

**FS60 Series – Isolated AC/DC Converters**  
85 – 264Vac Input, Maximum Power: 60WData Sheet  
June 1, 2011**FS60 Series –small size isolated AC/DC converters****Features**

- High Efficiency
- Wide operating temperature range  
( -10°C to +60°C )
- Universal input range
- Built in EMI Filter
- Inrush current limit
- Over current protection
- Over voltage protection
- Output short circuit protection
- Input – Output Isolated
- Safety agency approval : Pending  
CE (EN 60950) through TÜV
- RoHS directive

**Applications**

- Telecommunication
- Datacom
- Instrumentation
- Distributed Power System

**Description**

FS60 Series is a High Efficiency AC/DC Converter that provides up to 60 watts of output power in ultra compact size. This module offers a cost effective solution for many space critical applications. Quasi- Resonant Flyback Topology is applied to achieve a high efficiency. It has a wide operating temperature from -10°C to +60°C and internal EMI Filter is employed for reduced noise level.

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June 1, 2011**Absolute Maximum Ratings**

Parameter	Min	Typ	Max	Unit	Notes
Input Voltage Continuous	85	-	264	VAC	
Operating Ambient Temperature	-10	-	60	°C	
Storage Temperature	-20	-	70	°C	
I/O Isolation Voltage	-	-	3000	VAC	

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device

**Electrical Specifications****Input Characteristics**

Parameter	Symbol	Min	Typ	Max	Unit
Operating voltage Range		85		264	Vac
Maximum Input current (At nominal input voltage and Maximum Output Power)	$I_{in}$		0.69		A ( @12V )
No load Input Power					W
FS60-5			0.3		
FS60-12			0.4		
FS60-15			0.5		
FS60-24			0.5		
FSD60-1212			0.4		
FSD60-1515			0.3		
Inrush Current@Cold start				30A max 60A max	@110VAC @220VAC
Operating Frequency		47		63	Hz



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### Output Characteristics

T<sub>A</sub> = +25°C Vin = 85 ~ 264VAC unless otherwise specified

Parameter	Symbol	Min	Typ	Max	Unit
Output Voltage tolerance	V <sub>o</sub>	-	-	±2	%
Output Current	I <sub>o</sub>				
FS60-5				10	A
FS60-12				5.0	A
FS60-15				4.0	A
FS60-24				2.5	A
FSD60-1212				±2.5	A
FSD60-1515				±2	A
Output Regulation;					
- Line Regulation (From minimum input voltage to maximum input voltage, constant load)		-	-	±1	%
- Load Regulation (From no load to maximum load, Constant load)		-	-	±1	%
Output Current Limit (Automatic recovery)		>105			%
Output Ripple and noise (Vin =24V, and I <sub>o</sub> =Max Output Current Bandwidth 20MHz, 1uF Ceramic cap)	mVp-p	-	1% of V <sub>out</sub>		mV
Efficiency					
FS60-5			83		%
FS60-12			87		%
FS60-15			87		%
FS60-24			89		%
FSD60-1212			87		%
FSD60-1515			88		%
(100% of max I <sub>o</sub> , Vin = 220VAC)					
Dynamic Load Response (1uF Ceramic 25% to 50 %, 50% to 25%,			±	3% of Output Voltage	mV


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Slew rate = 0.05A/us)					
Start – Up Time		-	-	400	ms
Hold – Up Time				10	ms
Turn – on overshoot		-	-	1	%
Maximum output capacitance					$\mu$ F

### Isolation Specifications

Parameter	Symbol	Min	Typ	Max	Unit
I/O Isolation Voltage (AC500V, 1 Min)					
- Input-Output:			-	3000	VAC
- Input-Case:			-	3000	VAC
- Output-case:			-	1500	VAC
Isolation Resistance - Output-Case (at DC500V at 25°C And 70%RH for 1 min)	RISO	>100	-	-	M $\Omega$
Isolation Capacitance	CISO				pF

### General Specifications

Parameter	Symbol	Min	Typ	Max	Unit
Switching Frequency		65		100	KHz
MTBF (MiL-HDBK- 217F)		5.3 x 10 <sup>5</sup>			hrs
Dimensions (W.H.L)		57.8 x 32.8 x 130			mm
Weight			260		Grams

### Environmental

Parameter	Symbol	Min	Typ	Max	Unit
Operating Temperature		-10		60	°C
Operating Humidity (RH non-condensing)		5		95	%



