

PWM BUCK DC/DC CONVERTER FAMILY

Description

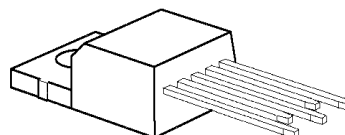
IL1501, IL1501-33, IL1501-50, IL1501-12 - are monolithic ICs of a step-down DC-DC converters. The principle of operation of ICs is based on control of build-in power NPN transistor, quantity of energy transferred to load is regulated by means of pulse-width modulation. So output voltage practically do not depends from load. ICs are purposed for application inside power supply units of consumer & industrial devices.

Family consist of:

- IL1501 - PWM voltage regulator with adjustable output voltage;
- IL1501-33 - PWM voltage regulator with fixed output voltage 3,3 V;
- IL1501-50 - PWM voltage regulator with fixed output voltage 5,0 V;
- IL1501-12 - PWM voltage regulator with fixed output voltage 12,0 V;

Features:

- Output voltage: 3.3V, 5V, 12V and adjustable output version;
 - Adjustable version output voltage range, 1.23V to 37V+4%;
 - Oscillator with build-in capacity for 150Khz switching frequency;
 - PWM contro circuit of output voltage;
 - Overheating and current-limit protection ;
 - Switch on/off control circuit;
 - Up to 40V operating voltage
 - Output load current: 3A
 - Standby mode with low power consumption
 - Built-in switching transistor on chip
- IC realized in 5-pin plastic package TO220AB/5



