



Thermal Camera Module Component

TECHNICAL MANUAL

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Chapter 1. Technical Index

The technical index of thermal camera module component includes the performance index and the function index.

Performance Index

Take the table below for the index of thermal camera module component performance.

No.	Technical Index	Description
1	Type	DS-2TM06-NF
2	Detector Type	Vanadium Oxide Uncooled Focal Plane Arrays
3	Detector Material	Vanadium Oxide
4	Detector Resolution	640 × 512
5	Response Waveband	8 μm to 14 μm
6	Detector Pitch	17 μm
7	NETD	<35mk @ F1.0, 30 °C (86 °F)
8	Working Environment Temperature	-40 °C to +70 °C (-40 °F to 158 °F)
9	Storage Condition	-45 °C to +85 °C (-49 °F to 185°F)
10	Power Voltage	12 V DC
11	First image	< 5s
12	Power Consumption	≤ 1.8w (TYP)
13	Video Output	BT.656 (720 × 576)
14	Communication Type	RS-232 Serial Port
15	Shutter Life	300,000 Times
16	Dimensions	40 mm × 41 mm × 49 mm (1.57 "× 1.61 "× 1.93 ")
17	Lens Mount	M34*0.75
18	Lens (Optional)	15 mm, FOV: 40° × 32° (H × V); 25 mm, FOV: 24° × 19° (H × V)
19	Palettes	White Hot, Black Hot, Fusion1, Rainbow, Fusion2, Ironbow1, Ironbow2, Sepia, Color1, Color2, Ice Fire, Rain, Green Hot, Red Hot, Dark Blue
20	Weight (without Lens)	Less than 90 g (0.20 lb.)
21	Frame	25 fps
22	Impact Strength	750g, 1 MS

Function Index

Take the table below for the index of thermal camera module component function.

No.	Function
1	Manual Background Correction, Manual Shutter Correction.
2	Shutter Release (Auto-correction, Scheduled Correction, Disable Correction)
3	Disable Crossed Mark Display, Crossed Mark Position Adjustment.
4	Manual Image Contrast and Brightness Adjustment.
5	DDE (Digital Detail Enhancement)
6	3D DNR (Digital Noise Reduction)
7	Freeze Image
8	Online Defective Pixel Correction, Defective Pixel Saved.
9	Save User Settings, Restore Factory Settings
10	CVBS Output (ON and OFF)
11	Palettes

Chapter 2. Product Introduction

Appearance Requirement

The detector window should be dust-free, scratch-free, and no redundancy or break. The detector size should meet the requests in **Section Appearance Dimensions**.

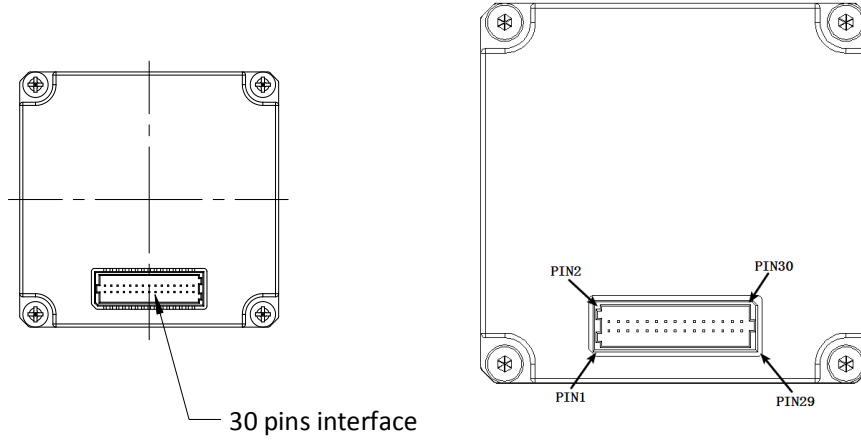
Electrical Interface

The FPC connector interfaces (30-pin) of thermal camera module component is shown below.

