MINMAX®

MKA10C Series

Electric Characteristic Note

DC-DC Power Module 10W

Features

- ►**Fully Encapsulated Plastic Case for Chassis and DIN-Rail Mounting Version**
- ►**80-160VDC Wide Input Voltage Range**
- ►**Fully Regulated Output Voltage**
- ►**High Efficiency up to 85%**
- ►**I/O Isolation 3000VAC with Reinforced Insulation, rated for 1000Vrms Working Voltage**
- ►**Operating Ambient Temp. Range -40℃ to +87℃**
- ►**No Min. Load Requirement**
- ►**Very Low No Load Power Consumption**
- ►**Under-voltage, Overload and Short Circuit Protection**
- ►**Remote On/Off Control**
- ►**EMI Emission EN 55032 Class A Approved**
- ►**EMC Immunity EN 61000-4-2,3,4,5,6,8 Approved**
- ►**UL/cUL/IEC/EN 62368-1 Safety Approval & CE Marking**

Applications

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

Product Overview

The MINMAX MKA10C series is the latest 10Watt isolated DC-DC power module generation with 9 fixed output voltage models:5 / 5.1 / 12 / 15 / 24 / 48 / ±12 / ±15 / ±24VDC. The wide input range from 80VDC to 160VDC is specifically for electricity and renewable energy field applications within the usage of terminal strip connectors in chassis and DIN-Rail package.
The key performances are: 3000VAC I/O Isolation, reinforced insulation, high efficiency, wide operating ambient temp. range -40℃ to +87℃, no min. load, low no-load power consumption, remote on/off, built-in EMI emission EN 55032 Class A, UVLO, and SCP. The MKA10C series certificates in safety UL/cUL/IEC/EN 62368-1 with CB report and CE marking and offers a solution for eliminating components of a power board.

Table of contents

Model Selection Guide							
Model Number	Input Voltage (Range)	Output Voltage	Output Current	Input Current		Max. capacitive Load	Efficiency (typ.)
			Max.	@Max. Load	@No Load		@Max. Load
	VDC	VDC	mA	mA(typ.)	mA(typ.)	µF	%
MKA10-110S05C	110 (80 ~ 160)	5	2000	110	20	1000	83
MKA10-110S051C		5.1	2000	112		1000	83
MKA10-110S12C		12	833	107		470	85
MKA10-110S15C		15	666	107		330	85
MKA10-110S24C		24	416	107		150	85
MKA10-110S48C		48	208	109		68	83
MKA10-110D12C		±12	±416	107		220#	85
MKA10-110D15C		±15	±333	107		150#	85
MKA10-110D24C		±24	±208	108		68#	84

For each output

Input Specifications					
Parameter	Conditions / Model	Min.	Typ.	Max.	Unit
Input Surge Voltage (1 sec. max.)		-0.7	---	170	VDC
Start-Up Threshold Voltage		---	---	80	
Under Voltage Shutdown		---	78	---	
Start Up Time (Power On)	Nominal Vin and Constant Resistive Load	---	30	---	ms
Input Filter	All Models	Internal Pi Type			

Remote On/Off Control					
Parameter	Conditions	Min.	Typ.	Max.	Unit
Converter On	3.5V ~ 12V or Open Circuit				
Converter Off	0~1.2V or Short Circuit (Pin 1 and Pin 2)				
Control Input Current (on)	Vctrl = 5V	---	---	500	µA
Control Input Current (off)	Vctrl = 0V	---	---	-500	µA
Control Common	Referenced to Negative Input				
Standby Input Current	Nominal Vin	---	2.5	---	mA

Output Specifications						
Parameter	Conditions / Model		Min.	Typ.	Max.	Unit
Output Voltage Setting Accuracy			---	---	±2.0	%Vnom.
Output Voltage Balance	Dual Output, Balanced Loads		---	±1.0	±2.0	%
Line Regulation	Vin=Min. to Max. @Full Load		---	---	±0.5	%
Load Regulation	Io=0% to 100%		---	---	±0.5	%
Load Cross Regulation (Dual Output Models)	Asymmetrical Load 25/100% Full Load		---	---	±5.0	%
Minimum Load	No minimum Load Requirement					
Ripple & Noise	0-20 MHz Bandwidth	24V & ±24V & 48V Output Models	---	180	---	mV P-P
		Other Output Models	---	90	---	mV P-P
Transient Recovery Time	25% Load Step Change		---	---	500	µsec
Transient Response Deviation			---	±3	±5	%
Temperature Coefficient			---	±0.01	±0.02	%/°C
Over Load Protection	Hiccup		---	150	---	%
Short Circuit Protection	Continuous, Automatic Recovery (Hiccup Mode 0.7Hz typ.)					

General Specifications

Parameter	Conditions	Min.	Typ.	Max.	Unit
I/O Isolation Voltage	60 Seconds Reinforced insulation, rated for 1000Vrms working voltage	3000	---	---	VAC
I/O Isolation Resistance	500 VDC	1000	---	---	MΩ
I/O Isolation Capacitance	100kHz, 1V	---	2200	---	pF
Switching Frequency		---	275	---	kHz
MTBF (calculated)	MIL-HDBK-217F@25℃, Ground Benign	3,746,600	---	---	Hours
Safety Approvals	UL/cUL 62368-1 recognition(UL certificate), IEC/EN 62368-1 & 60950-1(CB report)				

EMC Specifications

Parameter	Standards & Level			Performance
EMI	Conduction	EN 55032	Without external components	Class A
	Radiation			
EMS	EN 55035			
	ESD	Direct discharge	Indirect discharge HCP & VCP	A
		EN 61000-4-2 Air ± 8kV	Contact ± 6kV	
	Radiated immunity	EN 61000-4-3 10V/m		A
	Fast transient	EN 61000-4-4 ±2kV		A
	Surge	EN 61000-4-5 ±2kV		A
	Conducted immunity	EN 61000-4-6 10Vrms		A
	PFMF	EN 61000-4-8 100A/m		A

Environmental Specifications

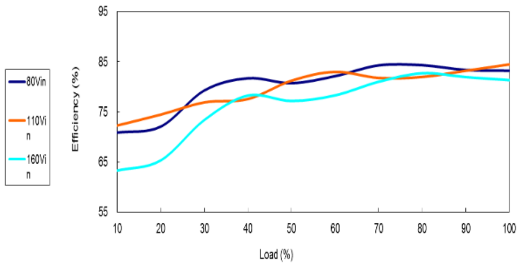
Parameter	Min.	Max.	Unit
Operating Ambient Temperature Range (See Power Derating Curve)	-40	+87	℃
Case Temperature	---	+105	℃
Storage Temperature Range	-50	+125	℃
Humidity (non condensing)	---	95	% rel. H
Altitude	---	5000	m
Lead Temperature (1.5mm from case for 10Sec.)	---	260	℃

