



复旦微电子

FM3316/3315 ***Ultra Low Power MCU***

Brief Datasheet

Jun. 2017

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Contents

CONTENTS	3
1 OUTLINE	4
2 PRODUCT OVERVIEW	5
2.1 INTRODUCTION	5
2.2 FEATURES	5
2.3 ELECTRICAL CHARACTERISTICS	6
2.3.1 <i>Limited parameters</i>	6
2.3.2 <i>DC parameters</i>	6
2.4 ARCHITECTURE	10
2.5 PIN DESCRIPTION	11
2.5.1 <i>LQFP64</i>	11
2.5.2 <i>LQFP48</i>	12
2.5.3 <i>Pin function of FM3316</i>	12
2.5.4 <i>Pin function of FM3315</i>	14
3 PACKAGE	16
3.1 LQFP64	16
3.2 LQFP48	17
REVISION HISTORY	19
SALES AND SERVICE	20



1 Outline

This document is a brief datasheet for FM3316 chip, which is a ultra-low-power MCU designed by Fudan Microelectronics (FMSH). Please contact FMSH for detailed documentations and design support.

2 Product Overview

2.1 Introduction

FM3316 is an ultra-low-power MCU with embedded Flash. FM3316 contains a 16-bit “8xC251” processor core, 64K bytes Flash memory, 4K bytes retention RAM (with parity check), general peripherals including LCD, RTC, ADC, UART, I2C, SPI, etc.

FM3316 is designed for water/heat meter, smart meter, and other low-cost metering products applications.

2.2 Features

- | Operating Voltage Range: 1.8~5.5V
- | Operating Temperature Range: -40 ~+85
- | Typical current consumption
 - n Active : 150uA/MHz
 - n Standby : 10uA@32KHz
 - n Sleep : 5uA
 - n DeepSleep : 2uA
 - n Stop with RTC and RAM data retention : 1uA
 - n DeepStop : 0.5uA
- | Ultra low power mode rapid awakening
 - n Sleep mode awaken time: 5us
 - n Stop mode awaken time: 10us
- | 16-bit processor core compliant to 8xC251
- | Bird-Owl on-line debugger
- | Flash memory
 - n Max 64K bytes program space
 - n Endurance >10,000cycles
 - n Data retention >10yrs (@85)
 - n Bootloader self-programming supported
- | 4K bytes RAM w/ parity, all data retained under LPM
- | Power-on reset
- | Power-down reset
- | 16 external interrupt pins
- | Software configurable Watchdog timer
- | Independent programmable timer
 - n 8-bit general timer*2; 16-bit general timer*2
 - n 1 programmable counter array, include 1 16-bit timer and 5 comparator/capturer module
 - n 1 16-bit low-power timer

- I Peripheral interface:
 - n UART 4ch, 300~115200bps
 - n 7816 1ch
 - n I2C 1ch, 400K
 - n High-speed SPI 1ch, max baud rate 8Mbps
 - n Dual channel DMA
 - n Programmable CRC module
- I LCD driver
 - n 4COM × 26SEG / 6COM × 24SEG
 - n Internal buffer mode or external capacitor mode
 - n Support display under LPM
- I Low power real time clock with digital calibration, calibration precision: +/-0.119ppm
- I 10-bit ADC, supports voltage and temperature measurement
- I On-chip low power RC oscillator, max 24MHz
- I Low power 32K crystal oscillator w/ fail detector
- I On-chip low speed RC oscillator, 30KHz
- I Supply voltage detector w/ programmable threshold
- I PLL, max output frequency 16.384MHz
- I Device-level reliability: HBM>+/-4KV, CDM>+/-500V

2.3 Electrical Characteristics

2.3.1 Limited parameters

Symbol	description	value	unit
V_{DD}	Power supply	-0.3 ~ 5.5	V
V_{PIN}	Pin voltage	$V_{SS}-0.3 \sim V_{DD}+0.3$	V
T_A	Operating temperature	-40 ~ 85	
T_{STG}	Storage temperature	-55 ~ 150	
HBM	ESD HBM	+/-4000	V
CDM	ESD CDM	+/-500	V

Table 2-1 FM3316 limited parameters

2.3.2 DC parameters

2.3.2.1 Supply voltage

Symbol	description	condition	Parameter			unit
			min	typ	max	
V_{DD}	Power supply		1.8		5.5	V
$V_{OP_{min}}$	Min operating voltage	PDR disabled, code	1.8			V



