PT8100 Series

40-A 3.3/5-V Input Programmable Integrated Switching Regulator

EXCALIBUR

SLTS157A

(Revised 8/23/2002)

Features

- 40ADC Output Current
- +3.3V or +5V Input
- Low Output Voltages: 0.8V—2.7V
- High Efficiency
- Programmable Output: *(VRM Compatible 5-bit Codes)*
- Multiphase Topology
- Output Remote Sense
- Short-Circuit Protection
- Thermal Shutdown
- Standby On/Off Control
- Space-Saving Package
- Solderable Copper Case

Description

The PT8100 Excalibur™ power modules are a family of high-output, high-efficiency, fully integrated switching regulators (ISRs), housed in a solderable 31-pin space-saving copper package. Modules are available for operation from either a 3.3V or 5V nominal input bus voltage. Each provides up to 40A of output current at output voltages as low as 0.8V. The output voltage is programmable via a 5-bit input code.

The PT8100 series incorporates a state-of-the-art, 2-phase, multiple power path topology. This extends the output current range while providing superior transient response and input current ripple performance. The modules are designed for high-end computing and signal processing applications, both of which demand high output currents at low supply voltages.

The modules have a number of standard features to facilitate system integration. These include short-circuit protection, thermal shutdown, standby (On/Off) control, and an output remote sense to compensate for voltage drop between the regulator and the load. In addition, the voltage programming codes are compatible with Intel's® VRM specifications.

Ordering Information

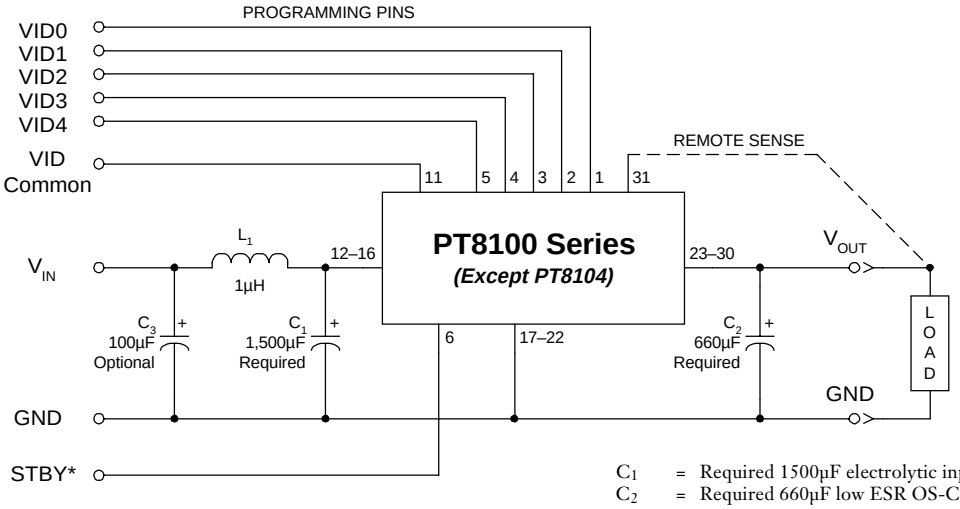
Part No.	Output Voltage Progam Range	Input Bus
PT8101❒	=1.300 to 2.70V	5V
PT8102❒	=1.075 to 1.85V	5V
PT8103❒	=1.075 to 1.85V	3.3V
PT8104❒	=1.050 to 1.825V	5V
PT8105❒	=0.800 to 1.575V	3.3V

PT Series Suffix (PT1234x)

Case/Pin Configuration	Order Suffix	Package Code
Vertical	**N**	(EKH)
Horizontal	**A**	(EKF)
SMD	**C**	(EKG)

(Reference the applicable package code drawing for the dimensions and PC board layout)

Standard Application (See p.3 for PT8104 application schematic)



C_1 = Required 1500µF electrolytic input capacitor
C_2 = Required 660µF low ESR OS-Con®, or 1,200µF aluminum electrolytic
L_{in}/C_3 = Optional input filter components. 1µH input choke and 100µF electroytic capacitor.

Pin-Out Information (Except PT8104 –see p.3)

Pin	Function	Pin	Function	Pin	Function
1	VID 0	12	V_{in}	22	GND
2	VID 1	13	V_{in}	23	V_{out}
3	VID 2	14	V_{in}	24	V_{out}
4	VID 3	15	V_{in}	25	V_{out}
5	VID 4	16	V_{in}	26	V_{out}
6	STBY *	17	GND	27	V_{out}
7	Do Not Connect	18	GND	28	V_{out}
8	Do Not Connect	19	GND	29	V_{out}
9	Do Not Connect	20	GND	30	V_{out}
10	Do Not Connect	21	GND	31	Remote Sense
11	VID Common				

* *For STBY pin:*
Open =*Output Enabled*
VID Common =*Output Disabled*

Voltage Programming Information (Except PT8104 –see p.3)