TO220AB/5 package

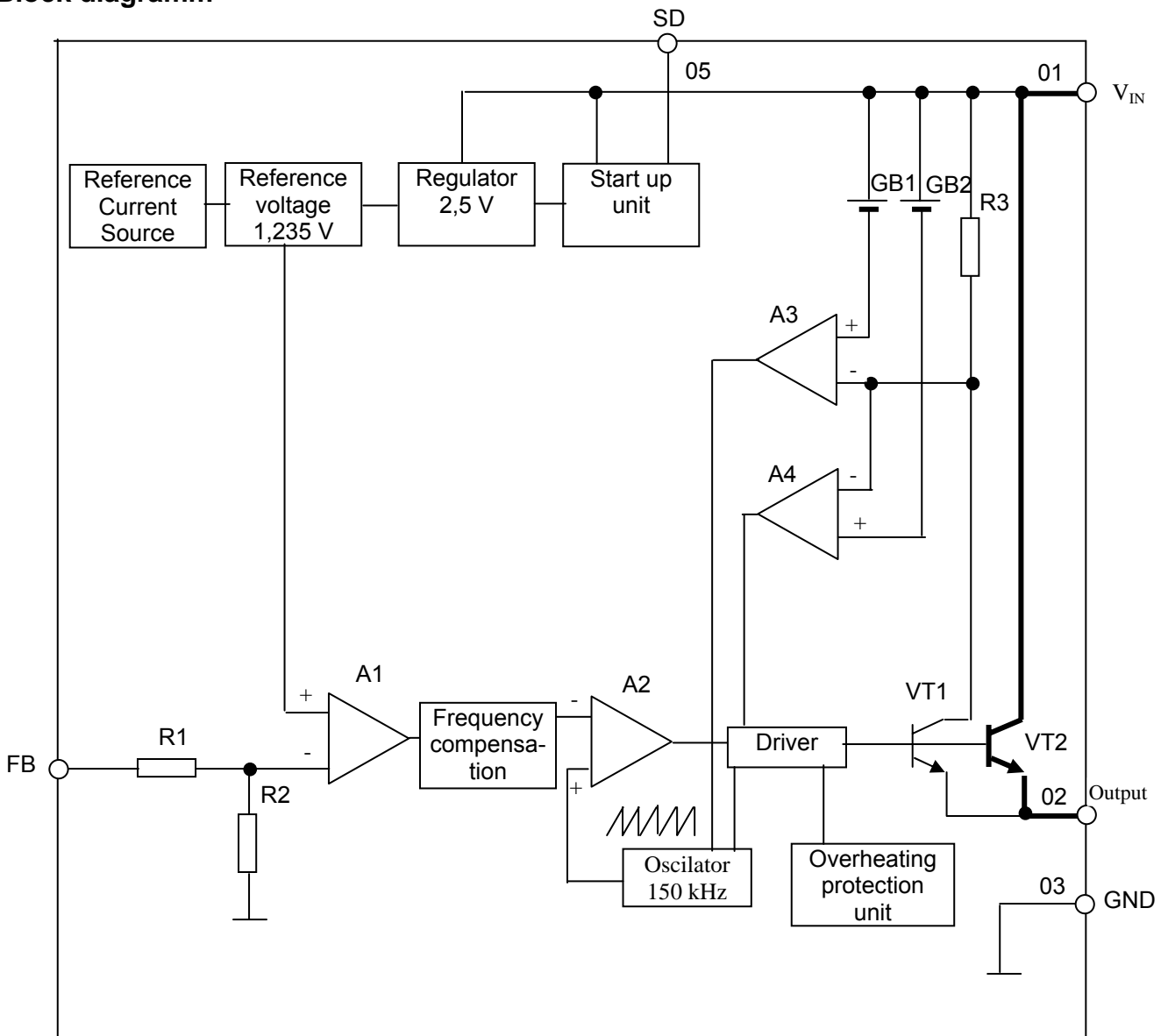
Pinning diagram



Pin/Pad Description Table

Pin number	Pad number	Symbol	Purpose description
01	01, 02	V_{IN}	Input (operating voltage)
02	03	Output	Output
03	04, 22	GND	Common pin
04	06	FB	Feedback control pin
05	17	SD	Switching on/off pin
-	05, 07-16, 18-21, 23, 24	-	Not connected

Block diagramm



A1 - amplifier;
 A2 – A4 – comparators;
 GB1 – battery 200 mV;
 GB2 – battery 220 mV;
 R1 - R3 –resistors;
 VT1, VT2 - transistors

Recommended mode and Absolute Maximum Ratings

Parameter, unit	Symbol	Recommended mode		Absolute Maximum Ratings	
		min	max	min	max
Input (operating) voltage, V	V_{IN}	4,5	40	-	45
Output voltage relative to GND, V	V_{OUT}	-	-	-1,0	-
CD pin input voltage, V	V_{SD}	-	-	-0,3	25
Feedback control voltage, V	V_{FB}	-	-	-0,3	25
Storage temperature, °C	T_{stg}	-	-	-60	150
Junction temperature, °C	T_j	-40*	125	-40*	150
Thermal resistance junction-case, °C/W	$R_{th\ j-c}$	-	2,5***	-	2,5***
Thermal resistance junction-ambient, °C/W	$R_{th\ j-a}$	-	65**	-	65**
Thermal resistance junction-ambient (with heat sink), °C/W	$R_{th\ j-a}$	-	28**	-	28**

* Ambient temperature is indicated

** $R_{th\ j-a}$ – Thermal resistance junction-ambient (for IC without additional heat sink is equal 65 °C/W, for IC with copper radiator 19 sm² the value of parameter is estimated as 28 °C/W). Thermal resistance junction-ambient $R_{th\ j-a}$, °C/W for ICs with additional heat sink is calculated by formula:

$$R_{th\ j-a} = R_{th\ j-c} + R_{th\ c-a} \quad , \quad (1)$$

*** $R_{th\ j-c}$ - thermal resistance junction case, °C /W. (the value of parameter is estimated as 2,5 °C/W);

$R_{th\ c-a}$ - thermal resistance case ambient

Heat sink, application mode (power consumption) and ambient temperature have to provide junction temperature $T_j \leq 125$ °C.

Maximum dissipation power, P_{tot} , W, is calculated by formula

$$P_{tot} = (125 - T_A) \cdot R_{th\ j-a} \quad , \quad (2)$$

125 – maximum permissible junction temperature , °C

T_A – ambient temperature, °C;

$R_{th(j-a)}$ – thermal resistance junction-ambient, °C/W.

