

High Performance Waterproof Time-of-Flight (ToF) Sensor



Features

- Fast, accurate distance ranging
 - Measures absolute range up to 25m (white target) with accuracy indication
 - Output data rate up to 54Hz
 - Measuring result is not sensitive to the target color and reflectivity
 - Embedded electrical & optical cross-talk compensation
 - -10°C~+55°C temperature compensation
 - Ambient light compensation enables accurate measurement in high infrared ambient light levels
- Fully integrated miniature module
 - ABS + Aviation aluminum waterproof case
 - 850nm infrared LED emitter
 - Emitter driver
 - Integrated optimally-designed emitting & receiving optical lens
 - Ranging sensor with advanced embedded micro controller
 - Advanced embedded data processing & filtering algorithm
 - 1Mbps CAN interface
 - 53(W) x 32(H) x 26.5(D) mm, 27g
- Eye safety
 - Compliant with latest Photobiological Safety of Lamps and Lamp Systems Standard IEC62471(Class 0), CE, FCC, RoHS

Applications

- Drones (collision avoidance, soft-landing)
- Robotics & AGV (obstacle detection)
- Industrial location and proximity sensing
- Security and surveillance
- 1D gesture recognition

Description

HPS-166C is a new generation waterproof Time-of-Flight (ToF) infrared ranging sensor with optimally-designed emitting & receiving optical lens, suitable for precise, long-distance measurements. It provides accurate distance measurement whatever the target color and reflectivity unlike conventional technologies. HPS-166C can measure absolute distances up to 25m on a white target, setting a new benchmark in ranging performance levels, opening the door to various new applications.

HPS-166C integrates a high-power 850nm infrared LED and a high-sensitivity photodiode (PD) coupled with internal physical infrared filters, enables longer ranging distance and higher immunity to ambient light.

Advanced embedded data processing & filtering algorithm realizes extremely stable and real-time measurement outputs.

CE **FCC** **RoHS**

Overview

1.1 Technical specification

Table 1. Technical specification

Parameter	Values	Unit
Size	53(L) x 32(W) x 26.5(H) *	mm
Weight	27 * ¹	g
Power supply	5 ~ 15	V
Maximum power consumption	1.4	W
Quiescent power consumption	0.1	W
Storage temperature	-40 ~ 85	°C
Operating temperature	-10 ~ 55 * ²	°C
Infrared LED emitter	850	nm
Emitting angle	±1.8	°
Maximum measuring distance	25 * ³	m
Minimum measuring distance	0.08	m
Output data rate	54	Hz
Output data	Distance, accuracy, signal strength, ambient IR level, temperature	-
Connector	MX3.0mm-pitch, 4-pin connector	-
Interface	CAN, 1Mbps	-
Cable length	700	mm

Note: *1 Sensor body.

*2 In continuous ranging mode, HPS-166C needs a few seconds warm-up time to stabilize the output. Attention needs to be paid to the heat dissipation of aluminum back board to avoid the increasing of thermal circuit noise.

*3 Tested on 90% reflectance white target.

