

SPDT Switch GaAs MMIC

■ GENERAL DESCRIPTION

NJG1612HA8 is a SPDT switch IC featured extremely high speed switching.

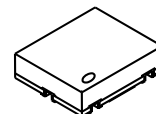
This device is suitable for high speed switching of Tx/Rx signals at sub-microwave applications.

This switch exhibits wide frequency range from 100MHz to 5.0GHz at low operating voltage of 2.5V, and is operated up to 20dBm at 3.0V operating voltage.

An ultra small and ultra thin package of USB6-A8 is adopted.

This product is RoHS directive compliant.

■ PACKAGE OUTLINE



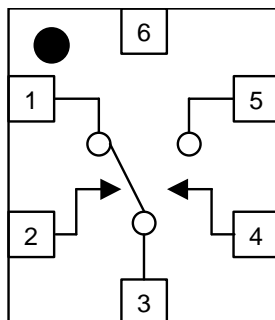
NJG1612HA8

■ FEATURES

- Single low voltage control +2.5~+6.5V
- Switching time 3ns typ.
- Low insertion loss 0.45dB typ. @f=2.5GHz
0.8dB typ. @f=5.0GHz
- High isolation 21dB typ. @f=2.5GHz
14dB typ. @f=5.0GHz
- Pin at 0.2dB compression point 25dBm typ. @f=2.5GHz, $V_{CTL}=3.0V$
- Ultra small & ultra thin package USB6-A8 (Mount Size: 1.0x1.2x0.38mm)

■ PIN CONFIGURATION

Top view



Pin connection

- 1.P2
- 2.VCTL2
- 3.PC
- 4.VCTL1
- 5.P1
- 6.GND

■ TRUTH TABLE

VCTL1	H	L
VCTL2	L	H
PC-P1	ON	OFF
PC-P2	OFF	ON

NJG1612HA8

■ ABSOLUTE MAXIMUM RATINGS

($T_a=25^\circ\text{C}$, $Z_s=Z_l=50\Omega$)

PARAMETER	SYMBOL	CONDITIONS	CONDITIONS	UNITS
RF Input Power	P_{IN}	$V_{CTL(L)}=0\text{V}$, $V_{CTL(H)}=3\text{V}$	29	dBm
Control Voltage	V_{CTL}	$V_{CTL(H)}-V_{CTL(L)}$	7.5	V
Power dissipation	P_D	At on PCB board $T_{jmax}=150^\circ\text{C}$	150	mW
Operating Temp.	T_{opr}		-40~+85	$^\circ\text{C}$
Storage Temp.	T_{stg}		-55~+150	$^\circ\text{C}$

■ ELECTRICAL CHARACTERISTICS

(General conditions, $V_{CTL(L)}=0\text{V}$, $V_{CTL(H)}=3\text{V}$, $Z_s=Z_l=50\Omega$, $T_a=25^\circ\text{C}$)

PARAMETERS	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Control Current	I_{CTL}	$f=2.5\text{GHz}$, $P_{IN}=10\text{dBm}$	-	5	10	μA
Control Voltage (LOW)	$V_{CTL(L)}$		-0.2	-	0.2	V
Control Voltage (HIGH)	$V_{CTL(H)}$		2.5	3.0	6.5	V
Insertion Loss 1	Loss1	$f=1\text{GHz}$	-	0.35	0.55	dB
Insertion Loss 2	Loss2	$f=2\text{GHz}$	-	0.40	0.60	dB
Insertion Loss 3	Loss3	$f=2.5\text{GHz}$	-	0.45	0.65	dB
Insertion Loss 4	Loss4	$f=5\text{GHz}$,	-	0.8	1.2	dB
Isolation 1	ISL1	$f=1\text{GHz}$	25	28	-	dB
Isolation 2	ISL2	$f=2\text{GHz}$	20	23	-	dB
Isolation 2	ISL2	$f=2.5\text{GHz}$	18	21	-	dB
Isolation 2	ISL2	$f=5\text{GHz}$,	11	14	-	dB
Pin at 0.2dB Compression Point 1	P-0.2dB(1)	$f_{in}=2.5\text{GHz}$	22	25		dBm
Pin at 0.2dB Compression Point 2	P-0.2dB(2)	$f_{in}=5\text{GHz}$	21	24		dBm
VSWR1	VSWR1	$f=0.1\sim 3\text{GHz}$, ON state	-	1.2	1.4	
VSWR2	VSWR2	$f=3\sim 5\text{GHz}$, ON state		1.5	1.7	
Switching time	T_{sw}	$f_{in}=0.1\sim 5\text{GHz}$ 50% VCTL to 10/90% RF	-	3	6	ns

