



**THE DATASHEET OF
STK17T88-RF25**



32K x 8 AutoStore nvSRAM with Real Time Clock

Features

- nvSRAM Combined With Integrated Real-Time Clock Functions (RTC, Watchdog Timer, Clock Alarm, Power Monitor)
- Capacitor or Battery Backup for RTC
- 25, 45 ns Read Access and R/W Cycle Time
- Unlimited Read/Write Endurance
- Automatic Nonvolatile STORE on Power Loss
- Nonvolatile STORE Under Hardware or Software Control
- Automatic RECALL to SRAM on Power Up
- Unlimited RECALL Cycles
- 200K STORE Cycles
- 20-Year Nonvolatile Data Retention
- Single 3V +20%, -10% Power Supply
- Commercial and Industrial Temperatures
- 48-Pin 300-mil SSOP Package (RoHS Compliant)

Description

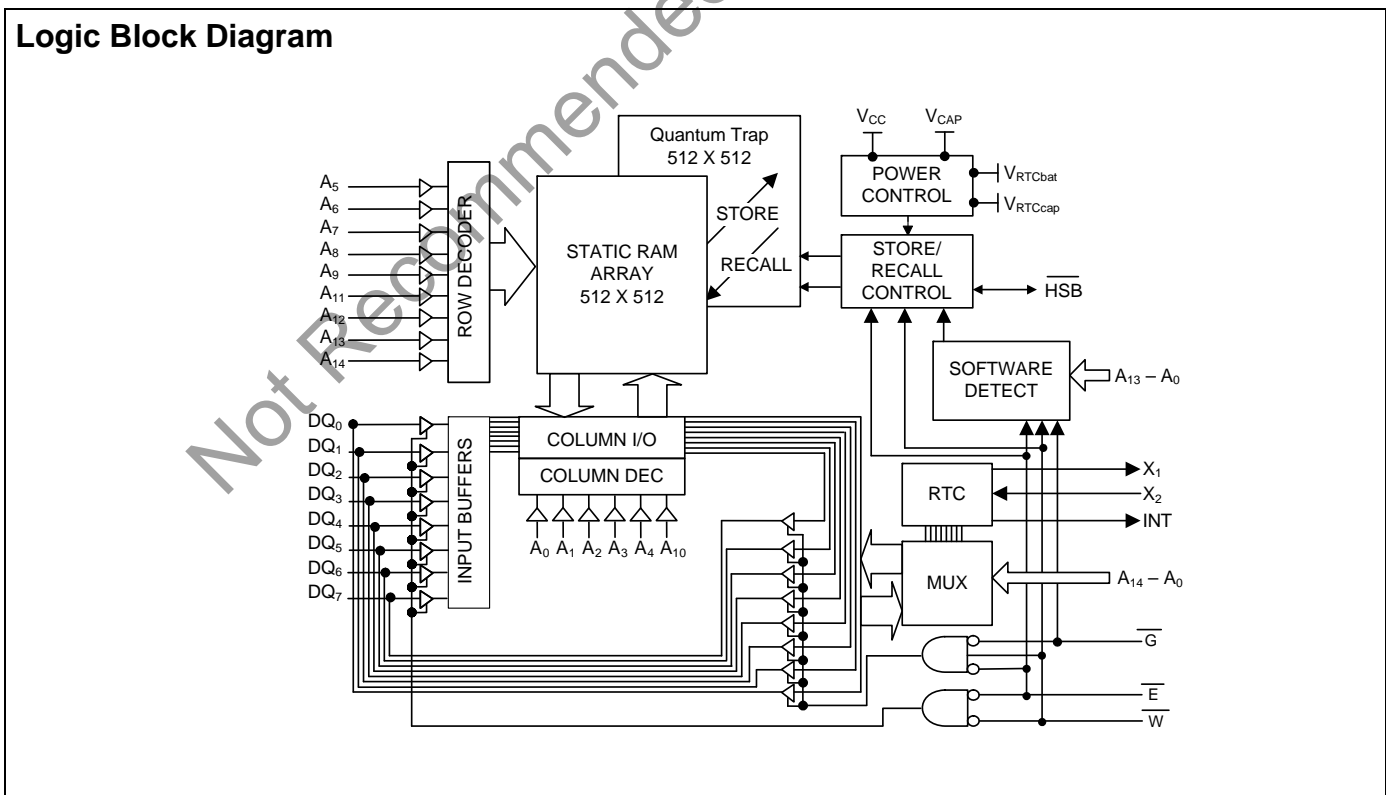
The Cypress STK17T88 combines a 256 Kb nonvolatile static RAM (nvSRAM) with a full-featured real-time clock in a reliable, monolithic integrated circuit.

The 256 Kb nvSRAM is a fast static RAM with a nonvolatile QuantumTrap storage element included with each memory cell.

The SRAM provides the fast access and cycle times, ease of use and unlimited read and write endurance of a normal SRAM. Data transfers automatically to the nonvolatile storage cells when power loss is detected (the *STORE* operation). On power up, data is automatically restored to the SRAM (the *RECALL* operation). Both *STORE* and *RECALL* operations are also available under software control.

The real time clock function provides an accurate clock with leap year tracking and a programmable, high accuracy oscillator. The Alarm function is programmable for one-time alarms or periodic minutes, hours, or days alarms. There is also a programmable watchdog timer for processor control.

Logic Block Diagram



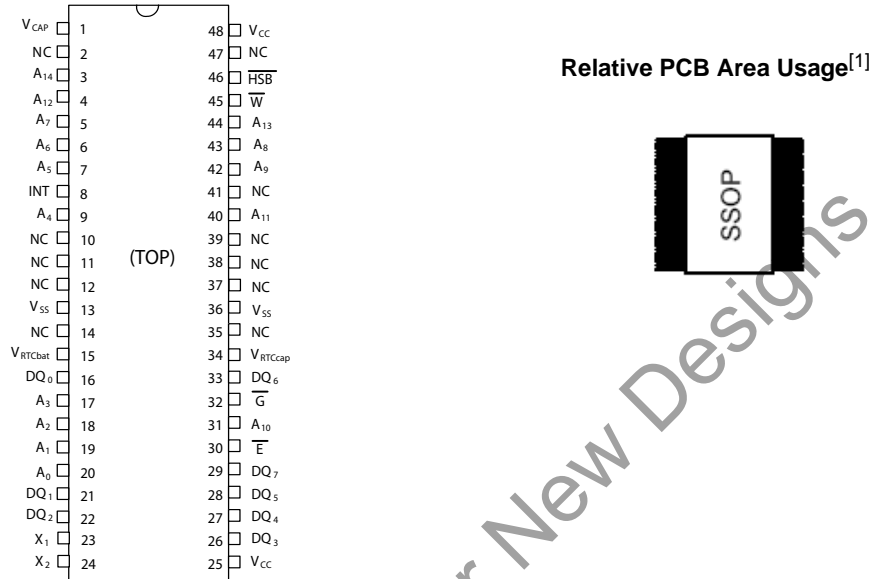
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Pin Configurations

Figure 1. 48-Pin SSOP



Pin Descriptions

| Pin Name | I/O Type | Description |
|----------------------------------|--------------|---|
| A ₁₄ -A ₀ | Input | Address: The 15 address inputs select one of 32,768 bytes in the nvSRAM array or one of 16 bytes in the clock register map. |
| DQ ₇ -DQ ₀ | I/O | Data: Bi-directional 8-bit data bus for accessing the nvSRAM and RTC. |
| \bar{E} | Input | Chip Enable: The active low \bar{E} input selects the device. |
| \bar{W} | Input | Write Enable: The active low \bar{W} enables data on the DQ pins to be written to the address location selected on the falling edge of \bar{E} . |
| \bar{G} | Input | Output Enable: The active low \bar{G} input enables the data output buffers during read cycles. De-asserting \bar{G} high caused the DQ pins to tristate. |
| X ₁ | Output | Crystal Connection, Drives Crystal on Startup. |
| X ₂ | Input | Crystal Connection for 32.768 kHz Crystal. |
| V _{RTCcap} | Power Supply | Capacitor Supplied Backup RTC Supply Voltage (Left unconnected if V _{RTCbat} is used). |
| V _{RTCbat} | Power Supply | Battery Supplied Backup RTC Supply Voltage (Left unconnected if V _{RTCcap} is used). |
| V _{CC} | Power Supply | Power: 3.0V, +20%, -10% |
| HSB | I/O | Hardware Store Busy: When low this output indicates a store is in progress. When pulled low external to the chip, it initiates a nonvolatile STORE operation. A weak pull up resistor keeps this pin high if not connected. (Connection Optional). |
| INT | Output | Interrupt Control: Can be programmed to respond to the clock alarm, the watchdog timer and the power monitor. Programmable to either active high (push/pull) or active low (open-drain) |
| V _{CAP} | Power Supply | AutoStore Capacitor: Supplies power to nvSRAM during power loss to store data from SRAM to nonvolatile storage elements. |
| V _{SS} | Power Supply | Ground. |
| NC | No Connect | Unlabeled Pins have no Internal Connections. |

Note

1. For detailed package size specifications, see [Package Diagram](#) on page 23.

Absolute Maximum Ratings

| | |
|---|------------------------------|
| Voltage on Input Relative to Ground..... | -0.5V to 4.1V |
| Voltage on Input Relative to V_{SS} | -0.5V to ($V_{CC} + 0.5V$) |
| Voltage on DQ_{0-7} or \overline{HSB} | -0.5V to ($V_{CC} + 0.5V$) |
| Temperature under Bias | -55°C to 125°C |
| Junction Temperature | -55°C to 140°C |
| Storage Temperature | -65°C to 150°C |
| Power Dissipation..... | 1W |
| DC Output Current (1 output at a time, 1s duration).... | 15 mA |

Note Stresses greater than those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

RF (SSOP-48) Package Thermal Characteristics

θ_{jc} 6.2 C/W; θ_{ja} 51.1 [0 fpm], 44.7 [200 fpm], 41.8 C/W [500 fpm]

