# Design Reference

## 24W charger with Quick Charge 3.0 /PumpExpress2.0/ACCP using fairchild FAN602+FAN6290

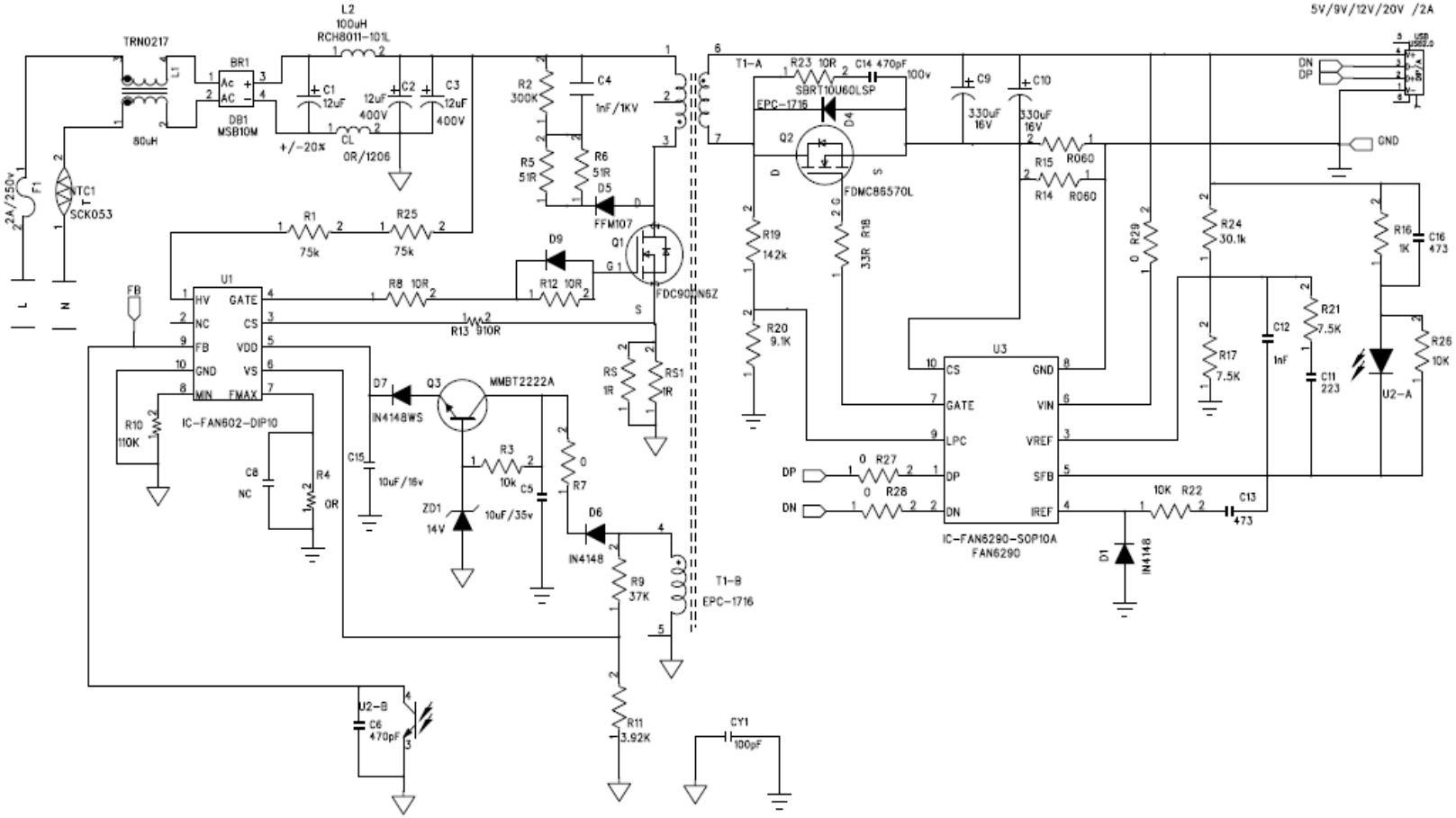
2016/3/15 V1.0

# Feature

- Input voltage:90~265Vac
- Output power:**24W** max
- Output :3.6~5.0V/2.0A,5V/2.0A,9V/2.0A,12V/2.0A (meet QC3.0 class A)
- High power density(34mm*38mm**)**
- Efficiency up to **89%**
- No load power consumption<**20mW** @5V
- With the **FAN602A** dual QR/DCM operation Programmable Fswmax: 60kHz~140kHz;Programmable burst entry and exit.Two Stage OVP Protection
- **FAN6290Q** is a highly integrated, secondary-side power adaptor controller compatible with the Quick Charge 3.0 (QC3.0)/PE+2.0/ACCP protocol. FAN6290Q internally adopts synchronous rectifier control for less BOM counts as well as easy design.

# Schematic




5V/9V/12V/20V /2A
L2
100uH
RCH8011-101L
TRN0217
BR1
DB1
MSB10M
80uH
+/-20%
0R/1206
2A/250v
F1
NTC1
SCK053
L
N
FB
U1
HV
GATE
NC
CS
FB
VDD
GND
VS
MIN
FMAX
IC-FAN602-DIP10
R10
110K
C8
NC
R4
0R
C15
10uF/16v
D7
IN4148WS
Q3
MMBT2222A
R3
10k
C5
ZD1
14V
10uF/35v
D6
IN4148
R7
0
R9
37K
R11
3.92K
U2-B
C6
470pF
CY1
100pF
T1-B
EPC-1716
R1
75k
R25
75k
R2
300K
C4
1nF/1KV
R5
51R
R6
51R
D5
FFM107
D9
R8 10R
R12 10R
R13 910R
Q1
FDC90N6Z
RS
1R
RS1
1R
T1-A
R23 10R
C14 470pF
100v
SBRT10U60LSP
D4
EPC-1716
Q2
FDMC86570L
C9
330uF
16V
C10
330uF
16V
R15
R060
R14
R060
R19
142k
R20
9.1K
R18
33R
R29
0
R24
30.1k
R17
7.5K
C12
1nF
R21
7.5K
C11
223
R16
1K
C16
473
U2-A
R26
10K
U3
CS
GATE
LPC
DP
DN
GND
VIN
VREF
SFB
IREF
IC-FAN6290-SOP10A
FAN6290
R27
0
R28
0
10K R22
C13
473
D1
IN4148
DN
DP
GND
USB
VBUS
D-
D+
GND

