

M62320GP

8-bit I/O Expander for I²C BUS

REJ03D0909-0100
Rev.1.00
Mar 25, 2008

Description

The M62320GP is a CMOS 8-bit I/O expander, which has serial to parallel and parallel to serial data converting functions.

It can communicate with a microcontroller via few wiring thanks to the adoption of the two-line I²C BUS.

Parallel data I/O terminal can be set to input or output mode alternatively in individual bits.

Maximum 8 ICs can be connected to a bus by using three chip-select pins, so that it is possible to handle up to 64 bits data.

Features

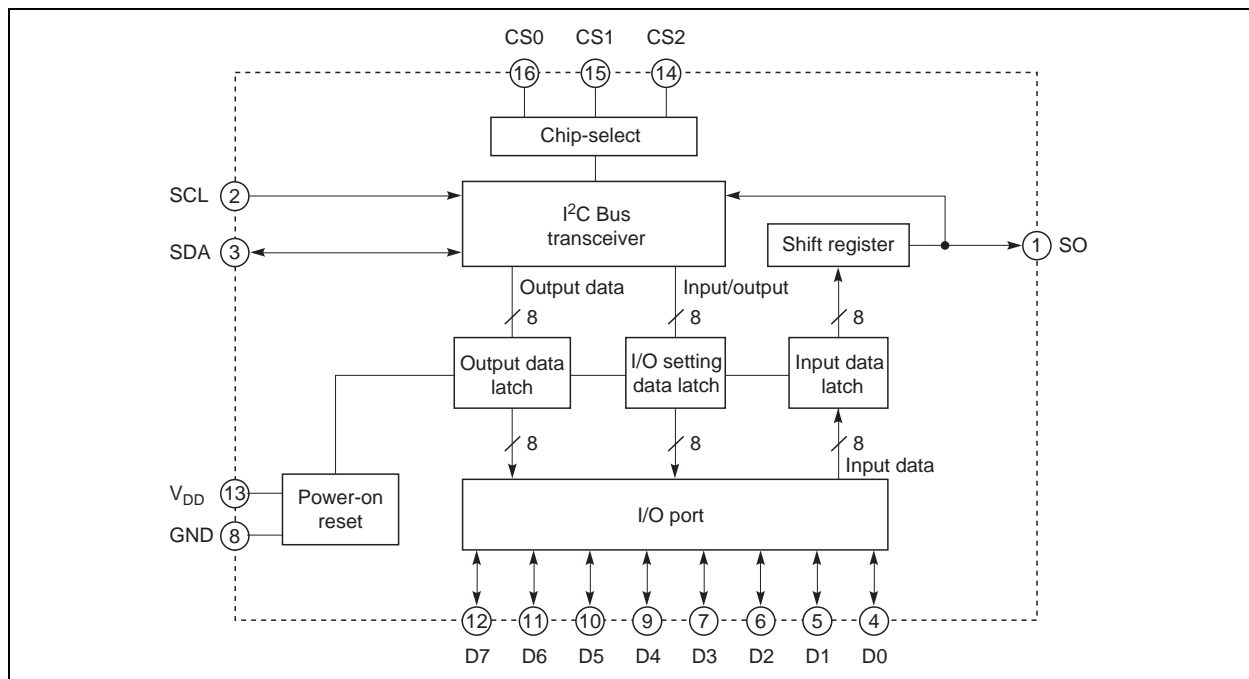
- Simple two-line (SCL and SDA) communication with a microcontroller.
- 8-bit data conversion between serial and parallel by I²C BUS.
- Built-in power-on reset.

