

### True Multi-Touch Capacitive Touch Panel Controller

#### INTRODUCTION

The FT3X27 is a single-chip capacitive touch panel controller which built-in enhanced Micro-controller unit (MCU). It provides the benefits of full screen common mode scan technology, fast response time and high level accuracy. It can drive capacitive type touch panel with up to 13 driving and 25 sensing lines or 14 driving and 28 sensing lines.

#### FEATURES

- I Mutual Capacitive Sensing Techniques
- I Full Screen Common Mode Scan Techniques
- I True Multi-touch up to 10 Points of absolute X and Y Coordinates
- I High immunity to RF and power Interferences
- I Insensitive to Capacitance and Environmental Variations
- I FT3327 Supports up to 13TX + 25 RX
- I FT3427 Supports up to 14TX + 28 RX
- I Support up to 7.0" touch screen with 5 mm sensor pitch
- I Full Programmable Scan Sequences to Support Various TX/RX Configurations
- I High Report Rate: Over 100Hz
- I Touch Resolution of 100 Dots per Inch (dpi) or above
- I Auto-calibration
- I Support Interfaces: I2C
- I Built-in 64KB Flash
- I 2.75 to 3.6V Operating Voltage
- I IOVCC (Ext. or Int.) supports from 1.8V to 3.6V
- I Single Channel (TX/RX) resistance: Up to 150K  $\Omega$
- I Single Channel (transmit/receive) Capacitance: 20pF
- I Optimal Sensing Mutual Capacitor: 0.5pF~4pF
- I 11-Bit ADC Accuracy
- I 3 Operating Modes
  - Ø Active
  - Ø Monitor
  - Ø Hibernate
- I Operating Temperature Range: -40°C to +85°C
- I Package: QFN56L6x6x0.6mm, 0.35mm/pitch

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# OVERVIEW

## 1.1 Typical Applications

FT3X27 accommodates a wide range of applications with a set of buttons up to a 2D touch sensing device; their typical applications are listed below.

- | Mobile phones
- | Tablets
- | MIDs
- | Navigation systems, GPS
- | Game consoles
- | POS (Point of Sales) devices
- | Portable MP3 and MP4 media players
- | Digital cameras

FT3X27 support  $\leq 7.0''$  Touch Panel, the spec is listed in the following table,

Part Number	Package	TX	RX	Total Channels	Recommended TP Size (16:9)
FT3327	QFN 56L 6x6x0.6mm Pitch =0.35mm	13	25	38	$\leq 5.5''$ *
FT3427	QFN 56L 6x6x0.6mm Pitch =0.35mm	14	28	42	$\leq 7.0''$

\*5.5'' FHD resolution, FT3427 will be recommended.

## 2 FUNCTIONAL DESCRIPTION

### 2.1 Architectural Overview

Figure-2-1 shows the overall architecture for the FT3X27.

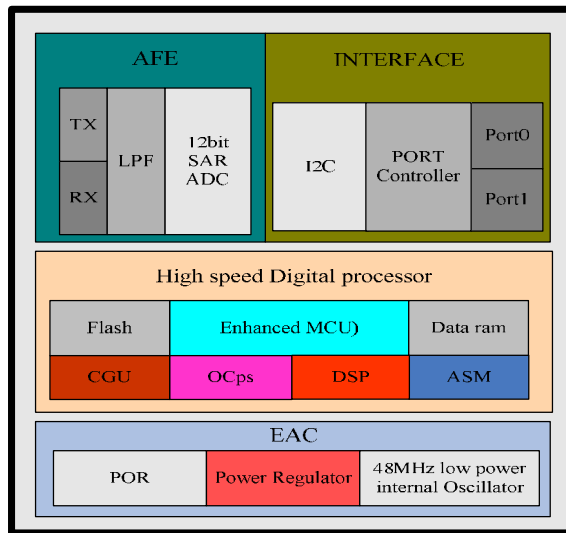


Figure 2-1 System Architecture Diagram

The FT3X27 is comprised of five main functional parts listed below,

- | Touch Panel Interface Circuits

The main function for the AFE and AFE controller is to interface with the touch panel. It scans the panel by sending AC signals to the panel and processes the received signals from the panel. It includes both Transmit (TX) and Receive (RX) functions. Key parameters

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to configure this circuit can be sent via serial interfaces.

#### I Enhanced MCU with DSP accelerator

For the Enhanced MCU, larger program and data memories are supported. Furthermore, a Flash memory is implemented to store programs and some key parameters.

