Features

- Few External Components
- Low Power Consumption
- Microcomputer Compatible
- Insensitive to Ambient Light and Other Continuous Interferences

Applications

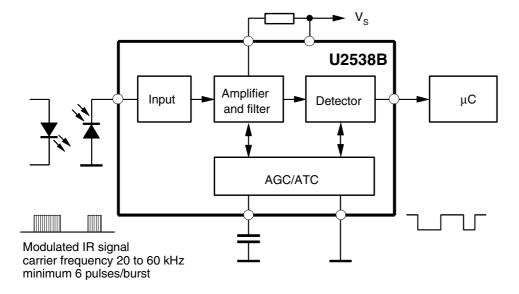
- Keyless Entry Systems
- Remote Control
- · Wireless Data Transfer up to 4 kbit/s

Pb Lead Free

1. Description

The IC U2538B is a complete IR receiver for data communication. The useful input signals are separated by a special input circuit and amplified by a gain-controlled amplifier. The bandpass filter suppresses the off-band signals. The signal detector, consisting of a demodulator, an integrator and a Schmitt trigger, forms the input signal to an output pulse that can be interfaced to a microcomputer. The AGC and the ATC circuit control the receiver's sensitivity, making it insensitive to ambient light sources.

Figure 1-1. Block Diagram with Typical Circuit





IR Receiver for Data Communication

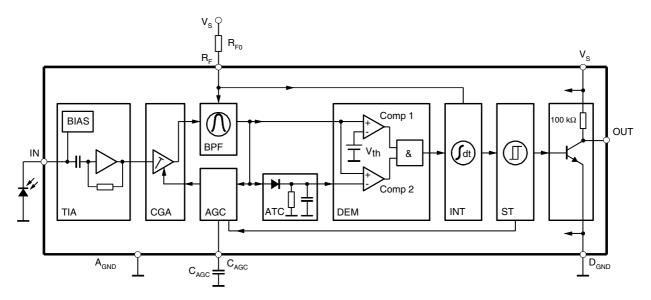
U2538B



Rev. 4717B-IRRC-09/05



Figure 1-2. Block Diagram



TIA	Transimpedance amplifier	ATC	Automatic threshold control
CGA	Controlled gain amplifier	DEM	Demodulator
BPF	Bandpass filter	INT	Integrator
AGC	Automatic gain control	ST	Schmitt trigger

2. Pin Configuration

Figure 2-1. Pinning SO8

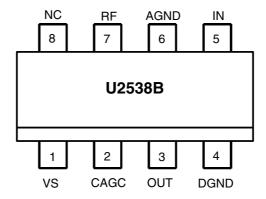


Table 2-1.Pin Description

Pin	Symbol	Function
1	VS	Supply voltage
2	CAGC	AGC capacitor
3	OUT	Data output
4	DGND	GND - DEM/INT/ST
5	IN	Input pin diode
6	AGND	GND amplifier
7	RF	Frequency determination
8	NC	Not connected



3. Functional Description

3.1 Input Stage (TIA)

The input stage provides the necessary bias voltage for the photo diode and ensures decoupling of the useful signal. This involves processing the DC and AC portions in separate parts of the circuit: the bias voltage (BIAS) and the transimpedance amplifier circuit (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 low-frequency signals (3 to 100 k Ω), but as high as possible for the operating frequency (100 kHz to 1 MHz) depending on the input current). The ac portion of the input signal feeds an inverted amplifier with a sufficiently low input resistance ($Z_i < 10 \text{ k}\Omega$). If the input resistance is too high, the useful signal will be lost due to the junction capacitance of the photodiode.

3.2 Controlled Gain Amplifier (CGA)

The controlled gain amplifier accounts for the greatest part of the voltage gain and can be controlled via the voltage at CAGC (pin 2). Gain control is needed to support the interference suppression of the detector. High-pass behavior results from the capacitive coupling of the individual stages. The cut-off frequency is approximately 20 kHz.

