# AAT3510/1/2/3/4/5/6/7/8/9

## Micropower µP Reset with Watchdog Timer

PowerManager™

## General Description

The AAT351x PowerManager™ products are members of AnalogicTech™'s Total Power Management IC™ product family. This family of Microprocessor Reset Circuits provides the ultimate in versatility, allowing system designers full customization of the µP monitor and Reset function without any additional components. The AAT351x family offers several combinations of threshold voltage, watchdog timeout period, reset active period and output drive configurations, which are all factory programmed options. All devices are available in 32 reset threshold voltages from 2.6V up to 5V, with three watchdog timeout periods from 6.3ms to 1600ms and three reset timeouts from 1ms up to 140ms. Available output configurations are active low push-pull, active low open drain, active low bi-directional and active high push-pull

The AAT351x family is designed to ignore fast negative transients on $V_{DD}$ and to ensure that Reset outputs remain valid down to 1V.

The AAT351x family is available in the space saving 5-pin SOT23 surface mount package and is specified over the -40 to +85°C temperature range.

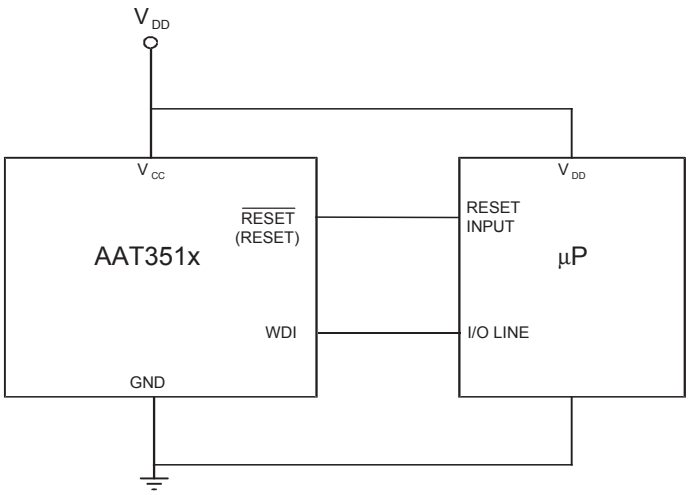
## Features

- Tight voltage tolerance: ±1.5%
- Low quiescent current: 5µA
- Guaranteed Reset Valid down to 1V
- 32 voltage options from 2.6V to 5.0V
- 3 Reset active period options
  - 1ms, 20ms, 140ms
- 3 Watchdog timeout period options
  - 6.3ms, 102ms, 1600ms
- 4 output options:
  - Open drain
  - Inverting
  - Non-inverting
  - Bi-directional
- Low Tempco: 100ppm/°C
- 5-pin SOT23 package

## Applications

- Notebook Computers
- Portable Electronics
- Industrial Controllers
- Intelligent Instruments
- Critical µP and µC Supply Monitoring
- Power-On reset circuits
- Embedded Control Systems

## Typical Application

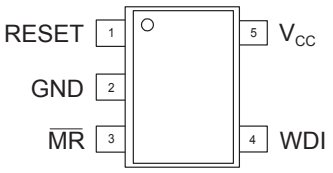


## Pin Descriptions

| Pin # | | | | Symbol | Function |
|---|---|---|---|---|---|
| AAT3510 AAT3511 AAT3517 | AAT3512 | AAT3513 AAT3514 AAT3518 | AAT3515 AAT3516 AAT3519 | | |
| 1 | N/A | 1 | 1 | $\overline{\text{RESET}}$ | AAT3510/13/15: $\overline{\text{RESET}}$ output goes low whenever $V_{DD}$ falls below the reset threshold. CMOS push-pull Output |
| | | | | | AAT3511/14/16: $\overline{\text{RESET}}$ output goes low whenever $V_{DD}$ falls below the reset threshold. Bidirectional CMOS push-pull Output intended to interface directly to microprocessors with bi-directional resets |
| | | | | | AAT3517/18/19: $\overline{\text{RESET}}$ output goes low whenever $V_{DD}$ falls below the reset threshold. Open drain output. Connect a pull-up resistor to any supply voltage up to 5.5V |
| 2 | 2 | 2 | 2 | GND | Ground connection pin |
| | 1 | 3 | 3 | RESET | RESET active-high output. This CMOS push-pull signal is the logical inverse of $\overline{\text{RESET}}$. |
| 3 | 3 | N/A | 4 | $\overline{\text{MR}}$ | Manual reset input pin. Active low. Pull low to force a reset. |
| 4 | 4 | 4 | N/A | WDI | Watchdog input pin. Triggers a reset if it remains in a steady state for the duration of the watchdog timer period. |
| 5 | 5 | 5 | 5 | $V_{CC}$ | Input voltage pin |

