TDK-Lambda

DPX40-xxDxx Dual Output: DC-DC Converter Module

9.5 ~ 18 VDC, 18 ~ 36 VDC and 36 ~ 75 VDC input; ±12 to ±15 VDC Dual Output; 40 Watts Output Power

FEATURES

- 1600VDC INPUT TO OUTPUT ISOLATION
- SCREW TERMINALS FOR INPUT AND OUTPUT CONNECTIONS
- RELIABLE SNAP-ON FOR DIN RAIL TS-35/7.5 OR TS-35/15
- CASE PROTECTION MEETS IP20(IEC60529)
- INPUT FUSE PROTECTION
- INPUT REVERSE POLARITY PROTECTION
- INPUT IN-RUSH CURRENT LIMIT CIRCUIT
- OUTPUT DC-OK INDICATOR
- 2:1 WIDE INPUT VOLTAGE RANGE
- FIXED SWITCHING FREQUENCY
- INPUT UNDER-VOLTAGE PROTECTION
- OUTPUT OVER-VOLTAGE PROTECTION
- OVER-CURRENT PROTECTION
- OUTPUT SHORT CIRCUIT PROTECTION
- MEETS EN55022 CLASS B
- COMPLIANT TO RoHS II & REACH

CE MARKED

SAFETY MEETS: UL60950-1
EN60950-1
IEC60950-1

APPLICATIONS

- COMMUNICATION SYSTEMS
- INDUSTRY CONTROL SYSTEMS
- FACTORY AUTOMATION EQUIPMENT
- SEMICONDUCTOR EQUIPMENT

OPTIONS

- REMOTE ON/OFF

GENERAL DESCRIPTION

The DPX40-xxDxx series was designed for applications requiring din rail mountable DC-DC converters. Easy installation is provided with snap-on mounting to the DIN-rail. Internal circuits provide protection against reverse input voltage, input in-rush current, output short-circuit, output over-current, and output over-voltage conditions. A green LED at the front panel displays the status of the output voltage.

Contents

Output Specifications					
Parameter	Model	Min	Typ	Max	Unit
Output Voltage (Vin(nom); Full Load; Ta=25℃)	xxD12 xxD15	11.82 14.775	12 15	12.18 15.225	VDC
Output Regulation Line (Vin(min) to Vin(max); Full Load) Load (0% to 100% of Full Load)	All	-0.5 -1.5		+0.5 +1.5	%
Output Ripple and Noise Peak to Peak (20MHz Bandwidth)	xxD12 xxD15		120 150	150 200	mVp-p
Cross Regulation (Asymmetrical Load 25% / 100% of Full Load)	All	-5.0		+5.0	% of Vout
Temperature Coefficient	All	-0.02		+0.02	%/℃
Output Voltage Overshoot (Vin(min) to Vin(max) Full Load; Ta=25℃)	All		0	5	% of Vout
Dynamic Load Response (Vin(nom); Ta=25℃) Load step change from 75% to 100% or 100 to 75% of Full Load Peak Deviation Settling Time (Vout 10% peak deviation)	All All		250 250		mV μs
Output Current	xxD12 xxD15	±144 ±112		±1800 ±1400	mA
Output Capacitance Load	xxD12 xxD15			±1200 ±750	μF
Output Over Voltage Protection (see page 18) (Zener diode clamp)	xxD12 xxD15		15 18		VDC
Output Indicator	All	Green LED			
Output Over Current Protection (see page18) (% of Iout rated; Hiccup mode)	All			150	% of FL
Output Short Circuit Protection (see page 18)	All	Continuous, automatic recovery			

Input Specifications					
Parameter	Model	Min	Typ	Max	Unit
Operating Input Voltage					
Continuous	12Dxx	9.5	12	18	VDC
	24Dxx	18	24	36	VDC
	48Dxx	36	48	75	VDC
Transient (100ms,max)	12Dxx			36	VDC
	24Dxx			50	VDC
	48Dxx			100	VDC
Input Standby Current					
(Typical value at Vin(nom); No Load)	12D12		37		mA
	12D15		45		mA
	24D12		27		mA
	24D15		27		mA
	48D12		20		mA
	48D15		20		mA
Under Voltage Lockout Turn-on Threshold	12Dxx			9.5	VDC
	24Dxx			18	VDC
	48Dxx			36	VDC
Under Voltage Lockout Turn-off Threshold	12Dxx		8		VDC
	24Dxx		16		VDC
	48Dxx		33		VDC
Input Reflected Ripple Current (see page 18) (Vin(nom); Full Load)	All		15		mAp-p
Start Up Time (Vin(nom) and constant resistive load)	All				ms
Power up			100		ms
Remote ON/OFF			25		ms
Remote ON/OFF Control (see page 19) (The Ctrl pin voltage is referenced to negative input)					
Positive Logic (Optional)					
On/Off pin High Voltage (Remote ON)	**xxDxx-P**	Open or 3.5 ~ 12VDC			
On/Off pin Low Voltage (Remote OFF)		Short or 0 ~ 1.2VDC			
Negative Logic (Optional)					
On/Off pin High Voltage (Remote ON)	**xxDxx-N**	Short or 0 ~ 1.2VDC			
On/Off pin Low Voltage (Remote OFF)		Open or 3.5 ~ 12VDC			
Input Current of Remote Control Pin		-0.5		0.5	mA
Remote Off State Input Current			2.5		mA
Input Fuse (Slow Blow)	12Dxx		8		A
	24Dxx		8		A
	48Dxx		4		A
In-rush Current	All		15		A

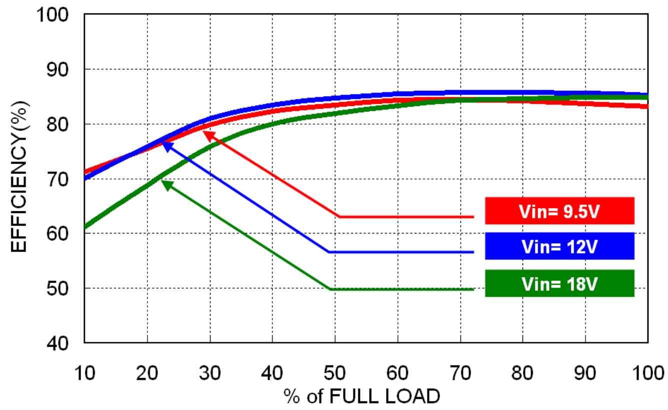
General Specifications					
Parameter	Model	Min	Typ	Max	Unit
Efficiency					
(Vin(nom); Full Load; Ta=25℃)	12D12		83		%
	12D15		83		
	24D12		85		
	24D15		85		
	48D12		85		
	48D15		85		
Isolation Voltage (1 minute)					
Input to Output	All	1600			VDC
Input to Chassis, Output to Chassis		1600			
Isolation Resistance (500VDC)	All	1			GΩ
Isolation Capacitance	All			4000	pF
Switching Frequency	All	270	300	330	kHz
Safety Meets	All	IEC60950-1,UL60950-1, EN60950-1			
Weight	All		182		g
MTBF (see page 21) MIL-HDBK-217F Ta=25ºC, Full load	All		8.080×10^5		hours
Chassis Material	All	Aluminum			

Environmental Specifications					
Parameter	Model	Min	Typ	Max	Unit
Operating Ambient Temperature Without derating	All	-40		+58	℃
With derating	All	+58		+97	℃
Storage Temperature	All	-40		105	℃
Relative Humidity	All	5		95	% RH
Thermal Shock	All	MIL-STD-810F			
Vibration	All	IEC60068-2-6			

