



# TS7211

## SINGLE BiCMOS RAIL TO RAIL μPOWER COMPARATOR

- RAIL TO RAIL INPUTS
- PUSH-PULL OUTPUT
- SUPPLY OPERATION FROM 2.7V TO 10V
- TYPICAL SUPPLY CURRENT: 6μA @ 5V
- RESPONSE TIME OF 0.5μs AT 5V
- LOW INPUT CURRENT
- ESD PROTECTION : 2KV (HBM) 200V (MM)
- AVAILABLE IN TINY SOT23-5 PACKAGE

### DESCRIPTION

The TS7211 is a micropower comparator featuring rail to rail input performance in a tiny SOT23-5 package. This comparator is ideally suited to space and weight critical applications. It is fully specified at 2.7V, 5V and 10V operations over the industrial temperature range (-40/+85°C).

The TS7211 features a push-pull output stage. The speed to power ratio makes this device ultra versatile for a wide range of applications.

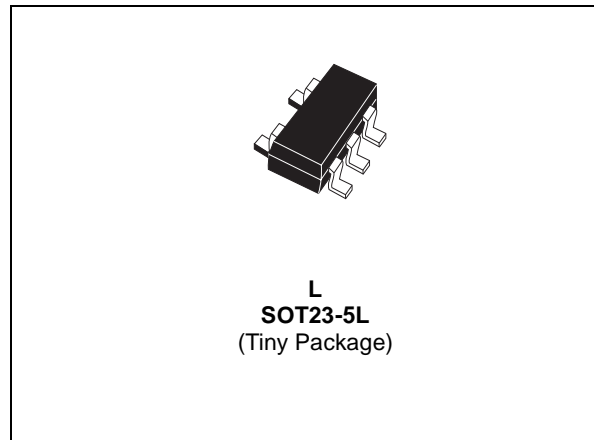
### APPLICATIONS

- Battery powered systems
- Notebooks and PDAs
- PCMCIA cards
- Cellulare and mobile communication
- Alarm and security systems
- Replacement of amplifiers used in comparator configuration with better performances

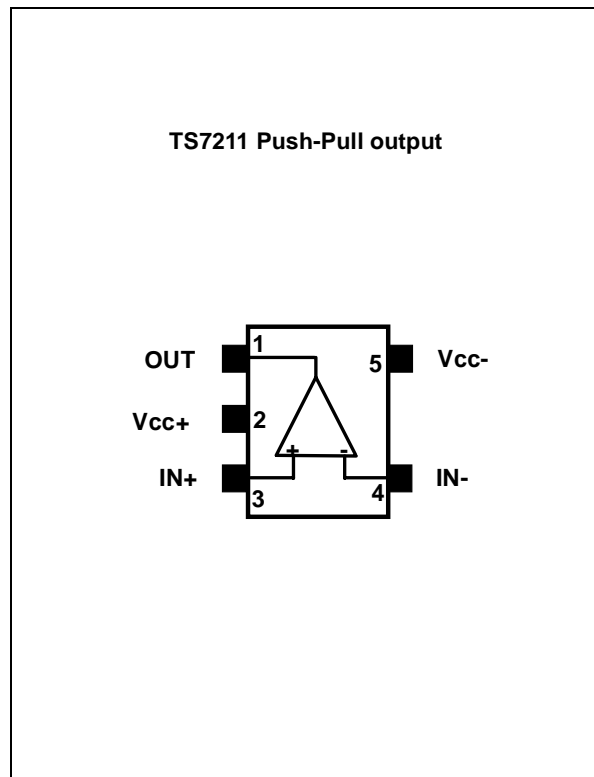
### ORDER CODE

Part Number	Temperature Range	Package	SOT23-5 Marking
		L	
TS7211AI	-40°C, +85°C	•	K515
TS7211BI		•	K516
Example : TS7211AILT			

L = Tiny Package (SOT23-5) - only available in Tape & Reel (LT)



