P R
B X

POWERBOX Industrial Line
MAF08 Series
6-24W Single Output
DC/DC Converter
Manual V1.0

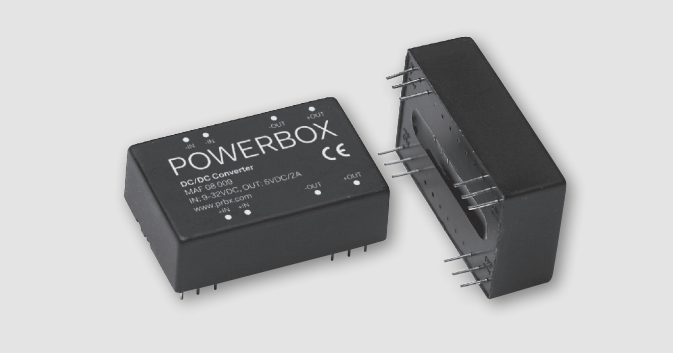


Table of Contents

Features

- 6-24W non-isolated output
- Efficiency to 94%
- Input LC filter
- 24-pin DIP or SMD package
- Regulated output

Model Number	Input Voltage	Output Voltage	Output Current	Input Current No Load	Input Current Full Load	Efficiency
MAF 08 003	4.7-6 VDC	3.3 VDC	2000 mA	15 mA	1553 mA	85 %
MAF 08 006	9-32 VDC	3.3 VDC	2000 mA	15 mA	655 mA	84 %
MAF 08 009	9-32 VDC	5 VDC	2000 mA	15 mA	947 mA	88 %
MAF 08 012	9-32 VDC	12 VDC	830 mA	15 mA	954 mA	87 %
MAF 08 015	9-32 VDC	15 VDC	666 mA	15 mA	957 mA	87 %
MAF 08 018	16-32 VDC	12 VDC	1600 mA	15 mA	860 mA	93 %
MAF 08 021	19-32 VDC	15 VDC	1600 mA	15 mA	1064 mA	94 %

Note:
1. Nominal input voltage 5, 12 or 24 VDC.
2. All specifications typical at nominal line , full load and 25oC unless otherwise notes.

Specifications

Input Specifications

Parameters	Min	Nominal	Max	Unit	Note
Input voltage range	4.7	5	6	VDC	
	9	12	32	VDC	
	16	24	32	VDC	
	19	24	32	VDC	
Input filter					LC-filter

Output Specifications

Parameters	Max	Unit	Note
Voltage accuracy	2.0	%	
Temperature coefficient	0.025	%/°C	
Ripple and noise 20MHz BW	100	mVrms	3.3V, 5V output
	1%	Vp-p	12V, 15V output
Short circuit protection			Continuous
Line regulation	0.5	%	From high line to low line
Load regulation	0.5	%	From full load to 10% load

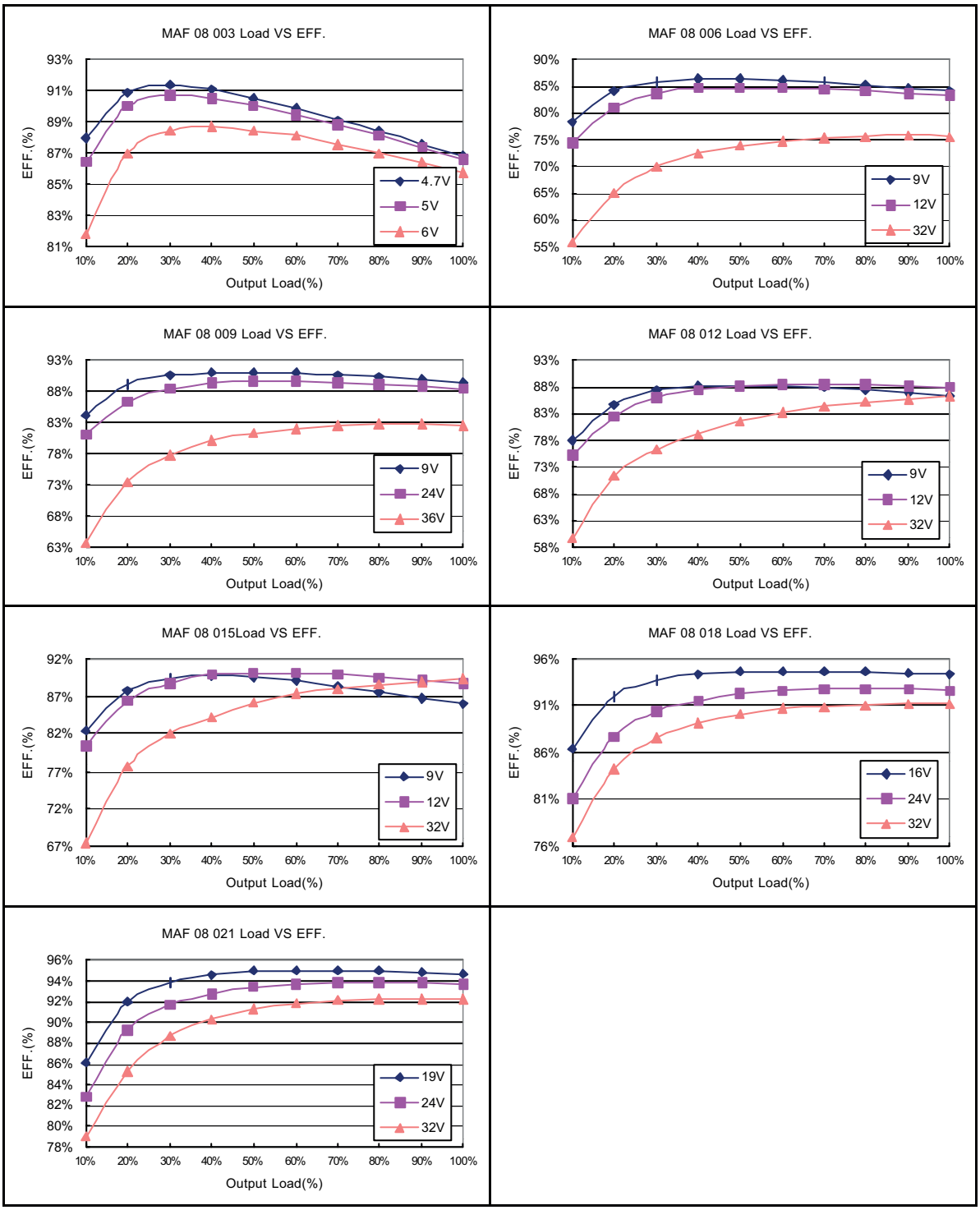
General Specifications

Parameters	Min	Max	Unit	Note
Switching frequency				150 KHz typical
Operating temperature range	-25	+71	°C	
Case temperature		+100	°C	
Storage temperature range	-40	+100	°C	
Cooling				Free air convection
Case material				Black coated copper with non-conductive base
Case dimensions				1.25 x 0.8 x 0.4 inches (31.8 x 20.3 x 10.2 mm)

