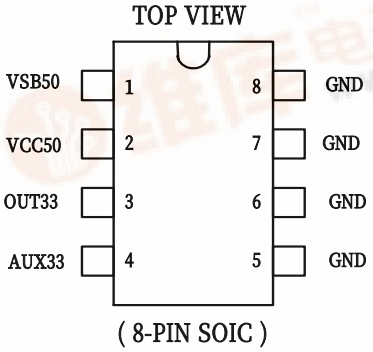
# 400-mA MULTI-INPUT LOW-DROPOUT REGULATOR WITH $V_{AUX}$ SWITCH

## Features

- Complete Power Management
- Automatic Input Voltage Selection
- Input Voltage Source Detector With Hysteresis
- 400-mA Load Current Capability With VCC50 or VSB50 or AUX33 Input Source
- Integrated Low $r_{DS\ (on)}$ Switch
- Regulated Output 3.3V (fixed)
- Output Short Circuit Protection

## Pin Configuration




( 8-PIN SOIC )

## Description

The AAT1204 is a multi-input low-dropout regulator that provides constant output supply 3.3V at the output capable of driving a 400-mA load.

The AAT1204 provides regulated power output for systems that have multiple input sources and require constant voltage source with a low-dropout voltage. This is a intelligent power source selection device with a low-dropout regulator for either VCC50 or VSB50 inputs, and a low-resistance bypass switch for the AUX33 input.

Transitions may occur from one input supply to another without generating a glitch outside of the specification range on the 3.3-V output. The device has an incorporated reverse-blocking scheme to prevent excess leakage from the input terminals in the event that the output voltage is greater than the input voltage.

The input voltage is prioritized in the following order: VCC50, VSB50, AUX33.

**Functions Table**

| INPUT VOLTAGE STATUS (V) | | | INPUT SELECTED | OUTPUT (V) | OUTPUT (I) (mA) |
|---|---|---|---|---|---|
| **VCC50** | **VSB50** | **AUX33** | **VCC50/VSB50/AUX33** | **OUT33** | **Iout33** |
| 0 | 0 | 0 | None | 0 | 0 |
| 0 | 0 | 3.3 | AUX33 | 3.3 | 400 |
| 0 | 5 | 0 | VSB50 | 3.3 | 400 |
| 0 | 5 | 3.3 | VSB50 | 3.3 | 400 |
| 5 | 0 | 0 | VCC50 | 3.3 | 400 |
| 5 | 0 | 3.3 | VCC50 | 3.3 | 400 |
| 5 | 5 | 0 | VCC50 | 3.3 | 400 |
| 5 | 5 | 3.3 | VCC50 | 3.3 | 400 |

**PIN Description**

| TERMINAL NAME | NO. | I/O | Description |
|---|---|---|---|
| VSB50 | 1 | I | 5-V standby supply input |
| VCC50 | 2 | I | 5-V main supply input |
| OUT33 | 3 | O | 3.3-V regulated output |
| AUX33 | 4 | I | 3.3-V auxiliary supply input |
| GND | 5 | I | Ground |
| GND | 6 | I | Ground |
| GND | 7 | I | Ground |
| GND | 8 | I | Ground |

**absolute maximum ratings**[+]

- Main Supply voltage, $V_{(VCC50)}$ ..... -0.5V~7V
- Standby Supply voltage, $V_{(VSB50)}$ ..... -0.5V~7V
- Auxiliary Supply voltage, $V_{(AUX33)}$ ..... -0.5V~7V
- Output current limit, $I_{(LIMIT)}$ ..... 1.5A
- Continuous power dissipation, $P_D$ (see Note 1) ..... 1.1W
- Electrostatic discharge susceptibility, human body model.....2kV
- Operating ambient temperature range, $T_A$.....0℃ to 70℃
- Storage temperature range, Tstg.....-55℃ to 150℃
- Operating junction temperature range, $T_J$.....-5℃ to 135℃
- Lead temperature (soldering, 10 second) ,$T_{(LEAD)}$ .....260℃

NOTE 1：The device deteriorate with increase in ambient temperature, TA. See Thermal Information section.

