SL621, Programmable Linear Hall Sensor IC

Description:

The SL621 is a member of SENK SEMI semiconductor's programmable linear Hall IC. With its wide adjustable sensitivity range, easy programming, and high cost performance, it is recognized by our customers.

The SL621 is currently available in a standard TO92 in-line package that can be programmed to measure a magnetic field perpendicular to the IC plane and provide a voltage output proportional to the applied magnetic field. Users can flexibly configure sensitivity, static (zero-field) output voltage, reference voltage, and temperature compensation coefficient with the VIOUT pin as a bidirectional communication port in the power-on state. In order to ensure the stability of the integrated circuit in the harsh solenoid environment, the configuration parameters are solidified into the built-in memory.

Its unique multi-segment temperature compensation coefficient makes it easy for customers to do the temperature compensation of the system to remove the temperature effect of the core or position.

The SL621 can be used to check any position displacement in conjunction with the core, and can also easily detect the current, and its programmability can eliminate assembly and position errors, ensuring high accuracy and high consistency.

Features

- Selectable ultra-wide sensitivity range: 1.8~29mV/G
- The VIOUT pin can be programmed into two types and three modes:

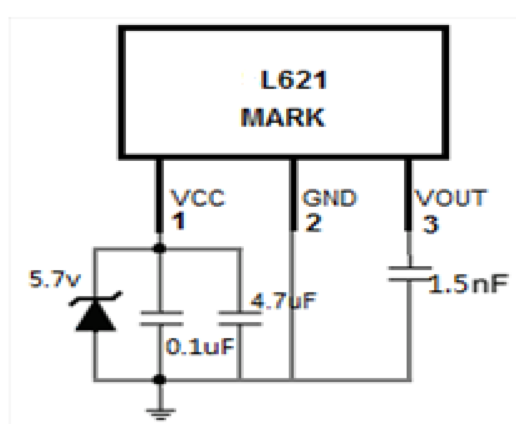
  Ratio: 0.5Vcc

  Non-ratiometric measurements: Fixed 2.5V
- Programmable sensitivity error <±10mV@5V
- Programmable quiescent voltage error <±6mV@5V
- Response time <10us
- Support parallel programming of multiple sensors
- Single power supply +5V
- Extremely thin package: 1.52mm thickness
- Wide ambient temperature range: -40℃~125℃

Package View

SL621

Typical Application

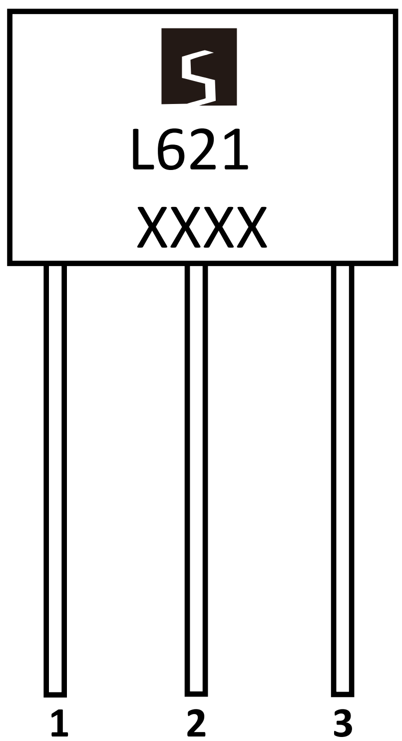


Order information

Part Number	Packing	Package type	Product status
SL621	1000pcs/bag	TO92	MP
SL621 K-A-T	1000pcs/bag	TO92	MP

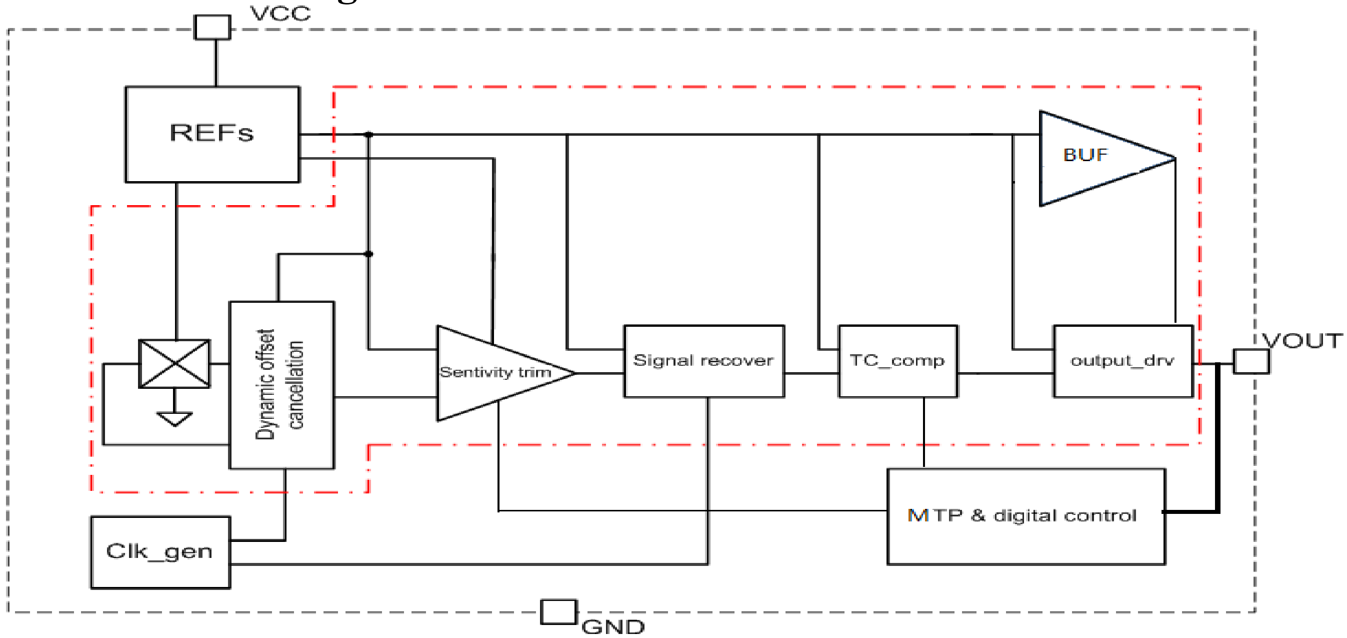
Note: The SL621K-A-T is for the purpose of renewing the sales part number, and the performance is exactly the same as that of SL621

