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ILI2315

ILI2315
Single Chip Capacitive Touch Sensor Controller

Specification

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Revision History

Version	Date	Page	Description
V1.00	2015/06/12		Draft specification released.
V1.01	2015/07/09	7	1. Modify Ball Assignment
		8	2. Modify Pin Definition
V1.02	2015/07/19	8	Modify Pin Definition
V1.03	2015/07/29	8	Modify Pin Definition
V1.04	2015/08/04	16	Modify VBUS min. recommended operating voltage to 4.4V
V1.05	2015/08/07	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
V1.06	2015/08/27	21	Update "Typical Application Circuit"
V1.07	2015/09/04	12	Modify Pin Definition
V1.08	2015/11/17	20	1. Update "Marking Description"
		21	2. Modify "Typical Application Circuit"
		All	3. Remove "ILITEK Confidential"
		Title	4. Remove "Preliminary"

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1. Description

The ILI2315 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 154 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

- 154 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

LDO LVR	HV Charge Pump	154-ch HV I/O CDC
USB SPI I2C	OSC PLL	Timer
32-bit CPU core	Memory Flash ROM / SRAM	
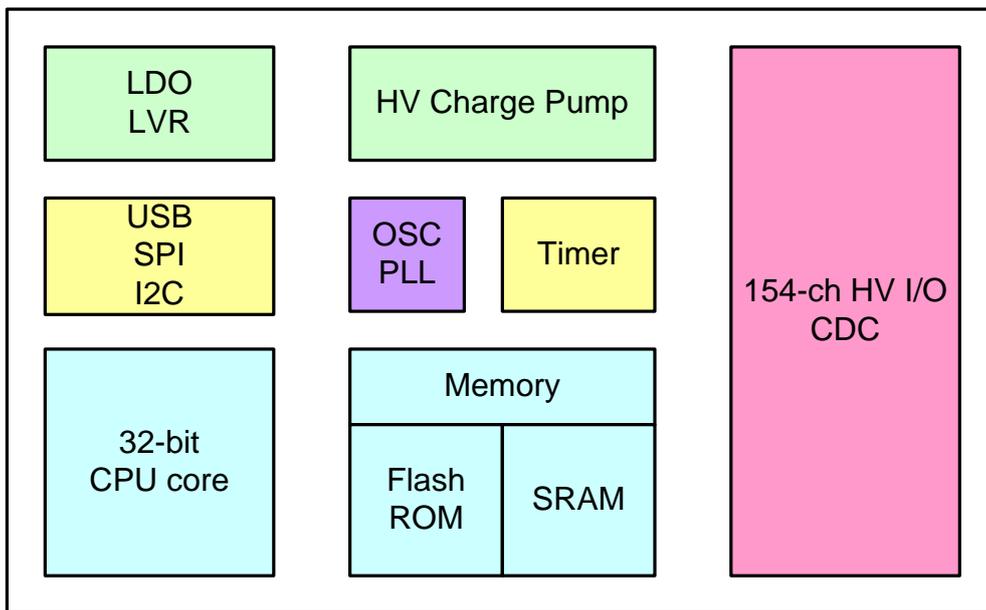
Figure 3-1: ILI2315 Block Diagram

