2A Synchronous Buck Converter for POL

■FEATURES

- ●Synchronous Rectification
- ●Current Mode Control
- ●Operating Voltage Range 2.7V to 5.5V
- ●Switching Current 2.64A min.
- ●Adjustable Oscillating Frequency 100kHz to 2.4MHz
- ●External Clock Synchronization
- ●PWM Control
- ●Maximum Duty Cycle 100%
- ●External Compensation Circuit
- ●Correspond to Ceramic Capacitor (MLCC)
- ●Soft Start Function 1ms typ.
- ●UVLO (Under Voltage Lockout)
- ●Over Current Protection (Hiccup type)
- ●Thermal Shutdown Protection
- ●Standby Function
- ●Package Outline DFN8-U1 (ESON8-U1)

■GENERAL DESCRIPTION

The NJW4122 is a synchronous buck converter with 2A MOSFET. The NJW4122 has wide switching oscillating frequency range, 100kHz to 2.4MHz and external clock synchronization function. Therefore it can avoid interference with the AM radio frequency.

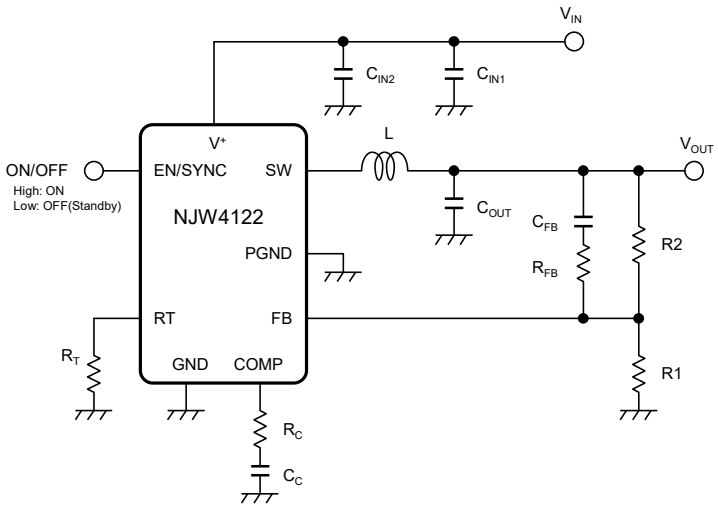
Internal protection functions: UVLO, an over current protection and a thermal shutdown circuit can protect at abnormal condition.

It is suitable for power supply circuit of SoC, DSP, DDR memory and so on that needs fast transient response.

