

## Infrared IrDA Integrated Interface Circuits

**ULC-Technology:** High-performance gate array package using dual metal layer CMOS technology, featuring sub-micronic channel length (0.8  $\mu\text{m}$ )

### Description

The TOIM3xxx series ICs provide proper timing for the front end infrared transceiver TFDS3000, as specified by the IrDA standard. In the transmit mode, the TOIM3xxx provides IrDA-compatible electrical pulses to the infrared transceiver TFDS3000 on logic LOW electrical input. In the receive mode, the TOIM3xxx stretches received infrared pulses to the proper bit width at the operating bit rate. The IrDA bit rate varies from 2.4 to 115.2 kbit/s.

- For the UART interface, the TOIM3000 uses the 1.8432 MHz clock input as the fast clock and the baud clock output from the UART to do the pulse stretching and shortening. The baud clock is 16 times the baud

rate. The output pulses are fixed at 1.627  $\mu\text{s}$  or 3/16 of bit time.

- For the RS232 interface, the TOIM3232 uses an external crystal clock 3.6864 MHz for its pulse stretching and shortening. The TOIM3232 is programmable to operate from 1200 bit/s to 115.2 kbit/s by the communication software through the RS232 port. Output pulses are software-programmable as either 1.627  $\mu\text{s}$  or 3/16 of bit time.

The typical power consumption of both circuits is very low with about 10 mW in operational state. It is in the order of magnitude of microwatts in standby mode.

### Features

#### TOIM3000

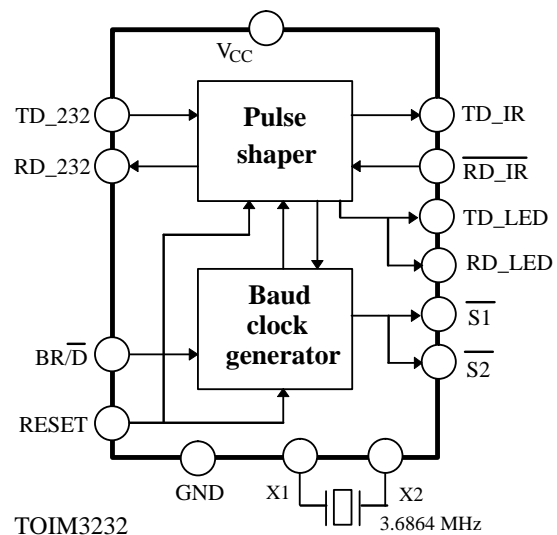
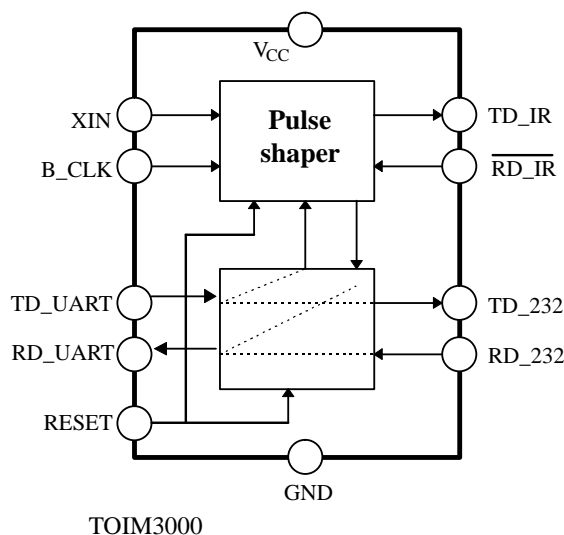
- Pulse shaping function (shortening and stretching) used in infrared IrDA standard applications
- Directly interfaces the infrared transceiver TFDS3000<sup>\*)</sup> to a UART or a microcontroller
- 3 V and 5 V operation with low operating current
- SO16L package

#### TOIM3232

- Pulse shaping function (shortening and stretching) used in infrared IrDA standard applications
- Directly interfaces the infrared transceiver TFDS3000<sup>\*)</sup> to an RS232 port
- Programmable baud clock generator (1200 Hz ~ 115 kHz), 13 baud rates
- 3 V and 5 V operation
- SO16L package

