◇ STRUCTURE Silicon Monolithic Integrated Circuit

◇ PRODUCT CMOS 16kbit serial EEPROM built-in LDO REGULATOR

◇ PART NUMBER BU9829GUL-W

PART NUMBER	PACKAGE
BU9829GUL-W	VCSP50L1

◇ FEATURES

EEPROM PART

- 2,048 words ×8 bits architecture serial EEPROM
- Wide operating voltage range (1.6V～3.6V)
- Serial Peripheral Interface
- Self-timed write cycle with automatic erase
- Low Power consumption
  - Write (3.6V) : 1.5mA (Typ.)
  - Read (3.6V) : 0.5mA (Typ.)
  - Standby (3.6V) : 0.1 μA (Typ.)
- Auto-increment of registers address for Read mode
- 32 byte Page Write mode
- DATA security
  - Defaults to power up with write-disabled state
  - Software instructions for wirte-enable/disable
  - Block writes protection by status register
  - Write inhibit at low Vcc
- Data retention : 10 years
- Endurance : 100,000 erase/write cycles
- Initial data FFh in all address and 00h in status register

LDO REGULATOR PART

- Low power consumption
  - Standby (3.6V) : 0.1 μA (Typ.)
  - Operation (3.6V) : 0.1mA (Typ.)
- Power on/off by enable pin
- Setting output voltage by EEPROM coommand (VSET WRITE)

◇ ABSOLUTE MAXIMUM RATING (Ta=25℃)

Parameter	Symbol	Rating	Unit
Supply Voltage	Vcc1(EEPROM)	−0.3～4.5	V
	Vcc2 (LDO)		
Power Dissipation	Pd	220 (*)	mW
Storage Temperature	Tstg	−65～125	℃
Operating Temperature	Topr	−30～85	℃
Terminal Voltage	—	−0.3～Vcc+0.3	V

＊Degradation is done at 2.2mW/℃(*)

◇ EEPROM RECOMMENDED OPERATING CONDITION

Parameter	Symbol	Rating	Unit
Supply Voltage	Vcc1	1.6～3.6	V
Input Voltage	VIN	0～Vcc1	V

◇ LDO REGURATOR RECOMMENDED OPERATING CONDITION

Parameter	Symbol	Rating	Unit
Supply Voltage	Vcc2	2.9～3.6	V
Input Voltage	VIN	0～Vcc2	V

◇ MEMORY CELL CHARACTERISTICS(Ta=25℃, Vcc1=1.6～3.6V)

Parameter		Specification			Unit
		Min.	Typ.	Max.	
Write/Erase Cycle	*1	100,000	–	–	Cycle
Data Retention	*1	10	–	–	Year

◇ EEPROM DC OPERATING CHARACTERISTICS
(Unless otherwise specified Ta=−30～85℃, Vcc1=1.6～3.6V)

Parameter	Symbol	Specification			Unit	test condition
		Min.	Typ.	Max.		
"H" Input Voltage1	VIH1	0.7xVcc1	—	Vcc1+0.3	V	2.5V≦Vcc1≦3.6V
"H" Input Voltage2	VIH2	0.75xVcc1	—	Vcc1+0.3	V	1.6V≦Vcc1<2.5V
"L" Input Voltage1	VIL1	−0.3	—	0.3xVcc1	V	2.5V≦Vcc1≦3.6V
"L" Input Voltage2	VIL2	−0.3	—	0.25xVcc1	V	1.6V≦Vcc1<2.5V
"L" Output Voltage1	VOL1	0	—	0.2	V	IOL=1.0mA, 2.5V≦Vcc1≦3.6V
"L" Output Voltage2	VOL2	0	—	0.2	V	IOL=1.0mA, 1.6V≦Vcc1<2.5V
"H" Output Voltage1	VOH1	Vcc1−0.2	—	Vcc1	V	IOH=−0.4mA, 2.5V≦Vcc1≦3.6V
"H" Output Voltage2	VOH2	Vcc1−0.2	—	Vcc1	V	IOH=−100μA, 1.6V≦Vcc1<2.5V
Input Leakage Current	ILI	−1	—	1	μA	VIN=0V～Vcc1
Output Leakage Current	ILO	−1	—	1	μA	VOUT=0V～Vcc1 , CSB=Vcc1
Operating current Write	ICC1	–	–	1.5	mA	Vcc1=1.8V, fSCK=2MHz, tE/W=5ms Byte Write, Page Write, Write Status Register
	ICC2	–	—	2.0	mA	Vcc1=2.5V , fSCK=5MHz , tE/W=5ms Byte Write, Page Write, Write Status Register
Operating Current Read	ICC3	—	—	0.2	mA	Vcc1=1.8V , fSCK=2MHz, SO=OPEN Read, Read Status Register
	ICC4	—	—	0.6	mA	Vcc1=2.5V , fSCK=5MHz, SO=OPEN Read, Read Status Register
Standby Current	ISB	–	—	1.0	μA	Vcc1=3.6V, CSB=SCK=SI=Vcc1/GND,SO=OPEN

