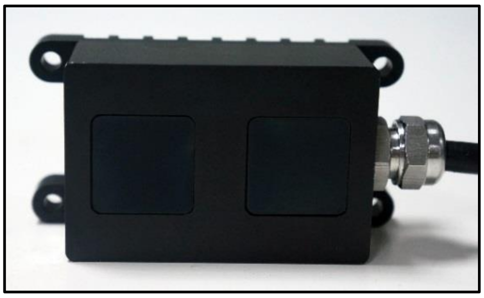
HYPERSEN TECHNOLOGIES CO., LTD.

HPS-3D160

Solid-State LiDAR Sensor



Features

- Full frame rate up to 35 fps
- Field of View: 76° x 32°, resolution: 160 x 60
- Support 16 groups of user defined region of interest settings. Each group supports multiple user defined regions
- Various communication interfaces, support USB, RS-232 and optocoupler isolated GPIO.
- Support GPIO synchronized measurement.
- Measuring range up to 12m
- Centimeter point cloud accuracy
- Excellent ambient light suppression capability
- Embedded anti-interference algorithm, support multiple LiDAR simultaneous operation
- Total solid structure, industrial IP67 protection
- Support Normal mode, Simple-HDR mode, Auto-HDR mode and Super-HDR mode, with good scene adaptability.

Applications

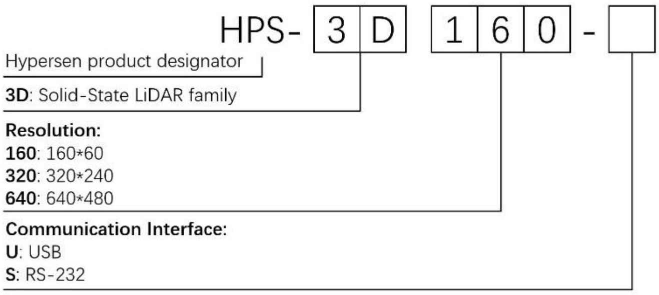
- Robotics & AGV (obstacle avoidance, SLAM applications)
- Drones collision avoidance and hovering
- Industrial safety area protection and proximity detection
- Safety surveillance
- 3D movement recognition
- 3D modeling

Description

HPS-3D160 is a new generation high-performance solid-state LiDAR sensor based on time-of-fight (ToF) principle. Equipped with optimized lighting system and low distortion infrared optical lens, measurable distance up to 12m on 90% reflective white targets. Flexible user defined region of interest (ROI) function, Simple-HDR, Auto-HDR, and Super-HDR modes, make HPS-3D160 suitable for various applications.

HPS-3D160 integrates high-power 850nm infrared VCSEL emitters and high-photosensitive CMOS. Embedded high-performance processor, advanced data processing, filtering and compensation algorithms, enable very stable and simultaneous measure data output. Full solid structure, industrial IP67 protection design and sturdy aviation aluminum housing enable the HPS-3D160 to be used in complex environments.

Ordering information



Class1 laser product.
Laser classification measurement according to IEC60825-1: 2014.

CE FC RoHS

Overview

1.1 Technical specification

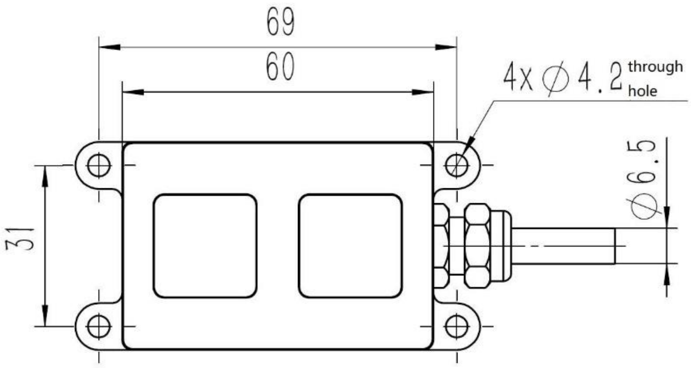
Parameter	Values	Unit
Size	78（L）x 40（W）x 30（H）	mm
Weight	110 [*1]	g
Power supply	9 ~ 12	V
Maximum power consumption	6	W
Quiescent power consumption	0.7	W
Storage temperature	-40 ~ 85	℃
Operating temperature	-10 ~ 55	℃
Infrared VCSEL emitter	850	nm
Emitting angle	76（Horizontal）x 32（Vertical）	°
Maximum measurable distance	12 [*2]	m
Minimum measurable distance	0.25	m
Maximum output frame rate	35 [*3]	fps
Output data	Depth, average distance, signal strength, quantity of weak signal pixels, quantity of saturated pixels, maximum distance, minimum distance	-
Operating mode	Normal mode, Auto-HDR mode Super-HDR mode, Simple-HDR mode	-
Power-on initialization time	1500	ms
Interface	Option：USB or RS232	-
Optocoupler isolated I/O	Input x 1, output x 1	-
Cable length	200	cm

