Utilizing a Vishay IrDA Transceiver for Remote Control

Executive Summary

Design engineers of handheld devices such as mobile phones, PDAs, and notebooks are faced with the increasingly difficult task of combining multiple functions in a single device. Among the new features being integrated into such devices is TV remote control. Constrained by size and cost, design of these new-generation portable electronics presents engineers with a significant challenge.

Most handheld devices feature an IrDA transceiver, used for short-distance wireless communication. The transceiver's LED emitter can also be used to transmit signals for IR remote control, eliminating the need to design-in an additional discrete LED emitter. Requiring no additional cost and no additional board space, this appears to be a clever solution. But will an IrDA transceiver transmit over adequate distances? Tests performed by Vishay demonstrate that the transmit distance of IrDA transceiver's is excellent. Table 1 shows the transmit distances for several IrDA transceivers and remote control receivers. The transmit distance for a remote control emitter, TSAL6400, is included for comparison. Note that with a higher peak current, I_F, the intensity of emitted radiation increases which increases the transmit distance.

	Remote Control Emitter	SIR Transceivers			MIR Transceiver	FIR Transceiver	
		Vishay	Zilog	Agilent[1]	Vishay	Vishay	Agilent
Part Number	TSAL6400	TFDU4100	ZHX1810	HSDL3201	TFDU5107	TFDU6102	HSDL3600
IRED Peak Current	I_F = 100 mA	I_F = 100 mA	I_F = 500 mA	I_F = 34 mA	I_F = 420 mA	I_F = 420 mA	I_F = 283 mA
Intensity	41 mW/sr	48 mW/sr	163 mW/sr	8 mW/sr	300 mW/sr	360 mW/sr	144 mW/sr
Wavelength	940 nm	886 nm	890 nm	872 nm	886 nm	886 nm	872 nm
RC Receivers							
Vishay TSOP1238	19 m	11 m	22 m	3.3 m	27 m	29 m	17 m
Vishay TSOP4838	25 m	22 m	45 m	7.5 m	60 m	65 m	39 m
Sharp GP1UM281YK	22 m	15 m	29 m	4.5 m	33 m	36 m	23 m
Rohm RPM7138	16 m	10 m	20 m	3 m	22 m	24 m	15 m
Panasonic PNA4612M	11 m	8 m	15 m	2.5 m	20 m	21 m	13 m
Kodenshi PIC-37043SM	18 m	11 m	22 m	3.3 m	23 m	25 m	16 m

[1]Low-power SIR transceivers have a minimum intensity of 4 mW/sr, typically too low for remote control.

Table 1: Test Results

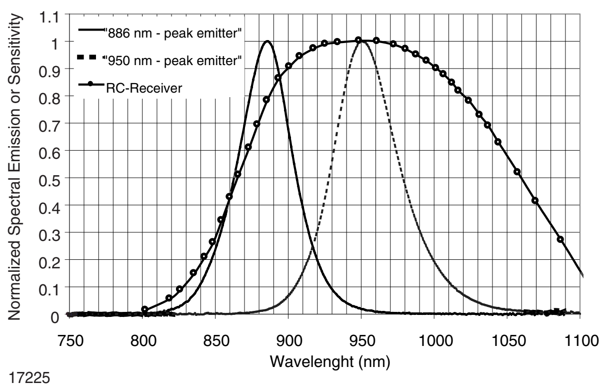

Figure 1. RC-Receiver spectral sensitivity and spectral distribution of RC-(950 nm) and IrDA® (886 nm) emitter diodes

Wavelength Overlap

This dual function is possible because the remote control receiver is sensitive to the wavelength emitted by the transceiver. Figure 2 shows this spectral sensitivity 'overlap'. Some transceiver manufacturers package two emitters in their transceivers to provide IrDA and remote control communication. The wavelength emitted by the second emitter matches the peak sensitivity of most remote control receivers. Because some IrDA emitters emit a wavelength long enough to be received by the remote control receivers, a second emitter is not necessary. Though the peak wavelength of emitter and receiver are not matched, enough radiation is received to function well.

Details of Test

To verify that Vishay's IrDA transceivers can effectively be used as remote control emitters several tests were performed. These tests were performed using Vishay's standard remote control test procedures and equipment. Vishay, the leading supplier of remote control receivers, as well other leading supplier's receivers were tested including: Sharp, Rohm, Panasonic, and Kodenshi. The measurements are performed on a long corridor, where reflections from walls, floor and ceiling cannot be neglected. Therefore the range data is not following the square law rule for free air transmission. The measured ranges are not resulting from a statistical relevant number of devices. Therefore the single result may not be representative.

