	8-15v dc, 150mA	
Case construction	Anodised aluminium	
Maximum dimensions	60.4(W) X 70 (L) X 35 (H)	70.4(W) X 75 (L) X 35 (H)
Mass	175g	220g
Fixing method	5mm mounting holes machined for M4 shoulder screws	
Sensor orientation		
IP rating	IP55	IP67
Operating temperature	-20 to +60°C	
Humidity	5-90% non condensation	5-95% non condensation
Vibration	20g all axis 5 minutes	
Sensor alignment	Internal sensor ±0.2 degrees from case mounting holes	
Pulse Output	5v, 25% duty cycle approx 100Hz. Rising edge synchronised with data	

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Technical Specification Gyroscopes					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
GYROSCOPE SENSITIVITY	Each axis				
Initial sensitivity	25°C, dynamic range = ± 300°/s	0.0725	0.07326	0.0740	°/s/LSB
	25°C, dynamic range = ± 150°/s		0.03663		°/s/LSB
	25°C, dynamic range = ± 75°/s		0.01832		°/s/LSB
Temperature coefficient			40		ppm/°C
Gyroscope axis nonorthogonality	25°C, difference from 90° ideal		±0.05		Degree
Gyroscope axis misalignment	25°C, relative to base-plate and guide pins		±0.5		Degree
Nonlinearity	Best fit straight line		0.1		% of FS
GYROSCOPE BIAS					
In run bias stability	25°C, 1σ		0.015		°/s
Angular random walk	25°C		4.2		°/√hr
Temperature coefficient			0.01		°/s/°C
Linear acceleration effect	Any axis, 1σ		0.05		°/s/*g*
GYROSCOPE NOISE PERFORMANCE					
Output noise	25°C, ± 300°/s range, 2-tap filter setting		0.60		°/s rms
	25°C, ± 150°/s range, 8-tap filter setting		0.35		°/s rms
	25°C, ± 75°/s range, 32-tap filter setting		0.17		°/s rms
Rate noise density	25°C, f= 25 Hz, ± 300°/s, no filtering		0.05		°/s/√Hz rms
GYROSCOPE FREQUENCY RESPONSE					
3 dB bandwidth			350		Hz
Sensor resonant frequency			14		kHz

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Technical Specification Accelerometers					
Parameter	**Conditions**	**Min**	**Typ**	**Max**	**Unit**
ACCELEROMETER SENSITIVITY	Each axis				
Dynamic range		±8	±10		*g*
Initial sensitivity	25°C	2.471	2.522	2.572	m*g*/LSB
Temperature coefficient			40		ppm/°C
Axis nonorthogonality	25°C, difference from 90° ideal		±0.25		Degree
Axis misalignment	25°C, relative to base-plate and guide pins		±0.5		Degree
Nonlinearity	Best fit straight line		±0.2		% of FS
ACCELEROMETER BIAS					
In-run bias stability	25°C, 1σ		0.7		m*g*
Velocity random walk	25°C		2.0		m/s/√hr
Temperature coefficient			0.5		m*g*/°C
ACCELEROMETER NOISE PERFORMANCE					
Output noise	25°C, no filtering		35		m*g* rms
Noise density	25°C, no filtering		1.85		m*g*/√Hz rms
ACCELEROMETER FREQUENCY RESPONSE					
3 dB bandwidth			350		Hz
Sensor resonant frequency			10		kHz

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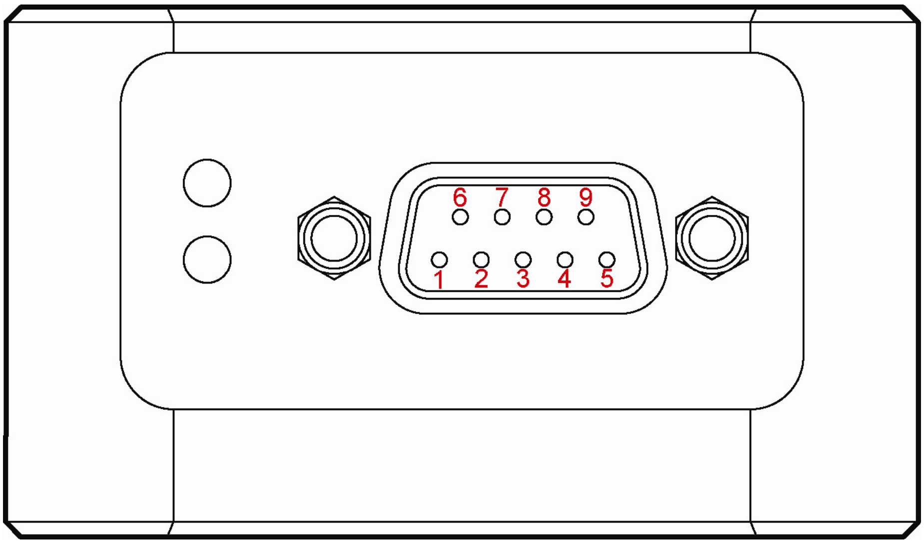
Connector pinout details



