

Description

ACE301 is a series of high precision voltage detector with ultra low current consumption (500nA typ. at $V_{DD}=3.0V$). It can work at very low voltage, which makes it perfect for system reset.

ACE301 is composed of high precision voltage reference, comparator, output driver and resistor array. Internally preset detect voltage has a low temperature drift and requires no external trimming.

Two type of output, CMOS and N-channel open-drain are available.

ACE301 is available in SOT-89-3, SOT-23-3 TO-92, SOT23-5, packages which is Pb free.

Features

- High-precision detection Voltage: $\pm 2\%$
- Detection Voltage: 0.9V~6.0V (in 0.1V steps)
- Precise hysteresis: 4% typ.
- Operating Voltage range: 0.7V~10V
- Ultra-low current consumption: 500nA typ. (at $V_{DD}=3.0V$)
- Two Output forms: CMOS and N-channel open-drain

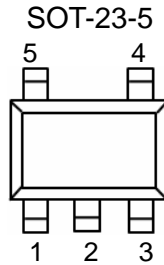
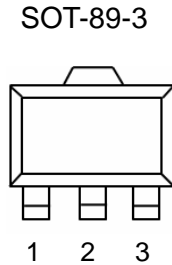
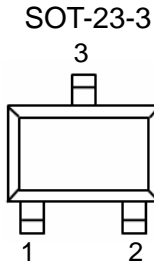
Application

- Power monitor for portable equipment such as PDA, DSC, Mobile phone, Notebook, MP3
- CPU and Logic Circuit Reset
- Battery Checker
- Battery Back-up Circuit
- Power Failure Detector

Absolute Maximum Ratings

Parameter	Symbol	Max	Unit
Input Voltage		-0.3~12	V
Output Voltage		-0.3~12	V
Maximum Output current		70	mA
Maximum power dissipation		150	mW
Ambient temperature		-40~+70	°C
Storage temperature		-40~125	°C

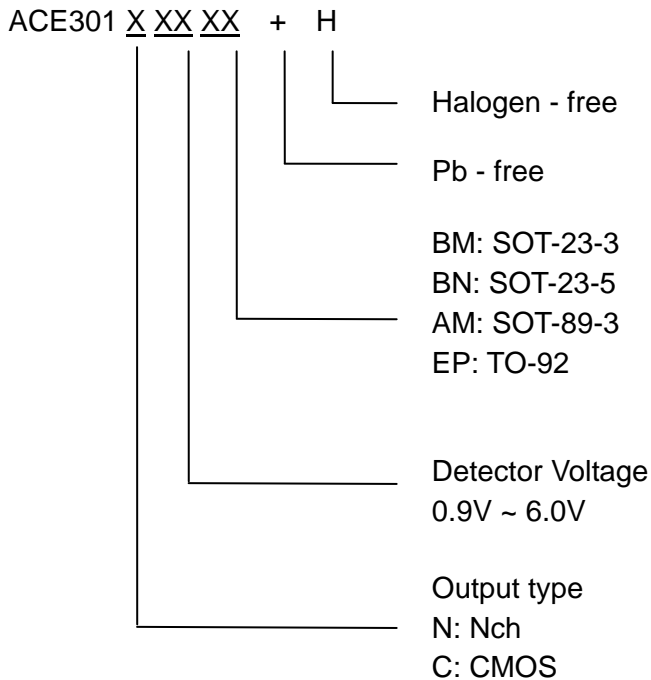
Packaging Type



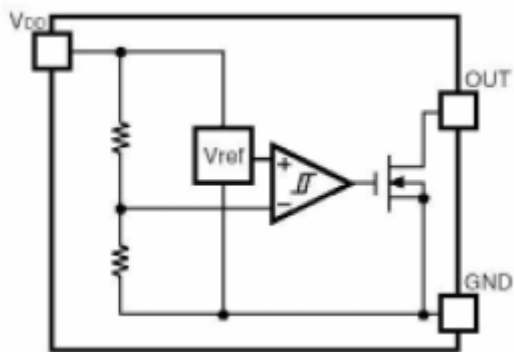
Pin number				Pin name	Description
SOT-23-3	SOT-89-3	SOT-23-5	TO-92		
1	1	1	3	V _{OUT}	Voltage detection output Pin
3	2	2	1	V _{DD}	Voltage input Pin
2	3	3	2	V _{SS}	GND Pin
		4		NC	No connection
		5		NC	No connection

Ordering information

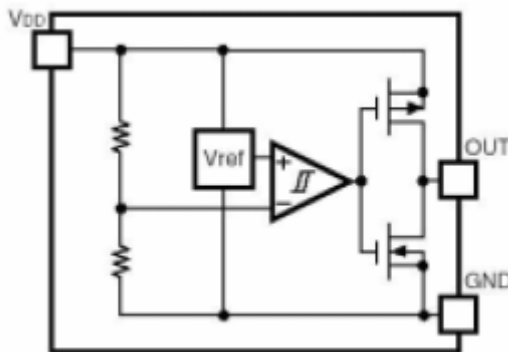
Selection Guide



Block diagram



N channel open-drain



CMOS output

Recommended Work Conditions

Item	Min	Recommended	Max	Unit
Input Voltage	0.7		10	V
Ambient temperature	-40	25	70	°C

Electrical Characteristics:

ACE301C/N09XX + (0.9V)

(T_{opt}=25°C, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		0.882	0.9	0.918	V
V _{HYS}	Detector Threshold Hysteresis		0.018	0.036	0.054	V
I _{SS}	Current Consumption	V _{DD} =2.9V		1	1.5	uA
V _{DDH}	Maximum Operating Voltage				10	V
V _{DDL}	Minimum Operating Voltage			0.5		V
I _{OUT}	Output Current	Nch V _{DS} =0.05V, V _{DD} =0.7V V _{DS} =0.50V, V _{DD} =0.8V	0.01 0.05	0.05 0.50		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA
T _{PLH}	Output Delay Time				20	uS

ACE301C/N27XX + (2.7V)

(T_{opt}=25°C, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		2.646	2.7	2.754	V
V _{HYS}	Detector Threshold Hysteresis		0.054	0.108	0.162	V
I _{SS}	Current Consumption	V _{DD} =4.7V		0.5	1	uA
V _{DDH}	Maximum Operating Voltage				10	V
V _{DDL}	Minimum Operating Voltage			0.5		V
I _{OUT}	Output Current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA
T _{PLH}	Output Delay Time				20	uS

ACE301C/N30XX + (3.0V)

(T_{opt}=25°C, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		2.94	3.0	3.06	V
V _{HYS}	Detector Threshold Hysteresis		0.060	0.12	0.18	V
I _{SS}	Current Consumption	V _{DD} =5.0V		0.5	1	uA
V _{DDH}	Maximum Operating Voltage				10	V
V _{DDL}	Minimum Operating Voltage			0.5		V
I _{OUT}	Output Current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA
T _{PLH}	Output Delay Time				20	uS

ACE301C/N34XX + (3.4V)

(T_{opt}=25°C, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		3.332	3.4	3.468	V
V _{HYS}	Detector Threshold Hysteresis		0.068	0.136	0.204	V
I _{SS}	Current Consumption	V _{DD} =5.0V		0.5	1	uA
V _{DDH}	Maximum Operating Voltage				10	V
V _{DDL}	Minimum Operating Voltage			0.5		V
I _{OUT}	Output Current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =4.50V	1.0	2.0		mA
T _{PLH}	Output Delay Time				20	uS

ACE301C/N44XX + (4.4V)

(T_{opt}=25°C, Unless otherwise specified.)