General Information

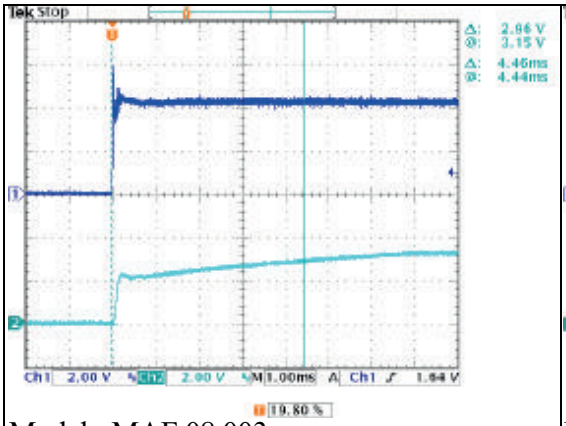
The MAF08 unit has many operational characterized aspects, including efficiency, start up delay time, overshoot, output ripple & noise , dynamic response to load and over current protection.

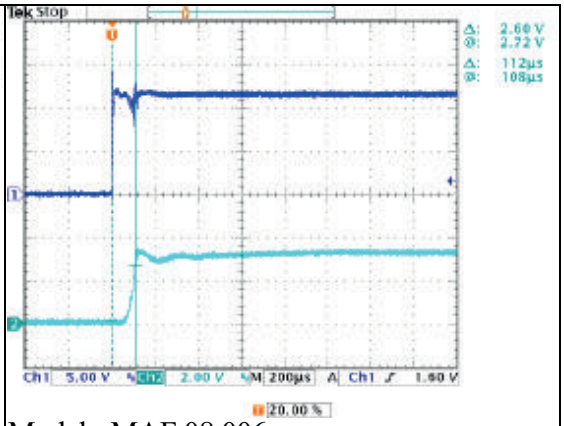
Efficiency



Start Up Delay Time

Start up input power, measuring the time between input power is turn on and output voltage go within 90% Vout. At nominal input and maximum load.

<table>
<tr>
<td> 

Model : MAF 08 003
Ch1 : Vin Ch2 : Vout
Delay time : 4.46ms</td>
<td> 

Model : MAF 08 006
Ch1 : Vin Ch2 : Vout
Delay time : 112us</td>
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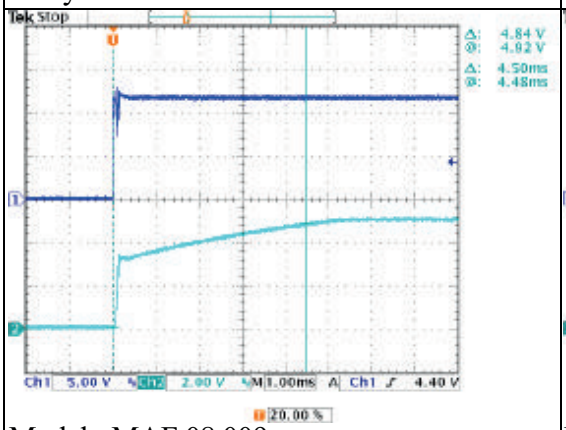
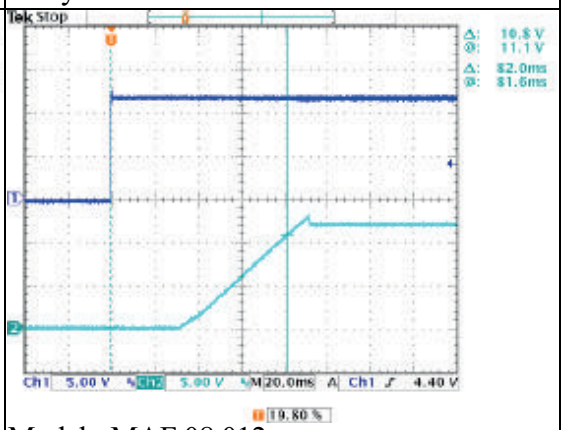
<td> 

Model : MAF 08 009
Ch1 : Vin Ch2 : Vout
Delay time : 4.50ms</td>
<td> 

Model : MAF 08 012
Ch1 : Vin Ch2 : Vout
Delay time : 82.0ms</td>
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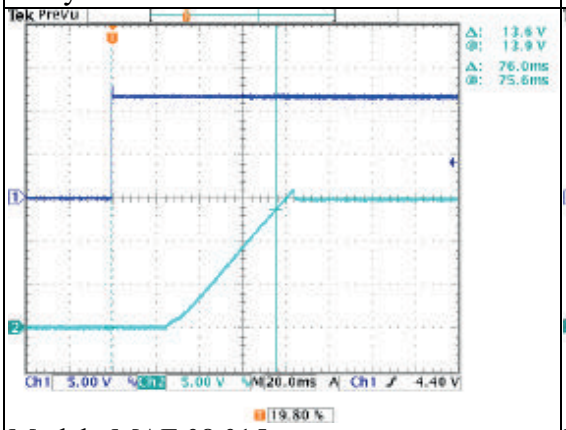
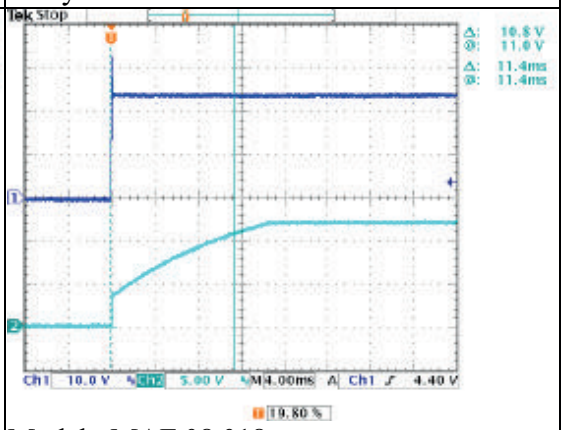
<tr>
<td> 

