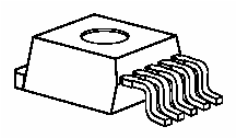
5-V Low-Drop Fixed Voltage Regulator

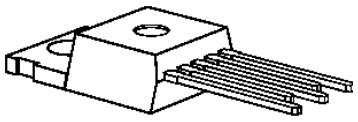
Features

- Output voltage tolerance ≤ ± 2 %
- Low-drop voltage
- Integrated overtemperature protection
- Reverse polarity protection
- Input voltage up to 42 V
- Overvoltage protection up to 65 V (≤ 400 ms)
- Short-circuit proof
- Suitable for use in automotive electronics
- Wide temperature range
- Adjustable reset time
- ESD protection > 4000 V

ILE4270G



ILE4270S



ILE 4270G – packege
P-TO263-5-1
ILE 4270S – packege
P-TO220-5-12
T_A = -40° ÷ 125° C for all packages.

Functional Description

This device is a 5-V low-drop fixed-voltage regulator. The maximum input voltage is 42 V (65 V, ≦400 ms). Up to an input voltage of 26 V and for an output current up to 550 mA it regulates the output voltage within a 2 % accuracy. The short circuit protection limits the output current of more than 650 mA. The device incorporates overvoltage protection and temperature protection that disables the circuit at unpermissibly high temperatures.

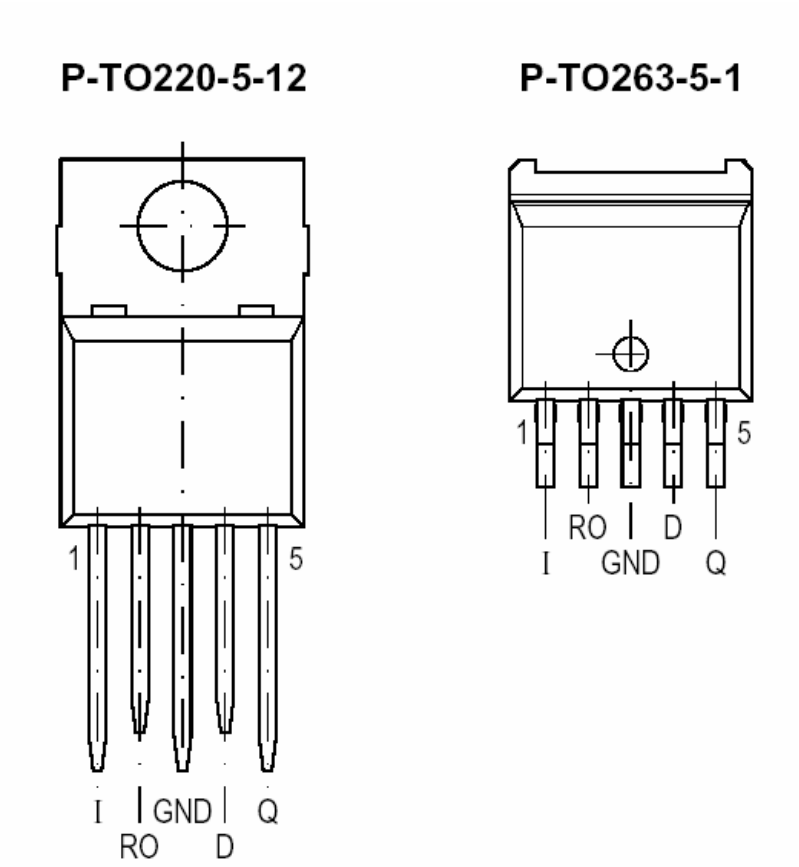
Application Description

The IC regulates an input voltage in the range of 5.5 V < V_I < 36 V to V_{Qnom} = 5.0 V. Up to 26 V it produces a regulated output current of more than 550 mA. Above 26 V the save-operating-area protection allows operation up to 36 V with a regulated output current of more than 300 mA. Overvoltage protection limits operation at 42 V. The overvoltage protection hysteresis restores operation if the input voltage has dropped below 36 V. A reset signal is generated for an output voltage of V_Q < 4.5 V. The delay for power-on reset can be set externally with a capacitor.

Design Notes for External Components

An input capacitor C_I is necessary for compensation of line influences. The resonant circuit consisting of lead inductance and input capacitance can be damped by a resistor of approx. 1 Ω in series with C_I. An output capacitor C_Q is necessary for the stability of the regulating circuit. Stability is guaranteed at values of C_Q ≥ 22 µF and an ESR of < 3 Ω.

