SD5820A

Single Wire Communication Digital Temperature Sensor

Features

- 12 bits digital temperature reading with 0.0625°C resolution
- ±0.5°C typical error at -10~+85°C range
- ±0.8°C typical error at -55~+125°C range
- Single wire data communication with CRC function
- Factory set 64-bits ID code
- Programmable over temperature alarm threshold
- 2.7~5.5V power supply range
- Compatible with DS18B20

Description

The SD5820A is a highly accurate temperature measurement IC. It supports single wire data communication and outputs 9 to 12 bits temperature readings. The maximum error is ±0.8°C from -10°C to +85°C and ±1.5°C over the full military temperature range of -55°C to +125℃.

Over-temperature alarm thresholds can be set through internal register. Operating at "parasitic power" mode, the SD5820A derives power directly from the data line without the use of an external power supply.

Each chip has a unique 64-bits ID code useful for multi-slave communication system.

Applications

Temperature control systems
Industrial process control
Power system thermal protection
Ambient temperature measurement

Ordering Information

Package	Part Number
TO-92	SD5820A

Pin Diagram and Descriptions

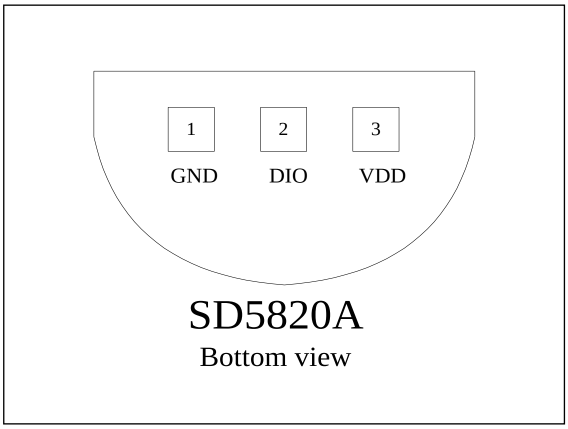


Figure 1. TO-92 pin-out diagram

Table 1. Pin Descriptions

Pin Number	Pin Name	Attribute	Description
1	GND	Ground	Ground
2	DIO	I/O	Open drain, single wire data communication port
3	VDD	Power	Power

Functional Description

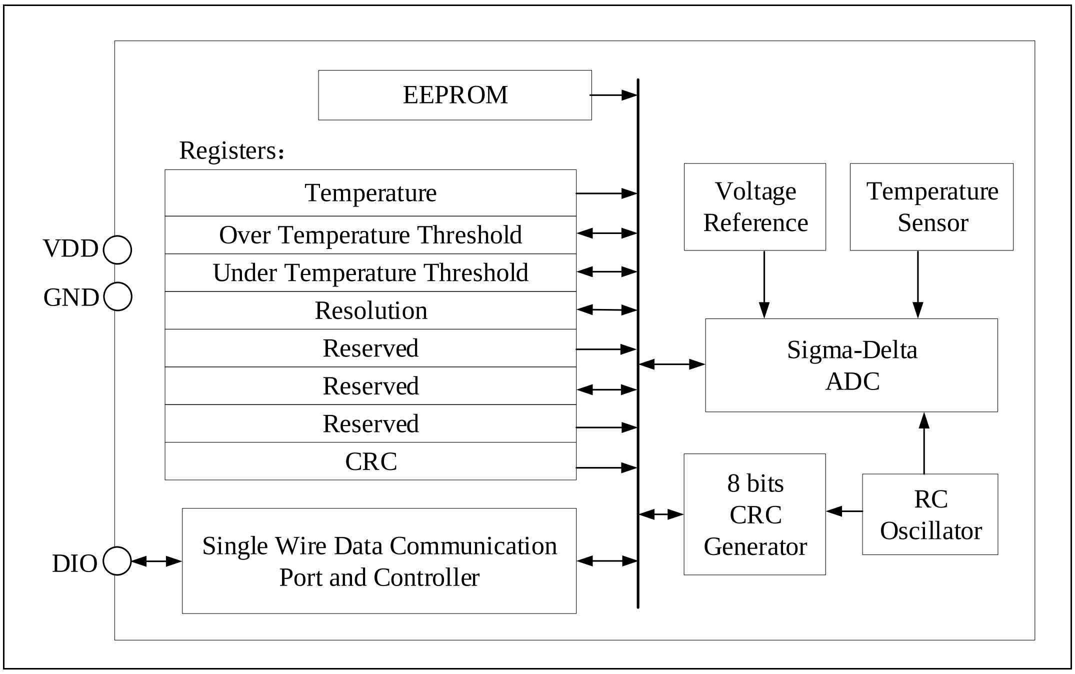


Figure 2. Functional block diagram

Figure 2 is the functional block diagram for SD5820A. It is a digital temperature sensor with single wire communication capability. The DIO pin requires an external pull-up resistor. The ID code is 64-bits wide and very suitable for a multi-slave communication system.

The internal sensor generates a voltage signal that is proportional to temperature. The signal is digitized by an ADC that carries its own voltage reference. The result is a 12-bits word in two's complement format. The highest bit is the sign bit where "0" indicates positive temperature and "1" indicates negative temperature. This result is compared with the over temperature threshold values in EEPROM to decide whether to set the over or under temperature alarm signal.

The system clock comes from the RC oscillator. During temperature measurement, the ADC, voltage reference, and clock circuits are all active. The power consumption is then at the maximum.

Temperature value read-out and register setting are done via a single wire communication interface. A cyclic redundancy check (CRC) is performed on register addresses 00h-07h (Refer to Figure 3) to ensure the register data is read correctly, resulting in enhanced communication reliability.

The SD5820A works in single measurement mode. It enters the standby state after each temperature measurement. The user sends commands to start the next measurement through the single wire interface.

Temperature Format

The temperature data is stored as a 16-bit sign-extended two's complement number in the temperature register. S is the sign bit: 0 for positive temperature, 1 for negative temperature. See Table 2 below.

The temperature register value upon power on and before the first temperature measurement is +85 ℃ (0550h).

Table 2. Temperature Register Format

bit15	bit14	bit13	bit12	bit11	bit10	bit9	bit8
S	S	S	S	S	2^6	2^5	2^4
bit7	**bit6**	**bit5**	**bit4**	**bit3**	**bit2**	**bit1**	**bit0**
2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}

Alarm Signaling

After SD5820A performs a temperature conversion, the temperature value is compared to the user-defined two's complement alarm trigger values stored in the T_H and T_L registers. This format is shown in Table 3. The sign bit S indicates 0 for positive temperature and 1 for negative temperature. The T_H and T_L are also saved in the internal EEPROM, so their values are retained when the device is powered down. The initial values set at factory are T_H = 80 ℃ and T_L = 75 ℃.

If the measured temperature is either lower than or equal to T_L, or higher than or equal to T_H, an alarm condition exists, and an alarm flag is set inside the SD5820A. This flag is updated after every temperature measurement. If the alarm condition goes away, the flag will turn off after the next temperature conversion.

The master device can check the alarm flag status of all SD5820As on the bus by issuing an ALARM SEARCH command [ECh]. Any SD5820A with a set alarm flag will respond to the command, so the master can determine exactly which SD5820A has experienced an alarm condition. If this condition exists and the T_H or T_L settings have been changed, another temperature conversion should be done to validate the alarm condition.