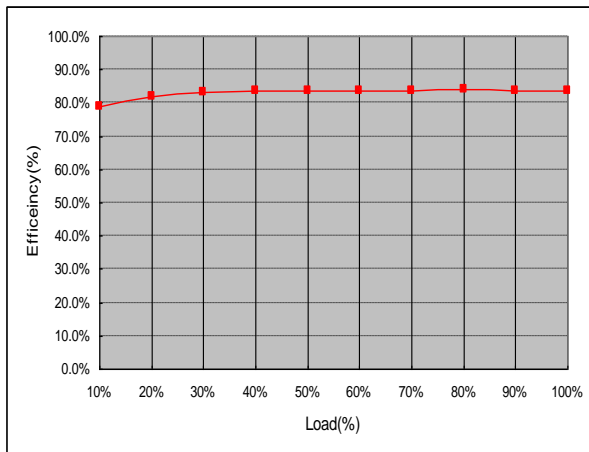
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Storage Temperature		-20		70	°C
Vibration @10G(98m/s <sup>2</sup> )		10		55	Hz

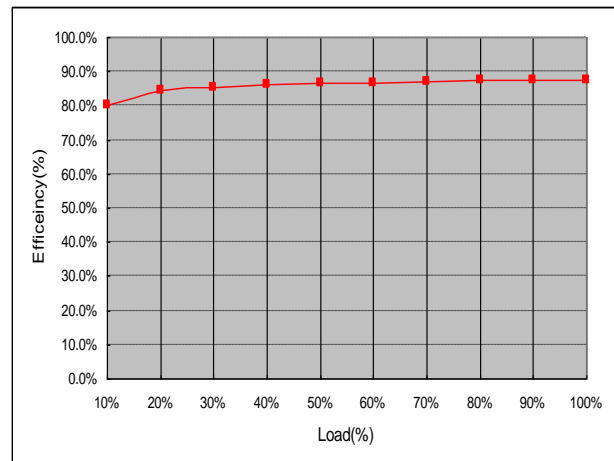
## Characteristic Curves Efficiency Curves