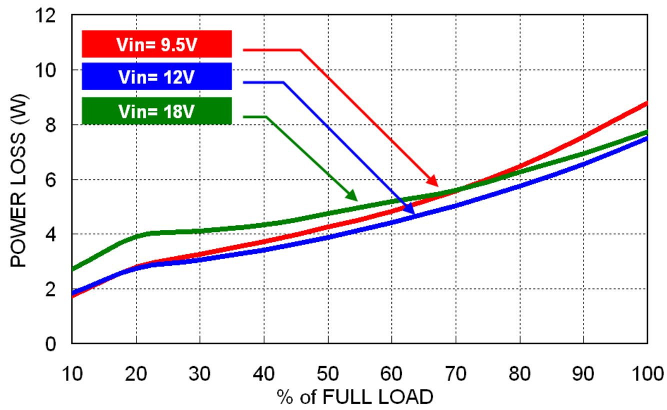
EMC Characteristics			
Characteristic	Standard	Condition	Level
EMI	EN55022	Module stand-alone	Class B
ESD	EN61000-4-2	Air ±8kV Contact ±6kV	Perf. Criteria A
Radiated Immunity	EN61000-4-3	10V/m	Perf. Criteria A
Fast Transient (see page 19)	EN61000-4-4	±2kV	Perf. Criteria A
Surge (see page 19)	EN61000-4-5	±1kV	Perf. Criteria A
Conducted Immunity	EN61000-4-6	10V r.m.s	Perf. Criteria A
Power Frequency Magnetic Field	EN61000-4-8	100A/m continuous; 1000A/m 1 second	Perf. Criteria A

Characteristic Curves

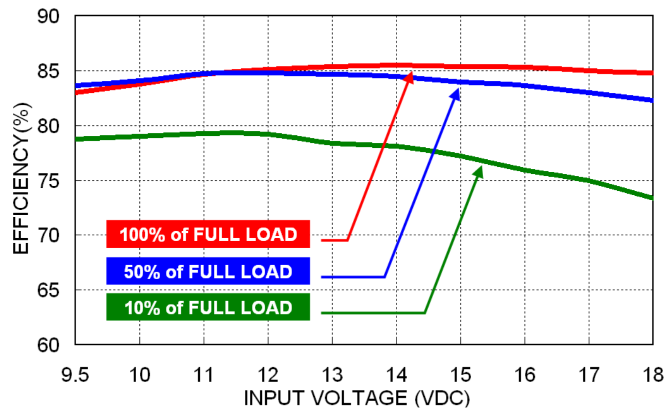
All test conditions are at 25℃.The figures are for DPX40-12D12



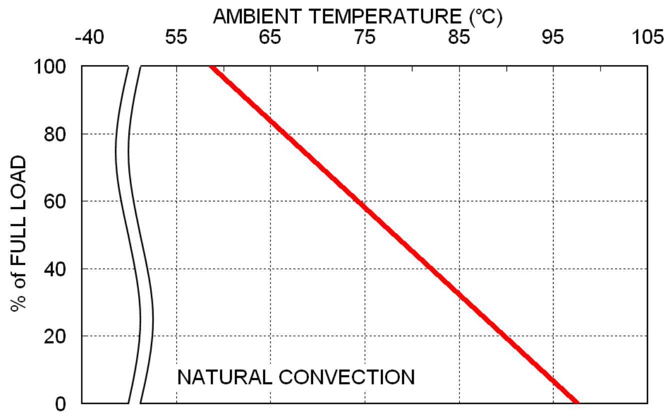
Efficiency versus Output Load



Power Dissipation versus Output Load



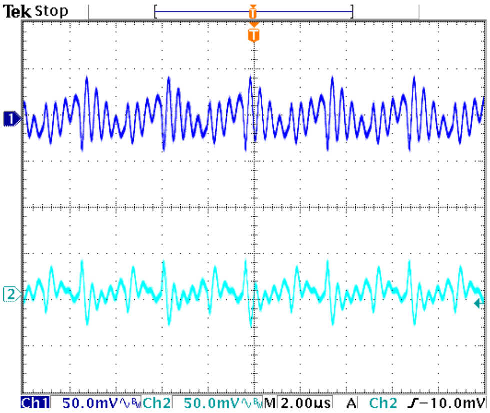
Efficiency versus Input Voltage



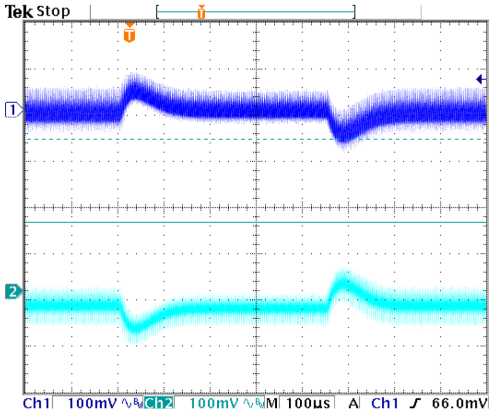
Derating Output Current versus Ambient Temperature and Airflow
Vin(nom)

Characteristic Curves (Continued)

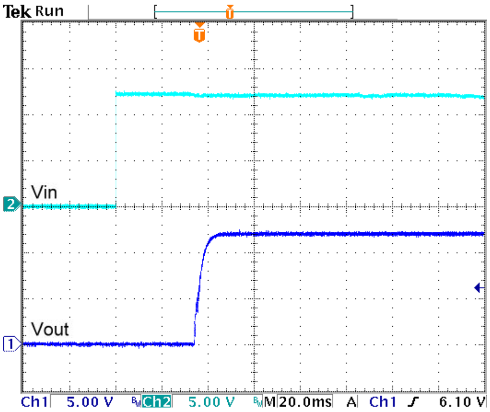
All test conditions are at 25℃.The figures are for DPX40-12D12



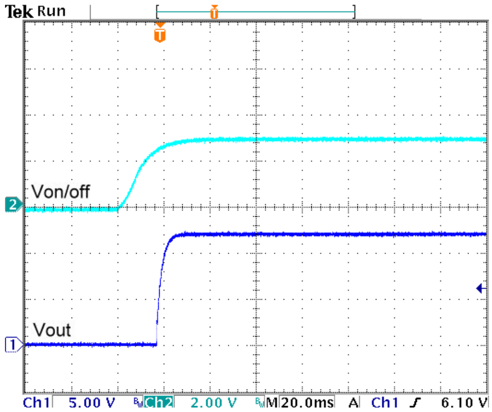
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load; Vin(nom)



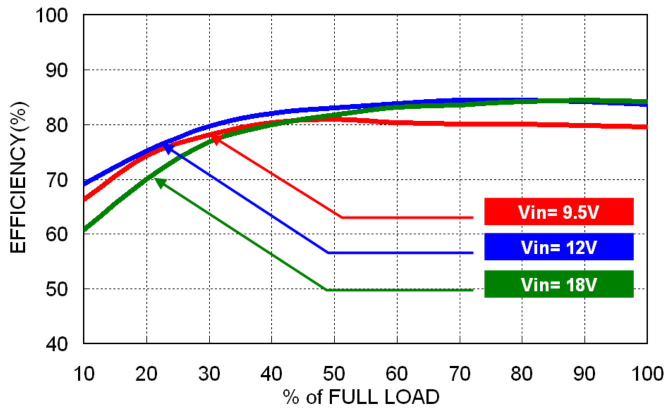
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



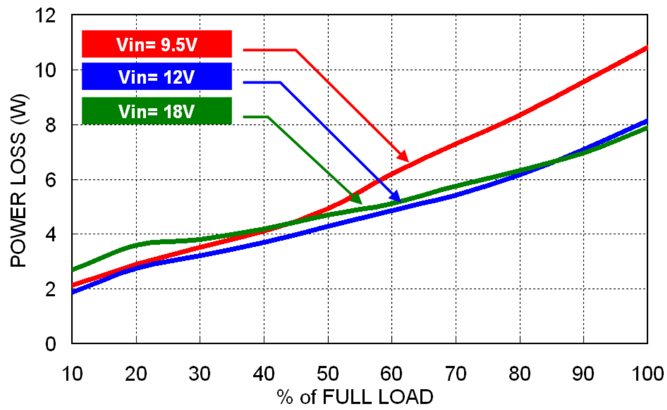
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves (Continued)

