TEMIC

TELEFUNKEN Semiconductors

U 2537 B

IR Preamplifier

Technology: Bipolar

Features:

- Few external components

- Low power consumption

- Microcomputer compatible

- Insensitive to ambient light, also in the case of continuous interference sources
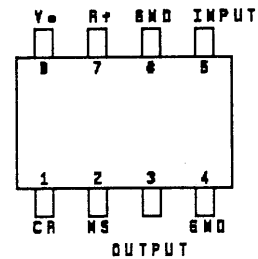
- output polarity programmable

Case: SO8

Figure 1 Pin configuration

Function:

The infrared pulses arriving at the photo diode are treated by a special input circuit and are amplified by the integrated band-pass filter. The following evaluation section, after the integrated band-pass filter, consists of a comparator, integrator and Schmitt-trigger. The polarity of the output signal can be programmed by means of the pin MS. The SBC and LCC mechanisms render the component insensitive to the influence of external light.
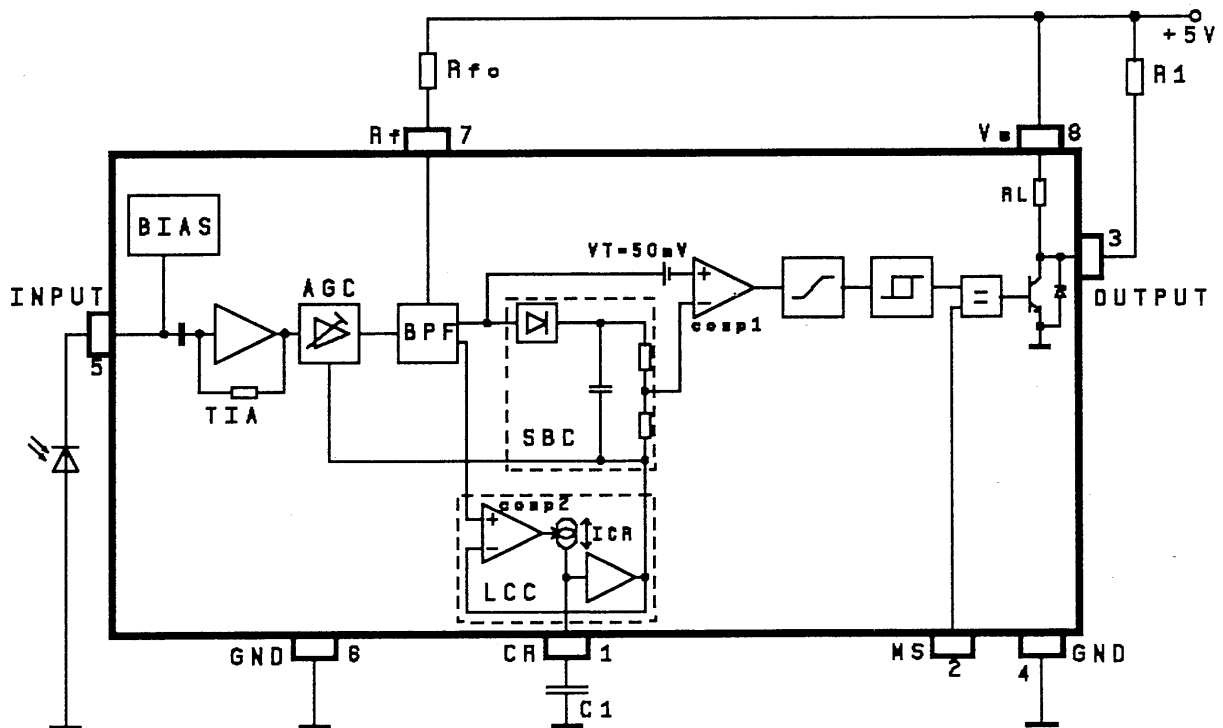
Block circuit diagram:

Figure 2 Block circuit diagram

1

Functional description:

Input stage

The input stage provides the necessary bias voltage for the photo diode and ensures decoupling of the wanted signal. This involves processing the DC and AC portions in separate parts of the circuit, bias voltage BIAS and transimpedance amplifier TIA. The bias voltage circuit operates like a load resistor with respect to the photo diode, the value of which is low for DC and lowfrequency signals, $(3 ... 100 \text{ k}\Omega)$, but as high as possible for the operating frequency, $(100 \text{ k}\Omega ... 1 \text{ M}\Omega$, depending on the input current). The AC portion of the input signal feeds an inverted amplifier with a sufficiently low input resistance $(Z_i < 10 \text{ k}\Omega)$, also known as the transimpedance amplifier. If the resistance of the input was too high, the wanted signal would be lost to the junction capaticance of the photo diode.

AGC amplifier

This amplifier accounts for the greatest part of the voltage amplification which can be controlled via the voltage at C_1 (pin 1). In so doing, it supports the interference suppression of the evaluation circuit. High-pass behaviour results from the capacitive coupling of the individual stages. The cut-off frequency is approximately 20 kHz.

Band-pass filter

The band-pass filter (BPF) is largely made up of integrated components. An external resistor determines the mid-frequency. The filter quality is around 10 and is practically independent of the set mid-frequency. The following formula can be used for calculating the resistor R_{f0}:

$$R_{f0}(k\Omega) = \frac{4800}{f_0(kHz)} - 8 \qquad \text{where:} \qquad 20 \text{ kHz} < f_0 < 60 \text{ kHz}$$

Evaluation circuit

The signal delivered from the band-pass filter is compared with a reference by means of the signal comparator comp 1. This reference is determined by the short-time boost circuit and the long-time control circuit. The voltage V_T determines the sensitivity of the evaluation circuit and thereby prevents low interference voltages causing oscillations at the output.

The integrator is controlled by the above mentioned comparison. Its output is used to control the output stage after being processed through a Schmitt-trigger. Use of the integrator keeps the output free of short-time interference.

The polarity of the output signal can be programmed by way of the pin MS. When the pin is not connected, the output switches "active low". It has to be connected to ground to invert the output signal. The internal pull-up resistor, $R_L = 100 \text{ k}\Omega$, can replace an external resistor, depending on the application. The output current is internally limited to 10 mA. The ground of the signal evaluation circuit is routed out separately, (pin 4), in order to minimize effects of the output switching edges.

Short-time boost circuit

The short-time boost circuit, (SBC), reduces the sensitivity of the evaluation circuit after reception of a signal. This prevents interference voltages, which can arise during a telegram, from affecting the output. The reduction in sensitivity is achieved by boosting the negative input of the signal comparator. Here the voltage divider determines the degree of reduction. The time constant of the SBC, $(t \approx 10 \text{ ms})$, is identified by the capacitor connected in parallel to the divider.

Long-time control circuit

The long-time control circuit (LCC) improves the circuit's resistance to interference by adapting the sensitivity of the evaluation circuit, and the amplification of the AGC amplifier, to the relevant existing interference level. Reduction of the evaluation circuit sensitivity is thereby achieved in the same way, as for the SBC, by raising the negative signal comparator input. The necessary control voltage, $V_{(C1)}$, is provided by the comparator comp 2, in conjunction with the switched current source I_{CR}. In order to prevent it responding to transmitted data signals, it gradually reduces the sensitivity only from a duty cycle of $T/T > 0.3$. When using telegrams with higher duty cycles than this value, the capacitor C_1 maintains the sensitivity for a proportional time period. A higher capacitance thereby enables a longer transmission time. A capacitance of $C_1 = 100 \text{ nf}$ is adequate for most of the known telegrams.

The monoflop function implied in comp 2 results in a minimum time for charging the capacitor C_1. In this way, interference voltages occurring for a short time are used to a proportionally greater extent for generating the control voltage, than the transmitted data signals.

