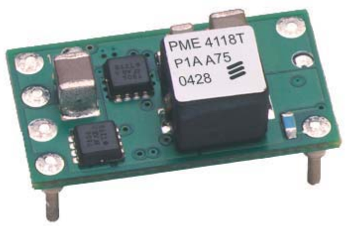
PME 4118 T 3.3-V Input

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

POLA code: PTH03050 W



NOMINAL SIZE = 0.87 in x 0.5 in
(22,1 mm x 12,57 mm)

Features

- Up to 6-A Output Current
- 3.3-V Input Voltage
- Wide-Output Voltage Adjust (0.8 V to 2.5 V)
- Efficiencies up to 94 %
- 103 W/in³ Power Density
- On/Off Inhibit
- Pre-Bias Startup
- Under-Voltage Lockout
- Operating Temp: –40 to +85 °C
- Auto-Track™ Sequencing(1)
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- IPC Lead Free 2
- Safety Agency Approvals: UL 1950, CSA 22.2 950, EN60950 VDE (Pending)
- Point-of-Load Alliance (POLA) Compatible

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

Description

The PME 4118 T is one of the smallest non-isolated power modules from Ericsson Power Modules that features Auto-Track™. Auto-Track simplifies supply voltage sequencing in power systems by enabling modules to track each other, or any other external voltage, during power up and power down.

Although small in size (0.87 in ´0.5 in), these modules are rated for up to 6 A of output current, and are an ideal choice in applications where space, performance, and a power-up sequencing capability are important attributes.

The product provides high-performance step-down conversion from a 3.3-V input bus voltage. The output voltage of the PME 4118 T can be set to any voltage over the range, 0.8 V to 2.5 V, using a single resistor.

Other operating features include an on/off inhibit, output voltage adjust (trim), and output over-current protection. For high efficiency these parts employ a synchronous rectifier output stage, but a pre-bias hold-off capability ensures that the output will not sink current during startup.

Target applications include telecom, industrial, and general purpose circuits, including low-power dual-voltage systems that use a DSP, microprocessor, ASIC, or FPGA.

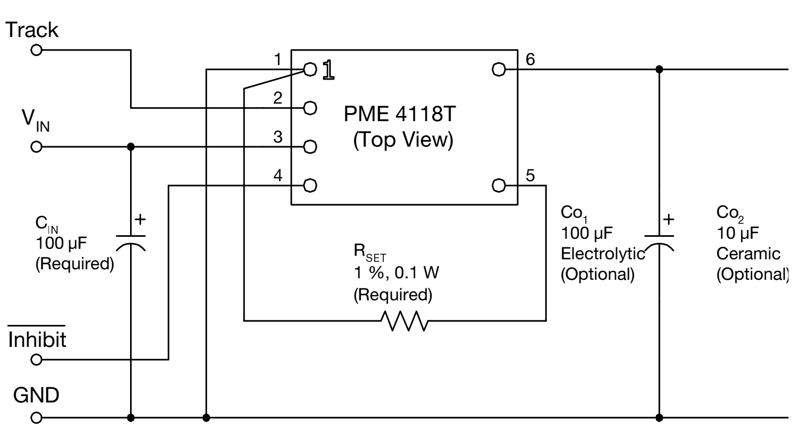
Package options include both through-hole and surface mount configurations.

Pin Configuration

Pin	Function
1	GND
2	Track
3	V_{in}
4	Inhibit *
5	V_o Adjust
6	V_{out}

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

Standard Application



R_{set} = Required to set the output voltage to a value higher than 0.8 V. (See spec. table for values)
C_{in} = Required 100 µF
Co_1 = Optional 100 µF capacitor
Co_2 = Optional 10 µF ceramic capacitor for reduced output ripple.

ERICSSON

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

Product Table (PME 4118 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 /6 A	15 W	P	Horiz. T/H	PME 4118 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	56 pcs	/B	PME 4118T P /B
Tape & Reel [2]	250 pcs	/C	PME 4118T 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.

Vo Adjust: A 0.1 W 1 % resistor must be directly connected between this pin and *GND* to set the output voltage to a value higher than 0.8 V. The temperature stability of the resistor should be 100 ppm/°C (or better). The set-point range for the output voltage is from 0.8 V to 2.5 V. The resistor value required for a given output voltage may be calculated from the following formula. If this pin is left open circuit, the output voltage will default to its lowest value. For further information on output voltage adjustment consult the related application note.

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

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

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.

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 should be connected to V_{in}. *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.*

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

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 (i)	—	85	°C
Solder Reflow Temperature	T_{reflow}	Surface temperature of module body or pins			235 (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	—		—	2.9	—	grams
Flammability	—	Meets UL 94V-O				

Notes: *(i) For operation below 0 °C the external capacitors m ust bave 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.

Specifications (Unless otherwise stated, T_a =25 °C, V_{in} =3.3 V, V_o =2.5 V, C_{in} =100 µF, Co_1 =0 µF, Co_2 =0 µF, and I_o =$I_o$max)

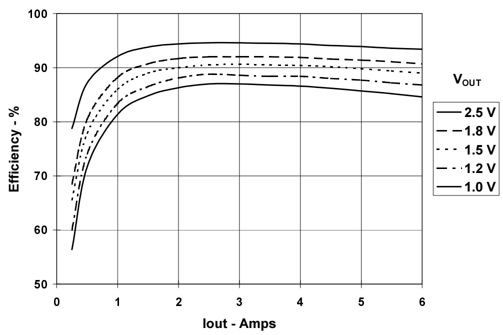
			PME 4118 T			
Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Output Current	I_o	0.8 V ≤ V_o ≤ 2.5 V, 85 °C, natural convection	0	—	6 (1)	A
Input Voltage Range	V_{in}	Over I_o range	2.95	—	3.65	V
Set-Point Voltage Tolerance	V_o tol		—	—	±2 (2)	$\%V_o$
Temperature Variation	ΔReg_{temp}	–40 °C < T_a < +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 =4 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	— — — — — —	94 92 91 90 88 87	— — — — — —	%
V_o Ripple (pk-pk)	V_r	20 MHz bandwidth, Co_2 =10 µF ceramic	—	20 (3)	—	mVpp
Over-Current Threshold	I_o trip	Reset, followed by auto-recovery	—	12	—	A
Transient Response t_{tr} 	 ΔV_{tr}	1 A/µs load step, 50 to 100 % $I_o$max, Co_1 =100 µF Recovery Time V_o over/undershoot	 — —	 70 100	 — —	 µSec mV
Track Input Current (pin 2)	I_{IL} track	Pin to GND	—	—	–130 (4)	µA
Track Slew Rate Capability	dV_{track}/dt	C_{out} ≤ C_{out}(max)	—	—	1	V/ms
Under-Voltage Lockout	U V L O	V_{in} increasing V_{in} decreasing	— 2.2	2.45 2.40	2.8 —	V
Inhibit Control (pin4) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	Referenced to GND	 V_{in} –0.5 –0.2	 — —	 Open (4) 0.6	V
Input Low Current	I_{IL} inhibit	Pin to GND	—	–130	—	µA
Input Standby Current	I_{in} inh	Inhibit (pin 4) to GND, Track (pin 2) open	—	10	—	mA
Switching Frequency	f_s	Over V_{in} and I_o ranges	550	600	650	kHz
External Input Capacitance	C_{in}		100 (5)	—	—	µF
External Output Capacitance	Co_1, Co_2	Capacitance value non-ceramic ceramic	0 0	100 (6) —	3,300 (7) 300	µF
		Equiv. series resistance (non-ceramic)	4 (8)	—	—	mW
Reliability	M T B F	Per Bellcore TR-332 50 % stress, T_a =40 °C, ground benign	6	—	—	10^6 Hrs

