PMG 4318 T 3.3-V Input

15-A, 3.3-V Input Non-Isolated
Wide-Output Adjust Power Module

POLA code: PTH03010 W

NOMINAL SIZE = 1.37 in x 0.62 in
(34,8 mm x 15,75 mm)

Features

- Up to 15-A Output Current
- 3.3-V Input Voltage
- Wide-Output Voltage Adjust (0.8 V to 2.5 V)
- Efficiencies up to 95 %
- 125 W/in³ Power Density
- On/Off Inhibit
- Output Voltage Sense
- Pre-Bias Startup
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- Auto-Track™ Sequencing(1)
- Margin Up/Down Controls
- Under-Voltage Lockout
- Operating Temp: –40 to +85 °C
- DSP Compatible Output Voltages
- IPC Lead Free 2
- Safety Agency Approvals (Pending) UL 1950, CSA 22.2 950, & EN60950
- Point-of-load Alliance (POLA) Compatible

Note: (1) Auto-Track™ is a trademark of Texas Instruments

Description

The PMG 4318 T series of non-isolated power modules are small in size but big on performance and flexibility. Their high output current, compact footprint, and industry-leading features offers system designers a versatile module for powering complex multi-processor digital systems.

The series employs double-sided surface mount construction and provides high-performance step-down power conversion for up to 15 A of output current from a 3.3-V input bus voltage. The output voltage of the PMG 4318 T can be set to any value over the range, 0.8 V to 2.5 V, using a single resistor.

This series includes Auto-Track™. Auto-Track ™ simplifies the task of supply voltage sequencing in a power system by enabling modules to track each other, or any external voltage, during power up and power down.

Other operating features include an on/off inhibit, output voltage adjust (trim), and margin up/down controls. To ensure tight load regulation, an output voltage sense is also provided. A non-latching over-current trip serves as load fault protection.

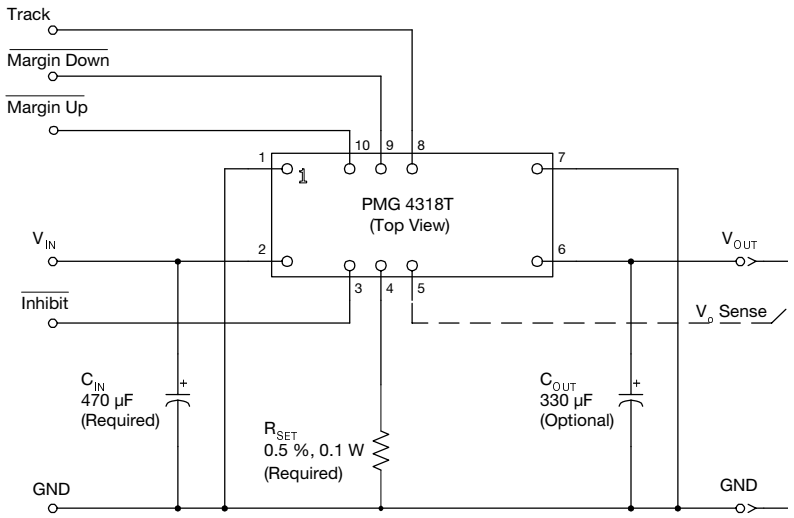
Target applications include complex multi-voltage, multi-processor systems that incorporate the industry's high-speed DSPs, micro-processors and bus drivers.

Pin Configuration

Pin	Function
1	GND
2	V_{in}
3	Inhibit *
4	V_o Adjust
5	V_o Sense
6	V_{out}
7	GND
8	Track
9	Margin Down *
10	Margin Up *

* *Denotes negative logic:*
Open = Normal operation
Ground = Function active

Standard Application



R_{set} = Resistor to set the desired output voltage (see spec. table for values)
C_{in} = Required electrolytic 470 µF
C_{out} = Recommended 330 µF electrolytic

Product Table (PMG 4318 T x)[1]

V_{In}	V_O / I_O max	P_O max	Package Code[1]	Description	Ordering No.
2.95-3.65 V	0.8-2.5 V /15 A	37.5 W	P	Horiz. T/H	PMG 4318 T x[1]
			S	SMD, Standard	

[1] Replace "x"in the Ordering No. with Package Code.

Ordering Information

Delivery Option	M.o.q.	Suffix	Example
Tray	25 pcs	/B	PMG 4318T P /B
Tape & Reel [2]	250 pcs	/C	PMG 4318T S /C

[2] Tape & Reel available only for SMD packages

Pin Descriptions

Vin: The positive input voltage power node to the module, which is referenced to common *GND*.

Vout: The regulated positive power output with respect to the *GND* node.

GND: This is the common ground connection for the *Vin* and *Vout* power connections. It is also the 0 VDC reference for the control inputs.

Inhibit: The Inhibit pin is an open-collector/drain negative logic input that is referenced to *GND*. Applying a low-level ground signal to this input disables the module's output and turns off the output voltage. When the *Inhibit* control is active, the input current drawn by the regulator is significantly reduced. If the *Inhibit* pin is left open-circuit, the module will produce an output whenever a valid input source is applied.

Vo Adjust: A 0.5 %, 0.1 W resistor must be connected between this pin and the GND pin to set the output voltage to the desired value. The set point range for the output voltage is from 0.8 V to 2.5 V. The resistor required for a given output voltage may be calculated from the following formula. If left open circuit, the module output will default to its lowest output voltage value. For further information on the adjustment and/or trimming of the output voltage, consult the related application note.

$$R_{set} = 10\ k\Omega \cdot \frac{0.8\ V}{V_{out} - 0.8\ V} - 2.49\ k\Omega$$

The specification table gives the preferred resistor values for a number of standard output voltages.

Vo Sense: The sense input allows the regulation circuit to compensate for voltage drop between the module and the load. For optimal voltage accuracy *Vo Sense* should be connected to *Vout*. It can also be left disconnected.

Track: This is an analog control input that enables the output voltage to follow an external voltage. This pin becomes active typically 20 ms after the input voltage has been applied, and allows direct control of the output voltage from 0 V up to the nominal set-point voltage. Within this range the output will follow the voltage at the *Track* pin on a volt-for-volt basis. When the control voltage is raised above this range, the module regulates at its set-point voltage. The feature allows the output voltage to rise simultaneously with other modules powered from the same input bus. If unused, the input may be left unconnected. *Note: Due to the under-voltage lockout feature, the output of the module cannot follow its own input voltage during power up. For more information, consult the related application note.*

Margin Down: When this input is asserted to *GND*, the output voltage is decreased by 5% from the nominal. The input requires an open-collector (open-drain) interface. It is not TTL compatible. A lower percent change can be accomodated with a series resistor. If unused, this input may be left unconnected. For further information, consult the related application note.

Margin Up: When this input is asserted to *GND*, the output voltage is increased by 5%. The input requires an open-collector (open-drain) interface. It is not TTL compatible. The percent change can be reduced with a series resistor. If unused, this input may be left unconnected. For further information, consult the related application note.

Environmental & Absolute Maximum Ratings (Voltages are with respect to GND)

Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Track Input Voltage	V_{track}		–0.3	—	V_{in} + 0.3	V
Operating Temperature Range	T_a	Over V_{in} Range	–40	—	85	°C
Solder Reflow Temperature	T_{reflow}	Surface temperature of module body or pins			235 (i)	°C
Storage Temperature	T_s	—	–40	—	125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, ½ Sine, mounted	—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 20-2000 Hz	—	20	—	G's
Weight	—		—	5	—	grams
Flammability	—	Meets UL 94V-O				

Notes: *(i) During reflow of SMD package version do not elevate peak temperature of the module, pins or internal components above the stated maximum.*

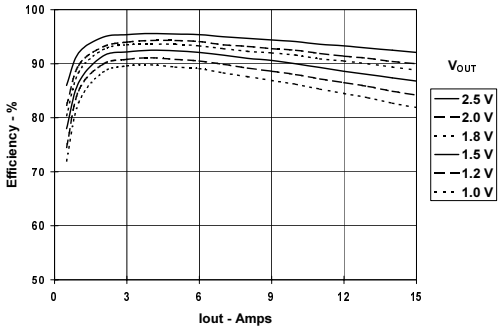
Specifications (Unless otherwise stated, T_a =25 °C, V_{in} =3.3 V, V_{out} =2 V, C_{in} =470 µF, C_{out} =0 µF, and I_o =I_o max)

