

Highly Efficient 100W Quarter-brick DC/DC Converter

for Railway Applications



Railway



Industrial

QBE100W Series DC/DC Converters

- 100W Output Power
- Standard 1/4 Brick Package
- 4:1 Input Range: 9–36, 18–75, and 40–160 Vdc
- Output Voltage: 3.3, 5, 12, 15, 24, 28, 48, and 54Vdc
- 3000Vac Reinforced Insulation for 110Vin
- 3000Vdc Basic Insulation for 24 and 48Vin
- 5000m Operating Altitude
- EN 50155, IEC/UL/EN 62368–1 Safety Approval (*pending)
- 3 Years Product Warranty

【お問い合わせ先】



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P-DUKE POWER

QBE100W Series

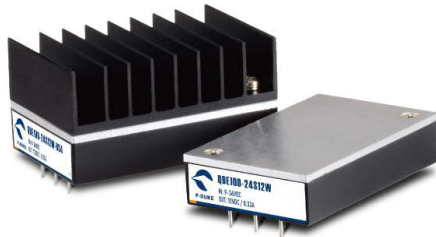
Quarter-Brick DC-DC Converter
Up to 100 Watts

3

YEARS
WARRANTY

ROHS
COMPLIANT

REACH
COMPLIANT



Railway



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV

3000
VAC
Reinforced
Insulation

3000
VDC
Basic
Insulation

4 : 1
Wide
Input
Range

NO
Min. Load
Required

LOW
Standby
Power

Operating
Altitude
5000
meter

REMOTE
ON
OFF

OCP

OTP

OVP

SCP

UVP

PART NUMBER STRUCTURE

QBE100 -

48

S

05

W

-

P

HS

Series Name

Input
Voltage
(VDC)

Output
Quantity

Output
Voltage
(VDC)

Input
Range

Ctrl and Pin
Options

Assembly
Options

24: 9~36
48: 18~75
110: 40~160

S:Single

3P3:3.3
05:5
12:12
15:15
24:24
28:28
48:48
54:54

4:1

□:Negative logic
P:Positive logic

□: None
Heat-sink type
HS:7G-0029B-F;H=0.24"
HS2:7G-0031B-F;H=0.24"
HS4:7GA0124P01-F;H=0.65"
HS5:7GA0125P01-F;H=1"
Through hole type
TH:No thread*

* The module can't equip Heat-sink with TH option.

TECHNICAL SPECIFICATION All specifications are typical at nominal input, full load and 25°C unless otherwise noted

Model Number	Input Range	Output Voltage	Output Current @Full Load	Input Current @No Load	Efficiency	Maximum Capacitor Load
	VDC	VDC	A	mA	%	μF
QBE100-24S3P3W	9 ~ 36	3.3	25	35	89	75000
QBE100-24S05W	9 ~ 36	5	20	40	91	40800
QBE100-24S12W	9 ~ 36	12	8.33	40	92	7000
QBE100-24S15W	9 ~ 36	15	6.67	40	92	4600
QBE100-24S24W	9 ~ 36	24	4.17	40	92	1800
QBE100-24S28W	9 ~ 36	28	3.57	40	92	1350
QBE100-24S48W	9 ~ 36	48	2.08	40	92	430
QBE100-24S54W	9 ~ 36	54	1.85	45	92	380
QBE100-48S3P3W	18 ~ 75	3.3	25	15	89	75000
QBE100-48S05W	18 ~ 75	5	20	15	91	40800
QBE100-48S12W	18 ~ 75	12	8.33	15	92	7000
QBE100-48S15W	18 ~ 75	15	6.67	15	92	4600
QBE100-48S24W	18 ~ 75	24	4.17	15	92	1800
QBE100-48S28W	18 ~ 75	28	3.57	15	92	1350
QBE100-48S48W	18 ~ 75	48	2.08	25	92	430
QBE100-48S54W	18 ~ 75	54	1.85	25	92	380
QBE100-110S3P3W	40 ~ 160	3.3	25	8	89	75000
QBE100-110S05W	40 ~ 160	5	20	8	91	40800
QBE100-110S12W	40 ~ 160	12	8.33	8	92	7000
QBE100-110S15W	40 ~ 160	15	6.67	8	92	4600
QBE100-110S24W	40 ~ 160	24	4.17	10	92	1800
QBE100-110S28W	40 ~ 160	28	3.57	10	92	1350
QBE100-110S48W	40 ~ 160	48	2.08	12	91	430
QBE100-110S54W	40 ~ 160	54	1.85	12	92	380