Application

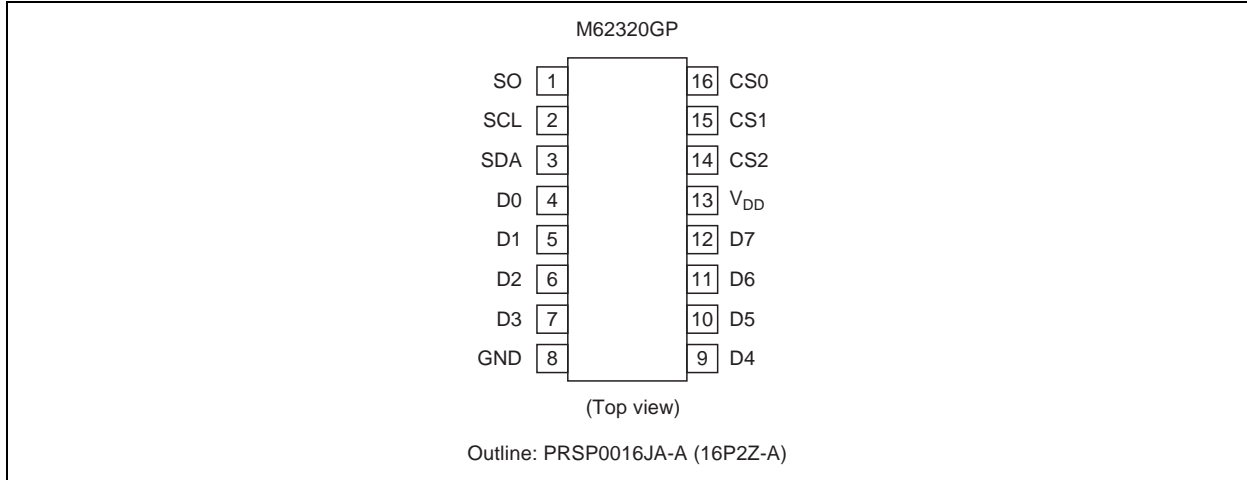
I/O port expansion for a microcontroller.

Data conversion between serial and parallel in microcontroller peripherals.

Block Diagram



Pin Arrangement



Pin Description

Pin No.	Pin Name	I/O	Function
2	SCL	Input	Serial clock input
3	SDA	Input/Output	Serial data input/output
1	SO	Output	Serial data output
16	CS0	Input	Chip select data input
15	CS1		
14	CS2		
4	D0	Input/Output	Parallel data input/output
5	D1		
6	D2		
7	D3		
9	D4		
10	D5		
11	D6		
12	D7		
13	V _{DD}	—	Power supply
8	GND	—	GND

Absolute Maximum Ratings

Item	Symbol	Ratings	Unit	Conditions
Supply voltage	V_{DD}	-0.3 to +7.0	V	
Input voltage	V_I	-0.3 to $V_{DD} + 0.3$	V	
Output voltage	V_O	-0.3 to $V_{DD} + 0.3$	V	
Output current "Low"	I_{OH}	-5 to 0	mA	D0 to D7
Output current "High"	I_{OL}	0 to 30	mA	D0 to D7
Power dissipation	P_d	761	mW	$T_a = 25^\circ\text{C}$
Operating temperature	T_{opr}	-20 to +85	$^\circ\text{C}$	
Storage temperature	T_{stg}	-40 to +125	$^\circ\text{C}$	

Recommended Operating Conditions

- Supply voltage: $V_{DD} = 3\text{V to } 5.5\text{V}$
- Input high voltage: $V_{IH} = 0.7 V_{DD} \text{ to } V_{DD}$
- Input low voltage: $V_{IL} = 0 \text{ to } 0.2 V_{DD}$

Electrical Characteristics

($V_{DD} = 5\text{V} \pm 10\%$, $\text{GND} = 0\text{V}$, $T_a = -20 \text{ to } +85^\circ\text{C}$, unless otherwise noted)

