

# DATA SHEET



## **PCA9558**

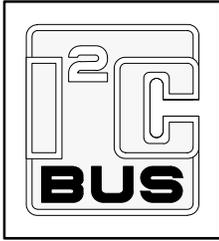
8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM  
DIP switch and 2-kbit EEPROM

Product data  
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# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

## PCA9558



### FEATURES

- 5-bit 2-to-1 multiplexer, 1-bit latch DIP switch
- 6-bit MUX\_OUTx and NON\_MUXED\_OUT EEPROM programmable and readable via I<sup>2</sup>C-bus
- 5 V tolerant open drain MUX\_OUTx and NON\_MUXED\_OUT outputs
- Active-LOW override input forces all MUX\_OUTx outputs to logic 0
- I<sup>2</sup>C readable MUX\_INx inputs
- 5 V tolerant open drain I/Ox pins, power-up default as outputs
- 1 address pin, allowing up to 2 devices on the I<sup>2</sup>C-bus
- Active-LOW reset input with internal pull-up for the 8 I/O pins
- 2048-bit EEPROM programmable and readable via the I<sup>2</sup>C or I/Os
- Operating power supply voltage range of 3.0 V to 3.6 V
- SMBus compliance with fixed 3.3 V levels
- 2.5 V to 5 V tolerant inputs
- 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 PCA9558 is a highly integrated, multi-function device that is composed of a 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C/SMBus EEPROM DIP switch, an 8-bit I/O expander and a 2-kbit serial EEPROM with write protect. The PCA9558 integrates these commonly used components into a single chip to reduce component count and board space requirements and is useful in computer, server and telecom/networking applications.

**Multiplexed/latched EEPROM DIP switch** — used to select digital information between a set of 5-bits of default hardware inputs and

an alternative set of inputs provided by the I<sup>2</sup>C/SMBus interface and stored in the EEPROM. Examples of this type of selection include processor voltage configuration or processor vendor identification (VID). The multiplexed/latched EEPROM can also be used to replace DIP switches or jumpers, since the settings can be easily changed via I<sup>2</sup>C/SMBus without having to power down the equipment to open the cabinet. The non-volatile memory retains the most current setting selected before the power is turned off.

**8-bit I/O expander** — used to control, monitor or collect remote information or power LEDs. Monitored or collected information can be read through the I<sup>2</sup>C/SMBus or can be stored in the internal EEPROM.

**2-kbit serial EEPROM** — used to store information such as card identification or revision/maintenance history on every motherboard/linecard and can be read or written via I<sup>2</sup>C/SMBus when required.

The PCA9558 has 1 address pin allowing up to 2 devices to be placed on the same I<sup>2</sup>C-bus or SMBus.

### PIN CONFIGURATION

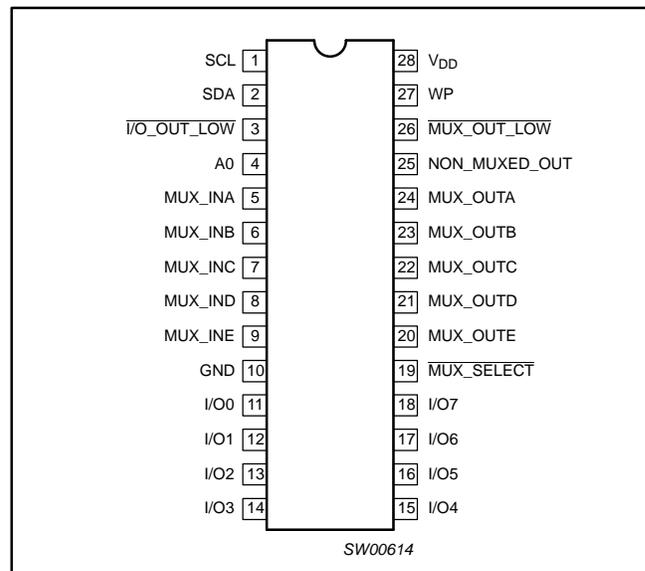


Figure 1. Pin configuration

### ORDERING INFORMATION

PACKAGES	TEMPERATURE RANGE	ORDER CODE	TOPSIDE MARK	DRAWING NUMBER
28-Pin Plastic TSSOP	0 to +70 °C	PCA9558PW	PCA9558DH	SOT361-1

Standard packing quantities and other packaging data is available at [www.philipslogic.com/packaging](http://www.philipslogic.com/packaging).

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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## PIN DESCRIPTION

PIN NUMBER	SYMBOL	FUNCTION
1	SCL	Serial I <sup>2</sup> C-bus clock
2	SDA	Serial bi-directional I <sup>2</sup> C-bus data
3	$\overline{\text{I/O\_OUT\_LOW}}$	Active-LOW control forces all GPIO to logic 0 outputs
4	A0	A0 Address
5-9	MUX_IN A-E	External inputs to multiplexer
10	GND	Ground
11-18	I/O[0-7]	General purpose Input/Output 0 through 7 (open drain outputs)
19	$\overline{\text{MUX\_SELECT}}$	Active-LOW Select of MUX_IN inputs or EEPROM contents for MUX_OUT outputs
20-24	MUX_OUT E-A	Open drain multiplexed outputs
25	NON_MUXED_OUT	Open drain outputs from non-volatile memory
26	$\overline{\text{MUX\_OUT\_LOW}}$	Active-LOW control forces all MUX outputs to logic 0
27	WP	Active-HIGH EEPROM write protect
28	V <sub>DD</sub>	Power supply : +3.0 to +3.6 V

8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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**BLOCK DIAGRAM**

