

DC-DC CONVERTERS

QUARTER BRICK, UP TO 40 WATTS

12:1 ULTRA WIDE INPUT VOLTAGE RANGE

RAILWAY APPLICATIONS

OFQC40 SERIES



FEATURES

- 3,000 Vac Reinforced Insulation
- 2,250 Vdc Basic Insulation
- 12:1 Ultra-Wide Input Range
- No Minimum Load Required
- Low Standby Power
- Remote ON/OFF
- Over Current Protection
- Over Temperature Protection
- Over Voltage Protection
- Under Voltage Protection
- Short Circuit Protection
- UL 62368-1, UL 60950-1
- RoHS Compliant
- REACH Compliant
- CE Mark

SELECTION GUIDE All specifications are typical at 230Vac input, full load and 25°C, unless otherwise noted.

Input Range Vdc	Output Voltage Vdc	Output Current at Full Load A	Input Current at No Load mA	Efficiency %	Model Number*	Maximum Capacitor Load µF
9 - 75	5	8	20	89	OFQC40-36S5	16,000
9 - 75	12	3.33	30	91	OFQC40-36S12	2,800
9 - 75	15	2.67	30	91	OFQC40-36S15	1,800
9 - 75	24	1.67	20	90	OFQC40-36S24	720
9 - 75	28	1.43	20	91	OFQC40-36S28	520
9 - 75	48	0.83	20	91	OFQC40-36S48	180
9 - 75	53	0.75	20	91	OFQC40-36S53	150
14 - 160	5	8	15	89	OFQC40-72S5	16,000
14 - 160	12	3.33	20	91	OFQC40-72S12	2,800
14 - 160	15	2.67	20	91	OFQC40-72S15	1,800
14 - 160	24	1.67	15	90	OFQC40-72S24	720
14 - 160	28	1.43	15	91	OFQC40-72S28	520
14 - 160	48	0.83	15	90	OFQC40-72S48	180
14 - 160	53	0.75	15	91	OFQC40-72S53	150

BUS & UVP ADJ.

- None: No suffix needed
- With Bus and UVP adj. Use suffix "K"
- With UVP adj. Use Suffix "V"

REMOTE CONTROL OPTIONS:

- Negative Logic: No Suffix needed
- Positive Logic: Use Suffix "P"

HEAT SINK TYPE:

- None: No Suffix needed
- 7G-0029B-F; H=0.24" Use suffix: HS
- 7G-0030B-F; H=0.5" Use Suffix: HS1
- 7G-0031B-F; H=0.24 Use Suffix: HS2
- 7G-0032B-F; H=0.5" Use suffix: HS3
- 7GA0124P01-F; H=0.6" Use Suffix: HS4
- 7GA0125P01-F; H=1" Use Suffix: HS5

THROUGH HOLE TYPE:

- No thread: Use Suffix "TH"
- No heat sink available for "TH" Option.

