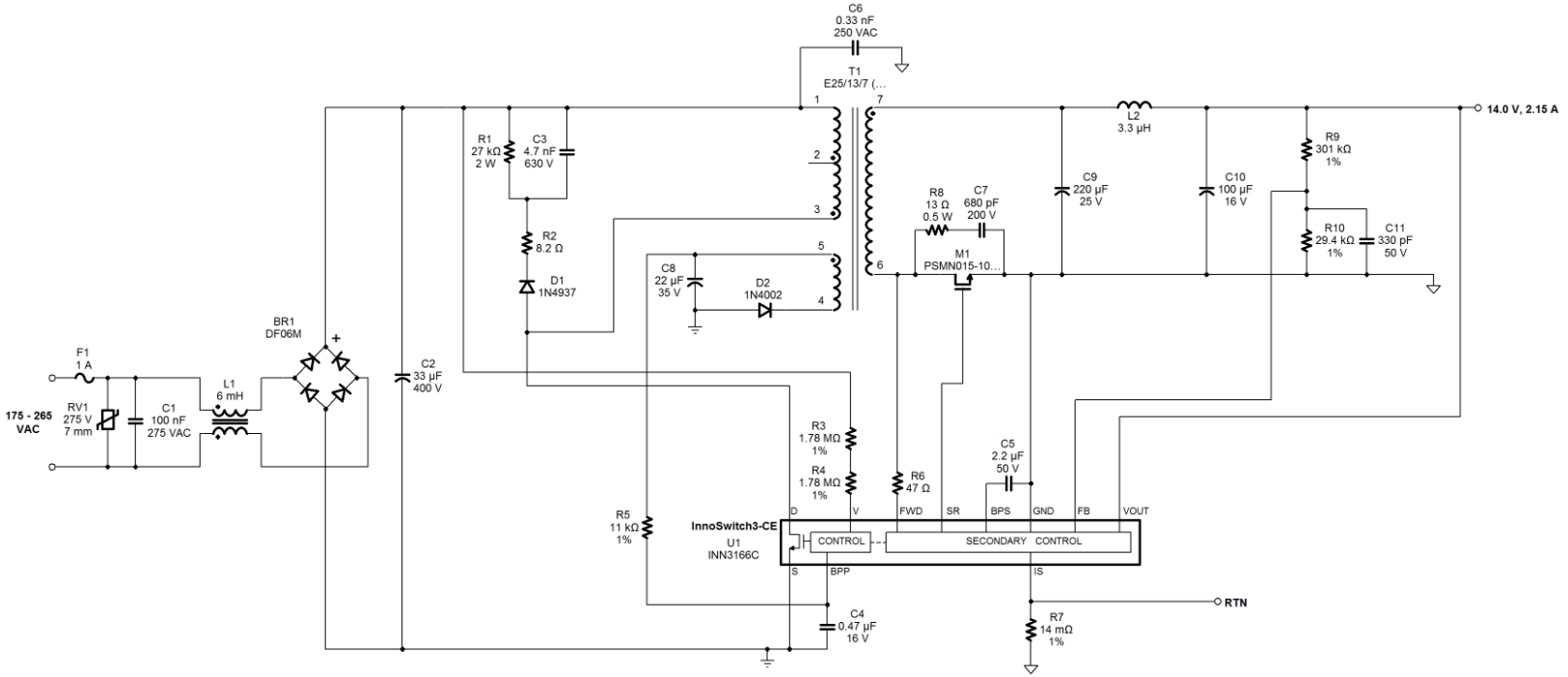

C6
0.33 nF
250 VAC
T1
E25/13/7 (…
1
7
2
3
5
6
4
L2
3.3 µH
14.0 V, 2.15 A
R1
27 kΩ
2 W
C3
4.7 nF
630 V
R2
8.2 Ω
D1
1N4937
C8
22 µF
35 V
D2
1N4002
R8
13 Ω
0.5 W
C7
680 pF
200 V
M1
PSMN015-10…
C9
220 µF
25 V
C10
100 µF
16 V
R9
301 kΩ
1%
R10
29.4 kΩ
1%
C11
330 pF
50 V
BR1
DF06M
F1
1 A
175 - 265
VAC
RV1
275 V
7 mm
C1
100 nF
275 VAC
L1
6 mH
C2
33 µF
400 V
R3
1.78 MΩ
1%
R4
1.78 MΩ
1%
R5
11 kΩ
1%
R6
47 Ω
C5
2.2 µF
50 V
InnoSwitch3-CE
U1
INN3166C
D
V
FWD
SR
BPS
GND
FB
VOUT
CONTROL
SECONDARY CONTROL
S
BPP
IS
C4
0.47 µF
16 V
R7
14 mΩ
1%
RTN

## Power Supply Input

| Var | Value | Units | Description |
|---|---|---|---|
| VACMIN | 175 | V | Minimum Input AC Voltage (Manual Overwrite) |
| VACNOM | 220 | V | Nominal AC Voltage (For universal designs low line nominal voltage is displayed) |
| VACMAX | 265 | V | Maximum Input AC Voltage (Manual Overwrite) |
| FL | 50 | Hz | Line Frequency (Manual Overwrite) |
| η | 87.0 | % | Efficiency Estimate (Target) |
| TC | 1.86 | ms | Input Rectifier Conduction Time |
| Z | 0.52 | | Loss Allocation Factor |
| VMIN | 210.9 | V | Minimum DC Input Voltage |
| VMAX | 374.8 | V | Maximum DC Input Voltage |
| ENCLOSURE | Adapter | | Enclosure |
| TAMB | 60 | °C | Maximum Operating Ambient air Temperature |

## Input Section

| Var | Value | Units | Description |
|---|---|---|---|
| Fuse | 1.00 | A | Input Fuse Rated Current |
| IAVG | 0.15 | A | Average Diode Bridge Current (DC Input Current) |
| MOV_VRATED | 275 | V | MOV Rated Voltage |

