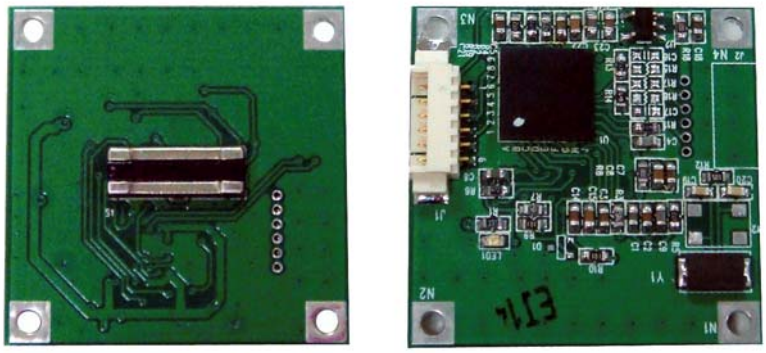
WM168 DataSheet V1.0



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1. Features

1.1 Sweep sensor

Advanced HD3D active-pixel sensing
Maximum finger speed: Up to 40 cm/s
Sensor strip (image) width: 7.2 mm
Array width: 144 pixels
Integrated bezel
Pixel pitch: 50 microns
Image resolution: 508 DPI
ESD tolerance: ±30kV air discharge (Exceeds IEC 61000-4-2 Level 4)
Ball Grid Array (BGA) 3 × 11, 1 mm pitch
Black and stainless-steel bezel colors

1.2 Companion Chip

32-bit RISC architecture
Up to 144 MIPS
32 KB NVM available for biometric data
- More then 100,000 erase/write cycles
- More then 40 years data retention

Package-Ball Grid Array (BGA)
- 8 mm × 8mm, 81 balls

1.3 Host Interface

UART interface (Up to 230.4 Kbps)
USB 2.0 full speed (12 Mbps) interface (under developed)
SPI interface (under developed)

1.4 Power Consumption

Deep sleep: 900 uA @ 3.3 V
Stand-by mode (Finger detect active): 1150 uA @ 3.3 V
Imaging mode: ~78 mA @ 3.3 V (sensor ~11 mA, companion chip ~67 mA)
Wake-up time: <15 ms (Deep sleep or standby to imaging)
Single supply voltage: 3.0 V to 3.6 V

1.5 Environmental Specifications

Operating temperature:
- Sensor: -30° C to +70° C
- Companion chip: -40° C to +85° C

Storage temperature: –40° C to +125° C
Storage/operating humidity: 5% to 93% RH without condensation
RoHS Complian

1.6 Applications

Desktop PC security
Mobile PCs
Portable storage devices
Custom application
Home and office use
Handheld devices and PDAs
Compatible with the Protector Suite Application family

2. Biometric System

WM168 is a trusted biometric security system that designers can use to embed advanced, highly secure fingerprint acquisition and verification technologies within their products.

The WM168 chipset is an all-in-one solution capable of performing all the necessary functions to match a live finger that is swiped across the sensor surface against a pre-enrolled fingerprint template. The pre-enrolled template may be stored internally of the companion chip.

The WM168 is a major leap forward in the evolution of biometric systems, providing greater security, higher performance, and lower overall cost.

3. Chipset Functionality

3.1 Image Capture

The WM168 chipset incorporates a state-of-the-art algorithm to capture fingerprint images based on scanned finger data. The algorithm compensates for variations in speed and direction, making it extremely easy to use with a minimum of user training. The standard (high quality) image capture mode supports finger swipe speeds of 26 cm/sec, and speeds of up to 40 cm/sec are also supported.

The firmware included in the companion chip includes an image optimization library that allows the sensor to capture the best-quality fingerprint image, according to environmental conditions and skin types. Variations in speed or direction are automatically compensated so that the captured image has minimal distortion. Eliminating distortion is the key to high biometric performance, because the matching algorithm does not need to lower the match criteria. Competing swipe sensor systems, without high-quality image capture and normalization, must loosen the match process to allow for distortion, but this inherently increases the chance of a false match and a security violation.

3.2 Biometric Database Functionality

The WM168 Chipset incorporates non-volatile EEPROM memory (NVM) that provides for

storage of a database of several enrolled fingerprint templates directly on the chip. Each template stored in the database is assigned a sequential record number, called a slot number. Stored templates can be used for verification/matching operations or can be deleted. Once a template is saved to the database, it is impossible to copy or extract the template outside of the module.

