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ILI2302M
Capacitive Touch Sensor Controller

Specification

Version: V1.00

Date: 2014/7/28

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Revision History

Version No.	Date	Page	Description
V0.01	2013/11/18		Preliminary specification released.
V0.01	2014/02/14		Add item 5.3 power consumption.
V0.03	2014/7/25		1. Modify Fly cap value to 0.1uF in Pin Description section. 2. Add I2C and USB timing characteristics.
V1.00	2014/7/28		Formal specification release

CONTENT

1. Description

The ILI2302M is a single chip capacitive touch sensor controller optimized for NB and AIO touch panel design. It integrates with specialized 32-bit MCU, high speed CDC (capacitance to digital converter), 96CH high voltage driving and sensing I/O channels and high voltage charge pump controller in a compact 132-pin VFBGA 5mm*10mm*1mm package. It also supports both USB and I2C host control interface. It meets Windows 8 requirements with best human touch performance.

2. Features

- 96 channels for capacitive touch panel.
- Flexible driving or sensing channel assignment
- Programmable driving voltage with slew rate control for driving channels
- High speed ADC with programmable 8-bit or 10-bit resolution
- Support auto baseline calibration circuit
- Support smart edge sensing
- Support smart touch detection
- Built-in noise processing function
- High speed 32-bit micro-controller
- USB 2.0 full speed device
- Up to 1MHz I2C slave device
- High voltage charge pump controller with programmable clamp voltage function
- Input voltage low level detection circuit
- Input voltage power on reset circuit
- Support power down mode
- Driving to Sensing mutual capacitance: 1pF to 4pF

