



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°C to +70°C
- ▶ 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°C)	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	%°C	
Over Load Protection	Hiccup mode, 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°C, 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)					

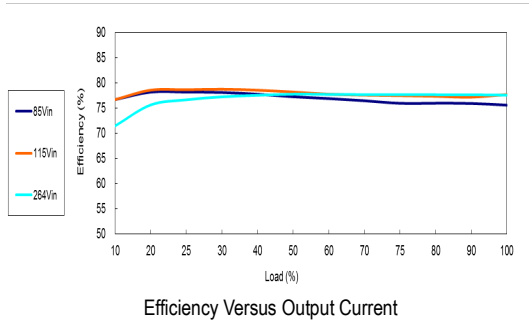
EMC Specifications				
Parameter	Standards & Level			Performance
EMI	Conduction	EN 55014-1, EN 55032	Without external components	Class B
	Radiation			
EMS	EN 55014-2, EN 55035			
	ESD	EN 61000-4-2 Air \pm 8kV , Contact \pm 6kV		A
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient	EN 61000-4-4 \pm 2kV		A
	Surge	EN 61000-4-5 \pm 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	°C
Power Derating	+50°C to +70°C	0.25		W / °C
Storage Temperature Range		-40	+85	°C
Humidity (non condensing)		---	95	% rel. H
Lead Temperature (1.5mm from case for 10Sec.)		---	260	°C

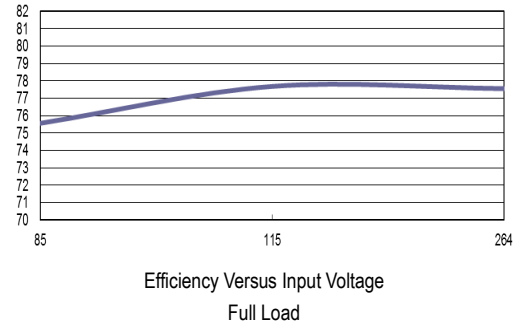
Notes	
1	Peak load lasting <30s with a maximum duty cycle of 10%, average output power not to exceed maximum power.
2	All specifications typical at Ta=+25°C, resistive load, 115VAC, 60Hz input voltage and after warm-up time rated output current unless otherwise noted.
3	We recommend to protect the converter 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

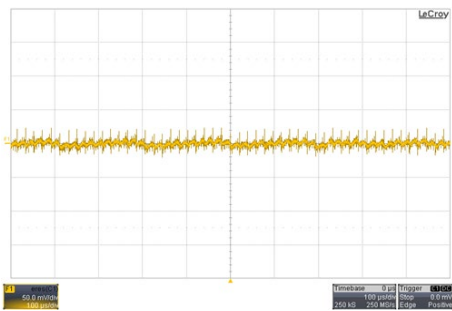
All test conditions are at 25°C The figures are identical for ACF-10S03



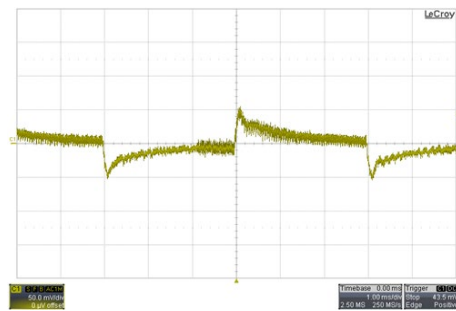
Efficiency Versus Output Current



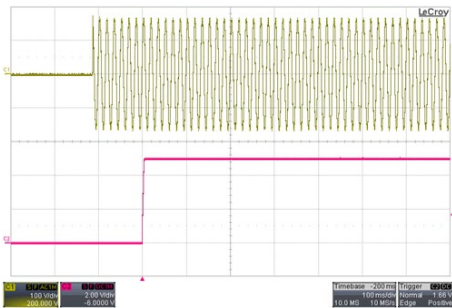
Efficiency Versus Input Voltage Full Load



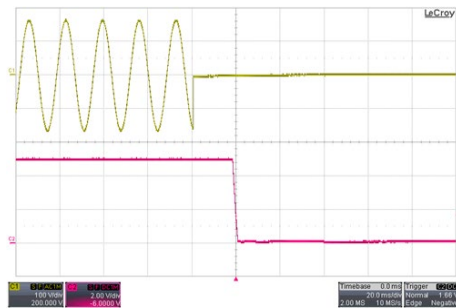
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



