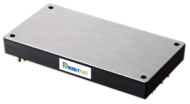
Technical Specification

DFB400W24 Series

4:1 Input Full Brick Isolated 400Watts DC/DC Converters

FEATURES

- 4:1Wide input range: 9-36VDC
- 400W isolated outputs
- Effciency up to 89%
- Fixed outputs from 5 to 28VDC
- Adjustable Vout (±10%)
- Fixed switching frequency, predicted EMI
- Stable @ no-load operation
- Remote On/Off control
- 1500VDC I/O isolation
- Industry standard full brick footprint (4.20" × 2.40" × 0.50")
- Extensive self-protection, UVLO, 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 DFB400W24 series are highly reliable, and efficient isolated DC/DC converter. Wide input range of 9-36V(24V nominal) is ideal for automation, power grid, railway, semiconductor equipment, instrumentation, test and measurement, and distribution power system.

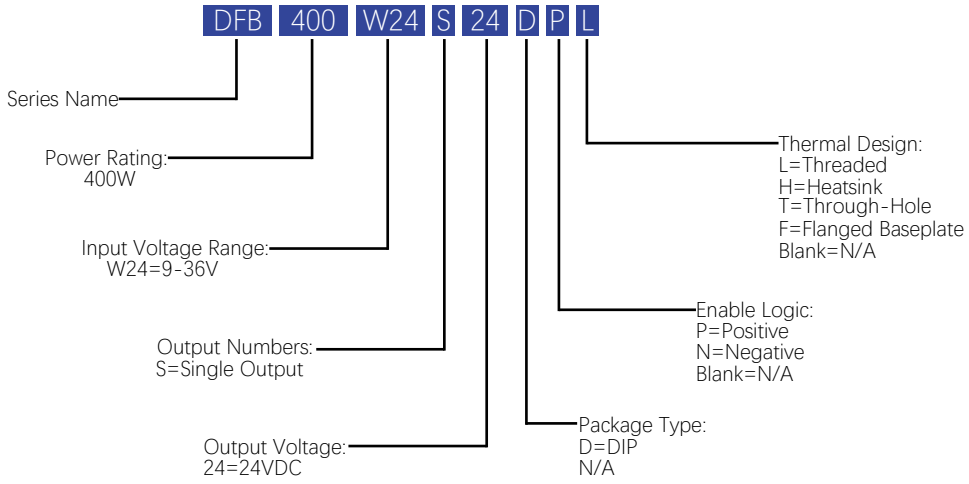
A wealth of self-protection features included input undervoltage lockout, over temperature shutdown, over current protection with “hiccup” autorestart technique, provides indefinite short-circuit protection, along with output OVP. Threaded or through holes are provided to allow easy mount or the addition 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 DFB400W24 series have current share function which also support N+1 redundant parallel operation.

The DFB400W24 series are designed to safety standards IEC/EN 60950, 2nd edition.

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]
DFB400W24S05	24	9-36	5	80	89	10000	4.20"×2.40"×0.50"
DFB400W24S12	24	9-36	12	33.3	86.5	10000	
DFB400W24S24	24	9-36	24	16.7	88	5600	
DFB400W24S28	24	9-36	28	14.3	88	4700	

Model Numbering



Absolute Maximum Ratings					
Parameters	Conditions	Min.	Typ.	Max.	Units
Input Voltage Continuous		-0.7		40	VDC
Input Voltage Transient(< 100ms)				50	VDC
On/Off Remote Control	Referred to -on/off			10	VDC
On/Off Remote Control Current		0	0.25	10	mA
Operating Baseplate Temperature		-40		100	°C
Operating Environment Temperature		-40		85	°C
Storage Temperature Range		-55		125	°C
Soldering Temperature	Wave Soldering < 10s			260	°C
Safety and EMC Compliance					
Conducted Emission	EN55022	Class A (With external filter)			
Radiated Emission	EN55022	Class A (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	±2KV Contact ±4KV Air Criteria A			
Isolation Safety Rating	Basic insulation				

