

TMA Series

1W, SIP, Single & Dual Output DC/DC Converters

Features

- ▶ SIP Package with Industry Standard Pinout
- ▶ Package Dimension:
19.5 x 10.2 x 6.1 mm (0.77"x 0.4"x 0.24") 5V&12V Models
19.5 x 10.2 x 7.1 mm (0.77"x 0.4"x 0.28") 15V&24V Models
- ▶ Single and Dual Output Models
- ▶ I/O-Isolation 1000 VDC
- ▶ Operating Temp. Range -40°C to +85°C
- ▶ 3 Years Product Warranty



Applications

- ▶ Distributed power architectures
- ▶ Workstations
- ▶ Computer equipment
- ▶ Communications equipment

General Description

The TMA series is a range of 1W DC/DC converters in a small SIP Package featuring I/O-isolation of 1000VDC. An excellent efficiency allows an operating temperature range of -40°C to +85°C. These converters offer an economical solution for many applications where a voltage has to be isolated i.e for noise reduction, ground loop elimination, digital interfaces or for board level power distribution.

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Absolute Maximum Rating

Parameter	Model	Min	Max	Unit
Input Voltage				
Input Surge Voltage (1 sec.)	5VDC Input Models	-0.7	9	VDC
	12VDC Input Models	-0.7	18	
	15VDC Input Models	-0.7	18	
	24VDC Input Models	-0.7	30	
Operating Ambient Temperature				
Without Derating (3.3V,5V & ±5V)	All	-40	+75	°C
Without Derating (all other output)		-40	+80	
With Derating (3.3V,5V & ±5V)		-40	+85	
With Derating (all other output)		-40	+90	
Operating Case Temperature	All	---	+90	°C
Storage Temperature	All	-40	+125	°C

Output Specification

Parameter	Model	Min	Nominal	Max	Unit
Output Voltage ($V_{in} = V_{in\ nom}$; Full Load; $T_A = 25^\circ\text{C}$)	TMA xx03S	3.201	3.3	3.399	VDC
	TMA xx05S	4.85	5	5.15	
	TMA xx09S	8.73	9	9.27	
	TMA xx12S	11.64	12	12.36	
	TMA xx15S	14.55	15	15.45	
	TMA xx05D	±4.85	±5	±5.15	
	TMA xx09D	±8.73	±9	±9.27	
	TMA xx12D	±11.64	±12	±12.36	
	TMA xx15D	±4.85	±15	±15.45	
Output Regulation					
Line ($V_{in\ min}$ to $V_{in\ max}$ at Full Load)		---	±1.2	±1.5	%
Output Regulation					
Load (20% to 100% of Full Load)	TMA 0503S	---	---	10	%
	TMA 0505S	---	---	10	
	TMA 0509S	---	---	8	
	TMA 0512S	---	---	7	
	TMA 0515S	---	---	7	
	TMA 0505D	---	---	10	
	TMA 0509D	---	---	8	
	TMA 0512D	---	---	7	
	TMA 0515D	---	---	7	
	TMA 1203S,2403S	---	---	8	
	TMA 1205S,2405S	---	---	8	
	TMA 1209S, 2409S	---	---	5	
	TMA 1212S, 2412S	---	---	5	
	TMA 1215S, 2415S	---	---	5	
	TMA 1205D, 2405D	---	---	8	
	TMA 1209D, 2409D	---	---	5	
	TMA 1212D, 2412D	---	---	5	
	TMA 1215D, 1215D	---	---	5	
	TMA 1505S	---	---	8	
	TMA 1512S	---	---	5	
	TMA 1515S	---	---	5	
	TMA 1505D	---	---	8	
	TMA 1512D	---	---	5	
	TMA 1515D	---	---	5	

Output Specification

Parameter	Model	Min	Nominal	Max	Unit
Output Ripple & Noise Peak-to-Peak (5Hz to 20MHz bandwidth)		---	50	75	mV pk-pk
Temperature Coefficient	All	---	±0.01	±0.02	%/°C
Output Current	TMA xx03S TMA xx05S TMA xx09S TMA xx12S TMA xx15S TMA xx05D TMA xx09D TMA xx12D TMA xx15D	5 4 2 1.5 1 ±2 ±1 ±0.8 ±0.7	--- --- --- --- --- --- --- --- ---	260 200 110 84 67 ±100 ±56 ±42 ±34	mA
Output Short Circuit Protection	All	0.5 Second Max.			

Input Specification

Parameter	Model	Min	Nominal	Max	Unit
Operating Input Voltage	5V Input Models 12V Input Models 15V Input Models 24V Input Models	4.5 10.8 13.5 21.6	5 12 15 24	5.5 13.2 16.5 26.4	VDC
Input Current (Maximum value at $V_{in} = V_{in\ nom}$; Full Load)	TMA 0503S TMA 0505S TMA 0509S TMA 0512S TMA 0515S TMA 0505D TMA 0509D TMA 0512D TMA 0515D TMA 1203S TMA 1205S TMA 1209S TMA 1212S TMA 1215S TMA 1205D TMA 1209D TMA 1212D TMA 1215D TMA 1505S TMA 1512S TMA 1515S TMA 1505D TMA 1512D TMA 1515D TMA 2403S TMA 2405S TMA 2409S TMA 2412S TMA 2415S TMA 2405D TMA 2409D TMA 2412D TMA 2415D	--- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---	235 281 260 258 258 278 262 258 258 96 114 106 105 104 113 106 104 105 93 85 85 93 85 85 49 59 54 54 53 58 55 53 53	--- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- --- ---	mA

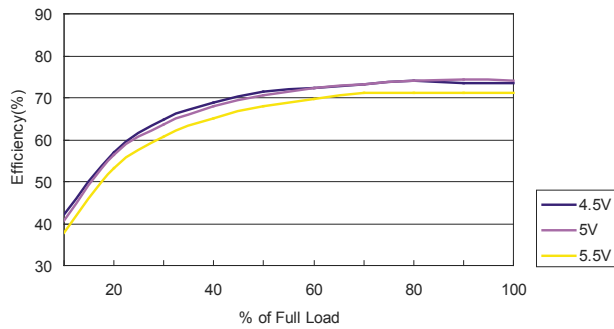
Input Specification					
Parameter	Model	Min	Nominal	Max	Unit
Input Standby Current (Typical value at $V_{in} = V_{in\ nom}$; No Load)	TMA 0503S	---	30	---	mA
	TMA 0505S				
	TMA 0509S				
	TMA 0512S				
	TMA 0515S				
	TMA 0505D				
	TMA 0509D				
	TMA 0512D				
	TMA 0515D				
	TMA 1203S	---	12	---	
	TMA 1205S				
	TMA 1209S				
	TMA 1212S				
	TMA 1215S				
	TMA 1205D				
	TMA 1209D				
	TMA 1212D				
	TMA 1215D				
	TMA 1505S	---	11	---	
	TMA1512S				
	TMA 1515S				
	TMA 1505D				
	TMA 1512D				
	TMA 1515D				
	TMA 2403S	---	7	---	
	TMA 2405S				
	TMA 2409S				
	TMA 2412S				
	TMA 2415S				
	TMA 2405D				
	TMA 2409D				
	TMA 2412D				
	TMA 2415D				

General Specification

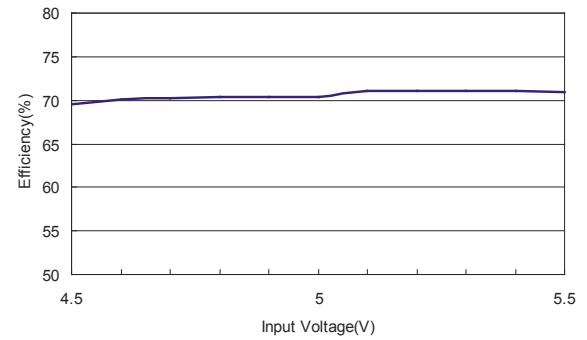
Parameter	Model	Min	Nominal	Max	Unit
Efficiency ($V_{in} = V_{in\,nom}$; Full Load; $T_A = 25^\circ\text{C}$)	TMA 0503S	---	73	---	%
	TMA 0505S	---	71	---	
	TMA 0509S	---	76	---	
	TMA 0512S	---	78	---	
	TMA 0515S	---	78	---	
	TMA 0505D	---	72	---	
	TMA 0509D	---	77	---	
	TMA 0512D	---	78	---	
	TMA 0515D	---	79	---	
	TMA 1203S	---	74	---	
	TMA 1205S	---	73	---	
	TMA 1209S	---	78	---	
	TMA 1212S	---	80	---	
	TMA 1215S	---	80	---	
	TMA 1205D	---	74	---	
	TMA 1209D	---	79	---	
	TMA 1212D	---	81	---	
	TMA 1215D	---	81	---	
	TMA 1505S	---	72	---	
	TMA 1512S	---	79	---	
	TMA 1515S	---	79	---	
	TMA 1505D	---	72	---	
	TMA 1512D	---	80	---	
	TMA 1515D	---	80	---	
	TMA 2403S	---	73	---	
	TMA 2405S	---	71	---	
	TMA 2409S	---	76	---	
	TMA 2412S	---	78	---	
	TMA 2415S	---	79	---	
	TMA 2405D	---	72	---	
	TMA 2409D	---	76	---	
	TMA 2412D	---	79	---	
	TMA 2415D	---	80	---	
Isolation Voltage	60 Seconds	1000	---	---	VDC
Isolation Resistance	500VDC	1000	---	---	MΩ
Isolation Capacitance	100KHz, 1V	---	60	100	pF
Switching Frequency		70	100	120	KHz
MTBF MIL-STD-217F, TC=25°C		2000	---	---	K Hours

Characteristic Curves

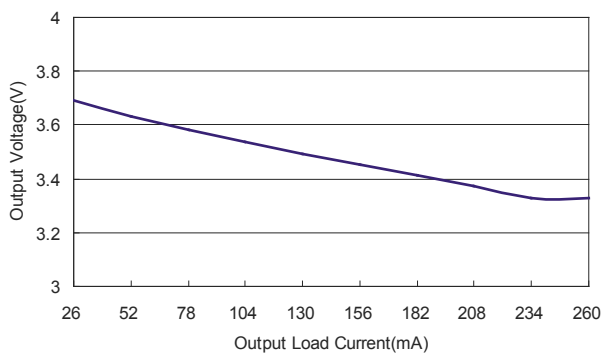
All test conditions are at 25°C The figures are identical for TMA 0503S



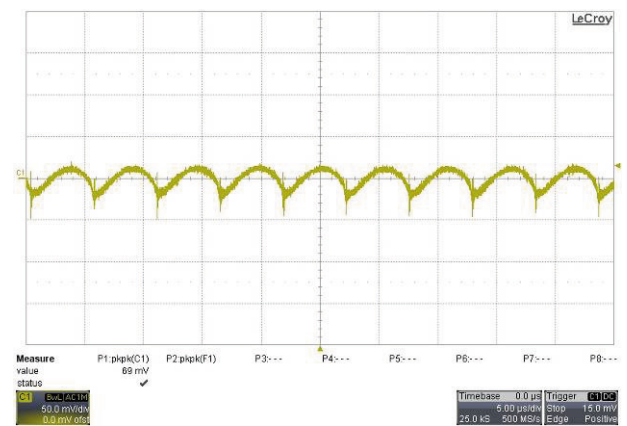
Efficiency Versus Output Current



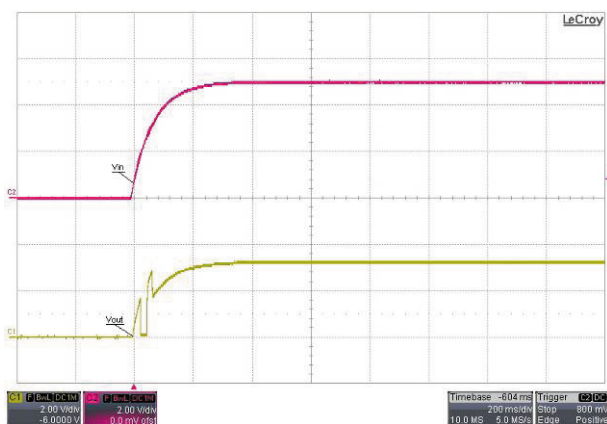
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



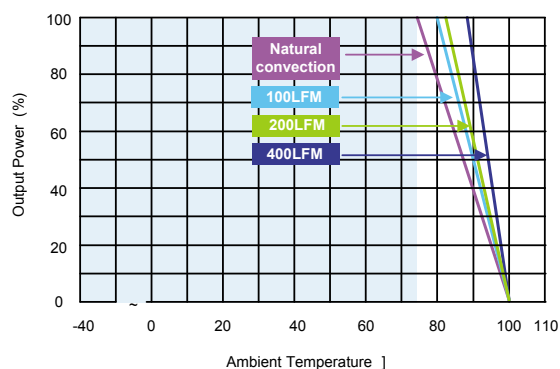
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

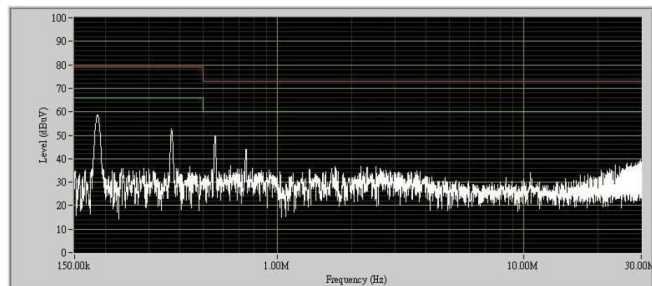
Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0503S (Continued)



Derating Output Current Versus Ambient Temperature and Airflow

$$V_{in} = V_{in\ nom}$$

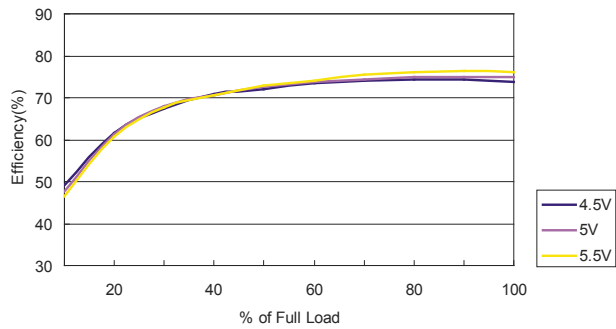


Conduction Emission of EN55022 Class A

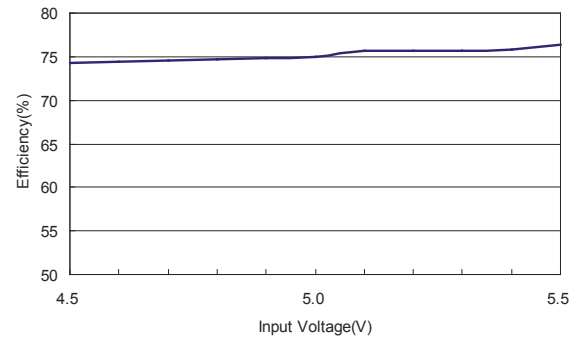
$$V_{in} = V_{in\ nom} ; \text{ Full Load (See Page 73)}$$

Characteristic Curves

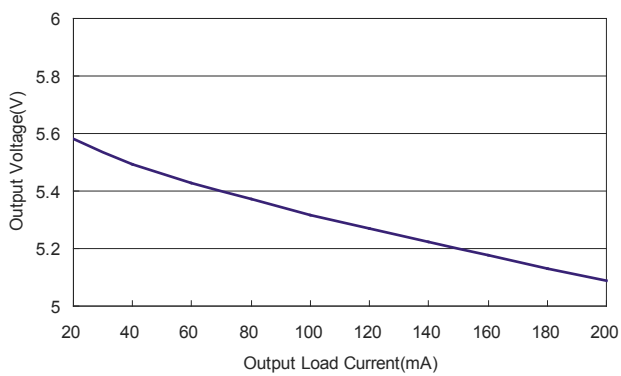
All test conditions are at 25°C The figures are identical for TMA 0505S



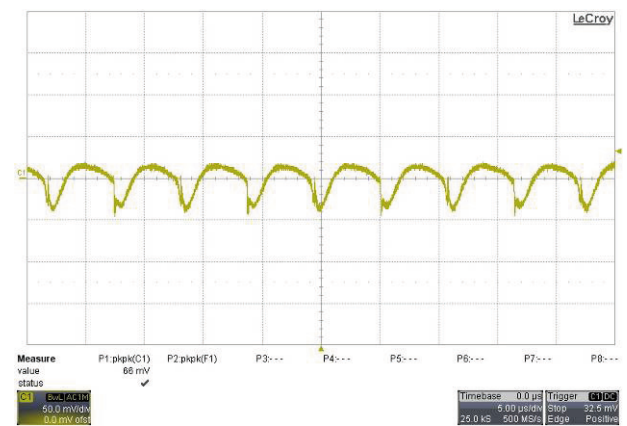
Efficiency Versus Output Current



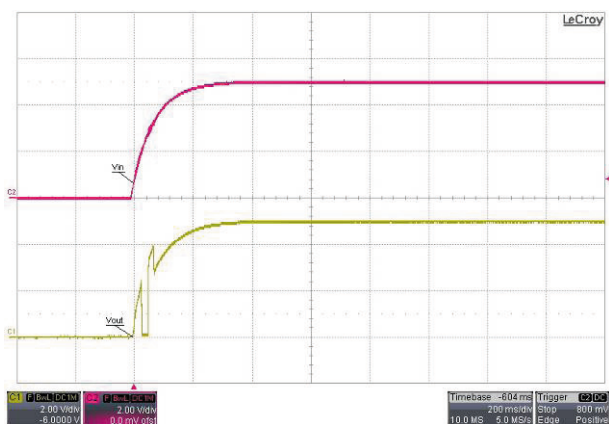
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



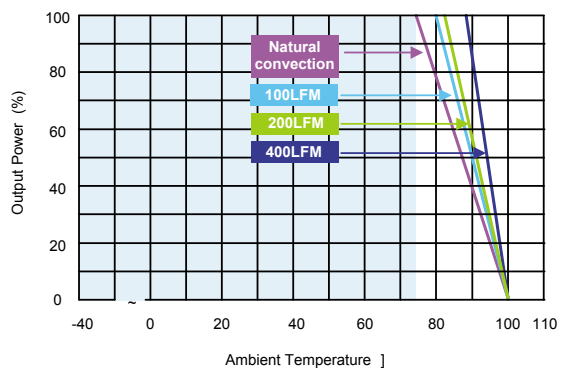
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

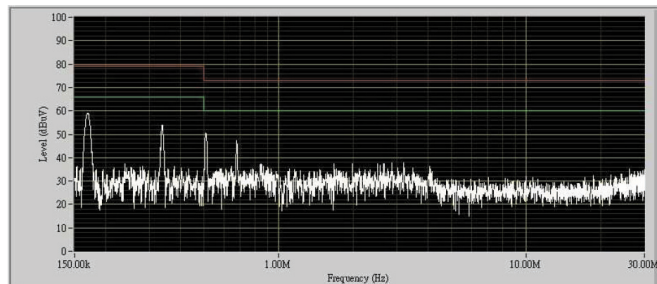
Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0505S (Continued)



Derating Output Current Versus Ambient Temperature and Airflow

$$V_{in} = V_{in\ nom}$$

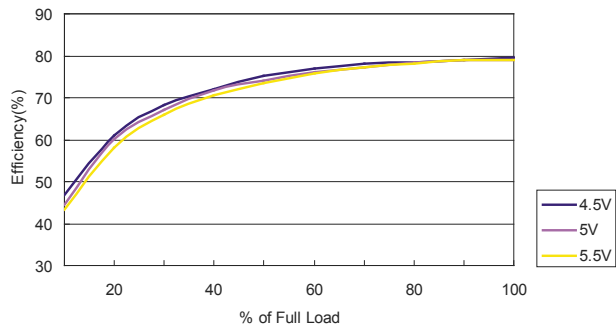


Conduction Emission of EN55022 Class A

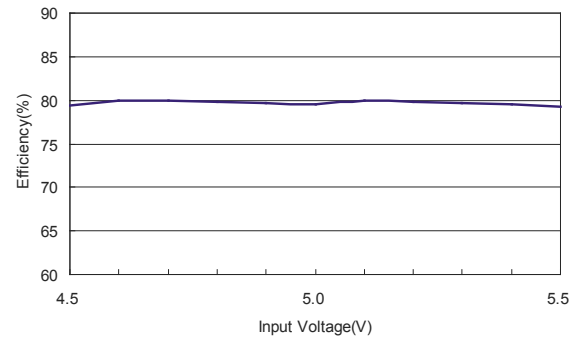
$$V_{in} = V_{in\ nom} ; \text{ Full Load (See Page 73)}$$

Characteristic Curves

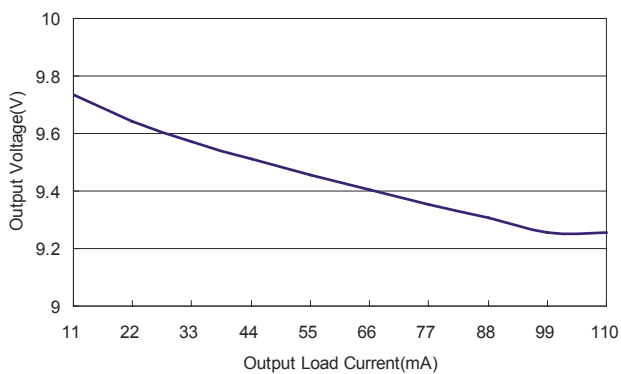
All test conditions are at 25°C The figures are identical for TMA 0509S



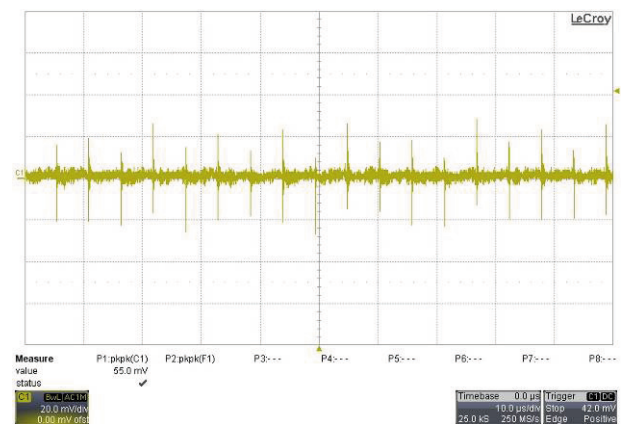
Efficiency Versus Output Current



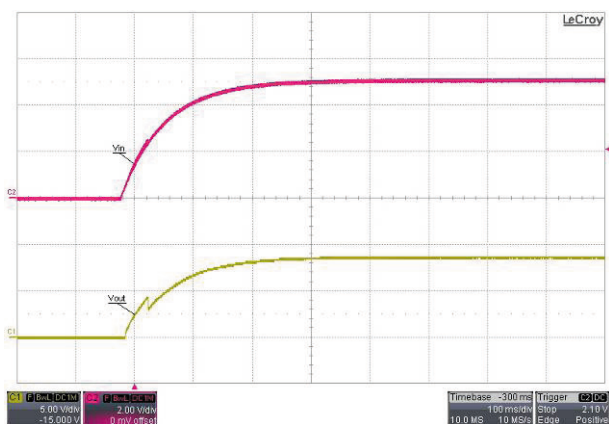
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



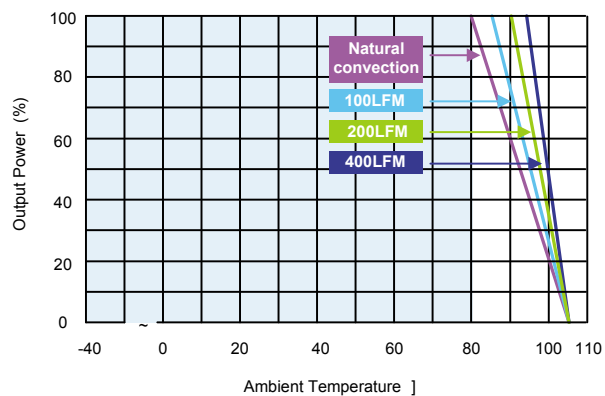
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



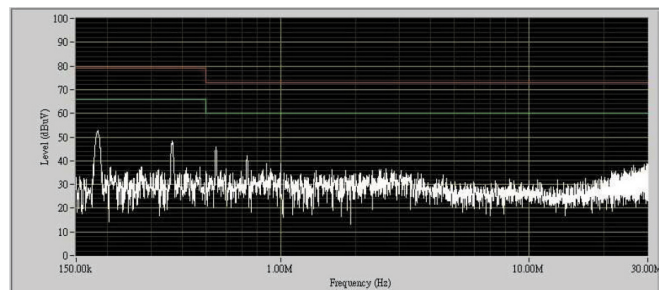
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0509S (Continued)



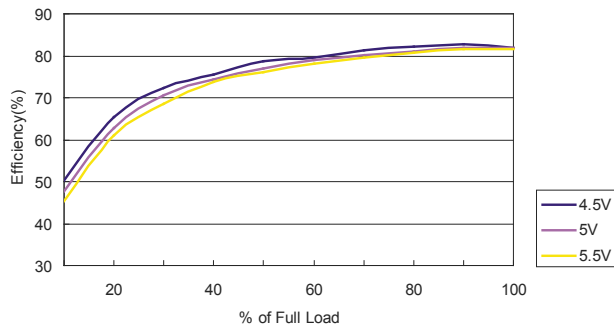
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



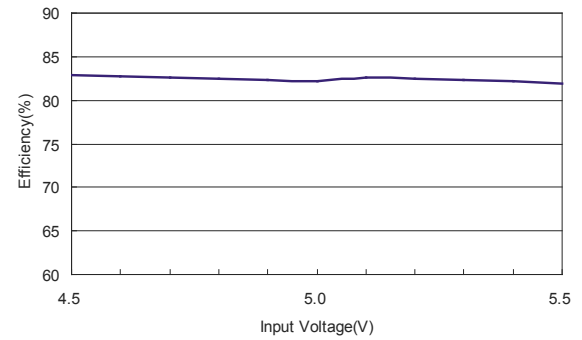
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