INPUT SPECIFICATIONS						
Parameter	Conditions			Min.	Typ.	Max. Unit
Operating input voltage range	24Vin(nom)			9	24	36
	48Vin(nom)			18	48	75
	110Vin(nom)			40	110	160
Start up voltage	24Vin(nom)					9
	48Vin(nom)					18
	110Vin(nom)					40
Shutdown voltage	24Vin(nom)			7.5	8.0	8.8
	48Vin(nom)			15.5	16.0	17.5
	110Vin(nom)			32.0	34.0	36.0
Start up time	Constant resistive load	Power up			75	100 ms
Input surge voltage	1 second, max.	Remote ON/OFF				
		24Vin(nom)				50
		48Vin(nom)				100
Input filter ⁽¹⁾		110Vin(nom)				185
				Pi type		
Remote ON/OFF	Referred to -Vin pin	Negative logic	DC-DC ON	Short or 0 ~ 1.2VDC		
		(Standard)	DC-DC OFF	Open or 3 ~ 12 VDC		
		Positive logic	DC-DC ON	Open or 3 ~ 12 VDC		
		(Option)	DC-DC OFF	Short or 0 ~ 1.2VDC		
		Input current of Ctrl pin		-0.5	1	mA
		Remote off input current			3	mA

OUTPUT SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Voltage accuracy		-1.0		+1.0	%
Line regulation	Low Line to High Line at Full Load	-0.1		+0.1	%
Load regulation	No Load to Full Load	-0.2		+0.2	%
	3.3 & 5Vout Others	-0.1		+0.1	
Voltage adjustability	Maximum output deviation is inclusive of remote sense	-20		+10	%
Remote sense	% of Vout(nom) If remote sense is not being used, sense pins should connect to the output pins with the same polarity.			10	%
Ripple and noise	Measured by 20MHz bandwidth		80		mVp-p
	With a 1 μ F/25V X7R MLCC and a 47 μ F/20V SP-CAP		100		
	With a 22 μ F/25V X7R MLCC		220		
	With a 4.7 μ F/50V X7R MLCC		300		
	With a 4.7 μ F/100V X7R MLCC				
Temperature coefficient		-0.02		+0.02	%/°C
Transient response recovery time	25% load step change		250		μ s
Over voltage protection	% of Vout(nom); Hiccup mode	115	125	130	%
Over load protection	% of Iout rated; Hiccup mode	125	150	170	%
Short circuit protection		Continuous, automatic recovery			

GENERAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Isolation voltage	1 minute	110Vin(nom)	Input to Output	3000	VAC
	(Reinforced insulation)		Input (Output) to Base-Plate	1500	
	1 minute	Others	Input to Output	3000	VDC
	(Basic insulation)		Input (Output) to Base-Plate	1600	
Isolation resistance	500VDC	1			G Ω
Isolation capacitance				1500	pF
Switching frequency		140	190	250	kHz
Safety approvals (Pending)		IEC/ EN/ UL 62368-1			
Standard approvals (Pending)		EN50155 EN45545-2			
Case material		Aluminum base-plate with plastic case			
Potting material		Silicone (UL94 V-0)			
Weight		67.5g (2.38oz)			
MTBF	MIL-HDBK-217F, Full load	6.143 x 10 ⁵ hrs			

ENVIRONMENTAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating base-plate temperature		-40		+105	°C
Maximum case temperature				105	°C
Over temperature protection			110		°C
Storage temperature range		-55		+125	°C
Operating altitude				5000	m
Thermal impedance	Module without assembly option		9		°C/W
	Only mount on the iron base-plate		2.8		
	Heat-sink type with 0.24" Height		7.1		
	Heat-sink type with 0.65" Height		4.2		
	Heat-sink type with 1" Height		3.4		
Thermal shock		MIL-STD-810F			
Shock		EN61373, MIL-STD-810F			
Vibration		EN61373, MIL-STD-810F			
Relative humidity		5% to 95% RH			

EMC SPECIFICATIONS

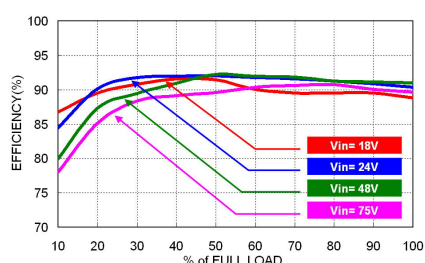
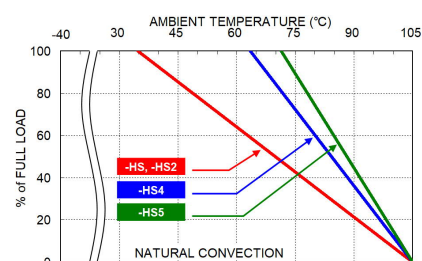
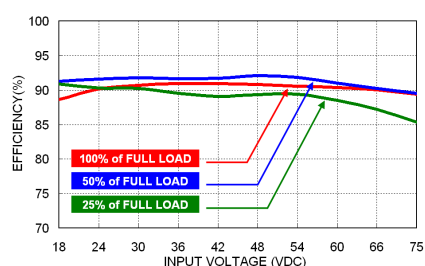
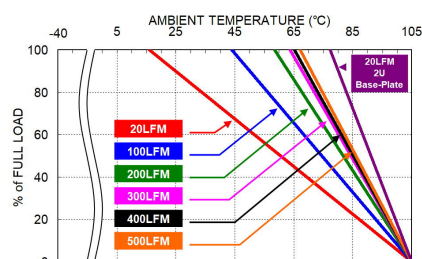
Parameter	Conditions	Level
EMI	EN55032, EN50121-3-2 With external components	Class A, Class B
EMS	EN55035, EN50121-3-2	
ESD	EN61000-4-2 Air $\pm 8\text{kV}$ and Contact $\pm 6\text{kV}$	Perf. Criteria A
Radiated immunity	EN61000-4-3 20 V/m	Perf. Criteria A
Fast transient	EN61000-4-4 $\pm 2\text{kV}$	Perf. Criteria A
	QBE100-24S□□W QBE100-48S□□W QBE100-110S□□W	With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 330 μF /100V) With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KXJ series, 150 μF /200V)
Surge	EN61000-4-5 $\pm 2\text{kV}$	Perf. Criteria A
	QBE100-24S□□W QBE100-48S□□W QBE100-110S□□W	With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KY series, 330 μF /100V) With 2 pcs of aluminum electrolytic capacitor (Nippon Chemi-con KXJ series, 150 μF /200V)
Conducted immunity	EN61000-4-6 10 Vr.m.s	Perf. Criteria A
Power frequency magnetic field	EN61000-4-8 100A/m continuous; 1000A/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 QBE100-24S□□W and QBE100-48S□□W recommended external filter capacitor Nippon Chemi-con KY series, 330 μF /100V. The QBE100-110S□□W recommended external filter capacitor Nippon Chemi-con KXJ series, 150 μF /200V.
- 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.

CHARACTERISTIC CURVE



QBE100-48S05W Derating Curve with Heat-sink
(See Thermal Considerations)

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.