Table 3. T_H and T_L Registers Format

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
S	2^6	2^5	2^4	2^3	2^2	2^1	2^0

Powering SD5820A

The SD5820A can be powered by an external supply on the VDD pin, or it can operate in "parasite power" mode. This allows the SD5820A to function without an external supply. In "parasite power" mode, VDD must be shorted to GND.

Note: When the SD5820A is performing temperature conversion or reading from/writing to EEPROM, the operating current can be as high as 1.5mA. If the IC is operated in "parasitic power" mode, it is necessary to provide a strong pull-up on the 1-Wire bus.

Memory

SD5820A memory consists of high-speed registers SCRATCHPAD and nonvolatile EEPROM. Figure 3 shows how they are organized. SCRATCHPAD consists of nine bytes:

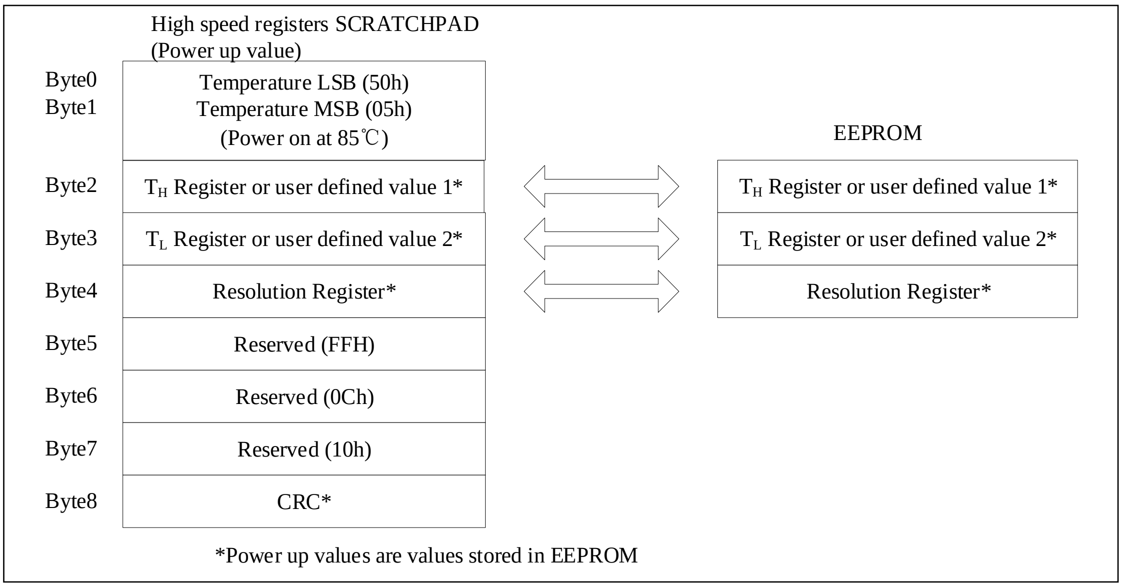


Figure 3. SD5820A Memory Map

- Byte 0 and 1 are the temperature register's LSB and MSB bytes. These bytes are read only.
- Bytes 2 and 3 are the T_H and T_L registers.
- Byte 4 contains the resolution register data. It is explained in detail in the Resolution Register section.
- Bytes 5, 6, and 7 are reserved for internal use and cannot be written.
- Byte 8 is the CRC code for SCRATCHPAD bytes 0 through 7. The method is described in the CRC Generation section. This byte is read only.

Use the WRITE SCRATCHPAD command to write data into SCRATCHPAD bytes 2, 3, and 4.

Use the READ SCRATCHPAD command to verify data integrity after data is written into SCRATCHPAD.

Use the COPY SCRATCHPAD command to transfer the T_H, T_L, and resolution data from the SCRATCHPAD to EEPROM.

Data in the EEPROM is retained when the device is powered down. At power-up the EEPROM data is loaded into the corresponding SCRATCHPAD locations. Data can also be loaded from EEPROM to SCRATCHPAD at any time using the Recall E^2 command. The master can issue read time slots following the Recall E^2 command. SD5820A will then indicate the recall status by transmitting 0 while the recall is in progress and 1 when the recall is done.

ID Code

Each SD5820A contains a unique 64–bit code as shown in Table 4. The least significant 8 bits is the SD5820A product code (28h). The middle 48 bits contain a unique serial number. The most significant 8 bits is the CRC byte for the first 56 bits of the ID code. The ID code is set at factory and cannot be modified by user.

Resolution Register

Resolution register bit definition is shown in Table 5. Conversion resolution is set by R1 and R0 as shown in Table 6. The power-up default is R1 = R0 = 1 (12-bit resolution).

Note: There is a direct tradeoff between resolution and conversion time. Bit 7 and bit 4-0 in the resolution register are reserved for internal use and cannot be overwritten.

Table 4. 64-bit Unique ID Code

ID[63:56]	ID[55:8]	ID[7:0]
8-bit CRC	48-bit serial number	8-bit family code (28h)
MSB LSB	MSB LSB	MSB LSB

Table 5. Resolution Register

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
0	R1	R0	1	1	1	1	1

Table 6. Temperature Resolution Setup

R1	R0	Resolution	Conversion Time(t_{CONV})	SD5820A Realization
0	0	9-bit	93.75 ms	1 time temperature measurement
0	1	10-bit	187.5 ms	Averaging of 2 measurement
1	0	11-bit	375 ms	Averaging of 4 measurement
1	1	12-bit	750 ms	Averaging of 8 measurement (default)

Note: The maximum conversion time is decided by the ADC’s conversion speed.

CRC Generation

SD5820A generates CRC bytes in the ID code and the SCRATCHPAD. The bus master calculates the CRC code from data sent from SD5820A (SCRATCHPAD or ID code) and compares it with the corresponding CRC byte sent from SD5820A. The read data is valid if the two CRC codes are identical. Otherwise the bus master should request data be re-sent from SD5820A.

The CRC-8 polynomial used in SD5820A is:

$$CRC = X^8 + X^5 + X^4 + 1$$

As shown in Figure 4, the CRC circuit consists of an eight-bits shift register and three XOR gates. Input data is SCRATCHPAD byte8-0 or ID code. The eight-bit shift register should reset to 0 before the CRC generation starts. Data is serially shifted in with the least significant bit first (SCRATCHPAD byte0 bit0 or ID[0]). After shifting in the 56th bit, the polynomial will contain the bus master calculated CRC code.

Instead of comparing the two CRC codes, one could continue shifting in the remaining data, which is the SD5820A generated CRC code (SCRATCHPAD byte8 or ID[63:56]). The read data is valid if the shift register bits are all 0s after all data bits are shifted in.