Pin	Signal	Description	Pin	Signal	Description
1	Power Input +	POWER, 12VDC	2	GND	GND
3	Power Input +	POWER, 12VDC	4	GND	GND
5	GND	GND	6	NC	Reserved
7	RS232_RXD	For User: TXD, Standard	8	NC	Reserved
9	RS232_TXD	For User: RXD, Standard	10	VP_D7 (LVTTTL Level)	Data 7
11	NC	Reserved	12	VP_D6 (LVTTTL Level)	Data 6
13	NC	Reserved	14	VP_D5 (LVTTTL Level)	Data 5
15	NC	Reserved	16	VP_D4 (LVTTTL Level)	Data 4
17	NC	Reserved	18	VP_D3 (LVTTTL Level)	Data 3
19	NC	Reserved	20	VP_D2 (LVTTTL Level)	Data 2
21	Video GND	GND	22	VP_D1 (LVTTTL Level)	Data 1
23	Video GND	GND	24	VP_D0 (LVTTTL Level)	Data 0
25	Video	CVBS	26	GND	GND
27	Video GND	GND	28	VP_CLK (LVTTTL Level)	Clock
29	NC	Reserved	30	GND	GND

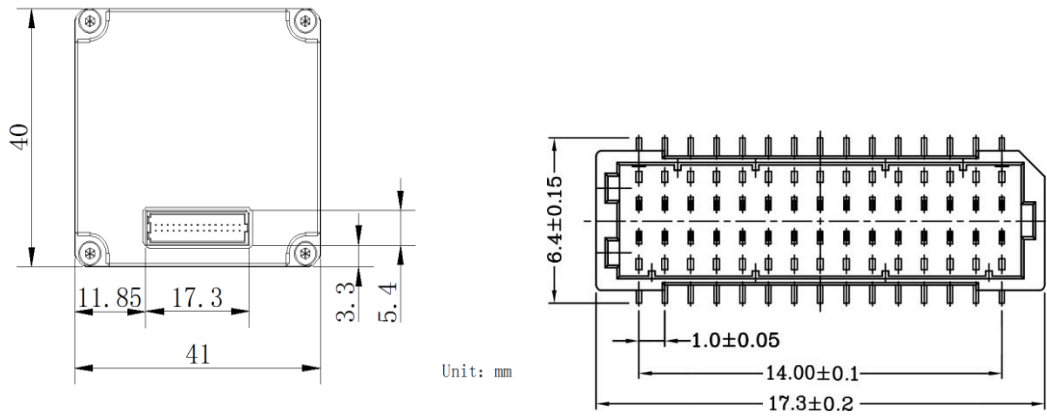
Terminals and Interfaces

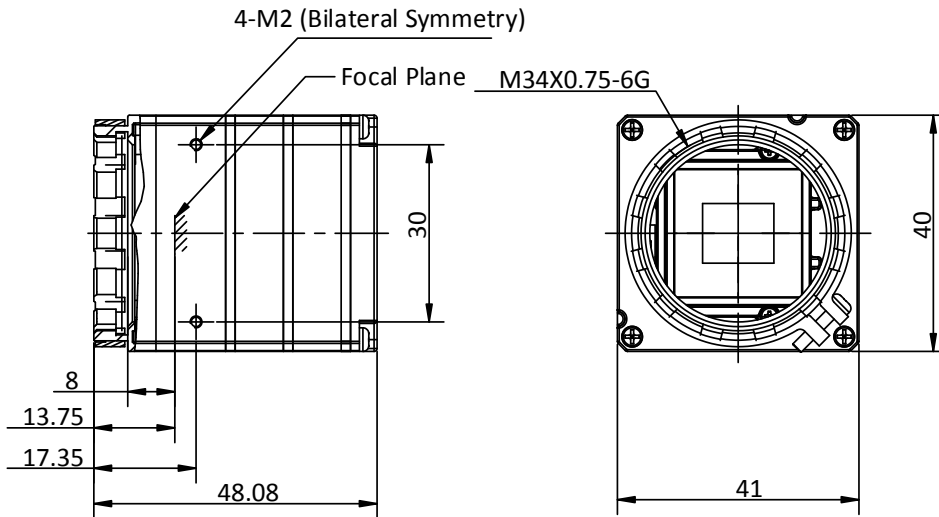
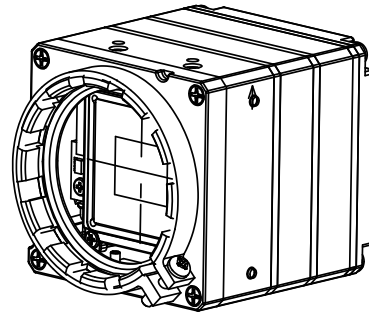
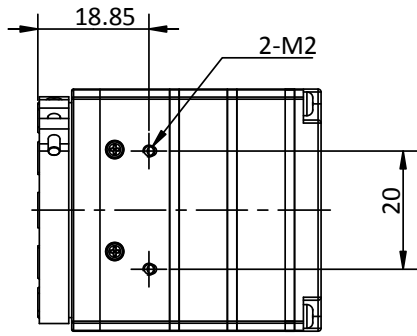
The terminal and interface description are shown in the figure below.



