MINMAX®

ACF-10 Series

Electric Characteristic Note

ACF-10 Series EC Note

AC-DC Power Module 10W

Features

- **Ultra Compact Size 1.5 x 1.0 x 0.6"**
- **Fully Encapsulated Module for PCB Mounting**
- **Universal Input 85-264VAC, 47-440Hz**
- **I/O Isolation 4000VAC with Reinforced Insulation**
- **No Min. Load Requirement**
- **Operating Ambient Temp. Range -25℃ to +70℃**
- **Overload/Voltage and Short Circuit Protection**
- **EMI Emission EN 55032/14-1 Class B Approved**
- **EMC Immunity EN 61000-4-2,3,4,5,6,8,11 Approved**
- **Eco Design, Low No Load Power Consumption< 150mW**
- **Safety Approval to UL/cUL/IEC/EN 62368-1(60950-1), TUV IEC/EN 60335-1 & CE Marking**

Applications

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

Product Overview

The ACF-10 Series is a range of ultra-small, fully encapsulated 10 Watt AC-DC power supply modules. They are designed for easy PCB mounting featuring measuring only 1.5"x1"x0.6". The ACF-10 series consist 7 models featuring universal AC input (85-264VAC) and fixed regulated single output voltage ranging from 3.3-48VDC; 4000VAC isolation with reinforced insulation; EMI emission EN 55032/14-1 Class B approved; EMC immunity EN 61000-4-2,3,4,5,6,8,11 approved; no minimum load requirement; short circuit / overload / overvoltage protection and low stand-by power consumption.

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Model Selection Guide

Model Number	Output Voltage	Output Current		Input Current		Max. capacitive Load	Efficiency (typ.)
				115VAC, 60Hz	230VAC, 50Hz		
		Max.	Peak(1)	@Max. Load			@Max. Load, 115VAC
	VDC	mA	mA	mA(typ.)		μF	%
ACF-10S03	**3.3**	**2600**	3380	186	121	4400	77
ACF-10S05	**5**	**2000**	2600	209	136	2200	80
ACF-10S09	**9**	**1100**	1440	199	130	680	83
ACF-10S12	**12**	**830**	1080	198	129	390	84
ACF-10S15	**15**	**660**	860	197	128	240	84
ACF-10S24	**24**	**410**	530	191	124	100	86
ACF-10S48	**48**	**210**	270	201	130	24	84

Input Specifications

Parameter	Conditions / Model	Min.	Typ.	Max.	Unit
Input Voltage Range	All Models	85	---	264	VAC
Input Frequency Range		47	---	440	Hz
Input Voltage Range		120	---	370	VDC
No-Load Power Consumption		---	---	0.15	W
Inrush Current (Cold Start at 25℃)	115VAC	---	---	20	A
	230VAC	---	---	40	A

Output Specifications

Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy			---	±1.0	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load		---	---	±0.5	%
Load Regulation	Io=0% to 100%		---	---	±1.0	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	3.3V & 5VDC Output Models	---	---	60	mV_{P-P}
		Other Output Models	---	---	1	$\%V_{PP}$ of Vo
Over Voltage Protection	Zener diode clamp		---	125	---	% of Vo
Temperature Coefficient			---	±0.01	±0.02	%/℃
Over Load Protection	Foldback, auto-recovery (long term overload condition may cause damage)		---	150	---	%Inom.
Short Circuit Protection	Hiccup mode, Automatic Recovery					

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds	4000	---	---	VAC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
Switching Frequency		---	45	---	kHz
Hold-up Time	115VAC, 60Hz	---	8	---	ms
	230VAC, 50Hz	---	40	---	ms
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	452,916	---	---	Hours
Safety Approvals	UL/cUL 60950-1 recognition(UL certificate), IEC/EN 60950-1(CB-report)				
	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1(CB-report)				
	IEC/EN 60335-1 recognition(TUV certificate,CB-report)				

EMC Specifications

Parameter	Standards & Level			Performance
EMI	Conduction	EN 55014-1, EN 55032	Without external components	Class B
	Radiation			
EMS	EN 55014-2, EN 55024			
	ESD	EN 61000-4-2 Air ± 8kV , Contact ± 6kV		A
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient	EN 61000-4-4 ±2kV		A
	Surge	EN 61000-4-5 ±1kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
	PFMF	EN 61000-4-8 30A/m		A
	Dips	EN 61000-4-11 30% 10ms		A
	Interruptions	EN 61000-4-11 >95% 5000ms		B