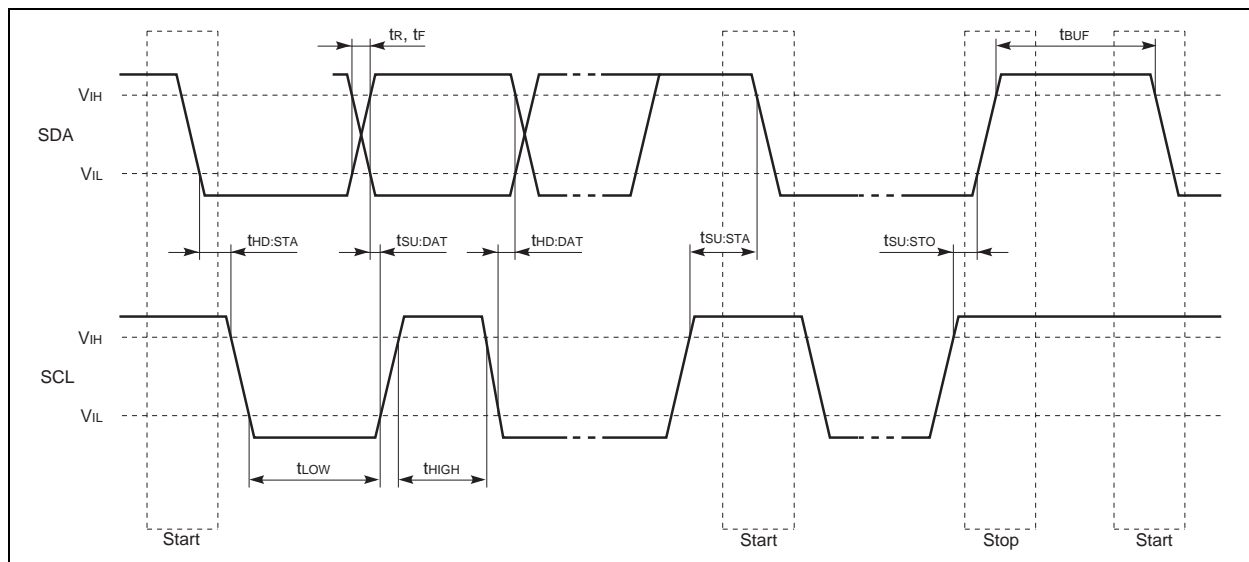
Item	Symbol	Limits			Unit	Conditions
		Min	Typ	Max		
Circuit current	I_{DD}	—	0.05	0.5	mA	$V_{IH} = V_{DD}$, $V_{IL} = \text{GND}$, $f_{SCL} = 400\text{kHz}$
		—	0.1	1.0	μA	$V_{IH} = V_{DD}$, $V_{IL} = \text{GND}$, $f_{SCL} = \text{stop}$
Input leak current	I_{ILK}	-10	—	10	μA	
Output low voltage (SDA)	V_{OL}	—	—	0.4	V	$I_{sink} = 3\text{mA}$
Input high voltage	V_{IH}	$0.7 V_{DD}$	—	V_{DD}	V	
Input low voltage	V_{IL}	—	—	$0.2 V_{DD}$	V	
Output high voltage (D0 to D7)	V_{OH}	$V_{DD} - 0.4$	—	V_{DD}	V	$I_{OH} = -1\text{mA}$, $V_{DD} = 5\text{V}$
		$V_{DD} - 0.4$	—	V_{DD}		$I_{OH} = -500\mu\text{A}$, $V_{DD} = 3\text{V}$
Output low voltage (D0 to D7)	V_{OL}	0	—	0.4	V	$I_{OL} = 5\text{mA}$, $V_{DD} = 5\text{V}$
		0	—	0.4		$I_{OL} = 2.5\text{mA}$, $V_{DD} = 3\text{V}$
Output current "Low" (D0 to D7)	I_{OL}	5	10	—	mA	$V_{OL} = 0.4\text{V}$, $V_{DD} = 5\text{V}$
		2.5	5	—		$V_{OL} = 0.4\text{V}$, $V_{DD} = 3\text{V}$
		15	25	—		$V_{OL} = 1.0\text{V}$, $V_{DD} = 5\text{V}$
		5	10	—		$V_{OL} = 1.0\text{V}$, $V_{DD} = 3\text{V}$

I²C BUS Characteristics

Item	Symbol	Limits		Unit
		Min	Max	
SCL clock frequency	f_{SCL}	0	100	kHz
Free time: the bus must be free before a new transmission can start	t_{BUF}	4.7	—	μ s
Hold time START Condition After this period, the first clock pulse is generated.	$t_{HD:STA}$	4.0	—	μ s
Low period of the clock	t_{LOW}	4.7	—	μ s
High period of the clock	t_{HIGH}	4.0	—	μ s
Set-up time for START condition Only relevant for a repeated START condition	$t_{SU:STA}$	4.7	—	μ s
Data Hold time	$t_{HD:DAT}$	0	—	μ s
Data Set-up time	$t_{SU:DAT}$	250	—	ns
Rise time of SDA and SCL signals	t_R	—	1000	ns
Fall time of SDA and SCL signals	t_F	—	300	ns
Set-up time for STOP condition	$t_{SU:STO}$	4.0	—	μ s

Note: Transmitter must internally provide at least a hold time to bridge the undefined region (300 ns max) of the falling edge of SCL.