Notes:

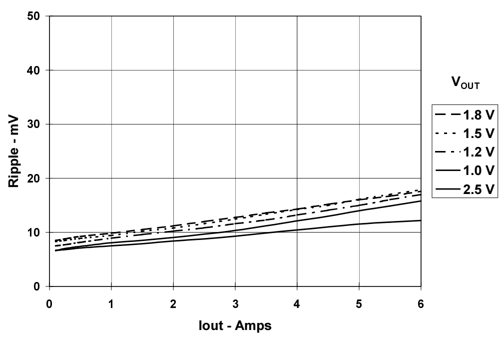
(1) No derating is required when the module is soldered directly to a 4-layer PCB with 1 oz. copper.
(2) The set-point voltage tolerance is affected by the tolerance and stability of R_{SET}. The stated limit is unconditionally met if R_{SET} has a tolerance of 1 % with 100 ppm/°C or better temperature stability.
(3) The pk-pk output ripple voltage is measured with an external 10 µF ceramic capacitor. See the standard application schematic.
(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 100 µF input capacitor is required for proper operation. The capacitor must be rated for a minimum of 300 mA rms of ripple current.
(6) An external output capacitor is not required for basic operation. Adding 100 µF of distributed capacitance at the load will improve the transient response.
(7) This is the calculated maximum. The minimum ESR limitation will often result in a lower value. Consult the application notes for further guidance.
(8) This is the typcial ESR for all the electrolytic (non-ceramic) output capacitance. Use 7 mW as the minimum when using max-ESR values to calculate.

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

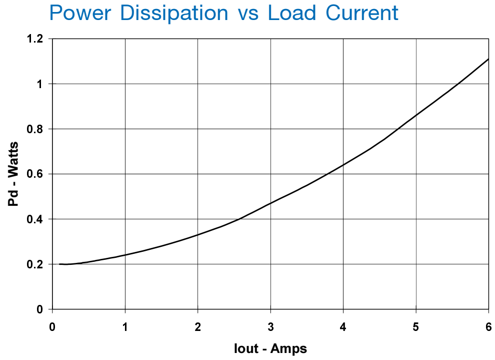
Efficiency vs Load Current



Output Ripple vs Load Current *(See Note 3 to Table)*



Power Dissipation vs Load Current



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

PME 5218 T 5-V Input

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

POLA code: PTH05050 W

NOMINAL SIZE = 0.87 in x 0.5 in
(22,1 mm x 12,57 mm)

Features

- Up to 6-A Output Current
- 5-V Input Voltage
- Wide-Output Voltage Adjust (0.8 V to 3.6 V)
- Efficiencies up to 95 %
- 135 W/in³ Power Density
- On/Off Inhibit
- Pre-Bias Startup
- Under-Voltage Lockout
- Operating Temp: –40 to +85 °C
- Auto-Track™ Sequencing(1)
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- IPC Lead Free 2
- Safety Agency Approvals: UL 1950, CSA 22.2 950, EN60950 VDE (Pending)
- Point-of-Load Alliance (POLA) Compatible

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

Description

The PME 5218 T is one of the smallest non-isolated power modules from Ericsson Power Modules that features Auto-Track™.

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

Although small in size (0.87 in ´ 0.5 in), these modules are rated for up to 6 A of output current, and are an ideal choice in applications where space, performance, and a power-up sequencing capability are important attributes.

The product provides high-performance step-down conversion from a 5-V input bus voltage. The output voltage of the PME 5218 T can be set to any voltage over the range, 0.8 V to 3.6 V, using a single resistor.

Other operating features include an on/off inhibit, output voltage adjust (trim), and output over-current protection. For high efficiency these parts employ a synchronous rectifier output stage, but a pre-bias hold-off capability ensures that the output will not sink current during startup.

Target applications include telecom, industrial, and general purpose circuits, including low-power dual-voltage systems that use a DSP, microprocessor, ASIC, or FPGA.

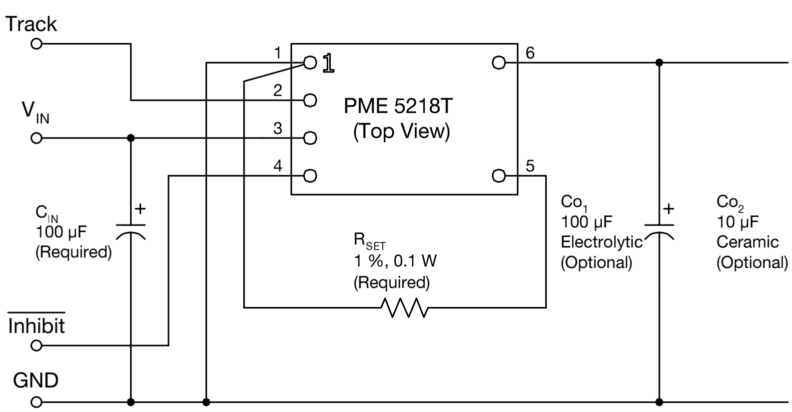
Package options include both through-hole and surface mount configurations.

Pin Configuration

Pin	Function
1	GND
2	Track
3	V_{in}
4	Inhibit *
5	V_o Adjust
6	V_{out}

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

Standard Application



R_{set} = Required to set the output voltage to a value higher than 0.8 V. (See spec. table for values)
C_{in} = Required 100 µF
Co_1 = Optional 100 µF capacitor
Co_2 = Optional 10 µF ceramic capacitor for reduced output ripple.

Product Table (PME 5218 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 /6 A	22 W	P	Horiz. T/H	PME 5218 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	56 pcs	/B	PME 5218T P /B
Tape & Reel (2)	250 pcs	/C	PME 5218T 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.

Vo Adjust: A 1 % 0.1 W resistor must be directly connected between this pin and *GND* to set the output voltage to a value higher than 0.8 V. The temperature stability of the resistor should be 100 ppm/°C (or better). The set point range for the output voltage is from 0.8 V to 3.6 V. The resistor value required for a given output voltage may be calculated from the following formula. If this is pin is left open circuit, the output voltage will default to its lowest value. For further information on output voltage adjustment consult the related application note.

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

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

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.

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 should be connected to V_{in}. *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.*

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

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 (i)	—	85	°C
Solder Reflow Temperature	T_{reflow}	Surface temperature of module body or pins			235 (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	—		—	2.9	—	grams
Flammability	—	Meets UL 94V-O				

Notes: *(i) For operation below 0 °C the external capacitors m ust bave 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.

