

OPTICAL TRANSCEIVER FOR DATA TRANSFER AND CONTROL APPLICATIONS

Field of the Invention

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The present invention relates to optical transceivers used for data transfer and control applications.

Background

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An infrared (IR) transceiver module typically comprises an IR light emitting diode (LED) operating at 870 nm and a photodiode, packaged together with appropriate supporting circuitry to form a self-contained unit.

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Electrical terminals are exposed on the outside of the self-contained unit to enable electrical coupling to external circuitry. To facilitate use of the unit, the light output from the LED illuminates a large area (typically a cone of $\pm 15^\circ$). Consequently, a user need not precisely align the transmitter and receiver.

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By combining various components of an IR transceiver into a single package, the size and form factor of the transceiver can be considerably reduced. Further, the package is typically more durable and may consume less power than equivalent transceivers comprising discrete components. IR transceivers are used extensively in a wide variety of consumer and personal electronic appliances, such as cellular telephones, personal digital assistance and laptop computers. Such appliances typically include an IR transmitting

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The Infrared Data Association (IrDA) is an industry organization that promotes international standards for hardware and software used in IR communication links. Most IR communications functionality included in consumer and personal appliances conforms with IrDA specifications. Fig. 1 schematically represents an example of two IrDA-compliant devices communicating via an IR link. Device A 110 communicates with device B 120 via IR link 130.

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When an IR link communication channel is created between two IR transceiver modules, the LED in the first transceiver optically couples with the photodiode in the second transceiver. Further, LED in the second transceiver optically couples with the photodiode
5 in the first transceiver. Although the IR transceivers use IR frequency bands, other frequency bands can also be used. The IR transceiver module is deeply mounted on an importune of a main printed circuit board (PCB). This transceiver module comprises a main body having a moulded lens shape over the LED and the photodiode.

10 **Summary**

An optical transceiver device is described herein for combining the functions of IrDa-compliant infrared transceivers and remote control devices. A receiver of the transceiver allows the remote control facilities of the transceiver to encompass bidirectional remote
15 control capabilities.

The described optical transceiver comprises a first transmitter, operating around a first frequency band, for transforming electrical signals into transmitted optical signals, a second transmitter, operating around a second frequency band different from said first
20 frequency band, for transforming electrical signals into transmitted optical signals, and a first receiver, operating around the first frequency band, for transforming into electrical signals optical signals received in the first frequency band or the second frequency band. The first transmitter and the second transmitter can independently transmit data, and the first receiver can receive data from a corresponding transmitter similar to said first
25 transmitter or said second transmitter.

The first transmitter and the first receiver can be used for IrDA-compliant infrared communications, and the second transmitter and the first receiver can be used for remote control applications. Consequently, the first frequency band is approximately 805 nm to
30 900nm, and the second frequency band is approximately 915 nm to 965 nm. The first receiver is not particularly selective and, as a result, is able to detect remote control signals transmitted in the second frequency band.

The first transmitter and the second transmitter comprise respective light emitting diodes, which are both within a transmitter lens to achieve a desired viewing angle. The first receiver comprises a photodiode. The first transmitter and the second transmitter are formed on a single integrated circuit.

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Description of Drawings

Fig. 1 is a schematic representation of infrared communication between two devices.

10 Fig. 2 is a schematic representation of an example of a communication protocol for remote control communication.

Fig. 3 is a schematic representation of a side view of a housing for an optical transceiver described herein.

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Fig. 4 is a schematic representation of the housing of Fig. 3, as viewed from above.

Fig. 5 is an electrical circuit schematic representation of circuitry for an optical transceiver described herein, housed in the housing of Figs. 3 and 4.

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Fig. 6 is an electrical circuit schematic representation of switching circuitry external to the configuration represented in Fig. 5.

Detailed Description

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An optical transceiver that combines functionality for IrDA-compliant infrared communications and remote control infrared communications is described herein. An overview of remote control communications is provided, followed by a comparison of infrared and remote control communications. The hybrid optical transceiver that
30 combines these respective facilities is then described in detail, together with possible applications for this hybrid transceiver.

Remote control transmitter

A remote control transmitter comprises an IR LED (operating at 940 nm), which is electrically connected to a switching transistor and a battery supply. When a key is pressed on a handheld remote control unit, a predetermined pulse pattern is generated. This pulse pattern is activated by a transistor, and the LED is consequently activated. An IR signal from the LED is received by a remote control receiver (in, for example, an appliance), and the encoded function communicated by the pulsed pattern is decoded.