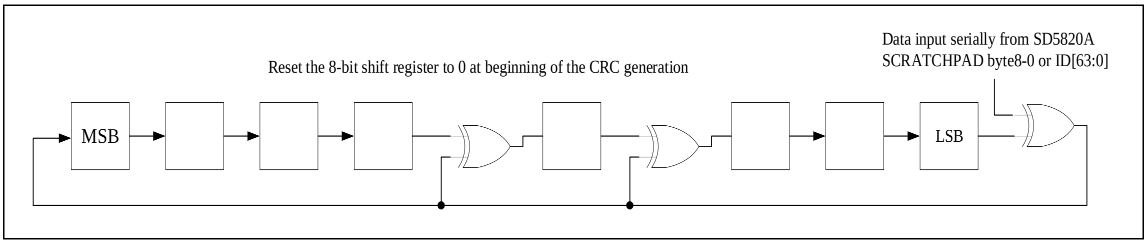


Figure 4. CRC Generator

Execution Sequence

The transaction sequence for accessing the SD5820A is as follows:

- Step 1：Initialization
- Step 2：ROM Command
- Step 3：SD5820A Function Command

It is very important to follow this sequence every time the SD5820A is accessed, as the SD5820A will not respond if any steps in the sequence are missing or out of order. Exceptions to this rule are the SEARCH ROM [F0h] and ALARM SEARCH [ECh] commands. After issuing either of these ROM commands, the master must return to Step 1 in the sequence. A summary of all commands is presented in Table 7.

Step 1. Initialization

All transactions on the 1-Wire bus begin with an initialization sequence. The sequence consists of a reset pulse transmitted by the bus master, followed by presence pulse(s) transmitted by the slave(s). The presence pulse lets the bus master know that slave devices (such as the SD5820A), are on the bus and are ready to operate. Timing for the reset and presence pulses is detailed in the 1-Wire Signaling section.

Step 2. ROM Commands

After the bus master has detected a presence pulse, it can issue a ROM command. There are five ROM commands, and each command is 8 bits long. A flowchart for operation of the ROM commands is shown in Figure5.

SEARCH ROM [F0h]

When a system is initially powered up, the master must identify the ID codes of all slave devices on the bus. This allows the master to determine the number of slaves and their device types. If there is only one slave on the bus, the simpler READ ROM command (see below) can be used in place of the SEARCH ROM process. After every SEARCH ROM cycle, the bus master must return to Step 1 (Initialization) in the transaction sequence.

READ ROM [33h]

It allows the bus master to read the slave's 64-bit ID codes without using the SEARCH ROM procedure.

Note: This command can only be used when there is one slave on the bus. If this command is used when there is more than one slave present on the bus, a data collision will occur when all the slaves attempt to respond at the same time.

MATCH ROM [55h]

The MATCH ROM command followed by a 64-bit ID codes sequence allows the bus master to address a specific slave device on a multi-drop or single-drop bus. Only the slave that exactly matches the 64-bit ID codes sequence will respond to the function command issued by the master. All other slaves on the bus will wait for a reset pulse.

SKIP ROM [CCh]

The master can use this command to address all devices on the bus simultaneously without sending out any ID codes information. For example, the master can make all SD5820As on the bus perform simultaneous temperature conversions by issuing a SKIP ROM command followed by a CONVERT T [44h] command.

Note: The READ SCRATCHPAD [BEh] command can follow the SKIP ROM command only if there is a single slave device on the bus. In this case, time is saved by allowing the master to read from the slave without sending the device's 64-bit ID codes. If there is more than one slave device on the bus, data collision will occur if such operation is performed.

ALARM SEARCH [ECh]

The operation of this command is identical to the operation of the SEARCH ROM command except that only slaves with a set alarm flag will respond. This command allows the master device to determine if any SD5820As experienced an alarm condition during the most recent temperature conversion. After every ALARM SEARCH cycle (i.e., ALARM SEARCH command followed by data exchange), the bus master must return to Step 1 (Initialization) in the transaction sequence. Refer to the ALARM SIGNALING section for an explanation of alarm flag operation.

Step 3. Function Commands

After the bus master has used a ROM command to address the SD5820A with which it wishes to communicate, the master can issue one of the function commands. This allows the master to write to and read from the SD5820A's SCRATCHPAD memory, initiate temperature conversions and determine the power supply mode. The SD5820A function commands described below are illustrated by the flowchart in Figure 6.

CONVERT T [44h]

This command initiates a single temperature conversion. Following the conversion, the resulting thermal data is stored in the 2-byte temperature register in the SCRATCHPAD memory. The SD5820A will then return to its low-power idle state. If the device is being used in parasite power mode, within 10µs (max) after the CONVERT T command is issued, the master must enable a strong pull-up on the 1-Wire bus for the duration of the conversion (t_{conv}). If the SD5820A is powered by an external supply, the master can issue read time slots after the CONVERT T command. The SD5820A will respond by transmitting a 0 while the temperature conversion is in progress and a 1 when the conversion is done. In parasite power mode this notification technique cannot be used since the bus is pulled high by the strong pull-up during the conversion.

WRITE SCRATCHPAD [4Eh]

This command allows the master to write 3 bytes of data to the SD5820A's SCRATCHPAD. The first data byte is written into the T_H register (byte 2 of the SCRATCHPAD). The second byte is written into the T_L register (byte 3), and the third byte is written into the resolution register (byte 4). Data must first be transmitted starting with the least significant bit. All three bytes must be written before the master issues a reset, or the data may be corrupted.

READ SCRATCHPAD [BEh]

This command allows the master to read the contents of the SCRATCHPAD. The data transfer starts with the least significant bit of byte 0 and continues through the SCRATCHPAD until the 9th byte (byte 8 – CRC) is read. The master may issue a reset to terminate reading at any time if only part of the SCRATCHPAD data is needed.

COPY SCRATCHPAD [48h]

This command copies the contents of the SCRATCHPAD T_H, T_L and resolution registers (bytes 2, 3 and 4) to EEPROM. If the device is used in parasite power mode within 10μs (max) after this command is issued, the master must enable a strong pull-up on the 1-Wire bus for at least 10ms.

RECALL E^2 [B8h]

This command recalls the alarm trigger values (T_H and T_L) and resolution data from EEPROM, and places the data in bytes 2, 3, and 4. in the SCRATCHPAD memory. The master device can issue read time slots following the RECALL E^2 command. The SD5820A will indicate the status of the recall by transmitting 0 while the recall is in progress and 1 when the recall is done. The recall operation happens automatically at power-up, so valid data is available in the SCRATCHPAD as soon as power is applied to the device.

Note: The master always read EEPROM at power-up. A strong pull-up is needed at this time if the device is being used in parasite power mode.

READ POWER SUPPLY [B4h]

The master device issues this command followed by a read time slot to determine if any SD5820As on the bus are using parasite power. During the read time slot, parasite powered SD5820As will pull the bus low, and externally powered SD5820As will let the bus remain high.