Pin definition



SL621	Pin name	Description
1	VCC	Supply voltage
2	GND	Ground
3	VIOUT	Analog output signals, which are also used to program digital I/O

Functional block diagram



Absolute maximum rating

The absolute maximum rating is the limit value applied individually, and beyond which the maintainability of the circuit may be compromised. Functional operability is not necessarily implicit. Prolonged exposure to absolute maximum rating conditions can affect device reliability.

Symbol	Parameter	Notes	Rating	Unit
V_{CC}	Supply voltage		6.0	V
V_{RCC}	Reverse Supply Voltage		-0.1	V
V_{IOUT}	Output voltage		6.0	V
V_{RIOUT}	Reverse Output Voltage		-0.1	V
T_A	Nominal Operating Ambient Temperature		-40~125	℃
$T_{J\,(max)}$	Maximum Junction Temperature		165	℃
T_{stg}	Storage Temperature		–65~165	℃
$I_{OUT(Source)}$	Output Current Source	Shorted Output-to-Ground Current	19	mA
$I_{OUT(Sink)}$	Output Current Sink	Shorted Output-to-VCC Current	52	mA
ESD	HBM mode		4	KV

External Capacitor

Device	Test Condition	Min.	Typ.	Max.	Units
C_{VCC}	Power filter capacitor, connected between VCC / GND	--	0.1	--	uF
C_{VIOUT}	V_{OUT} filter capacitor, connected between VOUT / GND	--	1.5	--	nF

Common Operating Characteristics

Note: Over full range of T_A= -40°C ~ 125°C, C_{Bypass}=0.1uF， C_{Load}=1.5nF, V_{CC}=5V, unless otherwise specified.

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Supply Voltage	V_{CC}	Programmed to be 5.0v	4.5	5.0	5.5	V
Supply Current	I_{CC}	V_{CC} = 5.0V, output open	5	9	12	mA
Output capacitive load	CL	VIOUT to Gnd			1.5	nF
Output Load Resistance	RL	VIOUT to Gnd				kΩ
Nonlinearity	ELIN	Measured using full-scale and half-scale IP			1	%
Response Time	t_r	T_A = 25°C, C_{OUT} =1nf		10		µS
Response delay time	T_{pd}	IP= Full scale		2		uS
Power-On Time	t_{PO}	output reaches steady-state level,T_J = 25°C		100	200	uS
Frequency Bandwidth	Fc	T_A = 25°C		500		kHz
Response delay time	f	Small signal –3 dB, CL = 1 nF, TA = 25°C;		120		kHz

Output characteristics

Note: Over full range of T_A= -40°C ~ 125°C, C_{Bypass}=0.1uF， C_{Load}=1.5nF, V_{CC}=5V, unless otherwise specified.

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Quiescent output voltage	VIOUT (QU)	Non-variable ratio（fixed 2.5V）， TA = 25°C,VCC=5V	2.494	2.5	2.506	V
		Variable ratios（0.5VCC）, TA = 25°C,VCC=5V	2.494	2.5	2.506	V
Follow-up sensitivity scale factor	Sen_coef	Variable rate: VREF@0.5*VCC VCC=4.5v~5.5v Sens_coef=Sens(VCC)/Sens(5V)		VCC/5		
Zero point at fixed zero voltage	VIOUT@IP=0A	Non-variable ratio: VREF@2.5V VCC=4.5v~5.5v		2.5		V
VIout linear rail to rail output range	Vrail-rail	RL=4.7kΩ	10		90	%VCC
VIOUT， Zero output error	VIOUT	TA = 25°C		±10		mV
		TA = -40°C to 25°C		±15		mV
		TA = 25°C to 125°C		±15		mV
Total error	ETOT	T_A=25°C, output filtered		±1.5		%
		TA = -40°C to 25°C		±2.0		%
		TA = 25°C to 125°C		±2.8		%
noise	VN	T_A = 25°C, C_{OUT} = 1nF, Sens=2mv/GS		30.2		mV_{p-p}
		T_A = 25°C, C_{OUT} = 1nF, Sens=2mv/GS		2.36		mV_{RMS}
		T_A = 25°C, C_{OUT} = 1nF, Sens=30mv/GS		122.4		mV_{p-p}
		T_A = 25°C, C_{OUT} = 1nF, Sens=30mv/GS		12.95		mV_{RMS}