				PT8101 (VRM 8.4)		PT8102/8103 (VRM 9.1)		PT8105 (Custom Code)	
VID 3	VID 2	VID 1	VID 0	VID 4=1 Vout (iv)	VID 4=0 Vout	VID 4=1 Vout	VID 4=0 Vout	VID 4=1 Vout	VID 4=0 Vout
1	1	1	1	2.00	1.30V	1.075V	1.475V	0.800V	1.200V
1	1	1	0	2.10	1.35V	1.100V	1.500V	0.825V	1.225V
1	1	0	1	2.30	1.40V	1.125V	1.525V	0.850V	1.250V
1	1	0	0	2.40	1.45V	1.150V	1.550V	0.875V	1.275V
1	0	1	1	2.50	1.50V	1.175V	1.575V	0.900V	1.300V
1	0	1	0	2.60	1.55V	1.200V	1.600V	0.925V	1.325V
1	0	0	1	2.70	1.60V	1.225V	1.625V	0.950V	1.350V
1	0	0	0	N/A	1.65V	1.250V	1.650V	0.975V	1.375V
0	1	1	1	N/A	1.70V	1.275V	1.675V	1.000V	1.400V
0	1	1	0	N/A	1.75V	1.300V	1.700V	1.025V	1.425V
0	1	0	1	N/A	1.80V	1.325V	1.725V	1.050V	1.450V
0	1	0	0	N/A	1.85V	1.350V	1.750V	1.075V	1.475V
0	0	1	1	N/A	1.90V	1.375V	1.775V	1.100V	1.500V
0	0	1	0	N/A	1.95V	1.400V	1.800V	1.125V	1.525V
0	0	0	1	N/A	2.00V	1.425V	1.825V	1.150V	1.550V
0	0	0	0	N/A	2.05V	1.450V	1.850V	1.175V	1.575V

Notes:
i) Logic 0 = Connect to VID Common
ii) Logic 1 = Open circuit (no pull-up resistors)
iii) VID3 and VID4 may not be changed while the unit is operating.
iv) The output voltage of the PT8101 must not be set higher than 2.7V.

Pin-Out Information (PT8104 only)

Pin	Function	Pin	Function
1	VID 25mV	17	GND
2	VID 0	18	GND
3	VID 1	19	GND
4	VID 2	20	GND
5	VID 3	21	GND
6	STBY	22	GND
7	Do Not Connect	23	V_{out}
8	Do Not Connect	24	V_{out}
9	Do Not Connect	25	V_{out}
10	Do Not Connect	26	V_{out}
11	VID Common	27	V_{out}
12	V_{in}	28	V_{out}
13	V_{in}	29	V_{out}
14	V_{in}	30	V_{out}
15	V_{in}	31	Remote Sense
16	V_{in}		

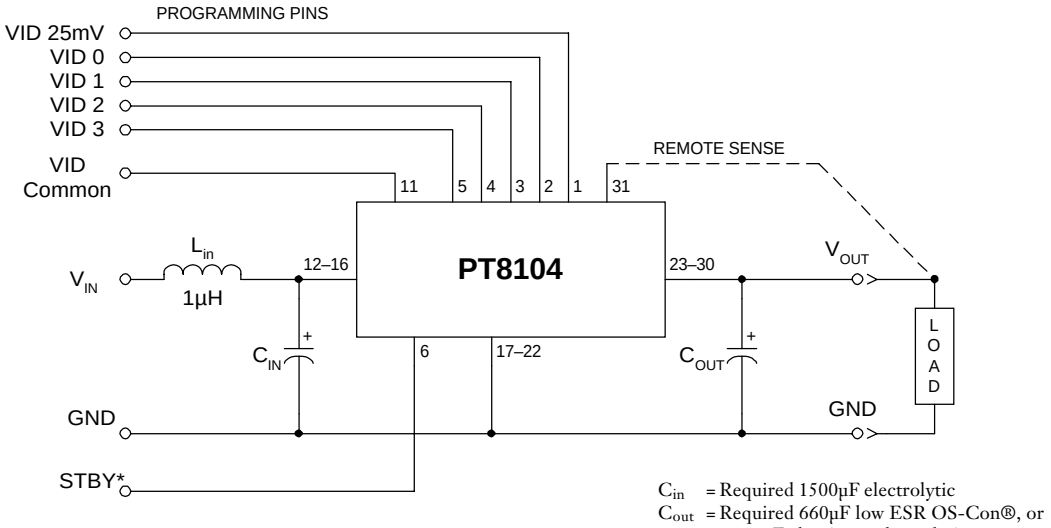
* *For STBY pin:*
Open =*Output Enabled*
VID Common =*Output Disabled*

Voltage Programming Information (PT8104 only)

VID 3	VID 2	VID 1	VID 0	PT8104 (VRM 8.5) VID 25mV=0 Vout	PT8104 (VRM 8.5) VID 25mV=1 Vout
1	1	1	1	1.300V	1.325V
1	1	1	0	1.350V	1.375V
1	1	0	1	1.400V	1.425V
1	1	0	0	1.450V	1.475V
1	0	1	1	1.500V	1.525V
1	0	1	0	1.550V	1.575V
1	0	0	1	1.600V	1.625V
1	0	0	0	1.650V	1.675V
0	1	1	1	1.700V	1.725V
0	1	1	0	1.750V	1.775V
0	1	0	1	1.800V	1.825V
0	1	0	0	1.050V	1.075V
0	0	1	1	1.100V	1.125V
0	0	1	0	1.150V	1.175V
0	0	0	1	1.200V	1.225V
0	0	0	0	1.250V	1.275V

Notes:
i) Logic 0 = Connect to VID Common
ii) Logic 1 = Open circuit (no pull-up resistors)
iii) VID3 and VID4 may not be changed while the unit is operating.

