# ACT4515
# High Performance 5V/1.2A Car Charger With USB Application Report

## High Performance Car Charger with EMI Solution

## FEATURES

- Wide input voltage range from 10V to 24V
- 5% output voltage accuracy
- No load standby input current 5mA
- 7.5% constant current accuracy
- Thermal shutdown protection
- Cycle-by-cycle current limit
- Cord compensation
- Over current protection with frequency fold back

## SPECIFICATION

| DESCRIPTION | CONDITION | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|
| Input Voltage | | 10 | | 24 | V |
| Switching Frequency | | | 210 | | kHz |
| No-load Standby Input current | Vin=12V no Load | | 5 | | mA |
| | Vin=24V no Load | | 4 | | mA |
| Output Voltage | | 4.75 | 5 | 5.25 | V |
| Output Current | | | | 1200 | mA |
| Ripple Voltage | Vin=12V Io=1.2A | | 40 | | mVpp |
| Efficiency at full load | Vin=12V Io=1.2A | | 86.3 | | % |
| **ENVIRONMENTAL** | | | | | |
| ESD | Contact | | 4 | | kV |
| | Through air | | 8 | | kV |
| Ambient Temperature | Free convection | 0 | | 50 | ºC |

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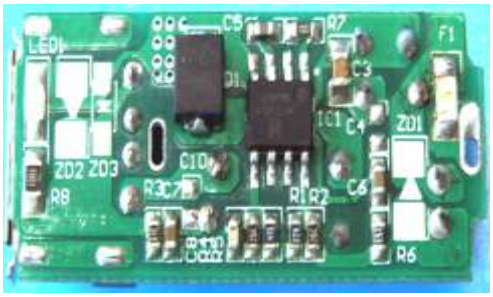
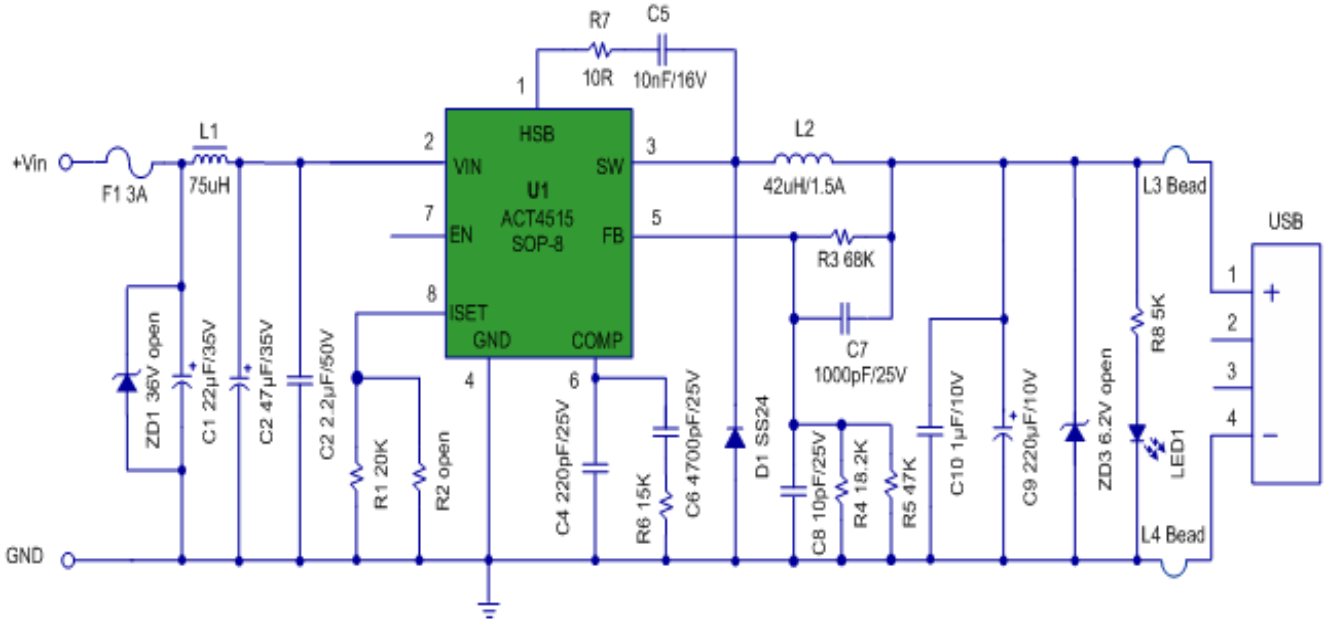
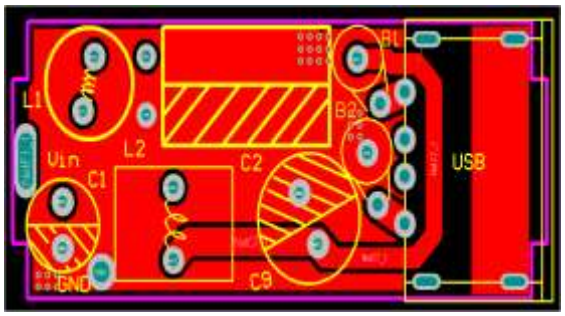
## 1. DEMO BOARD PHOTO