## Device Variables

| Var | Value | Units | Description |
|---|---|---|---|
| Device | INN3166C | | PI Device Name (Manual Overwrite) |
| Current Limit Mode | Standard | | Device Current Limit Mode |
| BVDSS | 650 | V | Drn-Src Bkdn Voltage |
| ILIMITMIN | 1.162 | A | Minimum Current Limit |
| ILIMITTYP | 1.250 | A | Typical Current Limit |
| ILIMITMAX | 1.338 | A | Maximum Current Limit |
| RDSON | 2.02 | Ω | PI Device RDSON (100°C) |
| RDSON_25C | 1.30 | Ω | PI Device RDSON (25°C) |
| PO | 30.10 | W | Total Output Power |
| VDRAIN Estimated | 537.29 | V | Estimated Drain Voltage |
| VOR | 91.84 | V | Reflected Output Voltage |
| VDS | 0.31 | V | On state Drain to Source Voltage |
| FS | 90000 | Hz | Switching Frequency (at VMIN and Full Load) |
| KP | 1.177 | | Continuous/Discontinuous Operating Ratio (at VMIN and Full Load) |
| DMAX | 0.270 | | Maximum Duty Cycle (at VMIN and Full Load) |
| TIME_OFF | 8.13 | µs | Expected Device Off-time (at VMIN and Full Load) |
| TIME_ON | 3.64 | µs | Primary controller on-time |
| IP | 1.288 | A | Peak Primary Current (at VMIN and Full Load) |
| IR | 1.288 | A | Primary Ripple Current (at VMIN and Full Load) |
| IRMS | 0.364 | A | Primary RMS Current (at VMIN and Full Load) |
| UVOV_PRIORITY | Overvoltage | | Input Undervoltage/Overvoltage Priority type |
| RTH_DEVICE | 129.25 | °C/W | PI Device Heatsink Maximum Thermal Resistance |
| DEV_HSINK_TYPE | 2 Oz (70 µ) 2-Sided Copper | | PI Device Heatsink Type |
| DEV_HSINK_AREA | 104 | mm² | PI Device Heatsink Area |