# BOM



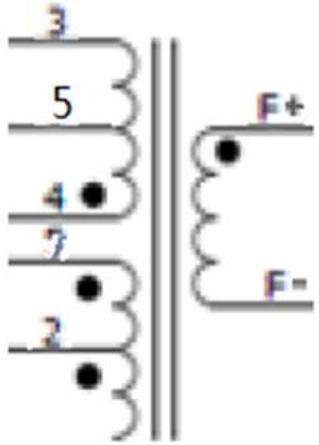
| | Part name | spec | Qty | |
|---|---|---|---|---|
| 1 | SMD Res 0603 ±5% | 0 | 3 | R7,27-29 |
| 2 | SMD Res 0603 ±5% | 10R | 3 | R8 R12 R23 |
| 3 | SMD Res 0603 ±5% | 33R | 1 | R18 |
| 4 | SMD Res 0603 ±5% | 1K | 2 | R13,R16 |
| 5 | SMD Res 0603 ±5% | 3.92K | 1 | R11 |
| 6 | SMD Res 0603 ±5% | 7.5K | 2 | R17 R21 |
| 7 | SMD Res 0603 ±5% | 8.2K | 1 | R20 |
| 8 | SMD Res 0603 ±5% | 10K | 2 | R3,R26 |
| 9 | SMD Res 0603 ±5% | 30.1K | 1 | R24 |
| 10 | SMD Res 0603 ±5% | 47K | 1 | R22 |
| 11 | SMD Res 0603 ±5% | 80K | 1 | R4 |
| 12 | SMD Res 0603 ±5% | 221K | 1 | R19 |
| 13 | SMD Res 0603 ±5% | 274K | 1 | R19A |
| 14 | SMD Res 1206 ±5% | 0 | 3 | R5-6 CL |
| 15 | SMD Res 1206 ±1% | R060 | 2 | R14-15 |
| 16 | SMD Res 1206 ±1% | 1R | 2 | RS RS1 |
| 17 | SMD Res 1206 ±5% | 37K | 1 | R9 |
| 18 | SMD Res 1206 ±5% | 100k | 2 | R1 R25 |
| 19 | SMD Res 1206 ±5% | 300K | 1 | R2 |
| 20 | X7R 0603 ±10% | 22pF/50V | 1 | C7 |
| 21 | X7R 0603 ±10% | 47pF/50V | 1 | C14 |
| 22 | X7R 0603 ±10% | 75pF/50V | 1 | C8 |
| 23 | X7R 0603 ±10% | 470pF/50V | 1 | C6 |
| 24 | X7R 0603 ±10% | 1nF/50V | 1 | C12 |
| 25 | X7R 0603 ±10% | 10nF/50V | 1 | C16 |
| 25 | X7R 0603 ±10% | 10nF/50V | 1 | C16 |
| 26 | X7R 0603 ±10% | 47nF/25V | 2 | C11 C13 |
| 27 | X7R 0805 ±10% | 4.7uF/25v | 1 | C15 |
| 28 | X7R 1206 ±10% | 10uF/35v | 1 | C5 |
| 29 | X7R 1206 ±10% | 1nF/1kv | 1 | C4 |
| 30 | Y-cap | 100p/250V | 1 | CY1 |
| 31 | Solid Cap ULR | 330uF/16V | 2 | C9-10 |
| 32 | Electrolytic Cap | 12uF/400V | 3 | C1-3 |
| 33 | TRN0217 | 80uH | 1 | L1 |
| 34 | AXIS Inductor RCH8011-101L | 100uH SUMID | 1 | L2 |
| 35 | SMD Diode 1N4148WS | 1A/100V SOD-323 Fairchild | 3 | D1 D6 D9 |