Note: *1 Not include cable

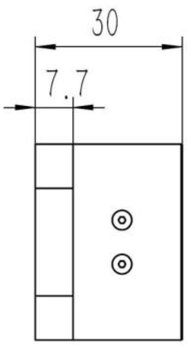
*2 Tested on a 90% reflectance white target

*3 The frame rate will be higher if the ROI is defined.

1.2 Dimensions and cable definitions



HPS-3D160 front view



HPS-3D160 left view

Cable color	Signal name	Signal type	Description	Remark
Red	VCC	Power	Power, connect to DC +9 ~ 12V	The product with different communication interface has different definition for DATA+ and DATA- terminals.
Black	GND	GND	Power ground	
Blue	OUT	I/O	Optocoupler isolated output terminal	
Blue/White	IN	I/O	Optocoupler isolated input terminal	
Purple/White	COM	I/O	Optocoupler isolated COM terminal	
Purple	GND	Digital	Signal ground	
Orange	DATA+	Digital	USB D+ / RS-232 TX	
Orange/white	DATA-	Digital	USB D- / RS-232 RX	
Shield layer	SHIELD	-	Cable shield layer, internal part connects to product outer shell	

2.1 Communication interface

HPS-3D160 can communicate with host through USB or RS232 interface, and HPS-3D160 also equipped with 3 optocoupler isolated input terminals and 3 optocoupler isolated output terminals, which are convenient to connect with PLC or relay.

2.2 USB and RS232 communication protocol

2.2.1 Communication protocol

Each command consists of 2 header bytes, 1 message length byte, 1 command byte, 1 device address byte, parameter field, 2 CRC16-CCITT bytes; Every returned data consists 2 header bytes, 2 message length bytes, 1 device address byte, 1 RID byte (Returned ID, normally same as command byte), data field, 2 CRC16-CCITT bytes, 2 message end bytes. Command packet and returned data packet are little endian, that is, the lower memory address stores the lower byte.

2.2.2 Multi-sensor support

Each sensor has a programmable device address (Default address is 0x00, broadcast address is 0xFF), user can change it to enable multi sensors work on a same bus.

2.2.3 Command data packet is defined as the following table:

Byte No.	Description
0	0xF5, Header 1
1	0x0A, Header 2
2	Length byte，indicates the number of bytes starting from byte No.3
3	Command byte
4	Device address，specify the target device. Default address: 0x00, broadcast address: 0xFF
N	Parameter field
5+N	CRC16 Low byte
5+N+1	CRC16 High byte

Note: The CRC calculation starts from byte No.3 to N.

Returned data packet is defined as the following table:

Byte No.	Description
0	0xF5, Header 1
1	0x5F, Header 2
2	Low byte of remaining valid data length
3	High byte of remaining valid data length
4	Device address
5	Returned packet type ID (RID)
N	Data field
6+N	CRC16 Low byte
6+N+1	CRC16 High byte
6+N+2	0x5F, Message end 1
6+N+3	0xF5, Message end 2

Note: The CRC calculation starts from byte No.4 to N.

