

**Subject**  
**OB2238N Demo Board Manual**

Board Model:AD18V0.3A2238N.00  
Doc. No.: OB\_DOC\_DBM\_2238N01



**Key features:**

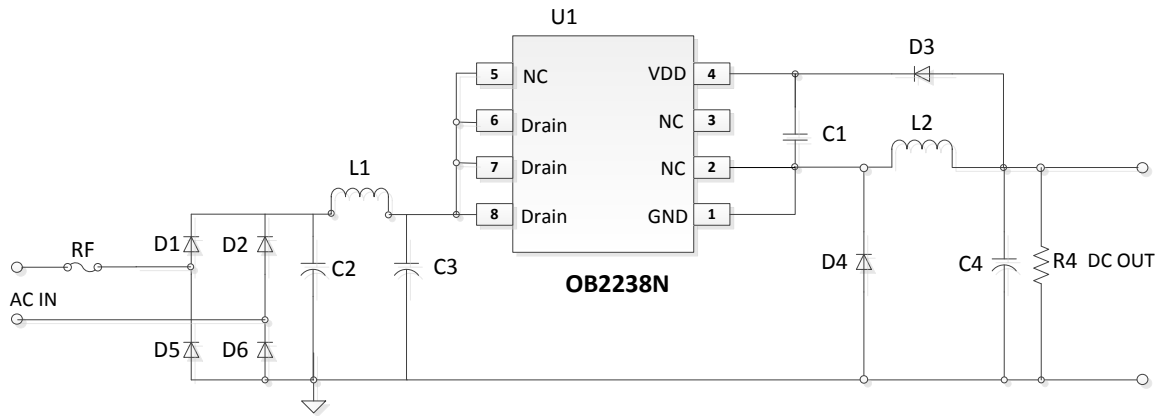
- Lowest possible component count
- Standby power <75mW @264Vac
- Efficiency measured >75% at full load
- Good dynamic response
- Comprehensive protection including output short protection, OTP, OCP etc.

## Revision History

| Revise Date | Version | Reason/Issue               |
|-------------|---------|----------------------------|
| 2019-11-20  | 00      | First issue                |
| 2020-07-06  | 01      | Update the board schematic |

## 1. Board Information

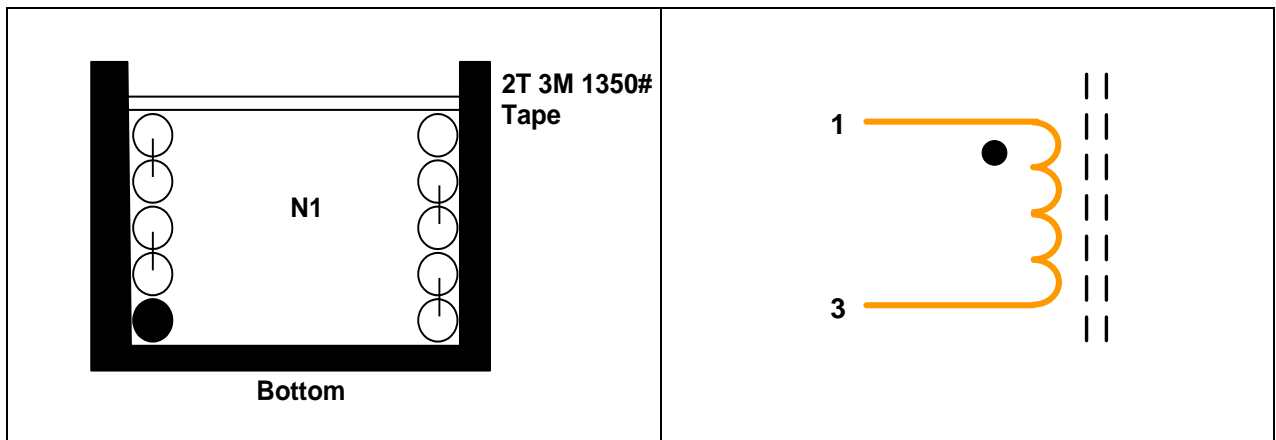
### 1.1. Board schematic



### 1.2. Component list

| No. | Position       | Description           | Quantity |
|-----|----------------|-----------------------|----------|
| 1   | RF             | Resistor fuse 10R/1W  | 1        |
| 2   | R4             | SMD RES 20K /5% /1206 | 1        |
| 3   | C1             | E.C. 4.7uF /50V       | 1        |
| 4   | C2, C3         | E.C. 3.3uF /400V      | 2        |
| 5   | C4             | E.C. 330uF /25V       | 1        |
| 6   | D1, D2, D5, D6 | Diode 1N4007          | 4        |
| 7   | D3             | Diode M7              | 1        |
| 8   | D4             | Fast diode ES1J       | 1        |
| 9   | L1             | Inductor 2.2mH /0510  | 1        |
| 10  | L2             | Inductor 670uH /EE10  | 1        |
| 11  | U1             | OB2238N, DIP8         | 1        |
|     | Total          |                       | 15       |