3. Block Diagram

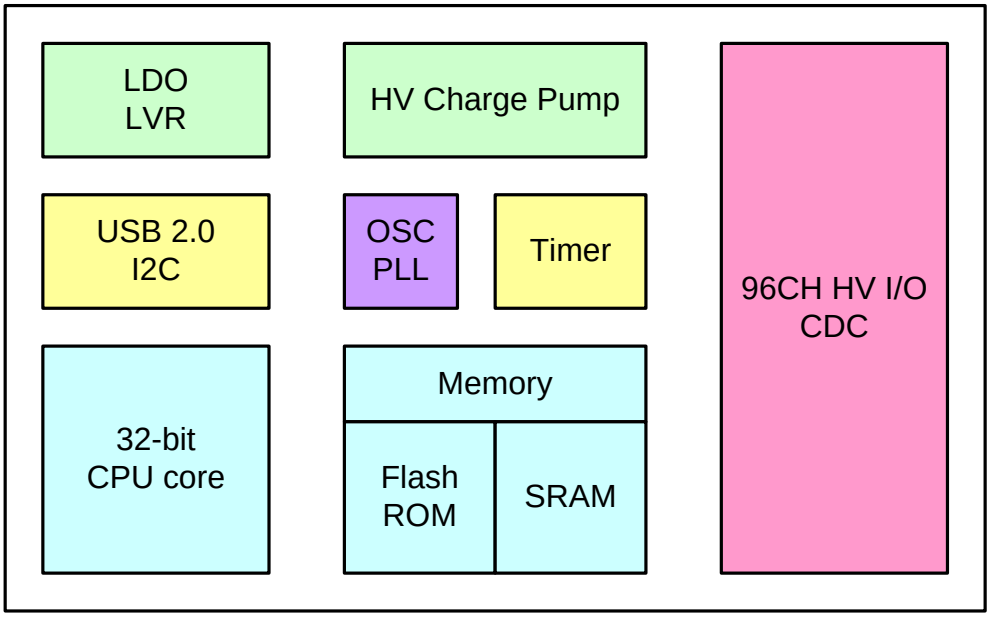
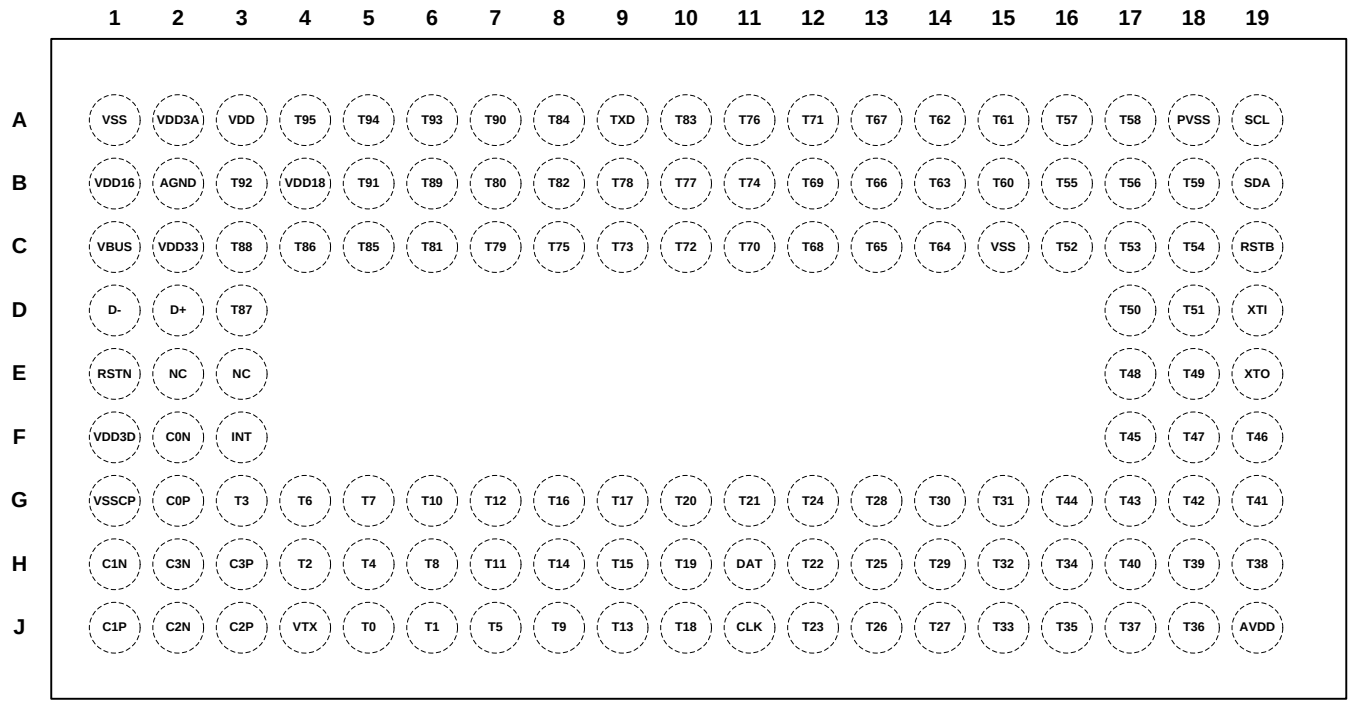


Figure 3-1: ILI2302M Block Diagram

4. Pin Definition

4.1 VFBGA-132 Ball Assignment

Top View



4.2 Pin Description

VFBGA-132 Pin Description

Ball No.	Pin Name	Pin Type*	Description
A1	VSS	P	Digital circuit reference ground. Connect to GND.
A2	VDD3A	P	Power supply pin. Connect a bypass capacitor 2.2uF to GND.
A3	VDD	P	Power supply pin. Connect a bypass capacitor 4.7uF to GND.
A4	T95	I/O	HV I/O channel 95
A5	T94	I/O	HV I/O channel 94
A6	T93	I/O	HV I/O channel 93
A7	T90	I/O	HV I/O channel 90
A8	T84	I/O	HV I/O channel 84
A9	TXD	O	Data transmitting pin for debug.
A10	T83	I/O	HV I/O channel 83
A11	T76	I/O	HV I/O channel 76
A12	T71	I/O	HV I/O channel 71
A13	T67	I/O	HV I/O channel 67
A14	T62	I/O	HV I/O channel 62
A15	T61	I/O	HV I/O channel 61
A16	T57	I/O	HV I/O channel 57
A17	T58	I/O	HV I/O channel 58
A18	PVSS	P	Analog circuit reference ground. Connect to GND.
A19	SCL	I	I2C clock pin. Connect a resistor 4.7kΩ to VDD3D.
B1	VDD16	P	Internal power regulator 1.6V decoupling pin. Connect a bypass capacitor 2.2uF to GND.
B2	AGND	P	Analog circuit reference ground. Connect to GND.
B3	T92	I/O	HV I/O channel 92
B4	VDD18	P	Internal power regulator 1.8V decoupling pin. Connect a bypass capacitor 4.7uF to GND.
B5	T91	I/O	HV I/O channel 91
B6	T89	I/O	HV I/O channel 89
B7	T80	I/O	HV I/O channel 80
B8	T82	I/O	HV I/O channel 82
B9	T78	I/O	HV I/O channel 78
B10	T77	I/O	HV I/O channel 77
B11	T74	I/O	HV I/O channel 74
B12	T69	I/O	HV I/O channel 69
B13	T66	I/O	HV I/O channel 66
B14	T63	I/O	HV I/O channel 63
B15	T60	I/O	HV I/O channel 60
B16	T55	I/O	HV I/O channel 55

