IrDA-Compatible Data Transmission

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Paving the Way to a Wireless Information Environment

The world of information processing is constantly striving to create ever more powerful tools to produce, retrieve, present and transmit information. The hardware and software needed – regardless of how highly sophisticated it may be – has to provide a user-friendly interface. The interface to the user should appear simple, self explanatory, efficient and – of course – wireless. Wireless communication and wireless control of any equipment is the cornerstone of appeal to the user. **I**nfra**r**ed (IR) communication is the most cost-efficient approach to provide a cordless user interface. Moreover, it is reliable, short-ranged, already available, and as natural as sun light. It is now accepted that IR communication technology will have a big future in **P**ersonal **A**rea **N**etworks (PANs). The IrDA standard will help to make this happen.

IR communication started in Europe, actually in Germany, as far back as 1974. The remote control of TV sets via infrared transmission conquered the world within 10 years. Today, beside TV sets, VCRs and audio equipment, nearly every product of consumer electronics is controlled via IR communication. In addition to this, IR technology has spread to the development of car keys and automobile immobilizing systems.

TEMIC has been a major supplier of infrared communication devices from the beginning. Today, TEMIC is the world's leading supplier of infrared receivers, which integrate a photo pin diode and an elaborate amplifier IC, and is a leading supplier of optimized IR emitters or transmitters.

The technological basis of infrared transmission links is wide spread.

Highly efficient emitters are based on III-V compound semiconductors. An optimized layer structure is needed, made from several compositions, mostly of the mixed compound GaAlAs. The active layer is part of a pn junction and either doped by the amphoteric impurity Si, or, without intentional doping, embedded into a double-hetero structure. By varying the GaAlAs composition, the energy band gap can be adjusted within a wide range to meet specific design requirements. The required structure is produced by liquid phase epitaxy. TEMIC is an experienced specialist of this technology, not only capable of achieving leading-edge results, but also providing large production capacity.

Detectors are photo pin diodes made from Si with low capacitance and high dynamic sensitivity at long IR wave lengths. The bipolar production process of these devices has to be capable of achieving unwanted impurity levels below 10^{11} cm^{-3}.

The integrated first signal processing stage is a dedicated circuit. TEMIC's development effort for IrDA-compatible receiver circuits is based on its long-standing experience with remote controls. These circuits are produced by TEMIC in very large quantities of approximately 100 million units per year. They use sophisticated gain control which compensates for adverse ambient environments. This circuit principle is also incorporated in the new IrDA amplifiers.

Last, but not least, custom packaging is best used to create optimized IrDA-suitable devices. TEMIC has the knowledge and the experience needed to develop and produce dedicated optoelectronic packages.

It is our firm belief that the standardization effort of IrDA and the technological leadership of TEMIC as well as its commitment to cordless IR communication can be fruitfully combined to contribute to the big future of IR data communication.

IrDA-Compatible Data Transmission

Serial infrared data communication has been on the computer market for several years. Standardization and consequently mutual understanding between different devices has been achieved by the creation of the IrDA standard.

What is IrDA?

IrDA is the abbreviation for **I**nfra**r**ed **D**ata **A**ssociation, a non-profit organization for setting a standard in IR serial computer connections.

IrDA's interoperable infrared serial data link features low power consumption with data speeds up to 4 Mb/s, allowing a cordless 'walk-up-to' data transfer in a simple yet compelling way. Applications are in both consumer and commercial markets with a universal data connection relevant in the use of docking and input units, printers, telephones, desktop/ laptop PCs, network nodes, ATMs, and hand-held mobile peers (PDA meets PDA). Yesterday's systems with IR capabilities such as Newton, Omnibook, Wizard and Zoomer are not easily connectable with each other or other complementary devices. IrDA is the response in which many segments of the industry have committed themselves to realize the opportunity of a general standard providing data links which are non-interfering and interoperable.

How IrDA Transmission Works

The transmission in an IrDA-compatible mode (sometimes called SIR for serial IR) uses in the simplest case the RS232 port, a built-in standard of all compatible PCs. With a simple interface, shortening the bit length to a maximum of 3/16 of its original length for power-saving requirements, an infrared emitting diode is driven to transmit an optical signal to the receiver.

This type of transmission covers the data range up to 115.2 kb/s which is the maximum data rate supported by standard UARTs (see figure 1). The minimum demand for transmission speed for IrDA is only 9600 bit/s. All transmissions must be started at this frequency to enable compatibility. Higher speeds are a matter of negotiation of the ports after establishing the links.

Higher speeds require special interfaces which operate at 1.152 Mb/s and use a similar pulse-shortening process as in the RS232-related mode, but with a pulse reduction to ¼ of the original pulse length. The fastest data rate supported by IrDA is 4.0 Mb/s (often called FIR), operating with 125-ns pulses in a 4-PPM (PPM = **P**ulse-**P**osition **M**odulation) mode. The typical interfaces for the various modes are shown in figure 2. In the following chapter "IrDA Standard", the reader will find the definitions of the IrDA standard.

Optical output power and receiver sensitivity are set to a level where a point-and-shoot activity (±15°) is sufficient for point-to-point communication, but prevents the pollution of the ambient by straying needless power. Transmission over a distance of at least 1 m is ensured. The detector front end receives the transmitted signal, reshapes the signal and feeds it to the port. The system works in a half-duplex mode that allows only one transmission direction to be active at any given time.

For frequencies up to 115.2 kb/s, the minimum output intensity is defined with 40 mW/sr. For higher speeds, a higher output intensity of 100 W/sr minimum is used. The sensitivity thresholds are 40 mW/m^2 and 100 mW/m^2 for SIR and FIR respectively.

The wavelength chosen for the standard is between 850 nm and 900 nm.

What Do I Need to Enable IrDA Transmission?

The simplest way of optical interfacing in the SIR mode is shown in figure 1. For pulse shaping and recovery, the TEMIC devices TOIM3000 or TOIM3232 are recommended. The front end including transmitter and receiver should be realized by the integrated module TFDS3000. The TFDS3000 can also be directly connected to Super I/Os™ (see page 14). A transimpedance amplifier is used in the receiver for input amplification. Its output signal is fed to the comparator input, whose reference level is adjusted to efficiently suppress noise and interferences from the ambient.

Additionally, the digital pulse-shaping circuit must be inserted for shortening the pulse to be emitted to 1.6 µs (i.e., 3/16 of the bit length at 115 kb/s) and pulse recovery of the detected signal to comply with the IrDA standard. Only the active low bits (0) are transmitted.

For the high-speed mode, the TFDS6000 is recommended to be operated with NSC's or SMC's new IrDA-compatible Super I/O™ circuits. Circuit proposals for the various modes are given on page 14.

