Power Management Switch IC Series for PCs and Digital Consumer Product

Power Switch for ExpressCard™

BD4156MUV

No. 09029EAT02

●Description

BD4156MUV is a power management switch IC for the next generation PC card (ExpressCard™) developed by the PCMCIA. It conforms to the PCMCIA ExpressCard™ Standard, ExpressCard™ Compliance Checklist. The power switch offers a number of functions - card detector, and system status detector - which are ideally suited for laptop and desktop computers.

●Features

1) Incorporates three low on-resistance FETs for ExpressCard™.
2) Incorporates an FET for output discharge.
3) Incorporates an enabler.
4) Incorporates under voltage lockout (UVLO) protection.
5) Employs an SSOP-B20 package.
6) Built-in thermal shutdown protector (TSD).
7) Built-in soft start function.
8) Incorporates an overcurrent protection (OCP).
9) Built-in enable signal for PLL
10) Built-in Pull up resistance for detecting ExpressCard™
11) Conforms to the ExpressCard™ Standard.
12) Conforms to the ExpressCard™ Compliance Checklist.
13) Conforms to the ExpressCard™ Implementation Guideline.

●Applications

Laptop and desktop computers, and other ExpressCard™ equipped digital devices.

●Product Lineup

Parameter	BD4156MUV
Package	VQFN020V4040

"ExpressCard™" is a registered trademark registered of the PCMCIA (Personal Computer Memory Card International Association).

●ABSOLUTE MAXIMUM RATINGS

◎BD4156MUV

Parameter	Symbol	Limit	Unit
Input Voltage	V3AUX_IN, V3_IN, V15_IN	-0.3～5.0 *11	V
Logic Input Voltage 1	EN,CPPE#,CPUSB#,SYSR, PERST_IN#,RCLKEN	-0.3～V3AUX_IN+0.3 *11	V
Logic Output Voltage 1	RCLKEN	-0.3～V3AUX_IN+0.3 *11	V
Logic Output Voltage 2	PERST#	-0.3～V3AUX_IN+0.3	V
Output Voltage	V3AUX,V3, V15	-0.3～5.0 *11	V
Output Current 1	IOV3AUX	1.0	A
Output Current 2	IOV3	2.0	A
Output Current 3	IOV15	2.0	A
Power Dissipation 1	Pd1	0.34 *12	W
Power Dissipation 2	Pd2	0.70 *13	W
Operating Temperature Range	Topr	-40～+100	℃
Storage Temperature Range	Tstg	-55～+150	℃
Maximum Junction Temperature	Tjmax	+150	℃

*11 Not to exceed Pd.

*12 Reduced by 2.7mW for each increase in Ta of 1℃ over 25℃

*13 Reduced by 5.6mW for each increase in Ta of 1℃ over 25℃(When mounted on a board 70mm×70mm×1.6mm Glass-epoxy PCB).

●OPERATING CONDITIONS (Ta=25℃)

◎BD4156MUV

Parameter	Symbol	MIN	MAX	Unit
Input Voltage 1	V3AUX_IN	3.0	3.6	V
Input Voltage 2	V3_IN	3.0	3.6	V
Input Voltage 3	V15_IN	1.35	1.65	V
Logic Input Voltage 1	EN	-0.3	3.6	V
Logic Input Voltage 2	CPPE#,CPUSB#,SYSR, PERST_IN#,RCLKEN	0	V3AUX_IN	V
Logic Output Voltage 1	RCLKEN	0	V3AUX_IN	V
Logic Output Voltage 2	PERST#	0	V3AUX_IN	V
Output Current 1	IOV3AUX	0	275	mA
Output Current 2	IOV3	0	1.3	A
Output Current 3	IOV15	0	650	mA

★ This product is not designed to offer protection against radioactive rays.

●ELECTRICAL CHARACTERISTICS (unless otherwise noted, Ta=25℃, VEN=3.3V, V3AUX_IN =V3_IN=3.3V, V15_IN=1.5V)

Parameter	Symbol	Standard Value			Unit	Condition
		MIN	TYP	MAX		
Standby Current	IST	-	40	80	uA	VEN=0V (Include IEN, IRCLKEN)
Bias Current 1	Icc1	-	120	250	uA	VSYSR=0V
Bias Current 2	Icc2	-	250	500	uA	VSYSR=3.3V
[Enable]						
High Level Enable Input Voltage	VENHI	2.0	-	5.5	V	
Low Level Enable Input Voltage	VENLOW	-0.2	-	0.8	V	
Enable Pin Input Current	IEN	10	-	30	uA	VEN=0V
[Logic]						
High Level Logic Input Voltage	VLHI	2.0	-	-	V	
Low Level Logic Input Voltage	VLLOW	-	-	0.8	V	
Logic Pin Input Current	ICPPE#	-	0	1	uA	CPPE#=3.6V
		10	-	30	uA	CPPE#=0V
	ICPUSB#	-	0	1	uA	CPUSB#=3.6V
		10	-	30	uA	CPUSB#=0V
	ISYSR	-	0	1	uA	SYSR=3.6V
		10	-	30	uA	SYSR=0V
	IPRT_IN#	-	0	1	uA	PERST_IN#=3.6V
		10	-	30	uA	PERST_IN#=0V
	IRCLKEN	-	0	1	uA	RCLKEN=3.6V
		10	-	30	uA	RCLKEN=0V
RCLKEN Low Voltage	VRCLKEN	-	0.1	0.3	V	IRCLKEN=0.5mA
RCLKEN Leak Current	IRCLKEN	-	-	1	uA	VRCLKEN=3.65V
[Switch V3AUX]						
On Resistance	R_{V3AUX}	-	120	220	mΩ	Tj=-10～100℃ *
Discharge On Resistance	R_{V3AUX} Dis	-	60	150	Ω	
[Switch V3]						
On Resistance	R_{V3}	-	42	90	mΩ	Tj=-10～100℃ *
Discharge On Resistance	R_{V3}Dis	-	60	150	Ω	
[Switch V15]						
On Resistance	R_{V15}	-	45	90	mΩ	Tj=-10～100℃ *
Discharge On Resistance	R_{V15}Dis	-	60	150	Ω	
[Over Current Protection]						
V3 Over Current	OCP_{V3}	1.3	-	-	A	
V3AUX Over Current	OCP_{V3AUX}	0.275	-	-	A	
V15 Over Current	OCP_{V15}	0.65	-	-	A	
[Under Voltage Lockout]						
V3_IN UVLO OFF Voltage	$VUVLO_{V3\_IN}$	2.60	2.80	3.00	V	sweep up
V3_IN Hysteresis Voltage	$\Delta VUVLO_{V3\_IN}$	50	100	150	mV	sweep down
V3AUX_IN UVLO OFF Voltage	$VUVLO_{V3AUX\_IN}$	2.60	2.80	3.00	V	sweep up
V3AUX_IN Hysteresis Voltage	$\Delta VUVLO_{V3AUX\_IN}$	50	100	150	mV	sweep down
V15_IN UVLO OFF Voltage	$VUVLO_{V15\_IN}$	1.10	1.20	1.30	V	sweep up
V15_IN Hysteresis Voltage	$\Delta VUVLO_{V15\_IN}$	50	100	150	mV	sweep down
[POWER GOOD]						
V3 POWER GOOD Voltage	PG_{V3}	2.700	2.850	3.000	V	
V3AUX POWER GOOD Voltage	PG_{V3AUX}	2.700	2.850	3.000	V	
V15 POWER GOOD Voltage	PG_{V15}	1.200	1.275	1.350	V	
PERST# LOW Voltage	$VPERST\#_{Low}$	-	0.1	0.3	V	I_{PERST}=0.5mA
PERST# HIGH Voltage	$VPERST\#_{HIGH}$	3.0	-	-	V	
PERST# Delay Time	$T_{PERST\#}$	4	-	20	ms	
PERST# assertion time	Tast	-	-	500	ns	
[OUTPUT RISE TIME]						
V3_IN to V3	T_{V3}	0.1	-	3	ms	
V3AUX_IN to V3AUX	T_{V3AUX}	0.1	-	3	ms	
V15_IN to V15	T_{V15}	0.1	-	3	ms	

* Design target

●Reference data

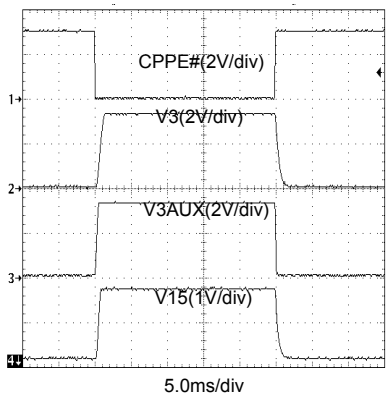


Fig.1 Card Assert/ De-assert (Active)

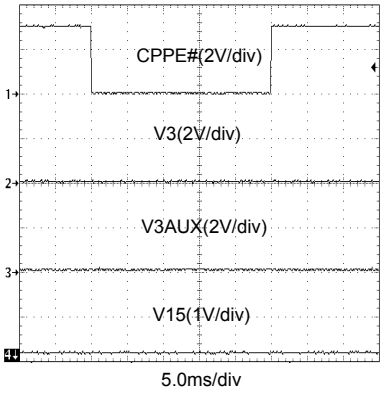


Fig.2 Card Assert/De-assert (Standby)

