

ACT4524

5V/3.4A Car Charger Solution

Application Report

Car Charger Using ACT4524

FEATURES

- Wide input voltage range from 6.5V to 36V
- Transparent input voltage surge up to 40V
- 4.75V-5.25V during input and load transients
- Dual 5.1V outputs with 1% accuracy
- 2.65A constant current regulation for VOUT1
- 1.2A constant current regulation for VOUT2
- Hiccup mode protection at output short
- 90% efficiency at full load
- 0.5mA low standby input current
- 5.7V over voltage protection
- Cord voltage drop compensation
- Meet EN55022 Class B radiated EMI standard
- SOP-8EP package

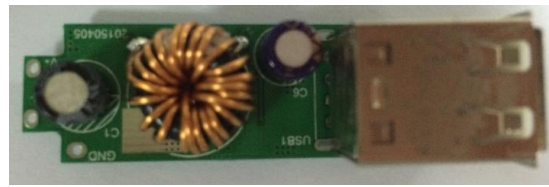
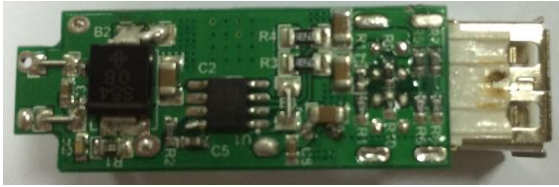
SPECIFICATION

DESCRIPTION	CONDITION	MIN	TYP	MAX	UNITS
Input Voltage		10		40	V
Switching Frequency			125		kHz
No-load Standby Input current	Vin=12V no load		0.48		mA
	Vin=24V no oad		0.44		mA
Output Voltage	CSP		5.1		V
Output1 Current	CS1, Rcs1=25mΩ	2.5	2.65	2.8	A
Output2 Current	CS2, Rcs1=50mΩ	1.1	1.2	1.3	A
Ripple Voltage	Vin=12V, Io=3.4A		29		mVpp
	Vin=24V, Io=3.4A		33		
Efficiency at full load	Vin=12V, Io=3.4A		90.21		%
	Vin=24V, Io=3.4A		89.75		%
ENVIRONMENTAL					
ESD	Contact		4		kV
	Through air		8		kV
Ambient Temperature	Free convection	0		50	°C

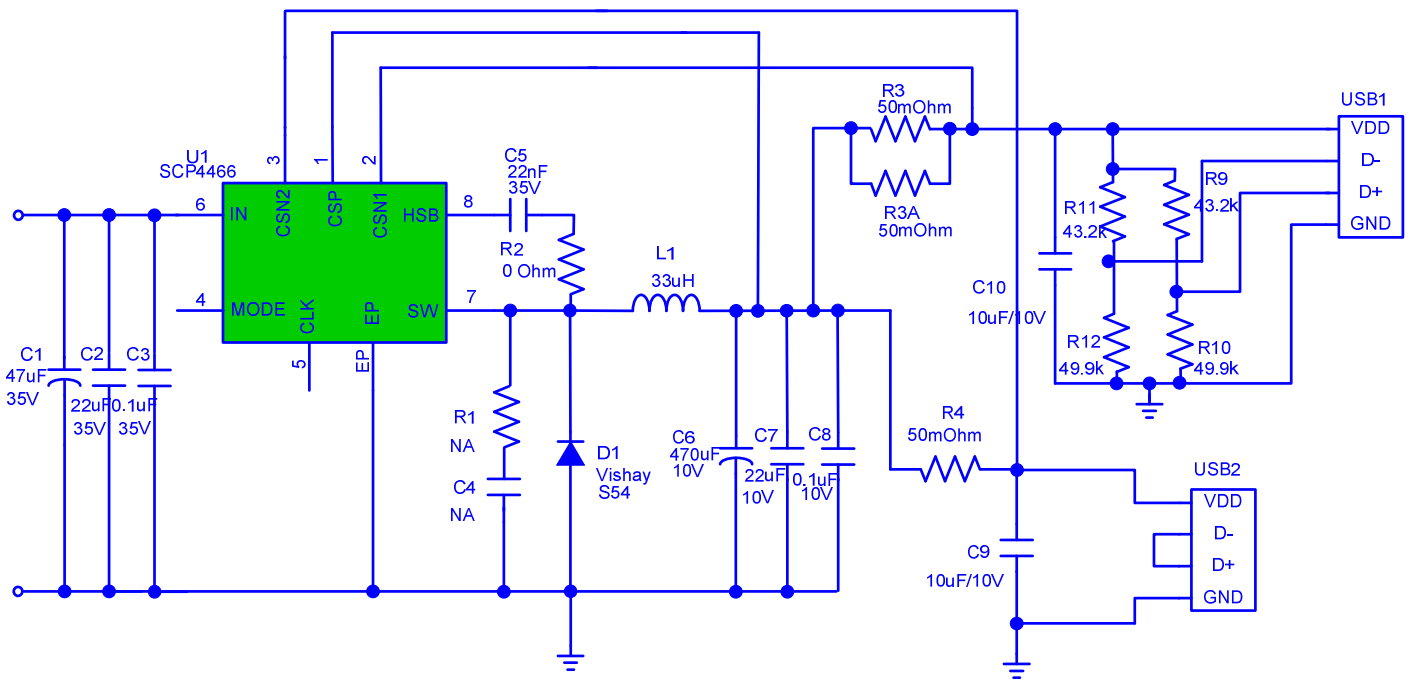
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1. DEMO BOARD PHOTO

