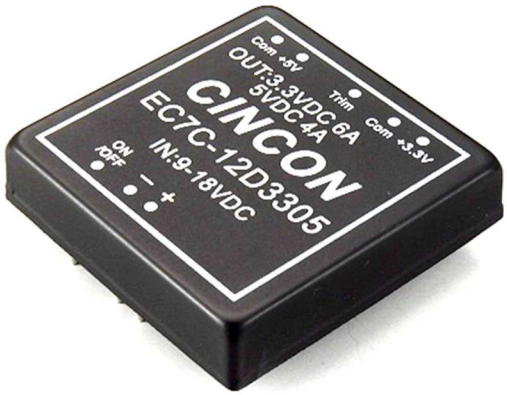
EC7C SERIES 40W DC-DC Converters

Application Note V12

ISOLATED DC-DC Converter
EC7C SERIES
APPLICATION NOTE



Approved By:

Department	Approved By	Checked By	Written By
Research and Development Department	Jacky	Astray	Joyce
Quality Assurance Department	Benny	JoJo	

EC7C SERIES 40W DC-DC Converters

Application Note V12

Content

EC7C SERIES 40W DC-DC Converters

Application Note V12

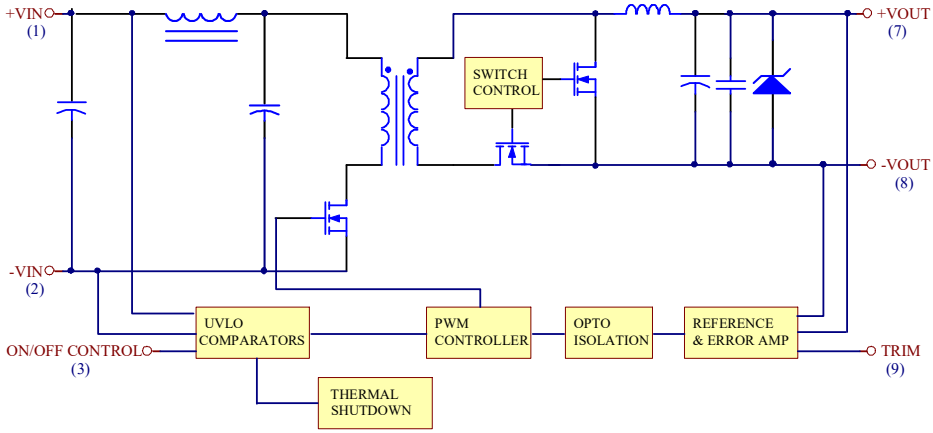
1. Introduction

The EC7C series offer 40 watts of output power with Industry standard package in a 2 x 2 x 0.40inches (50.8 x 50.8 x 10.2mm). The EC7C series has a 2:1 wide input voltage range of 9-18、18-36 and 36-75VDC and provides a precisely regulated output. This series has features such as high efficiency, 1500VDC of isolation and allows an ambient operating temperature range of -40℃ to 85℃.The modules are fully protected against UVLO (under voltage lock-out), over temperature conditions, short circuit, and over-voltage conditions. Furthermore, the standard functions include remote on/off control and output voltage trimming. All models are very suitable for telecommunications, distributed power architectures, battery operated equipment, industrial, and mobile equipment applications.

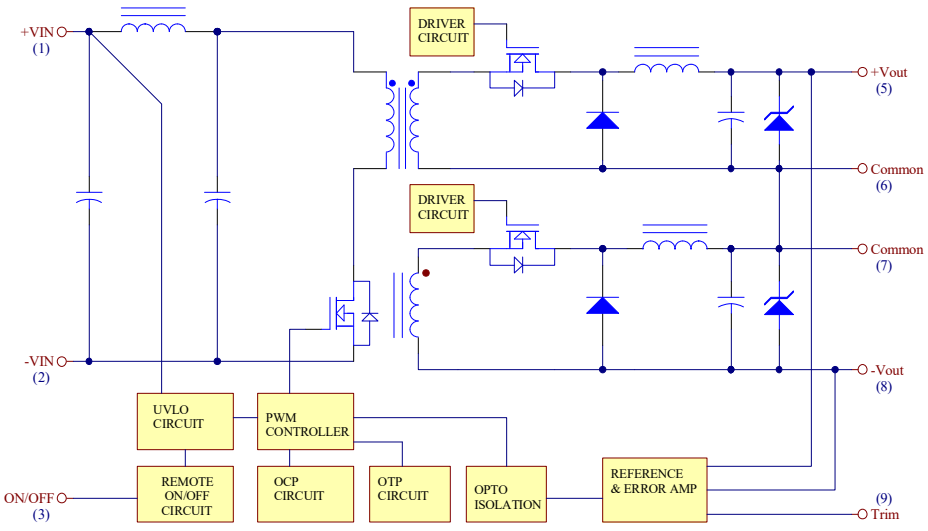
2. DC-DC Converter Features

- 40W Isolated Output
- 2” X 2” Six-Sided Shield Metal Case
- High Efficiency Up to 93%
- Fixed 350KHz Switching Frequency
- 2:1 Input Range
- Regulated Outputs
- Continuous Short Circuit Protection
- UL60950-1 Approval (Except EC7C-XXD3305)
- Safety Meets IEC/EN/UL 62368-1

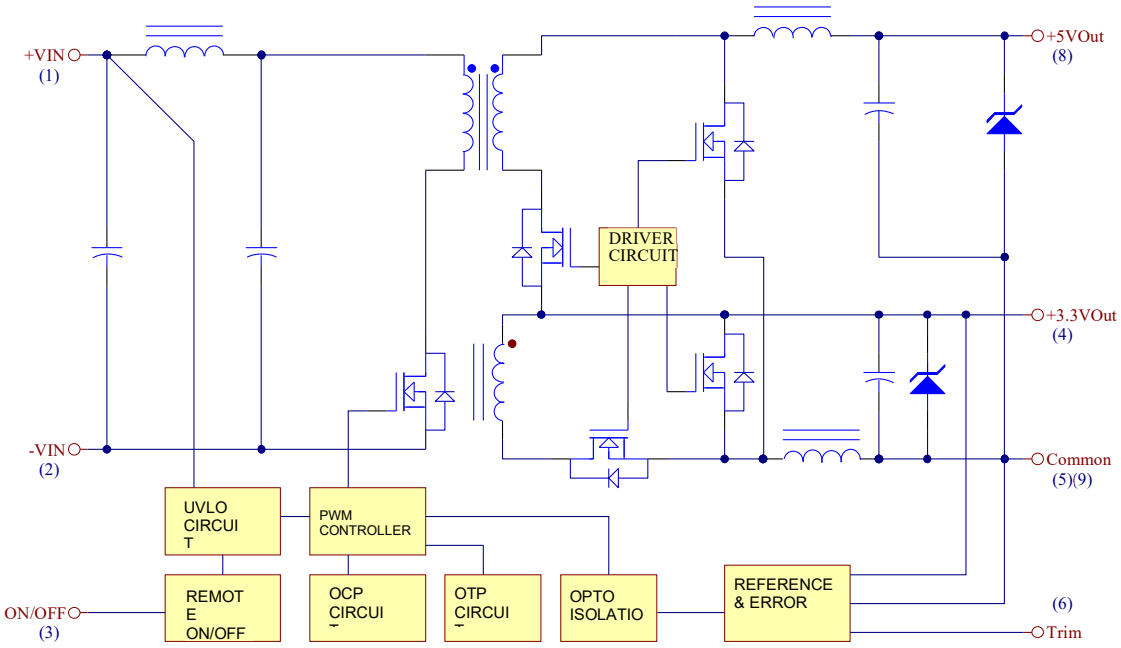
3. Electrical Block Diagram



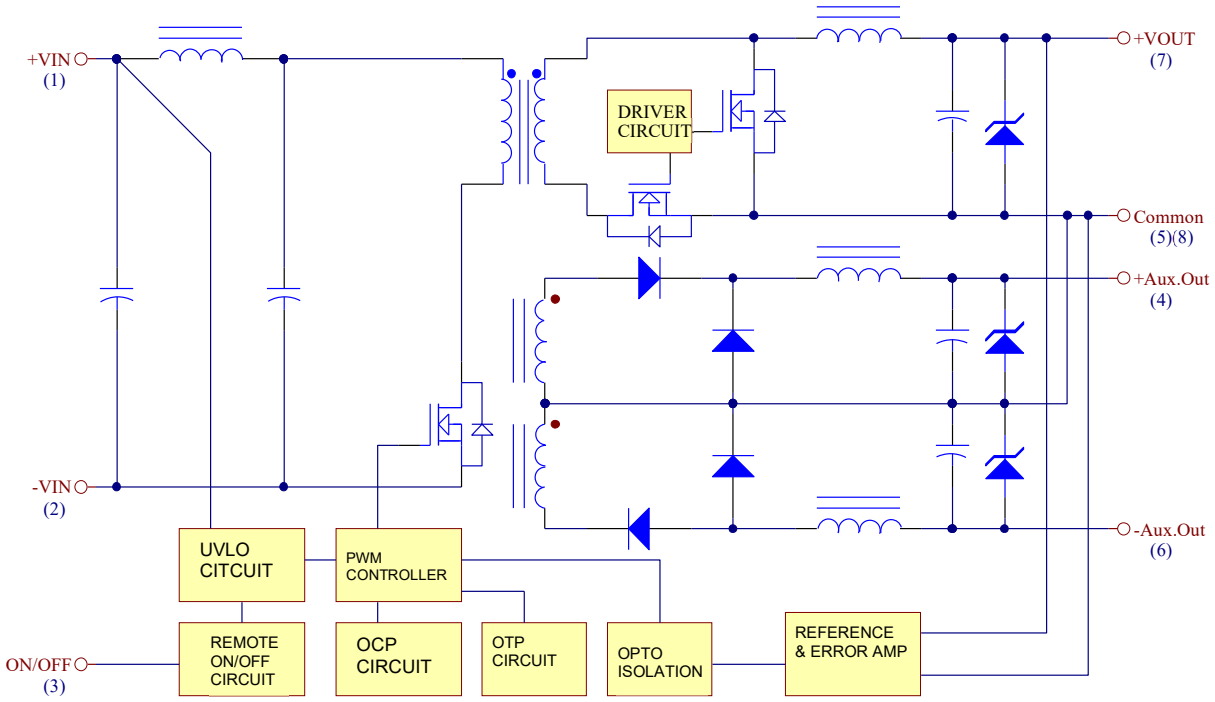
(a) EC7C Series for single output



(b) EC7C Series for dual output



(c) EC7C-XXD3305 for dual positive output



(d) EC7C series for triple output

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						
Continuous		12Vin 24Vin 48Vin	-0.3 -0.3 -0.3		18 36 75	V_{dc}
Transient (100ms)	100ms	12Vin 24Vin 48Vin			25 50 100	V_{dc}
Operating Ambient Temperature	De-rating, above 60℃	All	-40		+85	℃
Case Temperature		All			100	℃
Storage Temperature		All	-55		+125	℃
Input/Output Isolation Voltage	1 minute	All	1500			V_{dc}