Pin Configuration



Pin Definitions and Functions

Pin	Symbol	Function
1	I	**Input**; block to ground directly on the IC with ceramic capacitor
2	RO	**Reset Output**; the open collector output is connected to the 5 V output via an integrated resistor of 30 kΩ.
3	GND	**Ground**; internally connected to heatsink.
4	D	**Reset Delay**; connect a capacitor to ground for delay time adjustment.
5	Q	**5-V Output**; block to ground with 22 µF capacitor, ESR < 3 Ω.

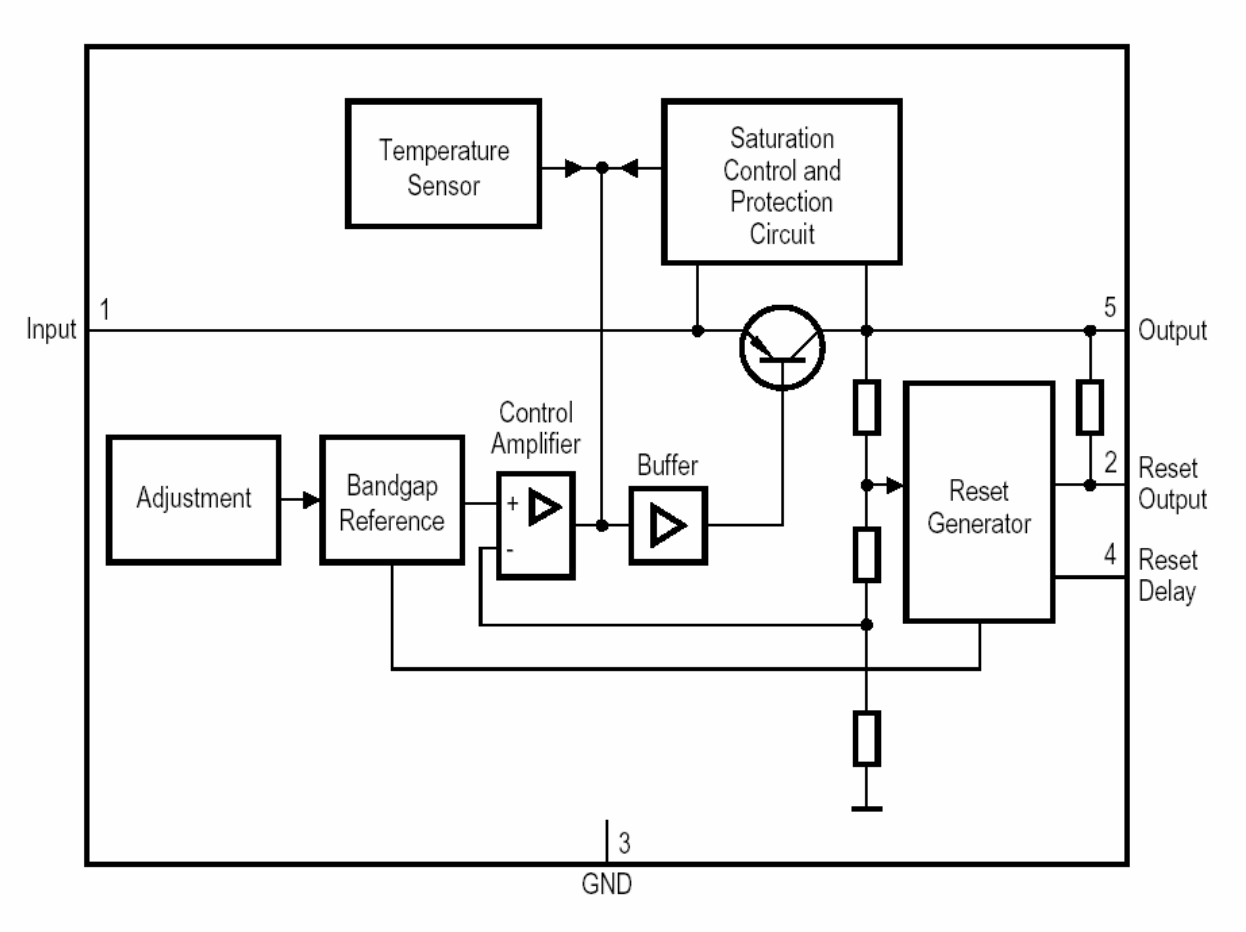
Circuit Description

The control amplifier compares a reference voltage, which is kept highly accurate by resistance adjustment, to a voltage that is proportional to the output voltage and drives the base of a series transistor via a buffer. Saturation control as a function of the load current prevents any over-saturation of the power element. If the output voltage decreases below 4.5 V, an external capacitor C_D on pin 4 (D) will be discharged by the reset generator. If the voltage on this capacitor drops below V_{DRL}, a reset signal is generated on pin 2 (RO), i.e. reset output is set low. If the output

