



**Preliminary**

## 3.3V LVDS 1:4 Clock Fanout Buffer AK8181F

### Features

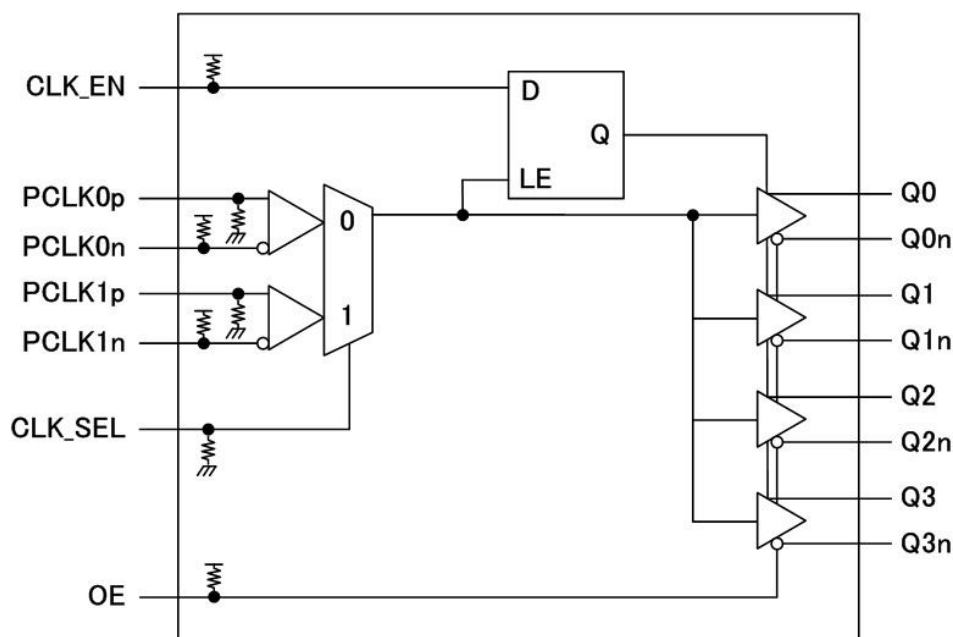
- Four differential 3.3V LVDS outputs
- Selectable differential PCLK0p/n or LVPECL clock inputs
- PCLK0p/n pair can accept the following differential input levels; LVDS, LVPECL, LVHSTL, SSTL, HCSL
- PCLK1p/n supports the following input types; LVPECL, CML, SSTL
- Clock output frequency up to 650MHz
- Translates any single-ended input signal to 3.3V LVDS levels with resistor bias on PCLK0n input
- Output skew : 30ps (maximum)
- Part-to-part skew : 600ps (maximum)
- Propagation delay : 2.5ns (maximum)
- Operating Temperature Range: -40 to +85°C
- Package: 20-pin TSSOP (Pb free)
- Pin compatible with ICS8543I

### Description

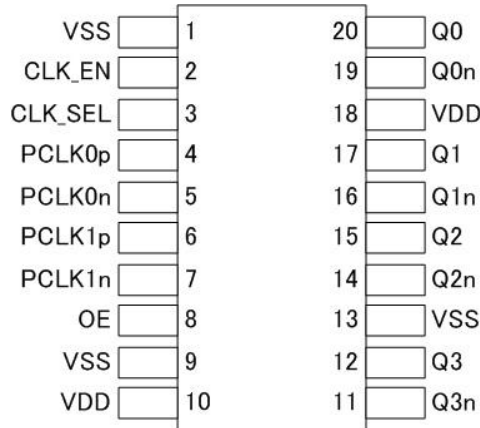
The AK8181F is a member of AKM's LVDS clock fanout buffer family designed for telecom, networking and computer applications, requiring a range of clocks with high performance and low skew. The AK8181F distributes 4 buffered clocks.

AK8181F are derived from AKM's long-term-experienced clock device technology, and enable clock output to perform low skew. The AK8181F is available in a 20-pin TSSOP package.