				PTH03010W		
Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Output Current	I_o	0.8 V ≤ V_o ≤ 2.5 V, 60 °C, 200 LFM airflow 25 °C, natural convection	0 0	— —	15 (1) 15 (1)	A
Input Voltage Range	V_{in}	Over I_o range	2.95 (2)	—	3.65	V
Set-Point Voltage Tolerance	V_o tol		—	—	±2 (3)	%V_o
Temperature Variation	ΔReg_{temp}	–40 °C < T_a < +85 °C	—	±0.5	—	%V_o
Line Regulation	ΔReg_{line}	Over V_{in} range	—	±10	—	mV
Load Regulation	ΔReg_{load}	Over I_o range	—	±12	—	mV
Total Output Variation	ΔReg_{tot}	Includes set-point, line, load, –40 °C ≤ T_a ≤ +85 °C	—	—	±3 (3)	%V_o
Efficiency	η	I_o = 10 A, R_{SET} = 2.21 kΩ, V_o = 2.5 V R_{SET} = 4.12 kΩ, V_o = 2.0 V R_{SET} = 5.49 kΩ, V_o = 1.8 V R_{SET} = 8.87 kΩ, V_o = 1.5 V R_{SET} = 17.4 kΩ, V_o = 1.2 V R_{SET} = 36.5 kΩ, V_o = 1.0 V	— — — — — —	93 92 91 89 87 85	— — — — — —	%
V_o Ripple (pk-pk)	V_r	20 MHz bandwidth	—	20	—	mVpp
Over-Current Threshold	I_o trip	Reset, followed by auto-recovery	—	27.5	—	A
Transient Response		1 A/µs load step, 50 to 100 % $I_o$max, C_{out} = 330 µF				
	t_{tr} ΔV_{tr}	Recovery Time V_o over/undershoot	— —	70 100	— —	µSec mV
Margin Up/Down Adjust	V_o adj		—	±5	—	%
Margin Input Current (pins 9 /10)	I_{IL} margin	Pin to GND	—	–8 (4)	—	µA
Track Input Current (pin 8)	I_{IL} track	Pin to GND	—	—	–130 (5)	µA
Track Slew Rate Capability	dV_{track}/dt	$\lvert V_{track} - V_o \rvert$ ≤ 50 mV and V_{track} < V_o(nom)	5	—	—	V/ms
Under-Voltage Lockout	UVLO	V_{in} increasing V_{in} decreasing	— 2.2	2.8 2.7	2.95 —	V
Inhibit Control (pin3) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	Referenced to GND	 V_{in} –0.5 –0.2	 — —	 Open (5) 0.8	V
Input Low Current	I_{IL} inhibit	Pin to GND	—	–130	—	µA
Input Standby Current	I_{in} inh	Inhibit (pin 3) to GND, Track (pin 8) open	—	10	—	mA
Switching Frequency	f_s	Over V_{in} and I_o ranges	275	300	325	kHz
External Input Capacitance	C_{in}		470 (6)	—	—	µF
External Output Capacitance	C_{out}		0	330 (7)	3,300	µF
Reliability	MTBF	Per Bellcore TR-332 50 % stress, T_a =40 °C, ground benign	5.7	—	—	10^6 Hrs

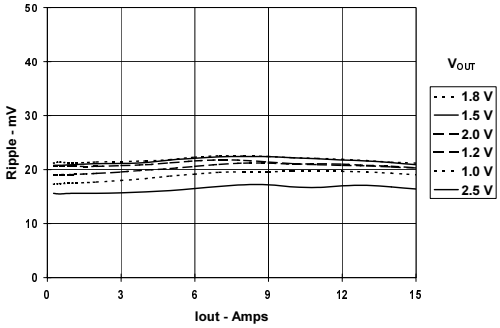
Notes: (1) See SOA curves or consult factory for appropriate derating.
(2) The minimum input voltage is equal to 2.95 V or Vout + 0.65 V, whichever is greater.
(3) The set-point voltage tolerance is affected by the tolerance and stability of R_{SET}. The stated limit is unconditionally met if R_{SET} has a tolerance of 1 % with 100 ppm/°C or better temperature stability.
(4) A small low-leakage (<100 nA) MOSFET is recommended to control this pin. The open-circuit voltage is less than 1 Vdc.
(5) This control pin has an internal pull-up to the input voltage Vin. If it is left open-circuit the module will operate when input power is applied. A small low-leakage (<100 nA) MOSFET is recommended for control. For further information, consult the related application note.
(6) A 470-µF electrolytic input capacitor is required for proper operation. The capacitor must be rated for a minimum of 700 mArms of ripple current.
(7) An external output capacitor is not required for basic operation. Adding 330 µF of distributed capacitance at the load will improve the transient response.

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

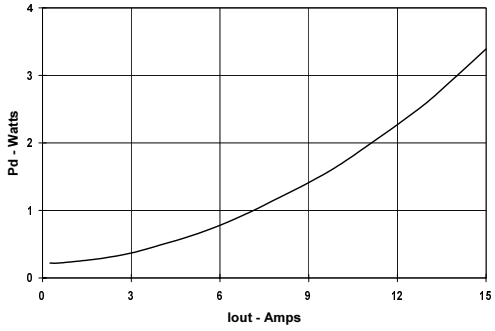
Efficiency vs Load Current



Output Ripple vs Load Current

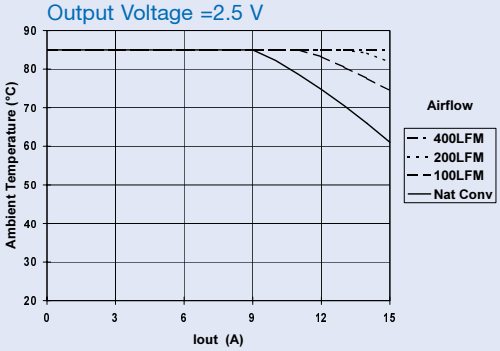


Power Dissipation vs Load Current

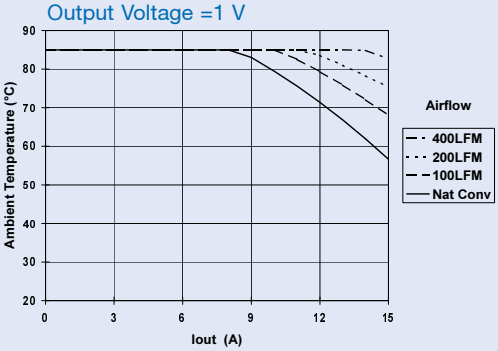


Safe Operating Area; V_{in} =3.3 V *(See Note B)*

Output Voltage =2.5 V



Output Voltage =1 V



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. Derating limits apply to modules soldered directly to a 4 in. ´ 4 in. double-sided PCB with 1 oz. copper.*

PMG 5518 T 5-V Input

15-A, 5-V Input Non-Isolated
Wide-Output Adjust Power Module

POLA code: PTH05010 W

NOMINAL SIZE = 1.37 in x 0.62 in
(34,8 mm x 15,75 mm)

Features

- Up to 15-A Output Current
- 5-V Input Voltage
- Wide-Output Voltage Adjust (0.8 V to 3.6 V)
- Efficiencies up to 96 %
- 160 W/in³ Power Density
- On/Off Inhibit
- Output Voltage Sense
- Pre-Bias Startup
- Margin Up/Down Controls
- Auto-Track™ Sequencing(1)
- Under-Voltage Lockout
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- Surface Mountable
- Operating Temp: –40 to +85 °C
- DSP Compatible Output Voltages
- IPC Lead Free 2
- Point-of-Load Alliance (POLA) Compatible

Note: (1) Auto-Track™ is a trademark of Texas Instruments

Description

The PMG 5518 T series of non-isolated power modules are small in size but big on performance and flexibility. Their high output current, compact footprint, and industry-leading features offers system designers a versatile module for powering complex multi-processor digital systems.

The series employs double-sided surface mount construction and provides high-performance step-down power conversion for up to 15 A of output current from a 5-V input bus voltage. The output voltage of the PMG 5518 T can be set to any value over the range, 0.8 V to 3.6 V, using a single resistor.

This series includes Auto-Track™.

Auto-Track simplifies the task of supply voltage sequencing in a power system by enabling modules to track each other, or any external voltage, during power up and power down.

Other operating features include an on/off inhibit, output voltage adjust (trim), and margin up/down controls. To ensure tight load regulation, an output voltage sense is also provided. A non-latching over-current trip serves as load fault protection.

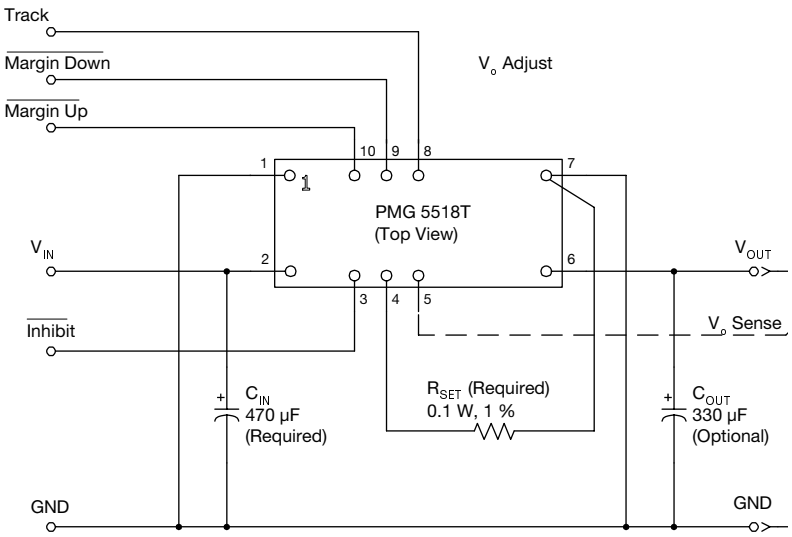
Target applications include complex multi-voltage, multi-processor systems that incorporate the industry's high-speed DSPs, micro-processors and bus drivers.