General Specifications

Parameters	Conditions	Min.	Typ.	Max.	Units
Isolation Voltage	Input to output	1500			VDC
	Input to case	1500			VDC
	Output to case	1000			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		2000		pF
Isolation Safety Rating	Basic insulation				
Switching Frequency			300		KHz
Start-up Delay	From start-up threshold recover to 10% Vout			100	mS
Rise Time	From 10% Vout to 90% Vout capacitive load			50	mS
Remote On/Off Control					
"P" suffix					
Positive Logic, ON state		3.0		10	VDC
Positive Logic, OFF state		0		0.8	VDC
"N" suffix					
Negative Logic, ON state		0		0.8	VDC
Negative Logic, OFF state		3.0		10	VDC
Remote Control Current		0		10	mA
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		9	24	36	VDC
Start-up Threshold		8.0		9.0	VDC
Under Voltage Shutdown		7.0		8.5	VDC
Input Current @ No Load	5V Output		300	500	mA
	12V, 24V, 28V Outputs		150	250	mA
Input Current @ Min. Line	Min. Vin and full load			52	A
Input Current @ Shutdown Mode				200	mA
Reflect Ripple Current (Peak-Peak)	Measured at input pin with 10μH inductor and 820μF capacitance			100	mA
Recommended Input Fuse			100		A
Recommended External Input Capacitance			820		μF

Output Specifications					
Parameters	Conditions	Min.	Typ.	Max.	Units
Output Power				400	W
Vout Accuracy	50% Load, Vin=24VDC	-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=24VDC	-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	115		140	%
Over Current Protection	Hiccup, Auto-recover	110		150	%
Short Circuit Protection	Hiccup, Auto-recover				
Aux Power Supply Voltage		7	10	13	VDC
Aux Power Supply Current				20	mA
Current Share Accuracy		-10		+10	%
Remote Sense Voltage				10	%
Minimum Load	No minimum load required				

Output Specifications					
Parameters		Modules			
		S05	S12	S24	S28
Output Voltage Normal(VDC)		5	12	24	28
Ripple & Noise Max. (mV pk-pk) ①		100	120	240	280
Dynamic Load Peak Deviation (%Vout) ②		±5	±5	±5	±5
Dynamic Load Response (μS)		500	500	500	500
Capacitive Load (μF)	Min.	470	470	470	470
	Max.	10000	10000	5600	4700

Notes
① Ripple & noise is tested with certain filter parameters, please see output ripple & noise in technical notes on page 10 for more details.
② The load is set from 50%-75%-50% of Imax, di/dt=1A/μS, please refer to dynamic waveforms in performance data on page 7 for details.

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

Technical Specification

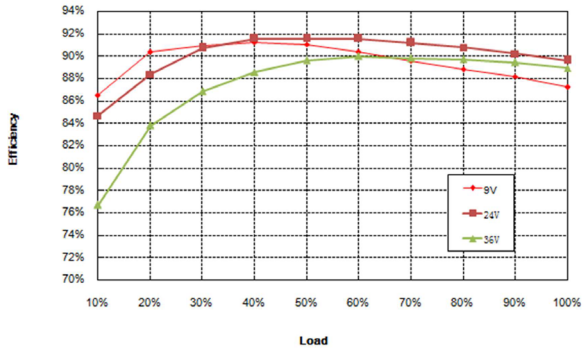
DFB400W24 Series

4:1 Input Full Brick Isolated 400Watts DC/DC Converters

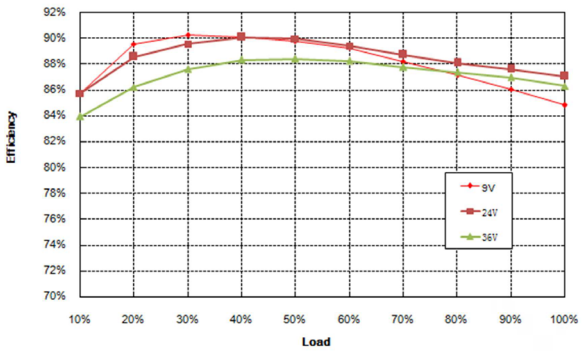
Performance Data

EFFICIENCY VS LOAD

DFB400W24S05



DFB400W24S12



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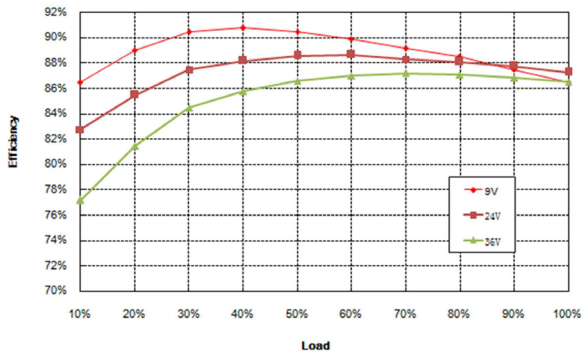