Connector pinout details	
Pin	**Function**
1	Calibrate switch (IP67 version only)
2	RS232 TX
3	RS232 RX
4	NC
5	GND
6	CAN L
7	Power in
8	CAN H
9	Timing signal

Calibration

The standard IMU06 unit has a calibration button positioned on the top of the unit. The button is small and is positioned flush with the main case to avoid unintended calibration during use. The button will require a pointed object to depress it.

The IP67 IMU06 unit requires an external switch to be connected for calibration. The switch must be connected between pin 1 and pin 5 of the d-type connector.

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Appendix A. CAN data format

CAN data can be output at user selectable bit rates of 125k/250k/500k or 1Mbit. The output values can be transmitted at up to 100Hz. The address used by the CAN system can either by a Race Technology format 29 bit address, in which case the actual address used will be shown in the configuration software, or a user defined 11 or 29 bit address. The format of the output messages is as follows:

RT CAN Message Specification
=============================

For all messages, bit zero of the validity byte refers to the first data (not accuracy) packet, bit 1 to the next data packet, etc. When the bit is 1, the data is valid, when the bit is zero, the data is invalid.
Since the last 5 bits of the address are made up of the unit id, this will need to be added to the addresses shown. The default unit ID is 2. A .dbc file containing all signals is available on request.

Inertial messages (group 128)
==============================

RT_Accel: 128, 0 (0x800020+ unit id)

```
----
Byte 0: Validity
Byte 1: Accuracy
Bytes 2-3: Accel Longitudinal (g)
Bytes 4-5: Accel Lateral (g)
Bytes 6-7: Accel Vertical (g)
----
Accel resolution is g/1000.
```

RT_Gyro_Rates: 128, 1 (0x800120+ unit id)

```
----
Byte 0: Validity
Byte 1: Accuracy
Bytes 2-3: Yaw rate (degrees/s)
Bytes 4-5: Pitch rate (degrees/s)
Bytes 6-7: Roll rate (degrees/s)
----
Rate resolutions are degrees/s/100.
```

Race Technology CAN address format

When the option is selected to use the Race Technology addressing system.. This should be selected whenever the IMU is used along with other Race Technology units on a CAN bus. The message contents are exactly the same irrespective of mode, but in the RT format mode the 29 bit address is used to carry data as to the data type, source, and destination. As follows:

All messages use a 29 bit address, made up as follows:

3 bit priority
These are set by the transmitter. The lower the number the higher the priority.

2 bits for future expansion (currently set as 00)

16 bit data type
If the MSB is <128 then this is a destination specific message, the destination address is given by the LSB (Data Format 1)
If the MSB is >127 this is a broadcast message, the MSB determines the main data type, LSB determines the sub type (Data Format 2)

8 bit source address

The top three bits are the data group, the lower 5 bits are the particular unit within that group. Default values are set on units, these will only need to be changed when there is more than one of a particular unit on the CAN network. Groups are as follows.

1 Data source
2 Displays
3 Data stores

Units are assigned to a group based on their primary function. A data logger will be classed as a data store, even if it has some built in channels.

Default unit numbers are as follows:

Data source group

1 IMU06
2 SPEEDBOX
3 BRAKEBOX

Appendix B. RS232 data format

The RS232 data is transmitted in packets at 115200baud using the standard Race Technology format. Each message consists of a header byte, data bytes, and a checksum byte. The checksum is calculated as the sum of all preceding bytes MOD256.