### PIN CONNECTIONS (top view)



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
ESD	Human body model (HBM)	2000	V
	Machine model (MM)	200	
$V_{ID}$	Differential Input Voltage	$(V_{CC}^-) - 0.3$ to $(V_{CC}^+) + 0.3$	V
$V_{IN}$ & $V_{OUT}$	Input and output Voltages <sup>1)</sup>	$(V_{CC}^-) - 0.3$ to $(V_{CC}^+) + 0.3$	V
$V_{CC}$	Supply voltage	12	V
$I_{IN}$	Current at input pins	$\pm 5$	mA
$I_{OUT}$	Current at output pin	$\pm 30$	mA
$T_{Lead}$	Lead temperature (soldering 10 seconds)	250	°C
$T_{STG}$	Storage Temperature	-65 to +150	°C
$T_J$	Junction Temperature	150	°C
$P_D$	Power dissipation <sup>2)</sup> SOT23-5	500	mW

1. The magnitude of input and output voltages must never exceed 0.3V beyond the supply voltage.

2.  $T_J = 150^\circ\text{C}$ ,  $T_{AMB} = 25^\circ\text{C}$  with  $R_{TH-JA} = 250^\circ\text{C/W}$  for SOT23-5 package

**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	2.7 to 10	V
$T_{AMB}$	Ambient Temperature	-40 to +85	°C
$V_{ICM}$	Common mode input voltage range	$(V_{CC}^-) - 0.3$ to $(V_{CC}^+) + 0.3$	V

**ELECTRICAL CHARACTERISTICS** $V_{CC}^+ = 2.7V$ ,  $T_{AMB} = 25^\circ C$  (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{IO}$	Input Offset Voltage (Full common mode range) TS7211A $T_{MIN} \leq T_{AMB} \leq T_{MAX}$  TS7211B $T_{MIN} \leq T_{AMB} \leq T_{MAX}$			7 10  15 18	mV
$\Delta V_{IO}$	Input Offset Voltage Drift with temperature		6		$\mu V/^\circ C$
$I_{IB}$	Input Bias Current <sup>1)</sup> $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		1	300 600	pA
$I_{IO}$	Input Offset Current <sup>1)</sup> $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		1	150 300	pA
CMRR	Common-mode Rejection Ratio ( $0 < V_{icm} < 2.7V$ )		65		dB
PSRR	Power Supply Rejection Ratio ( $2.7 < V_{CC} < 10V$ )		80		dB
$A_{VD}$	Voltage Gain <sup>2)</sup>		240		dB
$V_{ICM}$	Input Common Mode Voltage Range (upper rail) $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	3 2.7			V
	Input Common Mode Voltage Range (lower rail) $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	-0.3 0.0			
$V_{OH}$	High Level Output Voltage - $I_{source} = 2.5mA$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	2.35 2.15	2.45		V
$V_{OL}$	Low Level Output Voltage - $I_{sink} = 2.5mA$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		0.2	0.35 0.45	V
$I_{CC}$	Supply Current No load, output low		6	12	$\mu A$
	No load, output high		8	14	
$T_{PLH}$	Response Time Low to High ( $V_{ic} = 1.35V$ , $C_L = 50pF$ ) Overdrive = 10mV Overdrive = 100mV		1.5 0.6		$\mu s$
$T_{PHL}$	Response Time Low to High ( $V_{ic} = 1.35V$ , $C_L = 50pF$ ) Overdrive = 10mV Overdrive = 100mV		1.5 0.5		$\mu s$
$T_F$	Fall Time ( $C_L = 50pF$ ) Overdrive = 100mV		20		ns
$T_R$	Rise Time ( $C_L = 50pF$ ) Overdrive = 100mV		20		ns

1) Maximum values include unavoidable inaccuracies of the industrial test.

2) Design evaluation.

3) Limits are 100% production tested at +25°C. Limits over temperature are guaranteed through correlation and by design.