INPUT CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Operating Input Voltage		12Vin 24Vin 48Vin	9 18 36	12 24 48	18 36 75	V_{dc}
Input Under-Voltage Lockout						
Turn-On Voltage Threshold		12Vin 24Vin 48Vin	8 16.5 33	8.5 17 34	8.8 17.5 34.5	V_{dc}
Turn-Off Voltage Threshold		12Vin 24Vin 48Vin	7.7 15.5 31.5	8 16 32.5	8.3 16.5 33	V_{dc}
Lockout Hysteresis Voltage		12Vin 24Vin 48Vin		0.6 0.9 1.8		V_{dc}
Maximum Input Current	100% Load, V_{in}= 9 V 100% Load, V_{in}=18V 100% Load, V_{in}=36V	12Vin 24Vin 48Vin		5100 2550 1270		mA
No-Load Input Current		12S25 12S33 12S05 12S12 12S15 12D12 12D15		200 200 200 200 200 100 100		mA

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
No-Load Input Current		12D3305		100		mA
		12T3312		200		
		12T3315		200		
		12T0512		200		
		12T0515		200		
		24S25		100		
		24S33		100		
		24S05		110		
		24S12		100		
		24S15		100		
		24D12		100		
		24D15		100		
		24D3305		50		
		24T3312		100		
		24T3315		100		
		24T0512		100		
		24T0515		100		
		48S25		50		
		48S33		50		
		48S05		60		
		48S12		60		
		48S15		60		
		48D12		50		
		48D15		50		
		48D3305		50		
		48T3312		50		
		48T3315		50		
		48T0512		50		
		48T0515		50		
Off Converter Input Current	Shutdown input idle current	All			10	mA
Inrush Current (I^2t)		All			0.1	A^2s
Input Reflected-Ripple Current	P-P thru 12uH inductor, 5Hz to 20MHz	All		30		mA

OUTPUT CHARACTERISTIC

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Output Voltage Set Point	Vin Nominal, $I_o=I_{o\_max}$, T_c=25℃ Single Output (EC7C-xxSxx) Dual Output (EC7C-xxDxx)	2.5Vdc	2.475	2.5	2.525	V_{dc}
		3.3Vdc	3.267	3.3	3.333	
		5Vdc	4.95	5.0	5.05	
		12Vdc	11.88	12	12.12	
		15Vdc	14.85	15	15.15	
	Vin Nominal, $I_o=I_{o\_max}$, T_c=25℃ Dual Positive Output (EC7C-xxD3305)	3.3Vdc	3.267	3.3	3.333	V_{dc}
		5Vdc	4.85	5.0	5.15	
	Vin nominal, $I_o=I_{o\_max}$, T_c=25℃ Triple Output (EC7C-xxTxxxx)	3.3Vdc	3.267	3.3	3.333	V_{dc}
		5Vdc	4.95	5.0	5.05	
		12Vdc	11.4	12	12.6	
		15Vdc	14.25	15	15.75	

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Voltage Balance	V_{in} Nominal, I_o=I_{o_max}, T_c=25℃	Dual			±2	%
Output Voltage Regulation						
Load Regulation	Io=Full load to 10% full load	Single Dual			±0.5 ±1	%
Load Regulation	Dual positive output $5V_o$=No load, $3.3V_o$: Full load to no load $3.3V_o$=No load, $5V_o$: Full load to no load	3.3Vdc 5Vdc			±1.5 ±4	%
	Triple output Io=Full load to 10% full load	Main Auxiliary			±1 ±4	%
Line Regulation	Vin=High line to low line, full load	Single Dual			±0.5	%
	Dual positive output, V_{in}=High to low line $3.3V_{dc}$: Io=6A, $5V_{dc}$: Io=4A	3.3Vdc 5Vdc			±0.5	%
	Triple output, V_{in}=High to low line Io=Full load	Main Auxiliary			±1 ±3	% %
Temperature Coefficient	T_a=-40℃ to 85℃	All			±0.02	%/℃
Output Voltage Ripple and Noise						
Peak-to-Peak	Full Load, 0.1uF ceramic capacitor 20MHz bandwidth, single and main output	2.5Vdc 3.3Vdc 5Vdc			50	mV
		12Vdc 15Vdc			75	
	Full Load, 0.1uF ceramic capacitor 20MHz bandwidth, dual output, auxiliary output	±12Vdc ±15Vdc			120 150	
	Full Load, 0.1uF ceramic capacitor 20MHz bandwidth, dual positive output	3.3Vdc 5Vdc			100	mV
RMS	Full Load, 0.1uF ceramic capacitor 20MHz bandwidth	xxS25 xxS33 xxS05			20	mV
Operating Output Current Range	$2.5V_{out}$	xxS25	0		10000	mA
	$3.3V_{out}$	xxS33	0		10000	
	$5V_{out}$	xxS05	0		8000	
	$12V_{out}$	xxS12	0		3333	
	$15V_{out}$	xxS15	0		2666	
	$\pm12V_{out}$	xxD12	90		±1800	
	$\pm15V_{out}$	xxD15	70		±1400	
	$3.3V_{out}$ $5V_{out}$	xxD3305	0 0	6000 4000	10000 7500	

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
	$3.3V_{out}$ $\pm 12V_{out}$	xxT3312	600 ±40		6000 ±400	
	$3.3V_{out}$ $\pm 15V_{out}$	xxT3315	600 ±30		6000 ±300	
	$5V_{out}$ $\pm 12V_{out}$	xxT0512	600 ±40		6000 ±400	
	$5V_{out}$ ±15Vout	xxT0515	600 ±30		6000 ±300	
Output DC Current-Limit Inception	Output voltage =90% nominal output voltage	All	110	125	140	%
Maximum Output Capacitance	$2.5V_{out}$ $3.3V_{out}$ $5V_{out}$ $12V_{out}$ $15V_{out}$ $\pm 12V_{out}$ $\pm 15V_{out}$	xxS25 xxS33 xxS05 xxS12 xxS15 xxD12 xxD15			10000 10000 8000 3300 2700 1800 1400	uF
	$3.3V_{out}$ $5V_{out}$	xxD3305			6800 6800	
	$3.3V_{out}$ $\pm 12V_{out}$	xxT3312			6000 400	
	$3.3V_{out}$ $\pm 15V_{out}$	xxT3315			6000 330	
	$5V_{out}$ $\pm 12V_{out}$	xxT0512			6000 400	
	$5V_{out}$ $\pm 15V_{out}$	xxT0515			6000 330	

DYNAMIC CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	75% $I_{o.max}$ to 100% $I_{o.max.}$, 0.1A/us, main output	All			±5	%
Setting Time (within 1% Vout Nominal)	di/dt=0.1A/us, main output	All			300	us
Turn-On Delay and Rise Time						
Turn-On Delay Time, From On/Off Control	$V_{on/off}$ to 90%$V_{o, set}$	All		5.5		ms
Turn-On Delay Time, From Input	$V_{in,min.}$ to 90%$V_{o, set}$	All		5.5		ms
Output Voltage Rise Time	10%$V_{o, set}$ to 90%$V_{o, set}$	All		4.5		ms

EFFICIENCY

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
100% Load	Output load: 3.3V/6A, 5V/4A	12S25		88		%
		12S33		89		
		12S05		89		
		12S12		90		
		12S15		90		
		12D12		89		
		12D15		90		
		12D3305		87		
		12T3312		88		
		12T3315		88		
		12T0512		88		
		12T0515		90		
		24S25		88		
		24S33		89		
		24S05		91		
		24S12		92		
		24S15		92		
		24D12		91		
		24D15		92		
	Output load: 3.3V/6A, 5V/4A	24D3305		89.5		
		24T3312		90		
		24T3315		90		
		24T0512		90		
		24T0515		90		
		48S25		89		
		48S33		90		
		48S05		90		
		48S12		91		
		48S15		92		
		48D12		90		
		48D15		91		
	Output load: 3.3V/6A, 5V/4A	48D3305		89.5		
		48T3312		89		
		48T3315		87		
		48T0512		88		
		48T0515		90		

ISOLATION CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Input to Output	1 Minute	All			1500	V_{dc}
Isolation Resistance		All	100			MΩ
Isolation Capacitance		All		1000		pF

EC7C SERIES 40W DC-DC Converters

Application Note V12

FEATURE CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Switching Frequency		All		350		KHz
On/Off Control, Negative Remote On/Off Logic						
Logic Low (Module On)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All	0		1.8	V
Logic High (Module Off)	$V_{on/off}$ at $I_{on/off}$=0.0uA	All	3.5		75 or Open circuit	V
On/Off Control, Positive Remote On/Off Logic						
Logic Low (Module Off)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All	0		1.8	V
Logic High (Module On)	$V_{on/off}$ at $I_{on/off}$=0.0uA	All	3.5		75 or Open circuit	V
On/Off Current (for Both Remote On/Off Logic)	$I_{on/off}$ at $V_{on/off}$=0.0V	All			1	mA
Leakage Current (for Both Remote On/Off Logic)	Logic high, $V_{on/off}$=15V	All			30	uA
Off Converter Input Current	Shutdown input idle current	All		4	10	mA
Output Voltage Trim Range	$P_{out} \leqq$ max rated power 40watts	All	-10		+10	%
Output Over-Voltage Protection		2.5Vdc 3.3Vdc 5Vdc 12Vdc 15Vdc		3.6 3.9 6.2 15 18		V

GENERAL SPECIFICATIONS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typical	Max.	Units
Over-Temperature Shutdown	Case temperature	All		110		℃
MTBF	Io=100%of $I_{o.max}$, T_a=25℃ per MIL-HDBK-217F	All		800		K hours
Weight		All		65		g

5. Main Features and Functions

5.1 Operating Temperature Range

The EC7C series converters can be operated within a wide ambient temperature range of -40℃ to 85℃ with de-rating. The consideration must be given to the de-rating curves when ascertaining maximum power that can be drawn from the converter. The maximum power drawn from open frame models is influenced by the same factors, such as:

- Input voltage range
- Output load current
- Forced air or natural convection
- Mother board PCB design, especially ground and power planes

5.2 Over-Temperature Protection (OTP)

The EC7C series converters are equipped with non-latching over-temperature protection. If the temperature exceeds a threshold of 110°C (typical) the converter will shut down, disabling the output. When the temperature has decreased the converter will automatically restart. The over-temperature condition can be induced by a variety of reasons such as external overload condition or a system fan failure.

5.2 Output Voltage Adjustment

Section 6.6 describes in detail as to how to trim the output voltage with respect to its set point. The output voltage on single and dual models is adjustable in the range from +10% to –10%. The output voltage on dual positive models is adjustable in the range from +5% to -5%.

5.3 Over Current Protection

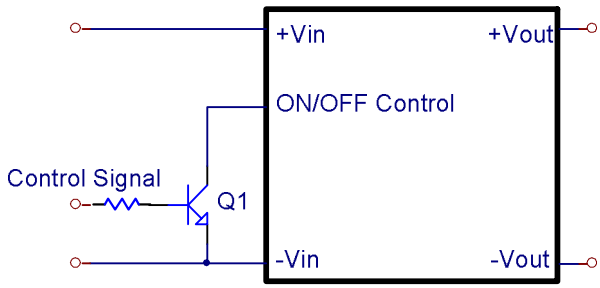
All different voltage models have full continuous short-circuit protection. To provide protection in a fault condition, the unit is equipped with internal over-current protection. The unit operates normally once the fault condition is removed. At the point of current-limit inception, the converter will go into a hiccup mode protection.

