

ILI2312

Single Chip Capacitive Touch Sensor Controller

Specification

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Revision History

Version	Date	Page	Description
V1.01	2015/07/09		Draft specification released.
V1.02	2015/08/27		Modified TRX Channel Number
		16	Modify VBUS min. recommended operating voltage to 4.4V
		17	1. Modify USB 5V min. input power supply voltage to 4.4V 2. Modify USB 5V max. input power supply voltage to 5.5V
		21	Update "Typical Application Circuit"
V1.03	2015/11/17	21	1. Modify "Typical Application Circuit"
		Title	2. Remove "Preliminary"

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1. Description

The ILI2312 is a single chip capacitive touch sensor controller optimized for All-in-One PC (AIO) and NB capacitive Touch Panel. It integrates high speed Capacitance to Digital Converter (CDC), total 126 channels including high voltage Driving and Sensing channels, high voltage Charge Pump Controller and 32-bit high performance Micro-controller (MCU) in a 200-ball BGA 9mm*9mm*1mm package. It meets all Windows 8.1 and Windows 10 requirements with best user touch performance.

2. Features

- 126 channels for capacitive touch panel
- Flexible driving or sensing channel assignment
- Programmable driving voltage for driving channels
- High voltage charge pump controller with programmable high voltage regulator
- High speed 12-bit ADC converter
- Support baseline calibration function
- Support mutual-capacitance sensing
- Support self-capacitance sensing
- Built-in noise processing function
- Built-in 32-bit high performance Micro-controller (MCU)
- Input voltage low level detection circuit
- Input voltage power on reset circuit
- Driving to Sensing mutual capacitance: 1pF to 4pF