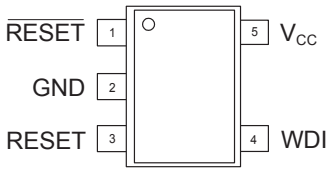
## Pin Configuration

5-lead SOT23
(Top View)



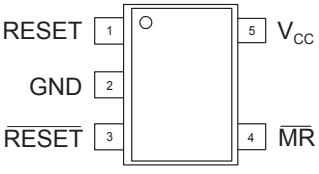

AAT3510
AAT3511
AAT3517

5-lead SOT23
(Top View)



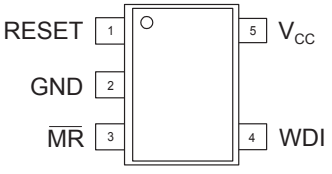

AAT3513
AAT3514
AAT3518

5-lead SOT23
(Top View)




AAT3515
AAT3516
AAT3519

5-lead SOT23
(Top View)




AAT3512

## Absolute Maximum Ratings ($T_A$=25°C unless otherwise noted)

| Symbol | Description | Max | Units |
|---|---|---|---|
| $V_{CC}$ | $V_{CC}$ to GND | -0.3 to 6 | V |
| $V_{MR}$, $V_{WDI}$ | $\overline{MR}$, WDI to GND | -0.3 to $V_{CC}$+0.3 | V |
| $V_{RESET}$ | $\overline{RESET}$ to GND (Push-Pull or Bidirectional Output) | -0.3 to $V_{CC}$+0.3 | V |
| | RESET to GND (Open Drain Output) | -0.3 to 6 | |
| $I_{VCC}$, $I_{MR}$, $I_{WDI}$ | Maximum Continuous Input Current | 20 | mA |
| $I_{RESET}$ | RESET/$\overline{RESET}$ Output Current | 20 | mA |
| $dV_{CC}/dt$ | Rate of rise of $V_{CC}$ | 100 | V/µs |
| $T_J$ | Operating Junction Temperature Range (-40° to 150°C) | 150 | °C |

Note: Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. Functional operation at conditions other than the operating conditions specified is not implied. Only one Absolute Maximum rating should be applied at any one time.

## Thermal Information

| Symbol | Description | Value | Units |
|---|---|---|---|
| $\Theta_{JA}$ | Maximum Thermal Resistance[1] | 190 | °C/W |
| $P_D$ | Maximum Power Dissipation[1] | 526 | mW |

Note 1: Mounted on FR4 board

## Electrical Characteristics ($V_{CC}$ = 2.5V to 5.5V, $T_A$ = -40 to +85°C [1] unless otherwise noted. Typical values are at $T_A$=25°C )

| Symbol | Description | Conditions | | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $V_{CC}$ | Operating Voltage Range | $T_A$ = -40°C to +85°C | | 1 | | 5.5 | V |
| $I_{CC}$ | Supply Current | AAT3510/1/2/3/4/7/8: | $V_{CC}$ = 3.6V | | 5 | 15 | µA |
| | | $\overline{MR}$ & WDI unconnected | $V_{CC}$ = 5.5V | | 6 | 18 | |
| | | AAT3515/6/9: | $V_{CC}$ = 3.6V | | | 15 | |
| | | $\overline{MR}$ unconnected | $V_{CC}$ = 5.5V | | | 18 | |
| $V_{TH}$ | Reset Threshold Voltage | $T_A$ = 25°C | | $V_{THNOM}$-1.5% | $V_{TH}$ | $V_{THNOM}$+1.5% | V |
| | | $T_A$ = -40 to +85°C | | $V_{THNOM}$-2.5% | $V_{TH}$ | $V_{THNOM}$+2.5% | |
| $T_C$ | Reference Voltage Temp Coeff | -40°C < $T_A$ < +85°C | | | ±40 | | ppm/°C |
| $t_{RP}$ | Reset Active Timeout Period | AAT351xIGV-xx-A-x-T1 | | 1 | 1.4 | 2 | ms |
| | | AAT351xIGV-xx-B-x-T1 | | 20 | 28 | 40 | |
| | | AAT351xIGV-xx-C-x-T1 | | 140 | 200 | 280 | |
| $T_{RD}$ | $V_{CC}$ to RESET Delay | $V_{CC}$ falling at 1mV/µs | | | 40 | | µs |