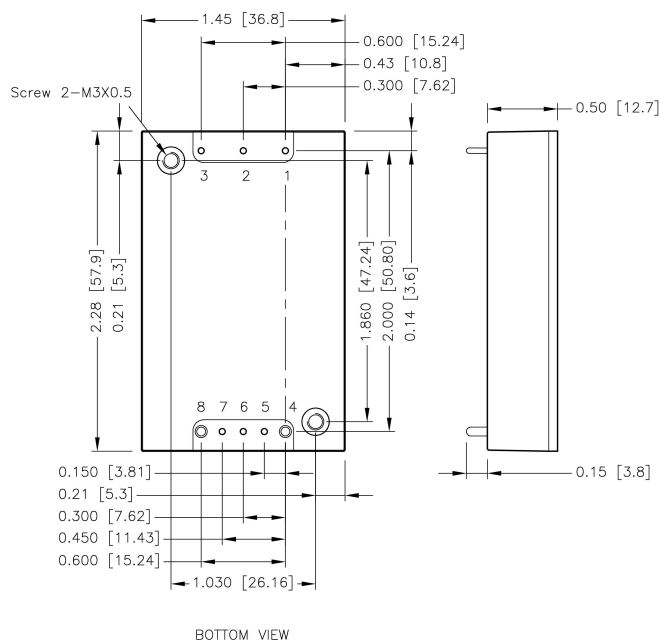
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

Model	Fuse Rating (A)	Fuse Type
QBE100-24S□□W	20	Fast-Acting
QBE100-48S□□W	12	Fast-Acting
QBE100-110S□□W	5	Slow-Blow

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

MECHANICAL DRAWING

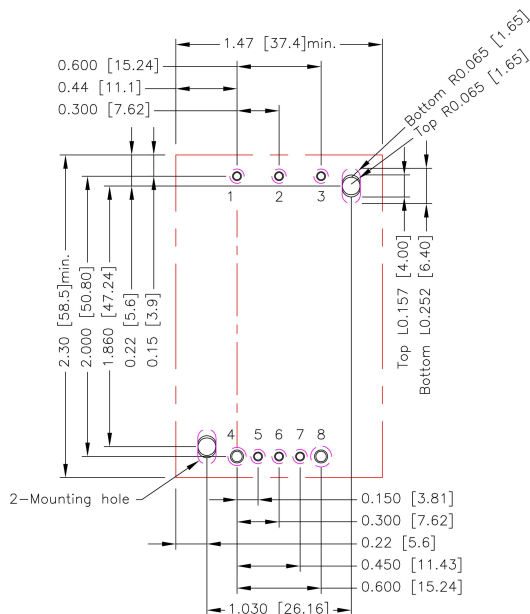


PIN CONNECTION

PIN	DEFINE	DIAMETER
1	- Vin	0.04 Inch
2	Ctrl	0.04 Inch
3	+ Vin	0.04 Inch
4	- Vout	0.06 Inch
5	- Sense	0.04 Inch
6	Trim	0.04 Inch
7	+ Sense	0.04 Inch
8	+ Vout	0.06 Inch

1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]
x.xxx±0.010 [x.xx±0.25]
3. Pin dimension tolerance ±0.004[0.10]
4. The screw locked torque:MAX 3.5kgf-cm [0.34N-m]

RECOMMENDED PAD LAYOUT



All dimensions in inch[mm]

Pad size(lead free recommended)

Through hole 1.2.3.5.6.7: $\varnothing 0.051[1.30]$

Through hole 4.8: $\varnothing 0.075[1.90]$

Through hole of mounting: $\varnothing 0.126[3.20]$

Top view pad 1.2.3.5.6.7: $\varnothing 0.064[1.63]$

Top view pad 4.8: $\varnothing 0.094[2.38]$

Top view pad of mounting: Groove R0.065[1.65]L0.157[4.00]

Bottom view pad 1.2.3.5.6.7: $\varnothing 0.102[2.60]$

Bottom view pad 8: $\varnothing 0.150[3.80]$

Bottom view pad 4: $\varnothing 0.130[3.30]$

Bottom view pad of mounting: Groove R0.065[1.65]L0.252[6.40]

THERMAL CONSIDERATIONS

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.