<sup>\*)</sup> TFDS3000 is an infrared IrDA transceiver made by TEMIC

### Block Diagrams



## Pin Description TOIM3000

Pin	Symbol	Function	I/Q	Active
1	RESET	Resets all internal registers. Initially must be HIGH to reset internal registers. When LOW, the TOIM3000 connects the UART with IrDA transmitter. Data received from the UART transmits out through the infrared receiver. Data received from the infrared receiver is routed to the UART. When HIGH, the TOIM3000 connects the UART with the RS232 port. Data received from the UART transmits out through the RS232 port, while data received from the RS232 port is routed to the UART. Minimum hold time for reset is 1 $\mu$ s.	I	
2	RD_UART	Received data to the UART	O	LOW
3	TD_UART	Data from the UART to be transmitted	I	LOW
4	B_CLK	16 times baud rate clock, input from the UART (Baudout)	I	
5	XIN	Oscillator input, 1.8432 MHz clock (to be connected to Xout pin of the UART)	I	
6	NC	No connection		
7	NC	No connection		
8	GND	Ground in common with the UART and RS232 port		
9	S0	Must be connected to GND		
10	S1	Must be connected to GND for output pulse length of 1.627 $\mu$ s, Connected to V <sub>CC</sub> for pulse length of 3/16 of bit *)		
11	RD_232	Data input from the RS232 port, RXD pin	I	LOW
12	TD_232	Data output to the RS232 port, TXD pin	O	LOW
13	NC	No connection		
14	TD_IR	Data output to infrared transmitter TFDS3000	O	HIGH
15	RD_IR	Data receive input from the infrared transmitter TFDS3000	I	LOW
16	V <sub>CC</sub>	Supply voltage		

\*) The use of a pulse length of 3/16 of bit duration is not recommended when both clocks, Xout and Baudout, of the UART are available

**Pin Description TOIM3232**

Pin	Symbol	Function	I/Q	Active
1	RESET	Resets all internal registers. Initially must be HIGH ("1") to reset internal registers. When HIGH, the TOIM3232 sets the IrDA default bit rate of 9600 b/s, sets pulse width to 1.627 $\mu$ s. Then the TOIM3232 enters the power-saving mode. When RESET turns to LOW, the TOIM3232 exits power-saving mode, and sets the baud rate and 1.627 $\mu$ s pulse width mode. In the application, the RESET pin can be controlled by either the RTS or DTR line through RS232 level converter. Minimum hold time for reset is 1 $\mu$ s.	I	HIGH
2	BR/D	Baud Rate control / Data When BR/D = 0, RD_232 data is transmitted to the IrDA transmitter pin TD_IR, while RD_IR is routed to the transmitter pin TD_232. When BR/D = 1, data received from the RS232 port is interpreted as the control word. The control word programs the baud rate and pulse width of TD_IR signal. The new baud rate and pulse width will be effective as soon as BR/D returns to LOW.	I	
3	RD_232	Data output of stretched signal to the RS232 port (using level converter); received signal	O	HIGH
4	TD_232	Data input from the RS232 port (passing the level converter); signal to be transmitted	I	HIGH
5	VCC_SD	V <sub>CC</sub> shut-down output function. This pin can be used to shut down a transceiver (e.g. TFDS3000). Output polarity: Inverted RESET input.	O	LOW
6	X1	Crystal input clock 3.6864 MHz	I	
7	X2	Crystal input clock	I	
8	GND	Ground in common with the RS232 port and IrDA transceiver ground		
9	TD_LED	Transmit LED indicator driver. Use 270 $\Omega$ current limiting resistor in series to LED to connect to V <sub>CC</sub> (V <sub>CC</sub> = 5 V).	O	LOW
10	RD_LED	Receive LED indicator driver. Use 270 $\Omega$ current limiting resistor in series to LED to connect to V <sub>CC</sub> (V <sub>CC</sub> = 5 V).	O	LOW
11	NC	No connection		
12	S1	User-programmable output. Can be used to turn a front end infrared transceiver ON/OFF (e.g. an infrared module at the adapter front).	O	LOW
13	S2	User-programmable output. Can be used to turn a front end infrared transceiver ON/OFF (e.g. an infrared module at the adapter back).	O	LOW
14	TD_IR	Data output of shortened signal to the infrared transceiver TFDS3000	O	HIGH
15	RD_IR	Data input from the infrared transceiver TFDS3000	I	LOW
16	V <sub>CC</sub>	Supply voltage	I	

