



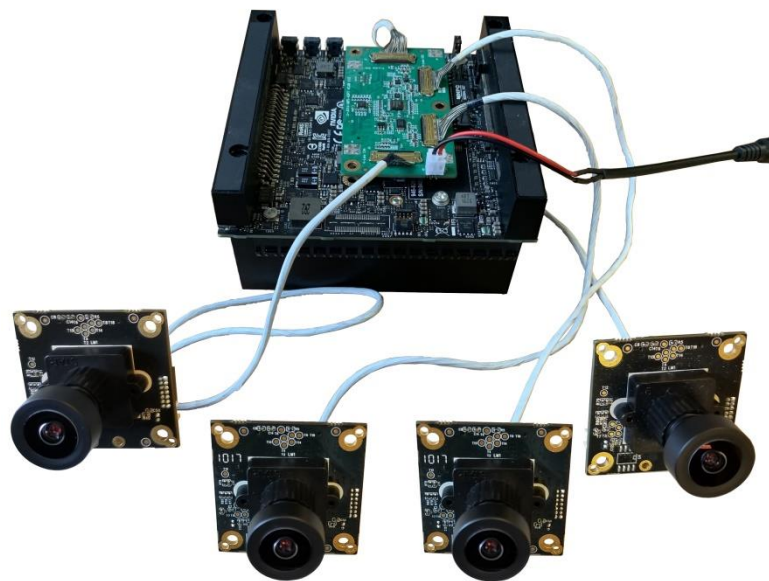
LEOPARD IMAGING INC

LI-XAVIER-KIT-IMX415M12-X

Data Sheet

Key Features

- Compatible with Nvidia® Jetson AGX Xavier™ Developer Kit
- MIPI CSI-2 interface
- Support up to six cameras
- Two adapter board options
 - LI-JXAV-MIPI-ADPT-4CAM
 - LI-JXAV-MIPI-ADPT-6CAM-FP
- Sony Diagonal 6.43 mm (Type 1/2.8) CMOS Image Sensor IMX415
- Active pixels: 3864H x 2176V
- Color camera
- Length of the I-PEX cable: 300mm
- Support multiple length cables
- Connector Part#: 20525-030E-02C
- Provide customization services
- Part#:
 - (1 cam) LI-XAVIER-KIT-IMX415M12
 - (2 cam) LI-XAVIER-KIT-IMX415M12-D
 - (3 cam) LI-XAVIER-KIT-IMX415M12-T
 - (4 cam) LI-XAVIER-KIT-IMX415M12-Q
 - (6 cam) LI-XAVIER-KIT-IMX415M12-H



Lens Spec

- Model: SYD1201A
- Focal length: 3.7 mm
- Aperture, F/#: 2.8 +/- 5%
- Built in 650nm IR cut filter
- FOV (D/H/V): 84 ° / 75.2 ° / 47.2 °
- TV Distortion: -1.0 %
- Mount: M12 x P0.5

BOM

Nvidia AGX Xavier Developer Kit not included

#	Items	QTY
1	LI-JXAV-MIPI-ADPT-4CAM or LI-JXAV-MIPI-ADPT-6CAM-FP	1
2	LI-IMX415-MIPI-M12	1, 2, 3, 4 or 6
3	FAW-1233-03 cable	1, 2, 3, 4 or 6

Applications

- Industrial Applications
- Surveillance cameras



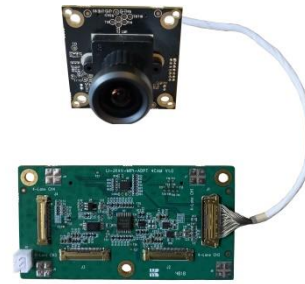
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LI-XAVIER-KIT-IMX415M12

BOM

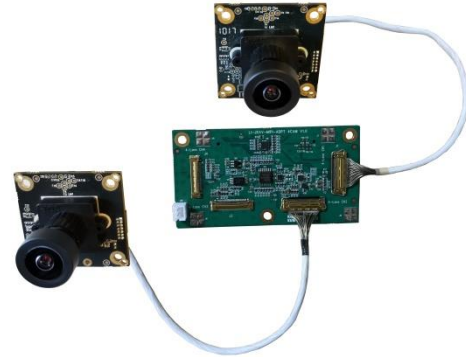
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1	LI-JXAV-MIPI-ADPT-4CAM	1
2	LI-IMX415-MIPI-M12	1
3	FAW-1233-03 cable	1



LI-XAVIER-KIT-IMX415M12-D

BOM

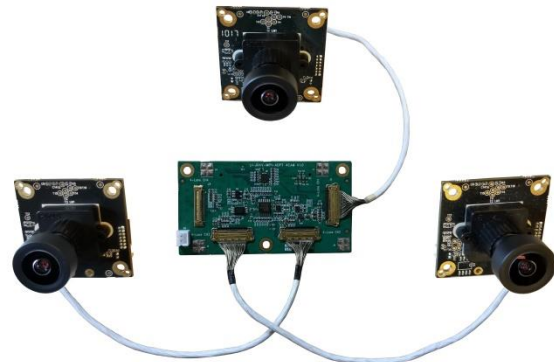
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1	LI-JXAV-MIPI-ADPT-4CAM	1
2	LI-IMX415-MIPI-M12	2
3	FAW-1233-03 cable	2



LI-XAVIER-KIT-IMX415M12-T

BOM

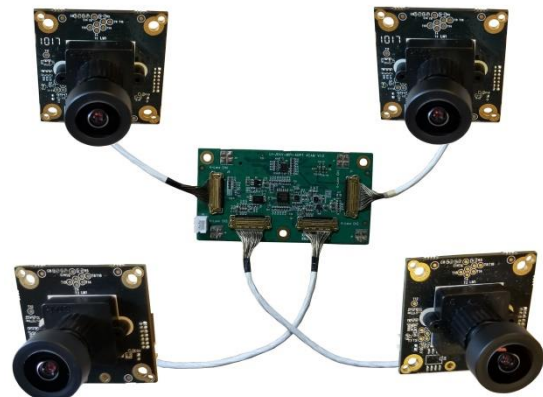
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1	LI-JXAV-MIPI-ADPT-4CAM	1
2	LI-IMX415-MIPI-M12	3
3	FAW-1233-03 cable	3



