Multi Layer Chip Series Varistors

Introduction

Multilayer chip varistors(MLV) have good nonlinear voltage-current characteristics and high surge capability. They also have fast- response characteristics in several hundred pico second level. They are very suitable and widely used for the problems of transient over-voltage protection caused by ESD(Electrostatic Discharge).

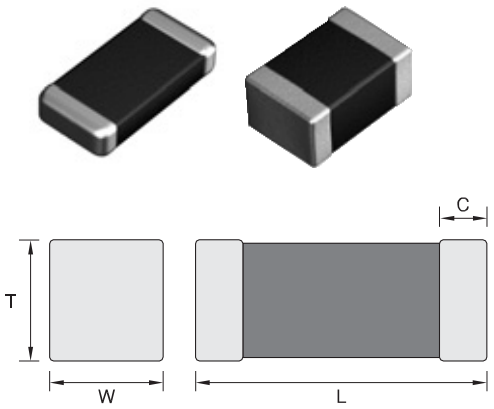
Features

- The fastest response time about 300~700ps
- Repetitive pulse characteristics
- High discharge transient current and energy handling capability
- Thermal stability through 125Ç
- EMI/RFI Attenuation characteristics

Applications

- Latch up protection for CMOS
- MOSFET protection for ESD/EOS
- High speed data I/O Port protection
- Keypad, Keyboard protection
- CDMA, GSM, Cordless phone
- Notebook, Workstations
- Digital camcorder
- CD-ROM, DVD-ROM, MD, MP3-PLAYER
- Automotive Application
- Onboard computer, electric motor control

Shape & Dimensions



(Unit : mm)

Size Code	L	W	T Max.	C Min.
1005(0402)	1.0±0.05	0.5±0.05	0.55	0.1
1608(0603)	1.6±0.15	0.8±0.15	0.9	0.2
2012(0805)	2.0±0.20	1.25±0.20	1.3	0.2
3216(1206)	3.2±0.25	1.60±0.20	1.4	0.2

How to Order(Product Identification)

VSN 1005 X 05 N R

1 2 3 4 5 6

1. Series

Code	Product Name
VSN	Chip Varistor Normal Type
VSL	Low Capacitance Type
VSH	High Surge Type
VHS	High Speed Type

2. Size Code

The first two digits : Length(mm)

The last two digits : Width(mm)

3. Energy Rating Code

Code	Energy rating	Code	Energy rating
A	0.1J	H	1.2J
B	0.2J	J	1.5J
C	0.3J	K	2.0J
D	0.4J	P	3.0J
E	0.6J	U	0.01J
F	0.7J	V	0.02J
G	0.9J	X	0.05J