## Clamp Circuit

| Var | Value | Units | Description |
|---|---|---|---|
| Clamp Type | **RCD Clamp** | | Clamp Circuit Type |
| VCLAMP | **70.68** | V | Average Clamping Voltage |
| VC_MARGIN | **113.39** | V | Clamp Voltage Safety Margin |

## Primary Bias Variables

| Var | Value | Units | Description |
|---|---|---|---|
| VB | **12.0** | V | Bias Voltage |
| VBMIN | **9.6** | V | Minimum Bias Voltage |
| VBMAX | **24.0** | V | Maximum Bias Voltage |
| Use Linear Regulator | **NO** | | Use Linear Regulator Circuit |
| PIVB | **69** | V | Bias Rectifier Maximum Peak Inverse Voltage |
| NB | **7** | | Primary Bias Winding Number of Turns |

## Transformer Construction Parameters

| Var | Value | Units | Description |
|---|---|---|---|
| Core Type | **E25/13/7 (EF25)** | | Core Type |
| Core Material | **3F3** | | Core Material |
| Bobbin Reference | **Generic, 5 pri. + 5 sec.** | | Bobbin Reference |
| Bobbin Orientation | **Vertical** | | Bobbin type |
| Primary Pins | **5** | | Number of Primary pins used |
| Secondary Pins | **2** | | Number of Secondary pins used |
| USE_SHIELDS | **NO** | | Use shield Windings |
| LP_nom | **574** | µH | Nominal Primary Inductance |
| LP_Tol | **5.0** | % | Primary Inductance Tolerance |
| NP | **46.0** | | Calculated Primary Winding Total Number of Turns |
| NSM | **7** | | Secondary Main Number of Turns |
| CMA | **1408** | Cmils/A | Primary Winding Current Capacity |
| BW | **15.30** | mm | Bobbin Winding Width |
| ML | **0.00** | mm | Safety Margin on Left Width |
| MR | **0.00** | mm | Safety Margin on Right Width |
| FF | **69.72** | % | Actual Transformer Fit Factor. 100% signifies fully utilized winding window |
| AE | **52.50** | mm² | Core Cross Sectional Area |
| ALG | **271** | nH/T² | Gapped Core Specific Inductance |
| BM | **3178** | Gauss | Maximum Flux Density |
| BP | **3417** | Gauss | Peak Flux Density |
| BAC | **1589** | Gauss | AC Flux Density for Core Loss |
| LG | **0.206** | mm | Estimated Gap Length |
| L_LKG | **14.35** | µH | Estimated primary leakage inductance |
| LSEC | **20** | nH | Secondary Trace Inductance |

## Primary Winding Section 1

| Var | Value | Units | Description |
|---|---|---|---|
| NP1 | **23** | | Number of Primary Winding Turns in the First Section of Primary |
| Wire Size | **23** | AWG | Primary Winding - Wire Size |
| Winding Type | **Single (x1)** | | Primary Winding - Number of Parallel Wire Strands |

| | | | |
|---|---|---|---|
| *L* | **0.95** | | *Primary Winding - Number of Layers* |

## Primary Winding Section 2

| *Var* | *Value* | *Units* | *Description* |
|---|---|---|---|
| *NP2* | **23** | | *Rounded (Integer) Number of Primary winding turns in the second section of primary* |
| *Wire Size* | **23** | *AWG* | *Primary Winding - Wire Size* |
| *Winding Type* | **Single (x1)** | | *Primary Winding - Number of Parallel Wire Strands* |
| *L2* | **0.95** | | *Primary Number of Layers in 2nd split winding* |

