To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document 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 Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics 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 appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

To all our customers

Regarding the change of names mentioned in the document, such as Mitsubishi Electric and Mitsubishi XX, to Renesas Technology Corp.

The semiconductor operations of Hitachi and Mitsubishi Electric were transferred to Renesas Technology Corporation on April 1st 2003. These operations include microcomputer, logic, analog and discrete devices, and memory chips other than DRAMs (flash memory, SRAMs etc.) Accordingly, although Mitsubishi Electric, Mitsubishi Electric Corporation, Mitsubishi Semiconductors, and other Mitsubishi brand names are mentioned in the document, these names have in fact all been changed to Renesas Technology Corp. Thank you for your understanding. Except for our corporate trademark, logo and corporate statement, no changes whatsoever have been made to the contents of the document, and these changes do not constitute any alteration to the contents of the document itself.

Note : Mitsubishi Electric will continue the business operations of high frequency & optical devices and power devices.

Renesas Technology Corp.
Customer Support Dept.
April 1, 2003

M66010FP/GP

24-BIT I/O EXPANDER

DESCRIPTION

M66010 Semiconductor Integrated Circuit inputs 24-bit data in series and outputs it in parallel and vice versa, using shift register function.
Equipped with 2 independent shift registers, one for serial-to-parallel, the other for parallel-to-serial, this IC is able to read serial input data into a shift register while converting data from parallel to serial. Parallel input/output pins are set to input or output according to the bit.
The M66010 is useful in a wide range of applications, such as MCU (micro controller unit) input/output port extension and serial bus system data communication.

FEATURES

- Two-way serial data communication with MCU
- Serial data intake possible during parallel-to-serial conversion
- Parallel input/output switchable according to the bit
- Low power dissipation: 100μW maximum per package
  (V_{CC} =5V, Ta = 25°C, quiescent)
- Schmidt input (DI, CLK, $\overline{S}$, $\overline{CS}$)
- Open drain output (DO, D1 thru D24)
- Parallel data input and output (D1 thru D24)
- Wide operating supply voltage range (V_{CC} = 2V ~ 6V)

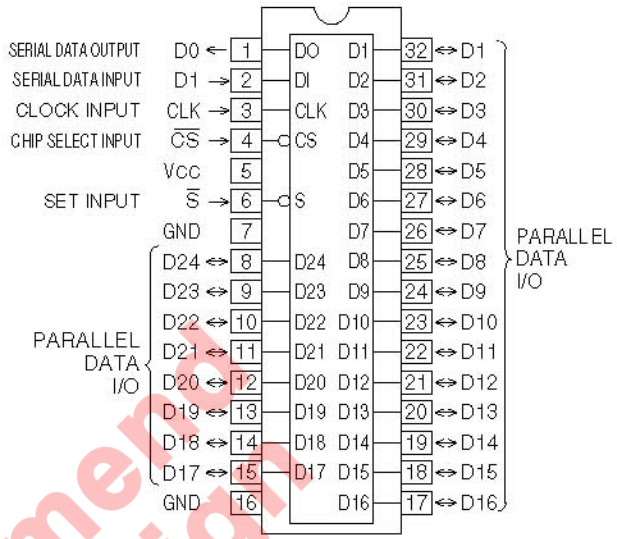
APPLICATION

MCU-related serial-parallel data conversion, serial bus control by MCU, etc.

FUNCTION

The M66010 is produced by using the silicon gate CMOS (complementary metal-oxide semiconductor) technology. It is distinguished for low power dissipation and high noise resistance.
Because two independent shift registers are built in, one for serial-to-parallel, the other for parallel-to-serial, this IC is able to read serial input data into a shift register while converting parallel data into serial data.
One cycle of latching 24-bit parallel data and outputing it in series while taking in serial data from MCU is initiated by $\overline{CS}$'s shift from "H" to "L". At $\overline{CS}$ fall edges, 24-bit parallel data is latched, and output in series from pin DO synchronously with shift clock fall edges. At shift clock rise edges, serial data is taken in from MCU via pin DI. The data is read into shift register. The 25th and following shift clock pulses are ignored and read-in operation is masked. The pin D0 status shifts to high-impedance. As $\overline{CS}$ is then shifted from "L" to "H", 24-bit serial data taken in via pin DI is output in parallel to pins D1 thru D24. Because parallel output pins are the n-channel open drain output type, write data "H" for pins which should be set to input.