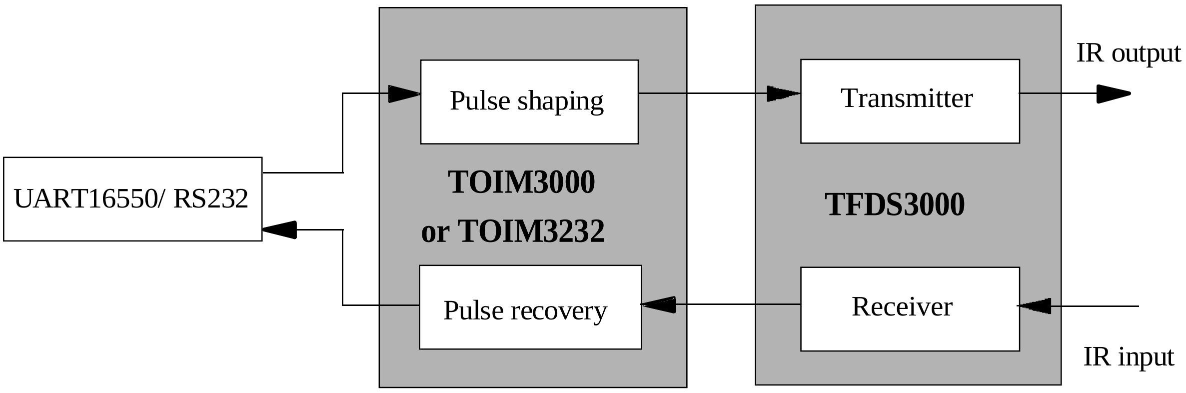


Figure 1. Block diagram of one end of the overall SIR link

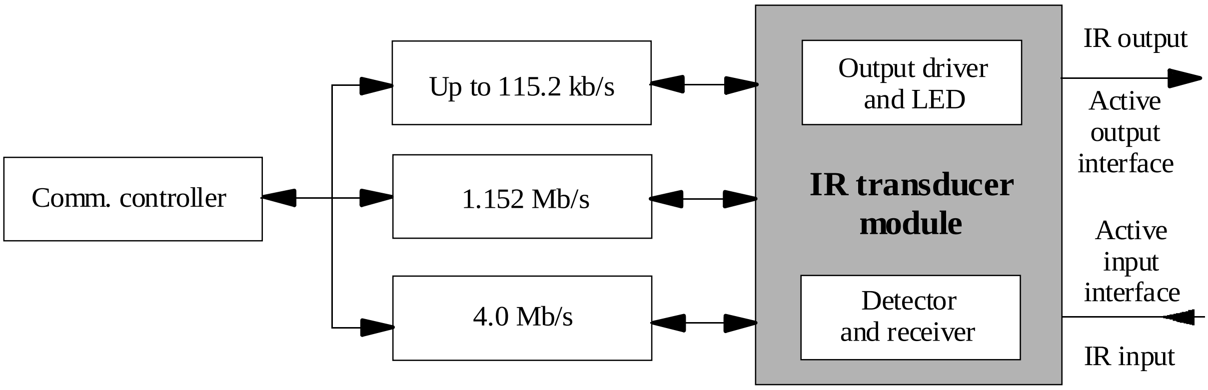


Figure 2. Block diagram of one end of the link for signaling rates up to 4.0 Mb/s

IrDA Standard

Specification

In SIR mode, the data is represented by optical pulses between 1.6 µs and 3/16 of the bit length of the RS232 data pulse in SIR mode. Pulse-length reduction is also applied in the higher frequency modes. The limits of the standards are shown in tables 1 and 2. The optical radiant intensity and detector sensitivity are adjusted to guarantee a point-to-point transmission in a cone of ±15° over a distance of at least 1 m. The radiant intensity and the sensitivity of the front end can be increased to ensure a transmission over 3 m (see figure 4). Data of the optical interface standard are documented in tables 1 to 3.

Media Interface Specification

Overall Link

The link length is from 0 to at least 1 m. The distance is measured between the optical reference surfaces. The link should operate and meet the **B**it-**E**rror **R**atio (BER) specification over this range. The BER should be no greater than 10^{-8}.

Table 1. Signaling rate and pulse-duration specification

Signaling Rate	Modulation	Rate Tolerance % of Rate	Pulse Duration Minimum	Pulse Duration Nominal	Pulse Duration Maximum
2.4 kb/s	RZI*	±0.87	1.41 µs	78.13 µs	88.55 µs
9.6 kb/s	RZI*	±0.87	1.41 µs	19.53 µs	22.13 µs
19.2 kb/s	RZI*	±0.87	1.41 µs	9.77 µs	11.07 µs
38.4 kb/s	RZI*	±0.87	1.41 µs	4.88 µs	5.96 µs
57.6 kb/s	RZI*	±0.87	1.41 µs	3.26 µs	4.34 µs
115.2 kb/s	RZI*	±0.87	1.41 µs	1.63 µs	2.23 µs
0.576 Mb/s	RZI*	±0.1	295.2 ns	434.0 ns	520.8 ns
1.152 Mb/s	RZI*	±0.1	147.6 ns	217.0 ns	260.4 ns
4.0 Mb/s Single pulse Double pulse	 4 PPM 4 PPM	 ±0.01 ±0.01	 115.0 ns 240.0 ns	 125.0 ns 250.0 ns	 135.0 ns 260.0 ns

* RZI = **R**eturn to **Z**ero **I**nverted

Active Output interface

At the active output interface, an infrared signal is emitted. The specified active output interface parameters in table 2 are defined in the physical layer specification of the IrDA standard. The complete standard is available from IrDA.

Table 2. Active output specification

Specification	**Data Rates**	**Minimum**	**Maximum**
Peak wavelength, λ_p, µm	All	0.85	0.90
Maximum intensity in angular range, mW/sr	All	–	500
Minimum intensity in angular range, mW/sr	115.2 kb/s and below	40	–
	Above 115.2 kb/s	100	–
Half angle, degrees	All	±15	±30
Signaling rate (known as clock accuracy)	All	See table 1	See table 1
Rise time t_r 10 - 90%, fall time t_f 90 - 10%, ns	115.2 kb/s and below	–	600
	Above 115.2 kb/s	–	40
Pulse duration	All	See table 1	See table 1
Optical overshoot, %	All	–	25
Edge jitter, % of nominal bit duration	115.2 kb/s and below	–	±6.5
Edge jitter, relative to reference clock, % of nominal duration	0.576 and 1.152 Mb/s	–	±2.9
Edge jitter % of nominal chip duration	4.0 Mb/s	–	±4.0

Active Input Interface

If a suitable infrared optical signal impinges on the active input interface, the signal is detected, conditioned by the receiver circuitry, and transmitted to the IR receive decoder.