| 36 | SMD Diode FFM107M | 1A/1000V SOD-123 | 1 | D5 |
| 37 | SMD Diode 1N4148WS | 2A/100V SOD-123 | 1 | D7 |
| 38 | Transformer | RM8 | 1 | T1 |
| 39 | MOS FDMC86570L | 84A/60V Power 33 | 1 | Q2 |
| 40 | MOS FCU900N60Z | 4.5A/600V TO-21 | 1 | Q1 |
| 41 | FUS-R,2A/250v | 2A/250v | 1 | F1 |
| 42 | IC controller FAN602 | Fan602 | 1 | U1 |
| 43 | IC controller FAN6290 | FAN6290 | 1 | U3 |
| 44 | Transistor MMBT2222A | MMBT2222A | 1 | Q3 |
| 45 | Photo Coupler | LTV-817S-TA1-B | 1 | U2 |
| 46 | Schottky Diode POWERDI5060-8 | SBRT20U100LSP | 1 | D4 |
| 47 | Thermistor | SCK053 | 1 | NTC1 |
| 48 | USBCON-S,DIP, L*W*H:14mm*7.2mm*13.1mm | TYPE A Receptacle | 1 | USB |
| 49 | SMD ZRNER MMSZ5244B | 0.5W /14V, SOD-123 | 1 | ZD1 |

# Transformer specification and structure

## Core & Bobbin : RM8 (Ae=62mm2)

| winding | Margin Tape (mm) | Terminal (pin) | Wire Gauge (mm) | Turns (T) | Note |
|---|---|---|---|---|---|
| Bobbin | | | | | |
| N1-1 | NC | 3→5 | 0.28*1 | 16 | |
| Mylar Tape *2T | | | | | |
| N2 | NC | 2→7 | 0.2¢*1 | 8 | Two wire parallel |
| | | 3→x(floating) | 0.18¢*2 | 8 | |
| Mylar Tape *2T | | | | | |
| N3 | NC | Fly-→Fly+ | 0.6¢*1 | 4 | |
| Mylar Tape *2T | | | | | |
| N3 | NC | Connecting to PIN 2 by0.2¢ wire | Copper-Foil | 1 | |
| Mylar Tape *2T | | | | | |
| N3 | NC | 5→4 | 0.28*1 | 16 | |
| Mylar Tape *2T | | | | | |
| Core-RM8(Ae:62mm²) | | | | | |
| N3 | NC | Connecting to PIN 2 by0.2¢ wire | Copper-Foil for core | 1 | |
| Mylar Tape *2T | | | | | |

| Specifications | Terminal (pin) | Inductance (μH) | Remark |
|---|---|---|---|
| Primary-side Inductance | 3--4 | 300μH±5% | 100kHz, 1V |
| Primary-side Effective Leakage Indutance | 3--4 | <15μH Max | Short All Other Pins |

