

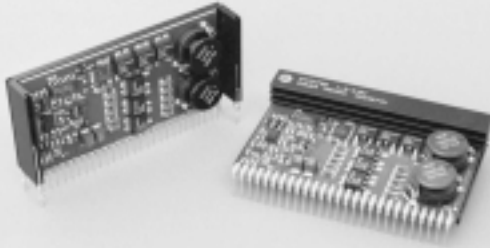
Description

The PT7778 is a high-output 32A Integrated Switching Regulator (ISR), housed in a 27-pin SIP package. The PT7778 is the 3.3V-input bus version of the PT7779. It includes short circuit protection and requires only 330 μ F of output capacitance for proper operation.

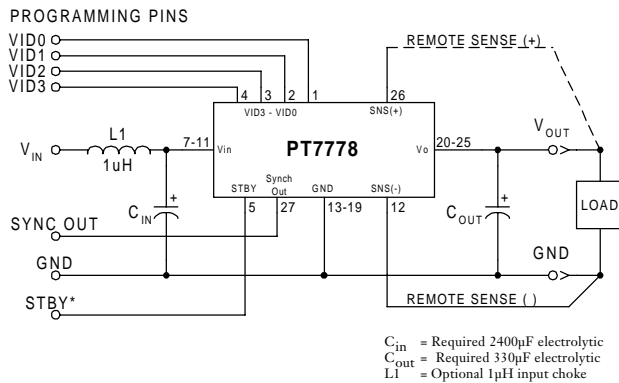
The output voltage of the PT7778 is programmable from 1.3V to 2.05V using a 4-bit input, which is compati-

ble with Intel's Pentium®II Processors. The 32A capability provides the ideal power source for the industry's latest high-speed, low-voltage μ Ps, DSPs, and custom VLSI devices. For additional current, the PT7778 may be paralleled with up to two PT7740 32A current boosters.

A differential remote sense is provided to compensate for voltage drop between the ISR and load.



Standard Application



Pin-Out Information

| Pin | Function | Pin | Function |
|-----|----------------------|-----|-------------------------------|
| 1 | VID0 | 15 | GND |
| 2 | VID1 | 16 | GND |
| 3 | VID2 | 17 | GND |
| 4 | VID3 | 18 | GND |
| 5 | STBY*- Stand-by | 19 | GND |
| 6 | N/C | 20 | V _{out} |
| 7 | V _{in} | 21 | V _{out} |
| 8 | V _{in} | 22 | V _{out} |
| 9 | V _{in} | 23 | V _{out} |
| 10 | V _{in} | 24 | V _{out} |
| 11 | V _{in} | 25 | V _{out} |
| 12 | Remote Sense Gnd (3) | 26 | Remote Sense V _{out} |
| 13 | GND | 27 | Sync Out |
| 14 | GND | | |

For STBY* pin; open = output enabled;
ground = output disabled.

Specifications

| Characteristics (T _a = 25°C unless noted) | Symbols | Conditions | PT7778 | | | |
|---|---------------------|--|----------------------|-------|----------------------|-----------|
| | | | Min | Typ | Max | Units |
| Output Current | I _o | T _a = +60°C, 200 LFM, pkg N T _a = +25°C, natural convection | 0.1 (1) | — | 32 | A |
| Input Voltage Range | V _{in} | 0.1A ≤ I _o ≤ 32A | 3.1 | — | 3.6 | V |
| Output Voltage Tolerance | ΔV _o | V _{in} = +3.3V, I _o = 32A -40°C ≤ T _a ≤ +85°C | V _o -0.03 | — | V _o +0.03 | V |
| Line Regulation | Reg _{line} | 3.1V ≤ V _{in} ≤ 3.6V, I _o = 32A | — | ±10 | — | mV |
| Load Regulation | Reg _{load} | V _{in} = +3.3V, 0.1 ≤ I _o ≤ 32A | — | ±10 | — | mV |
| V _o Ripple/Noise pk-pk | V _n | V _{in} = +3.3V, I _o = 32A | — | 50 | — | mV |
| Transient Response with C _{out} = 330 μ F | t _{tr} | I _o step between 16A and 32A | — | 100 | — | μ Sec |
| | V _{os} | V _o over/undershoot | — | 200 | — | mV |
| Efficiency | η | V _{in} = +3.3V, I _o = 20A, V _o = 1.8V | — | 90 | — | % |
| Switching Frequency | f _o | 3.1V ≤ V _{in} ≤ 3.6V 0.1A ≤ I _o ≤ 32A | 300 | 350 | 400 | kHz |
| Absolute Maximum Operating Temperature Range | T _a | Over V _{in} Range | -40 | — | +85 (2) | °C |
| Storage Temperature | T _s | — | -40 | — | +125 | °C |
| Mechanical Vibration | — | Per Mil-STD-883D, Method 2007.2 20-20,000Hz, Soldered in a PC board | — | 10/15 | — | G's |
| Weight | — | Vertical/Horizontal | — | 53/66 | — | grams |

