

## TRA 1 Series

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

### Features

- ▶ Standard SIP-7 Package
- ▶ Semi-regulated Output Voltage
- ▶ High Efficiency to 88.5%
- ▶ I/O-isolation 1000VDC
- ▶ Operating Temp. Range -40°C to +85°C
- ▶ UL/IEC/EN 60950-1 Safety (Approval pending)
- ▶ Industry Standard Pinout
- ▶ 3 Years Product Warranty



### Applications

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

### General Description

The TRACO TRA 1 series is a new range of isolated 1W DC/DC converter modules in a small SIP-package. There are 24 models available with 5V, 12V or 24VDC input and single-or dual-output voltages. These products provide have a typical load regulation of 2.5% to 5.0% depending on model.

The TRA1 DC/DC converters are a compromise between a more expensive fully regulated converter and a non-regulated converter. They offer the designer a new solution for many cost critical applications where the output voltage variation has to be kept in a certain limit under all load conditions.

### Table of contents

Absolute Maximum Rating.....	P2	Mechanical Data.....	P32
Output Specification.....	P2	Recommended Pad Layout Single & Dual	P32
Input Specification.....	P3	Packaging Information.....	P33
General Specification.....	P5	Soldering and Reflow Consideration.....	P33
Characteristic Curves.....	P6	Part Number Structure.....	P34
Testing Configurations.....	P30	Safety and Installation Instruction.....	P35
EMC Considerations.....	P31	MTBF and Reliability.....	P35
Input Source Impedance.....	P31		

<b>Absolute Maximum Rating</b>				
<b>Parameter</b>	<b>Model</b>	<b>Min</b>	<b>Max</b>	<b>Unit</b>
Input Voltage Input Surge Voltage ( 1 sec. )	5VDC Input Models 12VDC Input Models 24VDC Input Models	-0.7 -0.7 -0.7	9 18 30	VDC
Operating Ambient Temperature Without Derating	All	-40	+85	°C
Operating Case Temperature	All	---	+90	°C
Storage Temperature	All	-50	+125	°C

<b>Output Specification</b>					
<b>Parameter</b>	<b>Model</b>	<b>Min</b>	<b>Nominal</b>	<b>Max</b>	<b>Unit</b>
Output Regulation Line ( $V_{in\ min}$ to $V_{in\ max}$ at Full Load)			±1.05	±1.2	%
Output Regulation Load (20% to 100% of Full Load)	TRA 1-0511 TRA 1-0519 TRA 1-0512 TRA 1-0513 TRA 1-0521 TRA 1-0522 TRA 1-0523			6.5 5 5.2 5 5.2 4.6 4.5	%
	TRA 1-1211 TRA 1-1219 TRA 1-1212 TRA 1-1213 TRA 1-1221 TRA 1-1222 TRA 1-1223			5 3.4 3.4 2.7 3.9 2.9 2.6	
	TRA 1-2411 TRA 1-2419 TRA 1-2412 TRA 1-2413 TRA 1-2421 TRA 1-2422 TRA 1-2423			3.7 2.5 2.4 2.3 3.7 2.4 2.3	

Output Specification					
Parameter	Model	Min	Nominal	Max	Unit
Output Ripple & Noise Peak-to-Peak (5Hz to 20MHz bandwidth)			30	60	mV pk-pk
Temperature Coefficient	All		±0.01	±0.02	%/°C
Output Current	TRA 1-XX11	4		200	mA
	TRA 1-XX19	2		110	
	TAR 1-XX12	1.5		84	
	TRA 1-XX13	1		67	
	TRA 1-XX21	±2		±100	
	TRA 1-XX22	±0.8		±42	
	TRA 1-XX23	±0.7		±34	
Output Short Circuit Protection	All	0.5 Second Max.			

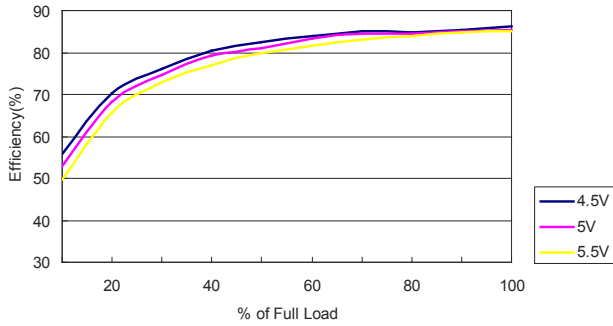
Input Specification					
Parameter	Model	Min	Nominal	Max	Unit
Operating Input Voltage	5V Input Models	4.5	5	5.5	VDC
	12V Input Models	10.8	12	13.2	
	24V Input Models	21.6	24	26.4	
Input Current (Maximum value at $V_{in} = V_{in\ nom}$ ; Full Load)	TRA 1-0511		238		mA
	TRA 1-0519		228		
	TRA 1-0512		232		
	TRA 1-0513		230		
	TRA 1-0521		237		
	TRA 1-0522		233		
	TRA 1-0523		236		
	TRA 1-1211		99		
	TRA 1-1219		95		
	TRA 1-1212		95		
	TRA 1-1213		95		
	TRA 1-1221		99		
	TRA 1-1222		95		
	TRA 1-1223		94		
	TRA 1-2411		50		
	TRA 1-2419		48		
	TRA 1-2412		48		
	TRA 1-2413		48		
	TRA 1-2421		50		
	TRA 1-2422		48		
	TRA 1-2423		49		

<b>Input Specification</b>					
<b>Parameter</b>	<b>Model</b>	<b>Min</b>	<b>Nominal</b>	<b>Max</b>	<b>Unit</b>
Input Standby Current (Typical value at $V_{in} = V_{in,nom}$ ; No Load)	TRA 1-0511				mA
	TRA 1-0519				
	TRA 1-0512				
	TRA 1-0513		30		
	TRA 1-0521				
	TRA 1-0522				
	TRA 1-0523				
	TRA 1-1211				
	TRA 1-1219				
	TRA 1-1212				
	TRA 1-1213		12		
	TRA 1-1221				
	TRA 1-1222				
	TRA 1-1223				
	TRA 1-2411				
	TRA 1-2419				
	TRA 1-2412				
	TRA 1-2413			11	
	TRA 1-2421				
	TRA 1-2422				
	TRA 1-2423				

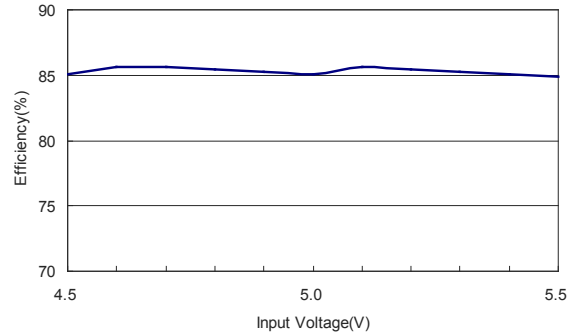
<b>General Specification</b>					
<b>Parameter</b>	<b>Model</b>	<b>Min</b>	<b>Nominal</b>	<b>Max</b>	<b>Unit</b>
Efficiency ( $V_{in} = V_{in\ nom}$ ; Full Load; $T_A = 25^\circ\text{C}$ )	TRA 1-0511		84		%
	TRA 1-0519		87		
	TRA 1-0512		87		
	TRA 1-0513		87.5		
	TRA 1-0521		84.5		
	TRA 1-0522		86.5		
	TRA 1-0523		86.5		
	TRA 1-1211		84		
	TRA 1-1219		86.5		
	TRA 1-1212		88.5		
	TRA 1-1213		88		
	TRA 1-1221		84.5		
	TRA 1-1222		88.5		
	TRA 1-1223		87.5		
	TRA 1-2411		84		
	TRA 1-2419		86.5		
	TRA 1-2412		87.5		
	TRA 1-2413		87.5		
	TRA 1-2421		83.5		
	TRA 1-2422		87		
	TRA 1-2423		87		
Isolation Voltage Input to Output (for 60 seconds)		1000			VDC
Isolation Resistance	All	1000			MΩ
Isolation Capacitance		40	60	120	pF
Switching Frequency		50	100	120	KHz
MTBF MIL-STD-217F, TC=25°C		2,000,000			Hours

**Characteristic Curves**

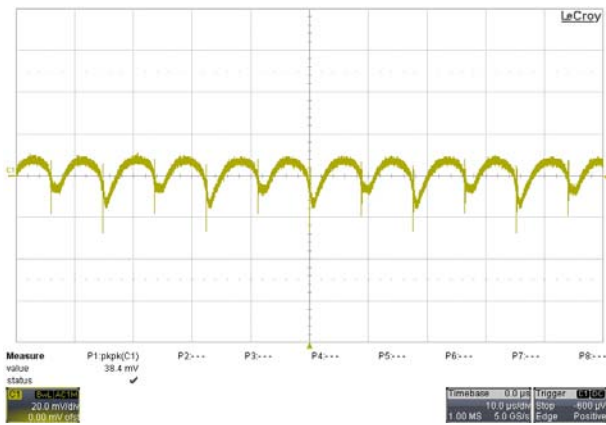
All test conditions are at 25°C The figures are identical for TRA 1-0511



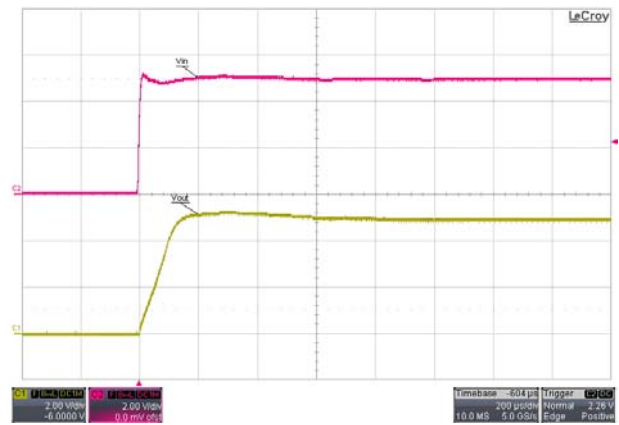
Efficiency Versus Output Current



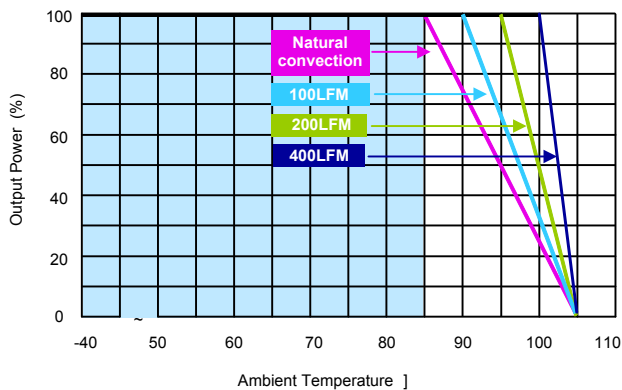
Efficiency Versus Input Voltage. Full Load



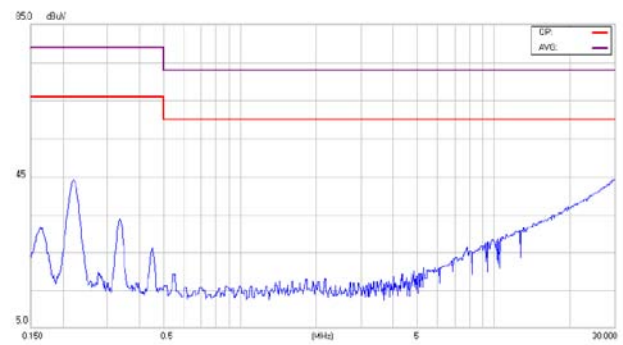
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



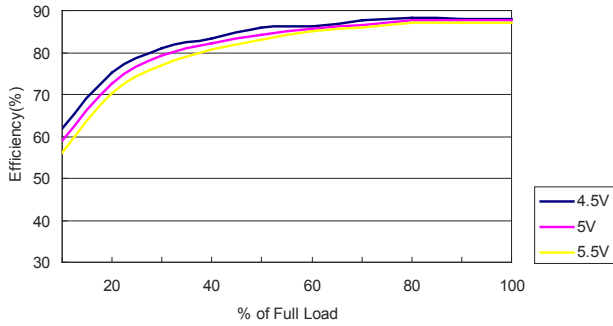
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



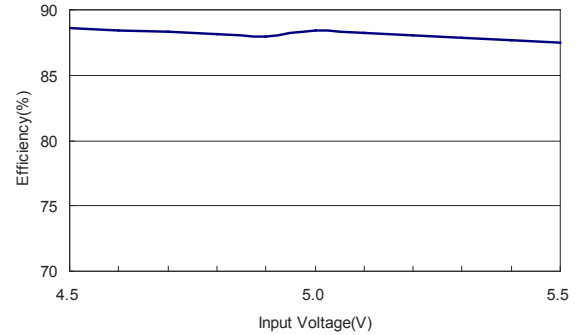
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

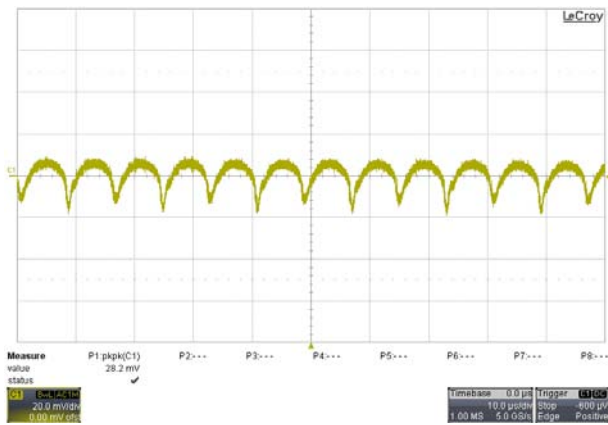
All test conditions are at 25°C The figures are identical for TRA 1-0519



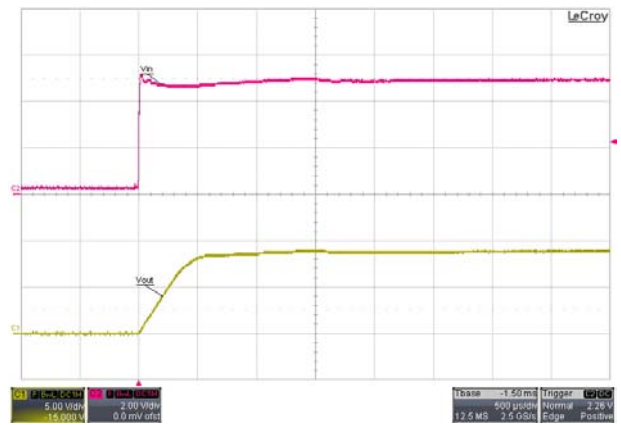
Efficiency Versus Output Current



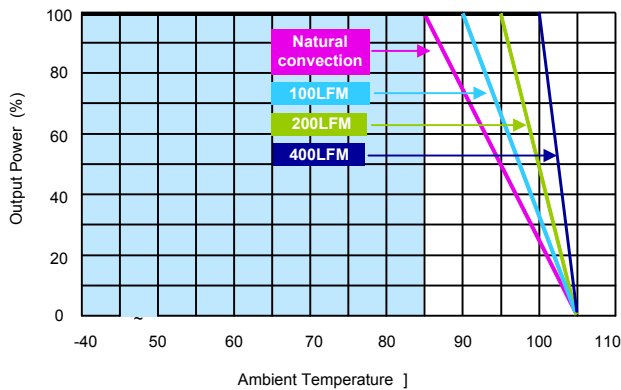
Efficiency Versus Input Voltage. Full Load



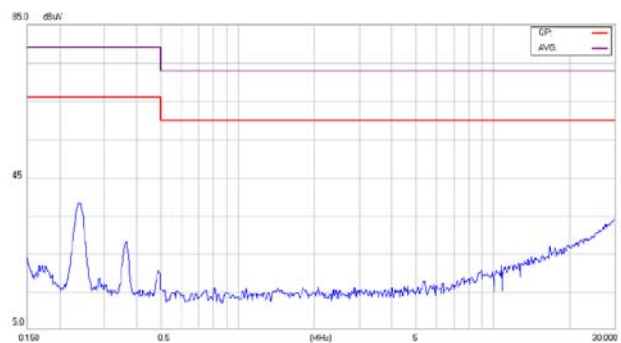
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



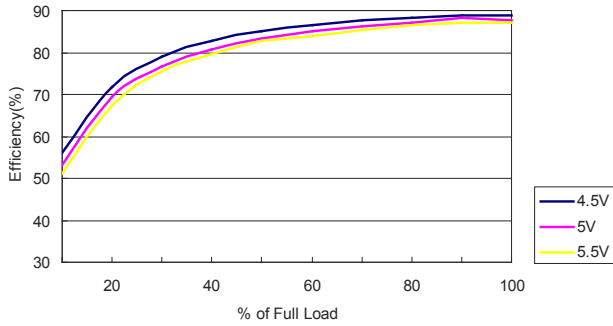
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