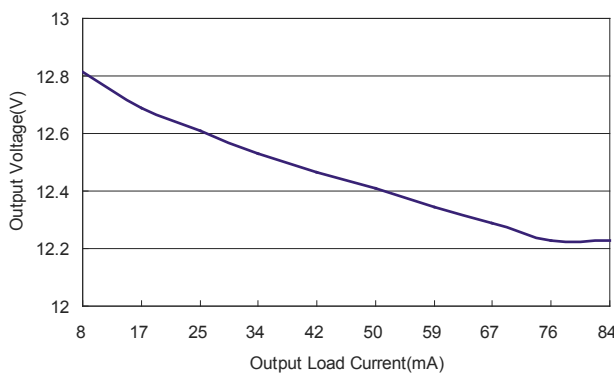
All test conditions are at 25°C The figures are identical for TMA 0512S



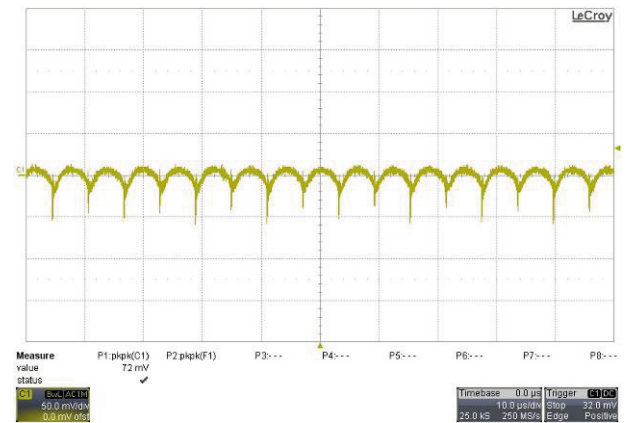
Efficiency Versus Output Current



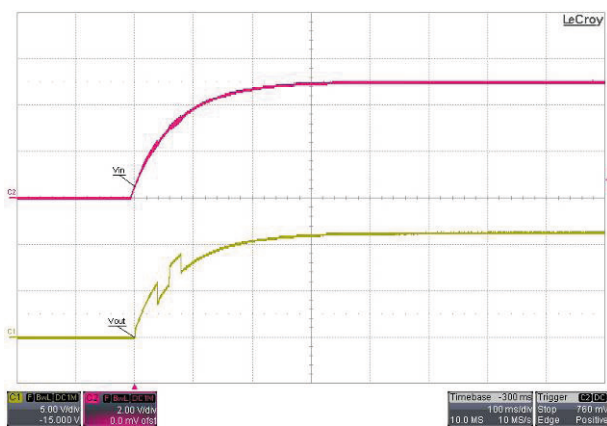
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



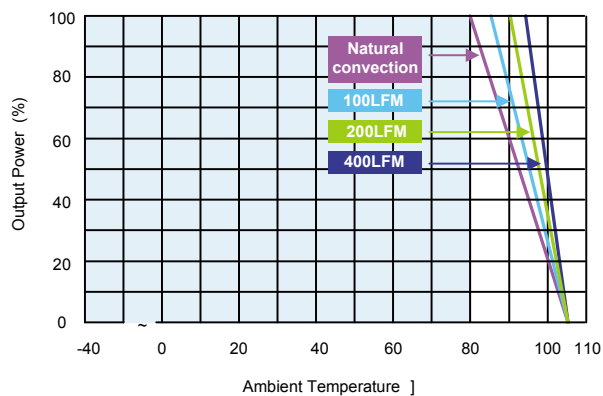
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



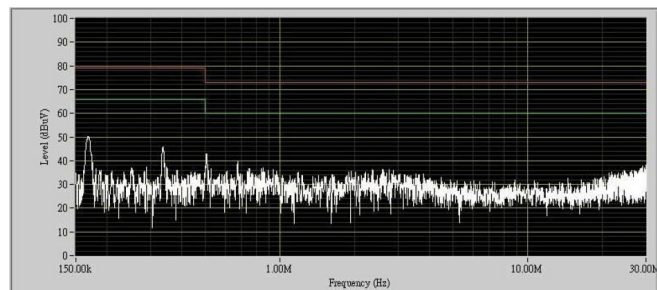
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0512S (Continued)



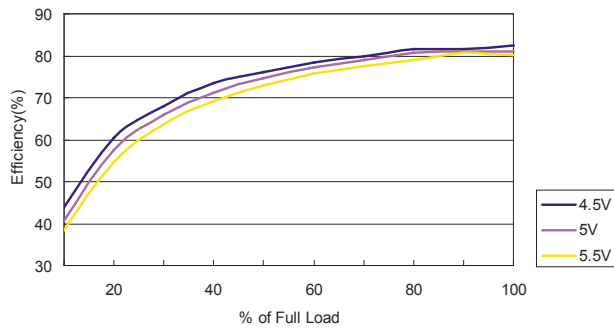
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



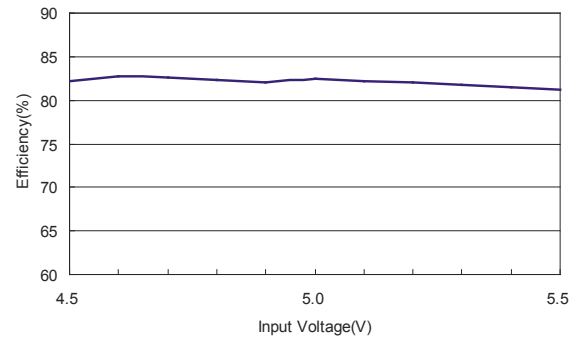
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

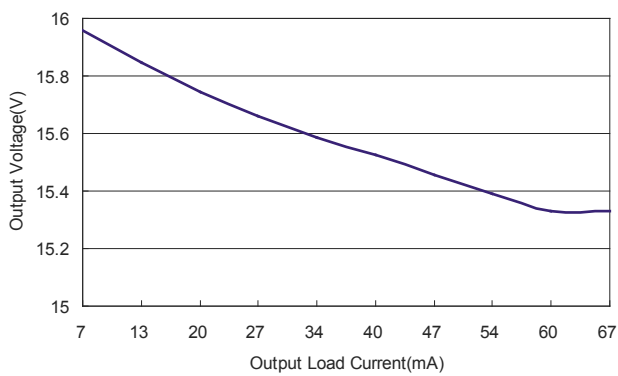
All test conditions are at 25°C The figures are identical for TMA 0515S



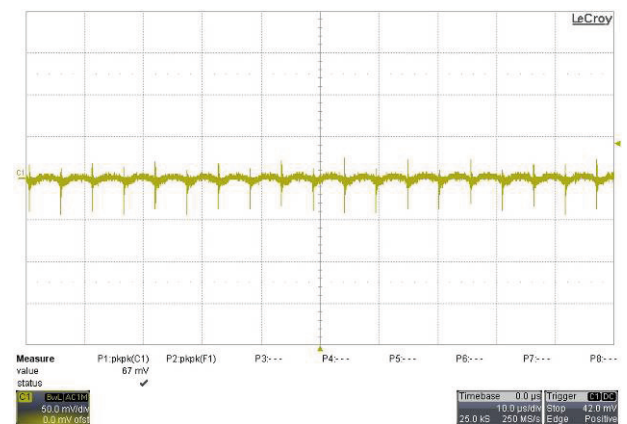
Efficiency Versus Output Current



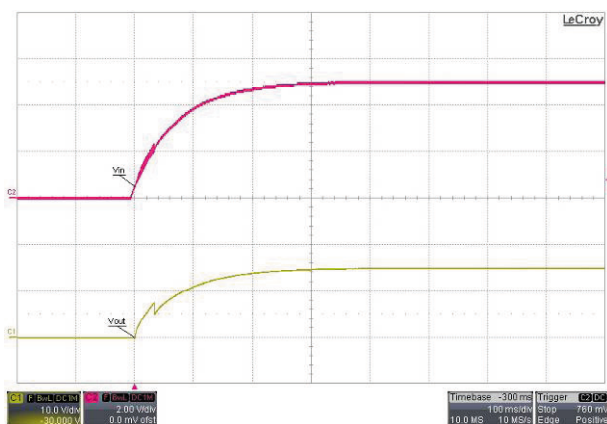
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



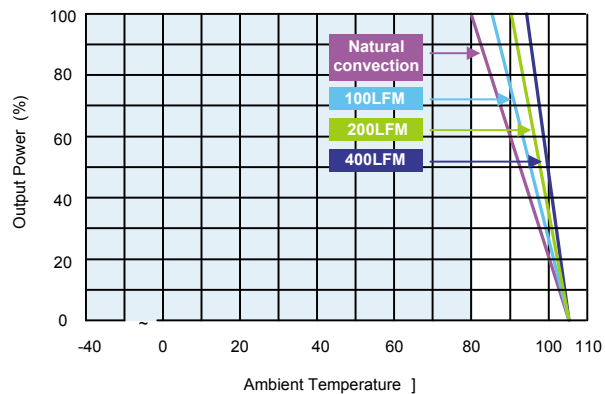
Typical Output Ripple and Noise.
 $V_{in} = V_{in nom}$; Full Load; T_A



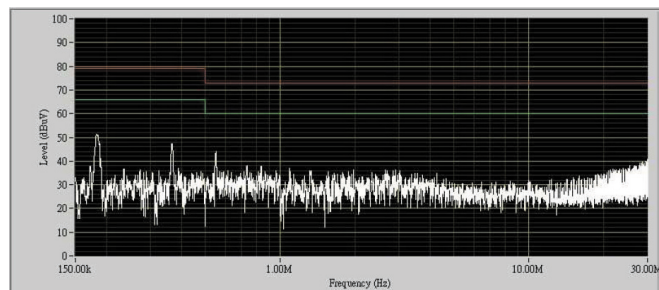
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0515S (Continued)



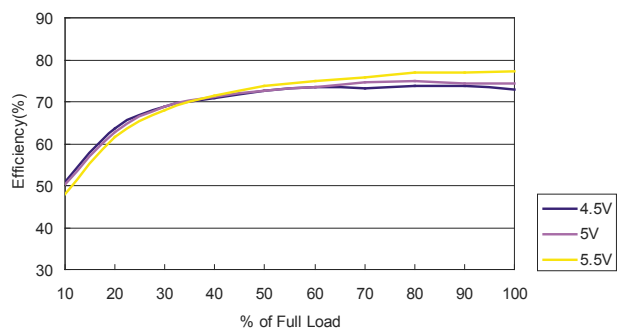
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



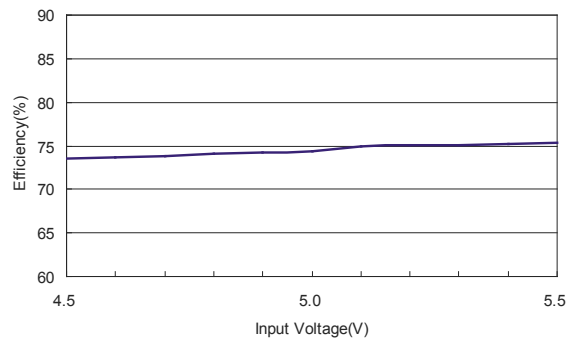
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

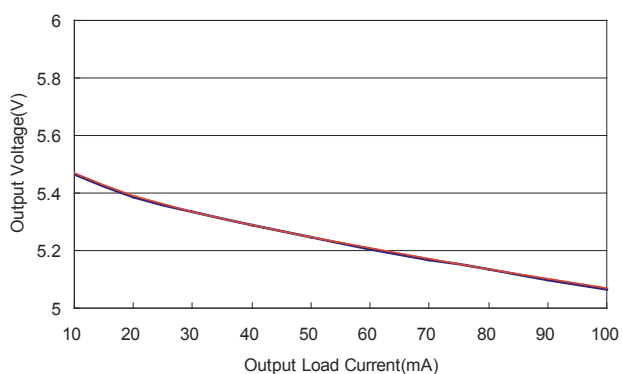
All test conditions are at 25°C The figures are identical for TMA 0505D



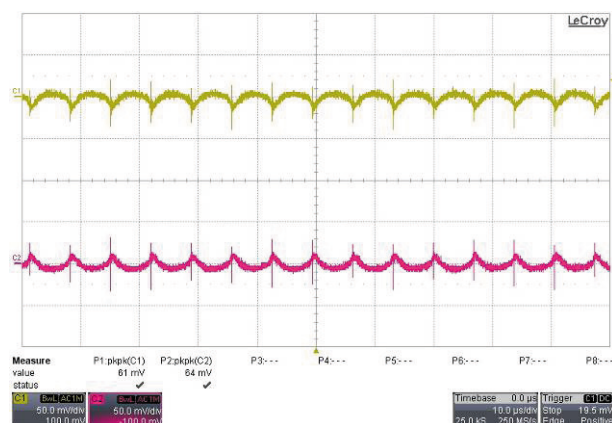
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

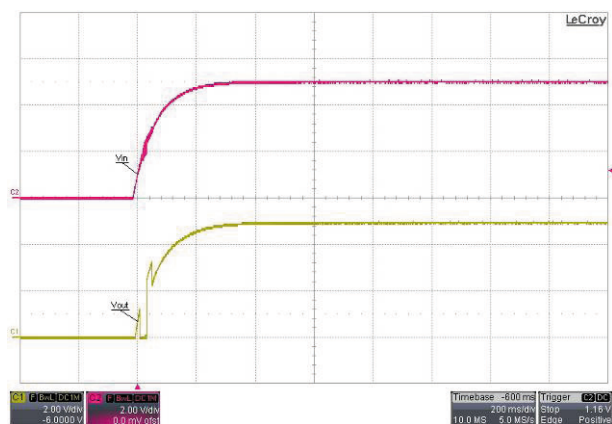


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$V_{in} = V_{in\ nom}$; Full Load; T_A

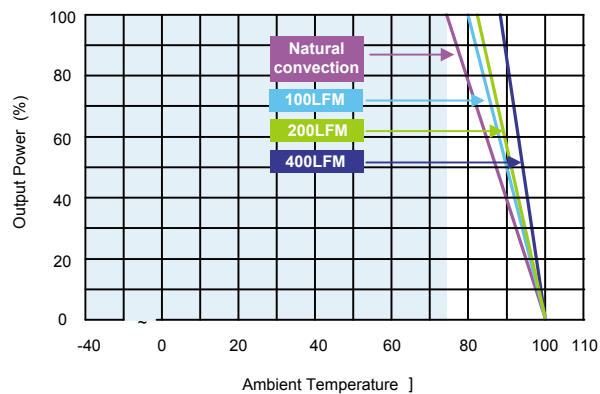


Typical Input Start-Up and Output Rise Characteristic

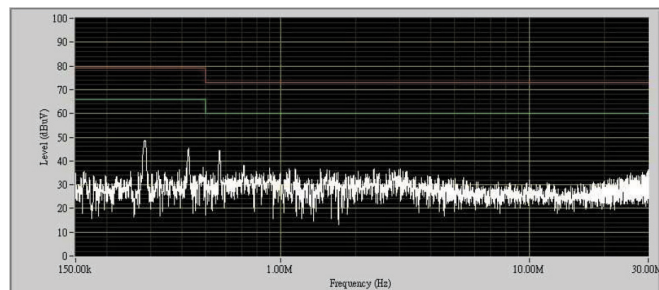
$V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0505D (Continued)



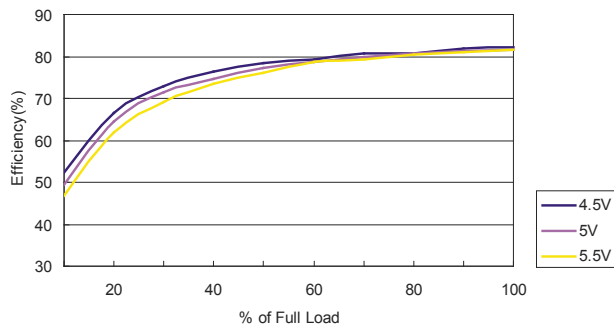
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



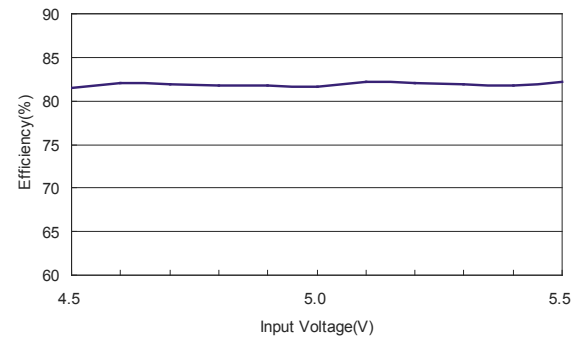
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

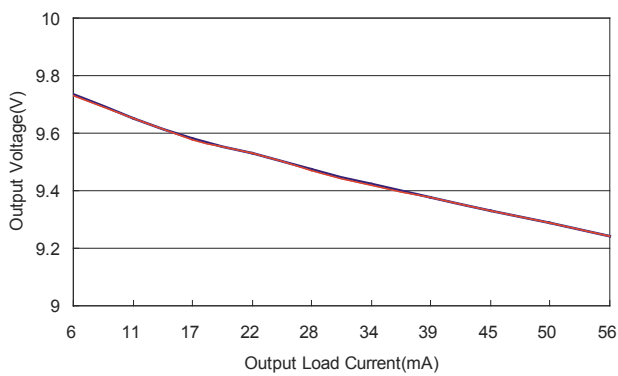
All test conditions are at 25°C The figures are identical for TMA 0509D



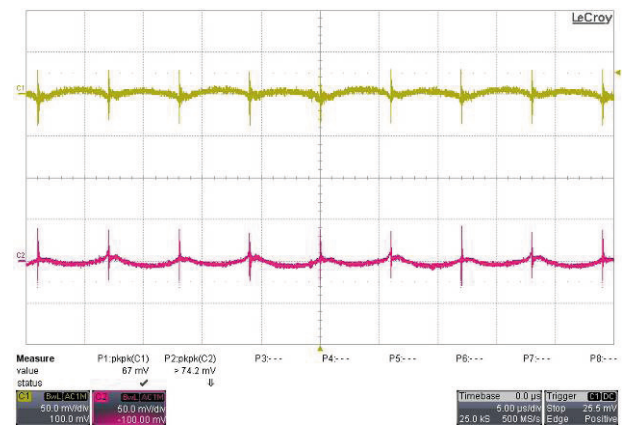
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

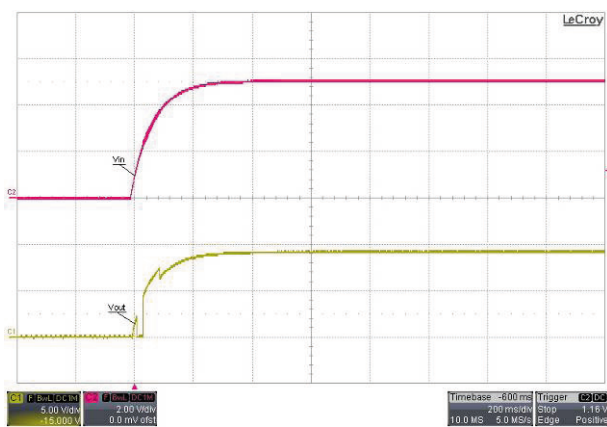


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$$V_{in} = V_{in\ nom}; \text{ Full Load; } T_A$$

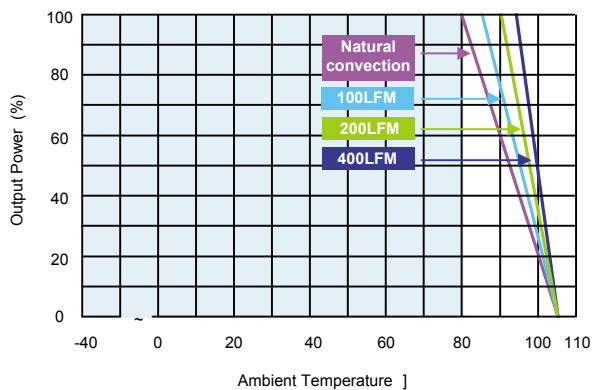


Typical Input Start-Up and Output Rise Characteristic

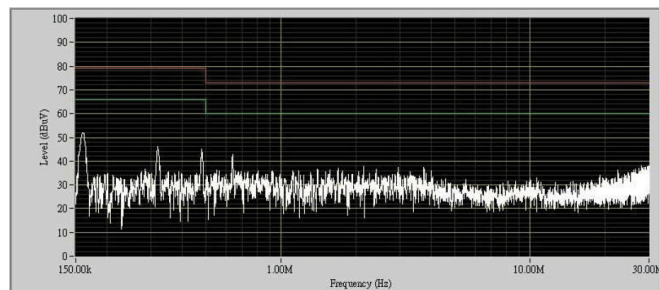
$$V_{in} = V_{in\ nom}; \text{ Full Load}$$

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0509D (Continued)



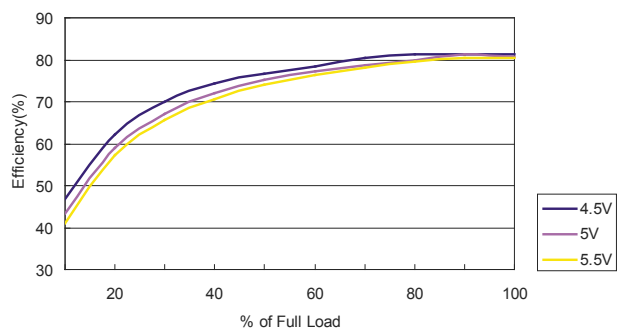
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



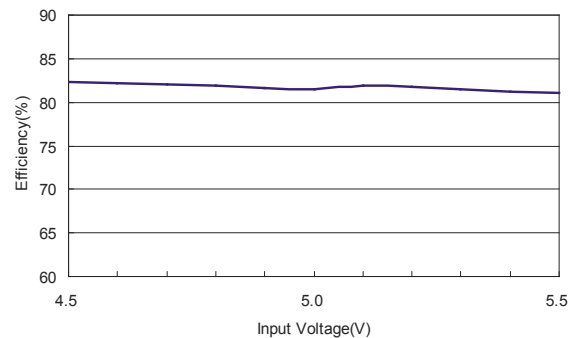
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

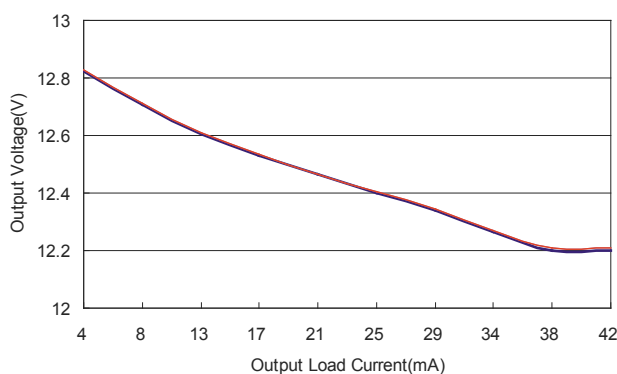
All test conditions are at 25°C The figures are identical for TMA 0512D



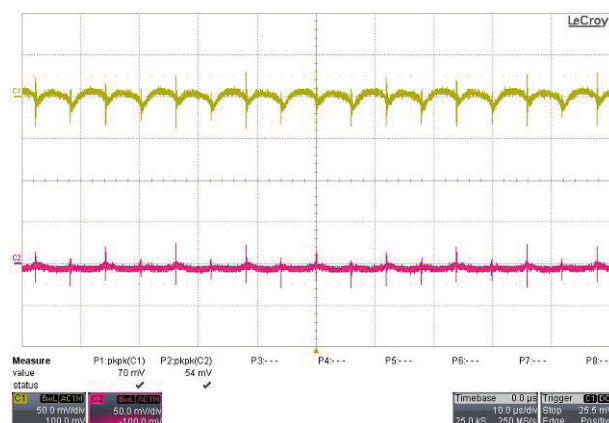
Efficiency Versus Output Current



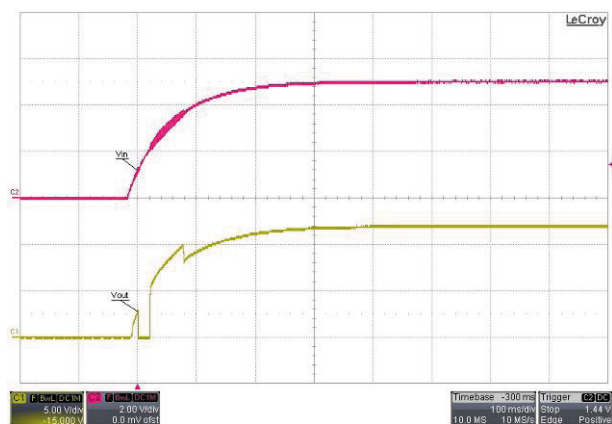
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



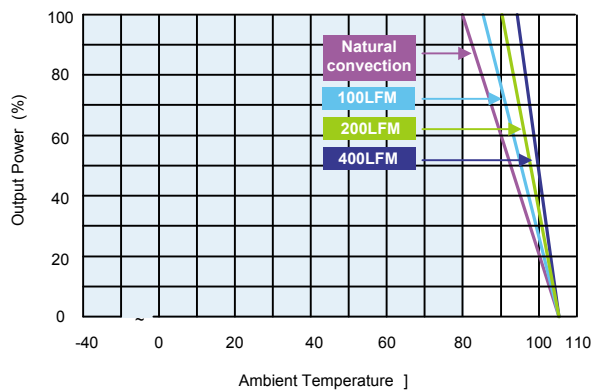
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



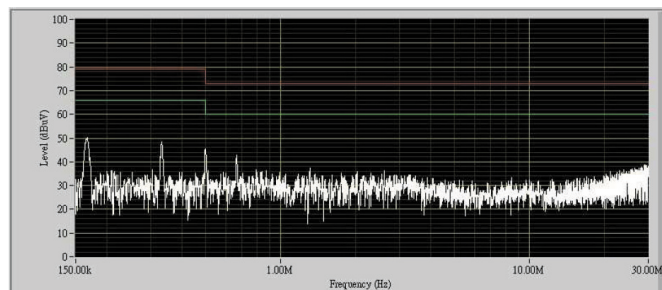
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0512D (Continued)



