Reader-IC for Immobilizers

Description

The U2270B is a bipolar integrated circuit which implements all important functions for immobilizer and identification systems. The IC incorporates the required circuitry for the energy transfer to the transponder, like on chip power supply, oscillator and a powerful reader coil driver. It also includes all signal processing circuits that are necessary to form the small input signal into a microcomputer output information.

Features

- Power supply: 5 V or battery voltage (7 V to 14 V)
- Tuning capability
- Microcontroller compatible
- Special coil driver function: common mode or differential mode
- Power supply output for microcontroller
- Low power consumption in standby mode

Applications

- Car immobilizer
- Access control
- Animal identification
- Access control combined with credit card

Case: SO 16 U2270B-FP

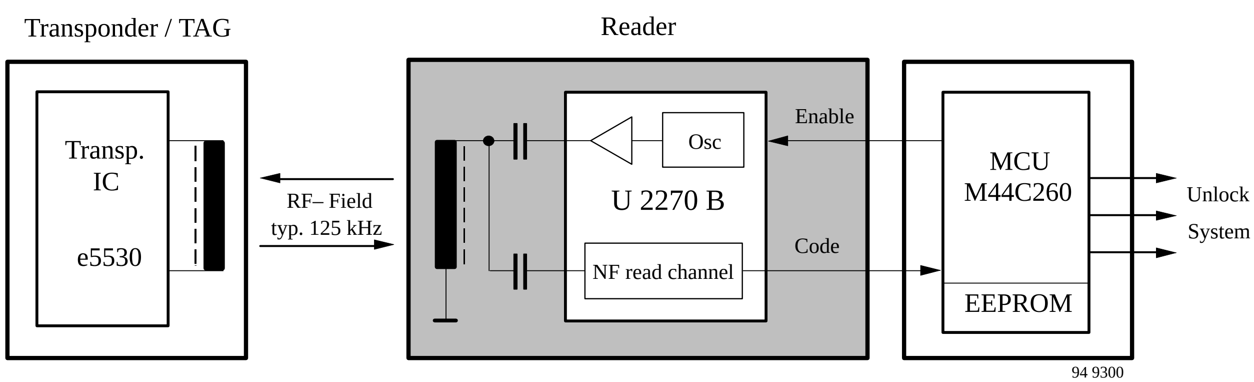


Figure 1.

Pin Description

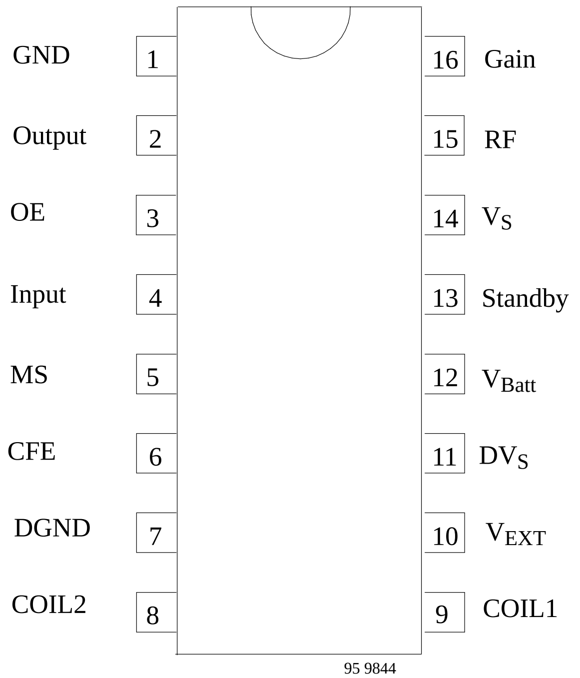


Figure 2. Pinning

Pin	Symbol	Function
1	GND	Ground
2	Output	Data output
3	OE	Data output enable
4	Input	Data input
5	MS	Mode select coil 1: Common mode / Differential mode
6	CFE	Carrier frequency enable
7	DGND	Driver ground
8	COIL 2	Reader coil driver 2
9	COIL 1	Reader coil driver 1
10	V_{EXT}	External power supply
11	DV_S	Driver supply voltage
12	V_{Batt}	Battery voltage
13	Standby	Standby input
14	V_S	Internal power supply (5 V)
15	RF	Frequency adjustment
16	Gain	Gain control