Appearance Dimensions

The appearance dimensions are shown in the figure below.





Chapter 3. Serial Port Communication

Communication Type

The thermal camera module component adopts the RS-232 asynchronous serial communication.

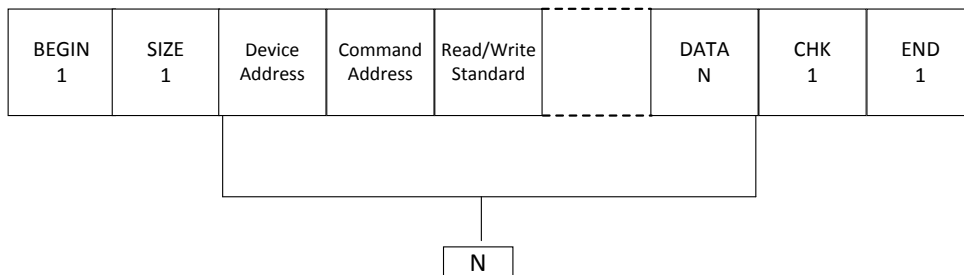
Communication Format

The thermal camera module component serial port communication format is shown in the table below.

Baud Rate	19200 bps by default. Adjustable via software, ranges from 2400bps to 115200bps.
Start Bit	1-digit
Data Bit	8-digit
Stop Bit	1-digit
Verification Mode	None

Sending Data Package

Thermal camera module component serial communication data package contains multiple fields, as shown in the figure below.

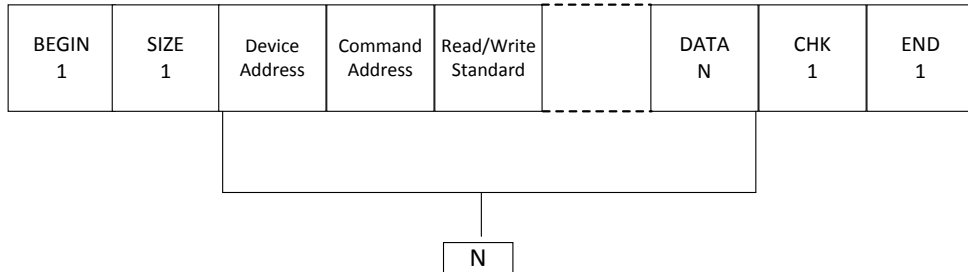


The specific definition of each field of communication data package is in the figure below.

Field	Digit	Description	Value	Position (Byte)
BEGIN	1	Command Package Start	0xF0	1
SIZE	1	Length: N		2
Device Address	1	Device address: 0x36	0x36	3
Specified Address	1	Specified Address		4
Read/Write Standard	1	Read/Write Standard	Write: 0x0 Read: 0x1	5
DATA	N - 2	Data Content	0x00 (Default)	6 - N+2
CHK	1	Sum Verification	Device Address + Specified Address + Read/Write Standard + DATA1 ... +DATAN	(N+3)
END	1	End Command Package	FF	(N+4)

Receiving Data Package

The format of command from the thermal module component to the controller is shown in the figure below. DATA1 is high byte, and DATA N is low byte.



The specific definition of each field of communication data package is in the figure below.

Field	Digit	Description	Value	Position (Byte)
BEGIN	1	Command Package Start	0xF0	1
SIZE	1	Length: N	Depend on Length	2
Device Address	1	Device address: 0x36	0x36	3
Command Number	1	Command Number		4
Return Standard	1	Read/Write Standard Return Standard	Return: 0x03	5
DATA	N - 2	Data Content	0x00 (Default)	6 – N+2
CHK	1	Verification	Device Address + Command Number + Return Standard + DATA1 ... +DATAN	(N+3)
END	1	End Command Package	FF	(N+4)

When the controller sends the Read/Write command to the thermal module component, the thermal module component receives complete of them and returns the actual status of Write command to the controller. Value 0x01 means successful, and value 0x00 means failed. When the thermal module component receives the Read Command, it reads the data from the register and returns the data to the controller by protocol.

Communication Protocol Request

The thermal camera sends command to the thermal camera module component, and the thermal module component realizes corresponding action.

The communication command will be sent according to the agreed data package format.

Control Command

Thermal camera sends control command according to the list below.