### Block Diagram



Pin Descriptions



Package: 20-Pin TSSOP(Top View)

Pin No.	Pin Name	Pin Type	Pullup down	Description
1	VSS	PWR	---	Negative power supply
2	CLK_EN	IN	Pull up	Synchronizing clock output enable (LVCMOS/LVTTL) Pin is connected to VDD by internal resistor. (typ. 51kΩ) High (Open): clock outputs follow clock input. Low: Q outputs are forced low, Qn outputs are forced high.
3	CLK_SEL	IN	Pull down	CLK Select Input (LVCMOS/LVTTL) Pin is connected to VSS by internal resistor. (typ. 51kΩ) High: selects PCLK1p/n inputs Low (Open): selects PCLK0p/n inputs
4	PCLK0p	IN	Pull down	Non-inverting differential clock input Pin is connected to VSS by internal resistor. (typ. 51kΩ) *When using PCLK1 input (CLK_SEL=High), it should be connected to VSS or opened.
5	PCLK0n	IN	Pull up	Inverting differential clock input Pin is connected to VDD by internal resistor. (typ. 51kΩ) *When using PCLK1 input (CLK_SEL=High), it should be connected to VDD or opened.
6	PCLK1p	IN	Pull down	Non-inverting differential LVPECL clock input Pin is connected to VSS by internal resistor. (typ. 51kΩ) *When using PCLK0 input (CLK_SEL=Low), it should be connected to VSS or opened.
7	PCLK1n	IN	Pull up	Inverting differential LVPECL clock input Pin is connected to VDD by internal resistor. (typ. 51kΩ) *When using PCLK0 input (CLK_SEL=Low), it should be connected to VDD or opened.
8	OE	IN	Pull up	Output enable. Controls enabling and disabling of outputs Q0, Q0n through Q3, Q3n Pin is connected to VDD by internal resistor. (typ. 51kΩ)
9	VSS	PWR	---	Negative power supply
10	VDD	PWR	---	Positive power supply

Pin No.	Pin Name	Pin Type	Pullup down	Description
11, 12	Q3n, Q3	OUT	---	Differential clock output (LVDS)
13	VSS	PWR	---	Negative power supply
14, 15	Q2n, Q2	OUT	---	Differential clock output (LVDS)
16, 17	Q1n, Q1	OUT	---	Differential clock output (LVDS)
18	VDD	PWR	---	Positive power supply
19, 20	Q0n, Q0	OUT	---	Differential clock output (LVDS)

### Ordering Information

Part Number	Marking	Shipping Packaging	Package	Temperature Range
AK8181F	AK8181F	Tape and Reel	20-pin TSSOP	-40 to 85 °C

## Absolute Maximum Rating

Over operating free-air temperature range unless otherwise noted <sup>(1)</sup>

Items	Symbol	Ratings	Unit
Supply voltage	VDD	-0.3 to 4.6	V
Input voltage	V <sub>in</sub>	VSS-0.5 to VDD+0.5	V
Input current (any pins except supplies)	I <sub>IN</sub>	±10	mA
Storage temperature	T <sub>stg</sub>	-55 to 150	°C

Note

(1) Stress beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated under “Recommended Operating Conditions” is not implied. Exposure to absolute-maximum-rating conditions for extended periods may affect device reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

(2) VSS=0V



### ESD Sensitive Device

This device is manufactured on a CMOS process, therefore, generically susceptible to damage by excessive static voltage. Failure to observe proper handling and installation procedures can cause damage. AKM recommends that this device is handled with appropriate precautions.

## Recommended Operation Conditions

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating temperature	T <sub>a</sub>		-40		85	°C
Supply voltage <sup>(1)</sup>	VDD	VDD±5%	3.135	3.3	3.465	V

(1) Power of 3.3V requires to be supplied from a single source. A decoupling capacitor of 0.1μF for power supply line should be located close to each VDD pin.