Table 3. Active input specifications

Specification	**Data Rates**	**Minimum**	**Maximum**
Maximum irradiance in angular range, m/W^2	All	–	5000
Minimum irradiance in angular range, m/W^2	115.2 kb/s and below	40	–
	Above 115.2 kb/s	100	–
Half angle, degrees	All	±15	–
Receiver latency allowance, ms		–	10

Tolerance Field of Angular Emission

The optical radiant intensity is limited to a maximum of 500 mW/sr and an angle of ±30° to enable the independent operation of more than one system in a room. In figure 4, the tolerance field of an infrared transmitter's emission is shown. A typical farfield characteristic of a transmitter is also shown in this figure.

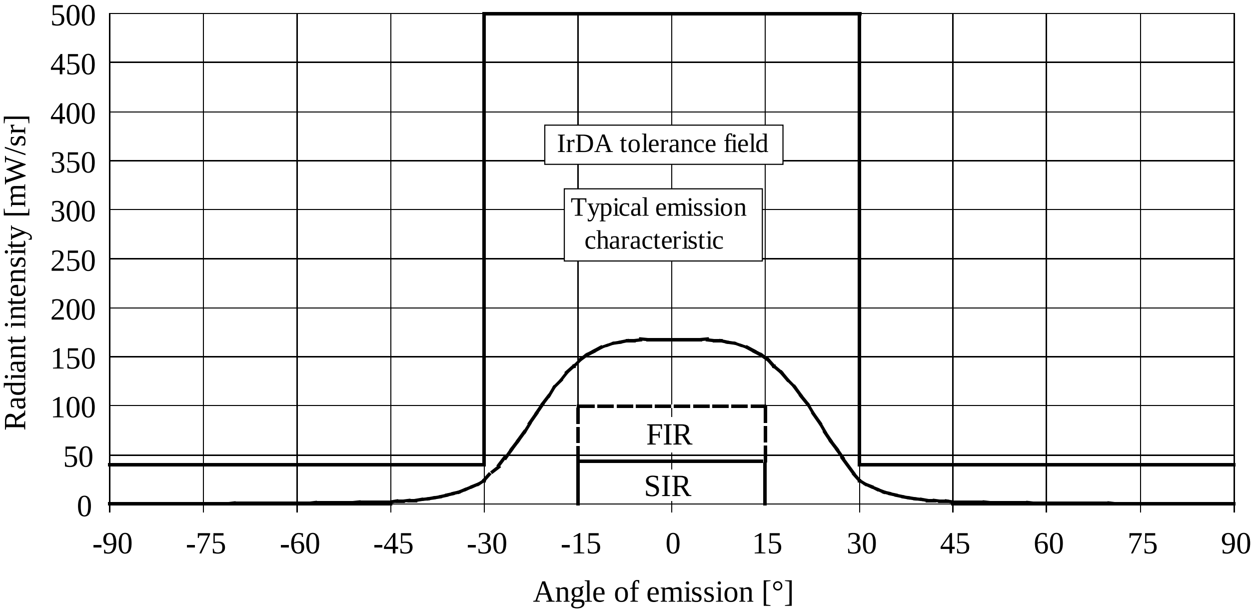


Figure 4. Tolerance field of angular emission

Transmission Distance

From figure 5, the transmission distance as a function of the sensitivity (necessary irradiance on the detector) can be read. For example: A sensitivity given as a minimum irradiance on the detector of 40 mW/m², combined with an intensity of 40 mW/sr, results in a transmission distance of 1 m. A combination of a detector with a minimum irradiance of 10 mW/m² and an emitter with 250 mW/sr can transmit over nearly five meters.

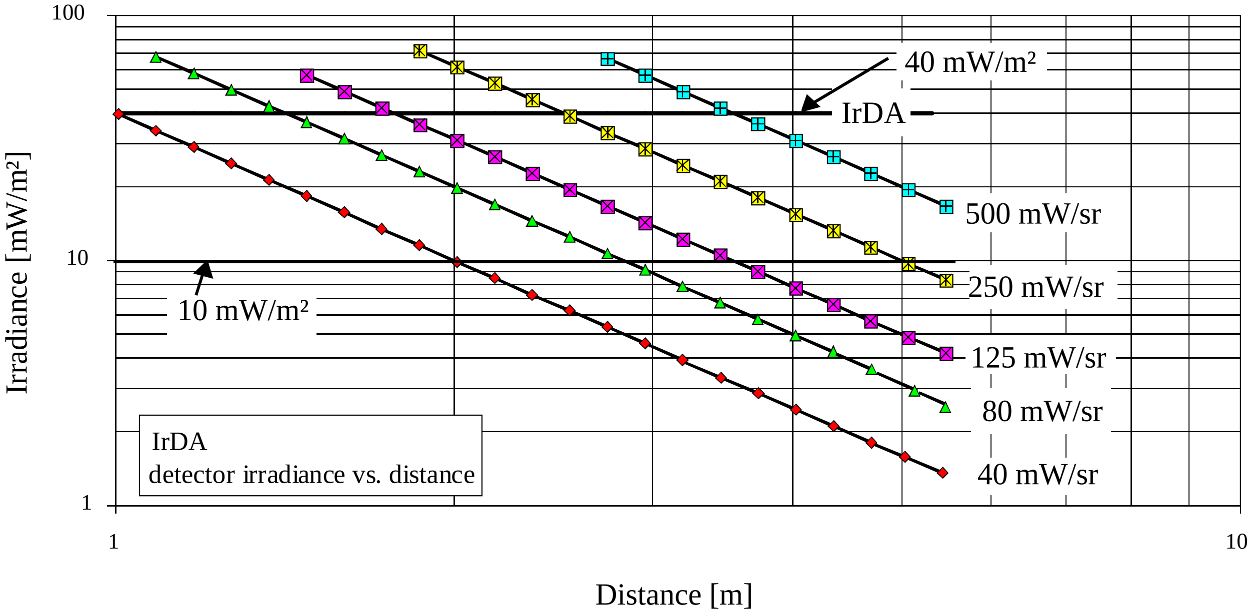


Figure 5. IrDA transmission distance

Future Developments

The IrDA committee has developed and supports a standard for IR communication. The standard is the marketing tool to ensure deep market penetration by enabling inter-operability of different manufacturer's equipment. TEMIC has actively worked within the IrDA committee in order to incorporate part of its 20 years' know how with remote controls and supports the widest possible spread of the standard. The TEMIC devices developed according to the standard, especially the TFDS3000 and TFDS6000, efficiently support the spreading of the standard. These devices are well ahead of market requirements and can contribute to the success of your equipment in production or under development.