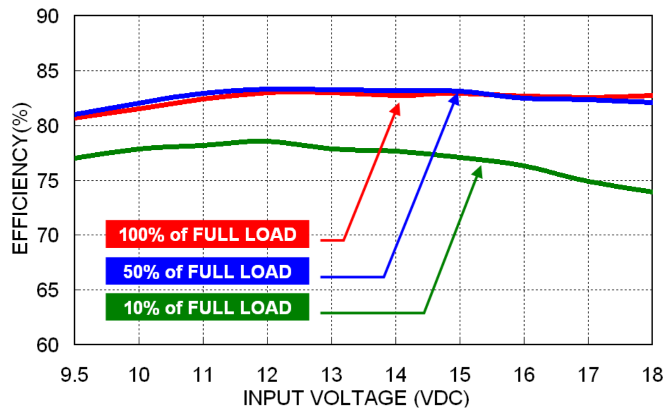
All test conditions are at 25℃.The figures are for DPX40-12D15



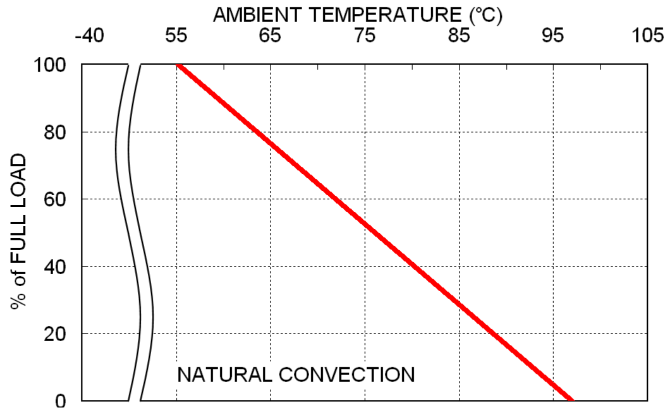
Efficiency versus Output Load



Power Dissipation versus Output Load



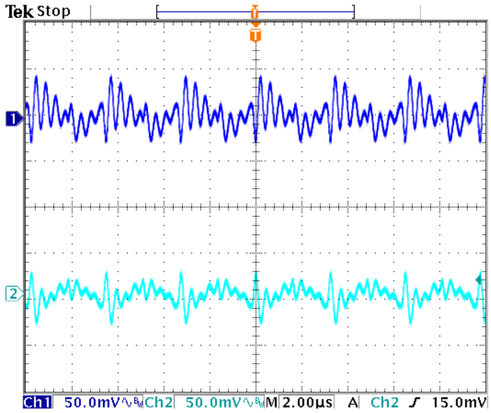
Efficiency versus Input Voltage



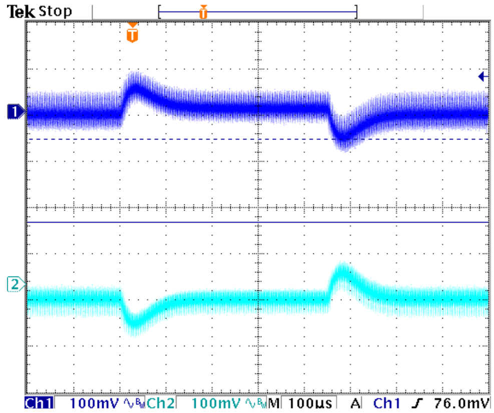
Derating Output Current versus Ambient Temperature and Airflow
Vin(nom)

Characteristic Curves (Continued)

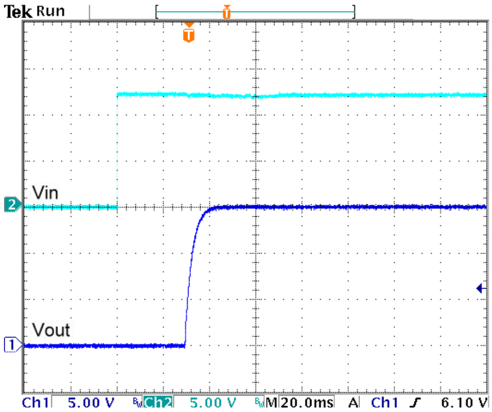
All test conditions are at 25℃.The figures are for DPX40-12D15



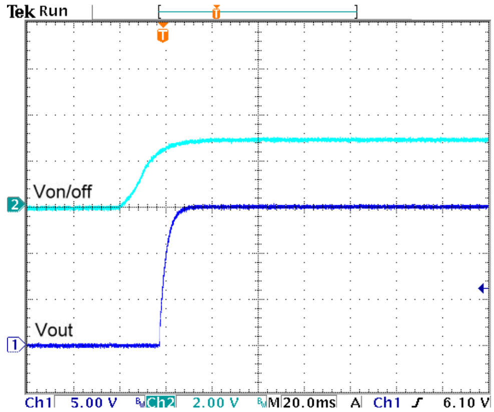
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



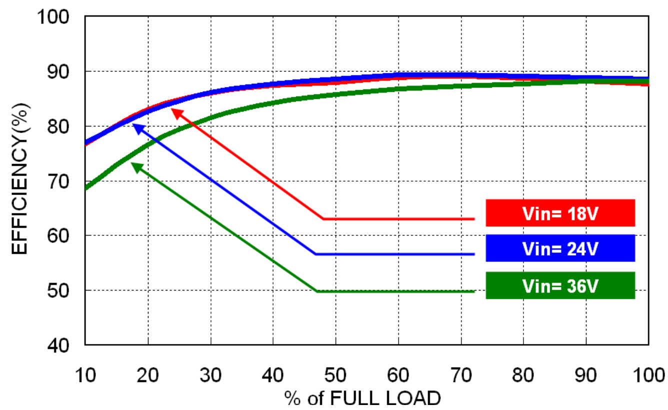
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



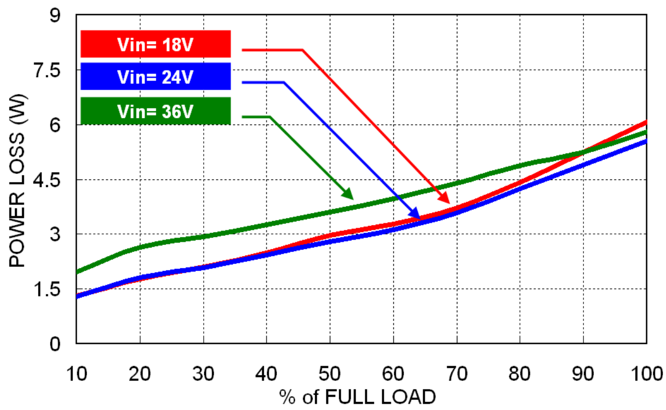
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves (Continued)

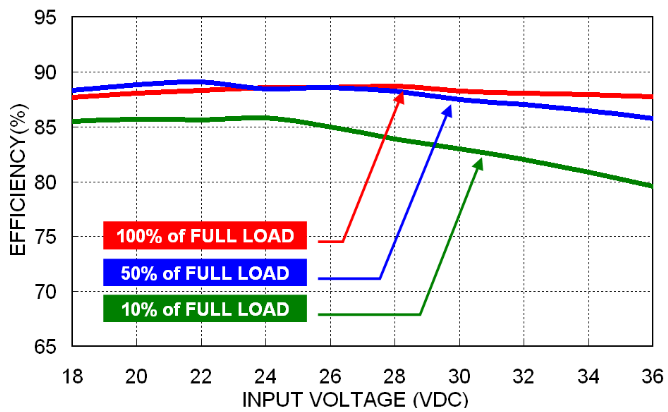
All test conditions are at 25℃.The figures are for DPX40-24D12



