POLYTRON DEVICES

DATA SHEET

DC-DC CONVERTERS

SINGLE OUTPUT, 60 WATTS

EXTREMELY WIDE 12:1 INPUT VOLTAGE RANGE: 9-75VDC, 14-160VDC

RAILWAY APPLICATIONS

c UL us CB CE

FEATURES

- 60 Watt Output Power
- Extremely Wide 12:1 Input range: 9-75Vdc, 14-160Vdc
- Output Voltage: 5, 12, 15, 24, 28, 48, 53Vdc
- Isolation Voltage Up To 3000Vac
- Operating Base Plate Temperature: -40 to +105 °C
- Standard 1/4 Brick Package
- Compliant to EN55032 Railway Standard
- Over Current Protection
- Over Temperature Protection
- Over Voltage Protection
- Under Voltage Protection
- Short Circuit Protection
- 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	12	20	89	OFQC60-36S5	24000
9 - 75	12	5	20	89	OFQC60-36S12	4200
9 - 75	15	4	20	89	OFQC60-36S15	2700
9 - 75	24	2.5	20	90	OFQC60-36S24	1100
9 - 75	28	2.15	20	90	OFQC60-36S28	780
9 - 75	48	1.25	20	92	OFQC60-36S48	260
9 - 75	53	1.14	20	90	OFQC60-36S53	220
14 - 160	5	12	12	89	OFQC60-72S5	24000
14 - 160	12	5	15	89	OFQC60-72S12	4200
14 - 160	15	4	15	89	OFQC60-72S15	2700
14 - 160	24	2.5	12	90	OFQC60-72S24	1100
14 - 160	28	2.15	12	90	OFQC60-72S28	780
14 - 160	48	1.25	12	90	OFQC60-72S48	260
14 - 160	53	1.14	12	90	OFQC60-72S53	220

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.

POLYTRON DEVICES

DATA SHEET

OFQC60 SERIES

Input Specifications

Operating input voltage range, Vdc	9 Min., 36 Typ., 75 Max.	36Vin(nom)
	14 Min., 72 Typ., 160 Max.	72Vin(nom)
Start up voltage, Vdc	9 Max.	36Vin(nom)
	14 Max.	72Vin(nom)
Shutdown voltage, Vdc	7.3 Min., 7.7 Typ., 8.1 Max.	36Vin(nom)
	10 Min., 11 Typ., 12 Max.	72Vin(nom)
Start up time, ms	75 Typ., 100 Max.	Constant resistive load, Power up
	75 Typ., 100 Max.	Remote ON/OFF
Input transient voltage, Vdc	8.1 Max.	36Vin(nom), 100 mS, Max.
	12 Max.	72Vin(nom)
Input surge voltage, Vdc	100 Max.	36Vin(nom), 1 second, Max.
	185 Max.	72Vin(nom)
Input filter[1]	Pi type	
Remote ON/OFF Control, Vdc		Referred to -Vin pin
	Short or 0 - 1.2	Negative logic DC-DC ON
	Open or 3 - 12	(Standard) DC-DC OFF
	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

Output Specifications

Voltage accuracy, %	-1 Min., 1 Max.	
Line regulation, %	-0.1 Min., 0.1 Max.	Low line to high line at full load
Load regulation, %	-0.1 Min., 0.1 Max.	No load to full load
Voltage adjustability, %	-20 Min., 10 Max.	Max. output deviation is inclusive of remote sense
Remote sense, %	10 Max.	% of Vout(nom). If remote sense is not being used, SENSE pins should connect to corresponding polrity OUTPUT pins.
Ripple and noise, mVp-p		20MHz bandwidth
	75 Typ.	5Vout, with a 1μF/25V X7R MLCC and a 22μF/25V POS-CAP
	100 Typ.	12Vout, 15Vout, with a 22μF/25V X7R MLCC
	200 Typ.	24Vout, 28 Vout, with a 4.7μF/50V X7R MLCC
	300 Typ.	48Vout, 53 Vout, with a 2.2μF/100V X7R MLCC
Temperature coefficient, %/°C	-0.02 Min., 0.02 Max.	
Transient response recovery time, μs	250 Typ.	25% load step change
Over voltage protection, Vdc	120 Min., 135 Max.	% of Vout(nom); Hiccup mode
Over load protection, %	120 Min., 140 Max.	% of Iout rated; Hiccup mode
Short circuit protection		Continuous, automatic recovery

General Specifications

Isolation voltage	1 minute, 72Vin(nom)	Input to output	3000 Min. Vac		
	(Reinforced insulation)	Input (output) to Base-Plate	1500 Min. Vac		
	1 minute, 36Vin(nom)	Input to output	2250 Min., Vdc		
	(Basic insulation)	Input (output) to Base-Plate	1600 Min., Vdc		
Isolation resistance, GΩ	500Vdc		1 Min.		
Isolation capacitance, pF					1000 Max.
Switching frequency, kHz				180 Typ.	

