PRELIMINARY

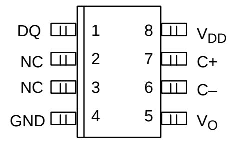
DALLAS SEMICONDUCTOR

DS1724
Programmable Analog/ Digital Thermometer

FEATURES

- Temperature measurements require no external components
- Digital output temperatures measure from –55°C to +125°C. Fahrenheit equivalent is –67°F to +257°F
- Temperature is read as a 9–bit digital value (0.5°C increments)
- Analog volatge output is available for temperatures from –25°C to +100°C. Fahrenheit equivalent is –13°F to +212°F
- Temperature is read as a 10–bit analog voltage (5 mV increments) defined by a user–programmable EEPROM look–up–table
- Voltage ouptut measures +1.280V to +6.395V
- Converts temperature to digital word and analog voltage in 1 second (max)
- Digital data is read/written via a 1–Wire™ serial interface
- Applications include temperature–compensated crystal oscillators for test equipment and radio systems
- 8–pin SOIC (xxx–mil) package

PIN ASSIGNMENT



DS1724S 8–PIN SOIC (xxx MIL)

PIN DESCRIPTION

DQ	–	Digital Data In/Out
V_{DD}	–	2.7V – 5.5V Power Supply
GND	–	Ground
V_O	–	Analog Voltage Out
C+	–	Positive Polarity of Filter Cap
C–	–	Negative Polarity of Filter Cap
NC	–	No Connect

DESCRIPTION

The DS1724 Programmable Analog/Digital Thermometer provides a direct–to–digital temperature reading with no external components required. Furthermore, a user–programmable EEPROM look–up–table (LUT) defines an analog voltage output based on the measured temperature. Digital data is written/read over a simple 1–Wire interface, minimizing required board traces.

Applications for the DS1724 include temperature–compensated crystal oscillators (TCXOs) in test and radio equipment. The presence of an analog and digital interface allow the user to compensate for temperature–dependent shifts in frequency in nearly real time.

The small outline surface mount package allows the DS1724 to be in close proximity to the crystal, while consuming a minimal amount of board space.

DETAILED PIN DESCRIPTION Table 1

PIN	SYMBOL	DESCRIPTION
1	DQ	**Digital Data In/Out** for 1–Wire programming and digital temperature data extraction.
2	NC	**Nc Connect.**
3	NC	**Nc Connect.**
4	GND	**Ground.**
5	V_O	**Analog Voltage Out** represents measured temperature as defined by EEPROM LUT.
6	C–	**Negative Polarity of Filter Cap** optional filter cap connection to reduce V_O leakage.
7	C+	**Positive Polarity of Filter Cap** optional filter cap connection to reduce V_O leakage.
8	V_{DD}	**Supply Voltage** 2.7V to 5.5V input power pin.

OVERVIEW

A block diagram of the DS1724 is shown in Figure 1. The DS1724 consists of three major components:

1. Direct–to–digital temperature sensor
2. 2.57 kbit EEPROM LUT
3. Digital–to–analog converter

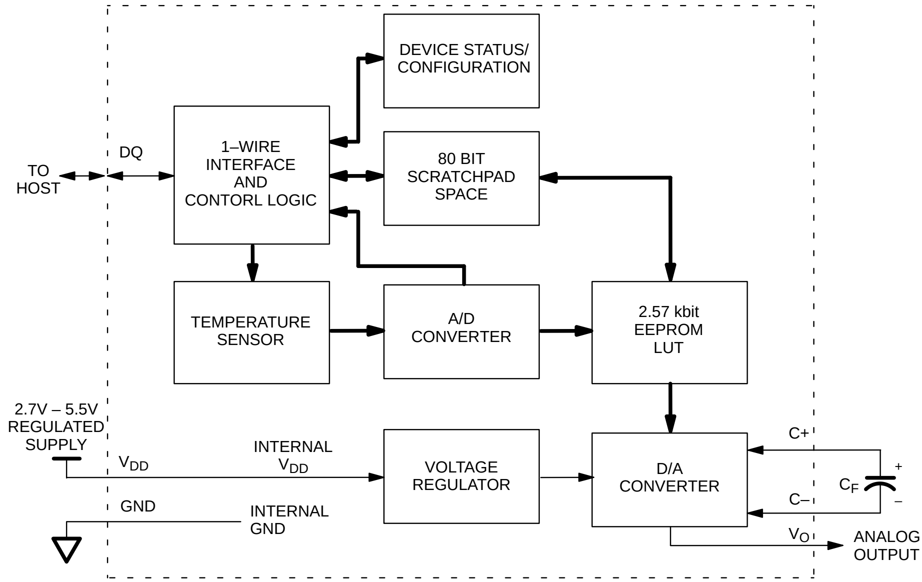
The factory–calibrated direct–to–digital temperature sensor requires no external components. A function command initializes temperature conversions, and the 9–bit result can be read over the 1–Wire serial interface with another function protocol. The DS1724 can be configured to continuously perform conversions, always storing the last completed result in the temperature register, or perform a measurement only when commanded to do so. This is a useful feature in power–sensitive applications.

