



## Integrated Interface Circuits

### ULC Technology:

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

### Description

The TOIM3232 IC provides proper pulse shaping for the front end infrared transceivers of the 3000- and 4000-series (3000- and 4000-series devices are infrared transceiver compliant to the IrDA standard made by Vishay Telefunken), as specified by the IrDA standard. In the transmit mode, the TOIM3232 shortens the RS232 output signal to IrDA compatible electrical pulses to drive the infrared. In the receive mode, the TOIM3232 stretches the received infrared pulses to the proper bit width at the operating bit rate. The IrDA bit rate varies between 2.4 kbit/s to 115.2 kbit/s.

The TOIM3232 is using a crystal clock 3.6864 MHz for its pulse stretching and shortening. The clock can be generated by the internal oscillator or an external clock can be used, too. The TOIM3232 is programmable to operate from 1200 bit/s to 115.2kbit/s by the communication software through the RS232 port. The output pulses are software programmable as either 1.627  $\mu\text{s}$  or 3/16 of bit time. The typical power consumption is very low with about 10 mW in operational state and in the order of a few microwatts in standby mode.

### Features

- Pulse shaping function (shortening and stretching) used in infrared IrDA standard applications
- Directly interfaces the infrared transceiver TFDx4xxx series to RS232 port
- Programmable baud clock generator (1200 Hz to 115 kHz), 13 baud rates
- SO16L package
- 3 V and 5 V operation  
Low operating current

### Block Diagram

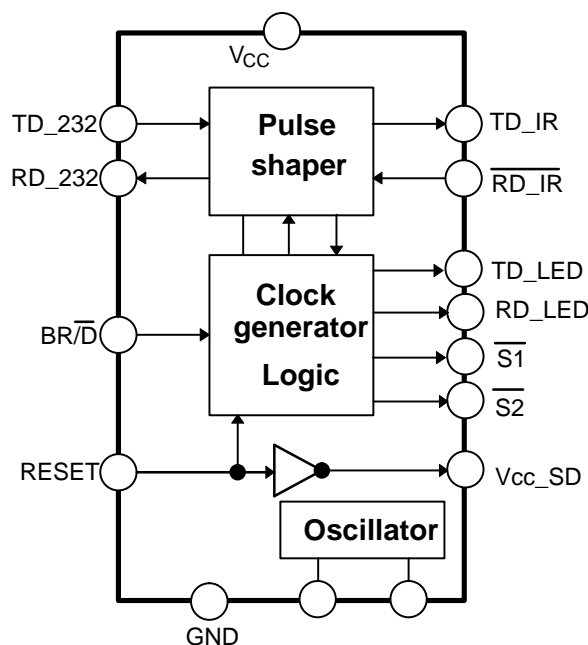


Figure 1. Block diagram

## Pin Assignment and Description

Pin	Symbol	Function	I/O	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, sets pulse width to 1.627 $\mu$ s. Then the TOIM3232 enters the front-end (TFDS400) power saving mode by setting VCC_SD low and therefore switching off the transceiver. When RESET returns to LOW, the TOIM3232 sets VCC_SD HIGH switching on the front-end device, and sets the new baud rate in the 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: 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 will be effective as soon as BR/ D return to LOW.	I	
3	RD_232	Received signal data output of stretched signal to the RS232 port (using level converter).	O	HIGH
4	TD_232	Input of the signal to be transmitted from the RS232 port (passing the level converter).	I	HIGH
5	VCC_SD	VCC shutdown output function. This pin can be used to shut down a transceiver (e.g., TFDx4xxx). Output polarity: Inverted RESET input.	O	LOW
6	X1	Crystal input clock, 3.6864 MHz nominal. Input for external clock *)	I	
7	X2	Crystal *)	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 VCC. (VCC = 5 V)	O	LOW
10	RD_LED	Receive LED indicator driver. Use 270 $\Omega$ current limiting resistor in series to LED to connect to VCC. (VCC = 5 V)	O	LOW
11	NC	No connection		
12	S1	User Programmable Bit. Can be used to turn ON/ OFF a front-end infrared transceiver (e.g., an infrared module at the adapter front)	O	LOW
13	S2	User Programmable Bit. Can be used to turn ON/ OFF a front-end infrared transceiver (e.g., an infrared module at the adapter back)	O	LOW
14	TD_IR	Data output of shortened signal to the infrared transceiver TFDx4xxx	O	HIGH
15	RD_IR	Data input from the infrared transceiver TFDx4xxx	I	LOW
16	VCC	Supply voltage	I	