DC Characteristics ($V_{CC} = 2.7V-3.6V$)

| Symbol | Parameter | Commercial | | Industrial | | Units | Notes |
|-----------|--|----------------|----------------|----------------|----------------|---------|--|
| | | Min | Max | Min | Max | | |
| I_{CC1} | Average V_{CC} Current | | 65 50 | | 70 55 | mA | $t_{AVAV} = 25$ ns $t_{AVAV} = 45$ ns Dependent on output loading and cycle rate. Values obtained without output loads. |
| I_{CC2} | Average V_{CC} Current during STORE | | 3 | | 3 | mA | All Inputs Don't Care, $V_{CC} = \text{Max}$ Average current for duration of STORE cycle (t_{STORE}) |
| I_{CC3} | Average V_{CC} Current at $t_{AVAV} = 200$ ns 3V, 25°C, Typical | | 10 | | 10 | mA | $W \geq (V_{CC} - 0.2V)$ All Other Inputs Cycling at CMOS Levels Dependent on output loading and cycle rate. Values obtained without output loads. |
| I_{CC4} | Average V_{CAP} Current during AutoStore Cycle | | 3 | | 3 | mA | All Inputs Don't Care Average current for duration of STORE cycle (t_{STORE}) |
| I_{SB} | V_{CC} Standby Current (Standby, Stable CMOS Levels) | | 3 | | 3 | mA | $E \geq (V_{CC} - 0.2V)$ All Others $V_{IN} \leq 0.2V$ or $\geq (V_{CC} - 0.2V)$ Standby current level after nonvolatile cycle complete |
| I_{ILK} | Input Leakage Current | | ± 1 | | ± 1 | μA | $V_{CC} = \text{Max}$ $V_{IN} = V_{SS}$ to V_{CC} |
| I_{OLK} | Off-State Output Leakage Current | | ± 1 | | ± 1 | μA | $V_{CC} = \text{Max}$ $V_{IN} = V_{SS}$ to V_{CC} , \overline{E} or $\overline{G} \geq V_{IH}$ |
| V_{IH} | Input Logic “1” Voltage | 2.0 | $V_{CC} + 0.5$ | 2.0 | $V_{CC} + 0.5$ | V | All Inputs |
| V_{IL} | Input Logic “0” Voltage | $V_{SS} - 0.5$ | 0.8 | $V_{SS} - 0.5$ | 0.8 | V | All Inputs |
| V_{OH} | Output Logic “1” Voltage | 2.4 | | 2.4 | | V | $I_{OUT} = -2$ mA |
| V_{OL} | Output Logic “0” Voltage | | 0.4 | | 0.4 | V | $I_{OUT} = 4$ mA |
| T_A | Operating Temperature | 0 | 70 | -40 | 85 | °C | |
| V_{CC} | Operating Voltage | 2.7 | 3.6 | 2.7 | 3.6 | V | 3.0V +20%, -10% |
| V_{CAP} | Storage Capacitance | 17 | 57 | 17 | 57 | μF | Between V_{CAP} pin and V_{SS} , 5V rated. |
| NV_C | Nonvolatile STORE Operations | 200 | | 200 | | K | |
| $DATA_R$ | Data Retention | 20 | | 20 | | Years | At 55°C |

Note

- The \overline{HSB} pin has $I_{OUT} = -10$ μA for V_{OH} of 2.4V, this parameter is characterized but not tested.
- The INT is open-drain and does not source or sink high current when interrupt register bit D3 is low.

AC Test Conditions

Input Pulse Levels0V to 3V
 Input Rise and Fall Times ≤5 ns
 Input and Output Timing Reference Levels 1.5V
 Output Load.....See Figure 2 and Figure 3

Capacitance

| Symbol | Parameter ^[2] | Max | Units | Conditions |
|------------------|--------------------------|-----|-------|--------------|
| C _{IN} | Input Capacitance | 7 | pF | ΔV = 0 to 3V |
| C _{OUT} | Output Capacitance | 7 | pF | ΔV = 0 to 3V |

Figure 2. AC Output Loading

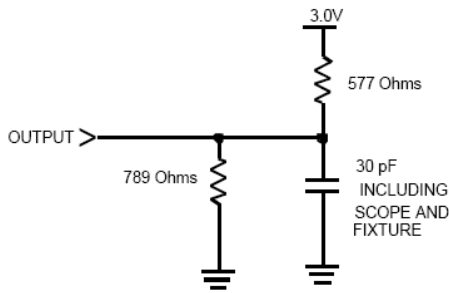
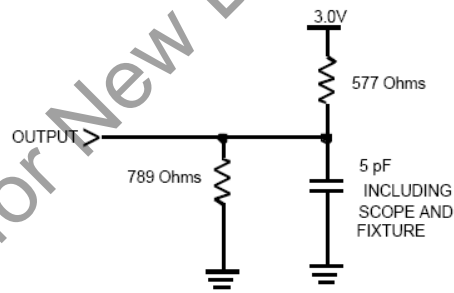


Figure 3. AC Output Loading for Tristate Specifications
 (T_{HZ}, t_{LZ}, t_{WLQZ}, t_{WHQZ}, t_{GLQZ}, t_{GHQZ})



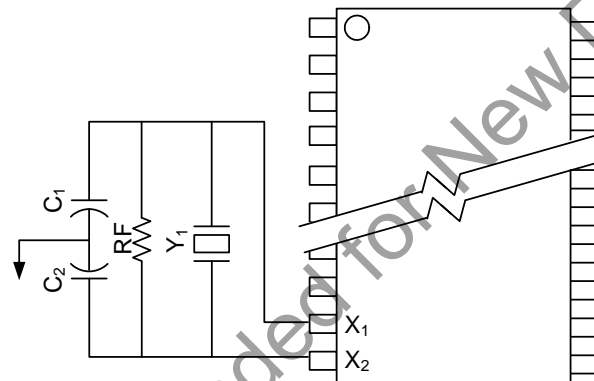
Not Recommended for New Designs

Note

2. These parameters are guaranteed but not tested.

RTC DC Characteristics

| Symbol | Parameter | Commercial | | Industrial | | Units | Notes |
|-------------------|------------------------------|------------|-----|------------|-----|-------|--|
| | | Min | Max | Min | Max | | |
| IBAK | RTC Backup Current | – | 300 | – | 350 | nA | From either VRTCcap or VRTCbat |
| VRTCbat | RTC Battery Pin Voltage | 1.8 | 3.3 | 1.8 | 3.3 | V | Typical = 3.0V during normal operation |
| VRTCcap | RTC Capacitor Pin Voltage | 1.2 | 2.7 | 1.2 | 2.7 | V | Typical = 2.4V during normal operation |
| t _{oscs} | RTC Oscillator Time to Start | – | 10 | – | 10 | sec | At minimum temperature from power up or enable |
| | | – | 5 | – | 5 | sec | At 25°C from power up or enable |

Figure 4. RTC Component Configuration

Recommended Values
 $Y_1 = 32.768 \text{ kHz}$
 $RF = 10 \text{ MO}$
 $C_1 = 0$ (install cap footprint, but leave unloaded)

 $C_2 = 56 \text{ pF} \pm 10\%$ (do not vary from this value)

SRAM READ Cycles #1 and #2

| No. | Symbols | | | Parameter | STK17T88-25 | | STK17T88-45 | | Units |
|-----|------------------|--------------------|-----------|---|-------------|-----|-------------|-----|-------|
| | #1 | #2 | Alt. | | Min | Max | Min | Max | |
| 1 | | t_{ELQV} | t_{ACS} | Chip Enable Access Time | | 25 | | 45 | ns |
| 2 | $t_{AVAV}^{[3]}$ | $t_{ELEH}^{[5]}$ | t_{RC} | Read Cycle Time | 25 | | 45 | | ns |
| 3 | $t_{AVQV}^{[4]}$ | $t_{AVQV}^{[6]}$ | t_{AA} | Address Access Time | | 25 | | 45 | ns |
| 4 | | t_{GLQV} | t_{OE} | Output Enable to Data Valid | | 12 | | 20 | ns |
| 5 | $t_{AXQX}^{[4]}$ | t_{AXQX} | t_{OH} | Output Hold after Address Change | 3 | | 3 | | ns |
| 6 | | t_{ELQX} | t_{LZ} | Address Change or Chip Enable to Output Active | 3 | | 3 | | ns |
| 7 | | t_{EHQZ} | t_{HZ} | Address Change or Chip Disable to Output Inactive | | 10 | | 15 | ns |
| 8 | | t_{GLQX} | t_{OLZ} | Output Enable to Output Active | 0 | | 0 | | ns |
| 9 | | $t_{GHQZ}^{[5]}$ | t_{OHZ} | Output Disable to Output Inactive | | 10 | | 15 | ns |
| 10 | | $t_{ELICCL}^{[3]}$ | t_{PA} | Chip Enable to Power Active | 0 | | 0 | | ns |
| 11 | | $t_{EHICCH}^{[3]}$ | t_{PS} | Chip Disable to Power Standby | | 25 | | 45 | ns |

Figure 5. SRAM READ Cycle #1: Address Controlled^[3,4,6]