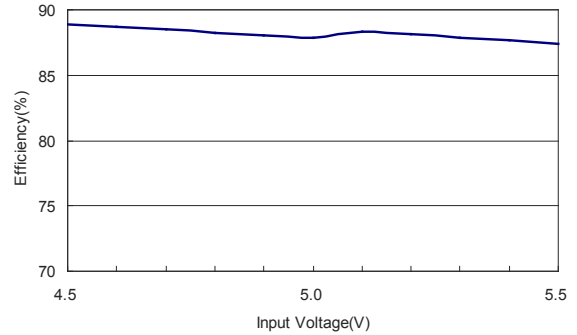
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

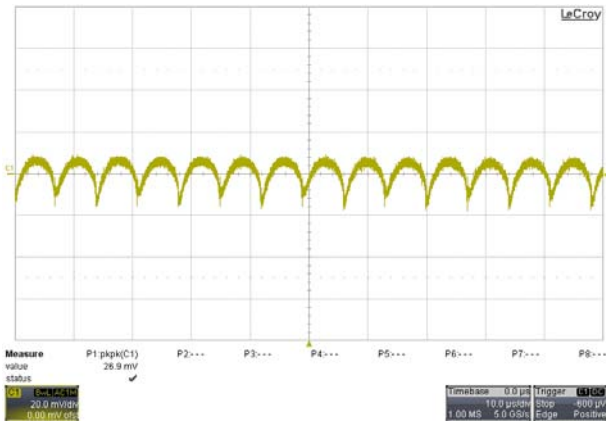
All test conditions are at 25°C The figures are identical for TRA 1-0512



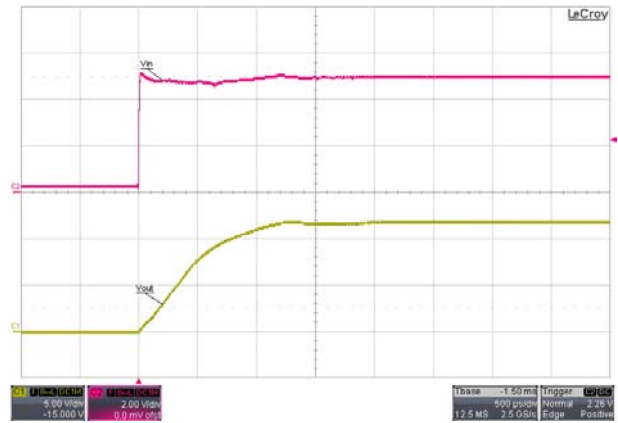
Efficiency Versus Output Current



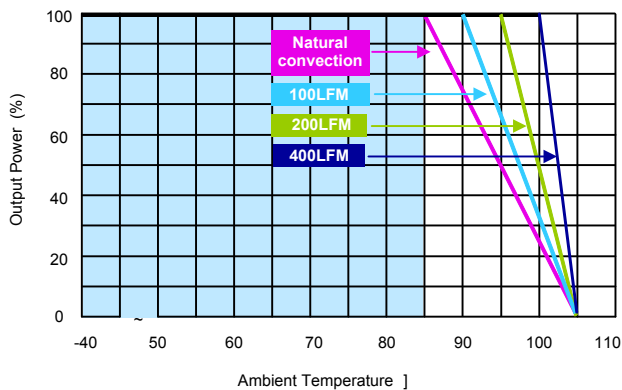
Efficiency Versus Input Voltage. Full Load



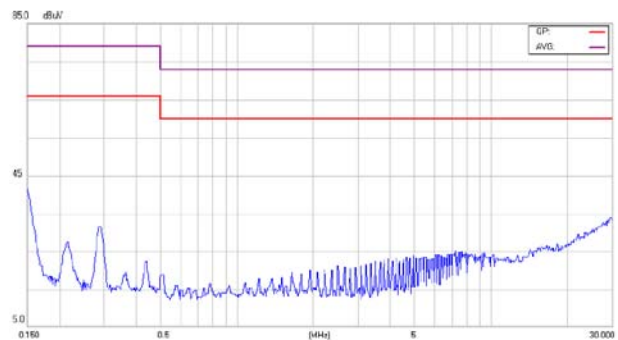
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



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

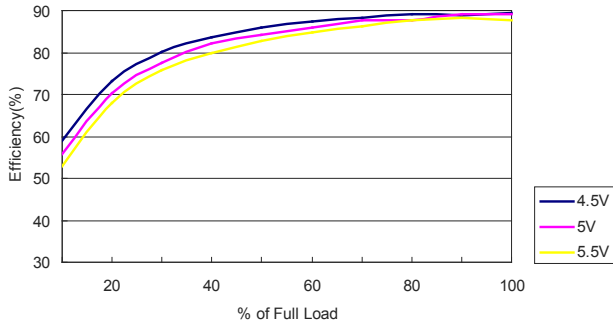


Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

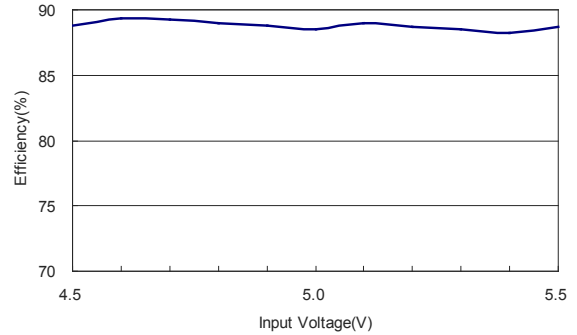


**Characteristic Curves**

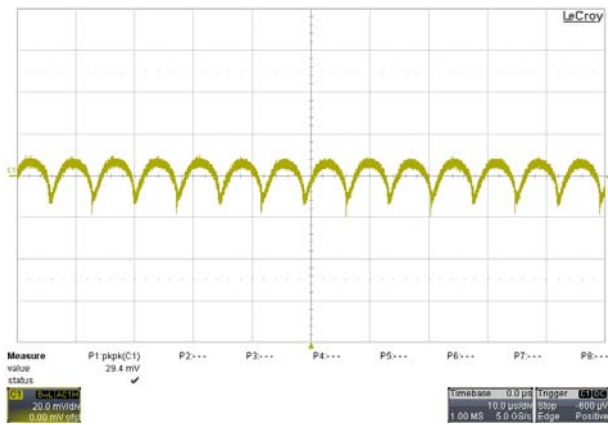
All test conditions are at 25°C The figures are identical for TRA 1-0513



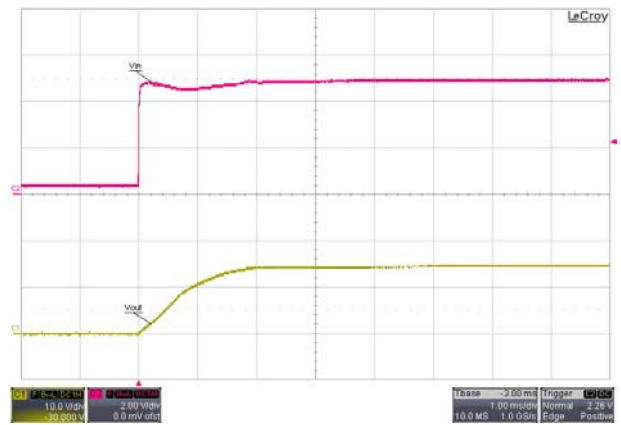
Efficiency Versus Output Current



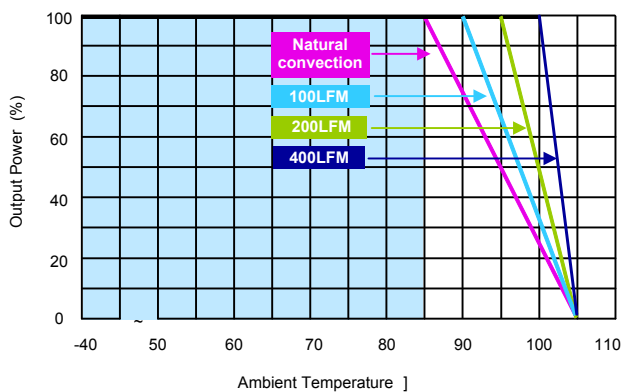
Efficiency Versus Input Voltage. Full Load



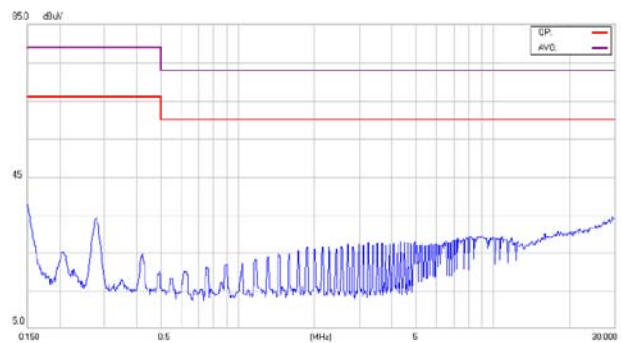
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



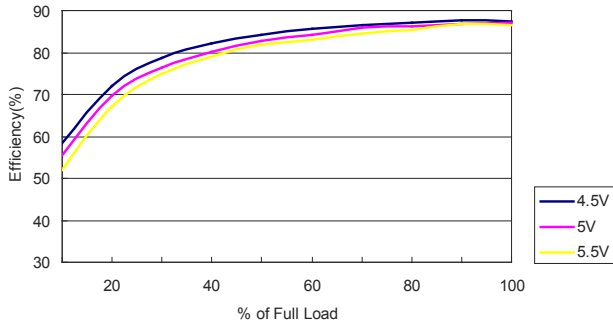
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



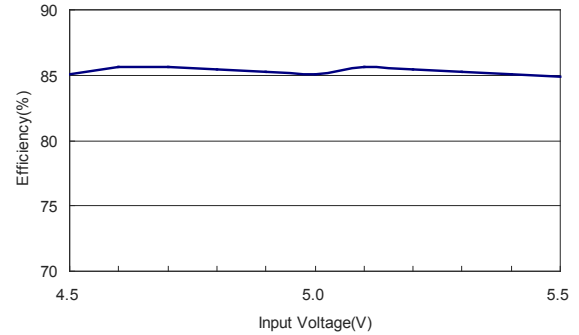
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

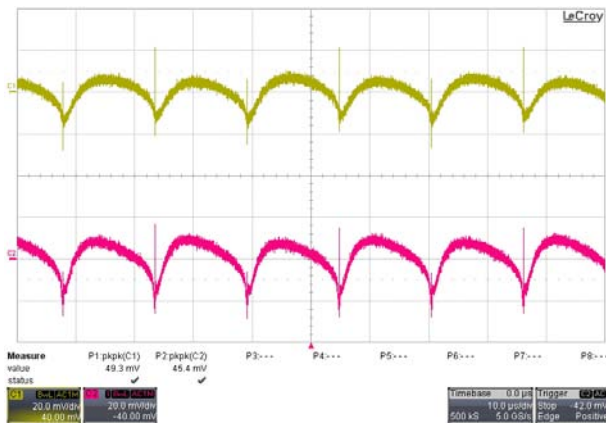
All test conditions are at 25°C The figures are identical for TRA 1-0521



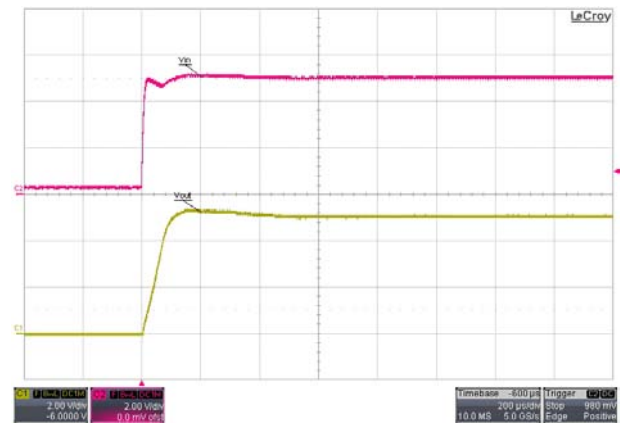
Efficiency Versus Output Current



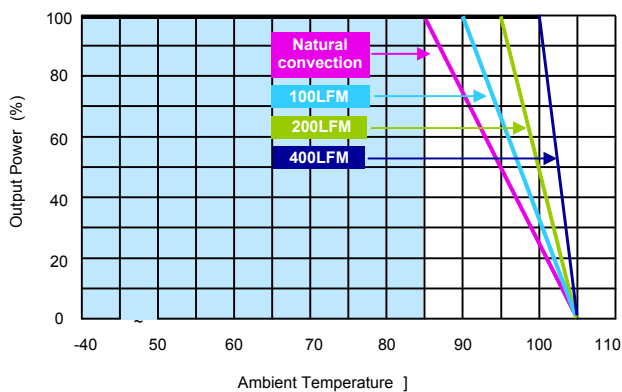
Efficiency Versus Input Voltage. Full Load



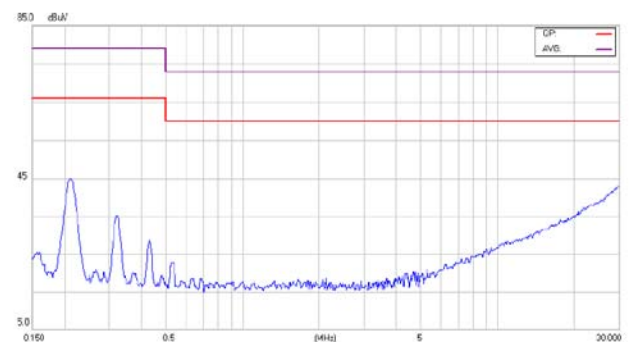
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



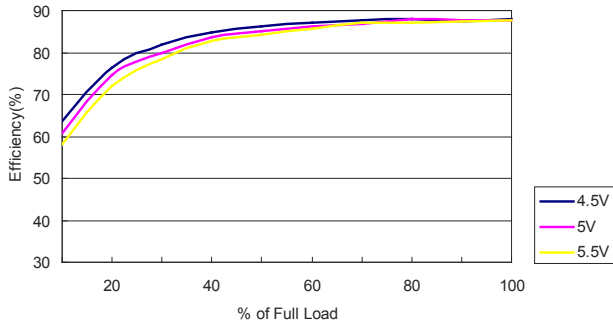
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



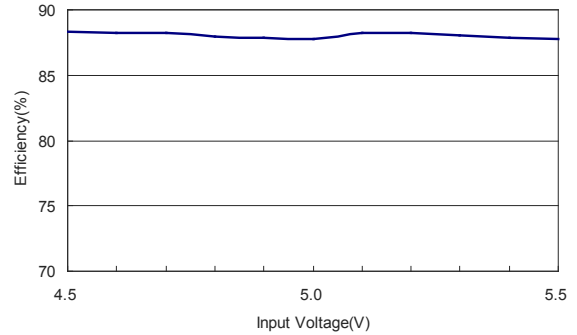
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

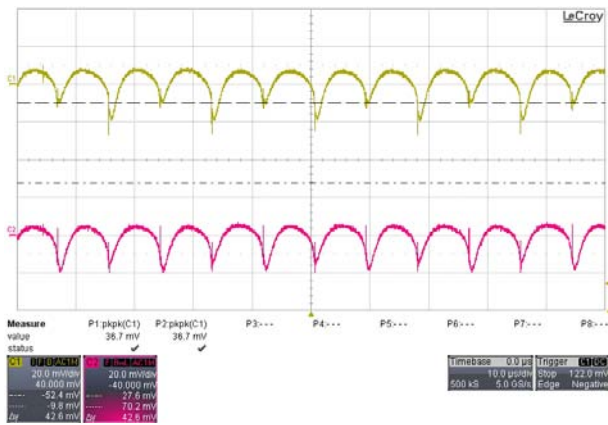
All test conditions are at 25°C The figures are identical for TRA 1-0524



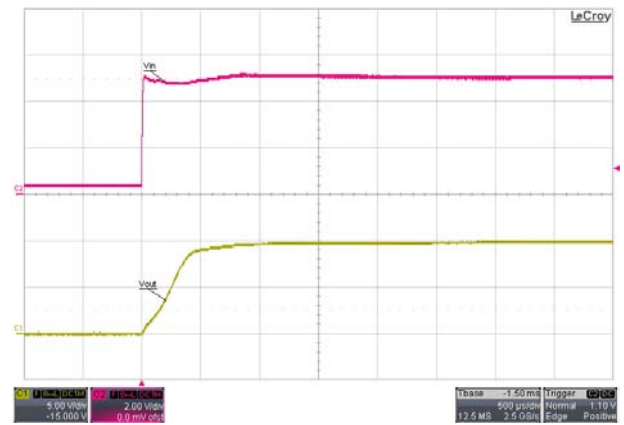
Efficiency Versus Output Current



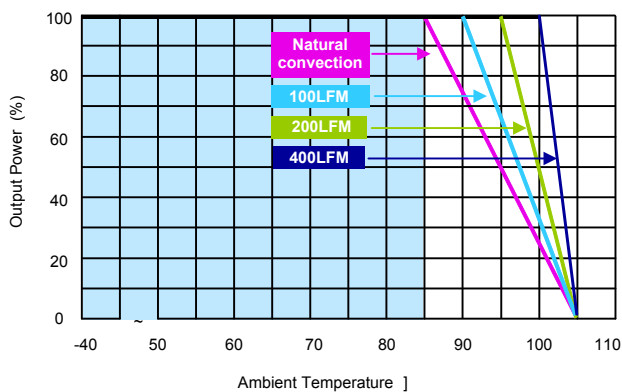
Efficiency Versus Input Voltage. Full Load



