



2.5V, 3.3V LVCMOS 1:10 Clock Fanout Buffer AK8180D

Features

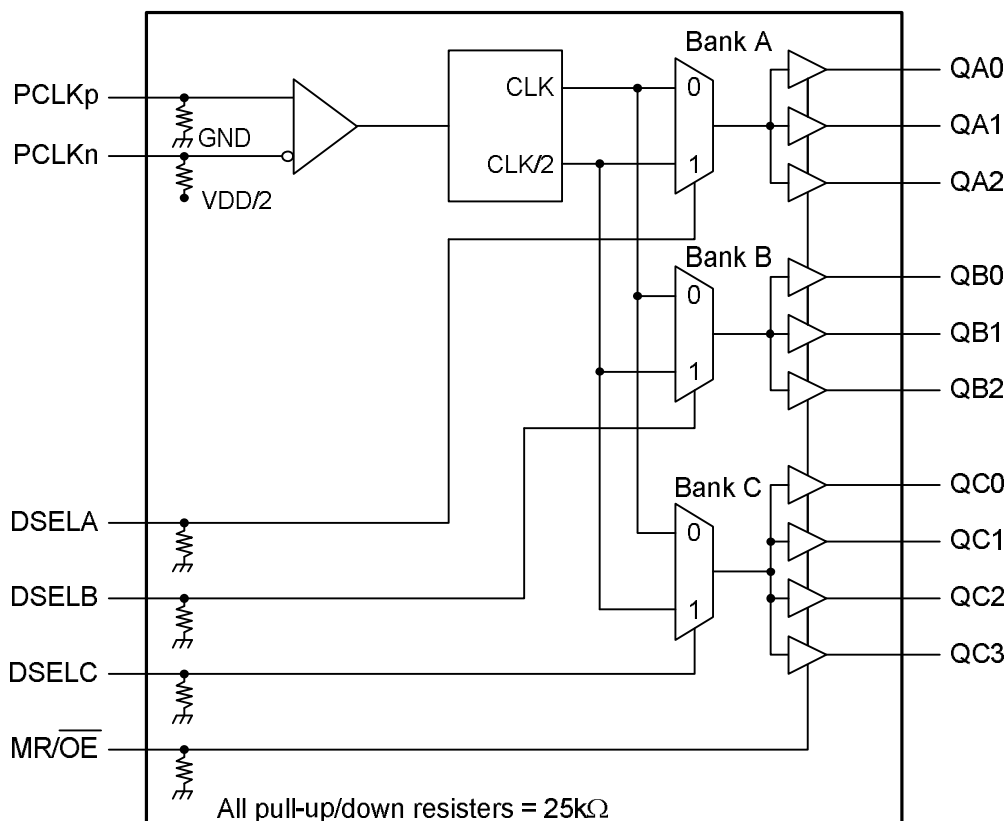
- 3 – 3 – 4 configurable 10 LVCMOS outputs
- Translate LVPECL input to LVCMOS output
- Single, dual and mixed voltage supply available on 2.5V and 3.3V
- Clock output frequency up to 250MHz
- Output-to-output skew : 200ps max
- High-impedance output control
- Enable to drive up to 20 series terminated clock lines
- Operating Temperature Range: -40 to +85°C
- Package: 32-pin LQFP (Pb free)
- Pin compatible with MPC9456