Timing Chart



Functional Blocks

I²C BUS Interface

The I²C BUS interface recognizes start/stop conditions, a slave address and a write/read mode selection by receiving SDA, SCL, CS0, CS1 and CS2 signals and then the latch pulses, dedicated to each data latch are generated.

Data Latch

This IC has 3 types of data latch: the I/O setting data latch, the input data latch and the output data latch and each latch is controlled by the I²C BUS interface.

- I/O setting data latch
These latches set input- or output-state of each parallel data terminals (D0 to D7). They are set at the next byte after receiving the slave address byte in the write mode from the master. In case this latch is set to high, the data is transferred from the I²C BUS interface to the parallel data terminals. In the opposite transmission: from the parallel data terminals to the I²C BUS, it is set to low.
- Output data latch
In the write mode, the data from the I²C BUS to the parallel data terminals is latched. When the master transmits output data after a setting in write mode, the output data is taken into the latches.
- Input data latch
In the read mode, the data of parallel data terminals is latched in the input data latches. The input data is taken into the latches from the parallel data terminals on every 8th negative edge of SCL clock. The latched data is output to the master through the sift resistor. On the output terminal assigned by the I/O setting latch, the input data latch takes the state of the output terminal.

Parallel Input/Output Port

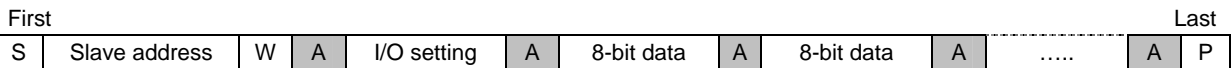
In case I/O setting latch is set to low (the input mode), each parallel terminal becomes hi-impedance and is able to accept an input. In another case I/O setting latch is set to high (output mode), each parallel terminal output a data according to the state of the output data latch.

Power on Reset

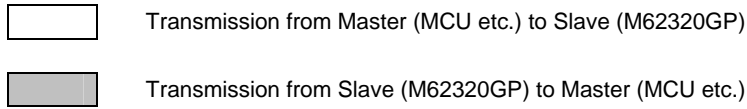
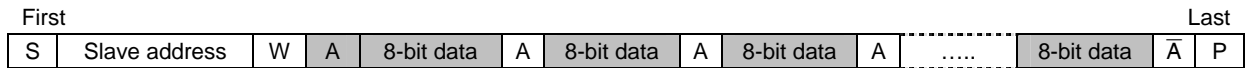
When power is turned on, each latch is reset and then the parallel data I/O terminals become hi-impedance (input mode).

Digital Data Format

1. Write mode: I²C BUS data input to parallel data output

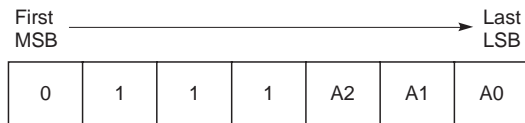


2. Read mode: Parallel data input to I²C BUS data output



- S: Start condition
While SCL level is high, SDA line level should be changed from high to low.

- Slave address



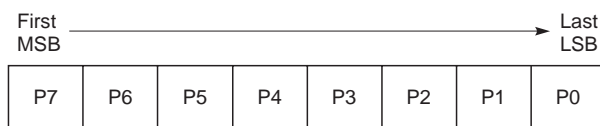
Note: Lower three bits (A0, A1, A2) are a programmable address. This IC is accessed only when the lower 3 bits data of slave address coincide with the data of CS0 to CS2. (refer to the right table)

Chip select data

MSB			LSB		
A2	A1	A0	CS2	CS1	CS0
0	0	0	L	L	L
0	0	1	L	L	H
0	1	0	L	H	L
:	:	:	:	:	:
1	1	1	H	H	H

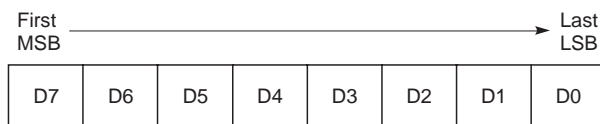
Note: L = Low, H = High

- W: Write (SDA = Low), R: Read (SDA = High)
- A: Acknowledge bit
- I/O setting data (I/O setting of parallel data I/O terminals.)