5.4 Output Over Voltage Protection

The output overvoltage protection consists of circuitry that internally zener diode clamps the output voltage. If a more accurate output over voltage protection circuit is required then this can be used external control the remote on/off pin.

5.5 Remote On/Off

The remote On/Off input feature of the converter allows external circuitry to turn the converter On or Off. Active-high remote On/Off is available as standard. The converter is turned on if the remote On/Off pin is high (>3.5Vdc to 75Vdc or open circuit). Setting the pin low (0 to <1.8Vdc) will turn the converter 'Off'. The signal level of the remote on/off input is defined with respect to "-Vin". If not using the remote on/off pin, leave the pin open (module will be on). The part number suffix "N" is negative remote On/Off version. The unit is turned off if the remote On/Off pin is high (>3.5Vdc to 75Vdc or open circuit). The converter is turned on if the On/Off pin input is low (0 to <1.8Vdc). The recommended On/Off drive circuit as shown as below figure.



Remote On/Off Input Drive Circuit

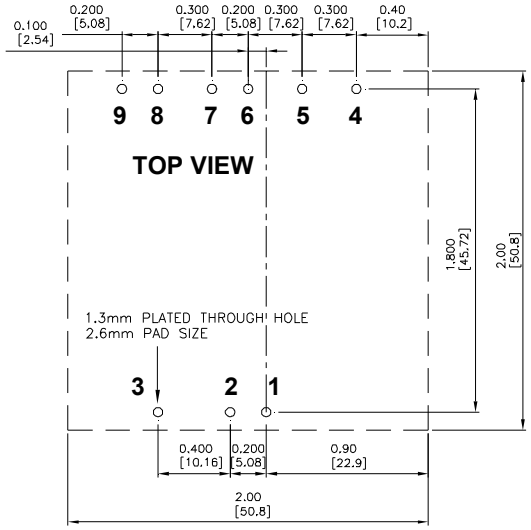
5.6 UVLO (Under-Voltage Lockout)

Input under voltage lockout is standard with the EC7C unit. The unit will shut down when the input voltage drops below a threshold, and the unit will turn on when the input voltage goes to the upper threshold.

6. Applications

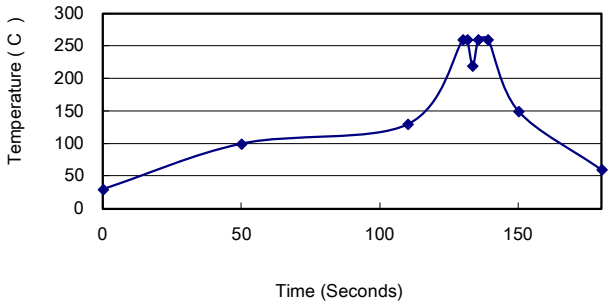
6.1 Recommended Layout PCB Footprints and Soldering Information

The system designer or the end user must ensure that other components and metal in the vicinity of the converter meet the spacing requirements to which the system is approved. Low resistance and low inductance PCB layout traces are the norm and should be used where possible. Due consideration must also be given to proper low impedance tracks between power module, input and output grounds. The recommended footprint and soldering profile is shown as below.



Recommend Footprint for PCB Layout

Lead Free Wave Soldering Profile



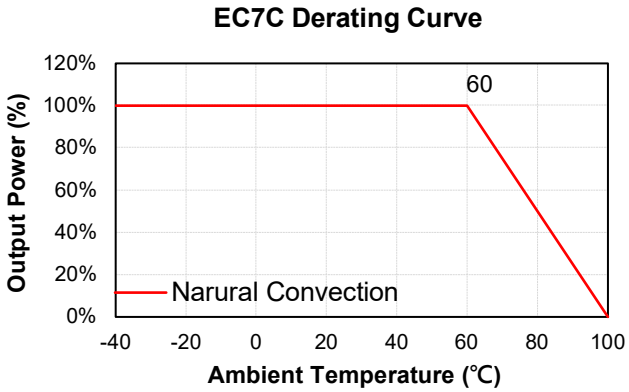
Recommended wave Soldering Profile

Note：

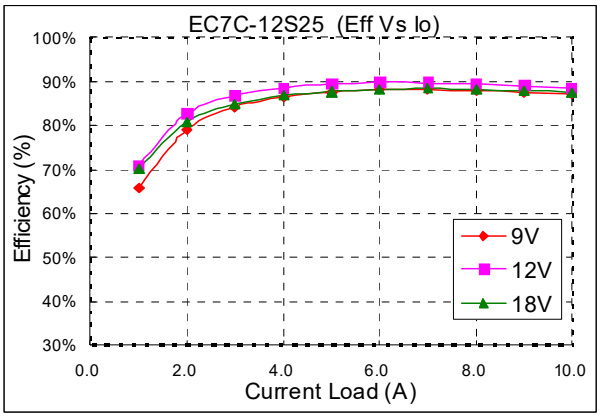
1. Soldering Materials: Sn/Cu/Ni
2. Ramp up rate during preheat: 1.4℃/Sec (From 50℃ to 100℃)
3. Soaking temperature: 0.5℃/Sec (From 100℃ to 130℃), 60±20 seconds
4. Peak temperature: 260℃, above 250℃ 3~6 Seconds
5. Ramp up rate during cooling: -10.0℃/Sec (From 260℃ to 150℃)

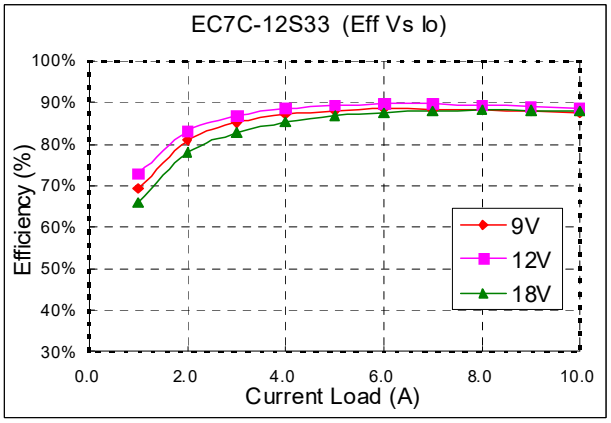
6.2 Power De-Rating Curves for EC7C Series

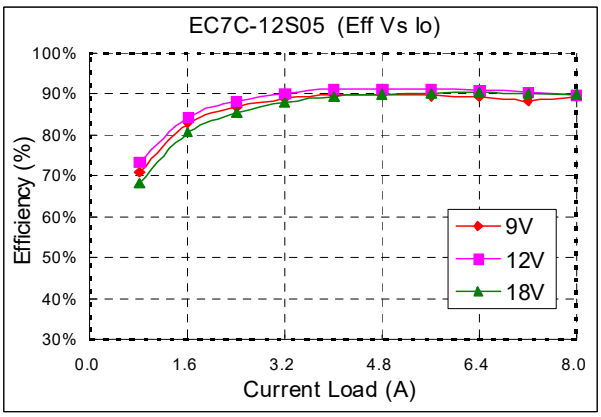
Operating Ambient temperature Range: -40℃ ~ 85℃ with de-rating

