FEATURES

30W isolated DC-DC converter in 1x1 inch

- Wide 4:1 input voltage range
- High efficiency up to 88%
- I/O isolation test voltage 1.5K VDC
- Input under-voltage protection,output short circuit,over-current, over–voltage protection
- Industry standard pin-out
- Three year warranty

Model Number	Input Voltage	Output Voltage	Output Current		Input Current		% Eff.		Capacitive Load Max.
			Min.	Max.	No Load	Full Load	(2)	(3)	
CFDA30-24S03	9-36VDC	3.3VDC	0mA	7500mA	8mA	1172mA	88	88	7500uF
CFDA30-24S05		5VDC		6000mA		1389mA	89	88	6000uF
CFDA30-24S12		12VDC		2500mA		1404mA	89	89	1500uF
CFDA30-24S15		15VDC		2000mA		1404mA	89	89	1000uF
CFDA30-24S24		24VDC		1250mA		1389mA	88	90	750uF
CFDA30-24S28		28VDC		1071mA		1389mA	88	90	750uF
CFDA30-24D12		±12VDC		±1250mA		1404mA	88	88	1250uF
CFDA30-24D15		±15VDC		±1000mA		1404mA	88	88	1000uF
CFDA30-48S03	18-75VDC	3.3VDC		7500mA	4mA	586mA	86	88	7500uF
CFDA30-48S05		5VDC		6000mA		694mA	86	88	6000uF
CFDA30-48S12		12VDC		2500mA		694mA	86	88	2000uF
CFDA30-48S15		15VDC		2000mA		702mA	86	88	1500uF
CFDA30-48S24		24VDC		1250mA		702mA	86	88	470uF
CFDA30-48D12		±12VDC		±1250mA		710mA	89	88	2000uF
CFDA30-48D15		±15VDC		±1000mA		702mA	89	89	1500uF
CFDA30-48D24		±24VDC		±625mA		711mA	86	88	470uF

NOTE:

1. Nominal Input Voltage 24 or 48VDC
2. Measure at 12VDC for 24 Vin, 24VDC for 48 Vin
3. Measure at Nominal Input Voltage

1. Introduction

The CFDA30 series offer 30 watts of output power in a 1.0x1.0x0.46 inches copper packages. The CFDA30 series has a 4:1 wide input voltage range of 9-36 and 18-75VDC,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°C to 55°C (de-rating above 55 °C). The modules are fully protected against input UVLO (under voltage lock out), output over-current,over-voltage protection and over-temperature and continuous short circuit conditions.Furthermore,the standard control functions include remote on/off and adjustable output voltage. All models are very suitable for distributed power architectures,telecommunications,battery operated equipment and industrial applications.

2. 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.	Typ.	Max.	Units
Input Voltage						
Continuous		$24V_{in}$ $48V_{in}$	-0.3 -0.3		36 75	V_{DC}
Transient	100ms	$24V_{in}$ $48V_{in}$			50 100	V_{DC}
Operating Ambient Temperature	Derating, Above 55℃	All	-40		+85	℃
Case Temperature		All			105	℃
Storage Temperature		All	-55		+125	℃
Input/Output Isolation Voltage	1 minute	All			1500	V_{DC}

INPUT CHARACTERISTICS						
PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Operating Input Voltage		$24V_{in}$ $48V_{in}$	9 18	24 48	36 75	V_{DC}
Input Under Voltage Lockout						
Turn-On Voltage Threshold		$24V_{in}$ $48V_{in}$	8 16.5	8.5 17	8.8 17.5	V_{DC}
Turn-Off Voltage Threshold		$24V_{in}$ $48V_{in}$	7.7 15.5	8 16	8.3 16.5	V_{DC}
Lockout Hysteresis Voltage		$24V_{in}$ $48V_{in}$		0.5 1		V_{DC}
Maximum Input Current	100% Load, V_{in} =9V	24Vin			3900	mA
	100% Load, V_{in} =18V	48Vin			1950	
No-Load Input Current	V_{in} =Nominal input	24S33 24S05 24S12 24S15 24D12 24D15 48S33 48S05 48S12 48S15 48D12 48D15		10 10 10 10 10 10 8 8 8 8 8 8		mA
Off Converter Input Current	Shutdown input idle current	All		4	10	mA
Inrush Current (I^2t)	As per ETS300 132-2	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.	Typ.	Max.	Units
Output Voltage Set Point	V_{in} =Nominal V_{in}, I_o = I_{o_max}, Tc=25℃	Vo=3.3 Vo=5.0 Vo=12 Vo=15 Vo=±12 Vo=±15	3.2505 4.925 11.82 14.775 11.82 14.775	3.3 5 12 15 12 15	3.3495 5.075 12.18 15.225 12.18 15.225	V_{DC}
Output Voltage Balance	V_{in} =nominal, Io= I_{o_max}, Tc=25℃	Dual			±1.5	%
Output Voltage Regulation						
Line Regulation	V_{in} =High line to Low line Full Load	Single Dual			±0.2 ±0.5	% %
Load Regulation	I_o = Full Load to min. Load	Single Dual			±0.2 ±1.0	% %
Cross Regulation	Load cross variation 10%/100%	Dual			±5	%
Temperature Coefficient	TC=-40℃ to 80℃				±0.03	%/℃
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth					
Peak-to-Peak	Full Load, 20MHz bandwidth 10uF tantalum and 1uF ceramic capacitor	Vo=3.3V Vo=5V			75	mV
		Vo=15V Vo=12V Vo=±15V Vo=±12V			100	mV
Operating Output Current Range		Vo=3.3V Vo=5V Vo=12V Vo=15V Vo=±12V Vo=±15V	0 0 0 0 0 0		7500 6000 2500 2000 ±1250 ±1000	mA
Output DC Current-Limit Inception	Output Voltage=90% $V_{O,\ nominal}$		110	140	170	%
Maximum Output Capacitance	Full load, Resistance	Vo=3.3V Vo=5V Vo=12V Vo=15V Vo=±12V Vo=±15V			7500 6000 2500 2000 1250 1000	uF

