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PRODUCT OVERVIEW

SAM87RC PRODUCT FAMILY

Samsung's SAM87RC family of 8-bit single-chip CMOS microcontrollers offers a fast and efficient CPU, a wide range of integrated peripherals, and various mask-programmable ROM sizes. Important CPU features include:

- Fast SAM87RC (Reduced Cycle) core
- Efficient register-oriented architecture
- Release by interrupt of Idle and Stop power-down modes

KS88C9616 MICROCONTROLLER

The KS88C9616 single-chip CMOS microcontroller is specially designed and packaged for “smart card” applications.

The SAM87RC CPU architecture supports Stop and Idle power-down modes for reduced power consumption. To increase the general-purpose register space, the physical internal register file is logically expanded.

The KS88C9616 has 32 K bytes of program memory (ROM), 16 K bytes of data memory (EEPROM), 272-byte general-purpose register file and 1024-bytes data buffer (SRAM). The following peripherals are integrated on-chip:

- One 16-bit random number generator
- Asynchronous serial I/O interface (half-duplex)
- EEPROM write inhibit features for data security
- Non erasable 32 bytes of EEPROM

Data can be loaded into the EEPROM in units ranging from one byte to 32-byte. A typical EEPROM erase or write operation takes 1.5 milliseconds.

A simple yet effective hardware-level security feature based on abnormal voltage, frequency, decapsulation temperature and light exposure detection circuits keeps data stored in PROM/EEPROM.

The KS88C9616's 8-pin COB package and its serial I/O interface are fully compliant with ISO standards 7816, respectively.

FEATURES

CPU

- 8-bit architecture CPU in CMOS technology (SAM87RC core)
- 78 instructions including multiply and divide
- 2 interrupt sources
- Power down modes control

Memory

- 32 K bytes for user application program
- 1-Kbyte static RAM
- 272 bytes for general-purpose register file

EEPROM

- 16-Kbyte EEPROM as data memory
- 1 to 32-byte multi-byte write and erase
- 1.5 ms fast erase or write time
- 1,000,000 erase/write cycles
- 100 years data retention

Serial I/O Interface (hardware)

- Asynchronous half-duplex character transmission serial interface (conforms to ISO standards 7816-3)

Security

- Secure (non-readable) ROM coding
- 32 bytes security PROM for unique serial number
- Non erasable 32bytes of EEPROM
- Reset operations are selective if abnormal voltage, frequency, temperature, light exposure, decapsulation are detected

Random Number Generator

- One 16-bit random number generator for security key generation
- Start and Stop control