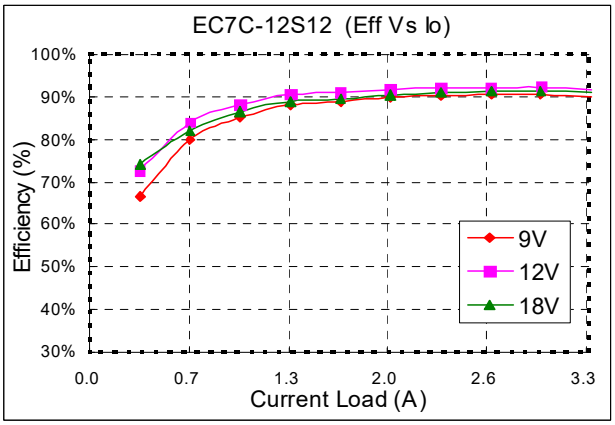


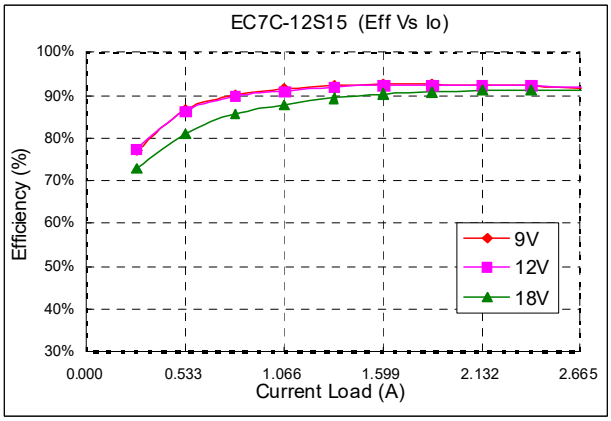
6.3 Efficiency vs. Load Curves

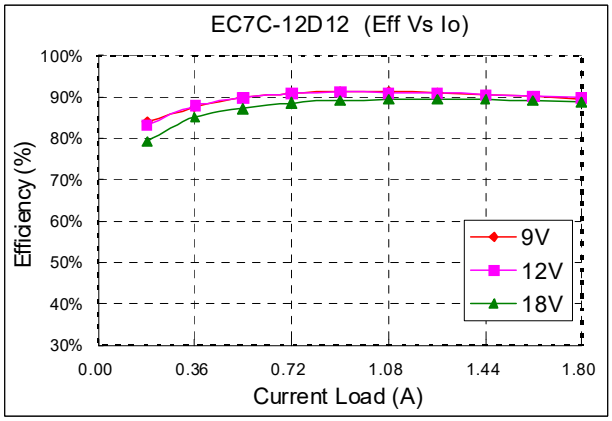


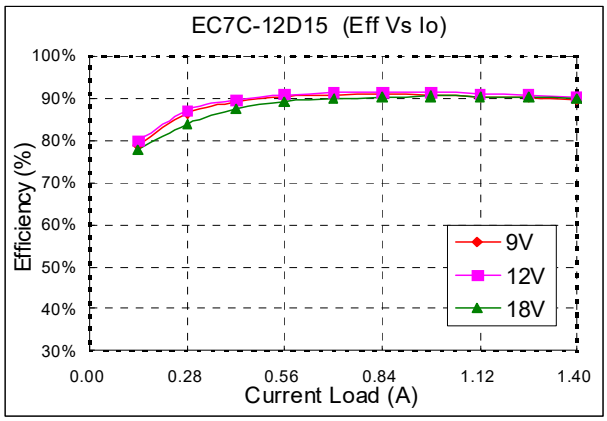


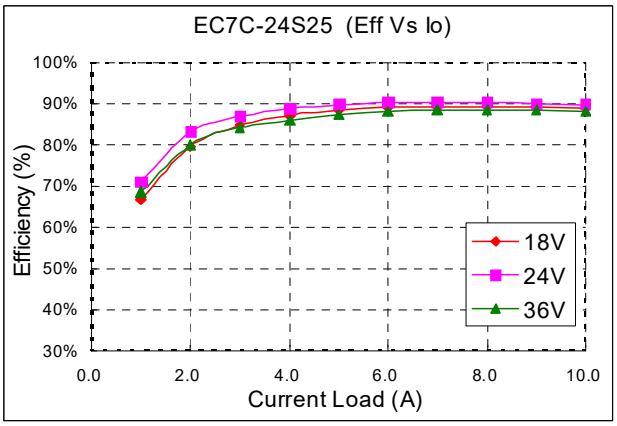


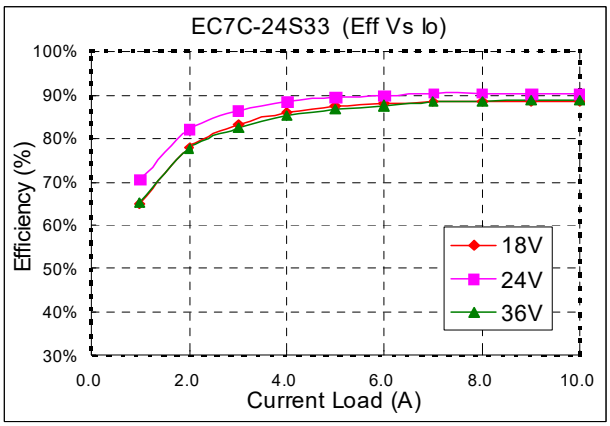


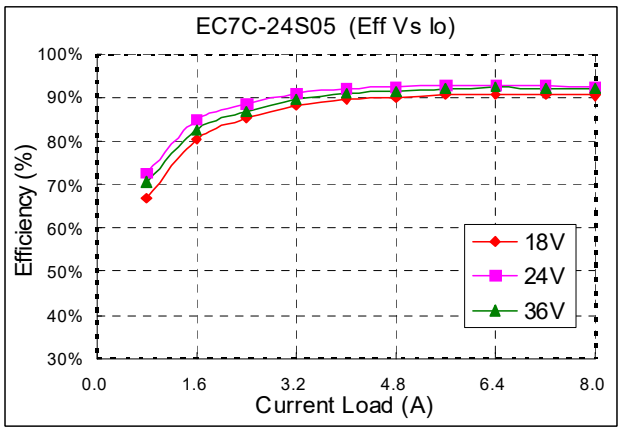


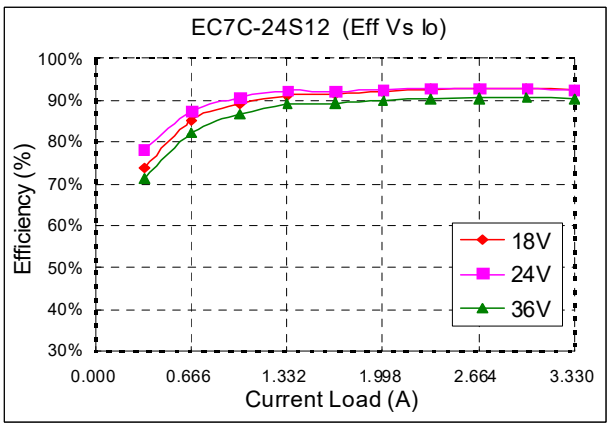


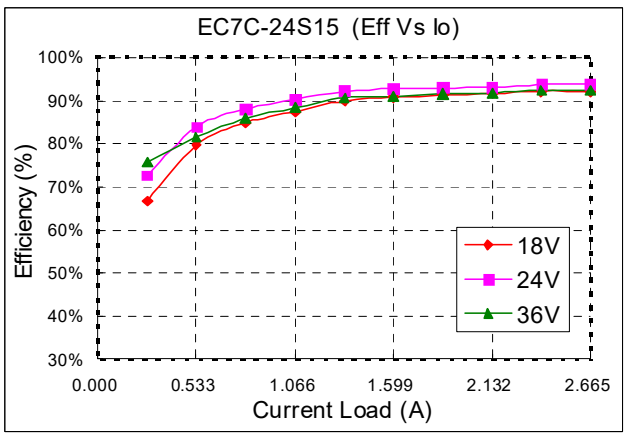

EC7C-12D15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.00
0.28
0.56
0.84
1.12
1.40
Current Load (A)
9V
12V
18V

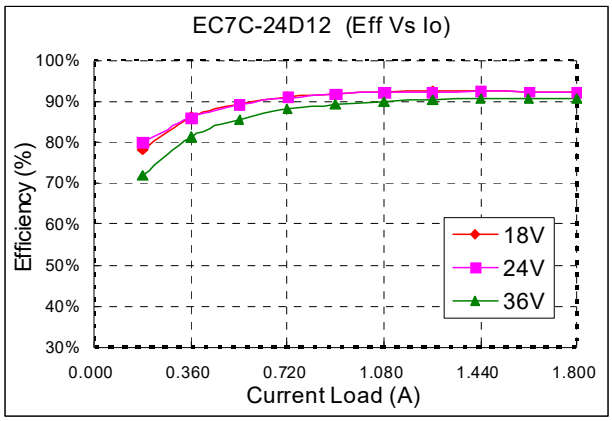

EC7C-24S25 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.0
2.0
4.0
6.0
8.0
10.0
Current Load (A)
18V
24V
36V

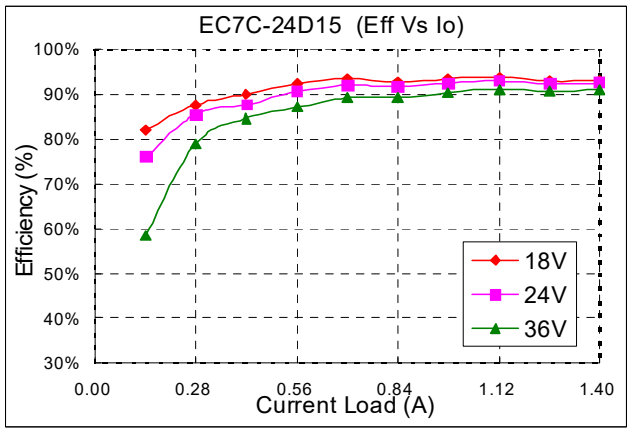

EC7C-24S33 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.0
2.0
4.0
6.0
8.0
10.0
Current Load (A)
18V
24V
36V

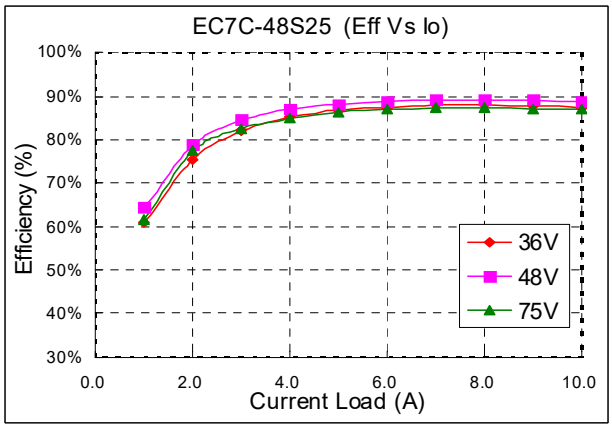

EC7C-24S05 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.0
1.6
3.2
4.8
6.4
8.0
Current Load (A)
18V
24V
36V

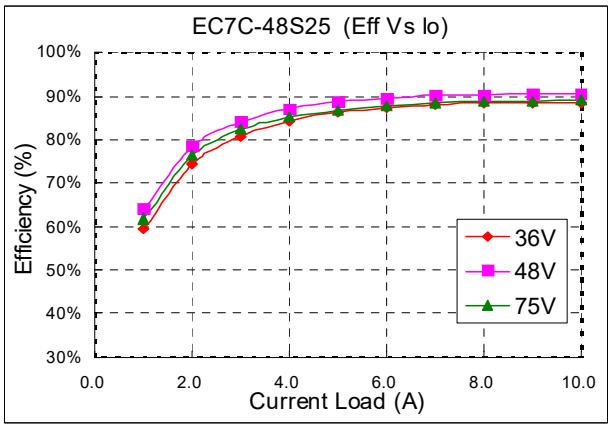

EC7C-24S12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.000
0.666
1.332
1.998
2.664
3.330
Current Load (A)
18V
24V
36V

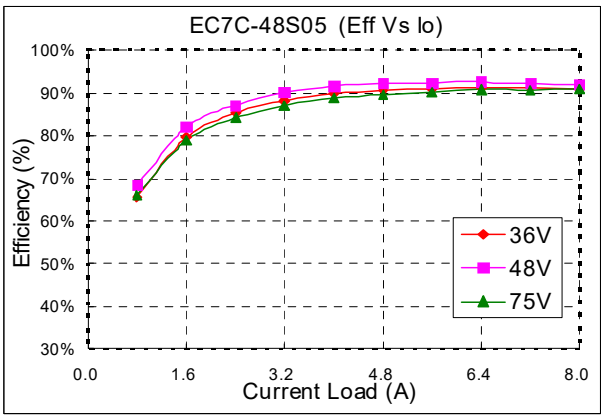

EC7C-24S15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.000
0.533
1.066
1.599
2.132
2.665
Current Load (A)
18V
24V
36V

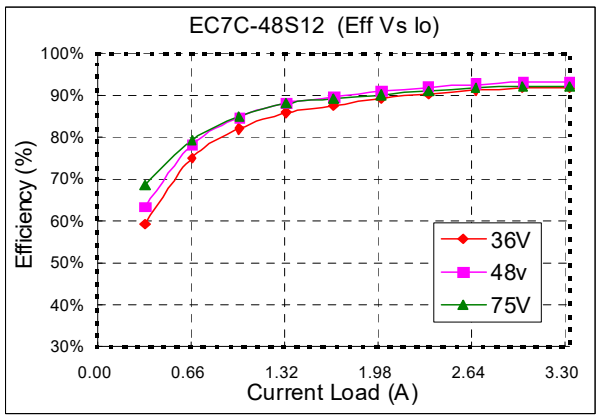

EC7C-24D12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.000
0.360
0.720
1.080
1.440
1.800
Current Load (A)
18V
24V
36V

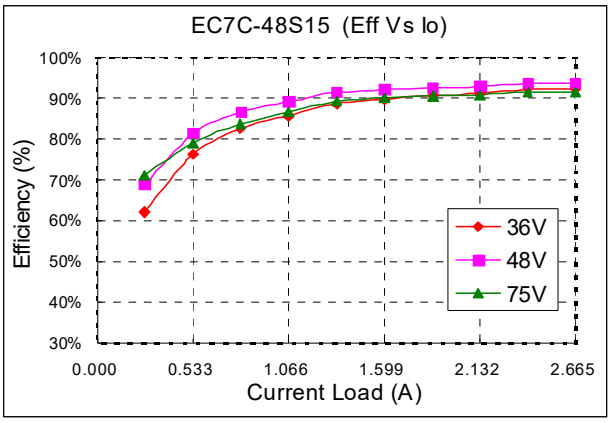

EC7C-24D15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.00
0.28
0.56
0.84
1.12
1.40
Current Load (A)
18V
24V
36V

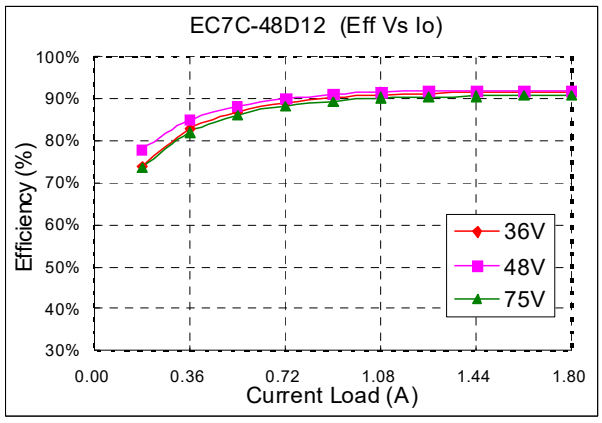

EC7C-48S25 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.0
2.0
4.0
6.0
8.0
10.0
Current Load (A)
36V
48V
75V