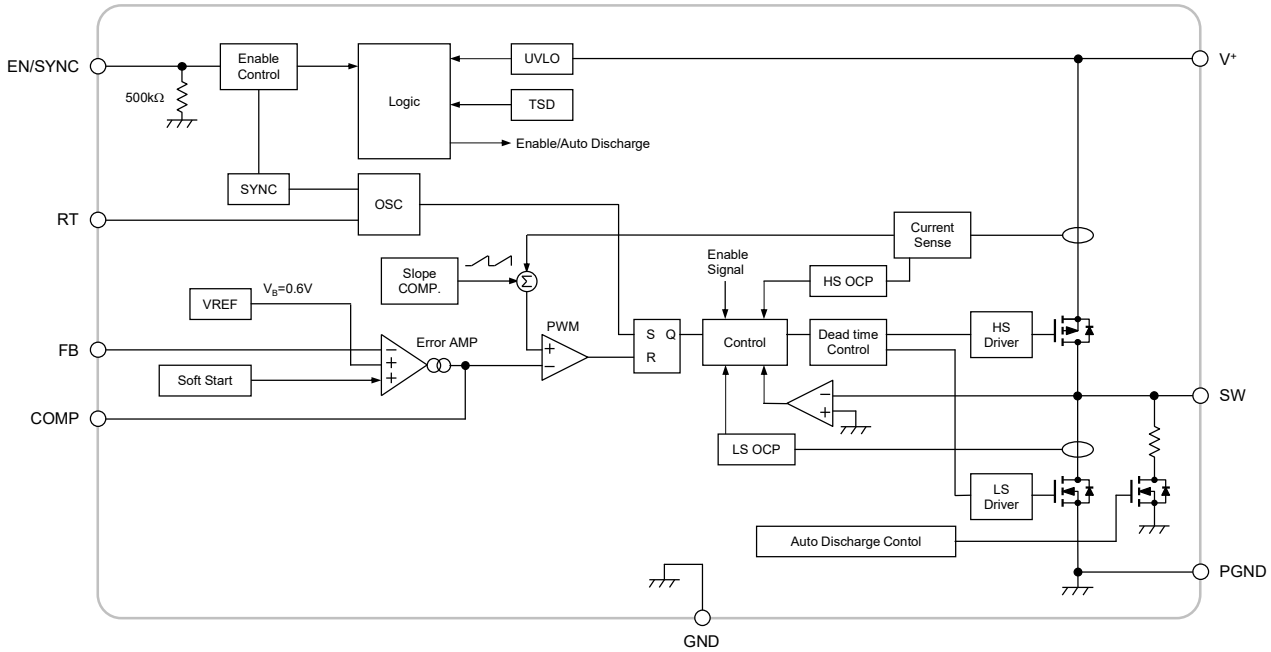
■APPLICATION

- ●Power supply for SoC, ASIC, DDR and the others

■TYPICAL APPLICATION

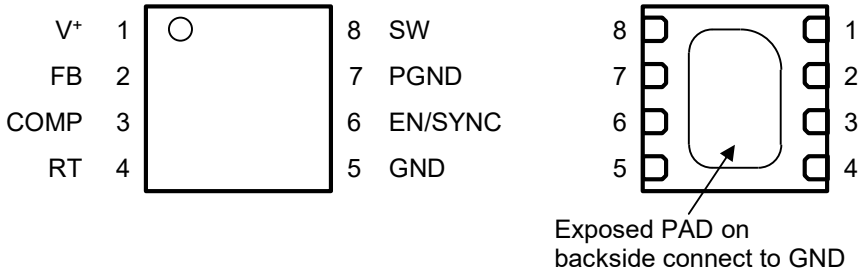


■BLOCK DIAGRAM



■PIN CONFIGURATION

DFN8-U1 (ESON8-U1)

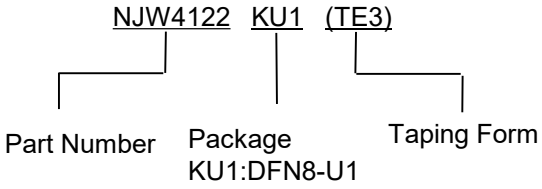


(Top View) (Bottom View)

Note) Exposed Pad on backside should be connected to ground and soldered to PCB.

PIN NO.	SYMBOL	DESCRIPTION
1	V^+	Power supply for IC
2	FB	Feedback input
3	COMP	Error Amplifier output
4	RT	Oscillating frequency setting
5	GND	Signal ground
6	EN/SYNC	Enable control and external clock synchronization
7	PGND	Power ground
8	SW	Switch output

■PRODUCT NAME INFORMATION



■ORDERING INFORMATION

PRODUCT NAME	PACKAGE OUTLINE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ(pcs)
NJW4122KU1 (TE3)	DFN8-U1	yes	yes	Sn2Bi	4122	5.3	3,000

■ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	-0.3 to +7	V
SW pin Voltage	V_{SW}	-0.3 to +7	V
EN/SYNC pin Voltage	$V_{EN/SYNC}$	-0.3 to +7	V
FB pin Voltage	V_{FB}	-0.3 to +7	V
Power Dissipation(Ta=25°C) DFN8-U1	P_D	(2-layer / 4-layer) 520[1]/ 1,400[2]	mW
Junction Temperature	T_j	-40 to +150	°C
Operating Temperature	T_{opr}	-40 to +125	°C
Storage Temperature	T_{stg}	-50 to +150	°C

(1): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)

(2): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)
(For 4Layers: Applying 99.5×99.5mm inner Cu area and thermal via holes to a board based on JEDEC standard JESD51-5)

■RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V^+	2.7 to 5.5	V
Timing Resistor	R_T	1.8 to 56	kΩ
Oscillating Frequency	f_{OSC}	100 to 2,400	kHz
External Clock Input	f_{SYNC}	f_{OSC}×0.9 to f_{OSC}×1.9 (Maximum 2,800kHz)	kHz

■ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, $V^+=V_{EN/SYNC}=3.3V$, $R_T=5.1k\Omega$, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Under Voltage Lockout Block						
ON Threshold Voltage	V_{T_ON}	V^+= L → H	2.5	2.6	2.7	V
OFF Threshold Voltage	V_{T_OFF}	V^+= H → L	2.4	2.5	2.6	V
Hysteresis Voltage	V_{HYS}		80	100	–	mV
Soft Start Block						
Soft Start Time	t_{SS}	V_B=0.55V	0.5	1	2.5	ms
Oscillator Block						
Oscillating Frequency 1	f_{OSC1}	$R_T=18k\Omega$	270	300	330	kHz
Oscillating Frequency 2	f_{OSC2}	$R_T=5.1k\Omega$	870	970	1,070	kHz
Oscillating Frequency 3	f_{OSC3}	$R_T=1.8k\Omega$	2,200	2,400	2,600	kHz
Error Amplifier Block						
Reference Voltage	V_B		-1.0%	0.6	+1.0%	V
Input Bias Current	I_B		-0.1	–	0.1	μA
Error Amplifire Transconductance	gm		–	380	–	μA/V
Error Amplifire Gain	Av		–	1,000	–	–
Output Source Current	I_{OM+}		35	45	55	μA
Output Sink Current	I_{OM-}		35	45	55	μA
PWM Comparate Block						
Maximum Duty Cycle	$M_{AX}D_{UTY}$	V_{FB}=0.5V	100	–	–	%
Minimum OFF Time	$t_{OFF-min}$		–	55	–	ns
Minimum ON Time	t_{ON-min}		–	60	–	ns

