DHA® QJ/DHA 01.71-2019 **LDA505**

IC for Inductive Proximity Switches with Short Circuit Protection

Introduction

The LDA505 (instead of the TCA505) is an application-specific integrated circuit with short-circuit protection developed for inductive proximity switching applications. It can be used in a wide range of proximity sensors or proximity control systems, as well as in a variety of inductive instrumentation. Induction tachometer, etc. The LDA505 consists of an oscillator, a switching circuit, and an amplifying output circuit. The basic working principle is to use an external inductor and capacitor to form an LC high-frequency resonant circuit and generate an alternating magnetic field in the resonant loop. When the detected metal target approaches the magnetic field and reaches the sensing distance, an eddy current is generated in the detected metal target and the energy of the oscillator is taken up, so that the amplitude of the oscillator is attenuated or stopped. The oscillation and oscillation of the oscillator are processed by the post-amplifier circuit and converted into a switching signal to trigger the drive control device, thereby achieving the purpose of non-contact detection. LDA505 has the characteristics of high integration, wide working voltage, large output current, adjustable control distance, few peripheral circuits, convenient application and stable and reliable operation. Compared with the inductive proximity switch scheme composed of general discrete components, the LDA505 integrated chip solution has better consistency and stability, so it is especially suitable for high reliability and high reliability.

Feature

- Wide supply voltage: 4.0~40V
- Low current consumption: < 0.7mA
- Integrated output stage current: >70mA
- High noise immunity
- High switching frequencies up to 5 kHz
- Suitable for two-wire AC proximity switches
- Temperature response of the IC compensates that of the coil
- Short-circuit and overload protection of output stages and external components
- Temperature range -40~+125℃

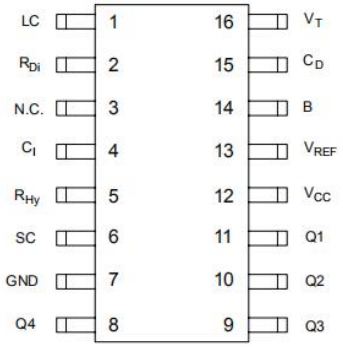
Order information

Package	Remarks
SOP16	Tubed, Reeled, Pb-free

Typical application

- Inductive proximity switch
- Contactless switch
- Position control
- Isolation detection
- Speed measurement

Pin Configurations



Pin	Symbol	Function	Description
1	LC	Oscillator	An external inductor and capacitor are connected between LC and GND to form a resonant circuit.
2	R_{Di}	Distance	R_{Di} external resistor that sets the current and detection distance in the oscillator.
3	N.C.	Not connected	
4	C_I	Integrating capacitance	An external 1nF capacitor is usually connected between C_I and GND to reduce interference.
5	R_{Hy}	Hysteresis	An external resistor between R_{Hy} and GND is used to set the detected window hysteresis.
6	SC	Short-circuit detector	Short-circuit sampling of the output stage of the circuit (can be for VCC or GND).
7	GND	Ground	
8	Q4	Output	Emitter of second output transistor (open circuit)
9	Q3	Output	Collector of second output transistor (open circuit)
10	Q2	Output	Emitter of first output transistor (open circuit)
11	Q1	Output	Collector of first output transistor (open circuit)
12	V_{CC}	Supply voltage	
13	V_{REF}	Internal reference voltage	Internal stable reference voltage, approximately 3.0V. When V_{REF} and V_{CC} are connected together, the operating voltage range of the circuit can be reduced to 3.1~4.5V.
14	B	Base Output Transistors	Used to limit the base voltage of the internal output stage transistors.
15	C_D	Turn-ON delay Short-circuit delay	An external capacitor between C_D and GND is used to set the action delay time.
16	V_T	Two-wire regulator	In two-wire applications, V_T and V_{CC} are connected together.