The other major feature of the DS1724 is an analog voltage output that represents the measured temperature as defined by a 2.57 kbit user–programmable EEPROM look–up–table (LUT). Therefore, any V vs. T profile can be achieved by programming the required map in the EEPROM memory space. Because it is EEPROM, the profile map maintains its program during the absence or cycling of the 2.7V – 5.5V power supply. Therefore, the map can be preprogrammed once before insertion in the final application, or the profile can be interactively altered in the final application to account for a changing environment.

The analog voltage output can be programmed to range from 1.280 to 6.395V with a 10–bit resolution, yielding a step size of approximately 5 mV. Each 0.5°C temperature increment of the LUT is programmed with a 10–bit word, representing the binary equivalent of the desired voltage for that temperature. Therefore, the best resolution possible with the analog output is approximately 10mV/°C. The range of operation for the analog to voltage output of the DS1724 is between –25°C and +100°C.

Digital data is written to/read from the DS1724 via a 1–Wire interface, and all communication is LSb first.

DS1724 FUNCTIONAL BLOCK DIAGRAM Figure 1



OPERATION–Digital Temperature Sensor

The core of DS1724 functionality is its direct–to–digital temperature sensor. The DS1724 measures temperature through the use of an on–board proprietary temperature measurement technique with an operating range from –55°C to +125°C. Temperature conversions are initiated with the Start Convert T (EEh) protocol (see "Memory Function Commands" section), and the 9–bit result is latched in a register. The device can be configured to perform a single conversion, store the result, and return to a standby mode. Or, conversions can be performed continuously following the command protocol to start the first measurement; in this mode of operation, the last completed conversion is stored in the temperature register. Regardless of the mode used, the digital temperature can be retrieved from the temperature register using the Read Temperature (AAh) protocol, as described in detail in the "Memory Function Command" section. Details on how to define the operating mode of the DS1724 are contained in the "OPERATION–Programming" section.

The thermal sensing algorithm of the DS1724 provides a 0.5°C resolution. The temperature reading is provided in a 9–bit, two's complement reading by issuing a Read Temperature command. Table 2 describes the exact relationship of output data to measured temperature. The data is transmitted serially through the 1–Wire serial interface, LSb first. The MSb of the temperature register contains the "sign" (S) bit, denoting whether the temperature is positive or negative. The DS1724 can measure temperature over the range of –55°C to +125°C in 0.5°C increments. For Fahrenheit usage, a lookup table or conversion factor must be used.

Temperature/Data Relationships Table 2

S	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	LSB
MSb				(unit = °C)				LSb	

TEMP	DIGITAL OUTPUT (Binary)	DIGITAL OUTPUT (Hex)
+125°C	0 1111 1010	0FAh
+85°C	0 1010 1010	0AAh
+25.5°C	0 0011 0011	033h
0°C	0 0000 0000	000h
–10.5°C	1 1110 1011	1EBh
–25°C	1 1100 1110	1CEh
–55°C	1 1001 0010	192h

OPERATION–Programming

There are two areas of interest in programming the DS1724: Configuration/Status register, and the 2.57 kbit EEPROM LUT. All programming is done via the 1–Wire interface (DQ pin) using the protocols discussed in the “1–Wire Bus System” section.

Configuration/Status Register Programming

The configuration/status register is written to via the Write Status (0Ch) function command. The factory default setting of the DS1724 has the analog output enabled and the part in a continuous temperature conversion mode. If the user wishes to alter these settings, it is done so using the Write Status command followed with data in the format shown below in Figure. 2. This register can also be read using the Read Status (ACh) command to determine the status of a temperature conversion or EEPROM write.

Configuration/Status Register Figure 2

TB	NVB	X	X	X	X	VO?	1 SHOT
MSb							LSb

1SHOT = Temperature Conversion Mode. If 1SHOT is “1”, the DS1724 will perform one temperature conversion upon reception of the Start Convert T protocol. If 1SHOT is “0”, the DS1724 will continuously perform temperature conversions. This bit is nonvolatile, and the factory default state is “0” (continuous conversion mode).

VO? = Analog Output Enable. If VO? = “1” (factory default state), the DAC and thus the analog voltage output is enabled. If VO? = “0”, the DAC is disabled, thus saving power. The V_O pin should be left floating in this mode. The VO? bit is also nonvolatile.

NVB = Nonvolatile Memory Busy Flag. “1” = Copy from Scratchpad to EEPROM in progress; “0” = Nonvolatile memory not busy. A copy to EEPROM may take from 2 ms to 10 ms (taking longer at lower supply voltages).

TB = Temperature Busy Flag. “1” = temperature conversion in progress; “0” = temperature conversion complete.