◇ EEPROM AC OPERATING CHARACTERISTICS
(Ta=−30～85℃)

Parameter	Symbol	1.6V≦Vcc1<1.8V			1.8V≦Vcc1≦3.6V			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
SCK clock Frequency	fSCK	—	—	2.5	—	—	5	MHz
SCK High Time	tSCKWH	200	—	—	80	—	—	ns
SCK Low Time	tSCKWL	200	—	—	80	—	—	ns
CSB High Time	tCS	200	—	—	90	—	—	ns
CSB Setup Time	tCSS	150	—	—	60	—	—	ns
CSB Hold Time	tCSH	150	—	—	60	—	—	ns
SCK Setup Time	tSCKS	50	—	—	50	—	—	ns
SCK Hold Time	tSCKH	50	—	—	50	—	—	ns
SI Setup Time	tDIS	50	—	—	20	—	—	ns
SI Hold Time	tDIH	50	—	—	20	—	—	ns
Output Data Delay Time	tPD	–	—	100	–	—	80	ns
Output Hold Time	tOH	0	—	–	0	—	–	ns
Output Disable Time *1	tOZ	—	—	200	–	—	80	ns
SCK Rise Time *1	tRC	—	—	1	–	—	1	μs
SCK Fall Time *1	tFC	—	—	1	–	—	1	μs
Output Rise Time *1	tRO	—	—	50	–	—	50	ns
Output Fall Time *1	tFO	—	—	50	–	—	50	ns
Write Cycle Time	tE/W	—	—	5	—	—	5	ms
Wait Time From Vcc1 on To EEPROM Command	tON	15	—	—	15	—	—	ms

*1 Not 100% TESTED

◇ LDO REGULATOR DC OPERATING CHARACTERISTICS
(Unless otherwise specified Ta=−30～85℃, Vcc2=2.9～3.6V)

Parameter	Symbol	Specification			Unit	Test condition
		Min.	Typ.	Max.		
Output Voltage1−1	$V_{OUT}1-1$	2.9	3.0	3.2	V	3.2V≦Vcc2≦3.6V, IOUT=0,2mA, VSET=1,0=[1:1]
Output Voltage1−2	$V_{OUT}1-2$	2.9	3.0	3.1	V	3.2V≦Vcc2≦3.6V, IOUT=2,10mA, VSET=1,0=[1:1]
Output Voltage2−1	$V_{OUT}2-1$	2.8	2.9	3.1	V	3.1V≦Vcc2≦3.6V, IOUT=0,2mA, VSET=1,0=[1:0]
Output Voltage2−2	$V_{OUT}2-2$	2.8	2.9	3.0	V	3.1V≦Vcc2≦3.6V, IOUT=2,10mA, VSET=1,0=[1:0]
Output Voltage3−1	$V_{OUT}3-1$	2.7	2.8	3.0	V	3.0V≦Vcc2≦3.6V, IOUT=0,2mA, VSET=1,0=[0:1]
Output Voltage3−2	$V_{OUT}3-2$	2.7	2.8	2.9	V	3.0V≦Vcc2≦3.6V, IOUT=2,10mA, VSET=1,0=[0:1]
Output Voltage4−1	$V_{OUT}4-1$	2.6	2.7	2.9	V	2.9V≦Vcc2≦3.6V, IOUT=0,2mA, VSET=1,0=[0:0]
Output Voltage4−2	$V_{OUT}4-2$	2.6	2.7	2.8	V	2.9V≦Vcc2≦3.6V, IOUT=2,10mA, VSET=1,0=[0:0]
Operating Current	Icc	–	–	200	μA	Vcc2=3.6V, IOUT=0A
Standby Current	ISB	–	–	1.0	μA	Vcc2=3.6V, IOUT=0A, LDOEN=GND
"H"Input Voltage	VIH	1.4	–	Vcc2+0.3	V	2.9V≦Vcc2≦3.6V
"L"Input Voltage	VIL	−0.3Vcc2	–	0.6	V	2.9V≦Vcc2≦3.6V

○This product is not designed for protection against radioactive rays.

