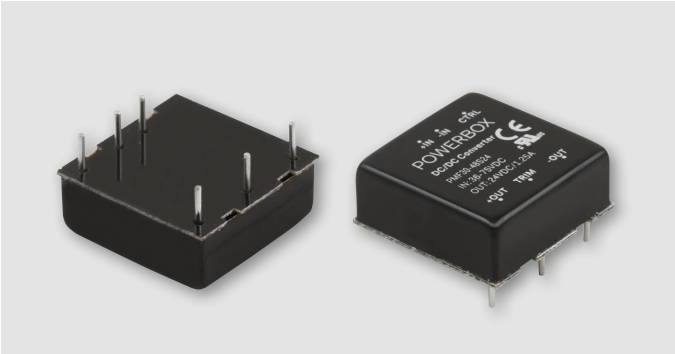
POWERBOX Industrial Line
PMF30 Series
30W 2:1 Single Output
DC/DC Converter
Manual



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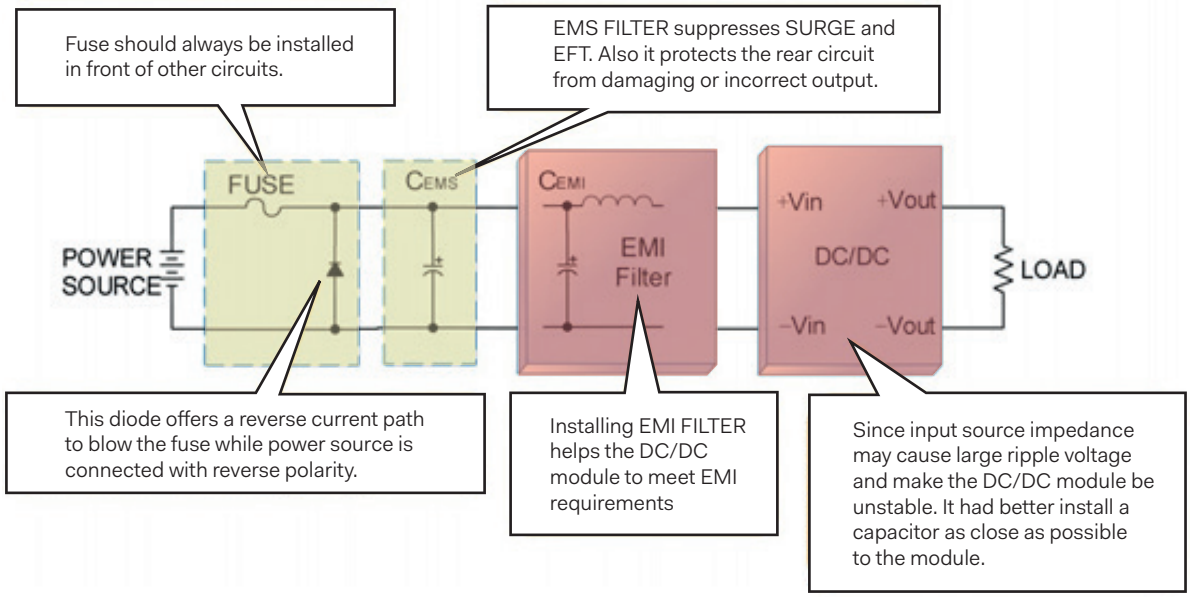
Line Protection & EMC Considerations

1. Typical Application

- Below shows some blocks connected between power source and DC/DC module. Install the circuit of the block which is required.
- Each block has individual function and should be placed on the corresponding location.
- If CEMI is an Aluminum electrolytic capacitor and connected in parallel with CEMS. The capacitance we recommended for meeting EMS requirements could be CEMS pluses CEMI.



2. Line Protections

Fuse

- The DC/DC converter is not internally fused. An input line fuse must always be used.
- Fuses should be installed in front of each module when multiple DC/DC converters connect to the same power source.

Model	Fuse Rating (A)	Fuse Type
PMF30-12□□□	6	Slow-Blow
PMF30-24□□□	3	Slow-Blow
PMF30-48□□□	2	Slow-Blow

Table 2-1 FUSE selection

- According to actual current value, calculating fuse ratings base on the following equations:

$I_{FUSE} \geq I_{in}$ /(rerating x safety margin)

Melting $I^2t = I^2_{PULSE,act} \cdot t / 0.22$

Where

I_{FUSE} is current rating of fuse.

I_{in} is actual value of input current.

Rerating is percentage of fuse rating base on ambient temperature. Fuse rating is variety under different ambient temperature.

Safety margin is percentage of fuse rating set by user.

Melting I^2t is pulse energy rating of fuse.

$I_{PULSE,act}$ is actual input pulse current.

t is the width of the input pulse current.

Reverse Input Voltage Protection

- Avoid the reverse polarity input voltage; otherwise, it will damage the DC/DC converter.
- It is likely to protect the module from the reverse input voltage by installing an external diode.
- The diode can block reverse voltage or blow the line fuse to protect DC/DC converter.
- Recommend using Schottky diode for reverse input voltage protection

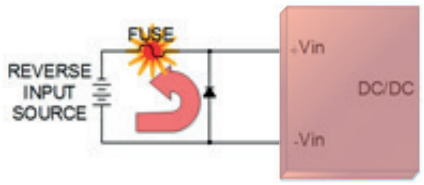


Fig. 2-1 Reverse input voltage protection

Model	Voltage Rating of the Diode	Current Rating of the Diode
PMF30-12□□□	40V	
PMF30-24□□□	60V	1~1.5 x Fuse Rating
PMF30-48□□□	100V	

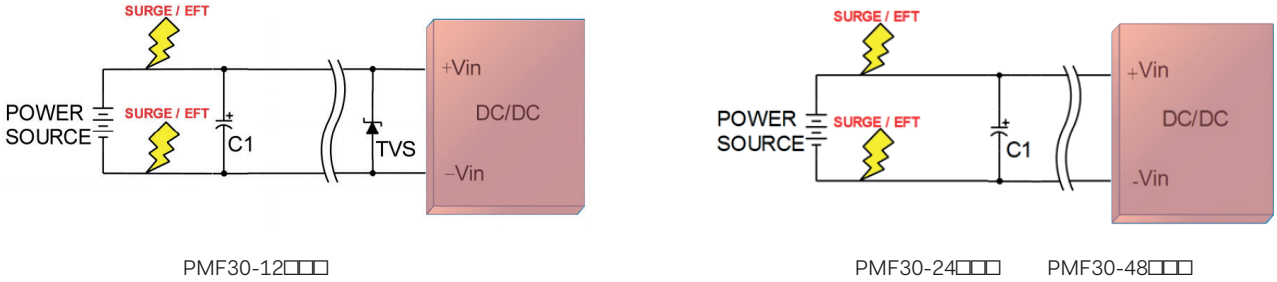
Fig. 2-2 Reverse protection diode selection

3. EMS Considerations

- The module can meet EMS requirements as below.
- An external input filter capacitor is required if the module has to meet EN61000-4-4, EN61000-4-5

Parameter	Conditions		Level
ESD	EN61000-4-2	Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3	10V/m	Perf. Criteria A
Fast transient	EN61000-4-4	±2kV	Perf. Criteria A
Surge	EN61000-4-5	±2kV	Perf. Criteria A
Conducted immunity	EN61000-4-6	10Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100A/m continuous; 1000A/m 1 second	Perf. Criteria A

Table 3-1 EMS requirements



PMF30-12□□□ PMF30-24□□□ PMF30-48□□□

Fig. 3-1 Surge & EFT protections

- It should be noticed that the current path of the PCB trace. Wrong PCB layout reduces ability of suppressing SURGE or EFT.

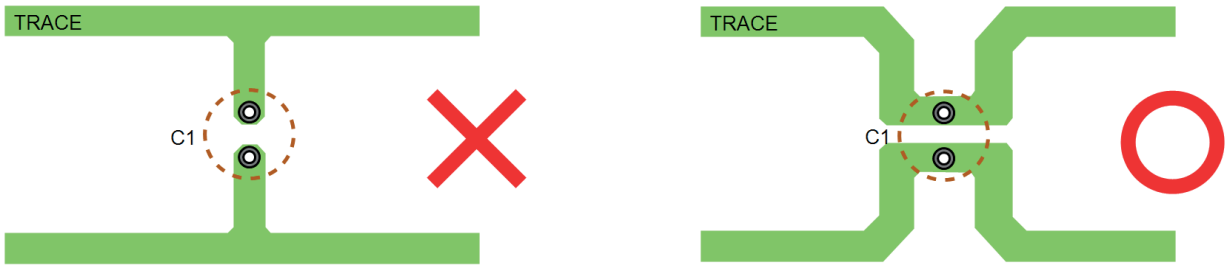


Fig. 3-2 PCB trace

Model	Component	Specification	Reference
PMF30-12□□□	C1	220μF/100V	Nippon Chemi-con KY series
	TVS	58V/3000V	Littelfuse, SMDJ58A
PMF30-24□□□	C1	220μF/100V	Nippon Chemi-con KY series
PMF30-48□□□	C1	220μF/100V	Nippon Chemi-con KY series

Table 3-2 Surge & EFT filter

4. EMI Considerations

Recommended External EMI Filter for EN55032 Class A

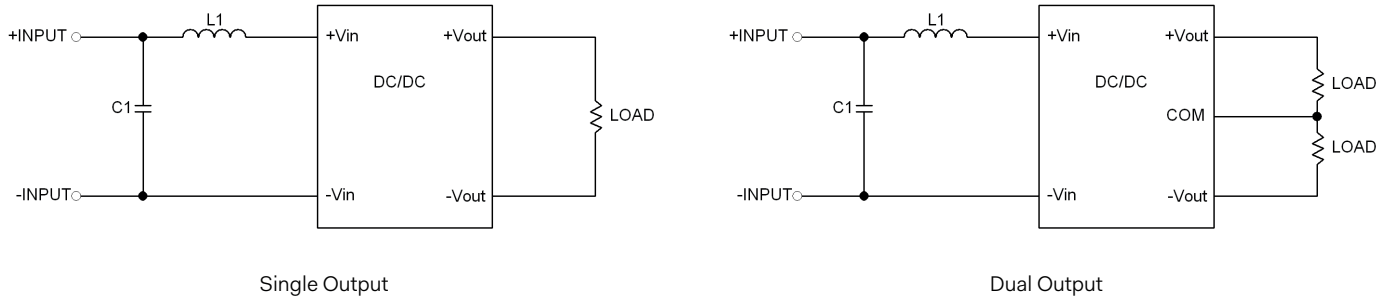


Fig. 4-1 Recommended EMI filter for EN55032 Class A

Model	C1	L1
PMF30-12□□□	4.7μF/25V 1812 MLCC	2.2μH, PMT-097
PMF30-24□□□	4.7μF/50V 1812 MLCC	2.2μH, PMT-097
PMF30-48□□□	4.7μF/100V 1812 MLCC	10μH, PMT-070

Table 4-1 B.O.M. of external EMI filter

Fig. 4-2 Recommended layout pattern for Single Output

Fig. 4-3 Recommended layout pattern for Dual Output

Recommended External EMI Filter for EN55032 Class B

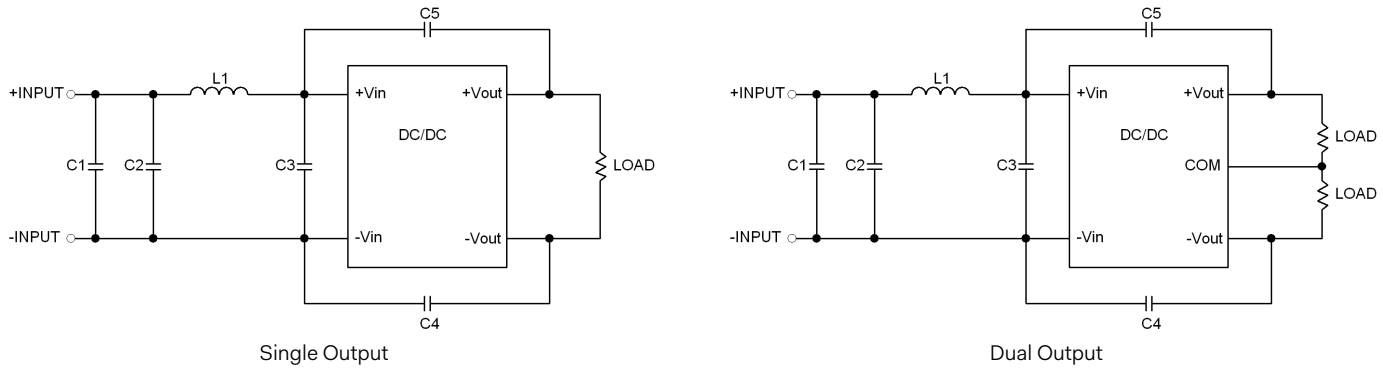


Fig. 4-4 Recommended EMI filter for EN55032 Class B

Model	C1, C2, C3	C4, C5	L1
PMF30-12□□□	4.7μF/25V 1812 MLCC	1000pF/2kV 1206 MLCC	2.2μH, PMT-097
PMF30-24□□□	4.7μF/50V 1812 MLCC	1000pF/2kV 1206 MLCC	2.2μH, PMT-097
PMF30-48□□□	4.7μF/100V 1812 MLCC	2200pF/2kV 1206 MLCC	10μH, PMT-070

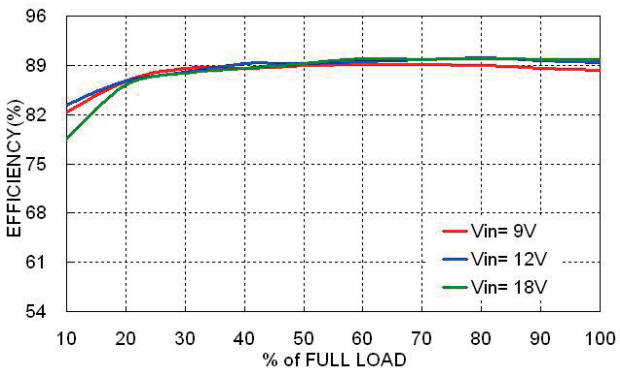
Table 4-2 B.O.M. of external EMI filter

Fig. 4-5 Recommended layout pattern for Single Output

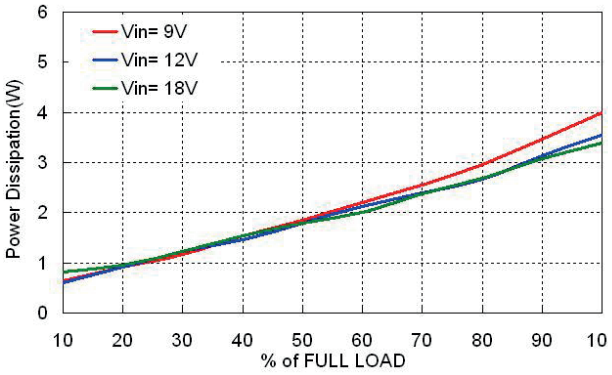
Fig. 4-6 Recommended layout pattern for Dual Output

Characteristic Curves

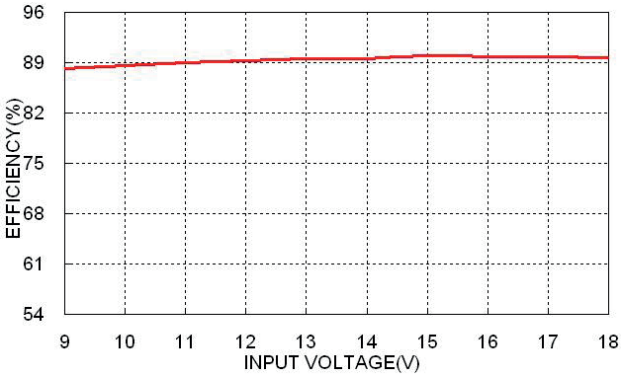
All test conditions are at 25°C. The figures are identical for PMF30-12D12



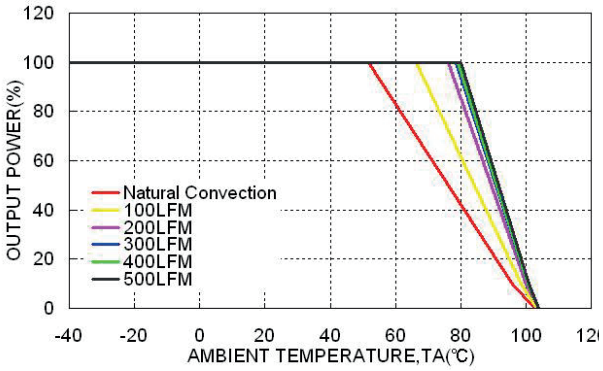
Efficiency versus Output Load



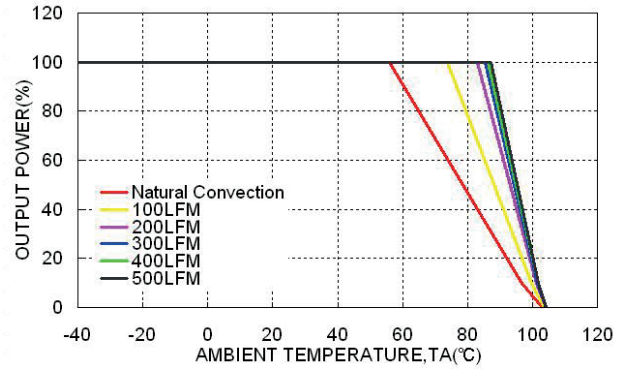
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



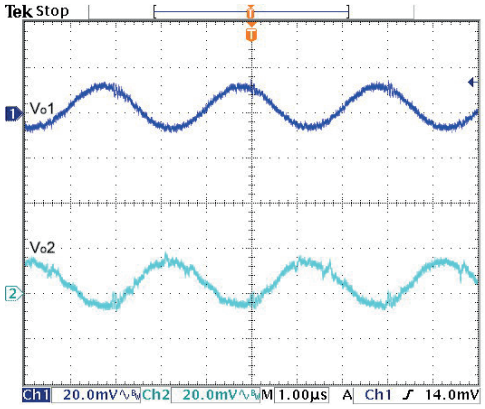
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



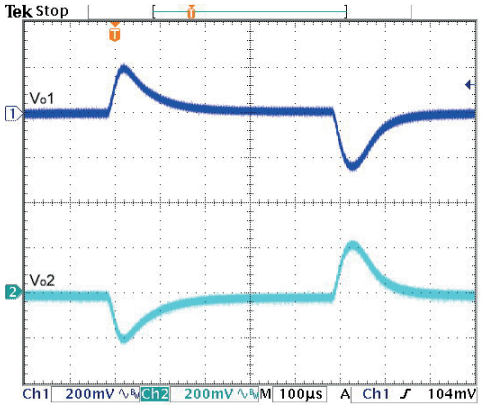
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

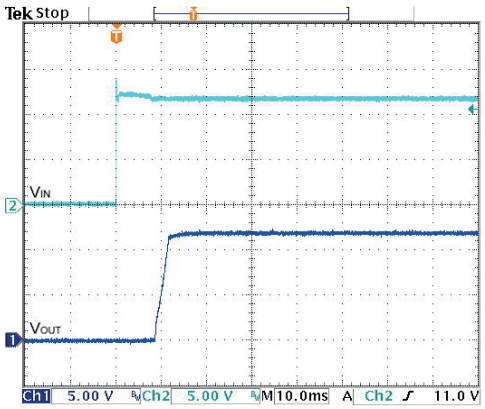
All test conditions are at 25°C. The figures are identical for PMF30-12D12



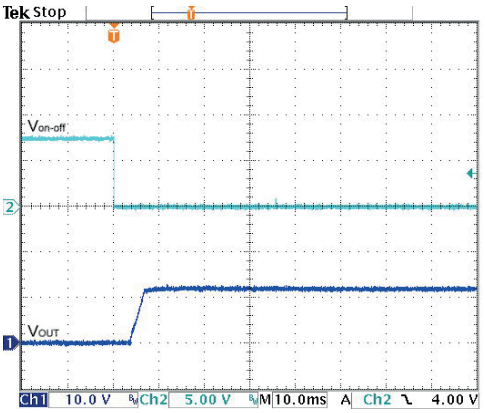
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



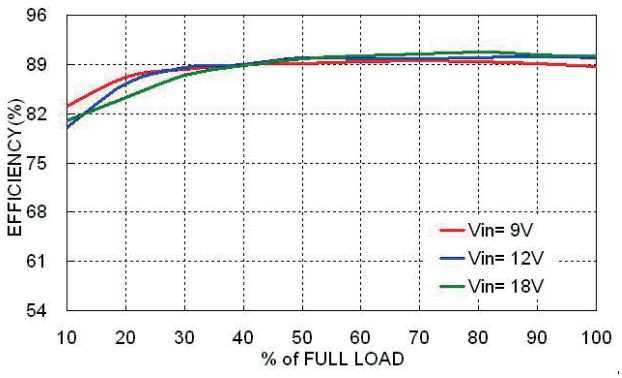
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



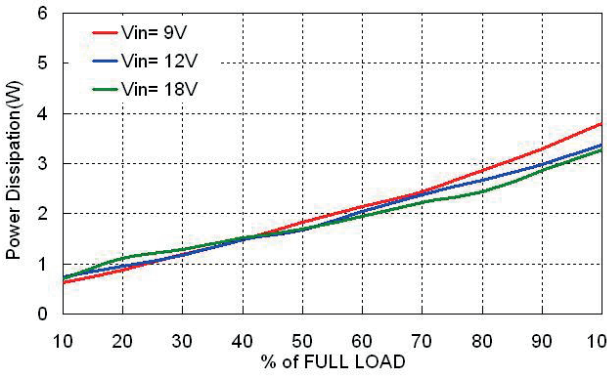
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