Symbol	description	condition	Parameter			unit
			min	typ	max	
		excuting from flash				
V _{RTC}	RTC operating voltage		1.2			V
V _{RAM}	RAM retention voltage	T=25	1.0			V

Table 2-2 FM3316 supply parameters

2.3.2.2 Current consumption

Default condition: VDD=3.0V , T=25

Symbol	decription	condition	Parameter			Unit
			min	typ	max	
I _{stop}	Current consumption under STOP mode	PDR/RCHF/LVD/LCD disabled, RTC operating on 32K crystal, CPU & RAM state retained		0.9		μA
I _{dpstop}	Current consumption under DEEPSTOP mode	PDR/RCHF/LVD/LCD disabled, RTC stops, CPU & RAM state retained		0.5		μA
I _{sleep1}	Current consumption under SLEEP mode	PDR/LVD/LCD enabled, LCD using internal buffer, RTC operating on 32K crystal, CPU & RAM state retained		4.5		μA
I _{dpsleep}	Current consumption under DEEPSLEEP mode	PDR/ LVD/LCD enabled, LCD using external capacitor, RTC operating on 32K crystal, CPU & RAM state retained		3		μA
I _{stdb}	Current consumption under STANDBY mode	PDR/LVD/LCD enabled, RTC operating on 32K crystal, code excuting from Flash @32KHz		10		μA
I _{VDD3}	Current consumption under ACTIVE mode	code excuting from Flash		150		μA

Table 2-3 FM3316 current consumption

2.3.2.3 Reset

Symbol	decription	condition	Parameter			Unit
			min	typ	max	
V _{POR}	Power-on reset voltage		2.2	2.4	2.6	V
V _{BOR}	Power-down reset voltage			2.1		V
V _{LVD}	Supply monitor threshold	LVD[3:0]=0000		1.9		V
		LVD[3:0]=0001		2.0		V
		LVD[3:0]=0010		2.1		V
		LVD[3:0]=0011		2.2		V
		LVD[3:0]=0100		2.3		V
		LVD[3:0]=0101		2.4		V
		LVD[3:0]=0110		2.5		V
		LVD[3:0]=0111		2.6		V
		LVD[3:0]=1000		2.7		V
		LVD[3:0]=1001		2.8		V
		LVD[3:0]=1010		2.9		V
		LVD[3:0]=1011		3.0		V
		LVD[3:0]=1100		3.1		V
LVD[3:0]=1101		4.0		V		

Table 2-4 FM3316 Reset parameters

2.3.2.4 Flash

Symbol	description	condition	Parameter			unit
			min	typ	max	
	Flash size		64K			bytes
T _{PROG}	Byte Program Time		6		7.5	μs
T _{ERASE}	Sector/Block Erase		4		5	ms
	Chip Erase		20		40	ms
N _{ED}	Sector Endurance		10,000			Erase/Write cycles
T _{DR}	Data Retention	T=85	10			yrs

Table 2-5 FM3316 Flash parameter



2.3.2.5 Internal RC oscillator

symbol	description	condition	Parameter			Unit
			min	typ	max	
f_{RCHF}	RCHF frequency		8		24	MHz
f_{RCLP}	RCLP frequency		30	32	34	KHz

Table 2-6 FM3316 internal RC oscillation

2.3.2.6 ADC

symbol	description	condition	Parameter			Unit
			min	typ	max	
Reso	Resolution			11		bits
DNL	Differential nonlinearity		-0.3	± 1	+0.3	LSB
INL	Integral nonlinearity		-2	± 4	+5	
Offset			-12	± 2	-8	
V_{IN}	Input voltage range		0		VDD	V
SNR				TBD		dB
SINAD				TBD		
	ADC operating clock			512		KHz
	Throughput Rate				500	Sps

Table 2-7 FM3316 ADC parameter

2.3.2.7 Temperature sensor

Symbol	description	condition	parameter			unit
			min	typ	max	
Reso		For high resolution application, triple-point temperature testing is needed			± 0.25	$^{\circ}\text{C}$
Slope				TBD		$\text{mV}/^{\circ}\text{C}$
Offset				TBD		mV