## Electrical Characteristics

($V_{CC}$ = 2.5V to 5.5V, $T_A$ = -40 to +85ºC[1] unless otherwise noted. Typical values are at $T_A$=25°C )

| Symbol | Description | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Push/Pull RESET Output (AAT3510, 3512, 3513, 3514, 3515, 3516, 3518, 3519)** | | | | | | |
| $V_{OL}$ | $\overline{RESET}$ Low Output Voltage | $V_{CC} \geq 1.0V$, $I_{SINK}$ = 50µA | | | 0.3 | V |
| | | $V_{CC} \geq 1.2V$, $I_{SINK}$ = 100µA | | | 0.3 | |
| | | $V_{CC} \geq 2.7V$, $I_{SINK}$ = 1.2mA | | | 0.3 | |
| | | $V_{CC} \geq 4.5V$, $I_{SINK}$ = 3.2mA | | | 0.4 | |
| $V_{OH}$ | $\overline{RESET}$ High Output Voltage | $V_{CC} \geq 2.7V$, $I_{SOURCE}$ = 500µA | 0.8 x $V_{CC}$ | | | V |
| | | $V_{CC} \geq 4.5V$, $I_{SOURCE}$ = 800µA | $V_{CC}$ - 1.5 | | | |
| $V_{OH}$ | RESET Low Output Voltage | $V_{CC} \geq 2.7V$, $I_{SINK}$ = 1.2mA | | | 0.3 | V |
| | | $V_{CC} \geq 4.5V$, $I_{SINK}$ = 3.2mA | | | 0.4 | |
| | RESET High Output Voltage | $V_{CC} \geq 1.8V$, $I_{SOURCE}$ = 150µA | 0.8 x $V_{CC}$ | | | |
| | | $V_{CC} \geq 2.7V$, $I_{SOURCE}$ = 500µA | 0.8 x $V_{CC}$ | | | |
| | | $V_{CC} \geq 4.5V$, $I_{SOURCE}$ = 800µA | $V_{CC}$ - 1.5 | | | |
| **Bidirectional $\overline{RESET}$ Output (AAT3511, 3514, 3516)** | | | | | | |
| $t_S$ | Transition Flip-Flop Setup Time[2] | | | 400 | | ns |
| $t_R$ | $\overline{RESET}$ Output Rise Time[3] | $V_{CC}$ = 3.0V, $C_L$ = 120pF | | | 333 | ns |
| | | $V_{CC}$ = 5.0V, $C_L$ = 200pF | | | 333 | |
| | | $V_{CC}$ = 3.0V, $C_L$ = 250pF | | | 666 | |
| | | $V_{CC}$ = 5.0V, $C_L$ = 400pF | | | 666 | |
| $V_{PTH}$ | Active Pullup Enable Threshold | $V_{CC}$ = 5.0V | 0.4 | 0.65 | | V |
| | $\overline{RESET}$ Active Pullup Current | $V_{CC}$ = 5.0V | | 20 | | mA |
| | $\overline{RESET}$ Pullup Resistance | | 4.2 | 4.7 | 5.2 | kΩ |
| **Open-Drain $\overline{RESET}$ Output (AAT3517, 3518, 3519)** | | | | | | |
| $V_{OL}$ | $\overline{RESET}$ Low Output Voltage | $V_{CC} \geq 1.0V$, $I_{SINK}$ = 50µA | | | 0.3 | V |
| | | $V_{CC} \geq 1.2V$, $I_{SINK}$ = 100µA | | | 0.3 | |
| | | $V_{CC} \geq 2.7V$, $I_{SINK}$ = 1.2mA | | | 0.3 | |
| | | $V_{CC} \geq 4.5V$, $I_{SINK}$ = 3.2mA | | | 0.4 | |
| $I_{D(OFF)}$ | Reset Leakage Current | | | | 1.0 | µA |
| **Watchdog Input (AAT3510, 3511, 3512, 3513, 3514, 3517, 3518)** | | | | | | |
| $t_{WD}$ | Watchdog Timeout Period | AAT351xIGV-xx-x-A-T1 | 4.3 | 6.3 | 9.3 | ms |
| | | AAT351xIGV-xx-x-B-T1 | 71 | 102 | 153 | |
| | | AAT351xIGV-xx-x-C-T1 [4] | 1.12 | 1.6 | 2.4 | s |
| $t_{WDI}$ | WDI Minimum Pulse Width | $V_{IL}$ = 0.3 x $V_{CC}$, $V_{IH}$ = 0.7 x $V_{CC}$ | | 50 | | ns |
| $V_{IL}$ | WDI Input Threshold [5] | | 0.3 x $V_{CC}$ | | | |
| $V_{IH}$ | WDI Input Threshold [5] | | | | 0.8 x $V_{CC}$ | V |
| $I_{WDI}$ | WDI Input Current [6] | WDI = $V_{CC}$, time average | | 120 | 160 | µA |
| | | $V_{WDI}$ = 0, time average | -20 | -15 | | |