Note: DATA INPUT from parallel data terminals = Low
DATA OUTPUT to parallel data terminals = High
Each bit data corresponds to the I/O state of the parallel data terminals.

- 8-bit data



- P: Stop condition
While SCL level is high, SDA level should be changed from low to high.

Functional Description

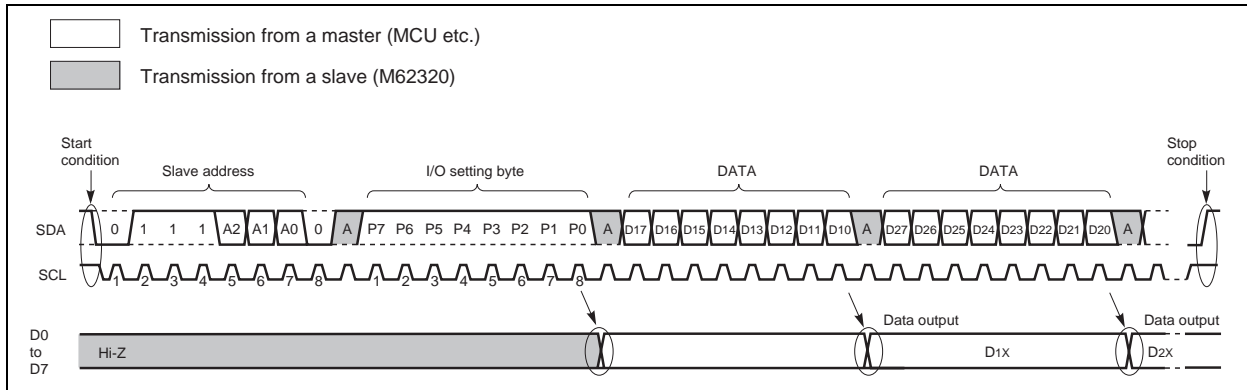
All parallel data I/O terminals are set to the input-state after power-on. In case any terminals need to be set to the output state, the corresponding terminals should be set during the write mode. This setting is hold until a next setting.

In the write mode, 8 bits data can be transmitted from the I²C BUS interface to the parallel ports continually after the slave address and I/O setting.

In the read mode, 8 bits data can be transmitted from the parallel ports to the I²C BUS interface continually after the slave address setting.

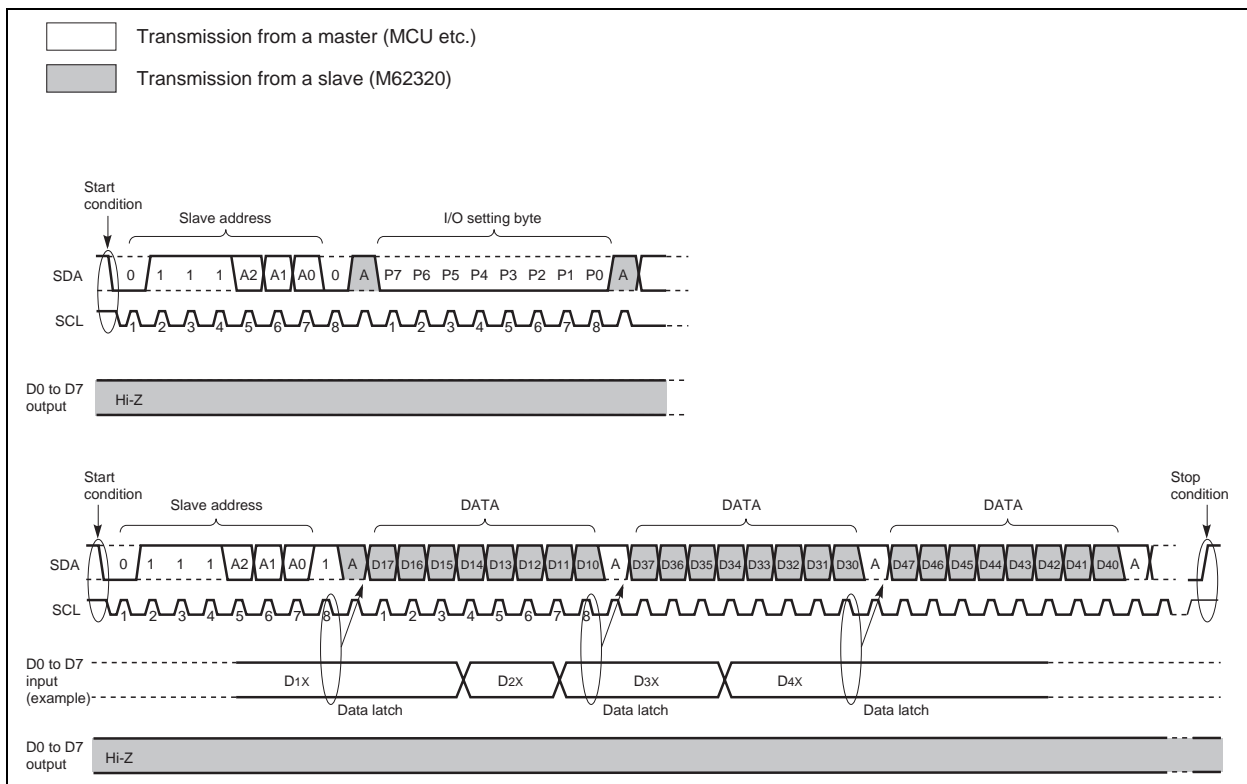
In the case of a changing between the write-and read-mode, the data must be transmitted again from the starting condition.