Table 2-8 FM3316 TS parameter

2.4 Architecture

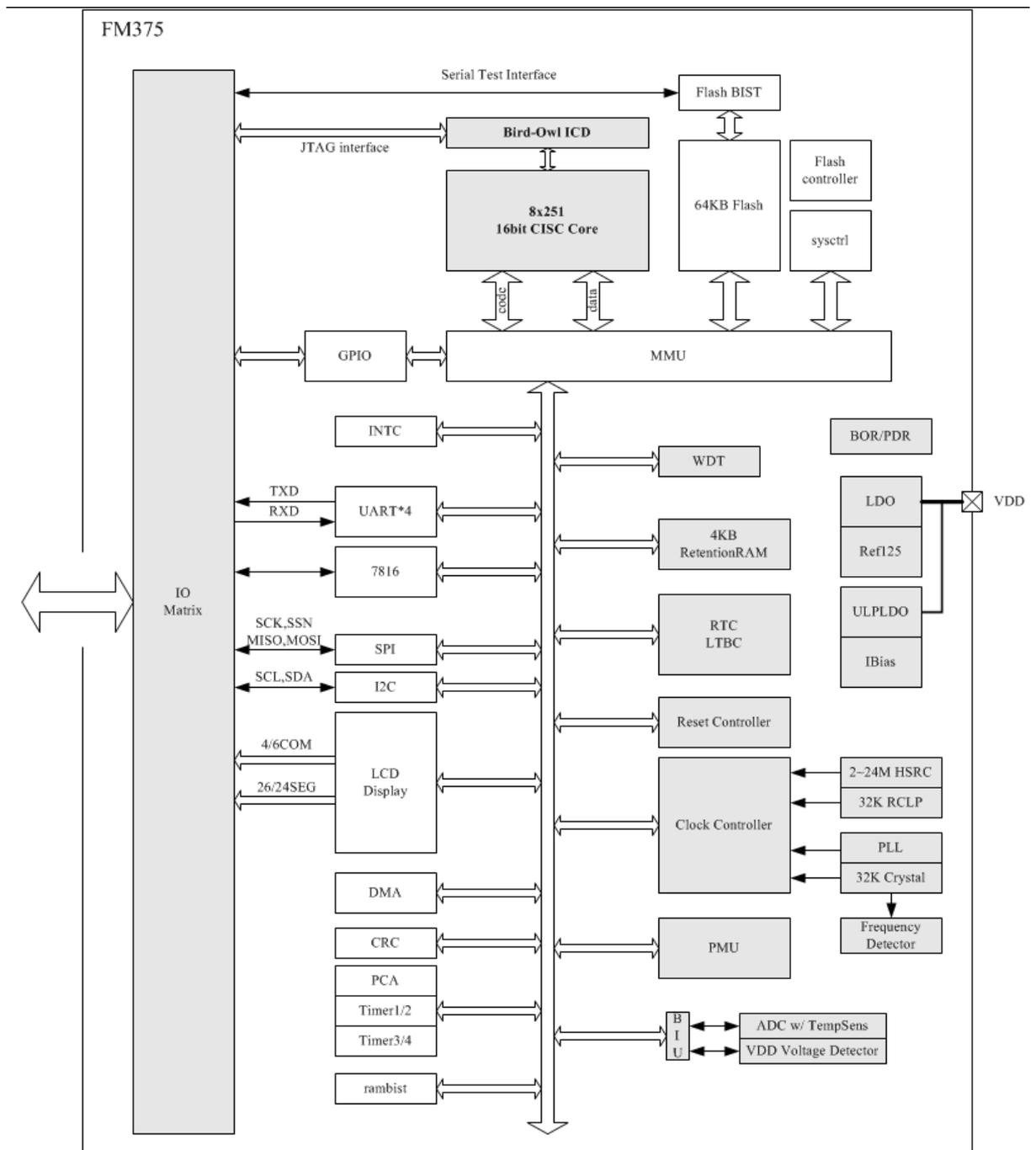


Fig 2-1 FM3316 architecture

