MCF51MM256VLL Datasheet

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DiGi Electronics Part Number	MCF51MM256VLL-DG
Manufacturer	NXP USA Inc.
Manufacturer Product Number	MCF51MM256VLL
Description	IC MCU 32BIT 256KB FLASH 100LQFP
Detailed Description	Coldfire V1 MCF51MM Microcontroller IC 32-Bit Single-Core 50MHz 256KB (256K x 8) FLASH 100-LQFP (14x14)

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Manufacturer Product Number:	Manufacturer:
MCF51MM256VLL	NXP USA Inc.
Series:	Product Status:
MCF51MM	Active
DiGi-Electronics Programmable:	Core Processor:
Not Verified	Coldfire V1
Core Size:	Speed:
32-Bit Single-Core	50MHz
Connectivity:	Peripherals:
CANbus, EBI/EMI, I2C, SCI, SPI, USB OTG	LVD, PWM, WDT
Number of I/O:	Program Memory Size:
65	256KB (256K x 8)
Program Memory Type:	EEPROM Size:
FLASH	-
RAM Size:	Voltage - Supply (Vcc/Vdd):
32K x 8	1.8V ~ 3.6V
Data Converters:	Oscillator Type:
A/D 8x16b; D/A 1x12b	External
Operating Temperature:	Mounting Type:
-40°C ~ 105°C (TA)	Surface Mount
Supplier Device Package:	Package / Case:
100-LQFP (14x14)	100-LQFP
Base Product Number:	
MCF51	

Environmental & Export classification

RoHS Status:	Moisture Sensitivity Level (MSL):
ROHS3 Compliant	3 (168 Hours)
REACH Status:	ECCN:
REACH Unaffected	3A991A2
HTSUS:	
8542.31.0001	

Freescale Semiconductor
Data Sheet: Technical Data

Document Number: MCF51MM256
Rev. 5, 07/2012

An Energy-Efficient Solution from Freescale

MCF51MM256/128

The MCF51MM256 series devices are members of the low-cost, low-power, high-performance ColdFire V1 family of 32-bit microcontrollers (MCUs) designed for handheld metering devices.


80-LQFP
12mm x 12mm


81-BGA
10mm x 10mm


100-LQFP
14mm x 14mm


104-BGA
10mm x 10mm

Not all features are available in all devices or packages; see Table 1 for a comparison of features by device.

32-Bit ColdFire V1 Central Processor Unit (CPU)
- Up to 50.33 MHz ColdFire CPU above 2.4 V and 40 MHz CPU above 2.1V and 20 MHz CPU above 1.8 V across temperature range of -40°C to 105°C.
- ColdFire Instruction Set Revision C (ISA_C).
- 32-bit multiply and accumulate (MAC) supports signed or unsigned integer or signed fractional inputs.

On-Chip Memory
- 256 K Flash comprised of two independent 128 K flash arrays; read/program/erase over full operating voltage and temperature; allows interrupt processing while programming.
- 32 KB System Random-access memory (RAM).
- Security circuitry to prevent unauthorized access to RAM and Flash contents.

Power-Saving Modes
- Two ultra-low power stop modes. Peripheral clock enable register can disable clocks to unused modules to reduce currents.
- Time of Day (TOD) — Ultra low-power 1/4 sec counter with up to 64 sec timeout.
- Ultra-low power external oscillator that can be used in stop modes to provide accurate clock source to the TOD. 6 µs typical wake up time from stop3 mode.

Clock Source Options
- Oscillator (XOSC1) — Loop-control Pierce oscillator; 32.768 kHz crystal or ceramic resonator dedicated for TOD operation.
- Oscillator (XOSC2) for high frequency crystal input for MCG reference to be used for system clock and USB operations.
- Multipurpose Clock Generator (MCG) — PLL and FLL; precision trimming of internal reference allows 0.2% resolution and typical +0.5% to -1% deviation over temperature and voltage; supports CPU frequencies from 4 kHz to 50 MHz.

System Protection
- Watchdog computer operating properly (COP) reset with option to run from dedicated 1 kHz internal clock source or bus clock.
- Low-voltage detection with reset or interrupt; selectable trip points separate low voltage warning with optional interrupt; selectable trip points.
- Illegal opcode and illegal address detection with reset.
- Flash block protection for each array to prevent accidental write / erasure.
- Hardware CRC to support fast cyclic redundancy checks.

Development Support
- Integrated ColdFire DEBUG_Rev_B+ interface with single wire BDM connection supports same electrical interface used by the S08 family debug modules.
- Real-time debug with 6 hardware breakpoints (4 PC, 1 address and 1 data).
- On-chip trace buffer provides programmable start/stop recording conditions.

Peripherals
- **USB** — Dual-role USB On-The-Go (OTG) device, supports USB in either device, host or OTG configuration. On-chip transceiver and 3.3V regulator help save system cost, fully compliant with USB Specification 2.0. Allows control, bulk, interrupt and isochronous transfers.
- **SCIx** — Two serial communications interfaces with optional 13-bit break; option to connect Rx input to PRACMP output on SCI1 and SCI2; High current drive on Tx on SCI1 and SCI2; wake-up from stop3 on Rx edge.
- **SPI1** — Serial peripheral interface with 32-bit FIFO buffer; 16-bit or 8-bit data transfers; full-duplex or single-wire bidirectional; double-buffered transmit and receive; master or slave mode; MSB-first or LSB-first shifting.
- **SPI2** — Serial peripheral interface with full-duplex or single-wire bidirectional; Double-buffered transmit and receive; Master or Slave mode; MSB-first or LSB-first shifting.
- **IIC** — Up to 100 kbps with maximum bus loading; Multi-master operation; Programmable slave address; Interrupt driven byte-by-byte data transfer; supports broadcast mode and 11-bit addressing.
- **CMT** — Carrier Modulator timer for remote control communications. Carrier generator, modulator and driver for dedicated infrared out (IRO). Can be used as an output compare timer.
- **TPM**x — Two 4-channel Timer/PWM Module; Selectable input capture, output compare, or buffered edge- or center-aligned PWM on each channel; external clock input/pulse accumulator.
- **Mini-FlexBus** — Multi-function external bus interface with user programmable chip selects and the option to multiplex address and data lines.
- **PRACMP** — Analog comparator with selectable interrupt; compare option to programmable internal reference voltage; operation in stop3.

Measurement Engine
- **ADC16** — 16-bit successive approximation ADC with up to 4 dedicated differential channels and 8 single-ended channels; range compare function; 1.7 mV/×C temperature sensor; internal bandgap reference channel; operation in stop3; fully functional from 3.6 V to 1.8 V, Configurable hardware trigger for 8 Channel select and result registers.
- **PDB** — Programmable delay block with 16-bit counter and modulus and prescale to set reference clock to bus divided by 1 to bus divided by 2048; 8 trigger outputs for ADC module provides periodic coordination of ADC sampling sequence with sequence completion interrupt; Back-to-Back mode and Timed mode.
- **DAC** — 12-bit resolution DAC; configurable settling time.
- **OPAMPx** — 2 flexible operational amplifiers configurable for general operations; Low offset and temperature drift.
- **TRIAMPx** — 2 trans-impedance amplifiers dedicated for converting current inputs into voltages.

Input/Output
- Up to 68 GPIOs and 1 output-only pin.
- Voltage Reference output (VREFO).
- Dedicated infrared output pin (IRO)with high current sink capability.
- Up to 16 KBI pins with selectable polarity.
- Up to 16 pins of rapid general purpose I/O (RGPIO).

Energy Efficient Solutions optimized for low power

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The following table provides a cross-comparison of the features of the MCF51MM256/128 according to package.

4ABLE -&&&ATURESBY&AND0ACKAGE

&ATURE	-&				-&	
CI>PE Pfwb %_vqbp&	/3/.11				.0.-4/	
O>J Pfwb %_vqbp&	0/H				0/H	
Mfk Nr^kqfqv	.-1	.--	5.	5-	5.	5-
Moldo^ j j ^_ib >k^ild @l j m^o^qlo %MO>@JM&	vbp	vbp	vbp	vbp	vbp	vbp
Ab_rd Jlarib %A?D&	vbp	vbp	vbp	vbp	vbp	vbp
Jriqfmromlpb @il`h Dbkbo^qlo %J@D&	vbp	vbp	vbp	vbp	vbp	vbp
Fkqbo*Fkqbdo^qba @l j j rkf`^qflk %FF@&	vbp	vbp	vbp	vbp	vbp	vbp
Fkqboormq Obnrbpq Mfk %FON&	vbp	vbp	vbp	vbp	vbp	vbp
Hbv_l^oa Fkqboormq %H?F&	.3	.3	.3	.3	.3	.3
Afdfq^i Dbkbo^i Mromlpb F,L·	36	32	15	14	15	14
Abaf`^qba >k^ild Fkmrq Mfkp	.1	.1	.1	.1	.1	.1
Ml tbo ^ka Dolrka Mfkp	5	5	5	5	5	5
Qfjb Lc A^v %QLA&	vbp	vbp	vbp	vbp	vbp	vbp
Pbof^i @l j j rkf`^qflkp %P@F.&	vbp	vbp	vbp	vbp	vbp	vbp
Pbof^i @l j j rkf`^qflkp %P@F/&	vbp	vbp	vbp	vbp	vbp	vbp
Pbof^i Mbofmebo^i Fkqboc^`b %PMF.%CFCL&&	vbp	vbp	vbp	vbp	vbp	vbp
Pbof^i Mbofmebo^i Fkqboc^`b%PMF/&	vbp	vbp	vbp	vbp	vbp	vbp
@^oofbo Jlari^qlo Qfjbo Mfk %FOL&	vbp	vbp	vbp	vbp	vbp	vbp
QMJ Fkmrq @il`h Mfk %QMJ@IH&	vbp	vbp	vbp	vbp	vbp	vbp
QMJ. @e^kkbip	1	1	1	1	1	1
QMJ/ @e^kkbip	1	1	1	1	1	1
ULP@.	vbp	vbp	vbp	vbp	vbp	vbp
ULP@/	vbp	vbp	vbp	vbp	vbp	vbp
RP? Lk*qeb*Dl	vbp	vbp	vbp	vbp	vbp	vbp
Jfkf*Cibu?rp	vbp	vbp	A>Q>/	A>Q>/	A>Q>/	A>Q>/
O^mfa DMFL	.3	.3	6	6	6	6
JB>PROBJBKQ BKDFKB						
Moldo^ j j ^_ib Abi^v ?il`h %MA?&	vbp	vbp	vbp	vbp	vbp	vbp
.3*?fq P>O >A@ Afccbobkqf^i @e^kkbip0	1	1	1	1	1	1
.3*?fq P>O >A@ Pfkdib*Bkaba @e^kkbip	5	5	5	5	5	5
A>@ Lrmrq Mfk %A>@L&	vbp	vbp	vbp	vbp	vbp	vbp
Sliq^db Obcbobk`b Lrqmrq Mfk %SOBCL&	vbp	vbp	vbp	vbp	vbp	vbp
Dbkbo^i Mromlpb Lmbo^qflk^i > j mifcfbo %LM> JM&	vbp	vbp	vbp	vbp	vbp	vbp
Qo^kp*F jmba^k`b > j mifcfbo %QOF> JM&	vbp	vbp	vbp	vbp	vbp	vbp

· Mloq F,L `lrkq albp klq fk`irab ?IJP) ?HDA ^ka FON+ ?IJP ^ka ?HDA ^ob Lrqmrq lkiv) FON fp fkmrq lkiv+

/ Qeb 5-,5. mfk m^`h^dbp `lkq^fk qeb Jfkf*Cibu?rp a^q^ mfkp ql prmmloq ^k 5*_fq a^q^ _rp fkqboc^`b ql buqbok^i mbofmebo^ip+

0 B^`e afccbobkqf^i `e^kkbi fp `l j mofpba lc / mfk fkmrqp+

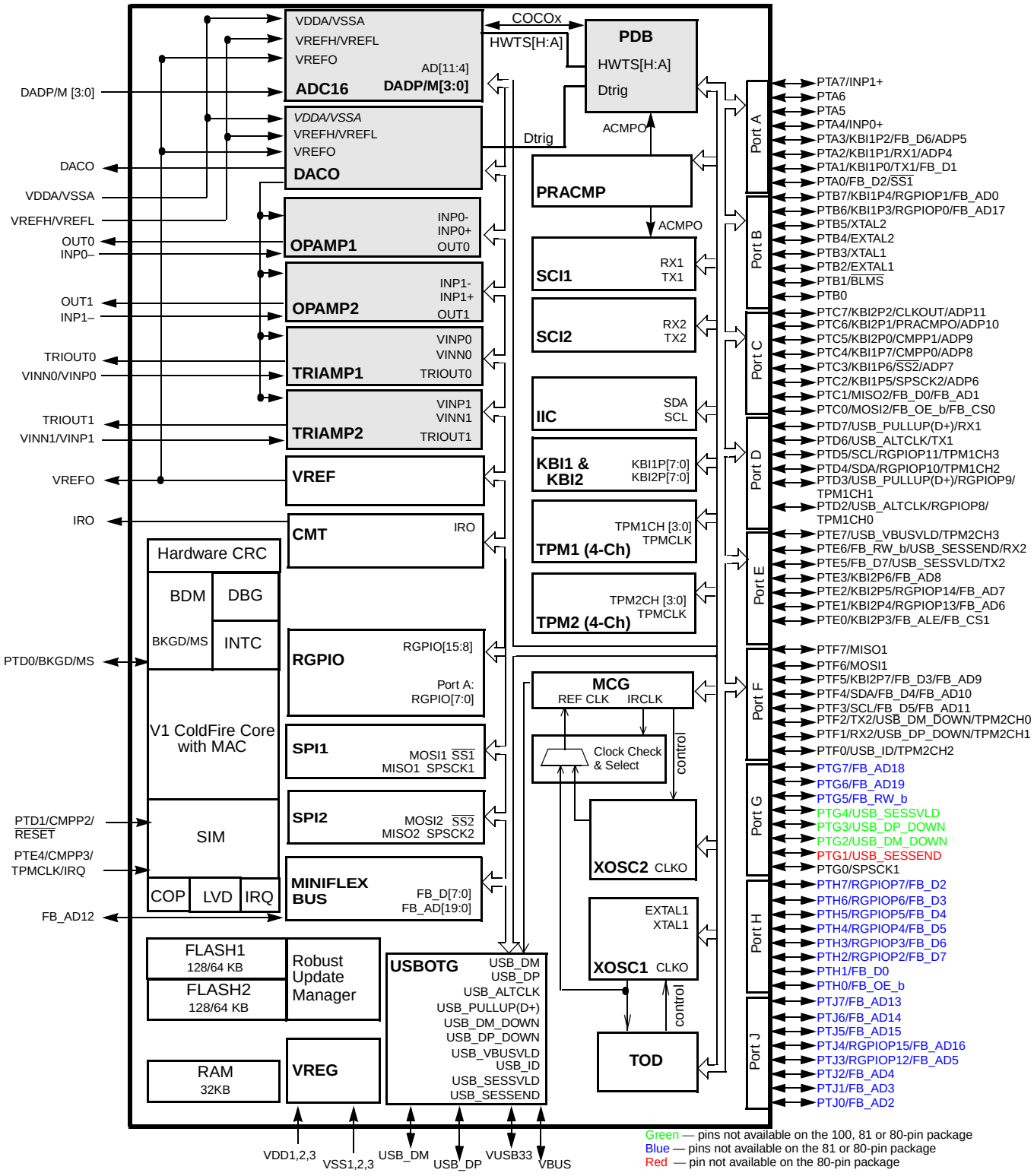

Figure 1. MCF51MM256 Series Block Diagram

The following table describes the functional units of the MCF51MM256/128.

4ABLE -&& &NCTIONAL5NITS

5NIT	&NCTION
Jb^prob j bkq Bkdfkb	A>@ %afdfq^i ql ^k^ild `lksboqbo& Æ Rpba ql lrqmrq sliq^db ibsbip+
	.3*?FQ P>O >A@ %^k^ild*ql*afdfq^i `lksboqbo& Æ Jb^probp ^k^ild sliq^dbp ^q rmql .3 _fqp lc obplirqflk+ Qeb >A@ e^p rmql clro afccbobkqf^i ^ka 5 pfkdib*bkaba fkmrqp+
	LM> JM Æ Dbkbo^i mromlpb lm ^ j m rpba clo pfdk^i cfiqbofkd lo ^ j mifcf`^qflk+
	QOF> JM Æ* Qo^kpf j mba^k`b ^ j mifcfbo lmqf j fwba clo `lksboqfkd p j ^ii `roobkqp fkql sliq^dbp+
	Jb^prob j bkq Bkdfkb MA? Æ Qeb j b^prob j bkq bkdfkb MA? fp rpba ql mob`fpbiv qofddbo qeb A>@ ^ka qeb >A@ j laribp ql `l j mibqb pbkplo _f^pfkd ^ka j b^profkd+
Jfkf*Cibu?rp	Molsfabp bum^kpflk `^m^_fifqv clo lcc*`efm j b j lov ^ka mbofmebo^ip+
RP? Lk*qeb*Dl	Prmmloqp qeb RP? Lk*qeb*Dl ar^i*olib `lkqoliibo+
@JQ %@^oofbo Jlari^qlo Qfjbo&	Fkco^oba lrqmrq rpba clo qeb Obj lqb @lkqoliibo lmbo^qflk+
J@D %Jriqfmromlpb @il`h Dbkbo^qlo&	Molsfabp `il`hfkd lmqflkp clo qeb absf`b) fk`irafkd ^ me^pb*il`hba illm %Mll& ^ka cobnrbk`v*il`hba illm %Cll& clo j riqfmivfkd pil tbo obcbobk`b `il`h plro`bp+
?AJ %?^`hdolrka Ab_rd Jlarib&	Molsfabp pfkdib mfk ab_rddfkd fkqboc^`b %m^oq lc qeb S. @liaCfob `lob&+
@C. @LOB %S. @liaCfob @lob&	Bub`rqbp moldo^ j p ^ka fkqboormq e^kaibop+
MO>@JM	>k^ild `l jm^o^qlop clo `l jm^ofkd buqbok^i ^k^ild pfdk^ip ^d^fkpq b^`e lqebo) lo ^ s^ofbqv lc obcbobk`b ibsbip+
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FON %Fkqboormq Obnrbpq&	Pfkdib*mfk efde*moflofqv fkqboormq %m^oq lc qeb S. @liaCfob `lob&+
@O@ %@v`if` Obarka^k`v @eb`h&	Efde*pmbba @O@ `^i`ri^qflk+
A?D %Ab_rd&	Molsfabp ab_rddfkd ^ka b j ri^qflk `^m^_fifqfbp %m^oq lc qeb S. @liaCfob+ `lob&
CI>PE %Ci^pe Jb j lov&	Molsfabp pqlo^db clo moldo^ j `lab) `lkpq^kqp) ^ka s^of^_ibp+
FF@ %Fkqbo*fkqbdo^qba @fo`rfqp&	Prmmloqp pq^ka^oa FF@ `l j jrkf`^qflkp molql`li ^ka PJ?rp+
FKQ@ %Fkqboormq @lkqoliibo&	@lkqolip ^ka moflofqfwbp ^ii absf`b fkqboormqp+
H?F. # H?F/	Hbv_l^oa Fkqboc^`bp . ^ka /+
ISA %llt*sliq^db Abqb`q&	Molsfabp ^k fkqboormqql qeb@liaCfob S. @LOB fk qeb bsbkq qe^q qeb prmmiv sliq^db aolmp _bilt ^ `ofqf`^is^irb+ Qeb ISA `^k ^ipl _b moldo^ j jba ql obpbq qeb absf`b rmlk ^ ilt sliq^db bsbkq+
SOBC %Sliq^db Obcbobk`b&	Qeb Sliq^db Obcbobk`b lrqmrq fp ^s^fi^_ib clo _lqe lk* ^ka lcc*`efm rpb+
O>J %O^kalj*>``bpp Jbjlov&	Molsfabp pq^`h ^ka s^of^_ib pqlo^db+
ODMFL %O^mfa Dbkbo^i*mromlpb Fkmrq,lrqmrq&	>iiltp clo F,L mloq ^``bpp ^q @MR `il`h pmbbap+ ODMFL fp rpba ql fjmibjbkq DMFL crk`qflk^ifqv+

Q^_ib /+ J@C2. J J /23,. /5 Crk`qflk^i Rkfqp %`lkqfkrba&

Rkfq	Crk`qflk
P@F.) P@F/ %Pbof^i @l j j rkf`^qflkp Fkqboc^``bp&	Pbof^i `l j j rkf`^qflkp R>OQp `^m^_ib lc prmmloqfkd OP*/0/ ^ka lFK molql`lip+
PFJ %pvpqb j fkqbdo^qflk rkfq&	
PMF. %CFCL&) PMF/ %Pbof^i Mbofmebo^i Fkqboc^``bp&	PMF. ^ka PMF/ molsfab pq^ka^oa j ^pqbo,pi^sb `^m^_fifqv+ PMF `lkq^fkp ^ CFCL _rccbo fk loabo ql fk`ob^pb qeb qeolrdemrq clo qefp mbofmebo^i+
QMJ.) QMJ/ %Qfjbo,MTJ Jlarib&	Qfjbo,MTJ jlarib `^k_brpba clo ^s^ofbqv lc dbkbof` qfjbo lmbo^qflkp ^p tbii ^p mripb*tfaqe jlari^qflk+
SOBD %Sliq^db Obdri^qlo&	@lkqolip mltbo j ^k^db jbkq ^`olpp qeb absf`b+
ULP@. ^ka ULP@/ %@ovpq^i Lp`fii^qlop&	Qebpb absf`bp fk`lomlo^qb obarka^kq `ovpq^i lp`fii^qlop+ Lkb fp fkqbkaba mofj ^ofiv clo rpb _v qeb QLA) ^ka qeb lqebo _v qeb @MR ^ka lqebo mbofmebo^ip+

