

Description

The SC8927 provides an integrated motor driver solution for cameras, consumer products, toys, and other low-voltage or battery-powered motion control applications. The device has a two-channel H-bridge driver, and drives two DC motors, as well as other devices like shutter or iris on cameras. An internal charge pump generates gate drive voltages.

The SC8927 supplies up to 1.0-A of output current.

The operates on a motor power supply voltage from 2.0 V to 5.5 V.

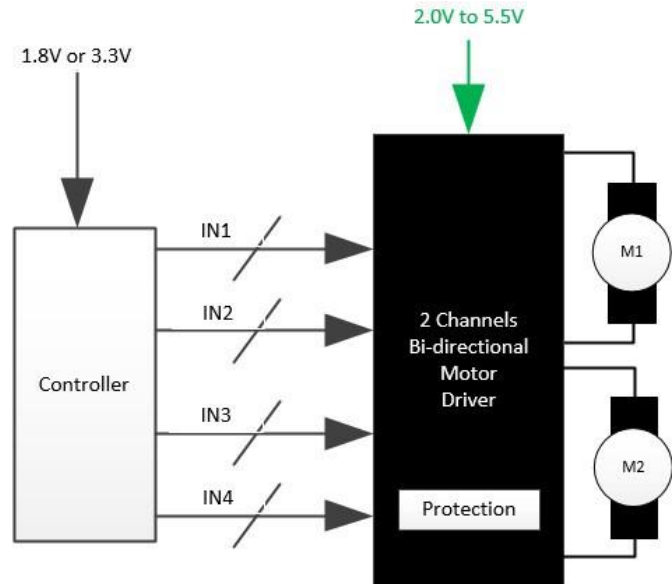
The SC8927 device has a PWM (IN/IN) input interface. Internal shutdown functions are provided for overtemperature.

The SC8927 is packaged in a 10-pin DFN package or a 10-pin MSOP.

Features

- H-Bridge Motor Driver
 - Drives 2-DC Motors or Other Loads
 - Low saturation voltage: 0.50V typ. At 400mA
- Low operating Current
- Low voltage operation:
 - VDD min =2.0V
- Low input current
- High output sinking and driving capability
- Small Package and Footprint
 - DFN-10(With Thermal Pad)
 - MSOP-10
- Protection Features
 - Thermal Shutdown(TSD)

Simplified Schematic



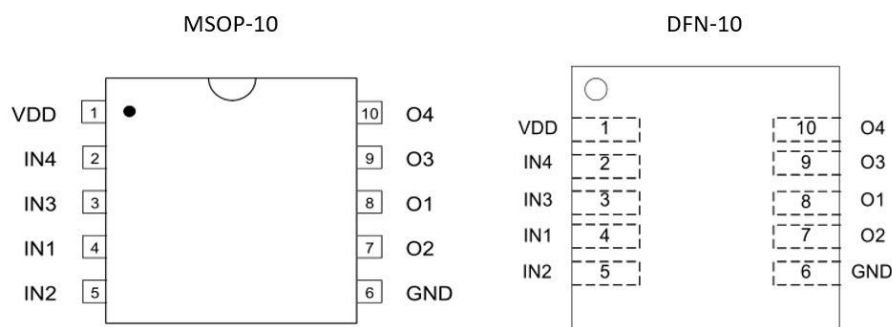
Applications

- Battery-Powered:
 - Cameras
 - DSLR Lenses
 - Consumer Products
 - Toys
 - Robotics
 - Medical Devices

Device Information

PART NUMBER	PACKAGE	BODY SIZE (NOM)
SC8927D	DFN (10)	3.00 mm × 3.00 mm
SC8927S	MSOP (10)	3.00 mm × 3.00 mm

Pin Configuration and Functions



Pin Functions

PIN NAME	PIN NO.	TYPE	DESCRIPTION	EXTERNAL COMPONENTS OR CONNECTIONS
POWER AND GROUND				
GND	6	PWR	Device ground	This pin must be connected to the PCB ground
VDD	1	PWR	Motor supply	Bypass to GND with a 0.1uF(minimum) ceramic capacitor
CONTROL				
IN1	4	I	Bridge input 1	Logic high sets OUT1 high Internal pulldown resistor
IN2	5	I	Bridge input 2	Logic high sets OUT2 high Internal pulldown resistor
IN3	3	I	Bridge input 1	Logic high sets OUT3 high Internal pulldown resistor
IN4	2	I	Bridge input 2	Logic high sets OUT4 high Internal pulldown resistor
OUTPUT				
OUT1	8	O	Bridge output 1	Connect to motor winding
OUT2	7	O	Bridge output 2	
OUT3	9	O	Bridge output 3	Connect to motor winding
OUT4	10	O	Bridge output 4	

