# Low-Drop Voltage Regulator

ILE4263

ILE4263 is designed to create voltage of value in 5V with drop voltage not more than 0.5V at load current of 150 mA and the IC is used in power sources of electronic equipment, in particular in automotive electronics.

ILE4263 is designed to power the microprocessor systems operating in severe conditions of automotive applications, so it includes additional functions of over-temperature protection, input voltage reverse polarity protection, short circuit proof of output to the ground, it incorporates limitation of the maximum load current with output voltage temperature reset.

ILE4263

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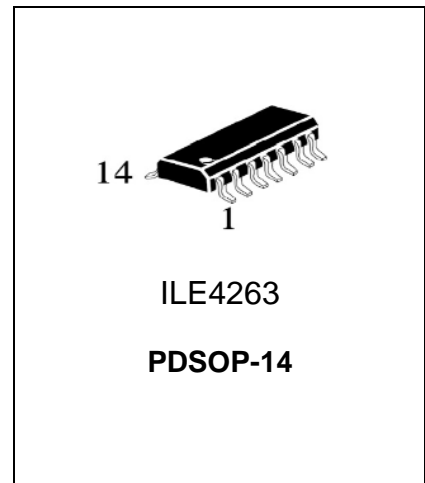
FEATURES

- Output voltage accuracy is not more than $\pm$ 2 % in range of output current from 5 mA to 150 mA and input voltage from 6 to 28 V;

- Maximum load current capability is up to 200 mA;

- Low power consumption in standby mode;

- Low drop voltage;

- Watchdog microcontroller function;

- Adjustable reset threshold;

- Built-in overtemperature protection;
- Short circuit proof;

- Input voltage reverse polarity protection up to –42V;

- Suitable for use in automotive electronics;

- Wide temperature range;

IK Semicon

Table 1. **Pins Description**

Chip Contact	Symbol	Function
1	RO	**Reset and watchdog output.** Open-collector output connected to the output via resistor of 30 kΩ
2	N.C.	**Not connected**
3 ,4, 5, 10, 11, 12	GND	**Ground**
6	D	**Reset delay**. The capacitor is connected between this output and the ground to adjust the delay time.
7	RADJ	**Reset threshold.** For setting the switching threshold, connect a voltage divider (from output Q to GND) to the pin. If this input is connected to ground, the reset is triggered at the internal threshold.
8	W	**Watchdog input.** Positive-edge-triggered input at least 5 V/µs for monitoring a microcontroller
9	Q	**Output.** Connected to the ground via an external tantalum capacitor with a minimum capacity of 22 µF and $1 \Omega \leq ESR \leq 3 \Omega$ within the operating temperature range at frequency of 10 kHz
13	I	**Input.** The input voltage is applied to the IC. Use the ceramic capacitor connected between this pin and the ground
14	INH	**Inhibit input.** TTL-compatible, low-active voltage