\*) Crystal should be connected as shown in figure 2. In addition connect a 100 k $\Omega$  resistor from Pin 6 to Pin 7 and from Pin 6 and Pin 7 a 22 pF capacitor to ground, respectively. When an external clock is available connect it to Pin 6 leaving Pin 7 open.



### Operation Description

Figure 2 shows a typical example of an RS232 port interface. The TOIM3232 connects to an RS232 level converter on one side, and an infrared transceiver on the other. Software can be written to program the TOIM3232 baud rate generator. When BR/D = 0, the TOIM3232 interprets TD\_232 data as data transmitted to the TFDS4000. On the other hand, whenever BR/D = 1, the TOIM3232 interprets TD\_232 as Control Word. Baud rate can be programmed to operate from 1200 bit/s to 115 kbit/s. As RS232 level converter, EIA232 or MAX232 or equivalent are recommended.

Typical external resistors and capacitors are needed as shown in the TFDx4xxx references.

The output pulse length can be programmed, see chapter "Operation Description". To use 1.627 µs output pulses is strongly recommended to save battery power. A resonator like a Matura Ceramic Resonator (CERALOCK®) CSAC3.68MGC-TC is recommended.

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

### Features of TOIM3232

The baud rate at which an RS232 serial port communicates with the external adapter is programmable inside the TOIM3232. This programmable baud rate is especially useful when the baud clock and the UART oscillator clock are not available and must be regenerated. When BR/D = 0, the TOIM3232 interprets the signals at TD\_232 as transmit and RD\_IR as received data. On the other hand, whenever BR/D = 1, the TOIM3232 interprets the 7 LSBs at the TD\_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") Set the UART to 8 bit, no parity, 1 stop bit.

### Control Byte (8 bit)

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

- where
- X: Do not care
- S1, S2: User programmable bit to program the outputs S1 and S2
- S0: IrDA pulse select
  - = (1) 1.627 µs output pulses
  - = (0) 3/16 bit time pulses, not recommended
- B0 .. B3: Baud rate select words
  - Baud rate selects, B0 = LSB

Note:  
IrDA Standard only supports 2.4, 9.6, 19.2, 38.4, 57.6 and 115.2 kbit/s.

### 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	2nd Char	Baud Rate
0	0	0	0	0	115.2 k
0	0	0	1	1	57.6 k
0	0	1	0	2	38.4 k
0	0	1	1	3	19.2 k
0	1	0	0	4	14.4 k
0	1	0	1	5	12.8 k
0	1	1	0	6	9.6 k
0	1	1	1	7	7.2 k
1	0	0	0	8	4.8 k
1	0	0	1	9	3.6 k
1	0	1	0	A	2.4 k
1	0	1	1	B	1.8 k
1	1	0	0	C	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

programming 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 data 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 length pulses. Z = 0 sets to 115.2 kbit/s. 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 reprogram a new data rate by restarting from step 3. The UART also must be set to the correct data rate *).