**ELECTRICAL CHARACTERISTICS**

$V_{CC}^+ = 5V$ ,  $T_{AMB} = 25^{\circ}C$  (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{IO}$	Input Offset Voltage (Full common mode range) TS7211A $T_{MIN} \leq T_{AMB} \leq T_{MAX}$			7 10	mV
	TS7211B $T_{MIN} \leq T_{AMB} \leq T_{MAX}$			15 18	
$\Delta V_{IO}$	Input Offset Voltage Drift with temperature		6		$\mu V/^{\circ}C$
$I_{IB}$	Input Bias Current <sup>1)</sup> $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		1	300 600	pA
$I_{IO}$	Input Offset Current <sup>1)</sup> $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		1	150 300	pA
CMRR	Common-mode Rejection Ratio ( $0 < V_{icm} < 5V$ )		70		dB
PSRR	Power Supply Rejection Ratio ( $2.7 < V_{CC} < 10V$ )		80		dB
$A_{VD}$	Voltage Gain <sup>2)</sup>		240		dB
$V_{ICM}$	Input Common Mode Voltage Range (upper rail) $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	5.3 5.0			V
	Input Common Mode Voltage Range (lower rail) $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	-0.3 0.0			
$V_{OH}$	High Level Output Voltage - $I_{source} = 5mA$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	4.6 4.45	4.8		V
$V_{OL}$	Low Level Output Voltage - $I_{sink} = 5mA$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		0.2	0.40 0.55	V
$I_{CC}$	Supply Current No load, output low		6	12	$\mu A$
	No load, output high		8	14	
$T_{PLH}$	Response Time Low to High ( $V_{ic} = 2.5V$ , $C_L = 50pF$ ) Overdrive = 10mV Overdrive = 100mV		2 0.5		$\mu s$
$T_{PHL}$	Response Time Low to High ( $V_{ic} = 2.5V$ , $C_L = 50pF$ ) Overdrive = 10mV Overdrive = 100mV		2 0.4		$\mu s$
$T_F$	Fall Time ( $C_L = 50pF$ ) Overdrive = 100mV		20		ns
$T_R$	Rise Time ( $C_L = 50pF$ ) Overdrive = 100mV		20		ns

1) Maximum values include unavoidable inaccuracies of the industrial test.

2) Design evaluation.

3) Limits are 100% production tested at +25°C. Limits over temperature are guaranteed through correlation and by design.

**ELECTRICAL CHARACTERISTICS** $V_{CC}^+ = 10V$ ,  $T_{AMB} = 25^\circ C$  (unless otherwise specified)

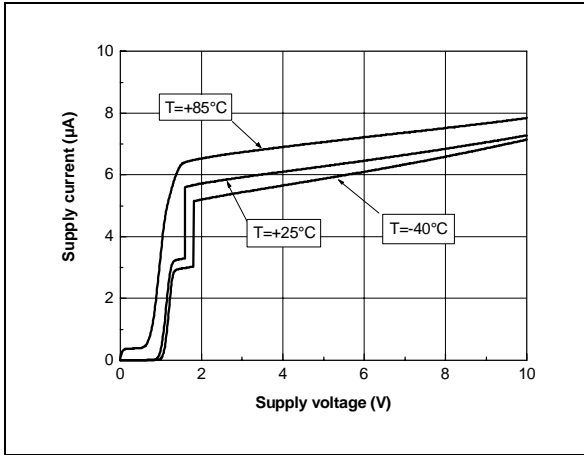
Symbol	Parameter	Min.	Typ.	Max.	Unit
$V_{IO}$	Input Offset Voltage (Full common mode range) TS7211A $T_{MIN} \leq T_{AMB} \leq T_{MAX}$  TS7211B $T_{MIN} \leq T_{AMB} \leq T_{MAX}$			7 10  15 18	mV
$\Delta V_{IO}$	Input Offset Voltage Drift with temperature		6		$\mu V/^\circ C$
$I_{IB}$	Input Bias Current <sup>1)</sup> $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		1	300 600	pA
$I_{IO}$	Input Offset Current <sup>1)</sup> $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		1	150 300	pA
CMRR	Common-mode Rejection Ratio ( $0 < V_{icm} < 10V$ )		75		dB
PSRR	Power Supply Rejection Ratio ( $2.7 < V_{CC} < 10V$ )		80		dB
$A_{VD}$	Voltage Gain <sup>2)</sup>		240		dB
$V_{ICM}$	Input Common Mode Voltage Range (upper rail) $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	10.3 10.0			V
	Input Common Mode Voltage Range (lower rail) $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	-0.3 0.0			
$V_{OH}$	High Level Output Voltage - $I_{source} = 5mA$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$	9.6 9.45	9.8		V
$V_{OL}$	Low Level Output Voltage - $I_{sink} = 5mA$ $T_{MIN} \leq T_{AMB} \leq T_{MAX}$		0.2	0.40 0.55	V
$I_{CC}$	Supply Current No load, output low  No load, output high		7 10	14 16	$\mu A$
$T_{PLH}$	Response Time Low to High ( $V_{ic} = 5V$ , $C_L = 50pF$ ) Overdrive = 10mV Overdrive = 100mV		3 0.5		$\mu s$
$T_{PHL}$	Response Time Low to High ( $V_{ic} = 5V$ , $C_L = 50pF$ ) Overdrive = 10mV Overdrive = 100mV		4 0.4		$\mu s$
$T_F$	Fall Time ( $C_L = 50pF$ ) Overdrive = 100mV		20		ns
$T_R$	Rise Time ( $C_L = 50pF$ ) Overdrive = 100mV		20		ns