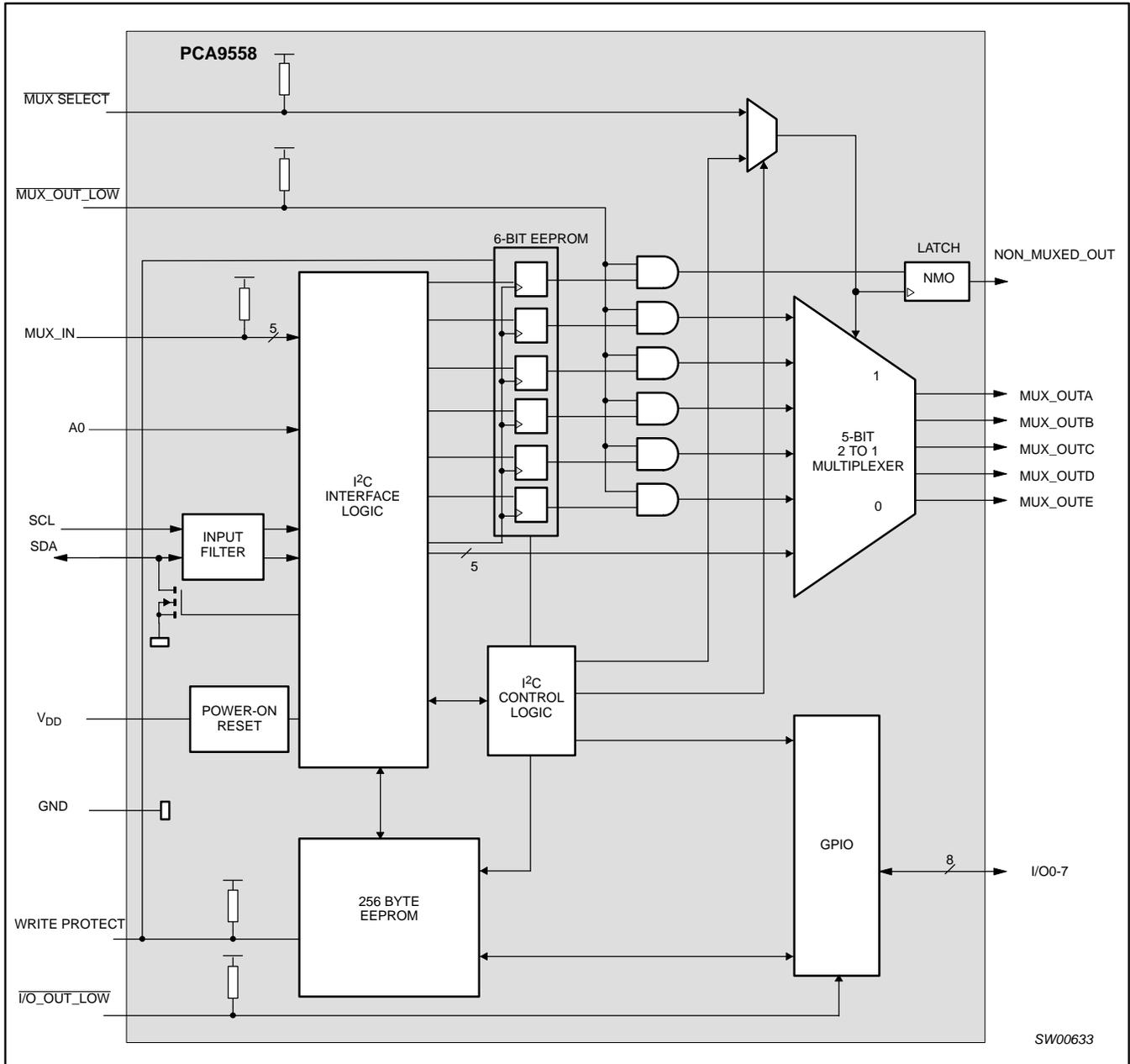


Figure 2. Block diagram

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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## I<sup>2</sup>C INTERFACE

Communicating with this device is initiated by sending a valid address on the I<sup>2</sup>C-bus. The address format (see Figure 3) has 6 fixed bits and one user-programmable bits followed by a 1-bit read/write value which determines the direction of the data transfer.

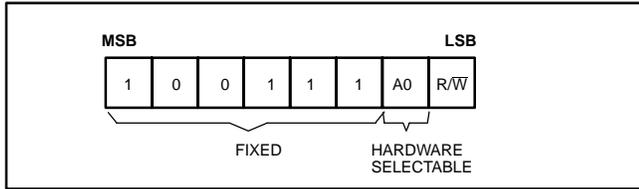


Figure 3. I<sup>2</sup>C Address Byte

Following the address and acknowledge bit are 8 data bits which, depending on the read/write bit in the address, will read data from or write data to the EEPROM. Data will be written to the register if the read/write bit is logic 0 and the WP input is logic 0. Data will be read from the register if the bit is logic 1. The four high-order bits are latched outputs, while the four low order bits are multiplexed outputs (Figure 5).

**NOTE:**

1. To ensure data integrity, the EEPROM must be internally write protected when V<sub>CC</sub> to the I<sup>2</sup>C-bus is powered down or V<sub>CC</sub> to the component is dropped below normal operating levels.

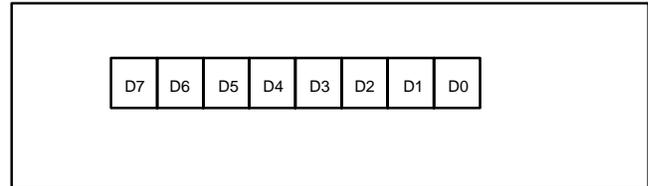


Figure 4. Command Byte

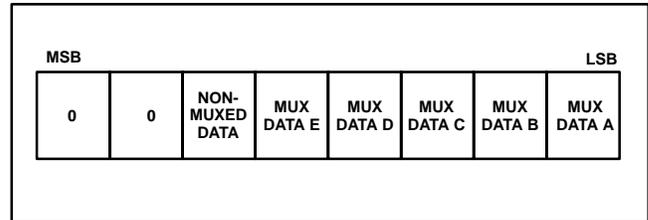


Figure 5. I<sup>2</sup>C MUX\_OUT Data Byte

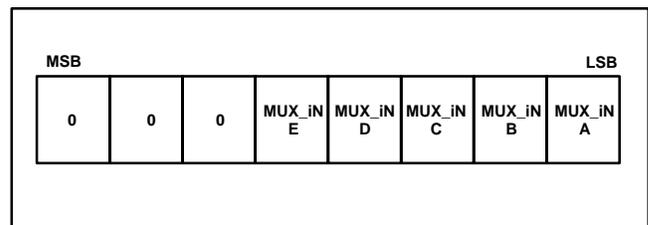


Figure 6. I<sup>2</sup>C MUX\_IN Data Byte

Table 1. Command byte

D7	D6	D5	D4	D3	D2	D1	D0	COMMAND
0	0	0	0	0	0	0	1	Write to 256EE via I <sup>2</sup> C
0	0	0	0	0	0	1	1	Read from 256EE via I <sup>2</sup> C
0	0	0	0	0	1	0	0	Write to 6 bit EE via I <sup>2</sup> C
0	0	0	0	0	1	1	0	Read from 6 bit EE via I <sup>2</sup> C
0	0	0	0	0	1	1	1	Read IP (Input Port) Register via I <sup>2</sup> C
0	0	0	0	1	0	0	0	Read/Write OP (Output Port) Register via I <sup>2</sup> C
0	0	0	0	1	0	0	1	Read/Write PI (Polarity Inversion) Register via I <sup>2</sup> C
0	0	0	0	1	0	1	0	Read/Write IOC (Input/Output Configuration) Register via I <sup>2</sup> C
0	0	0	0	1	0	1	1	Read/Write MUXCNTRL (Mux Control) Register via I <sup>2</sup> C
0	0	0	0	1	1	0	0	Read MUXIN values via I <sup>2</sup> C
0	0	0	0	1	1	0	1	Reserved
0	0	0	0	1	1	1	0	Reserved
0	0	0	0	1	1	1	1	Read 256EE and Write OP Register
0	0	0	1	0	0	0	0	Read 256EE and Write PI Register
0	0	0	1	0	0	0	1	Read 256EE and Write IOC Register
0	0	0	1	0	0	1	0	Read IP Register and Write to 256EE
0	0	0	1	0	0	1	1	Reserved
...	...	...	...	...	...	...	...	
1	1	1	1	1	1	1	1	Reserved

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

## PCA9558

The Multiplexer function controls the six open drain outputs, MUX\_OUTx and NON\_MUXED\_OUT. This control is effected by the input pins MUX\_SELECT (Pin 19), MUX\_OUT\_LOW (Pin 26), and/or an internal register programmed via the I<sup>2</sup>C-bus. Upon power-up the multiplex function is controlled by the MUX\_SELECT and MUX\_OUT\_LOW pins. When the MUX\_SELECT signal is a logic 0, the multiplexer will select the data from the 6-bit EEPROM to drive on the MUX\_OUTx and NON\_MUXED\_OUT pins. When the MUX\_SELECT signal is a logic 1, the multiplexer will select the MUX\_INx pins to drive on the MUX\_OUTx pins. The NON\_MUXED\_OUT output is latched from the 6-bit EEPROM on a rising edge of the MUX\_SELECT signal. This latch is transparent while the MUX\_SELECT signal is a logic 0. An internal control register, written via the I<sup>2</sup>C-bus, can also control the multiplexer function. When this register is written, the MUX\_SELECT function can change from the external pin to an internal register. In this register a bit will act in a similar fashion to the MUX\_SELECT input, i.e., a logic 1 will cause the multiplexer to select data from the 6-bit EEPROM to drive on the MUX\_OUTx and NON\_MUXED\_OUT pins. In this configuration, the NON\_MUXED\_OUT will latch data when the PCA9558 acknowledges the I<sup>2</sup>C-bus. The MUX\_SELECT pin will have no effect on the MUX\_OUTx or NON\_MUXED\_OUT while in this mode. When the MUX\_OUT\_LOW signal is a logic 0 and the multiplexer is configured so that the MUX\_OUTx pins are being driven by the 6-bit EEPROM, the MUX\_OUTx pins will be driven to a logic 0. This information is summarized in Table 2.