Description

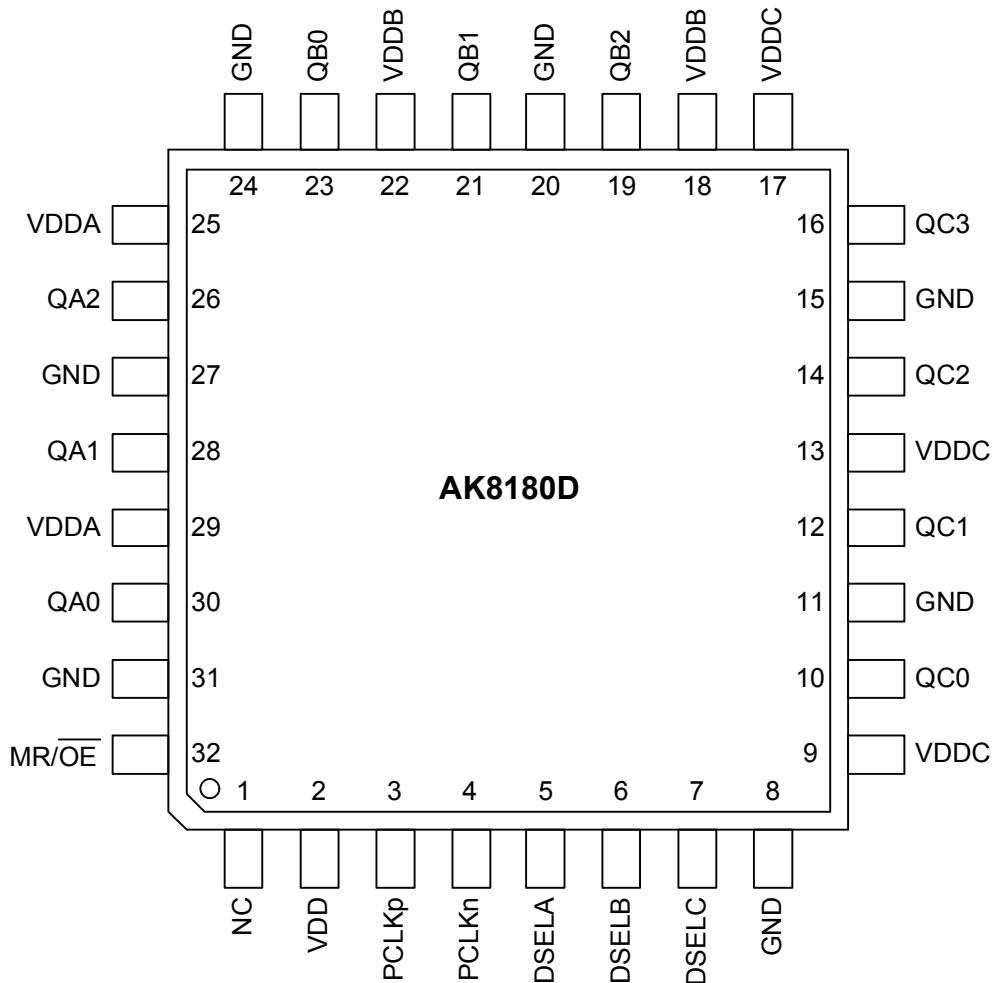
The AK8180D is a member of AKM's LVCMOS clock fanout buffer family designed for telecom, networking and computer applications, requiring a range of clocks with high performance and low skew. The AK8180D distributes 10 buffered clocks configured by pin-setting per bank. The 10 outputs can drive 10 terminated 50 Ω clock lines.

AK8180D are derived from AKM's long-term-experienced clock device technology, and enable clock output to perform low skew. The AK8180D is available in a 7mm x 7mm 32-pin LQFP package.

Block Diagram



Pin Descriptions



Package: 32-Pin LQFP(Top View)

| Pin No. | Pin Name | Pin Type | Pullup /down | Description |
|---------|----------|----------|--------------|---------------------------------------|
| 1 | NC | --- | -- | No internal connection |
| 2 | VDD | -- | -- | Power Supply |
| 3 | PCLKp | IN | PD | LVPECL Differential Clock Inputs |
| 4 | PCLKn | IN | PU/PD | |
| 5 | DSELA | IN | PD | Divide Select Input for Output Bank A |
| 6 | DSELB | IN | PD | Divide Select Input for Output Bank B |
| 7 | DSELC | IN | PD | Divide Select Input for Output Bank C |
| 8, | GND | -- | -- | Ground |
| 9 | VDDC | -- | -- | Power Supply for Output bank C |
| 10 | QC0 | OUT | -- | Clock output Bank C |
| 11 | GND | -- | -- | Ground |
| 12 | QC1 | OUT | -- | Clock output Bank C |