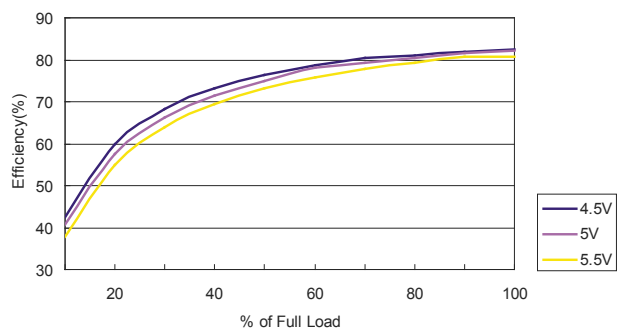
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



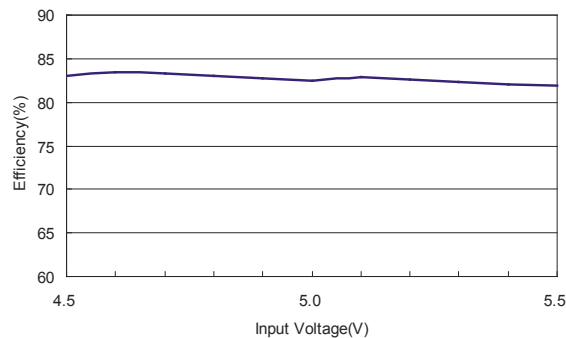
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

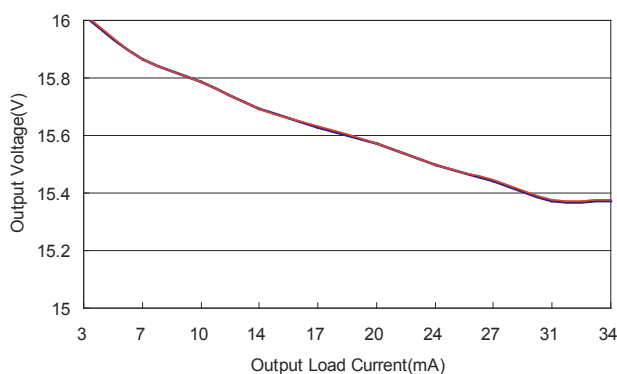
All test conditions are at 25°C The figures are identical for TMA 0515D



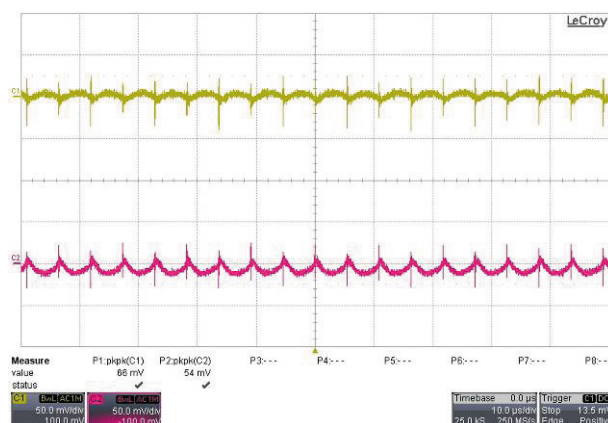
Efficiency Versus Output Current



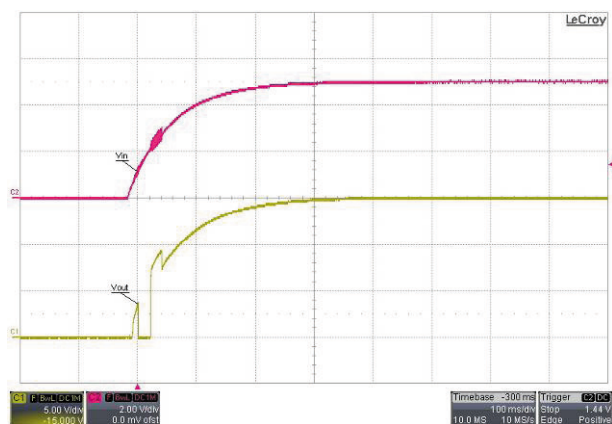
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



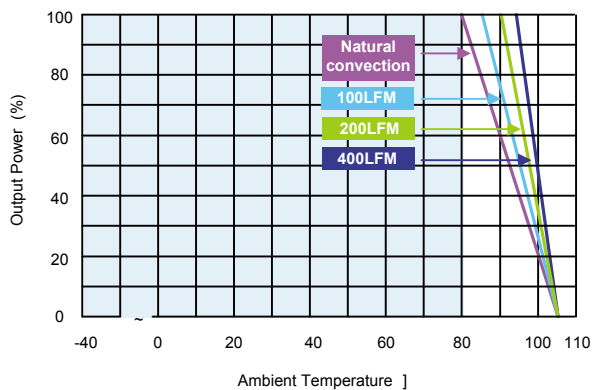
Typical Output Ripple and Noise.
 $V_{in} = V_{in nom}$; Full Load; T_A



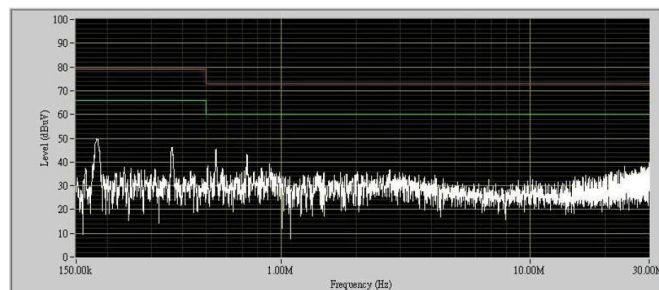
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 0515D (Continued)



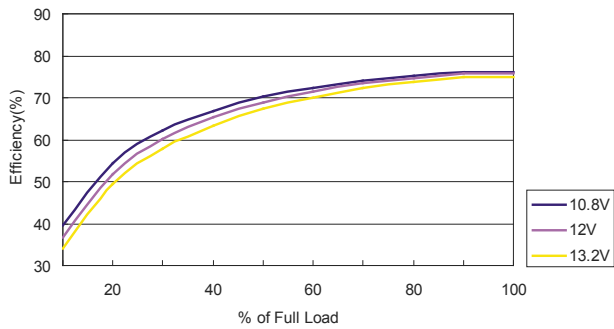
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



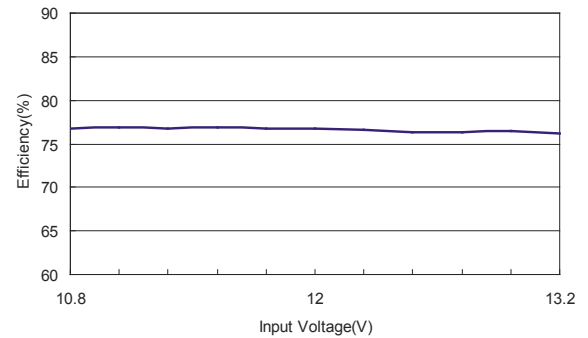
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

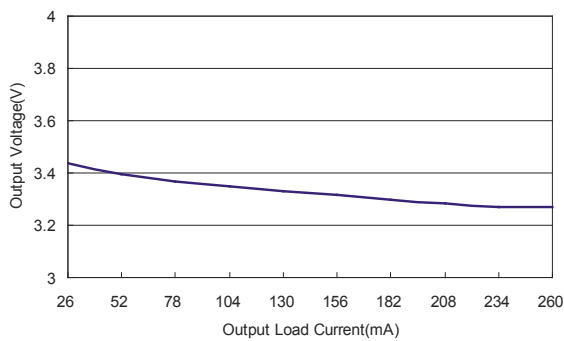
All test conditions are at 25°C The figures are identical for TMA 1203S



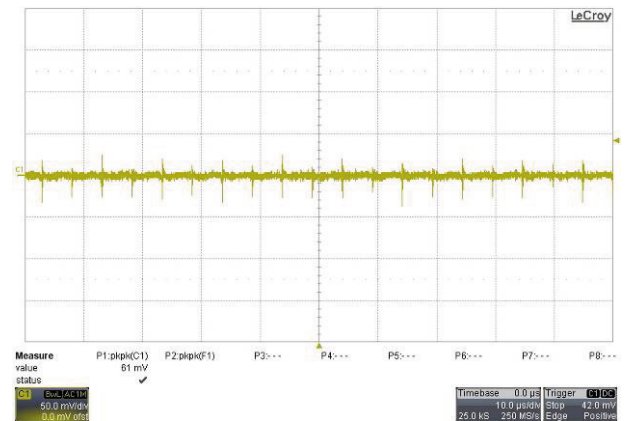
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

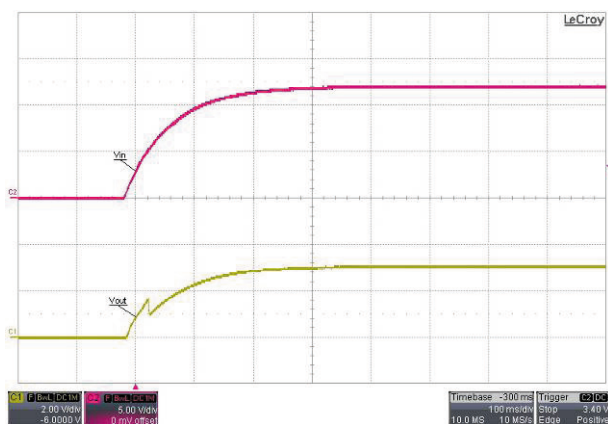


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$$V_{in} = V_{in\ nom}; \text{ Full Load; } T_A$$

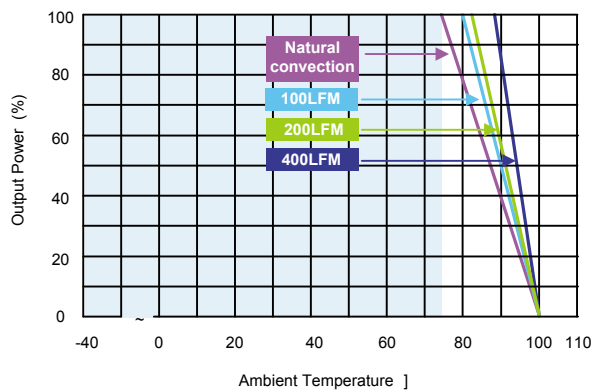


Typical Input Start-Up and Output Rise Characteristic

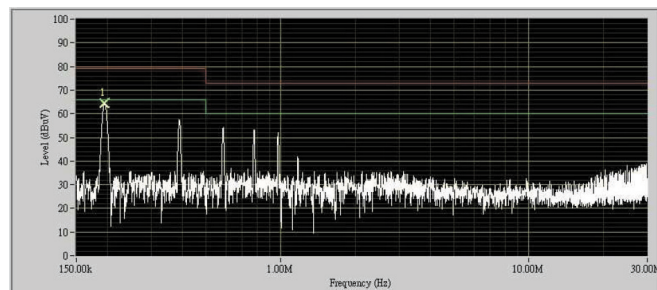
$$V_{in} = V_{in\ nom}; \text{ Full Load}$$

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1203S (Continued)



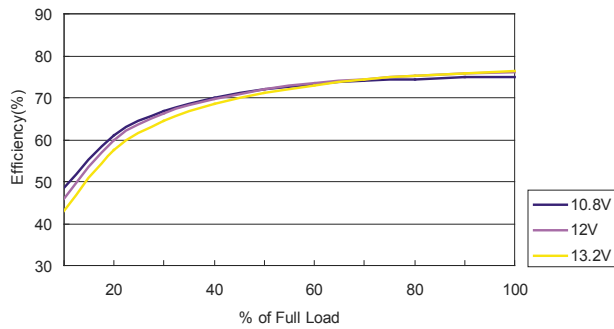
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



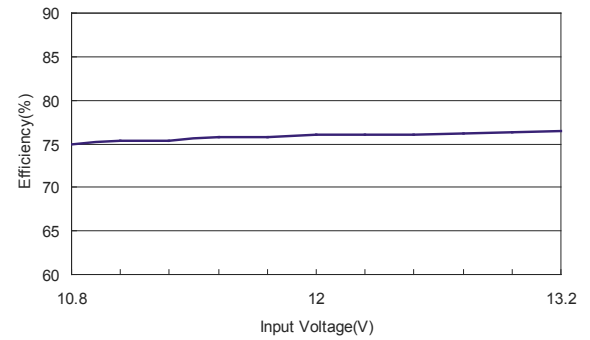
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

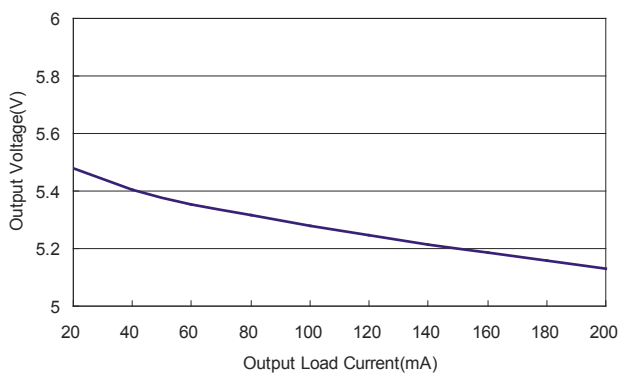
All test conditions are at 25°C The figures are identical for TMA 1205S



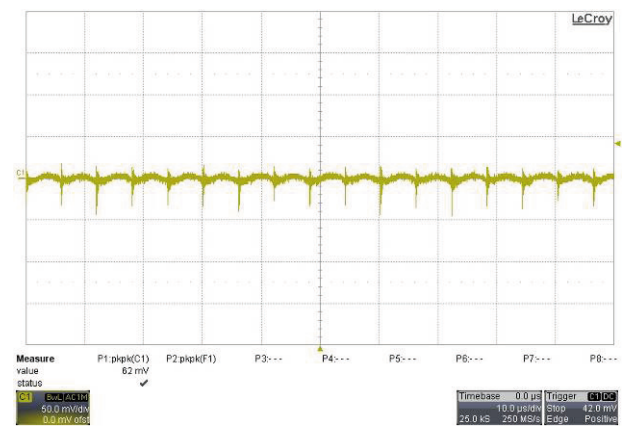
Efficiency Versus Output Current



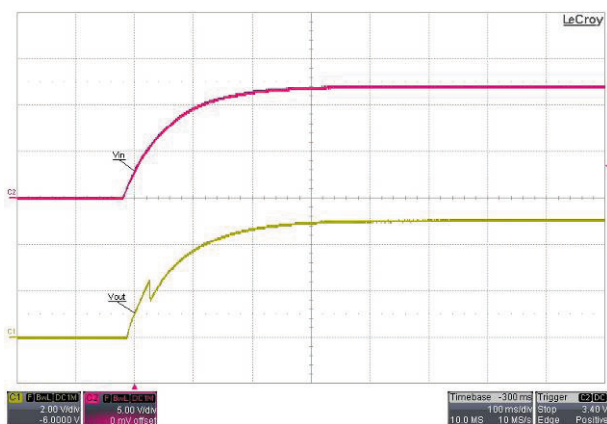
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



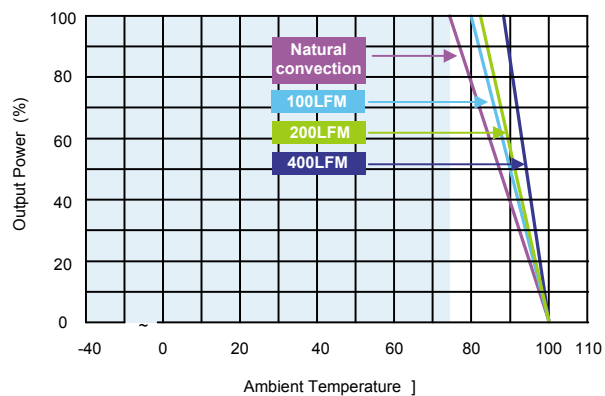
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



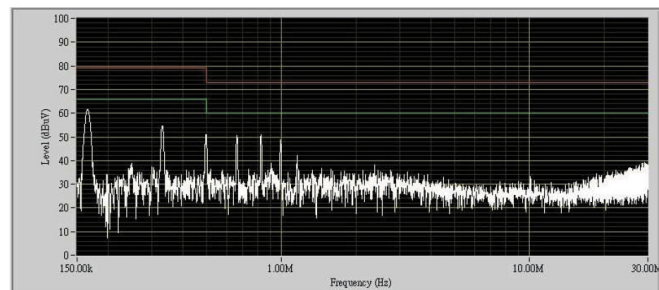
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1205S (Continued)



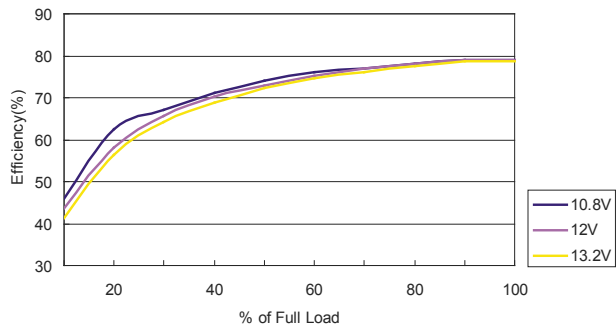
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



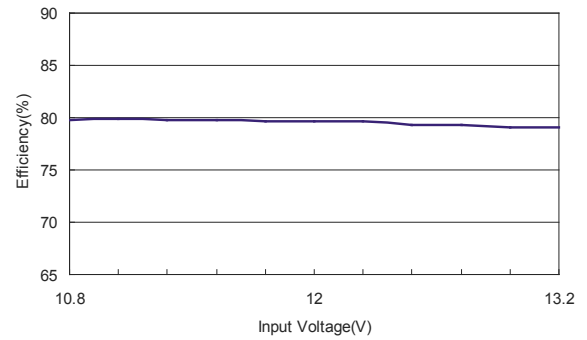
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

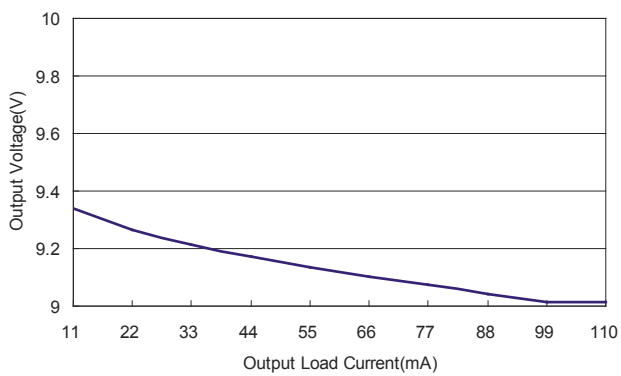
All test conditions are at 25°C The figures are identical for TMA 1209S



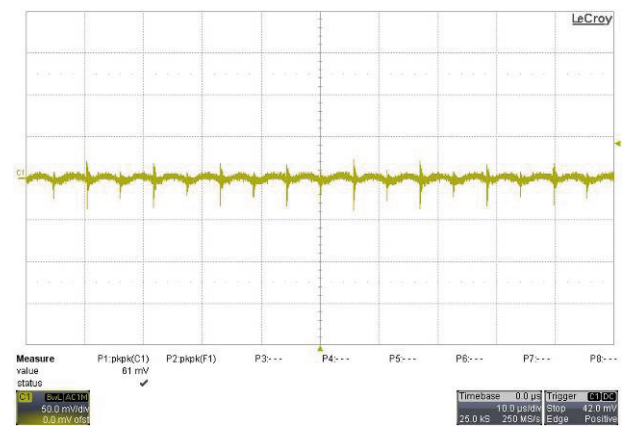
Efficiency Versus Output Current



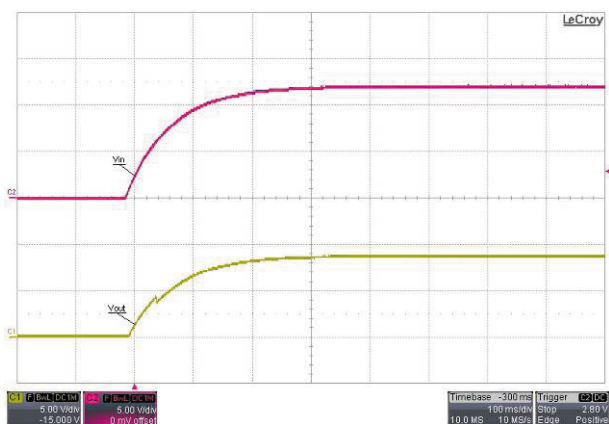
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



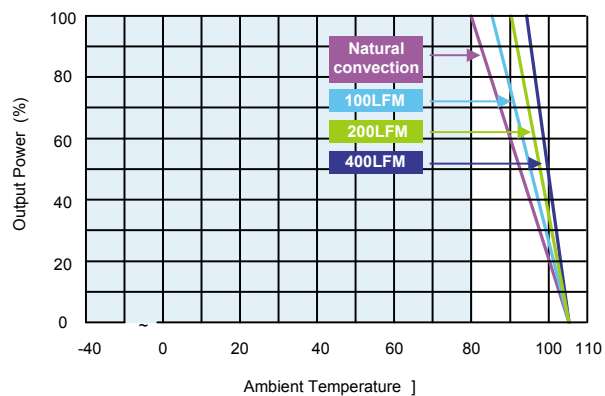
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



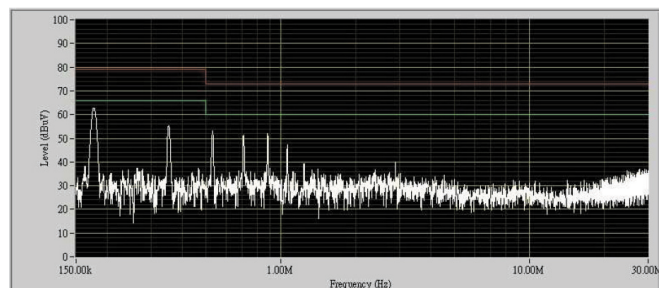
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1209S (Continued)



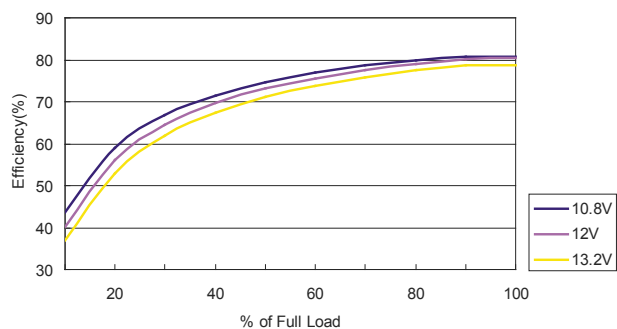
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



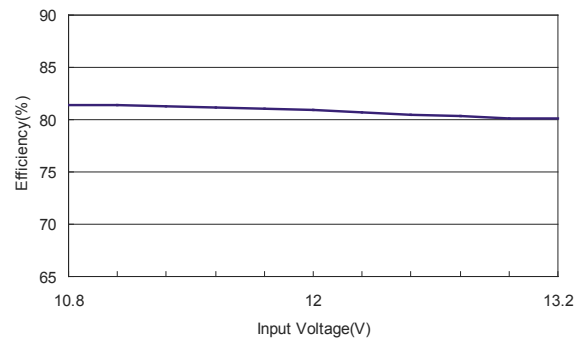
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

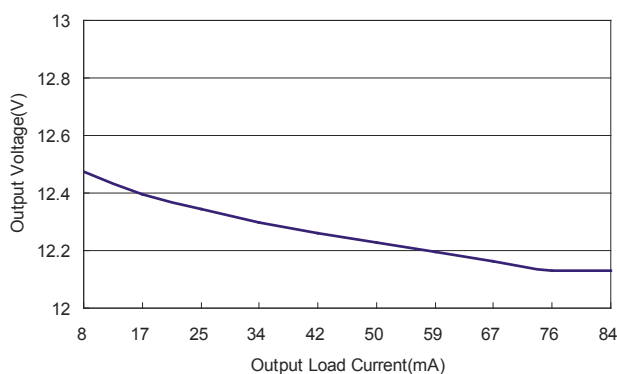
All test conditions are at 25°C The figures are identical for TMA 1212S



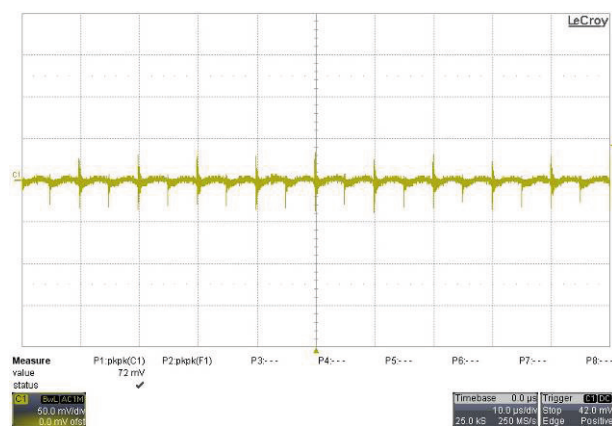
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

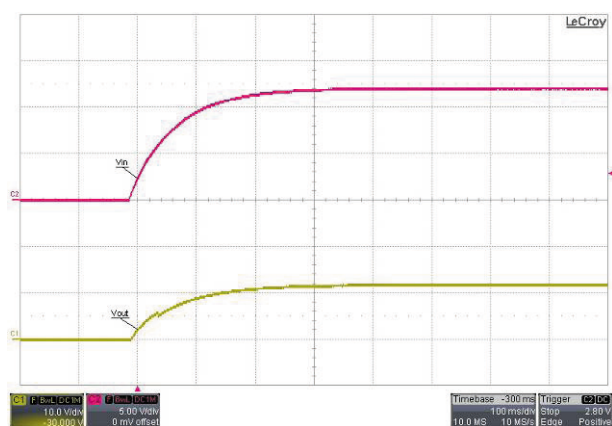


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$V_{in} = V_{in\ nom}$; Full Load; T_A