#### FS60-5



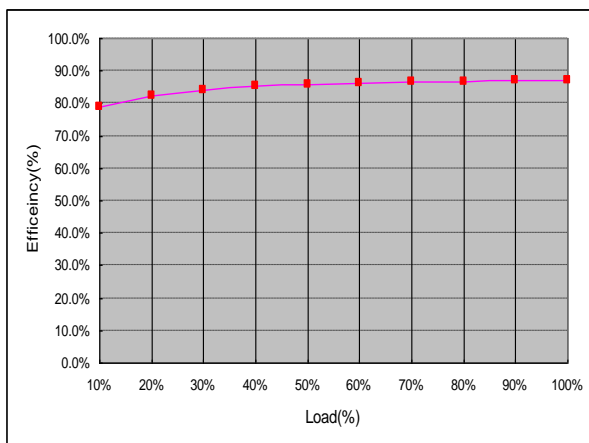
Vin=220VAC, Vo=5V@10A, At 25°C

#### FS60-12



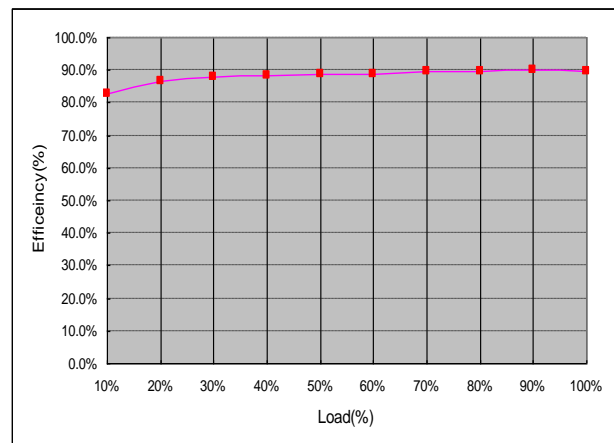
Vin=220VAC, Vo=12V@5A, At 25°C

#### FS60-15



Vin=220VAC, Vo=15V@4A, At 25°C

#### FS60-24



Vin=220VAC, Vo=24V@2.5A, At 25°C

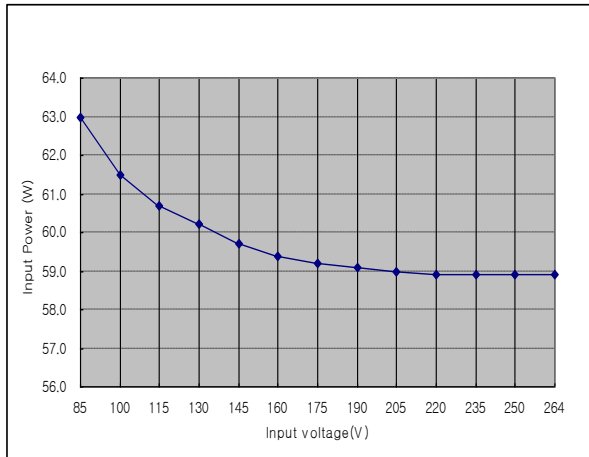


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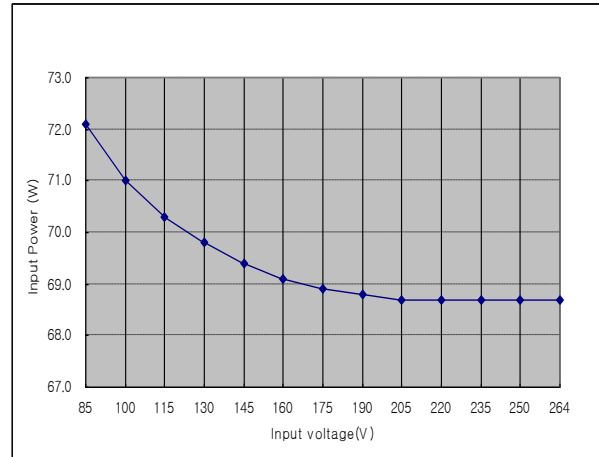
**Input Voltage vs Input Power**

**FS60-5**



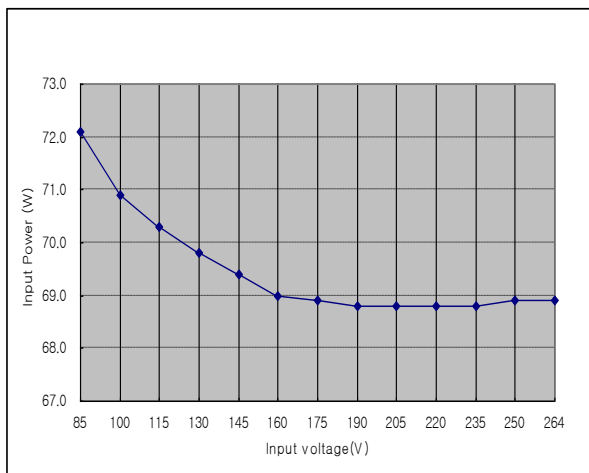
$I_o = 10A$  , At 25°C

**FS60-12**



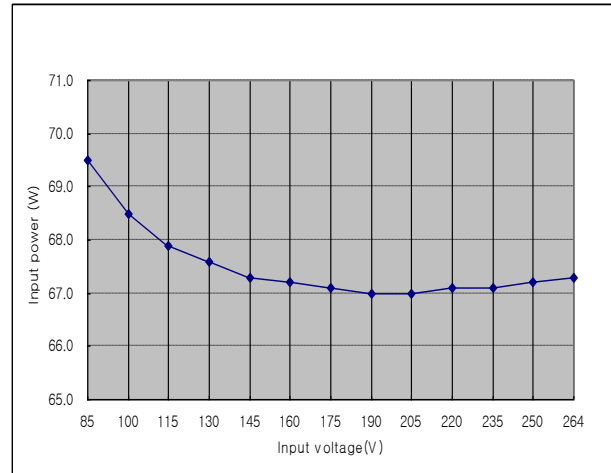
$I_o = 5A$ , At 25°C

**FS60-15**



$I_o = 4A$  , At 25°C

**FS60-24**



$I_o = 2.5A$ , At 25°C

**Start-up Time**

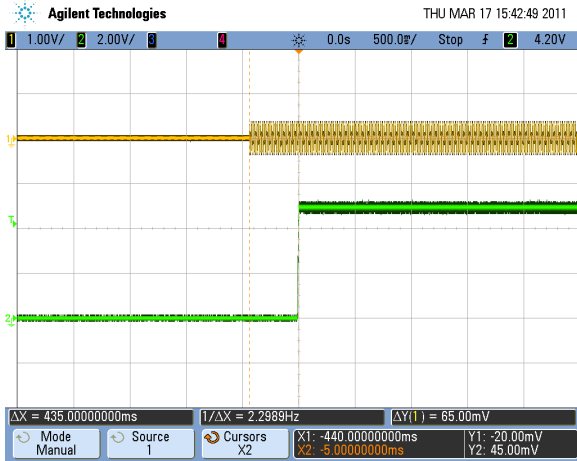


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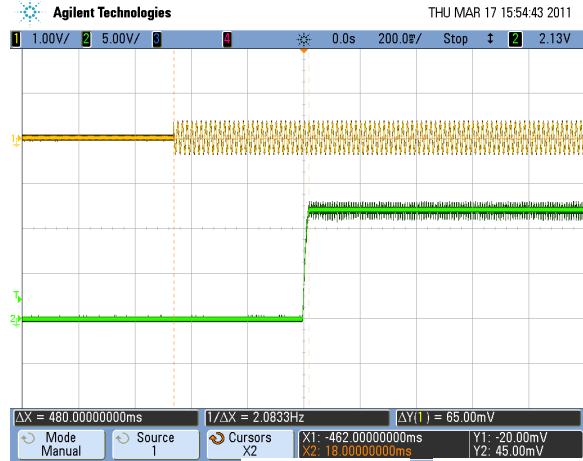
## FS60-5