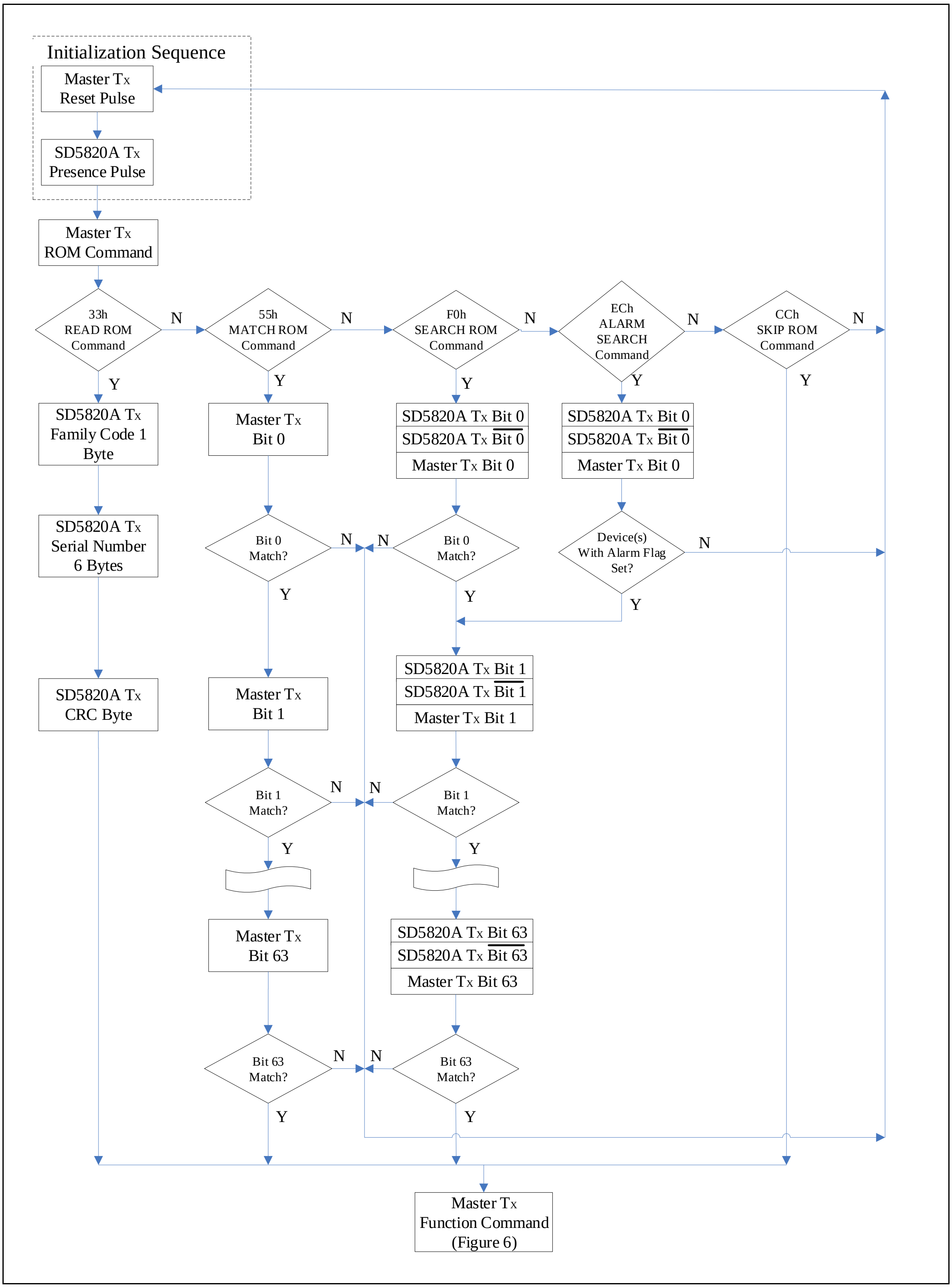


Figure 5. SD5820A ROM Commands Flowchart

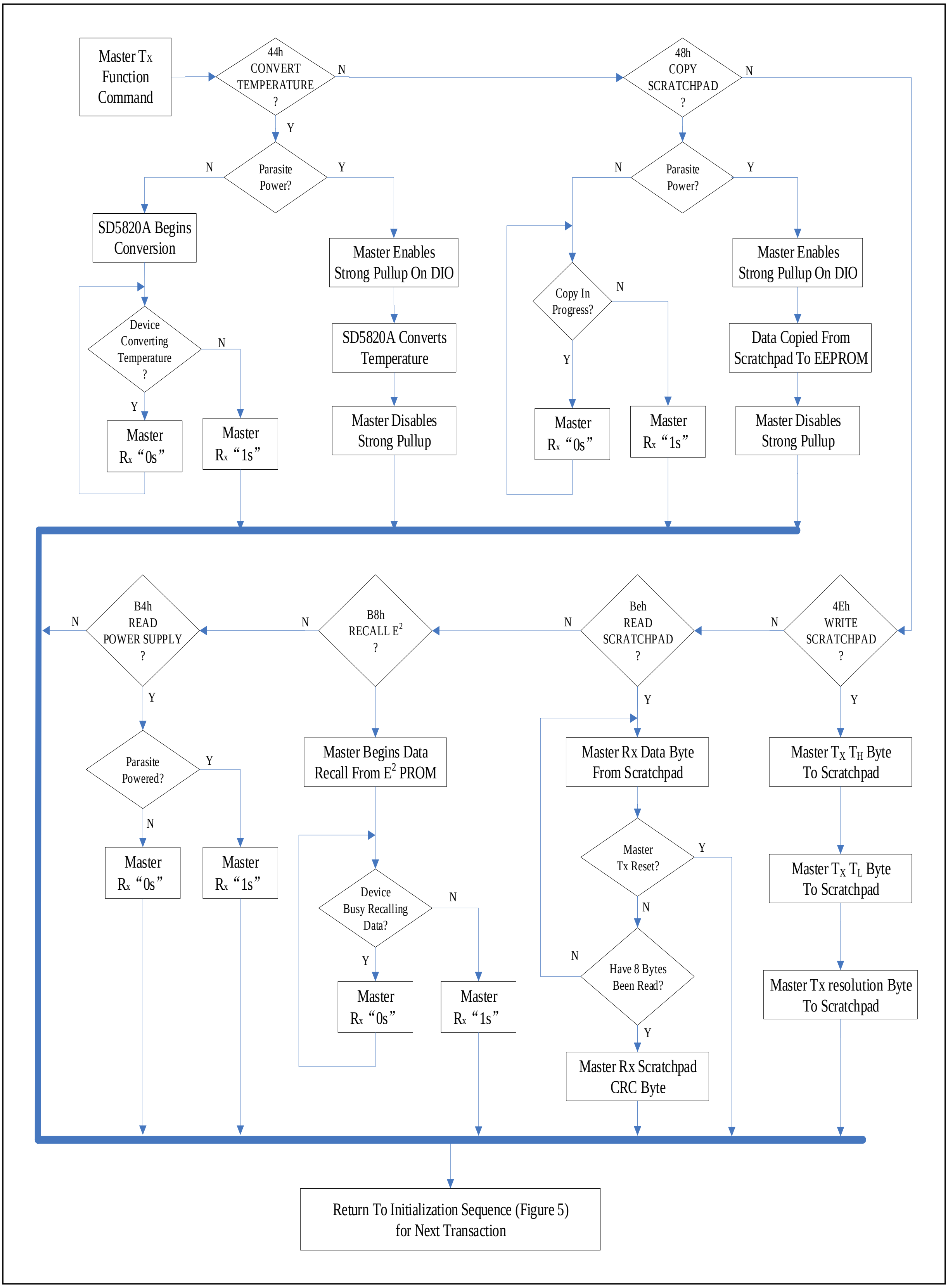


Figure 6. SD5820A Function Commands Flow Chart

Table 7. Command summary

Command type	Command	Description
ROM Command	F0h	SEARCH ROM
	33h	READ ROM
	55h	MATCH ROM
	CCh	SKIP ROM
	ECh	ALARM SEARCH
Function Command	44h	CONVERT TEMPERATURE
	4Eh	WRITE SCRATCHPAD
	BEh	READ SCRATCHPAD
	48h	COPY SCRATCHPAD
	B8h	RECALL EEPROM
	B4h	READ POWER SUPPLY

1-Wire Signaling

The SD5820A uses a strict 1-Wire communication protocol to ensure data integrity. Several signal types are defined by this protocol: reset pulse, presence pulse, write 0, write 1, read 0, and read 1. The bus master initiates all of these signals, with the exception of the presence pulse.