Pin Configuration

Pin	Function
1	GND
2	V_{in}
3	Inhibit *
4	V_o Adjust
5	V_o Sense
6	V_{out}
7	GND
8	Track
9	Margin Down *
10	Margin Up *

* *Denotes negative logic:*
Open = Normal operation
Ground = Function active

Standard Application



R_{set} = Resistor to set the desired output voltage (see spec. table for values)
C_{in} = Required electrolytic 470 µF
C_{out} = Recommended 330 µF electrolytic

Product Table (PMG 5518 T x)[1]

V_{In}	V_O / I_O max	P_O max	Package Code[1]	Description	Ordering No.
4.5-5.5 V	0.8-3.6 V /15 A	54 W	P	Horiz. T/H	PMG 5518 T x[1]
			S	SMD, Standard	

[1] Replace "x"in the Ordering No. with Package Code.

Ordering Information

Delivery Option	M.o.q.	Suffix	Example
Tray	25 pcs	/B	PMG 5518T P /B
Tape & Reel [2]	250 pcs	/C	PMG 5518T S /C

[2] Tape & Reel available only for SMD packages

Pin Descriptions

GND: This is the common ground connection for the *Vin* and *Vout* power connections. It is also the 0 VDC reference for the control inputs.

Vin: The positive input voltage power node to the module, which is referenced to common *GND*.

Inhibit: The Inhibit pin is an open-collector/drain negative logic input that is referenced to *GND*. Applying a low-level ground signal to this input disables the module's output and turns off the output voltage. When the *Inhibit* control is active, the input current drawn by the regulator is significantly reduced. If the *Inhibit* pin is left open-circuit, the module will produce an output whenever a valid input source is applied.

Vo Adjust: A 0.1 W, 1 % tolerance (or better) resistor must be directly connected between this pin and pin 7 (*GND*) pin to set the output voltage to the desired value. The set point range for the output voltage is from 0.8 V to 3.6 V. The resistor required for a given output voltage may be calculated from the following formula. If left open circuit, the module output will default to its lowest output voltage value. For further information on output voltage adjustment consult the related application note.

$$R_{set} = 10\ k\Omega \frac{0.8\ V}{V_{out} - 0.8\ V} - 2.49\ k\Omega$$

The specification table gives the preferred resistor values for a number of standard output voltages.

Vo Sense: The sense input allows the regulation circuit to compensate for voltage drop between the module and the load. For optimal voltage accuracy *Vo Sense* should be connected to *Vout*. It can also be left disconnected.

Vout: The regulated positive power output with respect to the *GND* node.

Track: This is an analog control input that allows the output voltage to follow another voltage during power-up and power-down sequences. The pin is active from 0 V up to the nominal set-point voltage. Within this range the module's output will follow the voltage at the *Track* pin on a volt-for-volt basis. When the control voltage is raised above this range, the module regulates at its nominal output voltage. If unused, this input may be left unconnected. For further information consult the related application note.

Margin Down: When this input is asserted to *GND*, the output voltage is decreased by 5% from the nominal. The input requires an open-collector (open-drain) interface. It is not TTL compatible. A lower percent change can be accomodated with a series resistor. For further information, consult the related application note.

Margin Up: When this input is asserted to *GND*, the output voltage is increased by 5%. The input requires an open-collector (open-drain) interface. It is not TTL compatible. The percent change can be reduced with a series resistor. For further information, consult the related application note.

Environmental & Absolute Maximum Ratings (Voltages are with respect to GND)

Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Track Input Voltage	V_{track}		–0.3	—	V_{in} + 0.3	V
Operating Temperature Range	T_a	Over V_{in} Range	–40	—	85	°C
Solder Reflow Temperature	T_{reflow}	Surface temperature of module body or pins			215 (i)	°C
Storage Temperature	T_s	—	–40	—	125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, ½ Sine, mounted	—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 Suffix H 20-2000 Hz Suffix S	— —	20 15	— —	G's
Weight	—		—	5	—	grams
Flammability	—	Meets UL 94V-O				

Notes: *(i) During reflow of SMD package version do not elevate peak temperature of the module, pins or internal components above the stated maximum. For further guidance refer to the application note, "Reflow Soldering Requirements for Plug-in Power Surface Mount Products."*

Specifications (Unless otherwise stated, T_a =25 °C, V_{in} =5 V, V_o =3.3 V, C_{in} =470 µF, C_{out} =0 µF, and I_o = $I_o$max)

Characteristics	Symbols	Conditions	PTH05010W Min	Typ	Max	Units
Output Current	I_o	0.8 V ≤ V_o ≤ 3.6 V, 60 °C, 200 LFM airflow 25 °C, natural convection	0 0	— —	15 (1) 15 (1)	A
Input Voltage Range	V_{in}	Over I_o range	4.5	—	5.5	V
Set-Point Voltage Tolerance	V_o tol		—	—	±2 (2)	%V_o
Temperature Variation	ΔReg_{temp}	–40 °C < T_a < +85 °C	—	±0.5	—	%V_o
Line Regulation	ΔReg_{line}	Over V_{in} range	—	±10	—	mV
Load Regulation	ΔReg_{load}	Over I_o range	—	±12	—	mV
Total Output Variation	ΔReg_{tot}	Includes set-point, line, load, –40 °C ≤ T_a ≤ +85 °C	—	—	±3 (2)	%V_o
Efficiency	η	I_o = 10 A, R_{SET} = 698 Ω, V_o = 3.3 V	—	95	—	%
		R_{SET} = 2.21 kΩ, V_o = 2.5 V	—	93	—	
		R_{SET} = 4.12 kΩ, V_o = 2.0 V	—	92	—	
		R_{SET} = 5.49 kΩ, V_o = 1.8 V	—	91	—	
		R_{SET} = 8.87 kΩ, V_o = 1.5 V	—	90	—	
		R_{SET} = 17.4 kΩ, V_o = 1.2 V	—	88	—	
		R_{SET} = 36.5 kΩ, V_o = 1.0 V	—	86	—	
V_o Ripple (pk-pk)	V_r	20 MHz bandwidth	—	30	—	mVpp
Over-Current Threshold	I_o trip	Reset, followed by auto-recovery	—	27.5	—	A
Transient Response		1 A/µs load step, 50 to 100 % $I_o$max, C_{out} = 330 µF				
	t_{tr}	Recovery Time	—	70	—	µSec
	ΔV_{tr}	V_o over/undershoot	—	100	—	mV
Margin Up/Down Adjust	ΔV_o margin		—	±5	—	%
Margin Input Current (pins 9 /10)	I_{IL} margin	Pin to GND	—	–8 (3)	—	µA
Track Input Current (pin 8)	I_{IL} track	Pin to GND	—	—	–130 (4)	µA
Track Slew Rate Capability	dV_{track}/dt	$\lvert V_{track} - V_o \rvert$ ≤ 50 mV and V_{track} < V_o(nom)	5	—	—	V/ms
Under-Voltage Lockout	UVLO	V_{in} increasing V_{in} decreasing	— 3.4	4.3 3.7	4.45 —	V
Inhibit Control (pin3) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	Referenced to GND	 V_{in} –0.5 –0.2	 — —	 Open (4) 0.8	V
Input Low Current	I_{IL} inhibit	Pin to GND	—	–130	—	µA
Input Standby Current	I_{in} inh	Inhibit (pin 3) to GND, Track (pin 8) open	—	10	—	mA
Switching Frequency	f_s	Over V_{in} and I_o ranges	275	300	325	kHz
External Input Capacitance	C_{in}		470 (5)	—	—	µF
External Output Capacitance	C_{out}		0	330 (6)	15,000	µF
Reliability	MTBF	Per Bellcore TR-332 50 % stress, T_a = 40 °C, ground benign	5.7	—	—	10^6 Hrs

Notes: (1) See SOA curves or consult factory for appropriate derating.

(2) The set-point voltage tolerance is affected by the tolerance and stability of R_{SET}. The stated limit is unconditionally met if R_{SET} has a tolerance of 1 % with 200 ppm/°C or better temperature stability.

(3) A small low-leakage (<100 nA) MOSFET is recommended to control this pin. The open-circuit voltage is less than 1 Vdc.

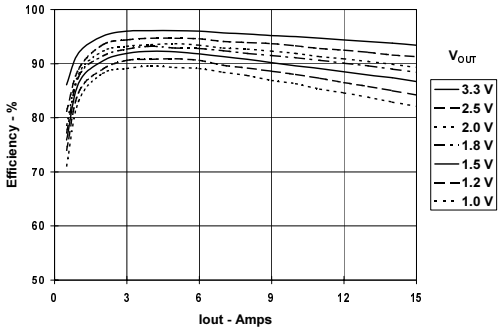
(4) This control pin has an internal pull-up to the input voltage Vin. If it is left open-circuit the module will operate when input power is applied. A small low-leakage (<100 nA) MOSFET is recommended for control. For further information, consult the related application note.

(5) A 470 µF electrolytic input capacitor is required for proper operation. The capacitor must be rated for a minimum of 700 mA rms of ripple current.

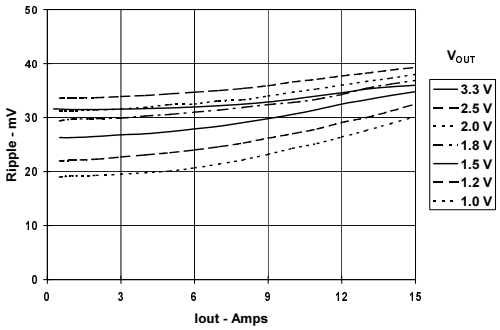
(6) An external output capacitor is not required for basic operation. Adding 330 µF of distributed capacitance at the load will improve the transient response.

