Technical Specification

DFB1K2D300 Series

High Input Voltage Full Brick 1200Watts DC/DC Converter

FEATURES

- 2:1 input range: 200-400VDC
- 1200W isolated outputs
- Efficiency up to 94%
- Fixed outputs: 14, 24VDC
- Adjustable Vout (-20% to +10%)
- Fixed switching frequency, predicted EMI
- Remote On/Off control
- 4250VDC I/O isolation
- Industry standard full brick footprint
- Extensive self-protection, UVLO, OVLO, OVP, OTP, OCP and short protection
- Operating temperature range: -40°C to +100°C
- Fully encapsulated, high reliability
- Flexible extra heat-sink mount type
- Accurate current sharing, N+1 redundant parallel

PRODUCT OVERVIEW

The DFB1K2D300 series are highly reliable, and efficient isolated DC/DC converter with industry standard DOSA full brick footprint. This series provide a 2:1 high voltage DC input range (200VDC-400VDC). Typical application include automation, power grid, instrumentation, test and measurement, and avionics systems where require high voltage distribution power system and specific low-profile power supply.

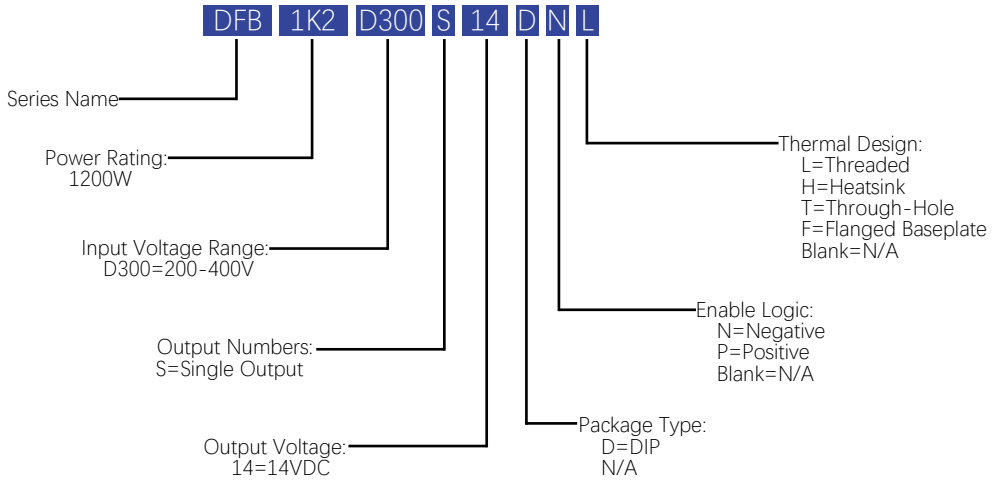
A wealth of self-protection features included input undervoltage lockout, over temperature shutdown, over current protection with "hiccup" autorestart technique, provides indefinite short-circuit protection, along with output OVP. Threaded or through holes are provided to allow easy mount or the addition of a heat sink for extended temperature operation. The operation temperature is -40°C to 100°C, the module delivers full output power @ 100°C baseplate temperature. The DFB1K2D300 series have current share function which also support N+1 redundant parallel operation.

The DFB1K2D300 series are designed to safety standards IEC/EN 62368-1.

Models Selections

Basic Models	Input Voltage [VDC]	Input Voltage Range [VDC]	Output Voltage [VDC]	Output Current [A]	Efficiency typ. [%]	Capacitive Load Max [μF]	Package [inch]
DFB1K2D300S14	300	200-400	14	85.7	94	10000	4.2"×2.4"×0.5"
DFB1K2D300S24	300	200-400	24	50	91.5	10000	4.2"×2.4"×0.67"

Model Numbering



Absolute Maximum Ratings					
Parameters	Conditions	Min.	Typ.	Max.	Units
Input Voltage Continuous		-0.7		420	VDC
Input Voltage Transient(< 100ms)				450	VDC
On/Off Remote Control	Referred to -on/off			75	VDC
On/Off Remote Control Current		0	0.25	1	mA
Operating Baseplate Temperature		-40		100	°C
Operating Environment Temperature		-40		85	°C
Storage Temperature Range		-55		125	°C
Humidity		10		95	%
Soldering Temperature	Wave Soldering < 10s			260	°C
Safety and EMC Compliance					
Conducted Emission	EN55032	Class B (With external filter)			
Radiated Emission	EN55032	Class B (With external filter)			
Conducted Susceptibility	IEC/EN61000-4-6	10Vrms Criteria A			
Radiated Susceptibility	IEC/EN61000-4-3	10V/m Criteria A			
EFT	IEC/EN61000-4-4	±2KV Criteria A (With external filter)			
Surge	IEC/EN61000-4-5	±2KV Criteria A (With external filter)			
ESD	IEC/EN61000-4-2	±4KV Contact ±4KV Air Criteria A			
Isolation Safety Rating	Reinforced insulation				

General Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Input to output	4250			VDC
	Input to case	3000			VDC
	Output to case	1500			VDC
Isolation Resistance (Viso=500VDC)	Input to output	100			MΩ
	Input to case	100			MΩ
	Output to case	100			MΩ
Isolation Capacitance	Input to output		1500		pF
Isolation Safety Rating	Reinforced insulation				
Switching Frequency			120		KHz
Start-up Delay	From start-up threshold recover to 10% Vout		300	500	mS
Rise Time	From 10% Vout to 90% Vout capacitive load		80	100	mS
Remote On/Off Control	Positive Logic, ON state	Open or 3 ≤ Vr ≤ 75			VDC
Positive Logic, ON state	Positive Logic, OFF state	Short or 0 ≤ Vr ≤ 1.2			VDC
Positive Logic, OFF state	Negative Logic, ON state	Short or 0 ≤ Vr ≤ 1.2			VDC
Negative Logic, ON state	Negative Logic, OFF state	Open or 3 ≤ Vr ≤ 75			VDC
Remote Control Current		0	0.25	1	mA
MTBF	MIL-HDBK-217F	200			KHrs
Vibration	IEC 60068-2-64, Environmental testing - Part 2				
Shock	IEC 60068-2-27, Environmental Testing- Part 2.27				

Input Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Operating Voltage Range		200	300	400	VDC
Start-up Threshold		175	190	200	VDC
Under Voltage Shutdown		160	175	190	VDC
Input Over Voltage Shutdown		425	440	455	VDC
Input Over voltage Recovery		410	425	440	VDC
Input Current @ No Load				150	mA
Input Current @ Min. Line	Min. Vin and full load			7	A
Input Current @ Shutdown Mode				50	mA
Reflect Ripple Current (Peak-Peak)	Measured at input pin with 10μH inductor and 220μF capacitance			200	mA
Recommended Input Fuse			15		A
Recommended External Input Capacitance			220		μF

Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Power				1200	W
Vout Accuracy	50% Load, Vin=300VDC	-1.5		+1.5	%
Adjustable Range	Trim up/ Trim down	-20		+10	%
Line Regulation	Vin from min. line to max. line, 50% load	-0.2		+0.2	%
Load Regulation	From min. load to full load, Vin=300VDC	-0.5		+0.5	%
Temperature Coefficient		-0.02		+0.02	%/°C
Total Regulation		-2		+2	%
Thermal Shutdown		105	110	115	°C
Thermal Shutdown Recover		85	95	100	°C
Over Voltage Protection	Hiccup, Auto-recover	110		140	%
Over Current Protection	Hiccup, Auto-recover	105		140	%
Short Circuit Protection	Hiccup, Auto-recover				
Aux Power Supply Voltage		9	12	16	VDC
Aux Power Supply Current				20	mA
IOG(Power Good) ①	Power Good	9		16	VDC
	Power Fault	0		1	VDC
Current Share Accuracy		-5		+5	%
Remote Sense Voltage				10	%
Minimum Load	No minimum load required				

Output Specifications			
Parameters		Modules	
		S14	S24
Output Voltage Normal(VDC)		14	24
Ripple & Noise Max. (mV pk-pk) ②		200	240
Dynamic Load Peak Deviation (%Vout) ③		±5	±5
Dynamic Load Response (μS)		1000	1000
Capacitive Load (μF)	Min.	1000	470
	Max.	10000	10000

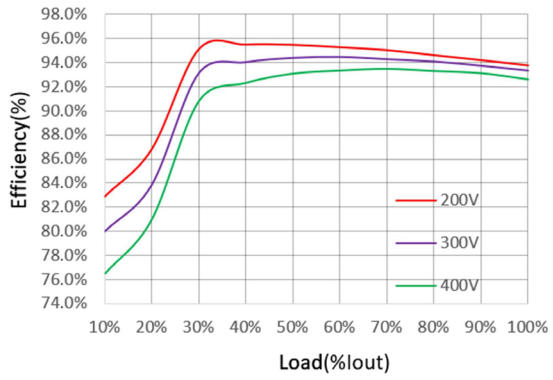
Notes
① An external pull-up resistance(5.1kΩ) is connected between IOG and AUX.
② Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 10 for more details.
③ The load is set from 50%-75%-50% of Imax, di/dt=1A/μS, please refer to dynamic waveforms in performance data on page 5 & 6 for details.

All specifications are tested at 25 ℃ ambient temperature, nominal input voltage, rated output current conditions unless otherwise specified.

