DC/DC Converter – Power Supply 28 V

Description

The U6229B is a multifunctional power supply IC which provides four different voltages dedicated to supply components of complex microcontroller systems. Supplied by a battery voltage in the wide range from 6 V to 26 V, the U6229B generates typically 28.4 V with a step-up converter, PWM, external power MOSFET and 150 µH inductivity. This voltage is fed to a step-down converter with external 150 µH inductivity to generate a 7-V auxiliary voltage with a small ripple. By means of this voltage, two linear regulators with only a small power dissipation provide a constant 5-V (±3%) supply for microcontrollers and an even more accurate 5-V (±2%) supply as a reference for sensors and a/d converters.

Features

- Voltage outputs
  - 28.4-V step-up converter with I ≤ 1.2 A
  - 7-V step-down converter with I ≤ 400 mA
  - 5-V logic supply with I ≤ 14 mA
  - 5-V reference voltage with I ≤ 14 mA
- Logic input ENABLE
  - Enables the step-up converter
- Analog input VKL15
  - Energy-reserve mode switches off the step-up converter at V_{Batt} < 5.25 V
  - Controls start-up behavior
- Logic output NRES
  - N-reset output with over/ under voltage monitoring of both 5-V supplies

Ordering Information

Extended Type Number	Package	Remarks
U6229B	SO20	

Block Diagram

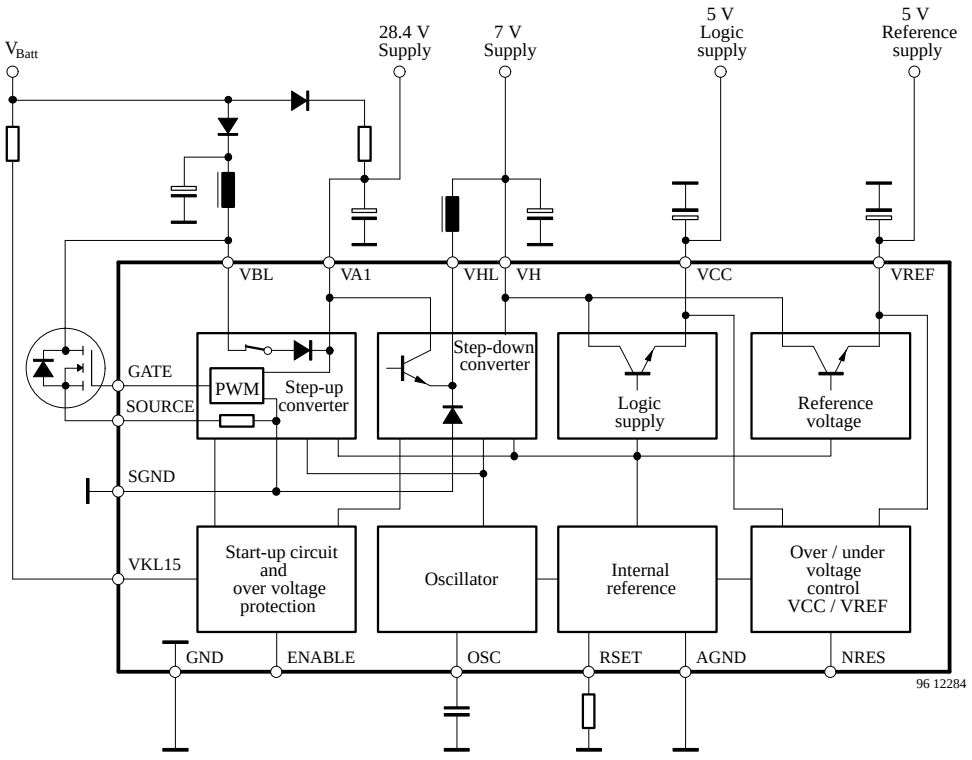


Figure 1. Block diagram with external circuit

Pin Description

Pin	Symbol	Input / Output	Function
1	OSC	Analog input	Oscillator
2	V_{BL}	Analog input	Input set-up converter