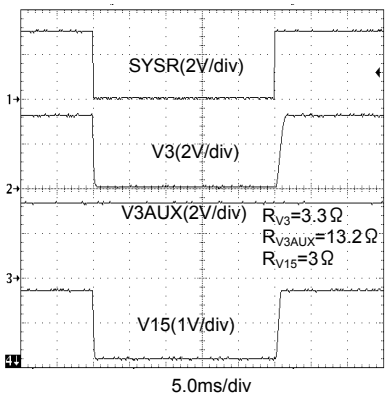


Fig.3 System Active ⇔Standby(Card Present)

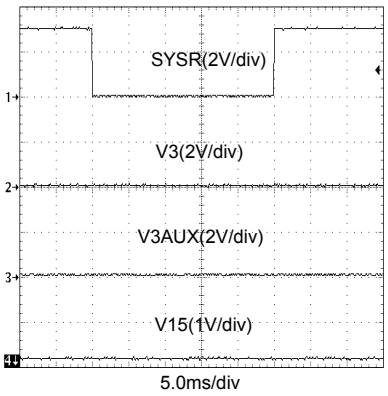


Fig.4 System Active ⇔Standby(No Card)

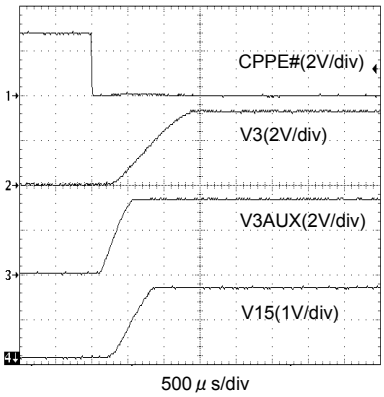


Fig.5 Wakeup Wave Form (Card Assert)

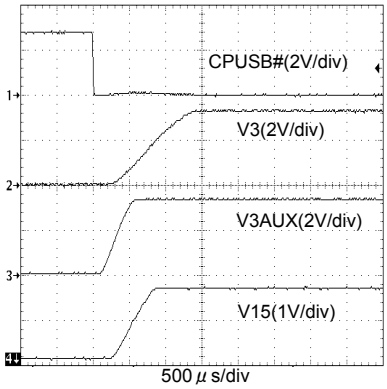


Fig.6 Wakeup Wave Form (USB2.0 Assert)

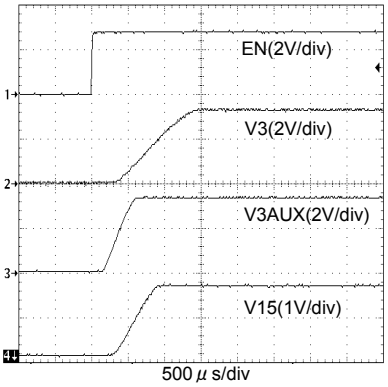


Fig.7 Wakeup Wave Form (Shut Down→Active)

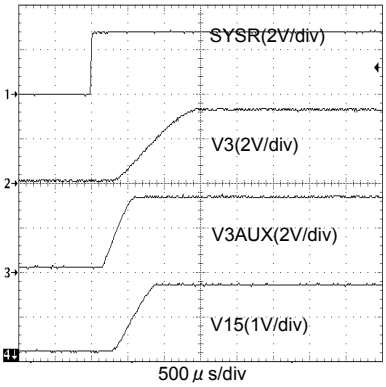


Fig.8 Wakeup Wave Form (Standby→Active)

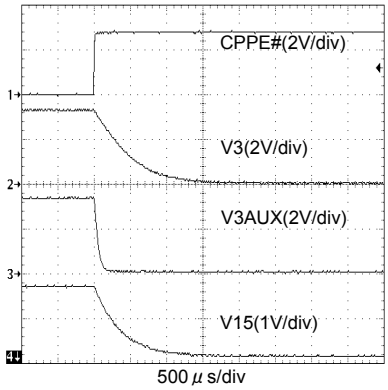


Fig.9 Power Down Wave Form (Card De-assert)

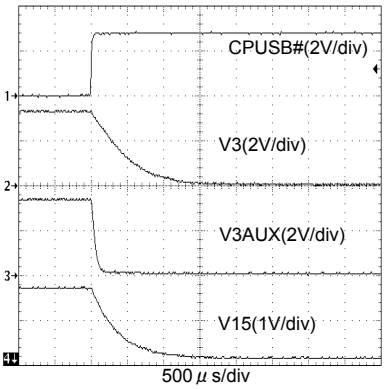


Fig.10 Power Down Wave Form (USB2.0 De-assert)

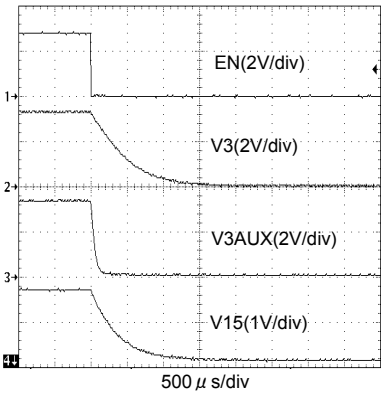


Fig.11 Power Down Wave Form (Active→Shut Down)

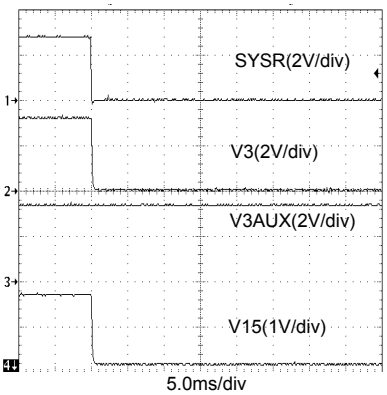


Fig.12 Power Down Wave Form (Active→Standby)

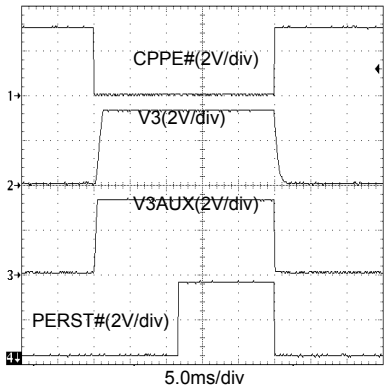


Fig.13 PERST# Wave Form
(Card Assert/ De-assert)

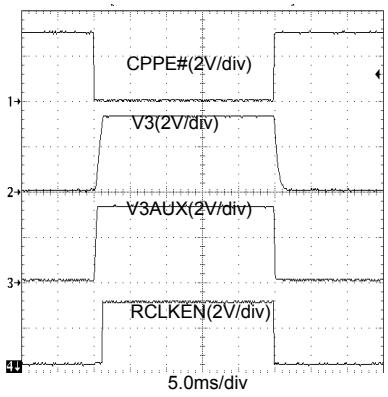


Fig.14 RCLKEN Wave Form
(Card Assert/ De-assert)

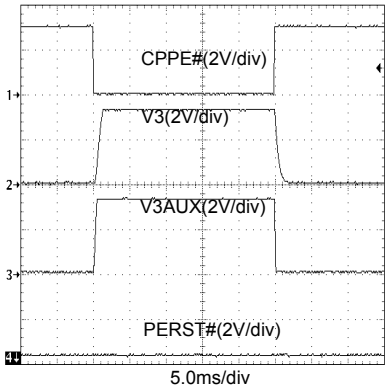


Fig.15 PERST# Wave Form
(USB2.0 Assert/ De-assert)

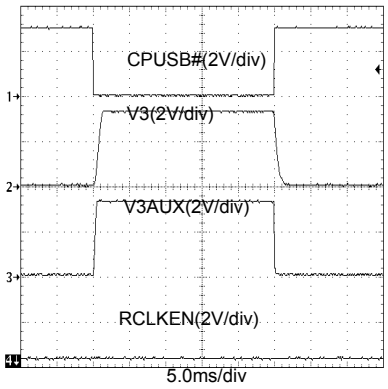


Fig.16 RCLKEN Wave Form
(USB2.0 Assert/ De-assert)

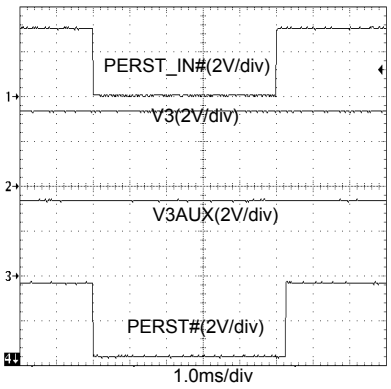


Fig.17 PERST# Wave Form
(PERST_IN# Input)

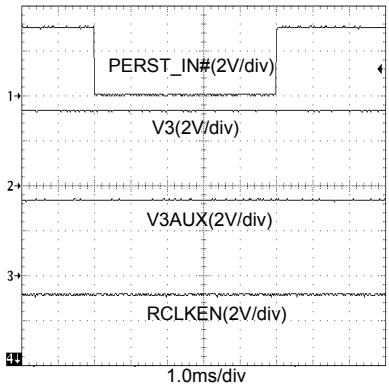


Fig.18 RCLKEN Wave Form
(PERST_IN# Input)

