4-wire Resistive Touch Screen Controller

BU21027MUV

General Description

BU21027MUV supports 2 points coordinate at the 4-wire resistive touch screen.
Introduction of 2 points touch detection becomes easy by automatic adjustment function.

Features

- Support 4-wire resistive touch screen.
- Support 2 points touch detection.
- Automatic adjustment of parameters for 2 points touch detection.
- 2-wire serial bus interface.
- Single power supply.
- Auto power down.(power down = sleep)
- Built-in clock oscillator circuit.

Applications

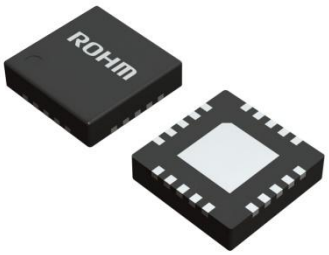
- Equipment with built-in user interface for 4-wire resistive touch screen.
- Information equipment like education tablet and touch monitor.
- Office equipment like printer and copying machine.

Key Specifications

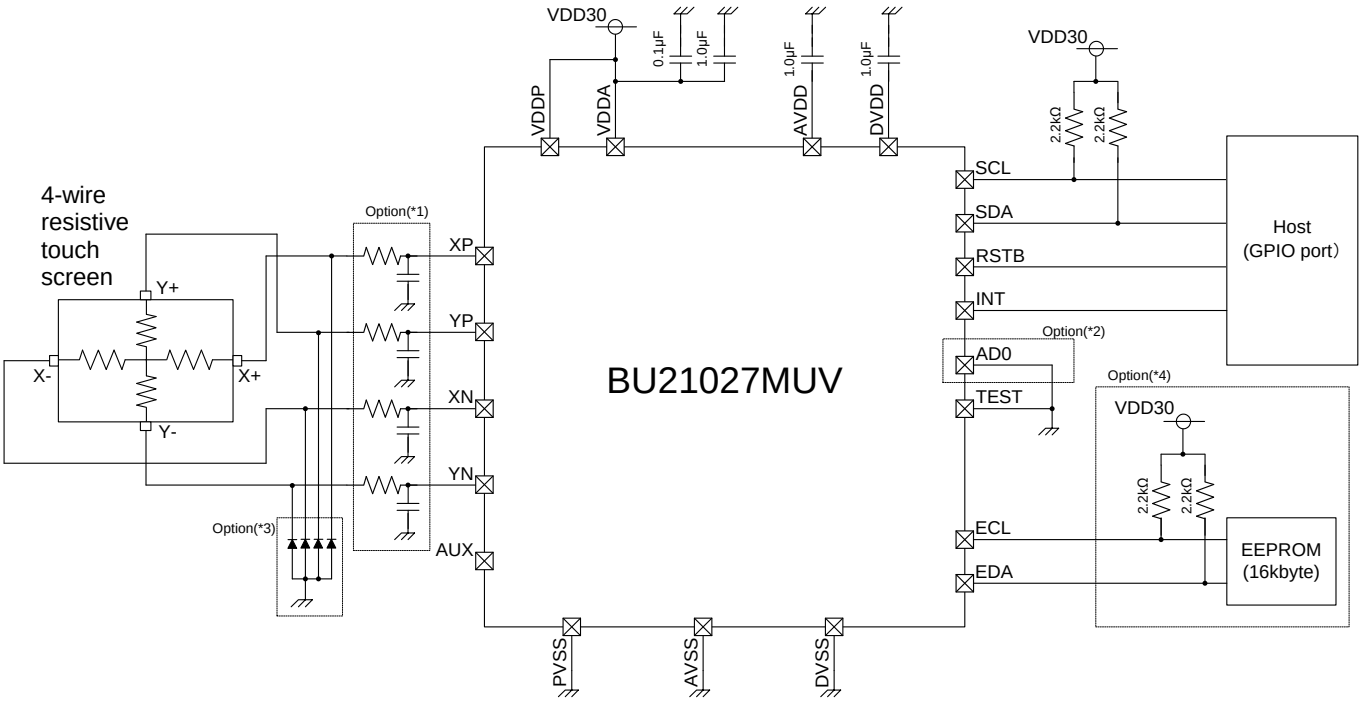
- Power supply voltage: 2.7V to 3.6V
- Operating Temperature Range: -20°C to +85°C
- Standby current: 1µA(Max)
- Sleep current: 70µA(Typ)
- Operating current: 8mA(Typ)
- Coordinate resolution: 12bit

Package

Package	W(Typ) x D(Typ) x H(Max)
VQFN020V4040	4.00mm x 4.00mm x 1.00mm



Typical Application Circuit



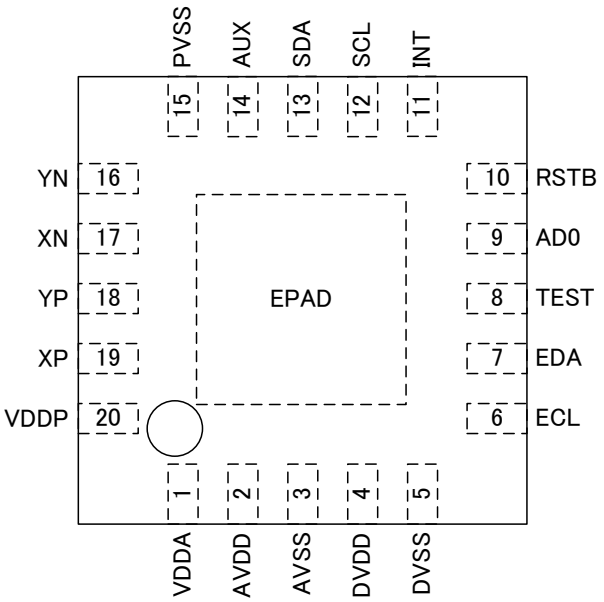
VDD30 : external power supply.
Option(*1) For Noise protection. (Constants of RC-filter choose by evaluation)
Option(*2) 7bit I^2C slave address select. (AD0=L : Slave address = 0x5C, AD0 = H : Slave address = 0x5D)
Option(*3) For ESD protection. (Zener diode / TVS diode)
Option(*4) If don't use EEPROM for firmware download, please connect ECL and EDA to DVSS.