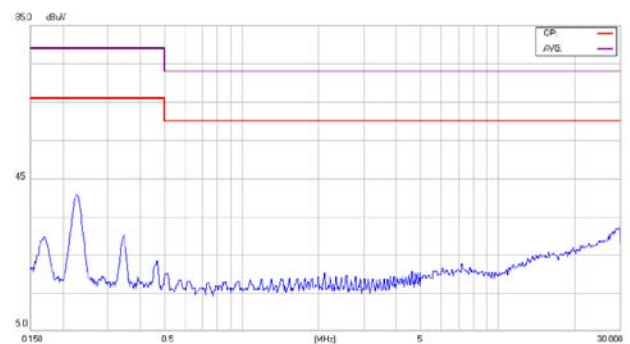
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



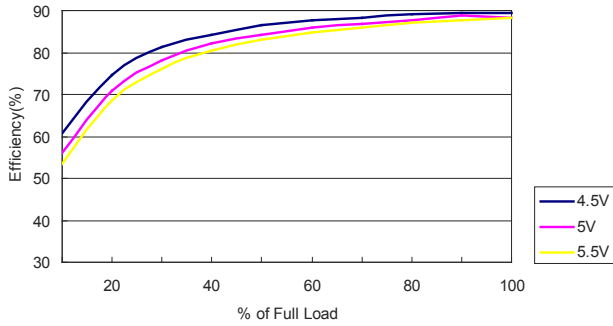
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



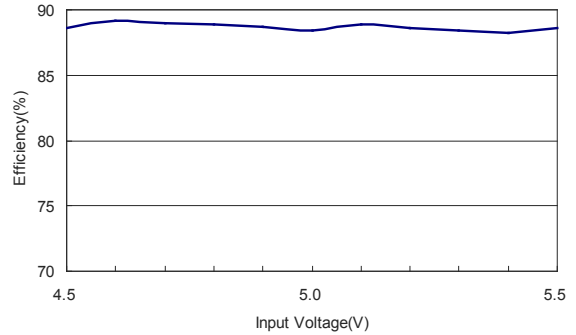
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

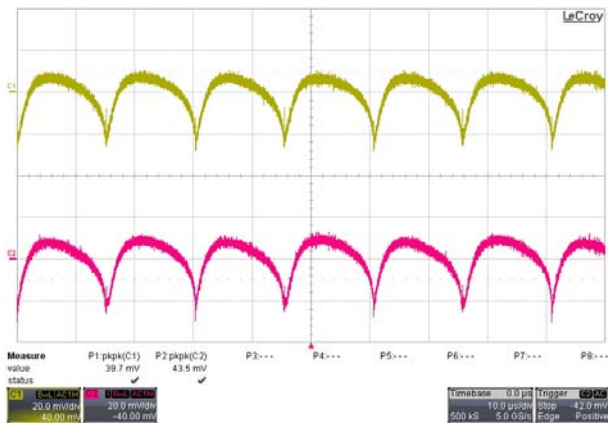
All test conditions are at 25°C The figures are identical for TRA 1-0522



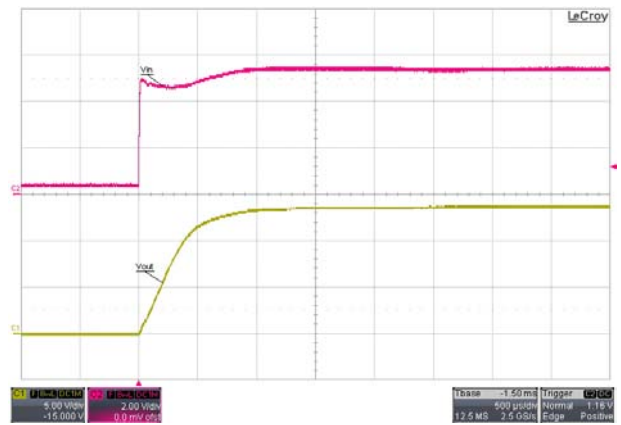
Efficiency Versus Output Current



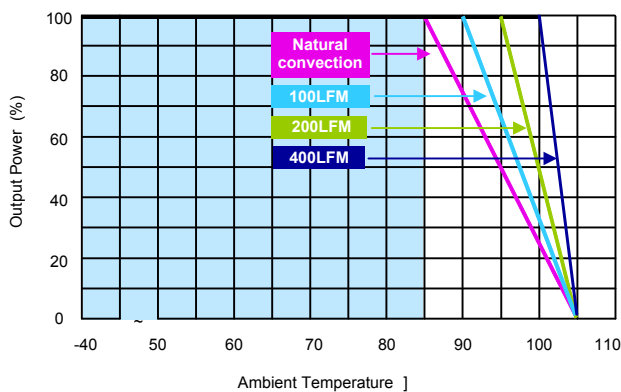
Efficiency Versus Input Voltage. Full Load



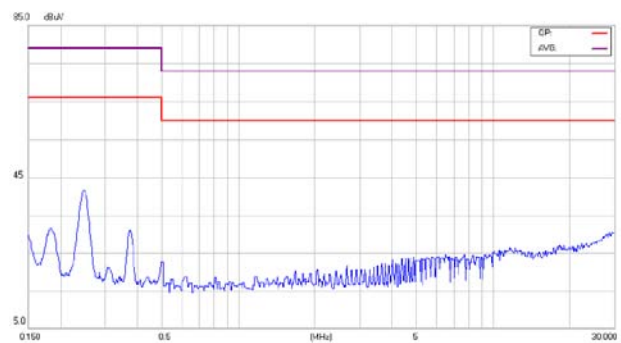
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



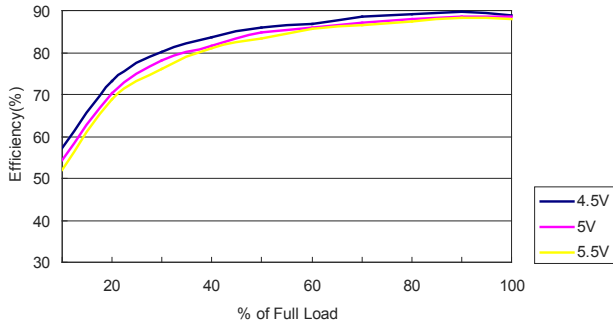
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



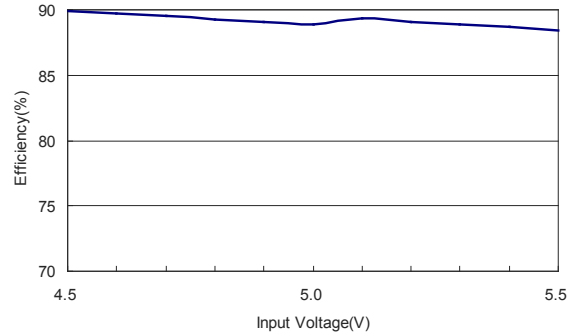
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

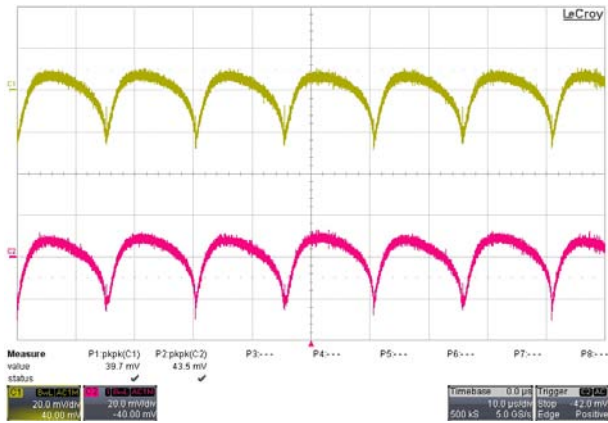
All test conditions are at 25°C The figures are identical for TRA 1-0523



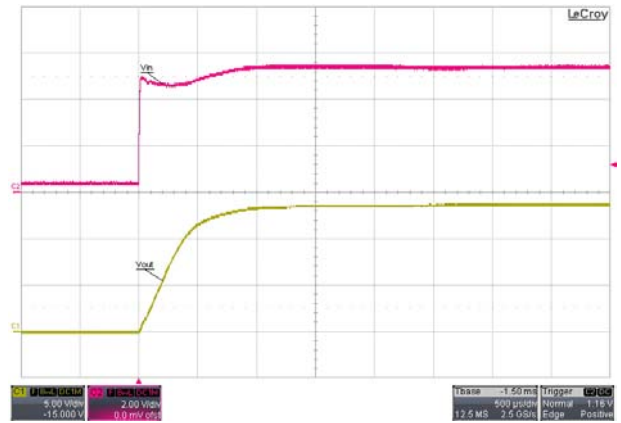
Efficiency Versus Output Current



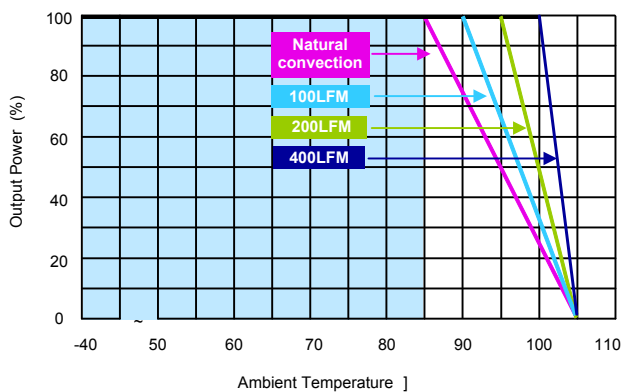
Efficiency Versus Input Voltage. Full Load



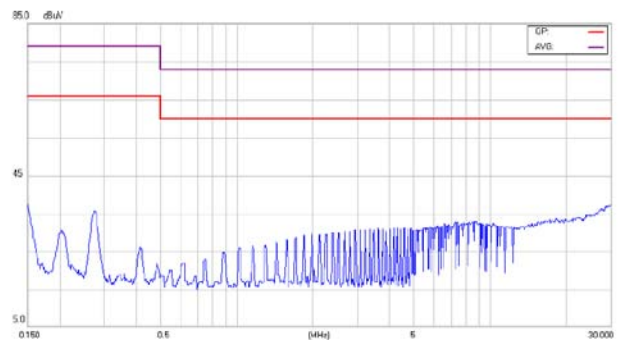
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



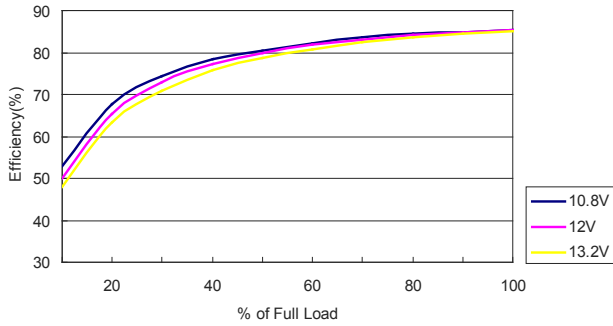
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



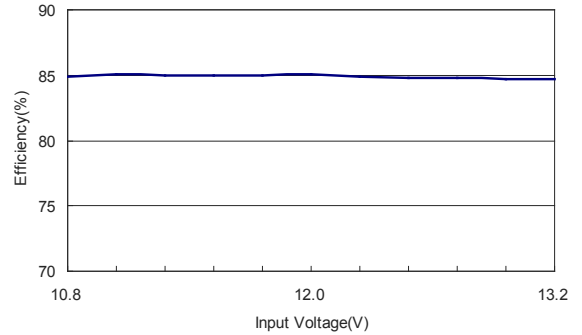
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

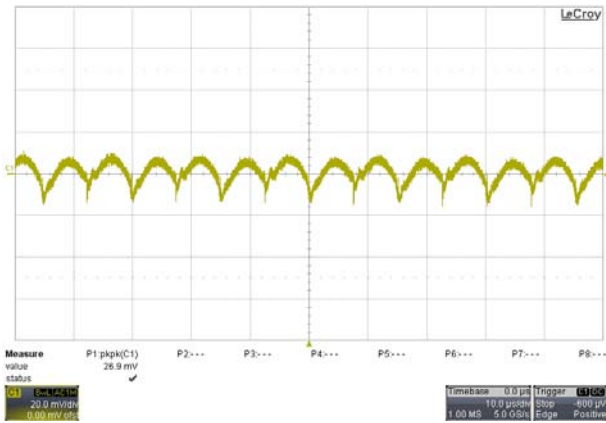
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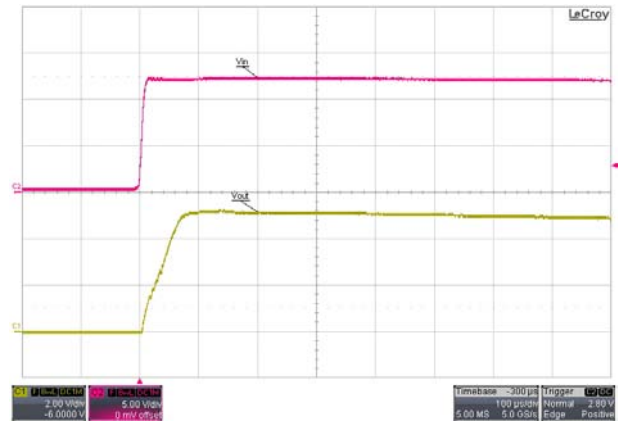
Efficiency Versus Output Current



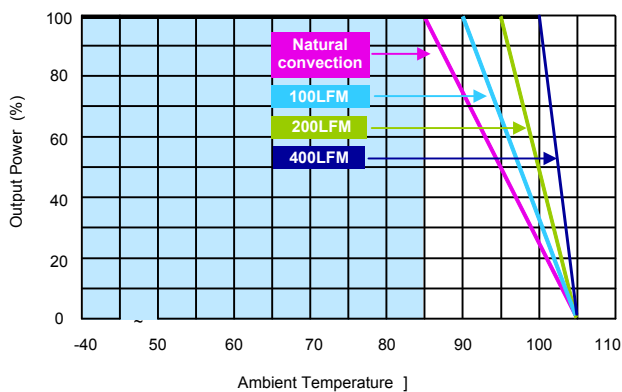
Efficiency Versus Input Voltage. Full Load



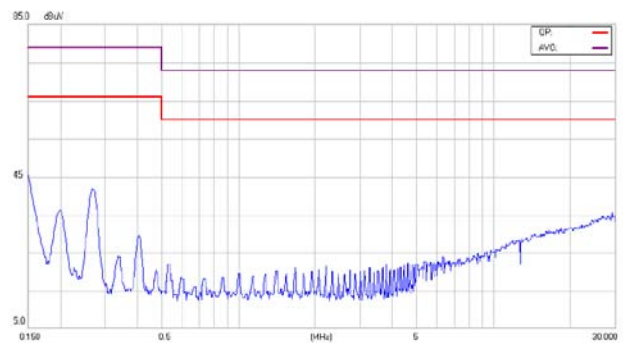
Typical Output Ripple and Noise.  
 $V_{in} = V_{in,nom}$ ; Full Load;  $T_A$



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



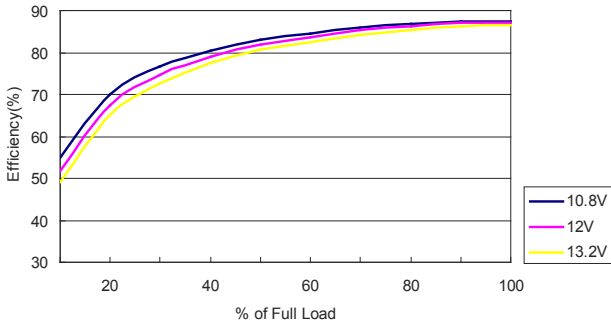
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in,nom}$



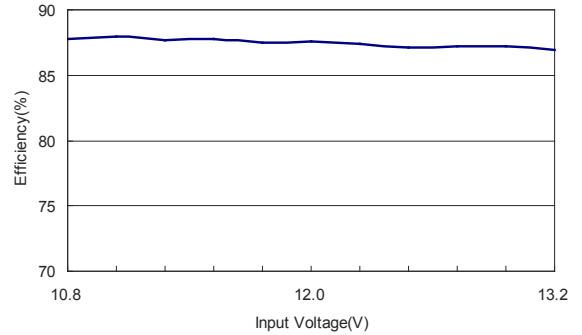
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in,nom}$ ; Full Load

**Characteristic Curves**

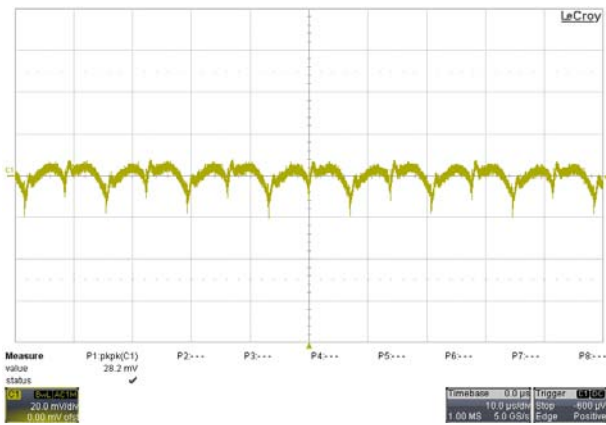
All test conditions are at 25°C The figures are identical for TRA 1-1219



