



LEOPARD IMAGING INC

LI-NANO-CB-IMX412CS-X

Data Sheet

Key Features

- Compatible with Nvidia® Jetson NANO™
- MIPI CSI-2 interface
- Support up to four cameras (2-lane mode)
- Sony Diagonal 7.857 mm (Type 1/2.3) CMOS Image Sensor IMX412
- Active pixels: 4056H x 3040V
- Pixel size: 1.55 um x 1.55 um
- Color camera
- Support 4056 x 3040 (12M) @ 15fps and 1920 x 1080 @ 60fps
- Support PoE (options)
- I-PEX cable part#: FAW-1233-03
- Length of the I-PEX cable: 300mm
- Support multiple length cables
- MIPI connector part#: 20525-030E-02C
- Support CS lens
- Provide driver binary and source code
- Provide customization services
- Part#:

LI-NANO-CB-IMX412CS-X

LI-NANO-CB-POE-IMX412CS-X



Lens Spec

- Model: ES0522F.IR
- Focal length: 5.0 mm
- Aperture, F/#: 2.2
- FOV (D/H/V): 96.5 °/ 80 °/61.5 °
- TV Distortion: < -8%
- Mount Type: CS

BOM

#	Items	QTY
1	LI-NANO-CB V1.2 or LI-NANO-CB-POE V1.2	1
2	Nvidia Jetson Nano SOM	1
3	LI-IMX412-MIPI-CS	1,2,3 or 4
4	FAW-1233-03 cable	1,2,3 or 4
5	DC 12V power supply	1
6	USB 2.0 Type A - Micro B cable	1



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Order Information

LI-NANO-CB-IMX412CS / LI-NANO-CB-POE-IMX412CS

BOM

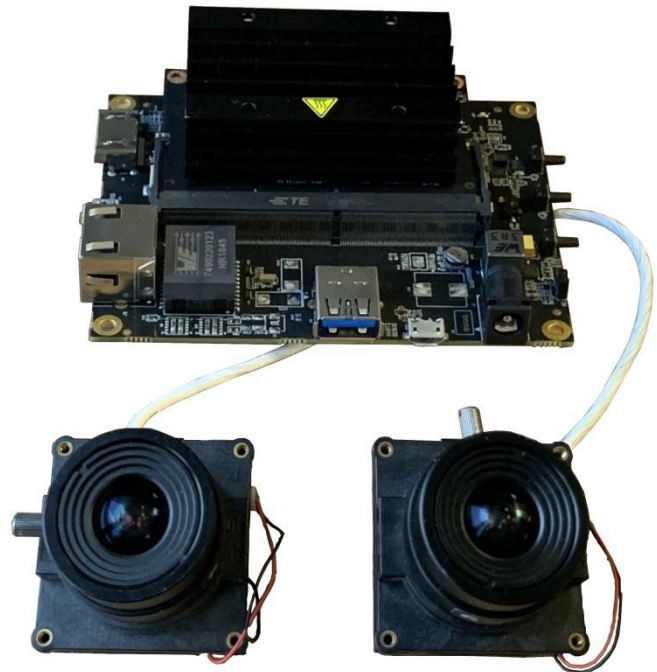
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1	LI-NANO-CB or LI-NANO-CB-POE	1
2	Nvidia Jetson Nano SOM	1
3	LI-IMX412-MIPI-CS	1
4	FAW-1233-03 cable	1
5	DC 12V power supply	1
6	USB 2.0 Micro B cable	1



LI-NANO-CB-IMX412CS-D / LI-NANO-CB-POE-IMX412CS-D

BOM

#	Items	QTY
1	LI-NANO-CB or LI-NANO-CB-POE	1
2	Nvidia Jetson Nano SOM	1
3	LI-IMX412-MIPI-CS	2
4	FAW-1233-03 cable	2
5	DC 12V power supply	1
6	USB 2.0 Micro B cable	1



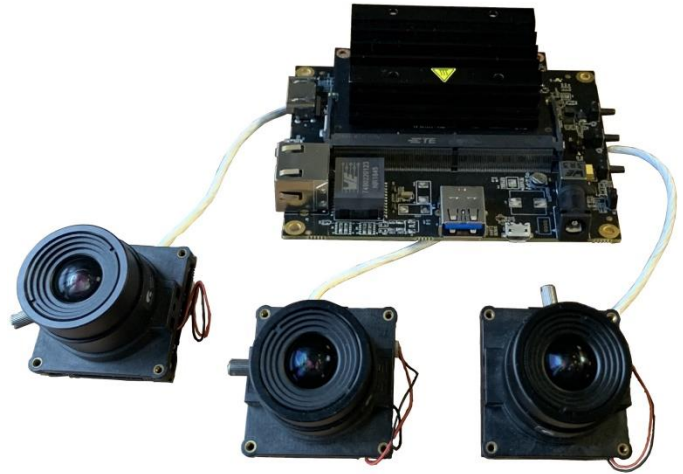
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LI-NANO-CB-IMX412CS-T / LI-NANO-CB-POE-IMX412CS-T