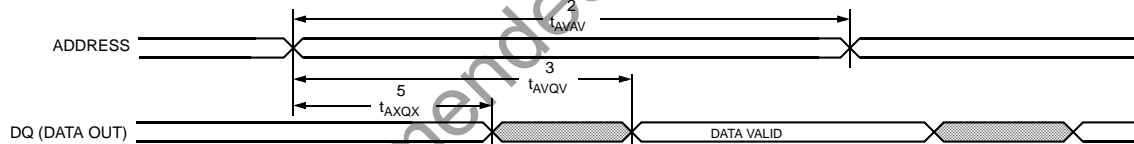
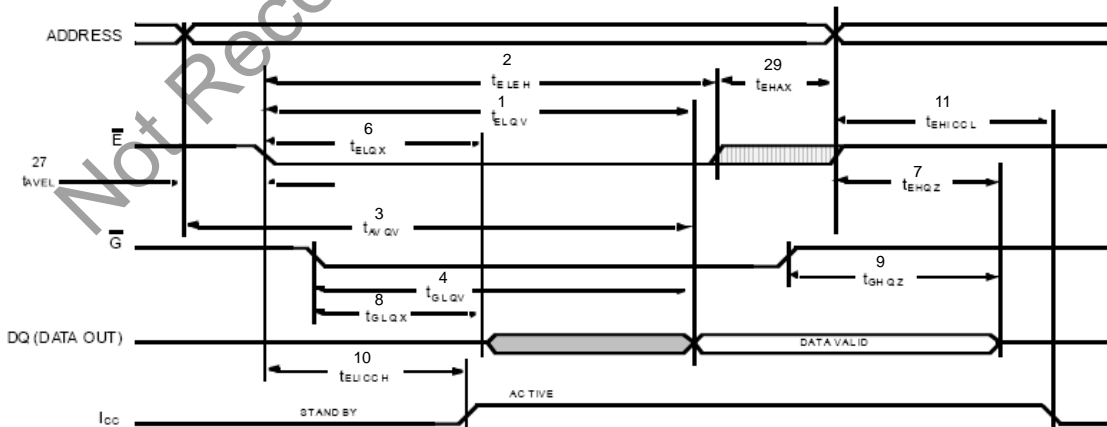


Figure 6. SRAM READ Cycle #2: \bar{E} and \bar{G} Controlled^[6]



Notes

- 3. W must be high during SRAM READ cycles.
- 4. Device is continuously selected with \bar{E} and \bar{G} both low
- 5. Measured ± 200 mV from steady state output voltage.
- 6. HSB must remain high during READ and WRITE cycles.

SRAM WRITE Cycles #1 and #2

| No. | Symbols | | | Parameter | STK17T88-25 | | STK17T88-45 | | Units |
|-----|------------|------------|----------|----------------------------------|-------------|-----|-------------|-----|-------|
| | #1 | #2 | Alt. | | Min | Max | Min | Max | |
| 12 | t_{AVAV} | t_{AVAV} | t_{WC} | Write Cycle Time | 25 | | 45 | | ns |
| 13 | t_{WLWH} | t_{WLEH} | t_{WP} | Write Pulse Width | 20 | | 30 | | ns |
| 14 | t_{ELWH} | t_{ELEH} | t_{CW} | Chip Enable to End of Write | 20 | | 30 | | ns |
| 15 | t_{DVWH} | t_{DVEH} | t_{DW} | Data Setup to End of Write | 10 | | 15 | | ns |
| 16 | t_{WHDX} | t_{EHDX} | t_{DH} | Data Hold after End of Write | 0 | | 0 | | ns |
| 17 | t_{AVWH} | t_{AVEH} | t_{AW} | Address Setup to End of Write | 20 | | 30 | | ns |
| 18 | t_{AVWL} | t_{AVEL} | t_{AS} | Address Setup to Start of Write | 0 | | 0 | | ns |
| 19 | t_{WHAX} | t_{EHAX} | t_{WR} | Address Hold after End of Write | 0 | | 0 | | ns |
| 20 | t_{WLQZ} | | t_{WZ} | Write Enable to Output Disable | | 10 | | 15 | ns |
| 21 | t_{WHQX} | | t_{OW} | Output Active after End of Write | 3 | | 3 | | ns |

Figure 7. SRAM WRITE Cycle #1: \bar{W} Controlled^[7, 8]

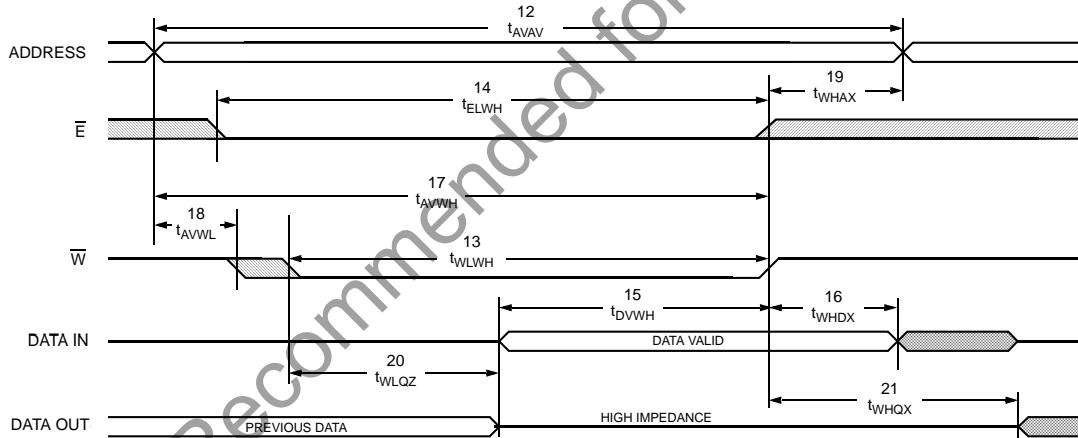
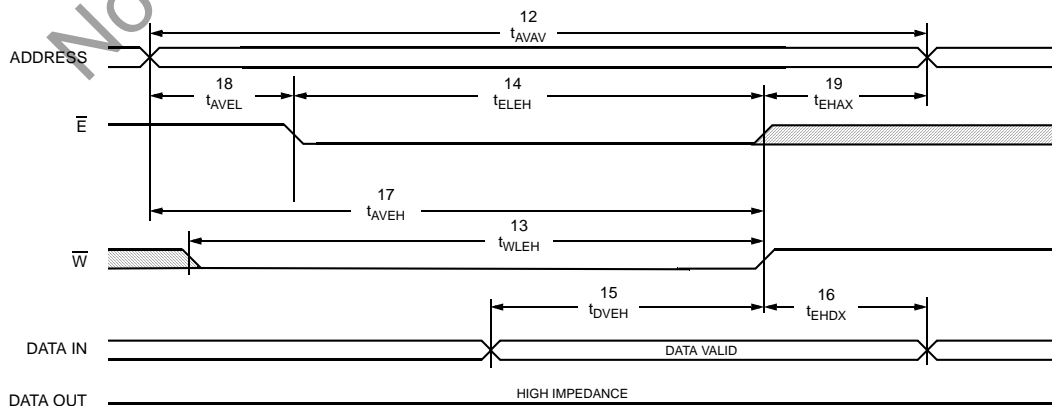


Figure 8. SRAM WRITE Cycle #2: \bar{E} Controlled^[7, 8]



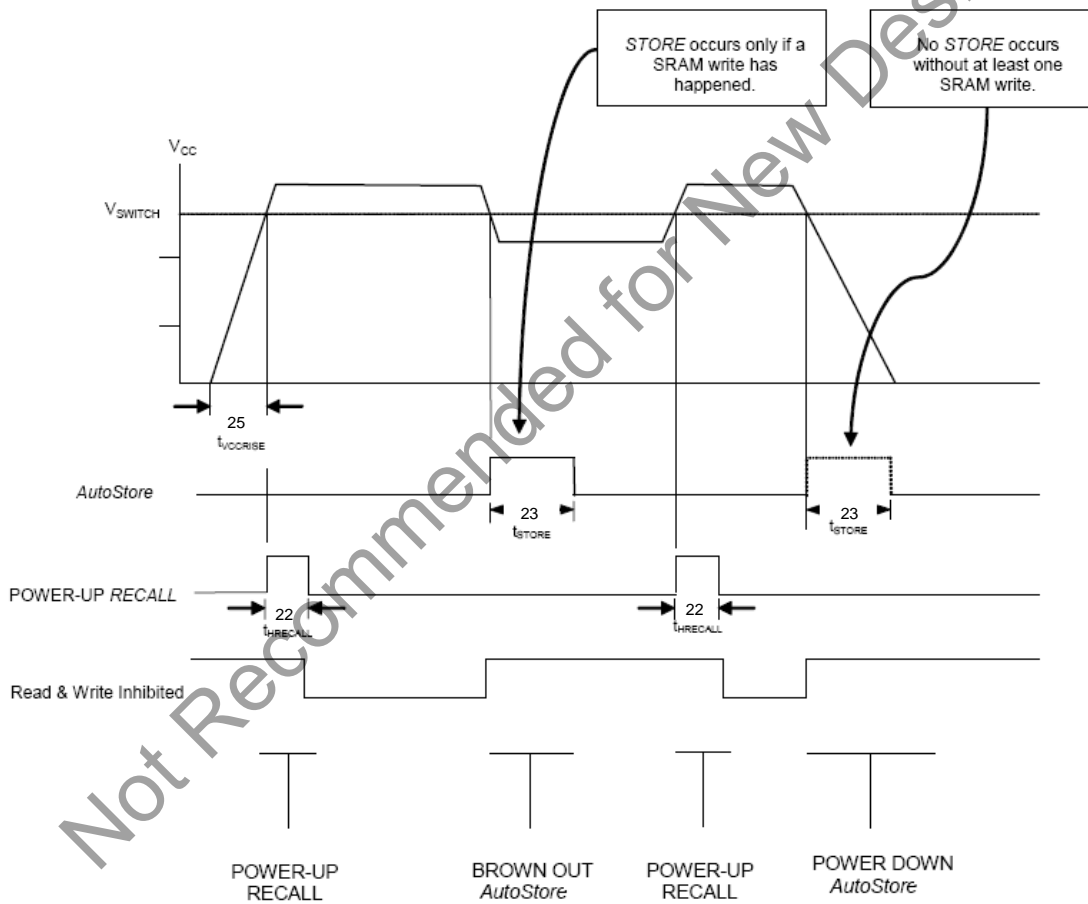
Notes

- 7. If \bar{W} is low when \bar{E} goes low, the outputs remain in the high impedance state.
- 8. \bar{E} or \bar{W} must be $\geq V_{IH}$ during address transitions.