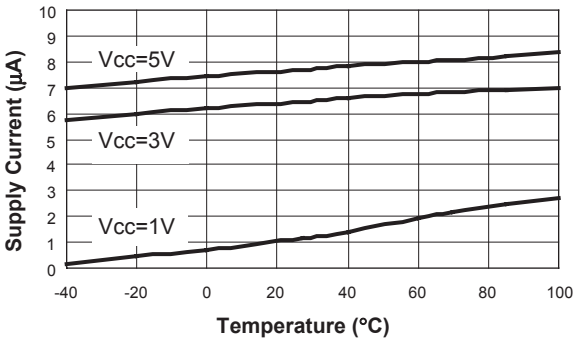
| Symbol | Description | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Manual RESET Input (AAT3510, 3511, 3512, 3515, 3516, 3517, 3519)** | | | | | | |
| $V_{IL}$ | $\overline{MR}$ Input Threshold | | 0.3 x $V_{CC}$ | | | V |
| $V_{IH}$ | $\overline{MR}$ Input Threshold | | | | 0.7 x $V_{CC}$ | |
| | $\overline{MR}$ Input Pulse Width | | 1 | | | µs |
| | $\overline{MR}$ Glitch Rejection | | | 100 | | ns |
| | $\overline{MR}$ Internal Pullup Resistance | $T_A$ = 25°C | 35 | 52 | 75 | kΩ |
| | $\overline{MR}$ to Reset Delay | $V_{CC}$ = 5V | | 230 | | ns |

Note 1: Over-temperature limits are guaranteed by design, not production tested.
Note 2: This is the minimum time $\overline{RESET}$ must be held low by an external pulldown source to set the active pullup flip-flop.
Note 3: Measured from $\overline{RESET}$ $V_{OL}$ to (0.8 x $V_{CC}$), Open Circuit Output.
Note 4: Watchdog timeout period C is not available on AAT3513, AAT3514, and AAT3518.
Note 5: WDI is internally serviced within the watchdog period if WDI is left unconnected.
Note 6: The WDI input current is specified as the average input current when the WDI input is driven high or low. The WDI input is designed for a three-stated-output device with a 10µA maximum leakage current and capable of driving a maximum capacitive load of 200pF. The three-state device must be able to source and sink at least 200µA when active.