3	V_{A1}	Analog output	Output set-up converter
4	SOURCE	Analog input	Source of switching transistor
5, 6, 15, 16, 17	S_{GND}	Ground	Ground
7	GATE	Analog output	Gate of switch transistor
8	V_{HL}	Analog input	Output of power switch step-down converter
9	V_H	Analog output	Regulator input step-down converter
10	V_{CC}	Analog output	5-V supply voltage
11	V_{REF}	Analog output	5-V reference voltage
12	NRES	Logic output	Power-on reset
13	ENVA3	Logic input	Control step-up converter
14	V_{KL15}	Analog input	Monitoring supply voltage
18	A_{GND}	Ground	Reference ground
19	R_{SET1}	Analog input	Connect external resistor to GND – bias of the current sources
20	GND	Ground	Ground

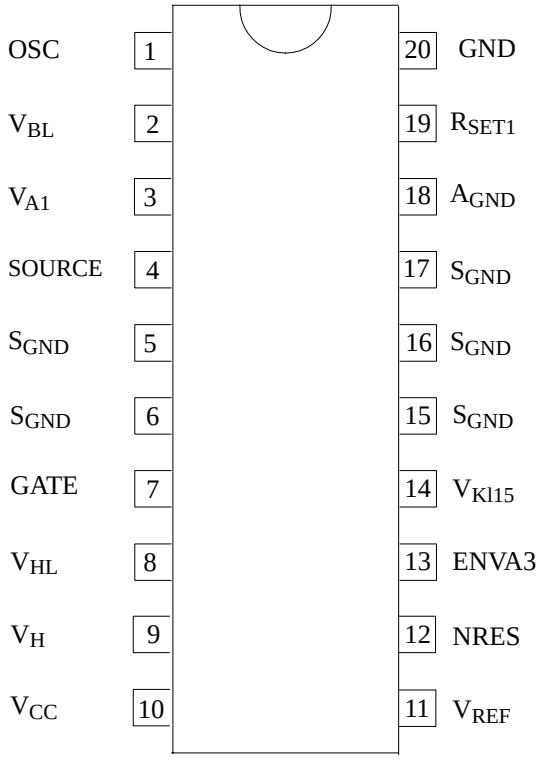


Figure 2. Pinning U6229B

Functional Description

Oscillator, Pin 1

The switching frequency f_{osc} is defined with (as) a triangle oscillator and is programmed with the capacitor COS1.

$$f_{osc} = K_{osc}/C_{OS1}$$

Step-up Converter V_{BL} Pin 2, V_{A1} Pin 3

The step–up converter uses the battery voltage (6V to 26 V) to produce a constant output voltage (V_{A1} typ. 28.4 V). An external power MOSFET serves as the electronic power switch of the step–up converter. When this switch is activated, the coil current increases up to a limit determined by the controller. The power MOSFET is switched off when this limit is reached, and the energy stored in the coil is discharged into the capacitance C_{VA1} via the diode and the switches between V_{BL} and V_{A1}. The maximum possible coil current is limited to typ. 1.2 A by the circuit.