Accuracy characteristic curves

Figure 1: Zero output VS ambient temperature

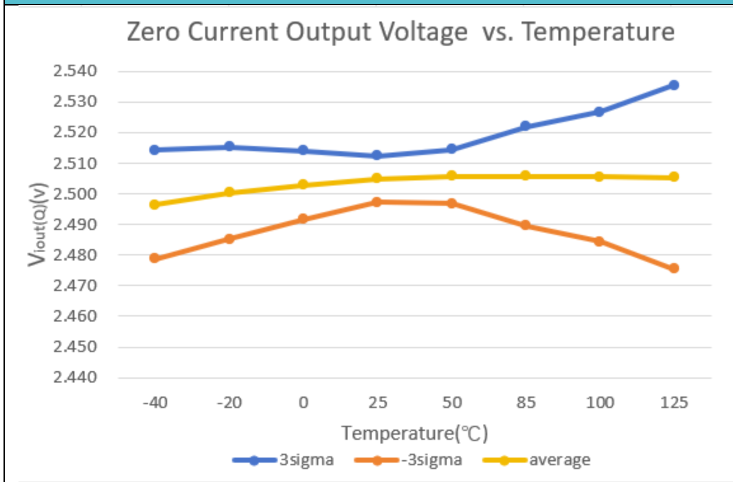


Figure 2: Zero error VS ambient temperature

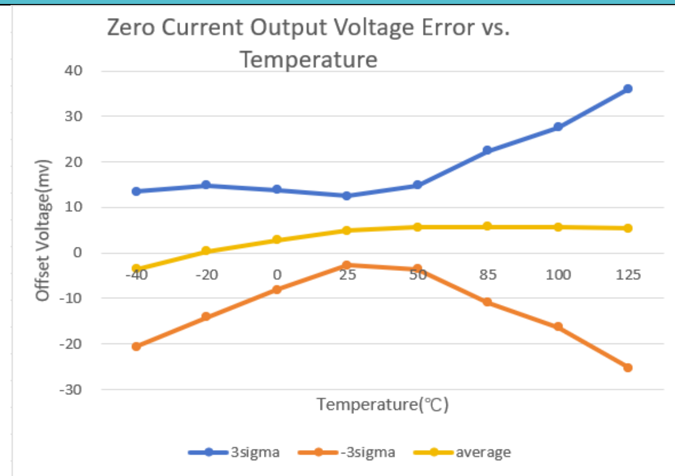


Figure 3: Nonlinearity VS ambient temperature

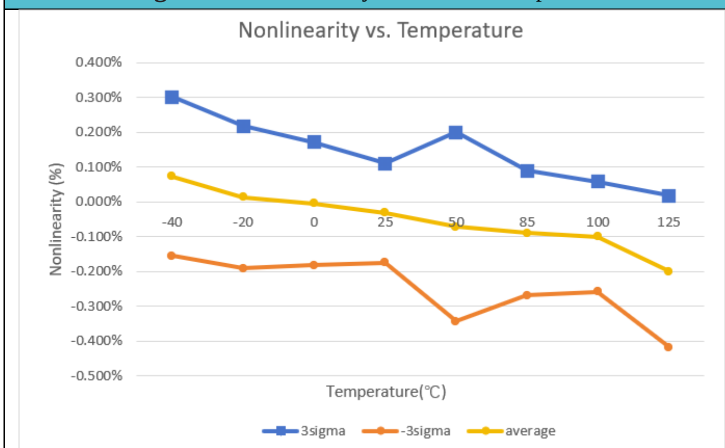
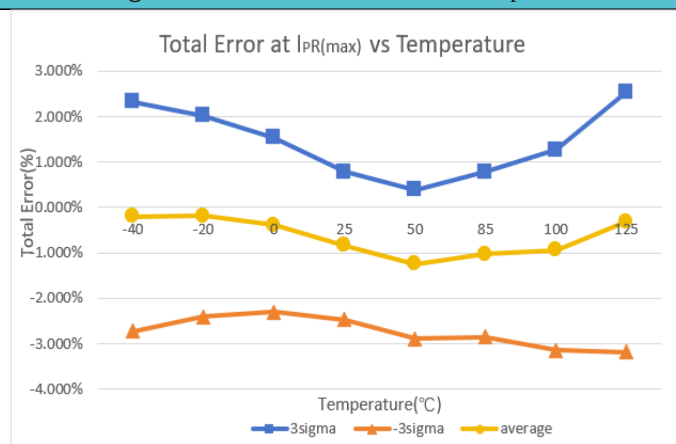