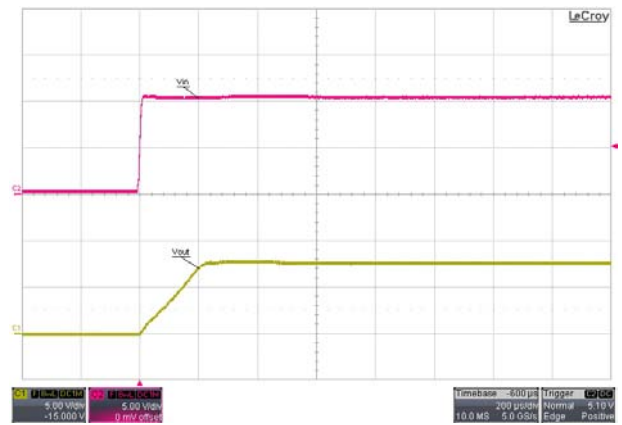
Efficiency Versus Output Current



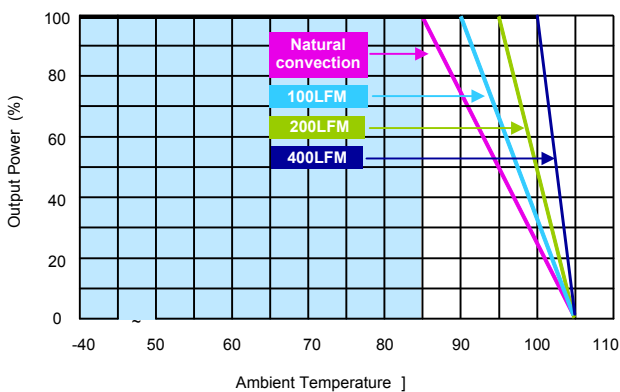
Efficiency Versus Input Voltage. Full Load



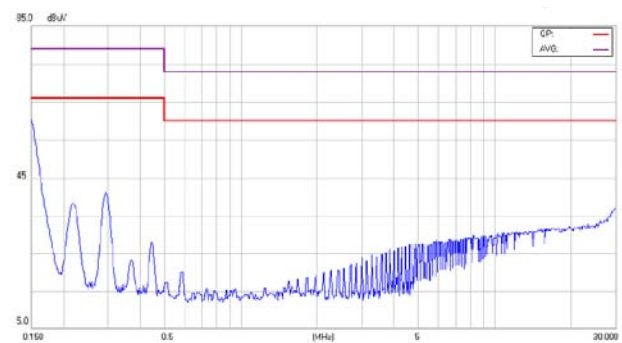
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



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

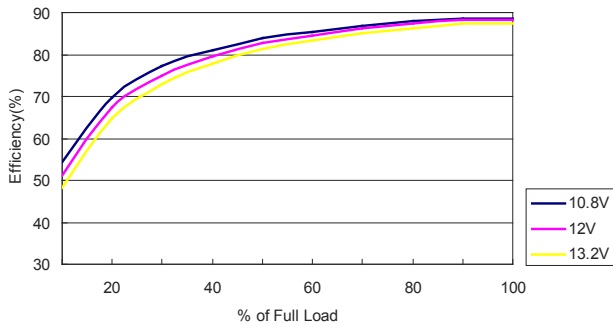


Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

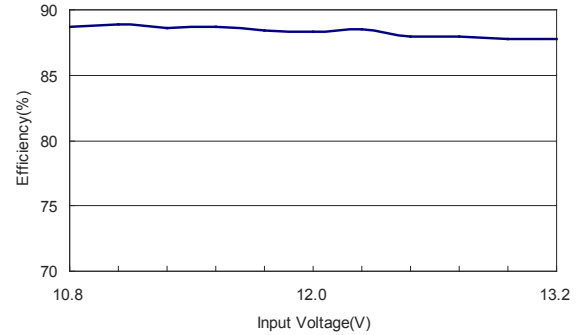


**Characteristic Curves**

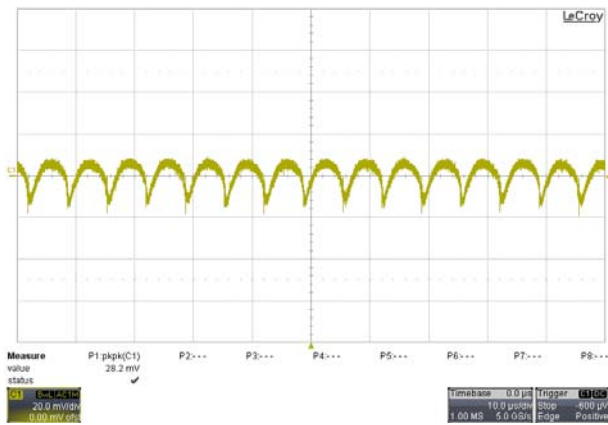
All test conditions are at 25°C The figures are identical for TRA 1-1212



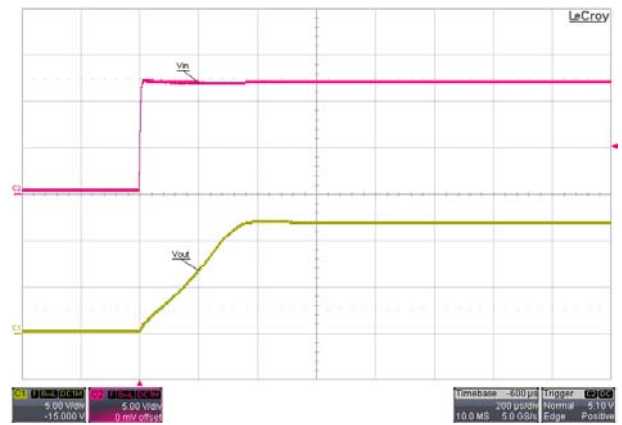
Efficiency Versus Output Current



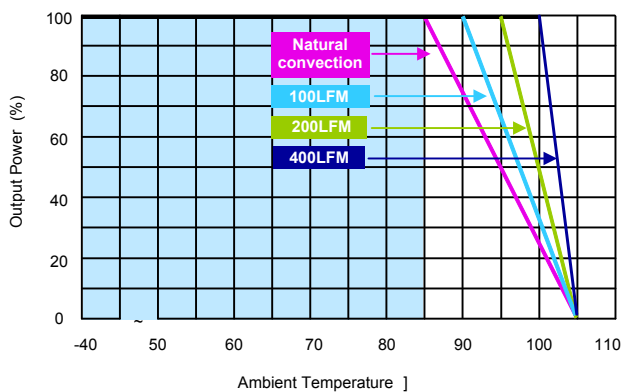
Efficiency Versus Input Voltage. Full Load



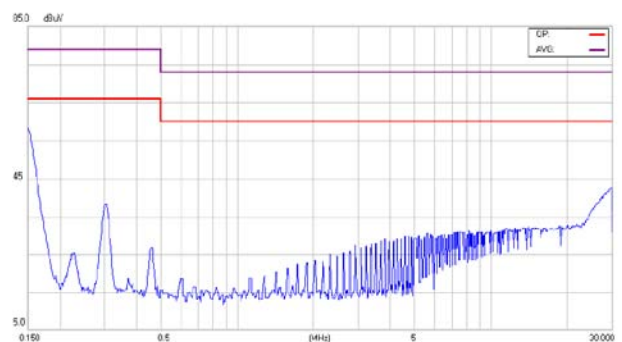
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



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

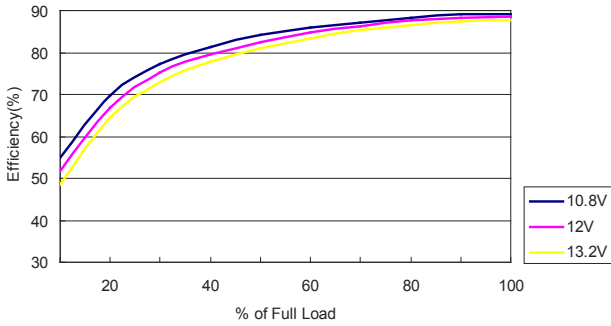


Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

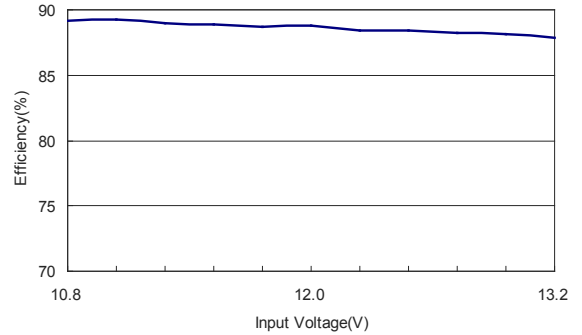


**Characteristic Curves**

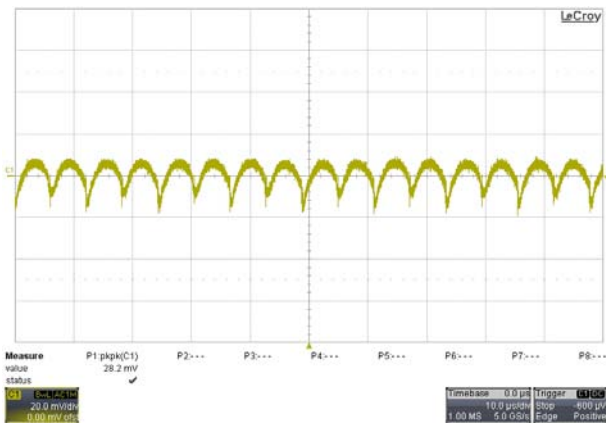
All test conditions are at 25°C The figures are identical for TRA 1-1213



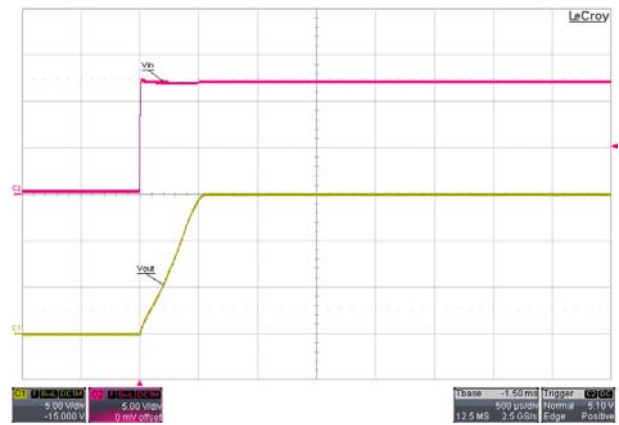
Efficiency Versus Output Current



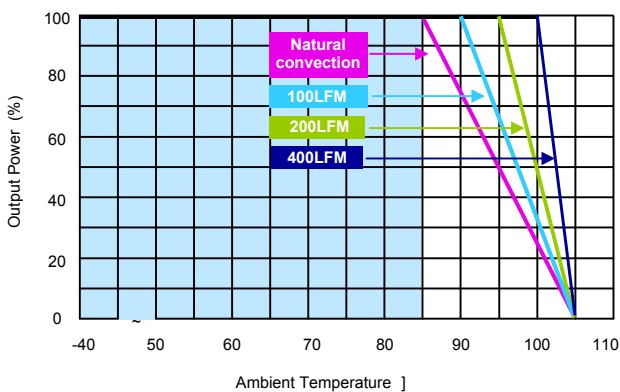
Efficiency Versus Input Voltage. Full Load



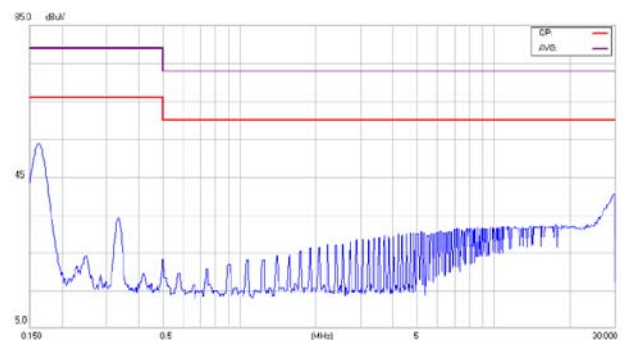
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



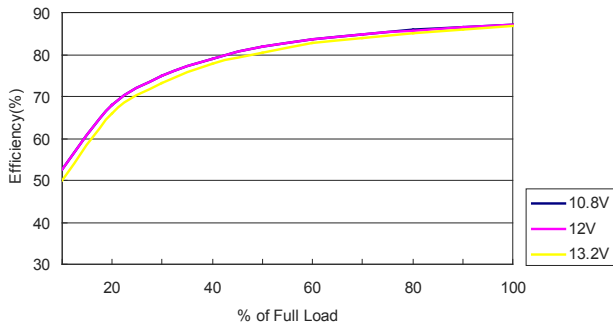
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



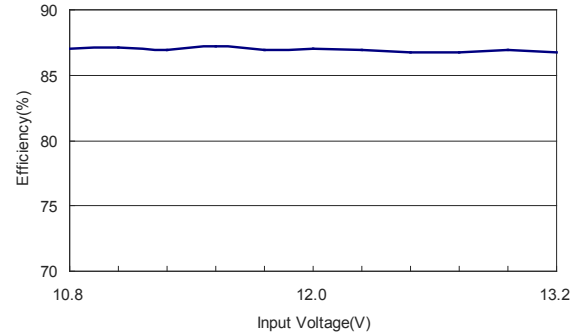
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

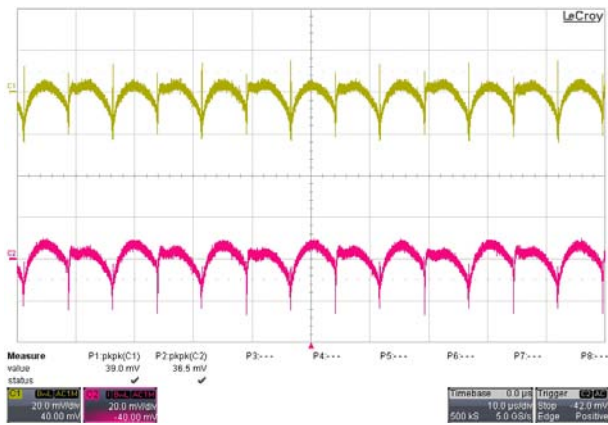
All test conditions are at 25°C The figures are identical for TRA 1-1221



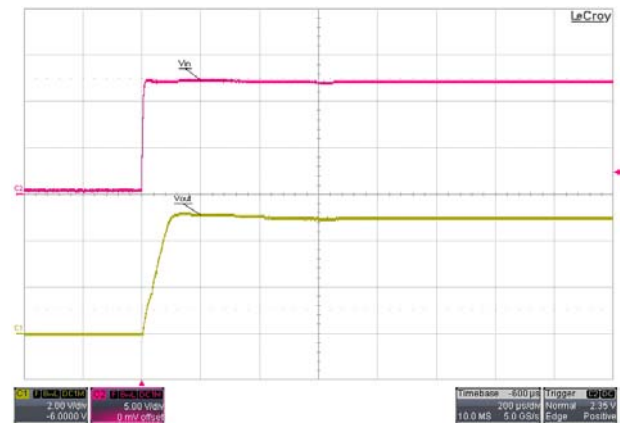
Efficiency Versus Output Current



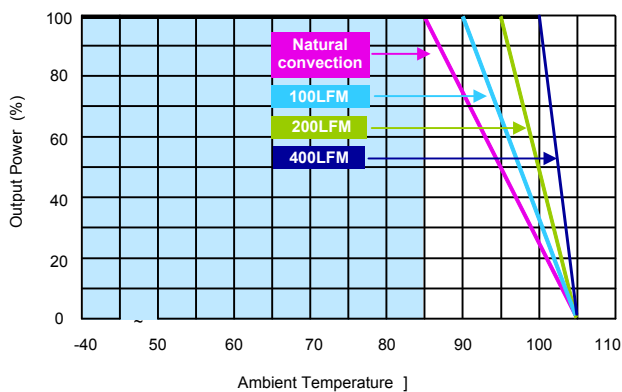
Efficiency Versus Input Voltage. Full Load



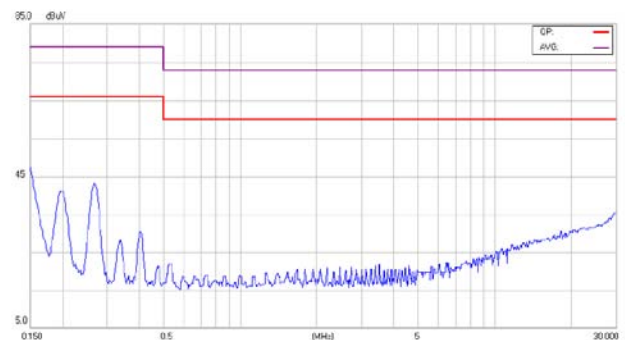
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



