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POWERBOX Industrial Line
PQAE60U Series
Up to 60W 12:1 Single Output
DC/DC Converter



Features

1/4 brick package
9-75, 14-160VDC extremely wide input range
Efficiency up to 92%
Operating base-plate temperature -40°C~105°C.
Compliant EN50155 railway standard
3000VAC reinforced insulation
2250VDC basic insulation
No minimum load required
Low standby power
Remote on/off

Input

Input voltage range	36Vin(nom)	9 ~ 75VDC
	72Vin(nom)	14 ~ 160VDC
Start-up voltage	36Vin(nom)	9VDC
	72Vin(nom)	14VDC
Shutdown voltage	36Vin(nom)	7.3 ~ 8.1VDC
	72Vin(nom)	10 ~ 12VDC
Start up time	Power up	75ms typ
	Remote ON/OFF	75ms typ
	Constant resistive load	
Transient voltage	36Vin(nom)	8.1VDC min
100mS, max	72Vin(nom)	12VDC min
Input surge voltage	36Vin(nom)	100VDC max
1 second, max	72Vin(nom)	185VDC max
Input filter ¹⁾	Pi type	
Remote ON/OFF	Referred to -Vin pin	
	Negative logic DC-DC ON	Short or 0~1.2V
	(Standard) DC-DC OFF	Open or 3~12V
	Positive logic DC-DC ON	Open or 3~12V
	(Option) DC-DC OFF	Short or 0~1.2V
	Input current of Ctrl pin	0.5mA ~ 1mA
	Remote off input current	3mA.

Output

Voltage accuracy	±1%.
Line regulation	LL to HL at full load
	±0.1
Load regulation	No load to full load
	±0.1
Voltage adjustability	-20%/+10%. Maximum output deviation is inclusive of remote sense.
Remote sense	10% of Vout (nom). If remote sense is not being used, SENSE pins should be connected to corresponding polarity OUTPUT pins.
Ripple and noise	Measured by 20MHz bandwidth.
With a 1µF/25V X7R MLCC and a 22µF/25V POS-CAP	5Vout
	75mV p-p typ
With a 22µF/25V X7R MLCC	12Vout, 15Vout
	100mV p-p typ
With a 4.7µF/50V X7R MLCC	24Vout, 28Vout
	200mV p-p typ
With a 2.2µF/100V X7R MLCC	48Vout, 53Vout
	300mV p-p typ

Environmental

Op. baseplate temp.	With derating -40°C to +105°C.
Max case temperature	+105°C.
Over temp protection	+110°C.
Storage temperature	-55°C to +125°C.
Thermal impedance	DC/DC module
	8.27°C/W
	Only mount on iron base-plate
	2.43°C/W
	Heat-sink type with 0.24" height
	7.40°C/W
	Heat-sink type with 0.5" height
	6.16°C/W
Thermal shock	EN61373, MIL-STD-810F.
Vibration	EN61373, MIL-STD-810F.
Relative humidity	5-95% RH.

General

Isolation voltage	1 minute (reinforced insulation) 72Vin(nom)
Input to output	3000VAC min
Input (output) to baseplate	1500VAC min
1 minute (basic insulation)	36Vin(nom)
Input to output	2250VDC min
Input (output) to baseplate	1600VDC min
Isolation resistance	500VDC
	1GΩ
Isolation capacitance	1000pF.
Switching frequency	180kHz.
Case material	Aluminum base-plate with plastic case.
Potting material	Silicon (UL94-V0).
Weight	64g.
MTBF	MIL-STD-217F, full load
	7.381 x 10 ⁵ hrs.

Standards

Safety approvals	IEC/UL/EN60950-1 (pending).
	IEC/UL/EN62368-1 (pending).
Railway approvals	EN50155, EN45545-2 (pending).

