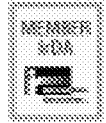# Integrated Interface Circuits

**ULC Technology:**
High-performance gate array package using dual metal layer CMOS technology, featuring sub-micron channel length (0.8 $\mu$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 $\mu$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
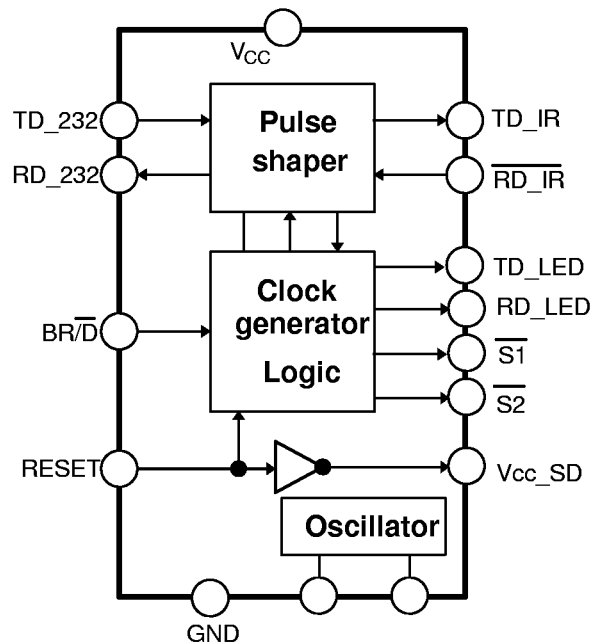  Low operating current

## Block Diagram



Figure 1. Block diagram

# TOIM3232

## Vishay Telefunken

## 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 µs. 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 µs 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 µs. | I | HIGH |
| 2 | BR/ D | Baud Rate control/ Data.<br>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 | $V_{CC}$_SD | $V_{CC}$ 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 Ω current limiting resistor in series to LED to connect to $V_{CC.}$ ($V_{CC}$ = 5 V) | O | LOW |
| 10 | RD_LED | Receive LED indicator driver. Use 270 Ω current limiting resistor in series to LED to connect to $V_{CC.}$ ($V_{CC}$ = 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 | $V_{CC}$ | Supply voltage | I | |

*) Crystal should be connected as shown in figure 2. In addition connect a 100 kΩ 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 µs. |
| 3 | LOW | HIGH | X | X | X | X | Wait at least 7 µs. The TOIM3232 now enters the Control Word (programming) mode. |
| 4 | LOW | HIGH | YZ with Y = 1 for 1.627 µs Y = 0 for 3/16 bit length | X | X | X | Sending the Control Word YZ. Send '1Z' if 1.627 µs 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 µs 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 $0 \sim 70$°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<br>  Positive threshold<br>  Negative threshold | | $V_{T+}$<br>$V_{T-}$ | 1.1 | | 1.4 | V<br>V |
| Input leakage<br>  No pull-up/ down | $V_{IN} = V_{DD}$ or GND | $I_L$ | | $\pm 1$ | $\pm 5$ | µA |
| 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<br>  Standby<br>  Dynamic | Inputs grounded, no output load *)<br>$V_{CC} = 5$ V, T = 25°C | $I_{SB}$<br>$I_{DD}$ | | 2 | 1 | µA<br>mA |

*)      Oscillator inactivated.