PIN CONFIGURATION (TOP VIEW)

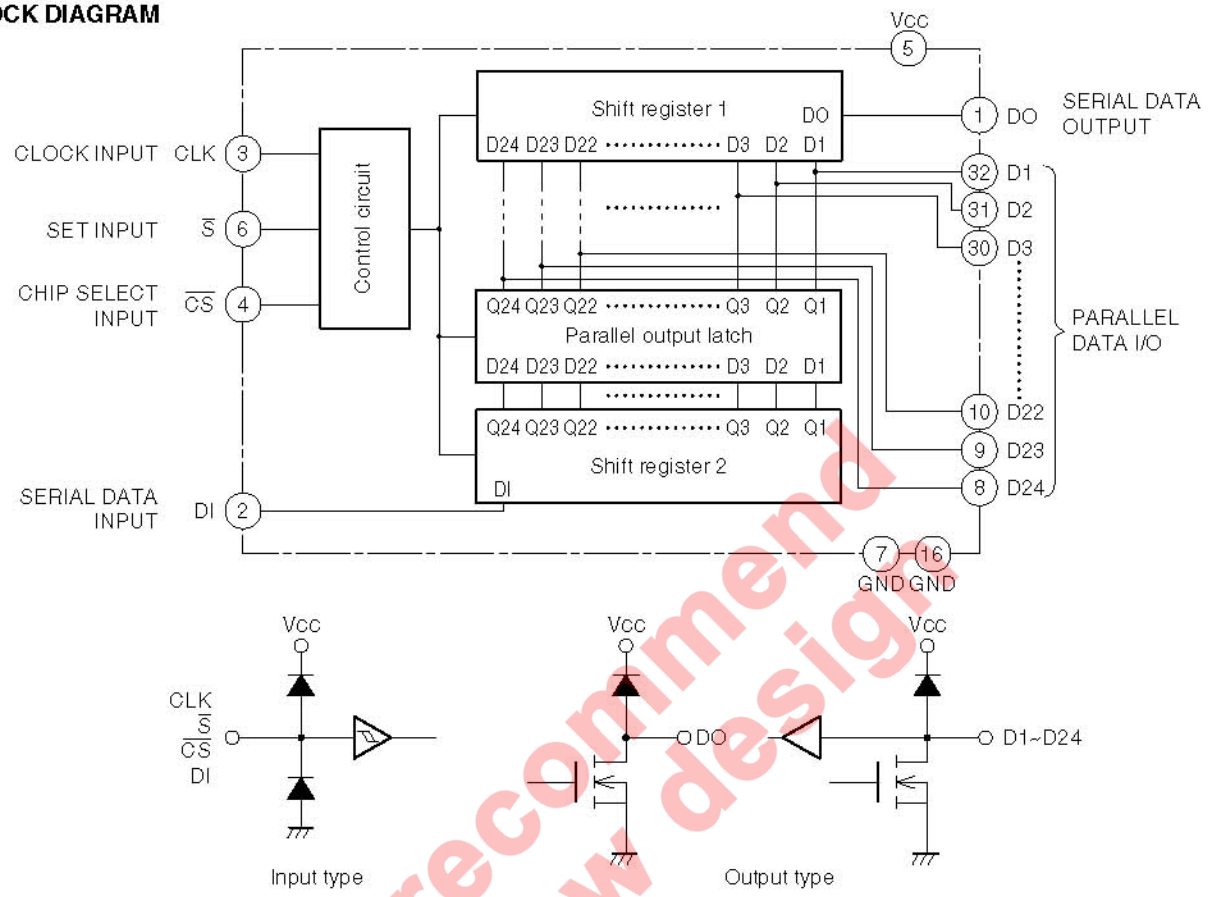


Outline 32P2W-A
32P2U-B

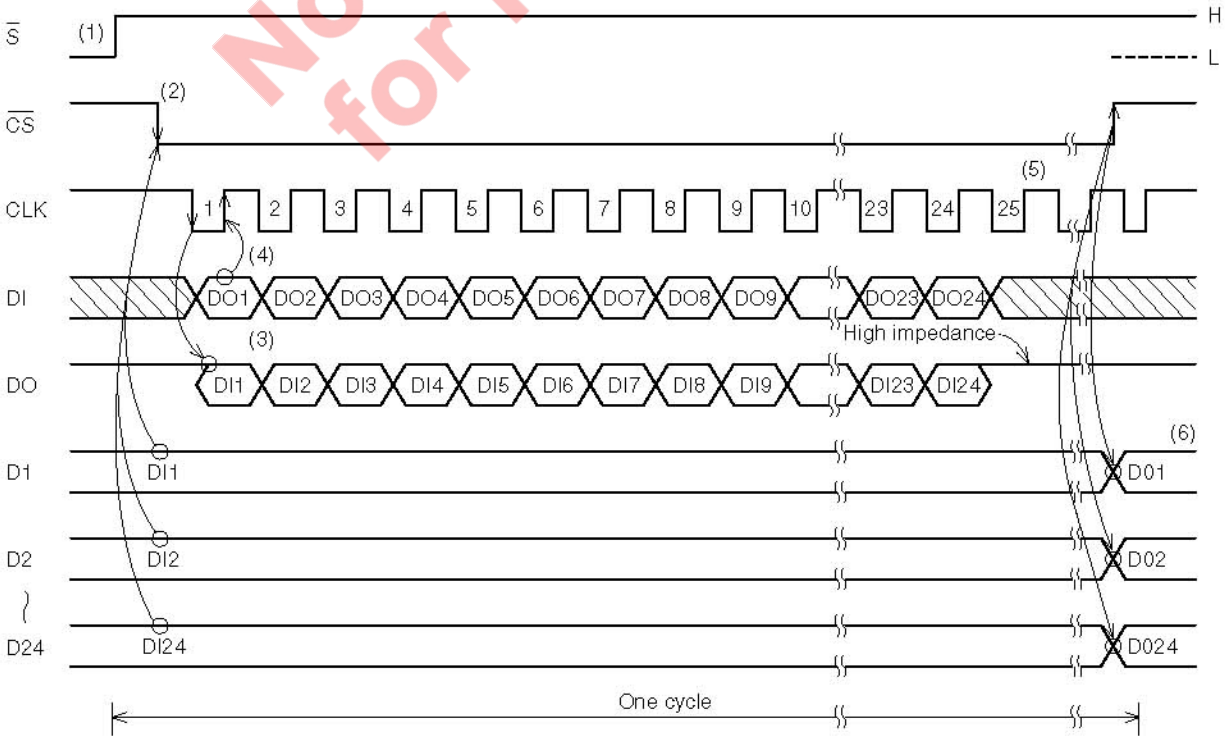
OPERATION

(1) When power is turned on, the status of pins D0 and D1 thru D24 is unstable. Their status turns high-impedance when $\overline{S}$ is shifted to "L".
(2) At $\overline{CS}$ fall edges, the status of pins D1 thru D24 is loaded on shift register 1.
(3) At CLK fall edges, 24-bit data loaded as described above is output in series from pin D0.
(4) At CLK rise edges, 24-bit serial data is taken in from pin DI and written on shift register 2.
(5) The 25th and following CLK pulses are ignored, and serial data write is discontinued. Pin D0 status turns high-impedance.
(6) At $\overline{CS}$ rise edges, data written as described in (4) is output to pins D1 thru D24.
(7) Shift register 1 loads data added from outside as well as AND tie data which has the same contents as data latched by serial output latch.