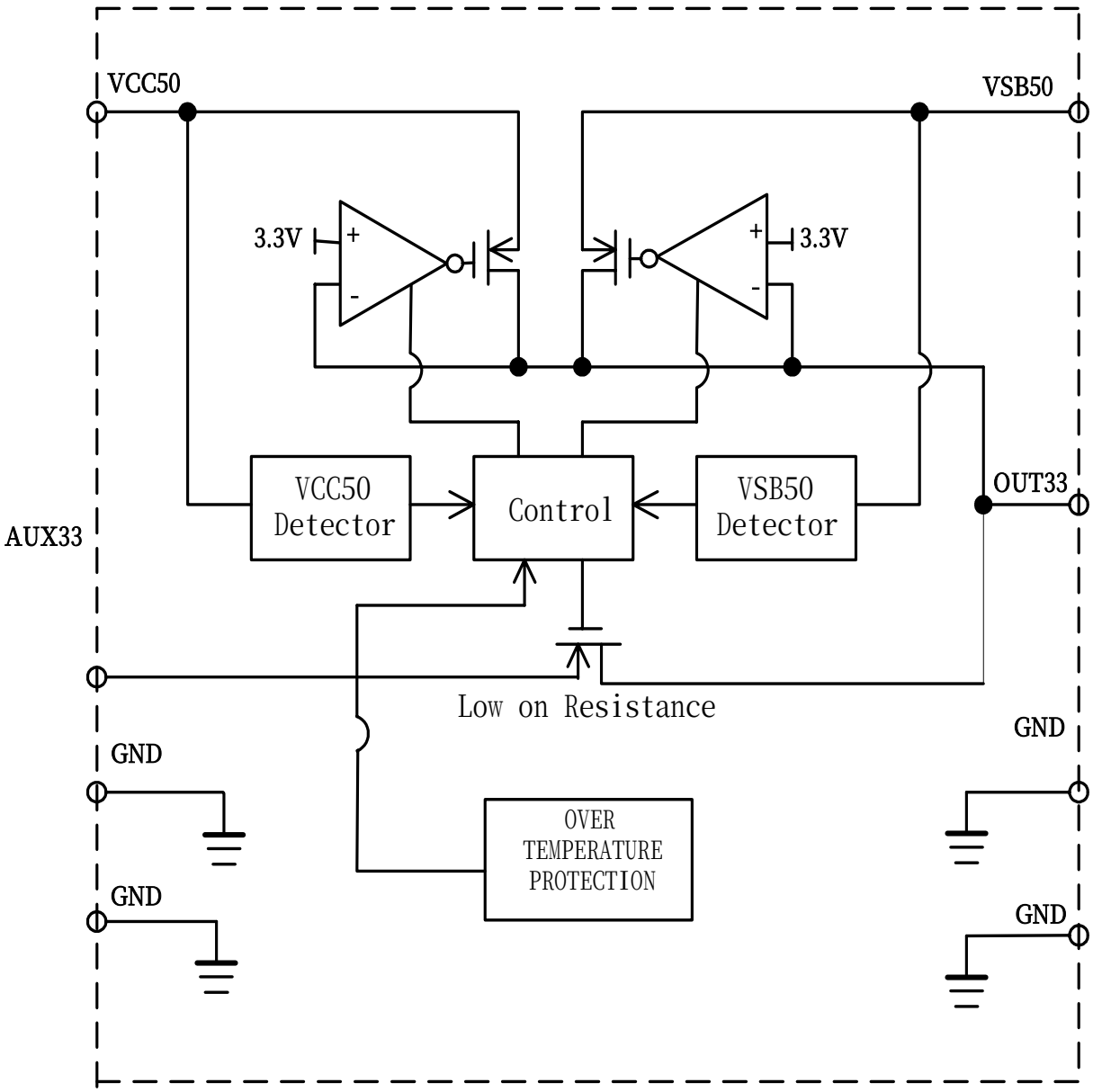
**Recommended operating conditions**

| | Min | Typ | Max | Unit |
|---|---|---|---|---|
| 5-V main supply input, VCC50 | 4.5 | | 5.5 | V |
| 5-V standby supply input, VSB50 | 4.5 | | 5.5 | V |
| 3.3V auxiliary supply input, AUX33 | 3 | | 3.6 | V |
| Load capacitance, $C_L$ | 4.23 | 4.7 | 5.17 | µF |
| Load current, $I_L$ | 0 | | 400 | mA |
| Ambient temperature, $T_A$ | 0 | | 70 | ℃ |

**Electrical Characteristics over recommended operating free-air temperature, TA = 0℃ to 70 ℃,CL = 4.7µF (unless otherwise noted)**

| Parameter | | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| VCC50<br>VSB50 | 5-V inputs | | 4.5 | 5 | 5.5 | V |
| OUT33 | 3.3-V output | Iout33 = 400mA | 3.135 | 3.3 | 3.465 | V |
| $\triangle V_{O\ (\triangle VI)}$ | Line regulation voltage | VSB50 or VCC50 = 4.5V to 5.5V | | 2 | | mV |
| $\triangle V_{O\ (\triangle IO)}$ | Load regulation voltage | 20 mA＜$I_L$＜400 mA | | 40 | | mV |
| $I_{50}$ | Quiescent supply current | From VCC50 VSB50 terminals, $I_L$= 0 to 400mA | | 1.0 | 3.0 | mA |
| $I_{AUX}$ | | From AUX33 terminal, IL = 0A | | 1.0 | 3.0 | mA |
| $I_{L33}$ | Out33 load current | | 0.4 | | | A |
| $I_{LIMIT}$ | Output current limit | Out33 output short to 0v | | | 1.5 | A |
| $T_{TSD}$ | Thermal shutdown（NOTE 2） | | 150 | | 180 | ℃ |
| $T_{hys}$ | Thermal hysteresis（NOTE2） | | | 15 | | ℃ |
| $C_L$ | Load capacitance | Minimal ESR to insure stability of regulated output | | 4.7 | | µF |
| $I_{lkg(REV)}$ | Reverse leakage output current | Tested for input that is grounded. AUX33, VSB50 or VCC50 = GND, Out33 = 3.3v | | | 50 | µA |
| $V_{LO}$ | Threshold voltage, low | VSB50 or VCC50↓ | 4.0 | 4.2 | 4.4 | V |
| $V_{HI}$ | Threshold voltage, high | VSB50 or VCC50↑ | 4.25 | 4.45 | 4.65 | V |
| $R_{(SWITCH)}$ | Auxiliary switch resistance | VSB50 = VCC50 = 0V, AUX33 = 3.3V, $I_L$ = 150mA | | | 0.4 | Ω |
| $R_{\theta JA}$ | Thermal impedance, Junction-to-ambient（NOTE3） | Without copper for heat spreading | | 100 | | ℃/W |
| | | With copper for heat spreading | | 70 | | ℃/W |