BOM

#	Items	QTY
1	LI-NANO-CB or LI-NANO-CB-POE	1
2	Nvidia Jetson Nano SOM	1
3	LI-IMX412-MIPI-CS	3
4	FAW-1233-03 cable	3
5	DC 12V power supply	1
6	USB 2.0 Micro B cable	1



LI-NANO-CB-IMX412CS-Q / LI-NANO-CB-POE-IMX412CS-Q

BOM

#	Items	QTY
1	LI-NANO-CB or LI-NANO-CB-POE	1
2	Nvidia Jetson Nano SOM	1
3	LI-IMX412-MIPI-CS	4
4	FAW-1233-03 cable	4
5	DC 12V power supply	1
6	USB 2.0 Micro B cable	1



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Register Information

Device (on LI-NANO-CB)	I2C address (7-bit)
tca9548 (I2C switcher)	0x70
J13 (CAM1)	0x00
J3 (CAM2)	0x01
J25 (CAM3)	0x02
J26 (CAM4)	0x03

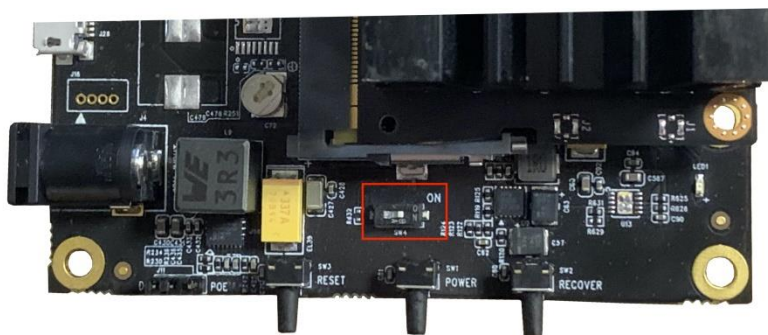
Device (on LI-IMX412-MIPI)	I2C address (7-bit)
IMX412 sensor	0x10

Power Consumption

Opened Cameras	Power consumption
No camera	Around 220mA @ 12V
1 camera (4056x3040@15fps)	Around 350mA @ 12V
2 cameras (4056x3040@15fps)	Around 450mA @ 12V
3 cameras (4056x3040@15fps)	Around 560mA @ 12V
4 cameras (4056x3040@15fps)	Around 670mA @ 12V