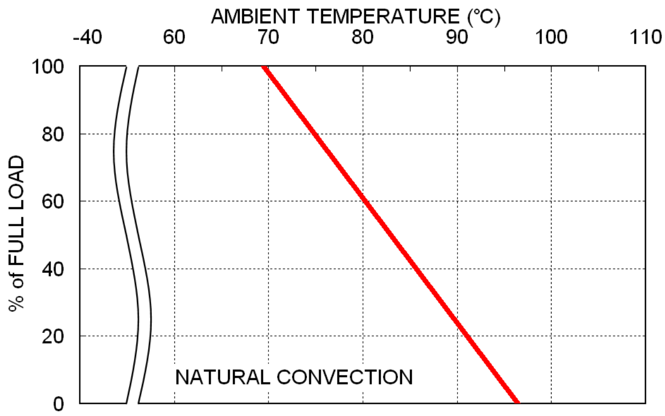
Efficiency versus Output Load



Power Dissipation versus Output Load



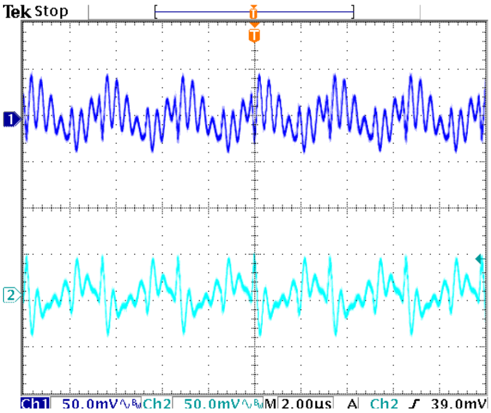
Efficiency versus Input Voltage



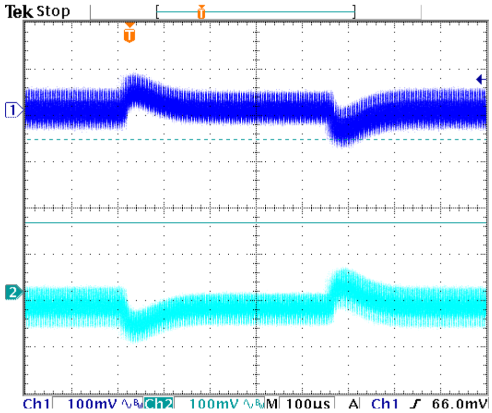
Derating Output Current versus Ambient Temperature and Airflow
Vin(nom)

Characteristic Curves (Continued)

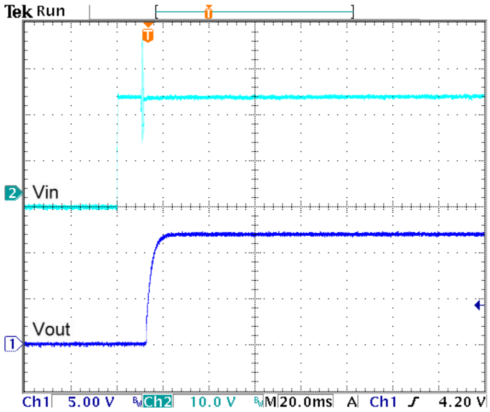
All test conditions are at 25℃.The figures are for DPX40-24D12



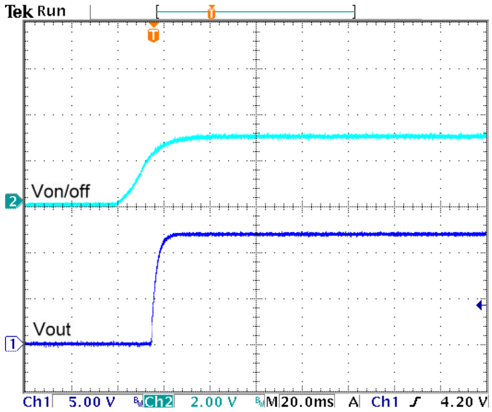
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



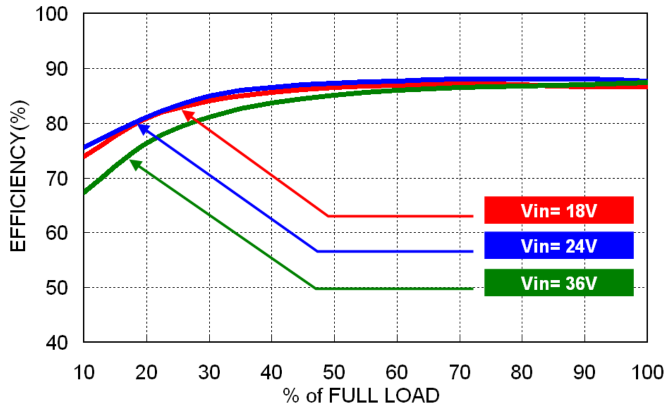
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



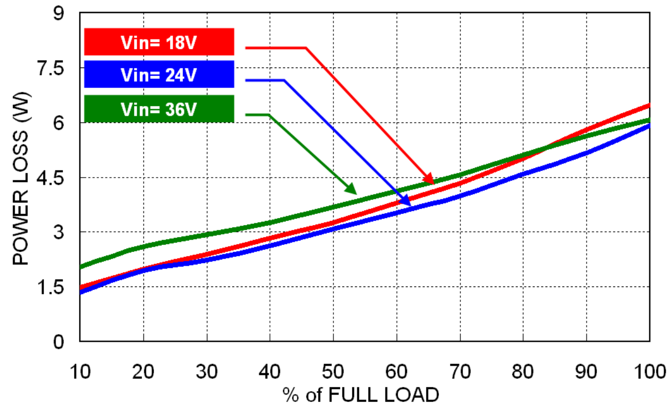
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves (Continued)

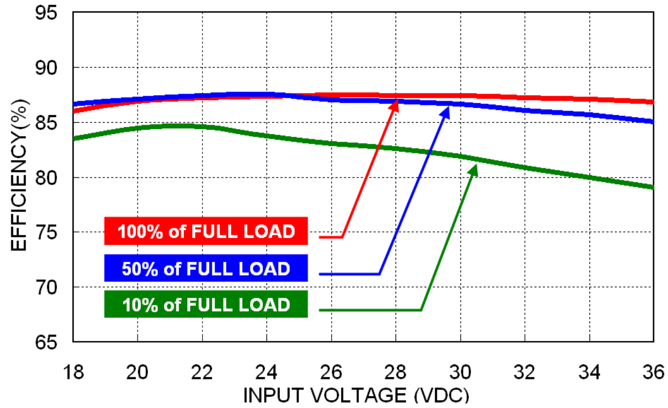
All test conditions are at 25℃.The figures are for DPX40-24D15