DYNAMIC CHARACTERISTICS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Output Voltage Current Transient						
Step Change in Output Current	75% to 100% of I_{o_max} di/dt=0.1A/us	All			±5	%
Setting Time (within 1% $Vo_{nominal}$)		All			250	us
Turn-On Delay and Rise Time						
Turn-On Delay Time, From On/Off Control	$V_{on/off}$ to 10%V_{o_set}	All		10		ms
Turn-On Delay Time, From Input	V_{in_min} to 10%V_{o_set}	All		10		ms
Output Voltage Rise Time	10% V_{o_set} to 90% V_{o_set}	All		10		ms

EFFICIENCY						
PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
100% Load	V_{in}=12V_{DC},I_o = I_{o_max}, Tc=25℃	24S33		88		%
		24S05		89		
		24S12		89		
		24S15		89		
		24D12		88		
		24D15		88		
	V_{in}=24V_{DC},I_o=I_{o_max},Tc=25℃	24S33		88		%
		24S05		90		
		24S12		89		
		24S15		89		
		24D12		88		
		24D15		88		
100% Load	V_{in}=24V_{DC},I_o=I_{o_max},Tc=25℃	48S33		88		%
		48S05		90		
		48S12		90		
		48S15		90		
		48D12		89		
		48D15		89		
	V_{in} =48V_{dc},I_o=I_{o_max},Tc=25℃	48S33		88		%
		48S05		90		
		48S12		89		
		48S15		89		
		48D12		88		
		48D15		89		

ISOLATION CHARACTERISTICS						
PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Input to Output	1 minutes	All	1500			V_{DC}
Isolation Resistance		All	1000			MΩ
Isolation Capacitance		All		1500		pF

FEATURE CHARACTERISTICS						
PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
Switching Frequency		Vo=3.3V Vo=5V		270		KHz
		Others		330		
On/Off Control, Positive Remote On/Off logic						
Logic High (Module On)	$V_{on/off}$ at $I_{on/off}$=0.1uA	All	3.5 or Open Circuit		75	V_{DC}
Logic Low (Module Off)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All			1.2	V_{DC}
On/Off Control, Negative Remote On/Off logic						
Logic High (Module Off)	$V_{on/off}$ at $I_{on/off}$=1.0mA	All	3.5 or Open Circuit		75	V_{DC}
Logic Low (Module On)	$V_{on/off}$ at $I_{on/off}$=0.1uA	All			1.2	V_{DC}

On/Off Current (for both remote on/off logic)	$I_{on/off}$ at $V_{on/off}$=0V	All		0.3	1	mA
Leakage Current (for both remote on/off logic)	Logic High,$V_{on/off}$ =15V				30	uA
Output Over Voltage Protection	Zener or TVS Clamp	Vo=3.3V Vo=5.0V Vo=12V Vo=15V Vo=±12V Vo=±15V		3.9 6.2 15 18 ±15 ±18		V_{DC}

GENERAL SPECIFICATIONS

PARAMETER	NOTES and CONDITIONS	Device	Min.	Typ.	Max.	Units
MTBF	I_o =100%of I_{o_max};Ta=25℃ per MIL-HDBK-217F	All		TBD		M hours
Weight		All		18		grams

3. Main Features and Functions

3.1 Operating Temperature Range

The CFDA30 series converters can be operated by a wide ambient temperature range from -40℃to 55℃(de-rating above 55℃). The standard model has a Copper case and case temperature can not over 105℃ at normal operating.

3.2 Remote On/Off

The CFDA30 series allows the user to switch the module on and off electronically with the remote on/off feature. All models are available in "positive logic" versions. The converter turns on if the remote on/off pin is high (>3.5VDC to 75VDC or open circuit). Setting the pin low (<1.2VDC) will turn the converter off. The signal level of the remote on/off input is defined with respect to ground. If not using the remote on/off pin, leave the pin open (converter will be on).Models with part number suffix "N" are the "negative logic" remote on/off version. The unit turns off if the remote on/off pin is high (>3.5VDC to 75VDC or open circuit). The converter turns on if the on/off pin input in low(<1.2VDC).Note that the converter is off by default.

3.3 UVLO (Under Voltage Lock Out)

Input under voltage lockout is standard on the CFDA30 unit. The unit will shut down when the input voltage drops below a threshold,and the unit will operate when the input voltage goes above the upper threshold.

3.4 Over Current Protection

All models have internal over current and continuous short circuit protection. The unit operates normally once the fault condition is removed.At the point of current limit inception,the converter will go into hiccup mode protection.

3.5 Over Voltage Protection

The over-voltage protection consists of a zener diode to limiting the out voltage.

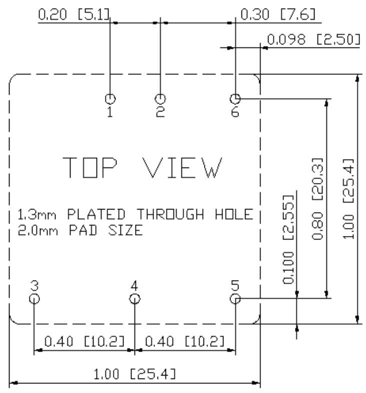
3.6 Over-Temperature Protection (OTP)

The CFDA30 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.

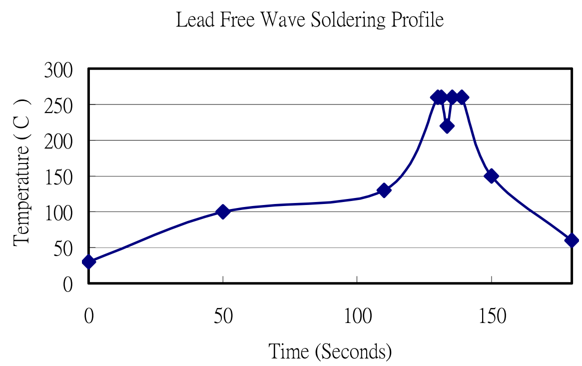
4. Applications

4.1 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 thesystem 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 footprints and soldering profiles are shown as Figure 4.