OFQC40 SERIES

Input Specifications			Output Specifications		
Operating input voltage range, Vdc	9 Min., 36 Typ., 75 Max.	36Vin(nom)	Voltage accuracy, %	-1 Min., 1 Max.	
	14 Min., 72 Typ., 160 Max.	72Vin(nom)	Line regulation, %	-0.1 Min., 0.1 Max.	Low line to high line at full load
Start up voltage, Vdc	9 Max.	36Vin(nom)	Load regulation, %	-0.1 Min., 0.1 Max.	No load to full load
	14 Max.	72Vin(nom)	Voltage adjustability, %	-20 Min., 10 Max.	Max. output deviation is inclusive of remote sense
Shutdown voltage, Vdc	7.3 Min., 7.7 Typ., 8.1 Max.	36Vin(nom)	Remote sense, %	10 Max.	% of Vout(nom). If remote sense is not being used, SENSE pins should connect to corresponding polarity OUTPUT pins.
	10 Min., 11 Typ., 12 Max.	72Vin(nom)			
Start up time, ms	75 Typ., 100 Max.	Constant resistive load, Power up	Ripple and noise, mVp-p	75 Typ.	20MHz bandwidth
	75 Typ., 100 Max.	Remote ON/OFF			5Vout, with a 1µF/25V X7R MLCC and a 22µF/25V POS-CAP
Input transient voltage, Vdc	8.1 Max.	36Vin(nom), 100 mS, Max.	100 Typ.	12Vout, 15Vout, with a 22µF/25V X7R MLCC	
	12 Max.	72Vin(nom)	200 Typ.	24Vout, 28 Vout, with a 4.7µF/50V X7R MLCC	
Input surge voltage, Vdc	100 Max.	36Vin(nom), 1 second, Max.	300 Typ.	48Vout, 53 Vout, with a 2.2µF/100V X7R MLCC	
	185 Max.	72Vin(nom)	Temperature coefficient, %/°C	-0.02 Min., 0.02 Max.	
Input filter ⁽¹⁾	Pi type		Transient response recovery time, µs	250 Typ.	25% load step change
		Referred to -Vin pin	Over voltage protection, Vdc	120 Min., 135 Max.	% of Vout(nom); Hiccup mode
Remote ON/OFF Control, Vdc	Short or 0 - 1.2	Negative logic DC-DC ON	Over load protection, %	120 Min., 140 Max.	% of Iout rated; Hiccup mode
	Open or 3 - 12	(Standard) DC-DC OFF	Short circuit protection		Continuous, automatic recovery
	Open or 3 - 12	Positive logic DC-DC ON			
	Short or 0 - 1.2	(Option) DC-DC OFF			
	-0.5 Min., 1 Max., mA	Input current of Ctrl pin			
	3 Typ., mA	Remote off input current			

General Specifications				
Isolation voltage	1 minute, 72Vin(nom)	Input to output	3,000 Min. Vac	
	(Reinforced insulation)	Input (output) to Base-Plate	1,500 Min. Vac	
	1 minute, 36Vin(nom)	Input to output	2,250 Min., Vdc	
	(Basic insulation)	Input (output) to Base-Plate	1,600 Min., Vdc	
Isolation resistance, GΩ	500Vdc		1 Min.	
Isolation capacitance, pF				1,000 Max.
Switching frequency, kHz			160 Min.	180 Typ. 200 Max.

Environmental Specifications				
Operating base-plate temperature, °C		With derating	-40 Min.	105 Max.
Max. case temperature, °C				105 Max.
Over temperature protection, °C			110 Typ.	
Storage temperature range, °C			-55 Min.	125 Max.
Thermal impedance, °C/W	Module without assembly option		8.3 Typ.	
	Only mount on the iron base-plate		2.5 Typ.	
	Heat-sink type with 0.24" height		7.4 Typ.	
	Heat-sink type with 0.5" height		6.2 Typ.	
	Heat-sink type with 0.65" height		5.1 Typ.	
Heat-sink type with 1" height		4.1 Typ.		
Thermal shock			MIL-STD-810F	
Shock			EN61373, MIL-STD-810F	
Vibration			EN61373, MIL-STD-810F	
Relative humidity			5% to 95% RH	

OFQC40 SERIES

Physical Specifications

Design meet safety standard	IEC/UL/EN6236801, EN50155, EN45545-2, UL: E193009, CB:UL(Demko)	
Case material	Aluminum base-plate with plastic case	
Potting material	Silicone (UL94 V-0)	
Weight, g	64g (2.26oz)	
Dimensions	2.28" × 1.45" × 0.50" (57.9mm × 36.8mm × 12.7mm)	
MTBF	8.297 × 10 ⁵ hrs, MIL-HDBK-217F, Full load	

EMC Specifications

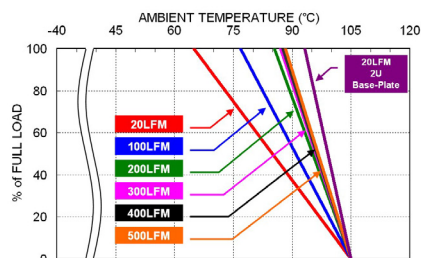
Specifications	Conditions	Level
EMI	EN55032, EN50121-3-2	With external components Class A Class B
ESD	EN61000-4-2	Air ±8kV and Contact ±6kV Perf. Criteria A
Radiated immunity	EN61000-4-3	20V/m Perf. Criteria A
Fast transient ⁽¹⁾	EN61000-4-4	±2KV Perf. Criteria A
	OFQC60-36S	With 2pcs of aluminum electrolytic capacitor
Surge ⁽¹⁾	OFQC60-72S	With 2pcs of aluminum electrolytic capacitor
	EN61000-4-5	EN55024: ±1kV and EN50155:±2kV Perf. Criteria A
Conducted immunity	OFQC60-36S	With 2pcs of aluminum electrolytic capacitor
	OFQC60-72S	With 2pcs of aluminum electrolytic capacitor
Power frequency magnetic field	EN61000-4-6	10 Vr.m.s Perf. Criteria A
	EN61000-4-8	100 A/m continuous; 1,000 A/m 1 second Perf. Criteria A