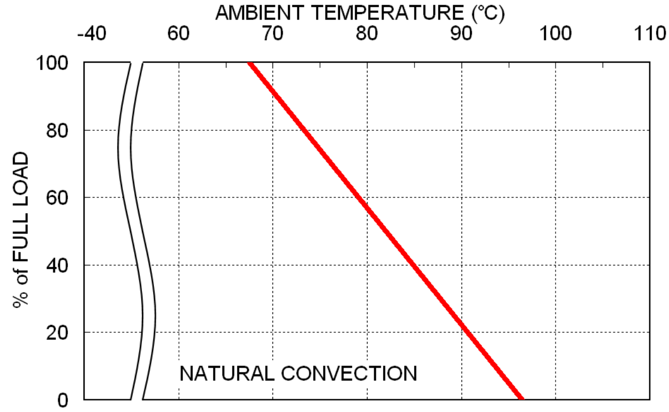
Efficiency versus Output Load



Power Dissipation versus Output Load



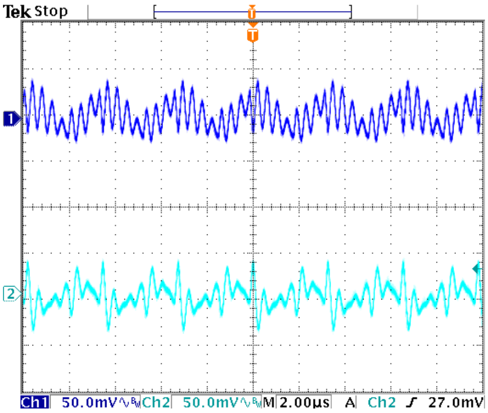
Efficiency versus Input Voltage



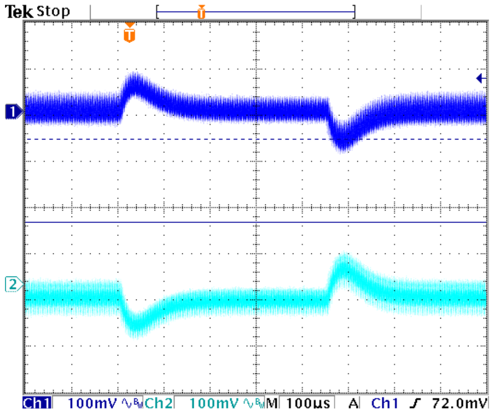
Derating Output Current versus Ambient Temperature and Airflow
Vin(nom)

Characteristic Curves (Continued)

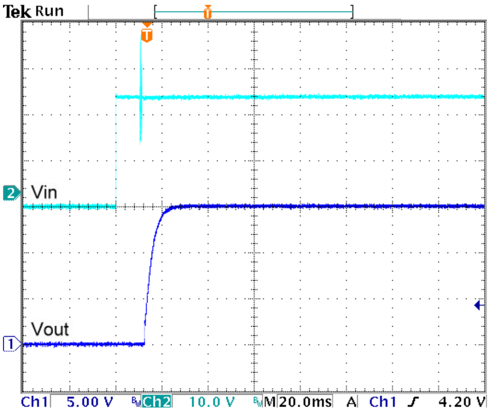
All test conditions are at 25℃.The figures are for DPX40-24D15



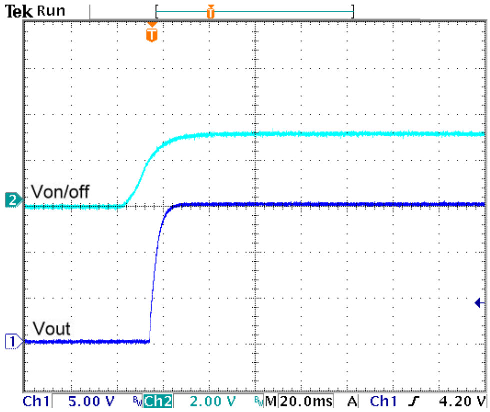
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



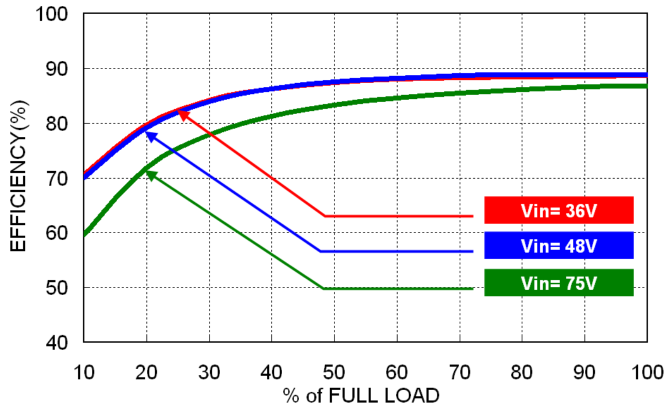
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



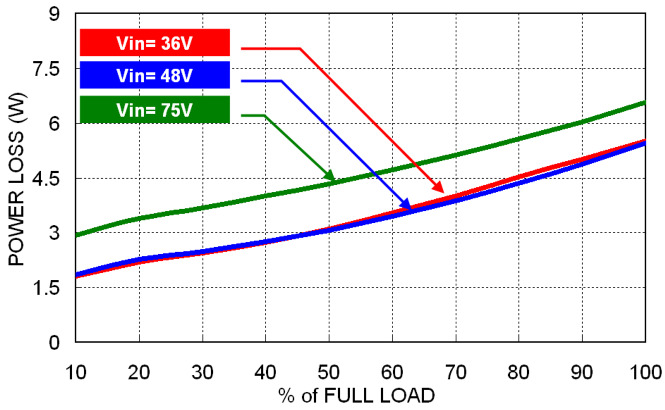
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves (Continued)

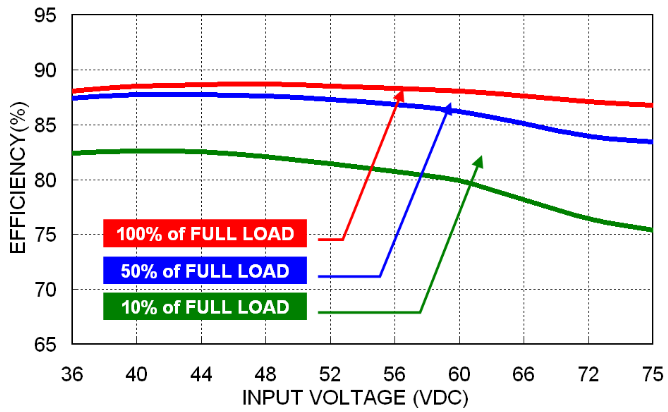
All test conditions are at 25℃.The figures are for DPX40-48D12



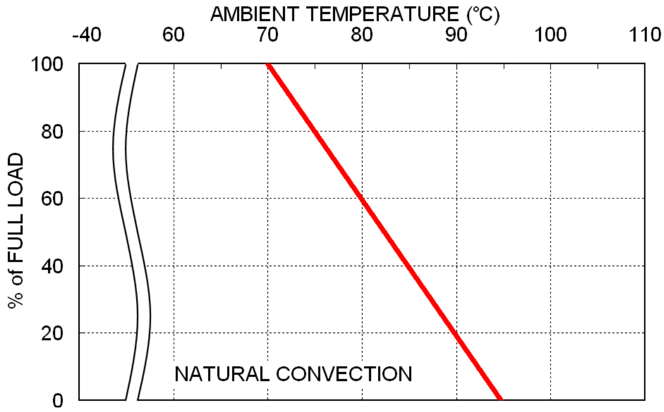
Efficiency versus Output Load



Power Dissipation versus Output Load



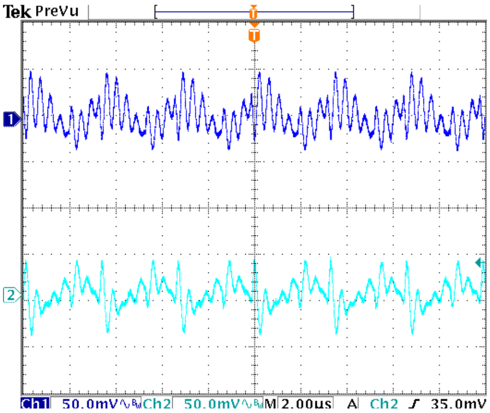
Efficiency versus Input Voltage



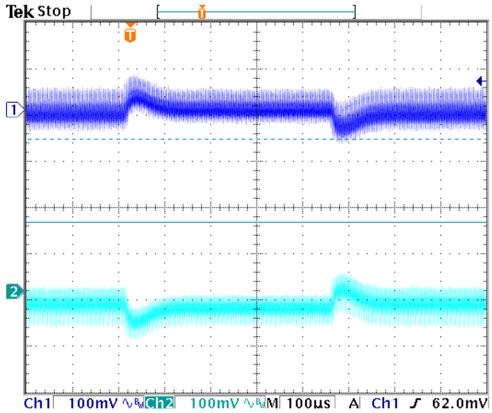
Derating Output Current versus Ambient Temperature and Airflow
Vin(nom)