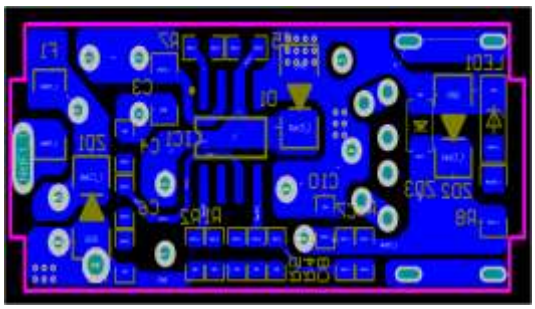


## 2. SCHEMATICS




## 3. PCB LAYOUT





## 4. BILL OF MATERIALS

| Item | Reference | Description | QTY | Manufacturer |
|---|---|---|---|---|
| 1 | F1 | Fuse 3A,1206 | 1 | |
| 2 | L1 | Choke Coil,75uH,DR=6x8mm, 1A, dip | 1 | |
| 3 | L2 | Choke Coil, ring core,42uH,8*4*4mm, 1.5A, dip | 1 | |
| | L3,L4 | Bead,K5B,T3.5x3x1.2mm | | |
| 4 | D1 | Schottky Diode, SS24/40V, 2A, | | Panjit |
| 5 | ZD1 | Open | | |
| 6 | ZD2 | Open | | |
| 7 | ZD3 | Open | | |
| 8 | C1 | Capacitor,Electrolytic,22uF/35V,Φ5x7mm,Dip | 1 | KSC |
| 9 | C2 | Capacitor,Electrolytic,47uF/35V,Φ7.5x8mm,Dip | 1 | Koshin |
| 10 | C3 | Ceramic capacitor, 2.2uF/50V, X7R, 0805 | 1 | Murata/TDK |
| 11 | C4 | Ceramic capacitor, 220pF/25V, X7R, 0603 | 1 | Murata/TDK |
| 12 | C5 | Ceramic capacitor, 10nF/16V, X7R, 0603 | 1 | Murata/TDK |
| 13 | C6 | Ceramic capacitor, 4700pF/25V, X7R, 0603 | 1 | Murata/TDK |
| 14 | C7 | Ceramic capacitor, 1000pF/25V, X7R, 0603 | 1 | Murata/TDK |
| 15 | C8 | Ceramic capacitor, 10pF/25, X7R, 0603 | 1 | Murata/TDK |
| 16 | C9 | Capacitor,Electrolytic,220uF/10V,Φ6.3x7.2mm,Dip | 1 | Micon |
| 17 | C10 | Ceramic capacitor, 1uF/10V, X7R, 0603 | 1 | Murata/TDK |
| 18 | R1 | Chip Resistor, 20KΩ, 1/16W, 1%, 0603 | 1 | Murata/TDK |
| 19 | R2 | Open | | |
| 20 | R3 | Chip Resistor, 68KΩ, 1/16W, 1%, 0603 | 1 | Murata/TDK |
| 21 | R4 | Chip Resistor, 18.2KΩ, 1/16W, 1%, 0603 | 1 | Murata/TDK |
| 22 | R5 | Chip Resistor, 47KΩ, 1/16W, 1%, 0603 | 1 | Murata/TDK |
| 23 | R6 | Chip Resistor, 15KΩ, 1/16W ,5%, 0603 | 1 | Murata/TDK |
| 24 | R7 | Chip Resistor, 10Ω, 1/16W, 5%,0603 | 1 | Murata/TDK |
| 25 | R8 | Chip Resistor, 5KΩ, 1/16W, 5%,0805 | 1 | Murata/TDK |
| 26 | U1 | IC, ACT4515 SO-8 | 1 | Active semi |
| 27 | LED | LED ,Green,0805 | 1 | LED Manu |
| 28 | USB | 15mm*10mm*8mm | 1 | USB Manu |