5. Working Voltage Code

Code	Working Voltage
03	3.5Vdc
05	5.6Vdc
09	9.0Vdc
□□	Two digits are real

6. Termination Code

N : Plating(Ni/Sn) Type

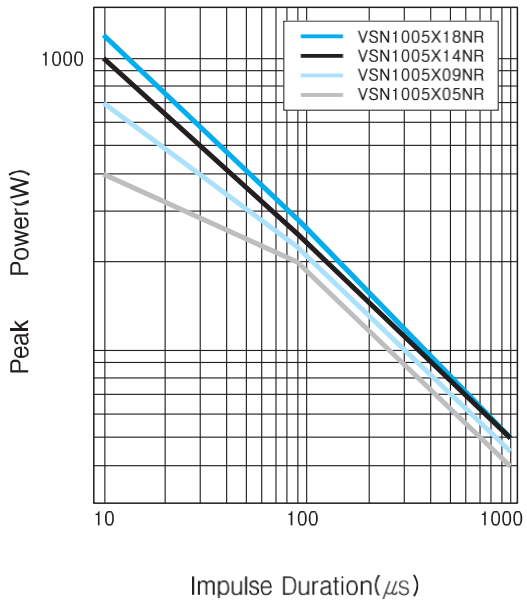
7. Packaging Code

Code	Packaging
B	Bulk Pack
R	Tape&Reel Pack
E	Embossed Tape Pack

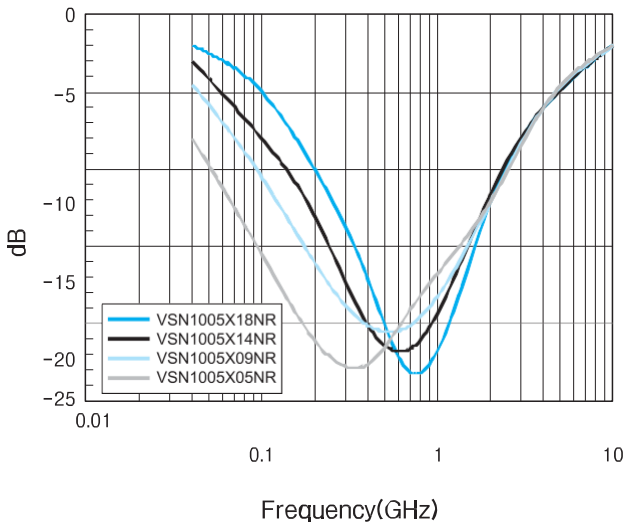
ESD Protection of RF Amplifier, FET, High Speed Date Line

Part No.	Working Voltage	Varistor Voltage	Clamping Voltage	Max. Peak Current	Max Energy	Typical Capacitance pF@1MHz
	$V_{W(DC)}$	$V_{b(@1mA)}$	V_C	I_P(A)	E_t(J)	
VSN1005X05NR	5.6	7.6~9.3	15.5	20	0.05	180
VSN1005X09NR	9	11.0~14.0	20	20	0.05	150
VSN1005X14NR	14	16.5~20.3	30	20	0.05	120
VSN1005X18NR	18	22.9~28.0	40	20	0.05	90

Peak Power VS Pulse Duration



Insertion Loss Characteristics



Specifications(Normal Type)

For ESD, COMS Latch Up, PET Protection

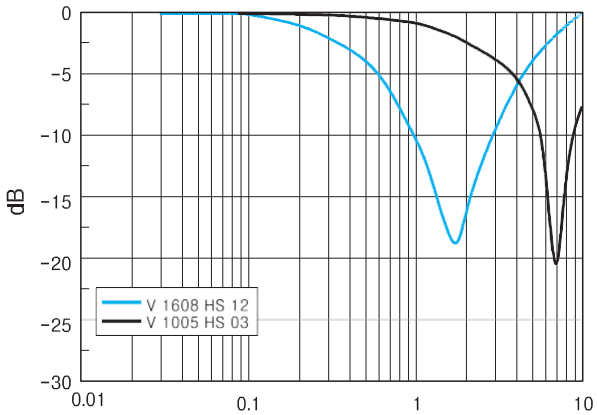
Part No.	Working Voltage $V_{W(DC)}$	Varistor Voltage $V_{b(@1mA)}$	Clamping Voltage V_c	Max. Peak Current I_p(A)	Max Energy E_t(J)	Typical Capacitance pF@1MHz
VSN1608A05NR	5.6	7.6~9.3	16	30	0.1	80
VSN1608A09NR	9.0	11.0~14.0	20	30	0.1	500
VSN1608A12NR	12	14.8~18.3	27	40	0.1	35
VSN1608A14NR	14	16.5~20.3	30	30	0.1	25
VSN1608A18NR	18	22.9~28.0	40	30	0.1	20
VSN1608A26NR	26	31.0~38.0	58	30	0.1	70
VSN1608A30NR	30	37.0~46.0	65	30	0.1	70
VSN2012A05NR	5.6	7.6~9.3	16	40	0.1	1250
VSN2012A09NR	9	11.0~14.0	20	40	0.1	74
VSN2012A12NR	12	14.8~18.3	25	40	0.1	52
VSN2012A14NR	14	16.5~20.3	30	40	0.1	37
VSN2012A18NR	18	22.9~28.0	40	30	0.1	35
VSN2012A26NR	26	31.0~38.0	58	30	0.1	140
VSN2012A30NR	30	37.0~46.0	65	30	0.1	100
VSN3216A05NR	5.6	7.6~9.3	16	40	0.1	85
VSN3216A09NR	9	11.0~14.0	20	40	0.1	65
VSN3216A14NR	14	16.5~20.3	30	40	0.1	50
VSN3216A18NR	18	22.9~28.0	40	30	0.1	29
VSN3216A26NR	26	31.0~38.0	58	30	0.1	270
VSN3216A30NR	30	37.0~46.0	65	30	0.1	200