1.2 Mechanical drawing & device pinout

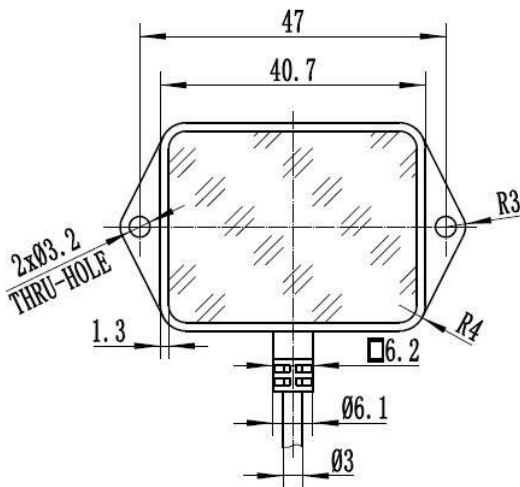


Figure 1. Front view of HPS-166C

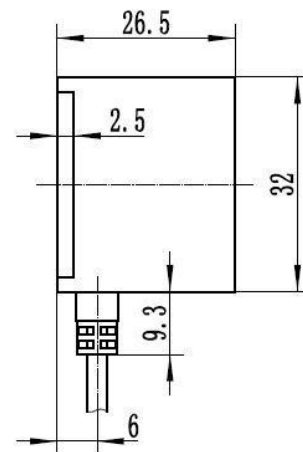


Figure 2. Side view of HPS-166C

Table 2. HPS-166C pin description

Pin No.	Signal name	Signal type	Description	Plug outline
1	GND	GND	Ground	
2	CANH	Digital	CAN bus H terminal	
3	CANL	Digital	CAN bus L terminal	
4	VDD	Power	Supply, DC +5V~+15V	

Control interface

2.1 CAN bus communication protocol

HPS-166C communicates with the host through the CAN bus interface, it supports both Standard Frame Format and Extended Frame Format. The sensor will enter the “warming-up” mode just after it is powered up and will switch to “Continuous ranging” mode when the “warming-up” is completed. The default warming-up time is 5 seconds which can be configured by the host.

2.1.1 Command frame ID

Host can send commands to HPS-166C using either Extended Frame ID or Standard Frame ID, the default IDs are 0x10310000 and 0x731 for each.

Table 3. Command frame ID

Baud rate	1Mbps
Command Extended Frame ID	0x10310000
Command Standard Frame ID	0x731

2.1.2 Sensor returned data frame ID

HPS-166C supports either Standard Frame Format or Extended Frame Format for its returned data, which can be configurable by users. The default setting is Extended Frame Format.

Table 4. Default sensor returned data frame ID

Baud rate	1Mbps
Command Extended Frame ID	0x00000000 (Default)
Command Standard Frame ID	0x000 (Default)

2.1.3 Multi sensor support

Up to 16 sensors are supported to work simultaneously on a same CAN bus, different ID can be set for each sensor by users.

2.1.4 Command and returned data format

Host must use correct Command Frame ID and Sensor ID to communicate with the sensor, otherwise there will be no response. Normally, sensor will return a data frame just after received a command from the host. The default type of returned data frame is Extended Frame Format, the default frame ID is: 0x00000000. Both the type of returned data frame and frame ID are configurable by users.

Sensor command uses an 8-byte fixed length format:

Table 5. Sensor command format

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, Bit3 ~ Bit0: Reserved ; Default value: 0x00
1	Command byte
2	Parameter byte
3	
4	
5	
6	
7	

The length of sensor returned data is variable, the returned data will be divided into several CAN frames if the total length exceeded one CAN frame. In the returned data, Bit7 ~ Bit4 of the first byte is the sensor ID, Bit3 ~ Bit0 is the indexed sequential number of the current frame data.

Table 6. Sensor returned data format

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, Bit3 ~ Bit0: Indexed sequential number
1	Command byte (If the sensor is working under “Continuous ranging” mode, this byte is same as the command byte of “Continuous ranging” command)
2	Length of the valid data in current data frame
3	Data byte
4	
5	
6	
7	

Note: If sensor is working in “Continuous ranging” mode, it is recommended to send a “Stop ranging” commend (commend #13) before sending any other commends.

Command #1: Set sensor ID

This commend is used to set the sensor ID (Default value: 0x00). The new ID will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 7. Set sensor ID command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xFF	New sensor ID, only Bit7~Bit4 are effective	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 8. Returned data of Set sensor ID command

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFF: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #2: Acquire the firmware version of CAN interface

This command is used to read the firmware version of CAN interface.

Table 9. Acquire the firmware version of CAN interface command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xFE	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 10. Returned data of Set sensor ID command

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFE: Command byte
2	0x03: Length of the valid data in current data frame
3	Major version No.
4	Minor version No.
5	Revision No.
6	Reserved
7	Reserved

Command #3: Restore CAN interface firmware

This command is used to restore the CAN interface firmware to factory settings, it is a global valid command that all the sensors connected on the CAN bus will receive this command and restore its sensor ID to default value: "0x00".