2.5 Pin Description

2.5.1 LQFP64

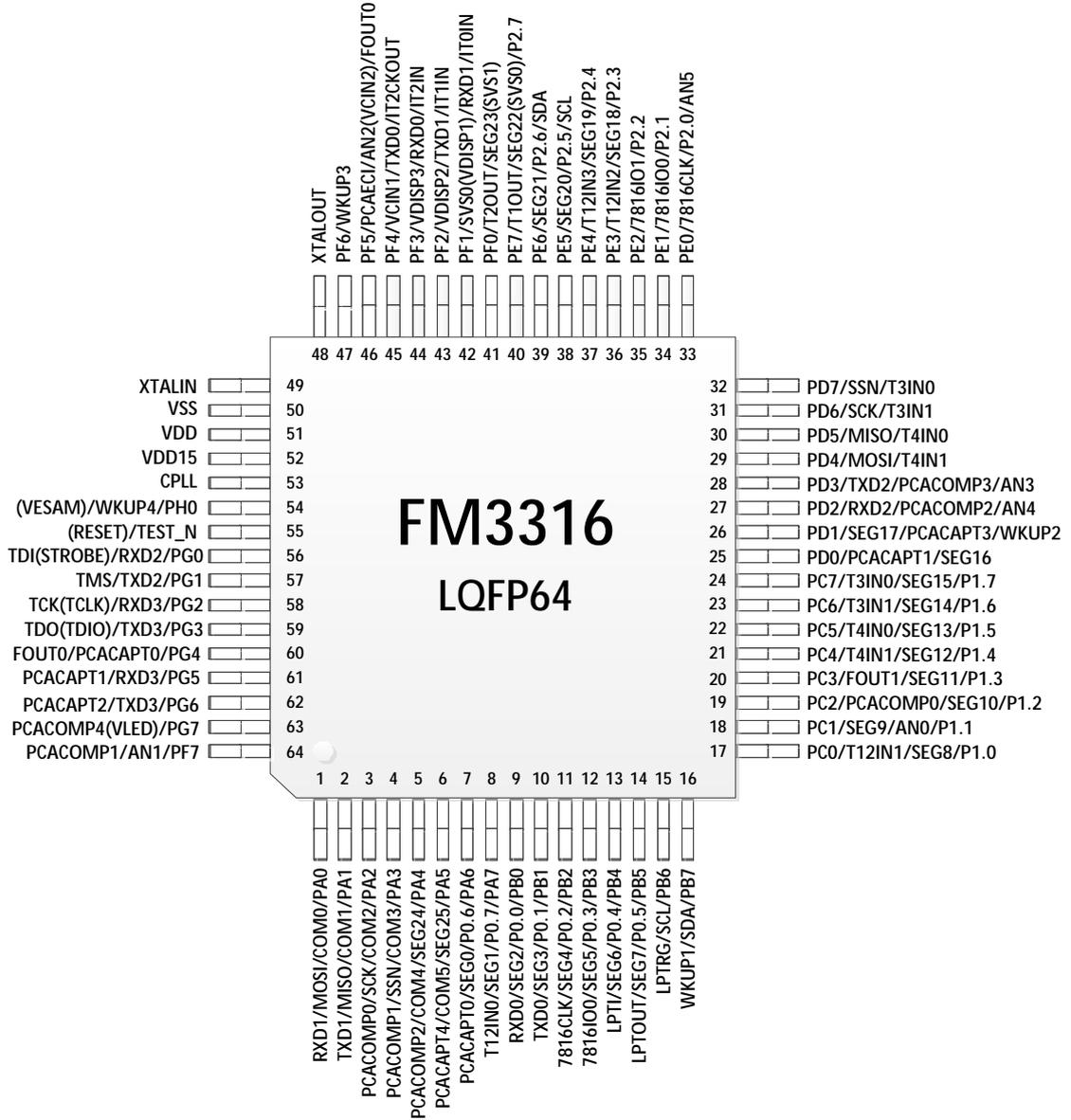
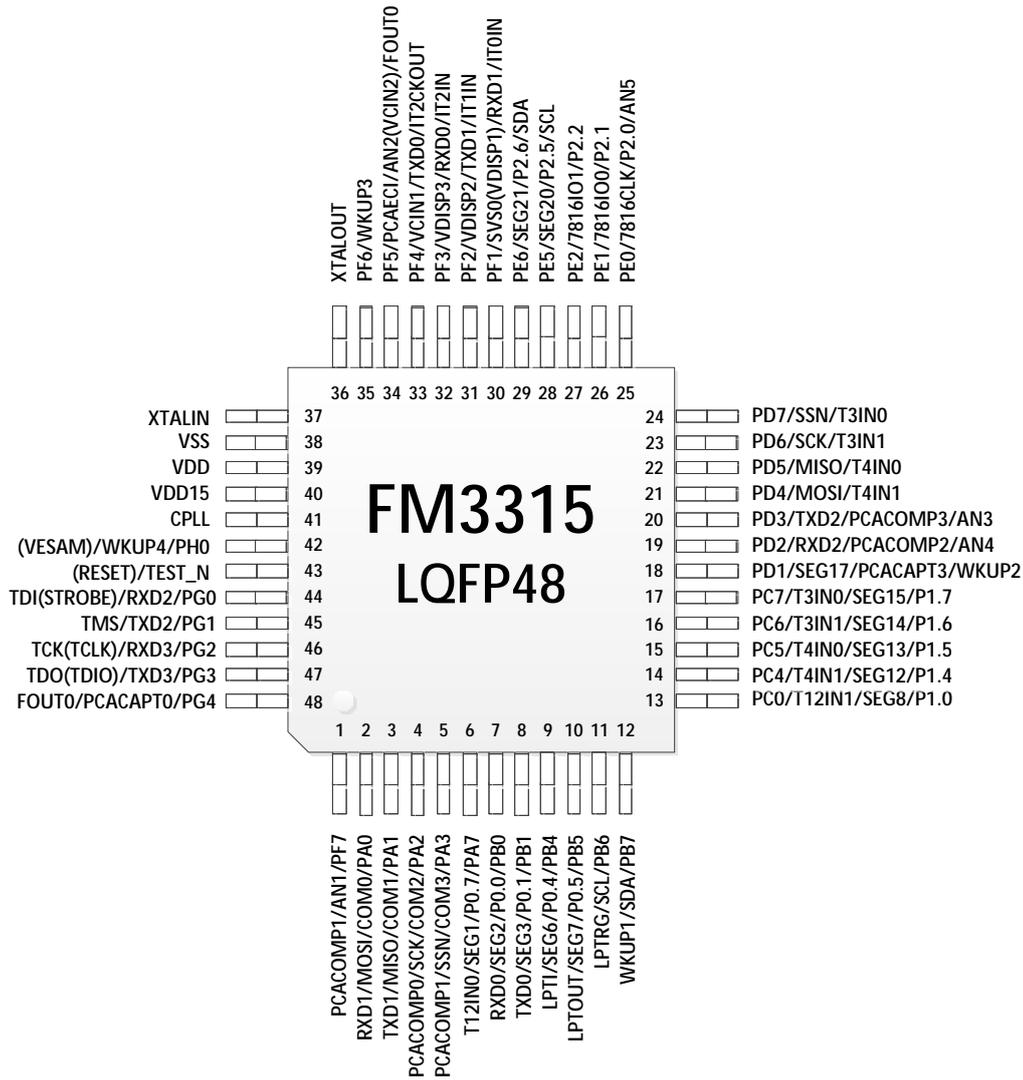