Functional block diagram

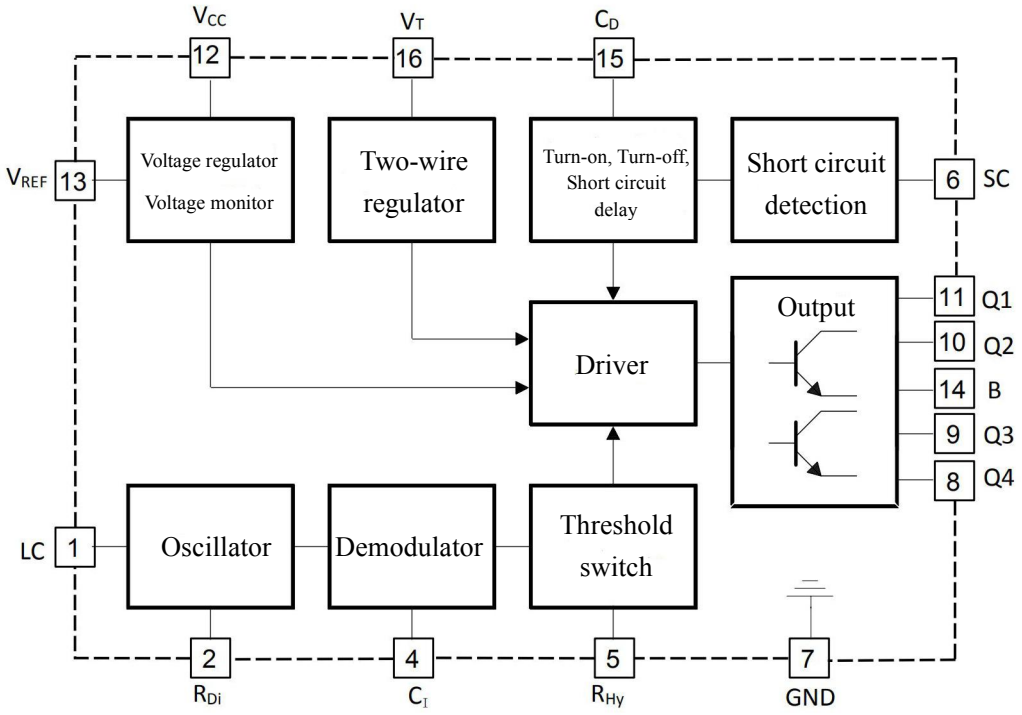


Figure 1. Schematic diagram of the internal structure of the LDA505

Recommended working conditions

Parameter	Symbol	Min	Max	Unit	Test Conditions
Voltage	Vcc	4	40	V	Normal work
Voltage	Vcc	3.1	4.5	V	$V_{CC}=V_{REF}$, Low voltage work
Range of working temperature	T_A	-40	125	℃	

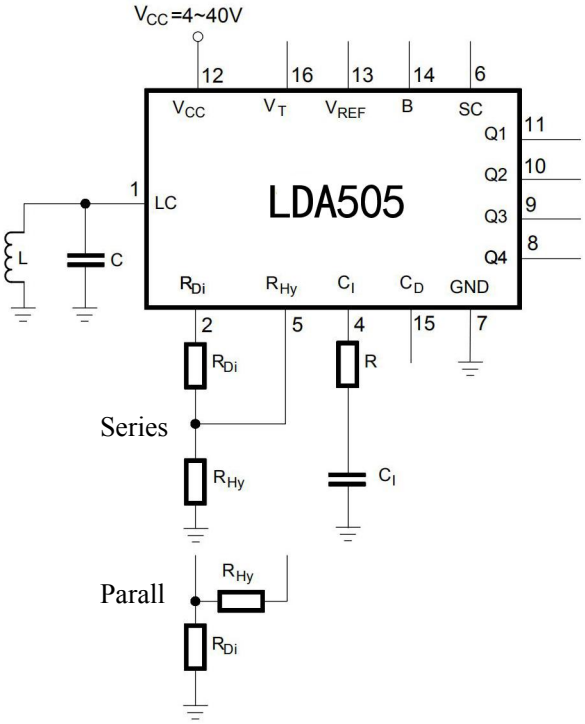
Limit parameter

Parameter	Symbol	Min	Max	Unit	Test Conditions
Voltage	Vcc	-0.3	50	V	
Output pin voltage	V_{Q1};V_{Q3}	-1	45	V	V_{Q2};$V_{Q4}\leq V_{CC}$
Output tube voltage (B-pin open)	V_{Q2};V_{Q4}	-1	V_{CC}	V	V_{Q1};V_{Q2};$V_{Q4}<V_{Q3}$
Output tube voltage (B-pin connection)	V_{Q2};V_{Q4}	-1	V_B	V	V_{Q1};V_{Q2};$V_{Q4}<V_{Q3}$
Output tube output current	I_{Q1}; I_{Q3}	0	70	mA	No short circuit protection
Output tube output current	-I_{Q2}; -I_{Q4}	0	70	mA	No short circuit protection
V_T pin voltage	V_T	-0.3	14	V	
V_{REF} pin current	-I_{VREF}	0	100	μA	
SC pin voltage	V_{SC}	0	V_{CC}	V	
R_{Di} pin pull current	-I_{RDi}	0	2	mA	
R_{Hys} pin sink current	I_{RHy}	0	2	mA	
B pin voltage	V_B	-0.3	V_{CC}	V	
Junction temperature	T_J	-40	150	℃	
Storage temperature	T_S	-55	160	℃	

Electrical parameters Typical test conditions: V_{CC}=4~40V， T_A=25℃， unless otherwise stated.