IL1501, IL1501-33, IL1501-50, IL1501-12

Electric parameters

IC	Parameter, unit	Symbol			Test condition	T _A , °C
			min	max		
IL1501	Feedback bias current , nA	I _B	-	$\frac{60}{100}$	V _{FB} = 1,3 V; V _{IN} = 12 V	$\frac{25 \pm 10}{125^*}$ -40
	Oscillator frequency, kHz	f _{OSC}	$\frac{127}{110}$	$\frac{173}{173}$	V _{IN} = 12 V V _{IN} = 40 V	
	Saturation voltage V	V _{SAT}	-	$\frac{1,4}{1,5}$	V _{FB} = 0 V; V _{IN} = 12 V; I _{OUT} = -3 A no external circuit	
	Current limit, A	I _{CL}	$\frac{3,6}{3,6}$	$\frac{5,5}{6,5}$	V _{FB} = 0 V; V _{IN} = 12 V; -3 A ≤ I _{OUT} ≤ -7 A no external circuit	
	Output leakage current, mA	I _{L(0)}	-	-0,2	V _{FB} = 12 V; V _{IN} = 40 V; V _{OUT} = 0 V no external circuit	25±10
		I _{L(-1)}	-	-60	V _{FB} = 12 V; V _{IN} = 40 V; V _{OUT} = -1 V	
	Quiescent current, mA	I _Q	-	10	V _{FB} = 12 V; V _{IN} = 12 V	
	Standby mode Quiescent current, uA	I _{STBY}	-	$\frac{250}{300}$	V _{FB} = 0 V; V _{IN} = 40 V; V _{SD} = 5 V	$\frac{25 \pm 10}{125^*}$ -40
	SD pin low level input voltage (switching on), V	V _{IL}	-	0,6	V _{IN} = 12 V; V _{SD} from 2,5 to 0,5V	25±10
	SD pin high level input voltage (switching off), V	V _{IH}	2,0	-	V _{FB} = 0 V; V _{IN} = 12 V; V _{SD} from 0,5 to 2,5 V	
	SD pin high level input current (switching off), uA	I _H	-	25	V _{IN} = 12 V; V _{SD} = 2,5 V	
	SD pin low level input current (switching on), uA	I _L	-	5,0	V _{IN} = 12 V; V _{SD} = 0,5 V	
	Feedback voltage, V	V _{FB}	$\frac{1,193}{1,18}$	$\frac{1,267}{1,28}$	4,5 B ≤ V _{IN} ≤ 40 V; -0,2 ≤ I _{OUT} ≤ -3 A; V _{OUT} programmed on 3 V	$\frac{25 \pm 10}{125^*}$ -40

IL1501, IL1501-33, IL1501-50, IL1501-12

Electric parameters (continued)

IC	Parameter, unit	Symbol			Test condition	T _A , °C
			min	max		
IL1501-33	Oscillator frequency, kHz	f _{OSC}	<u>127</u>	<u>173</u>	V _{IN} = 12 V	<u>25±10</u> 125* -40
			110	173	V _{IN} = 40 V	
	Saturation voltage V	V _{SAT}	-	<u>1,4</u> 1,5	V _{FB} = 0 V; V _{IN} = 12 V; I _{OUT} = -3 A no external circuit	
	Current limit, A	I _{CL}	<u>3,6</u> 3,6	<u>5,5</u> 6,5	V _{FB} = 0 V; V _{IN} = 12 V; -3 A ≤ I _{OUT} ≤ -7 A no external circuit	
	Output leakage current, mA	I _{L(0)}	-	-0,2	V _{FB} = 12 V; V _{IN} = 40 V; V _{OUT} = 0 V no external circuit	25±10
		I _{L(-1)}	-	-60	V _{FB} = 12 V; V _{IN} = 40 V; V _{OUT} = -1 V	
	Quiescent current, mA	I _Q	-	10	V _{FB} = 12 V; V _{IN} = 12 V	
	Standby mode Quiescent current, uA	I _{STBY}	-	<u>250</u> 300	V _{IN} = 40 V; V _{SD} = 5 V	<u>25±10</u> 125* -40
	SD pin low level input voltage (switching on), V	V _{IL}	-	0,6	V _{IN} = 12 V; V _{SD} = 2,5 V	25±10
	SD pin high level input voltage (switching off), V	V _{IH}	2,0	-	V _{IN} = 12 V; V _{SD} = 0,5 V	
	SD pin high level input current (switching off), uA	I _{IH}	-	25	V _{IN} = 12 V; V _{SD} = 2,5 V	
	SD pin low level input current (switching on), uA	I _{IL}	-	5,0	V _{IN} = 12 V; V _{SD} = 0,5 V	
	Output voltage, V	V _{OUT}	<u>3,168</u> 3,135	<u>3,432</u> 3,465	4,75 V ≤ V _{IN} ≤ 40 V; -0,2 ≤ I _{OUT} ≤ -3 A;	

IL1501, IL1501-33, IL1501-50, IL1501-12

Electric parameters (continued)