Complex signal processing algorithms are implemented by MCU and DSP accelerator to detect the touches reliably and efficiently. Communication protocol software is also implemented in this MCU to exchange data and control information with the host processor.

#### I External Interface

- Ø I2C: an interface for data exchange with host
- Ø INT: an interrupt signal to inform the host processor that touch data is ready for read
- Ø RSTN: an external low signal reset the chip. The port is also use to wakeup the FT3X27 from the Hibernate mode.

I A watch dog timer is implemented to ensure the robustness of the chip.

I A voltage regulator to generate 1.8V for digital circuits from the input VDD3 supply

I Power On Reset (POR) is active until VDDD is higher than some level and hold decades of  $\mu$ s.

## 2.2 MCU

This section describes some critical features and operations supported by the enhanced MCU.

Figure 2-2 shows the overall structure of the MCU block. In addition to the enhanced MCU core, we have added the following circuits,

- I A DSP accelerator cooperates with MCU to process the complex algorithms
- I Timer: A number of timers are available to generate different clocks
- I Clock Manager: To control various clocks under different operation conditions of the system

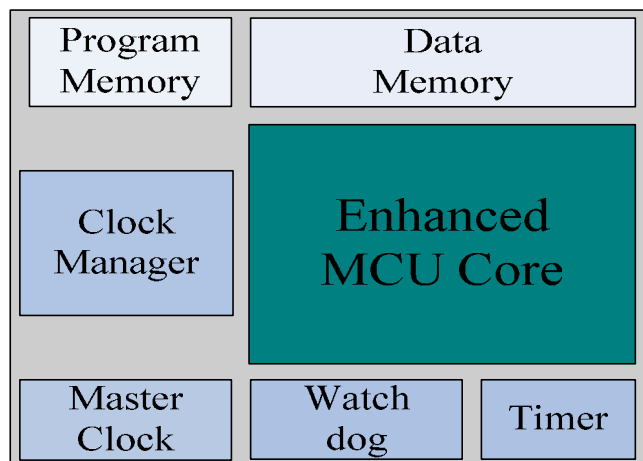


Figure 2-2 MCU Block Diagram

## 2.3 Operation Modes

FT3X27 offers following three modes:

#### I Active Mode

When in this mode, FT3X27 actively scans the panel. The default scan rate is 100 frames per second. The host processor can configure it to speed up or to slow down.

#### I Monitor Mode

In this mode, FT3X27 scans the panel at a reduced speed. The default scan rate is 25 frames per second and the host processor can increase or decrease this rate. In this mode, most algorithms are stopped. A simpler algorithm is being executed to determine if there is a touch or not. When a touch is detected, FT3X27 shall enter the Active mode immediately to acquire the touch information quickly. During this mode, the serial port is closed and no data shall be transferred with the host processor.

#### I Hibernate Mode

In this mode, the chip is set in a power down mode. It shall only respond to the "RESET" signal from the host processor. The chip therefore consumes very little current, which helps prolong the standby time for the portable devices.

## 2.4 Host Interface

Figure 2-3 shows the interface between a host processor and FT3X27. This interface consists of the following three sets of signals:

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- I Serial Interface
- I Interrupt from FT3X27 to the Host
- I Reset Signal from the Host to FT3X27

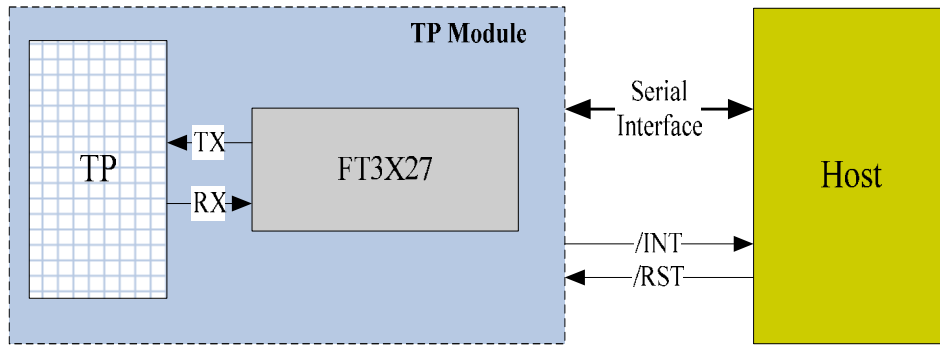


Figure 2-3 Host Interface Diagram

The serial interface of FT3X27 is I2C. The detail of the interface is described in detail in Section 2.5. The interrupt signal (/INT) is used for FT3X27 to inform the host that data are ready for the host to receive. The /RST signal is used for the host to wake up FT3X27 from the Hibernate mode. After resetting, FT3X27 shall enter the Active mode.