Command #1 Read sensor device address

This command is used to read sensor device address.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x05	Message length
3	0xBA	Command byte
4	0xFF	Broadcast address
5	0x02	Fixed parameter
6	0x1F	CRC16 Low byte
7	0xD6	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	……	Low byte of message length
3	High byte of message length	……	High byte of message length
4	Device address	……	Currently responding device address
5	RID	0xBA	Returned packet type ID (RID)
6	Device address	……	Currently responding device address
7	CRC16 LSB	……	CRC16 Low byte
8	CRC16 MSB	……	CRC16 High byte
9	Message end 1	0x5F	Message end 1
10	Message end 2	0xF5	Message end 2

Command #2 Set sensor device address

This command is used to set sensor device address, the new address will be valid immediately.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x06	Message length
3	0xBA	Command byte
4	Target device address	Target device address (0x00 ~ 0xFE)
5	0x01	Fixed parameter
6	0x00 ~ 0xFE	New device address
7	……	CRC16 Low byte
8	……	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	0x07	Low byte of message length
3	High byte of message length	0x00	High byte of message length
4	Device address	……	Currently responding device address (old address)
5	RID	0xBA	Returned packet type ID (RID)
6	Confirmation byte	……	0x01: Succeed, 0x00: Fail
7	CRC16 LSB	……	CRC16 Low byte
8	CRC16 MSB	……	CRC16 High byte
9	Message end 1	0x5F	Message end 1
10	Message end 2	0xF5	Message end 2

Command #3 Read sensor hardware version number.

This command is used to read sensor hardware version number.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x04	Message length
3	0xA0	Command byte
4	Target device address	Target device address, 0x00 ~ 0xFE
5	……	CRC16 Low byte
6	……	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	0x0C	Low byte of message length
3	High byte of message length	0x00	High byte of message length
4	Device address	……	Currently responding device address
5	RID	0xA0	Returned packet type ID (RID)
6	Year	……	Example: 2018-09-19 V1.3 Rev3 [6]: 0x12, [7]: 0x09, [8]: 0x13, [9]: 0x01, [10]: 0x03, [11]: 0x03
7	Month	……	
8	Day	……	
9	Main version	……	
10	Minor version	……	
11	Revisions	……	
12	CRC16 LSB	……	CRC 16 Low byte
13	CRC16 MSB	……	CRC 16 High byte
14	Message end 1	0x5F	Message end 1
15	Message end 2	0xF5	Message end 2

Command #4 Read sensor serial number

This command is used to read sensor serial number, each sensor has a unique serial number.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x05	Message length
3	0xA1	Command byte
4	Target device address	Target device address, 0x00 ~ 0xFE
5	0x02	Fixed parameter
6	……	CRC16 Low byte
7	……	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	0x44	Low byte of message length
3	High byte of message length	0x00	High byte of message length
4	Device address	……	Currently responding device address
5	RID	0xa0	Returned packet type ID (RID)
6~67	Sensor serial number	ASCII string	ASCII string, end up with’\0’ (ASCII value is 0) Example: HPS-3D160-U-1810130 [6]: ’H’, [7]: ’P’, [8]: ’S’, [9]: ’-’, [10]: ‘3’, [11]: ‘D’, [12]: ‘1’, [13]: ‘6’, [14]: ‘0’, [15]: ‘-’, [16]: ‘U’, [17]: ‘-’, [18]: ‘1’, [19]: ‘8’, [20]: 1, [21]: ‘0’, [22]: ‘1’, [23]: ‘3’, [24]: ‘0’, [25]: ‘\0’ Other bytes can be neglected.
68	CRC16 LSB	……	CRC16 Low byte
69	CRC16 MSB	……	CRC16 High byte
70	Message end 1	0x5F	Message end 1
71	Message end 2	0xF5	Message end 2

Command #5 Set sensor working mode

This command can set sensor’s working mode.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x06	Message length
3	0xA3	Command byte
4	Target device address	Target device address, 0x00 ~ 0xFE
5	0x01	Fixed parameter
6	……	0x00: Standby mode, 0x01: Single measurement mode, 0x02: Continuous measurement mode
7	……	CRC16 Low byte
8	……	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	0x07	Low byte of message length
3	High byte of message length	0x00	High byte of message length
4	Device address	……	Currently responding device address

5	RID	0xA3	Returned packet type ID (RID)
6	Confirmation byte	……	0x01: Succeed, 0x00: Fail
7	CRC16 LSB	……	CRC16 Low byte
8	CRC16 MSB	……	CRC16 High byte
9	Message end 1	0x5F	Message end 1
10	Message end 2	0xF5	Message end 2