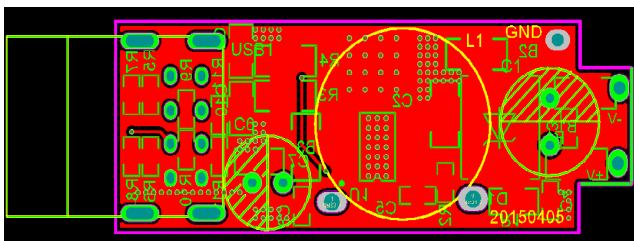


2. SCHEMATIC

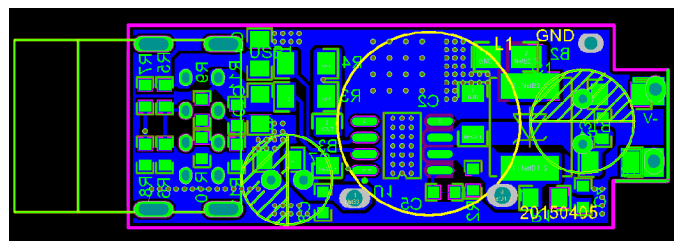


3. PCB LAYOUT

TOP LAYER



BOTTOM LAYER



4. BILL OF MATERIALS

Item	Reference	Description	QTY	Manuf.
1	L1	Choke Coil, Dip, T11.5*5*4mm, phi=0.8mm, L=33uH	1	
2	D1	Schottky Diode, S54, 40V/5A, SMC	1	Vishay
3	C1	Electrolytic capacitor, 47uF/35V, 7x8mm	1	Koshin
4	C2	Ceramic capacitor, 22uF/35V, X7R, 1206	1	Murata/TDK
5	C3	Ceramic capacitor, 0.1uF/35V, X7R, 0603	1	Murata/TDK
6	C4	Ceramic capacitor, 2.2nF/25V, X7R, 0603(NA)	1	Murata/TDK
7	C5	Ceramic capacitor, 22nF/25V, X7R, 0603	1	Murata/TDK
8	C6	Electrolytic capacitor, 220uF/10V, 6.3x7mm	1	Murata/TDK
9	C7,C9,C10	Ceramic capacitor, 22uF/10V, X7R, 1206	3	Murata/TDK
10	C8	Ceramic capacitor, 0.1uF/10V, X7R, 0603	1	Murata/TDK
11	F1	Fuse, 3A, 1206 (Replaced by 0Ω 0805 chip resistor)	1	Murata/TDK
12	R1	Chip Resistor, 10Ω, 1/8W, 5%, 0805(NA)	1	Murata/TDK
13	R2	Chip Resistor, 0Ω, 1/10W, 5%, 0603	1	Murata/TDK
14	R3,R3A,R4	Chip Resistor, 50mΩ, 1/4W, 1%, 1206	3	Murata/TDK
15	R9,R11	Chip Resistor, 43.2KΩ, 1/10W, 1%, 0603	2	Murata/TDK
16	R10,R12	Chip Resistor, 49.9KΩ, 1/10W, 1%, 0603	2	Murata/TDK
17	U1	IC, ACT4524, SOP-8-EP	1	ACT
18	USB1, USB2	USB Rev:A	1	

