NCC 1T 8051-MCU

ATM8F8040A

Datasheet

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1. Core Features

CPU

8-bit 1T 8051 core

1/2/4/8 System Clock Division

Dual DPTR

Dual-line debugging

ROM

16K bytes FLASH Program Memory(1K erase/write cycles)

128 bytes EEPROM(10K erase/write cycles)

data retention: 10 years

RAM

256 bytes IRAM

512 bytes XRAM

GPIO

Up to 18 I/O pins

Interrupt on any port change

Timer/PWM

16-bit 8051 standard timers T0/T1

16-bit timer T2 with capture and programmable output

16-bit pwm with 7-channels complementary outputs

AWU

WDT

Others

CRC16 calculation unit

Configurable logic cell（CPL）

External crystal oscillator stop detection

Communication

two UARTs

Analog Peripherals

12-bit and 10 channels ADC

Power-on reset

Brownout reset

Clock management

Internal 32MHz RC(±1%)

Internal 32KHz RC

1 to 20MHz crystal oscillator

Mode

Normal mode

IDLE mode

STOP mode，minimum current <1uA

Operating Characteristics

Clock：up to 32MHz

Voltage Range： 2.7~5.5V

Temperature Range： -40℃~85℃

Package

TSSOP20

QFN20

SOP16

2. Description

ATM8F8040A is an 8-bit MCU with 16K bytes of Flash program memory.It has the following features:16K bytes of Flash program memory,256 bytes of SRAM,512 bytes of extended XRAM,128 bytes of internal EEPROM, two 16-bit high-performance timers T0/T1,one 16-bit timer T2 with 3-channels capture, one PWM with dead-time,one WDT,two UARTs,one 12-bit ADC,one CRC,one configurable logic cell(CPL).ATM8F8040A suitable for consumer and control electronic product applications.

