

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



IR Receiver for Data Communication

U2538B

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

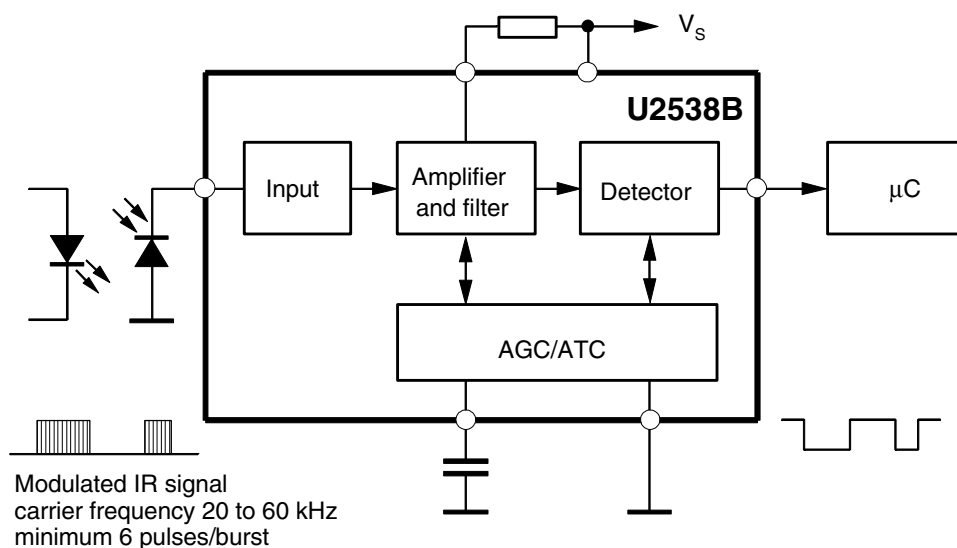
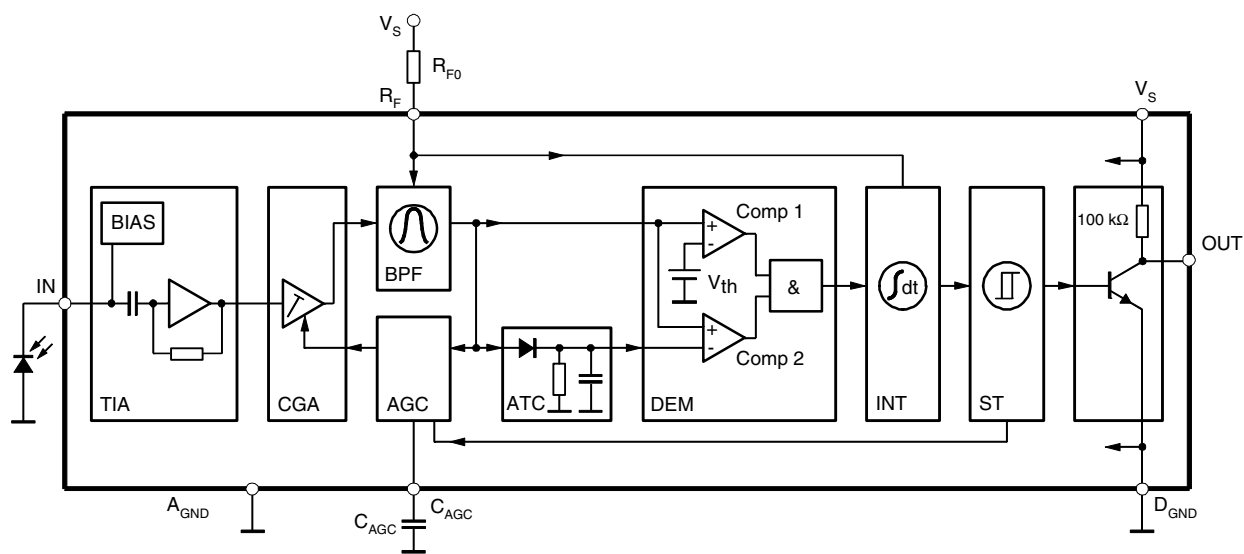


Figure 1-2. Block Diagram



TIA Transimpedance amplifier
 CGA Controlled gain amplifier
 BPF Bandpass filter
 AGC Automatic gain control