Auto Boot

SW4	Boot mode
ON	Manual boot
OFF	Auto boot

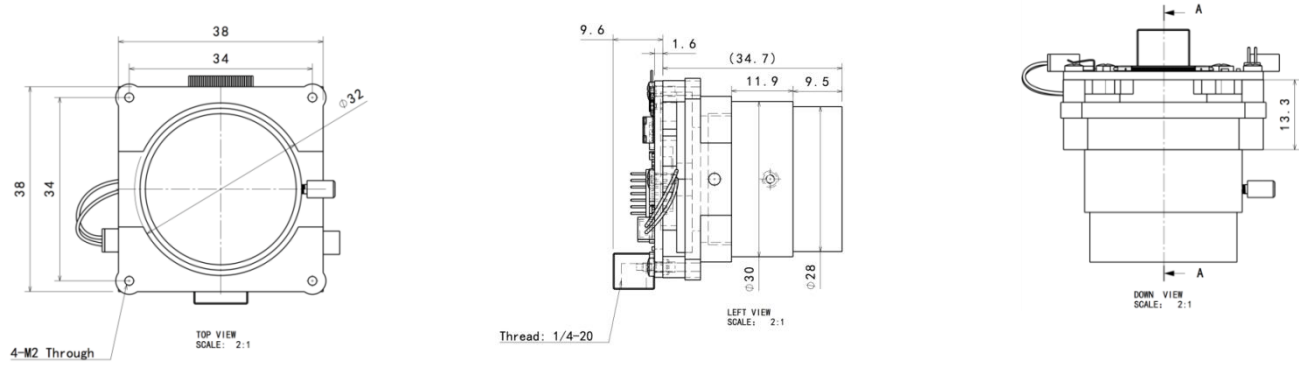


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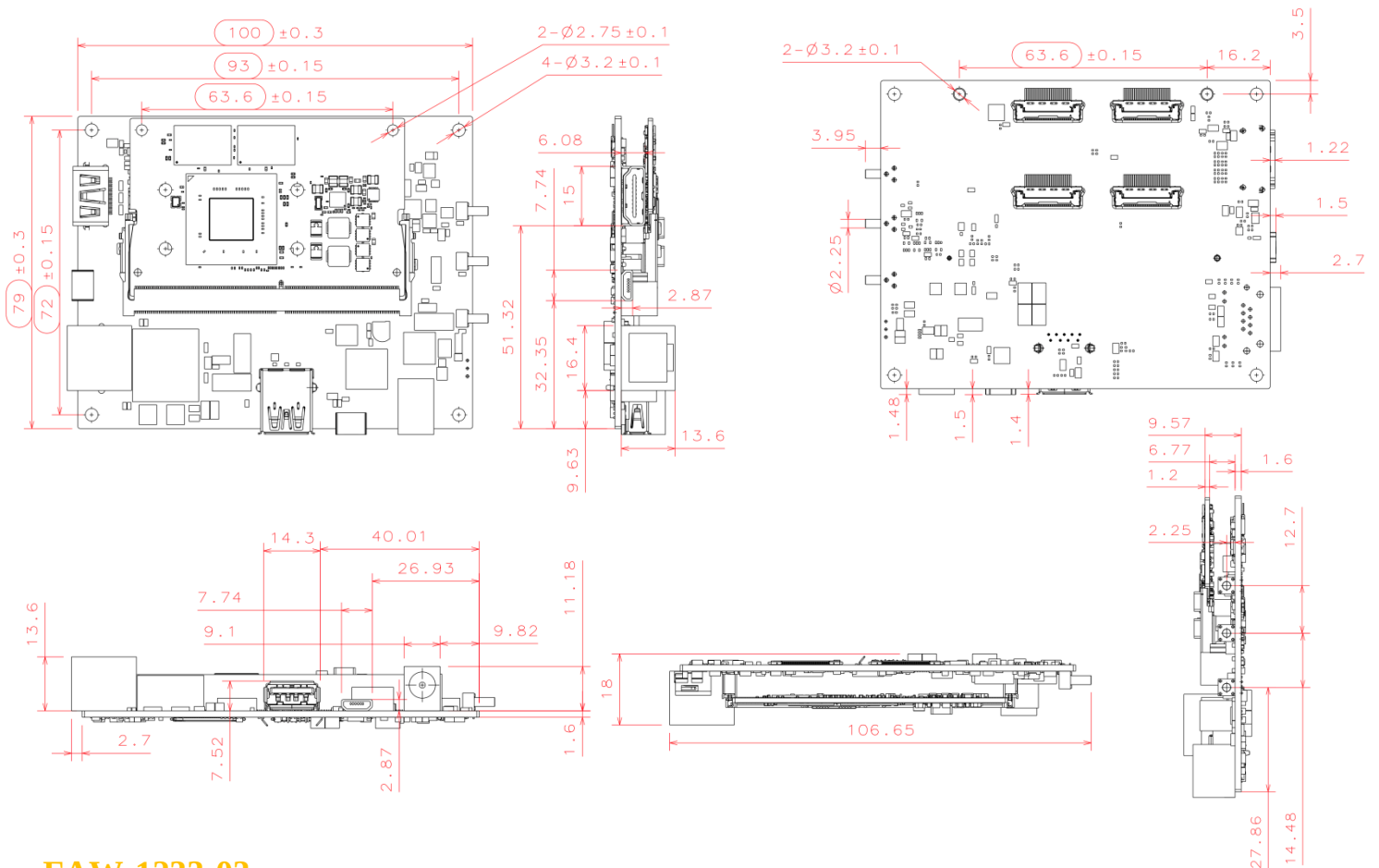
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Dimensions

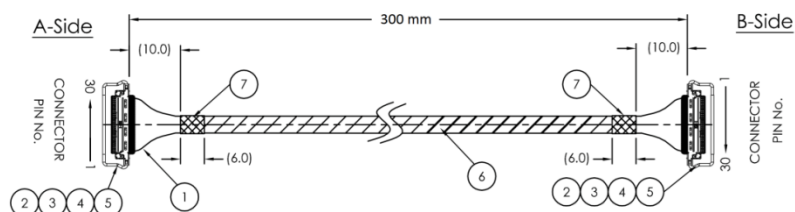
LI-IMX412-MIPI-CS



LI-NANO-CB / LI-NANO-CB-POE

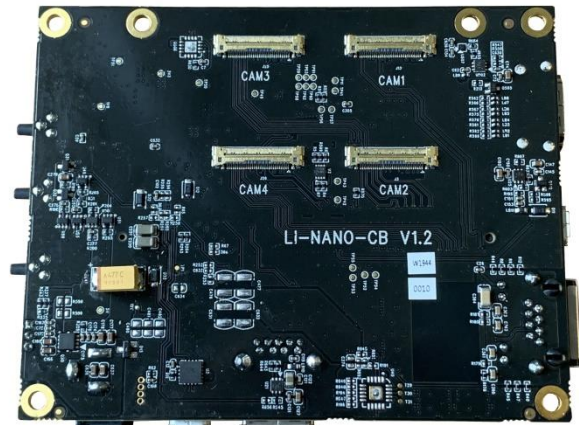
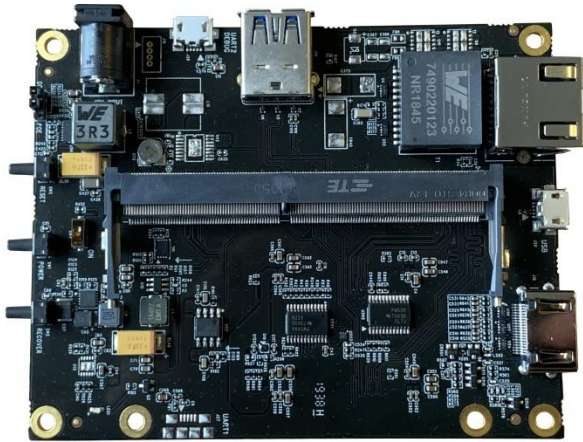