ABSOLUTE MAXIMUM RATINGS

SEE (1) (2)

Parameter	MIN	MAX	UNIT
VDD Power supply voltage	-0.3	5.5	V
Digital input pin voltage	-0.5	VDD+0.4	V
Peak motor drive output current	Internally limited		A
T _j Operating junction temperature	-40	150	°C
T _{stg} Storage temperature	-60	150	°C

(1) Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to

absolute-maximum-rated conditions for extended periods may affect device reliability.

(2) All voltage values are with respect to network ground terminal.

Recommended Operating Conditions

PARAMETER		MIN	NOM	MAX	UNIT
V_{DD}	power supply voltage	2.0	3.0	5.5	V
V_{IN}	Logic level input voltage	0		VDD	V
I_{OUT}	Continuous motor drive output current	0	0.6	1.0	A
T_A	Operating ambient temperature	-40		85	°C

Thermal Information

THERMAL METRIC		VALUE		UNIT
		MSOP-10	DFN-10	
R_{JA}	Junction-to-ambient thermal resistance	125.6	64.3	°C/W
R_{JC}	Junction-to-thermal resistance	49.0	42.1	°C/W

Electrical Characteristics

$T_A = 25^{\circ}\text{C}$, $V_{DD} = 3.0\text{ V}$ (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
POWER SUPPLY						
I _{DDO}	VDD sleep mode supply current	V _{IN1,IN2,IN3,IN4} =0V		0.1	10	μA
I _{DD1}	VDD operating supply current	V _{IN1,IN2,IN3,IN4} ≠0V		0.2	0.5	mA
V _{UVLO}	VDD undervoltage lockout voltage	V _{DD} rising			2.5	V
		V _{DD} falling			2.3	V
LOGIC-LEVEL INPUTS						
V _{IL}	Input low voltage		-0.4		0.2*V _{DD}	V
V _{IH}	Input high voltage		0.5*V _{DD}		V _{DD} +0.4	V
I _{IL}	Input low current	V _{IN} =0	-5		5	μA
I _{IH}	Input high current	V _{IN} =3V			50	μA
R _{PD}	Pulldown resistance			100		KΩ
H-BRIDGE FETS						
V _{OUT}	Output Voltage(upper + lower)	I _{OUT} =100mA		0.12	0.2	V
		I _{OUT} =200mA		0.28	0.4	V
		I _{OUT} =400mA		0.50	0.7	V
I _{OFF}	OFF-state leakage current	V _{OUTX} =0V			±200	nA
PROTECTION CIRCUITS						
t _{TSD} (1)	Thermal shutdown temperature	Die temperature	150	160	190	°C

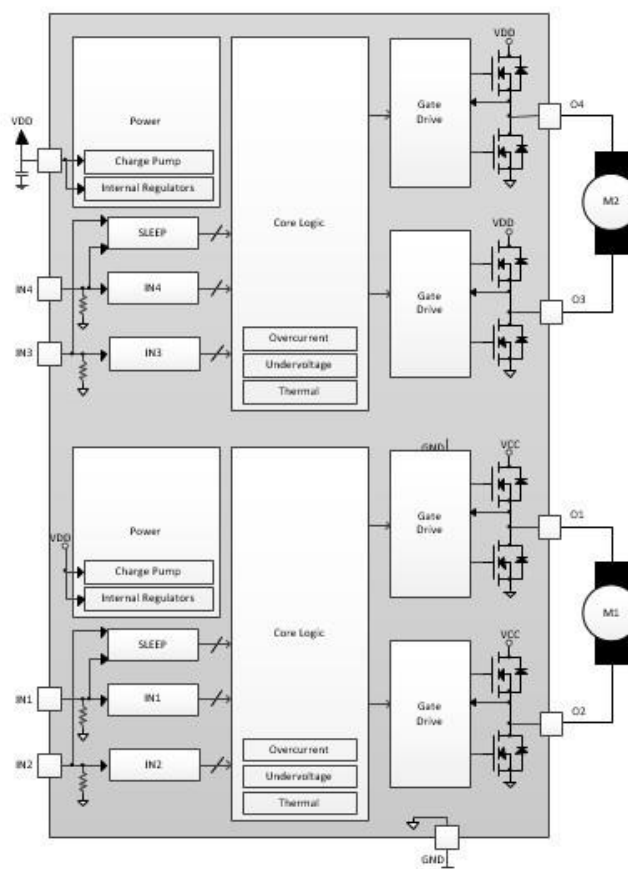
(1) Not tested in production;limits are based on characterization data