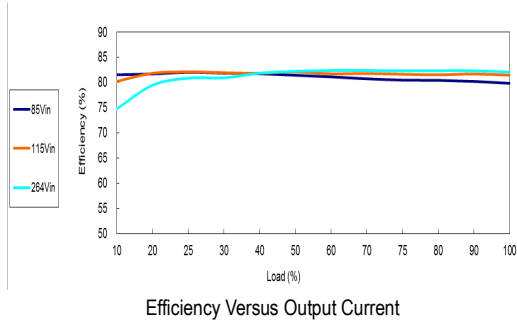
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



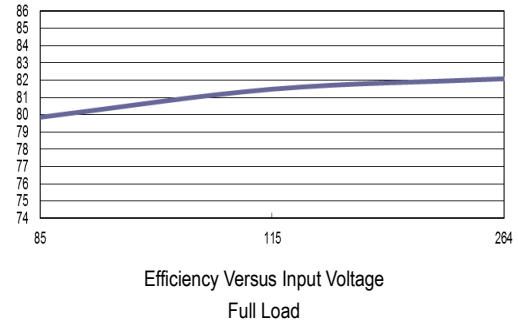
Typical Input Hold-up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load

Characteristic Curves

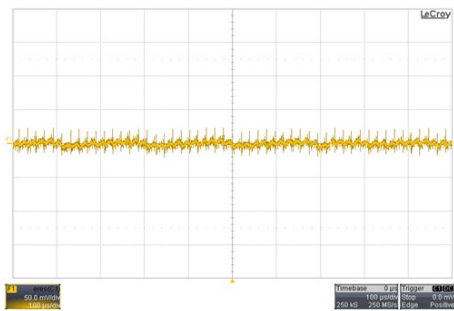
All test conditions are at 25°C The figures are identical for ACF-10S05



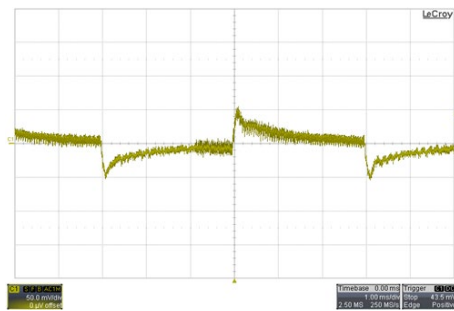
Efficiency Versus Output Current



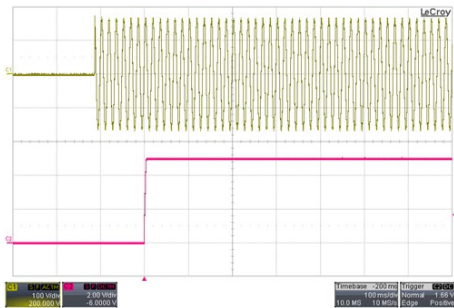
Efficiency Versus Input Voltage Full Load



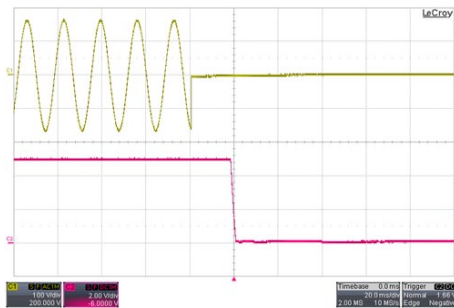
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



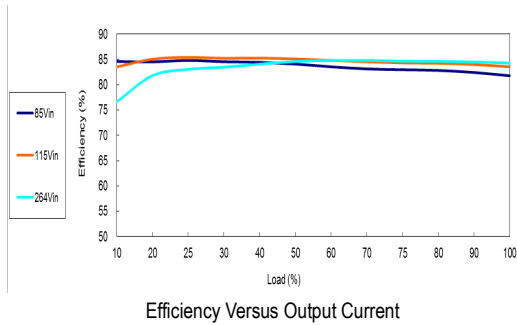
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



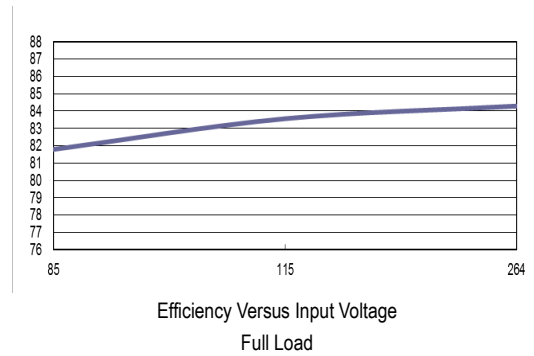
Typical Input Hold-up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load

