

DATA SHEET



PCA9556

Octal SMBus and I²C registered interface

Product data
Supersedes data of 2000 Nov 13

2002 Mar 28

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FEATURES

- SMBus compliance with fixed 3.3V voltage levels
- Operating power supply voltage range of 3.0 V – 5.5 V
- Active high polarity inverter register
- Each I/O is configurable as an input or output
- Active low reset pin
- Low leakage current on power-down
- Noise filter on SCL/SDA inputs
- No glitch on power-up
- Internal power-on reset
- 8 I/O pins which default to 8 inputs
- High impedance open drain on I/O0
- ESD protection exceeds 2000 V HBM per JESD22-A114, 200 V MM per JESD22-A115 and 1000 V CDM per JESD22-C101
- Latch-up testing is done to JESDEC Standard JESD78 which exceeds 100 mA

DESCRIPTION

The PCA9556 is a silicon CMOS circuit which provides parallel input/output expansion for SMBus applications. The PCA9556 consists of an 8-bit input port register, 8-bit output port register, and an SMBus interface. It has low current consumption and a high impedance open drain output pin, I/O0.

The SMBus system master can reset the PCA9556 in the event of a timeout by asserting a LOW on the reset input. The SMBus system master can also invert the PCA9556 inputs by writing to the active HIGH polarity inversion bits. Finally, the system master can enable the PCA9556's I/Os as either inputs or outputs by writing to the configuration register.

ORDERING INFORMATION

| PACKAGES | TEMPERATURE RANGE | ORDER CODE | DRAWING NUMBER |
|----------------------|-------------------|------------|----------------|
| 16-Pin Plastic TSSOP | –40 to +85 °C | PCA9556PW | SOT403-1 |

Standard packing quantities and other packaging data is available at www.philipslogic.com/packaging. SMBus as specified by the Smart Battery System Implementers Forum is a derivative of the Philips I²C patent. I²C is a trademark of Philips Semiconductors Corporation.

The power-on reset puts the registers in their default state and initializes the SMBus state machine. The RESET pin causes the same reset/initialization to occur without depowering the part.

The PCA9557 8-bit I²C SMBus I/O port with reset is the higher performance pin-for-pin replacement for the PCA9556.

PIN CONFIGURATION

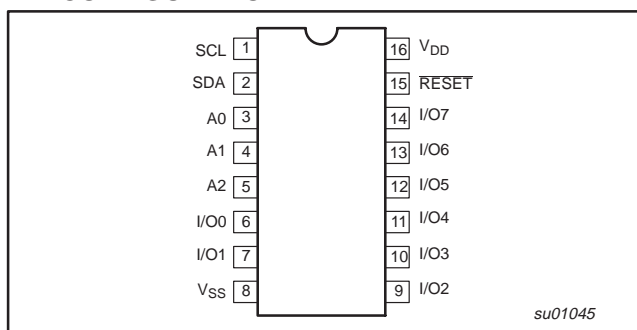


Figure 1. Pin configuration

PIN DESCRIPTION

| PIN NUMBER | SYMBOL | FUNCTION |
|------------|-----------------|-----------------------------|
| 1 | SCL | Serial clock line |
| 2 | SDA | Serial data line |
| 3 | A0 | Address input 0 |
| 4 | A1 | Address input 1 |
| 5 | A2 | Address input 2 |
| 6 | I/O0 | I/O0 (open drain) |
| 7 | I/O1 | I/O1 |
| 8 | V _{SS} | Supply GROUND |
| 9–14 | I/O2–I/O7 | I/O2 to I/O7 |
| 15 | RESET | External reset (active LOW) |
| 16 | V _{DD} | Supply voltage |