Block Diagram

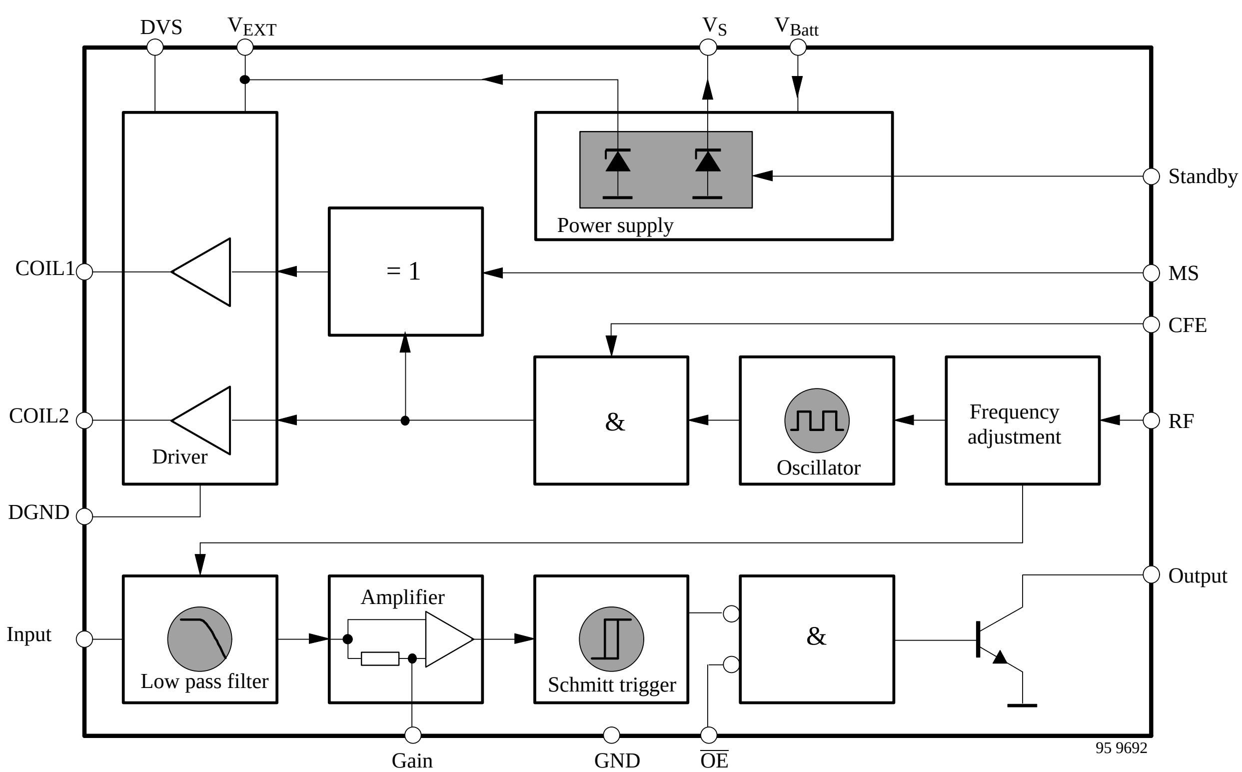


Figure 3.

Functional Description

Power Supply (PS)

The U2270B can be operated from a single 5 V supply rail or from the 12 V battery voltage of a vehicle. The 12 V supply capability is achieved via the on chip power supply (see figure 3). The power supply provides two different output voltages, V_S and V_{EXT}.

