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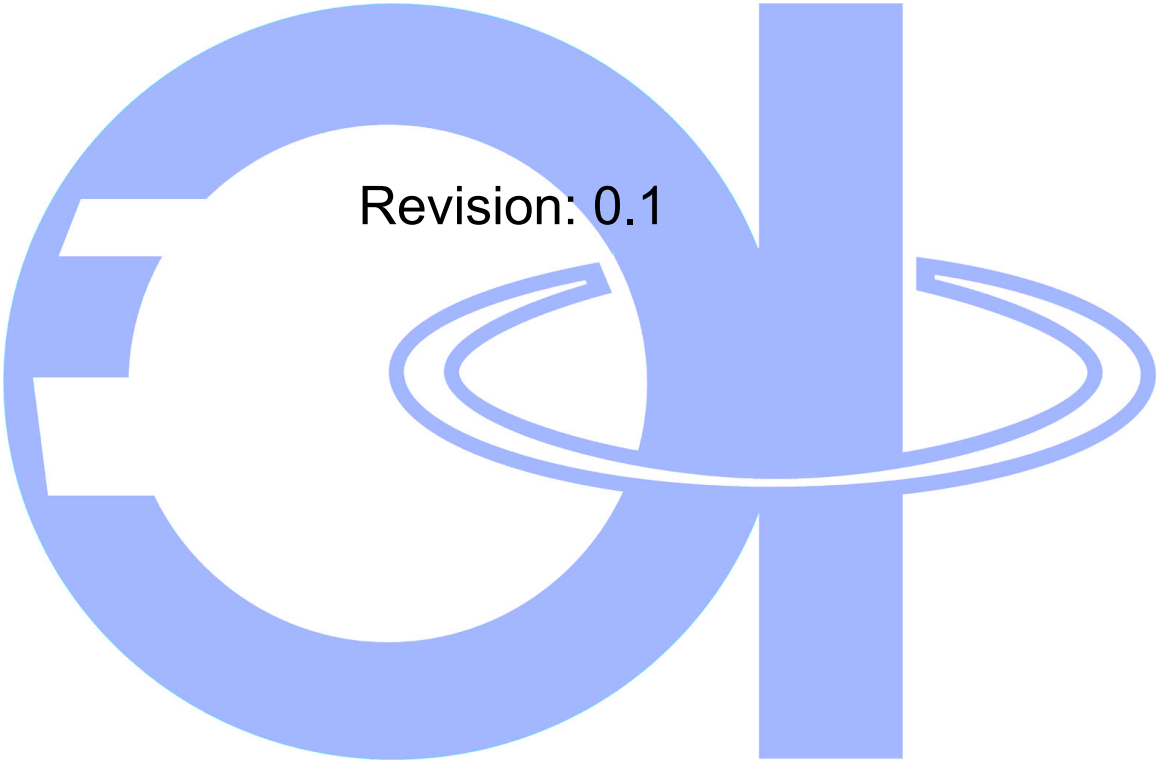
JL32xxAV1 -

UART Host Interface



Revision: 0.1

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Revision History

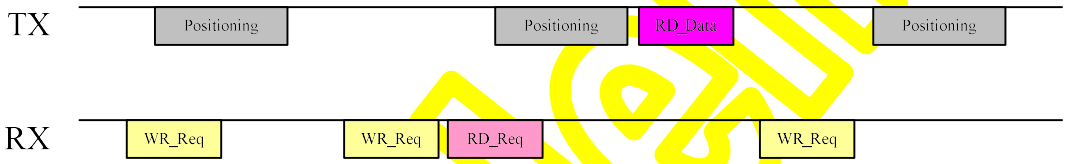
Revision	Description of Changes	Date
0.1	Preliminary release	Jan/27/2018

Introduction

This document describes UART host interface of JL32xxAV1. The “JL32xx” represents JL3283, JL3285 and JL3287. “V1” represents mask ROM revision 1.

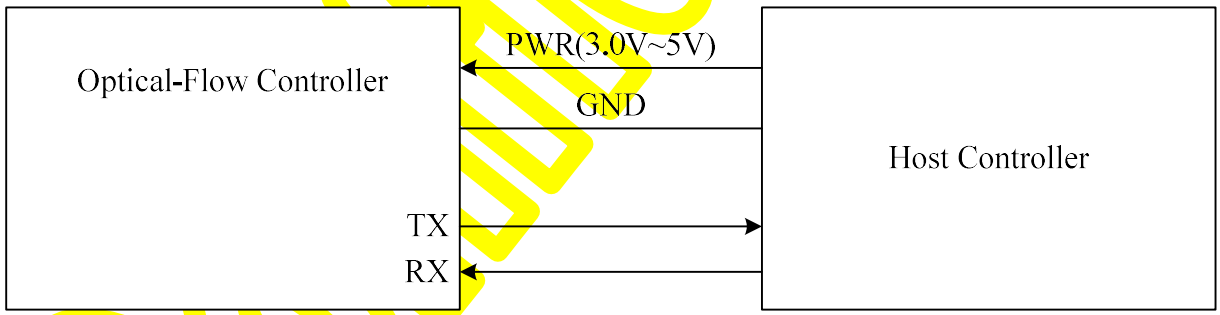
JL3283AV1 supports QVGA sensor, JL3285AV1 supports VGA sensor and JL3287AV1 supports dual QVGA sensors for both downward and forward positioning.