## Application

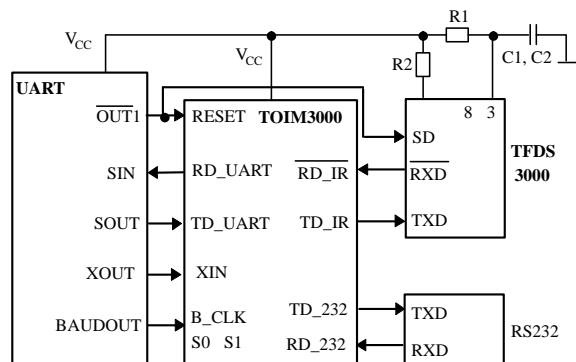


Figure 1. TOIM3000 – UART interface (built-in infrared port)

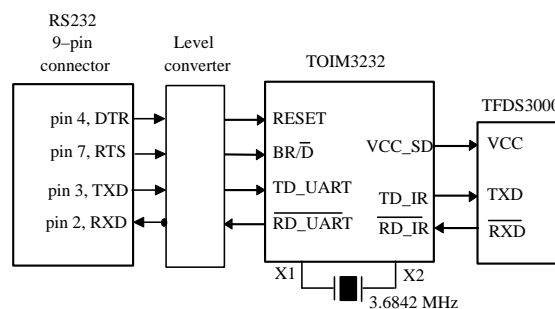


Figure 2. TOIM3232 – RS232 port interface (external infrared adapter)

Figure 1 shows a typical example of a UART interface. As shown, XIN accepts the 1.8432 MHz input clock, and B\_CLK accepts the 16 times baud rate clock.

Set S1 = S0 = LOW (“0”). When RESET = 0, the TOIM3000 sends the data to, or receives the data from the infrared transceiver TFDS3000. If Reset is active, RESET = 1, the TOIM3000 handles the normal electrical data exchange with the RS232 port.

R1 = 2.2 kΩ optional (only necessary when  $\overline{\text{RxD}}-\overline{\text{RD\_IR}}$  line is capacitive loaded).

R2 = 100 Ω, R3 = 10 Ω, C1 = 6.8 μF and C2 = 0.1 μF. C1 and C2 are in parallel ( $V_{CC} = 5$  V, in case of 3 V supply, value of R3 should be reduced, see introductory text).

### Single clock operation

TOIM3000 can be operated with only a single clock. In this case, B\_CLK and XIN are tight together and connected to the Baudout pin of the UART. The pulse width is then shortened to 3/16 of the bit length and noise filtering is deactivated. S1 should be connected to  $V_{CC}$  and S0 to GND.

Figure 2 shows a typical example of an RS232 port interface. The TOIM3232 interfaces the RS232 port to an infrared transceiver. Due to the various voltage levels, an additional level converter (discrete or integrated) is necessary. The baud rate generator is programmable. A description of programming is given in the Chapter “Software for the TOIM3232” page 7 (IrDA Design Guide). When BR/D = 0, the TOIM3232 interprets RD\_232 data as data transmitted to the TFDS3000. On the other hand, whenever BR/D = 1, the TOIM3232 interprets RD\_232 as the control word. The baud rate can be programmed to operate from 1200 bit/s to 115 kbit/s. As RS232 level converter, EIA232 or MAX232 or equivalent should be used.

The external resistors and capacitors needed are shown in figure 1. Please also refer to figure 1 for the recommended power supply filter and pull-up resistors.

The output pulse length can be programmed, see chapter “Operation Description”. It is strongly recommended to use 1.627 μs output pulses to save battery power.

### Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply voltage	$V_{CC}$	-0.5		7	V	
Input/ output voltage		-0.5		$V_{CC} + 0.5$	V	All pins
Output sinking current	$I_{out}$	8			mA	All pins
Junction temperature	$T_j$			125	°C	
Ambient temperature (operating)	$T_{amb}$	0		70	°C	
Storage temperature	$T_{stg}$	-25		85	°C	
Soldering temperature	$T_{sldr}$		215	230	°C	t = 20 s @ 215°C

### DC Characteristics

Specified at  $V_{CC} = 5\text{ V} \pm 10\%$  \*\*, operating temperature 0 to 70°C

Parameter	Test Conditions	Symbol	Min.	Typ.	Max.	Unit
Input HIGH voltage		$V_{IH}$	2.2			V
Input LOW voltage		$V_{IL}$			0.8	V
Schmitt trigger Positive threshold		$V_{T+}$	1.1			V
Negative threshold		$V_{T-}$			1.4	V
Input leakage No pull-up/ down	$V_{IN} = V_{DD}$ or GND	$I_L$		$\pm 1$	$\pm 5$	$\mu\text{A}$
Output HIGH voltage	$I_{OH} = -3.2\text{ mA}$	$V_{OH}$	2.4			V
Output LOW voltage	$I_{OL} = +3.2\text{ mA}$	$V_{OL}$			0.4	V
Current consumption Standby	Inputs grounded, no output load, $V_{CC} = 5\text{ V}$ , $T = 25\text{ °C}$	$I_{SB}$			1	$\mu\text{A}$
Dynamic		$I_{DD}$		2		mA

\*\* Operation at  $V_{CC} = 3\text{ V}$  is also specified. For data compare TEMIC Matra MHS ULC technology data sheet.