○Product structure : Silicon monolithic integrated circuit ○This product has no designed protection against radioactive rays

Contents

Pin Configuration

(TOP VIEW)



Pin Description

Pin No.	Pin Name	I/O	Function	I/O Equivalent Circuit
1	VDDA	-	Power supply. *(Note 1)*	-
2	AVDD	O	Regulator output for analog circuit. *(Note 2)*	Figure 4
3	AVSS	-	Ground for analog circuit.	-
4	DVDD	O	Regulator output for digital circuit. *(Note 3)*	Figure 4
5	DVSS	-	Ground for digital circuit.	-
6	ECL	O	Serial clock for EEPROM. *(Note 4)*	Figure 3
7	EDA	I/O	Serial data for EEPROM. *(Note 4)*	Figure 3
8	TEST	I	Test control.	Figure 5
9	AD0	I	7bit I^2C slave address select.(H=0x5D, L=0x5C)	Figure 1
10	RSTB	I	Reset.	Figure 1
11	INT	O	Interrupt output.	Figure 2
12	SCL	I	Serial clock for HOST interface. *(Note 4)*	Figure 3
13	SDA	I/O	Serial data for HOST interface. *(Note 4)*	Figure 3
14	AUX	I/O	Auxiliary channel input.	Figure 4
15	PVSS	-	Ground for touch screen interface.	-
16	YN	I/O	Touch screen interface.	Figure 4
17	XN	I/O	Touch screen interface.	Figure 4
18	YP	I/O	Touch screen interface.	Figure 4
19	XP	I/O	Touch screen interface.	Figure 4
20	VDDP	-	Power supply for touch screen interface. *(Note 1)*	-
-	EPAD	-	Please connect to AVSS.	-

(Note 1) Please short VDDA and VDDP, and connect bypass capacitor to AVSS. (Please check Typical Application Circuit of page 1.)
(Note 2) Bypass AVDD to AVSS with 1.0µF capacitor and do not connect to external power supply.
(Note 3) Bypass DVDD to DVSS with 1.0µF capacitor and do not connect to external power supply.
(Note 4) ECL, EDA, SCL and SDA need a pull-up resistor 2.2kΩ or more. If don't use EEPROM for firmware download, please connect ECL and EDA to DVSS.