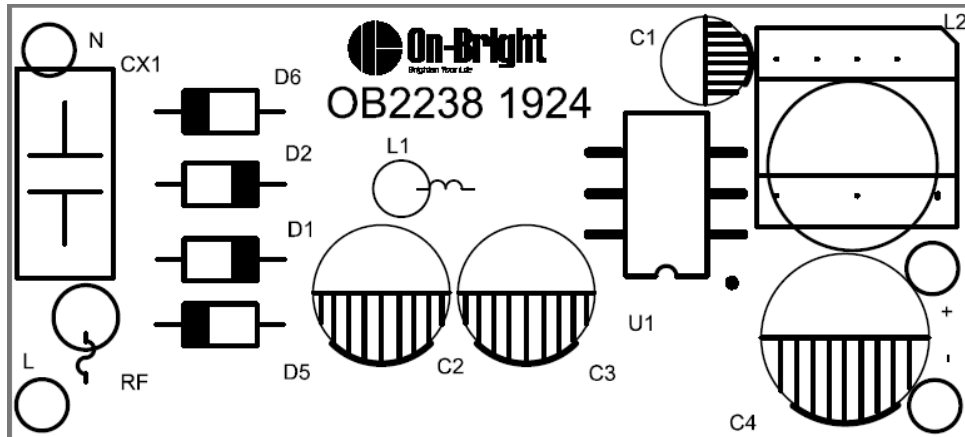
### 1.3. Inductor design



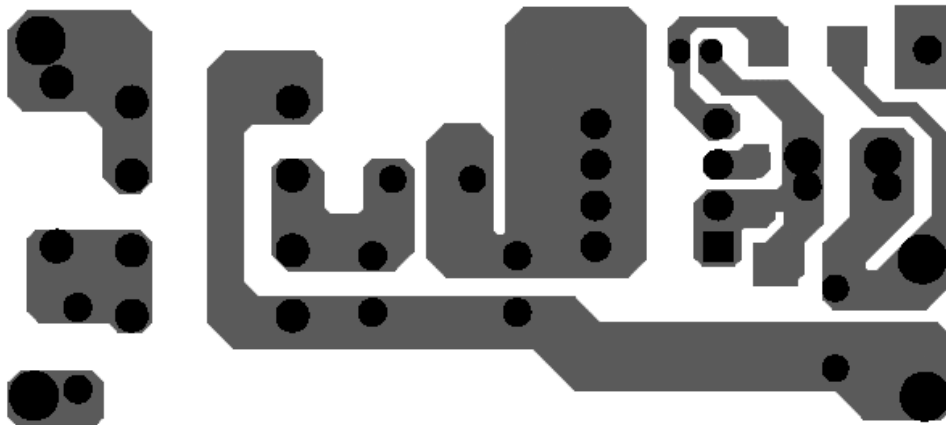
1. Bobbin: EE10
2. Core: TDK PC40.
3. L1-3= 670uH (at:10KHz, 1V)

| Material      | Turns | Inductance & Tolerance |
|---------------|-------|------------------------|
| Φ0.22 *1 2UEW | 130   | 670uH ± 7%             |