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	DC-DC module			8.27 Typ.	
	Only mount on the iron base-plate			2.43 Typ.	
	Heat-sink type with 0.24" height			7.40 Typ.	
	Heat-sink type with 0.5" height			6.16 Typ.	
Thermal shock			EN61373, MIL-STD-810F		
Vibration			EN61373, MIL-STD-810F		
Relative humidity			5% to 95% RH		

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OFQC60 SERIES

Physical Specifications

Design meet safety standard	IEC/UL/EN60950-1, IEC/UL/EN62368-1, EN50155, EN45545-2
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	7.381 × 10^5 hrs , MIL-HDBK-217F, Full load

EMC Specifications

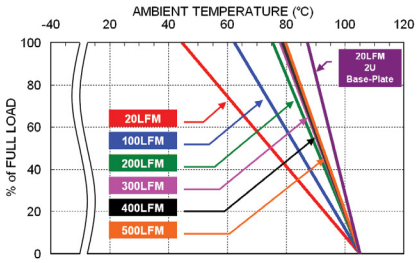
Specifications	Conditions		Level
EMI	EN55011, EN55032	With external components	Class A Class B
ESD	EN61000-4-2	Air ±8kV and Contact ±6kV	Perf. Criteria A
Radiated immunity	EN61000-4-3	20V/m	Perf. Criteria A
Fast transient[1]	EN61000-4-4	±2KV	Perf. Criteria A
	OFQC60-36S	With 2pcs of aluminum electrolytic capacitor	
	OFQC60-72S	With 2pcs of aluminum electrolytic capacitor	
Surge[1]	EN61000-4-5	EN55024: ±1kV and EN50155:±2kV	Perf. Criteria A
	OFQC60-36S	With 2pcs of aluminum electrolytic capacitor	
	OFQC60-72S	With 2pcs of aluminum electrolytic capacitor	
Conducted immunity	EN61000-4-6	10 Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100 A/m continuous; 1000 A/m 1 second	Perf. Criteria A

Note:

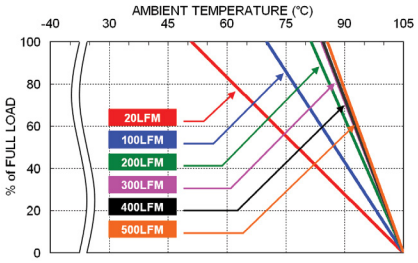
1. Input source impedance: The power module will operate as specifications without external components, assuming that the source voltage has a very low impedance and reasonable input voltage regulation. Highly inductive source impedances can affect the stability of the power module. Since real-world 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.
2. BASE-PLATE GROUNDING: When connecting two screw bolts to shield plane, the EMI could be reduced.
3. For further information, please contact Polytron Devices.

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

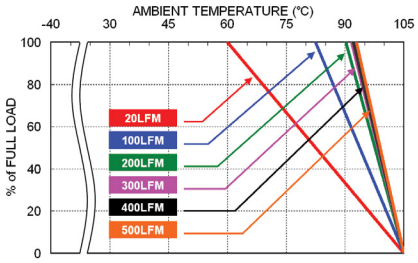
Characteristic Curve



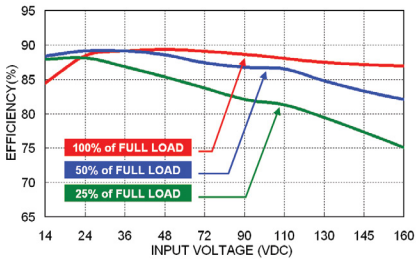
OFQC60-72S5 Derating Curve
(see Thermal Considerations)



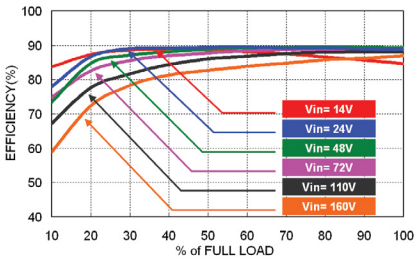
OFQC60-72S5 Derating Curve
With 0.24" Height Heat-sink
(see Thermal Considerations)



OFQC60-72S5 Derating Curve
With 0.5" Height Heat-sink
(see Thermal Considerations)