ATC Automatic threshold control
 DEM Demodulator
 INT Integrator
 ST Schmitt trigger

2. Pin Configuration

Figure 2-1. Pinning SO8

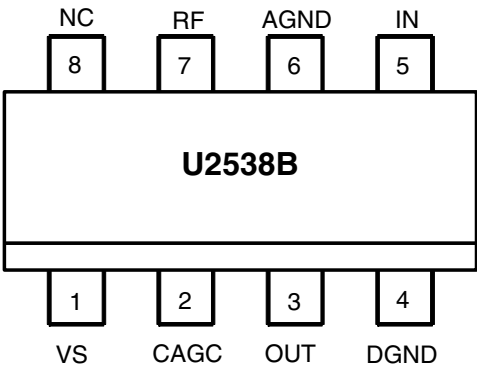


Table 2-1. Pin Description

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 kΩ), 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.

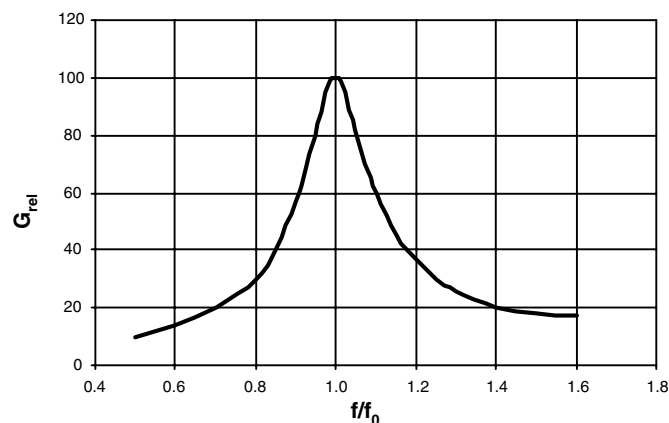
3.3 Bandpass Filter (BPF)

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_{f0} :

$$R_{f0}(\text{k}\Omega) = \frac{8855}{f_0(\text{kHz})} - 13$$

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

Figure 3-1. Characteristic of the Bandpass Filter



3.4 Automatic Threshold Control (ATC)

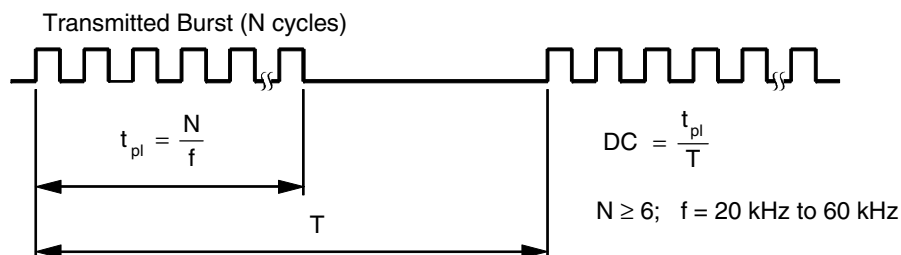
During the reception of an incoming telegram, the ATC reduces the sensitivity of the demodulator to establish the highest possible signal-to-noise ratio according to the signal strength. This prevents interferences which may arise during transmission from affecting the output. The advantage of the circuit 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 $C_1 = 22 \text{ nF}$ 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 $T_{amb} = 105^{\circ}\text{C}$	P_{tot}	110	mW
Junction temperature	T_j	125	$^{\circ}\text{C}$
Ambient temperature	T_{amb}	−40 to +105	$^{\circ}\text{C}$
Storage temperature	T_{stg}	−40 to +125	$^{\circ}\text{C}$

5. Thermal Resistance

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

6. Electrical Characteristics

$T_{amb} = 25^{\circ}\text{C}$, $V_S = 5\text{V}$

Parameters	Test Conditions	Symbol	Min.	Typ.	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: $I_{OL} = 2\text{ mA}$	Pin 3	V_{OL}			0.2	V
Internal pull-up resistor	Pin 3	R_L	75	100	125	$k\Omega$
Center frequency of bandpass $R_F = 240k$		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, $i_{IN} = 0.7\text{ nA (rms)}$	Pin 3, see Figure 6-1	t_{don}	3		7.5	Period
Switch-off delay, $i_{IN} = 0.7\text{ nA (rms)}$	Pin 3, see Figure 6-1	t_{doff}	5		10	Period
Pulse width, $i_{IN} = 0.7\text{ nA (rms)}$, 6 pulse bursts	Pin 3, see Figure 6-1	t_{po}	4.5		10	Period