Host CPU exchanges info with optical flow controller via bi-directional UART bus. All data on UART bus are packed into packets for delivery. Optical flow controller outputs “Positioning” packet on TX bus after each frame processed, host CPU launches “WR_Req” or “RD-Req” packets to set device configurations or polling device status as needed. The following figure shows an example of UART communication scenario.



Detail UART protocol is described as bellows:

Wire Connection



Baud settings

- Baud rate: 115200
- Data: 8 bit
- Parity: none
- Stop: 1 bit

Packet Framework

4 types of packet would be delivered on UART bus, i.e. “Positioning”, “WR_Req”, “RD_Req” and “RD_Data”. The structure of each packet explains as bellows:

- **Positioning Packet (TX)**

  This packet delivers positioning info to host CPU after each image frame processed automatically, The packet rate is same as image frame rate. If DSP is JL3287AV1, the packet rate will be the frame rate sum of both sensors. Positioning packet structure is backward compatible with JL3281A positioning packet.

Symbol	Byte order	Description	Remark
"#JB#" or “#S2#”	B[0:3]	4-characters string as packet ID #JB# represents positioning packet of downward-sensor #S2# represents positioning packet of forward-sensor, only JL3287AV1 can launch this packet.	
Reserved	B[4]	Reserved	
Quality	B[5]	This value tells the positioning quality of surface feature, the bigger the better. ● Quality between 128~255 indicates surface feature is strong ● Quality between 64~127 indicates surface feature is normal ● Quality between 32~63 indicates surface feature is weak, it is not suggest for high speed motion over these surfaces. ● Quality between 0~31 indicates surface feature is poor or ambient light is very low. Motion over these surfaces may with accumulated errors. Value range: 0~255	
Delta-X	B[6]	The X-axis pixel motion value between successive images. Value range: Forward QVGA sensor: -7~+7 pixel/frame Downward QVGA sensor: -45~45 pixel /frame Downward VGA sensor: -55~+55 pixel /frame	
Delta-Y	B[7]	The Y-axis pixel motion value between successive images. Value range: Forward QVGA sensor: -7~+7 pixel /frame Downward QVGA sensor: -45~45 pixel /frame Downward VGA sensor: -55~+55 pixel /frame	
Reference	B [8]	Reference search images update counter. If accumulated motion	

number		value over 5, the reference searching image will be updated automatically. This value will auto wrap to 0 after reaching 255. Value range: 0~255	
Lightness	B[9]	This value indicates the lightness of ambient. Low light environment will cause poor positioning outcomes. Value rang: 0~255	
Delta_Z	B[10]	Z-axis motion value between successive images. Optical flow controller senses object approaching or departing movement to lens. This value only supports in downward sensor (#JB# packet), in forward sensor (#S2# packet) this value will be fixed to 0. Value range: -28~28	
Sub_X	B[11]	The sub-view X-axis pixel motion value between successive images. This value only supports in downward sensor (#JB# packet), in forward sensor (#S2# packet) this value will be fixed to 0. Value range: VGA sensor: -14~14 pixel /frame QVGA sensor: -7~7 pixel /frame	
Sub_Y	B[12]	The sub-view Y-axis pixel motion value between successive images. This value only supports in downward sensor (#JB# packet), in forward sensor (#S2# packet) this value will be fixed to 0. Value range: VGA sensor: -14~14 pixel /frame QVGA sensor: -7~7 pixel /frame	
Timestamp	B[13~16]	The timestamp value, the unit is millisecond. Value range: 32bit unsigned, Little Endian	
Checksum	B[17]	Checksum value of byte 4~16. Host CPU detects check sum error if sum up of B[4] to B[17] is not 0.	
"\r\n"	B[18:19]	Packet footer	

■ WR_Req Packet (RX)

This packet delivers the bank, address and writes data of setting register to Optical flow controller. Optical flow controller will write received data to the register as mentioned.