Communication using remote control devices is uni-directional. There is no common standard for remote control coding. RC5 code is one remote control code. Fig. 2 schematically represents a modulation scheme used by RC5 codes. A remote control signal generated using RC5 comprises a series of data frames 210. Each data frame 210 comprises a command word 220 consisting of 14 bits. The structure of this command word 220 is indicated in Fig. 2. Each bit 230 comprises 32 pulses at a frequency of 36 kHz.

Many remote receivers have a relatively narrow spectral reception band centred around 940 nm. Such receivers are not able to reliably receive IR emission from IrDA-compliant transceivers operating at 870 nm.

Comparison of remote control and IrDA specifications

Table 1 below tabulates, in comparative form, the difference between various parameters of typical remote control systems, and IrDA-compliant systems.

TABLE 1

	Remote Control	IrDA
Wavelength (nm)	915-965	805-900
Transmission	Unidirectional	Bi-directional
Frame format	Proprietary for each vendor	Defined by IrDA

Modulation	Bi-Phase, Pulse length, and Pulse Distance	RZI, 3-16 duration
Receiver sensitivity	0.05 $\mu\text{W}/\text{cm}^2$	4 $\mu\text{W}/\text{cm}^2$
Link Distance	8m (typical)	1 m
Transmit Angle	+/- 20°	+/- 15°
Carrier Frequency	30-60 khz	
Receiver bandwidth	Carrier Freq +/- 2kHz	Wide bandwidth
Data Rate	2000-4000bps	2.4bps-16Mbps

These two IR schemes are relatively similar, though these schemes are not compatible with each other and consequently cannot inter-operate.

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Hybrid transceiver

Fig. 3 schematically represents a side view of an IR transceiver package 310, in which the described hybrid transceiver can be housed. Fig. 4 schematically represents the same package from above. With reference to Figs. 3 and 4, emitter 320 and receiver 330 are provided at either end of the package 310, with a shield 340 separating the emitter lens 320 and the receiver lens 330. The emitter 320 houses not only an IR LED (840 nm) 324 but also a remote control LED (940 nm) 322. The profile of the emitter lens 320 is not modified to accommodate the remote control LED.

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The two LEDs 322, 324 are accurately positioned with respect to the optical axis of the emitter lens 320, to achieve a suitable viewing angle at a receiver.

The electrical circuit supporting the two transmitters is configured so that the operating current through each LED 322, 324 is appropriate. This configuration assists in producing a relatively low-power IrDA transceiver and a standard remote control transmitter. Each package of the designed component also includes sufficient heat sink material around the two LEDs 322, 324 to achieve sufficient thermal dissipation.

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Fig. 5 schematically represents electrical circuitry 510 supporting the two transmitters incorporated in the package 310 of Figs. 3 and 4. This circuitry 510 is based upon a HSDL 3000 Stargate platform, which is selected for a lower idle current specification, and as this component is qualified at a relatively high operating current. The transceiver circuitry 510 comprises transmitter circuitry 520 and receiver circuitry 530, which
5 respectively support the operation of the two transmitter LEDs 322, 324 and the receiver photodiode 332.

Fig. 6 schematically represents switching circuitry external to the transceiver circuitry 510 of Fig. 5. Independent inputs 522, 524 are provided for respective transmitting LEDs 322, 324. The advantages of this represented configuration are that (i) data can be transmitted using one or both LEDs 322, 324, and (ii) operating currents can be independently configured for each LED 322, 324.

15 ***Applications***

The described hybrid transceiver is suited to remote control transmission in a bi-directional mode. For example, a user can activate an appliance from an held-hand remote control, and the appliance transmits back to the held hand remote control a menu of possible selections to the user. Examples of such selections include temperature and humidity settings from an air conditioner, a song list from a compact disc player, lighting controls from a multimedia device. The user can select an desired choice from the menu, and then transmits this selection to the appliance.

25 In this case, the receiver circuitry of the IrDA receiver is used to receive and interpret data from the remotely controlled appliance. The IrDA receiver is not particularly selective, and can interpret remote control frequency signals centred around 940 nm.