## 2.5 Serial Interface

FT3X27 supports the I2C interfaces, which can be used by a host processor or other devices.

The I2C is always configured in the Slave mode. The data transfer format is shown in Figure 2-4.

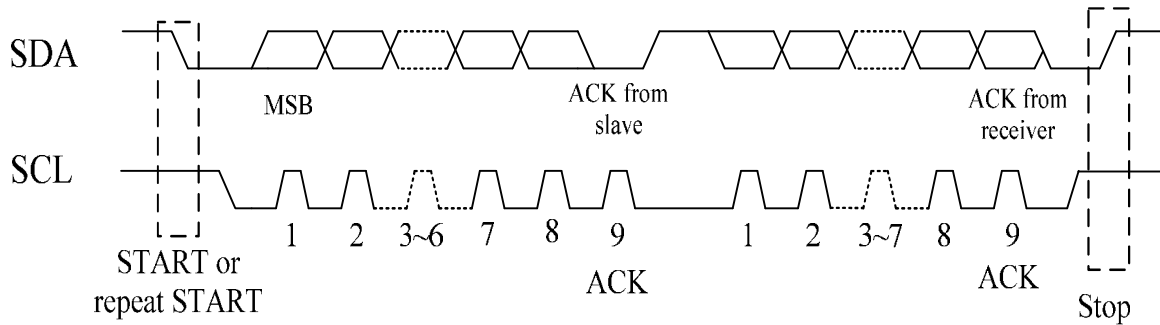


Figure 2-4 I2C Serial Data Transfer Format

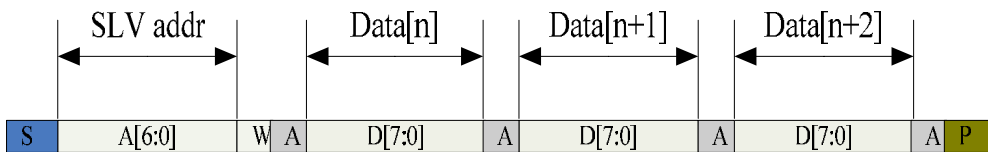


Figure 2-5 I2C master write, slave read

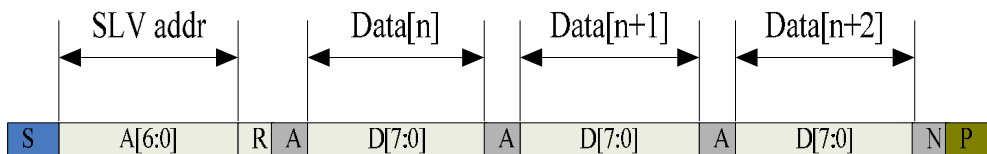


Figure 2-6 I2C master read, slave write

Table 2-1 lists the meanings of the mnemonics used in the above figures.

**Table 2-1 Mnemonics Description**

Mnemonics	Description
S	I2C Start or I2C Restart
A[6:0]	Slave address
R/ W	READ/WRITE bit, '1' for read, '0' for write
A(N)	ACK(NACK) bit
P	STOP: the indication of the end of a packet (if this bit is missing, S will indicate the end of the current packet and the beginning of the next packet)

I2C Interface Timing Characteristics is shown in Table 2-2.

**Table 2-2 I2C Timing Characteristics**

Parameter	Min	Max	Unit
SCL frequency	0	400	KHz
Bus free time between a STOP and START condition	1.3		us
Hold time (repeated) START condition	0.6		us
Data setup time	100		ns
Setup time for a repeated START condition	0.6		us
Setup time for STOP condition	0.6		us
Rise time of both SDA and SCL signals	20	300	ns
Fall time of both SDA and SCL signals	20x (VDD/5.5V)	300	ns

## 2.6 Proximity Modes

FT3X27 support the following three proximity modes:

### I Air Swipe

In this mode, FT3X27 could recognize the large object movement in two dimensions (x and Y axis). This can enable functions like picture scrolling, page up and page down.

### I Glove Usage

FT3X27 has increased sensitivity that allows the touch sensors to detect Finger through glove.