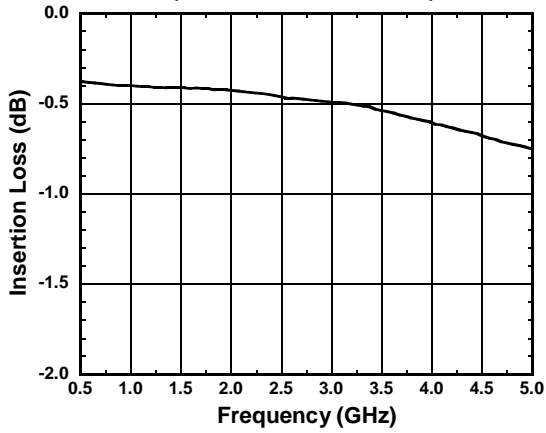
■ TERMINAL INFORMATION

No.	SYMBOL	DESCRIPTION
1	P2	RF port. This port is connected with PC port by controlling 2 nd pin ($V_{CTL(H)}$) to 2.5~6.5V and 4 th pin ($V_{CTL(L)}$) to -0.2~+0.2V. An external capacitor is required to block the DC bias voltage of internal circuit. (0.1~0.5GHz: 1000pF, 0.5~3GHz: 56pF, 3~5GHz: 27pF)
2	VCTL2	Control port 2. The voltage of this port controls PC to P2 state. The 'ON' and 'OFF' state is toggled by controlling voltage of this terminal such as high-state (2.5~6.5V) or low-state (-0.2~+0.2V). The voltage of 4 th pin has to be set to opposite state. The bypass capacitor has to be chosen to reduce switching time delay from 10pF~1000pF range.
3	PC	Common RF port. In order to block the DC bias voltage of internal circuit, an external capacitor is required. (0.1~0.5GHz: 1000pF, 0.5~3GHz: 56pF, 3~5GHz: 27pF)
4	VCTL1	Control port 1. The voltage of this port controls PC to P1 state. The 'ON' and 'OFF' state is toggled by controlling voltage of this terminal such as high-state (2.5~6.5V) or low-state (-0.2~+0.2V). The voltage of 2 nd pin has to be set to opposite state. The bypass capacitor has to be chosen to reduce switching time delay from 10pF~1000pF range.
5	P1	RF port. This port is connected with PC port by controlling 4 th pin ($V_{CTL(H)}$) to 2.5~6.5V and 2 nd pin ($V_{CTL(L)}$) to -0.2~+0.2V. An external capacitor is required to block the DC bias voltage of internal circuit(0.1~0.5GHz: 1000pF, 0.5~3GHz: 56pF, 3~5GHz: 27pF)
6	GND	Ground terminal. Please connect this terminal with ground plane as close as possible for excellent RF performance.

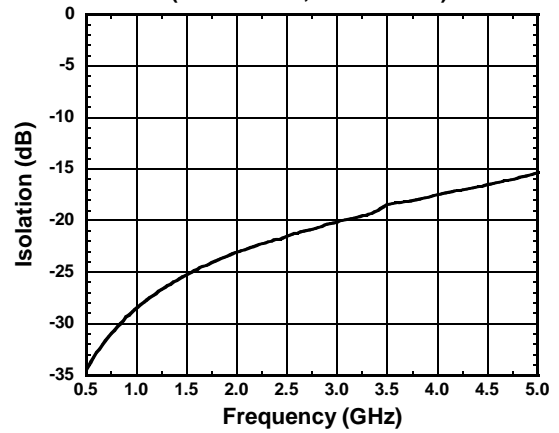
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■ELECTRICAL CHARACTERISTICS (With Application circuit, Loss of external circuit are excluded)