/ Mfk l rqp ^ka Mfk >ppfdk j bkqp

/+. .-1*Mfk J>M?D>

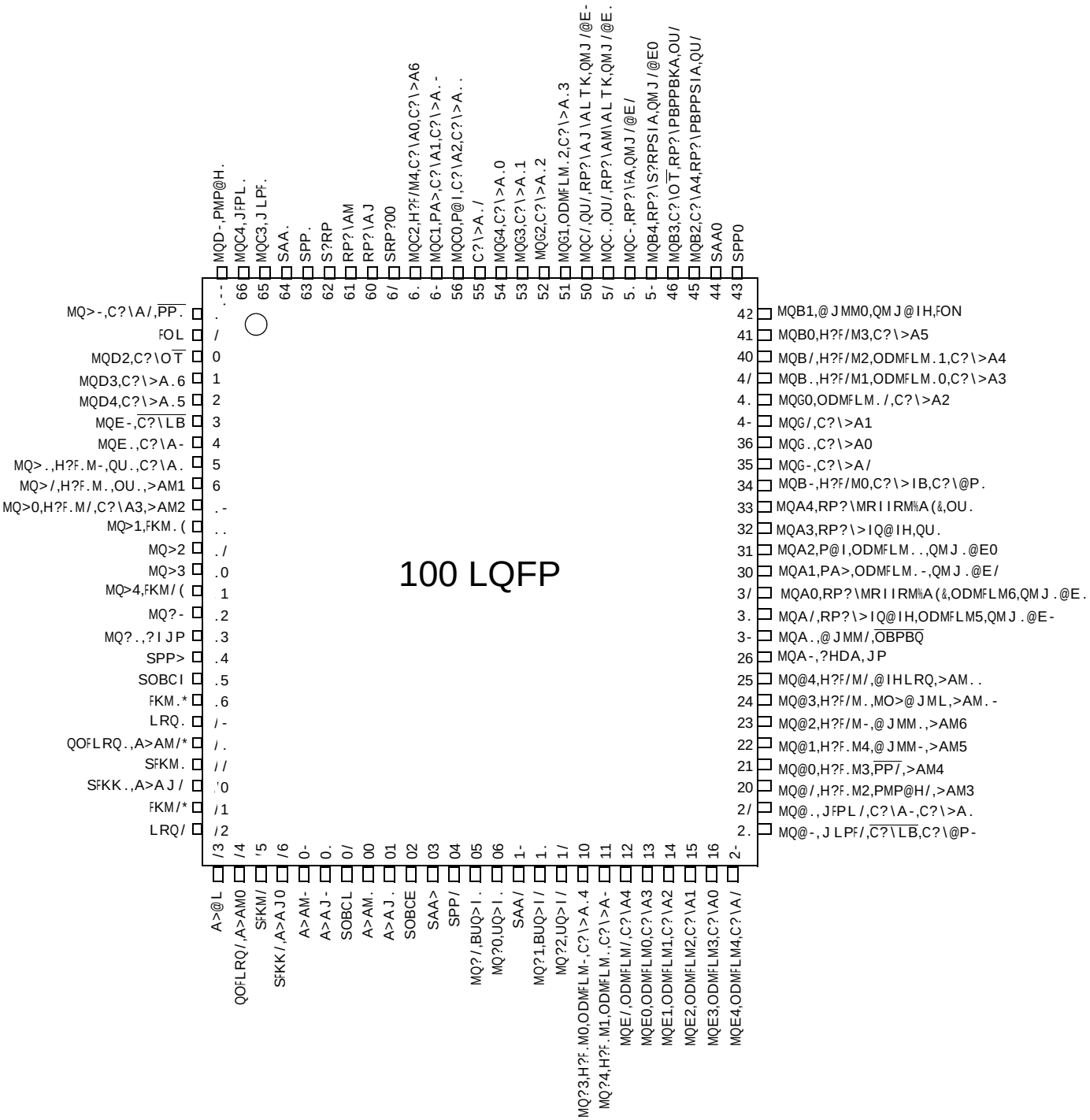
The following figure shows the 104-pin MAPBGA pinout configuration.

!	MQC3	MQC4	RP?\AM	RP?\AJ	SRP?00	MQC1	MQC0	C?\>A./	MQG4	MQG2	MQG1	>
?	MQD-	MQ>-	MQD0	S?RP	MQC2	MQG3	MQE-	MQB2	MQC-	MQC.	MQC/	?
@	FOL	MQD1	MQ>3	MQD/	MQD3	MQD2	MQD4	MQE.	MQB1	MQB3	MQB4	@
A	MQ>2	MQ>1	MQ?.	SAA.		SAA/		SAA0	MQ>.	MQB0	MQB/	A
B	SPP>	MQ>4	MQ?-						MQ>/	MQG0	MQB.	B
C	SOBCI	FKM.*	FKM/*	MQD.				MQ@4	MQG/	MQG-	MQG.	C
D	QOFLRQ.	LRQ.	LRQ/						MQA2	MQA4	MQB-	D
E	SFKM.	SFKK.	MQ>0	SPP.		SPP/		SPP0	MQA1	MQA0	MQA/	E
G	A>AM-	A>AJ-	MQE4	MQE3	MQE1	MQE0	MQE/	MQA3	MQ@/	MQ@-	MQ@.	G
H	SFKM/	SFKK/	A>AM.	MQE2	MQ?3	MQ?4	MQ@0	MQA.	MQ@1	MQ@2	MQ@3	H
I	QOFLRQ/	A>@L	A>AJ.	SOBCL	SOBCE	SAA>	MQ?0	MQ?/	MQA-	MQ?2	MQ?1	I
	.	/	0	1	2	3	4	5	6	.-	..	

Cfdrob /+.-1*Mfk J>M?D>

/+/ .--*Mfk INCM

The following figure shows the 100-pin LQFP pinout configuration.



&GURE 0IN,18&

/+0 5.*Mfk J>M?D>

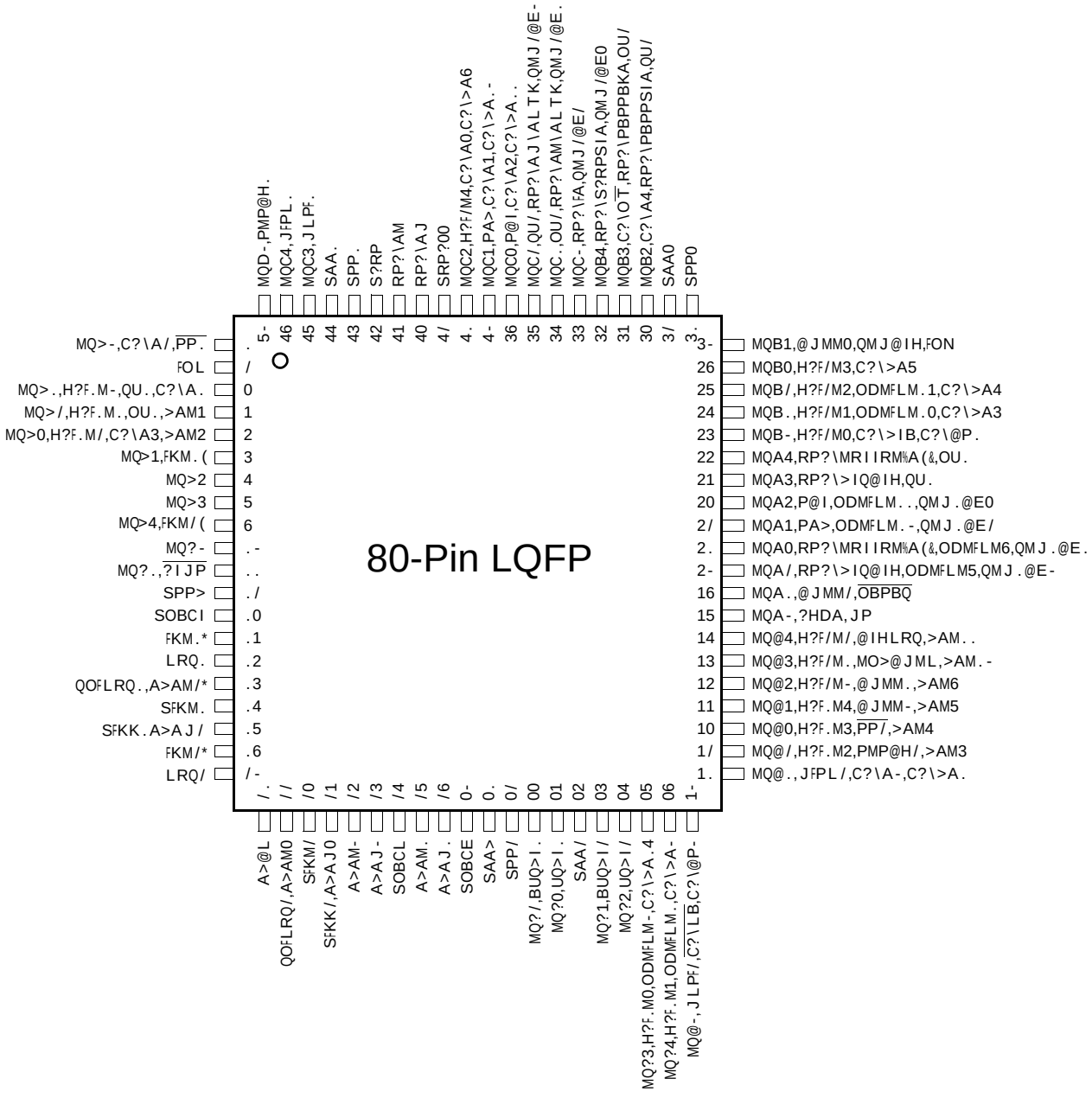
The following figure shows the 81-pin MAPBGA pinout configuration.

!	FOL	MQD-	MQC3	RP?\AM	S?RP	SRP?00	MQC1	MQC0	MQB1	>
?	MQC4	MQ>-	MQD.	RP?\AJ	MQC2	MQB4	MQC.	MQC-	MQB0	?
@	MQ>1	MQ>2	MQ>3	MQ>.	MQC/	MQB3	MQB2	MQB/	MQB.	@
A	FKM.*	MQ>4	MQ?-	MQ?.	MQ>/	MQ>0	MQA2	MQA4	MQB-	A
B	LRQ.	SFKK.	LRQ/	SAA/	SAA0	SAA.	MQA/	MQA0	MQA3	B
C	SFKM.	QOFLRQ.	FKM/*	SPP/	SPP0	SPP.	MQ?4	MQ@4	MQA1	C
D	A>AM-	A>@L	QOFLRQ/	SFKK/	SOBCL	MQ?3	MQ@-	MQ@.	MQ@/	D
E	A>AJ-	A>AJ.	A>AM.	SFKM/	MQ@0	MQ@1	MQA-	MQ@2	MQ@3	E
G	SPP>	SOBCI	SOBCE	SAA>	MQ?/	MQ?0	MQA.	MQ?1	MQ?2	G
	.	/	0	1	2	3	4	5	6	

Cfdr0b 1+ 5.*Mfk J>M?D>

/+1 5-*Mfk INCM

The following figure shows the 80-pin LQFP pinout configuration.



8GURE 0IN,18&

/+2 Mfk >ppfdk j bkqp

Q^_ib 0+ M^`h^db Mfk >ppfdk j bkqp

M^`h^db				Abc^riq Crk`qflk	>iqbok^qb .	>iqbok^qb /	>iqbok^qb 0	@l j mlpfqb Mfk K^ j b
.-1 J>M?D>	.-- INCM	5. J>M?D>	5- INCM					
?/	.	?/	.	MQ>-	C?\A/	PP.	Æ	MQ>-,C?\A/,PP.
@.	/	>.	/	FOL	Æ	Æ	Æ	FOL
@3	0	Æ	Æ	MQD2	C?\OT	Æ	Æ	MQD2,C?\OT
@2	1	Æ	Æ	MQD3	C?\>A.6	Æ	Æ	MQD3,C?\>A.6
@4	2	Æ	Æ	MQD4	C?\>A.5	Æ	Æ	MQD4,C?\>A.5
?4	3	Æ	Æ	MQE-	C?\LB	Æ	Æ	MQE-,C?\LB
@5	4	Æ	Æ	MQE.	C?\A-	Æ	Æ	MQE.,C?\A-
A6	5	@1	0	MQ>.	H?F.M-	QU.	C?\A.	MQ>.,H?F.M-,QU.,C?\A.
B6	6	A2	1	MQ>/	H?F.M.	OU.	>AM1	MQ>/,H?F.M.,OU.,>AM1
E0	.-	A3	2	MQ>0	H?F.M/	C?\A3	>AM2	MQ>0,H?F.M/,C?\A3,>AM2
A/	..	@.	3	MQ>1	FKM.(	Æ	Æ	MQ>1,FKM.(
A.	./	@/	4	MQ>2	Æ	Æ	Æ	MQ>2
@0	.0	@0	5	MQ>3	Æ	Æ	Æ	MQ>3
B/	.1	A/	6	MQ>4	FKM/(	Æ	Æ	MQ>4,FKM/(
B0	.2	A0	.-	MQ?-	Æ	Æ	Æ	MQ?-
A0	.3	A1	..	MQ?.	?IJP	Æ	Æ	MQ?.,?IJP
B.	.4	G.	./	SPP>	Æ	Æ	Æ	SPP>
C.	.5	G/	.0	SOBCI	Æ	Æ	Æ	SOBCI
C/	.6	A.	.1	FKM.*	Æ	Æ	Æ	FKM.*
D/	/-	B.	.2	LRQ.	Æ	Æ	Æ	LRQ.
D.	/.	C/	.3	A>AM/	QOFLRQ.	Æ	Æ	A>AM/,QOFLRQ.
E.	//	C.	.4	SFKM.	Æ	Æ	Æ	SFKM.
E/	/0	B/	.5	A>AJ/	SFKK.	Æ	Æ	A>AJ/,SFKK.
C0	/1	C0	.6	FKM/*	Æ	Æ	Æ	FKM/*
D0	/2	B0	/-	LRQ/	Æ	Æ	Æ	LRQ/
I/	/3	D/	/.	A>@L	Æ	Æ	Æ	A>@L
I.	/4	D0	//	A>AM0	QOFLRQ/	Æ	Æ	A>AM0,QOFLRQ/
H.	/5	E1	/0	SFKM/	Æ	Æ	Æ	SFKM/
H/	/6	D1	/1	A>AJ0	SFKK/	Æ	Æ	A>AJ0,SFKK/

Q^_ib 0+ M^`h^db Mfk >ppfdk j bkq p %`lkqfkrba&

M^`h^db				Abc^riq Crk`qflk	>iqbok^qb .	>iqbok^qb /	>iqbok^qb 0	@l j mlpfqb Mfk K^ j b
.-1 J>M?D>	.-- INCM	5. J>M?D>	5- INCM					
G.	0-	D.	/2	A>AM-	Æ	Æ	Æ	A>AM-
G/	0.	E.	/3	A>AJ-	Æ	Æ	Æ	A>AJ-
I1	0/	D2	/4	SOBCL	Æ	Æ	Æ	SOBCL
H0	00	E0	/5	A>AM.	Æ	Æ	Æ	A>AM.
I0	01	E/	/6	A>AJ.	Æ	Æ	Æ	A>AJ.
I2	02	G0	0-	SOBCE	Æ	Æ	Æ	SOBCE
I3	03	G1	0.	SAA>	Æ	Æ	Æ	SAA>
E3	04	C1	0/	SPP/	Æ	Æ	Æ	SPP/
I5	05	G2	00	MQ?/	BUQ>I.	Æ	Æ	MQ?/,BUQ>I.
I4	06	G3	01	MQ?0	UQ>I.	Æ	Æ	MQ?0,UQ>I.
A3	1-	B1	02	SAA/	Æ	Æ	Æ	SAA/
I..	1.	G5	03	MQ?1	BUQ>I/	Æ	Æ	MQ?1,BUQ>I/
I.-	1/	G6	04	MQ?2	UQ>I/	Æ	Æ	MQ?2,UQ>I/
H2	10	D3	05	MQ?3	H?F.M0	ODMFLM-	C?\>A.4	MQ?3,H?F.M0,ODMFLM-,C?\>A.4
H3	11	C4	06	MQ?4	H?F.M1	ODMFLM.	C?\>A-	MQ?4,H?F.M1,ODMFLM.,C?\>A-
G4	12	Æ	Æ	MQE/	ODMFLM/	C?\A4	Æ	MQE/,ODMFLM/,C?\A4
G3	13	Æ	Æ	MQE0	ODMFLM0	C?\A3	Æ	MQE0,ODMFLM0,C?\A3
G2	14	Æ	Æ	MQE1	ODMFLM1	C?\A2	Æ	MQE1,ODMFLM1,C?\A2
H1	15	Æ	Æ	MQE2	ODMFLM2	C?\A1	Æ	MQE2,ODMFLM2,C?\A1
G1	16	Æ	Æ	MQE3	ODMFLM3	C?\A0	Æ	MQE3,ODMFLM3,C?\A0
G0	2-	Æ	Æ	MQE4	ODMFLM4	C?\A/	Æ	MQE4,ODMFLM4,C?\A/
G.-	2.	D4	1-	MQ@-	JLPF/	C?\LB	C?\@P-	MQ@-,JLPF/,C?\LB,C?\@P-
G..	2/	D5	1.	MQ@.	JFPL/	C?\A-	C?\>A.	MQ@.,JFPL/,C?\A-,C?\>A.
G6	20	D6	1/	MQ@/	H?F.M2	PMP@H/	>AM3	MQ@/,H?F.M2,PMP@H/,>AM3
H4	21	E2	10	MQ@0	H?F.M3	PP/	>AM4	MQ@0,H?F.M3,PP/,>AM4
H6	22	E3	11	MQ@1	H?F.M4	@JMM-	>AM5	MQ@1,H?F.M4,@JMM-,>AM5
H.-	23	E5	12	MQ@2	H?F/M-	@JMM.	>AM6	MQ@2,H?F/M-,@JMM.,>AM6
H..	24	E6	13	MQ@3	H?F/M.	MO>@JML	>AM.-	MQ@3,H?F/M.,MO>@JML,>AM.-
C5	25	C5	14	MQ@4	H?F/M/	@IHLRQ	>AM..	MQ@4,H?F/M/,@IHLRQ,>AM..
I6	26	E4	15	MQA-	?HDA	JP	Æ	MQA-,?HDA,JP
H5	3-	G4	16	MQA.	@JMM/	OBPBQ	Æ	MQA.,@JMM/,OBPBQ

Q^_ib 0+ M^`h^db Mfk >ppfdk j bkq p %`lkqfkrba&

M^`h^db				Abc^riq Crk`qflk	>iqbok^qb .	>iqbok^qb /	>iqbok^qb 0	@l j mlpfqb Mfk K^ j b
.-1 J>M?D>	.-- INCM	5. J>M?D>	5- INCM					
E..	3.	B4	2-	MQA/	RP?\>IQ@IH	ODMFLM5	QMJ.@E-	MQA/,RP?\>IQ@IH,ODMFLM5,QMJ.@E-
E.-	3/	B5	2.	MQA0	RP?\MRIIRM %A(&	ODMFLM6	QMJ.@E.	MQA0,RP?\MRIIRM%A(&,ODMFLM6,QMJ.@E.
E6	30	C6	2/	MQA1	PA>	ODMFLM.-	QMJ.@E/	MQA1,PA>,ODMFLM.-,QMJ.@E/
D6	31	A4	20	MQA2	P@I	ODMFLM..	QMJ.@E0	MQA2,P@I,ODMFLM..,QMJ.@E0
G5	32	B6	21	MQA3	RP?\>IQ@IH	QU.	Æ	MQA3,RP?\>IQ@IH,QU.
D.-	33	A5	22	MQA4	RP?\MRIIRM %A(&	OU.	Æ	MQA4,RP?\MRIIRM%A(&,OU.
D..	34	A6	23	MQB-	H?F/M0	C?\>IB	C?\@P.	MQB-,H?F/M0,C?\>IB,C?\@P.
C.-	35	Æ	Æ	MQG-	C?\>A/	Æ	Æ	MQG-,C?\>A/
C..	36	Æ	Æ	MQG.	C?\>A0	Æ	Æ	MQG.,C?\>A0
C6	4-	Æ	Æ	MQG/	C?\>A1	Æ	Æ	MQG/,C?\>A1
B.-	4.	Æ	Æ	MQG0	ODMFLM./	C?\>A2	Æ	MQG0,ODMFLM./,C?\>A2
B..	4/	@6	24	MQB.	H?F/M1	ODMFLM.0	C?\>A3	MQB.,H?F/M1,ODMFLM.0,C?\>A3
A..	40	@5	25	MQB/	H?F/M2	ODMFLM.1	C?\>A4	MQB/,H?F/M2,ODMFLM.1,C?\>A4
A.-	41	?6	26	MQB0	H?F/M3	C?\>A5	Æ	MQB0,H?F/M3,C?\>A5
@6	42	>6	3-	MQB1	@JMM0	QMJ@IH	FON	MQB1,@JMM0,QMJ@IH,FON
E5	43	C2	3.	SPP0	Æ	Æ	Æ	SPP0
A5	44	B2	3/	SAA0	Æ	Æ	Æ	SAA0
?5	45	@4	30	MQB2	C?\A4	RP?\ PBPPSIA	QU/	MQB2,C?\A4,RP?\PBPPSIA,QU/
@.-	46	@3	31	MQB3	C?\$\overline{OT}$	RP?\ PBPPBKA	OU/	MQB3,C?\$\overline{OT}$,RP?\PBPPBKA,OU/
@..	5-	?3	32	MQB4	RP?\ S?RPSIA	QMJ/@E0	Æ	MQB4,RP?\S?RPSIA,QMJ/@E0
?6	5.	?5	33	MQC-	RP?\FA	QMJ/@E/	Æ	MQC-,RP?\FA,QMJ/@E/
?.-	5/	?4	34	MQC.	OU/	RP?\AM\A LTK	QMJ/@E.	MQC.,OU/,RP?\AM\ALTK,QMJ/@E.
?..	50	@2	35	MQC/	QU/	RP?\AJ\ ALTK	QMJ/@E-	MQC/,QU/,RP?\AJ\ALTK,QMJ/@E-
>..	51	Æ	Æ	MQG1	ODMFLM.2	C?\>A.3	Æ	MQG1,ODMFLM.2,C?\>A.3
>.-	52	Æ	Æ	MQG2	C?\>A.2	Æ	Æ	MQG2,C?\>A.2
?3	53	Æ	Æ	MQG3	C?\>A.1	Æ	Æ	MQG3,C?\>A.1
>6	54	Æ	Æ	MQG4	C?\>A.0	Æ	Æ	MQG4,C?\>A.0

Q^_ib 0+ M^`h^db Mfk >ppfdk j bkq p %`lkqfkrba&

M^`h^db				Abc^riq Crk`qflk	>iqbok^qb .	>iqbok^qb /	>iqbok^qb 0	@l j mlpfqb Mfk K^ j b
.-1 J>M?D>	.-- INCM	5. J>M?D>	5- INCM					
>5	55	Æ	Æ	C?\>A./	Æ	Æ	Æ	C?\>A./
>4	56	>5	36	MQC0	P@I	C?\A2	C?\>A..	MQC0,P@I,C?\A2,C?\>A..
>3	6-	>4	4-	MQC1	PA>	C?\A1	C?\>A.-	MQC1,PA>,C?\A1,C?\>A.-
?2	6.	?2	4.	MQC2	H?F/M4	C?\A0	C?\>A6	MQC2,H?F/M4,C?\A0,C?\>A6
>2	6/	>3	4/	SRP?00	Æ	Æ	Æ	SRP?00
>1	60	?1	40	RP?\AJ	Æ	Æ	Æ	RP?\AJ
>0	61	>1	41	RP?\AM	Æ	Æ	Æ	RP?\AM
?1	62	>2	42	S?RP	Æ	Æ	Æ	S?RP
E1	63	C3	43	SPP.	Æ	Æ	Æ	SPP.
A1	64	B3	44	SAA.	Æ	Æ	Æ	SAA.
>.	65	>0	45	MQC3	JLPF.	Æ	Æ	MQC3,JLPF.
>/	66	?.	46	MQC4	JFPL.	Æ	Æ	MQC4,JFPL.
?.	.--	>/	5-	MQD-	PMP@H.	Æ	Æ	MQD-,PMP@H.
C1	Æ	>.	Æ	MQD.	RP?\ PBPPBKA	Æ	Æ	MQD.,RP?\PBPPBKA
@1	Æ	Æ	Æ	MQD/	RP?\AJ\ ALTK	Æ	Æ	MQD/,RP?\AJ\ALTK
?0	Æ	Æ	Æ	MQD0	RP?\AM\ ALTK	Æ	Æ	MQD0,RP?\AM\ALTK
@/	Æ	Æ	Æ	MQD1	RP?\PBPPSIA	Æ	Æ	MQD1,RP?\PBPPSIA

0 Bib`qof`^i @e^o^`qbofpqf`p

This section contains electrical specification tables and reference timing diagrams for the MCF51MM256/128 microcontroller, including detailed information on power considerations, DC/AC electrical characteristics, and AC timing specifications.