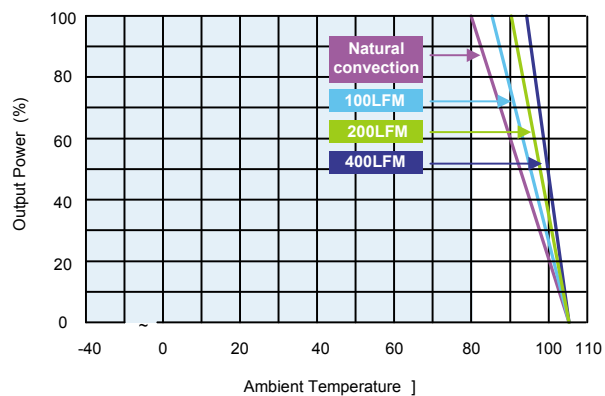


Typical Input Start-Up and Output Rise Characteristic

$V_{in} = V_{in\ nom}$; Full Load

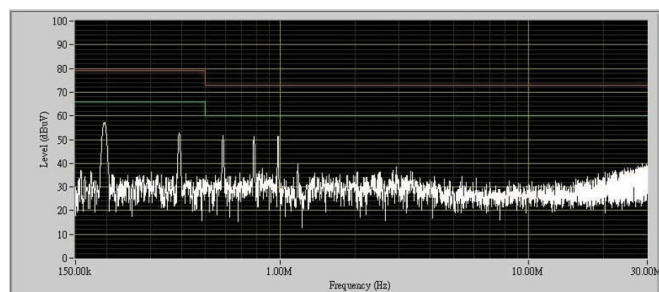
Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1212S (Continued)



Derating Output Current Versus Ambient Temperature and Airflow

$$V_{in} = V_{in\ nom}$$

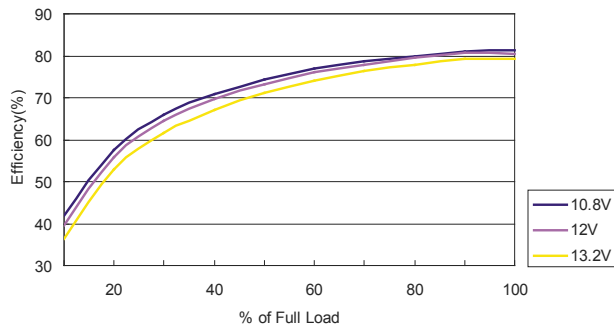


Conduction Emission of EN55022 Class A

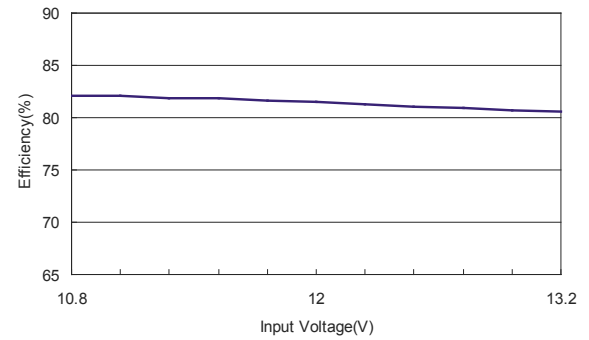
$V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

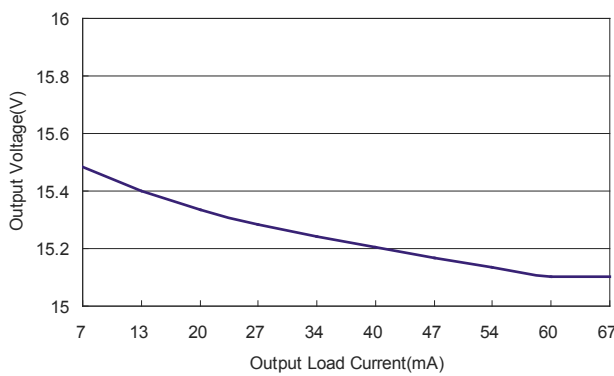
All test conditions are at 25°C The figures are identical for TMA 1215S



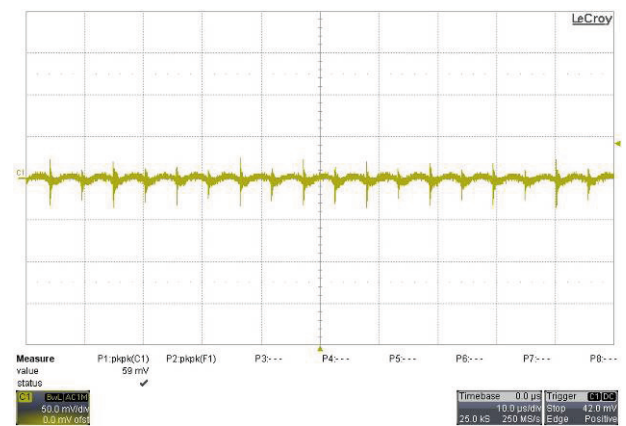
Efficiency Versus Output Current



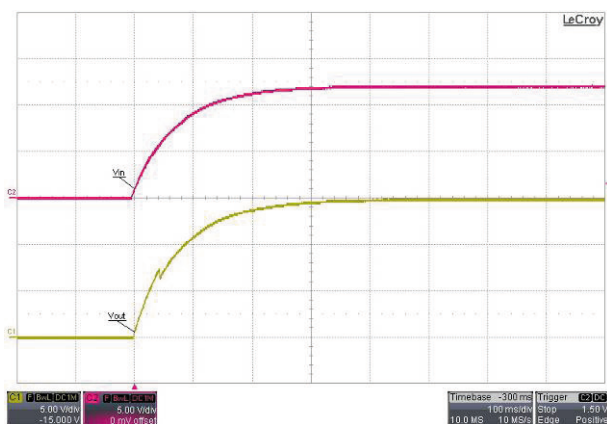
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



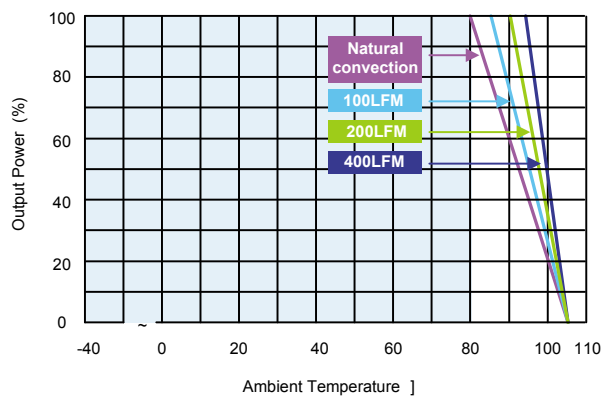
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



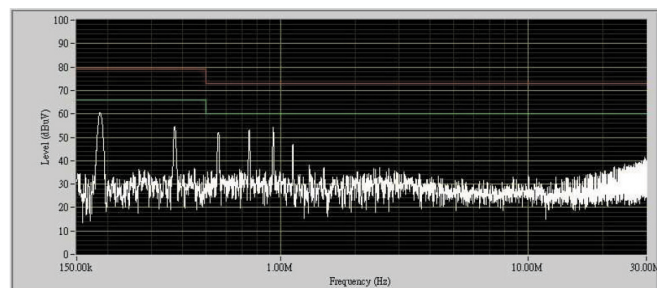
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1215S (Continued)



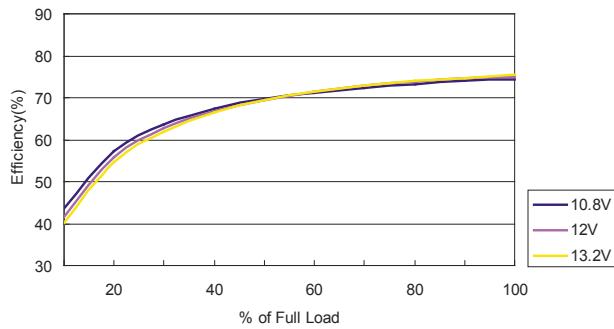
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



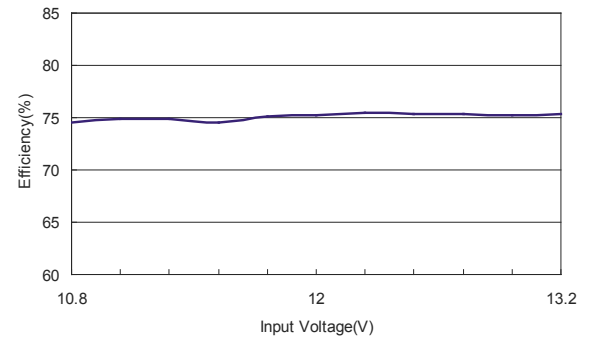
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

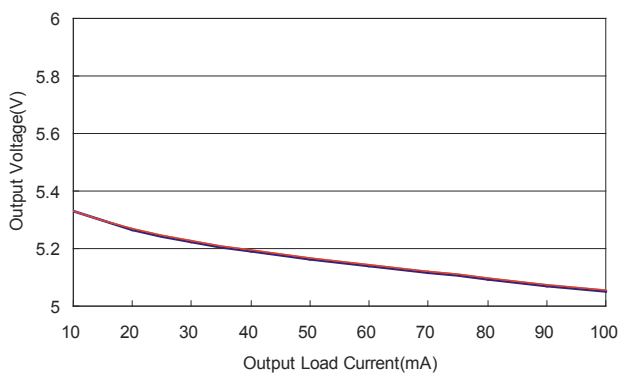
All test conditions are at 25°C The figures are identical for TMA 1205D



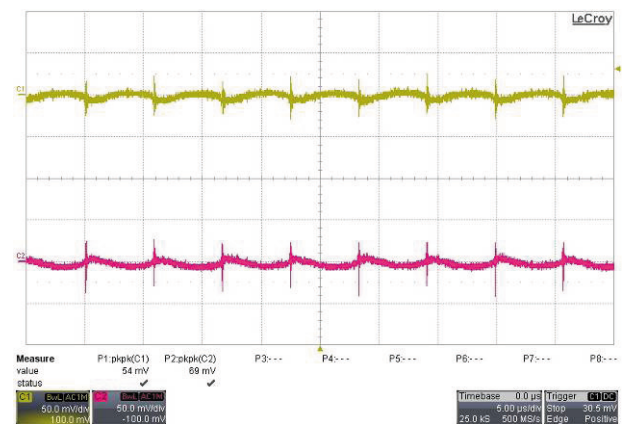
Efficiency Versus Output Current



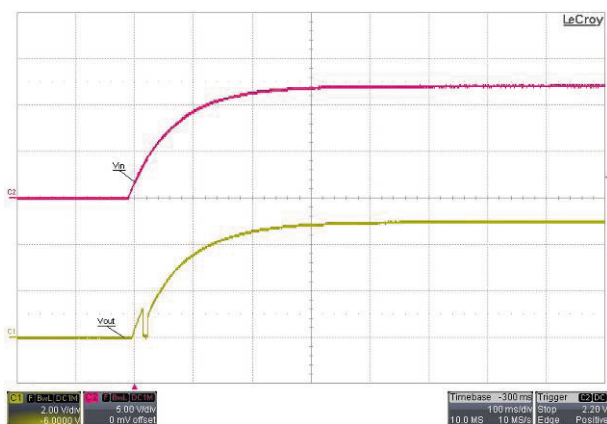
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



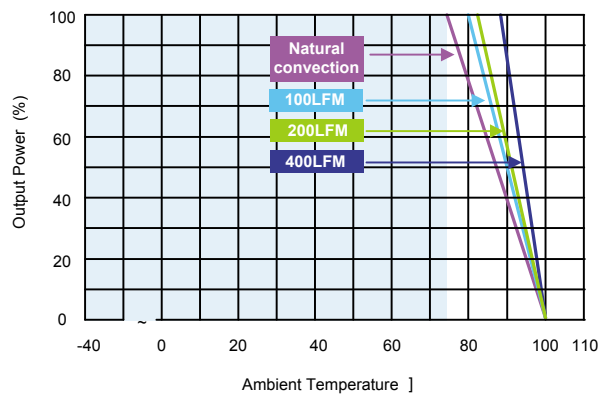
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



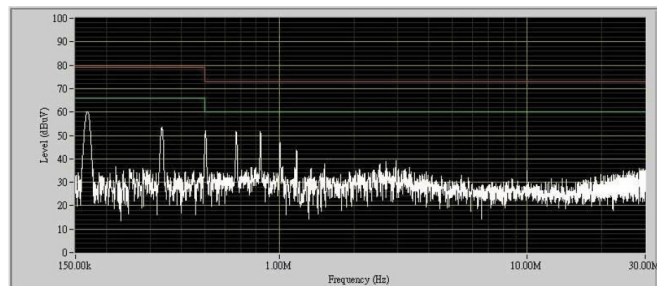
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1205D (Continued)



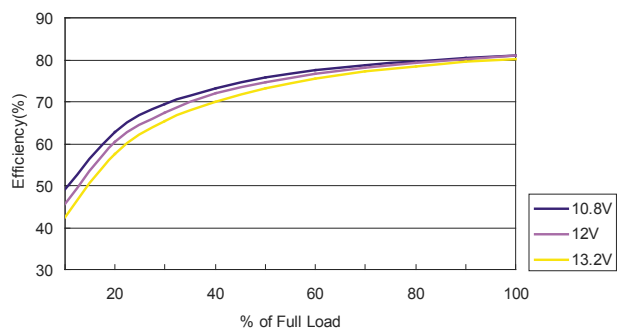
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



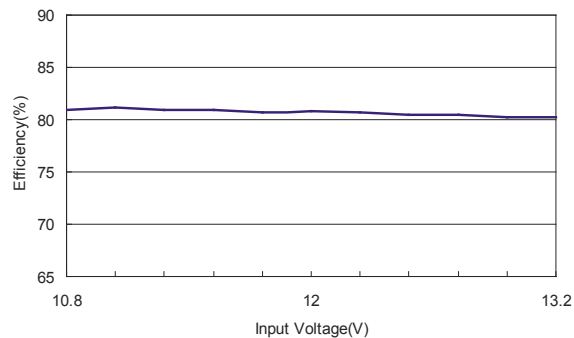
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

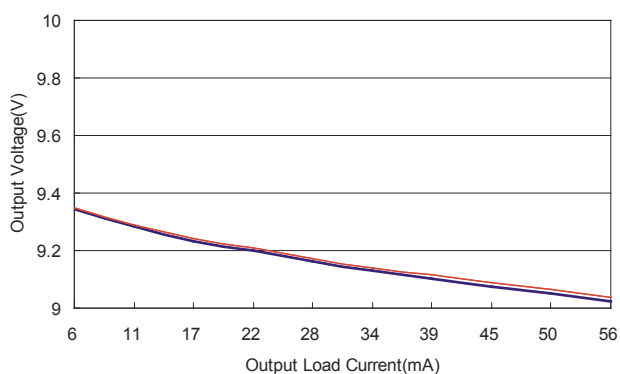
All test conditions are at 25°C The figures are identical for TMA 1209D



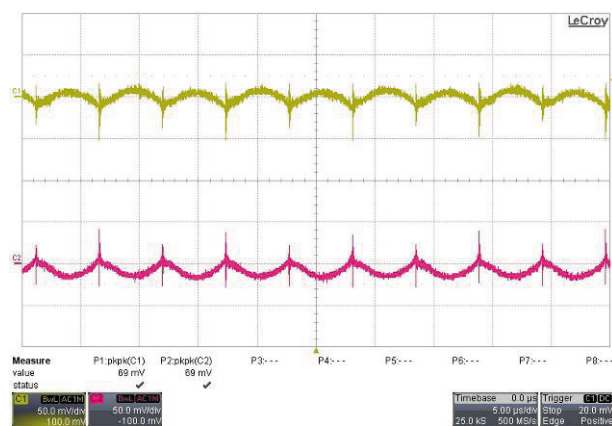
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

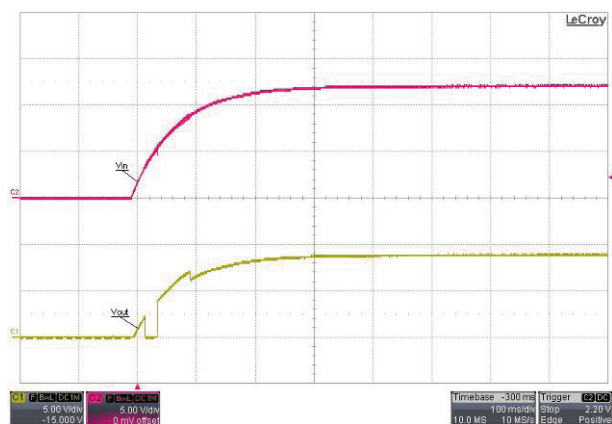


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$V_{in} = V_{in\ nom}$; Full Load; T_A

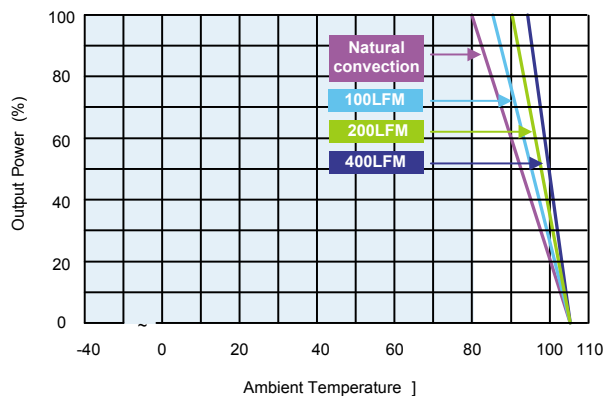


Typical Input Start-Up and Output Rise Characteristic

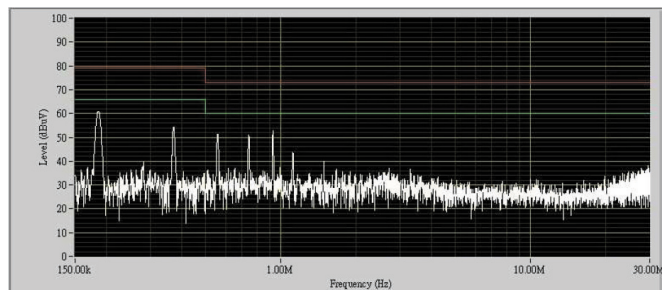
$V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1209D (Continued)



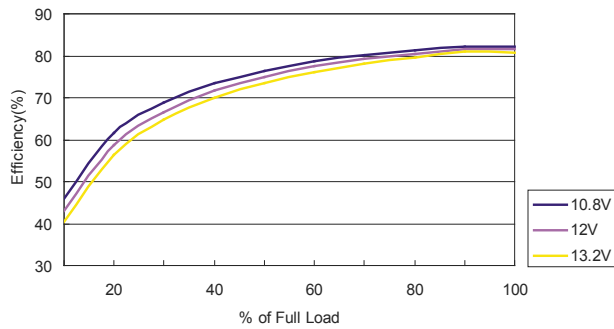
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



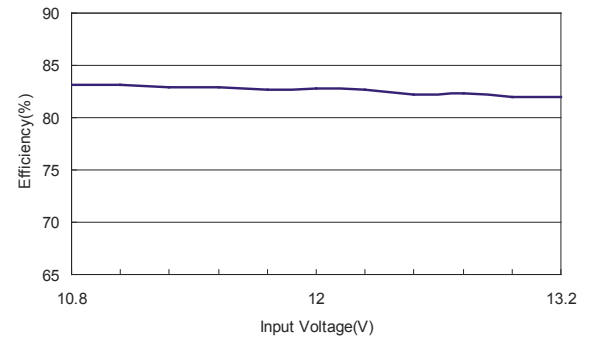
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

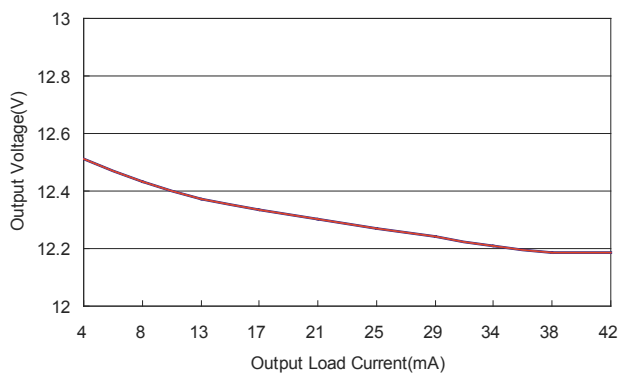
All test conditions are at 25°C The figures are identical for TMA 1212D



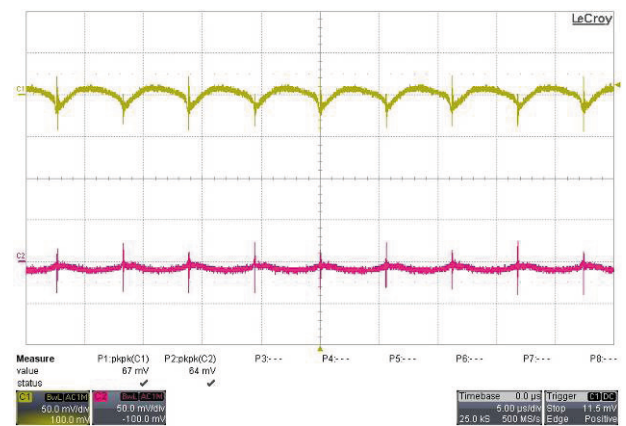
Efficiency Versus Output Current



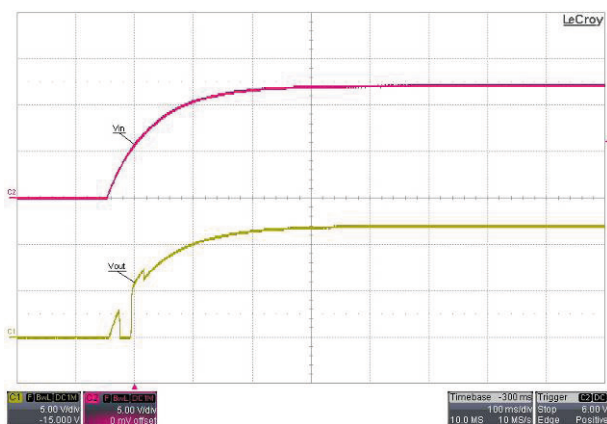
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



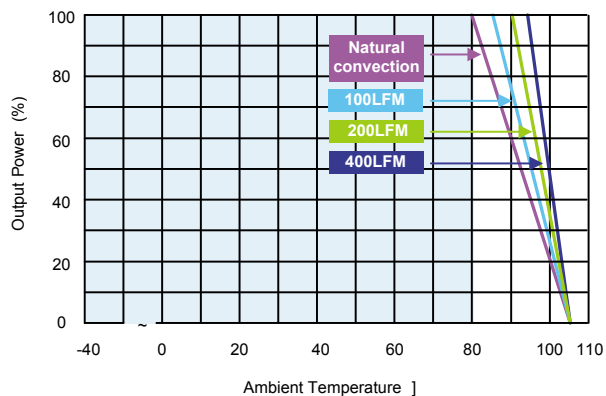
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



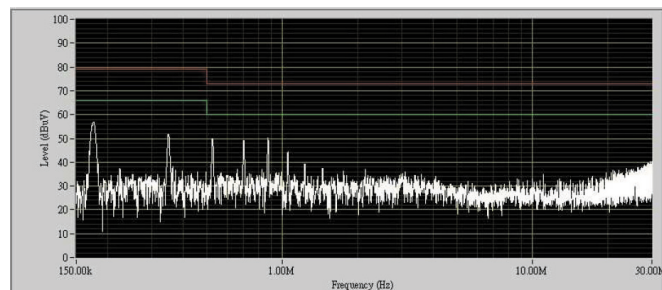
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1212D (Continued)



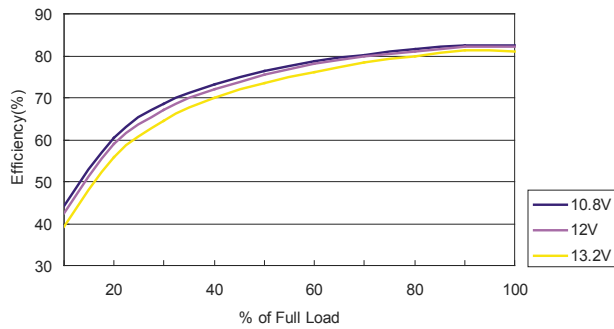
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



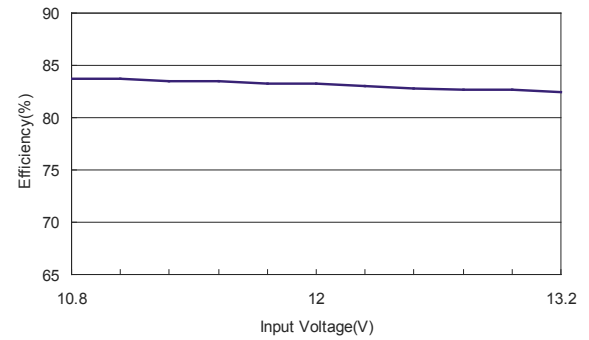
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

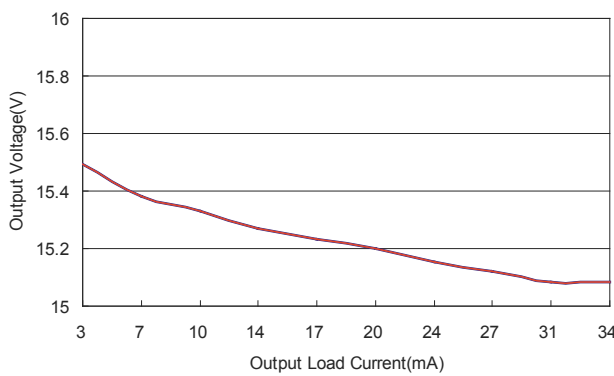
All test conditions are at 25°C The figures are identical for TMA 1215D