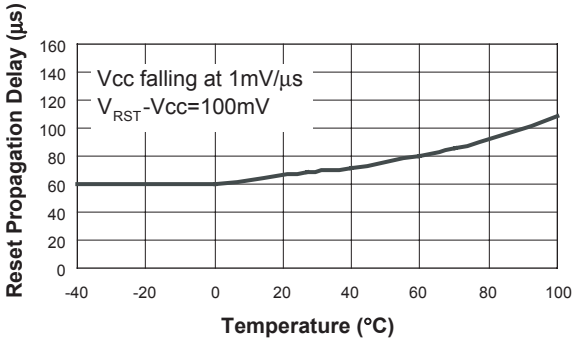
## Typical Characteristics

(Unless otherwise noted, $V_{IN}$ = 3V, $T_A$ = 25°C)

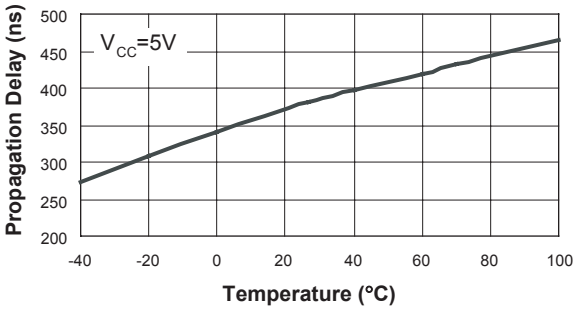
### Supply Current vs. Temperature



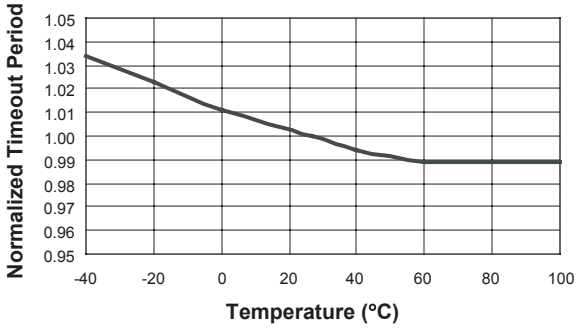

### Vcc Falling To RESET Propagation Delay vs. Temperature



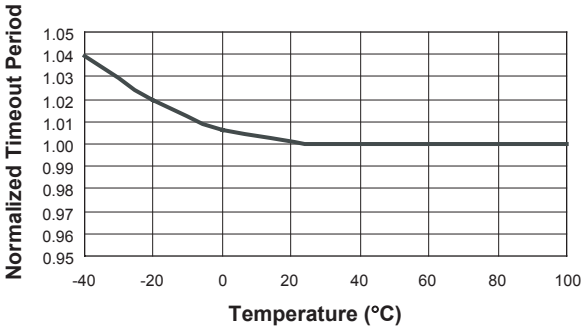

### Manual Reset to RESET Propagation Delay vs. Temperature



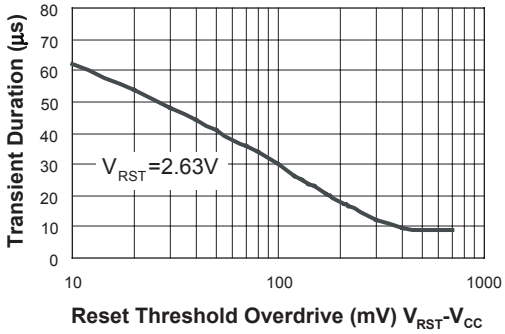

### Normalized Reset Timeout Period vs. Temperature




### Normalized Watchdog Timeout Period vs. Temperature



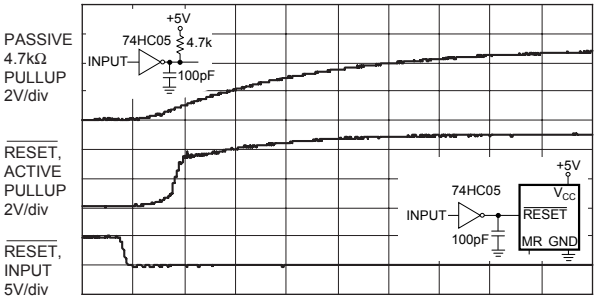

### Maximum $V_{CC}$ Transient Duration vs. Reset Threshold Overdrive



## Typical Characteristics

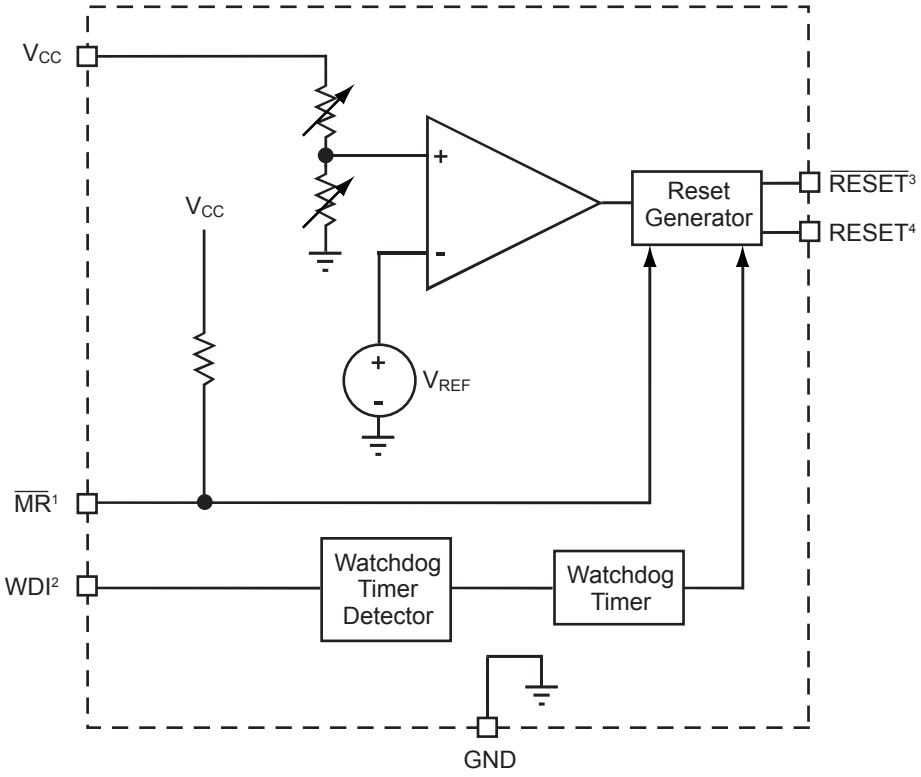
(Unless otherwise noted, $V_{IN}$ = 3V, $T_A$ = 25°C)

**Bidirectional Pullup Characteristic**




**200ns/div**

## Functional Block Diagram




Note 1: MR pin available on AAT3510/1/2/5/6/7/9

Note 2: WDI pin avaliable on AAT3510/1/2/3/4/7/8

Note 3: $\overline{\text{RESET}}$ pin available on AAT3510/1/3/4/5/6/7/8/9

Note 4: RESET pin available on AAT3512/3/4/5/6/8/9