## Pin Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input Capacitance	C <sub>IN</sub>			4		pF
Input Pullup Resistor	R <sub>PU</sub>			51		kΩ
Input Pulldown Resistor	R <sub>PD</sub>			51		kΩ

## Power Supply Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Power Supply Current	I <sub>DD</sub>	PCLK0p/n = input 650MHz PCLK1p/n = open			45	mA
		PCLK0p/n = open PCLK1p/n = input 650MHz			45	mA

### DC Characteristics (LVCMOS/LVTTL)

All specifications at VDD=3.3V±5%, VSS=0V, Ta: -40 to +85°C, unless otherwise noted

Parameter		Symbol	Conditions	MIN	TYP	MAX	Unit
Input High Voltage		V <sub>IH</sub>		2.0		VDD+0.3	V
Input Low Voltage		V <sub>IL</sub>		-0.3		0.8	V
Input High Current	CLK_SEL	I <sub>H</sub>	Vin=VDD=3.465V			150	μA
	CLK_EN, OE		Vin=VDD=3.465V			5	μA
Input Low Current	CLK_SEL	I <sub>L</sub>	Vin=VSS, VDD=3.465V	-5			μA
	CLK_EN, OE		Vin=VSS, VDD=3.465V	-150			μA

### DC Characteristics (Differential)

All specifications at VDD=3.3V±5%, VSS=0V, Ta: -40 to +85°C, unless otherwise noted

Parameter		Symbol	Conditions	MIN	TYP	MAX	Unit
Input High Current	PCLK0p	I <sub>H</sub>	Vin=VDD=3.465V			150	μA
	PCLK0n		Vin=VDD=3.465V			5	μA
Input Low Current	PCLK0p	I <sub>L</sub>	Vin=VSS, VDD=3.465V	-5			μA
	PCLK0n		Vin=VSS, VDD=3.465V	-150			μA
Peak-to-Peak Input Voltage		V <sub>PP</sub>		0.15		1.3	V
Common Mode Input Voltage <sup>(1) (2)</sup>		V <sub>CMR</sub>		VSS+0.5		VDD-0.85	V

(1) For single ended applications, the maximum input voltage for PCLK0p and PCLK0n is VDD+0.3V.

(2) Common mode voltage is defined as V<sub>IH</sub>.

### DC Characteristics (LVPECL)

All specifications at VDD=3.3V±5%, VSS=0V, Ta: -40 to +85°C, unless otherwise noted

Parameter		Symbol	Conditions	MIN	TYP	MAX	Unit
Input High Current	PCLK1p	I <sub>H</sub>	Vin=VDD=3.465V			150	μA
	PCLK1n		Vin=VDD=3.465V			5	μA
Input Low Current	PCLK1p	I <sub>L</sub>	Vin=VSS, VDD=3.465V	-5			μA
	PCLK1n		Vin=VSS, VDD=3.465V	-150			μA
Peak-to-Peak Input Voltage		V <sub>PP</sub>		0.3		1.0	V
Common Mode Input Voltage <sup>(1) (2)</sup>		V <sub>CMR</sub>		VSS+1.5		VDD	V

(1) For single ended applications, the maximum input voltage for PCLK1p and PCLK1n is VDD+0.3V.

(2) Common mode voltage is defined as V<sub>IH</sub>.

## DC Characteristics (LVDS)

All specifications at VDD=3.3V±5%, VSS=0V, Ta: -40 to +85°C, unless otherwise noted

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Differential Output Voltage	V <sub>OD</sub>		200	280	360	mV
V <sub>OD</sub> Magnitude Change	ΔV <sub>OD</sub>			0	40	mV
Offset Voltage	V <sub>OS</sub>		1.125	1.25	1.375	V
V <sub>OS</sub> Magnitude Change	ΔV <sub>OS</sub>			5	25	mV
High Impedance Leakage Current	I <sub>OZ</sub>	OE=L	-10		+10	μA
Differential Output Short Circuit Current	I <sub>OSD</sub>			-3.5	-5	mA
Output Voltage High	V <sub>OH</sub>			1.34	1.6	V
Output Voltage Low	V <sub>OL</sub>		0.9	1.06		V