I/O Equivalent Circuit

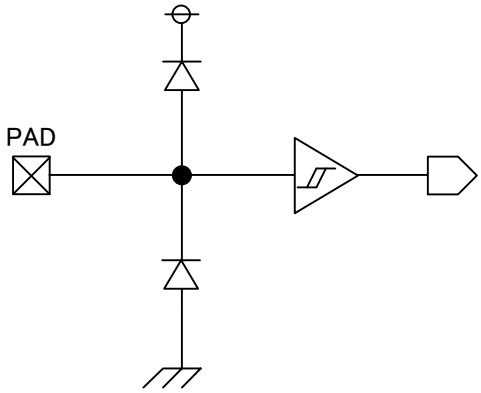


Figure 1

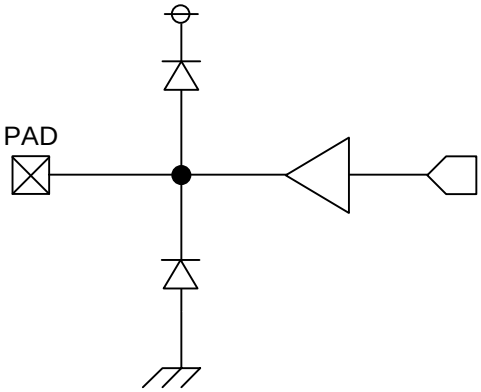


Figure 2

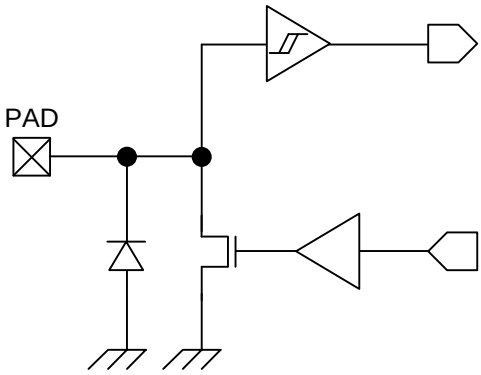


Figure 3

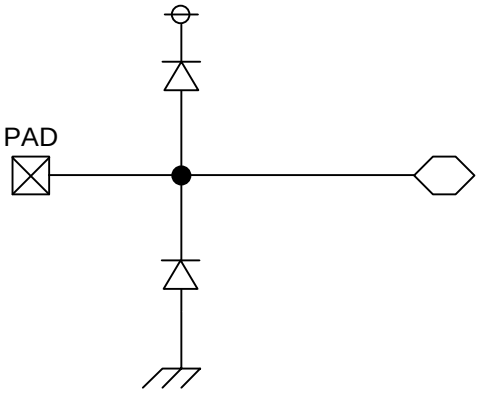


Figure 4

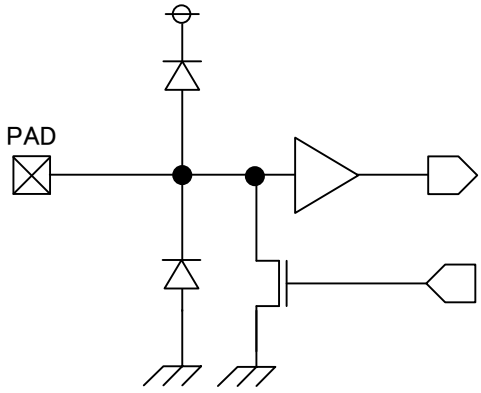
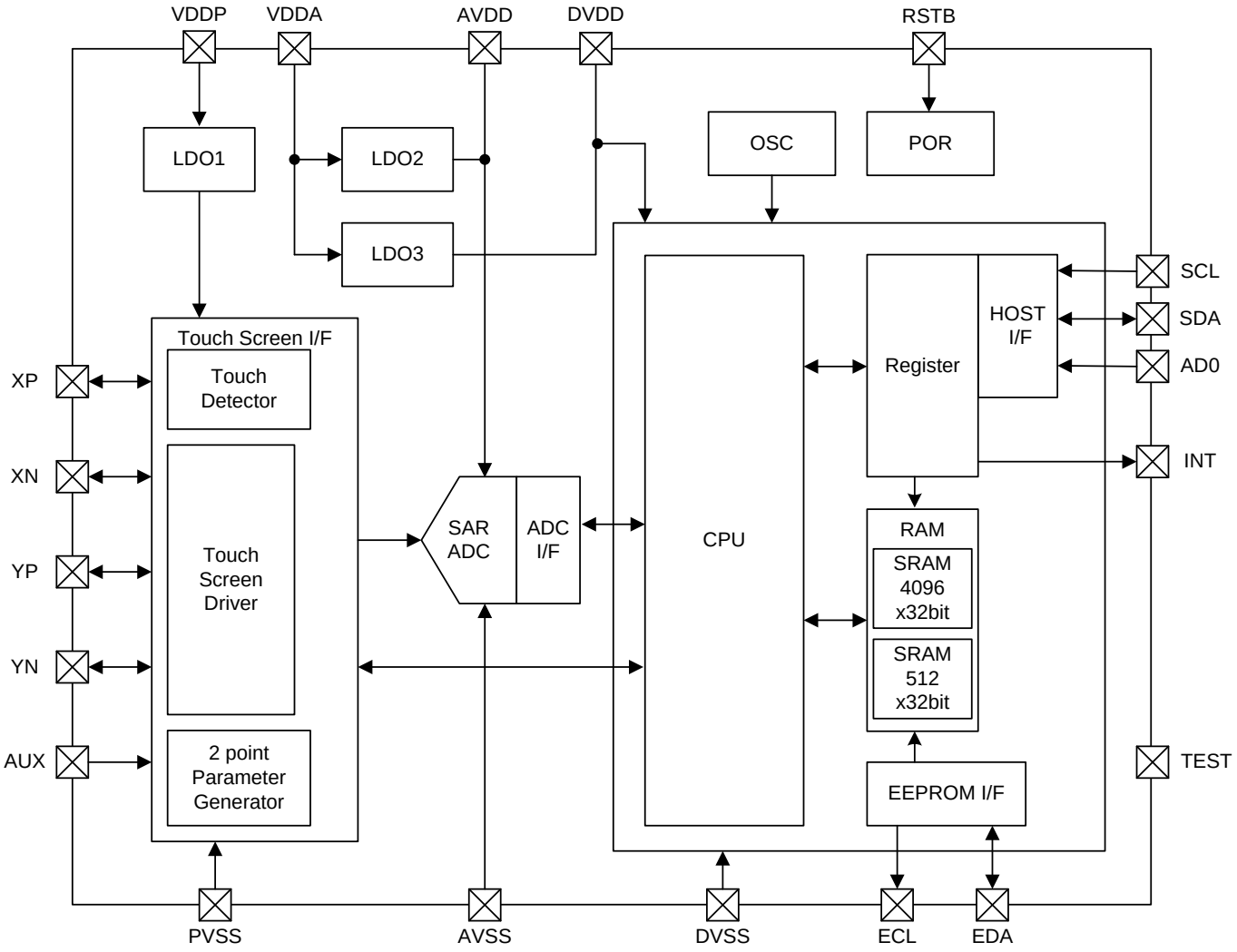


Figure 5

Block Diagram



Description of Blocks

1. Touch Screen I/F
   (1) Touch Detector
   Check touch condition and report a touch to CPU.
   (2) Touch Screen Driver
   Analog switch for touch screen control.
   (3) 2 points Parameter Generator
   Generate parameters for 2 points detection from touch condition.

2. SAR ADC
   12bit A/D converter.

3. ADC I/F
   SAR ADC controller.

4. LDO1
   Regulator for Touch Screen I/F.

5. LDO2
   Regulator for SAR ADC.

6. LDO3
   Regulator for digital circuit.

Description of Blocks - continued

7. CPU
Control of sensing sequence and calculate coordinate.

8. HOST I/F
HOST interface. BU21027MUV works as I^2C slave device.

9. Register
Coordinate and RAW data are stored.

10. RAM
(1) SRAM 4096x32bit
Program memory for CPU.
(2) SRAM 512x32bit
Work memory for CPU.

11. EEPROM I/F
16kBytes EEPROM interface for firmware download.

12. POR
Power on reset.

13. OSC
Clock oscillator.

Absolute Maximum Ratings (Ta = 25°C)