Standard Application (PT8104 only)



C_{in} = Required 1500µF electrolytic
C_{out} = Required 660µF low ESR OS-Con®, or 1,200µF aluminum electrolytic
L_{in} = Optional 1µH input choke

PT8101 /2 Specifications (Unless otherwise stated T_a =25°C, C_1 =1,500µF, C_2 =660µF, V_{in} =5V, & I_o =40A)

Characteristics	Symbols	Conditions	PT8101/2, V_{in} =5V Min	Typ	Max	Units
Output Current	I_o	25°C, natural convection 60°C with 200LFM airflow	0.1 (1) 0.1 (1)	— —	38 40	A
Input Voltage Range	V_{in}	Over I_o Range	4.5	—	5.5	V
Set-Point Voltage Tolerance	V_o tol	Over V_o range	—	±1	±2	%V
Line Regulation	ΔReg_{line}	Over V_{in} range	—	±5	—	mV
Load Regulation	ΔReg_{load}	Over I_o range	—	±5	—	mV
Temperature Variation	ΔReg_{temp}	–40°C ≤T_a ≤85°C	—	±0.5	—	%V_o
Total Output Voltage Variation	ΔV_otot	Includes set-point, line load, –40°C ≤T_a ≤ 85°C	—	—	±3	%V
Efficiency	η	Io =20A, V_o =2.5V	—	93	—	%
		Io =20A, V_o =1.8V	—	90	—	%
		Io =20A, V_o =1.5V	—	88	—	%
		Io =20A, V_o =1.2V	—	86	—	%
		I_o =40A, V_o =2.5V	—	89	—	%
		I_o =40A, V_o =1.8V	—	85	—	%
		I_o =40A, V_o =1.5V	—	83	—	%
		I_o =40A, V_o =1.2V	—	81	—	%
V_o Ripple (pk-pk)	V_r	20MHz bandwidth	—	25	—	mV
Transient Response (V_o =1.8V)	t_{tr}	1A/µs load step, 50% to 100% $I_o$max	—	50	—	µSec
	ΔV_{tr}	V_o over/undershoot	—	75	—	mV
Transient Response (V_o =1.2V)	t_{tr}	1A/µs load step, 50% to 100% $I_o$max	—	25	—	µSec
	ΔV_{tr}	V_o over/undershoot	—	30	—	mV
Short Circuit Threshold	$I_o$sc		—	60	—	A
Switching Frequency	f_o	Over load range	300	350	400	kHz
Standby Control (pin 6) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	 Referenced to GND (pins 17–22)	 — -0.2	 — —	 Open (2) 0.8	 V
Input Low Current	I_{IL}	Pin 6 to GND	—	0.5	—	mA
Standby Input Current	I_{in} standby	Pin 6 to GND	—	35	—	mA
External Output Capacitance	C_2	See application schematic	660 (5)	—	15,000	µF
External Input Capacitance	C_1	See application schematic	1,500	—	—	µF
Operating Temperature Range	T_a	Over V_{in} Range	–40 (3)	—	+85 (4)	°C
Storage Temperature	T_s	—	-40	—	+125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, Half Sine, mounted to a fixture	—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 Vertical 20-2000 Hz, soldered in PCB Horizontal	— —	20 (6) 20 (6)	—	G's
Weight	—	Vertical/Horizontal	—	55	—	grams
Flammability	—	Materials meet UL 94V-0				

Notes: *(1) ISR-will operate down to no load with reduced specifications.*
(2) The Standby input (pin 6) has an internal pull-up. If it is left open-circuit the module will operate when input power is applied. A low-leakage MOSFET is recommended to control this input. The open-circuit voltage is nominally 5V. See application notes for interface considerations.
(3) For operation below 0°C, C_{out} must have stable characteristics. Use either low ESR tantalum or Oscon® capacitors.
(4) See safe Operating Area curves or consult factory for the appropriate derating.
(5) The PT8100 regulators require a minimum of 660µF, low ESR ouput capacitance (1,200µF for standard aluminum electrolytic) for proper operation.
(6) The case pins on the through-hole package types (suffixes N & A) must be soldered. For more information see the applicable package outline drawing.

Input Filter: *The filter components L_1, and C_3 are optional for most applications. The inductor must be rated to handle the projected input current. A rating of 30ADC is recommended. The capacitance C_1 must be rated for a minimum of 1Arms of ripple current. For transient or dynamic load applications, additional capacitance may be required. For more information refer to the application note on capacitor recommendations for this product.*

PT8103/5 Specifications (Unless otherwise stated T_a =25°C, C_1 =1,500µF, C_2 =660µF, V_{in} =3.3V, & I_o = 40A)