## AC Characteristics

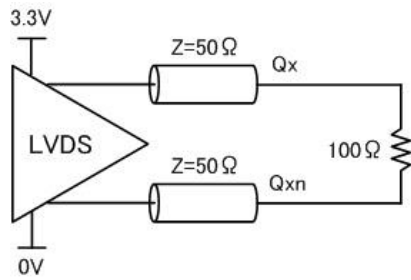
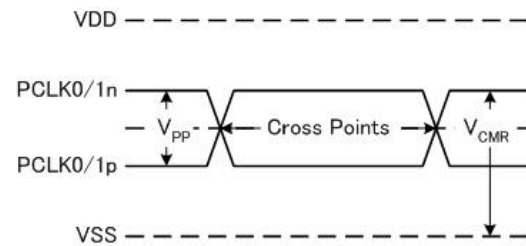
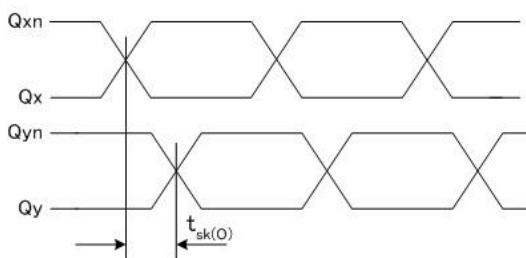
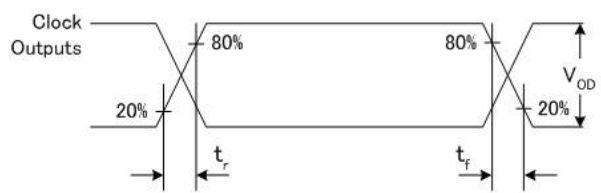
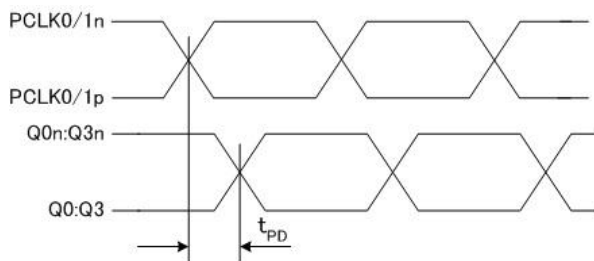
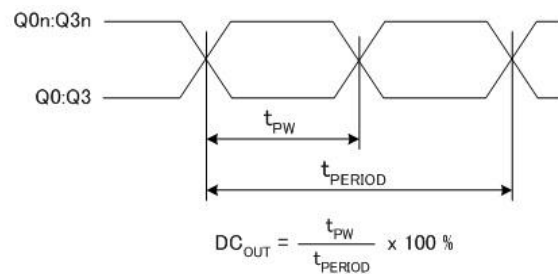
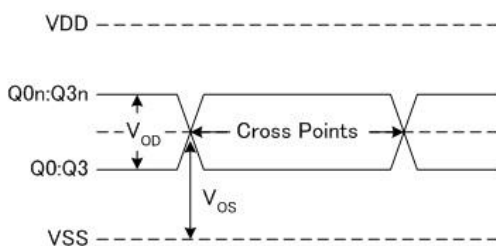
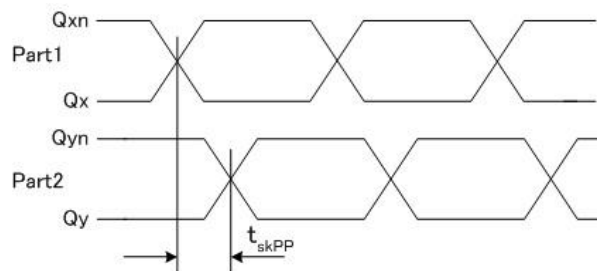
All specifications at VDD=3.3V±5%, VSS=0V, Ta: -40 to +85°C, unless otherwise noted

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Output Frequency	f <sub>OUT</sub>				650	MHz
Propagation Delay <sup>(1)</sup>	t <sub>PD</sub>		0.9		2.5	ns
Output Skew <sup>(2) (3)</sup>	t <sub>sk(O)</sub>				30	ps
Part-to-Part Skew <sup>(3) (4)</sup>	t <sub>skPP</sub>				600	ps
Output Rise/Fall Time <sup>(5)</sup>	t <sub>r</sub> , t <sub>f</sub>	20% to 80% @50MHz	100		300	ps
Output Duty Cycle	DC <sub>OUT</sub>		45	50	55	%

All parameters measured at f ≤ 650MHz unless noted otherwise.