The electrical specifications are preliminary and are from previous designs or design simulations. These specifications may not be fully tested or guaranteed at this early stage of the product life cycle. These specifications will, however, be met for production silicon. Finalized specifications will be published after complete characterization and device qualifications have been completed.

./4%

The parameters specified in this data sheet supersede any values found in the module specifications.

0ARAMETER#LASSIFICATION

The electrical parameters shown in this supplement are guaranteed by various methods. To give the customer a better understanding, the following classification is used and the parameters are tagged accordingly in the tables where appropriate:

4ABLE 0ARAMETER#LASSIFICATIONS

0	Qelpb m^o^ j bqbop ^ob dr^o^kqbba arofkd molar`qflk qbpqfkd lk b^`e fkafsfar^i absf`b+
@	Qelpb m^o^ j bqbop ^ob ^`efbsba _v qeb abpfdk `e^o^`qbofw^qflk _v j b^profkd ^ pq^qfpqf`^iiv obibs^kq p^ j mib pfwb ^`olpp mol`bpp s^of^qflkp+
Q	Qelpb m^o^ j bqbop ^ob ^`efbsba _v abpfdk `e^o^`qbofw^qflk lk ^ p j ^ii p^ j mib pfwb colj qvmf`^i absf`bp rkabo qvmf`^i `lkafqflkp rkibpp lqebo tfpb klqba+ >ii s^irbp pelt k fk qeb qvmf`^i `lir j k ^ob tfqefk qefp `^qbdlov+
A	Qelpb m^o^ j bqbop ^ob abofsba j ^fkiv colj pf j ri^qflkp+

./4%

The classification is shown in the column labeled “C” in the parameter tables where appropriate.

0+/ >_plirqb J^ufjrj O^qfkdp

Absolute maximum ratings are stress ratings only, and functional operation at the maxima is not guaranteed. Stress beyond the limits specified in the following table may affect device reliability or cause permanent damage to the device. For functional operating conditions, refer to the remaining tables in this section.

4ABIE ! BSOLUTE AK MUM2 ATINGS

	2ATING	3MBOL	6ALUE	5NIT
.	Prmmivsliq^db	S_{AA}	¬-+0ql (0+5	S
/	J^ufjrj `roobkqfkql S_{AA}	F_{AA}	./-	j >
0	Afdfq^ifkmrqsliq^db	S_{Fk}	¬-+0ql S_{AA} (-+0	S
1	Fkpq^kq^kblrp j^ufjrj `roobkq Pfkdibmfk if jfq%^mmifbpql ^iimloqmfkp&·)/)0	F_A	°/2	j >
2	Pqlo^dbqbjmbo^qrobo^kdb	Q_{pqd}	¬22ql .2-	¯@

1 Input must be current limited to the value specified. To determine the value of the required current-limiting resistor, calculate resistance values for positive (V_{DD}) and negative (V_{SS}) clamp voltages, then use the larger of the two resistance values.

2 All functional non-supply pins are internally clamped to V_{SS} and V_{DD}.

3 Power supply must maintain regulation within operating V_{DD} range during instantaneous and operating maximum current conditions. If positive injection current ($V_{In} > V_{DD}$) is greater than I_{DD}, the injection current may flow out of V_{DD} and could result in external power supply going out of regulation. Ensure external V_{DD} load will shunt current greater than maximum injection current. This will be the greatest risk when the MCU is not consuming power. Examples are: if no system clock is present, or if the clock rate is very low (which would reduce overall power consumption).

This device contains circuitry protecting against damage due to high static voltage or electrical fields; however, it is advised that normal precautions be taken to avoid application of any voltages higher than maximum-rated voltages to this high-impedance circuit. Reliability of operation is enhanced if unused inputs are tied to an appropriate logic voltage level (for instance, either V_{SS} or V_{DD}).

0+0 Qebo j ^i @e^o^`qbofpqf`p

This section provides information about operating temperature range, power dissipation, and package thermal resistance. Power dissipation on I/O pins is usually small compared to the power dissipation in on-chip logic and it is user-determined rather than being controlled by the MCU design. In order to take $P_{I/O}$ into account in power calculations, determine the difference between actual pin voltage and V_{SS} or V_{DD} and multiply by the pin current for each I/O pin. Except in cases of unusually high pin current (heavy loads), the difference between pin voltage and V_{SS} or V_{DD} will be very small.

4ABLE 4HERMAL#HARACTERISTICS

	3YMBOL	2ATING	6ALUE	5NIT
.	Q>	Lmbo^qfkd qb j mbo^qrob o^kdb %m^`h^dba&7		¯@
		J@C2.JJ/23	¬1-ql.-2	
		J@C2.JJ./5	¬1-ql.-2	
/	QGJ>U	J^uf j r j grk`qflk qb j mbo^qrob	.02	¯@
0	qG>	Qebo j ^i obpfpq^k`b·)/)0)1 Pfkdib*i^vbo _l^oa Æ .p		¯@,T
		.-1*mfk J?D>	34	
		.--*mfk INCM	20	
		5.*mfk J?D>	34	
		5-*mfk INCM	20	
1	qG>	Qebo j ^i obpfpq^k`b·) /) 0) 1 Clro*i^vbo _l^oa Æ /p/m		¯@,T
		.-1*mfk J?D>	06	
		.--*mfk INCM	1.	
		5.*mfk J?D>	06	
		5-*mfk INCM	06	

· Grk`qflk qb j mbo^qrob fp ^ crk`qflk lc afb pfwb) lk*`efm ml tbo afppfm^qflk) m^`h^db qebo j ^i obpfpq^k`b) j lrkqfkd pfqb %_l^oa& qb j mbo^qrob) ^ j _fbkq qb j mbo^qrob) ^focil t) ml tbo afppfm^qflk lc lqebo `l j mlkbkqp lk qeb_l^oa) ^ka _l^oa qebo j ^i obpfpq^k`b+

/ Grk`qflk ql > j _fbkq K^qro^i @lksb`qflk

0 .p Æ Pfkdib i^vbo _l^oa) lkb pfdk^i i^vbo

1 /p/m Æ Clro i^vbo _l^oa) / pfdk^i ^ka / ml tbo i^vbop

The average chip-junction temperature (T_J) in qC can be obtained from:

$$4*4 \quad !\ 0 \quad \$\ u\ T_{\text{!}*} \qquad \textit{Eqn. 1}$$

where:

T_A = Ambient temperature, qC

T_{JA} = Package thermal resistance, junction-to-ambient, qC/W

$P_D = P_{int} \quad P_{I/O}$

$P_{int} = I_{DD}$ u V_{DD}, Watts — chip internal power

$P_{I/O}$ = Power dissipation on input and output pins — user determined

For most applications, $P_{I/O}$ P_{int} and can be neglected. An approximate relationship between P_D and T_J (if $P_{I/O}$ is neglected) is:

0 $ +y 4 * q# **Eqn. 2**

Solving Equation 1 and Equation 2 for K gives:

+0 $ u4 ! q # T* u0 $ **Eqn. 3**

where K is a constant pertaining to the particular part. K can be determined from Equation 3 by measuring P_D (at equilibrium) for a known T_A. Using this value of K, the values of P_D and T_J can be obtained by solving Equation 1 and Equation 2 iteratively for any value of T_A.

98ROTECTION#HARACTERISTICS

Although damage from static discharge is much less common on these devices than on early CMOS circuits, normal handling precautions should be used to avoid exposure to static discharge. Qualification tests are performed to ensure that these devices can withstand exposure to reasonable levels of static without suffering any permanent damage.

All ESD testing is in conformity with CDF-AEC-Q00 Stress Test Qualification for Automotive Grade Integrated Circuits. (http://www.aecouncil.com/) This device was qualified to AEC-Q100 Rev E.

A device is considered to have failed if, after exposure to ESD pulses, the device no longer meets the device specification requirements. Complete dc parametric and functional testing is performed per the applicable device specification at room temperature followed by hot temperature, unless specified otherwise in the device specification.

4ABLE 98AND,ATCHUP4EST#ONDITIONS

-ODEL	$ESCRIPTION	3YMBOL	6ALUE	5NIT
Er j ^k ?lav	Pbofbp Obpfpq^k`b	O.	.2--	W
	Pqlo^db @^m^`fq^k`b	@	.--	mC
	Kr j _bo lc Mripb mbo mfk	Æ	0	Æ
J^`efkb	Pbofbp Obpfpq^k`b	O.	-	W
	Pqlo^db @^m^`fq^k`b	@	/--	mC
	Kr j _bo lc Mripb mbo mfk	Æ	0	Æ
l^q`e*rm	Jfkf j r j fkmrq sliq^db if j fq	Æ	¬/+2	S
	J^uf j r j fkmrq sliq^db if j fq	Æ	4+2	S

Q^_ib 5+ BPA ^ka l^q`e*Rm Molqb`qflk @e^o^` qbofpqf`p

	O^qfkd	Pv j _li	Jfk	J^u	Rkfq	@
.	Er j ^k ?lav J labi %E? J&	$S_{E?J}$	°/---	Æ	S	T
/	J^`efkb J labi %J J&	S_{JJ}	°/--	Æ	S	T

4ABLE 3% AND,ATCH5P0ROTECTION#HARA CTERISTICS CONTINUED

0	@e^odb Absf`b J labi %@A J&	$S_{@AJ}$	°2--	Æ	S	T
1	l^q`e*rm @roobkq ^q Q> : ./2¯@	$F_{I>Q}$	°1--	Æ	j >	T

0+2 A@ @e^o^`qbofpqf`p

This section includes information about power supply requirements, I/O pin characteristics, and power supply current in various operating modes.

4ABLE #HARACTERISTICS

.UM	3MBOL	#HARACTERISTIC	#ONDITION	-IN	4YP	-AX	5NIT	#
.	Æ	Lmbo^qfkd Sliq^db	Æ	.+5/	Æ	0+3	S	Æ
/	S_{LE}	Lrqmrq efde sliq^db	>ii F,L mfkp) il t *aofsb pqobkdqe					
			S_{AA} ² .+5 S) F_{ll^a} : ¬3- - m>	S_{AA} ¬ -+2	Æ	Æ	S	@
			>ii F,L mfkp) efde*aofsb pqobkdqe					
			S_{AA} ² /+4 S) F_{ll^a} : ¬. - j >	S_{AA} ¬ -+2	Æ	Æ	S	M
			S_{AA} ² /+0 S) F_{ll^a} : ¬3 j >	S_{AA} ¬ -+2	Æ	Æ	S	Q
			S_{AA} ² .+5S) F_{ll^a} : ¬0 j >	S_{AA} ¬ -+2	Æ	Æ	S	@
0	F_{LEQ}	Lrqmrq efde `roobkq	J^u qlq^i F_{LE} clo ^ii mloqp					
			Æ	Æ	Æ	. - -	j >	A
1	S_{LI}	Lrqmrq il t sliq^db	>ii F,L mfkp) il t *aofsb pqobkdqe					
			S_{AA} ² .+5 S) F_{ll^a} : 3- - m>	Æ	Æ	-+2	S	@
			>ii F,L mfkp) efde*aofsb pqobkdqe					
			S_{AA} ² /+4 S) F_{ll^a} : . - j >	Æ	Æ	-+2	S	M
			S_{AA} ² /+0 S) F_{ll^a} : 3 j >	Æ	Æ	-+2	S	Q
			S_{AA} ² .+5 S) F_{ll^a} : 0 j >	Æ	Æ	-+2	S	@
2	F_{LIQ}	Lrqmrq il t `roobkq	J^u qlq^i F_{LI} clo ^ii mloqp	Æ	Æ	Æ	. - -	j >	A
3	S_{FE}	Fkmrq efde sliq^db ^ii afdfq^i fkmrqp						
			S_{AA} > /+4 S	-+4- u S_{AA}	Æ	Æ	S	M
			S_{AA} > .+5 S	-+52 u S_{AA}	Æ	Æ	S	@

Q^_ib 6+ A@ @e^o^``qbofpqf`p %`lk qfkrba&

Krj	Pvj_li	@e^o^``qbofpqf`	@lkafqflk	Jfk	Qvm ·	J^u	Rkfq	@
4	S_{Fl}	Fkmrq il t sliq^db ^ii afdfq^i fkmrqp						
			S_{AA} > /+4 S	Æ	Æ	-+02 u S_{AA}	S	M
			S_{AA} >.+5 S	Æ	Æ	-+0- u S_{AA}	S	@
5	S_{evp}	Fkmrq evpqbobpfp ^ii afdfq^i fkmrqp	Æ	-+-3 u S_{AA}	Æ	Æ	j S	@
6	y_{FFky}	Fkmrq ib^h^db `roobkq ^ii fkmrq lkiv mfkp %Mbo mfk&	S_{Fk} : S_{AA} lo S_{PP}	Æ	Æ	-+2	m>	M
.-	y_{FLWy}	Ef*W %lcc*pq^qb& ib^h^db `roobkq[0] ^ii afdfq^i fkmrq,lrqmrq %mbo mfk&	S_{Fk} : S_{AA} lo S_{PP}	Æ	-+--0	-+2	m>	M
..	O_{MR}	Mrii*rm obpfpqlop ^ii afdfq^i fkmrqp) tebk bk^_iba	Æ	.4+2	Æ	2/+2	hW	M
./	O_{MA}	Fkqbok^i mrii*alt k obpfpqlop[1]	Æ	.4+2	Æ	2/+2	hW	M
.0	$F_{F@}$	A@ fkgb`qflk `roobkq[2) 3) 4] Pfkdib mfk if j fq						
			S_{PP} ; S_{FK} ; S_{AA}	¬-+/	Æ	-+/	j >	A
		Qlq^i J@R if j fq) fk`irabp pr j lc ^ii pqobppba mfkp						
			S_{PP} ; S_{FK} ; S_{AA}	¬2	Æ	2	j >	A
.1	$@_{Fk}$	Fkmrq @^m^``fq^k`b) ^ii mfkp	Æ	Æ	Æ	5	mC	@
.2	$S_{O>J}$ O>J obqbkqflk sliq^db		Æ	Æ	-+3	.+-	S	@
.3	S_{MLO}	MLO ob*^o j sliq^db[5]	Æ	-+6	.+1	.+46	S	@
.4	q_{MLO}	MLO ob*^o j qf j b	Æ	.-	Æ	Æ	mp	A
.5	S_{ISAE}[6]	Ilt*sliq^db abqb`qflk qeobpelia Æ efde o^kdb S_{AA} c^iifkd						
			Æ	/+..	/+.3	/+//	S	M
		S_{AA} ofpfkd						
			Æ	/+.3	/+/.	/+/4	S	M
.6	S_{ISAI}	Ilt*sliq^db abqb`qflk qeobpelia Æ ilt o^kdb[6] S_{AA} c^iifkd						
			Æ	.+5-	.+5/	.+6.	S	M
		S_{AA} ofpfkd						
			Æ	.+53	.+6-	.+66	S	M

4ABLE ##HARACTERISTICSCON TNUED

.UM	3MBOL	##HARACTERISTIC	#ONDITION	-IN	4YP	-AX	5NIT	#
/ -	S_{ISTE}	I l t *s l iq^db t ^okfkd qeobpe l ia Æ efde o^kdb[6]	S_{AA} c^iifkd					
			Æ	/+03	/+13	/+23	S	M
			S_{AA} ofpfkd					
			Æ	/+03	/+13	/+23	S	M
/ .	S_{ISTI}	I l t *s l iq^db t ^okfkd qeobpe l ia Æ il t o^kdb[6]	S_{AA} c^iifkd					
			Æ	/+. .	/+.3	/+/ /	S	M
			S_{AA} ofpfkd					
			Æ	/+.3	/+/ .	/+/4	S	M
/ /	S_{evp}	I l t *s l iq^db fkef_fq obpbq,ob` l sboevpqbobpfp· -	Æ	Æ	2-	Æ	j S	@
/0	$S_{?D}$	?^kad^m Sl iq^db Obcbobk`b··	Æ	.+. . -	.+.4	.+/0-	S	M

1 Typical values are measured at 25qC. Characterized, not tested

2 As the supply voltage rises, the LVD circuit will hold the MCU in reset until the supply has risen above V_{LVDL}.

0 Albp k l q fk`irab ^k^ild j larib mfkp+ Abaf`^qba ^k^ild mfkp pe l ria k l q _b m riiba q l S_{AA} l o S_{PP} ^ka pe l ria _b ibcq ci l ^qfkd t ebk k l q rpba q l obar`b ` roobkq ib^h^db+

1 Jb^prob a t fqe S_{Fk} : S_{AA}+

5 All functional non-supply pins are internally clamped to V_{SS} and V_{DD} except PTD1.

6 Input must be current limited to the value specified. To determine the value of the required current-limiting resistor, calculate resistance values for positive and negative clamp voltages, then use the larger of the two values.

7 Power supply must maintain regulation within operating V_{DD} range during instantaneous and operating maximum current conditions. If positive injection current ($V_{In} > V_{DD}$) is greater than I_{DD}, the injection current may flow out of V_{DD} and could result in external power supply going out of regulation. Ensure external V_{DD} load will shunt current greater than maximum injection current. This will be the greatest risk when the MCU is not consuming power. Examples are: if no system clock is present, or if clock rate is very low (which would reduce overall power consumption).

