



复旦微电子

FM33A0xx ***Low Power MCU***

Brief Datasheet

2017.05

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1 Outline

This document is a brief datasheet for FM33A0xx MCU family, 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

FM33A0xx is an ultra-low-power MCU with embedded Flash. FM33A0xx integrates a 32-bit ARM Cortex-M0+ processor core, up to 512K bytes Flash memory, up to 64K bytes SRAM, and general peripherals including LCD, RTC, ADC, UART, I2C, SPI, etc.

2.2 Features

- | Operating Voltage Range: 1.8~5.5V
- | Operating Temperature Range: -40 ~+85
- | Typical current consumption
 - n Active : 150uA/MHz
 - n Standby : 15uA@32KHz
 - n Sleep w/ LCD on : <10uA
 - n DeepSleep w/ RTC & 16KB RAM : 1uA
 - n DeepSleep w/o RTC : 0.5uA
- | Low power mode fast wake-up
 - n Sleep mode wake-up time: <20us
 - n DeepSleep mode wake-up time: <50us
- | ARM Cortex-M0+
 - n Frequency up to 40MHz
 - n Memory Protection Unit
 - n Unprivileged/Privileged mode
 - n NVIC
 - n SWD debug interface
- | Flash memory
 - n Up to 512K bytes program space
 - n Endurance 20,000cycles
 - n Data retention >10yrs (@85)
 - n Bootloader self-programming supported
 - n Code protection mechanism
- | Up to 64K bytes RAM
- | Power-on reset
- | Software configurable Power-down reset & supply voltage monitor
- | 24 external interrupt pins
- | 2 independent Watchdog timers
- | AES128/192/256bit hardware accelerator
- | True Random Number generator

- | Independent programmable timer
 - n 8-bit general timer*4; 16-bit general timer*4
 - n 16-bit low-power timer*1
 - n 24bit Systick*1
- | Communication interface
 - n UART*6
 - n 7816*2
 - n I2C*1
 - n SPI*3
 - n 7-channel peripheral DMA
 - n 1-channel memory DMA
 - n Programmable CRC module
- | LCD driver
 - n 4COM x 44SEG / 6COM x 42SEG / 8COM x 40SEG
 - n Internal buffer mode or external capacitor mode
 - n Support display under LPM
 - n Internal VLCD voltage booster
 - n 16-level of adjustable contrast
- | Low power real-time-clock with digital calibration, precision up to +/-0.119ppm
- | 11-bit ADC, supports voltage and temperature measurement
- | Temperature Sensor: +/-2
- | Low power analog comparator*2
- | Programmable high speed RC oscillator, 8/16/24MHz, factory-trimmed to +/-1%, variation less than +/-2% for 8MHz under -40~+85
- | Low power 32K crystal oscillator w/ fail detector
- | On-chip low speed RC oscillator, 32KHz
- | PLL, max output frequency 40MHz
- | Up to 91 GPIOs

2.3 Device Lineup

Part code	Flash (KBytes)	RAM (KBytes)	Package
FM33A068	512	64	LQFP80
FM33A0610	512	64	LQFP100
FM33A058	384	48	LQFP80
FM33A0510	384	48	LQFP100
FM33A048	256	32	LQFP80
FM33A0410	256	32	LQFP100
FM33A038	192	16	LQFP80
FM33A0310	192	16	LQFP100

Table 2-1 FM33A0XX device lineup

2.4 Electrical Characteristics

2.4.1 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	+/-2000	V
CDM	ESD CDM	+/-1000	V

Table 2-2 FM33A0XX limited parameters

2.4.2 DC parameters

2.4.2.1 Supply voltage

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

Table 2-3 FM33A0XX supply parameters

2.4.2.2 Current consumption

Default condition: $V_{DD}=3.0V$, $T=25$

Symbol	decription	condition	Parameter			Unit
			min	typ	max	
I_{sleep1}	Current consumption under SLEEP mode	PDR/LVD/LCD enabled, LCD using internal buffer, RTC operating on 32K crystal, CPU & RAM state retained		6		μA
I_{sleep2}	Current consumption under SLEEP mode	PDR/LVD enabled, LCD disabled, RTC operating on 32K crystal, CPU & RAM state retained		3.5		
$I_{dpsleep}$	Current consumption under DEEPSLEEP mode	PDR/ LVD enabled, LCD disabled, RTC operating on 32K crystal, CPU & RAM state retained		1		μA
I_{LPRUN}	Current consumption	code excuting from Flash @32KHz		15		μA