**Table 2. Multiplexer function table**

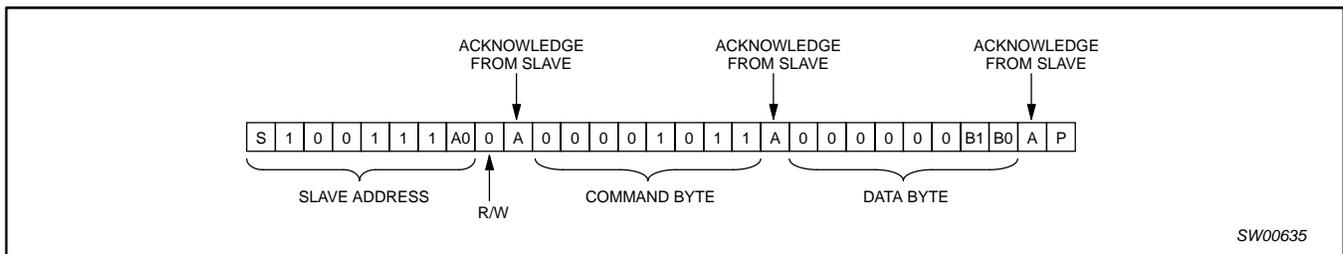
REG.		INPUT		OUTPUT	
B1 <sup>3</sup>	B0 <sup>3</sup>	MUX_OUT_LOW	MUX_SELECT	MUX_OUTx	NON_MUXED_OUT
x	0	0	1	MUX_INx inputs	latched from EEPROM <sup>1</sup>
x	0	0	0	0	0
x	0	1	1	MUX_INx inputs	latched from EEPROM <sup>1</sup>
x	0	1	0	from EEPROM	from EEPROM
0	1	0	x	MUX_INx inputs	latched from EEPROM <sup>2</sup>
1	1	0	x	0	0
0	1	1	x	MUX_INx inputs	latched from EEPROM <sup>2</sup>
1	1	1	x	from EEPROM	from EEPROM

**NOTES:**

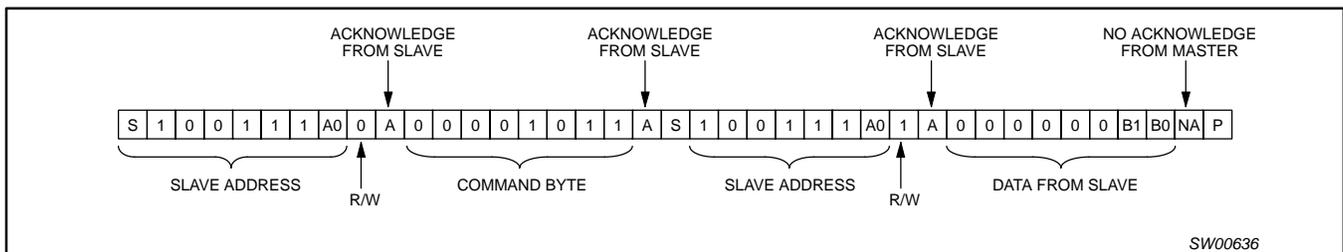
- NON\_MUXED\_OUT value will be the value present in the 6-bit EEPROM at the time of the rising edge of the MUX\_SELECT input.
- NON\_MUXED\_OUT value will be the value present in the 6-bit EEPROM at the time of the slave ACK when bit 1 has changed from '0' to '1'.
- These are the 2 LSBs of the MUXCNTRL (Mux Control) Register

If the MUX\_OUTx outputs are being driven by the 6-bit EEPROM and this EEPROM is programmed, the outputs will remain stable and change to the new values after the EEPROM program cycle completes.

Examples of Read/Write for MUX control can be found in Figure 7.



**Figure 7. I<sup>2</sup>C write for MUXCNTRL register**



**Figure 8. I<sup>2</sup>C read for MUXCNTRL register**

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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The GPIOs are controlled by a set of 4 internal registers: Input Port Register (IPR); Output Port Register (OPR); Polarity Inversion Register (PIR); and the Input/Output Configuration Register (IOCR). Each register is read/write via the I<sup>2</sup>C-bus or 256 byte EEPROM, with the exception of the IPR, which is read only, one at a time. The read/write takes place on the slave ACKNOWLEDGE. The control of which register is currently available to the I<sup>2</sup>C-bus is set by bits in the control register. See Tables 3 through 6 for details.

**Table 3. Input Port Register (IPR)**

Bit	I7	I6	I5	I4	I3	I2	I1	I0
Default	0	0	0	0	0	0	0	0

This register is an input-only port. It reflects the logic value present on the GPIO pins regardless of whether they are configured as inputs or outputs (IOCR). Writes to this register have no effect.

**Table 4. Output Port Register (OPR)**

Bit	O7	O6	O5	O4	O3	O2	O1	O0
Default	0	0	0	0	0	0	0	0

This register is an output-only port. It reflects the outgoing logic levels of the GPIO defined as outputs in the IOCR. Bit values in this register have no effect on GPIO defined as inputs. In turn, reads from this register reflect the value stored in the flip-flop controlling the output, **not** the actual output value.

**Table 5. Polarity Inversion Register (PIR)**

Bit	P7	P6	P5	P4	P3	P2	P1	P0
Default	1	1	1	1	0	0	0	0

This register enables polarity inversion of GPIO defined as inputs by the IOCR. If a bit in this register is set to a logic 1, the corresponding GPIO input port is inverted. If a bit in this register is set to a logic 0, the corresponding GPIO input port is not inverted.

**Table 6. I/O Configuration Register (IOCR)**

Bit	C7	C6	C5	C4	C3	C2	C1	C0
Default	0	0	0	0	0	0	0	0

This register configures the direction of the GPIO pins. If a bit is set to a logic 1, the corresponding port pin is enabled as an input with a high impedance output driver. If a bit is set to a logic 0, the corresponding port pin is enabled as an output.

Examples of Read/Write to these registers can be found in Figures 9, 10, 15, and 16.

The  $\overline{\text{I/O\_OUT\_LOW}}$  input, when held LOW longer than the time  $t_{W}$ , will reset the GPIO registers to their default (power-up) values.

A read of the present value of the inputs MUX\_INx can be done via the I<sup>2</sup>C. This is done by addressing the PCA9558 in a write mode and entering the correct command code. The preset value on the MUX\_INx inputs is latched at the command code ACKNOWLEDGE. A REPEATED START is then sent with the R/W bit set to a logic 1, read, and this latched data is read out on the I<sup>2</sup>C-bus. See Figure 11.

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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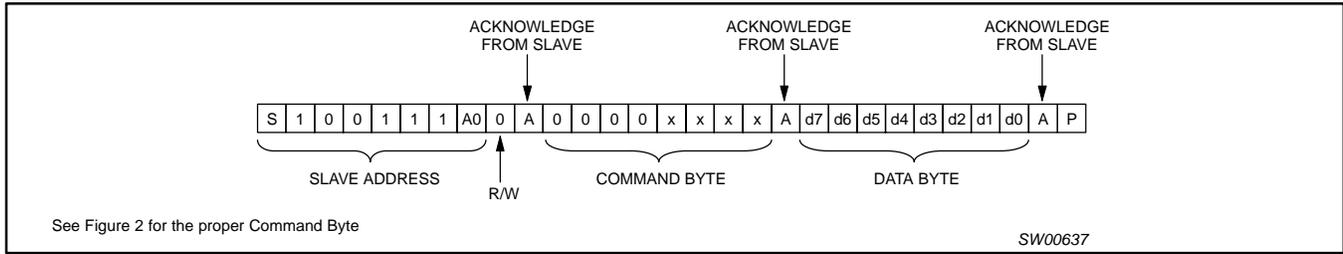