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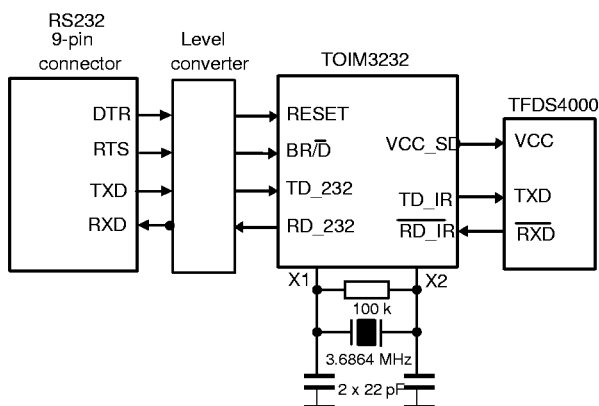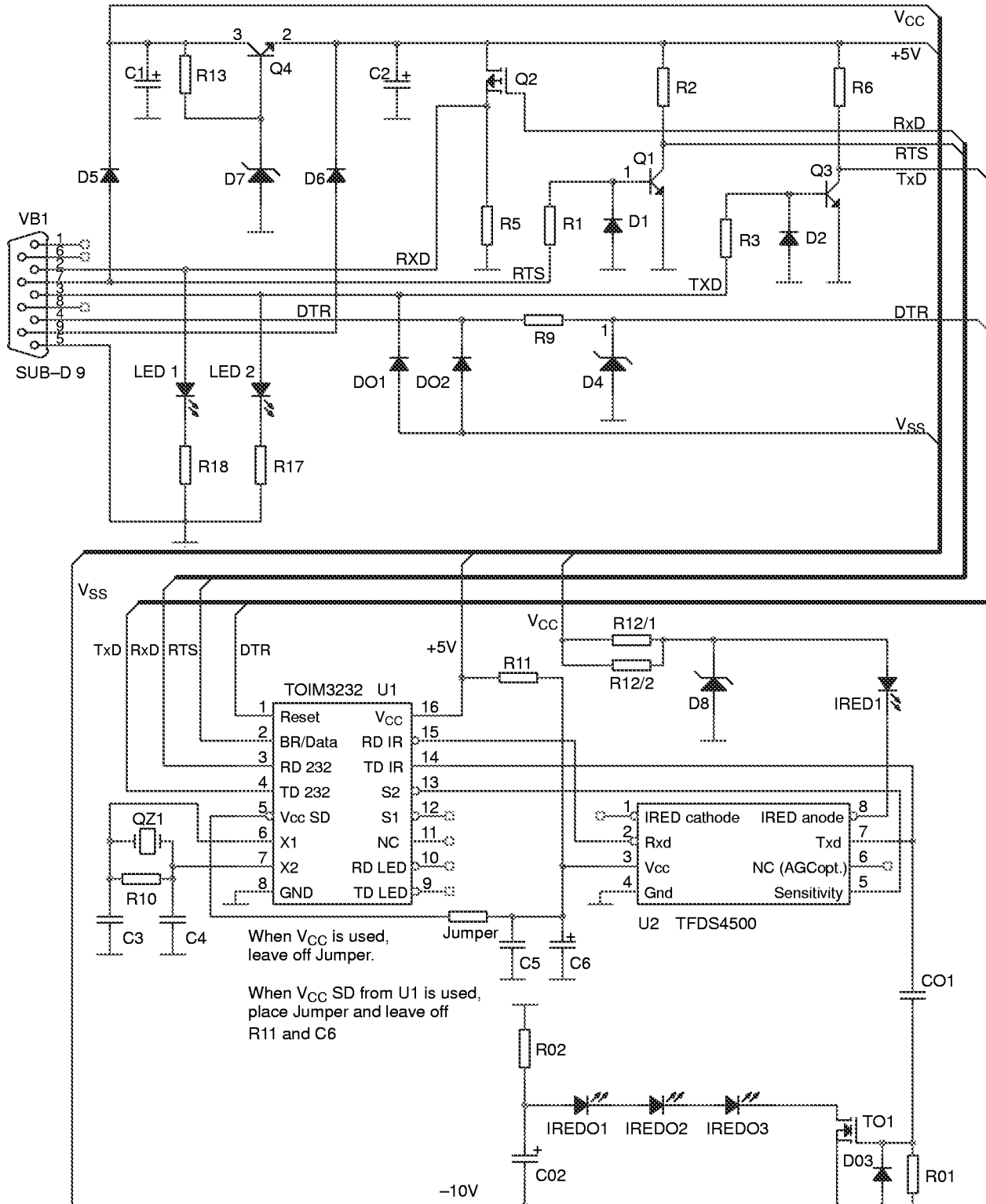
## Application



Figure 2.  RS232 Port interface
(external infrared adapter)

Table 1. Recommended Application Circuit Components

| Compo-<br>nent | Recom-<br>mended<br>Value | Vishay Part Number |
|---|---|---|
| C1 | 22 pF | VJ 1206 A 220 J XAMT |
| C2 | 22 pF | VJ 1206 A 220 J XAMT |
| R1 | 100 kΩ | 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.