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

## Absolute Maximum Ratings

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

## DC Characteristics

$V_{CC} = 5$  V  $\pm$  10% \*\*, operating temperature 0 ~ 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	$I_L$		$\pm 1$	$\pm 5$	$\mu$ A
Output HIGH voltage	$I_{OH} = -3.2$ mA	$V_{OH}$	2.4			V
Output LOW voltage	$I_{OL} = +3.2$ mA	$V_{OL}$			0.4	V
Current consumption						
Standby	Inputs grounded, no output load *)	$I_{SB}$			1	$\mu$ A
Dynamic	$V_{CC} = 5$ V, $T = 25^\circ$ C	$I_{DD}$		2		mA

\*) Oscillator inactivated.

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

## Application

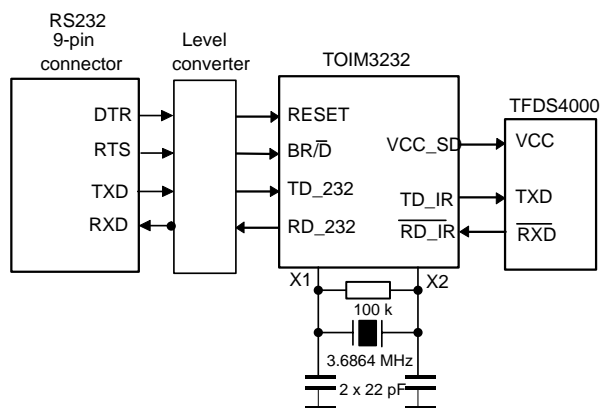
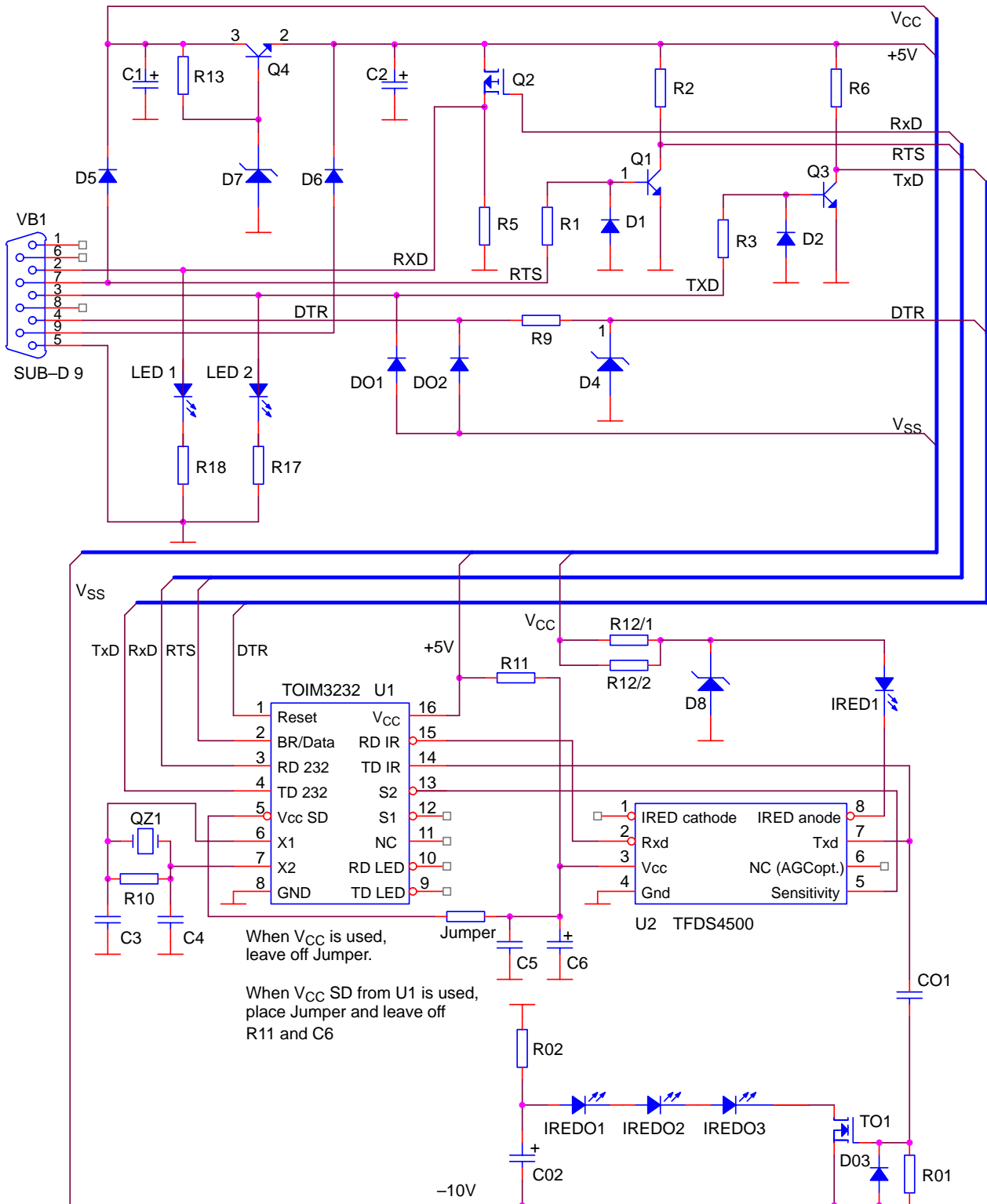


