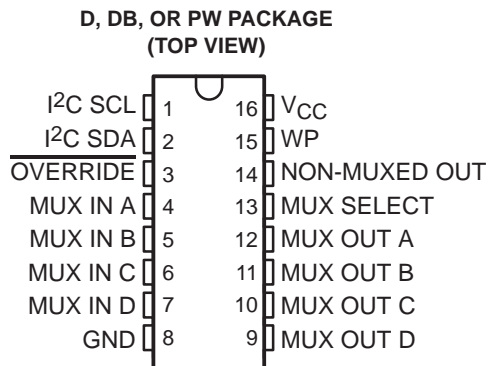


# PCA8550 NONVOLATILE 5-BIT REGISTER WITH I<sup>2</sup>C INTERFACE

SCPS050A – MARCH 1999 – REVISED APRIL 1999

- **EPIC™ (Enhanced-Performance Implanted CMOS) Submicron Process**
- **Useful for Jumperless Configuration of PC Motherboard**
- **Inputs Accept Voltages to 5.5 V**
- **MUX OUT Signals are 2.5-V Outputs**
- **NON-MUXED OUT Signal is a 3.3-V Output**
- **Minimum of 1000 Write Cycles**
- **Minimum of 10 Years Data Retention**
- **Package Options Include Plastic Small-Outline (D), Shrink Small-Outline (DB), and Thin Shrink Small-Outline (PW) Packages**



## description

This 4-bit 1-of-2 multiplexer with I<sup>2</sup>C input interface is designed for 3-V to 3.6-V V<sub>CC</sub> operation.

The PCA8550 is designed to multiplex four bits of data from parallel inputs or from I<sup>2</sup>C input data stored in a nonvolatile register. An additional bit of register output also is provided, which is latched to prevent changes in the output value during the write cycle. The factory default for the contents of the register is all low. These stored values can be read from, or written to, using the I<sup>2</sup>C bus. The ability to control writing to the register is provided by the write protect (WP) input. The override ( $\overline{\text{OVERRIDE}}$ ) input forces all the register outputs to a low.

This device provides a fast-mode (400 kbit/s) or standard-mode (100 kbit/s) I<sup>2</sup>C serial interface for data input and output. The implementation is as a slave. The device address is specified in the I<sup>2</sup>C interface definition table. Both of the I<sup>2</sup>C Schmitt-trigger inputs (SCL and SDA) provide integrated pullup resistors and are 5-V tolerant.

The PCA8550 is characterized for operation from 0°C to 70°C.

**FUNCTION TABLE**

INPUTS		OUTPUTS	
MUX SELECT	$\overline{\text{OVERRIDE}}$	MUX OUT	NON-MUXED OUT
L	L	L	L
L	H	Nonvolatile register	Nonvolatile register
H	X	MUX IN	Latched NON-MUXED OUT†

† The latched NON-MUXED OUT state is the value present on the NON-MUXED OUT output at the time the MUX SELECT input transitions from the low to the high state.