Accelerometer data

Lateral and longitudinal acceleration – Channel 8, 4 bytes		
Data bytes 1 and 2	**Lateral acceleration**	
	Format	Big endian (raw hex). 15 data bits, 1 sign bit
	Signing	Sign-and-magnitude. First bit (msb) is sign (0 => -ve)
	Units	g
	Scaling	Output = g x 256
	Example	Acc(g) = (byte 1 & 0x&F) + (byte 2 / 256) If (byte 1 & 0x80) = 0, Acc = -Acc
Data bytes 3 and 4	**Longitudinal acceleration**	
	Format	All format the same as lateral acceleration above

Vertical acceleration – Channel 92, 2 bytes		
Data bytes 1 and 2	**Vertical acceleration**	
	Format	All format the same as lateral acceleration above

Gyroscope data

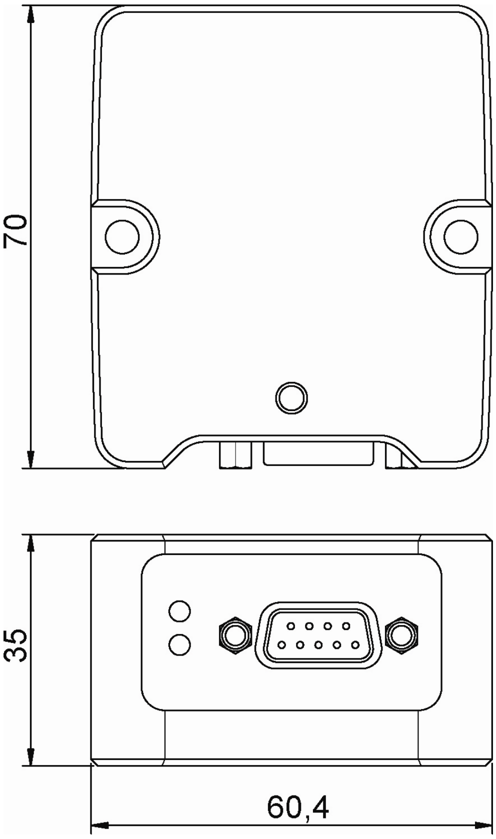
Yaw rate – Channel 79, 2 bytes		
Data bytes 1 and 2	**Yaw rate**	
	Format	Big endian (raw hex). 16 data bits
	Signing	Unsigned
	Units	Degrees
	Scaling	Output = 327.68 – degrees x 0.01

Pitch rate – Channel 81, 3 bytes		
Data bytes 1 and 2	**Pitch rate**	
	Format	Big endian (raw hex). 16 data bits
	Signing	Unsigned
	Units	Degrees
	Scaling	Output = 327.68 – degrees x 0.01
Data byte 3	**Pitch rate accuracy estimate**	
	Format	Big endian (raw hex). 32 data bits
	Signing	Unsigned
	Units	Undefined, lower is better

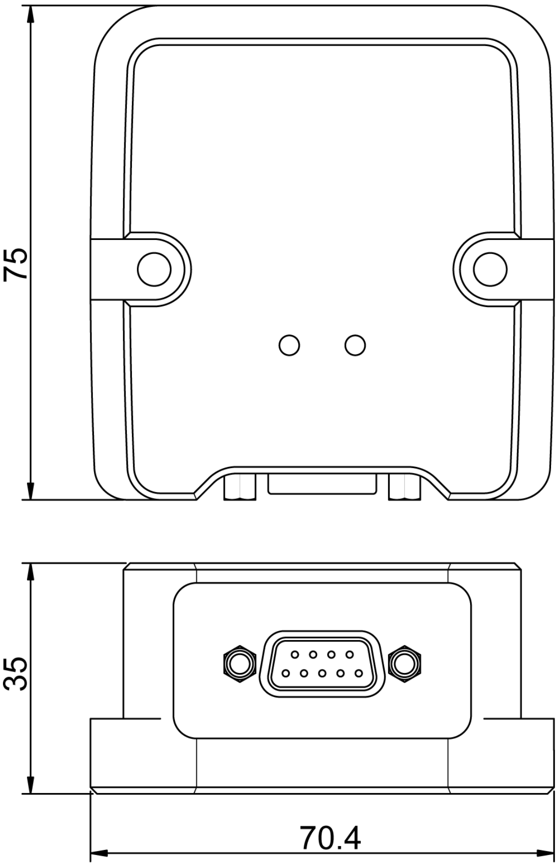
Roll rate – Channel 84, 3 bytes		
Data bytes 1 and 2	**Roll rate**	
	Format	Big endian (raw hex). 16 data bits
	Signing	Unsigned
	Units	Degrees
	Scaling	Output = 327.68 – degrees x 0.01
Data byte 3	**Roll rate accuracy estimate**	
	Format	Big endian (raw hex). 32 data bits
	Signing	Unsigned
	Units	Undefined, lower is better

Dimensions

IMU06:



IMU06WP:



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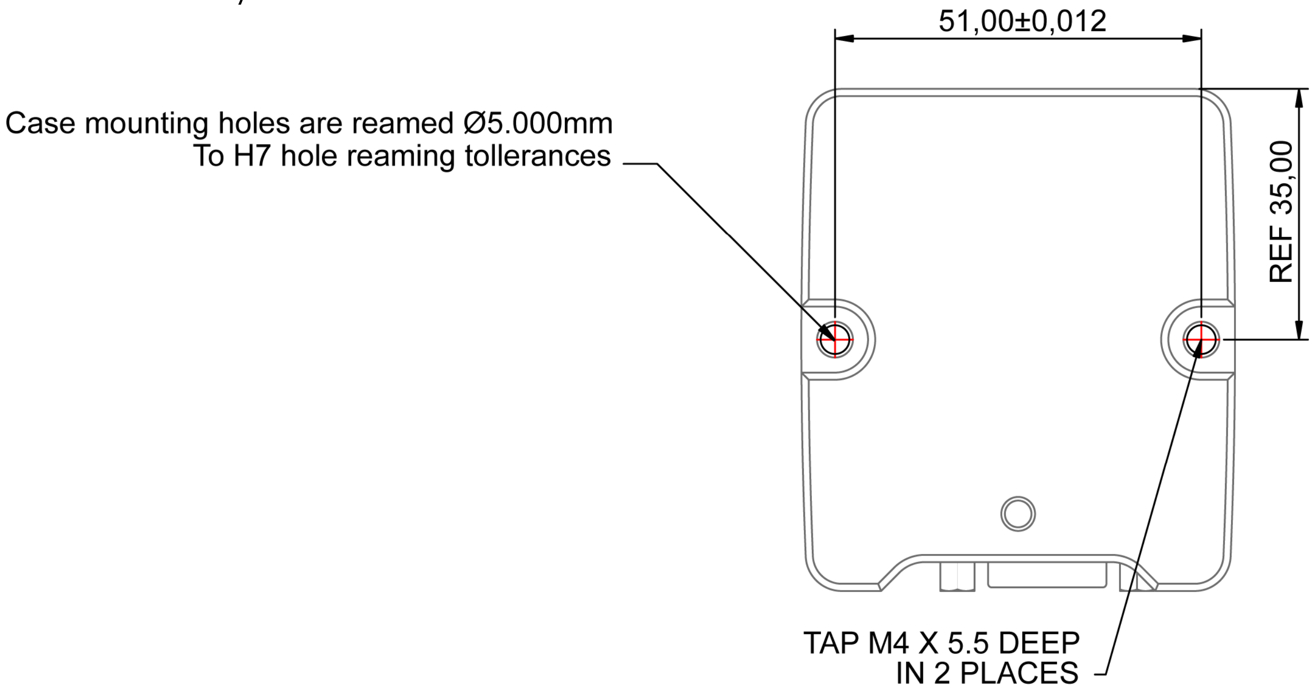
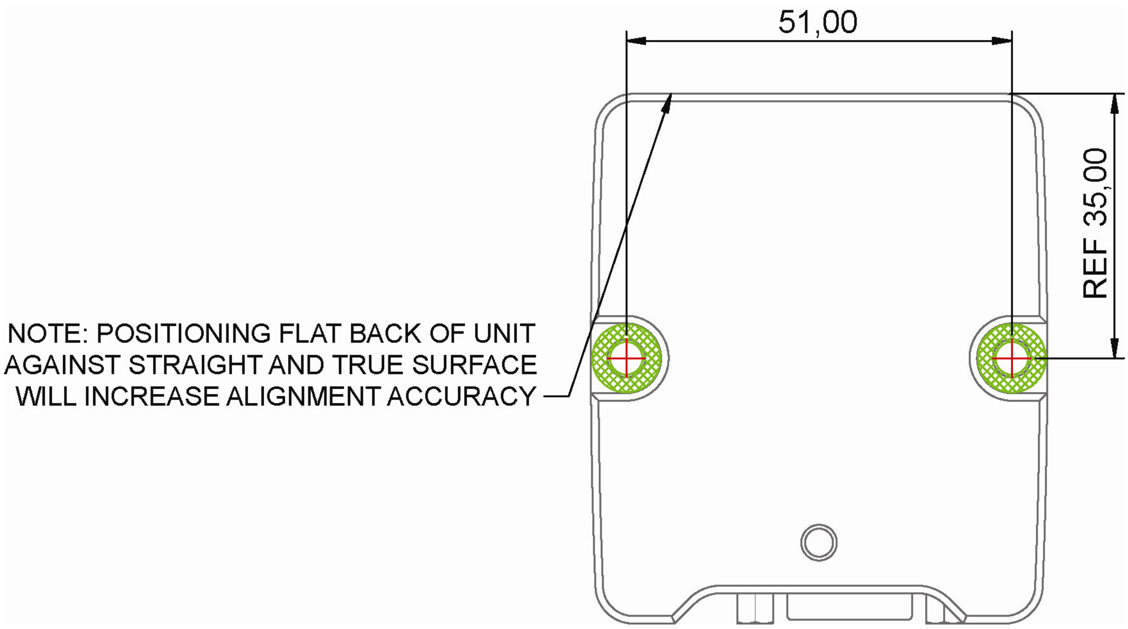
Mounting the unit - IMU06