FAW-1233-03



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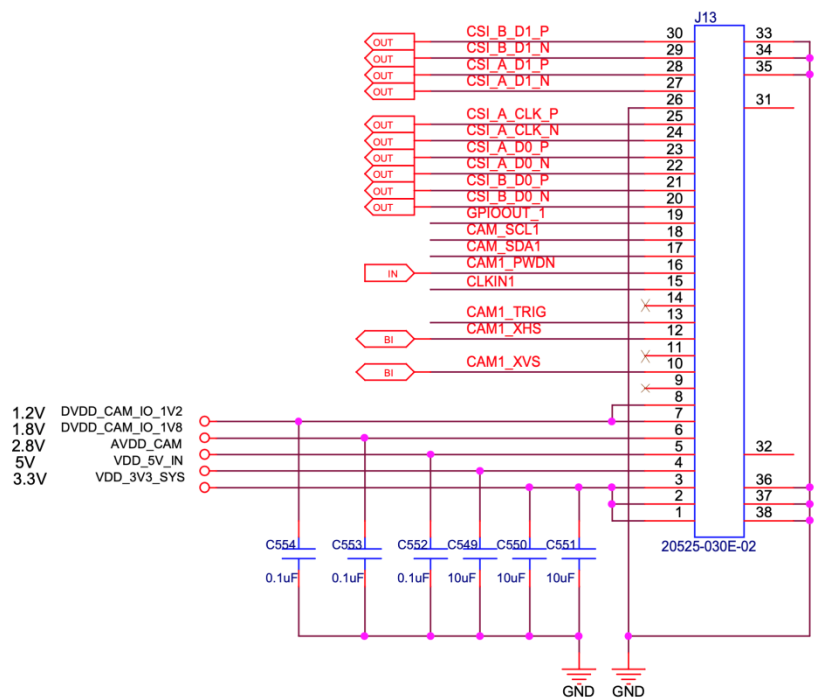
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Camera Interfaces

Interface J13 (CAM1)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-xx
- MIPI lane: 4 (the current driver support 2-lane)

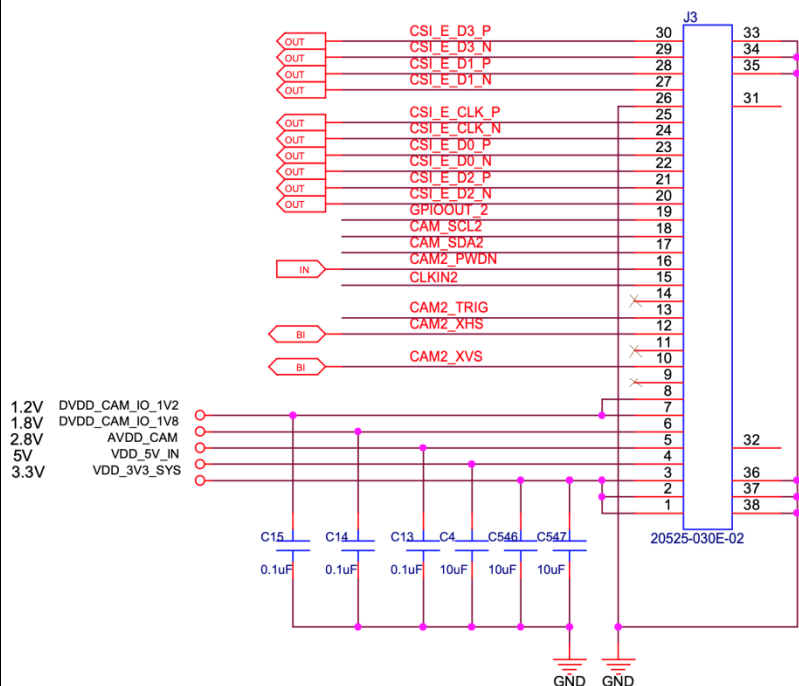


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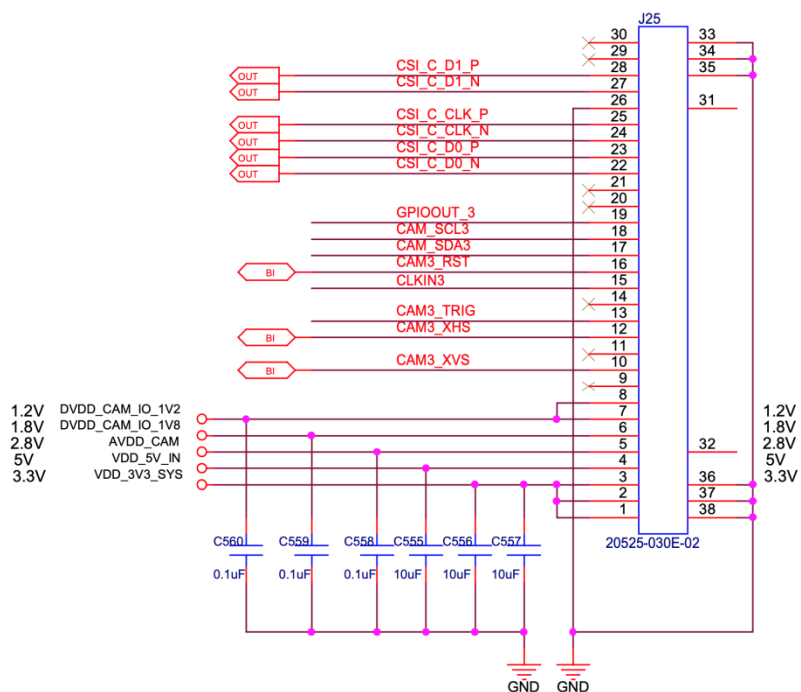
Interface J3 (CAM2)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-xx
- MIPI lane: 4 (the current driver support 2-lane)