The WM168 provides for the following biometric database management features:

- Enroll a live finger to a biometric database (Add database record)
- Delete a specified record from the database
- Delete all records from the database
- List database (Lists all slot numbers and content of each record's data tag)

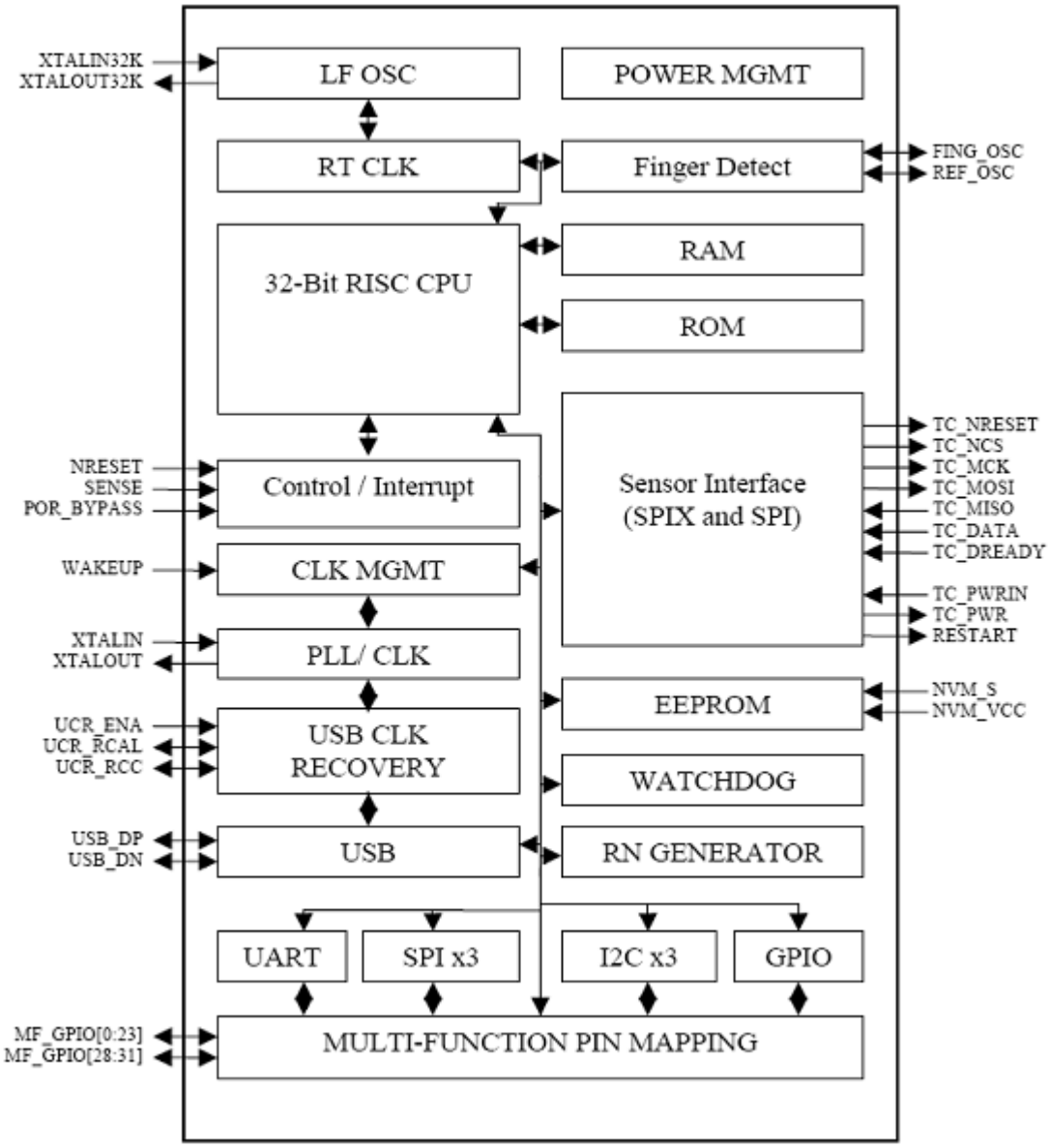
Depending of the size of the fingerprint template (including any payload data used), up to 15 fingerprint records may be stored in the database. The device includes recovery mechanisms to guard against data loss in the event that power is removed during a write operation. This mechanism is not completely power-failure safe: if a file is being written when the power fail occurs, that file may be lost.