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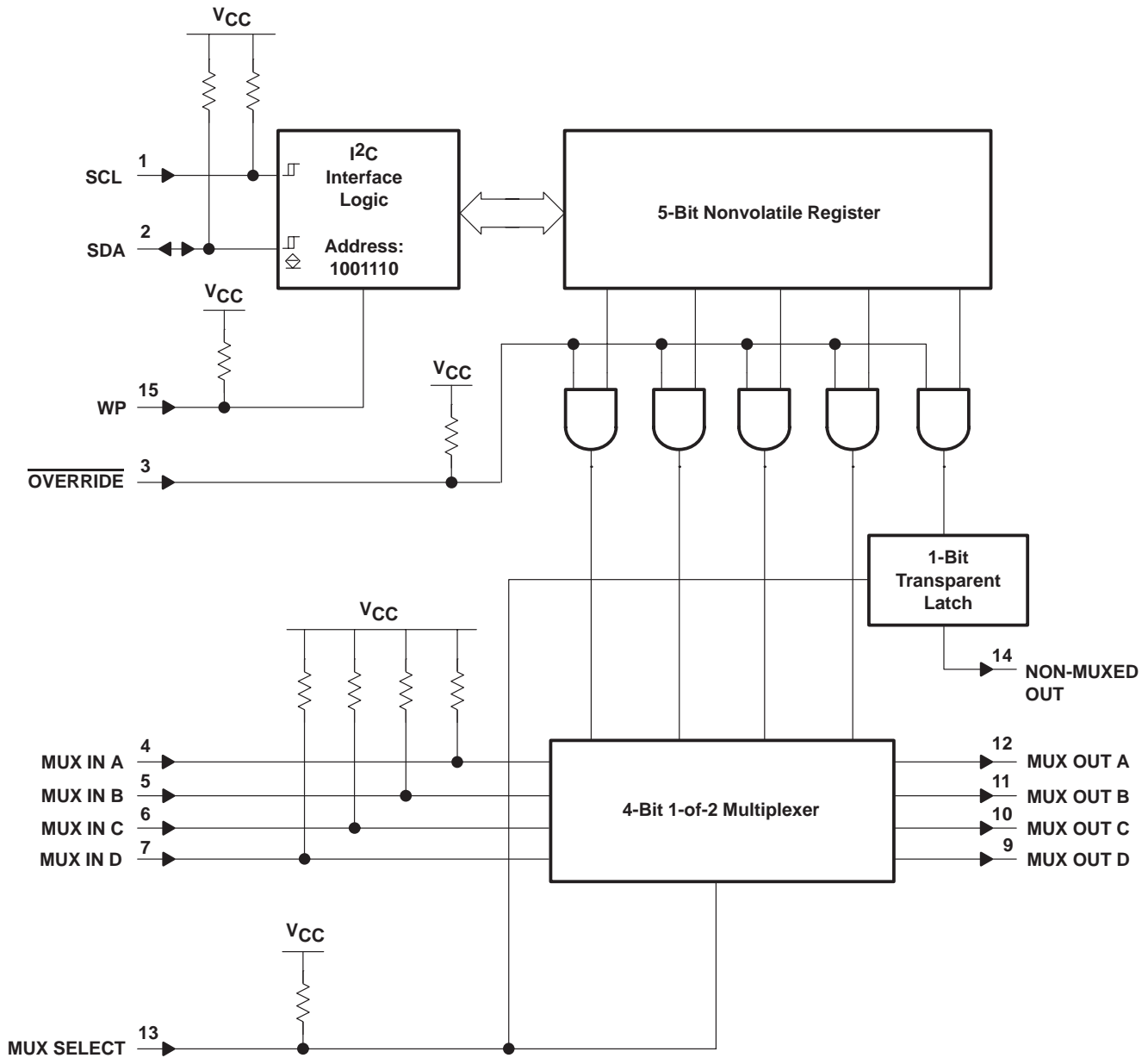
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# PCA8550 NONVOLATILE 5-BIT REGISTER WITH I<sup>2</sup>C INTERFACE

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## logic diagram (positive logic)



**I<sup>2</sup>C interface**

I<sup>2</sup>C communication with this device is initiated by a master sending a start condition, a high-to-low transition on the serial data (SDA) input/output while the serial clock (SCL) input is high. After the start condition, the device address byte is sent, MSB first, including the data-direction bit ( $\overline{R/W}$ ). This device does not respond to the general call address. After receiving the valid address byte, this device responds with an acknowledge, a low on the SDA input/output during the high of the acknowledge-related clock pulse.

The data byte follows the address acknowledge. If the  $\overline{R/W}$  bit is high, the data from this device are the values read from the nonvolatile register. If the  $\overline{R/W}$  bit is low, the data are from the master, to be written into the register. A valid data byte is one in which the three high-order bits are low. The first valid data byte that is received is written into the register, following the stop condition. If an invalid data byte is received, it is acknowledged, but is not written into the register. The data byte is followed by an acknowledge sent from this device. If other data bytes are sent from the master following the acknowledge, they are ignored by this device.