LI-XAVIER-KIT-IMX415M12-Q

BOM

#	Items	QTY
1	LI-JXAV-MIPI-ADPT-4CAM	1
2	LI-IMX415-MIPI-M12	4
3	FAW-1233-03 cable	4



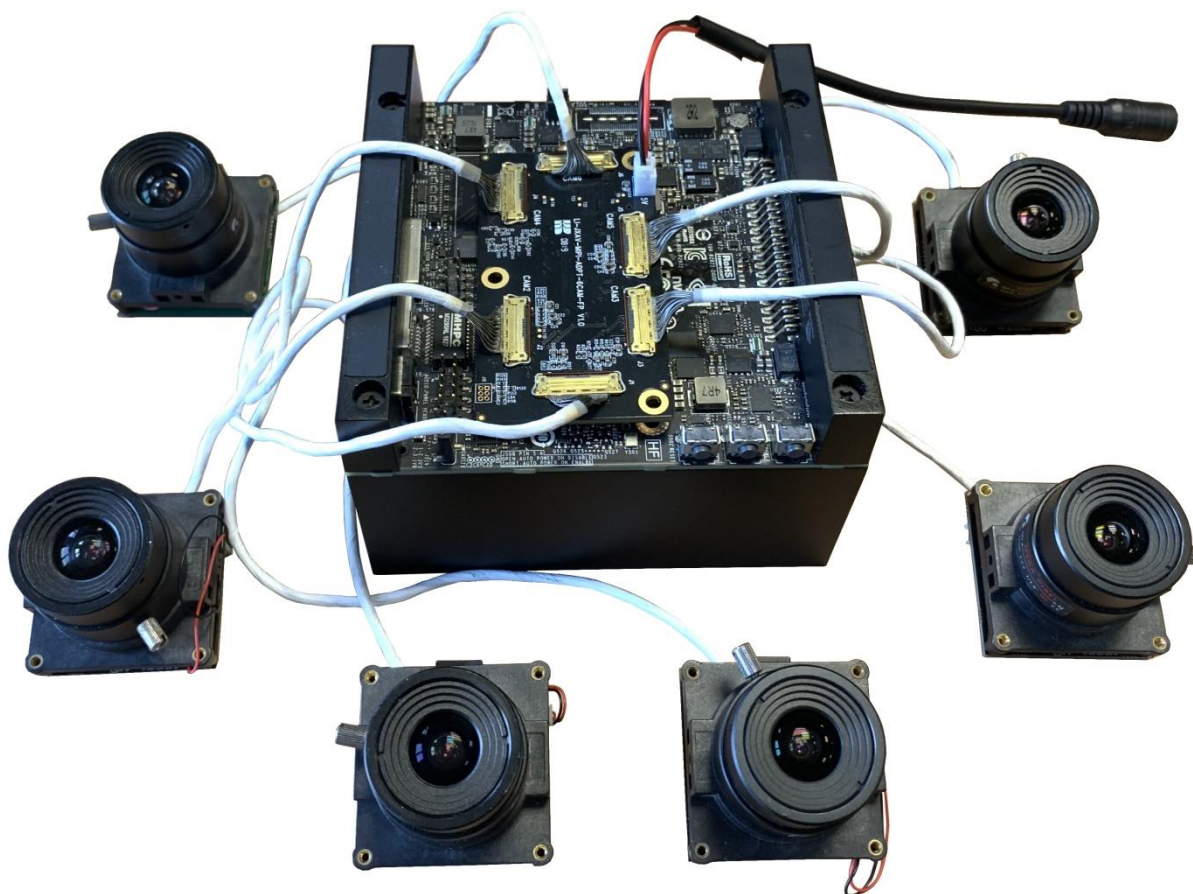
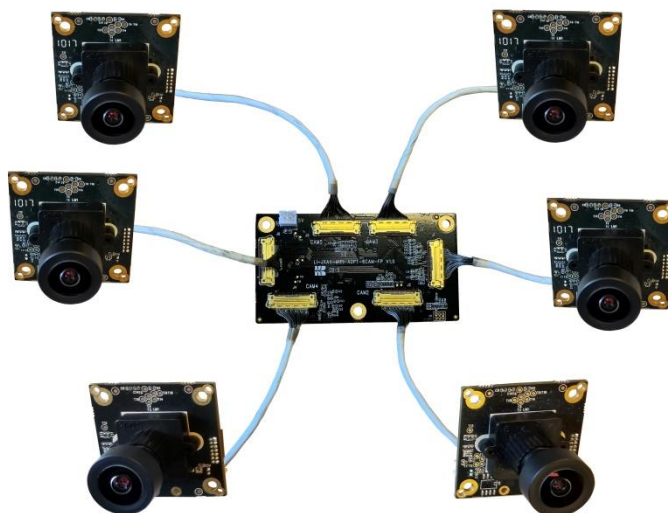
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LI-XAVIER-KIT-IMX415M12-H

