



P-DUKE POWER

FEC40 Series

DC-DC Converter
Up to 40 Watts

3

YEARS
WARRANTY

ROHS
COMPLIANT

REACH
COMPLIANT



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



Railway

c US CB CE

1600
VDC
Isolation
Voltage

2 : 1
Input
Range

6
sided
Shielding

REMOTE
ON
OFF

OCP

OTP

OVP

SCP

UVP

PART NUMBER STRUCTURE

FEC40 - 48 S 05 - HC

Series Name	Input Voltage (VDC)	Output Quantity	Output Voltage (VDC)	Assembly Option
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12:9~18
24:18~36
48:36~75

S:Single

1P5:1.5
1P8:1.8
2P5:2.5
3P3:3.3
05:5
12:12
15:15

□: None
HC: Heat-sink with Clamp

D: Dual

12:±12
15:±15

Dual Positive

3305:3.3 / 5

T: Triple

3312:3.3 / ±12
3315:3.3 / ±15
0512:5 / ±12
0515:5 / ±15

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	Min. Load mA	Full Load mA	mA	%	μF
FEC40-12S1P5	9 ~ 18	1.5	0	8000	110	84	45000
FEC40-12S1P8	9 ~ 18	1.8	0	8000	110	82	37700
FEC40-12S2P5	9 ~ 18	2.5	0	8000	110	84	27000
FEC40-12S3P3	9 ~ 18	3.3	0	8000	175	86	21000
FEC40-12S05	9 ~ 18	5	0	8000	225	86	13600
FEC40-12S12	9 ~ 18	12	0	3333	255	86	2360
FEC40-12S15	9 ~ 18	15	0	2666	310	87	1510
FEC40-12D12	9 ~ 18	±12	±144	±1800	30	85	±1200
FEC40-12D15	9 ~ 18	±15	±112	±1400	35	85	±750
FEC40-12D3305	9 ~ 18	3.3 / 5	0	4000 / 4000	325	85	11000 / 6800
FEC40-12T3312	9 ~ 18	3.3 / ±12	600 / ±40	6000 / ±400	215	84	13000 / ±330
FEC40-12T3315	9 ~ 18	3.3 / ±15	600 / ±30	6000 / ±300	230	84	13000 / ±110
FEC40-12T0512	9 ~ 18	5 / ±12	600 / ±40	6000 / ±400	280	86	6800 / ±330
FEC40-12T0515	9 ~ 18	5 / ±15	600 / ±30	6000 / ±300	255	86	6800 / ±110
FEC40-24S1P5	18 ~ 36	1.5	0	8000	40	81	45000
FEC40-24S1P8	18 ~ 36	1.8	0	8000	40	83	37700
FEC40-24S2P5	18 ~ 36	2.5	0	8000	40	86	27000
FEC40-24S3P3	18 ~ 36	3.3	0	8000	60	87	21000
FEC40-24S05	18 ~ 36	5	0	8000	80	89	13600
FEC40-24S12	18 ~ 36	12	0	3333	70	88	2360
FEC40-24S15	18 ~ 36	15	0	2666	85	89	1510
FEC40-24D12	18 ~ 36	±12	±144	±1800	20	87	±1200
FEC40-24D15	18 ~ 36	±15	±112	±1400	20	87	±750
FEC40-24D3305	18 ~ 36	3.3 / 5	0	4000 / 4000	80	86	11000 / 6800
FEC40-24T3312	18 ~ 36	3.3 / ±12	600 / ±40	6000 / ±400	65	85	13000 / ±330
FEC40-24T3315	18 ~ 36	3.3 / ±15	600 / ±30	6000 / ±300	65	85	13000 / ±110
FEC40-24T0512	18 ~ 36	5 / ±12	600 / ±40	6000 / ±400	60	87	6800 / ±330
FEC40-24T0515	18 ~ 36	5 / ±15	600 / ±30	6000 / ±300	75	87	6800 / ±110
FEC40-48S1P5	36 ~ 75	1.5	0	8000	25	82	45000
FEC40-48S1P8	36 ~ 75	1.8	0	8000	25	84	37700
FEC40-48S2P5	36 ~ 75	2.5	0	8000	25	86	27000
FEC40-48S3P3	36 ~ 75	3.3	0	8000	35	88	21000
FEC40-48S05	36 ~ 75	5	0	8000	40	90	13600
FEC40-48S12	36 ~ 75	12	0	3333	50	89	2360
FEC40-48S15	36 ~ 75	15	0	2666	50	89	1510
FEC40-48D12	36 ~ 75	±12	±144	±1800	15	87	±1200
FEC40-48D15	36 ~ 75	±15	±112	±1400	15	87	±750
FEC40-48D3305	36 ~ 75	3.3 / 5	0	4000 / 4000 ⁽³⁾	45	88	11000 / 6800
FEC40-48T3312	36 ~ 75	3.3 / ±12	600 / ±40	6000 / ±400	35	86	13000 / ±330
FEC40-48T3315	36 ~ 75	3.3 / ±15	600 / ±30	6000 / ±300	35	86	13000 / ±110
FEC40-48T0512	36 ~ 75	5 / ±12	600 / ±40	6000 / ±400	30	88	6800 / ±330
FEC40-48T0515	36 ~ 75	5 / ±15	600 / ±30	6000 / ±300	40	88	6800 / ±110