3. Block diagram

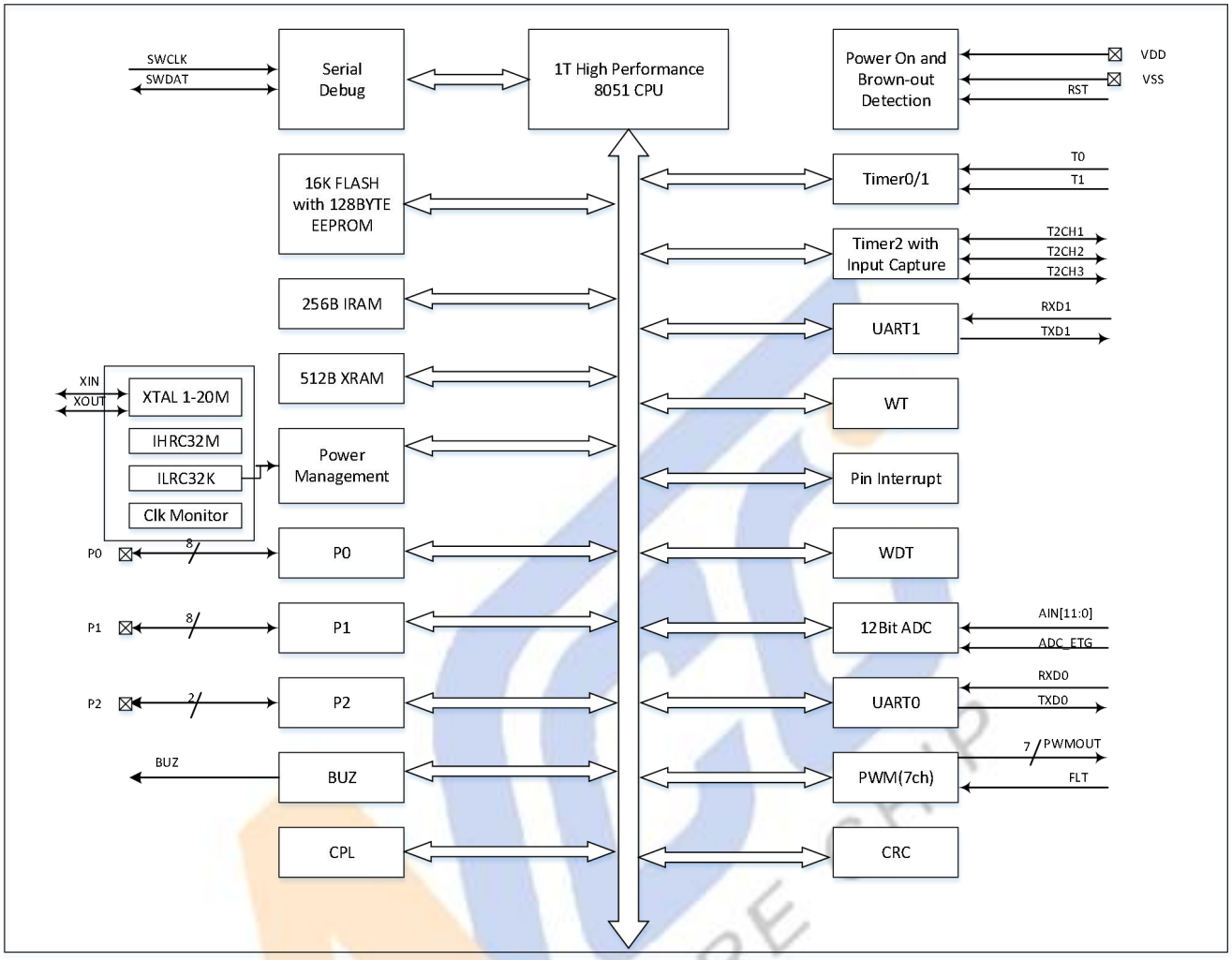


Figure 3-1 Block diagram

4. Pins description and alternate functions

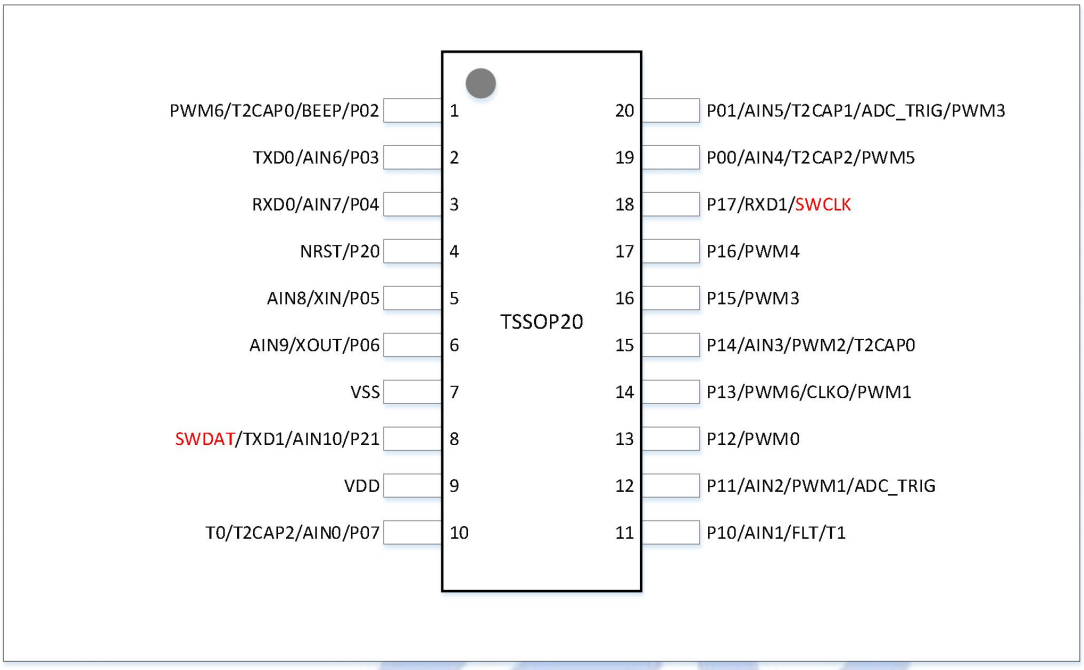


Figure 4-1 TSSOP20

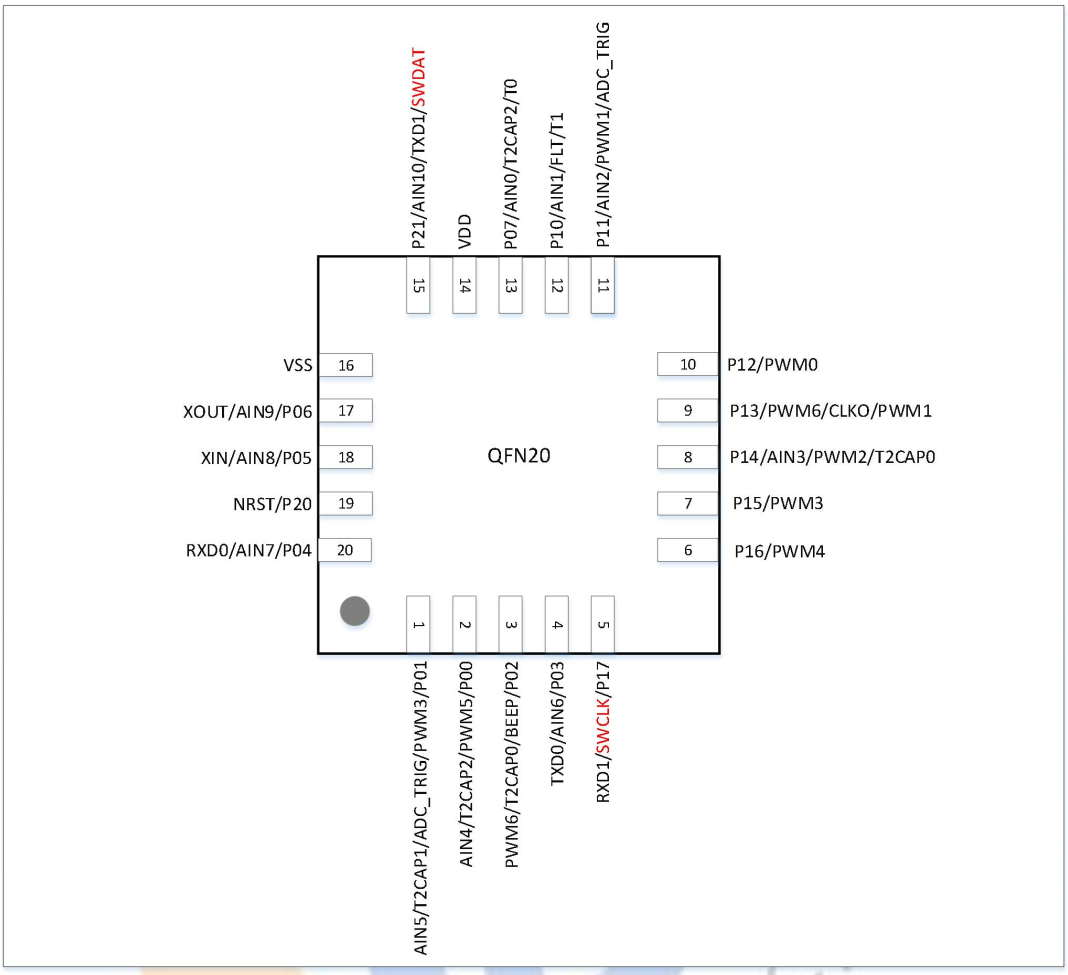