3. Block Diagram

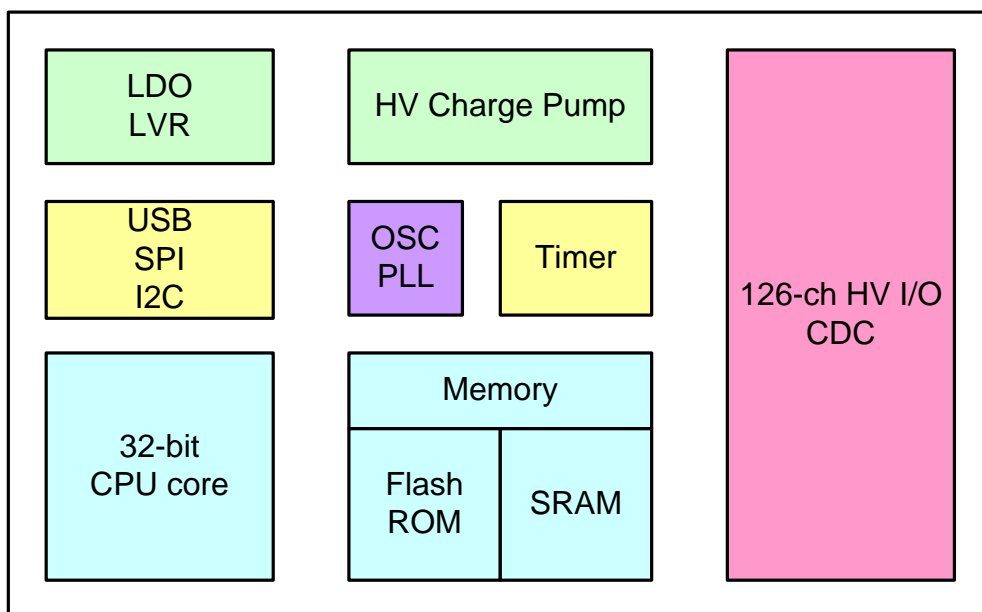


Figure 3-1: ILI2312 Block Diagram

4. Pin Definition

4.1 BGA-200 Ball Assignment

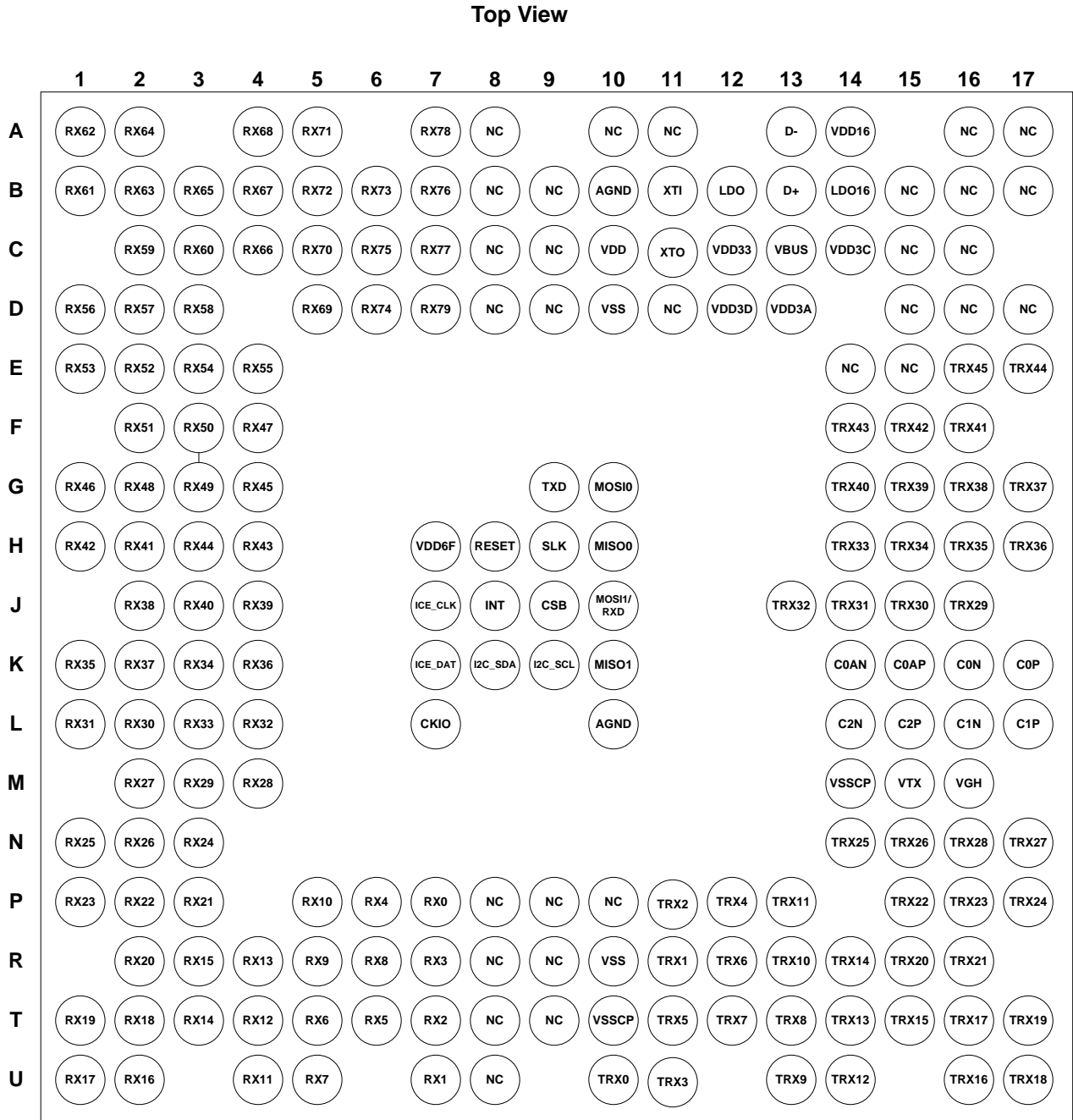


Figure 4-1: ILI2312 BGA-200 Package Diagram

4.2 BGA-200 Pin Description

Table 4-1: ILI2312 Pin Assignment

Ball No.	Pin Name	Pin Type	Description
A1	RX62	I/O	HV I/O channel RX62
A2	RX64	I/O	HV I/O channel RX64
A4	RX68	I/O	HV I/O channel RX68
A5	RX71	I/O	HV I/O channel RX71
A7	RX78	I/O	HV I/O channel RX78
A8	NC		No connection.
A10	NC		No connection.
A11	NC		No connection.
A13	D-	I/O	Input differential data signal of USB.
A14	VDD16	P	Input power supply for digital circuit. Connect to LDO16(B14).
A16	NC		No connection.
A17	NC		No connection.
B1	RX61	I/O	HV I/O channel RX61
B2	RX63	I/O	HV I/O channel RX63
B3	RX65	I/O	HV I/O channel RX65
B4	RX67	I/O	HV I/O channel RX67
B5	RX72	I/O	HV I/O channel RX72
B6	RX73	I/O	HV I/O channel RX73
B7	RX76	I/O	HV I/O channel RX76
B8	NC		No connection.
B9	NC		No connection.
B10	AGND	P	Analog circuit reference ground. Connect to GND.
B11	XTI	CLK	Input clock signal for crystal.
B12	LDO	P	Output power supply of internal LDO. Connect a bypass capacitor 2.2uF to GND.
B13	D+	I/O	Input differential data signal of USB.
B14	LDO16	P	Output power supply of internal LDO. Connect a bypass capacitor 2.2uF to GND.
B15	NC		No connection.
B16	NC		No connection.

Ball No.	Pin Name	Pin Type	Description
B17	NC		No connection.
C2	RX59	I/O	HV I/O channel RX59
C3	RX60	I/O	HV I/O channel RX60
C4	RX66	I/O	HV I/O channel RX66
C5	RX70	I/O	HV I/O channel RX70
C6	RX75	I/O	HV I/O channel RX75
C7	RX77	I/O	HV I/O channel RX77
C8	NC		No connection.
C9	NC		No connection.
C10	VDD	P	Input power supply. Connect a bypass capacitor 2.2uF to GND.
C11	XTO	CLK	Output clock signal for crystal.
C12	VDD33	P	Output power supply of internal LDO. Connect a bypass capacitor 2.2uF to GND.