Ball No.	Pin Name	Pin Type*	Description
B17	T56	I/O	HV I/O channel 56
B18	T59	I/O	HV I/O channel 59
B19	SDA	I/O	I2C data I/O pin. Connect a resistor 4.7kΩ to VDD3D.
C1	VBUS	USB	Input power supply. Connect a bypass capacitor 2.2uF to GND.
C2	VDD33	USB	Output power supply of internal LDO. Connect a bypass capacitor 2.2uF to GND.
C3	T88	I/O	HV I/O channel 88
C4	T86	I/O	HV I/O channel 86
C5	T85	I/O	HV I/O channel 85
C6	T81	I/O	HV I/O channel 81
C7	T79	I/O	HV I/O channel 79
C8	T75	I/O	HV I/O channel 75
C9	T73	I/O	HV I/O channel 73
C10	T72	I/O	HV I/O channel 72
C11	T70	I/O	HV I/O channel 70
C12	T68	I/O	HV I/O channel 68
C13	T65	I/O	HV I/O channel 65
C14	T64	I/O	HV I/O channel 64
C15	VSS	P	Digital circuit reference ground. Connect to GND.
C16	T52	I/O	HV I/O channel 52
C17	T53	I/O	HV I/O channel 53
C18	T54	I/O	HV I/O channel 54
C19	RSTB	I	Input reset signal of MCU. Low active reset.
D1	D-	USB	Input differential data signal of USB.
D2	D+	USB	Input differential data signal of USB.
D3	T87	I/O	HV I/O channel 87
D17	T50	I/O	HV I/O channel 50
D18	T51	I/O	HV I/O channel 51
D19	XTI	I	Input clock signal for crystal.
E1	RSTN	O	Reset of CDC output pin. Low active reset.
E2	NC	I/O	No connection.
E3	NC	I	No connection.
E17	T48	I/O	HV I/O channel 48
E18	T49	I/O	HV I/O channel 49
E19	XTO	O	Output clock signal for crystal.
F1	VDD3D	P	Input power supply. Connect a bypass capacitor 2.2uF to GND.
F2	C0N	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C0P.
F3	INT	O	Output interrupt signal for host controller.

Ball No.	Pin Name	Pin Type*	Description
F17	T45	I/O	HV I/O channel 45
F18	T47	I/O	HV I/O channel 47
F19	T46	I/O	HV I/O channel 46
G1	VSSCP	P	Charge pump circuit reference ground. Connect to GND.
G2	C0P	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C0N.
G3	T3	I/O	HV I/O channel 3
G4	T6	I/O	HV I/O channel 6
G5	T7	I/O	HV I/O channel 7
G6	T10	I/O	HV I/O channel 10
G7	T12	I/O	HV I/O channel 12
G8	T16	I/O	HV I/O channel 16
G9	T17	I/O	HV I/O channel 17
G10	T20	I/O	HV I/O channel 20
G11	T21	I/O	HV I/O channel 21
G12	T24	I/O	HV I/O channel 24
G13	T28	I/O	HV I/O channel 28
G14	T30	I/O	HV I/O channel 30
G15	T31	I/O	HV I/O channel 31
G16	T44	I/O	HV I/O channel 44
G17	T43	I/O	HV I/O channel 43
G18	T42	I/O	HV I/O channel 42
G19	T41	I/O	HV I/O channel 41
H1	C1N	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C1P.
H2	C3N	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C3P.
H3	C3P	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C3N.
H4	T2	I/O	HV I/O channel 2
H5	T4	I/O	HV I/O channel 4
H6	T8	I/O	HV I/O channel 8
H7	T11	I/O	HV I/O channel 11
H8	T14	I/O	HV I/O channel 14
H9	T15	I/O	HV I/O channel 15
H10	T19	I/O	HV I/O channel 19
H11	DAT	I/O	Input data signal of ICE.
H12	T22	I/O	HV I/O channel 22
H13	T25	I/O	HV I/O channel 25
H14	T29	I/O	HV I/O channel 29
H15	T32	I/O	HV I/O channel 32