Detailed Description

Overview

The SC8927 device is a two-channel driver that can drive two DC motor or other devices like shutter on the cameras. The outputs are controlled using a PWM interface. This device greatly reduces the component count of motor driver systems by integrating the necessary driver FETs and FET control circuitry into a single device. In addition, the SC8927 device adds protection features beyond traditional discrete implementations: undervoltage lockout, overcurrent protection, and thermal shutdown.

Functional Block Diagram



Feature Description

Bridge Control

The SC8927 device is controlled using a PWM input interface, also called an IN/IN interface. Each output is controlled by a corresponding input pin.

Table 1 shows the logic for the SC8927 device.

Table 1. SC8927 Device Logic

IN1/IN3	IN2/IN4	O1/O3	O2/O4	MODE
L	L	OFF	OFF	Standby
H	L	H	L	Forward
L	H	L	H	Reverse
H	H	—	—	Keep the previous mode (Forward/Reverse)

Note: “—” indicates a “don’t care” input

Power Supplies and Input Pins

The input pins can be driven within the recommended operating conditions with or without the VDD. No leakage current path exists to the supply. Each input pin has a weak pulldown resistor (approximately 100 k Ω) to ground.

Protection Circuits

The SC8927 is fully protected against VDD undervoltage, overcurrent, and overtemperature events.

- VDD undervoltage lockout

If at any time the voltage on the VDD pin falls below the undervoltage lockout threshold voltage, all FETs in the H-bridge are disabled. Operation resumes when the VDD pin voltage rises above the UVLO threshold.

- Overcurrent protection (OCP)

An analog current-limit circuit on each FET limits the current through the FET by removing the gate drive. If this analog current limit persists for longer than t_{DEG}, all FETs in the H-bridge are disabled. Operation resumes automatically after t_{RETRY} has elapsed. Overcurrent conditions are detected on both the high-side and low-side devices. A short to the VDD pin, GND, or from the OUT1 pin to the OUT2 pin results in an overcurrent condition.

- Thermal shutdown (TSD)

If the die temperature exceeds safe limits, all FETs in the H-bridge are disabled. After the die temperature falls to a safe level, operation automatically resumes.

Table 2. Fault Behavior

FAULT	CONDITION	H-BRIDGE	INTERNAL CIRCUIT	RECOVERY
VDD undervoltage (UVLO)	$V_{DD} < 2.3V$	Disabled	Disabled	$V_{DD} > 2.5V$
Overcurrent (OCP)	$I_{OUT} > 1.2A(MIN)$	Disabled	Operating	t _{OCR}
Thermal Shutdown (TSD)	$T_J > 150^{\circ}C(MIN)$	Disabled	Operating	$T_J < 150^{\circ}C$

Application and Implementation

NOTE

Information in the following applications sections is not part of the SteadiChips Component specification, and SteadiChips does not warrant its accuracy or completeness. SteadiChips's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

Application Information

The SC8927 device is used to drive one DC motor or other devices like solenoids. The following design procedure can be used to configure the SC8927 device.

