



# AN2001 Application note

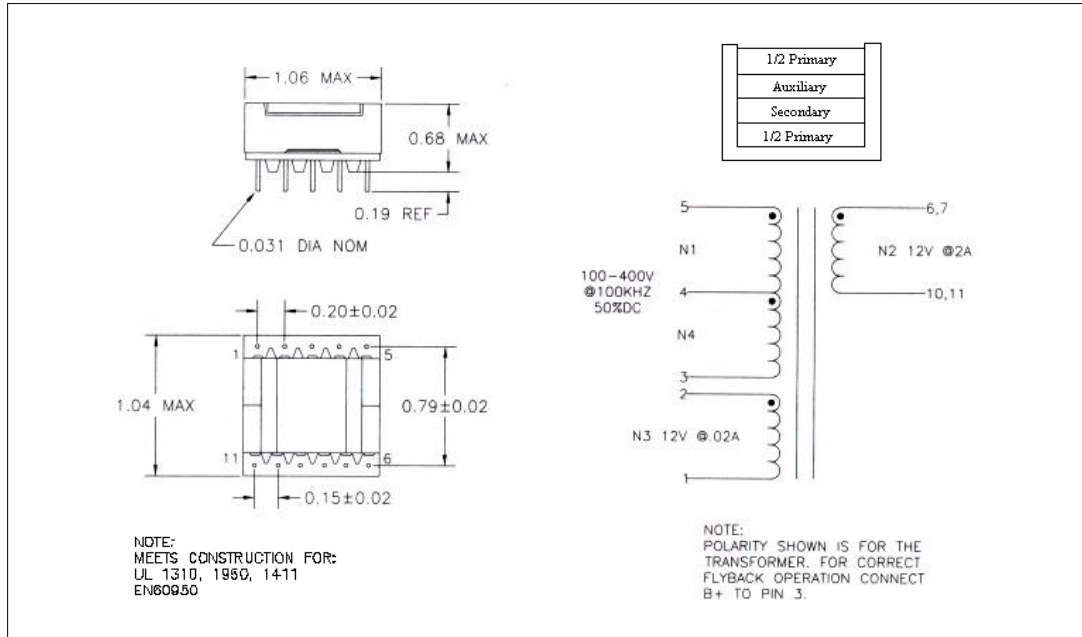
## VIPower™: the VIPer53-E single output reference board with 90 to 264 Vac input, 24 W output

**Table 1. Operating conditions**

| Parameter             | Limits             |
|-----------------------|--------------------|
| Input voltage range   | From 90 to 264 Vac |
| Input frequency       | 100 kHz            |
| Output voltage        | V = 12 V           |
| Output power          | 24 W               |
| Efficiency            | 75% typical        |
| Line regulation       | +/- 0              |
| Load regulation       | +/- 0.2%           |
| Output ripple voltage | 15 mVpp            |
| EMI                   | EN55022 Class B    |

### Transformer specifications

**Figure 11. Transformer specifications**



The transformer is designed and manufactured by Cramer Coil and Transformer Co., Inc. Below the electrical specifications of the transformer:

- Primary inductance 1.10 mH±10%

- Primary leakage inductance 6.4  $\mu$ H typical
- HIPOT (N1, N3, N4 to N2) 4000 Vac, 1 second
- DCR (N1/N4) 0.905  $\Omega$  typical
- DCR (N2) 0.020  $\Omega$  typical
- DCR (N3) 0.112  $\Omega$  typical
- Turn ratio (N1/N4:N2) 1:0.121 $\pm$ 3%
- Turn ratio (N1/N4:N3) 1:0.121 $\pm$ 3%

When the VIPer53-E is on, the energy is stored in the primary winding of the transformer (pins from 3 to 5). This energy is transferred to the auxiliary winding (pins 1 and 2), and to the output (6, from 7 to 10, 11) when the VIPer53-E is off. The auxiliary winding provides the bias voltage for the VIPer53-E on pin 7 ( $V_{DD}$ ).

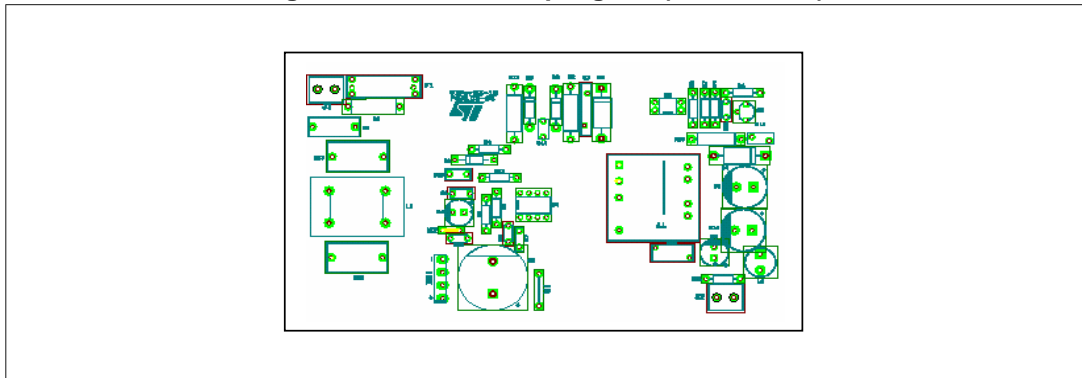
## Different output current and voltage capability

The standard voltage and current values for the reference board can be changed to deliver a different voltage and current value, as shown in [Table 1](#).