X = Don’t care

2.57 Kbit EEPROM LUT Programming

The DS1724’s EEPROM Look–up–table (LUT) is organized as shown in Figure 3. The memory consists of a scratchpad RAM and storage EEPROM. The scratchpad helps insure data integrity when communicating over the 1–Wire bus. Data is first written to the scratchpad (Write Scratchpad (4Eh) command) where it can be read back (Read Scratchpad (BEh) command). After the data has been verified, a Copy Scratchpad (48h) command will transfer the data to the corresponding EEPROM page. This process insures data integrity when modifying the memory.

The DS1724’s memory is organized as 2,570 bits of EEPROM, in 33 80–bit pages. Each page defines the 10–bit analog voltage for eight 0.5 °C temperature increments. (The first page has 60 bits of user–definable space. The last page contains 70 bits of undefined space that will read as all 1’s.) Table 3 shows the temperature ranges that are associated with each page. If any or all of the ranges will never be encountered in a particular application, that page can be used for general EEPROM storage.

Temperature/Page Association Table 3

PAGE	ASSOCIATED TEMPERATURE RANGE
00h	–25°C to –24.5°C
01h	–24.0°C to –20.5°C
02h	–20.0°C to –16.5°C
03h	–16.0°C to –12.5°C
04h	–12.0°C to –8.5°C
05h	–8.0°C to –4.5°C
06h	–4.0°C to –5.0°C
07h	0.0°C to 3.5°C
08h	4.0°C to 7.5°C
09h	8.0°C to 11.5°C
0Ah	12.0°C to 15.5°C
0Bh	16.0°C to 19.5°C
0Ch	20.0°C to 23.5°C
0Dh	24.0°C to 27.5°C
0Eh	28.0°C to 31.5°C
0Fh	32.0°C to 35.5°C
10h	36.0°C to 39.5°C
11h	40.0°C to 43.5°C
12h	44.0°C to 47.5°C
13h	48.0°C to 51.5°C
14h	52.0°C to 55.5°C
15h	56.0°C to 59.5°C
16h	60.0°C to 63.5°C
17h	64.0°C to 67.5°C
18h	68.0°C to 71.5°C
19h	72.0°C to 75.5°C
1Ah	76.0°C to 79.5°C
1Bh	80.0°C to 83.5°C
1Ch	84.0°C to 87.5°C
1Dh	88.0°C to 91.5°C
1Eh	92.0°C to 95.5°C
1Fh	96.0°C to 99.5°C
20h	100.0°C

Each temperature increment is programmed with the binary equivalent (5 mV LSb) of the desired voltage output if that particular temperature is measured by the DS1724. A DC offset of 1.280V is added to the voltage represented by the binary equivalent to arrive at the analog voltage out, V_O. Table 4 below illustrates the exact relationship between the 10–bit word programmed into a given temperature increment and the voltage output, should the DS1724 measure that temperature.

Voltage/Data Relationships Table 4

2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	LSB

MSb (unit = 5 mV) LSb

Programmed Word	Voltage Equivalent of Programmed Word	Analog Voltage Out
00 0000 0000	0.000V	1.280V
00 0000 0001	0.005V	1.285V
00 0011 0010	0.250V	1.530V
00 1100 1000	1.000V	2.280V
01 1111 0100	2.500V	3.780V
10 1100 0111	3.555V	4.835V
11 1111 1111	5.115V	6.395V

OPERATION – Analog Voltage Temperature Sensor

The DS1724 outputs the measured temperature as a 9–bit digital word (see "OPERATION – Digital Temperature Sensor" section) and as an analog voltage. The V vs. T profile of the analog output depends upon the map programmed in the 2.57 Kbit EEPROM LUT. The minimum voltage step between 0.5°C temperature increments is 5 mV. The output (V_O) can range from 1.280V to 6.395V.

Additional Analog Voltage Temperature Sensor information to be provided.

EEPROM LOOK–UP TABLE MAP Figure 3

PAGE 00h

	MSb									LSb
USER	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
USER	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
USER	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
USER	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
USER	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
USER	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–25.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–24.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

PAGE 01h

	MSb									LSb
–24.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–23.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–23.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–22.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
⋮		⋮			⋮			⋮		
–21.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–20.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

PAGE 02h

	MSb									LSb
–20°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–19.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–19.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–18.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
⋮		⋮			⋮			⋮		
–17.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
–16.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

⋮

PAGE 07h

	MSb									LSb
–4.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
⋮		⋮			⋮			⋮		
–0.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

PAGE 08h

	MSb									LSb
0.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
⋮		⋮			⋮			⋮		
3.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

⋮

PAGE 1Fh

	MSb									LSb
96.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
⋮		⋮			⋮			⋮		
99.5°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

PAGE 20h

	MSb									LSb
100.0°C	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X
	X	X	X	X	X	X	X	X	X	X