Reset

- Power-on reset and external reset operation

Operating Frequency Range

- 1–5 MHz

Operating Temperature

- – 25 °C to + 70 °C

Operating Voltage Range

- 2.7 V to 5.5 V

BLOCK DIAGRAM

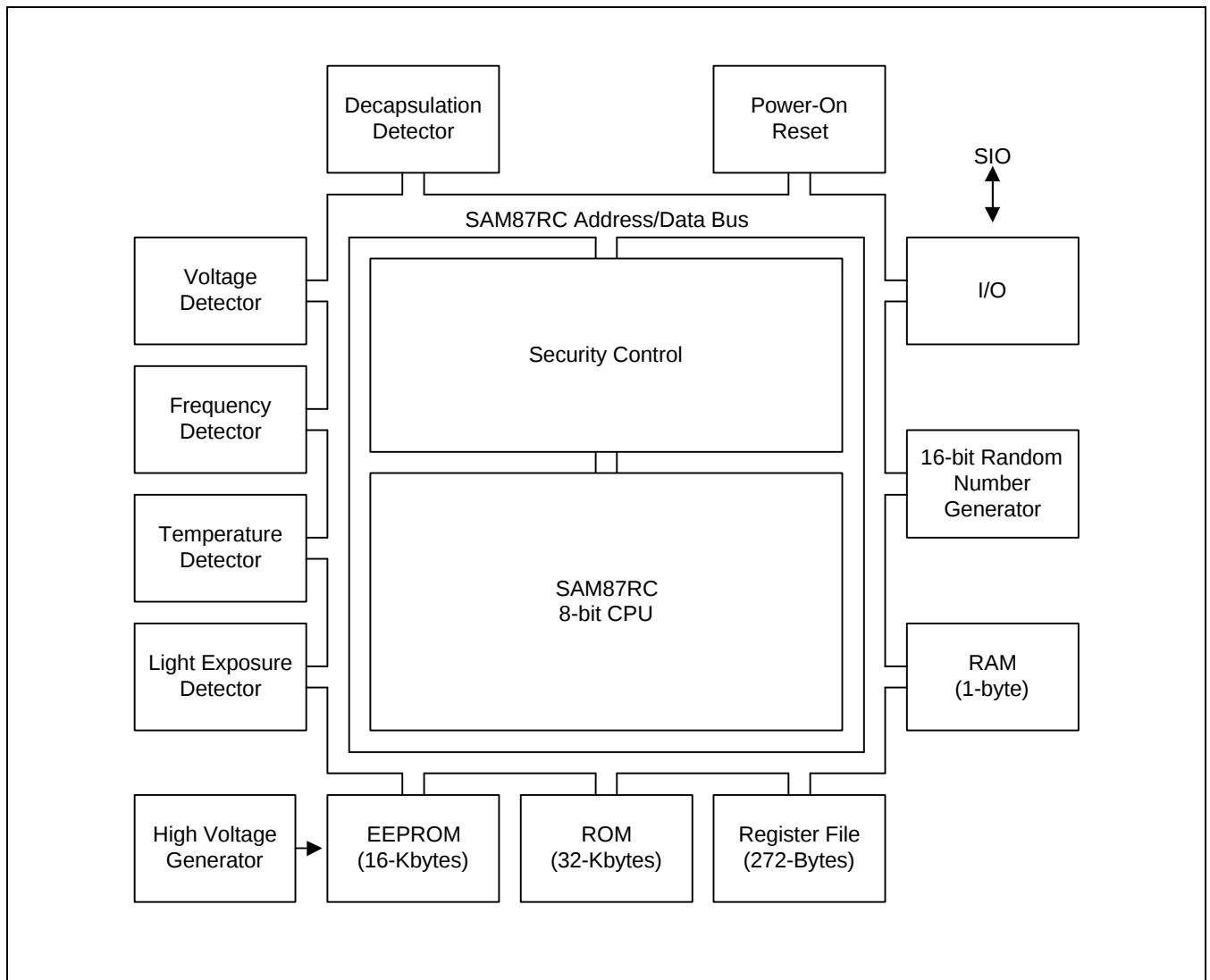


Figure 1-1. Block Diagram

PIN ASSIGNMENTS

Table 1-1. KS88C9616 Pin Descriptions

Pin Number	Pin Name	Function Description	Pin Type	Circuit Type
C1	V _{DD}	Power input	–	–
C2	RST	System reset input	Input	1
C3	CLK	External clock input	Input	2
C4	NC	No connection	–	–
C5	GND	Ground	–	–
C6	NC	No connection	–	–
C7	SIO	Serial data input and output; A pull up resistor should be connected to V _{DD}	Input/output	3
C8	NC	No connection	–	–

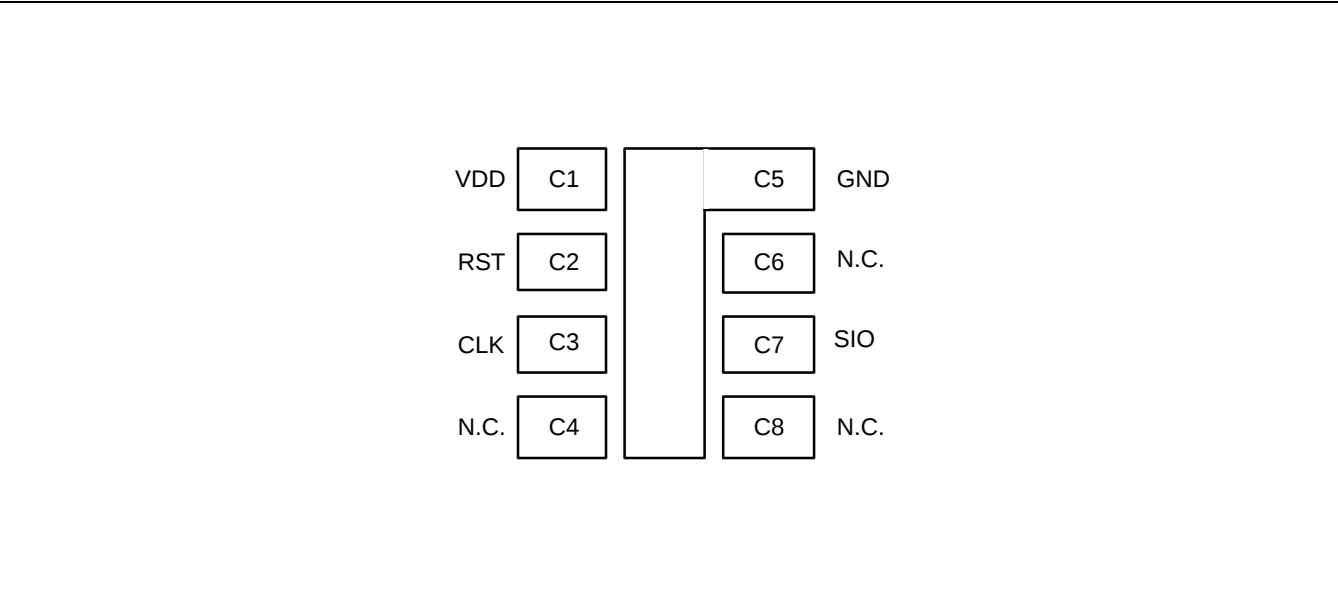


Figure 1-2. KS88C9616 COB Package Pin Arrangement

PIN CIRCUITS

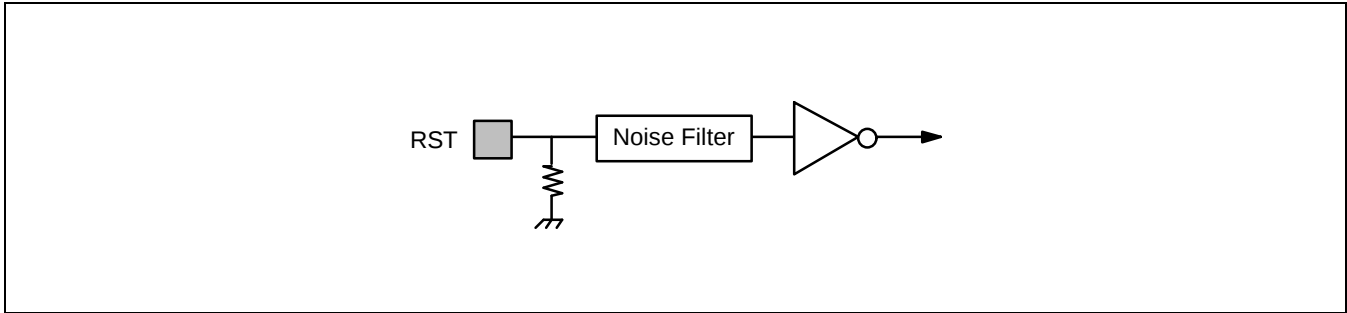


Figure 1-3. Pin Circuit Type 1 (RST)