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BLOCK DIAGRAM

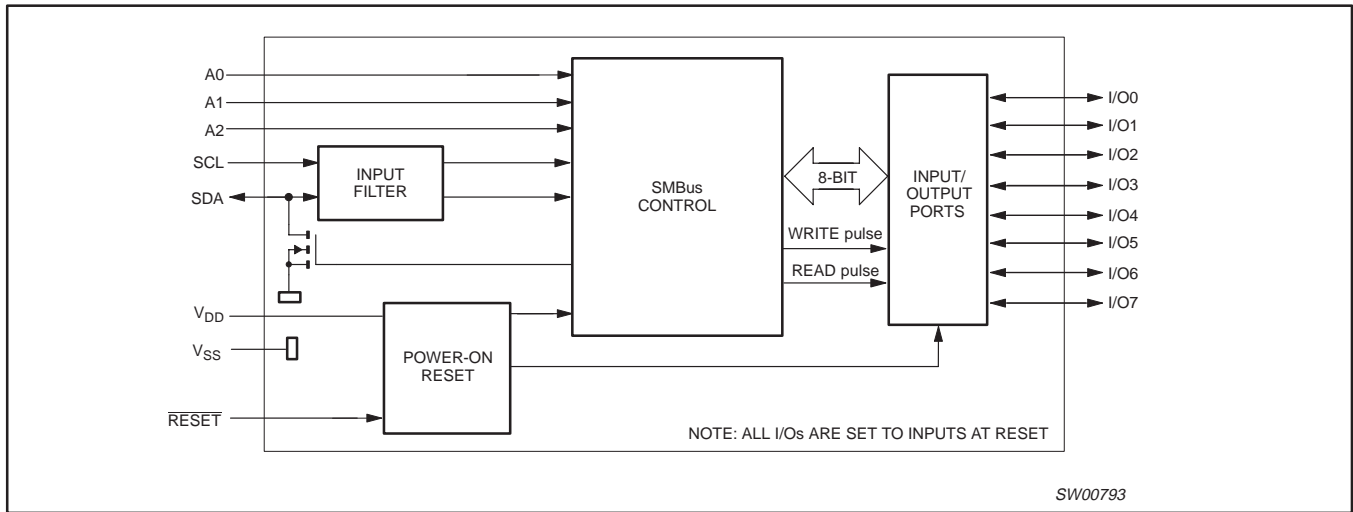


Figure 2. Block diagram

SYSTEM DIAGRAM

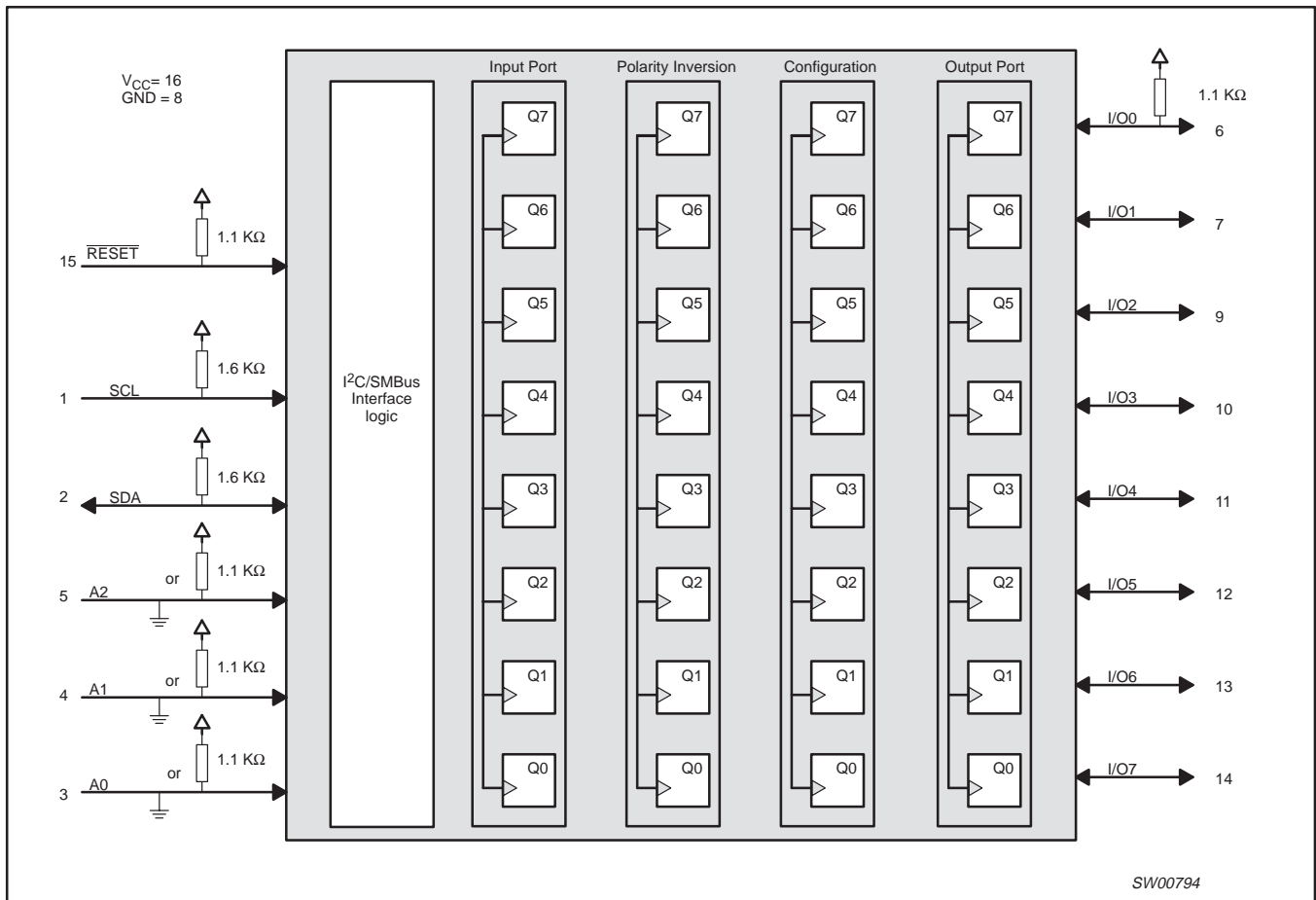


Figure 3. System diagram

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REGISTERS

Command Byte

| Command | Protocol | Function |
|---------|-----------------|-----------------------------|
| 0 | Read byte | Input port register |
| 1 | Read/write byte | Output port register |
| 2 | Read/write byte | Polarity inversion register |
| 3 | Read/write byte | Configuration register |

The command byte is the first byte to follow the address byte during a write transmission. It is used as a pointer to determine which of the following registers will be written or read.