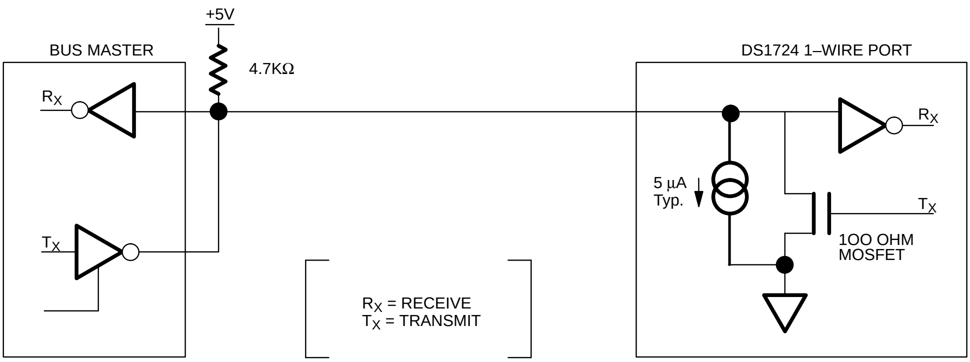
1–WIRE BUS SYSTEM

The 1–Wire bus is a system that has a single bus master and one slave. The DS1724 behaves as a slave. The DS1724 is not able to be multidropped, unlike other 1–Wire devices from Dallas Semiconductor. The discussion of this bus system is broken down into three topics: hardware configuration, transaction sequence, and 1–Wire signaling (signal types and timing).

HARDWARE CONFIGURATION

The 1–Wire bus has only a single line by definition; it is important that each device on the bus be able to drive it at the appropriate time. To facilitate this, each device attached to the 1–Wire bus must have open drain or 3–state outputs. The 1–Wire port of the DS1724 (DQ pin) is open drain with an internal circuit equivalent to that shown in Figure 4. The 1–Wire bus requires a pull–up resistor of approximately 5kΩ.

HARDWARE CONFIGURAITON Figure 4



The idle state for the 1–Wire bus is high. If for any reason a transaction needs to be suspended, the bus MUST be left in the idle state if the transaction is to resume. Infinite recovery time can occur between bits so long as the 1–Wire bus is in the inactive (high) state during the recovery period. If this does not occur and the bus is left low for more than 480 µs, all components on the bus will be reset.

TRANSACTION SEQUENCE

The protocol for accessing the DS1724 via the 1–Wire port is as follows:

- Initialization
- Memory Function Command
- Transaction/Data

INITIALIZATION

All transactions on the 1–Wire bus begin with an initialization sequence. The initialization sequence consists of a reset pulse transmitted by the bus master followed by presence pulse transmitted by the slave.

The presence pulse lets the bus master know that the DS1724 is on the bus and is ready to operate. For more details, see the “1–Wire Signaling” section.

MEMORY COMMAND FUNCTIONS

The following command protocols are summarized in Table 5.

Write Scratchpad [4Eh]

This command writes to the scratchpad of the DS1724. The entire 80–bit scratchpad space may be written, but all writing begins with the byte present at address 0 of the selected scratchpad. Writing may be terminated at any point by issuing a reset.

Read Scratchpad [BEh]

This command reads the contents of the scratchpad on the DS1724. After issuing this command, the user may begin reading the data, always beginning at address 0 of the selected scratchpad. The user may read through the end of the scratchpad space, with any undefined data bits reading all logic 1’s and after which the data read will be all logic 1’s. If not all locations are to be read, the master may issue a reset to terminate reading at any time.

Copy Scratchpad [48xxh]

This command copies the scratchpad into the EEPROM memory page xxh of the DS1724. After issuing this command, the user must write a page number to direct which page of memory the scratchpad is to be copied. Valid page numbers are 00h – 20h. If the bus master issues read time slots following this command, the DS1724 will output "0" on the bus as long as it is busy copying the scratchpad to EEPROM; it will return a "1" when the copy process is complete.

Recall Memory [B8xxh]

This command recalls the stored values in EEPROM page xxh to the scratchpad. This command must proceed a Read SP command in order to read any page of memory on the DS1724. No data is available directly with a Read SP command. Valid page numbers are 00h – 20h.

Write Status [0Ch]

This command writes to the status/configuration register. It is used if the user wishes to change the operating mode of the DS1724. After issuing the command, the bus master must follow with 8 bits of data. See the "Configuration/Status Register Programming" section for the formatting of this register.

Read Status [ACh]

The command reads the status/configuration register, informing the bus master of conversion and EEPROM write cycle status. After issuing this command, the bus master issues 8 read slots.

Start Convert T [44h]

This command begins a temperature conversion. No further data is required. In the OneShot mode, the temperature conversion will be performed and the DS1724 will return to a standby state. In the continuous conversion mode, this command will initiate continuous conversions. If the bus master issues read time slots following this command, the DS1724 will output "0" on the bus as long as it is busy making a temperature conversion; it will return a "1" when the temperature conversion is complete.

