


**SANYO Semiconductors**

# DATA SHEET

An ON Semiconductor Company

## LV5216CS — Bi-CMOS IC LED Driver

### Overview

The LV5216CS is 10ch LED driver IC for the cell phones with built-in charge pump circuit.

### Features

- LED driver ×10 channels (MAIN, 3-color, 1-color) and charge pump circuit incorporated.
- Each LED driver current value adjusted by serial bus.
- Main LED automatic luminance control with illumination sensor incorporated.
- Usable both the LOG type and the linear type illumination sensor.
- Output level changeover possible for illumination sensor ON/OFF control output.
- Ringing tone and 3-color LEDs synchronization function incorporated.
- Gradation function incorporated (3-color LEDs)

### Function

- Charge pump circuit ((One time and automatic switch method of 1.5 times) 5.0V time fixed output 1.5 times)
- LED driver

Main LCD backlight LED driver ×6 with automatic luminance control

LED current 5-bit changeover (0.6 to 19.2mA)

Fade IN / OUT function.

External brightness control function.

MLED5 and MLED6 independently controllable. Full ON possible.

Dim mode 3-bit changeover (0.2mA to 1.6mA)

3-color LEDs driver ×1

LED current 5-bit changeover (0.6 to 19.2mA)

Gradation function

Ringing tone synchronization function (Forced to operate at SCTL: H)

1-color LED driver ×1

LED current 5-bit changeover (0.6 to 19.2mA)

2-fold current mode available

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment (home appliances, AV equipment, communication device, office equipment, industrial equipment etc.). The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for applications outside the standard applications of our customer who is considering such use and/or outside the scope of our intended standard applications, please consult with us prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

**SANYO Semiconductor Co., Ltd.**
<http://semicon.sanyo.com/en/network>

# LV5216CS

## Specifications

**Maximum Ratings** at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V <sub>CC</sub> max		4.5	V
Maximum pin voltage	V <sub>I</sub> max	LED driver, charge pump circuit	6	V
Allowable power dissipation	P <sub>d</sub> max	* Mounted on a circuit board	850	mW
Operating temperature	T <sub>opr</sub>		-30 to +75	°C
Storage temperature	T <sub>stg</sub>		-40 to +125	°C

\* Specified board: 40mm × 50mm × 0.8mm, glass epoxy board. (2S2P (4-layer board))

**Operating Conditions** at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage 1	V <sub>BAT</sub>		3.0 to 4.5	V
Supply voltage 2	V <sub>DD</sub>		1.7 to V <sub>BAT</sub>	V

**Electrical Characteristics** at Ta = 25°C, V<sub>CC</sub> = 5.0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Consumption current						
Consumption current	I <sub>CC1</sub>	RESET:L (standby mode)		0	5	μA
	I <sub>CC2</sub>	RESET:H (sleep mode)		0.3	5.0	μA
	I <sub>CC3</sub>	charge pump: ON		4	7	mA
Charge pump block						
Output voltage	V <sub>O1</sub>	I <sub>O</sub> =50mA One time		3.65		V
	V <sub>O2</sub>	I <sub>O</sub> =50mA 1.5 times		5.0		V
Resistance current	I <sub>LM</sub>	1.5 times mode V <sub>BAT</sub> =3.4V >4V	170			mA
Charge pump change voltage						
Threshold voltage	V <sub>D1</sub>	When you set the voltage of the LED pin and the MAIN current value 19.2mA		0.25	0.35	V
Charge pump clock block						
Clock frequency	F <sub>OSC</sub>		400	500	600	kHz
LED driver block						
Minimum output current value	I <sub>MIN1</sub>	MAIN LED driver, Serial data=#00, V <sub>O</sub> =0.5V	0.2	0.6	1.7	mA
	I <sub>MIN2</sub>	3+1-color LED driver, Serial data=#00, V <sub>O</sub> =0.5V	0.2	0.6	1.7	mA
	I <sub>MIN3</sub>	1-color LED driver, Serial data=#00, V <sub>O</sub> =0.5V, 2 times current mode	0.4	1.2	3.4	mA
Maximum output current value	I <sub>MAX1</sub>	MAIN LED driver, Serial data=#FF, V <sub>O</sub> =0.5V	18.0	19.2	20.4	mA
	I <sub>MAX2</sub>	3+1-color LED driver, Serial data=#FF, V <sub>O</sub> =0.5V	18.0	19.2	20.4	mA
	I <sub>MAX3</sub>	1-color LED driver, Serial data=#FF, V <sub>O</sub> =0.5V, 2 times current mode	36.0	38.4	40.8	mA
Non-linearity error	LE	*1	-2		2	LSB
Differential linearity error	DLE	*2	-2		2	LSB
Maximum output current	ΔIL1	MAIN LED driver Maximum current setting V <sub>O</sub> =2 or 0.2V	-10			%
	ΔIL2	3+1-color LED driver Maximum current setting V <sub>O</sub> =4 to0.35V	-10			%
Leakage current	IL1	MAIN LED driver, LED driver: OFF, V <sub>O</sub> =5V			1	μA
	IL2	3+1-color LED driver, LED driver: OFF, V <sub>O</sub> =5V			1	μA
External CTL current	V <sub>EM1</sub>	MLED fixed current mode current value, MICTL pin voltage =1.8V, RT2=100kΩ, Serial MISW: Difference current with turning OFF, MICTLC:01h	-0.05	0	0.05	mA
	V <sub>EM2</sub>	MLED fixed current mode current value, MICTL pin voltage =0.98V, RT2=100kΩ, Serial MISW: Ratio to current value when turning it OFF. MICTLC:01h	45	50	55	%