Symbol	decription	condition	Parameter			Unit
			min	typ	max	
	under LPRUN mode					
I_{VDD3}	Current consumption under ACTIVE mode	code excuting from Flash@8MHz		1.3		mA

Table 2-4 FM33A0XX current consumption

2.4.2.3 Reset

Symbol	decription	condition	Parameter			Unit
			min	typ	max	
V_{POR}	Power-on reset voltage			1.8		V
V_{BOR}	Power-down reset voltage			1.7		V
V_{LVD}	Supply monitor threshold	LVD[3:0]=0000	Fall	1.800		V
			Rise	1.900		
		LVD[3:0]=0001	Fall	2.014		V
			Rise	2.114		
		LVD[3:0]=0010	Fall	2.229		V
			Rise	2.329		
		LVD[3:0]=0011	Fall	2.443		V
			Rise	2.543		
		LVD[3:0]=0100	Fall	2.657		V
			Rise	2.757		
		LVD[3:0]=0101	Fall	2.871		V
			Rise	2.971		
		LVD[3:0]=0110	Fall	3.086		V
			Rise	3.186		
		LVD[3:0]=0111	Fall	3.300		V
			Rise	3.400		
		LVD[3:0]=1000	Fall	3.514		V
			Rise	3.614		
LVD[3:0]=1001	Fall	3.729		V		
	Rise	3.829				
LVD[3:0]=1010	Fall	3.943		V		
	Rise	4.043				
LVD[3:0]=1011	Fall	4.157		V		
	Rise	4.257				
LVD[3:0]=1100	Fall	4.371		V		
	Rise	4.471				
		LVD[3:0]=1101	Fall	4.586		V

Symbol	decription	condition	Parameter			Unit
			min	typ	max	
			Rise	4.686		V
		LVD[3:0]=1110	Fall	4.800		
			Rise	4.900		

Table 2-5 FM33A0XX Reset parameters

2.4.2.4 Flash

Symbol	description	condition	Parameter			unit
			min	typ	max	
	Flash size		192K		512K	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		20,000			Erase/Write cycles
T _{DR}	Data Retention	T=85	10			yrs

Table 2-6 FM33A0XX Flash parameter

2.4.2.5 Internal RC oscillator

Symbol	description	condition	Parameter			unit	
			min	typ	max		
f _{RCHF} ^[1]	RCHF frequency	VDD=5V	FSEL==2'b00	7.92	8	8.08	MHz
			FSEL==2'b01	15.84	16	16.16	
			FSEL==2'b10	23.76	24	24.24	
ACC _{RCHF} ₁ ^[2]	RCHF temperature variation	VDD=5V	FSEL==2'b00 T=-40~+85	-1	-	1.5	%
			FSEL==2'b01 T=-40~+85	-2.5	-	3	%
			FSEL==2'b10 T=-40~+85	-3	-	4	%
f _{RCLP}	RCLP frequency	VDD=1.8~5.5V T=25	28	32	35	KHz	

Table 2-7 FM33A0XX internal RC oscillation

Note:

[1] Guaranteed by test in production.

[2] Guaranteed by characterization results.



2.4.2.6 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
	ADC operating clock			512		KHz
	Throughput Rate			250		Sps

Table 2-8 FM33A0XX ADC parameter

2.4.2.7 Temperature sensor

Symbol	description	condition	parameter			unit
			min	typ	max	
Reso		For high resolution application, triple-point temperature testing is needed		±0.2		°C
Slope			4.8	5.08	5.5	LSB/°C