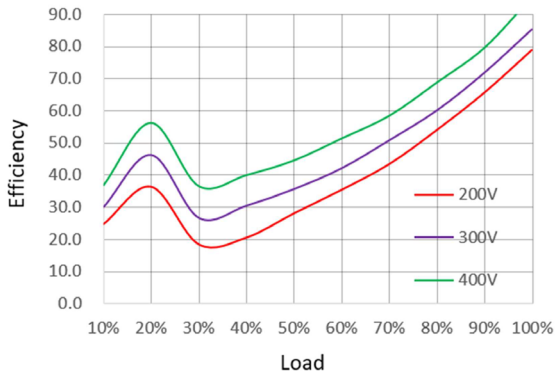
Performance Data

DFB1K2D300S14

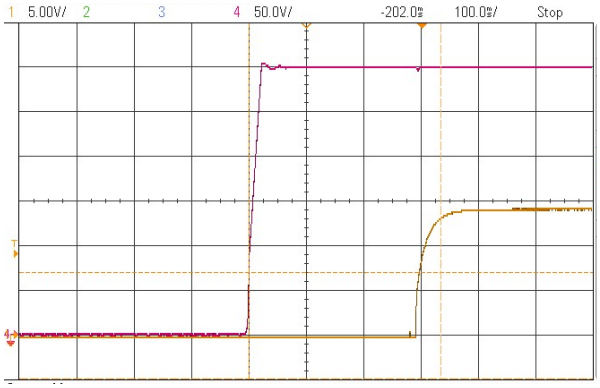
EFFICIENCY VS LOAD



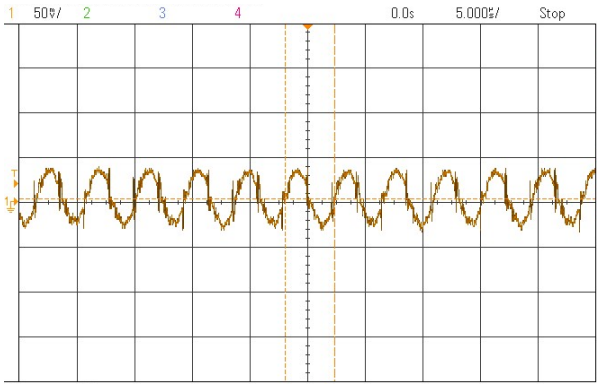
POWER DISSIPATION VS LOAD



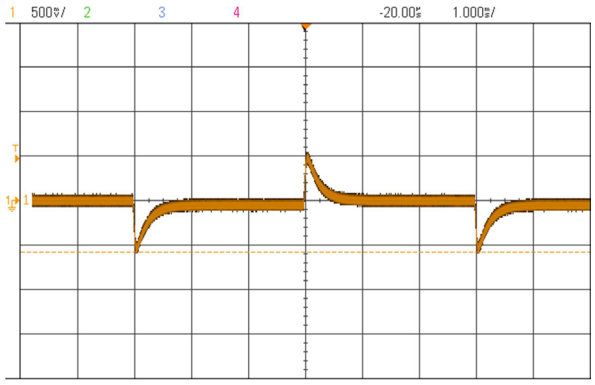
START UP Ch1:Vout Ch4:Vin



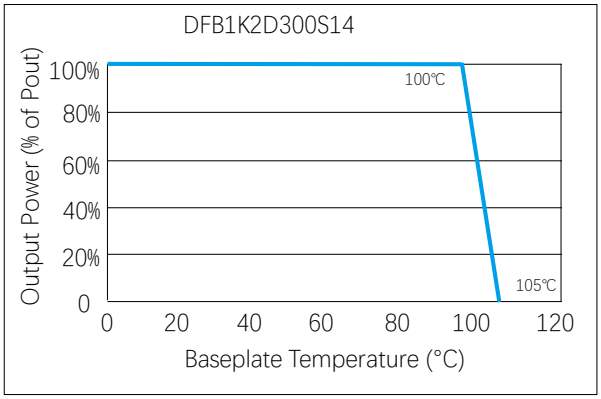
RIPPLE & NOISE Bandwith:20MHz



DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



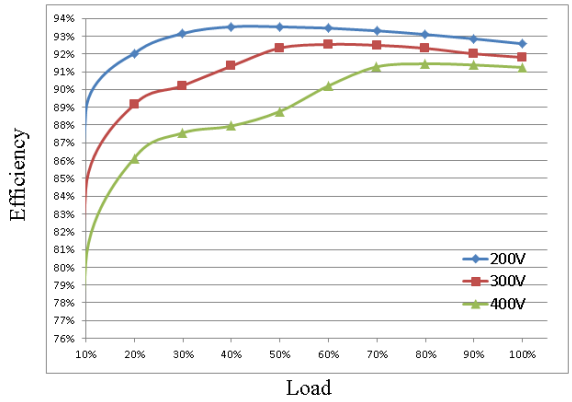
THERMAL DREATING CURVE