NOTE 2：Design targets only. Not tested in production.
NOTE 3：Please refer to "Thermal Information"


VCC50
VSB50
3.3V
+
-
3.3V
+
-
VCC50
Detector
Control
VSB50
Detector
OUT33
AUX33
Low on Resistance
GND
GND
OVER
TEMPERATURE
PROTECTION
GND
GND

## TYPICAL CHARACTERISTICS

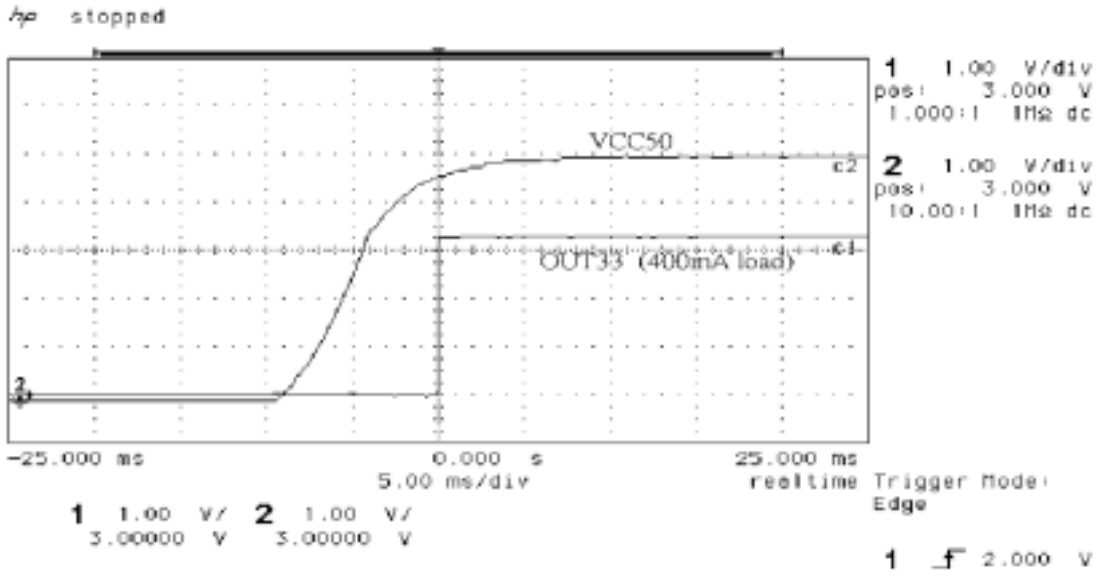



**Figure 1. 3.3V VCC50 Cold Start**

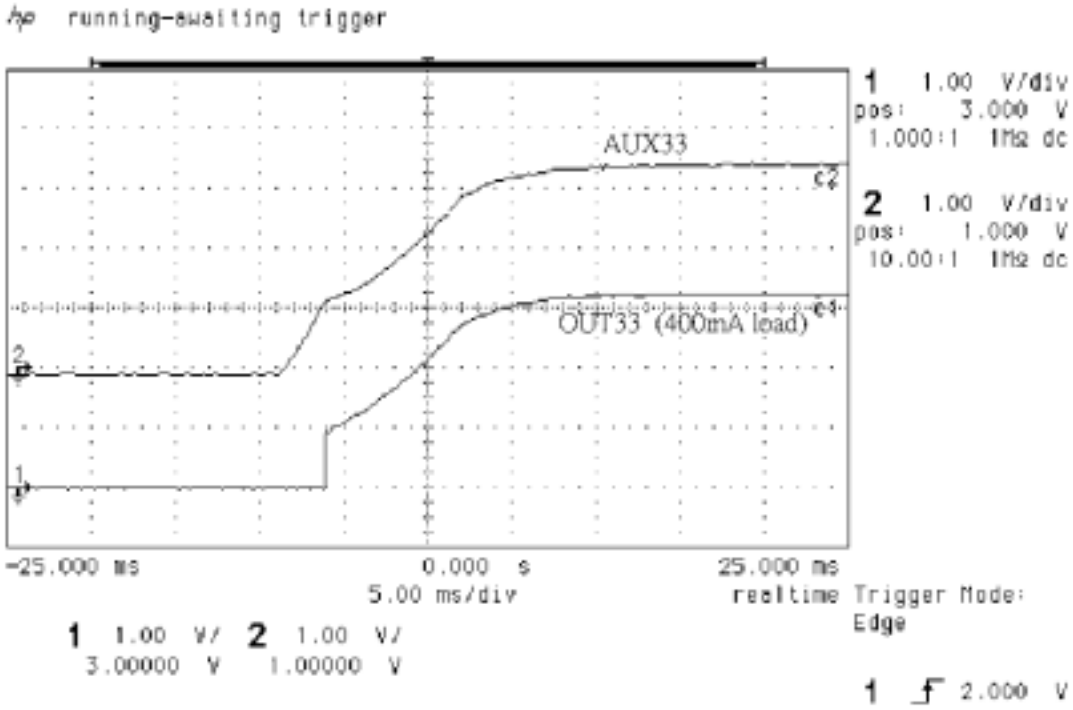



**Figure 2. 3.3V AUX33 Cold Start**

## TYPICAL CHARACTERISTICS

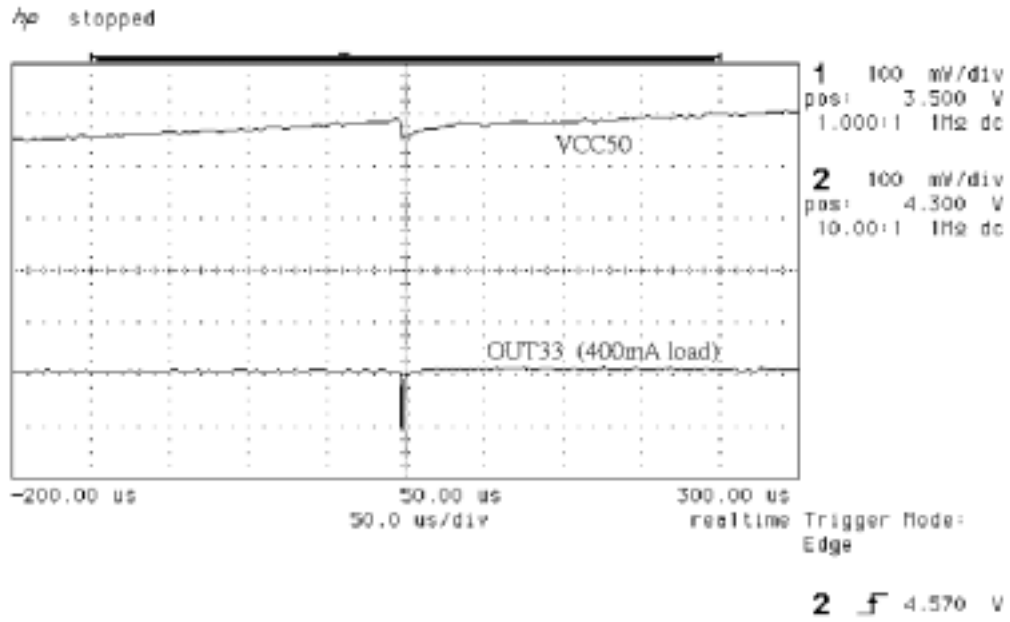



**Figure 3. 3.3V VCC50 Power Up(VSB50=5V)**

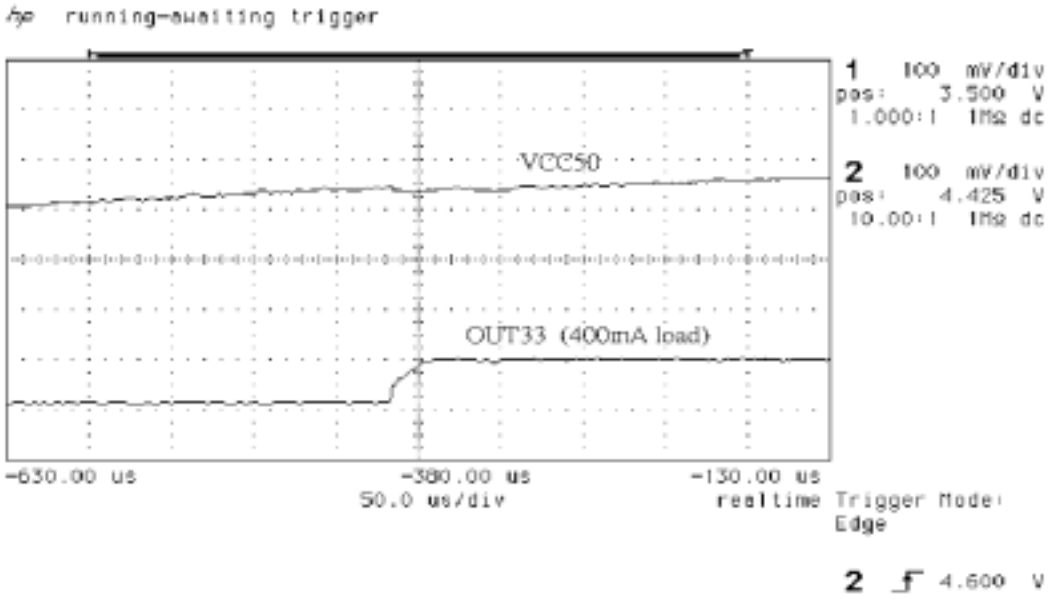