Table 2-9 FM33A0XX TS parameter

2.5 Pin Description

2.5.1 LQFP100

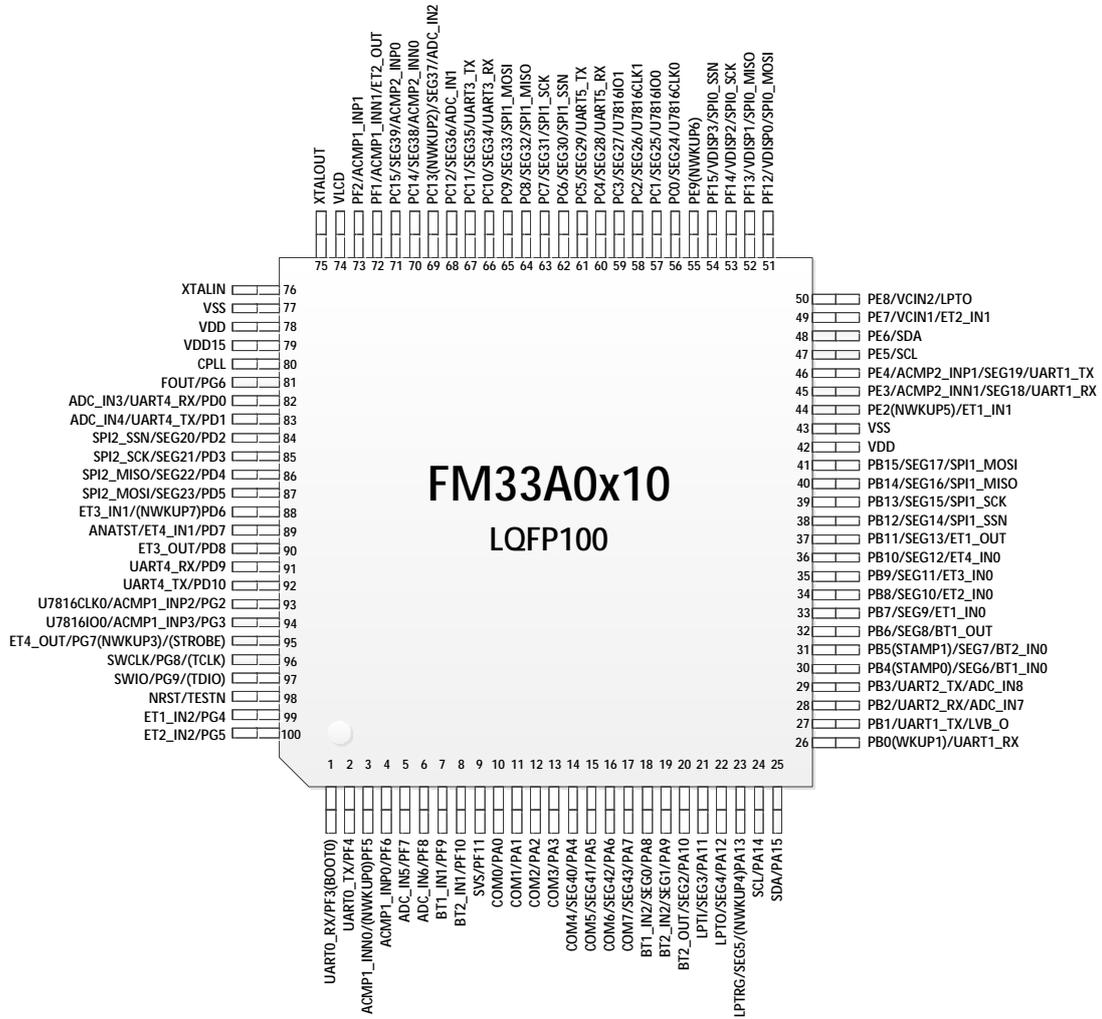


Figure 2-1 FM33A0XX LQFP100 pin assignment

2.5.2 LQFP80

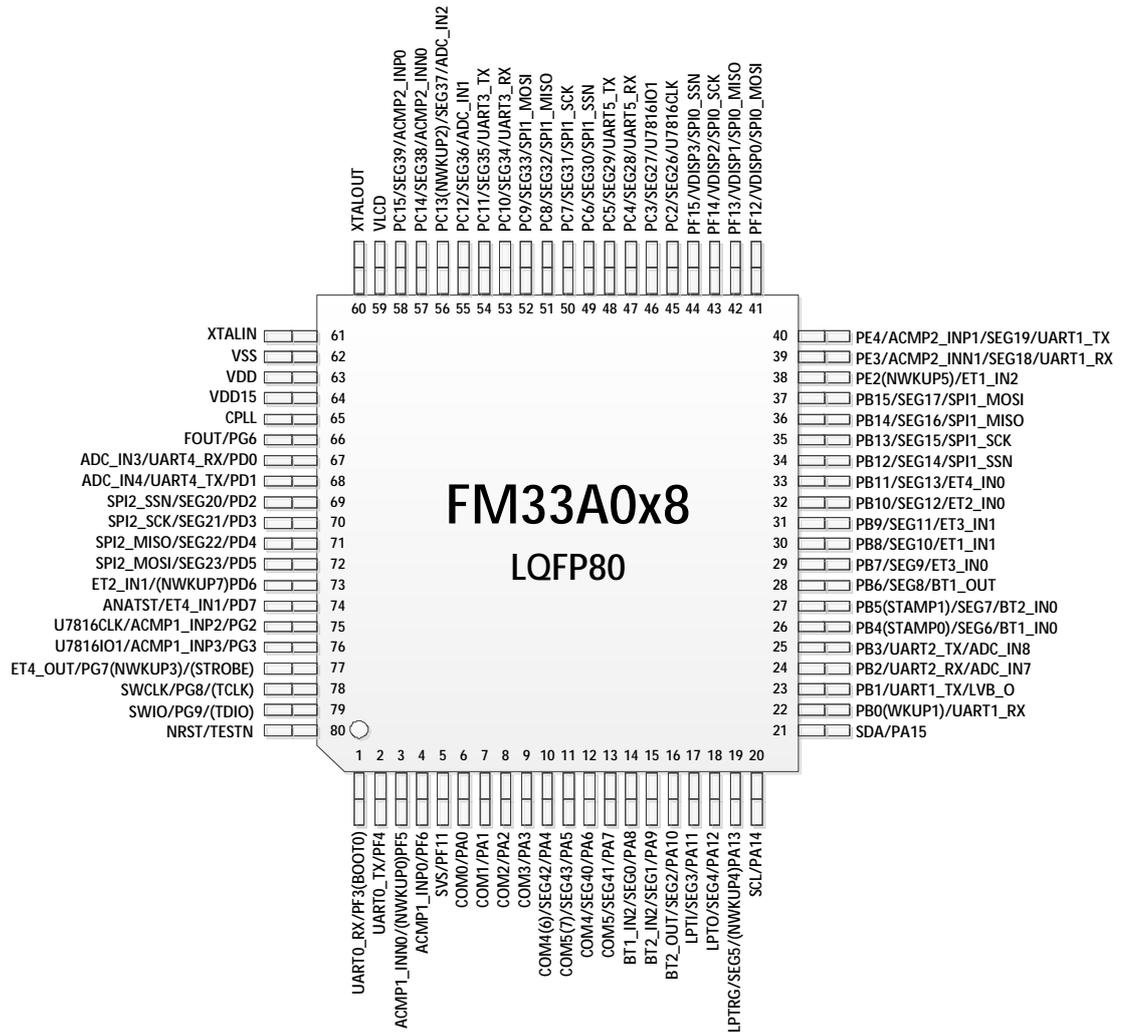


Figure 2-2 FM33A0xx LQFP80 pin assignment

2.5.3 Pin function

Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
1	1	PF3	GPIO
		UART0_RX	UART0 receive
2	2	PF4	GPIO
		UART0_TX	UART0 transmit
3	3	PF5(NWKUP0)	GPIO (Asynchronous wakeup)
		ACMP0_INN0	Negative input for Comparator0
4	4	PF6	GPIO
		ACMP0_INP0	Positive input for Comparator0
5	-	PF7	GPIO
		ADC_IN7	ADC input



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
6	-	PF8	GPIO
		ADC_IN8	ADC input
7	-	PF9	GPIO
		BT1_IN1	Input channel for basic timer1
8	-	PF10	GPIO