Characteristics	Symbols	Conditions	PT8103/5, V_{in} =3.3V Min	Typ	Max	Units
Output Current	I_o	25°C, natural convection	0.1 (1)	—	39	A
		60°C with 200LFM airflow	0.1 (1)	—	40	
Input Voltage Range	V_{in}	Over I_o Range	3.1	—	3.6	V
Set-Point Voltage Tolerance	V_o tol	Over V_o range	—	±1	±2	%V
Line Regulation	ΔReg_{line}	Over V_{in} range	—	±5	—	mV
Load Regulation	ΔReg_{load}	Over I_o range	—	±5	—	mV
Temperature Variation	ΔReg_{temp}	–40°C ≤T_a ≤85°C	—	±0.5	—	%V_o
Total Output Voltage Variation	ΔV_otot	Includes set-point, line, load, –40°C ≤T_a ≤ 85°C	—	—	±3	%V
Efficiency	η	I_o =20 V_o =1.8V	—	90	—	%
		V_o =1.5V	—	89	—	
		V_o =1.2V	—	87	—	
		V_o =0.8V	—	84	—	
		I_o =40 V_o =1.8V	—	86	—	%
		V_o =1.5V	—	84	—	
		V_o =1.2V	—	82	—	
		V_o =0.8V	—	78	—	
V_o Ripple (pk-pk)	V_r	20MHz bandwidth	—	25	—	mV
Transient Response (V_o =1.2V)	t_{tr}	1A/µs load step, 50% to 100% Iomax	—	25	—	µSec
	ΔV_{tr}	V_o over/undershoot	—	30	—	mV
Short Circuit Threshold	$I_o$sc		—	60	—	A
Switching Frequency	f_o	Over load range	300	350	400	kHz
Standby Control (pin 6) Input High Voltage	V_{IH}	Referenced to GND (pins 17–22)	—	—	Open (2)	V
Input Low Voltage	V_{IL}		-0.2	—	0.8	
Input Low Current	I_{IL}	Pin 6 to GND	—	0.5	—	mA
Standby Input Current	I_{in} standby	Pin 6 to GND	—	35	—	mA
External Output Capacitance	C_2	See application schematic	660 (5)	—	15,000	µF
External Input Capacitance	C_1	See application schematic	1,500	—	—	µF
Operating Temperature Range	T_a	Over V_{in} Range	–40 (3)	—	+85 (4)	°C
Storage Temperature	T_s	—	-40	—	+125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, Half Sine, mounted to a fixture	—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 Vertical	—	20 (6)	—	G's
		20-2000 Hz, soldered in PCB Horizontal	—	20 (6)		
Weight	—	Vertical/Horizontal	—	55	—	grams
Flammability	—	Materials meet UL 94V-0				

Notes: *(1) ISR-will operate down to no load with reduced specifications.*

(2) The Standby input (pin 6) has an internal pull-up. If it is left open-circuit the module will operate when input power is applied. A low-leakage MOSFET is recommended to control this input. The open-circuit voltage is nominally 5V. See application notes for interface considerations.

(3) For operation below 0°C, C_{out} must have stable characteristics. Use either low ESR tantalum or Oscon® capacitors.

(4) See safe Operating Area curves or consult factory for the appropriate derating.

(5) The PT8100 regulators require a minimum of 660µF, low ESR ouput capacitance (1,200µF for standard aluminum electrolytic) for proper operation.

(6) The case pins on the through-hole package types (suffixes N & A) must be soldered. For more information see the applicable package outline drawing.

Input Filter: *The filter components L_1 and C_3 are optional for most applications. The inductor must be rated to handle the projected input current. A rating of 30ADC is recommended. The input capacitance, C_1 must be rated for a minimum of 1Arms of ripple current. For transient or dynamic load applications, additional capacitance may be required. For more information refer to the application note on capacitor recommendations for this product.*

PT8104 Specifications (Unless otherwise stated T_a =25°C, C_1 =1,500µF, C_2 =660µF, V_{in} =5V, V_o =1.8V, & I_o =40A)

Characteristics	Symbols	Conditions	PT8104, V_{in} =5V Min	Typ	Max	Units
Output Current	I_o	25°C, natural convection 60°C with 200LFM airflow	0.1 (1) 0.1 (1)	— —	38 40	A
Input Voltage Range	V_{in}	Over I_o Range	4.5	—	5.5	V
Set-Point Voltage Tolerance	V_o tol	Over V_o range	—	±1	±2	%V
Line Regulation	ΔReg_{line}	Over V_{in} range	—	±10	—	mV
Load Regulation (Droop)	ΔReg_{load}	Over I_o range	—	1.5	—	mV/A
Temperature Variation	ΔReg_{temp}	–40°C ≤T_a ≤85°C	—	±0.5	—	%V_o
Total Output Voltage Variation	ΔV_otot	Includes set-point, line, load, –40°C ≤T_a ≤ 85°C, pin 31 to GND	—	—	75 (2)	mV
Efficiency	η	I_o =15A, V_o =1.8V	—	90	—	%
		I_o =15A, V_o =1.5V	—	88	—	%
		I_o =15A, V_o =1.2V	—	87	—	%
		I_o =40A, V_o =1.8V	—	85	—	%
		I_o =40A, V_o =1.5V	—	82	—	%
		I_o =40A, V_o =1.2V	—	80	—	%
V_o Ripple (pk-pk)	V_r	20MHz bandwidth	—	25	—	mV
Transient Response (V_o =1.2V)	t_{tr}	1A/µs load step, 50% to 100% Iomax	—	50	—	µSec
	ΔV_{tr}	V_o over/undershoot	—	50	—	mV
Short Circuit Threshold	$I_o$sc		—	58	—	A
Switching Frequency	f_o	Over load range	300	350	400	kHz
Standby Control (pin 6) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	 Referenced to GND (pins 17–22)	 — –0.2	 — —	 Open (3) 0.8	 V
Input Low Current	I_{IL}	Pin 6 to GND	—	0.5	—	mA
Standby Input Current	I_{in} standby	Pin 6 to GND	—	35	—	mA
External Output Capacitance	C_2	See PT8104 application schematic	660 (6)	—	15,000	µF
External Input Capacitance	C_1	See PT8104 application schematic	1,500	—	—	µF
Operating Temperature Range	T_a	Over V_{in} Range	–40 (4)	—	+85 (5)	°C
Storage Temperature	T_s	—	–40	—	+125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, Half Sine, mounted to a fixture	—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 20-2000 Hz, soldered in PCB	Vertical — Horizontal —	20 (7) 20 (7)	—	G's
Weight	—	Vertical/Horizontal	—	55	—	grams
Flammability	—	Materials meet UL 94V-0				