1) Maximum values include unavoidable inaccuracies of the industrial test.

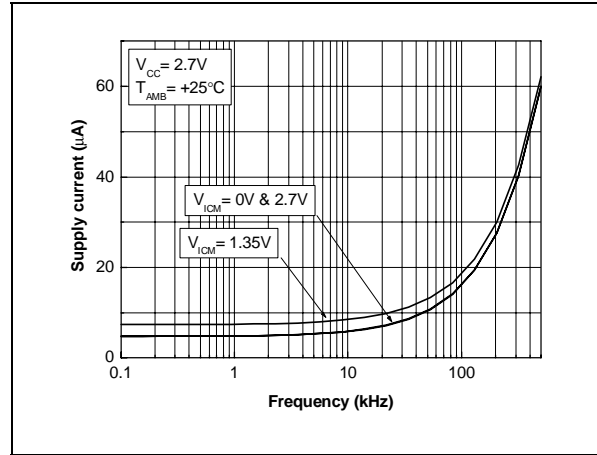
2) Design evaluation.

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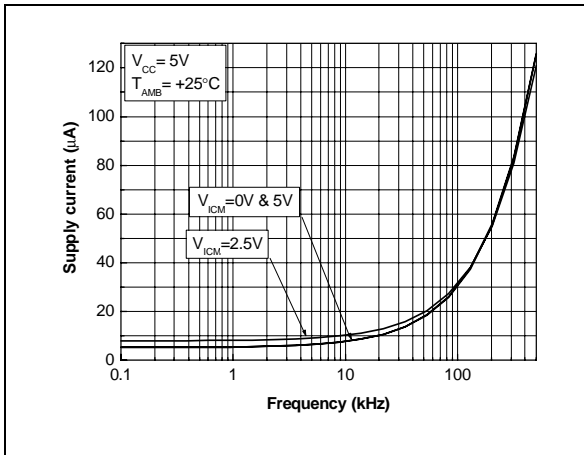
Supply current versus supply voltage  
(Output low)



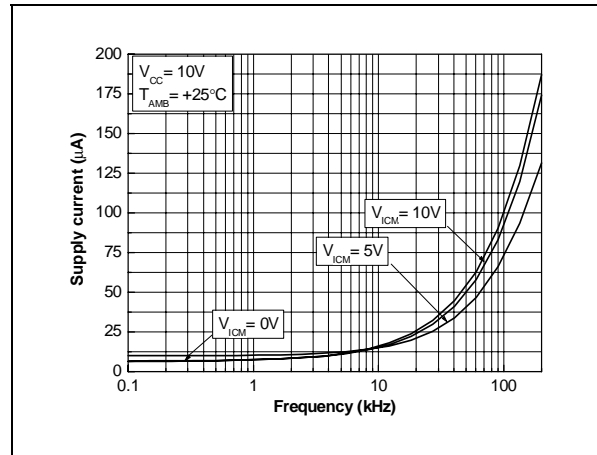
$I_{CC}$  versus output frequency  
and  $V_{ICM}$  @  $V_{CC} = 2.7V$