Figure 4-2 QFN20

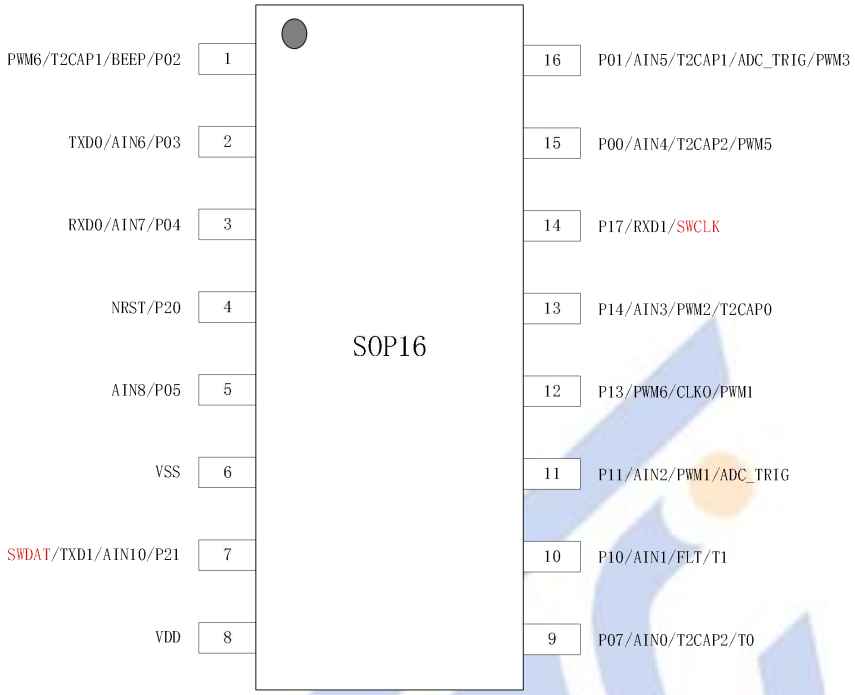


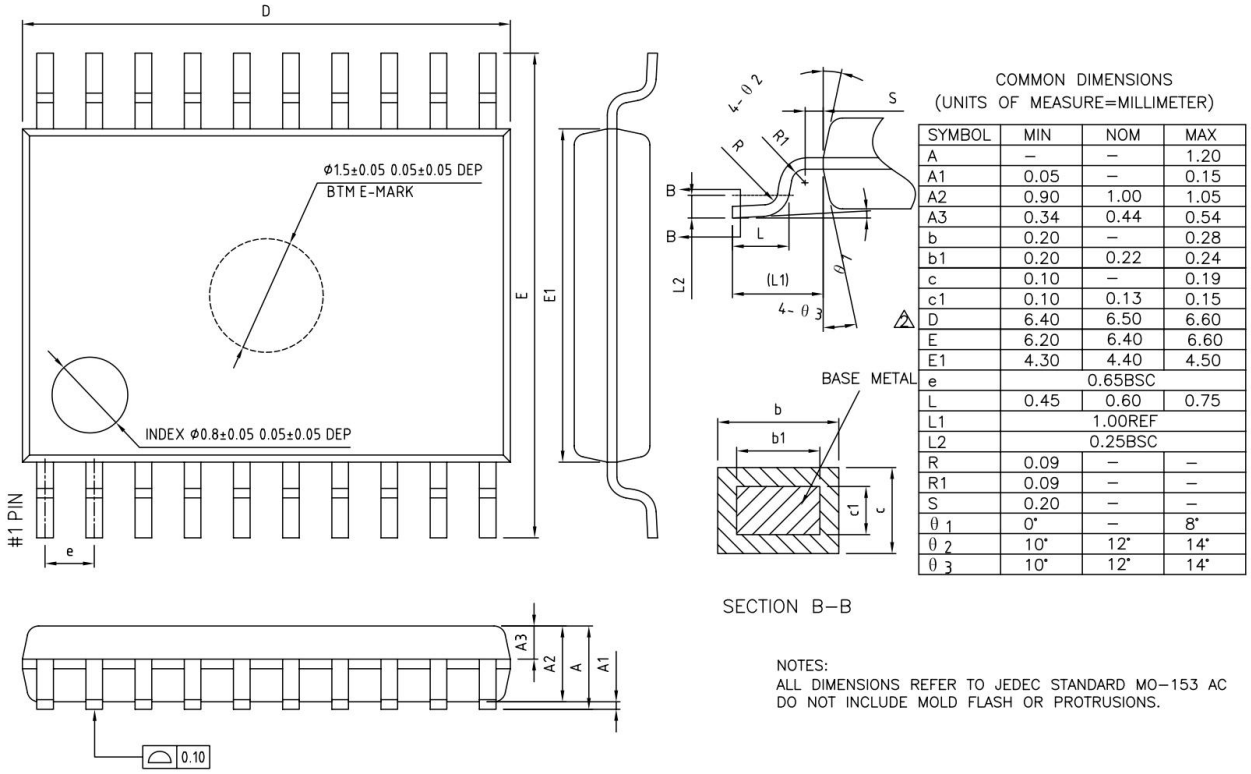
Figure 4-3 SOP16

Table 4- 1 Pins description

TSSOP20	QFN20	SOP16	I/O	Alternate Functions
1	3	1	P02	PWM6/T2CAP0/BEEP
2	4	2	P03	TXD0/AIN6
3	20	3	P04	RXD0/AIN7
4	19	4	P20	NRST
5	18	5	P05	AIN8/XIN
6	17		P06	AIN9/XOUT
7	16	6	VSS	
8	15	7	P21	SWDAT/TXD1/AIN10
9	14	8	VDD	
10	13	9	P07	AIN0/T2CAP2/T0
11	12	10	P10	AIN1/FLT/T1
12	11	11	P11	AIN2/PWM1/ADC_TRIG
13	10		P12	PWM0
14	9	12	P13	PWM6/CLKO/PWM1
15	8	13	P14	AIN3/PWM2/T2CAP0
16	7		P15	PWM3
17	6		P16	PWM4
18	5	14	P17	SWCLK/RXD1
19	2	15	P00	AIN4/T2CAP2/PWM5
20	1	16	P01	AIN5/T2CAP1/ADC_TRIG/PWM3