Characteristic Curves (Continued)

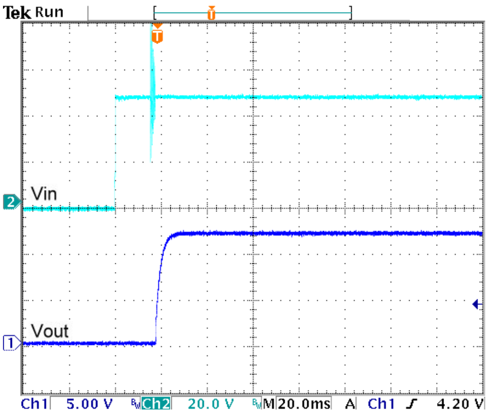
All test conditions are at 25℃.The figures are for DPX40-48D12



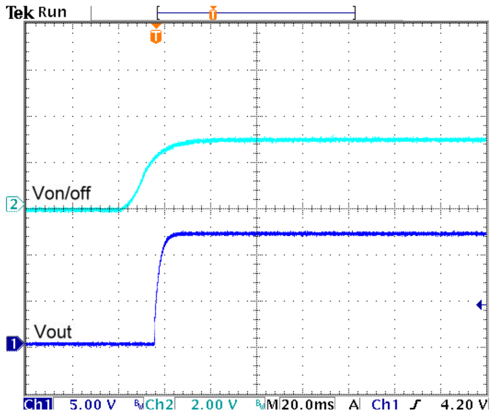
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



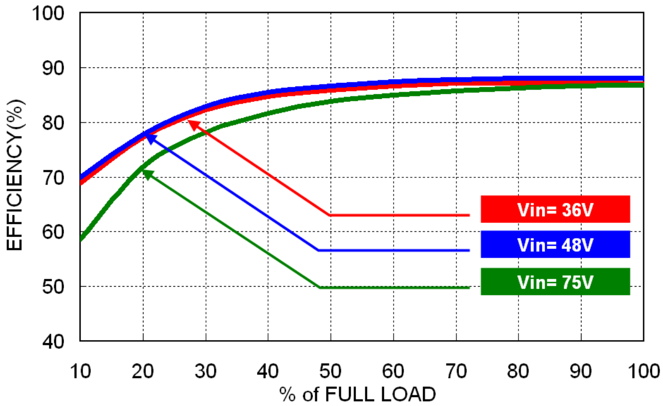
Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load



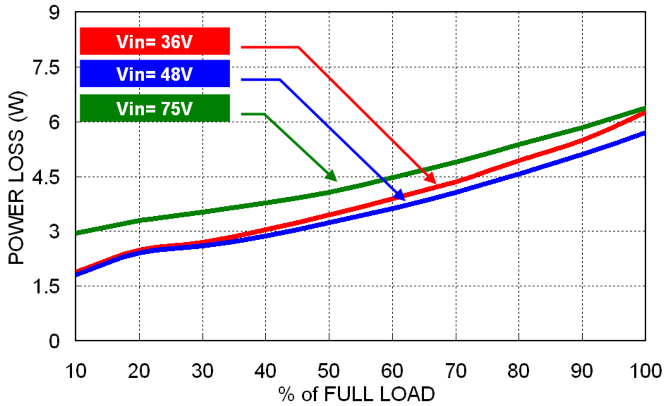
Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Characteristic Curves (Continued)

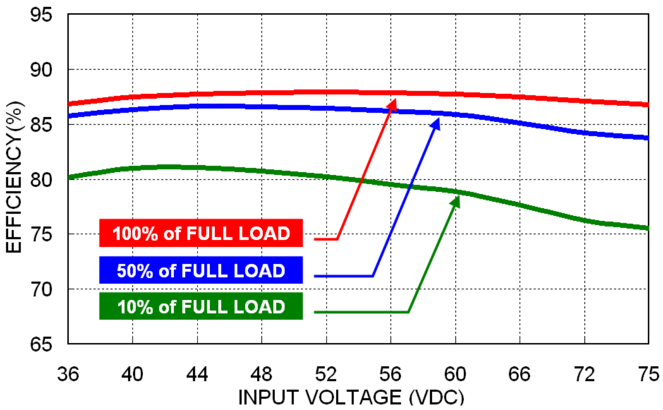
All test conditions are at 25℃.The figures are for DPX40-48D15



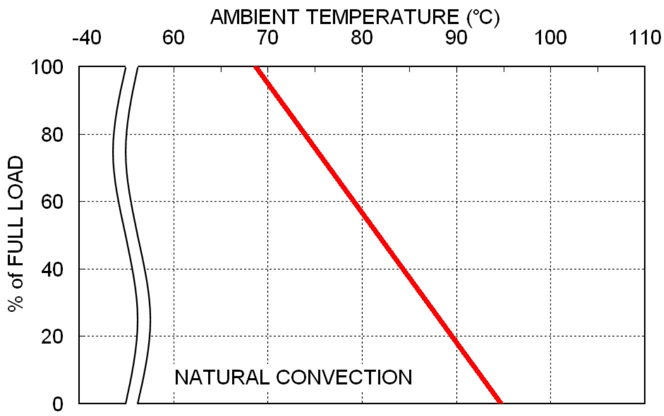
Efficiency versus Output Load



Power Dissipation versus Output Load



Efficiency versus Input Voltage



Derating Output Current versus Ambient Temperature and Airflow
Vin(nom)

Characteristic Curves (Continued)

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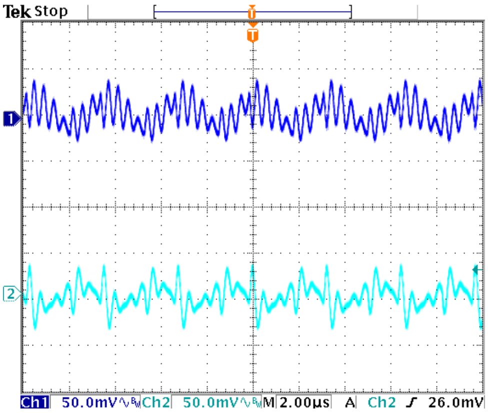
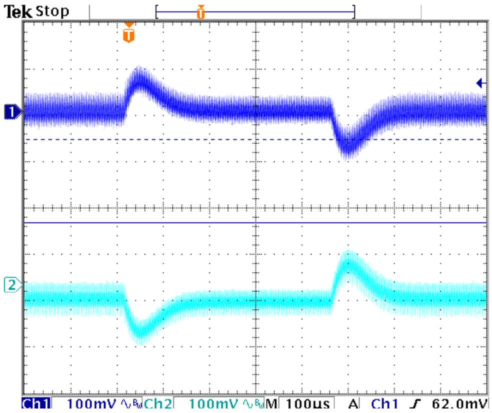
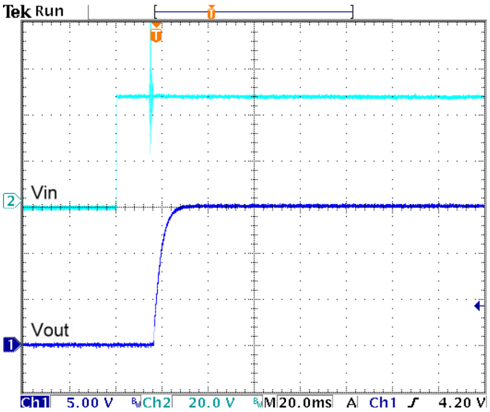