3.3 GUI Callbacks

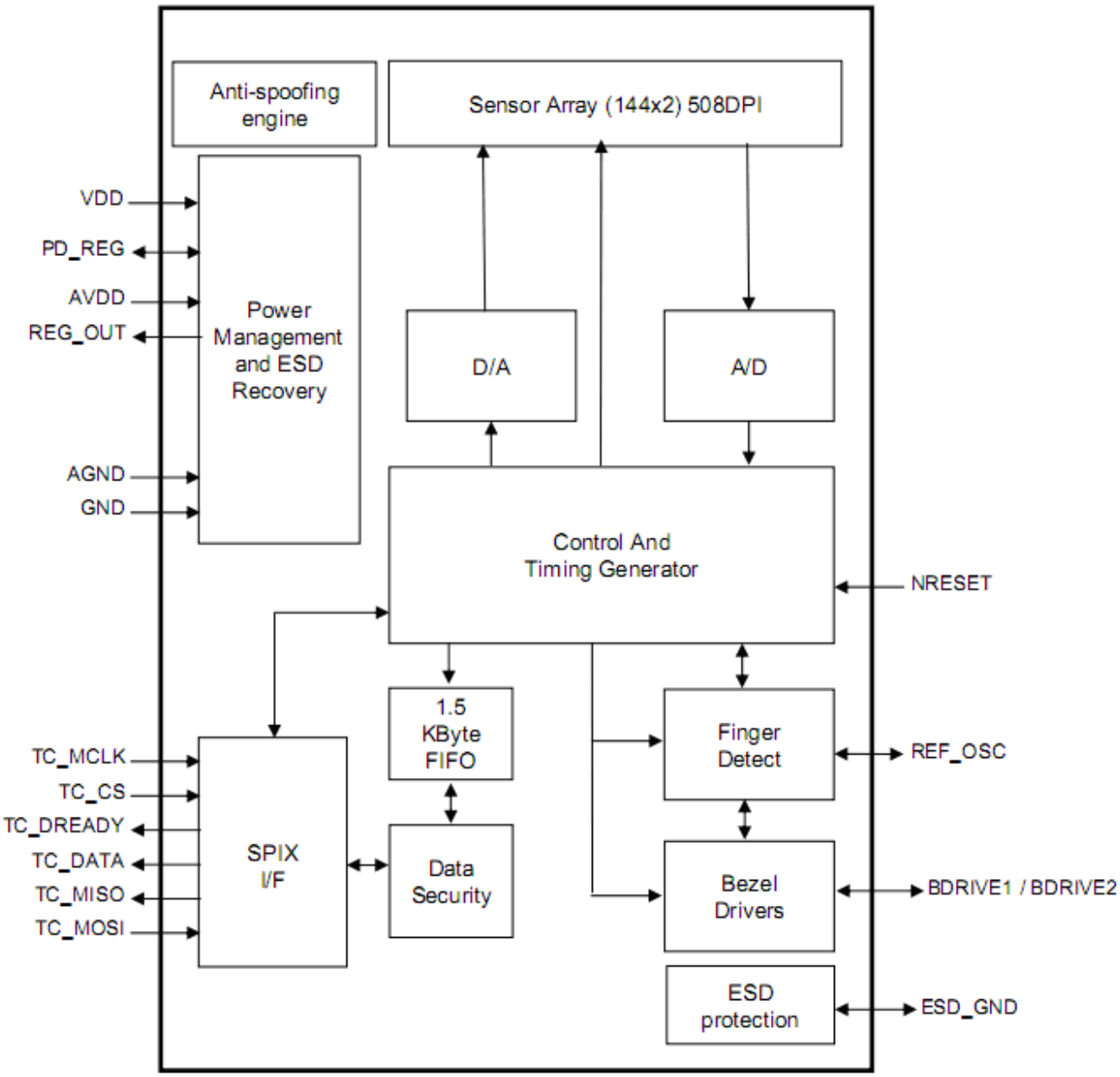
All live fingerprint-scanning operations offer to the application the option to display a GUI feedback. The application can choose the level of callback communication, from simple (only requests to put/lift/swipe finger) to a full finger positioning feedback (e.g., advising user/application to move finger more to left, right etc.).

4. Chipset Hardware Architecture

4.1 Companion Chip Block Diagram



4.2 Sensor Block Diagram



4.3 System Block diagram

(Add Figure)

5. I/O and Interfaces

The main communication link between the WM168 and any host system is via the USB, SPI or UART interfaces. All commands, status, and data are transmitted over a link based on one of these interfaces.

5.1 Communication Interface HW Auto-detection

Companion chip will auto-detect the intended communication interface at boot time. If the companion chip is attached to an USB bus, the USB host controller will push both USB D+ and USB D- lines low. To enforce a serial (UART or SPI) interface, USB D- needs to be pulled up or tied to VDD. USB D+ will then be used to select between UART and SPI. The companion chip firmware will read both USB D+ and USB D- line value at boot time to determine the active interface. Some firmware variants may override this auto-detection feature and have the selected interface hardcoded.

USB_DN	USB_DP	Selected Interface
L	L	USB
H	H	UART
H	L	SPI

5.2 USB 2.0 Full Speed Bulk (12 Mbps)

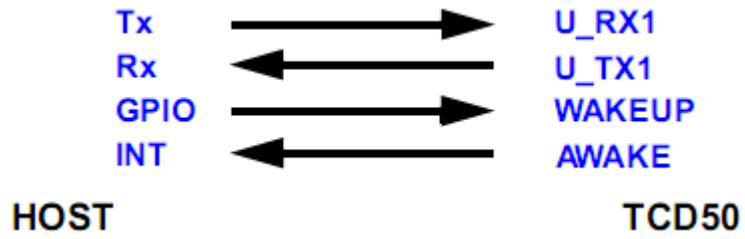
The USB interface is fully compliant with USB 2.0 full speed (12 Mbps) specification. This interface is used for both command communication and image data transfer.

5.3 UART

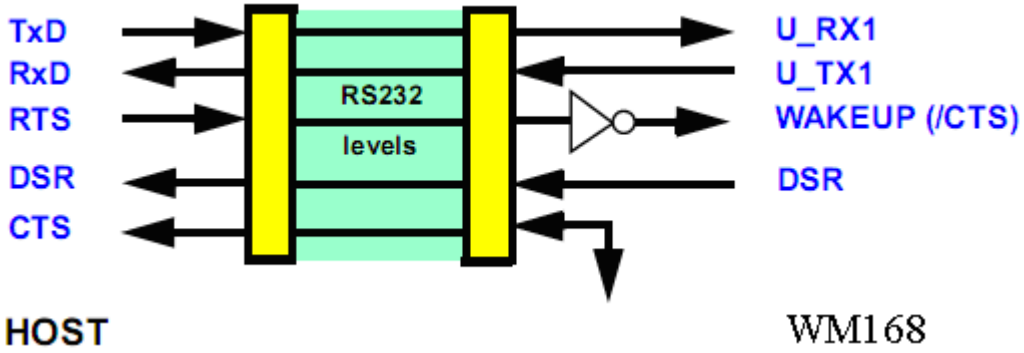
The UART interface is a standard Universal Asynchronous Receive/Transmit interface compliant with the 16C550 UART specification. The UART interface is intended to be used as a primary command and communication interface, though it can also be used for image data transfer (depending on image transfer speed requirements).

