AC-DC SWITCHING ADAPTER
TR36M Series
APPLICATION NOTE

Approved By:

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TR36M Series

Application Note V12 April 2019

Content

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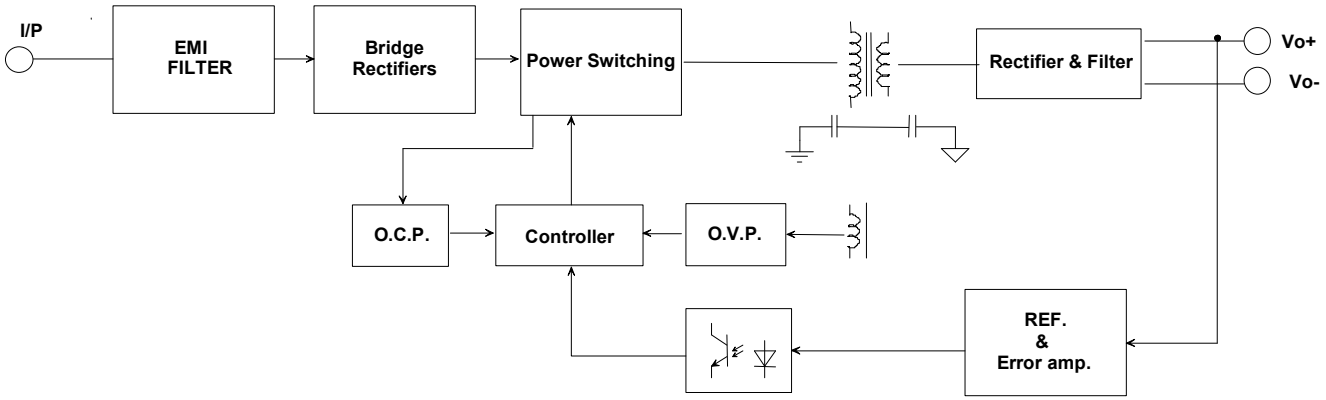
1. Introduction

This application note describes the features and functions of Cincon's TR36M series of adapter, switching AC-DC power. These are highly efficient, reliable, compact, high power density, single output AC/DC power. The power is fully protected against short circuit and over-voltage conditions. Cincon's world class automated manufacturing methods, together with an extensive testing and qualification program, ensure that the TR36M series power is extremely reliable.

2. TR36M Series Features

- Universal Input Range 80~264VAC
- Continuous Short Circuit Protection
- Over Voltage Protection
- Approved EN55011, FCC CFR47 Part 15 Class B
- Meets EN60335-1
- Approved EN60601-1-11 for Home Healthcare Applications
- Meets CoC Tier 2 & DoE Level VI
  (Output Cable Length ≦1800mm)
  (TR36M050:Output Cable Length ≦1220mm)
- No Load Power Consumption <75mW
- Low Leakage Current <80uA
- Meets 2MOPP Class II

3. Electrical Block Diagram



4. Technical Specifications

(All specifications are typical at nominal input, full load at 25℃ unless otherwise noted.)

ABSOLUTE MAXIMUM RATINGS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Input Voltage	See Derating Curve	All	80		264	Vac
			120		370	Vdc
Operating Temperature	See derating Curve	All	-30		+60	℃
Storage Temperature		All	-30		+85	℃
Input/Output Isolation Voltage		All	4000			Vac
Altitude		All			5000	m

INPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Operating Voltage Range		All	100		240	Vac
Input Frequency Range		All	47		63	Hz
Maximum Input Current	100% Load, Vin=100Vac	All			0.9	A
Leakage Current		All			80	uA
Inrush Current	Vin=240Vac, Cold Start at 25℃.	All			100	A

OUTPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Output Voltage Set Point	Voltage Setpoint at 60% Full Load. Tc=25℃	TR36M050		5		Vdc
		TR36M090		9		
		TR36M120		12		
		TR36M135		13.5		
		TR36M150		15		
		TR36M180		18		
		TR36M240		24		
		TR36M360		36		
		TR36M480		48		
Operating Output Current Range		TR36M050			5	A
		TR36M090			3.3	
		TR36M120			2.5	
		TR36M135			2.4	
		TR36M150			2.4	
		TR36M180			2	
		TR36M240			1.5	
		TR36M360			1	
		TR36M480			0.75	
Holdup Time	Vin=115Vac	All		10		ms

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Output Voltage Regulation						
Load Regulation	From 60% to Full Load and From 60% to 20% Load	TR36M050 TR36M090 TR36M120 TR36M135 TR36M150 TR36M180 TR36M240 TR36M360 TR36M480			±6 ±4 ±2 ±2 ±2 ±2 ±2 ±2 ±2	%
Line Regulation	Vin=High Line to Low Line, Full Load	All			±1	%
Over Voltage Protection		TR36M050 TR36M090 TR36M120 TR36M135 TR36M150 TR36M180 TR36M240 TR36M360 TR36M480			7.44 12.6 15.9 18.5 21.5 24.8 31.5 45.2 59.6	VDC
Output Ripple and Noise	1. Add a 0.1uF Ceramic Capacitor and a 10uF Aluminum Electrolytic Capacitor to Output 2. Oscilloscope is 20MHz Bandwidth. 3. Ambient Temperature=25℃	TR36M050 TR36M090 TR36M120 TR36M135 TR36M150 TR36M180 TR36M240 TR36M360 TR36M480			100 120 120 130 150 180 240 360 480	mVp-p
Load Capacitance	1. Ambient Temperature=25℃ 2. Input Voltage is 115VAC and 230VAC 3. Output is max. Load	TR36M050 TR36M090 TR36M120 TR36M135 TR36M150 TR36M180 TR36M240 TR36M360 TR36M480			5000 3300 2500 2400 2400 2000 1500 1000 750	uF
Efficiency	Average Efficiency Measured at 25%, 50%, 75%, 100% Load and Input Voltage is 115Vac/230Vac.	TR36M050 TR36M090 TR36M120 TR36M135 TR36M150 TR36M180 TR36M240 TR36M360 TR36M480	85.00 87.70 87.70 87.97 88.3 88.3 88.3 88.3 88.3			%

ISOLATION CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Input to Output	1 Minute	All			4000	Vac
Isolation Resistance		All	100			MΩ

FEATURE CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Switching Frequency		All		65		KHz

GENERAL SPECIFICATIONS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
MTBF	Vin=115Vac, Io=100%, Ta=25℃ Per MIL-HDBK-217F	TR36M050 TR36M090 TR36M120 TR36M135 TR36M150 TR36M180 TR36M240 TR36M360 TR36M480		1081,200 1001,030 840,074 769,884 950,326 980,650 977,277 966,266 880,394		hours
Weight		All		150		g
Safety	Class II, IEC60601-1, EN60601-1-11, EN60601-1, ANSI/AAMI ES60601-1					Ed.3.1
EMC Emission	EN55011 Class B, EN61000-3-2:2014, EN6100-3-3:2013, FCC CFR47 Part 15					Ed.4.0
Conducted disturbance	EN55011, FCC CFR47 Part 15					
Radiated disturbance	EN55011, FCC CFR47 Part 15,					
Harmonic current emissions	EN61000-3-2:2014					
Voltage fluctuations & flicker	EN61000-3-3:2013					
EMC Immunity	EN60601-1-2:2015, IEC61000-4-2,3,4,5,6,8,11					
Electrostatic discharge (ESD)	IEC 61000-4-2:2008					Criteria A
Radio Frequency electromagnetic field (RS)	IEC 61000-4-3:2010					Criteria A
Electrical fast transient (EFT)	IEC 61000-4-4:2012					Criteria A
Surge	IEC 61000-4-5:2014					Criteria A
Conducted disturbances, induced by RF fields	IEC 61000-4-6:2013					Criteria A
Voltage dips and interruptions	IEC 61000-4-11:2004					Criteria B