Characteristic Curves

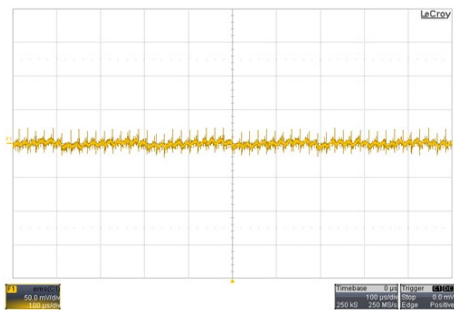
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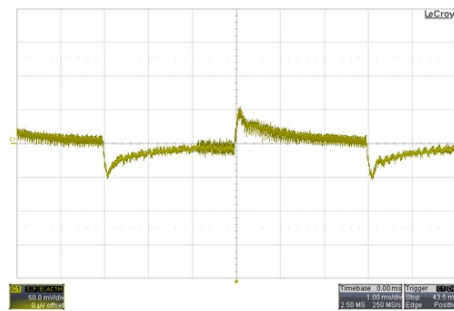
Efficiency Versus Output Current



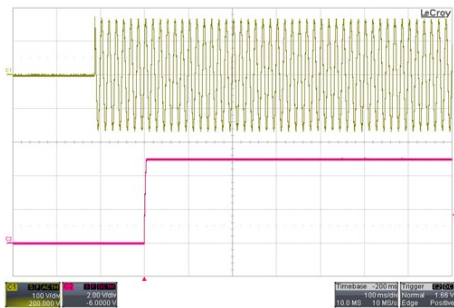
Efficiency Versus Input Voltage Full Load



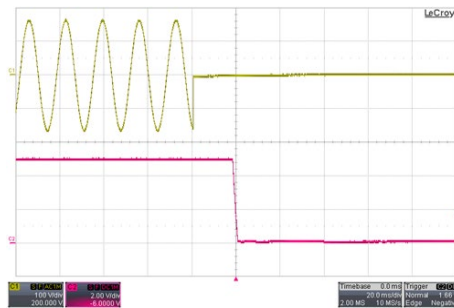
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



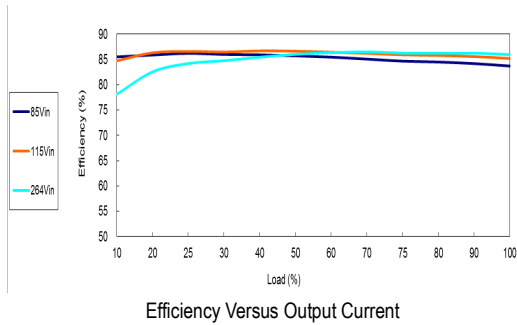
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



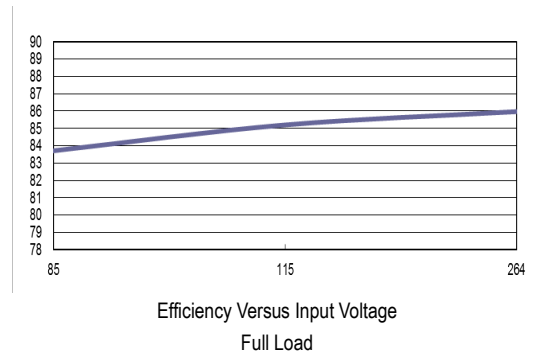
Typical Input Hold-up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load

Characteristic Curves

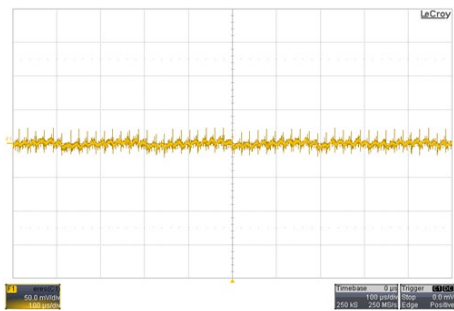
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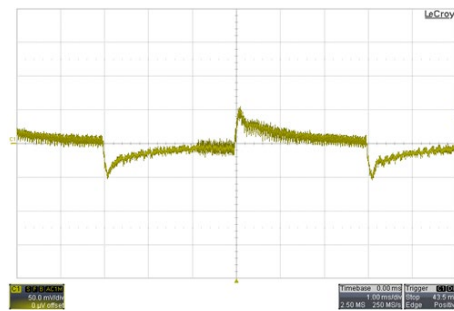
Efficiency Versus Output Current



