

## DESCRIPTION

- The series of DC-DC switching power supplies in a package of 57.9x36.8x12.7 mm are capable of delivering 60 watts. They are designed for industrial control system, railway application, transportation system.

## FEATURES

- 60 Watts output power in quarter brick
- Ultra wide 12:1 input voltage range from 14-160VDC
- Efficiency up to 89%
- 3KVDC / 1 minute isolation
- RoHS compliant

## WATTAGE

Wattage: 60W

## DIMENSION

Dimension: 57.9 (L) x 36.8 (W) x 12.7 (H)mm



## SAFETY STANDARD APPROVAL

Meet EN50155/EN62368-1

## ENVIRONMENTAL SPECIFICATION

Operating temperature: -40°C to +110°C

## SELECTION GUIDE

Part number	Input voltage	Output voltage	Output current @ full load	Ripple & Noise <sup>(1)</sup> (max.)	Efficiency <sup>(2)</sup> (typ.)	Capacitive load <sup>(3)</sup> (max.)
D60-BQ12-AH	14-160 VDC	12 VDC	5000 mA	150mVp-p	89%	3000uF
D60-BQ12-AA		24 VDC	2500 mA	150mVp-p	88%	1200uF
D60-BQ12-AF		48 VDC	1250 mA	150mVp-p	88%	390uF
D60-BQ12-AW		54 VDC	1111 mA	150mVp-p	88%	330uF

- 20MHZ BW at Vin range 0~100% load with a 1μF/50V X7R MLCC.
- The efficiency is test by nominal input and max. full load @25°C.
- The capacitive load is test by minimum input and constant resistive load.
- Special input and output voltage combinations available by request, please check with our sales.

## SPECIFICATION

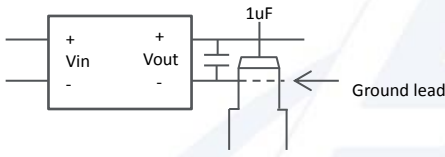
	Parameter	Conditions	Min.	Typ.	Max.	Unit
Input	Input filter		Pi type			
	Input voltage range		14	110	160	VDC
	No load input current				15	mA
	Under voltage lockout	0%~100% load		12		VDC
	Start-up voltage	0%~100% load			13.9	VDC
	Input surge voltage	1s max.		200		VDC
	Start-up time/max	100% Load at Nominal Vin		40		mS
	Remote on/off	DC-DC off DC-DC on		Open or 3V < Vr < 12V Short or 0V < Vr < 1.2V		
Output	Output voltage accuracy	100% Load & 110V input	-1		+1	%
	Voltage adjustability			±10		%
	Minimum load				0	%
	Line voltage regulation	LL to HL at 100% load	-0.2		+0.2	%
	Load voltage regulation	0%~100% load	-0.2		+0.2	%
	Ripple & noise	@20MHz BW (@110Vin)			150	mVp-p
	Temperature coefficient				+0.05	%/°C
	Transient response recovery time	25% load step change (75%-100% load)		500		μs
Environment	Short circuit protection		Continuous, automatic recovery			
	Operating temperature	Baseplate temperature	-40		110	°C
	Over temperature protection				115	°C
	Relative humidity		5		95	%RH
	Operating altitude		4000m			
	Safety approval		Meet EN50155/EN62368-1			
Function	Isolation voltage	1 minute, Input to Output Cut-off current: 1mA for VDC	3			KVDC
		1 minute, Input to Output	2			KVAC
	Isolation resistance		1000			MΩ
	Isolation capacitance			2200		pF
	Over load protection	% of Vout at 110 Vin			150	%
	Over voltage protection	0% to 100% load			150	%
	MTBF	25°C	800			KHrs
	Short circuit protection		Continuous automatic recovery			
EMI	Vibration		EN61373			
	EMI	EN55032	Class A/B			
	ESD	EN61000-4-2 air±8kV, contact±6kV	Criteria A			
	Radiated immunity	EN61000-4-3 10V/m	Criteria A			
	Conducted immunity	EN61000-4-6 10Vrms	Criteria A			

This content is subject to change, please refer to specification for more detail.  
FSP reserve the right to change the content without prior notice.