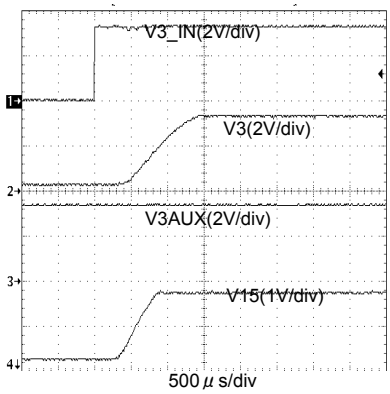


Fig.19 Output Voltage
(V3_IN:OFF→ON)

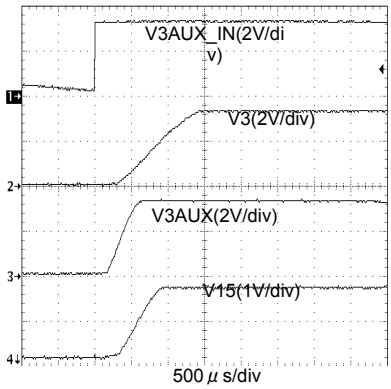


Fig.20 Output Voltage
(V3AUX_IN:OFF→ON)

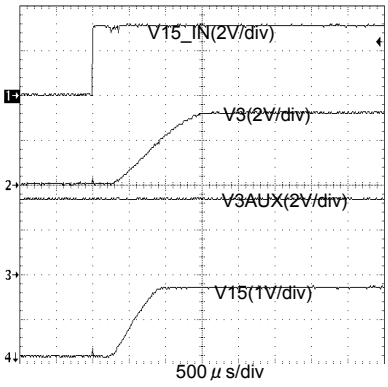


Fig.21 Output Voltage
(V15_IN:OFF→ON)

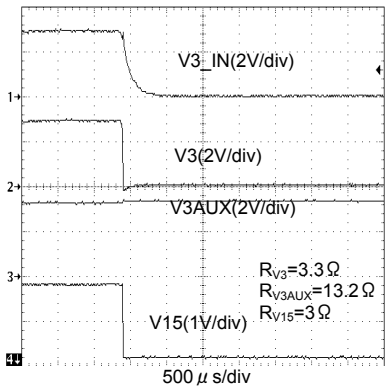


Fig.22 Output Voltage
(V3_IN:ON→OFF)

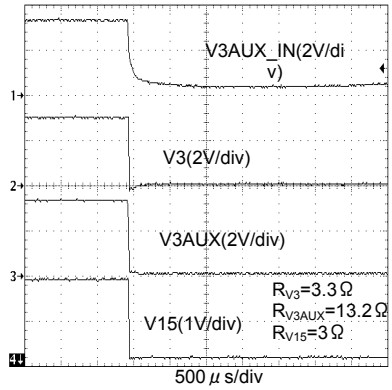


Fig.23 Output Voltage
(V3AUX_IN:ON→OFF)

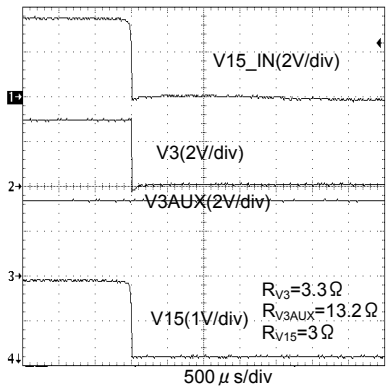
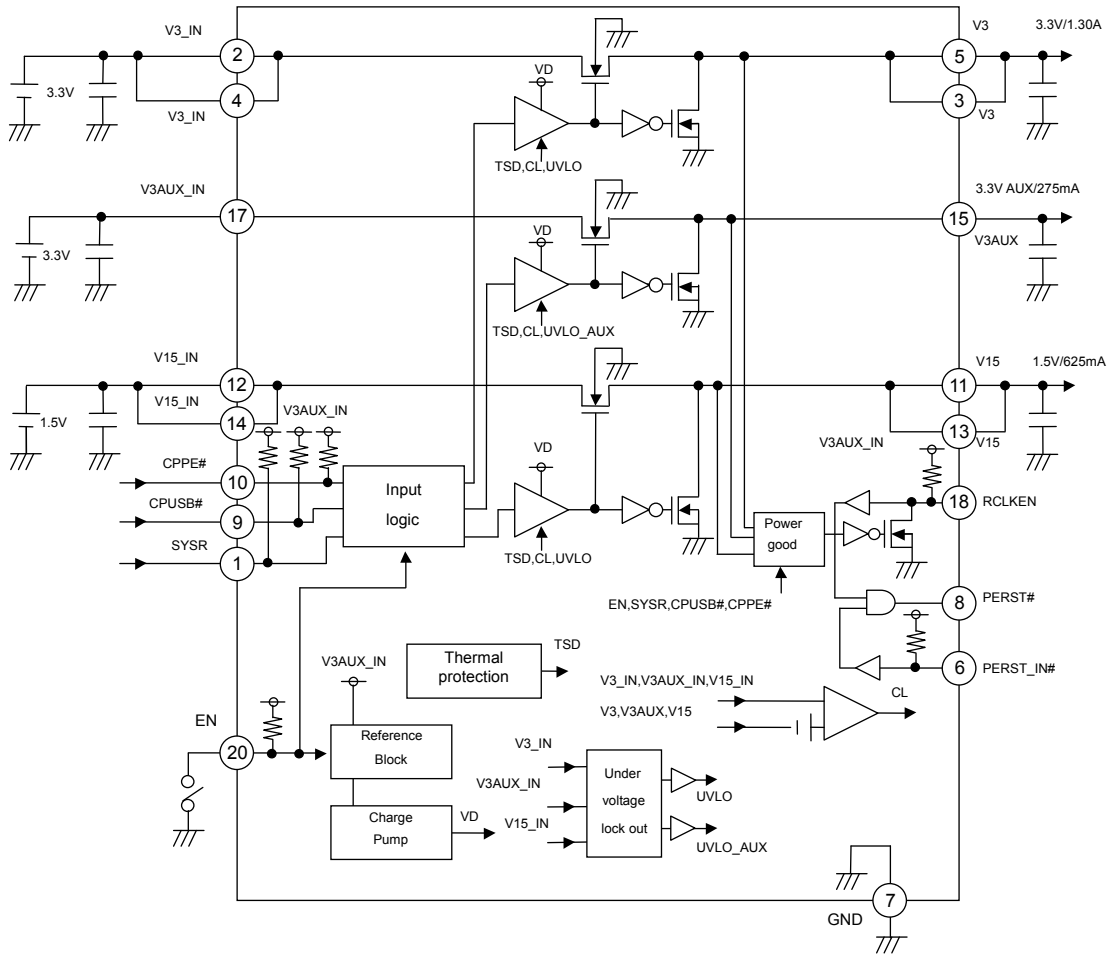
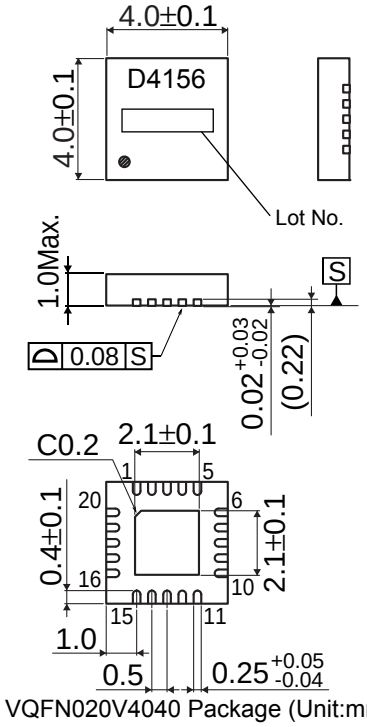


Fig.24 Output Voltage
(V15_IN:ON→OFF)

●BLOCK DIAGRAM



●PHYSICAL DIMENSIONS



VQFN020V4040 Package (Unit:mm)

●PIN FUNCTION

PIN No	PIN NAME	PIN FUNCTION
1	SYSR	Logic input pin
2	V3_IN	V3 input pin
3	V3	V3 output pin
4	V3_IN	V3 input pin
5	V3	V3 output pin
6	PERST_IN#	PERST# control input pin (SysReset#)
7	GND	GND pin
8	PERST#	Logic output pin
9	CPUSB#	Logic input pin
10	CPPE#	Logic input pin
11	V15	V15 output pin
12	V15_IN	V15 input pin
13	V15	V15 output pin
14	V15_IN	V15 input pin
15	V3AUX	V3AUX output pin
16	TEST	Test pin
17	V3AUX_IN	V3AUX input pin 1
18	RCLKEN	Reference clock enable signal / Power good signal (No delay)
19	N.C.	Must be open or GND.
20	EN	Enable input pin

●Description of block operation

EN

With an input of 2.0 volts or higher, this terminal goes HIGH to activate the circuit, and goes LOW to deactivate the circuit (with the standby circuit current of 40 μA), It discharges each output and lowers output voltage when the input falls to 0.8 volts or less.

V3_IN, V15_IN, and V3AUX_IN

These are the input terminals for each channel of a 3ch switch. V3_IN and V15_IN terminals have two pins each, which should be short-circuited on the pc board with a thick conductor. A large current runs through these three terminals : (V3_IN: 1.35A; V3AUX_IN: 0.275 A; and V15_IN: 0.625 A). In order to lower the output impedance of the connected power supply, it is recommended that ceramic capacitors (with B-type characteristics or better) be provided between these terminals and the ground. Specifically, the capacitors should be on the order of 1 μF between V3_IN and GND, and between V15_IN and GND; and on the order of 0.1 μF between V3AUX_IN and GND.