BOM

#	Items	QTY
1	LI-JXAV-MIPI-ADPT-6CAM-FP	1
2	LI-IMX415-MIPI-M12	6
3	FAW-1233-03 cable	6

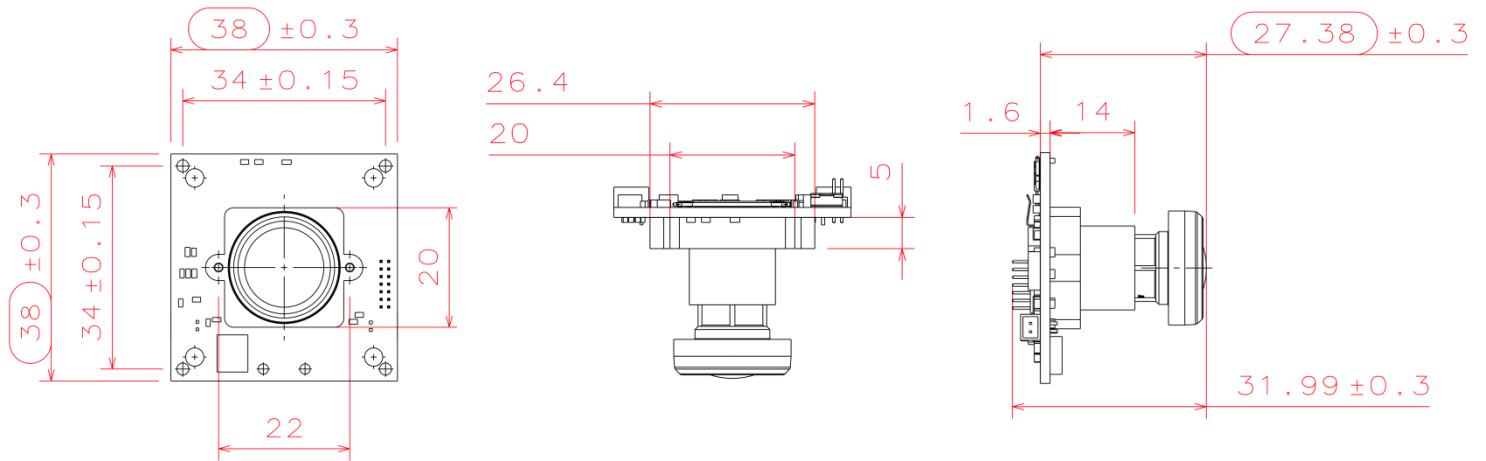


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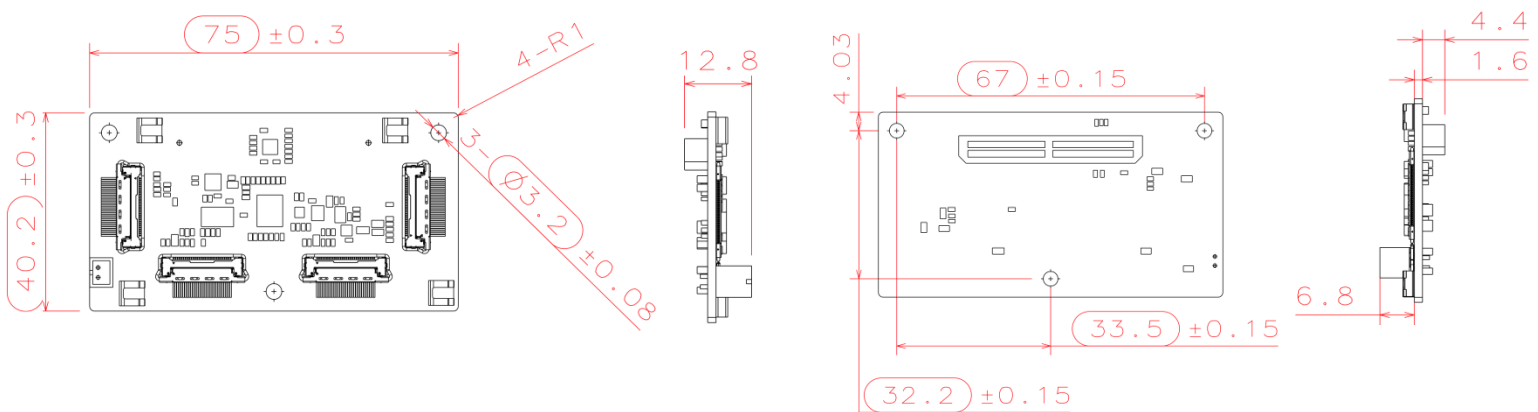
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Dimensions

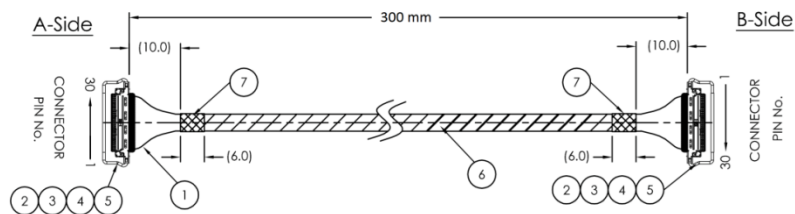
LI-IMX415-MIPI-M12



LI-JXAV-MIPI-ADPT-4CAM



FAW-1233-03



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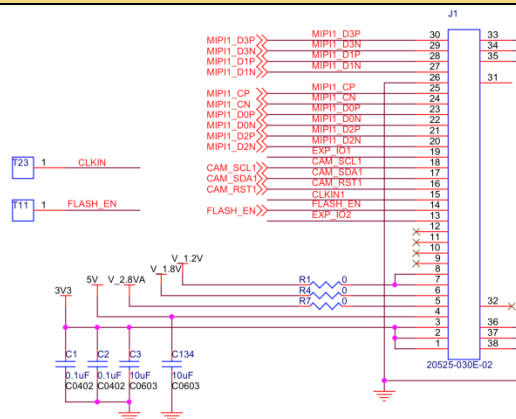
LI-JXAV-MIPI-ADPT-4CAM



Interfaces

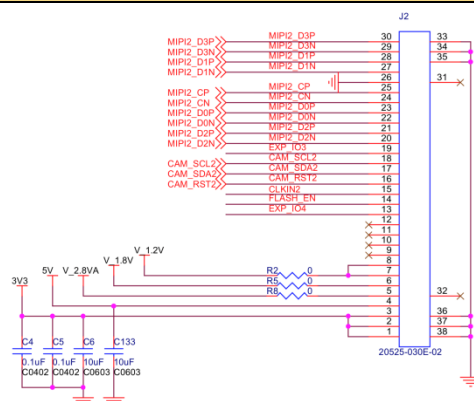
Interface J1

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-03 (300mm)



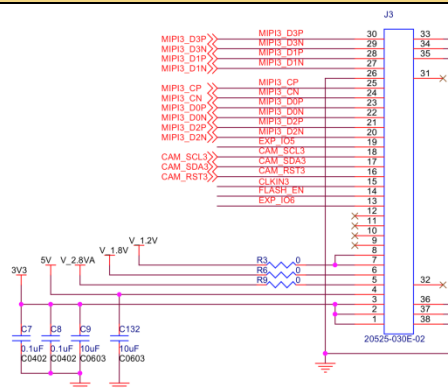
Interface J2

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-03 (300mm)



Interface J3

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-03 (300mm)

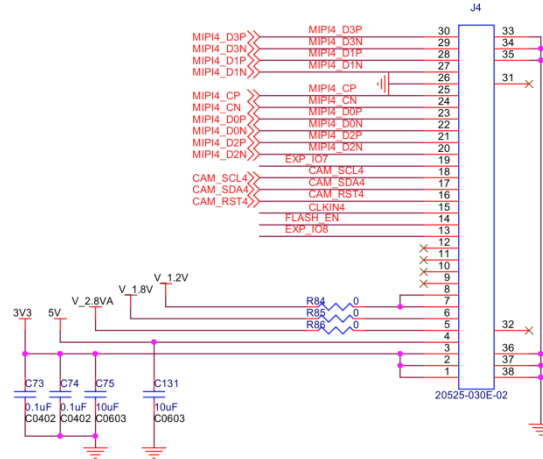


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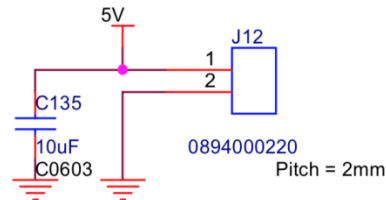
Interface J4

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-03 (300mm)