Notes

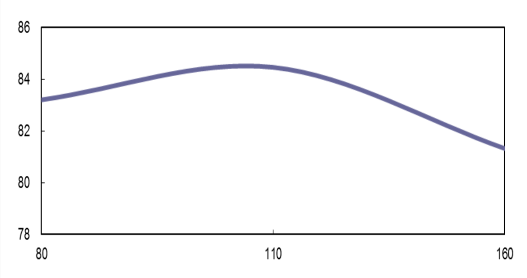
1. Specifications typical at Ta=+25℃, resistive load, nominal input voltage and rated output current unless otherwise noted.
2. Transient recovery time is measured to within 1% error band for a step change in output load of 75% to 100%
3. We recommend to protect the converter by a slow blow fuse in the 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

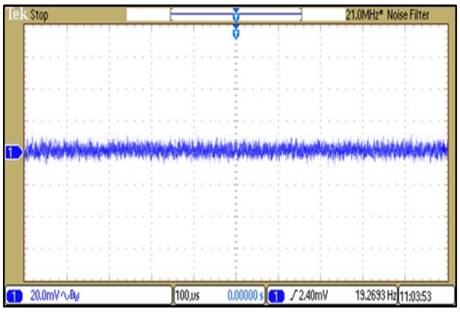
All test conditions are at 25℃ The figures are identical for MKA10-110S05C



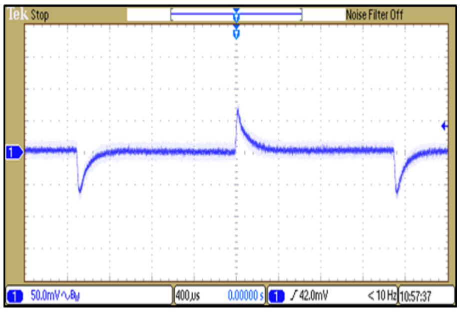
Efficiency Versus Output Current



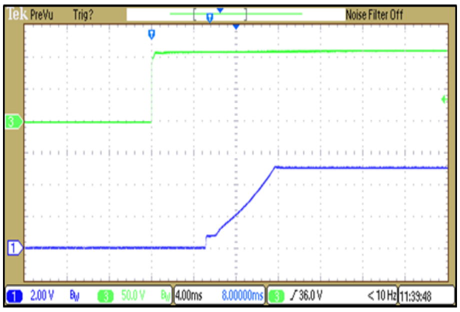
Efficiency Versus Input Voltage
Full Load



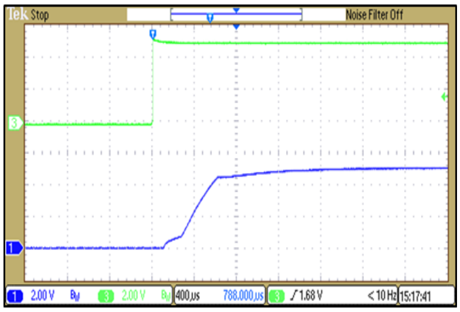
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



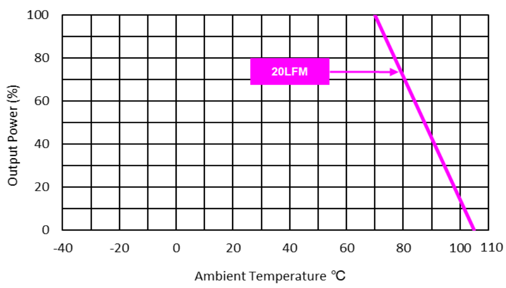
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



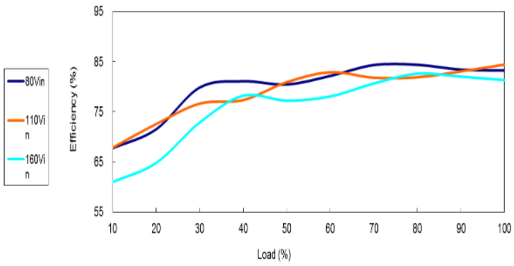
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



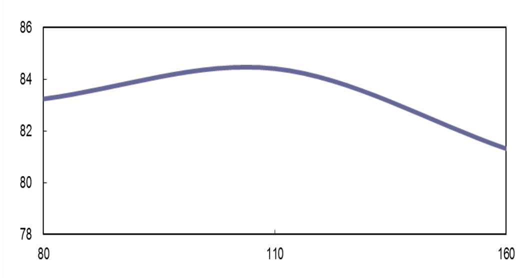
Derating Output Power Versus Ambient Temperature
$V_{in}=V_{in\ nom}$

Characteristic Curves

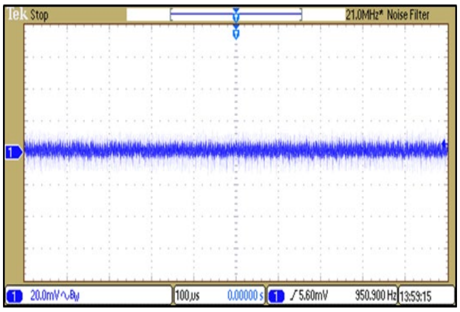
All test conditions are at 25℃ The figures are identical for MKA10-110S051C



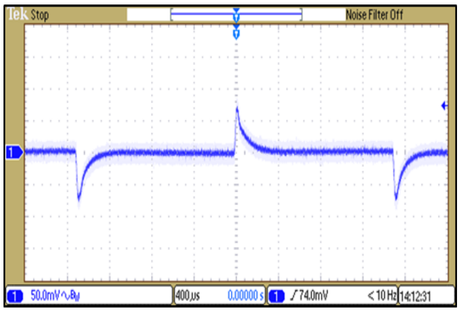
Efficiency Versus Output Current



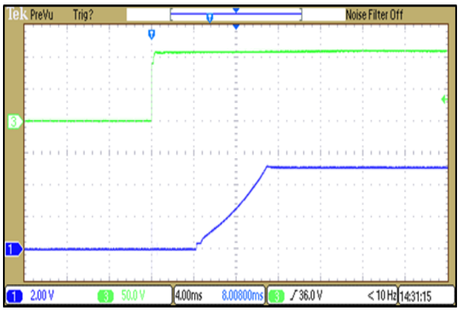
Efficiency Versus Input Voltage
Full Load



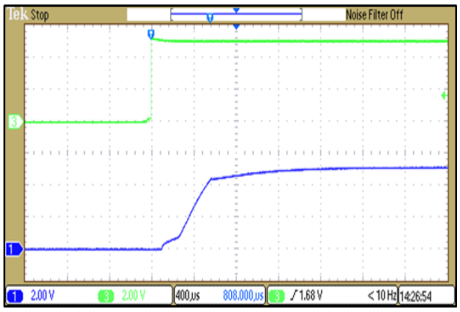
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