4. Pin Definition

4.1 BGA-200 Ball Assignment

Top View

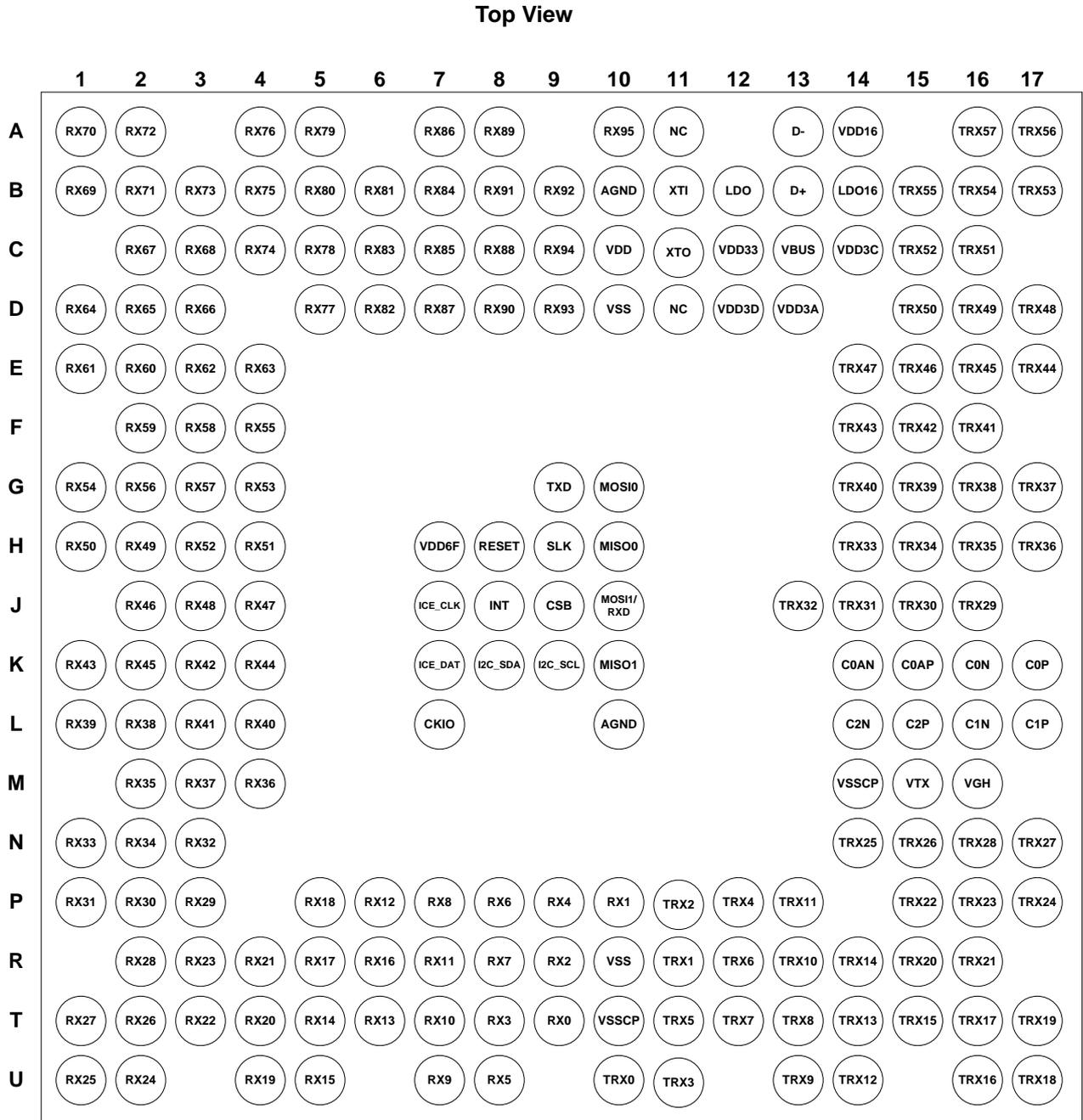|	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
A	RX70	RX72		RX76	RX79		RX86	RX89		RX95	NC		D-	VDD16		TRX57	TRX56
B	RX69	RX71	RX73	RX75	RX80	RX81	RX84	RX91	RX92	AGND	XTI	LDO	D+	LDO16	TRX55	TRX54	TRX53
C		RX67	RX68	RX74	RX78	RX83	RX85	RX88	RX94	VDD	XTO	VDD33	VBUS	VDD3C	TRX52	TRX51	
D	RX64	RX65	RX66		RX77	RX82	RX87	RX90	RX93	VSS	NC	VDD3D	VDD3A		TRX50	TRX49	TRX48
E	RX61	RX60	RX62	RX63										TRX47	TRX46	TRX45	TRX44
F		RX59	RX58	RX55										TRX43	TRX42	TRX41	
G	RX54	RX56	RX57	RX53					TXD	MOSI0				TRX40	TRX39	TRX38	TRX37
H	RX50	RX49	RX52	RX51			VDD6F	RESET	SLK	MISO0				TRX33	TRX34	TRX35	TRX36
J		RX46	RX48	RX47			ICE_CLK	INT	CSB	MOSI1/RXD			TRX32	TRX31	TRX30	TRX29	
K	RX43	RX45	RX42	RX44			ICE_DAT	I2C_SDA	I2C_SCL	MISO1				C0AN	C0AP	C0N	C0P
L	RX39	RX38	RX41	RX40			CKIO			AGND				C2N	C2P	C1N	C1P
M		RX35	RX37	RX36										VSSCP	VTX	VGH	
N	RX33	RX34	RX32											TRX25	TRX26	TRX28	TRX27
P	RX31	RX30	RX29		RX18	RX12	RX8	RX6	RX4	RX1	TRX2	TRX4	TRX11		TRX22	TRX23	TRX24
R		RX28	RX23	RX21	RX17	RX16	RX11	RX7	RX2	VSS	TRX1	TRX6	TRX10	TRX14	TRX20	TRX21	
T	RX27	RX26	RX22	RX20	RX14	RX13	RX10	RX3	RX0	VSSCP	TRX5	TRX7	TRX8	TRX13	TRX15	TRX17	TRX19
U	RX25	RX24		RX19	RX15		RX9	RX5		TRX0	TRX3		TRX9	TRX12		TRX16	TRX18