Symbol	Parameter	Conditions	Reference data			Unit
			Min.	Typ.	Max.	
-V _{DET}	Detector Threshold		4.312	4.4	4.488	V
V _{HYS}	Detector Threshold Hysteresis		0.088	0.176	0.264	V
I _{SS}	Current Consumption	V _{DD} =6.4V		0.5	1	uA
V _{DDH}	Maximum Operating Voltage				10	V
V _{DDL}	Minimum Operating Voltage			0.5		V
I _{OUT}	Output Current	Nch V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05		mA
		Pch V _{DS} =-2.1V, V _{DD} =8.0V	1.5	3.0		mA
T _{PLH}	Output Delay Time				20	uS

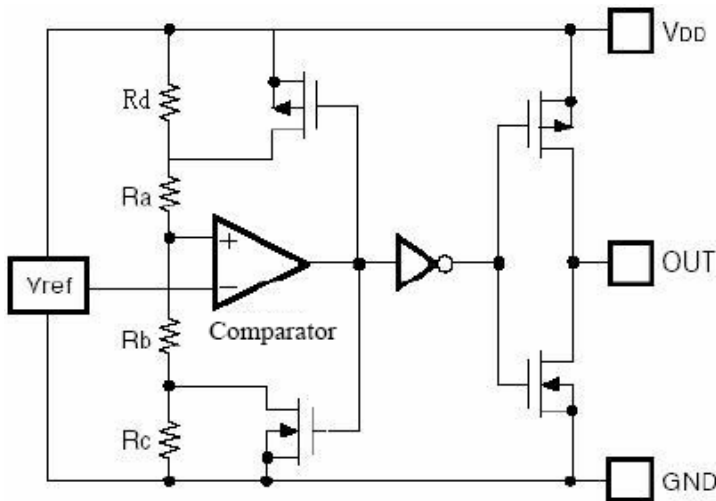
Electrical Characteristics by Detector Threshold

Part Number	Detector Threshold			Detector Threshold Hysteresis			Supply Current1			Supply Current2				
	-Vdet[V]			Vhys[V]			Iss1[uA]			Iss2[uA]				
	Min.	Typ.	Max.	Min.	Typ.	Max.	Condition	Typ.	Max.	Condition	Typ.	Max.		
ACE301X09XX+	0.882	0.900	0.918	0.018	0.036	0.054	Vdd= (-Vdet)+0.1V	0.5	1.0	Vdd= (-Vdet)+2V	1.0	1.5		
ACE301X10XX+	0.980	1.000	1.020	0.020	0.040	0.060								
ACE301X11XX+	1.078	1.100	1.122	0.022	0.044	0.066								
ACE301X12XX+	1.176	1.200	1.224	0.024	0.048	0.072								
ACE301X13XX+	1.274	1.300	1.326	0.026	0.052	0.078								
ACE301X14XX+	1.372	1.400	1.428	0.028	0.056	0.084								
ACE301X15XX+	1.470	1.500	1.530	0.030	0.060	0.090								
ACE301X16XX+	1.568	1.600	1.632	0.032	0.064	0.096								
ACE301X17XX+	1.666	1.700	1.734	0.034	0.068	0.102								
ACE301X18XX+	1.764	1.800	1.836	0.036	0.072	0.108								
ACE301X19XX+	1.862	1.900	1.938	0.038	0.076	0.114								
ACE301X20XX+	1.960	2.000	2.040	0.040	0.080	0.120							0.5	1.0
ACE301X21XX+	2.058	2.100	2.142	0.042	0.084	0.126								
ACE301X22XX+	2.156	2.200	2.244	0.044	0.088	0.132								
ACE301X23XX+	2.254	2.300	2.346	0.046	0.092	0.138								
ACE301X24XX+	2.352	2.400	2.448	0.048	0.096	0.144								
ACE301X25XX+	2.450	2.500	2.550	0.050	0.100	0.150								
ACE301X26XX+	2.548	2.600	2.652	0.052	0.104	0.156								
ACE301X27XX+	2.646	2.700	2.754	0.054	0.108	0.162								
ACE301X28XX+	2.744	2.800	2.856	0.056	0.112	0.168								
ACE301X29XX+	2.842	2.900	2.958	0.058	0.116	0.174								
ACE301X30XX+	2.940	3.000	3.060	0.060	0.120	0.180								
ACE301X31XX+	3.038	3.100	3.162	0.062	0.124	0.186								
ACE301X32XX+	3.136	3.200	3.264	0.064	0.128	0.192								
ACE301X33XX+	3.234	3.300	3.366	0.066	0.132	0.198								
ACE301X34XX+	3.332	3.400	3.468	0.068	0.136	0.204								
ACE301X35XX+	3.430	3.500	3.570	0.070	0.140	0.210								
ACE301X36XX+	3.528	3.600	3.672	0.072	0.144	0.216								
ACE301X37XX+	3.626	3.700	3.774	0.074	0.148	0.222								
ACE301X38XX+	3.724	3.800	3.876	0.076	0.152	0.228								
ACE301X39XX+	3.822	3.900	3.978	0.078	0.156	0.234								
ACE301X40XX+	3.920	4.000	4.080	0.080	0.160	0.240								
ACE301X41XX+	4.018	4.100	4.182	0.082	0.164	0.246								
ACE301X42XX+	4.116	4.200	4.284	0.084	0.168	0.252								
ACE301X43XX+	4.214	4.300	4.386	0.086	0.172	0.258								