V_S is the internal power supply voltage except of that for the driver circuit. Pin V_S is used to connect a block capacitor. V_S can be switched off by the Pin Standby. In the standby mode, the chip's power consumption is very low. V_{EXT} is the supply voltage of the antenna's predriver. This voltage can also be used to operate external circuits i.e. a microcontroller. In conjunction with an external NPN transistor, it also establishes the supply voltage of the reader coil driver, DVS.

There are mainly 3 different possibilities to power the different systems of the reader IC.

1. One Rail Operation

All internal circuits are operated from one 5 V power rail (refer to figure 1). V_S ,V_{EXT} and DV_S serve as inputs in that case. V_{Batt} is not used, but should also be connected to that supply rail.

2. Two Rail Operation

In that application, the driver voltage (DV_S) and the predriver supply (V_{EXT}) are operated at a higher voltage than the rest of the circuits, to obtain a higher magnetic field. V_S is connected to a 5 V supply, whereas the driver voltages can be as high as 8 V.

3. Battery Voltage Operation

Using this operation mode, V_S and V_{EXT} are generated by the internal power supply (refer to figure 2). V_{EXT} is an output voltage in that case and supplies the base of the external NPN transistor. The emitter of that transistor can deliver the current for the output stage of the antenna driver.

Oscillator Osc

The frequency of the on-chip oscillator is controlled by a current fed into the R_F input. An integrated compensation circuit ensures a widely temperature and supply voltage independent frequency which is selected by a fixed resistor between R_f (Pin 15) and V_S (Pin 14). For 125 kHz a resistor value of 110 kΩ is defined. For other frequencies use the following formula:

$$R_f = \frac{14375}{f_0[kHz]} - 5\ k\Omega$$

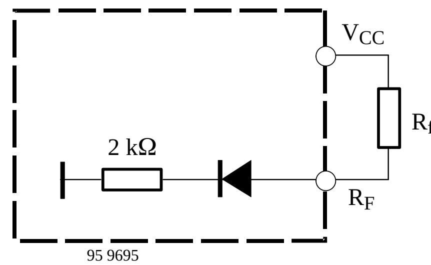


Figure 4. Equivalent circuit of pin R_F

Filter (LPF)

The full integrated low-pass filter (4th order butterworth) removes the remaining carrier signal and high frequency disturbances after demodulation. The upper cut-off frequency of the LPF depends on the selected oscillator frequency. The typical value is f(osc)/18. That means data rates up to fosc/25 are possible if biphase encoding is used.

A high pass filter results from the capacitive coupling at the input (Pin 4) shown in figure 5. The input voltage swing is limited at 2 V_{pp}. For frequency response calculation the impedances of the signal source and LPF input (typical 220 kΩ) have to be considered.

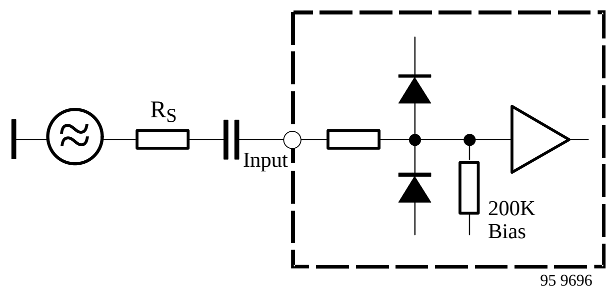


Figure 5. Equivalent circuit of Pin Input

Amplifier (AMP)

The differential amplifier basically has a fixed gain. The Gain pin is used for dc decoupling and to set the gain to a lower value by an additional resistor (R_{Gain}). The lower cut-off frequency of the decoupling circuit and the gain are as follows:

$$G = 30 \frac{R_i}{R_i + R_{Gain}}$$

$$f_{cut} = \frac{1}{2\ \pi\ C_{Gain}\ (\ R_i + R_{Gain})}$$

The value of the internal resistor R_i can be assumed to 2.5 kΩ.