8 Maximum is highest voltage that POR is guaranteed.

9 Run at 1 MHz bus frequency

10 Low voltage detection and warning limits measured at 1 MHz bus frequency.

11 Factory trimmed at V_{DD} = 3.0 V, Temp = 25qC

0+3 Prmmiv @roobkq @e^o^`qbofpqf`p

Q^_ib .-+ Prmmiv @roobkq @e^o^`qbofpqf`p

	Pvj_li	M^o^jbqbo	?rp Cobn	S_{AA} %S&	Qvm·	J^u	Rkfq	Qbjm %¯@&	@
.	OF_{AA}	Ork prmmiv `roobkq CBFjlab8^iijlaribp LK/							
			/2+.32 JEw	0	11	15	mA	–40 to 25	M
			/2+.32 JEw	0	11	15	mA	105	M
			/- JEw	0	0/+0	Æ	mA	–40 to 105	Q
			5 JEw	0	.3+1	Æ	mA	–40 to 105	Q
			. JEw	0	/+6	Æ	mA	–40 to 105	Q
/	OF_{AA}	Ork prmmiv `roobkq CBFjlab8^iijlaribp LCC0							
			/2+.32 JEw	0	/6	/6+3	j>	¬1-qI .-2	@
			/- JEw	0	/2+1	Æ	j>	–40 to 105	Q
			5 JEw	0	./+4	Æ	mA	–40 to 105	Q
			. JEw	0	/+1	Æ	mA	–40 to 105	Q
0	OF_{AA}	Ork prmmiv `roobkq IMO:-8^iijlaribp LCC0							
			.3hEw C?F	0	/0/	/5-	m>	–40 to 105	Q
			.3hEw C?B	0	/0.	/63	mA	–40 to 105	Q
1	RI_{DD}	Run supply current IMO:.)^iijlaribp LCC0							
			.3hEw ?IMB	0	41	42	mA	-qI 4-	Q
			.3hEw ?IMB	0	41	./-	mA	¬1-qI .-2	Q

Q^_ib .-+ Prmmiv @roobkq @e^o^`qbofpqf`p %` lkqfkrba&

	Pvj_li	M^o^ jbqbo	?rp Cobn	S_{AA} %S&	Qvm·	J^u	Rkfq	Qbjm %¯@&	@
2	WI_{DD}	Wait mode supply current CB⁻ jlab) ^ii jlaribp LCC[0]							
			/2+.32 JEw	0	.3+2	Æ	mA	–40 to 105	@
			/- JEw	0	.-+0	Æ	mA	–40 to 105	Q
			5 JEw	0	3+3	Æ	mA	–40 to 105	Q
			. JEw	0	.+4	Æ	mA	–40 to 105	Q
3	$LPWI_{DD}$	Low-Power Wait mode supply current							
			.3 HEw	0	/5	3/	µA	–40 to 105	Q
4	$S2I_{DD}$	Stop2 mode supply current[4]							
			K,>	0	-+1.-	.+--	µA	–40 to 25	M
			K,>	0	0+4	.-	µA	70	@
			K,>	0	.-	/-	µA	85	@
			K,>	0	/.	0.+2	µA	105	M
			K,>	/	-+1.-	-+31-	µA	–40 to 25	@
			K,>	/	0+1	6	µA	70	@
			K,>	/	6+2	.5	µA	85	@
			K,>	/	/-	0-	µA	105	@

4ABLE 3UPPLY URRENT HARACTERISTICS CONTINUED

#	Symbol	Parameter	Bus Freq	V_{DD} (V)	Typ[1]	Max	Unit	Temp (qC)	C
5	$S3I_{DD}$	Stop3 mode supply current[4] No clocks active	n/a	3	0.750	1.3	PA	–40 to 25	P
					8.5	18		70	C
					20	28		85	C
					53	63		105	P
				2	0.400	0.900		–40 to 25	C
					8.2	16		70	C
					18	26		85	C
					47	59		105	C

1 Data in Typical column was characterized at 3.0 V, 25°C or is typical recommended value.

2 ON = System Clock Gating Control registers turn on system clock to the corresponding modules.

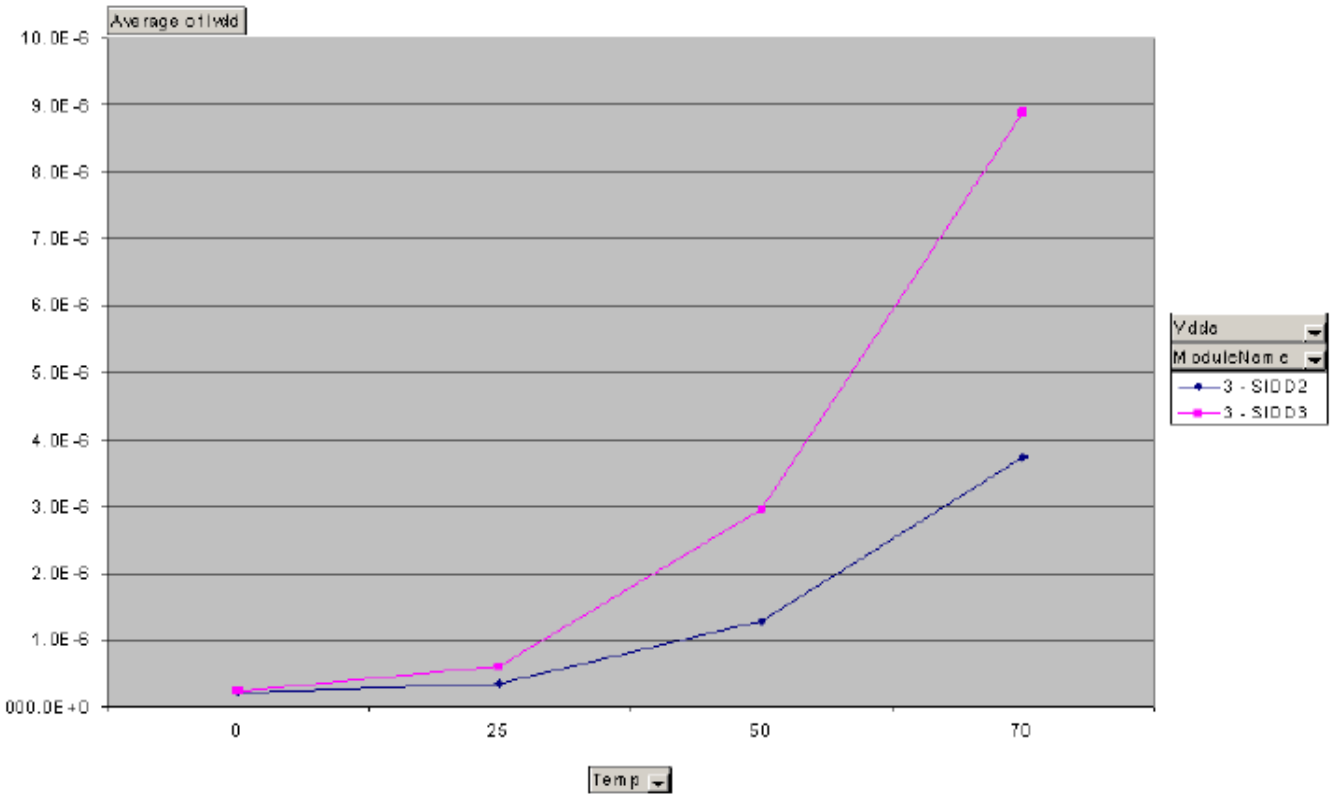
3 OFF = System Clock Gating Control registers turn off system Clock to the corresponding modules.

4 All digital pins must be configured to a known state to prevent floating pins from adding current. Smaller packages may have some pins that are not bonded out; however, software must still be configured to the largest pin package available so that all pins are in a known state. Otherwise, floating pins that are not bonded in the smaller packages may result in a higher current draw. NOTE: I/O pins are configured to output low; input-only pins are configured to pullup-enabled. IRO pin connects to ground. FB_AD12 pin is pullup-enabled. TRIAMPx, OPAMPx, DACO, and VREFO pins are at reset state and unconnected.

4ABLE 4 ICAL 3TOP-ODE DDERS

#	Parameter	Condition	Temperature (°C)					Units	C
			-40	25	70	85	105		
.	LPO	Æ	50	75	100	150	250	nA	D
/	EREFSTEN	RANGE = HGO = 0	600	650	750	850	1000	nA	D
0	IREFSTEN[1]	Æ	—	73	80	93	125	PA	T
1	TOD	Does not include clock source current	50	75	100	150	250	nA	D
2	LVD[1]	LVDSE = 1	116	117	126	132	172	PA	T
3	PRACMP[1]	Not using the bandgap (BGBE = 0)	17	18	24	35	74	PA	T
4	ADC[1]	ADLPC = ADLSMP = 1 Not using the bandgap (BGBE = 0)	190	195	210	220	260	PA	T
5	DAC[1]	High-Power mode; no load on DACO	339	345	346	346	360	PA	T
		Low-Power mode	41	43	43	44	50	PA	T
6	OPAMP[1]	High-Power mode	276	350	370	376	390	PA	T
		Low-Power mode	42	49	57	58	68	PA	T
. -	TRIAMP[1]	High-Power mode	420	432	433	438	478	PA	T
		Low-Power mode	52	52	52	55	60	PA	T

1 Not available in stop2 mode.



Cfdrob 4+ Pqlm FAA sboprp Qb j mbo^qrob

0+4 MO>@ J M Bib`qof`^ip

4ABLE 02#0%ECTRIC AL3PECIFICATIONS

	#HARACTERISTIC	3MBOL	-IN	4PICAL	-AX	5NIT #	
.	Prmmiv sliq^db	S_{MTO}	.+5	Æ	0+3	S	M
/	Prmmiv `roobkq %^`qfsb& %MOD bk^_iba&	$F_{AA>@Q.}$	Æ	Æ	5-	m>	A
0	Prmmiv `roobkq %^`qfsb& %MOD afp^_iba&	$F_{AA>@Q/}$	Æ	Æ	1-	m>	A
1	Prmmiv `roobkq %>@ J M ^ka MOD ^ii afp^_iba&	F_{AAAFP}	Æ	Æ	/	k>	A
2	>k^ild fkmrq sliq^db	$S_{>FK}$	S_{PP} ¬ -+0	Æ	S_{AA}	S	A
3	>k^ild fkmrq lccpbq sliq^db	$S_{>FL}$	Æ	2	1-	j S	A
4	>k^ild `l j m^o^qlo evpqbobpfp	S_E	0+-	Æ	/-+-	j S	A
5	>k^ild fkmrq ib^h^db `roobkq	$F_{>IHD}$	Æ	Æ	.	k>	A
6	>k^ild `l j m^o^qlo fkfqf^ifw^qflk abi^v	qFKFQ	Æ	Æ	.+-	mp	A
.-	Moldo^ j j ^_ib obcbobk`b dbkbo^qlo fkmrqp	$S_{Fk/}$ %$S_{AA/2}$&	.+5	Æ	/+42	S	A
..	Moldo^ j j ^_ib obcbobk`b dbkbo^qlo pbqrm abi^v	q_{MODPQ}	Æ	.	Æ	Õp	A
./	Moldo^ j j ^_ib obcbobk`b dbkbo^qlo pqbm pfwb	Spqbm	-+42	.	.+/2	IP?	A
.0	Moldo^ j j ^_ib obcbobk`b dbkbo^qlo sliq^db o^kdb	Smodlrq	S_{Fk},0/	Æ	S_{fk}	S	M

I'T%ECTRICALS

Q^_ib .0+ A>@ ./ IS Lmbo^qfkd Obnrfob j bkqp

	@e^o^`qbofpqf`	Pv j _l i	Jfk	J^u	Rkfq	@	Klqbp
.	Prmmiv sliq^db	$S_{AA>}$	.+5	0+3	S	M	
/	Obcbobk`b sliq^db	$S_{A>@O}$	.+.2	0+3	S	@	
0	Qb j mbo^qrob	$Q_>$	¬1-	.-2	Þ@	@	
1	Lrqmrqil^a `^m^`fq^k`b	$@_I$	Æ	.--	mF	@	> p j ^ii il^a `^m^`f* q^k`b %14 mF& `^k f j molsb qeb _^ka* tfaqe mbocl o j ^k`b lc qeb A>@+
2	Lrqmrqil^a `roobkq	F_I	Æ	.	j >	@	

Q^_ib .1+ A>@ ./*?fq Lmbo^qfkd ?be ^sflop

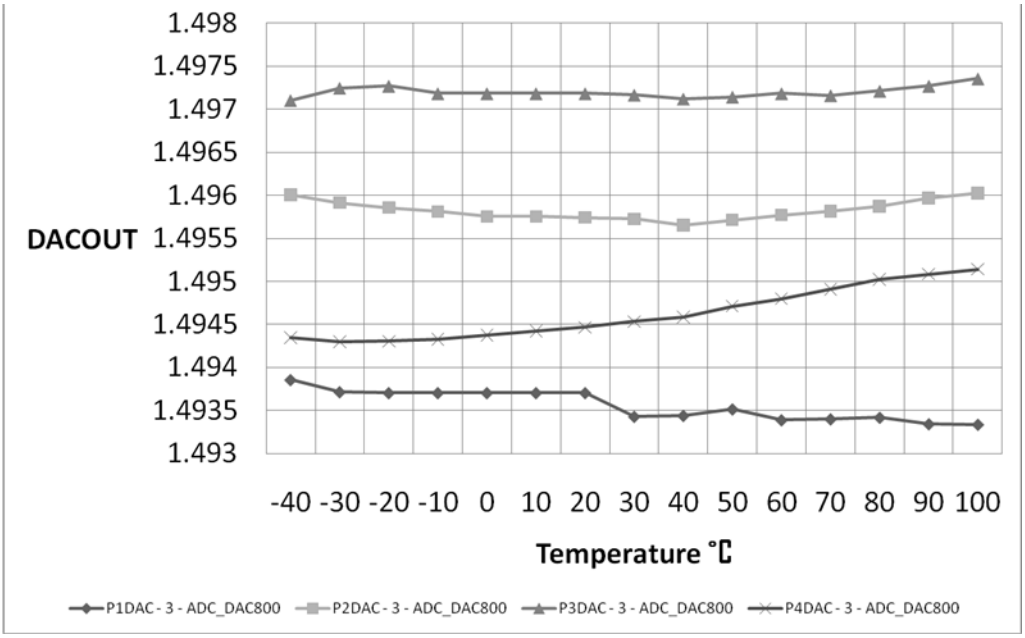
	@e^o^`qbofpqf`	Pv j _li	Jfk	Qvm	J^u	Rkfq	@	Klqb p
.	Obplirqflk	K	./	Æ	./	_fq	Q	

Q^_ib .1+ A>@ ./*?fq Lmbo^qfkd ?be^sflop %`lkqfkrba&

	@e^o^`qbofpqf`	Pvj_li	Jfk	Qvm	J^u	Rkfq	@	Klqbp
/	Prmmiv `roobkq il t*ml tbo j lab	$F_{AA>\A>@IM}$	Æ	2-	.--	Õ>	Q	
0	Prmmiv `roobkq efde*ml tbo j lab	$F_{AA>\A>@EM}$	Æ	012	2--	Õ>	Q	
1	Frii*p`^ib Pbqqifkd qf j b %Ù. IP?& %-u-5- ql -uC4C lo -uC4C ql -u-5-& il t*ml tbo j lab	$Qp_{CP}IM$	Æ	Æ	/--	Õp	Q	± $S_{AA>}$: 0 S lo /+/ S ± S_{OBCPBI} : . ± Qb j mbo^qrob : /2Þ@
2	Frii*p`^ib Pbqqifkd qf j b %Ù. IP?& %-u-5- ql -uC4C lo -uC4C ql -u-5-& efde*ml tbo j lab	$Qp_{CP}EM$	Æ	Æ	0-	Õp	Q	± $S_{AA>}$: 0 S lo /+/ S ± S_{OBCPBI} : . ± Qb j mbo^qrob : /2Þ@
3	@lab*ql*`lab Pbqqifkd qf j b %Ù. IP?& %-u?C5 ql -u@-5 lo -u@-5 ql -u?C5& il t*ml tbo j lab	$Qp_{@*@}IM$	Æ	Æ	2	Õp	Q	± $S_{AA>}$: 0 S lo /+/ S ± S_{OBCPBI} : . ± Qb j mbo^qrob : /2Þ@
4	@lab*ql*`lab Pbqqifkd qf j b %Ù. IP?& %-u?C5 ql -u@-5 lo -u@-5 ql -u?C5& efde*ml tbo j lab %0 S ^q Oll j Qb j mbo^qrob&	$Qp_{@*@}EM$	Æ	.	Æ	Õp	Q	± $S_{AA>}$: 0 S lo /+/ S ± S_{OBCPBI} : . ± Qb j mbo^qrob : /2Þ@
5	A>@ lrqmrq sliq^db o^kdb il t %efde*ml tbo j lab) kl il^a) A>@ pbq ql -& %0 S ^q Oll j Qb j mbo^qrob&	$S_{a^`lrqi}$	Æ	Æ	.--	j S	Q	
6	A>@ lrqmrq sliq^db o^kdb efde %efde*ml tbo j lab) kl il^a) A>@ pbq ql -u-CCC&	$S_{a^`lrqe}$	$S_{A>@O}$ *.--	Æ	Æ	j S	Q	
.-	Fkqbdo^i k lk*ifkb^ofqv booo lo	FKI	Æ	Æ	Ù 5	IP?	Q	
..	Afccbobkqf^i k lk*ifkb^ofqv booo lo SA>@O fp ; /+1 S	AKI	Æ	Æ	Ù .	IP?	Q	
./	Lccpbq booo lo	B_L	Æ	Ù-+1	Ù 0	" CPO	Q	@^i`ri^qba _v ^ _bpq cfq `rosb co l j S_{PP} (.-- j S ql S_{OBCE} ¬.-- j S
.0	D^fk booo lo) S_{OBCE} : S_{buq} : S_{AA}	B_D	Æ	Ù-+.	Ù -+2	" CPO	Q	@^i`ri^qba _v ^ _bpq cfq `rosb co l j S_{PP} (.-- j S ql S_{OBCE} ¬.-- j S

Q^_ib .1+ A>@ ./*?fq Lmbo^qfk d ?be^sflop %`lkqfkrba&

	@e^o^`qbofpqf`	Pvj_li	Jfk	Qvm	J^u	Rkfq	@	Klqb p
.1	Ml tbo prmmiv obqb`qflk o^qfl S_{AA} ² /+1 S	MPOO	3-	Æ	Æ	a?	Q	
.2	Qb j mbo^qrob aofcq lc lccpbq sliq^db %A>@ pbq ql -u-5--&	Q`l	Æ	Æ	/	j S	Q	Pbb Qvmf`^i Aofcq cfdrob qe^q cliil tp+
.3	Lccpbq ^dfkd `lbccf`fbkq	>`	Æ	Æ	5	ÕS,vo	Q	



Cfdrob 4+ Lccpbq ^q E^ic P`^ib sp Qb j mbo^ qrob

0+6 >A@ @e^o^`qbofpqf`p

Q^_ib .2+ .3*?fq >A@ Lmbo^qfkd @lkafqflkp

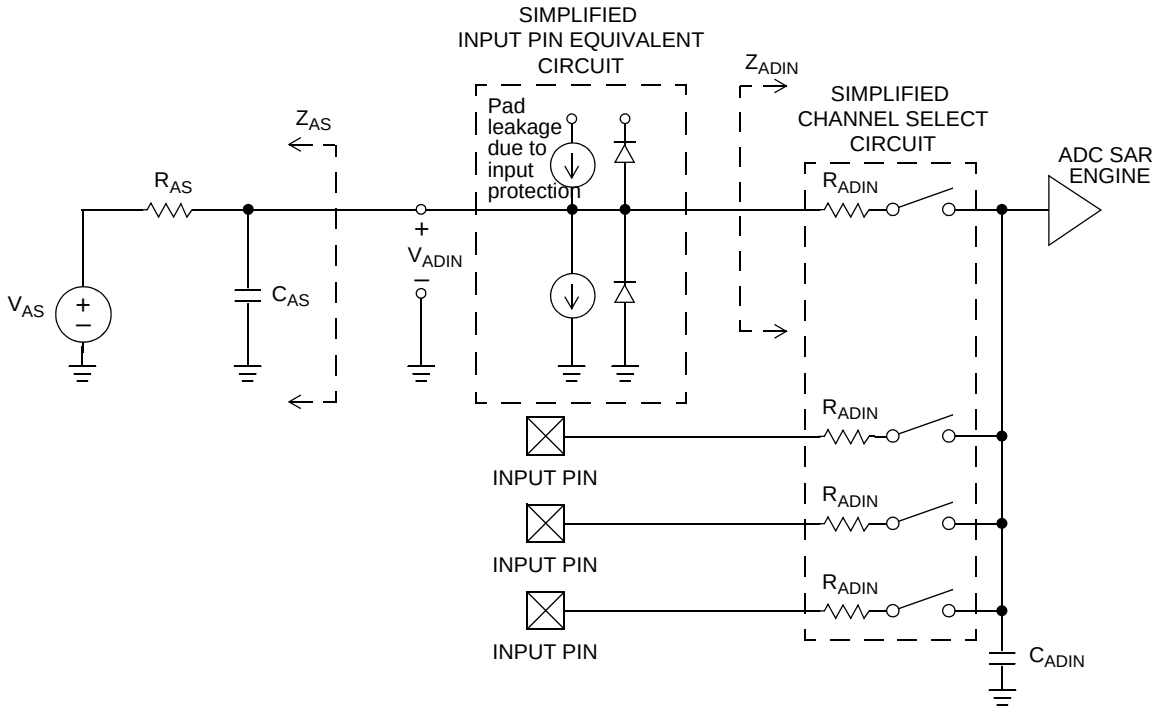
	Pvj_	@e^o^`qbofpqf`	@lkafqflkp	Jfk	Qvm	J^u	Rkfq	@	@lj jbkq
.	$S_{AA>}$	Prmmiv sliq^db	>_plirqb	.+5	Æ	0+3	S	A	
/	$DS_{AA>}$		Abiq^ ql S_{AA} %S_{AA}¬$S_{AA>}$&/	¬.--	-	(.--	j S	A	
0	$DS_{PP>}$	Dolrka sliq^db	Abiq^ ql S_{PP} %S_{PP}¬$S_{PP>}$&/	¬.--	-	(.--	j S	A	
1	S_{OBCE}	Obc Sliq^db Efde		.+.2	$S_{AA>}$	$S_{AA>}$	S	A	

4ABLE ITB ERATI NG ONDITIONS CONTINUED

	3MB	#ARACTERISTIC	ONDITIONS	-IN	4P	-AX	5NIT	#	OMMENT
2	S_{OBCI}	Obc Sliq^db l l t		$S_{PP>}$	$S_{PP>}$	$S_{PP>}$	S	A	
3	$S_{>AFK}$	Fkmrq Sliq^db		S_{OBCI}	Æ	S_{OBCE}	S	A	
4	$@_{>AFK}$	Fkmrq .3*_fq j labp @^m^`fq^k`b 5,.-,../*_fq j labp		Æ	5 1	.- 2	mC	Q	
5	$O_{>AFK}$	Fkmrq Obpfpq^k`b		Æ	/	2	hW	Q	
6	$O_{>P}$	>k^ild Plro`b Obpfpq^k`b							Buqbok^iql J@R >ppr j bp >AIPJM:-
		.3*_fq j lab	$C_{>A@H}$; 5 JEw	Æ	Æ	-+2	hW	Q	
			1 JEw 9 $C_{>A@H}$ 95 JEw	Æ	Æ	.	hW	Q	
			$C_{>A@H}$ 91 JEw	Æ	Æ	/	hW	Q	
		.0,./*_fq j lab	$C_{>A@H}$; 5 JEw	Æ	Æ	.	hW	Q	
			1 JEw 9 $C_{>A@H}$ 95 JEw	Æ	Æ	/	hW	Q	
			$C_{>A@H}$ 91 JEw	Æ	Æ	2	hW	Q	
		..,.-*_fq j lab	$C_{>A@H}$; 5 JEw	Æ	Æ	/	hW	Q	
			1 JEw 9 $C_{>A@H}$ 95 JEw	Æ	Æ	2	hW	Q	
			$C_{>A@H}$ 91 JEw	Æ	Æ	.-	hW	Q	
		6,5*_fq j lab	$C_{>A@H}$; 5 JEw	Æ	Æ	2	hW	Q	
			$C_{>A@H}$ 95 JEw	Æ	Æ	.-	hW	Q	
.-	$C_{>A@H}$	>A@ @lksbopflk @il`h Cobnrbk`v							
		>AIM@:-) >AEP@:.		.+-	Æ	5+-	JEw	A	
		>AIM@:-) >AEP@:-		.+-	Æ	2+-	JEw	A	
		>AIM@:.) >AEP@:-		.+-	Æ	/+2	JEw	A	

1 Typical values assume V_{DDA} = 3.0 V, Temp = 25 qC, f_{ADCK}=1.0 MHz unless otherwise stated. Typical values are for reference only and are not tested in production.