AutoStore/Power Up RECALL

| No. | Symbols | | Parameter | STK17T88 | | Units | Notes |
|-----|----------------------|-------------------|---------------------------|----------|------|-------|--------|
| | Standard | Alternate | | Min | Max | | |
| 22 | t _{HRECALL} | | Power up RECALL Duration | | 40 | ms | 9 |
| 23 | t _{STORE} | t _{HLHZ} | STORE Cycle Duration | | 12.5 | ms | 10, 11 |
| 24 | V _{SWITCH} | | Low Voltage Trigger Level | | 2.65 | V | |
| 25 | V _{CCRISE} | | V _{CC} Rise Time | 150 | | μS | |

Figure 9. AutoStore Power Up RECALL



Note Read and Write cycles are ignored during STORE, RECALL, and while V_{CC} is below V_{SWITCH}

Notes

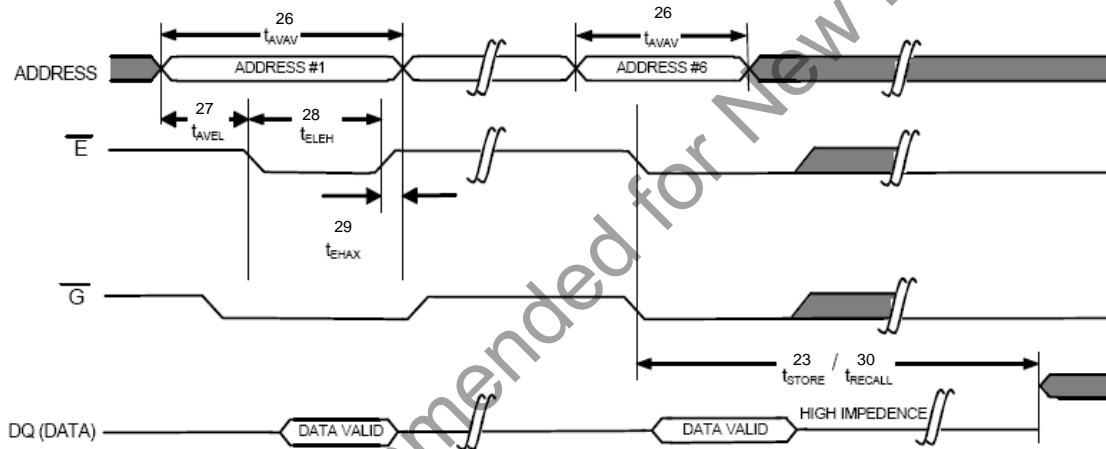
- 9. t_{HRECALL} starts from the time V_{CC} rises above V_{SWITCH}
- 10. If an SRAM WRITE has not taken place since the last nonvolatile cycle, no STORE will take place
- 11. Industrial Grade devices require 15 ms maximum.

Software-Controlled STORE/RECALL Cycle

In the following table, the software controlled STORE and RECALL cycle parameters are listed. [12, 13]

| No. | Symbols | | Parameter | STK17T88-35 | | STK17T88-45 | | Units | Notes |
|-----|----------------|-----------|------------------------------------|-------------|-----|-------------|-----|-------|-------|
| | \bar{E} Cont | Alternate | | Min | Max | Min | Max | | |
| 26 | t_{AVAV} | t_{RC} | STORE/RECALL Initiation Cycle Time | 25 | | 45 | | ns | 13 |
| 27 | t_{AVEL} | t_{AS} | Address Setup Time | 0 | | 0 | | ns | |
| 28 | t_{ELEH} | t_{CW} | Clock Pulse Width | 20 | | 30 | | ns | |
| 29 | t_{EHAX} | | Address Hold Time | 1 | | 1 | | ns | |
| 30 | t_{RECALL} | | RECALL Duration | | 100 | | 100 | us | |

Figure 10. Software Store/Recall Cycle: \bar{E} CONTROLLED [13]



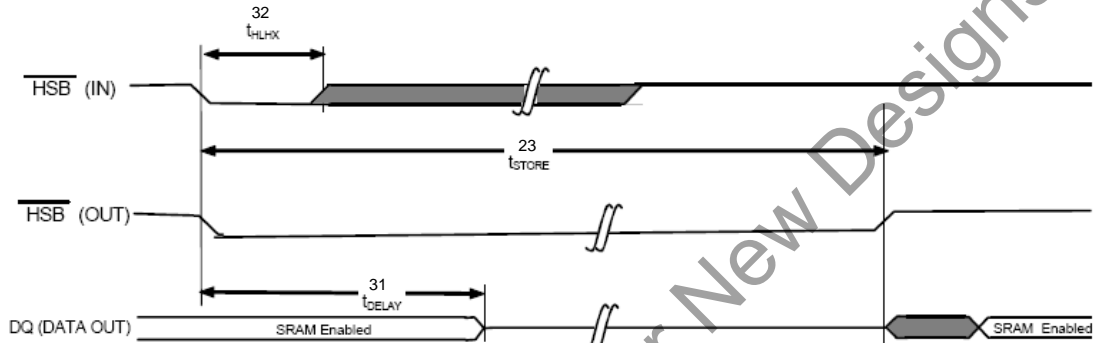
Notes

- 12. The software sequence is clocked on the falling edge of \bar{E} controlled READs
- 13. The six consecutive addresses must be read in the order listed in the Mode Selection table. W must be high during all six consecutive cycles.

Hardware STORE Cycle

| No. | Symbols | | Parameter | STK17T88 | | Units | Notes |
|-----|-------------|------------|---------------------------------|----------|-----|---------|-------|
| | Standard | Alternate | | Min | Max | | |
| 31 | t_{DELAY} | t_{HLQZ} | Hardware STORE to SRAM Disabled | 1 | 70 | μ s | 14 |
| 32 | t_{HLHX} | | Hardware STORE Pulse Width | 15 | | ns | |

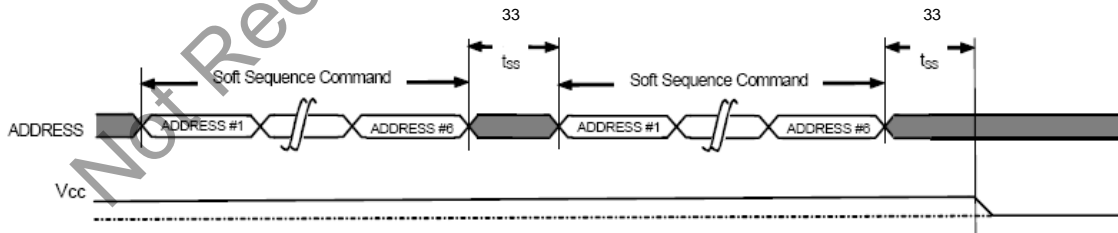
Figure 11. Hardware STORE Cycle



Soft Sequence Commands

| No. | Symbol | Parameter | STK17T88 | | Units | Notes |
|-----|----------|-------------------------------|----------|-----|---------|--------|
| | Standard | | Min | Max | | |
| 33 | t_{SS} | Soft Sequence Processing Time | | 70 | μ s | 15, 16 |

Figure 12. Soft Sequence Command



Notes

- 14. On a hardware STORE initiation, SRAM operation continues to be enabled for time t_{DELAY} to allow read/write cycles to complete
- 15. This is the amount of time that it takes to take action on a soft sequence command. Vcc power must remain high to effectively register command.
- 16. Commands such as Store and Recall lock out I/O until operation is complete which further increases this time. See specific command

Mode Selection

| \bar{E} | \bar{W} | \bar{G} | A ₁₄ -A ₀ | Mode | I/O | Power | Notes |
|-----------|-----------|-----------|---------------------------------|--------------------|---------------|---------|----------|
| H | X | X | X | Not Selected | Output High Z | Standby | |
| L | H | L | X | Read SRAM | Output Data | Active | |
| L | L | X | X | Write SRAM | Input Data | Active | |
| L | H | L | 0x0E38 | Read SRAM | Output Data | Active | 17,18,19 |
| | | | 0x31C7 | Read SRAM | Output Data | | |
| L | H | L | 0x03E0 | Read SRAM | Output Data | Active | 17,18,19 |
| | | | 0x3C1F | Read SRAM | Output Data | | |
| L | H | L | 0x303F | Read SRAM | Output Data | Active | 17,18,19 |
| | | | 0x0FC0 | Nonvolatile Store | Output High Z | | |
| L | H | L | 0x0E38 | Read SRAM | Output Data | Active | 17,18,19 |
| | | | 0x31C7 | Read SRAM | Output Data | | |
| L | H | L | 0x03E0 | Read SRAM | Output Data | Active | 17,18,19 |
| | | | 0x3C1F | Read SRAM | Output Data | | |
| L | H | L | 0x303F | Read SRAM | Output Data | Active | 17,18,19 |
| | | | 0x0C63 | Nonvolatile Recall | Output High Z | | |

Not Recommended for New Designs

Notes

- 17. The six consecutive addresses must be in the order listed. \bar{W} must be high during all six consecutive cycles to enable a nonvolatile cycle.
- 18. While there are 15 addresses on the STK17T88, only the lower 13 are used to control software modes.
- 19. I/O state depends on the state of \bar{G} . The I/O table assumes \bar{G} low.