Note:

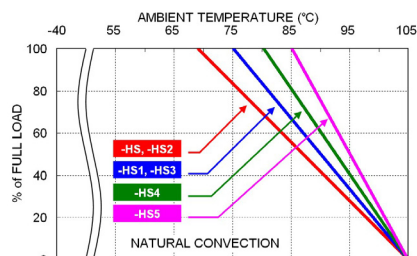
- Input source impedance: The power module will operate as specifications without external components, assuming that the source voltage has a very low impedance and reasonable input voltage regulation. Highly inductive source impedances can affect the stability of the power module. Since real-world voltage source has finite impedance, performance can be improved by adding external filter capacitor. The OFQC60-36S recommended Nippon Chemi-con KY series, 220 μF/100V. The OFQC60-72S recommended Nippon Chemi-con KXJ series, 150 μF/200V.
- BASE-PLATE GROUNDING: When connecting two screw bolts to shield plane, the EMI could be reduced.
- For further information, please contact Polytron Devices.

CAUTION: This power module is not internally fused. An input line fuse must always be used.

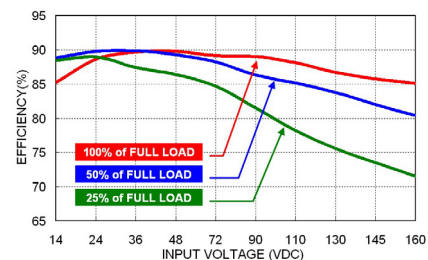
Characteristic Curve



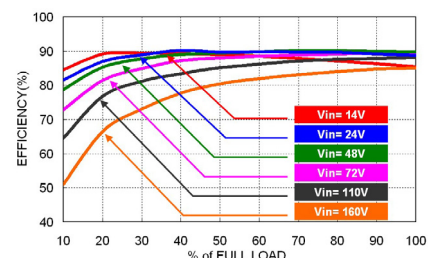
OFQC40-72S5 Derating Curve
(see Thermal Considerations)



OFQC40-72S5 Derating Curve with Heat-sink
(see Thermal Considerations)



OFQC40-72S5 Efficiency vs. Input Voltage



OFQC40-72S5 Efficiency vs. Output Load

OFQC40 SERIES

Fuse Consideration

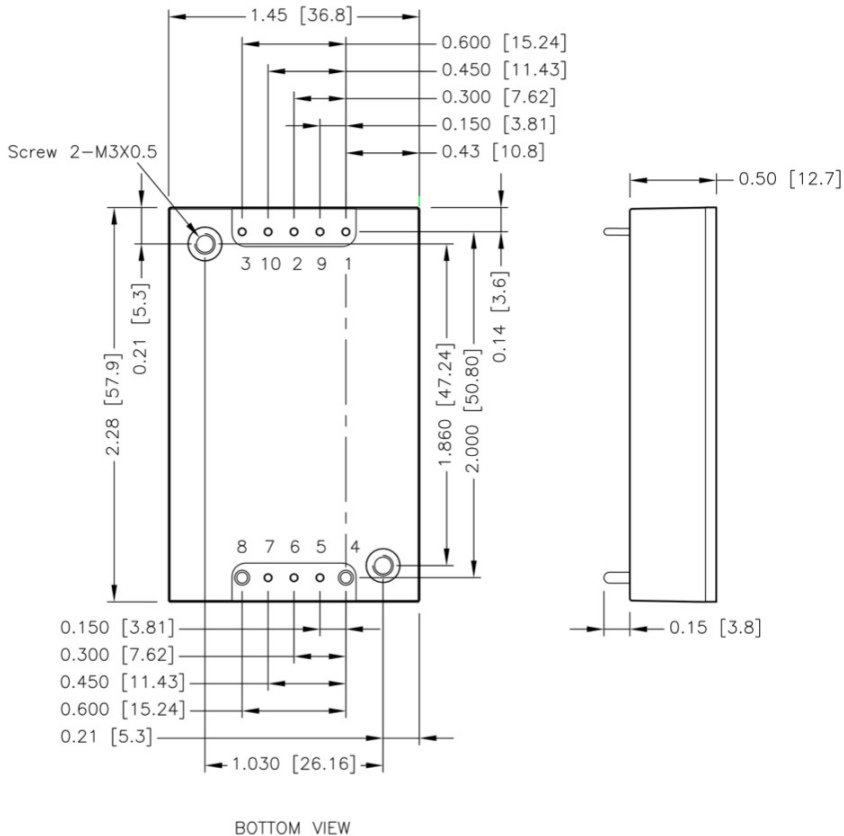
Model	Fuse Rating (A)	Fuse Type
OFQC40-36S	8	Fast-Acting
OFQC40-72S	5	Slow-Blow