Figure 4: Total Error VS Ambient Temperature



AC characteristic graph

Figure 1: Dynamic rise time

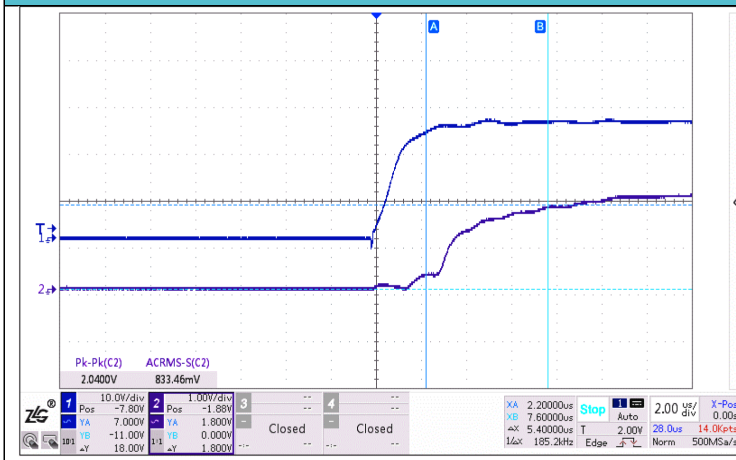


Figure 2: Response time

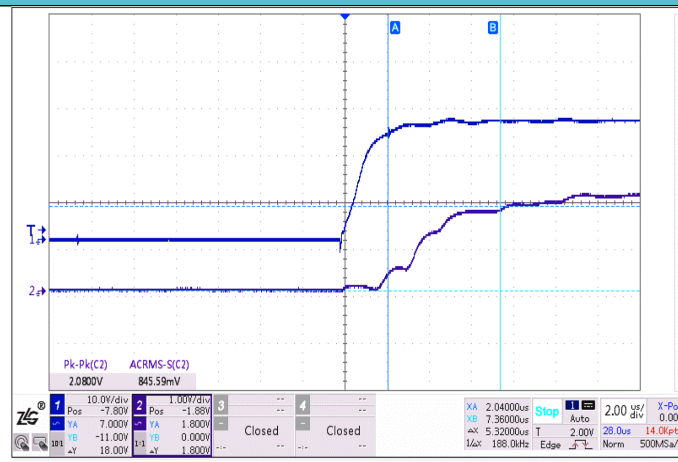


Figure 3: Response delay time

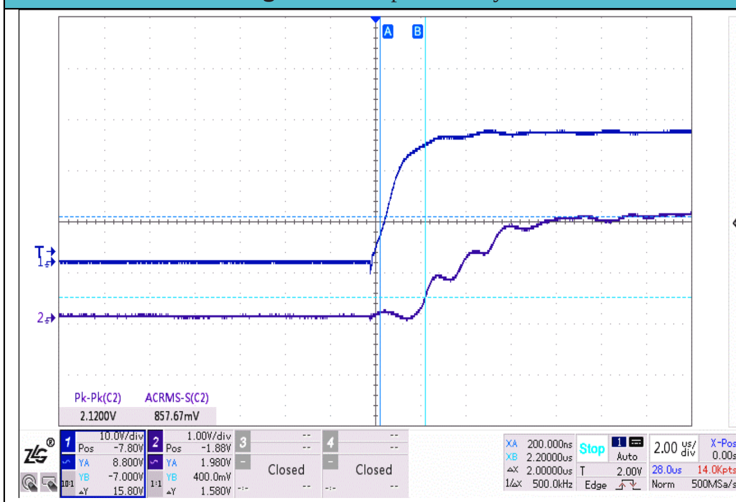
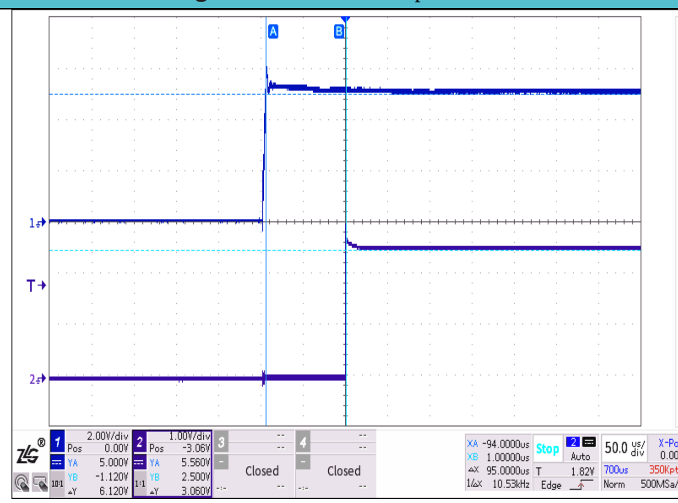