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EMC Parameter	Conditions	Level
EMI	EN55011, EN55032	Class A, Class B
ESD	EN61000-4-2	Perf. Criteria A
Radiated immunity	EN61000-4-3	Perf. Criteria A
Fast transient	EN61000-4-4	Perf. Criteria A
	PQAE60-36S□□U	With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 220μF/100V)
	PQAE60-72S□□U	With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KXJ series, 150μF/200V)
Surge	EN61000-4-5	EN55024:±1kV and EN50155:±2kV
	PQAE60-36S□□U	With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 220μF/100V)
	PQAE60-72S□□U	With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KXJ series, 150μF/200V)
Conducted immunity	EN61000-4-6	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8	100A/m continuous; 1000A/m 1 second

Notes:

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.

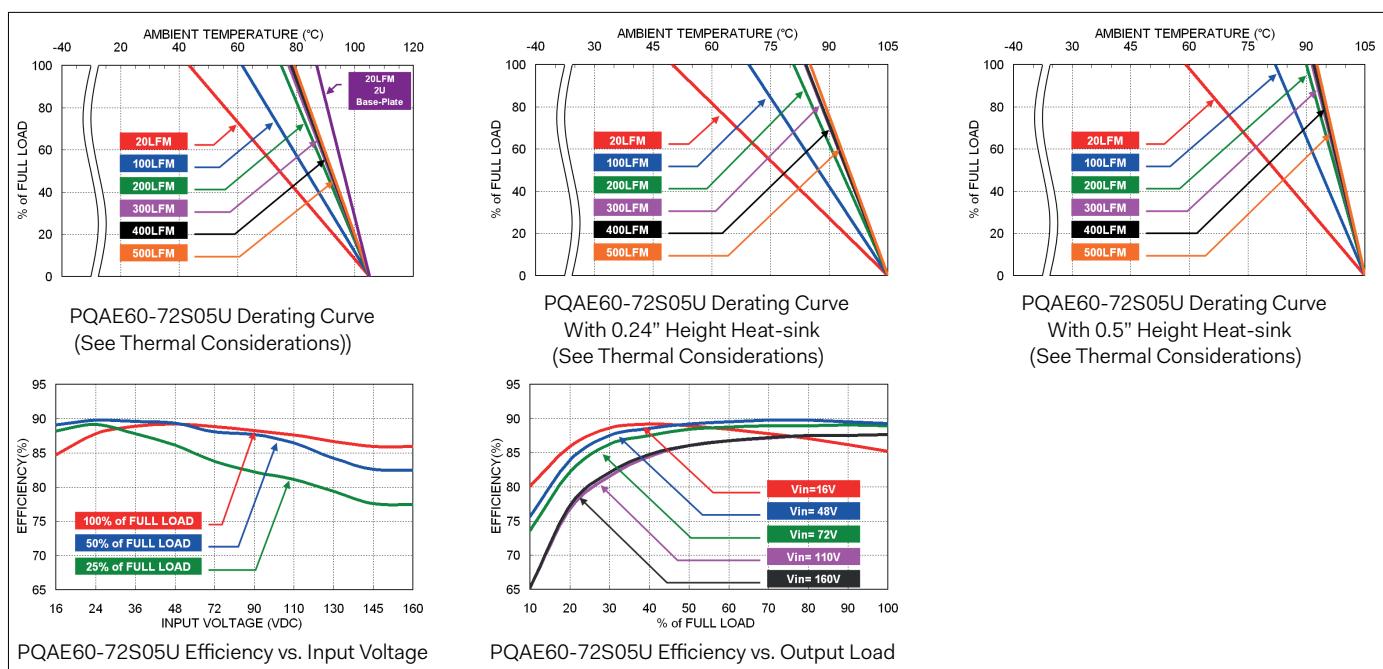
The PQAE60-36SU recommended Nippon Chemi-con KY series, 220μF/100V.

The PQAE60-72SU recommended Nippon Chemi-con KXJ series, 150μF/200V.