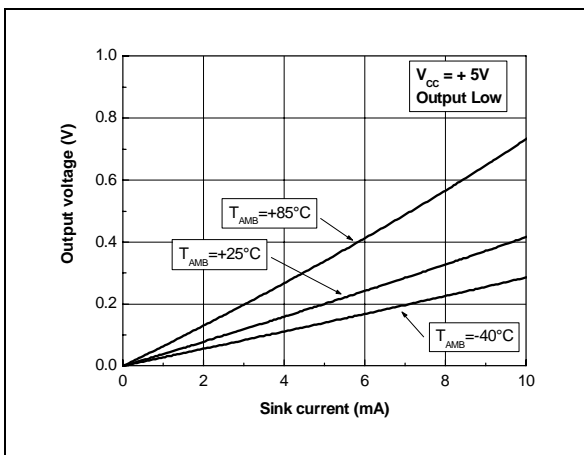
$I_{CC}$  versus frequency and  $V_{ICM}$  @  $V_{CC} = 5V$



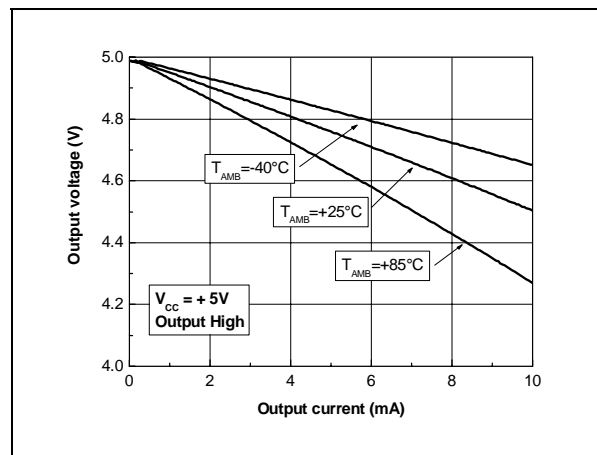
$I_{CC}$  versus frequency and  $V_{ICM}$  @  $V_{CC} = 10V$



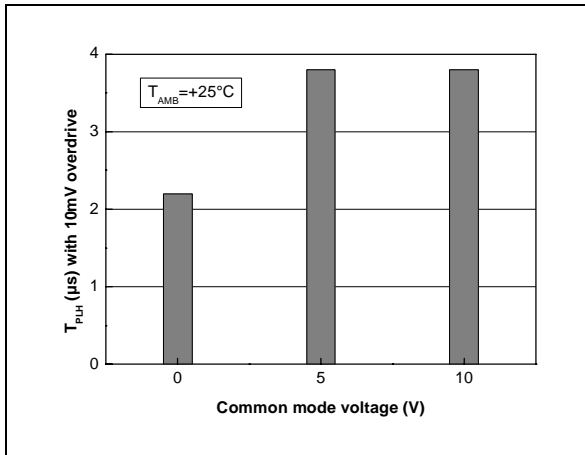
Output sinking current vs Output voltage @  
 $V_{CC} = +5V$



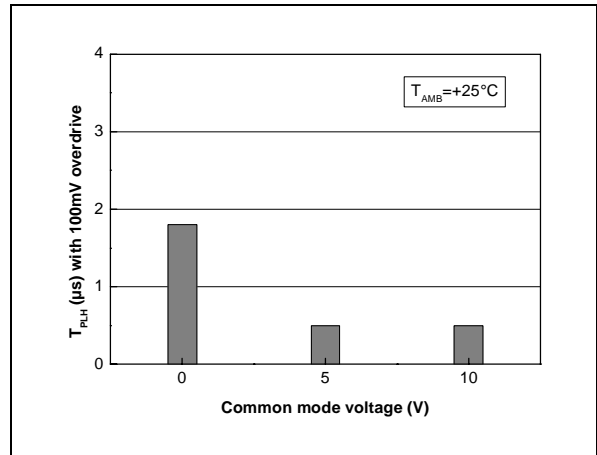
Output sourcing current vs Output voltage @  
 $V_{CC} = +5V$