ACE301X44XX+	4.312	4.400	4.488	0.088	0.176	0.264						
ACE301X45XX+	4.410	4.500	4.590	0.090	0.180	0.270						
ACE301X46XX+	4.508	4.600	4.692	0.092	0.184	0.276						
ACE301X47XX+	4.606	4.700	4.794	0.094	0.188	0.282						
ACE301X48XX+	4.704	4.800	4.896	0.096	0.192	0.288						
ACE301X49XX+	4.802	4.900	4.998	0.098	0.196	0.294						
ACE301X50XX+	4.900	5.000	5.100	0.100	0.200	0.300						
ACE301X51XX+	4.998	5.100	5.202	0.102	0.204	0.306						
ACE301X52XX+	5.096	5.200	5.304	0.104	0.208	0.312						
ACE301X53XX+	5.194	5.300	5.406	0.106	0.212	0.318						
ACE301X54XX+	5.292	5.400	5.508	0.108	0.216	0.324						
ACE301X55XX+	5.390	5.500	5.610	0.110	0.220	0.330						
ACE301X56XX+	5.488	5.600	5.712	0.112	0.224	0.336						
ACE301X57XX+	5.586	5.700	5.814	0.114	0.228	0.342						
ACE301X58XX+	5.684	5.800	5.916	0.116	0.232	0.348						
ACE301X59XX+	5.782	5.900	6.018	0.118	0.236	0.354						
ACE301X60XX+	5.880	6.000	6.120	0.120	0.240	0.360						

Output Current1			Output Current2				Output Delay Time	Minimum Operation Voltage			Detector Threshold Temperature Coefficient	
Iout1[mA]			Iout2[mA]				T _{PLH} [us]	V _{DDL} [V]			Δ-V _{DET} /ΔTppm/°C	
Condition	Min.	Typ.	Condition		Min.	Typ.	Max.	Typ.	Max.	Condition	Typ.	
NCH, V _{DS} =0.05V, V _{DD} =0.7V	0.01	0.05	NCH, V _{DS} =0.5V	V _{DD} =0.85V	0.1	0.5	20	0.5	0.7	-40°C ≤ T _{opt} ≤ 85°C	±100	
				V _{DD} =1.0V	0.2	1.0						
				V _{DD} =1.5V	1.0	2.0						

Function description



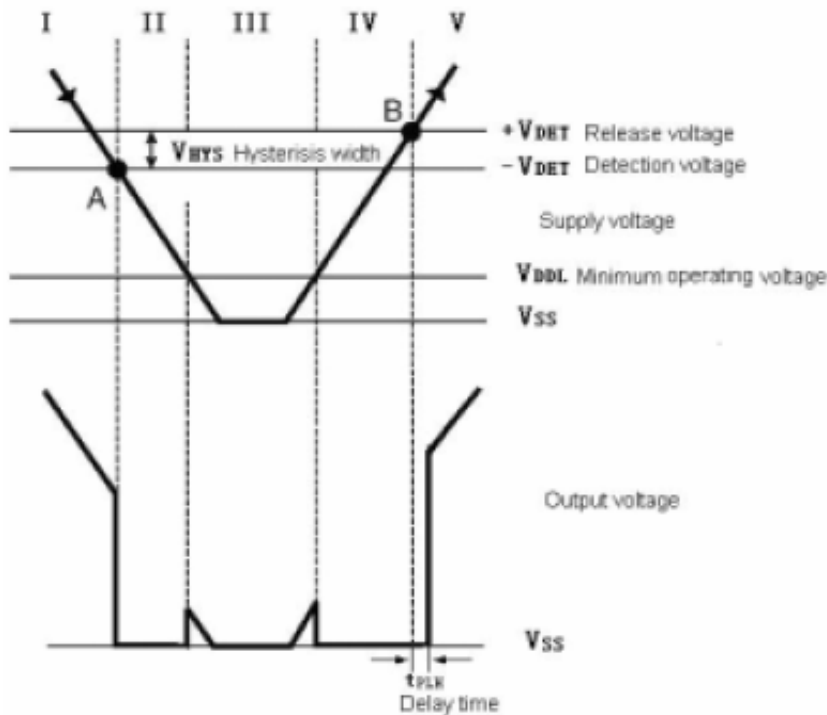
High precision low temperature co-efficiency reference voltage is applied to the negative input of a comparator. Input voltage, divided by resistor array of Ra Rb and Rc, is applied to the positive input of the comparator. Output of the comparator controls a pair of NMOS and PMOS switches, generating the hysteresis. Output of the comparator passes a series of buffer to drive the output CMOS pair.

$+V_{DET}$, $-V_{DET}$, V_{HYS} can be calculated as follows:

$$-V_{DET} = V_{REF} * (1 + Ra / (Rb + Rc))$$

$$+V_{DET} = V_{REF} * (1 + (Ra + Rb) / Rb) = V_{REF} * (1 + (Ra + Rc) / Rb)$$

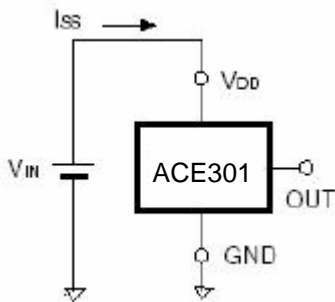
$$V_{HYS} = +V_{DET} - (-V_{DET}) = V_{REF} * (Ra + Rb + Rc) * (1/Rb - 1/(Rb + Rc))$$



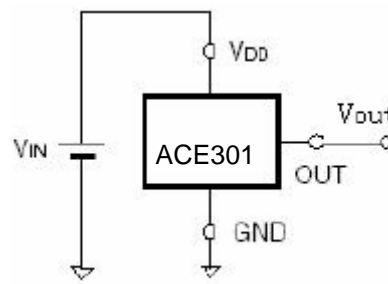
No.	Operation status	Output status
I	$V_{DD} > -V_{DET}$	Output voltage is equal to the supply voltage
II	V_{DD} drops below $-V_{DET}$	Output voltage equals to GNP level
III	V_{DD} drops further below V_{DDL}	Output voltage is undefined
IV	V_{DD} rises above V_{DDL}	Output voltage equals to GNP level
V	V_{DD} rises above $+V_{DET}$	Output voltage equals to supply voltage, $V_{HYS} = (+V_{DET}) - (-V_{DET})$

Test circuits

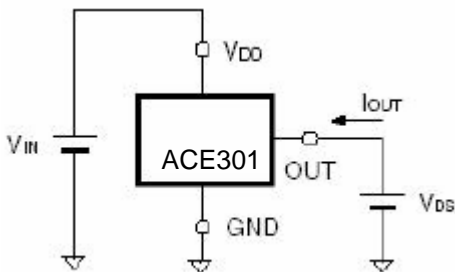
(1) Supply current test circuit



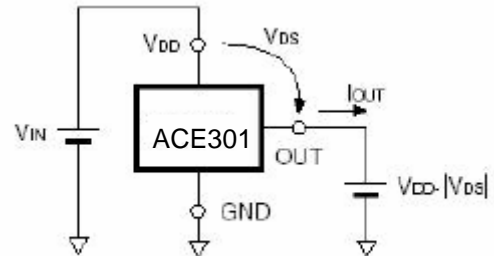
(2) Detector threshold test circuit



(3) NCH Drive Output Current Test Circuit



(4) PCH Drive Output Current Test Circuit

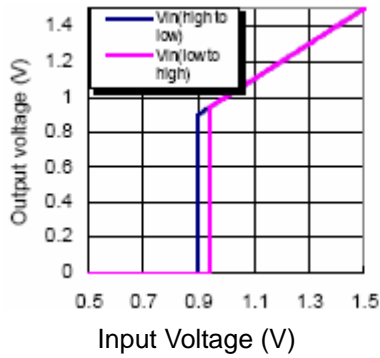


Typical Performance Characteristics

(1) Output voltage VS. Input Voltage

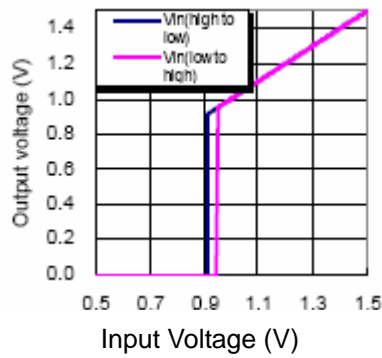
Detector threshold=0.9V

(-40°C)