Protect for very High Speed Data Transmission Line

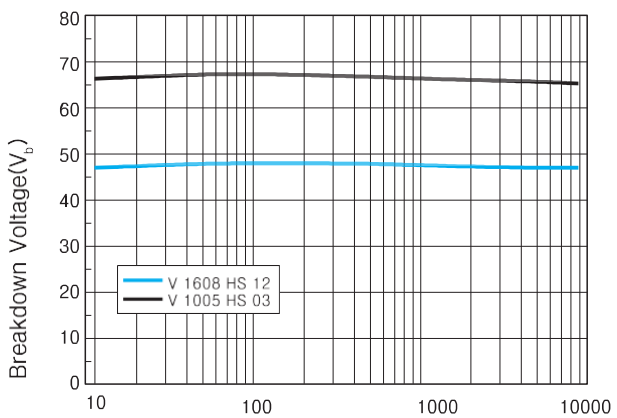
- 3pF & 12pF Capacitance Versions Suitable for High Speed Data-Rate Line
- Very Low Leakage Currents
- ESD Rated to IEC 61000-4-2(Level 4)
- Very Suitable for USB, IEEE 1394 Data Line Protection
- Mobile Communications/Cellular Phone Etc.

Part No.	Working Voltage	Maximu Leakage Current at Specified DC Voltage				Max Energy pF@1MHz	Typical Inductance (di/dt=0.1A/ns)
	$V_{W(DC)}$	3.5V	5.5V	9V	15V		
V1005HS03	< 30	0.05	0.10	0.15	0.25	3	< 1.0
V1005HS06	< 30	0.05	0.10	0.15	0.25	6	< 1.0
V1005HS12	< 18	0.10	0.15	0.25	0.50	12	< 1.0
V1608HS03	< 30	0.05	0.10	0.15	0.25	3	< 1.0
V1608HS06	< 30	0.05	0.10	0.15	0.25	6	< 1.0
V1608HS12	< 18	0.10	0.15	0.25	0.50	12	< 1.0

Insertion Loss Characteristics



ESD Repetitive Characteristics



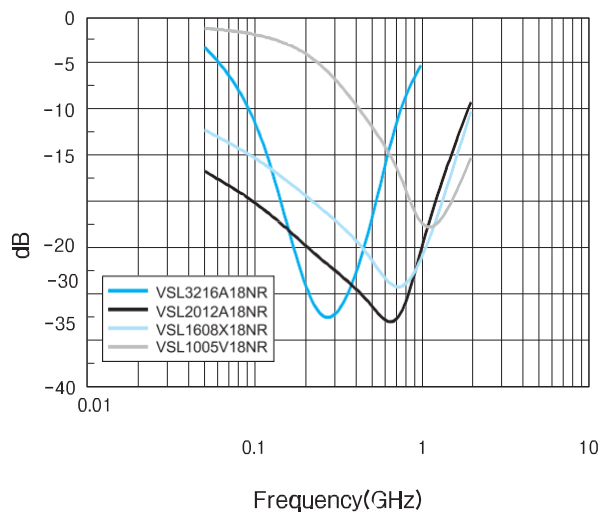
Specifications(Low Capacitance Type)

Protect for very High Speed Data Transmission Line

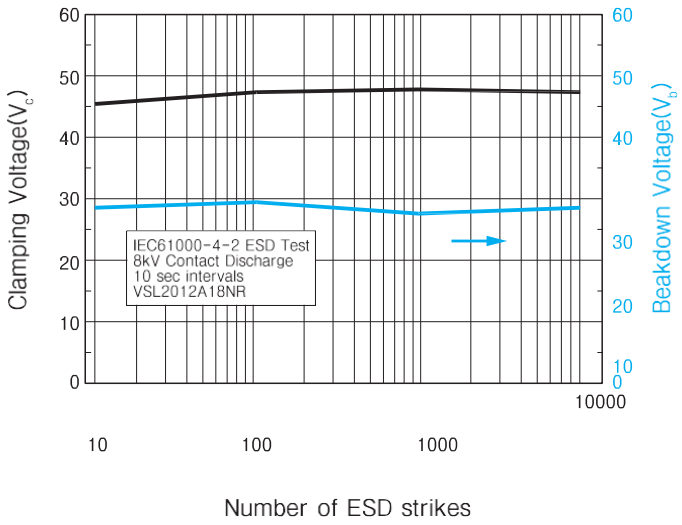
- Very Low Leakage Current Type for Battery Operated Equipment
- Very Low Capacitance about <200pF Proper to High Speed Data Transmission
- Suitable for USB, IEEE1394 Data Line Protection