## Operation Description

### Features only for TOIM3000

The TOIM3000 uses 2 clocks from the UART: the 1.8432 MHz clock and the Baud\_out clock for its internal timing. Both are connected to XIN and B\_CLK, respectively. The B\_CLK is used as a reference for pulse stretching whereas XIN is used as a time base for pulse shortening to 1.627  $\mu$ s and noise filtering.

### Single clock operation

TOIM3000 can be operated with only a single clock. In this case, the B\_CLK and XIN are tight together and connected to the Baudout pin of the UART. The pulse width is then shortened to 3/16 of the bit length and noise filtering is deactivated. S1 is to be connected to V<sub>CC</sub> and S0 to GND.

**We strongly recommend not to use this mode in battery-operated systems because the 3/16 pulse length at lower bit rates consumes more power than the shorter pulses. At a baud rate of 9600 bit/s, the ratio of power consumption of both modes is a factor of 12 (!).**

The TOIM3000 interfaces to an RS232 level converter through two pins, RD\_232 and TD\_232. These two pins provide the extra function that a single TOIM3000 IC can time share with both an infrared IrDA port and an RS232 port. Whenever RESET = 0, the TOIM3000 links to the infrared transceiver TFDS3000 through RD\_IR and TD\_IR pins. On the other hand, when RESET = 1, the TOIM3000 links to the RS232 port through RD\_232 and TD\_232 pins (see figure 1).

### Features only for TOIM3232

The baud rate at which an RS232 serial port communicates with the external adapter is programmable inside the TOIM3232. This programmable baud rate should be used when the baud clock and the UART oscillator clock are not available. When BR/D = 0, the TOIM3232 interprets the signals at RD\_232 and RD\_IR pins as data to be transmitted and received data. On the other hand, whenever BR/D = 1, the TOIM3232 interprets the seven LSBs at the RD\_232 input as the control word. The operating baud rate will change to its supposedly new baud rate when the BR/D returns back to LOW ("0") (see figure 2).

## Control Byte (8 bit)

<----- First char. ----->				<----- Second char. ----->			
X	S2	S1	S0	B3	B2	B1	B0

where

X: Don't care

S1, S2: User-programmable bit

S0: IrDA pulse select

= (1) 1.627  $\mu$ s output pulses

= (0) 3/16 bit time pulses \*)

B0 .. B3: Baud rate selects, B0 = LSB

\*) not recommended

## Baud Rate Select Words

Note: IrDA standard only supports 2.4, 9.6, 19.2, 57.6, and 115.2 kbit/s.

B3	B2	B1	B0	Second Char.	Baud Rate
0	0	0	0	<b>0</b>	<b>115.2 k</b>
0	0	0	1	<b>1</b>	<b>57.6 k</b>
0	0	1	0	<b>2</b>	<b>38.4 k</b>
0	0	1	1	<b>3</b>	<b>19.2 k</b>
0	1	0	0	<b>4</b>	14.4 k
0	1	0	1	<b>5</b>	12.8k
0	1	1	0	<b>6</b>	<b>9.6k</b>
0	1	1	1	<b>7</b>	7.2 k
1	0	0	0	<b>8</b>	4.8 k
1	0	0	1	<b>9</b>	3.6 k
1	0	1	0	<b>A</b>	<b>2.4 k</b>
1	0	1	1	<b>B</b>	1.8 k
1	1	0	0	<b>C</b>	1.2 k

## Software for the TOIM3232

The control word is composed of two characters, written in hexadecimal, in format:YZ.

### UART Programming

For proper operation, the RS232 must be programmed to send a START bit plus an 8 bit data word, YZ and no STOP bit for every word sent. The transfer rate for pro-

gramming must be identical with the formerly programmed data rate, or after resetting the TOIM3232, the default rate of 9600 bit/s is used.