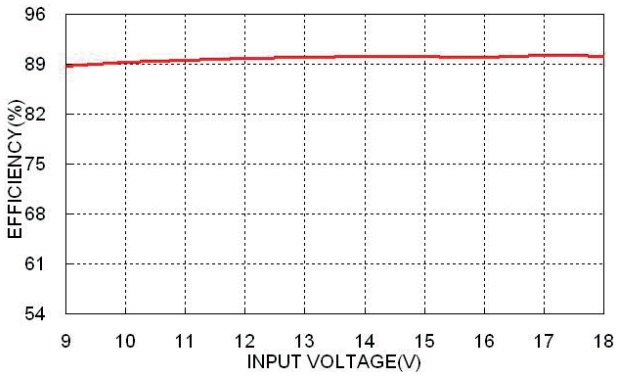
All test conditions are at 25°C. The figures are identical for PMF30-12D15



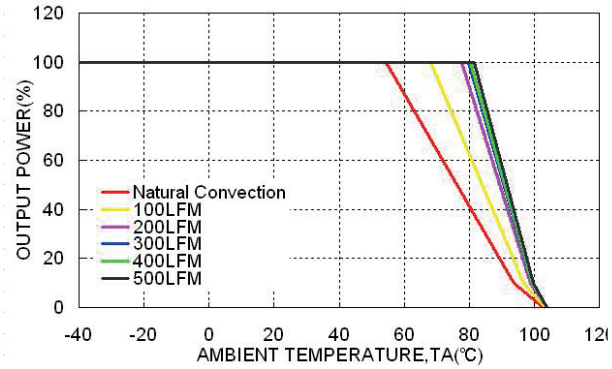
Efficiency versus Output Load



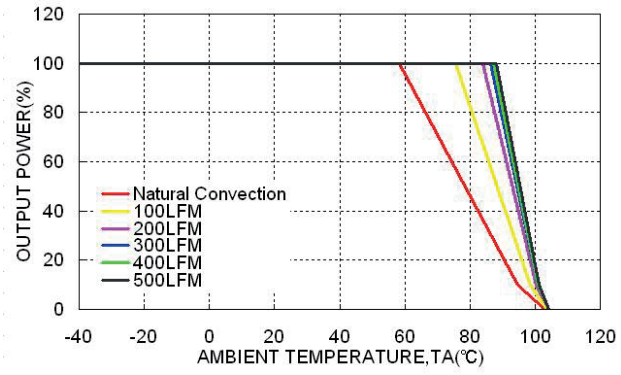
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



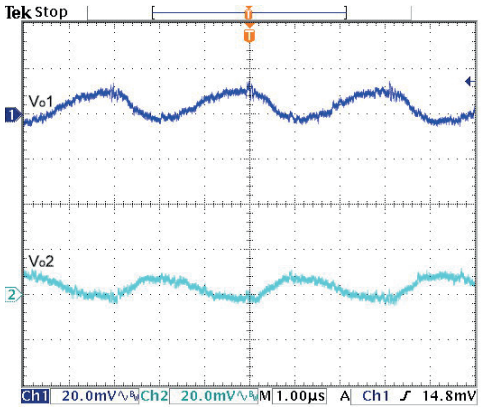
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



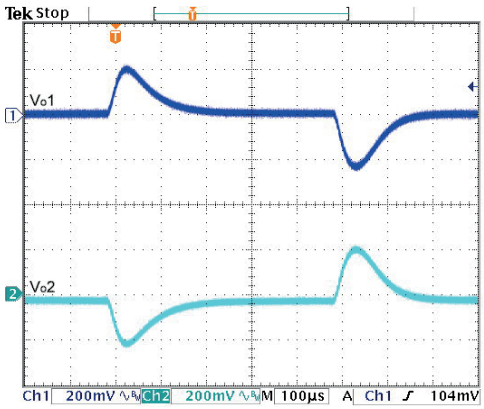
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

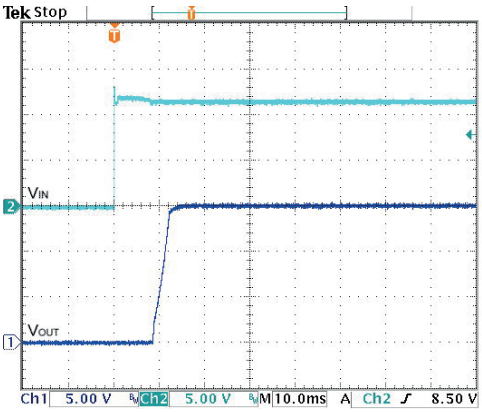
All test conditions are at 25°C. The figures are identical for PMF30-12D15



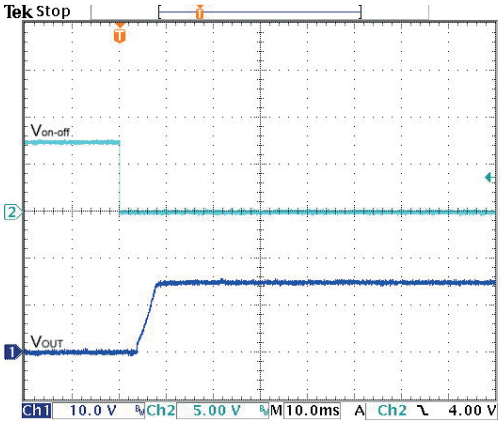
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



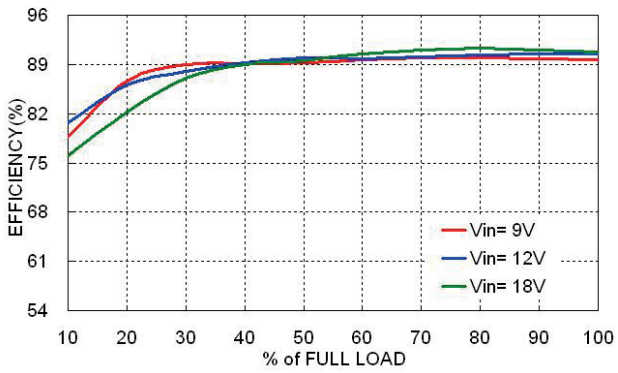
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



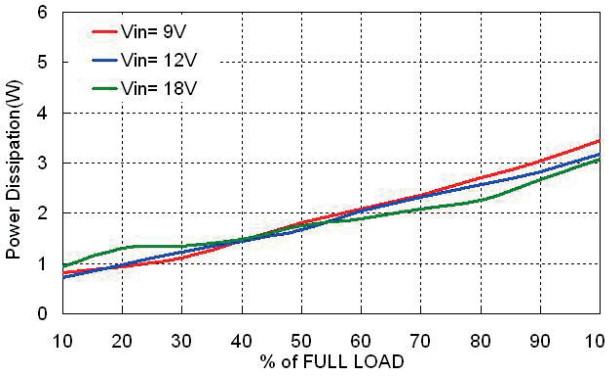
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

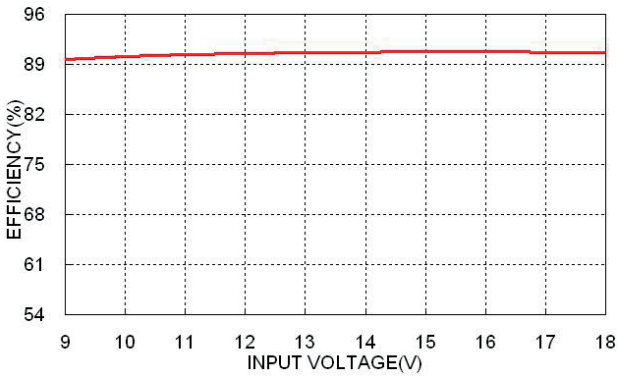
All test conditions are at 25°C. The figures are identical for PMF30-12D24



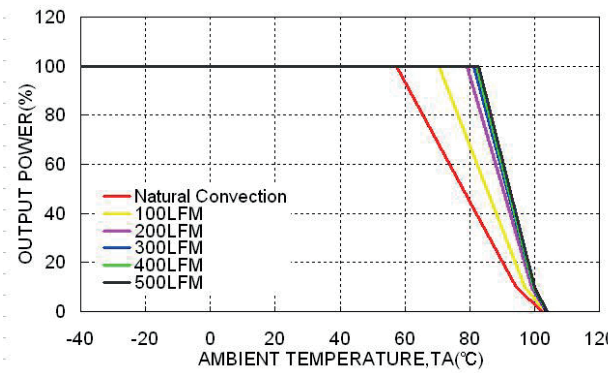
Efficiency versus Output Load



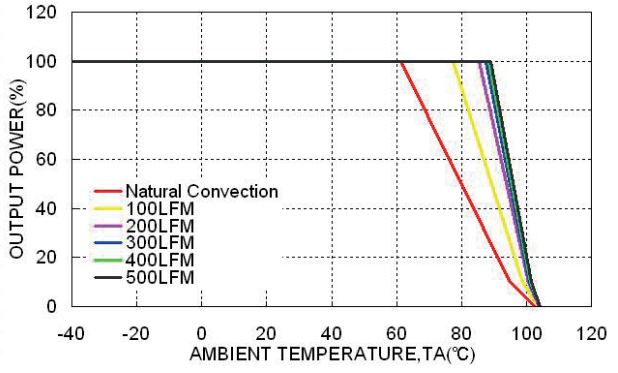
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



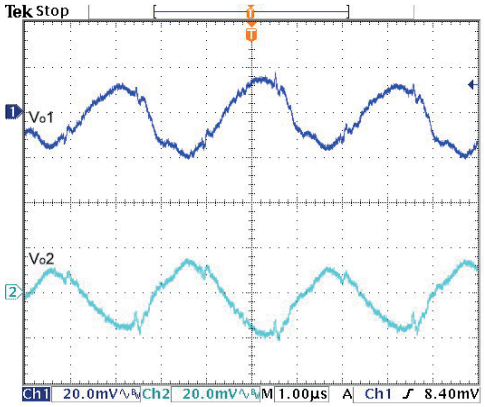
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



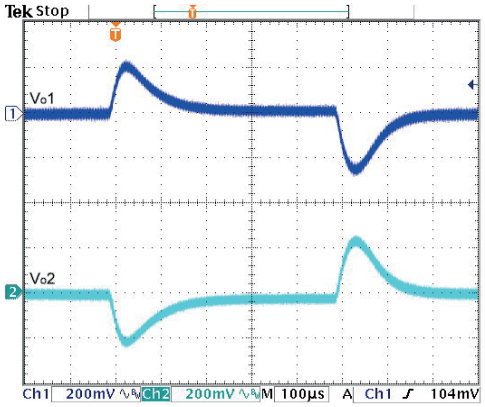
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

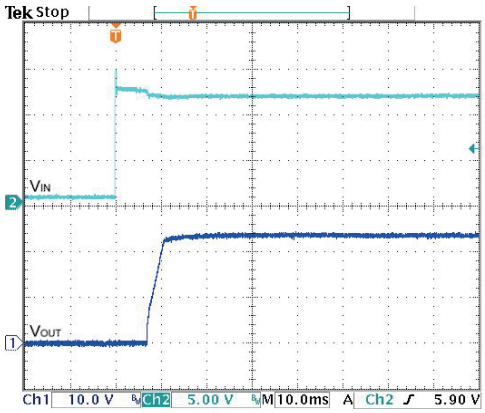
All test conditions are at 25°C. The figures are identical for PMF30-12D24



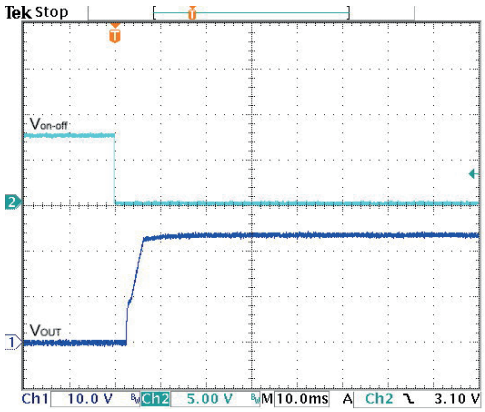
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



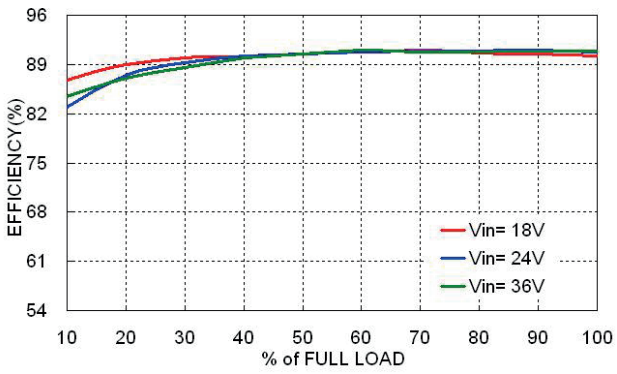
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



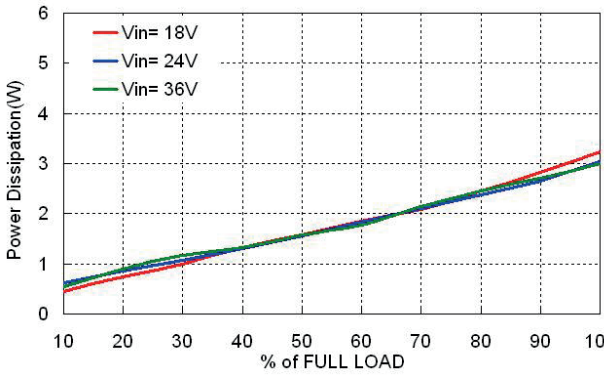
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

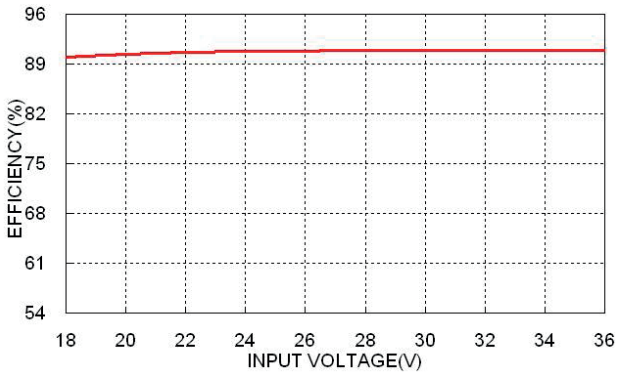
All test conditions are at 25°C. The figures are identical for PMF30-24D12



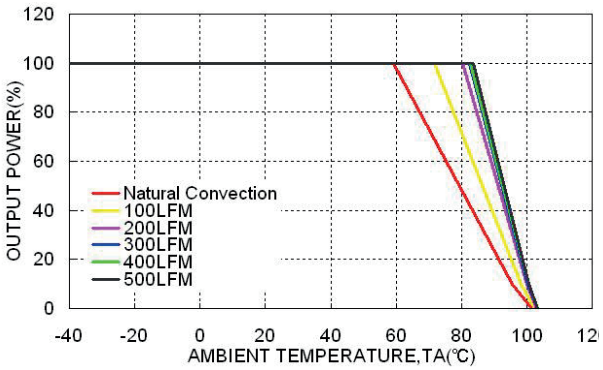
Efficiency versus Output Load



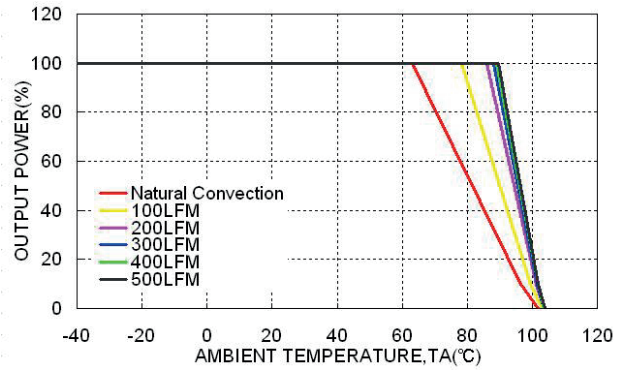
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



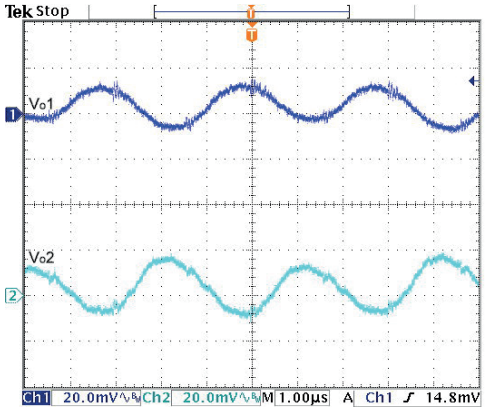
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



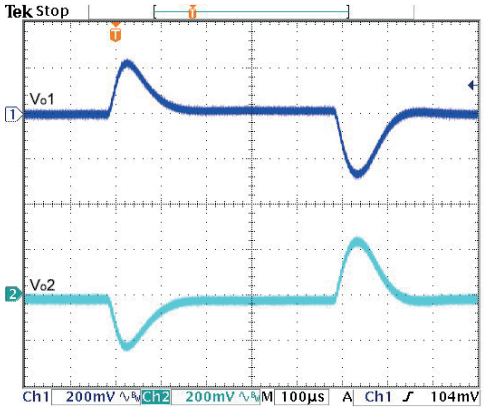
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

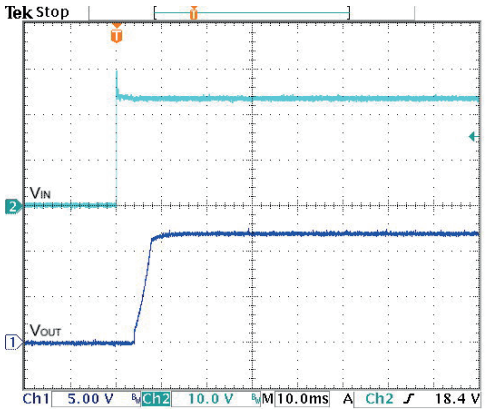
All test conditions are at 25°C. The figures are identical for PMF30-24D12



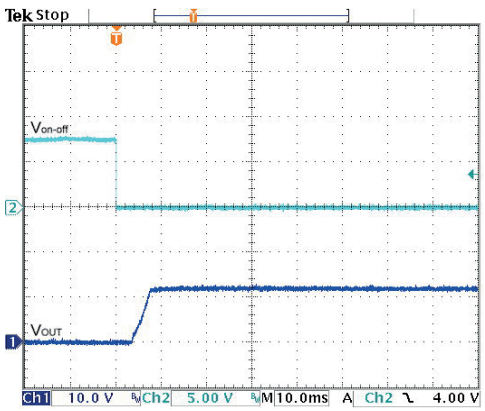
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



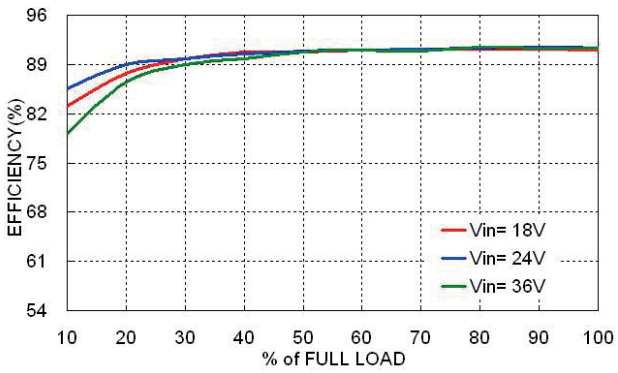
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



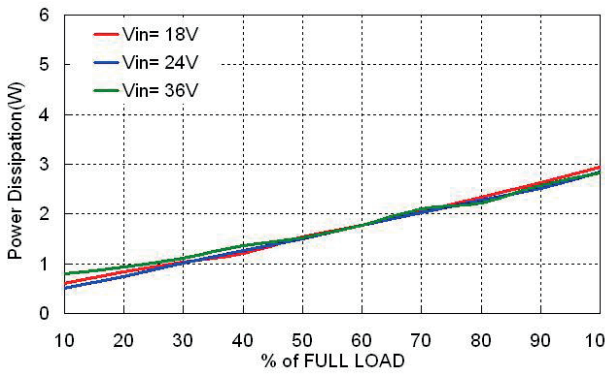
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

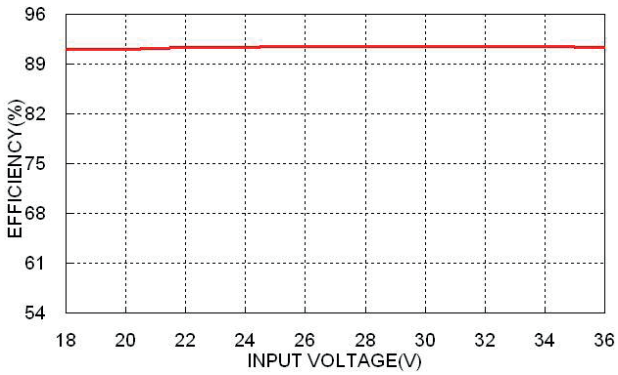
All test conditions are at 25°C. The figures are identical for PMF30-24D15