Figure 4-1: ILI2315 BGA-200 Package Diagram

4.2 BGA-200 Pin Description

Table 4-1: ILI2315 Pin Assignment

Ball No.	Pin Name	Pin Type	Description
A1	RX70	I/O	HV I/O channel RX70
A2	RX72	I/O	HV I/O channel RX72
A4	RX76	I/O	HV I/O channel RX76
A5	RX79	I/O	HV I/O channel RX79
A7	RX86	I/O	HV I/O channel RX86
A8	RX89	I/O	HV I/O channel RX89
A10	RX95	I/O	HV I/O channel RX95
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	TRX57	I/O	HV I/O channel TRX57
A17	TRX56	I/O	HV I/O channel TRX56
B1	RX69	I/O	HV I/O channel RX69
B2	RX71	I/O	HV I/O channel RX71
B3	RX73	I/O	HV I/O channel RX73
B4	RX75	I/O	HV I/O channel RX75
B5	RX80	I/O	HV I/O channel RX80
B6	RX81	I/O	HV I/O channel RX81
B7	RX84	I/O	HV I/O channel RX84
B8	RX91	I/O	HV I/O channel RX91
B9	RX92	I/O	HV I/O channel RX92
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	TRX55	I/O	HV I/O channel TRX55
B16	TRX54	I/O	HV I/O channel TRX54
B17	TRX53	I/O	HV I/O channel TRX53
C2	RX67	I/O	HV I/O channel RX67

Ball No.	Pin Name	Pin Type	Description
C3	RX68	I/O	HV I/O channel RX68
C4	RX74	I/O	HV I/O channel RX74
C5	RX78	I/O	HV I/O channel RX78
C6	RX83	I/O	HV I/O channel RX83
C7	RX85	I/O	HV I/O channel RX85
C8	RX88	I/O	HV I/O channel RX88
C9	RX94	I/O	HV I/O channel RX94
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	TRX52	I/O	HV I/O channel TRX52
C16	TRX51	I/O	HV I/O channel TRX51
D1	RX64	I/O	HV I/O channel RX64
D2	RX65	I/O	HV I/O channel RX65
D3	RX66	I/O	HV I/O channel RX66
D5	RX77	I/O	HV I/O channel RX77
D6	RX82	I/O	HV I/O channel RX82
D7	RX87	I/O	HV I/O channel RX87
D8	RX90	I/O	HV I/O channel RX90
D9	RX93	I/O	HV I/O channel RX93
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	TRX50	I/O	HV I/O channel TRX50
D16	TRX49	I/O	HV I/O channel TRX49
D17	TRX48	I/O	HV I/O channel TRX48
E1	RX61	I/O	HV I/O channel RX61
E2	RX60	I/O	HV I/O channel RX60
E3	RX62	I/O	HV I/O channel RX62
E4	RX63	I/O	HV I/O channel RX63

Ball No.	Pin Name	Pin Type	Description
E14	TRX47	I/O	HV I/O channel TRX47
E15	TRX46	I/O	HV I/O channel TRX46
E16	TRX45	I/O	HV I/O channel TRX45
E17	TRX44	I/O	HV I/O channel TRX44
F2	RX59	I/O	HV I/O channel RX59
F3	RX58	I/O	HV I/O channel RX58
F4	RX55	I/O	HV I/O channel RX55
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	RX54	I/O	HV I/O channel RX54
G2	RX56	I/O	HV I/O channel RX56
G3	RX57	I/O	HV I/O channel RX57
G4	RX53	I/O	HV I/O channel RX53
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	RX50	I/O	HV I/O channel RX50
H2	RX49	I/O	HV I/O channel RX49
H3	RX52	I/O	HV I/O channel RX52
H4	RX51	I/O	HV I/O channel RX51
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
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	RX46	I/O	HV I/O channel RX46