### I Cheek Check

As soon as user's cheek approaches to mobile phone screen, cheek proximity detection allows the host to turn off the mobile phone screen.

## 3 ELECTRICAL SPECIFICATIONS

### 3.1 Absolute Maximum Ratings

**Table 3-1 Absolute Maximum Ratings**

Item	Symbol	Value	Unit	Note
Power Supply Voltage	VDD3 – VSS	2.7 ~ 3.6	V	1
I/O Digital Voltage	IOVCC	1.71~3.6	V	1
Operating Temperature	Topr	-40 ~ +85	°C	1
Storage Temperature	Tstg	-55 ~ +150	°C	1

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## Notes

1. If used beyond the absolute maximum ratings, FT3X27 may be permanently damaged. It is strongly recommended that the device be used within the electrical characteristics in normal operations. If exposed to the condition not within the electrical characteristics, it may affect the reliability of the device.
2. Make sure VDDA (high)  $\geq$  VSSA (low)

## 3.2 DC Characteristics

**Table 3-2 DC Characteristics**

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
Input high-level voltage	VIH	V		0.7 x IOVCC	--	IOVCC	
Input low-level voltage	VIL	V		-0.3	--	0.3 x IOVCC	
Output high-level voltage	VOH	V	IOH=3mA	0.7 x IOVCC	--	--	
Output low-level voltage	VOL	V	IOL=4.5mA	--	--	0.3 x IOVCC	
I/O leakage current	ILI	uA	Vin=0~VDD3	-1	--	1	
Current consumption (Normal operation mode)	Iopr	mA	VDD3 = 3V Ta=25°C	--	11	--	
Current consumption (Monitor mode)	Imon	mA	VDD3 = 3V Ta=25°C	--	0.43	--	
Current consumption (Sleep mode)	Islp	uA	VDD3 = 3V Ta=25°C	--	42	--	
Step-up output voltage	VDD5	V	VDD3= 2.8V		0.25		
Step-up output voltage	VDD10	V	VDD3= 2.8V		0.5		
Output voltage	VDD5	V	VDD3= 2.8V	5		6.25	
Output voltage	VDD10	V	VDD3= 2.8V	7		11.5	
Power Supply voltage	VDD3	V		2.7	--	3.6	

Notes: This consumption data is intended for design guidance only. Actual current will depend on the particular sensor design and firmware options.

## 3.3 AC Characteristics

**AC Characteristics of Oscillators**

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
OSC clock 1	fosc1	MHz	VDD3 = 2.8V; Ta=25°C	49	50	51	

**Table 3-3 AC Characteristics of TX & RX**

Item	Symbol	Test Condition	Min	Typ	Max	Unit	Note
TX acceptable clock	ftx		100	150	400	KHz	
TX output rise time	Ttxr		--	TBD	--	nS	
TX output fall time	Ttxf		--	TBD	--	nS	
RX input voltage	Trxi		1.2	TBD	1.6	V	

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### 3.4 I/O Ports Circuits

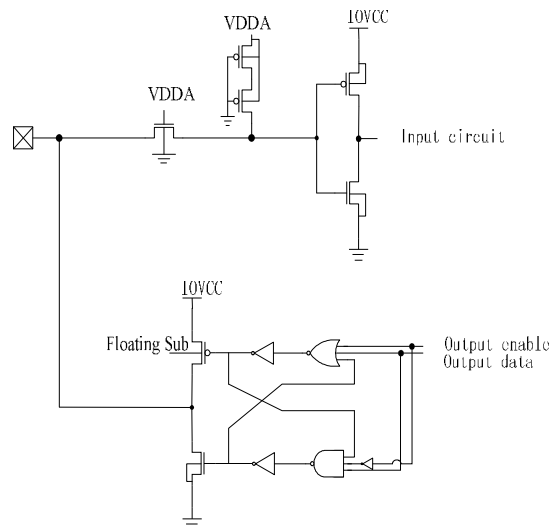


Figure 3-1 General Purpose In/Out Port Circuit.

The input/output property can be configured via firmware setting. The firmware can also control its output behavior as push-pull or as open-drain that SDA of I2C interface is required.