TFDS6000

According to the physical layer revision 1.1, the data rates 1 and 4 Mb/s were added to the IrDA standard. Therefore, TEMIC developed the TFDS6000 which is pin-to-pin compatible to the TFDS3000. Data sheets and samples have been available since January 1996.

TFDS2000

The TFDS2000 is an emitter-detector combination that includes the emitter and the detector of the TFDS3000. In contrast to the TFDS3000, the TFDS2000 does not contain amplifier and driver capabilities. The driver IC which is contained in the TFDS3000 is also available separately (TOIM2532).

The Future of the IrDA Standard

It is TEMIC's policy to support the further development of the standard and not to support hardware developments in order to short cut any standardization efforts. It is firmly believed that this is in the best interest of the future of the IR communication market and all industrial participants in it. In discussion are extensions of the standard towards:

- Data rates beyond 4 Mb/s
- Diffuse data transmission
- Remote control applications

TEMIC is actively involved in the further development of the standard and will use its influence to reach most beneficial rules for practical operation.

The Future of the Technology

The future of the IrDA standard is not limited by the technology. The IRED series TSHF5... of TEMIC is capable of a bit rate of up to 8 to 10 M/s. Even higher bit rates (~ 30 Mb/s) can be achieved in the future. Similarly, the bandwidth of the detecting pin diode can be increased beyond the requirements of the existing IrDA standard. Operating at 10 M/s should feasible with today's technology.

Finally, the bandwidth of the IC has to be increased. Here, TEMIC can fully depend on its long-standing experience with remote controls as well as high-frequency applications. The step into the 30-Mb/s region will be achieved when required.

IrDA Application Hints: TFDS3000

Circuit Blocks in the IC of TFDS3000

Block diagram

In figure 6, the block diagram of the built-in IC chip U2532B of TFDS3000 is shown. The numbering of the connections is not necessarily identical to that of TFDS3000. For more detailed information (e.g., PIN description) please consult the TFDS3000 data sheet.

Receiver

The IR radiation detector is a Silicon photo pin diode which is integrated into the package of TFDS3000. This diode is produced in a technology used also for BPW22 and BPW23, but is a special product for the IrDA transceiver TFDS3000.

TIA (Transimpedance Amplifier)

The input stage provides the necessary bias voltage for the photo diode and ensures decoupling of the useful signal. This involves processing the DC- and AC portions in separate parts of the circuit, BIAS (Bias Voltage) and TIA. The BIAS circuit separates the DC part (sunlight, incandescent light) from the input signal. The AC portion of the input current is fed to an inverting amplifier with a sufficiently low input resistance transimpedance amplifier (TIA). The TIA prevents the signal slopes to be negatively affected by the junction capacitance of the photo diode.

CGA (Controlled Gain Amplifier)

The CGA consists of two differential amplifiers. The total gain is 17 in the high-sense mode (sensitivity control input HIGH) and can be reduced to 8 if the sensitivity control input is set to LOW. The lower and upper cut-off frequencies of the amplifier are 25 kHz and 900 kHz respectively. Additionally, the overall gain can be attenuated by 30 dB in 2-dB steps. The attenuation is digitally controlled by the AGC (Automatic Gain Control) circuit.

COMP (Comparator)

The comparator compares the output signal of the CGA to an internal threshold voltage. The output of that comparator is directly connected to an open collector output stage.

AGC (Automatic Gain Control)

The AGC adjusts the sensitivity of the receiver according to the strength of the incoming signals. When the input signal increases, the amplification of the CGA is reduced to a value where a BER < 10E^{-9} is still guaranteed, but signals from disturbers can be effectively suppressed. With this feature, correct data transmission can be maintained also in the presence of energy-saving lamps and ceiling lamps that are common in offices.

The dynamic range of the AGC is max. 30 dB. This provides the ability to also suppress strong interferences. As the AGC reduces gain when the input signal increases, the transmission distance is reduced if disturbances have to be suppressed.

The AGC is digitally controlled and therefore not dependent on any time constant. The amplification of the CGA is set at every input pulse and is maintained until the next input pulse is detected. The signal strength determines whether to reduce, increase or maintain the gain. If no input signal is detected during a period of 14 ms, the AGC switches the receiver to the next higher sensitivity level. After several periods of 14 ms, maximum sensitivity is reached.

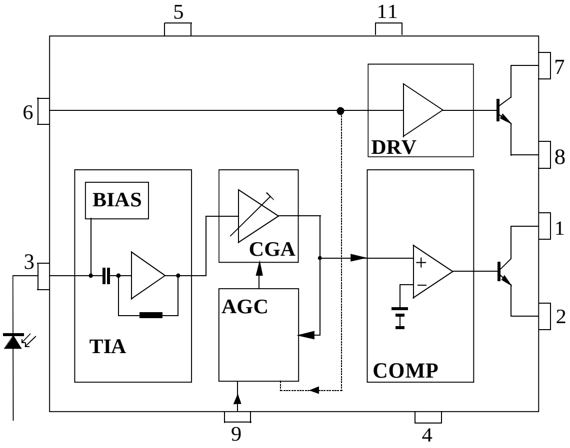
The gain of the AGC is also maintained while the transceiver is transmitting.

Transmitter

DRV (IRED Driver)

The IRED driver DRV is also monolithically integrated on the transceiver chip, providing a high-impedance input to drive a fast IR emitter diode included in the package of TFDS3000.

The active HIGH input signal drives the output stage. This stage mainly consists of an input amplifier and an open collector NPN transistor which is saturation-controlled.



DRV = Driver
COMP = Comparator
TIA = Transimpedance amplifier
CGA = Controlled gain amplifier
AGC = Automatic gain control
The pin notation refers to U2532B (not to TFDS3000).

Figure 6. Block diagram of U2532B (integrated circuit inside TFDS3000)

Application Circuits

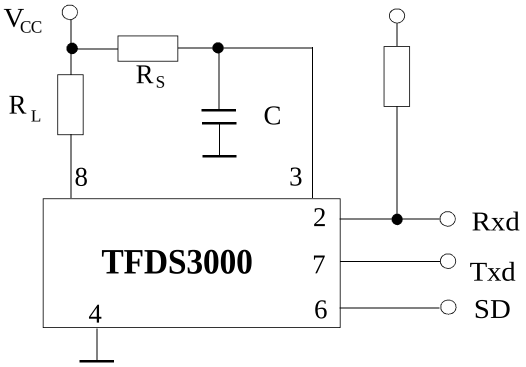


Figure 7.