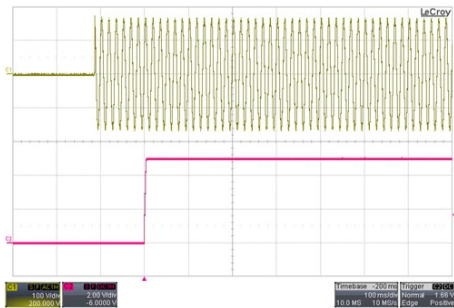
Efficiency Versus Input Voltage Full Load



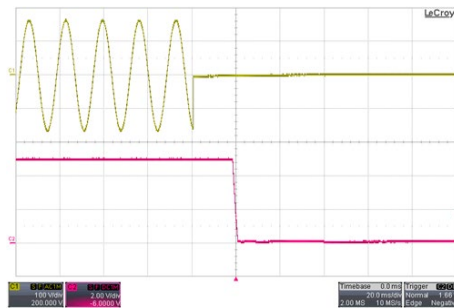
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



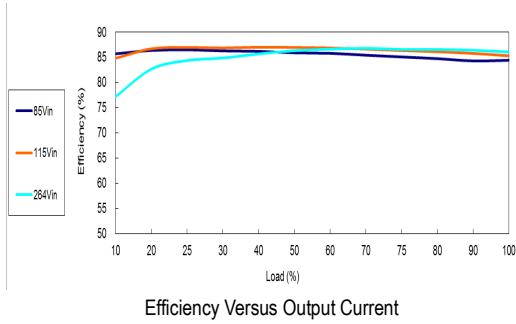
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



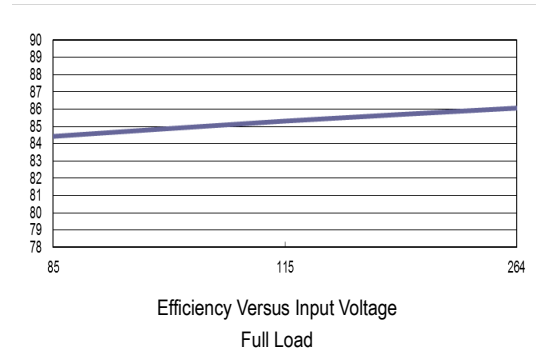
Typical Input Hold-up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load

Characteristic Curves

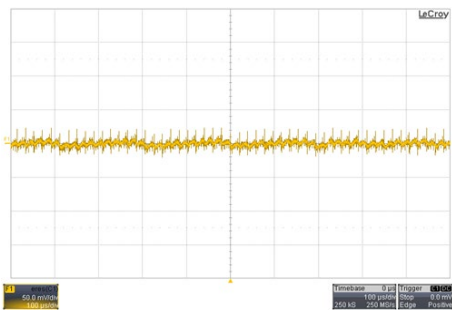
All test conditions are at 25°C The figures are identical for ACF-10S15



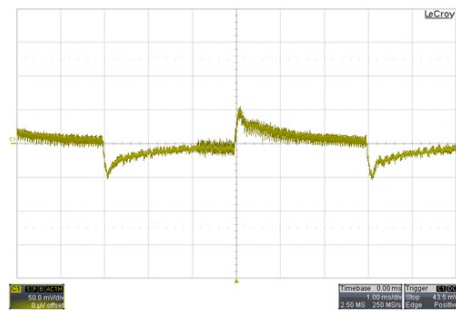
Efficiency Versus Output Current



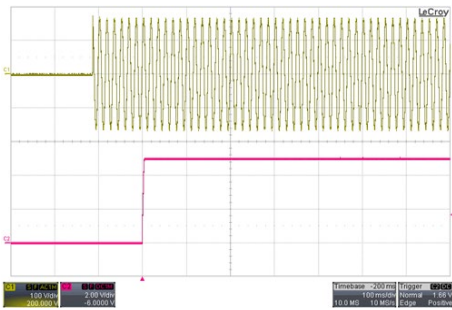
Efficiency Versus Input Voltage Full Load



