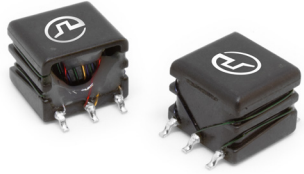


# Isolation Power Transformers

Toroid Platform SMD PH9384.XXXNL and PM2185.XXXNL



- Push Pull Converter Transformer
- 4KVrms Isolation (550Vrms Continuous)
- Reinforced Insulation (IEC62368-1), UL 60950-1 Certified
- 8mm Creepage
- Patented:** US Pat 9,646,755

## Electrical Specifications @ 25°C - Operating Temperature -40°C to +125°C

| Part Number  |                         | Inductance<br>(1-3) | Leakage Inductance<br>(1-3) with (4-6) shorted | Capacitance<br>(1, 2, 3) to (4, 5, 6) | DCR (1-3) | DCR (4-6) | MAX (1-3) <sup>1</sup> | Turns Ratio<br>(1:3) (6:4) | Isolated Voltage<br>(Vrms) |
|--------------|-------------------------|---------------------|------------------------------------------------|---------------------------------------|-----------|-----------|------------------------|----------------------------|----------------------------|
| Commerical   | Automotive <sup>3</sup> | (μH ±35%)           | (μH MAX)                                       | (pF MAX)                              | (Ω MAX)   | (Ω MAX)   | (V-μsec Max)           |                            |                            |
| PH9384.011NL | PM2185.011NL            | 538                 | 0.8                                            | 20                                    | 0.30      | 0.40      | 24                     | 1CT : 1CT                  | 4000                       |
| PH9384.012NL | PM2185.012NL            | 538                 | 0.6                                            | 30                                    | 0.33      | 0.65      | 24                     | 1CT : 2CT                  |                            |
| PH9384.021NL | PM2185.021NL            | 538                 | 1.6                                            | 15                                    | 0.30      | 0.25      | 24                     | 2CT : 1CT                  |                            |
| PH9384.034NL | PM2185.034NL            | 680                 | 0.6                                            | 30                                    | 0.35      | 0.52      | 27                     | 3CT : 4CT                  |                            |
| PH9384.035NL | PM2185.035NL            | 680                 | 0.7                                            | 30                                    | 0.35      | 0.65      | 27                     | 3CT : 5CT                  |                            |
| PH9384.038NL | PM2185.038NL            | 538                 | 0.7                                            | 30                                    | 0.40      | 0.90      | 27                     | 3CT : 8CT                  |                            |
| PH9384.043NL | PM2185.043NL            | 538                 | 0.8                                            | 20                                    | 0.30      | 0.30      | 24                     | 4CT : 3CT                  |                            |
| PH9384.083NL | PM2185.083NL            | 538                 | 2.0                                            | 15                                    | 0.30      | 0.22      | 24                     | 8CT : 3CT                  |                            |
| PH9384.089NL | PM2185.089NL            | 538                 | 0.6                                            | 30                                    | 0.30      | 0.42      | 24                     | 8CT : 9CT                  |                            |

### Notes:

- The ET Max is calculated to limit the core loss and temperature rise at 200KHz based on a bipolar flux swing of 210mT Peak. This value needs to be derated for higher frequencies using the temperature rise calculation to remain with operating temperature range.
- A. To calculate total copper loss (W), use the following formula:  

$$\text{Copper Loss (W)} = \text{Irms\_Primary}^2 * \text{DCR\_Primary} + \text{Irms\_Secondary}^2 * \text{DCR\_Secondary}$$
 B. To calculate total core loss (W), use the following formula:  

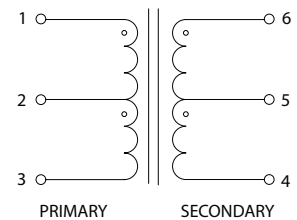
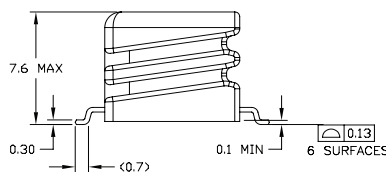
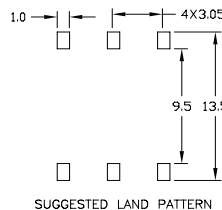
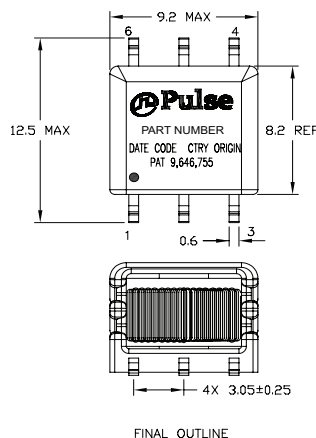
$$\text{Core Loss (W)} = 2.31E-11 * (\text{Frequency in kHz})^{1.68} * (210 * [\text{ET/ET Max}])^{2.55}$$
 Where ET is the applied Volt Second, ET Max is the rated Volt Second for 210mT flux swing
- C. To calculate temperature rise, use the following formula:  

$$\text{Temperature Rise (°C)} = 130 * (\text{Core Loss(W)} + \text{Copper Loss (W)})$$
- For Push-Pull topology, where the voltage is applied across half the primary winding turns, the ET needs to be derated by 50% for the same flux swing.
- The PM2185.XXXNL part numbers are AEC-Q200 and IATF16949 certified. The mechanical dimensions are 100% tested in production but do not necessarily meet a product capability index (Cpk) >1.33 and therefore may not strictly conform to PPAP.
- Optional Tape & Reel packing can be ordered by adding a "T" suffix to the part number (i.e. PH9384.012NL becomes PH9384.012NLT). Pulse complies to industry standard tape and reel specification EIA481.
- The "NL" suffix indicates an RoHS-compliant part number.