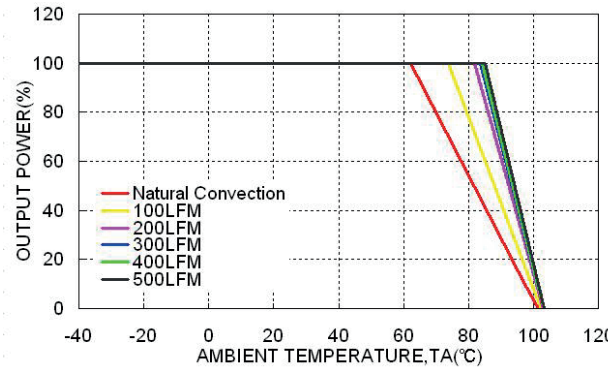
Efficiency versus Output Load



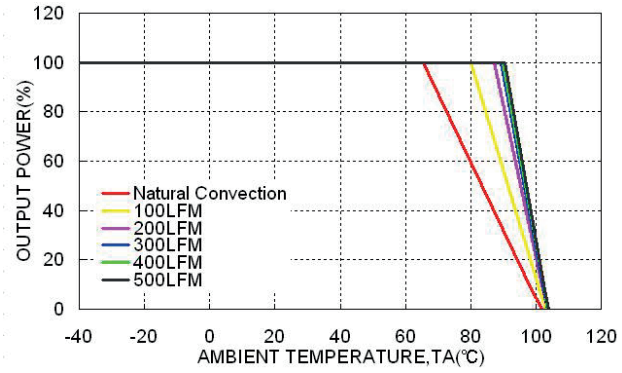
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



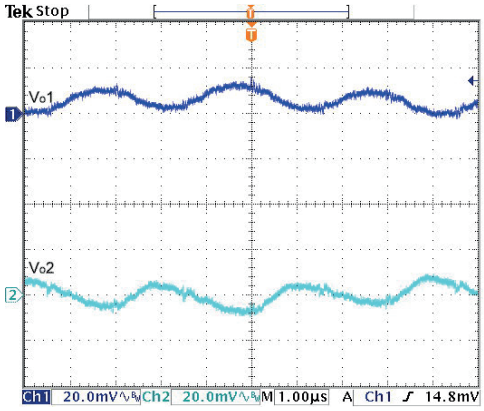
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



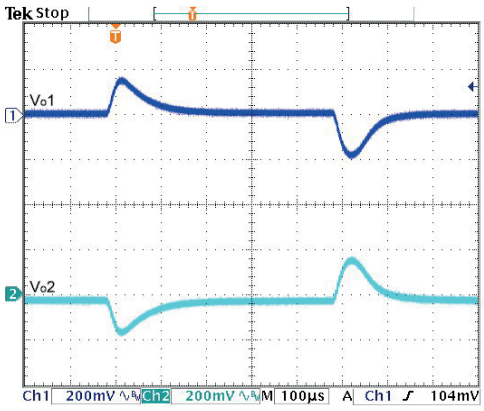
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

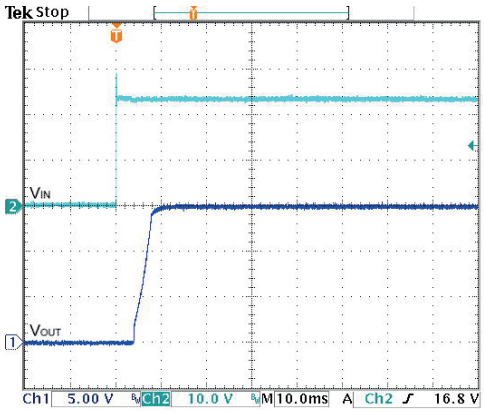
All test conditions are at 25°C. The figures are identical for PMF30-24D15



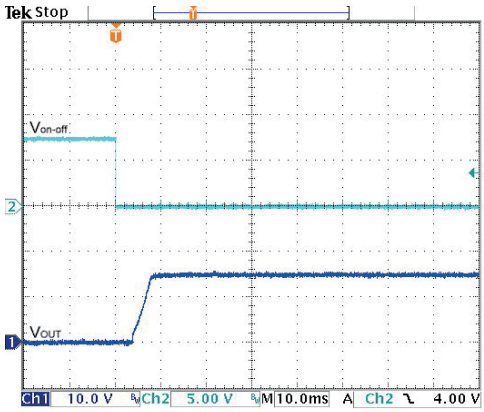
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



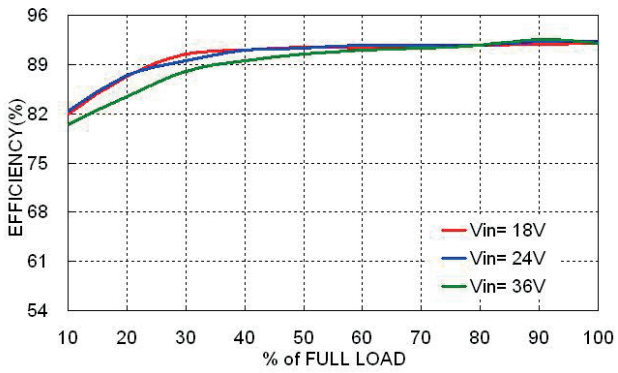
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



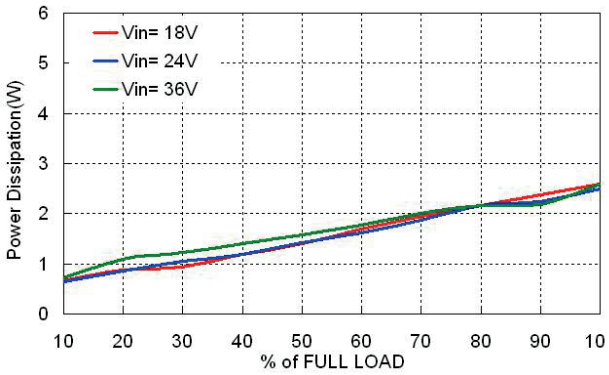
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

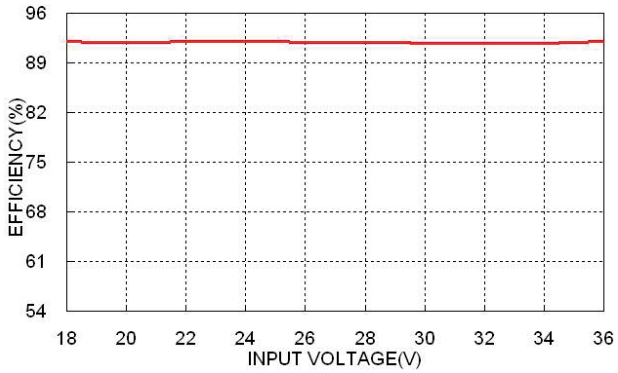
All test conditions are at 25°C. The figures are identical for PMF30-24D24



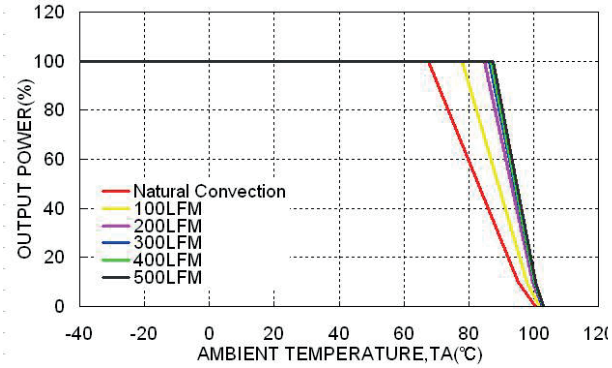
Efficiency versus Output Load



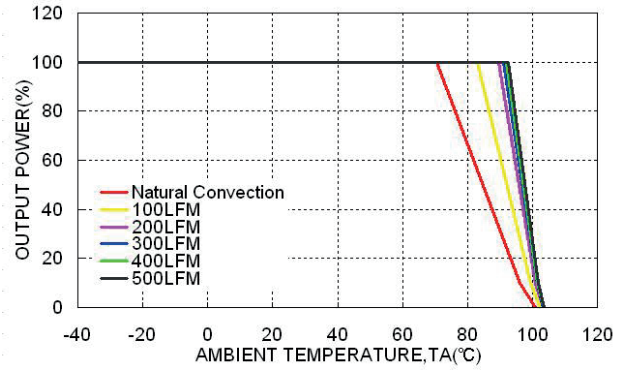
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



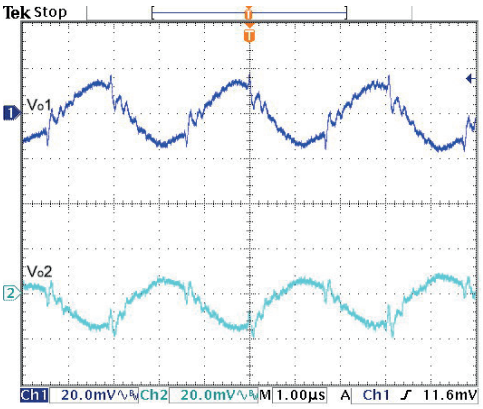
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



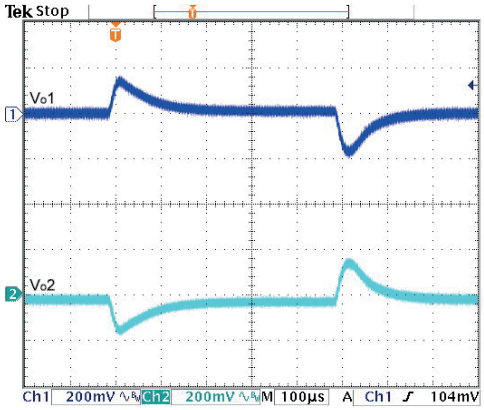
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

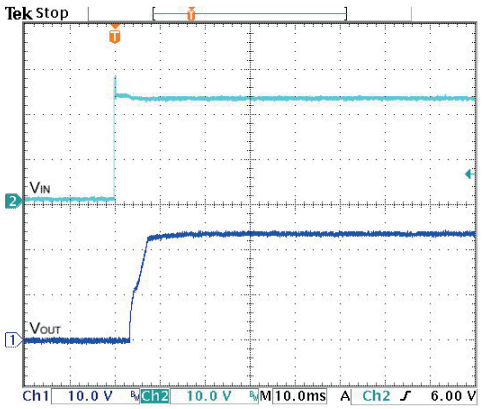
All test conditions are at 25°C. The figures are identical for PMF30-24D24



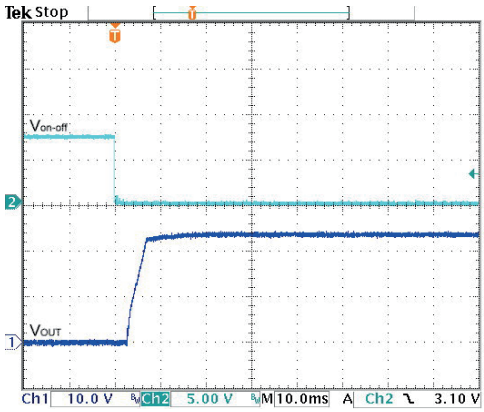
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



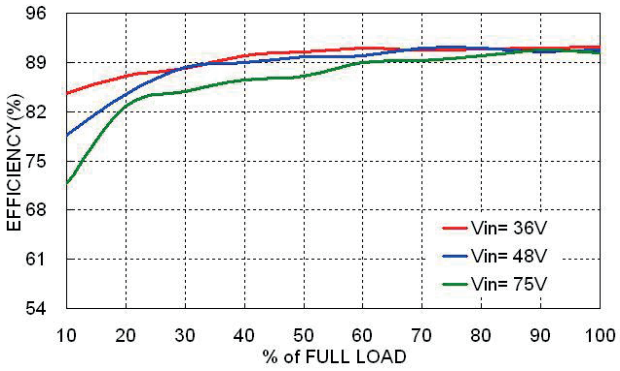
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



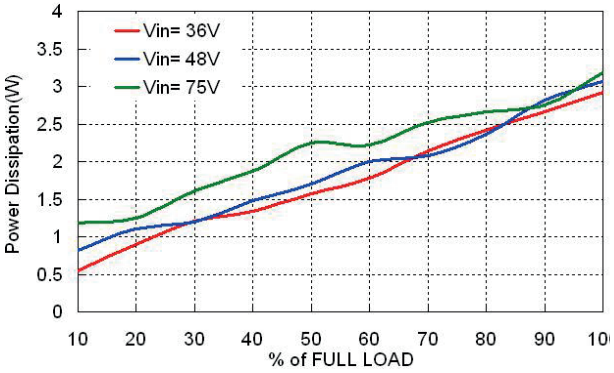
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

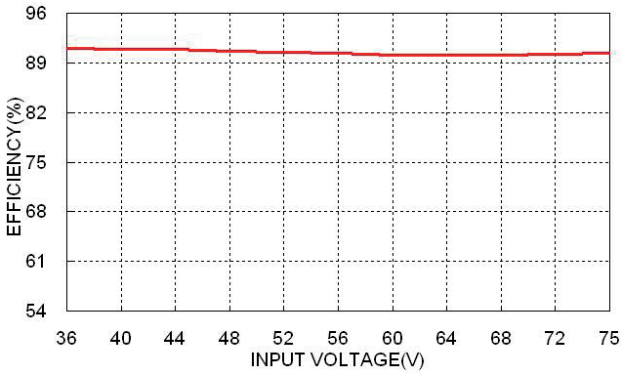
All test conditions are at 25°C. The figures are identical for PMF30-48D12



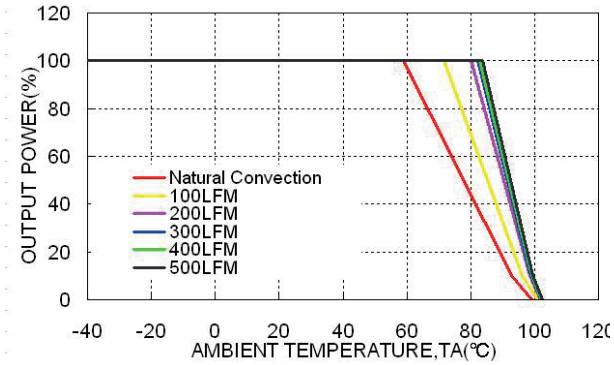
Efficiency versus Output Load



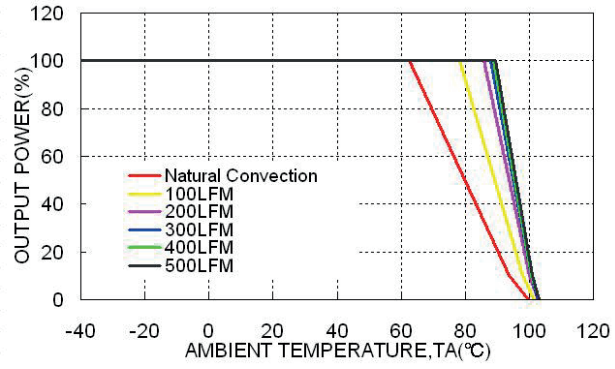
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



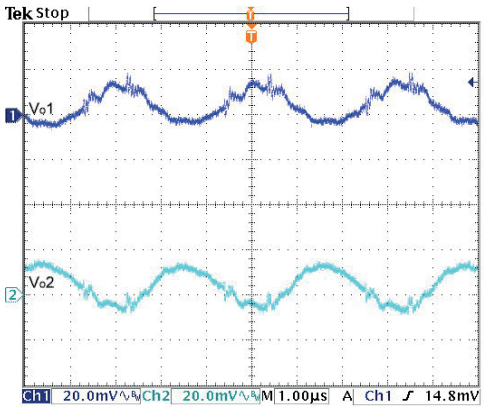
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



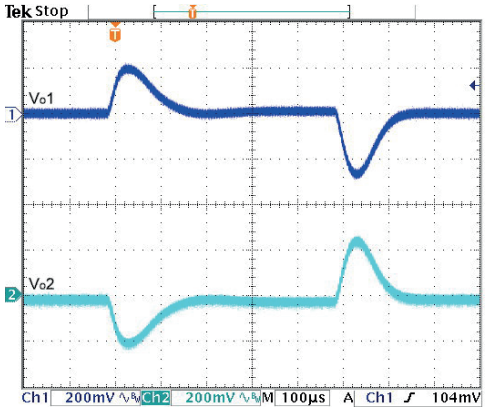
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

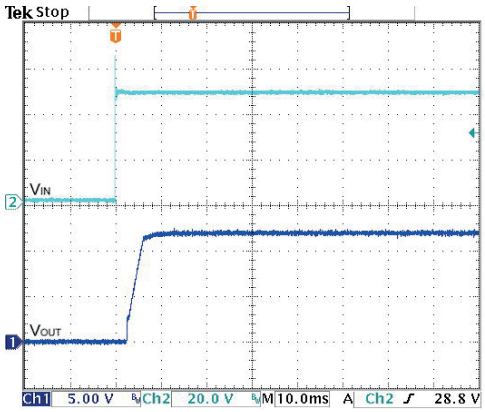
All test conditions are at 25°C. The figures are identical for PMF30-48D12



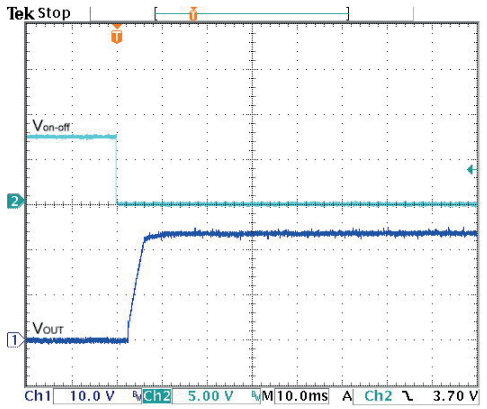
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



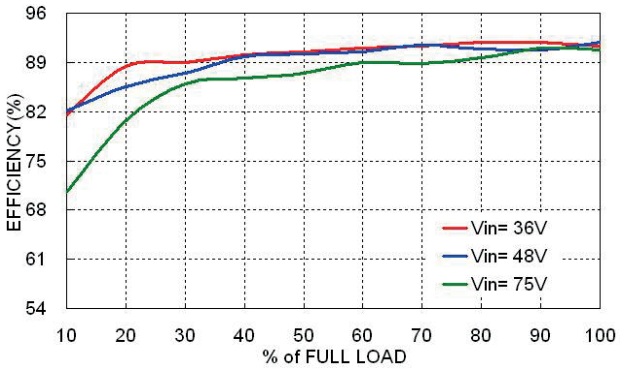
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



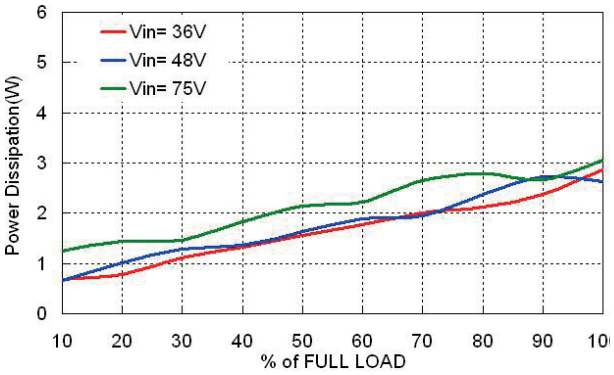
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

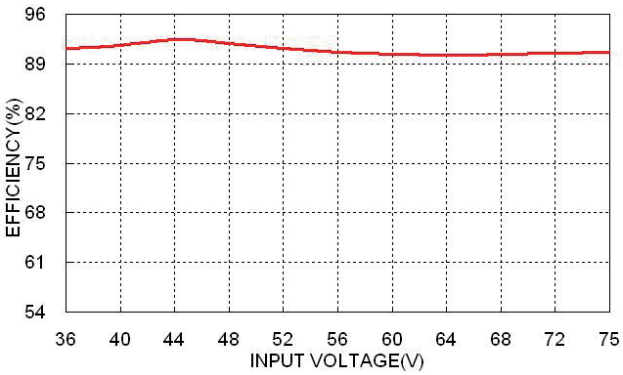
All test conditions are at 25°C. The figures are identical for PMF30-48D15



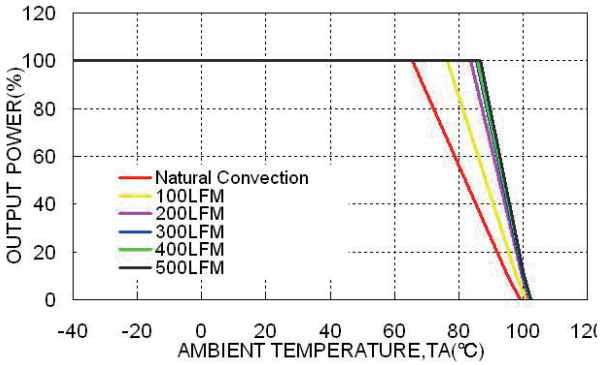
Efficiency versus Output Load



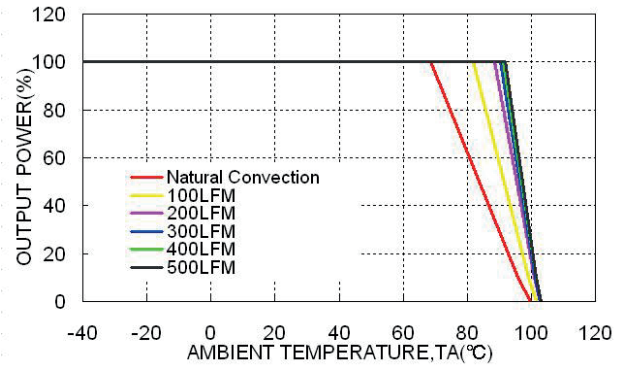
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



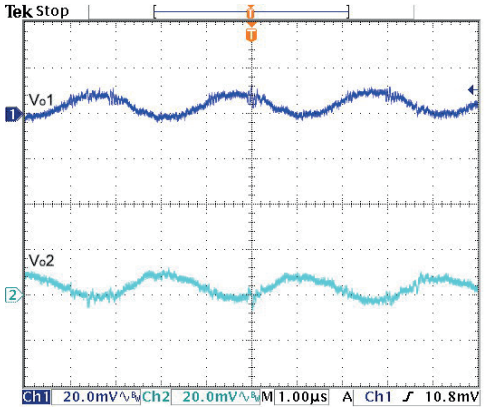
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