5. FUNCTIONAL TEST

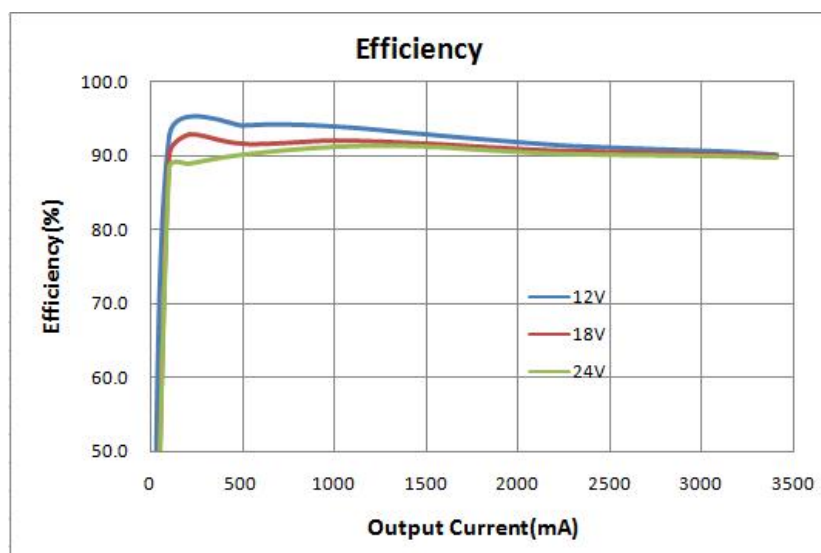
5.1. Output Regulation

VIN	Output1 Voltage(V) at Max. load	Output1 Voltage (V) at No load	Load regulation	Iload(max)
12V	5.084	5.101	0.33%	2.4A
18V	5.084	5.101	0.33%	
24V	5.84	5.101	0.33%	

VIN	Output2 Voltage(V) at Max. load	Output2 Voltage (V) at No load	Load regulation	Iload(max)
12V	5.038	5.101	1.24%	1.2A
18V	5.038	5.101	1.24%	
24V	5.038	5.101	1.24%	

5.2. Efficiency (Ta=25C)

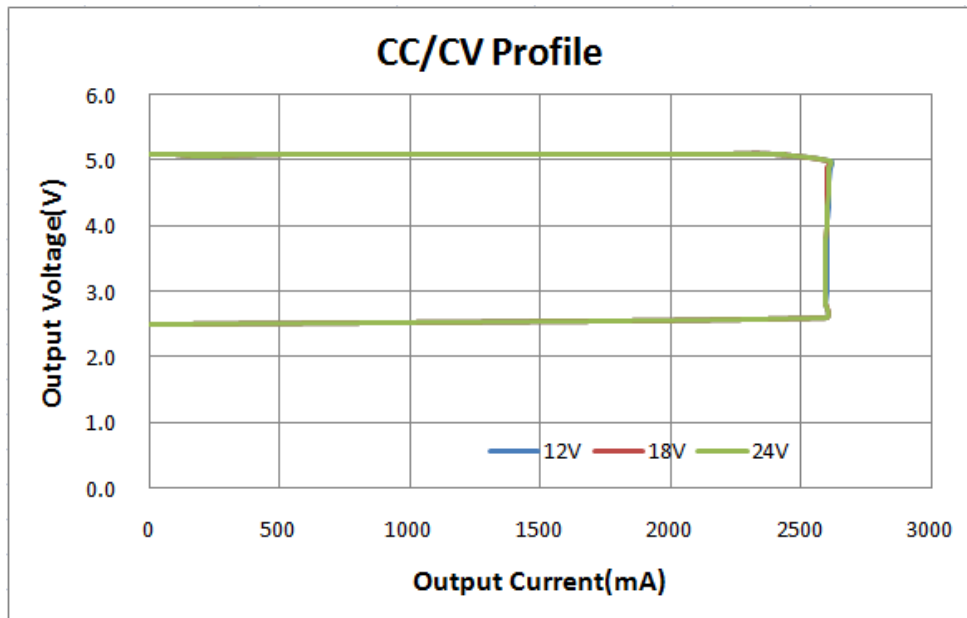
VIN	Efficiency (%)					
	Io=100mA	Io=1000mA	Io=2100mA	Io=2400mA	Io=3100mA	Io=3400mA
12V	92.7	94.0	91.7	91.2	90.6	90.2
18V	90.1	92.0	90.8	90.5	90.2	89.9
24V	88.4	91.2	90.4	90.3	90.0	89.8



