Ambient Light and Electromagnetic Interference

IrDA specifies normative tests, with specific ambient conditions, under which IrDA applications must be able to operate within the IrDA specifications.

These normative conditions are part of the physical layer specification IrPHY 1.4, Appendix A.
In the following these four essential requirements are quoted from the original standard:

Background Light and Electromagnetic Field

There are four ambient interference conditions in which the receiver is to operate correctly. The conditions are to be applied separately.

1. Electromagnetic field:
   3 V/m maximum Refer to IEC 61000-4-3 test level 2 for details. (For devices that intend to connect with or operate in the vicinity of a mobile phone or pager, a field of 30 V/m with frequency ranges from 800 MHz to 960 MHz and 1.4 GHz to 2.0 GHz including 80% amplitude modulation with a 1 kHz sine wave is recommended. Refer to IEC 61000-4-3 test level 4 for details.
   The 30 V/m condition is a recommendation; 3 V/m is the normative condition.)
2. Sunlight:
   10 kilolux maximum at the optical port This is simulated with an IR source having a peak wavelength within the range 850 nm to 900 nm and a spectral width less than 50 nm biased to provide 490 µW/cm^2 (with no modulation) at the optical port. The light source faces the optical port. This simulates sunlight within the IrDA spectral range. The effect of longer wavelength radiation is covered by the incandescent condition.
3. Incandescent Lighting:
   1000 lux maximum This is produced with general service, tungsten-filament, gas-filled, inside-frosted lamps in the 60 Watt to 150 Watt range to generate 1000 lux over the horizontal surface on which the equipment under test rests. The light sources are above the test area. The source is expected to have a filament temperature in the 2700 to 3050 degrees Kelvin range and a spectral peak in the 850 nm to 1050 nm range.
4. Fluorescent Lighting :
   1000 lux maximum This is simulated with an IR source having a peak wavelength within the range 850 nm to 900 nm and a spectral width of less than 50 nm biased and modulated to provide an optical square wave signal (0 µW/cm^2 minimum and 0.3 µW/cm^2 peak amplitude with 10 % to 90 % rise and fall times less than or equal to 100 ns) over the horizontal surface on which the equipment under test rests. The light sources are above the test area. The frequency of the optical signal is swept over the frequency range from 20 kHz to 200 kHz. Due to the variety of fluorescent lamps and the range of IR emissions, this condition is not expected to cover all circumstances. It will provide a common floor for IrDA operation.

Electromagnetic Interference (EMI)

Standards

The IrDA EMI specification is similar to the conditions specified by the standard conditions used for European "CE" certification. The standards to be taken into account are specified as IEC standards or equivalent EN standards

IEC/EN 61000-4-3: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 3: Radiated, radio-frequency, electromagnetic field immunity test".

IrDA doesn't specify the immunity to conducted disturbances. However, this is also necessary for CE certification for the final product. See for that:

IEC/EN 61000-4-6: "Electromagnetic compatibility (EMC) - Part 4: Testing and measurement techniques - Section 6: Immunity to conducted disturbances, induced by radio-frequency fields".

For mobile phone applications the conditions are listed in
ETSI EN 301 489-1
Electromagnetic compatibility
and Radio spectrum Matters (ERM);
ElectroMagnetic Compatibility (EMC)
standard for radio equipment and services;
Part 1: Common technical requirements

ETSI EN 301 489-7

ElectroMagnetic compatibility and Radio spectrum Matters (ERM);

ElectroMagnetic Compatibility (EMC) standard for radio equipment and services;

Part 7: Specific conditions for mobile and portable radio and ancillary equipment of digital cellular radio telecommunications systems (GSM and DCS)

Testing

The Vishay Semiconductors transceivers for IrDA applications are tested according the standards in the frequency range of 15 kHz (the standard starts at 150 kHz) to 80 MHz and for mobile phone frequencies in the extended range of 700 MHz to 2100 MHz covering the 800 MHz, 900 MHz, 1800 MHz, and 1900 MHz mobile phone applications. The test capabilities also include frequencies up to 3000 MHz to cover the 2400 MHz band.

In the frequency range of 700 MHz to 3000 MHz a GTEM 250 Cell with a field strength test capability of up to 500 Vrms/m is used. This RF signal is AM modulated by 217 Hz, 80 % modulation depth, GSM equivalent burst duration of 550 µs.

Another tool available for testing is DPI (direct power injection).

In the lower frequencies (15 kHz to 80 MHz) strip line boxes are used with a maximum applied field of about 80 Vrms/m. The RF signal is AM modulated by 1 kHz, 80 % modulation depth.

In both ranges the transceivers are tested for the specified Bit Error Ratio (BER).

The IrDA specified field strengths are sufficient for normal applications. However, when transceivers are operated close to an antenna, much higher field strengths may occur.

An electromagnetic compatibility (EMC) of 30 V/m is not sufficient when the transceiver is built into a mobile phone close to an antenna. Experience shows that a minimum of 100 V/m is necessary in the case when pick-up in the wired circuit is avoided.

Board – Layout and EMI

In most of the GSM Applications - EMI is not caused by the transceivers. At these frequencies very strong (and resonant) coupling to the wiring from and to the transceiver can occur. Therefore all connecting lines should be sandwiched between grounded layers and these lines should be handled like strip lines and terminated. Transceiver inputs/ outputs detect the RF signal when the signal voltage is above the threshold. In 3 V applications, using DPI test method, it was verified that applied GSM signals with RF voltages of more than 1.5 V trigger the input. Therefore it has to be pointed out, that a suitable circuit layout and correct termination of lines is the major issue when discussing the EMI behavior of transceivers. The design goal for the transceiver itself (when used in mobile phones) is to withstand field strength of 300 V/m when terminated lines are used and no RF signals above the threshold are applied.

The internal shielding mechanism in the transceivers is efficient and additional metal EMI shields are not necessary. Additional metal shielding has no or even worse effect on the EMI behavior.

Interference with Optical Light (Radiation) Sources

Unmodulated sources of optical radiation are e.g. sunlight and incandescent lamps. The spectra of both are different, therefore the eye sensitivity related visible impression of a source (measured e.g. in lux or lumen per Watt) is quite different, also in the case when the optically generated detector current (A) in a Si-detector might be the same. The Silicon detector absorption characteristic defining the detector sensitivity is very different from the human eye. The invisible infrared part of the radiation of incandescant light is much larger compared to sunlight and more efficiently detected. Therefore the incandescent lamp is a more disturbing source for a Silicon receiver than sunlight, same illuminance assumed.

Such unmodulated sources generate a background current in the photo detector, which generates noise, and offsets and displacements of the operating conditions. Vishay typically specifies and test designs for higher values than given by the standard.

Vishay is testing with vertical incidence on the optical axis, a condition much worse than the IrDA given condition with irradiating the optical test setup from the ceiling.

Fluorescent Lighting

Fluorescent Lamps and especially Compact Fluorescent Lamps operated with electronic ballasts generate a quite strong infrared radiation modulated with a wide electrical spectrum. The IrDA specified value of 3 mW/m^2 reflects the worst-case irradiance in about a meter distance of a fluorescent lamp. In this case also Vishay is testing with vertical incidence on the optical axis, a condition much worse than the IrDA given condition with irradiating the optical test setup from the ceiling. The majority of the Vishay Semiconductors transceivers are specified with a no-output level of 4 mW/m^2, an additional safety margin vs. the IrDA specified value.