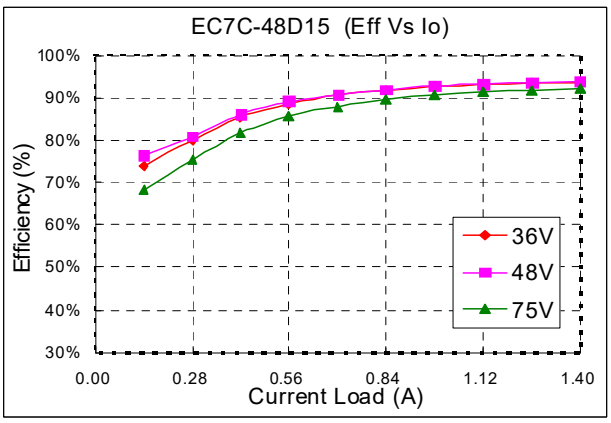

EC7C-48S25 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.0
2.0
4.0
6.0
8.0
10.0
Current Load (A)
36V
48V
75V

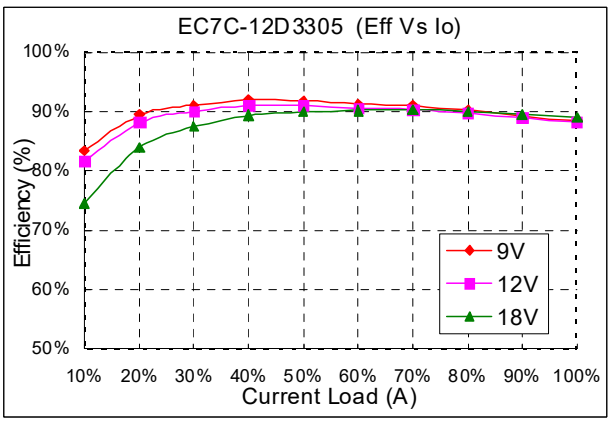

EC7C-48S05 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.0
1.6
3.2
4.8
6.4
8.0
Current Load (A)
36V
48V
75V

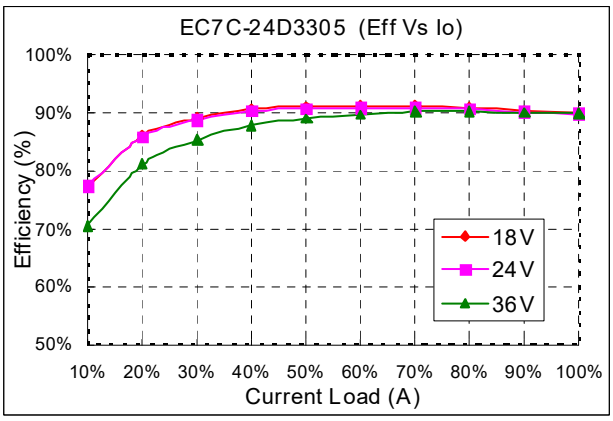

EC7C-48S12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.00
0.66
1.32
1.98
2.64
3.30
Current Load (A)
36V
48v
75V

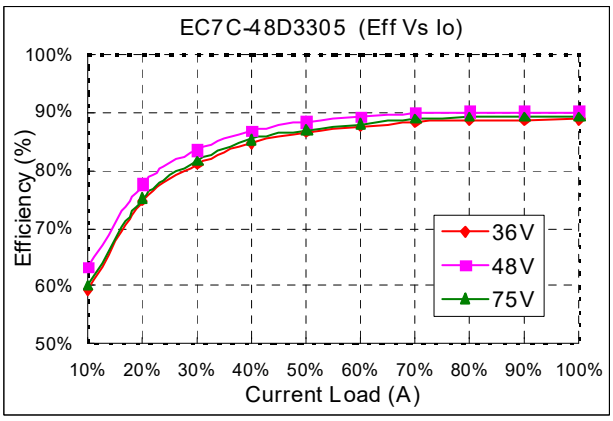

EC7C-48S15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.000
0.533
1.066
1.599
2.132
2.665
Current Load (A)
36V
48V
75V

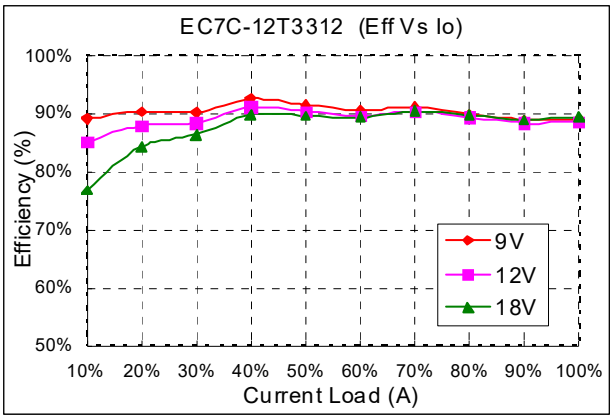

EC7C-48D12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.00
0.36
0.72
1.08
1.44
1.80
Current Load (A)
36V
48V
75V

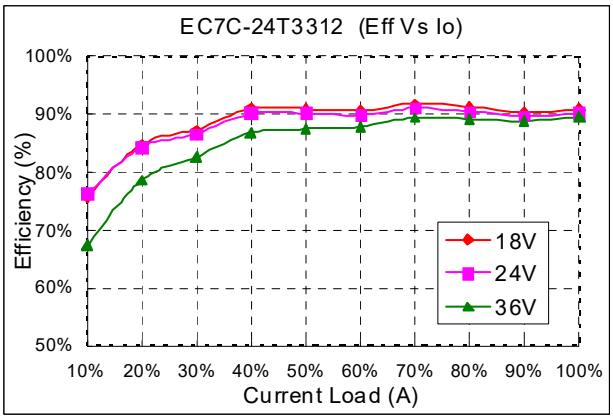

EC7C-48D15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
40%
30%
0.00
0.28
0.56
0.84
1.12
1.40
Current Load (A)
36V
48V
75V

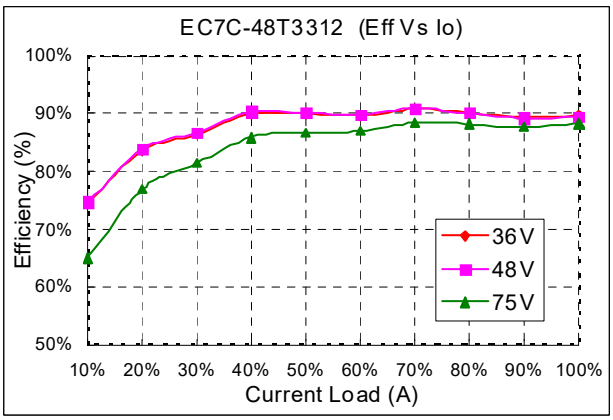

EC7C-12D3305 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Current Load (A)
9V
12V
18V

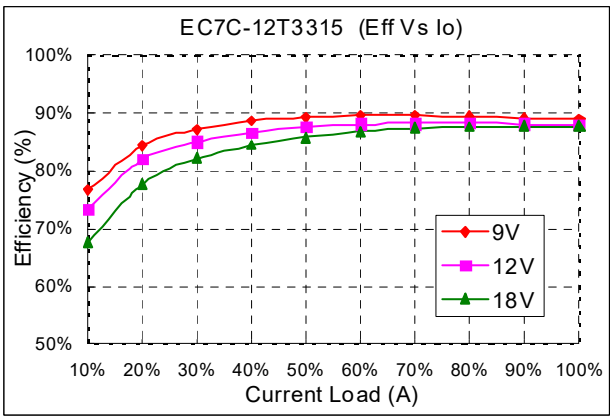

EC7C-24D3305 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Current Load (A)
18V
24V
36V

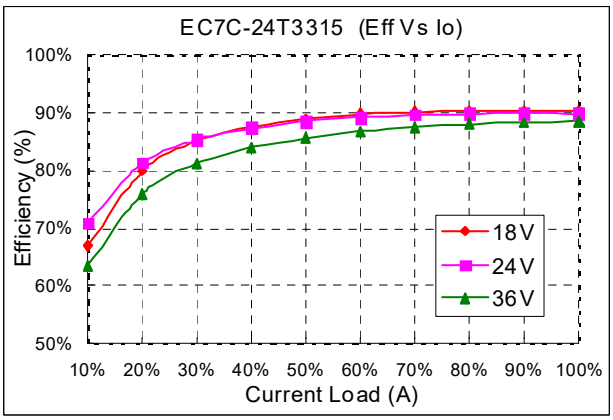

EC7C-48D3305 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
Current Load (A)
36V
48V
75V