Register 0 — Input Port Register

| | | | | | | | |
|----|----|----|----|----|----|----|----|
| I7 | I6 | I5 | I4 | I3 | I2 | I1 | I0 |
|----|----|----|----|----|----|----|----|

This register is an read-only port. It reflects the incoming logic levels of the pins, regardless of whether the pin is defined as an input or an output by register 3. Writes to this register have no effect.

Register 1 — Output Port Register

| bit | O7 | O6 | O5 | O4 | O3 | O2 | O1 | O0 |
|---------|----|----|----|----|----|----|----|----|
| default | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

This register reflects the outgoing logic levels of the pins defined as outputs by register 3. Bit values in this register have no effect on pins defined as inputs. In turn, reads from this register reflect the value that is in the flip-flop controlling the output selection, NOT the actual pin value.

Register 2 — Polarity Inversion Register

| bit | N7 | N6 | N5 | N4 | N3 | N2 | N1 | N0 |
|---------|----|----|----|----|----|----|----|----|
| default | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 |

This register enables polarity inversion of pins defined as inputs by register 3. If a bit in this register is set (written with '1'), the corresponding port pin's polarity is inverted. If a bit in this register is cleared (written with a '0'), the corresponding port pin's original polarity is retained.

Register 3 — Configuration Register

| bit | C7 | C6 | C5 | C4 | C3 | C2 | C1 | C0 |
|---------|----|----|----|----|----|----|----|----|
| default | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

This register configures the directions of the I/O pins. If a bit in this register is set, the corresponding port pin is enabled as an input with high impedance output driver. If a bit in this register is cleared, the corresponding port pin is enabled as an output.

RESET

Power-on Reset

When power is applied to V_{DD}, an internal power-on reset holds the PCA9556 in a reset state until V_{DD} has reached V_{POR}. At that point, the reset condition is released and the PCA9556 registers and SMBus state machine will initialize to their default states.