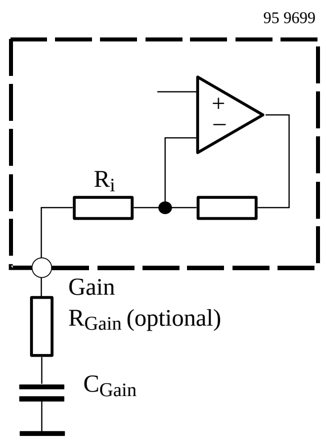


Figure 6. Equivalent circuit of pin GAIN

Schmitt-Trigger

Finally the signal is processed by a schmitt-trigger to suppress noise and to make it μC compatible. The hysteresis is 100 mV symmetrically to the DC operation point. The open collector output is enabled by a low level at OE (Pin 3).

Driver (DRV)

The driver supplies the reader coil with the appropriate energy. The circuits consists of two independent output stages. This output stages can be operated in two different modes. In the common mode, the outputs of the stages are in phase. In this mode, the outputs can be interconnected, to achieve a high current output capability. Using the differential mode, the output voltages are in antiphase. In this way, the reader antenna is driven with a higher voltage, having a lower output current capability. These functions are controlled by two digital inputs (MS, CFE, refer to function list). The equivalent circuit of the driver is shown in figure 3.

Function List

MS low	common mode
MS high	differential mode
CFE low	carrier disabled
CFE high	carrier active
OE low	output enabled
OE high	output disabled
Standby low	standby mode
Standby high	IC active

Absolute Maximum Ratings

All voltages are referred to GND (pins 1 and 7).

Parameters/Conditions Pin	Symbol	Min.	Typ.	Max.	Unit
Operating voltage Pin 12	V_{Batt}	V_S		14	V
Operating voltage Pins 10 and 14	V_S, V_{EXT}	–0.3		8	V
Range of all input and output voltages Pins 2, 3, 4, 5, 6, 8, 9, 13, 15 and 16		–0.3		V_S+0.3	V
Output current Pin 10	I_{EXT}			10	mA
Output current Pin 2	I_{OUT}			10	mA
Driver output current Pins 8 and 9	I_{coil}			200	mA
Power dissipation SO 16	P_{tot}			380	mW
Junction temperature	T_{jmax}			150	°C
Storage temperature	T_{stg}	–55		125	°C
Ambient temperature	T_{amb}	–40		105	°C

Maximum Thermal Resistance

Parameters/Conditions Pin	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance SO 16	R_{thJA}			120	K/W

Operating Range

All voltages are referred to GND (pins 1 and 7)

Parameters/Conditions Pin		Symbol	Min.	Typ.	Max.	Unit
Operating voltage	Pin 12	V_{Batt}	7	12	14	V
Operating voltage	Pin 14	V_S	4.5	5.3	6.0	V
Operating voltage	Pin 10 Pin 11	V_{EXT} DV_S	4.5		8	
Carrier frequency		f_{osc}	100	125	150	kHz

Electrical Characteristics

Test conditions (unless otherwise specified): V_{Batt} = 12 V, T_{amb} = 25°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Data output – collector emitter saturation voltage	Pin 2 I_{out} = 5 mA	V_{CEsat}			400	mV
Data output enable – low level input voltage – high level input voltage	Pin 3	V_{il} V_{ih}	 2.4		0.8	V V
Data input – low level input voltage – high level input voltage – input resistance – input sensitivity	Pin 4 f = 3 kHz (squarewave) gain capacitor = 100 nF	V_{il} V_{ih} R_{in}	2 10	 220	 3.8	V V kΩ mV
Driver polarity mode – low level input voltage – high level input voltage	Pin 5	V_{il} V_{ih}	 2.4		0.2	V V
Carrier frequency enable – low level input voltage – high level input voltage	Pin 6	V_{il} V_{ih}	 3.0		0.8	V V
Operating current	Pin 14	I_S		1.4		mA
Standby current	Pin 12	I_{St}	16	28	40	µA
Supply voltage	Pin 14	V_S	4.5	5.3	6	V
Driver output voltage	I_L = ±100 mA Pin 7	V_{DRV}	3.3	4.0		V_{PP}
Vext – Output voltage – Output current – Standby output current	Pin 10 IC active standby mode	V_{EXT} I_{EXT} I_{osc}	5.0	5.5 1	6.0 3.5 1.2	V mA mA
Standby input – low level input voltage – high level input voltage	Pin 13	V_{il} V_{ih}	 2.5		0.8	V V