The cycle to cycle jitter on the input will equal the jitter on the output. The part does not add jitter.

- (1) Measured from the differential input crossing point to the differential output crossing point.
- (2) Defined as skew between outputs at the same supply voltage and with equal load conditions.
- (3) This parameter is defined in accordance with JEDEC Standard 65.
- (4) Defined as skew between outputs on different devices operating at the same supply voltages and with equal load conditions. Using the same type of inputs on each device, the outputs are measured at the differential cross points.
- (5) Design value.


**Figure 1 3.3V Output Load AC Test Circuit**

**Figure 2 Differential Input Level**

**Figure 3 Output Skew**

**Figure 4 Output Rise/Fall Time**

**Figure 5 Propagation Delay**

**Figure 6 Output Duty/ Pulse Width/ Period**

**Figure 7 Differential Output Level**

**Figure 8 Part-to-Part Skew**

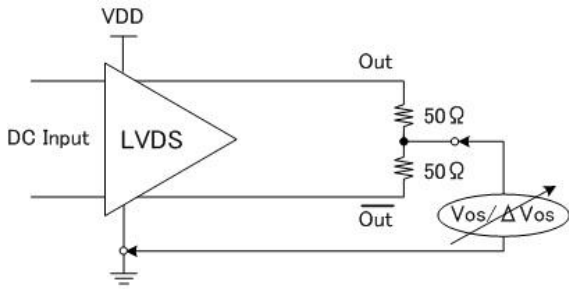


Figure 9 Offset Voltage Setup

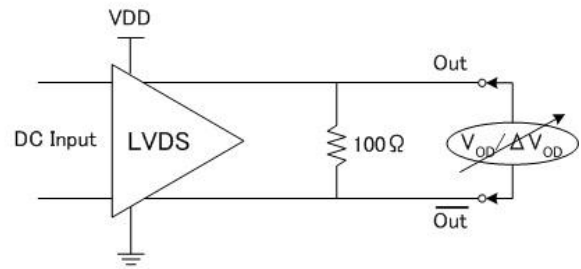


Figure 10 Differential Output Voltage Setup

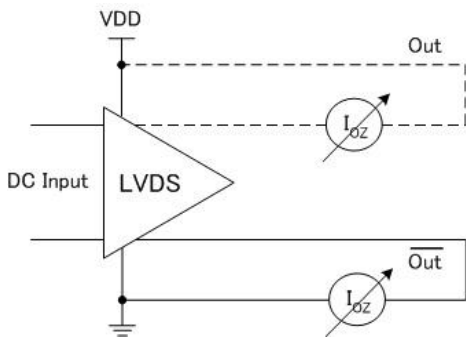


Figure 11 High Impedance Leakage Current Setup

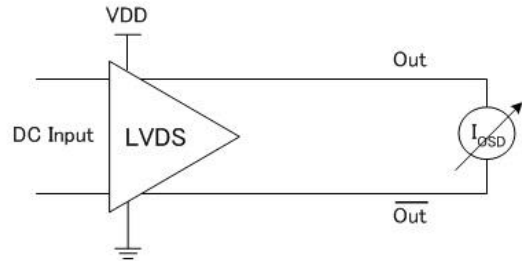


Figure 12 Differential Output Short Circuit Setup



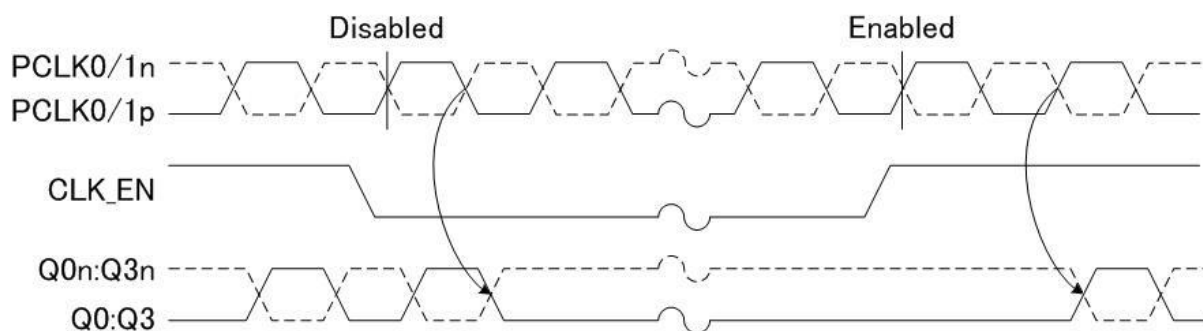