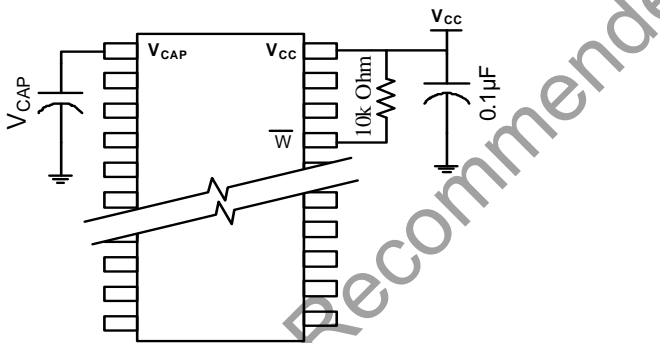
nvSRAM Operation

The STK17T88 nvSRAM is made up of two functional components paired in the same physical cell. These are the SRAM memory cell and a nonvolatile QuantumTrap cell. The SRAM memory cell operates similar to a standard fast static RAM. Data in the SRAM can be transferred to the nonvolatile cell (the STORE operation), or from the nonvolatile cell to SRAM (the RECALL operation). This unique architecture allows all cells to be stored and recalled in parallel. During the STORE and RECALL operations SRAM READ and WRITE operations are inhibited. The STK17T88 supports unlimited read and writes similar to a typical SRAM. In addition, it provides unlimited RECALL operations from the nonvolatile cells and up to 200K STORE operations.

SRAM READ

The STK17T88 performs a READ cycle whenever \bar{E} and \bar{G} are low while W and HSB are high. The address specified on pins A_{0-14} determine which of the 32,768 data bytes are accessed. When the READ is initiated by an address transition, the outputs are valid after a delay of t_{AVQV} (READ cycle #1). If the READ is initiated by \bar{E} and \bar{G} , the outputs are valid at t_{ELQV} or at t_{GLQV} , whichever is later (READ cycle #2). The data outputs repeatedly respond to address changes within the t_{AVQV} access time without the need for transitions on any control input pins, and remain valid until another address change or until \bar{E} or \bar{G} is brought high, or W and HSB is brought low.

Figure 13. AutoStore Mode



SRAM WRITE

A WRITE cycle is performed whenever \bar{E} and \bar{W} are low and HSB is high. The address inputs must be stable prior to entering the WRITE cycle and must remain stable until either \bar{E} or W goes high at the end of the cycle. The data on the common I/O pins DQ_{0-7} are written into memory if it is valid t_{DVWH} before the end of a W controlled WRITE or t_{DVEH} before the end of an \bar{E} controlled WRITE.

It is recommended that \bar{G} be kept high during the entire WRITE cycle to avoid data bus contention on common I/O lines. If \bar{G} is left low, internal circuitry turns off the output buffers t_{WLQZ} after W goes low.

AutoStore Operation

The STK17T88 stores data to nvSRAM using one of three storage operations. These operations are Hardware Store (activated by HSB), Software Store (activated by an address sequence), and AutoStore (on power down).

AutoStore operation, a unique feature of Cypress QuantumTrap technology that is a standard feature on the STK17T88.

During normal operation, the device draws current from V_{CC} to charge a capacitor connected to the V_{CAP} pin. This stored charge is used by the chip to perform a single STORE operation. If the voltage on the V_{CC} pin drops below V_{SWITCH} , the part automatically disconnects the V_{CAP} pin from V_{CC} . A STORE operation is initiated with power provided by the V_{CAP} capacitor.

Figure 13 shows the proper connection of the storage capacitor (V_{CAP}) for automatic store operation. Refer to the DC Characteristics ($V_{CC} = 2.7V-3.6V$) table for the size of the capacitor. The voltage on the V_{CAP} pin is driven to 5V by a charge pump internal to the chip. A pull up should be placed on W to hold it inactive during power up.

To reduce unnecessary nonvolatile stores, AutoStore and Hardware Store operations are ignored unless at least one WRITE operation has taken place since the most recent STORE or RECALL cycle. Software initiated STORE cycles are performed regardless of whether a WRITE operation has taken place. The HSB signal can be monitored by the system to detect an AutoStore cycle is in progress.

Hardware STORE (\bar{HSB}) Operation

The STK17T88 provides the \bar{HSB} pin to control and acknowledge the STORE operations. The HSB pin can be used to request a hardware STORE cycle. When the HSB pin is driven low, the STK17T88 conditionally initiates a STORE operation after t_{DELAY} . An actual STORE cycle only begins if a WRITE to the SRAM took place since the last STORE or RECALL cycle. The HSB pin has a very resistive pull up and is internally driven low to indicate a busy condition while the STORE (initiated by any means) is in progress. This pin must be externally pulled up if it is used to drive other inputs.

SRAM READ and WRITE operations that are in progress when HSB is driven low by any means are given time to complete before the STORE operation is initiated. After HSB goes low, the STK17T88 continues to allow SRAM operations for t_{DELAY} . During t_{DELAY} , multiple SRAM READ operations may take place. If a WRITE is in progress when HSB is pulled low, it is allowed a time, t_{DELAY} , to complete. However, any SRAM WRITE cycles requested after HSB goes low are inhibited until HSB returns high.

During any STORE operation, regardless of how it was initiated, the STK17T88 continues to drive the HSB pin low, releasing it only when the STORE is complete. Upon completion of the STORE operation, the STK17T88 remains disabled until the HSB pin returns high.

If HSB is not used, it should be left unconnected.

Hardware Recall (POWER UP)

During power up or after any low power condition ($V_{CC} < V_{SWITCH}$), an internal RECALL request is latched. When V_{CC} again exceeds the sense voltage of V_{SWITCH} , a RECALL cycle is automatically initiated and takes $t_{HRECALL}$ to complete.

Software STORE

Data can be transferred from the SRAM to the nonvolatile memory by a software address sequence. The STK17T88 software *STORE* cycle is initiated by executing sequential \bar{E} controlled READ cycles from six specific address locations in exact order. During the *STORE* cycle, previous data is erased and the new data is programmed into the nonvolatile elements. When a *STORE* cycle is initiated, further memory inputs and outputs are disabled until the cycle is completed.

To initiate the software *STORE* cycle, the following READ sequence must be performed:

1. Read address 0x0E38, Valid READ
2. Read address 0x31C7, Valid READ
3. Read address 0x03E0, Valid READ
4. Read address 0x3C1F, Valid READ
5. Read address 0x303F, Valid READ
6. Read address 0x0FC0, Initiate *STORE* cycle

After the sixth address in the sequence is entered, the *STORE* cycle commences and the chip is disabled. It is important that READ cycles and not WRITE cycles be used in the sequence. After the t_{STORE} cycle time is fulfilled, the SRAM is again activated for READ and WRITE operation.

Software RECALL

Data can be transferred from the nonvolatile memory to the SRAM by a software address sequence. A software *RECALL* cycle is initiated with a sequence of READ operations in a manner similar to the software *STORE* initiation. To initiate the *RECALL* cycle, the following sequence of \bar{E} controlled READ operations must be performed:

1. Read address 0x0E38, Valid READ
2. Read address 0x31C7, Valid READ
3. Read address 0x03E0, Valid READ
4. Read address 0x3C1F, Valid READ
5. Read address 0x303F, Valid READ
6. Read address 0x0C63, Initiate *RECALL* cycle

Internally, *RECALL* is a two-step procedure. First, the SRAM data is cleared, and second, the nonvolatile information is transferred into the SRAM cells. After the t_{RECALL} cycle time, the SRAM is again ready for READ or WRITE operations. The *RECALL* operation in no way alters the data in the nonvolatile storage elements.

Data Protection

The STK17T88 protects data from corruption during low voltage conditions by inhibiting all externally initiated *STORE* and *WRITE* operations. The low voltage condition is detected when $V_{CC} < V_{SWITCH}$.

If the STK17T88 is in a *WRITE* mode (both \bar{E} and \bar{W} low) at power up, after a *RECALL*, or after a *STORE*, the *WRITE* is inhibited until a negative transition on \bar{E} or \bar{W} is detected. This protects against inadvertent writes during power up or brown out conditions.

Noise Considerations

The STK17T88 is a high speed memory and so must have a high frequency bypass capacitor of 0.1 μ F connected between both V_{CC} pins and V_{SS} ground plane with no plane break to chip V_{SS} . Use leads and traces that are as short as possible. As with all high speed CMOS ICs, careful routing of power, ground, and signals reduce circuit noise.

Preventing AutoStore

Because of the use of nvSRAM to store critical RTC data, the AutoStore function cannot be disabled on the STK17T88.

Best Practices

nvSRAM products have been used effectively for over 15 years. While ease-of-use is one of the product's main system values, experience gained working with hundreds of applications has resulted in the following suggestions as best practices:

- The nonvolatile cells in an nvSRAM are programmed on the test floor during final test and quality assurance. Incoming inspection routines at customer or contract manufacturer's sites sometimes reprograms these values. Final NV patterns are typically repeating patterns of AA, 55, 00, FF, A5, or 5A. The end product's firmware should not assume an NV array is in a set programmed state. Routines that check memory content values to determine first time system configuration, cold or warm boot status, and so on should always program a unique NV pattern (for example, complex 4-byte pattern of 46 E6 49 53 hex or more random bytes) as part of the final system manufacturing test to ensure these system routines work consistently.
- Power up boot firmware routines should rewrite the nvSRAM into the desired state (such as AutoStore enabled). While the nvSRAM is shipped in a preset state, best practice is to again rewrite the nvSRAM into the desired state as a safeguard against events that might flip the bit inadvertently (program bugs, incoming inspection routines, and so on).
- The OSCEN bit in the Calibration register at 0x7FF8 should be set to '1' to preserve battery life when the system is in storage (see [Stopping and Starting the RTC Oscillator](#) on page 15).
- The V_{CAP} value specified in this data sheet includes a minimum and a maximum value size. Best practice is to meet this requirement and not exceed the maximum V_{CAP} value because the nvSRAM internal algorithm calculates V_{CAP} charge time based on this maximum V_{cap} value. Customers who want to use a larger V_{CAP} value to make sure there is extra store charge and store time should discuss their V_{cap} size selection with Cypress to understand any impact on the V_{CAP} voltage level at the end of a t_{RECALL} period.

Real Time Clock

The clock registers maintain time up to 9,999 years in one-second increments. The user can set the time to any calendar time and the clock automatically keeps track of days of the week and month, leap years, and century transitions. There are eight registers dedicated to the clock functions which are used to set time with a write cycle and to read time during a read cycle. These registers contain the Time of Day in BCD format. Bits defined as '0' are currently not used and are reserved for future use by Cypress.