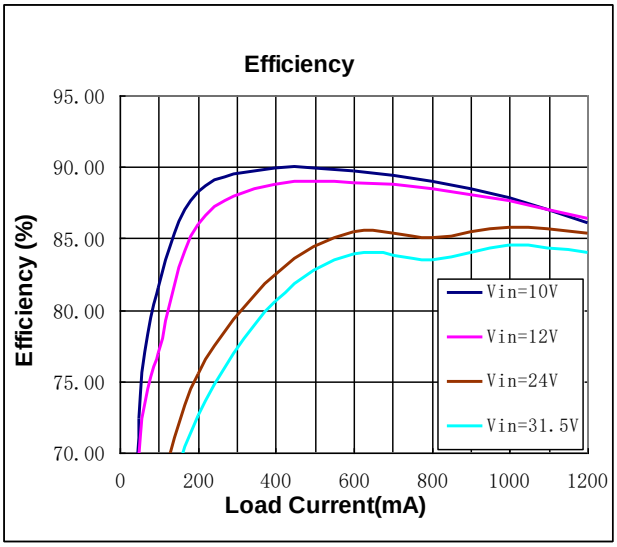
# 5. FUNCTIONAL TEST

## 5.1. Output Regulation

| Voltage | Output Voltage at Max. load | Output Voltage at Min. load | Load regulation | Iload(max) |
|---|---|---|---|---|
| Vin=24V | 5.08 | 4.97 | -2.2% | 1.2A |
| Vin=12V | 5.09 | 4.98 | -2.2% | |

## 5.2. Efficiency

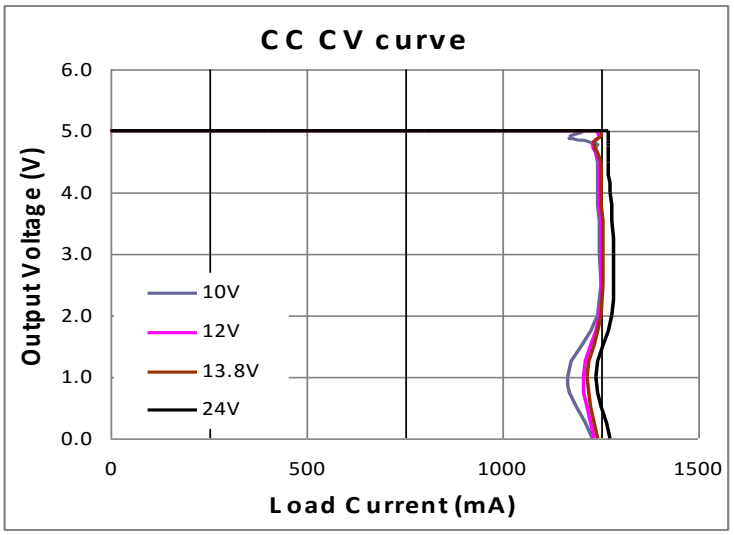
| | Efficiency (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Iout | Io=0mA | Io=100mA | Io=200mA | Io=400mA | Io=600mA | Io=800mA | Io=1000mA | Io=1200mA |
| Vin=31.5V | 0.00 | 63.40 | 72.56 | 80.58 | 83.91 | 83.50 | 84.49 | 84.06 |
| Vin=24V | 0.00 | 66.50 | 75.54 | 82.44 | 85.44 | 85.08 | 85.81 | 85.31 |
| Vin=12V | 0.00 | 76.93 | 85.96 | 88.80 | 88.84 | 88.49 | 87.68 | 86.36 |
| Vin=10V | 0.00 | 81.48 | 88.23 | 89.88 | 89.66 | 88.96 | 87.89 | 86.11 |