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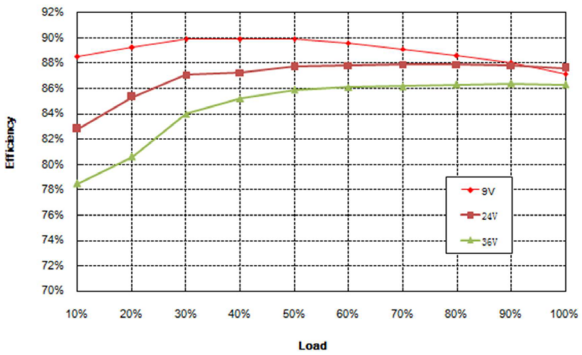
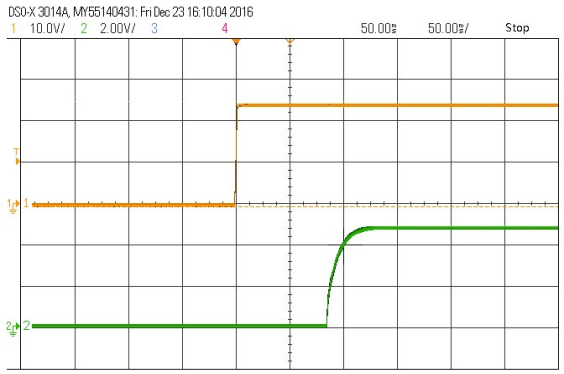


START UP Ch1: Vin Ch2: Vout

DFB400W24S05



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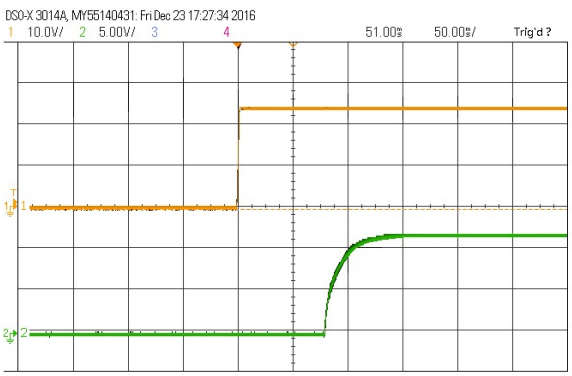
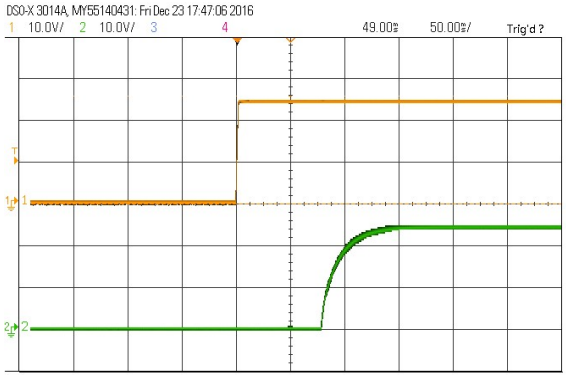


Performance Data

START UP Ch1: Vin Ch2: Vout

DFB400W24S24



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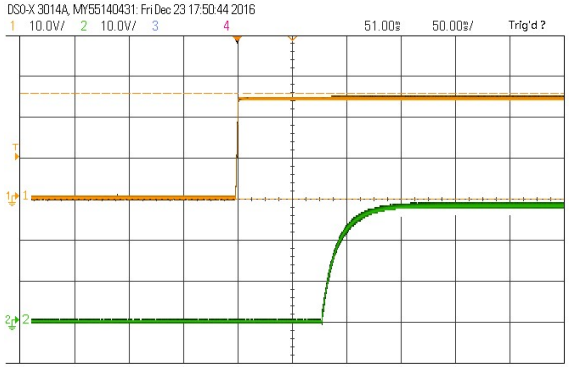
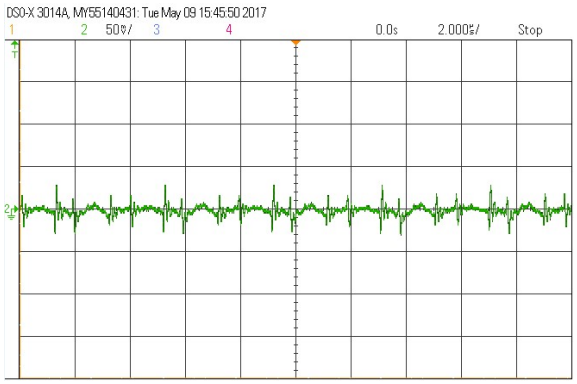