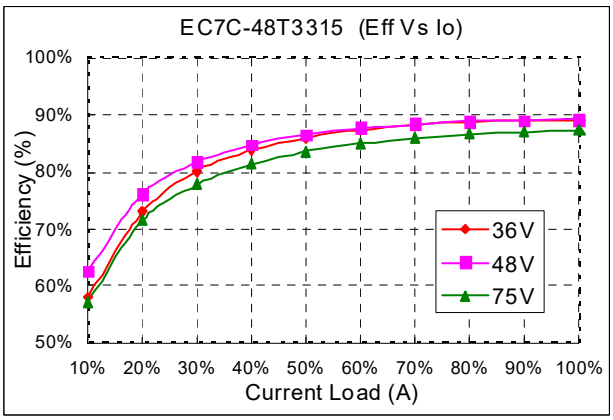

EC7C-12T3312 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
9V
12V
18V

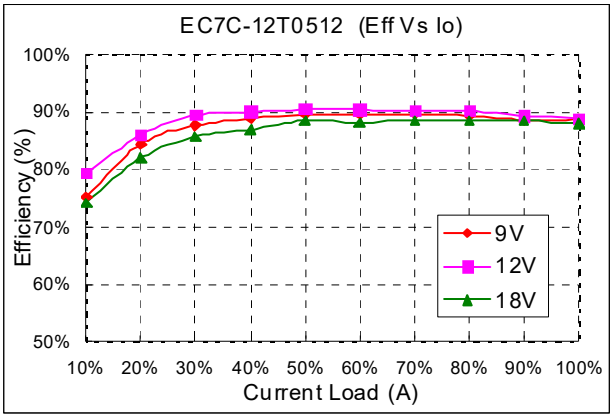

EC7C-24T3312 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
18V
24V
36V

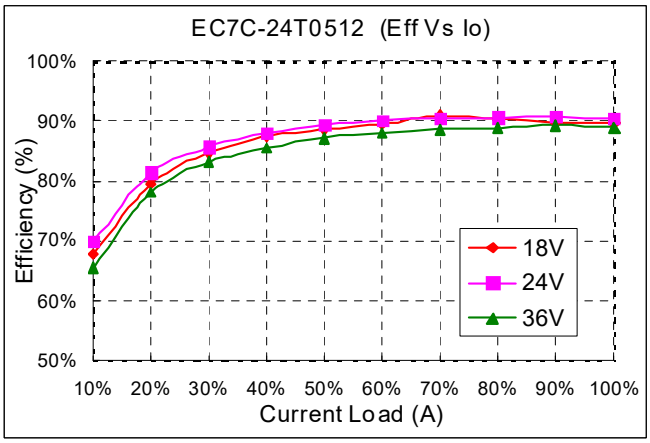

EC7C-48T3312 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
36V
48V
75V

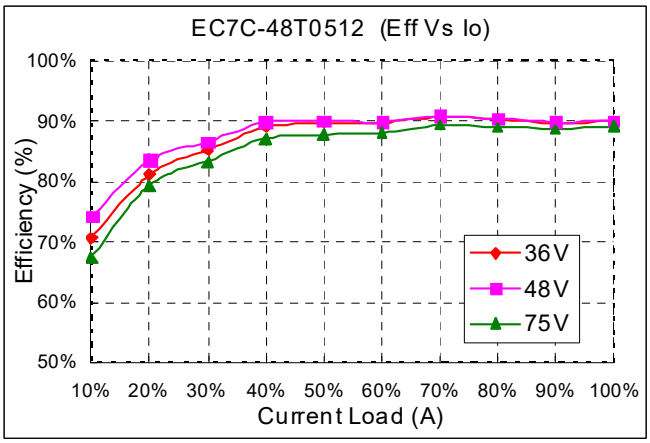

EC7C-12T3315 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
9V
12V
18V

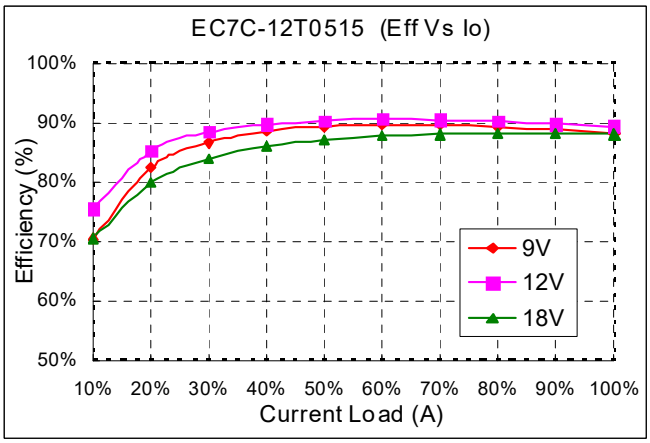

EC7C-24T3315 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
18V
24V
36V

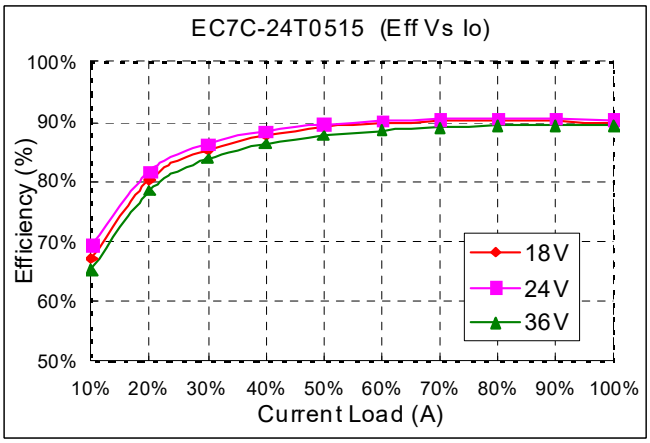

EC7C-48T3315 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
36V
48V
75V

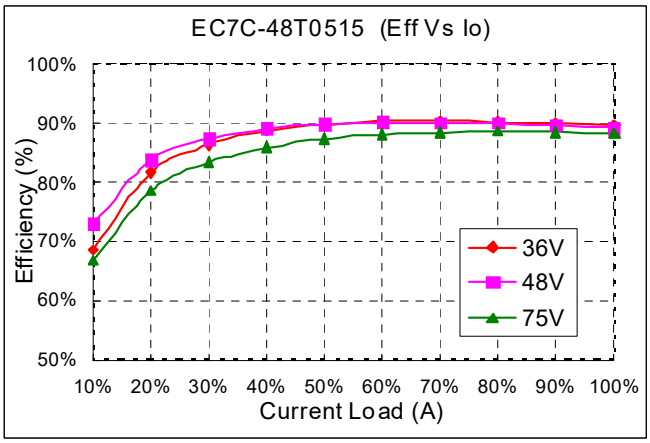

EC7C-12T0512 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
9V
12V
18V


EC7C-24T0512 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
18V
24V
36V


EC7C-48T0512 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
36V
48V
75V

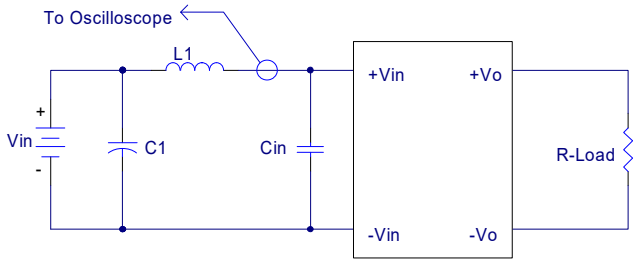

EC7C-12T0515 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
9V
12V
18V


EC7C-24T0515 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
18V
24V
36V


EC7C-48T0515 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
50%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (A)
36V
48V
75V

6.4 Input Capacitance at the Power Module

The converters must be connected to low AC source impedance. To avoid problems with loop stability source inductance should be low. Also, the input capacitors (Cin) should be placed close to the converter input pins to de-couple distribution inductance. However, the external input capacitors are chosen for suitable ripple handling capability. Low ESR capacitors are good choice. Circuit as shown as below represents typical measurement methods for reflected ripple current. C1 and L1 simulate a typical DC source impedance. The input reflected-ripple current is measured by current probe to oscilloscope with a simulated source Inductance (L1).



L1: 12uF
C1: 220uF ESR<0.1ohm @100KHz
Cin: 33uF ESR<0.7ohm @100KHz

Input Reflected-Ripple Test Setup

6.5 Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown as below. When testing the modules 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:

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

Where

Vo is output voltage,
Io is output current,
Vin is input voltage,
Iin is input current.

The value of load regulation is defined as:

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

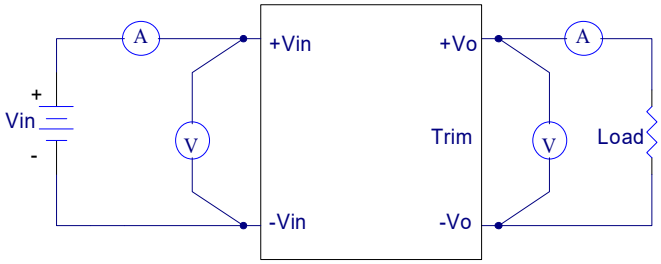
Where

V_{FL} is the output voltage at full load
V_{NL} is the output voltage at no 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.



EC7C Series Test Setup

6.6 Test Set-Up for Dual positive output

The basic test set-up to measure parameters such as efficiency and load regulation is shown as below. When testing the modules 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:

$$\eta = \frac{(Vo1 \times Io1) + (Vo2 \times Io2)}{Vin \times Iin} \times 100\%$$

Where

Vo1 is +5.0V output voltage,
Vo2 is +3.3V output voltage,
Rated Load is +5V/4A, +3.3V/6A
Io1 is +5.0V output current 4A,
Io2 is +3.3V output current 6A,
Any combination at 5V/3.3V rated output current, not to exceeded 40W of output power
Vin is input voltage,
Iin is input current.

The value of load regulation is defined as:

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

Where

V_{FL} is the output voltage at max. load

V_{NL} is the output voltage at no load

other output at zero 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 Rate load. V_{LL} is the output voltage of minimum input voltage at Rate load.

The value of load regulation is defined as:

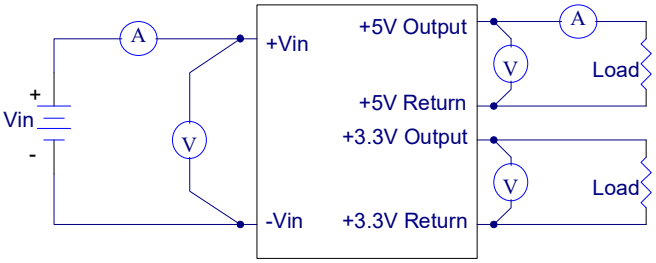
$$Cross.reg = \frac{V_{FL} - V_{10\%FL}}{V_{FL}} \times 100\%$$

Where

V_{FL} is the output voltage at Max. load

$V_{10\%FL}$ is the output voltage at 10% Max. load

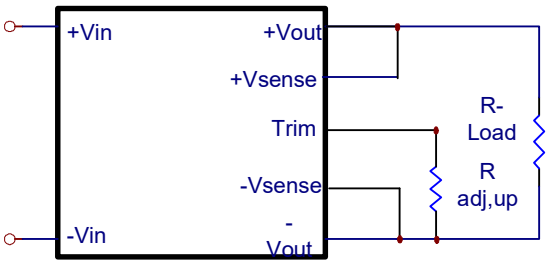
other output at 10% Max. load



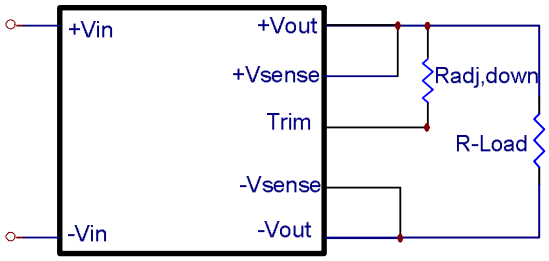
EC7C-XXD3305 Test Setup

6.7 Output Voltage Adjustment

In order to trim the voltage up or down one needs to connect the trim resistor either between the trim pin and - Vo for trim-up and between trim pin and +Vo for trim-down. The output voltage trim range is ±10%. This is shown as below:



Trim up output voltage Setup



Trim down Output voltage Setup

The value of Radj,up & Radj,down defined as:

12S25、24S25、48S25：

$$R_{adj,up} = \frac{2.877}{\Delta Vo} - 8.25(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{2.923}{\Delta Vo} - 10.57(\mathrm{K}\Omega)$$

12S33、24S33、48S33：

$$R_{adj,up} = \frac{3.151}{\Delta Vo} - 9.1(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{5.172}{\Delta Vo} - 11.84(\mathrm{K}\Omega)$$

12S05、24S05、48S05：

$$R_{adj,up} = \frac{5.8}{\Delta Vo} - 8.2(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{2.32Vo - 5.8}{\Delta Vo} - 8.2(\mathrm{K}\Omega)$$

12S12、24S12、48S12：

$$R_{adj,up} = \frac{51}{\Delta Vo} - 22(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{48.167}{\Delta Vo} - 28.8(\mathrm{K}\Omega)$$

12S15、24S15、48S15：

$$R_{adj,up} = \frac{52.893}{\Delta Vo} - 27(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{67.67}{\Delta Vo} - 35.06(\mathrm{K}\Omega)$$

12D12、24D12、48D12：

$$R_{adj,up} = \frac{44.5}{\Delta Vo} - 22(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{63.106}{\Delta Vo} - 30.9(\mathrm{K}\Omega)$$

12D15、24D15、48D15：

$$R_{adj,up} = \frac{73.22}{\Delta Vo} - 27(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{96.068}{\Delta Vo} - 38.3(\mathrm{K}\Omega)$$

Where: Vo is the desired output voltage

$$\Delta Vo = | V_O - V_{Onom} |$$

To give an example of the above calculation, to set a voltage of 5.3Vdc using EC7C -48S05, $R_{adj,up}$ is given by:

$$\Delta Vo = | 5.0 - 5.3 | = 0.3Vdc$$

$$R_{adj,up} = \frac{5.8}{0.3} - 8.2 = 11.133(\mathrm{K}\Omega)$$

Connect it between trim pin to –Vo pin.