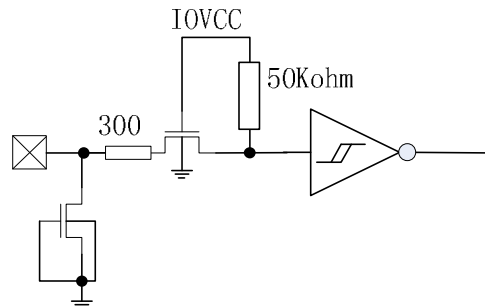


Figure 3-2 Reset Input Port Circuits

### 3.5 POWER ON/Reset Sequence

Reset should be pulled down to be low before powering on and powering down. I2C shouldn't be used by other devices during Reset time after VDD powering on ( $T_{rtp}$ ). INT signal will be sent to the host after initializing all parameters and then start to report points to the host. If Power is down, the voltage of supply must be below 0.3V and  $T_{pdt}$  is more than 1ms.

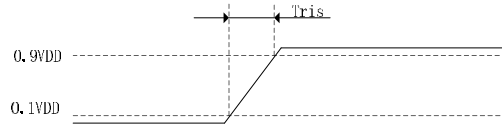


Figure 3-3 Power on time

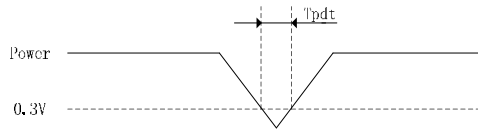


Figure 3-4 Power Cycle requirement

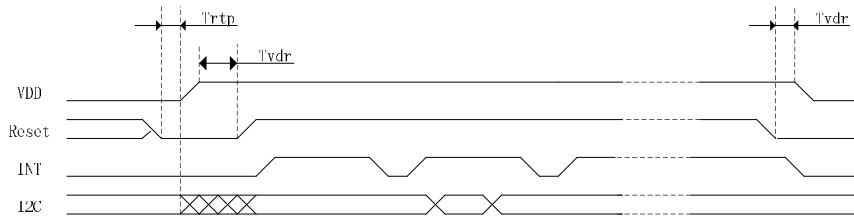


Figure 3-5 Power on Sequence

Reset time must be enough to guarantee reliable reset, the time of starting to report point after resetting approach to the time of starting to report point after powering on.

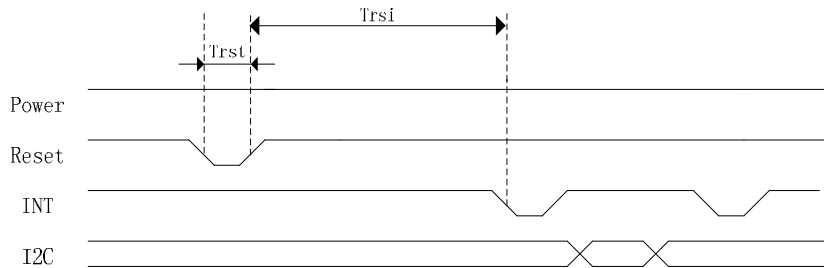


Figure 3-6 Reset Sequence

**Table 3-5 Power on/Reset Sequence Parameters**

Parameter	Description	Min	Max	Units
Tris	Rise time from 0.1VDD to 0.9VDD	--	5	ms
Tpdt	Time of the voltage of supply being below 0.3V	5	--	ms
Trtp	Time of resetting to be low before powering on	100	--	μs
Tvdr	Reset time after VDD powering on	1	--	ms
Trsi	Time of starting to report point after resetting	--	200	ms
Trst	Reset time	1	--	ms

