

# LOW DISTORTION LINE MATCHING TRANSFORMER

# P5233

## Features

- \* Lead-free (Pb-free)
- \* RoHS compliant
- \* Low Distortion
- \* 10.4mm (0.41") Seated Height
- \* Industry Standard Pinout
- \* IEC 60950 and UL 60950 Certified
- \* Supplementary Insulation for a Primary Circuit
- \* Extended Frequency Response
- \* Flat TX and RX Responses
- \* Simple Matching
- \* Low Insertion Loss
- \* High Thermal Stability

## Applications

- \* V.90 and V.92 Modems
- \* V.34 Modems
- \* Fax Machines
- \* Instrumentation
- \* Set Top Box/Web browsing
- \* Internet Feature Phones

## DESCRIPTION

P5233 is intended for low cost V.90 and V.92 (56kbps) modems and other high-speed applications. It is a direct substitute for P3356, being mechanically compatible and having identical signal/distortion and matching characteristics, and suitable for supplementary insulation, 250V working.

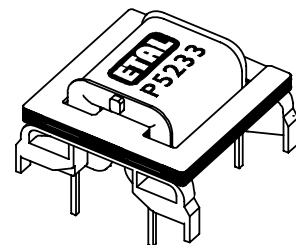
P5233 uses patented design and construction methods to achieve excellent signal performance and safety isolation to international standards.

P5233 has exceptionally flat frequency response from 30Hz to 10kHz, a 3dB bandwidth of 60kHz and requires only the very simplest of matching to achieve good return loss and transhybrid loss across the voiceband, with very low levels of signal distortion at signal frequencies as low as 150Hz.

P5233 is certified to IEC 60950 and UL 60950. P5233 is a UL Recognized Component and is supported by an IEC CB certificate. The part is completely lead-free, compliant with RoHS Directive 2002/95/EC, and suitable for lead-free and conventional processing.



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## SPECIFICATIONS

### Electrical

At T = 25°C and as circuit Fig. 2 unless otherwise stated.

| Parameter                                | Conditions                      | Min  | Typ | Max  | Units |
|--|---------------------------------|------|-----|------|-------|
| Insertion Loss                           | f = 2kHz, R <sub>L</sub> = 600Ω | -    | 1.5 | -    | dB    |
| Frequency Response                       | LF -3dB cutoff                  | -    | 10  | -    | Hz    |
|  | HF -3dB cutoff                  | -    | 60  | -    | kHz   |
|  | 100Hz – 4kHz                    | -    | -   | ±0.1 | dB    |
| Return Loss <sup>(5)</sup>               | 200Hz – 4kHz                    | 16   | -   | -    | dB    |
| Transhybrid Loss <sup>(5)</sup>          | 200Hz – 4kHz                    | -    | 20  | -    | dB    |
| Third Harmonic Distortion <sup>(1)</sup> | 150Hz -3dBm in line             | -    | -70 | -    | dBm   |
|  | 200Hz -10dBm in line            | -    | -89 | -    | dBm   |
| Balance                                  | DC – 5kHz<br>Method TG 25       | 80   | -   | -    | dB    |
| Voltage Isolation <sup>(2)</sup>         | 50Hz                            | 2.12 | -   | -    | kVrms |
|  | DC                              | 3.0  | -   | -    | kV    |
| Operating Range:                         | Functional                      | 0    | -   | +70  | °C    |
|  | Storage                         | -40  | -   | +85  | °C    |

Lumped equivalent circuit parameters as Fig. 1

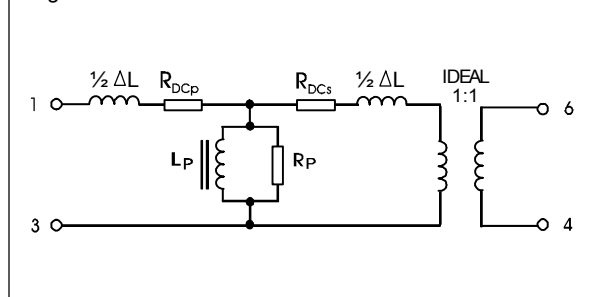
|   |                                       |     |    |     |    |
|---|---------------------------------------|-----|----|-----|----|
| DC resistance <sup>(3)(6)</sup>                 | Primary resistance R <sub>DCp</sub>   | 84  | -  | 107 | Ω  |
|   | Secondary resistance R <sub>DCs</sub> | 81  | -  | 100 | Ω  |
| Leakage inductance, ΔL                          |                                       | 2.2 | -  | 5   | mH |
| Shunt inductance, L <sub>p</sub> <sup>(4)</sup> | 200Hz 10mV                            | 6   | 9  | -   | H  |
| Shunt loss, R <sub>p</sub>                      | 200Hz 10mV                            | 12  | 15 | -   | kΩ |