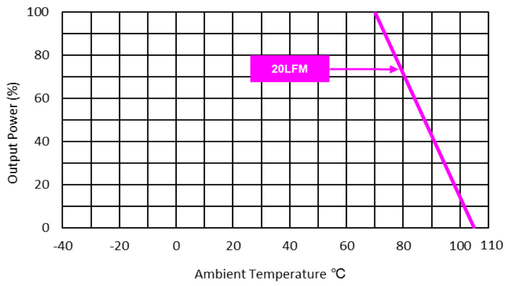
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



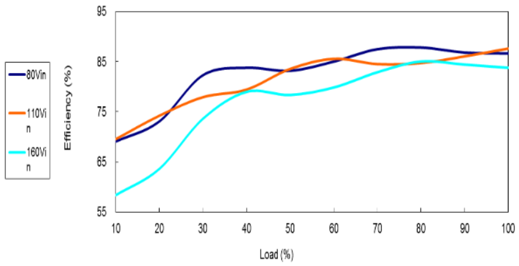
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



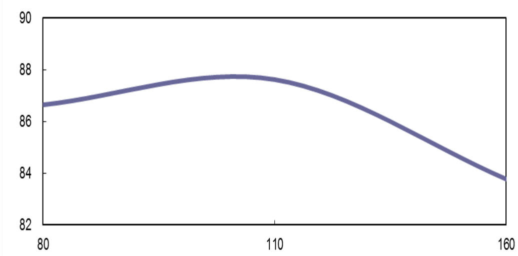
Derating Output Power Versus Ambient Temperature
$V_{in}=V_{in\ nom}$

Characteristic Curves

All test conditions are at 25℃ The figures are identical for MKA10-110S12C

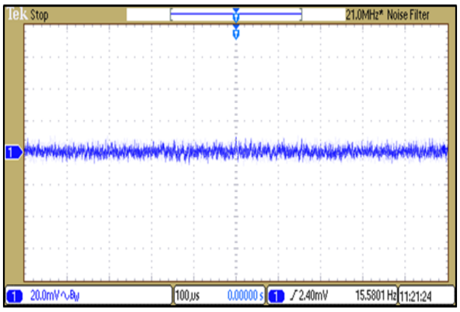


Efficiency Versus Output Current



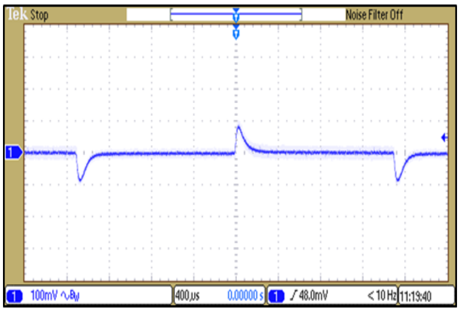
Efficiency Versus Input Voltage

Full Load



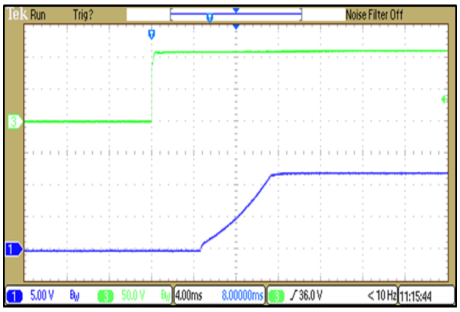
Typical Output Ripple and Noise

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



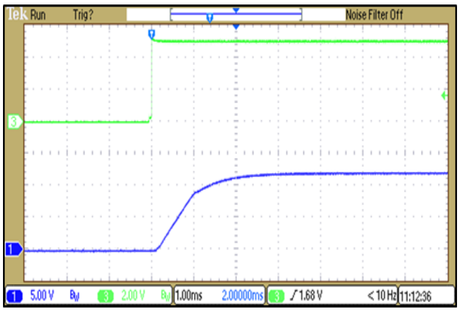
Transient Response to Dynamic Load Change

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



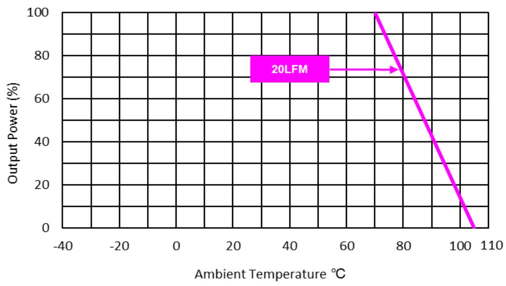
Typical Input Start-Up and Output Rise Characteristic

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



ON/OFF Voltage Start-Up and Output Rise Characteristic

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

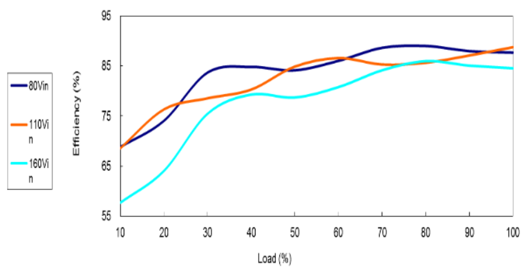


Derating Output Power Versus Ambient Temperature

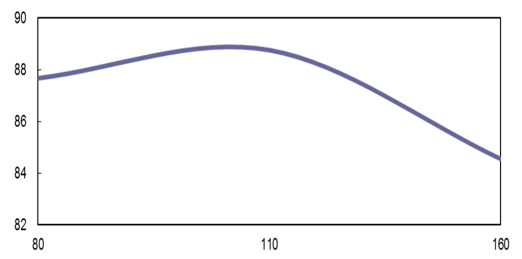
$V_{in}=V_{in\ nom}$

Characteristic Curves

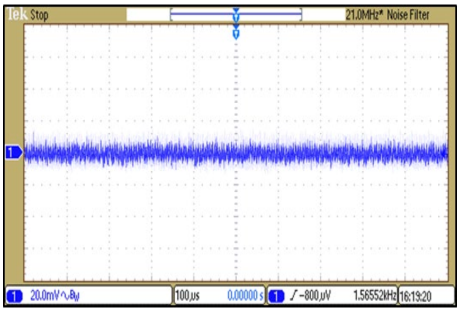
All test conditions are at 25℃ The figures are identical for MKA10-110S15C



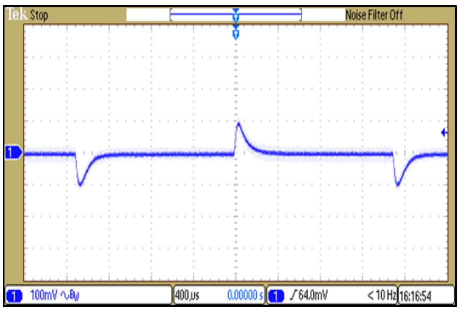
Efficiency Versus Output Current



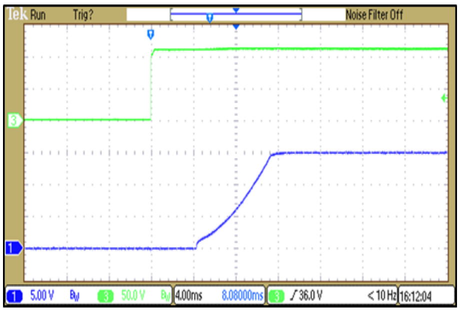
Efficiency Versus Input Voltage
Full Load