Parameter	Symbol	Rating	Unit
Power Supply Voltage1 (VDDA)	V_{DDA}	-0.3 to +4.5	V
Power Supply Voltage2 (VDDP)	V_{DDP}	-0.3 to +4.5	V
Digital Input Voltage	V_{IN1}	-0.3 to VDDA +0.3	V
AUX Input Voltage	V_{IN2}	-0.3 to 2.1	V
Touch Screen Interface Input Voltage	V_{IN3}	-0.3 to 2.1	V
Maximum Junction Temperature	Tjmax	125	°C
Storage Temperature Range	Tstg	-50 to +125	°C

Caution 1: *Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.*

Caution 2: *Should by any chance the maximum junction temperature rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, design a PCB boards with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.*

Thermal Resistance*(Note 5)*

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s*(Note 7)*	2s2p*(Note 8)*	
VQFN020V4040				
Junction to Ambient	θ_{JA}	153.9	37.4	°C/W
Junction to Top Characterization Parameter*(Note 6)*	Ψ_{JT}	13	7	°C/W

(Note 5) Based on JESD51-2A(Still-Air).

(Note 6) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.

(Note 7) Using a PCB board based on JESD51-3.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3mm x 76.2mm x 1.57mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70µm

(Note 8) Using a PCB board based on JESD51-5, 7.

Layer Number of Measurement Board	Material	Board Size	Thermal Via*(Note 9)*	
			Pitch	Diameter
4 Layers	FR-4	114.3mm x 76.2mm x 1.6mmt	1.20mm	Φ0.30mm

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70µm	74.2mm x 74.2mm	35µm	74.2mm x 74.2mm	70µm

(Note 9) This thermal via connects with the copper pattern of all layers.

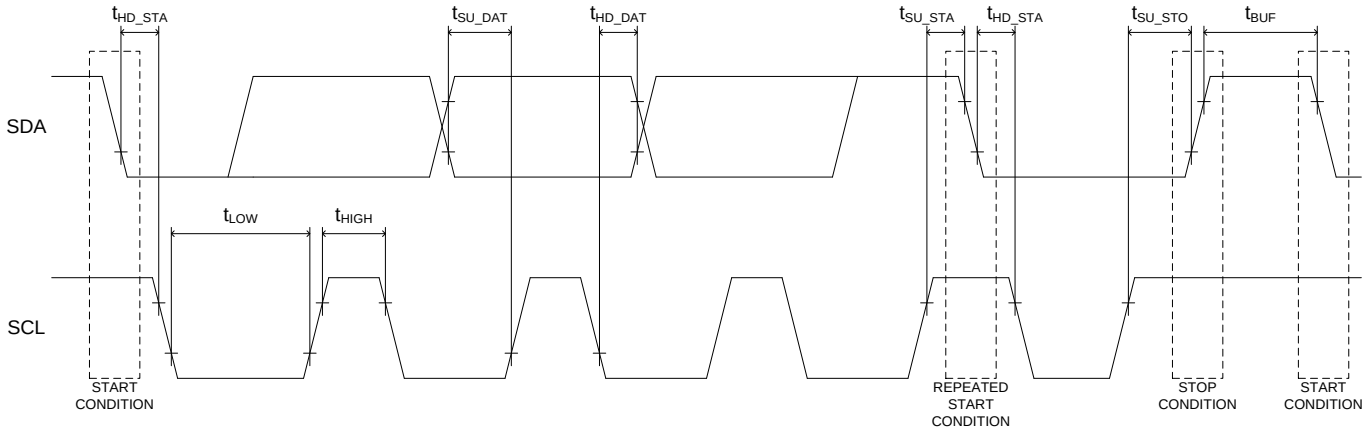
Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Power Supply Voltage1 (VDDA)	V_{DDA}	2.7	3.0	3.6	V	VDDA=VDDP
Power Supply Voltage2 (VDDP)	V_{DDP}	2.7	3.0	3.6	V	VDDA=VDDP
Operating Temperature	Topr	-20	+25	+85	°C	

Electrical Characteristics
(Unless otherwise specified VDDA=VDDP=3.0V, DVSS=AVSS=PVSS=0.00V, Tj=25°C)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Low-level Input Voltage	V_{IL}	- 0.3	-	V_{DDA} * 0.2	V	AD0, SDA, SCL, RSTB, ECL, EDA, TEST
High-level Input Voltage	V_{IH}	V_{DDA} * 0.8	-	V_{DDA} + 0.3	V	AD0, SDA, SCL, RSTB, ECL, EDA,TEST
Low-level Output Voltage	V_{OL}	-	-	0.4	V	SDA, ECL, EDA, INT (I_L=3mA)
High-level Output Voltage	V_{OH}	V_{DDA} - 0.4	-	-	V	INT (I_L=3mA)
Standby Current	I_{ST}	-	-	1	µA	RSTB=L
Sleep Current	I_{SLP}	-	70	100	µA	Sleep = Power down
Operating Current	I_{ACT}	3.5	8	12.5	mA	No load (Not include 4-wire resistive touch screen current) Sensing sequence is running
Resolution	A_D		12		bit	
Differential Non-Linearity Error	D_{NL}	-3	-	+3	LSB	
Integrate Non-Linearity Error	I_{NL}	-5	-	+5	LSB	
Switch On-resistance	R_{ON}	0.5	5.0	10.0	Ω	XP, XN, YP, YN