Part No.	Working Voltage	Varistor Voltage	Clamping Voltage	Max. Peak Current	Max Energy	Typical Capacitance
	$V_{W(DC)}$	V1mA	V_C	I_P(A)	E_t(J)	pF@1MHz
VSL1005X03NR	3.6	8	15.5	15	0.05	150
VSL1005X05NR	5.6	12	20	20	0.05	100
VSL1005U05NR	5.6	12	20	15	0.01	50
VSL1005X12NR	12	18	30	20	0.05	50
VSL1005V12NR	12	18	30	15	0.02	25
VSL1005V18NR	18	27	50	15	0.02	30
VSL1005U18NR	18	27	50	10	0.01	15
VSL1608A05NR	5.6	12	20	25	0.1	400
VSL1608X05NR	5.6	12	20	20	0.05	100
VSL1608V05NR	5.6	12	20	15	0.02	50
VSL1608X12NR	12	18	30	20	0.05	80
VSL1608X18NR	18	27	50	20	0.05	75

Insertion Loss Characteristics



ESD Repetitive Characteristics

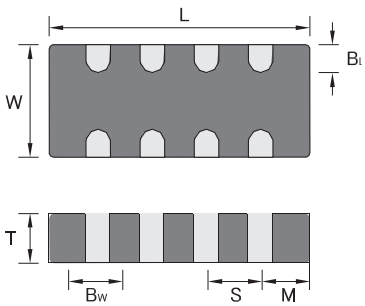


For Line Surge , Switching Surge , ESD Protection

Part No.	Working Voltage		Varistor Voltage	Clamping Voltage	Max. Peak Current	Max Energy	Typical Capacitance pF@1MHz
	$V_{W(DC)}$	$V_{W(AC)}$	$V_{b(@1mA)}$	V_C	I_P(A)	E_t(J)	
VSH2012C05NR	5.6	4.0	7.6~9.3	15.5	120	0.3	1600
VSH2012C09NR	9	6.4	11.0~14.0	20	120	0.3	1200
VSH2012C14NR	14	10	16.5~20.3	30	120	0.3	600
VSH2012C18NR	18	12	22.9~28.0	40	100	0.3	400
VSH2012C26NR	26	18	31.0~38.0	58	100	0.3	250
VSH2012C30NR	30	21	37.0~46.0	65	100	0.3	200
VSH3216D05NR	5.6	4.0	7.6~9.3	16	150	0.4	1800
VSH3216D09NR	9	6.4	11.0~14.0	20	150	0.4	1500
VSH3216D14NR	14	10	16.5~20.3	30	150	0.4	700
VSH3216D18NR	18	12	22.9~28.0	40	150	0.4	400
VSH3216D26NR	26	18	31.0~38.0	58	120	0.4	300
VSH3216D30NR	30	21	37.0~46.0	65	120	0.4	200

Array Type

Shape & Dimensions



(Unit : mm)

Type	MP4L1220	MP4L1632
L	2.0±0.20	3.2±0.2
W	1.25±0.20	1.60±0.20
T	0.6±0.1	1.2 Max.
S	0.5±0.05	0.80±0.1
M	0.2±0.15	0.40±0.1
BL	0.2±0.15	0.4±0.15
BW	0.25±0.1	0.20~0.45

How to Order (Product Identification)

MP 4 L 1632 A 05 N R

1 2 3 4 5 6 7 8

1. Series

Multi-Line Protection
Chip Varistor Array

2. Array Type

4 : 4Arrays

3. Style

L : Low Capacitance Type

4. Size Code

The first two digits : Width(mm)
The lost two digits : Length(mm)

5. Energy Rating Code

X : 0.05Joules

6. Working Voltage Code

Code	Working Voltage
05	5.6 Vdc
09	9.0 Vdc
14	14 Vdc
□□	Two digits are real value