Device Address	Command	Additional Data	Description	Default

0x36	0x02	Read camera module component FPGA program version number. (Read Only)	e.g. 5.1.12, 5 is version number, 1 is minor version number, and 12 is subdivision version, occupies 3 bytes, such as 0x050112.	
0x36	0x03	Read camera module component FPGA program compilation time. (Read Only)	e.g. 20140820 occupies 4 bytes, such as 0x20140820.	
0x36	0x04	Read camera module software version. (Read Only)	Refer to 0x02	
0x36	0x05	Read camera module software compile time. (Read Only)	Refer to 0x03	
0x36	0x06	Read device model. 0x00 0x52 0x71 0x00 0x00 (Read Only)	5-bytes, return device model	
0x36	0x07	Change baud rate (Write Only)	0~8 : Baud Rate code 0: 1200 1: 2400 2: 4800 3: 9600 4: 14400 5: 19200 6: 38400 7: 56000 8: 115200	Default is 5
0x36	0x0E	Read camera manufacture date (Read Only)	e.g. 20170101 occupies 4 bytes, such as 0x20170101. MSB is high byte, 0x20170101.	
0x36	0x0F	Read camera hardware date (Read Only)	e.g. 20170101 occupies 4 bytes, such as 0x20170101. MSB is high byte, 0x20170101.	
0x36	0x10	0x01 Shutter release 0 x00 Shutter close (Write Only)	Shutter Release	
0x36	0x11	(Write Only)	Manual Shutter Correction, FFC	
0x36	0x12	(Write Only)	Manual Background Correction, External Correction	
0x36	0x13	0x00 Auto-switch close 0x01 Auto-switch open, scheduled control. 0x02 Auto-switch open, temperature difference control. 0x03, Auto-switch open, referred to scheduled mode and temperature	Shutter Release Auto-Switch	0x00

		difference mode. (Write Only)		
0x36	0x14	Duration of minutes, 2-bytes 10 minutes by default, as 0x00 0x0A.	Shutter switch Interval	Auto- Time 0x0A
0x36	0x16	0x00 Disable 0x01 Enable (Write Only)	NUC function	0x01
0x36	0x17	Data is one byte, Valid range is 30 to 160.	AGC Expected Brightness	0x32
0x36	0x18	Data is one byte, Valid range is 0 to 128, 64 as default.	AGC Contrast	0x32
0x36	0x20	Data is two bytes, Valid range is 0 to 511, 256 by default.	DDE Detail Strength	0x32
0x36	0x25	Data is one byte, Valid range is 0 to 100, 50 by default.	DNR Spectral Level	0x32
0x36	0x26	Data is one byte, Valid range is 0 to 100, 50 by default.	DNR Temporal Level	0x32
0x36	0x30	0x00 to close the cross cursor, 0x0F to enable the cross cursor, 0x02 to move upward the cross cursor, 0x03 to move downward the cross cursor, 0x04 to move leftward the cross cursor, 0x05 to move rightward the cross cursor, 0x06 to place the cross cursor in the center, 0x0D to add the cross cursor to dead pixel list, 0x0E to delete the cross cursor to dead pixel list, 0x2N to move N digits the cross cursor (N is 0x1 ~ 0xf)	Manual DPC and Cross Cursor Control Switch	0x00 by Default, Closed.
0x36	0x31	Data length is two bytes, ranges from 1 to 640 (from high to low). Note that the cursor position starts from 1, such as 384, and the data is 0x0180.	Cross Cursor Horizontal Ordinate	321
0x36	0x32	Data length is two bytes, ranges from 1 to 512 (from high to low). Note that the cursor position starts from 1, such as 288, and the data is 0x0120.	Cross Cursor Vertical Ordinate	257
0x36	0x33	Data length is four bytes, first two bytes are horizontal ordinate, and the last two bytes are vertical ordinate, such as (384,288), and the data is 0x01, 0x80, 0x01, 0x20.	Cross Cursor Central Ordinate	(321, 257)
0x36	0x39	14 Pallets 0x0: White Hot 0x1: Black Hot 0x2: Fusion 1 0x3: Rainbow 0x4: Fusion 2 0x5: Ironbow 1 0x6: Ironbow2		

		0x7: Sepia 0x8: Color 1 0x9: Color 2 0xA: Ice Fire 0xB: Rain 0xC: Green hot 0xD: Red hot 0xE: Dark Blue		
0x36	0x3A	0x00 OFF 0x01 ON	CVBS	0x00
0x36	0x80	Restore parameters of camera module component to factory settings	Restore factory settings	
0x36	0x81	Saving modified parameters of camera module component ISP	Save user settings	

Thermal Module Component Control Command

When the thermal module component receives query command from the thermal camera, it sends back corresponding return to the host. The data package meets the “Communication Data Package Agreement”.