EC7C-XXD3305：

$$R_{adj,up} = \frac{4.81}{\Delta Vo} - 20(\mathrm{K}\Omega)$$

$$R_{adj,down} = \frac{7.893}{\Delta Vo} - 23.85(\mathrm{K}\Omega)$$

Where: V_o is the desired output voltage (+3.3V output)

$$\Delta Vo = | V_O - V_{Onom} |$$

To give an example of the above calculation, to set a voltage of 3.3Vdc using EC7C –XXD3305, $R_{adj,up}$ is given by:

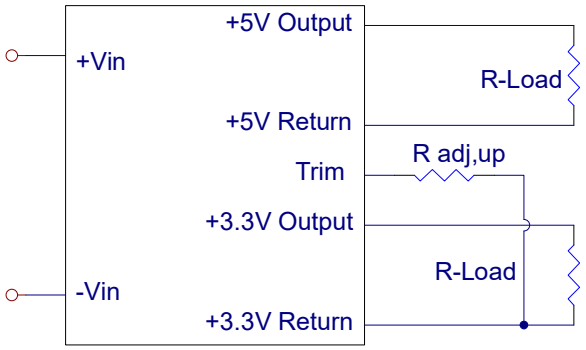
$$\Delta Vo = | 3.465 - 3.3 | = 0.165Vdc$$

$$R_{adj,up} = \frac{4.811}{0.165} - 20 = 9.16(\mathrm{K}\Omega)$$

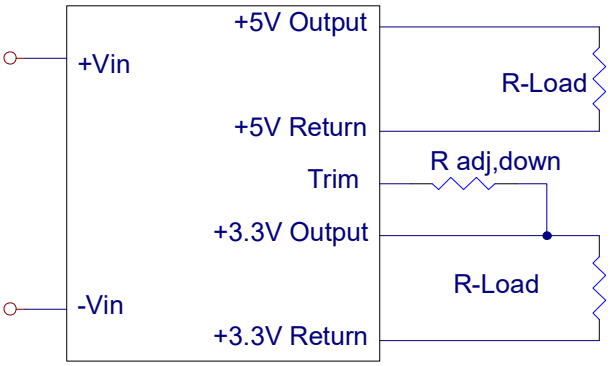
Connect it between Trim pin to +3.3V Return pin.

6.8 Output Voltage Adjustment for Dual Positive Output

In order to trim the voltage up or down one needs to connect the trim resistor either between the trim pin and +3.3V Return for trim-up and between trim pin and +3.3V Output for trim-down. The output voltage trim range is ±5%. This is shown as below:



Trim up output voltage Setup

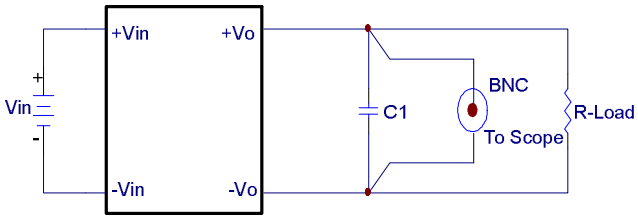


Trim down Output voltage Setup

The value of $R_{adj,up}$ & $R_{adj,down}$ defined as:

6.9 Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown as below. A coaxial cable was used to prevent impedance mismatch reflections disturbing the noise readings at higher frequencies. Measurements are taken with output appropriately loaded and all ripple/noise specifications are from D.C. to 20MHz Band Width. The output ripple/noise is measured with 0.1uF ceramic capacitor across output.



Output test BNC at 50mm to 75mm (2” to 3”) from the module

C1：0.1uF ceramic capacitor

Output Voltage Ripple and Noise Measurement set-up

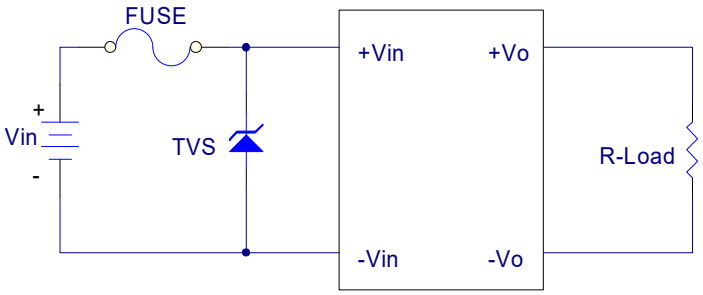
6.10 Output Capacitance

The EC7C series converters provide unconditional stability with or without external capacitors. For good transient response low ESR output capacitors should be located close to the point of load. For high current applications point has already been made in layout considerations for low resistance and low inductance tracks. Output capacitors with its associated ESR values have an impact on loop stability and bandwidth. Cincon's converters are designed to work with load capacitance up-to 1000uF per amp. The maximum capacitance refer section 4 technical specifications.

7. Safety & EMC

7.1 Input Fusing and Safety Considerations.

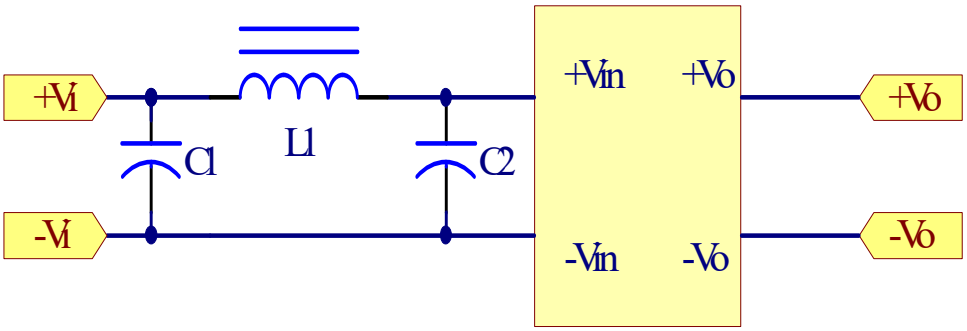
The EC7C series converters have not an internal fuse. However, to achieve maximum safety and system protection, always use an input line fuse. We recommended a time delay fuse 8A for 12Vin models 4A for 24Vin models, and 2A for 48Vin models. The circuit as below is recommended by a Transient Voltage Suppressor diode across the input terminal to protect the unit against surge or spike voltage and input reverse voltage.



Input protection circuit

7.2 EMC Considerations

The figure shows a suggested configuration to meet the conducted emission limits of EN55032 Class A and class B.
Suggested Configuration for EN55032 Class A and Class B



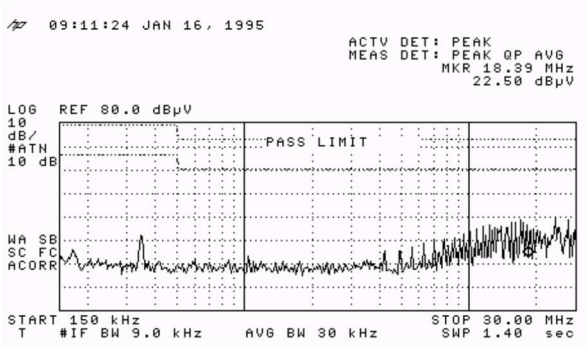
Recommended component value for EN55032 Class A

Model No.	C1	C2	L1
EC7C-12S25	47uF/25V KY	NC	8uH
EC7C-12S33	47uF/25V KY	NC	8uH
EC7C-12S05	47uF/25V KY	NC	8uH
EC7C-12S12	47uF/25V KY	NC	8uH
EC7C-12S15	47uF/25V KY	NC	8uH
EC7C-12D12	47uF/25V KY	NC	8uH
EC7C-12D15	47uF/25V KY	NC	8uH
EC7C-24S25	NC	100uF/50V KY	Short
EC7C-24S33	NC	100uF/50V KY	Short
EC7C-24S05	NC	100uF/50V KY	Short
EC7C-24S12	NC	100uF/50V KY	Short
EC7C-24S15	NC	100uF/50V KY	Short
EC7C-24D12	22uF/50V KY	NC	8uH
EC7C-24D15	22uF/50V KY	NC	8uH
EC7C-48S25	NC	47uF/100V KY	Short
EC7C-48S33	NC	47uF/100V KY	Short
EC7C-48S05	NC	47uF/100V KY	Short
EC7C-48S12	NC	47uF/100V KY	Short
EC7C-48S15	NC	47uF/100V KY	Short
EC7C-48D12	10uF/100V KMF	NC	8uH
EC7C-48D15	10uF/100V KMF	NC	8uH
EC7C-12T3312	330uF/25V KY	1210 10uF/25V X7R	Short
EC7C-12T3315	330uF/25V KY	1210 10uF/25V X7R	Short
EC7C-12T0512	330uF/25V KY	1210 10uF/25V X7R	Short
EC7C-12T0515	330uF/25V KY	1210 10uF/25V X7R	Short
EC7C-24T3312	NC	NC	Short
EC7C-24T3315	47uF/50V KY	NC	Short
EC7C-24T0512	47uF/50V KY	NC	Short
EC7C-24T0515	100uF/50V KY	NC	Short
EC7C-48T3312	NC	NC	Short
EC7C-48T3315	NC	NC	Short
EC7C-48T0512	NC	NC	Short
EC7C-48T0515	NC	NC	Short

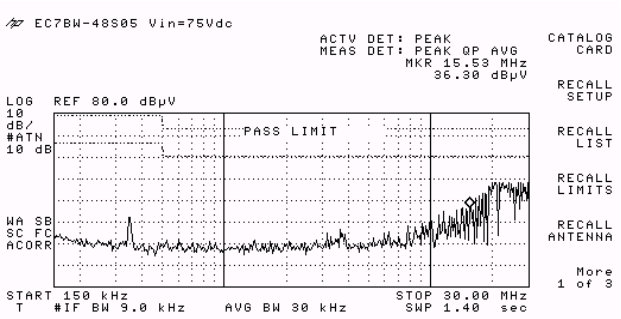
Note:

47uF/25V KY, 22uF/50V KY, 22uF/50V KY, 100uF/50V KY

47uF/100V KY, 330uF/25V KY and 10uF/100V KMF aluminum capacitors are made by NIPPON CHEMI-CON.