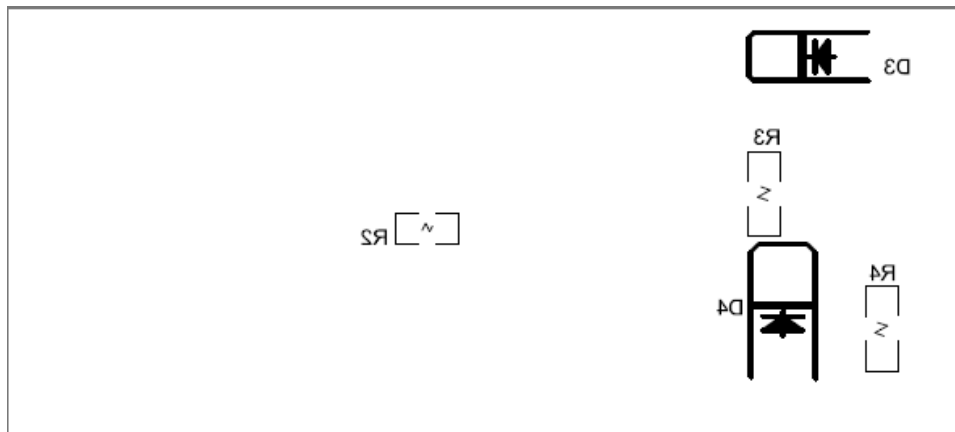
1.4.PCB Gerber File



Top

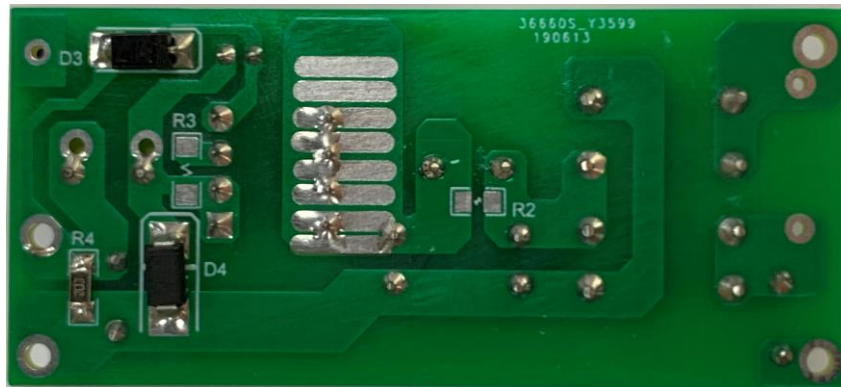


Bottom



Silkscreen Bottom

**1.5. Snapshot**



## **2. Converter Specification**

### **2.1. Input Characteristics**

- AC input voltage range                      90Vac ~ 264Vac
- AC input frequency range                  47Hz ~ 63Hz

### **2.2. Output Characteristics**

- Output voltage  $V_{OUT}$                       18.0V
- Output current  $I_{OUT}$                       300mA
- Operating frequency                      40KHz
- Output power                              5.4W

### **2.3. Performance Function**

- Standby Power                              < 75mW @ 264Vac/50Hz, no load, 25°C
- Efficiency                                      >75%
- Ripple & Noise                              <120mV

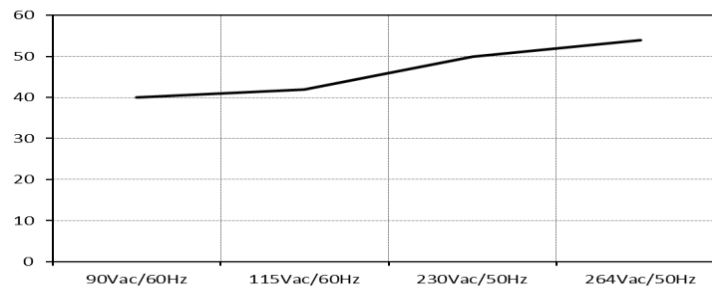
### **2.4. Protection Function**

- Short Circuit Protection                      Output shut down with auto-restart
- Over Temperature Protection                Output shut down with auto-restart
- Over Current Protection                      Output shut down with auto-restart

### 3. Performance Evaluation

#### 3.1. Standby Power

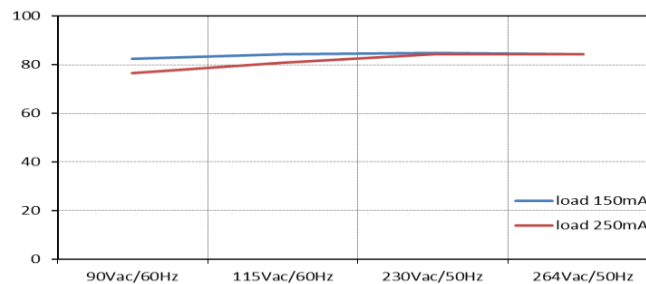
| Input voltage | $P_{IN}$ (mW) | Spec           | Remark |
|---------------|---------------|----------------|--------|
| 90Vac/60Hz    | 40            | $<75\text{mW}$ | Pass   |
| 115Vac/60Hz   | 42            |                | Pass   |
| 230Vac/50Hz   | 50            |                | Pass   |
| 264Vac/50Hz   | 54            |                | Pass   |