Figure 9. I<sup>2</sup>C write for GPIO registers

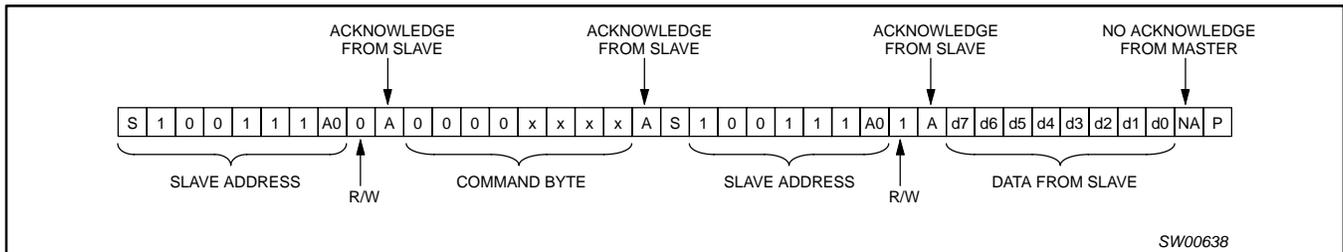


Figure 10. I<sup>2</sup>C read for GPIO registers

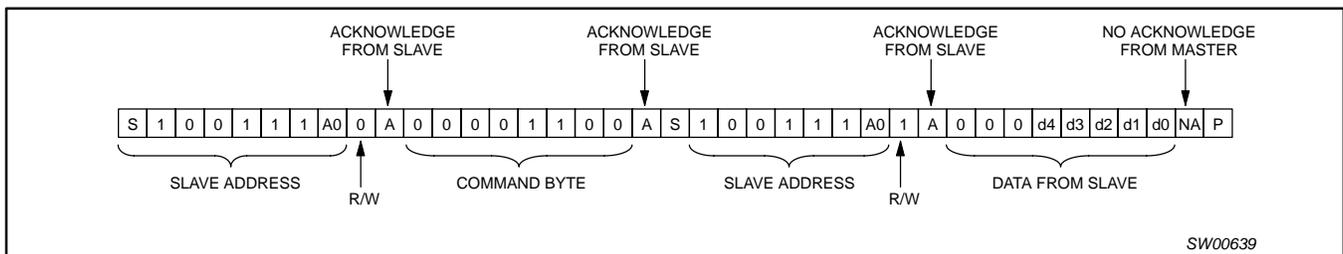


Figure 11. I<sup>2</sup>C read of MUX\_INx inputs

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

## PCA9558

### EEPROM write operation

#### 6-bit write operation

A write operation to the 6-bit EEPROM requires that an address byte be written after the command byte. This address points to the 6-bit address space in the EEPROM array. Upon receipt of this address, the PCA9558 waits for the next byte that will be written to the EEPROM. The master then ends the transaction with a STOP condition on the I<sup>2</sup>C. See Figure 12.

After the STOP condition, the E/W cycle starts, and the parts will not respond to any request to access the EEPROM array until the cycle finishes, approximately 4 ms.

#### 6-bit read operation

A read operation is initiated in the same manner as a write operation, with the exception that after the word address has been written a REPEATED START condition is placed on the I<sup>2</sup>C-bus and the direction of communication is reversed (see Figure 13).

#### 256 byte write operation (I<sup>2</sup>C)

A write operation to the 256 byte EEPROM requires that an address byte be written after the command byte. This address points to the starting address in the EEPROM array. The four LSBs of this address select a position on a 16 byte page register, the 4 MSBs select which page register. The four LSBs will be auto-incremented after receipt of each byte of data; in this manner, the entire page register can be written starting at any point. Up to 16 bytes of data may be sent to the PCA9558, followed by a STOP condition on the I<sup>2</sup>C-bus. If the master sends more than 16 bytes of data prior to generating a STOP condition, data within the address page will be overwritten and unpredictable results may occur. See Figure 14.

After the STOP condition, the E/W cycle starts, and the parts will not respond to any request to access the EEPROM array until the cycle finishes, approximately 4 ms.

#### 256 byte read operation (I<sup>2</sup>C)

A read operation is initiated in the same manner as a write operation, with the exception that after the word address has been written, a REPEATED START condition is placed on the I<sup>2</sup>C-bus, and the direction of communication is reversed. For a read operation, the entire address is incremented after the transmission of each byte, meaning that the entire 256 byte EEPROM array can be read at one time. See Figure 15.

#### 256 byte EEPROM write to GPIO

A mode is available whereby a byte of data in the 256 byte EEPROM array can be written to the GPIO (OPR). This is initiated by the I<sup>2</sup>C-bus. In this mode, a control word indicating a read from the 256 byte EEPROM and write to the GPIO is sent, followed by the word address of the data within the EEPROM array. Upon ACKNOWLEDGE from the slave, the data is sent to the GPIO. See Figure 16.

#### 256 byte EEPROM write from GPIO

A mode is available whereby data in the GPIO (IPR) can be written to the 256 byte EEPROM. This is initiated by the I<sup>2</sup>C-bus. In this mode, a control word indicating a read from the GPIO and write to the 256 byte EEPROM is sent, followed by the word address for the data to be written. Once the slave sent an ACKNOWLEDGE, the master must send a STOP condition. See Figure 17.

After the STOP condition, the E/W cycle starts, and the parts will not respond to any request to access the EEPROM array until the cycle finishes, approximately 4 ms.

When the Write Protect (WP) input is a logic 0 it allows writes to both EEPROM arrays. When a logic 1, it prevents any writes to the EEPROM arrays.