C13	VBUS	P	Input power supply. Connect a bypass capacitor 2.2uF to GND.
C14	VDD3C	P	Input power supply for charge pump circuit. Connect a bypass capacitor 2.2uF to GND.
C15	NC		No connection.
C16	NC		No connection.
D1	RX56	I/O	HV I/O channel RX56
D2	RX57	I/O	HV I/O channel RX57
D3	RX58	I/O	HV I/O channel RX58
D5	RX69	I/O	HV I/O channel RX69
D6	RX74	I/O	HV I/O channel RX74
D7	RX79	I/O	HV I/O channel RX79
D8	NC		No connection.
D9	NC		No connection.
D10	VSS	P	Digital circuit reference ground. Connect to GND.
D11	NC		No connection.
D12	VDD3D	P	Input power supply. Connect a bypass capacitor 2.2uF to GND.
D13	VDD3A	P	Input power supply. Connect a bypass capacitor 2.2uF to GND.
D15	NC		No connection.
D16	NC		No connection.
D17	NC		No connection.

Ball No.	Pin Name	Pin Type	Description
E1	RX53	I/O	HV I/O channel RX53
E2	RX52	I/O	HV I/O channel RX52
E3	RX54	I/O	HV I/O channel RX54
E4	RX55	I/O	HV I/O channel RX55
E14	NC		No connection.
E15	NC		No connection.
E16	TRX45	I/O	HV I/O channel TRX45
E17	TRX44	I/O	HV I/O channel TRX44
F2	RX51	I/O	HV I/O channel RX51
F3	RX50	I/O	HV I/O channel RX50
F4	RX47	I/O	HV I/O channel RX47
F14	TRX43	I/O	HV I/O channel TRX43
F15	TRX42	I/O	HV I/O channel TRX42
F16	TRX41	I/O	HV I/O channel TRX41
G1	RX46	I/O	HV I/O channel RX46
G2	RX48	I/O	HV I/O channel RX48
G3	RX49	I/O	HV I/O channel RX49
G4	RX45	I/O	HV I/O channel RX45
G9	TXD	O	Output data signal for UART TXD.
G10	MOSI0	I/O	Input data signal A of SPI.
G14	TRX40	I/O	HV I/O channel TRX40
G15	TRX39	I/O	HV I/O channel TRX39
G16	TRX38	I/O	HV I/O channel TRX38
G17	TRX37	I/O	HV I/O channel TRX37
H1	RX42	I/O	HV I/O channel RX42
H2	RX41	I/O	HV I/O channel RX41
H3	RX44	I/O	HV I/O channel RX44
H4	RX43	I/O	HV I/O channel RX43
H7	VDD6F	P	Input power supply for test. Please floating.
H8	RESET	I	Input reset signal of chip. Low active reset.
H9	SLK	I/O	Clock signal of SPI.
H10	MISO0	O	Output data signal A of SPI.
H14	TRX33	I/O	HV I/O channel TRX33