V3, V15, and V3AUX

These are the output terminals for each switch. The V3 and V15 terminals have two pins each, which should be short-circuited on the PC board and connected to an ExpressCard connector with a thick conductor, as short as possible. In order to stabilize the output, it is recommended that ceramic capacitors (with B-type characteristics or better) be provided between these terminals and the ground. Specifically, the capacitors should be on the order of 10 μF between V3 and GND, and between V15 and GND; and on the order of 1 μF between V3AUX and GND.

CPPE#

This pin is used to find whether or not a PCI-Express signal compatible card is present. Turns to “High” level with an input of 2.0 volts or higher, which means that no card is provided, while it turns to “Low” level when the input is lowered to 0.8 volts or less, which means that a card is provided. Controls the ON/OFF, switch selecting the proper mode based on the status of the system.Pull up resistance (100kΩ～200kΩ) is built into, so the number of components is reduced.

CPUSB#

This pin is used to find whether or not a USB2.0 signal compatible card is present. Turns to “High” level with an input of 2.0 volts or higher, which means that no card is provided, while it turns to “Low” level when the input is lowered to 0.8 volts or less, which means that a card is provided. Controls the ON/OFF switch, selecting the proper mode based on the system status. Pull up resistance (100kΩ～200kΩ) is built into, so the number of components is reduced.

SYSR

This pin is used to detect the system status. Turns to “High” level with an input of 2.0 volts or higher, which means that the system is activated, while it turns to “Low” level when the input is lowered to 0.8 volts or less, which means that the system is on standby.

PERST_IN#

This pin is used to control the reset signal (PERST#) to a card from the system side. (Also referred to as “SysReset#” by PCMCIA.) Turns to “High” level with an input of 2.0 volts or higher, and sets PERST# to “High” AND with a “Power Good” output. Turns to “Low” level and sets PERST# to “Low” when the input falls to 0.8 volts or less.

PERST#

This pin is used to send a reset signal to a PCI-Express compatible card. Reset status is determined by the outputs, PERST_IN#, CPPE# system status, and EN on/off status. Turns to “High” level and activates the PCI-Express compatible card only if each output is within the “Power Good” threshold, with the card inserted and PERST_IN# turned to “High” level.

RCLKEN

This pin is used to send an enable signal to the reference clock. Activation status is determined by the outputs, CPPE# system status, and EN on/off status. Turns to “High” level and activates the reference clock PLL only if each output is within the “Power Good” threshold, with the card kept inserted.

TEST

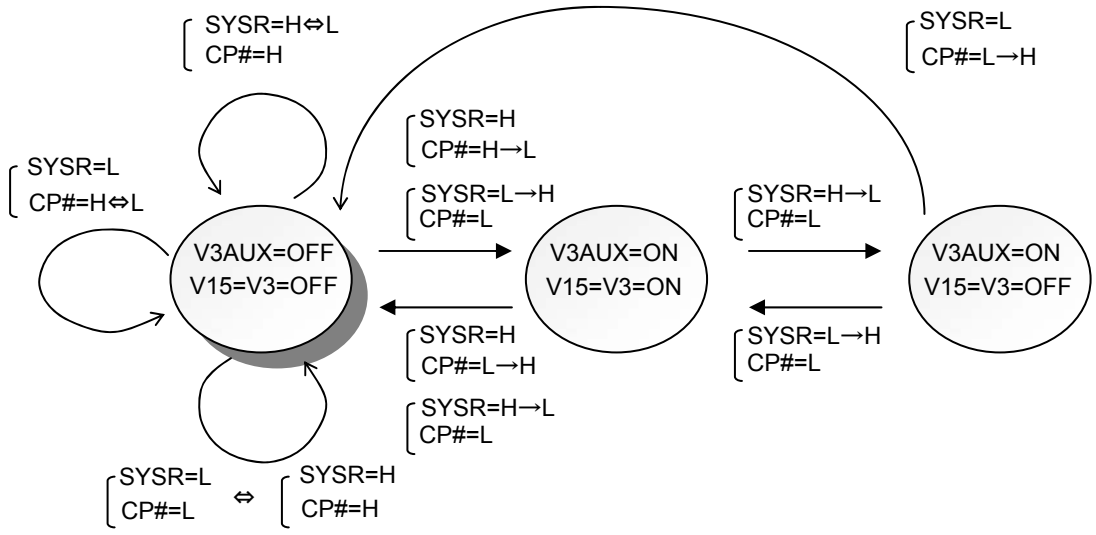
This pin is used to test, which should be short-circuited to the GND. When it is short-circuited to V3AUX_IN, UVLO (V3_IN, V15_IN) turns OFF.

●TIMING CHART

Power ON/OFF Status of ExpressCard™

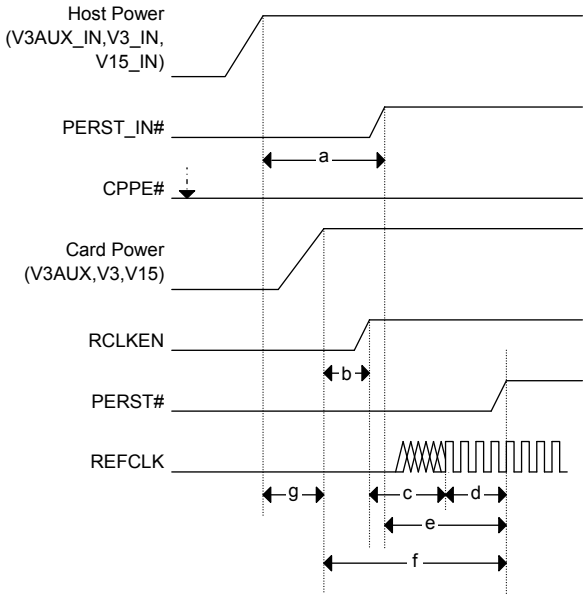
System Status		ExpressCard™ Module Status	Power Switch Status	
Primary	Auxiliary		Primary (+3.3V and +1.5V)	Auxiliary (3.3V Aux)
OFF	OFF	Don't care	OFF	OFF
ON	ON	De-asserted	OFF	OFF
		Asserted	ON	ON
ON	ON	De-asserted	OFF	OFF
		Asserted Before This	OFF	ON
		Asserted After This	OFF	OFF

ExpressCard™ States Transition Diagram



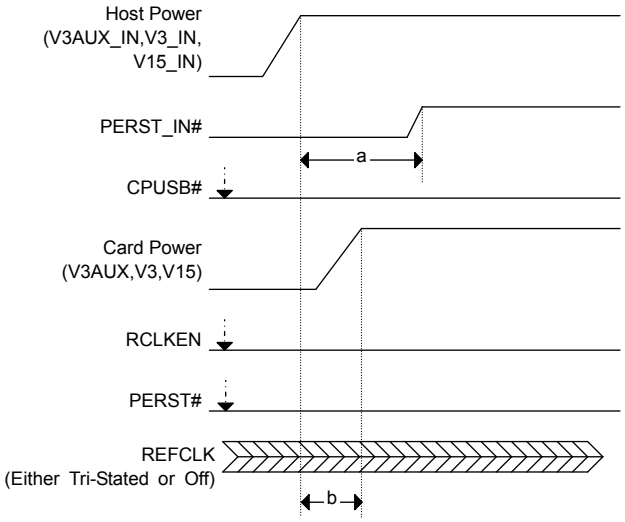
System Status		Card Status	
Stand-by Status	:SYSR=L	Card Asserted Status	:CP#=L
ON Status	:SYSR=H	Card De-asserted Status	:CP#=H
From ON to Stand-by Status	:SYSR=H→L	From De-asserted to Asserted Status	:CP#=H→L
From Stand-by to ON Status	:SYSR=L→H	From Asserted to De-asserted Status	:CP#=L→H

●EXPRESS CARD TIMING DIAGRAMS



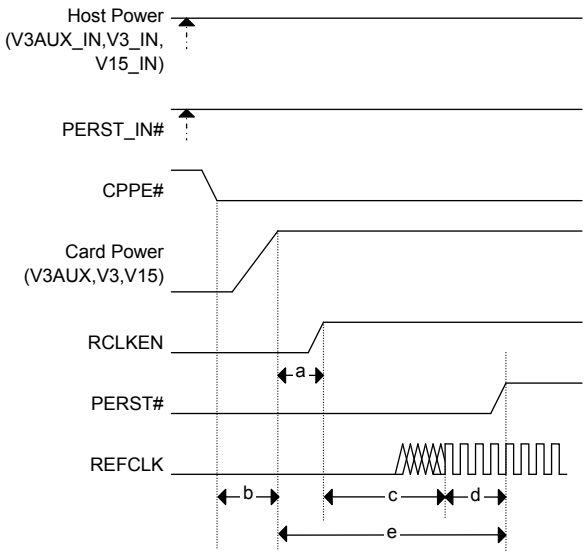
Timing Signals-Card Present Before Host Power is On

Tpd	Min	Max	Units
a	System Dependent		
b	-	100	us
c	System Dependent		
d	System Dependent		
e	100	-	us
f	4	20	ms
g	-	10	ms