Symbol	Byte order	Description
"#BW#"	B[0:3]	4-characters string as packet ID

		#BW# represents Write Request packet
Bank	B[4]	Bank of write register
Addr	B[5]	Address of write register
Data	B[6]	Write data
"\r\n"	B[7:8]	Packet footer

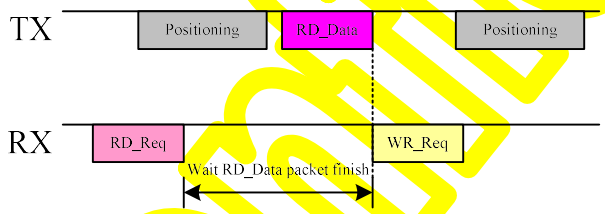
■ RD_Req Packet (RX)

This packet delivers the bank & address of register to be read to Optical flow controller. Optical flow controller will return read value to RD_Data packet to host CPU.

Symbol	Byte order	Description
"#BR#"	B[0:3]	4-characters string as packet ID #BR# represents Read Request packet
Bank	B[4]	Bank of read register
Addr	B[5]	Address of read register
"\r\n"	B[6:7]	Packet footer

■ RD_Data Packet (TX)

This packet was launched by Optical flow controller to acknowledge RD_Req packet, the payload data is the register read value. Host CPU should not issue any new RD/WR_Req packet until current RD_Req was acknowledged by optical flow controller.



Symbol	Byte order	Description
"#RG#"	B[0:3]	4-characters string as packet ID #RG# represents returned data packet
Data	B[4]	The value of register
"\r\n"	B[5:6]	Packet footer

Translating motion value to transitional distance

The x-y motion value can not regard as translational motion directly; it also includes rotational motion of vehicle roll/pitch tilting. For positioning purpose, we only interest in translational motion, the rotational motion portion must be removed at first. Since rotational value is proportion to pitch/roll angle changes and can be removed by the angle change multiplied by a constant factor kA. The following equation shows the rotational compensation equation:

X_trans_motion =X_motion - kA * Roll angle change

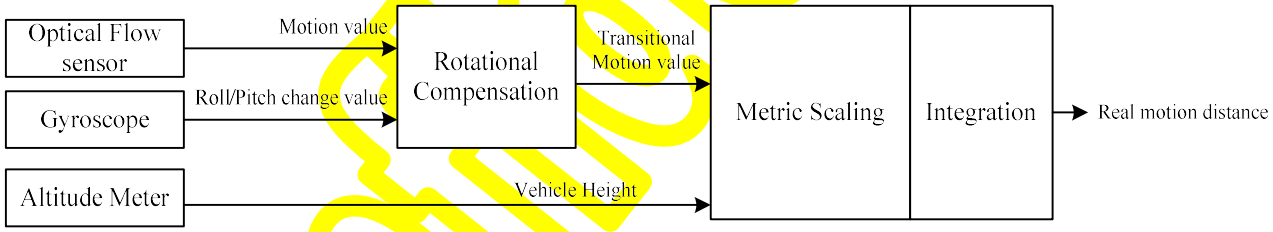
Y_trans_motion =Y_motion - kA * Pitch angle change

To convert translational motion to real transitional distance, the height of vehicle must take into consideration. Real transitional distance is proportion to vehicle height, host CPU must get vehicle height from altitude meter and perform metric scaling to get real transitional distance. The metric scaling equation described as bellows:

X_dist = X_trans_motion *kM *Height

Y_dist = Y_trans_motion *kM *Height

A suggested data flow of motion distance calculation is as follows:



The kA, kM value varies with image sensor pixels and lens FOV. The values of current VGA/QVGA optical flow module list as bellows:

Module Name	Sensor	Lens	FOV	kA	kM
JLOF_3283M1	BF3901	202	42	9.75	0.00225
JLOF_3285M1	GC0328	HG1	56	13.88	0.00175

Units:

Motion value: pixel

FOV: degree

kA : pixel/degree

kM: 1/pixel

Gyroscope: degree

Altitude Meter: Metric meter

Real distance: Metric meter

Performance enhance settings

To optimized positioning performance, host CPU should update some initial registers to optical flow controller after power up. The content of initial code varies with mask ROM revision, sensor type and lens type. Host CPU must check ROM Revision at first to decide which group of settings to be updated.

ROM Revision register

Bank	Addr	Remark	Type
0x03	0x96	Mask ROM revision registers.	Read only

Performance enhance settings for JL32xxAV1 + BF3901 + 202 lens

Bank	Addr	Data	Remark
0x0F	0x34	0x00	Select downward sensor I2C
0x0F	0x2D	0x00	Reserved
0x0F	0x30	0x24	
0x0F	0x2D	0xFF	Reserved
0x0F	0x30	0x28	
0x0F	0x2D	0x07	De-noise
0x0F	0x30	0x70	
0x0F	0x2D	0x30	Reserved
0x0F	0x30	0x6C	
0x0F	0x2D	0x00	Reserved
0x0F	0x30	0x3E	
0x0F	0x2D	0x80	Th1 value for outdoor scene judgment
0x0F	0x30	0x96	
0x0F	0x2D	0xB0	Th2 value for outdoor scene judgment
0x0F	0x30	0x9A	
Delay 500ms			
0x0F	0x2D	0x00	Reserved
0x0F	0x30	0x28	
0x0F	0x2D	0x50	Reserved
0x0F	0x30	0x24	
0x06	0xB4	0x02	DSP motion detection settings
0x06	0xDF	0x02	