#### Notes:

- Third harmonic typically exceeds other harmonics by 10dB.
- Components are 100% tested at 3.25kVDC.
- Caution: do not pass DC through windings. Telephone line current must be diverted using semiconductor line hold circuit or choke.
- At signal levels greater than 100mV, L<sub>p</sub> will increase and R<sub>p</sub> will decrease slightly but the effect is usually favourable to the return loss characteristic.
- Return loss and transhybrid loss can be improved to 30dB in improved matching circuit. The values shown relate to the simplest configuration, Fig. 2.
- At signal frequencies, the primary and secondary resistance appear in series with the load and therefore present a sum of resistances in the range 165-207Ω in common with P3356.

#### Equivalent Circuit

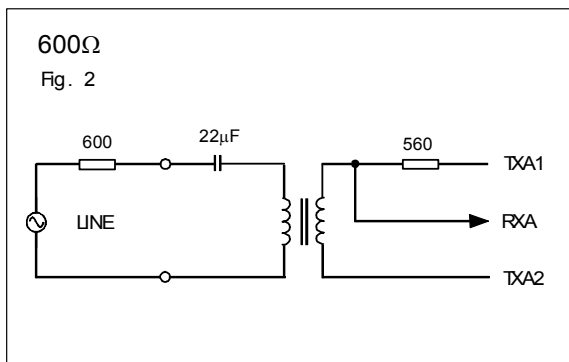
Fig. 1



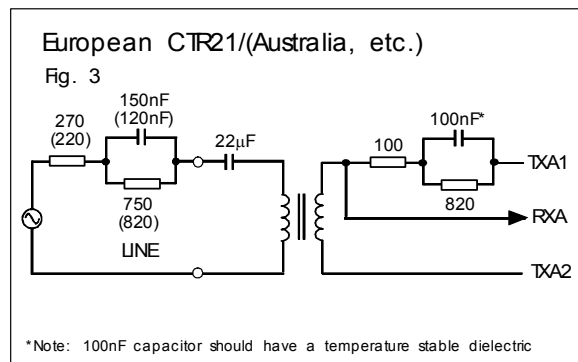
**MATCHING RECOMMENDATIONS**

The following recommendations start with the simplest implementations and progress to enhanced performance utilizing additional components. Good performance is achieved even with the simplest configurations. The implementations assume a low impedance balanced TX drive and a relatively high impedance RX input, as is commonly available, though use with other TX/RX arrangements is straightforward. Note that there are no changes to components on the line side, or in the hybrid, whether 600Ω or complex reference impedance selected, thus assisting country configuration. For complex impedance, the matching circuits derived are suitable for reference impedances of the type 270 + 750//150nF e.g. European CTR21 and 220 + 820//120nF (or 115nF) e.g. Australia, South Africa, etc., and yield similar performance characteristics. For other impedances, please contact Profec Technologies.

**Minimum Cost Implementations**

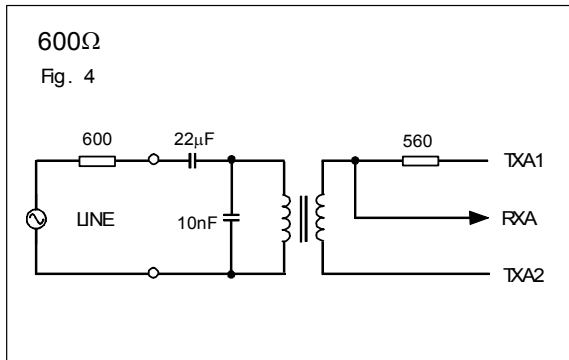


Insertion Loss: 1.8dB @ 2kHz  
Frequency Response : ±0.2dB 30Hz – 10kHz  
Return Loss: 16dB 200Hz – 4kHz  
Transhybrid Loss: 22dB 200Hz – 4kHz