Change Baud Rate

Change Baud Rate:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x07	0x00	0~8 : Baud Rate code 0: 1200 1: 2400 2: 4800 3: 9600 4: 14400 5: 19200 6: 38400 7: 56000 8: 115200	Change Baud Rate

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x07	0x03	0: change succeeded 1: change failed	

Manual Shutter Correction

Manual Shutter Correction:

Device Address	Command Standard	Read/Write	Attached Data	Remark
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		Standard		
0x36	0x11	0x00	N/A	Manual Shutter Correction

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x11	0x03	N/A	

Manual Background Correction

Manual Background Correction:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x12	0x00	N/A	Manual Background Correction

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x12	0x03	N/A	

DDE Detail Strengths

DDE Detail Strength:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x20	0x00	0 to 511, 256 by default.	DDE Detail

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x20	0x03	N/A	

DNR Spectral Level

DNR Spectral Level Adjustment:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x25	0x00	0 to 100, 50 by default.	DNR Spectral Level

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x25	0x03	N/A	

DNR Temporal Level

DNR Spectral Level Adjustment:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x26	0x00	0 to 100, 50 by default.	DNR Spectral Level

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x26	0x03	N/A	

Brightness Level

Brightness Level Adjustment:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x17	0x00 (write)	0 to 100, 50 by default.	

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x17	0x03	N/A	

Contrast Level

Contrast Level Adjustment:

Device Address	Command Standard	Read/Write Standard	Attached Data	Remark
0x36	0x18	0x00 (write)	0 to 100, 50 by default.	

Return

Device Address	Command Standard	Return Standard	Attached Data	Remark
0x36	0x18	0x03	N/A	

Data Upgrade Command and Transmission Order

Change Baud Rate (Normal UART Command)

Change Baud Rate:

Begin	Size	Device address	Command Address	Write	Data Bit	CHK	END
0xF0	0x04	0x36	0x07	0x00	0x08	0x45	0xFF

Return

Begin	Size	Device address	Command Address	Return	Data Bit	CHK	END
0xF0	0x04	0x36	0x07	0x03	0x01	0x41	0xFF

Start Upgrade (Normal UART Command)

Start Upgrade:

Begin	Size	Device address	Command Address	Write	CHK	END
0xF0	0x03	0x36	0xE0	0x00	0x16	0xFF

Return

Begin	Size	Device address	Command Address	Return	Data Bit	CHK	END
0xF0	0x04	0x36	0xE0	0x03	0x01	0x1A	0xFF

Confirm Upgrade (Normal Mode UART Command)

Confirm Upgrade:

Begin	Size	Device address	Command Address	Write	CHK	END
0xF0	0x03	0x36	0xE1	0x00	0x17	0xFF

Return

Begin	Size	Device address	Command Address	Return	Data Bit	CHK	END
0xF0	0x04	0x36	0xE1	0x03	0x01	0x1B	0xFF

Send Upgrade Address (Upgrade Mode UART Command)

Send Upgrade Address:

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x00 0x05	0xE3	0XX 0XX	0XX	0xFF

			0xXX 0xXX		
--	--	--	--------------	--	--

Return

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xE3	0x01	0xE4	0xFF

Send Upgrade Package Size (Upgrade Mode UART Command)

Send Upgrade Package Size:

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x00 0x04	0xE4	0xXX 0xXX 0xXX	0xXX	0xFF

Return

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xE4	0x01	0xE5	0xFF

Send Upgrade Data (Upgrade Mode UART Command)

Send Upgrade Data:

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0xXX 0xXX	0xEE	--	0xXX	0xFF

Return

Succeed

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xEE	0x01	0xF0	0xFF

Failed, send again:

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xEE	0x00	0xEF	0xFF

Send Upgrade End Command (Upgrade Mode UART Command)

Send Upgrade End Command:

Begin	Size	Command Number	CHK	END
0xF1	0x00 0x01	0xE5	0xE5	0xFF

Return

Succeed

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xE5	0x01	0xE6	0xFF

Failed

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xE5	0x00	0xE5	0xFF

Quit Upgrade Mode (Upgrade Mode UART Command)

Send Upgrade Data:

Begin	Size	Command Number	CHK	END
0xF1	0x00 0x01	0xE6	0xE6	0xFF

Return

Begin	Size	Command Number	Data Bit	CHK	END
0xF1	0x01	0xE6	0x01	0xE7	0xFF

Note: when UART Command in upgrade mode, $CHK = \text{Command Number} + \text{Data Bit}$

Chapter 4. BT656 Communication Protocol

The thermal camera module component support BT656 output. A field of standard video interface ITU-RBT.656 (PAL, 720*576) consists of four sections.