Note: Dimensions are in inches (millimeters)



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℃)

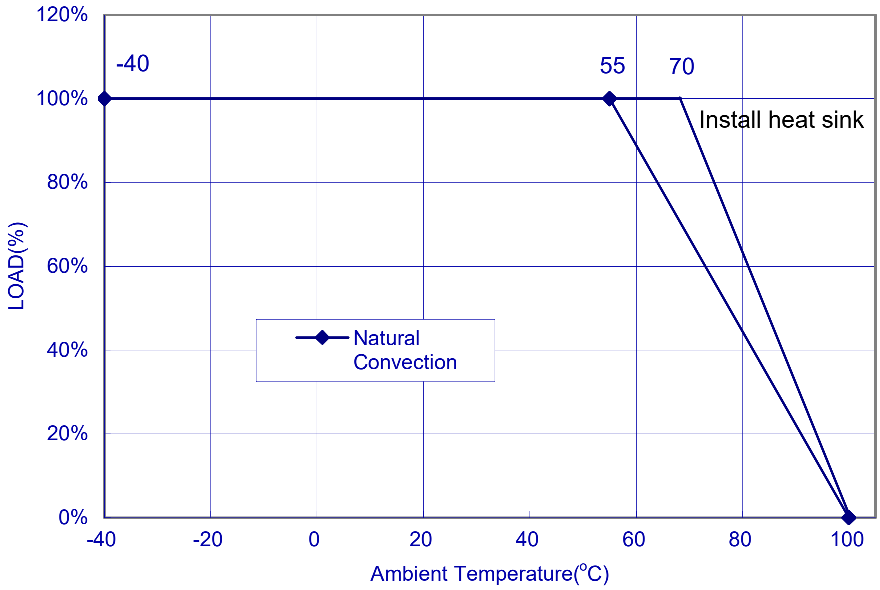
Figure 4. Recommended PCB Layout Footprints and Wave Soldering Profiles for SB packages

6.2 Power De-Rating Curves for CFDA30 Series

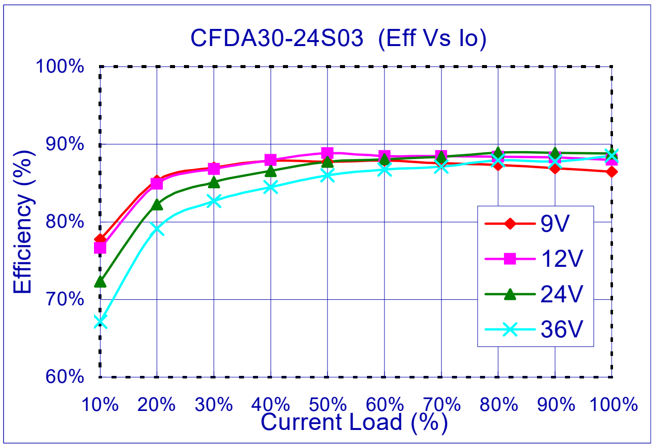
Operating Ambient temperature Range:-40℃ ~ 55℃ (derating above 55℃).

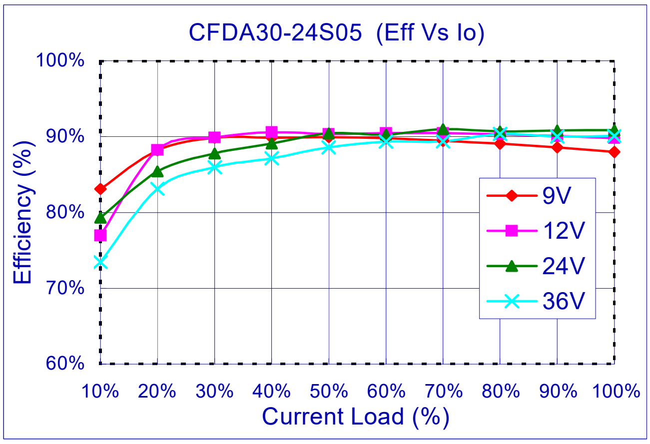
Maximum case temperature under any operating condition should not exceed 105℃.

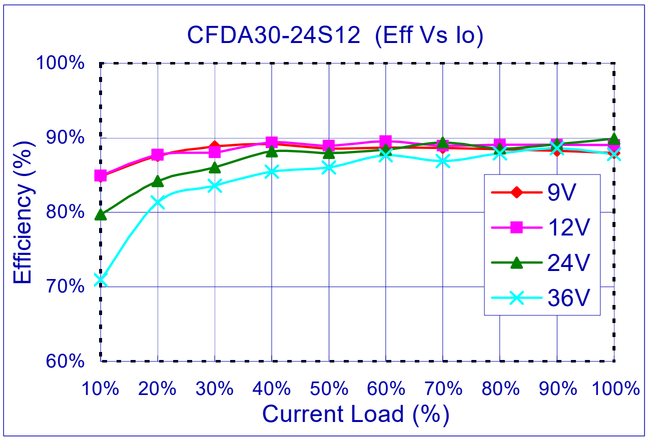
Typical Derating curve for Natural Convection