Command #6 Select the group of user defined region of interest (ROI)

This command is used to select the ROI group. User can define 16 groups of ROI settings, and each group supports 30 ROIs.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x06	Message length
3	0xAC	Command byte
4	Target device address	Target device address, 0x00 ~ 0xFE
5	0xA9	Fixed parameter
6	0x00 ~ 0x0F	ROI group ID
7	……	CRC16 Low byte
8	……	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	0x07	Low byte of message length
3	High byte of message length	0x00	High byte of message length
4	device address	……	Currently responding device address
5	RID	0xAC	Returned packet type ID (RID)
6	Confirmation byte	……	0x01: Succeed, 0x00: Fail
7	CRC16 LSB	……	CRC16 Low byte
8	CRC16 MSB	……	CRC16 High byte
9	Message end 1	0x5F	Message end 1
10	Message end 2	0xF5	Message end 2

Command #7 Read current ROI group ID

This command is used to read the ROI group ID number.

Byte No.	Value	Description
0	0xF5	Header 1
1	0x0A	Header 2
2	0x05	Message length
3	0xAC	Command byte

4	Target device address	Target device address, 0x00 ~ 0xFE
5	0xAA	Fixed parameter
6	……	CRC16 Low byte
7	……	CRC16 High byte

Returned data：

Byte No.	Name	Value	Description
0	Header 1	0xF5	Header 1
1	Header 2	0x5F	Header 2
2	Low byte of message length	0x07	Low byte of message length
3	High byte of message length	0x00	High byte of message length
4	Device address	……	Currently responding device address
5	RID	0xAC	Returned packet type ID (RID)
6	ROI group ID	0x00 ~ 0x0F	Region of interest (ROI) group ID
7	CRC16 LSB	……	CRC16 Low byte
8	CRC16 MSB	……	CRC16 High byte
9	Message end 1	0x5F	Message end 1
10	Message end 2	0xF5	Message end 2

2.2.4 Decoding of packet data

There are 4 types of data packet:

1. Complete data packet of full frame: Consists of the critical measurement data and full frame depth data. It is suitable for applications that require depth data for secondary development. The requirement of data processing capability for terminal devices is higher. The packet data is defined as follows:

Header	Message length	Device address	RID	Measure data	CRC16 value	Message end

Among these, detailed format for measuring data segment is as followed:

Byte No.	Name	Value	Description
0 ~ 1	Dummy	Arbitrary value	Those bytes can be neglected
2	Average distance	Low byte	Average distance of full frame, unit: mm
3		High byte	
4	Effective signal strength	Low byte	Effective signal strength, this value has no unit
5		High byte	
6	Average signal strength	Low byte	Average signal strength of full frame, this value has no unit, specified definition is: Average signal strength < 150: Weak signal 150 <= Average signal strength <= 800: Signal good Average signal strength > 800: Signal too high
7		High byte	
8	Number of weak signal pixels	Low byte	Number of weak signal pixels
9		High byte	
10	Number of	Low byte	Number of saturated pixels

11	saturated pixels	High byte	
12	Maximum distance	Low byte	Maximum distance of full frame, if this value is 0, it indicates invalid data
13		High byte	
14	Minimum distance value	Low byte	Minimum distance of full frame, if the value is 65535, it indicates invalid data
15		High byte	
16	Data frame counter	Lowest byte	Data frame counter, used for confirming data transmission, and check whether frame is lost
17		Low byte	
18		High byte	
19		Highest byte	
20 ~ 23	Reserved bytes	……	Reserved bytes
19200 bytes	Depth data	2 bytes / pixel, lower byte data is stored in lower byte	Data is arranged as: Pixel 1…Pixel 160 Pixel 161…Pixel 320 …… Pixel 9440…Pixel 9600

2. Simplified data packet of full frame: Only critical measurement data are included. It is suitable for applications that require only critical measurement data of full frame, it requires less data processing capability and communication band width for terminal devices. The packet data is defined as follows:

Byte No.	Name	Value	Description
0 ~ 1	Dummy	Arbitrary value	Those bytes can be neglected
2	Average distance	Low byte	Average distance of full frame, unit: mm
3		High byte	
4	Effective signal strength	Low byte	Effective signal strength, this value has no unit
5		High byte	
6	Average signal strength	Low byte	Average signal strength of full frame, this value has no unit, specified definition is: Average signal strength < 150: Weak signal 150 <= Average signal strength <= 800: Signal good Average signal strength > 800: Signal too high
7		High byte	
8	Number of weak signal pixels	Low byte	Number of weak signal pixels
9		High byte	
10	Number of saturated pixels	Low byte	Number of saturated pixels
11		High byte	
12	Maximum distance value	Low byte	Maximum distance of full frame, if this value is 0, it indicates invalid data
13		High byte	
14	Minimum distance value	Low byte	Minimum distance of full frame, if the value is 65535, it indicates invalid data
15		High byte	
16	Data frame counter	Lowest byte	Data frame counter, used for confirming data transmission, and check whether frame is lost
17		Low byte	
18		High byte	

19		Highest byte	
20 ~ 23	Reserved bytes	……	Reserved bytes

3. Complete data packet of ROI: Consists of the critical measurement data and depth data of ROI. It is suitable for applications that only require a specific ROI information in the perspective. The requirement for data processing capability of the terminal device is moderate. The packet data is defined as follows:

Header	Message length	Device address	RID	ROI information	ROI measuring data 1	……	ROI measuring data N	CRC16	Message end

Among these, detailed format for ROI information segment is as followed:

Byte No.	Name	Value	Description
0	Number of enabled ROI	0x00~0x07	The number of enabled ROI
1	Group ID of ROI	0x00~0x0F	Current group ID of ROI
2	Data frame counter	Lowest byte	Data frame counter, used for confirming data transmission, and check whether frame is lost
3		Low byte	
4		High byte	
5		Highest byte	
6 ~ 23	Reserved bytes	……	Reserved bytes

Detailed format for ROI measuring data segment is as followed:

Byte No.	Name	Value	Description
0	ROI ID	Low byte	ID number current region of interest
1		High byte	
2	Upper left corner X coordinate of ROI	Low byte	Upper left corner X coordinate of current region of interest
3		High byte	
4	Upper left corner Y coordinate of ROI	Low byte	Upper left corner Y coordinate of current region of interest
5		High byte	
6	Lower right corner X coordinate of ROI	Low byte	Lower right corner X coordinate of current region of interest
7		High byte	
8	Lower right corner Y coordinate of ROI	Low byte	Lower right corner Y coordinate of current region of interest
9		High byte	
10	Average signal strength	Low byte	Average signal strength of ROI, this value has no unit, the larger value corresponds to higher reflected signal strength, specified definition is: Average signal strength < 150: Weak signal 150 <= Average signal strength <= 800: Signal good Average signal strength > 800: Signal too high
11		High byte	
12	Effective signal strength	Low byte	Effective signal strength, this value has no unit
13		High byte	

14	Average distance	Low byte	Average distance of ROI, unit: mm
15		High byte	
16	Maximum distance	Low byte	Maximum distance of ROI, if this value is 0, it indicates invalid data
17		High byte	
18	Minimum distance	Low byte	Minimum distance of ROI, if the value is 65535, it indicates invalid data
19		High byte	
20	Number of saturated pixels	Low byte	Number of saturated pixels
21		High byte	
22	Threshold comparison result	Low byte	Bit0 ~ Bit2: threshold 0, threshold 1 and threshold 2, the corresponding bit will be automatically set 1 or 0 when alarm triggered or alarm released Bit3 ~ Bit15: reserved
23		High byte	
24	X coordinate of maximum distance pixel	Low byte	X coordinate of maximum distance pixel in ROI
25		High byte	
26	Y coordinate of maximum distance pixel	Low byte	Y coordinate of maximum distance pixel in ROI
27		High byte	
28	X coordinate of minimum distance pixel	Low byte	X coordinate of minimum distance pixel in ROI
29		High byte	
30	Y coordinate of minimum distance pixel	Low byte	Y coordinate of minimum distance pixel in ROI
31		High byte	
……	Depth data	2 bytes / pixel, lower byte data is stored in lower byte	The initial data is the first pixel on left upper corner, remaining data outputs in line order.