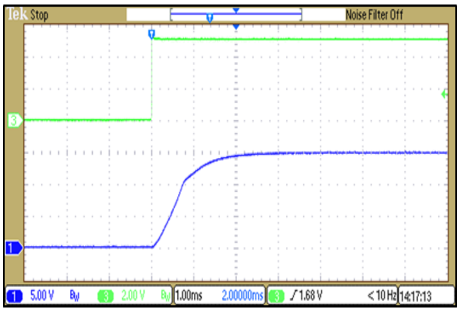
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



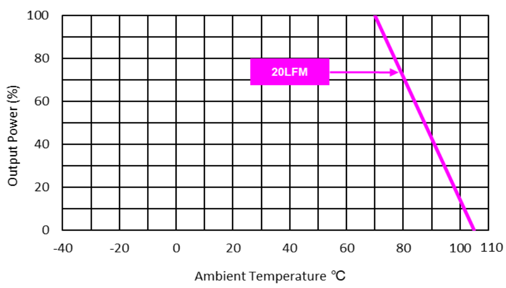
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



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



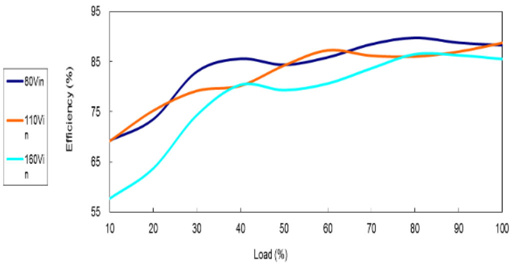
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



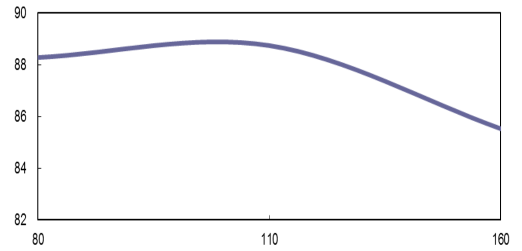
Derating Output Power Versus Ambient Temperature
V_{in}=$V_{in\ nom}$

Characteristic Curves

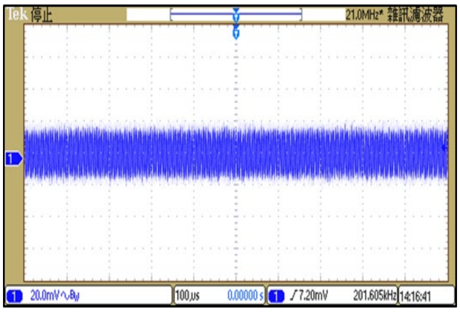
All test conditions are at 25℃ The figures are identical for MKA10-110S24C



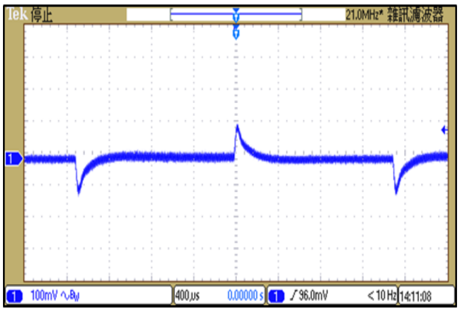
Efficiency Versus Output Current



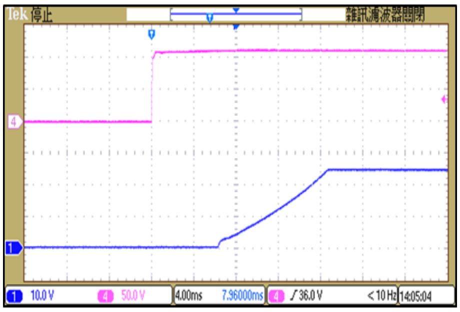
Efficiency Versus Input Voltage
Full Load



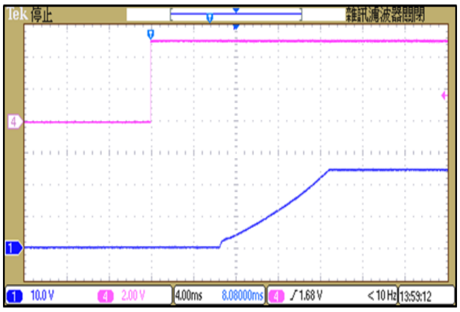
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



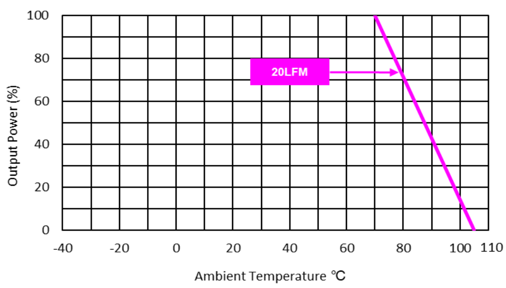
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



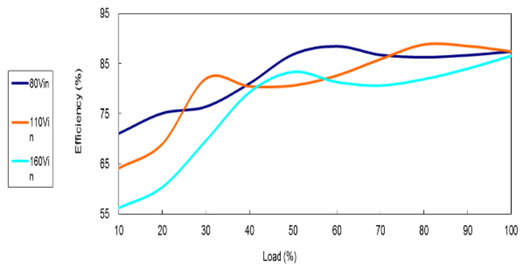
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



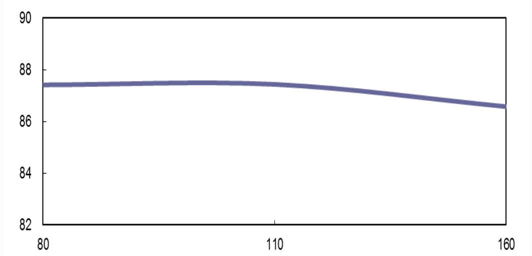
Derating Output Power Versus Ambient Temperature
$V_{in}=V_{in\ nom}$

Characteristic Curves

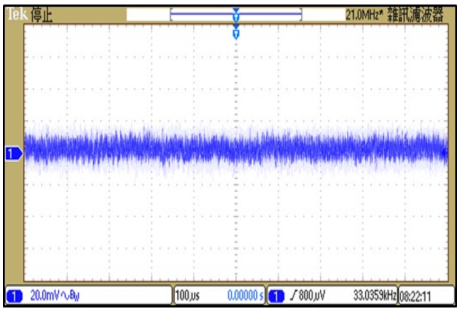
All test conditions are at 25℃ The figures are identical for MKA10-110S48C