5. Package information

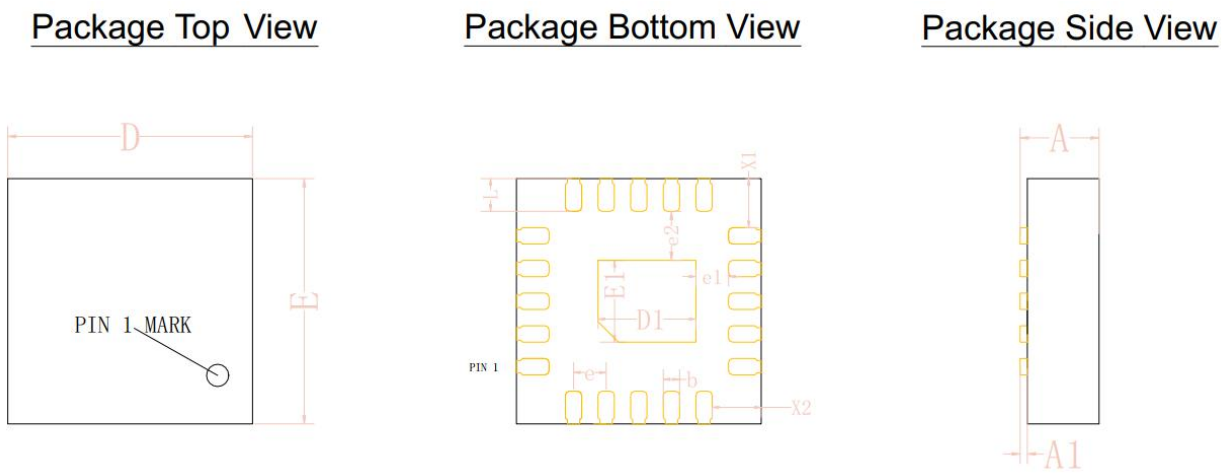
5.1. TSSOP20



SYMBOL	MIN	NOM	MAX
A	–	–	1.20
A1	0.05	–	0.15
A2	0.90	1.00	1.05
A3	0.34	0.44	0.54
b	0.20	–	0.28
b1	0.20	0.22	0.24
c	0.10	–	0.19
c1	0.10	0.13	0.15
D	6.40	6.50	6.60
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	0.60	0.75
L1	1.00REF		
L2	0.25BSC		
R	0.09	–	–
R1	0.09	–	–
S	0.20	–	–
θ1	0°	–	8°
θ2	10°	12°	14°
θ3	10°	12°	14°

Figure 5-1 TSSOP20 package information

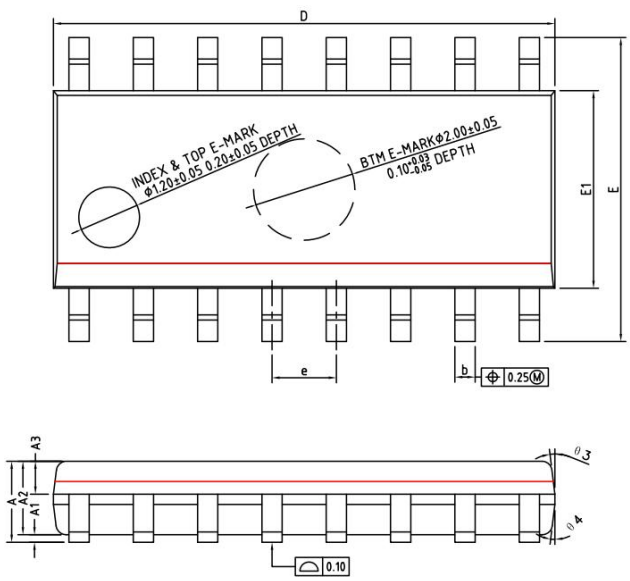
5.2. QFN20

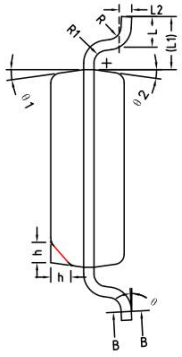


SYMBOLS	DIMENSION IN MM		
	MIN	NOM	MAX
A	0.500	0.550	0.600
A1	0.007	0.012	0.017
D	2.900	3.000	3.100
E	2.900	3.000	3.100
D1	1.150	1.200	1.250
E1	0.950	1.000	1.050
L	0.350	0.400	0.450
b	0.150	0.200	0.250
e	0.350	0.400	0.450
e1	0.350	0.400	0.450
e2	0.550	0.600	0.650
X1	0.550	0.600	0.650
X2	0.550	0.600	0.650

Figure 5-2 QFN20 package information

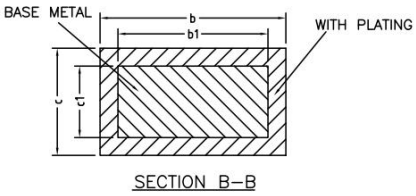
5.3. SOP16





COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	–	–	1.75
A1	0.10	0.15	0.25
A2	1.35	1.45	1.55
A3	0.55	0.65	0.75
b	0.36	–	0.51
b1	0.35	0.40	0.45
c	0.18	–	0.25
c1	0.17	0.20	0.23
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.22	1.27	1.32
L	0.45	0.60	0.80
L1	1.04REF		
L2	0.25BSC		
R	0.07	–	–
R1	0.07	–	–
h	0.30	0.40	0.50
θ	0°	–	8°
θ 1	6°	8°	10°
θ 2	6°	8°	10°
θ 3	5°	7°	9°
θ 4	5°	7°	9°



NOTES:
ALL DIMENSIONS MEET JEDEC STANDARD MS–012 AC
DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.