**Table 2. Secondary component value to obtain different output voltage and current**

| $V_{OUT}$ and $I_{OUT}$ | T1        | R6                 | R9                 | C8, C16           | D4        |
|-------------------------|-----------|--------------------|--------------------|-------------------|-----------|
| 5.0 V 4.8 A             | CVP53-003 | 2.49 k $\Omega$ 1% | 2.49 k $\Omega$ 1% | 3300 $\mu$ F 10 V | STPS1045  |
| 12 V 2.0 A              | CVP53-001 | 3.48 k $\Omega$ 1% | 13.3 k $\Omega$ 1% | 1000 $\mu$ F 25 V | BYW98-200 |
| 15 V 1.6 A              | CVP53-004 | 2.94 k $\Omega$ 1% | 14.7 k $\Omega$ 1% | 1000 $\mu$ F 35 V | BYW98-200 |
| 24 V 1.0 A              | CVP53-005 | 1.50 k $\Omega$ 1% | 13.0 k $\Omega$ 1% | 470 $\mu$ F 50 V  | BYW98-200 |

**Figure 12. PC board top legend (not in scale)**



**Figure 13. PC board bottom copper (not in scale)**

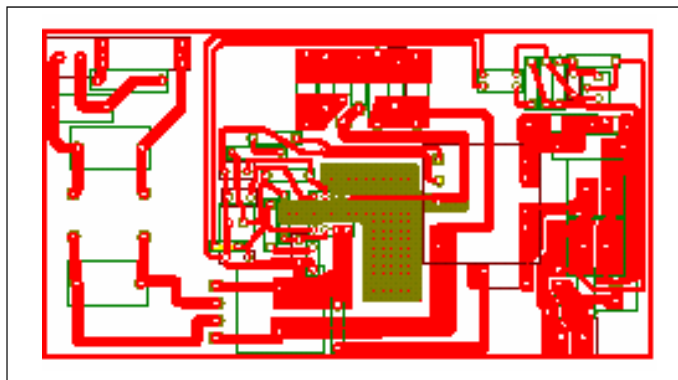


Table 3. Component list

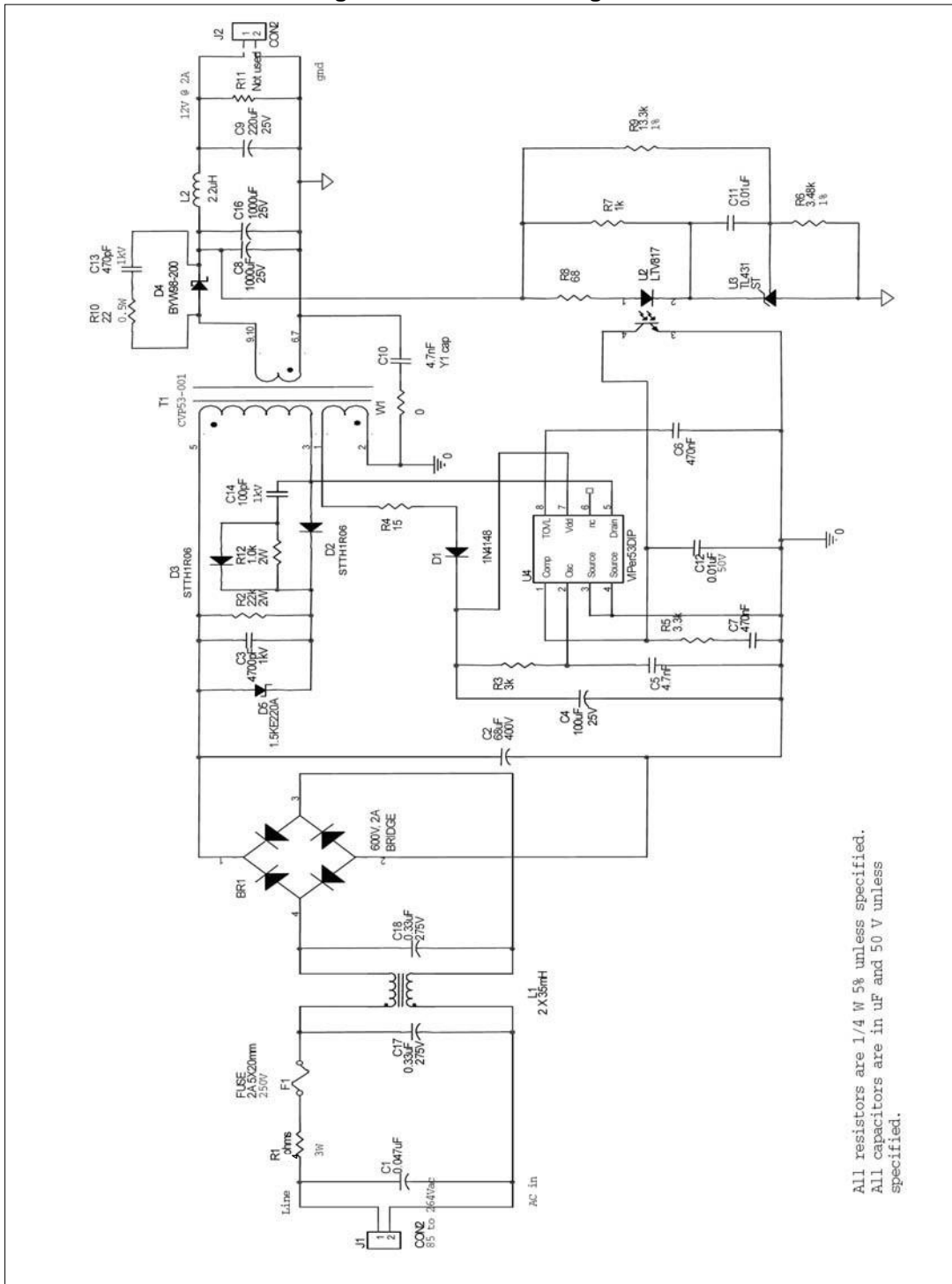
| Quantity | Reference | Description                            |
|----------|-----------|--|
| 1        | BR1       | KBP210GDI bridge rectifier             |
| 1        | C1        | 0.047 $\mu$ F 250 V                    |
| 1        | C2        | 68 $\mu$ F/400 V electrolytic          |
| 1        | C3        | 4700 pF 1 k V ceramic                  |
| 1        | C4        | 100 $\mu$ F/25 V electrolytic          |
| 1        | C5        | 4.7 nF 50 V polyester                  |
| 2        | C6, C7    | 470 nF 50 V ceramic                    |
| 2        | C8, C16   | 1000 $\mu$ F/25 V electrolytic         |
| 1        | C9        | 220 $\mu$ F/25 V electrolytic          |
| 1        | C10       | 4.7 nF/250 V Y1 cap                    |
| 2        | C11, C12  | 0.01 $\mu$ F 50 V ceramic              |
| 1        | C13       | 470 pF/1 k V ceramic                   |
| 1        | C14       | 100 pF/1 k V ceramic                   |
| 1        | C15       | Not used                               |
| 2        | C17, C18  | 0.33 $\mu$ F/250 V                     |
| 1        | L1        | Panasonic 35 mH common-mode line choke |
| 1        | L2        | Coilcraft 2.2 $\mu$ H inductor         |