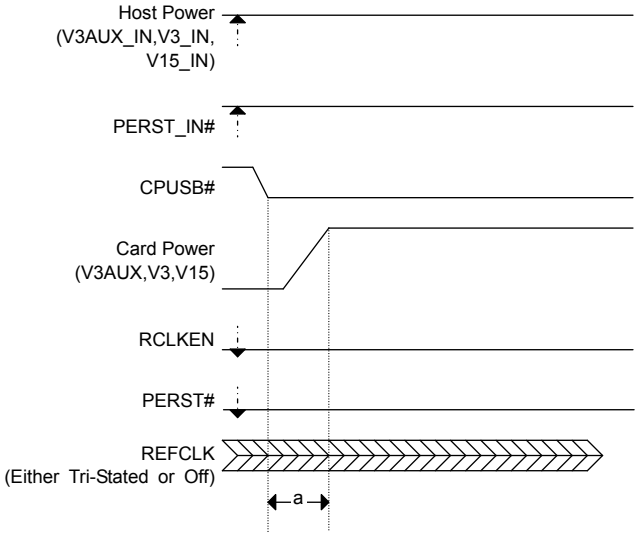
Timing Signals-USB Present Before Host Power is On

Tpd	Min	Max	Units
a	System Dependent		
b	-	10	ms



Tpd	Min	Max	Units
a	-	100	us
b	-	10	ms
c	System Dependent		
d	System Dependent		
e	4	10	ms

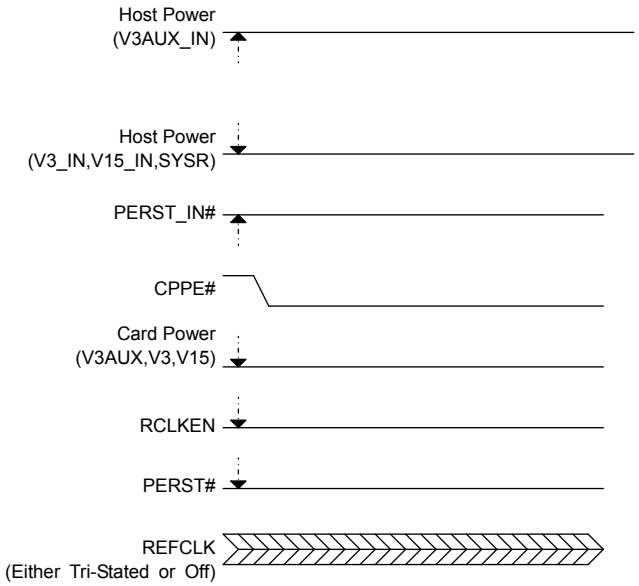
Timing Signals Host Power is On Prior to Card Insertion



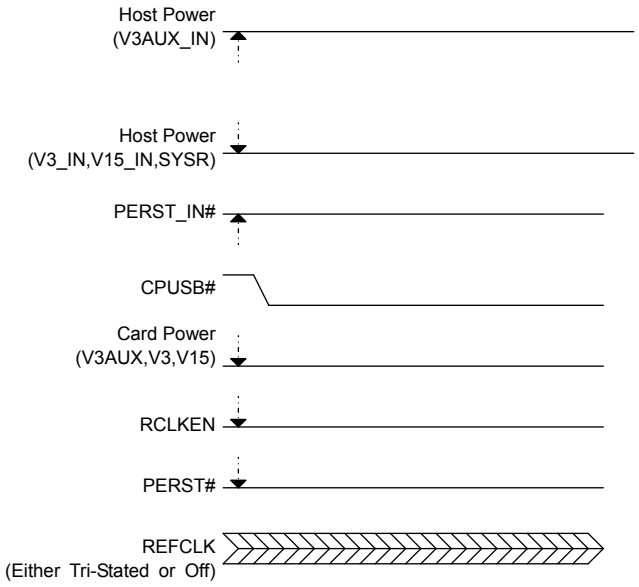
Tpd	Min	Max	Units
a	-	10	ms

Timing Signals Host Power is On Prior to USB Insertion

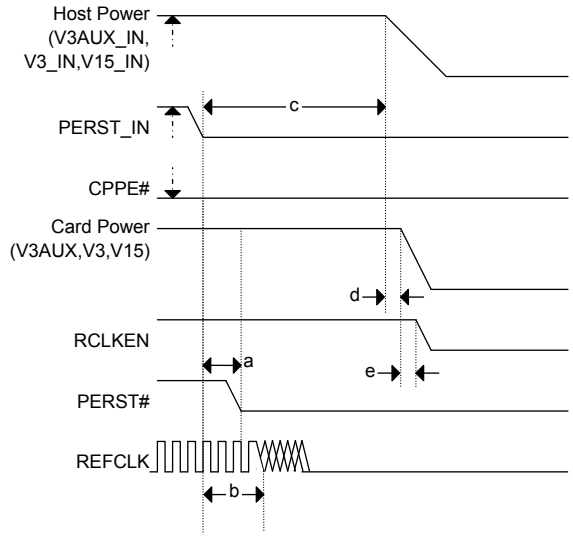
●APPLICATION INFORMATION (continued)



Timing Signals-Host System In Standby Prior to Card Insertion

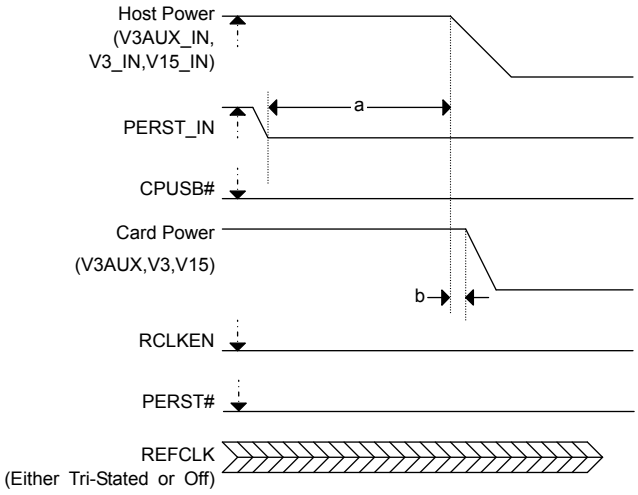


Timing Signals-Host System In Standby Prior to USB Insertion



Tpd	Min	Max	Units
a	-	2	us
b	System Dependent		
c	System Dependent		
d	Load Dependent		
e	-	2	us

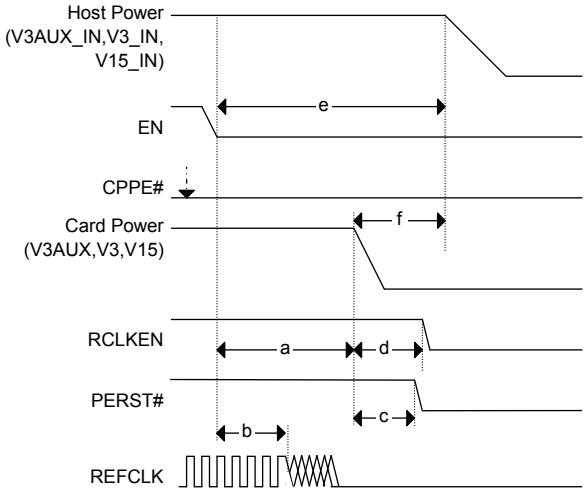
Timing Signals Host Controlled Power Down



Tpd	Min	Max	Units
a	System Dependent		
b	Load Dependent		

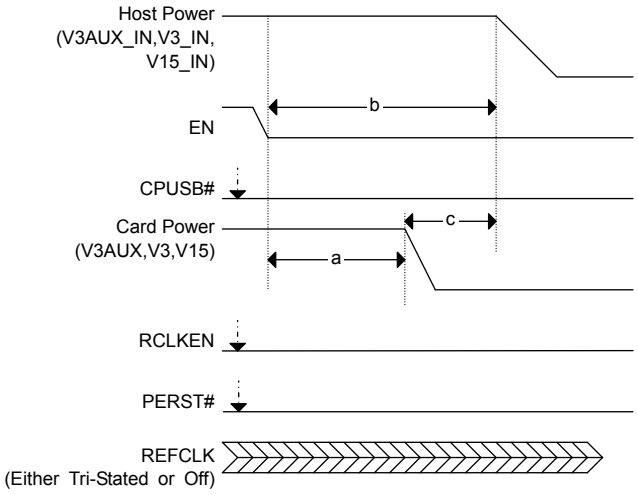
Timing Signals Host Controlled Power Down

●APPLICATION INFORMATION (continued)



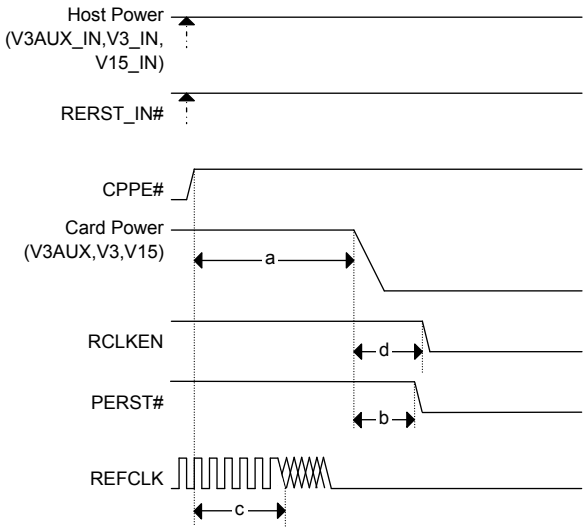
Tpd	Min	Max	Units
a	Load Dependent		
b	System Dependent		
c	-	500	ns
d	-	2	us
e	System Dependent		
f	System Dependent		