- Notes: (1) ISR will operate down to no load with reduced specifications.
 (2) Consult the Safe Operating Area curves, or contact the factory for the appropriate derating.
 (3) If the remote sense ground is not used, pin 12 must be connected to pin 13 for optimum output voltage accuracy.

External Capacitors: The PT7778 requires a minimum output capacitance of 330 μ F for proper operation. The PT7778 also requires an input capacitance of 2400 μ F, which must be rated for a minimum of 2.0Arms of ripple current. For transient or dynamic load applications, additional capacitance may be required. For further information, see the accompanying application note on capacitor selection for this product.

Input Filter: An input filter inductor is optional for most applications. The input inductor must be sized to handle 32ADC with a typical value of 1 μ H.

PT7778—3.3V

32 Amp Programmable Integrated Switching Regulator

Features

- +3.3V Input
- 32A Output (64A with PT7740 Booster)
- 4-bit Programmable: 1.3V to 2.05V
- High Efficiency
- Short Circuit Protection
- Differential Remote Sense
- 27-pin SIP Package

Programming Information

| VID3 | VID2 | VID1 | VID0 | V _{out} |
|------|------|------|------|------------------|
| 1 | 1 | 1 | 1 | 1.30V |
| 1 | 1 | 1 | 0 | 1.35V |
| 1 | 1 | 0 | 1 | 1.40V |
| 1 | 1 | 0 | 0 | 1.45V |
| 1 | 0 | 1 | 1 | 1.50V |
| 1 | 0 | 1 | 0 | 1.55V |
| 1 | 0 | 0 | 1 | 1.60V |
| 1 | 0 | 0 | 0 | 1.65V |
| 0 | 1 | 1 | 1 | 1.70V |
| 0 | 1 | 1 | 0 | 1.75V |
| 0 | 1 | 0 | 1 | 1.80V |
| 0 | 1 | 0 | 0 | 1.85V |
| 0 | 0 | 1 | 1 | 1.90V |
| 0 | 0 | 1 | 0 | 1.95V |
| 0 | 0 | 0 | 1 | 2.00V |
| 0 | 0 | 0 | 0 | 2.05V |

Logic 0 = Pin 12 potential (remote sense gnd)
 Logic 1 = Open circuit (no pull-up resistors)
 VID3 may not be changed while the unit is operating.

Ordering Information

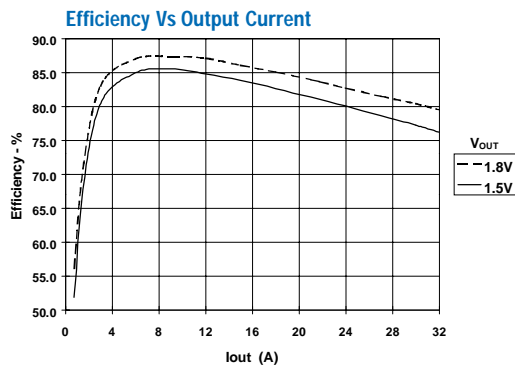
PT7778□ = 1.3 to 2.05 Volts
 For dimensions and PC board layout, see Package Style 1020 and 1030