## Output 1

| *Var* | *Value* | *Units* | *Description* |
|---|---|---|---|
| *VO* | **14.00** | *V* | *Typical Output Voltage* |
| *IO* | **2.15** | *A* | *Output Current* |
| *VOUT_ACTUAL* | **14.00** | *V* | *Actual Output Voltage* |
| *Cable Drop Compensation* | **0** | *mV* | *Cable Drop Compensation* |
| *NS* | **7** | | *Secondary Number of Turns* |
| *Wire Size* | **25** | *AWG* | *Wire size of secondary winding* |
| *Winding Type* | **Trifilar (x3)** | | *Output winding number of parallel strands* |
| *L_S_OUT* | **0.89** | | *Secondary Output Winding Layers* |
| *PIVS* | **71.03** | *V* | *Output Rectifier Maximum Peak Inverse Voltage* |
| *ISP* | **8.464** | *A* | *Peak Secondary Current* |
| *ISRMS* | **3.619** | *A* | *Secondary RMS Current* |
| *RTH_RECTIFIER* | **121.31** | *°C/W* | *Output Rectifier Heatsink Maximum Thermal Resistance* |
| *OR_HSINK_TYPE* | **2 Oz (70 µ) 2-Sided Copper** | | *Output Rectifier Heatsink Type* |
| *OR_HSINK_AREA* | **104** | *mm²* | *Output Rectifier Heatsink Area* |
| *OSR_RDSON* | **15.00** | *mΩ* | *Synchronous Rectifier RDSON (Manual Overwrite)* |
| *CO* | **220 x 1** | *µF* | *Output Capacitor - Capacitance* |
| *IRIPPLE* | **2.912** | *A* | *Output Capacitor - RMS Ripple Current* |
| *Expected Lifetime* | **24386** | *hr* | *Output Capacitor - Expected Lifetime* |

## Feedback Circuit

| *Var* | *Value* | *Units* | *Description* |
|---|---|---|---|
| *DUAL_OUTPUT_FB_FLAG* | **NO** | | *Get feedback from 2 outputs* |

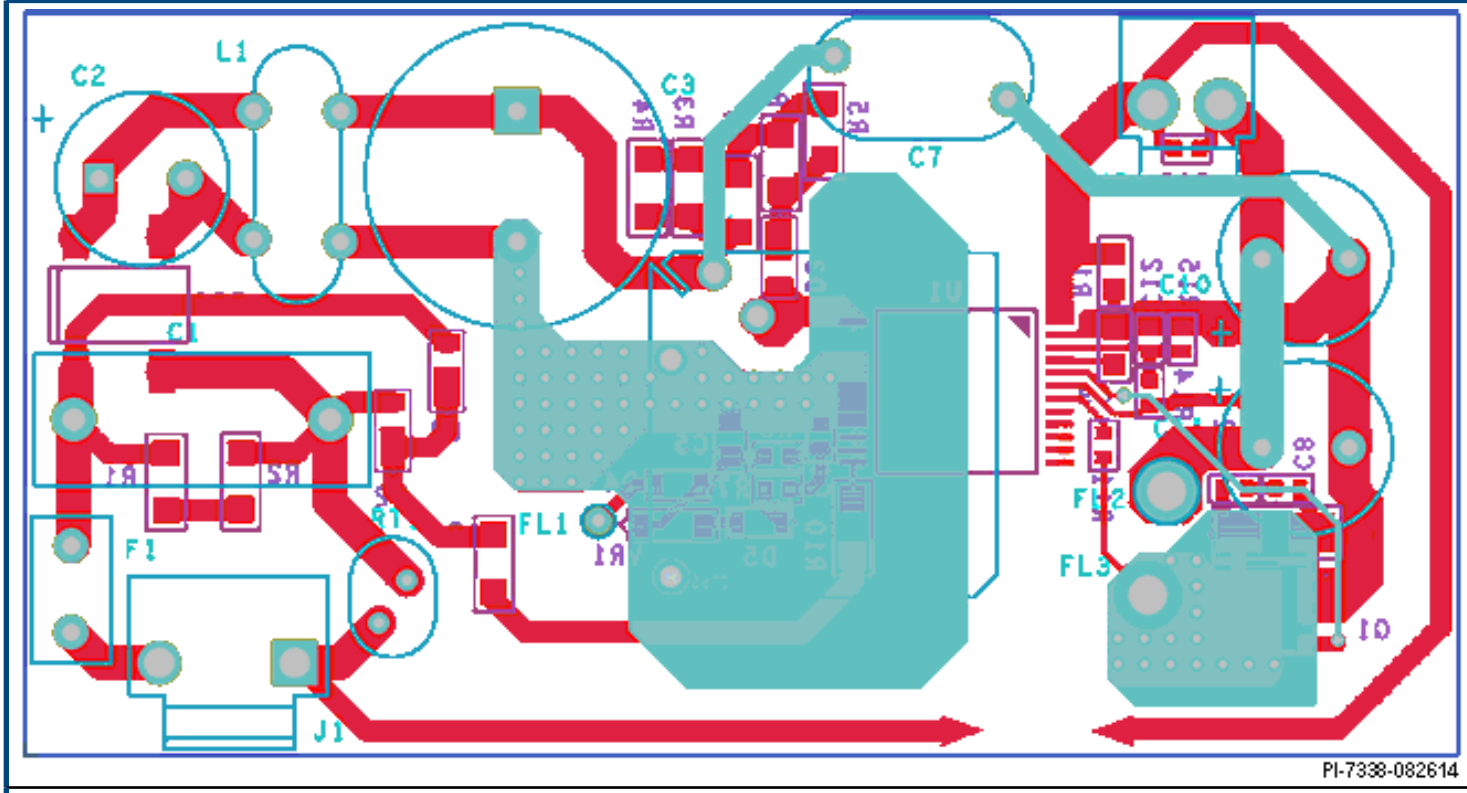
## Power Supply Efficiency and Losses (at VACMIN - VACNOM and Full Load)