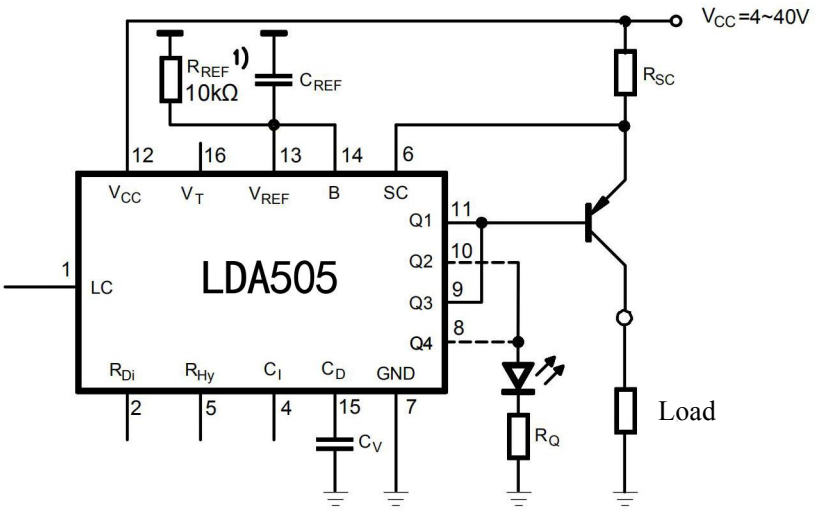
Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
Power section						
Static supply current	Three-wire system	I_{CC}		0.55	0.70	mA
Static supply current	Two-wire system	I_{CC}		0.62	0.80	mA
Three-wire system						
Minimum starting voltage	Output start action	V_{TON1}		3.64	4	V
Shutdown voltage	Output to no action	V_{TOFF1}	3.0	3.6		V
Hysteresis	V_{TON1}-V_{TOFF1}	ΔV_{Hy1}		0.04		V
Oscillator section (LC, R_{Di})						
Oscillating frequency		f_{OSC}			3	MHz
Oscillation amplitude		A_{OSC}		0.8		V_{PP}
Modulator and threshold switch section (C_I, R_{Hy})						
C_I Pin threshold		V_{CI}		2		V
C_I Pin hysteresis		V_{HyCI}		0.8		V
C_I pin sink current		I_{CI}		7		μA
C_I pin pull current		$-I_{CI}$		6		μA
On-off level frequency	C_I < 50 pF， L=70μH	f_S		5		kHz
Reference voltage (V_{REF})						
Reference voltage	I_{VREF}=0~100μA	V_{REF}	2.65	3.0	3.10	
Two-wire regulator (V_T)						
Minimum starting voltage		V_{TON2}	6.7	8.0	9.3	V
Shutdown voltage		V_{TOFF2}	5.0	6.0	7.0	V
Hysteresis	V_{TON2}-V_{TOFF2}	ΔV_{Hy2}	1.6	2.0	2.4	V
Switch delay and short circuit protection delay (C_D)						
Turn-on delay		t_{DON}	0.49	0.65	0.82	ms/nF
Shutdown delay		t_{VA}	17.0	25	34.0	μs/nF
Short circuit protection delay		t_{SC}	1.70	2.5	3.40	μs/nF
Output stage (Q1, Q2, Q3, Q4)						
Output voltage difference	I_Q=5mA,V_{Q1}-V_{Q2},V_{Q3}-V_{Q4}	V_{QR}		0.10	0.14	V
Output voltage difference	I_Q=70mA,V_{Q1}-V_{Q2},V_{Q3}-V_{Q4}	V_{QR}		0.5	0.99	V
Output current during short circuit protection		I_{QSC}		300	500	mA
Short circuit detection (SC)						
Trigger voltage when short-circuiting the power supply VCC		V_{SCS}	0.255	0.3	0.345	V
Trigger current when short circuit to power supply VCC		I_{SCS}			30	μA
Trigger voltage when shorted to ground GND		V_{SCO}	0.255	0.3	0.345	V
Trigger current when shorted to ground GND		$-I_{SCO}$			6	μA

Application circuit



The input circuit uses four pins of LC, R_{Di}, R_{Hy}, and C_I.