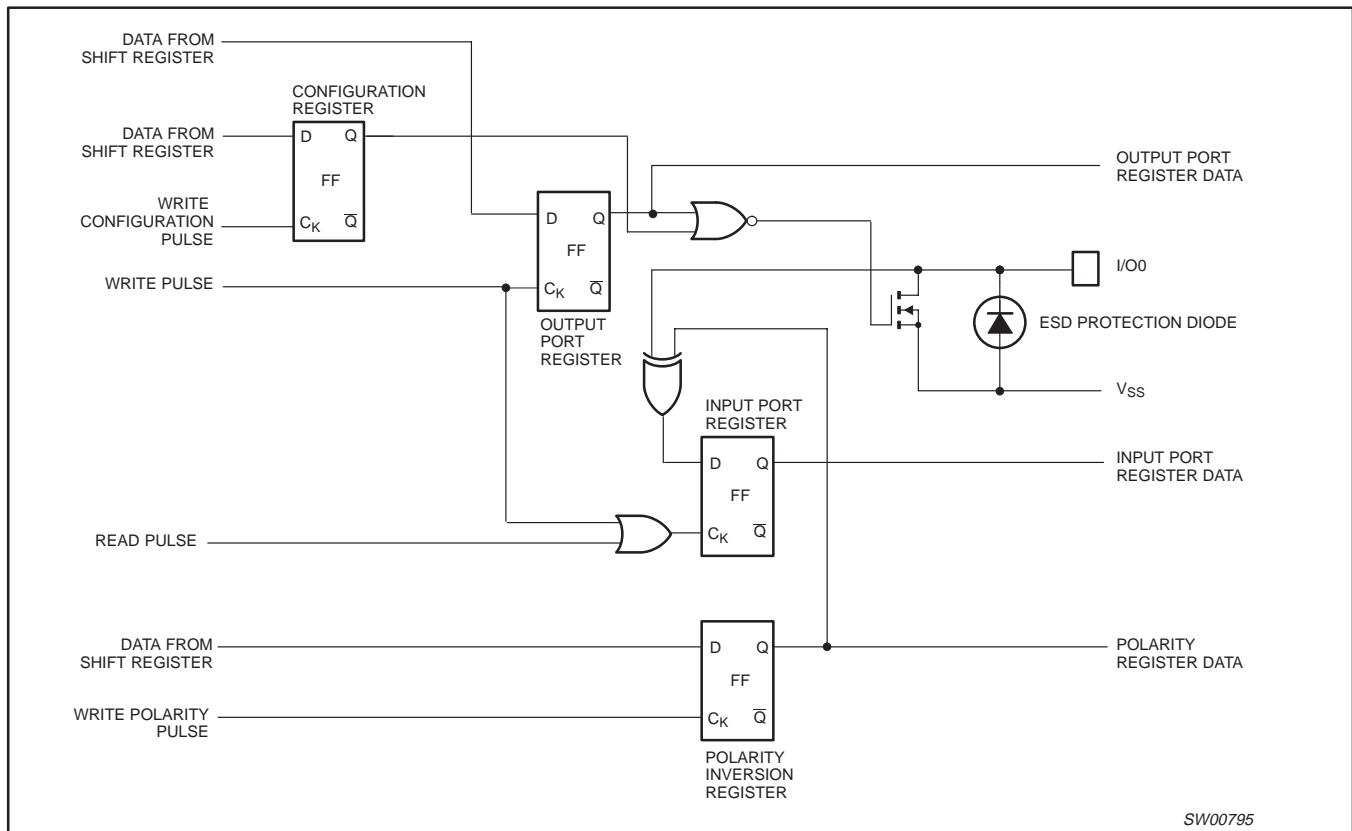
External Reset

A reset can be accomplished by holding the $\overline{\text{RESET}}$ pin low for a minimum of T_W. The PCA9556 registers and SMBus/I²C state machine will be held in their default state until the RESET input is once again high. This input typically requires a pull-up to 3.3 V V_{CC}.

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SIMPLIFIED SCHEMATIC OF I/O0



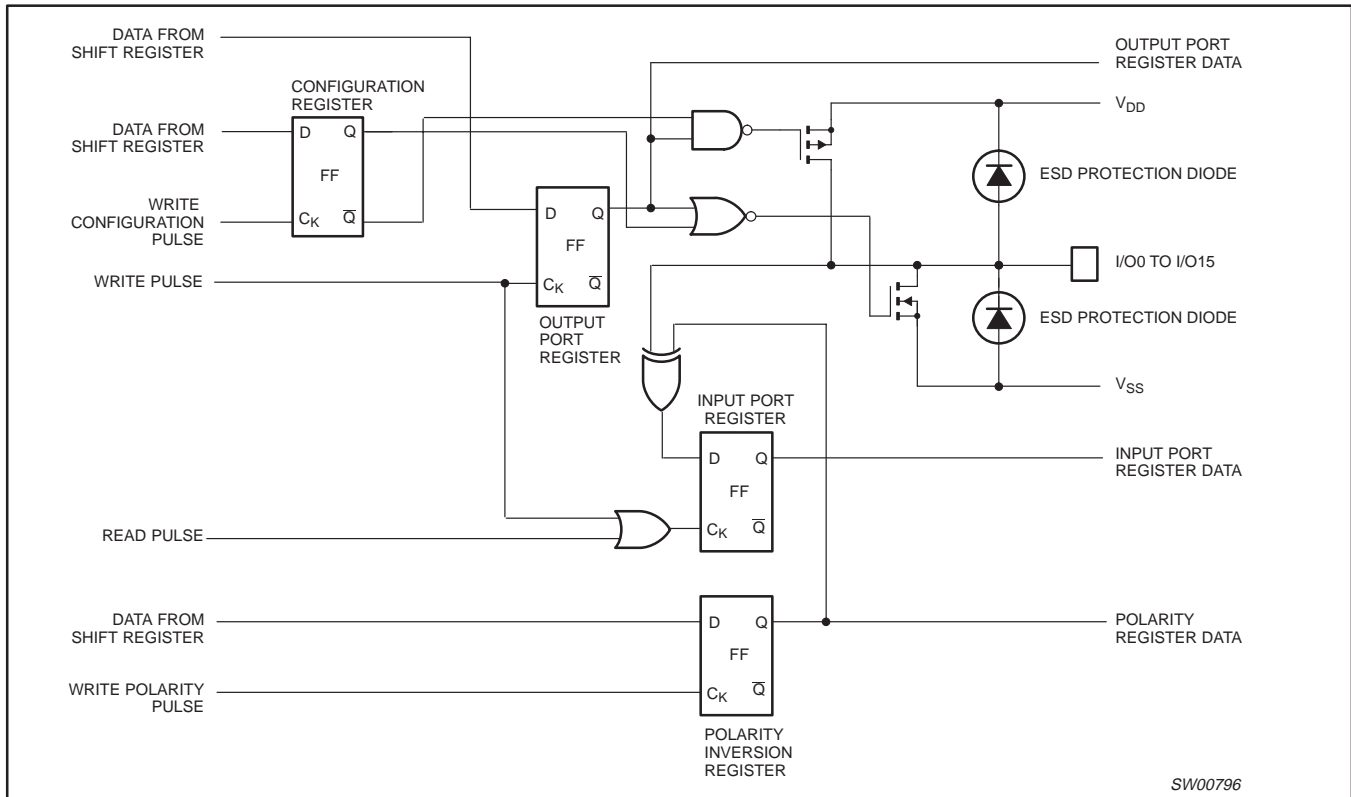
NOTE: On power-up or reset, all registers return to default values.

Figure 4. Simplified schematic of I/O0

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SIMPLIFIED SCHEMATIC OF I/O1 TO I/O7



NOTE: On power-up or reset, all registers return to default values.

Figure 5. Simplified schematic of I/O1 to I/O7

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SMBus Address

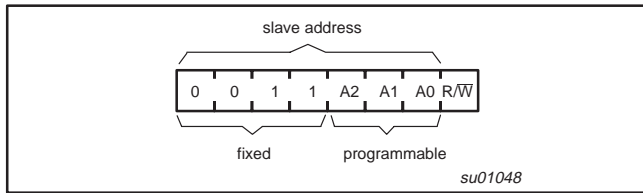


Figure 6. PCA9556 address

SMBus Transactions

Data is transmitted to the PCA9556 registers using Write Byte transfers (see Figures 7 and 8). Data is read from the PCA9556 registers using Read and Receive Byte transfers (see Figures 9 and 10).