| *Var* | *Value* | *Units* | *Description* |
|---|---|---|---|
| *N_ACTUAL_RANGE* | **89.84 - 90.10** | *%* | *Calculated Efficiency* |
| *TOTAL_LOSS_RANGE* | **3.31 - 3.40** | *W* | *Total Power Supply Losses* |
| *DEV_LOSS_RANGE* | **0.58 - 0.63** | *W* | *Total Device Circuit Losses* |
| *TRF_LOSS_RANGE* | **0.68 - 0.71** | *W* | *Total Transformer Losses* |
| *INSTAGE_LOSS_RANGE* | **1.26 - 1.45** | *W* | *Total Primary Side Losses* |
| *OUTSTAGE_LOSS_RANGE* | **0.70 - 0.74** | *W* | *Total Secondary Side Losses* |

*The regulation and tolerances do not account for thermal drifting and component tolerance of the output diode forward voltage drop and voltage drops across the LC post filter. The actual voltage values are estimated at full load only.*

*Please verify cross regulation performance on the bench.*

## Board Layout Recommendations




*Click on the "Show me" icon to highlight relevant areas on the sample layout.*

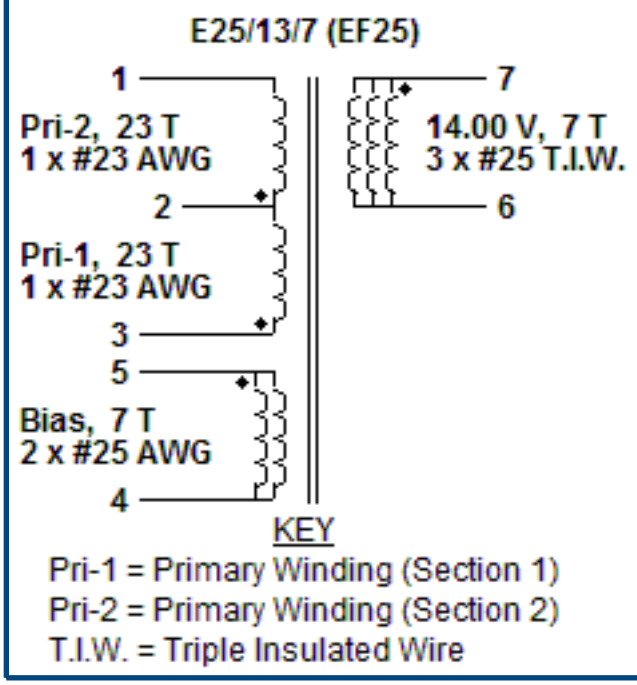
| | Description | Show Me |
|---|---|---|
| 1 | *Minimize loop area formed by secondary winding, the output rectifier and the output filter capacitor* | |
| 2 | *Y-capacitor connected directly to the DC pin of the primary and secondary GND* | |
| 3 | *Minimize loop area formed by drain, clamp and transformer* | |
| 4 | *Maximize hatched area for heat-sinking* | |
| 5 | *Minimize loop area formed by drain, input capacitor and transformer* | |
| 6 | *Spark gaps with adequate creepage help in steering away the destructive energy created during an ESD event through the protection components such as the Y-cap.* | |
| 7 | *The BYPASS pin capacitor should be located as close as possible to the BYPASS and SOURCE pins* | |