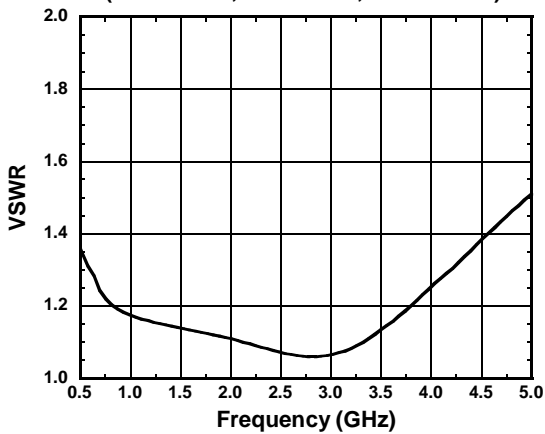
PC-P1 Insertion Loss vs. Frequency
(VCTL1=3V, VCTL2=0V)



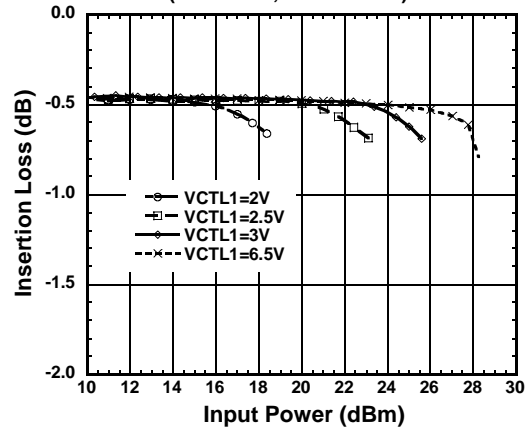
PC-P1 Isolation vs. Frequency
(VCTL1=0V, VCTL2=3V)



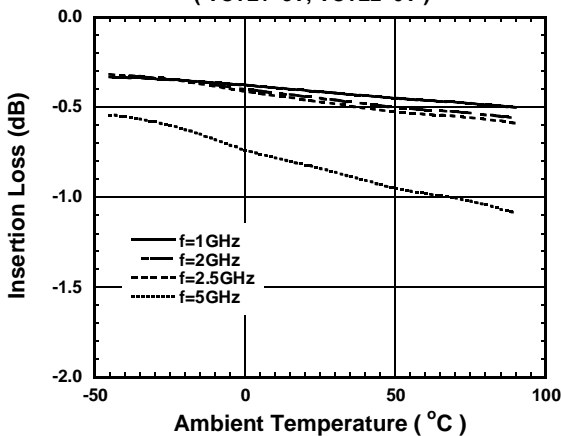
P1 VSWR vs. Frequency
(PC-P1 ON, VCTL1=3V, VCTL2=0V)



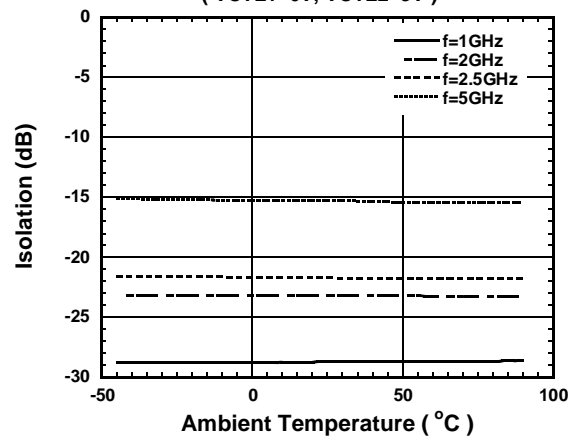
PC-P1 Insertion Loss vs. Input Power
(f=2.5GHz, VCTL2=0V)