voltage rises above 4.5 V, C_D will be charged with constant current. After the power-on-reset time the voltage on the capacitor reaches V_{DU} and the reset output will be set high again. The value of the power-on-reset time can be set within a wide range depending of the capacitance of C_D.

The IC also incorporates a number of internal circuits for protection against:

- Overload
- Overvoltage
- Overtemperature
- Reverse polarity



Block Diagram

Absolute Maximum Ratings
T_j = – 40 to 150 °C

Parameter	Symbol	Limit Values		Unit	Notes
		min.	max.		
Input					
Voltage Voltage Current	V_I V_I I_I	– 42	42 65	V V	 $t \leq 400$ ms internally limited
Reset Output					
Voltage Current	V_R I_R	– 0.3	7	V	 Internally limited
Reset Delay					
Voltage Current	V_D I_D	– 0.3	7	V	 Internally limited
Output					
Voltage Current	V_Q I_Q	– 1.0	16	V	 Internally limited
Ground					
Current	I_{GND}	– 0.5	–	A	–
Temperatures					
Junction temperature Storage temperature	T_j T_{stg}	 – 50	150 150	°C °C	–

Optimum reliability and life time are guaranteed if the junction temperature does not exceed 125 °C in operating mode. Operation at up to the maximum junction temperature of 150 °C is possible in principle. Note, however, that operation at the maximum permitted ratings could affect the reliability of the device.

Operating Range

Parameter	Symbol	Limit Values		Unit	Notes
		min.	max.		
Input voltage	V_I	6	42	V	–
Junction temperature	T_j	– 40	150	°C	–
Thermal Resistance					
Junction ambient	R_{thja}	–	65	K/W	TO263
Junction case	R_{thjc} Z_{thjc}	–	3 2	K/W K/W	$t < 1$ ms TO263

Characteristics

V_I = 13.5 V; – 40 °C ≤ T_j = ≤ 125 °C (unless otherwise specified)