RIPPLE & NOISE 20MHz Bandwidth

DFB400W24S05



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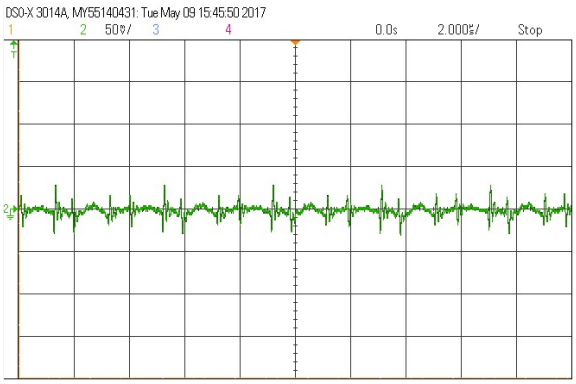

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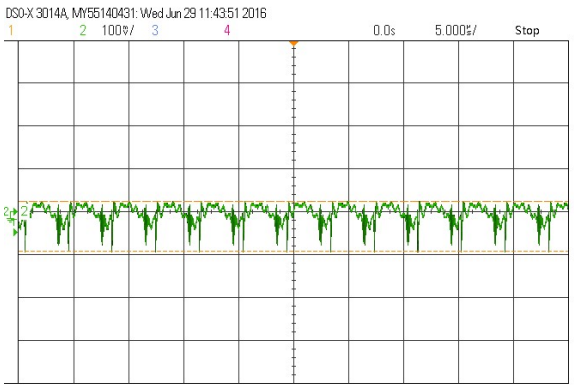

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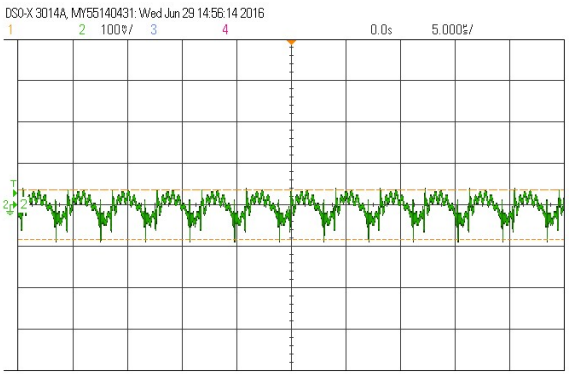
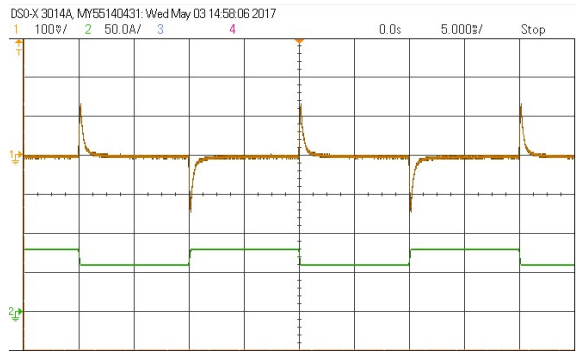


Performance Data

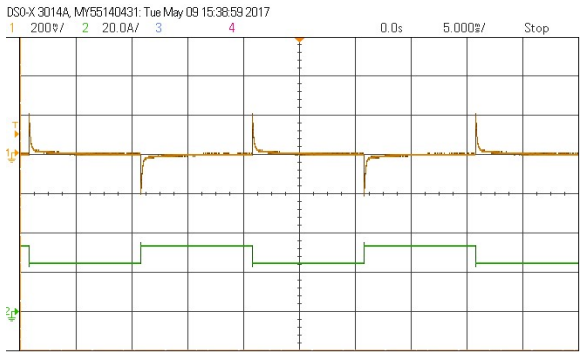
DYNAMIC RESPONSE (50%~75%~50% of I_{max}, di/dt=1A/μs)