Environmental Specifications

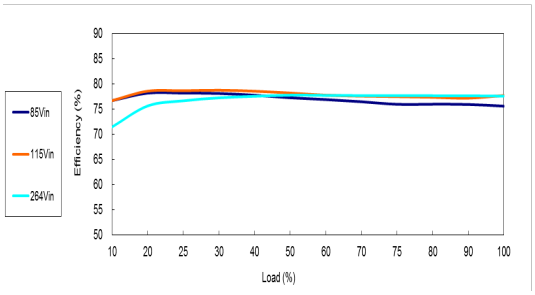
Parameter	Conditions	Min.	Max.	Unit
Operating Ambient Temperature Range		-25	+70	℃
Power Derating	+50℃ to +70℃	0.25		W / ℃
Storage Temperature Range		-40	+85	℃
Humidity (non condensing)		---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)		---	260	℃

Notes

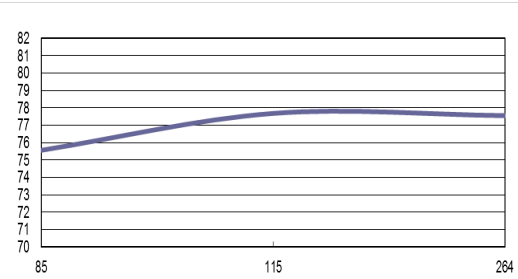
1. Peak load lasting <30s with a maximum duty cycle of 10%, average output power not to exceed maximum power.
2. All specifications typical at Ta=+25℃, resistive load, 115VAC, 60Hz input voltage and after warm-up time rated output current unless otherwise noted.
3. We recommend to protect the converter by a slow blow fuse in the input supply line.
4. Other input and output voltage may be available, please contact MINMAX.
5. Specifications are subject to change without notice.

Characteristic Curves

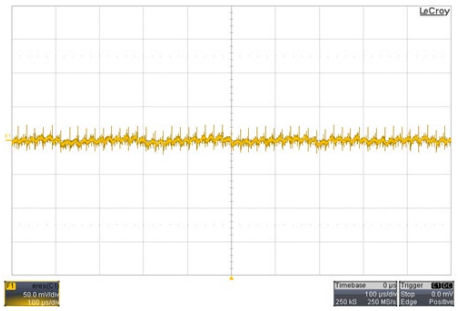
All test conditions are at 25°C The figures are identical for ACF-10S03



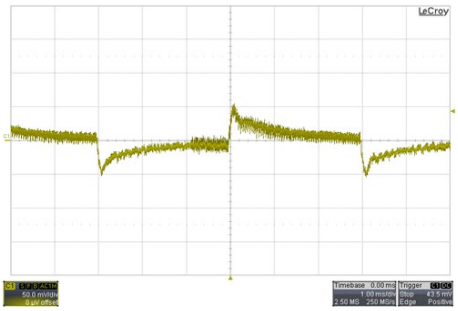
Efficiency Versus Output Current



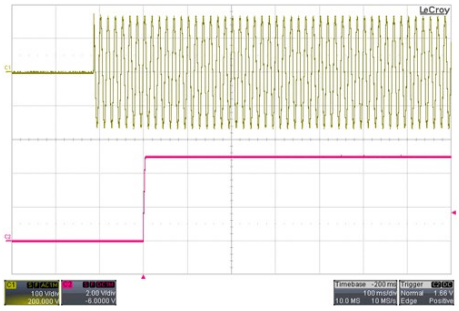
Efficiency Versus Input Voltage
Full Load



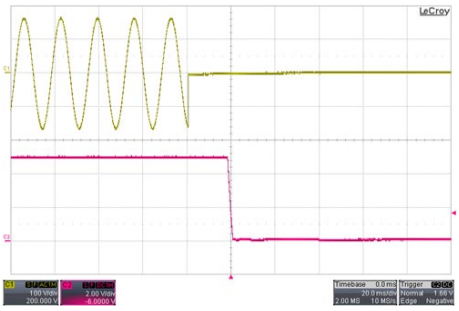
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



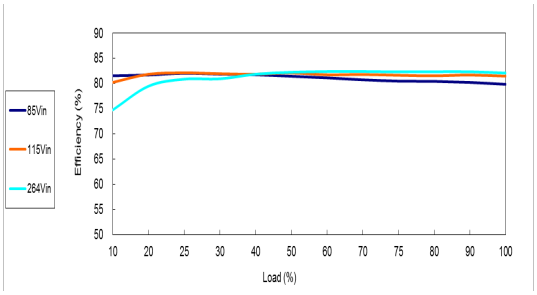
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