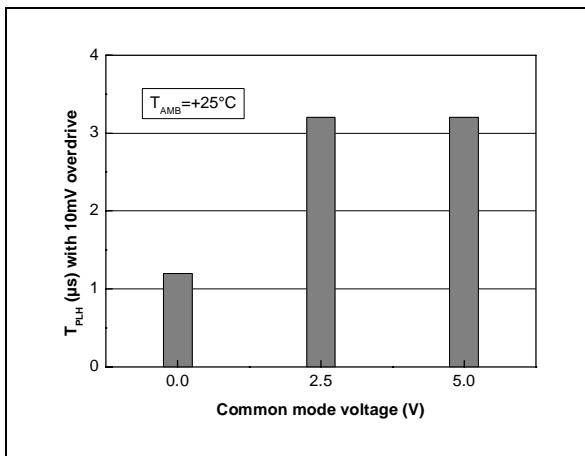
$T_{PLH}$  vs  $V_{ICM}$  @  $V_{CC}=10V$  and 10mV overdrive



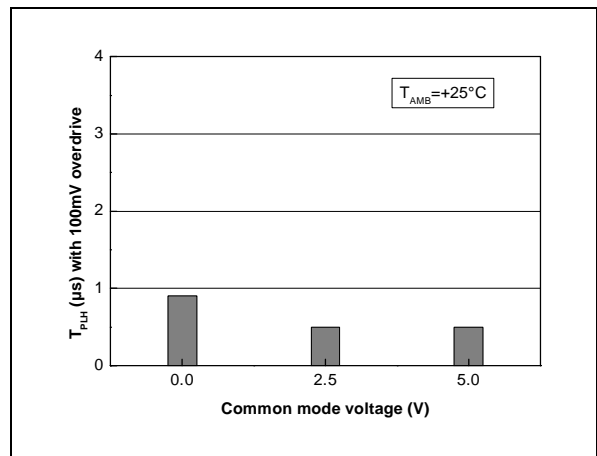
$T_{PLH}$  vs  $V_{ICM}$  @  $V_{CC}=10V$  and 100mV overdrive



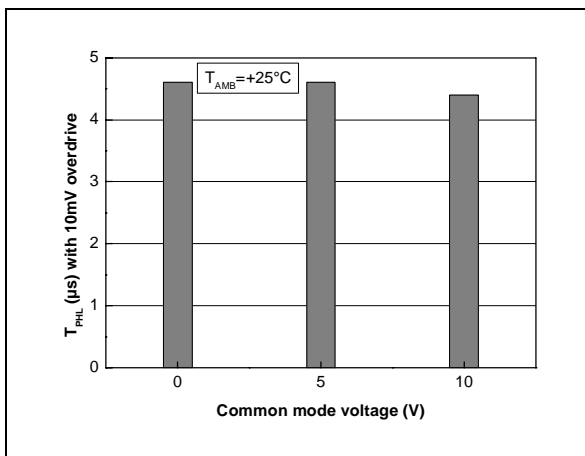
$T_{PLH}$  vs  $V_{ICM}$  @  $V_{CC}=5V$  and 10mV overdrive



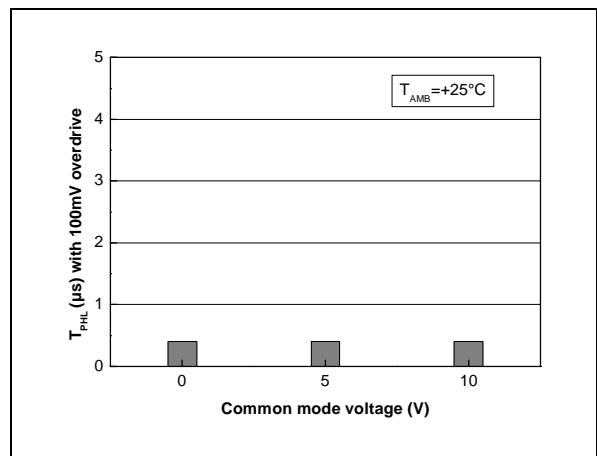
$T_{PLH}$  vs  $V_{ICM}$  @  $V_{CC}=5V$  and 100mV overdrive