Fig 2-2 FM3316 LQFP64 pin assignment

2.5.2 LQFP48



2.5.3 Pin function of FM3316

PackageNo.	PrimaryFunc	AlternateFunc1	AlternateFunc2	AnalogFunc
1	GPIOA0	MOSI	RXD1	COM0
2	GPIOA1	MISO	TXD1	COM1
3	GPIOA2	SCK	PCACOMP0	COM2
4	GPIOA3	SSN	PCACOMP1	COM3
5	GPIOA4	-	PCACOMP2	COM4/SEG24
6	GPIOA5	-	PCACAPT4	COM5/SEG25
7	GPIOA6	P0.6	PCACAPT0	SEG0
8	GPIOA7	P0.7	T12IN0	SEG1
9	GPIOB0	P0.0	RXD0	SEG2
10	GPIOB1	P0.1	TXD0	SEG3
11	GPIOB2	P0.2	7816CLK	SEG4
12	GPIOB3	P0.3	7816IO0	SEG5



PackageNo.	PrimaryFunc	AlternateFunc1	AlternateFunc2	AnalogFunc
13	GPIOB4	P0.4	LPTI	SEG6
14	GPIOB5	P0.5	LPTOUT	SEG7
15	GPIOB6	SCL	LPTRG	-
16	GPIOB7	SDA	NWKUP1	-
17	GPIOC0	P1.0	T12IN1	SEG8
18	GPIOC1	P1.1		SEG9 (AN0)
19	GPIOC2	P1.2	PCACOMP0	SEG10
20	GPIOC3	P1.3	PCACOMP1	SEG11
21	GPIOC4	P1.4	T4IN1	SEG12
22	GPIOC5	P1.5	T4IN0	SEG13
23	GPIOC6	P1.6	T3IN1	SEG14
24	GPIOC7	P1.7	T3IN0	SEG15
25	GPIOD0	-	PCACAPT1	SEG16
26	GPIOD1	PCACAPT3	NWKUP2	SEG17
27	GPIOD2	RXD2	PCACOMP2	AN4
28	GPIOD3	TXD2	PCACOMP3	AN3
29	GPIOD4	MOSI	T4IN1	-
30	GPIOD5	MISO	T4IN0	-
31	GPIOD6	SCK	T3IN1	-
32	GPIOD7	SSN	T3IN0	-
33	GPIOE0	P2.0	7816CLK	AN5
34	GPIOE1	P2.1	7816IO0	-
35	GPIOE2	P2.2	7816IO1	-
36	GPIOE3	P2.3	T12IN2	SEG18
37	GPIOE4	P2.4	T12IN3	SEG19
38	GPIOE5	P2.5	SCL	SEG20
39	GPIOE6	P2.6	SDA	SEG21
40	GPIOE7	P2.7	T1OUT	SEG22
41	GPIOF0	-	T2OUT	SEG23(SVS1)
42	GPIOF1	RXD1		VDISP1(SVS0)
43	GPIOF2	TXD1		VDISP2
44	GPIOF3	RXD0	-	VDISP3
45	GPIOF4	TXD0	-	VCIN1
46	GPIOF5	FOUT0	PCAECI	VCIN2 (AN2)
47	GPIOF6	RTCCalib	NWKUP3	-
48	XTALOUT	-	-	-
49	XTALIN	-	-	-
50	VSS	-	-	-
51	VDD	-	-	-