Transmitter

The signal was generated using a Phillips remote control transmitter, Figure 2 and Figure 3 and Phillips RC5® code with a modified carrier frequency of 38 kHz with a pulse width of 9 µs. Since carrier frequency has no influence on the optical matching of transmitter to receiver, the collected data can be transferred to any other carrier frequency system. This remote control transmitter generated a digital signal. The signal is fed to an IRED driver transistor. When testing IrDA transceivers with internal current controllers, the signal from the remote control was directly fed to the Txd input of the transceiver. For transceivers without internal current controllers, a serial resistor was used to generate a constant current signal during the pulse. The transmitter supply voltage was set to 3 V. The spectral emission curve for the IrDA transceiver emitter is shown in Figure 1.

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Figure 2. Phillips remote control used in test

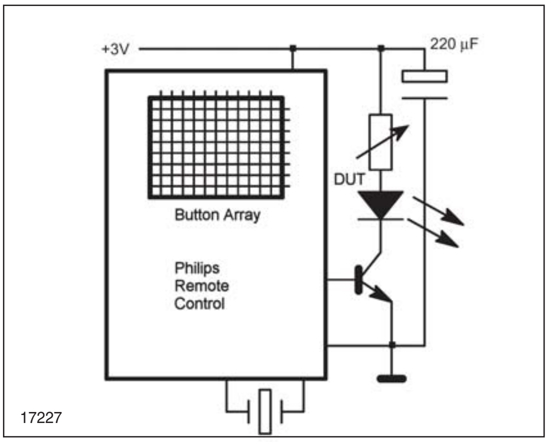

Figure 3. Circuit diagram for driver the DUT

Receivers

The signal decoder was a Phillips SAA3049, Figure 4. As with all receiver testing, the Vishay test corridor was used. In this ambient, some reflections from walls, floor and ceiling are allowed. A general overview about remote control receivers, standard receiver test conditions and the test corridor are described in the application notes found at http://www.vishay.com/ref/irdc. The spectral sensitivity curves for each receiver tested are shown in Figure 5 to 9. Transmit distances were recorded for each of the IrDA transceivers shown in Table 1.

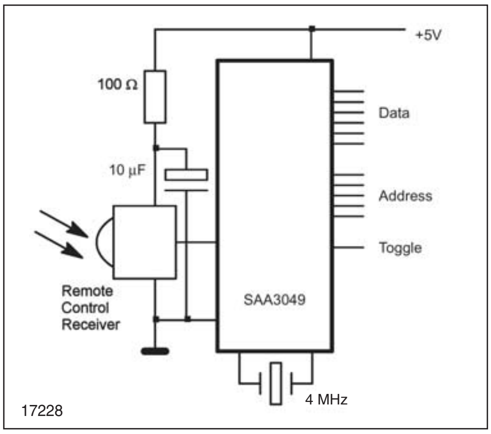

Figure 4.

Intensities of Remote Control and IrDA® Transceiver Emitters

The intensities of remote control emitters are typically 100 mW/sr with maximum values varying widely from 250 mW/sr to 600 mW/sr. Typical emission angles where intensity drops by 50 % are greater than ± 30° but very dependent on the manufacturer. The Infrared Data Association defines the intensities of IrDA transceivers. Full-range SIR transceivers have a minimum intensity of 40 mW/sr over an emission cone of ± 15°. Full-range FIR transceivers have a minimum intensity of 100 mW/sr over the same cone. Emission at larger angles than ± 30° is not allowed in IrDA® systems. Typical values especially in the center of the distribution are often much higher, for example 100 mW/sr for SIR and more than 200 mW/sr for MIR/FIR.

The intensities of remote control emitters and IrDA® transceivers are similar.

Expected loss due to absorption in the cut-off filters

The transmission wavelength of remote control emitters is 940 nm to 950 nm. Vishay transceivers use an IR emitter with typically 886 nm wavelength while the remote control emitters have a wavelength of 940 nm to 950 nm. There are two types of cut-off filters used in remote control receivers. Low cut-off filters wavelengths below 830 nm, which has no impact on transmit distance (resulting in also very large transmission distances for IrDA devices as shown in Table 1 with TSOP4838). High cut-off filters attenuate wavelengths below 900 nm which does impact transmit distance. These cause an attenuation of the IrDA® emitter signal. When using a minimum wavelength of 880 nm the loss is less than 60 %.