A stop condition, a low-to-high transition on the SDA input/output while the SCL input is high, is sent by the master. If the WP input is low during the falling edge of the first valid data byte acknowledge on the SCL input and the  $\overline{R/W}$  bit is low, the stop condition causes the I<sup>2</sup>C interface logic to write the data byte value into the nonvolatile register. Data are written only if complete bytes are received and acknowledged. Writing to the register takes time ( $t_{wr}$ ), during which the device does not respond to its slave address. If the WP input is high, the I<sup>2</sup>C interface logic does not write to the register.

**I<sup>2</sup>C INTERFACE DEFINITION TABLE**

BYTE	BIT							
	7 (MSB)	6	5	4	3	2	1	0 (LSB)
Address	H	L	L	H	H	H	L	$\overline{R/W}$
Data	L	L	L	NON-MUXED OUT	MUX OUT D	MUX OUT C	MUX OUT B	MUX OUT A

**absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†**

Supply voltage range, $V_{CC}$ .....	–0.5 V to 6.5 V
Input voltage range, $V_I$ (see Note 1) .....	–0.5 V to 6.5 V
Output voltage range, $V_O$ (SDA) (see Note 1) .....	–0.5 V to 6.5 V
Output voltage range, $V_O$ (MUX OUT outputs) (see Note 1) .....	–0.5 V to 2.9 V
Output voltage range, $V_O$ (NON-MUXED OUT output) (see Notes 1 and 2) .....	–0.5 V to $V_{CC} + 0.5$ V
Input clamp current, $I_{IK}$ ( $V_I < 0$ ) .....	–50 mA
Output clamp current, $I_{OK}$ ( $V_O < 0$ or $V_O > V_{CC}$ ) (see Note 2) .....	–50 mA, +10 mA
Input/output clamp current, $I_{OK}$ ( $V_O < 0$ ) .....	–50 mA
Continuous output current, $I_O$ ( $V_O = 0$ to $V_{CC}$ ) (see Note 2) .....	±15 mA
Continuous current through $V_{CC}$ or GND .....	±30 mA
Package thermal impedance, $\theta_{JA}$ (see Note 3): D package .....	113°C/W
DB package .....	131°C/W
PW package .....	149°C/W
Storage temperature range, $T_{stg}$ .....	–65°C to 85°C

† Stresses beyond those listed under “absolute maximum ratings” 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.

- NOTES: 1. The input negative-voltage and output voltage ratings may be exceeded if the input and output current ratings are observed.  
 2. The value of  $V_{CC}$  is provided in the recommended operating conditions table.  
 3. The package thermal impedance is calculated in accordance with JESD 51.

**PCA8550**  
**NONVOLATILE 5-BIT REGISTER**  
**WITH I<sup>2</sup>C INTERFACE**

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**recommended operating conditions**

		MIN	MAX	UNIT	
V <sub>CC</sub>	Supply voltage	3	3.6	V	
V <sub>IH</sub>	High-level input voltage	SCL, SDA	2.7	4	V
		OVERVERRIDE, MUX IN, MUX SELECT, WP	2	4	
V <sub>IL</sub>	Low-level input voltage	SCL, SDA	-0.5	0.9	V
		OVERVERRIDE, MUX IN, MUX SELECT, WP	-0.5	0.8	
I <sub>OH</sub>	High-level output current		-2	mA	
I <sub>OL</sub>	Low-level output current	SDA		6	mA
		MUX OUT, NON-MUXED OUT		2	
Δt/Δv	Input transition rise or fall rate			10	ns/V
T <sub>A</sub>	Operating free-air temperature	0	70	°C	

**electrical characteristics over recommended operating free-air temperature range, V<sub>CC</sub> = 3.3 V ± 0.3 V (unless otherwise noted)**

PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
V <sub>IK</sub>	Input diode clamp voltage	I <sub>I</sub> = -18 mA	-1.5		V
V <sub>hys</sub> <sup>†</sup>	SCL, SDA		0.19		V
V <sub>OH</sub>	MUX OUT	I <sub>OH</sub> = -100 μA	2	2.625	V
		I <sub>OH</sub> = -1 mA	1.7	2.625	
	NON-MUXED OUT	I <sub>OH</sub> = -100 μA	2.4	3.6	
		I <sub>OH</sub> = -2 mA	2	3.6	
V <sub>OL</sub>	MUX OUT	I <sub>OL</sub> = 100 μA	-0.3	0.4	V
		I <sub>OL</sub> = 2 mA	-0.3	0.7	
	NON-MUXED OUT	I <sub>OL</sub> = 100 μA	-0.5	0.4	
		I <sub>OL</sub> = 2 mA	-0.5	0.7	
	SDA	I <sub>OL</sub> = 3 mA		0.4	
		I <sub>OL</sub> = 6 mA		0.6	
I <sub>IH</sub>	SCL, SDA	V <sub>IH</sub> = 2.4 V	-1.5	-12	μA
	OVERVERRIDE, MUX SELECT, WP		-20	-100	
	MUX IN		-0.166	-0.75	mA
I <sub>IL</sub>	SCL, SDA	V <sub>IL</sub> = 0.4 V	-7	-32	μA
	OVERVERRIDE, MUX SELECT, WP		-86	-267	
	MUX IN		-0.72	-2	mA
I <sub>CC</sub>	During read or write cycle	V <sub>I</sub> = 0 to V <sub>CC</sub> , I <sub>O</sub> = 0, V <sub>CC</sub> = 3.3 V		10	mA
	Not during read or write cycle	V <sub>I</sub> = V <sub>CC</sub> , I <sub>O</sub> = 0		500	μA
C <sub>i</sub>		V <sub>I</sub> = V <sub>CC</sub> or GND		10	pF

<sup>†</sup> V<sub>hys</sub> is the hysteresis of Schmitt-trigger inputs.



**nonvolatile storage specifications**

PARAMETER	SPECIFICATIONS
Write time ( $t_{wr}$ )	10 ms, typical
Memory-cell data retention	10 years, minimum
Maximum number of memory-cell write cycles	1000 cycles, minimum

**I<sup>2</sup>C interface timing requirements over recommended operating free-air temperature range (unless otherwise noted) (see Figure 1)**

		$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
		MIN	MAX	
$f_{scl}$	I <sup>2</sup> C clock frequency	10	400	kHz
$T_{sch}$	I <sup>2</sup> C clock high time	600		ns
$T_{scl}$	I <sup>2</sup> C clock low time	1.3		$\mu$ s
$T_{sp}$	I <sup>2</sup> C spike time	0	50	ns
$T_{sds}$	I <sup>2</sup> C serial data setup time	100		ns
$T_{sdh}$	I <sup>2</sup> C serial data hold time	0	900	ns
$T_{icr}$	I <sup>2</sup> C input rise time	20	300	ns
$T_{icf}$	I <sup>2</sup> C input fall time	20	300	ns
$T_{ocf}$	I <sup>2</sup> C output fall time (10-pF to 400-pF bus)	$20 + 0.1 C_b^\dagger$	250	ns
$T_{buf}$	I <sup>2</sup> C bus free time between stop and start	1.3		$\mu$ s
$T_{sts}$	I <sup>2</sup> C start or repeated start condition setup	600		ns
$T_{sth}$	I <sup>2</sup> C start or repeated start condition hold	600		ns
$T_{sps}$	I <sup>2</sup> C stop condition setup	600		ns
$C_b^\dagger$	I <sup>2</sup> C bus capacitive load		400	pF