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

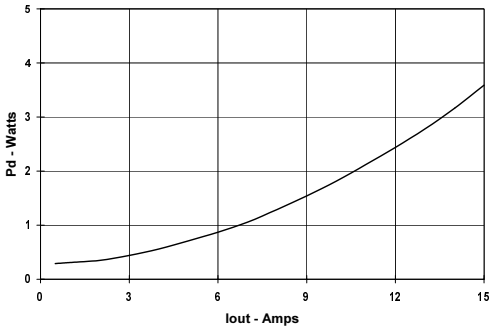
Efficiency vs Load Current



Output Ripple vs Load Current

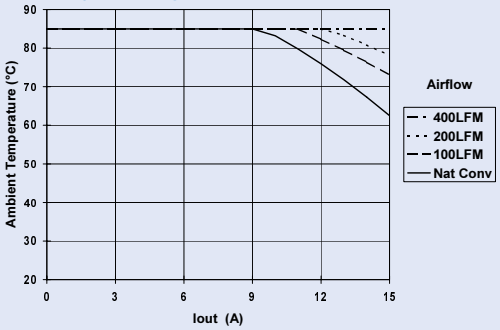


Power Dissipation vs Load Current

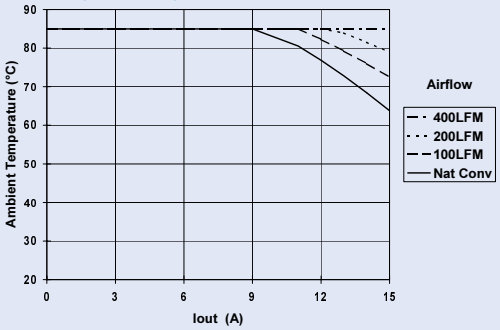


Safe Operating Area; V_{in} =5 V *(See Note B)*

Output Voltage =3.3 V



Output Voltage =1 V



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. Derating limits apply to modules soldered directly to a 4-layer PCB with 1 oz. copper.*

Adjusting the Output Voltage of the PMG 4318 T & PMG 5518 T Wide-Output Adjust Power Modules

The *V_o Adjust* control (pin 4) sets the output voltage of the PMG 4318 T and PMG 5518 T products. The adjustment range of the PMG 4318 T (3.3-V input) is from 0.8 V to 2.5 V [1], and the PMG 5518 T (5-V input) from 0.8 V to 3.6 V. The adjustment method requires the addition of a single external resistor, R_{set}, that must be connected directly between the *V_o Adjust* and *GND* pins [2]. Table 1-1 gives the preferred value of the external resistor for a number of standard voltages, along with the actual output voltage that this resistance value provides.

For other output voltages the value of the required resistor can either be calculated using the following formula, or simply selected from the range of values given in Table 1-2. Figure 1-1 shows the placement of the required resistor.

$$R_{set} = 10\ k\Omega \frac{0.8\ V}{V_{out} - 0.8\ V} - 2.49\ k\Omega$$

Table 1-1; Preferred Values of R_{set} for Standard Output Voltages

V_{out} (Standard)	R_{set} (Pref'd Value)	V_{out} (Actual)
3.3 V [1]	698 Ω	3.309 V
2.5 V	2.21 kΩ	2.502 V
2V	4.12 kΩ	2.010 V
1.8 V	5.49 kΩ	1.803 V
1.5 V	8.87 kΩ	1.504 V
1.2 V	17.4 kΩ	1.202 V
1 V	36.5 kΩ	1.005 V
0.8 V	Open	0.8 V

Figure 1-1; V_o Adjust Resistor Placement

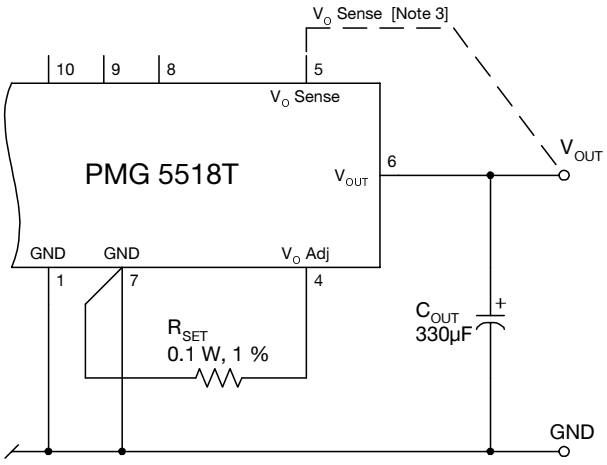


Table 1-2; Output Voltage Set-Point Resistor Values

V_a Req'd	R_{set}	V_a Req'd	R_{set}
0.800	Open	2.00	4.18 kΩ
0.825	318 kΩ	2.05	3.91 kΩ
0.850	158 kΩ	2.10	3.66 kΩ
0.875	104 kΩ	2.15	3.44 kΩ
0.900	77.5 kΩ	2.20	3.22 kΩ
0.925	61.5 kΩ	2.25	3.03 kΩ
0.950	50.8 kΩ	2.30	2.84 kΩ
0.975	43.2 kΩ	2.35	2.67 kΩ
1.000	37.5 kΩ	2.40	2.51 kΩ
1.025	33.1 kΩ	2.45	2.36 kΩ
1.050	29.5 kΩ	2.50	2.22 kΩ
1.075	26.6 kΩ	2.55	2.08 kΩ
1.100	24.2 kΩ	2.60	1.95 kΩ
1.125	22.1 kΩ	2.65	1.83 kΩ
1.150	20.4 kΩ	2.70	1.72 kΩ
1.175	18.8 kΩ	2.75	1.61 kΩ
1.200	17.5 kΩ	2.80	1.51 kΩ
1.225	16.3 kΩ	2.85	1.41 kΩ
1.250	15.3 kΩ	2.90	1.32 kΩ
1.275	14.4 kΩ	2.95	1.23 kΩ
1.300	13.5 kΩ	3.00	1.15 kΩ
1.325	12.7 kΩ	3.05	1.07 kΩ
1.350	12.1 kΩ	3.10	988 Ω
1.375	11.4 kΩ	3.15	914 Ω
1.400	10.8 kΩ	3.20	843 Ω
1.425	10.3 kΩ	3.25	775 Ω
1.450	9.82 kΩ	3.30	710 Ω
1.475	9.36 kΩ	3.35	647 Ω
1.50	8.94 kΩ	3.40	587 Ω
1.55	8.18 kΩ	3.45	529 Ω
1.60	7.51 kΩ	3.50	473 Ω
1.65	6.92 kΩ	3.55	419 Ω
1.70	6.4 kΩ	3.60	367 Ω
1.75	5.93 kΩ		
1.80	5.51 kΩ		
1.85	5.13 kΩ		
1.90	4.78 kΩ		
1.95	4.47 kΩ		

Notes:

1. Modules that operate from a 3.3-V input bus should not be adjusted higher than 2.5 V.
2. Use a 0.1 W resistor. The tolerance should be 1 %, with temperature stability of 100 ppm/°C (or better). Place the resistor as close to the regulator as possible. Connect the resistor directly between pins 4 and 7 using dedicated PCB traces.
3. Never connect capacitors from *V_o Adjust* to either *GND* or *V_{out}*. Any capacitance added to the *V_o Adjust* pin will affect the stability of the regulator.

Capacitor Recommendations for the PMG 4318 T & PMG 5518 T Series of Power Modules

Input Capacitor

The recommended input capacitor(s) is determined by the 470 µF minimum capacitance, and 700 mA rms minimum ripple current rating.

Ripple current and <100 mW equivalent series resistance (ESR) values are the major considerations, along with temperature, when designing with different types of capacitors. Tantalum capacitors have a recommended minimum voltage rating of twice 2´ (the maximum DC voltage + AC ripple). This is standard practice for tantalum capacitors to insure reliability.

Output Capacitors (Optional)

The recommended ESR of the capacitors is equal to or less than 150 mW. Electrolytic capacitors have marginal ripple performance at frequencies greater than 400 kHz but excellent low frequency transient response. Above the ripple frequency, ceramic 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 2-1.

Tantalum Capacitors

Tantalum type capacitors can be used for the output but only the AVX TPS, Sprague 593D/594/595 or Kemet T495/T510 series. These capacitors are recommended over many other tantalum types due to their higher rated surge, power dissipation, and ripple current capability. As a caution, the TAJ series by AVX is not recommended. This series has considerably higher ESR, reduced power dissipation, and lower ripple current capability. The TAJ series is less reliable than the AVX TPS series when determining power dissipation capability. Tantalum, ceramic or Os-con types are recommended for applications where ambient temperatures fall below 0 °C.

Ceramic capacitors may be substituted for electrolytic types with the minimum capacitor value for improved ripple reduction on the input and output bus.

Capacitor Table

Table 1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The number of capacitors required at both the input and output buses is identified for each capacitor type.

This is not an extensive capacitor list. Capacitors from other vendors are available with comparable specifications. Those listed are for guidance. The RMS ripple current rating and ESR are the critical parameters necessary to insure both optimum regulator performance and long capacitor life.