Specifications (Unless otherwise stated, T_a =25 °C, V_{in} =5 V, V_o =3.3 V, C_{in} =100 µF, Co_1 =0 µF, Co_2 =0µF, and I_o =$I_o$max)

			PME 5218 T			
Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Output Current	I_o	$0.8\ V \le V_o \le 3.6\ V$, 85°C, natural convection	0	—	6 (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, $-40\ °C \le T_a \le +85\ °C$	—	—	±3 (2)	%V_o
Efficiency	η	I_o =4 A R_{SET} = 698 Ω V_o = 3.3 V 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	— — — — — — —	95 93 91 90 89 87 85	— — — — — — —	%
V_o Ripple (pk-pk)	V_r	20 MHz bandwidth, Co_2 =10 µF ceramic	—	20 (3)	—	mVpp
Over-Current Threshold	I_o trip	Reset, followed by auto-recovery	—	12	—	A
Transient Response t_{tr}	 ΔV_{tr}	1 A/µs load step, 50 to 100 % $I_o$max, Co_1 =100 µF Recovery Time V_o over/undershoot	 — —	 70 100	 — —	 µSec mV
Track Input Current (pin 2)	I_{IL} track	Pin to GND	—	—	–130 (4)	µA
Track Slew Rate Capability	dV_{track}/dt	$C_{out} \le C_{out}(max)$	—	—	1	V/ms
Under-Voltage Lockout	U V L O	V_{in} increasing V_{in} decreasing	— 3.4	4.3 3.7	4.45 —	V
Inhibit Control (pin4) Input High Voltage Input Low Voltage	 V_{IH} V_{IL}	Referenced to GND	 V_{in} –0.5 –0.2	 — —	 Open (4) 0.6	V
Input Low Current	I_{IL} inhibit	Pin to GND	—	–130	—	µA
Input Standby Current	I_{in} inh	Inhibit (pin 4) to GND, Track (pin 2) open	—	10	—	mA
Switching Frequency	f_s	Over V_{in} and I_o ranges	550	600	650	kHz
External Input Capacitance	C_{in}		100 (5)	—	—	µF
External Output Capacitance	Co_1, Co_2	Capacitance value non-ceramic ceramic	0 0	100 (6) —	3,300 (7) 300	µF
		Equiv. series resistance (non-ceramic)	4 (8)	—	—	mW
Reliability	M T B F	Per Bellcore TR-332 50 % stress, T_a =40 °C, ground benign	6	—	—	10^6 Hrs

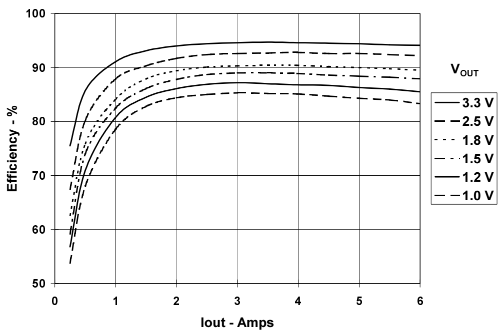
Notes:

(1) No derating is required when the module is soldered directly to a 4-layer PCB with 1 oz. copper.
(2) The set-point voltage tolerance is affected by the tolerance and stability ofR_{SET}. The stated limit is unconditionally met if R_{SET} has a tolerance of 1 % with 100 ppm/°C or better temperature stability.
(3) The pk-pk output ripple voltage is measured with an external 10 µF ceramic capacitor. See the standard application schematic.
(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 100 µF input capacitor is required for proper operation. The capacitor must be rated for a minimum of 300 mA rms of ripple current.
(6) An external output capacitor is not required for basic operation. Adding 100 µF of distributed capacitance at the load will improve the transient response.
(7) This is the calculated maximum. The minimum ESR limitation will often result in a lower value. Consult the application notes for further guidance.
(8) This is the typcial ESR for all the electrolytic (non-ceramic) output capacitance. Use 7 mΩas the minimum when using max-ESR values to calculate.

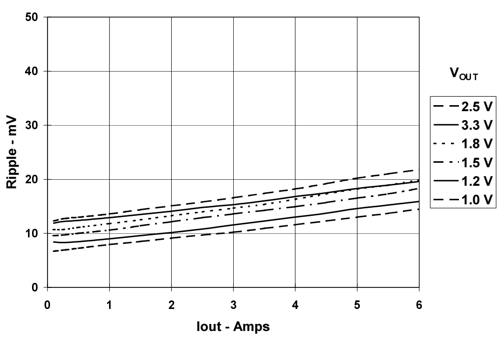
6-A, 5-V Input Non-Isolated
Wide-Output Adjust Power Module

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

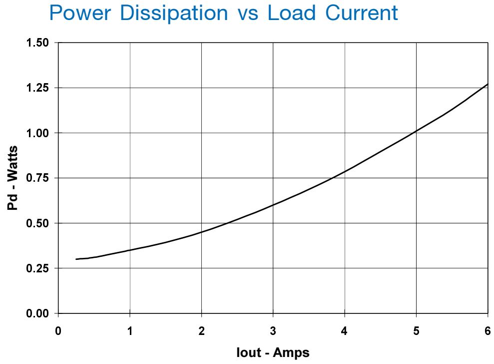
Efficiency vs Load Current



Output Ripple vs Load Current *(See Note 3 to Table)*



Power Dissipation vs Load Current



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

Capacitor Recommendations for the PME 4118 T & PME 5218 T Series of Power Modules

Input Capacitor

The recommended input capacitor(s) is determined by the 100 µF [1] minimum capacitance and 300 mArms minimum ripple current rating.

Ripple current, less than 100 mΩ equivalent series resistance (ESR), and temperature are the major considerations when selecting input capacitors. Unlike polymer tantalum, regular tantalum capacitors have a recommended minimum voltage rating of 2 ´ (maximum DC voltage + AC ripple). This is standard practice to ensure reliability.

For improved ripple reduction on the input bus, ceramic capacitors may be substituted for electrolytic types using the minimum required capacitance.

Output Capacitors (Optional)

For applications with load transients (sudden changes in load current), regulator response will benefit from an external output capacitance. The recommended output capacitance of 100 µF will allow the module to meet its transient response specification (see product data sheet). For most applications, a high quality computer-grade aluminum electrolytic capacitor is adequate. These capacitors provide decoupling over the frequency range, 2 kHz to 150 kHz, and are suitable when ambient temperatures above 0 °C. For operation below 0 °C tantalum, ceramic or Os-Con type capacitors are recommended. When using one or more non-ceramic capacitors, the calculated equivalent ESR should be no lower than 4 mΩ (7 mΩ using the manufacturer's maximum ESR for a single capacitor). A list of preferred low-ESR type capacitors are identified in Table 2-1.

Ceramic Capacitors

Above 150 kHz the performance of aluminum electrolytic capacitors becomes less effective. To further improve the reflected input ripple current or the output transient response, multilayer ceramic capacitors can also be added. Ceramic capacitors have very low ESR and their resonant frequency is higher than the bandwidth of the regulator. When used on the output their combined ESR is not critical as long as the total value of ceramic capacitance does not exceed 300 µF. Also, to prevent the formation of local resonances, do not place more than five identical ceramic capacitors in parallel with values of 10 µF or greater.

Tantalum Capacitors

Tantalum type capacitors can be used at both the input and output, and are recommended for applications where the ambient operating temperature can be less than 0 °C. The AVX TPS, Sprague 593D/594/595 and Kemet T495/ T510 capacitor series are suggested over many other tantalum types due to their higher rated surge, power dissipation, and ripple current capability. As a caution many general purpose tantalum capacitors have considerably higher ESR, reduced power dissipation and lower ripple current capability. These capacitors are also less reliable as they have reduced power dissipation and surge current ratings. Tantalum capacitors that do not have a stated ESR or surge current rating are not recommended for power applications.

When specifying Os-Con and polymer tantalum capacitors for the output, the minimum ESR limit will be encountered well before the maximum capacitance value is reached.

Capacitor Table

Table 2-1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The recommended 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 100kHz) are critical parameters necessary to insure both optimum regulator performance and long capacitor life.