PT Series Suffix (PT1234X)

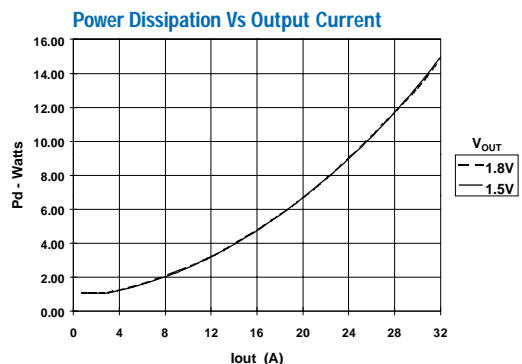
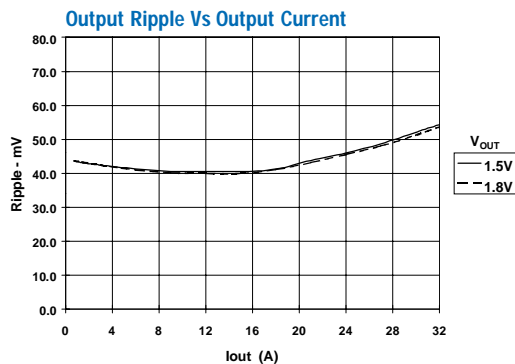
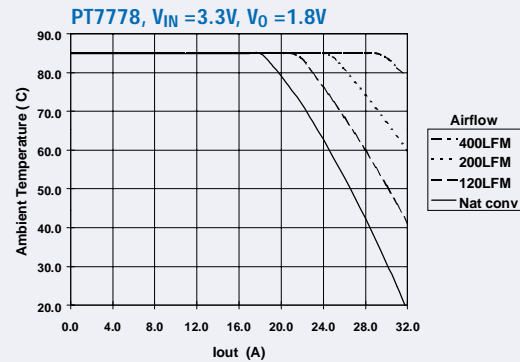
| Case/Pin Configuration | |
|--------------------------|----------|
| Vertical Through-Hole | N |
| Horizontal Through-Hole | A |
| Horizontal Surface Mount | C |

TYPICAL CHARACTERISTICS

Performance Characteristics, V_{in} = 3.3V (See Note A)



Safe Operating Area Curves (See Note B)



Note A: Characteristic data has been developed from actual products tested at 25°C. This data is considered typical for the regulator.

Note B: Safe Operating Area curves represent conditions at which internal components are at or below manufacturer's rated operating temperatures.

Capacitor Recommendations for the PT7775/8/9 Regulators and PT7740/1 Current Boosters

Input Capacitors

The recommended input capacitance is determined by 2.0 ampere minimum ripple current rating and 1500 μ F minimum capacitance. Capacitors listed below must be rated for a minimum of 2x the input voltage with +5V operation. Ripple current and $\leq 100\text{m}\Omega$ Equivalent Series Resistance (ESR) values are the major considerations along with temperature when selecting the proper capacitor.

Output Capacitors

The minimum required output capacitance is 330 μ F with a maximum ESR less than or equal to 100m Ω . Failure to observe this requirement may lead to regulator instability or oscillation. Electrolytic capacitors have poor ripple performance at frequencies greater than 400kHz, but excellent low frequency transient response. Above the ripple frequency ceramic decoupling capacitors are necessary to improve the transient response and reduce any microprocessor high frequency noise components apparent during higher current excursions. Preferred low ESR type capacitor part numbers are identified in the Table 1 below.

Tantalum Characteristics

Tantalum capacitors with a minimum 10V rating are recommended on the output bus, but only the AVX TPS Series, Sprague 594/595 Series, or Kemet T495/T510 Series. The AVX TPS Series, Sprague Series or Kemet Series capacitors are specified over other types due to their higher surge current, excellent power dissipation and ripple current ratings. As an example, the TAJ Series by AVX is not recommended. This series exhibits considerably higher ESR, reduced power dissipation and lower ripple current capability. The TAJ Series is a less reliable compared to the TPS series when determining power dissipation capability.