Table 2-1: Recommended Input/Output Capacitors

Capacitor Vendor/ Series	Capacitor Characteristicsy					Quantit		
	Working Voltage	Value (µF)	(ESR) Equivalen Series Resistance	Max. Ripple Current @105 °C (Irms)	Physical Size (mm)	Input Bus	Output Bus	Vendor Part Number
Panasonic FC (Radial) FK (Surface Mt.)	10 V 16 V 25 V 35 V	560 470 470 470	0.090 Ω 0.090 Ω 0080 Ω 0.060 Ω	755 mA 755 mA 850 mA 1100 mA	10×12.5 10×12.5 10×10.2 12.5×13.5	1 1 1 1	1 1 1 1	EEUFC1A561 EEUFC1C471 EEVFK1E471P EEVFK1V471Q
United Chemi-con PXA (Surface Mt.) LXZ Series FX LXZ Series	6.3 V 10 V 10 V 16 V	470 680 680 470	0.020 Ω 0.090 Ω 0.015 Ω 0.090 Ω	4130 mA 770 mA 4735 mA 760 mA	10×7.7 10×12.5 10×10.5 10×12.5	1 1 1 1	1 1 1 1	PXA6.3VC471MJ80TP LXZ10VB681M10X12LL 10FX680M LXZ16VB471M10X12LL
Nichicon PM Series HD	16 V 16 V 16 V	330 470 470	0.120÷2=0.060 Ω 0.090 Ω 1030 Ω	745 mA 770 mA 1030 mA	'10×12.5 10×15 10x12.5	2 1 1	1 1 1	UPM1C331MPH6 UPM1C 471MPH6 UHD1C471MPR
Sanyo-Os-con: SP SVP (Surface Mt.)	 10 V 10 V	 470 560	 0.015 Ω 0.013 Ω	 >4500 mA >5200 mA	 10×10.5 11×12.7	 1 1	 1 1	 10SP470M 10SVP560M
AVX Tantalum TPS (Surface Mt.)	10 V 10 V	470 470	0.045 Ω 0.060 Ω	1723 mA 1826 mA	7.3L ×5.7W ×4.1H	1 1	1 1	TPSE477M010R0045 TPSV477M010R0060
Kemet Polymer Tantalum T520/T530 Series (Surface Mt.)	10 V 10 V	330 330	0.040 Ω 0.015 Ω	1800 mA >3800 mA	4.3W ×7.3L ×4.0H	2 2	1 1	T520X337M010AS T530X337M010AS
Sprague Tantalum 595D Series (Surface Mt.)	10 V	470	0.100 Ω	1440 mA	7.2L ×6W ×4.1H	1	1	595D477X0010R2T

PMG 8618 L 12-V Input

12-A, 12-V Input Non-Isolated
Wide-Output Adjust Power Module

POLA code: PTH12010 W

NOMINAL SIZE = 1.37 in x 0.62 in
(34,8 mm x 15,75 mm)

Features

- Up to 12-A Output Current
- 12-V Input Voltage
- Wide-Output Voltage Adjust (1.2 V to 5.5 V)
- Efficiencies up to 94 %
- 200 W/in³ Power Density
- On/Off Inhibit
- Output Voltage Sense
- Margin Up/Down Controls
- Under-Voltage Lockout
- Auto-Track™ Sequencing(1)
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- Operating Temp: –40 to +85 °C
- IPC Lead Free 2
- Safety Agency Approvals (Pending) UL 1950, CSA 22.2 950, & EN60950
- Point of Load Alliance (POLA) Compatible

Note: (1) Auto-Track™ is a trademark of Texas Instruments

Description

The PMG 8618 L is a non-isolated power module that is small in size but big on performance and flexibility. The high output current, compact footprint, and industry-leading features offers system designers a versatile module for powering complex multi-processor digital systems.

The series employs double-sided surface mount construction and provides high-performance step-down power conversion for up to 12 A of output current. The output voltage of the PMG 8618 L can be set to any value over the range, 1.2 V to 5.5 V, using a single resistor. This series includes Auto-Track™ Sequencing.

Auto-Track simplifies the task of supply voltage sequencing in a power system by enabling modules to track each other, or any external voltage, during power up and power down. Other operating features include an on/off inhibit, output voltage adjust (trim), and margin up/down controls. For improved load regulation, an output voltage sense is also provided. A non-latching over-current trip serves as load fault protection.

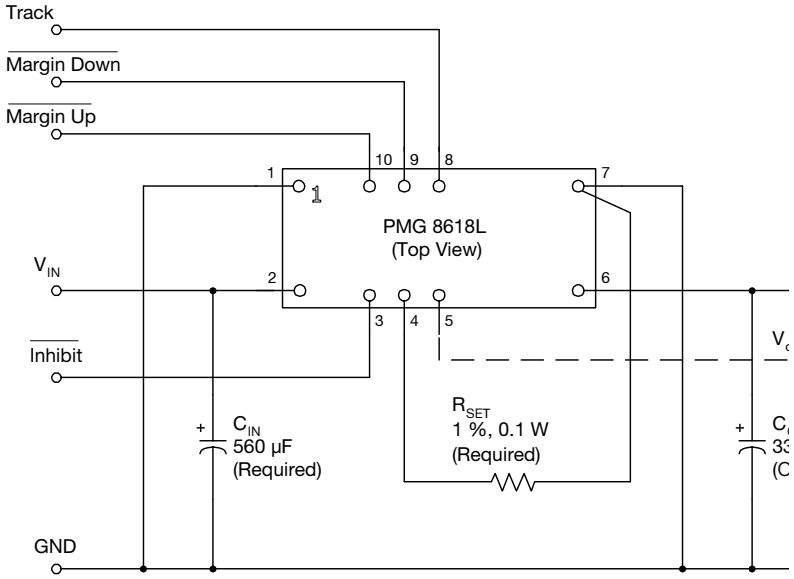
Target applications include complex multi-voltage, multi-processor systems that incorporate the industry's high-speed DSPs, micro-processors and bus drivers.

Pin Configuration

Pin	Function
1	GND
2	V_{in}
3	Inhibit *
4	V_o Adjust
5	V_o Sense
6	V_{out}
7	GND
8	Track
9	Margin Down *
10	Margin Up *

* *Denotes negative logic:*
Open = Normal operation
Ground = Function active

Standard Application



R_{set} = Required to set the output voltage to a value higher than 1.2 V. (See specification table for values)
C_{in} = Required 560 µF electrolytic capacitor
C_{out} = Optional 330 µF electrolytic capacitor

Product Table (PMG 8618 T x)[1]

V_{In}	V_O / I_O max	P_O max	Package Code[1]	Description	Ordering No.
10.8-13.2 V	1.2-5.5 V /12 A	66 W	P	Horiz. T/H	PMG 8618 T x[1]
			S	SMD, Standard	

[1] Replace "x"in the Ordering No. with Package Code.

Ordering Information

Delivery Option	M.o.q.	Suffix	Example
Tray	25 pcs	/B	PMG 8618L P /B
Tape & Reel [2]	250 pcs	/C	PMG 8618L S /C

[2] Tape & Reel available only for SMD packages

Pin Descriptions

GND: This is the common ground connection for the *Vin* and *Vout* power connections. It is also the 0 VDC reference for the control inputs.

Vin: The positive input voltage power node to the module, which is referenced to common *GND*.

Inhibit: The Inhibit pin is an open-collector/drain negative logic input that is referenced to *GND*. Applying a low-level ground signal to this input disables the module's output and turns off the output voltage. When the *Inhibit* control is active, the input current drawn by the regulator is significantly reduced. If the *Inhibit* pin is left open-circuit, the module will produce an output whenever a valid input source is applied.

Vo Adjust: A 1 % 0.1 W resistor must be directly connected between this pin and pin 7 (GND) to set the output voltage to a value higher than 1.2 V. The temperature stability of the resistor should be 100 ppm/°C or better. The set point range is from 1.2 V to 5.5 V. The resistor required for a given output voltage may be calculated from the following formula. If left open circuit the output voltage will default to its lowest value. For further information on output voltage adjustment consult the related application note.

$$R_{set} = 10\ k\Omega \frac{0.8\ V}{V_{out} - 1.2\ V} - 1.82\ k\Omega$$

The specification table gives the preferred resistor values for a number of standard output voltages.

Vo Sense: The sense input allows the regulation circuit to compensate for voltage drop between the module and the load. For optimal voltage accuracy *Vo Sense* should be connected to *Vout*. It can also be left disconnected.

Vout: The regulated positive power output with respect to the *GND* node.

Track: This is an analog control input that allows the output voltage to follow another voltage during power-up and power-down sequences. The pin is active from 0 V up to the nominal set-point voltage. Within this range the module's output will follow the voltage at the *Track* pin on a volt-for-volt basis. When the control voltage is raised above this range, the module regulates at its nominal output voltage. If unused, this input maybe left unconnected. For further information consult the related application note.

Margin Down: When this input is asserted to *GND*, the output voltage is decreased by 5% from the nominal. The input requires an open-collector (open-drain) interface. It is not TTL compatible. A lower percent change can be accomodated with a series resistor. For further information, consult the related application note.

Margin Up: When this input is asserted to *GND*, the output voltage is increased by 5%. The input requires an open-collector (open-drain) interface. It is not TTL compatible. The percent change can be reduced with a series resistor. For further information, consult the related application note.