Figure 4: Power-on response time



Sensitivity programming bits

Register	Test conditions				Min.	Typ.	Max.	Unit
sel_sensor[1]	Readable by customer				-	1	-	Bit
INC_HALL_I	Readable by customer				-	2	-	Bit
S3_OUT_DRV	Readable by customer				-	1	-	Bit
S2_double	Readable by customer				-	1	-	Bit
Gain_COARSE	Readable by customer				-	2	-	Bit
Gain_FINE					-	9	-	Bit
sel_sensor[1]	INC_HALL_I	S3_OUT_DRV	S2_double	Gain_COARSE				
0	2	0	0	0				mv/Gs
0	0	0	0	0				mv/Gs
0	0	0	0	1				mv/Gs
0	0	0	0	2				mv/Gs
0	0	0	0	3				mv/Gs
0	0	0	1	3				mv/Gs
0	0	1	1	3				mv/Gs
1	1	1	1	3				mv/Gs

Quiescent voltage programming bits

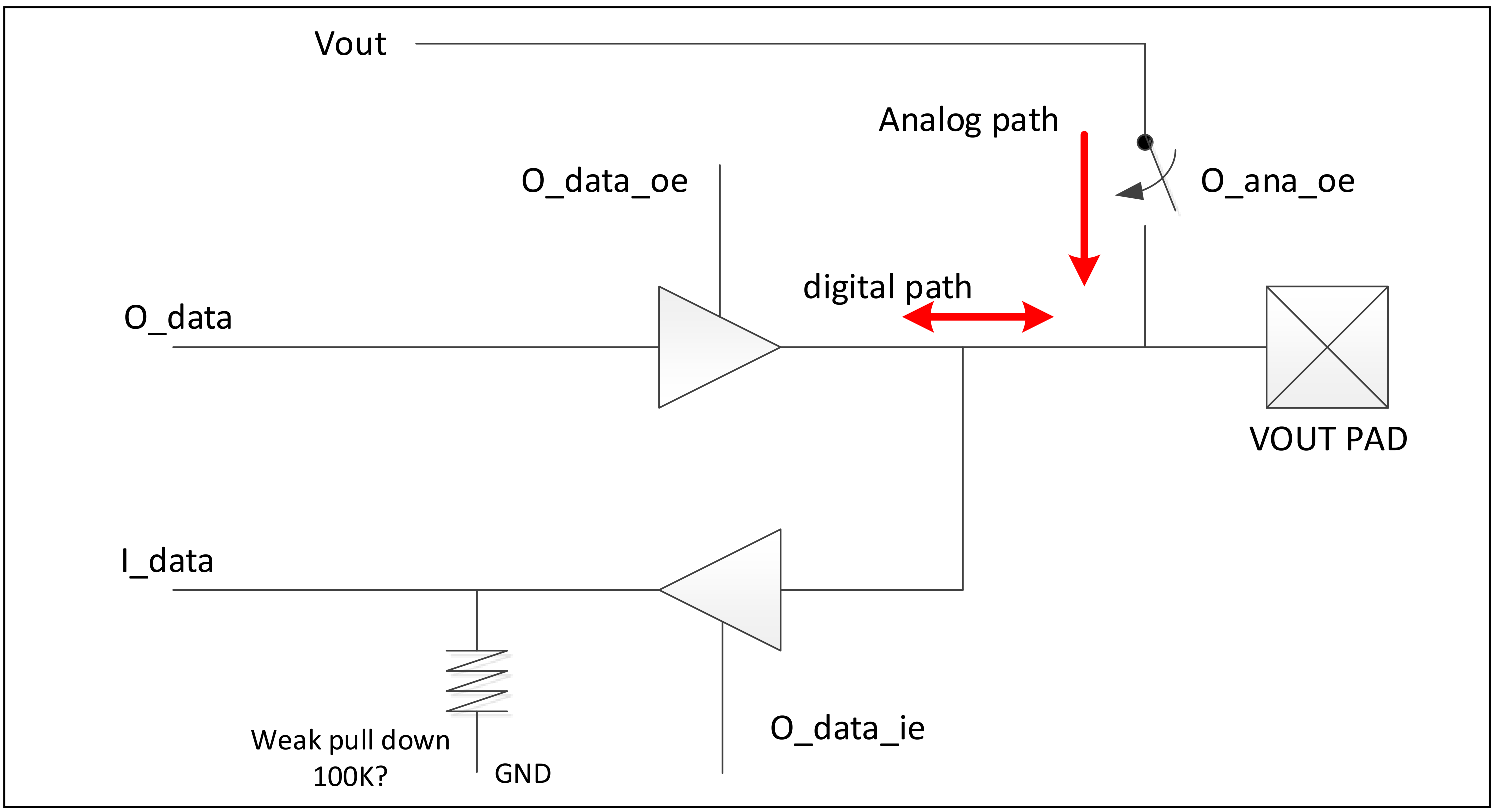
Parameter definitions	Parameter symbol	Test conditions	Min.	Typ.	Max.	Unit
VIOUT Offset the coarse programming bits	VIOUT		-	5	-	Bit
		VIOUT output voltage (0 Gauss) adjustment	-200	-	200	mV
		Minimal step adjustment		0.5		%
VIOUT Offset the fine-tuning programming bits	VIOUT			5		Bit
		VIOUT output voltage (0 Gauss) adjustment	-59	-	59	mV
		Minimal step adjustment		0.15		%