5.3. Constant Current and Constant Voltage (Ta=25C)

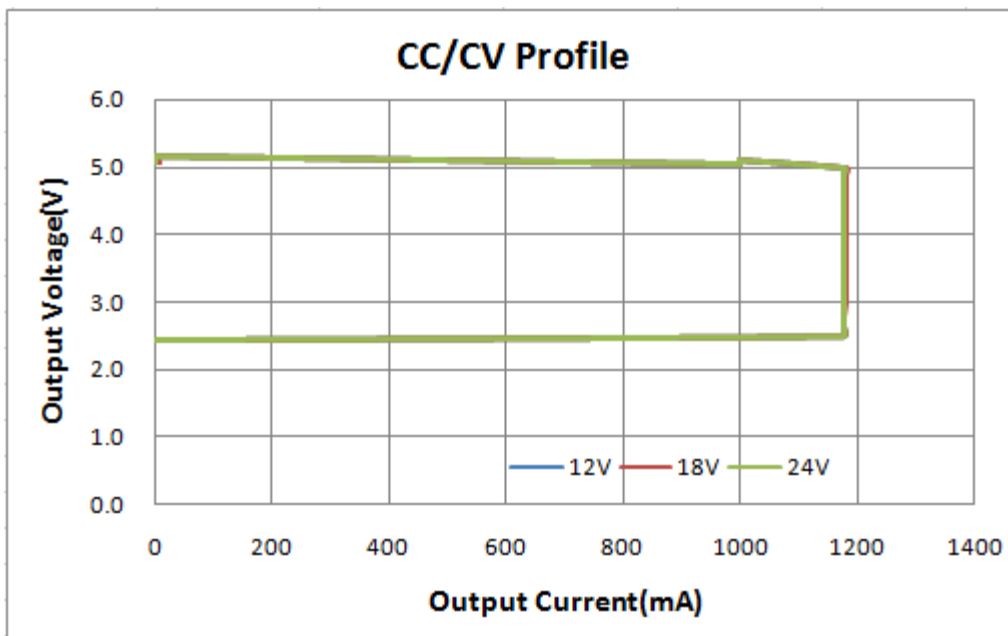
Output1

	Vin=12V		Vin=18V		Vin=24V	
	Vout(V)	Iout(mA)	Vout(V)	Iout(mA)	Vout (V)	Iout(mA)
CC Load	5.092	0	5.093	0	5.096	0
	5.090	1000	5.090	1000	5.094	1000
	5.089	1500	5.090	1500	5.092	1500
	5.090	2100	5.092	2100	5.094	2100
	5.091	2400	5.093	2400	5.095	2400
CV Load	5.0	2609	5.0	2603	5.0	2607
	4.9	2607	4.9	2600	4.9	1605
	4.5	2603	4.5	2597	4.5	2601
	4.3	2601	4.3	2596	4.3	2599
	4	2598	4	2595	4	2595
	3.5	2596	3.5	2592	3.5	2592
	3	2595	3	2591	3	2589
	2.8	2593	2.8	2590	2.8	2588
	2.6	2593	2.6	2589	2.6	2588
2.5	0	2.5	0	2.5	0	