(8) If the $\overline{CS}$ rises before CLK reaches the 24th bit, parallel output latch latches data which has been written on shift register, and output it to pins D1 thru D24.
(9) Pins D1 thru D24 are switched between input and output according to serial data input to pin DI. Pins for which "H" is written are set to input.

BLOCK DIAGRAM



OPERATION TIMING CHART



ABSOLUTE MAXIMUM RATINGS (Ta = −20 ~ 75°C unless otherwise noted)

Symbol	Parameter	Conditions	Ratings	Unit
V_{CC}	Supply voltage		−0.5 ~ +7.0	V
V_I	Input voltage		−0.5 ~ V_{CC} + 0.5	V
V_O	Output voltage		−0.5 ~ V_{CC} + 0.5	V
I_{IK}	Input protection diode current	V_I<0V	−20	mA
		V_I>V_{CC}	20	
I_{OK}	Output parasitic diode current	V_O<0V	−20	mA
		V_O>V_{CC}	20	
I_{GND}	GND current	GND	−150	mA
T_{stg}	Storage temperature		−65 ~ 150	°C

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Limits			Unit
		Min.	Typ.	Max.	
V_{CC}	Supply voltage	2		6	V
V_I	Input voltage	0		V_{CC}	V
V_O	Output voltage	0		V_{CC}	V
T_{opr}	Operating temperature	−20		75	°C

ELECTRICAL CHARACTERISTICS (V_{CC} = 2 ~ 6V unless otherwise noted)