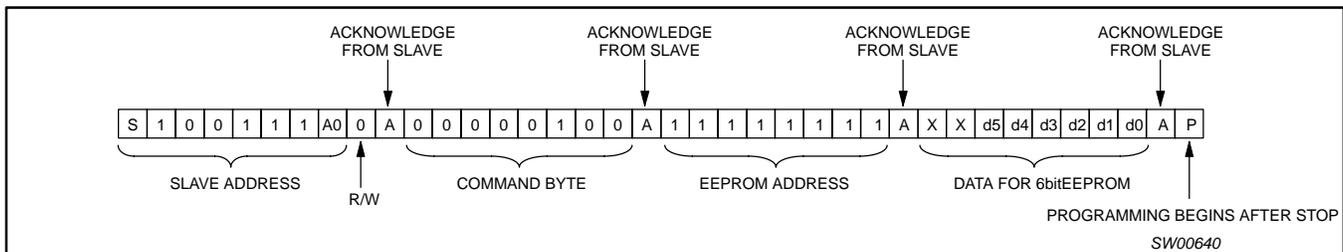


Figure 12. I<sup>2</sup>C write of 6-bit EEPROM

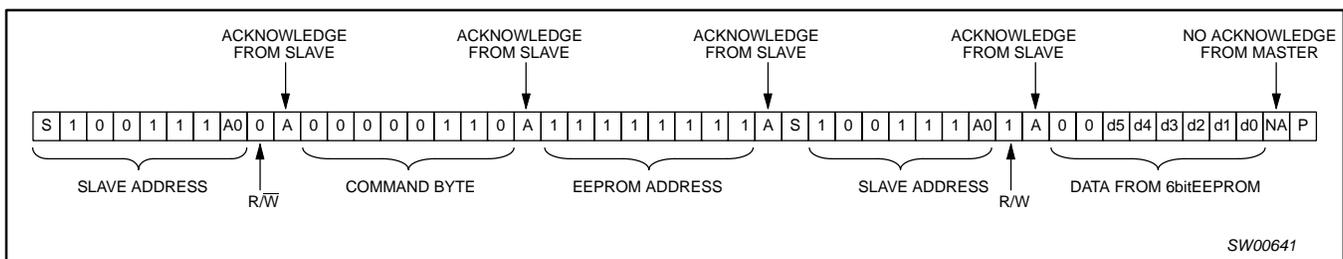


Figure 13. I<sup>2</sup>C read of 6-bit EEPROM

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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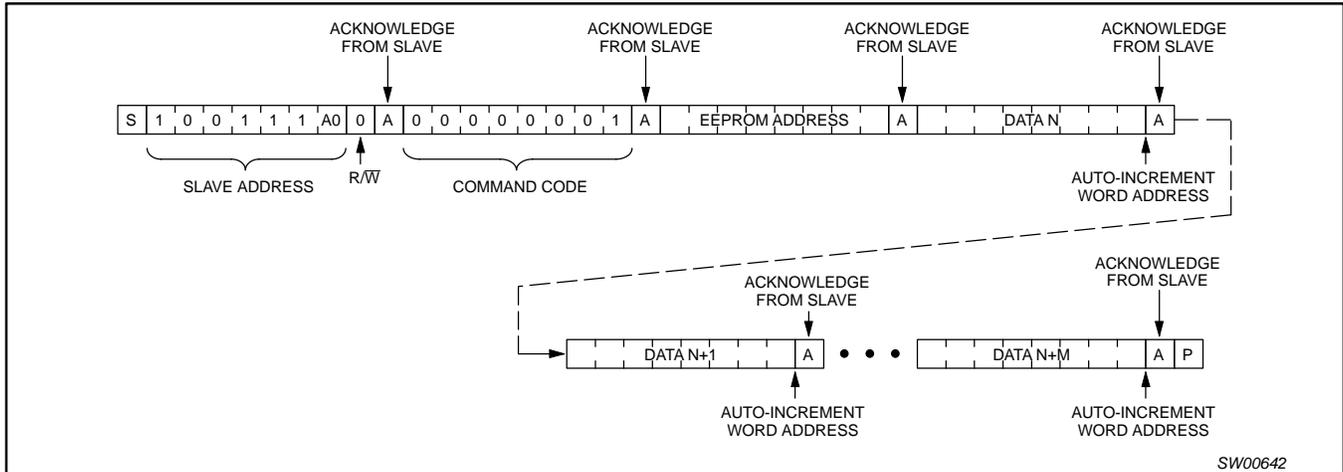


Figure 14. I<sup>2</sup>C page write operation to 256 byte EEPROM; M bytes where M ≤ 15

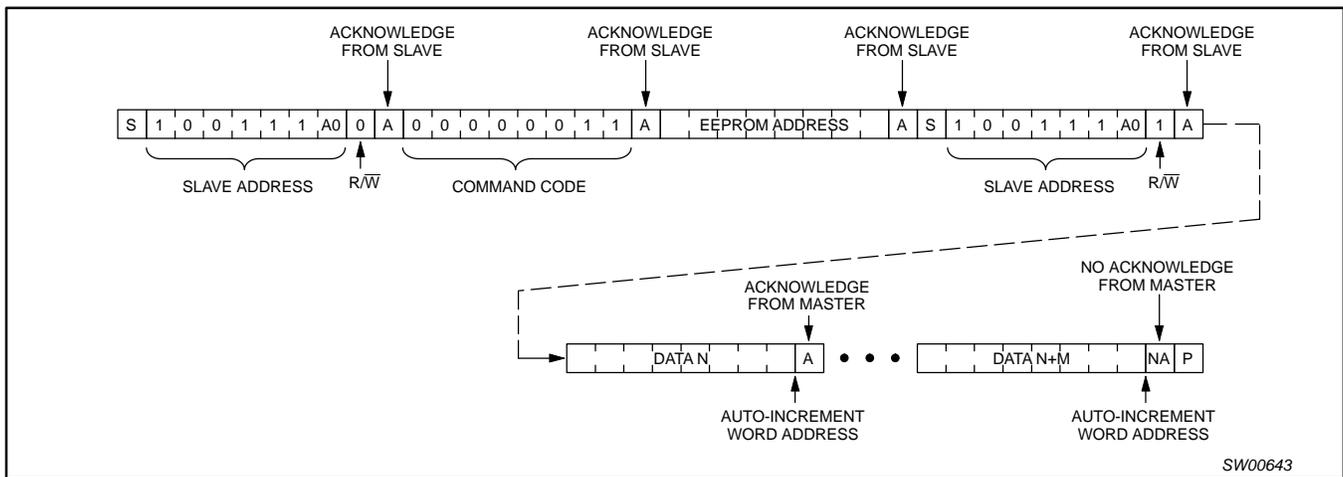


Figure 15. I<sup>2</sup>C read operation from 256 byte EEPROM; M bytes where M ≥ 1

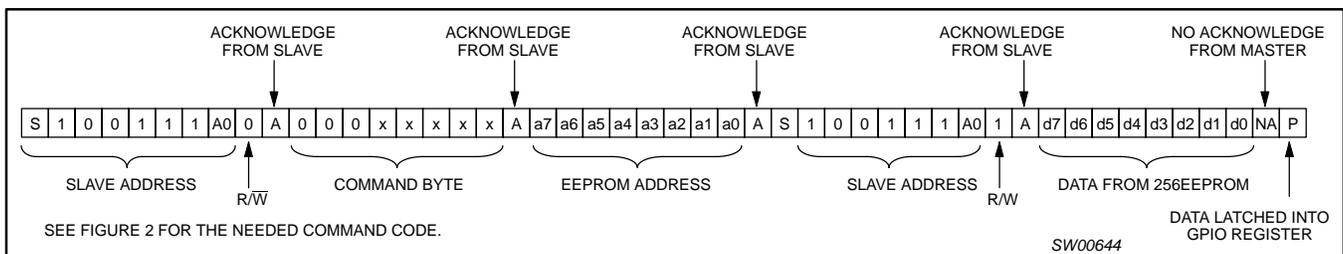


Figure 16. Read from 256 byte EEPROM and write to GPIO registers

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

PCA9558

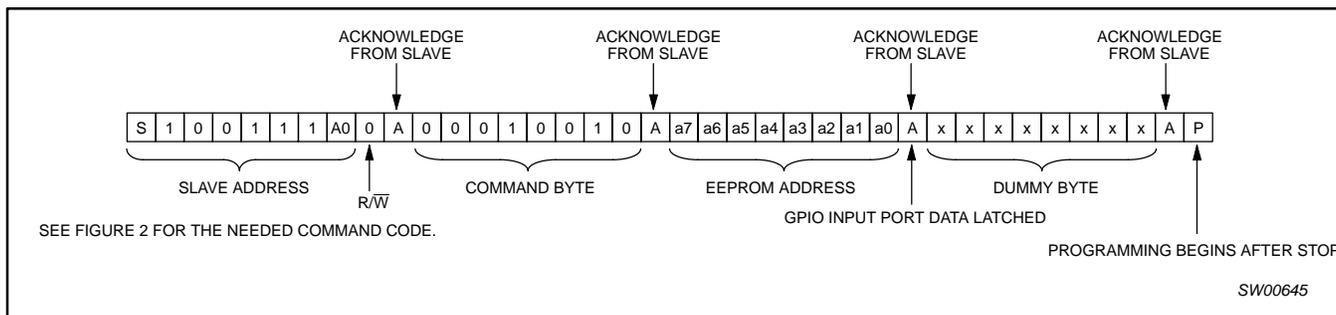


Figure 17. Read from GPIO Input Port Register and write to 256 byte EEPROM

## RESET

### Power-on Reset (POR)

When power is applied to  $V_{DD}$ , an internal power-on reset holds the PCA9558 in a reset state until  $V_{DD}$  has reached  $V_{POR}$ . At that point, the reset condition is released and the PCA9558 volatile registers and SMBus state machine will initialize to their default states.

The GPIO outputs will be selected as inputs and in high impedance. The DIP Switch MUX\_OUT and NON\_MUXED\_OUT pin values depend on:

- the MUX\_OUT\_LOW and MUX\_SELECT logic levels
- the previously stored values in the EEPROM register/current MUX\_IN pin values as shown in Table 2.

### External Reset

A reset of the GPIO registers can be accomplished by holding the I/O\_OUT\_LOW pin LOW for a minimum of  $t_w$ . These GPIO registers return to their default states until the I/O\_OUT\_LOW input is once again HIGH.