2. BASE-PLATE GROUNDING: When connect two screw bolts to shield plane, the EMI could be reduced.

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

Derating Curve



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Model Number	Input Range	Output Voltage	Output Current @Full Load	Input Current @No Load	Efficiency	Max Capacitor Load
PQAE60-36S05U	9 ~ 75 VDC	5 VDC	12 A	20	89%	24000 µF
PQAE60-36S12U	9 ~ 75 VDC	12 VDC	5 A	20	89%	4200 µF
PQAE60-36S15U	9 ~ 75 VDC	15 VDC	4 A	20	89%	2700 µF
PQAE60-36S24U	9 ~ 75 VDC	24 VDC	2.5 A	20	90%	1100 µF
PQAE60-36S28U	9 ~ 75 VDC	28 VDC	2.15 A	20	90%	780 µF
PQAE60-36S48U	9 ~ 75 VDC	48 VDC	1.25 A	20	92%	260 µF
PQAE60-36S53U	9 ~ 75 VDC	53 VDC	1.14 A	20	90%	220 µF
PQAE60-72S05U	14 ~ 160 VDC	5 VDC	12 A	12	89%	24000 µF
PQAE60-72S12U	14 ~ 160 VDC	12 VDC	5 A	15	89%	4200 µF
PQAE60-72S15U	14 ~ 160 VDC	15 VDC	4 A	15	89%	2700 µF
PQAE60-72S24U	14 ~ 160 VDC	24 VDC	2.5 A	12	90%	1100 µF
PQAE60-72S28U	14 ~ 160 VDC	28 VDC	2.15 A	12	90%	780 µF
PQAE60-72S48U	14 ~ 160 VDC	48 VDC	1.25 A	12	90%	260 µF
PQAE60-72S53U	14 ~ 160 VDC	53 VDC	1.14 A	12	90%	220 µF

Part Number Structure

PQAE60 - 72		S	05	U	-	P	HS
Series Name	Input Voltage	Output Quantity	Output Voltage	Input Range	CTRL and Pin Options	Assembly Options	
36: 9-75VDC	S: Single	05: 5VDC	8:1	<input type="checkbox"/> Negative logic	<input type="checkbox"/> None		
72: 14-160VDC		12: 12VDC	12:1	0.150" pin length	HS:7G-0029B-F;H=0.24"		
		15: 15VDC		L:Negative logic,	HS1:7G-0030B-F;H=0.5"		
		24: 24VDC		0.200" pin length	HS2:7G-0031B-F;H=0.24"		
		28: 28VDC		P:Positive logic,	HS3:7G-0032B-F;H=0.5"		
		48: 48VDC		0.150" pin length	TH:Through hole (No thread)*		
		53: 53VDC		S:Positive logic, 0.200" pin length	* The module can't equip Heat-sink with TH option.		