Interface J25 (CAM3)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-xx
- MIPI lane: 2

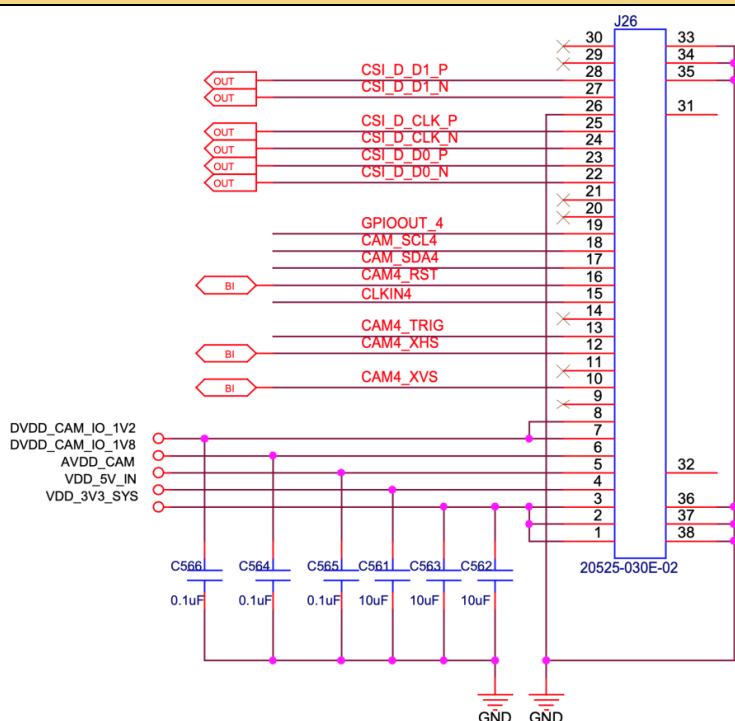


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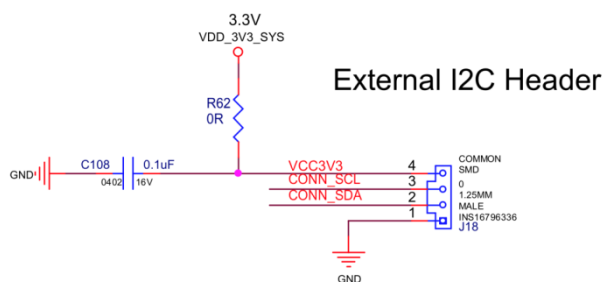
Interface J26 (CAM4)

- Part#: 20525-030E-02C
- Number of Positions: 30
- Pitch: 0.4mm
- Mating I-PEX cable: FAW-1233-xx
- MIPI lane: 2



Interface J18 (I2C header)

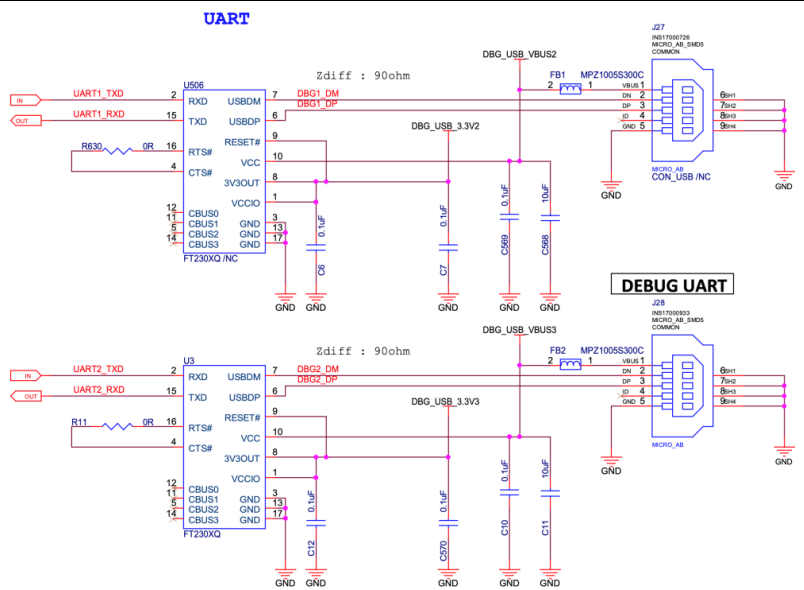
- Number of Positions: 4
- Pitch: 1.25mm



J27, J28 (UART)

- USB 2.0 micro-B interface

Note: R27 is not populated.