Environmental & Absolute Maximum Ratings (Voltages are with respect to GND)

Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Track Input Voltage	V_{track}		–0.2	—	V_{in}	V
Operating Temperature Range	T_a	Over V_{in} Range	–40 (i)	—	85	°C
Solder Reflow Temperature	T_{reflow}	Surface temperature of module body or pins			215 (ii)	°C
Storage Temperature	T_s	—	–40	—	125	°C
Mechanical Shock		Per Mil-STD-883D, Method 2002.3 1 msec, ½ Sine, mounted	—	500	—	G's
Mechanical Vibration		Mil-STD-883D, Method 2007.2 20-2000 Hz	—	20	—	G's
Weight	—		—	5	—	grams
Flammability	—	Meets UL 94V-O				

Notes: *(i) For operation below 0 °C the external capacitors must have stable characteristics. Use either a low-ESR tantalum, Os-Con, or ceramic capacitor.*
(ii) During reflow of SMD package version do not elevate peak temperature of the module, pins or internal components above the stated maximum. For further guidance refer to the application note, "Reflow Soldering Requirements for Plug-in Power Surface Mount Products."

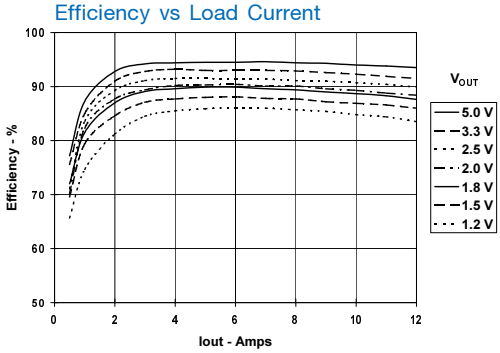
Specifications (Unless otherwise stated, T_a =25 °C, V_{in} =12 V, V_{out} =3.3 V, C_{in}=560 µF, C_{out} =0 µF, and I_o =$I_o$max)

Characteristics	Symbols	Conditions		PTH12010W Min	Typ	Max	Units
Output Current	I_o	1.2 V ≤ V_o ≤ 5.5 V	60 °C, 200 LFM airflow	0	—	12 (1)	A
			25 °C, natural convection	0	—	12 (1)	
Input Voltage Range	V_{in}	Over I_o range		10.8	—	13.2	V
Set-Point Voltage Tolerance	V_o tol			—	—	±2 (2)	%V_o
Temperature Variation	ΔReg_{temp}	–40 °C <T_a < +85 °C		—	±0.5	—	%V_o
Line Regulation	ΔReg_{line}	Over V_{in} range		—	±10	—	mV
Load Regulation	ΔReg_{load}	Over I_o range		—	±12	—	mV
Total Output Variation	ΔReg_{tot}	Includes set-point, line, load, –40 °C ≤ T_a ≤ +85 °C		—	—	±3 (2)	%V_o
Efficiency	η	I_o =8 A	R_{SET} = 280 Ω V_o = 5.0 V	—	94	—	%
			R_{SET} = 2.0 kΩ V_o = 3.3 V	—	93	—	
			R_{SET} = 4.32 kΩ V_o = 2.5 V	—	91	—	
			R_{SET} = 8.06 kΩ V_o = 2.0 V	—	90	—	
			R_{SET} = 11.5 kΩ V_o = 1.8 V	—	89	—	
			R_{SET} = 24.3 kΩ V_o = 1.5 V	—	88	—	
			R_{SET} = open cct V_o = 1.2 V	—	86	—	
V_o Ripple (pk-pk)	V_r	20 MHz bandwidth	V_o ≤2.5 V	—	25	—	mVpp
			V_o >2.5 V	—	1	—	%V_o
Over-Current Threshold	I_o trip	Reset, followed by auto-recovery		—	20	—	A
Transient Response		1 A/µs load step, 50 to 100 % $I_o$max, C_{out} =330 µF					
	t_{tr}		Recovery Time	—	70	—	µSec
	ΔV_{tr}		V_o over/undershoot	—	100	—	mV
Margin Up/Down Adjust	V_o adj			—	±5	—	%
Margin Input Current (pins 9 /10)	I_{IL} margin	Pin to GND		—	–8 (3)	—	µA
Track Input Current (pin 8)	I_{IL} track	Pin to GND		—	—	–0.13 (4)	mA
Track Slew Rate Capability	dV_{track}/dt	$\lvert V_{track} - V_o \rvert$ ≤ 50 mV and V_{track} < V_o(nom)		5	—	—	V/ms
Under-Voltage Lockout	UVLO	V_{in} increasing		—	9.5	10.4	V
		V_{in} decreasing		8.8	9	—	
Inhibit Control (pin3) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	Referenced to GND		 V_{in} –0.5 –0.2	 — —	 Open (4) 0.5	V
Input Low Current	I_{IL} inhibit	Pin to GND		—	–0.24	—	mA
Input Standby Current	I_{in} inh	Inhibit (pin 3) to GND, Track (pin 8) open		—	10	—	mA
Switching Frequency	f_s	Over V_{in} and I_o ranges		300	350	400	kHz
External Input Capacitance	C_{in}			560 (5)	—	—	µF
External Output Capacitance	C_{out}			0	330 (6)	10,000	µF
Reliability	MTBF	Per Bellcore TR-332 50 % stress, T_a =40 °C, ground benign		6.4	—	—	10^6 Hrs

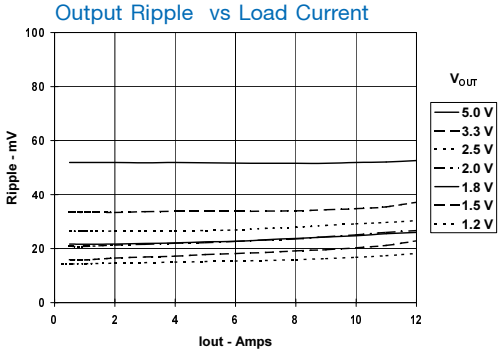
Notes:(1) See SOA curves or consult factory for appropriate derating.
(2) The set-point voltage tolerance is affected by the tolerance and stability of R_{SET}. The stated limit is unconditionally met if R_{SET} has a tolerance of 1 %, with 100 ppm/°C (or better) temperature stability.
(3) A small low-leakage (<100 nA) MOSFET is recommended to control this pin. The open-circuit voltage is less than 1 Vdc.
(4) This control pin has an internal pull-up to the input voltage Vin (7.5 V for pin 8). If it is left open-circuit the module will operate when input power is applied. A small low-leakage (<100 nA) MOSFET is recommended for control.
(5) A 560 µF electrolytic input capacitor are required for proper operation. The electrolytic capacitor must be rated for a minimum of 800 mA rms of ripple current. For further information, consult the related application note regarding capacitor selection.
(6) An external output capacitor is not required for basic operation. Adding 330 µF of distributed capacitance at the load will improve the transient response.

Characteristic Data; V_{in} =12 V *(See Note A)*

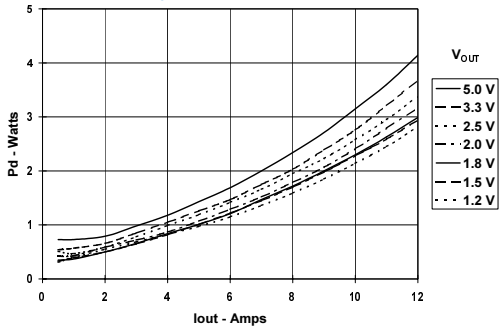
Efficiency vs Load Current



Output Ripple vs Load Current

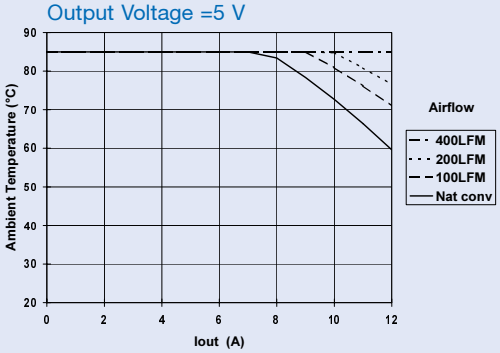


Power Dissipation vs Load Current

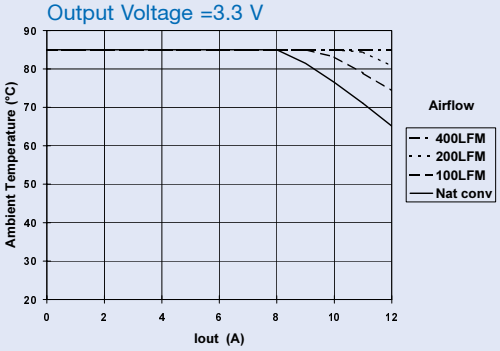


Safe Operating Area; V_{in} =12 V *(See Note B)*

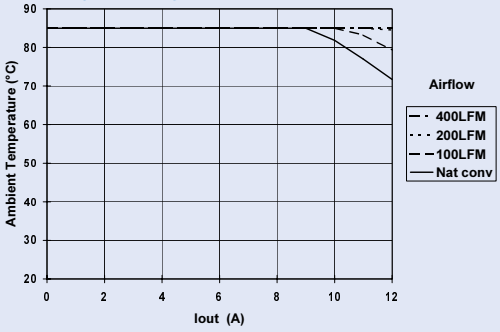
Output Voltage =5 V



Output Voltage =3.3 V



Output Voltage 1.8 V



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. Derating limits apply to modules soldered directly to a 4 in. ´ 4 in. double-sided PCB with 1 oz. copper.*

Adjusting the Output Voltage of the PMG 8618 L Wide-Output Adjust Power Module

The *V_o Adjust* control (pin 4) is used to set the output voltage to a value higher than 1.2 V. The adjustment method requires the addition of a single external resistor, R_{set}, that must be connected directly between the *V_o Adjust* and *GND* pins [1]. Table 1-1 gives the preferred value for the external resistor for a number of standard voltages, along with the actual output voltage that this resistance value provides.