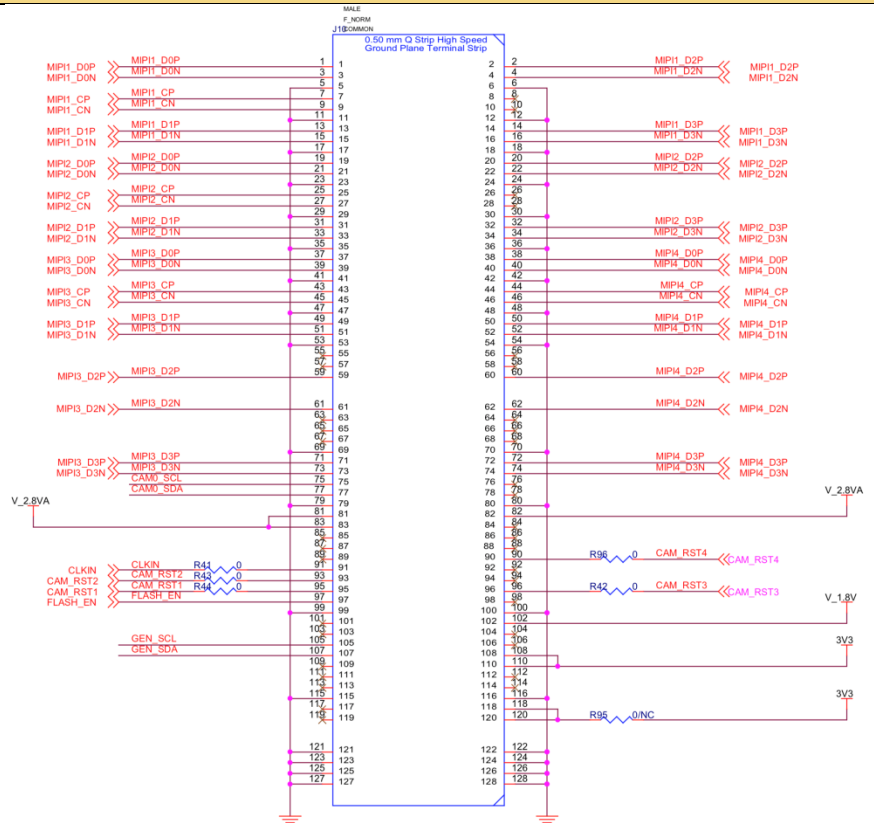
Interface J5

- Part#: 0894000220
- Number of Positions: 2
- Pitch: 2mm



Interface J10

- Part#: QTH-060-01-L-D-A
- Number of Positions: 120
- Number of Rows: 2
- Pitch: 0.5 mm



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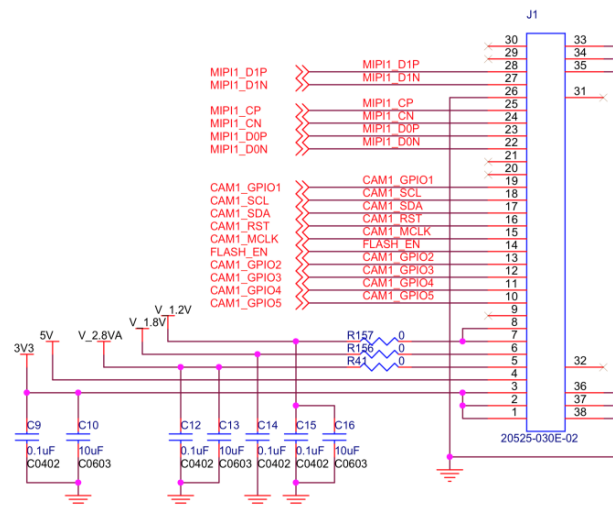
LI-JXAV-MIPI-ADPT-6CAM-FP



Interfaces

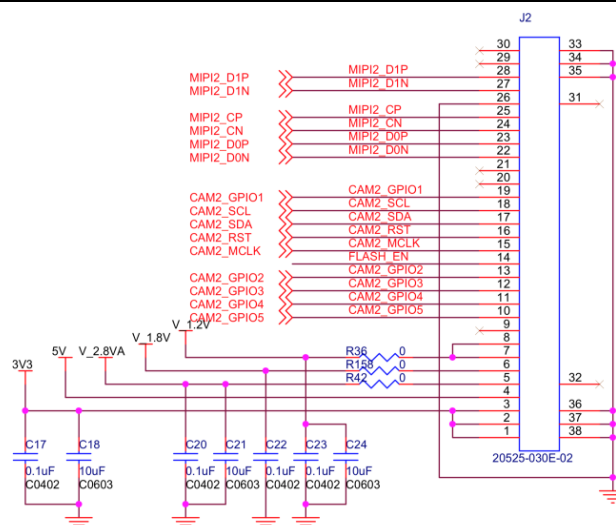
Interface J1 (camera channel 1)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-xx



Interface J2 (camera channel 2)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-xx

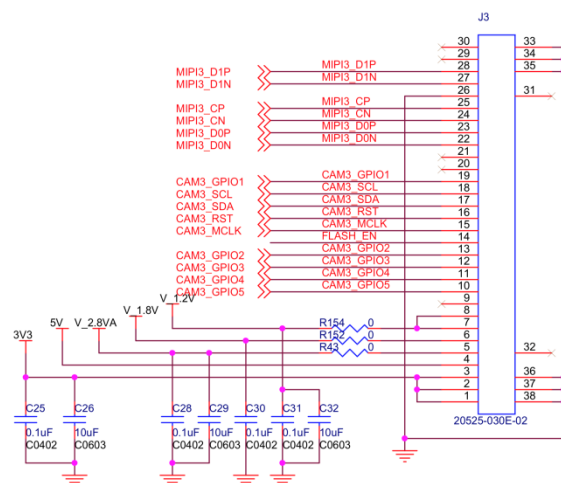


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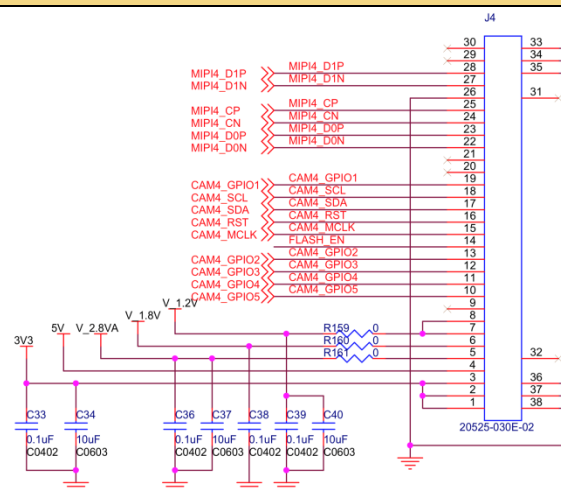
Interface J3 (camera channel 3)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable:
FAW-1233-xx



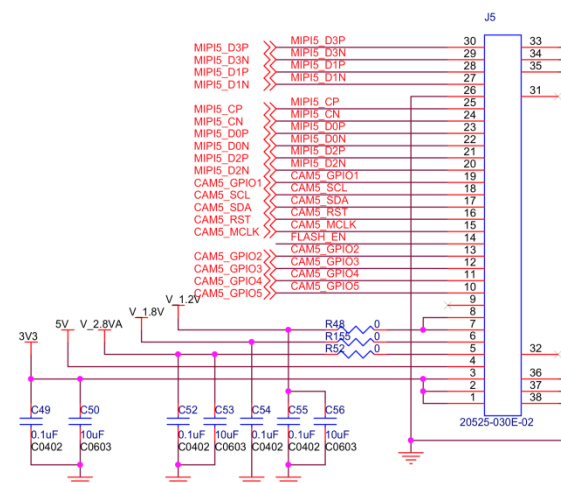
Interface J4 (camera channel 4)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable:
FAW-1233-xx



Interface J5 (camera channel 5)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable:
FAW-1233-xx