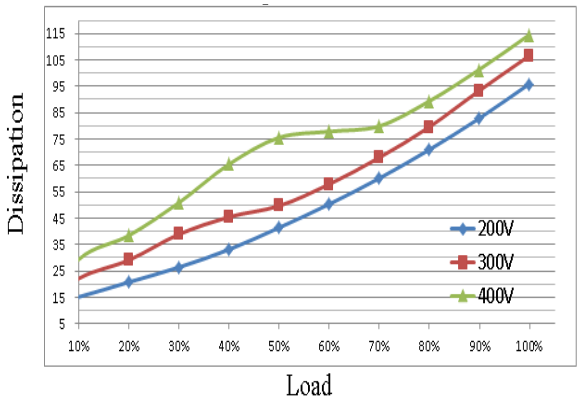
Performance Data

DFB1K2D300S24

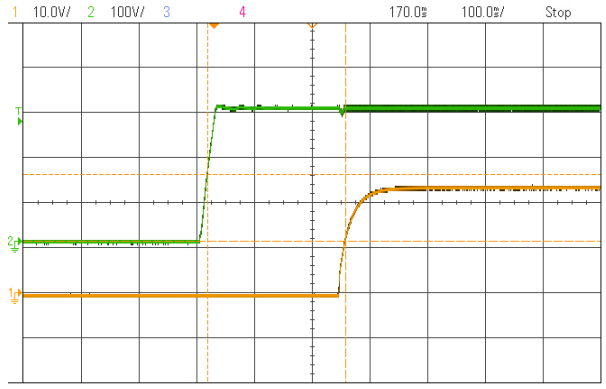
EFFICIENCY VS LOAD



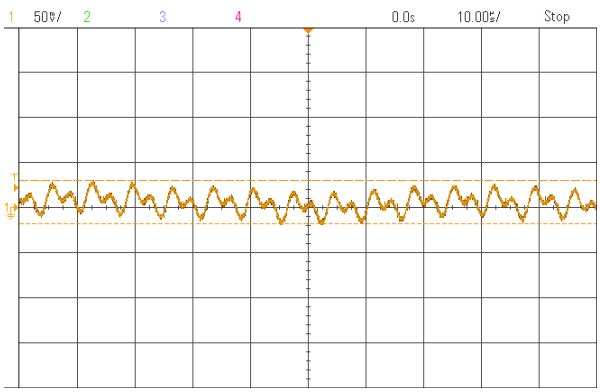
POWER DISSIPATION VS LOAD



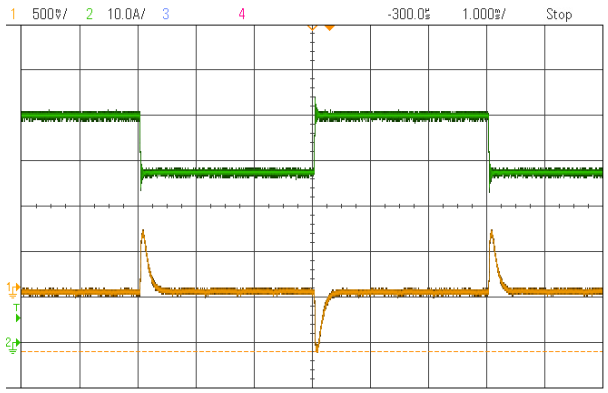
START UP Ch1:Vout Ch4:Vin



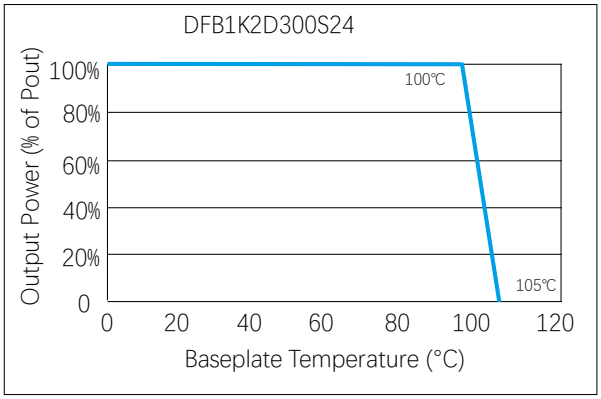
RIPPLE & NOISE Bandwith:20MHz



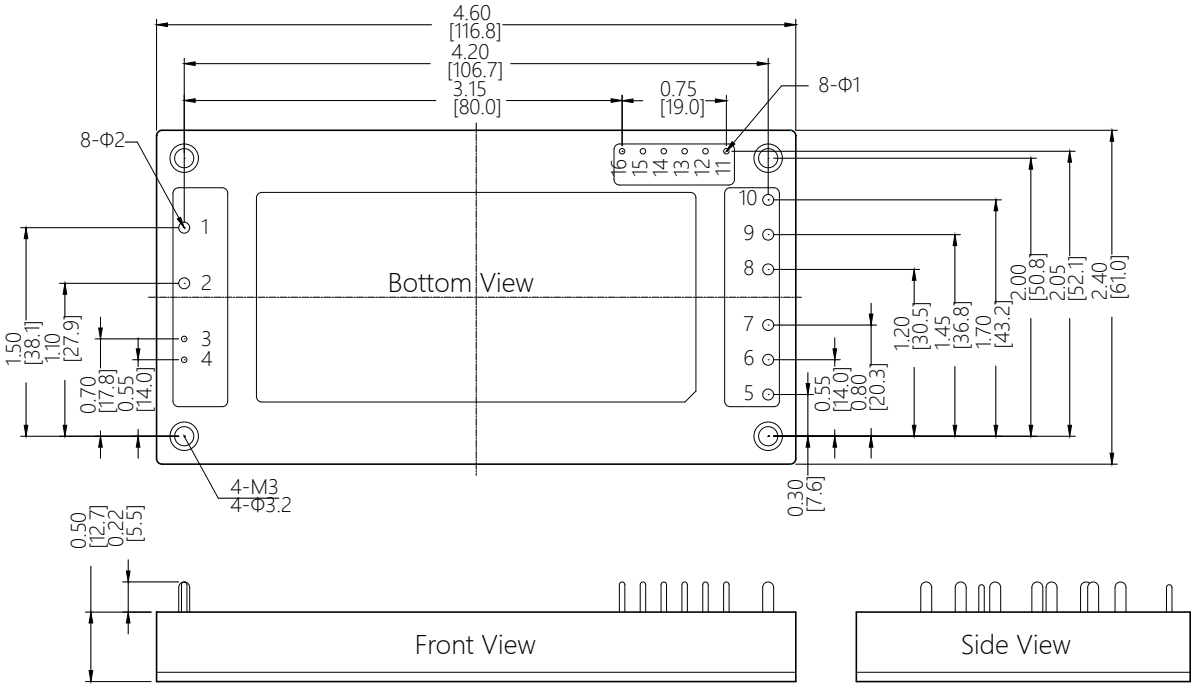
DYNAMIC RESPONSE (50%-75%-50% of $I_{max.}$)