For other output voltages the value of the required resistor can either be calculated using the following formula, or simply selected from the range of values given in Table 1-2. Figure 1-1 shows the placement of the required resistor.

$$R_{set} = 10\ k\Omega \frac{0.8\ V}{V_{out} - 1.2\ V} - 1.82\ k\Omega$$

Table 1-1; Preferred Values of R_{set} for Standard Output Voltages

V_{out} (Standard)	R_{set} (Pref'd Value)	V_{out} (Actual)
5 V	280 Ω	5.009 V
3.3 V	2 kΩ	3.294V
2.5 V	4.32 kΩ	2.503 V
2 V	8.06 kΩ	2.010V
1.8 V	11.5 kΩ	1.801 V
1.5 V	24.3 kΩ	1.506 V
1.2 V	Open	1.200 V

Figure 1-1; V_o Adjust Resistor Placement

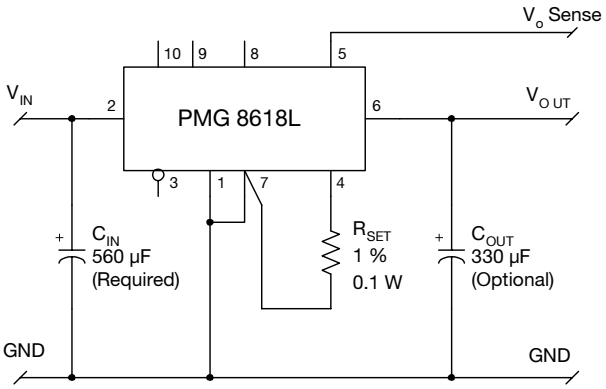


Table 1-2; Output Voltage Set-Point Resistor Values

V_a Req'd	R_{set}	V_a Req'd	R_{set}
1.200	Open	2.75	3.34 kΩ
1.225	318 kΩ	2.80	3.18 kΩ
1.250	158 kΩ	2.85	3.03 kΩ
1.275	105 kΩ	2.90	2.89 kΩ
1.300	78.2 kΩ	2.95	2.75 kΩ
1.325	62.2 kΩ	3.00	2.62 kΩ
1.350	51.5 kΩ	3.05	2.5 kΩ
1.375	43.9 kΩ	3.10	2.39 kΩ
1.400	38.2 kΩ	3.15	2.28 kΩ
1.425	33.7 kΩ	3.20	2.18 kΩ
1.450	30.2 kΩ	3.25	2.08 kΩ
1.475	27.3 kΩ	3.30	1.99 kΩ
1.50	24.8 kΩ	3.35	1.9 kΩ
1.55	21 kΩ	3.40	1.82 kΩ
1.60	18.2 kΩ	3.45	1.74 kΩ
1.65	16 kΩ	3.50	1.66 kΩ
1.70	14.2 kΩ	3.55	1.58 kΩ
1.75	12.7 kΩ	3.6	1.51 kΩ
1.80	11.5 kΩ	3.7	1.38 kΩ
1.85	10.5 kΩ	3.8	1.26 kΩ
1.90	9.61 kΩ	3.9	1.14 kΩ
1.95	8.85 kΩ	4.0	1.04 kΩ
2.00	8.18 kΩ	4.1	939 Ω
2.05	7.59 kΩ	4.2	847 Ω
2.10	7.07 kΩ	4.3	761 Ω
2.15	6.6 kΩ	4.4	680 Ω
2.20	6.18 kΩ	4.5	604 Ω
2.25	5.8 kΩ	4.6	533 Ω
2.30	5.45 kΩ	4.7	466 Ω
2.35	5.14 kΩ	4.8	402 Ω
2.40	4.85 kΩ	4.9	342 Ω
2.45	4.85 kΩ	5.0	285 Ω
2.50	4.33 kΩ	5.1	231 Ω
2.55	4.11 kΩ	5.2	180 Ω
2.60	3.89 kΩ	5.3	131 Ω
2.65	3.7 kΩ	5.4	85 Ω
2.70	3.51 kΩ	5.5	41 Ω

Notes:

1. Use a 0.1 W resistor. The tolerance should be 1 %, with temperature stability of 100 ppm/°C (or better). Place the resistor as close to the regulator as possible. Connect the resistor directly between pins 4 and 7 using dedicated PCB traces.
2. Never connect capacitors from *V_o Adjust* to either *GND* or *V_{out}*. Any capacitance added to the *V_o Adjust* pin will affect the stability of the regulator.

Capacitor Recommendations for the PMG 8718 T Series of Plug-in Power Modules

Input Capacitor

The recommended input capacitance is determined by 800 mA rms minimum ripple current rating and 560 µF minimum capacitance.

Ripple current and <100 mW equivalent series resistance (ESR) values are the major considerations, along with temperature, when designing with different types of capacitors. Tantalum capacitors have a recommended minimum voltage rating of 2 ´ (max. DC voltage + AC ripple). This is necessary to insure reliability for input voltage bus applications. Tantalum capacitors are not recommended on the input bus.

Output Capacitors (Optional)

The recommended ESR of the output capacitor is less than or equal to 150 mW. Electrolytic capacitors have marginal ripple performance at frequencies greater than 400 kHz but excellent low frequency transient response. Above the ripple frequency, ceramic capacitors are necessary to improve the transient response and reduce any high frequency noise components apparent during higher current excursions. Preferred low-ESR capacitor part numbers are identified in Table 2-1.

Tantalum Capacitors

Tantalum type capacitors can be used for the output but only the AVX TPS, Sprague 593D/594/595 or Kemet T495/T510 series. These capacitors are recommended over many other tantalum types due to their higher rated surge, power dissipation, and ripple current capability. As a caution the TAJ series by AVX is not recommended. This series has considerably higher ESR, reduced power dissipation, and lower ripple current capability. The TAJ series is also less reliable than the AVX TPS series when determining power dissipation capability. Tantalum or Oscon® types are recommended for applications where ambient temperatures fall below 0°C.

Ceramic Capacitors

Ceramic capacitors will compliment electrolytic types. Adding 10 µF to 47 µF of ceramic capacitance will reduce ripple on the input and output bus. Output ripple and transient measurement accuracy is improved by measuring directly across a 10 µF ceramic capacitor.

Capacitor Table

Table 2-1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The number of capacitors required at both the input and output buses is identified for each capacitor type.

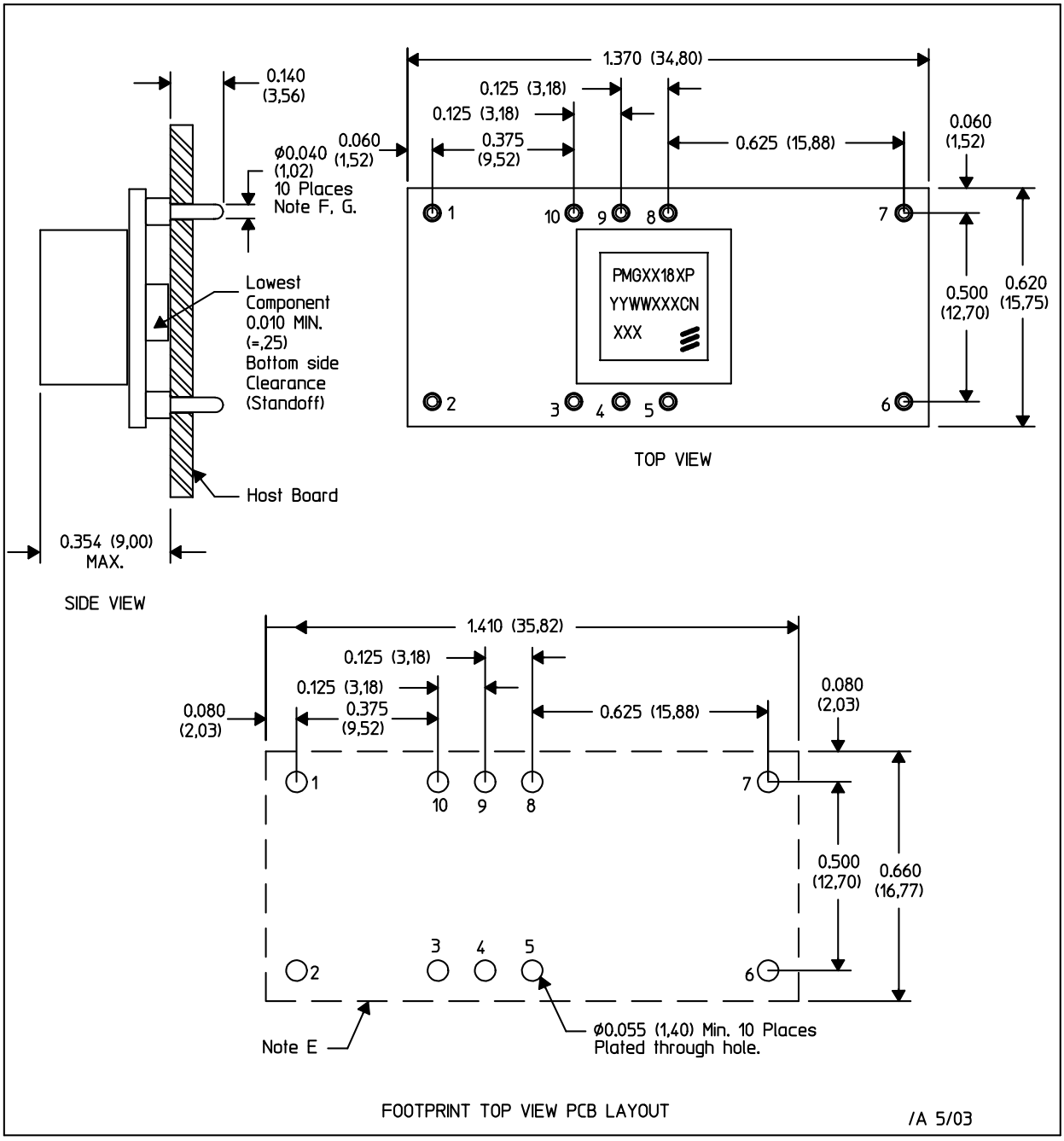
This is not an extensive capacitor list. Capacitors from other vendors are available with comparable specifications. Those listed are for guidance. The RMS ripple current rating and ESR (at 100 kHz) are critical parameters necessary to insure both optimum regulator performance and long-term reliability.