Ball No.	Pin Name	Pin Type*	Description
H16	T34	I/O	HV I/O channel 34
H17	T40	I/O	HV I/O channel 40
H18	T39	I/O	HV I/O channel 39
H19	T38	I/O	HV I/O channel 38
J1	C1P	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C1N.
J2	C2N	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C2P.
J3	C2P	O	Output clock signal of charge pump. Connect a fly capacitor 0.1uF to C2N.
J4	VTX	P	Internal charge pump voltage decoupling pin. Connect a bypass capacitor 0.1uF to GND.
J5	T0	I/O	HV I/O channel 0
J6	T1	I/O	HV I/O channel 1
J7	T5	I/O	HV I/O channel 5
J8	T9	I/O	HV I/O channel 9
J9	T13	I/O	HV I/O channel 13
J10	T18	I/O	HV I/O channel 18
J11	CLK	I	Input clock signal of ICE.
J12	T23	I/O	HV I/O channel 23
J13	T26	I/O	HV I/O channel 26
J14	T27	I/O	HV I/O channel 27
J15	T33	I/O	HV I/O channel 33
J16	T35	I/O	HV I/O channel 35
J17	T37	I/O	HV I/O channel 37
J18	T36	I/O	HV I/O channel 36
J19	AVDD	P	Input power supply. Connect a bypass capacitor 2.2uF to GND.

*Pin type: P=power or ground; I=input only; O=output only (push-pull); I/O=bi-direction; USB: USB pins

5. Electrical Characteristics

5.1 Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Min	Max	Unit
VDD to GND	VDD	-0.3	6.5	V
AVDD to GND	AVDD	-0.3	6.5	V
VBUS to GND	VBUS	-0.3	5.5	V
VDD33 to GND	VDD33	-0.3	3.3	V
VDD18 to GND	VDD18	-0.3	3.6	V
VDD3D	VDD3D	-0.3	3.3	V
VDD3A	VDD3A	-0.3	3.3	V
VDD16 to GND	VDD16	-0.3	1.65	V
VTX to GND	VTX	-0.3	32	V
ESD Susceptibility HBM (Human Body Mode) **(Note 2)**	HBM		2000	V
ESD Susceptibility MM (Machine Mode)	MM		200	V

Note 1: 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.

Note 2: Devices are ESD sensitive. Handling precaution is recommended.

5.2 Recommended Operating Conditions (Note 3)

Parameter	Symbol	Min	Max	Unit
VDD to GND	VDD	2.7	5.5	V
AVDD to GND	AVDD	2.7	5.5	V
VBUS to GND	VBUS	4.75	5.25	V
VDD3D	VDD3D	2.7	3.3	V
VDD3A	VDD3A	2.7	3.3	V
Operating Ambient Temperature Range	T_A	-40	85	℃
Operating Junction Temperature Range	T_J	-40	125	℃
Storage Ambient Temperature Range	T_{ST}	-40	150	℃

Note 3: The device is not guaranteed to function outside its operating conditions.