Timing Signals Controlled Power Down When EN Asserted



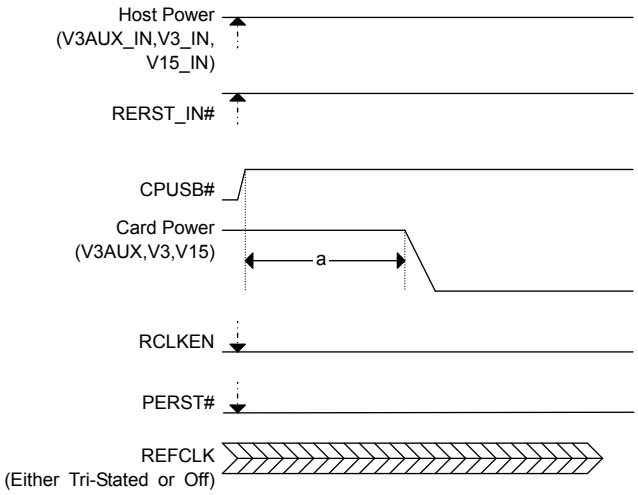
Tpd	Min	Max	Units
a	Load Dependent		
b	System Dependent		
c	System Dependent		

Timing Signals Controlled Power Down When EN Asserted



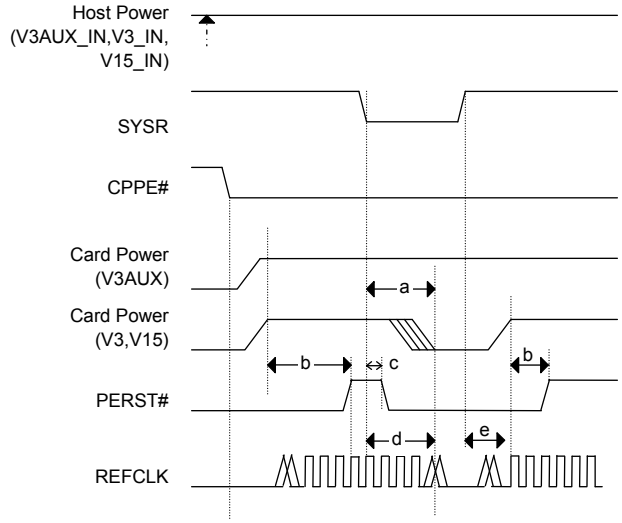
Timing Signals-Surprise Card Removal

Tpd	Min	Max	Units
a	Load Dependent		
b	-	500	ns
c	System Dependent		
d	-	2	us



Timing Signals-Surprise USB Removal

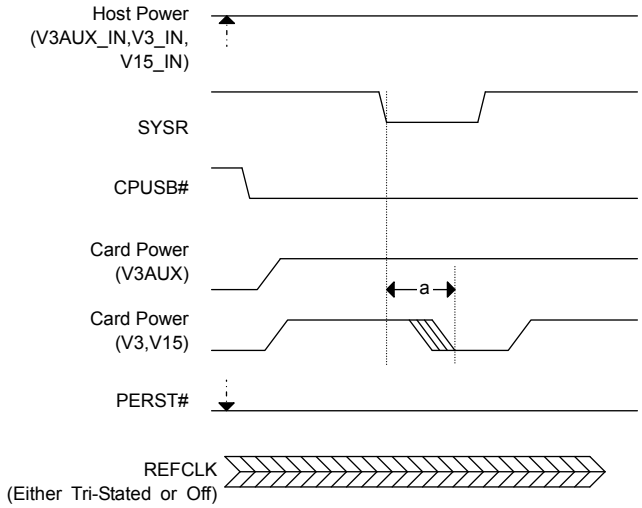
Tpd	Min	Max	Units
a	Load Dependent		



RCLKEN=OPEN, PERST_IN=3.3V,EN=3.3V

Tpd	Min	Max	Units
a	System Dependent		
b	4	20	ms
c	-	2	us
d	System Dependent		
e	System Dependent		

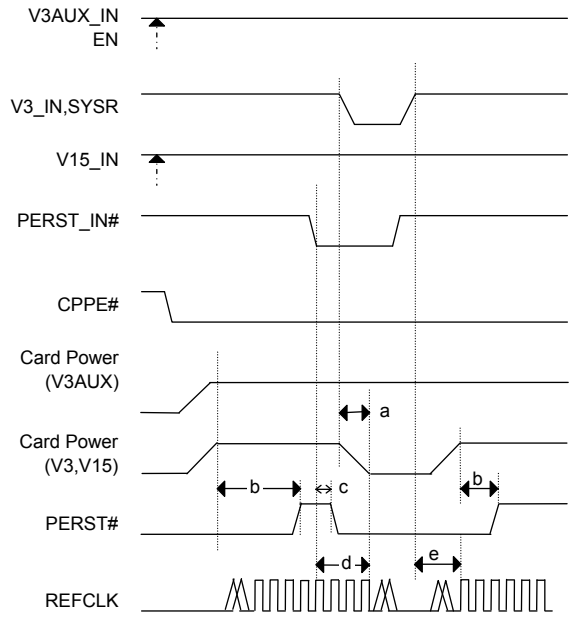
Timing Signals Power state transitions (Signal applies for SYSR)



RCLKEN=OPEN, PERST_IN=3.3V,EN=3.3V

Tpd	Min	Max	Units
a	System Dependent		

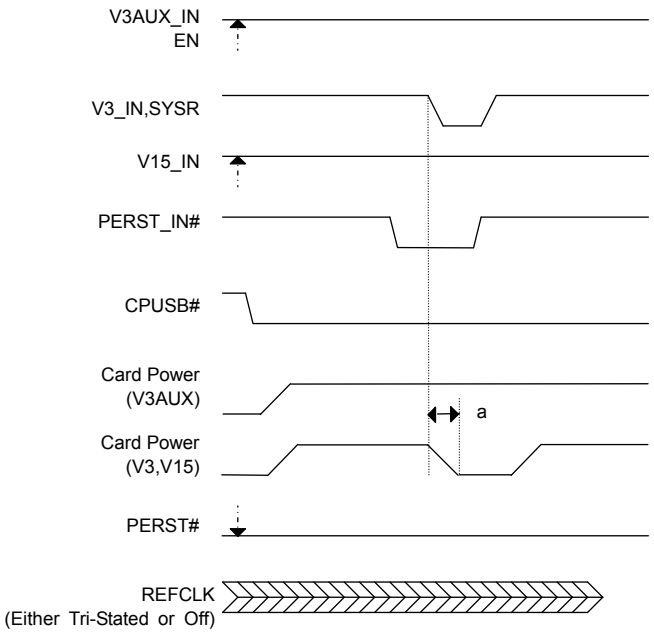
Timing Signals Power state transitions (Signal applies for SYSR)



Tpd	Min	Max	Units
a	System Dependent		
b	4	20	ms
c	-	2	us
d	System Dependent		
e	System Dependent		

RCLKEN=OPEN, PERST_IN# is asserted in advance of power changes.

Timing Signals – Power state transitions
(SYSR and EN are connected to V3_IN/V3AUX_IN.)

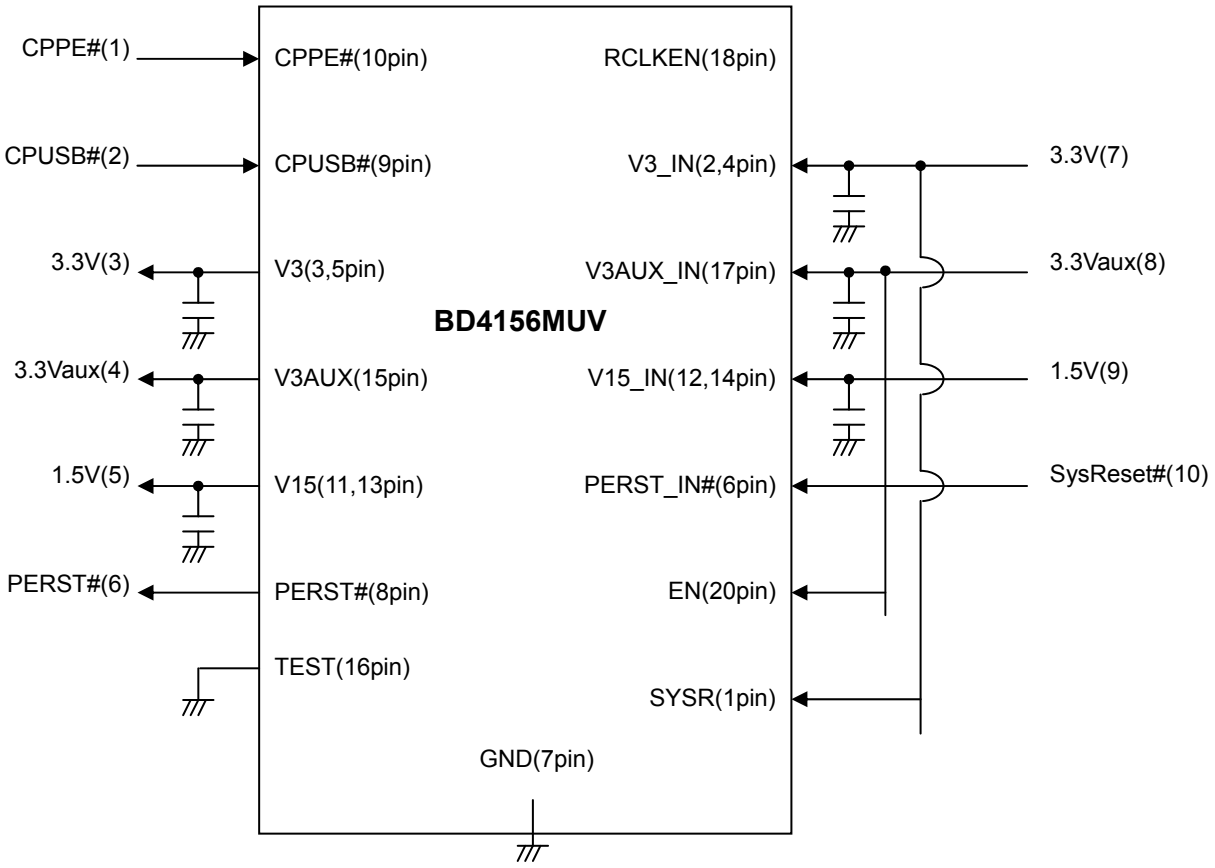


Tpd	Min	Max	Units
a	System Dependent		

RCLKEN=OPEN, PERST_IN# is asserted in advance of power changes.