Reading the Clock

Halt internal updates to the real time clock registers before reading clock data to prevent reading of data in transition. Stopping the internal register updates does not affect clock accuracy.

Write a '1' to the read bit "R" (in the Flags register at 0x7FF0) to capture the current time in holding registers. Clock updates do not restart until a '0' is written to the read bit. The RTC registers can now be read while the internal clock continues to run.

Within 20 ms after a '0' is written to the read bit, all real time clock registers are simultaneously updated.

Setting the Clock

Set the write bit "W" (in the Flags register at 0x7FF0) to '1' to enable the time to be set. The correct day, date, and time can then be written into the real time clock registers in 24-hour BCD format. The time written is referred to as the "Base Time." This value is stored in nonvolatile registers and used in calculation of the current time. Reset the write bit to '0' to transfer the time to the actual clock counters. The clock starts counting at the new base time.

Backup Power

The RTC is intended to keep time even when system power is lost. When primary power, V_{CC} , drops below V_{SWITCH} , the real time clock switches to the backup power supply connected to either the V_{RTCcap} or V_{RTCbat} pin.

The clock oscillator uses a maximum of 300 nanoamps at 2V to maximize the backup time available from the backup source.

The user can power the real time clock with either a capacitor or a battery. Factors to be considered when choosing a backup power source include the expected duration of power outages and the cost and reliability trade-off of using a battery versus a capacitor.

When selecting a capacitor power source, connect the capacitor to the V_{RTCcap} pin and leave the V_{RTCbat} pin unconnected. Capacitor backup time values based on maximum current specifications are shown below. Nominal times are approximately three times longer.

| Capacitor Value | Backup Time |
|-----------------|-------------|
| 0.1 F | 72 hours |
| 0.47 F | 14 days |
| 1.0 F | 30 days |

A capacitor has the obvious advantage of being more reliable and not containing hazardous materials. The capacitor is recharged every time the power is turned on so that the real time clock continues to have the same backup time over years of operation

When selecting a battery power source, connect the battery to the V_{RTCbat} pin and leave the V_{RTCcap} pin unconnected. A 3V lithium is recommended for this application. The battery capacity should be chosen for the total anticipated cumulative down-time required over the life of the system.

The real time clock is designed with a diode internally connected to the V_{RTCbat} pin. This prevents the battery from ever being charged by the circuit.

Stopping and Starting the RTC Oscillator

The OSCEN bit in the Calibration register at 0x7FF8 enables RTC oscillator operation. This bit is nonvolatile and shipped to customers in the "enabled" state (set to '0'). OSCEN should be set to '1' to preserve battery life while the system is in storage. This turns off the oscillator circuit extending the battery life. If the OSCEN bit goes from disabled to enabled, it typically takes 5 seconds (10 seconds maximum) for the oscillator to start.

The STK17T88 has the ability to detect oscillator failure due to loss of backup power. The failure is recorded by the OSCF (Oscillator Failed bit) of the Flags register (at address 0x7FF0). When the device is powered on (V_{CC} goes above V_{SWITCH}) the OSCEN bit is checked for "enabled" status. If the OSCEN bit is enabled and the oscillator is not active within 5 ms, the OSCF bit is set. Check for this condition and then write a '0' to clear the flag. When the OSCF flag bit, the real time clock registers are reset to the "Base Time" (see the section [Setting the Clock](#) on page 15, the value last written to the real time clock registers.

The value of OSCF should be reset to '0' when the real time clock registers are written for the first time. This initializes the state of this bit because it may have become set when the system was first powered on.

To reset OSCF, set the write bit "W" (in the Flags register at 0x7FF0) to '1' to enable writes to the Flags register. Write '0' to the OSCF bit and then reset the write bit to '0' to disable writes.

Calibrating The Clock

The RTC is driven by a quartz controlled oscillator with a nominal frequency of 32.768 kHz. Clock accuracy depends on the quality of the crystal specified (usually 35 ppm at 25°C). This error can equate to 1.53 minutes gain or loss per month. The STK17T88 employs a calibration circuit that can improve the accuracy to +1/-2 ppm at 25°C. The calibration circuit adds or subtracts counts from the oscillator divider circuit.

The number of time pulses added or subtracted depends upon the value loaded into the five calibration bits found in Calibration register (at 0x7FF8). Adding counts speeds the clock up; subtracting counts slows the clock down. The calibration bits occupy the five lower order bits of the register. These bits can be set to represent any value between 0 and 31 in binary form. Bit D5 is a Sign bit, where a '1' indicates positive calibration and a '0' indicates negative calibration. Calibration occurs during a 64 minute period. The first 62 minutes in the cycle may, once per minute, have one second either shortened by 128 or lengthened by 256 oscillator cycles.

If a binary '1' is loaded into the register, only the first 2 minutes of the 64 minute cycle is modified; if a binary '6' is loaded, the first 12 are affected, and so on. Therefore each calibration step has the effect of adding 512 or subtracting 256 oscillator cycles for every 125,829,120 actual oscillator cycles. That is +4.068 or -2.034 ppm of adjustment per calibration step in the Calibration register.

The Calibration register value is determined during system test by setting the CAL bit in the Flags register (at 0x7FF0) to '1'. This causes the INT pin to toggle at a nominal 512 Hz. This frequency is measured with a frequency counter. Any deviation measured from the 512 Hz indicates the degree and direction of the required correction. For example, a reading of 512.01024 Hz indicates a +20 ppm error, requiring a -10 (001010) to be loaded into the Calibration register. Note that setting or changing the calibration register does not affect the frequency test output frequency.

To set or clear CAL, set the write bit "W" (in the Flags register at 0x7FF0) to a '1' to enable writes to the Flags register. Write a value to CAL and then reset the write bit to '0' to disable writes.

The default Calibration register value from the factory is 00h. The user calibration value loaded is retained during a power loss.

Alarm

The alarm function compares a user-programmed alarm time/date (stored in registers 0x7FF1-5) with the real time clock time-of-day/date values. When a match occurs, the alarm flag (AF) is set and an interrupt is generated if the alarm interrupt is enabled. The alarm flag is automatically reset when the Flags register is read.

Each of the alarm registers has a match bit as its MSB. Setting the match bit to a '1' disables this alarm register from the alarm comparison. When the match bit is '0', the alarm register is compared with the equivalent real time clock register. Using the match bits, an alarm can occur as specifically as one particular second on one day of the month or as frequently as once per minute.

Note The product requires the match bit for seconds (0x7FF2, bit D7) be set to '0' for proper operation of the Alarm Flag and Interrupt.

The alarm value should be initialized on power up by software because the alarm registers are not nonvolatile.

To set or clear the Alarm registers, set the write bit "W" (in the Flags register at 0x7FF0) to '1' to enable writes to the Alarm registers. Write an alarm value to the alarm registers and then reset the write bit to '0' to disable writes.

Watchdog Timer

The watchdog timer is designed to interrupt or reset the processor should its program get hung in a loop and not respond in a timely manner. The software must reload the watchdog timer before it counts down to zero to prevent this interrupt or reset.

The watchdog timer is a free-running-down counter that uses the 32 Hz clock (31.25 ms) derived from the crystal oscillator. The

watchdog timer function does not operate unless the oscillator is running.

The watchdog counter is loaded with a starting value from the load register and then counts down to zero, setting the watchdog flag (WDF) and generating an interrupt if the watchdog interrupt is enabled. The watchdog flag bit is reset when the Flags register is read. The operating software normally reloads the counter by setting the watchdog strobe bit (WDS) to '1' within the timing interval programmed into the load register.

To use the watchdog timer to reset the processor on timeout, the INT is tied to processor master reset and Interrupt register is programmed to 24h to enable interrupts to pulse the reset pin on timeout.

To load the watchdog timer, set a new value into the load register by writing a '0' to the watchdog write bit (WDW) of the watchdog register (at 0x7FF7). Then load a new value into the load register. After the new value is loaded, the watchdog write bit is then set to '1' to disable watchdog writes. The watchdog strobe bit (WDS) is set to '1' to load this value into the watchdog timer. Note that setting the load register to zero disables the watchdog timer function.

The system software should initialize the watchdog load register on power up to the desired value because the register is not nonvolatile.

Power Monitor

The STK17T88 provides a power monitor function. The power monitor is based on an internal band-gap reference circuit that compares the V_{CC} voltage to V_{SWITCH} .

When the power supply drops below V_{SWITCH} , the real time clock circuit is switched to the backup supply (battery or capacitor).

When operating from the backup source, no data may be read or written and the clock functions are not available to the user. The clock continues to operate in the background. Updated clock data is available $t_{HRECALL}$ delay after V_{CC} is restored to the device.

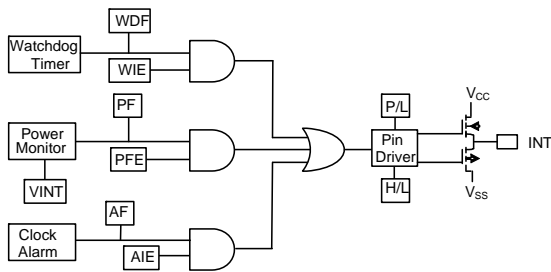
When the power is lost, the PF flag in the Flags register is set to indicate the power failure and an interrupt is generated if the power fail interrupt is enabled (Interrupt register=20h). The INT line is normally tied to the processor master reset input to perform power-off reset.

Interrupts

The STK17T88 has a Flags register, Interrupt register, and interrupt logic that can interrupt the microcontroller or general a power up master reset signal. There are three potential interrupt sources: the watchdog timer, the power monitor, and the clock alarm. Each can be individually enabled to drive the INT pin by setting the appropriate bit in the Interrupt register. In addition, each has an associated flag bit in the Flags register that the host processor can read to determine the interrupt source. Two bits in the interrupt register determine the operation of the INT pin driver.