5.3 Power Consumption (Note 4)

Parameter	Symbol	Typ.	Unit
Input Power Supply	VBUS	5	V
Active Current	I_{ACT}	60	mA
Idle Current	I_{IDL}	40	mA

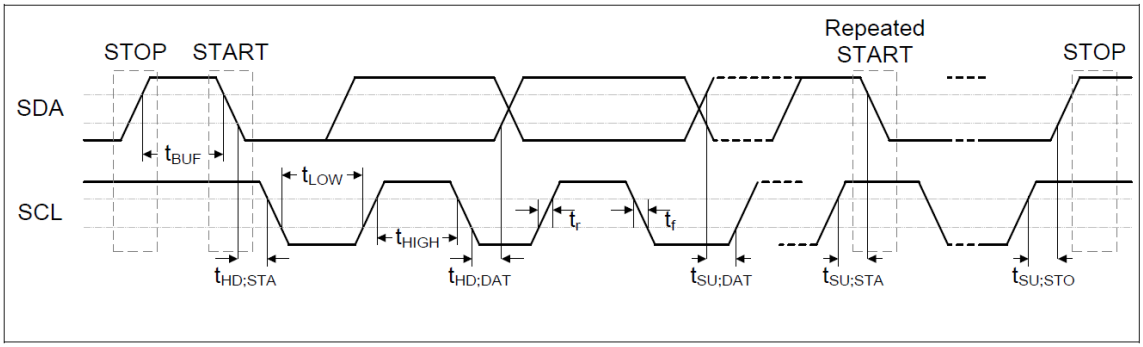
Note 4: The active current was measured under 100Hz report rate with 10 fingers touching. The touch panel size is 15.6 inch GFF type sensor.

5.4 I2C Interface Operating Conditions

5.4.1 I2C DC Electrical Characteristics

Parameter	Symbol	Conditions	Min	Max	Unit
Input high (driven)	V_{IH}		-0.5	$0.3V_{DD}$	V
Input low	V_{IL}		$0.7V_{DD}$		V
hysteresis of Schmitt trigger inputs	V_{hys}		$0.05V_{DD}$		V
LOW-level output voltage 1	V_{OL1}	(open-drain or open-collector) at 3 mA sink current; V_{DD} > 2 V	0	0.4	V
LOW-level output voltage 2	V_{OL2}	(open-drain or open-collector) at 2 mA sink current[3]; V_{DD} <= 2 V	0	$0.2V_{DD}$	V
LOW-level output current	I_{OL}	V_{OL} = 0.4 V	20		mA
output fall time from V_{IHmin} to V_{ILmax}	t_{of}		20 x (V_{DD} / 5.5 V)[	120	ns
pulse width of spikes that must be suppressed by the input filter	t_{SP}		0	50	ns
input current each I/O pin	I_i	$0.1V_{DD} < V_I < 0.9V_{DDmax}$	-10	+10	uA
capacitance for each I/O pin	C_i			10	pF

5.4.2 I2C Bus Timing



Parameter	Symbol	Conditions	Min	Max	Unit
SCL clock frequency	f_{SCL}			1000	kHz
hold time (repeated) START condition	$t_{HD;STA}$	After this period, the first clock pulse is generated.	0.26		us
LOW period of the SCL clock	t_{LOW}		0.5		us
HIGH period of the SCL clock	t_{HIGH}		0.26		us
set-up time for a repeated START condition	$t_{SU;STA}$		0.26		us
data hold time	$t_{HD;DAT}$	I2C-bus devices	0		us
rise time of both SDA and SCL signals	t_r			120	ns
fall time of both SDA and SCL signals	t_f		20x(V_{DD} / 5.5 V)	120	ns
set-up time for STOP condition	$t_{SU;STO}$		0.26		us
bus free time between a STOP and START condition	t_{BUF}		0.5		us
capacitive load for each bus line	C_b		0.5		us
data valid time	$t_{VD;DAT}$			0.45	us