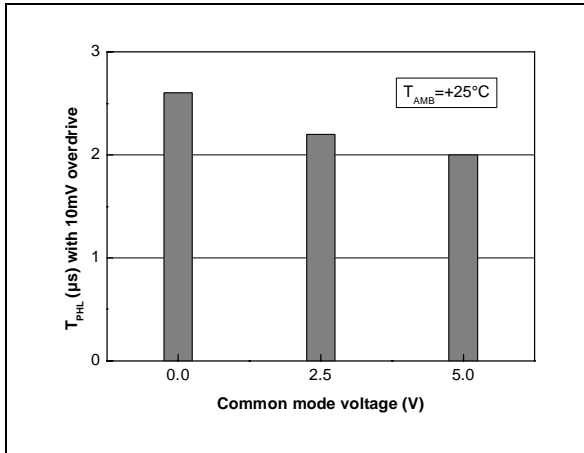
$T_{PHL}$  vs  $V_{ICM}$  @  $V_{CC}=10V$  and 10mV overdrive



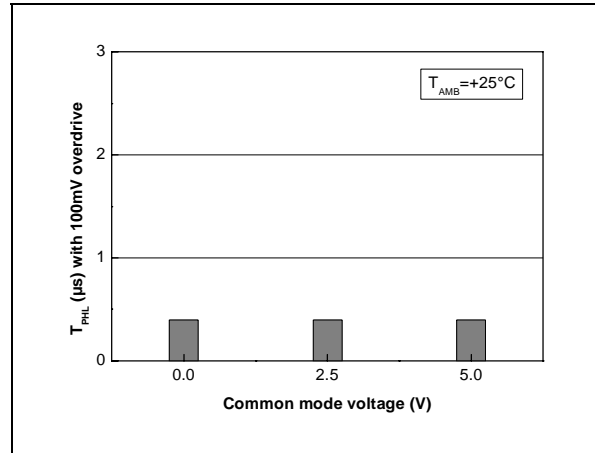
$T_{PHL}$  vs  $V_{ICM}$  @  $V_{CC}=10V$  and 100mV overdrive



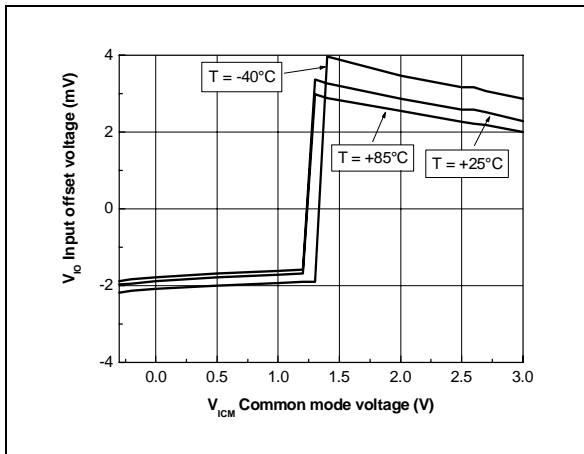
$T_{PHL}$  vs  $V_{ICM}$  @  $V_{CC}=5V$  and 10mV overdrive



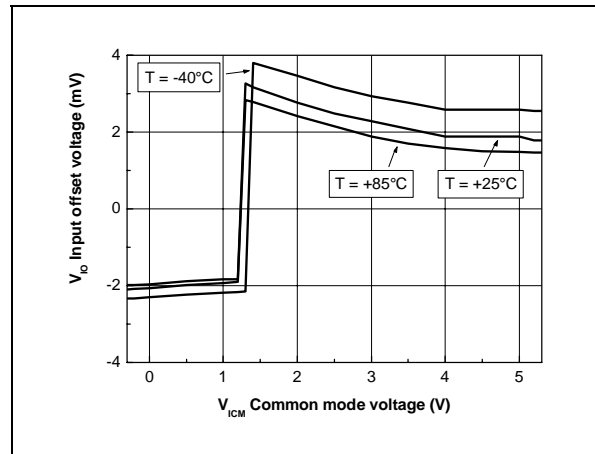
$T_{PHL}$  vs  $V_{ICM}$  @  $V_{CC}=5V$  and 100mV overdrive