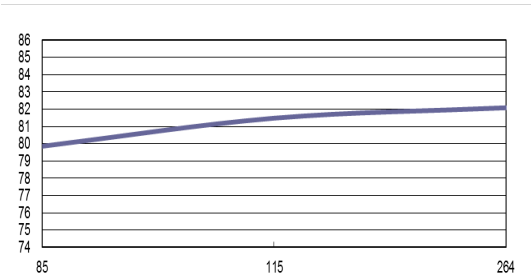
Typical Input Hold-up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

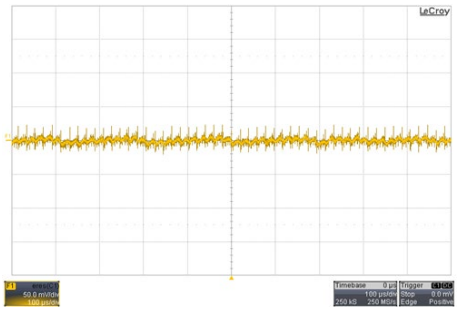
All test conditions are at 25℃ The figures are identical for ACF-10S05



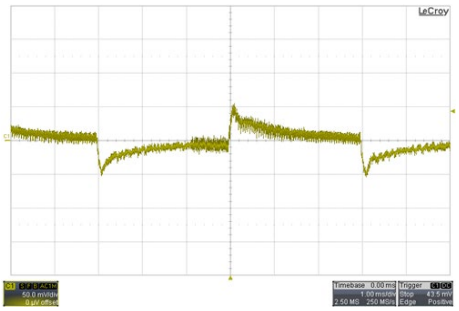
Efficiency Versus Output Current



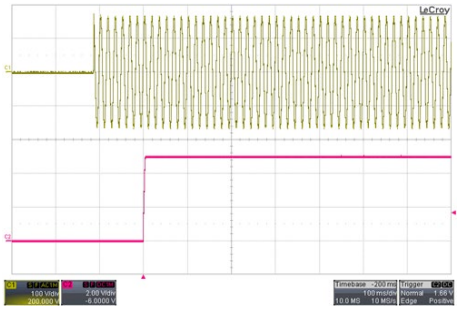
Efficiency Versus Input Voltage
Full Load



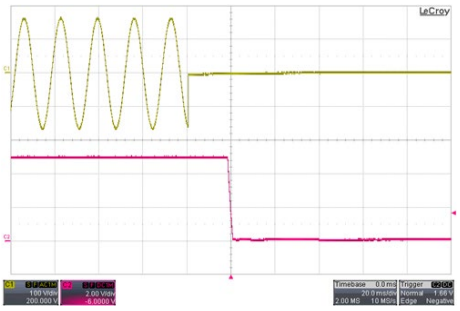
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



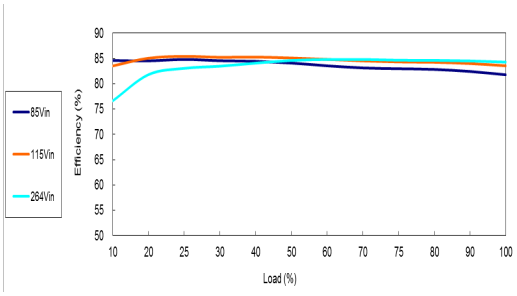
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



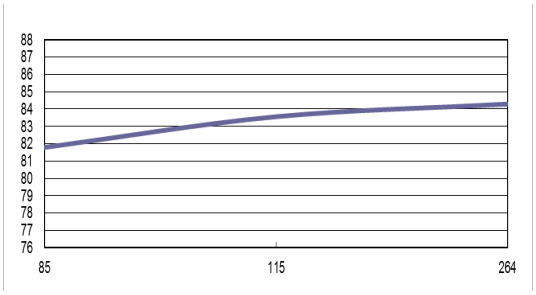
Typical Input Hold-up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

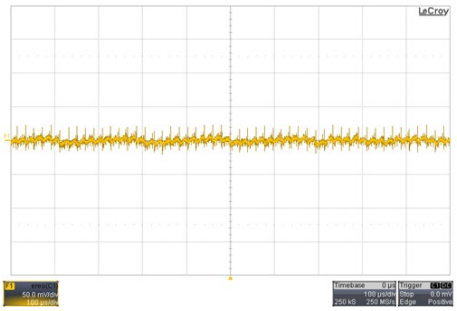
All test conditions are at 25°C The figures are identical for ACF-10S09