PackageNo.	PrimaryFunc	AlternateFunc1	AlternateFunc2	AnalogFunc
52	VDD15	-	-	-
53	CPLL	-	-	-
54	GPIOH0	-	NWKUP4	-
55	TEST_N	-	-	-
56	GPIOG0	RXD2	-	-
57	GPIOG1	TXD2		
58	GPIOG2	RXD3		
59	GPIOG3	TXD3		
60	GPIOG4	FOUT0	PCACAPT0	-
61	GPIOG5	RXD3	PCACAPT1	-
62	GPIOG6	TXD3	PCACAPT2	-
63	GPIOG7	-	PCACOMP4	EXVREF
64	GPIOF7	FOUT1		AN1

Tabel 2-9 FM3316 LQFP64 pin description

2.5.4 Pin function of FM3315

PackageNo.	PrimaryFunc	AlternateFunc1	AlternateFunc2	AnalogFunc
1	GPIOF7	PCACOMP1		AN1
2	GPIOA0	MOSI	RXD1	COM0
3	GPIOA1	MISO	TXD1	COM1
4	GPIOA2	SCK	PCACOMP0	COM2
5	GPIOA3	SSN	PCACOMP1	COM3
6	GPIOA7	P0.7	T12IN0	SEG1
7	GPIOB0	P0.0	RXD0	SEG2
8	GPIOB1	P0.1	TXD0	SEG3
9	GPIOB4	P0.4	LPTI	SEG6
10	GPIOB5	P0.5	LPTOUT	SEG7
11	GPIOB6	SCL	LPTRG	-
12	GPIOB7	SDA	NWKUP1	-
13	GPIOC0	P1.0	T12IN1	SEG8
14	GPIOC4	P1.4	T4IN1	SEG12
15	GPIOC5	P1.5	T4IN0	SEG13
16	GPIOC6	P1.6	T3IN1	SEG14
17	GPIOC7	P1.7	T3IN0	SEG15
18	GPIOD1	PCACAPT3	NWKUP2	SEG17
19	GPIOD2	RXD2	PCACOMP2	AN4
20	GPIOD3	TXD2	PCACOMP3	AN3
21	GPIOD4	MOSI	T4IN1	-
22	GPIOD5	MISO	T4IN0	-
23	GPIOD6	SCK	T3IN1	-



PackageNo.	PrimaryFunc	AlternateFunc1	AlternateFunc2	AnalogFunc
24	GPIOD7	SSN	T3IN0	-
25	GPIOE0	P2.0	7816CLK	-
26	GPIOE1	P2.1	7816IO0	AN5
27	GPIOE2	P2.2	7816IO1	-
28	GPIOE5	P2.5	SCL	SEG20
29	GPIOE6	P2.6	SDA	SEG21
30	GPIOF1	RXD1		VDISP1(SVS0)
31	GPIOF2	TXD1		VDISP2
32	GPIOF3	RXD0	-	VDISP3
33	GPIOF4	TXD0	-	VCIN1
34	GPIOF5	FOUT0	PCAECI	VCIN2 (AN2)
35	GPIOF6	RTCCalib	NWKUP3	ANTST0
36	XTALOUT	-	-	-
37	XTALIN	-	-	-
38	VSS	-	-	-
39	VDD	-	-	-
40	VDD15	-	-	-
41	CPLL	-	-	-
42	GPIOH0	-	NWKUP4	-
43	TEST_N	-	-	-
44	GPIOG0	RXD2	-	-
45	GPIOG1	TXD2		
46	GPIOG2	RXD3		
47	GPIOG3	TXD3		
48	GPIOG4	FOUT0	PCACAPT0	-