7. Termination Type

N : Plating(Ni/Sn) Type

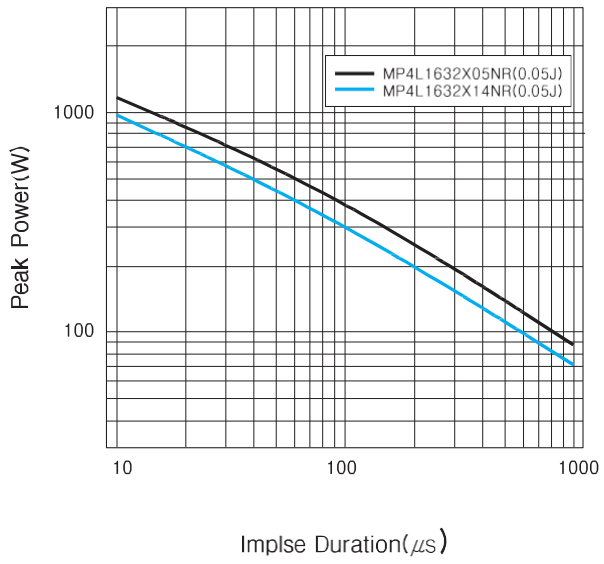
8. Packing Code

Code	Working Voltage
B	Bulk Pack
R	Tape & Reel Pack
E	Embossed Tape Pack

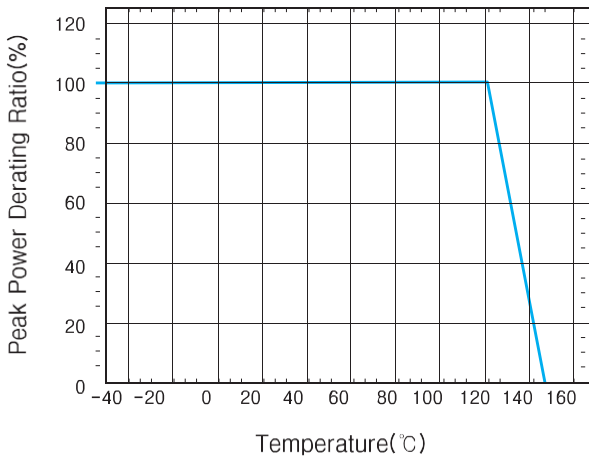
ESD Protection of Keypad, I/O, Port Protection

Part No.	Working Voltage	Varistor Voltage	Clamping Voltage	Max. Peak Current	Max Energy	Typical Capacitance pF@1MHz
	$V_{W(DC)}$	$V_{b(@1mA)}$	V_c	I_p(A)	E_t(J)	
MP4L1220X05NR	5.6	Typ.12	20	20	0.05	100
MP4L1220U05NR	5.6	Typ.12	20	15	0.01	50
MP4L1220X12NR	12	Typ.18	30	20	0.05	50
MP4L1220V12NR	12	Typ.18	30	15	0.02	25
MP4L1220V18NR	18	Typ.27	50	15	0.02	30
MP4L1220U18NR	18	Typ.27	50	10	0.01	15
MP4L1632X05NR	5.6	Typ.12	20	20	0.05	150
MP4L1632X12NR	12	Typ.18	30	20	0.05	100
MP4L1632X14NR	14	Typ.22	40	15	0.05	75
MP4L1632X18NR	18	Typ.27	50	15	0.05	50

Peak Power VS Pulse Duration



Temperature Rerating



Terminology

1. Working Voltage

$V_{w(DC)}$ - Maximum Continuous DC Voltage with which the waveform is flat. When a ripple voltage is supplied as from a rectifier source, make sure that the peak voltage is kept under the Vdcm.

$V_{w(ac)}$ - Maximum Continuous AC Voltage from a sine-wave shape. When the distortion in the waveform is extensive, make sure that the peak voltage is less than $\sqrt{2}$ times the $V_{w(AC)}$

2. Varistor Voltage ($V_{b(@1mA)}$, Breakdown Voltage)

The varistor terminal voltage which measured with supplying 1㎃ DC current.