Electrical Characteristics

Test conditions (unless otherwise specified): V_{Batt} = 12 V, T_{amb} = 25°C

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Oscillator – Carrier frequency	RF-resistor = 110 kΩ (application 2)	f_0	123	125	127	kHz
Low pass filter – Cut off frequency	Carrier freq. = 125 kHz	f_{cut}		7		kHz
Amplifier – Gain	Gain capacitor = 100 nF f = 3 kHz		25	30	35	
Schmitt trigger – Hysteresis voltage				100		mV

Application 1

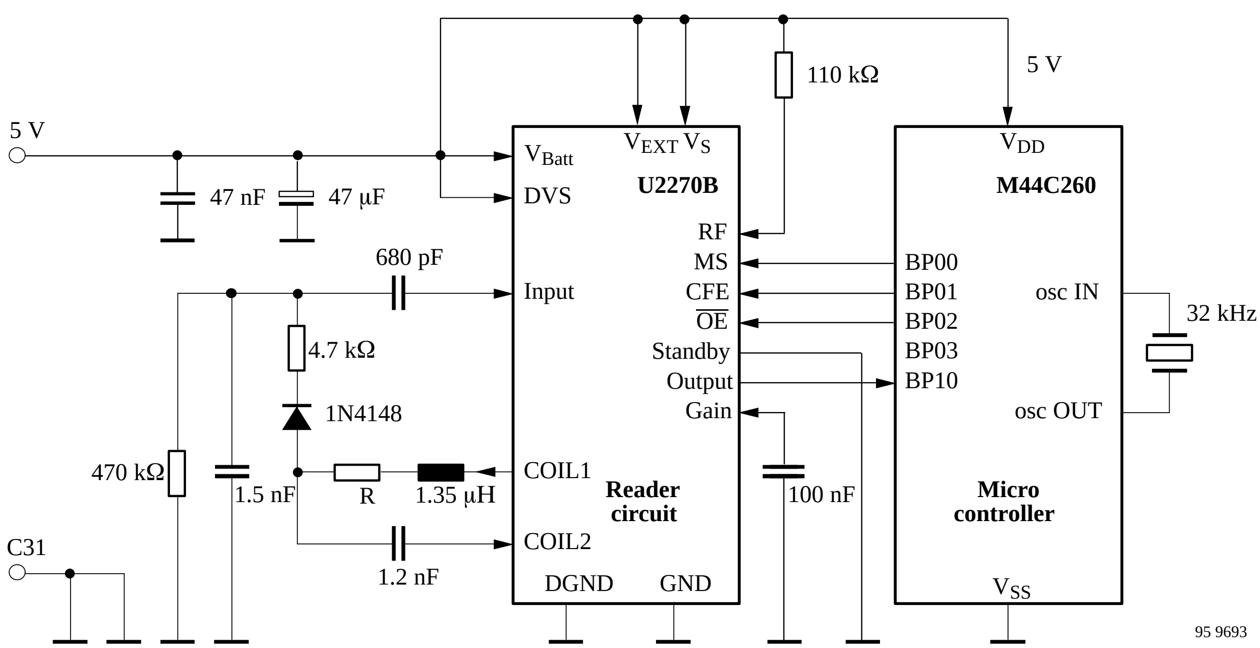


Figure 7.