Typical Application

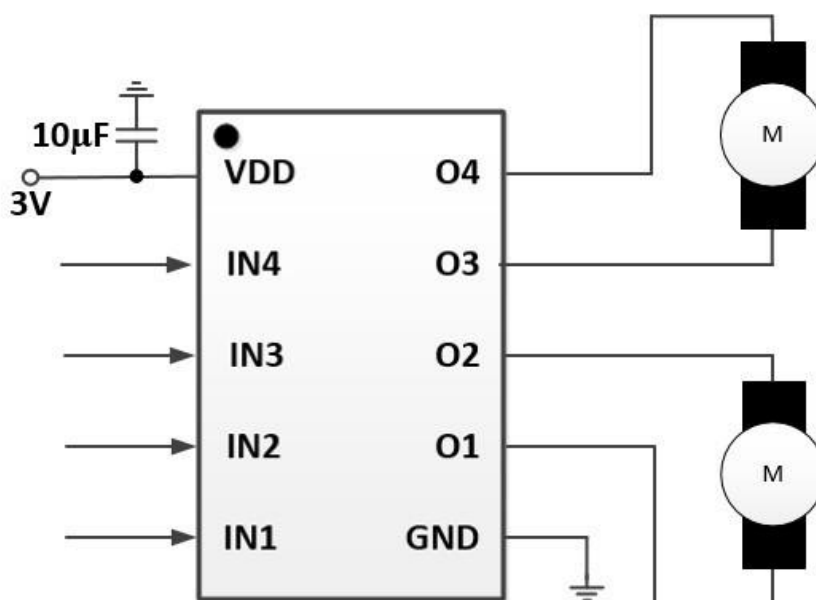


Figure 2. Schematic of SC8927 Application

Power Supply Recommendations

Bulk Capacitance

Having appropriate local bulk capacitance is an important factor in motor-drive system design. It is generally beneficial to have more bulk capacitance, while the disadvantages are increased cost and physical size.

The amount of local capacitance needed depends on a variety of factors, including:

- The highest current required by the motor system
- The power-supply capacitance and ability to source current

- The amount of parasitic inductance between the power supply and motor system
- The acceptable voltage ripple
- The type of motor used (brushed dc, brushless dc, stepper)
- The motor braking method

The inductance between the power supply and motor drive system limits the rate at which current can change from the power supply. If the local bulk capacitance is too small, the system responds to excessive current demands or dumps from the motor with a change in voltage. When adequate bulk capacitance is used, the motor voltage remains stable and high current can be quickly supplied.

The data sheet generally provides a recommended value, but system-level testing is required to determine the appropriate size of bulk capacitor.

The voltage rating for bulk capacitors should be higher than the operating voltage, to provide margin for cases when the motor transfers energy to the supply

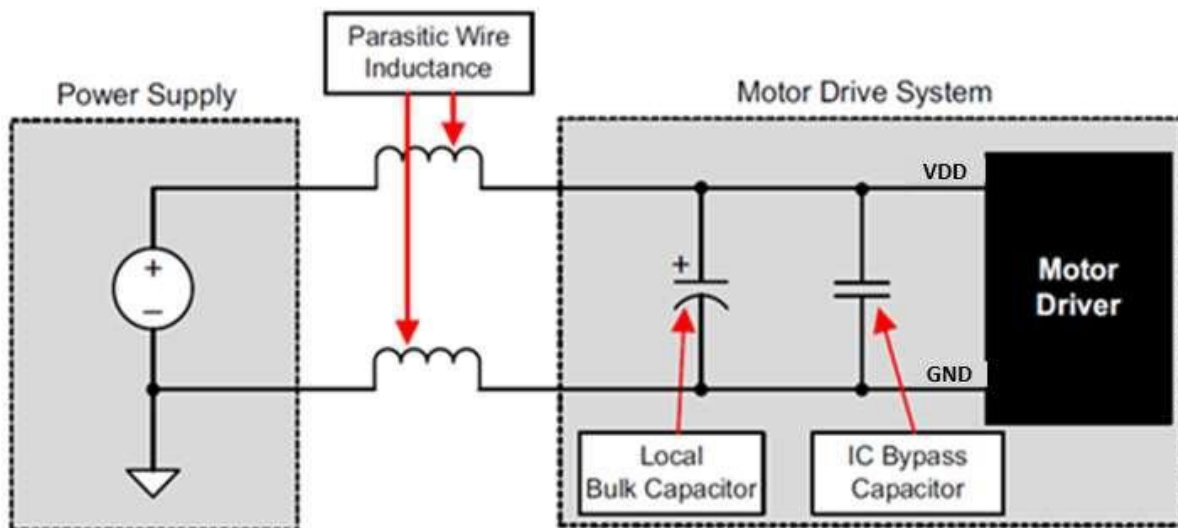


Figure 3. Example Setup of Motor Drive System With External Power Supply

Layout

Layout Guidelines

The VDD pins should be bypassed to GND using low-ESR ceramic bypass capacitors with a recommended value of 10 μF rated for the VM and VDD supplies. These capacitors should be placed as close to the VDD pins as possible with a thick trace or ground plane connection to the device GND pin.