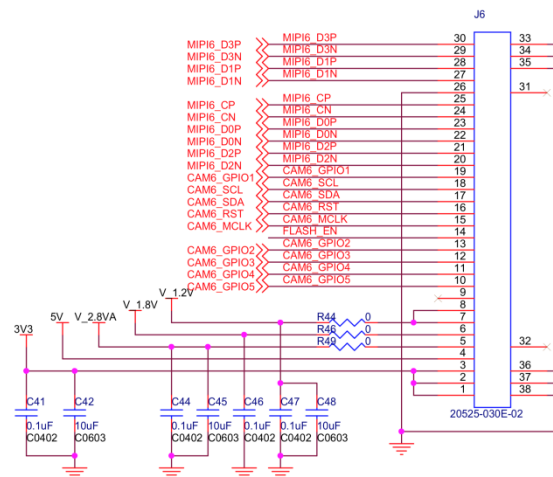


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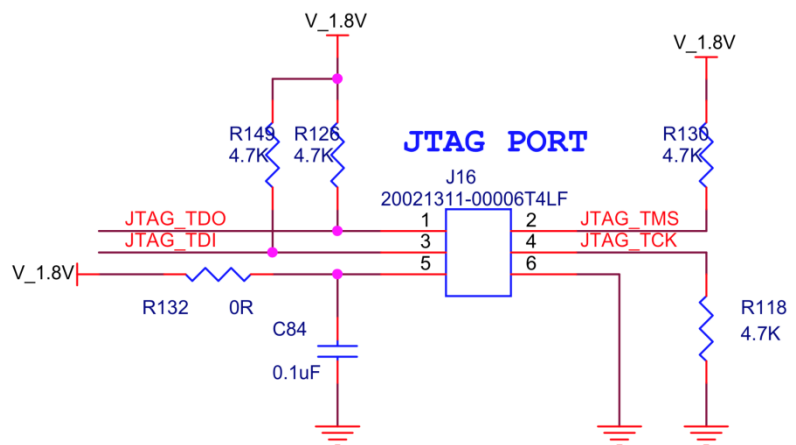
Interface J6 (camera channel 6)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable:
FAW-1233-xx



Interface J16 (FPGA programming interface)

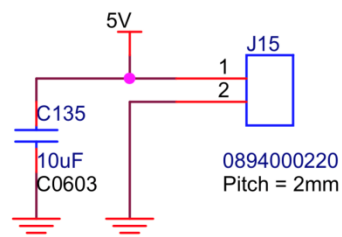
- Part#: 20021311-00006T4LF
- Number of Positions: 6
- Pitch: 0.050" (1.27mm)
- Number of Rows: 2



Interface J15 (External power input interface)

- Part#: 0894000220
- Number of Positions: 2
- Pitch: 2 mm

External Input Power

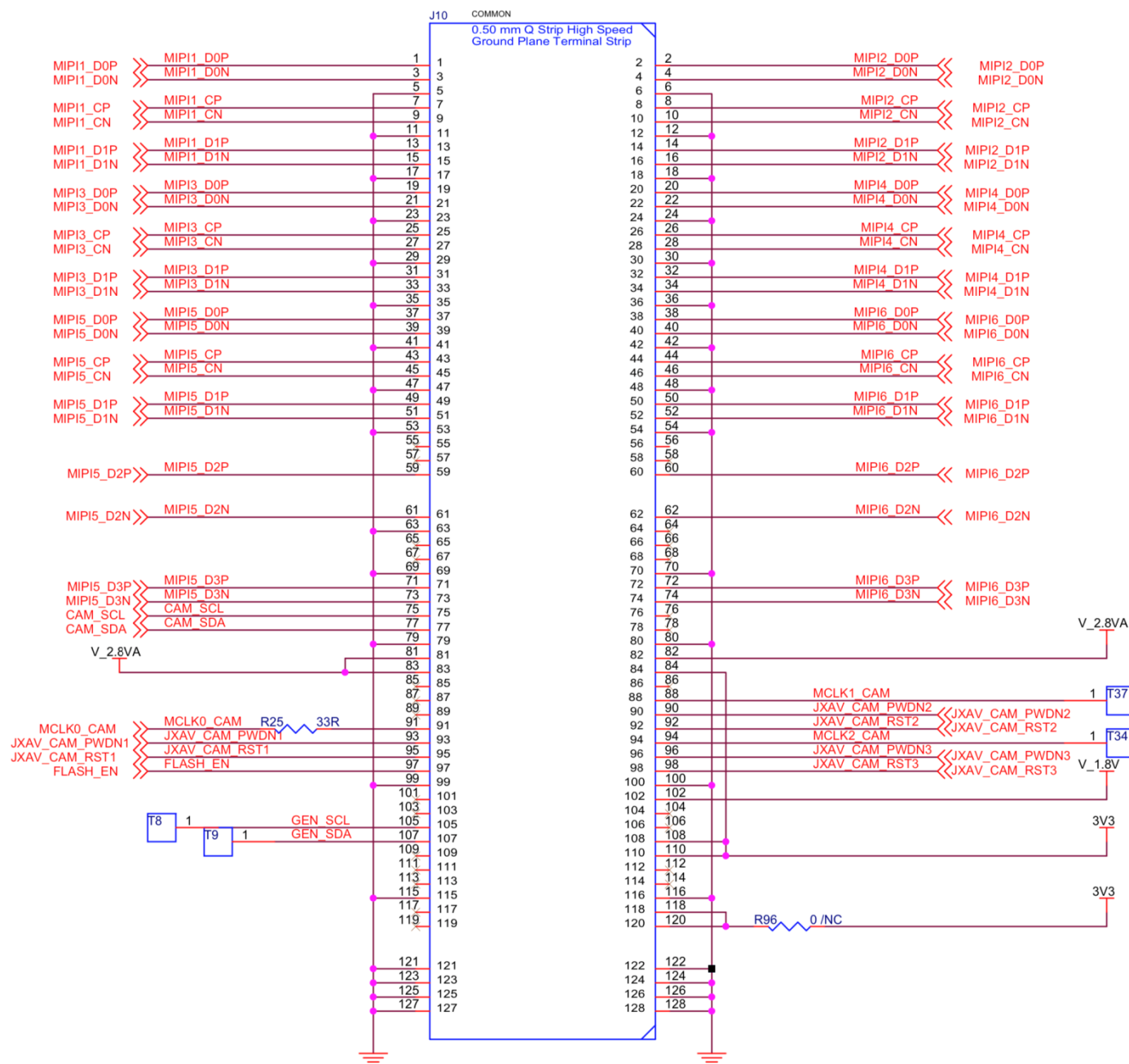


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Interface J10 (To Xavier)

- Part#: QTH-060-01-L-D-A
- Number of Positions: 120
- Number of Rows: 2
- Pitch: 0.5 mm



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LI-IMX415-MIPI-M12



Camera Spec	
Image Sensor	Sony Diagonal 6.43 mm (Type 1/2.8) CMOS Image Sensor IMX415
Optical format	1/2.8"
Number of active pixels	3864 (H) x 2176 (V)
Pixel size	1.45um (H) x 1.45um (V)
Color or Mono	Color
Interface	MIPI interface
Lens mount	M12
Weight	14 g
Interfaces	
Interface J4: - Part#: 20525-030E-02C - Number of Positions: 30 - Pitch: 0.4mm - Mating I-PEX cable: FAW-1233-03 (300mm)	
Interface J3: - Part#: 1734829-2 - Number of Positions: 2 - Pitch: 1.25mm	
Interface J6: - Part#: 1734829-2 - Number of Positions: 2 - Pitch: 1.25mm	