**Figure 4. 3.3V VCC50 Power Up(AUX33=3.3V)**

## TYPICAL CHARACTERISTICS

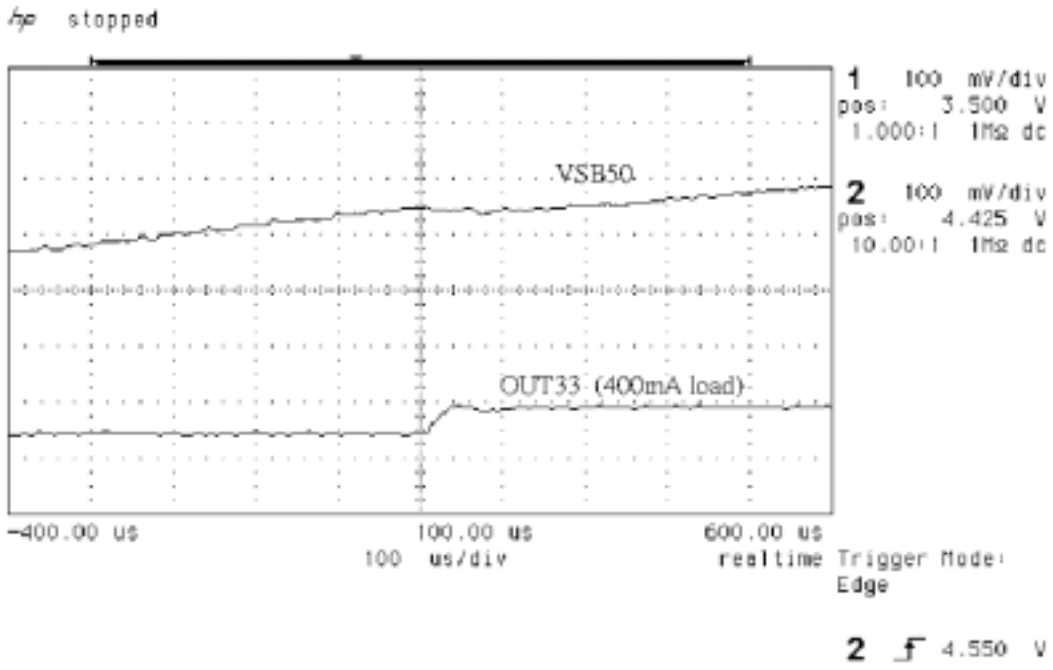



**Figure 5. 3.3V VSB50 Power Up(AUX33=3.3V)**

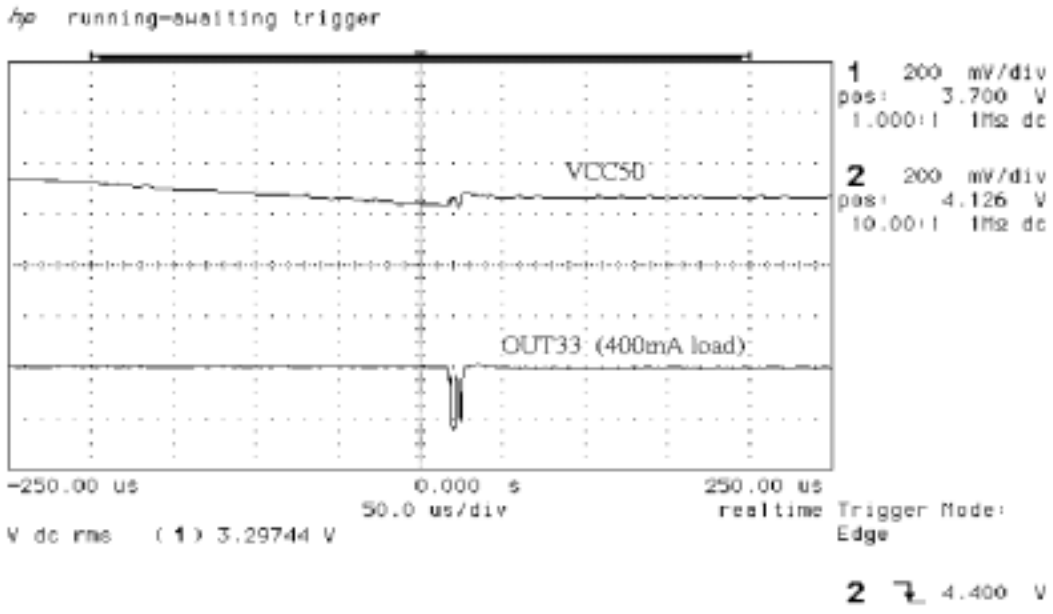



**Figure 6. 3.3V VCC50 Power Down(VSB=5V)**

**TYPICAL CHARACTERISTICS**

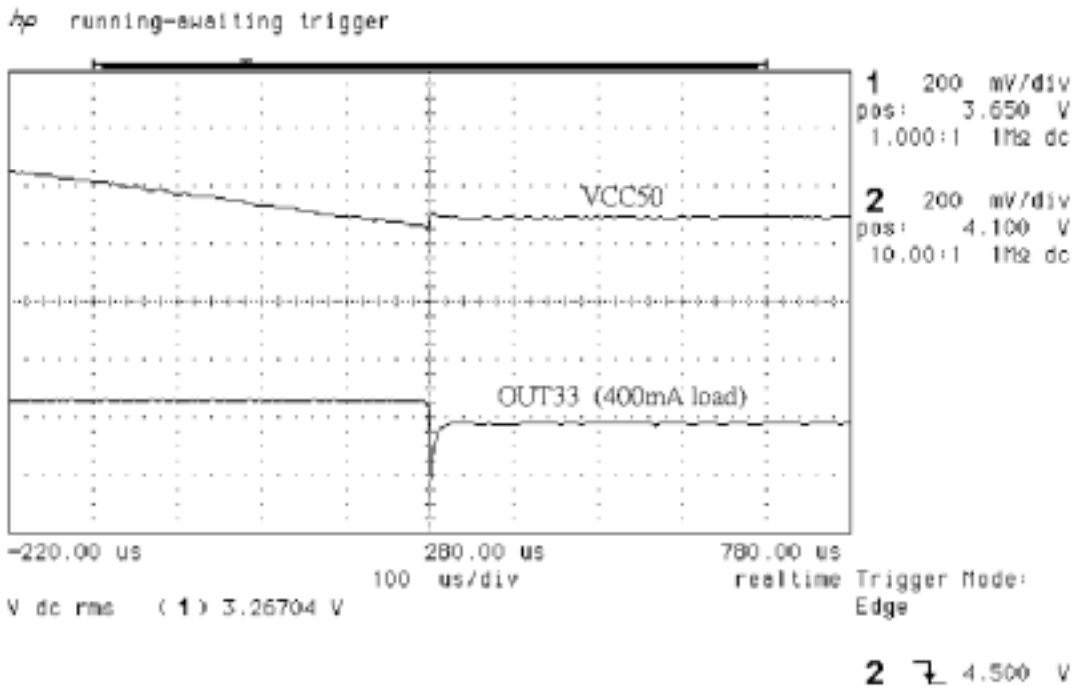



**Figure 7. 3.3V VCC50 Power Down(AUX33=3.3V)**

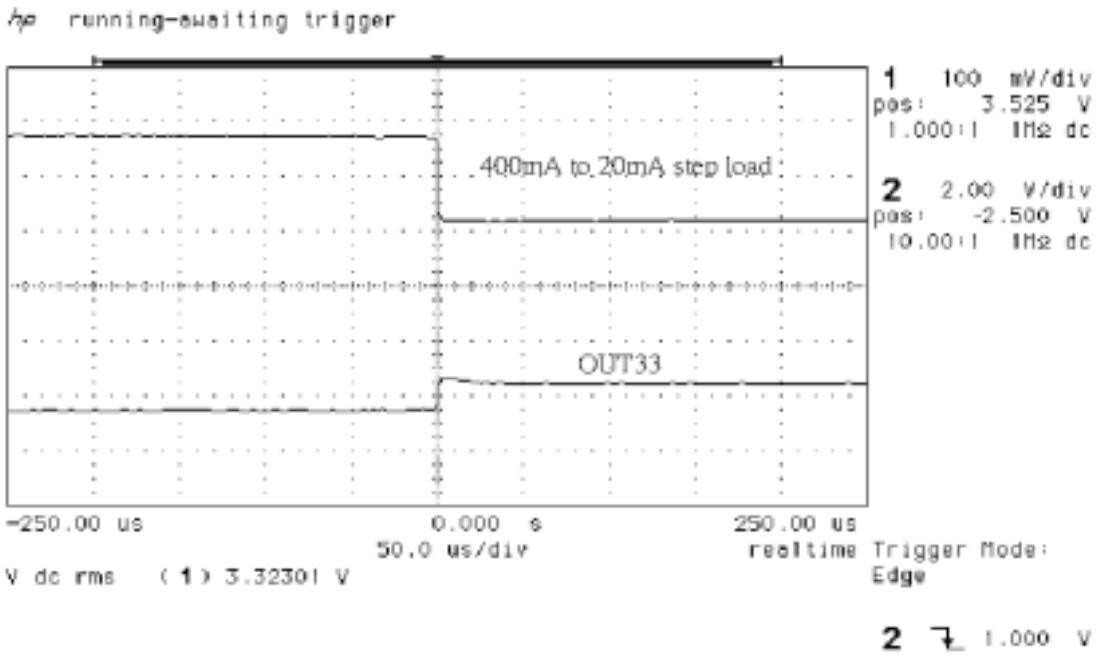



**Figure 8. 3.3V Load Transient Response Falling.**

**TYPICAL CHARACTERISTICS**

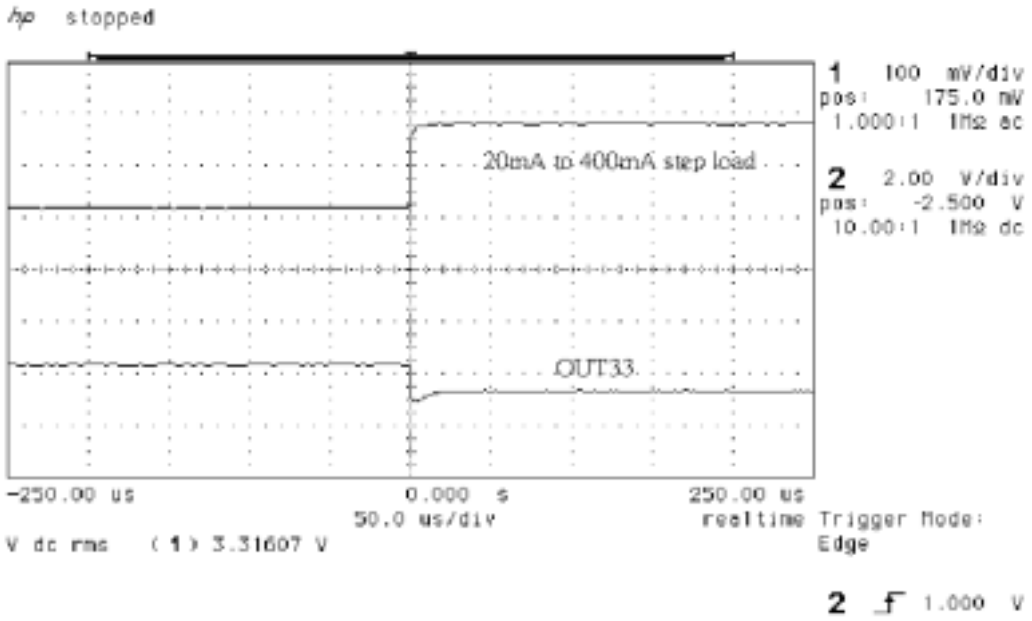