2 DC potential difference.



Cfdrob 5+ >A@ Fkmrq F j mba^k` b Bnrfs^ibk`v Af^do^ j

Q^_ib .3+ .3*?fq P>O >A@ @e^o^`qbofpqf `p crii lmbo^qfkd o^kdb
%S_{OBCE} : $S_{AA>}$) ; .+5) S_{OBCI} : $S_{PP>}$ ¢ 5 JEw) ¬1- ql 52 Þ@&

	@e^o^`qbofpqf`	@lkafqflkp ·	Pvj_	Jfk	Qvm /	J^u	Rkfq	@	@ljjbkq
.	Prmmiv @roobkq	>AIM@:.) >AEP@:-	$F_{AA>A}$	Æ	/.2	Æ	m>	Q	>AIPJM :- >A@L:.
		>AIM@:-) >AEP@:-		Æ	14-	Æ			
		>AIM@:-) >AEP@:.		Æ	3.-	Æ			
/	Prmmiv @roobkq	Pqlm) Obpbq) Jlarib Lcc	$F_{AA>A}$	Æ	-+-.	Æ	m>	Q	
0	>A@ >pvk`eolklrp @il`h Plro`b	>AIM@:.) >AEP@:-	$C_{>A>@H}$	Æ	/+1	Æ	JEw	@	$q_{>A>@H}$: .,$C_{>A>@H}$
		>AIM@:-) >AEP@:-		Æ	2+/	Æ			
		>AIM@:-) >AEP@:.		Æ	3+/	Æ			
1	P^jmib Qfjb	Pbb Obcbobk`b J^kr^iclo p^jmib qfjbp							
2	@lksbopflk Qfjb	Pbb Obcbobk`b J^kr^iclo `lksbopflk qfjbp							
3	Qlq^i Rk^aqrpqba Boolo	.3*_fq afccbobkqf^ijlab .3*_fq pfkdib*bkabajlab	QRB	Æ Æ	°.3 °/-	+15, ¬1- +23, ¬/5	IP?0	Q	0/u E^oat^ob >sbo^dfkd %>SDB : " . >SDP : " ..&
		.0*_fq afccbobkqf^ijlab ./*_fq pfkdib*bkabajlab		Æ Æ	°.+2 °.+42	°0+- °0+2		Q	
		..*_fq afccbobkqf^ijlab .-*_fq pfkdib*bkabajlab		Æ Æ	°-+4 °-+5	°.+2 °.+2		Q	
		6*_fq afccbobkqf^ijlab 5*_fq pfkdib*bkabajlab		Æ Æ	°-+2 °-+2	°.+- °.+-		Q	
4	Afccbobkqf^i Klk*lfkb^ofqv	.3*_fq afccbobkqf^ijlab .3*_fq pfkdib*bkabajlab	AKI	Æ Æ	°/+2 °/+2	+2,¬0 (2,¬0	IP?/	Q	
		.0*_fq afccbobkqf^ijlab ./*_fq pfkdib*bkabajlab		Æ Æ	°-+4 °-+4	°. °.		Q	
		..*_fq afccbobkqf^ijlab .-*_fq pfkdib*bkabajlab		Æ Æ	°-+2 °-+2	°-+42 °-+42		Q	
		6*_fq afccbobkqf^ijlab 5*_fq pfkdib*bkabajlab		Æ Æ	°-+/ °-+/	°-+2 °-+2		Q	

Q^_ib .3+ .3*?fq P>O >A@ @e^o^`qbofp qf`p crii lmbo^qfkd o^kdb
%S_{OBCE} : $S_{AA>}$) ; .+5) S_{OBCI} : $S_{PP>}$ ¢ 5 JEw) ¬1- ql 52 Þ@& %`lkqfkrba&

	@e^o^`qbofpqf`	@lkafqflkp	Pvj_	Jfk	Qvm /	J^u	Rkfq	@	@ljjbkq
5	Fkqbdo^i Klk*lfkb^ofqv	.3*_fq afccbobkqf^i j lab .3*_fq pfkdib*bkaba j lab	FKI	Æ Æ	°3+- °.-+-	°.3+- °/-+-	IP?/	Q	
		.0*_fq afccbobkqf^i j lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°.+- °.+-	°/+2 °/+2		Q	
		..*_fq afccbobkqf^i j lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+2 °-+2	°.+- °.+-		Q	
		6*_fq afccbobkqf^i j lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+0 °-+0	°-+2 °-+2		Q	
6	Wbol*P`^ib Boolo	.3*_fq afccbobkqf^i j lab .3*_fq pfkdib*bkaba j lab	B_{WP}	Æ Æ	°1+- °1+-	(0/,¬/1 (/1,¬.3	IP?/	Q	$S_{>AFK}$: $S_{PP>}$
		.0*_fq afccbobkqf^i j lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°-+4 °-+4	°/+2 °/+-		Q	
		..*_fq afccbobkqf^i j lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+1 °-+1	°.+- °.+-		Q	
		6*_fq afccbobkqf^i j lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+/ °-+/	°-+2 °-+2		Q	
.-	Crii*P`^ib Boolo	.3*_fq afccbobkqf^i j lab .3*_fq pfkdib*bkaba j lab	B_{CP}	Æ Æ	(.-,- (.1,-	(1/,¬/ (13,¬/	IP?/	Q	$S_{>AFK}$: $S_{AA>}$
		.0*_fq afccbobkqf^i j lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°.+- °.+-	°0+2 °0+2		Q	
		..*_fq afccbobkqf^i j lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+1 °-+1	°.+2 °.+2		Q	
		6*_fq afccbobkqf^i j lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+/ °-+/	°-+2 °-+2		Q	
..	Nr^kqfw^qflk Boolo	.3*_fq j labp	B_N	Æ	¬.ql-	Æ	IP?/	A	
		9.0*_fq j labp		Æ	Æ	°-+2			
./	Bccb`qfsb Krj_bo lc ?fqp	.3*_fq afccbobkqf^i j lab >sd:0/ >sd:.3 >sd:5 >sd:1 >sd:.	BKL?	./+5 ./+4 ./+3 ./+2 ..+6	.1+/ .0+5 .0+3 .0+0 ./+2	Æ Æ Æ Æ Æ	?fqp	@	C_{fk} : $C_{p^{\wedge}jmib}$,.-
.0	Pfdk^iql Klfpb mirp Afpqloqflk	Pbb BKL?	PFK>A	$SINAD = 6.02 \text{ˇ} ENOB + 1.76$			a?		

Q^_ib .3+ .3*?fq P>O >A@ @e^o^`qbofp qf`p criilmbo^qfkd o^kdb
%S_{OBCE} : $S_{AA>}$) ; .+5) S_{OBCI} : $S_{PP>}$ ¢ 5 JEw) ¬1-ql 52 Þ@& %`lkqfkrba&

	@e^o^`qbofpqf`	@lkafqflkp ·	Pvj_	Jfk	Qvm /	J^u	Rkfq	@	@ljjbkq
.1	Qlq^iE^ojlkf` Afpqloqflk	.3*_fq afccbobkqf^ijlab >sd:0/	QEA	Æ	¬6.+2	¬41+0	a?	@	C_{fk} : C_{p^jmib},.- -
		.3*_fq pfkdib*bkaba jlab >sd:0/		Æ	¬52+2	Æ		A	
.2	Pmrofl rp Cobb Avk^jf` O^kdb	.3*_fq afccbobkqf^ijlab >sd:0/	PCAO	42+-	6/+/	Æ	a?	@	C_{fk} : C_{p^jmib},.- -
		.3*_fq pfkdib*bkaba jlab >sd:0/		Æ	53+/	Æ		A	
.3	Fkmrq lb^h^db Booloo	^iijlabp	B_{FI}	F_{Fk} ' $O_{>P}$			jS	A	F_{Fk} : ib^h^db `roobkq %obcbo ql A@ `e^o^`qbof pqf`p&
.4	Qbjm Pbkploo Pilmb	¬1-¯@¬/2¯@	j	Æ	.+313	Æ	jS,å @	@	
		/2¯@¬./2¯@		Æ	.+436	Æ			
.5	Qbjm Pbkploo Sliq^db	/2¯@	$S_{QBJM/2}$	Æ	4.5+/	Æ	jS	@	

· >ii ^``ro^`v krj_bop ^pprjbqeb >A@ fp `^if_o^qba tfqe S_{OBCE}:$S_{AA>}$

/ Qvmf`^is^irbp ^pprjb $S_{AA>}$ : 0+-S) Qbjm : /2¯@) $c_{>A@H}$: /+- JEw rkibpp lqebo tfpb pq^qba+ Qvmf`^is^irbp ^ob clo obcbobk`b lkiv ^ka ^ob klqqbpqba fk molar`qflk+

0 . IP? : %S_{OBCE} ¬ S_{OBCI}&,/K

Q^_ib .4+ .3*_fq P>O >A@ @e^o^` qbofpqf`p crii lmbo^qfkd o^kdb
%S_{OBCE} : $S_{AA>}$)² /+4 S) S_{OBCI} : $S_{PP>}$) c>A>@H ¢ 1 JEw) >AEP@ : .&

	@e^o^`qbofpqf`	@lkafqflkp	Pvj_	Jfk	Qvm /	J^u	Rkfq	@	@ljjbkq
.	Qlq^i Rk^agrpqba Booloo	.3*_fq afccbobkqf^ij lab .3*_fq pfkdib*bkaba j lab	QRB	Æ Æ	°.3 °/-	+/1, ¬/1 +0/,¬/-	IP?0	Q	0/u E^oat^ob >sbo^dfkd %>SDB : ". >SDP : "..&
		.0*_fq afccbobkqf^ij lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°.+2 °.+42	°/+- °/+2		Q	
		..*_fq afccbobkqf^ij lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+4 °-+5	°.+- °.+/2		Q	
		6*_fq afccbobkqf^ij lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+2 °-+2	°.+- °.+-		Q	
/	Afccbobkqf^i Klk*lfkb^ofqv	.3*_fq afccbobkqf^ij lab .3*_fq pfkdib*bkaba j lab	AKI	Æ Æ	°/+2 °/+2	°0 °0	IP?/	Q	
		.0*_fq afccbobkqf^ij lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°-+4 °-+4	°. °.		Q	
		..*_fq afccbobkqf^ij lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+2 °-+2	°-+42 °-+42		Q	
		6*_fq afccbobkqf^ij lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+/ °-+/	°-+2 °-+2		Q	
0	Fkqbdo^i Klk*lfkb^ofqv	.3*_fq afccbobkqf^ij lab .3*_fq pfkdib*bkaba j lab	FKI	Æ Æ	°3+- °.-+-	°./+- °.3+-	IP?/	Q	
		.0*_fq afccbobkqf^ij lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°.+- °.+-	°/+- °/+-		Q	
		..*_fq afccbobkqf^ij lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+2 °-+2	°.+- °.+-		Q	
		6*_fq afccbobkqf^ij lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+0 °-+0	°-+2 °-+2		Q	
1	Wbolp`^ib Booloo	.3*_fq afccbobkqf^ij lab .3*_fq pfkdib*bkaba j lab	B_{WP}	Æ Æ	°1+- °1+-	(.3,- (.3,*5	IP?/	Q	$S_{>AFK}$: $S_{PP>}$
		.0*_fq afccbobkqf^ij lab ./*_fq pfkdib*bkaba j lab		Æ Æ	°-+4 °-+4	°/+- °/+-		Q	
		..*_fq afccbobkqf^ij lab .-*_fq pfkdib*bkaba j lab		Æ Æ	°-+1 °-+1	°.+- °.+-		Q	
		6*_fq afccbobkqf^ij lab 5*_fq pfkdib*bkaba j lab		Æ Æ	°-+/ °-+/	°-+2 °-+2		Q	

Q^_ib .4+ .3*_fq P>O >A@ @e^o^` qbofpqf`p crii lmbo^qfkd o^kdb
%S_{OBCE} : $S_{AA>}$)² /+4 S) S_{OBCI} : $S_{PP>}$) $c_{>A>@H}$ ¢ 1 JEw) >AEP@ : .& %`lkqfkrba&

	@e^o^`qbofpqf`	@lkafqflkp ·	Pvj_	Jfk	Qvm /	J^u	Rkfq	@	@ljjbkq
2	Crii*P`^ib Booloo	.3*_fq afccbobkqf^ijlab .3*_fq pfkdib*bkaba jlab	B_{CP}	Æ Æ	(5,- (./,-	(/1,- (/1,-	IP?/	Q	$S_{>AFK}$: $S_{AA>}$
		.0*_fq afccbobkqf^ijlab ./*_fq pfkdib*bkaba jlab		Æ Æ	°-+4 °-+4	°/+- °/+2		Q	
		..*_fq afccbobkqf^ijlab .-*_fq pfkdib*bkaba jlab		Æ Æ	°-+1 °-+1	°.+- °.+-		Q	
		6*_fq afccbobkqf^ijlab 5*_fq pfkdib*bkaba jlab		Æ Æ	°-+/ °-+/	°-+2 °-+2		Q	
3	Nr^kqfw^qflk Booloo	.3*_fq jlabp	B_N	Æ	¬.ql-	Æ	IP?/	A	
		9.0*_fq jlabp		Æ	Æ	°-+2			
4	Bccb`qfsb Krj_bo lc ?fqp	.3*_fq afccbobkqf^ijlab >sd:0/ >sd:.3 >sd:5 >sd:1 >sd:.	BKL ?	.1+0 .0+5 .0+1 .0+. ./+1	.1+2 .1+- .0+4 .0+1 ./+3	Æ Æ Æ Æ Æ	?fqp	@	C_{fk} : C_{p^jmib},.- -
5	Pfdk^iql Klfpb mirp Afpqloqflk	Pbb BKL?	PFK> A	$SINAD = 6.02 \tilde{} ENOB + 1.76$			a?		
6	Qlq^iE^ojlkf` Afpqloqflk	.3*_fq afccbobkqf^ijlab >sd:0/	QEA	Æ	¬62+5	¬6-+1	a?	@	C_{fk} : C_{p^jmib},.- -
		.3*_fq pfkdib*bkaba jlab >sd:0/		Æ	Æ	Æ		A	
.7	Pmrofirp Cobb Avk^jf` O^kdb	.3*_fq afccbobkqf^ijlab >sd:0/	PCAO	6.+-	63+2	Æ	a?	@	C_{fk} : C_{p^jmib},.- -
		.3*_fq pfkdib*bkaba jlab >sd:0/		Æ	Æ	Æ		A	
..	Fkmrq lb^h^db Booloo	^iijlabp	B_{FI}	F_{Fk} ' $O_{>P}$			jS	A	F_{Fk} : ib^h^db `roobkq %obcbo ql A@ `e^o^`qbof pqf`p&

· >ii ^```ro^`vkrj_bop ^pprjbqeb >A@ fp `^if_o^qba tfqe S_{OBCE}:$S_{AA>}$

/ Qvmf`^is^irbp ^pprjb $S_{AA>}$ : 0+-S) Qbjm : /2¯@) $c_{>A@H}$: /+- JEw rkibpp lqebotfpb pq^qba+ Qvmf`^is^irbp ^obclo obcbobk`blkiv ^ka ^ob klqbpqba fk molar`qflk+

0 . IP? : %S_{OBCE} ¬ S_{OBCI}&,/K

0+. - J@D ^ka Buqbok^i Lp`fii ^qlo %ULP@& @e^o^`qbofpqf`p

4ABLE -#EMPERATURE2ANGEnTO Þ@ > j _fbkq&

	O^qfkd		Pv j _li	Jfk	Qvmf`^i	J^u	Rkfq	@
.	Fkqbok^i obcbobk`b pq^oqrm qf j b		q_{fobcpq}	Æ	22	. - -	mp	A
/	>sbo^db fkqbok^i obcbobk`b cobnrbk`v	c^``qlov qof j j ba ^q SAA : 0+- S ^ka qb j m : /2¯@	$c_{fkq\cq}$	Æ	0.+/2	Æ	hEw	@
		rpbo qof j j ba		0.+/2	Æ	06+-3/2		@
0	A@L lrqmrq cobnrbk`v o^kdb Æ qof j j ba	l l t o^kdb %AOP : - -&	$c_{a`l\q}$	.3	Æ	/-	JEw	@
		Jfa o^kdb %AOP : - .&		0/	Æ	1-		@
		Efde o^kdb· %AOP : . -&		1-	Æ	3-		@
1	Obplirqflk lc qof j j ba A@L lrqmrq cobnrbk`v ^q cfuba sliq^db ^ka qb j mbo^qrob	tfqe CQOFJ	$D_{ca`l\obp\q}$	Æ	° -+.	° -+/	"$c_{a`l}$	@
		tfqelrq CQOFJ		Æ	° -+/	° -+1		@
2	Qlq^i absf^qflk lc qof j j ba A@L lrqmrq cobnrbk`v lsbo sliq^db ^ka qb j mbo^qrob	lsbo sliq^db ^ka qb j mbo^qrob	$D_{ca`l\q}$	Æ	°.+-	° /	"$c_{a`l}$	M
		lsbo cfuba sliq^db ^ka qb j m o^kdb lc - ¬ 4- ¯@		Æ	° -+2	° .		@
3	>`nrfpfqflk qf j b	Cll[/]	$q_{cii\^`nrfob}$	Æ	Æ	.	j p	@
		Mll[0]	$q_{mii\^`nrfob}$	Æ	Æ	.		A
4	llkd qbo j Gfqqbo lc A@L lrqmrq `il`h %^sbo^dba lsbo / j P fkqbos^i& [1]		$@_{Gfqqbo}$	Æ	-+-/	-+/	"$c_{a`l}$	@
5	S@L lmbo^qfkd cobnrbk`v		$c_{s`l}$	4+-	Æ	22+-	JEw	A
6	Mll obcbobk`b cobnrbk`v o^kdb		$c_{mii\obc}$	.+-	Æ	/+-	JEw	A
.-	Gfqqbo lc Mll lrqmrq `il`h j b^proba lsbo 3/2kp [2]	llkd qbo j	$c_{mii\gfqqbo\3/2kp}$	Æ	-+233[1]	Æ	"c_{mii}	A
..	ll`h cobnrbk`v qlibo^k`b	Bkqov[3]	$A_{il`h}$	° .+16	Æ	° /+65	"	A
		Bufq[4]	A_{rki}	° 1+14	Æ	° 2+64		A
./	ll`h qf j b	Cll	$q_{cii\il`h}$	Æ	Æ	$q_{cii\^`nrfob}$(.-42%.,$c_{fkq\q}$&	p	A
		Mll	$q_{mii\il`h}$	Æ	Æ	$q_{mii\^`nrfob}$(.-42%.,$c_{mii\obc}$&		A
.0	llpp lc buqbok^i `il`h j fkf j r j cobnrbk`v *O>KDB : -		$c_{il`\ilt}$	%0,2& u $c_{fkq\q}$	Æ	Æ	hEw	A
.1	llpp lc buqbok^i `il`h j fkf j r j cobnrbk`v *O>KDB : ·		$c_{il`\efde}$	%.3,2& u $c_{fkq\q}$	Æ	Æ	hEw	A

· Qefp pelria klq bu`bba qeb j ^uf j r j @MR cobnrbk`v clo qefp absf`b tef`e fp 2-+00 JEw+

/ Qefp pmb`fcf`^qflk ^mmifbp ql ^kv qf j b qeb Cll obcbobk`b plro`b lo obcbobk`b afsfabo fp `e^kdba) qof j s^irb fp `e^kdba) A JU0/ _fq fp `e^kdba) AOP _fq fp `e^kdba) lo `e^kdfkd co l j Cll afp^_iba %?IMB) ?IMF& ql Cll bk^_iba %CBF) CBB) C?B) C?F&+ Fc ^ `ovpq^i,obplk^qlo fp _bfkd rpba ^p qeb obcbobk`b) qefp pmb`fcf`^qflk ^ppr j bp fq fp ^iob^av orkkfkd+

0 Qefp pmb`fcf`^qflk ^mmifbp ql ^kv qf j b qeb Mll S@L afsfabo lo obcbobk`b afsfabo fp `e^kdba) lo `e^kdfkd co l j Mll afp^_iba %?IMB) ?IMF& ql Mll bk^_iba %M?B) MBB&+ Fc ^ `ovpq^i,obplk^qlo fp _bfkd rpba ^p qeb obcbobk`b) qefp pmb`fcf`^qflk ^ppr j bp fq fp ^iob^av orkkfkd+

1 Gfqqbo fp qeb ^sbo^db absf^qflk co l j qeb mo ldo^ j j ba cobnrbk`v j b^proba lsbo qeb pmb`fcfba fkqbos^i ^q j ^uf j r j c?RP+ Jb^prob j bkqp ^ob j ^ab t fqe qeb absf`b m l t boba _v cfiqboba prmmifbp ^ka `il`hba _v ^ pq^_ib buqbok^i `il`h pfdk^i+ Klfpb fkqb`qba fkql qeb Cll `fo`rfqov sf^ S_{AA} ^ka S_{PP} ^ka s^of^qflk fk `ovpq^i lp`fii^qlo cobnrbk`v fk`ob^pb qeb @Gfqqbo mbo`bkq^db clo ^ dfsbk fkqbos^i+

2 3/2 kp obmobpbkqp 2 qf j b nr^kq^ clo @>K ^mmif`^qflkp) rkabo t lopq*`^pb `lkafqflkp lc 5 JEw @>K _rp `il`h) . J_mp @>K ?rp pmbba) ^ka 5 qf j b nr^kq^ mbo _fq clo _fq qf j b pbqqfkdp+ 2 qf j b nr^kq^ fp qeb j fkf j r j qf j b _bq t bbk ^ pvk`eo lkfw^qflk badb ^ka qeb p^ j mib ml fkq lc ^ _fq rpfkd 5 qf j b nr^kq^ mbo _fq+

3 ?bil t $A_{il`h}$ j fkf j r j ) qeb J@D fp dr^o^kqbba ql bkqbo il`h+ >_lsb $A_{il`h}$ j ^uf j r j ) qeb J@D tfii klq bkqbo il`h+ ?rq fc qeb J@D fp ^iob^av fk il`h) qebk qeb J@D j ^v pq^v fk il`h+

4 ?bil t A_{rki} j fkf j r j) qeb J@D tfii klq bufq il`h fc ^iob^av fk il`h+ >_lsb A_{rki} j ^uf j r j) qeb J@D fp dr^o^kqbba ql bufq il`h+