Capacitor Table

Table 1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The suggested minimum quantities per regulator for both the input and output buses are identified.

This is not an extensive capacitor list. The table below is a selection guide for input and output capacitors. Other capacitor vendors are available with comparable RMS ripple current rating and ESR (Equivalent Series Resistance at 100kHz). These critical parameters are necessary to insure both optimum regulator performance and long capacitor life.

Table 1 Capacitors Characteristic Data

| Capacitor Vendor/ Series | Capacitor Characteristics | | | | | Quantity | | Vendor Number |
|---------------------------------|---------------------------|-----------------|------------------------------------|------------------------------------|--------------------------|-----------|------------|--|
| | Working Voltage | Value(μ F) | (ESR) Equivalent Series Resistance | 105°C Maximum Ripple Current(Irms) | Physical Size(mm) | Input Bus | Output Bus | |
| Panasonic FC Surface Mtg | 16V | 3300 | 0.028 Ω | 2490mA | 18x21.5 | 1 | 1 | EEVFC1C333N EEVFC1V331LQ |
| | 35V | 330 | 0.065 Ω | 1205mA | 12.5x16.5 | | | |
| FA Radial | 10V | 680 | 0.090 Ω | 755mA | 10x12.5 | 2 | 1 | EEUFA1A681 EEUFA1C122S |
| | 16V | 1200 | 0.038 Ω | 1690mA | 16x15 | | | |
| United Chemi -Con LFVSeries | 25V | 330 | 0.084 Ω | 825mA | 10x16 | 2 | 1 | LXV25VB331M10X16LL LXV16VB222M16X20LL LXV16VB471M10X16LL |
| | 16V | 2200 | 0.038 Ω | 1630mA | 16x20 | | | |
| | 16V | 470 | 0.084 Ω | 825mA | 10x16 | | | |
| Nichicon PL Series PM Series | 10V | 680 | 0.085 Ω | 795mA | 10x15 | 2 | 1 | UPL1A681MPH6 UPL1A272MHH6 UPL1E331MPH6 |
| | 10V | 2700 | 0.035 Ω | 1740mA | 16x20 | | | |
| | 25V | 330 | 0.095 Ω | 750mA | 10x15 | | | |
| Oscon SS SV | 10V | 330 | 0.025 $\Omega/7=0.006\Omega$ | >9800mA | 10x10.5 | 7 | N/R (Note) | 10SS330M 10SV330M(Sufvace Mtg) |
| | 10V | 330 | 0.020 $\Omega/7=0.005\Omega$ | >9800mA | 10.3x12.6 | | | |
| AVX Tantalum TPS- Series | 10V | 330 | 0.100/7=15 Ω | 3500mA | 7.3Lx | 7 | 1 | TPSV337M010R0100 TPSV337M010R0060 |
| | 10V | 330 | 0.060/7 Ω | 1826mA | 4.3Wx 4.1H | | | |
| Sprague Tantalum 595D/594D | 10V | 330 | 0.045W/7=0.011 Ω | >4500mA | 7.3L x 5.7W x | 7 | 1 | 594D337X0010R2T Surface Mount 595D687X0010R2T |
| | 10V | 680 | 0.090 $\Omega/4$ | >1660mA | 4.0H | | | |
| Kemet Tantalum T510/T495 Series | 10V | 330 | 0.035 $\Omega/5=0.007\Omega$ | 2000mA | 4.3Wx7.3L x4.0H | 7 | 1 | T510X337M010AS T495X227M010AS Surface Mount |
| | 10V | 220 | 0.070 $\Omega/2=0.035\Omega$ | >2000mA | | | | |
| Sanyo Poscap TPB | 10V | 220 | 0.040 Ω | 3000mA | 7.2L x 4.3W x 3.1H | 2 | 2 | 10TPB220M Surface Mount |

Note: (N/R) is not recommended for this application, extremely low Equivalent Series Resistance (ESR)