Table 11. Restore CAN interface firmware command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0xF0	0xFF	0x00	0xA0	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 12. Returned data of restore CAN interface firmware commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFF: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #4: Search sensors on CAN bus

This command is used to search the sensors on the CAN bus, each online sensor will return an ACK frame.

Table 13. Search sensors on CAN bus commend

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0xF0	0xFF	0x00	0xB0	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 14. Returned data of restore CAN interface firmware commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFF: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: ACK flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #5: Set warm-up duration time

This command is used to set the warm-up duration time after the power up. The default setting is 5 seconds, during the warm-up period sensor will not output measuring result. The set value will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 15. Set warm-up duration time commend

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xFD	Warm-up duration time (Unit: second)	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 16. Returned data of set warm-up duration time commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFD: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #6: Set frame type of CAN interface

This command is used to set the frame type of CAN interface (Standard Frame Format or Extended Frame Format). The default setting is Extended Frame Format. The settings will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 17. Set frame type of CAN interface command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xFB	0x00: Standard frame format 0xFF: Extended frame format	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 18. Returned data of set frame type of CAN interface command

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFA: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #7: Set frame ID of CAN interface

This command is used to set the frame ID of CAN interface (Standard Frame ID or Extended Frame ID). The default setting is 0x00000000. If the frame type is Standard Frame Format, Bit10~Bit0 are valid, and if the frame type is Extended Frame Format, Bit28~Bit0 are valid. The settings will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 19. Set frame type of CAN interface commend

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xFC	Frame ID Bit31~Bit24	Frame ID Bit23~Bit16	Frame ID Bit15~Bit8	Frame ID Bit7~Bit0	Reserved	Reserved

Returned data:

Table 20. Returned data of set frame type of CAN interface commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xFC: Commend byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #8: Set sensor working mode

This commend is used to set the sensor working mode after power up (Continuous Ranging Mode or Standby Mode). The default setting is Continuous Ranging Mode. The settings will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 21. Set sensor working mode commend

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xF9	0x00: Standby Mode 0xFF: Continuous Ranging Mode	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 22. Returned data of set sensor working mode commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xF9: Commend byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #9: Set terminal resistor

This command is used to enable or disable the internal 120-ohm CAN bus terminal resistor. The default setting is resistor enabled. The settings will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 23. Set terminal resistor command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0xF8	0x00: Disable 0xFF: Enable	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 24. Returned data of set terminal resistor command

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0xF8: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #10: Acquire sensor information

This command is used to acquire the detailed sensor information stored in the non-volatile memory.

Table 25. Acquire sensor information command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x2E	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:Table 26. Returned data of acquire sensor information command (1st frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x2E: Command byte
2	0x05: Length of the valid data in current data frame
3	0xB0: Sensor ACK flag
4	UUID (Byte0 ~ Byte3)
5	
6	
7	

Table 27. Returned data of acquire sensor information commend (2nd frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 1
1	0x2E: Commend byte
2	0x05: Length of the valid data in current data frame
3	UUID (Byte4 ~ Byte8)
4	
5	
6	
7	

Table 28. Returned data of acquire sensor information commend (3rd frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 2
1	0x2E: Commend byte
2	0x05: Length of the valid data in current data frame
3	UUID (Byte9 ~ Byte13)
4	
5	
6	
7	

Table 29. Returned data of acquire sensor information commend (4th frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 3
1	0x2E: Commend byte
2	0x05: Length of the valid data in current data frame
3	UUID (Byte14 ~ Byte15)
4	
5	Year
6	Month
7	Day

Table 30. Returned data of acquire sensor information commend (5th frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 4
1	0x2E: Commend byte
2	0x02: Length of the valid data in current data frame
3	Major version No.
4	Minor version No.
5	Reserved
6	Reserved
7	Reserved