Ball No.	Pin Name	Pin Type	Description
H15	TRX34	I/O	HV I/O channel TRX34
H16	TRX35	I/O	HV I/O channel TRX35
H17	TRX36	I/O	HV I/O channel TRX36
J2	RX38	I/O	HV I/O channel RX38
J3	RX40	I/O	HV I/O channel RX40
J4	RX39	I/O	HV I/O channel RX39
J7	ICE_CLK	I/O	Input clock signal of ICE.
J8	INT	I/O	Output interrupt signal for host controller.
J9	CSB	I/O	Chip selection signal of SPI.
J10	MOSI/RXD	I	Multi-function input data signal of SPI and UART RXD.
J13	TRX32	I/O	HV I/O channel TRX32
J14	TRX31	I/O	HV I/O channel TRX31
J15	TRX30	I/O	HV I/O channel TRX30
J16	TRX29	I/O	HV I/O channel TRX29
K1	RX35	I/O	HV I/O channel RX35
K2	RX37	I/O	HV I/O channel RX37
K3	RX34	I/O	HV I/O channel RX34
K4	RX36	I/O	HV I/O channel RX36
K7	ICE_DAT	I/O	Input data signal of ICE.
K8	I2C_SDA	I/O	Output/Input data signal of I2C. Connect a resistor 4.7kΩ to VDD.
K9	I2C_SCL	I	Input clock signal of I2C. Connect a resistor 4.7kΩ to VDD.
K10	MISO1	O	Output data signal B of SPI.
K14	C0AN	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C0AP.
K15	C0AP	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C0AN.
K16	C0N	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C0P.
K17	C0P	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C0P.
L1	RX31	I/O	HV I/O channel RX31
L2	RX30	I/O	HV I/O channel RX30
L3	RX33	I/O	HV I/O channel RX33

Ball No.	Pin Name	Pin Type	Description
L4	RX32	I/O	HV I/O channel RX32
L7	CKIO	CLK	Clock input single.
L10	AGND	P	Analog circuit reference ground. Connect to GND.
L14	C2N	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C2P.
L15	C2P	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C2N.
L16	C1N	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C1P.
L17	C1P	P	Output clock signal of charge pump. Connect a fly capacitor 1uF to C1N.
M2	RX27	I/O	HV I/O channel RX27
M3	RX29	I/O	HV I/O channel RX29
M4	RX28	I/O	HV I/O channel RX28
M14	VSSCP	P	Charge pump circuit reference ground. Connect to GND.
M15	VTX	P	Output power supply of charge pump. Connect a bypass capacitor 2.2uF to GND.
M16	VGH	P	Output power supply of charge pump. Connect a bypass capacitor 2.2uF to GND.
N1	RX25	I/O	HV I/O channel RX25
N2	RX26	I/O	HV I/O channel RX26
N3	RX24	I/O	HV I/O channel RX24
N14	TRX25	I/O	HV I/O channel TRX25
N15	TRX26	I/O	HV I/O channel TRX26
N16	TRX28	I/O	HV I/O channel TRX28
N17	TRX27	I/O	HV I/O channel TRX27
P1	RX23	I/O	HV I/O channel RX23
P2	RX22	I/O	HV I/O channel RX22
P3	RX21	I/O	HV I/O channel RX21
P5	RX10	I/O	HV I/O channel RX10
P6	RX4	I/O	HV I/O channel RX4
P7	RX0	I/O	HV I/O channel RX0
P8	NC		No connection.
P9	NC		No connection.