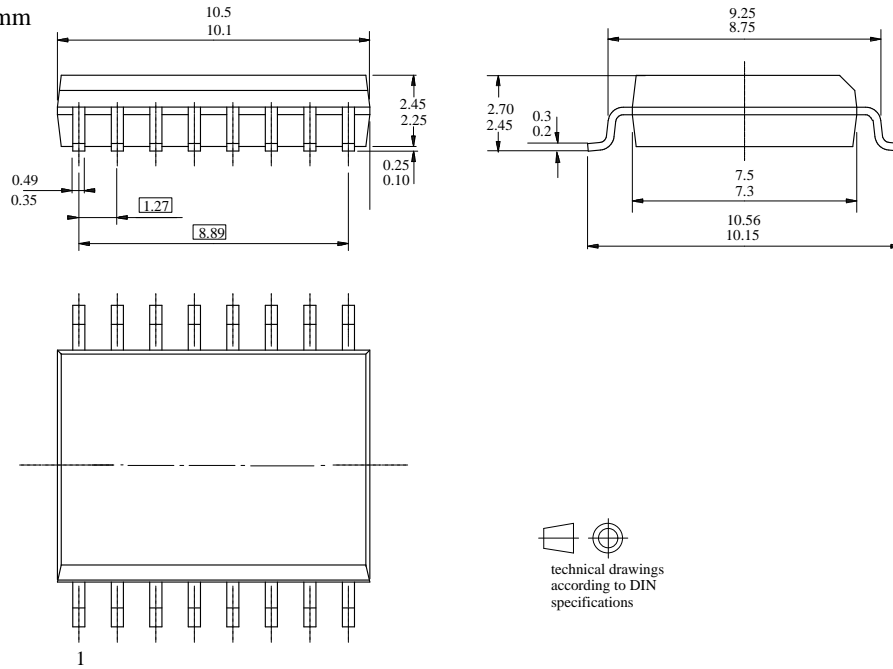
### Software Algorithm

STEP	RESET	BR/D	RD_UART	TD_UART	RD_IR	TD_IR	COMMENTS
1	HIGH	X	X	X	X	X	Resets all internal registers. Resets IrDA default baud rate of 9600 bit/s.
2	LOW	X	X	X	X	X	Wait at least 7 $\mu$ s.
3	LOW	HIGH	X	X	X	X	Wait at least 7 $\mu$ s. The TOIM3232 now enters the control word (programming) mode.
4	LOW	HIGH	YZ with Y = 1 for 1.627 $\mu$ s Y = 0 for 3/16 bit length	X	X	X	Sending the control word YZ. Send '1Z' if 1.627 $\mu$ s pulses are used. Otherwise send '0Z' if 3/16 bit pulses are used. 'Y6' keeps the 9.6 kbit/s data rate, whereas the '0Z' selects the 3/16 bit time pulses. Z = 0 sets to 115.2 kbit/s. Then wait at least 1 $\mu$ s for hold-time.
5	LOW	LOW	DATA	DATA	DATA	DATA	Data communication between the TOIM3232 and the RS232 port has been established by BR/D LOW. The TOIM3232 now enters the data transmission mode. Both RESET and BR/D must be kept LOW ('0') during data mode. Software can re-program a new data rate by re-starting from step 3. The UART also must be set to the correct data rate ***).

\*\*\*) For programming the UART, refer to the National Semiconductor's data sheet of PC 16550 UART.

## SO16L Package and Pin Assignment of TOIM3000

Dimensions in mm



95 11493



## Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC TELEFUNKEN microelectronic GmbH** to

1. Meet all present and future national and international statutory requirements.
2. Regularly and continuously improve the performance of our products, processes, distribution and operating systems with respect to their impact on the health and safety of our employees and the public, as well as their impact on the environment.

It is particular concern to control or eliminate releases of those substances into the atmosphere which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) intend to severely restrict the use of ODSs and forbid their use within the next ten years. Various national and international initiatives are pressing for an earlier ban on these substances.

**TEMIC TELEFUNKEN microelectronic GmbH** semiconductor division has been able to use its policy of continuous improvements to eliminate the use of ODSs listed in the following documents.

1. Annex A, B and list of transitional substances of the Montreal Protocol and the London Amendments respectively
2. Class I and II ozone depleting substances in the Clean Air Act Amendments of 1990 by the Environmental Protection Agency (EPA) in the USA
3. Council Decision 88/540/EEC and 91/690/EEC Annex A, B and C (transitional substances) respectively.

**TEMIC** can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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