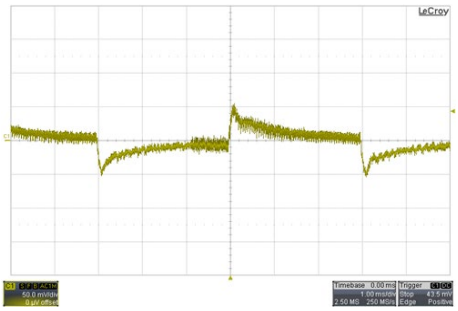
Efficiency Versus Output Current



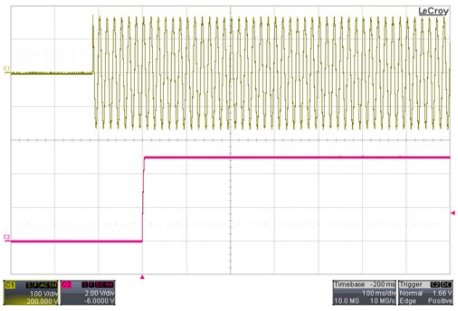
Efficiency Versus Input Voltage
Full Load



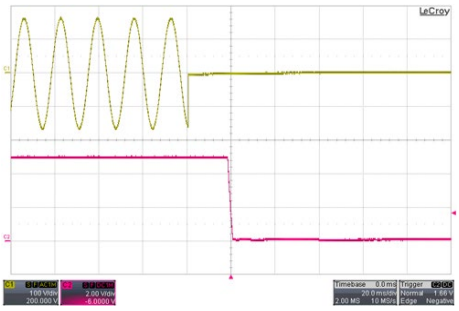
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



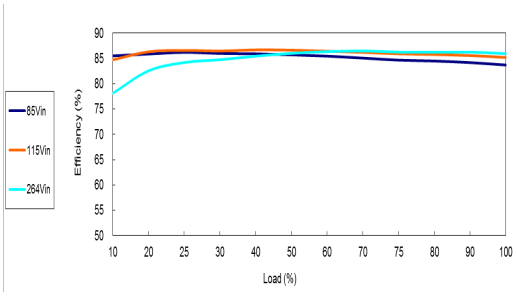
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



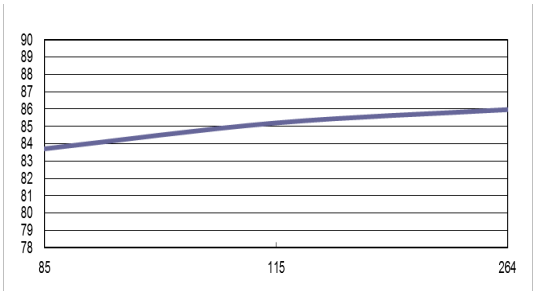
Typical Input Hold-up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

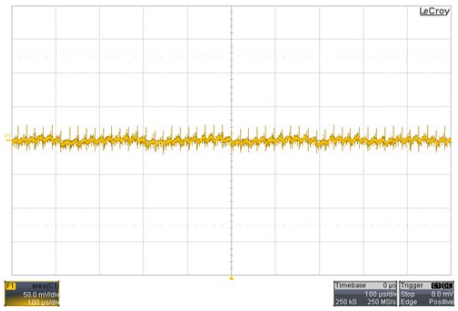
All test conditions are at 25℃ The figures are identical for ACF-10S12



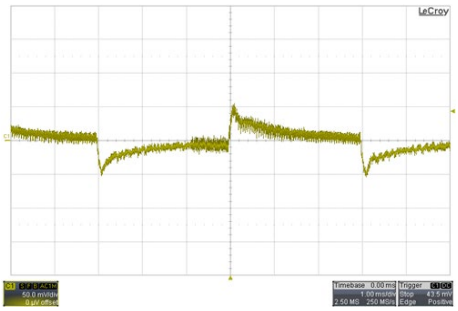
Efficiency Versus Output Current



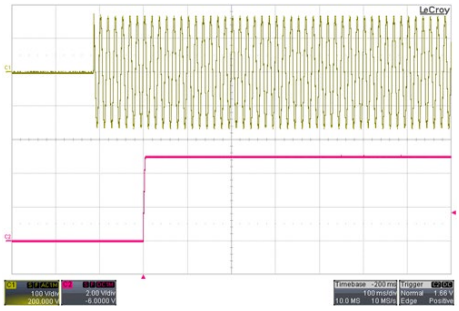
Efficiency Versus Input Voltage
Full Load



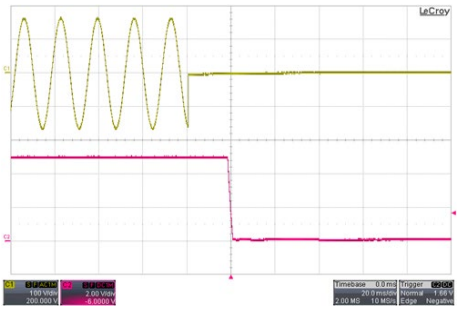
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