Ball No.	Pin Name	Pin Type	Description
P10	NC		No connection.
P11	TRX02	I/O	HV I/O channel TRX2
P12	TRX04	I/O	HV I/O channel TRX4
P13	TRX11	I/O	HV I/O channel TRX11
P15	TRX22	I/O	HV I/O channel TRX22
P16	TRX23	I/O	HV I/O channel TRX23
P17	TRX24	I/O	HV I/O channel TRX24
R2	RX20	I/O	HV I/O channel RX20
R3	RX15	I/O	HV I/O channel RX15
R4	RX13	I/O	HV I/O channel RX13
R5	RX9	I/O	HV I/O channel RX9
R6	RX8	I/O	HV I/O channel RX8
R7	RX3	I/O	HV I/O channel RX3
R8	NC		No connection.
R9	NC		No connection.
R10	VSS	P	Digital circuit reference ground. Connect to GND.
R11	TRX1	I/O	HV I/O channel TRX1
R12	TRX6	I/O	HV I/O channel TRX6
R13	TRX10	I/O	HV I/O channel TRX10
R14	TRX14	I/O	HV I/O channel TRX14
R15	TRX20	I/O	HV I/O channel TRX20
R16	TRX21	I/O	HV I/O channel TRX21
T1	RX19	I/O	HV I/O channel RX19
T2	RX18	I/O	HV I/O channel RX18
T3	RX14	I/O	HV I/O channel RX14
T4	RX12	I/O	HV I/O channel RX12
T5	RX6	I/O	HV I/O channel RX6
T6	RX5	I/O	HV I/O channel RX5
T7	RX2	I/O	HV I/O channel RX2
T8	NC		No connection.
T9	NC		No connection.
T10	VSSCP	P	Charge pump circuit reference ground. Connect to GND.
T11	TRX5	I/O	HV I/O channel TRX5

Ball No.	Pin Name	Pin Type	Description
T12	TRX7	I/O	HV I/O channel TRX7
T13	TRX8	I/O	HV I/O channel TRX8
T14	TRX13	I/O	HV I/O channel TRX13
T15	TRX15	I/O	HV I/O channel TRX15
T16	TRX17	I/O	HV I/O channel TRX17
T17	TRX19	I/O	HV I/O channel TRX19
U1	RX17	I/O	HV I/O channel RX17
U2	RX16	I/O	HV I/O channel RX16
U4	RX11	I/O	HV I/O channel RX11
U5	RX7	I/O	HV I/O channel RX7
U7	RX1	I/O	HV I/O channel RX1
U8	NC		No connection.
U10	TRX0	I/O	HV I/O channel TRX0
U11	TRX03	I/O	HV I/O channel TRX3
U13	TRX09	I/O	HV I/O channel TRX9
U14	TRX12	I/O	HV I/O channel TRX12
U16	TRX16	I/O	HV I/O channel TRX16
U17	TRX18	I/O	HV I/O channel TRX18

Table 4-2: Pin Type Define

Symbol	Description
P	Power pad
CLK	Clock
I	Input only
O	Output only (Push-pull)
I/O	input / output pad

5. Electrical Characteristics

5.1 Absolute Maximum Ratings

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.

Table 5-1: Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
USB 5V input power supply voltage	V_{BUS}	-0.3	6.0	V
V_{DD} to GND	V_{DD}	-0.3	3.3	V
AV_{DD} to GND	AV_{DD}	-0.3	3.6	V
V_{DD3A} to GND	V_{DD3A}	-0.3	3.6	V
V_{DD3C} to GND	V_{DD3C}	-0.3	3.6	V
V_{DD3D} to GND	V_{DD3D}	-0.3	3.6	V
V_{DD16} to GND	V_{DD16}	-0.3	1.65	V
V_{TX} to GND	V_{TX}	-0.3	35	V
ESD Susceptibility HBM (Human Body Mode) (Note 1)	HBM		2000	V
ESD Susceptibility MM (Machine Mode)	MM		200	V

Note 1: Devices are ESD sensitive. Handling precaution is recommended.

5.2 Recommended Operating Conditions

Table 5-2: Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
V_{BUS} to GND	V_{BUS}	4.4	5.5	V
V_{DD} to GND	V_{DD}	2.7	3.6	V
AV_{DD} to GND	AV_{DD}	2.7	3.6	V
V_{DD3A}	V_{DD3A}	2.7	3.6	V
V_{DD3C}	V_{DD3C}	2.7	3.6	V
V_{DD3D}	V_{DD3D}	2.7	3.6	V
Operating Ambient Temperature Range	T_A	-40	85	°C
Operating Junction Temperature Range	T_J	-40	125	°C
Storage Ambient Temperature Range	T_{ST}	-40	150	°C

Note: The device is not guaranteed to function outside its operating conditions.