* The output requires a minimum loading on the output to maintain specified regulation. Operation under no-load condition will not damage these devices, however they may not meet all listed specification.

* Any condition of dual output (3.3Vout, 5Vout) rated lout current do not exceed 8A of total output currents.

INPUT SPECIFICATIONS

Parameter	Conditions		Min.	Typ.	Max.	Unit
Operating input voltage range		12Vin(nom)	9	12	18	VDC
		24Vin(nom)	18	24	36	
		48Vin(nom)	36	48	75	
Start up voltage		12Vin(nom)			9	VDC
		24Vin(nom)			17.8	
		48Vin(nom)			36	
Shutdown voltage		12Vin(nom)	7	8	8.8	VDC
		24Vin(nom)	15	16	17.5	
		48Vin(nom)	32.5	34	35.5	
Start up time	Constant resistive load	Power up		25		ms
		Remote ON/OFF		25		
Input surge voltage	100 ms, max.	12Vin(nom)			36	VDC
		24Vin(nom)			50	
		48Vin(nom)			100	
Input filter			L-C type			
Remote ON/OFF	Referred to –Vin pin	Positive logic		Open or 3.5 ~ 12VDC		
		DC-DC ON		Short or 0 ~ 1.2VDC		
		DC-DC OFF				
		Input current of Ctrl pin	-0.5	+0.5	mA	
		Remote off input current		2.5		mA

OUTPUT SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Voltage accuracy	Single / Dual	-1.0		+1.0	%
	Triple: 3.3Vout, 5Vout	-1.0		+1.0	
	Triple: 12Vout, 15Vout	-5.0		+5.0	
Line regulation	Low Line to High Line at Full Load	Single / Dual		+0.5	%
		Triple: 3.3Vout, 5Vout		+1.0	
		Triple: 12Vout, 15Vout		+5.0	
Load regulation	Single / Dual: Min. Load to Full Load	Single		+0.5	%
		Dual		+1.0	
	Triple: Main output:(3.3Vout,5Vout) 10% to 100% with 10% to 100% balanced on auxiliaries. Auxiliary outputs 10% to 100% balanced on all Outputs.	Triple: 3.3Vout, 5Vout		+2.0	
		Triple: 12Vout, 15Vout		+5.0	
Cross regulation	Dual: Asymmetrical load 25%/100% FL Triple: Main output:(3.3Vout,5Vout) 100% load, auxiliary 100%, other auxiliary 25% to 100% load or main output:(3.3Vout,5Vout) 25%, auxiliary 25%, other auxiliary 25% to 100%.	Dual		+5.0	%
		Triple: 3.3Vout, 5Vout		+1.0	
		Triple: 12Vout, 15Vout		+5.0	
Voltage adjustability	Single and Dual output (not including Dual Positive and triple)	-10		+10	%
Ripple and noise	Measured by 20MHz bandwidth With a 0.1μF/50V MLCC	Single	Others	50	mVp-p
			12Vout, 15Vout	75	
		Dual	12Vout	120	
			15Vout	150	
	With a 1μF ceramic output capacitors	Triple	3.3Vout, 5Vout	50	
			12Vout, 15Vout	75	
		Dual Positive	3.3Vout, 5Vout	100	
Temperature coefficient		-0.02		+0.02	%/°C
Transient response recovery time	25% load step change		250		μs
Over voltage protection	Zener diode clamp	1.5Vout	3.9		VDC
		1.8Vout	3.9		
		2.5Vout	3.9		
		3.3Vout	3.9		
		5Vout	6.2		
		12Vout	15		
		15Vout	18		
Over load protection	% of Iout rated			150	%
Short circuit protection		Continuous, automatics recovery			