# Performance of Evaluation Board



## Input Power at Minimum Load Condition

### Test Condition

Measure the input power at 5V no load condition.

| Input Voltage | Vo = 5V |
|---|---|
| $90V_{AC}$/60Hz | 18.9 mW |
| $115V_{AC}$/60Hz | 18.4 mW |
| $230V_{AC}$/50Hz | 18.0 mW |
| $264V_{AC}$/50Hz | 19.5 mW |

**Table 3. Test Result**

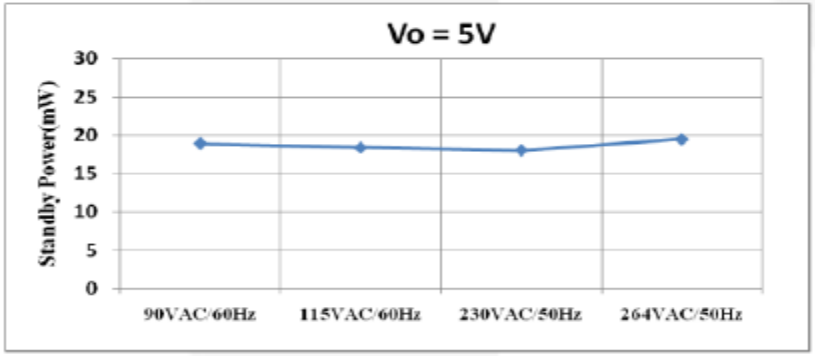



**Figure 7. Standby Power Curve**

# Dynamic Response

**Test condition**

Dynamic loading (10%~90%), 100ms duty cycle, 0.5 A/μs rising/falling time.

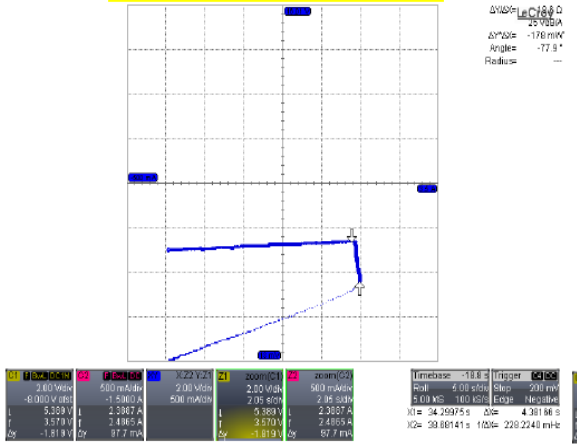
The measurements point at PCB end.

| Vo = 5V | | | |
|---|---|---|---|
| **Input Voltage** | **Over shoot** | **Under shoot** | **Specification** |
| $90V_{AC}$/60Hz | 5.554V | 4.95V | > 4.5V |
| $264V_{AC}$/50Hz | 5.57V | 4.94V | |
| **Vo = 9V** | | | |
| **Input Voltage** | **Over shoot** | **Under shoot** | **Specification** |
| $90V_{AC}$/60Hz | 9.564V | 8.912V | >8.1V |
| $264V_{AC}$/50Hz | 9.608V | 8.874V | |
| **Vo = 12V** | | | |
| **Input Voltage** | **Over shoot** | **Under shoot** | **Specification** |
| $90V_{AC}$/60Hz | 12.5V | 11.88V | >10.8V |
| $264V_{AC}$/50Hz | 12.55V | 11.83V | |