		BT2_IN1	Input channel for basic timer2
9	5	PF11	GPIO
		SVS	External input for supply monitor
10	6	PA0	GPIO
		COM0	LCD COM
11	7	PA1	GPIO
		COM1	LCD COM
12	8	PA2	GPIO
		COM2	LCD COM
13	9	PA3	GPIO
		COM3	LCD COM
14	10	PA4	GPIO
		COM4/SEG40	LCD COM/SEG
15	11	PA5	GPIO
		COM5/SEG41	LCD COM/SEG
16	12	PA6	GPIO
		COM6/SEG42	LCD COM/SEG
17	13	PA7	GPIO
		COM7/SEG43	LCD COM/SEG
18	14	PA8	GPIO
		SEG0	LCD SEG
		BT1_IN2	Input channel for basic timer1
19	15	PA9	GPIO
		SEG1	LCD SEG
		BT2_IN2	Input channel for basic timer2
20	16	PA10	GPIO
		SEG2	LCD SEG
		BT2_OUT	Output channel for basic timer2
21	17	PA11	GPIO
		SEG3	LCD SEG
		LPTI	Input channel for low power timer
22	18	PA12	GPIO
		SEG4	LCD SEG
		LPTO	output channel for low power timer
23		PA13(NWKUP4)	GPIO (asynchronous wakeup)