Figure 5-3 SOP16 package information

6. Electrical characteristics

6.1. Limit parameters

Table 6-1 limit parameters

Symbol	Parameters	Range	Unit	Others
VDD	External supply voltage	-0.3~6.0	V	-
T_{STG}	Storage temperature range	-40~125	℃	-
T_{opt}	Operating temperature	-40~85	℃	-
V_I	Input voltage on I/O	-0.3~VDD+0.3	V	-
V_O	Output voltage on I/O	-0.3~VDD+0.3	V	-
I_{OLT}	Total current sunk by sum all I/Os	100	mA	Max
I_{OHT}	Total current sourced by sum of all I/Os	-100	mA	Max

6.2. DC Characteristics

Table 6-2 Voltage and Current characteristics

If there are no other instructions，VDD-VSS=5V, TA=25℃

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
V_{DD}	Operating Voltage	F_{HRC}=32MHz, F_{CPU}=8MHz[1]	4.5		5.5	V
		F_{HRC}=16MHz, F_{CPU}=4MHz	2.7		5.5	V
I_{DD1}	Operating Current	F_{System} =32MHz;F_{CPU}=8MHz;ADC disabled;all I/Os push-pull output without load;P1 toggled;		12.5		mA
I_{DD11}	Operating Current	F_{System} =16MHz;F_{CPU}=4MHz;ADC disabled;all I/Os push-pull output without load;P1 toggled;		7.5		mA
I_{DD2}	IDLE Current(IDLE)	F_{System} =4MHz;F_{CPU}=2MHz;ADC disabled;All peripherals disabled;CPU is idle		1.9		mA
I_{DD3}	IDLE Current(STOP)	All analog peripherals disabled;BOR enable;CPU is stop		40		uA
I_{DD4}	IDLE Current(STOP)	All analog peripherals disabled;Internal LRC enable;WT enable;CPU is stop		3		uA
I_{DD5}	IDLE Current(STOP)	All analog disabled;BOR disable;CPU is stop		1		uA
V_{IH1}	I/O input high level voltage		0.7			VDD
V_{IL1}	I/O input low level voltage				0.3	VDD
I_{IL}	leakage current	Input low level voltage			1	uA
I_{IH}	leakage current	Input high level voltage			1	uA
V_{OH}	Output high level voltage	Isrc=10mA	0.9			VDD
V_{OL1}	Output low level voltage (except P11/P12/P13/ P14/P15/P16/P00/P01)	Isink=20mA			0.1	VDD
V_{OL2}	Output low level voltage	Isink=50mA			0.2	VDD

	(P11/P12/P13/P14/P15/ P16/P00/P01)					
R_{PUL1}	Pull-up (except P20)			50		KΩ
R_{PUL2}	Pull-up(P20)			150		KΩ
BOR	Brownout reset threshold	BOR level=4.3V	4.2	4.3	4.4	V
		BOR level=3.7V	3.6	3.7	3.8	V
		BOR level=2.9V	2.8	2.9	3.0	V
		BOR level=2.5V	2.4	2.5	2.6	V

[1]Internal HRC is configured by tool. CPU clock is configured by system clock division and FLASH wait time PWAIT.

6.3. ADC Characteristics

Table 6-3 ADC Characteristics

(TA=25℃)