## Bill Of Materials

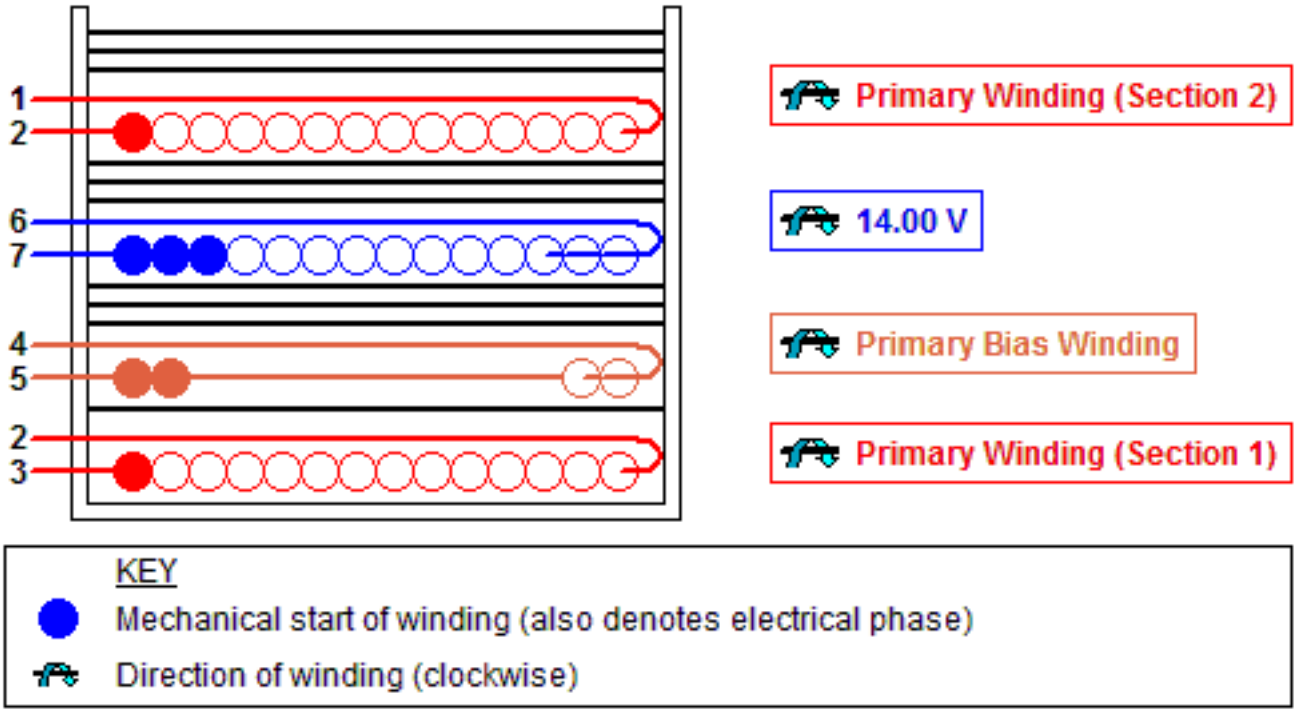
| Item # | Quantity | Part Ref | Value | Description | Mfg | Mfg Part Number |
|---|---|---|---|---|---|---|
| 1 | 1 | BR1 | DF06M | 600 V, 1 A, Standard Recovery Bridge, DFM | International Rectifier | DF06M |
| 2 | 1 | C1 | 100 nF | 100 nF, 275 VAC, Film, X Class | Kemet | R46KI310000M1K |
| 3 | 1 | C2 | 33 µF | 33 µF, 400 V, High Voltage Al Electrolytic, (35 mm x 10 mm) | United Chemi-Con | EPAG400VB33RM10X35LL |
| 4 | 1 | C3 | 4.7 nF | 4.7 nF, 630 V, High Voltage Ceramic | TDK | FA26NP02J472JNU06 |
| 5 | 1 | C4 | 0.47 µF | 0.47 µF, 16 V, Ceramic, X7R | TDK | C1608X7R1C474K |
| 6 | 1 | C5 | 2.2 µF | 2.2 µF, 50 V, Ceramic, X7R | Murata | RDER71H225K2K1C03B |
| 7 | 1 | C6 | 0.33 nF | 0.33 nF, 250 VAC, Ceramic, Y Class | Vishay Cera-Mite | 440LT33-R |
| 8 | 1 | C7 | 680 pF | 680 pF, 200 V, High Voltage Ceramic | Kemet | C0805C681K2RACAUTO |
| 9 | 1 | C8 | 22 µF | 22 µF, 35 V, Electrolytic, Gen Purpose, 17 mΩ, (8 mm x 6.3 mm) | Rubycon | 35MH722MEFCTZ6.3X7 |
| 10 | 1 | C9 | 220 µF | 220 µF, 25 V, Al Organic Polymer, 16 mΩ, (13 mm x 8 mm) | Nichicon | RNU1E221MDN1KX |
| 11 | 1 | C10 | 100 µF | 100 µF, 16 V, Electrolytic, Low ESR, 300 mΩ, (11 mm x 5 mm) | Panasonic | EEU-FR1C101B |
| 12 | 1 | C11 | 330 pF | 330 pF, 50 V, Ceramic, C0G | TDK | FK18C0G1H331J |
| 13 | 1 | D1 | 1N4937 | 600 V, 1 A, Fast Recovery, 200 ns, DO-41 | Vishay | 1N4937 |