5.3 DC Characteristics

Table 5-3: Input Power Supply and LDO

 (GND = 0V, T_{opr} = 25°C)

Item	Symbol	Min	Typ.	Max	Unit	Condition
USB 5V input power supply voltage	V _{BUS}	4.4	5	5.5	V	@ USB
Digital input power supply voltage	V _{DD}	2.7	3	3.3	V	
Analog input power supply voltage	AV _{DD}	2.7	3	3.3	V	
3.3V LDO output voltage	V _{DD33}	-10%	3.3	+10%	V	
1.8V LDO output voltage	LDO	-10%	1.8	+10%	V	
1.6V LDO output voltage	LDO16		1.6		V	

Table 5-4: DC Characteristics

 (V_{DD} = 3.3, GND = 0V, T_{opr} = 25°C)

Item	Symbol	Min	Typ.	Max	Unit	Condition
Power Ground	V _{SS}	-0.3			V	
Operation current	I _{op}		150		mA	
Input Low Voltage	V _{IL1}	-0.5		0.3V _{DD}	V	
Input High Voltage	V _{IH1}	0.65V _{DD}		V _{DD} +0.5	V	
Hysteresis voltage	V _{HY}		0.2V _{DD}		V	
Input Low Voltage, XT_In	V _{IL2}	0		0.6	V	V _{DD} =3.3V
Input High Voltage, XT_In	V _{IH2}	2.6		V _{DD} +0.2	V	V _{DD} =3.3V
Negative going threshold, /Reset	V _{ILS}	-0.5		0.2V _{DD}	V	
Positive going threshold, /Reset	V _{IHS}	0.6V _{DD}		V _{DD} +0.5	V	
Output High Voltage	V _{OH}	0.7V _{DD}			V	V _{DD} =3.3V, I _{OH} =8mA
Output Low Voltage	V _{OL}			0.3V _{DD}	V	V _{DD} =3.3V, I _{OL} =10mA

Table 5-5: USB DC Characteristics

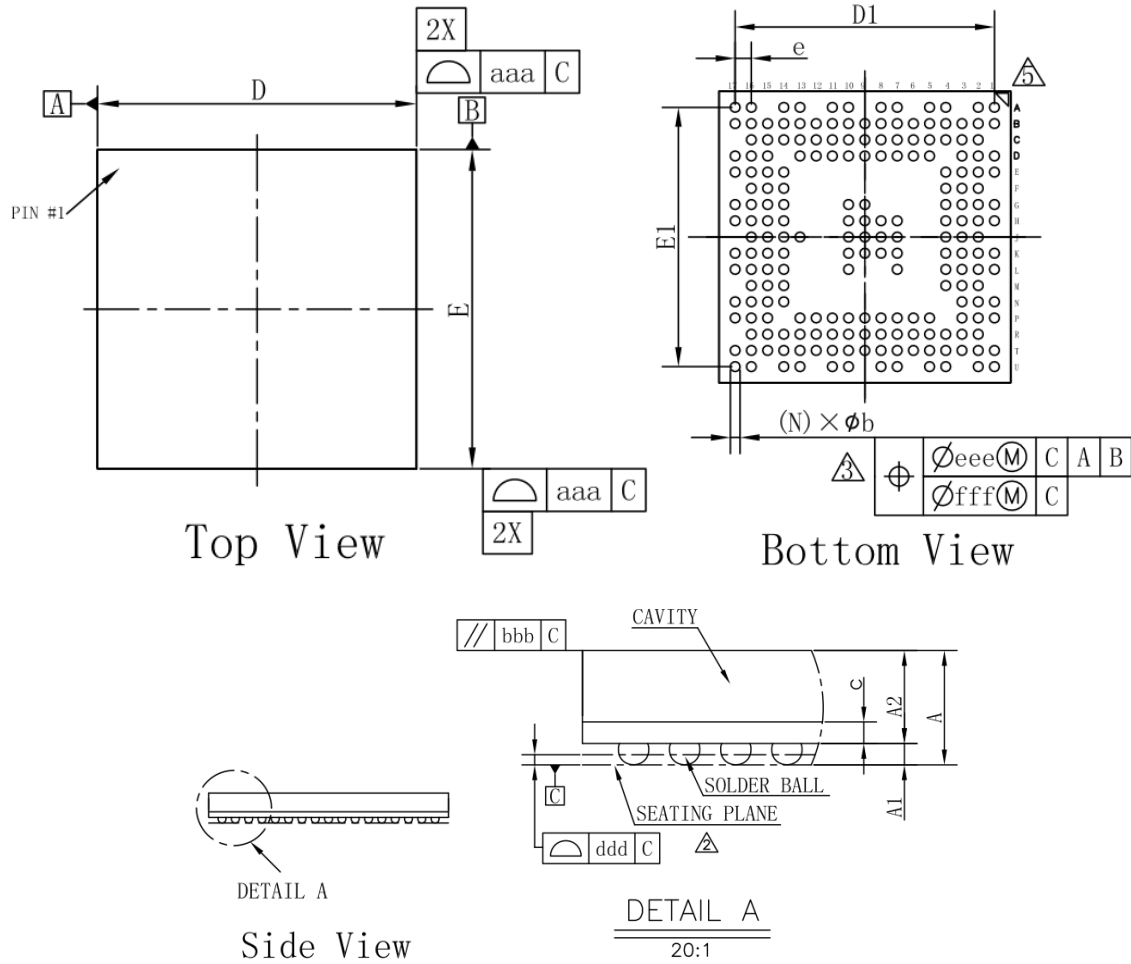
Item	Symbol	Min	Typ.	Max	Unit	Condition
Input Low	V_{IL}			0.8	V	
Input High (driven)	V_{IH}	2.0			V	
Differential input sensitivity	V_{DI}	0.2			V	(D+) – (D-)
Differential common-mode range	V_{CM}	0.8		2.5	V	Includes V_{DI} range
Single-ended receiver threshold	V_{SE}	0.8		2.0	V	
Receiver hysteresis	V_{RH}		200		mV	
Output low (driven)	V_{OL}	0		0.3		
Output high (driven)	V_{OH}	2.8		3.6		
Output signal cross voltage	V_{CRS}	1.3		2.0		
Pull-up resistor	R_{PU}	1.425		1.575		
Pull-down resistor	R_{PD}	14.25		15.75		
Termination Voltage for upstream port pull up (RPU)	V_{TRM}	3.0		3.6		