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| Pin No. | Pin Name | Pin Type | Pullup /down | Description |
|---------|----------------------------|----------|--------------|---|
| 13 | VDDC | -- | -- | Power Supply for Output bank C |
| 14 | QC2 | OUT | -- | Clock output Bank C |
| 15 | GND | -- | -- | Ground |
| 16 | QC3 | OUT | -- | Clock output Bank C |
| 17 | VDDC | -- | -- | Power Supply for Output bank C |
| 18 | VDDB | -- | -- | Power Supply for Output bank B |
| 19 | QB2 | OUT | -- | Clock output Bank B |
| 20 | GND | -- | -- | Ground |
| 21 | QB1 | OUT | -- | Clock output Bank B |
| 22 | VDDB | -- | -- | Power Supply for Output bank B |
| 23 | QB0 | OUT | -- | Clock output Bank B |
| 24 | GND | -- | -- | Ground |
| 25 | VDDA | -- | -- | Power Supply for Output bank A |
| 26 | QA2 | OUT | -- | Clock output Bank A |
| 27 | GND | -- | -- | Ground |
| 28 | QA1 | OUT | -- | Clock output Bank A |
| 29 | VDDA | -- | -- | Power Supply for Output bank A |
| 30 | QA0 | OUT | -- | Clock output Bank A |
| 31 | GND | -- | -- | Ground |
| 32 | MR/ $\overline{\text{OE}}$ | IN | PD | Master Reset and Output Enable (Output disable = High impedance) |

PU: Pull up PD: Pull down

Ordering Information

| Part Number | Marking | Shipping Packaging | Package | Temperature Range |
|-------------|---------|--------------------|-------------|-------------------|
| AK8180D | AK8180D | Tape and Reel | 32-pin LQFP | -40 to 85 °C |

Absolute Maximum Rating

Over operating free-air temperature range unless otherwise noted ⁽¹⁾

| Items | Symbol | Ratings | Unit |
|--|------------------|--------------------|------|
| Supply voltage | VDD | -0.3 to 4.6 | V |
| Input voltage | V _{in} | GND-0.3 to VDD+0.3 | V |
| Input current (any pins except supplies) | I _{IN} | ±10 | mA |
| Storage temperature | T _{stg} | -55 to 130 | °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.



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 _a | | -40 | | 85 | °C |
| Supply voltage ⁽¹⁾ | VDD | VDD±5% | 2.375 | 2.5 | 2.625 | V |
| | | | 3.135 | 3.3 | 3.465 | |

(1) Power of 2.5V or 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.

Supported VDD Supply Voltage Configurations

| Supply Voltage Configuration | VDD | VDDA | VDDB | VDDC | GND |
|------------------------------|-------|----------------|----------------|----------------|-----|
| 3.3 V | 3.3 V | 3.3 V | 3.3 V | 3.3 V | 0 V |
| 3.3 V and 2.5 V | 3.3 V | 3.3 V or 2.5 V | 3.3 V or 2.5 V | 3.3 V or 2.5 V | 0 V |
| 2.5 V | 2.5 V | 2.5 V | 2.5 V | 2.5 V | 0 V |

General Specification

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|-------------------------------|-----------------|------------------|------|-------|-----|------|
| Output Termination Voltage | V _{TT} | | | VDD/2 | | V |
| ESD Protection 1 | MM | Machine model | 200 | | | V |
| ESD Protection 2 | HBM | Human Body Model | 2000 | | | V |
| Latch-Up Immunity | LU | | 200 | | | mA |
| Power Dissipation Capacitance | | per output | | 10 | | pF |
| Input Capacitance | | | | 4.0 | | pF |

Power Supply Current <3.3V>

VDD= 3.3V±5%, Ta: -40 to +85°C

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|-----------------------------------|--------|---------------------------|-----|-----|-----|------|
| Full operation ⁽¹⁾ | IDD1 | CCLK0=250MHz CLK_SEL=L | | 95 | 120 | mA |
| Quiescent state ⁽¹⁾⁽²⁾ | IDD2 | | | 1.6 | 2.6 | mA |

(1) The outputs have no loads. (2) All inputs are in default state by the internal pull up/down resistors.