## 5.3. Constant Current and Contant Voltage

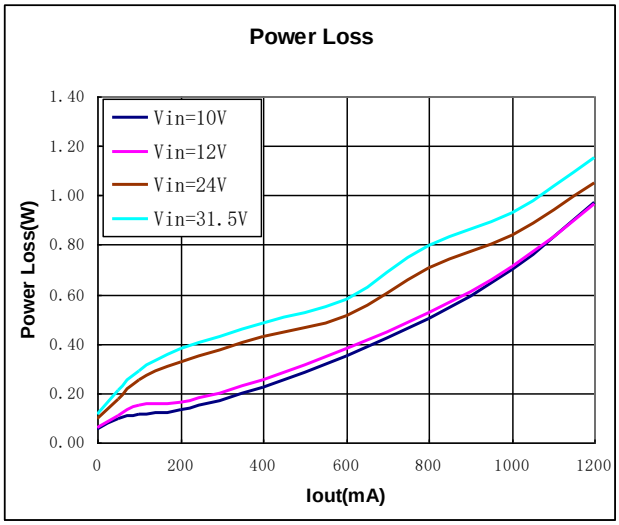
| | Vin=24V Vout | Vin=24V Iout (mA) | Vin=13.8V Vout | Vin=13.8V Iout (mA) | Vin=12V Vout | Vin=12V Iout (mA) | Vin=10V Vout | Vin=10V Iout (mA) |
|---|---|---|---|---|---|---|---|---|
| CC load | 5 | 0 | 5 | 0 | 5 | 0 | 5 | 0 |
| | 5 | 200 | 5 | 200 | 5 | 200 | 5 | 200 |
| | 5 | 400 | 5 | 400 | 5 | 400 | 5 | 400 |
| | 5 | 600 | 5 | 600 | 5 | 600 | 5 | 600 |
| | 5 | 800 | 5 | 800 | 5 | 800 | 5 | 800 |
| | 5 | 1000 | 5 | 1000 | 5 | 1000 | 5 | 1000 |
| | 5 | 1270 | 5 | 1250 | 5 | 1240 | 5 | 1200 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| CV load | 4.95 | 1270 | 4.95 | 1250 | 4.95 | 1245 | 4.95 | 1180 |
| | 4.9 | 1270 | 4.9 | 1250 | 4.9 | 1246 | 4.9 | 1171 |
| | 4.85 | 1270 | 4.85 | 1233 | 4.85 | 1232 | 4.85 | 1192 |
| | 4.8 | 1270 | 4.8 | 1234 | 4.8 | 1233 | 4.8 | 1241 |
| | 4.75 | 1270 | 4.75 | 1233 | 4.75 | 1229 | 4.75 | 1240 |
| | 4.5 | 1270 | 4.5 | 1251 | 4.5 | 1246 | 4.5 | 1242 |
| | 4 | 1274 | 4 | 1254 | 4 | 1248 | 4 | 1244 |
| | 3 | 1284 | 3 | 1259 | 3 | 1253 | 3 | 1247 |
| | 2 | 1278 | 2 | 1254 | 2 | 1248 | 2 | 1243 |
| | 1 | 1238 | 1 | 1216 | 1 | 1209 | 1 | 1166 |
| | 0 | 1273 | 0 | 1244 | 0 | 1236 | 0 | 1230 |




## 5.4. Power Loss

| VIN | Power loss (W) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Io=0mA | Io=100mA | Io=200mA | Io=400mA | Io=600mA | Io=800mA | Io=1000mA | Io=1200mA |
| Vin=31.5V | 0.12 | 0.29 | 0.38 | 0.48 | 0.58 | 0.80 | 0.93 | 1.15 |
| Vin=24V | 0.09 | 0.25 | 0.32 | 0.43 | 0.51 | 0.71 | 0.84 | 1.05 |
| Vin=12V | 0.06 | 0.15 | 0.16 | 0.25 | 0.38 | 0.53 | 0.71 | 0.97 |
| Vin=10V | 0.05 | 0.11 | 0.13 | 0.23 | 0.35 | 0.50 | 0.70 | 0.97 |




## 5.5. Standby Power Loss

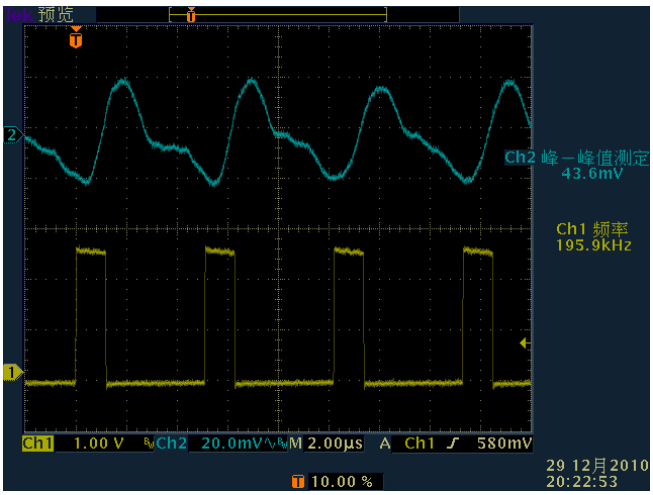
| Test Conditions | Iin at No Load | Power Loss at No Load | |
|---|---|---|---|
| Vin=24V | 4mA | 90mW | Max Load: 1.2A<br>No Load: 0A |
| Vin=12V | 5mA | 60mW | |