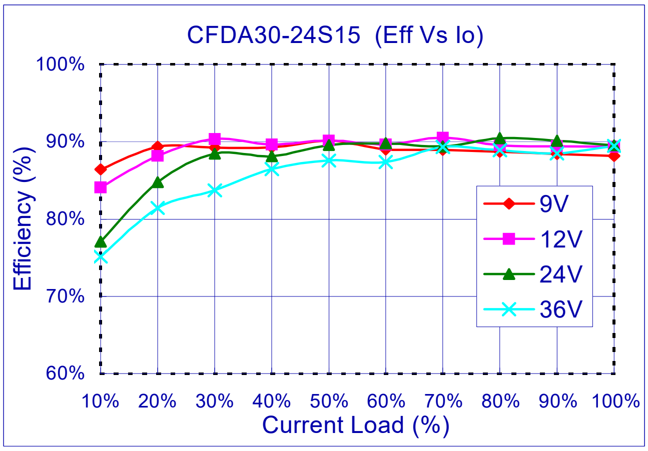


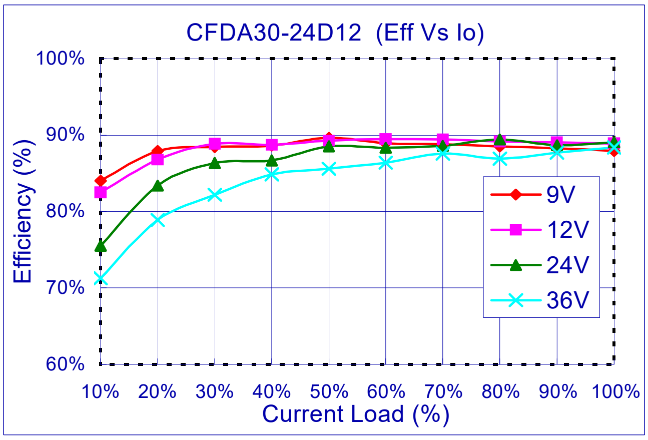
4.3 Efficiency vs. Load Curves

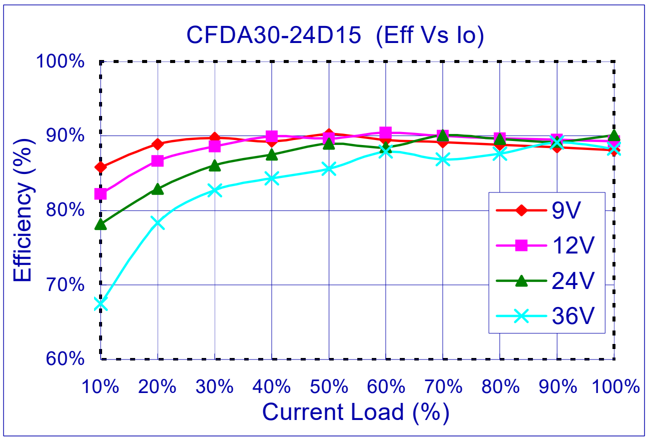


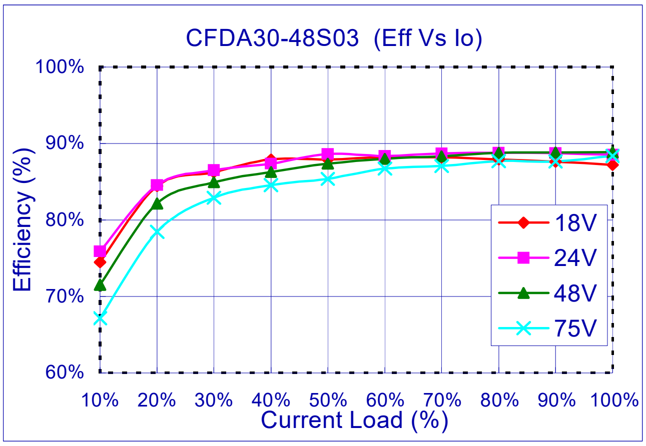


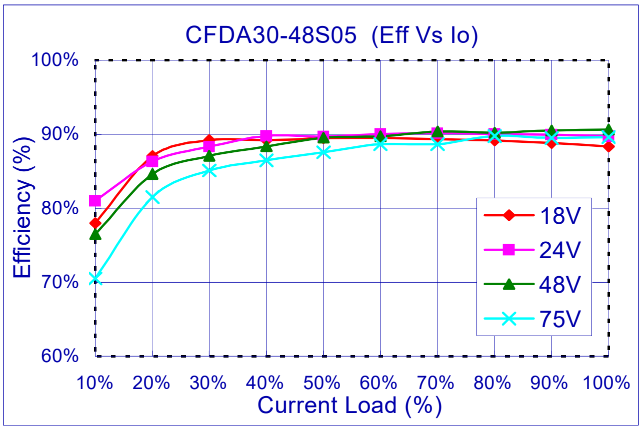


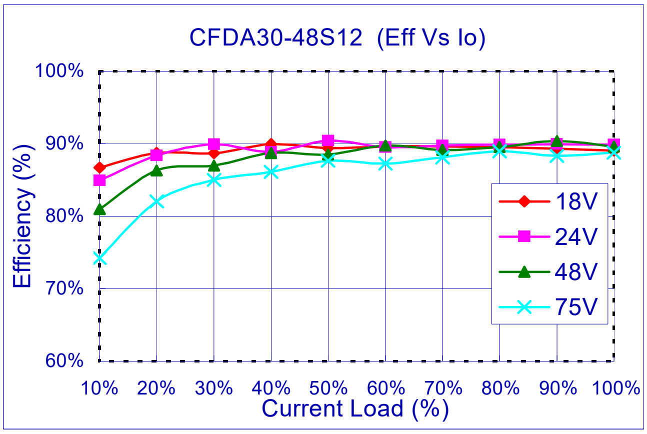


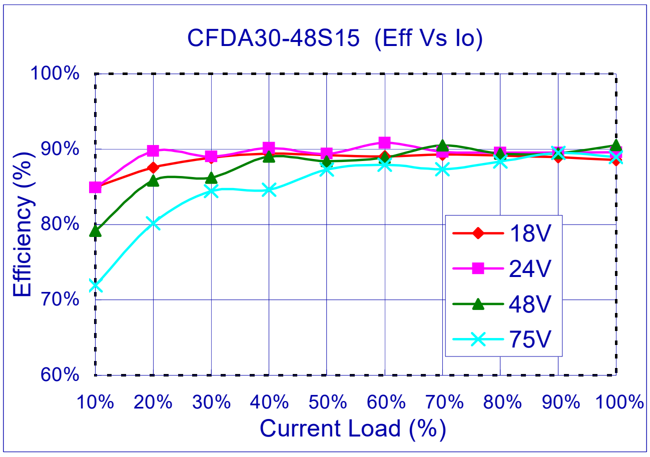


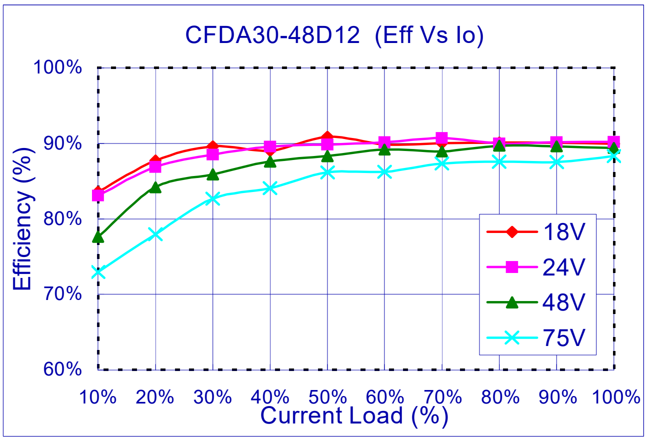


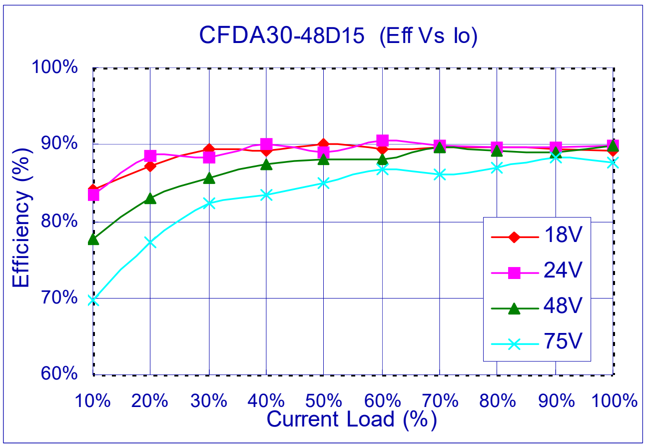

CFDA30-48S03 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


CFDA30-48S05 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


CFDA30-48S12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


CFDA30-48S15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

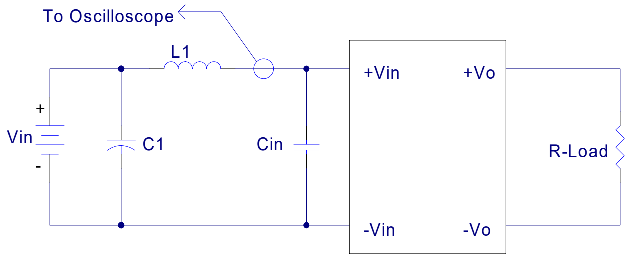

CFDA30-48D12 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V


CFDA30-48D15 (Eff Vs Io)
Efficiency (%)
100%
90%
80%
70%
60%
10% 20% 30% 40% 50% 60% 70% 80% 90% 100%
Current Load (%)
18V
24V
48V
75V

4.4 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 in Figure 5 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: 12uH
C1: 220uF ESR<0.1ohm @100KHz
Cin: 33uF ESR<0.7ohm @100KHz

Figure 5. Input Reflected-Ripple Test Setup