## Function Table

The following table shows the inputs/outputs clock state configured through the control pins.

**Table 1: Control Input Function Table**

Inputs				Outputs	
OE	CLK_EN	CLK_SEL	Selected Source	Q0:Q3	Q0n:Q3n
1	0	0 (Open)	PCLK0p/n	Disabled: Low	Disabled: High
1	0	1	PCLK1p/n	Disabled: Low	Disabled: High
1	1 (Open)	0 (Open)	PCLK0p/n	Enabled	Enabled
1	1 (Open)	1	PCLK1p/n	Enabled	Enabled
0	X	X	---	Hi-Z	Hi-Z

After CLK\_EN switches, the clock outputs are disabled or enabled following a rising and falling input clock edge as shown in Figure 13. In the active mode, the state of the outputs are a function of the PCLK0p/n and PCLK1p/n as described in Table 2.



**Figure 13 CLK\_EN Timing Diagram**

**Table 2 Clock Input Function Table**

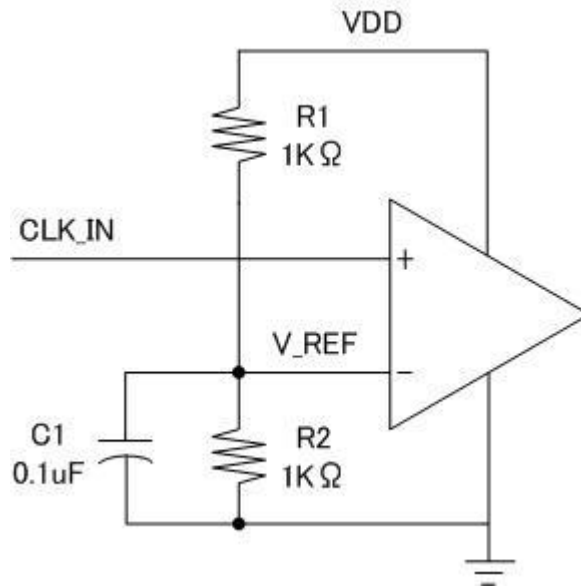
Inputs		Outputs		Input to Output	Polarity
PCLK0/1p	PCLK0/1n	Q0:Q3	Q0n:Q3n		
0	1	Low	High	Differential to Differential	Non Inverting
1	0	High	Low	Differential to Differential	Non Inverting
0	Biased <sup>(1)</sup>	Low	High	Single Ended to Differential	Non Inverting
1	Biased <sup>(1)</sup>	High	Low	Single Ended to Differential	Non Inverting
Biased <sup>(1)</sup>	0	High	Low	Single Ended to Differential	Inverting
Biased <sup>(1)</sup>	1	Low	High	Single Ended to Differential	Inverting

(1) Please refer to the application Information section, "Wiring the Differential Input to Accept Single Ended Levels".