CH2: 2V/DIV 500ms/DIV

Vin=110VAC, Vo=5V @10A , At 25°C

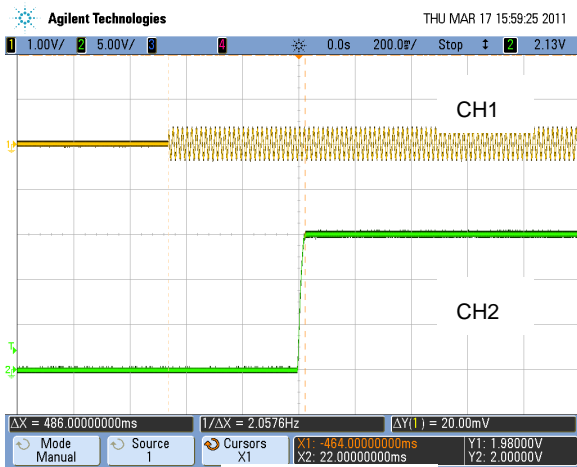
## FS60-12



CH2: 5V/DIV 200ms/DIV

Vin=110VAC, Vo=12V @5A, At 25°C

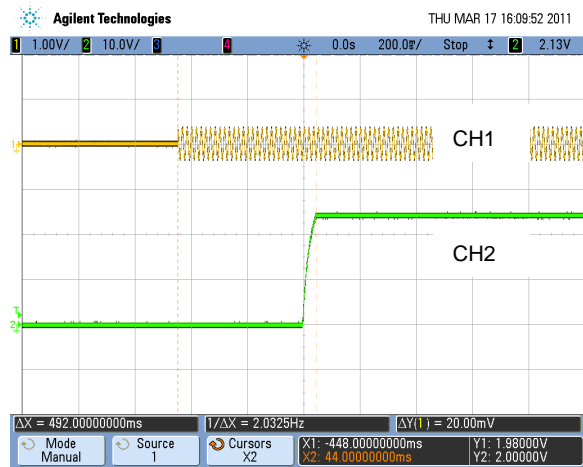
## FS60-15



CH2: 5V/DIV 200ms/DIV

Vin = 110VAC, Vo=15V @4A, At 25°C

## FS60-24



CH2 : 10V/DIV 200ms/DIV

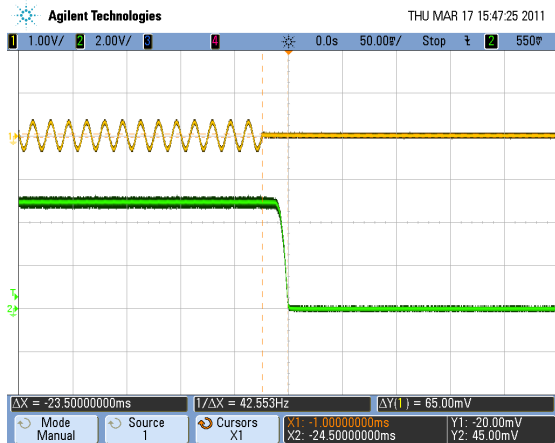
Vin = 110VAC, Vo=24V @2.5A, At 25°C



# FS60 Series – Isolated AC/DC Converters 85 – 264Vac Input, Maximum Power: 60W Hold Up Time

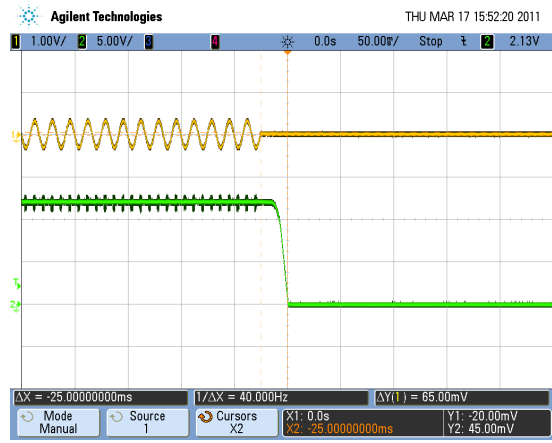
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### FS60-5