Figure 2. RS232 Port interface  
(external infrared adapter)

Table 1. Recommended Application Circuit Components

Component	Recommended Value	Vishay Part Number
C1	22 pF	VJ 1206 A 220 J XAMT
C2	22 pF	VJ 1206 A 220 J XAMT
R1	100 k $\Omega$	CRCW-1206-1003-F-RT1
Crystal	3.684 MHz	

### Recommended Circuit Diagram for Using TOIM3232 and TFDS4500 in IR Adapters at the Serial Port



Due to the very limited power to be drawn out of the RS232 port, it is recommended to operate the LEDs for displaying the state of transmission (D3, D4) with lowest possible current or not to use this function without external power supply. PCB layout, Gerber plots, component list, and control software are available on request.

Figure 3. Discrete solution for the interface to the RS232 port



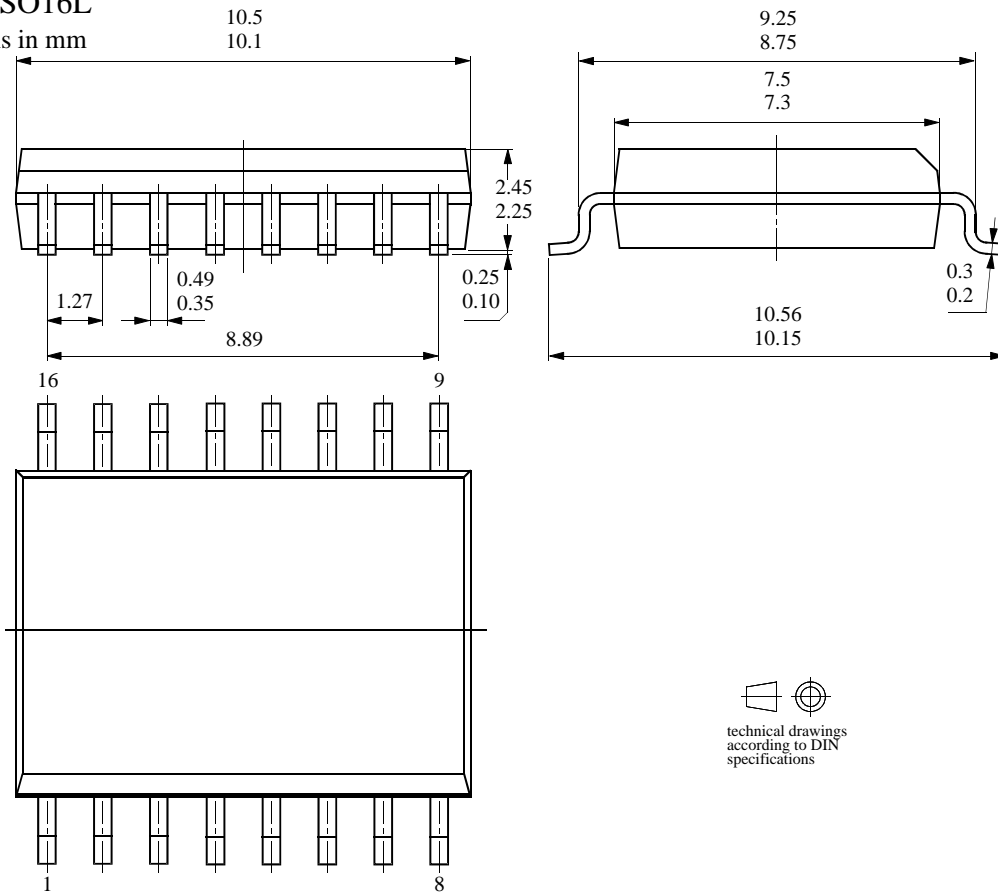
Table 1. Recommended Application Circuit Components