DC Characteristics <3.3V>

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

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|----------------------------------|------------------|---|------|-------|--------------|------|
| High Level Input Voltage | V _{IH} | LVC MOS | 2.0 | | VDD+0.3 | V |
| Low Level Input Voltage | V _{IL} | LVC MOS | -0.3 | | 0.8 | V |
| Peak-to-Peak Input Voltage | V _{pp} | LVPECL | 250 | | | mV |
| Common Mode Range ⁽¹⁾ | V _{cmr} | LCPECL | 1.1 | | VDD-0.6 | V |
| Input Current ⁽²⁾ | I _{L1} | V _{in} =GND or VDD | | | 200 | μA |
| High Level Output Voltage | V _{OH} | I _{OH} = -24mA ⁽³⁾ | 2.4 | | | V |
| Low level Output Voltage | V _{OL} | I _{OL} = +24mA ⁽³⁾ I _{OL} = +12mA | | | 0.55 0.30 | V |
| Output Impedance | | | | 14-17 | | Ω |

(1) V_{cmr}(DC) is the crosspoint of the differential input signal. Functional operation is obtained when the crosspoint is within the V_{cmr} range and the input swing lies within the V_{pp}(DC) specification.

(2) Input pull-up / pull down resistors influence input current.

(3) The AK8180D is capable of driving 50 Ω transmission lines of the incident edge. Each output drives one 50 Ω parallel terminated transmission line to a termination voltage of V_{TT}. Alternatively, the device drives up to two 50 Ω series terminated transmission lines.

(4) I_{DDQ} is the DC current consumption of the device with all outputs open and the input in its default state or open.

AC Characteristics <3.3V> ⁽¹⁾

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

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|-------------------------------------|--------------------------------------|--|-----|-----|-------------------|------|
| Input Frequency | f _{IN} | Pin: PCLKp/n | 0 | | 250 | MHz |
| Input Pulse Width | t _{pwIN} | Pin: PCLKp/n | 1.4 | | | ns |
| Peak-to-Peak Input Voltage | V _{pp} | Pin: PCLKp/n | 500 | | 1000 | mV |
| Common Mode Range ⁽²⁾ | V _{cmr} | Pin: PCLKp/n | 1.3 | | VDD-0.8 | |
| Input Rise/Fall time ⁽³⁾ | t _{rIN} , t _{fOUT} | Pin: PCLKp/n 0.8 to 2.0V | | | 1.0 | ns |
| Output Frequency | f _{OUT} | Pin: Q0-11 | 0 | | 250 | MHz |
| Propagation Delay | t _{PLH} t _{PHL} | PCLK to any Q | 1.3 | 2.2 | 3.55 | ns |
| Output Disable Time | t _{PLZ} , t _{PHZ} | | | | 10 | ns |
| Output Enable Time | t _{PZL} , t _{PZH} | | | | 10 | ns |
| Output-to-Output Skew | t _{skPP} | Within one bank Any output, same output divider Any output, Any output divider | | | 150 200 350 | ps |
| Device-to-Device Skew | t _{skD} | | | | 2.25 | ns |
| Output Pulse Skew ⁽⁴⁾ | t _{skO} | | | | 200 | ps |

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| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|-----------------------|---------------------------------|--|-----|-----|-----|------|
| Output Duty Cycle | DC _{OUT} | DC _{REF} = 50% x1 output | 45 | 50 | 55 | % |
| | | DC _{REF} = 25-75% x1/2 output | 47 | 50 | 53 | |
| Output Rise/Fall Time | t _r , t _f | 0.55 to 2.4V | 0.1 | | 1.0 | ns |

- (1) AC characteristics apply for parallel output termination of 50 Ω to VTT.
- (2) The AK8180D is functional up to an input and output clock frequency of 350MHz and is characterized up to 250MHz.
- (3) V_{cmr}(AC) is the crosspoint of the differential input signal. Normal AC operation is obtained when the crosspoint is within the V_{cmr} range and the input swing lies within the V_{pp}(AC) specification. Violation of V_{cmr} or V_{pp} impacts t_{PLH/PHL} and t_{skD}.
- (4) Violation of the 1.0 ns maximum input rise and fall time limit will affect the device propagation delay, device-to-device skew, input pulse width, output duty cycle and maximum frequency specifications.
- (5) Output pulse skew t_{skO} is the absolute difference of the propagation delay times: | t_{PLH} - t_{PHL} |. Output duty cycle is frequency dependent (= 0.5 ± t_{skO} x f_{out}). For example at f_{out} = 125 MHz the output duty cycle limit is 50% ± 2.5%.