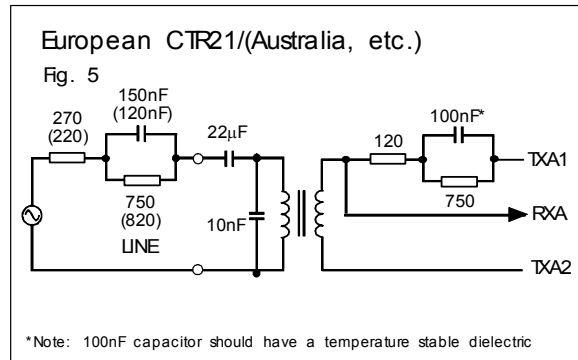


Insertion Loss: 1.0dB @ 2kHz  
Frequency Response : ±0.5dB 50Hz – 4kHz  
Return Loss: 18dB 200Hz – 4kHz  
Transhybrid Loss: 14dB 200Hz – 4kHz

**Improved matching**



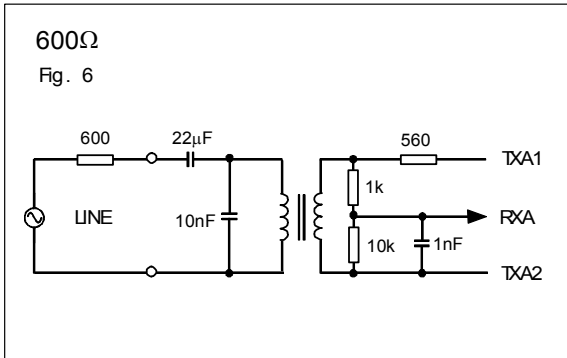
Insertion Loss: 1.8dB @ 2kHz  
Frequency Response : ±0.2dB 30Hz – 10kHz  
Return Loss: 18dB 200Hz – 4kHz  
Transhybrid Loss: 22dB 50Hz – 10kHz



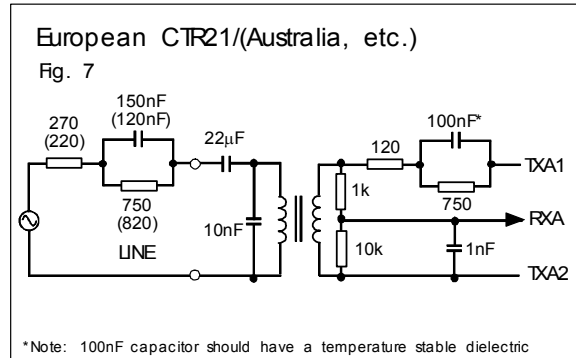
Insertion Loss: 1.0dB @ 2kHz  
Frequency Response : ±0.5dB 50Hz – 4kHz  
Return Loss: 20dB 200Hz – 4kHz  
Transhybrid Loss: 16dB 50Hz – 4kHz

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**Improved matching and hybrid**

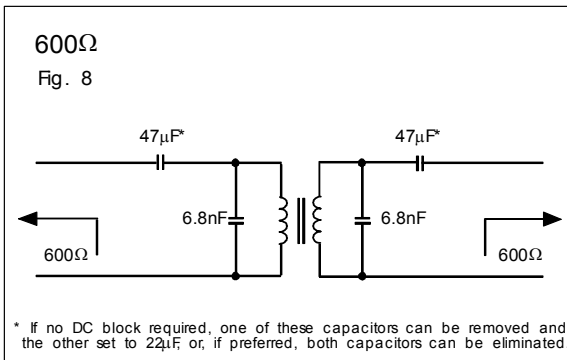


Insertion Loss (Line to RXA): 2.8dB @ 2kHz  
 Frequency Response : ±0.2dB 30Hz – 10kHz  
 Return Loss: 20dB 200Hz – 4kHz  
 Transhybrid Loss: 30dB 50Hz – 10kHz



Insertion Loss (Line to RXA): 2.2dB @ 2kHz  
 Frequency Response : ±0.5dB 50Hz – 4kHz  
 Return Loss: 20dB 200Hz – 4kHz  
 Transhybrid Loss: 18dB 200Hz – 4kHz

**600Ω Instrumentation**



Insertion Loss: 1.5dB @ 2kHz  
 Frequency Response : ±0.2dB 20Hz – 20kHz  
 Return Loss: 16dB 20Hz – 20kHz

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**SAFETY**

Constructed in accordance with IEC 60950-1, EN 60950-1, and UL 60950-1, supplementary insulation for a primary circuit, 250Vrms maximum working voltage, flammability class V-1.

Components should be installed in such a way that the core is separated from accessible conductive parts by a creepage of 2.5mm, clearance of 2mm, or by solid insulation of minimum thickness 0.4mm, or by appropriate thin film.