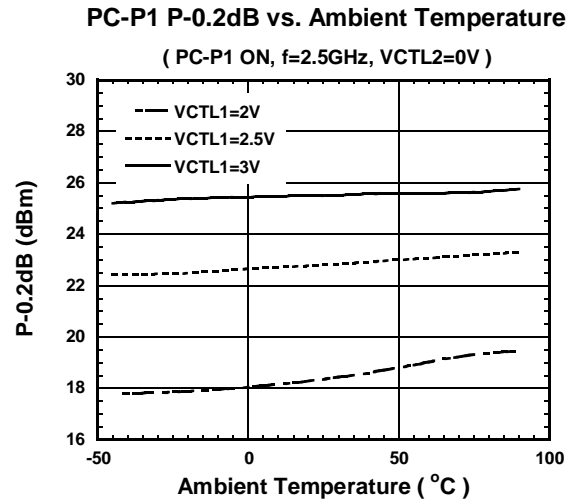
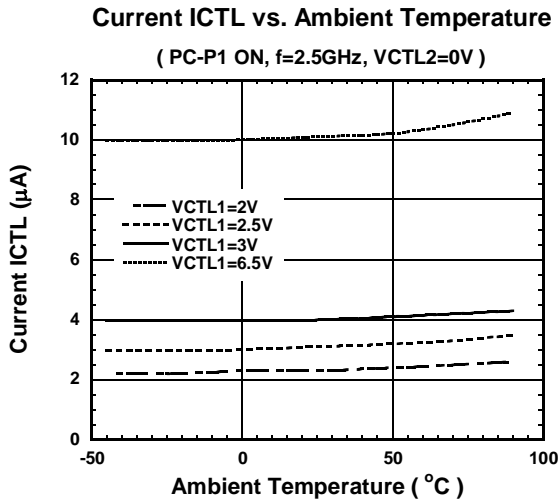
PC-P1 Loss vs. Ambient Temperature
(VCTL1=3V, VCTL2=0V)



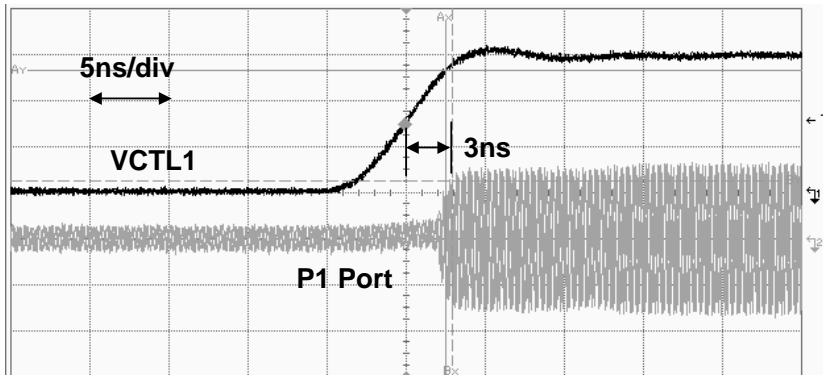
PC-P1 Isolation vs. Ambient Temperature
(VCTL1=0V, VCTL2=3V)



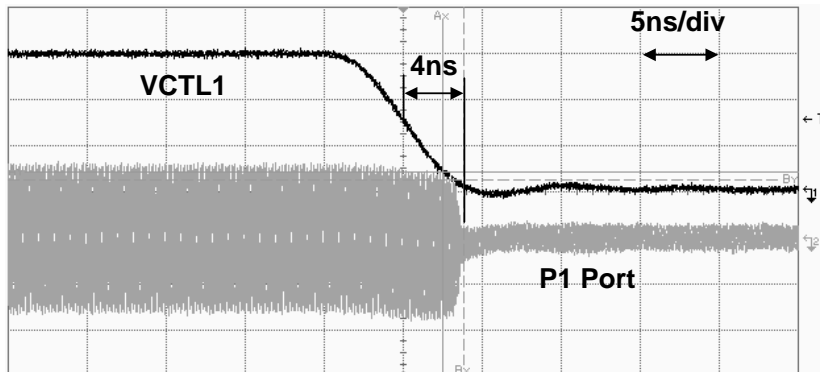
■ ELECTRICAL CHARACTERISTICS (With Application circuit, Loss of external circuit are excluded)



Switching Speed 1 (PC-P1 ON, 50% VCTL1 to 90% RF)