OFQC60 Efficiency vs. Input Voltage



OFQC60 Efficiency vs. Output Load

Fuse Consideration

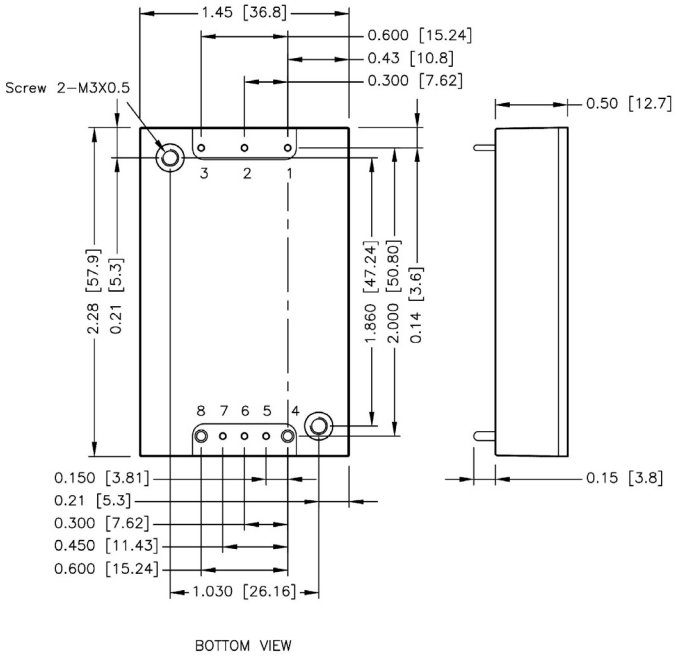
Model	Fuse Rating (A)	Fuse Type
OFQC60-36S	12	Fast-Acting
OFQC60-72S	8	Fast-Acting

Note:

1. The table based on the information provided in this data sheet on inrush energy and maximum DC 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"

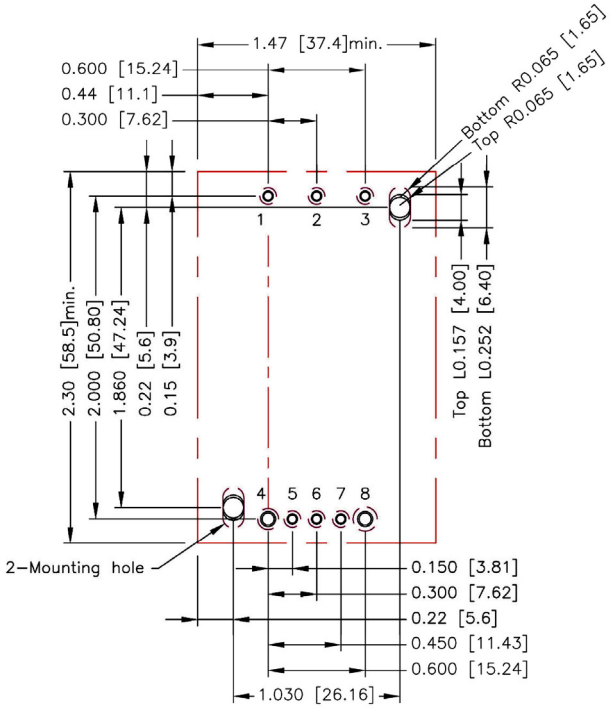
1. All dimensions in inches (mm)

2. Tolerance: x.xx±0.02 (x.x±0.5)x.xxx±0.01 (x.xx±0.25)

3. Pin pitch tolerance ±0.004 (0.10)

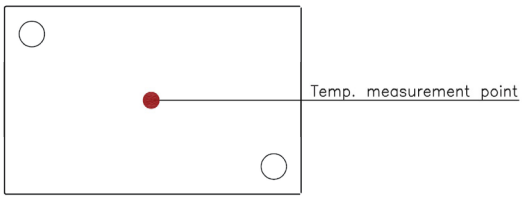
4. The screw locked torque: MAX 3.5kgf-cm (0.34N-m)

Recommended Pad Layout



1. **All dimensions in inches (mm)**
2. **Pad size (lead free recommended)**
3. **Through hole 1, 2, 3, 5, 6, 7: Ø0.051 (1.30)**
4. **Through hole 4, 8: Ø0.126(3.20)**
5. **Through hole of mounting: Ø0.126(3.20)**
6. **Top view pad 1, 2, 3, 5, 6, 7: Ø0.064 (1.63)**
7. **Top view pad 4, 8: Ø0.094 (2.38)**
8. **Top view pad of mounting: Groove R0.065(1.65)L0.157(4.00)**
9. **Bottom view pad 1, 2, 3, 5, 6, 7: Ø0.102(2.60)**
10. **Bottom view pad 8: Ø0.150(3.80)**
11. **Bottom view pad 4: Ø0.130(3.30)**
12. **Bottom view pad of mounting: Groove R0.065(1.65)L0.252(6.40)**