4.5 Test Set-Up

The basic test set-up to measure parameters such as efficiency and load regulation is shown in Figure 6. 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:

$$\eta = \frac{V_O \times I_O}{V_{IN} \times I_{IN}} \times 100\%$$

Where

V_O is output voltage,
I_O is output current,
VIN is input voltage,
I_{IN} 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 10% 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.

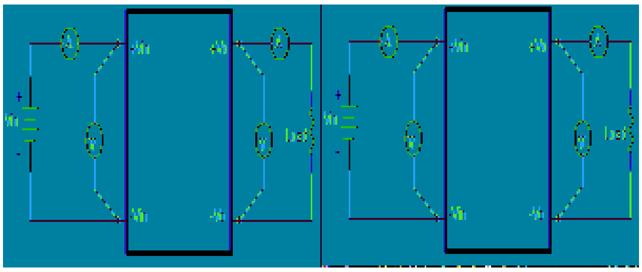


Figure 6. CFDA30 Series Test Setup

4.6 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 in Figure 7 and Figure 8:

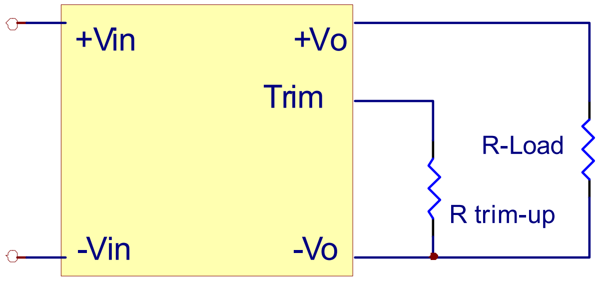


Figure 7. Trim-up Voltage Setup

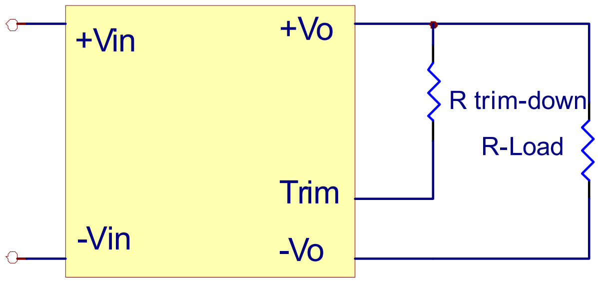


Figure 8. Trim-down Voltage Setup

1. The value of Rtrim-up defined as:

$$R_{trim-up} = \left(\frac{V_r \times R1 \times (R2 + R3)}{(Vo - V_{o,\,nom}) \times R2}\right) - Rt \ \ (K\Omega)$$

Where

$R_{trim\text{-}up}$ is the external resistor in Kohm.

$V_{O,\,nom}$ is the nominal output voltage.

V_O is the desired output voltage.

R1, Rt, R2, R3 and Vr are internal to the unit and are defined in Table 1.