THERMAL DREATING CURVE



Mechanical Specifications (DFB1K2D300S14)



PIN:
PIN1, PIN2, PIN5~PIN10: Φ0.078inch
Force: Applied force not exceed 9.8N
PIN3, PIN4, PIN11~PIN16 : Φ0.040inch
Force: Applied force not exceed 4.9N
Material: Copper alloy
Finish: Gold 3 ~ 5μm(min.) over nickel 50μm(Min.)
Baseplate screw locked torque: 0.7N·m Max.

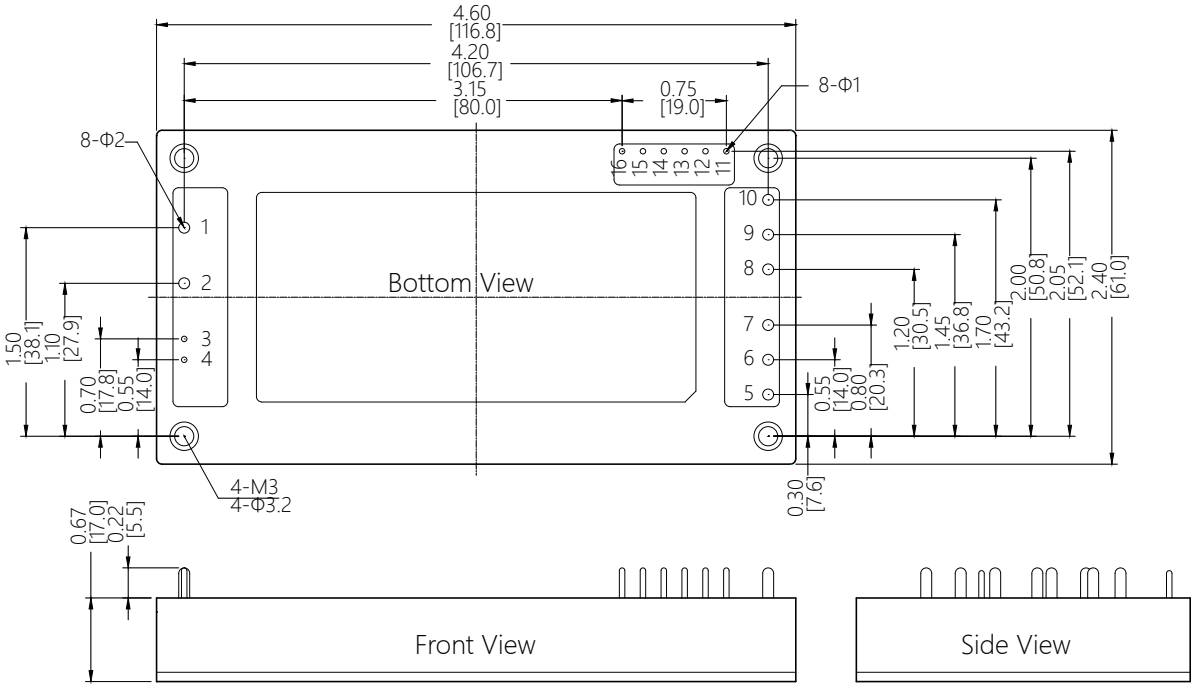
Tolerance:
X.XX=±0.02[0.5]
X.XXX= ±0.010[0.25]

Dimensions are in inches [mm]
Weight: ~230g.