Fast transient	EN61000-4-4 ±2kV	Criteria A
Surge	EN61000-4-5 ±2kV	Criteria A

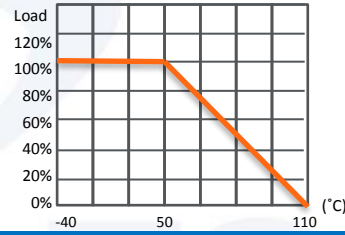
1. All specifications valid at nominal input voltage, full load and 25°C after warm-up time unless otherwise stated.
2. The product information and specifications are subject to change without prior notice.

### RIPPLE & NOISE

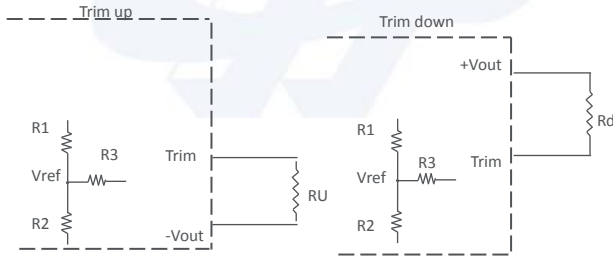


### DERATING CURVE

Ambient temperature natural convection (Nominal Vin)



### TRIM APPLICATION



Formula for trim resistor:

UP:  $R_u = \frac{aR_2}{R_2 - a} - R_3$      $a = \frac{V_{ref}}{V'_0 - V_{ref}} \cdot R_1$

DOWN:  $R_d = \frac{bR_1}{R_1 - b} - R_3$      $b = \frac{V'_0 - V_{ref}}{V_{ref}} \cdot R_2$

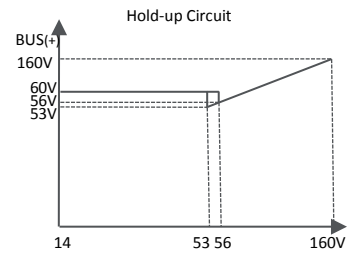
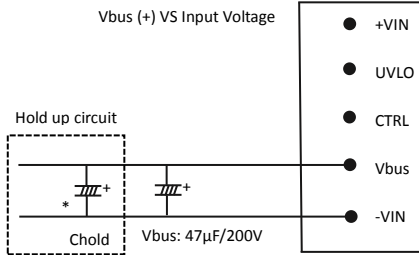
Note:

1.  $R_u$ ,  $R_d$  is mean trim resistor, please check the formula.
2.  $a$  &  $b$ : user define parameter, no actual meanings.
3.  $V'_0$  is mean trim up/down voltage.
4. Value for  $R_1$ ,  $R_2$ ,  $R_3$  and  $V_{ref}$  refer to the table below.

Vout	12V	24V
R1	12.56KΩ	17.2KΩ
R2	3.3KΩ	2KΩ
R3	24.9KΩ	15KΩ
Vref	2.5V	2.5V

### HOLD UP TIME

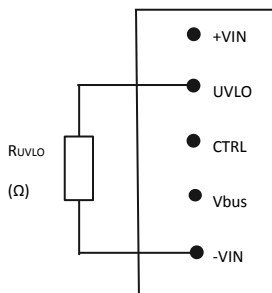
Vbus (+) VS Input Voltage



Chold table

Nominal Vin	24V	36V	48V	72V	96V	110V
10ms (S2)	800uF	800uF	800uF	440uF	180uF	120uF
30ms (C2)	2200uF	2200uF	2200uF	1200uF	540uF	400uF

### UVLO

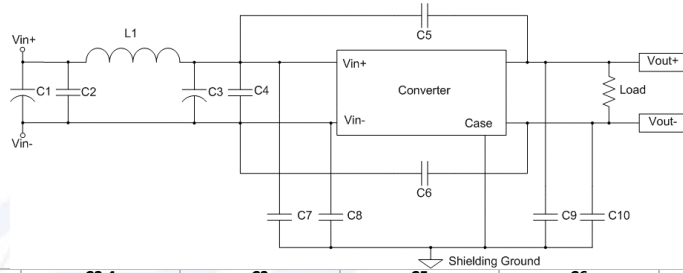


The under voltage threshold can set by external resistor placed between the UVLO and -VIN.