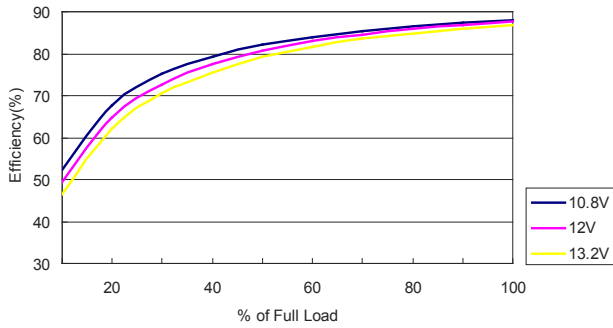
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



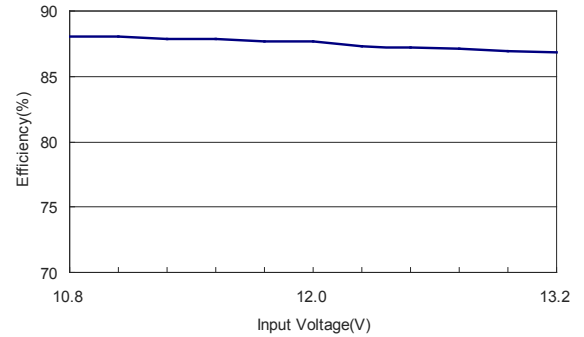
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

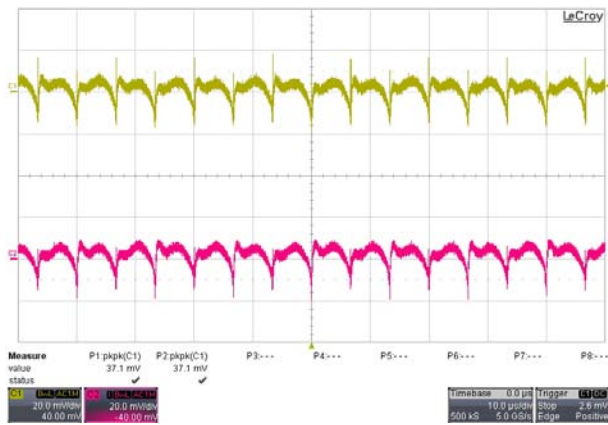
All test conditions are at 25°C The figures are identical for TRA 1-1224



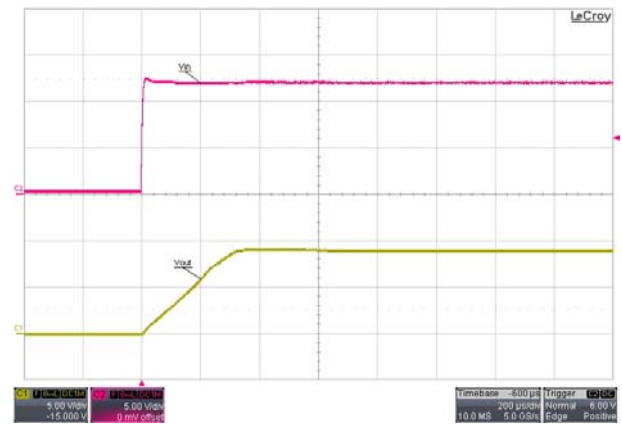
Efficiency Versus Output Current



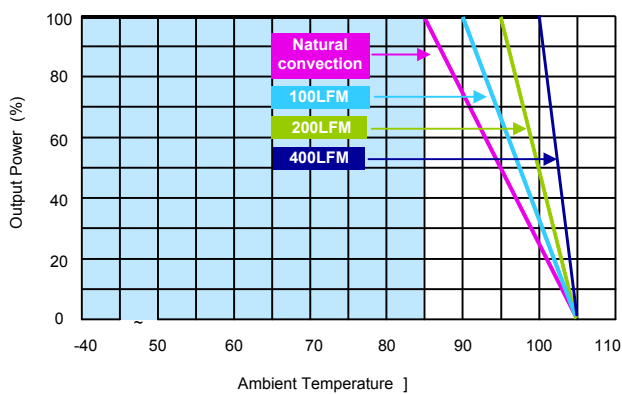
Efficiency Versus Input Voltage. Full Load



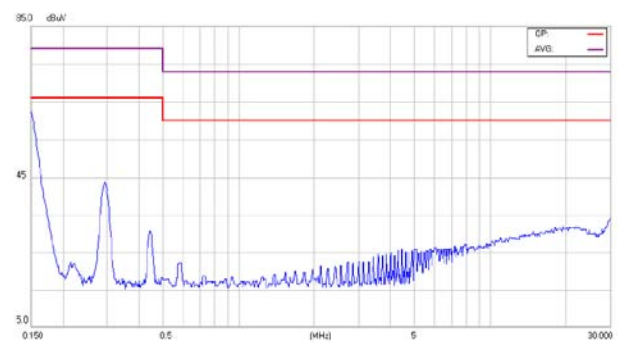
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



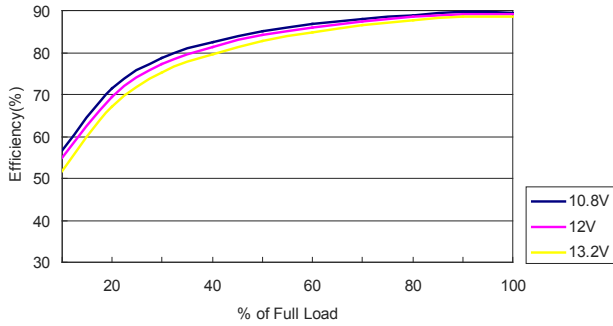
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



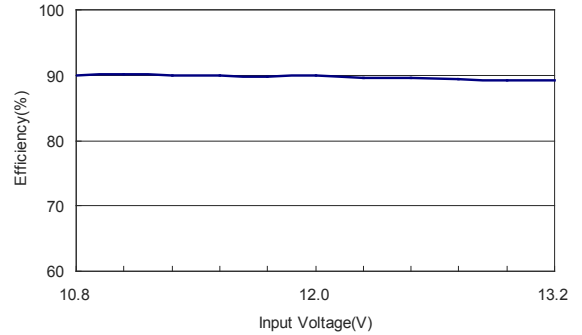
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

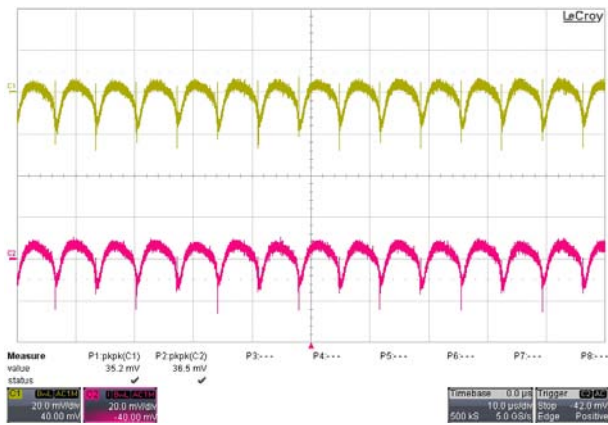
All test conditions are at 25°C The figures are identical for TRA 1-1222



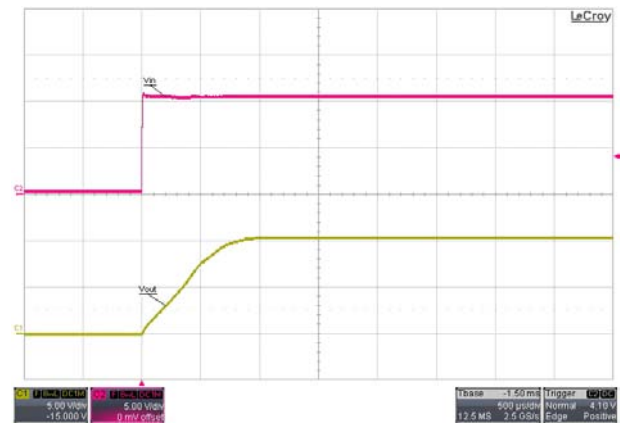
Efficiency Versus Output Current



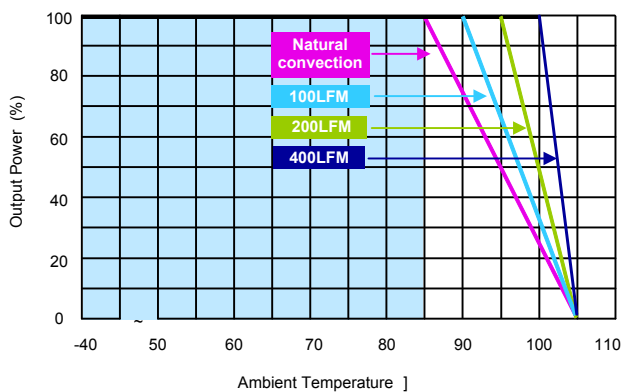
Efficiency Versus Input Voltage. Full Load



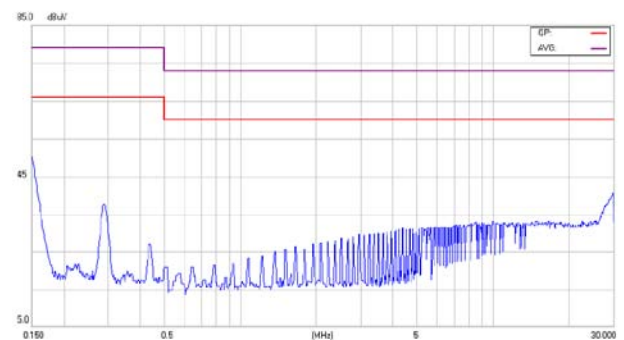
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



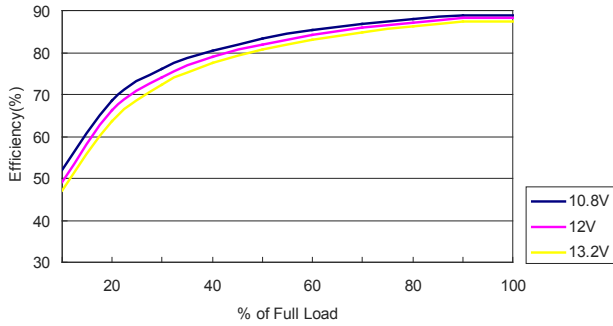
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



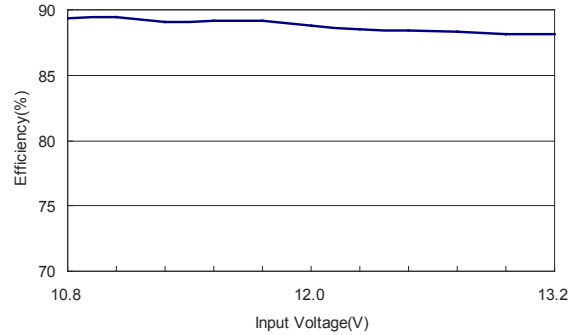
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

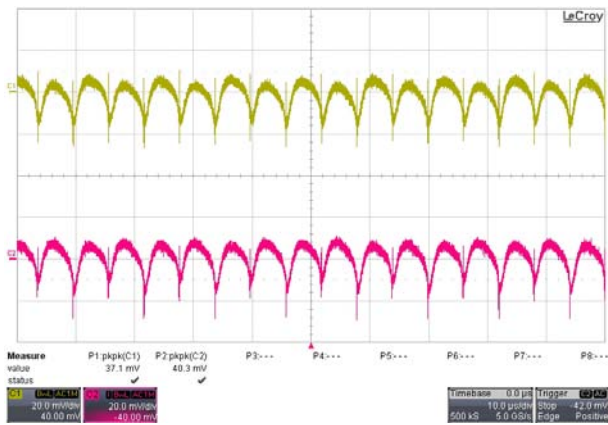
All test conditions are at 25°C The figures are identical for TRA 1-1223



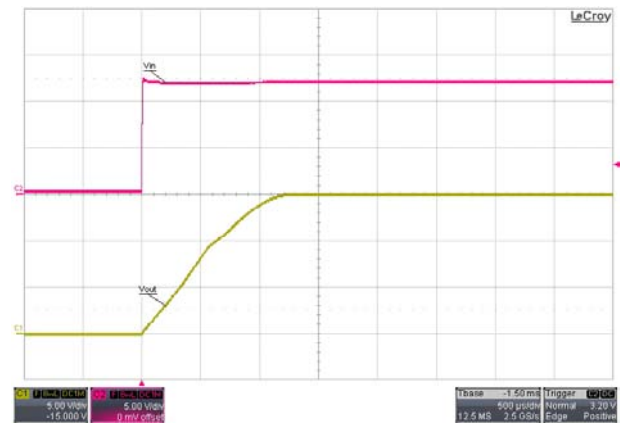
Efficiency Versus Output Current



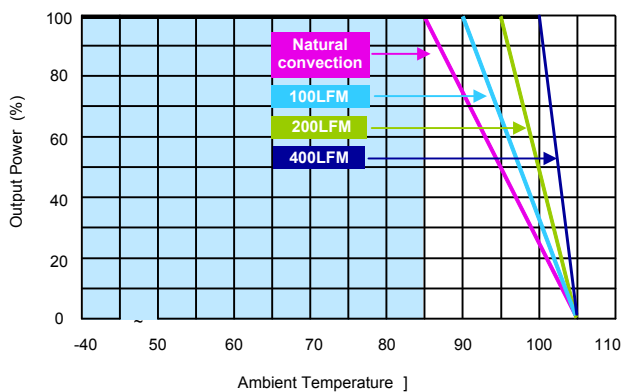
Efficiency Versus Input Voltage. Full Load



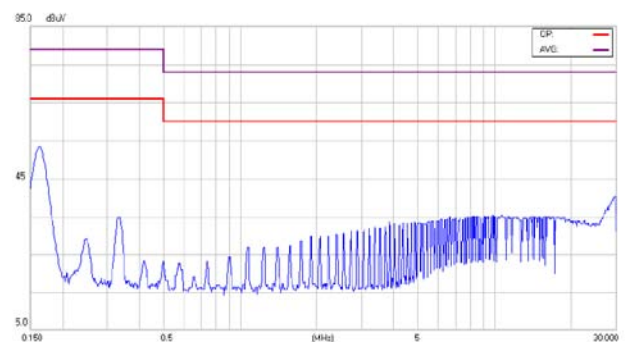
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



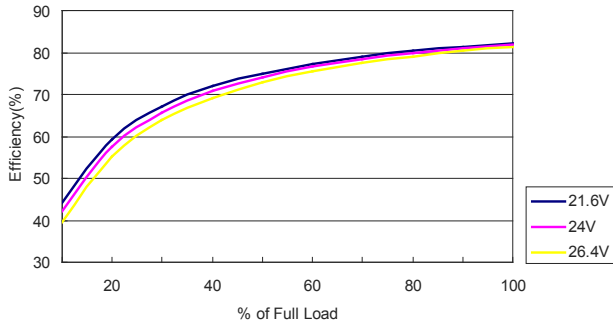
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



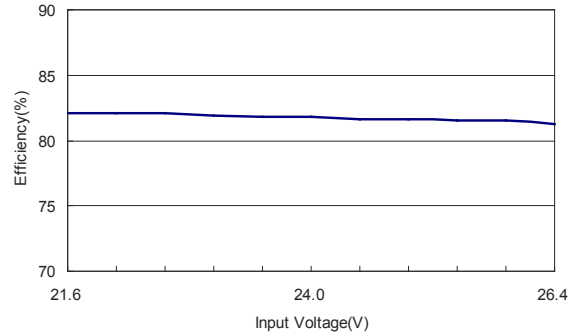
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

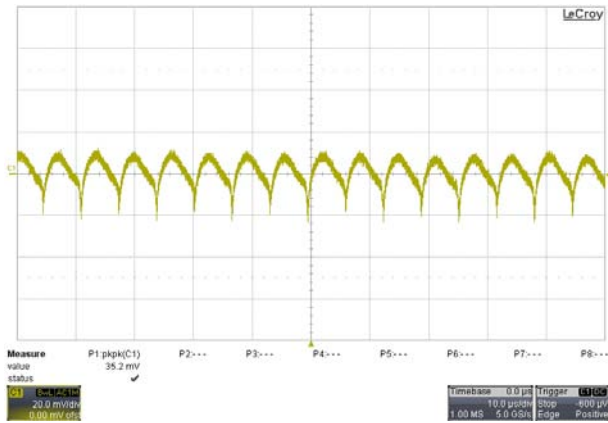
All test conditions are at 25°C The figures are identical for TRA 1-2411