■ELECTRICAL CHARACTERISTICS (CONTINUED)

(Unless otherwise noted, $V^+=V_{EN/SYNC}=3.3V$, $R_T=5.1k\Omega$, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
OCP Block						
COOL DOWN Time	t_{COOL}		–	120	–	ms
Output Block						
High-side SW ON Resistance	R_{ONH}	I_{SW}=-2A	–	125	175	mΩ
Low-side SW ON Resistance	R_{ONL}	I_{SW}=2A	–	80	130	mΩ
High-side Switching Current Limit	I_{LIMH}		2.64	3.3	3.96	A
Low-side Switching Current Limit	I_{LIML}		2.2	2.9	3.96	A
Auto Discharge Resistance	$R_{AUTODIS}$	I_{SW}=10mA	–	85	140	Ω
High-side SW Leak Current	I_{LEAKH}	$V^+ - V_{SW}$=5.5V	–	–	1	μA
Low-side SW Leak Current	I_{LEAKL}	V_{SW} - PGND=5.5V	–	–	1	μA
Enable Control / Sync Block						
EN/SYNC pin High Threshold Voltage	$V_{THH_EN/SYNC}$	$V_{EN/SYNC}$= L → H	1.2	–	V^+	V
EN/SYNC pin Low Threshold Voltage	$V_{THL_EN/SYNC}$	$V_{EN/SYNC}$= H → L	0	–	0.4	V
EN/SYNC pin Input Bias Current	$I_{EN/SYNC}$	$V_{EN/SYNC}$=5.5V	–	10	15	μA
General Characteristics						
Quiescent Current	I_{DD}	R_L= no load, Not Switching	–	2.2	2.7	mA
Standby Current	I_{DD_STB}	$V_{EN/SYNC}$=0V	–	–	1	μA

■THERMAL CHARACTERISTICS

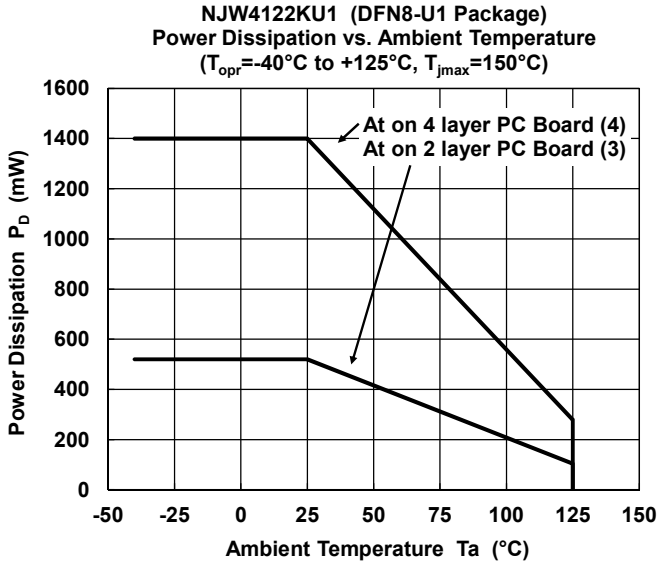
PARAMETER	SYMBOL	VALUE		UNIT
Junction-to-ambient thermal resistance	θja	DFN8-U1 (ESON8-U1)	242(3) 87(4)	°C/W
Junction-to-Top of package characterization parameter	ψjt	DFN8-U1 (ESON8-U1)	24.1(3) 10.1(4)	°C/W

(3): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 2Layers FR-4, with Exposed Pad)