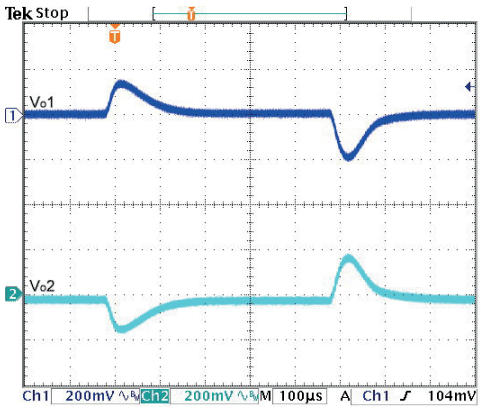
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

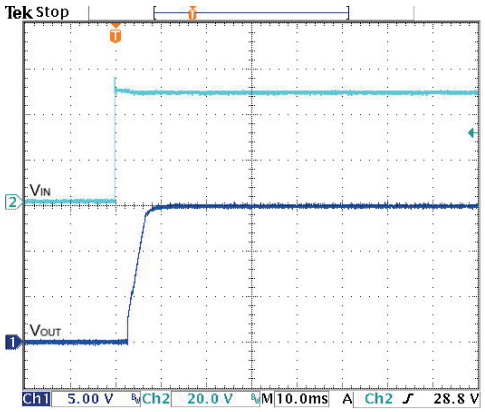
All test conditions are at 25°C. The figures are identical for PMF30-48D15



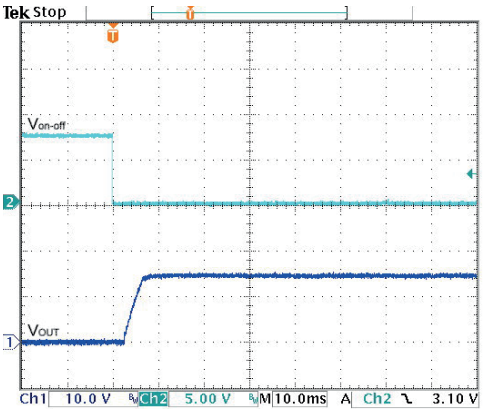
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



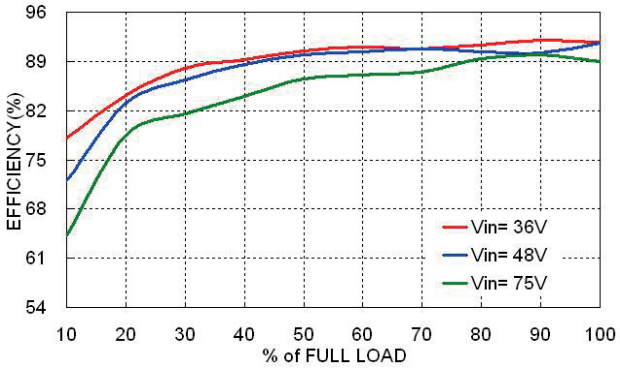
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



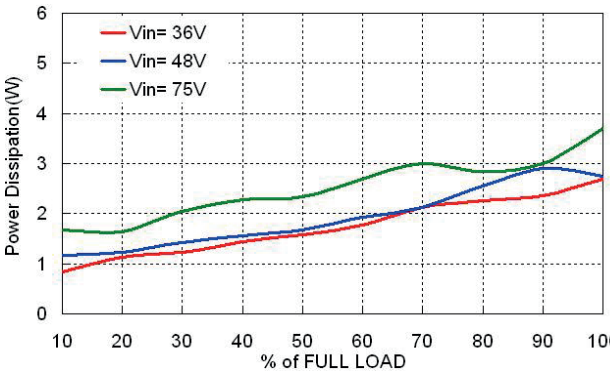
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

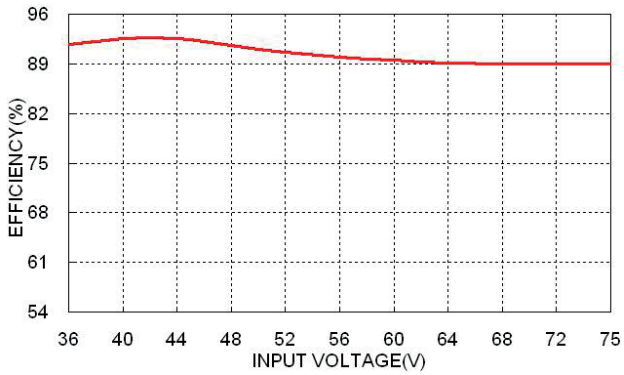
All test conditions are at 25°C. The figures are identical for PMF30-48D24



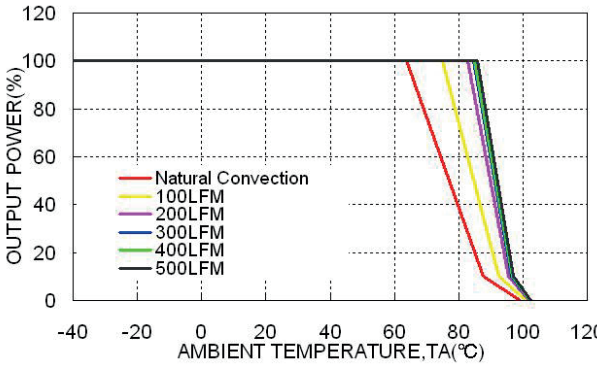
Efficiency versus Output Load



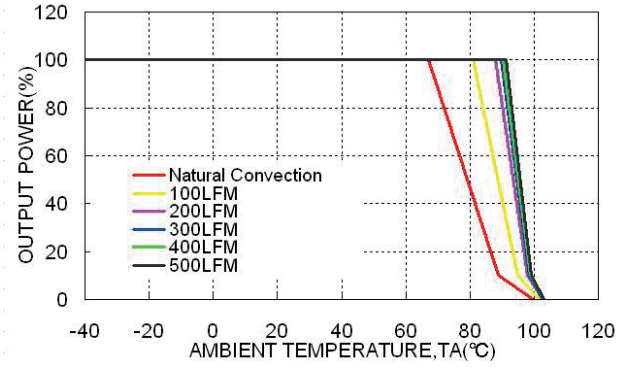
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



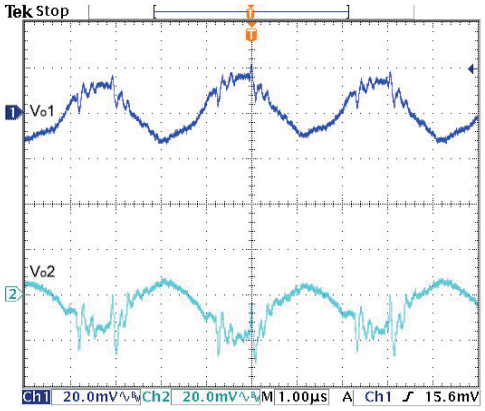
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



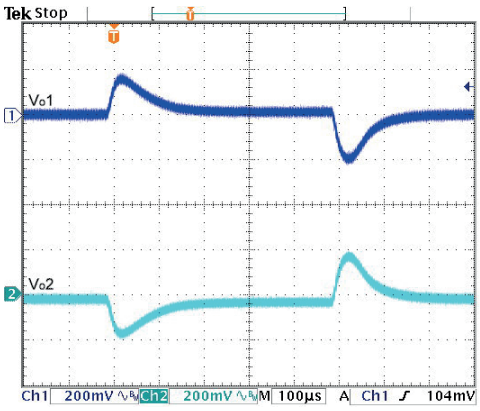
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

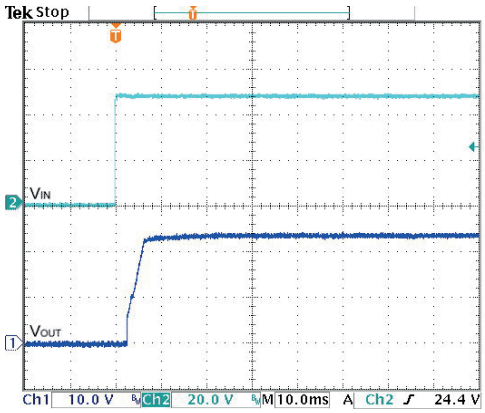
All test conditions are at 25°C. The figures are identical for PMF30-48D24



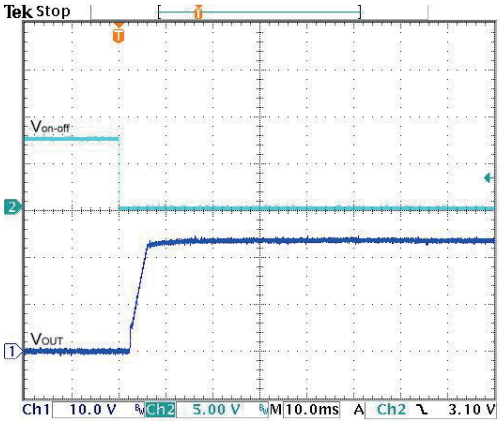
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



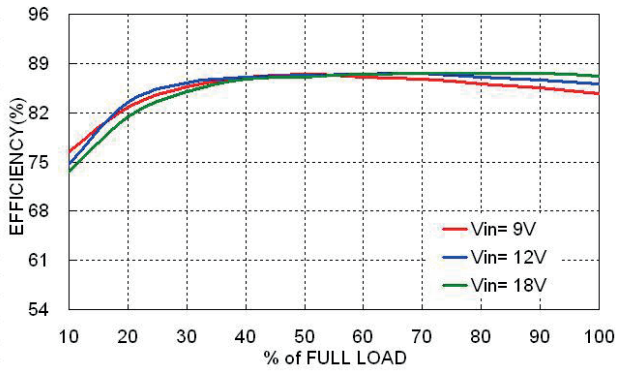
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



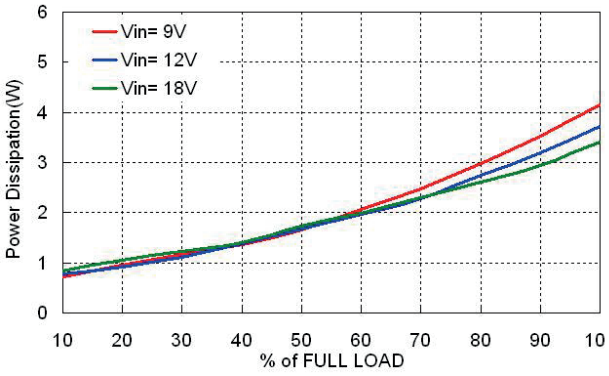
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

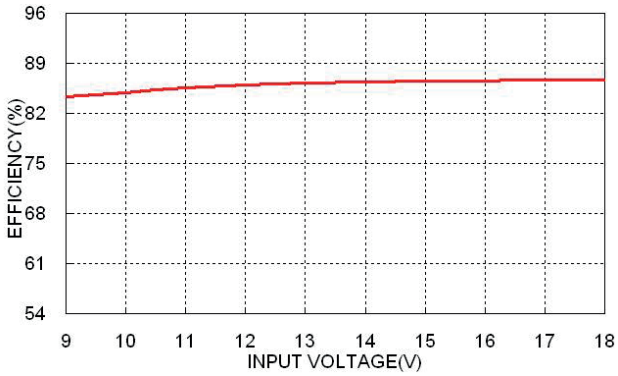
All test conditions are at 25°C. The figures are identical for PMF30-12S3P3



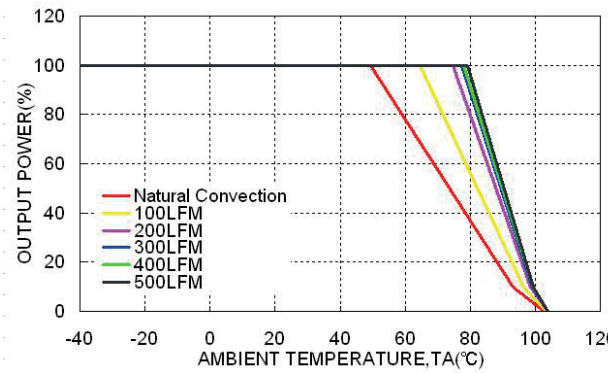
Efficiency versus Output Load



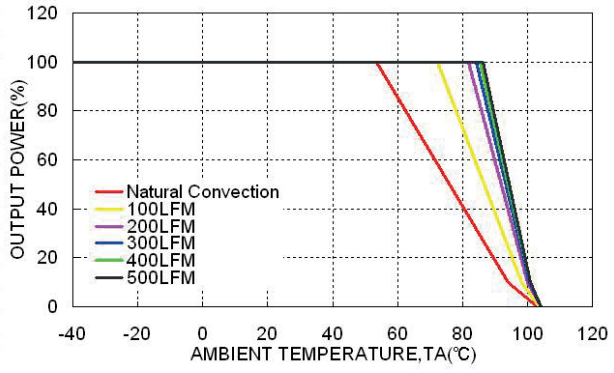
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



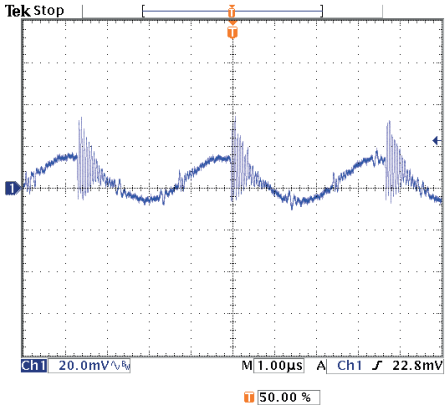
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



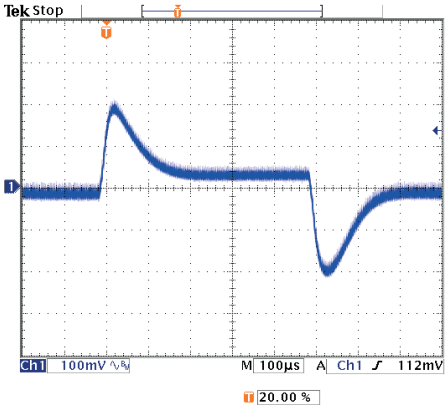
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

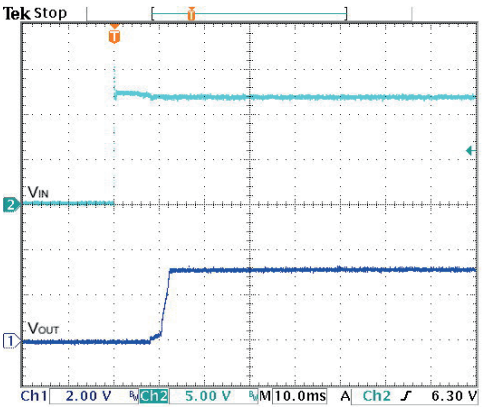
All test conditions are at 25°C. The figures are identical for PMF30-12S3P3



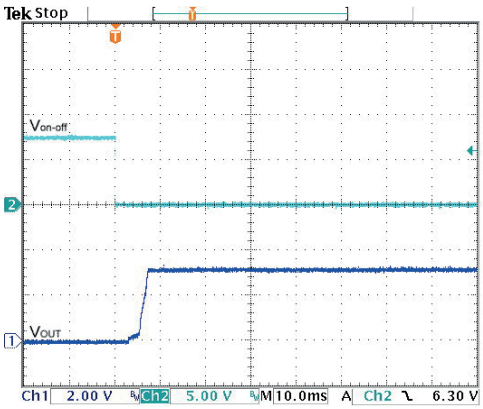
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



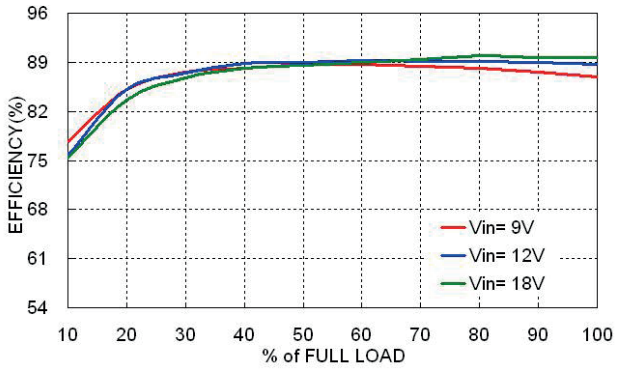
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



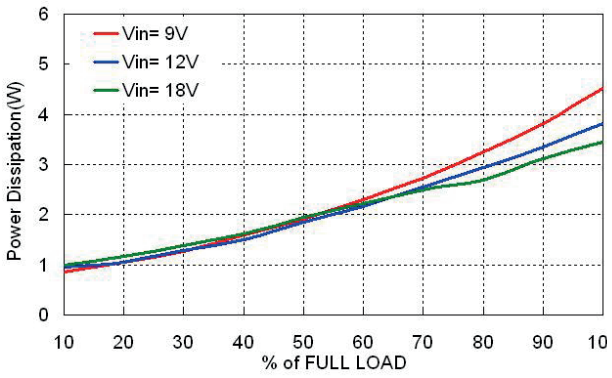
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

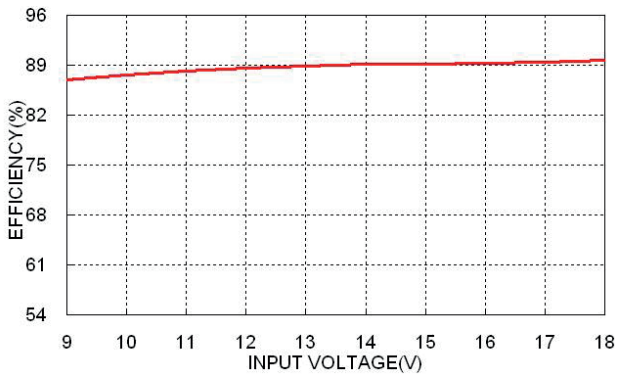
All test conditions are at 25°C. The figures are identical for PMF30-12S05



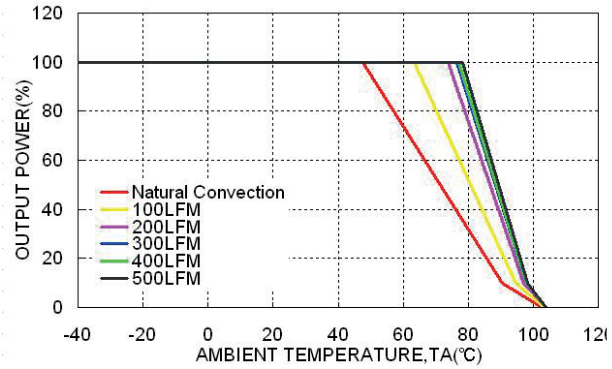
Efficiency versus Output Load



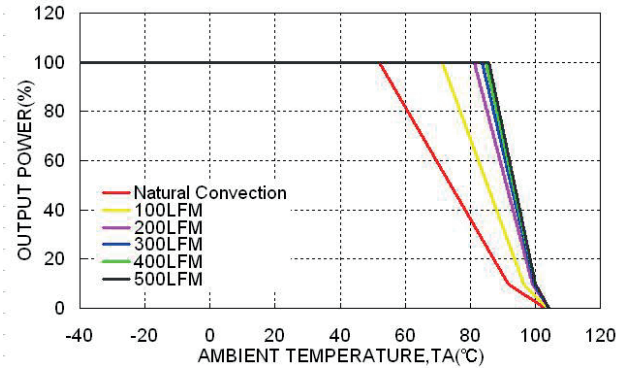
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



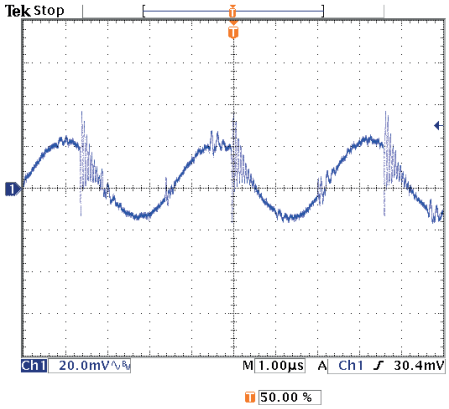
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



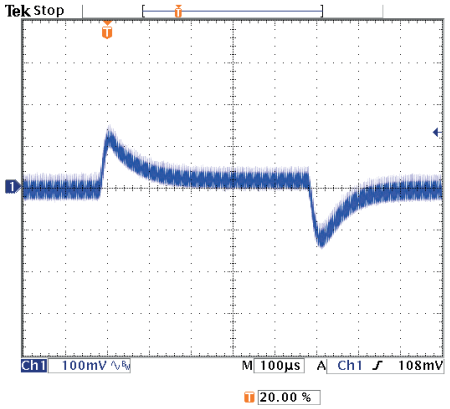
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

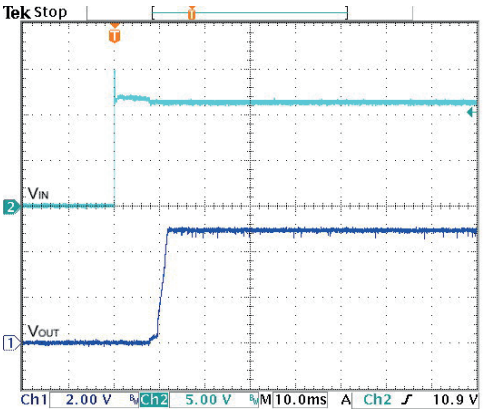
All test conditions are at 25°C. The figures are identical for PMF30-12S05