- In a case of a data conversion from serial to parallel.

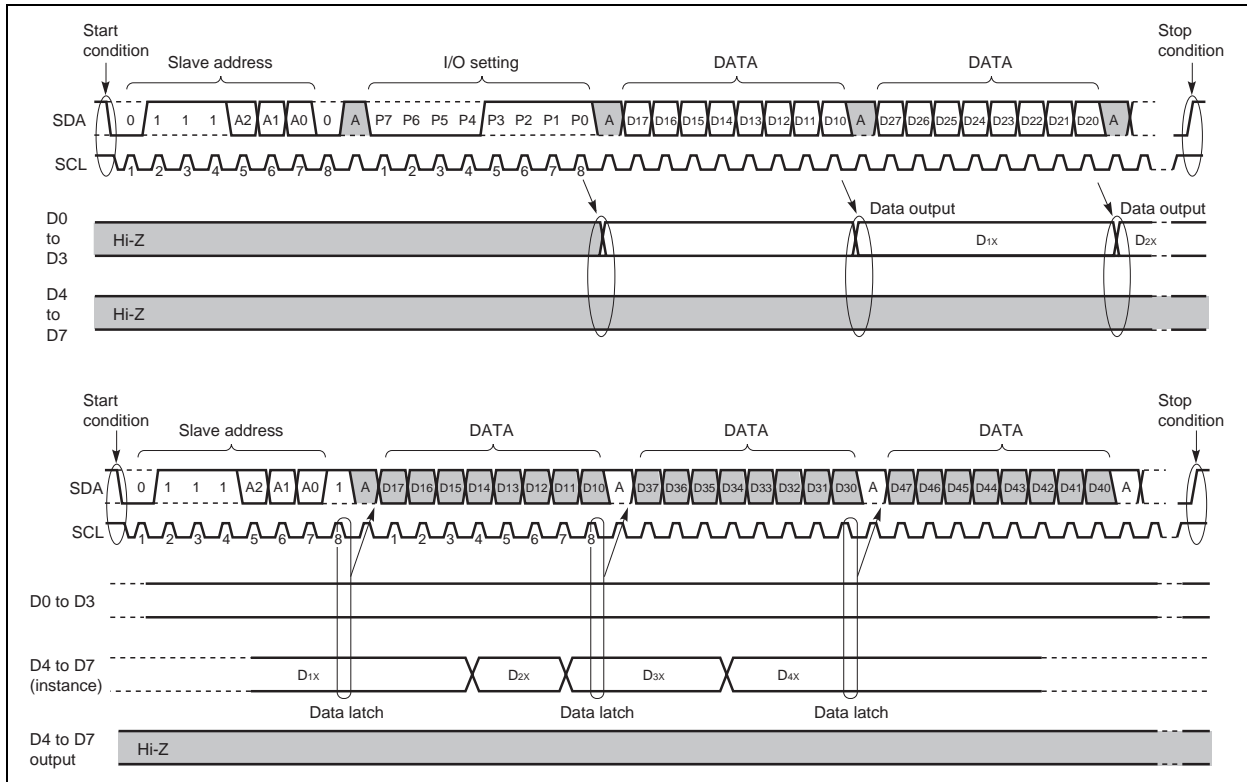


- In a case of a data conversion from parallel to serial.