#### 4 PIN CONFIGURATIONS

##### Pin List

**Table 4-1 Pin Definition**

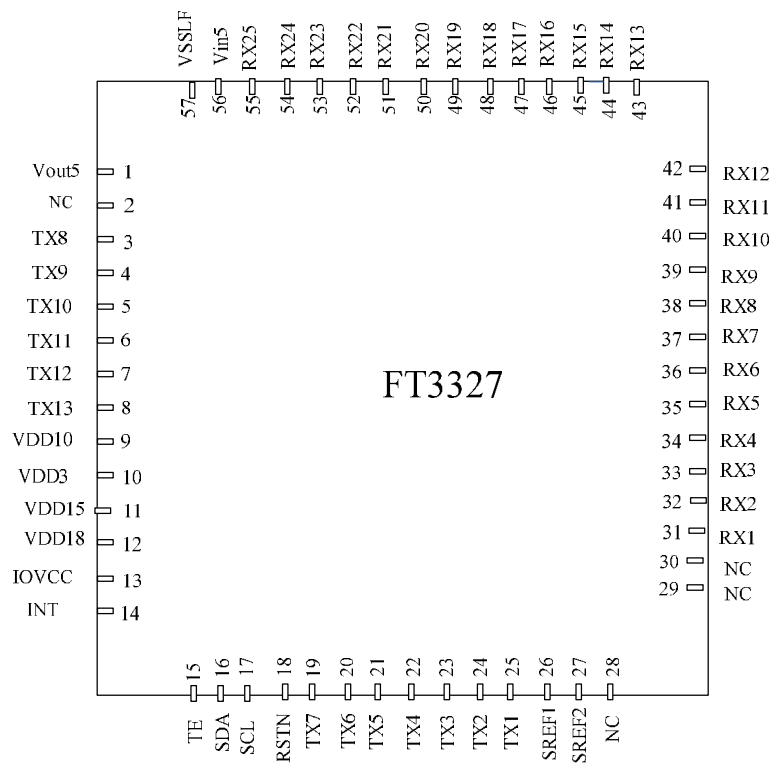
Name	Pin/BallNo.		Type	Description
	FT3327	FT3427		
RX28		55	I	Receiver input pins
RX27		54	I	Receiver input pins
RX26		53	I	Receiver input pins
RX25	55	52	I	Receiver input pins
RX24	54	51	I	Receiver input pins
RX23	53	50	I	Receiver input pins
RX22	52	49	I	Receiver input pins
RX21	51	48	I	Receiver input pins
RX20	50	47	I	Receiver input pins
RX19	49	46	I	Receiver input pins
RX18	48	45	I	Receiver input pins
RX17	47	44	I	Receiver input pins
RX16	46	43	I	Receiver input pins
RX15	45	42	I	Receiver input pins
RX14	44	41	I	Receiver input pins
RX13	43	40	I	Receiver input pins
RX12	42	39	I	Receiver input pins
RX11	41	38	I	Receiver input pins
RX10	40	37	I	Receiver input pins
RX9	39	36	I	Receiver input pins
RX8	38	35	I	Receiver input pins
RX7	37	34	I	Receiver input pins
RX6	36	33	I	Receiver input pins
RX5	35	32	I	Receiver input pins
RX4	34	31	I	Receiver input pins
RX3	33	30	I	Receiver input pins
RX2	32	29	I	Receiver input pins
RX1	31	28	I	Receiver input pins
VDD5_IN	56	56	PWR	internal generated 5V power supply, A 1 $\mu$ F ceramic capacitor to

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				ground is required.
VSSLF	57	57	PWR	Analog ground
VDD5_Out	1	1	PWR	digital power supply, A 1µF ceramic capacitor to ground is required.
NC	2/28/29/30	2/8	NC	
SREF1	26	4	O	Sensor reference channel
SREF2	27	5	O	Sensor reference channel
SREF3		6	O	Sensor reference channel
SREF4		7	O	Sensor reference channel
TX10	5	3	O	Transmit output pin
TX11	6	4	O	Transmit output pin
TX12	7	5	O	Transmit output pin
TX13	8	6	O	Transmit output pin
TX14		7	O	Transmit output pin
TX15			O	Transmit output pin
TX16			O	Transmit output pin
TX17			O	Transmit output pin
TX18			O	Transmit output pin
TX19			O	Transmit output pin
TX20			O	Transmit output pin
VDD10	9	9	PWR	digital power supply, A 1µF ceramic capacitor to ground is required.
VDD3	10	10	PWR	digital power supply, A 1µF ceramic capacitor to ground is required.
VDD15	11	11	PWR	digital power supply, A 1µF ceramic capacitor to ground is required.
VDD18	12	12	PWR	digital power supply, A 1µF ceramic capacitor to ground is required.
IOVCC	13	13	PWR	I/O power supply
INT	14	14	I/O	Interrupt request to the host, or Wakeup request from the host.
TE	15	15	I	LCD Sync
SDA	16	16	I/O	I2C data input and output
SCL	17	17	I/O	I2C clock input
RSTN	18	18	I	External Reset, Low is active
TX1	25	19	O	Transmit output pin
TX2	24	20	O	Transmit output pin
TX3	23	21	O	Transmit output pin