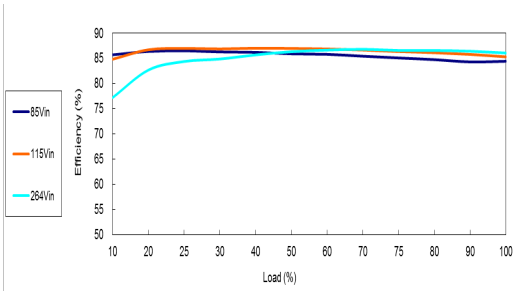
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



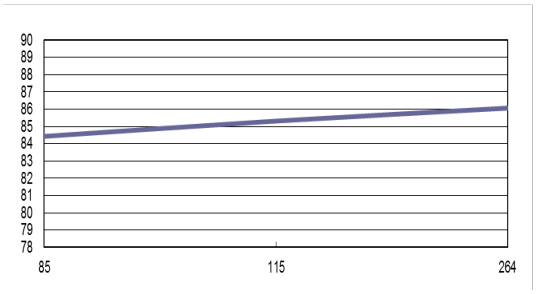
Typical Input Hold-up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

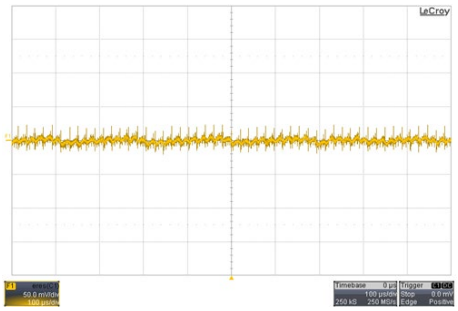
All test conditions are at 25°C The figures are identical for ACF-10S15



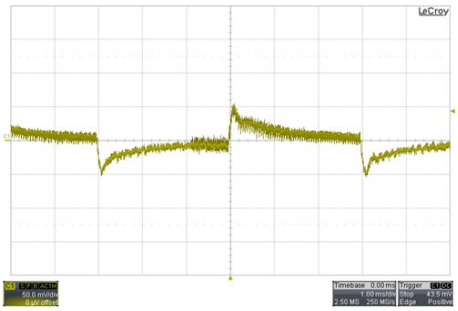
Efficiency Versus Output Current



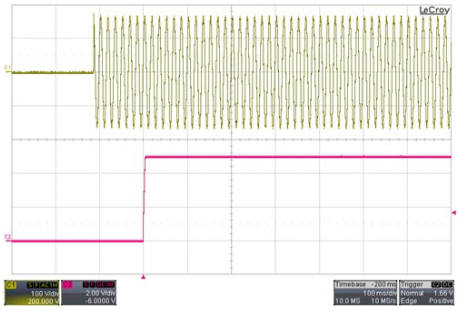
Efficiency Versus Input Voltage
Full Load



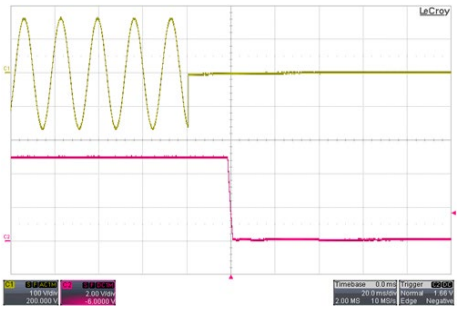
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



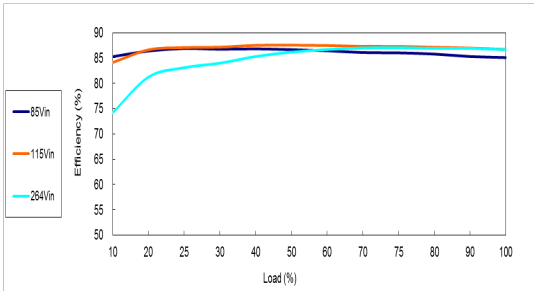
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



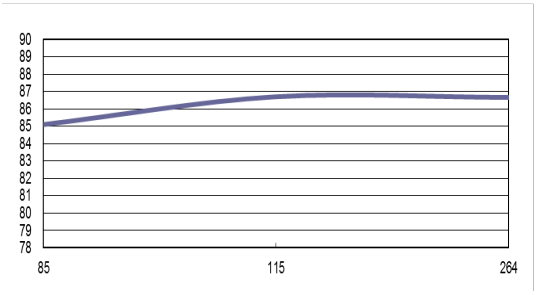
Typical Input Hold-up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