**Figure 9. 3.3V Load Transient Response Rising**

## THERMAL INFORMATION

To ensure reliable operation of the device, the junction temperature of the output device must be within the safe operating area（SOA）. This is achieved by having a means to dissipate the heat generated from the junction of the output structure. There are two components that contribute to thermal resistance. They consist of two paths in series. The first is the junction to case thermal resistance, $R_{JC}$; the second is the case to ambient thermal resistance, $R_{CA}$. The overall junction to ambient thermal resistance, $R_{JA}$, is determined by：

$$R_{JA}=R_{JC}+R_{CA}$$

The ability to efficiently dissipate the heat from the junction is a function of the package style and board layout incorporated in the application. The operating junction temperature is determined by the operation ambient temperature, $T_A$, and the junction power dissipation, $P_J$.

The junction temperature, $T_J$, is equal to the following thermal equation：

$$T_J=T_A+P_J（R_{JC}）+P_J（R_{CA}）$$
$$T_J=T_A+P_J（R_{JA}）$$

This particular application uses the 8-pin SO package with standard lead frame with a dedicated ground terminal. Hence, the maximum power dissipation allowable for an operating ambient temperature of 70℃, and a maximum junction temperature of 150℃ is determined as：

$$P_J=（T_J-T_A）/R_{JA}$$
$$P_J=（150-70）/70=1.1W$$

Worst case maximum power dissipation is determined by：

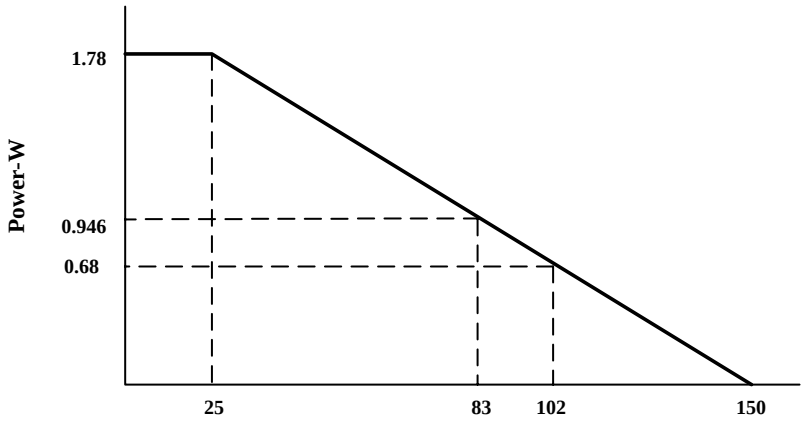
$$P_D=（5.5-3.135）\times0.4=0.946W$$

Normal operating maximum power dissipation is：

$$P_D=（5-3.3）\times0.4=0.68W$$

Note: The thermal characteristics of the AAT1204 were measured using a double-sided board with two square inches of copper area connected to the GND pins for "heat spreading". The use of multi-layer board construction with power planes will further enhance the thermal performance of the package.