Designing for Very Fast Load Transients

The transient response of the DC/DC converter has been characterized using a load transient with a di/dt of 1 A/µs. The typical voltage deviation for this load transient is given in the data sheet specification table using the optional value of output capacitance. As the di/dt of a transient is increased, the response of a converter's regulation circuit ultimately depends on its output capacitor decoupling network. This is an inherent limitation with any DC/DC converter once the speed of the transient exceeds its bandwidth capability. If the target application specifies a higher di/dt or lower voltage deviation, the requirement can only be met with additional output capacitor decoupling. In these cases special attention must be paid to the type, value and ESR of the capacitors selected.

If the transient performance requirements exceed that specified in the data sheet, or the total amount of load capacitance is above 3,000 µF, the selection of output capacitors becomes more important. For further guidance consult the separate application note, "*Selecting Output Capacitors for PME Products in High-Performance Applications.*"

POLA Point-of-Load Alliance

Table 2-1: Input/Output Capacitors

Capacitor Vendor, Type Series (Style)	Capacitor Characteristics y					Quantit		
	Working Voltage	Value (µF)	Max. (ESR) at 100 kHz	Max. Ripple at 85 ˚C Current (Irms)	Physical Size (mm)	Input Bus	Output Bus	Vendor Number
Panasonic FC, Aluminum (SMD) WA, Poly-Aluminum (SMD)	 25 V 10 V	 100 µF 120 µF	 0.300 Ω 0.035 Ω	 450 mA 2800 mA	 8×10 8.3×6.9	 1 1	 1 ≤5	 EEVFC1E101P EEFWA1A121P
Panasonic, Aluminum FC (Radial) FK (SMD)	 16 V 16 V	 220 µF 330 µF	 0.150 Ω 0.160 Ω	 555 mA 600 mA	 10×10.2 8×10.2	 1 1	 1 1	 EEUFC1C221 EEVFK1C331P
United Chemi–Con FS, Os-con (Radial) PXA, Poly-Alum (SMD) MVZ, Aluminum (SMD) PS, Poly-Alum. (Radial)	 10 V 10 V 16 V 10 V	 100 µF 120 µF 220 µF 100 µF	 0.040 Ω 0.027 Ω 0.170 Ω 0.024 Ω	 2100 mA 2430 mA 450 mA 4420 mA	 6.3×9.8 8×6.7 8×10 8×11.5	 1 1 1 1	 ≤5 ≤4 1 ≤4	 10FS100M PXA10VC121MH80TP MVZ25VC221MH10TP 10PS270MH11
Nichicon, Aluminum WG, Aluminum (SMD) PM, (Radial) F55, Tantalum (SMD)	 35 V 25 V 10 V	 100 µF 150 µF 100 µF	 0.150 Ω 0.160 Ω 0.055 Ω	 670 mA 460 mA 2000 mA	 10×10 10×11.5 7.7×4.3	 1 1 1	 1 1 1	 UWG1V101MNR1GS UPM1E151MPH F551A107MN
Sanyo SVP, Os-con (SMD) SP, Os-con (Radial) TPE Poscap Polymer (SMD)	 10 V 16 V 10 V	 120 µF 100 µF 220 µF	 0.040 Ω 0.025 Ω 0.025 Ω	 >2500 mA >2800 mA >2400mA	 7×8 6.3×9.8 7.3×5.7	 1 1 1	 ≤5 ≤4 ≤4	 10SVP120M 16SPS100M 10TPE220ML
AVX, Tantalum TPS (SMD)	 10 V 10 V	 100 µF 220 µF	 0.100 Ω 0.100 Ω	 >1090 mA >1414 mA	 7.3L ×4.3W ×4.1H	 1 1	 ≤5 ≤5	 TPSD107M010R0100 TPSV227M010R0100
Kemet T520, Poly-Alum (SMD) T495,Tantalum (SMD) A700-Poly-Alum. (SMD)	 10 V 10 V 6.3 V	 100 µF 100 µF 100 µF	 0.080 Ω 0.100 Ω 0.018 Ω	 1200 mA >1100 mA 2900 mA	 7.3L ×5.7W ×4.0H	 1 1 1	 1 1 ≤3	 T520D107M010AS T495X107M010AS A700D107M006AT
Vishay-Sprague 594D, Tantalum (SMD) 595D, Tantalum (SMD) 94SA, Os-con (Radial)	 10 V 10 V 10 V	 150 µF 120 µF 100 µF	 0.090 Ω 0.140 Ω 0.030 Ω	 1100 mA >1000 mA 2670 mA	 7.3L ×6.0W ×4.1H 8×10.5	 1 1 1	 1 1 ≤4	 594D157X0010C2T 595D127X0010D2T 94SA107X0010EBP
Kemet, Ceramic X5R (SMD)	16 V 6.3 V	10 47	0.002 Ω 0.002 Ω	—	1210 case 3225 mm	1 2 [1]	≤5 ≤5	C1210C106M4PAC C1210C476K9PAC
Murata, Ceramic X5R (SMD)	6.3 V 6.3 V 16 V 16 V	100 47 22 10	0.002 Ω	—	1210 case 3225 mm	1 2 [1] 5 1 [2]	≤3 ≤5 ≤5 ≤5	GRM32ER60J107M GRM32ER60J476M GRM32ER61C226K GRM32DR61C106K
TDK, Ceramic X5R (SMD)	6.3 V 6.3 V 16 V 16 V	100 47 22 10	0.002 Ω	—	1210 case 3225 mm	1 2 [1] 5 1 [2]	≤3 ≤5 ≤5 ≤5	C3225X5R0J107MT C3225X5R0J476MT C3225X5R1C226MT C3225X5R1C106MT

[1] Total capacitance of 94 µF is acceptable based on the combined ripple current rating.
[2] Small ceramic capacitors may be used to compliment electrolytic types at the input to reduce high-frequency ripple current.

Adjusting the Output Voltage of the PME 4118 T & PME 5218 T Wide-Output Adjust Power Modules

The V_o *Adjust* control (pin 5) sets the output voltage to a value higher than 0.8 V. The adjustment range of the PME 4118T (3.3-V input) is from 0.8 V to 2.5 V [1], and the PME 5218T (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.

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

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
2 V	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

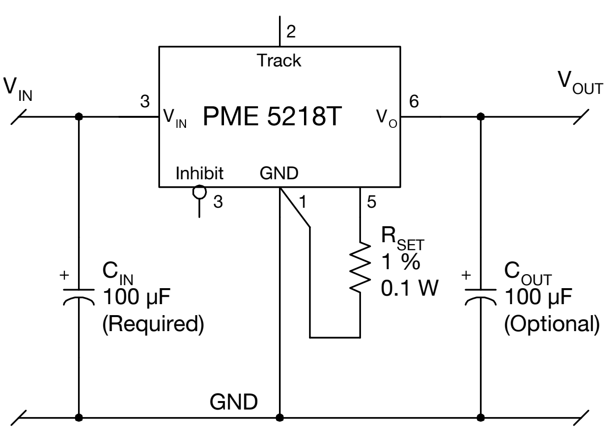


Table 1-2; Output Voltage Set-Point Resistor Values

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		

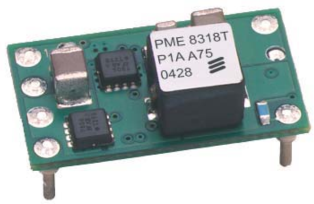
Notes:

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 5 and 1 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.