Symbol	Parameter	Test conditions		Limits					Unit
				Ta=25°C			Ta= −20~75°C		
				Min.	Typ.	Max.	Min.	Max.	
V_{T+}	Upper threshold voltage	V_O=0.1V, V_{CC}−0.1V $\|I_O\|$=20μA	CLK, $\overline{CS}$, $\overline{S}$, DI	0.35 × V_{CC}		0.8 × V_{CC}	0.35 × V_{CC}	0.8 × V_{CC}	V
V_{T-}	Lower threshold voltage	V_O=0.1V, V_{CC}−0.1V $\|I_O\|$=20μA	CLK, $\overline{CS}$, $\overline{S}$, DI	0.2 × V_{CC}		0.65 × V_{CC}	0.2 × V_{CC}	0.65 × V_{CC}	V
V_{IH}	High-level input voltage	V_O=0.1V, V_{CC}−0.1V $\|I_O\|$=20μA	D1 ~ D24	0.75 × V_{CC}			0.75 × V_{CC}		V
V_{IL}	Low-level input voltage	V_O=0.1V, V_{CC}−0.1V $\|I_O\|$=20μA	D1 ~ D24			0.25 × V_{CC}		0.25 × V_{CC}	V
V_{OL}	Open drain low-level output voltage	V_I=V_{T+}, V_{T-} V_{CC}=4.5V	I_{OL}=5mA			0.4		0.5	V
I_O	Output leakage current	V_I=V_{T+}, V_{T-} V_{CC}=6V	V_O=V_{CC}			1.0		10.0	μA
			V_O=GND			−1.0		−10.0	
I_{IH}	High-level Input leakage current	V_I=V_{CC}	V_{CC}=6.0V			0.1		1.0	μA
I_{IL}	Low-level output leakage current	V_I=GND	V_{CC}=6.0V			−0.1		−1.0	μA
I_{CC}	Static power dissipation	V_I=V_{CC}, GND	V_{CC}=6.0V			20.0		200.0	μA

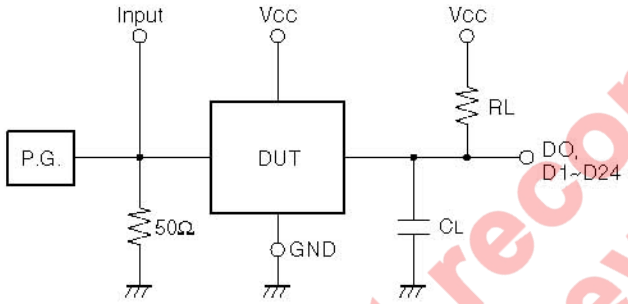
SWITCHING CHARACTERISTICS (V_{CC} = 5V)

Symbol	Parameter	Test conditions	Limits					Unit
			Ta=25°C			Ta= −20~75°C		
			Min.	Typ.	Max.	Min.	Max.	
fmax	Input clock maximum repetitive frequency	C_L=50pF R_L=1kΩ (Note)	2.5			1.9		MHz
tPLZ	"L−Z" and "Z−L" outputs propagation time CLK-DO				300		400	ns
tPZL					300		400	ns
tPLZ	"L−Z" and "Z−L" outputs propagation time $\overline{CS}$-D1 to D24				300		400	ns
tPZL					300		400	ns
tPLZ	"L−Z" outputs propagation time $\overline{S}$=DO, D1 to D24				300		400	ns

TIMING CONDITIONS (Vcc = 5V)

Symbol	Parameter	Test conditions	Limits					Unit
			Ta=25°C			Ta= −20~75°C		
			Min.	Typ.	Max.	Min.	Max.	
tw	CLK, $\overline{CS}$ and $\overline{S}$ pulse width		200			260		ns
tsu	DI setup time (in response to CLK)		100			130		ns
	$\overline{CS}$ setup time (in response to CLK)		100			130		
	DI thru D24 setup time (in response to $\overline{CS}$)		100			130		
th	DI hold time (in response to CLK)		100			130		ns
	$\overline{CS}$ hold time (in response to CLK)		100			130		
	D1 thru D24 hold time (in response to $\overline{CS}$)		100			130		
trec	$\overline{CS}$ recovery time (in response to $\overline{S}$)		100			130		ns

NOTE: TEST CIRCUIT



(1) Pulse generator (PG) characteristics: t_r=t_f=6ns (10% ~ 90%)
(2) Capacitance C_L includes connection floating capacitance and probe input capacitance.

TIMING CHARTS