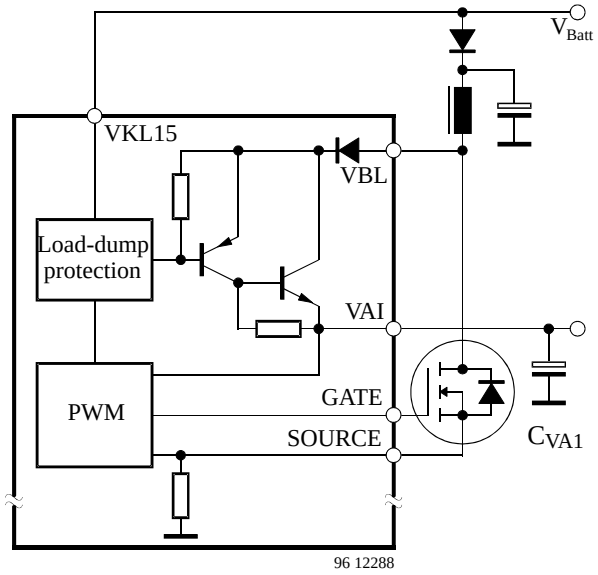


Figure 3. Basic principle of the step-up converter

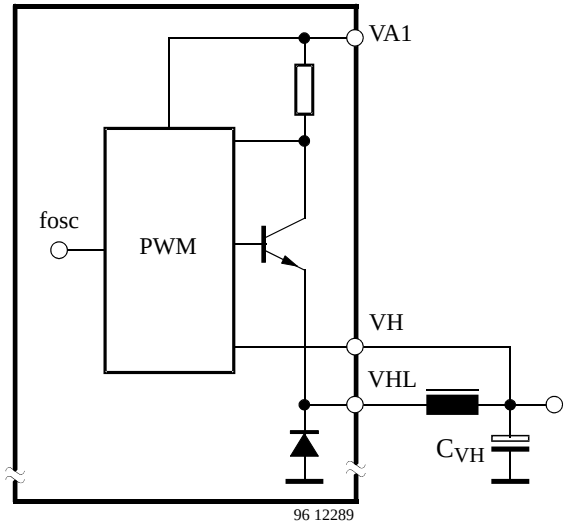


Figure 4. Basic principle of the step-down converter

SOURCE, Pin 4

A shunt resistor (typ. 180 mΩ) is connected between the SOURCE pin and S_{GND} for measurement of the coil current of the step-up converter.

S_{GND}, Pins 5, 6, 15, 16 and 17

S_{GND} is the power ground for the step-up and step-down converter.
These pins are at the same time metallically connected to the chip carrier. This results in a very low thermal resistance of the package, which can be significantly improved by further external measures (large copper areas or heat sink/metal housing near these pins).

GATE, Pin 7

The push-pull output Pin 7 is designed to trigger a power MOSFET.In order to protect the external FET, the maximum output voltage is limited by an integrated Zener diode.

Step-down Converter V_{HL} Pin 8, V_H Pin 9

The step-down converter produces a constant output voltage ($V_{Htyp.}$ 7 V) from the stepped-up voltage (V_{A1}). When the integrated electronic power switch of the step-down converter (Pin V_{HL}) is switched on, the coil current increases up to a limit determined by the controller. The switch is switched off when this limit is reached, and the energy stored in the coil is discharged into the capacitance C_{VH} via an integrated diode. The circuit limits the maximum possible coil current to typ. 0.4 A. Pin V_H is the controller input of the step-down converter.

V_{CC}, Pin 10

Output V_{CC} supplies a 5-V voltage suitable for powering systems with microcontroller. The linear controller producing this voltage obtains its supply voltage from the voltage (V_H) provided by the step-down converter. V_{CC} is continuously monitored for any overvoltage or undervoltage. If such conditions occur, Pin NRES is switched to 'Low' for this time. V_{REF} is deactivated simultaneously.

V_{REF}, Pin 11

Output V_{REF} supplies a precise output voltage of 5V (+/– 2%) (suitable, for example, as a reference voltage for an analog-to-digital converter). The linear controller producing this voltage obtains its supply voltage from the voltage (V_H) provided by the step-down converter. V_{CC} is continuously monitored for any overvoltage or undervoltage. If such conditions occur, Pin NRES is switched to 'Low' for this time.

NRES, Pin 12

As mentioned, the voltages V_{CC} and V_{REF} are continuously monitored within narrow limits to detect any overvoltages or undervoltages. A reset signal is issued at output NRES if overvoltages or undervoltages occur.

NRES = High:	Normal operation
NRES = Low:	Reset state

This function can trigger an error routine or a system reset in the event of disturbances.Pin NRES is an open collector output, which is protected by a 7-V Zener diode.

ENVA3, Pin 13

Pin ENVA3 serves as the control input for the step-up converter

ENVA3 = High/ open: Normal operation

ENVA3 = Low: Step-up converter switched off

VKl15, Pin 14

V_{Kl15} fulfills several monitoring functions with regard to the supply voltage.