PME 8318 L 12-V Input

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

POLA code: PTH12050 W



NOMINAL SIZE = 0.87 in x 0.5 in
(22,1 mm x 12,57 mm)

Features

- Up to 6-A Output Current
- 12-V Input Voltage
- Wide-Output Voltage Adjust (1.2 V to 5.5 V)
- Efficiencies up to 93 %
- 200 W/in³ Power Density
- On/Off Inhibit
- Under-Voltage Lockout
- Operating Temp: –40 to +85 °C
- Auto-Track™ Sequencing(1)
- Output Over-Current Protection (Non-Latching, Auto-Reset)
- IPC Lead Free 2
- Safety Agency Approvals: UL 1950, CSA 22.2 950, EN60950 VDE (Pending)
- Point-of-Load Alliance (POLA) Compatible

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

Description

The PME 8318 L is one of the smallest non-isolated power modules from Ericsson Power Modules that features Auto-Track™ Sequencing. Auto-Track simplifies the sequencing of supply voltages in power systems by enabling modules to track each other, or any other external voltage, during power up and power down.

Although small in size (0.87 in ´0.5 in), these modules are rated for up to 6 A of output current, and are an ideal choice in applications where space, performance, and a power-up sequencing capability are important attributes.

The product provides high-performance step-down conversion from a 12-V input bus voltage.

The output voltage of the PME 8318 L can be set to any voltage over the range, 1.2 V to 5.5 V, using a single resistor.

Other operating features include an on/off inhibit, output voltage adjust (trim), and output over-current protection. For high efficiency these parts employ a synchronous rectifier output stage.

Target applications include telecom, industrial, and general purpose circuits, including low-power dual-voltage systems that use a DSP, microprocessor, ASIC, or FPGA.

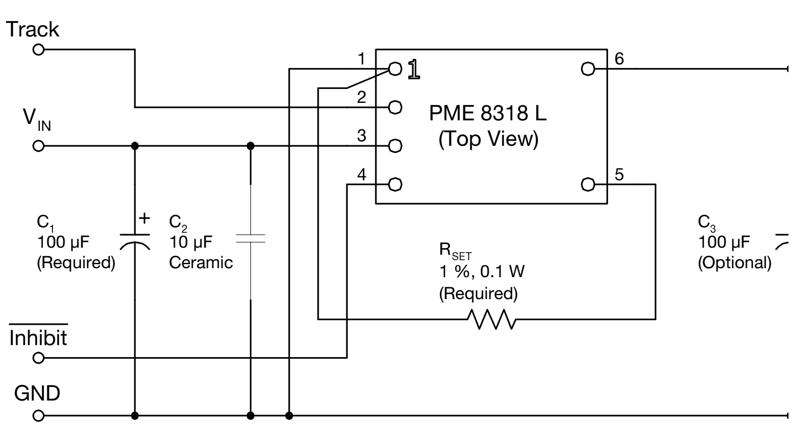
Package options include both through-hole and surface mount configurations.

Pin Configuration

Pin	Function
1	GND
2	Track
3	V_{in}
4	Inhibit *
5	V_o Adjust
6	V_{out}

* *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 spec. table for values)
C_1 = Required 100 µF capacitor
C_2 = 10 µF ceramic capacitor. Required for output voltages 3.3 V and higher
C_3 = Optional 100 µF capacitor

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

Product Table (PME 8318 L 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 /6 A	30 W	P	Horiz. T/H	PME 8318 L 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	56 pcs	/B	PME 8318L P /B
Tape & Reel (2)	250 pcs	/C	PME 8318L 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.

Vo Adjust: A 0.1 W 1 % resistor must be directly connected between this pin and pin 1 (*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 for the output voltage is from 1.2 V to 5.5 V. The resistor value 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.

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

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

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.

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 should be connected to V_{in}. *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.*

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

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	—		—	2.9	—	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} =12 V, V_{out} =3.3 V, C_1=100 µF, C_2 =10 µF, C_3 =0 µF, and I_o =$I_o$max)

			PME 8318L			
Characteristics	Symbols	Conditions	Min	Typ	Max	Units
Output Current	I_o	1.2 V ≤ V_o ≤ 5.5 V 85 °C, 400 LFM airflow 60 °C, natural convection	0 0	— —	6 (1) 6 (1)	A
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	—	±5	—	mV
Load Regulation	ΔReg_{load}	Over I_o range	—	±5	—	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 =5 A R_{SET} = 280 Ω V_o = 5.0 V R_{SET} = 2.0 kΩ V_o = 3.3 V R_{SET} = 4.32 kΩ V_o = 2.5 V R_{SET} = 8.06 kΩ V_o = 2.0 V R_{SET} = 11.5 kΩ V_o = 1.8 V R_{SET} = 24.3 kΩ V_o = 1.5 V R_{SET} = open cct V_o = 1.2 V	— — — — — — —	93 91 89 88 87 86 84	— — — — — — —	%
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	—	14	—	A
Transient Response	 t_{tr} ΔV_{tr}	1 A/µs load step, 50 to 100 % $I_o$max, C_3 =100 µF Recovery Time V_o over/undershoot	 — —	 70 100	 — —	 µSec mV
Track Input Current (pin 2)	I_{IL} track	Pin to GND	—	—	–0.13 (3)	mA
Track Slew Rate Capability	dV_{track}/dt	C_{out} ≤ C_{out}(max)	—	—	1	V/ms
Under-Voltage Lockout	U V L O	V_{in} increasing V_{in} decreasing	— 8.8	9.5 9	10.4 —	V
Inhibit Control (pin 4)		Referenced to GND				
Input High Voltage	V_{IH}		V_{in} –0.5	—	Open (3)	V
Input Low Voltage	V_{IL}		–0.2	—	0.5	
Input Low Current	I_{IL} inhibit	Pin to GND	—	–0.24	—	mA
Input Standby Current	I_{in} inh	Inhibit (pin 4) to GND, Track (pin 2) open	—	10	—	mA
Switching Frequency	f_s	Over V_{in} and I_o ranges	260	320	380	kHz
External Input Capacitance	C_1		100 (4)	—	—	µF
External Output Capacitance	C_3	Capacitance value non-ceramic ceramic	0 0	100 (5) —	3,300 (6) 300	µF
		Equiv. series resistance (non-ceramic)	4 (7)	—	—	
Reliability	M T B F	Per Bellcore TR-332 50 % stress, T_a =40 °C, ground benign	5.9	—	—	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) *This control pin has an internal pull-up to the input voltage Vin (7.5 V for pin 2). 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.*

(4) *A 100 µF electrolytic input capacitor is required for proper operation. The electrolytic capacitor must be rated for a minimum of 750 mA rms of ripple current. An additional 10 µF ceramic capacitor is required for output voltages 3.3 V and higher. For further information, consult the related application note on capacitor selection.*

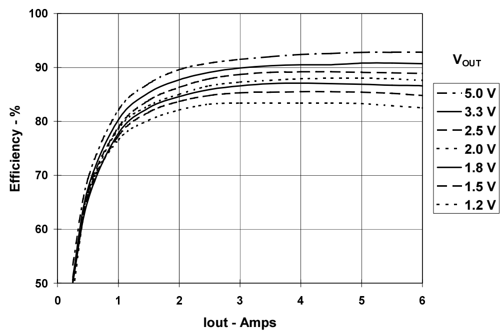
(5) *An external output capacitor is not required for basic operation. Adding 100 µF of distributed capacitance at the load will improve the transient response.*