The UART interface supports speeds from 9600 bps to 230.4 kbps and supports modems signal DSR and CTS. The UART is capable of supporting speed in excess of the 16C550 UART up to 230.4 kbps. Systems with high speed UART capability can make use of this higher speed UART communication mode.

The figure below shows the actual connection of the WM168 UART interface with a HOST UART when the HOST UART does not support any modem control signals



In case the HOST UART supports modem control signals like RTS and DSR, it is possible to make use of such signals for advance wake-up functionality as described in the figure below.



5.4 SPI

The WM168 incorporates an SPI interface that can be used to communicate to a host processor. This is a slave interface, i.e., the host acts as the SPI bus master. The range of supported clock speeds are 250 kbits/sec to 1 Mbit/sec.

6. System Clock Generation

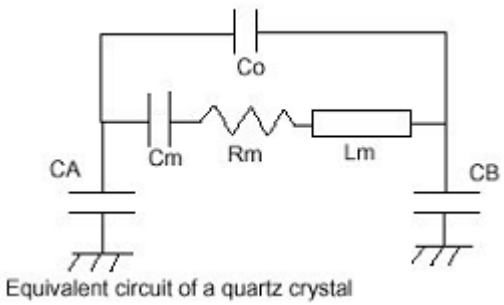
The WM168 supports the following configurations in order to provide the required 12 MHz clock.

6.1 Crystal Oscillator

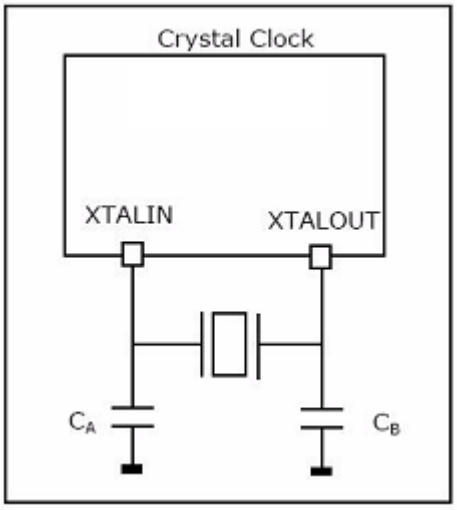
The WM168 includes a high frequency oscillator which allows the use of a 12 Mhz crystal to generate the internal system clock.

Crystal Freq	L_M	R_M	C_M	C_O	C_A	C_B
12MHz	5.6 mH	7.9 ohms	26.76 fF	4.4 pF	16 pF	16 pF

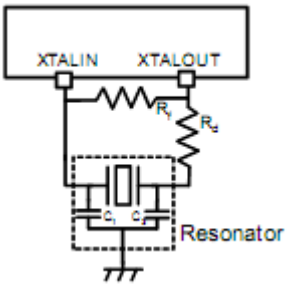
The tables are relative to fundamental quartz crystal only (not ceramic resonator). Recommended value for CA and CB for generating 12 MHz clock to the WM168 chipset is 22 pF.



Equivalent circuit of a quartz crystal



6.2 Ceramic Resonator



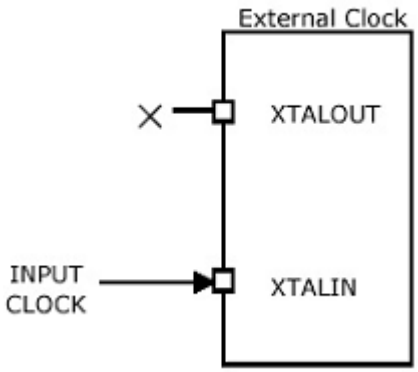
A ceramic resonator is typically lower in cost than a crystal. The following part number from Murata has been tested with the TCD50 and enables clock generation that is compliant to USB requirements.

Frequency (Hertz)	Murata Part Number	C_1 (pF)	C_2 (pF)	R_f (Ohms)	R_d (Ohms)
12.000M	CSTCE12M0GH5L11-R0	(33)	(33)	1M	0

(C1 and C2 are built into the resonator)

6.3 External Clock

In case the system has the availability of a 12 MHz clock according to the spec of Table 7, it can be provided through XTALIN.