BLOCK DIAGRAM
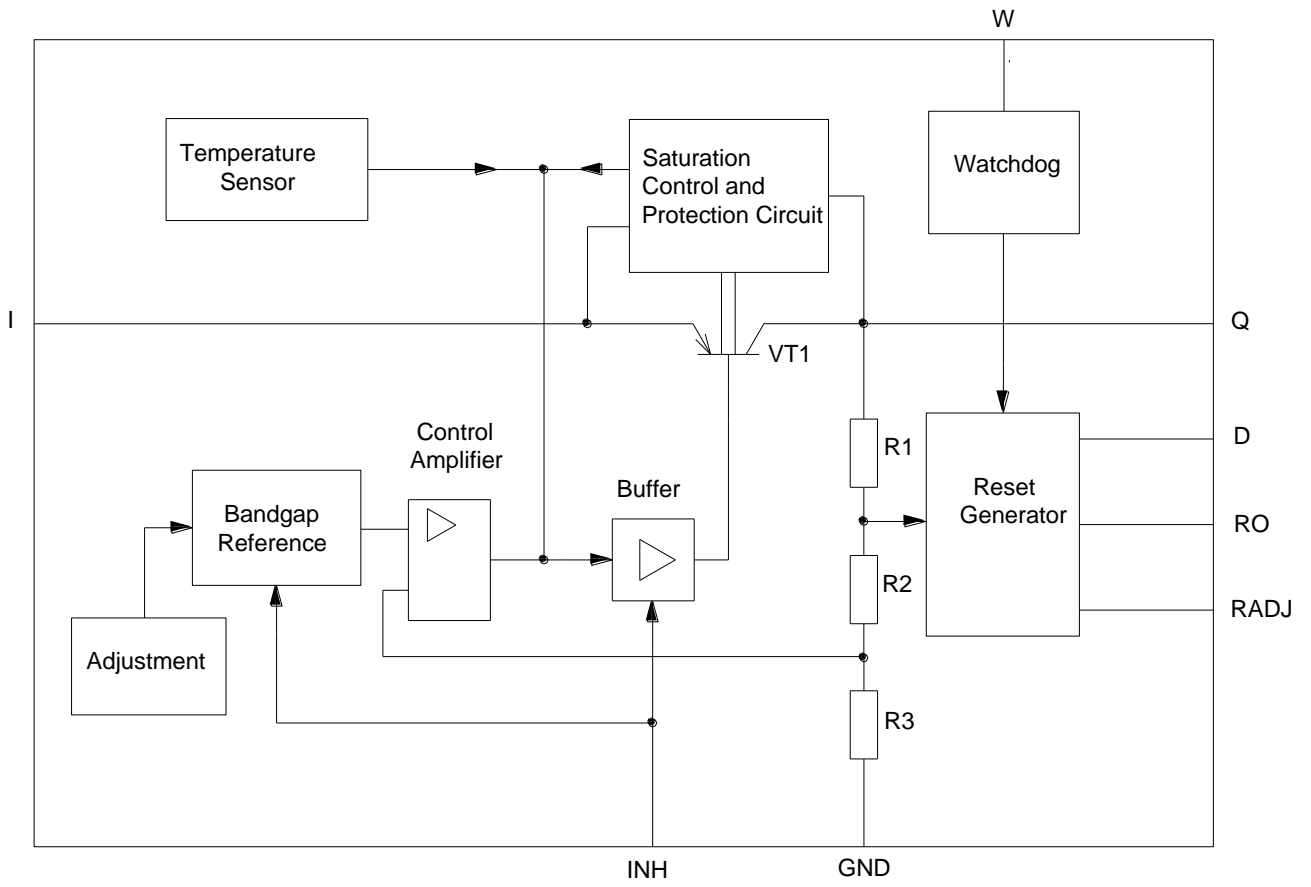
R1 – R3 - resistors
VT1 – transistor

Figure 1. Block Diagram

Table 2. **ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Limit Values		Unit
		Min	Max	
V_I	Input voltage	-42	45	V
V_R	Output voltage on output reset	-0.3*	42*	V
V_{RADJ}	Voltage on reset adjust intput	-0.3*	6*	V
V_D	Voltage on reset delay pin	-0.3*	42*	V
V_Q	Output voltage	-0.3*	7*	V
V_{INH}	Inhibit input voltage	-42*	45*	V
V_W	Input watchdog voltage	-0.3*	6*	V
T_J	Junction temperature	-40**	150	°C

Note:
* Without voltage supply to input I
** Ambient temperature

Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied.
Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Table 3. **RECOMMENDED OPERATION RATE**

Symbol	Parameter	Limit Values		Unit
		Min	Max	
V_I	Input voltage	5.7	45	V
V_Q	Output voltage	4.8	5.2	V
T_J	Temperature	-40*	125	°C

Note:
* Ambient temperature

Table 4. **ELECTRIC PARAMETERS**
-40°C* < Tj < 125°C; (unless specified otherwise)