Power Supply Current <2.5V>

VDD= 2.5V±5%, Ta: -40 to +85°C

| Parameter | Symbol | Conditions | Min | Typ | Max | Unit |
|-----------------------------------|--------|---------------------------|-----|-----|-----|------|
| Full operation ⁽¹⁾ | IDD1 | CCLK0=250MHz CLK_SEL=L | | 71 | 95 | mA |
| Quiescent state ⁽¹⁾⁽²⁾ | IDD2 | | | 1.6 | 2.5 | mA |

- (1) The outputs have no loads. (2) All inputs are in default state by the internal pull up/down resistors.

DC Characteristics <2.5V>

All specifications at VDD=VDDA=VDDDB=VDDC= 2.5V±5%, Ta: -40 to +85°C, unless otherwise noted

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|----------------------------------|------------------|--|------|-------|---------|------|
| High Level Input Voltage | V _{IH} | LVC MOS | 1.7 | | VDD+0.3 | V |
| Low Level Input Voltage | V _{IL} | LVC MOS | -0.3 | | 0.7 | V |
| Peak-to-Peak Input Voltage | V _{pp} | LVPECL | 250 | | | mV |
| Common Mode Range ⁽¹⁾ | V _{cmr} | LVPECL | 1.1 | | VDD-0.7 | V |
| Input Current ⁽²⁾ | I _{L1} | V _{in} =GND or VDD | | | 200 | μA |
| High Level Output Voltage | V _{OH} | I _{OH} = -15mA ⁽³⁾ | 1.8 | | | V |
| Low level Output Voltage | V _{OL} | I _{OL} = +15mA ⁽³⁾ | | | 0.6 | V |
| Output Impedance | | | | 17-20 | | Ω |

- (1) V_{cmr}(DC) is the crosspoint of the differential input signal. Functional operation is obtained when the crosspoint is within the V_{cmr} range and the input swing lies within the V_{pp}(DC) specification.
- (2) Input pull-up / pull down resistors influence input current.
- (3) The AK8180D is capable of driving 50 Ω transmission lines of the incident edge. Each output drives one 50 Ω parallel terminated transmission line to a termination voltage of VTT. Alternatively, the device drives up to two 50 Ω series terminated transmission lines.
- (4) I_{DDQ} is the DC current consumption of the device with all outputs open and the input in its default state or open.

AC Characteristics <2.5V> ⁽¹⁾

All specifications at VDD=VDDA=VDDB=VDDC= 2.5V±5%, Ta: -40 to +85°C, unless otherwise noted

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|-------------------------------------|--------------------------------------|--|-----|-----|-------------------|------|
| Input Frequency ⁽²⁾ | f _{IN} | Pin: PCLKp/n | | | 250 | MHz |
| Input Pulse Width | t _{pWIN} | Pin: PCLKp/n | 1.4 | | | ns |
| Peak-to-Peak Input Voltage | V _{pp} | Pin: PCLKp/n | 500 | | 1000 | mV |
| Common Mode Range ⁽²⁾ | V _{cmr} | Pin: PCLKp/n | 1.1 | | VDD-0.7 | |
| Input Rise/Fall time ⁽³⁾ | t _{rIN} , t _{fOUT} | Pin: PCLKp/n 0.8 to 2.0V | | | 1.0 | ns |
| Output Frequency ⁽²⁾ | f _{OUT} | DSELx = 0 x1 output DSELx = 1 x1/2 output | | | 250 125 | MHz |
| Propagation Delay | t _{PLH} t _{PHL} | PCLKp/n to any Q | 1.4 | 2.4 | 4.4 | ns |
| Output Disable Time | t _{PLZ} , t _{PHZ} | | | | 10 | ns |
| Output Enable Time | t _{PZL} , t _{PZH} | | | | 10 | ns |
| Output-to-Output Skew | t _{skPP} | Within one bank Any output, same output divider Any output, Any output divider | | | 150 200 350 | ps |
| Device-to-Device Skew | t _{skD} | | | | 3.0 | ns |
| Output Pulse Skew ⁽⁴⁾ | t _{skO} | | | | 200 | ps |
| Output Duty Cycle | DC _{OUT} | DC _{REF} = 50% x1 or 1/2 output | 45 | 50 | 55 | % |
| Output Rise/Fall Time | t _r , t _f | 0.6 to 1.8V | 0.1 | | 1.0 | ns |