– Overvoltage detection

The external FET of the step–up converter and the switch between V_{A1} and V_{BL} are switched off in the event of overvoltages of V_{Batt} > 27 V typ. The other parts of the circuit continue to function and are powered by the capacitor connected to VA1 during this time. A Zener diode rated at typ. 23 V is integrated in Pin V_{Kl15} to protect against overvoltages.

– Energy reserve state

The step-up converter is also switched off at battery voltages of V_{Batt} < 5.25 V. This leads to a reduced current requirement from V_{A1}. As the step-up converter and the two linear controllers V_{CC} and V_{REF} are powered by V_{A1}, the circuit is able to power a system even in the event of extended interruptions in the supply voltage. The duration depends on the external load and the size of C_{VA1}.

A_{GND}, Pin 18

Reference ground for voltages V_{A1}, V_H, V_{CC}, V_{REF} and internal reference

R_{SET1}, Pin 19

Pin 19 is connected to Pin 18 with a resistance of 35.7 kΩ (tolerance 1%). In the circuit, this resistance gives rise to a reference current from which various parameters such as the oscillator frequency, switch-off thresholds for step-up/step-down converter, threshold for overvoltage detection etc. are derived.

GND, Pin 20

Common ground

Starting Behavior

The step-up converter is started only if the following start-up conditions are fulfilled when it is switched on:
V_{Batt} > 5.25 V typ.
V3 > 3.4 V typ.
V_{Batt} – V3 > 3.6 V
The step-down converter is activated only if V3 > 7 V typ. This ensures that the step-down converter begins operation only once the step-up converter has started.

Absolute Maximum Ratings

Parameters	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{Batt}			44	V
Ambient temperature range	T_{amb}	–40		95	°C
Junction temperature range	T_j	–40		150	°C
Storage temperature range	T_{stg}	–55		150	°C

Thermal Resistance

Parameters	Symbol	Value	Unit
Junction to case	R_{thJC}	30	k/W
Junction ambient	R_{thJA}	90	k/W

Overvoltage protection according DIN 40839/4 and ISO/TR 7637/1

ESD:
HBM 2 kV: MIL 883D M.3015.7
MM 200 V: ESD S. 5.2 – 1994

Electrical Characteristics

V_{Batt} = 6 V to 26 V, T_{amb} = –40 to 95°C unless otherwise specified. Values measured at application example circuit figure 5.

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
Oscillator						
Frequency constant		K_{OSC}		81		HzµF
Oscillator frequency	C_{OS1} = 1 nF	f_{OSC}	73		89	kHz
Step-up converter						
Output voltage	V_{CVB} = 14 V Pin 3 I3 = 120 mA	V_{VA1}	27.5	28.4	29.3	V
Output voltage	V_{CVB} > 5 V Pin 3 I3 = 30 mA	V_{VA1}	27.5	28.4	29.3	V
Coefficient of efficiency	V_{CVB} = 5 V V3 = 27.5 V	η	65			%
Coefficient of efficiency	V_{CVB} = 11 V V3 = 27.5 V	η	82			%
Switch-off current	LVB Pin 2	I2		1.2	1.6	A
Voltage drop	$V_{BL} – V_{A1}$; I2 = 0.9 × $I2_{max}$	V2 – V3	1.0		3.5	V
Voltage at pin GATE	Output high Pin 7	V7	4.5		18	V
Voltage at pin GATE	Output low Pin 7 I7 = 100 µA	V7			1	V
Voltage at pin GATE	Output low Pin 7 I7 = 5 mA	V7			1.6	V
Step-up converter – starting behavior						
Power-on-reset	V_{Batt} > 6 V	V3	2.6	3.4	4.2	V
Precharge CVA1		V_{Batt} – V3	2.1		5.5	V
Step-up converter – Enable/Disable						
Supply voltage		V_{Batt}	5.5	5.25	5.5	V
Threshold voltage	V9 = 7 V	V_{13}	0.8		2.0	V
Input voltage	Pin 13 open	V_{13}	4.4		7.0	V
Inpu current	V13 = 0 V	I_{13}	– 1.9		– 0.4	V
Step-down converter						
Output voltage	I10 = –20 mA Pin 9	V_H	6.5		7.5	V
Coefficient of efficiency		η	70			%
Switch-off current	L_{VH} Pin 8	I8		– 0.4	– 0.65	A
Voltage drop	$V_{A1} – V_{HL}$; I8 = 0.9 × $I8_{max}$	V3 – V8			1.3	V
Forward voltage of free-wheeling diode	IV8 = 0.9 × $I8_{max}$	V8		– 1.2		V
Step-down converter – starting behavior						
Switch threshold	V_{Batt} > 6 V	V3	6.3		7.6	V
V_{CC} – regulator						
Output voltage	IV10 = 0 mA to –90 mA	V10	4.85		5.15	V
Switch-off threshold	Undervoltage Overvoltage	$dV10_{off}$ $dV10_{off}$			230 230	mV mV
Switch-on threshold	Undervoltage Overvoltage	$dV10_{on}$ $dV10_{on}$	50 50			mV mV