Fuse Consideration

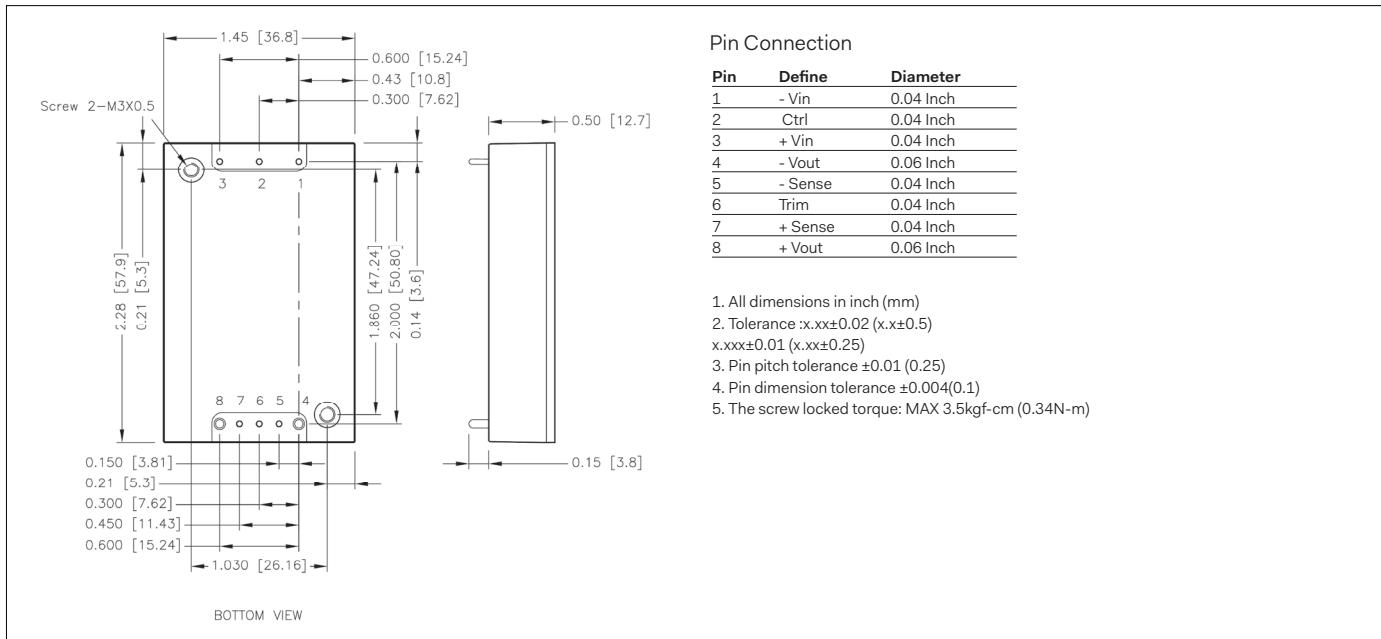
This power module is not internally fused. An input line fuse must always be used. This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse. The input line fuse suggest as below:

Model	Fuse Rating (A)	Fuse Type
PQAE60-36S□□U	12A	Fast-Acting
PQAE60-72S□□U	8A	Fast-Acting

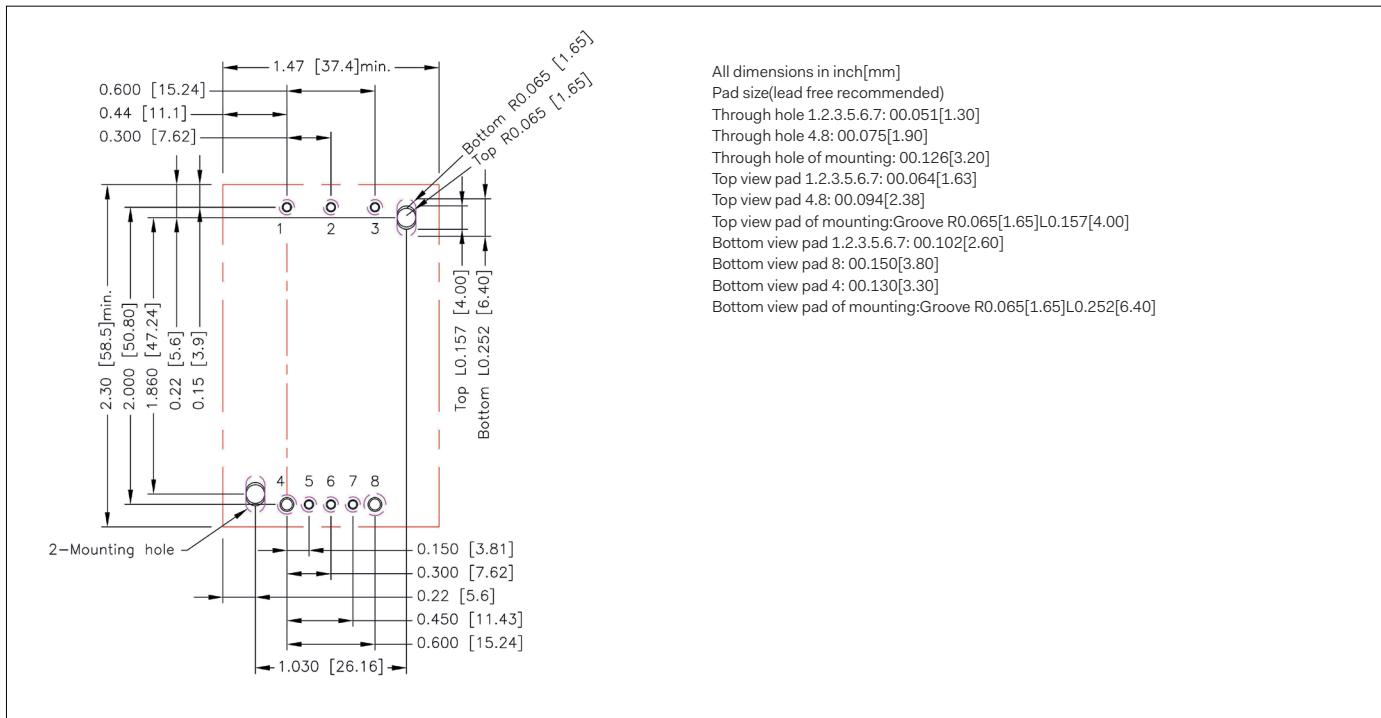
The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