4. Simplified data packet of ROI: Only critical measurement data of ROI are included. It requires lowest data processing capability and communication band width for terminal devices. The packet data is defined as follows:

Header	Message length	Device address	RID	ROI information	ROI measuring data 1	……	ROI measuring data N	CRC16	Message end

Among these, detailed format for ROI information segment is as followed:

Byte No.	Name	Value	Description
0	Number of enabled ROI	0x00~0x07	The number of enabled ROI
1	Group ID of ROI	0x00~0x0F	Current group ID of ROI
2	Data frame counter	Lowest byte	Data frame counter, used for confirming data transmission, and check whether frame is lost
3		Low byte	

4		High byte	
5		Highest byte	
6 ~ 23	Reserved bytes	……	Reserved bytes

Detailed format for ROI measuring data segment is as followed:

Byte No.	Name	Value	Description
0	ROI ID	Low byte	ID number current region of interest
1		High byte	
2	Average signal strength	Low byte	Average signal strength of ROI, this value has no unit, the larger value corresponds to higher reflected signal strength, specified definition is: Average signal strength < 150: Weak signal 150 <= Average signal strength <= 800: Signal good Average signal strength > 800: Signal too high
3		High byte	
4	Effective signal strength	Low byte	Effective signal strength, this value has no unit
5		High byte	
6	Average distance	Low byte	Average distance of ROI, unit: mm
7		High byte	
8	Maximum distance	Low byte	Maximum distance of ROI, if this value is 0, it indicates invalid data
9		High byte	
10	Minimum distance	Low byte	Minimum distance of ROI, if the value is 65535, it indicates invalid data
11		High byte	
12	Number of saturated pixels	Low byte	Number of saturated pixels
13		High byte	
14	Threshold comparison result	Low byte	Bit0 ~ Bit2: threshold 0, threshold 1 and threshold 2, the corresponding bit will be automatically set 1 or 0 when alarm triggered or alarm released Bit3 ~ Bit15: reserved
15		High byte	
16	X coordinate of maximum distance pixel	Low byte	X coordinate of maximum distance pixel in ROI
17		High byte	
18	Y coordinate of maximum distance pixel	Low byte	Y coordinate of maximum distance pixel in ROI
19		High byte	
20	X coordinate of minimum distance pixel	Low byte	X coordinate of minimum distance pixel in ROI
21		High byte	
22	Y coordinate of minimum distance pixel	Low byte	Y coordinate of minimum distance pixel in ROI
23		High byte	
24 ~ 32	Reserved bytes	……	Reserved bytes

Packet information

Type	HPS-3D160
Dimension	78 (L) x 40 (W) x 30 (H)
Weight	110g / unit （not include cable）
Packet box	183 (L) x 173 (W) x 66 (H) 1 pcs / box

Revision history

Date	Revision	Description
2018/10/15	1.0	Initial version.
2018/11/16	1.1	Corrected CRC initial value (0 -> 0xffff).