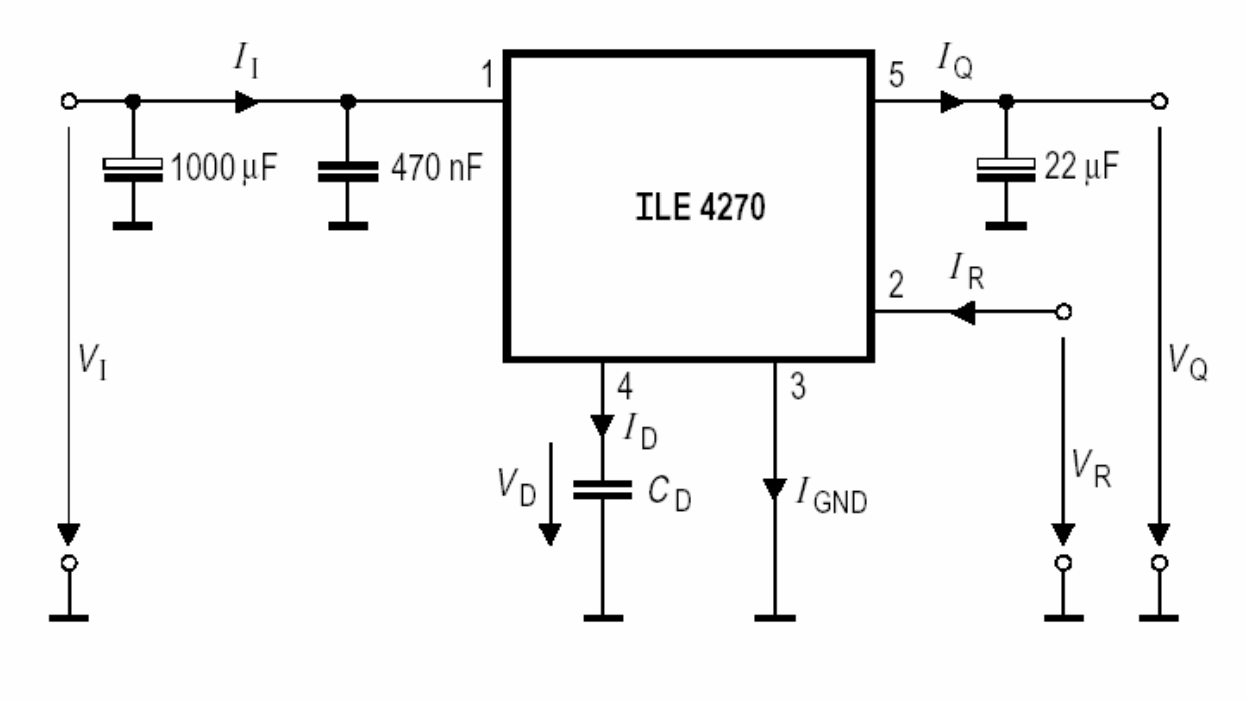
Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Output voltage	V_Q	4.90	5.00	5.10	V	5 mA ≤ I_Q ≤ 550 mA; 6 V ≤ V_I ≤ 26 V
Output voltage	V_Q	4.90	5.00	5.10	V	26 V ≤ V_I ≤ 36 V; I_Q ≤ 300 mA
Output current limiting	I_{Qmax}	650	850	–	mA	V_Q = 0 V
Current consumption $I_q = I_I - I_Q$	I_q	–	1	1.5	mA	I_Q = 5 mA
Current consumption $I_q = I_I - I_Q$	I_q	–	55	75	mA	I_Q = 550 mA
Current consumption $I_q = I_I - I_Q$	I_q	–	70	90	mA	I_Q = 550 mA; V_I = 5 V
Drop voltage	V_{dr}	–	350	700	mV	I_Q = 550 mA1)

1) Drop voltage = $V_I - V_Q$ (measured when the output voltage has dropped 100 mV from the nominal value obtained at 13.5 V input)

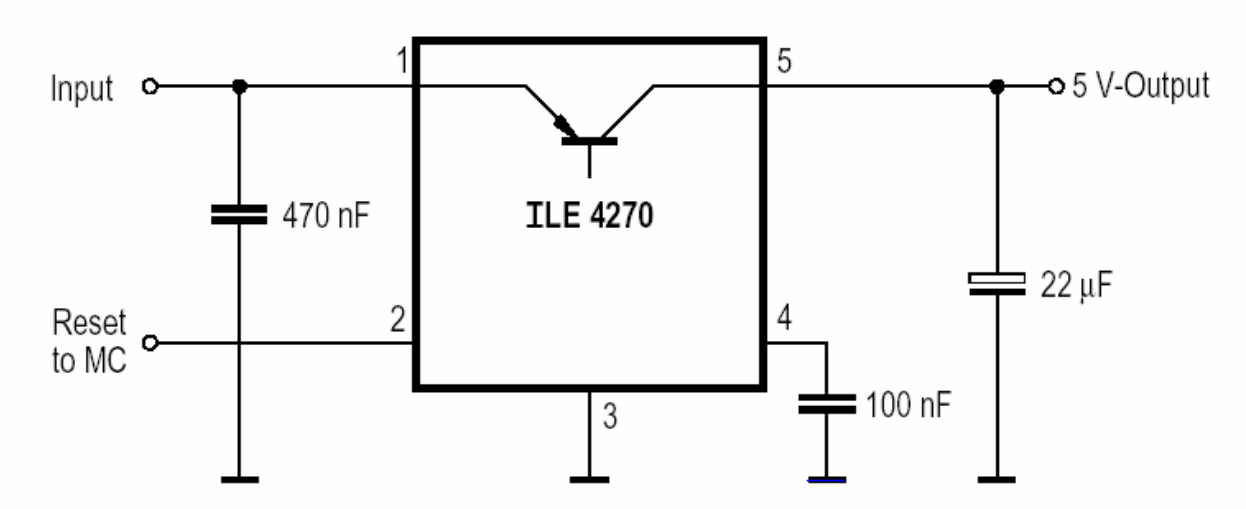
Characteristics (cont'd)
V_I = 13.5 V; – 40 °C ≤ T_j = ≤ 125 °C (unless otherwise specified)