GENERAL SPECIFICATIONS

Parameter	Conditions	Min.	Typ.	Max.	Unit
Isolation voltage	1 minute Input to Output Input(Output) to Case	1600 1600			VDC
Isolation resistance	500VDC	1			GΩ
Isolation capacitance				1000	pF
Switching frequency	Others	270	300	330	
	Dual Positive	270	300	330	kHz
	5Vout 3.3Vout	450	500	550	
Safety approvals	IEC/ UL/ EN60950-1			UL:E193009 CB: UL(Demko)	
Case material				Nickel-coated copper	
Base material				FR4 PCB	
Potting material				Epoxy (UL94 V-0)	
Weight				60g (2.11oz)	
MTBF	MIL-HDBK-217F, Full load			9.224 x 10 ⁵ hrs	

ENVIRONMENTAL SPECIFICATIONS

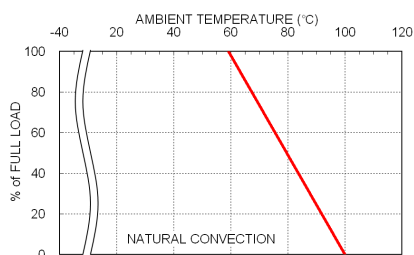
Parameter	Conditions	Min.	Typ.	Max.	Unit
Operating ambient temperature	With derating	-40		+85	°C
Maximum case temperature				+100	°C
Over temperature protection			+115		°C
Storage temperature range		-55		+125	°C
Thermal impedance	Without heat-sink		9.2		
	With heat-sink		7.6		°C/W
	With heat-sink (500LFM)		2.8		
Thermal shock				MIL-STD-810F	
Vibration				MIL-STD-810F	
Relative humidity				5% to 95% RH	

EMC SPECIFICATIONS

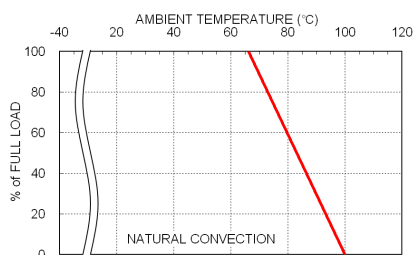
Parameter	Conditions	Level
EMI	EN55032 With external components	Class A, Class B
ESD	EN61000-4-2 Air ± 8kV and Contact ± 6kV	Perf. Criteria B
Radiated immunity	EN61000-4-3 10 V/m	Perf. Criteria A
Fast transient	EN61000-4-4 ±2kV	Perf. Criteria B
Surge	EN61000-4-5 ±1kV With an external input filter capacitor (Nippon chemi-con KY series, 220μF/100V)	Perf. Criteria B
	With an external input filter capacitor (Nippon chemi-con KY series, 220μF/100V)	
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

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

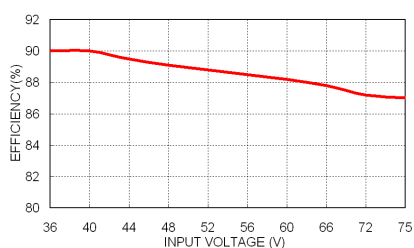
CHARACTERISTIC CURVE



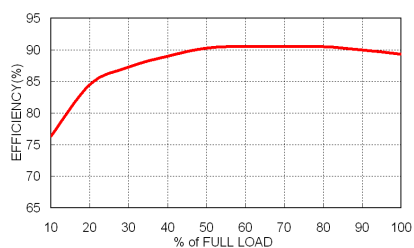
FEC40-48S05 Derating Curve



FEC40-48S05 Derating Curve With Heat-sink



FEC40-48S05 Efficiency vs. Input Voltage



FEC40-48S05 Efficiency vs. Output Load

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.

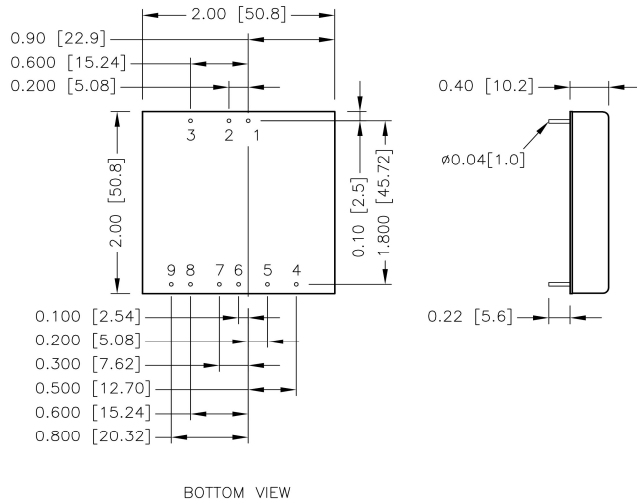
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