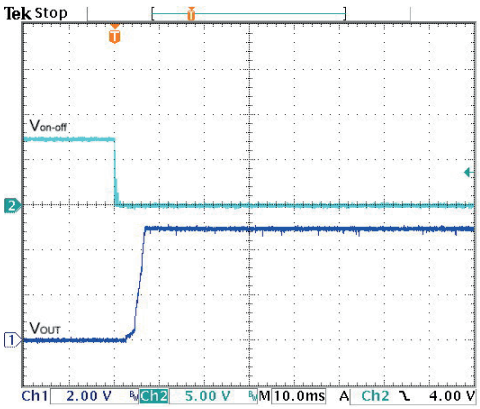
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



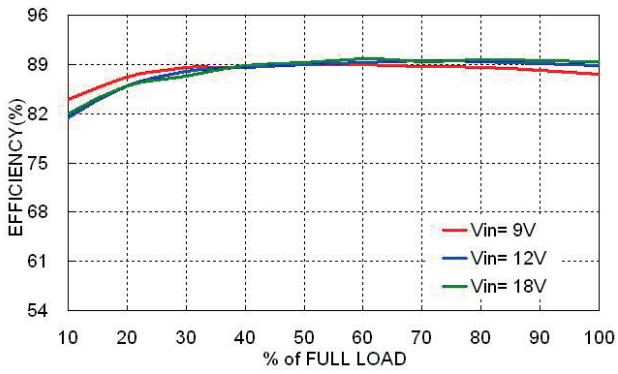
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



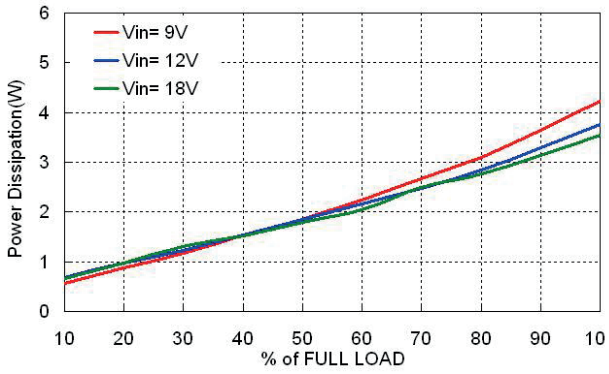
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

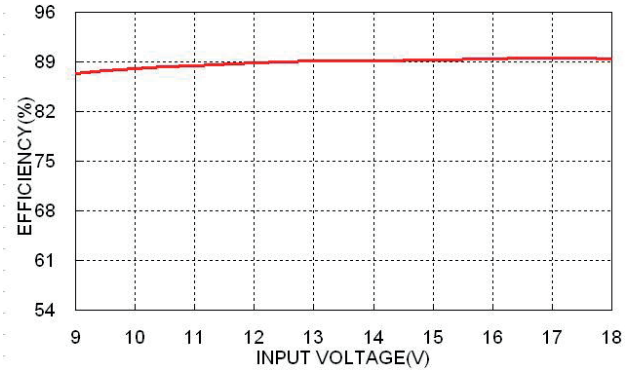
All test conditions are at 25°C. The figures are identical for PMF30-12S12



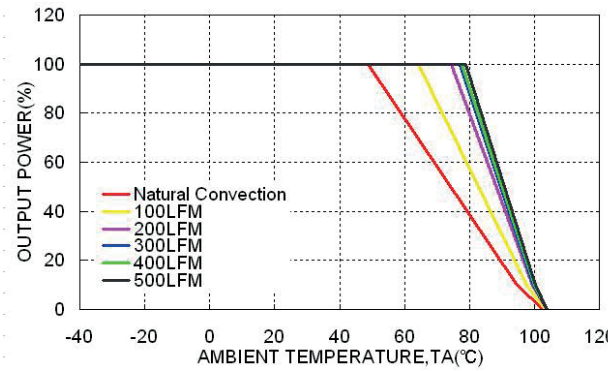
Efficiency versus Output Load



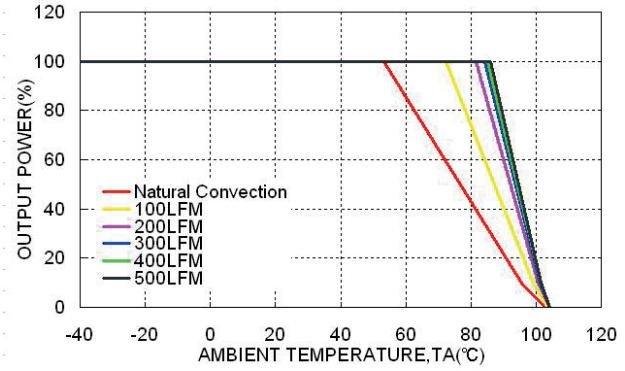
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



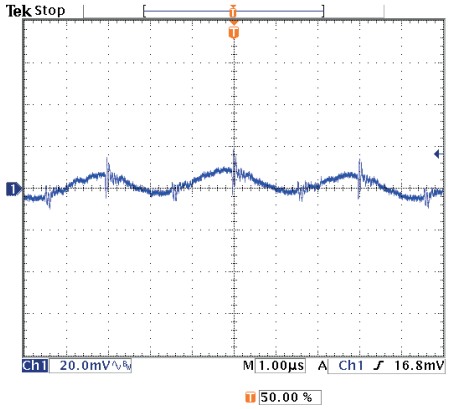
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



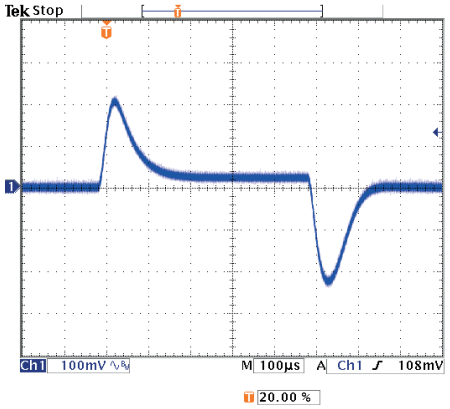
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

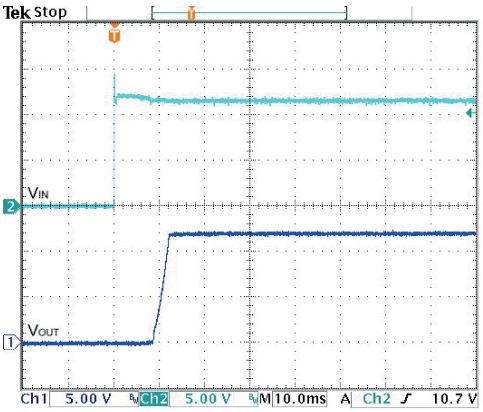
All test conditions are at 25°C. The figures are identical for PMF30-12S12



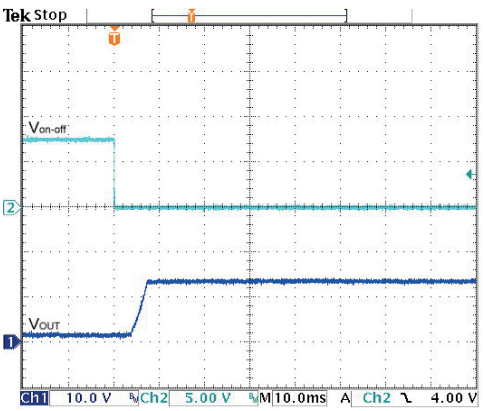
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



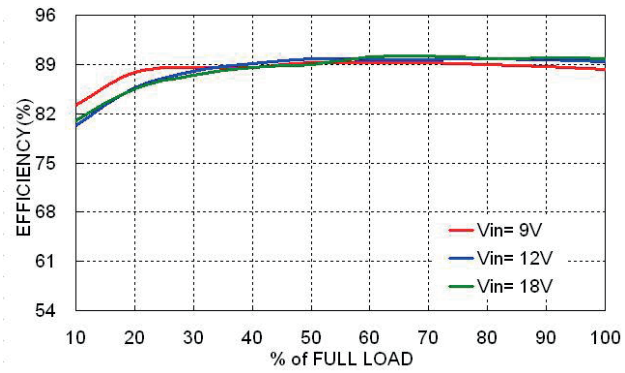
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



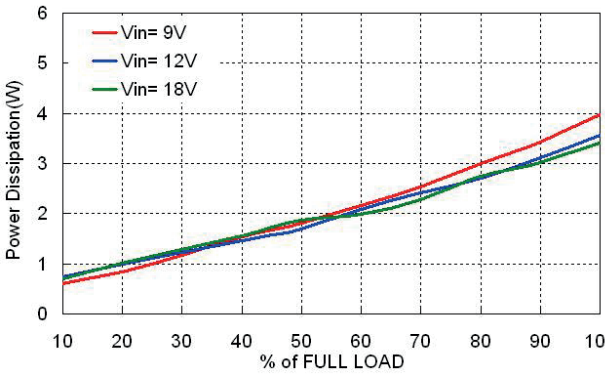
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

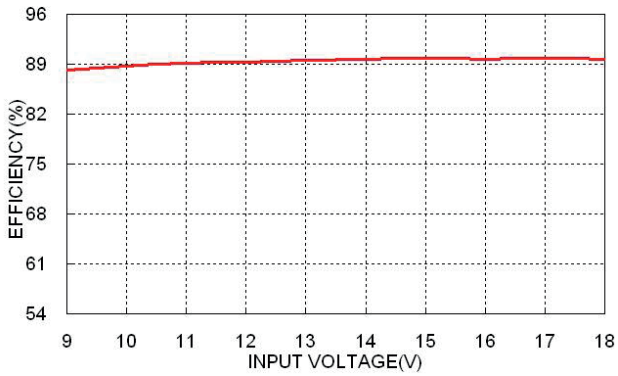
All test conditions are at 25°C. The figures are identical for PMF30-12S15



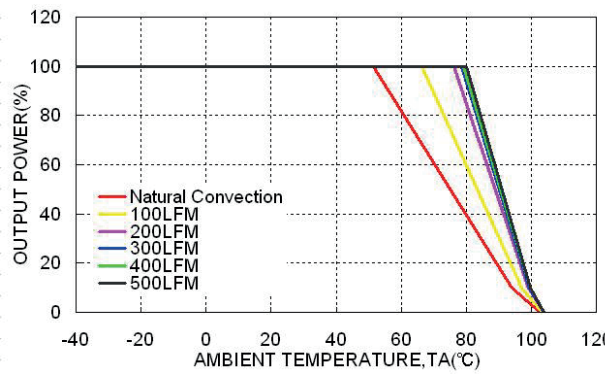
Efficiency versus Output Load



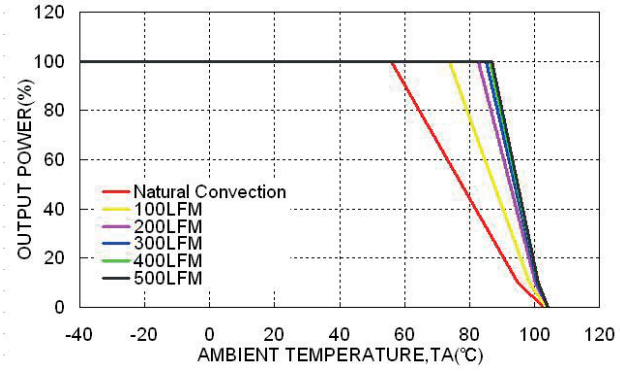
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



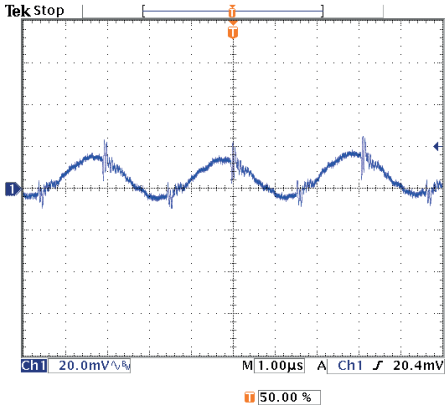
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



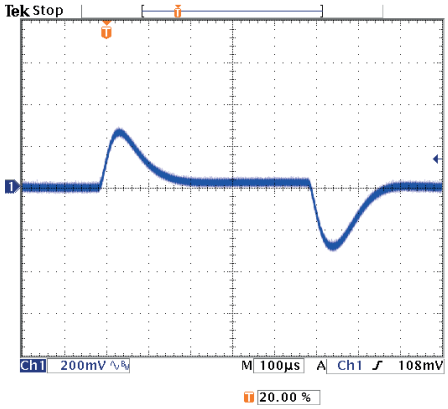
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

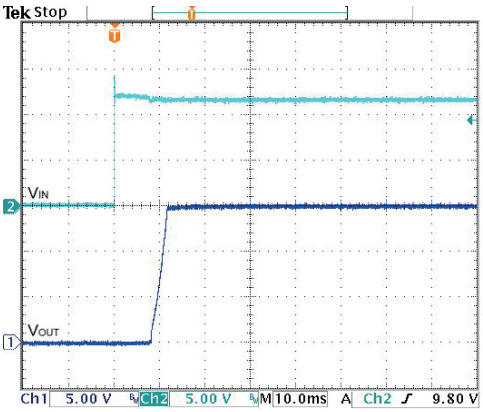
All test conditions are at 25°C. The figures are identical for PMF30-12S15



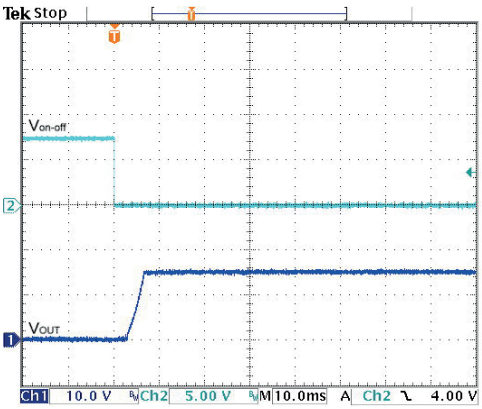
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



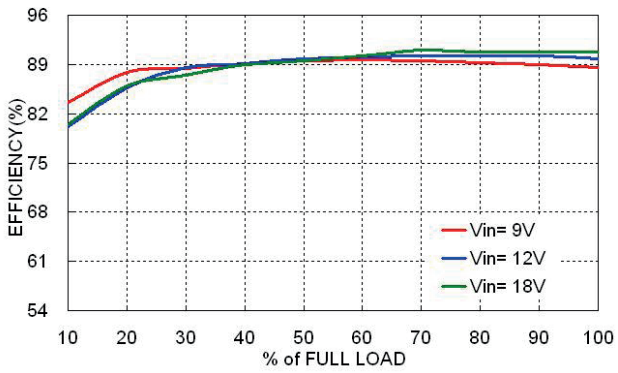
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



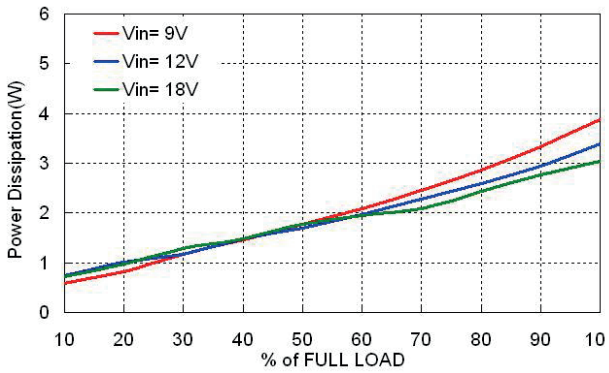
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

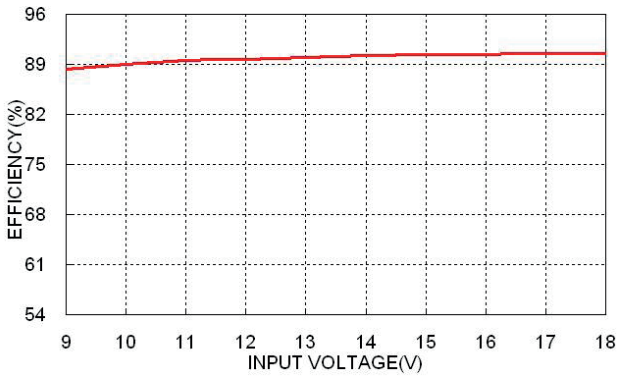
All test conditions are at 25°C. The figures are identical for PMF30-12S24



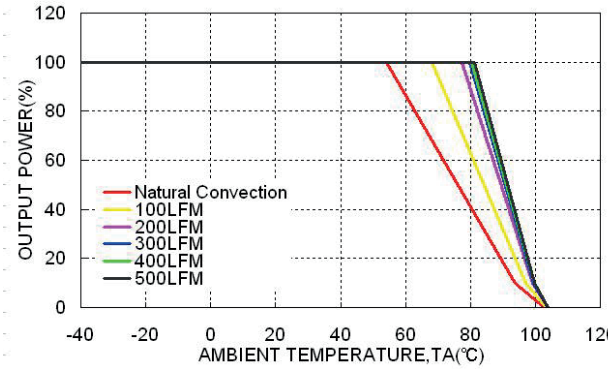
Efficiency versus Output Load



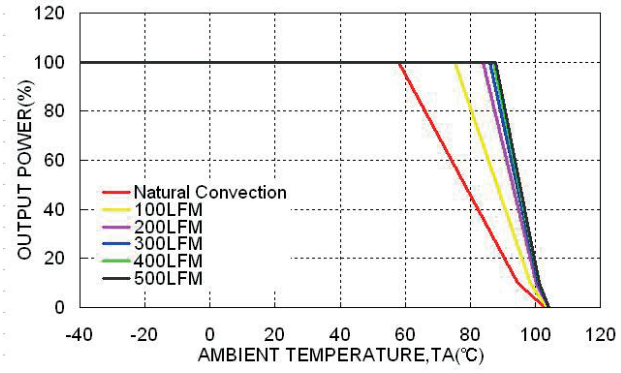
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



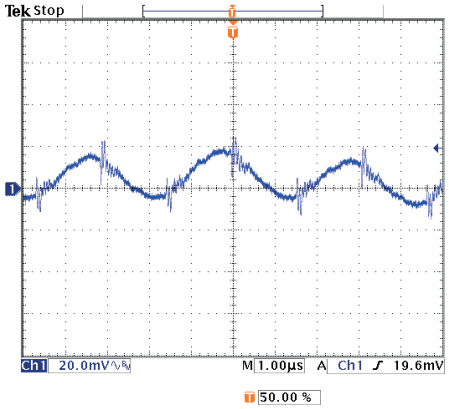
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



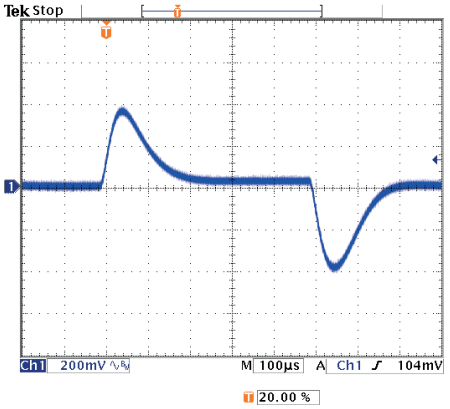
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

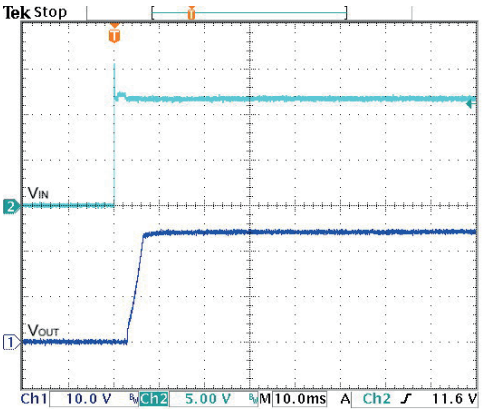
All test conditions are at 25°C. The figures are identical for PMF30-12S24



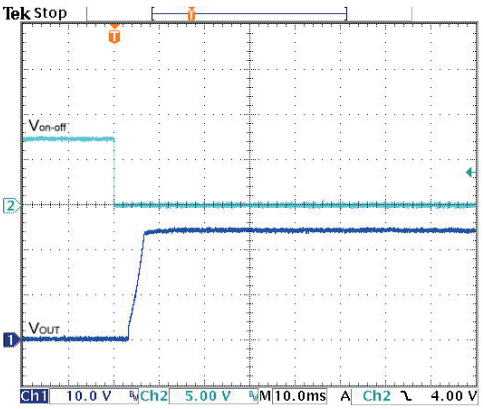
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



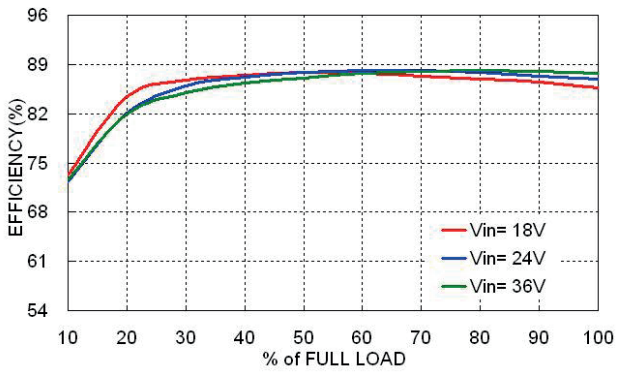
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



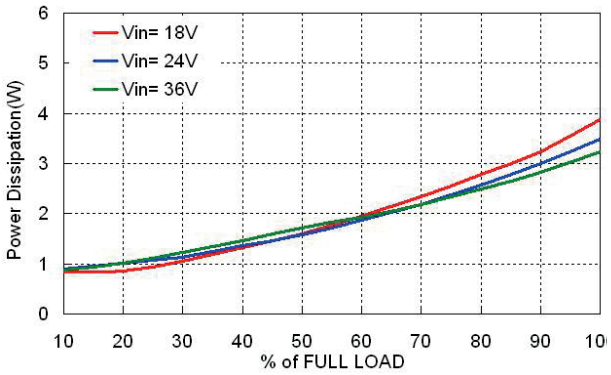
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