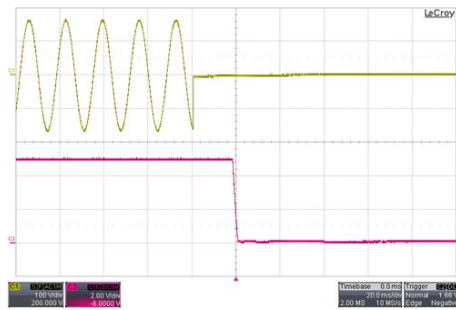
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



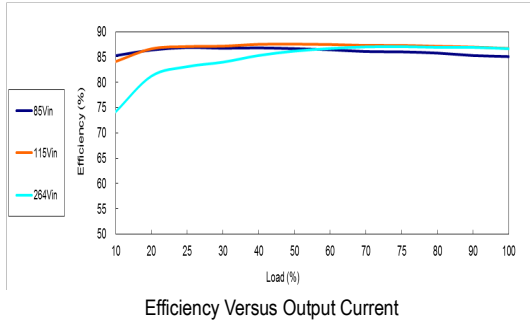
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



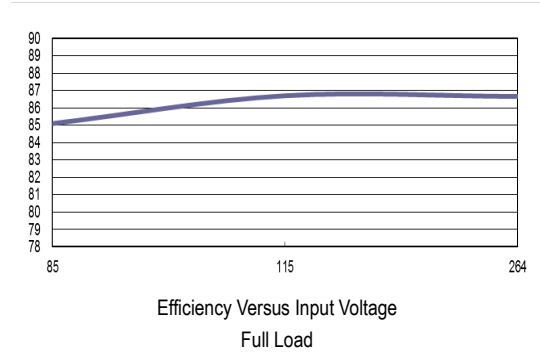
Typical Input Hold-up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load

Characteristic Curves

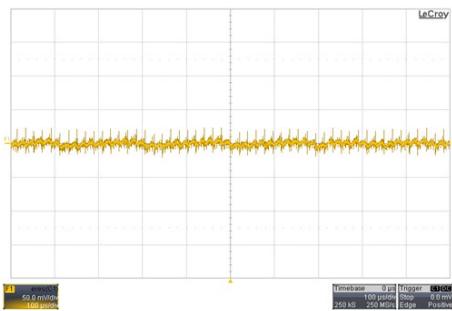
All test conditions are at 25°C The figures are identical for ACF-10S24



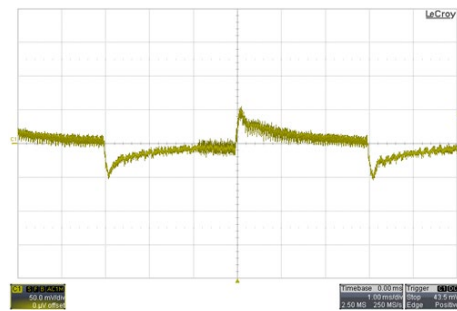
Efficiency Versus Output Current



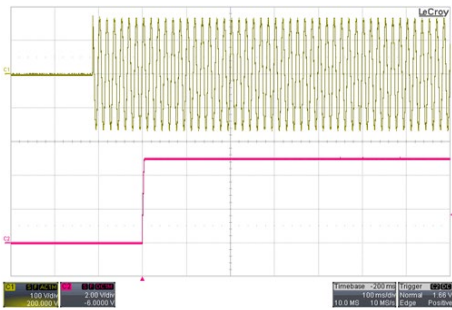
Efficiency Versus Input Voltage Full Load



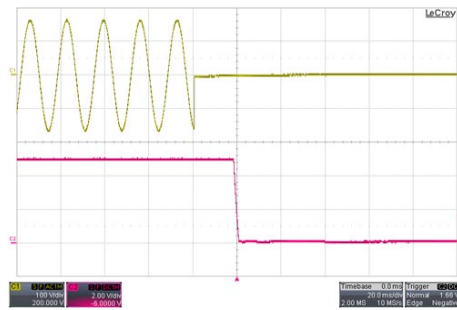
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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



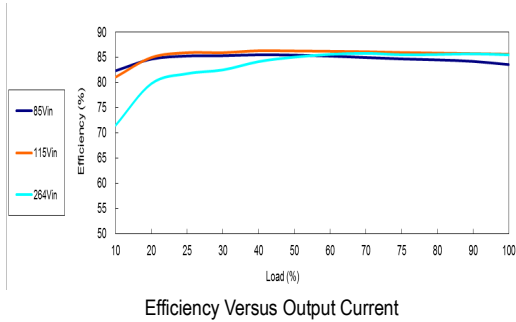
Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