IC	Parameter, unit	Symbol			Test condition	T _A , °C
			min	max		
IL1501-50	Oscillator frequency, kHz	f _{OSC}	<u>127</u>	<u>173</u>	V _{IN} = 12 V	<u>25±10</u> 125* -40
			110	173	V _{IN} = 40 V	
	Saturation voltage V	V _{SAT}	-	<u>1,4</u> 1,5	V _{FB} = 0 V; V _{IN} = 12 V; I _{OUT} = -3 A no external circuit	
	Current limit, A	I _{CL}	<u>3,6</u> 3,6	<u>5,5</u> 6,5	V _{FB} = 0 V; V _{IN} = 12 V; -3 A ≤ I _{OUT} ≤ -7 A no external circuit	
	Output leakage current, mA	I _{L(0)}	-	-0,2	V _{FB} = 12 V; V _{IN} = 40 V; V _{OUT} = 0 V no external circuit	25±10
		I _{L(-1)}	-	-60	V _{FB} = 12 V; V _{IN} = 40 V; V _{OUT} = -1 V	
	Quiescent current, mA	I _Q	-	10	V _{FB} = 12 V; V _{IN} = 12 V	
	Standby mode Quiescent current, uA	I _{STBY}	-	<u>250</u> 300	V _{FB} = 0 V; V _{IN} = 40 V; V _{SD} = 5 V	<u>25±10</u> 125* -40
	SD pin low level input voltage (switching on), V	V _{IL}	-	0,6	V _{FB} = 0 V; V _{IN} = 12 V; V _{SD} from 2,5 to 0,5 V	25±10
	SD pin high level input voltage (switching off), V	V _{IH}	2,0	-	V _{IN} = 12 V; V _{SD} from 0,5 to 2,5 V	
	SD pin high level input current (switching off), uA	I _H	-	25	V _{IN} = 12 V; V _{SD} = 2,5 V	
	SD pin low level input current (switching on), uA	I _L	-	5,0	V _{IN} = 12 V; V _{SD} = 0,5 V	
Output voltage, V	V _{OUT}	<u>4,8</u> 4,75	<u>5,2</u> 5,25	7,0 V ≤ V _{IN} ≤ 40 V; -0,2 ≤ I _{OUT} ≤ -3 A	<u>25±10</u> 125* -40	

Electric parameters (continued)

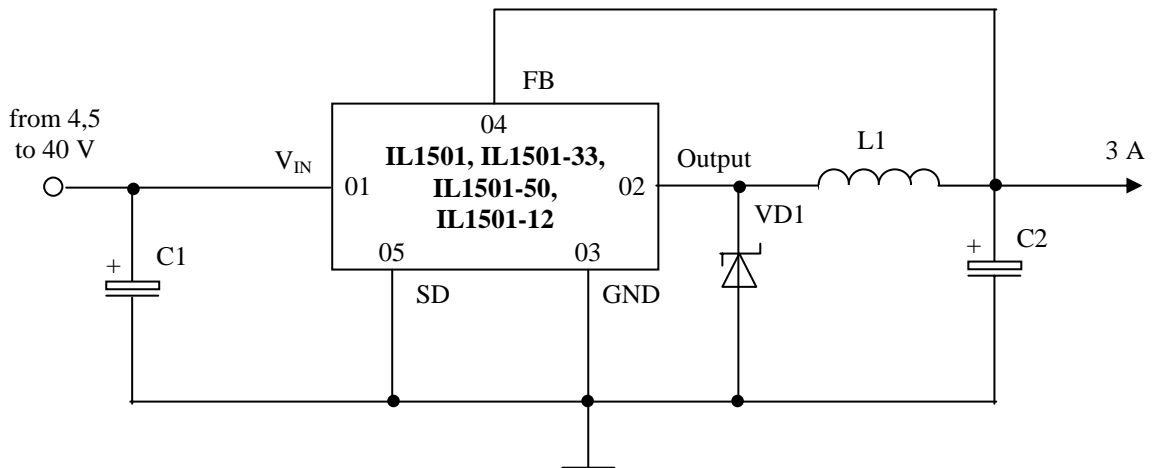
IC	Parameter, unit	Symbol			Test condition	T _A , °C
			min	max		
IL1501-12	Oscillator frequency, kHz	f _{OSC}	<u>127</u>	<u>173</u>	V _{IN} = 24 V	<u>25±10</u> 125* -40
			110	173	V _{IN} = 40 V	
	Saturation voltage V	V _{SAT}	-	<u>1,4</u> <u>1,5</u>	V _{FB} = 0 V; V _{IN} = 24 V; I _{OUT} = -3 A no external circuit	<u>25±10</u> 125* -40
	Current limit, A	I _{CL}	<u>3,6</u> 3,6	<u>5,5</u> 6,5	V _{FB} = 0 V; V _{IN} = 24 V; -3 A ≤ I _{OUT} ≤ -7 A no external circuit	
	Output leakage current, mA	I _{L(0)}	-	0,2	V _{FB} = 15 V; V _{IN} = 40 V; V _{OUT} = 0 V no external circuit	25±10
		I _{L(-1)}	-	60	V _{FB} = 15 V; V _{IN} = 40 V; V _{OUT} = -1 V	
	Quiescent current, mA	I _Q	-	10	V _{FB} = 15 V; V _{IN} = 24 V	<u>25±10</u> 125* -40
	Standby mode Quiescent current, uA	I _{STBY}	-	<u>250</u> 300	V _{IN} = 40 V; V _{SD} = 5 V	
	SD pin low level input voltage (switching on), V	V _{IL}	0,6	-	V _{IN} = 24 V; V _{SD} from 2,5 to 0,5 V	25±10
	SD pin high level input voltage (switching off), V	V _{IH}	-	2,0	V _{IN} = 24 V; V _{SD} from 0,5 to 2,5 V	
	SD pin high level input current (switching off), uA	I _H	-	25	V _{IN} = 24 V; V _{SD} = 2,5 V	
	SD pin low level input current (switching on), uA	I _L	-	5,0	V _{IN} = 24 V; V _{SD} = 0,5 V	
Output voltage, V	V _{OUT}	<u>11,52</u> 11,4	<u>12,48</u> 12,6	15 V ≤ V _{IN} ≤ 40 V; -0,2 ≤ I _{OUT} ≤ -3 A		