Output2

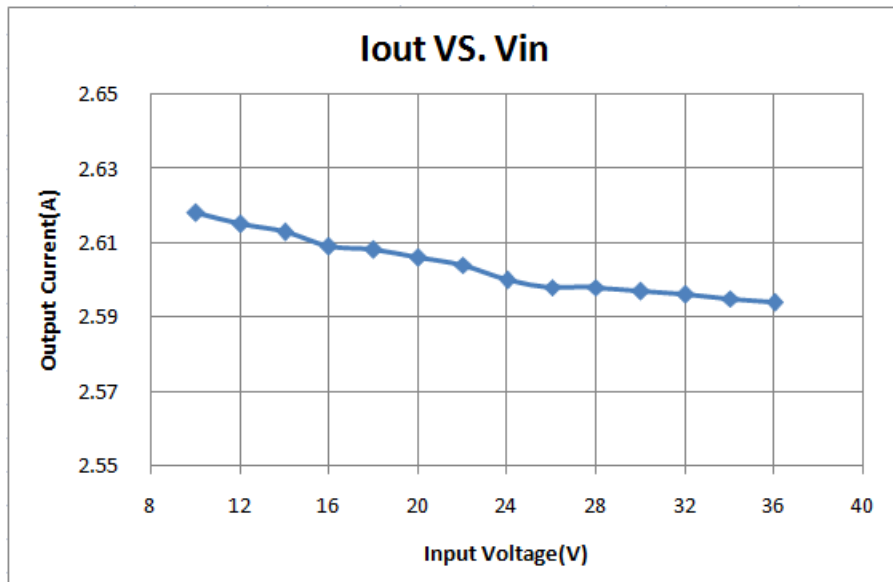
	Vin=12V		Vin=18V		Vin=24V	
	Vout(V)	Iout(mA)	Vout(V)	Iout(mA)	Vout (V)	Iout(mA)
CC Load	5.091	0	5.092	0	5.095	0
	5.051	200	5.075	200	5.077	200
	5.072	500	5.071	500	5.072	500
	5.056	800	5.055	800	5.056	800
	5.046	1000	5.045	1000	5.046	1000
CV Load	5.0	1177	5.0	1182	5.0	1178
	4.9	1177	4.9	1182	4.9	1178
	4.5	1177	4.5	1181	4.5	1177
	4.3	1177	4.3	1180	4.3	1176
	4	1177	4	1180	4	1176
	3.5	1177	3.5	1179	3.5	1176
	3	1177	3	1179	3	1176
	2.8	1177	2.8	1178	2.8	1176
	2.6	1176	2.6	1178	2.6	1176
	2.5	0	2.5	0	2.5	0



5.4. Current Limit vs. Input Voltage

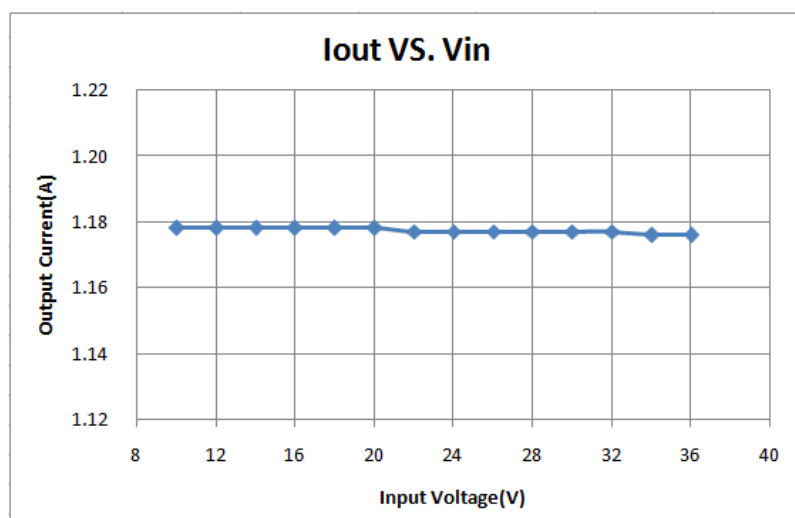
Output1 :No Wind (Test Condition : CV load 4.5V, Ta=25C)

Vin(V)	10	12	14	16	18	20	24	27	30	32	34	36
Iout1(A)	2.618	2.615	2.613	2.609	2.608	2.606	2.600	2.598	2.597	2.596	2.595	2.594