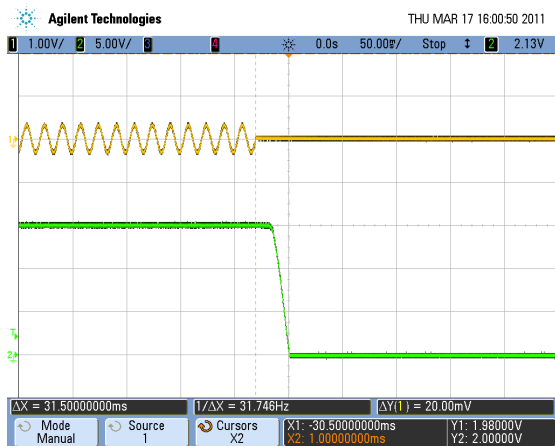
CH1: 2V/DIV 50ms/DIV  
Vin=110VAC, Vo=5V @10A, At 25°C

### FS60-12



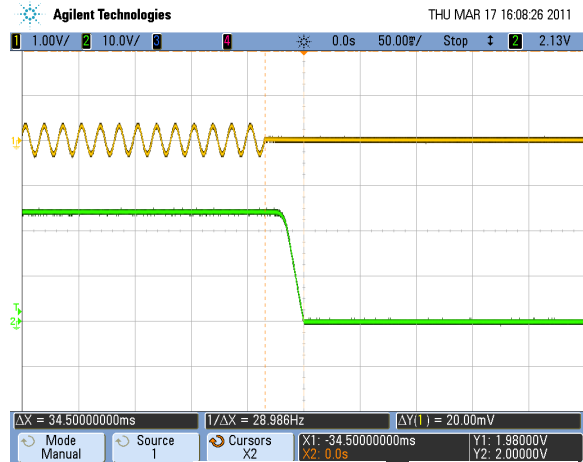
CH1: 5V/DIV 50ms/DIV  
Vin = 110VAC, Vo=12V @5A, At 25°C

### FS60-15



CH1: 5V/DIV 50ms/DIV  
Vin=110VAC, Vo=15V @4A, At 25°C

### FS60-24



CH1: 10V/DIV 50ms/DIV  
Vin=110VAC, Vo=24V @2.5A, At 25°C





# FS60 Series – Isolated AC/DC Converters

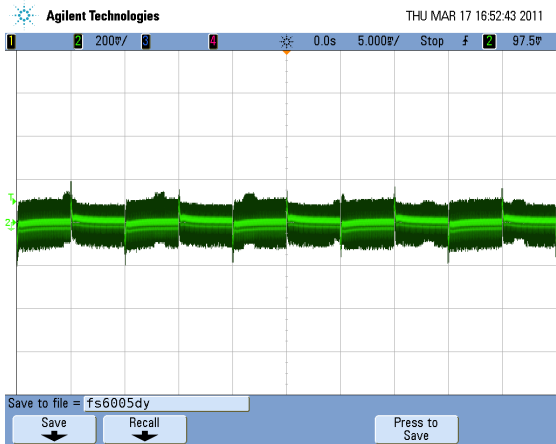
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## Output Load Transient Response

(Dynamic load change from 25% to 50% of full load, slew rate = 0.1A/us)