| 14 | 1 | D2 | 1N4002 | 100 V, 1 A, Standard Recovery, DO-41 | Vishay | 1N4002 |
| 15 | 1 | F1 | 1 A | 250 VAC, 1 A, Radial TR5, Time Lag Fuse | Littelfuse / Wickmann(R) | 37411000410 |
| 16 | 1 | L1 | 6 mH | 6 mH, 0.3 A | Kemet | SU9V/H |
| 17 | 1 | L2 | 3.3 µH | 3.3 µH, 2.66 A | Bourns Inc. | RL822-3R3K-RC |
| 18 | 1 | M1 | PSMN015-100YL | MOSFET, N-Channel, 100 V, 69 A, LFPAK-56 | Nexperia | PSMN015-100YL |
| 19 | 1 | R1 | 27 kΩ | 27 kΩ, 5 %, 2 W, Metal Oxide Film | Generic | |
| 20 | 1 | R2 | 8.2 Ω | 8.2 Ω, 5 %, 0.25 W, Carbon Film | Generic | |
| 21 | 2 | R3, R4 | 1.78 MΩ | 1.78 MΩ, 1 %, 0.25 W, Metal Film | Generic | |
| 22 | 1 | R5 | 11 kΩ | 11 kΩ, 1 %, 0.125 W, Metal Film | Generic | |
| 23 | 1 | R6 | 47 Ω | 47 Ω, 5 %, 0.125 W, Carbon Film | Generic | |
| 24 | 1 | R7 | 14 mΩ | 14 mΩ, 1 %, 0.25 W, Metal Film | Generic | |
| 25 | 1 | R8 | 13 Ω | 13 Ω, 5 %, 0.5 W, Carbon Film | Generic | |
| 26 | 1 | R9 | 301 kΩ | 301 kΩ, 1 %, 0.125 W, Metal Film | Generic | |
| 27 | 1 | R10 | 29.4 kΩ | 29.4 kΩ, 1 %, 0.125 W, Metal Film | Generic | |
| 28 | 1 | RV1 | V275LA4P | 275 V, 23 J, 7 mm, RADIAL, MOV | Littelfuse | V275LA4P |
| 29 | 1 | T1 | E25/13/7 (EF25) | 3F3 Core Material<br>See Transformer Construction's Materials List for complete information | Epcos | B66317-G-X127 |
| 30 | 1 | U1 | INN3166C | InnoSwitch3-CE, INN3166C, inSOP-24D | Power Integrations | INN3166C-H101 |
| 31 | 1 | | | 104 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Device U1. | Custom | |