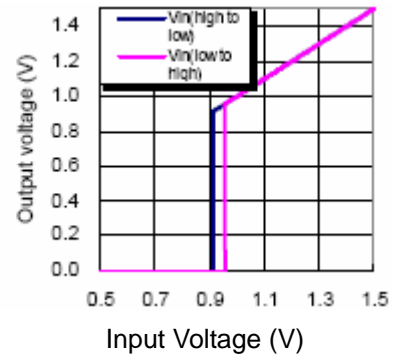
Detector threshold=0.9V

(25°C)



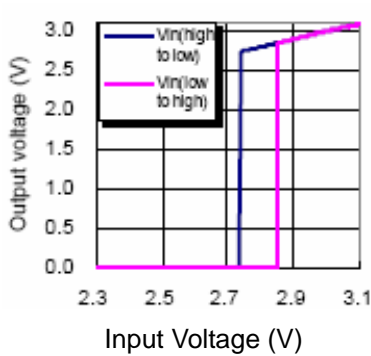
Detector threshold=0.9V

(70°C)



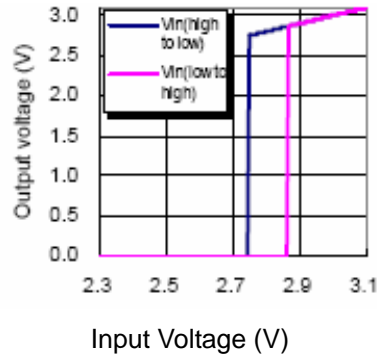
Detector threshold=2.7V

(-40°C)



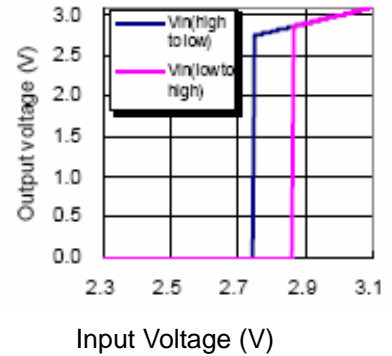
Detector threshold=2.7V

(25°C)



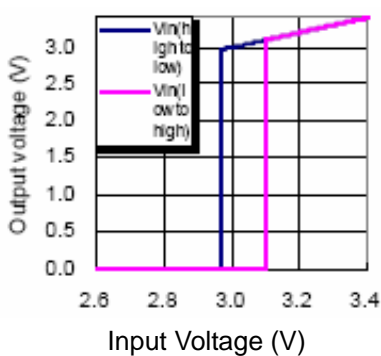
Detector threshold=2.7V

(70°C)



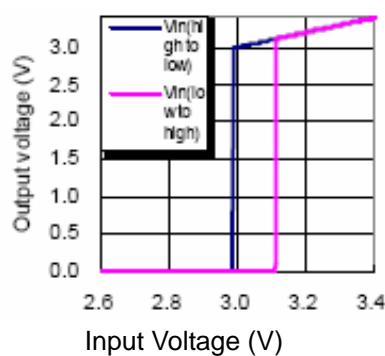
Detector threshold=3.0V

(-40°C)



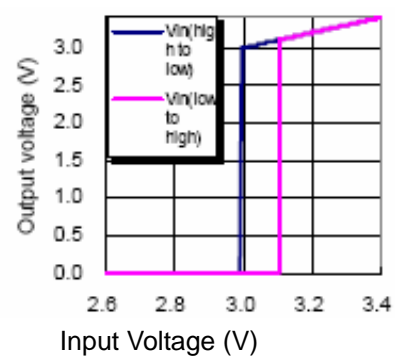
Detector threshold=3.0V

(25°C)

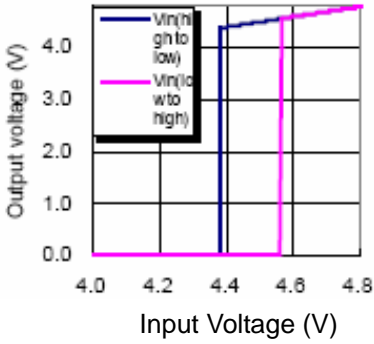


Detector threshold=3.0V

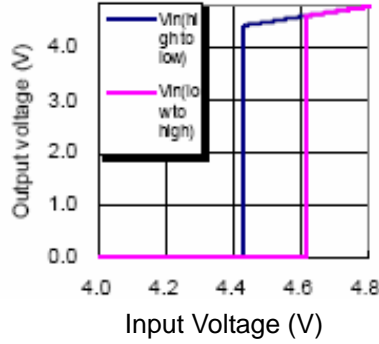
(70°C)



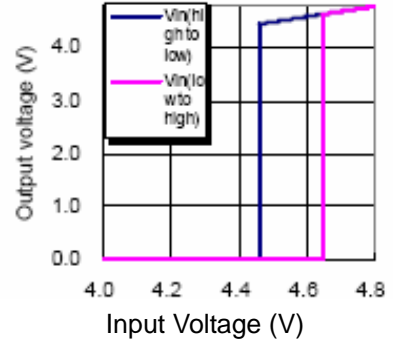
Detector threshold=4.4V
(-40°C)



Detector threshold=4.4V
(25°C)

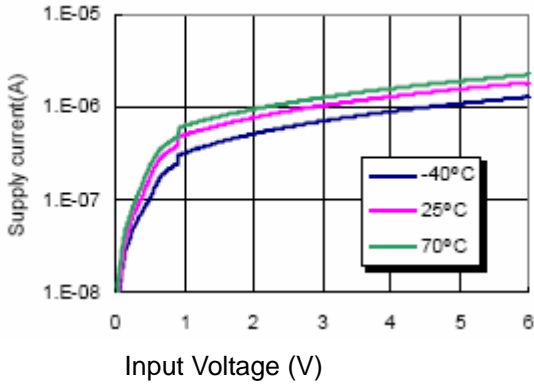


Detector threshold=4.4V
(70°C)