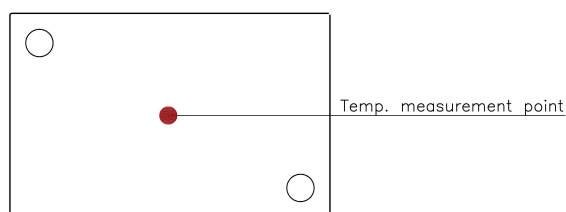
Proper cooling can be verified by measuring the point as the figure below.

The temperature at this location should not exceed "Maximum case temperature".

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.

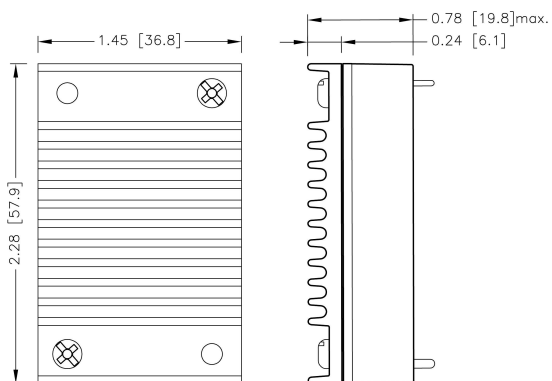
- Thermal test condition with vertical direction by natural convection (20LFM).
- The iron base-plate dimension is 19" X 3.5" X 0.063" (The height is EIA standard 2U).
- The heat-sink is optional and P/N: 7G-0029B-F, 7G-0031B-F, 7GA0124P01-F, 7GA0125P01-F.