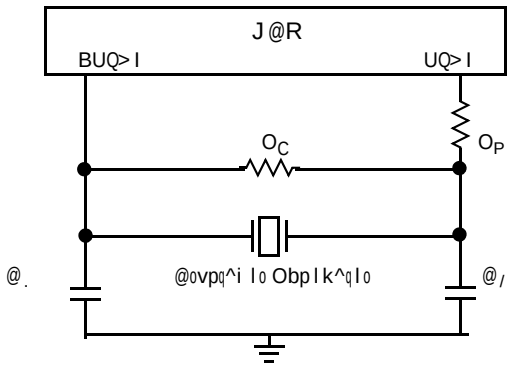
Q^_ib .6+ ULP@ %Qb j mbo^qrob O^kdb : ¬1- ql .-2 Þ@ > j _fbkq&

	@e^o^`qbofpqf`		Pv j _li	Jfk	Qvm ·	J^u	Rkfq	@
.	Lp`fii^qlo `ovpq^i lo obplk^qlo %BOBCP : .) BO@IHBK : .&	± Ilt o^kdb %O>KDB : -&	c_{il}	0/	Æ	05+1	hEw	A
		± Efde o^kdb %O>KDB : .&) ± CBB lo C?B j lab /	c_{ef*cii}	.	Æ	2	JEw	A
		± Efde o^kdb %O>KDB : .&) ± MBB lo M?B j lab 0	c_{ef*mii}	.	Æ	.3	JEw	A
		± Efde o^kdb %O>KDB : .&) ± Efde d^fk %EDL : .&) ± ?IMB j lab	c_{ef*edl}	.	Æ	.3	JEw	A
		± Efde o^kdb %O>KDB : .&) ± Ilt mltbo %EDL : -&) ± ?IMB j lab	c_{ef*im}	.	Æ	5	JEw	A
/	Il^a `^m^`fqlop		@. @/	Pbb `ovpq^i lo obplk^qlo j ^krc^`qrobo$p ob`l j jbka^qflk+				A
0	Cbba_^`h obpfpqlo	± Ilt o^kdb %O/ hEw ql 05+1 hEw&	O_C	Æ	. -	Æ	M:	A
		± Efde o^kdb %. JEw ql .3 JEw&	Æ	Æ	.	Æ		A
1	Pbofbp obpfpqlo Æ Ilt o^kdb	± Ilt D^fk %EDL : -&	O_P	Æ	-	Æ	k:	A
		± Efde D^fk %EDL : .&		Æ	.--	Æ		A
2	Pbofbp obpfpqlo Æ Efde o^kdb	± Ilt D^fk %EDL : -&	O_P	Æ	-	Æ	k:	A
		± Efde D^fk %EDL : .&						A
		² 5 JEw		Æ	-	-		A
		1 JEw		Æ	-	.-		A
		. JEw		Æ	-	/-		A

Q^_ib .6+ ULP@ %Qb j mbo^qrob O^kdb : ¬1- ql .-2 Þ@ > j _fbkq& %`lkqfkrba&

	@e^o^``qbofpqf`		Pv j _li	Jfk	Qvm ·	J^u	Rkfq	@
3	@ovpq^i pq^oq*rm qf j b [1]	± Ilt o^kdb) ilt d^fk %O>KDB : -) EDL : -&	q@PQI*IM	Æ	/--	Æ	jp	A
		± Ilt o^kdb) efde d^fk %O>KDB : -) EDL : .&	q@PQI*EDL	Æ	1--	Æ		A
		± Efde o^kdb) ilt d^fk %O>KDB : .) EDL : -& [2]	q@PQE*IM	Æ	2	Æ		A
		± Efde o^kdb) efde d^fk %O>KDB : .) EDL : .& [2]	q@PQE*EDL	Æ	.2	Æ		A

· A^q^ fk Qvmf`^i`lir j k t^p `e^o^``qbofwba ^q 0+- S) /2¯@ lo fp qvmf`^i ob`l j j bkaba s^irb+
/ Tebk J@D fp `lkcfdroba clo CBB lo C?B j lab) fkmrq `il`h plro`b j rpq _bafsfpf_ib rpfkd OAFS ql tfqefk qeb o^kdb lc 0.+/2 hEw ql 06+-3/2 hEw+
0 Tebk J@D fp `lkcfdroba clo MBB lo M?B j lab) fkmrq `il`h plro`b j rpq _bafsfpf_ib rpfkd OAFS ql tfqefk qeb o^kdb lc . JEw ql / JEw+
1 Qefp m^o^ j bqbo fp `e^o^``qbofwba ^ka klq qbpqba lk b^``e absf`b+ Molmbo M@ _l^oa i^vlrq mlo`barobp j rpq _b cliil tba ql ^`efbsb pmb`fcf`^qflkp+
2 1 JEw `ovpq^i+



-INI&EXS4IMING3PECIFICATIONS

A multi-function external bus interface called Mini-FlexBus is provided with basic functionality to interface to slave-only devices up to a maximum bus frequency of /2+.333 JEw. It can be directly connected to asynchronous or synchronous devices such as external boot ROMs, flash memories, gate-array logic, or other simple target (slave) devices with little or no additional circuitry. For asynchronous devices a simple chip-select based interface can be used.

All processor bus timings are synchronous; that is, input setup/hold and output delay are given in respect to the rising edge of a reference clock, MB_CLK. The MB_CLK frequency is half the internal system bus frequency.

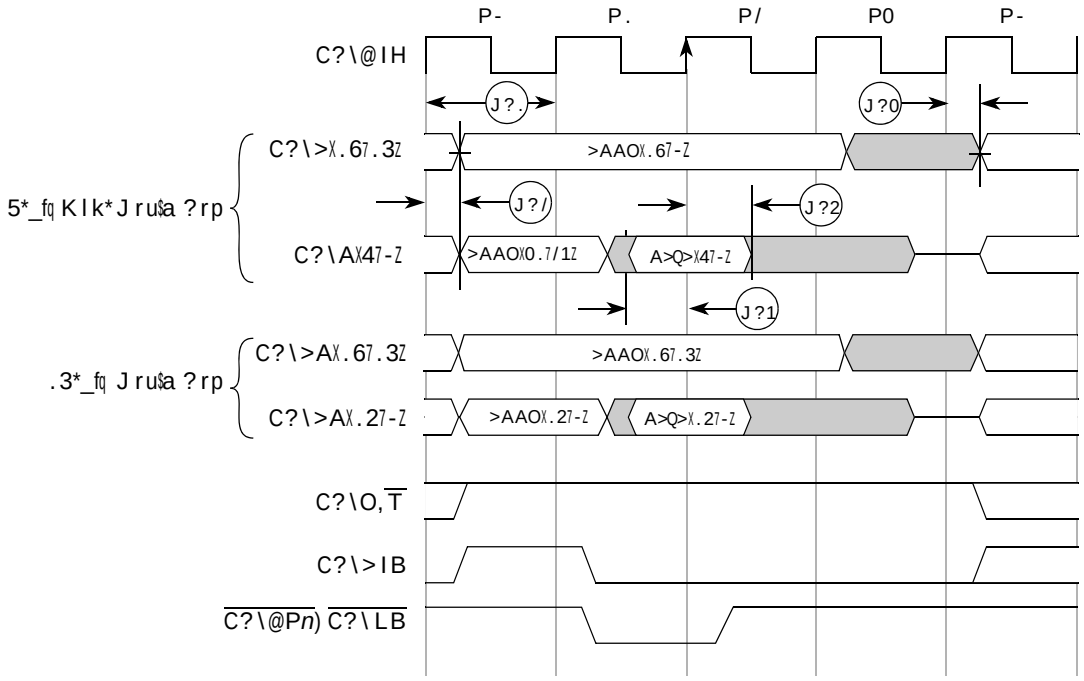
The following timing numbers indicate when data is latched or driven onto the external bus, relative to the Mini-FlexBus output clock (MB_CLK). All other timing relationships can be derived from these values.

Q^_ib /-+ Jfkf*Cibu?rp >@ Qfjfkd Pmb`fcf`^qflkp

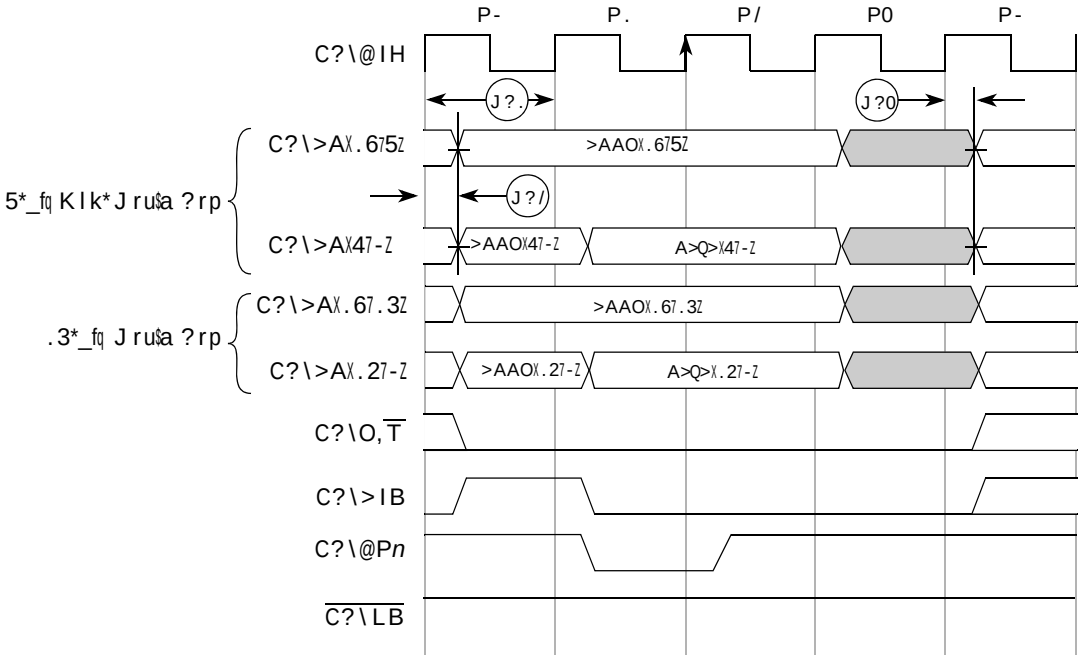
Krj	@	@e^o^``qbofpqf`	Jfk	J^u	Rkfq	Klqbp
Æ	Æ	Cobnrbk`v lc Lmbo^qflk	Æ	/2+.333	JEw	Æ
J?.	A	@il`h Mbofla	06+40	Æ	kp	Æ
J?/	A	Lrqmrq S^ifa	Æ	/-	kp	·
J?0	A	Lrqmrq Elia	.+-	Æ	kp	·
J?1	A	Fkmrq Pbqrm	//	Æ	kp	/
J?2	A	Fkmrq Elia	.-	Æ	kp	/

· Pmb`fcf`^qflk fp s^ifa clo ^ii J?\>X.67-Z) J?\AX47-Z) $\overline{\text{J?\@PX.7-Z}}$) $\overline{\text{J?\LB}}$) J?\O,$\overline{\text{T}}$) ^ka J?\>IB+

/ Pmb`fcf`^qflk fp s^ifa clo ^ii J?\AX47-Z+



Cfdrob 6+ Jfkf*Cibu?rp Ob^a Qfjfkd



Cfdrob .-+ Jfkf*Cibu?rp Tofqb Qfjfkd

0+. / >@ @e^o^`qbofpqf`p

This section describes ac timing characteristics for each peripheral system.

ØONTROL4IMING

4ABLE ØONTROL4IMING

	3YMBOL	0ARAMETER		-IN	4YPICAL	-AX	#	5NIT
.	$c_{?rp}$	?rp cobnrbk`v %q`v` : .,$c_{?rp}$&						JEw
			S_{AA} ² .+5 S	a`	Æ	.-	A	
			S_{AA} ; /+. S	a`	Æ	/-	A	
			S_{AA} ; /+1 S	a`	Æ	/2+.32	A	
/	q_{IML}	Fkqbok^iilt*mltbo lp`fii^qlo mbofla		4--	.---	.0--	M	mp
0	q_{buqopq}	Buqbok^iobpbq mripb tfaqe/ %q`v` : .,$c_{Pbic\obpbq}$&		.--	Æ	Æ	A	kp
1	q_{opqaos}	Obpbq il t aofsb		33 u $q_{`v`}$	Æ	Æ	A	kp
2	q_{JPPR}	>`qfsb _^`hdolrka ab_rd jlabi^q`e pbqrmqfjb		2--	Æ	Æ	A	kp
3	q_{JPE}	>`qfsb _^`hdolrka ab_rd jlabi^q`e elia qfjb		.--	Æ	Æ	A	kp
4	$q_{FIFE)}$ q_{FEFI}	FON mripb tfaqe ± >pvk`eolklrp m^qe/ ± Pvk`eolklrp m^qe0		.-- .+2 u $q_{`v`}$	Æ	Æ	A	kp
5	$q_{FIFE)}$ q_{FEFI}	H?FMu mripb tfaqe ± >pvk`eolklrp m^qe/ ± Pvk`eolklrp m^qe0		.-- .+2 u $q_{`v`}$	Æ	Æ	A	kp

Q^_ib / .+ @ l kqo li Qf j fkd %` lkqfkrba&

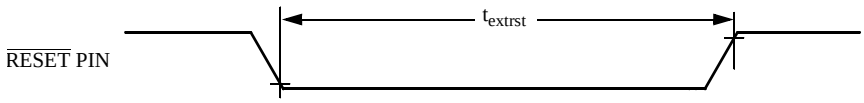
	Pv j _ li	M^o^ j bqbo		Jfk	Qvmf`^i ·	J^u	@	Rkfq
6	qOfpb) qC^ii	Mloq ofpb ^ka c^ii qf j b %il^a : 2- mC&[1]) l l t Aofsb						kp
			Pibt o^qb `lkqoli afp^_iba %MQuPB : -&	Æ	. .	Æ	A	
			Pibt o^qb `lkqoli bk^_iba %MQuPB : .&	Æ	02	Æ	A	
			Pibt o^qb `lkqoli afp^_iba %MQuPB : -&	Æ	1-	Æ	A	
			Pibt o^qb `lkqoli bk^_iba %MQuPB : .&	Æ	42	Æ	A	

· Qvmf`^is^irbp ^ob _^pba lk `e^o^`qbofw^qflk a^q^ ^q S_{AA} : 2+- S) /2 ¯@ rkibpp lqebo t fpb pq^qba+

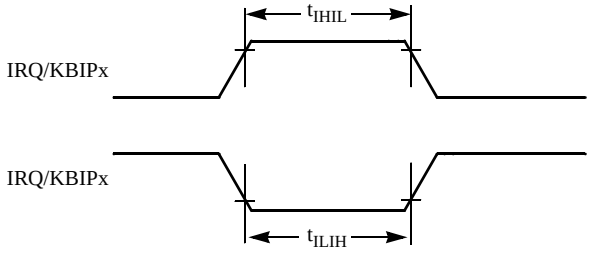
/ Qefp fp qeb pe loqbpq mripb qe^q fp dr^o^kqbba ql _b ob` ldkfwba ^p ^ obpbq mfk obnrbpq+ Pe loqbo mripbp ^ob klq dr^o^kqbba ql lsboofab obpbq obnrbpqp co l j fkqbok^i p lro`bp+

0 Qefp fp qeb j fkf j r j mripb t faqe qe^qfp dr^o^kqbba ql m^ppqeo l rde qeb mfkpvk`eo l kfw^qflk `fo` rfqov+ Pe loqbo mripbp j ^v lo j ^v klq _b ob` ldkfwba+ Fk pq lm j lab) qeb pvk`eo lkfwbo fp _vm^ppba pl pe loqbo mripbp `^k _b ob` ldkfwba fk qe^q `^pb+

1 Qf j fkd fp pe l t k t fqe obpmb`q ql / - " S_{AA} ^ka 5- " S_{AA} ibsbip+ Qb j mbo^qrob o^kdb ¬1- ¯@ ql . -2 ¯@+



Cfdrob . .+ Obpbq Qf j fkd



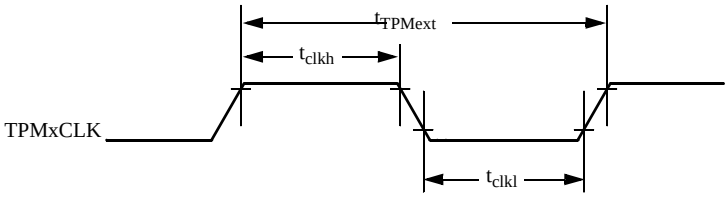
Cfdrob . /+ FON,H?FMu Qf j fkd

0+./+/ QMJ Qfjfkd

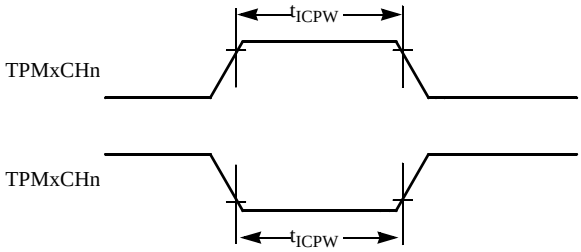
Synchronizer circuits determine the shortest input pulses that can be recognized or the fastest clock that can be used as the optional external source to the timer counter. These synchronizers operate from the current bus rate clock.

4ABLE 40-)NPUT4IMING

	#	&NCTION	3MBOL	-IN	-AX	5NIT
.	Æ	Buqbok^i`il`h cobnrbk`v	cQMJbuq	a`	c?rp,1	JEw
/	Æ	Buqbok^i`il`h mbofla	qQMJbuq	1	Æ	q`v`
0	A	Buqbok^i`il`h efde qfjb	q`ihe	.+2	Æ	q`v`
1	A	Buqbok^i`il`h il t qfjb	q`ihi	.+2	Æ	q`v`
2	A	Fkmrq`^mqrob mripb tfaqe	qF@MT	.+2	Æ	q`v`



8GURE 4IMER%XTERNAL#LOCK



8GURE 4IMER)NPUT#APTURE0ULSE

0+.0 PMF @e^o^``qbofpqf`p

Table 23 and Figure 15 through Figure 18 describe the timing requirements for the SPI system.

4ABLE 30)4IMING

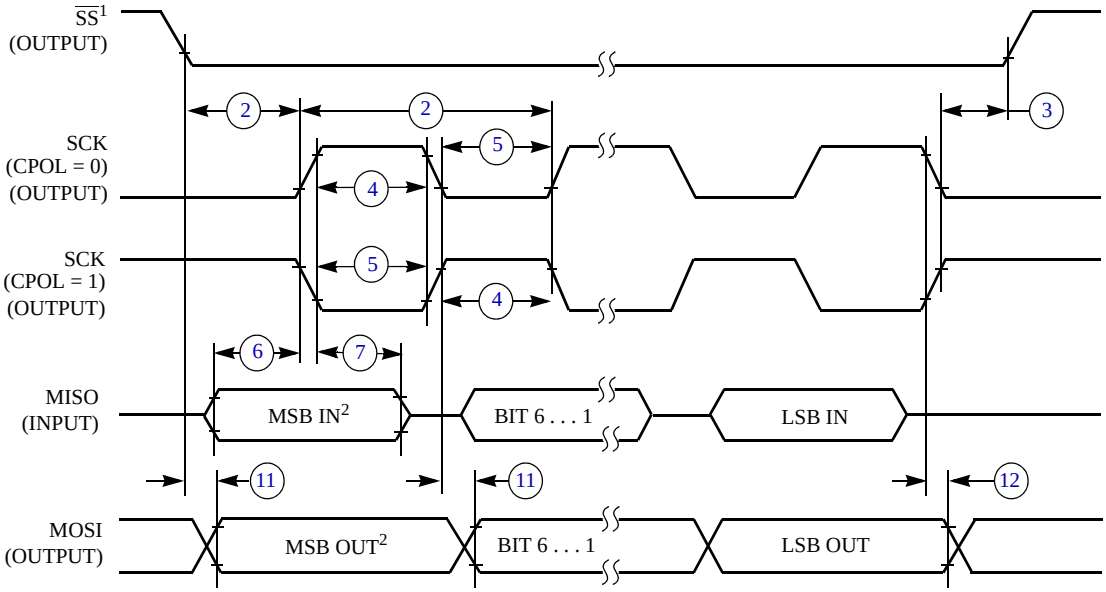
.O	@e^o^``qbofpqf` /	Pv j _li	Jfk	J^u	Rkfq	@
.	Lmbo^qfkd cobnrbk`v J^pqbo Pi^sb	clm	c?rp,/-15 -	c?rp,/ c?rp,1	Ew Ew	A
/	PMP@H mbofla J^pqbo Pi^sb	qPMP@H	/ 1	/-15 Æ	q`v` q`v`	A
0	Bk^_ib ib^a qf j b J^pqbo Pi^sb	qlb^a	.// .	Æ Æ	qPMP@H q`v`	A
1	Bk^_ib i^d qf j b J^pqbo Pi^sb	ql^d	.// .	Æ Æ	qPMP@H q`v`	A
2	@il`h %PMP@H& efde lo il t qf j b J^pqbo Pi^sb	qTPMP@H	q`v`¬0- q`v`¬0-	.-/1q`v` Æ	kp kp	A
3	A^q^ pbqrm qf j b %fkmrqp& J^pqbo Pi^sb	qPR qPR	.2 .2	Æ Æ	kp kp	A
4	A^q^ elia qf j b %fkmrqp& J^pqbo Pi^sb	qEF qEF	- /2	Æ Æ	kp kp	A
5	Pi^sb ^``bpp qf j b[0]	q^	Æ	.	q`v`	A
6	Pi^sb JFPL afp^_ib qf j b[1]	qafp	Æ	.	q`v`	A
.-	A^q^ s^ifa %^qbo PMP@H badb& J^pqbo Pi^sb	qs	Æ Æ	/2 /2	kp kp	A
..	A^q^ elia qf j b %lrqmrqp& J^pqbo Pi^sb	qEL	- -	Æ Æ	kp kp	A
./	Ofpb qf j b Fkmrq Lrqmrq	qOF qOL	Æ Æ	q`v`¬/2 /2	kp kp	A
.0	C^iiqf j b Fkmrq Lrqmrq	qCF qCL	Æ Æ	q`v`¬/2 /2	kp kp	A