R_L is used to adjust the current through the LED. Depending on the current to be adjusted, it varies from 3.3 to 10 Ω (see the following chapter).

R_S and C constitute the filter network to suppress power-supply noise and other disturbances. Both are strongly depending on the noise sources. Recommended: 100 Ω, 4.7 µF// 330 nF ceramics.

The Rxd output is internally connected to V_{CC} by a resistor of typical 20 kΩ load resistor. For on-board applications, no additional external load is necessary. When capacitive loads (long cables) have to be driven, an external load resistor of 2 kΩ is recommended.

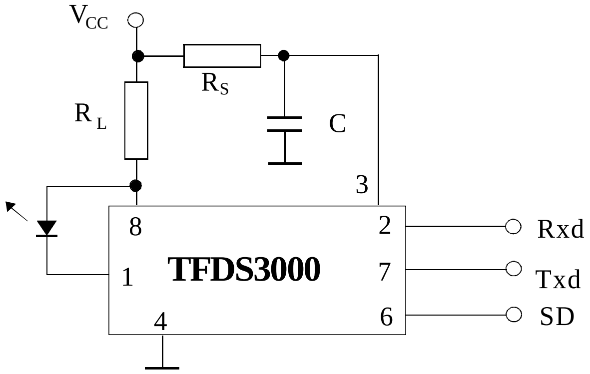


Figure 8.

To increase the output power in a transmission system, an external TSHF5400 or TSSF4500 can be added to the internal emitter in parallel. The IRED is connected to pins 8 and 1 (IRED anode, IRED cathode). This is the recommended circuit for a supply voltage of 3.3 V (see left). Due to the doubled current through both diodes, the resistor R_l has to be reduced by a factor of 2.

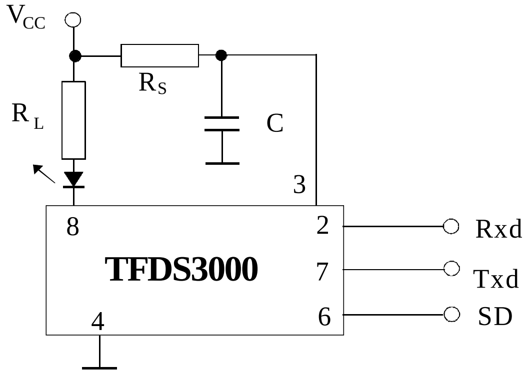


Figure 9.

In the case of a 5 V supply, an additional diode for improving the output power should be connected not parallel but in series to the internal diode. The serial current limiting resistor should be reduced to remain at the same current value.

Current-Control Resistor for IRED

The IRED of the transceiver TFDS3000 needs a current-control resistor which depends on the supply voltage chosen for the circuit. The recommended resistor value for the supply voltage 3.3 V to meet the IrDA standard is 4.7 Ω. For 5.0 V, it is 10.0 Ω (see table 2).

Table 4. Recommended current-control resistor for IRED

Power supply voltage/V	3.3	5.0
Current-control resistor/Ω	4.7	10.0

The resulting forward current range of the IRED is given in the tables 5 and 6. The scatter of the current depends mainly on the scatter of the power supply. According to the standard, a variation of ±10% is assumed. However, the scatter of the forward voltage of the IRED adds an additional tolerance. The scatter of the current has been calculated using ±6 sigma limits of the forward voltage of the diode. Naturally, the current is limited to a much narrower range in the case of the higher voltage of 5.0 V.

Table 5. Resulting I_F through the IRED for several current-control resistors at V_S from 3.0 to 3.6 V

	Supply Voltage 3.3 V			
Resistor/Ω	3.9	4.7	5.6	6.8
I_{min}/mA	250	220	190	170
I_{max}/mA	430	370	320	270

Table 6. Resulting I_F through the IRED for several current-control resistors at V_S from 4.5 to 5.5 V

	Supply Voltage 5.0 V			
Resistor/Ω	8.2	10.0	12	15
I_{min}/mA	290	250	210	170
I_{max}/mA	440	370	310	250

The maximum ambient temperature allowed and the current derating beyond this temperature depends on thermal considerations. The increase δT of the junction temperature beyond the ambient temperature can be calculated according to

$$\delta T = R_{thJA}\ I_{max}\ V_{max}\,(I_{max}) \times t/t_0$$

Values:
R_{thJA} = 350 k/W
t/t_0 = 3/16 = 0.1875
I_{max} = 0.5 A
V_{max} (0.5 A) = 2.1 V

Result: **δT = 70°C**

TEMIC allows a maximum junction temperature of 125°C. Therefore, the maximum operating temperature without current derating is

$T = T_{jmax} - \delta T = 125°C - 70°C = 55°C$.

According to tables 5 and 6, the maximum temperature can be increased to higher values when the forward current is limited to lower currents than the data sheet limit. The derating curves are shown in the TFDS3000 data sheet. Naturally, as in every electronic design, it is wise to stay as far as possible away from the limits of the allowed range of temperatures and currents. This increases the life of the circuit.

Window Size in Housings

In figure 10, the minimum window size in relation to the distance between the window and the transceiver is described.

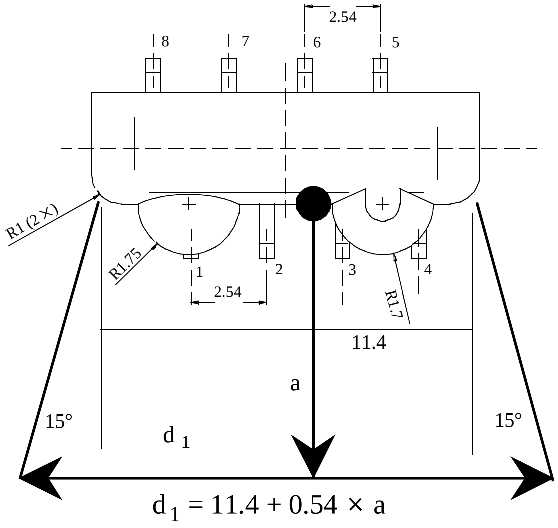


Figure 10a. Optical window size in relation to the distance to TFDS3000 (top view)

The optical window must be a minimum size of $\mathbf{d_1} \times \mathbf{d_2}$ rectangular or elliptical not to reduce the IrDA performance. The dimensions of d_1, d_2 and a are given in mm.