**Figure 1. Standby input power**

#### 3.2. Efficiency

| Input voltage | load 150mA | load 300mA | Spec    | Remark |
|---------------|------------|------------|---------|--------|
| 90Vac/60Hz    | 82.42%     | 76.61%     | $>75\%$ | Pass   |
| 115Vac/60Hz   | 84.16%     | 80.77%     |         | Pass   |
| 230Vac/50Hz   | 84.90%     | 84.36%     |         | Pass   |
| 264Vac/50Hz   | 84.26%     | 84.30%     |         | Pass   |



**Figure 2. Efficiency @ different load**

### 3.3. Output Voltage

| Input voltage | 0mA   | 100mA | 200mA | 300mA | Spec       | Remark |
|---------------|-------|-------|-------|-------|------------|--------|
| 90Vac/60Hz    | 18.67 | 17.97 | 17.88 | 17.82 | 17.0~20.0V | Pass   |
| 115Vac/60Hz   | 18.67 | 17.97 | 17.88 | 17.82 |            | Pass   |
| 230Vac/50Hz   | 18.70 | 17.97 | 17.88 | 17.82 |            | Pass   |
| 264Vac/50Hz   | 18.71 | 17.97 | 17.88 | 17.82 |            | Pass   |

### 3.4. Dynamic (Figure 9)

| Input voltage | V <sub>OUT-MAX</sub> (V) | V <sub>OUT-MIN</sub> (V) | Spec       | Remark |
|---------------|--------------------------|--------------------------|------------|--------|
| 90Vac/60Hz    | 18.64                    | 17.88                    | 17.0~20.0V | Pass   |
| 115Vac/60Hz   | 18.64                    | 17.88                    |            | Pass   |
| 230Vac/50Hz   | 18.64                    | 17.88                    |            | Pass   |
| 264Vac/50Hz   | 18.64                    | 17.88                    |            | Pass   |

*Note: A dynamic loading with low load set at 0mA load lasting for 20ms and high set at 300mA load lasting for 20ms is added to output. The ramp is set at 0.25A/us at transient.*

### 3.5. Over Current Protection & Recovery

| Input voltage | OCP (mA) | Recovery (mA) | Spec                     | Remark |
|---------------|----------|---------------|--------------------------|--------|
| 90Vac/60Hz    | 423      | 420           | $\geq 1.1 \cdot I_{OUT}$ | Pass   |
| 115Vac/60Hz   | 462      | 457           |                          | Pass   |
| 230Vac/50Hz   | 465      | 460           |                          | Pass   |
| 264Vac/50Hz   | 468      | 463           |                          | Pass   |

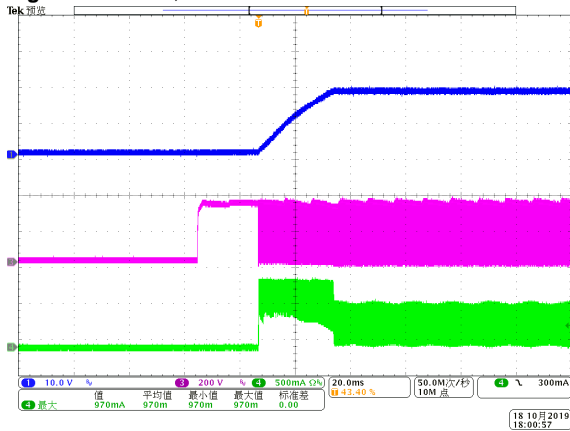
### 3.6. Ripple & Noise (Figure 7&8)

| Input voltage | No load (mV) | Full load (mV) | Spec   | Remark |
|---------------|--------------|----------------|--------|--------|
| 90Vac/60Hz    | 30           | 70             | <120mV | Pass   |
| 115Vac/60Hz   | 32           | 78             |        | Pass   |
| 230Vac/50Hz   | 46           | 92             |        | Pass   |
| 264Vac/50Hz   | 50           | 98             |        | Pass   |