Ball No.	Pin Name	Pin Type	Description
J3	RX48	I/O	HV I/O channel RX48
J4	RX47	I/O	HV I/O channel RX47
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	MOSI1/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	RX43	I/O	HV I/O channel RX43
K2	RX45	I/O	HV I/O channel RX45
K3	RX42	I/O	HV I/O channel RX42
K4	RX44	I/O	HV I/O channel RX44
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	RX39	I/O	HV I/O channel RX39
L2	RX38	I/O	HV I/O channel RX38
L3	RX41	I/O	HV I/O channel RX41
L4	RX40	I/O	HV I/O channel RX40
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.

Ball No.	Pin Name	Pin Type	Description
M2	RX35	I/O	HV I/O channel RX35
M3	RX37	I/O	HV I/O channel RX37
M4	RX36	I/O	HV I/O channel RX36
M14	VSSCP	P	Charge pump circuit reference ground. Connect to GND.
M15	VTX	P	Output power supply of charge pump. Connect a bypass capacitor 1uF to GND.
M16	VGH	P	Output power supply of charge pump. Connect a bypass capacitor 1uF to GND.
N1	RX33	I/O	HV I/O channel RX33
N2	RX34	I/O	HV I/O channel RX34
N3	RX32	I/O	HV I/O channel RX32
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	RX31	I/O	HV I/O channel RX31
P2	RX30	I/O	HV I/O channel RX30
P3	RX29	I/O	HV I/O channel RX29
P5	RX18	I/O	HV I/O channel RX18
P6	RX12	I/O	HV I/O channel RX12
P7	RX8	I/O	HV I/O channel RX8
P8	RX6	I/O	HV I/O channel RX6
P9	RX4	I/O	HV I/O channel RX4
P10	RX1	I/O	HV I/O channel RX1
P11	TRX2	I/O	HV I/O channel TRX2
P12	TRX4	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	RX28	I/O	HV I/O channel RX28
R3	RX23	I/O	HV I/O channel RX23
R4	RX21	I/O	HV I/O channel RX21
R5	RX17	I/O	HV I/O channel RX17
R6	RX16	I/O	HV I/O channel RX16

Ball No.	Pin Name	Pin Type	Description
R7	RX11	I/O	HV I/O channel RX11
R8	RX7	I/O	HV I/O channel RX7
R9	RX2	I/O	HV I/O channel RX2
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	RX27	I/O	HV I/O channel RX27
T2	RX26	I/O	HV I/O channel RX26
T3	RX22	I/O	HV I/O channel RX22
T4	RX20	I/O	HV I/O channel RX20
T5	RX14	I/O	HV I/O channel RX14
T6	RX13	I/O	HV I/O channel RX13
T7	RX10	I/O	HV I/O channel RX10
T8	RX3	I/O	HV I/O channel RX3
T9	RX0	I/O	HV I/O channel RX0
T10	VSSCP	P	Charge pump circuit reference ground. Connect to GND.
T11	TRX5	I/O	HV I/O channel TRX5
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	RX25	I/O	HV I/O channel RX25
U2	RX24	I/O	HV I/O channel RX24
U4	RX19	I/O	HV I/O channel RX19
U5	RX15	I/O	HV I/O channel RX15
U7	RX9	I/O	HV I/O channel RX9
U8	RX5	I/O	HV I/O channel RX5

Ball No.	Pin Name	Pin Type	Description
U10	TRX0	I/O	HV I/O channel TRX0
U11	TRX3	I/O	HV I/O channel TRX3
U13	TRX9	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	ºC
Operating Junction Temperature Range	T_J	-40	125	ºC
Storage Ambient Temperature Range	T_{ST}	-40	150	ºC

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} = 25ºC)

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} = 25ºC)