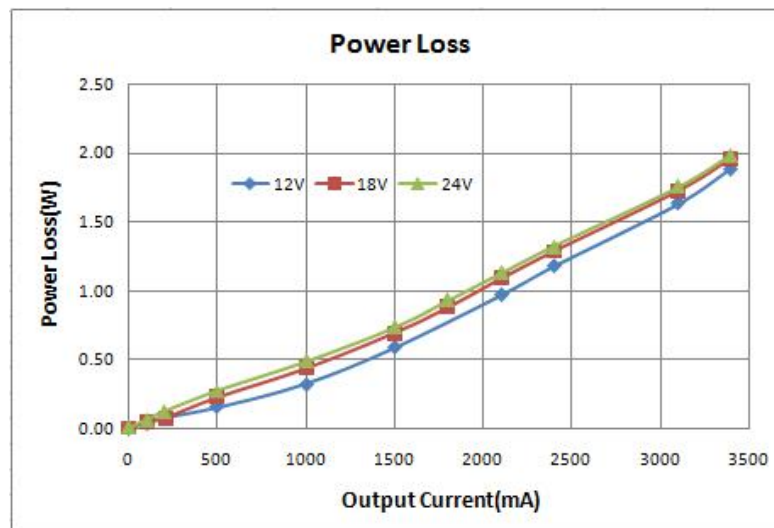
Output2 :No Wind (Test Condition : CV load 4.5V, Ta=25C)

Vin(V)	10	12	14	16	18	20	24	27	30	32	34	36
Iout2(A)	1.178	1.178	1.178	1.178	1.178	1.178	1.177	1.177	1.177	1.177	1.176	1.176



5.5. Power Loss

Vin	Power loss (W)					
	Io=0mA	Io=100mA	Io=1000mA	Io=2400mA	Io=3100mA	Io=3400mA
Vin=12V	0.01	0.04	0.32	1.18	1.63	1.88
Vin=18V	0.01	0.06	0.44	1.28	1.72	1.96
Vin=24V	0.01	0.07	0.49	1.32	1.75	1.98



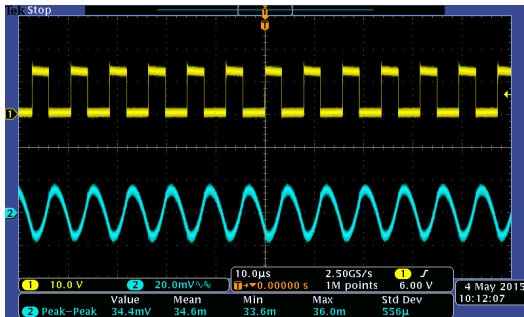
5.6. Standby Input Current

Test Conditions	Input Current (mA)	Power Loss at No Load (mW)
Vin=10V	0.50	5.00
Vin=12V	0.48	5.76
Vin=18V	0.44	7.92
Vin=24V	0.44	10.56
Vin=30V	0.43	12.9