1. Initialization Procedure

All communication with the SD5820A begins with an initialization sequence that consists of a reset pulse from the master followed by a presence pulse from the SD5820A. This is illustrated in Figure 7. When the SD5820A sends the presence pulse in response to the reset, it is indicating to the master that it is on the bus and ready to operate.

During the initialization sequence the bus master transmits (TX) the reset pulse by pulling the 1-Wire bus low for a minimum of 480µs. The bus master then releases the bus and goes into receive mode (RX). When the bus is released, the 4.7k pull-up resistor pulls the 1-Wire bus high. When the SD5820A detects this rising edge, it waits 15µs to 60µs and then transmits a presence pulse by pulling the 1-Wire bus low for 60µs to 240µs.

2. Write Time Slots

There are two types of write time slots: “Write 1” time slots and “Write 0” time slots. The bus master uses a Write 1 time slot to write a logic 1 to the SD5820A and a Write 0 time slot to write a logic 0 to the SD5820A. All Write time slots must be a minimum of 60µs in duration with a minimum of a 1µs recovery time between individual write slots. Both types of Write time slots are initiated by the master pulling the 1-Wire bus low (see Figure 8).

To generate a Write 1 time slot the bus master must release the 1-Wire bus within 15µs, after pulling the 1-Wire bus low,. When the bus is released, the 4.7k pull-up resistor will pull the bus high. To generate a Write 0 time slot, the bus master must continue to hold the bus low for the duration of the time slot (at least 60µs) after pulling the 1-Wire bus low.

The SD5820A samples the 1-Wire bus during a window that lasts from 15µs to 60µs after the master initiates the Write time slot. If the bus is high during the sampling window, a 1 is written to the SD5820A. If the line is low, a 0 is written.

3. Read Time Slots

The SD5820A can only transmit data to the master when the master issues Read time slots. Therefore, the master must generate Read time slots immediately after issuing a READ SCRATCHPAD [BEh] or READ POWER SUPPLY [B4h] command, so that the SD5820A can provide the requested data. In addition, the master can generate Read time slots after issuing CONVERT TEMPERATUR [44h], RECALL E^2 [B8h], or COPY SCRATCHPAD [48h] commands to find out status of the operation. All Read time slots must be a minimum of 60μs in duration with a minimum of a 1μs recovery time between slots. A Read time slot is initiated by the master device pulling the 1-Wire bus low for a minimum of 1μs and then releasing the bus (see Figure 8).

After the master initiates the read time slot, the SD5820A transmits a 1 by leaving the bus high or transmits a 0 by pulling the bus low. When transmitting a 0, the SD5820A will release the bus by the end of the time slot and the bus will be pulled back to its high idle state by the pull-up resister. Output data from the SD5820A is valid for 15μs after the falling edge initiated the read time slot. Therefore, the master must release the bus and then sample the bus state within 15μs from the start of the slot.