## 5.6. Switching Frequency, Ripple and Noise

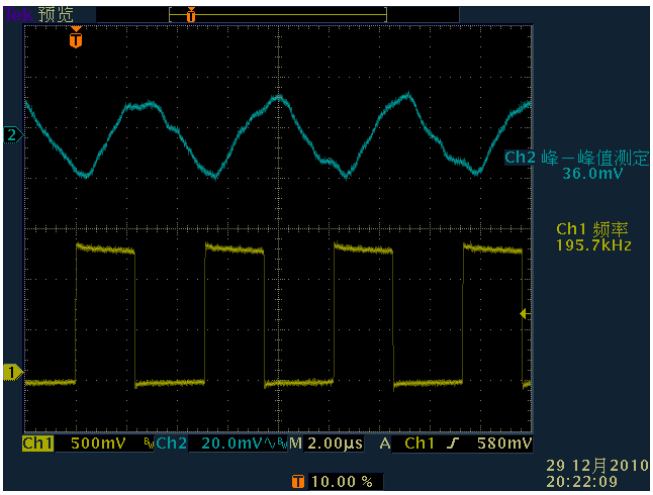
Ripple & noise are measured by using 20MHz bandwidth limited oscilloscope.

| Test Conditions | Max load (mV) | Mini Load(mV) | |
|---|---|---|---|
| Vin=24V | 45 | 13 | Max Load: 1A<br>Mini Load: 0mA |
| Vin=12V | 36 | 14 | |

Vin=24V Io=1.2A

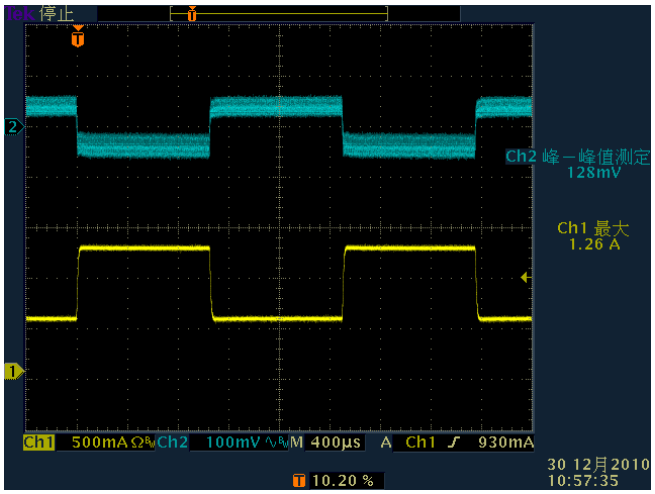



Vin=12V Io=1.2A

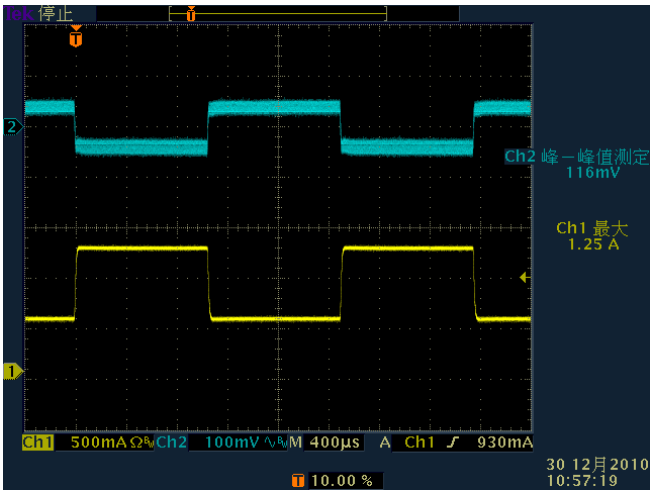



## 5.7. Dynamic Response

Vin=24V load step from 40%-100%




Vin=12V load step from 40%-100%




## 5.8. Key Components Temperature Test

Test condition: Ambient Temp: 60 ℃; full load Io=1200mA

Test on IC,。Inductor、 diode。Cin、Cout and PCB. Burning for 2 hours

| Test Conditions | IC (℃) | Inductor(℃) | Diode(℃) | Cin(℃) | Cout(℃) | PCB(℃) |
|---|---|---|---|---|---|---|
| Vin=24V | 114.7 | 125.3 | 109 | 96 | 98.1 | 98.4 |
| Vin=12V | 113 | 115.7 | 104 | 94.5 | 94.9 | 95.1 |