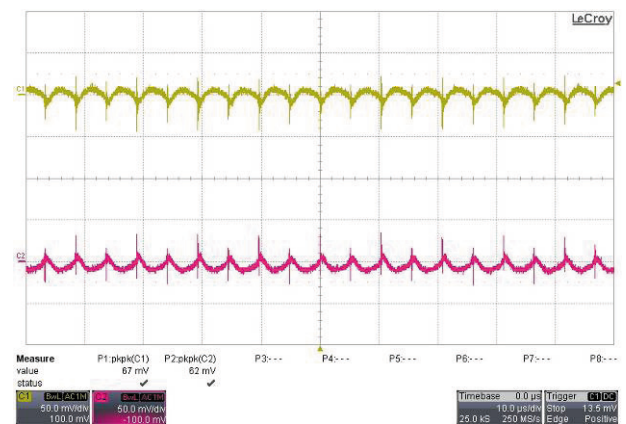
Efficiency Versus Output Current



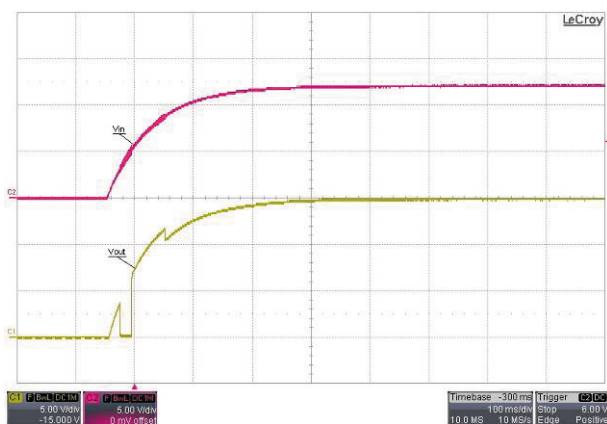
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



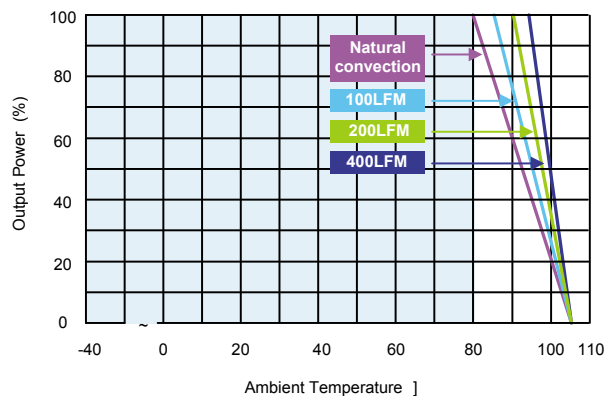
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



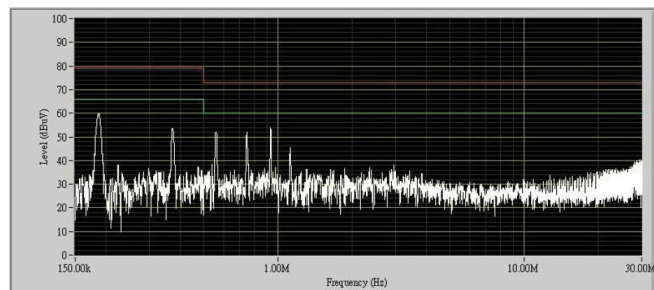
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1215D (Continued)



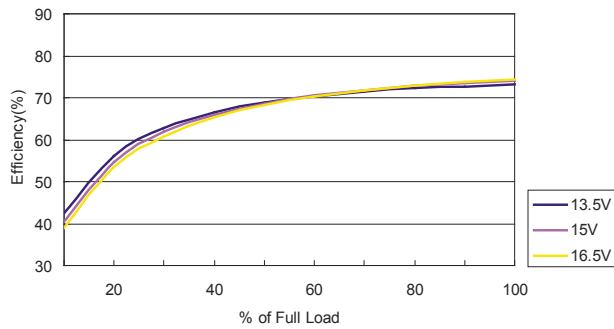
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



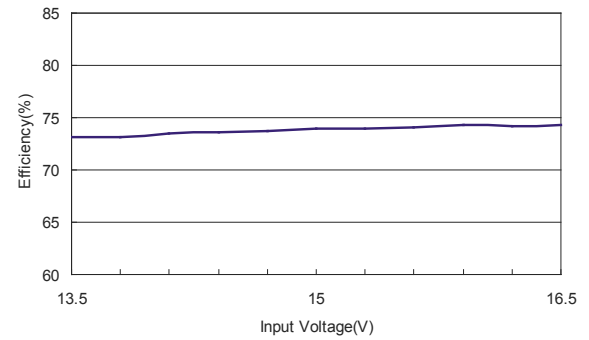
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

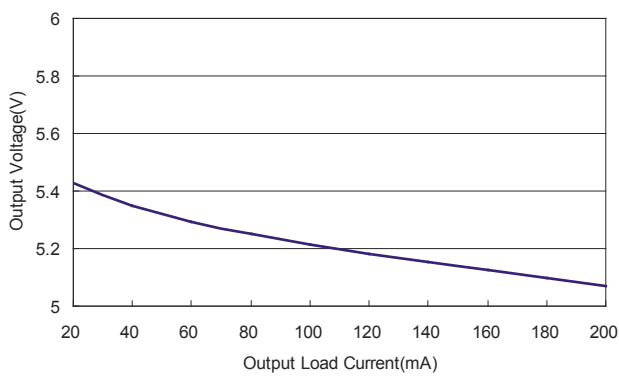
All test conditions are at 25°C The figures are identical for TMA 1505S



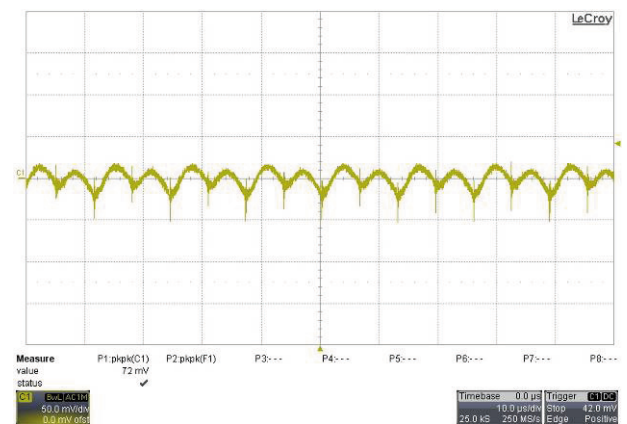
Efficiency Versus Output Current



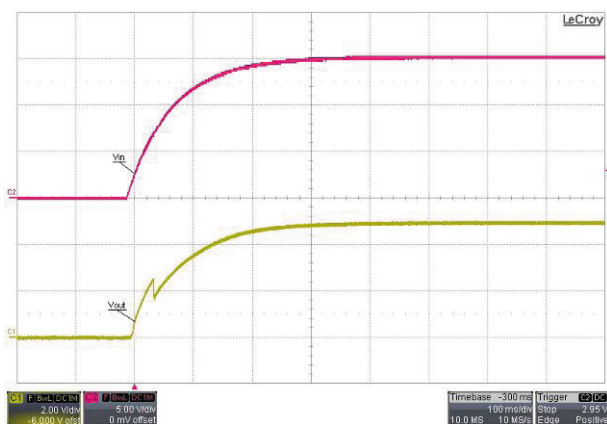
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



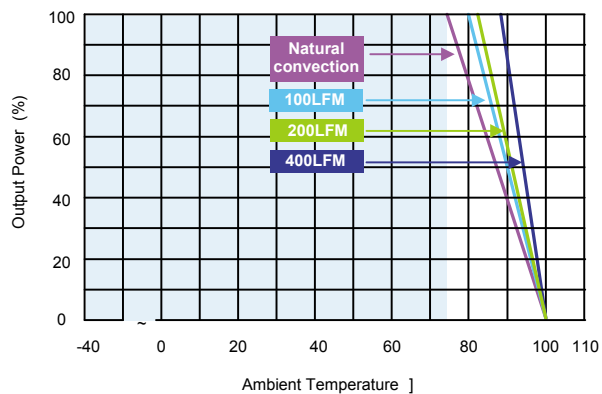
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



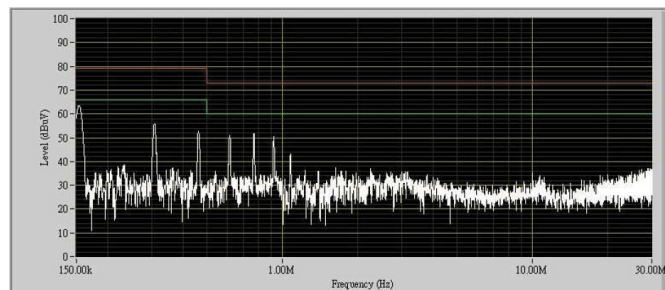
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1505S (Continued)



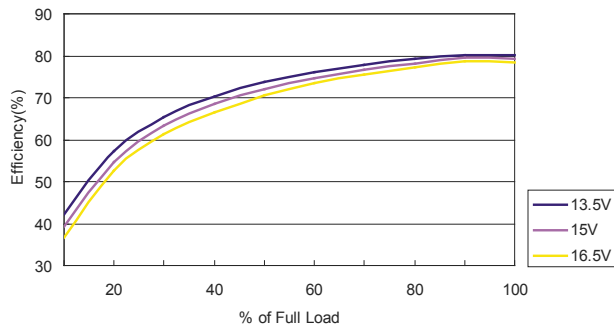
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



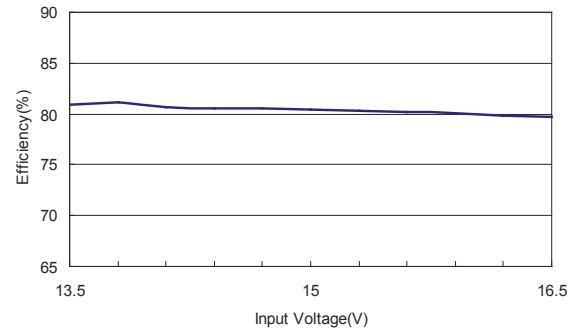
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

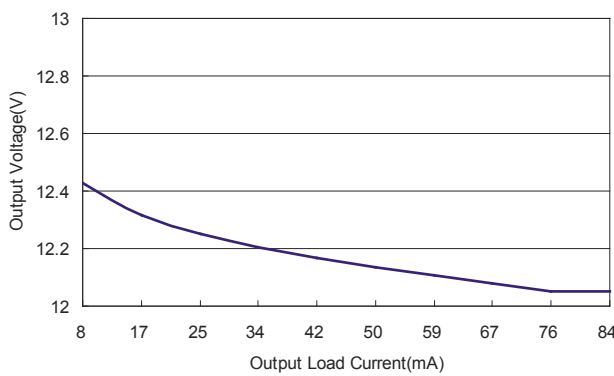
All test conditions are at 25°C The figures are identical for TMA 1512S



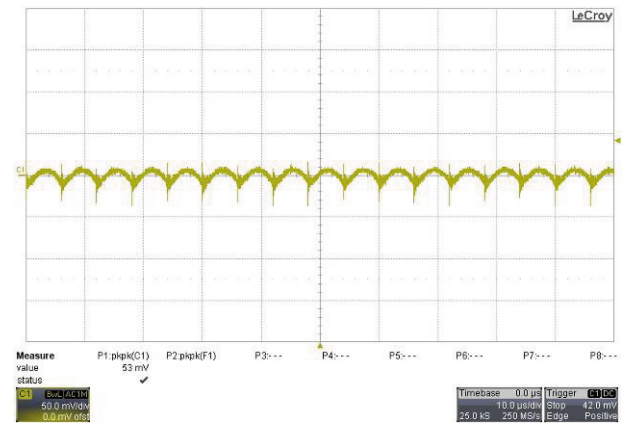
Efficiency Versus Output Current



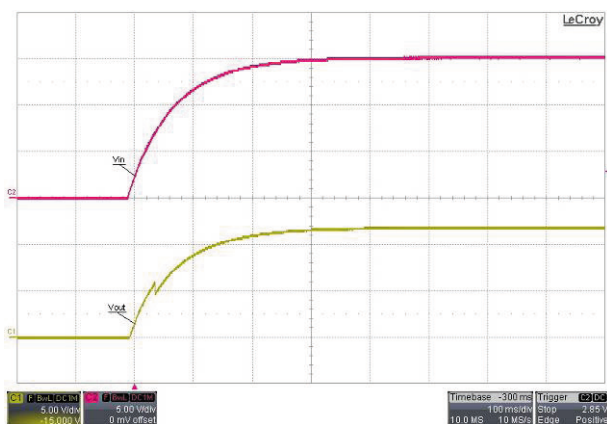
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



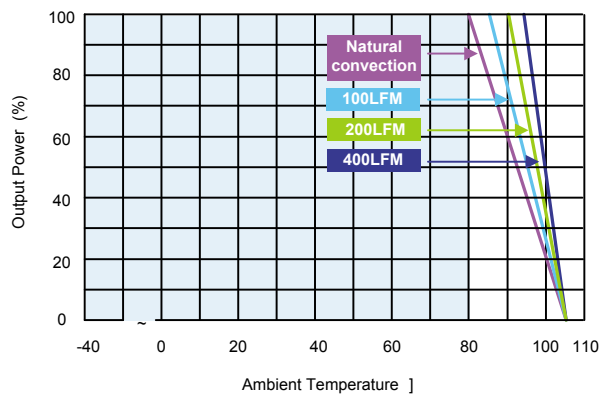
Typical Output Ripple and Noise.
 $V_{in} = V_{in nom}$; Full Load; T_A



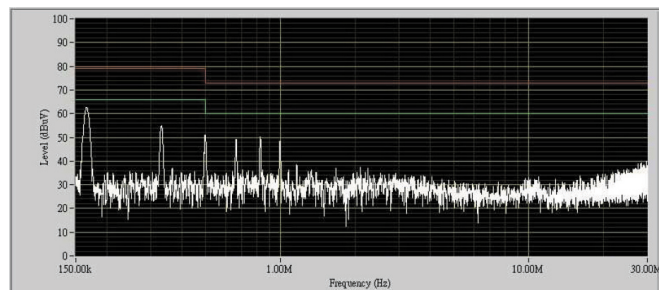
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1512S (Continued)



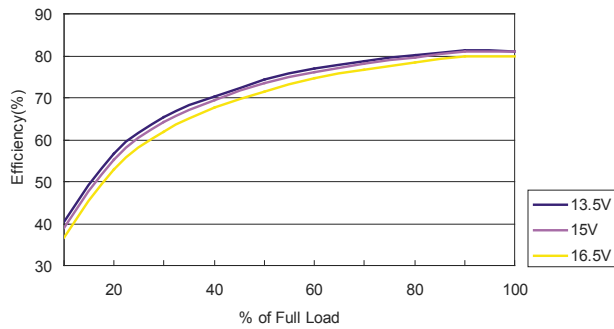
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



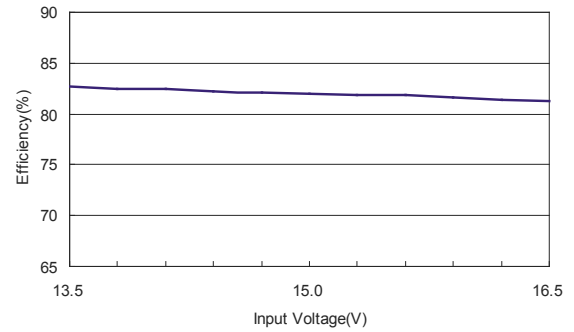
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

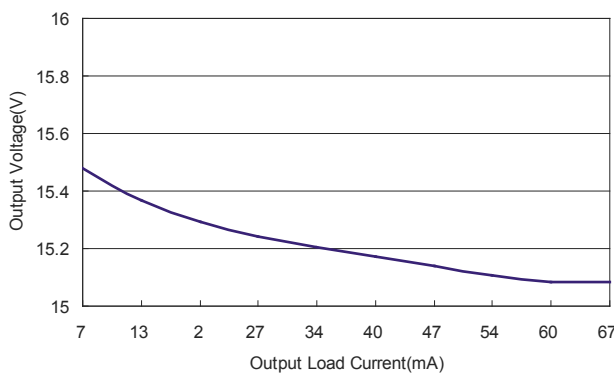
All test conditions are at 25°C The figures are identical for TMA 1515S



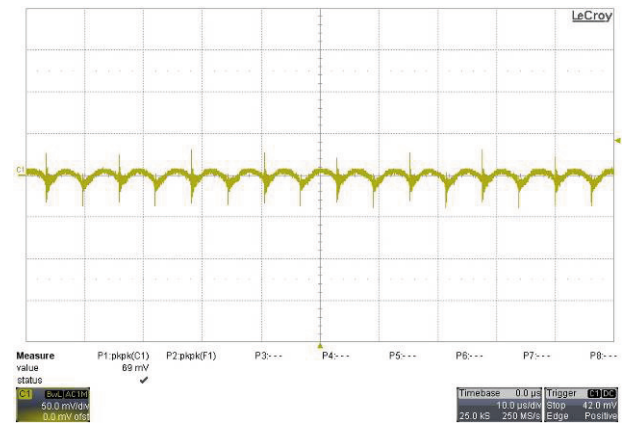
Efficiency Versus Output Current



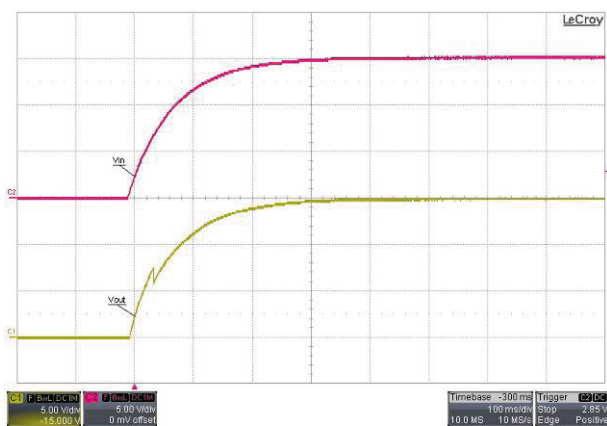
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



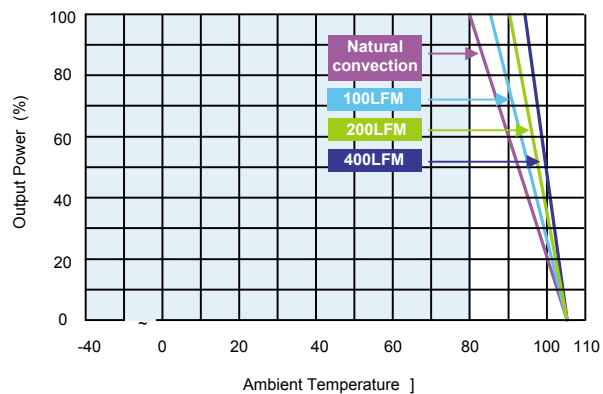
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



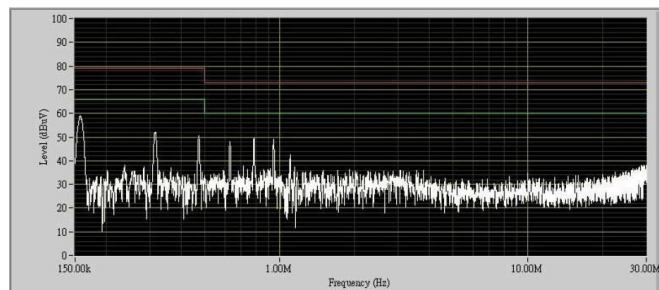
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1515S (Continued)



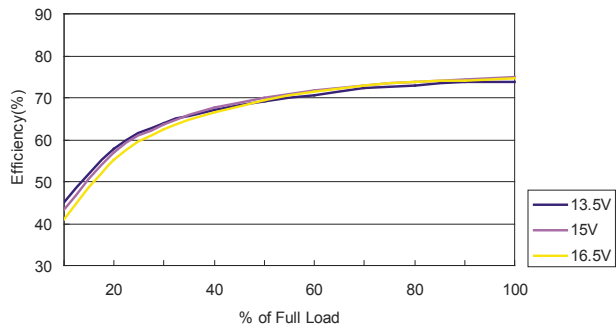
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



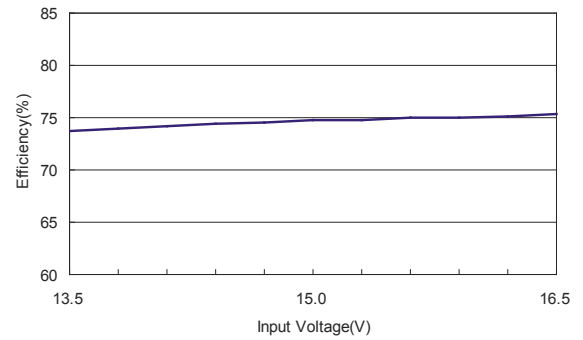
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

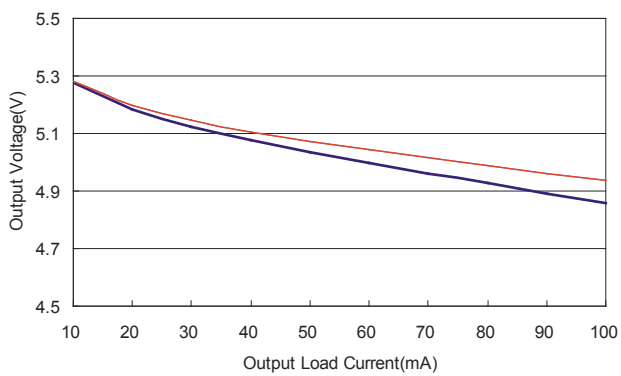
All test conditions are at 25°C The figures are identical for TMA 1505D



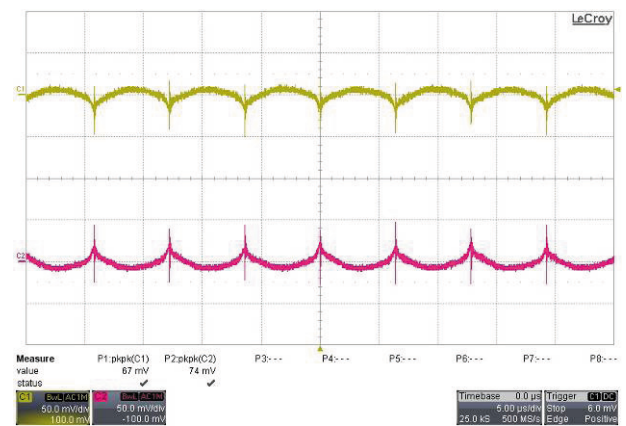
Efficiency Versus Output Current



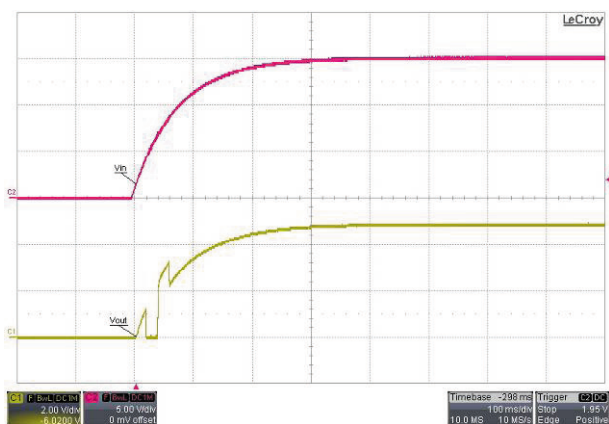
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



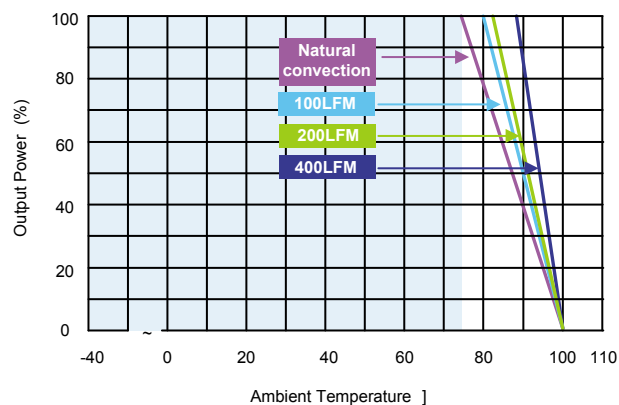
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



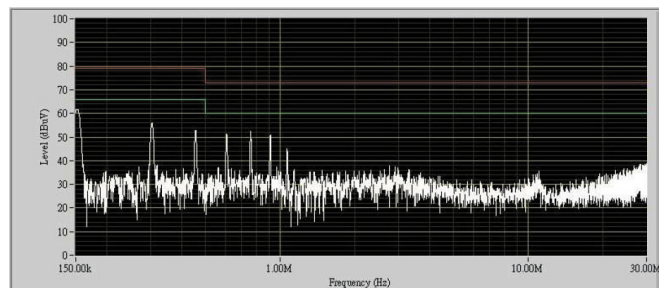
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1505D (Continued)



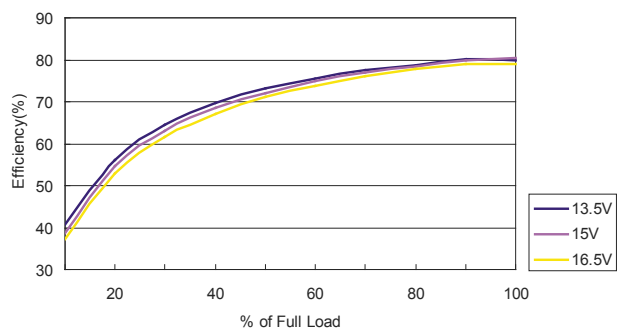
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



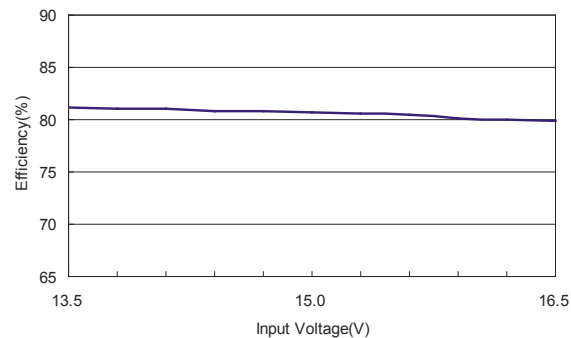
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