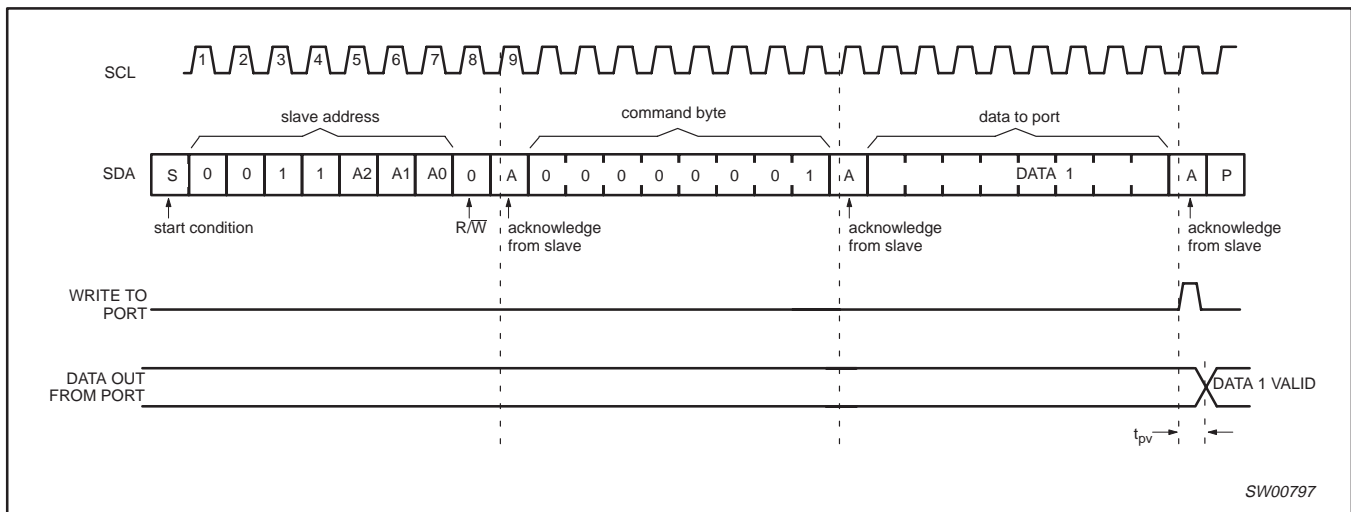


Figure 7. WRITE to output port register via Write Byte Protocol

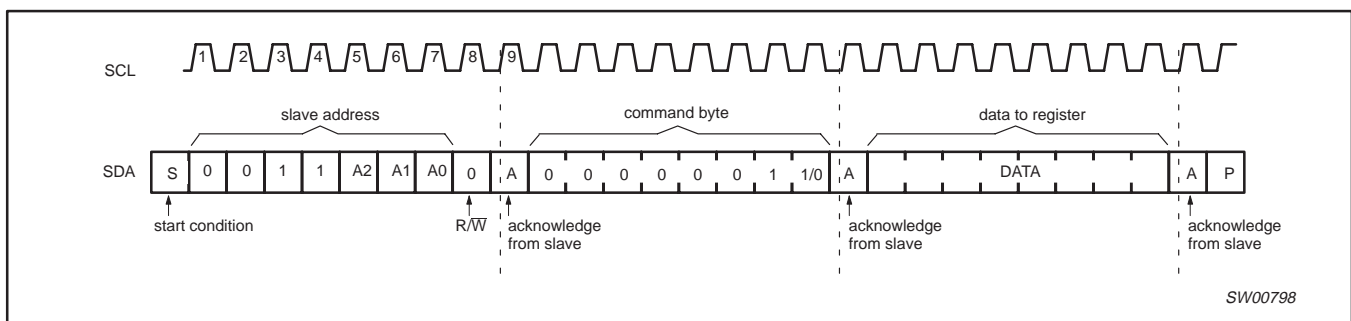


Figure 8. WRITE to I/O configuration or polarity inversion registers via Write Byte Protocol