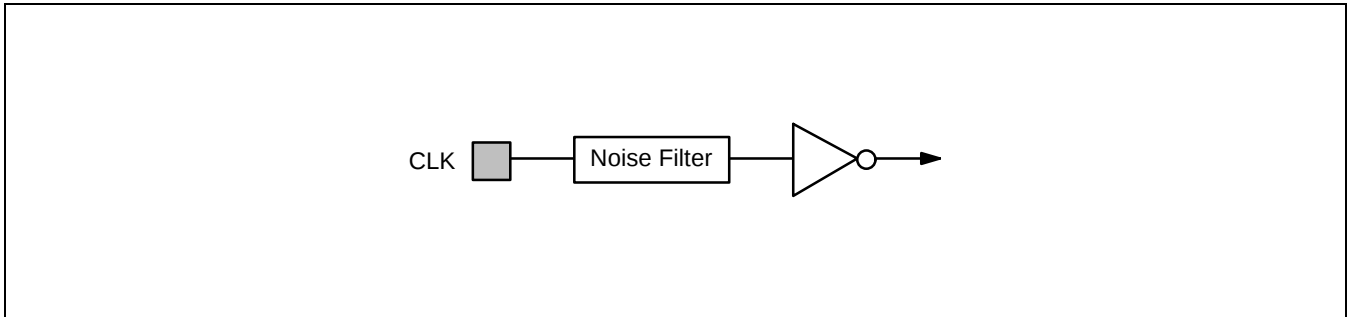


Figure 1-4. Pin Circuit Type 2 (CLK)

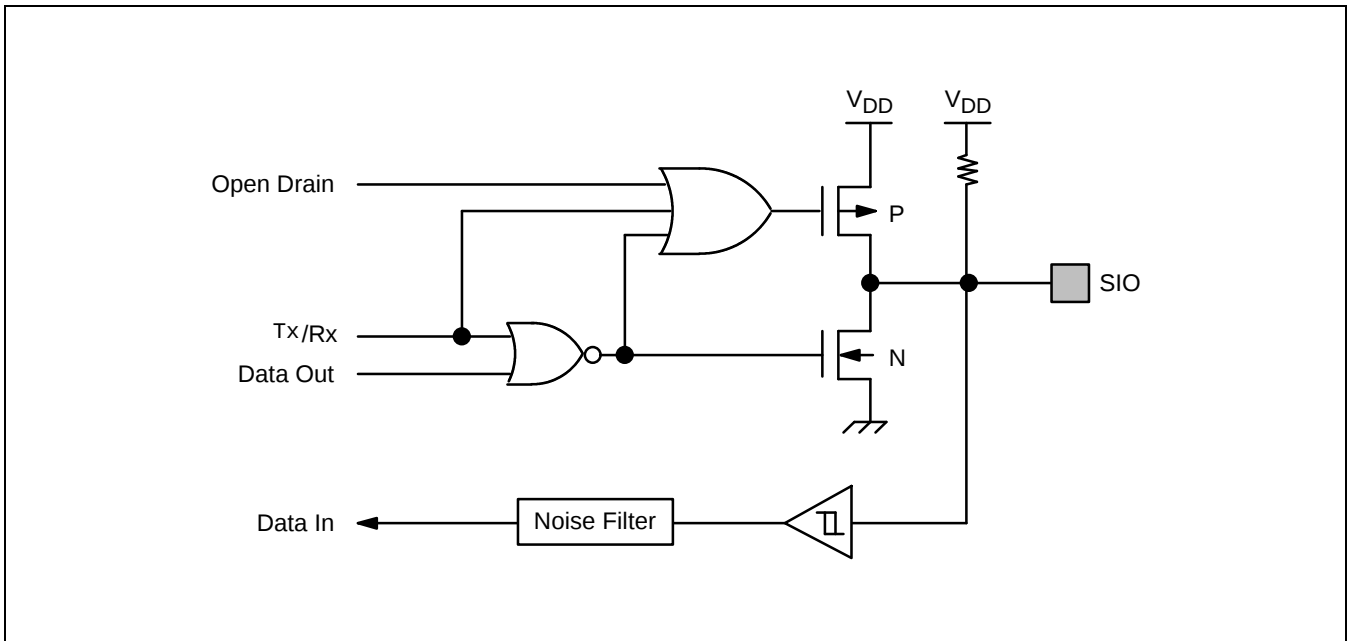


Figure 1-5. Pin Circuit Type 3 (SIO)

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ELECTRICAL DATA

OVERVIEW

In this section, KS88C9616 electrical characteristics are presented in tables and graphs. The information is arranged in the following order:

- Absolute maximum ratings
- D.C. electrical characteristics
- A.C. electrical characteristics

Table 13-1. Absolute Maximum Ratings

(T_A = 25 °C)

Parameter	Symbol	Conditions	Rating	Unit
Supply voltage	V _{DD}	–	– 0.3 to + 7.0	V
Input voltage	V _{IN}	–	– 0.3 to V _{DD} + 0.3	V
Output voltage	V _O	–	– 0.3 to V _{DD} + 0.3	V
Operating temperature	T _A	–	– 25 to + 70	°C
Storage temperature	T _{STG}	–	– 65 to + 150	°C
Electrostatic discharge	V _{ESD}	–	4000	V

Table 13-2. D.C. Electrical Characteristics

(T_A = – 25 °C to + 70 °C, V_{DD} = 2.7 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Low Voltage	V _{IL}	SIO	–	–	0.2 V _{DD}	V
		CLK			0.12 V _{DD}	
		RST			0.15 V _{DD}	
Input Low Current	I _{IL}	SIO	– 1000	–	+ 20	μA
		CLK	– 100			
		RST	– 200			
Input High Voltage	V _{IH}	SIO	0.7 V _{DD}	–	V _{DD}	V
		CLK	0.7 V _{DD}			
		RST	0.8 V _{DD}			
Input High Current	I _{IH}	SIO	– 300	–	+ 20	μA
		CLK	– 20		+ 100	
		RST	– 20		+ 150	
Output Low Voltage	V _{OL}	I _{OL} = 500 μA, SIO	0	–	0.15 V _{DD}	V
Output High Voltage	V _{OH}	I _{OH} = – 20 μA, SIO	0.7 V _{DD}	–	V _{DD}	V