Tabel 2-10 FM3315 LQFP48 pin description

3 Package

3.1 LQFP64

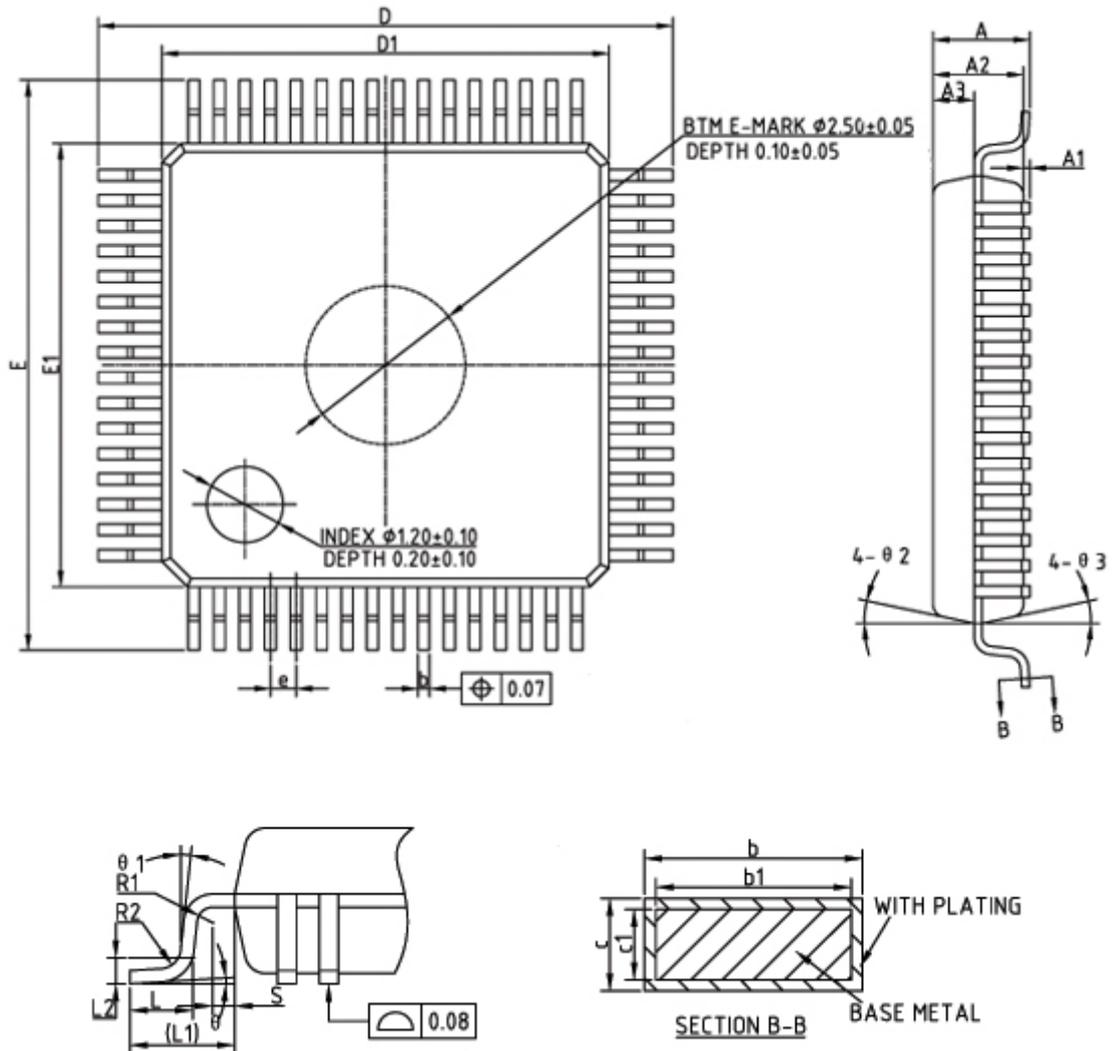


Fig 3-1 LQFP64 Package dimensions

Symbol	MIN	NOM	MA□
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.16	—	0.25
B1	0.15	0.18	0.21
c	0.13	—	0.18
C1	0.12	0.127	0.134