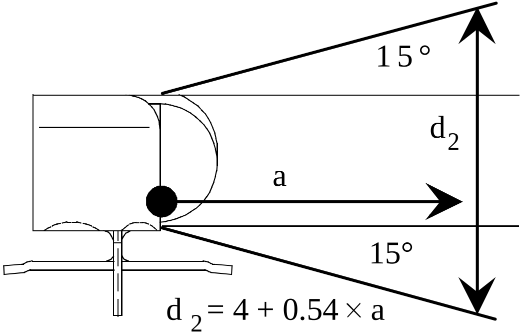


Figure 10b. Optical window size in relation to the distance to TFDS3000 (side view)

Reflow Soldering of TFDS3000

Reflow soldering consists of four steps:

1. Apply solder paste to the specified soldering pads, using a dispenser or by screen printing.
2. Use either a hot-air oven or an IR combination type with upper and lower heaters as a reflow furnace.
3. Set the furnace temperatures for pre-heating and heating in accordance with the reflow temperature profile as shown below in figure 11. The pre-heating phase is important to achieve a completely stabilized, constant temperature about 150°C throughout the package. Exercise extreme care to keep the maximum temperature below 230°C. The following temperature profile must be measured at the upper device surface. Since temperature differences occur between the device and the surface of the circuit board, depending on the types of circuit board or reflow oven, the solder flow as well as the package temperature should be verified by test runs. The duration of a temperature load above 160°C must not exceed 90 s.
4. Handling after reflow should be done only after the PCB has cooled down.

In the process flow of PCB assembly, sometimes repeated reflow solder passages are required. Soldering twice is considered to be unproblematic if the recommended profile (see figure 11) is observed.

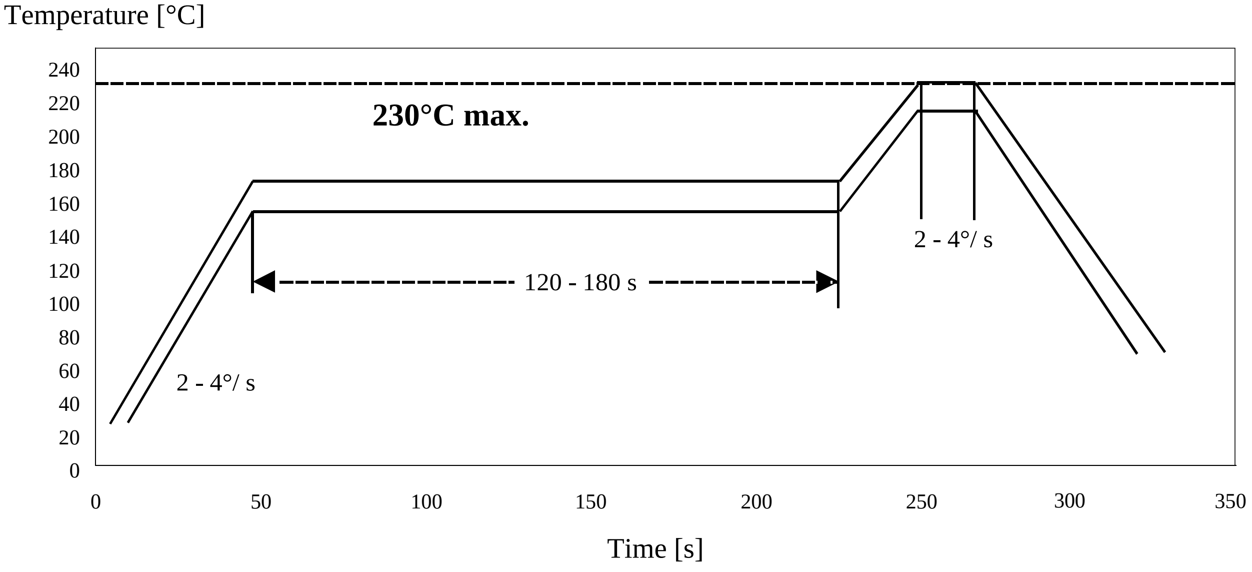


Figure 11. Recommended soldering temperature profile

TFDS3000 – Stability against Electromagnetic Interference (EMI)

RF - Environment Tests

Test	Conditions	Test Method	Result
Electrostatic discharge	3 kV discharge, human body, 100 pF, 1.5 kΩ	MIL 883D, 3015.7 equivalent to ESD S 5.1	O.K.
	220 V, machine model, 200 pF	ESD S 5.2	O.K.
	15 kV air discharge		O.K.

Electromagnetic Susceptibility

Frequency Band [MHz]	Antenna Polarity	Frequency Mode	Signal Strength [V/m]	Result
0.1 - 0.5				Not tested
0.5 - 30	Vertical	AM	7	O.K.
30 - 41	Vertical	AM, FM	2	O.K.
41 - 88	Horizontal	AM, FM	2	O.K.
88 - 108	Vertical, horizontal	FM	2	O.K.
136 - 174	Vertical	FM	8	O.K.
174 - 230	Horizontal	AM, FM	2	O.K.
440 - 512	Vertical, horizontal	FM	22	O.K.
806 - 845	Vertical, horizontal	FM	30	O.K.

Radar

Frequency Band [MHz]	Pulse Width [µs]	Pulse Rate [Hz]	Antenna Polarity	Signal Strength [V/m]	Result
600		250	Vertical, horizontal	13	O.K.
1300		333	Vertical, horizontal	10	O.K.
2800		1000	Vertical, horizontal	13	O.K.

European Requirements

Frequency Band [MHz]	Frequency Mode	Antenna Polarity	Signal Strength [V/m]	Result
27 - 80	Non-modulated, cw	Vertical, horizontal	1	O.K.
80 - 200	Non-modulated, cw	Vertical, horizontal	1	O.K.

IrDA Application Hints: Interface Circuits

Interfacing TFDS3000 to UART16550

There are various possibilities to connect the IrDA front end transceiver TFDS3000 to the serial RS232 port – either as a built-in infrared port or as an external infrared adapter. In the built-in port (see figure 12), the interface providing the pulse shaping and stretching is performed by a circuit (TOIM3000) directly connected to the UART (16450-/16550 compatible). Alternatively, the TSS4550 is proposed, integrating the UART and the pulse shaper.