5. Main Features and Functions

5.1 Operating Temperature Range

The highly efficient design of Cincon's TR36M series power has resulted in their ability to operate within ambient temperature environments from -30℃ to 60℃. Due consideration must be given to the de-rating curves when ascertaining the maximum power that can be drawn from the power. The maximum power which can be drawn is influenced by a number of factors, such as:

- Input voltage range
- Permissible Output load (per derating curve)

5.2 Output Current Protection

All different voltage models have a full continuous short-circuit protection. The unit will auto recover once the short circuit is removed. To provide protection in a fault condition, the unit is equipped with internal over-current protection. The unit operates normally once the fault condition is removed. The power module will supply up to 120% - 140% of rated current. In the event of an over current converter will go into a hiccup mode protection.

6. EMC & Safety

■ Emission and Immunity(Ed4.0)

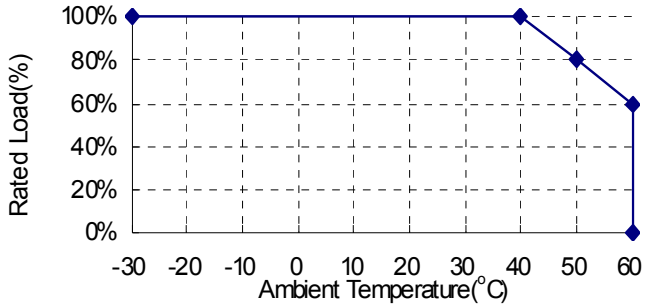
EN55011, EN60601-1-2, EN61000-3-2
EN61000-3-3, IEC61000-4-2, 3, 4, 5, 6, 8, 11
FCC CFR47 Part 15 Class B

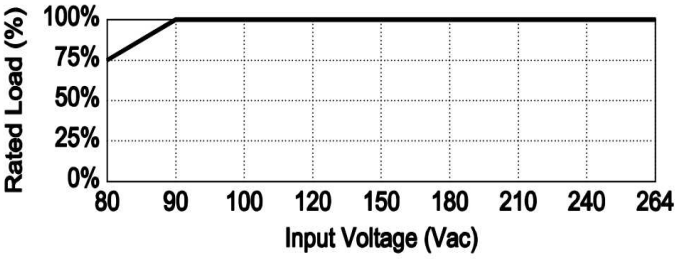
■ Safety (Ed3.1)

IEC60601-1:2005+A1, EN60601-1-11
EN60601-1:2006+A11:2011+A1+A12
ANSI/AAMI ES60601-1:2005/A1:2012

7. Applications

7.1 Power De-Rating Curve





7.2 Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown in Figure 1. When testing the Cincon's TR36M series under any transient conditions, please ensure that the transient response of the source is sufficient to power the equipment under test. We can calculate the

- Efficiency
- Load regulation and line regulation.

The value of efficiency is defined as:

$$\eta = \frac{Vo \times Io}{Pin} \times 100\%$$

Where:

Vo is output voltage,
Io is output current,
Pin is input power

The value of load regulation is defined as:

$$Load\ reg. = \frac{V_{FL} - V_{NL}}{V_{NL}} \times 100\%$$

Where:

V_{FL} is the output voltage at full load
V_{NL} is the output voltage at 10% load

The value of line regulation is defined as:

$$Line\ reg. = \frac{V_{HL} - V_{LL}}{V_{LL}} \times 100\%$$

Where :

V_{HL} is the output voltage of maximum input voltage at full load. V_{LL} is the output voltage of minimum input voltage at full load.

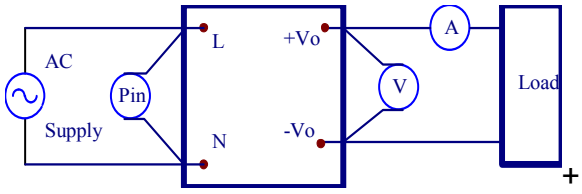


Figure 1. TR36M Series Test Setup

7.3 Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown in Figure 2 Measured method:

Add a 0.1 uF ceramic capacitor and a 10 uF electrolytic capacitor to output at 20 MHz Band Width.