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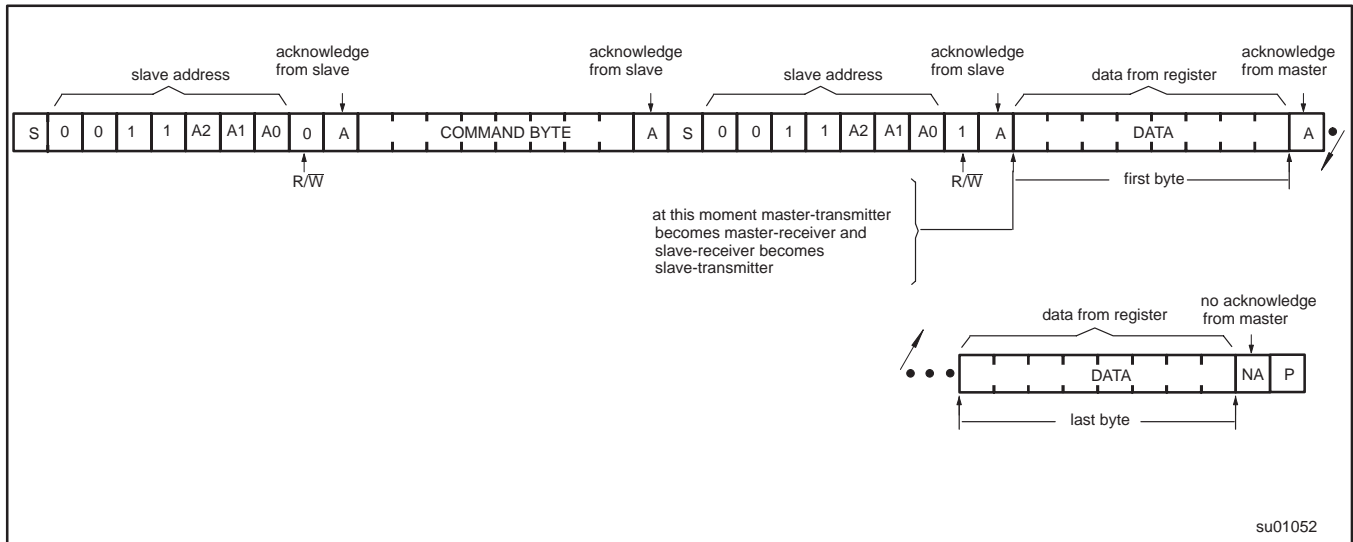
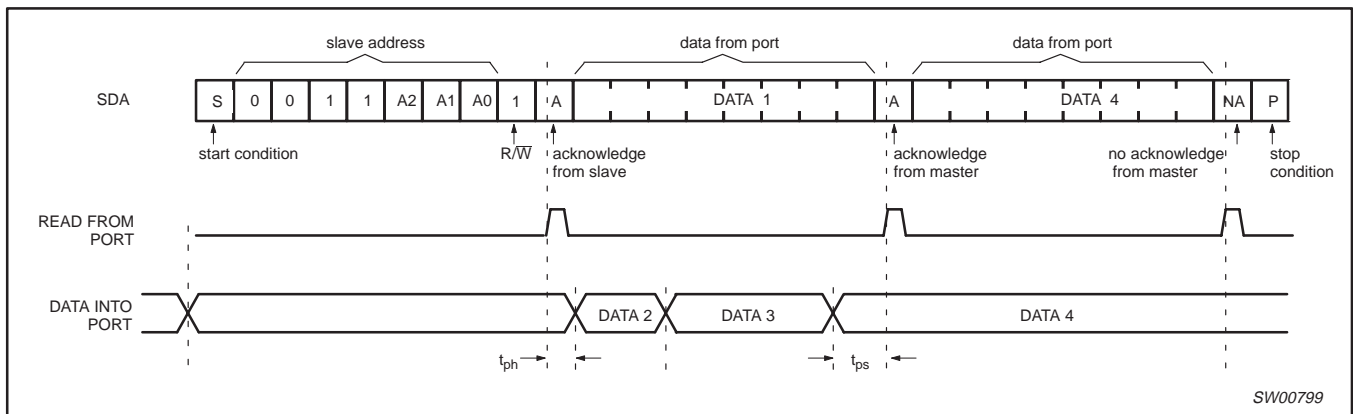


Figure 9. READ from register via Read byte protocol



NOTES:

1. This figure assumes the command byte has previously been programmed with 00h.
2. Transfer of data can be stopped at any moment by a stop condition. When this occurs, data present at the last acknowledge phase is valid (output mode). Input data is lost.

Figure 10. READ input port register via Receive byte protocol

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ABSOLUTE MAXIMUM RATINGS

In accordance with the Absolute Maximum Rating System (IEC 134).

| SYMBOL | PARAMETER | CONDITIONS | MIN | MAX | UNIT |
|-------------------|--|------------|-----------------------|-----------------------|------|
| V _{DD} | Supply voltage | | -0.5 | +6 | V |
| V _I | Input voltage | | V _{SS} - 0.5 | V _{DD} + 0.5 | V |
| I _I | DC input current | | — | ± 20 | mA |
| V _{I/O} | DC voltage on an I/O as an input other than I/O0 | | V _{SS} - 0.5 | V _{DD} + 0.5 | V |
| V _{I/O0} | DC voltage on I/O0 as an input | | V _{SS} - 0.5 | 4.6 | V |
| I _{I/O0} | DC input current on I/O0 | | — | +400 | μA |
| | | | — | -20 | mA |
| I _{I/O} | DC output current on an I/O | | — | ± 20 | mA |
| P _{tot} | Total power dissipation | | — | — | mW |
| P _O | Power dissipation per output | | — | — | mW |
| T _{stg} | Storage temperature range | | -65 | +150 | °C |
| T _{amb} | Operating ambient temperature | | -40 | +85 | °C |

HANDLING

Inputs and outputs are protected against electrostatic discharge in normal handling. However, to be totally safe, it is desirable to take precautions appropriate to handling MOS devices. Advice can be found in Data Handbook IC24 under "Handling MOS devices".