Layout Example

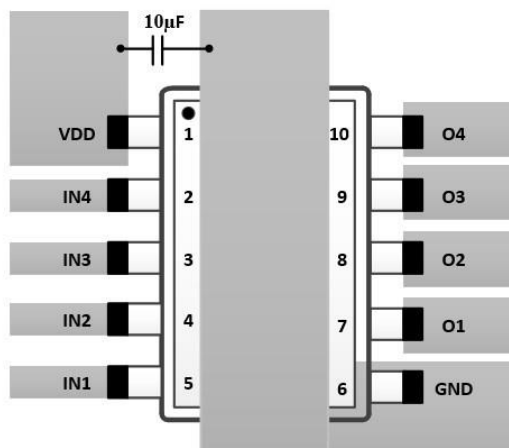


Figure 4. Simplified Layout Example

Power Dissipation

Power dissipation in the SC8927 is dominated by the power dissipated in the output FET resistance, or $R_{DS(on)}$. Average power dissipation when running both H-bridges can be roughly estimated by Equation 1:

$$P_{TOT} = R_{DS(on)} \times (I_{OUT(RMS)})^2 \quad (1)$$

where

- P_{TOT} is the total power dissipation
- $R_{DS(on)}$ is the resistance of the HS plus LS FETs
- $I_{OUT(RMS)}$ is the RMS or DC output current being supplied to the load

The maximum amount of power that can be dissipated in the device is dependent on ambient temperature and heatsinking.

NOTE

The value of $R_{DS(on)}$ increases with temperature, so as the device heats, the power dissipation increases.

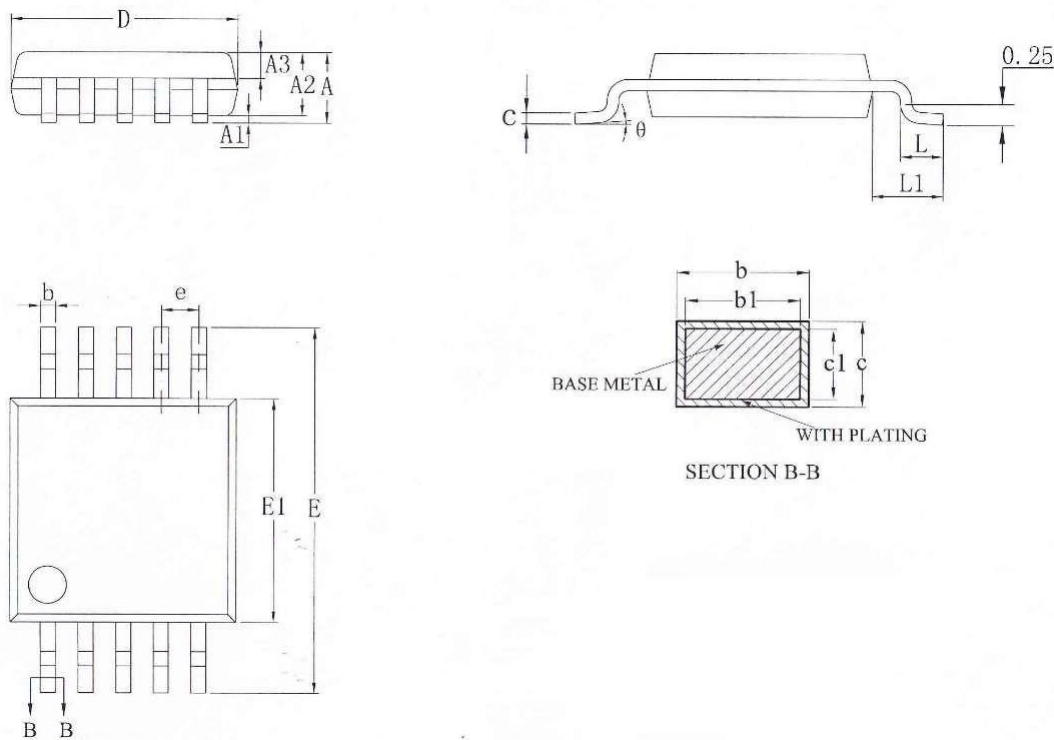
The SC8927 device has thermal shutdown protection. If the die temperature exceeds approximately 150°C, the device is disabled until the temperature drops to a safe level.