Performance enhance settings for JL32xxAV1 + GC0328 + HG1 lens

Bank	Addr	Data	Remark
0x0F	0x34	0x00	Select downward sensor I2C
0x0F	0x2D	0x01	Select page 1
0x0F	0x30	0xFE	
0x0F	0x2D	0x3C	LSC_row_center
0x0F	0x30	0xA1	
0x0F	0x2D	0x50	LSC_col_center
0x0F	0x30	0xA2	
0x0F	0x2D	0x20	LSC_Q1_red_b1
0x0F	0x30	0xA8	
0x0F	0x2D	0x20	LSC_Q1_green_b1
0x0F	0x30	0xA9	
0x0F	0x2D	0x20	LSC_Q1_blue_b1
0x0F	0x30	0xAA	
0x0F	0x2D	0x50	LSC_Q2_red_b1
0x0F	0x30	0xAB	
0x0F	0x2D	0x50	LSC_Q2_green_b1
0x0F	0x30	0xAC	
0x0F	0x2D	0x50	LSC_Q2_blue_b1
0x0F	0x30	0xAD	
0x0F	0x2D	0x20	LSC_Q3_red_b1
0x0F	0x30	0xAE	
0x0F	0x2D	0x20	LSC_Q3_green_b1
0x0F	0x30	0xAF	
0x0F	0x2D	0x20	LSC_Q3_blue_b1
0x0F	0x30	0xB0	
0x0F	0x2D	0x12	LSC_Q4_red_b1
0x0F	0x30	0xB1	
0x0F	0x2D	0x12	LSC_Q4_green_b1
0x0F	0x30	0xB2	
0x0F	0x2D	0x12	LSC_Q4_blue_b1
0x0F	0x30	0xB3	
0x0F	0x2D	0x25	LSC_right_red_b2
0x0F	0x30	0xB4	
0x0F	0x2D	0x25	LSC_right_green_b2

0x0F	0x30	0xB5	
0x0F	0x2D	0x25	LSC_right_blue_b2
0x0F	0x30	0xB6	
0x0F	0x2D	0x40	LSC_right_red_b4
0x0F	0x30	0xB7	
0x0F	0x2D	0x40	LSC_right_green_b4
0x0F	0x30	0xB8	
0x0F	0x2D	0x40	LSC_right_blue_b4
0x0F	0x30	0xB9	
0x0F	0x2D	0x25	LSC_left_red_b2
0x0F	0x30	0xBA	
0x0F	0x2D	0x25	LSC_left_green_b2
0x0F	0x30	0xBB	
0x0F	0x2D	0x25	LSC_left_blue_b2
0x0F	0x30	0xBC	
0x0F	0x2D	0x40	LSC_left_red_b4
0x0F	0x30	0xBD	
0x0F	0x2D	0x40	LSC_left_green_b4
0x0F	0x30	0xBE	
0x0F	0x2D	0x40	LSC_left_blue_b4
0x0F	0x30	0xBF	
0x0F	0x2D	0x18	LSC_top_red_b2
0x0F	0x30	0xC0	
0x0F	0x2D	0x18	LSC_top_green_b2
0x0F	0x30	0xC1	
0x0F	0x2D	0x18	LSC_top_blue_b2
0x0F	0x30	0xC2	
0x0F	0x2D	0x18	LSC_top_red_b4
0x0F	0x30	0xC3	
0x0F	0x2D	0x18	LSC_top_green_b4
0x0F	0x30	0xC4	
0x0F	0x2D	0x18	LSC_top_blue_b4
0x0F	0x30	0xC5	
0x0F	0x2D	0x18	LSC_bottom_red_b2
0x0F	0x30	0xC6	
0x0F	0x2D	0x18	LSC_bottom_green_b2

0x0F	0x30	0xC7	
0x0F	0x2D	0x18	LSC_bottom_blue_b2
0x0F	0x30	0xC8	
0x0F	0x2D	0x18	LSC_bottom_red_b4
0x0F	0x30	0xC9	
0x0F	0x2D	0x18	LSC_bottom_green_b4
0x0F	0x30	0xCA	
0x0F	0x2D	0x18	LSC_bottom_blue_b4
0x0F	0x30	0xCB	
0x06	0xB4	0x02	DSP motion detection settings
0x06	0xDF	0x02	

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