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

Figure 6-1: Package Information of BGA-200
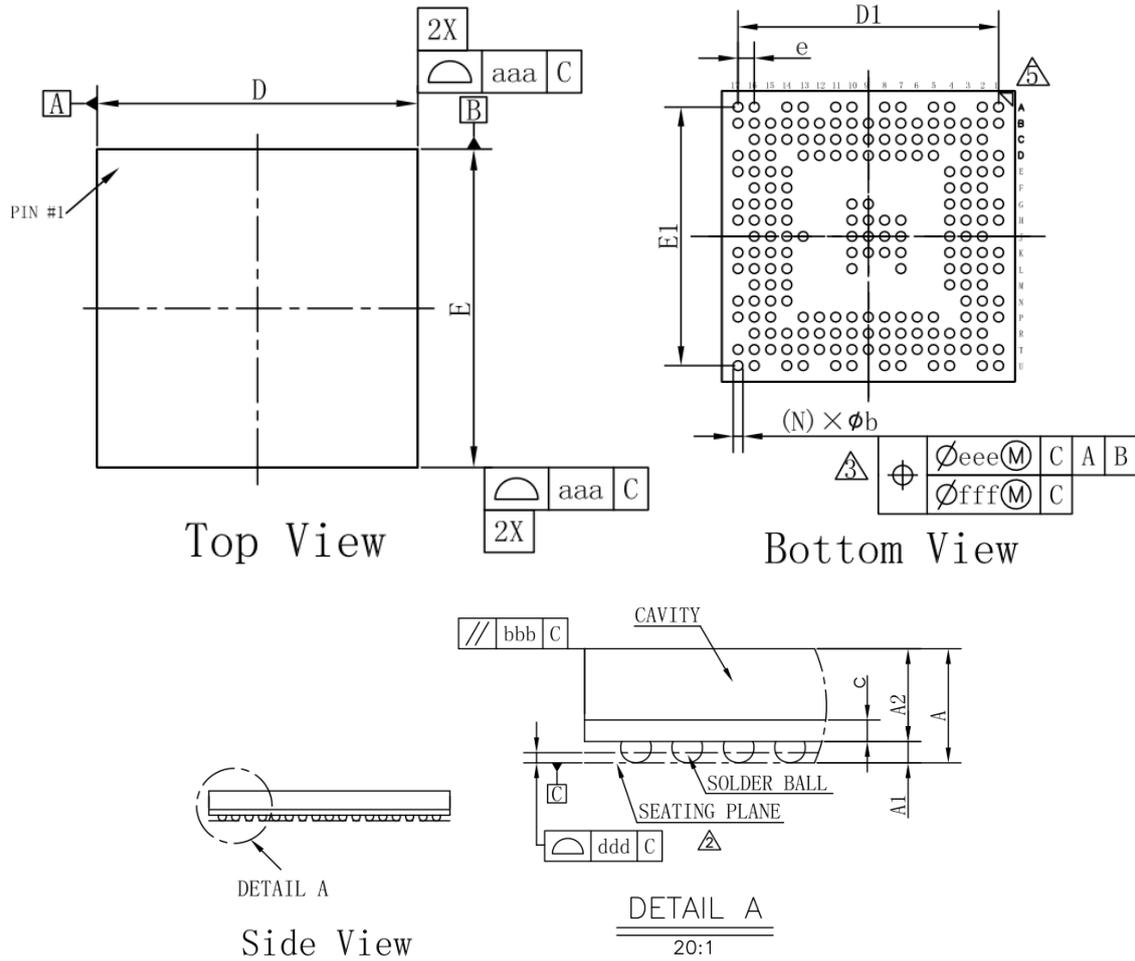
symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.220	---	---	0.048
A1	0.160	0.210	0.260	0.006	0.008	0.010
A2	0.860	0.910	0.960	0.034	0.036	0.038
c	0.170	0.210	0.250	0.007	0.008	0.010
D	8.900	9.000	9.100	0.350	0.354	0.358
E	8.900	9.000	9.100	0.350	0.354	0.358
D1	---	8.000	---	---	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		

6.2 Marking Description
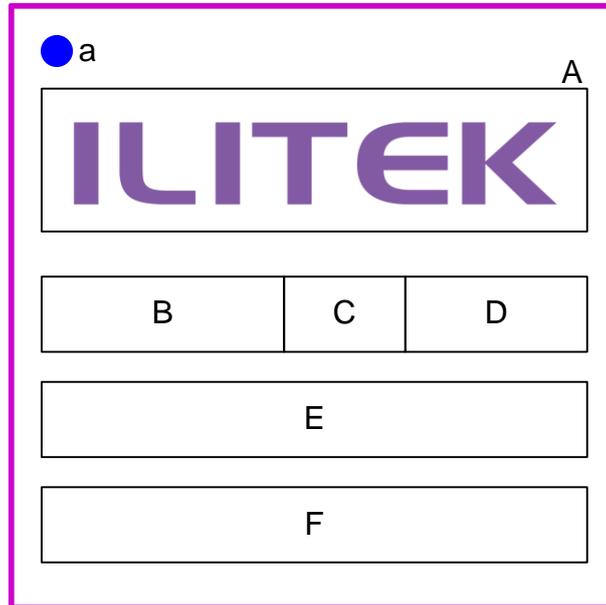
Figure 6-2: BGA-200 package top view

a – PIN1 Ref.