PIN CONNECTIONS	
Pin	Function
1	-Vi (Input Negative)
2	+Vi (Input Positive)
3	-ON/OFF (Remote Control)
4	+ON/OFF (Remote Control)
5, 6, 7	+Vo (Output Positive)
8, 9, 10	-Vo (Output Negative)
11	-S (Output Sense Negative)
12	+S (Output Sense Positive)
13	TRIM (Output Adjustable)
14	PC/NC (Current Share Bus)
15	IOG (Output Fault Signal) ④
16	AUX (Auxiliary Power Supply)

Note:
④ An external pull-up resistor (5.1kΩ 0.25W) is connected between IOG and AUX.

Mechanical Specifications (DFB1K2D300S24)



PIN:
PIN1, PIN2, PIN5~PIN10: Φ0.078inch
Force: Applied force not exceed 9.8N
PIN3, PIN4, PIN11~PIN16 : Φ0.040inch
Force: Applied force not exceed 4.9N
Material: Copper alloy
Finish: Gold 3 ~ 5μm(min.) over nickel 50μm(Min.)
Baseplate screw locked torque: 0.7N·m Max.

Tolerance:
X.XX=±0.02[0.5]
X.XXX= ±0.010[0.25]

Dimensions are in inches [mm]
Weight: ~300g.

PIN CONNECTIONS	
Pin	Function
1	-Vi (Input Negative)
2	+Vi (Input Positive)
3	-ON/OFF (Remote Control)
4	+ON/OFF (Remote Control)
5, 6, 7	+Vo (Output Positive)
8, 9, 10	-Vo (Output Negative)
11	-S (Output Sense Negative)
12	+S (Output Sense Positive)
13	TRIM (Output Adjustable)
14	PC/NC (Current Share Bus)
15	IOG (Output Fault Signal) ⑤
16	AUX (Auxiliary Power Supply)

Note:
⑤ An external pull-up resistor (5.1kΩ 0.25W) is connected between IOG and AUX.

Technical Notes

INPUT FUSING

Certain applications may require fuse at the inputs of power conversion components. Fuses should also be used when there is possibility of sustained input voltage reversal which is not current limited. The DFB1K2D300 modules are not internally fused. We strongly recommend a slow-blown fuse to be used in the ungrounded input supply line.

For safety agency approvals, the installer must install the converter in compliance with the end user safety standard.

TYPICAL APPLICATION CONNECTION

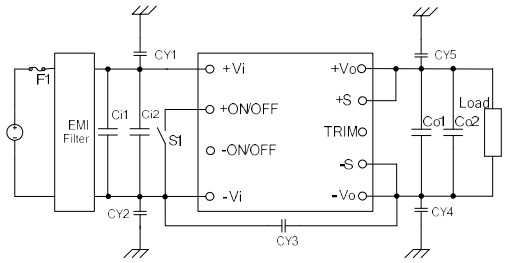


Figure 1·Typical Application Connection

Figure 1 shows the typical use of the module connection. In order to prevent the input line from causing the input oscillation, it is recommended to add the input capacitor close to the input pin of the module. Similarly, the output capacitor is added to the output of the module.Specific recommended parameters: input capacitance Ci1=220μF electrolytic capacitor, Ci2 = 1μF CBB capacitor. Output Capacitance Co1=10μF tantalum capacitor, Co2 ESR <0.1Ω. CY1,CY2,CY3 are Y Capaciors: 3300pF Y2 250V; CY4, CY5 are Y capacitors: 0.1μF Y2 275V.

REFLECTED RIPPLE CURRENT

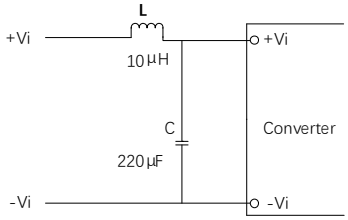


Figure 2· Reflected Ripple Current

Add LC filter at the front of the power module to reduce the interference of reflected ripple current on the DC bus, recommended value of L and C with appropriate current and voltage rating as below: L=10μH, C=220μF.

REMOTE CONTROL FUNCTION

Module Power Remote Control or called ON/OFF pin is for the user to enable or disable the output. Control uses high and low level control, there are two general control logics, positive logic or negative logic control.

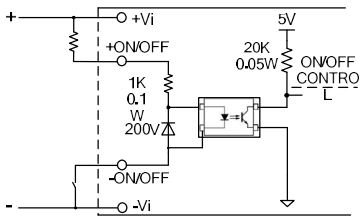


Figure 3· Remote Control

Remote Control Pin can be connected in parallel for multiple converters which with the same Remote Control characters. However, when several converters share the same remote control circuit, the total sink and source current must be taken into consideration, and make sure that the opto-coupler has enough drive capability.