Non-calibrated programming bits

Parameter definitions	Parameter symbol	Test conditions	Min.	Typ.	Max.	Unit
VIOUT Working mode	VIOUT		-	2	-	Bit
		Select the output voltage mode： 2b00: VIOUT= fixed 2.5V, 2b01: VIOUT=0.5*vcc,	-	-	-	-
Select the temperature coefficient	TC1			4		Bit
		Select the sensitivity TC slope of the temperature 4b0000: 0ppm …………………….. …………………….. 4b1111:1280ppm	0	-	1280	ppm
		Minimal stepping 80ppm		80		ppm
Select the temperature coefficient	TC2			4		Bit
		Select the sensitivity TC slope of the temperature 4b0000: 0ppm …………………….. …………………….. 4b1111:1280ppm	0	-	1280	ppm
		Minimal stepping 80ppm		80		ppm
Select the breakpoint for the two-stage TC calibration	TCTH			2		Bit
		2b00: -20℃ 2b01: -10℃ 2b10: 0℃ 2b11: 65℃	-	-	-	-
The magnetic field induces a reversal of direction				2		Bit
		Reverse induction 1b00: default 1b01: opposite polarity	-	-	-	-

Programming instructions

- As a programming pin, VIout supports input or output communication, and defaults to digital input and programmable mode.
- Through the locking protocol, the function of VIout switches to unidirectional analog output mode, and no longer supports digital input.
- Through the ability of analog multi-driver, read the digital code in the analog state, turn off the analog output, switch to the analog mode, realize the analog into the digital mode, and solve the secondary programming problem.



Feature parameter definition description

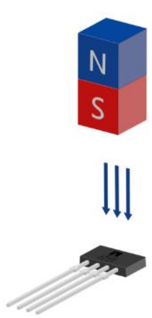
SL621 VIOUT Mode selection

Parameter definitions	Parameter symbol	Test conditions	Min.	Typ.	Max.	Unit
Working mode	VIOUT		-	2	-	Bit
		Select the output voltage mode： 2b00: VIOUT=Fixed 2.5V, 2b01: VIOUT=0.5*vcc,	-	-	-	-

- When 0.5Vcc (variable ratio) is selected, VIOUT outputs 0.5Vcc
- When 2.5V is selected (non-variable ratio), the VIOUT output is fixed at 2.5V

Magnetic induction direction selection

Parameter definitions	Parameter symbol	Test conditions	Min.	Typ.	Max.	Unit
The magnetic field induces a reversal of direction	-			2		Bit
		Reverse induction 1b00: default 1b01: opposite polarity	-	-	-	-



note：

By default, when the S-pole magnetic field approaches the silkscreen side of the SL621, the voltage output rises accordingly.

When (opposite polarity) is selected, the voltage output will increase accordingly as the N-pole magnetic field approaches the SL621 recognition surface.

◆ Delay time t_{pd} and Response time $t_{response}$

Response delay time (t_{pd})

The delay time is the time difference between when the output of the secondary side reaches 20% of the output value of the steady state and when the primary side reaches 20% of the current of the steady state.

Response time ($t_{RESPONSE}$)

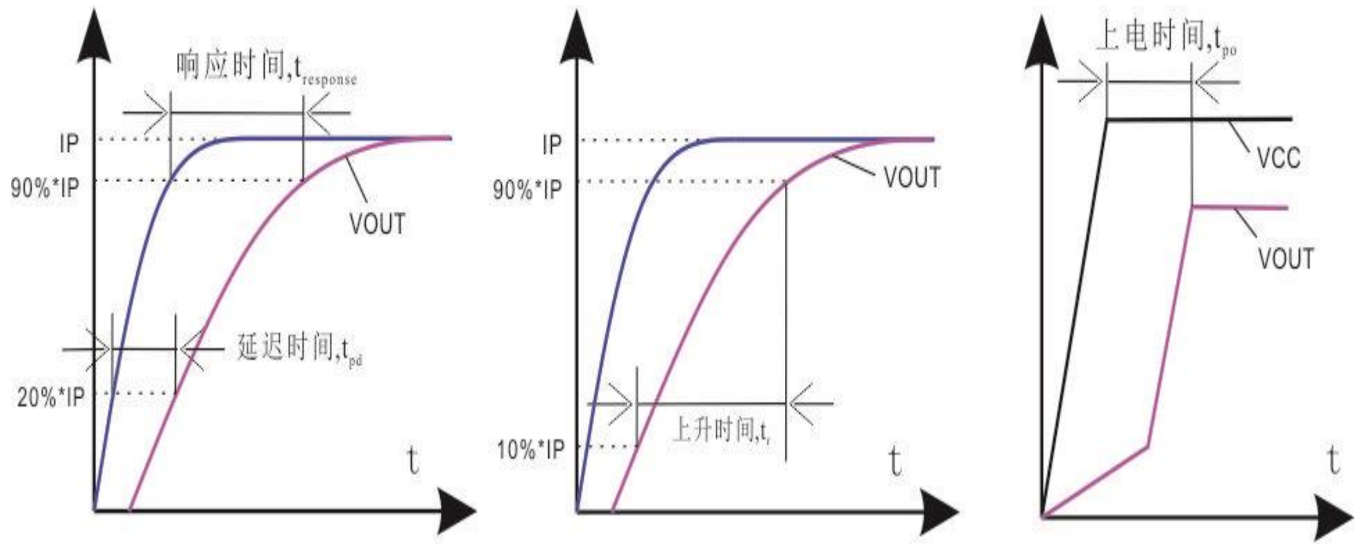
The response time is the time difference between when the output of the secondary side reaches 90% of the steady-state output value and when the primary side reaches 90% of the steady-state current.