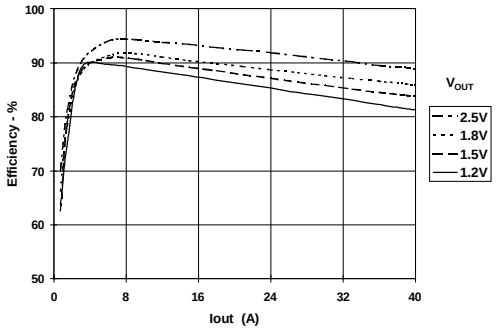
Notes: *(1) ISR-will operate down to no load with reduced specifications.*
(2) Total output voltage variation includes load regulation droop, which is required for compliance with specification VRM 8.4-5
(3) The Standby input (pin 6) has an internal pull-up. If it is left open-circuit the module will operate when input power is applied. A low-leakage MOSFET is recommended to control this input. The open-circuit voltage is nominally 5V. See application notes for interface considerations.
(4) For operation below 0°C, C_{out} must have stable characteristics. Use either low ESR tantalum or Oscon® capacitors.
(5) See safe Operating Area curves or consult factory for the appropriate derating.
(6) The PT8100 regulators require a minimum of 660µF, low ESR ouput capacitance (1,200µF for standard aluminum electrolytic) for proper operation.
(7) The case pins on the through-hole package types (suffixes N & A) must be soldered. For more information see the applicable package outline drawing.

Input Filter: *The filter components L_1 and C_3 are optional for most applications. The inductor must be rated to handle the projected input current. A rating of 20ADC is recommended. The input capacitance, C_1 must be rated for a minimum of 1Arms of ripple current. For transient or dynamic load applications, additional capacitance may be required. For more information refer to the application note on capacitor recommendations for this product.*

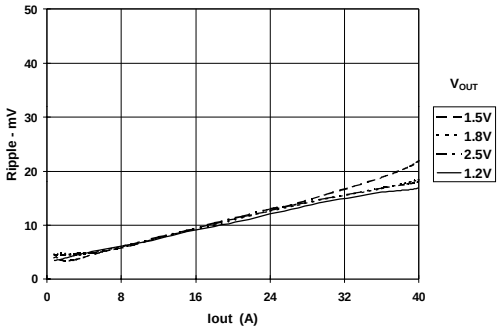
Typical Characteristics

Characteristic Data; V_{in} =5V, PT8101/2/4 *(See Note A)*

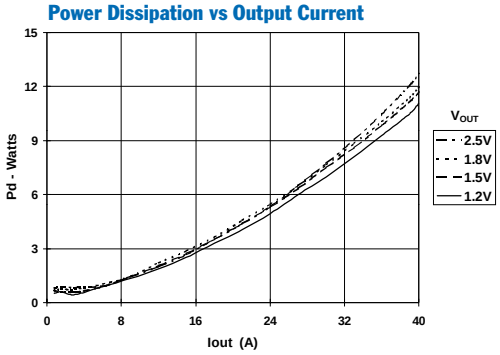
Efficiency vs Output Current



Output Ripple vs Output Current

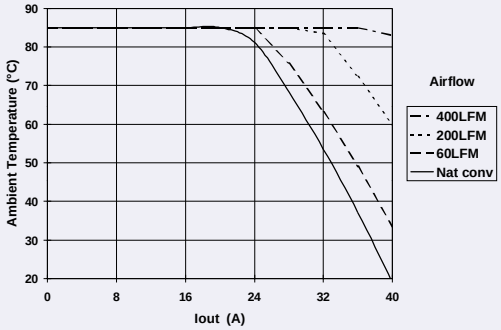


Power Dissipation vs Output Current

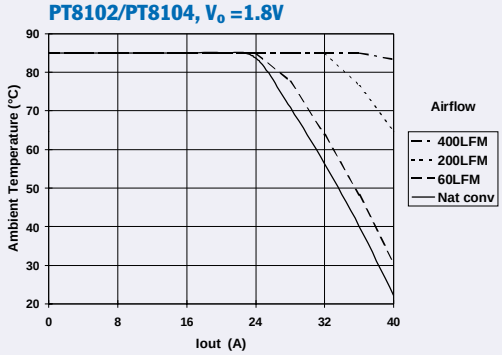


Safe Operating Area; V_{in} =5V *(See Note B)*

PT8101, V_o =2.5V



PT8102/PT8104, V_o =1.8V

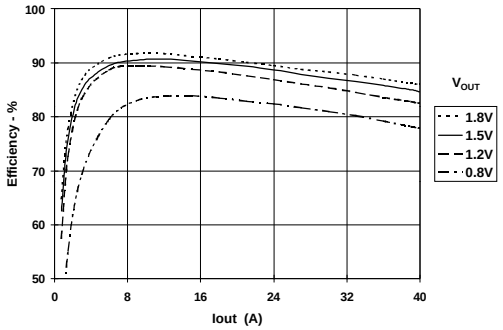


Note A: *Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the Converter.*
Note B: *SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures*