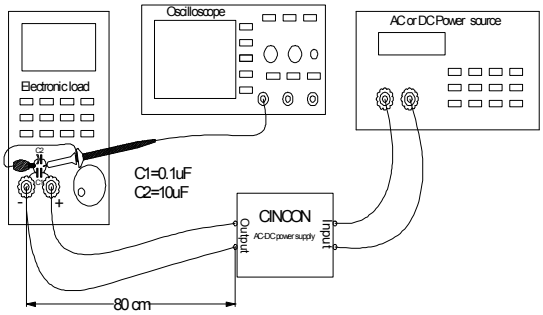
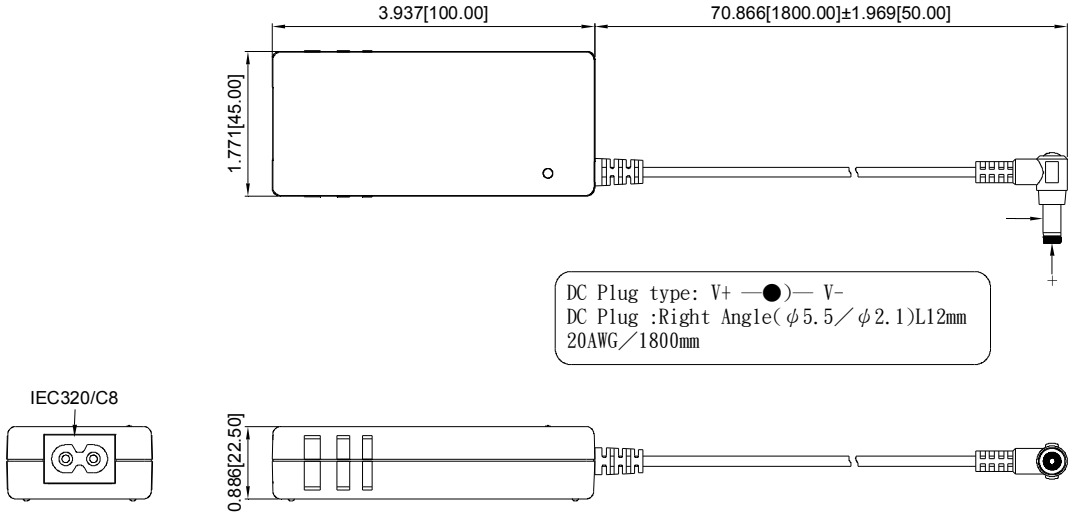


Figure 2. Output Voltage Ripple and Noise Measurement Set-Up

8. TR36M Series Mechanical Outline Diagrams

All Dimensions are in inches[mm]
Tolerance:Inches:X.XXX±0.02
Millimeters:X.XX±0.5



9. Part Number

TR36M XXX - XX X XX

SERIES

- 050：Output Voltage 5 VDC
- 090：Output Voltage 9 VDC
- 120：Output Voltage 12 VDC
- 135：Output Voltage 13.5 VDC
- 150：Output Voltage 15 VDC
- 180：Output Voltage 18 VDC
- 240：Output Voltage 24 VDC
- 360：Output Voltage 36 VDC
- 480：Output Voltage 48 VDC

DC Plug Type

G: UL1571 WITH OVP
E: UL1185 WITH OVP
* 16AWG / UL1571 or Equivalent for Vo: 5V
* 18AWG / UL1571 or Equivalent for Vo: 9V,12V,13.5V
* 20AWG / UL1571 or Equivalent for Vo: 15V,18V,24V
* 20AWG / UL1185 or Equivalent for Vo: 36V,48V

DC Cable Length and Type
01: 720mm
02: 1220mm
03: 1800mm
11: 720mm with Ferrite Core
12: 1220mm with Ferrite Core
13: 1800mm with Ferrite Core

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