Figure 14 is a functional diagram of the interrupt logic.

Figure 14. Interrupt Block Diagram



Interrupt Register

Watchdog Interrupt Enable (WIE). When set to '1', the watchdog timer drives the INT pin when a watchdog time-out occurs. When WIE is set to '0', the watchdog time-out only sets the WDF flag bit.

Alarm Interrupt Enable (AIE). When set to '1', the INT pin is driven when an alarm match occurs. When set to '0', the alarm match only sets the AF flag bit.

Power Fail Interrupt Enable (PFE). When set to '1', the INT pin is driven by a power fail signal from the power monitor. When set to '0', only the PF flag is set.

High/Low (H/L). When set to '1', the INT pin is active high and the driver mode is push-pull. The INT pin can drive high only when $V_{CC} > V_{SWITCH}$. When set to '0', the INT pin is active low and the drive mode is open-drain. The active low (open drain) output is maintained even when power is lost.

Pulse/Level (P/L). When set to '1', the INT pin is driven for approximately 200 ms when the interrupt occurs. The pulse is reset when the Flags register is read. When P/L is set to '0', the INT pin is driven high or low (determined by H/L) until the Flags register is read.

The Interrupt register is loaded with the default value 00h at the factory. Configure the Interrupt register to the desired value for the desired mode of operation. Once configured, the value is retained during power failures.

Flags Register

The Flags register has three flag bits: WDF, AF, and PF. These flags are set by the watchdog time-out, alarm match, or power fail monitor respectively. The processor can either poll this register or enable the interrupts to be informed when a flag is set. The flags are automatically reset when the register is read.

The Flags register is automatically loaded with the value 00h on power up (with the exception of the OSCF bit).

Not Recommended for New Designs

RTC Register Map

| Register | BCD Format Data | | | | | | | | Function/Range |
|----------|-----------------|------------------|------------------|---------------------|---------------|-------------|------|--------------------------|------------------------------------|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | |
| 0x7FFF | 10s Years | | | | Years | | | | Years: 00-99 |
| 0x7FFE | 0 | 0 | 0 | 10s Months | Months | | | | Months: 01-12 |
| 0x7FFD | 0 | 0 | 10s Day of Month | | Day of Month | | | | Day of Month: 01-31 |
| 0x7FFC | 0 | 0 | 0 | 0 | 0 | Day of Week | | | Day of week: 01-07 |
| 0x7FFB | 0 | 0 | 10s Hours | | Hours | | | | Hours: 00-23 |
| 0x7FFA | 0 | 10s Minutes | | | Minutes | | | | Minutes: 00-59 |
| 0x7FF9 | 0 | 10s Seconds | | | Seconds | | | | Seconds: 00-59 |
| 0x7FF8 | OSCEN [0] | 0 | Cal Sign | Calibration [00000] | | | | | Calibration values ^[20] |
| 0x7FF7 | WDS | WDW | WDT | | | | | Watchdog ^[20] | |
| 0x7FF6 | WIE[0] | AIE[0] | PFE[0] | 0 | H/L [1] | P/L [0] | 0 | 0 | Interrupts ^[20] |
| 0x7FF5 | M | 0 | 10s Alarm Date | | Alarm Day | | | | Alarm, Day of Month: 01-31 |
| 0x7FF4 | M | 0 | 10s Alarm Hours | | Alarm Hours | | | | Alarm, hours: 00-23 |
| 0x7FF3 | M | 10 Alarm Minutes | | | Alarm Minutes | | | | Alarm, minutes: 00-59 |
| 0x7FF2 | M | 10 Alarm Seconds | | | Alarm Seconds | | | | Alarm, seconds: 00-59 |
| 0x7FF1 | 10s Centuries | | | | Centuries | | | | Centuries: 00-99 |
| 0x7FF0 | WDF | AF | PF | OSCF | 0 | CAL[0] | W[0] | R[0] | Flags ^[20] |

0 - Not implemented, reserved for future use.

Default Settings of nonvolatile Calibration and Interrupt registers from factory.

Calibration Register=00h.

Interrupt Register=00h.

Configure the desired value at startup or during operation; the value is then retained during a power failure.

[] designates values shipped from the factory. See [Stopping and Starting the RTC Oscillator](#) on page 15.

Note

²⁰. A binary value, not a BCD value.

Register Map Detail

| 0x7FFF | Real Time Clock – Years | | | | | | | |
|------------------|--|-------------|------------------|-------------|--------------|-------------|----|----|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 10s Years | | | | Years | | | |
| | Contains the lower two BCD digits of the year. Lower nibble contains the value for years; upper nibble contains the value for 10s of years. Each nibble operates from 0 to 9. The range for the register is 0 to 99. | | | | | | | |
| 0x7FFE | Real Time Clock – Months | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 0 | 0 | 0 | 10s Month | Months | | | |
| | Contains the BCD digits of the month. Lower nibble contains the lower digit and operates from 0 to 9; upper nibble (one bit) contains the upper digit and operates from 0 to 1. The range for the register is 1 to 12. | | | | | | | |
| 0x7FFD | Real Time Clock – Date | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 0 | 0 | 10s Day of month | | Day of month | | | |
| | Contains the BCD digits for the date of the month. Lower nibble contains the lower digit and operates from 0 to 9; upper nibble contains the upper digit and operates from 0 to 3. The range for the register is 1 to 31. Leap years are automatically adjusted for. | | | | | | | |
| 0x7FFC | Real Time Clock – Day | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 0 | 0 | 0 | 0 | 0 | Day of week | | |
| | Lower nibble contains a value that correlates to day of the week. Day of the week is a ring counter that counts from 1 to 7 then returns to 1. The user must assign meaning to the day value, as the day is not integrated with the date. | | | | | | | |
| 0x7FFB | Real Time Clock – Hours | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 0 | 0 | 10s Hours | | Hours | | | |
| | Contains the BCD value of hours in 24 hour format. Lower nibble contains the lower digit and operates from 0 to 9; upper nibble (two bits) contains the upper digit and operates from 0 to 2. The range for the register is 0 to 23. | | | | | | | |
| 0x7FFA | Real Time Clock – Minutes | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 0 | 10s Minutes | | | Minutes | | | |
| | Contains the BCD value of minutes. Lower nibble contains the lower digit and operates from 0 to 9; upper nibble contains the upper minutes digit and operates from 0 to 5. The range for the register is 0 to 59. | | | | | | | |
| 0x7FF9 | Real Time Clock – Seconds | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | 0 | 10s Seconds | | | Seconds | | | |
| | Contains the BCD value of seconds. Lower nibble contains the lower digit and operates from 0 to 9; upper nibble contains the upper digit and operates from 0 to 5. The range for the register is 0 to 59. | | | | | | | |
| 0x7FF8 | Calibration | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | OSCEN | 0 | Calibration Sign | Calibration | | | | |
| OSCEN | Oscillator Enable. When set to '1', the oscillator is disabled. When set to '0', the oscillator is enabled. Disabling the oscillator saves battery/capacitor power during storage. | | | | | | | |
| Calibration Sign | Determines if the calibration adjustment is applied as an addition to or as a subtraction from the time-base. | | | | | | | |
| Calibration | These five bits control the calibration of the clock. | | | | | | | |

Register Map Detail (continued)

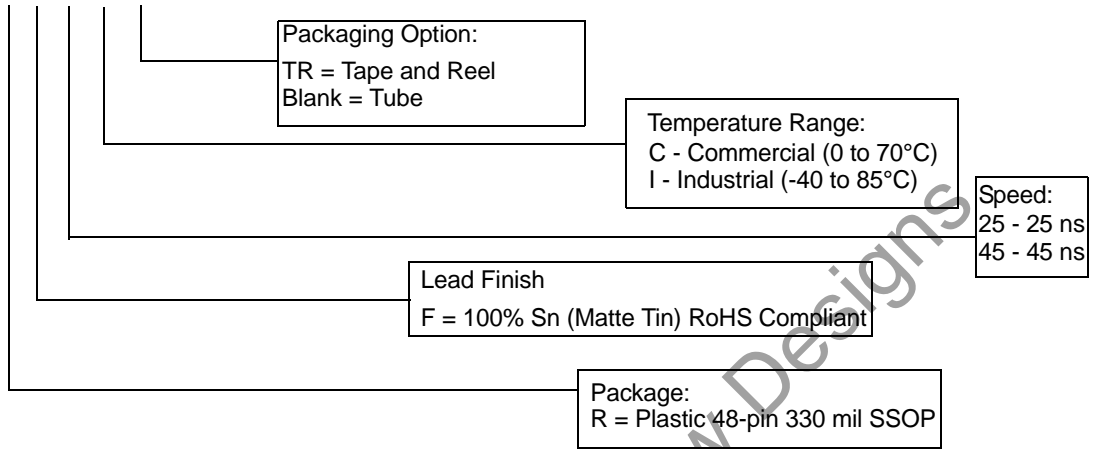
| 0x7FF7 | Watchdog Timer | | | | | | | |
|--------|---|-------------------|-----------------|-----|---------------|-------------|----|----|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | WDS | WDW | WDT | | | | | |
| WDS | Watchdog Strobe. Setting this bit to '1' reloads and restarts the watchdog timer. The bit is cleared automatically when the watchdog timer is reset. The WDS bit is write only. Reading it always returns a '0'. | | | | | | | |
| WDW | Watchdog Write Enable. Set this bit to '1' to disable writing of the watchdog time-out value (WDT5-WDT0). This allows to strobe the watchdog without disturbing the time-out value. Setting this bit to '0' allows bits 5-0 to be written. | | | | | | | |
| WDT | Watchdog time-out selection. The watchdog timer interval is selected by the 6-bit value in this register. It represents a multiplier of the 32 Hz count (31.25 ms). The range or time-out values is 31.25 ms (a setting of '1') to 2 seconds (setting of 3Fh). Setting the watchdog timer register to '0' disables the timer. These bits can be written only if the WDW bit was cleared to '0' on a previous cycle. | | | | | | | |
| 0x7FF6 | Interrupt | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | WIE | AIE | PFIE | ABE | H/L | P/L | 0 | 0 |
| WIE | Watchdog Interrupt Enable. When set to '1' and a watchdog time-out occurs, the watchdog timer drives the INT pin and sets the WDF flag. When set to '0', the watchdog time-out only sets the WDF flag. | | | | | | | |
| AIE | Alarm Interrupt Enable. When set to '1', the alarm match drives the INT pin and sets the AF flag. When set to '0', the alarm match only sets the AF flag. | | | | | | | |
| PFIE | Power-Fail Enable. When set to '1', a power failure drives the INT pin and sets the PF flag. When set to '0', a power failure only sets the PF flag. | | | | | | | |
| 0 | Reserved for Future Use | | | | | | | |
| H/L | High/Low. When set to a '1', the INT pin is driven active high. When set to '0', the INT pin is open drain, active low. | | | | | | | |
| P/L | Pulse/Level. When set to a '1', the INT pin is driven active (determined by H/L) by an interrupt source for approximately 200 ms. When set to '0', the INT pin is driven to an active level (as set by H/L) until the Flags register is read. | | | | | | | |
| 0x7FF5 | Alarm – Day | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | M | 0 | 10s Alarm Date | | | Alarm Date | | |
| | Contains the alarm value for the date of the month and the mask bit to select or deselect the date value. | | | | | | | |
| M | Match. Setting this bit to '0' causes the date value to be used in the alarm match. Setting this bit to '1' causes the match circuit to ignore the date value. | | | | | | | |
| 0x7FF4 | Alarm – Hours | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | M | 0 | 10s Alarm Hours | | | Alarm Hours | | |
| | Contains the alarm value for the hours and the mask bit to select or deselect the hours value. | | | | | | | |
| M | Match. Setting this bit to '0' causes the hours value to be used in the alarm match. Setting this bit to '1' causes the match circuit to ignore the hours value. | | | | | | | |
| 0x7FF3 | Alarm – Minutes | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | M | 10s Alarm Minutes | | | Alarm Minutes | | | |
| | Contains the alarm value for the minutes and the mask bit to select or deselect the minutes value. | | | | | | | |
| M | Match. Setting this bit to '0' causes the minutes value to be used in the alarm match. Setting this bit to '1' causes the match circuit to ignore the minutes value. | | | | | | | |