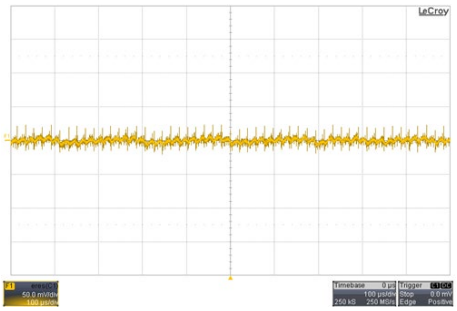
All test conditions are at 25℃ The figures are identical for ACF-10S24



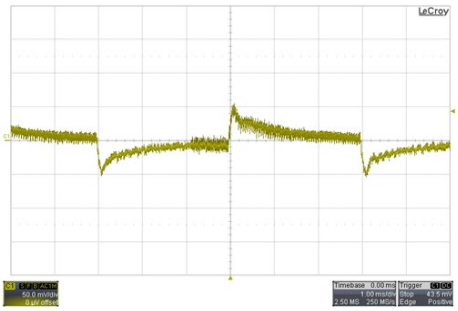
Efficiency Versus Output Current



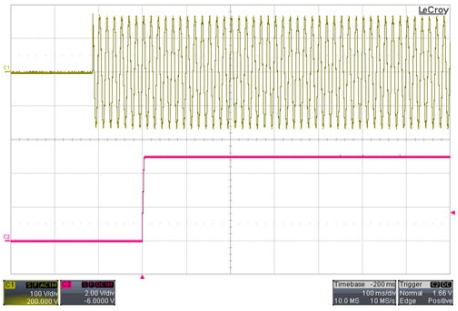
Efficiency Versus Input Voltage
Full Load



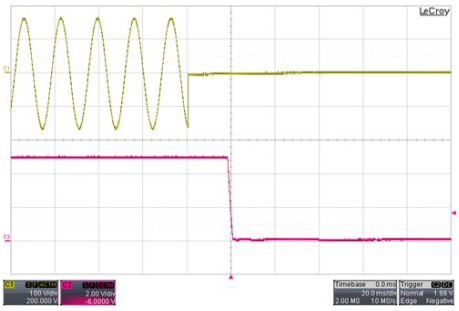
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



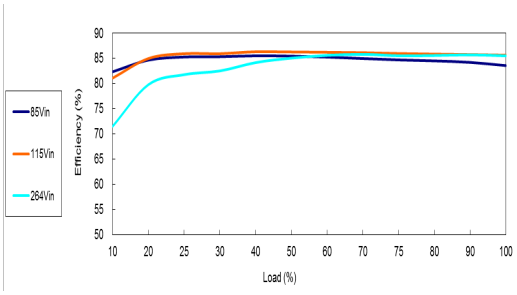
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



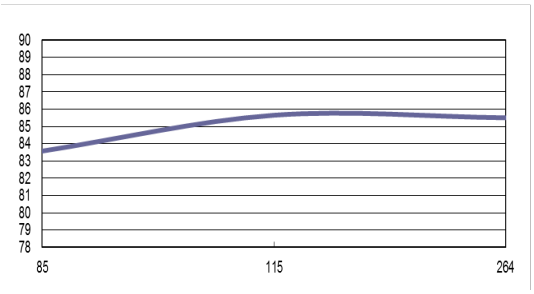
Typical Input Hold-up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load

Characteristic Curves

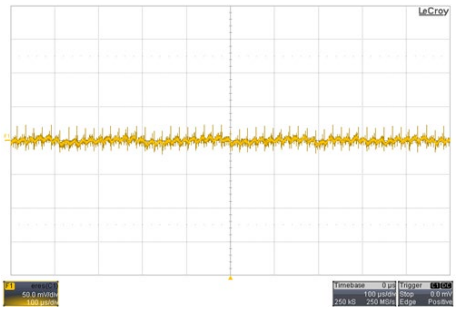
All test conditions are at 25℃ The figures are identical for ACF-10S48



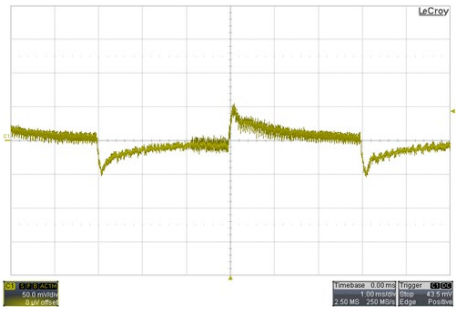
Efficiency Versus Output Current



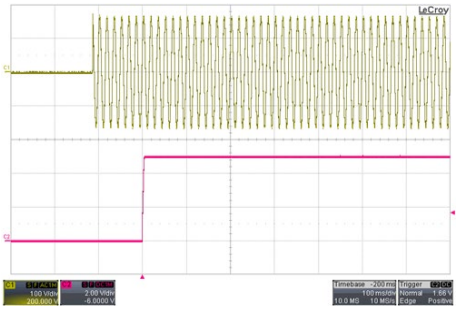
Efficiency Versus Input Voltage
Full Load