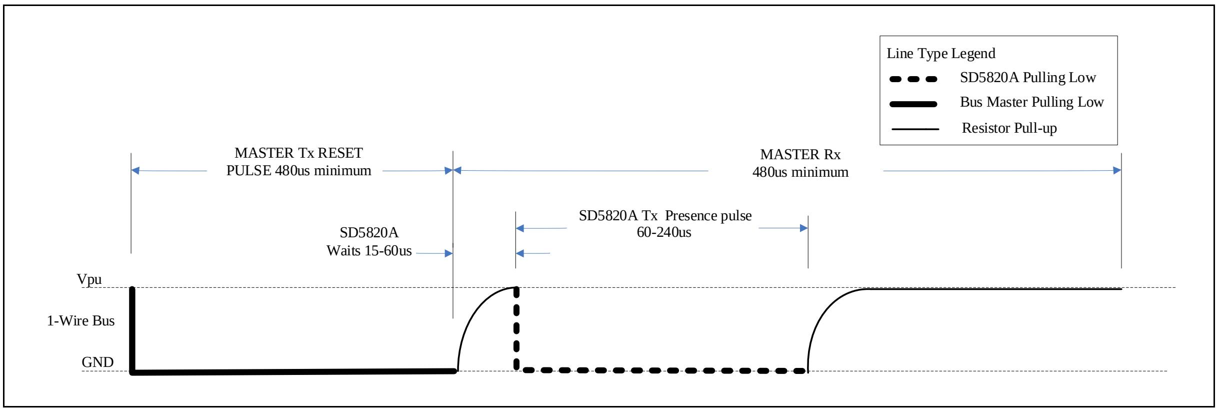


Figure 7. Initialization Timing

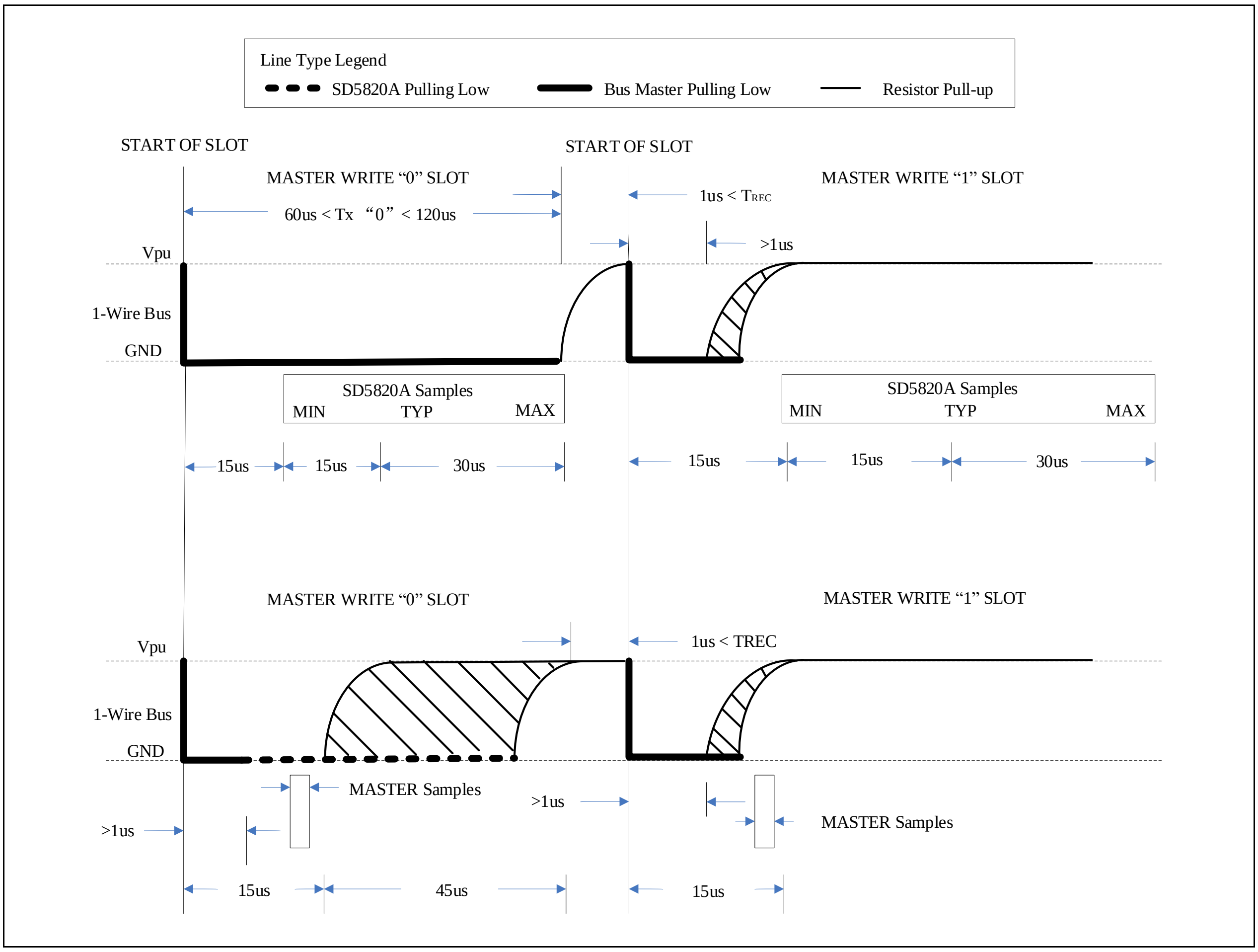


Figure 8. Read/Write Time Slot Timing Diagram

SD5820A Operation Example 1

In this example, there are multiple SD5820As on the bus and they are using parasite power. The bus master initiates a temperature conversion in a specific SD5820A, reads its SCRATCHPAD, and recalculates the CRC to verify the data. This example is illustrated in Table 8.

Table 8. Operation Example 1

Master Mode	Data (LSB First)	Comments
T_X	Reset	Master issues reset pulse.
R_X	Presence	SD5820As respond with presence pulse.
T_X	55h	Master issues MATCH ROM command.
T_X	64-bit ID codes	Master sends SD5820A ID codes.
T_X	44h	Master issues CONVERT T command.
T_X	DIO line held high by strong pull-up	Master applies strong pull-up to DIO for the duration of the conversion (t_{CONV}).
T_X	Reset	Master issues reset pulse.
R_X	Presence	SD5820As respond with presence pulse.
T_X	55h	Master issues MATCH ROM command.
T_X	64-bit ID codes	Master sends SD5820A ID codes.
T_X	BEh	Master issues READ SCRATCHPAD command.
R_X	9 data bytes	Master reads entire SCRATCHPAD, including CRC. The master then recalculates the CRC of the first eight data bytes from the SCRATCHPAD and compares the calculated CRC with the read CRC (byte 9). If they match, the master continues, if not, the read operation is repeated.

SD5820A Operation Example 2

In this example, there is only one SD5820A on the bus and it is using parasite power. The master writes to the T_H, T_L, and resolution registers in the SD5820A SCRATCHPAD, reads the SCRATCHPAD, and recalculates the CRC to verify the data. The master then copies the SCRATCHPAD contents to EEPROM. This example is illustrated in Table 9.

Table 9. Operation Example 2

Master Mode	Data (LSB First)	Comments
T_X	Reset	Master issues reset pulse.
R_X	Presence	SD5820A respond with presence pulse.
T_X	CCh	Master issues SKIP ROM command.
T_X	4Eh	Master issues Write SCRATCHPAD command.
T_X	3 data bytes	Master sends three data bytes to SCRATCHPAD (T_H, T_L, and resolution)
T_X	Reset	Master issues reset pulse.
R_X	Presence	SD5820A responds with presence pulse.
T_X	CCh	Master issues SKIP ROM command.
T_X	BEh	Master issues READ SCRATCHPAD command.
R_X	9 data bytes	Master reads entire SCRATCHPAD including CRC. The master then recalculates the CRC of the first eight data bytes from the SCRATCHPAD and compares the calculated CRC with the read CRC (byte 9). If they match, the master continues; if not, the read operation is repeated.
T_X	Reset	Master issues reset pulse.
R_X	Presence	SD5820A responds with presence pulse.
T_X	CCh	Master issues SKIP ROM command.
T_X	48h	Master issues Copy SCRATCHPAD command.
T_X	DIO line held high by strong pull-up	Master applies strong pull-up to DIO for at least 10ms while copy operation is in progress.

Self-Heating Effect

The SD5820A temperature measurement accuracy will be affected by its own power consumption and chip package thermal resistance. The IC's own power consumption is very small (typically 0.51mW at 3V supply voltage) but will still cause some temperature rise.

The SD5820A temperature rise is:

$$\Delta T \approx 0.51mW \times 162°C/W = 0.08°C$$

Temperature Calibration

The SD5820A has been accurately calibrated in the factory. No further calibration by the user is needed.

DIO Pin Description

The SD5820A's DIO pin is an open drain port. An external pull-up resistor, as shown in Figure 9, is needed to provide a convenient interface to other circuits with different power supplies.

Precautions

The SD5820A measures the IC's internal temperature. When it is used to monitor a heat source temperature, the IC should be placed close to the heat source to minimize the thermal resistance between them.

Typical Applications

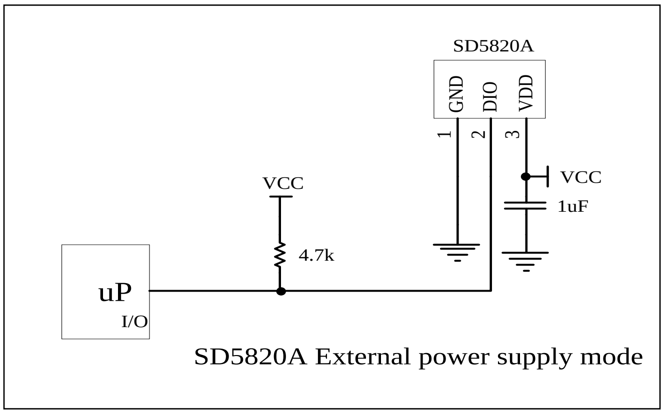


Figure 9(a). External power supply diagram

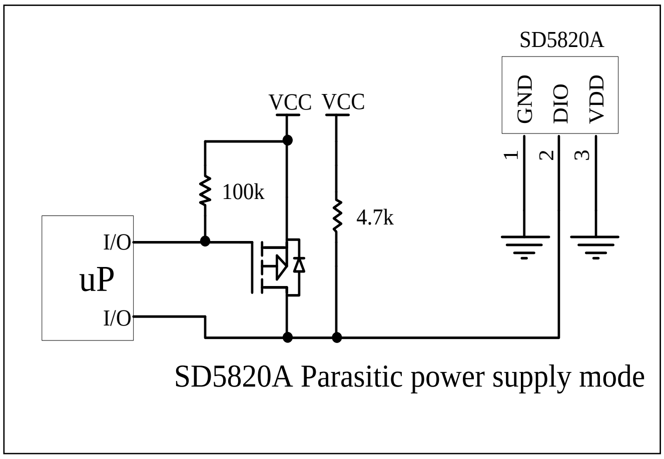


Figure 9(b). Parasitic power supply diagram

Electrical Specifications

Table 10. Absolute Maximum Ratings

Symbol	Parameter	Minimum	Maximum	Unit
TA	Operating temperature	-55	+125	℃
TS	Storage temperature	-65	+150	℃
VDD	Supply voltage	-0.3	+7.0	V
VIN, VOUT	Digital input/output voltage	-0.3	VDD+0.3	V
$Iout_{max}$	Maximum output current		10	mA
ESD	HBM	2000	--	V
TL	Reflow temperature profile	Per IPC/JEDECJ-STD-020C		℃

Remarks:

1. CMOS device can easily be damaged by electrostatics. It must be stored in conductive foam and must not exceed the operating voltage range.
2. Turn off power before inserting or removing the device.