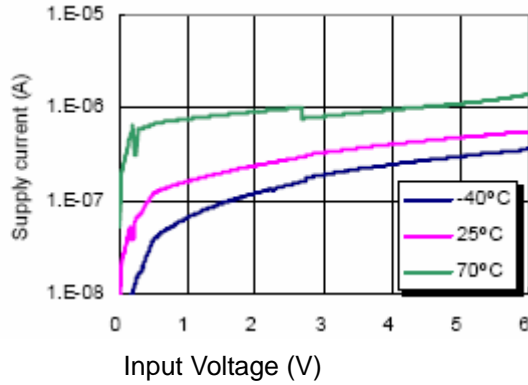


(2) Supply current VS. Input Voltage

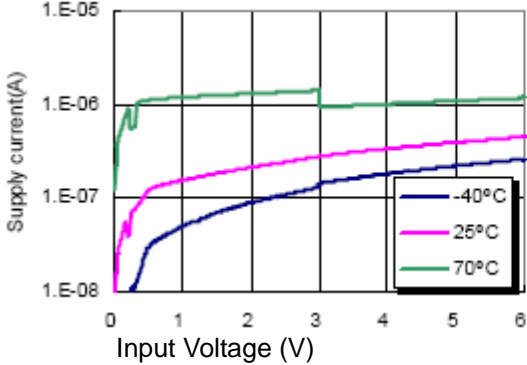
Detector threshold=0.9V



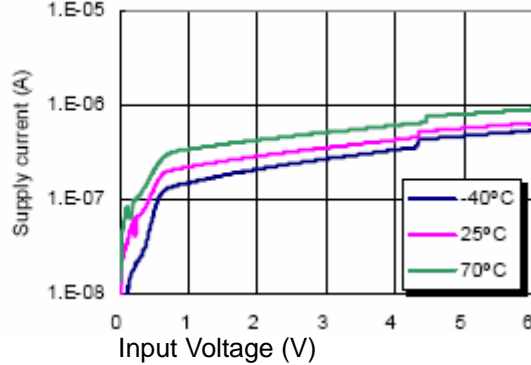
Detector threshold=2.7V



Detector threshold=3.0V

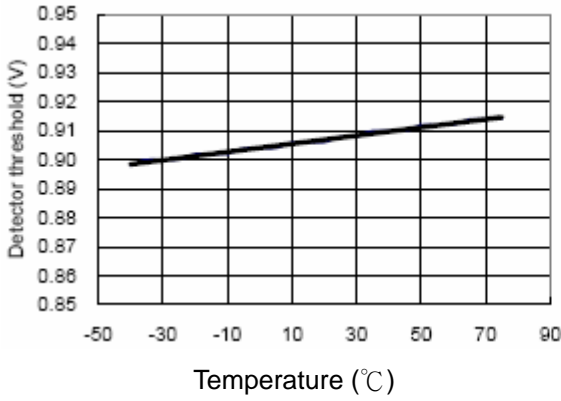


Detector threshold=4.4V

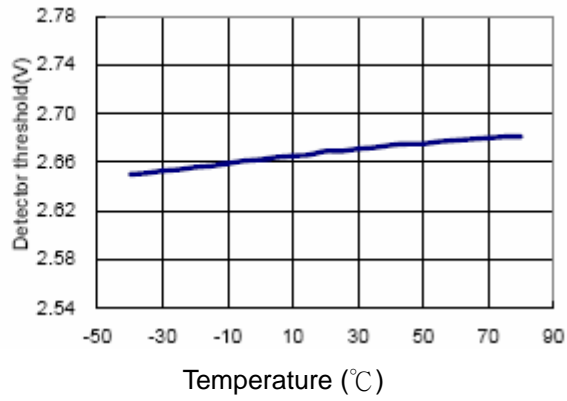


(3) Detector Threshold Hysteresis VS. Temperature

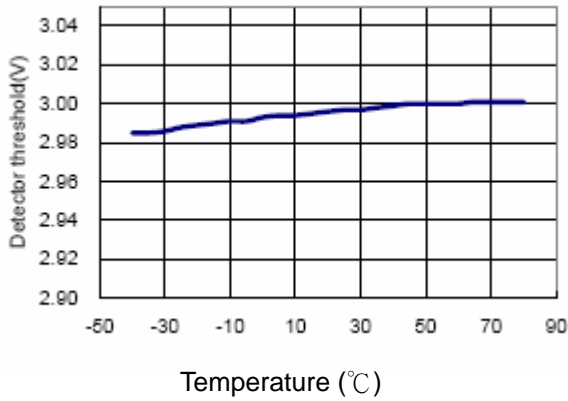
Detector threshold=0.9V



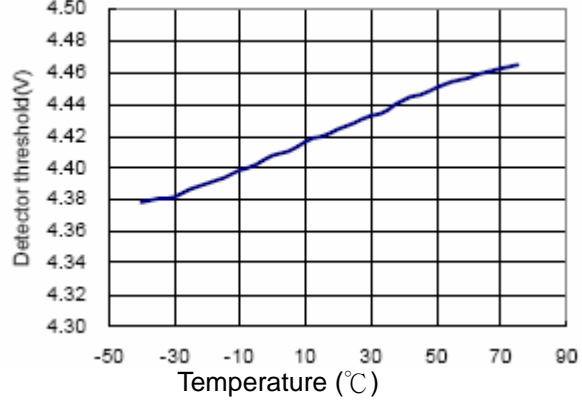
Detector threshold=2.7V



