

APPLICATION NOTE

Skyworks Optocouplers vs. Pulse Transformers

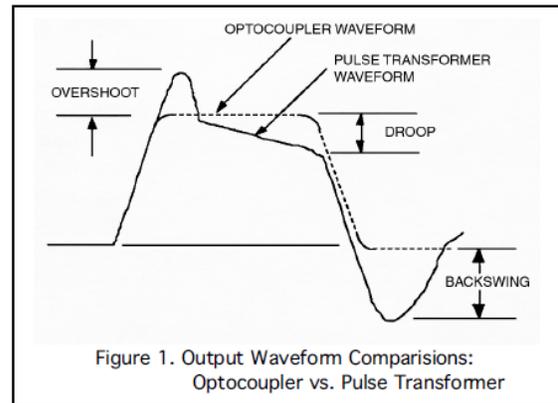
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In isolation applications where one needs to pass signals in presence of transient or continuous high voltages, reject extreme noise, and break ground loops, optical (optocouplers) and magnetic (pulse transformers) coupling isolation are often used. However pulse transformers are much more difficult to design with relative to optocouplers. When dealing with pulse transformers, the load becomes more critical than with any other type of transformer. Leakage and primary inductance values take on added significance because of the effect they have on the output waveshape. If the load disturbs this wave shape, severe problems can be created. [1]

In many applications, it is difficult to obtain a usable waveform with a pulse transformer (See Figure 1). This is essentially due to three factors: waveform droop, effects of the turns ratio on risetime, and backswing. [2]

A comparison between transformer and optocoupler characteristics are presented in Table 2.

Optocouplers are being used to replace pulse transformers due to their ease of design, simplicity, and smaller size. The use of state-of-the-art AlGaAs emitters in Isolink's optocouplers has greatly improved performance and reliability. AlGaAs LED emitters are brighter, faster, more efficient and linear, and slower to degrade than GaAs and GaAsP type emitters used in older optocoupler designs. For hybrid assembly applications, we offer the OLI optocoupler family in a small size, 100" X.110" X.045" high, package.



For “chip and wire” assembly. For applications requiring hermetic packaging, optocouplers are available in 6-pin leadless chip carrier (LCC) surface mount packages or TO-5 packages. Our products range from simple phototransistor outputs to high speed, high common mode rejection logic gates. The typical data rates range from 50KBaud to 10 MBaud. (See Table 1).

Notes and References

1. "Pulse Transformers", Eric Marchese, Powertechnics Magazine, December 1989.
2. Hewlett Packard Tech Brief 103.

Table 1: Optocouplers

| Part Number | Description | Typical Data Rate ¹ | Recommended Input Current | Typical Common Mode Transient Immunity ² |
|-------------|------------------------|--------------------------------|---------------------------|-----------------------------------------------------|
| OLX 100 | Transistor | 100 K bits/s | 5 mA | ± 5,000 V/μS |
| OLX 300 | Photodiodes Transistor | 1 M bits/s | 10 mA | ± 5,000 V/μS |
| OLX 400 | Photodiodes Darlington | 100 K bits/s | 0.5 mA | ± 5,000 V/μS |
| OLX 500 | High Speed Logic Gate | 10 M bits/s | 5 mA | ± 5,000 V/μS |

X = Package type

¹ At 25 C and recommended operating conditions for the particular product

² Vcm = 50V p-p

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Table 2: Advantages of Skyworks Optocouplers over Pulse Transformers

| Characteristics | Pulse Transformers | Optocouplers |
|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| Output Waveform Fidelity Waveform Droop | Waveform droop is a linear function of the pulse width, for example, in a given transformer of 10% droop at 1 us, droop will be 20% at 2 us. The magnitude of the droop should not exceed the designed allowable threshold or fraction of the initial amplitude. This constrains duty cycle and speed. Better magnetic flux coupling will improve droop characteristics but usually results in higher primary to secondary capacitance, which reduces common mode transient immunity and dielectric withstand voltage. | No waveform droop |
| Waveform Backswing | Backswing could damage adjoining sensitive circuitry. Clamping diode might be required to reduce backswing amplitude. Backswing also limits transformer duty cycle and performance. | No backswing |
| Primary to Secondary Turns Ratio | Capacitance depends on primary to secondary turns ratio. Equivalent capacitance will increase with higher turns ratio increasing rise time. Unity turns ratio must be used for high speed applications consuming minimum voltage and current at the primary to achieve a usable logic level signal at the output | No turns ratio effects |
| Data Format Requirements | Complex and expensive data encoding and decoding usually required due to constraints to duty cycle and to eliminate the signal's DC components. | No need for data conversion |
| Common Mode Transient Immunity | Common mode capacitance typically higher optocouplers. Fast common mode signals are more likely to be coupled through to the secondary. Improvements such as incorporating a Faraday shield between the primary and secondary or using two trans- formers in series will increase complexity, cost and board space. | Higher common mode transient immunity than most pulse transformers, without extra complexity |
| Size | Usually larger and higher profile than optocouplers. | Small size and low profile. Optocouplers for hybrid assembly are about .100" square and .045" high |

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