Timing Signals – Power state transitions
(SYSR and EN are connected to V3_IN/V3AUX_IN.)

●APPLICATION CIRCUIT (CIRCUIT for ExpressCard™ Compliance Checklist)



●Heat loss

Thermal design should allow the device to operate within the following conditions. Note that the temperatures listed are the allowed temperature limits. Thermal design should allow sufficient margin from these limits.

1. Ambient temperature Ta can be no higher than 100°C.
2. Chip junction temperature Tj can be no higher more than 150°C.

Chip junction temperature Tj can be determined as follows:

①Chip junction temperature Tj is calculated from IC surface temperature TC under actual application conditions:

Tj=TC+ θ j-c × W

<Reference value>

θ j-c:VQFN020V4040 **°C/W

②Chip junction temperature Tj is calculated from ambient temperature Ta:

Tj=TC+ θ j-a × W

<Reference value>

θ j-a:VQFN020V4040 **°C/W (IC only)

**°C/W Single-layer substrate

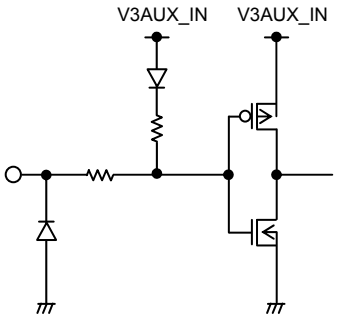
(substrate surface copper foil area: less than 3%)

Substrate size 70 × 70 × 1.6mm^3 (thermal vias in the board.)

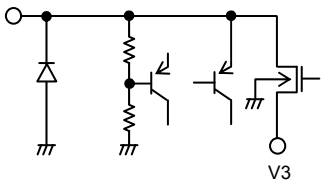
Most of heat loss in the BD4156MUV occurs at the output switch. The power lost is determined by multiplying the on-resistance by the square of output current of each switch.

●EQUIVALENT CIRCUIT

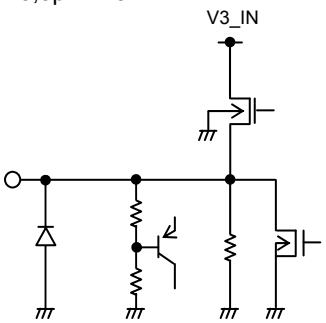
1pin<SYSR>



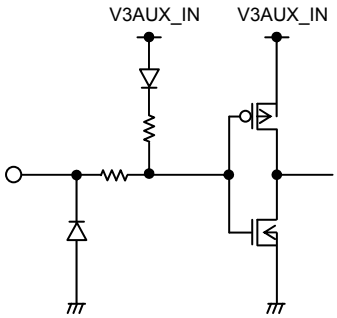
2,4pin<V3_IN>



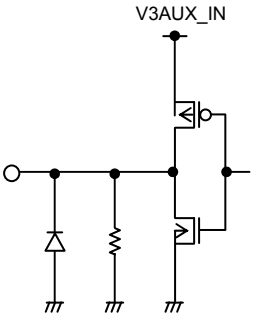
3,5pin<V3>



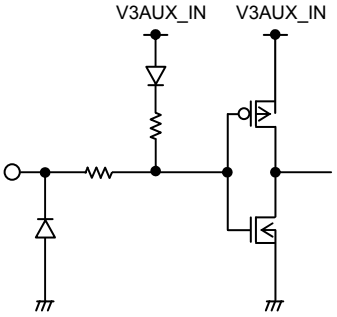
6pin<PERST_IN#>



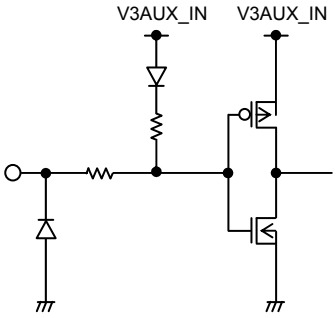
8pin<PERST#>



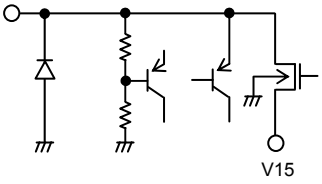
9pin<CPUSB#>



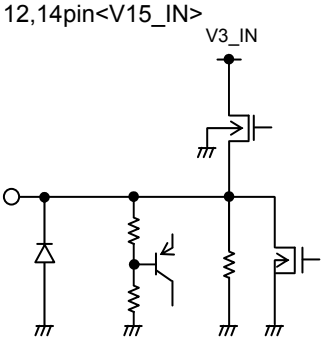
10pin<CPPE#>



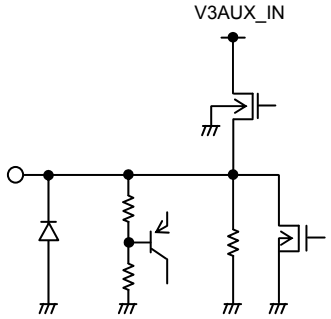
11,13pin<V15>



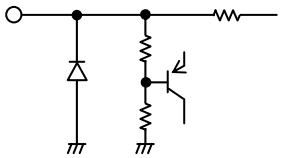
12,14pin<V15_IN>



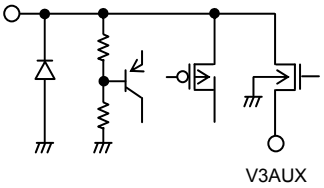
15pin<V3AUX>



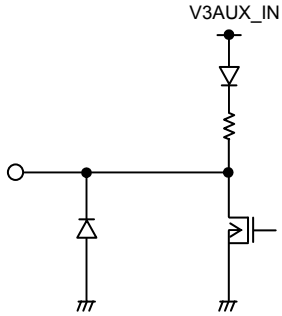
16pin<TEST>



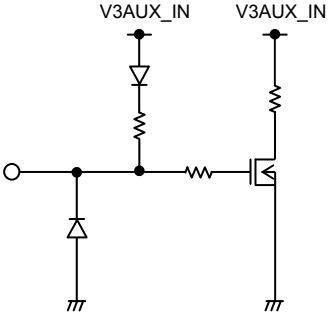
17pin<V3AUX_IN>



18pin<RCLKEN >



20pin<EN>



●USE NOTES

1.Absolute maximum ratings

Although quality is rigorously controlled, the device may be destroyed when applied voltage, operating temperature, etc. exceeds its absolute maximum rating. Because the source (short mode or open mode) cannot be identified once the IC is destroyed, it is important to take physical safety measures such as fusing when implementing any special mode that operates in excess of absolute rating limits.

2.Thermal design

Consider allowable loss (Pd) under actual operating conditions and provide sufficient margin in the thermal design.

3.Terminal-to-terminal short-circuit and mis-mounting

When the mounting the IC to a printed circuit board, take utmost care to assure the position and orientation of the IC are correct. In the event that the IC is mounted erroneously, it may be destroyed. The IC may also be destroyed when a short-circuit is caused by foreign matter introduced into the clearance between outputs, or between an output and power-GND.

4.Operation in strong electromagnetic fields

Using the IC in strong electromagnetic fields may cause malfunctions. Exercise caution in respect to electromagnetic fields.

5.Built-in thermal shutdown protection circuit

This IC incorporates a thermal shutdown protection circuit (TSD circuit). The working temperature is 175°C (standard value) with a -15°C (standard value) hysteresis width. When the IC chip temperature rises the TSD circuit is activated, while the output terminal is brought to the OFF state. The built-in TSD circuit is intended exclusively to shut down the IC in a thermal runaway event, and is not intended to protect the IC or guarantee performance in these conditions. Therefore, do not operate the IC after with the expectation of continued use or subsequent operation once this circuit is activated.

6.Capacitor across output and GND

When a large capacitor is connected across the output and GND, and the V3AUX_IN is short-circuited with 0V or GND for any reason, current charged in the capacitor flows into the output and may destroy the IC. Therefore, use a capacitor smaller than 1000 μF between the output and GND.