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

Timing diagram for a monostable multivibrator. The input V_{IN} shows a pulse labeled "Burst, X pulses". The output V_{OUT} shows a single rectangular pulse. The pulse width is labeled t_{po} . The time from the start of the input pulse to the start of the output pulse is labeled t_{don} . The time from the end of the input pulse to the end of the output pulse is labeled t_{doff} . The repetition rate is given as 10 ms.

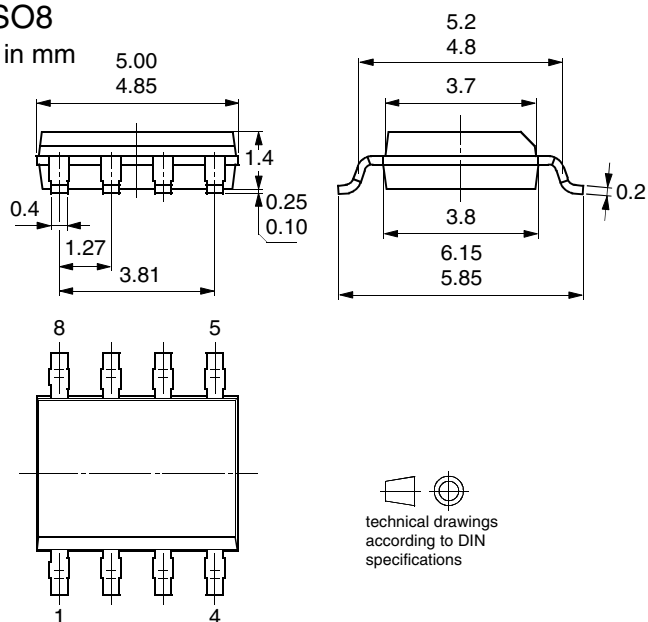
7. Ordering Information

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

8. Package Information

Package SO8

Dimensions in mm



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
4717B-IRRC-09/05	<ul style="list-style-type: none"> Put datasheet in a new template Pb-free Logo on page 1 added 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
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

Literature Requests

www.atmel.com/literature

Disclaimer: The information in this document is provided in connection with Atmel products. No license, express or implied, by estoppel or otherwise, to any intellectual property right is granted by this document or in connection with the sale of Atmel products. **EXCEPT AS SET FORTH IN ATMEL'S TERMS AND CONDITIONS OF SALE LOCATED ON ATMEL'S WEB SITE, ATMEL ASSUMES NO LIABILITY WHATSOEVER AND DISCLAIMS ANY EXPRESS, IMPLIED OR STATUTORY WARRANTY RELATING TO ITS PRODUCTS INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT. IN NO EVENT SHALL ATMEL BE LIABLE FOR ANY DIRECT, INDIRECT, CONSEQUENTIAL, PUNITIVE, SPECIAL OR INCIDENTAL DAMAGES (INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF PROFITS, BUSINESS INTERRUPTION, OR LOSS OF INFORMATION) ARISING OUT OF THE USE OR INABILITY TO USE THIS DOCUMENT, EVEN IF ATMEL HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.** Atmel makes no representations or warranties with respect to the accuracy or completeness of the contents of this document and reserves the right to make changes to specifications and product descriptions at any time without notice. Atmel does not make any commitment to update the information contained herein. Unless specifically provided otherwise, Atmel products are not suitable for, and shall not be used in, automotive applications. Atmel's products are not intended, authorized, or warranted for use as components in applications intended to support or sustain life.

© Atmel Corporation 2005. All rights reserved. Atmel®, logo and combinations thereof, Everywhere You Are® and others, are registered trademarks or trademarks of Atmel Corporation or its subsidiaries. Other terms and product names may be trademarks of others.



Printed on recycled paper.

4717B-IRRC-09/05

Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

Atmel:

[U2538B-MFPG3Y](#) [U2538B-MFPY](#)