Continued on next page.

# LV5216CS

Continued from preceding page.

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
External CTL current	V <sub>EM3</sub>	MLED fixed current mode current value, MICTL pin voltage =0V, RT2=100kΩ, MICTLC: 01h * Operation to erase LED by 0V impression is NG as for the MICTL pin.		0	0.5	mA
ON resistance for SW mode	FONR	MLED5 and 6: SW mode, I <sub>L</sub> =-30mA		10		Ω
Illuminance sensor information input circuit (LOG type)						
PTD pin thresh voltage 1	VPLG1	Voltage of change PTD pin of 1 in brightness and 2 in brightness, Serial TAD=0.42V, TAU=0.84 setting	0.197	0.247	0.297	V
PTD pin thresh voltage 2	VPLG15	Voltage of change PTD pin of 15 in brightness and 16 in brightness, Serial TAD=0.42V, TAU=0.84 setting	0.752	0.843	0.920	V
PTD pin thresh voltage difference 1	ΔVPLG	Difference of voltage of change PTD pin of change voltage of PTD pin, brightness n+2, and n+1 in brightness of brightness n+1 and n in brightness	VPLGn+1-VPLGn×0 (1≤n≤14)			V
Illuminance sensor information input circuit (Linear type)						
PTD pin thresh voltage 3	VPLN1	Voltage of change PTD pin of 1 in brightness and 2 in brightness, Serial TAU=0.84 setting	0.01	0.03	0.05	V
PTD pin thresh voltage 4	VPLN9A	Voltage of change PTD pin of 9 in brightness and 10 in brightness, Serial TAU=0.84 setting, PTGSW: open	0.84	0.99	1.14	V
PTD pin thresh voltage difference 2	ΔVPLNL	Difference of voltage of change PTD pin of change voltage of PTD pin, brightness n+2, and n+1 in brightness of brightness n+1 and n in brightness	VPLNn+1-VPLNn×0 (1≤n≤8)			V
PTD pin thresh voltage 5	VPLN8B	Voltage of change PTD pin of 8 in brightness and 9 in brightness, Serial TAU=0.84 setting, PTGSW: ON	0.04	0.06	0.08	V
PTD pin thresh voltage 6	VPLN15	Voltage of change PTD pin of 15 in brightness and 16 in brightness, Serial TAU=0.84 setting	1.08	1.23	1.38	V
PTD pin thresh voltage difference 3	ΔVPLNH	Difference of voltage of change PTD pin of change voltage of PTD pin, brightness n+2, and n+1 in brightness of brightness n+1 and n in brightness	VPLNn+1-VPLNn×0 (8≤n≤14)			V
Control circuit block						
H level 1	V <sub>INH1</sub>	Input H level Serial	V <sub>DD</sub> × 0.8			V
L level 1	V <sub>INL1</sub>	Input L level Serial	0		V <sub>DD</sub> × 0.2	V
H level 2	V <sub>INH2</sub>	Input H level RESET SCTL	1.5			V
L level 2	V <sub>INL2</sub>	Input L level RESET SCTL	0		0.3	V
H output level 1	V <sub>HO1</sub>	Output H level PTEN I <sub>L</sub> =1mA Serial PTENH:V <sub>BAT</sub> setting	V <sub>BAT</sub> - 0.3			V
H output level 2	V <sub>HO2</sub>	Output H level PTEN I <sub>L</sub> =1mA Serial PTENH:V <sub>DD</sub> setting	V <sub>DD</sub> - 0.3			V
L output level 1	V <sub>LO1</sub>	Output L level PTEN I <sub>L</sub> =1mA	0		0.3	V