Detector threshold=3.0V

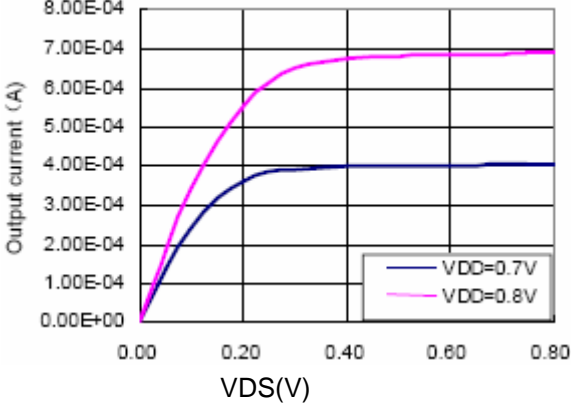


Detector threshold=4.4V

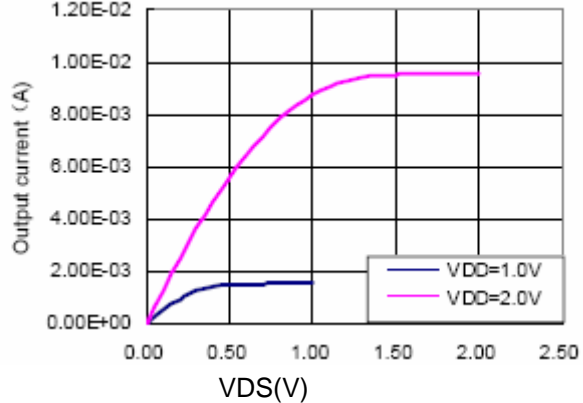


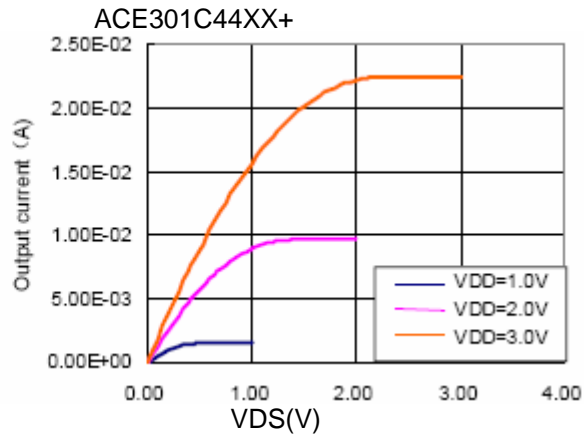
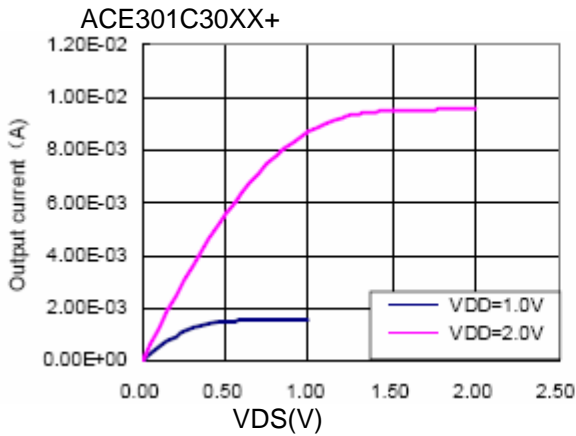
(4) Nch Driver Output Current VS. Vds

ACE301C09XX+



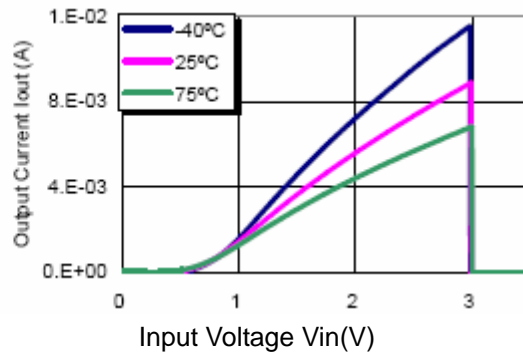
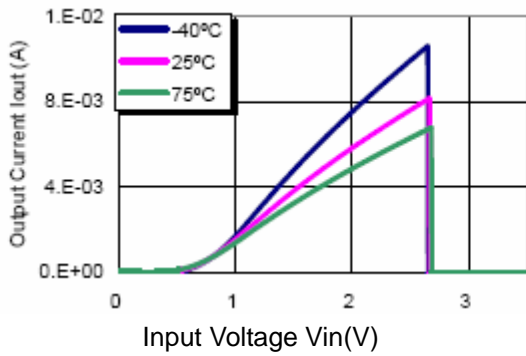
ACE301C27XX+





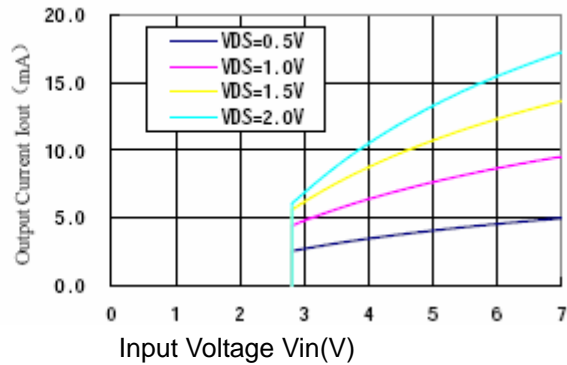
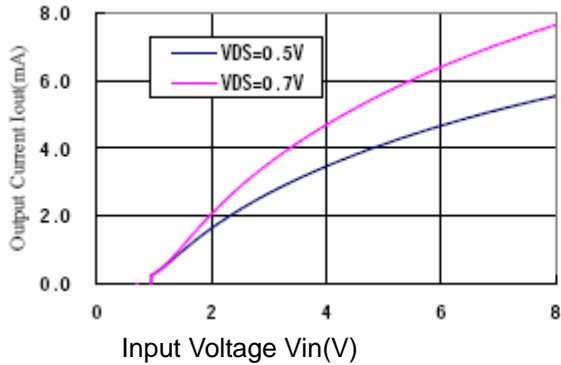
(5) Nch Driver Output Current VS. Input Voltage
Detector threshold=2.7V