Symbol	Parameter	Test Condition	Limit Values		Unit
			Min	Max	
Normal Operation					
I_q	Current consumption $(I_q = I_I - I_Q)$	V_I = 13.5 V, V_{INH} = 0 V	-	0.05	mA
		V_I = 13.5 V, V_{INH} = 3.6 V, I_Q = 0 mA	-	1.3	
		V_I = 13.5 V, V_{INH} = 3.6 V, I_Q = 150 mA	-	18	
		V_I = 4.5 V, V_{INH} = 3.6 V, I_Q = 150 mA	-	23	
I_Q	Output current	V_I = 13.5 V, V_{INH} = 3.6 V	200	400	mA
V_Q	Output voltage	6 V ≤ V_I ≤ 28 V, V_{INH} = 3.6 V, 5 mA ≤ I_Q ≤ 150 mA	4.9	5.1	V
		6 V ≤ V_I ≤ 32 V, V_{INH} = 3.6 V, I_Q = 100 mA, Tj=100°C	4.9	5.1	
$\Delta V_{Q(V)}$	Change in the output voltage when the input voltage changes	6 V ≤ V_I ≤ 28 V, V_{INH} = 3.6 V, I_Q = 150 mA	-	25	mV
$\Delta V_{Q(I)}$	Change in the output voltage when the current load changes	V_I = 13.5 V, V_{INH} = 3.6 V, 5 mA ≤ I_Q ≤ 150 mA	-	25	mV
V_{DR}	Drop voltage	V_{INH} = 3.6 V, I_Q = 150 mA[1]	-	0.5	V
Parameters of Reset Generator					
V_{RT}	Switching threshold	V_{INH} = 3.6 V, V_{RADJ} = 0 V, I_Q = 5 mA	4.5	4.8	V
V_{RADJTH}	Reset adjust threshold	V_{INH} = 3.6 V, I_Q = 5 mA	1.26	1.44	V
V_{ROL}	Reset low voltage	V_I = 13.5 V, V_{INH} = 3.6 V, R1 = 5.6 kΩ (I_{RO}=1 мА)	-	0.4	V

Table 4. **ELECTRIC PARAMETERS (continued)**

$-40°C^* < T_j < 125°C$; (unless specified otherwise)

Symbol	Parameter	Test condition	Limit Values		Unit
			Min	Max	
V_{Dsat}	Saturation voltage	$V_I = 13.5$ V, $V_{INH} = 3.6$ V, R1 = 5.6 kΩ	-	100	mV
V_{DU}	RO output threshold voltage switching to high state	$V_I = 13.5$ V, $V_{INH} = 3.6$ V, $I_Q = -5$ mA	1.45	2.05	V
V_{DRL} (V_{DWL})	Lower reset threshold	$V_I = 13.5$ V, $V_{INH} = 3.6$ V, $I_Q = -5$ mA	0.20	0.55	V
$I_{D,ch}$	Charge current	$V_I = 13.5$ V, $V_{INH} = 3.6$ V, $I_Q = -5$ mA	40	85	uA
t_{RD}	Reset delay time	$V_I = 13.5$ V $I_Q = -5$ mA C1 = 100 nF	1.3	4.1	ms
Parameters of Watchdog					
$I_{D,wd}$	Discharge current	$V_I = 13.5$ V, $V_{INH} = 3.6$ V, $I_Q = 5$ mA, $V_D = 1.0$ V	4.4	9.1	uA
$t_{WI,tr}$	Watchdog trigger time	$V_I = 13.5$ V, $V_{INH} = 3.6$ V, $I_Q = 5$ mA, C1 = 100 nF	16	27	ms
Parameters of Inhibit					
$V_{INH,ON}$	Switching voltage on inhibit input	$V_I = 13.5$ V	-	3.6	V
$V_{INH,OFF}$	Turn-off voltage on inhibit input	$V_I = 13.5$ V	0.8	-	V
I_{INH}	Input inhibit current	$V_I = 13.5$ V, $V_{INH} = 5$ V	5	25	uA

Notes

* Ambient temperature;

[1] Drop voltage= V_i-V_Q (measure when the output voltage has dropped 100mV from the nominal value obtained at 6V input).