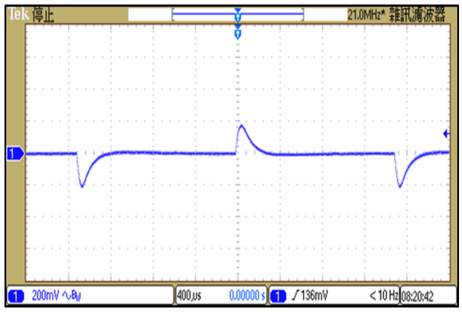
Efficiency Versus Output Current



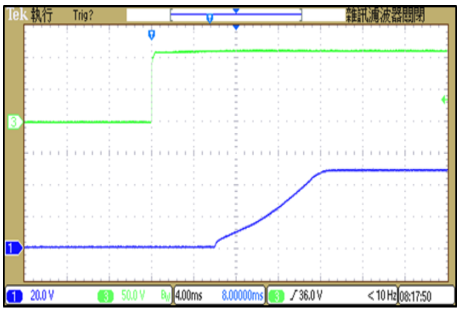
Efficiency Versus Input Voltage
Full Load



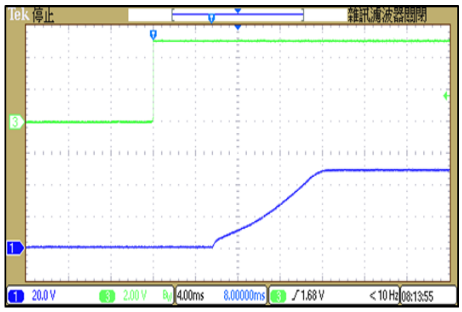
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



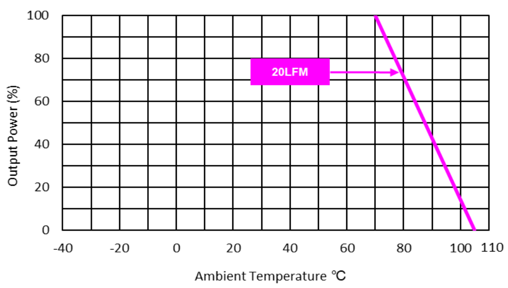
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



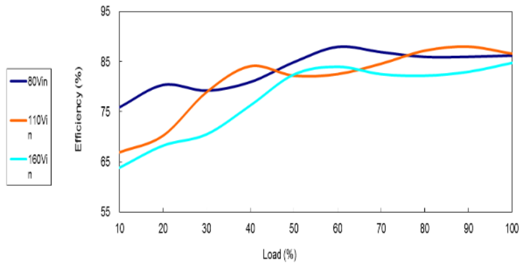
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



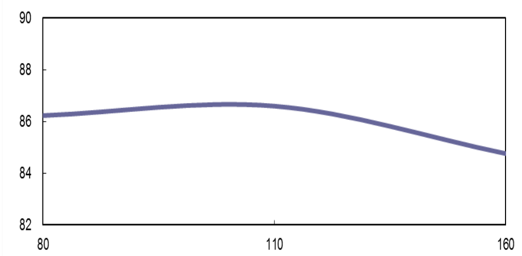
Derating Output Power Versus Ambient Temperature
$V_{in}=V_{in\ nom}$

Characteristic Curves

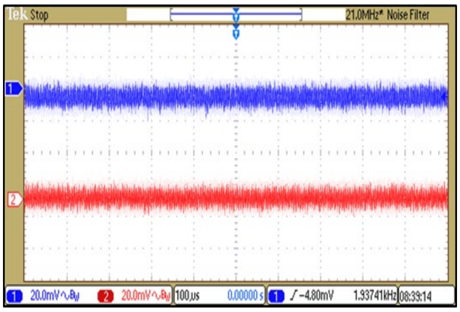
All test conditions are at 25℃ The figures are identical for MKA10-110D12C



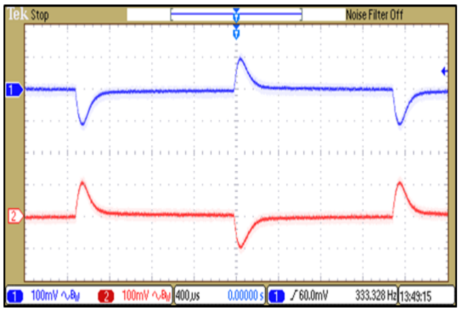
Efficiency Versus Output Current



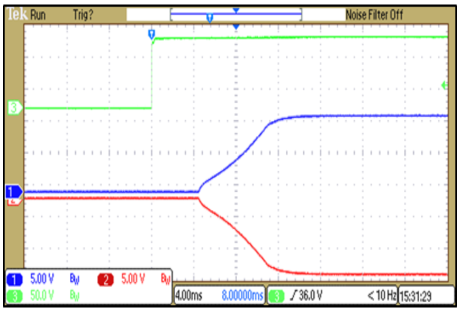
Efficiency Versus Input Voltage
Full Load



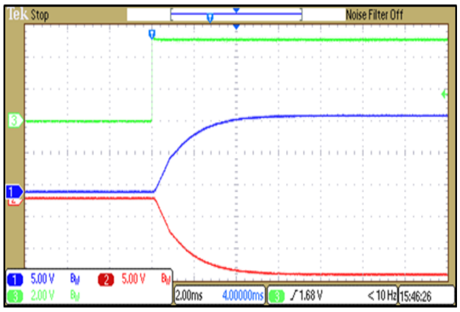
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



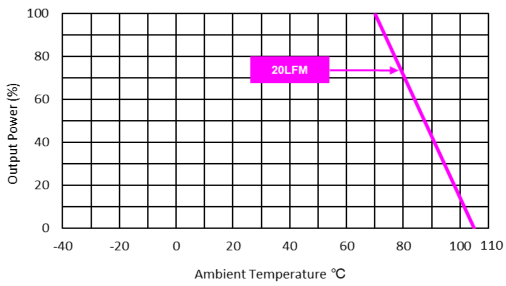
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



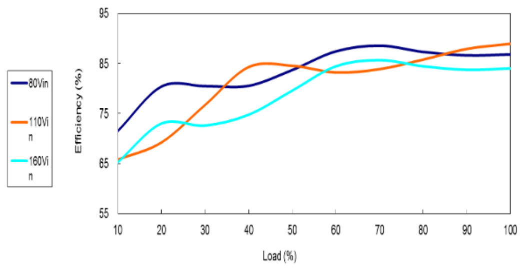
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