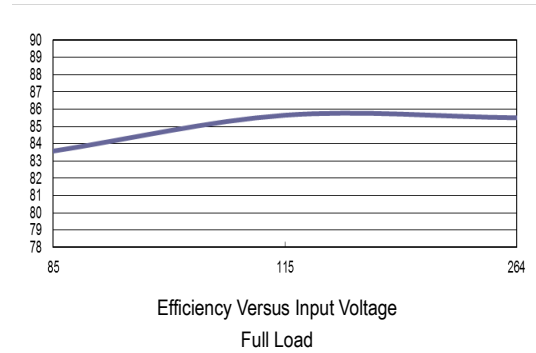
Typical Input Hold-up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load

Characteristic Curves

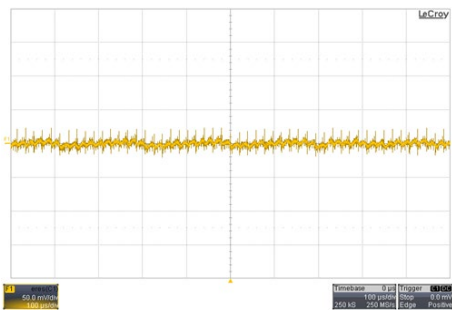
All test conditions are at 25°C The figures are identical for ACF-10S48



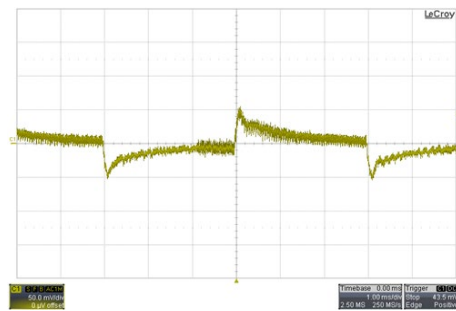
Efficiency Versus Output Current



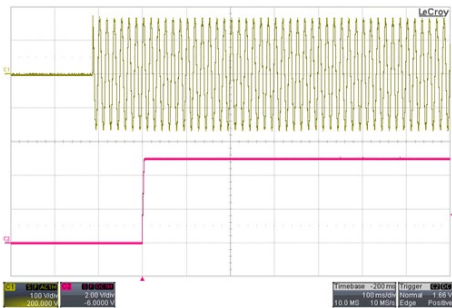
Efficiency Versus Input Voltage Full Load



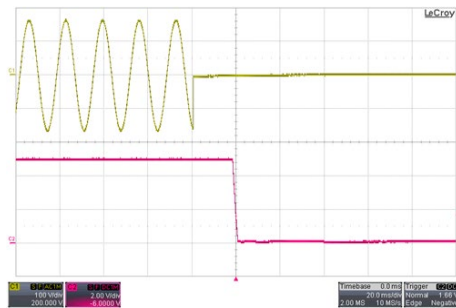
Typical Output Ripple and Noise
 $V_{in}=V_{in\ nom}$; Full Load



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

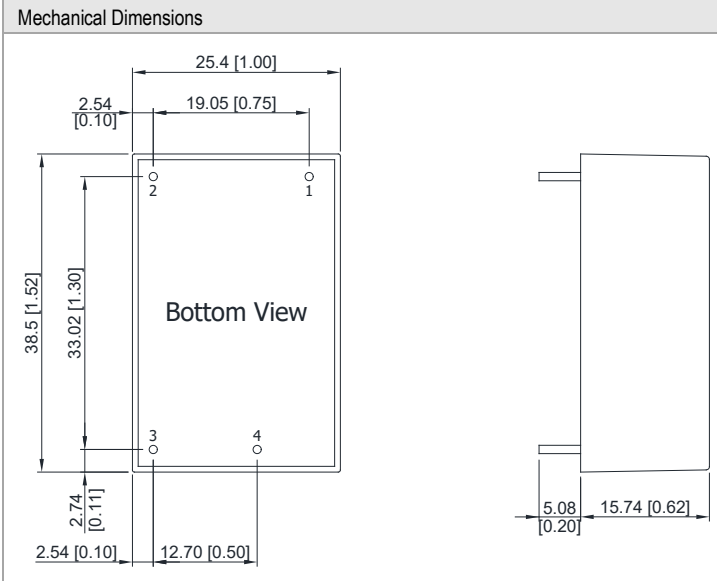


Typical Input Start-Up and Output Rise Characteristic
 $V_{in}=V_{in\ nom}$; Full Load