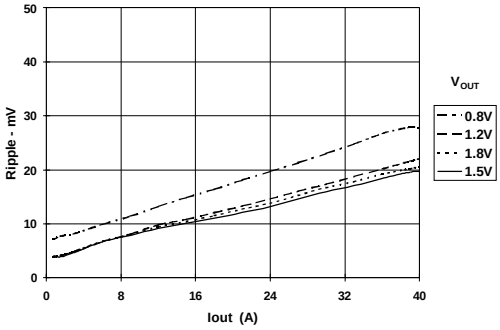
Typical Characteristics

Characteristic Data; V_{in} =3.3V, PT8103/5 *(See Note A)*

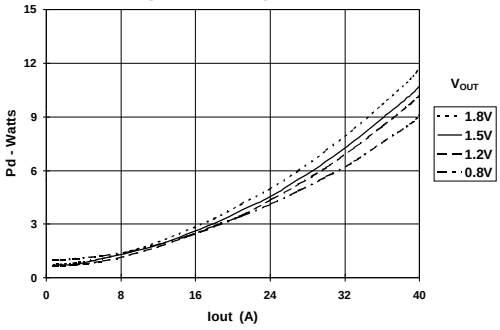
Efficiency vs Output Current



Output Ripple vs Output Current

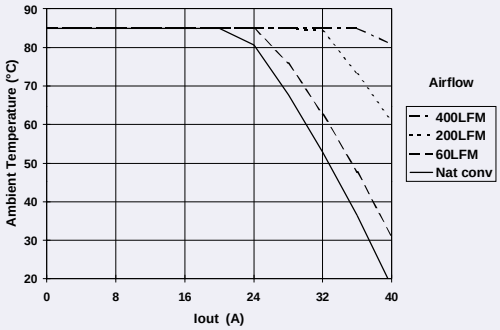


Power Dissipation vs Output Current

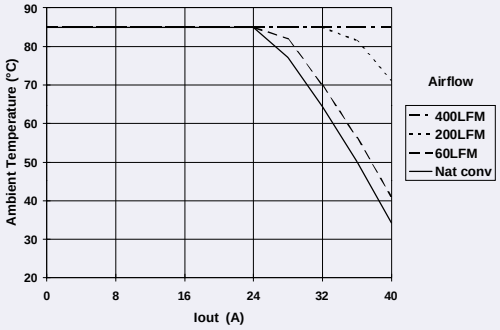


Safe Operating Area; V_{in} =3.3V *(See Note B)*

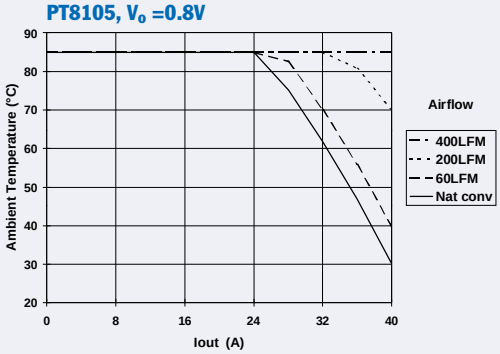
PT8103, V_o =1.8V



PT8105, V_o =1.5V



PT8105, V_o =0.8V



Note A: *Characteristic data has been developed from actual products tested at 25°C. This data is considered typical data for the Converter.*
Note B: *SOA curves represent the conditions at which internal components are at or below the manufacturer's maximum operating temperatures*

Capacitor Recommendations for the Non-Isolated 40-A Excalibur™ Series of Regulators

Input Capacitors

The recommended input capacitance is determined by the 1.0 ampere minimum ripple current rating and 1500µF minimum capacitance. Capacitors listed below must be rated for a minimum of 2× the input voltage with +5V operation. Ripple current and ≤100mΩ 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 either 660µF Oscon/Tantalum or 1200µF Alunimun Electrolytic with a maximum ESR less than or equal to 100mΩ. 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 high frequency noise components apparent during higher current excursions. Preferred low ESR type capacitor part numbers are identified in Table 1 below.

Tantalum Characteristics

Tantalum capacitors with a minimum 10V rating are recommended on the output bus, but only the AVX TPS, Sprague 594/595, or Kemet T495/T510 product series. The AVX TPS, Sprague, or Kemet series capacitors are specified over other types due to their higher surge current, excellent power dissipation, and ripple current ratings. As a caution, 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 also 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 suggested 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		
	Working Voltage	Value(µF)	(ESR) Equivalent Series Resistance	85°C Maximum Ripple Current(Irms)	Physical Size(mm)	Input Bus	Output Bus	Vendor Number
Panasonic FC/FK (Surface Mount) FC (Radial)	16V 16V 16V	1500 2200 1500	0.060Ω 0.038Ω 0.043Ω	1100mA 2000mA 1690mA	12.5×13.5 18x16.5 16x15	1 1 1	1 1 1	EEVFK1C152Q EEVFC1C222N EEUFC1C152S
United Chemi-Con LXZ (Radial) FX	16V 25V 6.3V 10V	1500 1800 1000 680	0.038Ω 0.029Ω 0.013Ω 0.015Ω÷2 =0.007Ω	1660mA 2200mA 4935mA >7000mA	12.5x20 16x20 10×10.5 10×10.5	1 1 1 2	1 1 1 1	LXZ16VB155M12X20LL LXZ25VB182M16X20LL 6FX1000M (Vin =3.3V) 10FX680M (Os-con)
Nichicon PL Series UD Series	10V 10V 10V	1500 1800 1000	0.050Ω 0.044Ω 0.09Ω	1190mA 1420mA 670mAx2	16x15 16x15 10×10	1 1 2	1 1 2	UPM1A152MHH6 UPM1A182MHH6 UUD1A102MCR1GS
Os-con: SS SVP (Surface Mount) SVP (Surface Mount)	 10V 10V 10V	 330 330 560	 0.025Ω÷3 =0.008Ω 0.017Ω÷3 =0.006Ω 0.013Ω÷2 =0.065Ω	 >7000mA >7000mA >7000mA	 10×10.5 10.3×12.6 10×12.7	 3 3 2	 2 2 2	 10SS330M 10SVP330M 10SVP560M
AVX Tanatalum TPS Series (Surface (Mount)	 10V 10V	 330 330	 0.100Ω÷3 =0.034Ω 0.060Ω÷3 =0.020Ω	 >3500mA >3500mA	7.0 L ×5.97 W ×3.45 H	 3 3	 2 2	 TPSV337M010R0100 TPSV337M010R0060
Vishay/Sprague Tantalum 595D/594D Series (Surface Mount)	 10V 10V	 330 680	 0.045Ω÷3 =0.015Ω 0.090Ω÷4 =0.023Ω	 >4600mA >2500mA	7.2 L ×6.0 W ×3.5 H	 3 2	 2 1	 594D337X0010R2T 595D687X0010R2T
Kemet Tantalum T510/T495 /T520 (Surface Mount)	 10V 10V	 330 220	 0.035Ω÷3 =0.012Ω 0.070Ω÷5 =0.035Ω	 >5000mA >3000mA	7.3 L ×4.3 W ×4.0 H	 3 5	 1 2	 T510X337M010AS T495X227M010AS
Sanyo Poscap TPB (Surface Mount)	10V	220	0.040Ω÷5 =0.008Ω	>3000mA	7.2 L ×4.3 W ×3.1 H	5	2	10TPB220M