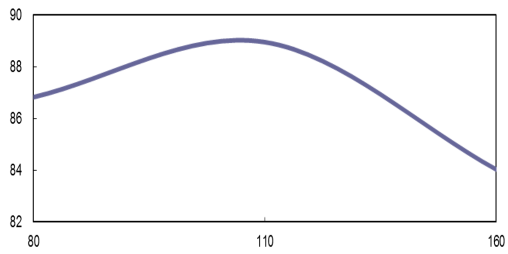
Derating Output Power Versus Ambient Temperature
$V_{in}=V_{in\ nom}$

Characteristic Curves

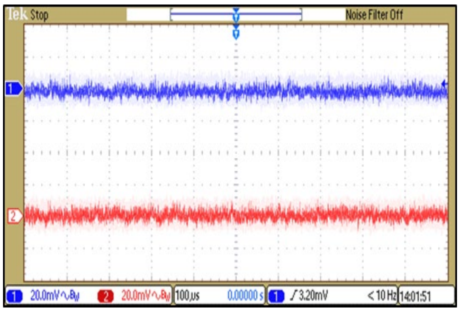
All test conditions are at 25°C The figures are identical for MKA10-110D15C



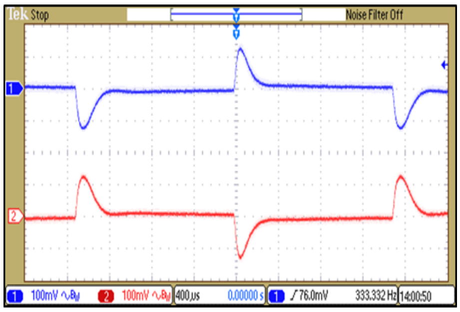
Efficiency Versus Output Current



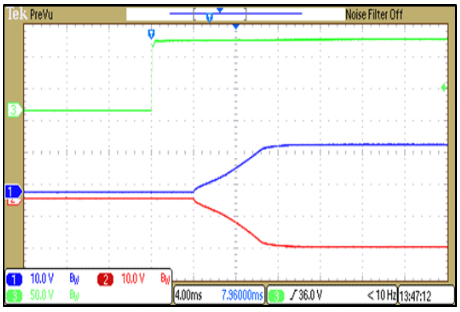
Efficiency Versus Input Voltage
Full Load



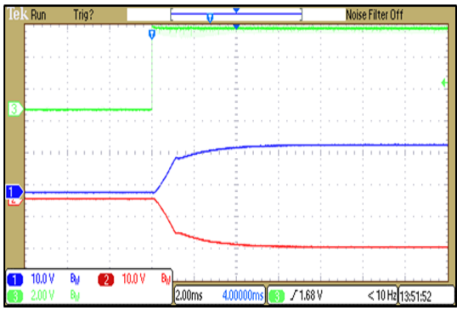
Typical Output Ripple and Noise
$V_{in}=V_{in\ nom}$; Full Load



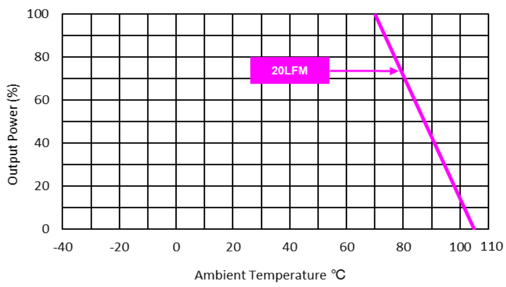
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; $V_{in}=V_{in\ nom}$



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



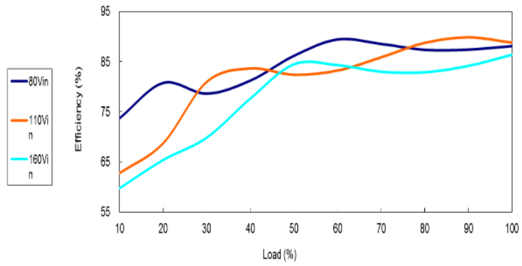
ON/OFF Voltage Start-Up and Output Rise Characteristic
$V_{in}=V_{in\ nom}$; Full Load



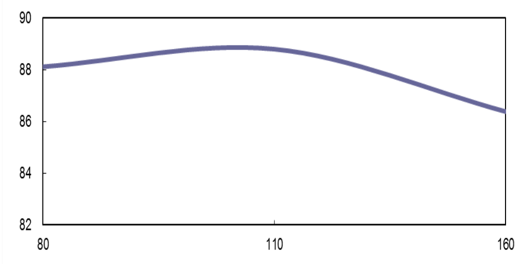
Derating Output Power Versus Ambient Temperature
$V_{in}=V_{in\ nom}$

Characteristic Curves

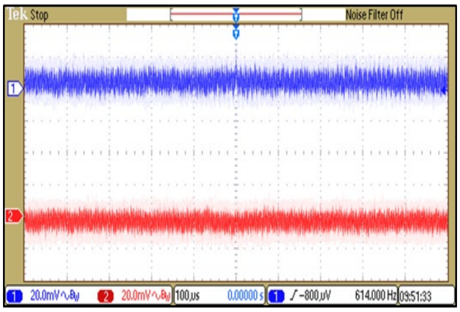
All test conditions are at 25℃ The figures are identical for MKA10-110D24C



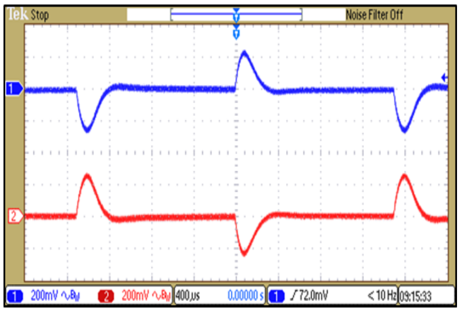
Efficiency Versus Output Current



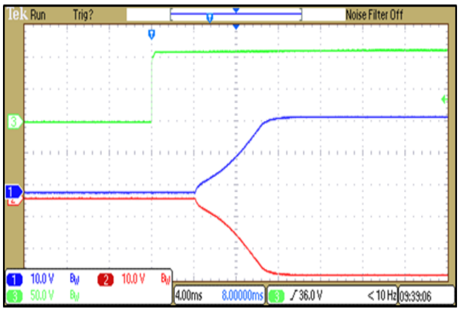
Efficiency Versus Input Voltage
Full Load



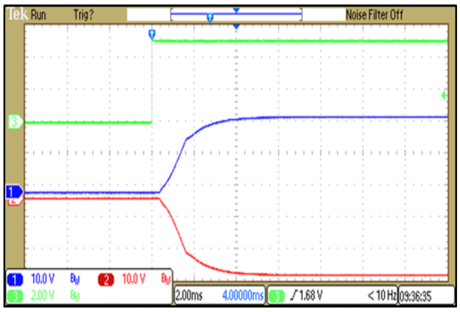
Typical Output Ripple and Noise
V_{in}=$V_{in\ nom}$; Full Load