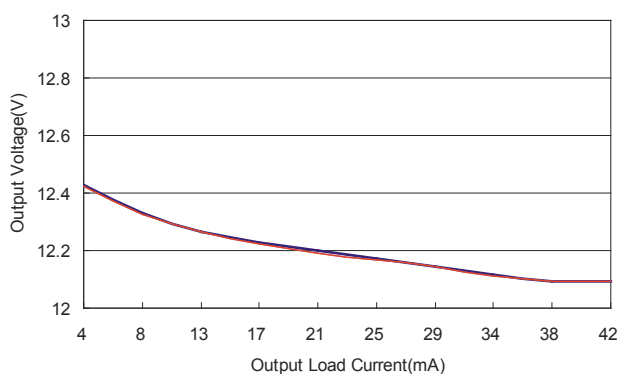
All test conditions are at 25°C The figures are identical for TMA 1512D



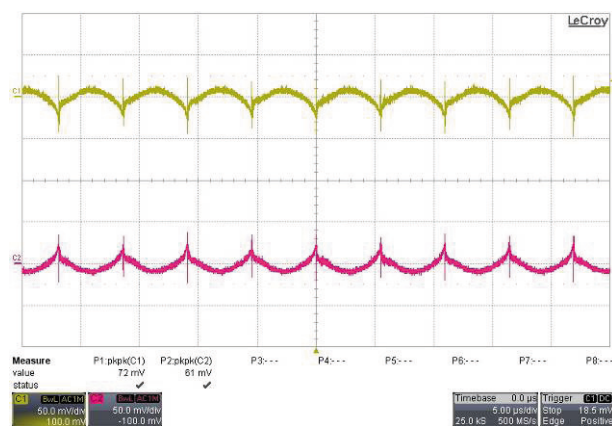
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

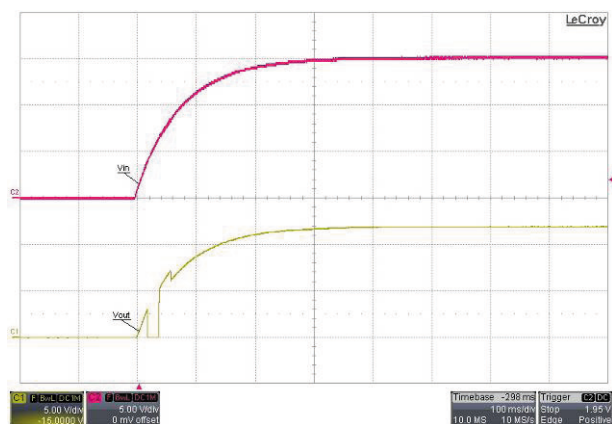


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$$V_{in} = V_{in\ nom}; \text{ Full Load; } T_A$$

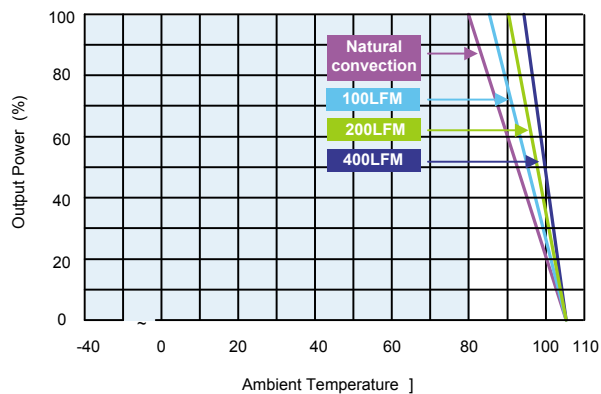


Typical Input Start-Up and Output Rise Characteristic

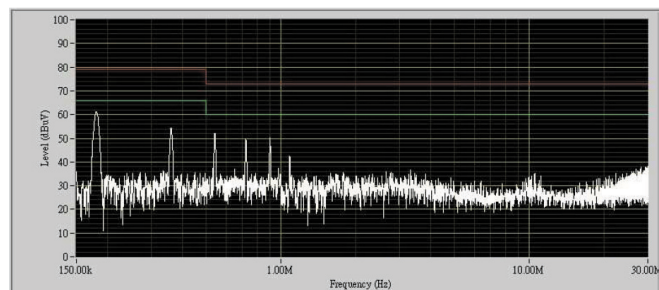
$$V_{in} = V_{in\ nom}; \text{ Full Load}$$

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1512D (Continued)



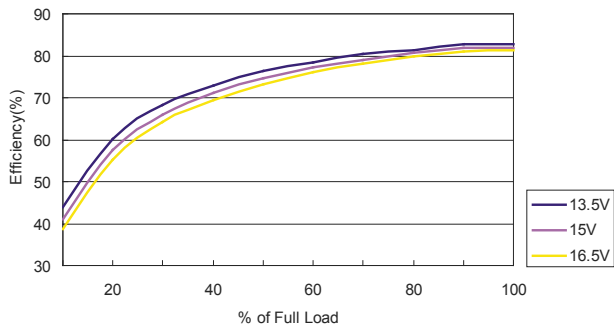
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



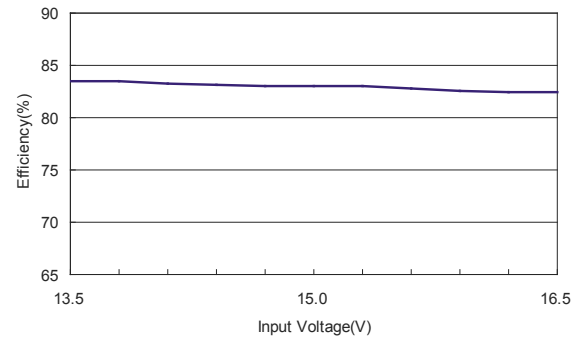
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

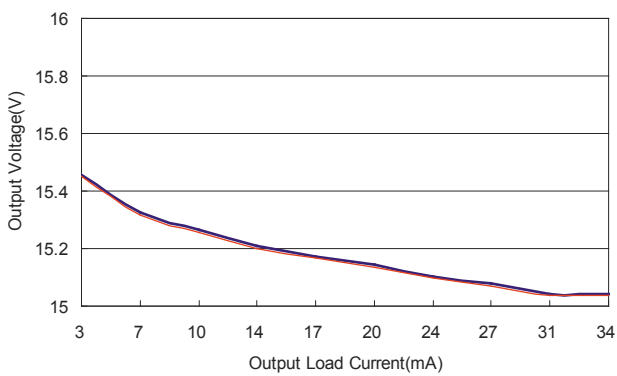
All test conditions are at 25°C The figures are identical for TMA 1515D



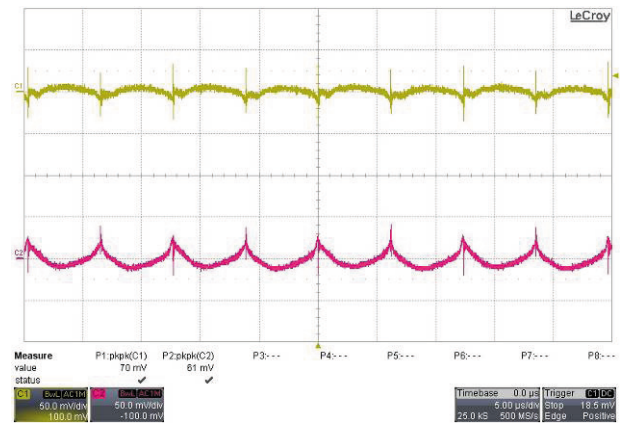
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

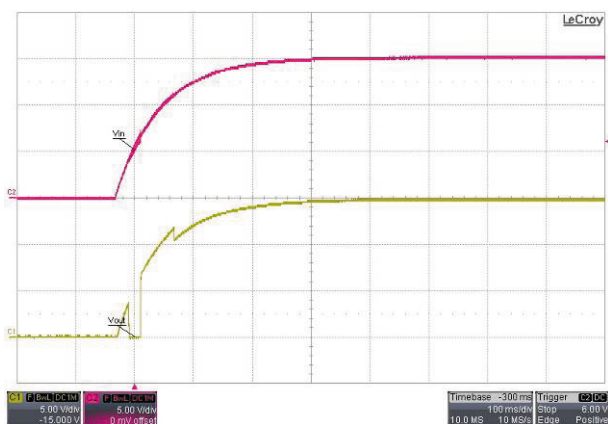


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$$V_{in} = V_{in\ nom}; \text{ Full Load; } T_A$$

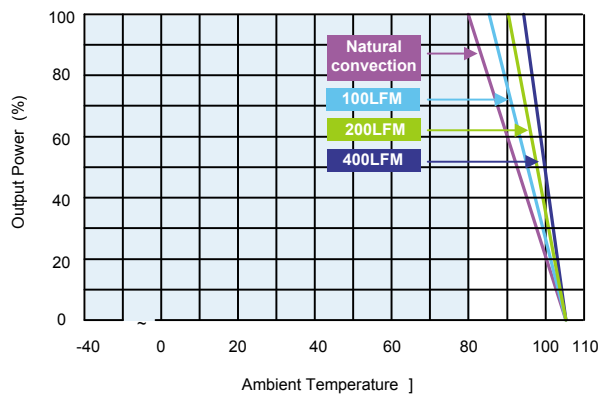


Typical Input Start-Up and Output Rise Characteristic

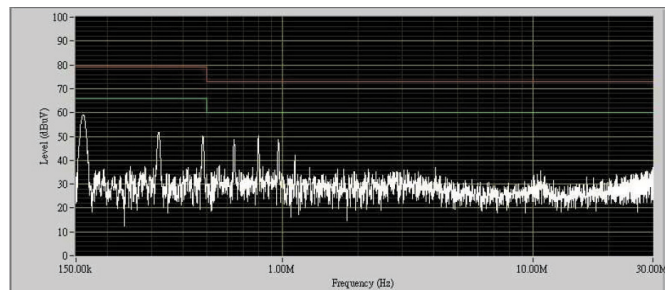
$$V_{in} = V_{in\ nom}; \text{ Full Load}$$

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 1515D (Continued)



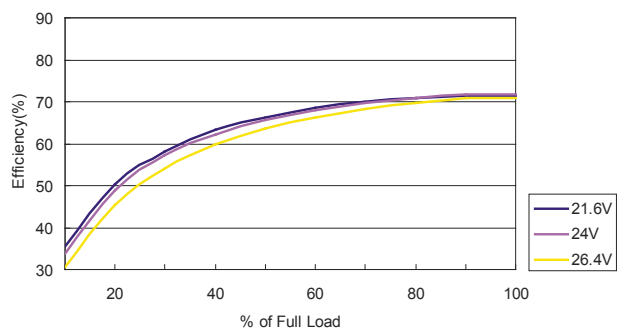
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



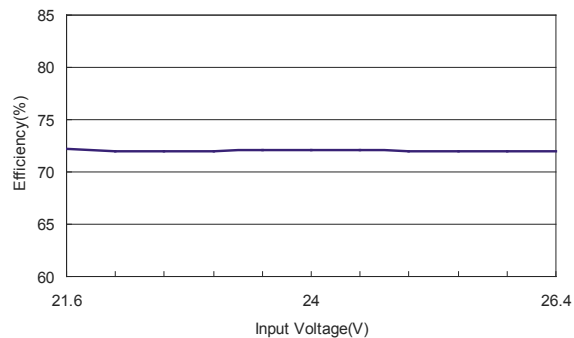
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

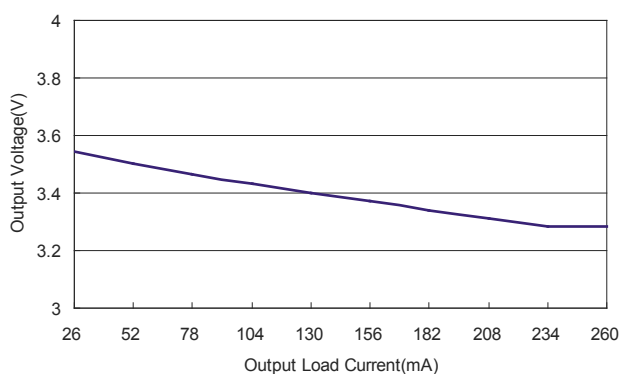
All test conditions are at 25°C The figures are identical for TMA 2403S



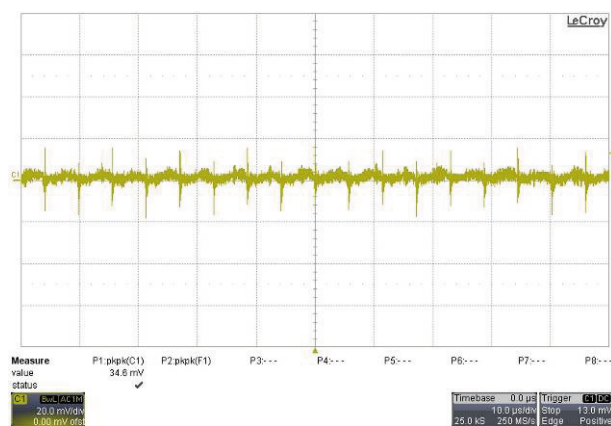
Efficiency Versus Output Current



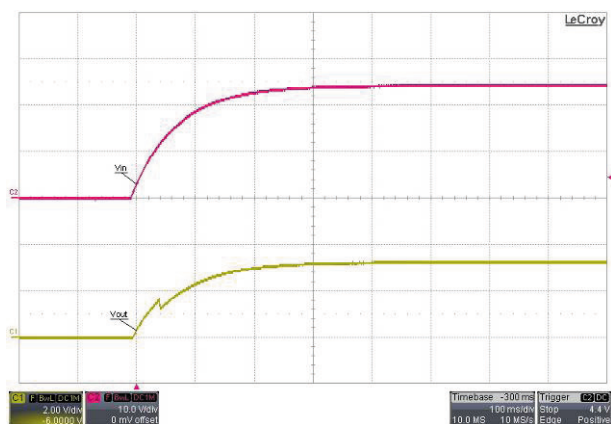
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



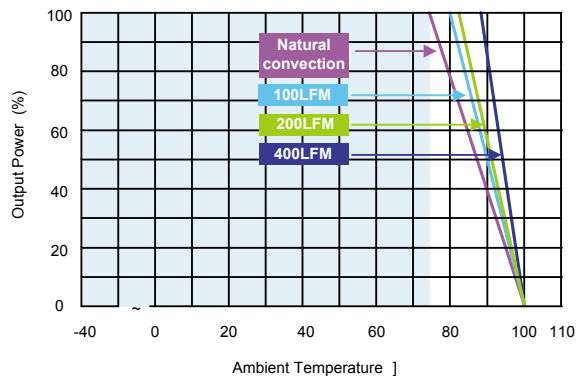
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



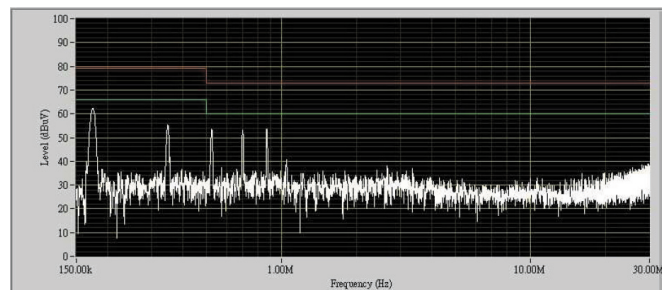
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2403S (Continued)



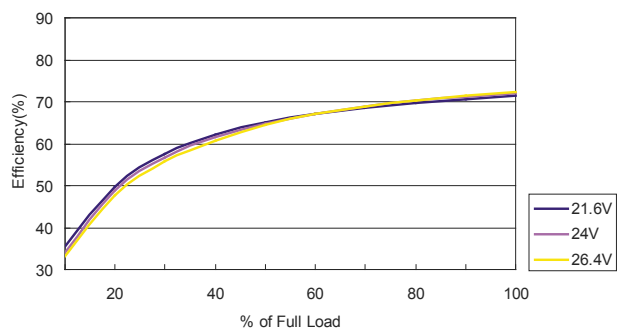
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



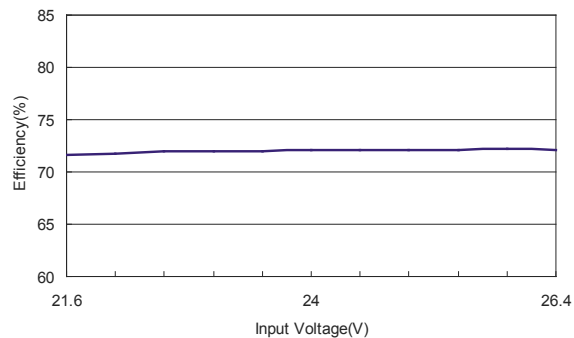
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

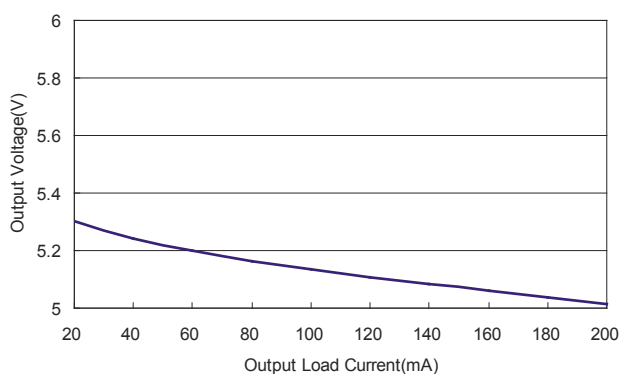
All test conditions are at 25°C The figures are identical for TMA 2405S



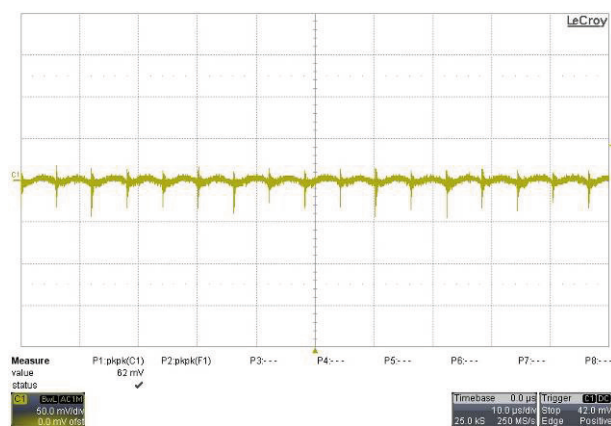
Efficiency Versus Output Current



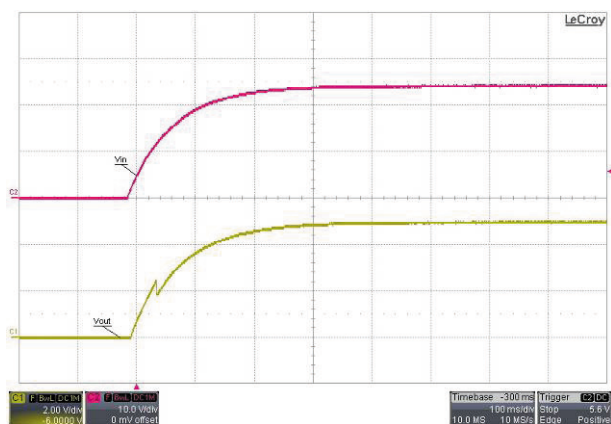
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



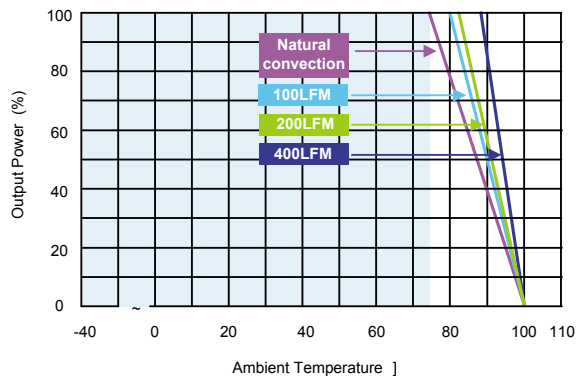
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

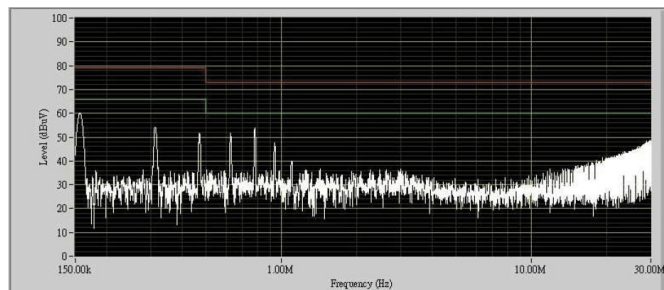
Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2405S (Continued)



Derating Output Current Versus Ambient Temperature and Airflow

$$V_{in} = V_{in\ nom}$$

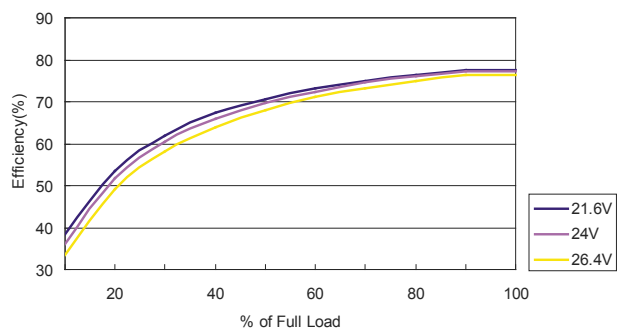


Conduction Emission of EN55022 Class A

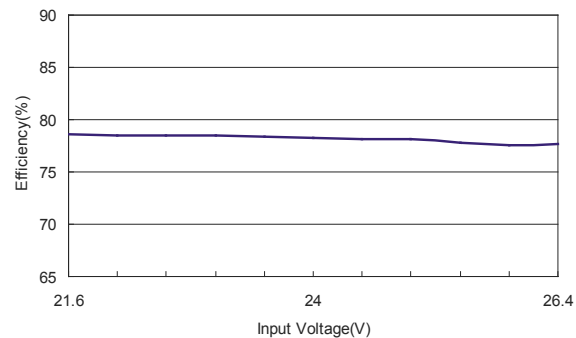
$$V_{in} = V_{in\ nom} ; \text{ Full Load (See Page 73)}$$

Characteristic Curves

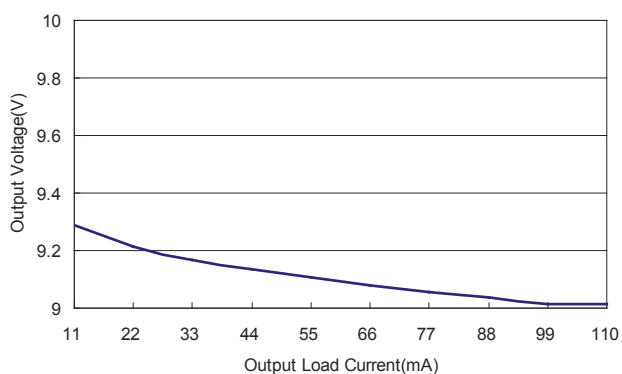
All test conditions are at 25°C The figures are identical for TMA 2409S



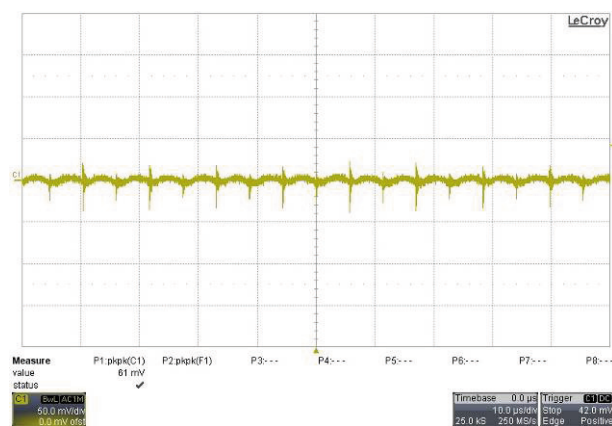
Efficiency Versus Output Current



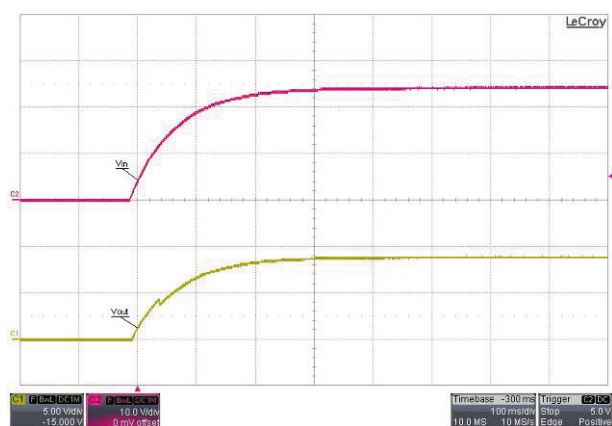
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



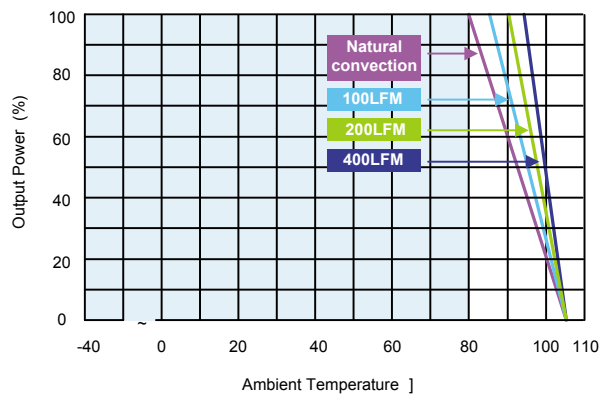
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