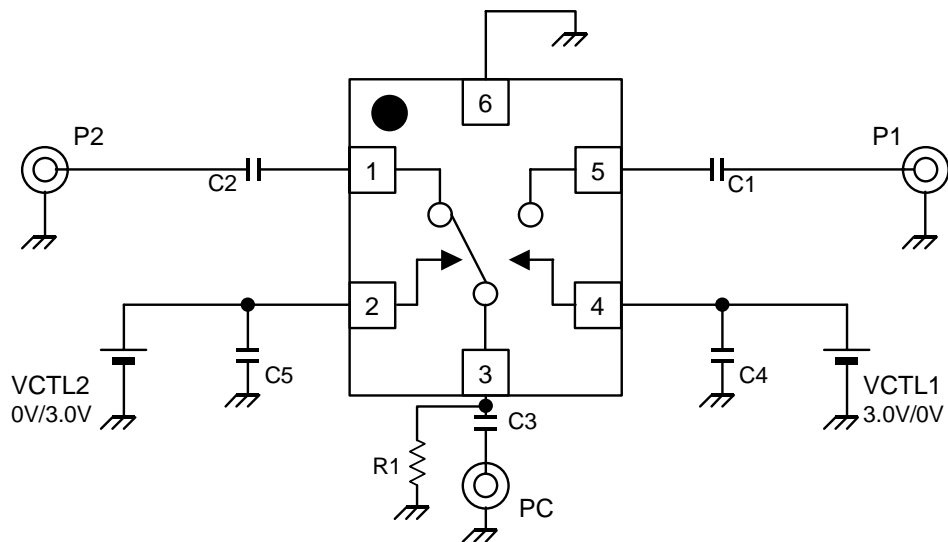


Switching Speed 2 (PC-P1 OFF, 50% VCTL1 to 10% RF)



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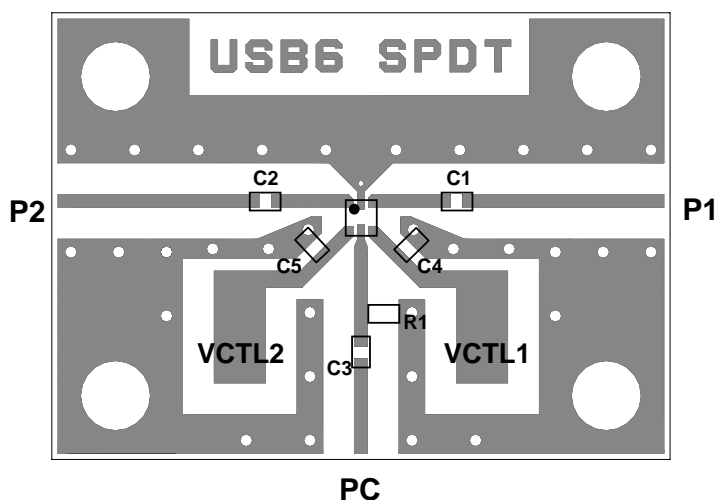
APPLICATION CIRCUIT



Parts List

Parts number	List 1	List 2	List 3	Notes
	$f_{in}=0.1\sim 0.5\text{GHz}$	$f_{in}=0.5\sim 3\text{GHz}$	$f_{in}=3\sim 5\text{GHz}$	
C1~C3	1000pF	56pF	27pF	GRM15 MURATA
C4, C5	10pF	10pF	10pF	GRM15 MURATA
R1	560k Ω	560k Ω	560k Ω	

RECOMMENDED PCB DESIGN



Circuit losses including losses of capacitor and connector.