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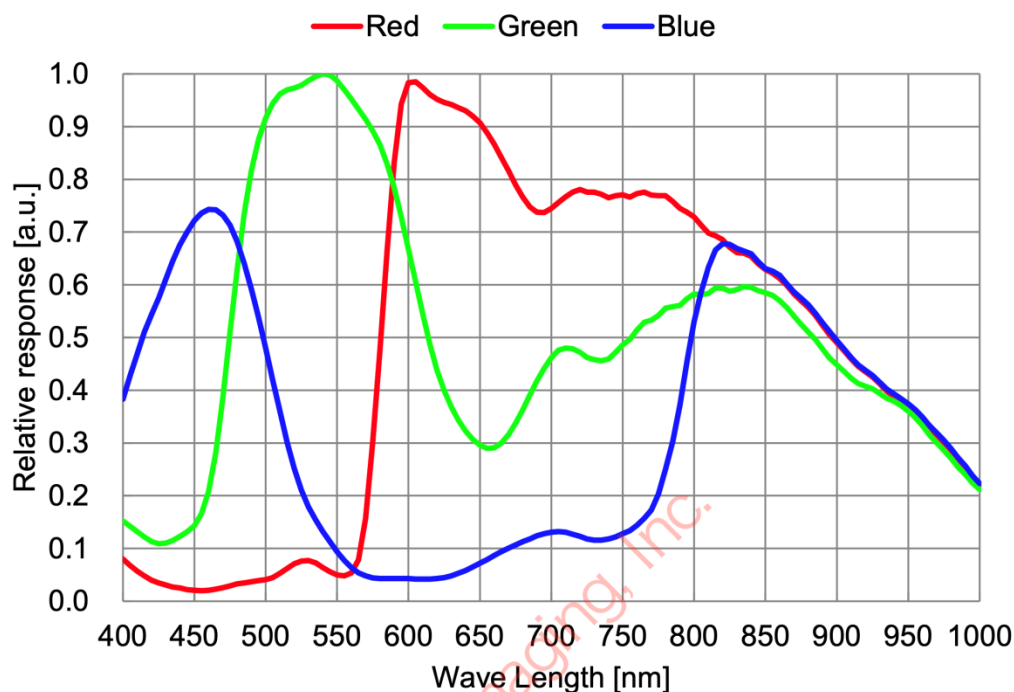
Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remarks
Supply voltage (analog: 2.9 V)	AV _{DD}	-0.3	3.3	V	
Supply voltage (interface: 1.8 V)	OV _{DD}	-0.3	3.3	V	
Supply voltage (digital: 1.1 V)	DV _{DD}	-0.3	2.0	V	
Input voltage	VI	-0.3	OV _{DD} + 0.3	V	Not exceed 3.3 V
Output voltage	VO	-0.3	OV _{DD} + 0.3	V	Not exceed 3.3 V
Operating temperature	T _{opr}	-30	85	°C	
Storage temperature	T _{stg}	-40	85	°C	

Application Conditions

Item	Symbol	Min.	Typ.	Max.	Unit
Supply voltage (analog: 2.9 V)	AV _{DD1}	2.80	2.90	3.00	V
Supply voltage (interface: 1.8 V)	OV _{DD}	1.70	1.80	1.90	V
Supply voltage (digital: 1.1 V)	DV _{DD1}	1.00	1.10	1.20	V
Performance guarantee temperature	T _{spec}	-10	—	60	°C

Spectral Sensitivity Characteristics



DC Characteristics

Item		Pins	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	Analog	VDDHx	AV _{DD}		2.80	2.90	3.00	V
	Interface	VDDMx	OV _{DD}		1.70	1.80	1.90	V
	Digital	VDDLx	DV _{DD}		1.00	1.10	1.20	V
Digital input voltage		XHS XVS XCLR INCK SLAMODE0 SLAMODE1	VIH	XVS / XHS Slave Mode	$0.8 \times OV_{DD}$	—	—	V
			VIL		—	—	$0.2 \times OV_{DD}$	V
Digital output voltage		XHS XVS TOUT	VOH	XVS / XHS Master Mode	$OV_{DD} - 0.2$	—	—	V
			VOL		—	—	0.2	V

Current Consumption

Item	Symbol	Typ.	Max.	Unit
Operating current MIPI CSI-2 / 4 Lane, 2079 Mbps 12 bit, 60 frame/s All-pixel mode	I _{AVDD}	128	156	mA
	I _{OVDD}	3	3	mA
	I _{DVDD}	187	250	mA
Standby current	I _{AVDD_STB}	—	0.2	mA
	I _{OVDD_STB}	—	0.2	mA
	I _{DVDD_STB}	—	15.1	mA

Operating current: (Typ.) Supply voltage 2.9 V / 1.8 V / 1.1 V, T_j = 25 °C, standard luminous intensity.
(Max.) Supply voltage 3.0 V / 1.9 V / 1.2 V, T_j = 60 °C, worst state of internal circuit operating current consumption,

Standby: (Max.) Supply voltage 3.0 V / 1.9 V / 1.2 V, T_j = 60 °C, INCK: 0 V, light-obstructed state.

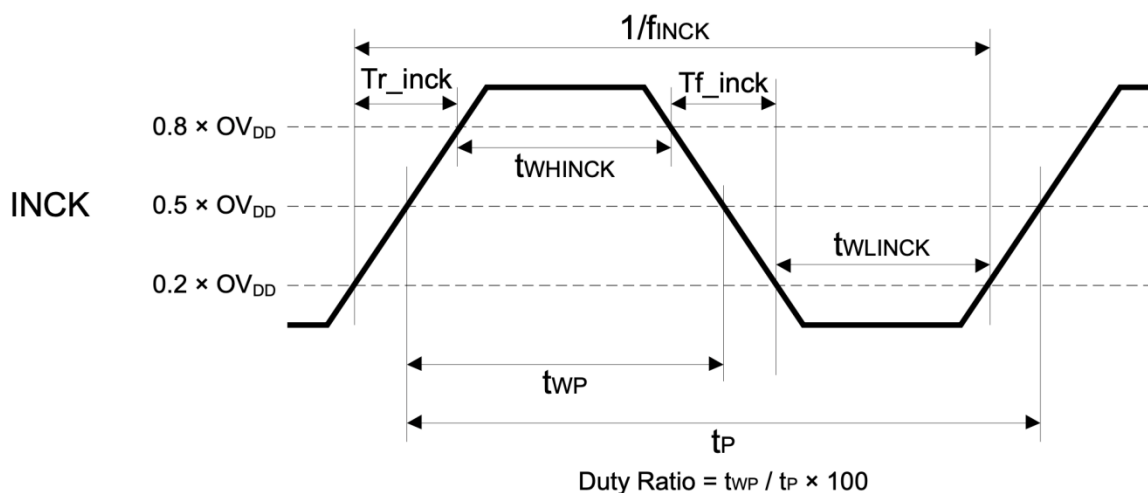


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AC Characteristics

Master Clock Waveform (INCK)



INCK 24MHz, 27MHz, 37.125MHz, 72MHz, 74.25MHz

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
INCK clock frequency	f_{INCK}	$f_{INCK} \times 0.96$	f_{INCK}	$f_{INCK} \times 1.02$	MHz	$f_{INCK} = 24 \text{ MHz}, 27 \text{ MHz}, 37.125 \text{ MHz}, 72 \text{ MHz}, 74.25 \text{ MHz}$
INCK Low level pulse width	t_{WLINCK}	4	—	—	ns	
INCK High level pulse width	t_{WHINCK}	4	—	—	ns	
INCK clock duty	—	45	50	55	%	Define with $0.5 \times OV_{DD}$
INCK Rise time	Tr_inck	—	—	5	ns	20 % to 80 %
INCK Fall time	Tf_inck	—	—	5	ns	80 % to 20 %

* The INCK fluctuation affects the frame rate.