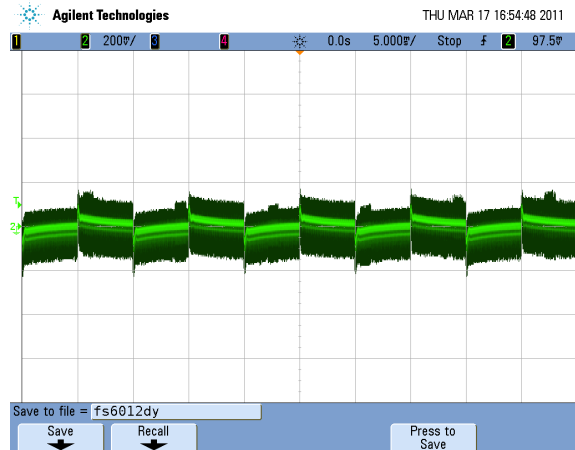
### FS60-5



CH1: 200mV/DIV 5ms/DIV

Vin=220VAC , At 25°C

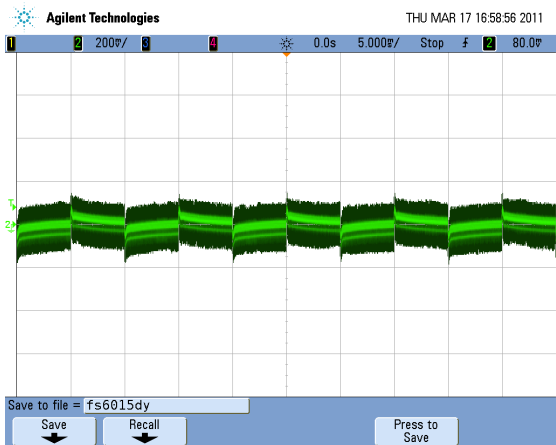
### FS60-12



CH1: 200mV/DIV 5ms/DIV

Vin=220VAC, At 25°C

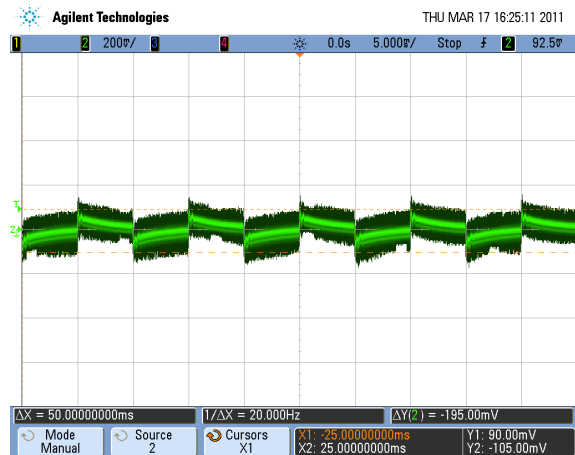
### FS60-15



CH1: 200mV/DIV 5ms/DIV

Vin = 220VAC, At 25°C

### FS60-24



CH1: 200mV/DIV 5ms/DIV

Vin=220VAC, At 25°C



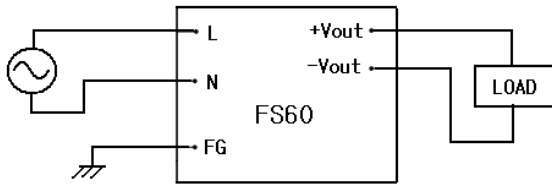
# FS60 Series – Isolated AC/DC Converters

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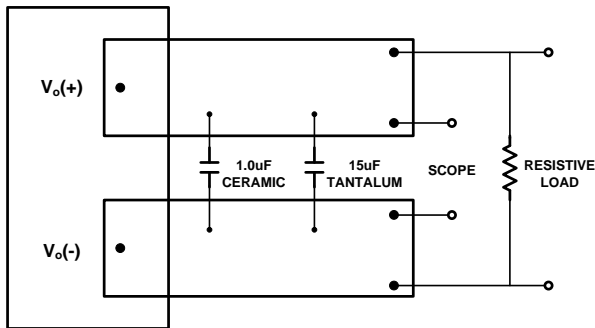
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## Instruction manual

### Basic connection



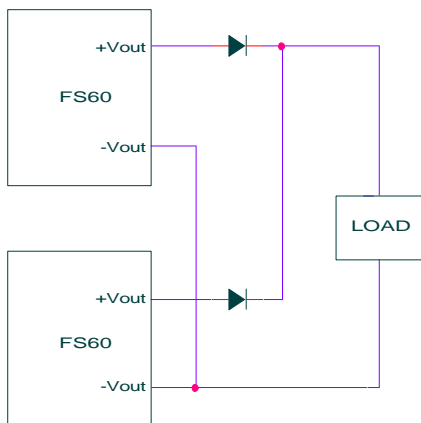
### Output ripple and noise Test



\* Conductor from Vout-pins to capacitors = 50mm (1.97in)

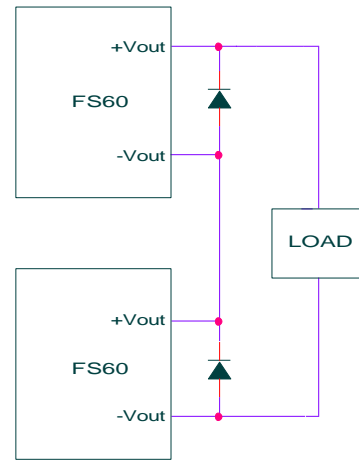
### Parallel operation

Parallel operation is available by connecting the units as shown below.