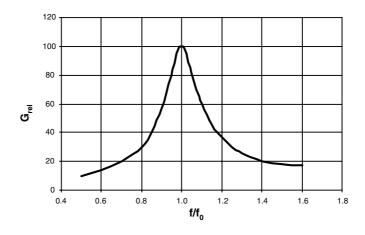
3.3 Bandpass Filter (BPF)

The bandpass filter basically consists of integrated components. An external resistor determines the mid-frequency. The filter quality is about 7 and is practically independent of the selected mid-frequency (see Figure 3-1). The following formula can be used for calculating the resistor, R_{fo}:

$$R_{fO}(k\Omega) = \frac{8855}{f_0(kHz)} - 13$$

where: $20 \text{ kHz} < f_0 < 60 \text{ kHz}$

Figure 3-1. Characteristic of the Bandpass Filter



3.4 Automatic Threshold Control (ATC)

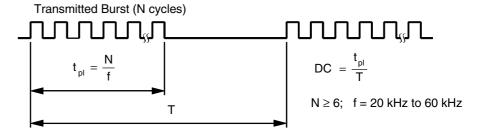
During the reception of an incoming telegram, the ATC reduces the sensitivity of the demodulator to establish the highest possible signal-to-noise ratio according to the signal strength. This prevents interferences which may arise during transmission from affecting the output. The advantage of the circuit is achieved if its output voltage exceeds V_{Th} (Comp 1). That is the case when the input signal strength is more than twice as much as the minimum detectable signal intensity.

3.5 Automatic Gain Control (AGC)

The automatic gain control improves the circuit's resistance to interference by adapting the amplification of the gain-controlled amplifier to the relevant existing interference level. In order to prevent the circuit from responding to transmitted data signals, it gradually reduces the sensitivity, but only if the duty cycle exceeds a specific value (see Figure 3-2). When using telegrams with higher duty cycles than this value, the capacitor, C_{AGC} , maintains the sensitivity for a certain time period. A higher capacitance enables a longer transmission time. A capacitance of $C_1 = 22$ nF is adequate for most known telegrams. A typical value for the maximum duty cycle (DC) can be calculated by the following formula:

$$DC_{max} = \frac{N}{14.2 + 1.1 \times N}$$

Figure 3-2. Duty Cycle



3.6 Detector

The output signal of the bandpass filter is compared to a fixed reference (Comp 1) and to a reference generated by the ATC circuit (Comp 2). The output of the comparator with the higher threshold voltage controls the integrator. Using the integrator keeps the output free of short-time interference.

The integrator drives the output stage after being processed through a Schmitt trigger. The internal pull-up resistor can replace an external resistor in some applications.





4. Absolute Maximum Ratings

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Parameters	Symbol	Value	Unit
Supply voltage, pin 1	V _S	-0.3 to +6.0	V
Input voltages Pins 2, 3, and 5 Pin 7	V _{IN} V _{IN}	−0.3 to V _S −0.3 to +1.5	V V
Input current, pin 7	I _{IN}	0 to 0.1	mA
Power dissipation T _{amb} = 105°C	P _{tot}	110	mW
Junction temperature	T _j	125	°C
Ambient temperature	T _{amb}	-40 to +105	°C
Storage temperature	T _{stg}	-40 to +125	°C

5. Thermal Resistance

Parameters	Symbol	Value	Unit	
Junction ambient	R_{thJA}	180	K/W	

6. Electrical Characteristics

 $T_{amb} = 25^{\circ}C$, $V_{S} = 5V$

Parameters	Test Conditions	Symbol	Min.	Тур.	Max.	Unit
Supply voltage	Pin 1	V _S	4.5		5.5	V
Supply current	Pin 1	I _S	0.35		0.65	mA
Maximum input current V _{IN} = 0	Pin 5	I _{IN}	0.6			mA
Output voltage low: I _{OL} = 2 mA	Pin 3	V _{OL}			0.2	V
Internal pull-up resistor	Pin 3	R _L	75	100	125	kΩ
Center frequency of bandpass RF = 240k		f ₀	33.3	35	36.7	kHz
Q factor		Q		7		
Frequency range		f	20		60	kHz
AGC current source sink	Pin 2		90 70	120 100	155 140	nA nA
AGC slope	Pin 2			20		dB/V
Number of pulses required			6			
Sensitivity	Pin 5				0.7	nA(rms)
Switch-on delay, i _{IN} = 0.7 nA (rms)	Pin 3, see Figure 6-1	t _{don}	3		7.5	Period
Switch-off delay, i _{IN} = 0.7 nA (rms)	Pin 3, see Figure 6-1	t _{doff}	5		10	Period
Pulse width, i _{IN} = 0.7 nA (rms), 6 pulse bursts	Pin 3, see Figure 6-1	t _{po}	4.5		10	Period