A – ILITEK Logo
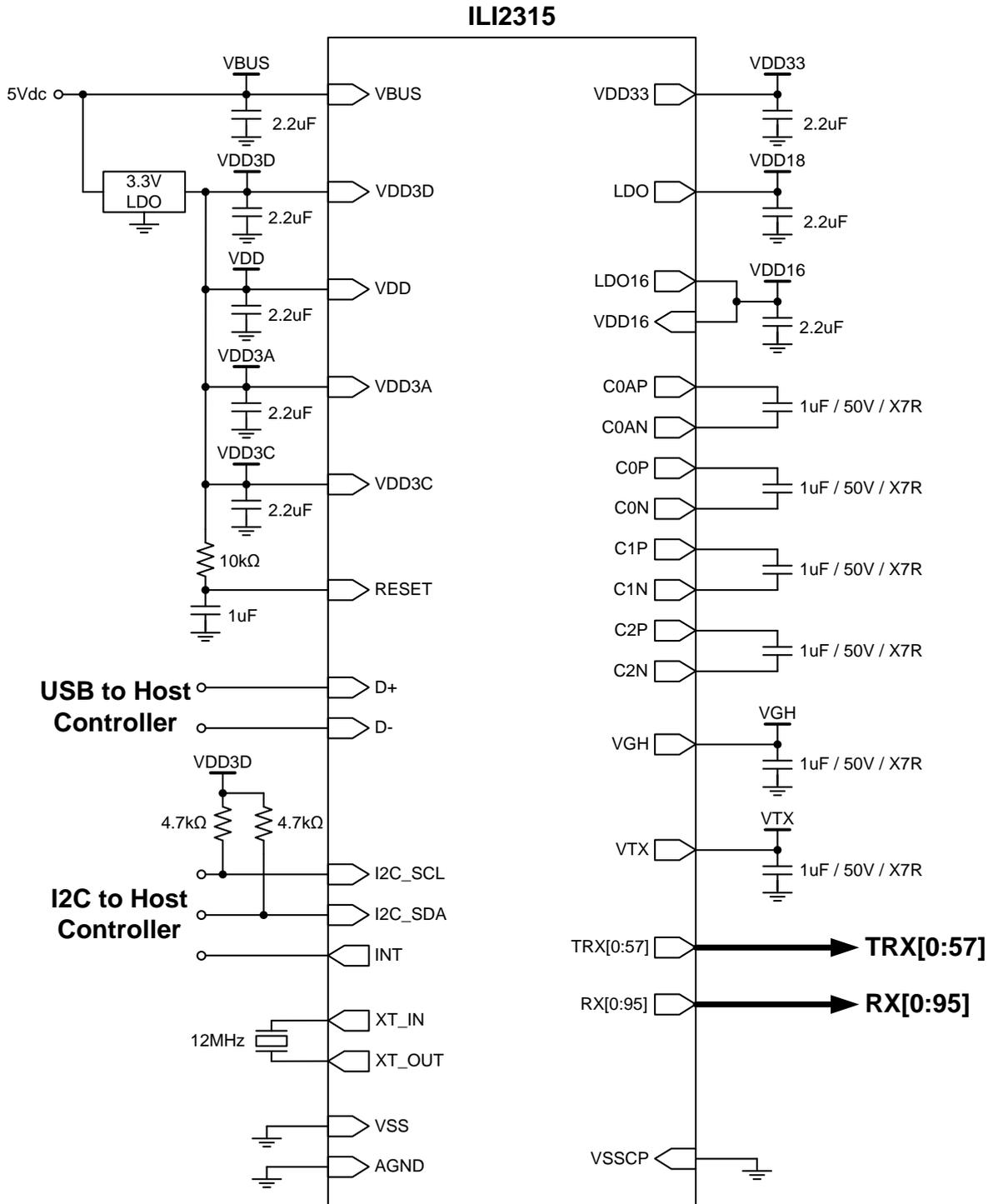
B – Product Name : 2315

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: ILI2315 Typical Application Circuit