The following is an example of the returned sensor information data:1st frame : 0x10 0x2E 0x05 0xB0 0x52 0x13 0x29 0x8C2nd frame : 0x11 0x2E 0x05 0xC7 0xE0 0xE5 0x11 0x8D3rd frame : 0x12 0x2E 0x05 0x2B 0xB9 0x57 0x2C 0xF34th frame : 0x13 0x2E 0x05 0xAD 0x25 0x12 0x01 0x085th frame : 0x14 0x2E 0x02 0x02 0x01 0x00 0x00 0x00**Decoding:**0x10 ~ 0x14: Sensor ID = 0001b, 1st ~ 5th frame data

0xB0: ACK byte

0x52 0x13 0x29 0x8C 0xC7 0xE0 0xE5 0x11 0x8D 0x2B 0xB9 0x57 0x2C 0xF3 0xAD 0x25: UUID

0x12 0x01 0x08: 18/01/08

0x02 0x01: Ver. 2.1

Command #11: Single ranging

Table 31. Single ranging command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x22	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Command #12: Continuous ranging

Table 32. Continuous ranging command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x24	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:Table 33. Returned data of single / continuous ranging command (1st frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x22 / 0x24: Command byte
2	0x05: Length of the valid data in current data frame
3	Measured distance MSB, unit: mm
4	Measured distance LSB, unit: mm
5	Received signal magnitude MSB
6	Received signal magnitude LSB
7	Received signal magnitude Exp.

Table 34. Returned data of single / continuous ranging commend (2nd frame)

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 1
1	0x22 / 0x24: Commend byte
2	0x03: Length of the valid data in current data frame
3	Relative ambient IR intensity
4	Precision MSB, small values correspond to small measurement errors
5	Precision LSB, small values correspond to small measurement errors
6	Reserved
7	Reserved

Note: Sensor will output a 65.53m over range indication if the measurement result is over ranged or receiving signal is too low.

The following is an example of the returned ranging results:

1st frame : 0x10 0x24 0x05 0x06 0xD9 0xFC 0x8C 0x02

2nd frame : 0x11 0x24 0x03 0x01 0x00 0x01 0x00 0x00

Decoding:

0x10 ~ 0x11: Sensor ID = 0001b, 1st ~ 2nd frame data

Measured distance = $(0x06 * 256 + 0xD9) / 1000.0f = 1.753$ (Unit: m)

Received signal magnitude = $((0xFC * 256 + 0x8C) \ll 0x02) / 10000.0f = 25.8608$

Relative ambient IR intensity = 1

Precision = $(0x00 * 256) + 0x01 = 1$

Command #13: Stop ranging

This commend is used to stop the continuous ranging.

Table 35. Stop ranging commend

Target sensor ID	Command byte	Data field					
		Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x30	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 36. Returned data of stop ranging commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x30: Commend byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #14: Set offset compensation value

Due to the individual deviation of sensor performances, this command can be used to compensate the small measuring offset deviation to achieve higher ranging precision. The offset values will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 37. Stop ranging command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x38	Offset MSB	Offset LSB	Reserved	Reserved	Reserved	Reserved

Offset = Actual distance – Sensor measured distance, unit: mm

Example:

Actual distance: 200mm, sensor measured distance: 215mm

Offset = 200 – 215 = -15 = 0xFFFF1 (Offset MSB = 0xFF, Offset LSB = 0xF1)

Returned data:

Table 38. Returned data of stop ranging command

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x38: Command byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #15: Set output filter strength

This command is used to adjust the output filter strength, increasing this value will improve the stability of output data but sacrifice some sensitivity. Decreasing this value makes the output data more sensitive to the distance change but sacrifice some stability. The default value is "0x000" and the setting values within ± 100 are recommended. The setting values will be automatically saved to the internal non-volatile memory and reloaded with each power up.