Note:

1. The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.
2. This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.
3. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.
4. For further information, please contact Polytron Devices.

CAUTION: This power module is not internally fused. An input line fuse must always be used.

Mechanical Drawing

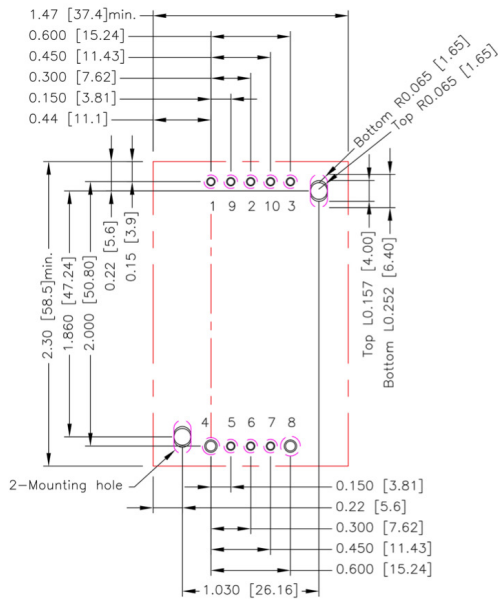


PIN CONNECTION

PIN	DEFINE	DIAMETER
1	-Vin	0.04"
2	Ctrl	0.04"
3	+Vin	0.04"
4	-Vout	0.06"
5	-Sense	0.04"
6	Trim	0.04"
7	+Sense	0.04"
8	+Vout	0.06"
9	Bus	0.04"
10	UVLO	0.04"

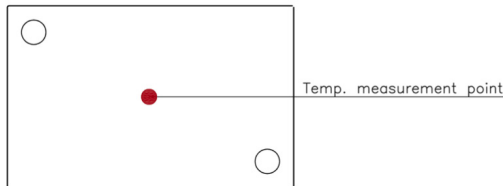
1. All dimensions in inches (mm)
2. Tolerance: $x.xx \pm 0.02$ ($x.x \pm 0.5$) $x.xxx \pm 0.01$ ($x.xx \pm 0.25$)
3. Pin pitch tolerance ± 0.004 (0.10)
4. The screw locked torque: MAX 3.5kgf-cm (0.34N-m)

Recommended Pad Layout



1. All dimensions in inch[mm]
2. Pad size(lead free recommended)
3. Through hole 1.2.3.5.6.7.9.10: \varnothing 0.051[1.30]
4. Through hole 4.8: \varnothing 0.075[1.90]
5. Through hole of mounting: \varnothing 0.126[3.20]
6. Top view pad 1.2.3.5.6.7.9.10: \varnothing 0.064[1.63]
7. Top view pad 4.8: \varnothing 0.094[2.38]
8. Top view pad of mounting: Groove R0.065[1.65]L0.157[4.00] Bottom view pad 1.2.3.5.6.7.9.10: \varnothing 0.102[2.60]
9. Bottom view pad 8: \varnothing 0.150[3.80]
10. Bottom view pad 4: \varnothing 0.130[3.30]
11. Bottom view pad of mounting: Groove R0.065[1.65]L0.252[6.40]