A particular advantage of using an IrDA transceiver for bi-directional remote control is that the transceiver receiver circuitry follows a similar logic to that required for bi-directional remote control functionality. The presence of light provides a “low” signal output and the absence of light provides a “high” signal output. Thus, the IR transmitter can provide a digitized output by receiving a remote control bit pattern, which obviates
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the need for an external digitizer. The IrDA transceiver also incorporates ambient light filtering, which is also suitable for receiving a remote control data signal.

Various exemplary relative measurements and circuitry are shown in the representations.

5 These are exemplary and not limiting on the broadest aspect of the invention.

Various alterations and modifications can be made to the arrangements and techniques described herein, as would be apparent to one skilled in the relevant art.

Claims:

1. An optical transceiver device comprising:

5 a first transmitter, operating around a first frequency band, for transforming electrical signals into transmitted optical signals;

 a second transmitter, operating around a second frequency band different from said first frequency band, for transforming electrical signals into
10 transmitted optical signals; and

 a first receiver, operating around the first frequency band, for transforming into electrical signals optical signals received in the first frequency band or the second frequency band;

15 wherein the first transmitter and the second transmitter can independently transmit data, and the first receiver can receive data from a corresponding transmitter similar to said first transmitter or said second transmitter.

20 2. The transceiver device as claimed in claim 1, wherein the first transmitter and the second transmitter comprise respective light emitting diodes.

 3. The transceiver device as claimed in claim 1 or 2, wherein the first transmitter
25 and second transmitter are housed within a transmitter lens to achieve a desired viewing angle.

 4. The transceiver device as claimed in claim 1, 2 or 3, wherein the first transmitter and the second transmitter are formed on a single integrated circuit.

30 5. The transceiver device as claimed in any one of the preceding claims, further comprising transmitter circuitry for supplying a modulated electrical signal to the first transmitter.

6. The transceiver device as claimed in any one of the preceding claims, wherein the first receiver comprises a photodiode.
- 5 7. The transceiver device as claimed in any one of the preceding claims, wherein the first frequency band is approximately 805 nm to 900nm, and the second frequency band is approximately 915 nm to 965 nm.
8. The transceiver device as claimed in any one of the preceding claims, wherein
10 the first transmitter and the first receiver can be used for IrDA-compliant infrared communications, and the second transmitter and the first receiver can be used for remote control applications.
9. The transceiver device as claimed in any one of the preceding claims, further
15 comprising a shield between said first and second transmitters and said first receiver.
10. The transceiver device as claimed in any one of the preceding claims, being provided in a unitary package.
- 20 11. A method of optical transception, the method comprising the steps of:

transforming electrical signals into transmitted optical signals using a first transmitter operating in a first frequency band;

25 transforming electrical signals into transmitted optical signals using a second transmitter operating in a second frequency band; and

transforming optical signals into electrical signals using a first receiver
30 operating in the first frequency band and able to accept signals transmitted in the first frequency band and the second frequency band;

wherein the first transmitter and second transmitter can independently transmit data, and the first receiver can receive data from a corresponding transmitter similar to said first transmitter or said second transmitter.

5 12. The method as claimed in claim 11, wherein the first transmitter and the second transmitter comprise respective light emitting diodes.

13. The method as claimed in claim 11 or 12, wherein the first transmitter and second transmitter are housed within a transmitter lens to achieve a desired
10 viewing angle.

14. The method as claimed in claim 11, 12 or 13, wherein the first transmitter and the second transmitter are formed on a single integrated circuit.

15 15. The method as claimed in any one of claims 11 to 14, further comprising transmitter circuitry for supplying a modulated electrical signal to the first transmitter.

16. The method as claimed in any one of claims 11 to 15, wherein the first receiver
20 is a photodiode.

17. The method as claimed in any one of claims 11 to 16, wherein the first frequency band is approximately 805 nm to 900nm, and the second frequency band is approximately 915 nm to 965 nm.

25 18. The method as claimed in any one of claims 11 to 17, wherein the first transmitter and the first receiver can be used for IrDA-compliant infrared communications, and the second transmitter and the first receiver can be used for remote control applications.

30 19. A method of optical transception substantially as hereinbefore described with reference to and as illustrated in accompanying figures 3 to 6.

20. A transceiver device constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in accompanying figures 3 to 6.
- 5 21. The transceiver device as claimed in any one of claims 1 to 10 and 20, being operable in accordance with the method of claim 11 or 19.
22. A remote controller comprising a user interface and the transceiver device of any one of claims 1 to 10, 20 and 21.