# **Preamplifier for IR Remote Control**

#### Description

The IC U2535B is a complete IR receiver for data communication. The PIN photodiode converts the transmitted IR telegram into electronic input signals. This is separated by a special input circuit. The characteristics (filter, gain) of the following amplifier are determined by exter-

Features

- Low current requirement (typical 260  $\mu$ A/ 12 V)
- Carrier frequencies 20 to 100 kHz
- Supply voltages: 5 or 7 to 16 V with internal stabilization
- Filter characteristics and gain are specified by few external components
- Demodulator with Schmitt trigger
- Open collector output

#### **Ordering Information**

nal components. The signal detector, consisting of a comparator, an integrator and a Schmitt trigger, forms the input signal to an output pulse that can be interfaced to a microcomputer.

#### Applications

- Keyless entry
- Remote control
- Wireless data transfer

| _ |                      |         |         |
|---|----------------------|---------|---------|
|   | Extended Type Number | Package | Remarks |
|   | U2535B-FP            | SO8     |         |

#### **Block Diagram**

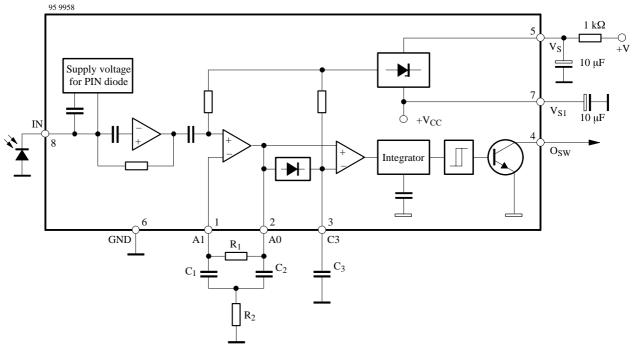
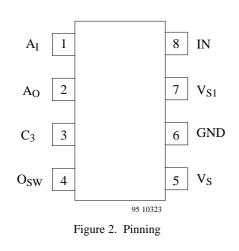


Figure 1. Block diagram

# U2535B

## **Pin Description**



| Pin | Symbol          | Function                                                                                                                                                               |
|-----|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1   | A <sub>I</sub>  | Inverting input of bandpass<br>amplifier, pin connection for<br>external filter function                                                                               |
| 2   | A <sub>O</sub>  | Output of bandpass amplifier                                                                                                                                           |
| 3   | C <sub>3</sub>  | Capacitor at Pin 3 to reject<br>(suppress) ripple during trans-<br>mission, also functions as delay<br>time for reference voltage of the<br>comparator                 |
| 4   | O <sub>SW</sub> | Switching output<br>Open collector output which<br>switches with time delay and<br>turns to LOW (transistor<br>switched ON) when the signal is<br>identified at Pin 2. |
| 5   | V <sub>S</sub>  | Supply voltage<br>The integrated Z-diode (typically<br>17 V) protects the circuit against<br>positive voltage spikes                                                   |
| 6   | GND             | Ground                                                                                                                                                                 |
| 7   | V <sub>S1</sub> | Unregulated supply voltage for 5 V operation                                                                                                                           |
| 8   | IN              | Input connection for photodiode with regulated bias voltage                                                                                                            |

## **Absolute Maximum Ratings**

Reference point Pin 6, unless otherwise specified

| Paramete                             | Symbol                  | Value                                                         | Unit                                 |             |
|--------------------------------------|-------------------------|---------------------------------------------------------------|--------------------------------------|-------------|
| Supply-voltage range                 | Pin 5                   | VS                                                            | -0.3 to +16                          | V           |
| Supply currents:<br>tp $\leq 250$ ms | Pin 5<br>Pin 5          | I <sub>S</sub><br>i <sub>S</sub>                              | 20<br>150                            | mA<br>mA    |
| Input voltages                       | Pin 1<br>Pin 4<br>Pin 8 | $\begin{matrix} V_{A(I)} \\ V_{0(SW)} \\ V_{IN} \end{matrix}$ | -0.3 to 5<br>-0.3 to 16<br>-0.3 to 5 | V<br>V<br>V |
| Output currents                      | Pins 2 and 4            | I <sub>0</sub>                                                | ±5                                   | mA          |
| Junction temperature                 | T <sub>i</sub>          | 125                                                           | °C                                   |             |
| Storage-temperature range            | T <sub>stg</sub>        | -40 to +125                                                   | °C                                   |             |
| Ambient-temperature range            |                         | T <sub>amb</sub>                                              | -40 to +105                          | °C          |

#### **Thermal Resistance**

| Parameters       | Symbol            | Value | Unit |
|------------------|-------------------|-------|------|
| Junction ambient | R <sub>thJA</sub> | 180   | K/W  |