REMOTE COMPENSATION FUNCTION

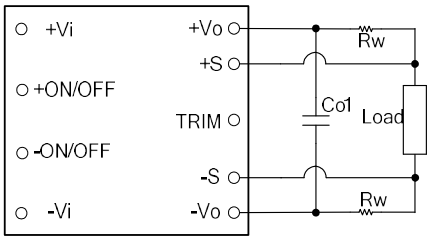


Figure 4· Remote Compensation

The remote compensation function compensates for the voltage drop across the output line. Module compensation function can't exceed 10%, that is:

$[(+Vo) - (-Vo)]-[(+S) -(-S)] \leqslant 10\%V_{onom}$

Remote Sense compensation at nominal Vo only.

Technical Notes

Incorrect connection of the sense leads may damage the module.
If the remote compensation function is not used, the +Sense and +Vout pin, -Sense and -Vout pins should be connected directly to ensure accurate regulation.

OUTPUT RIPPLE & NOISE

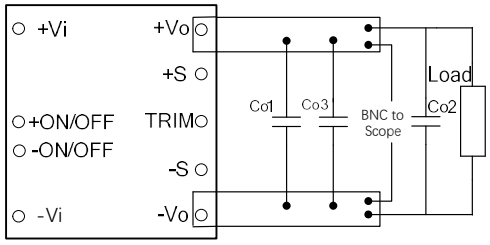


Figure 5· Output Ripple

These DFB1K2D300 modules' output ripple and noise are measured at the rated input voltage and output current, along with 10uF MLCC capacitor and 0.1uF MLCC used in parallel with appropriate voltage ratings and placed as C1&C2 shown in the figure above. The scope's bandwidth is set to 20MHz.
External output capacitors are required to reduce the ripple & noise. The output capacitors should be low ESR and appropriate frequency response with appropriate voltage ratings, and must be located as close to the converters as possible, also PCB layout must be taken into consideration.

INPUT UNDERVOLTAGE SHUTDOWN AND OVERVOLTAGE PROTECTION

Under normal start-up conditions, module will not begin to regulate until the ramping-up input voltage exceeds the Start-Up Threshold Voltage. Once operating, module will not turn off until the input voltage drops below the Undervoltage Shutdown limit. Subsequent re-start will not occur until the input is brought back up to the Start-Up Threshold. This built in hysteresis prevents any unstable on/off situations from occurring at a single input voltage.
When input voltage is over the input overvoltage protection set point, the PWM will be shutdown and the converter will not be turned on until the input voltage drops below input overvoltage thershold.

CURRENT LIMITING

The maximum current limit remains constant as the output voltage drops. However, once the impedance of the short across the output is small enough to make the output voltage drop below the specified Output Current Limit Shutdown Voltage, the converter turns off.
The converter then enters a “hiccup mode” where it repeatedly turns on and off until the short circuit condition is removed. This prevents excessive heating of the converter or the load board.

SHORT CIRCUIT CONDITION

When the converter is in current-limit mode, the output voltage will drop as the output current demand increases and then the converter will be shut down.If the short-circuit condition persists, another shutdown cycle will be initiated. This on/off cycling is referred to as "hiccup" mode. The hiccup cycling reduces the average output current, thereby preventing internal temperatures from rising to excessive levels. The module is capable of enduring an indefinite short circuit output condition.

OUTPUT OVERVOLTAGE PROTECTION

The output voltages are monitored for an overvoltage condition via magnetic feedback. The signal is coupled to the primary side and if the output voltage rises to a level which could be damaging to the load, the sensing circuitry will power down the PWM controller causing the output voltages to decrease. Following a timeout period the PWM will restart, causing the output voltages to ramp to their appropriate values. If the fault condition persists, and the output voltages again climb to excessive levels, the overvoltage circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

Technical Notes

THERMAL SHUTDOWN

These DFB1K2D300 converters are equipped with thermal shutdown circuitry. If environmental conditions cause the internal temperature of the converter to rise above the designed operating temperature, a precision temperature sensor will power down the unit. When the internal temperature decreases below the threshold of the temperature sensor, the unit will auto restart.

TRIMMING OUTPUT VOLTAGE

DFB1K2D300 converters have a trim capability that allows users to adjust the output voltages. Output voltage can be trimmed up or down by a trim pin by connecting a single fixed resistor between +S and +Vo or -S and TRIM, the output voltage can be increased or decreased depending on its connection. The maximum output voltage adjustment range is -20% to +10%. If the trim function is not used, keep TRIM pin floating.

Trim up:

Increase the output voltage by connecting an appropriate value resistor between +S and +Vo Pin. Show as below:

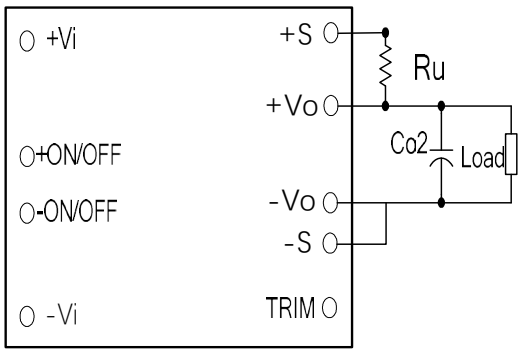


Figure 6· Trim Up Connection

Please follow up the Trim Up formula to calculate the resistor value according to the desired output voltage.

$$14V: Ru=\frac{40.68\times Vset}{40.92}-Vo\ (K\Omega)$$

$$24V: Ru=\frac{2.49\times(Vset-Vo)}{2.5}\ (K\Omega)$$

"Voset" is the output voltage when TRIM is floating, "Vo" is the normal output voltage.