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
	19	SEG5	LCD SEG
		LPTRG	External trigger for low power timer
24	20	PA14	GPIO
		SCL	I2C Clock
25	21	PA15	GPIO
		SDA	I2C Data
26	22	PB0(NWKUP1)	GPIO (asynchronous wakeup)
		UART1_RX	UART1 receive
27	23	PB1	GPIO
		UART1_TX	UART1 transmit
		LVB_O	Supply monitor output
28	24	PB2	GPIO
		UART2_RX	UART2 receive
		ADC_IN7	ADC input
29	25	PB3	GPIO
		UART2_TX	UART2 transmit
		ADC_IN8	ADC
30	26	PB4(STAMP0)	GPIO (RTC time stamp)
		SEG6	LCD SEG
		BT1_IN0	Input channel for basic timer1
31	27	PB5(STAMP1)	GPIO (RTC time stamp)
		SEG7	LCD SEG
		BT2_IN0	Input channel for basic timer2
32	28	PB6	GPIO
		SEG8	LCD SEG
		BT1_OUT	Output channel for basic timer1
33	29	PB7	GPIO
		SEG9	LCD SEG
		ET1_IN0	Input channel for extended timer1
34	30	PB8	GPIO
		SEG10	LCD SEG
		ET2_IN0	Input channel for extended timer2
35	31	PB9	GPIO
		SEG11	LCD SEG
		ET3_IN0	Input channel for extended timer3
36	32	PB10	GPIO
		SEG12	LCD SEG
		ET4_IN0	Input channel for extended timer4
37	33	PB11	GPIO
		SEG13	LCD SEG



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
		ET1_OUT	Output channel for extended timer1
38	34	PB12	GPIO
		SEG14	LCD SEG
		SPI1_SSN	SPI1 chip select
39	35	PB13	GPIO
		SEG15	LCD SEG
		SPI1_SCK	SPI1 clock
40	36	PB14	GPIO
		SEG16	LCD SEG
		SPI1_MISO	SPI1 data
41	37	PB15	GPIO
		SEG17	LCD SEG
		SPI1_MOSI	SPI1 data
42	-	VDD	Power Supply
43	-	VSS	Ground
44	38	PE2(NWKUP5)	GPIO (asynchronous wakeup)
		ET1_IN1	Input channel for extended timer1
45	39	PE3	GPIO
		ACMP1_INN1/SEG18	Negative input for comparator1/LCD SEG
		UART1_RX	UART1 receive
46	40	PE4	GPIO
		ACMP1_INP1/SEG19	Positive input for comparator1/LCD SEG
		UART1_TX	UART1 transmit
47	-	PE5	GPIO
		SCL	I2C clock
48	-	PE6	GPIO
		SDA	I2C data
49	-	PE7	GPIO
		VCIN1	Place 0.1uF between VCIN1 and VCIN2 when using LCD capacitor mode
		ET2_IN2	Input channel for extended timer2
50	-	PE8	GPIO
		VCIN2	Place 0.1uF between VCIN1 and VCIN2 when using LCD capacitor mode
		LPTO	Output channel for low power timer
51	41	PF12	GPIO



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
		V_DISP0	Connect 0.1uF to ground when using LCD capacitor mode
		SPI0_MOSI	SPI0 data
52	42	PF13	GPIO
		V_DISP1	Connect 0.1uF to ground when using LCD capacitor mode
		SPI0_MISO	SPI0 data
53	43	PF14	GPIO
		V_DISP2	Connect 0.1uF to ground when using LCD capacitor mode
		SPI0_SCK	SPI0 clock
54	44	PF15	GPIO
		V_DISP3	Connect 0.1uF to ground when using LCD capacitor mode
		SPI0_SSN	SPI0 chip select
55	-	PE9(NWKUP6)	GPIO (asynchronous wakeup)
56	-	PC0	GPIO
		SEG24	LCD SEG
		U7816CLK0	7816-0 clock
57	-	PC1	GPIO
		SEG25	LCD SEG
		U7816IO0	7816-0 data
58	45	PC2	GPIO
		SEG26	LCD SEG
		U7816CLK1	7816-1 clock
59	46	PC3	GPIO
		SEG27	LCD SEG
		U7816IO1	7816-1 data
60	47	PC4	GPIO
		SEG28	LCD SEG
		UART5_RX	UART5 receive
61	48	PC5	GPIO
		SEG29	LCD SEG
		UART5_TX	UART5 transmit
62	49	PC6	GPIO
		SEG30	LCD SEG
		SPI1_SSN	SPI1 chip select
63	50	PC7	GPIO
		SEG31	LCD SEG
		SPI1_SCK	SPI1 clock