## Mechanical

## Schematic

### PH9384.XXXNL and PM2185.XXXNL

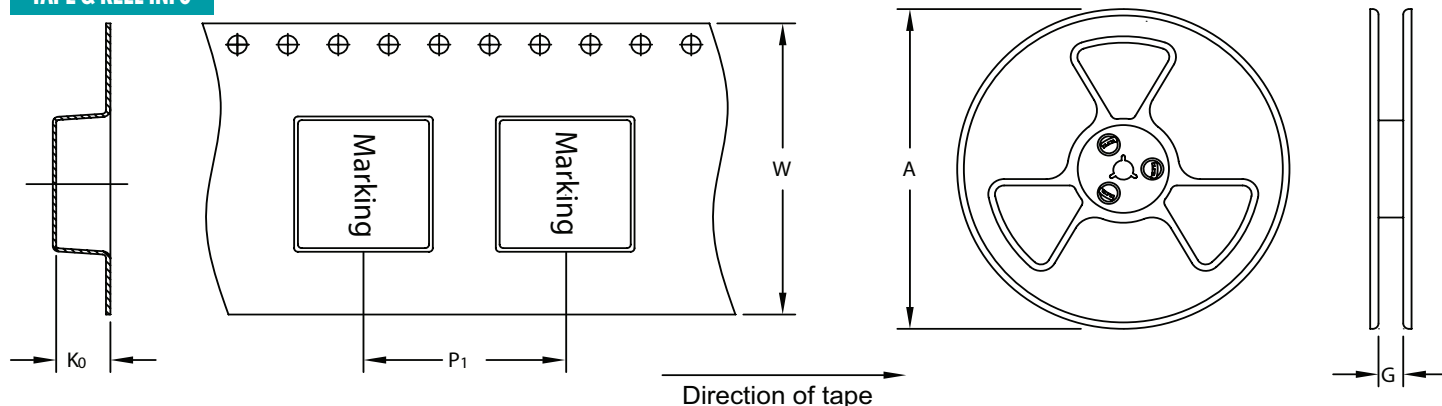


**Weight** .....0.85grams  
**Tape & Reel** .....400/reel  
**Tray** .....55/tray  
**Dimensions: mm**  
 Unless otherwise specified,  
 all tolerances are: ±0.25

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## TAPE & REEL INFO



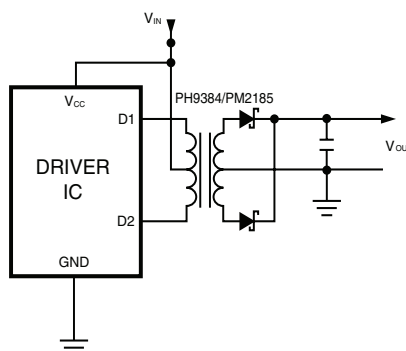
SURFACE MOUNTING TYPE, REEL/TAPE LIST

| PART NUMBER               | REEL SIZE (mm) |      | TAPE SIZE (mm) |    |                | QTY<br>PCS/REEL |
|---------------------------|----------------|------|----------------|----|----------------|-----------------|
|                           | A              | G    | P <sub>1</sub> | W  | K <sub>0</sub> |                 |
| PH9384.XXXNL/PM2185.XXXNL | Ø330           | 24.4 | 16             | 24 | 8.2            | 400             |

## APPLICATION

PH9384NL is a series of high isolation power supply transformer drivers. Intended to operate in a fixed duty cycle Push Pull topology, it is a part of a low cost solution for delivering lower power (up to 3W) from a low voltage source. A typical implementation would be an isolated RS-485/RS-232 power supply driver circuit, the design is compatible with the MAXIM™ MAX253 IC.

A schematic diagram for the Push Pull converter topology is given below.



For a fixed 50% duty cycle mode of operation, the output voltage is simply determined by the input voltage and turns ratio. So, with the available turns ratios, a variety of output voltages can be selected. PH9384.034NL has been certified by UL to comply with UL60950-1 2 edition with reinforced insulation for a working voltage up to 300Vac. 7mm creepage and 3000Vrms isolation voltage is guaranteed to meet this requirement. The remainder of the PH9384.XXXNL series was not included in the UL certification but are fully complaint with the requirements for reinforced insulation. Based on VDE approval of FIW wire under IEC60317-0-7, IEC60317-36 and IEC60851-5:2008, IEC62368-1 accepts the current construction of the PH9384/PM2185 series as fulfilling the requirements of reinforced insulation for a working voltage up to 300Vac/420Vpeak.

MAXIM is a registered trademark of Maxim Integrated Products.

## For More Information:

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