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LI-IMX412-MIPI-CS



Camera Spec	
Image Sensor	Sony Diagonal 7.857 mm (Type 1/2.3) CMOS Image Sensor IMX412
Optical format	1/2.3"
Number of active pixels	4056(H) x 3040(V)
Pixel size	1.55um (H) x 1.55um (V)
Color or Mono	Color
Interface	MIPI interface
Lens mount	CS
Weight	58 g
Interfaces	
Interface J1:	- Part#: 20525-030E-02C - Number of Positions: 30 - Pitch: 0.4mm - Mating I-PEX cable: FAW-1233-03 (300mm)
Interface J4:	- Part#: 1734829-2 - Number of Positions: 2 - Pitch: 1.25mm
Interface J1:	- Part#: 1734829-2 - Number of Positions: 2 - Pitch: 1.25mm



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Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	notes
Supply voltage (analog)	V _{ANA}	-0.3 to +3.3	V	refer to V _{SS} level
Supply voltage (digital)	V _{DIG}	-0.3 to +1.8	V	
Supply voltage (interface)	V _{IF}	-0.3 to +3.3	V	
Input voltage (digital)	V _I	-0.3 to +3.3	V	
Output voltage (digital)	V _O	-0.3 to +3.3	V	
Guaranteed operating temperature	T _{OPR}	-20 to +75	°C	
Guaranteed storage temperature	T _{STG}	-30 to +80	°C	
Guaranteed performance temperature	T _{SPEC}	-20 to +60	°C	

Recommended Operating Conditions

Item	Symbol	Ratings	Unit	notes
Supply voltage (analog)	V _{ANA} ^{*1}	2.8 ± 0.1	V	refer to V _{SS} level
Supply voltage (digital)	V _{DIG} ^{*2}	1.05 ± 0.1	V	
Supply voltage (interface)	V _{IF} ^{*3}	1.8 ± 0.1	V	

^{*1} V_{ANA}: V_{DD}SUB, V_{DD}HAN, V_{DD}HCM1 to 2, V_{DD}HSN1 to 4 (2.8 V power supply)

^{*2} V_{DIG}: V_{DD}LSC1 to 4, V_{DD}LCN1 to 2, V_{DD}LPL1 to 2, V_{DD}LIF (1.05 V power supply)

^{*3} V_{IF}: V_{DD}MIO1 to 2, V_{DD}MIF (1.8 V power supply)



DC Characteristics

Item	Pins	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage	V _{DD} SUB, V _{DD} HCM1 to 2, V _{DD} HSN1 to 4, V _{DD} HAN	V _{ANA}		2.7	2.8	2.9	V
	V _{DD} LCN1 to 2, V _{DD} LSC1 to 4, V _{DD} LIF, V _{DD} LPL1 to 2	V _{DIG}		0.95	1.05	1.15	V
	V _{DD} MIO1 to 2, V _{DD} MIF	V _{IF}		1.7	1.8	1.9	V
Digital input voltage	SDA,	V _{IH}		0.7 V _{IF}		2.9	V
	SCL	V _{IL}		- 0.3		0.3 V _{IF}	V
Digital input voltage	XCLR, INCK, SLASEL	V _{IH}		0.65 V _{IF}		V _{IF} + 0.3	V
		V _{IL}		- 0.3		0.35 V _{IF}	V
Digital output voltage	SDA	V _{OH}		V _{IF} - 0.4			V
		V _{OL}				0.4	V
Digital output voltage	GPO	V _{OH}		V _{IF} - 0.4			V
		V _{OL}				0.4	V



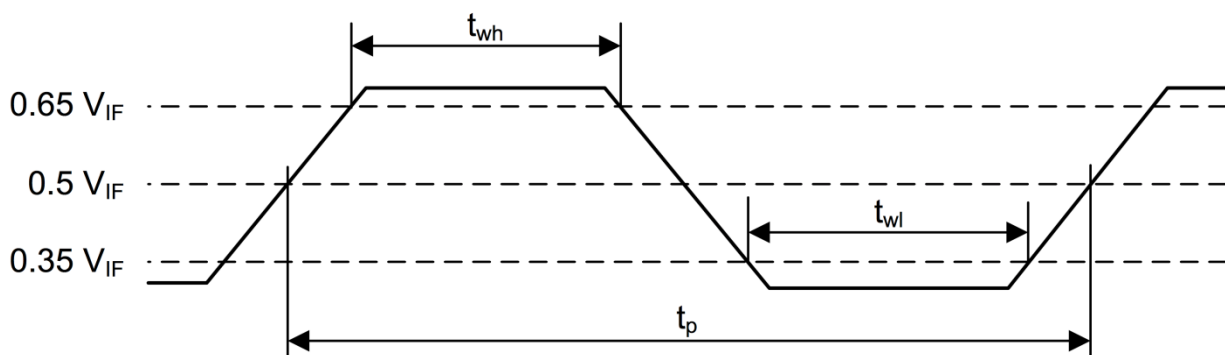
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AC Characteristics

Master Clock Square Waveform Input Diagram

Input specifications are shown below when square-wave signal is input directly into the external pin INCK.