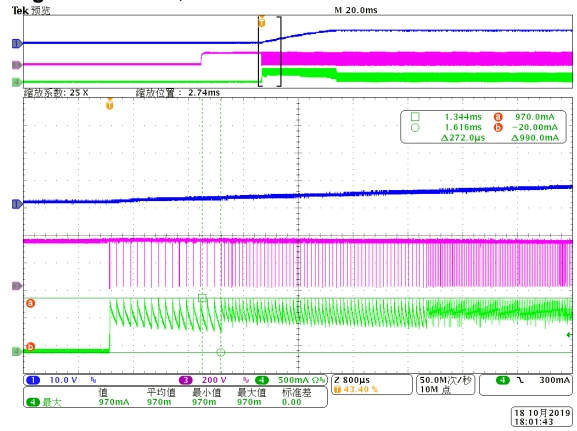
## 3.7. Waveforms

**Figure 3: 230Vac, start at full load**



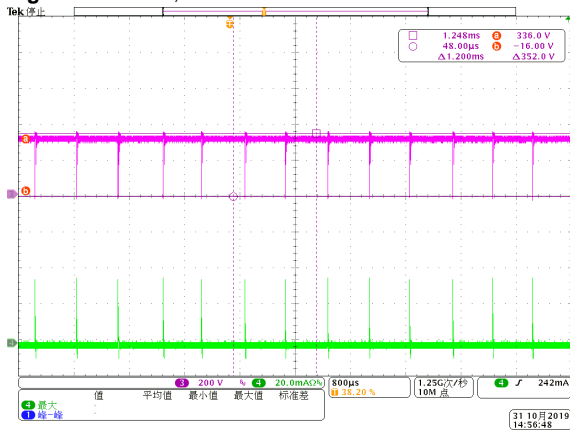
CH1:  $V_{out}$  CH3:  $V_{DS}$  CH4:  $I_{Inductor}$   
230Vac 输入, 满载启动,  $V_{DS}=340V$

**Figure 4: 230Vac, start at full load**



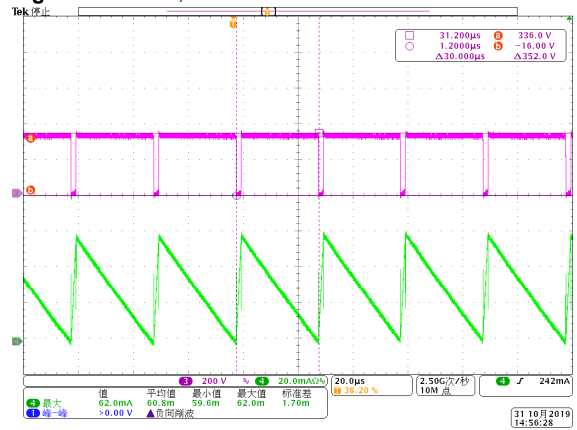
CH1:  $V_{out}$  CH3:  $V_{DS}$  CH4:  $I_{Inductor}$   
230Vac 输入, 满载启动波形展开,  $V_{DS}=340V$

**Figure 5: 230Vac, No-load**



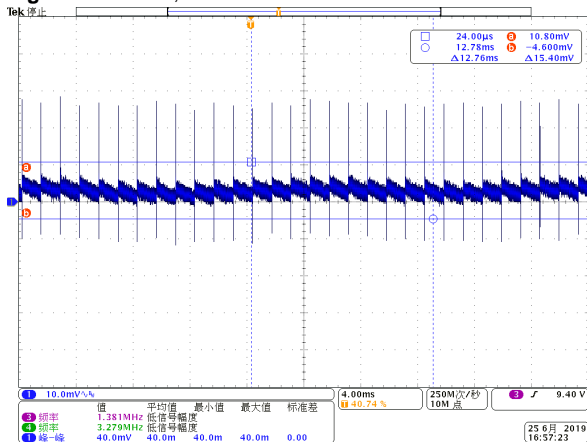
CH3:  $V_{DS}$  CH4:  $I_{Inductor}$   
230Vac 输入, 空载,  $V_{DS}=340V$