Application 2

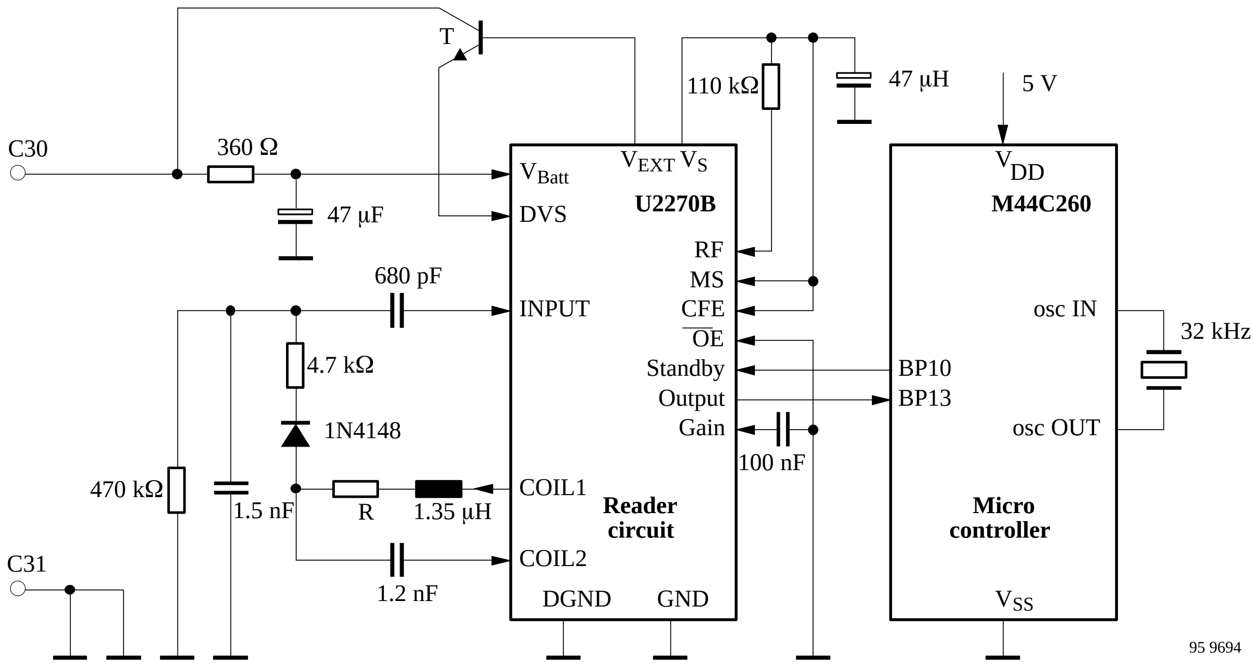
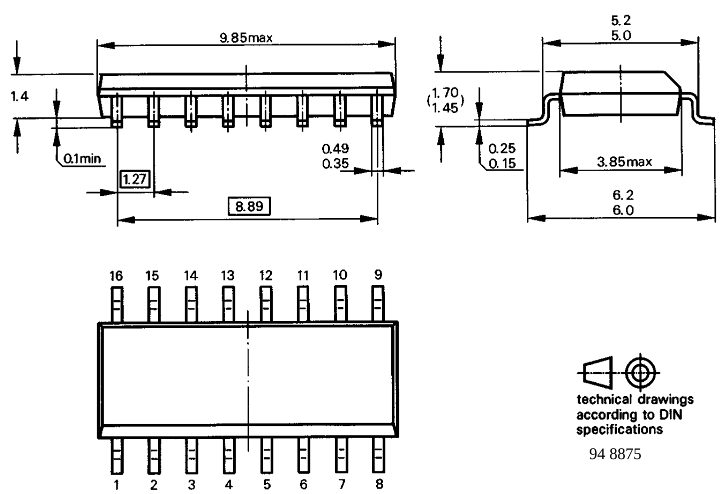


Figure 8.

Dimensions in mm

Package: SO 16



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.

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 TELEFUNKEN microelectronic GmbH semiconductor division 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.

TEMIC can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

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