The input divider integrated in the band-pass filter supplies the LCC with a higher signal level than it supplies to the signal comparator. This means that influences arising from continuous interference sources, e.g. noise, energy-saving lamps, etc., can also be effectively suppressed.

Absolute Maximum Ratings

Reference point pin 4, pin 6, unless otherwise specified

Parameters	Test Conditions / Pin	Symbol	Min	Typ	Max	Unit
Supply voltage range	8	V_S	−0.3		6.0	V
Input voltages	1,3,5,7		−0.3		$+V_S$	V
Input voltages	2		−0.3		0.6	V
Input current	2		−4		1000	μA
Power dissipation	$T_{amb} = 105\ °C$	P_{tot}		110		mW
Junction temperature		T_J		125		°C
Ambient temperature range		T_{amb}	−40		105	°C
Storage temperature range		T_{stg}	−40		125	°C

Thermal Resistance

Parameters	Symbol	Maximum	Unit
junction ambient	R_{thJA}	180	K/W

Electrical Characteristics

$T_{amb} = 25\,°C$, Reference point pin 4, pin 6, unless otherwise specified, see test circuit Figure 3
$f_0 = 20\ ...\ 60$ kHz

| Parameters	Test Conditions / Pin	Symbol	Min	Typ	Max	Unit
Supply voltage	8	V_S	4.5		5.5	V
Supply current	V_S=5V, T_{amb}=25°C 7,8	I_S	0.4	0.55	0.7	mA
	V_S=4.5V, T_{amb}=25°C	I_S		0.5	0.65	mA
	V_S=5.5V, T_{amb}=25°C	I_S		0.6	0.8	mA
Temperature dependence of supply current				−1.0		μA/K
Input current	$V_I = 0$ V 5	I_I	0.6			mA
Output voltage (active)	$I_O = 2$ mA 3				0.2	V
Internal pull up resistor	3, 8	R_L	80	100	120	kΩ
Mode select voltage	Output active high 3	V_{MS}			0.5	V
Mode select current	Output active high 3	I_{MS}			−20	μA
Mode select current	Output active low 3	I_{MS}	−4		500	μA
Mid frequency of the band-pass filter	$R_{fo} = 120$ kΩ		36	37.5	39	kHz
Slew rate LCC	$C_1 = 100$ nF 1	du/dt LCC		1.3		V/s
Switch on delay time	i_I=0.7nA, f=f_o=37.5kHz 3	t_{ON}	190	260	360	μs
Switch off delay time	i_I=0.7nA, f=f_o=37.5kHz 3	t_{OFF}	190	260	360	μs
Threshold irradiance see Figure 4	f=f_o=37.5kHz, $t_{ON} \le 300$ ms T/T 0.3 5	E_{emin}		0.7		nA
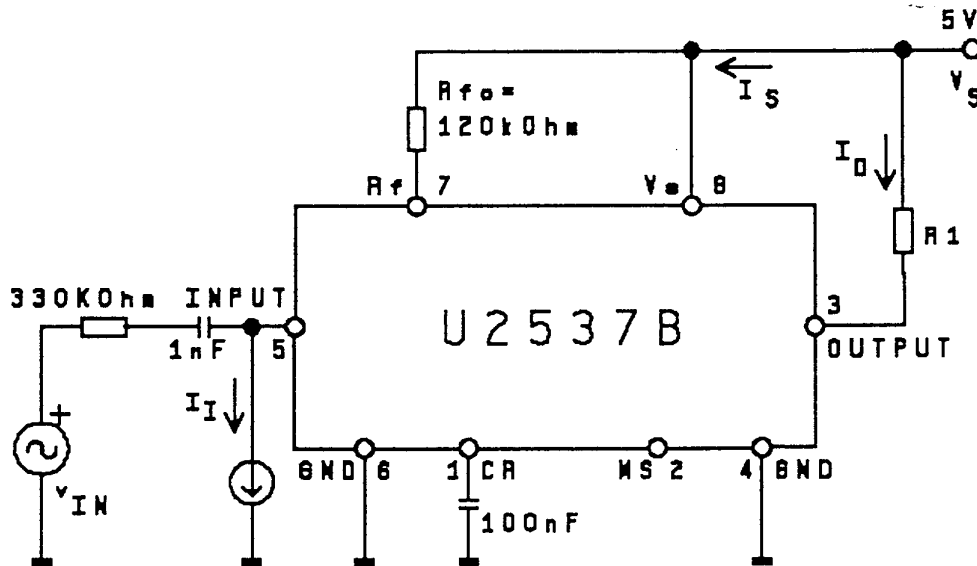
Figure 3 Test circuit
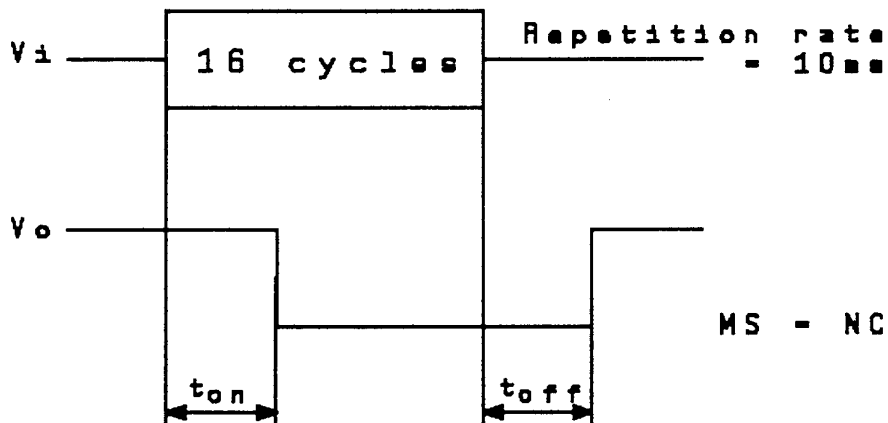
Figure 4 Testsignal (burst)