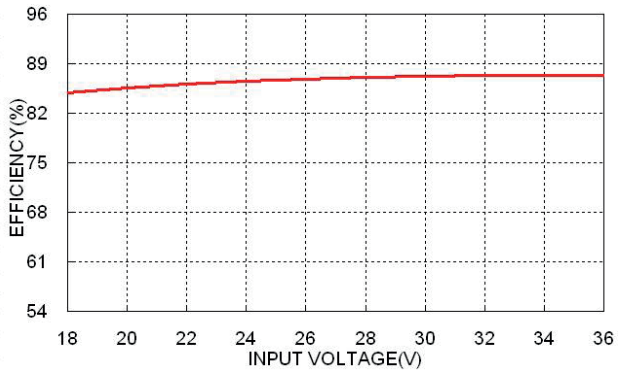
All test conditions are at 25°C. The figures are identical for PMF30-24S3P3



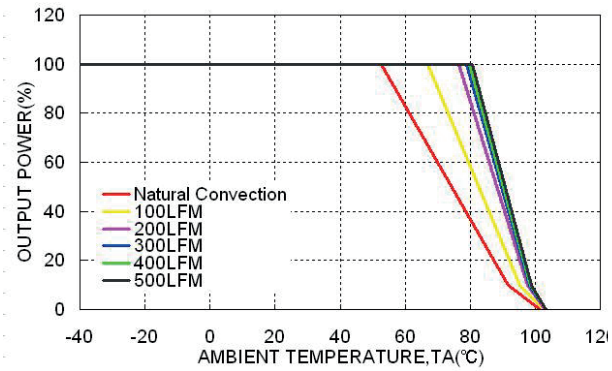
Efficiency versus Output Load



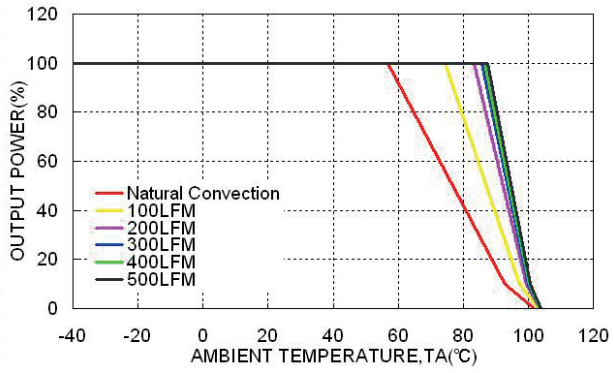
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



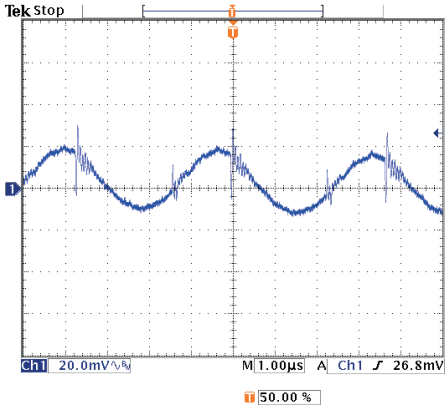
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



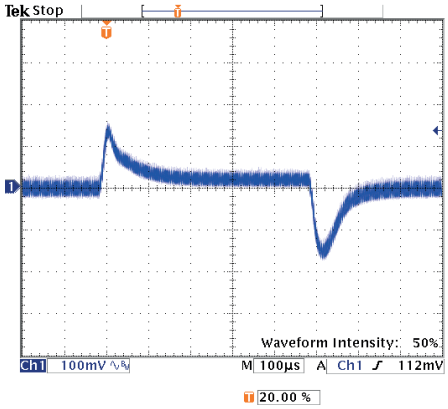
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

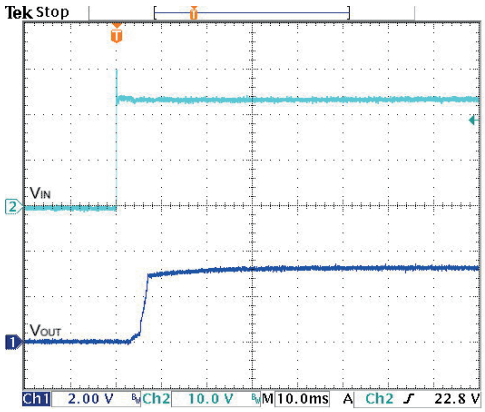
All test conditions are at 25°C. The figures are identical for PMF30-24S3P3



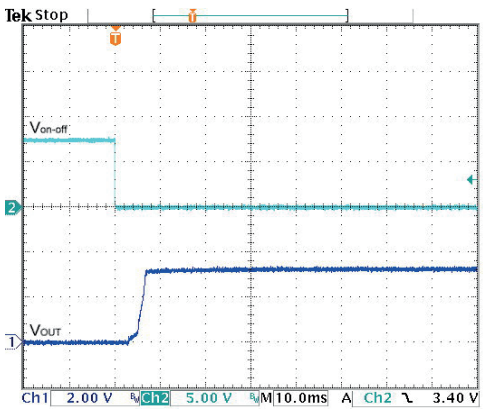
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



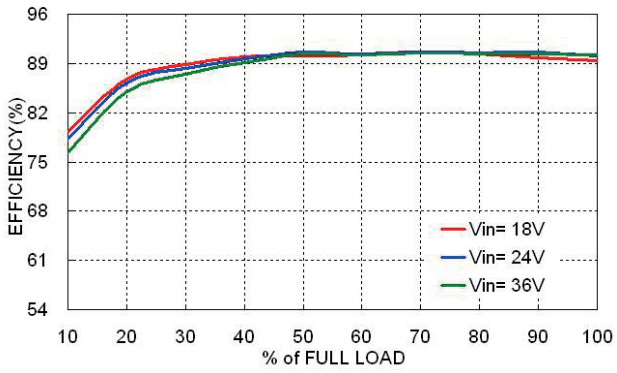
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



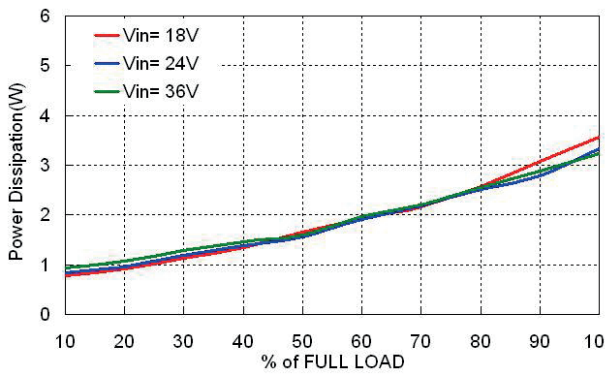
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

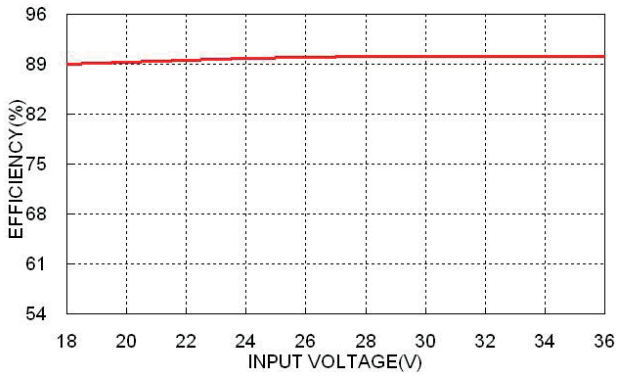
All test conditions are at 25°C. The figures are identical for PMF30-24S05



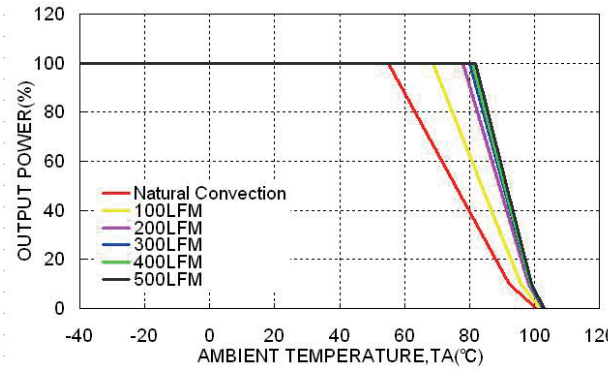
Efficiency versus Output Load



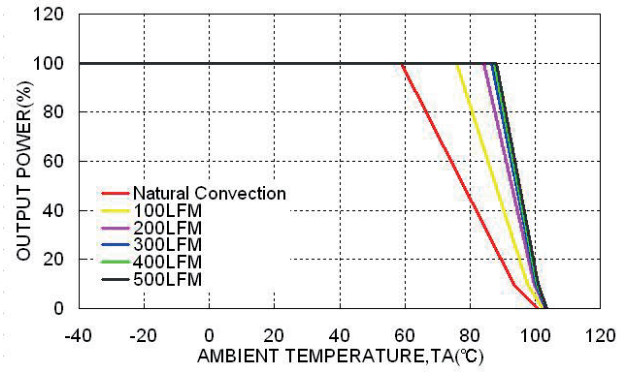
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



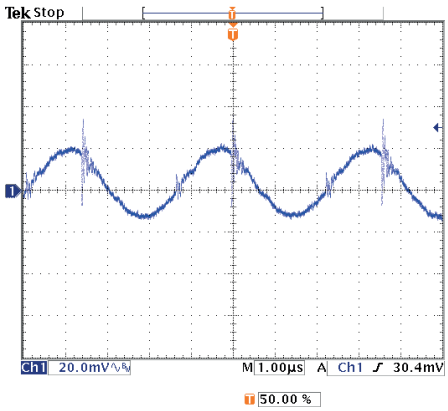
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



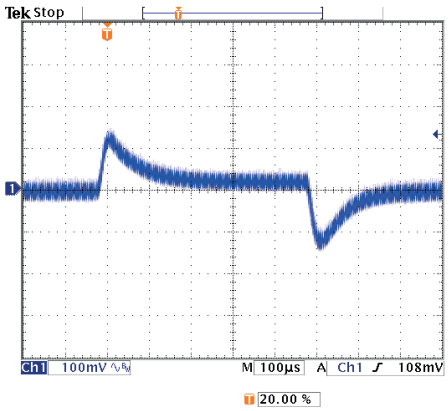
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

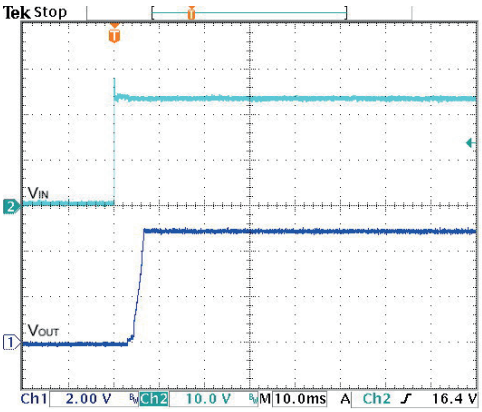
All test conditions are at 25°C. The figures are identical for PMF30-24S05



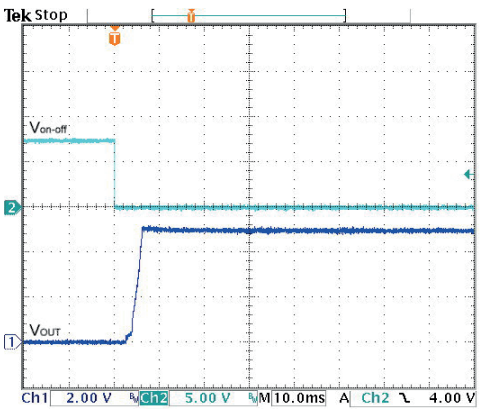
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



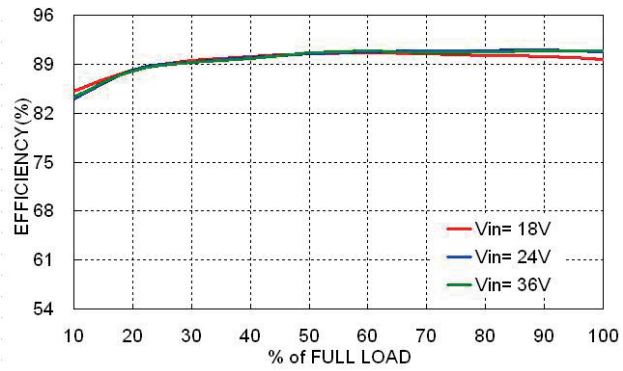
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



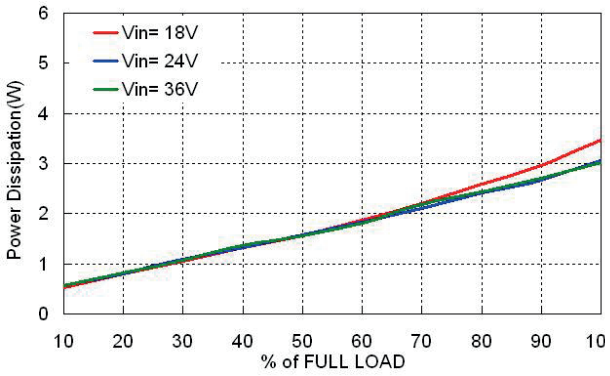
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

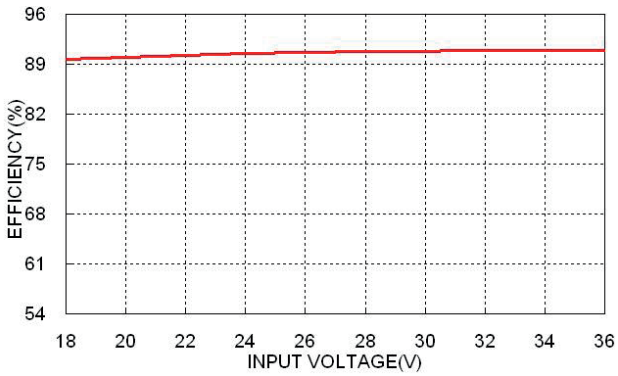
All test conditions are at 25°C. The figures are identical for PMF30-24S12



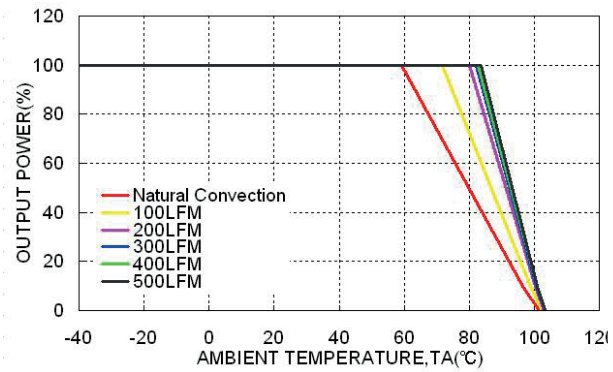
Efficiency versus Output Load



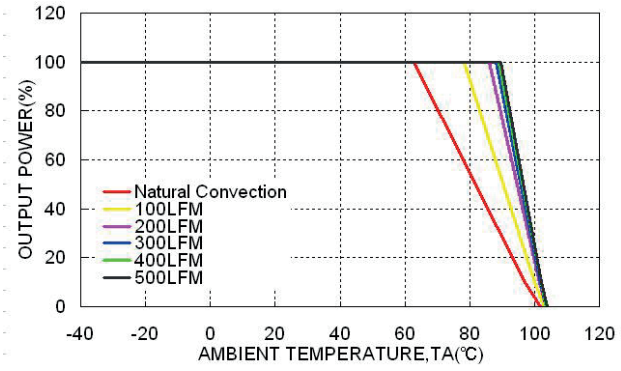
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



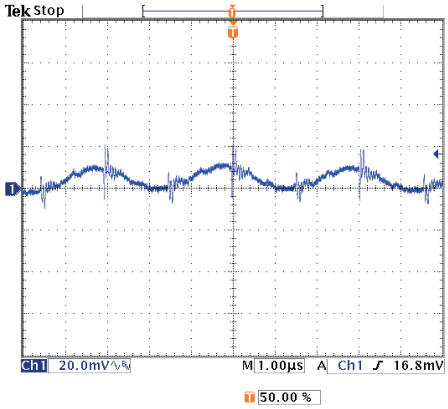
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



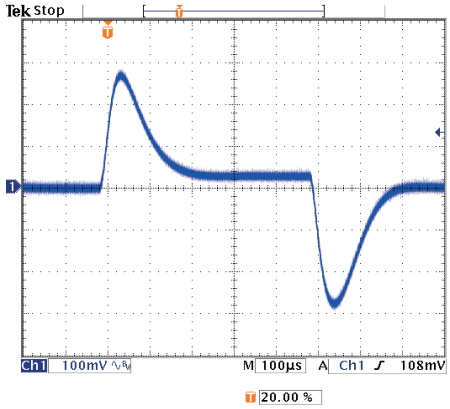
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

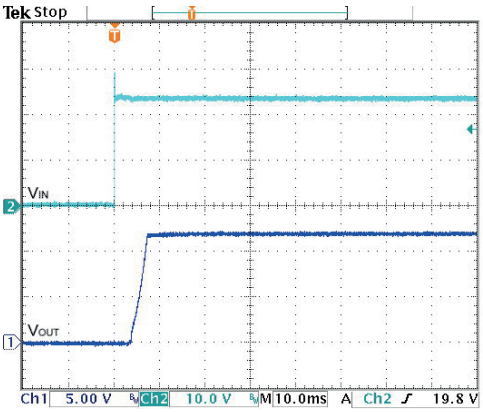
All test conditions are at 25°C. The figures are identical for PMF30-24S12



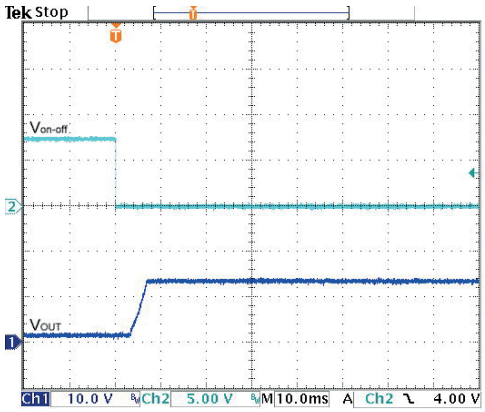
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



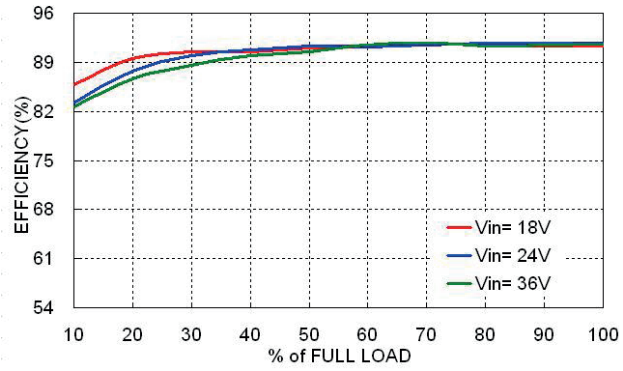
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



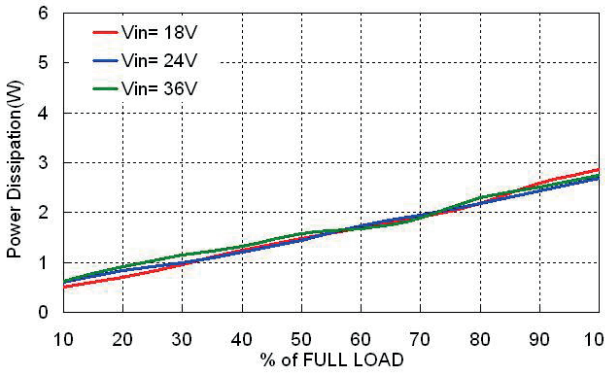
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

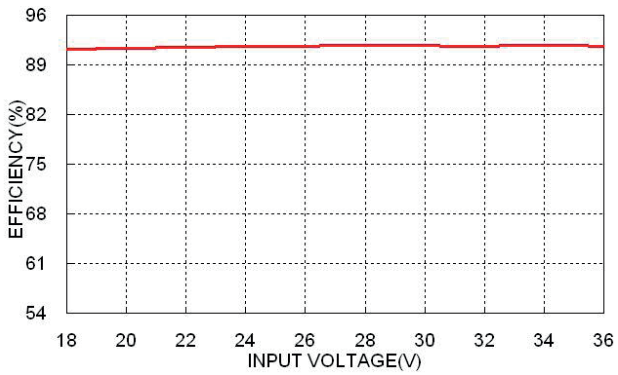
All test conditions are at 25°C. The figures are identical for PMF30-24S15