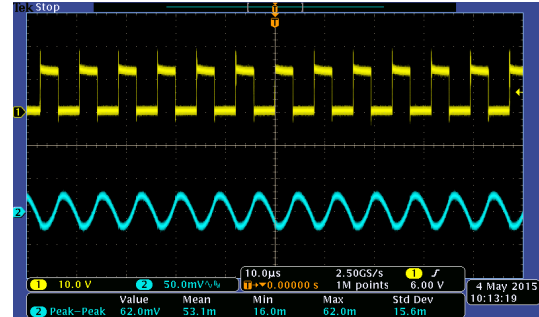
5.7. Ripple and Noise

CH1:SW CH2:Vout

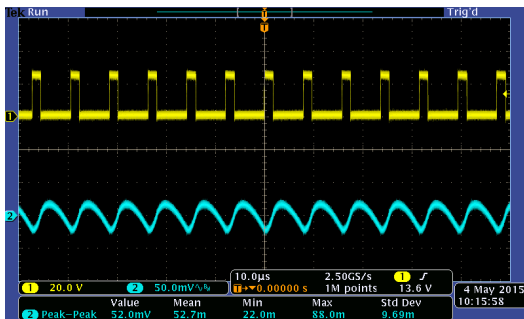
Vin=12V 1A output load



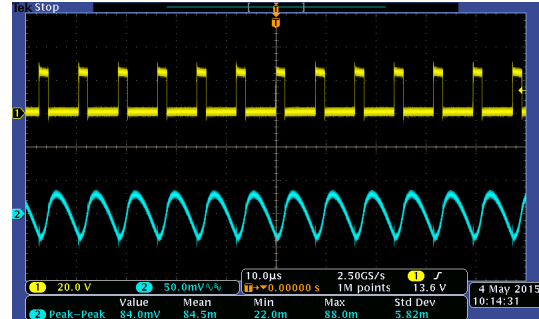
Vin=12V 3.8A output load



Vin=24V 1A output load



Vin=24V 3.8A output load

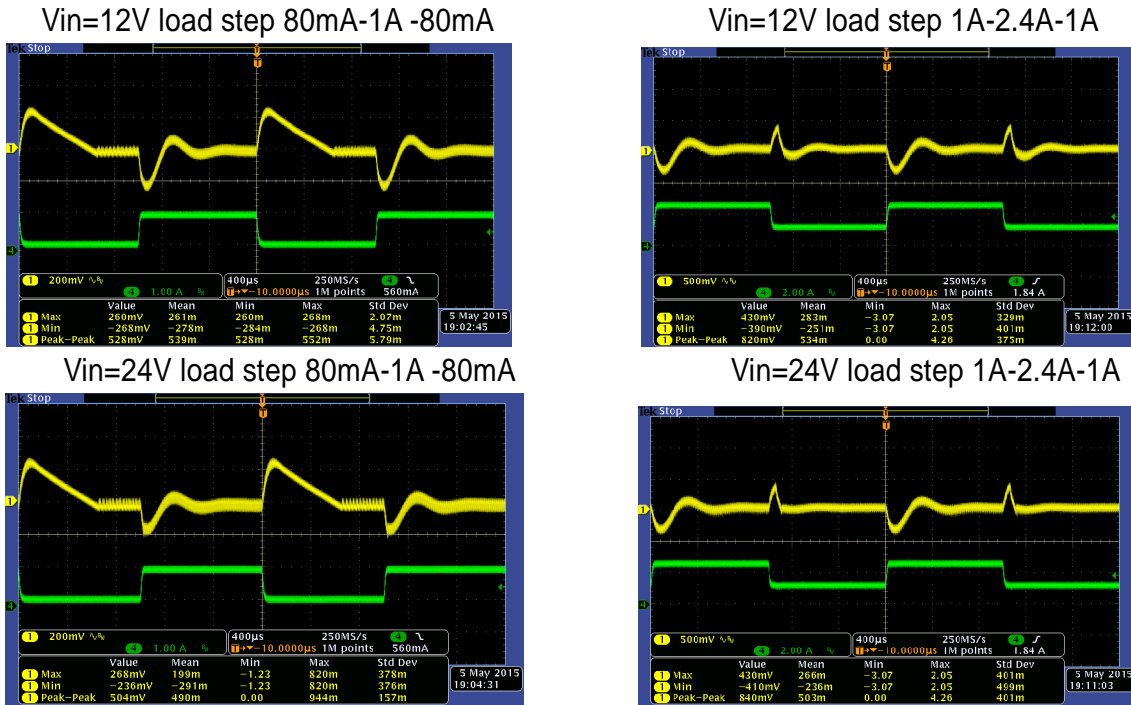


Ripple & noise are measured by using 20MHz bandwidth limited oscilloscope.

Test Conditions	Output Ripple at 1A Load (mV)	Output Ripple at 3.8A Load (mV)
Vin=12V	34	62
Vin=24V	52	84