(1) AC characteristics apply for parallel output termination of 50 Ω to VTT.

(2) The AK8180D is functional up to an input and output clock frequency of 350MHz and is characterized up to 250MHz.

(3) Violation of the 1.0 ns maximum input rise and fall time limit will affect the device propagation delay, device-to-device skew, input pulse width, output duty cycle and maximum frequency specifications.

(4) Output pulse skew t_{skO} is the absolute difference of the propagation delay times: | t_{PLH} - t_{PHL} |.
Output duty cycle is frequency dependent (= 0.5 ± t_{skO} × f_{out}). For example at f_{out} = 125 MHz the output duty cycle limit is 50% ± 2.5%.

AC Characteristics <mixed with 3.3V and 2.5V> ⁽¹⁾⁽²⁾

All specifications at VDD, VDDB= 3.3V±5%, VDDA, VDDC=2.5V±5%, Ta: -40 to +85°C, unless otherwise noted

| Parameter | Symbol | Conditions | MIN | TYP | MAX | Unit |
|----------------------------------|-------------------------------------|--|----------------|-----|-------------------|------|
| Propagation Delay | t _{PLH} , t _{PHL} | PCLK to any Q | See 3.3V table | | | ns |
| Output-to-Output Skew | t _{skPP} | Within one bank Any output, same output divider Any output, Any output divider | | | 150 250 350 | ps |
| Device-to-Device Skew | t _{skD} | | | | 2.5 | ns |
| Output Pulse Skew ⁽³⁾ | t _{skO} | | | | 250 | ps |
| Output Duty Cycle | DC _{OUT} | DC _{REF} = 50% x1 or 1/2 output | 45 | 50 | 55 | % |

(1) AC characteristics apply for parallel output termination of 50 Ω to VTT.

(2) For all other AC specifications, refer to 2.5V and 3.3V tables according to the supply voltage of the output bank.

(3) Output pulse skew t_{skO} is the absolute difference of the propagation delay times: | t_{PLH} - t_{PHL} |.
Output duty cycle is frequency dependent (= 0.5 ± t_{skO} × f_{out}). For example at f_{out} = 125 MHz the output duty cycle limit is 50% ± 2.5%.