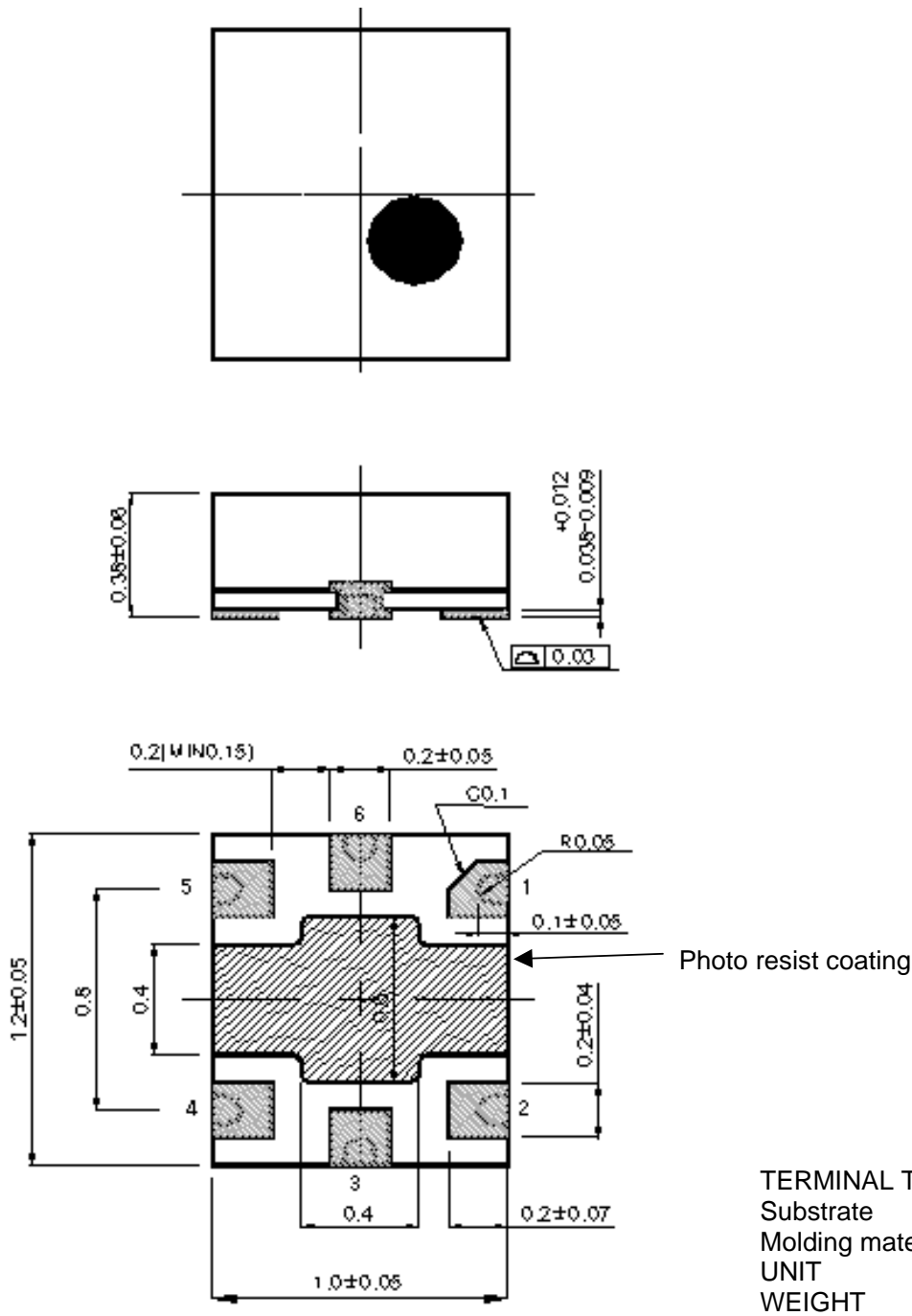
(DC blocking capacitor: 56pF)

freq	Loss
1GHz	0.22dB
2GHz	0.34dB
2.5GHz	0.42dB
5GHz	0.78dB

PRECAUTIONS

- [1] The DC blocking capacitors have to be placed at RF terminal of P1, P2 and PC.
- [2] To reduce stripline influence on RF characteristics, please locate bypass capacitors (C4, C5) close to each terminal.

PACKAGE OUTLINE (USB6-A8)



TERMINAL TREAT : Au
 Substrate : FR5
 Molding material : Epoxy resin
 UNIT : mm
 WEIGHT : 1.1mg

Cautions on using this product

This product contains Gallium-Arsenide (GaAs) which is a harmful material.

- Do NOT eat or put into mouth.
- Do NOT dispose in fire or break up this product.
- Do NOT chemically make gas or powder with this product.
- To waste this product, please obey the relating law of your country.

[CAUTION]

The specifications on this databook are only given for information, without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.

This product may be damaged with electric static discharge (ESD) or spike voltage. Please handle with care to avoid these damages.