Reference Parameters

Symbol	Parameter	Min	Max	Unit
I_{Q1}	Short-circuit current		400	mA
$T_{j, OFF}$	Temperature of circuit at the increasing temperature	151	200	ºC
t_{RR}	Reset reaction time	0.5	4.0	ms

IC Operation Description

The typical IC application diagram is shown on the Figure 2.

The timing diagram of the Watchdog Function Reset (Watchdog function is not active) is shown on the Figure 3.

The timing diagram of the active Watchdog Function is shown on the Figure 4.

Circuit Description

The error amplifier compares the reference voltage which is maintained with high precision resistor adjustment with a voltage that is proportional to the output voltage, and drive the serial transistor through the buffer. Saturation control, depending on the load current, prevents any powerful element oversaturation. If externally scaled output voltage at the input reset threshold RADJ falls below 1.35 V (typical valuation), then external delay reset discharge by the reset generator. When the capacitor voltage reaches lower threshold U_{DRL}, at the output the reset signal appears and held as long as the upper limit U_{DU} exceeded. If the reset threshold input RADJ is connected to GND, then the reset is triggered at the output voltage of 4.65 V (typical valuation). The connected microcontroller operation is monitored by Watchdog function. In the absence of pulses on pin W, RO reset output is set to a low level. Reset delay time can be set in a wide range by the reset delay capacitor. The IC can be switched on the inhibit input with active low level. The IC also contains a number of internal circuits for overload and overtemperature protection, reverse polarity protection.

Reset Timing

Power-up reset delay time is determined by the charge time of the external delay capacitor C_D, nF, that can be calculated as follows

$$C_D = (t_{rd} \times I_{D, ch}) / \Delta V, \tag{1}$$

where t_{rd} – reset delay time, ms,

$I_{D, ch}$ – charging current, uA (typical value 60 uA),

$\Delta V = V_{DU}$ – threshold RO output switching voltage to a high voltage state, V (typical value is 1.7 V).

Reset switching threshold

On default, installed typical value of reset switching threshold is 4.65 V. Using the ILE4263 the reset threshold can be set to 3.5 V $< V_{RT} <$ 4.6 V by connection to RADJ external resistive divider. Calculation is performed simplified as a reset input current adjustment may be neglected. If this function is not required, the RADJ pin should be connected to GND. The threshold voltage of output reset generator V_{RT}, V, is calculated by formula

$$V_{RT} = (1 + R1 / R2) \times V_{RADJTH}, \tag{2}$$

where V_{RADJTH} – switching threshold voltage at the input reset adjustment ,V (typical value 1.35V).

Timing of the Watchdog function

Watchdog pulse frequency should be higher than the frequency of the minimum pulse sequence that is determined by the external reset delay capacitor C_D, nF. Timing calculation $t_{WI, tr}$, ms is carried out according to the formula