# 6. EMC TEST

## 6.1. Conducted EMI Test

Vin=24V Io=1A

EMI TEST REPORT

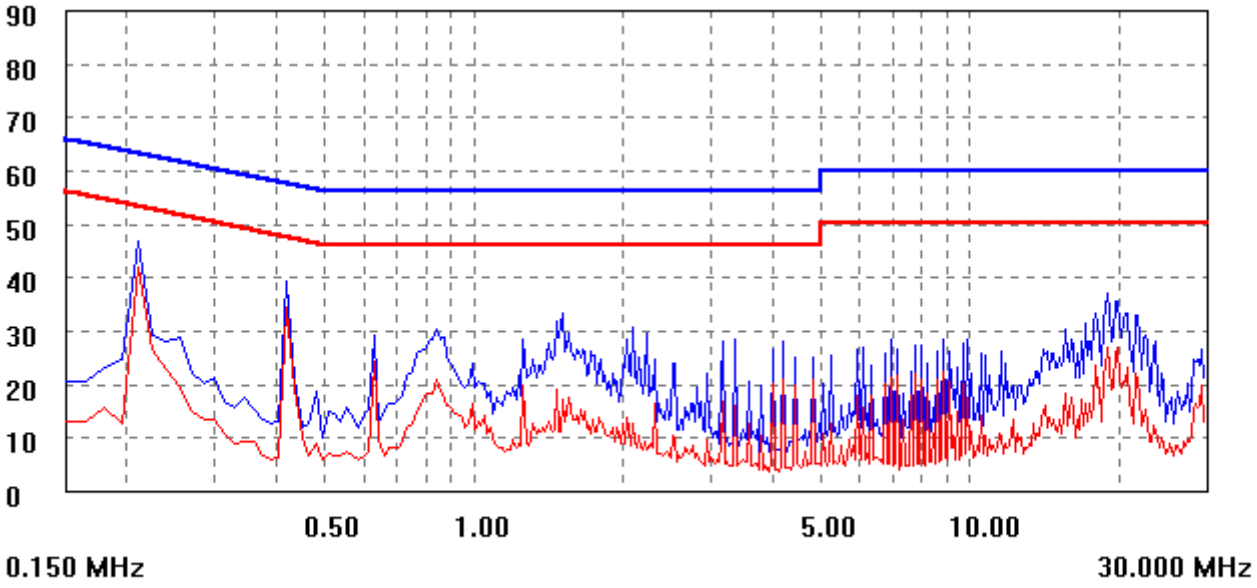
parameter

| | | | | | |
|---|---|---|---|---|---|
| Organization: | ACT | Operator: | | EUT: | |
| Place: | ACT LAB | Time: | 2010/12/30/16:50 | | |
| Detector: | PK+AV | Test-time(ms): | 5 | | |
| Limit: | EN55022 | Transductor: | 1 | | |
| Remark: | ACT4515 5V1.2A L | | | | |

freq, step

| Start(MHz) | End(MHz) | Step(MHz) |
|---|---|---|
| 0.150 | 5.000 | 0.015 |
| 5.000 | 30.000 | 0.030 |