| 1        | T1        | Cramer Coil CVP53-001                  |
| 1        | R1        | 4 $\Omega$ 5% 3 W wire wound           |
| 1        | R2        | 22 k $\Omega$ 5% 2 W resistor          |
| 1        | R3        | 3 k $\Omega$ 5% 0.5 W resistor         |
| 1        | R4        | 15 $\Omega$ 5% 0.25 W resistor         |
| 1        | R5        | 3.3 k $\Omega$ 5% 0.25 W resistor      |
| 1        | R6        | 3.48 k $\Omega$ 1% 0.25 W resistor     |
| 1        | R7        | 1 k $\Omega$ 5% 0.25 W resistor        |
| 1        | R8        | 68 $\Omega$ 5% 0.25 W resistor         |
| 1        | R9        | 13.3 k $\Omega$ 1% 0.25 W resistor     |
| 1        | R10       | 22 $\Omega$ 5% 0.5 W resistor          |

|   |        |                              |
|---|--------|------------------------------|
| 1 | R12    | 1 k $\wedge$ 5% 2 W resistor |
| 1 | R13    | Not used                     |
| 1 | D1     | 1N4148                       |
| 2 | D2, D3 | STTH1R06                     |
| 1 | D4     | BYW98-200                    |
| 1 | D5     | 1.5KE220A transil            |

Table 3. Component list (continued)

| Quantity | Reference | Description                     |
|----------|-----------|---------------------------------|
| 1        | U2        | H11A817A or LTV817A optocoupler |
| 1        | U3        | TL431                           |
| 1        | U4        | VIPer53DIP-E                    |
| 2        | W1, W2    | Jumper wire                     |
| 2        | J1, J2    | Connectors                      |

Figure 14. Schematic diagram



All resistors are 1/4 W 5% unless specified.  
All capacitors are in uF and 50 V unless specified.

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## 2 Revision history

**Table 4. Revision history**

| <b>Date</b> | <b>Revision</b> | <b>Changes</b>   |
|-------------|-----------------|--|
| 16-Jul-2004 | 1               | First issue  |
| 12-Sep-2006 | 2               | - New template<br>- Component list value modified<br>- Schematic diagram modified              |
| 12-Nov-2014 | 3               | Updated title in cover page.<br>Content reworked to improve readability, no technical changes. |

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