Figure 2, application circuit diagram 1



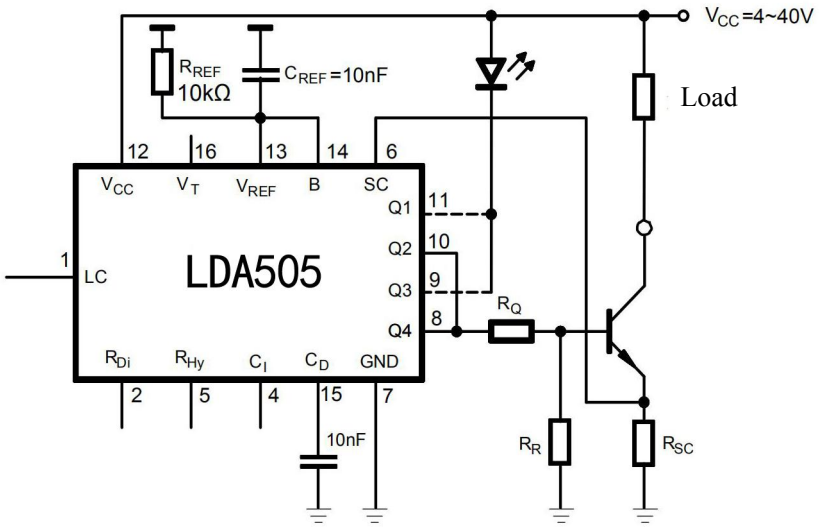
The output circuit uses eight pins of V_{REF}, B, SC, Q1, Q2, Q3, Q4, and C_D.

Remark: External PNP structure output with short circuit protection and LED indication. Generally, the short circuit protection is calculated by using the following equation:

$$Rsc = -\frac{0.3V}{\text{max. load current}}$$

During the current sampling period, the current in the chip is limited to a maximum of 250mA.

Figure 3, application circuit 2



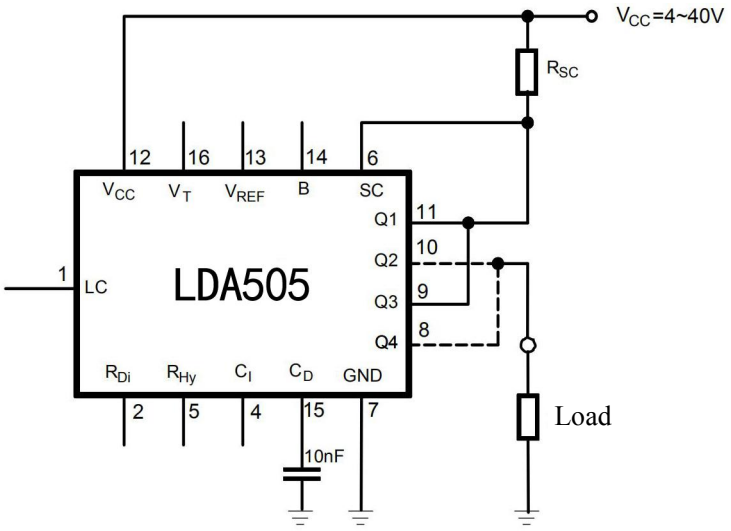
The output circuit uses eight pins of V_{REF}, B, SC, Q1, Q2, Q3, Q4, and C_D.

Remark: External NPN structure output with short circuit protection and LED indication. Generally, the short circuit protection is calculated by using the following equation:

$$Rsc = -\frac{0.3V}{\text{max. load current}},$$

During the current sampling period, the current in the chip is limited to a maximum of 250mA.

Figure 4, application circuit 3



The output circuit uses six pins of SC, Q1, Q2, Q3, Q4, and C_D.