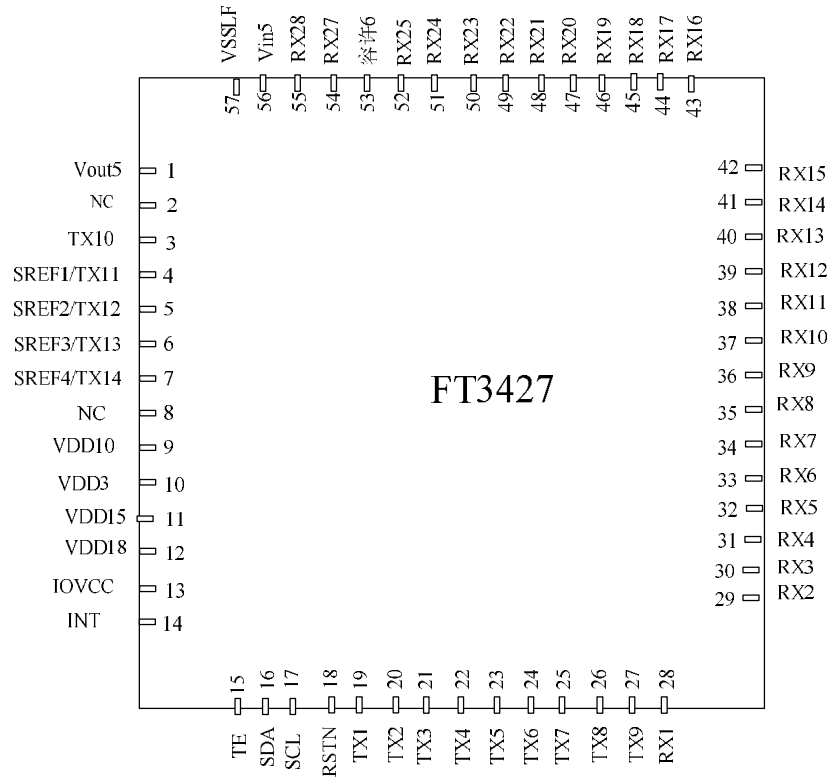
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TX4	22	22	O	Transmit output pin
TX5	21	23	O	Transmit output pin
TX6	20	24	O	Transmit output pin
TX7	19	25	O	Transmit output pin
TX8	3	26	O	Transmit output pin
TX9	4	27	O	Transmit output pin