7. Sensor Electrical Specifications

7.1 Absolute Maximum Ratings

Table 1: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD	Sensor supply voltage	-0.5	4.2	V
VIO	DC voltage on any other pin (other than VDD)	-0.5	VDD+0.5	V
TSTG	Storage temperature	-40	+125[1]	°C
IK	DC Diode current		20	mA

IO	DC Output source sink current		20	mA
ICC/IGND	DC VCC or ground current		100	mA
VESD	PIN electrostatic discharge voltage[1]	-2000	+2000	V

1.Based on temperature cycling, device inactive

2.JEDEC Std JESD22-A114-A (R=1.5 Kohm, C=100 pF)

7.2 Recommended Operating Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
VDD	Sensor supply voltage	3.0	3.3	3.6	V	
TOP	Operating temperature	-30		+70	°C	
AVDD	Analog Voltage Supply Noise			100	mV p-p	

7.3 DC Characteristics

Table 2: DC Characteristics

(VDD = 3.0 - 3.6 V, -30 < T < +70 °C, unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit	Condition
IDD	Imaging		11	16	mA	
	Sleep		200	420	uA	
VIH	High level input	2.0			V	
VIL	Low level input			0.8	V	
VOH	Output high IOH=4 mA	2.4			V	
VOL	Output low IOL=4 mA			0.4	V	
REG_OUT	Regulator output	2.38	2.5	2.63	V	PD_REG = high
AVDD	Analog input power	2.25	2.5	2.75	V	
IDDA	Analog input current		9	12	mA	Note 1

1. The IDDA current is also included in the total IDD current value above.

Unless otherwise stated, typical value are based on T = 25 °C and VDD = 3.3 V

7.4 AC Characteristics

For the AC characteristic of the sensor, please refer to “AC Characteristics” on page **10** and in particular, Table 6 on page **10**, Table 7 on page **10**, Table 8 on page **10** and Table 11 on page **10**.

8. Companion Chip Electrical Specifications

8.1 Absolute Maximum Ratings

Table 3: Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Unit
VDD	3 V chip supply voltage	-0.5	4.2	V
V_IO	DC voltage on any IO pin	-0.5	6.0	V

V_ANA	DC voltage on any ANA pin	-0.5	VDD+0.5	V
TGST	Storage temperature	-40	+125[1]	°C
IK DC	Diode current		+/- 20	mA
IO DC	Output source sink current		+/- 20	mA
ICC/IGND	DC VCC or ground current		+/- 200	mA
VESD	PIN Electrostatic discharge voltage[2]	-2000	+2000	V

1. Based on temperature cycling, device inactive

2. JEDEC Std JESD22-A114-A (R = 1.5 Kohm, C = 100 pF)

8.2 Recommended Operating Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
VDD	Sensor supply voltage	3.0	3.3	3.6	V	
TOP	Operating temperature	-40		+85	°C	

8.3 DC Characteristics

Table 4: DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit	Condition
IDD	Sleep mode		900	1200	uA	
	Stand-by		950	1300	uA	
	Imaging		67	80	mA	
VIH	High level input	2.0		VDD+0.3	V	
VIL	Low level input	-0.3		0.8	V	
VOH	Output high 2mA pads	VDD-0.5			V	IOH=2 mA
VOL	Output low 2mA pads			0.4	V	IOL=2 mA

Unless otherwise stated, typical values are based on T = 25C and VDD = 3.3V

8.4 AC Characteristics

This section summarizes the AC characteristic of the device. The parameters in the AC characteristic tables that follow are derived from tests performed under the AC Measurement Conditions summarized in Table 7. The designer should check that the operating conditions in their circuit match the measurement conditions when relying on the quoted parameters.

Table 5: AC Characteristics System Clock

Symbol	Parameter	Min	Nom	Max	Unit	Conditions
XTALIN	system frequency clock	12.0 +/- 2500 ppm			MHz	USB interface active
		12.0 +/- 1%			MHz	UART interface active[1]
	Input Clock Duty Cycle	45	50	55	%	External Clock Drive

1. Specification applies for all UART communication speeds from 9600 bps to 115200 bps, and includes high speed UART mode up to 250 kbps

Table 6: AC Measurement Conditions

Symbol	Parameter	Min	Nom	Max	Unit

C_L	Load capacitance	18			pF
T_{RISE}, T_{FALL}	Input rise and fall times	5	10	15	ns

Table 7: AC Characteristics - Communication Channel Timing Diagram

Time name	MIN	NOM	MAX	Units	Condition
T_{CK}[1]		62.5		ns	16 MHz[2]
		83.3		ns	12 MHz[3]
		125		ns	8 MHz[4]
T_{CL}		0	5	ns	
T_{CH}		0	5	ns	
T_{MO}		0	42	ns	
T_{MI}		32	42	ns	