Trim down:

Decrease the output voltage by connecting an appropriate value resistor between Trim Pin and -S(+Vo and +s is shorted). Show as below:

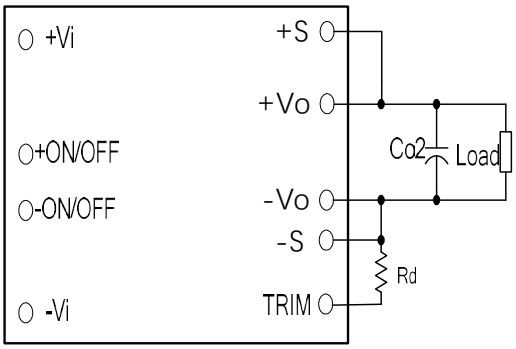


Figure 7· Trim Down Connection

Please follow up the Trim Down formula to calculate the resistor value according to the desired output voltage.

$$14V: Rd=\frac{253.44\times Vset}{40.92\times Vo-40.68\times Vset}\ (K\Omega)$$

$$24V: Rd=\frac{10\times Vset}{Vo-Vset}\ (K\Omega)$$

"Voset" is the output voltage when TRIM is floating, "Vo" is the normal output voltage.

CURRENT SHARE

DFB1K2D300 series are designed for parallel operation. To ensure that all modules in a parallel system accurately share current, the PC/NC pins on each modules should be connected together. In addition, It also supports highly reliable N+1 redundant parallel operation. Maximum parallel units are limited to 8 units. Typical parallel applications are shown as below:

Technical Notes

1.Current share circuits

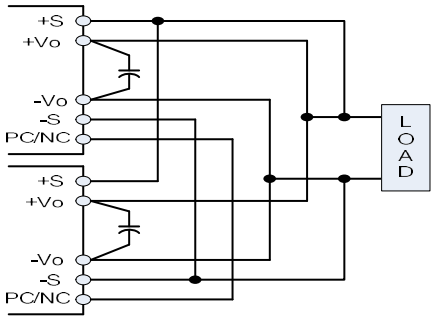


Figure 8· Current share circuits

2. Adjustable output current share circuits

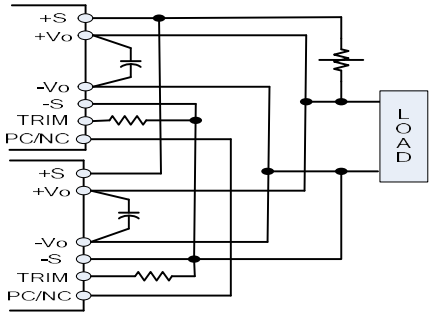


Figure 9· Adjustable output current share circuits

3. N+1 redundant current share circuits

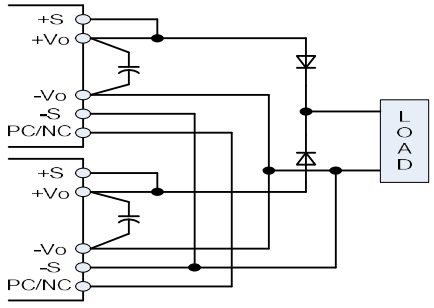


Figure 10· N+1 redundant current share circuits

4.Adjustable N+1 redundant current share circuits

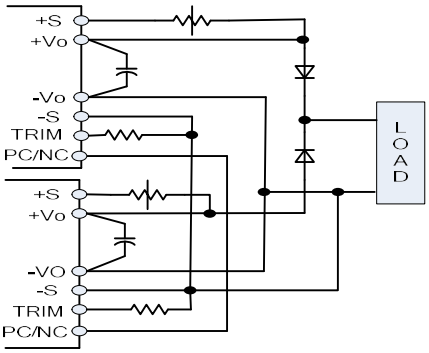


Figure 11· Adjustable output N+1 redundant current share circuits

TIMING

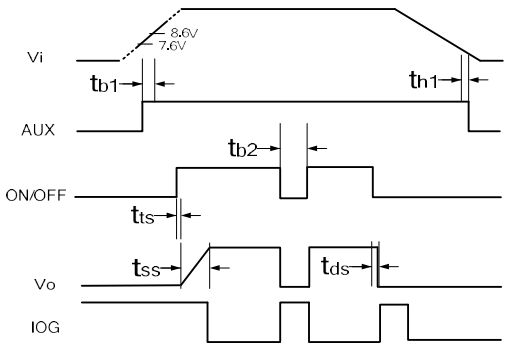


Figure 12· Timing (P Logic)

This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
Refer to: http://www.densitypower.com