Ch1: Vout Ch2: Iout

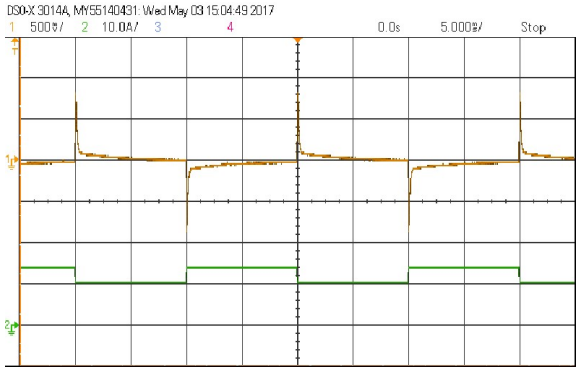
DFB400W24S05 C_{out}=470μF



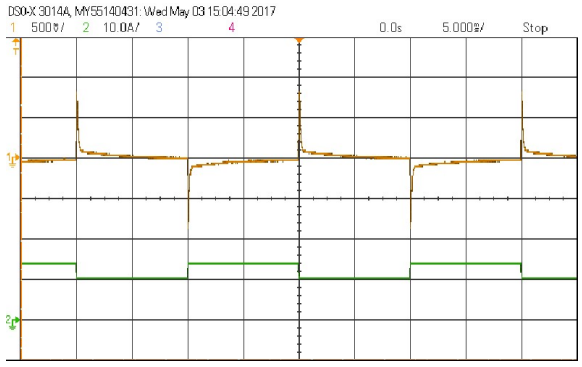
DFB400W24S12 C_{out}=470μF



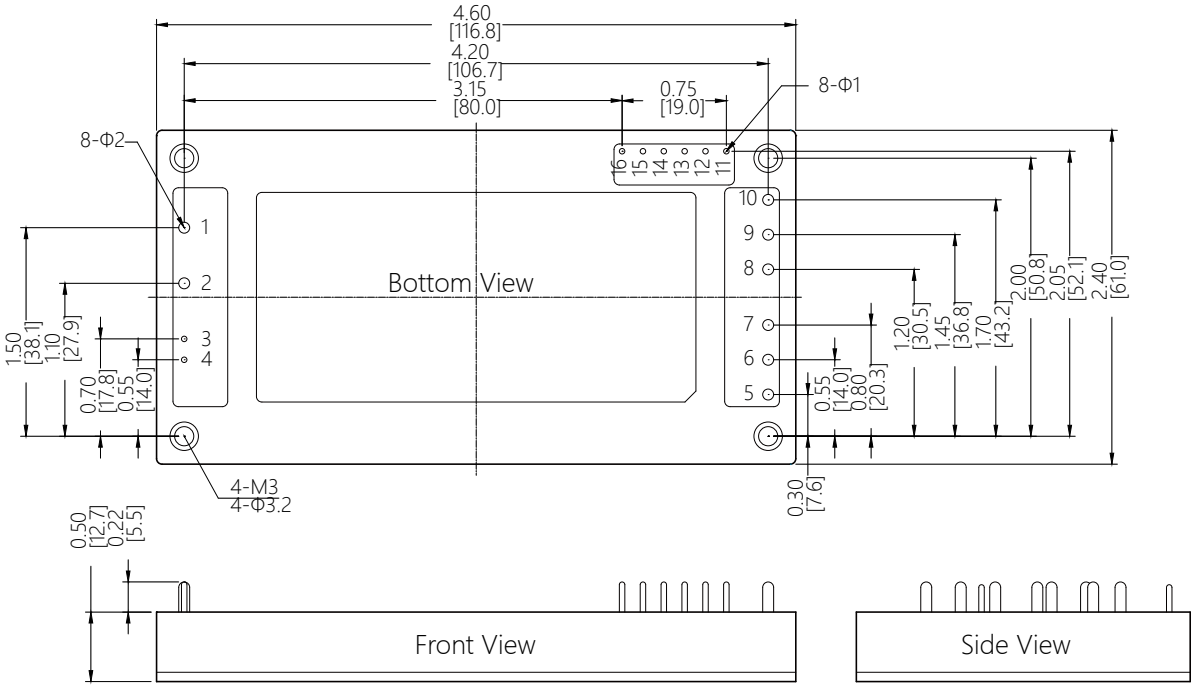
DFB400W24S24 C_{out}=470μF



DFB400W24S28 C_{out}=470μF



Mechanical Specifications



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: 0.3N·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) ③
16	AUX (Auxiliary Power Supply)

Note:
③ IOG pin connect with external pull-up resistor 1 kΩ to 5Vdc (Typical).