1. This timing tolerance depends on XTALIN tolerance

2. Typical frequency for image normalization, and during calibration

3. Start-up frequency as a result of PTOpen and during calibration

4. Low power navigation

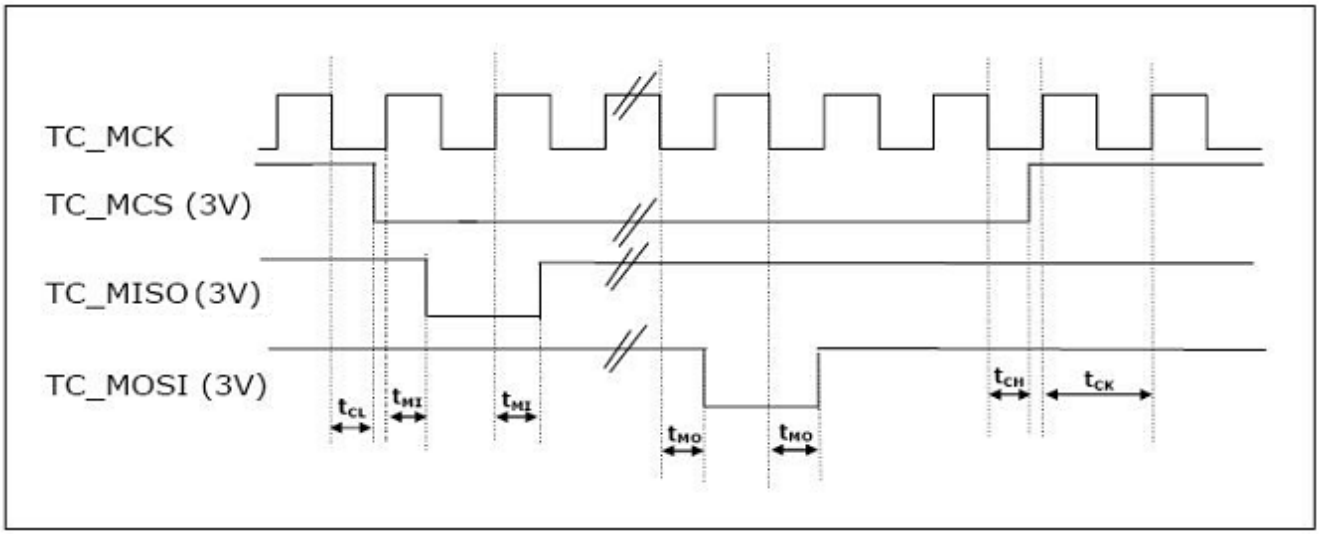
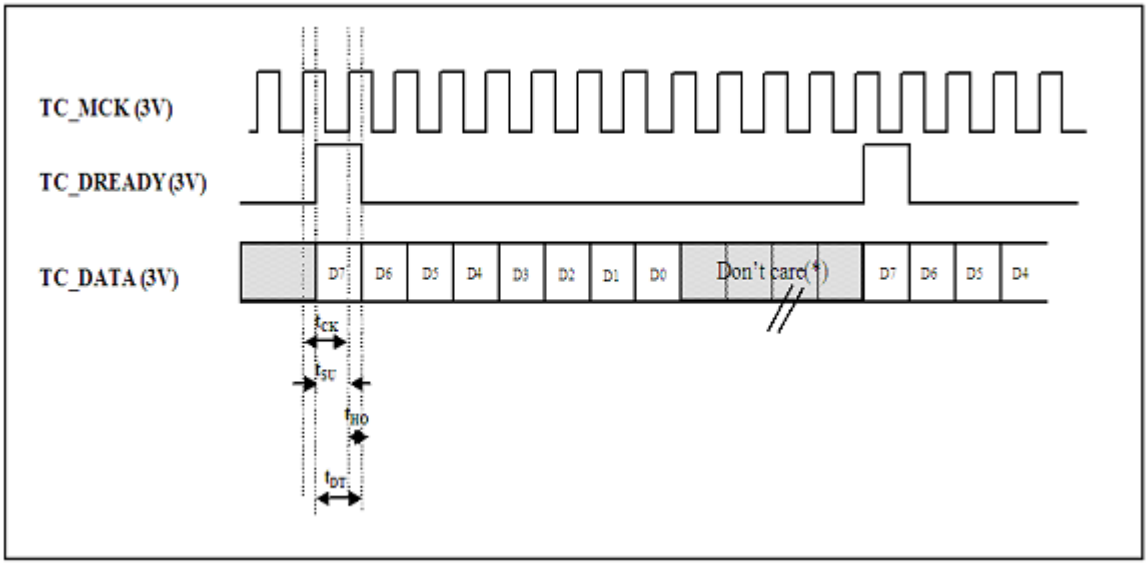


Table 8: AC Characteristics - Data Channel Signal & Timing Diagrams

Time name	MIN	NOM	MAX	Units	Condition
T_{DT}, T_{CK}[1]		62.5		ns	16 MHz[2]
		83.3		ns	12 MHz[3]
		125		ns	8 MHz[4]
T_{SU}	10	31.3		ns	
T_{HO}	10	31.2		ns	

1. This timing tolerance depends on XTALIN tolerance
2. Typical frequency for image normalization, and during calibration
3. Start-up frequency as a result of PTOpen and during calibration
4. Low power navigation



(*) Number of “Don’t care” bits depends on the image capture format for the navigation mode chosen (e.g., at 508/508/8 capture mode and max speed, there are 0 “Don’t care bits”).