## Factory Trimmed Reset Thresholds* and Ordering Information

**AAT351x IGV - X.XX-X-X-T1**

- Watchdog Timeout (if applicable)
- Reset Active Period
- Threshold Voltage

### Reset Active Period

A: $T_{R(MIN)}$ = 1ms
B: $T_{R(MIN)}$ = 20ms
C: $T_{R(MIN)}$ = 140ms

### Watchdog Timeout Period

A: $T_{WD(NOM)}$ = 6.3ms
B: $T_{WD(NOM)}$ = 102ms
C: $T_{WD(NOM)}$ = 1600ms*

### VDD Threshold Voltage

2.63: $V_{TH(NOM)}$ = 2.63V
2.70: $V_{TH(NOM)}$ = 2.7V
2.80: $V_{TH(NOM)}$ = 2.8V
2.93: $V_{TH(NOM)}$ = 2.93V
3.00: $V_{TH(NOM)}$ = 3.0V
3.08: $V_{TH(NOM)}$ = 3.08V
3.20: $V_{TH(NOM)}$ = 3.2V
3.30: $V_{TH(NOM)}$ = 3.3V
3.40: $V_{TH(NOM)}$ = 3.4V
3.50: $V_{TH(NOM)}$ = 3.5V
3.60: $V_{TH(NOM)}$ = 3.6V
3.70: $V_{TH(NOM)}$ = 3.7V
3.80: $V_{TH(NOM)}$ = 3.8V
3.90: $V_{TH(NOM)}$ = 3.9V
4.00: $V_{TH(NOM)}$ = 4.0V
4.10: $V_{TH(NOM)}$ = 4.1V
4.20: $V_{TH(NOM)}$ = 4.2V
4.38: $V_{TH(NOM)}$ = 4.3V
4.40: $V_{TH(NOM)}$ = 4.38V
4.50: $V_{TH(NOM)}$ = 4.5V
4.63: $V_{TH(NOM)}$ = 4.63V
4.70: $V_{TH(NOM)}$ = 4.7V
4.80: $V_{TH(NOM)}$ = 4.8V
4.90: $V_{TH(NOM)}$ = 4.9V
5.00: $V_{TH(NOM)}$ = 5.0V

* Watchdog timeout period C is not avaliable on AAT3513, AAT3514 and AAT3518.