Table 39. Set output filter strength command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x3D	Filter MSB	Filter LSB	Reserved	Reserved	Reserved	Reserved

Example:

Decrease the output stability by 50 units -> Filter value = -50 = 0xFFCE (Filter MSB = 0xFF, Filter LSB=0xCE)

Increase the output stability by 50 units -> Filter value = 50 = 0x0032 (Filter MSB = 0x00, Filter LSB=0x32)

Returned data:

Table 40. Returned data of stop ranging commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x3D: Commend byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #16: Load configuration profiles

Table 41. Load configuration profiles commend

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x3E	0x00: User profile 0xFF: Factory profile	Reserved	Reserved	Reserved	Reserved	Reserved

Returned data:

Table 42. Returned data of load configuration profiles commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x3E: Commend byte
2	0x01: Length of the valid data in current data frame
3	0x01: Succeed flag, other values indicate failures
4	Reserved
5	Reserved
6	Reserved
7	Reserved

Command #17: Acquire the analog frontend (AFE) temperature

This commend is used to acquire the analog frontend (AFE) temperature of sensor , , (Unit: Fahrenheit).

Table 43. Acquire the analog frontend (AFE) temperature command

Target sensor ID	Command byte	Data field					
Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
0x00 (Default)	0x3F	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

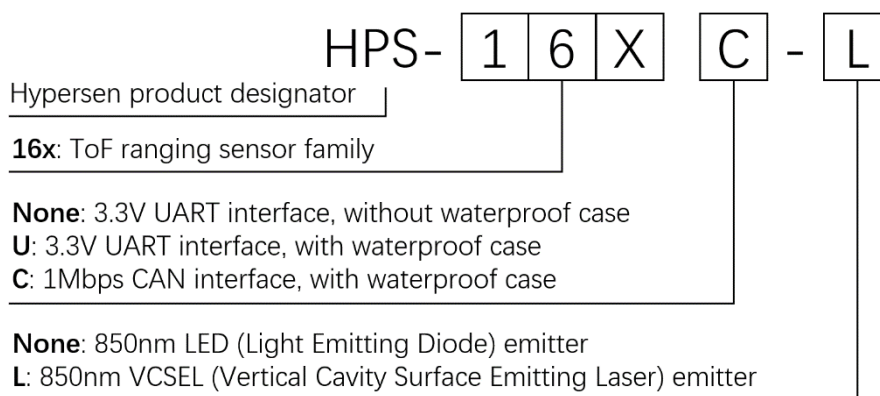
Returned data:

Table 44. Returned data of stop ranging commend

Byte No.	Description
0	Bit7 ~ Bit4: Sensor ID, indexed sequential number [Bit3 : Bit0] = 0
1	0x3F: Commend byte
2	0x03: Length of the valid data in current data frame
3	0x01: ACK flag, other values indicate failures
4	AFE Temperature MSB
5	AFE Temperature LSB
6	Reserved
7	Reserved

AFE Temperature = (AFE Temperature MSB * 256 + AFE Temperature LSB) / 100, (Unit: Fahrenheit)

Ordering information



Package information

Table 45. Package details

Model No.	HPS-166C
Module dimensions	53(W) x 32(H) x 26.5(D) mm
Weight	27g / pcs (Sensor body)
Tray	Modules of 15pcs. (5*3) per tray
Outer box	4 trays per box (module 60pcs)

Revision history

Table 46. Document revision history

Date	Revision	Description
24-March-2017	1.0	Initial release.
11-February-2018	1.1	Added description of over range indication and ordering information.
23-October-2018	1.2	Corrected the command byte of command#6 (0xFA -> 0xFB).

IMPORTANT NOTICE – PLEASE READ CAREFULLY

Hypersen Technologies Co., Ltd. reserve the right to make changes, corrections, enhancements, modifications, and improvements to Hypersen products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on Hypersen products before placing orders. Hypersen products are sold pursuant to Hypersen's terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of Hypersen products and Hypersen assumes no liability for application assistance or the design of Purchasers' products.

No license, express or implied, to any intellectual property right is granted by Hypersen herein.

Resale of Hypersen products with provisions different from the information set forth herein shall void any warranty granted by Hypersen for such product.

Hypersen and the Hypersen logo are trademarks of Hypersen. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.