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

Package Specifications



Pin Connections

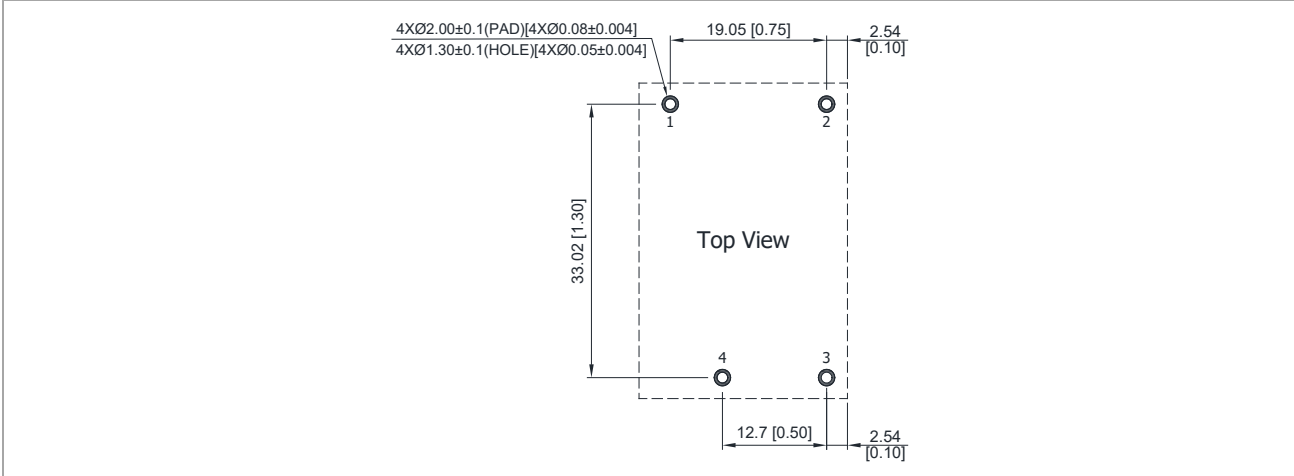
Pin	Function	Diameter mm (inches)
1	AC(N)	∅ 1.0 [0.04]
2	AC(L)	∅ 1.0 [0.04]
3	-Vout	∅ 1.0 [0.04]
4	+Vout	∅ 1.0 [0.04]

- ▶ 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

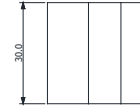
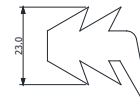
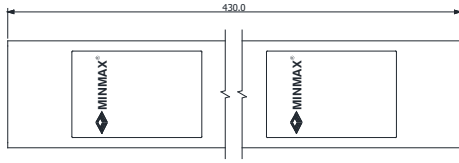
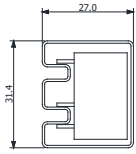
Recommended Pad Layout



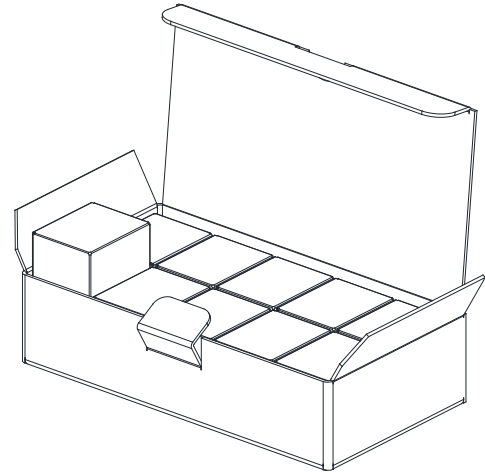
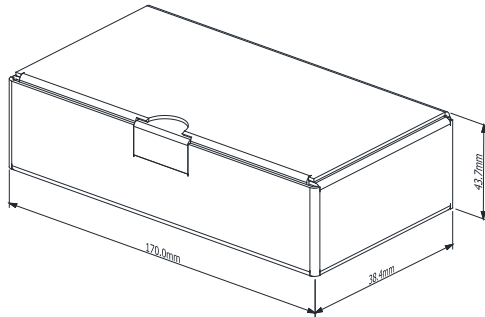
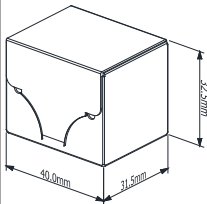
Packaging Information