(6) *This is the calculated maximum. The minimum ESR limitation will often result in a lower value. Consult the application notes for further guidance.*

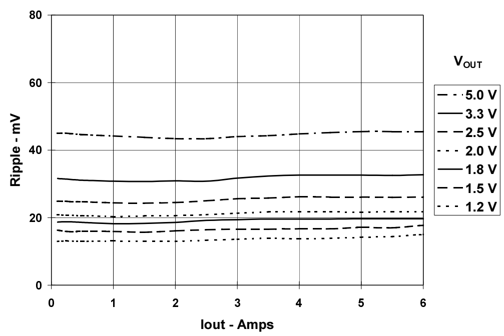
(7) *This is the typcial ESR for all the electrolytic (non-ceramic) output capacitance. Use 7 mW as the minimum when using max-ESR values to calculate.*

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

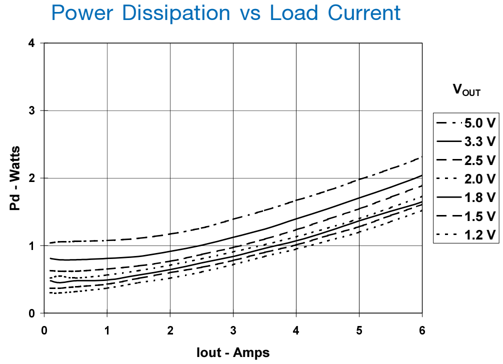
Efficiency vs Load Current



Output Ripple vs Load Current

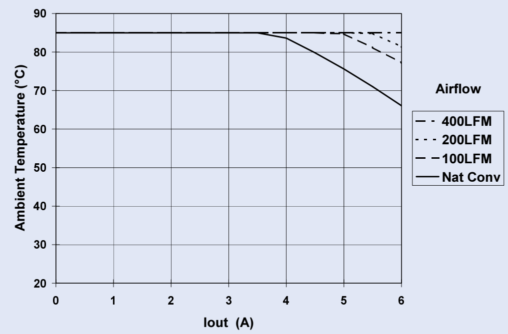


Power Dissipation vs Load Current



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

All Output Voltages



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.*

Capacitor Recommendations for the PME 8318L Series of Power Modules

Input Capacitor

The recommended input capacitor(s) is determined by the 100 µF minimum capacitance and 750 mArms minimum ripple current rating. A 10-µF X5R/X7R ceramic capacitor may also be added to reduce the reflected input ripple current. This is recommended for output voltage set points of 3.3 V and higher.

Ripple current, less than 100 mΩ equivalent series resistance (ESR) and temperature are major considerations when selecting input capacitors. Unlike polymer-tantalum capacitors, regular tantalum capacitors have a recommended minimum voltage rating of 2 ´ (max. DC voltage + AC ripple). This is standard practice to ensure reliability. Only a few tantalum capacitors have sufficient voltage rating to meet this requirement. At temperatures below 0 °C, the ESR of aluminum electrolytic capacitors increases. For these applications Os-Con, polymer-tantalum, and polymer-aluminum types should be considered.

Output Capacitors (Optional)

For applications with load transients (sudden changes in load current), regulator response will benefit from external output capacitance. The value of 330 µF is used to define the transient response specification (see data sheet). For most applications, a high quality computer-grade aluminum electrolytic capacitor is adequate. These capacitors provide decoupling over the frequency range, 2 kHz to 150 kHz, and are suitable for ambient temperatures above 0 °C. Below 0 °C, tantalum, ceramic or Os-Con type capacitors are recommended. When using one or more non-ceramic capacitors, the calculated equivalent ESR should be no lower than 4 mΩ (7 mΩ using the manufacturer's maximum ESR for a single capacitor). A list of preferred low-ESR type capacitors are identified in Table 2-1.

In addition to electrolytic capacitance, adding a 10-µF X5R/X7R ceramic capacitor to the output will reduce the output ripple voltage and improve the regulator's transient response. The measurement of both the output ripple and transient response is also best achieved across a 10-µF ceramic capacitor.

Ceramic Capacitors

Above 150 kHz the performance of aluminum electrolytic capacitors is less effective. Multilayer ceramic capacitors have very low ESR and a resonant frequency higher than the bandwidth of the regulator. They can be used to reduce the reflected ripple current at the input as well as improve the transient response of the output. When used on the output their combined ESR is not critical as long as the total value of ceramic capacitance does not exceed 300 µF. Also, to prevent the formation of local resonances, do not place more than five identical ceramic capacitors in parallel with values of 10 µF or greater.

Tantalum Capacitors

Tantalum type capacitors are most suited for use on the output bus, and are recommended for applications where the ambient operating temperature can be less than 0 °C. The AVX TPS, Sprague 593D/594/595 and Kemet T495/T510 capacitor series are suggested over other tantalum types due to their higher rated surge, power dissipation, and ripple current capability. As a caution many general purpose tantalum capacitors have considerably higher ESR, reduced power dissipation and lower ripple current capability. These capacitors are also less reliable as they have no surge current rating. Tantalum capacitors that do not have a stated ESR or surge current rating are not recommended for power applications.

When specifying Os-con and polymer tantalum capacitors for the output, the minimum ESR limit will be encountered well before the maximum capacitance value is reached.

Capacitor Table

Table 2-1 identifies the characteristics of capacitors from a number of vendors with acceptable ESR and ripple current (rms) ratings. The recommended 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 capacitor life.

Designing for Very Fast Load Transients

The transient response of the DC/DC converter has been characterized using a load transient with a di/dt of 1 A/µs. The typical voltage deviation for this load transient is given in the data sheet specification table using the optional value of output capacitance. As the di/dt of a transient is increased, the response of a converter's regulation circuit ultimately depends on its output capacitor decoupling network. This is an inherent limitation with any DC/DC converter once the speed of the transient exceeds its bandwidth capability. If the target application specifies a higher di/dt or lower voltage deviation, the requirement can only be met with additional output capacitor decoupling. In these cases special attention must be paid to the type, value and ESR of the capacitors selected.

If the transient performance requirements exceed that specified in the data sheet, or the total amount of load capacitance is above 3,000 µF, the selection of output capacitors becomes more important. For further guidance consult the separate application note, *"Selecting Output Capacitors for PME Products in High-Performance Applications."*