Master Clock Square Waveform Input Characteristics

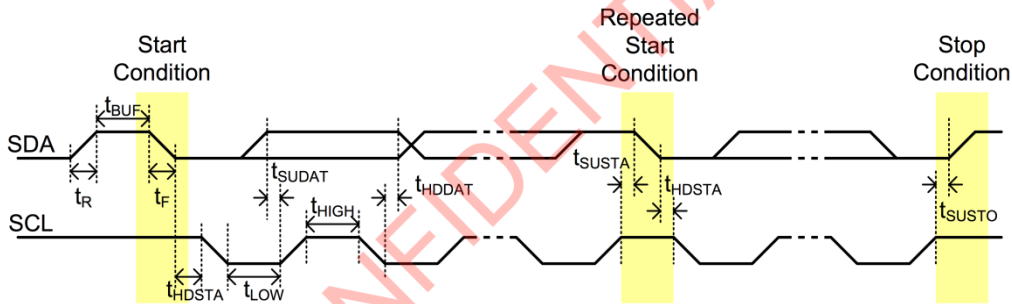
PARAMETER	Symbol	Min.	Typ.	Max.	Unit
INCK clock frequency	f _{SCK}	6		27	MHz
INCK clock period	t _p	37.0		166.7	ns
INCK low level width	t _{wl}	0.4 t _p		0.6 t _p	ns
INCK high level width	t _{wh}	0.4 t _p		0.6 t _p	ns
INCK jitter	T _{jitter}			600	ps



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2-wire serial communication block characteristics



2-wire serial communication block specification

Parameter	Symbol	Conditions	Min. (Fast-mode Plus)	Max. (Fast-mode Plus)	Unit
Low level input voltage	V_{IL}		-0.5	0.3 V_{IF}	V
High level input voltage	V_{IH}		0.7 V_{IF}	2.9	V
Low level output voltage	V_{OL1}	$V_{IF} > 2$ V, Sink 3 mA	0	0.4	V
	V_{OL2}	$V_{IF} < 2$ V, Sink 3 mA	0	0.2 V_{IF}	V
Output fall time	t_{of}	Load 10 pF – 400 pF, 0.7 $V_{IF} \rightarrow$ 0.3 V_{IF}		250 (120)	ns
Input current	I_I	0.1 $V_{IF} \rightarrow$ 0.9 V_{IF}	-10	10	μ A
SDA I/O capacitance	$C_{I/O}$			10	pF
SCL Input capacitance	C_I			10	pF

2-wire serial communication block AC specification

Parameter	Symbol	Min. (Fast-mode Plus)	Max. (Fast-mode Plus)	Unit
SCL clock frequency	f_{SCL}	0	400 (1000)	kHz
Rise time (SDA and SCL)	t_R	—	300 (120)	ns
Fall time (SDA and SCL)	t_F	—	300 (120)	ns
Hold time (start condition)	t_{HDSTA}	0.6 (0.26)	—	μ s
Setup time (rep.-start condition)	t_{SUSTA}	0.6 (0.26)	—	μ s
Setup time (stop condition)	t_{SUSTO}	0.6 (0.26)	—	μ s
Data setup time	t_{SUDAT}	100 (50)	—	ns
Data hold time	t_{HDDAT}	0	—	μ s
Bus free time between Stop and Start condition	t_{BUF}	1.3 (0.5)	—	μ s
Low period of the SCL clock	t_{LOW}	1.3 (0.5)	—	μ s
High period of the SCL clock	t_{HIGH}	0.6 (0.26)	—	μ s

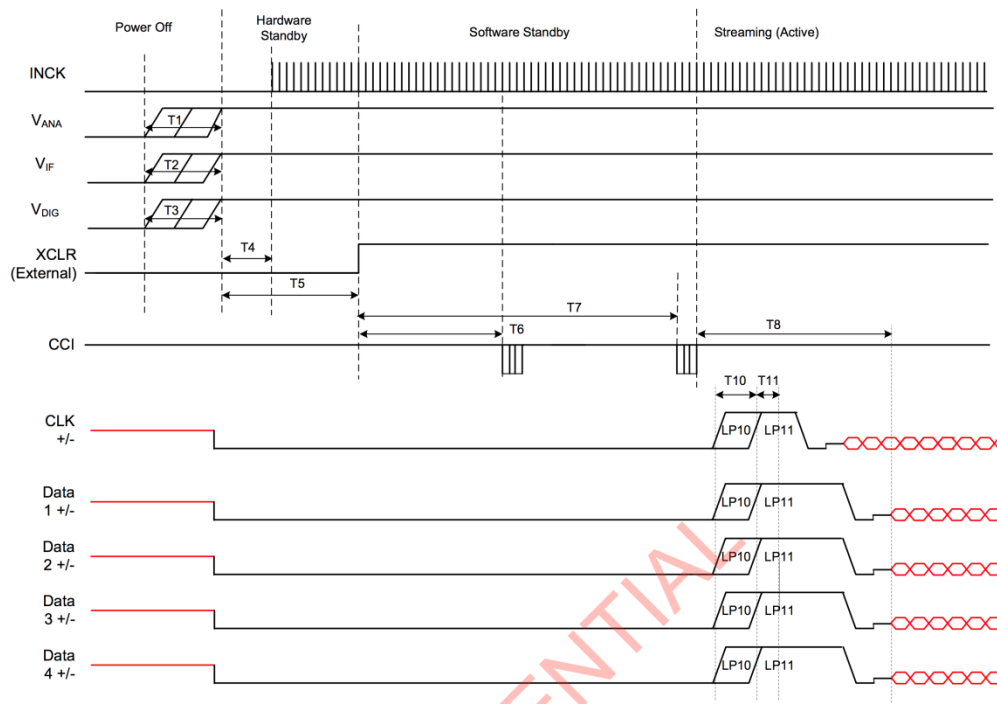
Note) Fast-mode Plus supports only available with INCK $\geq$ 8.0 MHz