## USING THE PCA9558 ON THE SMBus

It is possible to use Intel® chipsets to communicate with the PCA9558. There are no limitations when the SMBus Controller is communicating with the Mux or the GPIO; however, there are limitations with the 2K serial EEPROM. Because of being able to address any location in the EEPROM block using the 2nd command byte, the designer using the PCA9558 on the SMBus will have to program around it, an easy thing to do. The device designers had to deal with the specifics of addressing the EEPROM and chose the I<sup>2</sup>C spec and use the 2nd command byte to address any location in the EEPROM block.

In order to write to the EEPROM, write the EEPROM address byte in the Data0 byte and the data to be sent should be placed in the Data1 byte. The Intel® chipset's Word Data instruction would then send the address, followed by the command register then Data0 (EEPROM address), and then the Data1 (data byte). A read from the EEPROM would be a two step process. The first step would be to do a Write Byte with the EEPROM address in the Data0 register. The second step would be to do a Receive Byte where the data is stored in the command register.

Other differences from the SMBus spec:

Paragraph 5.5.5 - Read Byte/Word in figure 5-11 - the PCA9558 follows this same command code with one exception, the PCA9558 requires 2 bytes of command before the repeated start.

Paragraph 5.5.6 - Process call in figure 5-15 - the PCA9558 read operation is very similar to the SMBus process call. In the PCA9558 read operation you send a start condition - slave address with a write bit - 2 bytes of command code - repeated start - slave address with a read bit - then read data.

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

## PCA9558

### TYPICAL APPLICATION

#### Applications

- Board version tracking and configuration
- Board health monitoring and status reporting
- Multi-card systems in Telecom, Networking and Base Station Infrastructure Equipment
- Field recall and troubleshooting functions for installed boards
- General-purpose integrated I/O with DIP switch and memory

A central processor/controller typically located on the system main board can use the 400 kHz I<sup>2</sup>C/SMBus to poll the PCA9558 devices located on the system cards for status or version control type of information. The PCA9558 may be programmed at manufacturing to store information regarding board build, firmware version, manufacturer identification, configuration option data... Alternately, these devices can be used as convenient interface for board configuration, thereby utilizing the I<sup>2</sup>C/SMBus as an intra-system communication bus.

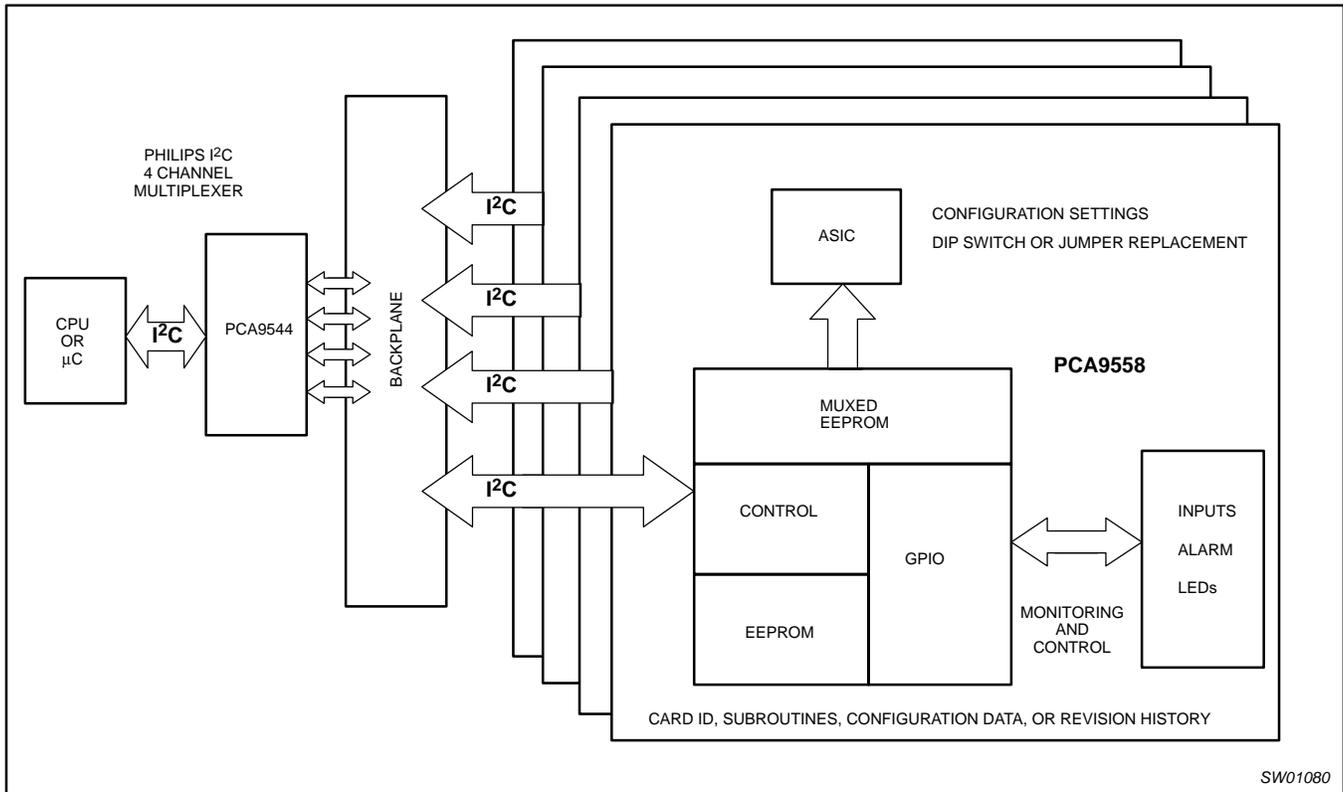


Figure 18. Typical application

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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## ABSOLUTE MAXIMUM RATINGS<sup>1, 2</sup>

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

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	CONDITIONS	RATING	UNIT
V <sub>DD</sub>	DC supply voltage		2.5 to 4.6	V
V <sub>I</sub>	DC input voltage	Note 3	-0.5 to V <sub>CC</sub> +0.5	V
V <sub>OUT</sub>	DC output voltage	Note 3	-0.5 to V <sub>CC</sub> +0.5	V
T <sub>stg</sub>	Storage temperature range		-60 to +150	°C

### NOTES:

- Stresses beyond those listed may cause permanent damage to the device. These are stress ratings only and 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-rated conditions for extended periods may affect device reliability.
- The performance capability of a high-performance integrated circuit in conjunction with its thermal environment can create junction temperatures which are detrimental to reliability. The maximum junction temperature of this integrated circuit should not exceed 150°C.
- The input and output voltage ratings may be exceeded if the input and output current ratings are observed.

## RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	CONDITIONS	LIMITS		UNIT	
			MIN	MAX		
V <sub>DD</sub>	DC supply voltage		3	3.6	V	
V <sub>IL</sub>	LOW-level input voltage	SCL, SDA	I <sub>OL</sub> = 3 mA	-0.5	0.9	V
V <sub>IH</sub>	HIGH-level input voltage	SCL, SDA	I <sub>OL</sub> = 3 mA	2.7	4.0	V
V <sub>OL</sub>	LOW-level output voltage	SCL, SDA	I <sub>OL</sub> = 3 mA	—	0.4	V
			I <sub>OL</sub> = 6 mA	—	0.6	V
V <sub>IL</sub>	LOW-level input voltage	MUX_OUT_LOW, MUX_IN, MUX_SELECT		-0.5	0.8	V
V <sub>IH</sub>	HIGH-level input voltage	MUX_OUT_LOW, MUX_IN, MUX_SELECT		2.0	4.0	V
I <sub>OL</sub>	LOW-level output current	MUX_OUT, NON_MUXED_OUT	V <sub>OL</sub> = 0.4 V	—	4	mA
I <sub>OH</sub>	HIGH-level output current	MUX_OUT, NON_MUXED_OUT		—	100	μA
dt/dv	Input transition rise or fall time			0	10	ns/V
T <sub>amb</sub>	Operating temperature			0	+70	°C