Detector threshold=3.0V

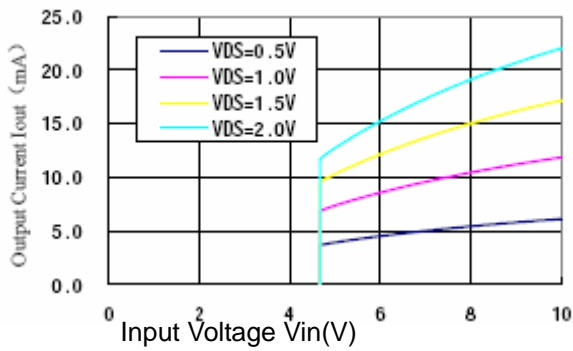


(6) PCH Driver Output Current VS. Input Current
Detector threshold=0.9V

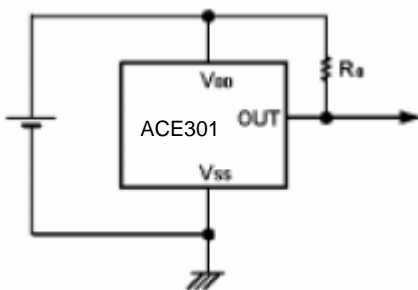
Detector threshold=2.7V



Detector threshold=4.4V



Typical applications

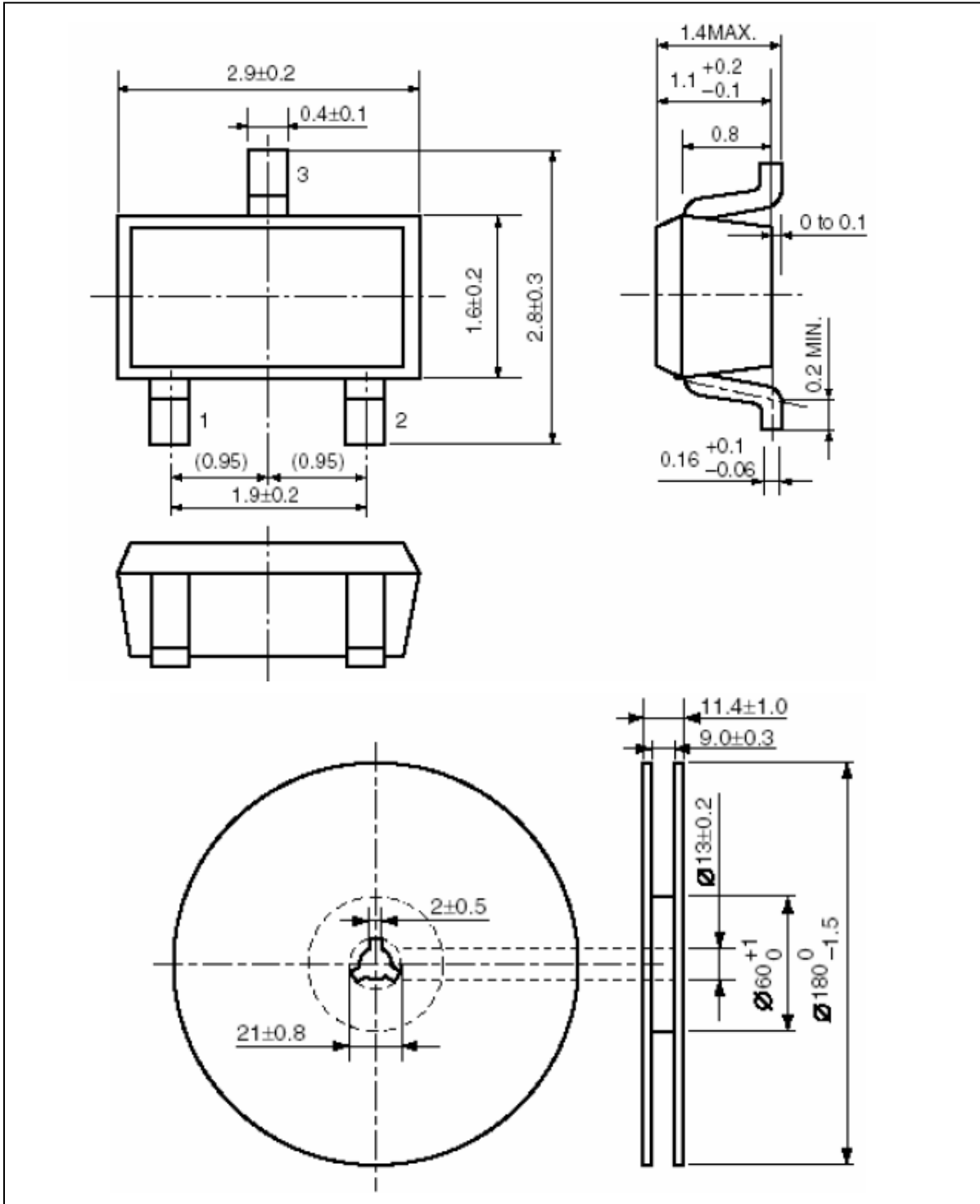


Note:

1. R_0 is unnecessary for CMOS output products.
2. The value of R_0 need to be selected in different application, Typical value is $470k\Omega$.