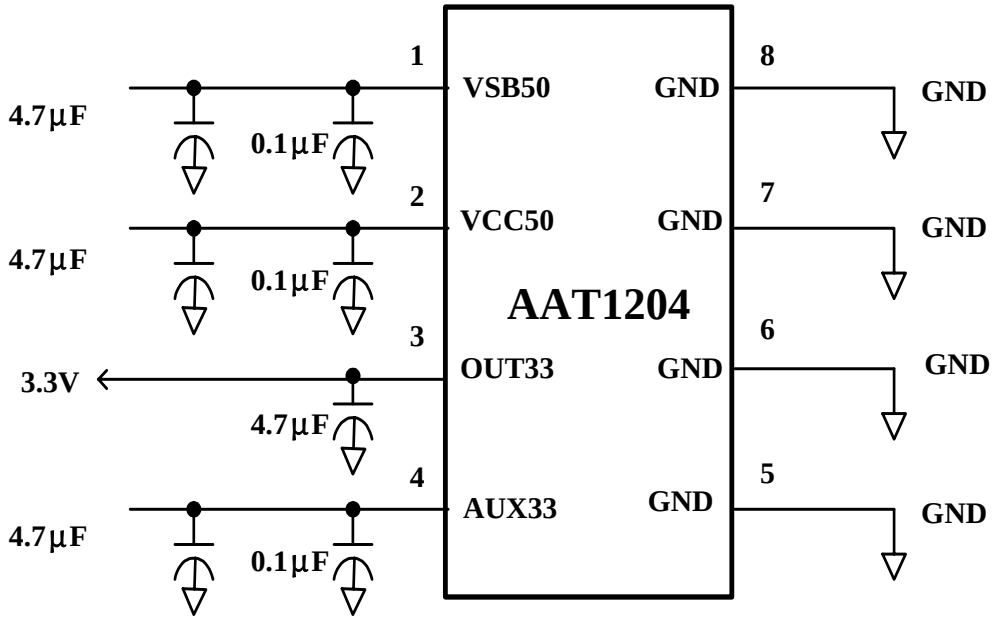
## THERMAL INFORMATION




NOTE: These curves are to be used for guideline purposes only. For a particular application, a more specijic thermal characterization is required.

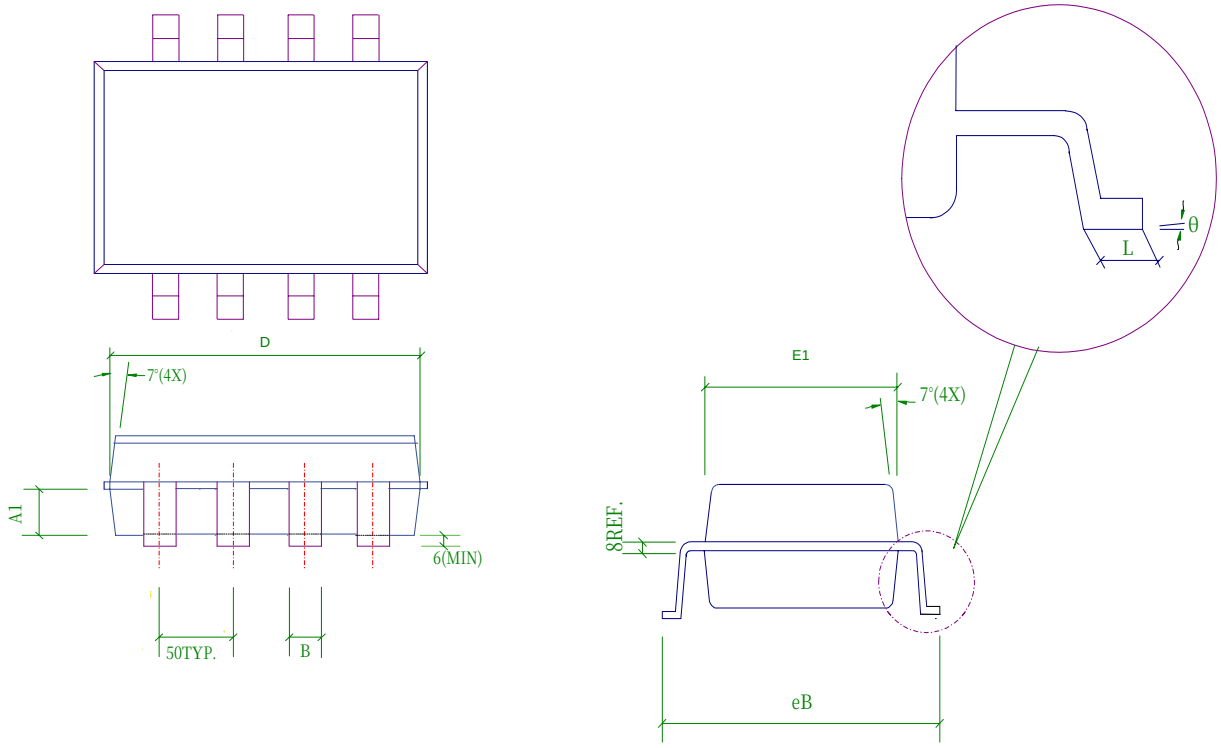
**Power Dissipation Derating Curves**

## APPLICATION INFORMATION




**Typical Application Schematic**

**Package Dimension**




| Symbol | Dimension in mils | | | Dimension in mm | | |
|---|---|---|---|---|---|---|
| | Min | Nom | Max | Min | Nom | Max |
| A | 59 | 63 | 67 | 1.498 | 1.600 | 1.702 |
| A1 | 22 | 24 | 26 | 0.56 | 0.610 | 0.66 |
| B | 12 | 16 | 20 | 0.305 | 0.406 | 0.508 |
| D | 188 | 190 | 192 | 4.775 | 4.826 | 4.877 |
| E1 | 152 | 154 | 156 | 3.861 | 3.912 | 3.962 |
| eB | 229 | 235 | 241 | 5.816 | 5.969 | 6.121 |
| L | 24 | -- | -- | 0.6 | -- | -- |
| θ | 0º | 3º | 6º | 0º | 3º | 6º |