Model : MAF 08 015
Ch1 : Vin Ch2 : Vout
Delay time : 76.0ms</td>
<td> 

Model : MAF 08 018
Ch1 : Vin Ch2 : Vout
Delay time : 11.4ms</td>
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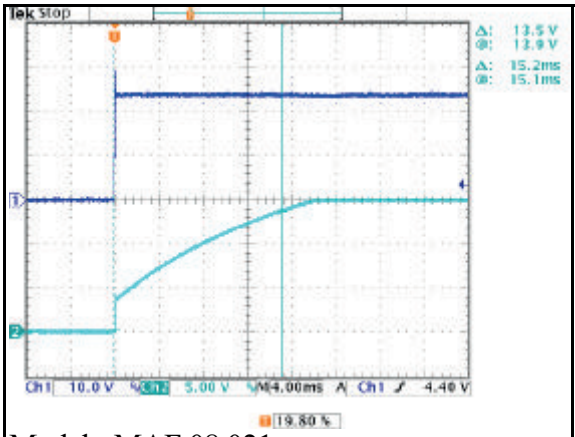
</table>

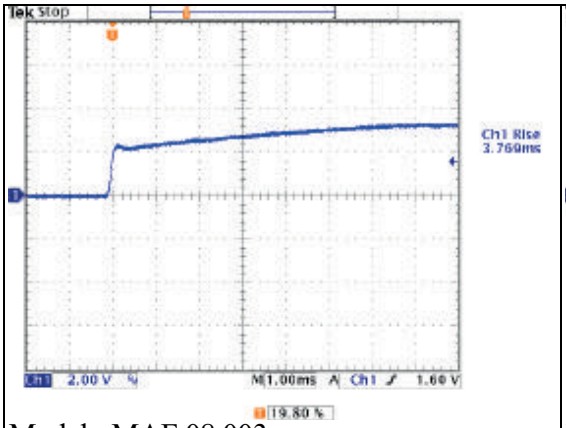
 Model : MAF 08 021 Ch1 : Vin Ch2 : Vout Delay time : 15.2ms	

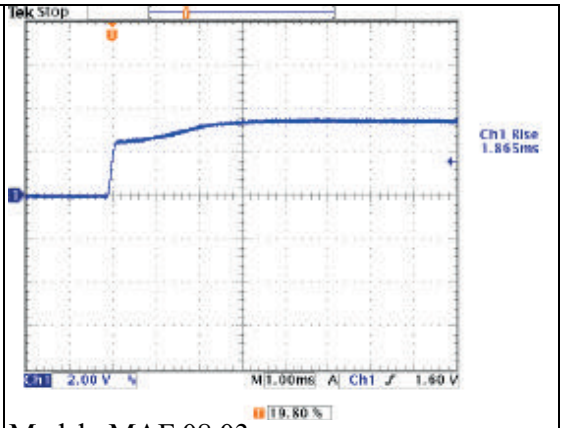
Overshoot

Start up input power, measuring the deviation which over the output. At nominal input , minimum load and maximum load.

Rise Time

Measuring the time between 10%-Vout to 90%-Vout. At nominal input , minimum load and maximum load.

<table>
<tr>
<td> 

Model : MAF 08 003
Ch1 : Vout (maximum load)
Rise time : 3.769ms
Overshoot : zero%</td>
<td> 

Model : MAF 08 03
Ch1 : Vout (minimum load)
Rise time : 1.865ms
Overshoot : zero%</td>
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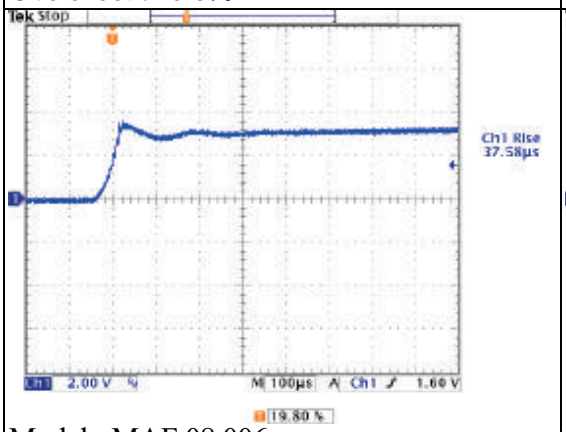
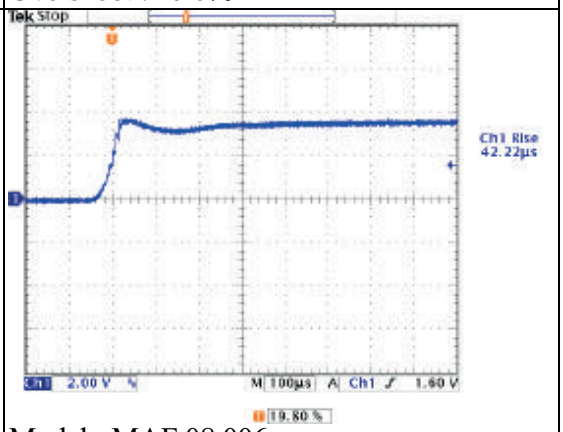
<tr>
<td> 

Model : MAF 08 006
Ch1 : Vout (maximum load)
Rise time : 37.58us
Overshoot : 9%</td>
<td> 

Model : MAF 08 006
Ch1 : Vout (minimum load)
Rise time : 42.22us
Overshoot : 15%</td>
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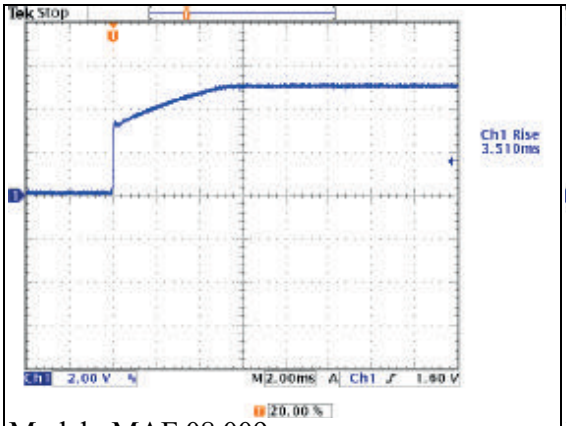
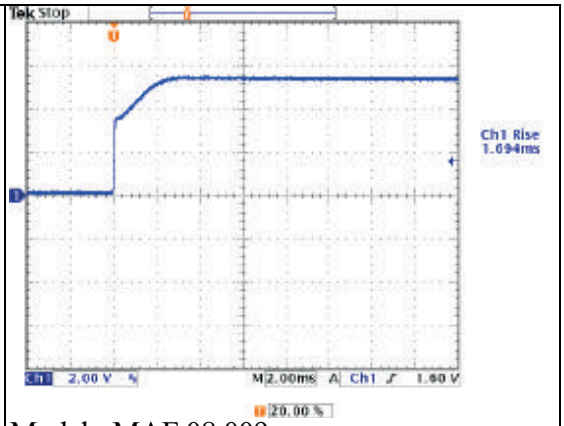
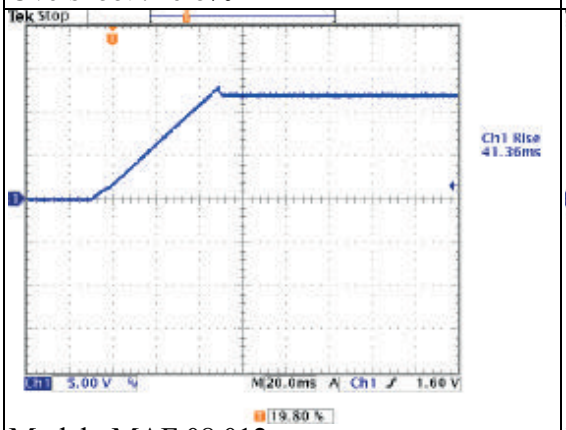
</table>