Thermal Considerations



BASE PLATE

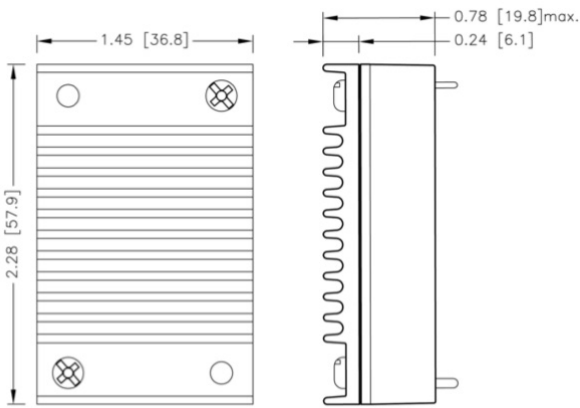
1. Thermal test condition with vertical direction by natural convection (20LFM)
2. The iron base-plate dimension is 19" x 3.5" x 0.063" (The height is EIA standard 2U).
3. The heat-sink is optional and P/N: 7G-0029B-F, 7G-0030B-F, 7G-0031B-F, 7G-0032B-F, 7GA0124P01-F, 7GA0125P01-F.

1. The power module operates in a variety of thermal environments.
2. However, sufficient cooling should be provided to help ensure reliable operation of the unit.
3. Heat is removed by conduction, convection, and radiation to the surrounding Environment.
4. Proper cooling can be verified by measuring the point as the figure below.
5. The temperature at this location should not exceed "Maximum case temperature"
6. When Operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature". You can limit this Temperature to a lower value for extremely high reliability.