3. Maximum Transient Clamping Voltage (Vc)

The peak terminal voltage which measured with an 8/20㎲ impulse of a given peak current

Transient Energy Rating	Specified Peak Current & Waveform
≤ 0.05J	1A 8/20㎲
0.1J	2A 8/20㎲
0.2~0.3J	5A 8/20㎲
0.4J ≥	10A 8/20㎲

4. Maximum Transient Peak Current (Ip)

Maximum single peak current which is based on 8/20㎲ current wave shape, without the device failure

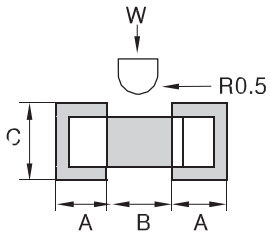
5. Maximum Transient Energy (Et)

Maximum single peak current which is based on 10/1000㎲ current wave shape, without the device failure

6. Capacitance

The Capacitance measured at a specified frequency 1MHz and zero voltage bias with 0.5Vrms

Item	Requirements	Test Conditions
Operating Temperature	–40℃~+125℃	
Storage Temp	40℃ Max., 70% RH Max.	At packing condition
Temperature Cycle	① No visible damage ② ⊿V/V1mA ≤ ±10%	1. –40±3℃ for 30minutes 2. 85±3℃ for 30minutes 3. Repeat 100 cycle
Low Temperature Resistance	① No visible damage ② ⊿V/V1mA ≤ ±10%	Temperature : –40±2℃ Tim : 1000±72/–24hours Measurement at room temperature after placing for 24±2hours
Humidity Resistance	① No visible damage ② ⊿V/V1mA ≤ ±10%	Temperature : 40±2 ℃ Humidity : 90~95 % RH Tim : 500±12hours Measurement at room temperature after placing for 24hours
Humidity Load Resistance	① No visible damage such as cracks ② ⊿V/V1mA ≤ ±10%	Temperature : 40±2℃ Humidity : 90~95 % RH Applied Voltage : Rated Voltage Tim : 500±12hours Measurement at room temperature after placing for 24hours
High Temperature Load Resistance	① No visible damage such as cracks ② ⊿V/V1mA ≤ ±10%	Temperature : 125±2℃ Applied Voltage : Rated Voltage Tim : 1000+72/-24hours Measurement at room temperature after placing for 24 hours
Resistance to Soldering Heat	① No visible damage such as cracks ② ⊿V/V1mA ≤ ±10%	Preheat : 120~150Ç 1minutes Solder Temperature : 260±5℃ Immersion Time : 10±1Sec. Take it out and set if for 1~2hours then measure.

<table>
<tr><th>Item</th><th>Requirements</th><th>Test Conditions</th></tr>
<tr><td>Solderability</td><td>① More than 90% of the terminal electrode shall be covered with new solder
② ⊿V/V1mA ≤ ±10%</td><td>Preheat Temperature : 120~150℃
Solder : 60Sn/40Pb
Preheat Time : 60Sec.
Solder Temperature : 230±5℃
Soldering Time : 3±1Sec.</td></tr>
<tr><td>Reflow Soldering</td><td>① Termination should be covered with now solder more than 20% of the terminal electrode height
② ⊿V/V1mA ≤ ±10%</td><td>At reflow soldering profile about 230℃</td></tr>
<tr><td>Lateral Push Strength</td><td>No Mechanical Damage
<table>
<tr><th>Chip Size</th><th>1005</th><th>1608</th><th>2012</th><th>3216</th></tr>
<tr><td>A(mm)</td><td>-</td><td>1.0</td><td>1.0</td><td>1.3</td></tr>
<tr><td>B(mm)</td><td>-</td><td>0.8</td><td>1.0</td><td>1.5</td></tr>
<tr><td>C(mm)</td><td>-</td><td>1.3</td><td>1.3</td><td>3.0</td></tr>
<tr><td>W(kgf)</td><td>-</td><td>2.0</td><td>4.0</td><td>5.0</td></tr>
</table></td><td> 
</td></tr>
<tr><td>Bending Strength</td><td>① No visible damage
② ⊿V/V1mA ≤ ±10%</td><td>According to JIS C 6485
Distance : 1mm
Speed : 30mm/Min.</td></tr>
<tr><td>Max. Peak Current Ip(A)</td><td>① No visible damage
② ⊿V/V1mA ≤ ±10%</td><td>8/20μs waveform
Impulse of +/–each polarity
Measurement at room temperature after placing for 25 hours</td></tr>
<tr><td>Max. Transient Energy Et(J)</td><td>① No visible damage
② ⊿V/V1mA ≤ ±10%</td><td>One standard circumstance Impulse the 10/1000μs specified current wave 1 times.
Measurement at room temperature afger placing for 24 hours</td></tr>
</table>