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DC CHARACTERISTICS $V_{DD} = 3.0$ to 5.5 V; $V_{SS} = 0$ V; $T_{amb} = -40$ to $+85$ °C; unless otherwise specified.

| SYMBOL | PARAMETER | CONDITIONS | $V_{DD} = 3.3$ V | | | $V_{DD} = 5$ V | | | UNIT |
|--|--|---|------------------|-----|----------------|----------------|------|----------------|---------|
| | | | MIN | TYP | MAX | MIN | TYP | MAX | |
| Supplies | | | | | | | | | |
| V_{DD} | Supply voltage | | 3.0 | — | 3.6 | 4.5 | — | 5.5 | V |
| I_{DD} | Supply current | Operating mode; no load; $V_I = V_{DD}$ or V_{SS} ; $f_{SCL} = 100$ kHz | — | 300 | 425 | — | 1100 | 1500 | μ A |
| I_{stb} | Standby current | Standby mode; no load; $V_I = V_{DD}$ or V_{SS} ; $f_{SCL} = 0$ kHz | — | 25 | 50 | — | 65 | 100 | μ A |
| V_{POR} | Power-on reset voltage | $V_{DD} = 3.3$ V; no load; $V_I = V_{DD}$ or V_{SS} ; note 1 | — | 1.3 | 2.4 | — | 1.3 | 2.4 | V |
| Input SCL; input/output SDA | | | | | | | | | |
| V_{IL} | LOW level input voltage | | -0.5 | — | 0.8 | -0.5 | — | 0.8 | V |
| V_{IH} | HIGH level input voltage | | 2.1 | — | 5.5 | 2.1 | — | 5.5 | V |
| I_{OL} | LOW level output current | $V_{OL} = 0.4$ V | 3 | — | — | 3 | — | — | mA |
| I_L | Leakage current | $V_I = V_{DD} = V_{SS}$ | -1 | — | +1 | -1 | — | +1 | μ A |
| C_I | Input capacitance | $V_I = V_{SS}$ | — | — | 10 | — | — | 10 | pF |
| I/Os | | | | | | | | | |
| V_{IL} | LOW level input voltage | | -0.5 | — | 0.8 | -0.5 | — | 0.8 | V |
| V_{IH} | HIGH level input voltage | | 2.0 | — | $V_{DD} + 0.5$ | 2.0 | — | $V_{DD} + 0.5$ | V |
| $I_{IHL(max)}$ | Maximum allowed input current through protection diode (I/O1 – I/O7) | $V_I \geq V_{DD}$ or $V_I \leq V_{SS}$ | — | — | ± 400 | — | — | ± 400 | μ A |
| I_{OL} | LOW level output current | $V_{OL} = 0.55$ V; $V_{DD} = 3.3$ V; note 2 | 8 | 10 | — | 8 | 10 | — | mA |
| I_{OH} | HIGH level output current except I/O0 | $V_{OH} = 2.4$ V; $V_{DD} = 3.3$ V; note 3 | 4 | — | — | 4 | — | — | mA |
| | HIGH level output current on I/O0 | $V_{DD} = 3.6$ V; $V_{OH} = 4.6$ V | — | — | 1 | — | — | 1 | μ A |
| | | $V_{DD} = 0$ V; $V_{OH} = 3.3$ V | — | — | 1 | — | — | 1 | |
| I_L | Input leakage current | $V_{DD} = 3.6$ V; $V_I = 0$ or V_{DD} | -1 | — | 1 | -1 | — | 1 | μ A |
| C_I | Input capacitance | | — | — | 10 | — | — | 10 | pF |
| C_O | Output capacitance | | — | — | 10 | — | — | 10 | pF |
| Select Inputs A0, A1, A2, and RESET | | | | | | | | | |
| V_{IL} | LOW level input voltage | | -0.5 | — | 0.8 | -0.5 | — | 0.8 | V |
| V_{IH} | HIGH level input voltage | | 2.0 | — | $V_{DD} + 0.5$ | 2.0 | — | $V_{DD} + 0.5$ | V |
| I_{LI} | Input leakage current | | -1 | — | 1 | -1 | — | 1 | μ A |

NOTES:

1. The power-on reset circuit resets the SMBus logic with $V_{DD} < V_{POR}$ and sets all I/Os to their default values.
2. The maximum total sink current must be limited to 54 mA at +85 °C, and 80 mA at +70 °C.
3. The maximum total source current must be limited to 54 mA at +85 °C, and 80 mA at +70 °C.