Table 5-6: Crystal Characteristics

Item	Symbol	Min	Typ.	Max	Unit	Condition
Input clock frequency	f_{XIN}	-1%	12	+1%	MHz	External crystal

6. Package Information

6.1 BGA-200 Package Dimension



symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.220	---	---	0.048
A1	0.160	0.210	0.260	0.006	0.008	0.010
A2	0.860	0.910	0.960	0.034	0.036	0.038
c	0.170	0.210	0.250	0.007	0.008	0.010
D	8.900	9.000	9.100	0.350	0.354	0.358
E	8.900	9.000	9.100	0.350	0.354	0.358
D1	---	8.000	---	---	0.315	---
E1	---	8.000	---	---	0.315	---
e	---	0.500	---	---	0.020	---
b	0.250	0.300	0.350	0.010	0.012	0.014
aaa	0.150			0.006		
bbb	0.200			0.008		
ddd	0.080			0.003		
eee	0.150			0.006		
fff	0.080			0.003		
N	200			200		
MD/ME	17/17			17/17		

Figure 6-1: Package Information of BGA-200

6.2 Marking Description

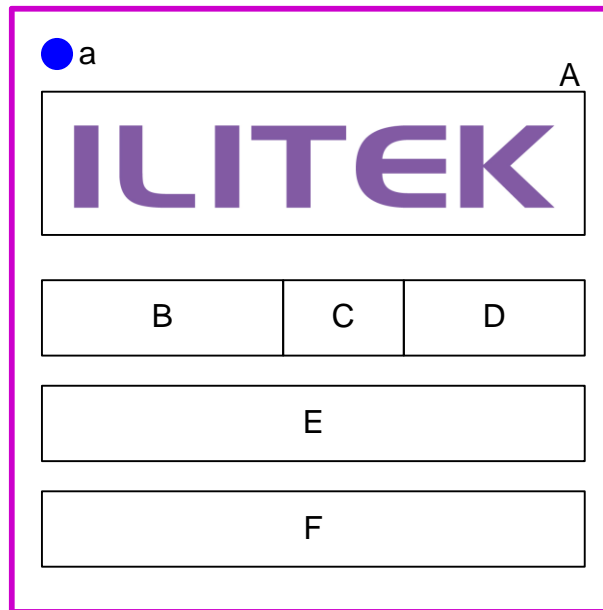


Figure 6-2: BGA-200 package top view

a – PIN1 Ref.