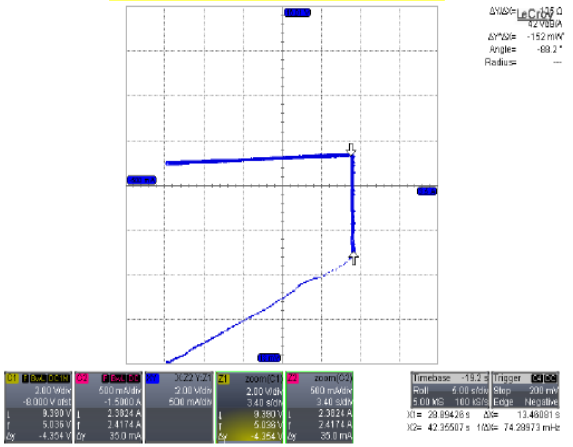
**Table 7. Test Result**

# CV/CC Characteristic

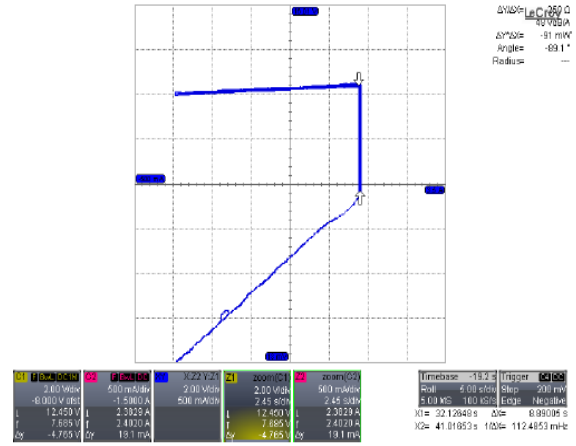
[5V mode]



[9V mode]



[12V mode]



| Foldback point | Vout | Iout |
|---|---|---|
| 5V mode | 3.57V | 2.49A |
| 9V mode | 5.036V | 2.41A |
| 12V mode | 7.685V | 2.4A |

✓Output current target of 5/9/12V mode is 2A~2.5A range.

# Efficiency

Measure input wattage and output wattage at PCB end. Average efficiency only include 25%, 50%,75% and 100% efficiency.

CoC Tier2:69.73%at10%load;79.00%atAvg.EFF@5Vo

| Vo=5V | 10% | 25% | 50% | 75% | 100% | Avg |
|---|---|---|---|---|---|---|
| 90Vac/60Hz | 86.10% | 86.95% | 88.32% | 88.62% | 88.54% | 88.11% |
| 115Vac/60Hz | 84.15% | 87.76% | 88.95% | 88.32% | 89.62% | 88.66% |
| 230Vac/50Hz | 82.23% | 86.55% | 86.76% | 86.95% | 88.32% | 87.15% |
| 264Vac/50Hz | 80.30% | 83.35% | 85.55% | 86.76% | 86.95% | 85.65% |

CoC Tier2:75.00%at10%load;85.45%atAvg.EFF@9Vo

| Vo=9V | 10% | 25% | 50% | 75% | 100% | Avg |
|---|---|---|---|---|---|---|
| 90Vac/60Hz | 86.23% | 87.95% | 88.92% | 88.94% | 90.06% | 88.97% |
| 115Vac/60Hz | 87.17% | 88.96% | 88.95% | 89.02% | 90.22% | 89.29% |
| 230Vac/50Hz | 86.23% | 86.55% | 87.76% | 88.95% | 89.19% | 88.11% |
| 264Vac/50Hz | 85.30% | 83.72% | 86.55% | 86.76% | 87.96% | 86.25% |

CoC Tier2:76.20%at10%load;86.80%atAvg.EFF@12Vo

| Vo=12V | 10% | 25% | 50% | 75% | 100% | Avg |
|---|---|---|---|---|---|---|
| 90Vac/60Hz | 86.23% | 88.88% | 88.92% | 88.95% | 90.07% | 89.21% |
| 115Vac/60Hz | 86.17% | 88.96% | 88.97% | 89.02% | 90.19% | 89.29% |
| 230Vac/50Hz | 86.23% | 88.55% | 88.76% | 88.94% | 89.39% | 88.91% |
| 264Vac/50Hz | 86.30% | 88.72% | 88.57% | 86.86% | 88.96% | 88.28% |