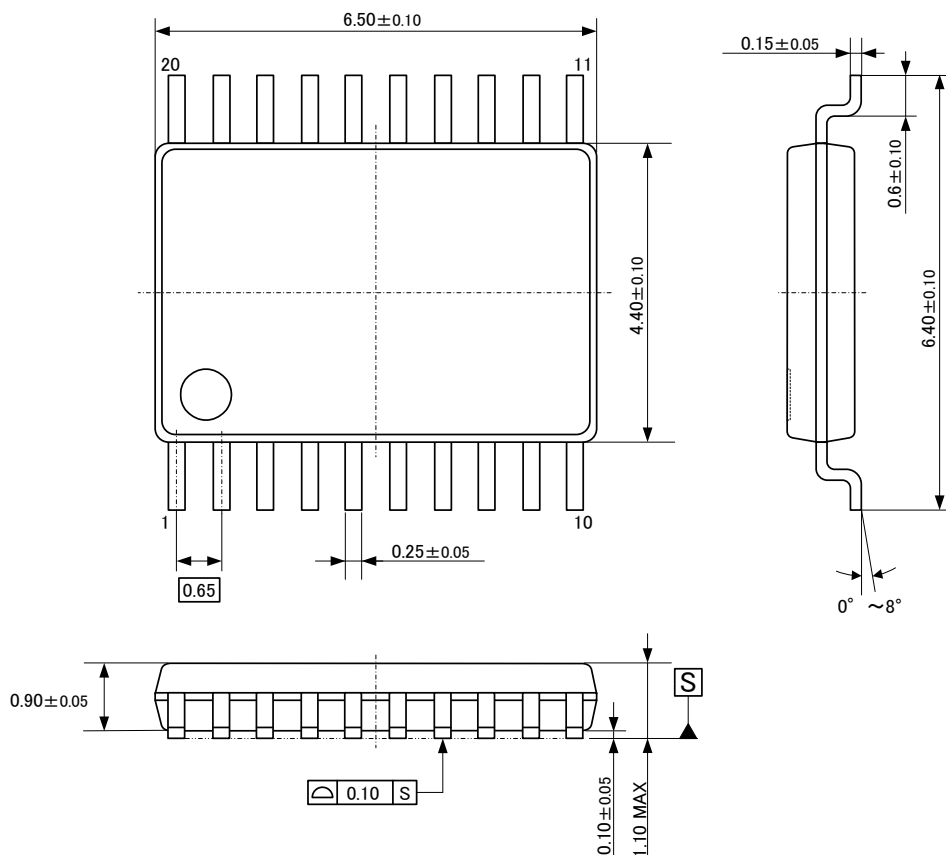
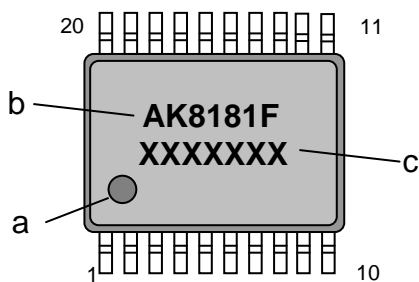
## Application Information

### *Wiring the Differential Input to Accept Single Ended Levels*

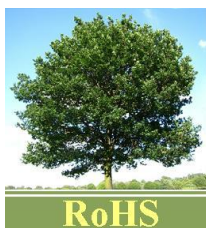
Figure.8 shows how the differential input can be wired to accept single ended levels. The reference voltage  $V\_REF = VDD/2$  is generated by the bias resistors R1, R2 and C1. This bias circuit should be located as close as possible to the input pin. The ratio of R1 and R2 might need to be adjusted to position the  $V\_REF$  in the center of the input voltage swing. For example, if the input clock swing is only 2.5V and  $VDD = 3.3V$ ,  $V\_REF$  should be 1.25V and  $R2/R1 = 0.609$ .



**Figure 14 Single Ended Signal Driving Differential Input**

**Package Information**
**• Mechanical data : 20pin TSSOP**

**• Marking**


- a: #1 Pin Index
- b: Part number
- c: Date code ( 7 digits)

**• RoHS Compliance**


All integrated circuits from Asahi Kasei Microdevices Corporation (AKM) assembled in “lead-free” packages\* are fully compliant with RoHS.

(\*) RoHS compliant products from AKM are identified with “Pb free” letter indication on product label posted on the anti-shield bag and boxes.

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