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Mechanical



Recommended Pad Layout

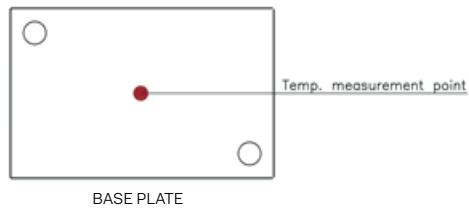


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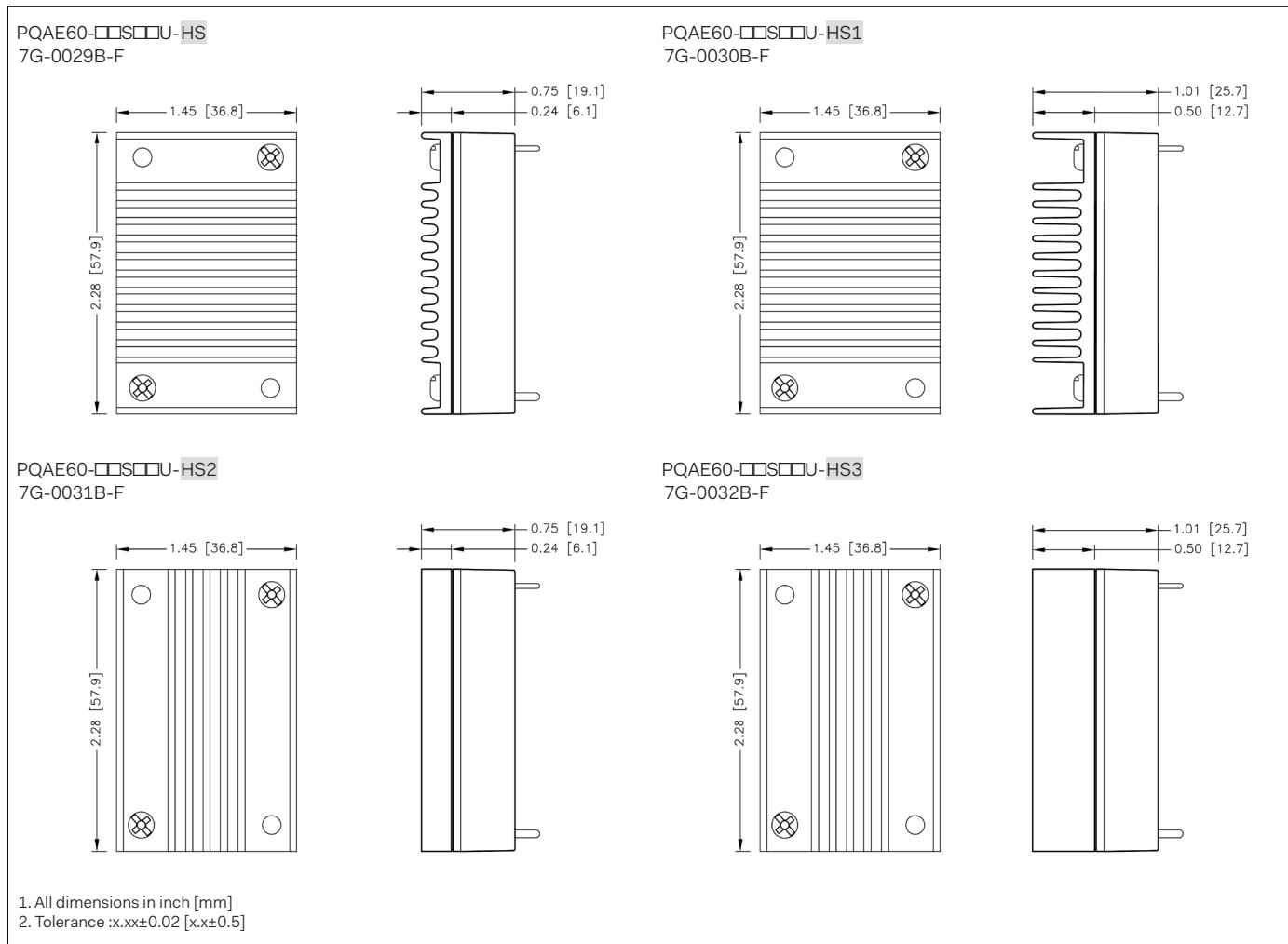
Thermal Consideration