scan result



Vin=12V Io=1A

# EMI TEST REPORT

parameter

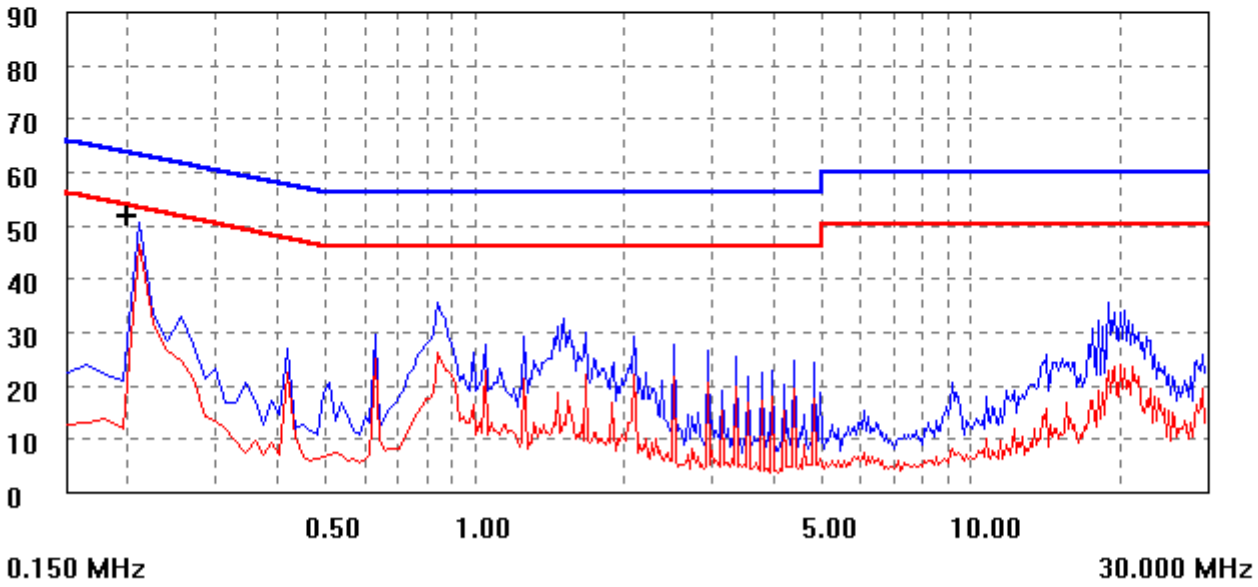
| | | | | | |
|---|---|---|---|---|---|
| Organization: | ACT | Operator: | | EUT: | |
| Place: | ACT LAB | Time: | 2010/12/30/16:48 | | |
| Detector: | PK+AV | Test-time(ms): | 5 | | |
| Limit: | EN55022 | Transductor: | 1 | | |
| Remark: | ACT4515 5V1.2A L | | | | |

freq, step

| Start(MHz) | End(MHz) | Step(MHz) |
|---|---|---|
| 0.150 | 5.000 | 0.015 |
| 5.000 | 30.000 | 0.030 |

scan result

dBuV




final test

## 6.2. Radiated EMI Test

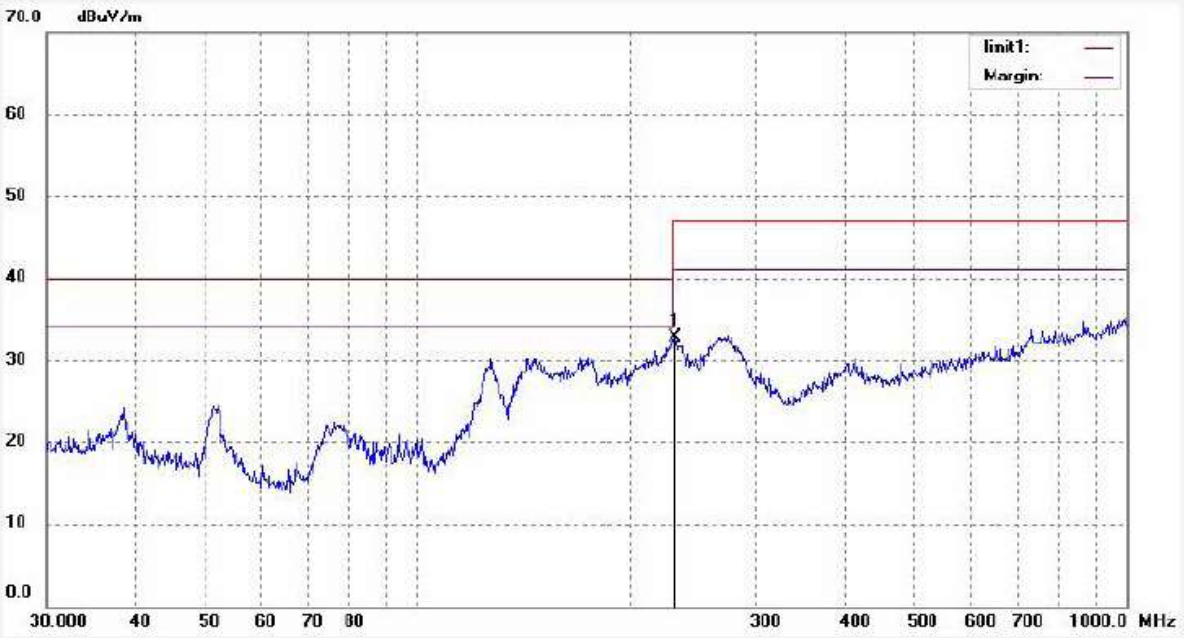
Vin=12V Io=1A H

ACCURATE TECHNOLOGY CO., LTD.
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China
Site: 966 chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