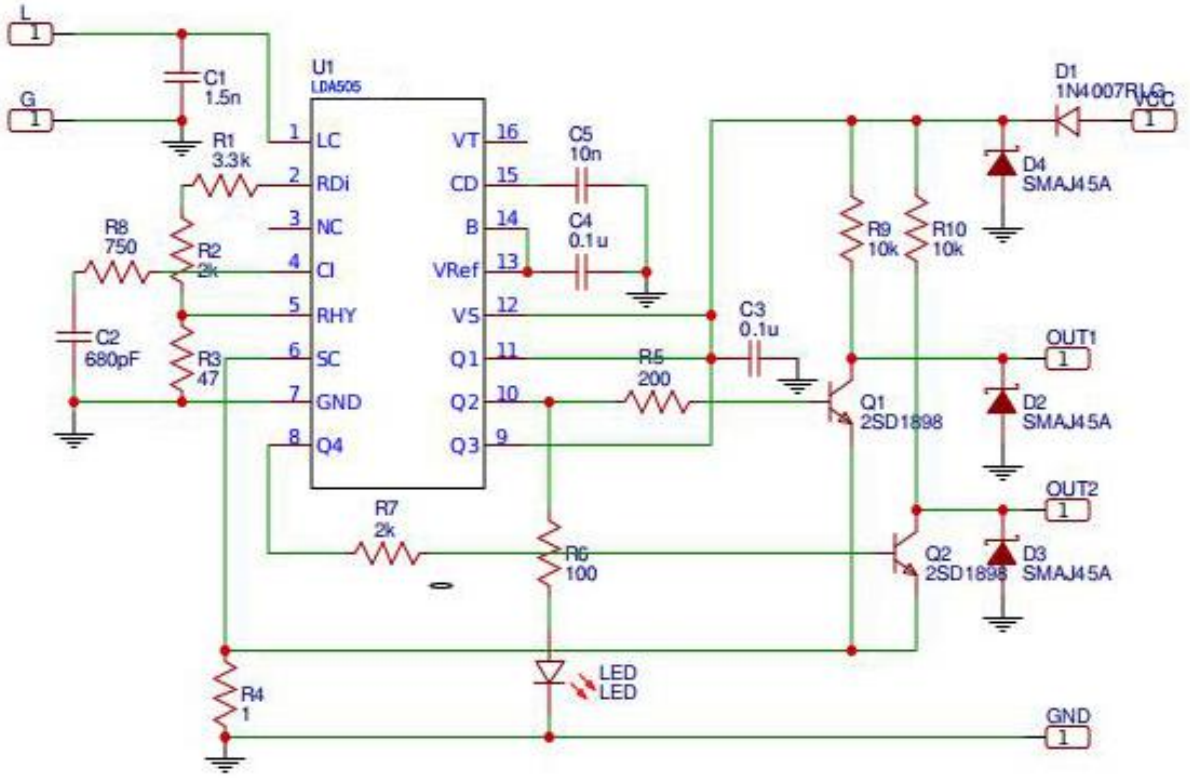
Note: Direct internal NPN output structure with short circuit protection and LED indication. Generally, the short circuit protection is calculated by using the following equation:

$$Rsc = -\frac{0.3V}{\text{max. load current}},$$

During the current sampling period, the current in the chip is limited to a maximum of 250mA.

Figure 5, application circuit 4

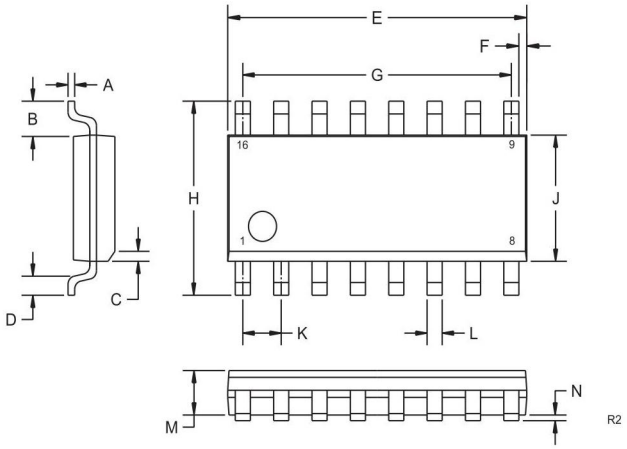
Application circuit diagram



Package Information

SOP16

Dimensions in mm



尺寸	最小	最大	典型
A	0.19	0.25	0.22
B	-	-	1.04
C	0.30	0.50	0.40
D	0.45	0.80	0.60
E	9.80	10.00	9.90
F	-	-	0.25
G	-	-	8.89
H	5.80	6.20	6.00
J	3.80	4.00	3.90
K	-	-	1.27
L	0.35	0.51	0.43
M	1.25	1.55	1.45
N	0.10	0.20	0.15
单位： mm