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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## DC CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS			UNIT
			MIN.	TYP.	MAX.	
<b>Supply</b>						
V <sub>DD</sub>	Supply voltage		3.0	—	3.6	V
I <sub>CCL</sub>	Supply current	Operating mode ALL inputs = 0 V	—	—	10	mA
I <sub>CCH</sub>	Supply current	Operating mode ALL inputs = V <sub>DD</sub>	—	—	10	mA
V <sub>POR</sub>	Power-on reset voltage	no load; V <sub>I</sub> = V <sub>DD</sub> or GND	—	2.3	2.6	V
<b>Input SCL: Input/Output SDA</b>						
V <sub>IL</sub>	LOW-level input voltage		-0.5	—	0.8	V
V <sub>IH</sub>	HIGH-level input voltage		2	—	V <sub>CC</sub> + 0.5	V
I <sub>OL</sub>	LOW-level output current	V <sub>OL</sub> = 0.4 V	3	—	—	mA
I <sub>OL</sub>	LOW-level output current	V <sub>OL</sub> = 0.6 V	6	—	—	mA
I <sub>IH</sub>	Leakage current HIGH	V <sub>I</sub> = V <sub>DD</sub>	-1	—	1	μA
I <sub>IL</sub>	Leakage current LOW	V <sub>I</sub> = GND	-1	—	1	μA
C <sub>I</sub>	Input capacitance		—	—	10	pF
<b>MUX_OUT_LOW, WP, MUX_SELECT</b>						
I <sub>IH</sub>	Leakage current HIGH	V <sub>I</sub> = V <sub>DD</sub>	—	—	1	μA
I <sub>IL</sub>	Leakage current LOW	V <sub>I</sub> = GND	—	—	-100	μA
C <sub>I</sub>	Input capacitance		—	—	10	pF
<b>MUX_IN A → MUX_IN E</b>						
I <sub>IH</sub>	Leakage current HIGH	V <sub>I</sub> = V <sub>DD</sub>	—	—	1	μA
I <sub>IL</sub>	Leakage current LOW	V <sub>I</sub> = GND	—	—	-100	μA
C <sub>I</sub>	Input capacitance		—	—	10	pF
<b>A0 Inputs</b>						
I <sub>IH</sub>	Leakage current HIGH	V <sub>I</sub> = V <sub>DD</sub>	—	—	1	μA
I <sub>IL</sub>	Leakage current LOW	V <sub>I</sub> = GND	—	—	-100	μA
C <sub>I</sub>	Input capacitance		—	—	10	pF
<b>MUX_OUTx</b>						
V <sub>OL</sub>	LOW-level output current	I <sub>OL</sub> = 100 μA	—	—	0.4	V
V <sub>OL</sub>	LOW-level output current	I <sub>OL</sub> = 4 mA	—	—	0.7	V
I <sub>OH</sub>	HIGH-level output current	V <sub>OH</sub> = V <sub>DD</sub>	—	—	100	μA
<b>NON_MUXED OUT</b>						
V <sub>OL</sub>	LOW level output current	I <sub>OL</sub> = 100 μA	—	—	0.4	V
V <sub>OL</sub>	LOW-level output current	I <sub>OL</sub> = 4 mA	—	—	0.7	V
I <sub>OH</sub>	HIGH-level output current	V <sub>OH</sub> = V <sub>DD</sub>	—	—	100	μA
<b>GPIO</b>						
V <sub>OL</sub>	LOW-level output current	I <sub>OL</sub> = 100 μA	—	—	0.4	V
V <sub>OL</sub>	LOW-level output current	I <sub>OL</sub> = 4 mA	—	—	0.7	V
I <sub>OH</sub>	HIGH-level output current	V <sub>OH</sub> = V <sub>DD</sub>	—	—	100	μA

### NOTE:

- V<sub>HYS</sub> is the hysteresis of Schmitt-Trigger inputs

## NON-VOLATILE STORAGE SPECIFICATIONS

PARAMETER	SPECIFICATION
Memory cell data retention	10 years min
Number of memory cell write cycles	100,000 cycles min

Application Note AN250 I<sup>2</sup>C DIP Switch provides additional information on memory cell data retention and the minimum number of write cycles.

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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## AC CHARACTERISTICS

SYMBOL	PARAMETER	LIMITS			UNIT
		MIN.	TYP.	MAX.	
<b>MUX_INx ⇒ MUX_OUTx</b>					
t <sub>PLH</sub>	LOW-to-HIGH transition time	—	21	28	ns
t <sub>PHL</sub>	HIGH-to-LOW transition time	—	7	10	ns
<b>MUX_SELECT ⇒ MUX_OUTx</b>					
t <sub>PLH</sub>	LOW-to-HIGH transition time	—	20	28	ns
t <sub>PHL</sub>	HIGH-to-LOW transition time	—	8	12	ns
<b>MUX_OUT_LOW ⇒ NON_MUXED_OUT</b>					
t <sub>PLH</sub>	LOW-to-HIGH transition time	—	20	26	ns
t <sub>PHL</sub>	HIGH-to-LOW transition time	—	8	15	ns
<b>MUX_OUT_LOW ⇒ MUX_OUTx</b>					
t <sub>PLH</sub>	LOW-to-HIGH transition time	—	20	28	ns
t <sub>PHL</sub>	HIGH-to-LOW transition time	—	7.0	15	ns
t <sub>R</sub>	Output rise time	1.0	—	10	ns/V
t <sub>F</sub>	Output fall time	1.0	—	5	ns/V
C <sub>L</sub>	Test load capacitance on outputs	—	—	—	pF
<b>I<sup>2</sup>C-bus</b>					
t <sub>SCL</sub>	SCL clock frequency	10	—	400	kHz
t <sub>BUF</sub>	Bus free time between a STOP and a START condition	1.3	—	—	μs
t <sub>HD:STA</sub>	Hold time (repeated) START condition. After this period, the first clock pulse is generated	600	—	—	ns
t <sub>LOW</sub>	LOW period of SCL clock	1.3	—	—	μs
t <sub>HIGH</sub>	HIGH period of SCL clock	600	—	-12	ns
t <sub>SU:STA</sub>	Set-up time for a repeated START condition	600	—	-32	ns
t <sub>HD:DAT</sub>	Data hold time	0	—	10	ns
t <sub>SU:DAT</sub>	Data set-up time	100	—	-100	ns
t <sub>SP</sub>	Data spike time	0	—	50	ns
t <sub>SU:STO</sub>	Set-up time for STOP condition	600	—	10	ns
t <sub>R</sub>	Rise time for both SDA and SCL signals (10 - 400 pF bus)	20	—	300	ns
t <sub>I</sub>	Fall time for both SDA and SCL signals (10 - 400 pF bus)	20	—	300	ns
C <sub>L</sub>	Capacitive load for each bus line	—	—	400	pF
T <sub>W</sub>	Write cycle time <sup>1</sup>	—	15	—	ms

### NOTE:

1. WRITE CYCLE time can only be measured indirectly during the write cycle. During this time, the device will not acknowledge its I<sup>2</sup>C Address.