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AC SPECIFICATIONS

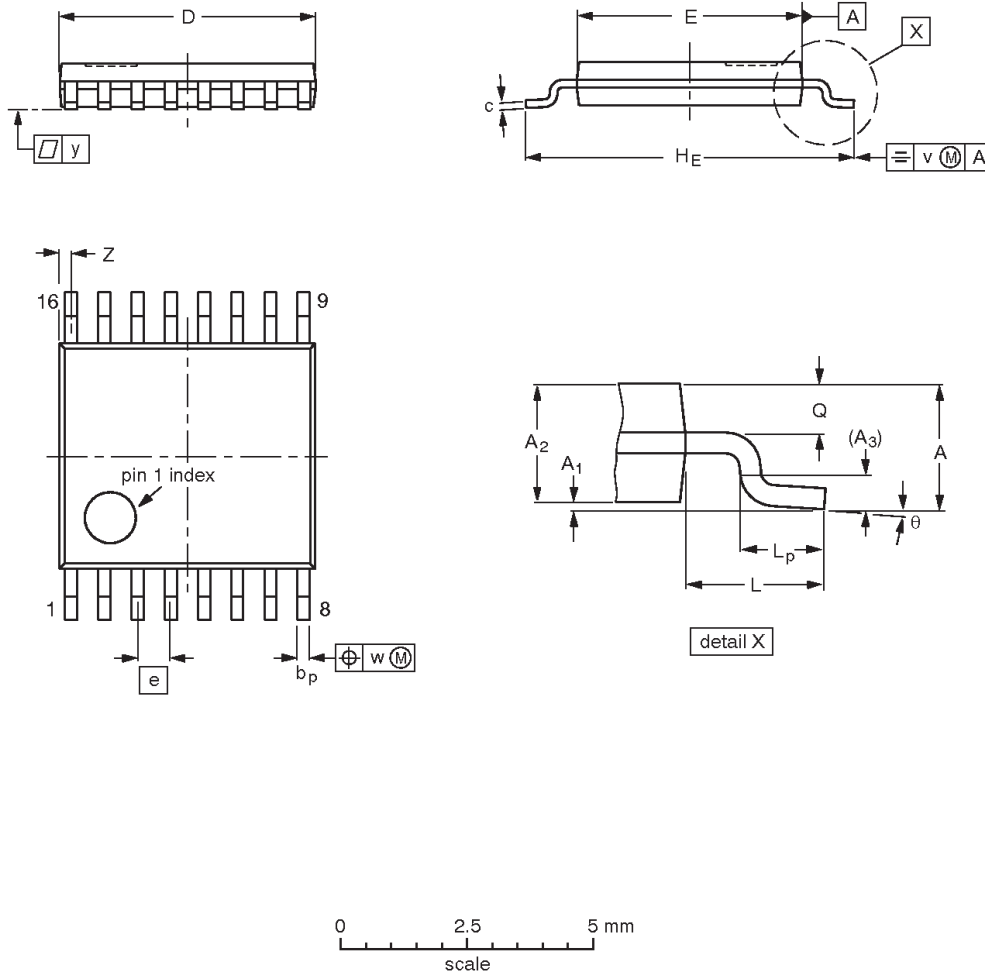
| SYMBOL | PARAMETER | LIMITS | | UNITS |
|---------------------|---|--------|------|-------|
| | | MIN | MAX | |
| f _{SMB} | SMB operating frequency | 10 | 100 | KHz |
| t _{BUF} | Bus free time between stop and start conditions | 4.7 | — | μs |
| t _{HO:STA} | Hold time after (repeated) start condition | 4.0 | — | μs |
| t _{SU:STA} | Repeated start condition setup time | 4.7 | — | μs |
| t _{HO:DAT} | Data hold time | 300 | — | ns |
| t _{SU:DAT} | Data setup time | 250 | — | ns |
| t _{LOW} | Clock LOW period | 4.7 | — | μs |
| t _{HIGH} | Clock HIGH period | 4.0 | — | μs |
| t _F | Clock/Data fall time | — | 300 | ns |
| t _R | Clock/Data rise time | — | 1000 | ns |
| Port Timing | | | | |
| t _{PV} | Output data valid | — | 4 | μs |
| t _{PS} | Input data setup time | 0 | — | μs |
| t _{PH} | Input data hold time | 4 | — | μs |
| Reset | | | | |
| t _W | Reset pulse width | 2 | — | ns |

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TSSOP16: plastic thin shrink small outline package; 16 leads; body width 4.4 mm

SOT403-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A max. | A ₁ | A ₂ | A ₃ | b _p | c | D ⁽¹⁾ | E ⁽²⁾ | e | H _E | L | L _p | Q | v | w | y | Z ⁽¹⁾ | θ |
|------|--------|----------------|----------------|----------------|----------------|------------|------------------|------------------|------|----------------|-----|----------------|------------|-----|------|-----|------------------|----------|
| mm | 1.10 | 0.15 0.05 | 0.95 0.80 | 0.25 | 0.30 0.19 | 0.2 0.1 | 5.1 4.9 | 4.5 4.3 | 0.65 | 6.6 6.2 | 1.0 | 0.75 0.50 | 0.4 0.3 | 0.2 | 0.13 | 0.1 | 0.40 0.06 | 8° 0° |

Notes

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|-----------------|------------|--------|------|--|---------------------|-----------------------|
| | IEC | JEDEC | EIAJ | | | |
| SOT403-1 | | MO-153 | | | | -95-04-04 99-12-27 |

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Purchase of Philips I²C components conveys a license under the Philips' I²C patent to use the components in the I²C system provided the system conforms to the I²C specifications defined by Philips. This specification can be ordered using the code 9398 393 40011.

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