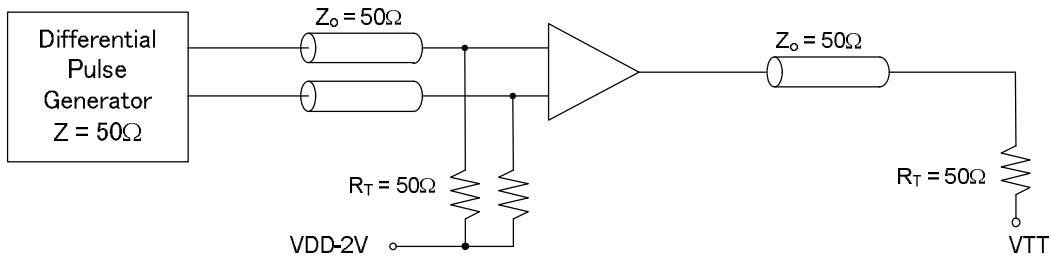


Figure 1 PCLK/PCLKn AC Test Reference

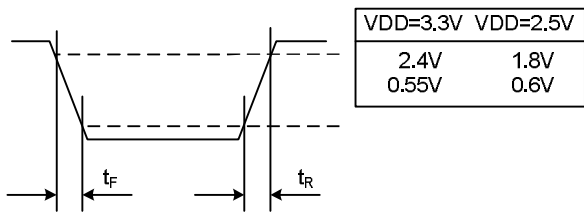


Figure 2 Output Transition Time Test Reference

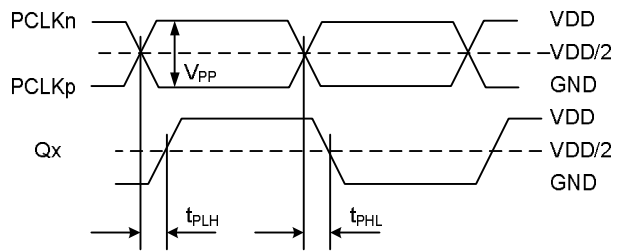
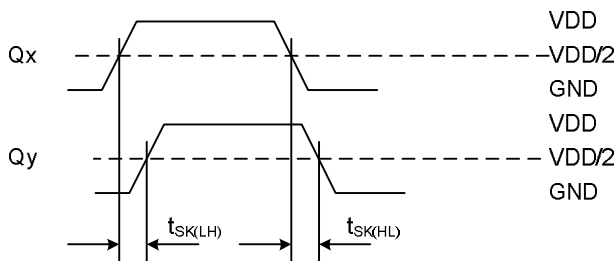
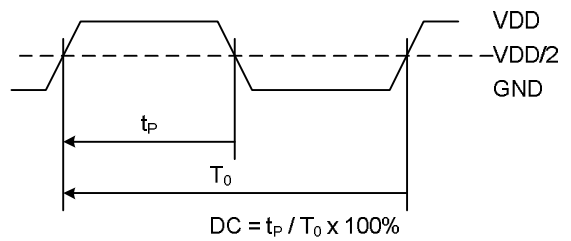


Figure 3 Propagation Delay Test Reference



The pin-to-pin skew is defined as the worst case difference in propagation delay between any two similar delay paths within a single device.

Figure 4 Output-to-Output Skew



The time from the PLL controlled edge to the non controlled edge, divided by the time between PLL controlled edges, expressed as a percentage.

Figure 5 Output Duty Cycle (DC)

Function Table

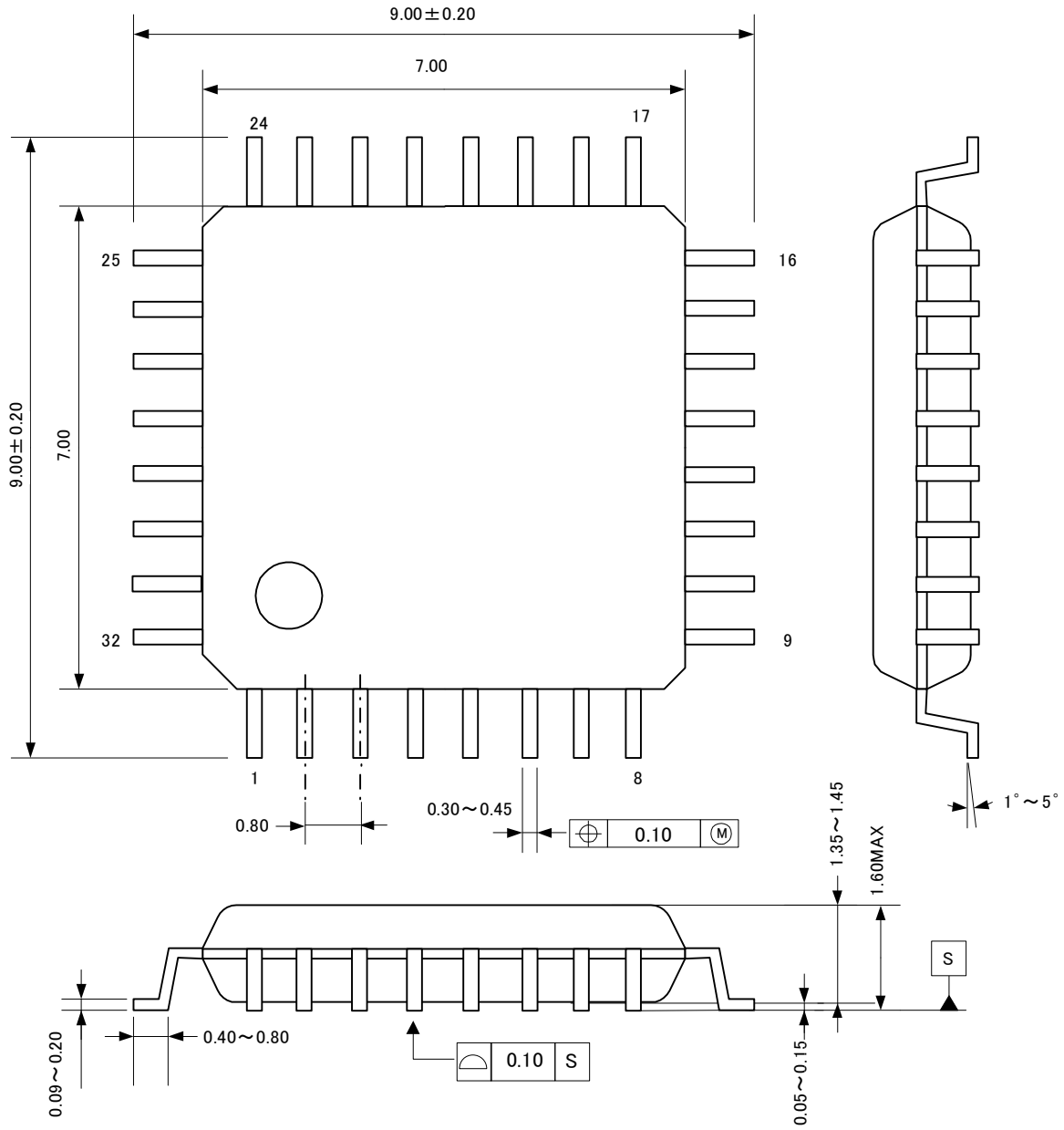
The following table shows the inputs/outputs clock state configured through the control pins.