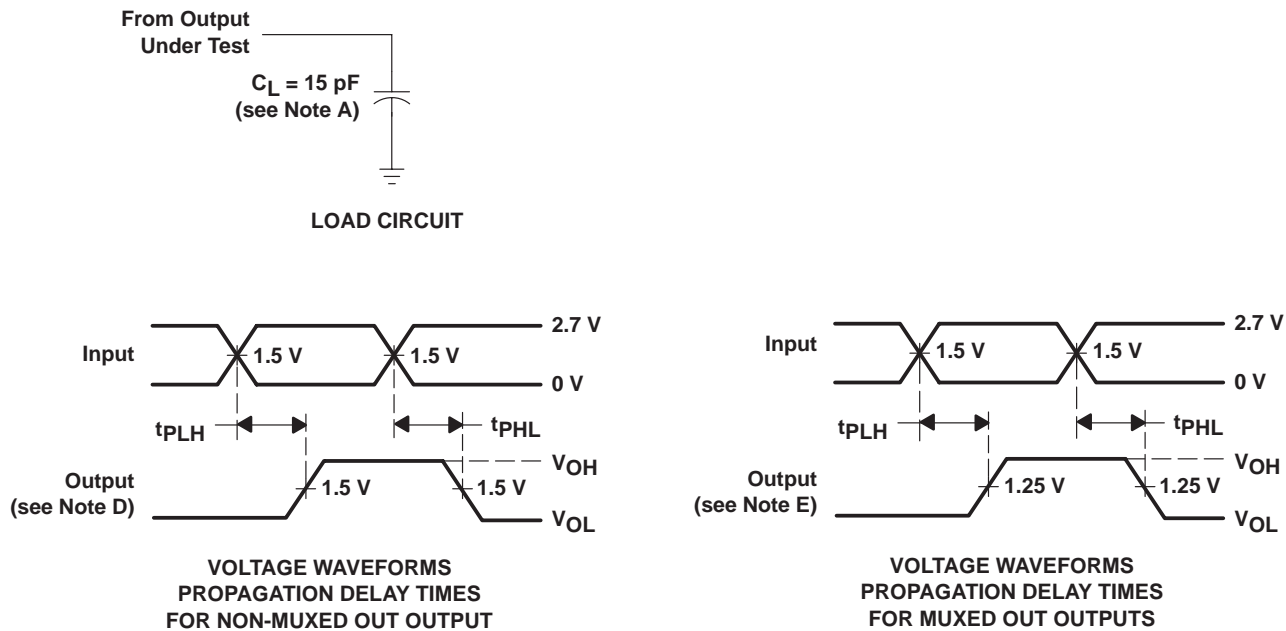
$^\dagger C_b$  = capacitance of one bus line in pF.

**switching characteristics over recommended operating free-air temperature range (unless otherwise noted) (see Figure 2)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	$V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$		UNIT
			MIN	MAX	
$t_{mpd}$	Mux input to output propagation delay	MUX IN		20	ns
$t_{sov}$	MUX SELECT to output valid	MUX SELECT		22	ns
$t_{ovn}$	$\overline{\text{OVERRIDE}}$ to NON-MUXED OUT output delay	$\overline{\text{OVERRIDE}}$		15	ns
$t_{ovm}$	$\overline{\text{OVERRIDE}}$ to MUX OUT output delay	$\overline{\text{OVERRIDE}}$		25	ns
$t_{su}$	Setup time	WP		30	ns
$t_h$	Hold time	WP		120	ns
$t_r$	Output rise time		1	3	ns/V
$t_f$	Output fall time		1	3	ns/V



PARAMETER MEASUREMENT INFORMATION



- NOTES: A.  $C_L$  includes probe and jig capacitance.  
 B. All input pulses are supplied by generators having the following characteristics:  $PRR \leq 10$  MHz,  $Z_O = 50 \Omega$ ,  $t_r \leq 2.5$  ns,  $t_f \leq 2.5$  ns.  
 C. The outputs are measured one at a time with one transition per measurement.  
 D.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{sov}$  and  $t_{ovn}$ .  
 E.  $t_{PLH}$  and  $t_{PHL}$  are the same as  $t_{mpd}$ ,  $t_{sov}$ , and  $t_{ovm}$ .

Figure 2. Load Circuit and Voltage Waveforms

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