Register Map Detail (continued)

| 0x7FF2 | Alarm – Seconds | | | | | | | |
|--------|--|-------------------|----|------|---------------|-----|----|----|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | M | 10s Alarm Seconds | | | Alarm Seconds | | | |
| | Contains the alarm value for the seconds and the mask bit to select or deselect the seconds' value. | | | | | | | |
| M | Match. Setting this bit to '0' causes the seconds' value to be used in the alarm match. Setting this bit to '1' causes the match circuit to ignore the seconds value. | | | | | | | |
| 0x7FF1 | Real Time Clock – Centuries | | | | | | | |
| | 10s Centuries | | | | Centuries | | | |
| | Contains the BCD value of centuries. Lower nibble contains the lower digit and operates from 0 to 9; upper nibble contains the upper centuries digit and operates from 0 to 9. The range for the register is 0 to 99 centuries. | | | | | | | |
| 0x7FF0 | Flags | | | | | | | |
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 |
| | WDF | AF | PF | OSCF | 0 | CAL | W | R |
| WDF | Watchdog Timer Flag. This read only bit is set to '1' when the watchdog timer is allowed to reach '0' without being reset by the user. It is cleared to '0' when the Flags register is read or on power up. | | | | | | | |
| AF | Alarm Flag. This read only bit is set to '1' when the time and date match the values stored in the Alarm registers with the match bits equal to '0'. It is cleared when the Flags register is read or on power up. | | | | | | | |
| PF | Power Fail Flag. This read only bit is set to '1' when power falls below the power-fail threshold V_{SWITCH} . It is cleared to '0' when the Flags register is read or on power up. | | | | | | | |
| OSCF | Oscillator Fail Flag. Set to '1' on power up only if the oscillator is enabled and not running in the first 5 ms of operation. This indicates that the RTC backup power failed and the clock value is no longer valid. Reset this bit to '0' to clear this condition. | | | | | | | |
| CAL | Calibration Mode. When set to '1', a 512 Hz square wave is output on the INT pin. When set to '0', the INT pin resumes normal operation. This bit defaults to '0' (disabled) on power up. | | | | | | | |
| W | Write Time. Setting the W bit to '1' freezes updates of the RTC registers. The user can then write to the RTC registers, Alarm registers, Calibration register, Interrupt register, and Flags register. Setting the W bit to '0' disables writes to the registers and causes the contents of the real time clock registers to be transferred to the timekeeping counters if the time has changed (a new base time is loaded). The bit defaults to '0' on power up. | | | | | | | |
| R | Read Time. Setting the R bit to '1' captures the current time in holding registers so that clock updates are not during the reading process. Set the R bit to '0' to enable the holding register to resume clock updates. The bit defaults to '0' on power up. | | | | | | | |

Commercial and Industrial Ordering Information

STK17T88 - R F 45 I TR



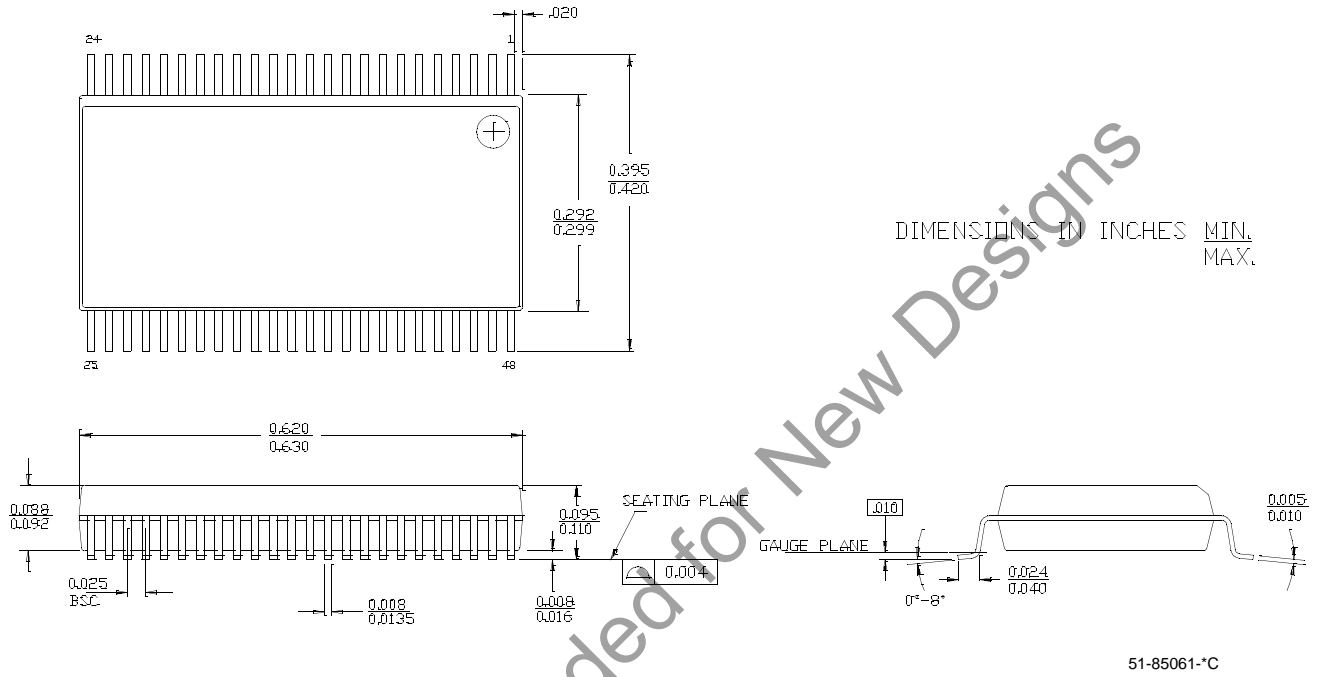
Ordering Codes

These parts are not recommended for new designs.

| Ordering Code | Description | Access Time (ns) | Temperature |
|------------------|--|------------------|-------------|
| STK17T88-RF25 | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 25 | Commercial |
| STK17T88-RF45 | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 45 | Commercial |
| STK17T88-RF25TR | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 25 | Commercial |
| STK17T88-RF45TR | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 45 | Commercial |
| STK17T88-RF25I | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 25 | Industrial |
| STK17T88-RF45I | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 45 | Industrial |
| STK17T88-RF25ITR | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 25 | Industrial |
| STK17T88-RF45ITR | 3.3V 32Kx8 AutoStore nvSRAM+RTC SSOP48-300 | 45 | Industrial |

Package Diagram

Figure 15. 48-Pin SSOP (51-85061)



Not Recommended for New Designs

Document History Page

| Document Title: STK17T88 32K x 8 AutoStore nvSRAM with Real-Time Clock | | | | |
|--|---------|-----------------|-----------------|---|
| Document Number: 001- 52040 | | | | |
| Rev. | ECN No. | Orig. of Change | Submission Date | Description of change |
| ** | 2668660 | GVCH/PYRS | 03/04/2009 | New data sheet |
| *A | 2675319 | GVCH | 03/17/2009 | Corrected typo on page 1 in 'Description' section: changed 256KB to 256Kb. |
| *B | 2793420 | GVCH/AESA | 10/27/09 | Figure 1: Updated pin 43 from A6 to A8. Updated t _{RECALL} unit from ms to us |
| *C | 2814390 | GVCH | 11/25/2009 | Added note in the Ordering Information section mentioning that these parts are not recommended for new designs. Added "Not recommended for new designs" watermark in the PDF.. |

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