Table 2-1: Input/Output Capacitors

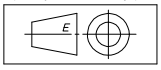
Capacitor Vendor/ Series	Capacitor Characteristics					Quantity		
	Working Voltage	Value (µF)	(ESR) Equivalent Series Resistance	105°C Maximum Ripple Current (Irms)	Physical Size(mm)	Input Bus	Optional Output Bus	Vendor Part Number
Panasonic WA (SMT)	16 V	330	0.022 Ω	>4100 mA	10×10.2	2	1	EEFWA1C331P
FC-Radial	25 V	330	0.090 Ω	755 mA	10×12.5	2	1	EEUFC1E331
	25 V	1000	0.060 Ω	1100 mA	12.5×13.5	1	1	EEVFK1E102Q
FK (SMT)	35 V	680	0.060 Ω	1100 mA	12.5×13.5	1	1	EEVFK1V681Q
United Chemi-Con-FX	16 V	330	0.018 Ω	4500 mA	10×10.5	2	1	16FX330M
PS Series	16 V	330	0.014 Ω	>5050 mA	10×12.5	2	1	16PS330MJ12
LXZ	16 V	680	0.068 Ω	1050 mA	10×16	1	1	LXZ16VB681M10X16LL
PXA (SMT)	16 V	180x3	0.026 Ω	>3400 mA	10×7.7	3	1	PXA16VC181MJ80TP
Nichicon	25 V	560	0.060 Ω	1060 mA	12.5×15	1	1	UPM1E561MHH6
PM Series	25 V	680	0.055 Ω	1270 mA	16×15	1	1	UPM1E681MHH6
	35 V	560	0.048 Ω	1360 mA	16×15	1	1	UPM1V561MHH6
WG	25 V	330	0.15÷2 Ω	>1000 mA	10×10	2	2	UWG1E331MNR1GS
Os-con:								
SP	16 V	270	0.018 Ω	>3500 mA	10×10.5	2	1	16SP270M
SVP (SMT)	16 V	330	0.016 Ω	4700 mA	11×12	2	1	16SVP330M
AVX Tantalum	10 V	330	0.10 Ω	>2500 mA	7.3L	N/R (1)	1	TPSE337M010R0100 (V_O<5.1V)
TPS (SMT)	10 V	330	0.06 Ω	>3000 mA	×5.7W	N/R (1)	1	TPSV337M010R0060 (V_O<5.1V)
					×4.1H			
Kemet Tantalum	10 V	330	0.04 Ω	1600 mA	4.3W	N/R (1)	1	520X337M010AS (V_O<5.1V)
T520/T495 Series	10 V	220	0.07 Ω	>2000 mA	×7.3L	N/R (1)	1	T495X227M0100AS (V_O<5.1V)
(SMT)					×4.0H			
Sprague Tantalum	10 V	330	0.045 Ω	2360 mA	7.2L	N/R (1)	1	594D337X0010R2T (V_O<5.1V)
594D Series (SMT)					×6W			
					×4.1H			

(1) N/R –Not recommended. The voltage rating does not meet the minimum operating limits.

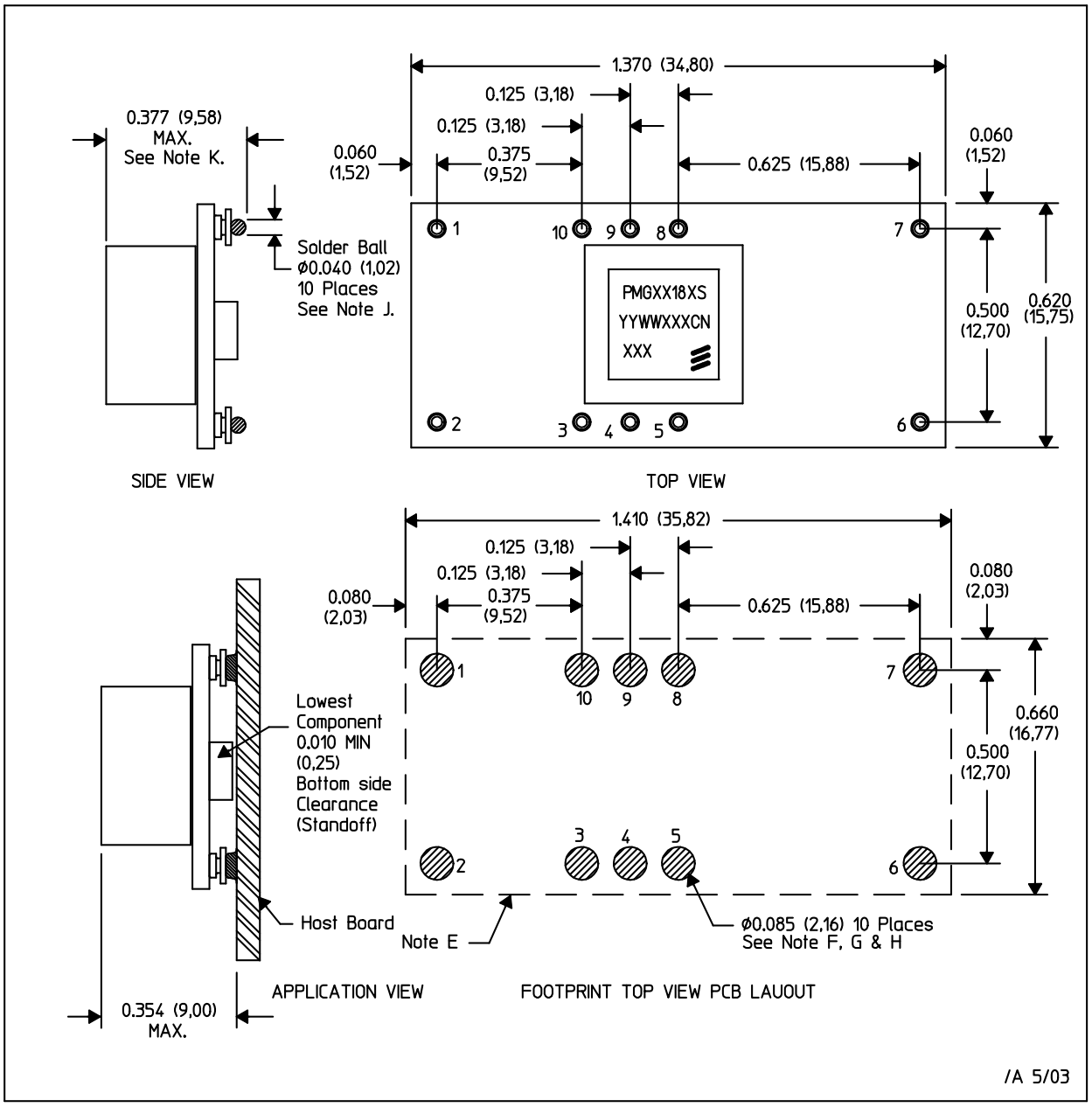
Hole mount version. DOUBLE SIDED MODULE



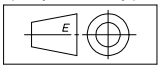
NOTES:
A. All linear dimensions are in inches (mm).
B. This drawing is subject to change without notice.
C. 2 place decimals are ±0.030 (±0,76mm).
D. 3 place decimals are ±0.010 (±0,25mm).
E. Recommended keep out area for user components.
F. Pins are 0.040" (1,02) diameter with
0.070" (1,78) diameter standoff shoulder.
G. All pins: Material - Copper Alloy
Finish - Tin (100%) over Nickel plate
H. European projection type is used.



Surface mount version. DOUBLE SIDED MODULE



NOTES:
A. All linear dimensions are in inches (mm).
B. This drawing is subject to change without notice.
C. 2 place decimals are ±0.030 (±0,76mm).
D. 3 place decimals are ±0.010 (±0,25mm).
E. Recommended keep out area for user components.
F. Power pin connection should utilize two or more vias to the interior power plane of 0.025 (0,63) I.D. per input, ground and output pin (or the electrical equivalent).
G. Paste screen opening: 0.080 (2,03) to 0.085 (2,16). Paste screen thickness: 0.006 (0,15).
H. Pad type: Solder mask defined.
J. All pins: Material - Copper Alloy
Finish - Tin (100%) over Nickel plate
Solder Ball - See product data sheet.
K. Dimension prior to reflow solder.
L. European projection type is used.



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