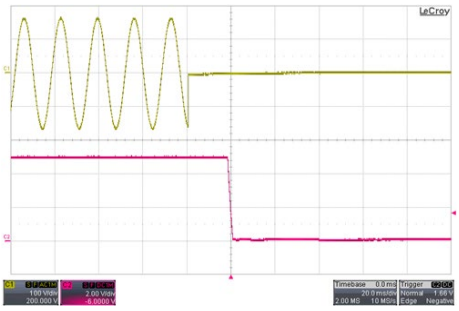
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



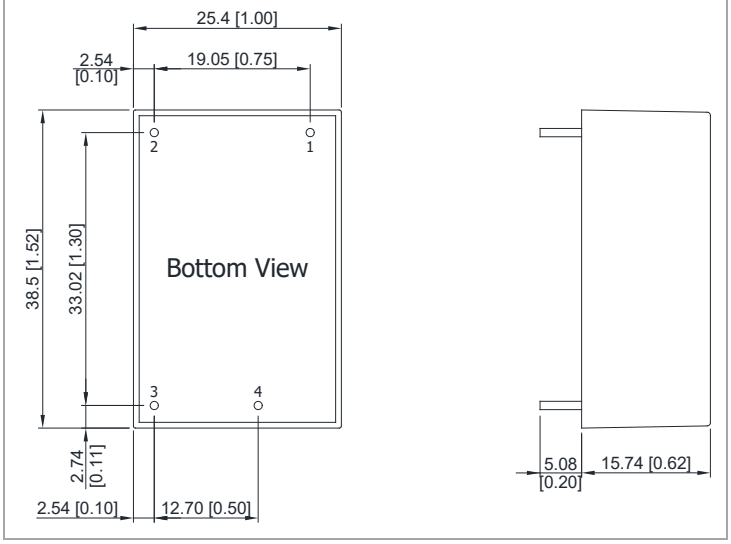
Typical Input Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



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

Package Specifications

Mechanical Dimensions



Pin Connections

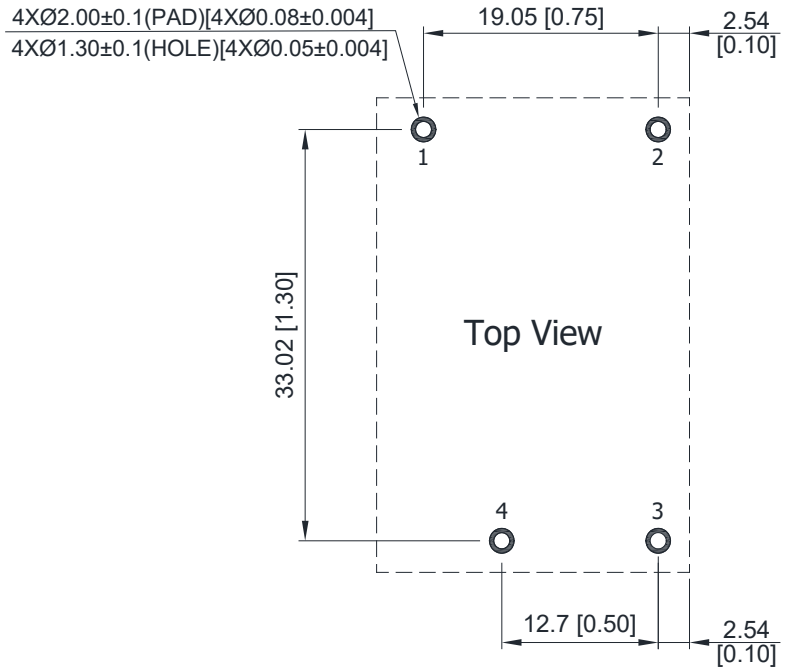
Pin	Function	Diameter mm (inches)
1	AC(N)	Ø 1.0 [0.04]
2	AC(L)	Ø 1.0 [0.04]
3	-Vout	Ø 1.0 [0.04]
4	+Vout	Ø 1.0 [0.04]

- All dimensions in mm (inches)
- Tolerance: ±0.5 (±0.02)
- Pin pitch tolerance: ±0.25 (±0.01)
- Pin diameter tolerance: X.X±0.1 (X.XX±0.004)