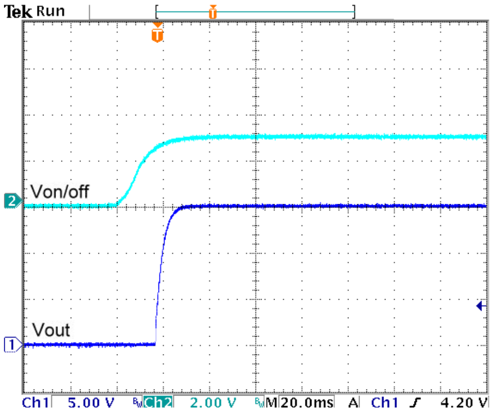
Typical Output Ripple and Noise.
Vin(nom); Full Load



Transient Response to Dynamic Load Change from
100% to 75% to 100% of Full Load; Vin(nom)



Typical Input Start-Up and Output Rise Characteristic
Vin(nom); Full Load

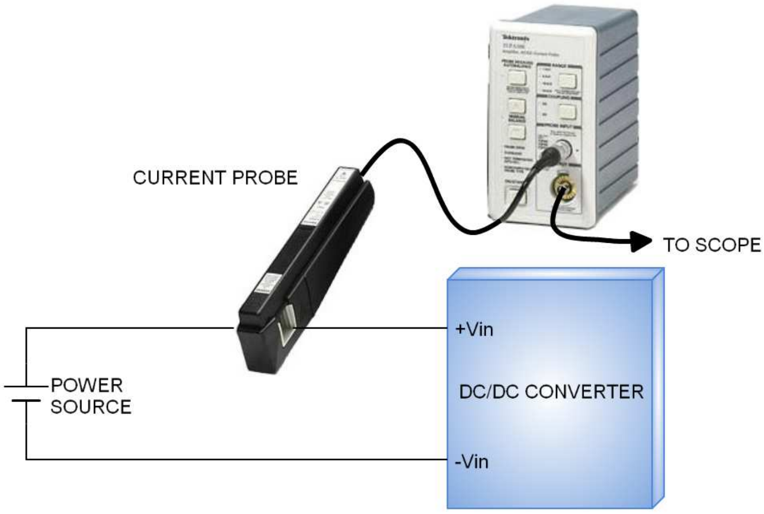


Using ON/OFF Voltage Start-Up and Output Rise Characteristic
Vin(nom); Full Load

Input Source Impedance

The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. The test configuration for the input reflected-ripple current measurement is shown below:

Input reflected-ripple current measurement setup



Output Over Current Protection

When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, overload current is maintained at approximately 150 percent of rated current for DPX40-xxDxx series.
Hiccup-mode is a method of operation in a power supply whose purpose is to protect the power supply from being damaged during an over-current fault condition. It also enables the power supply to restart when the fault is removed. There are other ways of protecting the power supply when it is over-loaded, such as the maximum current limiting or current fold-back methods.

One of the problems resulting from over current is that excessive heat may be generated in power devices; especially MOSFET and Schottky diodes and the temperature of those devices may exceed their specified limits. A protection mechanism has to be used to prevent those power devices from being damaged.

The operation of hiccup is as follows. When the current sense circuit sees an over-current event, the controller shuts off the power supply for a given time and then tries to start up the power supply again. If the over-load condition has been removed, the power supply will start up and operate normally; otherwise, the controller will see another over-current event and shut off the power supply again, repeating the previous cycle. Hiccup operation has none of the drawbacks of the other two protection methods, although its circuit is more complicated because it requires a timing circuit. The excess heat due to overload lasts for only a short duration in the hiccup cycle, hence the junction temperature of the power devices is much lower.

The hiccup operation can be done in various ways. For example, one can start hiccup operation any time an over-current event is detected; or prohibit hiccup during a designated start-up is usually larger than during normal operation and it is easier for an over-current event is detected; or prohibit hiccup during a designated start-up interval (usually a few milliseconds). The reason for the latter operation is that during start-up, the power supply needs to provide extra current to charge up the output capacitor. Thus the current demand during start-up is usually larger than during normal operation and it is easier for an over-current event to occur. If the power supply starts to hiccup once there is an over-current, it might never start up successfully. Hiccup mode protection will give the best protection for a power supply against over current situations, since it will limit the average current to the load at a low level, so reducing power dissipation and case temperature in the power devices.

Output Short Circuit Protection

Continuous and auto-recovery mode.
During an output short circuit, converter shuts down. The average current during this condition will be very low.

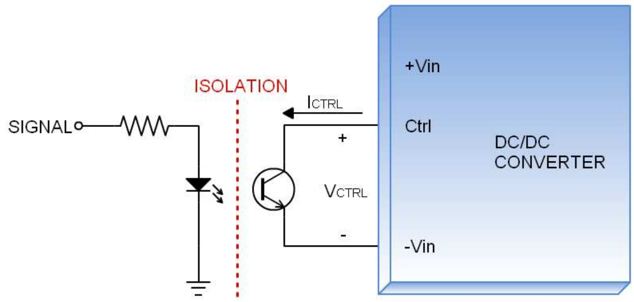
Output Over Voltage Protection

The output over-voltage protection consists of output Zener diode that monitors the voltage on the output terminals. If the voltage on the output terminals exceeds the over-voltage protection threshold, then the Zener diode clamps the output voltage.

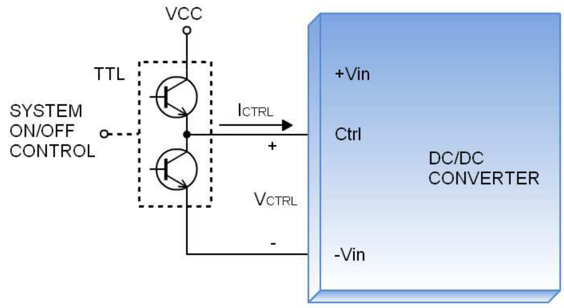
Remote On/off Control

The Ctrl Pin is used to turn the DC/DC power module on and off. The user must use a switch to control the logic voltage (high or low) level of the pin referenced to -Vin. The switch can be an open collector transistor, FET, or Photo-Coupler. The switch must be capable of sinking up to 1 mA at low-level logic voltage. A High-level logic of the Ctrl pin signal should be limited to a maximum voltage of 12V and a maximum current of 0.5 mA.

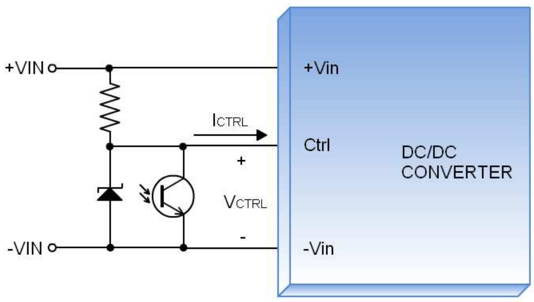
Remote ON/OFF Implementation



Isolated-Closure Remote ON/OFF



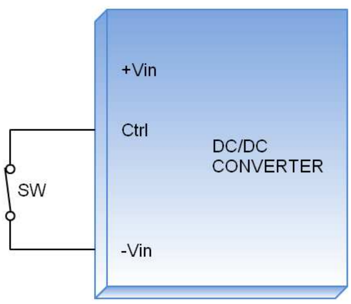
Level Control Using TTL Output



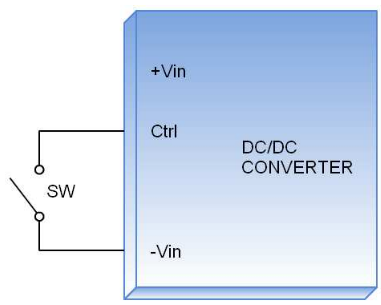
Level Control Using Line Voltage

There are two remote control options available, positive logic and negative logic.

a. The positive logic structure turns on the DC/DC module when the Ctrl pin is at a high-logic level and turns the module off using a low-logic level.