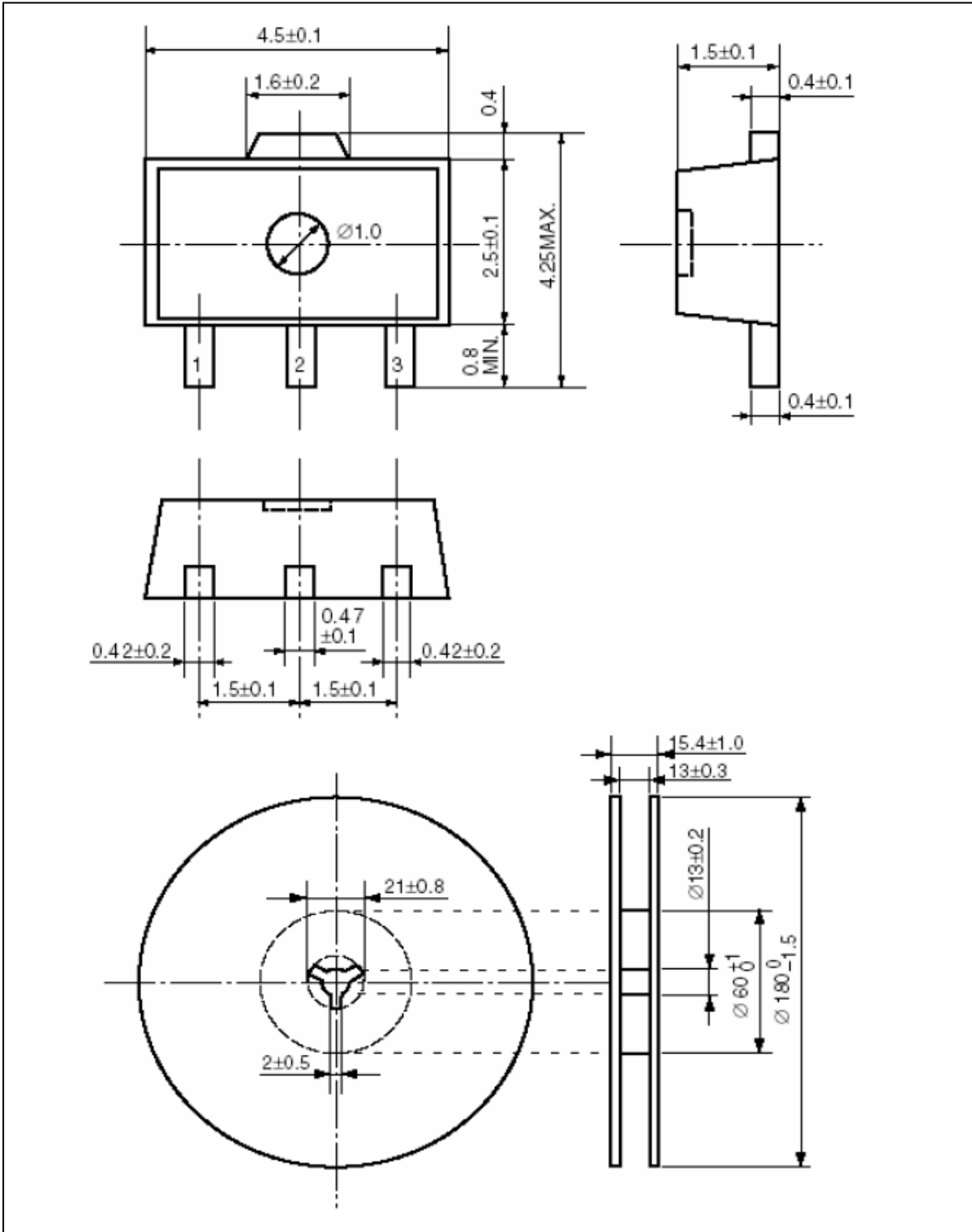
Packing Information

SOT-23-3



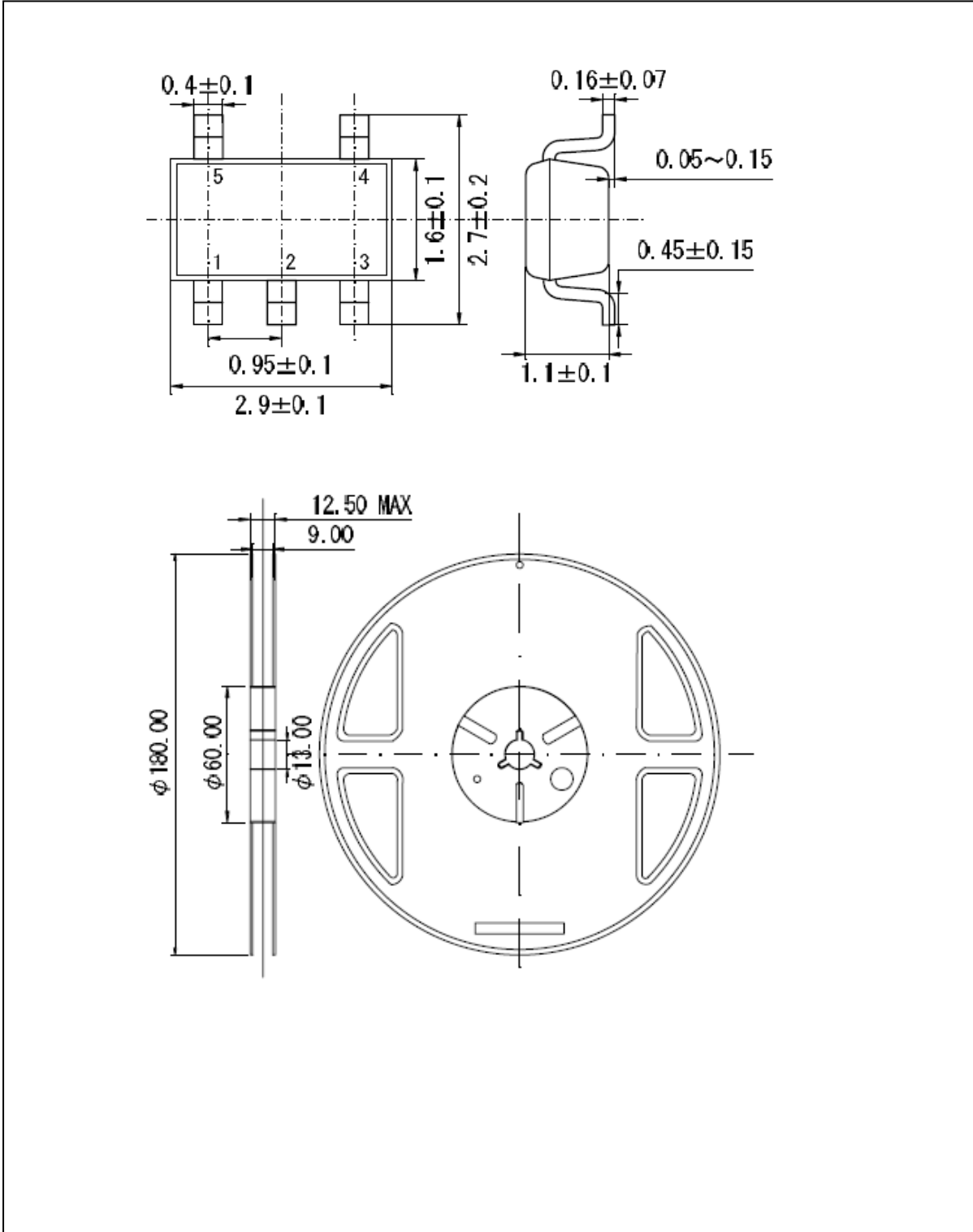
Packing Information

SOT-89-3



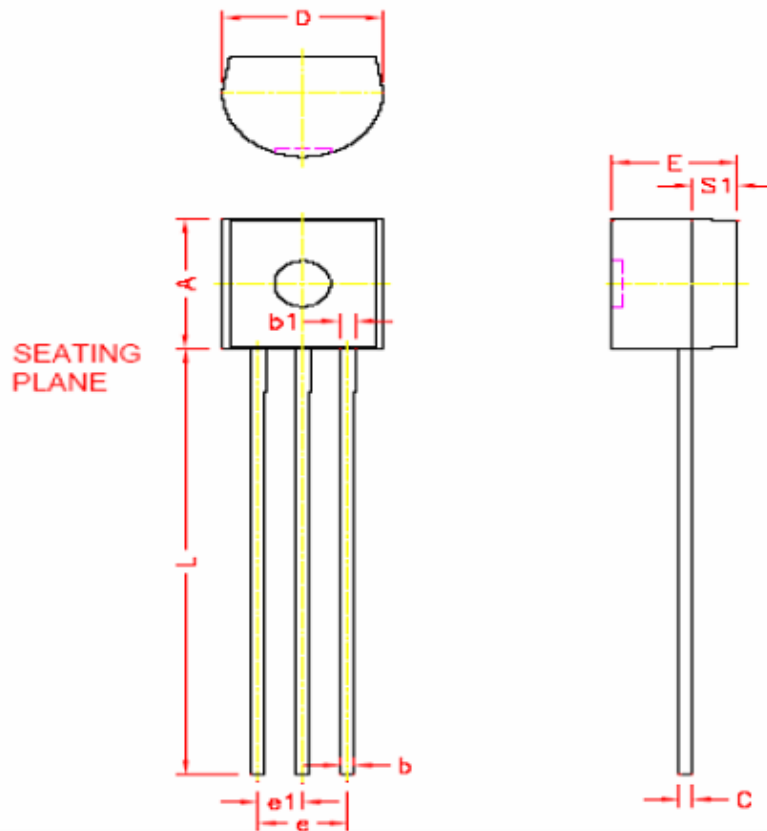
Packing Information

SOT-23-5



Packing Information

TO-92



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.45	4.70	D	4.44	4.7
S1	1.02	—	E	3.30	3.81
b	0.36	0.51	L	12.70	—
b1	0.36	0.76	e1	1.15	1.39
C	0.36	0.51	e	2.42	2.66

Notes

ACE does not assume any responsibility for use as critical components in life support devices or systems without the express written approval of the president and general counsel of ACE Electronics Co., LTD. As sued herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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