Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts,Customers Priority,Honest Operation,and Considerate Service",our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!

Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

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**

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.
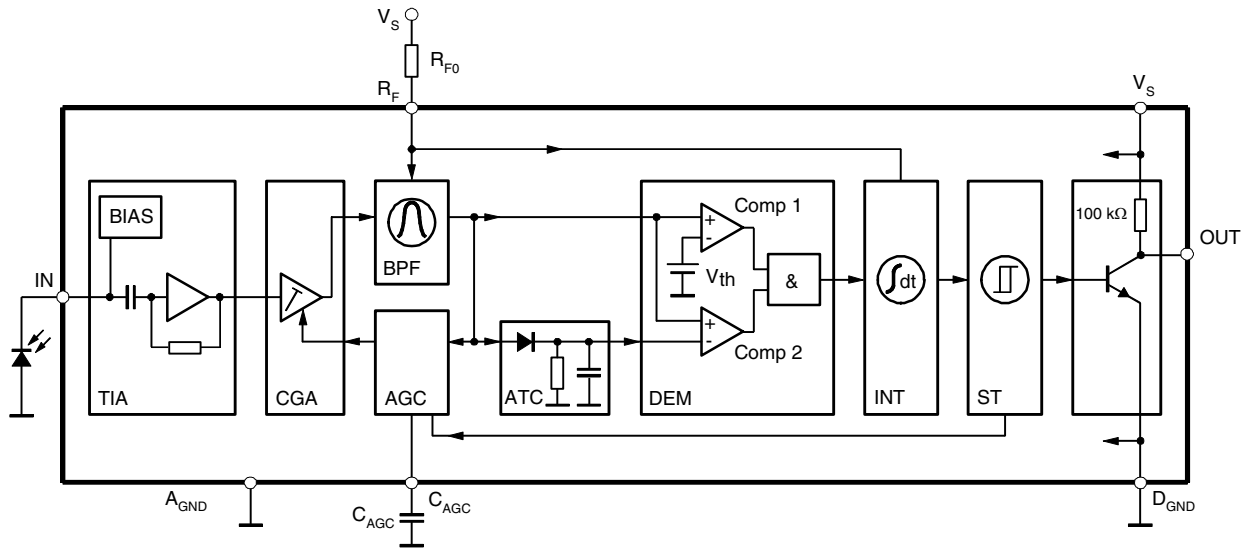
Figure 1. Block Diagram with Typical Circuit

Modulated IR signal
carrier frequency 20 to 60 kHz
minimum 6 pulses/burst
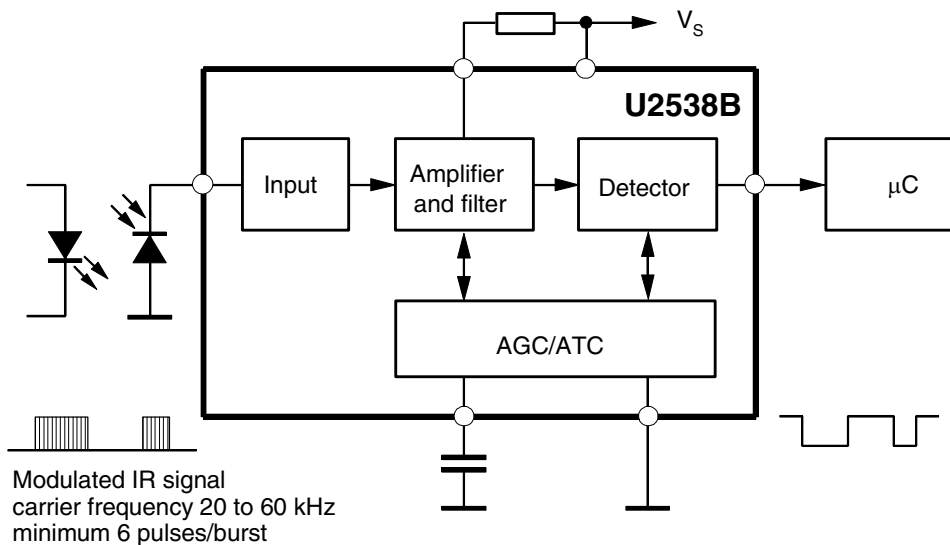
IR Receiver for Data Communication