- Valid Data
It includes odd field and even field. Each field has 288 lines. For each line, there are 1440 bytes, of which 720 bytes are Y data, 360 bytes Cr data and 360 bytes Cb data. The value of Y data is from 16 to 235, the value of Cb or Cr data is from 16 to 240.
- Horizontal Blanking
It includes 280 bytes.
- Vertical Blanking
- Control Code

The EAV (End of Active Video) and SAV (Start of Active Video) parts of the stream are timing codes. Both EAV and SAV codes have four bytes. The first three bytes in the sequence are a fixed preamble: FF, 00, 00. The fourth byte, often labeled "XY". The bit assignment of XY is shown as below:

Bit	Symbol	Function
7	1	Always set to 1.
6	F	Field bit Odd field or even field.
5	V	Vertical Blanking Status bit Blanking area or active video area.
4	H	Horizontal Blanking Status bit SAV or EAV.
3-0	P3P2P1P0	Protection bit $P3=V(XOR)H$; $P2=F(XOR)H$; $P1=F(XOR)V$; $P0=F(XOR)V(XOR)H$

The description of EAV and SAV is shown in table below:

Bit7	Bit6	Bit5	Bit4	Bit3	Hex	Description
1	0	0	0	0000	0x80	Even, Active, SAV
1	0	0	1	1101	0x9d	Even, Active, EAV
1	0	1	0	1011	0xab	Even, Blank, SAV
1	0	1	1	0110	0xb6	Even, Blank, EAV
1	1	0	0	0111	0xc7	Odd, Active, SAV
1	1	0	1	1010	0xda	Odd, Active, EAV
1	1	1	0	1100	0xec	Odd, Blank, SAV
1	1	1	1	0001	0xf1	Odd, Blank, EAV

Blanking in Figure 1 means the Horizontal Blanking, it is 80H/10H in general.

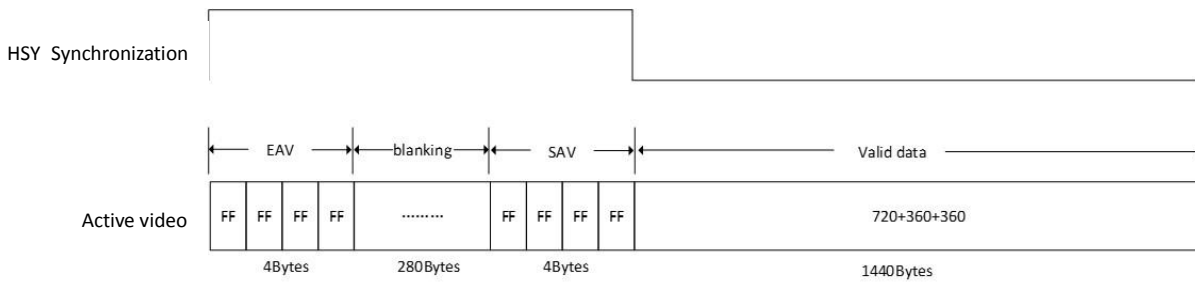


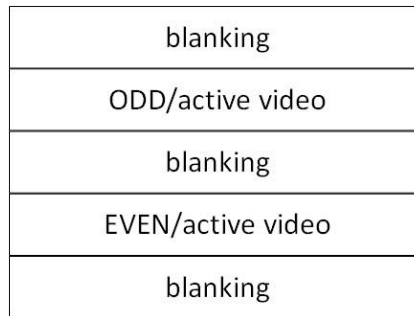
Figure 1



Figure 2

The data sequence of Valid data in Figure 1 is shown in Figure 2. Y : Cb : Cr=4 : 2 : 2. It means each pixel has an individual Y value. Neighbor pixels have Cb and Cr of the same value.

The data sequence of a field in PAL is shown below:



The description of BT656 signal is shown as table below:

Number	Signal	Function Description
1	Clock	Clock, transmission frequency: Approx. 27 Mhz
2	DATA	Data Signal, 8 bits