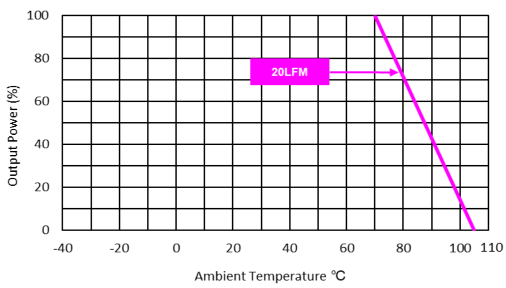
Transient Response to Dynamic Load Change
from 100% to 75% of Full Load ; V_{in}=$V_{in\ nom}$



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



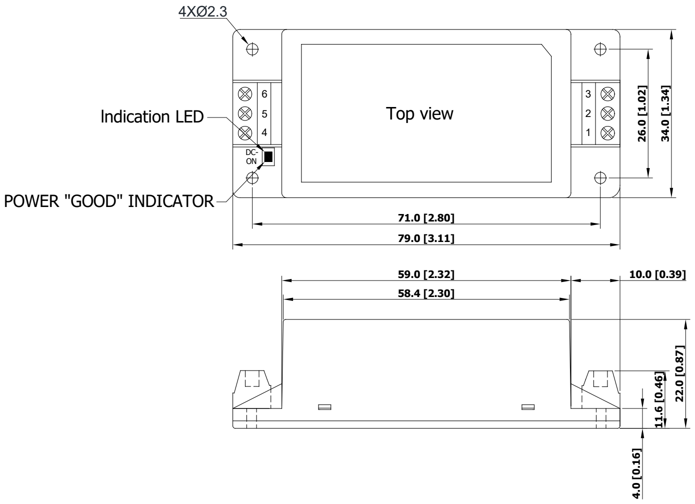
ON/OFF Voltage Start-Up and Output Rise Characteristic
V_{in}=$V_{in\ nom}$; Full Load



Derating Output Power Versus Ambient Temperature
V_{in}=$V_{in\ nom}$

Package Specifications

Mechanical Dimensions



Note:

Screw type Terminal: Wires 1.5mm^2 max.

Recommended Terminal Screw tightening torque: 0.2Nm (1.7lb.in.) max.

Pin Connections

Pin	Single Output	Dual Output
1	Remote On/Off	Remote On/Off
2	-Vin	-Vin
3	+Vin	+Vin
4	-Vout	-Vout
5	NC	Common
6	+Vout	+Vout

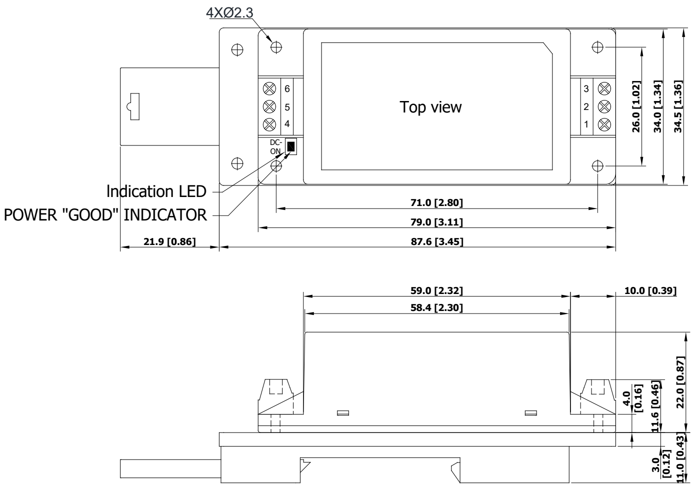
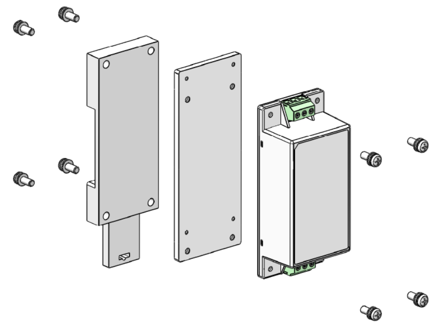
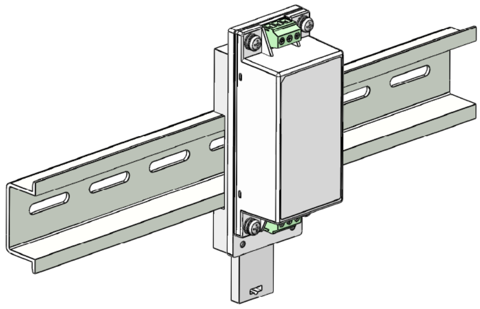
NC: No Connection

- All dimensions in mm (inches)
- Tolerance: X.X±0.5 (X.XX±0.02)
  X.XX±0.25 (X.XXX±0.01)

Physical Characteristics

Case Size	:	79.0x34.0x22.0mm (3.11x1.10x0.87 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Weight	:	69g

Package Specifications with DIN Rail Mounting Bracket (order code AC-DIN-05)

Mechanical Dimensions	DIN-Rail Mounting Kit
	 

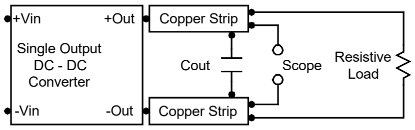
Physical Characteristics

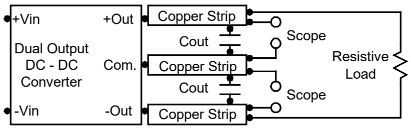
Case Size	:	79.0x34.0x22.0mm (3.11x1.10x0.87 inches)
Case Material	:	Plastic resin (flammability to UL 94V-0 rated)
Weight	:	108.76g

Test Setup

Peak-to-Peak Output Noise Measurement Test

Use a Cout 0.47μF ceramic capacitor. Scope measurement should be made by using a BNC socket, measurement bandwidth is 0-20 MHz. Position the load between 50 mm and 75 mm from the DC-DC Converter.





Technical Notes

Remote On/Off

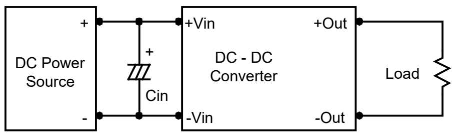
Positive logic remote on/off turns the module on during a logic high voltage on the remote on/off pin, and off during a logic low. To turn the power module on and off, the user must supply a switch to control the voltage between the on/off terminal and the -Vin terminal. The switch can be an open collector or equivalent. A logic low is 0V to 1.2V. A logic high is 3.5V to 12V. The maximum sink current at the on/off terminal (Pin 1) during a logic low is -500μA.

Overload Protection

To provide protection in a fault (output overload) condition, the unit is equipped with internal current limiting circuitry and can endure current limiting for an unlimited duration. At the point of current-limit inception, the unit shifts from voltage control to current control. The unit operates normally once the output current is brought back into its specified range.