$$t_{WI, tr} = ((V_{DU} - V_{DWL}) / I_{D, wd}) \times C_D, \tag{3}$$

where V_{DWL} – threshold voltage of the reset switch outputs to a low state, V,
$I_{D, wd}$ – discharge current, uA.
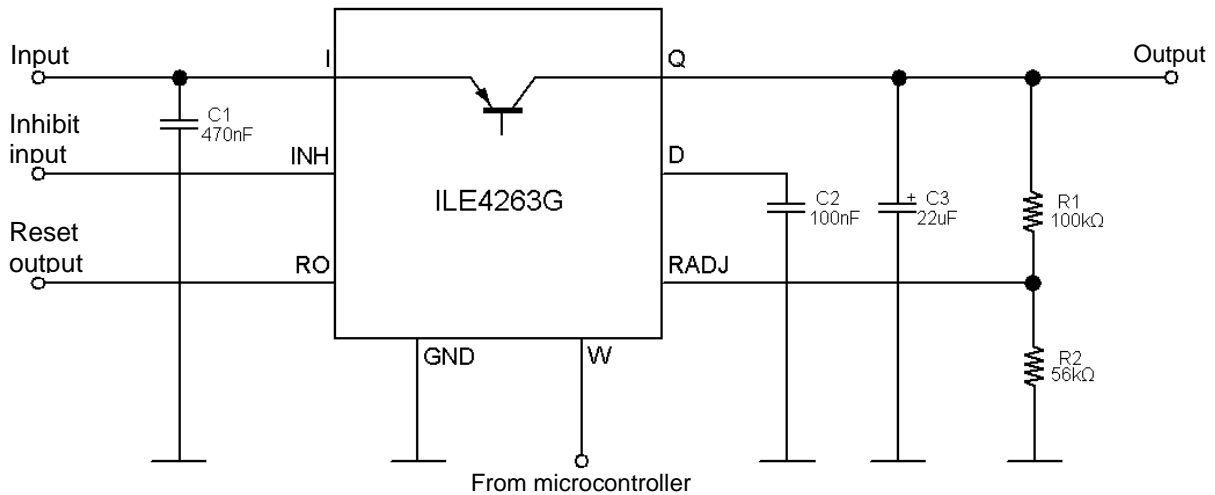
C1, C3 – capacitors
C2 – capacitor C_D
R1, R2 – resistors
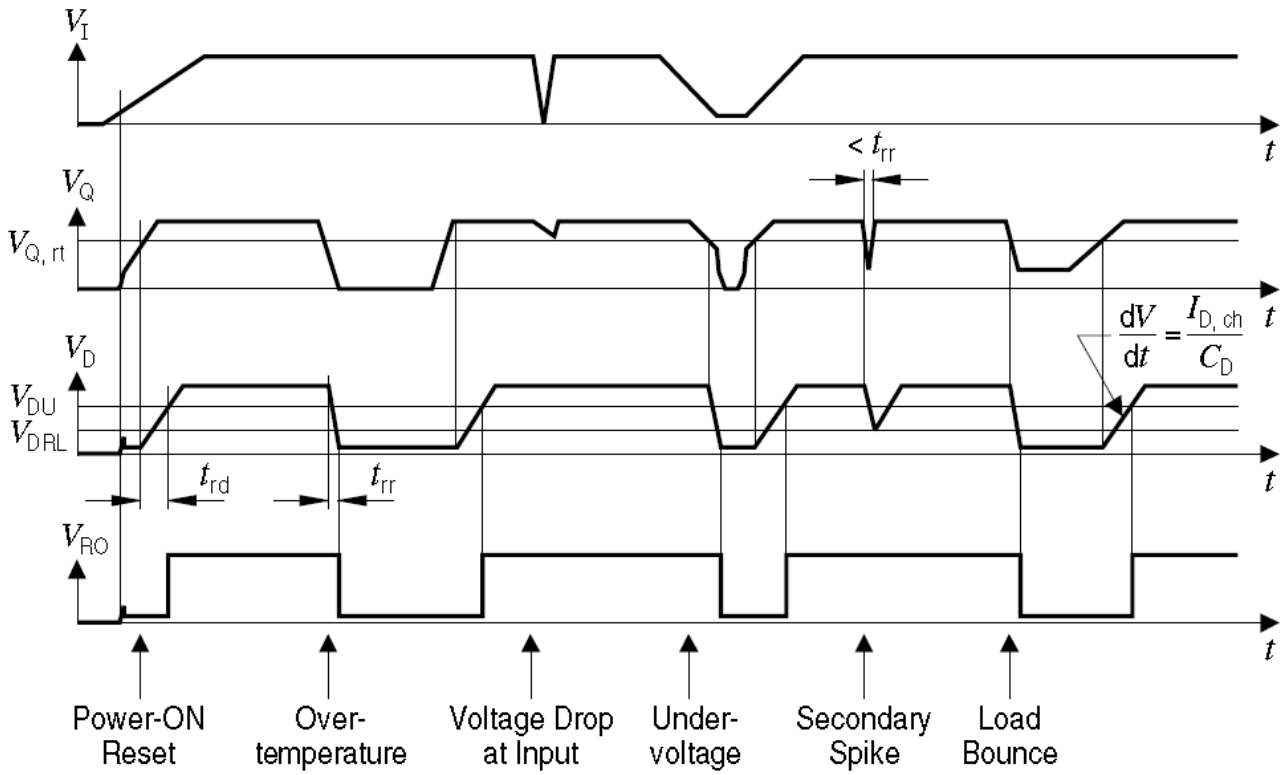
Figure 2 – Typical Application Circuit Diagram of ILE4263