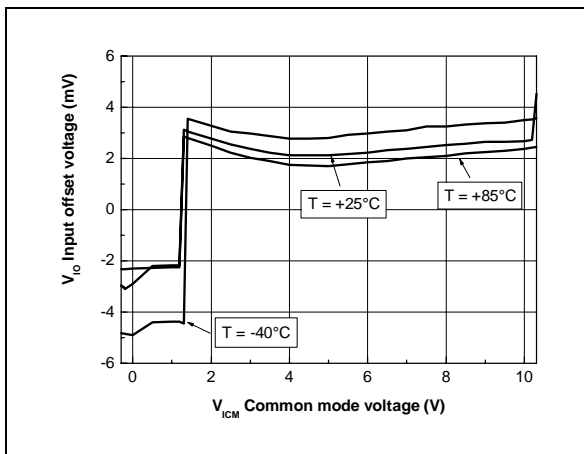
$V_{IO}$  vs  $V_{ICM}$  & Temperature @  $V_{CC}=2.7V$



$V_{IO}$  vs  $V_{ICM}$  & Temperature @  $V_{CC}=5V$

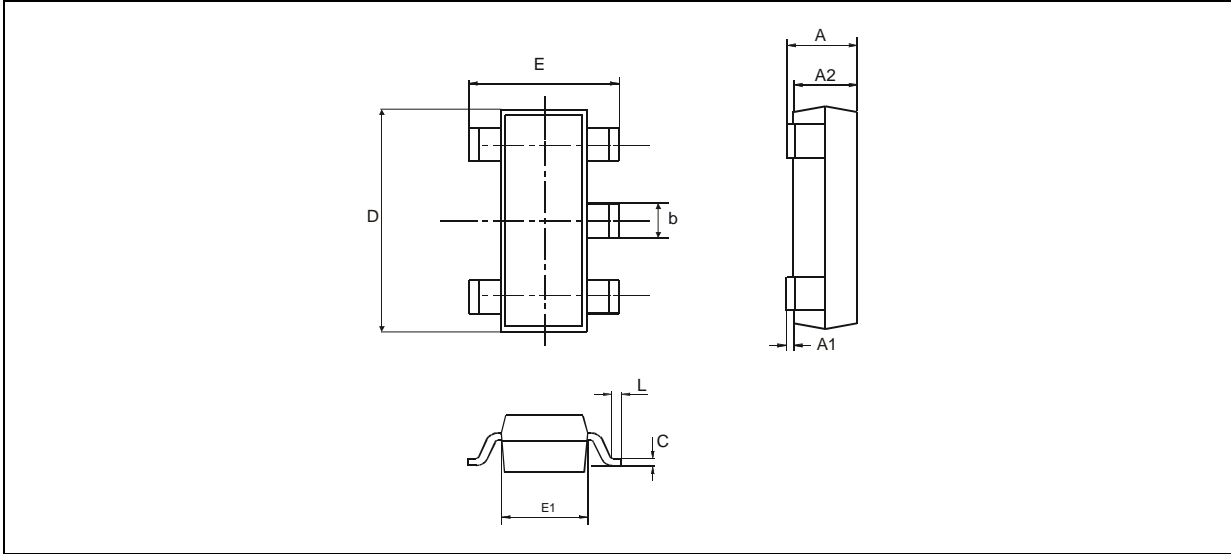


$V_{IO}$  vs  $V_{ICM}$  & Temperature @  $V_{CC}=10V$





**PACKAGE MECHANICAL DATA**  
**5 PINS - TINY PACKAGE (SOT23)**



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1	0		0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.014	0.016	0.020
C	0.09	0.15	0.20	0.004	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	2.80	3.00	0.102	0.110	0.118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.3	0.5	0.60	0.012	0.014	0.024
K	0d		10d	0d		10d

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