Parameters	Test Conditions / Pins	Symbol	Min.	Typ.	Max.	Unit
V_{REF} – regulator						
Output voltage	IV11 = –1 mA to –14 mA	V10	4.88		5.12	V
Switch-off threshold	Undervoltage Overvoltage	$dV11_{off}$ $dV11_{off}$			150 150	mV mV
Switch-on threshold	Undervoltage Overvoltage	$dV11_{on}$ $dV11_{on}$	50 50			mV mV
Overvoltage protection						
Threshold for overvoltage detection		V_{Batt}	26		28	V
Battery monitor	V_{Batt} = 40 V	V14	21	23	26	V
NRES						
Saturation voltage	I12 = 1.6 mA, NRES = low	V12			0.4	V
Reverse current	V12 = 5 V	Ir12			2	µA

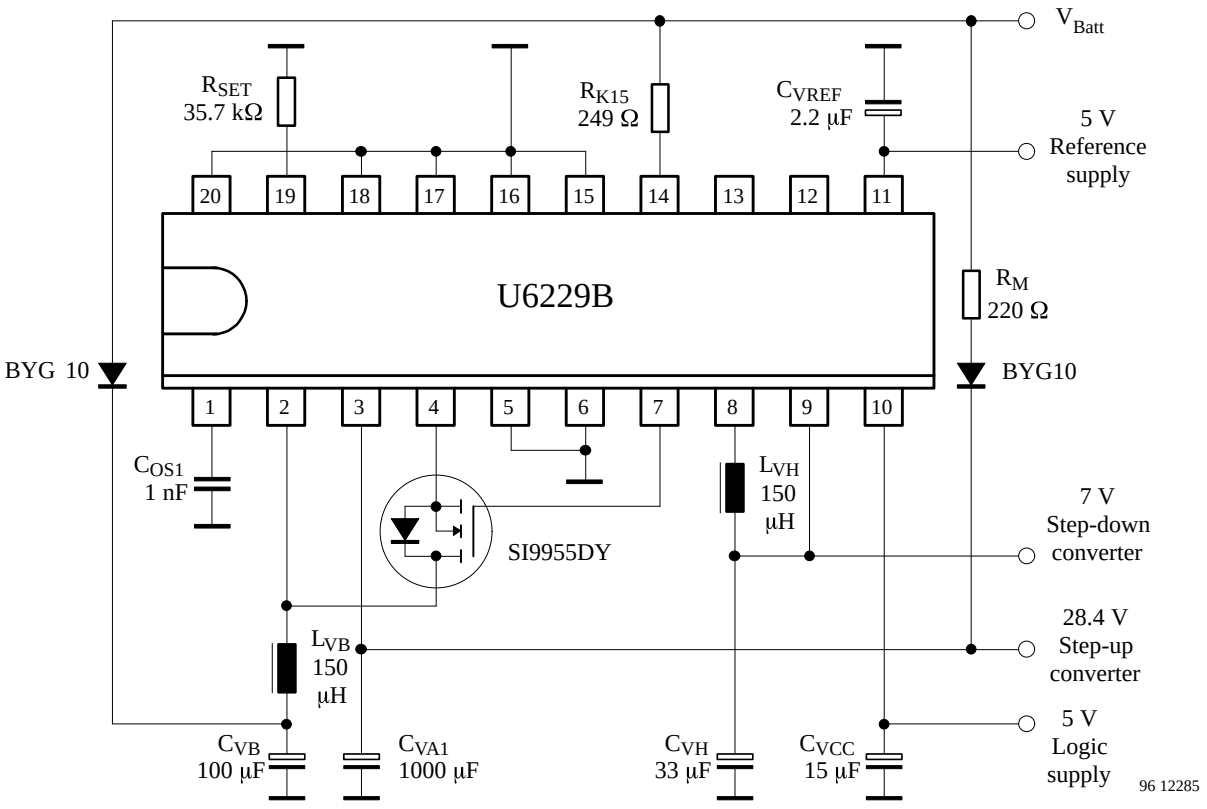


Figure 5. Application example