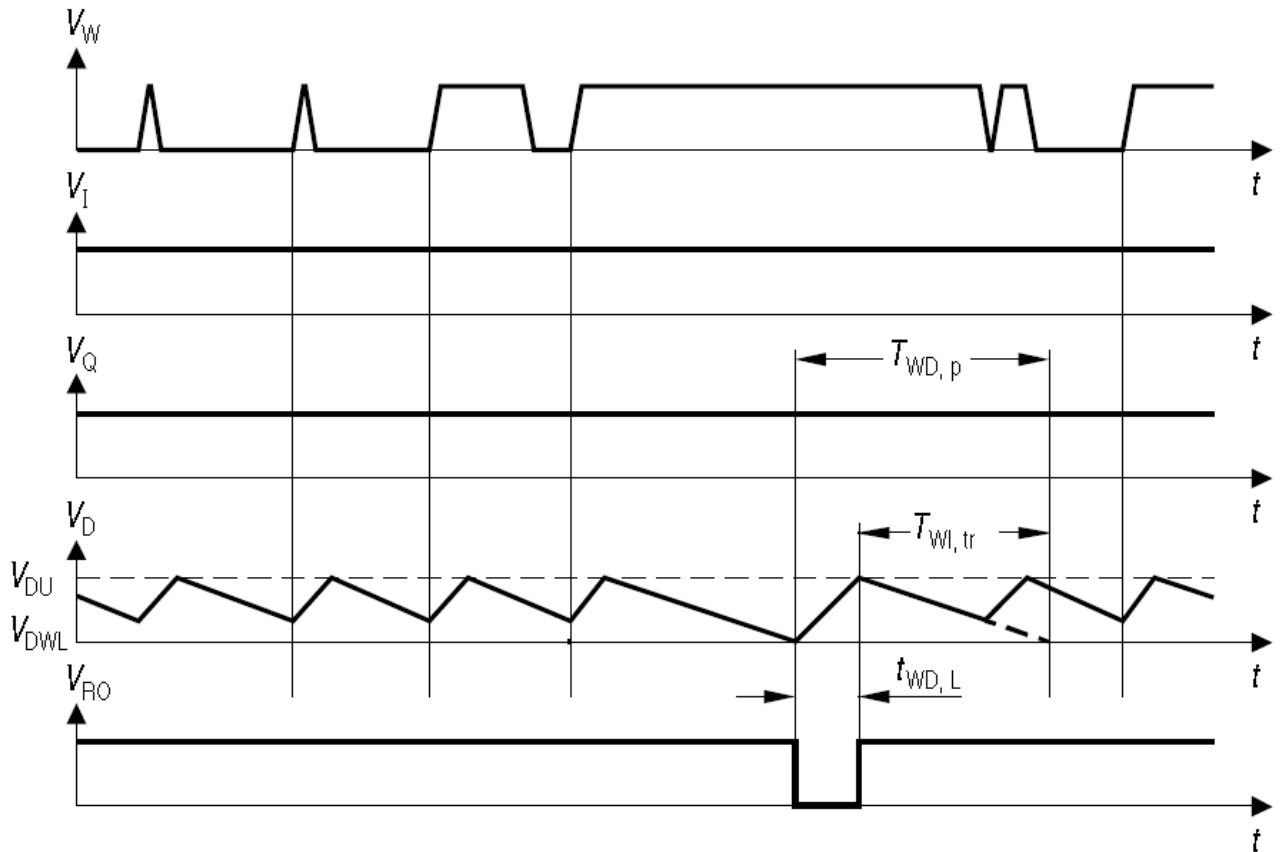Figure 3 – **Timing Diagram** (the Watchdog function is not active)

Figure 4 – **Timing Diagram** of the active Watchdog function

14-SOP-225 PACKAGE DIMENSION