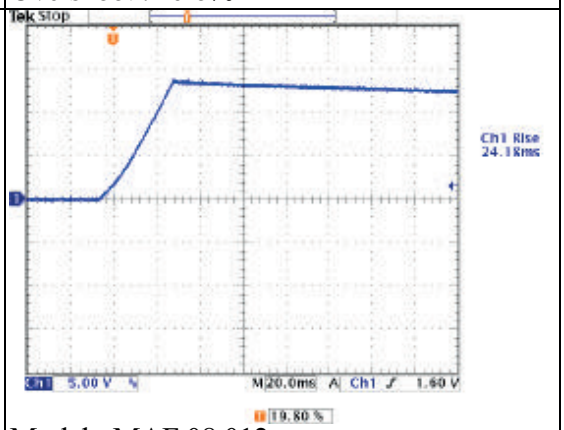
Model : MAF 08 009
Ch1 : Vout (maximum load)
Rise time : 3.510ms
Overshoot : zero%



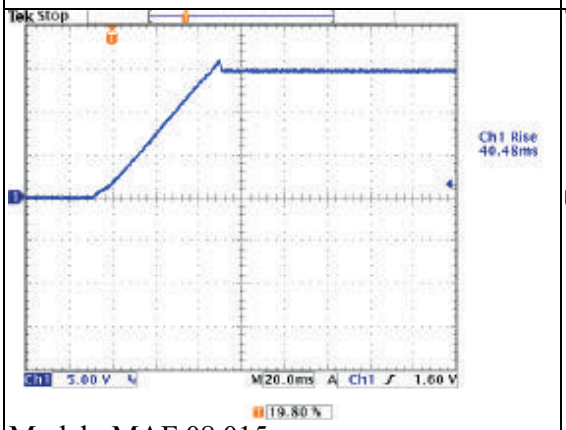
Model : MAF 08 009
Ch1 : Vout (minimum load)
Rise time : 1.694ms
Overshoot : zero%



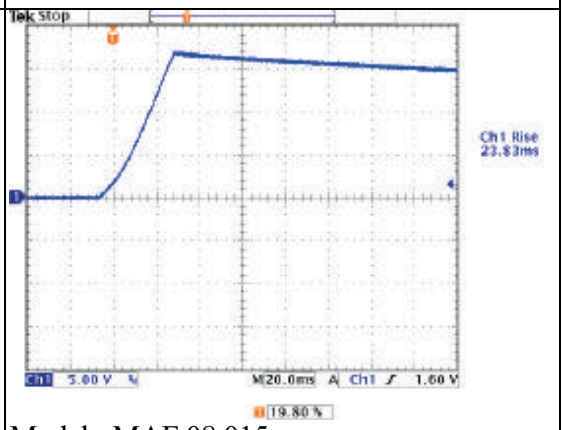
Model : MAF 08 012
Ch1 : Vout (maximum load)
Rise time : 41.36ms
Overshoot : 8%



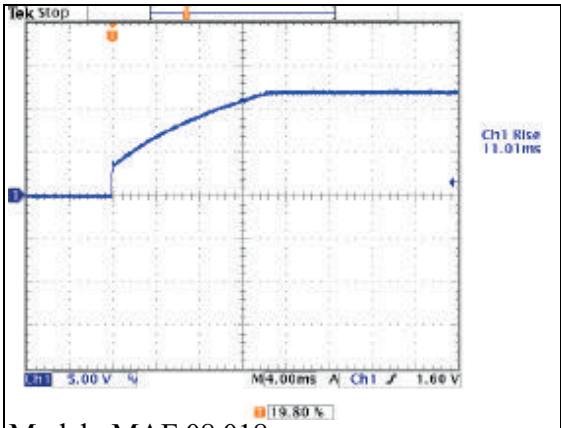
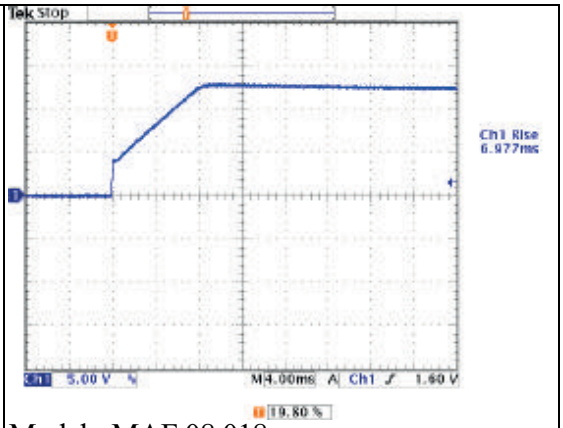
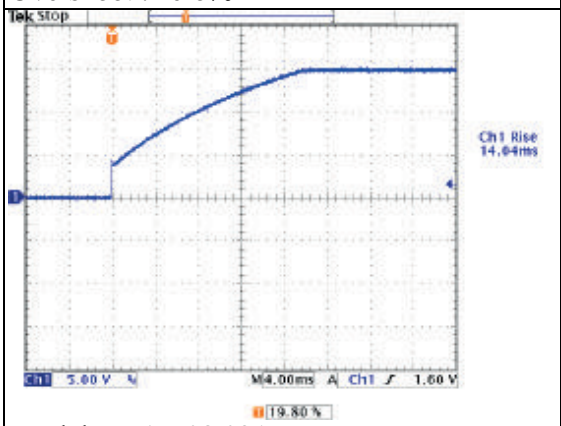
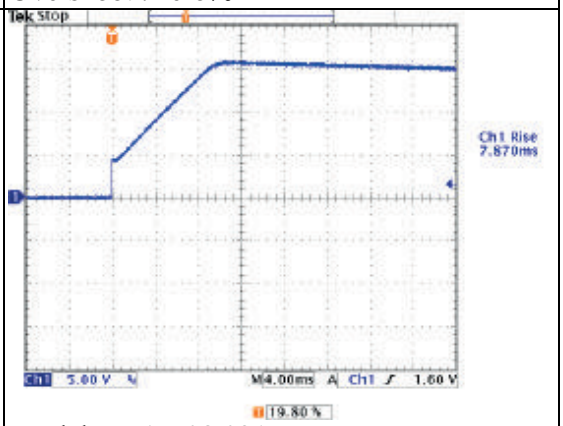
Model : MAF 08 012
Ch1 : Vout (minimum load)
Rise time : 24.18ms
Overshoot : 16%