5.5 USB DC Electrical Characteristics

5.5.1 USB DC Electrical Characteristics

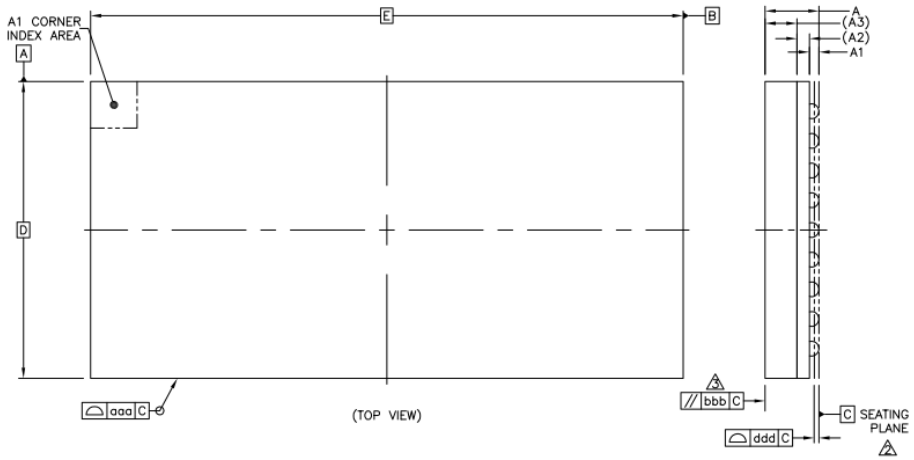
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input high (driven)	V_{IH}		2			V
Input low	V_{IL}				0.8	V
Differential input sensitivity	V_{DI}	|PADP-PADM|	0.2			V
Differential common-mode range	V_{CM}	Includes VDI range	0.8		2.5	V
Single-ended receiver threshold	V_{SE}		0.8		2	V
Receiver hysteresis				200	mV	
Output low (driven)	V_{OL}		0		0.3	V
Output high (driven)	V_{OH}		2.8		3.6	V
Output signal cross voltage	V_{CRS}		1.3		2	V
Pull-up resistor	R_{PU}		1.425		1.575	kΩ
Pull-down resistor	R_{PD}		14.25		15.75	kΩ
Termination Voltage for upstream port pull up (RPU)	V_{TRM}		3		3.6	V
Driver output resistance	Z_{DRV}	Steady state drive (Note5)		10		Ω
Transceiver capacitance	C_{IN}	Pin to GND			20	pF

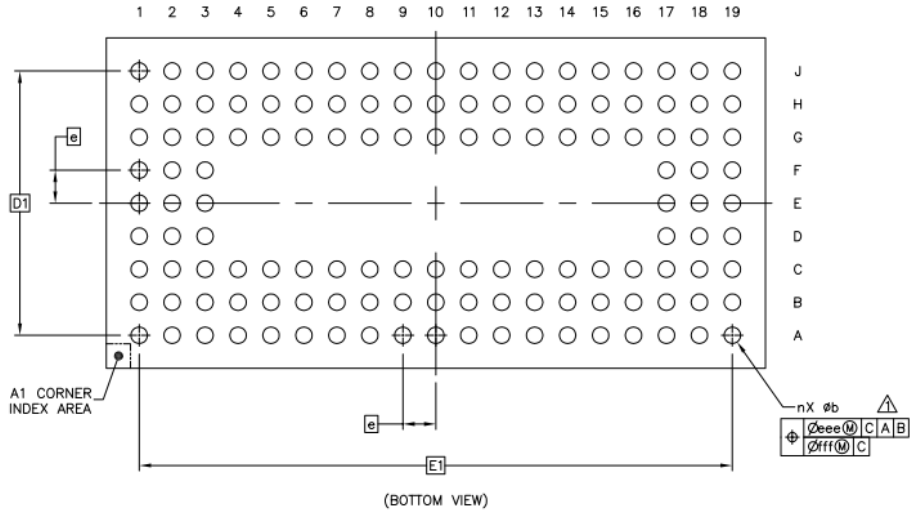
Note 5: Driver output resistance doesn't include series resistor resistance.

6. Package Information

6.1 VFBGA-132 Package Dimension

Unit: mm





	SYMBOL	COMMON DIMENSIONS		
		MIN.	NOR.	MAX.
TOTAL THICKNESS	A	---	---	1
STAND OFF	A1	0.12	---	0.2
SUBSTRATE THICKNESS	A2		0.21	REF
MOLD THICKNESS	A3		0.54	REF
BODY SIZE	D		5	BSC
	E		10	BSC
BALL DIAMETER			0.25	
BALL OPENING			0.25	
BALL WIDTH	b	0.2	---	0.3
BALL PITCH	e		0.5	BSC
BALL COUNT	n		132	
EDGE BALL CENTER TO CENTER	D1		4	BSC
	E1		9	BSC
BODY CENTER TO CONTACT BALL	SD		---	BSC
	SE		---	BSC
PACKAGE EDGE TOLERANCE	aaa		0.1	
MOLD FLATNESS	bbb		0.1	
COPLANARITY	ddd		0.08	
BALL OFFSET (PACKAGE)	eee		0.15	
BALL OFFSET (BALL)	fff		0.08	