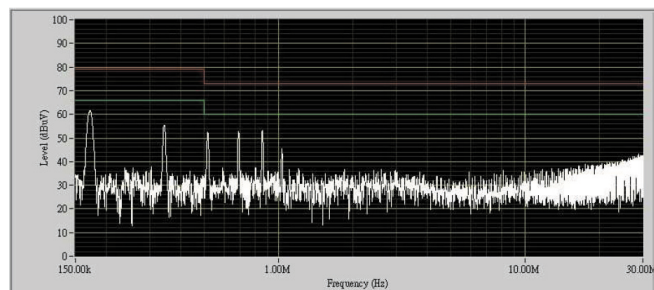
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2409S (Continued)



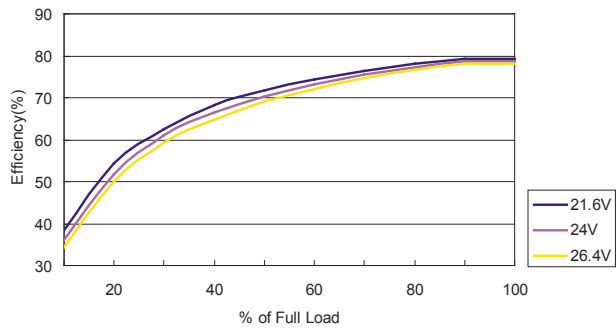
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



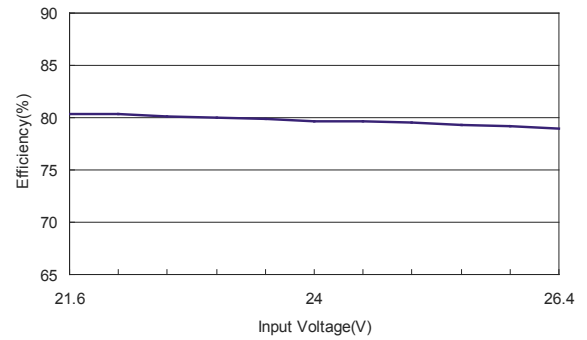
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

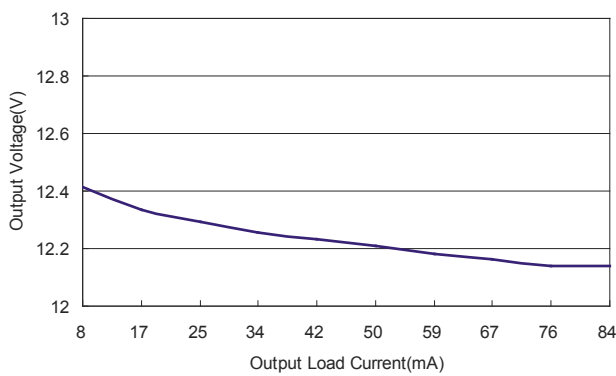
All test conditions are at 25°C The figures are identical for TMA 2412S



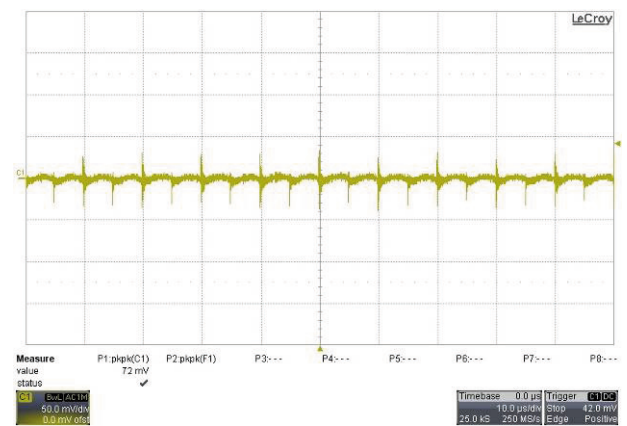
Efficiency Versus Output Current



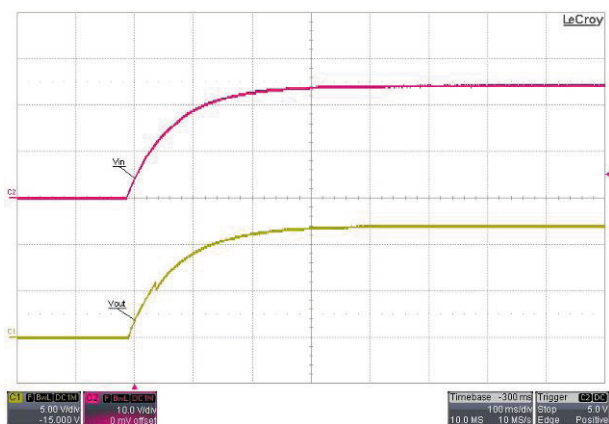
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



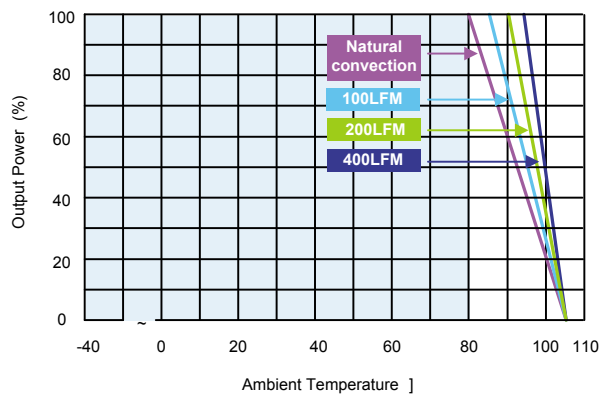
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



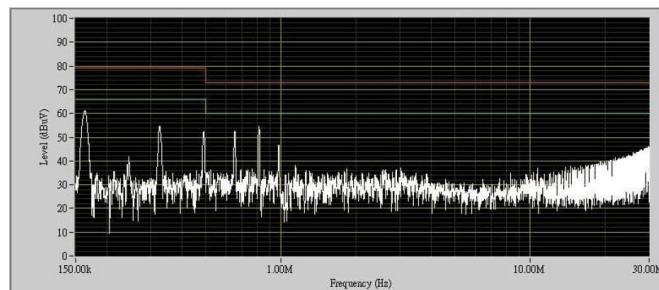
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2412S (Continued)



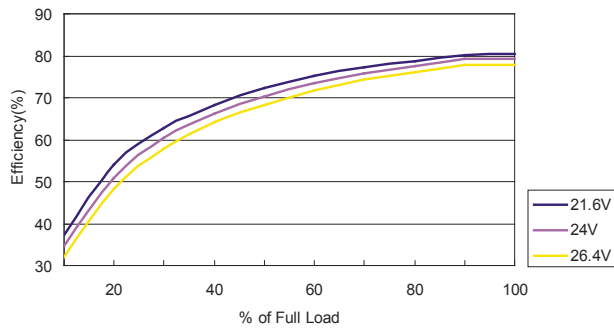
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



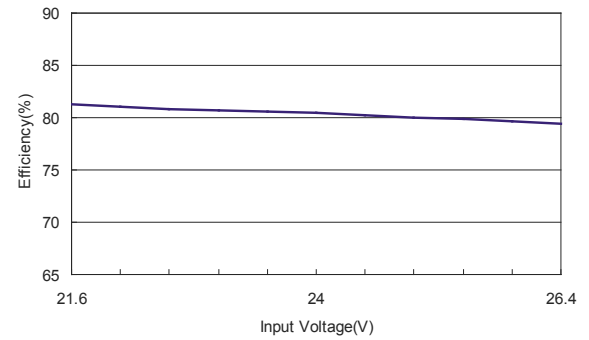
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

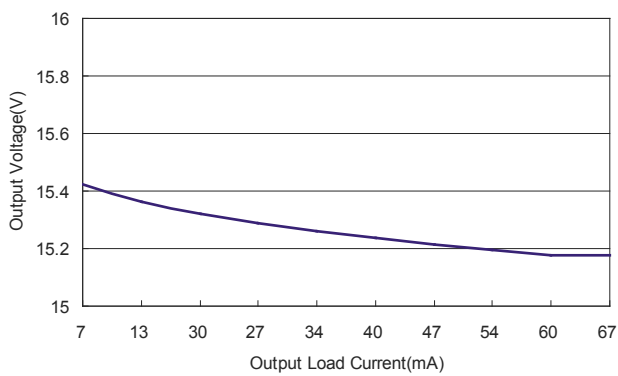
All test conditions are at 25°C The figures are identical for TMA 2415S



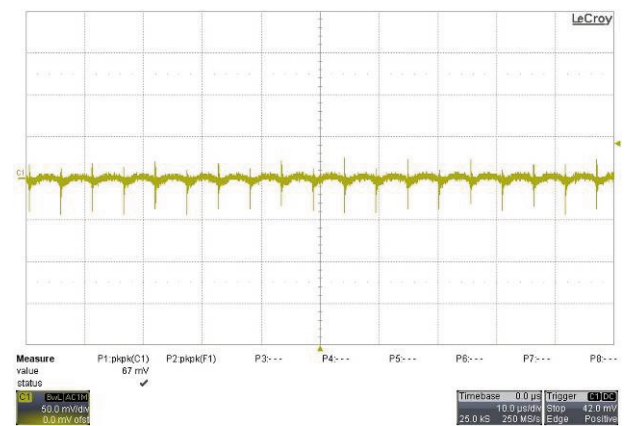
Efficiency Versus Output Current



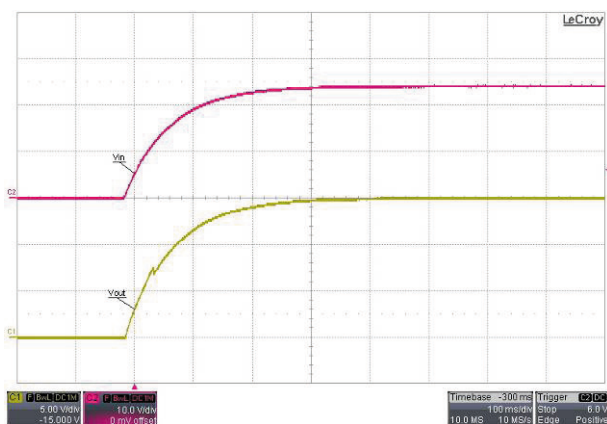
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



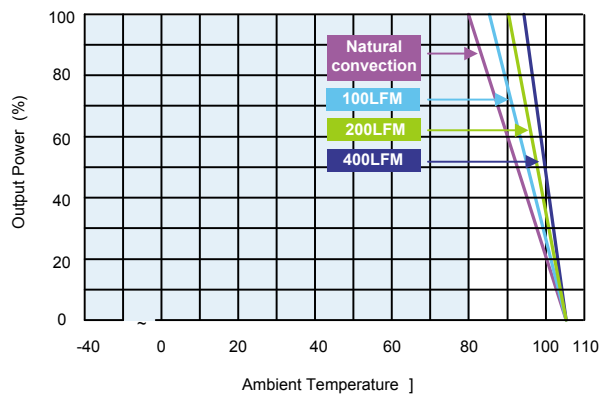
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



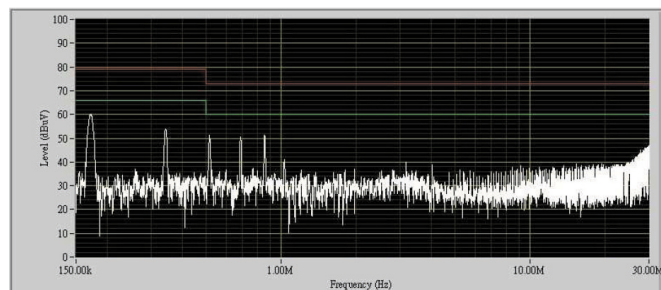
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2415S (Continued)



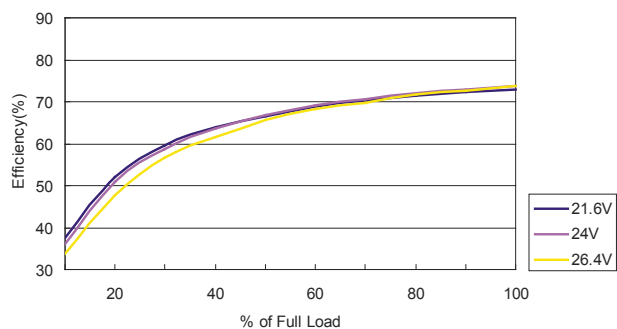
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



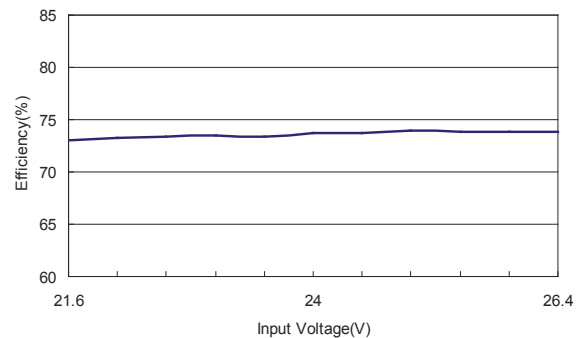
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

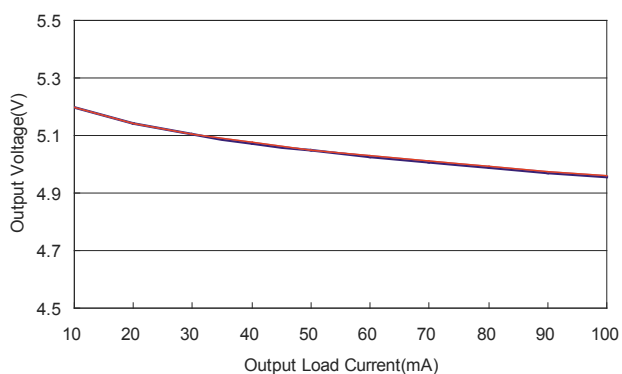
All test conditions are at 25°C The figures are identical for TMA 2405D



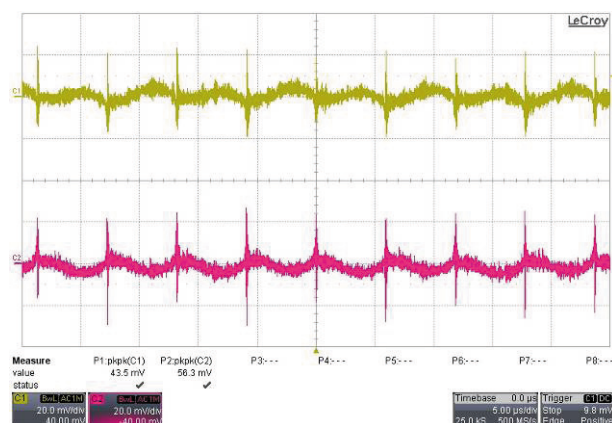
Efficiency Versus Output Current



Efficiency Versus Input Voltage. Full Load

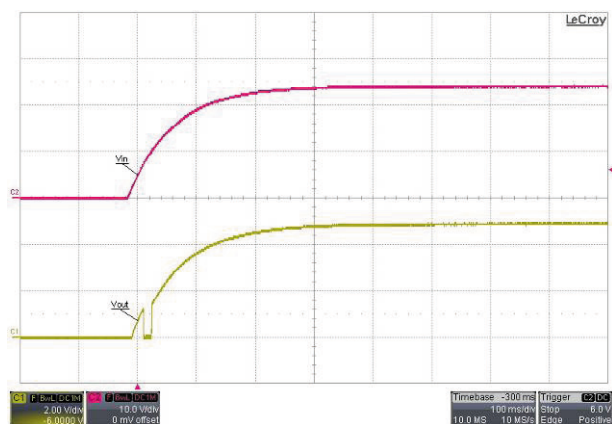


Output Voltage Versus Output Current



Typical Output Ripple and Noise.

$V_{in} = V_{in\ nom}$; Full Load; T_A

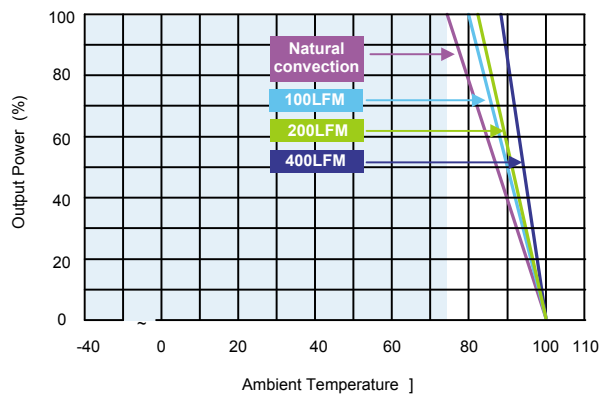


Typical Input Start-Up and Output Rise Characteristic

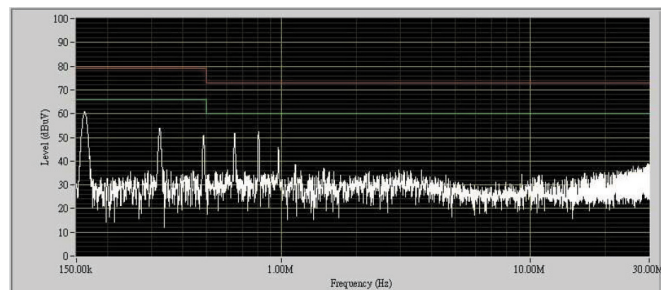
$V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2405D (Continued)



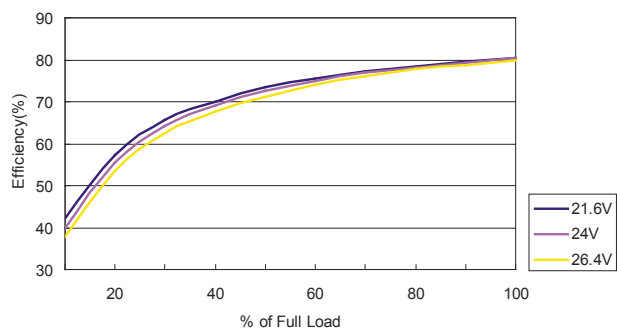
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



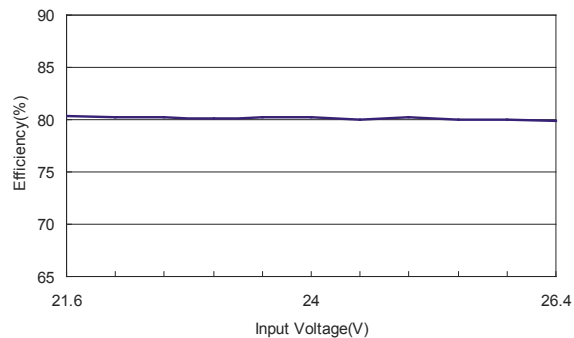
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

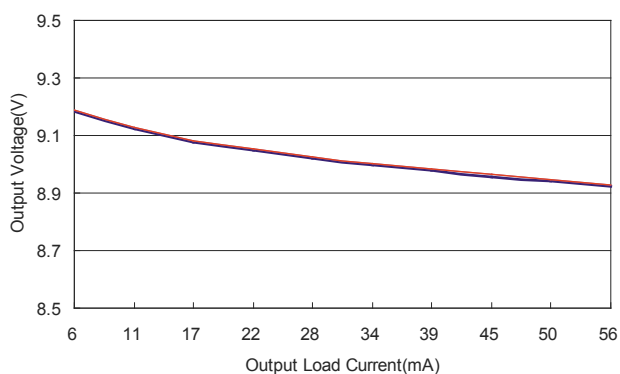
All test conditions are at 25°C The figures are identical for TMA 2409D



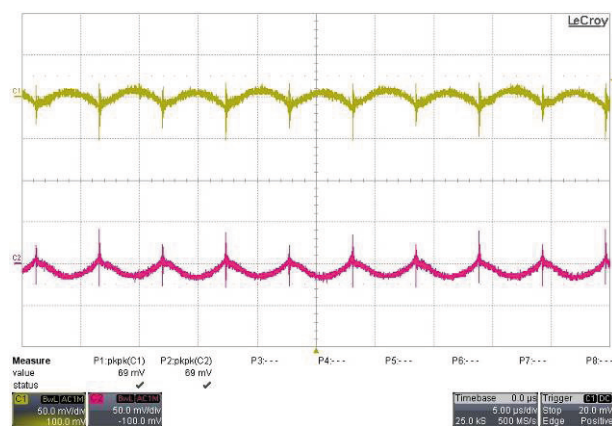
Efficiency Versus Output Current



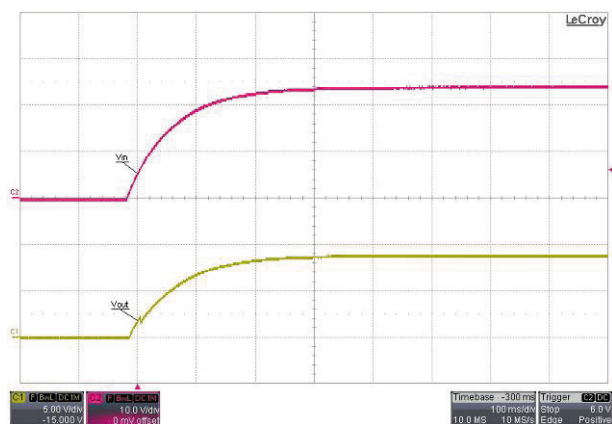
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



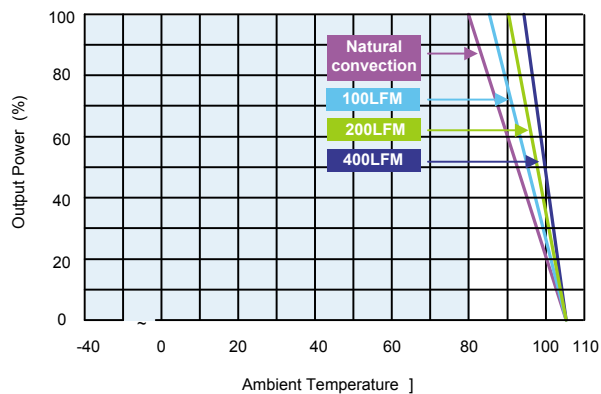
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



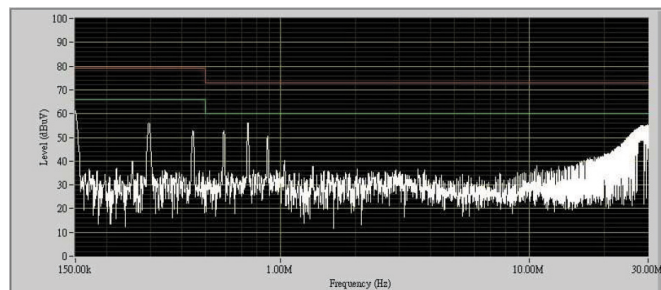
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2409D (Continued)



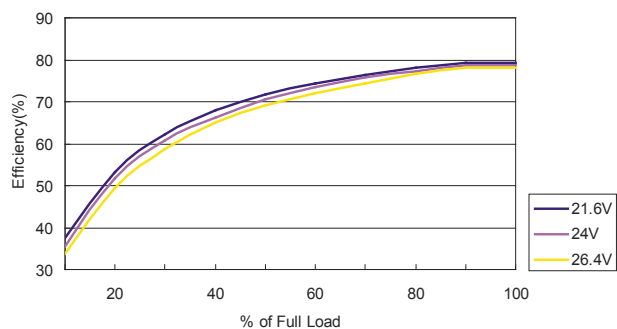
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



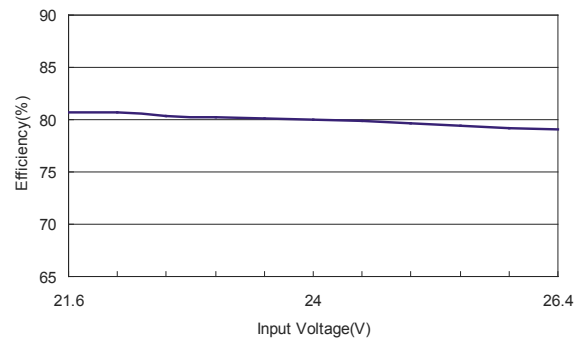
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

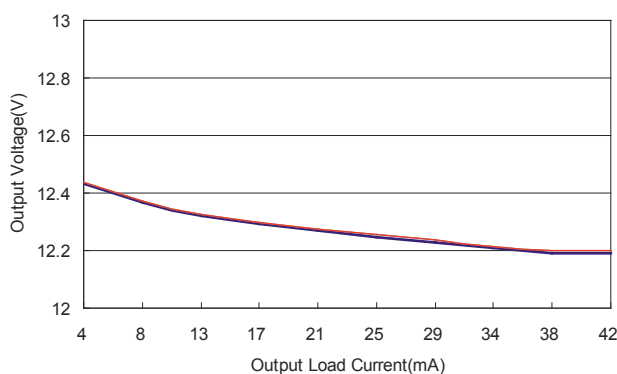
All test conditions are at 25°C The figures are identical for TMA 2412D



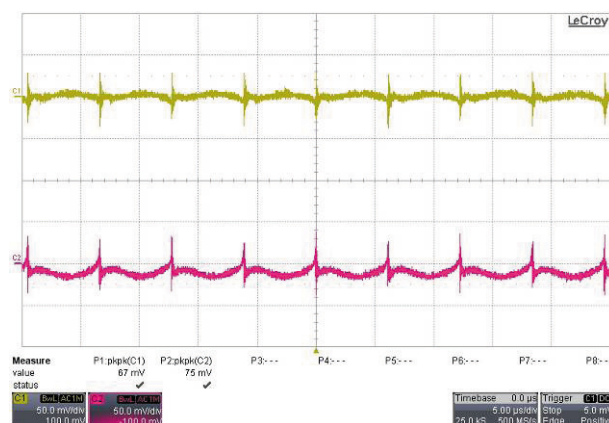
Efficiency Versus Output Current



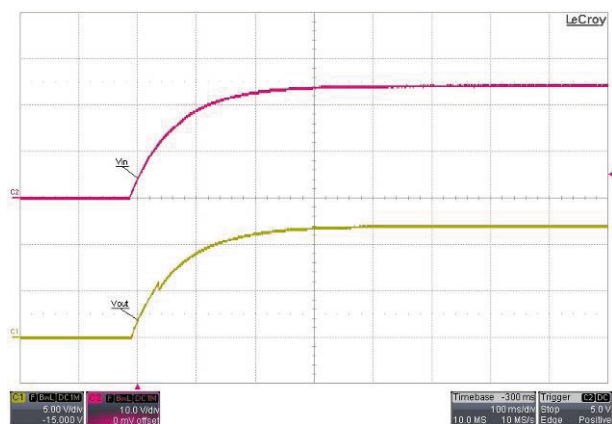
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