Appendix

CRC16's C language complementation

```
static const USIGN16 crc16_tab[] = {
      0x0000, 0x1021, 0x2042, 0x3063, 0x4084, 0x50a5, 0x60c6, 0x70e7,
      0x8108, 0x9129, 0xa14a, 0xb16b, 0xc18c, 0xd1ad, 0xe1ce, 0xf1ef,
      0x1231, 0x0210, 0x3273, 0x2252, 0x52b5, 0x4294, 0x72f7, 0x62d6,
      0x9339, 0x8318, 0xb37b, 0xa35a, 0xd3bd, 0xc39c, 0xf3ff, 0xe3de,
      0x2462, 0x3443, 0x0420, 0x1401, 0x64e6, 0x74c7, 0x44a4, 0x5485,
      0xa56a, 0xb54b, 0x8528, 0x9509, 0xe5ee, 0xf5cf, 0xc5ac, 0xd58d,
      0x3653, 0x2672, 0x1611, 0x0630, 0x76d7, 0x66f6, 0x5695, 0x46b4,
      0xb75b, 0xa77a, 0x9719, 0x8738, 0xf7df, 0xe7fe, 0xd79d, 0xc7bc,
      0x48c4, 0x58e5, 0x6886, 0x78a7, 0x0840, 0x1861, 0x2802, 0x3823,
      0xc9cc, 0xd9ed, 0xe98e, 0xf9af, 0x8948, 0x9969, 0xa90a, 0xb92b,
      0x5af5, 0x4ad4, 0x7ab7, 0x6a96, 0x1a71, 0x0a50, 0x3a33, 0x2a12,
      0xdbfd, 0xcbdc, 0xfbbf, 0xeb9e, 0x9b79, 0x8b58, 0xbb3b, 0xab1a,
      0x6ca6, 0x7c87, 0x4ce4, 0x5cc5, 0x2c22, 0x3c03, 0x0c60, 0x1c41,
      0xedae, 0xfd8f, 0xcdec, 0xddcd, 0xad2a, 0xbd0b, 0x8d68, 0x9d49,
      0x7e97, 0x6eb6, 0x5ed5, 0x4ef4, 0x3e13, 0x2e32, 0x1e51, 0x0e70,
      0xff9f, 0xefbe, 0xdfdd, 0xcffc, 0xbf1b, 0xaf3a, 0x9f59, 0x8f78,
      0x9188, 0x81a9, 0xb1ca, 0xa1eb, 0xd10c, 0xc12d, 0xf14e, 0xe16f,
      0x1080, 0x00a1, 0x30c2, 0x20e3, 0x5004, 0x4025, 0x7046, 0x6067,
      0x83b9, 0x9398, 0xa3fb, 0xb3da, 0xc33d, 0xd31c, 0xe37f, 0xf35e,
      0x02b1, 0x1290, 0x22f3, 0x32d2, 0x4235, 0x5214, 0x6277, 0x7256,
      0xb5ea, 0xa5cb, 0x95a8, 0x8589, 0xf56e, 0xe54f, 0xd52c, 0xc50d,
      0x34e2, 0x24c3, 0x14a0, 0x0481, 0x7466, 0x6447, 0x5424, 0x4405,
      0xa7db, 0xb7fa, 0x8799, 0x97b8, 0xe75f, 0xf77e, 0xc71d, 0xd73c,
      0x26d3, 0x36f2, 0x0691, 0x16b0, 0x6657, 0x7676, 0x4615, 0x5634,
      0xd94c, 0xc96d, 0xf90e, 0xe92f, 0x99c8, 0x89e9, 0xb98a, 0xa9ab,
      0x5844, 0x4865, 0x7806, 0x6827, 0x18c0, 0x08e1, 0x3882, 0x28a3,
      0xcb7d, 0xdb5c, 0xeb3f, 0xfb1e, 0x8bf9, 0x9bd8, 0xabbb, 0xbb9a,
      0x4a75, 0x5a54, 0x6a37, 0x7a16, 0x0af1, 0x1ad0, 0x2ab3, 0x3a92,
      0xfd2e, 0xed0f, 0xdd6c, 0xcd4d, 0xbdaa, 0xad8b, 0x9de8, 0x8dc9,
      0x7c26, 0x6c07, 0x5c64, 0x4c45, 0x3ca2, 0x2c83, 0x1ce0, 0x0cc1,
      0xef1f, 0xff3e, 0xcf5d, 0xdf7c, 0xaf9b, 0xbfba, 0x8fd9, 0x9ff8,
      0x6e17, 0x7e36, 0x4e55, 0x5e74, 0x2e93, 0x3eb2, 0x0ed1, 0x1ef0,
};

/*---------------------------------------------------------------------------*/
// @USIGN16 Calc_CRC16(const USIGN8 *buf, const int len)
// @brief Calculate 2 bytes 16 bit CRC check value
// @param buf- Data buffer pointer to be calculated
// @param len- Data length to be calculated
// @return 16bit CRC check value
/*---------------------------------------------------------------------------*/
```

```
USIGN16 Calc_CRC16(const USIGN8 *buf, const USIGN32 len)
{
    USIGN32 i;
    USIGN16 cksum;

    cksum = 0xffff;
    for (i = 0;   i < len;   i++) {
        cksum = crc16_tab[((cksum>>8) ^ *buf++) & 0xFF] ^ (cksum << 8);
    }
    return cksum;
}

/*--------------------------------The End of File----------------------------*/
```

Note:
The SDK is available, please contact sales@hypersen.com for more information.

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