Table 9: AC Characteristics - HOST UART CHANNEL: Protocol “8N1”

Time name	MIN	NOM	MAX	Units	Condition	Load
ETU[1]		8680 17360 26041 52083 104166		ns	115200 bps 57600 bps 38400 bps 19200 bps 9600 bps	20 pF
TX T_{RISE}		9.5		ns		20 pF
TX T_{FALL}		10.5		ns		20 pF
RX T_{RISE}			13	ns		N/A
RX T_{FALL}			13	ns		N/A

1. This timing tolerance depends on XTALIN tolerance

Table 10: Communication Channel Signal Diagram

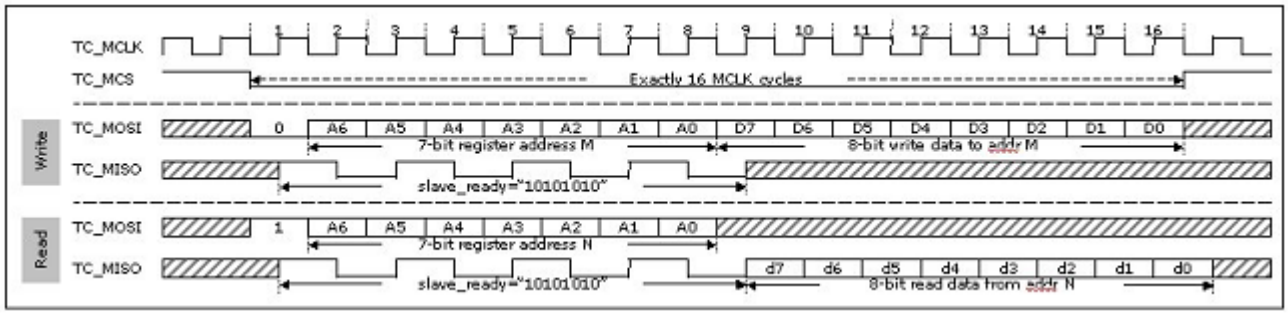


Table 11: Critical Pin Type Signal Noise Characteristics

Pin Type	Parameter	MIN	NOM	MAX	Units
VDD	Digital voltage supply noise			100	mV p-p
ANA	Analog voltage supply noise			70	mV p-p
AVDD	Analog voltage power noise			70	mV p-p

9. Chipset Electrical Specifications

When using the chipset in a USB application with the reference design, the following table can be used to understand the power used in active and standby states. The need to maintain the "connected" status by pulling up the USB D+ data line during USB suspend adds significantly to the current drawn in Sleep and Standby states.

Table 12: USB Power Usage

Power state	Min	Typical	Max	Units
Active (Normal imaging)		78		mA
Idle (USB active, crystal clock mode)		22		mA
Standby (USB suspended, finger detect active)		1350		uA
Sleep (USB suspended, finger detect not active)		1100		uA

10. Environmental Robustness

10.1 WM168 Chipset Lifetime

WM168 chipset lifetime is expected to be at least 10 years, based on extrapolation of accelerated life test data.

10.2 Electrostatic Discharge

The sensor can withstand +/- 15 kV air discharge on the sensor surface per IEC61000-4-2 Level 4 specification.

10.3 Scratch/Abrasion

The coating on the surface of the sensor provides protection from scratching and abrasion due to

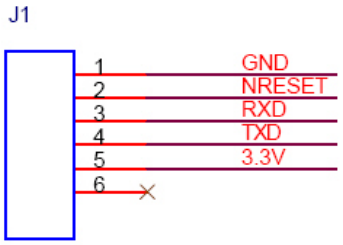
normal contact with fingertips and any incidental contact with fingernails. Applications requiring protection from direct contact of sharp metal objects with the sensor surface should provide such protection at the system (i.e., a sliding cover or some other means).

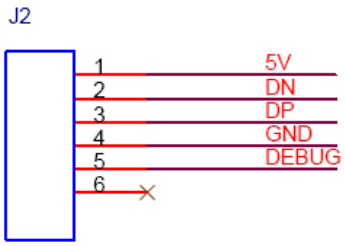
Small scratches on the sensor surface will not affect operation of the sensor. WISON provides a Visual Mechanical Inspection specification which details the procedures and criterion that may be used for quality control audits of incoming parts.

10.4 Chemical Contact

The coating on the sensor provides protection from exposure to a wide variety of chemical contaminants. Agents anticipated to come in contact with the sensor surface in normal use have been identified and tested. They do not cause damage or identifiable degradation in sensor performance or characteristics. A detailed list of the contaminants that have been tested is available upon request.