A – ILITEK Logo

B – Product Name : 2312

C – Package Type : BJ (BGA)

D – Control Code : The code will be updated by production control.

E – Assembly Lot No. : The code will be updated by production control.

F – Wafer Lot No. : The code will be updated by production control.

7. Typical Application Circuit

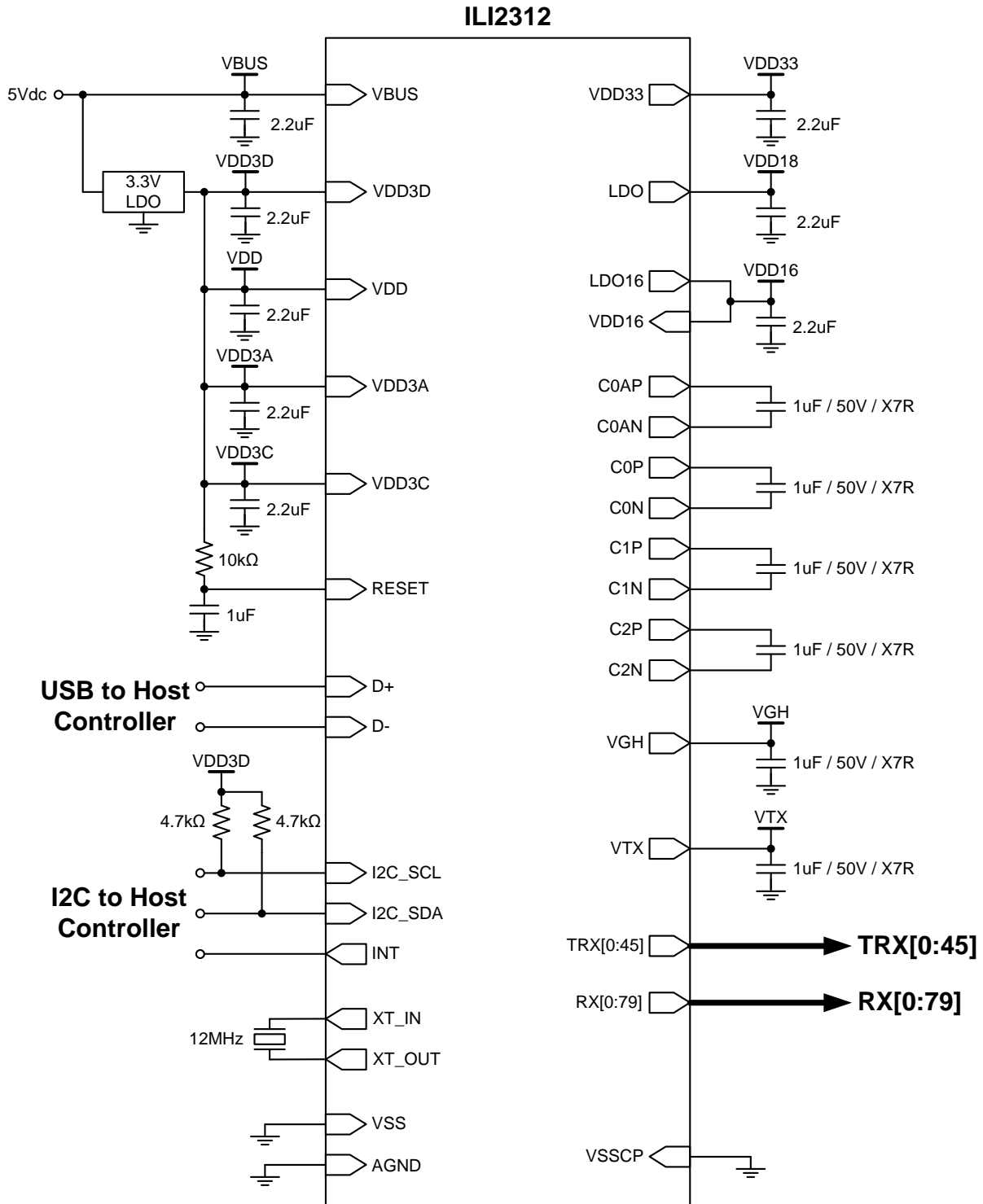


Figure 7-1: ILI2312 Typical Application Circuit