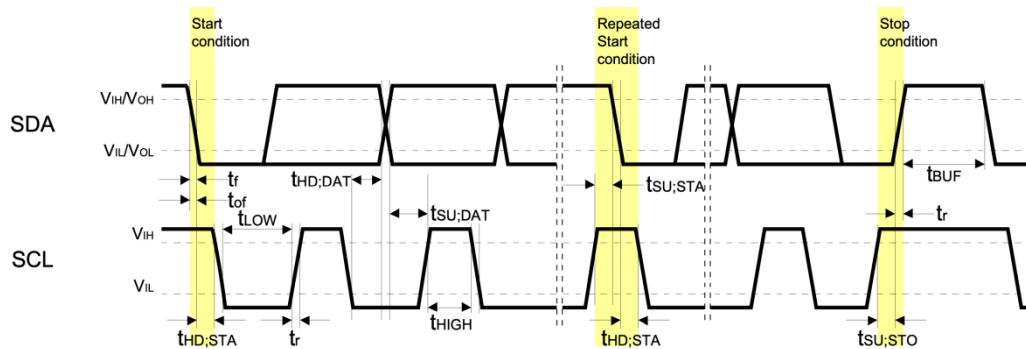


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Serial Communication

I²C



I2C Specification

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Low level input voltage	V_{IL}	-0.3	—	$0.3 \times OV_{DD}$	V	
High level input voltage	V_{IH}	$0.7 \times OV_{DD}$	—	1.9	V	
Low level output voltage	V_{OL}	0	—	$0.2 \times OV_{DD}$	V	$OV_{DD} < 2$ V, Sink 3 mA
High level output voltage	V_{OH}	$0.8 \times OV_{DD}$	—	—	V	
Input current	I_i	-10	—	10	μA	$0.1 \times OV_{DD}$ to $0.9 \times OV_{DD}$
Input Capacitance for SCL / SDA	C_i	—	—	10	pF	

I2C AC Characteristics (Standard-mode, Fast-mode)

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
SCL clock frequency	f_{SCL}	0	—	400	kHz	
Hold time (Start Condition)	$t_{HD,STA}$	0.6	—	—	μs	
Low period of the SCL clock	t_{LOW}	1.3	—	—	μs	
High period of the SCL clock	t_{HIGH}	0.6	—	—	μs	
Set-up time (Repeated Start Condition)	$t_{SU,STA}$	0.6	—	—	μs	
Data hold time	$t_{HD,DAT}$	0	—	0.9	μs	
Data set-up time	$t_{SU,DAT}$	100	—	—	ns	
Rise time of both SDA and SCL signals	t_r	—	—	300	ns	
Fall time of both SDA and SCL signals	t_f	—	—	300	ns	
Set-up time (Stop Condition)	$t_{SU,STO}$	0.6	—	—	μs	
Bus free time between a STOP and START Condition	t_{BUF}	1.3	—	—	μs	
Output fall time	t_{of}	—	—	250	ns	Load 10 pF to 400 pF, $0.7 \times OV_{DD}$ to $0.3 \times OV_{DD}$



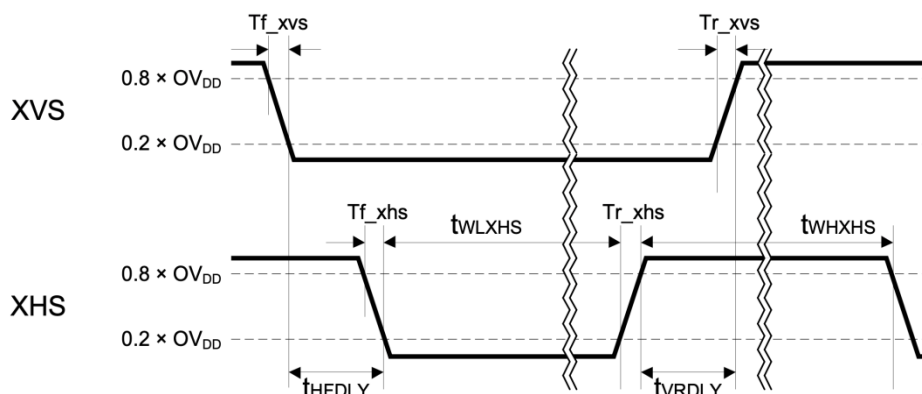
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I2C AC Characteristics (Fast-mode Plus)

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
SCL clock frequency	f_{SCL}	0	—	1000	kHz	$INCK \geq 16 \text{ MHz}$
Hold time (Start Condition)	$t_{HD;STA}$	0.26	—	—	μs	
Low period of the SCL clock	t_{LOW}	0.5	—	—	μs	
High period of the SCL clock	t_{HIGH}	0.26	—	—	μs	
Set-up time (Repeated Start Condition)	$t_{SU;STA}$	0.26	—	—	μs	
Data hold time	$t_{HD;DAT}$	0	—	0.9	μs	
Data set-up time	$t_{SU;DAT}$	50	—	—	ns	
Rise time of both SDA and SCL signals	t_r	—	—	120	ns	
Fall time of both SDA and SCL signals	t_f	—	—	120	ns	
Set-up time (Stop Condition)	$t_{SU;STO}$	0.26	—	—	μs	
Bus free time between a STOP and START Condition	t_{BUF}	0.5	—	—	μs	
Output fall time	t_{of}	—	—	120	ns	Load 10 pF to 400 pF, $0.7 \times OV_{DD}$ to $0.3 \times OV_{DD}$

XVS / XHS Input Characteristics in Slave Mode (Register XMASTER = 1)



Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
XHS Low level pulse width	t_{WLXHS}	$4 / f_{INCK}$	—	—	ns	
XHS High level pulse width	t_{WHXHS}	$4 / f_{INCK}$	—	—	ns	
XVS - XHS fall width	t_{HFDLY}	$1 / f_{INCK}$	—	—	ns	
XHS - XVS rise width	t_{VRDLY}	$1 / f_{INCK}$	—	—	ns	
XVS Rise time	T_{r_xvs}	—	—	5	ns	20 % to 80 %
XVS Fall time	T_{f_xvs}	—	—	5	ns	80 % to 20 %
XHS Rise time	T_{r_xhs}	—	—	5	ns	20 % to 80 %
XHS Fall time	T_{f_xhs}	—	—	5	ns	80 % to 20 %