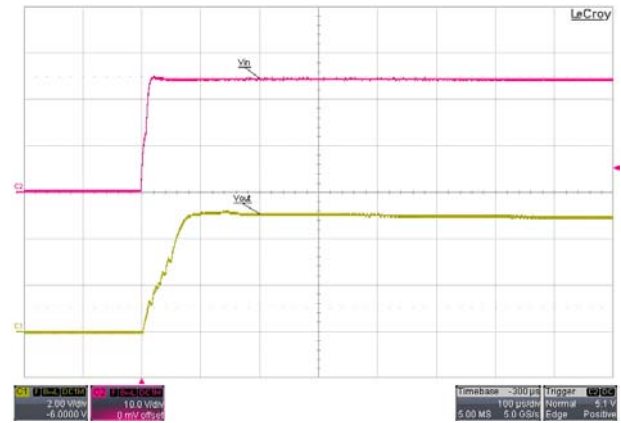
Efficiency Versus Output Current



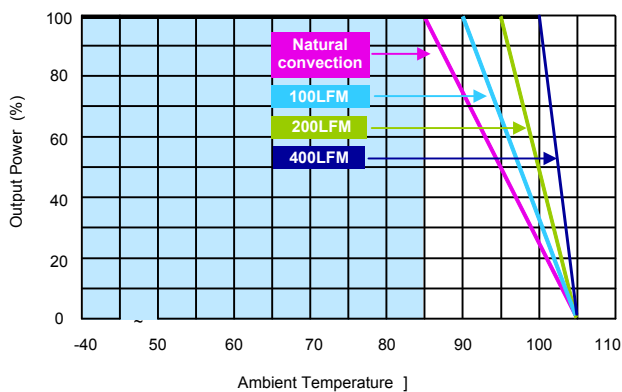
Efficiency Versus Input Voltage. Full Load



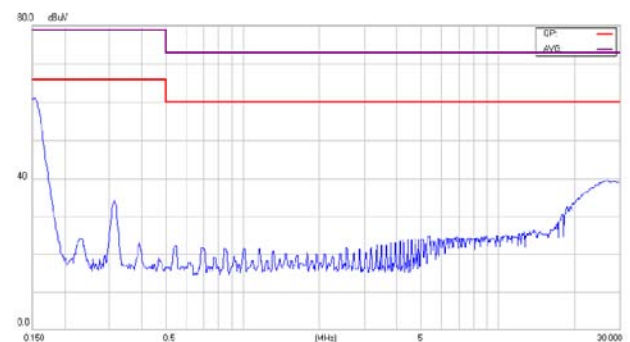
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



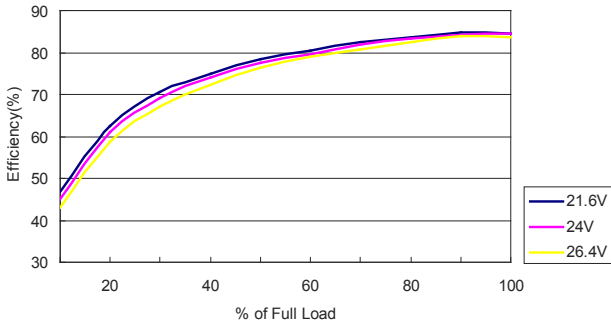
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



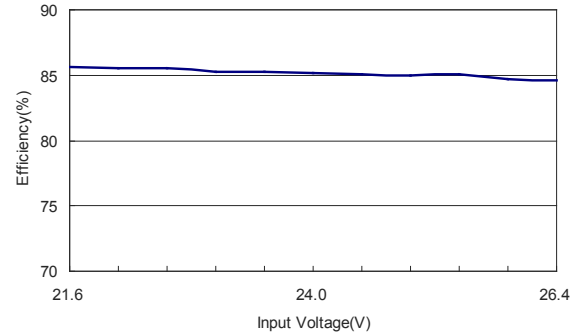
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

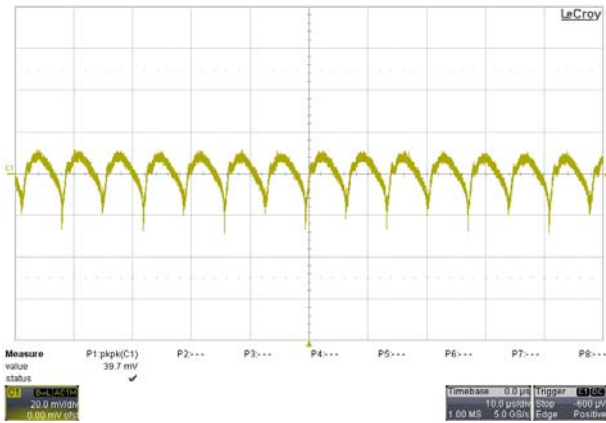
All test conditions are at 25°C The figures are identical for TRA 1-2419



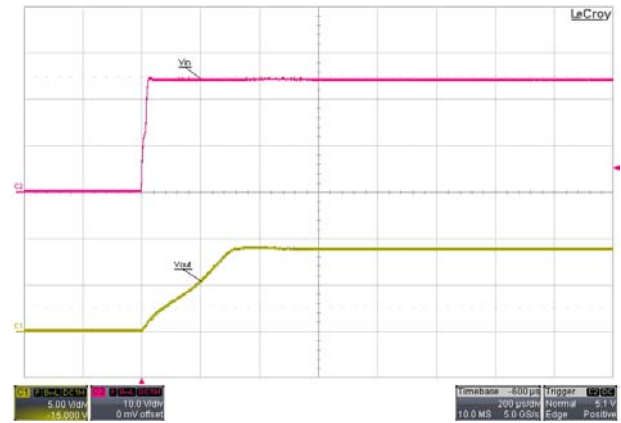
Efficiency Versus Output Current



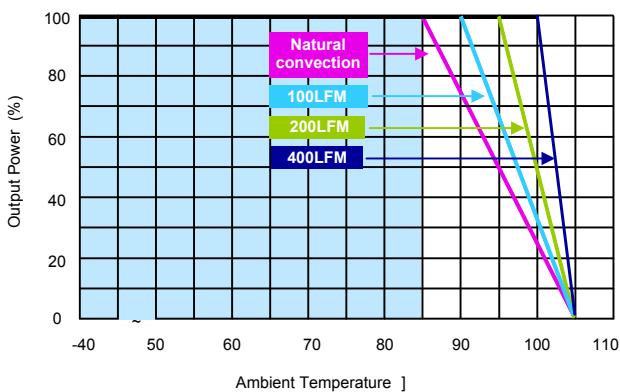
Efficiency Versus Input Voltage. Full Load



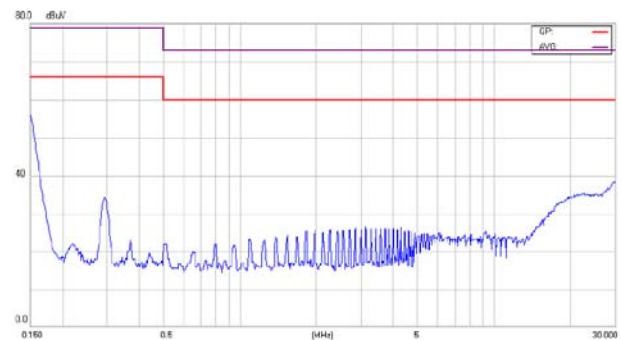
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



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

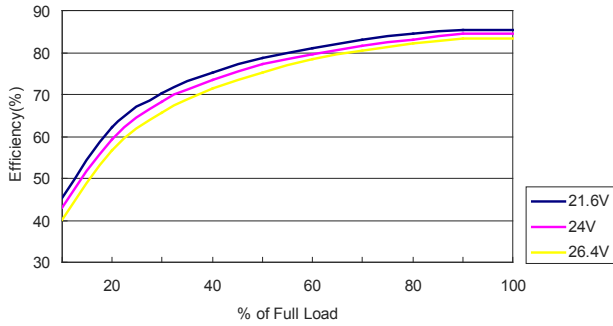


Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

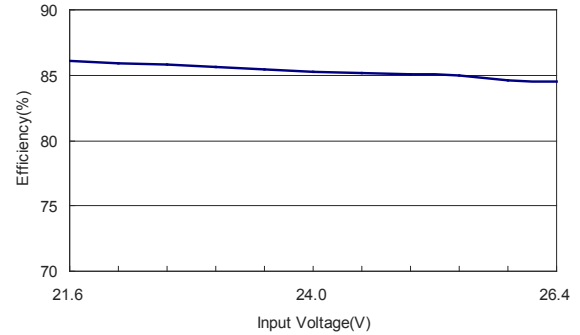


**Characteristic Curves**

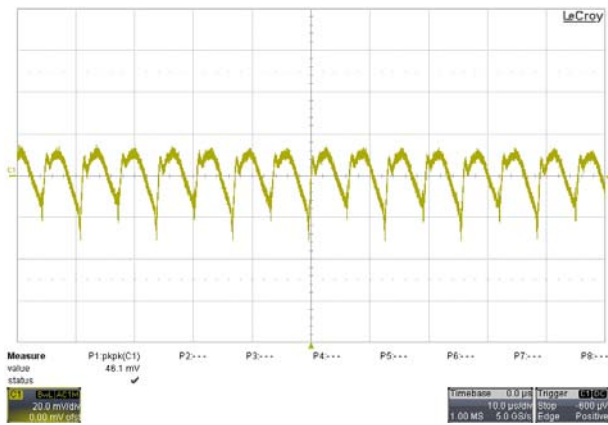
All test conditions are at 25°C The figures are identical for TRA 1-2412



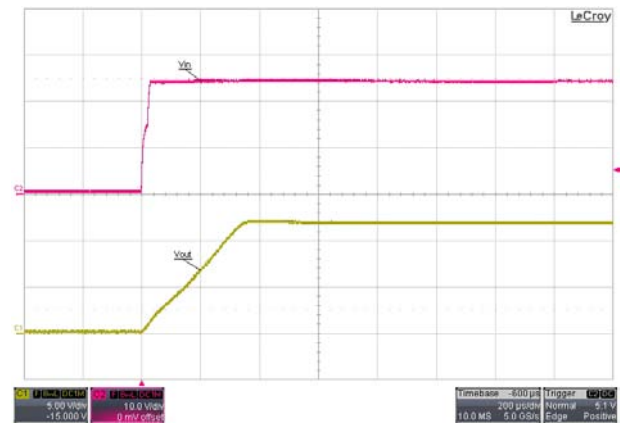
Efficiency Versus Output Current



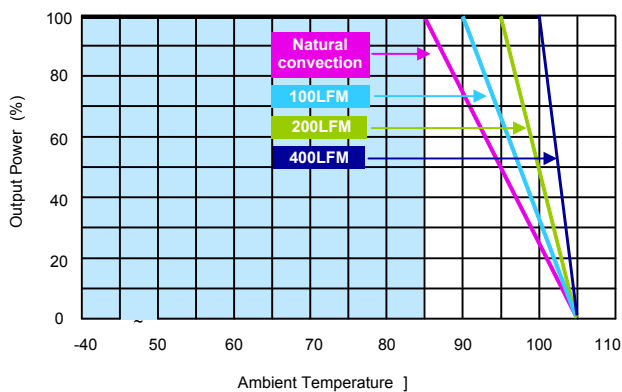
Efficiency Versus Input Voltage. Full Load



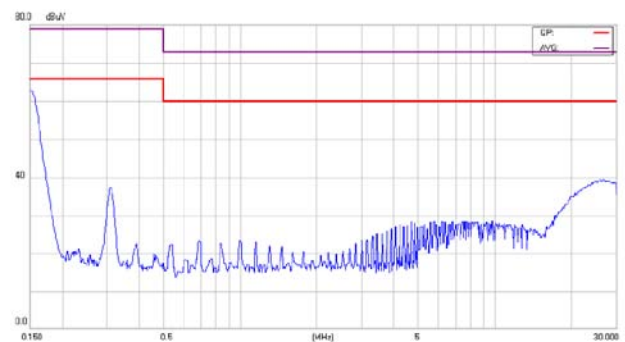
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



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

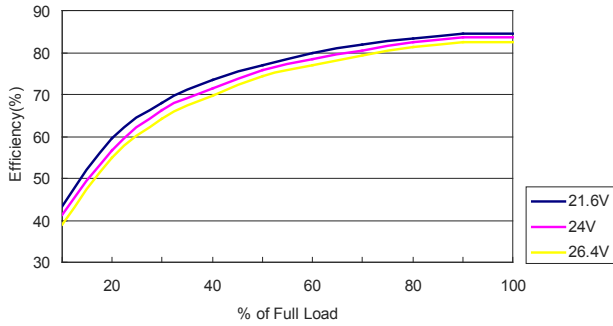


Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

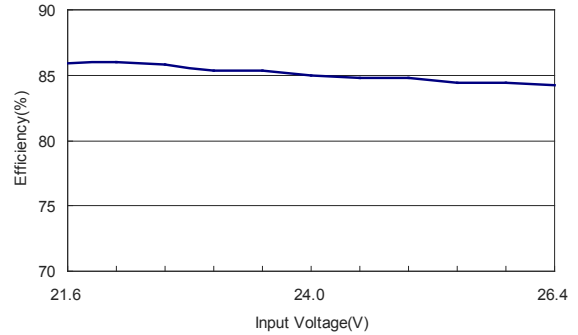


**Characteristic Curves**

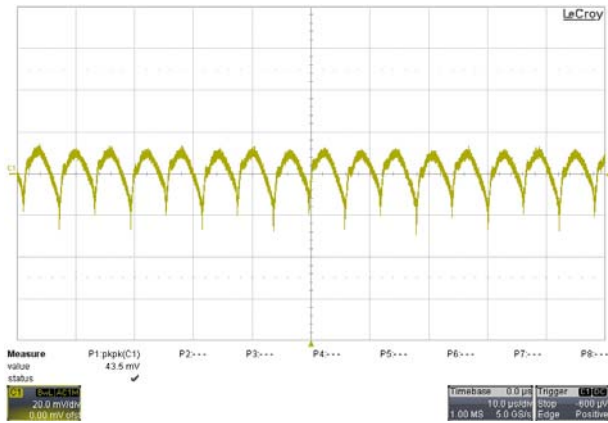
All test conditions are at 25°C The figures are identical for TRA 1-2413



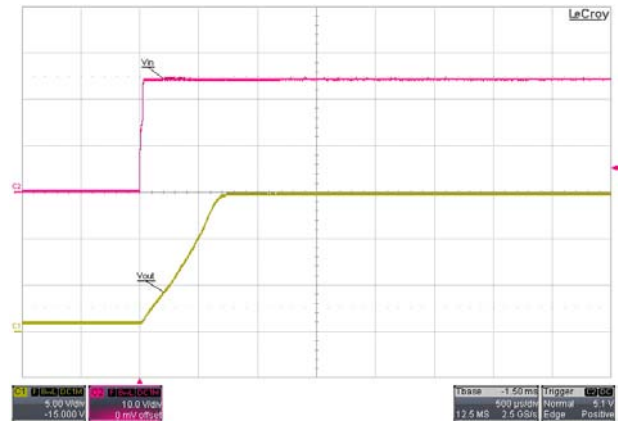
Efficiency Versus Output Current



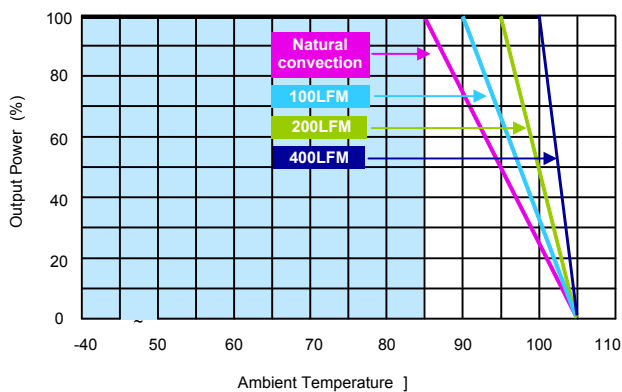
Efficiency Versus Input Voltage. Full Load



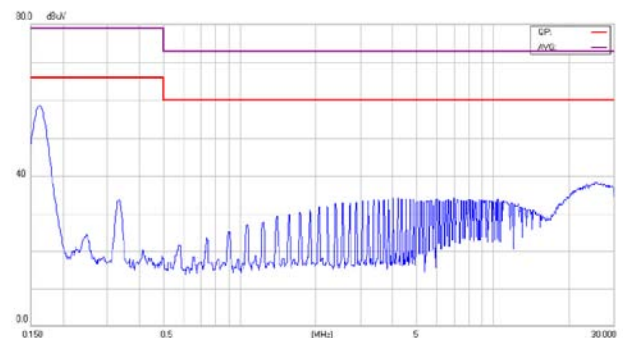
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



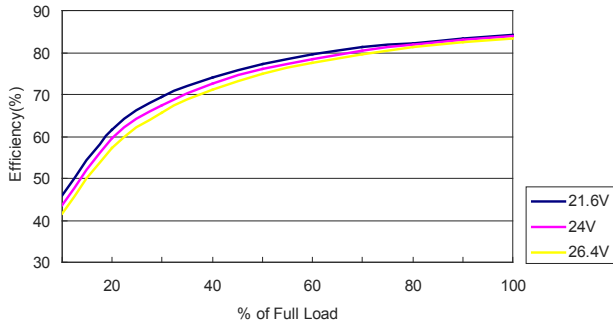
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