Model : MAF 08 015
Ch1 : Vout (maximum load)
Rise time : 40.48ms
Overshoot : 5%

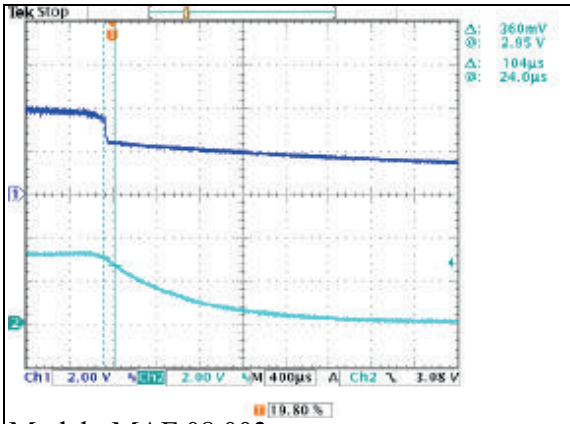


Model : MAF 08 015
Ch1 : Vout (minimum load)
Rise time : 23.83ms
Overshoot : 13%

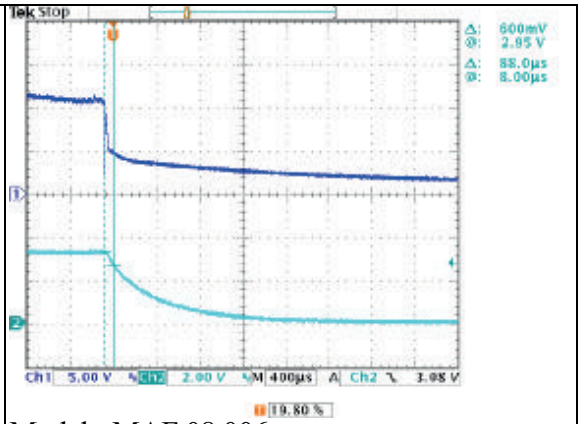
 Model : MAF 08 018 Ch1 : Vout (maximum load) Rise time : 11.01ms Overshoot : zero%	 Model : MAF 08 018 Ch1 : Vout (minimum load) Rise time : 6.977ms Overshoot : zero%
 Model : MAF 08 021 Ch1 : Vout (maximum load) Rise time : 14.04ms Overshoot : zero%	 Model : MAF 08 021 Ch1 : Vout (minimum load) Rise time : 7.870ms Overshoot : 6%

Hold Time

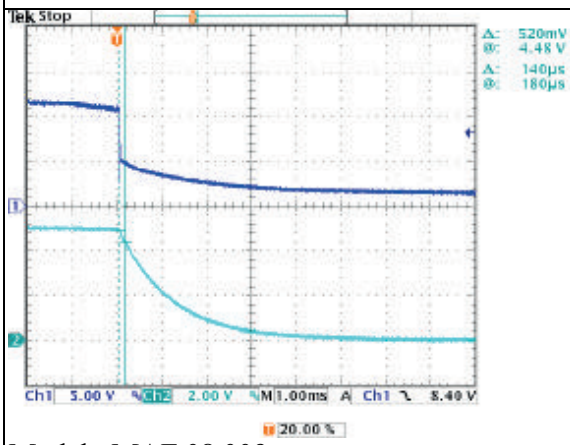
Measure from the power supply end to when Vout drop down to 90% output. At nominal input and maximum load.



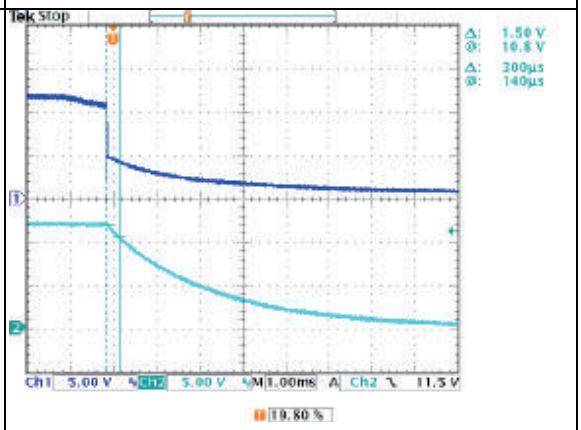
Model : MAF 08 003
Ch1 : Vin Ch2 : Vout
Hold time : 104us



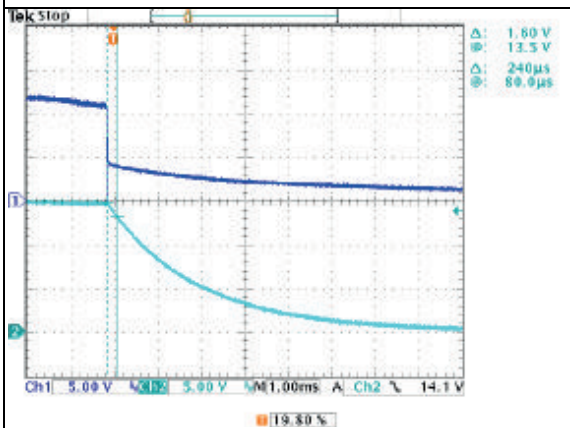
Model : MAF 08 006
Ch1 : Vin Ch2 : Vout
Hold time : 88.0us