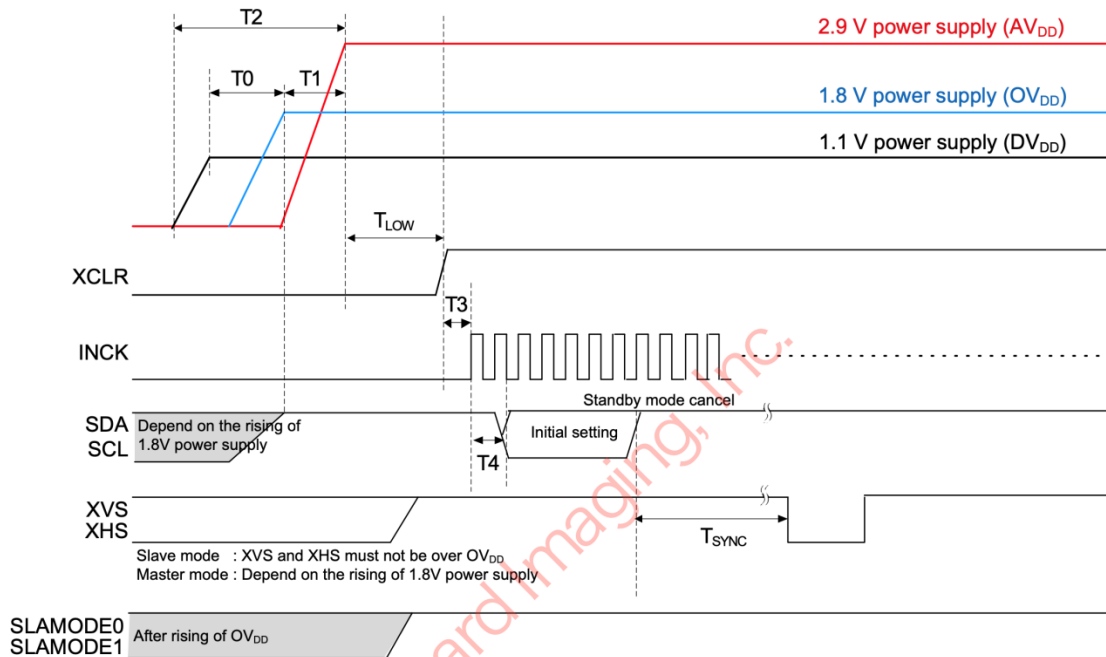


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Power-on Sequence

1. Turn On the power supplies so that the power supplies rise in order of 1.1 V power supply (DV_{DD}) → 1.8 V power supply (OV_{DD}) → 2.9 V power supply (AV_{DD}). In addition, all power supplies should finish rising within 200 ms.
2. The register values are undefined immediately after power-on, so the system must be cleared. Hold XCLR at Low level for 500 ns or more after all the power supplies have finished rising. (The register values after a system clear are the default values.)
3. The system clear is applied by setting XCLR to High level. The maser clock input after setting the XCLR pin to High level.
4. Make the sensor setting by register communication after the system clear.

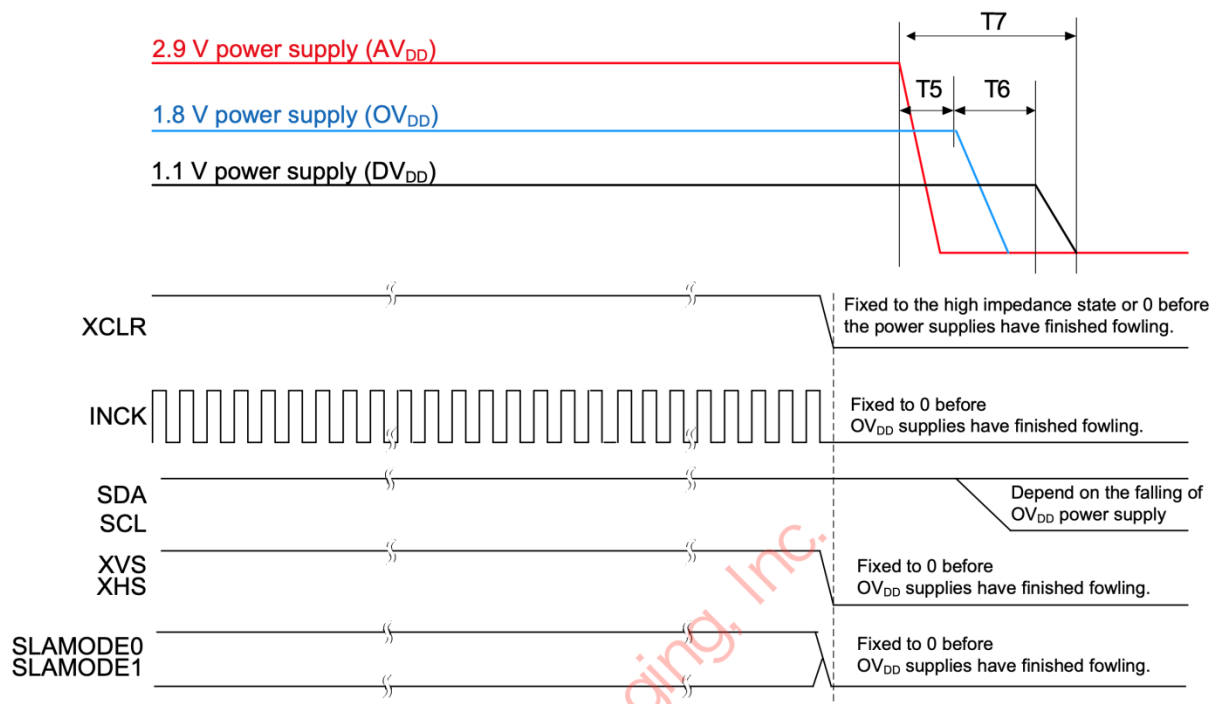


Item	Symbol	Min.	Max.	Unit
1.1 V power supply rising → 1.8 V power supply rising	T_0	0	—	ns
1.8 V power supply rising → 2.9 V power supply rising	T_1	0	—	ns
Rising time of all power supply	T_2	—	200	ms
2.9 V power supply rising → Clear OFF	T_{LOW}	500	—	ns
Clear OFF → INCK rising	T_3	1	—	μ s
Clear OFF → Communication start	T_4	20	—	μ s
Standby OFF (communication) → External input XHS, XVS (slave mode only)	T_{SYNC}	24	—	ms



Power-off Sequence

Turn Off the power supplies so that the power supplies fall in order of 2.9 V power supply (AV_{DD}) → 1.8 V power supply (OV_{DD}) → 1.1 V power supply (DV_{DD}). In addition, all power supplies should be falling within 200 ms. Set each digital input pin (INCK, SDA, SCL, XCLR, XVS, XHS) to 0 V before the 1.8 V power supply (OV_{DD}) falls.



Item	Symbol	Min.	Max.	Unit
2.9 V power shut down → 1.8 V power shut down	T5	0	—	ns
1.8 V power shut down → 1.1 V power shut down	T6	0	—	ns
Shut down time of all power supply	T7	—	200	ms



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Revision History

Revision	Description	Release Date
1.0	First Release	2. Feb. 2020



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