Two different mounting options are available. For a highly accurate alignment shoulder screws are used in the reamed 5mm diameter mounting holes. This option is recommended to ensure the correct alignment of the unit and the accuracy of the measurement.



For applications where this recommended mounting option is not possible to implement, a second non critical alignment option is available. We recommend that the flat back surface of the unit is used to align the unit against a flat aligned reference surface. The M4 clearance washers fit in the mounting recess and allow standard M4 mounting screws to hold the unit securely. This mounting option is not designed to ensure accurate alignment.



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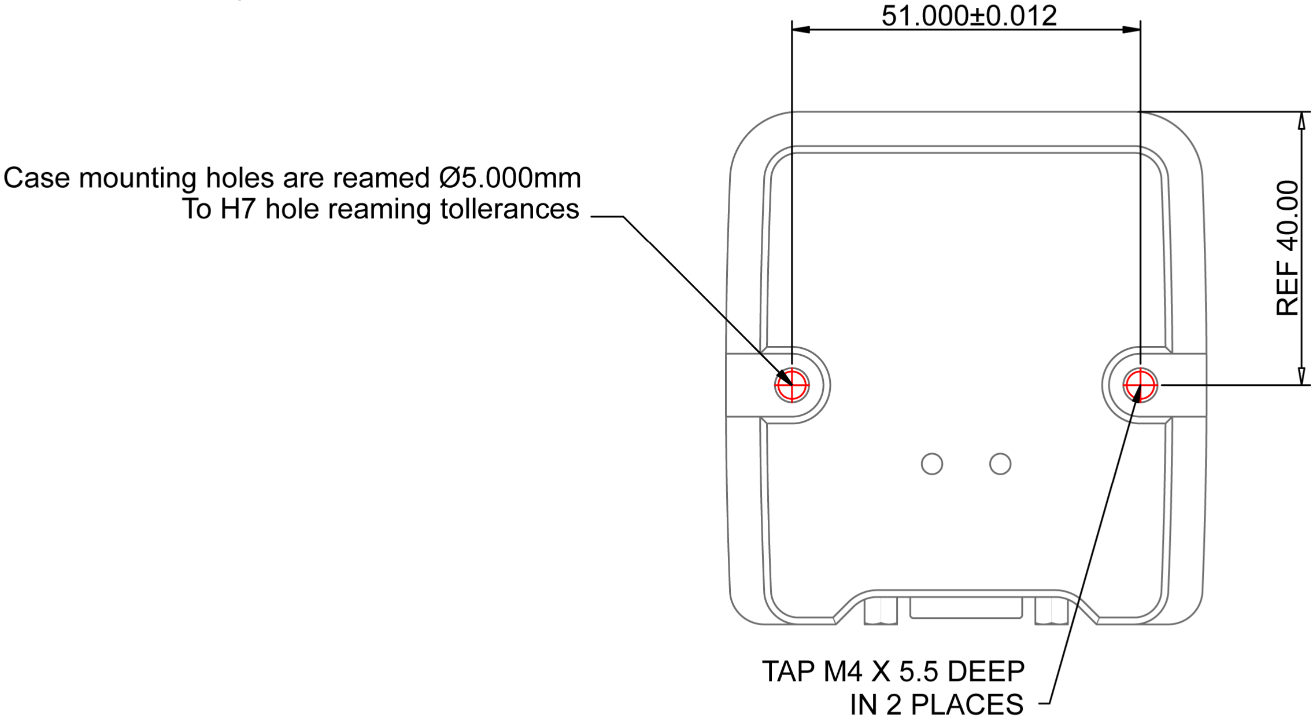

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