Read Temperature [AAh]

This command reads the contents of the register that contains the last completed temperature conversion. The bus master must issue nine read slots after issuing this protocol.

Stop Convert T [22h]

This command stops a temperature conversion. No further data is required. The command may be used to halt a DS1724 in a continuous conversion mode. After issuing the command, the current conversion in progress will be completed, and then the DS1724 will remain idle until a Start Convert T is issued to resume continuous operation.

DS1724 COMMAND SET Table 5

INSTRUCTION	DESCRIPTION	PROTOCOL	1–WIRE BUS MASTER STATUS AFTER ISSUING PROTOCOL	1–WIRE BUS DATA AFTER ISSUING PROTOCOL
MEMORY COMMANDS				
Read Scratchpad	Reads bytes from DS1724 Scratchpad	BEh	Rx	<read up to nine bytes of data>
Write Scratchpad	Writes bytes to DS1724 Scratchpad	4Eh	Tx	<write up to eight bytes of data>
Copy Scratchpad	Copies entire contents of Scratchpad to EEPROM/SRAM page xxh	48h <page 00h–20h>	Idle or Rx of NVB bit	{NVB bit in Status Register = 1 until copy complete (2–10 ms, typ)}
Recall Memory	Copies entire contents of EEPROM /SRAM page xxh to Scratchpad	B8h <page 00h–20h>	Idle	Idle
REGISTER COMMANDS				
Start Convert T	Initiates temperature conversion	44h	Idle or Rx of TB bit	{TB bit in Status Register = 1 until conversion complete}
Read Temperature	Reads temperature register	AAh	Rx	<read 9 bits of data>
Stop Convert T	Terminates continuous conversions	22h	Idle	Idle
Write Status	Programs the Status/Configuration register	0Ch	Tx	<write 8 bits of data>
Read Status	Reads the Status/Configuration register	ACh	Rx	<read 8 bits of data>

NOTES:

1. Temperature conversion takes up to 1 second.
2. EEPROM write takes up to 50 ms.

SAMPLE COMMAND SEQUENCE Table 6

Example: Bus Master configures the DS1724 for continuous conversions, initiates a temperature conversion, and reads the digital output.

MASTER MODE	DATA (LSB FIRST)	COMMENTS
TX	Reset	Reset pulse
RX	Presence	Presence pulse
TX	0Ch	Write Status
TX	02h	Enables V_O and configures for continuous conversions
TX	Reset	Reset pulse
RX	Presence	Presence pulse
TX	44h	Initiates temperature conversions
TX	Reset	Reset pulse
RX	Presence	Presence pulse
TX	AAh	Read Temperature register
TX	<9 read slots>	Read the 9 bits of the last completed temperature conversion
TX	Reset	Reset pulse
RX	Presence	Presence Pulse, done

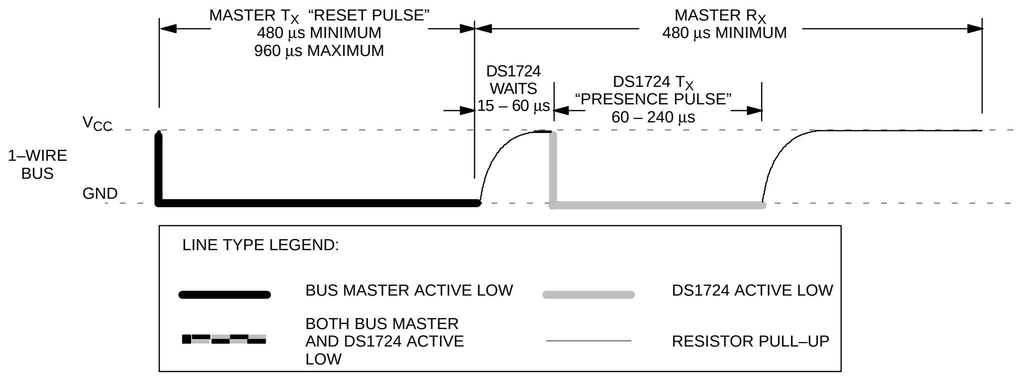
I/O SIGNALING

The DS1724 requires strict protocols to insure data integrity. The protocol consists of several types of signaling on one line: reset pulse, presence pulse, write 0, write 1, read 0, and read 1. All of these signals, with the exception of the presence pulse, are initiated by the bus master.

The initialization sequence required to begin any communication with the DS1724 is shown in Figure 5. A reset pulse followed by a presence pulse indicates the DS1724 is ready to send or receive data given a valid memory function command.

The bus master transmits (Tx) a reset pulse (a low signal for a minimum of 480 µs). The bus master then releases the line and goes into a receive mode (Rx). The 1–Wire bus is pulled to a high state via the 5kΩ pull–up resistor. After detecting the rising edge on the I/O pin, the DS1724 waits 15–60 µs and then transmits the presence pulse (a low signal for 60–240 µs).