Table 1 – Trim up and Trim down Resistor Values

Model Number	Output Voltage(V)	R1 (KΩ)	R2 (KΩ)	R3 (KΩ)	Rt (KΩ)	Vr (V)
CFDA30-24S03 CFDA30-48S03	3.3	2.74	1.8	0.27	9.1	1.24
CFDA30-24S05 CFDA30-48S05	5.0	2.32	2.32	0	8.2	2.5
CFDA30-24S12 CFDA30-48S12	12.0	6.8	2.4	2.32	22	2.5
CFDA30-24S15 CFDA30-48S15	15.0	8.06	2.4	3.9	27	2.5

For example, to trim-up the output voltage of 5.0V module (CFDA30-24S05) by 10% to 5.5V, R trim-up is calculated as follows:

$V_o - V_{o,\,nom} = 5.5 - 5.0 = 0.5V$

R1 = 2.32 KΩ

R2 = 2.32 KΩ

R3 = 0 KΩ

Rt = 8.2 KΩ,

Vr= 2.5 V

$$R_{trim-up} = \left(\frac{2.5 \times 2.32 \times (2.32+0)}{0.5 \times 2.32}\right) - 8.2 = 3.4K\Omega$$

2.The value of R trim-down defined as:

$$R_{trim-down} = R1 \times \ \frac{Vr \times R1}{(V_{o,\,nom} - Vo) \times R2} - 1) - Rt(K\Omega)$$

Where

$R_{trim\text{-}down}$ is the external resistor in Kohm.

$V_{O,\,nom}$ is the nominal output voltage.

V_O is the desired output voltage.

R1, Rt, R2, R3 and Vr are internal to the unit and are defined in Table 1.

For example, to trim-down the output voltage of 5.0V module (CFDA30-24S05) by 10% to 4.5V, R trim-down is calculated as follows:

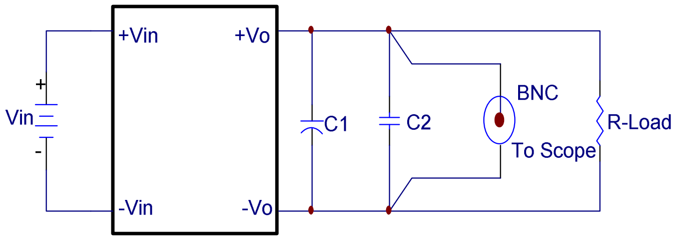
$V_{O,nom} - Vo = 5.0 - 4.5 = 0.5V$

R1 = 2.32 KΩ
R2 = 2.32 KΩ
R3 = 0 KΩ
Rt = 8.2 KΩ
Vr= 2.5 V

$$R_{trim-down} = 2.32 \times \left(\frac{(2.5\ 2.32)}{0.5 \times 2.32} - 1\right) - 8.2 = 1.8K\Omega$$

4.7 Output Ripple and Noise Measurement

The test set-up for noise and ripple measurements is shown in Figure 9. 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.



Note: C1: 10uF tantalum capacitor
C2: 1uF ceramic capacitor

Figure 9. Output Voltage Ripple and Noise Measurement Set-Up

6.8 Output Capacitance

The CFDA30 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. These series converters are designed to work with load capacitance to see technical specifications.

5. Safety/EMC

5.1 Input Fusing and Safety Considerations.

The CFDA30 series converters have not an internal fuse.However, to achieve maximum safety and system protection,always use an input line fuse. We recommend ed a time delay fuse 6A for 24Vin models and 3A for 48Vin modules. Figure 10 circuit 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.

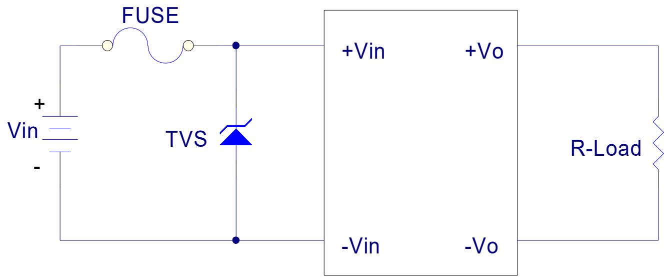


Figure 10.Input Protection

5.2 EMC Considerations

EMI Test standard: EN55022 Class A Conducted Emission
Test Condition:Input Voltage: Nominal,Output Load:Full Load

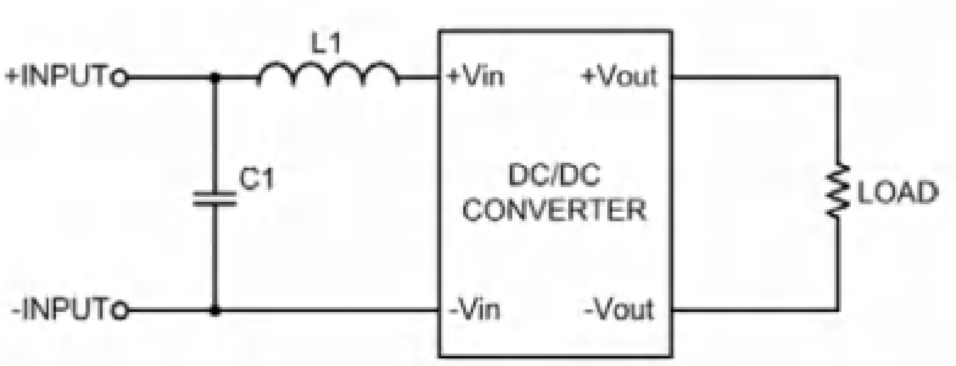


Figure 11. Connection circuit for conducted EMI testing

EN55022 class A					
Model No.	C1	L1	Model No.	C1	L1
CFDA30-24S03	100uF/50V	0.47uH	CFDA30-48S03	47uF/100V	2.2uH
CFDA30-24S05	100uF/50V	0.47uH	CFDA30-48S05	47uF/100V	2.2uH
CFDA30-24S12	100uF/50V	0.47uH	CFDA30-48S12	47uF/100V	2.2uH
CFDA30-24S15	100uF/50V	0.47uH	CFDA30-48S15	47uF/100V	2.2uH
CFDA30-24D12	100uF/50V	0.47uH	CFDA30-48D12	47uF/100V	2.2uH
CFDA30-24D15	100uF/50V	0.47uH	CFDA30-48D15	47uF/100V	2.2uH

Note: All of capacitors are CHEMI-CON KMF aluminum capa citors.