**FT3327 Package Diagram**

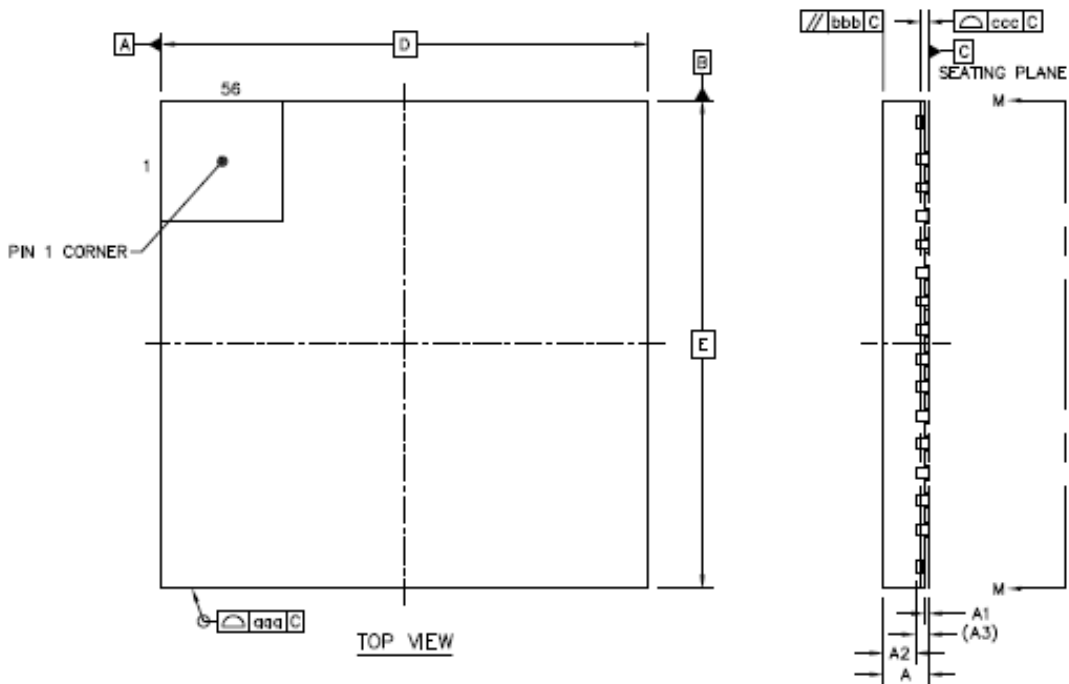
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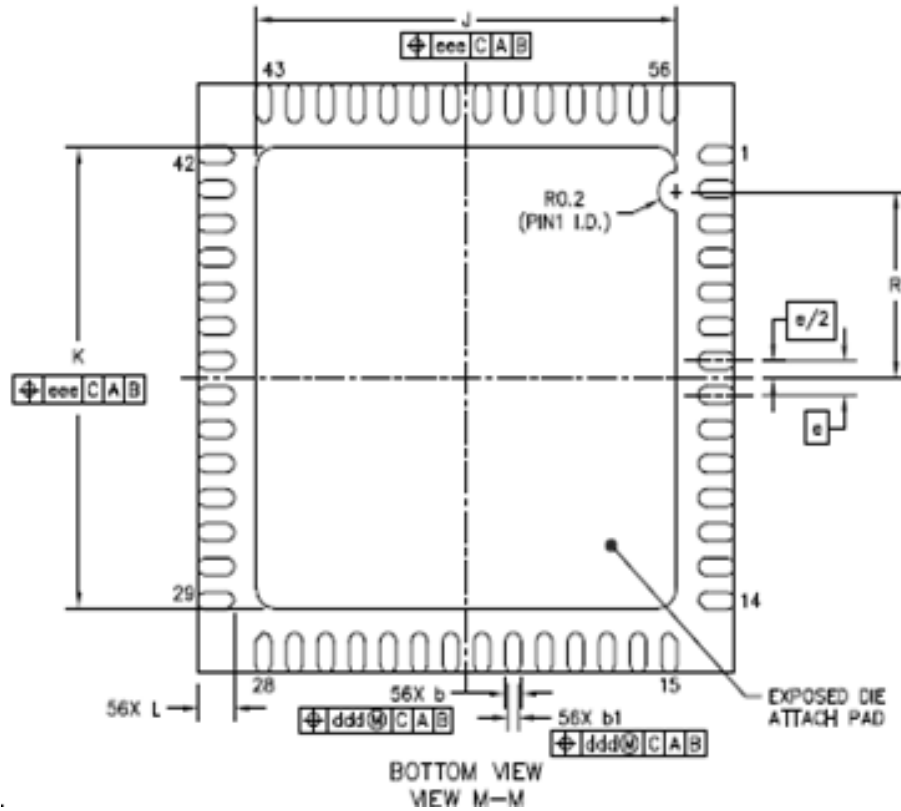
**FT3427 Package Diagram**

5 PACKAGE INFORMATION

5.1 Package Information of QFN-6x6-56L Package



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Item	Symbol	Millimeter		
		Min	Type	Max
Total Thickness	A	0.5	0.55	0.6
Stand Off	A1	0	0.035	0.05
Mold Thickness	A2	----	0.4	0.425
L/F Thickness	A3	0.152 REF		
Lead Width	b	0.13	0.18	0.23
	b1	0.07	0.12	0.17
Body Size	X	6 BSC		
	Y	6 BSC		
Lead Pitch	e	0.35 BSC		
EP Size	X	4.6	4.7	4.8
	Y	4.6	4.7	4.8
Lead Length	L	0.35	0.4	0.6
Package Edge Tolerance	aaa	0.1		
Mold Flatness	bbb	0.1		
Co Planarity	ccc	0.08		
Lead Offset	ddd	0.1		
Exposed Pad Offset	eee	0.1		

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5.2 Order Information

<b>Package Type</b>	<b>QFN</b>
	<b>56Pin(6 * 65 )</b>
	<b>0.6 - P0.35</b>
<b>Product Name</b>	<b>FT3327/FT3427</b>

**Appendix: IC Revision history of FT3x27 Specification**

<b>Version</b>	<b>Change Items</b>	<b>Effective Date</b>
0.1	1st Preliminary	27-Jun-14
0.2	Updated Y Drive	1-Aug-14
0.3	Add FT3327	10-Mar-15
0.4	Update Current consumption(monitor mode);	12-May-15
1.0	Delete FT3427DQT & FT3427WWa;	25-May-15
1.2	(1) Update FT3x27 netlist; (2) Update I/O Description	22-Jul-15
1.3	Update POWER ON/Reset Sequence	6-Sep-15

END OF DATASHEET

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