Component	Recommended Value	Vishay Part Number
C0	100 nF	VJ 1206 Y 104 J XXMT
C1	22 $\mu$ F, 16 V	293D 226X9 016C 2T
C2	47 $\mu$ F, 16 V	293D 476X9 016D 2T
C3	22 pF	VJ 1206 A 220 J XAMT
C4	22 pF	VJ 1206 A 220 J XAMT
C5	100 nF	VJ 1206 Y 104 J XXMT
C6	6.8 $\mu$ F	293D 685X9 016B 2T
C02	47 $\mu$ F, 16 V	293D 476X9 016D 2T
D1		1N4148
D2		1N4148
D4		BZT55C4V7
D5		1N4148
D6		1N4145
D7		BZT55C6V2
D8		BZT55C6V8
D01		1N4148
D02		1N4148
D03		1N4145
IRED1		TSHF5400
IRED01		TSHF5400
IRED02		TSHF5400
IRED03		TSHF5400
Jumper		CRCW-1206-000-F-RT1
LED1		TLLY4401
LED2		TLLG4401
Q1		BC817-25
Q2	MOSFET	VP 0610 0T
Q3		BC815-25
Q4		BC817-25
R0	220 k $\Omega$	CRCW-1206-2203-F-RT1
R1	22 k $\Omega$	CRCW-1206-2202-F-RT1
R2	10 k $\Omega$	CRCW-1206-1002-F-RT1
R3	22 k $\Omega$	CRCW-1206-2202-F-RT1
R5	1 k $\Omega$	CRCW-1206-1001-F-RT1
R6	47 k $\Omega$	CRCW-1206-4702-F-RT1
R9	5.6 k $\Omega$	CRCW-1206-5601-F-RT1
R10	100 k $\Omega$	CRCW-1206-1003-F-RT1
R11	100 $\Omega$	CRCW-1206-1000-F-RT1
R12	20 $\Omega$	CRCW-1206-20R0-F-RT1
R13	12 k $\Omega$	CRCW-1206-1202-F-RT1
R17	750 $\Omega$	CRCW-1206-7500-F-RT1
R18	750 $\Omega$	CRCW-1206-7500-F-RT1
R02	75 $\Omega$	CRCW-1206-75R0-F-RT1
T01		TN0201T

### Package Information

Package SO16L

Dimensions in mm



  
technical drawings  
according to DIN  
specifications

13011





## **Ozone Depleting Substances Policy Statement**

It is the policy of **Vishay Semiconductor 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.

**Vishay Semiconductor GmbH** 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.

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

**We reserve the right to make changes to improve technical design and may do so without further notice.**

Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use Vishay Telefunken products for any unintended or unauthorized application, the buyer shall indemnify Vishay Telefunken against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

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