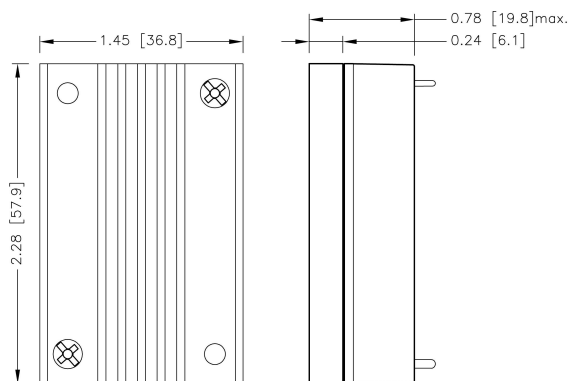
BASE PLATE

HEAT-SINK TYPE OPTIONS

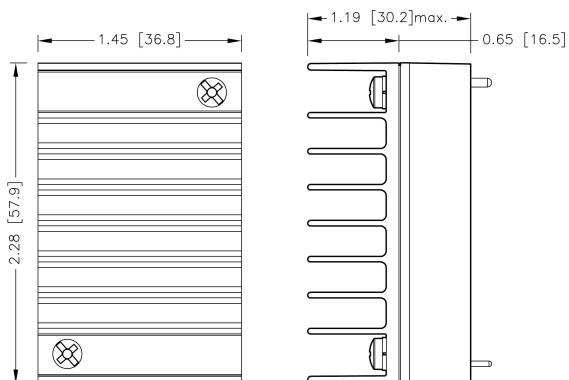
QBE100-□□S□□W -HS
7G-0029B-F



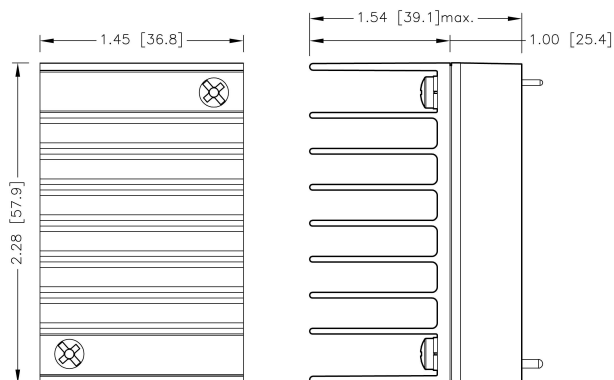
QBE100-□□S□□W -HS2
7G-0031B-F



QBE100-□□S□□W -HS4
7GA0124P01-F



QBE100-□□S□□W -HS5
7GA0125P01-F



1. All dimensions in inch [mm]
2. Tolerance :x.xx±0.02 [x.x±0.5]

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 increases.

With an external resistor between the Trim and +Sense pin, the output voltage set point decreases.

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 Equation

$$R_U = \left[\frac{G \times 2.5}{(V_{o,up} - V_{o,nom})} - H \right] \text{ k}\Omega$$

Trim Down Equation

$$R_D = \left[\frac{(V_{o,down} - 2.5) \times G}{(V_{o,nom} - V_{o,down})} - H \right] \text{ k}\Omega$$

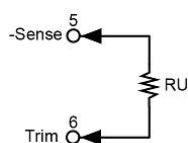
Trim Constants

Module	G	H
QBE100-□□S3P3W	5.1	1
QBE100-□□S05W	5.1	2
QBE100-□□S12W	10	5.1
QBE100-□□S15W	10	5.1
QBE100-□□S24W	56	13
QBE100-□□S28W	56	13
QBE100-□□S48W	66	27
QBE100-□□S54W	66	27

EXTERNAL OUTPUT TRIMMING

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

Trim-up



□□S3P3W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	3.333	3.366	3.399	3.432	3.465	3.498	3.531	3.564	3.597	3.630
R _U (kΩ)	385.36	192.18	127.79	95.59	76.27	63.39	54.19	47.30	41.93	37.64

□□S05W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	5.050	5.100	5.150	5.200	5.250	5.300	5.350	5.400	5.450	5.500
R _U (kΩ)	253.00	125.50	83.00	61.75	49.00	40.50	34.43	29.88	26.33	23.50

□□S12W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	12.120	12.240	12.360	12.480	12.600	12.720	12.840	12.960	13.080	13.200
R _U (kΩ)	203.23	99.07	64.34	46.98	36.57	29.62	24.66	20.94	18.05	15.73

□□S15W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	15.150	15.300	15.450	15.600	15.750	15.900	16.050	16.200	16.350	16.500
R _U (kΩ)	161.57	78.23	50.46	36.57	28.23	22.68	18.71	15.73	13.42	11.57

□□S24W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	24.240	24.480	24.720	24.960	25.200	25.440	25.680	25.920	26.160	26.400
R _U (kΩ)	570.33	278.67	181.44	132.83	103.67	84.22	70.33	59.92	51.81	45.33

□□S28W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	28.280	28.560	28.840	29.120	29.400	29.680	29.960	30.240	30.520	30.800
R _U (kΩ)	487.00	237.00	153.67	112.00	87.00	70.33	58.43	49.50	42.56	37.00

□□S48W

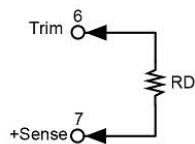
ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	48.480	48.960	49.440	49.920	50.400	50.880	51.360	51.840	52.320	52.800
R _U (kΩ)	316.75	144.88	87.58	58.94	41.75	30.29	22.11	15.97	11.19	7.38

□□S54W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	54.540	55.080	55.620	56.160	56.700	57.240	57.780	58.320	58.860	59.400
R _U (kΩ)	278.156	125.378	74.452	48.989	33.711	23.526	16.65	11.19	6.95	3.56

OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down



□□S3P3W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	3.267	3.234	3.201	3.168	3.135	3.102	3.069	3.036	3.003	2.970
RD (k Ω)	117.54	55.72	35.11	24.81	18.63	14.51	11.56	9.35	7.64	6.26