Table 1: Control-Pin-Setting Function Table

| Control Pin | Default | 0 | 1 |
|-------------|---------|--------------------|---|
| DSELA | 0 | QA0-2 = REFCLK x 1 | QA0-2 = REFCLK x 1/2 |
| DSELB | 0 | QB0-2 = REFCLK x 1 | QB0-2 = REFCLK x 1/2 |
| DSELC | 0 | QC0-3 = REFCLK x 1 | QC0-3 = REFCLK x 1/2 |
| MR/OE | 0 | Output enabled | Internal reset. Outputs disabled. (High impedance) |

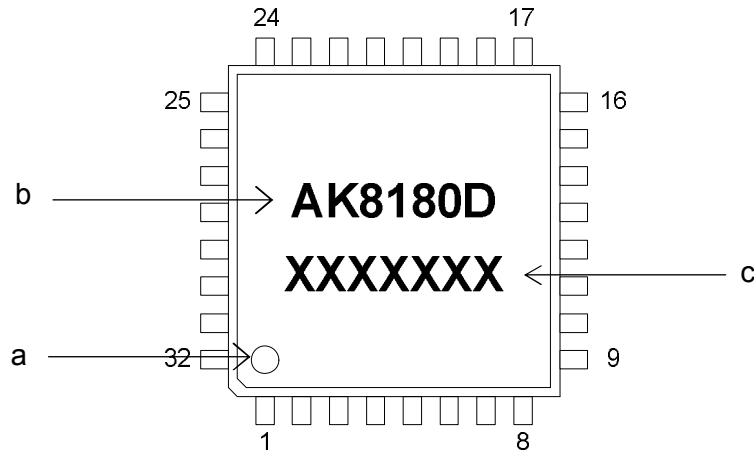
Package Information


- Mechanical data : 32-lead LQFP



- **Marking**

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



AKM and the logo  - are the brand of AKM's IC's and identify that AKM continues to offer the best choice for high performance mixed-signal solution under this brand.

- **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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 - Note2) A hazard related device or system is one designed or intended for life support or maintenance of safety or for applications in medicine, aerospace, nuclear energy, or other fields, in which its failure to function or perform may reasonably be expected to result in loss of life or in significant injury or damage to person or property.
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