INITIALIZATION PROCEDURE "RESET AND PRESENCE PULSES" Figure 5



DS1724 data is read and written through the use of time slots to manipulate bits and a command word to specify the transaction.

Write Time Slots

A write time slot is initiated when the host pulls the data line from a high (inactive) logic level to a low logic level. There are two types of write time slots: Write One time slots and Write Zero time slots. All write time slots must be a minimum of 60 µs in duration with a minimum of a 1 µs recovery time between individual write cycles.

The DS1724 samples the I/O line in a window of 15 µs to 60 µs after the I/O line falls. If the line is high, a Write One occurs. If the line is low, a Write Zero occurs (See Figure 10).

For the host to generate a Write One time slot, the data line must be pulled to a logic low level and then released, allowing the data line to pull up to a high level within 15 microseconds after the start of the write time slot.

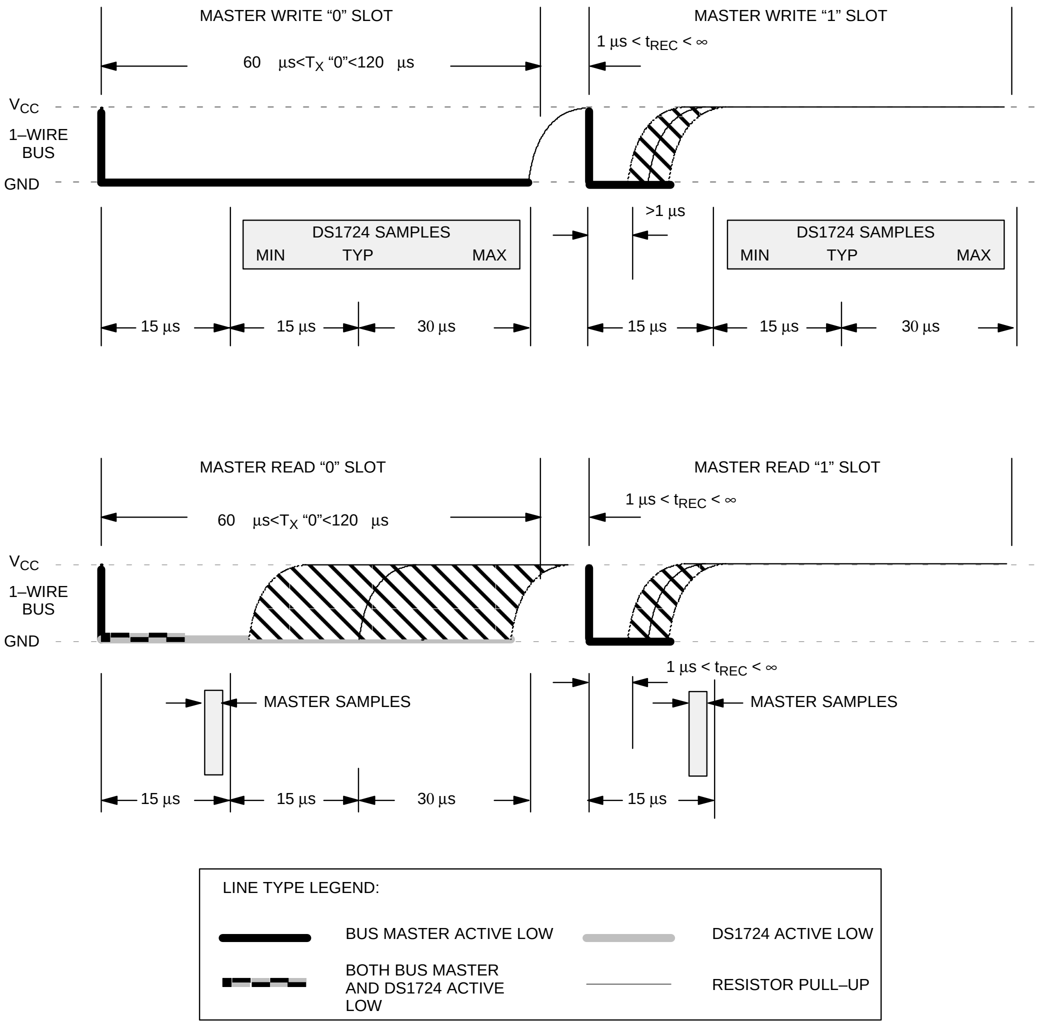
For the host to generate a Write Zero time slot, the data line must be pulled to a logic low level and remain low for the duration of the write time slot.