U2538B

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

Pin Configuration

Figure 2. Pinning SO8

```
        NC      RF     AGND     IN
        ┌──┐   ┌──┐    ┌──┐    ┌──┐
        │ 8│   │ 7│    │ 6│    │ 5│
    ┌───┴──┴───┴──┴────┴──┴────┴──┴───┐
    │                                 │
    │            U2538B               │
    │                                 │
    ├───┬──┬───┬──┬────┬──┬────┬──┬───┤
        │ 1│   │ 2│    │ 3│    │ 4│
        └──┘   └──┘    └──┘    └──┘
        VS     CAGC    OUT     DGND
```
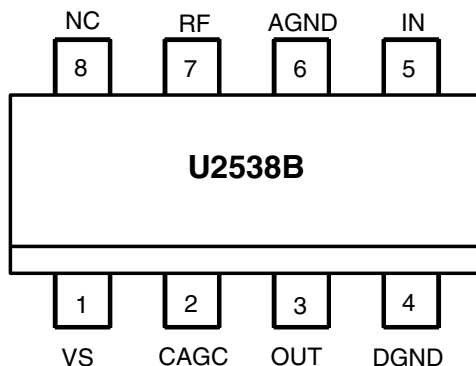
Pin Description

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

Functional Description

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 ($Z_i < 10$ kΩ). If the input resistance is too high, the useful signal will be lost due to the junction capacitance of the photodiode.

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 behaviour results from the capacitive coupling of the individual stages. The cut-off frequency is approximately 20 kHz.

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). The following formula can be used for calculating the resistor, R_{f0}:

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

where: 20 kHz < f_0 < 60 kHz

Figure 3. Characteristic of the Bandpass Filter
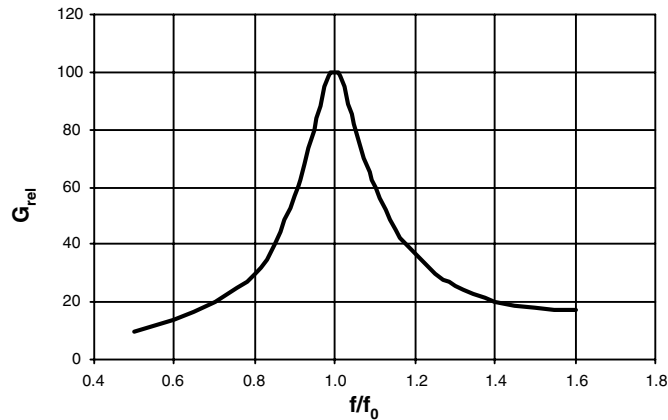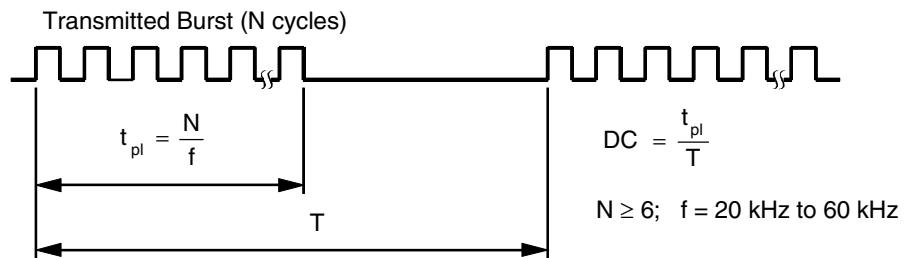
Automatic Threshold Control (ATC)

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.

Automatic Gain Control (AGC)

The automatic gaincontrol 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 4). 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 4. Duty Cycle

Transmitted Burst (N cycles)

$$t_{pl} = \frac{N}{f}$$

$$DC = \frac{t_{pl}}{T}$$

$$N \geq 6; \quad f = 20 \text{ kHz to } 60 \text{ kHz}$$

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.

Absolute Maximum Ratings

Parameters		Symbol	Value	Unit
Supply voltage	Pin 1	V_S	-0.3 to +6.0	V
Input voltages	Pin 2, 3, and 5	V_{IN}	-0.3 to V_S	V
	Pin 7		-0.3 to +1.5	
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

Thermal Resistance

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

Electrical Characteristics

T_{amb} = 25°C, V_S = 5 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 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 = 240 k		f_0	33.3	35	36.7	kHz
Q factor		Q		7		
Freqency 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 5	t_{don}	3		7.5	Period
Switch-off delay, i_{IN} = 0.7 nA (rms)	Pin 3, see Figure 5	t_{doff}	5		10	Period
Pulse width, i_{IN} = 0.7 nA (rms), 6 pulse bursts	Pin 3, see Figure 5	t_{po}	4.5		10	Period