Table 13-2. D.C. Electrical Characteristics (Continued)(T_A = -25 °C to +70 °C, V_{DD} = 2.7 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Current	I _{DD1}	f _{CLK} = 3.57 MHz, 5 V	—	3.5	10	mA
		f _{CLK} = 3.57 MHz, 3 V		1.0	5	
Idle Current	I _{DD2}	f _{CLK} = 3.57 MHz, 5 V	—	1.0	2.0	mA
Stop Current	I _{DD3}	f _{CLK} = GND, 3 V	—	—	10	μA
Low-voltage detection	V _{LVD}	f _{CLK} = 3.57 MHz	2	2.3	2.6	V
High-voltage detection	V _{HVD}	f _{CLK} = 3.57 MHz	6	6.5	7	V
Low-frequency detection	F _{LFD}	V _{DD} = 5 V, 25 °C	200	500	800	kHz
High-frequency detection	F _{HFD}	V _{DD} = 5 V, 25 °C	6	8	10	MHz

Table 13-3. A.C. Electrical Characteristics(T_A = -25 °C to +70 °C, V_{DD} = 2.7 V to 5.5 V)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
External clock	f _{CPU}	CPU clock	1	3.57	5.0	MHz
External clock duty	t _{CW}	Clock width	45	50	55	%
RESET Low level width	t _{RSW}	—	5	—	—	μA
EEPROM erase cycle time	t _{EC}	—	—	1.5	—	ms
EEPROM write cycle time	t _{WC}	—	—	1.5	—	ms
EEPROM data retention	t _{DR}	—	100	—	—	years
EEPROM endurance	T _{EN}	—	1,000,000	—	—	cycles
Rise/Fall time (C _{in} = 30 pF)	t _R , t _F	SIO, RESET	0	—	1	μs
		CLOCK			0.5 × 9%	

NOTE: The rise time, fall time data for CLK assumes 9% of the period with a maximum time of 0.5 μs. This condition is represented by the formula, $0.09 \times 1/f_{CLK}$.

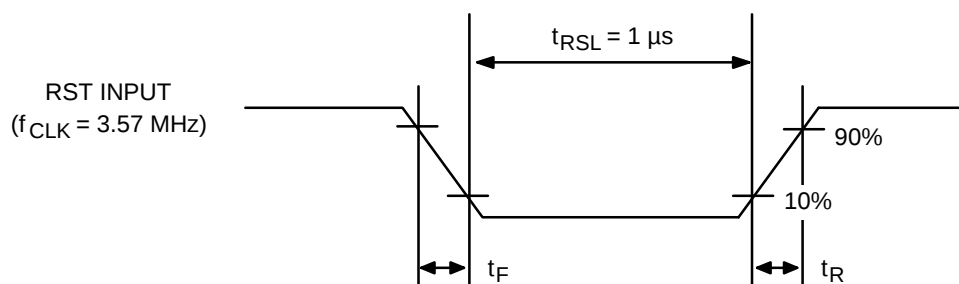


Figure 13-1. RST Input Wave Form

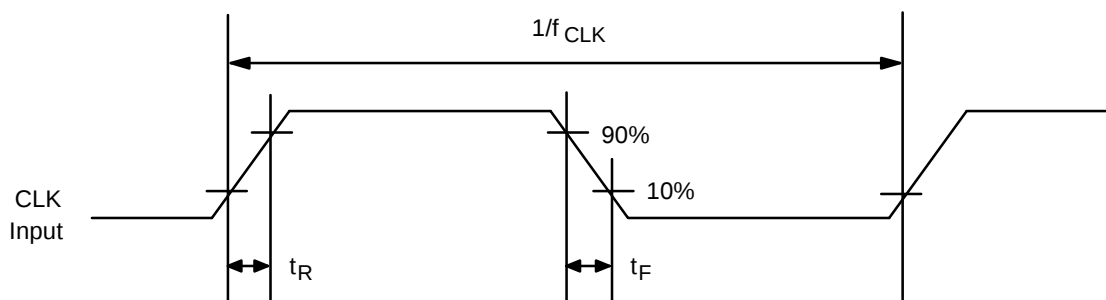


Figure 13-2. CLK Input Wave Form

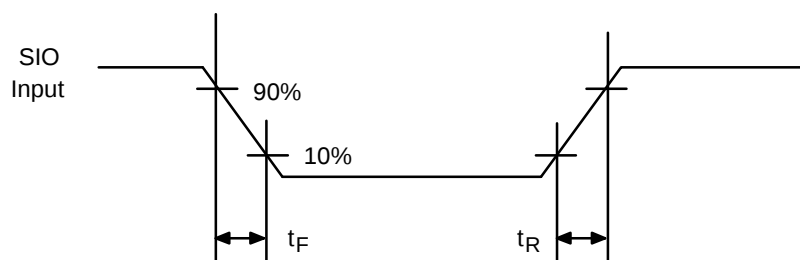


Figure 13-3. SIO Input Wave Form

CHARACTERISTIC CURVES

The characteristic values shown in the following graphs are based on actual test measurements. They do not, however, represent guaranteed operating values.