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
64	51	PC8	GPIO
		SEG32	LCD SEG
		SPI1_MISO	SPI1 data
65	52	PC9	GPIO
		SEG33	LCD SEG
		SPI1_MOSI	SPI1 data
66	53	PC10	GPIO
		SEG34	LCD SEG
		UART3_RX	UART3 receive
67	54	PC11	GPIO
		SEG35	LCD SEG
		UART3_TX	UART3 transmit
68	55	PC12	GPIO
		SEG36	LCD SEG
		ADC_IN5	ADC input
69	56	PC13(NWKUP2)	GPIO (asynchronous wakeup)
		SEG37	LCD SEG
		ADC_IN6	ADC input
70	57	PC14	GPIO
		SEG38	LCD SEG
		ACMP1_INN0	Negative input for comparator1
71	58	PC15	GPIO
		SEG39	LCD SEG
		ACMP1_INP0	Positive input for comparator1
72		PF1	GPIO
		ACMP0_INN1	Negative input for comparator0
		ET2_OUT	Output channel for extended timer2
73		PF2	GPIO
		ACMP0_INP1	Positive input for comparator0
74	59	VLCD	Connect 0.1uF to ground when using LCD booster
75	60	XTALOUT	32768Hz Crystal out
76	61	XTALIN	32768Hz Crystal in
77	62	VSS	Ground
78	63	VDD	Power Supply
79	64	VDD15	Regulator output, connect 0.1~1uF capacitor to ground
80	65	CPLL	PLL capacitor, connect 4nF to ground
81	66	PG6	GPIO



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
		FOUT	Test clock output
82	67	PD0	GPIO
		UART4_RX	UART4 receive
		ADC_IN3	ADC input
83	68	PD1	GPIO
		UART4_TX	UART4 transmit
		ADC_IN4	ADC input
84	69	PD2	GPIO
		SEG20	LCD SEG
		SPI2_SSN	SPI2 chip select
85	70	PD3	GPIO
		SEG21	LCD SEG
		SPI2_SCK	SPI2 clock
86	71	PD4	GPIO
		SEG22	LCD SEG
		SPI2_MISO	SPI2 data
87	72	PD5	GPIO
		SEG23	LCD SEG
		SPI2_MOSI	SPI2 data
88	73	PD6(NWKUP7)	GPIO (asynchronous wakeup)
		ET3_IN1	Input channel for extended timer 3
89	74	PD7	GPIO
		ANATST	Analog test channel
		ET4_IN1	Input channel for extended timer 4
90	-	PD8	GPIO
		ADC_IN2	ADC input
		ET3_OUT	Output channel for extended timer 3
91	-	PD9	GPIO
		UART4_RX	UART4 receive
92	-	PD10	GPIO
		UART4_TX	UART4 transmit
93	75	PG2	GPIO
		U7816CLK0	7816-0 clock
		ACMP0_INP2	Positive input for comparator0
94	76	PG3	GPIO
		U7816IO0	7816-0 data
		ACMP0_INP3	Positive input for comparator0
95	77	PG7(NWKUP3)	GPIO (asynchronous wakeup)
		ET4_OUT	Output channel for extended timer4
96	78	PG8	GPIO



Pin Number		Pin Function	Descriptions
LQFP100	LQFP80		
		SWCLK	SWD clock
97	79	PG9	GPIO
		SWIO	SWD data
98	80	NRST/TESTN	Reset or TEST pin
99	-	PG4	GPIO
		ET1_IN2	Input channel for extended timer1
100	-	PG5	GPIO
		ET2_IN2	Input channel for extended timer2