* Junction temperature. Because of measurements of electric parameters are executed in pulse mode, junction temperature is equal to ambient.

Typical Electric Parameters

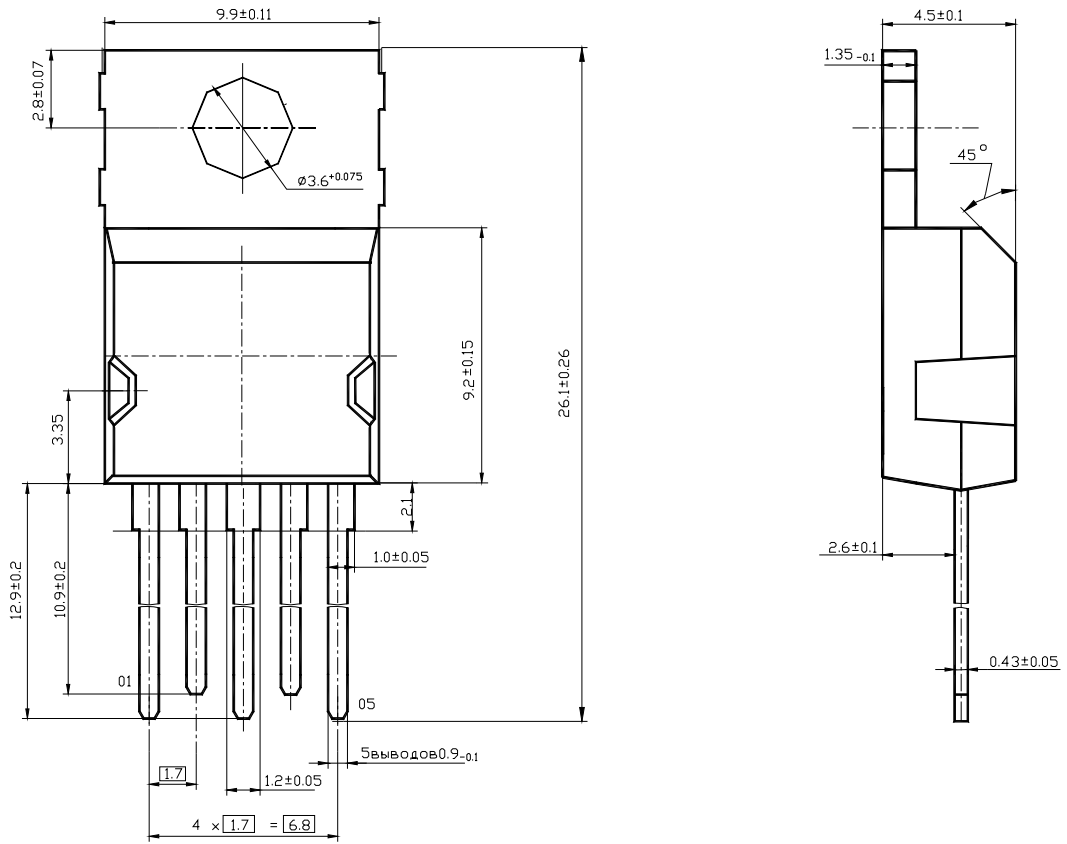
Parameter, unit	Symbol	Typ.	Test condition	Note
Efficiency, %	η		$V_{IN} = 12\text{ V}; I_{OUT} = 3\text{ A}$	1
- IL1501		73		
- IL1501-33		73		
- IL1501-50		80		
- IL1501-12		90	$V_{IN} = 15\text{ V}; I_{OUT} = -3\text{ A}$	
Max. Duty Cycle(ON), %	DC_{max}	100	$V_{FB} = 0\text{ V}$	2
Max. Duty Cycle(OFF), %	DC_{min}	0	$V_{FB} = 12\text{ V}$	3
Overheating protection operation threshold, °C	T_h	160*		