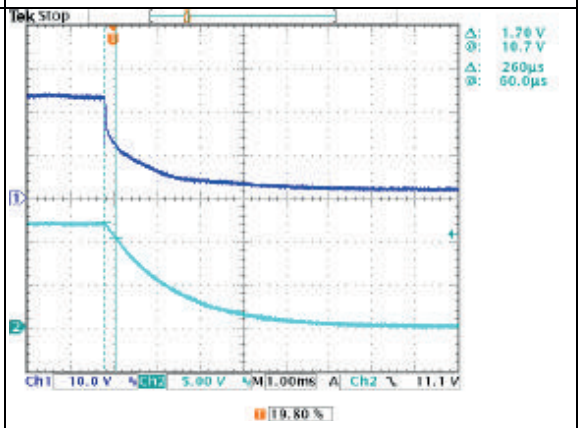
Model : MAF 08 009
Ch1 : Vin Ch2 : Vout
Hold time : 140us



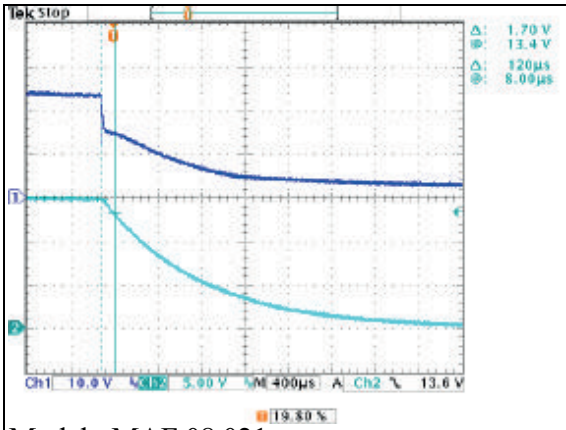
Model : MAF 08 012
Ch1 : Vin Ch2 : Vout
Hold time : 300us



Model : MAF 08 015
Ch1 : Vin Ch2 : Vout
Hold time : 240us

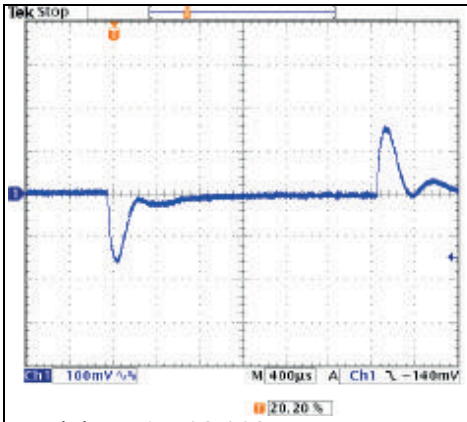


Model : MAF 08 018
Ch1 : Vin Ch2 : Vout
Hold time : 260us

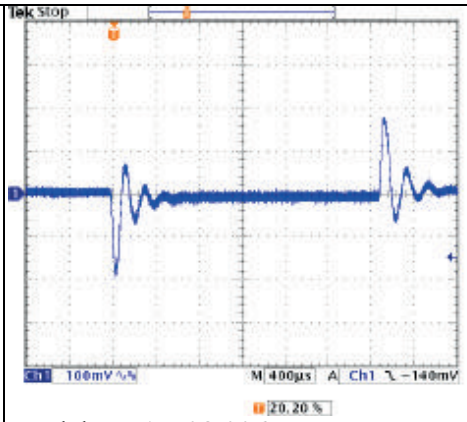
 Model : MAF 08 021 Ch1 : Vin Ch2 : Vout Hold time : 120us	

Dynamic Response

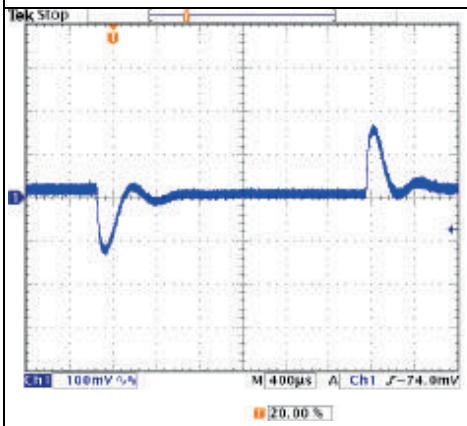
Output voltage dynamic response at nominal input and different load condition (load change 100% load to 50% load).
Load current=0.1A/us, Ton=Toff=2.5ms.



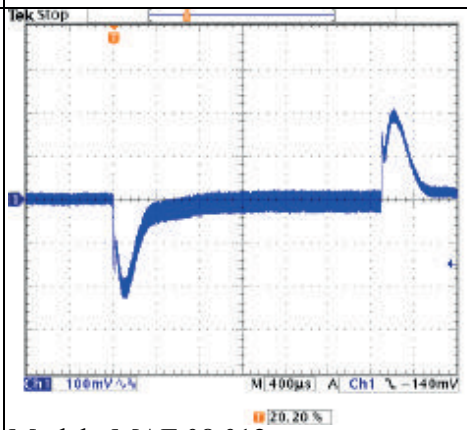
Model : MAF 08 003
Ch1 : Vout



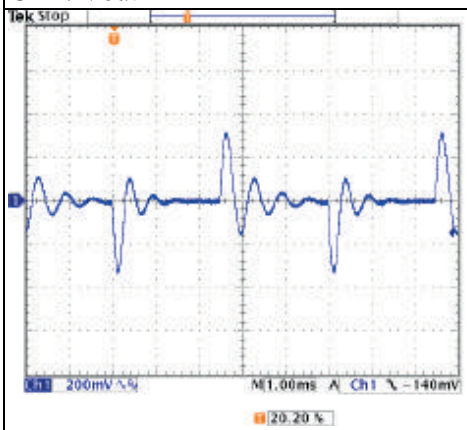
Model : MAF 08 006
Ch1 : Vout



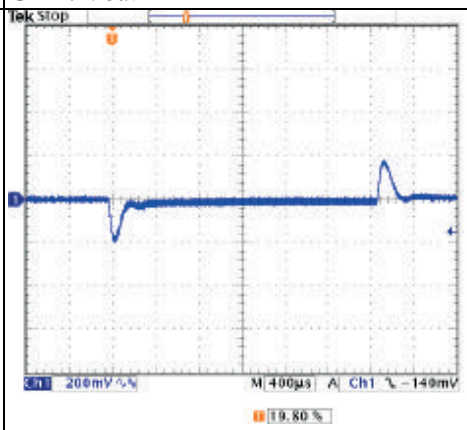
Model : MAF 08 009
Ch1 : Vout



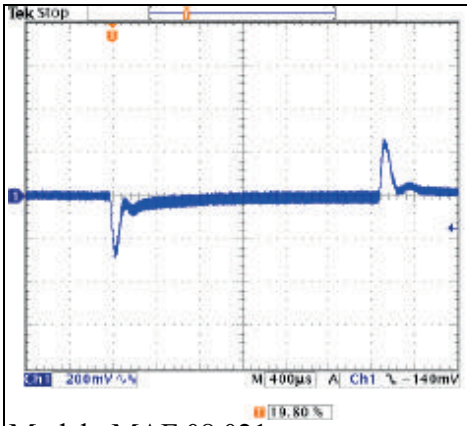
Model : MAF 08 012
Ch1 : Vout



Model : MAF 08 015
Ch1 : Vout



Model : MAF 08 018
Ch1 : Vout

 Model : MAF 08 021 Ch1 : Vout	

Output Ripple and Noise

Measuring output ripple waveform peak to peak. Measure mane bandwidth 20 MHz. At nominal input, maximum Iout and output with a 0.1uF ceramic capacitor