2-wire Serial Bus Interface AC Timing



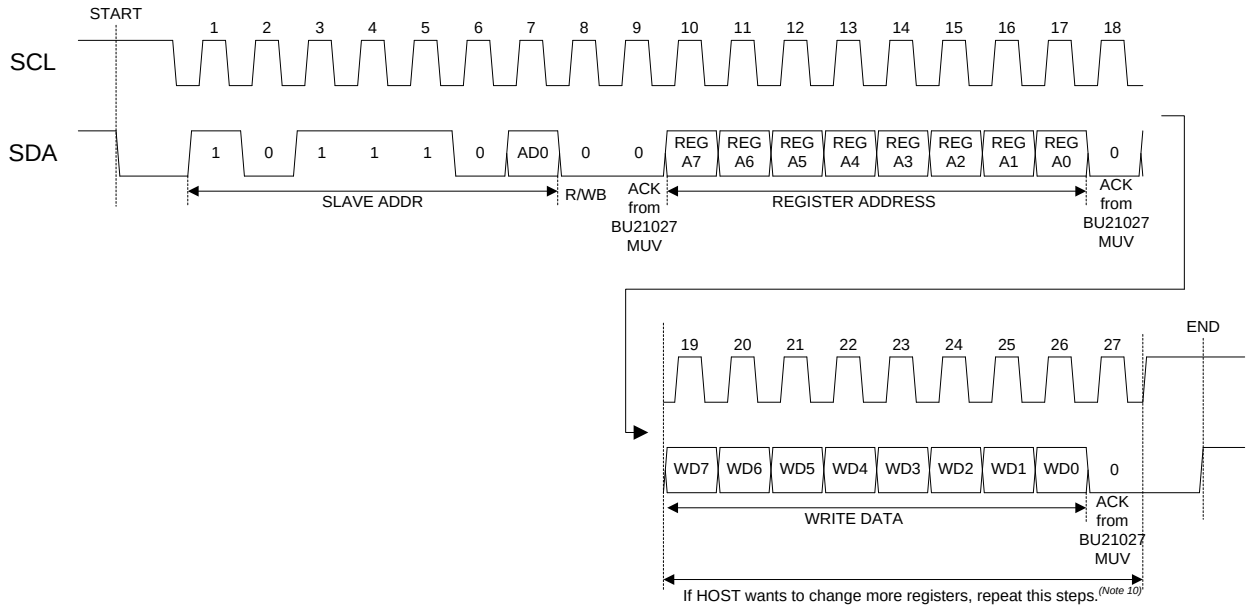
2-wire Serial Bus Interface AC Timing Characteristics
(Unless otherwise specified VDDA=VDDP=3.00V, DVSS=AVSS=PVSS=0.00V, Tj=25°C)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
SCL Clock Frequency	f_{SCL}	-	-	400	kHz	
START CONDITION Hold Time	t_{HD_STA}	0.6	-	-	µs	
SCL L Width	t_{LOW}	1.3	-	-	µs	
SCL H Width	t_{HIGH}	0.6	-	-	µs	
REPEATED START CONDITION Setup Time	t_{SU_STA}	0.6	-	-	µs	
Data Hold Time	t_{HD_DAT}	0	-	-	µs	
Data Setup Time	t_{SU_DAT}	0.1	-	-	µs	
STOP CONDITION Setup Time	t_{SU_STO}	0.6	-	-	µs	
Bus Free Time	t_{BUF}	1.3	-	-	µs	Between STOP CONDITION to START CONDITION

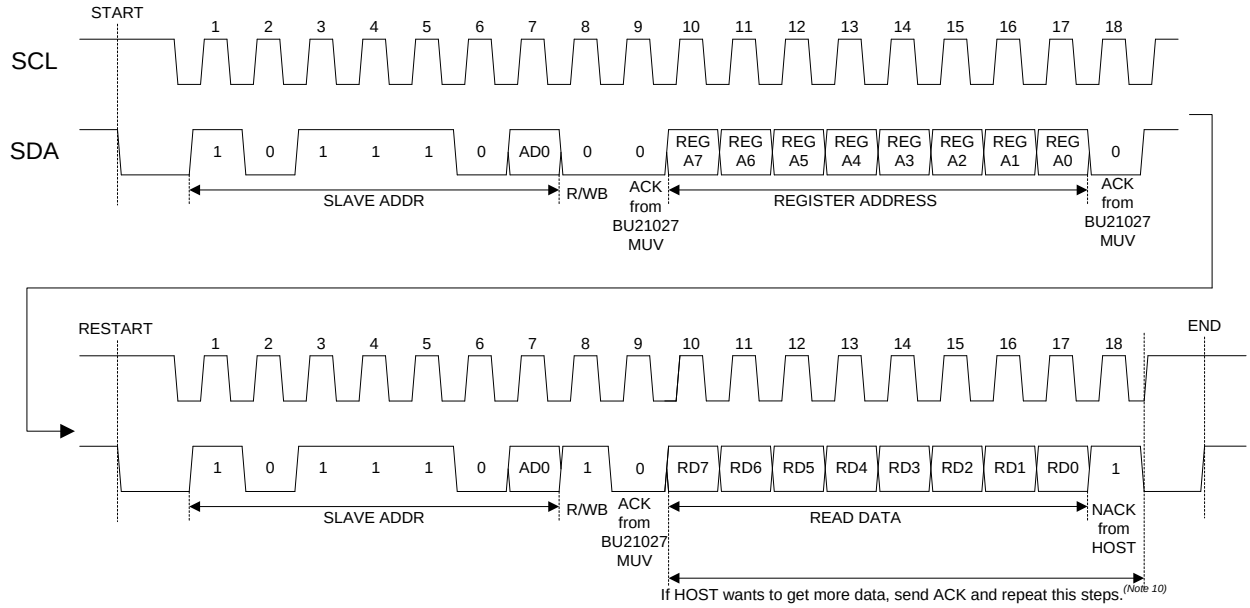
2-wire Serial Bus Interface Communication Protocol

2-wire serial bus interface of BU21027MUV supports I^2C bus. HOST controls BU21027MUV as I^2C slave device.
I^2C slave address of BU21027MUV is 0x5C or 0x5D and selected by AD0.