### Series operation

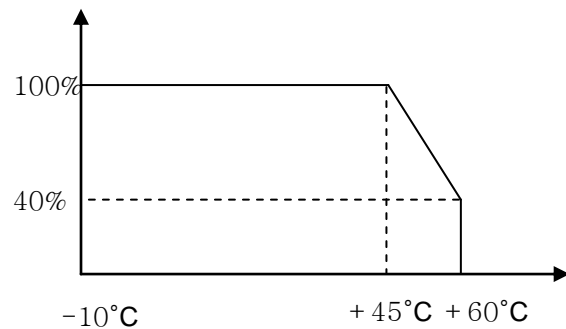
Series operation is available by connecting the outputs of two or more power supplies, as shown below. Output current in series connection should be lower than the lowest current in each unit. (Please use schottky barrier diode)



### Thermal Considerations

FS60 series has wide operating temperature range from -10°C to +60°C.

However, it should be required a enough air flow for more reliable operation. Output derating curve provide designers with a quantity of a current under the desired ambient temperature and velocity of a airflow.





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### Feature Description

#### Input Fuse

In order to comply with safety requirements, FS60 series has a fuse built in.

#### Input Output Filter

FS60 series have an internal EMI filter. To reduce conducted noise, additional external input filter is required

To reduce a output ripple and noise, external capacitor is required at the output of the device

#### Over current Protection (OCP)

FS60 series built in over current protection circuit which operates when the output current is over 105% of rating and automatically recovers when over current condition is removed

If the short or overload condition continues, the power module could be damaged.

#### Over Voltage Protection (OVP)

FS60 series built in overvoltage protection circuit.

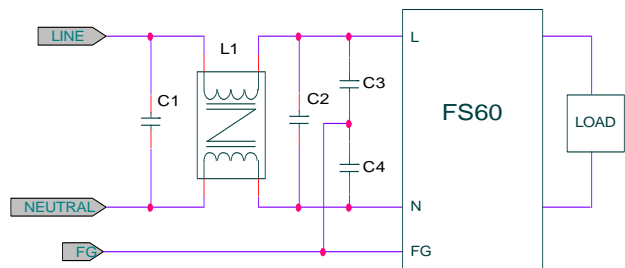
When the OVP trigger, the output will be shut down. The input must be taken out(for at least five seconds), and than re-inputted manually. Otherwise, the module will not operate.

#### Soldering Information

The product is intended for through hole mounting in a PCB, When wave soldering is used, the temperature on the pins is specified to maximum 260°C for maximum 10 seconds when hand soldering, care should be taken to avoid direct contact between the hot soldering iron tip and the pins for more than a few seconds in order to prevent overheating.

#### EMI Characteristic (conducted Emission)

In order to reduce conducted noise install an external input filter as shown in below.



Model Number	L1	C1	C2	C3,C4
FS60-12	10mH	330nF	1uF	2200pF

Complies with CISPR 22 CLASS B

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June 1, 2011**Pin assignments**

TOP VIEW

**Single Output**

PIN NO	NAME	FUNCTION
1	FG	Frame Ground
2	AC(L)	AC Input
3	AC(N)	AC Input
4	+Vout	Positive side of output voltage
5	-Vout	Negative side of output voltage
6	No pin	

