Application Note

Interface Circuits for Optoelectronic Devices

The following examples are typical circuits used for reflective or transmissive assemblies. Consult the product pages for specifications on the individual assemblies you are using. The design should be capable of tolerating a 25% reduction in the published light current value (I_L) resulting from short term thermal effects and long term IRED degradation.

Example 1: Formulas

$$R_1 = \frac{V_{CC} - V_F}{I_F}$$

$$R_2 = \frac{V_{CC} - 0.4}{\left(\frac{I_L}{4}\right)}$$

The published light current value (I_L) is usually measured at V_{CE} = 5 volts and is approximately 4 times greater than the same parameter measured at V_{CE} = 0.4 volts.

Example 2: Formulas

$$R_1 = \frac{V_{CC} - V_F}{I_F}$$

$$R_2 = \frac{V_t}{I_C - I_{IN}}$$

V_t -The positive threshold voltage of the SN7414.
I_{IN} -The input current required for the SN7414, when the input is high.

Example 3: Formulas

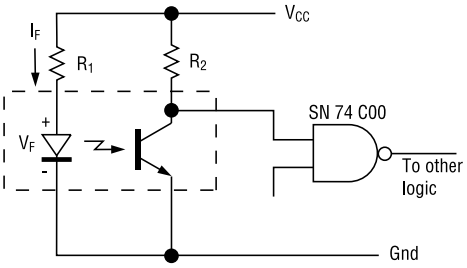
$$R_1 = \frac{V_{CC} - V_F}{I_F}$$

$$R_2 = \frac{V_{REF}}{I_L}$$

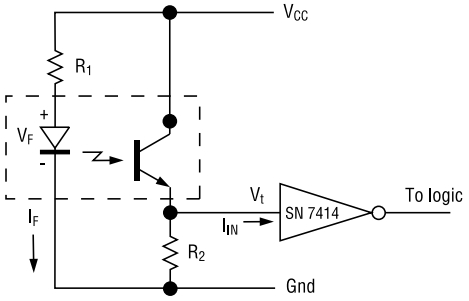
Example 4: Formulas

TTL interfacing requires 1.6 mA sinking current (I_{GATE}), with a voltage (V_{CE}) of 0.4 V at the input of the TTL gate. Example 4 shows a buffer circuit to interface optoelectronic assemblies that have a lower gate current to a TTL gate.

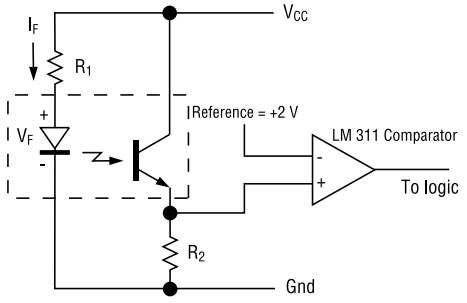
Example 1: Interface Circuit



Example 2: Interface Circuit



Example 3: Interface Circuit



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R_3 SELECTION

To get optimum noise immunity for the TTL gate and optimum switching characteristics for Q1, R_3 should be selected for the lowest possible value. The value of R_3 is a function of the HFE of Q1 and the drive current (I_L) available from the optoelectronic assembly.

Equation 1

$$I_{R3} = \frac{(V_{CC} - V_{CE1})}{R_3}$$

Equation 2

$$I_{C1} = I_{R3} + I_{GATE}$$

Equation 3

$$I_{B1} = \frac{I_{C1}}{HFE_{Q1}}$$

R_2 SELECTION

Equation 4

$$I_{R2} = I_L - I_{B1}$$

Equation 5

$$R_2 = \frac{V_{BE1} + I_{B1} R_4}{I_{R2}}$$

R_1 SELECTION

The value of R_1 is chosen to provide the required IRED forward current (I_F) as follows:

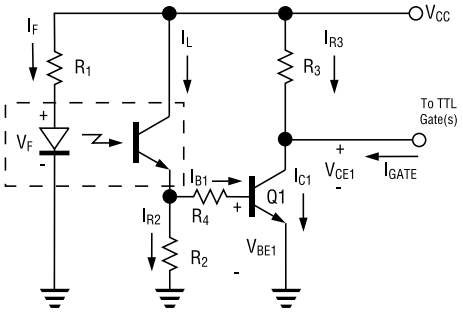
Equation 6

$$R_1 = \frac{V_{CC} - V_F}{I_F}$$

DESIGN EXAMPLE

This example interfaces the HOA1874-11 transmissive assembly with a standard TTL gate.

Example 4: Interface Circuit



HOA1874-11 Parameters:

I_L = .3 mA min. @ I_F = 20 mA, V_{CE} = 5 V

V_F = 1.6 V max. @ I_F = 20 mA

Q1 is a 2N2222 (HFE = 60 min.)

V_{CC} = 5.0 V nominal

SELECT R_3R_4

1 kΩ is a common value used as a pull-up and base current limiting resistor for TTL.

See Equation 1

$$I_{R3} = \frac{5.0\ V - 0.4\ V}{1000} = 4.6\ mA$$

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See Equation 2

$$I_{C1} = 4.6\ mA + 1.6\ mA = 6.2\ mA$$

See Equation 3

$$I_{B1} = \frac{6.2\ mA}{60} = 103\ \mu A$$

CALCULATE R_2:
See Equation 4

$$I_{R2} = 300\ \mu A - 103\ \mu A = 197\ \mu A$$

See Equation 5

$$R_2 = \frac{0.7\ V + 0.1V}{197\ \mu A} = 4.07\ k\Omega$$

CALCULATE R_1:
See Equation 6

$$R_1 = \frac{5\ V - 1.6\ V}{20\ mA} = 170\ \Omega$$

A standard resistor close to this value may be used.

This circuit will perform well with assemblies providing output currents as high as 5 mA.

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Honeywell reserves the right to make changes in order to improve design and supply the best products possible.