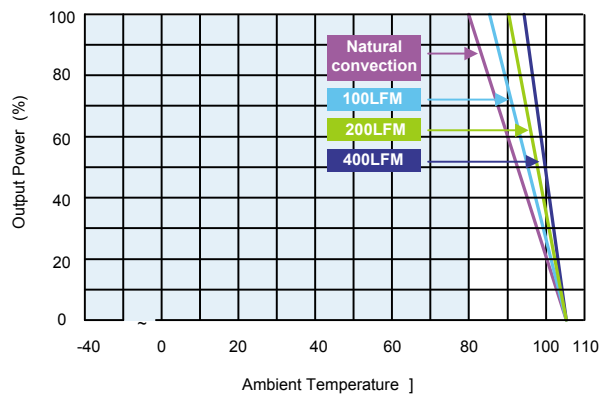
Typical Output Ripple and Noise.
 $V_{in} = V_{in\ nom}$; Full Load; T_A



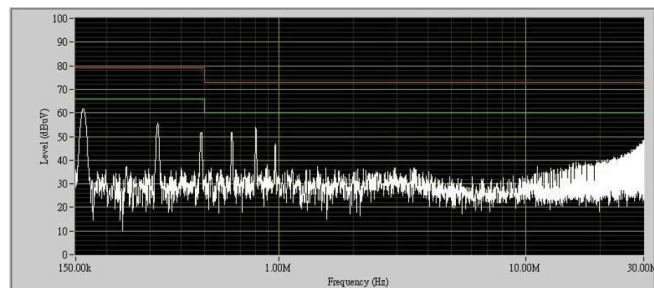
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in\ nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2412D (Continued)



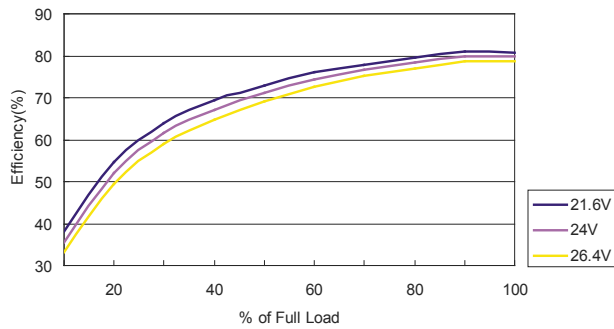
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



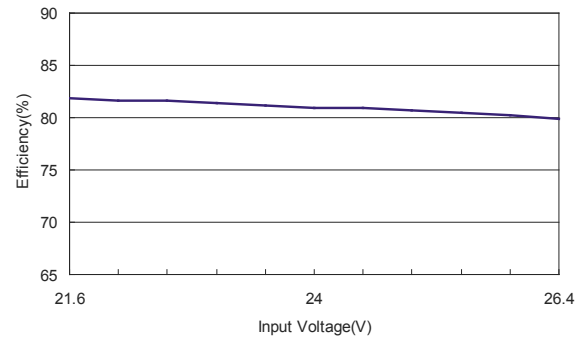
Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

Characteristic Curves

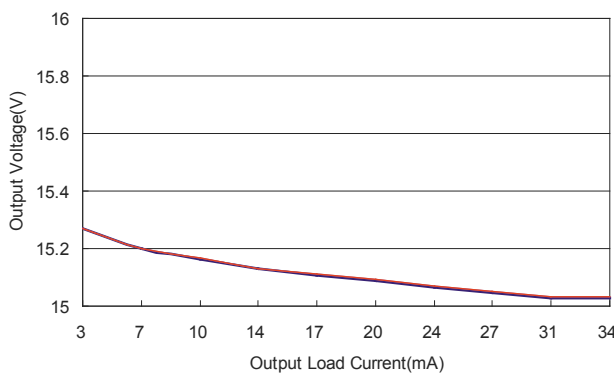
All test conditions are at 25°C The figures are identical for TMA 2415D



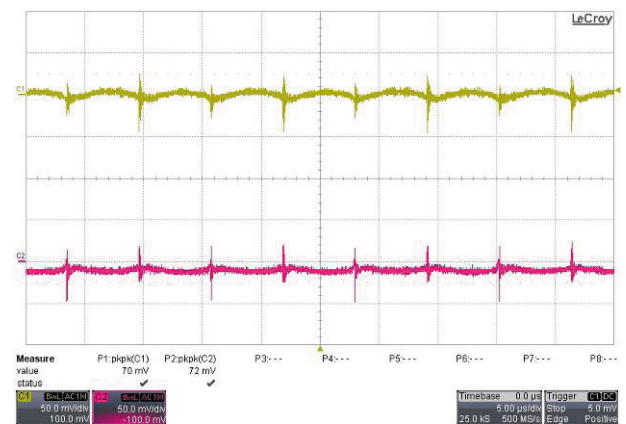
Efficiency Versus Output Current



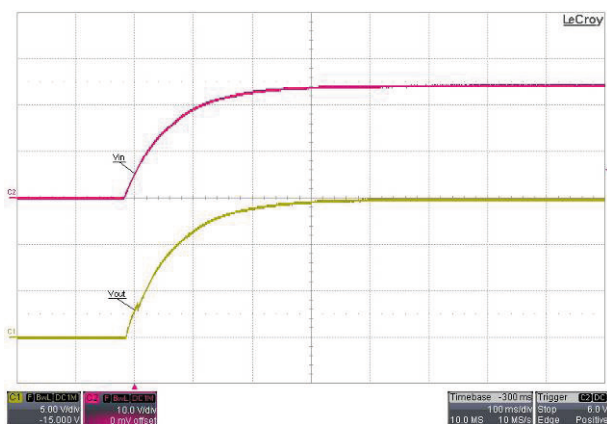
Efficiency Versus Input Voltage. Full Load



Output Voltage Versus Output Current



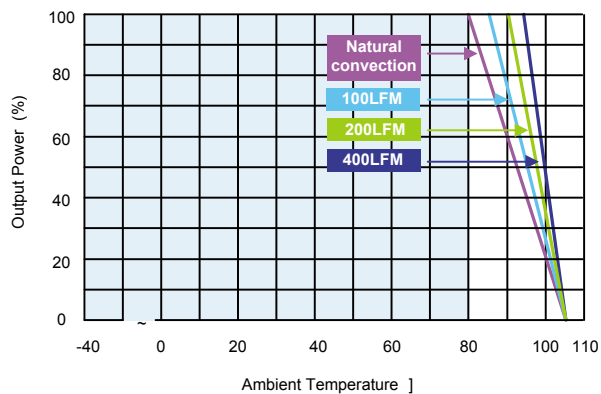
Typical Output Ripple and Noise.
 $V_{in} = V_{in nom}$; Full Load; T_A



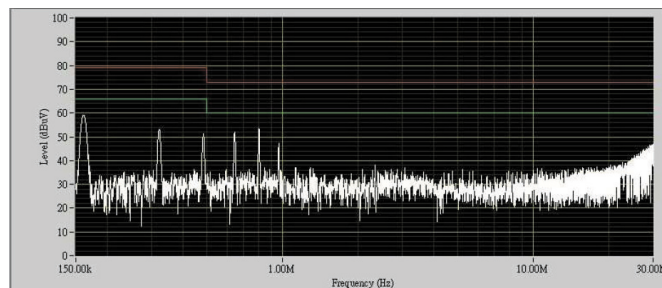
Typical Input Start-Up and Output Rise Characteristic
 $V_{in} = V_{in nom}$; Full Load

Characteristic Curves

All test conditions are at 25°C The figures are identical for TMA 2415D (Continued)



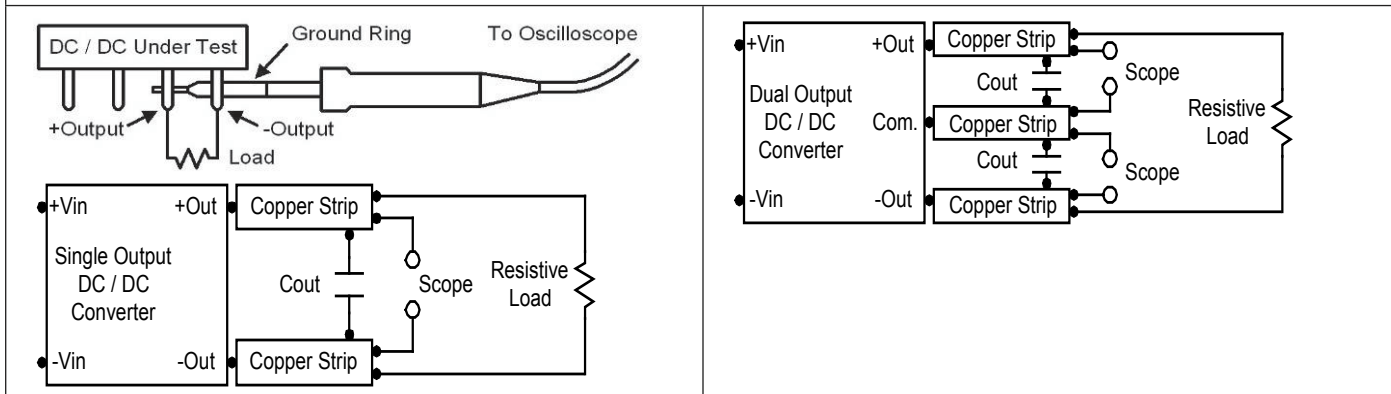
Derating Output Current Versus Ambient Temperature and Airflow
 $V_{in} = V_{in\ nom}$



Conduction Emission of EN55022 Class A
 $V_{in} = V_{in\ nom}$; Full Load (See Page 73)

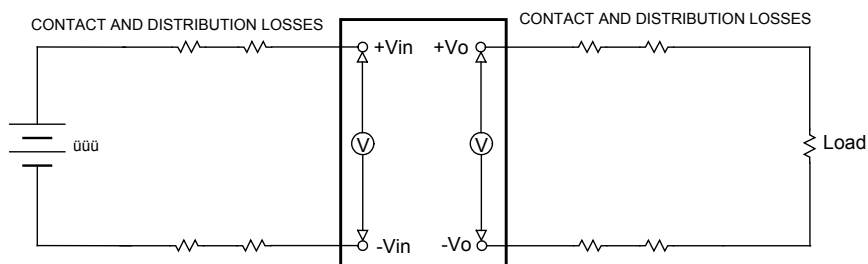
Testing Configurations

Peak-to-peak output ripple & noise measurement test up

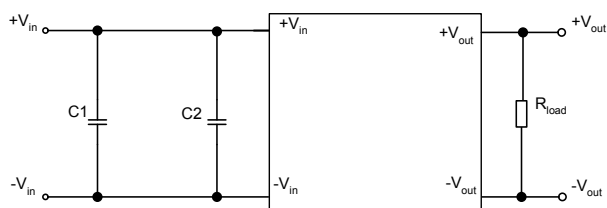


Output voltage and efficiency measurement test up

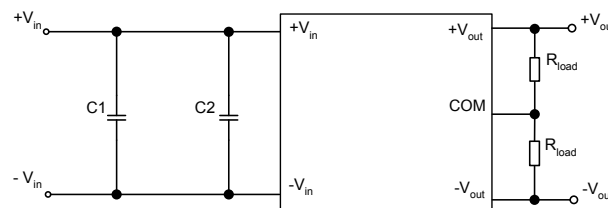
$$Efficiency = \left(\frac{V_{out} \times I_{out}}{V_{in} \times I_{in}} \right) \times 100\% = [\%]$$



EMC considerations

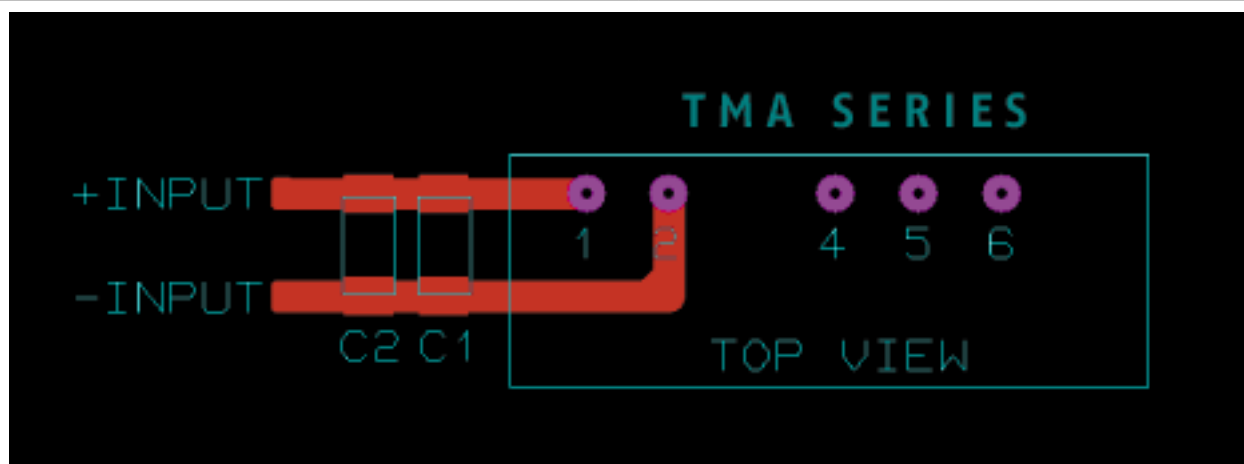


Single Output



Dual Output

Recommended circuit to comply EN55022 Class A Limits



Recommended PCB Layout with Input Filter

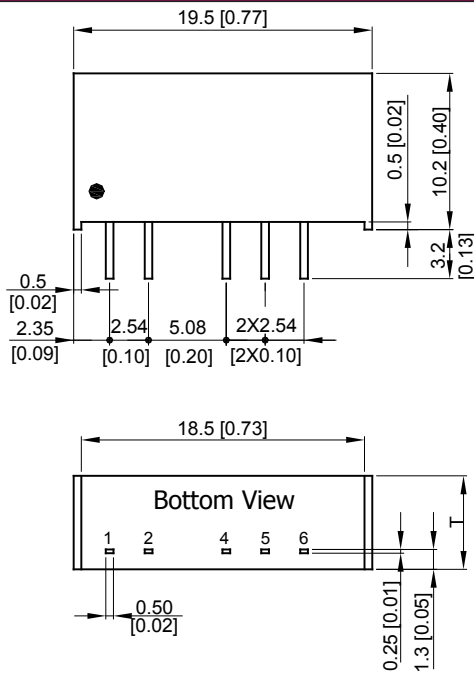
To: comply with EN55022 CLASS A following components are needed:

Model	Component	Value
TMA 05xx	C1	4.7 μ F/16V 1206 MLCC
TMA 12xx	C1	10 μ F/25V 1206 MLCC
TMA 15xx	C1,C2	4.7 μ F/50V 1206 MLCC
TMA 24xx	C1,C2	4.7 μ F/50V 1206 MLCC

Input Source Impedance

The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module. In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.

Capacitor mounted close to the power module helps ensure stability of the unit, it is commended to use a good quality low Equivalent Series Resistance (ESR < 1.0 Ω at 100 KHz) capacitor of a 2.2 μ F for the 5V input devices, a 1.0 μ F for the 12V, 15V input devices and a 0.47 μ F for the 24V devices.

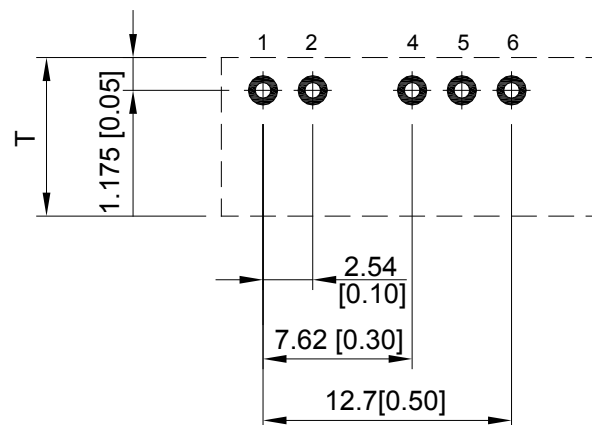
Mechanical Dimensions

Pin Connections

Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
4	-Vout	-Vout
5	No Pin	Common
6	+Vout	+Vout

T: 6.1mm(0.24 inch) for 5V&12V Input Models
T: 7.1mm(0.28 inch) for 15V&24V Input Models

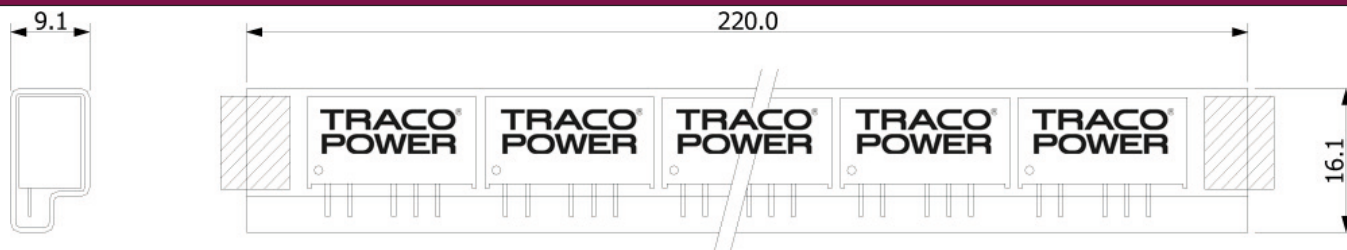
- All dimensions in mm (inches)
Tolerance: X.X±0.25 (X.XX±0.01")
X.XX±0.13 (X.XXX±0.005")
- Pin dimension tolerance: ±0.1 (±0.004")

Weight (5V&12V Input): 2.2g
Weight (15V&24V Input): 2.6g

Recommended Pad Layout for Single & Dual Output Converter


- All dimensions in Inches (mm)
Tolerance: x.xx±0.02" (x.x ±0.5mm)
x.xxx±0.01" (x.xx ±0.25mm)
- Pin pitch tolerance: ±0.01" (±0.25mm)
- Pin dimension tolerance: ±0.004" (±0.1mm)

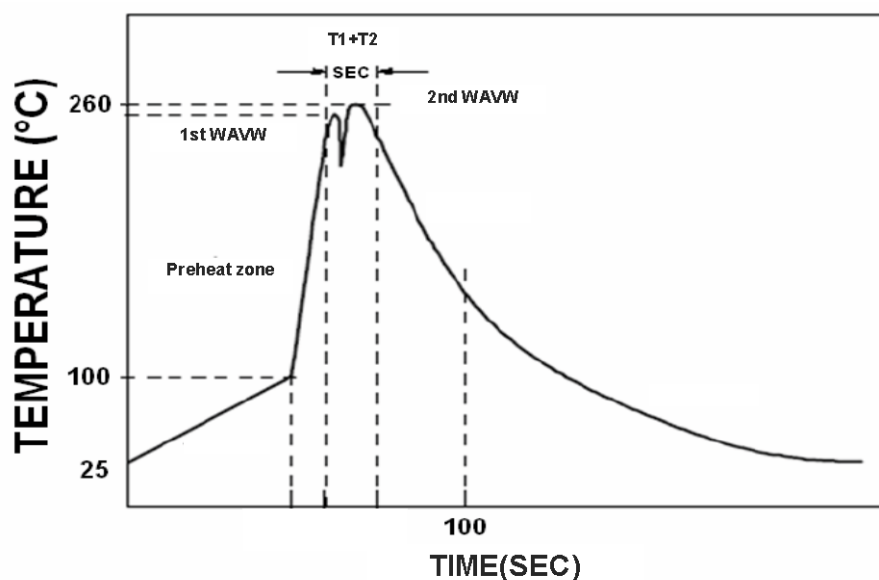
Packaging Information



Unit : mm
10 PCS per TUBE

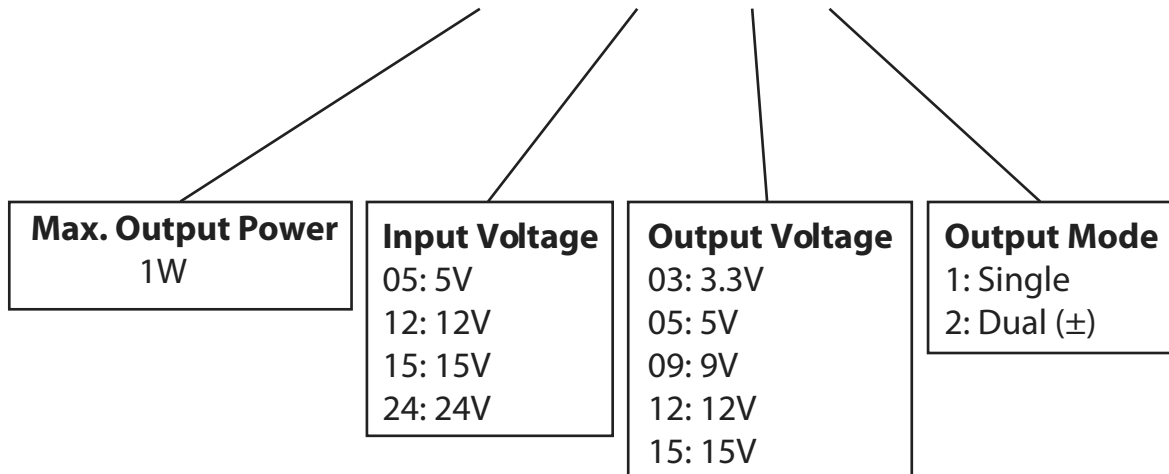
Soldering and Reflow Considerations

Lead free wave solder profile for TMA Series



Part Number Structure

TMA 2412S



Model Number	Input Range (VDC)	Output Voltage (VDC)	Max. Output Current (mA)	Input Current at Full Load ⁽¹⁾ (mA)	Efficiency ⁽²⁾ (%)
TMA 0503S	4.5-5.5	3.3	260	235	73
TMA 0505S	4.5-5.5	5	200	281	71
TMA 0509S	4.5-5.5	9	110	260	76
TMA 0512S	4.5-5.5	12	84	258	78
TMA 0515S	4.5-5.5	15	67	258	78
TMA 0505D	4.5-5.5	±5	±100	278	72
TMA 0509D	4.5-5.5	±9	±56	262	77
TMA 0512D	4.5-5.5	±12	±42	258	78
TMA 0515D	4.5-5.5	±15	±34	258	79
TMA 1203S	10.8-13.2	3.3	260	96	74
TMA 1205S	10.8-13.2	5	200	114	73
TMA 1209S	10.8-13.2	9	110	106	78
TMA 1212S	10.8-13.2	12	84	105	80
TMA 1215S	10.8-13.2	15	67	104	80
TMA 1205D	10.8-13.2	±5	±100	113	74
TMA 1209D	10.8-13.2	±9	±56	106	79
TMA 1212D	10.8-13.2	±12	±42	104	81
TMA 1215D	10.8-13.2	±15	±34	105	81
TMA 1505S	13.5-16.5	5	200	93	72
TMA 1512S	13.5-16.5	12	84	85	79
TMA 1515S	13.5-16.5	15	67	85	79
TMA 1505D	13.5-16.5	±5	±100	93	72
TMA 1512D	13.5-16.5	±12	±42	85	80
TMA 1515D	13.5-16.5	±15	±34	85	80
TMA 2403S	21.6-26.4	3.3	260	49	73
TMA 2405S	21.6-26.4	5	200	59	71
TMA 2409S	21.6-26.4	9	110	54	76
TMA 2412S	21.6-26.4	12	84	54	78
TMA 2415S	21.6-26.4	15	67	53	79
TMA 2405D	21.6-26.4	±5	±100	58	72
TMA 2409D	21.6-26.4	±9	±56	55	76
TMA 2412D	21.6-26.4	±12	±42	53	79
TMA 2415D	21.6-26.4	±15	±34	53	80

Note 1. Maximum value at nominal input voltage and full load of standard type.

Note 2. Typical value at nominal input voltage and full load.

Safety and Installation Instruction
Fusing Consideration

Caution: This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a normal-blow fuse in 5Vin with maximum rating of 500mA, in 12Vin with maximum rating of 200mA, in 15Vin with maximum rating of 150mA and in 24Vin with maximum rating of 100mA. Based on the information provided in this data sheet on Inrush energy and maximum dc input current; the same type of fuse with lower rating can be used. Refer to the fuse manufacturer's data for further information.

The MTBF of TMA series of DC/DC converters has been calculated using MIL-HDBK 217F NOTICE2, Operating Temperature 25°C, Ground Benign.

Model	MTBF	Unit
TMA 0503S	5,992,510	Hours
TMA 0505S	5,780,347	
TMA 0509S	4,212,743	
TMA 0512S	2,928,258	
TMA 0515S	2,393,776	
TMA 0505D	5,641,749	
TMA 0509D	4,253,057	
TMA 0512D	3,013,182	
TMA 0515D	2,466,852	
TMA 1203S	6,033,182	
TMA 1205S	5,818,182	
TMA 1209S	4,232,804	
TMA 1212S	2,937,936	
TMA 1215S	2,400,240	
TMA 1205D	5,677,786	
TMA 1209D	4,273,504	
TMA 1212D	3,023,431	
TMA 1215D	2,473,717	
TMA 1505S	2,122,579	
TMA 1512S	2,237,762	
TMA 1515S	2,353,634	
TMA 1505D	2,237,762	
TMA 1512D	2,351,558	
TMA 1515D	2,351,558	
TMA 2403S	5,494,506	
TMA 2405S	5,315,614	
TMA 2409S	3,960,396	
TMA 2412S	2,804,066	
TMA 2415S	2,310,136	
TMA 2405D	5,198,181	
TMA 2409D	3,996,004	
TMA 2412D	2,881,844	
TMA 2415D	2,378,122	

Specifications can be changed without notice