**Figure 6: 230Vac, Full load**



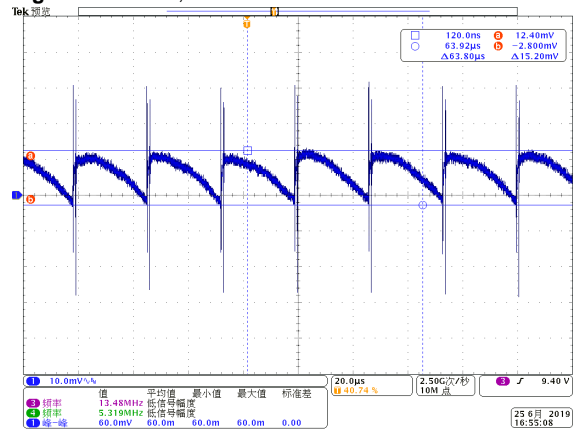
CH3:  $V_{DS}$  CH4:  $I_{Inductor}$   
230Vac 输入, 满载,  $V_{DS}=340V$

**Figure 7: 264Vac, No-load**

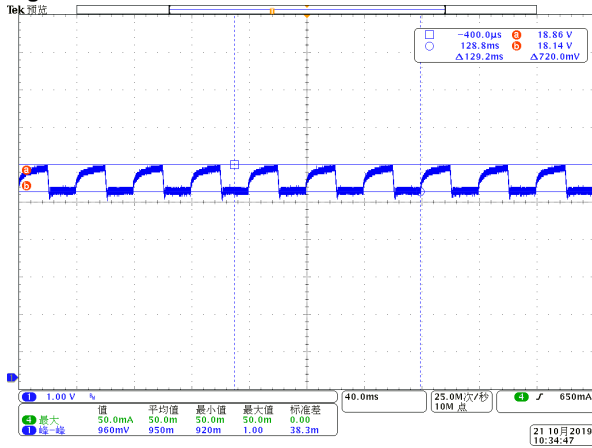


CH1:  $V_{ripple}$   
264Vac 输入, 空载,  $V_{ripple}=48mV$

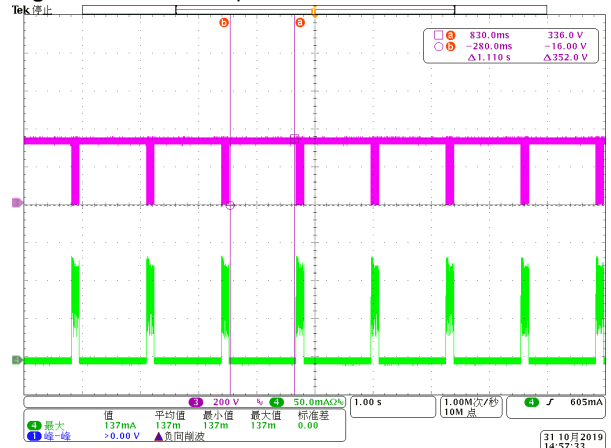
**Figure 8: 264Vac, Full load**



CH1:  $V_{ripple}$   
264Vac 输入, 满载,  $V_{ripple}=88mV$

**Figure 9: 230Vac, 0~300mA load**


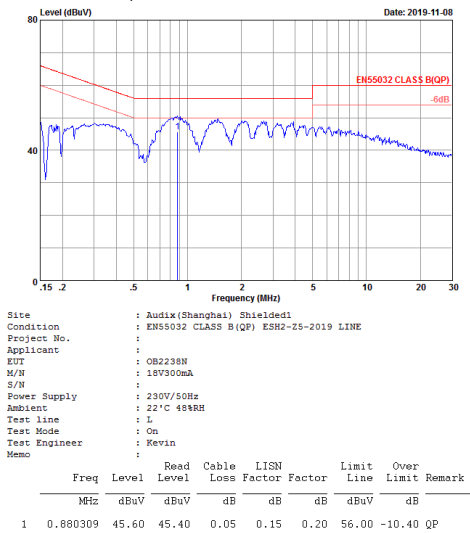
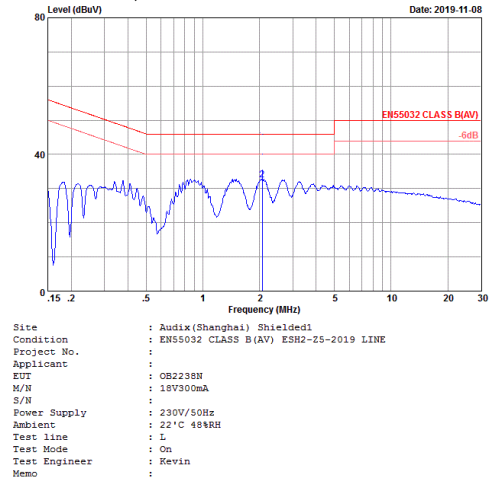
CH1:  $V_{OUT}$   
 230Vac 输入, 负载变化,  $V_{out}=18.14-18.86V$