· Krj _bop fk qefp `lirj k fabkqfcv bib j bkqp fk Cfdrob .2 qeolrde Cfdrob .5+

/ >ii qf j fkd fp pelt k tfqe obpmb`qql /-" $S_{AA}$ ^ka 4-" $S_{AA}$) rkibpp klqba8 .--mCil^a lk ^ii PMF mfkp+ >ii qf j fkd ^pprj bp pibt o^qb `lkqoli afp^_iba ^ka efde aofsb pqobkdqe bk^_iba clo PMF lrqmrq mfkp+

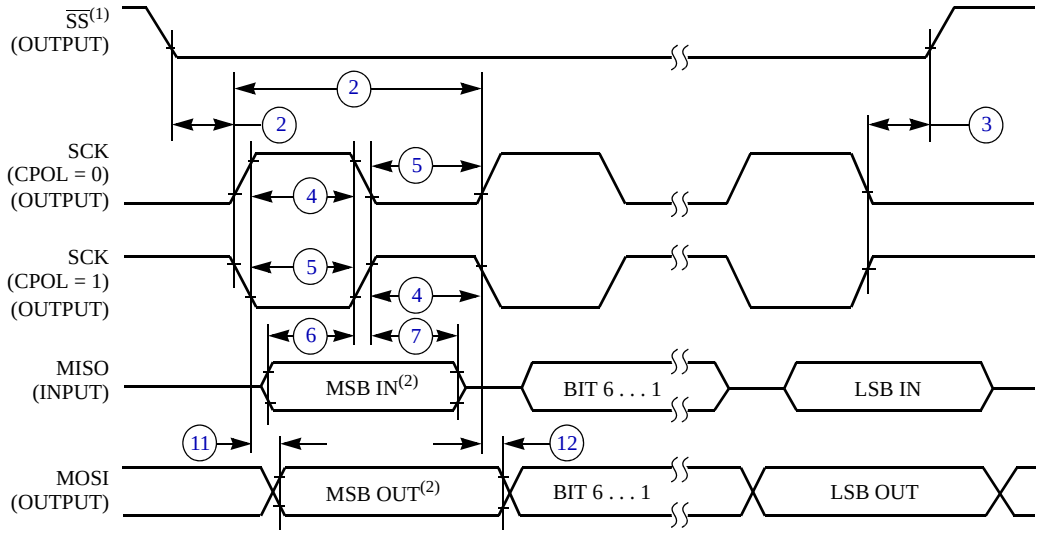
0 Qf j b ql a^q^ ^`qfsb col j efde*f j mba^k`b pq^qb+

1 Elia qf j b ql efde*f j mba^k`b pq^qb+



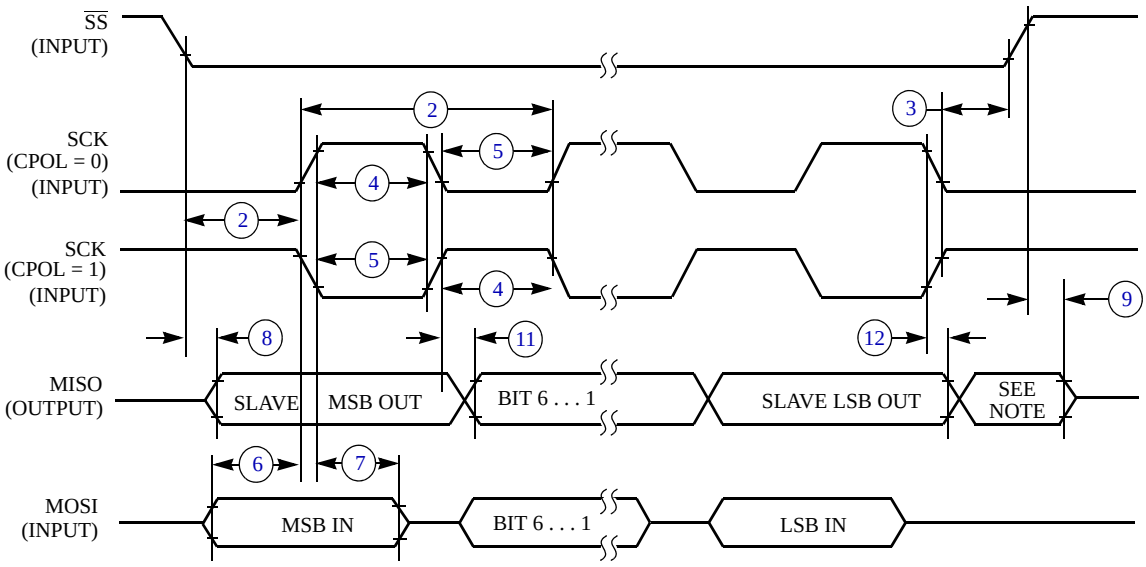
NOTES:
1. SS output mode (MODFEN = 1, SSOE = 1).
2. LSBF = 0. For LSBF = 1, bit order is LSB, bit 1, ..., bit 6, MSB.

Cfdrob .2+ PMF J^pqbo Qfjfkd %@ME> : -&



NOTES:
1. SS output mode (MODFEN = 1, SSOE = 1).
2. LSBF = 0. For LSBF = 1, bit order is LSB, bit 1, ..., bit 6, MSB.

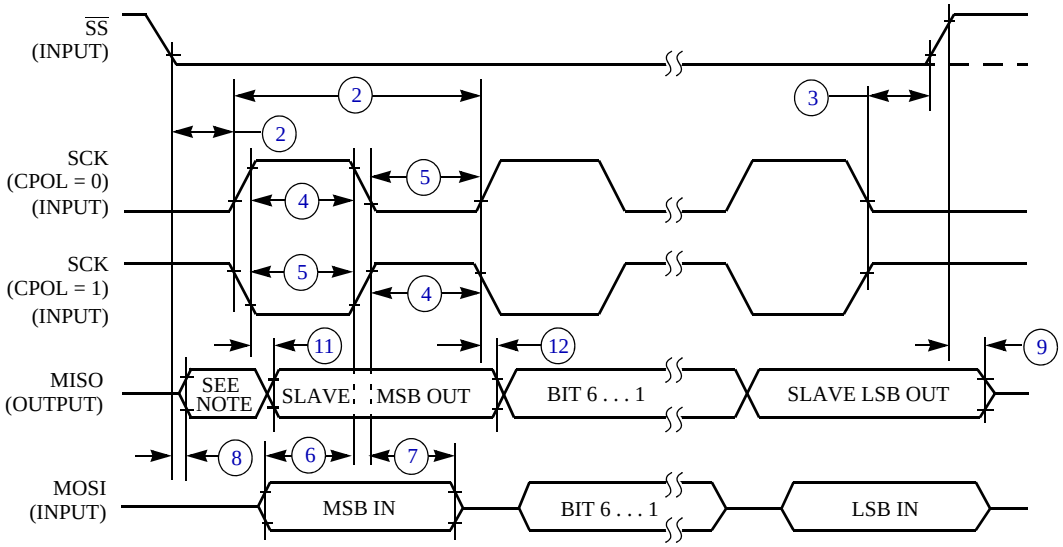
Cfdrob .3+ PMF J^pqbo Qfjfkd %@ME> : .&



NOTE:

1. Not defined, but normally MSB of character just received

Cfdrob .4+ PMF Pi^sb Qf j fkd %@ME> : -&



NOTE:

1. Not defined, but normally LSB of character just received

Cfdrob .5+ PMF Pi^sb Qf j fkd %@ME> : .&

0+.1 Ci^pe Pmb`fcf`^qflkp

This section provides details about program/erase times and program-erase endurance for the Flash memory.

Program and erase operations do not require any special power sources other than the normal V_{DD} supply. For more detailed information about program/erase operations, see the Memory chapter in the Reference Manual for this device (MCF51MM256RM).

4ABLE &ASH#HARACTERISTICS

	#HARACTERISTIC	3YMBOL	-IN	4YPICAL	-AX	5NIT	#
.	Prmmiv sliq^db clo mold o^ j ,bo^pb ¬1-¯@ql .-2¯@	S mold,bo^pb	.+5	—	0+3	S	A
/	Prmmiv sliq^db clo ob^a lmbo^qflk	SOb^a	.+5	—	0+3	S	A
0	Fkqbok^i C@IH cobnrbk`v·	CC@IH	.2-	—	/--	hEw	A
1	Fkqbok^i C@IH mbofla %.,C@IH&	qC`v`	2	—	3+34	mp	A
2	?vqb mold o^ j qf j b %o^kal j il`^qflk&/	qmold	6			qC`v`	M
3	?vqb mold o^ j qf j b %_ropq j lab&/	q?ropq	1			qC`v`	M
4	M^db bo^pb qf j b/	qM^db	1---			qC`v`	M
5	J^pp bo^pb qf j b/	qJ^pp	/-)---			qC`v`	M
6	Mold o^ j ,bo^pb bkaro^k`b0 Q l ql Q E : ¬1-¯@ql (.-2¯@ Q : /2¯@		.-)--- Æ	Æ .--)---	Æ Æ	`v`ibp	@
.-	A^q^ obqbkqflk1	qA\obq	.2	.--	Æ	vb^op	@

1 The frequency of this clock is controlled by a software setting.

2 These values are hardware state machine controlled. User code does not need to count cycles. This information supplied for calculating approximate time to program and erase.

3 **Typical endurance for flash** was evaluated for this product family on the HC9S12Dx64. For additional information on how Freescale defines typical endurance, please refer to Engineering Bulletin EB619, *Typical Endurance for Nonvolatile Memory*.

4 **Typical data retention** values are based on intrinsic capability of the technology measured at high temperature and de-rated to 25qC using the Arrhenius equation. For additional information on how Freescale defines typical data retention, please refer to Engineering Bulletin EB618, *Typical Data Retention for Nonvolatile Memory.*

0+.2 RP? Bib`qof`^ip

The USB electricals for the USB On-the-Go module conform to the standards documented by the Universal Serial Bus Implementers Forum. For the most up-to-date standards, visit http://www.usb.org.

If the Freescale USB On-the-Go implementation has electrical characteristics that deviate from the standard or require additional information, this space would be used to communicate that information.

4ABLE)NTERNAL53"66OLTAGE2EGULATOR#HARACTERISTICS

	#HARACTERISTIC	3YMBOL	-IN	4YP	-AX	5NIT	#
.	Obdri^qlo lmbo^qfkd slq^db	S_{obdfk}	0+6	Æ	2+2	S	@
/	SOBD lrqmrq	S_{obdlrq}	0	0+0	0+42	S	M
0	$S_{RP?00}$ fkmrq tfqe fkqbok^i SOBD afp^_iba	S_{rp_00fk}	0	0+0	0+3	S	@
1	SOBD Nrfbp`bkq @roobkq	F_{SON}	Æ	-+2	Æ	j >	@

3.16 VREF Electrical Specifications

Table 26. VREF Electrical Specifications

#	Characteristic	Symbol	Min	Max	Unit	C
.	Prmmiv sliq^db	$S_{AA>}$	.+5-	0+3	S	@
/	Lmbo^qfkd qb j mbo^qrob o^kdb	$Q_{>}$	¬1-	.-2	Þ@	@
0	Lrqmrq ll^a @^m^`fq^k`b	$@_{l}$	Æ	.--	kC	A
1	J^uf j r j ll^a	Æ	Æ	.-	j >	Æ
2	Sliq^db Obcbobk`b Lrqmrq tfqe C^`qlov Qof j + S_{AA} : 0 S ^q /2 Þ@	S_{lrq}	.+.12	.+.20	S	M
3	Qb j mbo^qrob Aofcq %S_{jfk}ÆS$_{j^u}$ ^`olpp qeb criiqb j mbo^qrob o^kdb&	Q_{aofcq}	Æ	/2	j S·	Q
4	>dfkd @lbccf`fbkq/	$>_{@}$	Æ	3-	mS,vb^o	@
5	Mltboba altk @roobkq %Lcc Jlab) SOBCBK:-) SOPQBK:-&	F	Æ	-+.-	m>	@
6	?^kad^m lkiv %Jlab\ISX.7-Z : --&	F	Æ	42	m>	Q
.-	llt*Mltbo _rccbo %JLAB\ISX.7-Z : -.&	F	Æ	./2	m>	Q
..	Qfdeq*Obdri^qflk _rccbo %JLAB\ISX.7-Z : .-&	F	Æ	.+.	j >	Q
./	ll^a Obdri^qflk JLAB\IS : .-	Æ	Æ	.--	mS, j >	@
.0	Ifkb Obdri^qflk JLAB : .7-) Qfdeq Obdri^qflk S_{AA} 9 /+0 S) Abiq^ $S_{AA>}$: .-- j S) SOBCE : .+/ S aofsbk buqbok^iiv tfqe SOBCL afp^_iba+%Mltbo Prmmiv Obgb`qflk&	A@	4-	Æ	a?	@

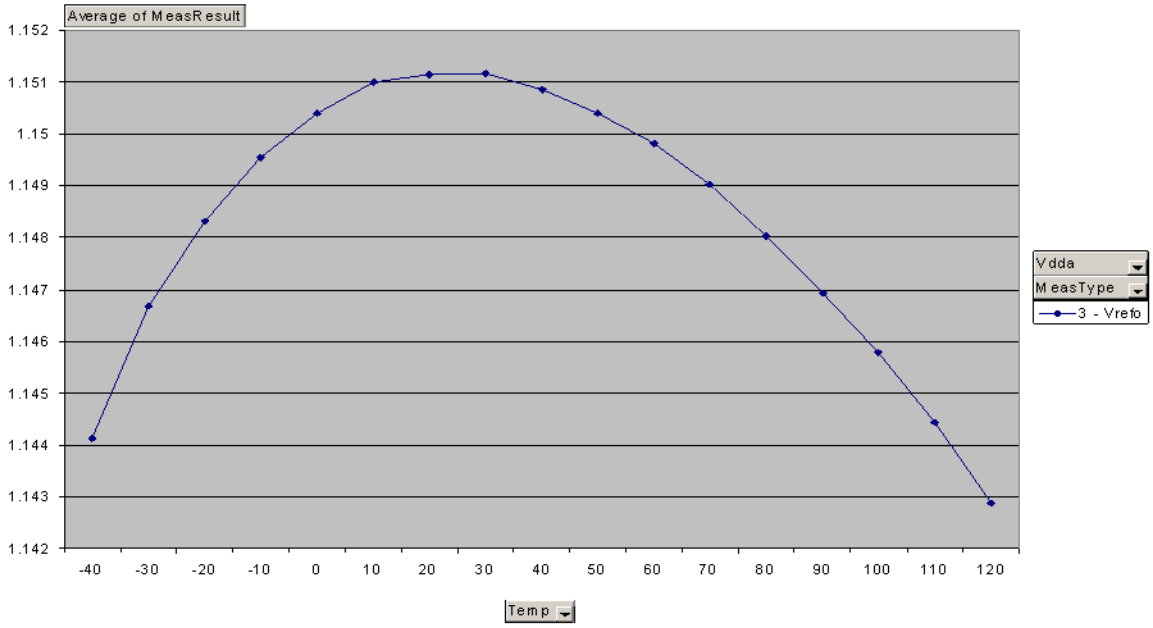
1 See typical chart that follows (Figure 20).

2 Linear reliability model (1008 hours stress at 125°C = 10 years operating life) used to calculate Aging PV/year. VREF0 data recorded per month.

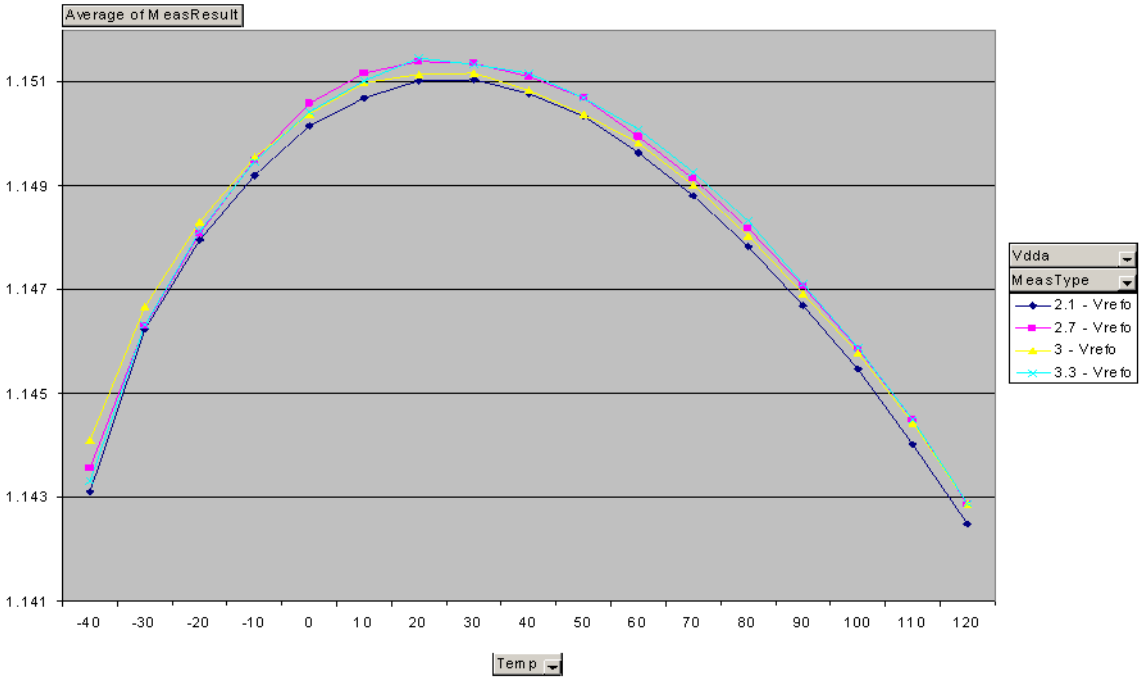
Table 27. VREF Limited Range Operating Behaviors

#	Characteristic	Symbol	Min	Max	Unit	C
.	Sliq^db Obcbobk`b Lrqmrq tfqe C^`qlov Qof j %Qb j mbo^qrob o^kdb colj -Þ@ql 2- Þ@&	S_{lrq}	.+.16	.+./	j S	Q
/	Qb j mbo^qrob Aofsb %S_{jfk} ÆS$_{j^u}$ Qb j mbo^qrob o^kdb colj - Þ@ql 2- Þ@&	Q_{aofcq}	Æ	0	j S·	Q

1 See typical chart that follows (Figure 20).



Cfdrob .6+ Qvmf`^i SOBC L rqmrq sp+ Qb j mbo^qrob



Cfdrob /-+ Qvmf`^i SOBC L rqmrq sp+ S AA

0+.4 QOF> J M Bib`qof`^i M^o^ j bqbop

Q^_ib /5+ QOF> J M @e^o^`qbofpqf`p .+5 ¬0+3 S) ¬1-Þ@{.-2Þ@

	@e^o^`qbofpqf`·	Pv j _li	Jfk	Qvm /	J^u	Rkfq	@
.	Lmbo^qfkd Sliq^db	S_{AA}	.+5	Æ	0+3	S	@
/	Prmmiv @roobkq %F_{LRQ}:- j >) @l:-& l l t*ml tbo j lab	F_{PRMMIV}	Æ	2/	3-	m>	Q
0	Prmmiv @roobkq %F_{LRQ}:- j >) @l:-& Efde*pmbba j lab	F_{PRMMIV}	Æ	10/	15-	m>	Q
1	Fkmrq Lccpbq Sliq^db	S_{LP}	Æ	Ù.	Ù2	jS	Q
2	Fkmrq Lccpbq Sliq^db Qb j mbo^qrob Aofcq	a_{SLP}	Æ	3--	Æ	mS	Q
3	Fkmrq Lccpbq @roobkq	F_{LP}	Æ	Ù./-	2--	m>	Q
4	Fkmrq ?f^p @roobkq %- { 2-Þ@&	$F_{?F>P}$	Æ	9 02-	9 Ù2--	m>	Q
5	Fkmrq ?f^p @roobkq %¬1- { .-2Þ@&	$F_{?F>P}$	Æ	0	3+22	k>	Q
6	Fkmrq @l j j lk J lab Sliq^db l l t	$S_{@JI}$	-	Æ	Æ	S	Q
.-	Fkmrq @l j j lk J lab Sliq^db Efde	$S_{@JE}$	Æ	Æ	S_{AA}¬.+1	S	Q
..	Fkmrq Obpfpq^k`b	O_{FK}	2--	Æ	Æ	JW	Q
./	Fkmrq @^m^`fq^k`bp	$@_{FK}$	Æ	Æ	2	mC	A
.0	>@ Fkmrq F j mba^k`b %c_{FK}:.--hEw&	$yU_{FK}y$	Æ	.	Æ	JW	A
.1	Fkmrq @l j j lk J lab Obgb`qflk O^qfl	@JOO	3-	4-	Æ	a?	Q
.2	Ml tbo Prmmiv Obgb`qflk O^qflk	MPOO	3-	4-	Æ	a?	Q
.3	Pibt O^qb %DS_{FK}:.--j S& l l t*ml tbo j lab	PO	Æ	-+.	Æ	S,mp	Q
.4	Pibt O^qb %DS_{FK}:.--j S& Efde*pmbba j lab	PO	Æ	.	Æ	S,mp	Q
.5	Rkfqv D^fk ?^ka t faqe %l l t*ml tbo j lab& 2-mC	D?T	-+.2	-+/2	Æ	JEw	Q
.6	Rkfqv D^fk ?^ka t faqe %Efde*pmbba j lab& 2-mC	D?T	Æ	.+3	Æ	JEw	Q
/-	A@ Lmbk l l l m Sliq^db D^fk	$>_S$	Æ	5-	Æ	a?	Q
/.	l l^a @^m^`fq^k`b Aofsfkd @^m^_fifqv	@l%j ^u&	Æ	Æ	.--	mC	Q
//	L rqmrq F j mba^k`b >@ Lmbk l l l m %=.--hEw l l t*ml tbo j lab&	O_{LRQ}	Æ	.+1	Æ	hW	A
/0	L rqmrq F j mba^k`b >@ Lmbk l l l m %=.--hEw Efde*pmbba j lab&	O_{LRQ}	Æ	.51	Æ	W	A
/1	L rqmrq Sliq^db O^kdb	qofl rq	-+.2	Æ	S_{AA} ¬ -+.2	S	Q
/2	L rqmrq Aofsb @^m^_fifqv	F_{LRQ}	Æ	Ù .+-	Æ	j >	Q
/3	D^fk J ^odfk	DJ	/-	Æ	Æ	a?	A
/4	Me^pb J ^odfk	MJ	12	22	Æ	abd	Q