Tube

Tube



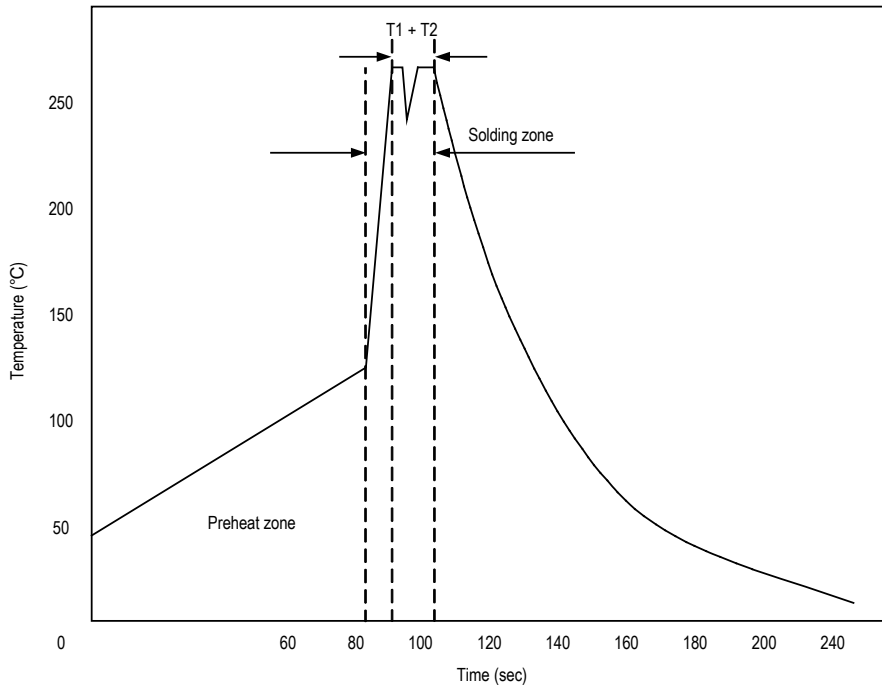
Unit: mm
10 PCS per TUBE



Unit: mm
10 PCS per Box

Wave Soldering Considerations

Lead free wave solder profile



Zone	Reference Parameter
Preheat	Rise temp. speed : 3°C/sec max.
zone	Preheat temp. : 100~130°C
Actual	Peak temp. : 250~260°C
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°C

Part Number Structure

ACF	-	10	S	03																												
		<table border="1"> <tr> <td style="text-align: center;">Output Power</td> </tr> <tr> <td style="text-align: center;">10 Watt</td> </tr> </table>	Output Power	10 Watt	<table border="1"> <tr> <td style="text-align: center;">Output Quantity</td> </tr> <tr> <td style="text-align: center;">S: Single</td> </tr> </table>	Output Quantity	S: Single	<table border="1"> <tr> <td colspan="3" style="text-align: center;">Output Voltage</td> </tr> <tr> <td style="text-align: center;">03:</td> <td style="text-align: center;">3.3</td> <td style="text-align: center;">VDC</td> </tr> <tr> <td style="text-align: center;">05:</td> <td style="text-align: center;">5</td> <td style="text-align: center;">VDC</td> </tr> <tr> <td style="text-align: center;">09:</td> <td style="text-align: center;">9</td> <td style="text-align: center;">VDC</td> </tr> <tr> <td style="text-align: center;">12:</td> <td style="text-align: center;">12</td> <td style="text-align: center;">VDC</td> </tr> <tr> <td style="text-align: center;">15:</td> <td style="text-align: center;">15</td> <td style="text-align: center;">VDC</td> </tr> <tr> <td style="text-align: center;">24:</td> <td style="text-align: center;">24</td> <td style="text-align: center;">VDC</td> </tr> <tr> <td style="text-align: center;">48:</td> <td style="text-align: center;">48</td> <td style="text-align: center;">VDC</td> </tr> </table>	Output Voltage			03:	3.3	VDC	05:	5	VDC	09:	9	VDC	12:	12	VDC	15:	15	VDC	24:	24	VDC	48:	48	VDC
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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	