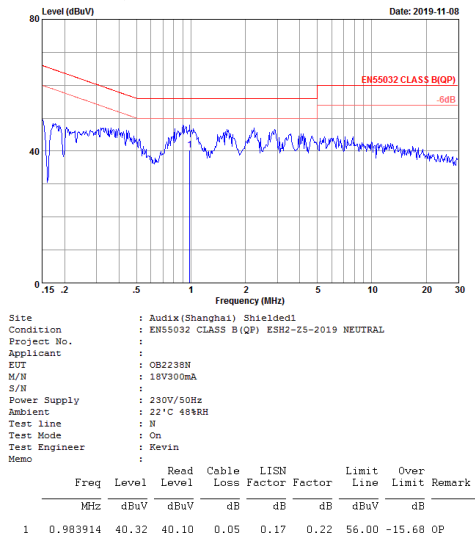
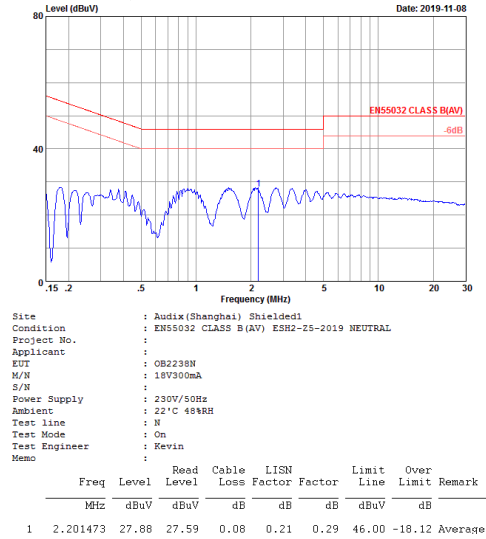
**Figure 10: 230Vac, Output short to GND**


CH3:  $V_{DS}$     CH4:  $I_{Inductor}$   
 230Vac 输入, 输出短路

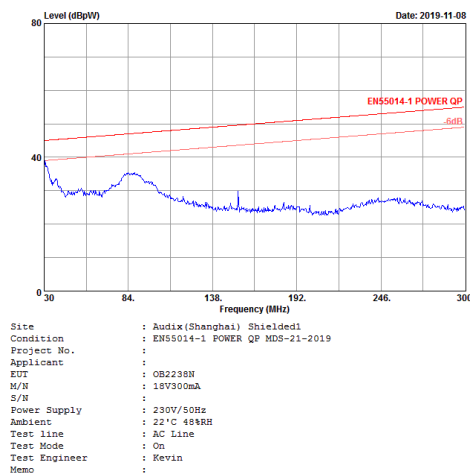
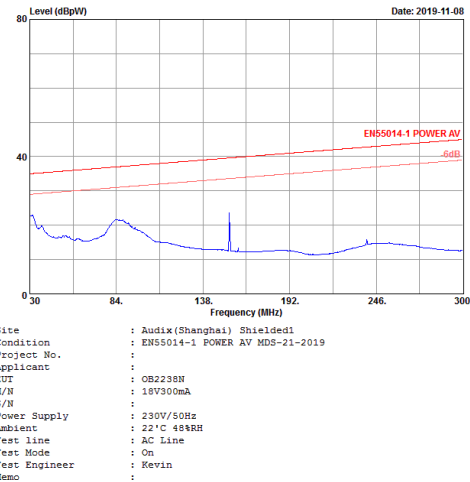
| Input                 | $V_{DS\_MAX}(V)$ | Remark   |
|-----------------------|------------------|----------|
| 230Vac @ No load      | 340              | Figure 5 |
| 230Vac @ Full load    | 340              | Figure 6 |
| 230Vac @ Output short | 340              | Figure10 |

### 3.8. Conducted EMI Test (EN55032 CLASS B standard)

**Figure 11: 230Vac, Line QP**

**Figure 12: 230Vac, Line AVG**


**Figure 13: 230Vac, Neutral QP**

**Figure 14: 230Vac, Neutral AVG**


### 3.9. Power Disturbance Test

**Figure 15: 230Vac, QP**

**Figure 16: 230Vac, AVG**


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