Table 11. Electrical Specifications

(VDD = 2.7~5.5V, T_A = 25°C. **Bold items applicable for T_A = -55~+125°C**)

Symbol	Parameter	Minimum	Typical	Maximum	Unit	Conditions/Remarks
VDD	Supply voltage	2.7	3.0	5.5	V	
Toper	Operating temperature	-55		+125	°C	
LSB	Resolution	--	0.0625	--	°C	12-bits digital output
Terr	Accuracy	--	±0.5	**±0.8**	°C	-10~+85°C, VDD = 2.7~5.5V
		--	±0.8	±1.5		-55~+125°C, VDD = 2.7~5.5V
Ivdd1	Supply current	--	170		uA	Measuring temperature No communication
Ivdd2		--	--	**3**		Standby
PSRR[1]	Power supply rejection ratio	--	0.1	--	°C/V	VDD = 2.7~5.5V[1]
DIO open drain output drive strength						
Isink	Output low current sink	4	--	--	mA	VOL = 0.3V
Ileak	Output high leakage source	--	--	**1**	uA	VOH = VDD

Note 1: PSRR parameter uses the temperature value at VDD = 3.0V as reference.

Table 12. Timing Specifications[1]

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS
Temperature Conversion Time	t_{CONV}	9-bit resolution			93.75	ms
		10-bit resolution			187.5	ms
		11-bit resolution			375	ms
		12-bit resolution			750	ms
Time Slot	t_{SLOT}		60		120	µs
Recovery Time	t_{REC}		1			µs
Write 0 Low Time	t_{LOW0}		60		120	µs
Write 1 Low Time	t_{LOW1}		1		15	µs
Read Data Valid	t_{RDV}				15	µs

Reset Time High	t_{RSTH}		480			μs
Reset Time Low[2]	t_{RSTL}		480			μs
Presence Detect High	t_{PDHIGH}		15		60	μs
Presence Detect Low	t_{PDLOW}		60		240	μs

Notes:

（1）Refer to timing diagrams in Figure 10.

（2）Under parasite power, if tRSTL > 960μs, a power on reset may occur.