Rise response time (t_r)

The rise time is used to characterize the time difference of the secondary side itself, that is, the time difference between the output of the secondary side reaching 90% of the steady-state output value and reaching 10% of the steady-state output value.

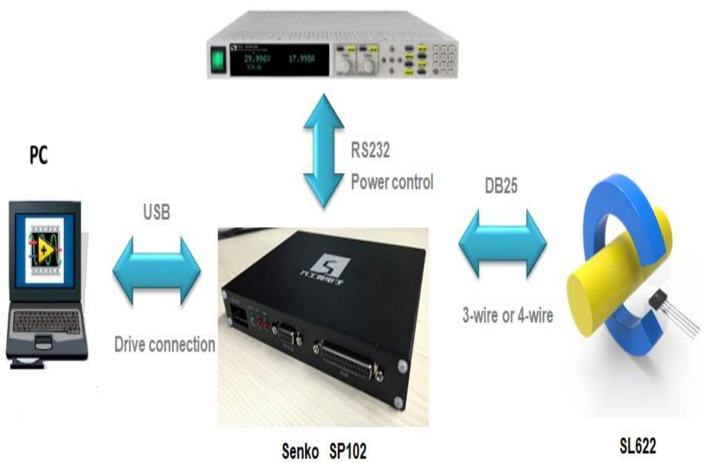
Power-on response time (t_{PO})

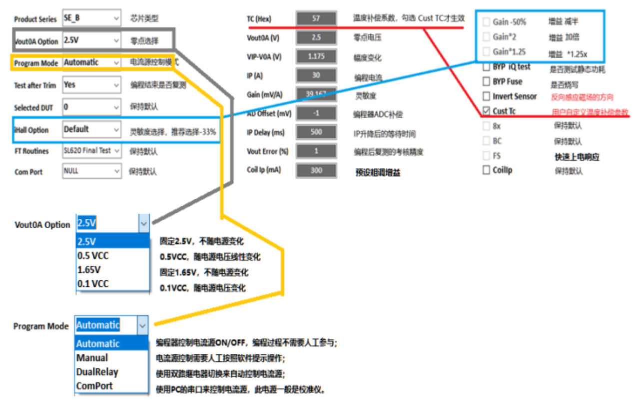
The power-up time is used to characterize the time difference between the secondary side and the power supply VCC, that is, the time difference between when the secondary output reaches the steady-state output value and when VCC reaches the steady-state output value.



Program programming system

The SL621 integrates a serial interface that allows an external controller named SP102 to automatically calibrate in MTPROM. For more information, please contact SenkoMicro's FAE.
Email: fae@senkomicro.com