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Load regulation	ΔV_Q	–	25	50	mV	I_Q = 5 to 550 mA; V_I = 6 V
Supply voltage regulation	ΔV_Q	–	12	25	mV	V_I = 6 to 26 V I_Q = 5 mA
Power supply Ripple rejection	$PSRR$	–	54	–	dB	f_r = 100 Hz; V_r = 0.5 V_{SS}
Reset Generator						
Switching threshold	V_{RT}	4.5	4.65	4.8	V	–
Reset High voltage	V_{ROH}	4.5	–	–	V	–
Reset low voltage	V_{ROL}	–	60	–	mV	R_{intern} = 30 kΩ2); 1.0 V ≤ V_Q ≤ 4.5 V
Reset low voltage	V_{ROL}	–	200	400	mV	I_R = 3 mA, V_Q = 4.4 V
Reset pull-up	R	18	30	46	kΩ	internally connected to Q
Lower reset timing threshold	V_{DRL}	0.2	0.45	0.8	V	$V_Q < V_{RT}$
Charge current	I_d	8	14	25	µA	V_D = 1.0 V
Upper timing threshold	V_{DU}	1.4	1.8	2.3	V	–
Delay time	t_d	–	13	–	ms	C_D = 100 nF
Reset reaction time	t_{RR}	–	–	3	µs	C_D = 100 nF
Overvoltage Protection						
Turn-Off voltage	$V_{I, ov}$	42	44	46	V	–

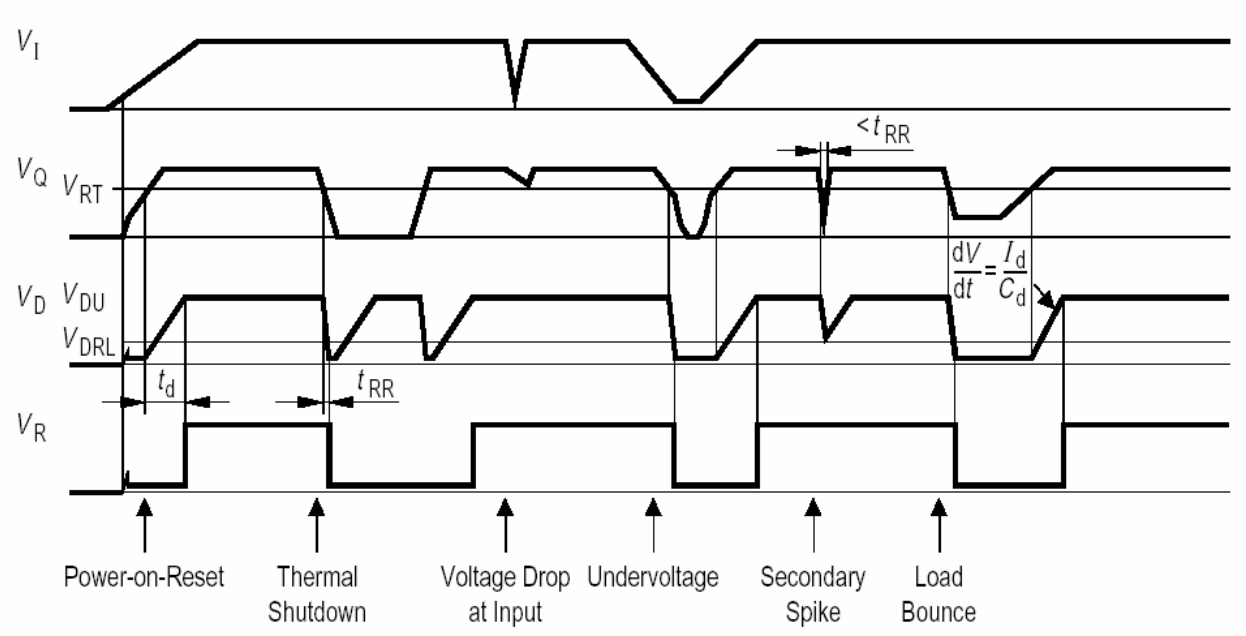
1) Drop voltage = V_I – V_Q (measured when the output voltage has dropped 100 mV from the nominal value obtained at 13.5 V input)
2) Reset peak is always lower than 1.0 V.



Test Circuit



Application Circuit



Time Response