Pin-Coded Output Voltage Programming of the 40-A Rated PT8100 Series Regulators

The PT8100 series of Excalibur® ISRs incorporate a pin-coded programmable output voltage. In each case the desired output voltage must be selected from a preset range defined by the regulator model. Programming is achieved by selectively connecting the control inputs, *"VID0–VID4"* (*"VID 25mV–VID3"* for PT8104), pins 1–5, to the *"VID Common,"* pin 11. [1] The programming code and pinout information for each model is provided in the PT8100 specifications. Some of the program codes are compatible with the "Voltage ID" codes defined by the Intel® VRM specifications. Figure 1 shows the pin-strap connections for selecting 1.5V output voltage from a PT8101.

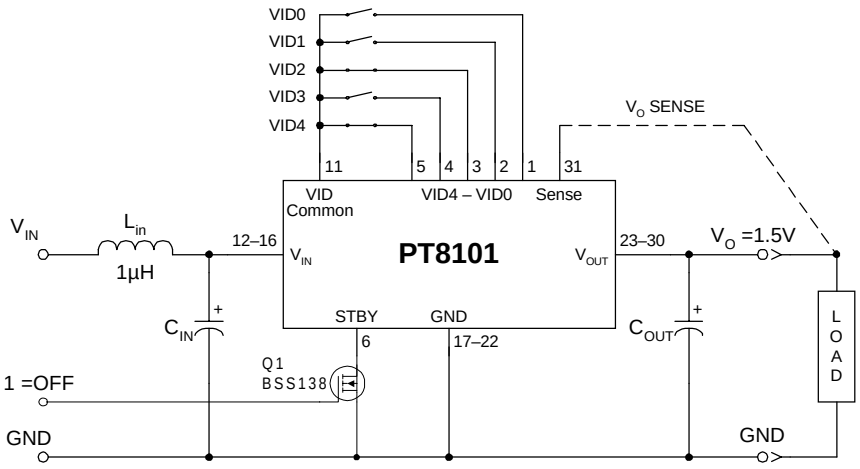
Notes:

1. The programming convention is as follows:-
   Logic 0: Connect to pin 11 (VID Common).
   Logic 1: Open circuit/open drain (See notes 2, & 4)
2. The output voltage range of the PT8101 is limited to 2.7V maximum. Above this voltage, the performance of the module is not guaranteed. Although the module will appear to function above this voltage, VID 4 (pin 5) should not be used to set the output voltage higher than 2.7V.
3. Do not connect pull-up resistors to the voltage programming pins.
4. To minimize output voltage error, use pin 11 (VID Common) as the logic "0" reference. However if the regulator is used to power a VRM compatible microprocessor this may not be possible. In this case either connect pin 11 to pins 17–22, or the ground plane close to the regulator. This will allow the microprocessor to use the common ground as a VID control reference.
4. If active devices are used to ground the voltage control pins, low-level open-drain MOSFETs should be used over bipolar transistors. The inherent V_{ce}(sat) in bipolar devices introduces errors in the device's internal voltage control circuit. Discrete transistors such as the BSS138, 2N7002, IRLML2402, are examples of appropriate devices.

Active Voltage Programming:

Special precautions should be taken when making changes to the voltage control progam code while the output is active. It is recommended that the ISR be powered down or placed in standby. Changes made to the program code while V_{out} is active can induce high current transients through the device. This is the result of the electrolytic output capacitors being either charged or discharged to the new output voltage set-point. The transient current can be minimized by making only incremental changes to the binary code, i.e. one LSB at a time. A minimum of 100µs settling time between each program state is also recommended. Making non-incremental changes to VID3 and VID4 with the output enabled is discouraged. The transients induced may activate the module's over-current protection. When using active devices to program the output voltage, their state should be asserted prior to input power being applied. If this is not possible, pull *STBY** (pin 6) to GND during the application of power, assert the program code, then release pin 6. The release of pin 6 will then to allow the device to initiate a soft-start power-up to the program voltage.