<table>
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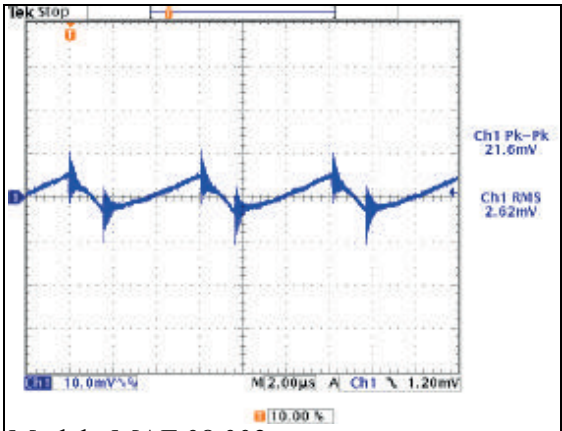
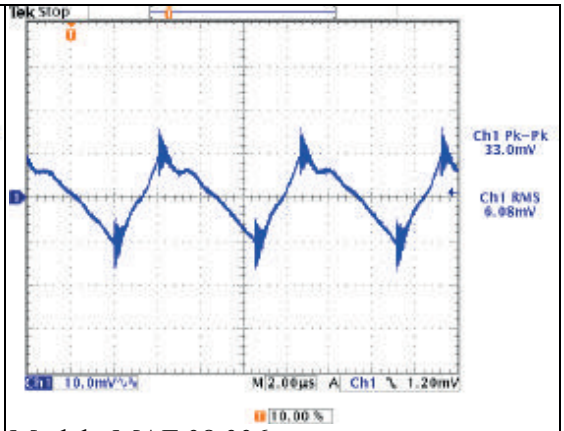
<td> 

Model : MAF 08 003
Ch1 : Vout
Ripple & noise : 21.6mVp-p</td>
<td> 

Model : MAF 08 006
Ch1 : Vout
Ripple & noise : 33.0mVp-p</td>
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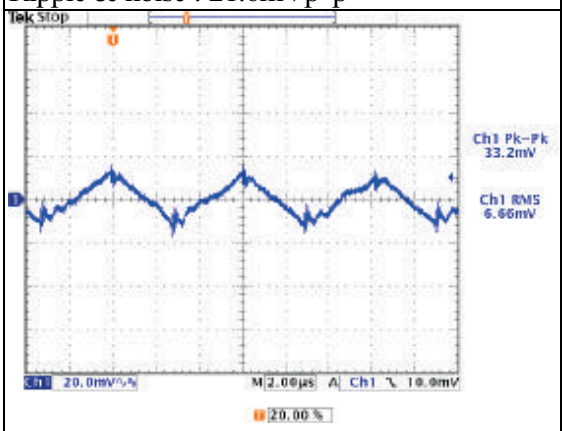
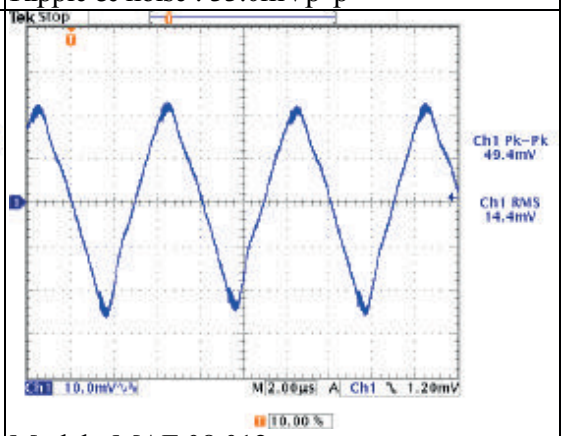
<tr>
<td> 

Model : MAF 08 009
Ch1 : Vout
Ripple & noise : 33.2mVp-p</td>
<td> 

Model : MAF 08 012
Ch1 : Vout
Ripple & noise : 49.4mVp-p</td>
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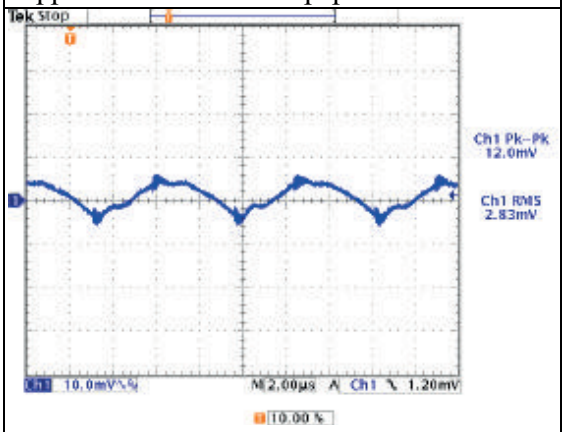
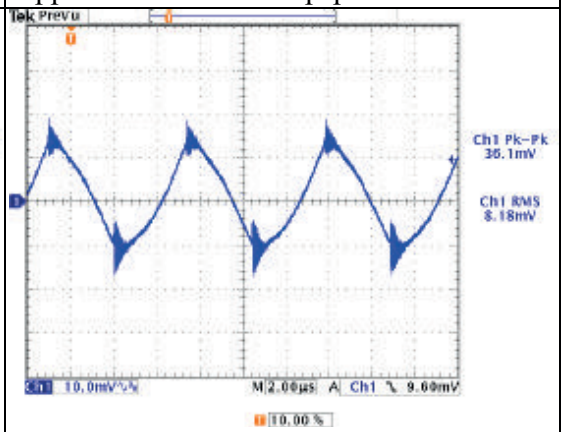
<td> 