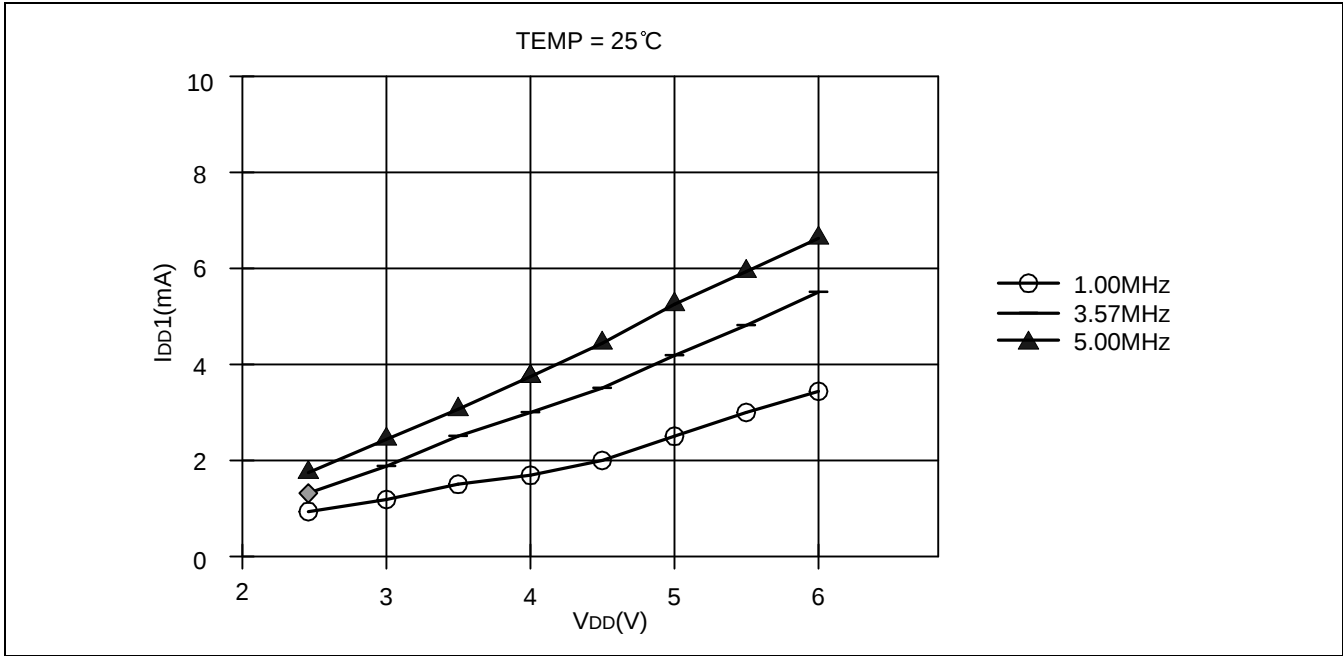


Figure 13-4. I_{DD1} vs. V_{DD}

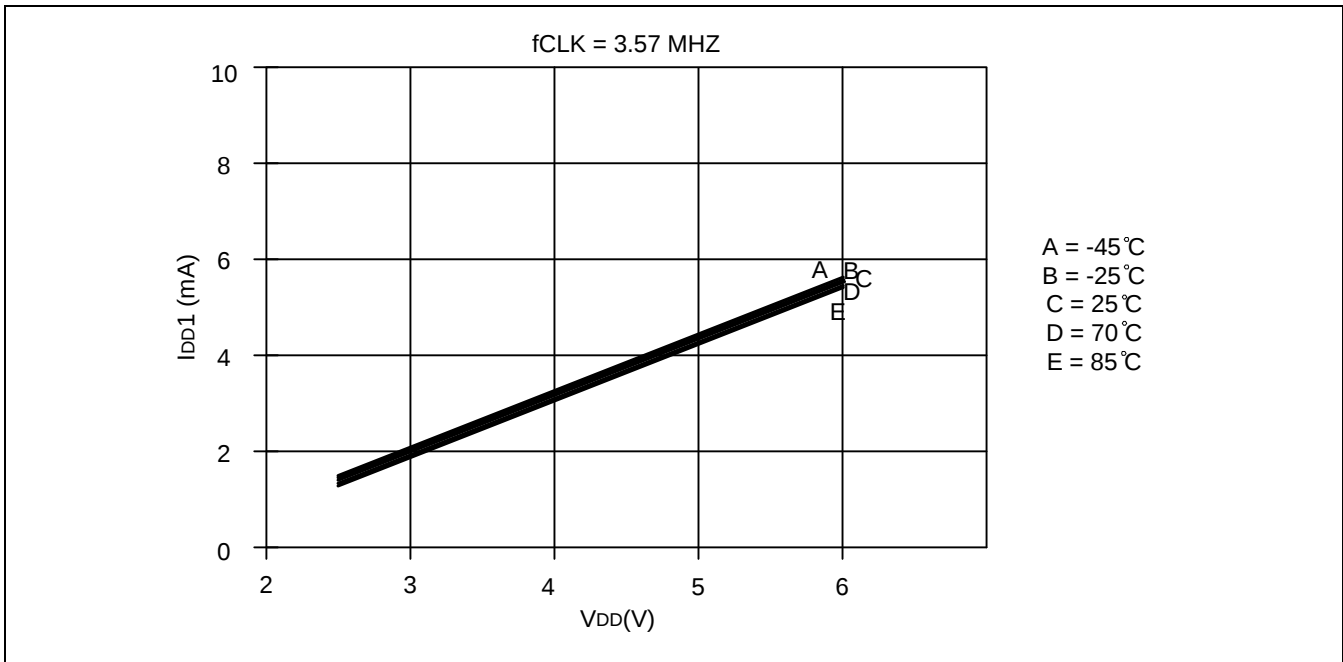


Figure 13-5. I_{DD1} vs. V_{DD}