| | | | | | | |
|---|---|---|---|---|---|---|
| *32* | *1* | | | *104 mm² area on Copper PCB. 2 oz (70 µm) thickness. Heatsink for use with Rectifier M1.* | *Custom* | |

## Electrical Diagram




## Mechanical Diagram




## Winding Instruction

**Primary Winding (Section 1)**

*Start on pin(s) 3 and wind 23 turns (x 1 filar) of item [5]. in 1 layer(s) from left to right. Winding direction is clockwise. On the final layer, spread the winding evenly across entire bobbin. Finish this winding on pin(s) 2.*

*Add 1 layer of tape, item [3], for insulation.*

**Primary Bias Winding**

*Start on pin(s) 5 and wind 7 turns (x 2 filar) of item [6]. Winding direction is clockwise. Spread the winding evenly across entire bobbin. Finish this winding on pin(s) 4.*

*Add 3 layers of tape, item [3], for insulation.*

**Secondary Winding**

*Start on pin(s) 7 and wind 7 turns (x 3 filar) of item [7]. Spread the winding evenly across entire bobbin. Winding direction is clockwise. Finish this winding on pin(s) 6.*

*Add 3 layers of tape, item [3], for insulation.*

**Primary Winding (Section 2)**

*Start on pin(s) 2 and wind 23 turns (x 1 filar) of item [5]. in 1 layer(s) from left to right. Winding direction is clockwise. On the final layer, spread the winding evenly across entire bobbin. Finish this winding on pin(s) 1.*

*Add 3 layers of tape, item [3], for insulation.*

**Core Assembly**

*Assemble and secure core halves. Item [1].*

**Varnish**

*Dip varnish uniformly in item [4]. Do not vacuum impregnate.*

## Comments

**1. Use of a grounded flux-band around the core may improve the EMI performance.**

**2. For non margin wound transformers use triple insulated wire for all secondary windings.**

## Materials

| *Item* | *Description* |
|---|---|
| **[1]** | **Core: E25/13/7 (EF25), 3F3, gapped for ALG of 271 nH/T²** |
| **[2]** | **Bobbin: Generic, 5 pri. + 5 sec.** |
| **[3]** | **Barrier Tape: Polyester film [1 mil (25 µm) base thickness], 15.30 mm wide** |
| **[4]** | **Varnish** |
| **[5]** | **Magnet Wire: 23 AWG, Solderable Double Coated** |
| **[6]** | **Magnet Wire: 25 AWG, Solderable Double Coated** |
| **[7]** | **Triple Insulated Wire: 25 AWG** |

## Electrical Test Specifications

| *Parameter* | *Condition* | *Spec* |
|---|---|---|
| *Electrical Strength, VAC* | **60 Hz 1 second, from pins 1,2,3,4,5 to pins 6,7.** | **3000** |
| *Nominal Primary Inductance, µH* | **Measured at 1 V pk-pk, typical switching frequency, between pin 1 to pin 3, with all other Windings open.** | **574** |
| *Tolerance, ±%* | **Tolerance of Primary Inductance** | **5.0** |
| *Maximum Primary Leakage, µH* | **Measured between Pin 1 to Pin 3, with all other Windings shorted.** | **14.35** |

*Although the design of the software considered safety guidelines, it is the user's responsibility to ensure that the user's power supply design meets all applicable safety requirements of user's product.*