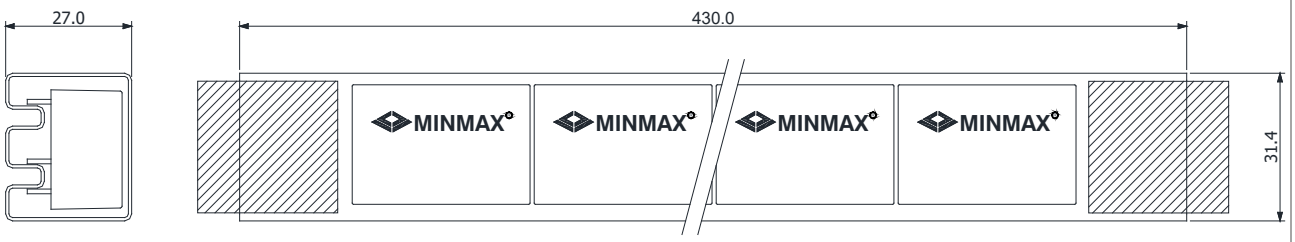
Physical Characteristics

Case Size	:	38.5x25.4x15.74mm (1.52x1.00x0.62 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Pin Material	:	Copper Alloy
Weight	:	29g

Recommended Pad Layout



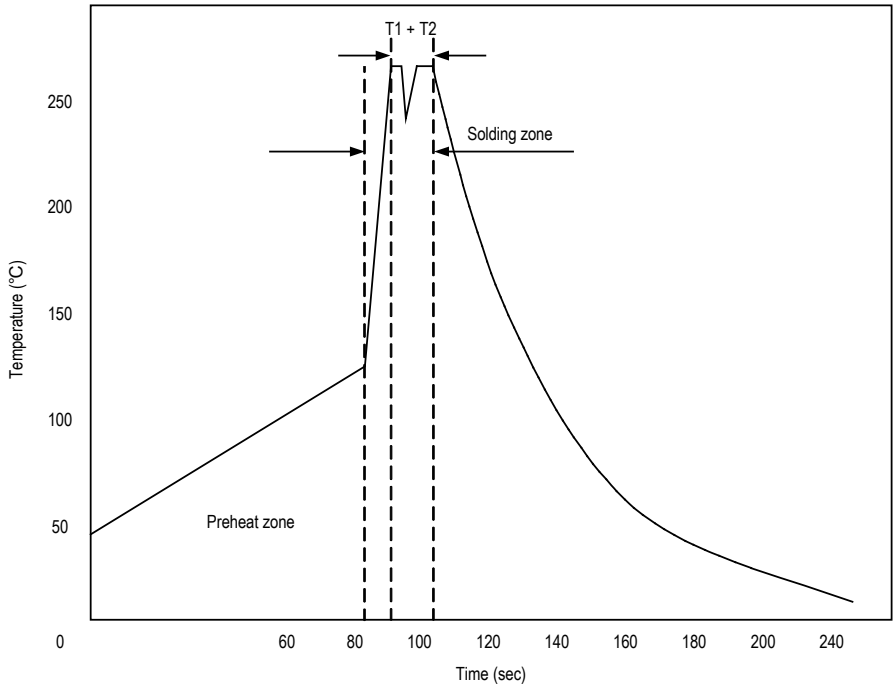
Packaging Information



Unit: mm
10 PCS per Tube

Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat	Rise temp. speed：3℃/sec max.
zone	Preheat temp.：100~130℃
Actual	Peak temp.：250~260℃
heating	Peak time(T1+T2)：4~6 sec

Hand Welding Parameter

Reference Solder: Sn-Ag-Cu：Sn-Cu：Sn-Ag

Hand Welding: Soldering iron：Power 60W

Welding Time: 2~4 sec

Temp.: 380~400℃

Part Number Structure

ACF	-	10	S	03

Output Power	Output Quantity	Output Voltage		
10 Watt	S:	Single		
		03:	3.3	VDC
		05:	5	VDC
		09:	9	VDC
		12:	12	VDC
		15:	15	VDC
		24:	24	VDC
		48:	48	VDC

MTBF and Reliability

The MTBF of ACF-10 series of AC-DC Power Module has been calculated using

MIL-HDBK 217F NOTICE2, Operating Temperature 25°C, Ground Benign.

Model	MTBF	Unit
ACF-10S03	452,916	Hours
ACF-10S05	469,582	
ACF-10S09	564,573	
ACF-10S12	606,988	
ACF-10S15	604,913	
ACF-10S24	614,998	
ACF-10S48	595,110	