## **Electrical Characteristics**

| Parameters             | Test Conditions / Pins                                   | Symbol          | Min. | Тур. | Max. | Unit              |  |  |
|------------------------|----------------------------------------------------------|-----------------|------|------|------|-------------------|--|--|
| Supply currents        | $V_{S1} = 5 V, I_{IN} = 0,$ Pin 7                        | I <sub>S1</sub> | 140  |      | 200  | μΑ                |  |  |
|                        | $V_{\rm S} = 12$ V, $I_{\rm IN} = 0$ , Pin 5             | Is              | 200  |      | 320  | μΑ                |  |  |
| Internal stabilization | $V_{S} = 12 V, I_{IN} = 0,$ Pin 7                        | V <sub>S1</sub> | 4.9  |      | 5.4  | V                 |  |  |
| Maximum input current  | $V_{S1} = 5 V, V_{IN} = 0, Pin 8$                        | $-I_{IN}$       | 0.8  |      | 1.2  | mA                |  |  |
| Low-level voltage      | $V_{S1} = 5 \text{ V}, I_{OL} = 0.5 \text{ mA}$ Pin 4    | V <sub>OL</sub> |      |      | 0.2  | V                 |  |  |
| Leakage current        | $V_{S1} = 5$ V, $V_0 = 12$ V, Pin 4                      | I <sub>OH</sub> |      |      | 1    | μΑ                |  |  |
| Input stage, amplifier |                                                          |                 |      |      |      |                   |  |  |
| Cut-off frequency      |                                                          | $f_L$           |      |      | 15   | kHz               |  |  |
|                        |                                                          | $f_{\rm H}$     | 100  |      |      | kHz               |  |  |
| Gain                   | $v_i = 2 mV_{rms}$ ,                                     |                 |      |      |      |                   |  |  |
|                        | f = 40  kHz                                              | Gv              | 47   | 50   |      | dB                |  |  |
|                        | f = 100  kHz                                             | G <sub>v</sub>  | 46   | 49   |      | dB                |  |  |
| Detector               |                                                          |                 |      |      |      |                   |  |  |
| Threshold voltage      | $t_d \le 200 \ \mu s, f = 40 \ kHz,$<br>Pin 2            | V <sub>A0</sub> |      | 150  |      | mV <sub>rms</sub> |  |  |
| Delay time             | $f = 40 \text{ kHz}, V_{A0} = 1 V_{rms}$<br>see figure 4 | t <sub>d</sub>  | 50   | 90   |      | μs                |  |  |
| Storage time           | $f = 40 \text{ kHz}, V_{A0} = 1 V_{rms}$<br>see figure 4 | ts              | 100  |      | 150  | μs                |  |  |

 $T_{amb} = 25^{\circ}C$ , reference point Pin 6, test circuit, unless otherwise specified

#### **Test Circuit**

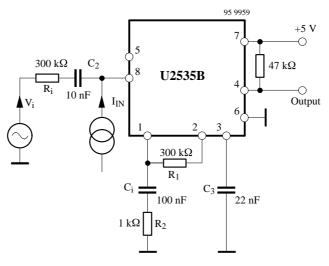


Figure 3. Test circuit



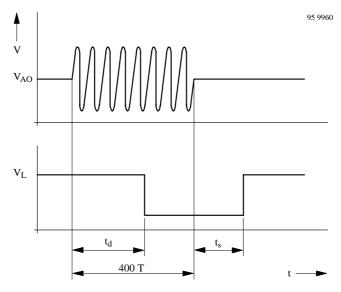


Figure 4. Waveforms for  $t_d$  and  $t_s$  measurement

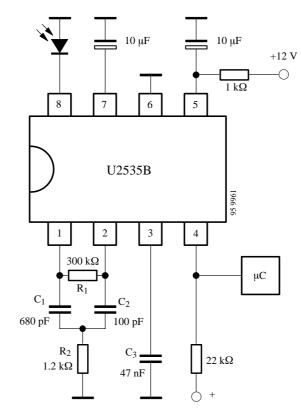


Figure 5. Application circuit

#### Rev. A2, 15-Oct-98

# Preliminary Information

## **Application Circuit**

#### **Bandpass Filter Design**

#### **Center frequency**

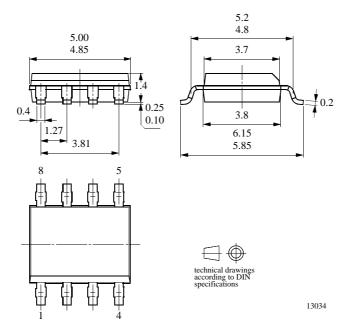
$$\begin{split} f_{0} &= \frac{1}{2\pi \sqrt{R_{1} \times C_{1} \times R_{2} \times C_{2}}} \\ GAIN &\approx \frac{R_{1} \times C_{1}}{R_{2} (C_{1} + C_{2})} \\ \end{split} \qquad \begin{array}{l} R_{1} &>> R_{2} \\ C_{1} &\geq C_{2} \end{array} \end{split}$$

 $Bandwidth \approx \frac{C_1 + C_2}{2\pi \times R_1 \times C_1 \times C_2} \qquad BW << f_O$ 

**Note:**  $R_1$  should be about 300 k $\Omega$ . Results can be influenced by feedback (Pin 2  $\rightarrow$  Pin 8)

#### **Package Information**

Package SO8 Dimensions in mm



#### **Ozone Depleting Substances Policy Statement**

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- 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 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.

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