Register write protocol

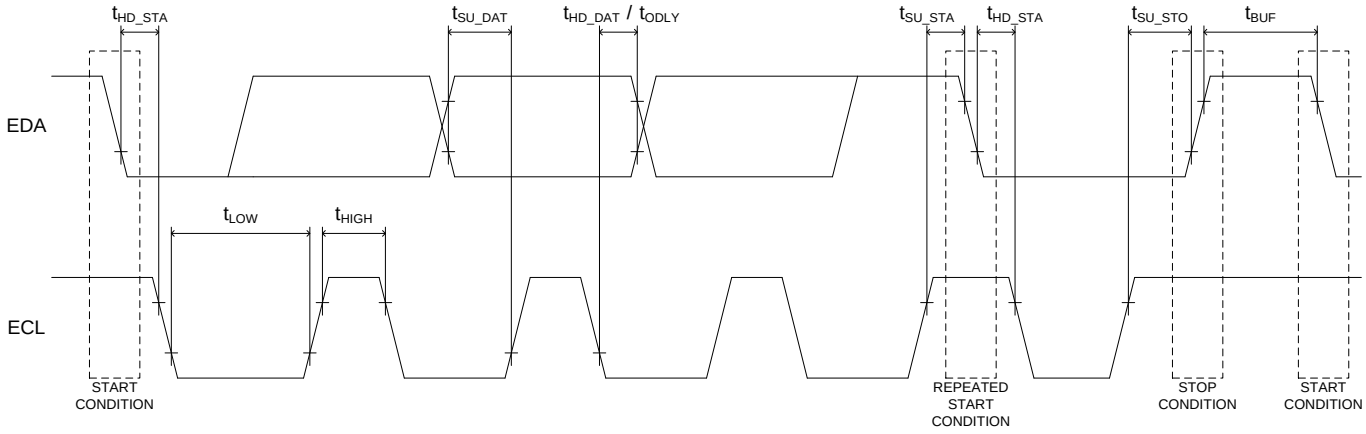


Register read protocol



(Note 10) If register address is less than 0x5F, register address is incremented automatically at the timing of ACK.

EEPROM Interface AC Timing

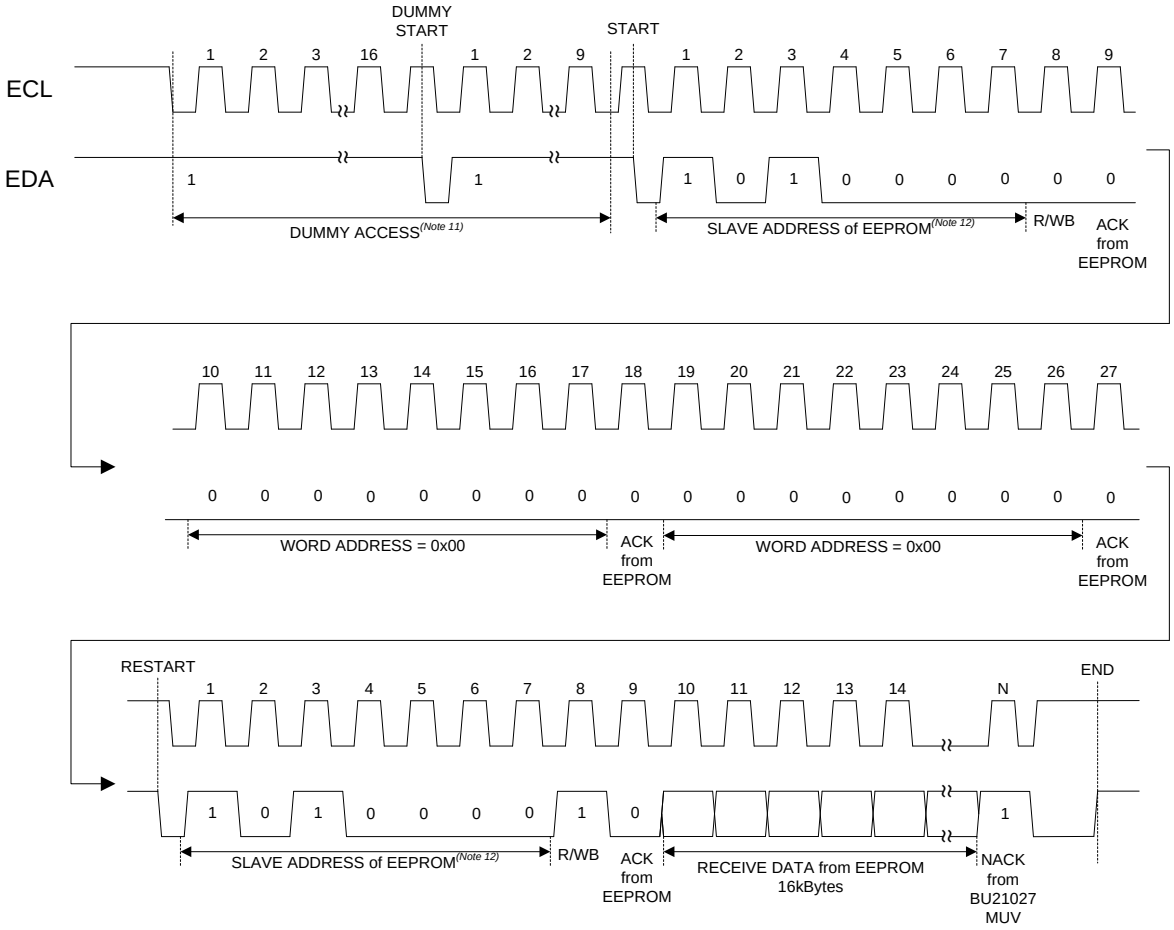


EEPROM Interface AC Timing Characteristics
(Unless otherwise specified VDDA=VDDP=3.00V, DVSS=AVSS=PVSS=0.00V, Tj=25°C)