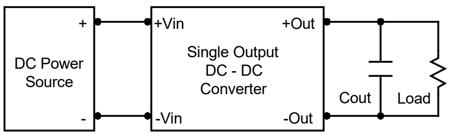
Input Source Impedance

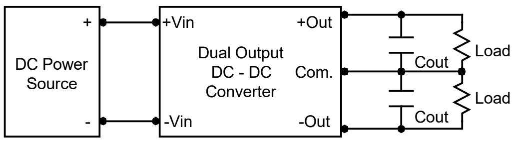
The power module should be connected to a low ac-impedance input source. Highly inductive source impedances can affect the stability of the power module.
In applications where power is supplied over long lines and output loading is high, it may be necessary to use a capacitor at the input to ensure startup.
By using a good quality low Equivalent Series Resistance (ESR < 1.0Ω at 100 kHz) capacitor of a 1μF for the 110V input devices, capacitor mounted close to the power module helps ensure stability of the unit.



Output Ripple Reduction

A good quality low ESR capacitor placed as close as practicable across the load will give the best ripple and noise performance. To reduce output ripple, it is recommended to use 3.3μF capacitors at the output.



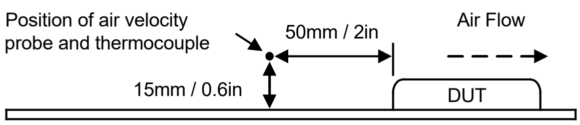


Maximum Capacitive Load

The MKA10C series has limitation of maximum connected capacitance on the output. The power module may operate in current limiting mode during start-up, affecting the ramp-up and the startup time. The maximum capacitance can be found in the data sheet.

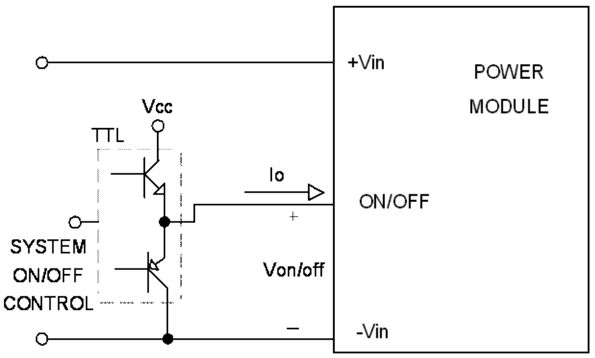
Thermal Considerations

Many conditions affect the thermal performance of the power module, such as orientation, airflow over the module and board spacing. To avoid exceeding the maximum temperature rating of the components inside the power module, the case temperature must be kept below 105℃.
The derating curves are determined from measurements obtained in a test setup.

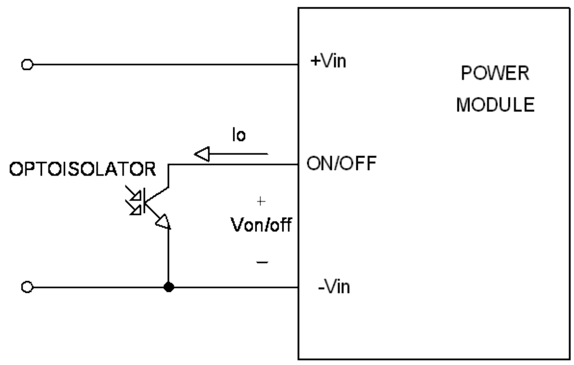


Remote On/Off Implementation

The positive logic remote ON/OFF control circuit is included. Turns the module ON during logic High on the ON/Off pin and turns OFF during logic Low. The ON/OFF input signal (Von/off) that referenced to -Vin. If not using the remote on/off feature, please open circuit between on/off pin and -Vin pin to turn the module on.

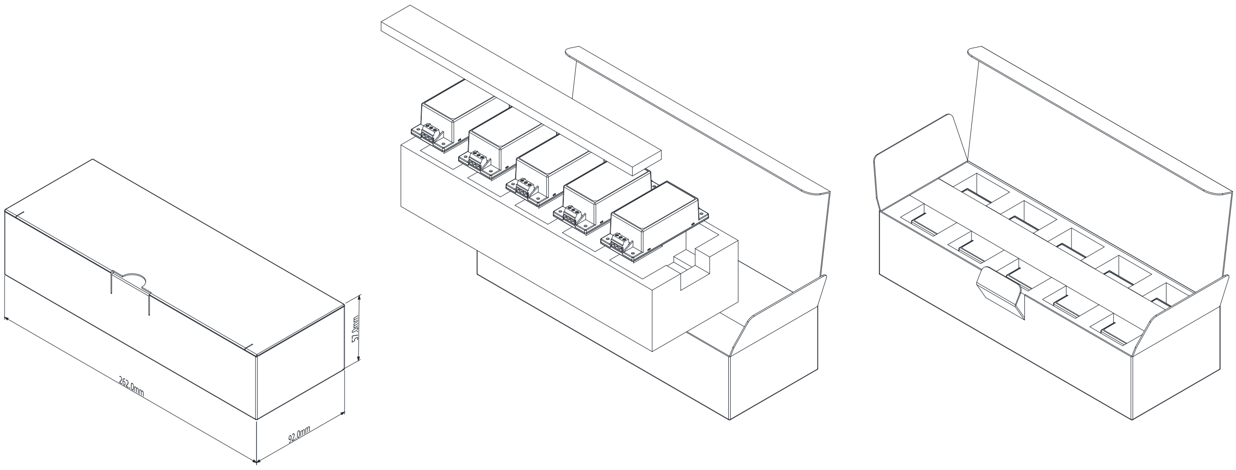


Level Control Using TTL Output



Isolated-Closure Remote ON/OFF

Packaging Information



Unit: mm
5 PCS per Box

Part Number Structure

MKA10-110S05C

2:1 Wide Input Range

Max. Output Power
10 Watts

Input Voltage Range
110 : 80 ~ 160 VDC

Output Voltage
S05 : 5 VDC
S051 : 5.1 VDC
S12 : 12 VDC
S15 : 15 VDC
S24 : 24 VDC
S48 : 48 VDC
D12 : ±12 VDC
D15 : ±15 VDC
D24 : ±24 VDC

MTBF and Reliability

The MTBF of MKA10C series of DC-DC converters has been calculated using

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

Model	MTBF	Unit
MKA10-110S05C	3,996,354	Hours
MKA10-110S051C	3,989,729	
MKA10-110S12C	4,202,380	
MKA10-110S15C	4,178,463	
MKA10-110S24C	4,209,566	
MKA10-110S48C	3,746,600	
MKA10-110D12C	4,103,375	
MKA10-110D15C	4,038,570	
MKA10-110D24C	3,898,488	