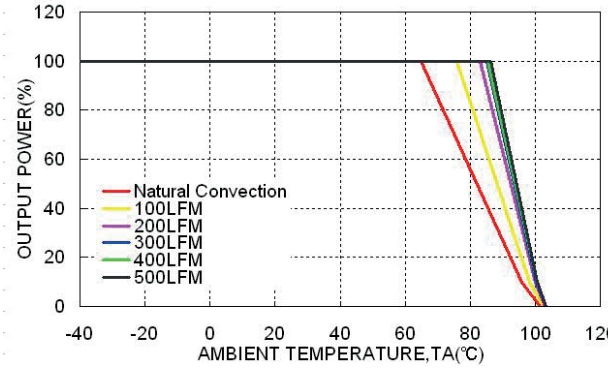
Efficiency versus Output Load



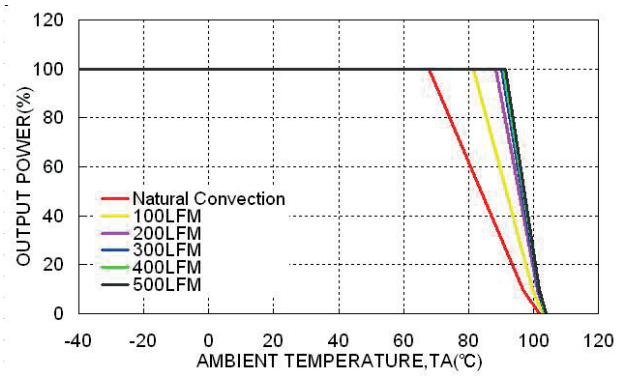
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



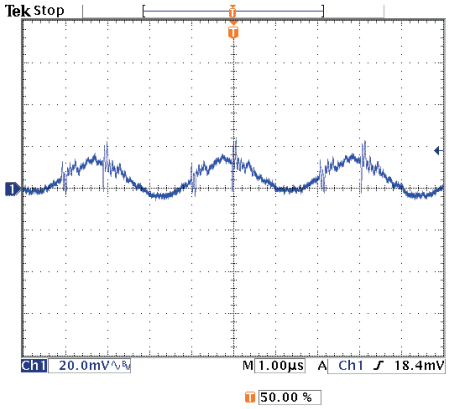
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



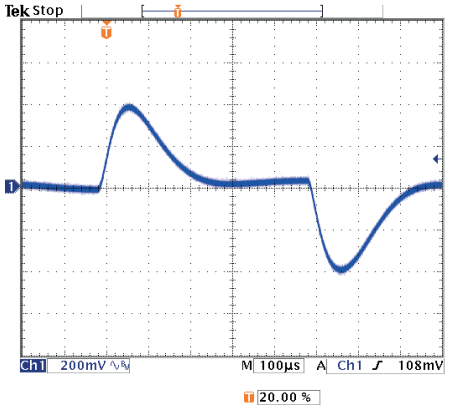
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

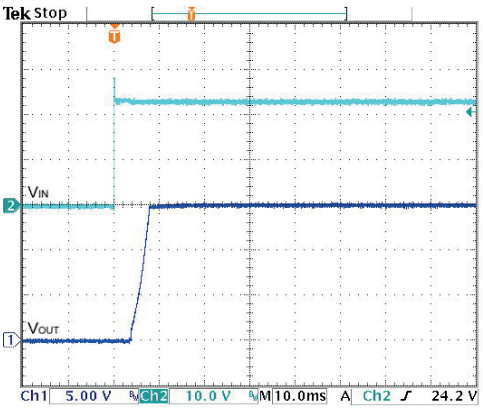
All test conditions are at 25°C. The figures are identical for PMF30-24S15



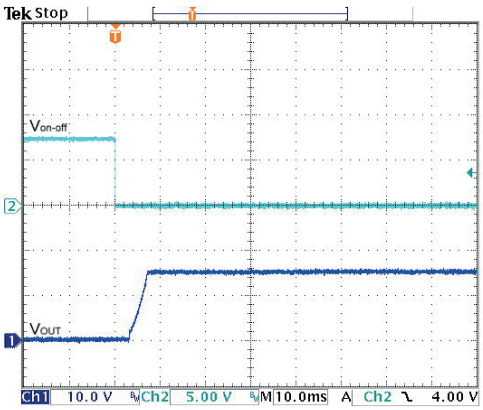
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



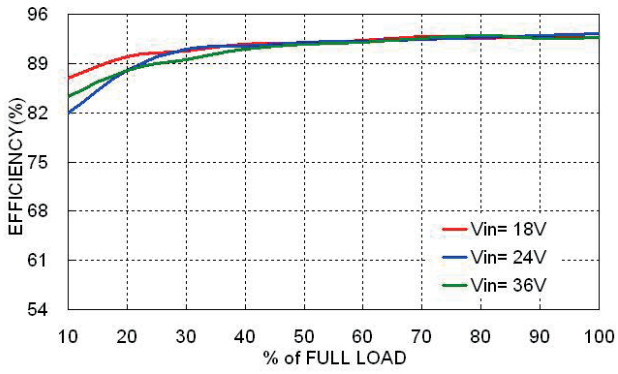
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



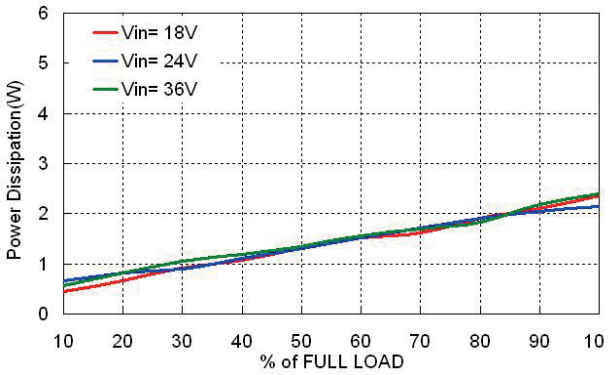
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

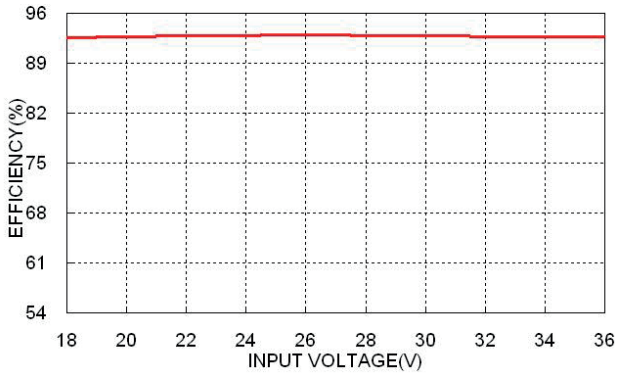
All test conditions are at 25°C. The figures are identical for PMF30-24S24



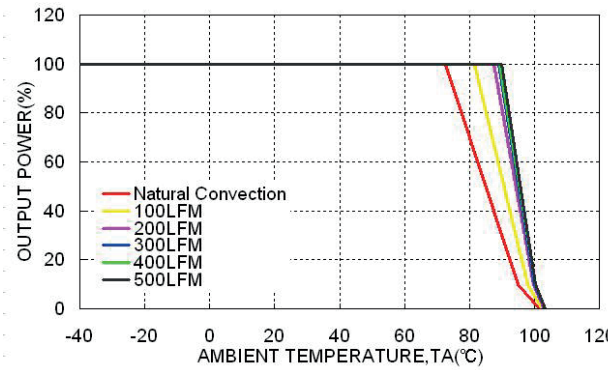
Efficiency versus Output Load



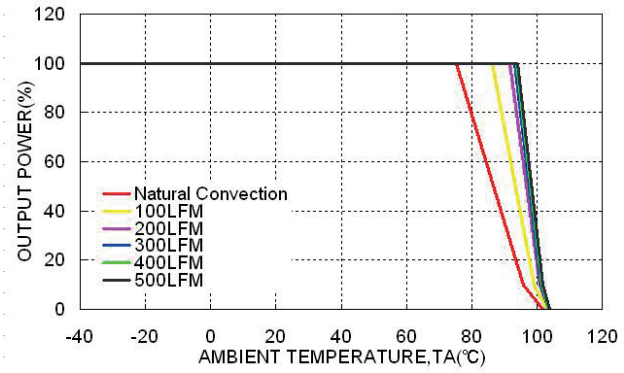
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



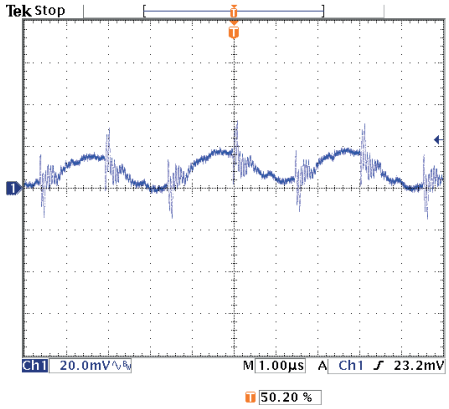
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



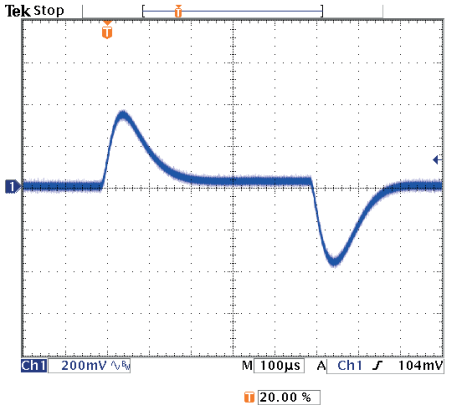
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

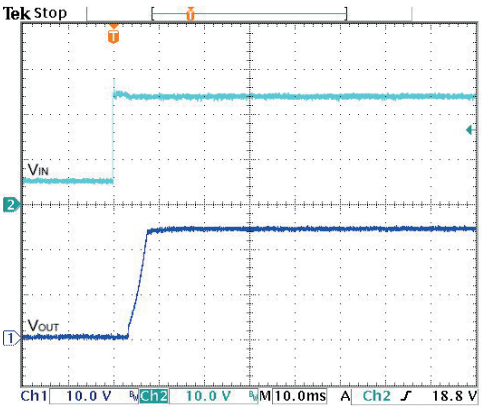
All test conditions are at 25°C. The figures are identical for PMF30-24S24



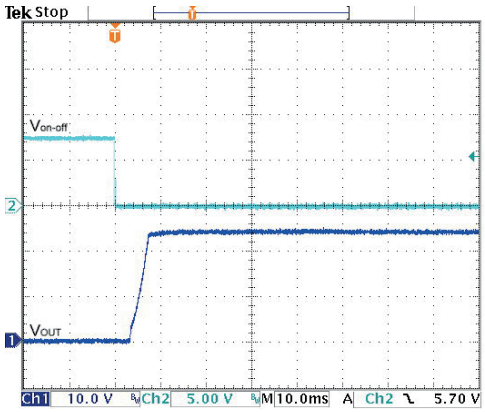
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



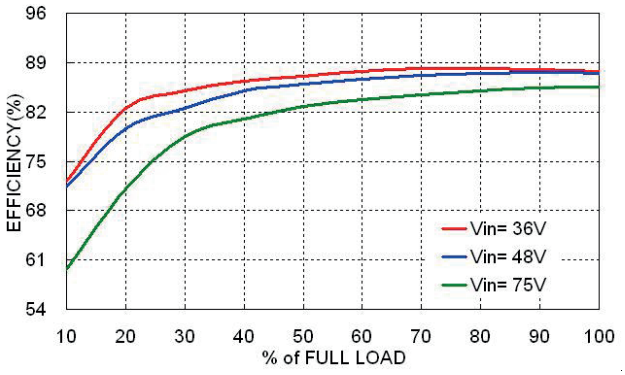
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



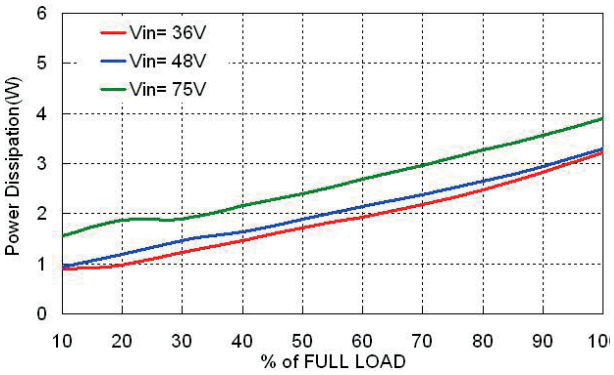
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

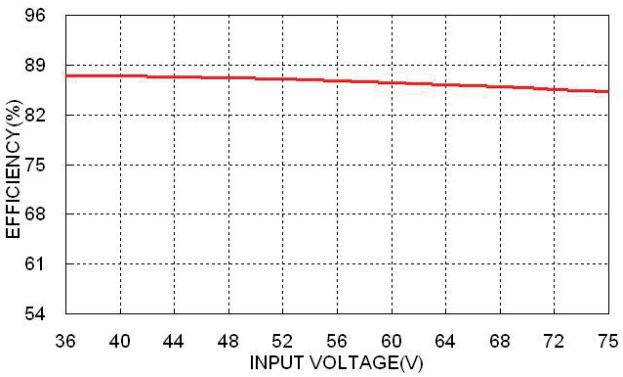
All test conditions are at 25°C. The figures are identical for PMF30-48S3P3



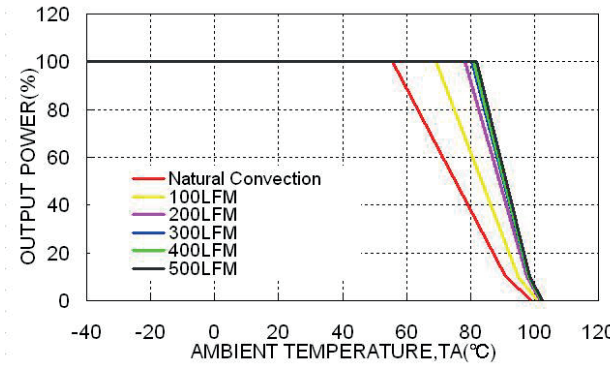
Efficiency versus Output Load



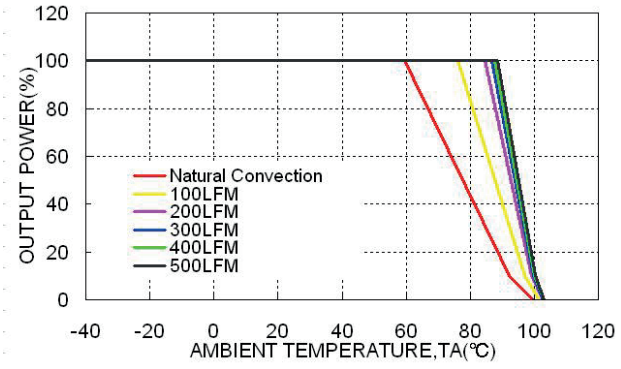
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



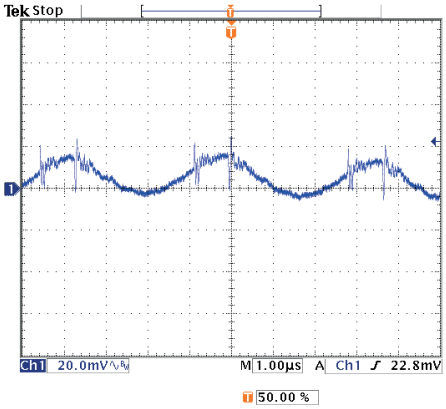
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



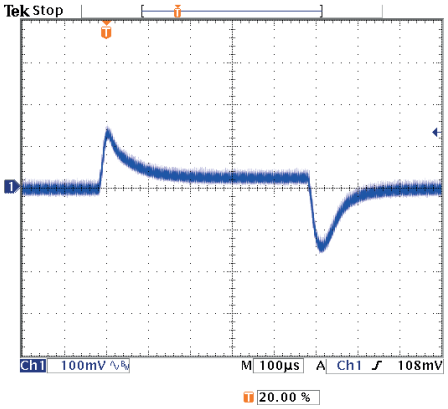
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

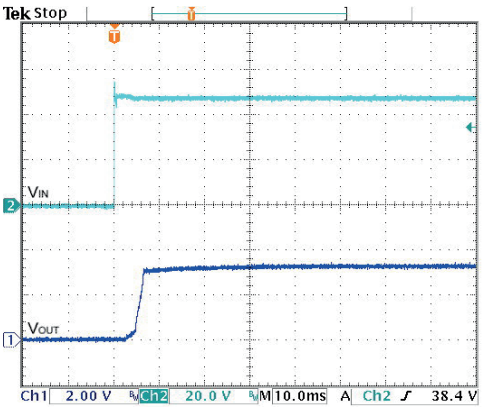
All test conditions are at 25°C. The figures are identical for PMF30-48S3P3



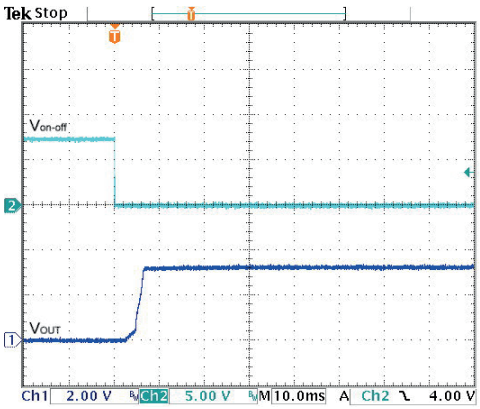
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



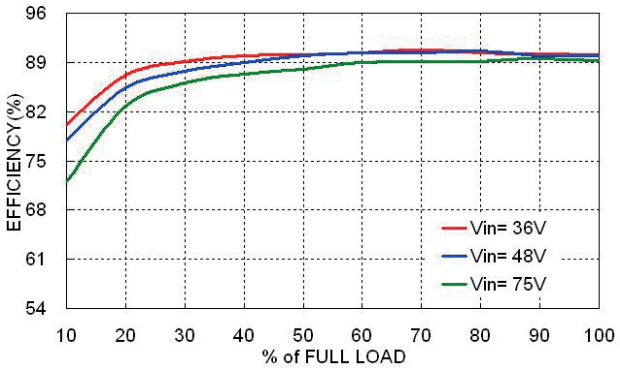
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



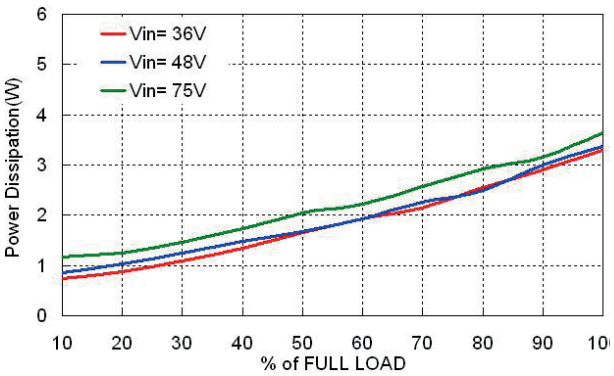
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

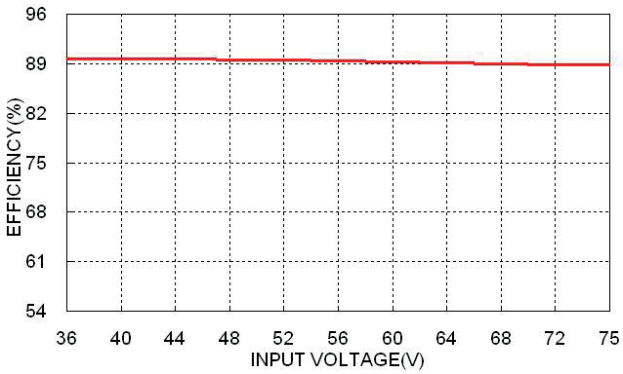
All test conditions are at 25°C. The figures are identical for PMF30-48S05



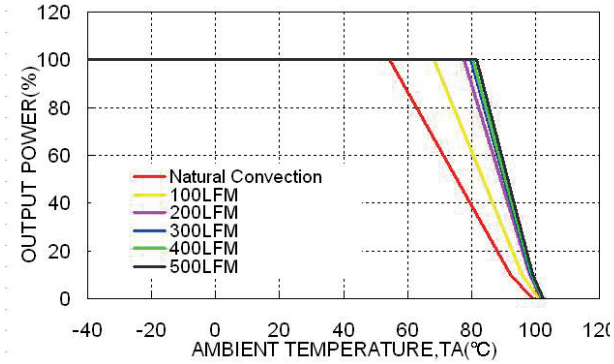
Efficiency versus Output Load



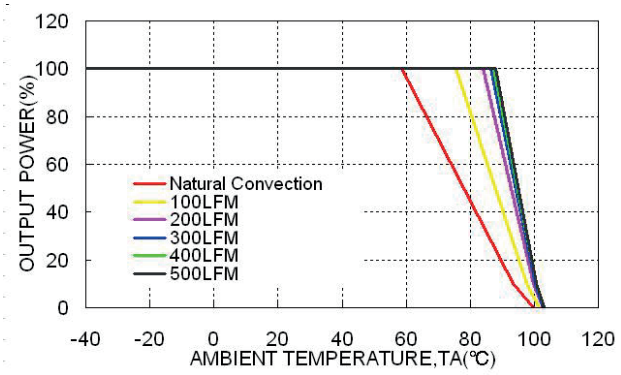
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



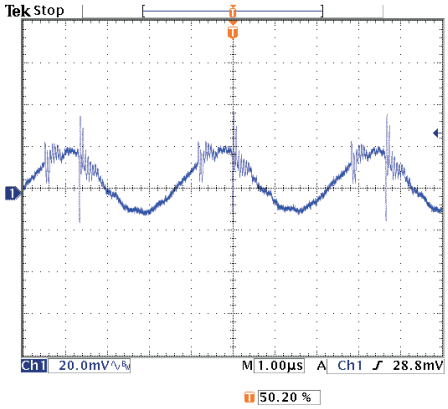
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



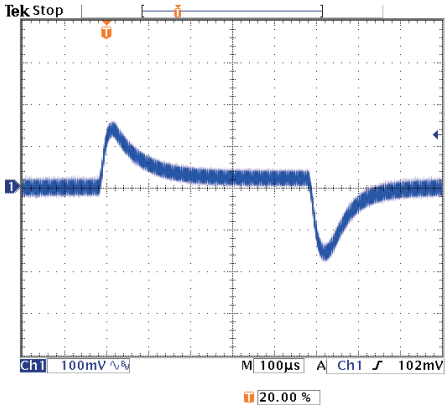
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