Table 2-1: Input/Output Capacitors

Capacitor Vendor/ Type Series (Style)	Capacitor Characteristics y					Quantit		Vendor Number
	Working Voltage	Value (µF)	Max. ESR @ 100 kHz	Max. Ripple at 85 °C Current (Irms)	Physical Size (mm)	Input Bus	Output Bus	
Panasonic, Aluminum FC (Radial) FK (SMD)	25 V 35 V 25 V	330 µF 180 µF 470 µF	0.090 Ω 0.090 Ω 0.080 Ω	755 mA 755 mA 850 mA	10×12.5 10×12.5 10×10.2	1 1 1	1 1 1	EEUFC1E331 EEUFC1V181 EEVFK1E471P
United Chemi-con PXA-Poly-Aluminum (SMD) FP, Os-con (Radial) FS, Os-con (Radial) LXZ, Aluminum (Radial)	 16 V 20 V 20 V 35 V	 150 µF 120 µF 100 µF 220 µF	 0.026 Ω 0.024 Ω 0.030 Ω 0.090 Ω	 3430 mA 3100 mA 2740 mA 760 mA	 10×7.7 8×10.5 8×10.5 10×12.5	 1 1 1 1	 ≤4 ≤4 ≤4 1	 PXA16VC151MJ80TP 20FP120MG 20FS100M LXZ35VB221M10X12LL
Nichicon Aluminum HD, (Radial) PM, (Radial)	 25 V 35 V	 220 µF 220 µF	 0.072 Ω 0.090 Ω	 760 mA 770 mA	 8×11.5 10×15	 1 1	 1 1	 UHD1E221MPR UPM1V221MHH6
Panasonic, Poly-Aluminum: WA (SMD) S/SE (SMD)	 16 V 6.3 V [1]	 100 µF 180 µF	 0.039 Ω 0.005 Ω	 2500 mA 4000 mA	 8×6.9 7.3×4.3×4.2	 1 N/R [2]	 ≤5 ≤1	 EEFWA1C101P EEFSE0J181R ($V_o \leq 5.1V$)
Sanyo SVP, Os-con (SMD) SP, Os-con (Radial) TPE, Pos-Ccap (SMD)	 20 V 20 V 10 V	 100 µF 120 µF 220 µF	 0.024 Ω 0.024 Ω 0.025 Ω	 >3300 mA >3100 mA >2400 mA	 8×12 8×10.5 7.3×5.7	 1 1 1	 ≤4 ≤4 ≤4	 20SVP100M 20SP120M 10TPE220ML
AVX, Tantalum TPS (SMD)	10 V 10 V 25 V	100 µF 220 µF 68 µF	0.100 Ω 0.100 Ω 0.095 Ω	>1090 mA >1414 mA >1451 mA	7.3L ×4.3W ×4.1H	N/R [2] N/R [2] 2	≤5 ≤5 ≤5	TPSD107M010R0100 TPSV227M010R0100 TPSV686M025R0095
Kemet T520, Poy-Tant (SMD) T495, Tantalum (SMD)	 10 V 10 V	 100 µF 100 µF	 0.080 Ω 0.100 Ω	 1200 mA >1100 mA	 7.3L×5.7W ×4.0H	 N/R [2] N/R [2]	 ≤5 ≤5	 T520D107M010AS T495X107M010AS
Vishay-Sprague 594D, Tantalum (SMD) 94SP, Organic (Radial)	 10 V 25 V 16 V	 150 µF 68 µF 100 µF	 0.090 Ω 0.095 Ω 0.070 Ω	 1100 mA 1600 mA 2890 mA	 7.3L×6.0W ×4.1H 10×10.5	 N/R [2] 2 1	 ≤5 ≤5 ≤5	 594D157X0010C2T 594D686X0025R2T 94SP107X0016FBP
Kemet, Ceramic X5R (SMD)	16 V 6.3 V	10 µF 47 µF	0.002 Ω 0.002 Ω	—	1210 case 3225 mm	1 [3] N/R [2]	≤5 ≤5	C1210C106M4PAC C1210C476K9PAC
Murata, Ceramic X5R (SMD)	6.3 V 6.3 V 16 V 16 V	100 µF 47 µF 22 µF 10 µF	0.002 Ω	—	1210 case 3225 mm	N/R [2] N/R [2] 1 [3] 1 [3]	≤3 ≤5 ≤5 ≤5	GRM32ER60J107M GRM32ER60J476M GRM32ER61C226K GRM32DR61C106K
TDK, Ceramic X5R (SMD)	6.3 6.3 V 16 V 16 V	100 µF 47 µF 22 µF 10 µF	0.002 Ω	—	1210 case 3225 mm	N/R [2] N/R [2] 1 [3] 1 [3]	≤3 ≤5 ≤5 ≤5	C3225X5R0J107MT C3225X5R0J476MT C3225X5R1C226MT C3225X5R1C106MT

[1] The voltage rating of this capacitor only allows it to be used for output voltages that are equal to or less than 5.1 V.
[2] N/R –Not recommended. The capacitor voltage rating does not meet the minimum derated operating limits.
[3] Ceramic capacitors may be used to compliment electrolytic types at the input to further reduce high-frequency ripple current.

Adjusting the Output Voltage of the PME 8318L Wide-Output Adjust Power Module

The V_o *Adjust* control (pin 5) 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.

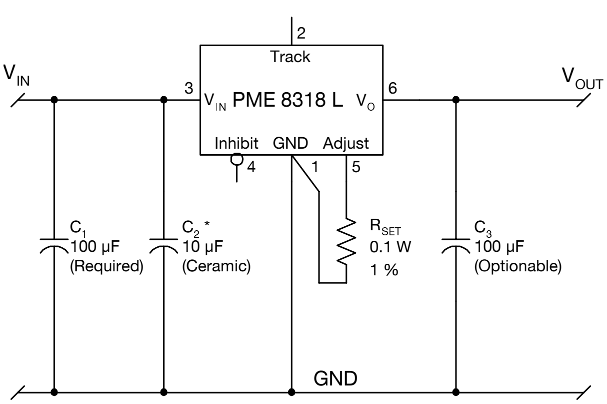
For other output voltages the value of the required resistor can either be calculated using the following formula, or simply selected from the range of values given in Table 1-2. Figure 1-1 shows the placement of the required resistor.