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convection, and radiation to the surrounding Environment. Proper cooling can be verified by measuring the point as the figure below. The temperature at this location should not exceed 105°C. When Operating, adequate cooling must be provided to maintain the test point temperature at or below 105°C. Although the maximum point Temperature of the power modules is 105C, you can limit this Temperature to a lower value for extremely high reliability.

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



Heat-Sink Type Options



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Output Voltage Adjustment

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.

With an external resistor between the Trim and -Sense pin, the output voltage set point decreases. With an external resistor between the Trim and +Sense pin, the output voltage set point increases. Maximum output deviation is +10% inclusive of remote sense. The external TRIM resistor needs to be at least 1/8W of rated power.

Trim-up Euqation

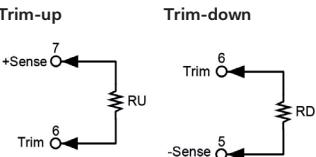
$$R_U = \left(\frac{5.11V_{OUT}(100 + \Delta\%)}{1.225\Delta\%} - \frac{511 + 10.22\Delta\%}{\Delta\%} \right) k\Omega$$

Trim-down Equation

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

External Output Trimming

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



Trim Up

□□S05U

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	(k Ω)	1585.35	797.994	535.542	404.316	325.58	273.09	235.596	207.476	185.605	168.109

□□S12U

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	(k Ω)	4534.55	2287.19	1538.08	1163.52	938.78	788.956	681.939	601.676	539.25	489.309

□□S15U

ΔV	(%)	1	2	3	4	5	6	7	8	9	10
Vout	(V)	115.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50
RU	(k Ω)	5798.49	2925.42	1967.73	1488.89	1201.58	1010.04	873.229	770.619	690.812	626.9666

□□S24U

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	(k Ω)	9590.32	4840.11	3256.7	2465	1989.98	1673.3	1447.1	1277.45	1145.5	1039.94

□□S28U

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	(k Ω)	11275.58	5691.08	3829.58	2898.83	2340.38	1968.08	1702.151	1502.705	1347.58	1223.48

□□S48U

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	(k Ω)	19701.9	9945.94	6693.96	5067.97	4092.38	3441.99	2977.42	2628.99	2357.99	2141.19

□□S53U

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	(k Ω)	21808.437	11009.651	7410.056	5610.259	4530.38	3810.461	3296.233	2910.562	2610.596	2370.623

Trim Down

□□S000U

ΔV	(%)	1	2	3	4	5	6	7	8	9	10
RU	(k Ω)	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
RU	(k Ω)	36.235	32.363	29.088	26.28	23.847	21.718	19.839	18.169	16.675	15.33

Specifications are subject to change without notice.