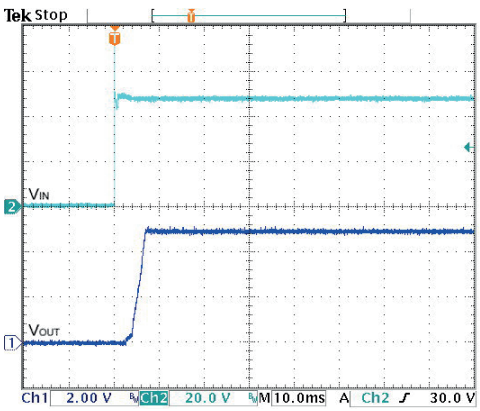
All test conditions are at 25°C. The figures are identical for PMF30-48S05



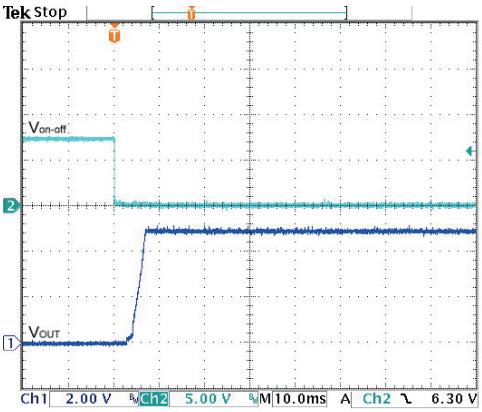
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



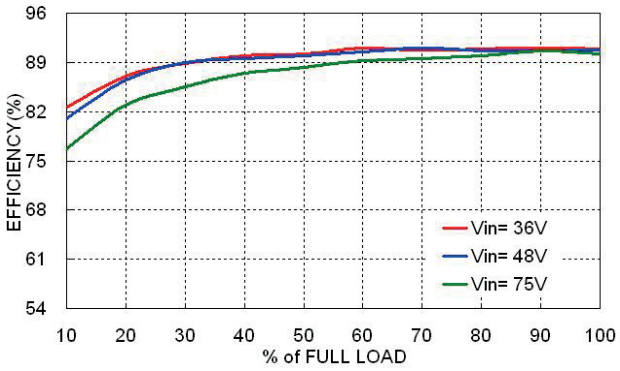
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



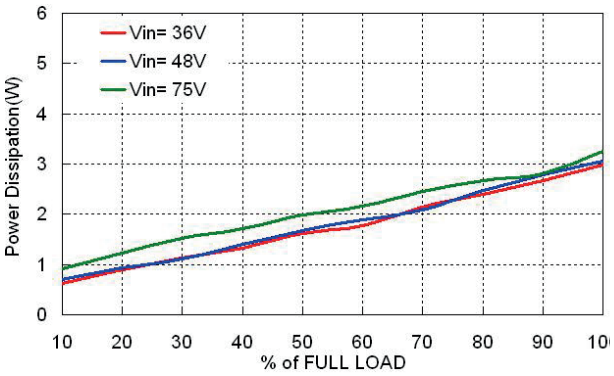
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

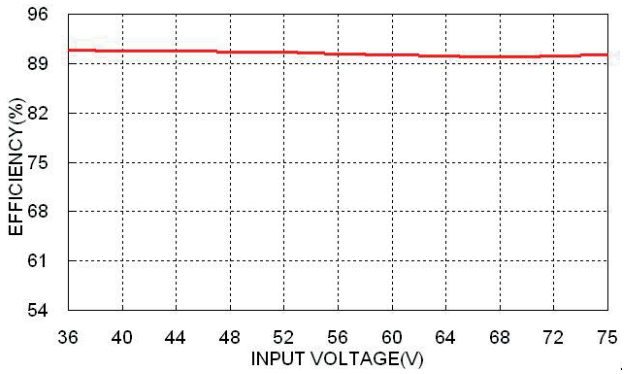
All test conditions are at 25°C. The figures are identical for PMF30-48S12



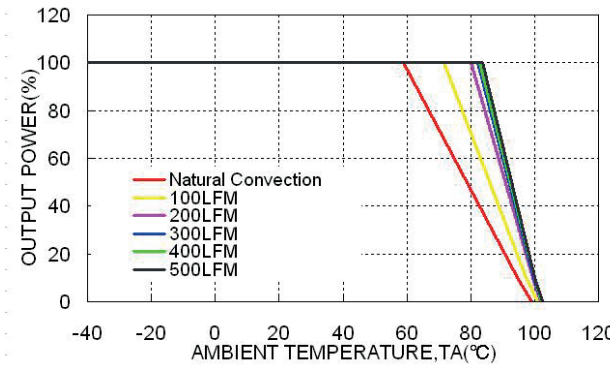
Efficiency versus Output Load



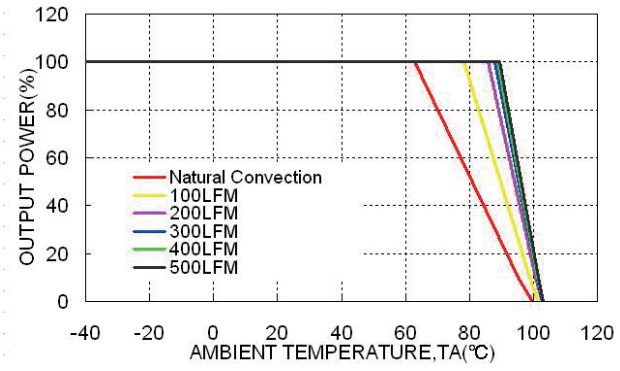
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



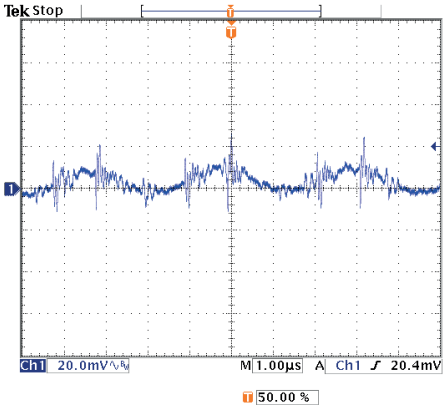
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



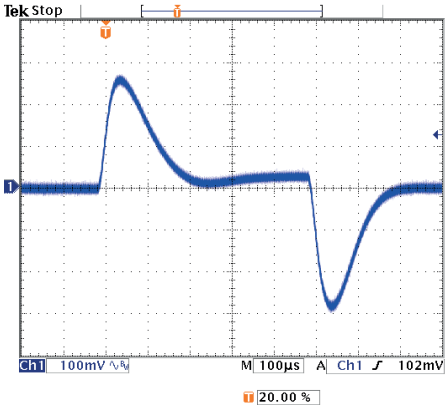
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

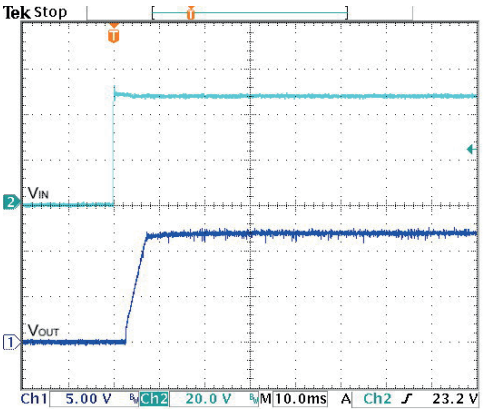
All test conditions are at 25°C. The figures are identical for PMF30-48S12



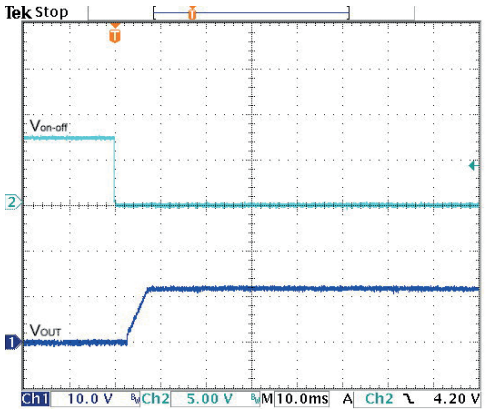
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



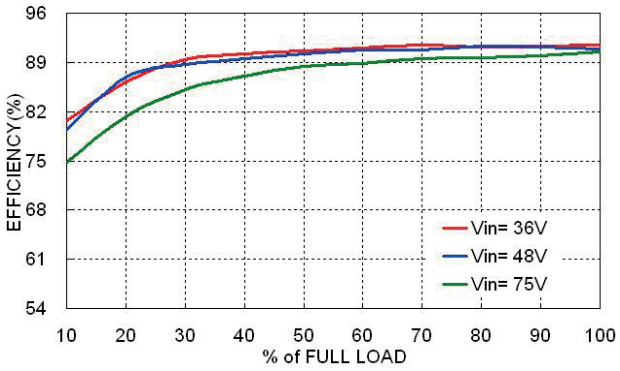
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



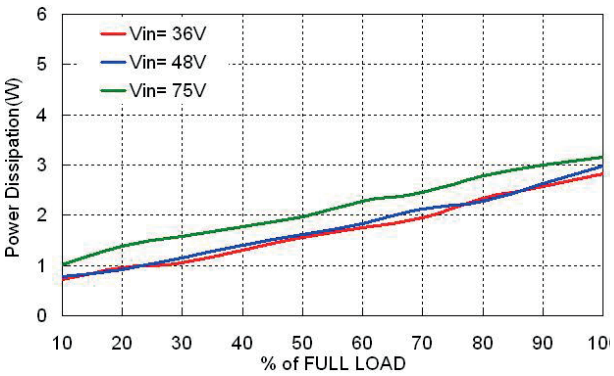
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

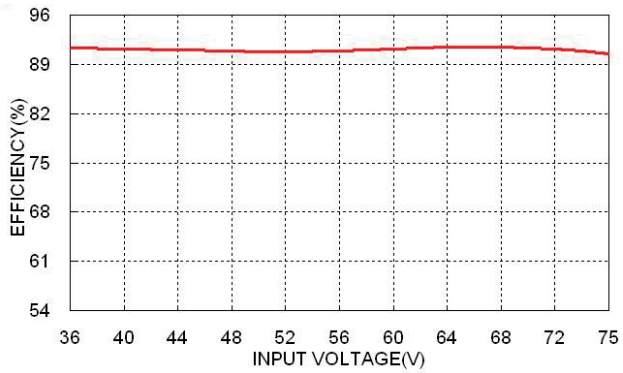
All test conditions are at 25°C. The figures are identical for PMF30-48S15



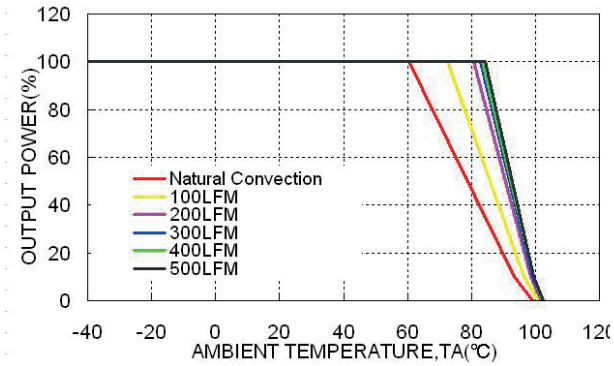
Efficiency versus Output Load



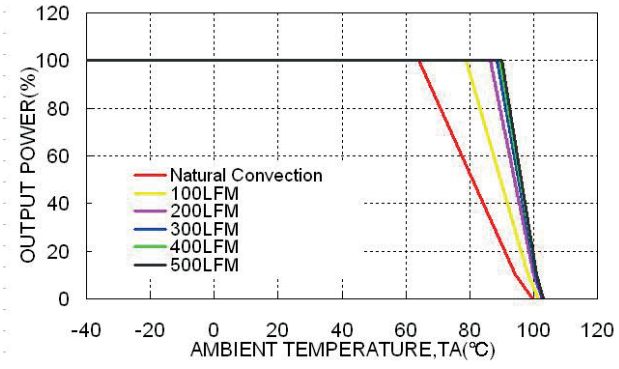
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



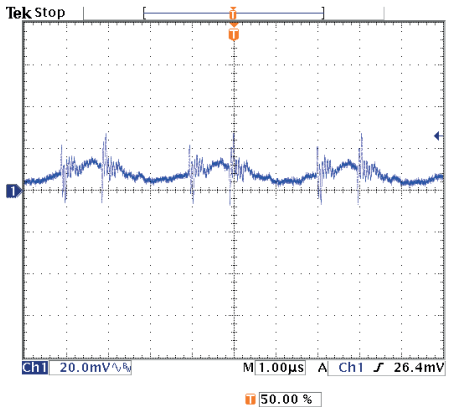
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



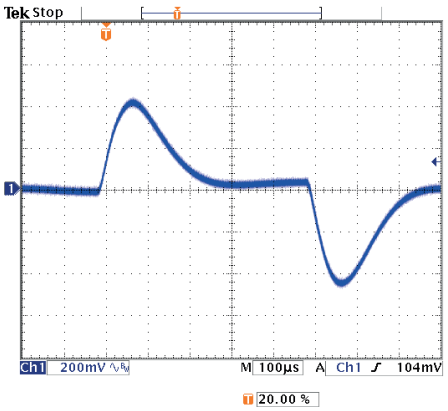
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

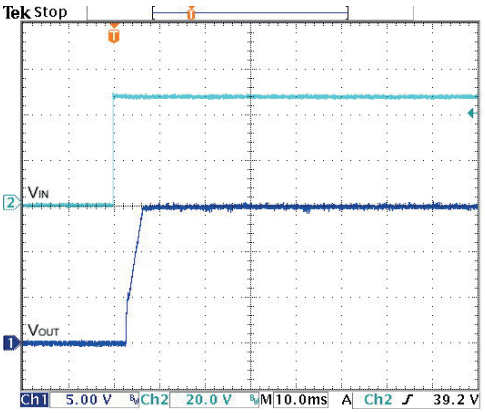
All test conditions are at 25°C. The figures are identical for PMF30-48S15



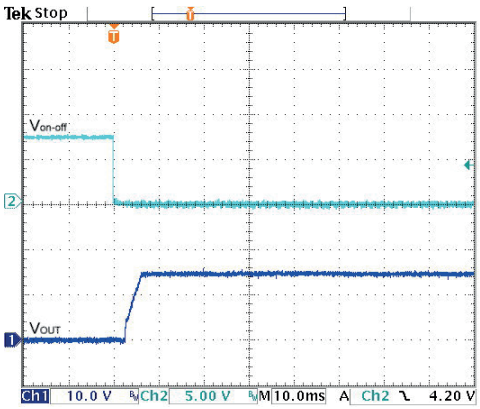
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



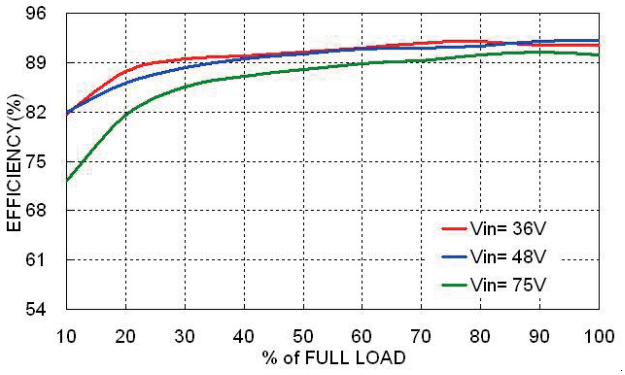
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



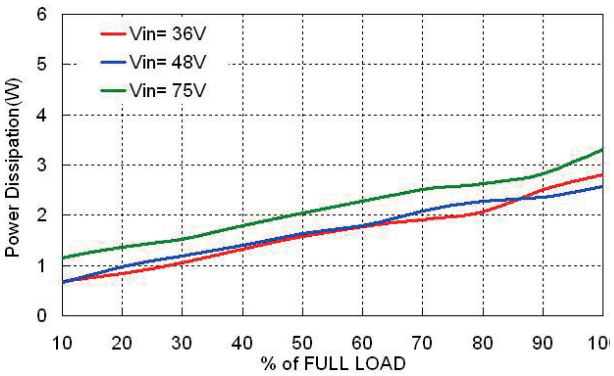
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves

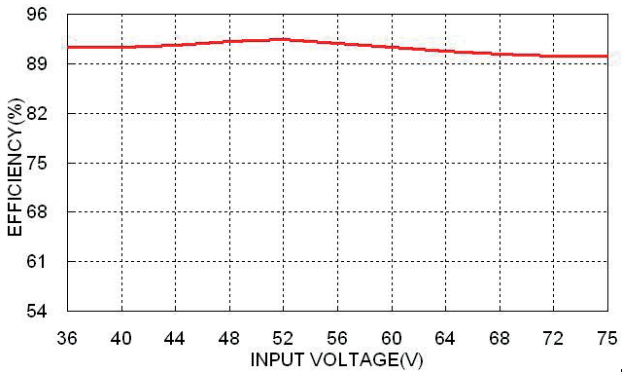
All test conditions are at 25°C. The figures are identical for PMF30-48S24



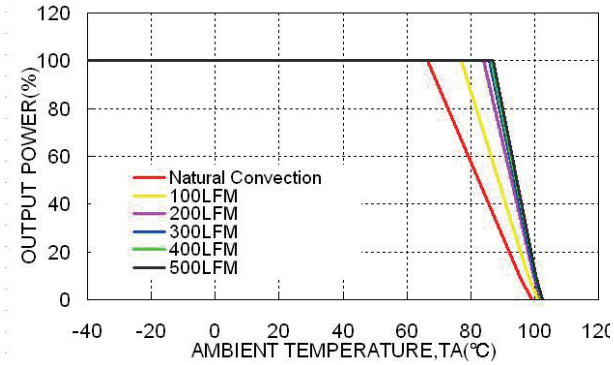
Efficiency versus Output Load



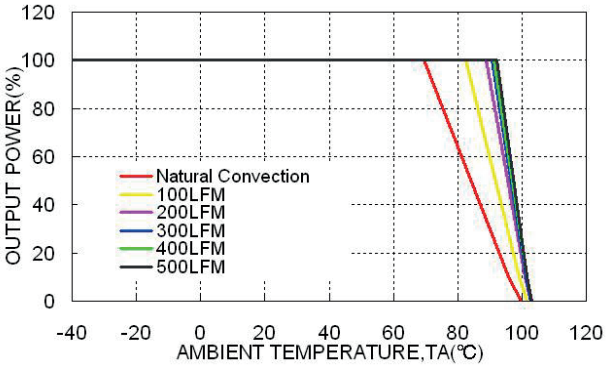
Power Dissipation versus Output Load



Efficiency versus Input Voltage
Full Load



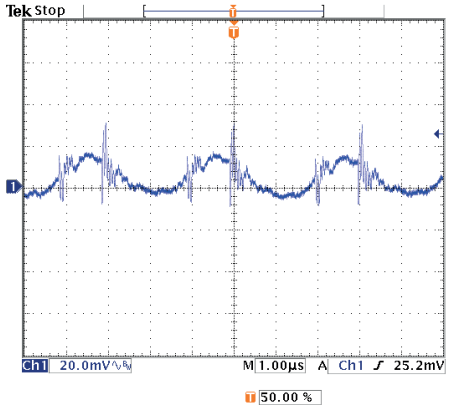
Derating Output Load versus Ambient Temperature and Airflow
Vin(nom)



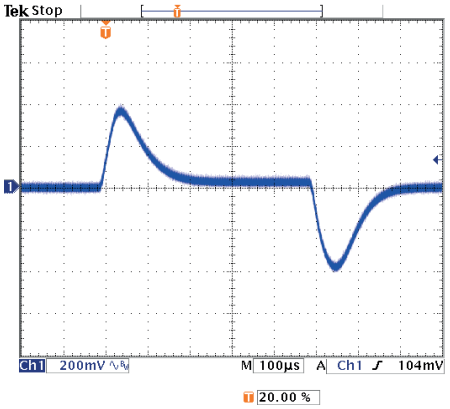
Derating Output Load versus Ambient Temperature with
Heat-sink and Airflow, Vin(nom)

Characteristic Curves

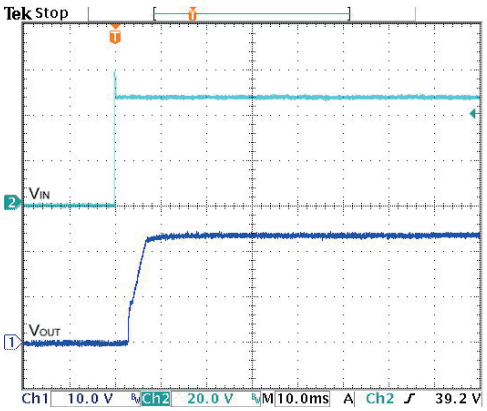
All test conditions are at 25°C. The figures are identical for PMF30-24S24



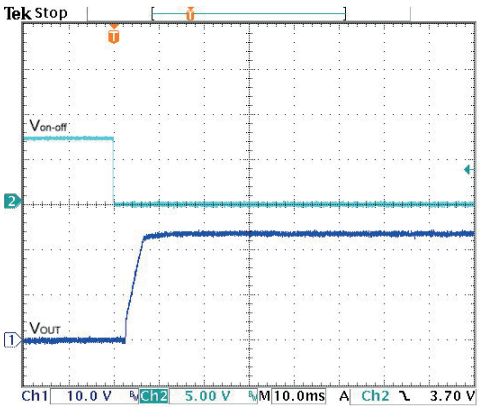
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load