$$R_{fO}(k\Omega) = \frac{8855}{f_0(kHz)} - 13 \ k\Omega$$

Figure 6-1. Switch On/Off Delay

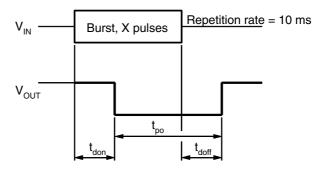
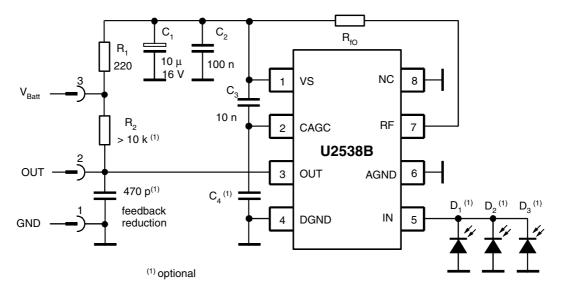


Figure 6-2. Application Circuit

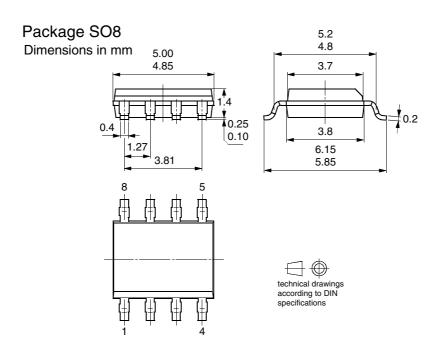




7. Ordering Information

Extended Type Number	Package	Remarks
U2538B-MFPY	SO8	Tube, Pb-free
U2538B-MFPG3Y	SO8	Taped and reeled, Pb-free

8. Package Information



9. Revision History

Please note that the following page numbers referred to in this section refer to the specific revision mentioned, not to this document.

Revision No.	History	
	Put datasheet in a new template	
4717B-IRRC-09/05	Pb-free Logo on page 1 added	
4/1/D-INNO-09/05	Heading Rows on Table "Absolute Maximum Ratings" on page 6 added	
	Ordering Information on page 8 changed	



Atmel Corporation

2325 Orchard Parkway San Jose, CA 95131, USA Tel: 1(408) 441-0311 Fax: 1(408) 487-2600

Regional Headquarters

Europe

Atmel Sarl Route des Arsenaux 41 Case Postale 80 CH-1705 Fribourg Switzerland

Tel: (41) 26-426-5555 Fax: (41) 26-426-5500

Asia

Room 1219 Chinachem Golden Plaza 77 Mody Road Tsimshatsui East Kowloon Hong Kong Tel: (852) 2721-9778

Tel: (852) 2721-9778 Fax: (852) 2722-1369

Japan

9F, Tonetsu Shinkawa Bldg. 1-24-8 Shinkawa Chuo-ku, Tokyo 104-0033 Japan

Tel: (81) 3-3523-3551 Fax: (81) 3-3523-7581

Atmel Operations

Memory

2325 Orchard Parkway San Jose, CA 95131, USA Tel: 1(408) 441-0311 Fax: 1(408) 436-4314

Microcontrollers

2325 Orchard Parkway San Jose, CA 95131, USA Tel: 1(408) 441-0311 Fax: 1(408) 436-4314

La Chantrerie BP 70602 44306 Nantes Cedex 3, France Tel: (33) 2-40-18-18-18 Fax: (33) 2-40-18-19-60

ASIC/ASSP/Smart Cards

Zone Industrielle 13106 Rousset Cedex, France Tel: (33) 4-42-53-60-00 Fax: (33) 4-42-53-60-01

1150 East Cheyenne Mtn. Blvd. Colorado Springs, CO 80906, USA

Tel: 1(719) 576-3300 Fax: 1(719) 540-1759

Scottish Enterprise Technology Park Maxwell Building East Kilbride G75 0QR, Scotland

Tel: (44) 1355-803-000 Fax: (44) 1355-242-743

RF/Automotive

Theresienstrasse 2 Postfach 3535 74025 Heilbronn, Germany Tel: (49) 71-31-67-0 Fax: (49) 71-31-67-2340

1150 East Cheyenne Mtn. Blvd. Colorado Springs, CO 80906, USA

Tel: 1(719) 576-3300 Fax: 1(719) 540-1759

Biometrics/Imaging/Hi-Rel MPU/ High Speed Converters/RF Datacom

Avenue de Rochepleine BP 123

38521 Saint-Egreve Cedex, France

Tel: (33) 4-76-58-30-00 Fax: (33) 4-76-58-34-80

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