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 DFB400W24 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

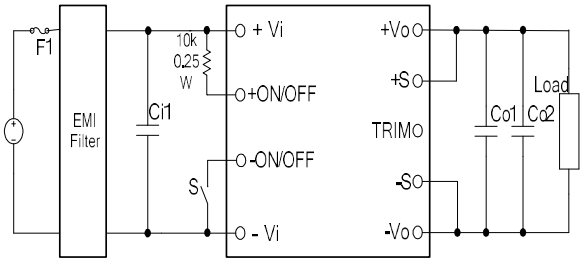


Figure 1·Typical Application Connection

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=820 or 470μF electrolytic capacitor, Ci2 = 1uF CBB capacitor. Output Capacitance Co1=10uF tantalum capacitor, Co2 ESR <0.1Ω.

REFLECTED RIPPLE CURRENT

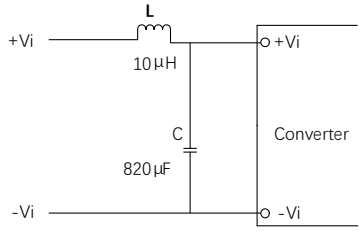


Figure 2· Reflected Ripple Current

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=820μF.

REMOTE CONTROL FUNCTION

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

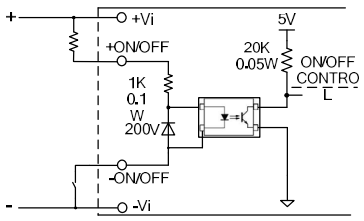


Figure 3· Remote Control

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

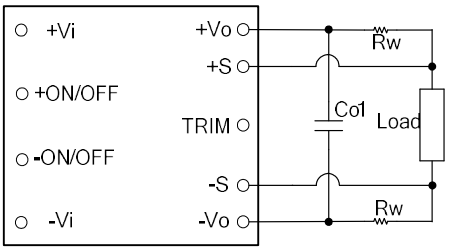


Figure 4· Remote Compensation

The remote compensation function compensates for the voltage drop across the output line. Module compensation function can't exceed 10%, that is:
$[(+Vo) - (-Vo)]-[(+S) -(-S)] \leqslant 10\%V_{onom}$

Technical Notes

If the remote compensation function is not used, the +Sense and +Vout pin, -Sense and -Vout pin need to be shorted directly close to the output.

OUTPUT RIPPLE & NOISE

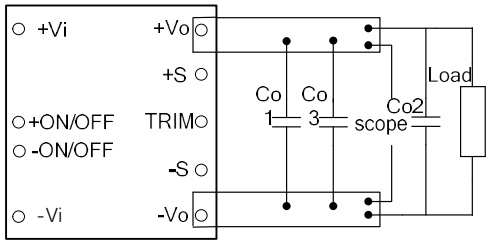


Figure 5· Output Ripple

These DFB400W24 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 START-UP THRESHOLD

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.

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.

THERMAL SHUTDOWN

These DFB400W24 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

Technical Notes

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

DFB400W24 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 volatge 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:

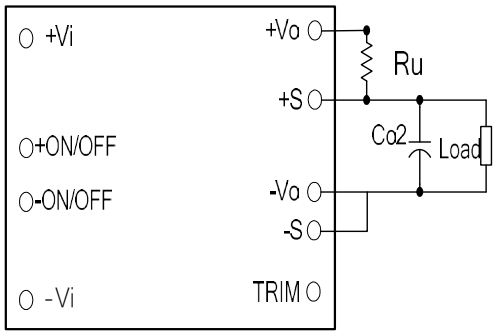


Figure 6· Trim Up Connection

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

$$R_u = \left(\frac{\Delta}{100} \times Voset\right) K\Omega$$

"Voset "is the output voltage when TRIM is floating," Δ% "is the change of output voltage, such as: 12V output is raised to 13.2V,
Δ% = (13.2-12) / 12 * 100% = 10%.