All I/O setting resistors are set to low (input) in the write mode, before a parallel data is read. (All I/O setting resistors are set to the input mode after power-on).

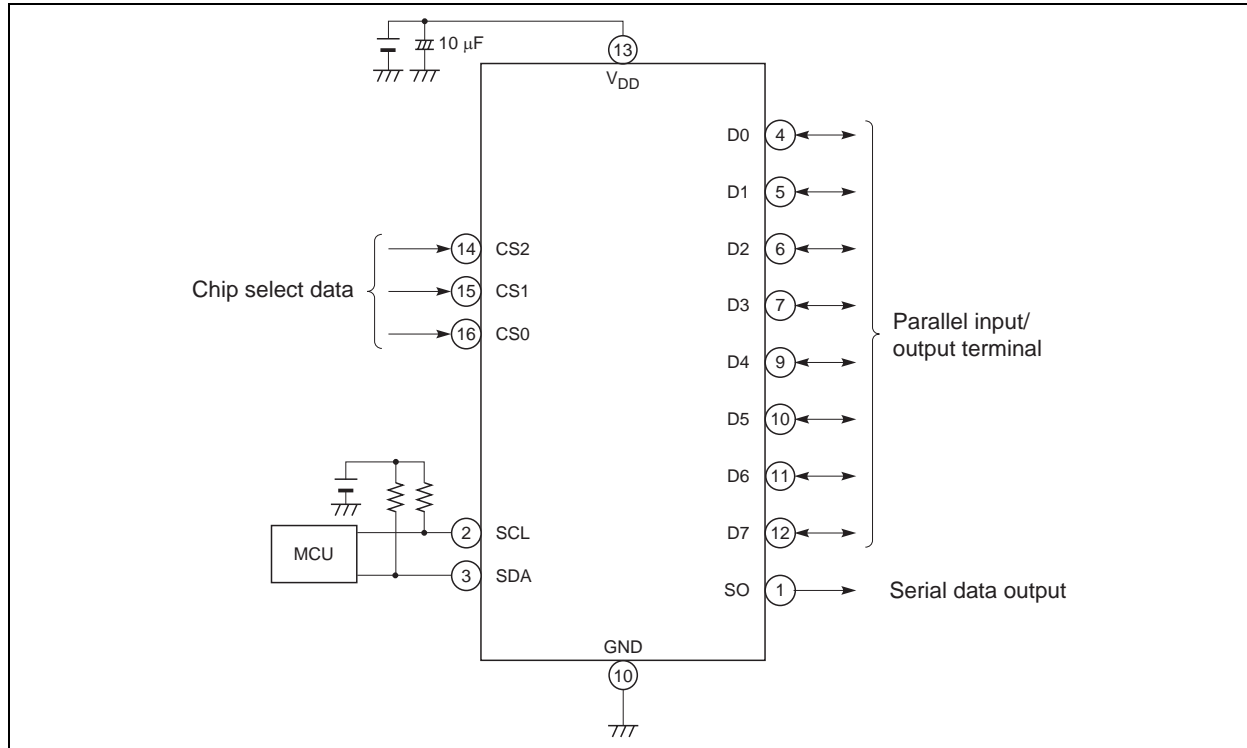


- In case the I/O setting is different between each terminals.
An example: the parallel port terminals of D0 to D3 and D4 to D7 are assigned as output and input terminals, respectively.



- **Write mode**
The terminal assigned as an output provides the data written in the output data latch.
After power-on, all terminals are reset to the input-state. Then an initial data low of the output latch are output after the I/O setting has been done. Finally the assigned output are provided after the 8-bit data transmission.
The terminal assigned as an input keeps the input condition (high-impedance) regardless of 8-bit data setting.
- **Read mode**
The input data is taken into the input latch on every 8th negative-going edge of the SCL clock through the terminal assigned as an input, and then the latched data is output via the SDA line.
The data of the output assigned terminal is also handled in the same procedures as above.