◇ LDO REGULATOR AC OPERATING CHARACTERISTICS
(Ta=−30～85℃)

Parameter	Symbol	2.9V≦Vcc≦3.6V			Unit	Test condition
		Min.	Typ.	Max.		
Vcc1 Rise Time	tVcc1	–	—	5	msec	Vcc1x0%→Vcc1x95%point
LDOEN Wait Time	tLDOEN	15	—	–	msec	Vcc1x0%point→LDOEN=High

◇ PIN No. / PIN NAME

PIN No.	PIN NAME
A1	Vcc1
A2	CSB
A3	SCK
B1	Vcc2
B2	SI
B3	SO
C1	VOUT
C2	GND
C3	LDOEN

◇ BLOCK DIAGRAM

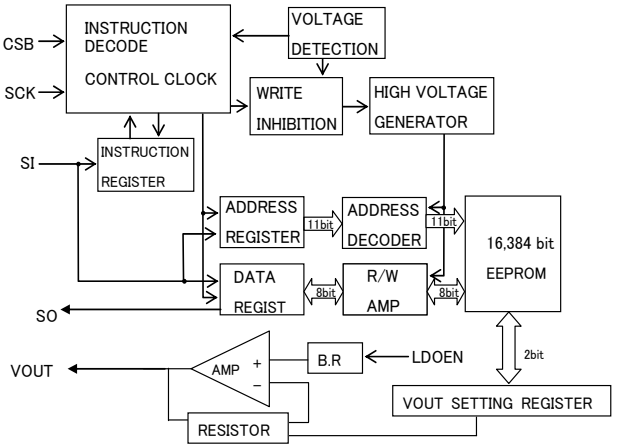

Fig.1 BLOCK DIAGRAM

◇ Input Power Supply Regulation Timing

①Using EEPROM PART

In case of using EEPROM part, be sure to raise Vcc1 up to operating voltage. In this time, Vcc2 has no connection with operating.

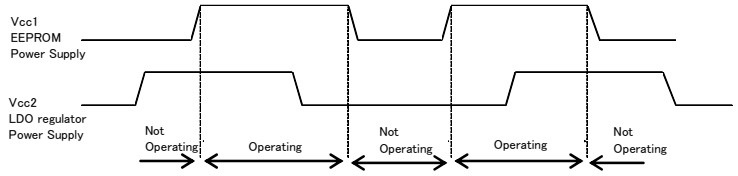

Fig.4 Using EEPROM Part, Regulation Timing

②Using LDO REGULATOR PART

In case of using LDO regulator part, be sure to raise Vcc1 and Vcc2 up to operating voltage.
After rising Vcc1, wait 15msec and rising LDOEN. When LDOEN is raised, Vcc1 must be operating voltage.

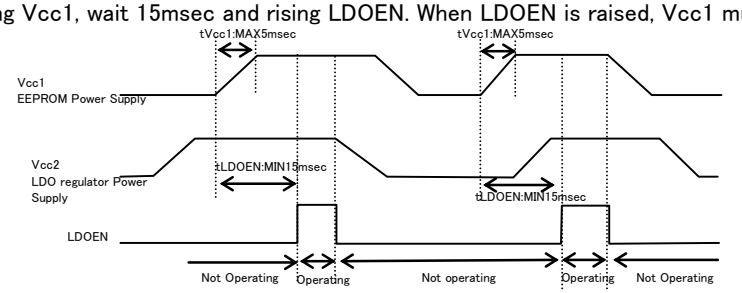

Fig.5 Using LDO REGULATOR Part, Regulation Timing

◇ I/O APPLICATION CIRCUIT

Pull up resistor is indispensable condition.
When CSB is "H" during power ON/OFF, error operating and writing is protected.

○PULL UP RESISTOR OF CSB PIN

The pull up resistor is needed in order to prevent error operating and writing from happening.
Decide the value of this resistor (Rup) properly, considering VOH, IOH characteristics of controller.