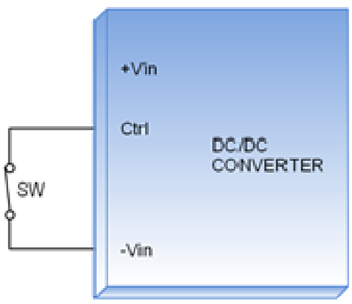


When DPX40-xxDxx module is turned off using a Low-logic level

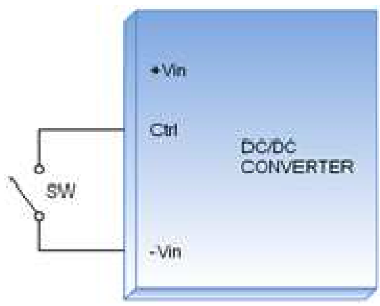


When DPX40-xxDxx module is turned on using a High-logic level

b. The negative logic structure turns on the DC/DC module when the Ctrl pin is at a low-logic level and turns the module off when using a high-logic level



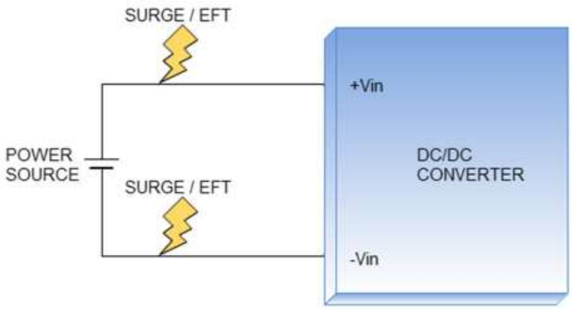
When DPX40-xxDxx module is turned on using a Low-logic level.



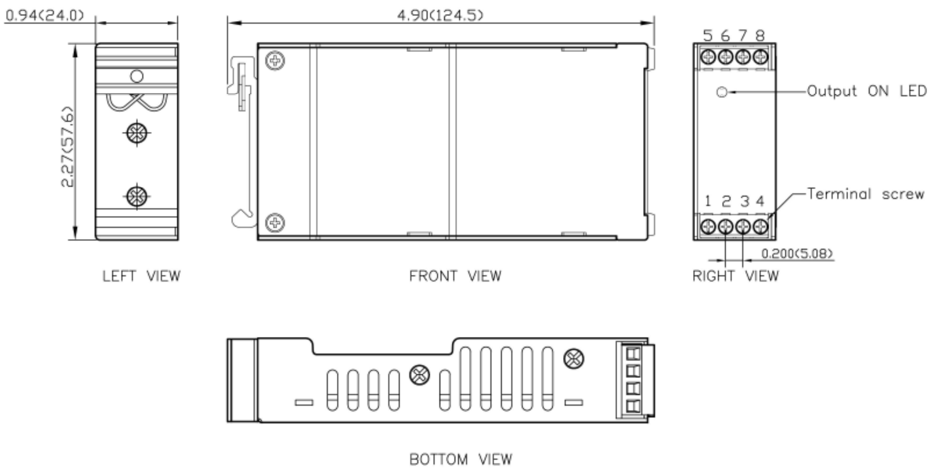
When DPX40-xxDxx module is turned off using a High Logic level.

EMS Considerations

The DPX40-xxDxx series can meet Fast Transient EN61000-4-4 and Surge EN61000-4-5 performance criteria A. Please see the following schematic:



Mechanical Data



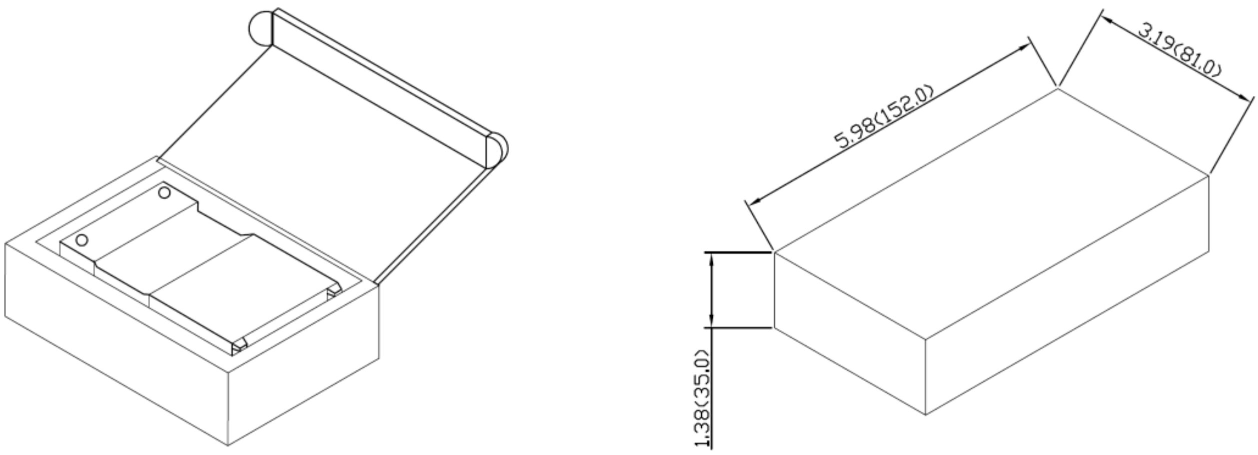
PINOUT

PIN	FUNCTION
1	Ctrl
2	-Vin
3	-Vin
4	+Vin
5	NC
6	-Vout
7	Common
8	+Vout

* NC : No Connection
* Screw terminals–wire range from 14 to 18 AWG

1. All dimensions in inch (mm)
2. Tolerance : X.XX±0.02 (X.X±0.5)
   X.XXX±0.01 (X.XX±0.25)
3. Terminal screw locked torque :
   MAX 2.5kgf—cm (0.25N—m)

Packaging Information



1PCS / BOX
All dimensions in mm

Part Number Structure

DPX40 - 48 D 05 -N

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Remote Control Option
DPX40	**12:** 9.5~18 **24:** 18~36 **48:** 36~75	**D:** Dual	**12:** ±12 **15:** ±15	P: Positive logic N: Negative logic

Model Number	Input Range	Output Voltage	Output Current @Full Load		Input Current @ No Load	Efficiency	Maximum Capacitor Load
	VDC	VDC	Min. Load (1) mA	Full Load mA	mA	%	µF
DPX40-12D12	9.5 ~ 18	±12	±144	±1800	37	83	±1200
DPX40-12D15	9.5 ~ 18	±15	±112	±1400	45	83	±750
DPX40-24D12	18 ~ 36	±12	±144	±1800	27	85	±1200
DPX40-24D15	18 ~ 36	±15	±112	±1400	27	85	±750
DPX40-48D12	36 ~ 75	±12	±144	±1800	20	85	±1200
DPX40-48D15	36 ~ 75	±15	±112	±1400	20	85	±750

Note:

1. The output requires a minimum load on the output to maintain specified regulation. Operation under no-load condition will not damage these devices; however, they may not meet all the listed specifications.

MTBF and Reliability

The MTBF for DPX40-xxDxx series of DC/DC converters has been calculated using MIL-HDBK-217F @ full load, operating temperature at 25℃. The resulting figure for MTBF is 8.080 × 10^5 hours.