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
ECL Clock Frequency	f_{ECL}	270	310	350	kHz	
START CONDITION Hold Time	t_{HD_STA}	0.7	-	0.9	µs	
ECL L Width	t_{LOW}	1.4	-	1.8	µs	
ECL H Width	t_{HIGH}	1.4	-	1.8	µs	
REPEATED START CONDITION Setup Time	t_{SU_STA}	0.6	-	1.0	µs	
Output Data Delay Time	t_{ODLY}	-	-	1.0	µs	
Data Hold Time	t_{HD_DAT}	0.0	-	-	µs	Input from EEPROM
Data Setup Time	t_{SU_DAT}	0.1	-	-	µs	Input from EEPROM
STOP CONDITION Setup Time	t_{SU_STO}	0.6	-	1.0	µs	
Bus Free Time	t_{BUF}	3.0	-	3.4	µs	Between STOP CONDITION to START CONDITION

EEPROM Communication Protocol

BU21027MUV supports only read for firmware download.

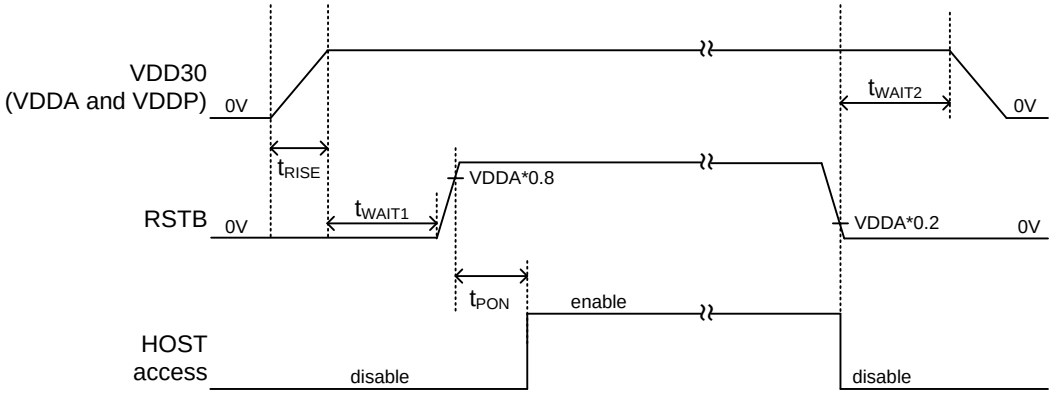


(Note 11) Dummy access for free serial bus.
(Note 12) This is selectable by using BU21027MUV register and initial value = 0x50.

Power Supply and Reset Timing Specification

A power supply sequence and timing AC characters of BU21027MUV are below.

BU21027MUV start wake-up of digital power supply after RSTB input goes to “H”.
Because wake-up sequence needs 1ms, HOST access is enabled after 1ms at RSTB goes to H.



Power Supply AC Timing Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
VDD30 Rise Time	t_{RISE}	1	-	10	ms	VDDA and VDDP
RSTB Wait Time1	t_{WAIT1}	1	-	-	ms	
RSTB Wait Time2	t_{WAIT2}	0	-	-	ms	
Wake-up Time	t_{PON}	1	-	-	ms	

Operational Notes

1. Reverse Connection of Power Supply

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. Ground Voltage

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. Ground Wiring Pattern

When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. Recommended Operating Conditions

The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

6. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

7. Operation Under Strong Electromagnetic Field

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

8. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

9. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

10. Unused Input Pins

Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

11. Regarding the Input Pin of the IC

In the construction of this IC, P-N junctions are inevitably formed creating parasitic diodes or transistors. The operation of these parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions which cause these parasitic elements to operate, such as applying a voltage to an input pin lower than the ground voltage should be avoided. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. Even if the power supply voltage is applied, make sure that the input pins have voltages within the values specified in the electrical characteristics of this IC.

12. Ceramic Capacitor

When using a ceramic capacitor, determine a capacitance value considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

Operational Notes – continued

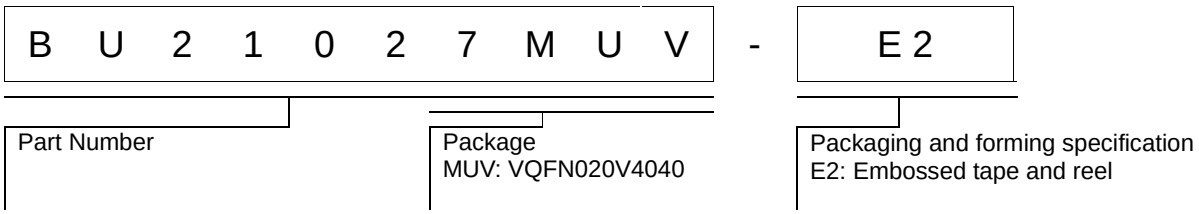
13. Area of Safe Operation (ASO)

Operate the IC such that the output voltage, output current, and the maximum junction temperature rating are all within the Area of Safe Operation (ASO).