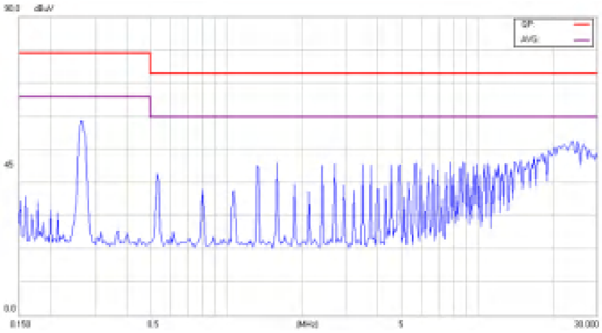


Figure 12. Conducted Class A of CFDA30-24S03

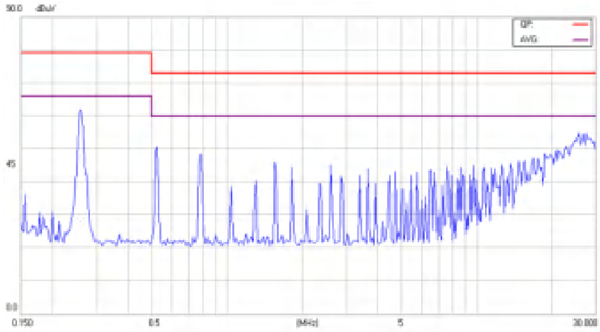


Figure 13. Conducted Class A of CFDA30-24S05

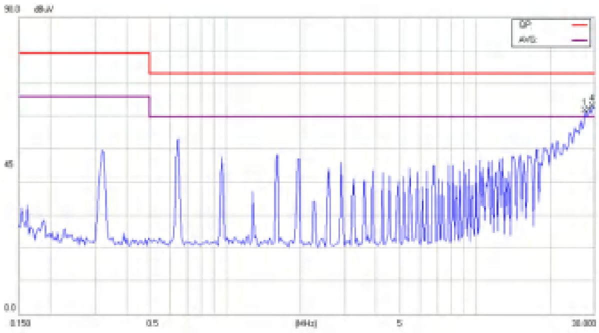


Figure 14. Conducted Class A of CFDA30-24S12

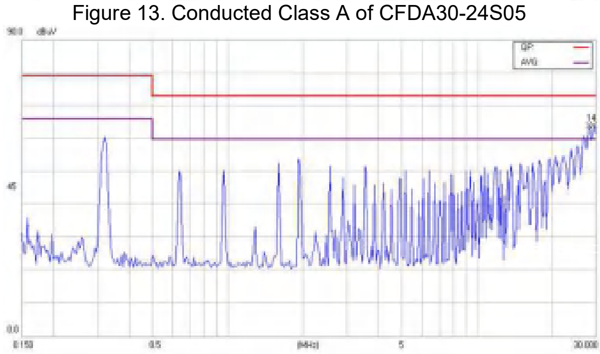


Figure 15. Conducted Class A CFDA30-24S15

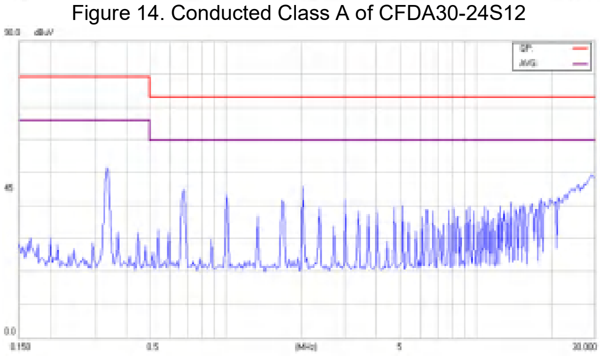


Figure 16. Conducted Class A of CFDA30-24D12

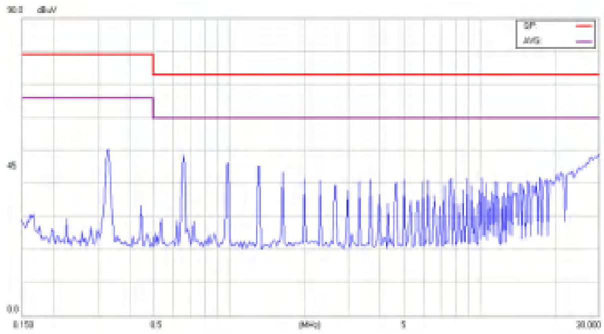


Figure 17. Conducted Class A of CFDA30-24D15

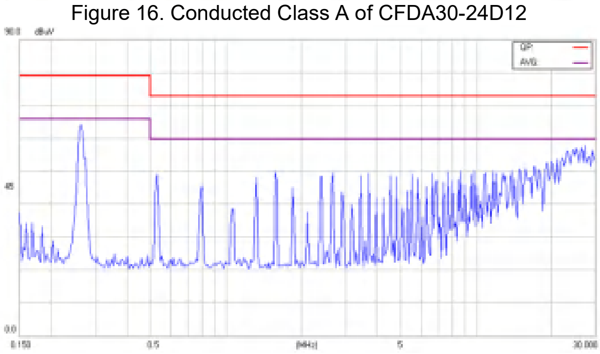


Figure 18. Conducted Class A of CFDA30-48S03

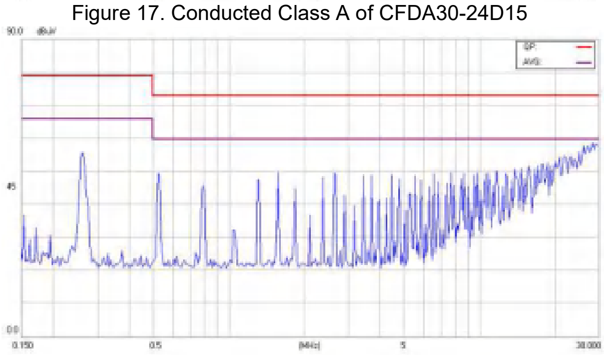


Figure 19. Conducted Class A of CFDA30-48S05

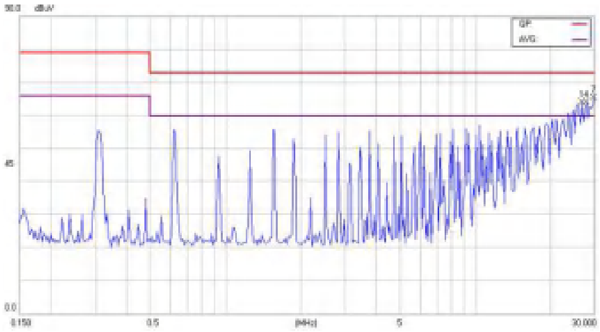


Figure 20. Conducted Class A of CFDA30-48S12

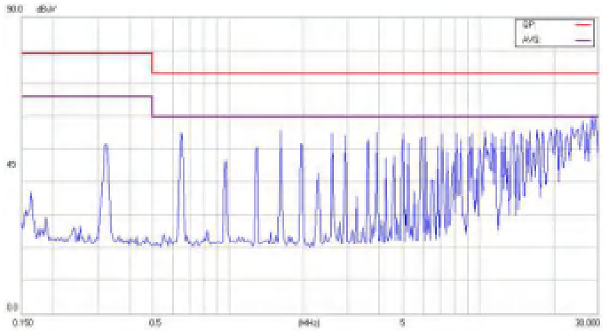


Figure 21. Conducted Class A of CFDA30-48S15