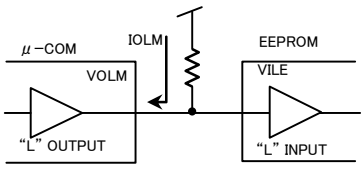

Fig.3 PULL UP RESISTOR OF CSB PIN

・VILE:VIL specification of EEPROM
・VOLM:VOL specification of CONTROLLER
・IOLM:IOL specification of CONTROLLER

$$Rpu \geqq \frac{VCC-VOLM}{IOLM} \quad \cdots①$$

$$VILE \geqq VOLM \quad \cdots②$$

Example) When Vcc=5V, VILE=1.5V, VOLM=0.4V, IOLM=2mA, according to ①,

$$Rpu \geqq \frac{5-0.4}{2\times10^{-3}}$$

$$\therefore \quad Rpu \geqq 2.5[k\Omega]$$

If the Rpu is under the conditions of the equation ①, VOLM is 0.4V or more.
If the Rpu is under the conditions of the equation ②, VILE(=1.5V) is VOLM or less.

◇CAUTIONS ON USE

(1) Absolute maximum ratings
If the absolute maximum ratings such as impressed voltage and operating temperature range and so forth are exceeded, LSI may be destructed. Do not impress voltage and temperature exceeding the absolute maximum ratings. In the case of fear exceeding the absolute maximum ratings, take physical safety countermeasures such as fuses, and see to it that conditions exceeding the absolute maximum ratings should not be impressed to LSI.

(2) GND electric potential
Set the voltage of GND terminal lowest at any action condition. Make sure that each terminal voltages is lower than that of GND terminal.

(3) Heat design
In consideration of permissible dissipation in actual use condition, carry out heat design with sufficient margin.

(4) Terminal to terminal shortcircuit and wrong packaging
When to package LSI onto a board, pay sufficient attention to LSI direction and displacement. Wrong packaging may destruct LSI. And in the case of shortcircuit between LSI terminals and terminals and power source, terminal and GND owing to foreign matter, LSI may be destructed.

(5) Strong electromagnetic field
Use in a strong electromagnetic field may cause malfunction, therefore, evaluated design sufficiently.

◇PHYSICAL DIMENSION

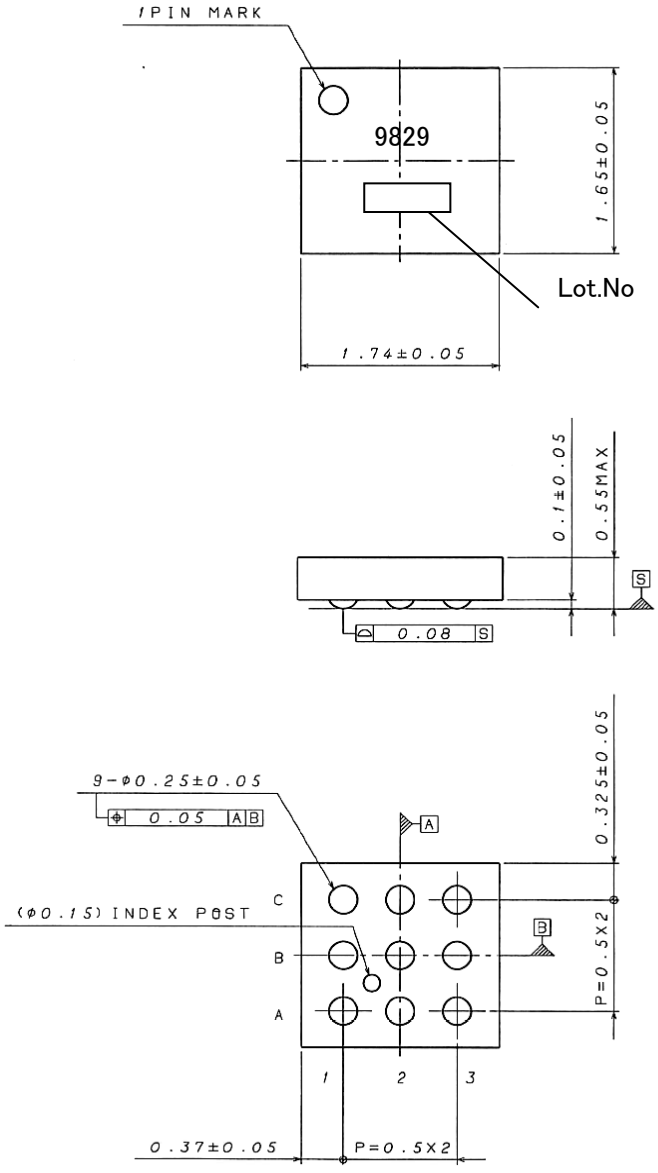

Fig.4 PHYSICAL DIMENSION VCSP50L1 (BU9829GUL-W)

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