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Power-on Sequence



Item	Label	Min.	Max.	Unit	Comment
V_{ANA} rising – V_{ANA} ON	T1	V_{ANA} and V_{IF} and V_{DIG} may rise in any order.		μs	Slew rate of V_{ANA} , V_{IF} and V_{DIG} (0 % - 100 %): Max. 50 mV/ μs
V_{IF} rising – V_{IF} ON	T2			μs	
V_{DIG} rising – V_{DIG} ON	T3			μs	
V_{ANA} and V_{IF} and V_{DIG} rising - INCK start	T4	0		μs	Presence of INCK during Power off is acceptable
V_{ANA} and V_{IF} and V_{DIG} rising - XCLR rising	T5	0		ms	After T1,T2 and T3
INCK start and XCLR rising till CCI Read version ID register wait time	T6	0.6		ms	
INCK start and XCLR rising till Send Streaming Command wait time (To complete reading all parameters from NVM)	T7	8		ms	
Start of first streaming from Sending Streaming Command.	T8		4.0 ms + The delay of the coarse integration time value		
D-PHY power up	T10	1	1.1	ms	
D-PHY init.	T11	100	110	μs	

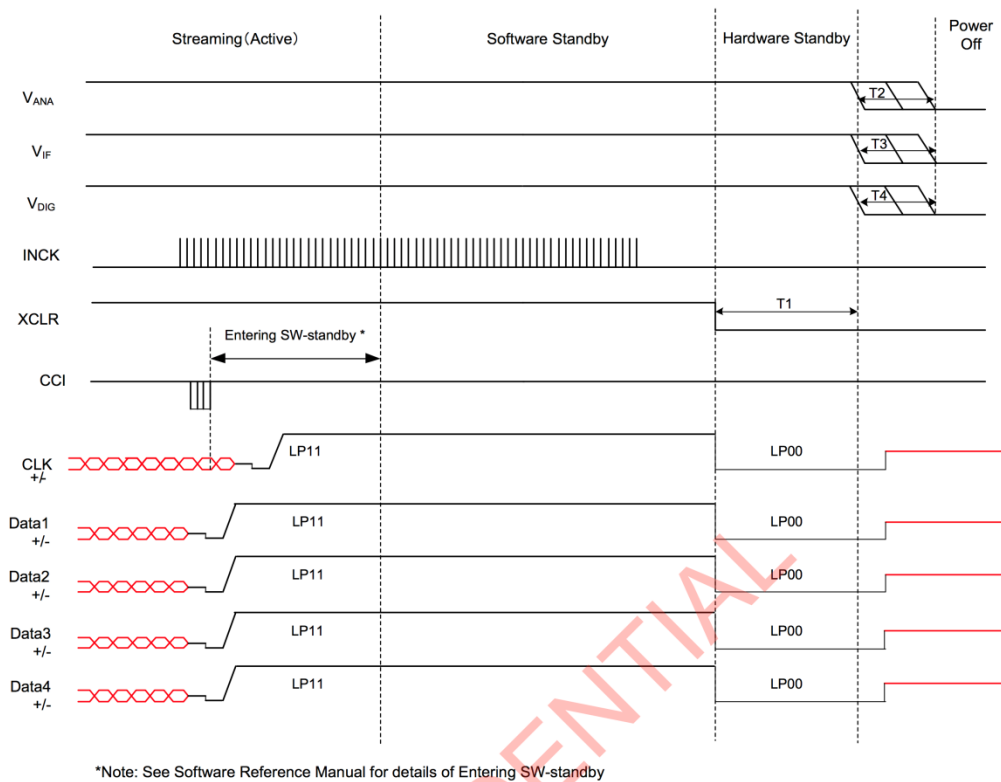
Note) XCLR needs to be Low until all power supplies complete power-on



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Power-off Sequence



Item	Label	Min.	Max.	Unit	Comment
XCLR Neg-edge - V _{ANA} (V _{IF} or V _{DIG}) fall	T1	0		μs	Presence of INCK during Power Off is acceptable.
Sequence free of V _{ANA} falling and V _{IF} falling and V _{DIG} falling	T2,T3,T4	V _{ANA} and V _{IF} and V _{DIG} may fall in any order.		μs	



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Revision History

Revision	Description	Release Date
1.0	First Release	1. Jan. 2020



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