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

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



* Required with output voltages ≥ 3.3 V

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

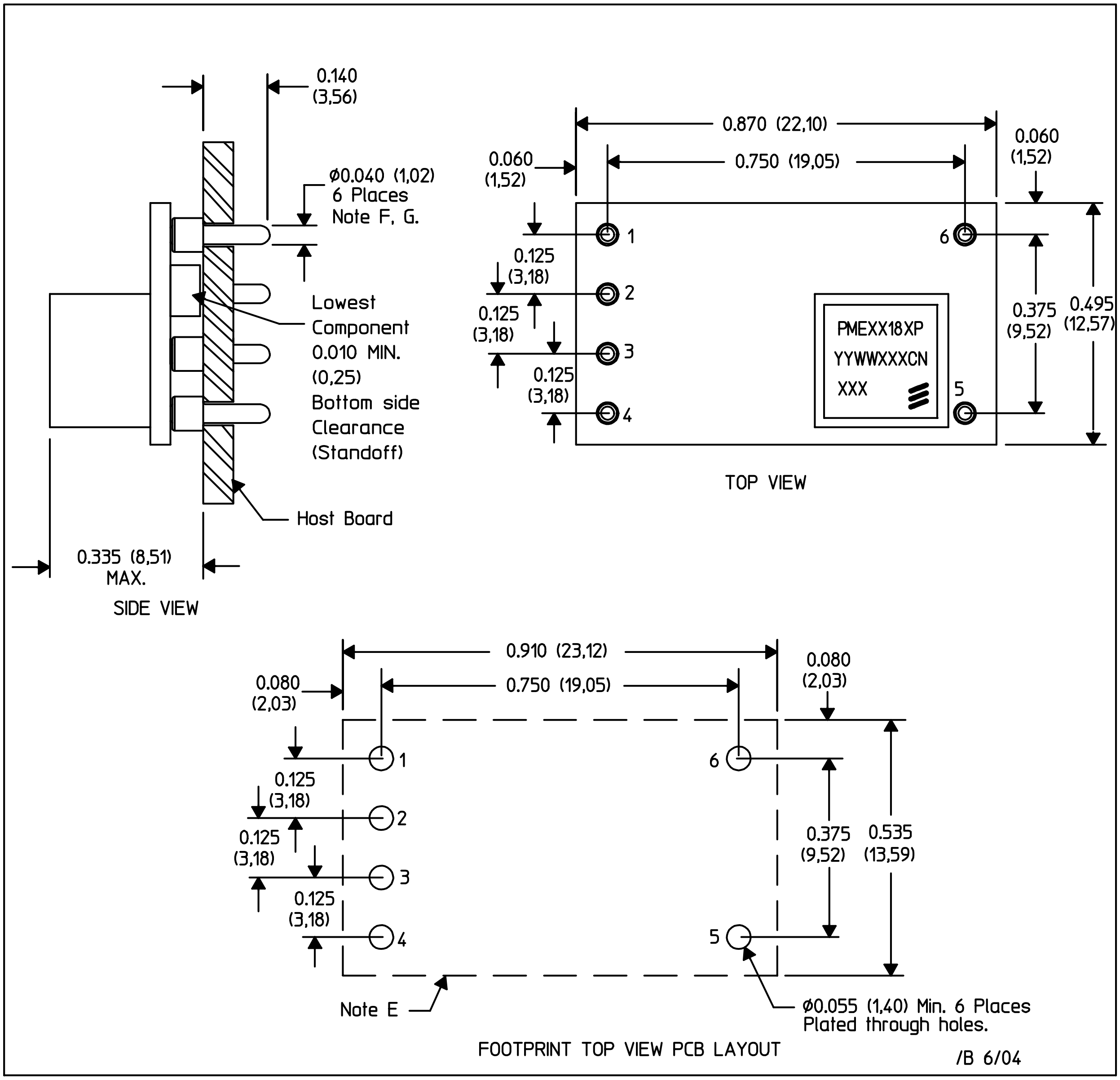
V_a Req'd	R_{set}	V_a Req'd	R_{set}
1.200	Open	2.75	3.34 kΩ
1.225	318 kΩ	2.80	3.18 kΩ
1.250	158 kΩ	2.85	3.03 kΩ
1.275	105 kΩ	2.90	2.89 kΩ
1.300	78.2 kΩ	2.95	2.75 kΩ
1.325	62.2 kΩ	3.00	2.62 kΩ
1.350	51.5 kΩ	3.05	2.5 kΩ
1.375	43.9 kΩ	3.10	2.39 kΩ
1.400	38.2 kΩ	3.15	2.28 kΩ
1.425	33.7 kΩ	3.20	2.18 kΩ
1.450	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:

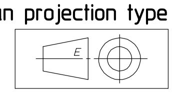
1. Use a 0.1 W resistor. The tolerance should be 1 %, with temperature stability of 100 ppm/°C (or better). Place the resistor as close to the regulator as possible. Connect the resistor directly between pins 1 and 5 using dedicated PCB traces.
2. Never connect capacitors from V_o *Adjust* to either *GND* or V_{out}. Any capacitance added to the V_o *Adjust* pin will affect the stability of the regulator.

PME Series Mechanical data

Hole mount version. DOUBLE SIDED MODULE

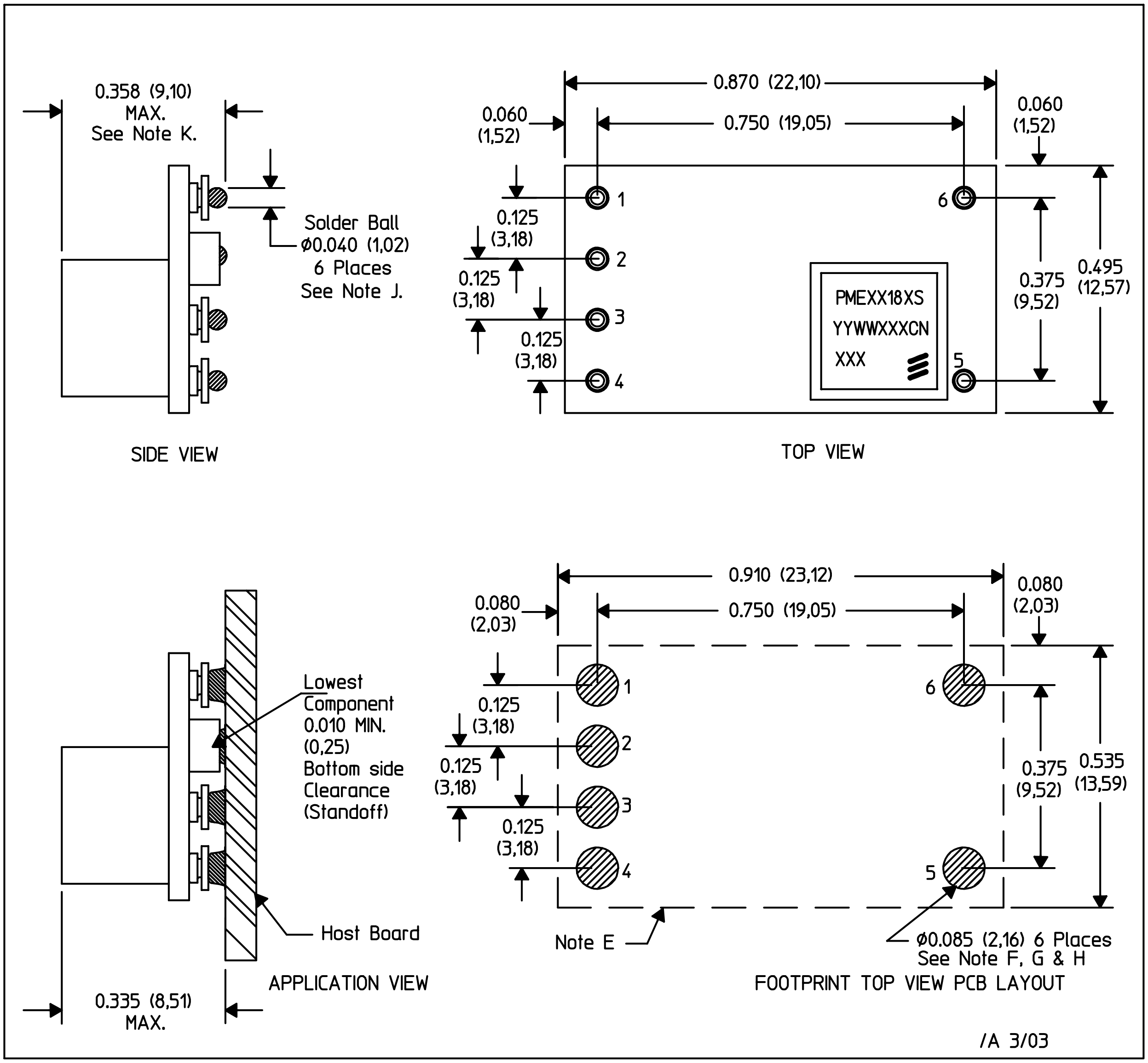


NOTES:
- A. All linear dimensions are in inches (mm).
- B. This drawing is subject to change without notice.
- C. 2 place decimals are ±0.030 (±0,76mm).
- D. 3 place decimals are ±0.010 (±0,25mm).
- E. Recommended keep out area for user components.
- F. Pins are 0.040" (1,02) diameter with 0.070" (1,78)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

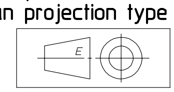


PME Series Mechanical data

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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