11. Connector PIN Description

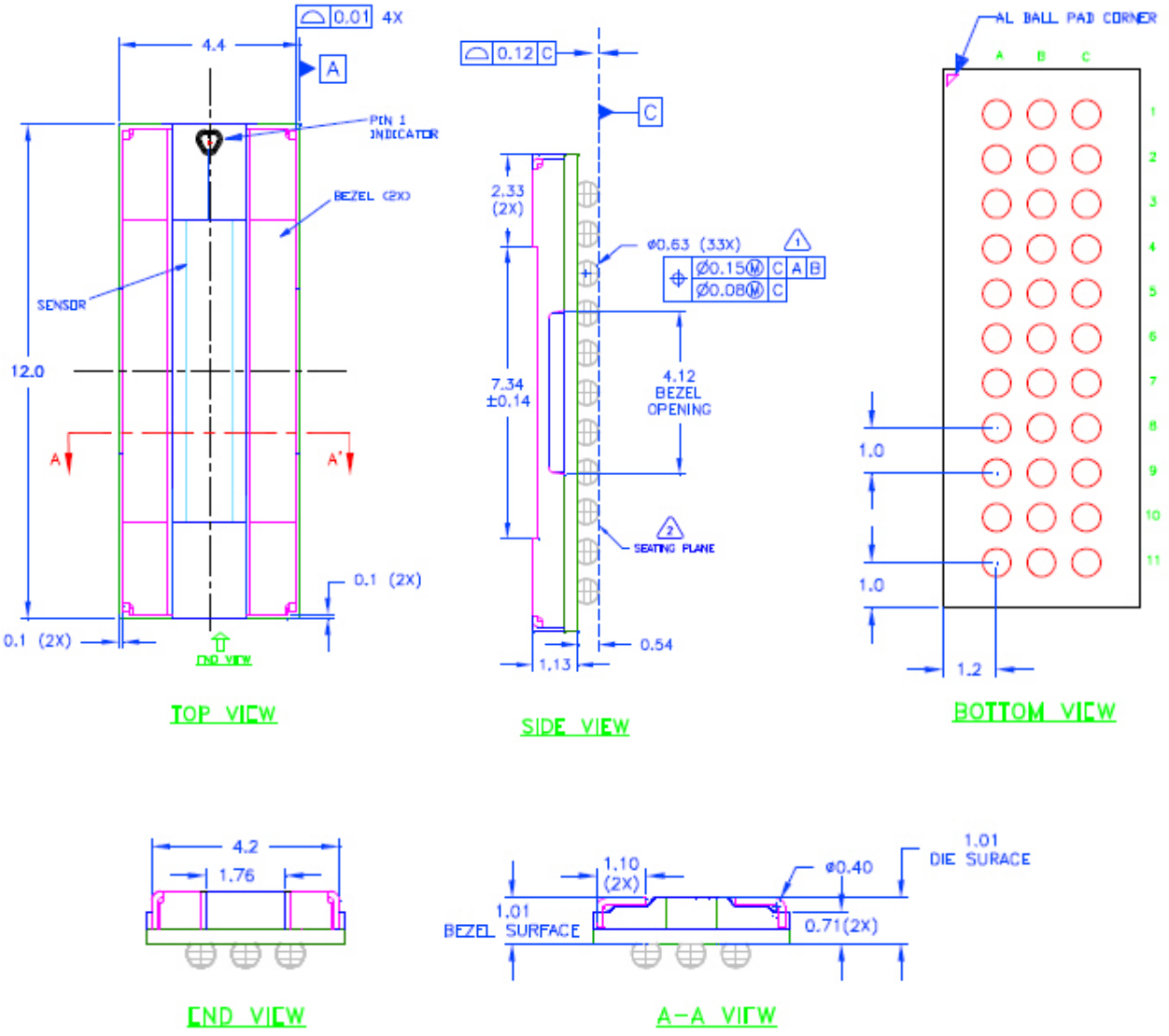




12. Mechanical Dimensions

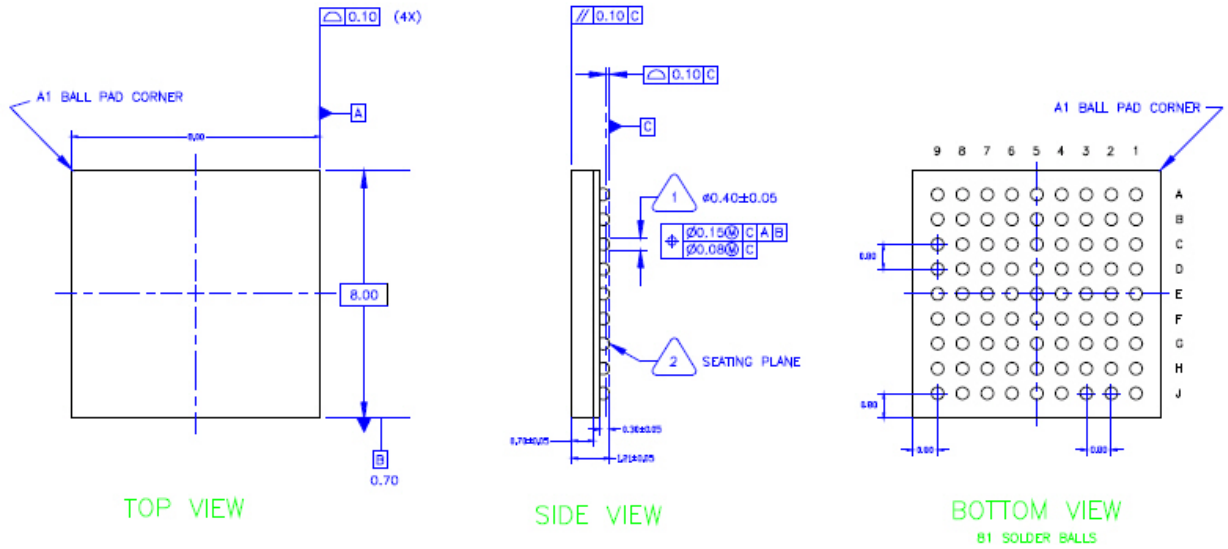
The WM168 chipset consist of two stand-alone components, the sensor and companion Chip.

12.1 Sensor Package Formats



Unit:MM

12.2 Companion Chip Package Formats



Unit : MM

12.3 WM168 Module Dimension

Dimension : 30*30mm