Table 2-10 FM33A0XX pin description

3 Package

3.1 LQFP100

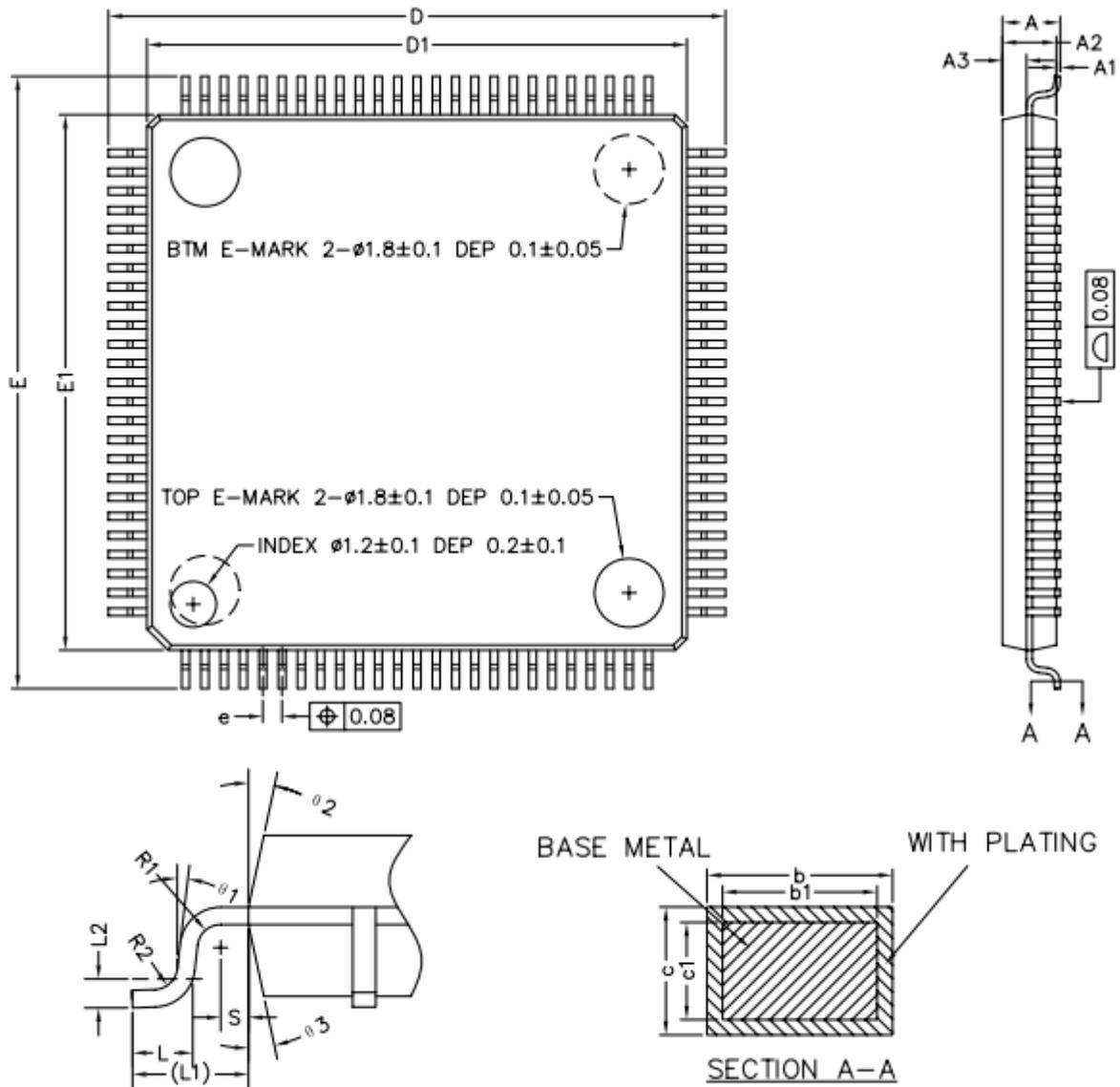


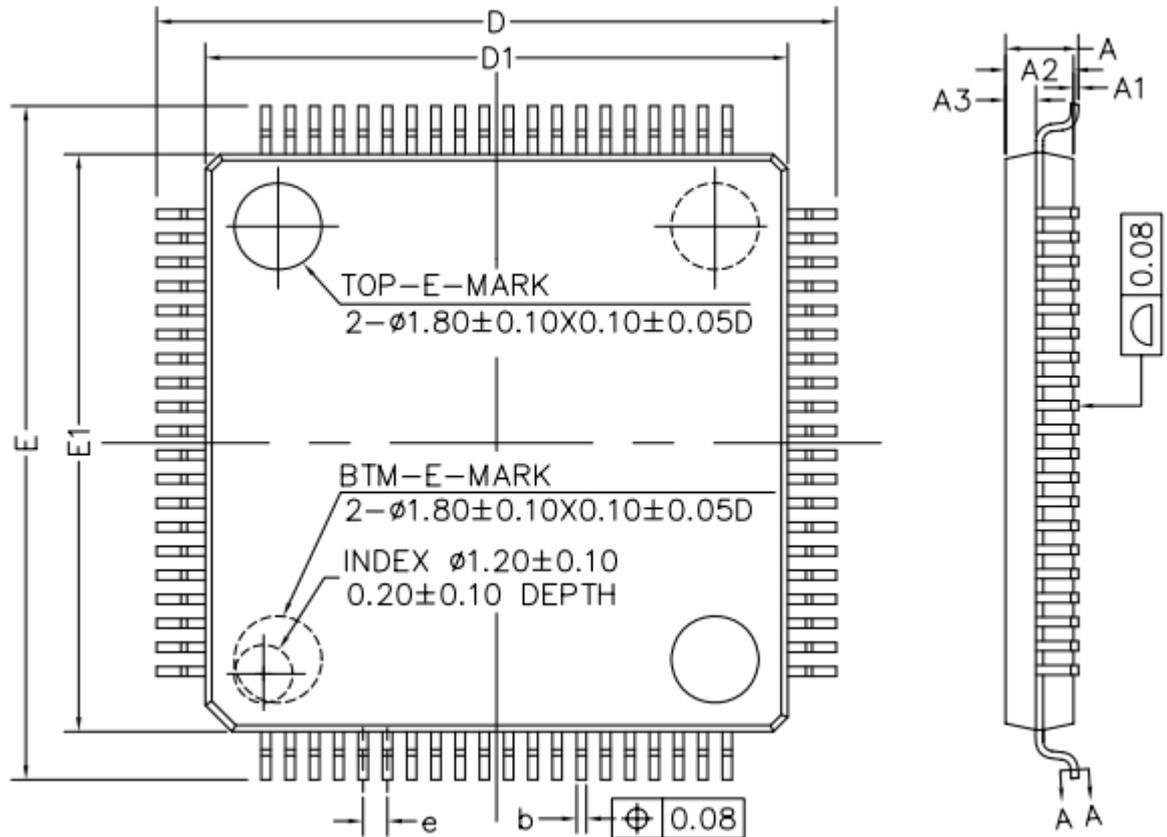
Figure 3-1 LQFP100 package information

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	0.18	—	0.27
b1	0.17	0.20	0.23
c	0.13	—	0.18
c1	0.12	0.127	0.134

Symbol	MIN	NOM	MA□
D	15.80	16.00	16.20
D1	13.90	14.00	14.10
E	15.80	16.00	16.20
E1	13.90	14.00	14.10
e	0.40	0.50	0.60
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°

NOTE:

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

3.2 LQFP80

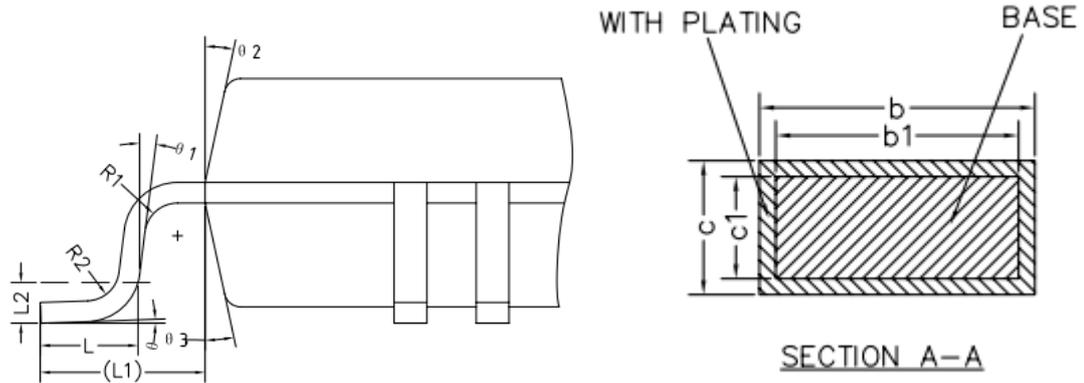


Figure 3-2 LQFP80 package information

Symbol	MIN	NOM	MAX
A	—	—	1.60
A1	0.05	—	0.15
A2	1.35	1.40	1.45
A3	0.59	0.64	0.69
b	0.18	—	0.27
b1	0.17	0.20	0.23
c	0.13	—	0.18
c1	0.12	0.127	0.134
D	13.80	14.00	14.20
D1	11.90	12.00	12.10
E	13.80	14.00	14.20
E1	11.90	12.00	12.10
e	0.40	0.50	0.60
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°

NOTE:

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



Revision history

Version	Publication date	Pages	Paragraph or Illustration	Revise Description
1.0	2016.10	24		Initial version
2.0	2017.05	24		Update package information



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