Thermal Considerations



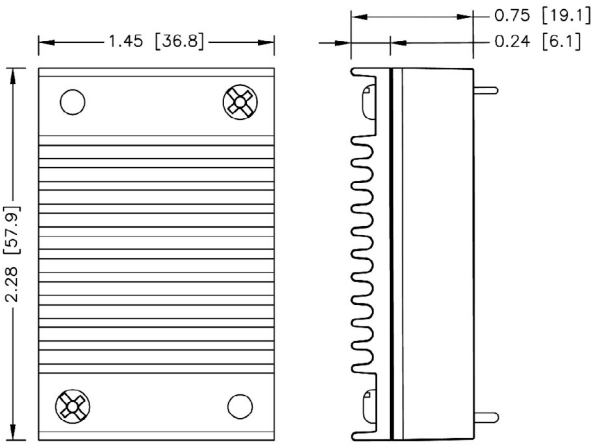
BASE PLATE

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**

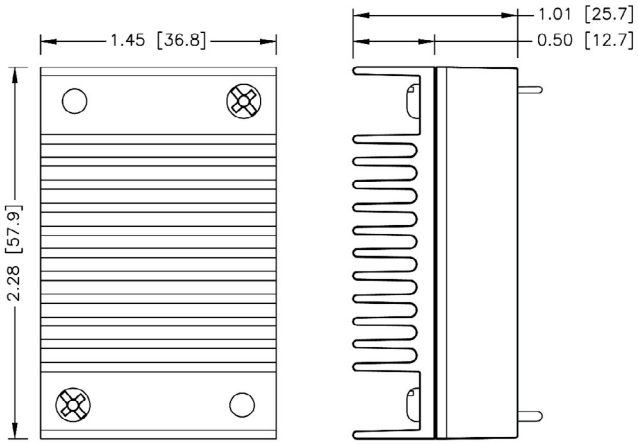
1. The power module operates in a variety of thermal environments.
2. Sufficient cooling should be provided to help ensure reliable operation of the unit.
3. Heat is removed by conduction, convection and radiation to the surrounding environment.
4. Proper cooling can be verified by measuring the point.
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”.
7. You can limit this temperature to a lower value for extremely high reliability.

Heat-Sink Options

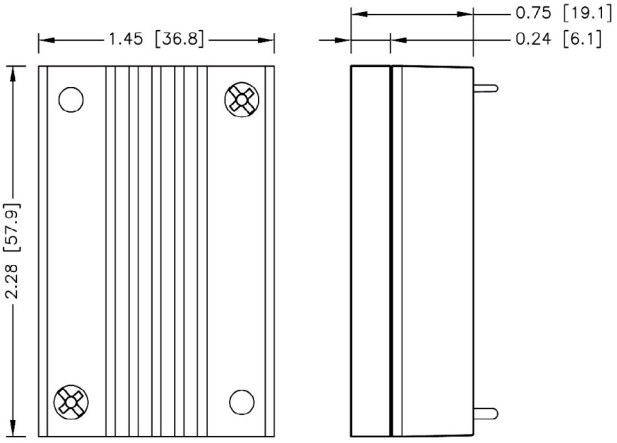
Suffix "HS"
7G-0029B-F



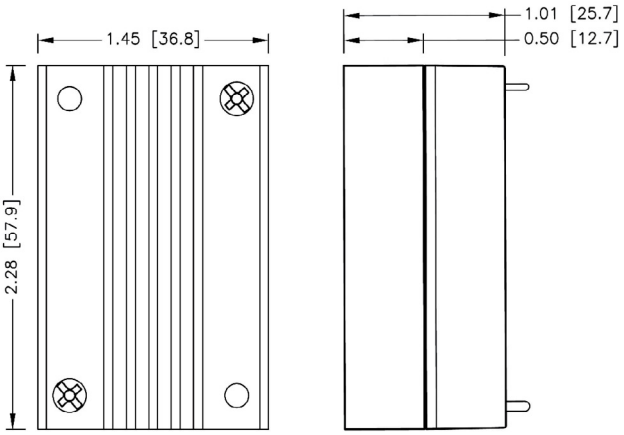
Suffix "HS1"
7G-0030B-F



Suffix "HS2"
7G-0031B-F



Suffix "HS3"
7G-0032B-F



1. **All dimensions in inches (mm)**
2. **Tolerance: x.xx±0.02 (x.x±0.5)**

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.

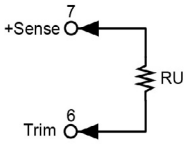
Trim Up Equation

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

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

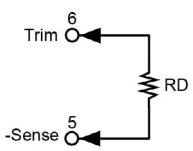
S48

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



SxxU

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

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