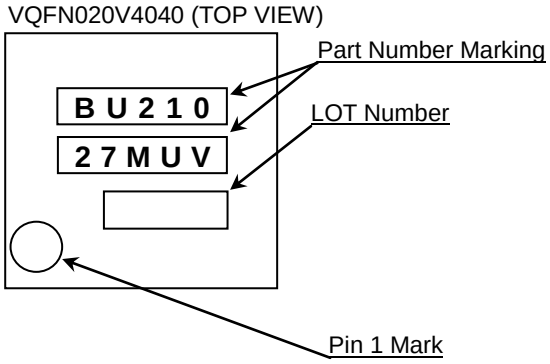
14. Over Current Protection Circuit (OCP)

This IC incorporates an integrated overcurrent protection circuit that is activated when the load is shorted. This protection circuit is effective in preventing damage due to sudden and unexpected incidents. However, the IC should not be used in applications characterized by continuous operation or transitioning of the protection circuit.

Ordering Information



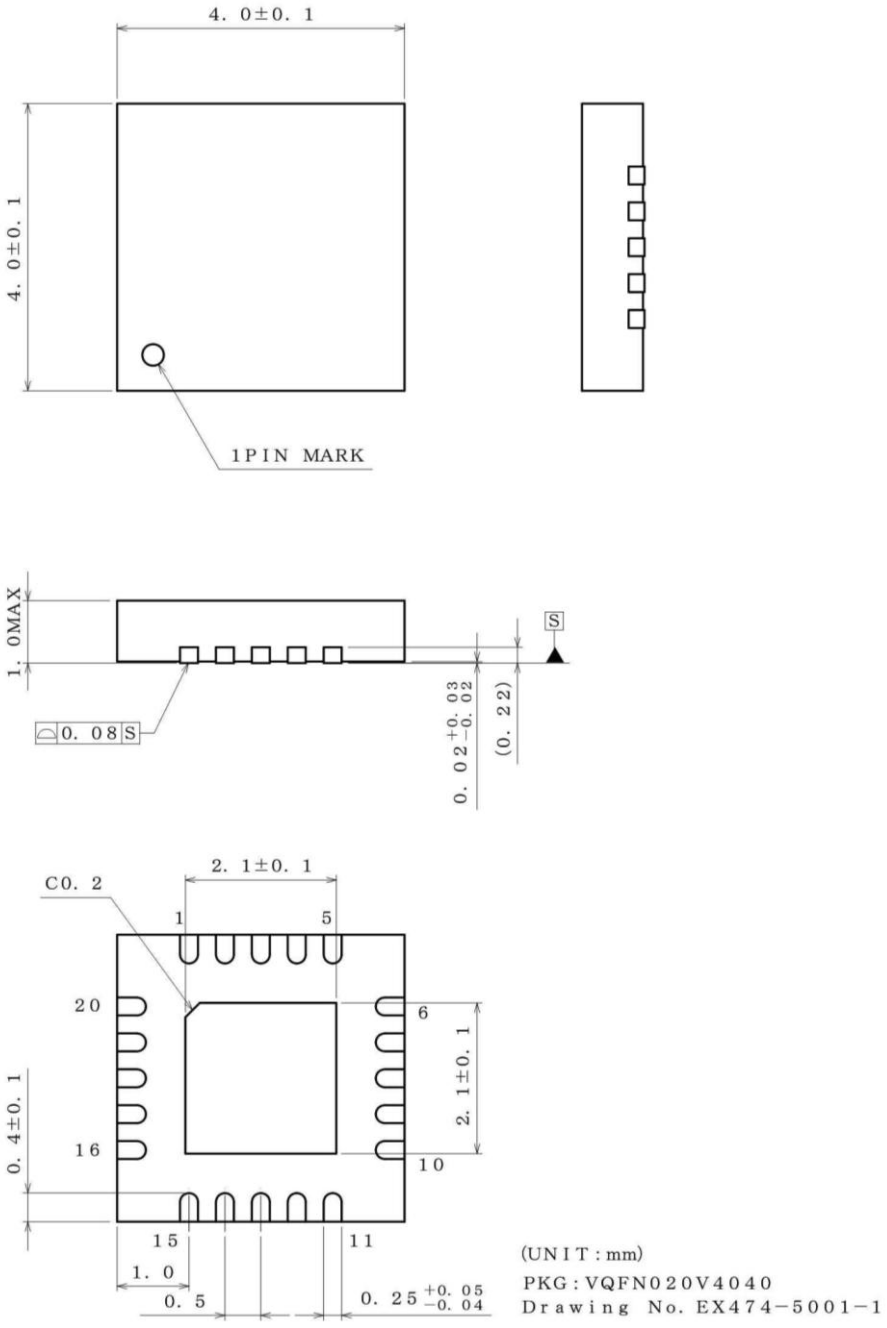
Marking Diagram



Part Number Marking	Package	Orderable Part Number
BU21027MUV	VQFN020V4040	BU21027MUV-E2

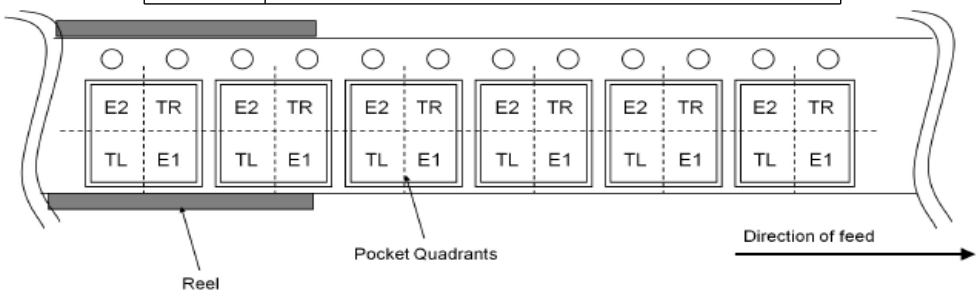
Physical Dimension and Packing Information

Package Name	VQFN020V4040



<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



Revision History

Date	Revision	Changes
04.Jul.2017	001	New Release

Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

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General Precaution

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