Any tendency of the device to enter thermal shutdown is an indication of either excessive power dissipation, insufficient heatsinking, or too high an ambient temperature.

Package Outline

MSOP-10

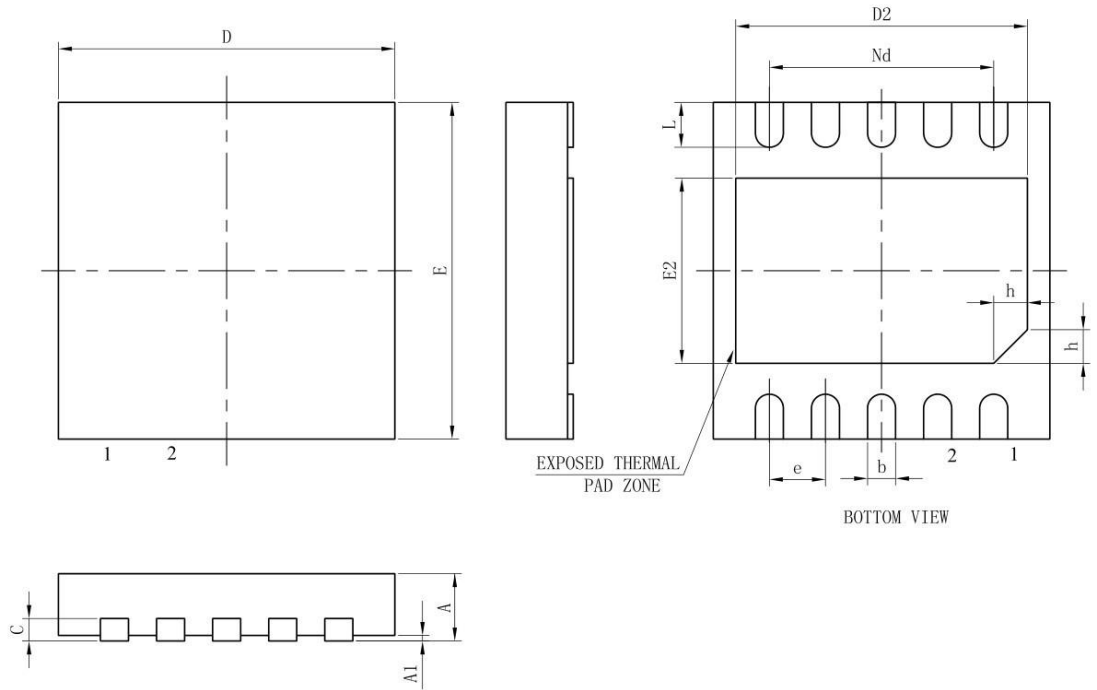
UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.10
A1	0.05	—	0.15
A2	0.75	0.85	0.95
A3	0.30	0.35	0.40
b	0.18	—	0.26
b1	0.17	0.20	0.23
c	0.15	—	0.19
c1	0.14	0.15	0.16
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.50BSC		
L	0.40	—	0.70
L1	0.95REF		
θ	0	—	8°

DFN-10

UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1	—	0.02	0.05
b	0.18	0.25	0.30
c	0.18	0.20	0.25
D	2.90	3.00	3.10
D2	2.40	2.50	2.60
e	0.50BSC		
Nd	2.00BSC		
E	2.90	3.00	3.10
E2	1.45	1.55	1.65
L	0.30	0.40	0.50
h	0.20	0.25	0.30
L/F载体尺寸 (mil)	106*75		