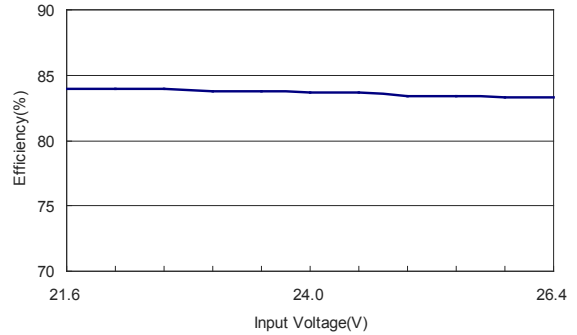
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

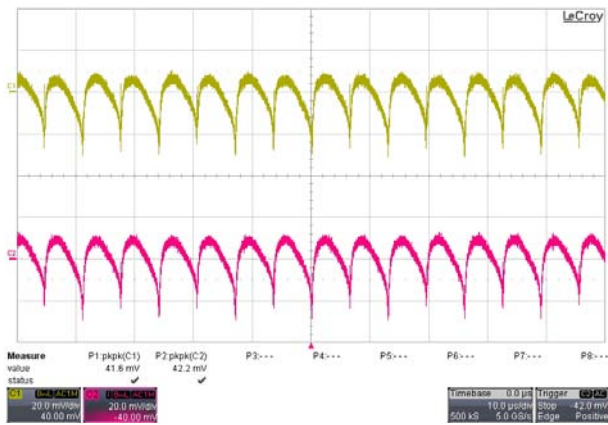
All test conditions are at 25°C The figures are identical for TRA 1-2421



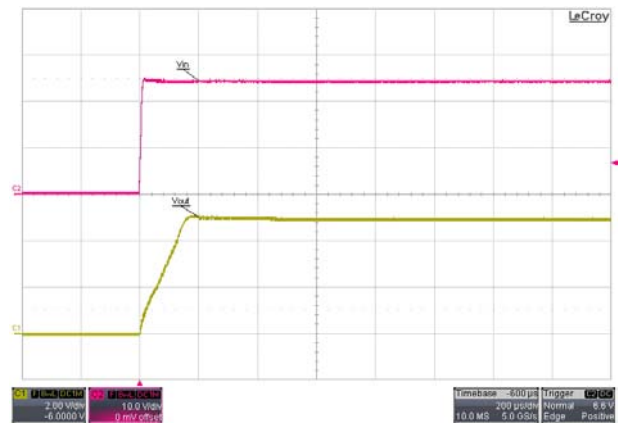
Efficiency Versus Output Current



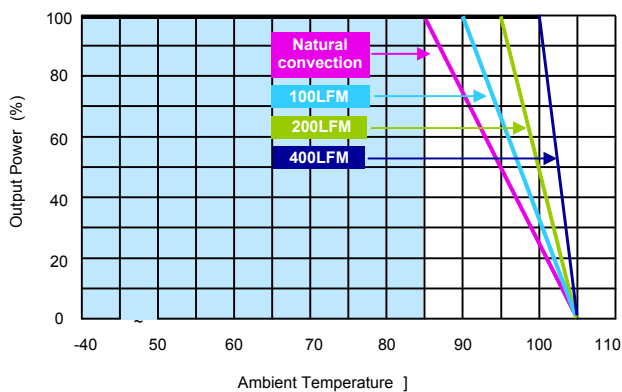
Efficiency Versus Input Voltage. Full Load



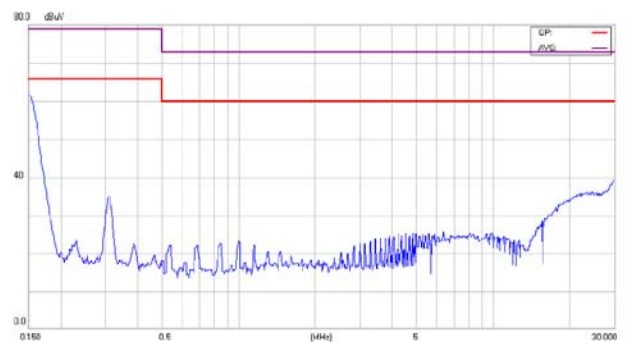
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



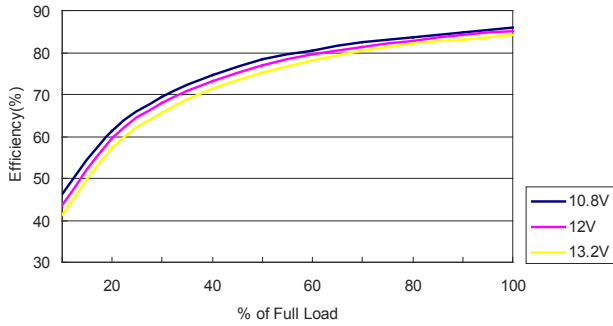
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



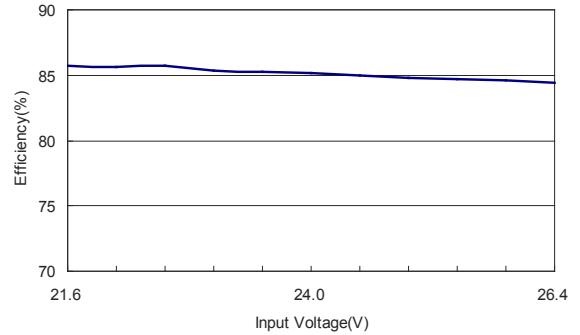
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

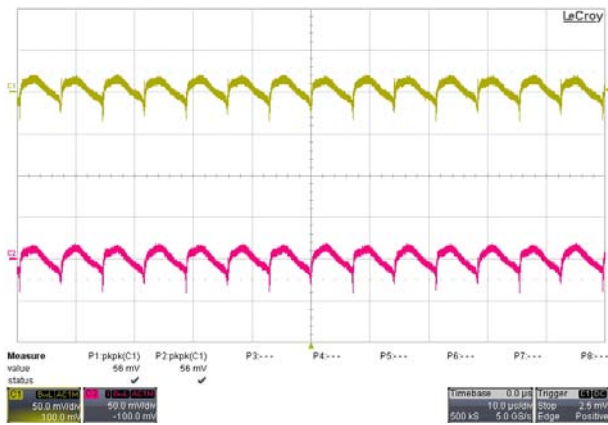
All test conditions are at 25°C The figures are identical for TRA 1-2424



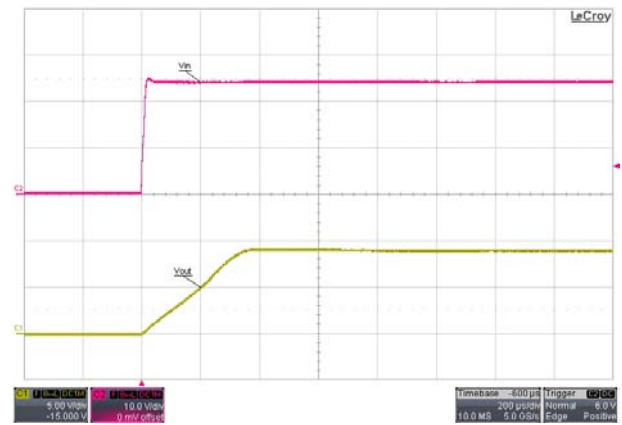
Efficiency Versus Output Current



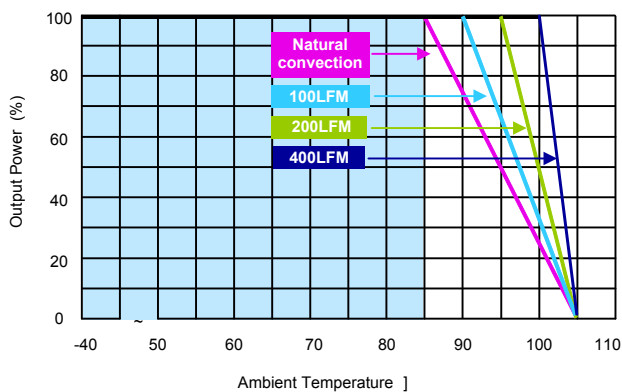
Efficiency Versus Input Voltage. Full Load



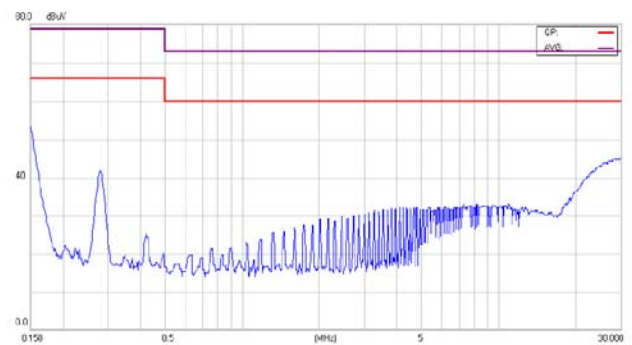
Typical Output Ripple and Noise.  
 $V_{in} = V_{in\ nom}$ ; Full Load;  $T_A$



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



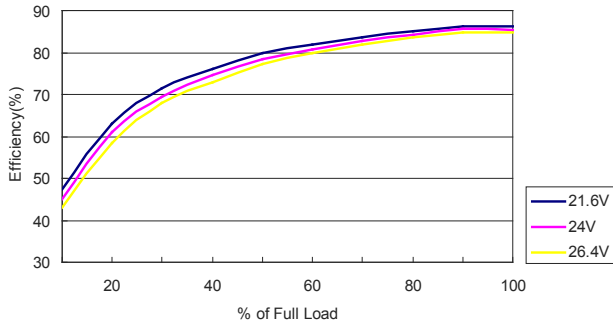
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in\ nom}$



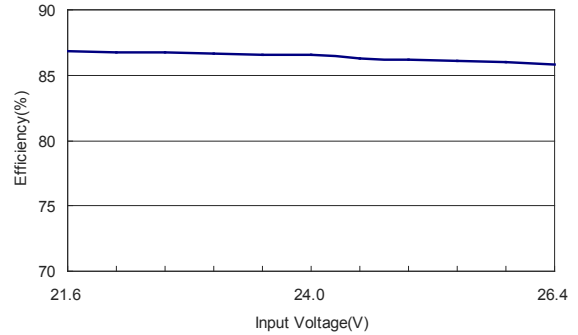
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in\ nom}$ ; Full Load

**Characteristic Curves**

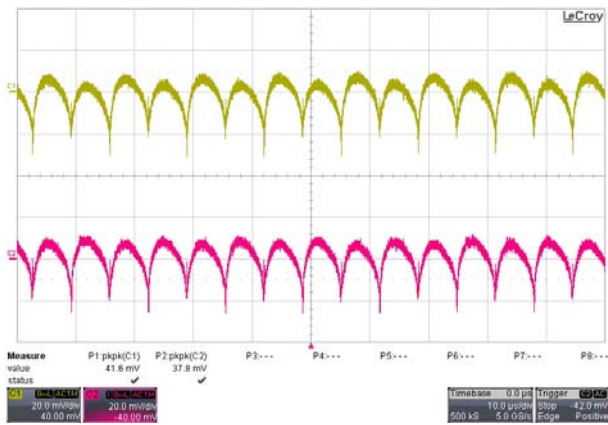
All test conditions are at 25°C The figures are identical for TRA 1-2422



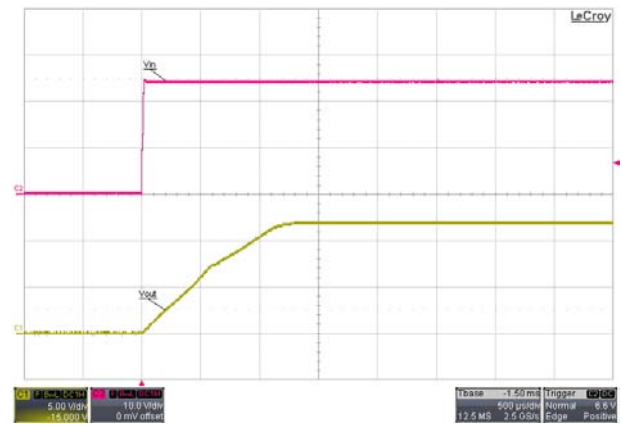
Efficiency Versus Output Current



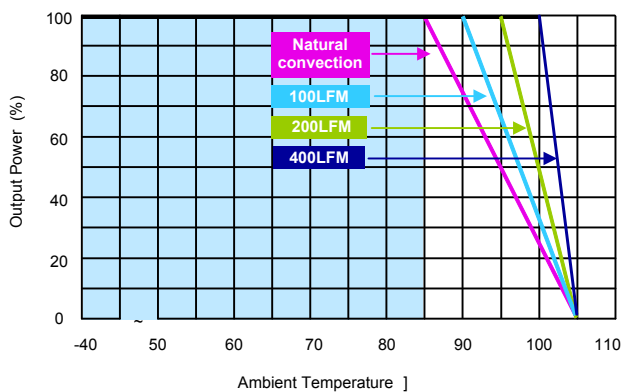
Efficiency Versus Input Voltage. Full Load



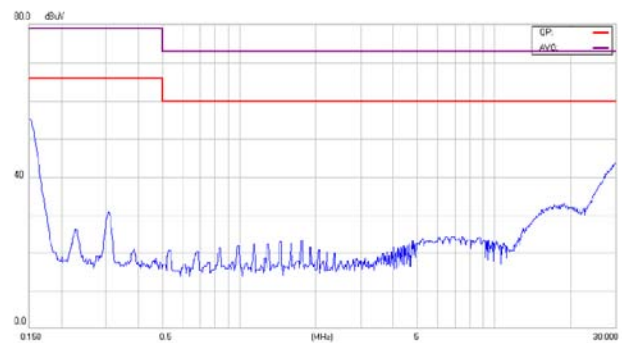
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



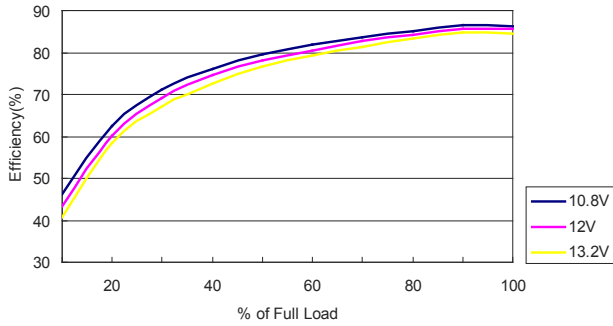
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



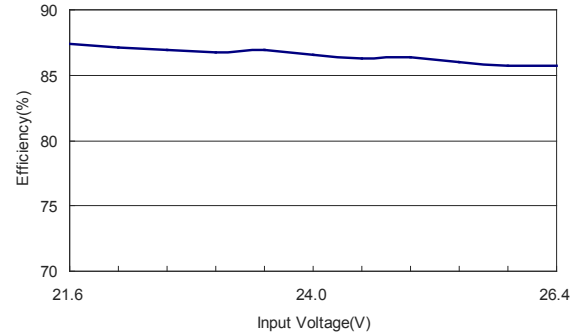
Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

**Characteristic Curves**

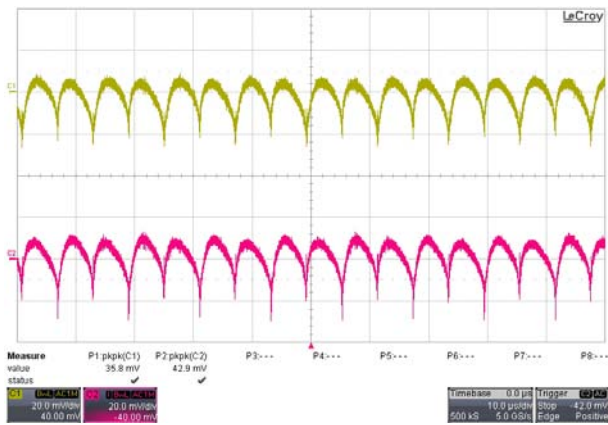
All test conditions are at 25°C The figures are identical for TRA 1-2423



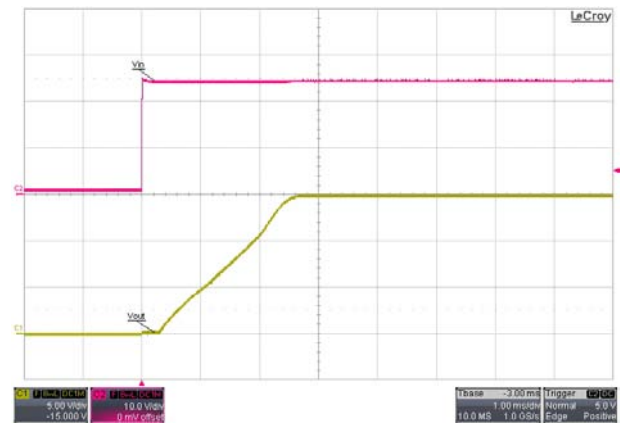
Efficiency Versus Output Current



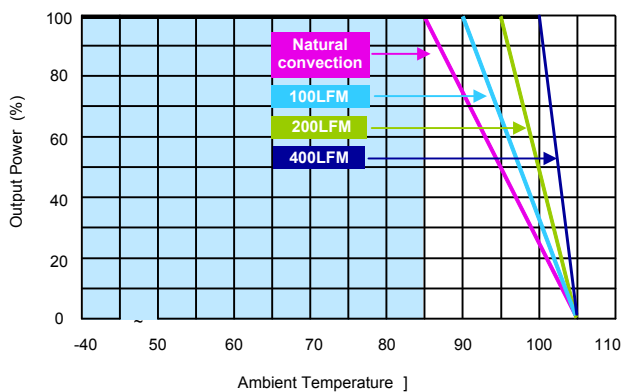
Efficiency Versus Input Voltage. Full Load