Read Time Slots

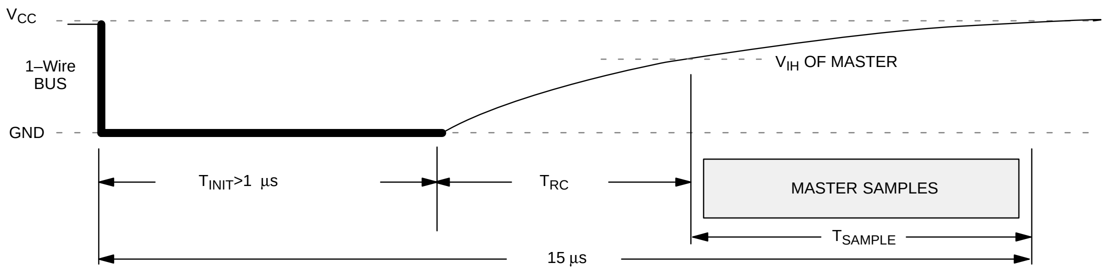
The host generates read time slots when data is to be read from the DS1724. A read time slot is initiated when the host pulls the data line from a logic high level to logic low level. The data line must remain at a low logic level for a minimum of 1 µs; output data from the DS1724 is then valid within the next 14 µs maximum. The host therefore must stop driving the I/O pin low in order to read its state 15 µs from the start of the read slot. (see Figure 6). By the end of the read time slot, the I/O pin will pull back high via the external pull–up resistor. All read time slots must be a minimum of 60 µs in duration with a minimum of a 1 µs recovery time between individual read slots.

Figure 7 shows that the sum of t_{INIT}, t_{RC}, and t_{SAMPLE} must be less than 15 µs. Figure 8 shows that system timing margin is maximized by keeping t_{INIT} and t_{RC} as small as possible and by locating the master sample time toward the end of the 15 µs period.

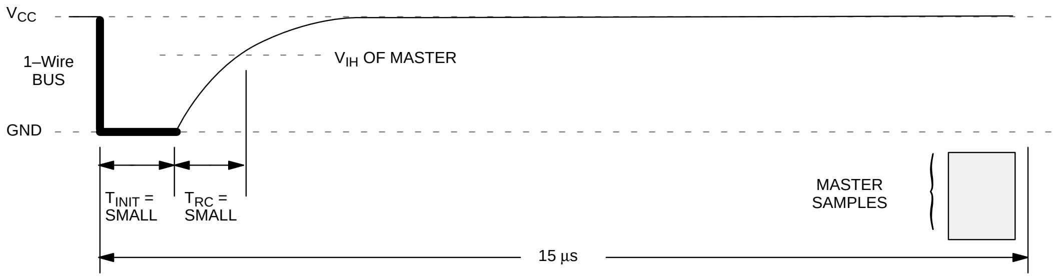
READ/WRITE TIMING DIAGRAM Figure 6

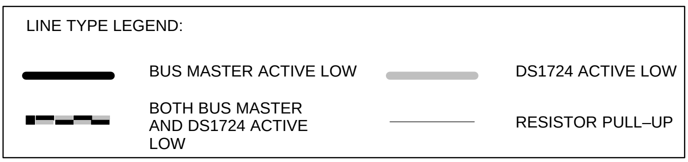


DETAILED MASTER READ "1" TIMING Figure 7



RECOMMENDED MASTER READ "1" TIMING Figure 8





ABSOLUTE MAXIMUM RATINGS*

Voltage on V_{DD}, Relative to Ground	–0.3V to 7.0V
Voltage on any other pin, Relative to Ground	–0.3°C to +7°C
Operating Temperature	–55°C to +125°C
Storage Temperature	–55°C to +125°C
Soldering Temperature	260°C for 10 seconds

* This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

RECOMMENDED DC OPERATING CONDITIONS

(–25°C to +85°C, 2.7V ≤ V_{DD} ≤ 5.5V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Supply Voltage	V_{DD}		2.7		5.5	V	1
Data Pin	DQ		–0.3		5.5	V	1

DC ELECTRICAL CHARACTERISTICS

(–25°C to +85°C, 2.7V ≤ V_{DD} ≤ 5.5V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Input Logic High	V_{IH}		2.0			V	1
Input Logic Low	V_{IL}		–0.3		0.8	V	1
Standby Current	I_{DD1}	DQ = 1		5	10	µA	2, 3
Active Current	I_{DD}	Temperature Conversion <u>or</u> EEPROM write in progress		250	1000	µA	3
Input Resistance	R_I	DQ			500	kΩ	4

ELECTRICAL CHARACTERISTICS: DIGITAL THERMOMETER

(–25°C to +85°C, 2.7V ≤ V_{DD} ≤ 5.5V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Thermometer Error (T_{ACTUAL} – $T_{MEASURED}$)	T_{ERR}	0°C to 70°C			±TBD	°C	5
Resolution					9	bits	
Conversion Time	t_{CONVT}			400	1000	ms	

ELECTRICAL CHARACTERISTICS:ANALOG THERMOMETER DAC

(–40°C to +85°C, 2.7V ≤ V_{DD} ≤ 5.5V)

PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

AC ELECTRICAL CHARACTERISTICS: 1–WIRE INTERFACE (–25°C to +85°C, 2.7V ≤ V_{DD} ≤ 5.5V)

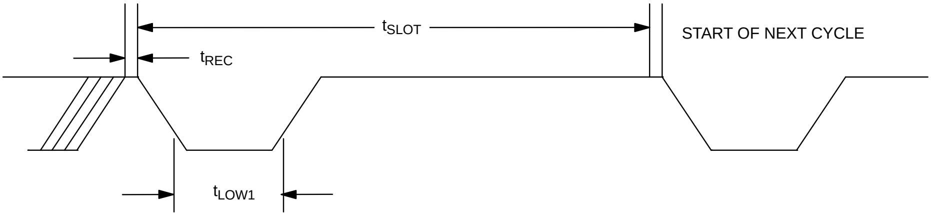
PARAMETER	SYMBOL	CONDITION	MIN	TYP	MAX	UNITS	NOTES
Time Slot	t_{SLOT}		60		120	µs	
Recovery Time	t_{REC}		1			µs	
Write 0 Low Time	t_{LOW0}		60		120	µs	
Write 1 Low Time	t_{LOW1}		1		15	µs	
Read Data Valid	t_{RDV}				15	µs	
Reset Time High	t_{RSTH}		480			µs	
Reset Time Low	t_{RSTL}		480			µs	
Presence Detect High	t_{PDH}		15		16	µs	
Presence Detect Low	t_{PDL}		60		240	µs	
DQ Capacitance	C_{DQ}				25	pF	

NOTES:

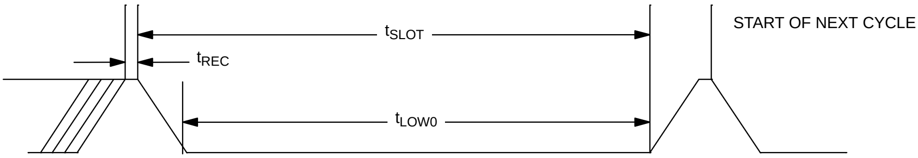
1. All voltages are referenced to GND.
2. Shutdown and Standby currents specified for the range 0°C to 70°C.
3. I_{DD} specified with V_{DD} = 5.0V.
4. Input load is to GND.
5. See Typical Curve for thermometer specification limits beyond 0°C to 70°C range.

TIMING DIAGRAMS Figure 9

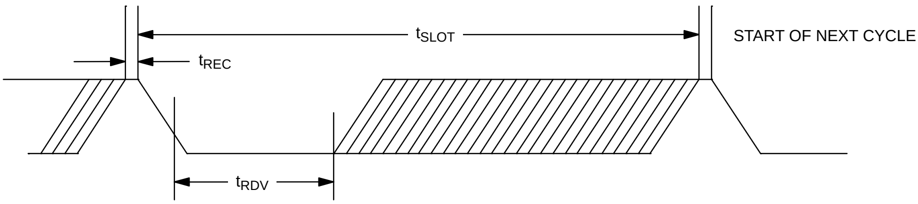
1–WIRE WRITE ONE TIME SLOT



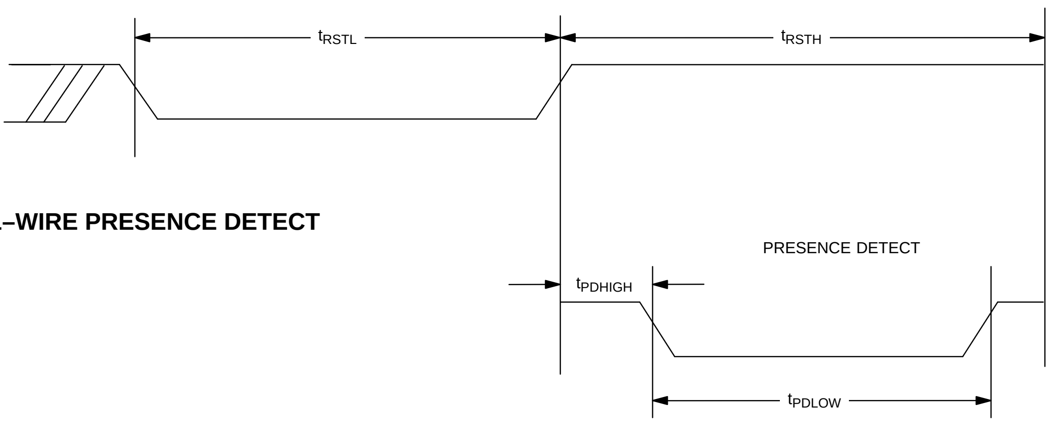
1–WIRE WRITE ZERO TIME SLOT



1–WIRE READ ZERO TIME SLOT



1–WIRE RESET PULSE



1–WIRE PRESENCE DETECT

TYPICAL THERMOMETER PERFORMANCE CURVE Figure 10

T B D