Trim down:

Decrease the output voltage by connecting an appropriate value resistor between Trim Pin and -S. Show as below:

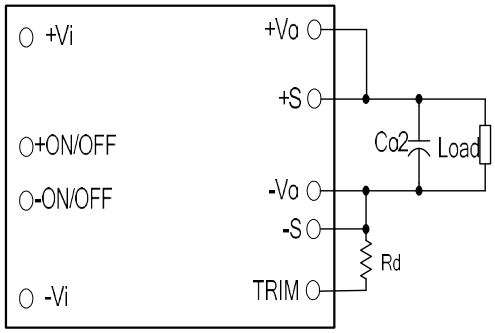


Figure 7· Trim Down Connection

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

$$R_d = \frac{252.78 \times (100 - \Delta)}{40.68 \times \Delta + 24} K\Omega$$

"Voset" is the output voltage when TRIM is floating, "Δ%" is the amount of change in output voltage. such as: 12V output is reduced to 10.8V,
Δ% = (12-10.8) / 12 * 100% = 10%.

CURRENT SHARE

DFB400W24 series are designed for parallel operation. Current share function can be achieved by keeping the PC/NC pins of the two modules connected. In addition, It also supports highly reliable N+1 redundant parallel operation. Maximum parallel units are limited to 10 units. Typical parallel applications are shown as below:

Technical Notes

1.Current share circuits

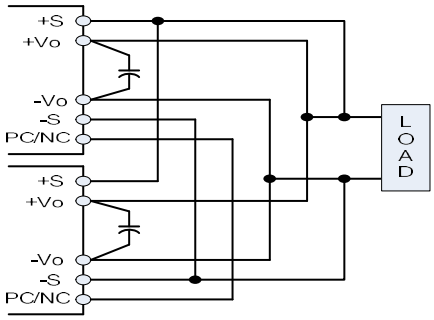


Figure 8· Current share circuits

2. Adjustable output current share circuits

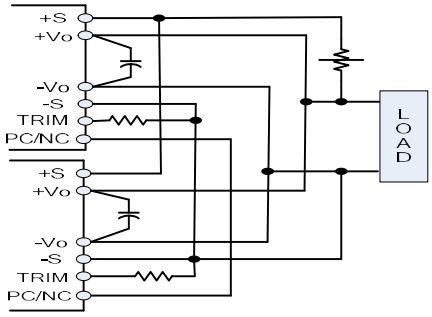


Figure 9· Adjustable output current share circuits

3. N+1 redundant current share circuits

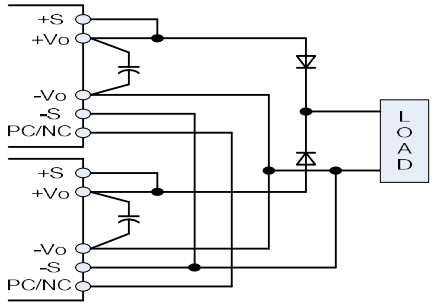


Figure 10· N+1 redundant current share circuits

4.Adjustable N+1 redundant current share circuits

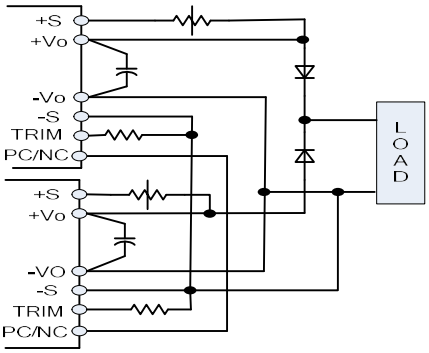


Figure 11· Adjustable output N+1 redundant current share circuits

TIMING

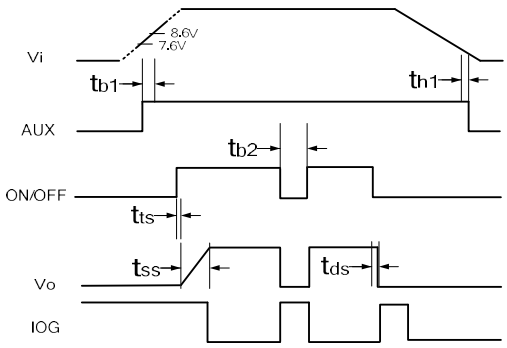


Figure 12· Timing (P Logic)

This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
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