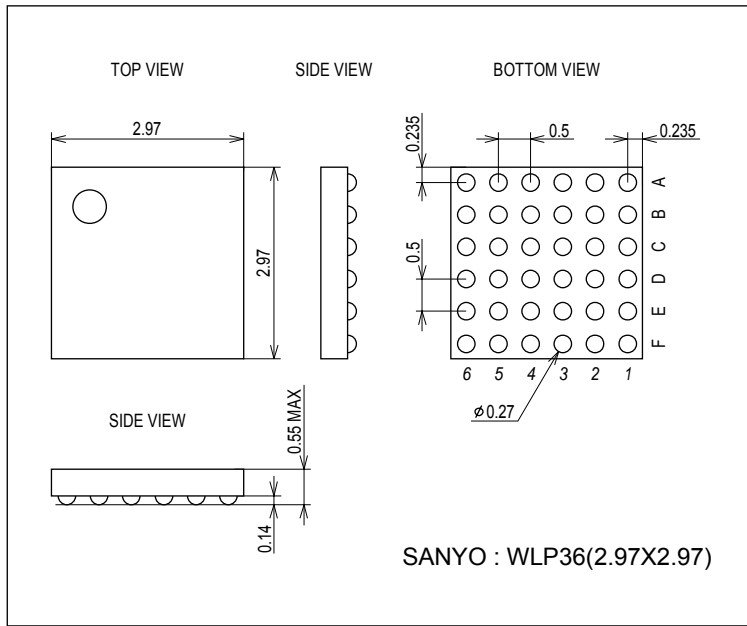
\*1. Non-linearity error: The difference between the actual and ideal current values.

\*2. Differential linearity error: The difference between the actual and ideal increment when one low-order bi value is added.