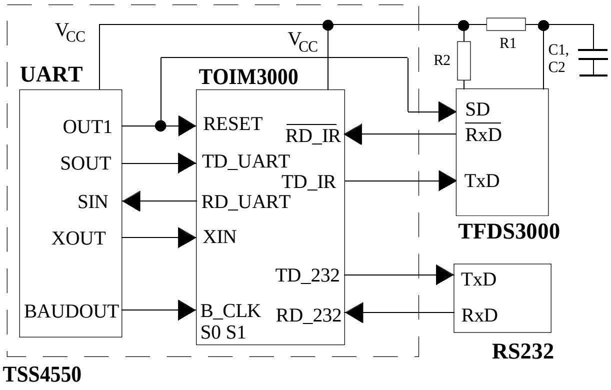


Figure 12. TOIM3000 – UART interface
(built-in infrared port)

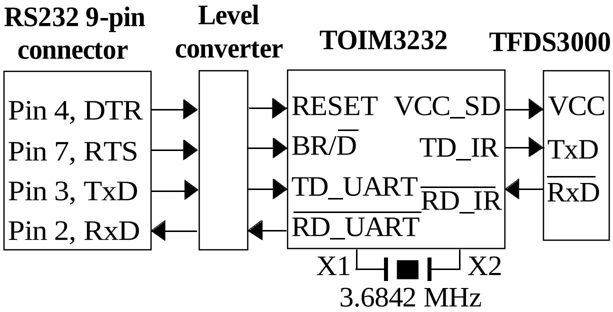


Figure 13. TOIM3232 – RS232 port interface
(external infrared adapter)

Interfacing TFDS3000 to RS232 Externally

The second solution (see figure 13) is an IR adapter (so-called dongle) which connects the transceiver front end TFDS3000 to the RS232 port as external component. The advantage is the external connectivity to a port with the drawback that the internal oscillator of the RS232 port cannot be used. The clock generator must also be added externally and is therefore integrated into the TOIM3232. The interface circuit TOIM3232 can be programmed by some commands to the register of the interface circuit.

Interfacing TFDS3000 by Super I/O™ Devices

Super I/O controllers, e.g., the National Semiconductor PC87334VLJ/ PC87334VJG and SMC (Standard Microsystems Corporation) FDC37C665IR/ FDC37C666IR can be directly interfaced to TFDS3000.

A capacitive coupling should be implemented in the TxD line as described in National Semiconductor's application note "Connecting a Serial Infrared (SIR) Analog Board to the PC87334VLJ".

Interfacing TFDS6000 by PC87108/338 Infrared Controllers

NSCPC87108

The configuration shown in figure 14 is recommended to interface the TFDS6000 to the National Semiconductor PC87108VHG "Advanced UART and Infrared Controller".

- C_1 and C_2 should be placed as close as possible to the TFDS6000.
- The area which is grounded should be large enough to cover as much space as possible between the circuit paths leading to the TFDS6000. This is to provide EMI shielding to the internal optoelectronics.

NSCPC87338VLJ

The configuration shown in figure 15 is recommended to interface the TFDS6000 to the National Semiconductor PC87338VLJ.

- C_1 and C_2 should be placed as close as possible to the TFDS6000.
- The area which is grounded should be large enough to cover as much space as possible between the circuit paths leading to the TFDS6000. This is to provide EMI shielding to the internal optoelectronics.

Interfacing TFDS6000 by SMC Infrared Controllers

Standard Microsystems Corporation SMC has announced a variety of new Super- and Ultra I/Os™. Typical representatives of the new controllers are the FDC37C669FR and the FDC37C93XFR. Application notes describing how to use the TEMIC TFDS6000 with regard to these circuits are available from SMC (address see appendix).

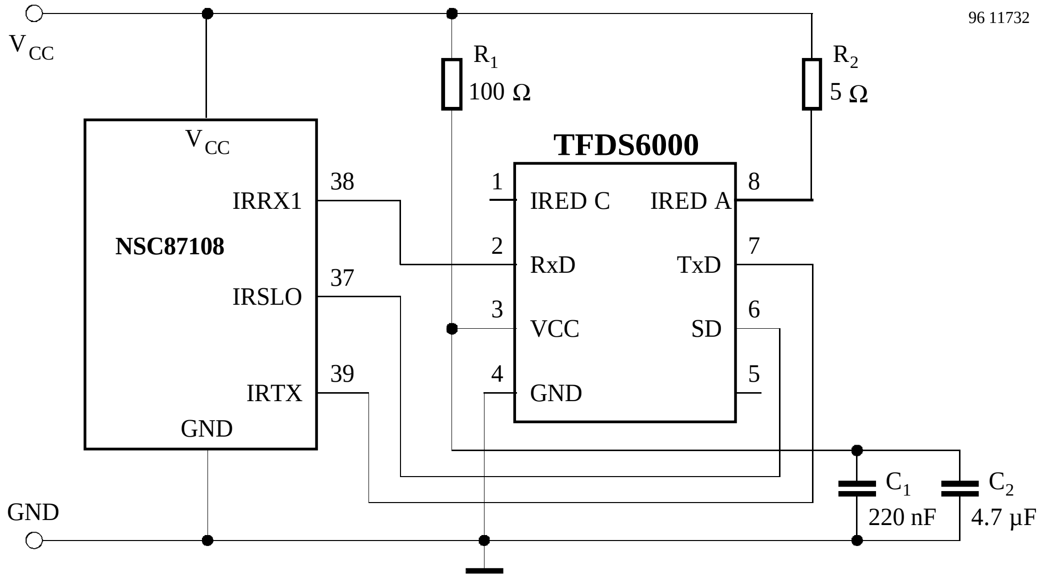


Figure 14.

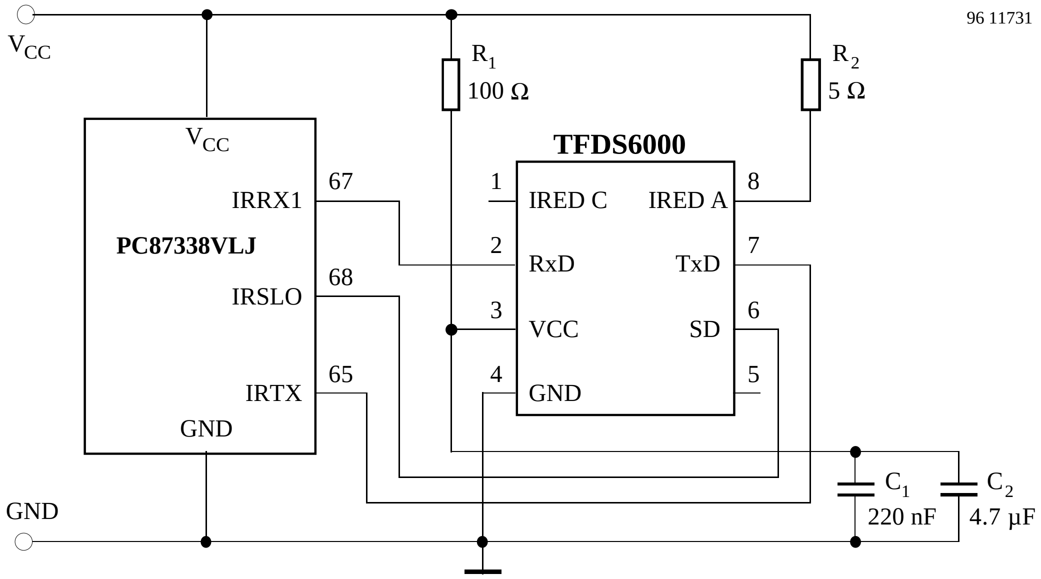


Figure 15.