Symbol	MIN	NOM	MA□
D	8.80	9.00	9.20
D1	6.90	7.00	7.10
E	8.80	9.00	9.20
E1	6.90	7.00	7.10
e	0.30	0.40	0.50
L	0.45	0.60	0.75
L1	1.00REF		
L2	0.25BSC		
R1	0.08	–	–
R2	0.08	–	0.20
S	0.20	–	–
θ	0°	3.5°	7°
$\theta 1$	0°	–	–
$\theta 2$	11°	12°	13°
$\theta 3$	11°	12°	13°

3.2 LQFP48

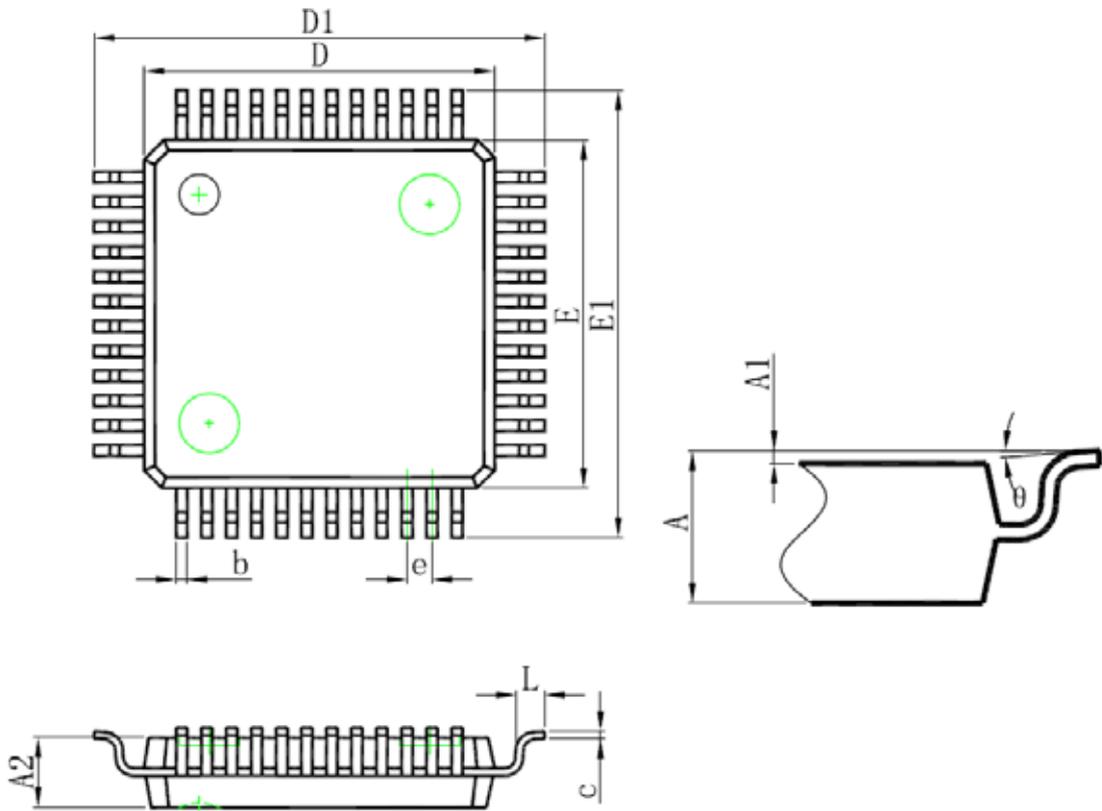


Fig 3-2 LQFP48 Package dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A		1.600		0.063
A1	0.050	0.150	0.002	0.006
A2	1.350	1.450	0.053	0.057
b	0.190	0.260	0.007	0.010
c	0.090	0.200	0.004	0.008
D	6.900	7.100	0.272	0.280
D1	8.850	9.150	0.348	0.360
E	6.900	7.100	0.272	0.280
E1	8.850	9.150	0.348	0.360
e	0.500 (BSC)		0.020 (BSC)	
L	0.450	0.750	0.018	0.030
θ	1°	7°	1°	7°

NOTE:

ALL DIMENSIONS REFER TO JEDEC STANDARD MO-220WMMMD-4.



Revision history

Version	Publication date	Pages	Paragraph or Illustration	Revise Description
1.0	2016.11	17		Initial draft
2.0	2017.04	17		RCHF max frequency modified to 24MHz
2.1	2017.06	20		Add FM3315 package information

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