Conducted Emission of EN55032 class A for EC7C-12S05



Conducted Emission of EN55032 class A for EC7C-48D12

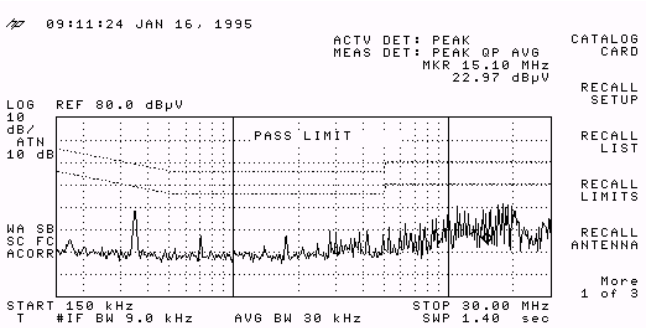
Recommended component value for EN55032 Class B

Model No.	C1	C2	L1
EC7C-12S25	47uF/25V KY	47uF/25V KY	8uH
EC7C-12S33	47uF/25V KY	47uF/25V KY	8uH
EC7C-12S05	47uF/25V KY	47uF/25V KY	8uH
EC7C-12S12	47uF/25V KY	47uF/25V KY	8uH
EC7C-12S15	47uF/25V KY	47uF/25V KY	8uH
EC7C-12D12	47uF/25V KY	47uF/25V KY	8uH
EC7C-12D15	47uF/25V KY	47uF/25V KY	8uH
EC7C-24S25	22uF/50V KY	22uF/50V KY	8uH
EC7C-24S33	22uF/50V KY	22uF/50V KY	8uH
EC7C-24S05	22uF/50V KY	22uF/50V KY	8uH
EC7C-24S12	22uF/50V KY	22uF/50V KY	8uH
EC7C-24S15	22uF/50V KY	22uF/50V KY	8uH
EC7C-24D12	22uF/50V KY	22uF/50V KY	8uH
EC7C-24D15	22uF/50V KY	22uF/50V KY	8uH
EC7C-48S25	10uF/100V KMF	10uF/100V KMF	8uH
EC7C-48S33	10uF/100V KMF	10uF/100V KMF	8uH
EC7C-48S05	10uF/100V KMF	10uF/100V KMF	8uH
EC7C-48S12	10uF/100V KMF	10uF/100V KMF	8uH
EC7C-48S15	10uF/100V KMF	10uF/100V KMF	8uH
EC7C-48D12	10uF/100V KMF	10uF/100V KMF	8uH
EC7C-48D15	10uF/100V KMF	10uF/100V KMF	8uH

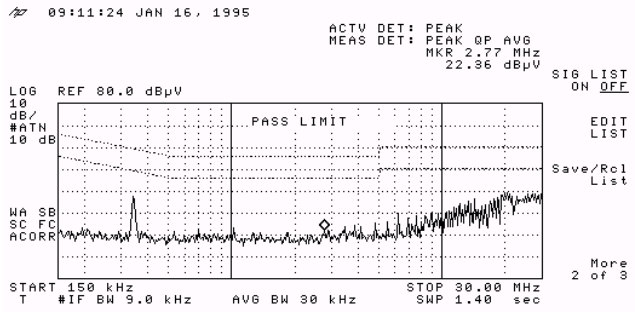
EC7C SERIES 40W DC-DC Converters

Application Note V12

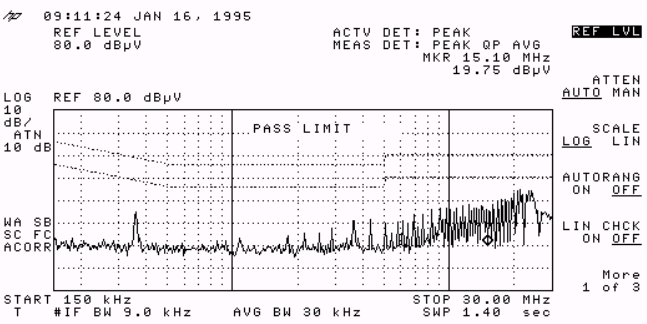
Model No.	C1	C2	L1
EC7C-12T3312	47uF/25V KY	NC	8uH
EC7C-12T3315	47uF/25V KY	NC	8uH
EC7C-12T0512	47uF/25V KY	NC	8uH
EC7C-12T0515	47uF/25V KY	NC	8uH
EC7C-24T3312	22uF/50V KY	NC	8uH
EC7C-24T3315	22uF/50V KY	NC	8uH
EC7C-24T0512	22uF/50V KY	NC	8uH
EC7C-24T0515	22uF/50V KY	NC	8uH
EC7C-48T3312	10uF/100V KMF	NC	8uH
EC7C-48T3315	10uF/100V KMF	NC	8uH
EC7C-48T0512	10uF/100V KMF	NC	8uH
EC7C-48T0515	10uF/100V KMF	NC	8uH



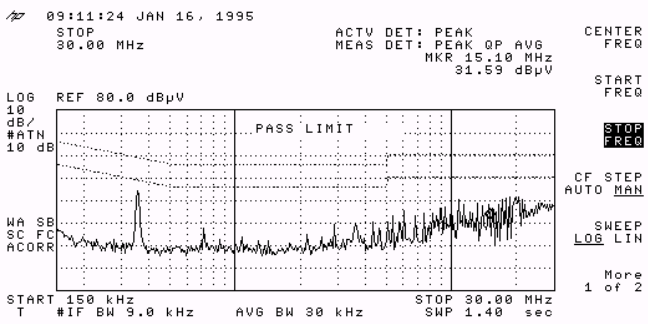
Conducted Emission of EN55032 Class B for EC7C-12S05



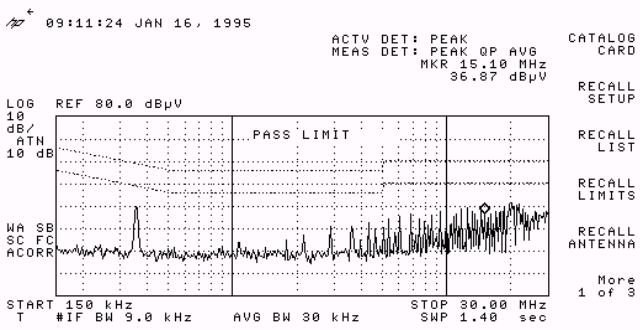
Conducted Emission of EN55032 Class B for EC7C-12D12



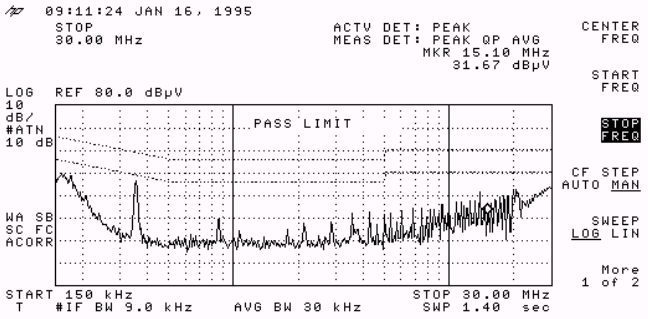
Conducted Emission of EN55032 Class B for EC7C-24S12



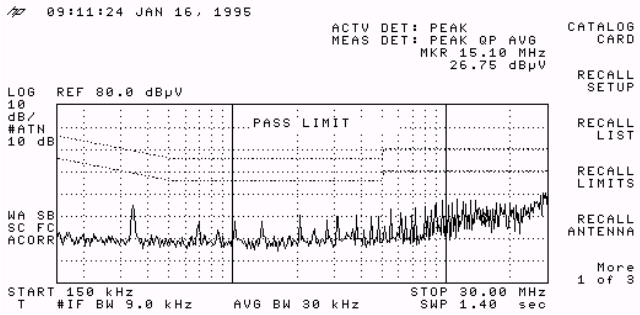
Conducted Emission of EN55032 Class B for EC7C-24D12



Conducted Emission of EN55032 Class B for EC7C-48S15



Conducted Emission of EN55032 Class B for EC7C-48D12



Conducted Emission of EN55032 Class B for EC7C-12T3315

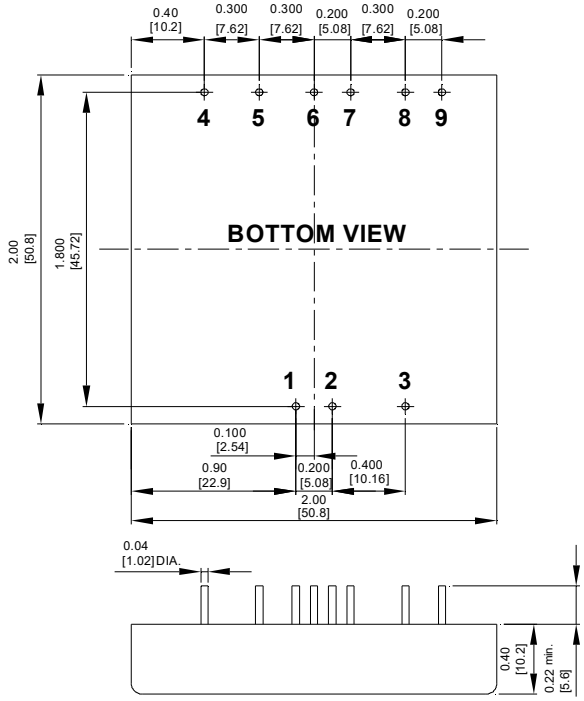
8. Part Number

Format: EC7C – II X OOOO L

Parameter	Series	Nominal Input Voltage	Number of Outputs	Output Voltage	Remote On/Off Logic
Symbol	EC7C	II	X	OOOO	L
Value	EC7C	12 : 12 Volts 24 : 24 Volts 48 : 48 Volts	S : Single Output D : Dual Output T : Triple Output	33 : 3.3 Volts 05 : 05 Volts 12 : 12 Volts 15 : 15 Volts 3305 : 3.3V, 5V Volts 3312 : 3.3V, ±12V Volts 3315 : 3.3V, ±15V Volts 0512 : 5V, ±12V Volts 0515 : 5V, ±15V Volts	None : Positive N : Negative

9. Mechanical Specifications

9.1 Mechanical Outline Diagrams



PIN CONNECTION				
Pin	Single	Dual	Dual Positive	Triple
1	+V Input	+V Input	+V Input	+V Input
2	- V Input	- V Input	- V Input	- V Input
3	On / Off	On / Off	On / Off	On / Off
4	NC	No Pin	+3.3Vout	+Aux. Out
5	- Sense	+V Output	Com(3.3V RTN)	Common
6	+Sense	Common	Trim	- Aux. Out
7	+V Output	Common	NC	+V Output
8	- V Output	- V Output	+5V Output	- V Output (Com)
9	Trim	Trim	Com(5V RTN)	NC

***NC : NO CONNECTION WITH PIN**

NOTE:Pin Size is 0.04±0.004 Inch(1.0±0.1mm) DIA
All Dimensions In Inches[mm]
Tolerances Inches:X.XX=±0.04,X.XXX±0.010
Millimeters:X.X=±1.0,X.XX=±0.25

CINCON ELECTRONICS CO., LTD.

Headquarters:

14F, No.306, Sec.4, Hsin Yi Rd.
Taipei, Taiwan
Tel: 886-2-27086210
Fax: 886-2-27029852
E-mail: sales@cincon.com.tw
Web Site: https://www.cincon.com

Factory:

No. 8-1, Fu Kung Rd.
Fu Hsing Industrial Park
Fu Hsing Hsiang,
ChangHua Hsien, Taiwan
Tel: 886-4-7690261
Fax: 886-4-7698031

Cincon North America:

1655Mesa Verde Ave. Ste 180
Ventura, CA93003
Tel: 805-639-3350
Fax: 805-639-4101
E-mail: info@cincon.com