8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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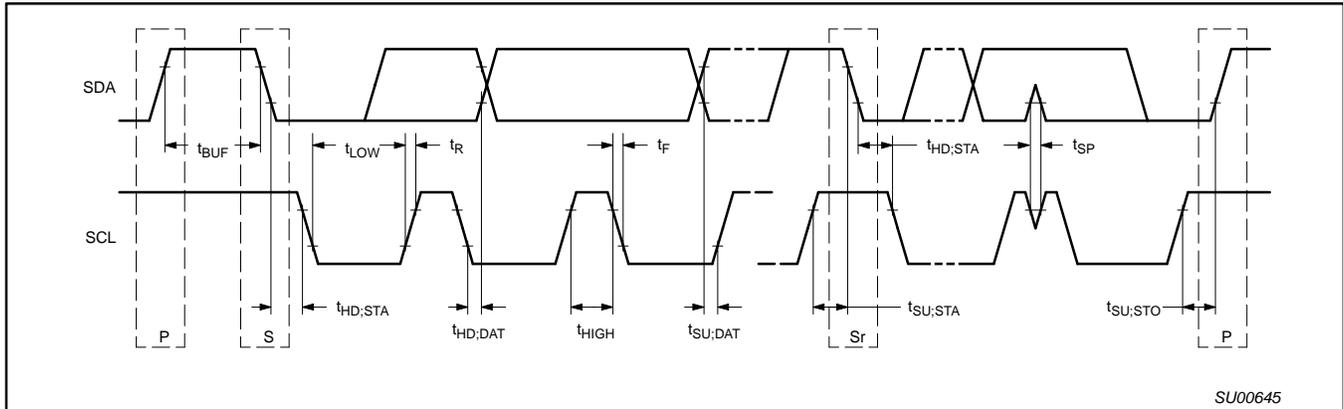


Figure 19. Definition of timing

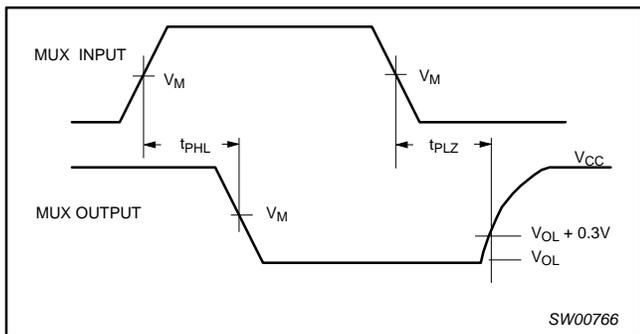
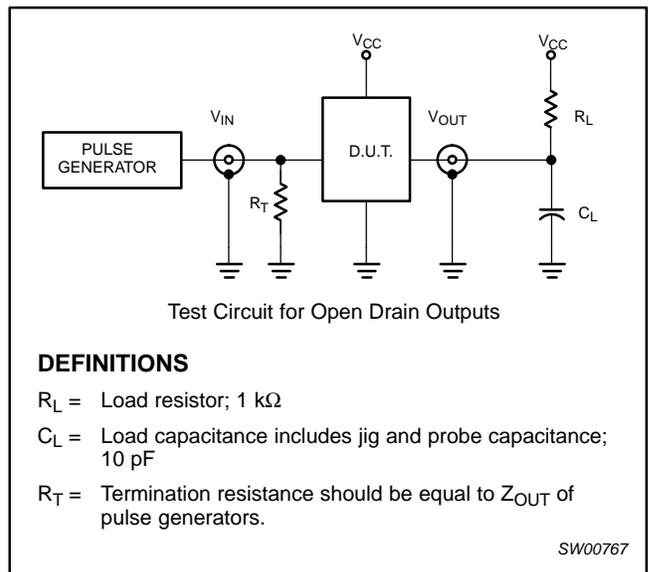


Figure 20. Open drain output enable and disable times



Test Circuit for Open Drain Outputs

**DEFINITIONS**

- $R_L$  = Load resistor; 1 k $\Omega$
- $C_L$  = Load capacitance includes jig and probe capacitance; 10 pF
- $R_T$  = Termination resistance should be equal to  $Z_{OUT}$  of pulse generators.

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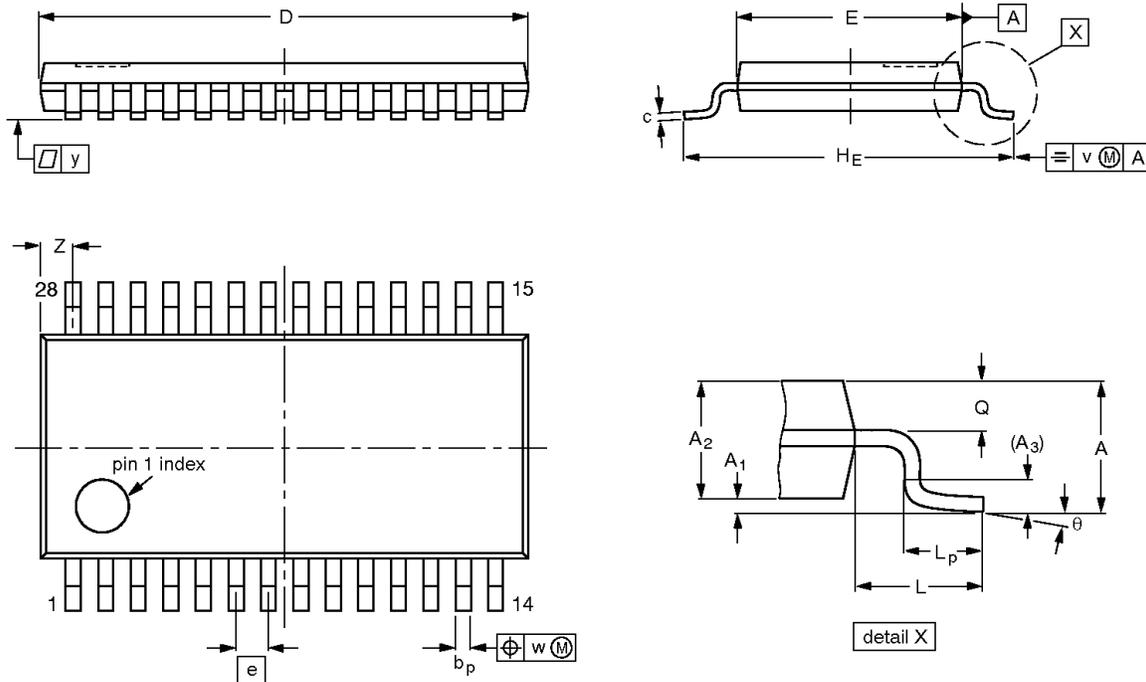
Figure 21. Test circuit

8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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TSSOP28: plastic thin shrink small outline package; 28 leads; body width 4.4 mm

SOT361-1



**DIMENSIONS (mm are the original dimensions)**

UNIT	A max.	A <sub>1</sub>	A <sub>2</sub>	A <sub>3</sub>	b <sub>p</sub>	c	D <sup>(1)</sup>	E <sup>(2)</sup>	e	H <sub>E</sub>	L	L <sub>p</sub>	Q	v	w	y	Z <sup>(1)</sup>	θ
mm	1.1	0.15 0.05	0.95 0.80	0.25	0.30 0.19	0.2 0.1	9.8 9.6	4.5 4.3	0.65	6.6 6.2	1	0.75 0.50	0.4 0.3	0.2	0.13	0.1	0.8 0.5	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	JEITA			
SOT361-1		MO-153				-99 12-27- 03-02-19

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8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit  
latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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**REVISION HISTORY**

Rev	Date	Description
_3	20030627	<b>Product data (9397 750 11674); ECN 853-2235 29936 dated 19 May 2003. Supersedes data of 2002 May 24 (9397 750 09889).</b> Modifications: <ul style="list-style-type: none"><li>• Update marketing information.</li><li>• Increase number of write cycles from 3K to 100K.</li></ul>
_2	20020524	Product data (9397 750 09889); ECN 853-2235 28310 of 24 May 2002.

# 8-bit I<sup>2</sup>C and SMBus I/O port with 5-bit multiplexed/1-bit latched 6-bit I<sup>2</sup>C EEPROM DIP switch and 2-kbit EEPROM

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Purchase of Philips I<sup>2</sup>C components conveys a license under the Philips' I<sup>2</sup>C patent to use the components in the I<sup>2</sup>C system provided the system conforms to the I<sup>2</sup>C specifications defined by Philips. This specification can be ordered using the code 9398 393 40011.

## Data sheet status

Level	Data sheet status <sup>[1]</sup>	Product status <sup>[2] [3]</sup>	Definitions
I	Objective data	Development	This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.
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