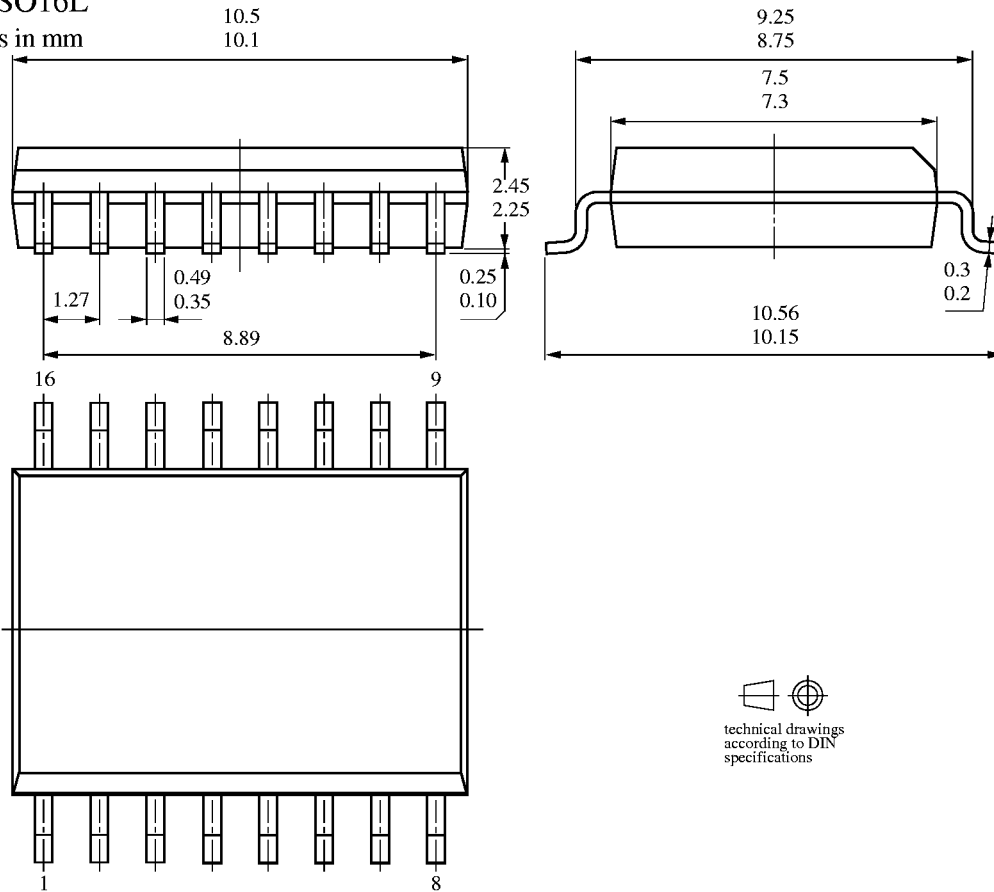Figure 3.  Discrete solution for the interface to the RS232 port

Table 1. Recommended Application Circuit Components

| Component | Recommended Value | Vishay Part Number |
|-----------|-------------------|--------------------|
| C0 | 100 nF | VJ 1206 Y 104 J XXMT |
| C1 | 22 µF, 16 V | 293D 226X9 016C 2T |
| C2 | 47 µF, 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 µF | 293D 685X9 016B 2T |
| C02 | 47 µF, 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 kΩ | CRCW–1206–2203–F–RT1 |
| R1 | 22 kΩ | CRCW–1206–2202–F–RT1 |
| R2 | 10 kΩ | CRCW–1206–1002–F–RT1 |
| R3 | 22 kΩ | CRCW–1206–2202–F–RT1 |
| R5 | 1 kΩ | CRCW–1206–1001–F–RT1 |
| R6 | 47 kΩ | CRCW–1206–4702–F–RT1 |
| R9 | 5.6 kΩ | CRCW–1206–5601–F–RT1 |
| R10 | 100 kΩ | CRCW–1206–1003–F–RT1 |
| R11 | 100 Ω | CRCW–1206–1000–F–RT1 |
| R12 | 20 Ω | CRCW–1206–20R0–F–RT1 |
| R13 | 12 kΩ | CRCW–1206–1202–F–RT1 |
| R17 | 750 Ω | CRCW–1206–7500–F–RT1 |
| R18 | 750 Ω | CRCW–1206–7500–F–RT1 |
| R02 | 75 Ω | CRCW–1206–75R0–F–RT1 |
| T01 | | TN0201T |

VISHAY

## Package Information

Package SO16L
Dimensions in mm

10.5
10.1

9.25
8.75

7.5
7.3

2.45
2.25

0.49
0.35

1.27

0.25
0.10

8.89

0.3
0.2

10.56
10.15

16

9

technical drawings
according to DIN
specifications

13011

16

1

8

# 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.