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
V_{DD}	Supply voltage	VDD=5V	2.7		5.5	V
V_{IREF1}	Internal reference voltage	VDD=5V	1.94	2.0	2.06	V
V_{IREF2}		VDD=5V	2.34	2.4	2.46	V
V_{IREF3}		VDD=5V	3.54	3.6	3.66	V
V_{EREF}	External reference voltage	VDD=5V			VDD	
V_{IN}	Conversion voltage range	VDD=5V	0		VREF	V
N_R	Accuracy	VDD=5V		12		Bit
DNL	Differential non linearity	VDD=5V			2	LSB
INL	Integral non linearity	VDD=5V			±3	LSB
E_F[1]	Gain error	VDD=5V			±4	LSB
E_{AD}[1]	Total absolute error	VDD=5V			±8	LSB
E_Z[1]	Offset error	VDD=5V			±4	LSB
F_{ADC1}	Clock frequency	4.5~5.5V			2	MHz
F_{ADC2}		2.7~5.5V			1	MHz
T_{ADC}	Conversion time	VDD=5V		13.5		TCK
T_{SAMP1}	Sampling time	VDD=5V,F_{ADC}=2MHz	4		16	TCK
T_{SAMP1}		VDD=3V,F_{ADC}=1MHz	4		16	TCK
C_{ADC}	CADC[2]	VDD=5V		25		pF

[1] The value is calibrated by software

[2] Guaranteed by design

6.4. IHRC Characteristics

Table 6-4 IHRC Characteristics

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
V_{DD}	Operating voltage		2.7		5.5	V
F_{req}	Frequency	Calibration value		32		MHz
F_{var}	Frequency error	25℃,5V	-1		+1	%
		-40～+85℃ ,2.7V~5.5V	-3		+3	%

6.5. ILRC Characteristics

Table 6-5 ILRCCharacteristics

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
V_{DD}	Operating voltage		2.7		5.5	V
F_{req3}	Frequency	Calibration value		32		kHz
F_{var2}	Frequency error	-40～+85℃ ,2.7V~5.5V	-10		+10	%

6.6. CRY Characteristics

Table 6-6 CRY Characteristics

(TA=25℃, 2.7V~5.5V)

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
F_{req}	Frequency	4.5V<VDD<5.5V,CL=22pF	1.0		20.0	MHz
		3.0V<VDD<5.5V,CL=30pF	1.0		12	MHz
		2.7V<VDD<5.5V,CL=30pF	1.0		8	MHz

6.7. Flash memory Characteristics

Table 6-7 FLASH memory Characteristics

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
V_{DD}	Operating voltage	-40～+85℃	2.7[1]		5.5	V
V_{DDR}	Operating temperature	read and write,VDD=5V	-40		85	℃

[1]The minimum voltage for flash write is 4.5v

Table 6-8 EEPROM Characteristics

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
V_{DD}	Operating temperature	-40℃~+125℃	2.7		5.5	V
V_{DDR}	Operating temperature	read and write,VDD=5V	-40		85	℃

6.8. NRST and EXTI Characteristics

Table 6-9 NRST and EXTI Characteristics

(TA=25℃, 5V)

Symbol	Parameters	Test Conditions	MIN	TYP	MAX	Unit
T_{INT}	EXTI input filtered pulse(expectedP20)	VDD=5.0V	5			us
T_{RST}	NRST input filtered pulse	VDD=5.0V	10			us

6.9. EFT Characteristics

Table 6-10 EFT Characteristics

(TA=25℃, 5V)

Symbol	Parameters	Test Conditions	Pass Value	Unit
V_{EFT}	Electrical Fast Transient	Fsys=IHRC，BOR 关闭	±4500	V

6.10. ESD Characteristics

Table 6-11 ESD Characteristics

(TA=25℃, 5V)

Symbol	Parameters	Test Conditions	Maximum	Unit
$V_{ESD(HBM)}$	Electrostatic discharge voltage(human body model)	TA=25℃	±8000	V
$V_{ESD(CDM)}$	Electrostatic discharge voltage(charge device model)		±2000	V

6.11. Latch up Characteristics

Table 6-12 Latch up Characteristics

Symbol	Parameters	Test Conditions	Pass Value	Unit
LU	Latch up	TA=25℃,VDD=5V	±200	mA

7. Chip type

Chip type	Package	Pins
ATM8F8040A-KT3	TSSOP20	20
ATM8F8040A-KQ3	QFN20	20
ATM8F8040A-DS3	SOP16	16

8. Revision history

Rebision	Date	Changes
1.0	2024.06.20	Initial release