Model : MAF 08 015
Ch1 : Vout
Ripple & noise : 12.0mVp-p</td>
<td> 

Model : MAF 08 018
Ch1 : Vout
Ripple & noise : 36.1mVp-p</td>
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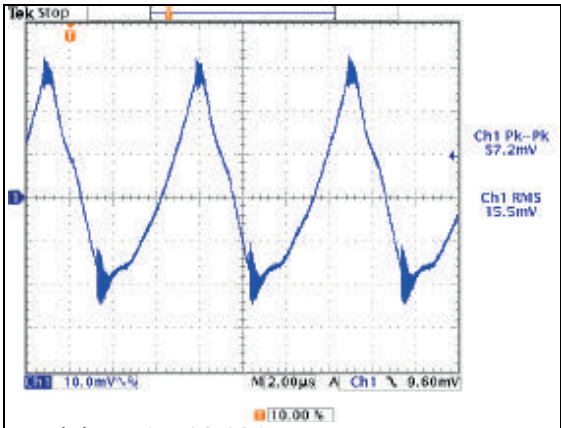
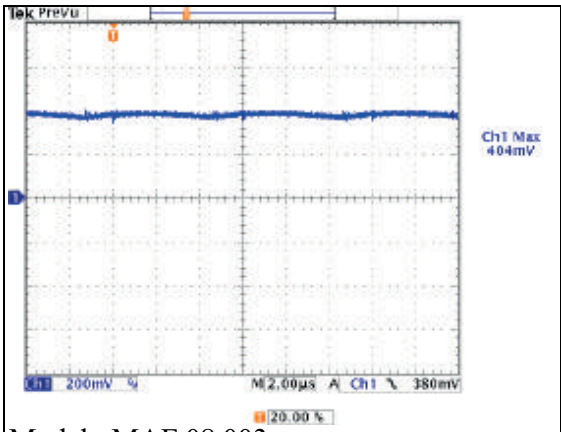
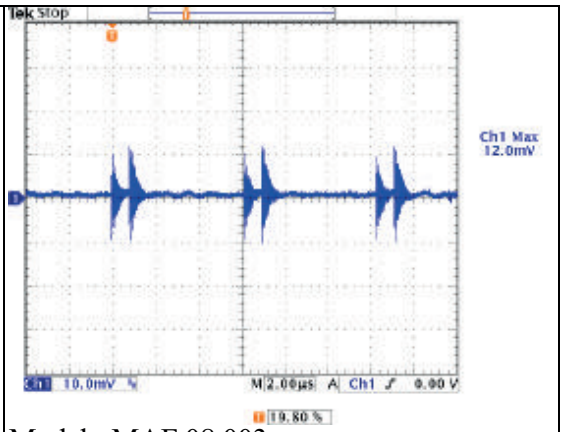


Model : MAF 08 021
Ch1 : Vout
Ripple & noise : 57.2mVp-p

Over current protection (OCP) and output short protection

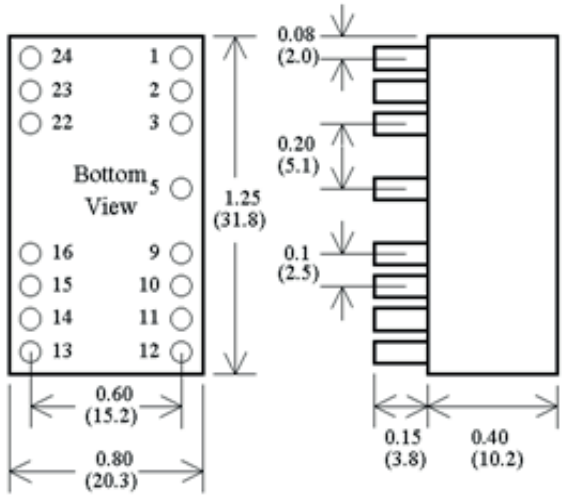


Model : MAF 08 003
Ch1 : Vout (OCP)



Model : MAF 08 003
Ch1 : Vout (output short protection)

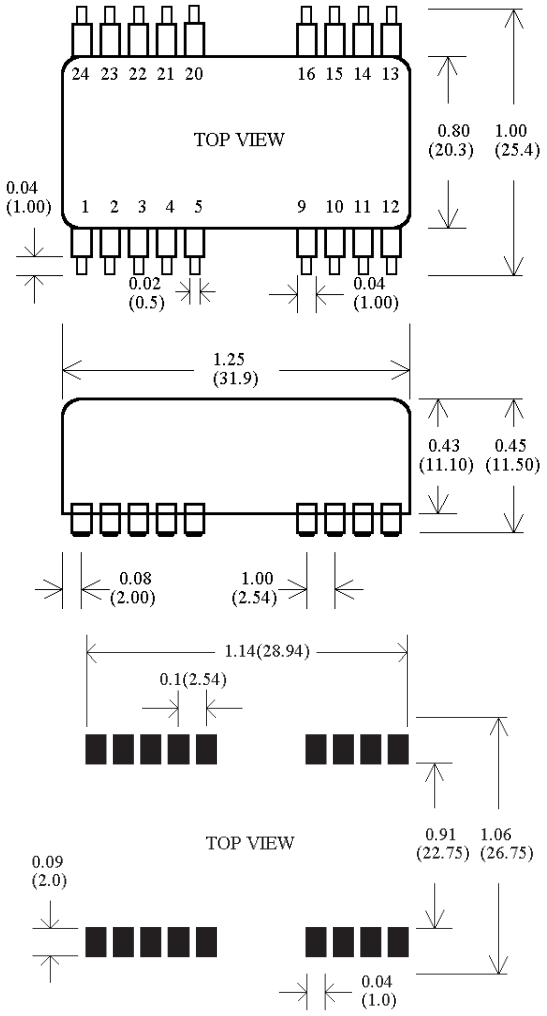
A case mechanical output diagrams



Pin	Function	Pin	Function
1	NP	24	NP
2	- V input	23	+V input
3	- V input	22	+V input
5	NP	20	NP
9	- V output	16	- V output
10	NC	15	NC
11	+V output	14	+V output
12	NP	13	NP

Note : 1. NP - No Pin
2. NC - No Connection with pin

AS case mechanical outline diagrams



Pin	Function	Pin	Function
1	NC	24	NC
2	- V input	23	+V input
3	- V input	22	+V input
4	NC	21	NC
5	NC	20	NC
9	- V output	16	- V output
10	NC	15	NC
11	+V output	14	+V output
12	NC	13	NC

Note : 1. NC - No Connection with pin