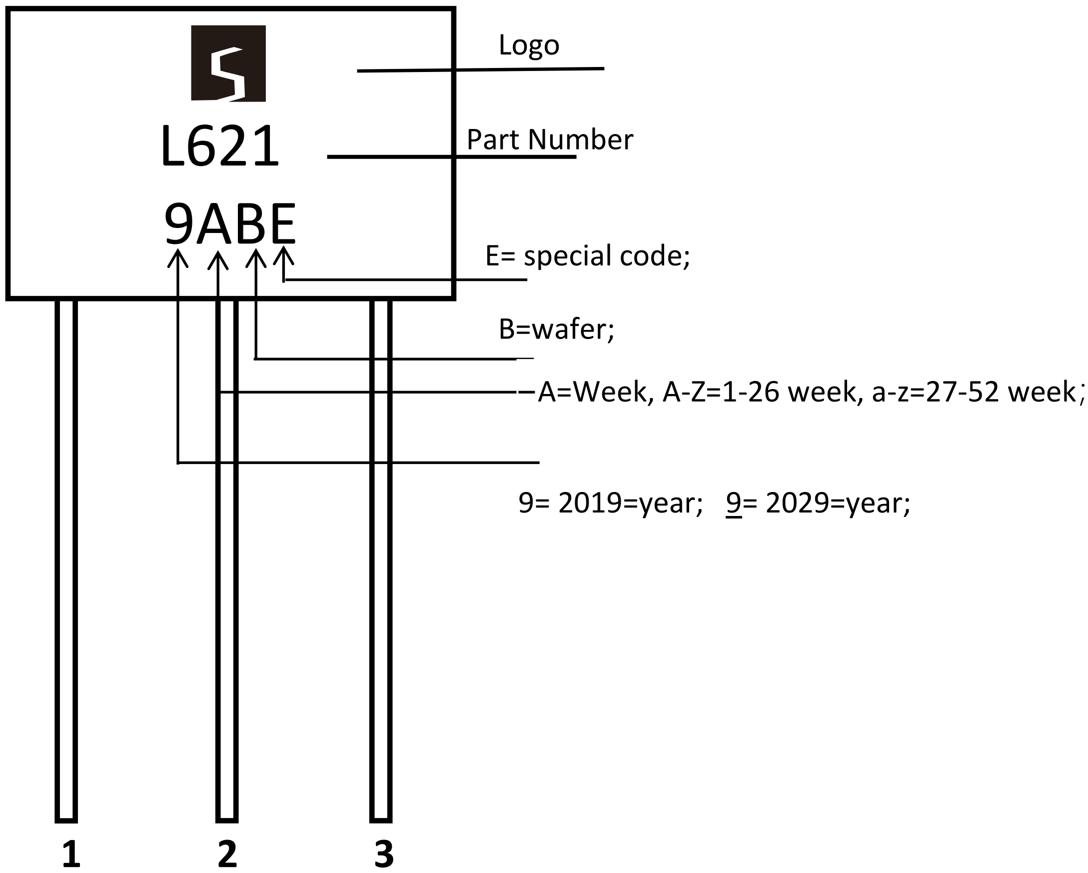


calibration system

- The programming hardware is based on SP102 as the core, the USB serial port installs the driver to realize the PC connection, and the RS232 serial port transmits the command to control the current source; The DB25 serial port provides a high-precision 5V power supply for the IC, and VIOUT is used as the programming pin to realize communication transmission.
- This program system opens all programmable functions, supports users to program in a wide range, and has great flexibility.
  There are error-proofing measures in the program settings. For example, the Bin3 and Bin4 product programs have a prompt judgment function. By default, the product program is unlocked, which means that the product can be reprogrammed and calibrated to reduce the probability of errors.

Note:
For detailed information on programming calibration, refer to the Technical Application Note.

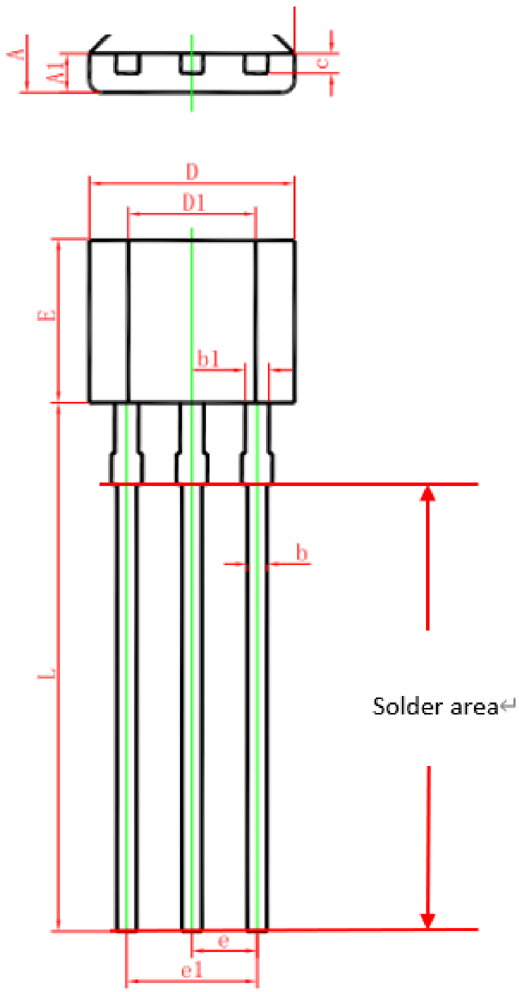
Silk screen description



Package information

Note: All dimensions are in millimeters.

SL621



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.420	1.620	0.056	0.064
A1	0.660	0.860	0.026	0.034
b	0.330	0.480	0.013	0.019
b1	0.400	0.510	0.016	0.020
c	0.330	0.510	0.013	0.020
D	3.900	4.100	0.154	0.161
D1	2.280	2.680	0.090	0.106
E	3.050	3.250	0.120	0.128
e	1.270 TYP.		0.050 TYP.	
e1	2.440	2.640	0.096	0.104
L	15.100	15.500	0.594	0.610
θ	45° TYP.		45° TYP.	

Important Notice

SENK SEMI.'s products are not to be used in life support devices or systems, if a failure of an SENK SEMI. product can reasonably be expected to cause the failure of that life support device or system, or to affect the safety or effectiveness of that device or system.

The information included herein is believed to be accurate and reliable. However, SENK SEMI co., Ltd. assumes no responsibility for its use; nor for any infringement of patents or other rights of third parties which may result from its use.

For the latest version of this document, visit our website: www.senkomicro.com

Revision History

Revision	Change	Page	Author	Date
1.0	Initial draft（SL621based on wafer B）		Deng	2020.02
2.0	Update POD information; Add solder area; Accuracy data and characteristic curves are added		MWJ	2024.02.29