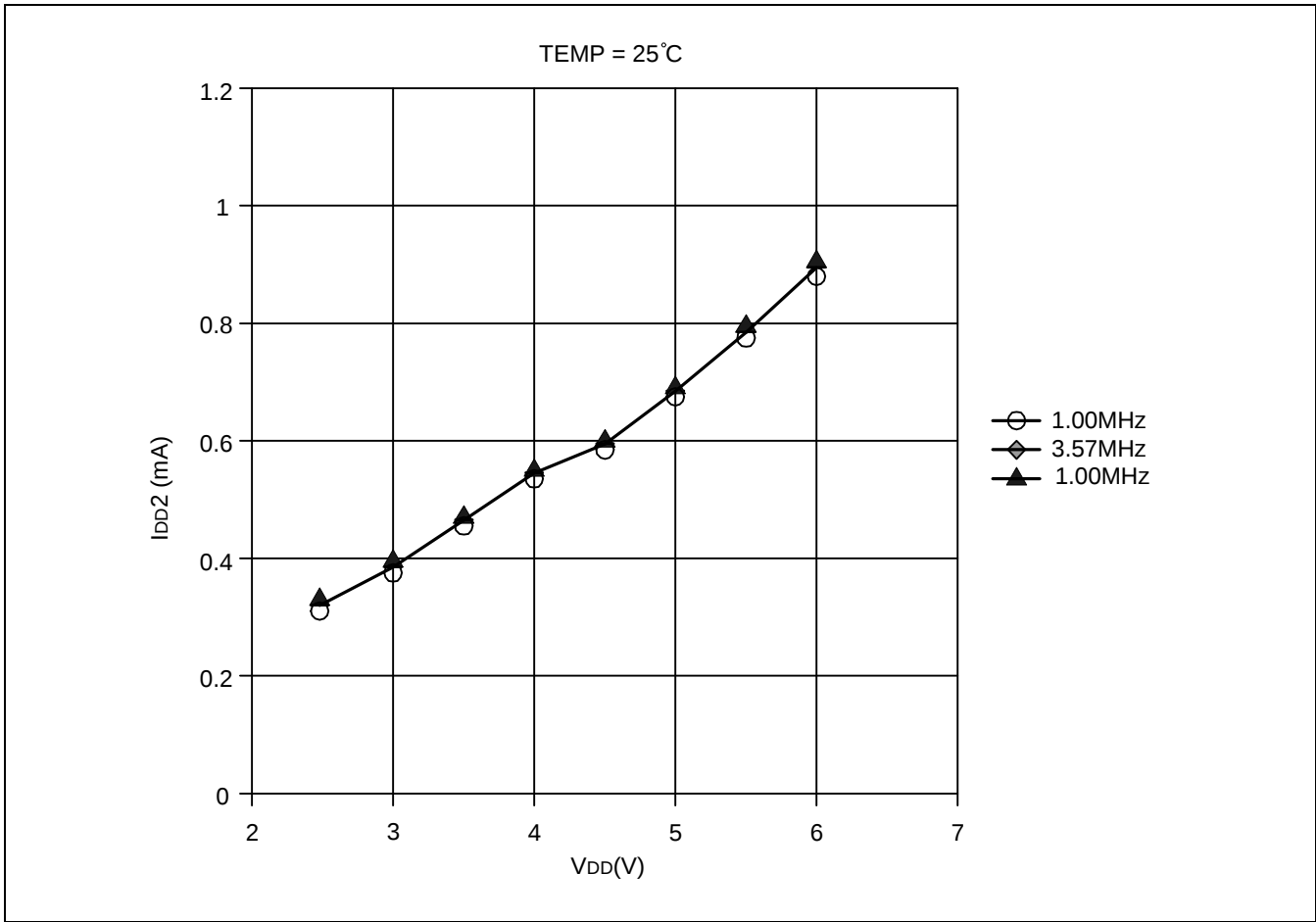


Figure 13-6. I_{DD2} (Idle) vs. V_{DD}

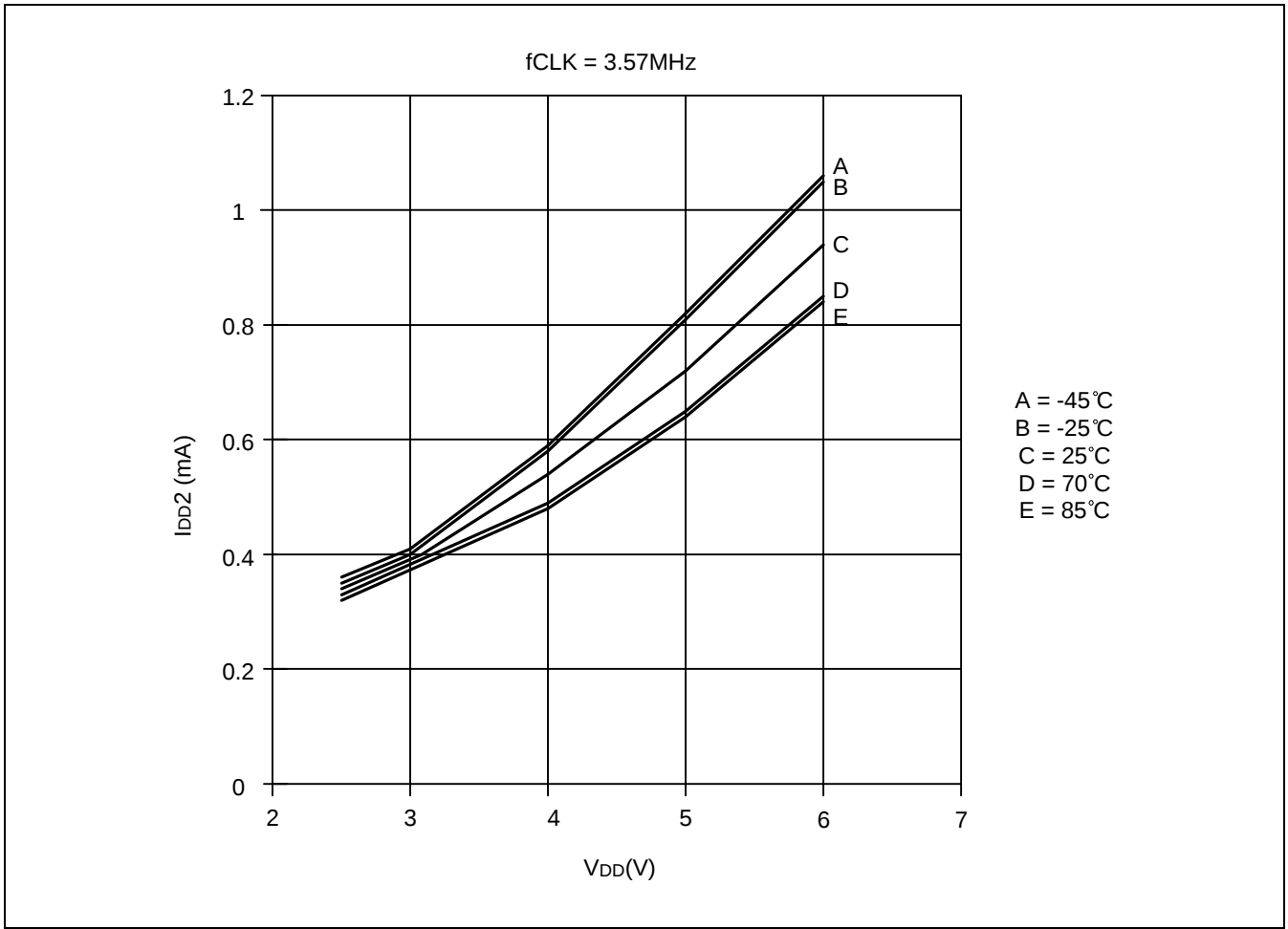