Expected Transmission Range for IrDA® Transmitters in Remote Control Applications

The maximum transmission distance of an IR remote control system depends on several factors. The primary factors are radiant intensity of the emitter (Ie, mW/sr) and sensitivity of the receiver (Ee, mW/m^2). Calculating transmission distance in the simplest case assumes a square-law relationship between distance (d) and irradiance. Shown below is the calculation using a receiver sensitivity of E_e = 0.4 mW/m^2 and the TFDU4100 IrDA® emitter (@880 nm) with an intensity of I_e = 40 mW/sr. The distance d is resulting as

$$d = \sqrt{\frac{\text{Intensity}}{\text{Sensitivity}}} = \sqrt{\frac{I_e}{E_e}} = \sqrt{\frac{40}{0,4}} = 10\ \text{m}$$

Transmission distance increases as the intensity increases and as the receiver becomes more sensitive. Transmission distance is also affected by other variables as IR - reflecting surfaces in the room that improve distance

The following diagrams show the specified spectral response of each type. These drawings are copied from the relevant data sheets of the suppliers.

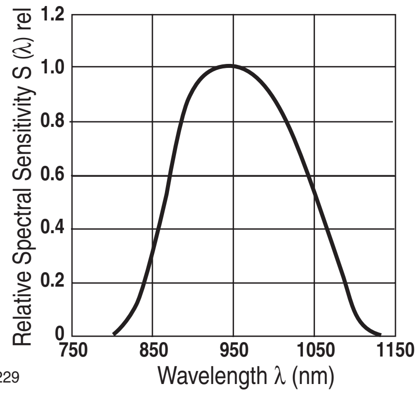

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Figure 5. Vishay TSOP1238-Spectral sensitivity curve

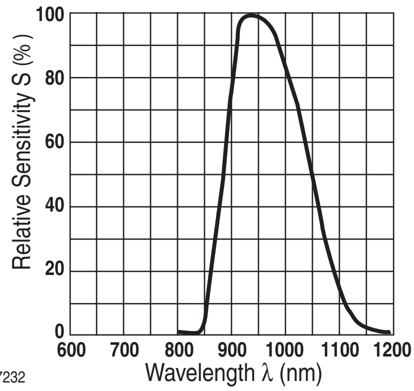

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Figure 8. Panasonic PNA4612--Spectral sensitivity curve

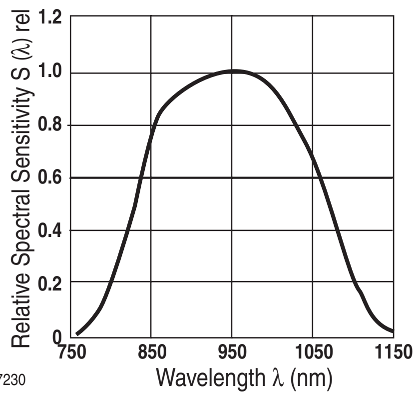

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Figure 6. Vishay TSOP4838--Spectral sensitivity curve

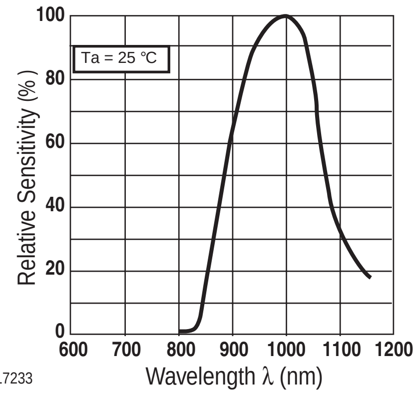

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Figure 9. Sharp GP1UM281YK--Spectral sensitivity curve

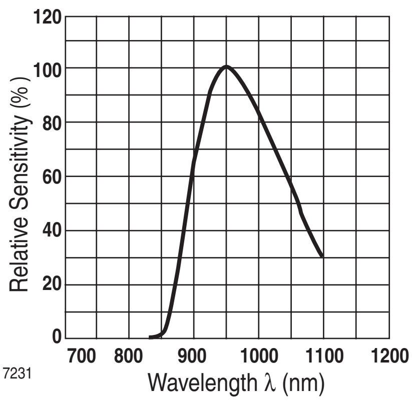

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Figure 7. Rohm RPM-7238--Spectral sensitivity curve