**Dual Output**

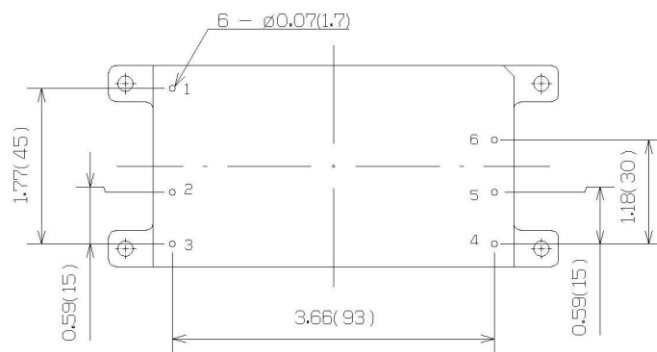
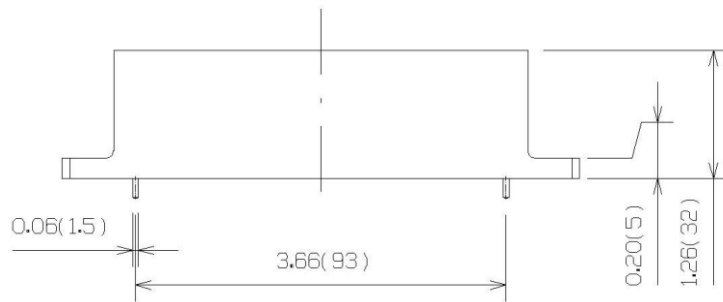
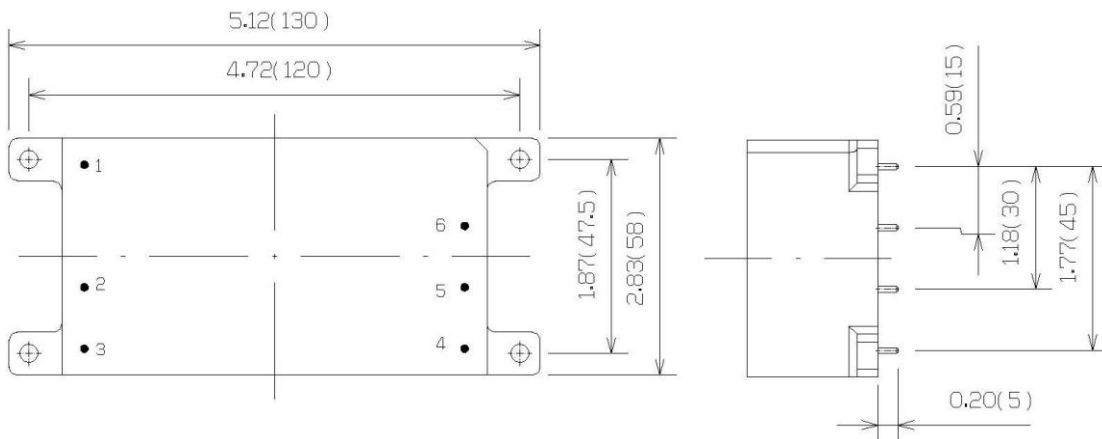
PIN NO	NAME	FUNCTION
1	FG	Frame Ground
2	AC(L)	AC Input
3	AC(N)	AC Input
4	-Vout	Negative side of output voltage
5	COM	Ground of output voltage
6	+Vout	Positive side of output voltage



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**Mechanical Specification**



※ Mounting hole top view

All dimensions are inches and (mm)

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Input	Output1, Output2	Maximum Power	Ripple & Noise Typ.	Efficiency Typ.	Model Number
85 – 264V	5V@10A	50W	80mVp-p	83%	FS60-5(C)
	12V@5A	60W	120mVp-p	87%	FS60-12(C)
	15V@4A	60W	150mVp-p	88%	FS60-15(C)
	+12V@2.5A, -12V@2.5A	60W	120mVp-p	87%	FSD60-1212(C)
	+15V@2A, -15V@2A	60W	150mVp-p	88%	FSD60-1515(C)

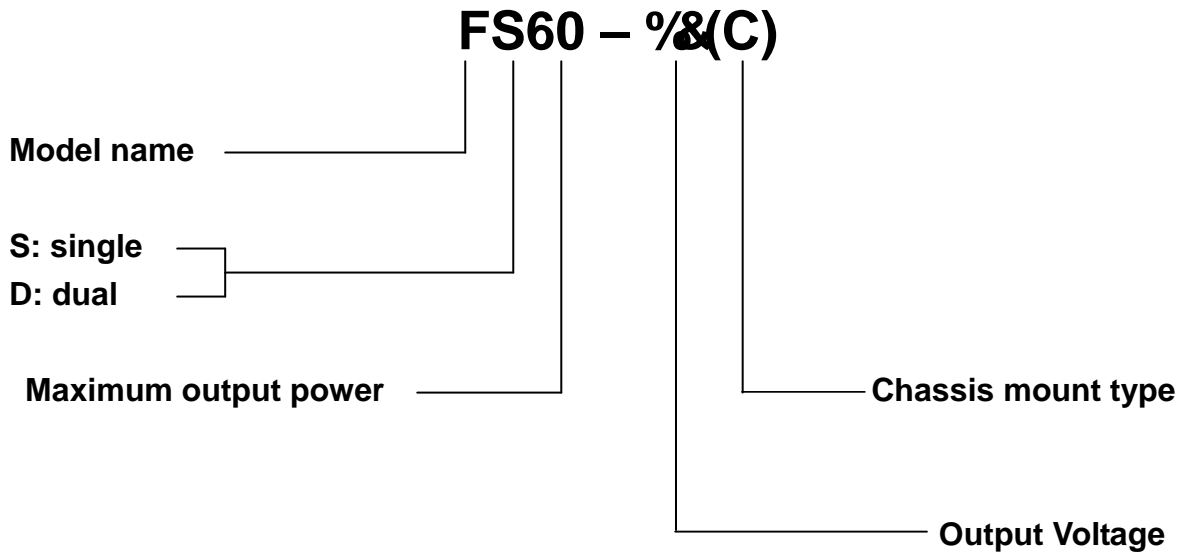
\* (C): Chassis mount type



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**Part number structure**



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