supply current (μA)
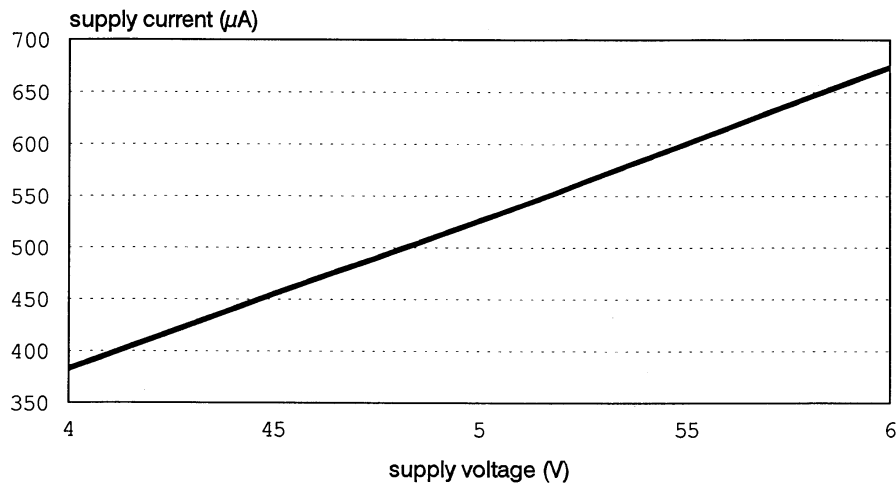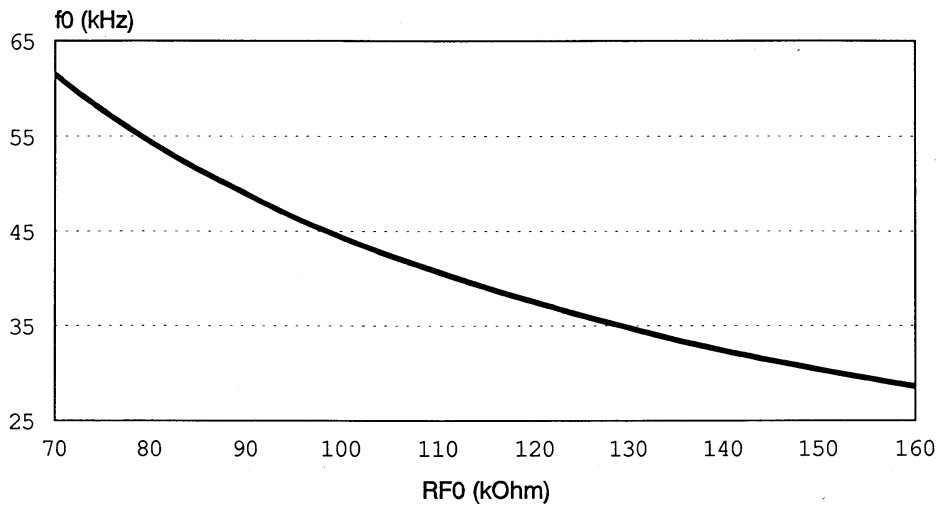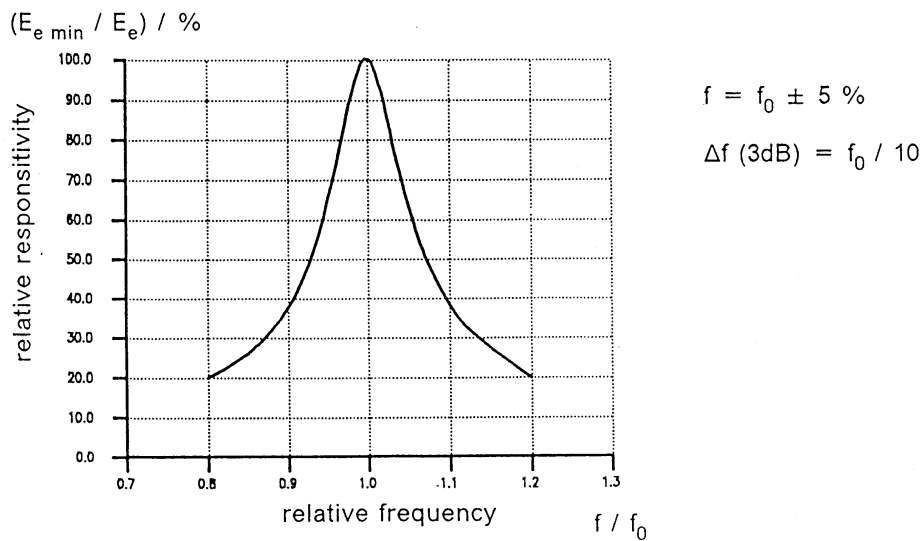
Figure 5 Supply current vs supply voltage

f0 (kHz)

$$f_0(kHz) = \frac{4800}{R_{F0}(k\Omega) + 8k\Omega}$$

Figure 6 f_0 vs R_{F0}

$(E_{e\ min} / E_e) / \%$

relative responsitivity

$f = f_0 \pm 5\ \%$

$\Delta f\ (3dB) = f_0 / 10$

relative frequency f / f_0

Figure 7 Frequency dependence of responsitivity

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 and

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.

Of particular concern is the control or elimination of releases into the atmosphere of these substances which are known as ozone depleting substances (ODSs).

The Montreal Protocol (1987) and its London Amendments (1990) will 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 any ODSs listed in the following documents that all refer to the same substances:

(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 and

(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 and do not contain ozone depleting substances.