Figure 1



Using the On/Off Standby Function of the PT8100 Series of Programmable ISRs

The PT8100 series of programmable ISRs incorporates an On/Off Standby function. This feature may be used to turn the regulated output of the module off while input voltage is applied. This places the module in "standby" mode. The standby control may be used for power-up sequencing, or wherever there is a requirement to control the module's output status from another circuit.

The Standby function is provided by the *STBY** control, pin 6. If pin 6 is left open-circuit the regulator operates normally, providing a regulated output when a valid supply voltage is applied to V_{in} (pins 10-16) with respect to GND (pins 17-22). Connecting pin 6 to ground [1] places the regulator in standby mode [2], and reduces the input current to typically 20mA. Applying a ground signal to pin 6 prior to power-up, will inhibit the output during the period that input power is applied. When the ground signal to pin 6 is removed, the regulator initiates a soft-start to re-establish the set output voltage. [3] To ensure that the regulator output is properly enabled, the *STBY** control pin must be open circuit.

Table 1 Standby Control Requirements [2]

Parameter	Min	Typ	Max
V_{IH}	—		Open Cct. [1]
V_{IL}	–0.2V	—	0.8V
I_{STBY}		–0.5mA	

Notes:

1. The standby on a PT8100 series regulators must be controlled with an open-collector (or open-drain) transistor (See fig. 1). *Do Not* use a pull-up resistor. Table 1 gives the *STBY** pin parameters. The control pin has an open-circuit voltage equal to V_{in}. To shut the regulator output off, the control pin must be "pulled" to less than 0.8Vdc with a low-impedance sink to ground.
2. In the standby mode the output of the regulator is tri-state, and the output voltage falls at the rate that the load circuit discharges the output filter capacitors.
3. When the ground signal to the *Standby* pin is removed, the regulator output initiates a soft-start cycle by first asserting a low impedance to ground. If an external voltage is applied to the output bus, it will sink current and possibly over-stress the part.

Turn-On Time

Turning Q_1 in Figure 1 off, removes the low-voltage signal at pin 6. After approximately 4ms the regulator output rises and reaches full regulation within 10ms. Fig. 2 shows the typical waveforms of a PT8101 following the prompt turn-off of Q_1. The turn-off of Q_1 corresponds to the rise in V_{stby}. The output voltage was set to 1.8V, and the waveforms were measured with a 5V input source, and 9.25A resistive load.

Figure 2

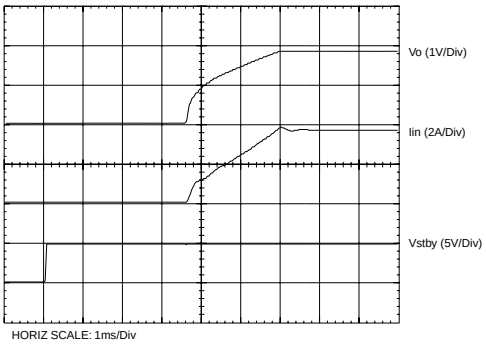
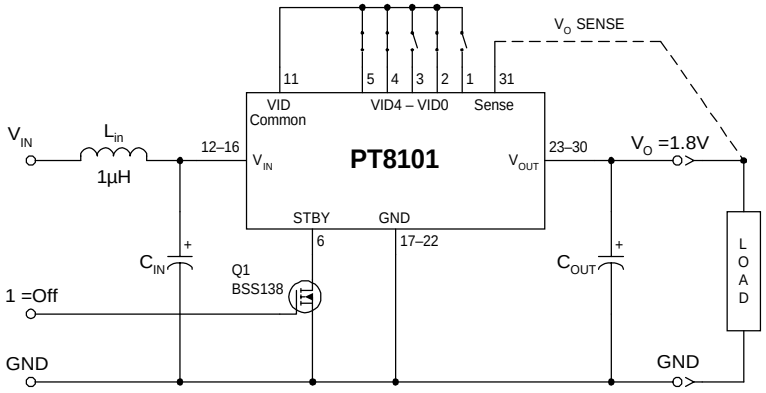


Figure 1



PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)
PT8101A	NRND	SIP MOD ULE	EKF	31	6	TBD	Call TI	Level-1-215C-UNLIM
PT8101C	NRND	SIP MOD ULE	EKG	31	6	TBD	Call TI	Level-3-215C-168HRS
PT8101N	NRND	SIP MOD ULE	EKH	31		TBD	Call TI	Call TI
PT8102A	NRND	SIP MOD ULE	EKF	31	6	TBD	Call TI	Level-1-215C-UNLIM
PT8102C	NRND	SIP MOD ULE	EKG	31		TBD	Call TI	Call TI
PT8102N	NRND	SIP MOD ULE	EKH	31	6	TBD	Call TI	Level-1-215C-UNLIM
PT8103A	NRND	SIP MOD ULE	EKF	31		TBD	Call TI	Call TI
PT8103C	ACTIVE	SIP MOD ULE	EKG	31	6	TBD	Call TI	Level-3-215C-168HRS
PT8103N	ACTIVE	SIP MOD ULE	EKH	31	6	TBD	Call TI	Level-1-215C-UNLIM
PT8104A	NRND	SIP MOD ULE	EKF	31		TBD	Call TI	Call TI
PT8104C	NRND	SIP MOD ULE	EKG	31		TBD	Call TI	Call TI
PT8105A	NRND	SIP MOD ULE	EKF	31	6	TBD	Call TI	Level-1-215C-UNLIM
PT8105C	NRND	SIP MOD ULE	EKG	31		TBD	Call TI	Call TI
PT8105N	NRND	SIP MOD ULE	EKH	31		TBD	Call TI	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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