Job No.: ACT #990
Standard: EN55022 ClassB Radiated
Test item: Radiation Test
Temp.( C)/Hum.(%) 25 C / 50 %
EUT:
Mode: FULL LOAD
Model: ACT4515
Manufacturer: ACT

Polarization: Horizontal
Power Source: DC 12V
Date: 2011/01/07
Time: 16:05:02
Engineer Signature: MASON
Distance: 3m

Note: 2#



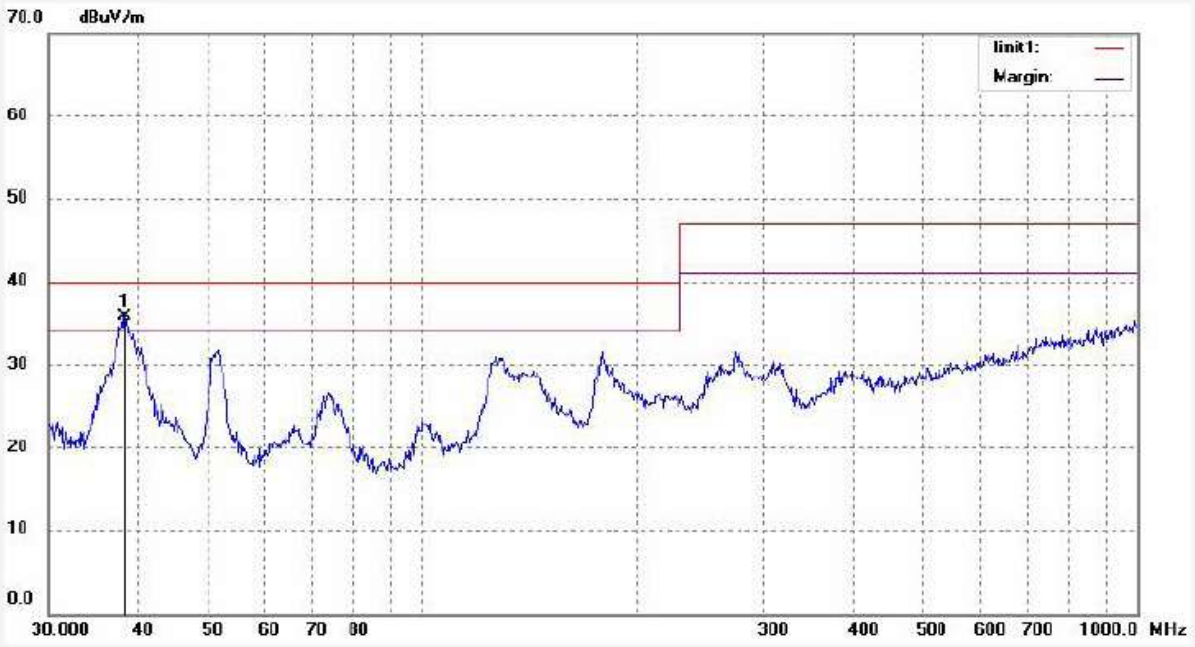

| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 231.0399 | 15.95 | 16.84 | 32.79 | 47.00 | -14.21 | peak | | | |

Vin=12V Io=1A **V**

ACCURATE TECHNOLOGY CO., LTD.
F1,Bldg,A,Changyuan New Material Port Keyuan Rd,
Science & Industry Park,Nanshan Shenzhen,P.R.China
Site: 966 chamber
Tel:+86-0755-26503290
Fax:+86-0755-26503396

| | |
|---|---|
| Job No.: ACT #989 | Polarization: Vertical |
| Standard: EN55022 ClassB Radiated | Power Source: DC 12V |
| Test item: Radiation Test | Date: 2011/01/07 |
| Temp.( C)/Hum.(%) 25 C / 50 % | Time: 16:03:49 |
| EUT: | Engineer Signature: MASON |
| Mode: FULL LOAD | Distance: 3m |
| Model: ACT4515 | |
| Manufacturer: ACT | |

Note: 2#




| No. | Freq. (MHz) | Reading (dBuV/m) | Factor (dB) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Detector | Height (cm) | Degree (deg.) | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 38.3650 | 19.35 | 16.46 | 35.81 | 40.00 | -4.19 | peak | | | |

## 6.3. ESD Test

| Test Condition | Vin=24V Io=1A | Vin=12V Io=1A |
|---|---|---|
| 4KV contact | 30 times pass | 30 times pass |
| 8KV air | 30 times pass | 30 times pass |