Test Software

The National Semiconductor Corporation provides test software for sending and receiving test files at 115 kb/s (SIR), 1.152 Mb/s (MIR) and 4 Mb/s (FIR). Test software is revised from time to time to reflect the NSCPC87108/ NSCPC87338VLJ version changes.

Firmware Configuration to Control NSCPC87108 and NSCPC87338VLJ

To Operate in SIR (115 kb/s) IrDA Mode

- Set the speed to SIR (115 kb/s)
- Write HIGH to IRSLO and hold for 0.5 µs
- Write LOW to IRSLO and hold for 0.5 µs

To operate in 1.6-µs mode, write B7..BO = 1000, 1101 to SIR_PW-SIR pulse-width register whose address = 2 of Bank 6. This mode is recommended to save power.

To operate in 3/16-bit-time mode, write B7..BO = 1000, 0000 to SIR_PW-SIR pulse-width register whose address = 2 of Bank 6.

To Operate in MIR (1.152 Mb/s) or FIR (4 Mb/s) IrDA Modes

- Set the speed to 1.152 Mb/s or 4 Mb/s.
- Write HIGH to IRSLO
- Write "1" to Bit 7 "STRV_MS" of IRCFG1 whose address = 4 of Bank 7. Wait for 0.5 µs
- Write "0" to IRSLO and wait for 0.5 µs

For more information on controlling the NSCPC87108/87338VLJ, please contact the National Semiconductor Corporation (address see appendix).

Software Support

Windows 95 supports IrDA data transmission. For actualized support, please contact Microsoft (address see appendix). A software driver (beta test version) for the TOIM3232 for Windows 95 is available on request from TEMIC.

Complete Application Software

PUMA Technology application software is recommended to provide file transaction applications associated with infrared data communication. For more information, please contact PUMA Technology (address see appendix).

Optoelectronic Devices for IrDA Links

Tabulated short-form data to be compared with the enclosed data sheets.

Emitters (wavelength λ_p = 875 nm)

Type	Angle α	Radiant Intensity I_e @ 0.1 A	Forward Voltage U_F @ I_{fmax}	Rise-/ Fall Time t_r, t_f	Side or Top View
TSHA550x	± 24°	30 mW/sr (> 20)	2.8 V @1.5 A (< 4.5 V)	500 ns	Top view
TSHF5400	± 24°	40 mW/sr	2.4 V @1 A	30 ns	Top view
TSSF4500	± 20°	25 mW/sr	2.4 V @1 A	30 ns	Side view

Detectors (photo pin diodes)

Type	Angle α	Photo Current @ E_e = 10 mW/cm^2 @ λ = 875 nm	Side or Top View
BPV10NF	±20°	65 µA	Top view
BPV22NF	±60°	85 µA (> 65)	Side view
BPV23NF	±60°	65 µA (> 55)	Side view

Transceivers

The transceivers incorporate the complete front end with IR emitter and detector, amplification circuitry including gain control and emitter current switch. Special interfaces for connecting the front end device directly to the UART or the RS232 port are also available (see interface ICs).

Type	Description
TFDS3000	Transceiver in SMD technology. 2.4 kb/s – 115kb/s. Size about 13 × 5.6 × 5.5 mm^3. In production.
TFDS6000	Transceiver in SMD technology. 2.4 kb/s – 4 Mb/s. Pin-to-pin compatible with TFDS3000. Samples available. Production starts May 1996.

A Qual Pack (38 pages) with excellent results is available on special request.

Interface ICs

Type	Description
TOIM3000	Pulse-shaping function (shortening and stretching) used in infrared IrDA standard applications Directly interfaces the infrared transceiver TFDS3000 to a UART 3-V and 5-V operation with low operating current, SO16 package
TOIM3232	Pulse-shaping function (shortening and stretching) used in infrared IrDA standard applications Directly interfaces the infrared transceiver TFDS3000 to an RS232 port Programmable baud clock generator (1200 ~ 115 kHz), 13 baud rates 3-V and 5-V operation with low operating current, SO16 package

Appendix

Sources for Accessories

IrDA

Infrared Data Association

John LaRoche
POB 3883
Walnut Creek, CA 94598, USA
E-mail: info@irda.org
Phone: +001 510 943 6546
Fax: +001 510 943 5600

Software

Microsoft Corporation

One Microsoft Way, 5/2153
Redmond, WA 98052-6399, USA
IrDA device drivers are available as an extension to Windows 95, and can be downlooaded from the Microsoft www:
http://www.windows.microsoft.com/windows.

PUMA Technologies

2940 North First Street
San Jose, CA 95134, USA
Phone: +001 408 321 7650
Fax: +001 408 433 2212

Traveling Software

18702 North Creek Parkway
Bothell, WA 98011, USA
Phone: +001 206 483 8088
Fax: +001 206 483 1284

Plastics

GE Plastics

Eisenstr.5
65403 Rüsselsheim, Germany
Phone: +49 6142 601101
Fax: +49 6142 65746

Bayer AG

51368 Leverkusen, Bayerwerk, Germany
Phone: +49 214 30 81558
Fax: +49 214 30 8523

GE Plastics

1 Plastics Avenue
Pittsfield/MA 01201, USA
Phone: +001 413 448 7352
Fax: +001 413 448 7425

Bayer Corporation

Plastic Department
Pittsburgh/PA 15205-9741, USA
Fax: +001 412 7777621

Bayer Ltd.

4-10-8, Takawana, Minato-ku, Japan
Tokyo 108
Phone: +81 3 32809705
Fax: +81 3 32809709

Bayer Taiwan Co. Ltd.

POB 55-35
Taipei - 10-477
Taiwan, R.O.C.
Fax: +88 6250 78043

Interface Circuits

National Semiconductor Corporation

2900 Semiconductor Drive
POB 580 90
Santa Clara, CA 95052-8090, USA
Phone: +001 408 721 5000

Standard Microsystems Corporation SMC

80 Arcay Drive
Hauppauge, NY 11788, USA
Phone: +001 516 435 6000
Fax: +001 516 231 6004
Faxback: +001 516 233 4260