UVLO table

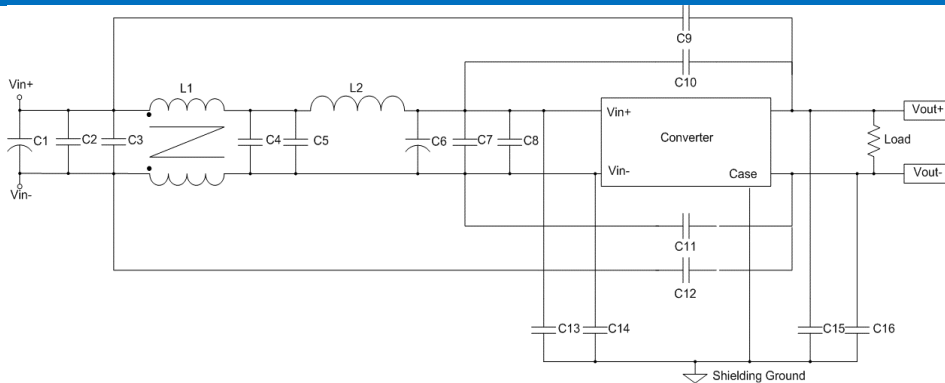
UVLO	External Resistor $R_{uvlo}(\Omega)$	Turn-off Threshold	Turn-on Threshold
OPEN	140K	12.7V	13.6V
62K	62K	19.6V	20.4V
27K	27K	26.3V	27.3V
		39.6V	40.8V

## EMI FILTERING SUGGESTION FOR EN50155 CLASS A



Vout	C1	C2,4	C3	C5	C6	C7,8,9,10	L1
12V	100uF 200V Aluminum Cap. KXJ Series	0.68uF 1210 250V Ceramic Cap.	47uF 200V Aluminum Cap. KXJ Series	1000pF 1808 3kV Ceramic Cap.	1000pF 1808 3kV Ceramic Cap.	1000pF 1206 2kV Ceramic Cap.	10uF GSTD1265PE- 100M
24V				2200pF 1808 3kV Ceramic Cap.			

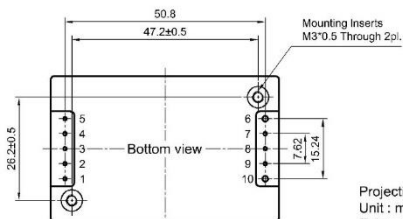
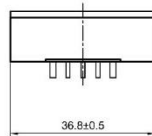
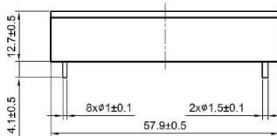
## EMI FILTERING SUGGESTION FOR EN50155 CLASS B



Vout	C1	C2,3,4,5,7,8	C6	C9	C10	C11	C12	C13,14,15,16	L1	L2
12V	100uF 200V Aluminum Cap. KXJ Series	0.68uF 1210 250V Ceramic Cap.	47uF 200V Aluminum Cap. KXJ Series	1500pF 1808 3kV Ceramic Cap.	2200pF 1808 3kV Ceramic Cap.	2200pF 1808 3kV Ceramic Cap.	1500pF 1808 3kV Ceramic Cap.	1000pF 1206 2kV Ceramic Cap.	CommomC hoke A10 T16X12X8C 2.2mH ±35%	4.7uF GSTD1265P E-4R7M
24V				1000pF 1808 3kV Ceramic Cap.		1000pF 1808 3kV Ceramic Cap.				

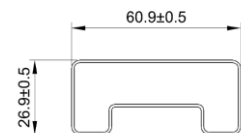
## MECHANICAL SPECIFICATION

## PACKAGE



Projection : Third angle projection  
Unit : mm  
Tolerance : ±0.25mm

Pin	Function
1	+Vin
2	UVLO
3	Ctrl
4	Vbus
5	-Vin
6	-Vout
7	-S
8	Trim
9	+S
10	+Vout



UNIT:mm  
1 Tube = 11 pcs  
Length:520±2mm

## RECOMMENDED FOOTPRINT