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**CERTIFICATION**

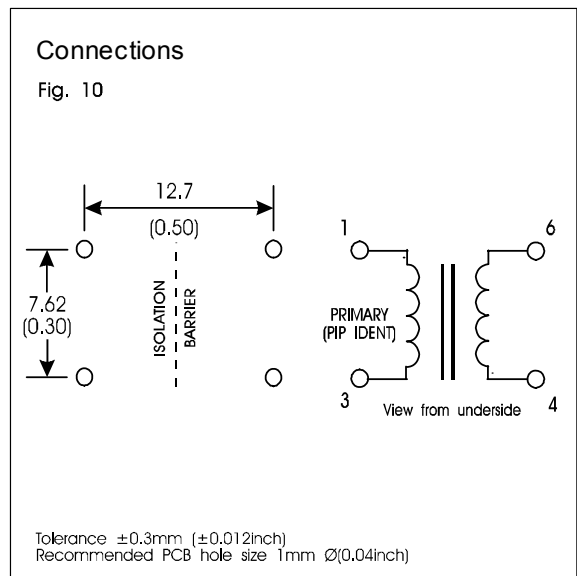
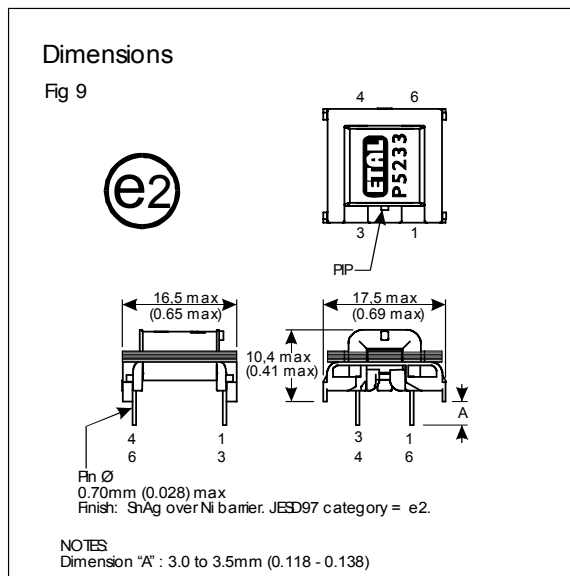
Certified under the IEC CB scheme (Certificate GB597W) to IEC 60950 Third Edition 1999 sub-clauses 1.5, 1.5.1, 1.5.2, 2.9, 2.9.1, 2.9.2, 2.9.4, 2.9.5, 2.10, 2.10.1, 2.10.3, 2.10.3.1, 2.10.3.2, 2.10.4, 2.10.5, 2.10.5.1, 2.10.5.2, 2.10.5.4, 4.5.2, 4.7, 4.7.3, 4.7.3.1, 4.7.3.4, (Flammability Class V-1) 5.2, 5.2.1, and 5.2.2 for a maximum working voltage of 250Vrms, nominal mains supply voltage not exceeding 250Vrms and a maximum operating temperature of +85°C in Pollution Degree 2 environment, supplementary insulation for a primary circuit.

Recognized under the Component Recognition Program of Underwriters Laboratories Inc. to US and Canadian requirements CAN/CSA C22.2 No. 60950-1-03/UL 60950-1, First Edition, based on IEC 60950-1, First Edition, maximum working voltage 250Vrms, Pollution Degree 2, supplementary insulation.

UL File number E203175

Additionally, Profec Technologies certifies all transformers as providing voltage isolation of 2.12kVrms, 3kV DC minimum. All shipments are supported by a certificate of conformity to current applicable safety standards.

**CONSTRUCTION**



Dimensions shown are in millimetres (inches).  
Geometric centres of outline and pin grid coincide within a tolerance circle of 0.6mm $\varnothing$ .  
Windings may be used interchangeably as primary or secondary.  
Total weight typically 4.8g.

## ABSOLUTE MAXIMUM RATINGS

(Ratings of components independent of circuit).

|                                   |                        |
|-----------------------------------|------------------------|
| Short term isolation voltage (1s) | 2.12kVrms,<br>3.0 kVDC |
| DC current                        | 100 $\mu$ A            |
| Storage temperature               | -40°C to<br>+85°C      |
| Lead temperature, 10s             | 260°C                  |

## INTELLECTUAL PROPERTY RIGHTS

ETAL, P5233 and P3356 are Trade Marks of Profec Technologies Ltd.

The Trade Mark ETAL is registered at the UK Trade Marks Registry.

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P5233 design and construction are protected by patents.

British Patent No. 2333646.

US Patent No. 6,344,787

European Patent No. 1082734

China Patent No. ZL99806739.3

Other patents pending.

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