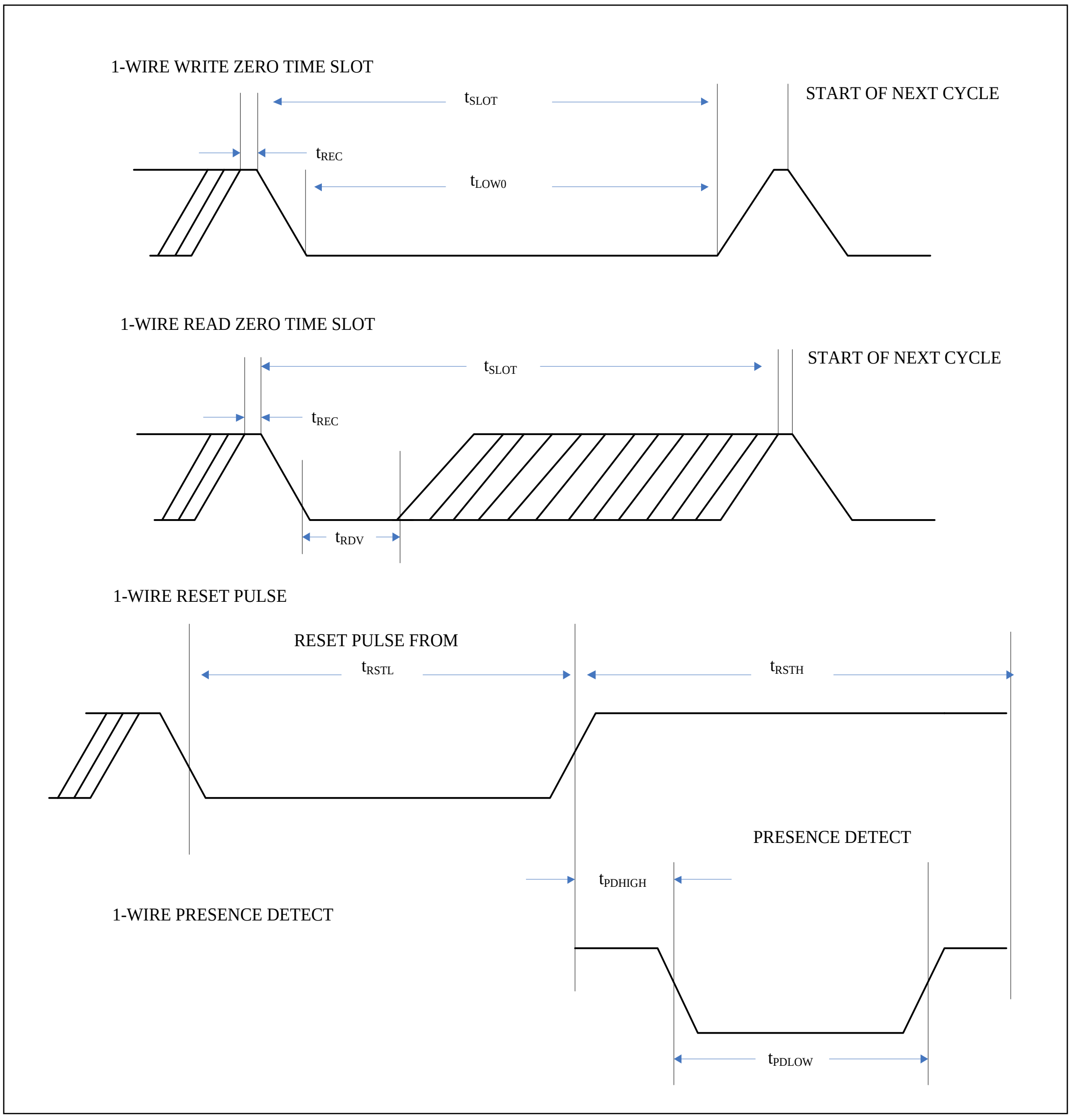


Figure10. Timing Diagrams

Performance Characteristics

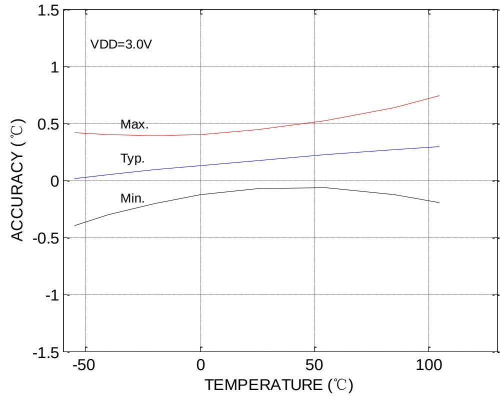


Figure 11. Temperature accuracy at 3V

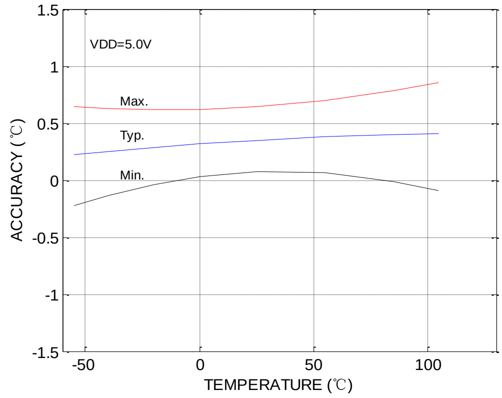


Figure 12. Temperature accuracy at 5V

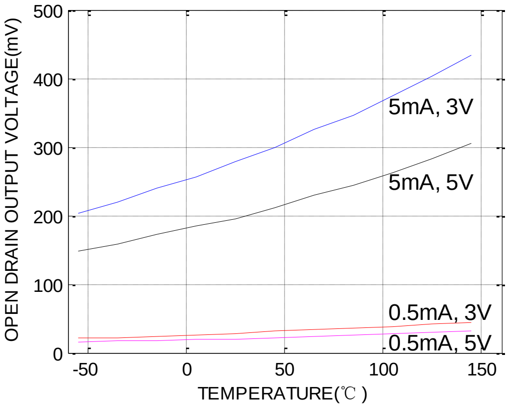


Figure 13. Open drain output voltage

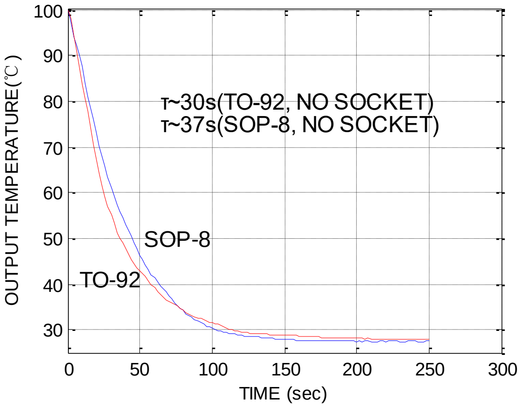


Figure 14. Thermal response time

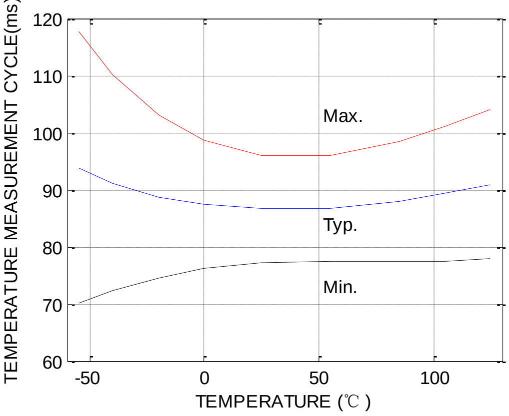


Figure 15. Temperature measurement cycle

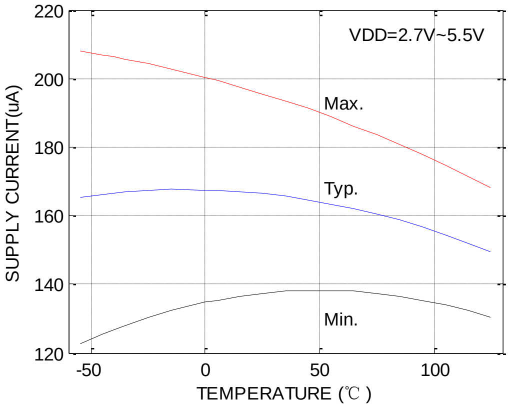


Figure 16. Supply current

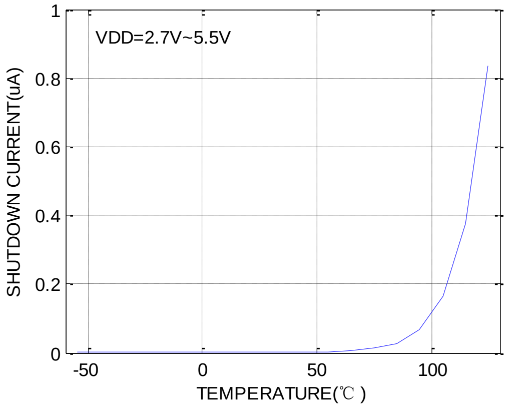
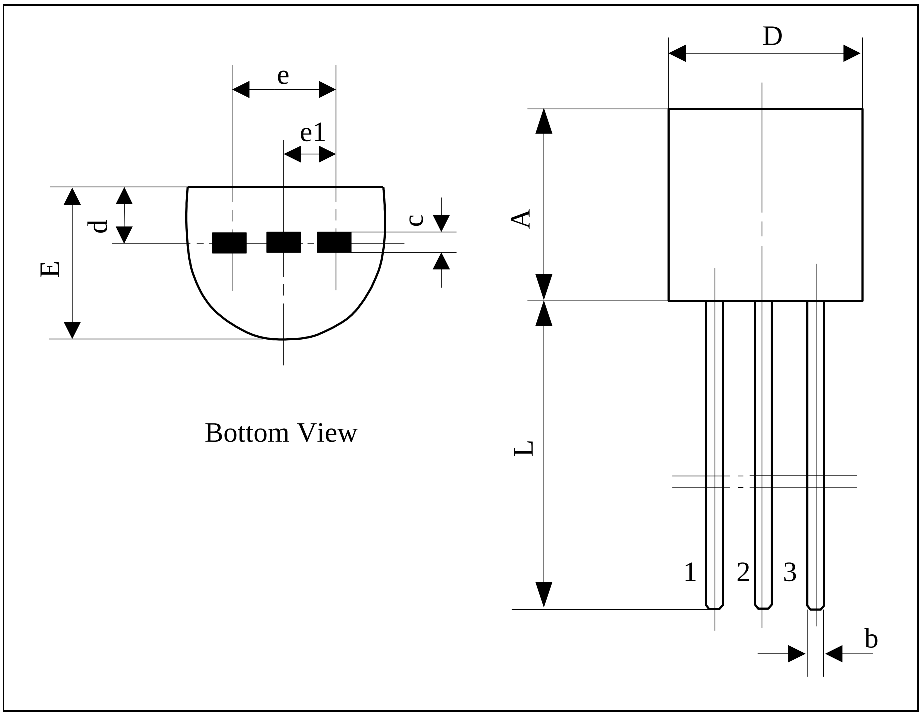


Figure 17. VDD current at shutdown mode

Packaging Information



Dimensions: mm

Symbol	Min.	Nom.	Max.
A	4.53	4.58	4.63
b	0.40	0.45	0.50
c	0.37	0.38	0.39
D	4.60	4.70	4.80
d	1.16	1.18	1.20
E	3.48	3.53	3.58
e	2.48	2.54	2.60
e1	1.24	1.27	1.30
L	13.80	14.15	14.50

Figure 18. TO-92 mechanical specification