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

6   **U2538B**

Figure 5. Switch On/Off Delay
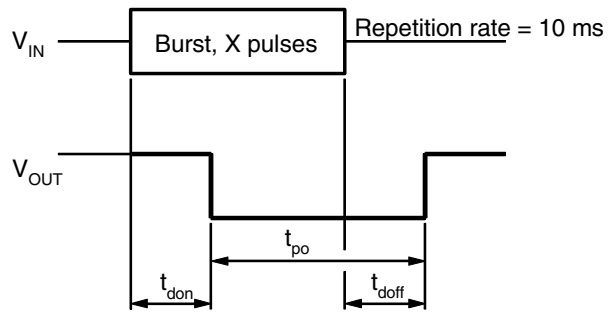
Figure 6. Application Circuit
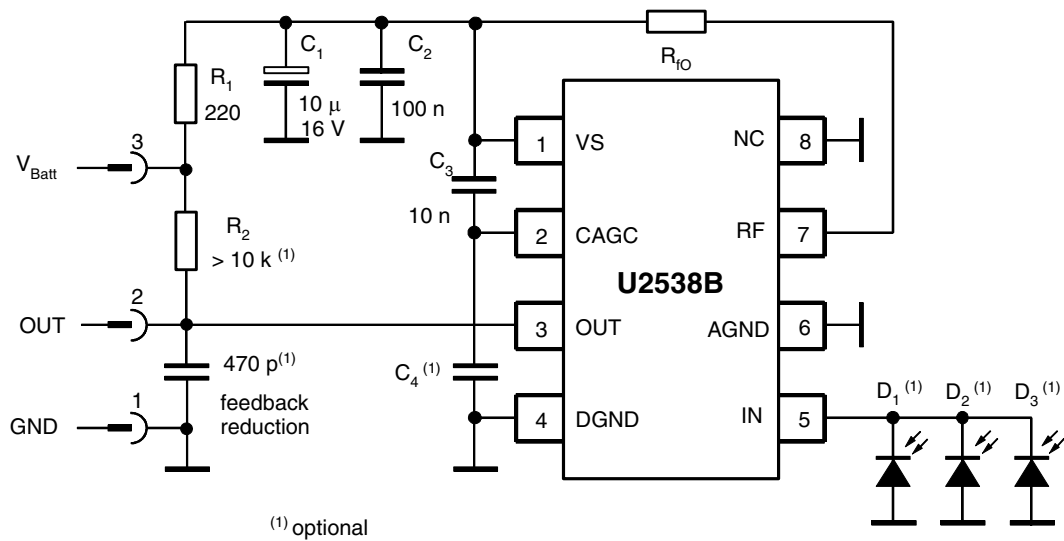
Ordering Information

Extended Type Number	Package	Remarks
U2538B-MFP	SO8	Tube
U2538B-MFPG3	SO8	Taped and reeled

Package Information

Package SO8
Dimensions in mm

technical drawings
according to DIN
specifications

![ATMEL logo]
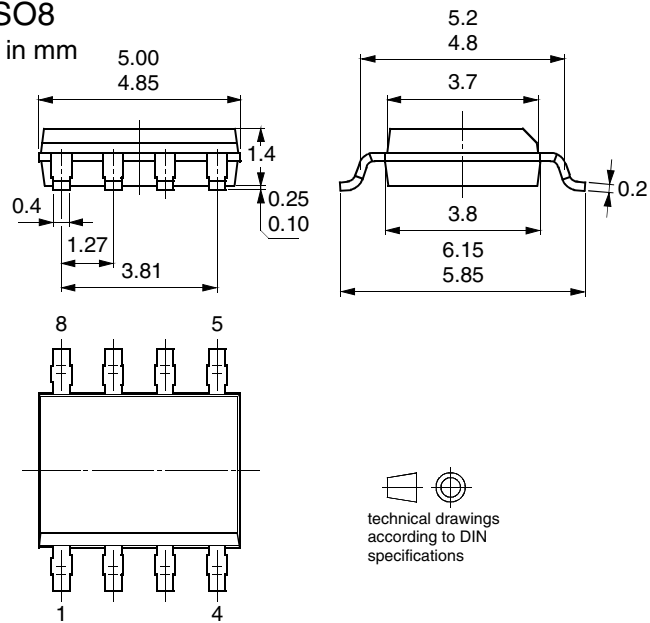
Atmel Headquarters

Corporate Headquarters
2325 Orchard Parkway
San Jose, CA 95131
TEL 1(408) 441-0311
FAX 1(408) 487-2600

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 Tsimhatsui
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
TEL 1(408) 441-0311
FAX 1(408) 436-4314

Microcontrollers
2325 Orchard Parkway
San Jose, CA 95131
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
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
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

e-mail
literature@atmel.com

Web Site
http://www.atmel.com

♻ Printed on recycled paper.