Q^_ib /5+ QOF> JM @e^o^`qbofpqf`p .+5 ¬0+3 S) ¬1-Þ@{.-2Þ@ %`lkqfkrba&

	@e^o^`qbofpqf`·	Pvj_li	Jfk	Qvm /	J^u	Rkfq	@
/5	Fkmrq Sliq^db Klfpb Abkpfqv	c:. hEw	Æ	.3-	Æ	kS,ÕEw	Q

· >ii m^o^ j bqbop ^ob j b^proba ^q 0+- S) @l: 14 mC ^`olpp qb j mbo^qrob ¬1-ql (.-2Þ@ rkibpp pmb`fcfba+
/ A^q^ fk Qvmf`^i `lir j k t^p `e^o^`qbofwba ^q 0+- S) /2Þ@ lo fp qvmf`^i ob`l j j bkaba s^irb+

0+.5 LM> JM Bib`qof`^i M^o^ j bqbop

Q^_ib /6+ LM> JM @e^o^`qbofpqf`p .+5 ¬0+3 S

	@e^o^`qbofpqf`p ·	Pvj_li	Jfk	Qvm /	J^u	Rkfq	@
.	Lmbo^qfkd Sliq^db	S_{AA}	.+5	Æ	0+3	S	@
/	Prmmiv @roobkq %F_{LRQ}:-j>) @l:- llt*Mltbo j lab&	F_{PRMMIV}	Æ	15	5-	m>	Q
0	Prmmiv @roobkq %F_{LRQ}:-j>) @l:- Efde*Pmbba j lab&	F_{PRMMIV}	Æ	02-	2--	m>	Q
1	Fkmrq Lccpbq Sliq^db	S_{LP}	Æ	°/	°3	jS	Q
2	Fkmrq Lccpbq Sliq^db Qb j mbo^qrob @lbccf`fbkq	a_{SLP}	Æ	.-	Æ	mS,@	Q
3	Fkmrq Lccpbq @roobkq %¬1-Þ@ ql .-2Þ@&	F_{LP}	Æ	°/+2	°/2-	k>	Q
4	Fkmrq Lccpbq @roobkq %¬1-Þ@ ql 2-Þ@&	F_{LP}	Æ	Æ	12	k>	Q
5	Mlpfqfsb Fkmrq ?f^p @roobkq %¬1-Þ@ ql .-2Þ@&	$F_{?F>P}$	Æ	-+5	0+2	k>	Q
6	Mlpfqfsb Fkmrq ?f^p @roobkq %¬1-Þ@ ql 2-Þ@&	$F_{?F>P}$	Æ	Æ	°/	k>	Q
.-	Kbd^qfsb Fkmrq ?f^p @roobkq %¬1-Þ@ ql .-2Þ@&	$F_{?F>P}$	Æ	/+2	/2-	k>	Q
..	Kbd^qfsb Fkmrq ?f^p @roobkq %¬1-Þ@ ql 2-Þ@&	$F_{?F>P}$	Æ	Æ	12	k>	Q
./	Fkmrq @l j j lk J lab Sliq^db llt	$S_{@JI}$	-+.	Æ	Æ	S	Q
.0	Fkmrq @l j j lk J lab Sliq^db Efde	$S_{@JE}$	Æ	Æ	S_{AA}	S	Q
.1	Fkmrq Obpfpq^k`b	O_{FK}	Æ	2--	Æ	JW	Q
.2	Fkmrq @^m^`fq^k`bp	$@_{FK}$	Æ	Æ	.-	mC	A
.3	>@ Fkmrq F j mba^k`b %c_{FK}:.--hEw Kbd^qfsb @e^kkbi&	$yU_{FK}y$	Æ	2/	Æ	hW	A
.4	>@ Fkmrq F j mba^k`b %c_{FK}:.--hEw Mlpfqfsb @e^kkbi&	$yU_{FK}y$	Æ	.0/	Æ	hW	A
.5	Fkmrq @l j j lk J lab Obqb`qflk O^qfl	@JOO	22	32	Æ	a?	Q
.6	Mltbo Prmmiv Obqb`qflk O^qfl	MPOO	3-	32	Æ	a?	Q
/-	Pibt O^qb %DS_{FK}:.--jS llt*Mltbo j lab&	PO	-+.	Æ	Æ	S,mp	Q
/.	Pibt O^qb %DS_{FK}:.--jS Efde*Pmbba j lab&	PO	.	Æ	Æ	S,mp	Q
//	Rkfqv D^fk ?^katfaqe %llt*Mltbo j lab&	D?T	-+/	Æ	Æ	JEw	Q
/0	Rkfqv D^fk ?^katfaqe %Efde*Pmbba j lab&	D?T	.	Æ	Æ	JEw	Q
/1	A@ Lmbk lllm Sliq^db D^fk	$>_S$	5-	6-	Æ	a?	Q
/2	ll^a @^m^`fq^k`b Aofsfkd @^m^_fifqv	@l%j^u&	Æ	Æ	.--	mC	Q
/3	Lrqmrq F j mba^k`b >@ Lmbk lllm %=.--hEw llt*Mltbo j lab&	O_{LRQ}	Æ	1h	Æ	W	A

Q^_ib /6+ LM> JM @e^o^`qbofpqf`p .+5 ¬0+3 S %`lkqfkrba&

	@e^o^`qbofpqf`p ·	Pvj_li	Jfk	Qvm /	J^u	Rkfq	@
/4	Lrqmrq Fjmba^k`b >@ Lmbk lllm%=.--hEw Efde*Pmbba jlab&	O_{LRQ}	Æ	//-	Æ	W	A
/5	Lrqmrq Sliq^db O^kdb	S_{LRQ}	-+.2	Æ	S_{AA}¬-+. 2	S	Q
/6	Lrqmrq Aofsb @^m^_fifqv	F_{LRQ}	°-+2	°.+-	Æ	j>	Q
0-	D^fk J^odfk	DJ	/-	Æ	Æ	a?	A
0.	Me^pb J^odfk	MJ	12	22	Æ	abd	Q
0/	DM> JM pq^oqrm qfjb%llt*Mltbo jlab& %Qlibo^k`b 9 .") Sfk : -+2 Sm¬m) @l : /2 mC) Ol : .--h&	Q_{pq^oqrm}	Æ	1	Æ	rP	Q
00	DM> JM pq^oqrm qfjb%llt*Mltbo jlab& %Qlibo^k`b 9 .") Sfk : -+2 Sm¬m) @l : /2 mC) Ol : .--h&	Q_{pq^oqrm}	Æ	.	Æ	rP	Q
01	Fkmrq Sliq^db Klfpb Abkpfqv	c:.hEw	Æ	/2-	Æ	kS,ÕEw	Q

: >iim^o^jbqbop ^ob jb^proba ^q O+O S) @l :14 mC ^`olpp qbjmbo^qrob ¬1- ql ( .-2Þ@ rkibpp pmb`fcfba+
/ A^q^ fk Qvmf`^i`lirjk t^p `e^o^`qbofwba ^q 0+- S) /2Þ@ lo fp qvmf`^iob`ljjbkaba s^irb+

4 Ordering Information

This section contains ordering information for the device numbering system. See Table 1 for feature summary by package information.

4.1 Part Numbers

Table 30. Orderable Part Number Summary

Freescale Part Number	Description	Flash / SRAM (Kbytes)	Package	Temperature
J@C2.JJ/23SJI	J@C2.JJ/23@IiaCfob Jf`oI`IkqoIiibo	/23H,0/H	.-1 J>M?D>	¬1-qI.-2Þ@
J@C2.JJ/23SII	J@C2.JJ/23@IiaCfob Jf`oI`IkqoIiibo	/23H,0/H	.-- INCM	¬1-qI.-2Þ@
J@C2.JJ/23SJ?	J@C2.JJ/23@IiaCfob Jf`oI`IkqoIiibo	/23H,0/H	5. J>M?D>	¬1-qI.-2Þ@
J@C2.JJ/23SIH	J@C2.JJ/23@IiaCfob Jf`oI`IkqoIiibo	/23H,0/H	5- INCM	¬1-qI.-2Þ@
J@C2.JJ./5SJ?	J@C2.JJ./5@IiaCfob Jf`oI`IkqoIiibo	./5H,0/H	5. J>M?D>	¬1-qI.-2Þ@
J@C2.JJ./5SIH	J@C2.JJ./5@IiaCfob Jf`oI`IkqoIiibo	./5H,0/H	5- INCM	¬1-qI.-2Þ@

4.2 Package Information

Table 31. Package Descriptions

Pin Count	Package Type	Abbreviation	Designator	Case No.	Document No.
.--	Ilt Nr^aCi^qM^`h^db	INCM	II	650*-0	65>PP/00-5T
5-	Ilt Nr^aCi^qM^`h^db	INCM	IH	.1.5	65>PP/0.41T
.-1	J>M?D>M^`h^db	J>M?D>	JI	./52*-/	65>OE65/34>
5.	J>M?D>M^`h^db	J>M?D>	J?	.33/*-.	65>P>.-34-A

4.3 Mechanical Drawings

Table 31 provides the available package types and their document numbers. The latest package outline/mechanical drawings are available on the MCF51MM256/128 Product Summary pages at http://www.freescale.com.

To view the latest drawing, either:

- Click on the appropriate link in Table 31, or
- Open a browser to the Freescale website (http://www.freescale.com), and enter the appropriate document number (from Table 31) in the “Enter Keyword” search box at the top of the page.

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5 Revision History

This section lists major changes between versions of the MCF51MM256 Data Sheet.

Table 32. Revision History

Revision	Date	Description
-	J^o`e,>mofi /--6	Fkfqf^i Ao^cq
.	Griv /--6	± Obsfpba ql cliil t pq^ka^oa qb j mi^qb+ ± Ob j lsba buqo^kblrp eb^afkdp col j qeb QL@+ ± @loob`qba rkfqp clo J lklqlkl`fqv ql _b _i^kh fk clo qeb A>@ pmb`fcf`^qflk+ ± Rma^qba >A@ `e^o^`qbofpqf` q^_ibp ql fk`irab .3*?fq P>O fk eb^afkdp+
/	Griv /--6	± @e^kdba J@D %ULP@& Bib`qof`^ip Q^_ib * Olt /) >sbo^db Fkqbok^i Obcbobk`b Cobnrbk`v qvmf`^i s^irb col j 0/+435 ql 0.+/2+
0	>mofi /-.-	± Rma^qba Qebo j ^i @e^o^`qbofpqf`p q^_ib+ Obfkpboqba qeb 5. ^ka .-1 J^m?D> absf`bp+ ± Obsfpba qeb BPA ^ka l^q`e*Rm Molqb`qflk @e^o^`qbofpqf` abp`ofmqflk ql ob^a7 l^q`e*rm @roobkq ^q Q> : ./2Þ@+ ± @e^kdba Q^_ib 6+ A@ @e^o^`qbofpqf`p olt p / ^ka 1) ql .+5 S) Fll^a : *3-- j > `lkafqflkp ql .+5 S) Fll^a : 3--m> obpmb`qfsbiv+ ± @loob`qba qeb .3*_fq P>O >A@ Lmbo^qfkd @lkafqflk q^_ib Obc Sliq^db Efde Jfk s^irb ql _b .+.0 fkpqb^a lc .+.2+ ± Rma^qba qeb >A@ bib`qof`^ip+ ± Fkpboqba qeb Jfkf*Cibu?rp Qf j fkd Pmb`fcf`^qflkp+ ± >aaba ^ Qb j m Aofcq m^o^ j bqbo ql qeb SOBC Bib`qof`^i Pmb`fcf`^qflkp+ ± Ob j lsba qeb P-5 K^ j fkd @lksbkqflk af^do^ j + ± Rma^qba qeb Loabo^_ib M^oq Krj _bo Prj j ^ov ql fk`irab qeb Cobbp`^ib M^oq Krj _bo prccfubp+ ± @l j mibqba qeb M^`h^db Abp`ofmqflk q^_ib s^irbp+ ± @e^kdba qeb 5-INCM m^`h^db ao^ tfkd col j 65>Ol.-20-A ql 65>PP/0.41T+ ± Rma^qba bib`qof`^i `e^o^`qbofpqf` a^q^+
1	L`ql_bo /-.-	± Rma^qba tfqe qeb i^qbpq `e^o^`qbofpqf` a^q^+ >aaba pbsbo^i cfdrobp+ >aaba qeb >A@ Typical Operation table.
2	Griv /-./	Fk ¦Prmmiv `roobkq `e^o^`qbofpqf`p´q^_ib) ± Clo POF_{AA}) qeb j ^uf j r j s^irb clo qeb cfopq olt ^q .m> fp `e^kdba ql .+0 m> ^ka qeb qvmf`^i s^irb -+32 m> fp `e^kdba ql -+42m>+ ± Clo m^o^ j bqbo 0) `e^kdba ¦IMP´ql ¦IMO´) ¦C?FIM´ql C?F ^ka ¦C?BIM´ql ¦C?B´+ ± Clo m^o^ j bqbo 1) `e^kdba ¦IMP´ql ¦IMO´) ^ka ¦C?BIM´ql ¦?IMB´fk _lqe fkpq^k`bp+

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Cobbp`^ib E^i_ibfqbo Abrqp`ei^ka D j _E
Qb`ekf`^i Fkclo j ^qflk @bkqbo
P`e^qw_ldbk 4
5.5/6 Jrbk`ebk) Dbo j ^kv
(11 ./63 05- 123 %Bkdifpe&
(13 5 2//---5- %Bkdifpe&
(16 56 6/.-0 226 %Dbo j ^k&
(00 . 36 02 15 15 %Cobk`e&
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Japan:
Cobbp`^ib Pb j f`lkar`qlo G^m^k lqa+
Eb^anr^oqbop
>O@L Ql tbo .2C
.*5*.) Pefj l*Jbdrol) Jbdrol*hr)
Qlhvl .20*--31
G^m^k
-./- .6.-.1 lo (5. 0 2104 6./2
prmmloq+q^m^k = cobbp`^ib+`l j

Asia/Pacific:
Cobbp`^ib Pb j f`lkar`qlo @efk^ lqa+
Bu`e^kdb ?rfiafkd /0C
Kl+ ..5 Gf^kdrl Ol^a
@e^lv^kd Afpqof`q
?bfgfkd .---//
@efk^
(53 .- 2546 5---
prmmloq+^pf^ = cobbp`^ib+`l j

Cobbp`^ib Pb j f`lkar`qlo lfqbo^qrob Afpqof_rqflk @bkqbo
M+L+ ?lu 21-2
Abksbo) @lilo^al 5-/.4
.*5--*11.*/114 lo (.*0-0*342*/.1-
C^u7 (.*0-0*342*/.2-
lA@ClocObbp`^ibPb j f`lkar`qlo = ef__boqdolrm+`l j

Al`r j bkq Kr j _bo7 J@C2. J J/23
Obs+ 2
-4,/-./

Fkclo j ^qflk fk qefp al`r j bkq fp molsfaba plibiv ql bk^_ib pvpqb j ^ka plcq t^ob
f j mib j bkqbop ql rpb Cobbp`^ib Pb j f`lkar`qlo molar`qp+ Qebob ^ob kl bumobpp lo
f j mifba `lmvofdeq if`bkpbp do^kqba ebobrkabo ql abpfdk lo c^_of`^qb ^kv fkqbdo^qba
`fo`rfqp lo fkqbdo^qba `fo`rfqp _^pba lk qeb fkclo j ^qflk fk qefp al`r j bkq+

Cobbp`^ib Pb j f`lkar`qlo obpbosbp qeb ofdeq ql j ^hb `e^kdbp tfqelrq croqebo klqf`b ql
^kv molar`qp ebobfk+ Cobbp`^ib Pb j f`lkar`qlo j ^hbp kl t^oo^kqv) obmobpbkq^qflk lo
dr^o^kqbb obd^oafkd qeb prfq^_fifqv lc fqp molar`qp clo ^kv m^oqf`ri^o mromlpb) klo albp
Cobbp`^ib Pb j f`lkar`qlo ^ppr j b ^kv if^_fifqv ^ofpfkd lrq lcqeb ^mmif`^qflk lo rpb lc ^kv
molar`q lo `fo`rfq) ^ka pmb`fcf`^iiv afp`i^f j p ^kv ^ka ^ii if^_fifqv) fk`irafkd tfqelrq
if j fq^qflk `lkpbnrbkqf^i lo fk`fabkq^i a^ j ^dbp+ ¦Qvmf`^i´ m^o^ j bqbop qe^q j ^v _b
molsfaba fk Cobbp`^ib Pb j f`lkar`qlo a^q^ pebbqp ^ka, lo pmb`fcf`^qflkp `^k ^ka al s^ov
fk afccbobkq ^mmif`^qflkp ^ka ^`qr^i mboclo j ^k`b j ^v s^ov lsbo qf j b+ >ii lmbo^qfkd
m^o^ j bqbop) fk`irafkd ¦Qvmf`^ip´) j rpq _b s^ifa^qba clo b^`e `rpql j bo ^mmif`^qflk _v
`rpql j bo$p qb`ekf`^i bumboqp+ Cobbp`^ib Pb j f`lkar`qlo albp klq `lksbv ^kv if`bkpb
rkabo fqp m^qbkq ofdeqp klo qeb ofdeqp lc lqebop+ Cobbp`^ib Pb j f`lkar`qlo molar`qp ^ob
klq abpfdkba) fkqbkaba) lo ^rqelofwba clo rpb ^p `l j mlkbkqp fk pvpqb j p fkqbkaba clo
prodf`^i f j mi^kq fkql qeb _lav) lo lqebo ^mmif`^qflkp fkqbkaba ql prmmloq lo prpq^fk ifcb)
locl o ^kv lqebo ^mmif`^qflk fk tef`e qeb c^firob lc qeb Cobbp`^ib Pb j f`lkar`qlo molar`q
`lria `ob^qb ^ pfqr^qflk tebob mbop lk^i fkgrov lo ab^qe j ^v l``ro+ Pelria ?rvbo
mro`e^pb lo rpb Cobbp`^ib Pb j f`lkar`qlo molar`qp clo ^kv pr`e rkfkqbkaba lo
rk^rqelofwba ^mmif`^qflk) ?rvbo pe^ii fkab j kfcv ^ka elia Cobbp`^ib Pb j f`lkar`qlo ^ka
fqp lccf`bop) b j milvbbp) pr_pfaf^ofbp) ^ccfif^qbp) ^ka afpqof_rqlop e^o j ibpp ^d^fkpq ^ii
`i^f j p) `lpqp) a^ j ^dbp) ^ka bumbkpbp) ^ka ob^plk^_ib ^qqlokbv cbbp ^ofpfkd lrq lc)
afob`qiv lo fkafob`qiv) ^kv `i^f j lc mbop lk^i fkgrov lo ab^qe ^ppl`f^qba tfqe pr`e
rkfkqbkaba lo rk^rqelofwba rpb) bsbk fc pr`e `i^f j ^iibdbp qe^q Cobbp`^ib
Pb j f`lkar`qlo t^p kbdifdbkq obd^oafkd qeb abpfdk lo j ^krc^`qrob lc qeb m^oq+

OlEP*`l j mif^kq ^ka, lo M_*cobb sboqflkp lc Cobbp`^ib molar`qp e^sb qeb crk`qflk^ifqv
^ka bib`qof`^i `e^o^`qbofpqf`p ^p qebfo klk*OlEP*`l j mif^kq ^ka, lo klk*M_*cobb
`lrkqbom^oqp+ Clo croqebo fkclo j ^qflk) pbb eqqm7,, t t t+cobbp`^ib+`l j lo `lkq^`q vlro
Cobbp`^ib p^ibp obmobpbkq^qfsb+

Clo fkclo j ^qflk lk Cobbp`^ib$p Bksfolk j bkq^i Molar`qp moldo^ j) dl ql
eqqm7,, t t t+cobbp`^ib+`l j ,bmm+

Cobbp`^ibÖ ^ka qeb Cobbp`^ib ildl ^ob qo^ab j ^ohp lc Cobbp`^ib Pb j f`lkar`qlo) Fk`+
>ii lqebo molar`q lo pbosf`b k^ j bp ^ob qeb molmboqv lc qebfo obpmb`qfsb ltkbop+
ç Cobbp`^ib Pb j f`lkar`qlo) Fk`+ /--6*/-./+ >ii ofdeqp obpbosba+

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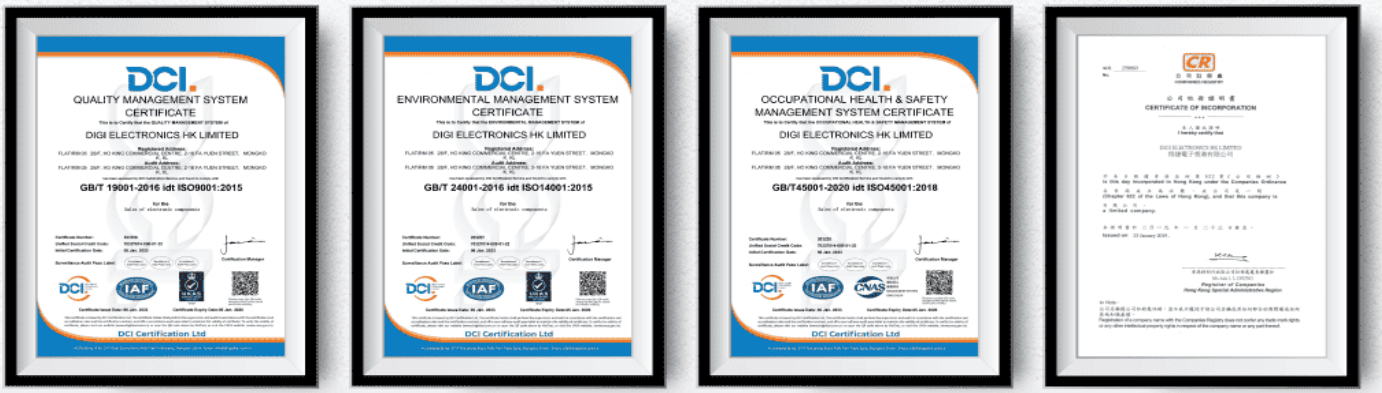

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