Model	Fuse Rating (A)	Fuse Type
FEC40-12S□□、FEC40-12D□□、FEC40-12T□□	8	Fast-Acting
FEC40-24S□□、FEC40-24D□□、FEC40-24T□□	4	Slow-Blow
FEC40-48S□□、FEC40-48D□□、FEC40-48T□□	2	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

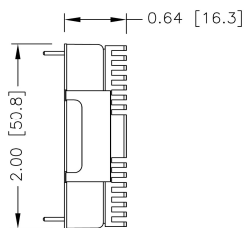
PIN	SINGLE	DUAL	DUAL POSITIVE	TRIPLE
1	+Vin	+Vin	+Vin	+Vin
2	-Vin	-Vin	-Vin	-Vin
3	Ctrl	Ctrl	Ctrl	Ctrl
4	NC	No pin	3.3Vout	+Aux
5	-Sense	+Vout	Common	Common
6	+Sense	Common	NC	-Aux
7	+Vout	Common	NC	+Vout
8	-Vout	-Vout	5Vout	Common
9	Trim	Trim	Common	NC

* NC : No Connection

1. All dimensions in inch [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 ± 0.01 [0.25]
4. Pin dimension tolerance ± 0.004 [0.10]

HEAT-SINK OPTIONS

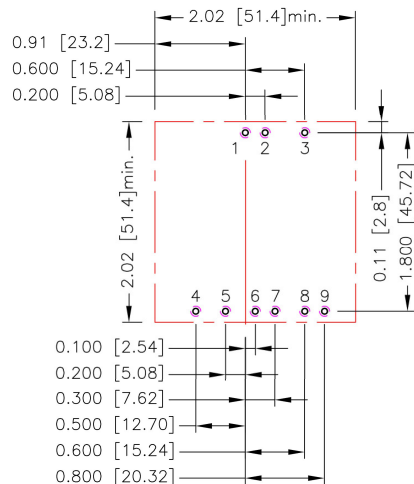
-HC (Heat-sink with clamps)



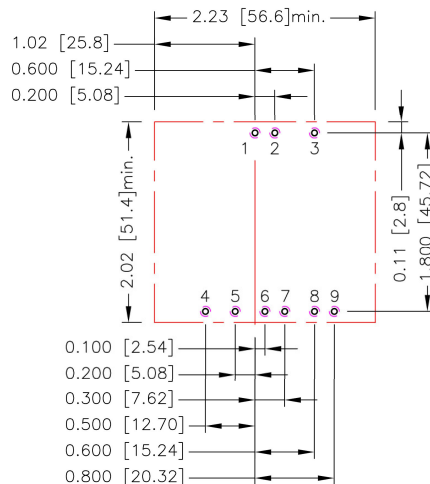
* All dimensions in inch [mm]

RECOMMENDED PAD LAYOUT

Standard



-HC



All dimensions in inch[mm]
 Pad size(lead free recommended)
 Through hole 1.2.3.4.5.6.7.8.9: $\varnothing 0.051$ [1.30]
 Top view pad 1.2.3.4.5.6.7.8.9: $\varnothing 0.064$ [1.63]
 Bottom view pad 1.2.3.4.5.6.7.8.9: $\varnothing 0.102$ [2.60]

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.

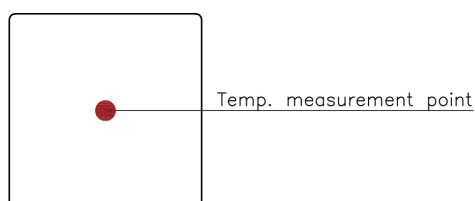
Proper cooling can be verified by measuring the point as the figure below.

The temperature at this location should not exceed 100°C.

When Operating, adequate cooling must be provided to maintain the test point temperature at or below 100°C.

Although the maximum point Temperature of the power modules is 100°C, you can limit this Temperature to a lower value for extremely high reliability.

- Thermal test condition with vertical direction by natural convection (20LFM).



TOP VIEW

OUTPUT VOLTAGE ADJUSTMENT

Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of the module.

Single Output

This is accomplished 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, the output voltage set point increases.

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

The external Trim resistor needs to be at least 1/16W resistors.