7. Typical Application Circuit

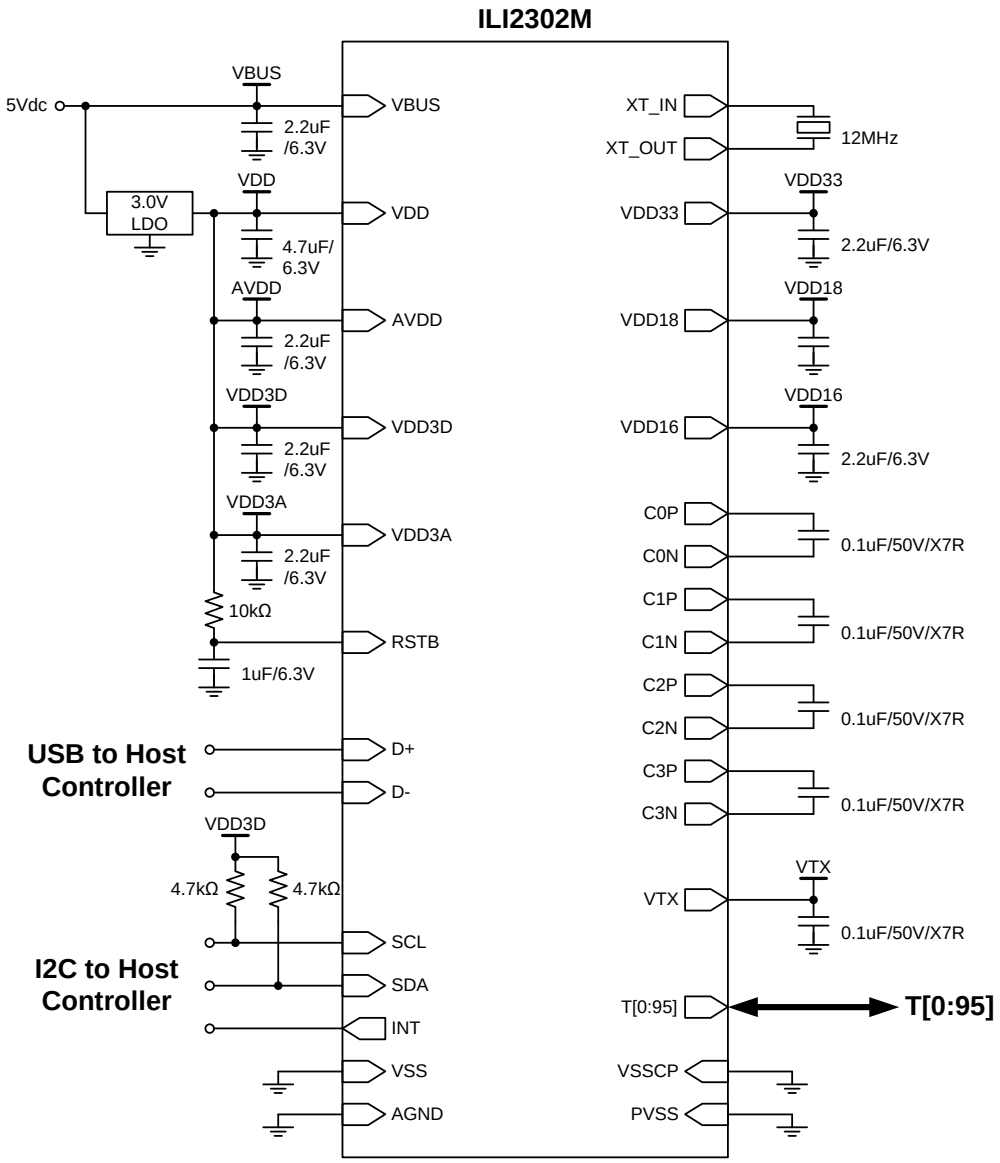


Figure 7-1: ILI2302M Typical Application Circuit