7.Set substrate inspection

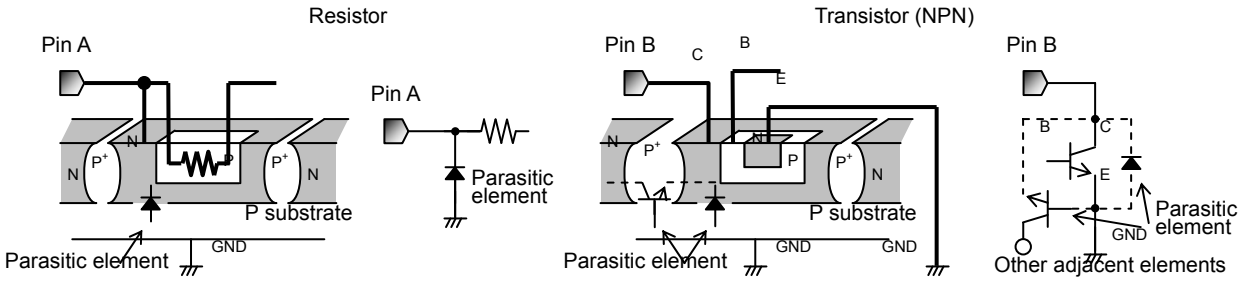
Connecting a low-impedance capacitor to a pin when running an inspection with a set substrate may produce stress on the IC. Therefore, be certain to discharge electricity at each process of the operation. To prevent electrostatic accumulation and discharge in the assembly process, thoroughly ground yourself and any equipment that could sustain ESD damage, and continue observing ESD-prevention procedures in all handling, transfer and storage operations. Before attempting to connect the set substrate to the test setup, make certain that the power supply is OFF. Likewise, be sure the power supply is OFF before removing the substrate from the test setup.

8.IC terminal input

This integrated circuit is a monolithic IC, with P substrate and P^+ isolation between elements.

The P layer and N layer of each element form a, PN junction. When the potential relation is GND>terminal A>terminal B, the PN junction works as a diode, and when terminal B>GND terminal A, the PN junction operates as a parasitic transistor.

Parasitic elements inevitably form, due to the nature of the IC construction. The operation of the parasitic element gives rise to mutual interference between circuits and results in malfunction, and eventually, breakdown. Consequently, take utmost care not to use the IC in a way that would cause the parasitic element to actively operate, such as applying voltage lower than GND (P substrate) to the input terminal.



9. GND wiring pattern

If both a small signal GND and a high current GND are present, it is recommended that the patterns for the high current GND and the small signal GND be separated. Proper grounding to the reference point of the set should also be provided. In this way, the small signal GND voltage will by unaffected by the change in voltage stemming from the pattern wiring resistance and the high current. Also, pay special attention to avoid undesirable wiring pattern fluctuations in any externally connected GND component.

10. Electrical characteristics

The electrical characteristics in the Specifications may vary, depending on ambient temperature, power supply voltage, circuit(s) externally applied, and/or other conditions. Therefore, please check all such factors, including transient characteristics, that could affect the electrical characteristics.

11. Capacitors applied to input terminals

The capacitors applied to the input terminals (V3_IN, V3AUX_IN and V15_IN) are used to lower the output impedance of the connected power supply. An increase in the output impedance of the power supply may result in destabilization of input voltages (V3_IN, V3AUX_IN and V15_IN). It is recommended that a low-ESR capacitor be used, with a lower temperature coefficient (change in capacitance vs. change in temperature), Recommended capacitors are on the order of 0.1 μF for V3AUX_IN, and1 μF for V3_IN and V15_IN. However, they must be thoroughly checked at the temperature and with the load range expected in actual use, because capacitor selection depends to a significant degree on the characteristics of the input power supply to be used and the conductor pattern of the PC board.

12. Capacitors applied to output terminals

Capacitors for the output terminals (V3, V3_AUX, and V15), should be connected between each of the output terminals and GND. A low-ESR, low temperature coefficient output capacitor is recommended-on the order of 1 μF for V3 and V15 terminals, and 1μF less for V3_AUX. However, they must be thoroughly checked at the temperature and with the load range expected in actual use, because capacitor selection depends to a significant degree on the temperature and the load conditions.

13. Not of a radiation-resistant design.

14. Allowable loss (Pd)

With respect to the allowable loss, please refer to the thermal derating characteristics shown in the Exhibit, which serves as a rule of thumb. When the system design causes the IC to operate in excess of the allowable loss, chip temperature will rise, reducing the current capacity and decreasing other basic IC functionality. Therefore, design should always enable IC operation within the allowable loss only.

15. Operating range

Basic circuit functions and operations are warranted within the specified operating range the working ambient temperature range. Although reference values for electrical characteristics are not warranted, no rapid or extraordinary changes in these characteristics are expected, provided operation is within the normal operating and temperature range.

16. The applied circuit example diagrams presented here are recommended configurations. However, actual design depends on IC characteristics, which should be confirmed before operation. Also, note that modifying external circuits may impact static, noise and other IC characteristics, including transient characteristics. Be sure to allow sufficient margin in the design to accommodate these factors.

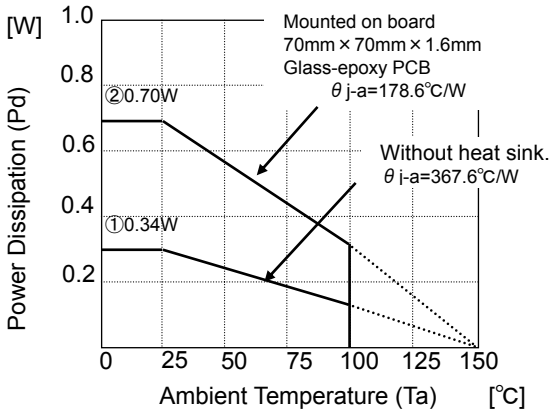
17. Wiring to the input terminals (V3 IN, V3AUX IN, and V15 IN) and output terminals (V3, V3AUX and V15) of the built-in FET should be carried out with special care. Using unnecessarily long and/or thin conductors may decrease output voltage and degrade other characteristics.

18. Heatsink

The heatsink is connected to the SUB, which should be short-circuited to the GND. Proper heatsink soldering to the PC board should enable lower thermal resistance.

●POWER DISSIPATION

◎BD4156MUV



● **Ordering part number**

B	D	4	1	5	6	M	U	V	-	E	2

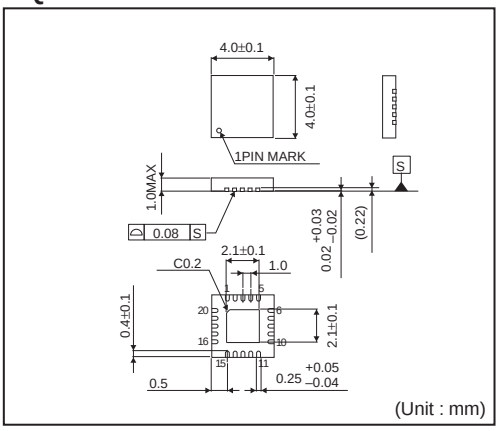
Part No. (BD)

Part No. (4156)

Package
MUV: VQFN020V4040

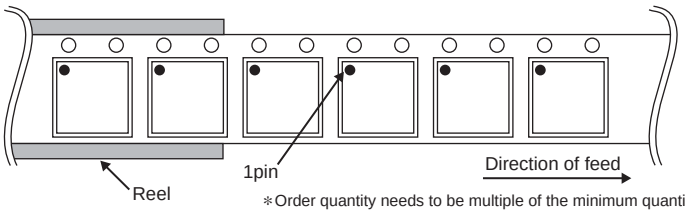
Packaging and forming specification
E2: Embossed tape and reel

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)



∗Order quantity needs to be multiple of the minimum quantity.

Notes

No copying or reproduction of this document, in part or in whole, is permitted without the consent of ROHM Co.,Ltd.

The content specified herein is subject to change for improvement without notice.

The content specified herein is for the purpose of introducing ROHM's products (hereinafter "Products"). If you wish to use any such Product, please be sure to refer to the specifications, which can be obtained from ROHM upon request.

Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

Great care was taken in ensuring the accuracy of the information specified in this document. However, should you incur any damage arising from any inaccuracy or misprint of such information, ROHM shall bear no responsibility for such damage.

The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM and other parties. ROHM shall bear no responsibility whatsoever for any dispute arising from the use of such technical information.

The Products specified in this document are intended to be used with general-use electronic equipment or devices (such as audio visual equipment, office-automation equipment, communication devices, electronic appliances and amusement devices).

The Products specified in this document are not designed to be radiation tolerant.

While ROHM always makes efforts to enhance the quality and reliability of its Products, a Product may fail or malfunction for a variety of reasons.

Please be sure to implement in your equipment using the Products safety measures to guard against the possibility of physical injury, fire or any other damage caused in the event of the failure of any Product, such as derating, redundancy, fire control and fail-safe designs. ROHM shall bear no responsibility whatsoever for your use of any Product outside of the prescribed scope or not in accordance with the instruction manual.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). ROHM shall bear no responsibility in any way for use of any of the Products for the above special purposes. If a Product is intended to be used for any such special purpose, please contact a ROHM sales representative before purchasing.

If you intend to export or ship overseas any Product or technology specified herein that may be controlled under the Foreign Exchange and the Foreign Trade Law, you will be required to obtain a license or permit under the Law.

ROHM SEMICONDUCTOR

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

http://www.rohm.com/contact/