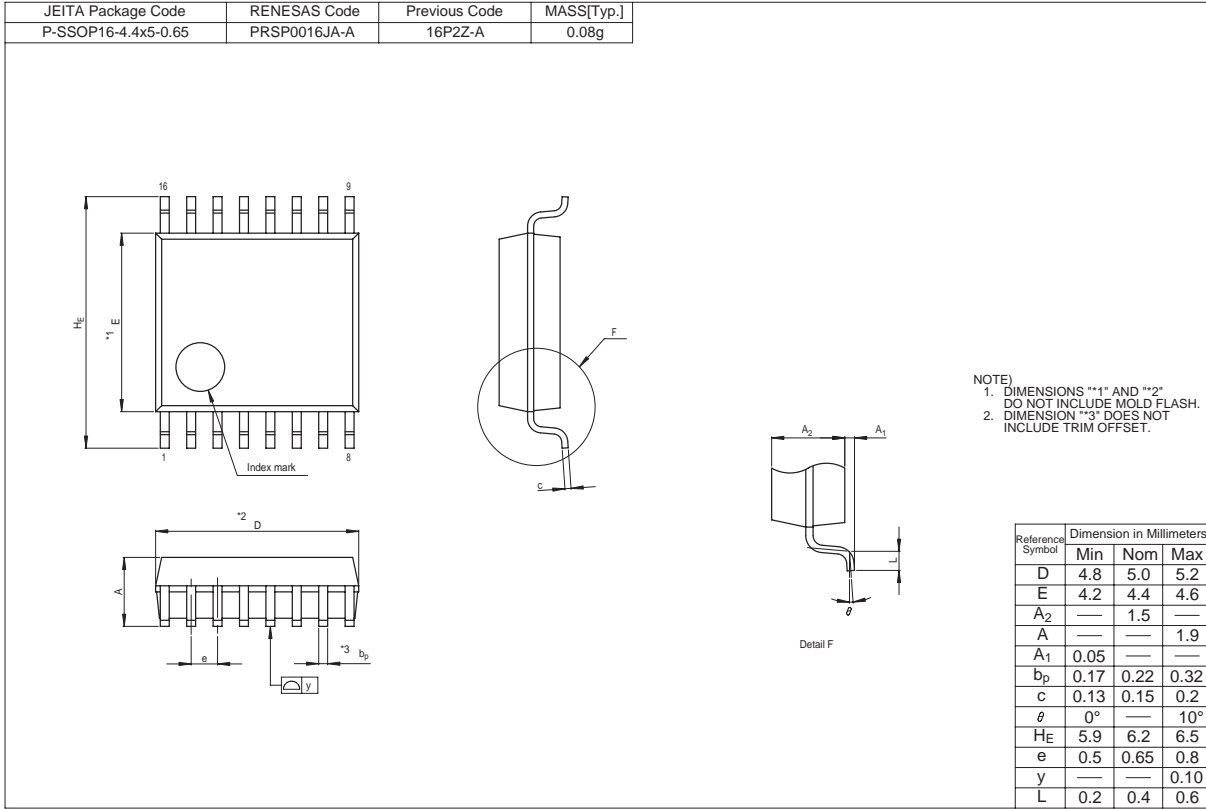
Typical Application



Precaution for Use

- Purchase of Renesas's I²C components conveys a license under the Philips I²C Patent Rights to use these components in an I²C system, provided that the system conforms to I²C Standard Specification as defined by Philips.

Package Dimensions



Notes:

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<http://www.renesas.com>)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guarantees regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
 - (1) artificial life support devices or systems
 - (2) surgical implantations
 - (3) healthcare intervention (e.g., excision, administration of medication, etc.)
 - (4) any other purposes that pose a direct threat to human lifeRenesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.



RENESAS SALES OFFICES

<http://www.renesas.com>

Refer to "<http://www.renesas.com/en/network>" for the latest and detailed information.

Renesas Technology America, Inc.

450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited

Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.

Unit 204, 205, AZIA Center, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.

7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.

10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

Renesas Technology Singapore Pte. Ltd.

1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.

Kukje Center Bldg, 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd

Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510