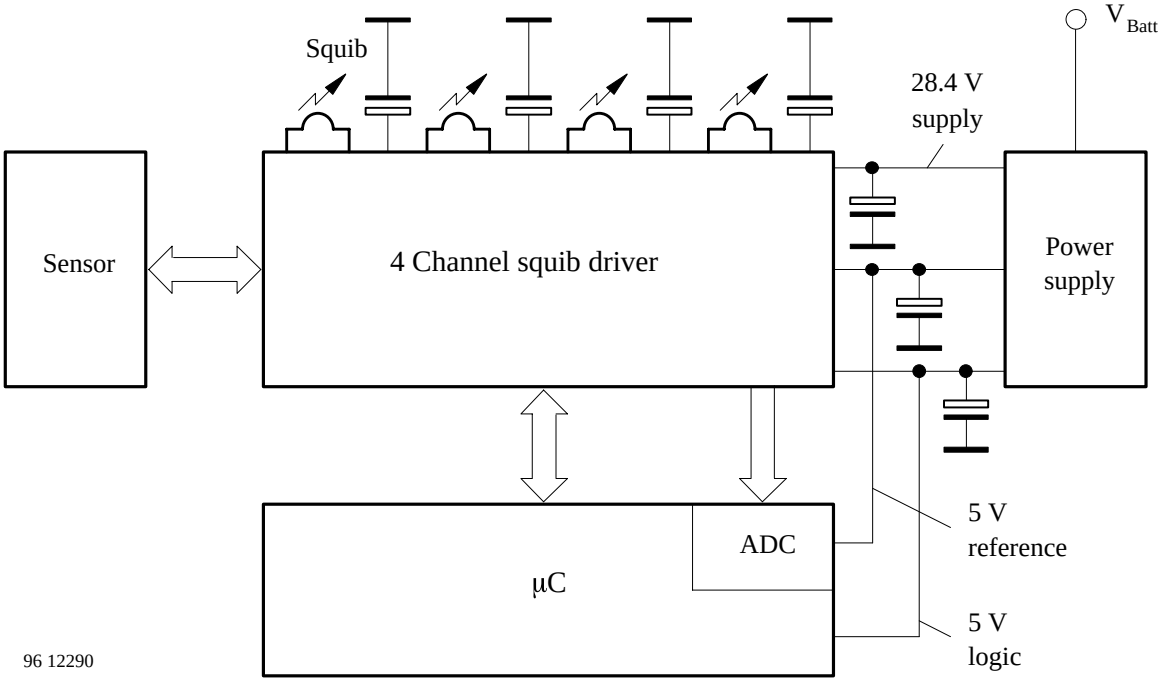
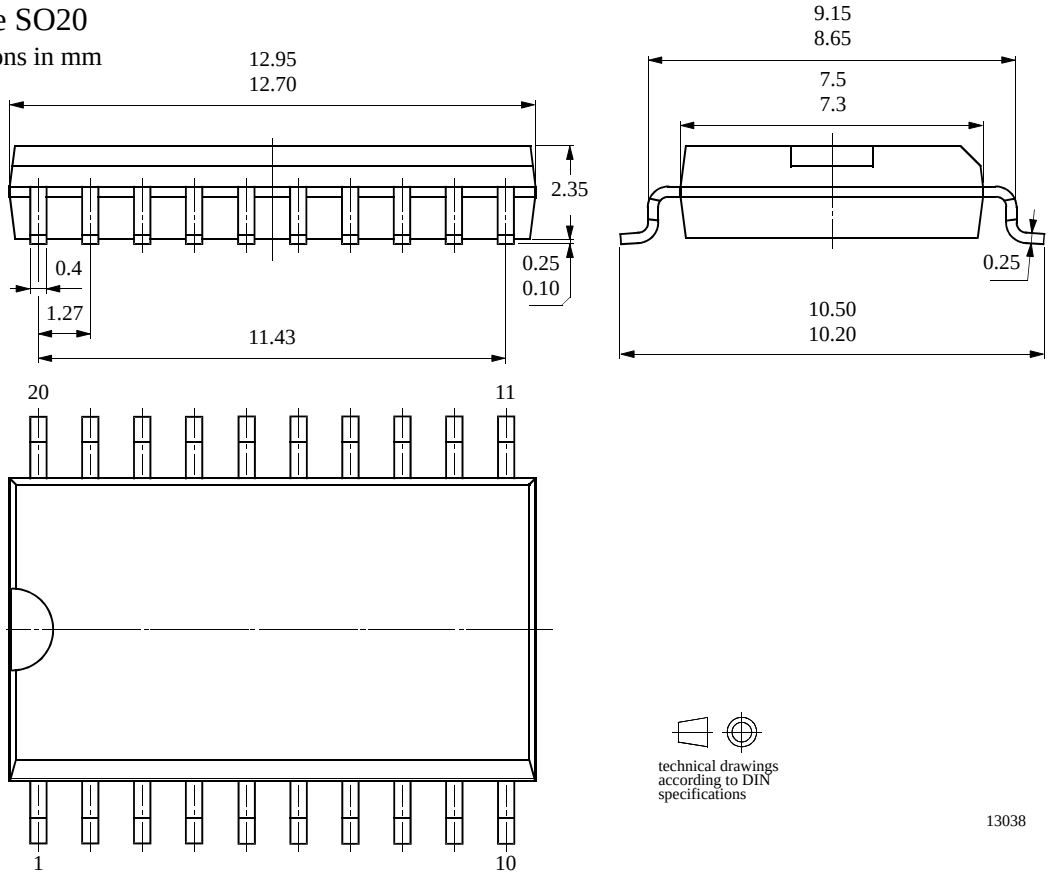


Figure 6. System block diagram

Package Information

Package SO20

Dimensions in mm



Ozone Depleting Substances Policy Statement

It is the policy of **TEMIC Semiconductor 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 Semiconductor GmbH 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 Semiconductor GmbH can certify that our semiconductors are not manufactured with ozone depleting substances and do not contain such substances.

We reserve the right to make changes to improve technical design and may do so without further notice.
Parameters can vary in different applications. All operating parameters must be validated for each customer application by the customer. Should the buyer use TEMIC Semiconductors products for any unintended or unauthorized application, the buyer shall indemnify TEMIC Semiconductors against all claims, costs, damages, and expenses, arising out of, directly or indirectly, any claim of personal damage, injury or death associated with such unintended or unauthorized use.

TEMIC Semiconductor GmbH, P.O.B. 3535, D-74025 Heilbronn, Germany
Telephone: 49 (0)7131 67 2594, Fax number: 49 (0)7131 67 2423