Application diagramm

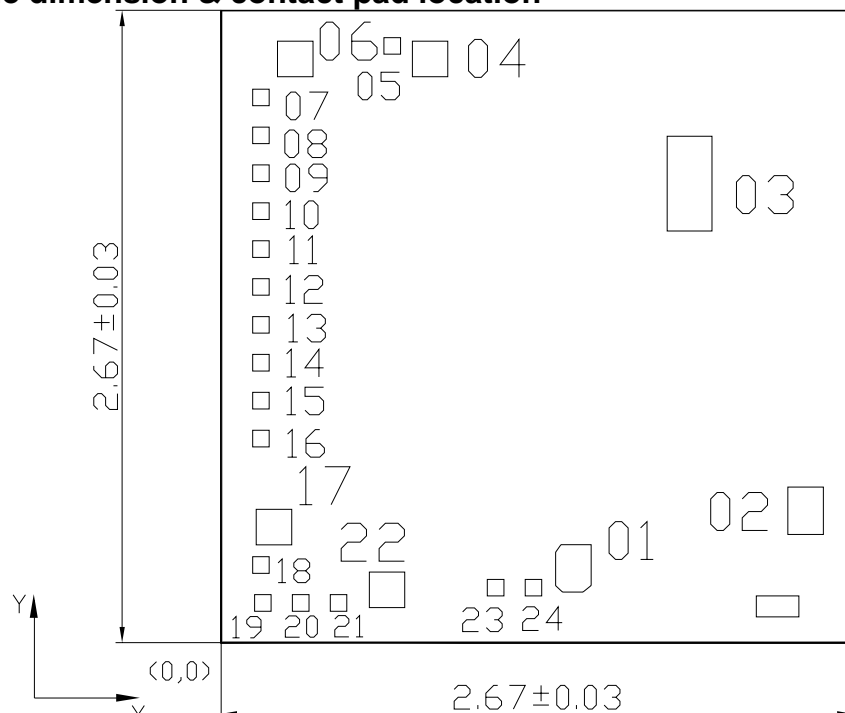


C1, C2 – electrolytic capacitors
 L1 – inductor;
 VD1 – diode

TO220AB/5 package dimensions



Die dimension & contact pad location



Technology mark coordinates, mm: left bottom corner x = 2,230 , y = 0,100.

Die thickness 0,35±0,02.

Pad location table

Pad number	Coordinates (left bottom corner), mm		Contact pad size, mm
	X	y	
01	1,4135	0,214	0,150x0,200
02	2,395	0,457	0,150x0,200
03	1,8845	1,385	0,190x0,400
04	0,808	2,3895	0,150x0,150
05	0,688	2,4845	0,070x0,070
06	0,238	2,3895	0,150x0,150
07	0,133	2,267	0,070x0,070
08	0,133	2,107	0,070x0,070
09	0,133	1,947	0,070x0,070
10	0,133	1,787	0,070x0,070
11	0,133	1,627	0,070x0,070
12	0,133	1,467	0,070x0,070
13	0,133	1,307	0,070x0,070
14	0,133	1,147	0,070x0,070
15	0,133	0,987	0,070x0,070
16	0,133	0,827	0,070x0,070
17	0,148	0,413	0,150x0,150
18	0,133	0,293	0,070x0,070
19	0,141	0,133	0,070x0,070
20	0,301	0,133	0,070x0,070
21	0,461	0,133	0,070x0,070
22	0,626	0,148	0,150x0,150
23	1,125	0,1975	0,070x0,070
24	1,285	0,1975	0,070x0,070

Note contact pad coordinates are indicated according passivation layer