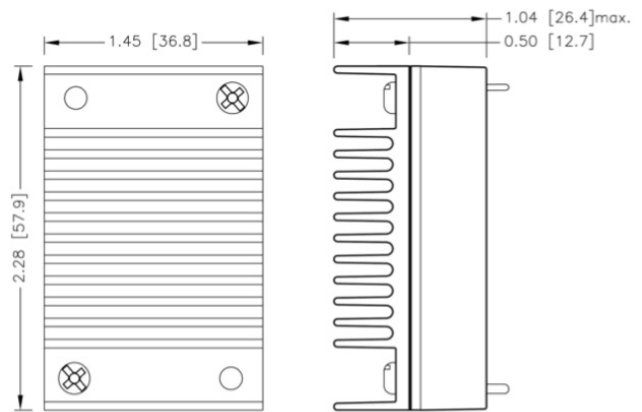
OFQC40 SERIES

Heat-Sink Options

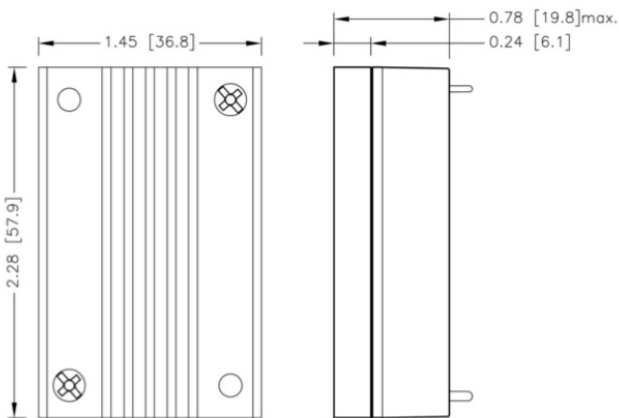
Suffix "HS"
 7G-0029B-F



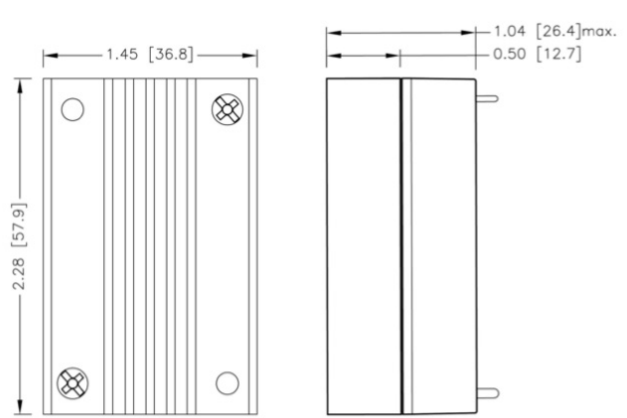
Suffix "HS1"
 7G-0030B-F



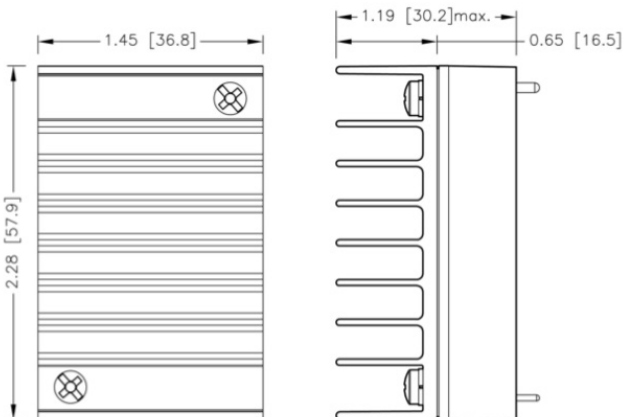
Suffix "HS2"
 7G-0031B-F



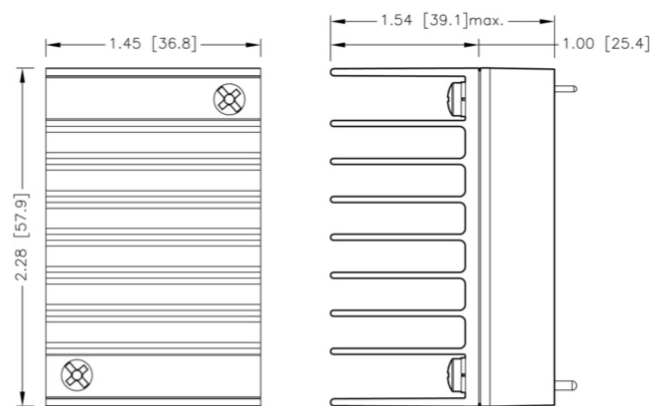
Suffix "HS3"
 7G-0032B-F



Suffix "HS4"
 7GA0124P01-F

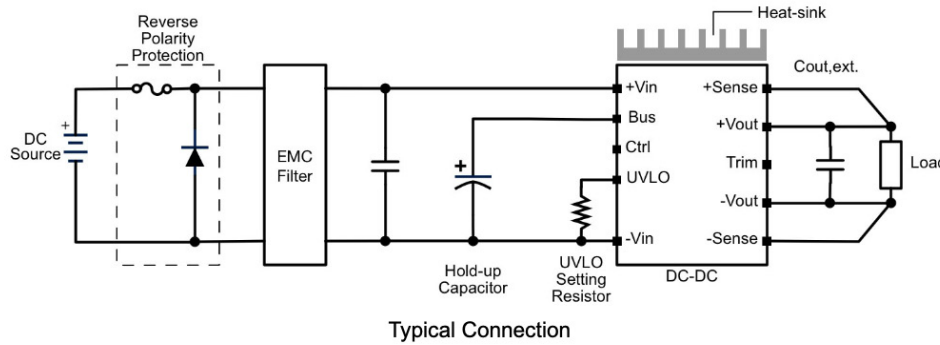


Suffix "HS5"
 7GA0125P01-F



1. All dimensions in inches (mm)
2. Tolerance: $x.xx \pm 0.02$ ($x.x \pm 0.5$)

Typical Application



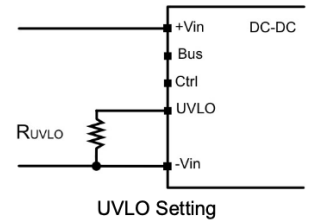
Typical Connection

UVLO

This series product has ultra wide input range. It could cover many kind of nominal input voltage in one module. In order to preventing incorrect operating under different input system, it offers UVLO adjustment by connecting a resistor to set UVLO threshold.