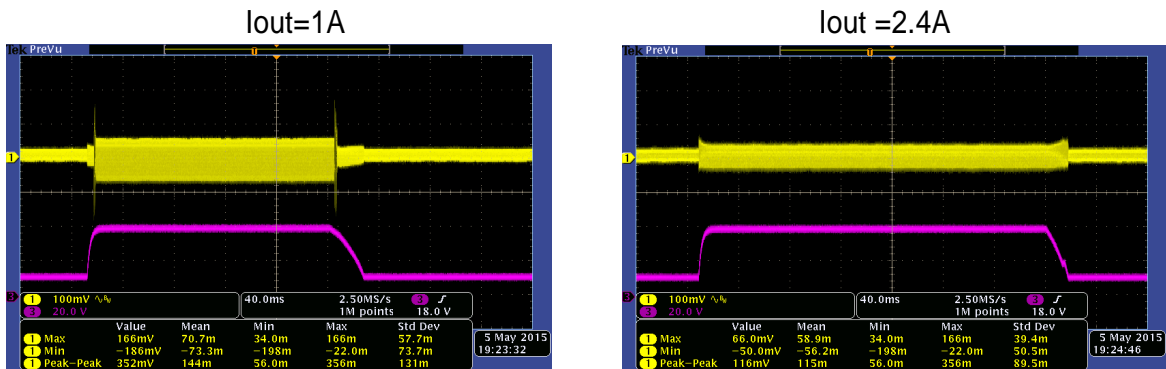
5.8. Load Dynamic Response

CH1:Vout CH4:Iout



5.9. Line Dynamic Response(Vin change from 12V to 40V , 1V/uS)

CH1:Vout CH3:Vin

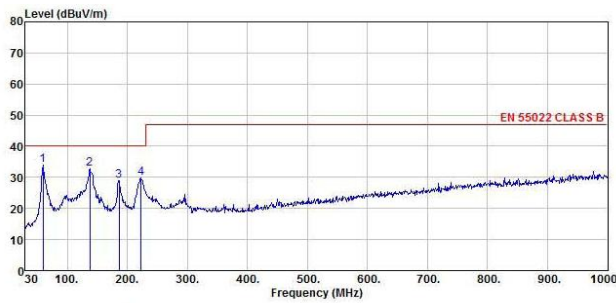


5.10.Key Components Temperature Test (Ta=27C, burning in for 2 hours with CLA)

Vin/Iout	Temperature(°C)			
	IC	Diode	Inductor	PCB
12V/2.4A+1A	77.5	85.8	75.1	67.9
24V/2.4A+1A	76.6	90.2	77.6	68.0
36V/2.4A+1A	76.9	92.8	79.7	68.4

6. EMI TEST

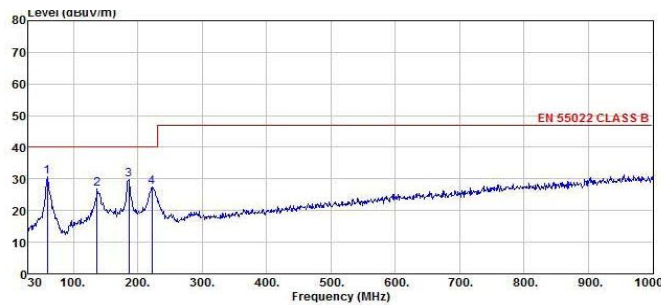
Vin=12V Io=2.4A+1.2A Horizontal



Site : chamber
Condition : EN 55022 CLASS B 3m VULB9160 HORIZONTAL
EUT :
Model Name : HP16-STD
Temp/Humi : 25 °C /56 %
Power Rating :
Mode :
Memo :

	Freq	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp	Level	Limit	Over	
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	Remark
1	pp 59.10	20.35	12.58	1.04	0.00	33.97	40.00	-6.03	Peak
2	137.67	17.88	13.21	1.62	0.00	32.71	40.00	-7.29	Peak
3	186.17	15.53	11.55	1.88	0.00	28.96	40.00	-11.04	Peak
4	223.03	16.73	10.86	2.10	0.00	29.69	40.00	-10.31	Peak

Vin=12V Io=2.4A+1.2A Vertical



Site : chamber
Condition : EN 55022 CLASS B 3m VULB9160 VERTICAL
EUT :
Model Name : HP16-STD
Temp/Humi : 25 °C /56 %
Power Rating :
Mode :
Memo :

	Freq	ReadAntenna Level	Antenna Factor	Cable Loss	Preamp	Level	Limit	Over	
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	Remark
1	pp 59.10	17.02	12.58	1.04	0.00	30.64	40.00	-9.36	Peak
2	136.70	11.93	13.21	1.62	0.00	26.76	40.00	-13.24	Peak
3	186.17	16.28	11.55	1.88	0.00	29.71	40.00	-10.29	Peak
4	222.06	14.62	10.86	2.10	0.00	27.58	40.00	-12.42	Peak