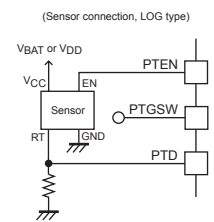
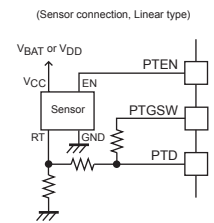
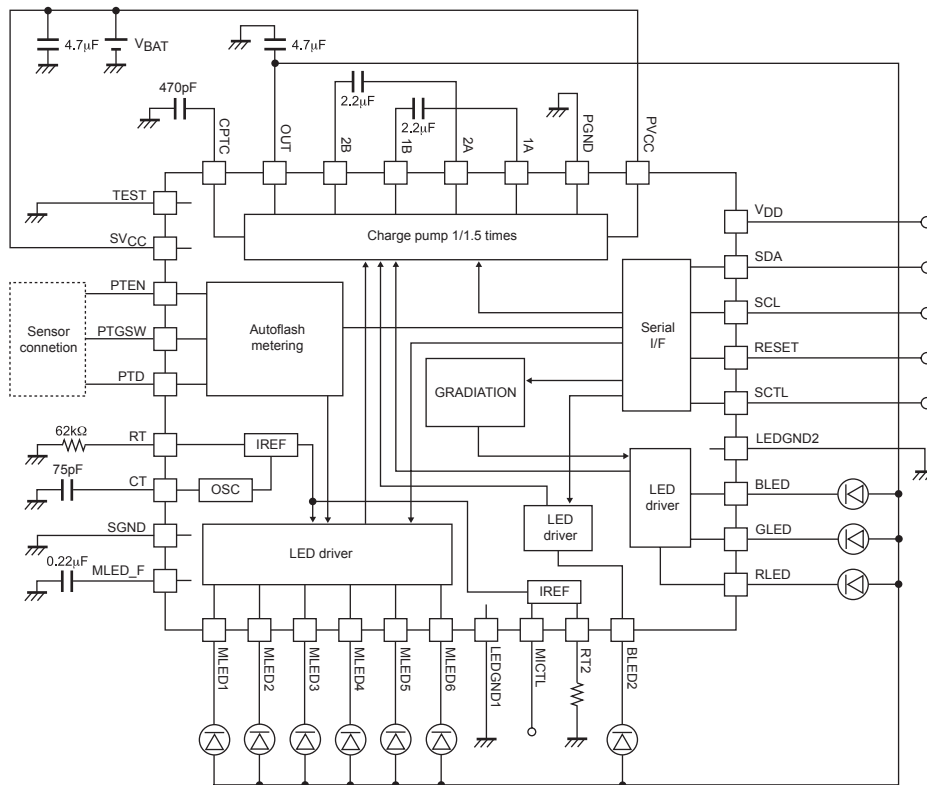
## Package Dimensions

unit : mm (typ)

3412

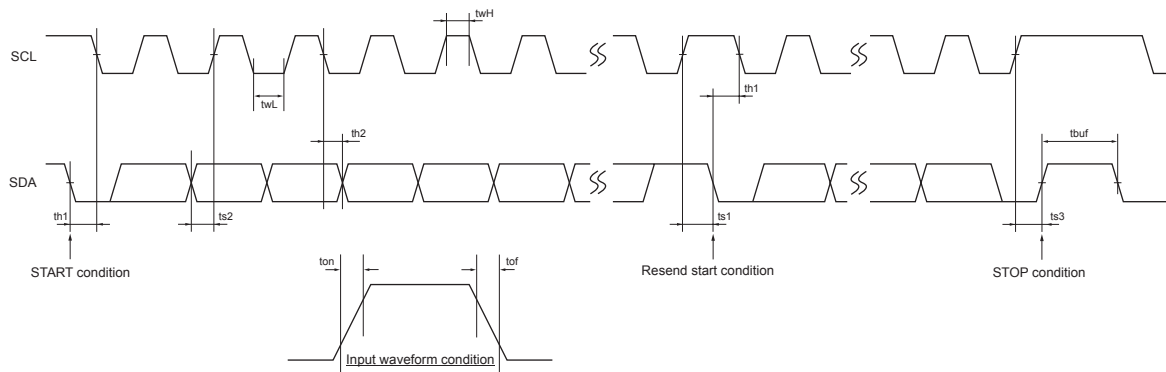


## Block Diagram & Pin arrangement drawing



## Serial Bus Communication Specifications

### 1) I<sup>2</sup>C serial transfer timing conditions



#### Standard mode

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
SCL clock frequency	fsc1	SCL clock frequency	0	-	100	kHz
Data setup time	ts1	SCL setup time relative to the fall of SDA	4.7	-	-	μs
	ts2	SDA setup time relative to the rise of SCL	250	-	-	ns
	ts3	SCL setup time relative to the rise of SDA	4.0	-	-	μs
Data hold time	th1	SCL hold time relative to the fall of SDA	4.0	-	-	μs
	th2	SDA hold time relative to the fall of SCL	0	-	-	μs
Pulse width	twL	SCL pulse width for the L period	4.7	-	-	μs
	twH	SCL pulse width for the H period	4.0	-	-	μs
Input waveform conditions	ton	SCL and SDA (input) rise time	-	-	1000	ns
	tof	SCL and SDA (input) fall time	-	-	300	ns
Bus free time	tbuf	Time between STOP condition and START condition	4.7	-	-	μs