Figure 13-7. I_{DD2} (Idle) vs. V_{DD}

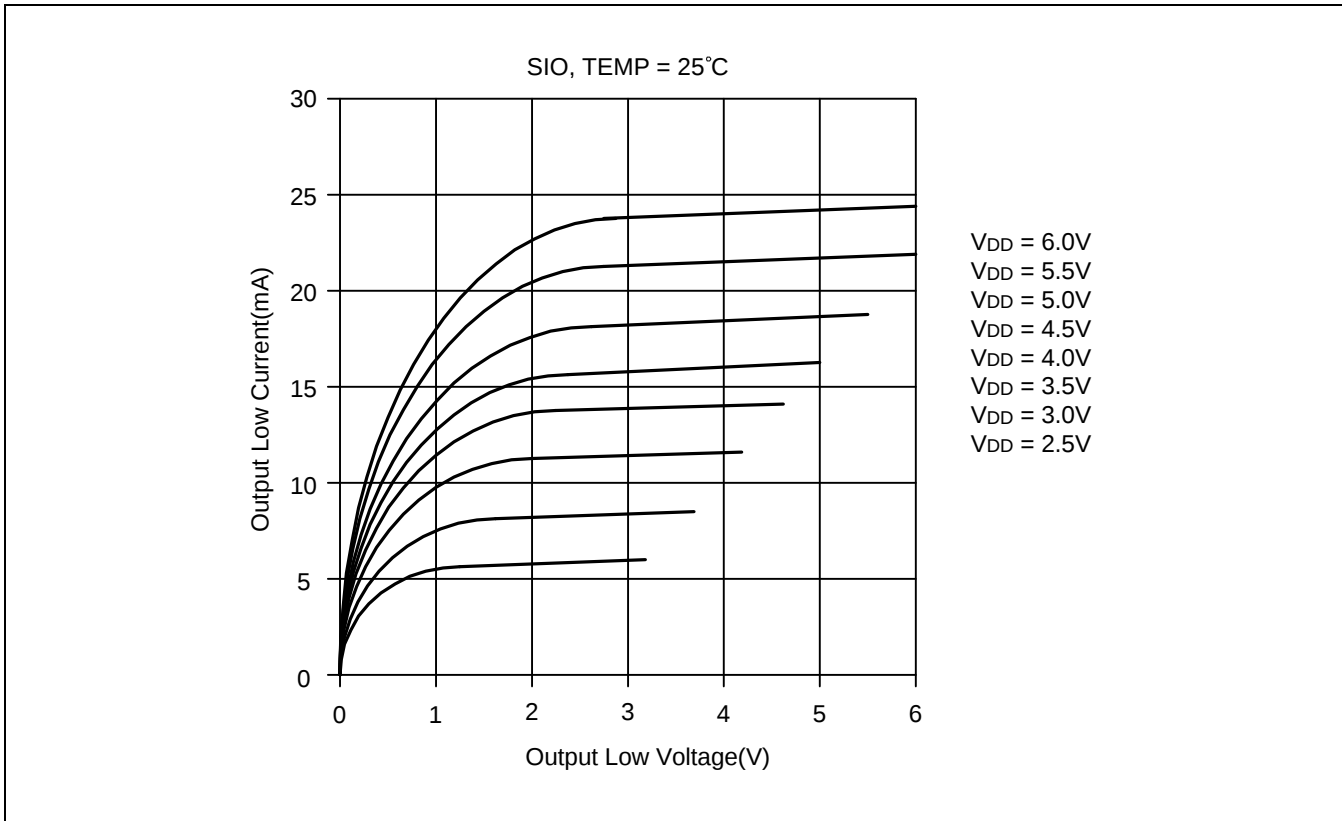


Figure 13-8. V_{OL} vs. I_{OL} (SIO Pin Output Low Voltage)