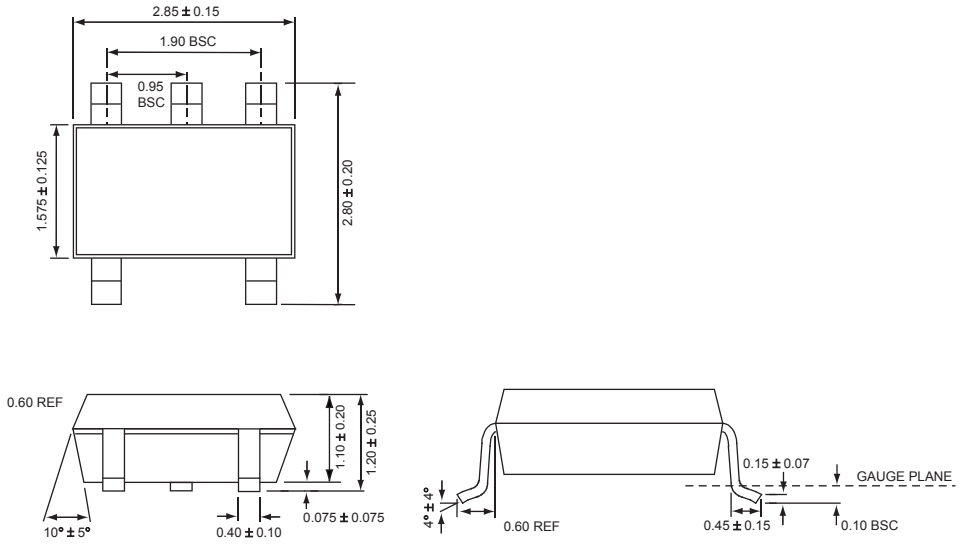
## Ordering Information

| Package | Marking[1] | Part Number (Tape and Reel) |
|---|---|---|
| SOT23-5 | HVXYY | **AAT3510IGV-2.63-C-C-T1** |
| SOT23-5 | HUXYY | **AAT3510IGV-2.93-C-C-T1** |
| SOT23-5 | HGXYY | **AAT3510IGV-3.08-C-C-T1** |
| SOT23-5 | HHXYY | **AAT3510IGV-4.38-C-C-T1** |
| SOT23-5 | EWXYY | **AAT3511IGV-2.63-C-C-T1** |
| SOT23-5 | MYXYY | **AAT3512IGV-2.63-A-C-T1** |
| SOT23-5 | JOXYY | AAT3512IGV-2.63-C-C-T1 |
| SOT23-5 | HFXYY | AAT3513IGV-2.63-C-C-T1 |
| SOT23-5 | HEXYY | **AAT3515IGV-2.63-C-T1** |
| SOT23-5 | HIXYY | **AAT3515IGV-2.93-B-T1** |
| SOT23-5 | KLXYY | **AAT3515IGV-2.93-C-T1** |
| SOT23-5 | JNXYY | **AAT3515IGV-3.08-C-T1** |
| SOT23-5 | KMXYY | **AAT3515IGV-4.38-C-T1** |
| SOT23-5 | MFXYY | **AAT3515IGV-4.63-C-T1** |
| SOT23-5 | INXYY | **AAT3517IGV-2.63-C-C-T1** |
| SOT23-5 | LZXYY | **AAT3517IGV-2.8-B-C-T1** |
| SOT23-5 | IQXYY | **AAT3517IGV-2.93-C-C-T1** |

Note: Sample stock is held on part numbers listed in **bold**.
Note 1: XYY = date and assembly code.

## Package Information

**SOT23-5**




All dimensions in millimeters.

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