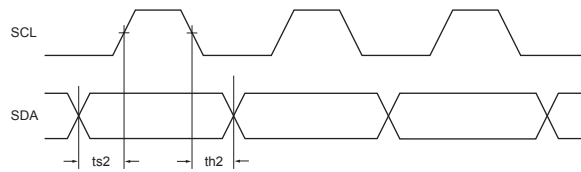
#### High-speed mode

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
SCL clock frequency	fsc1	SCL clock frequency	0	-	400	kHz
Data setup time	ts1	SCL setup time relative to the fall of SDA	0.6	-	-	μs
	ts2	SDA setup time relative to the rise of SCL	100	-	-	ns
	ts3	SCL setup time relative to the rise of SDA	0.6	-	-	μs
Data hold time	th1	SCL hold time relative to the fall of SDA	0.6	-	-	μs
	th2	SDA hold time relative to the fall of SCL	0	-	-	μs
Pulse width	twL	SCL pulse width for the L period	1.3	-	-	μs
	twH	SCL pulse width for the H period	0.6	-	-	μs
Input waveform conditions	ton	SCL and SDA (input) rise time	-	-	300	ns
	tof	SCL and SDA (input) fall time	-	-	300	ns
Bus free time	tbuf	Time between STOP and START conditions	1.3	-	-	μs

## 2) I<sup>2</sup>C bus transfer method

### Start and stop conditions

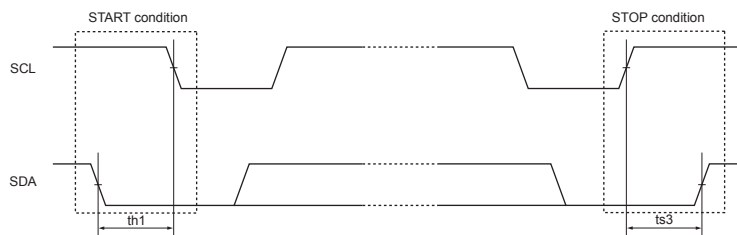
During data transfer operation using the I<sup>2</sup>C bus, SDA must basically be kept in constant state while SCL is "H" as shown below.



When data is not being transferred, both SCL and SDA are set in the "H" state.

When SCL=SDA is "H," the start condition is established when SDA is changed from "H" to "L," and access is started.

When SCL is "H," the stop condition is established when SDA is changed from "L" to "H," and access is ended.



### Data transfer and acknowledgement response

After the start condition has been established, the data is transferred one byte (8 bits) at a time.

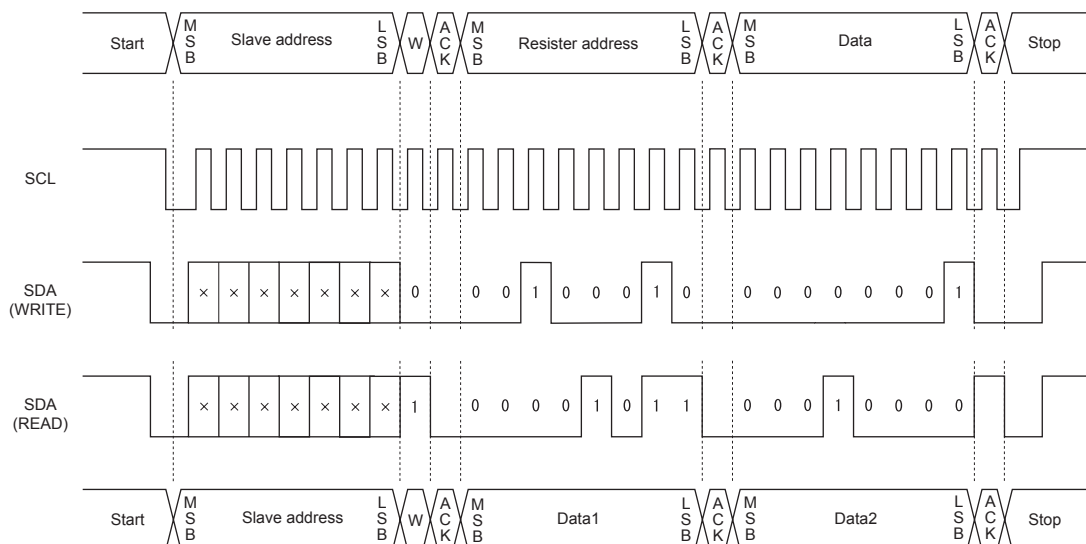
Any number of bytes of data can be transferred continuously.