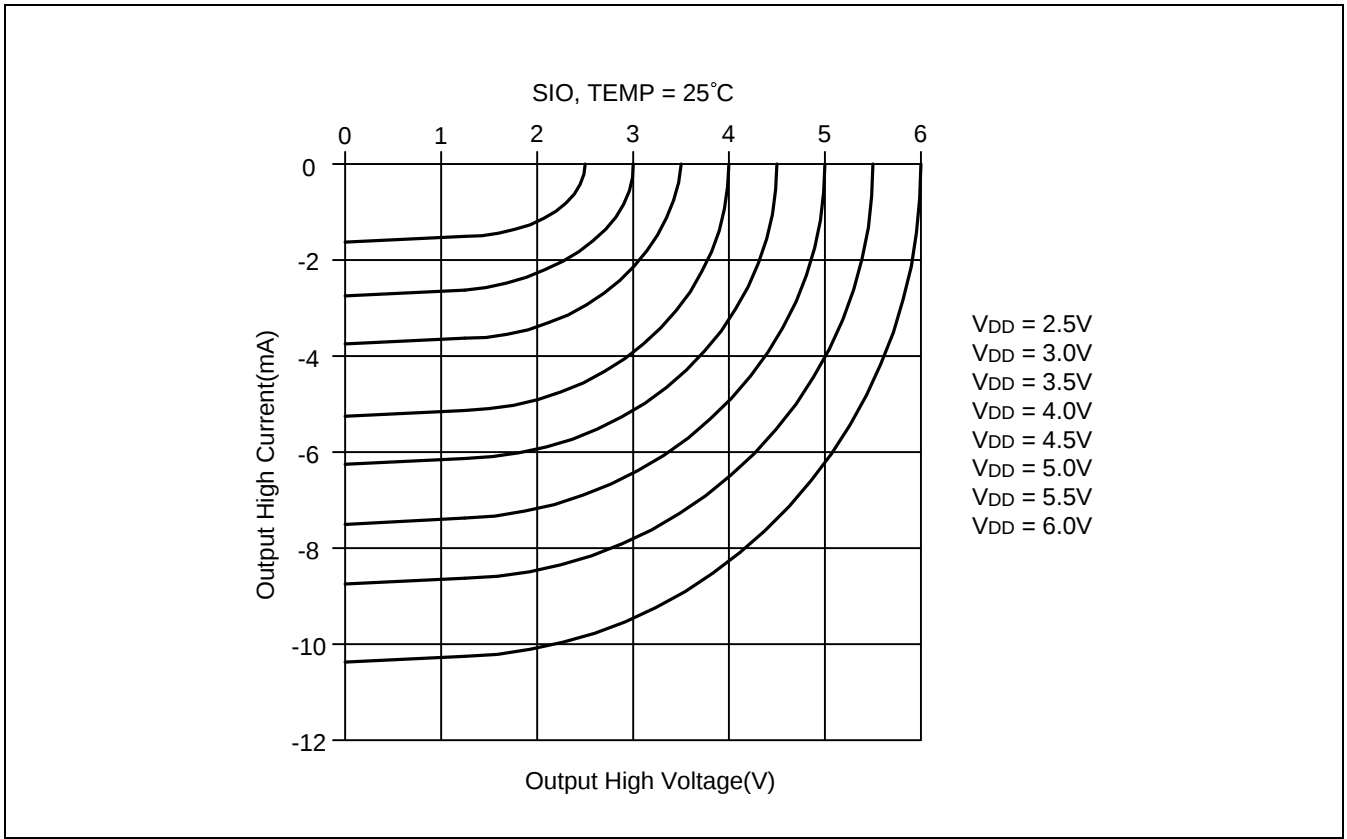


Figure 13-9. V_{OH} vs. I_{OH} (SIO Pin Output High Voltage)

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MECHANICAL DATA

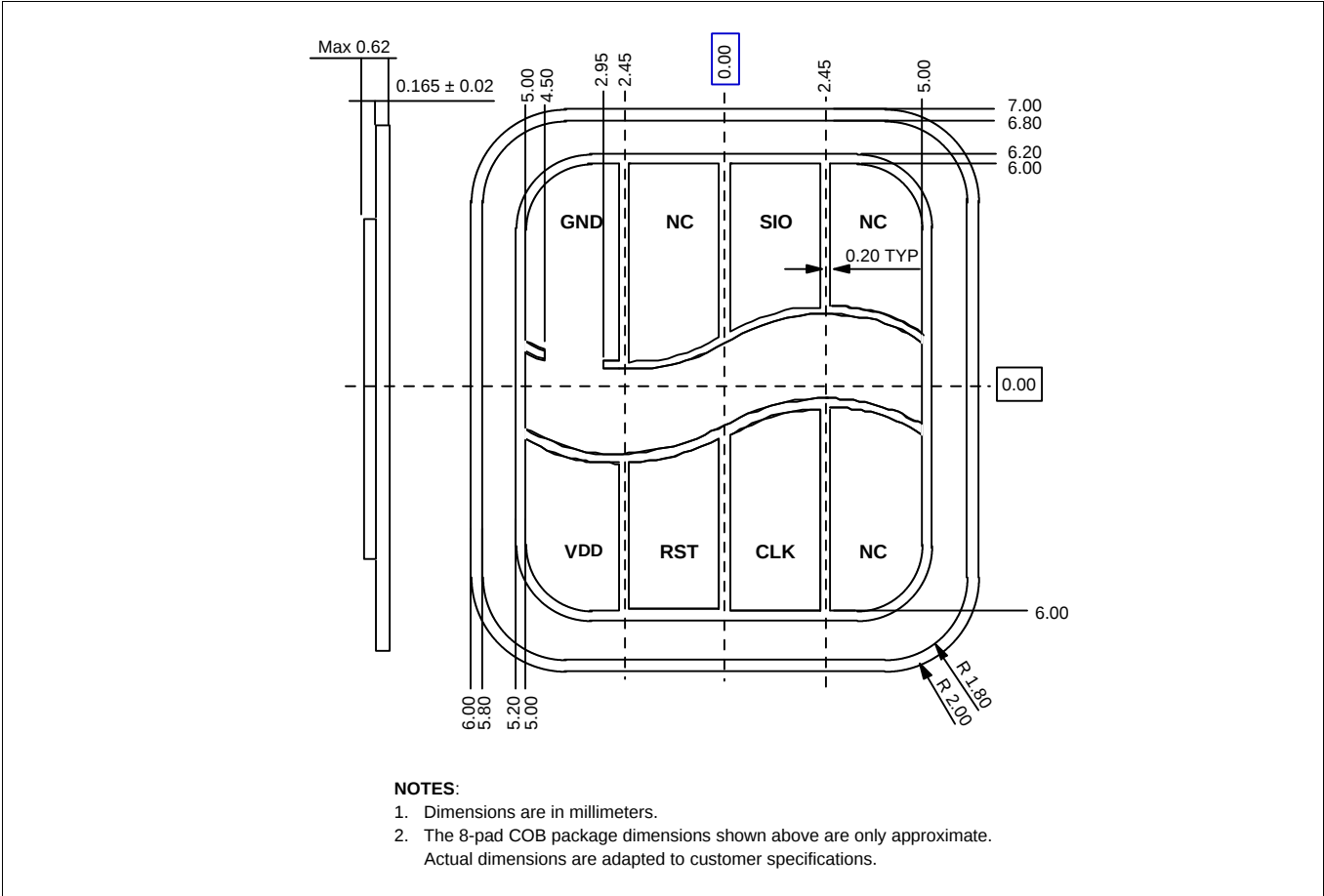


Figure 14-1. Mechanical Dimensions for 8-Pad COB Package

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