UVLO Constants

MODEL	A	B	C
OFQC40-36XX	48,000	8,237	0.96
OFQC40-72SXX	120,000	12,500	2.4



UVLO Setting

UVLO Equation

$$V_{start-up} = 1.25 \times \left[\frac{A \times (R_{UVLO} + B)}{R_{UVLO} \times B} + 1 \right]$$

Shutdown Voltage

$$V_{shutdown} = V_{start-up} - C$$

UVLO values for various nominal input voltage and R_{UVLO} table

OFQC40-36SXX

Nominal Vin	12V	24V	36V	48V
Start-up Voltage	8.46V	13.36V	20.56V	27.76V
Shutdown Voltage	7.5V	12.4V	19.6V	26.8V
UVLO Setting Resistor	Open	12.35KΩ	4.98KΩ	3.12KΩ

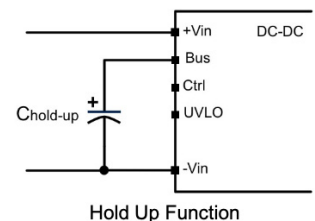
OFQC40-36SXX

Nominal Vin	24V	36V	48V	72V	96V	110V
Start-up Voltage	14.8V	22V	29.2V	43.6V	58V	66.4V
Shutdown Voltage	12.4V	19.6V	26.8V	41.2V	55.6V	64V
UVLO Setting Resistor	96.77KΩ	1714KΩ	9.40KΩ	4.94KΩ	3.35KΩ	2.82KΩ

Hold Up Time

Generally, connecting a large number of hold up capacitors on input are necessary to get a long duration of hold up time for S2, C2 described in EN50155. The Bus pin features excellent function can simply connect capacitors to Bus pin with less quantity of capacitors. It helps reduce layout area and smooth the inrush current.

For further information, please contact Polytron Devices.



Hold Up Function

Output Voltage Adjustment

EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

1. Output voltage is adjustable for 10% trim up or -20% trim down of nominal output voltage by connecting an external resistor between the Trim pin and either the +Sense or -Sense pins.
2. With an external resistor between the Trim and -Sense pin, the output voltage set point decreases.
3. With an external resistor between the Trim and +Sense pin, the output voltage set point increases.
4. Maximum output deviation is +10% inclusive of remote sense.
5. The external TRIM resistor needs to be at least 1/8W of rated power.

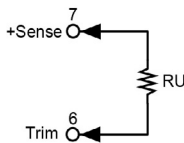
Trim Up Equation

$$R_U = \left(\frac{5.11V_{OUT}(100 + \Delta\%)}{1.225\Delta\%} - \frac{511 + 10.22\Delta\%}{\Delta\%} \right) k\Omega$$

Trim Down Equation

$$R_D = \left(\frac{511}{\Delta\%} - 10.22 \right) k\Omega$$

Trim Up



S5										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.05	5.10	5.15	5.20	5.25	5.30	5.35	5.40	5.45	5.50
RU (kΩ)	1585.35	797.994	535.542	404.316	325.58	273.09	235.596	207.476	185.605	168.109

S12										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20
RU (kΩ)	4534.55	2287.19	1538.08	1163.52	938.78	788.956	681.939	601.676	539.25	489.309

S15										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50
RU (kΩ)	5798.49	2925.42	1967.73	1488.89	1201.58	1010.04	873.229	770.619	690.812	626.966

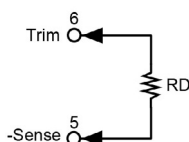
S24										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40
RU (kΩ)	9590.32	4840.11	3256.7	2465	1989.98	1673.3	1447.1	1277.45	1145.5	1039.94

S28										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	28.28	28.56	28.84	29.12	29.40	29.68	29.96	30.24	30.52	30.80
RU (kΩ)	11275.58	5691.08	3829.58	2898.83	2340.38	1968.08	1702.151	1502.705	1347.58	1223.48

S48										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80
RU (kΩ)	19701.9	9945.94	6693.96	5067.97	4092.38	3441.99	2977.42	2628.99	2357.99	2141.19

S53										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	53.53	54.06	54.59	55.12	55.65	56.18	56.71	57.24	57.77	58.30
RU (kΩ)	21808.437	11009.651	7410.056	5610.259	4530.38	3810.461	3296.233	2910.562	2610.596	2370.623

Trim Down



S										
ΔV (%)	1	2	3	4	5	6	7	8	9	10
RD (kΩ)	500.78	245.28	160.113	117.53	91.98	74.947	62.78	53.655	46.558	40.88

S										
ΔV (%)	11	12	13	14	15	16	17	18	19	20
RD (kΩ)	36.235	32.363	29.088	26.28	23.847	21.718	19.839	18.169	16.675	15.33