Dual Output

This is accomplished by connecting an external resistor between the Trim pin and either the +Output or -Output pins.

With an external resistor between the Trim and -Output pin, the output voltage set point increases.

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

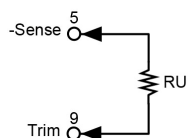
The external Trim resistor needs to be at least 1/16W resistors.

EXTERNAL OUTPUT TRIMMING

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

Trim-up

Single Output



□□S1P5

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	1.515	1.53	1.545	1.56	1.575	1.59	1.605	1.62	1.635	1.65
RU (k Ω)	4.578	2.605	1.227	0.808	0.557	0.389	0.27	0.18	0.11	0.054

□□S1P8

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	1.818	1.836	1.854	1.872	1.89	1.908	1.926	1.944	1.962	1.98
RU (k Ω)	11.639	5.205	3.06	1.988	1.344	0.915	0.609	0.379	0.2	0.057

□□S2P5

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	2.525	2.55	2.575	2.6	2.625	2.65	2.675	2.7	2.725	2.75
RU (k Ω)	37.076	16.675	9.874	6.474	4.434	3.074	2.102	1.374	0.807	0.354

□□S3P3

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
RU (k Ω)	57.930	26.165	15.577	10.283	7.106	4.988	3.476	2.341	1.459	0.753

□□S05

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
RU (k Ω)	36.570	16.580	9.917	6.585	4.586	3.253	2.302	1.588	1.032	0.588

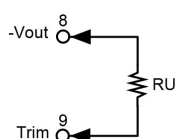
□□S12

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
RU (k Ω)	367.910	165.950	98.636	64.977	44.782	31.318	21.701	14.488	8.879	4.391

□□S15

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
RU (k Ω)	404.180	180.590	106.060	68.796	46.437	31.531	20.883	12.898	6.687	1.718

Dual Output



□□D12

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	±12.12	±12.24	±12.36	±12.48	±12.6	±12.72	±12.84	±12.96	±13.08	±13.2
RU (k Ω)	218.21	98.105	58.07	38.052	26.042	18.035	12.316	8.026	4.69	2.021

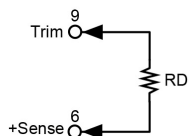
□□D15

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	±15.15	±15.3	±15.45	±15.6	±15.75	±15.9	±16.05	±16.2	±16.35	±16.5
RU (k Ω)	268.29	120.64	71.429	46.822	32.058	22.215	15.184	9.911	5.81	2.529

OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down

Single Output



□□S1P5

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	1.485	1.47	1.455	1.44	1.425	1.41	1.395	1.38	1.365	1.35
RD (k Ω)	5.704	2.571	1.527	1.005	0.692	0.483	0.334	0.222	0.135	0.065

□□S1P8

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	1.782	1.764	1.746	1.728	1.71	1.692	1.674	1.656	1.638	1.62
RD (k Ω)	14.66	6.57	3.874	2.525	1.716	1.177	0.792	0.503	0.278	0.098

□□S2P5

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	2.475	2.45	2.425	2.4	2.375	2.35	2.325	2.3	2.275	2.25
RD (k Ω)	49.641	22.481	13.428	8.902	6.186	4.375	3.082	2.112	1.358	0.754

□□S3P3

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)	69.470	31.235	18.490	12.117	8.294	5.745	3.924	2.559	1.497	0.647

□□S05

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)	45.533	20.612	12.306	8.152	5.660	3.999	2.812	1.922	1.230	0.676

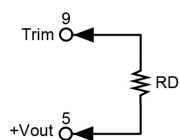
□□S12

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)	460.990	207.950	123.600	81.423	56.118	39.249	27.199	18.162	11.132	5.509

□□S15

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)	499.820	223.410	131.270	85.204	57.563	39.136	25.974	16.102	8.424	2.282

Dual Output



□□D12

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	± 11.88	± 11.76	± 11.64	± 11.52	± 11.4	± 11.28	± 11.16	± 11.04	± 10.92	± 10.8
RD (k Ω)	273.44	123.02	72.874	47.803	32.76	22.732	15.568	10.196	6.017	2.675

□□D15

ΔV (%)	1	2	3	4	5	6	7	8	9	10
Vout (V)	± 14.85	± 14.7	± 14.55	± 14.4	± 14.25	± 14.1	± 13.95	± 13.8	± 13.65	± 13.5
RD (k Ω)	337.71	152.02	90.126	59.178	40.609	28.23	19.387	12.756	7.598	3.471