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	2.937	2.904	2.871	2.838	2.805	2.772	2.739	2.706	2.673	2.640
RD (k Ω)	5.14	4.20	3.41	2.73	2.14	1.63	1.17	0.77	0.41	0.08

□□S05W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	4.950	4.900	4.850	4.800	4.750	4.700	4.650	4.600	4.550	4.500
RD (k Ω)	247.90	120.40	77.90	56.65	43.90	35.40	29.33	24.78	21.23	18.40

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	4.450	4.400	4.350	4.300	4.250	4.200	4.150	4.100	4.050	4.000
RD (k Ω)	16.08	14.15	12.52	11.11	9.90	8.84	7.90	7.07	6.32	5.65

□□S12W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	11.880	11.760	11.640	11.520	11.400	11.280	11.160	11.040	10.920	10.800
RD (k Ω)	776.57	380.73	248.79	182.82	143.23	116.84	98.00	83.86	72.86	64.07

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	10.680	10.560	10.440	10.320	10.200	10.080	9.960	9.840	9.720	9.600
RD (k Ω)	56.87	50.87	45.80	41.45	37.68	34.38	31.47	28.88	26.57	24.48

□□S15W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	14.850	14.700	14.550	14.400	14.250	14.100	13.950	13.800	13.650	13.500
RD (k Ω)	818.23	401.57	262.68	193.23	151.57	123.79	103.95	89.07	77.47	68.23

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	13.350	13.200	13.050	12.900	12.750	12.600	12.450	12.300	12.150	12.000
RD (k Ω)	60.66	54.34	49.00	44.42	40.46	36.98	33.92	31.20	28.76	26.57

□□S24W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	23.760	23.520	23.280	23.040	22.800	22.560	22.320	22.080	21.840	21.600
RD (k Ω)	4947.67	2439.33	1603.22	1185.17	934.33	767.11	647.67	558.08	488.41	432.67

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	21.360	21.12	20.88	20.64	20.40	20.16	19.92	19.68	19.44	19.20
RD (k Ω)	378.06	349.06	316.90	289.33	265.44	244.54	226.10	209.70	195.04	181.83

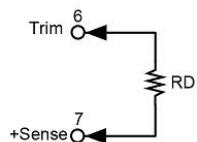
□□S28W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	27.720	27.440	27.160	26.880	26.600	26.320	26.040	25.760	25.480	25.200
RD (k Ω)	5031.00	2481.00	1631.00	1206.00	951.00	781.00	659.57	568.50	497.67	441.00

ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	24.920	24.640	24.360	24.080	23.800	23.520	23.240	22.960	22.680	22.400
RD (k Ω)	394.64	356.00	323.31	295.29	271.00	249.75	231.00	214.33	199.42	186.00

OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down



□□S48W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	47.520	47.04	46.56	46.08	45.60	45.12	44.64	44.16	43.68	43.20
RD (k Ω)	6163.25	3035.13	1992.42	1471.06	1158.25	949.71	800.75	689.03	602.14	532.63
ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	42.720	42.240	41.760	41.280	40.800	40.320	39.840	39.360	38.880	38.400
RD (k Ω)	475.75	428.35	388.25	353.88	324.08	298.2	275.01	254.54	236.28	219.81

□□S54W

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	53.460	52.920	52.380	51.840	51.300	50.760	50.220	49.680	49.140	48.600
RD (k Ω)	6201.44	3054.22	2005.15	1480.61	1165.89	956.07	806.21	693.81	606.38	536.44
ΔV (%)	11	12	13	14	15	16	17	18	19	20
Vout (V)	48.060	47.520	46.980	46.440	45.900	45.360	44.820	44.280	43.740	43.200
RD (k Ω)	479.22	431.54	391.19	356.60	326.63	300.40	277.26	256.69	238.29	221.72