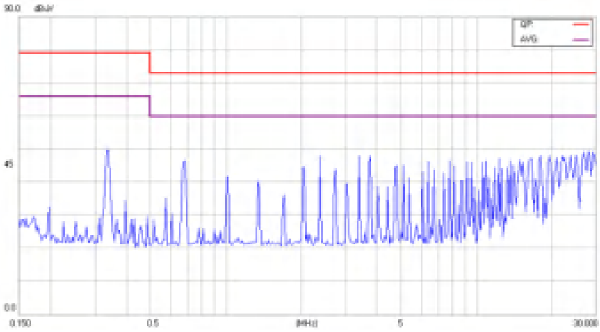


Figure 22. Conducted Class A of CFDA30-48D12

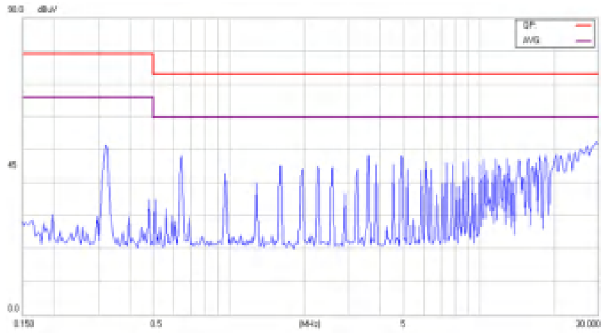


Figure 23. Conducted Class A of CFDA30-48D15

8. Part Number

CFDA30 – XX X XX X

S:Install heat sink

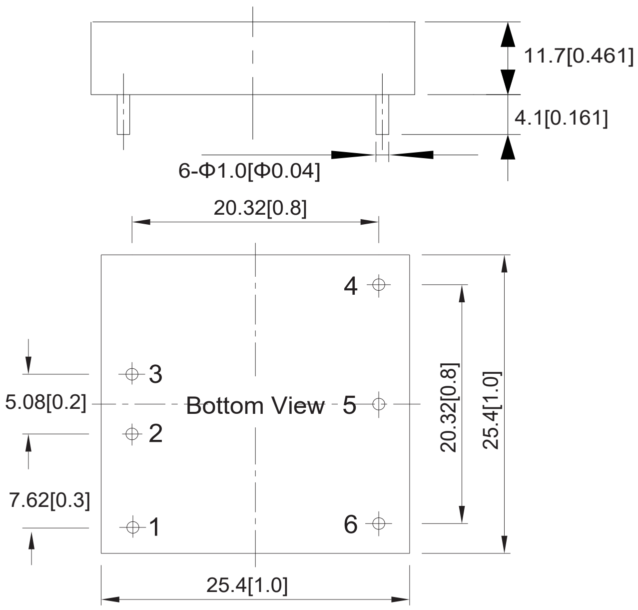
CFDA30 Series

S:Single Output
D:Dual Output

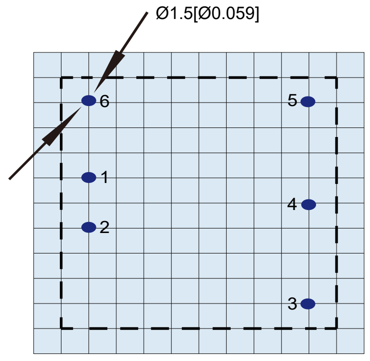
03:Output Voltage 3.3VDC
05:Output Voltage 5VDC
12:Output Voltage 12VDC
15:Output Voltage 15VDC

24:Nominal Input Voltage 24VDC
48:Nominal Input Voltage 48VDC

7. Mechanical Specifications

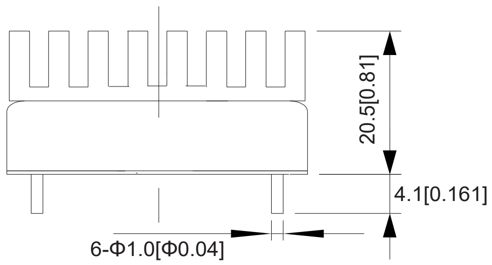


THIRD ANGLE PROJECTION



Note:Grid2.54*2.54mm

Note:
Unit:mm[inch]
Mounting rail:TS35
Winr range:24-12AWG
Tightening torque:Max 0.4N•m
General tolerances:±1.0[±0.039]



Pin	1	2	3	4	5	6
Single	CNT	-Vin	+Vin	+Vo	Trim	-Vo
Dual	CNT	-Vin	+Vin	+Vo1	COM	-Vo2

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