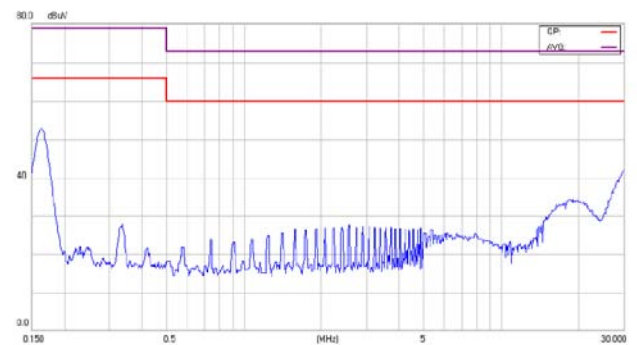
Typical Output Ripple and Noise.  
 $V_{in} = V_{in nom}$ ; Full Load;  $T_A$



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



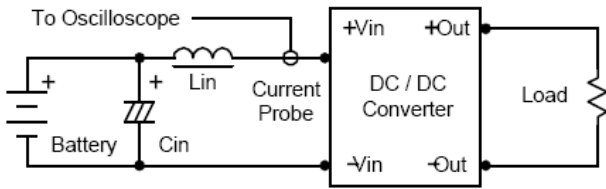
Derating Output Current Versus Ambient Temperature and Airflow  
 $V_{in} = V_{in nom}$



Conduction Emission of EN55022 Class A  
 $V_{in} = V_{in nom}$ ; Full Load

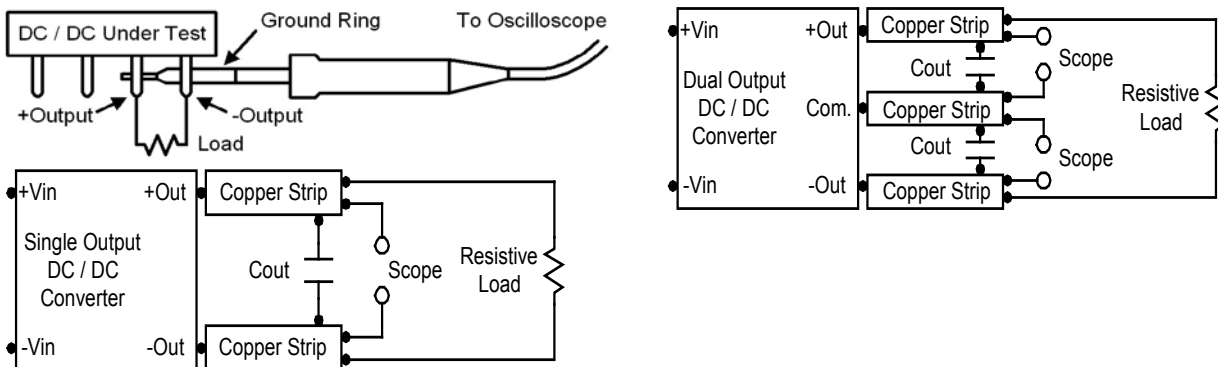
**Testing Configurations**

**Input reflected-ripple current measurement test up**



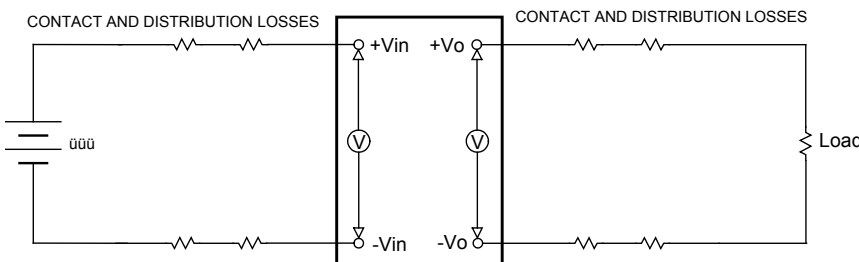
Component	Value	Reference
L	10μH	----
C	1μF (ESR<1.0Ω at 100KHz)	Aluminum Electrolytic Capacitor

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

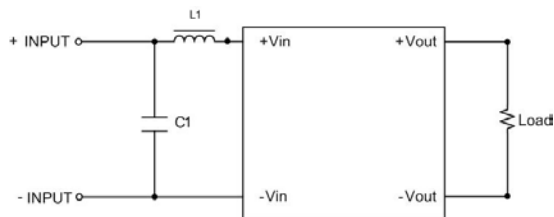


**Output voltage and efficiency measurement test up**

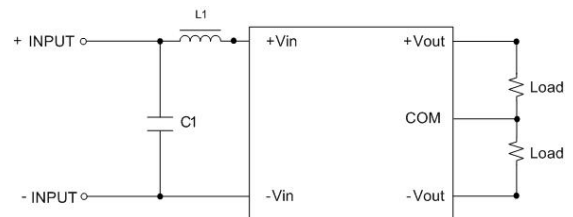
$$Efficiency = \left( \frac{V_{out} \times I_{out}}{V_{in} \times I_{in}} \right) \times 100\% = [\%]$$



**EMC considerations**

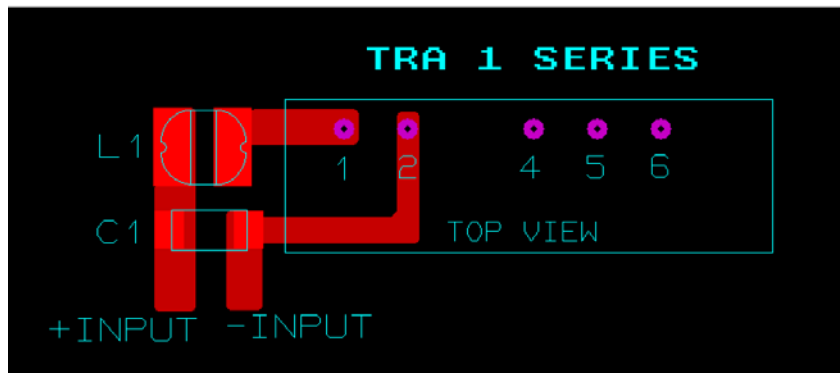


Single Output



Dual Output

Recommended circuit to comply EN55022 Class A Limits

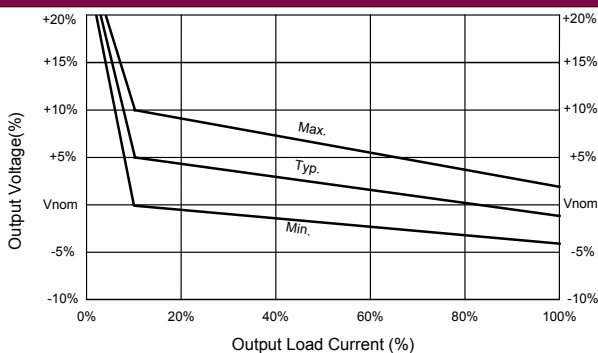


Recommended PCB Layout with Input Filter

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

Model	Component	Value
TRA 1-05xx TAR 1-12xx	C1	1 $\mu$ F/25V 1206 MLCC
	L1	12 $\mu$ H SR0302MS/0.75A
TRA 1-24xx	C1	4.7 $\mu$ F/50V 1206 MLCC
	L1	6.8 $\mu$ H SCD03021T/0.85A

**Tolerance Envelopes Graph**

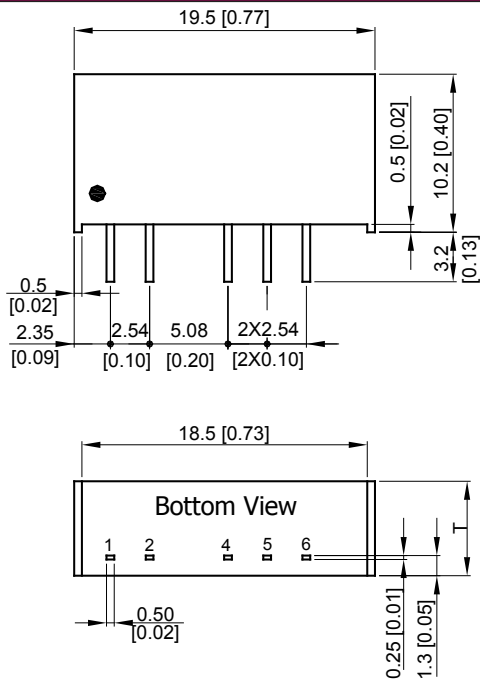


**Input Source Impedance**

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 ( $ESR < 1.0\Omega$  at 100 KHz) capacitor of a 2.2 $\mu$ F for the 5V input devices, a 1.0 $\mu$ F for the 12V input devices and a 0.47 $\mu$ F for the 24V devices.

**Mechanical Dimensions**



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

**Pin Connections**

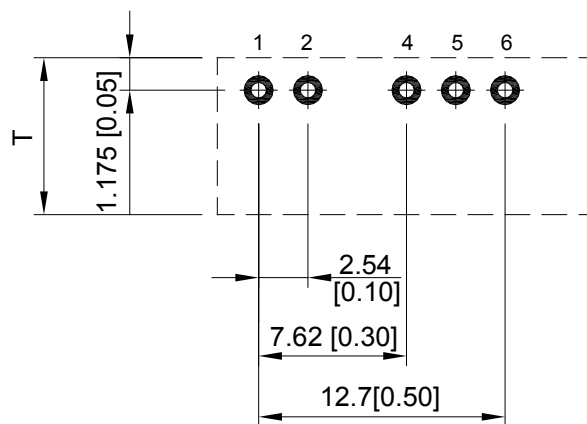
Pin	Single Output	Dual Output
1	+Vin	+Vin
2	-Vin	-Vin
4	-Vout	-Vout
5	No Pin	Common
6	+Vout	+Vout

T=6.1 [0.24] for 5V & 12V Input Models

T=7.1 [0.28] for 24V Input Models

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

**Recommended Pad Layout for Single & Dual Output Converter**



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

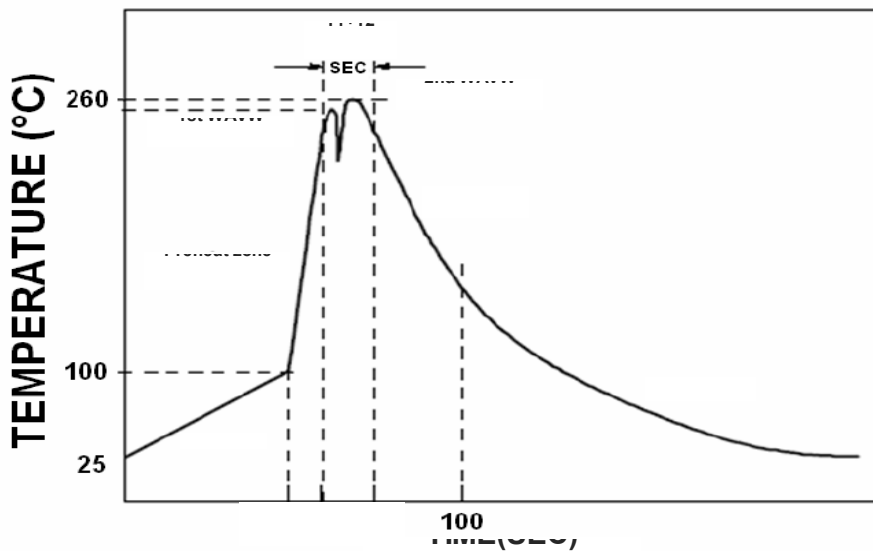


**Packaging Information**



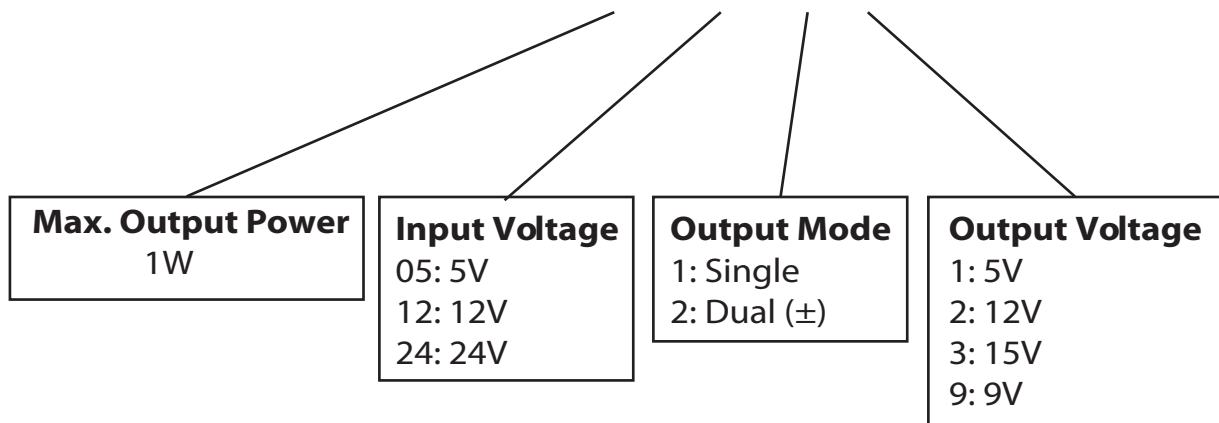
**Soldering and Reflow Considerations**

Lead free wave solder profile for TRA 1 Series



**Part Number Structure**

# TRA 1-1211



Model Number	Input Range (VDC)	Output Voltage (VDC)	Max. Output Current (mA)	Input Current at Full Load <sup>(1)</sup> (mA)	Efficiency <sup>(2)</sup> (%)
TRA 1-0511	4.5-5.5	5	200	238	84
TRA 1-0519	4.5-5.5	9	110	228	87
TRA 1-0512	4.5-5.5	12	84	232	87
TRA 1-0513	4.5-5.5	15	67	230	87.5
TRA 1-0521	4.5-5.5	$\pm 5$	$\pm 100$	237	84.5
TRA 1-0524	4.5-5.5	$\pm 9$	$\pm 56$	234	86
TRA 1-0522	4.5-5.5	$\pm 12$	$\pm 42$	233	86.5
TRA 1-0523	4.5-5.5	$\pm 15$	$\pm 34$	236	86.5
TRA 1-1211	10.8-13.2	5	200	99	84
TRA 1-1219	10.8-13.2	9	110	95	86.5
TRA 1-1212	10.8-13.2	12	84	95	88.5
TRA 1-1213	10.8-13.2	15	67	95	88
TRA 1-1221	10.8-13.2	$\pm 5$	$\pm 100$	99	84.5
TRA 1-1224	10.8-13.2	$\pm 9$	$\pm 56$	98	86
TRA 1-1222	10.8-13.2	$\pm 12$	$\pm 42$	95	88.5
TRA 1-1223	10.8-13.2	$\pm 15$	$\pm 34$	94	87.5
TRA 1-2411	21.6-26.4	5	200	50	84
TRA 1-2419	21.6-26.4	9	110	48	86.5
TRA 1-2412	21.6-26.4	12	84	48	87.5
TRA 1-2413	21.6-26.4	15	67	48	87.5
TRA 1-2421	21.6-26.4	$\pm 5$	$\pm 100$	50	83.5
TRA 1-2424	21.6-26.4	$\pm 9$	$\pm 56$	49	86
TRA 1-2422	21.6-26.4	$\pm 12$	$\pm 42$	48	87
TRA 1-2423	21.6-26.4	$\pm 15$	$\pm 34$	49	87

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, 12Vin, 24Vin with maximum rating of 500mA, 200mA, 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.

**MTBF and Reliability**

The MTBF of TRA 1 series of DC/DC converters has been calculated using MIL-HDBK 217F NOTICE2, Operating Temperature 25°C, Ground Benign.

Model	MTBF	Unit
TRA 1-0511	5,301,524	Hours
TRA 1-0519	3,944,773	Hours
TRA 1-0512	2,857,143	Hours
TRA 1-0513	2,343,292	Hours
TRA 1-0521	5,194,805	Hours
TRA 1-0524	3,988,036	Hours
TRA 1-0522	2,944,424	Hours
TRA 1-0523	2,419,842	Hours
TRA 1-1211	5,333,334	Hours
TRA 1-1219	3,962,358	Hours
TRA 1-1212	2,865,330	Hours
TRA 1-1213	2,348,796	Hours
TRA 1-1221	5,225,343	Hours
TRA 1-1224	4,006,009	Hours
TRA 1-1222	2,953,119	Hours
TRA 1-1223	2,425,713	Hours
TRA 1-2411	4,901,961	Hours
TRA 1-2419	3,838,771	Hours
TRA 1-2412	2,737,850	Hours
TRA 1-2413	2,262,443	Hours
TRA 1-2421	4,810,583	Hours
TRA 1-2424	3,757,633	Hours
TRA 1-2422	2,817,894	Hours
TRA 1-2423	2,333,722	Hours

Specifications can be changed without notice