Each time the 8-bit data is transferred, the ACK signal is sent from the receive side to the send side. The ACK signal is issued when SDA on the send side is released and SDA on the receive side is set to "L" immediately after fall of the clock pulse at the SCL eighth bit of data transfer to "L."

When the next 1-byte transfer is left in the receive state after sending the ACK signal from the receive side, the receive side releases SDA at the fall of the SCL ninth clock.

In the I<sup>2</sup>C bus, there is no CE signal. In its place, a 7-bit slave address is assigned to each device, and the first byte of transfer is assigned to the command (R/W) representing the 7-bit address and subsequent transfer direction. Note that only write is valid in this IC. The 7-bit address is transferred sequentially starting with MSB, and the eighth bit is set to "L" which indicates a write.

In the LV5216CS the slave address is specified as "1110100"



## Data transfer writing format

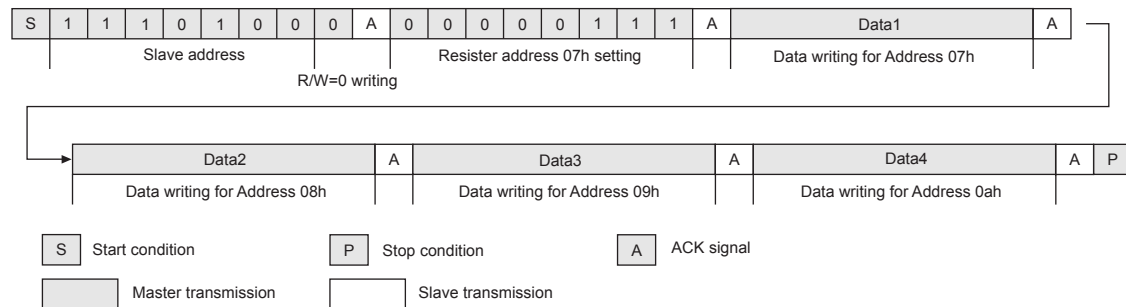
In the first one byte, the slave address and the Write command are allocated, and the following one byte specifies the register address in the cereal map.

The register address is done after the fourth byte be to do the data transfer to the address specified in the register address written in the third byte and the 2nd byte, and to continue data after that and the increment is done by the automatic operation.

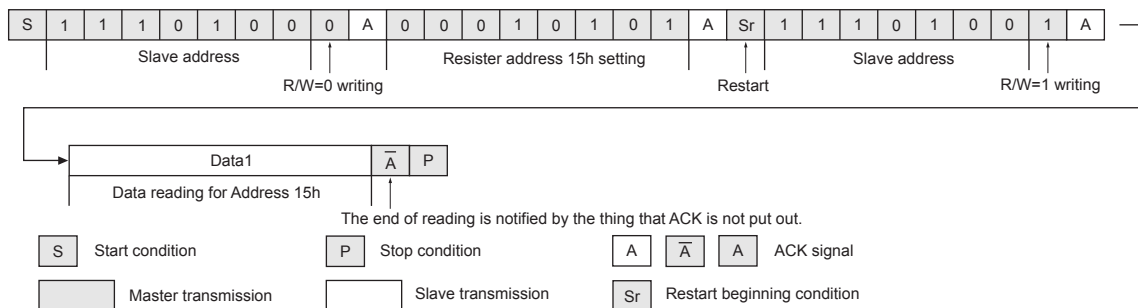
As a result, a data continuous sending from a specified address becomes possible.

However, when the address becomes 3fh, the forwarding address of the following byte becomes 00h.

## Example of writing data



## Example of reading data



- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only; it is not guaranteed for volume production.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of August, 2011. Specifications and information herein are subject to change without notice.



## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9