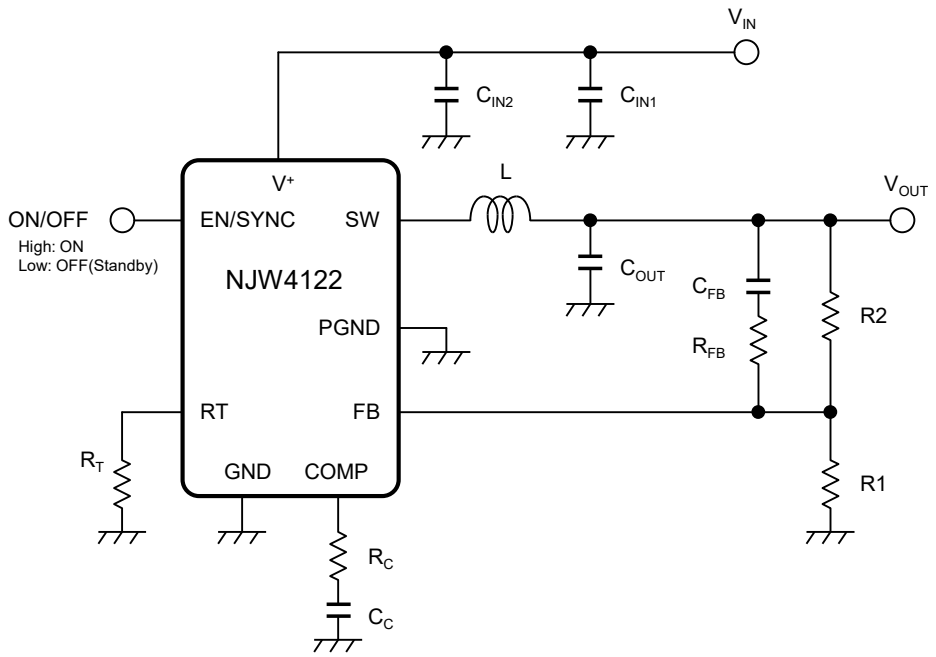
(4): Mounted on glass epoxy board. (101.5×114.5×1.6mm: based on EIA/JEDEC standard, 4Layers FR-4, with Exposed Pad)

(For 4Layers: Applying 99.5×99.5mm inner Cu area and thermal via holes to a board based on JEDEC standard JESD51-5)

■POWER DISSIPATION vs. AMBIENT TEMPERATURE

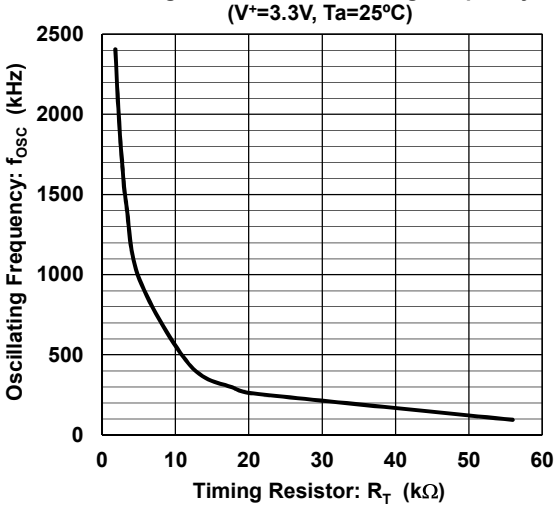


■TYPICAL APPLICATION

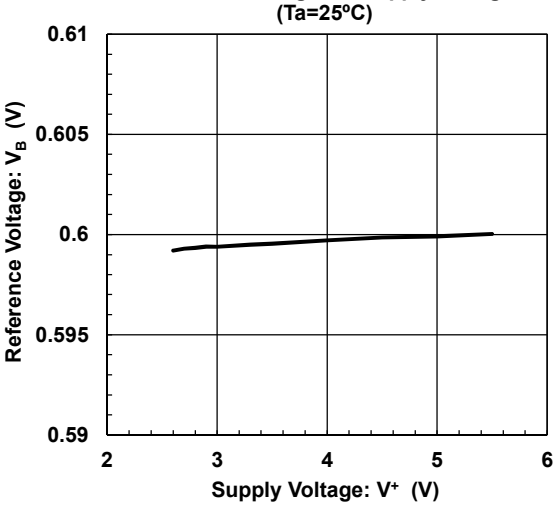


■TYPICAL CHARACTERISTICS

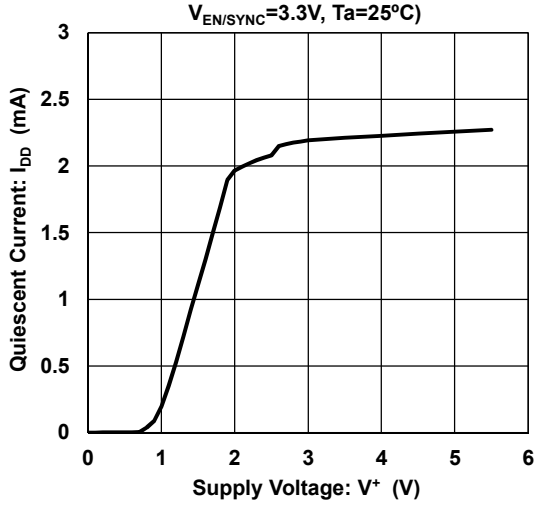
Timing Resistor vs. Oscillating Frequency
(V^+=3.3V, Ta=25ºC)



Reference Voltage vs. Supply Voltage
(Ta=25ºC)

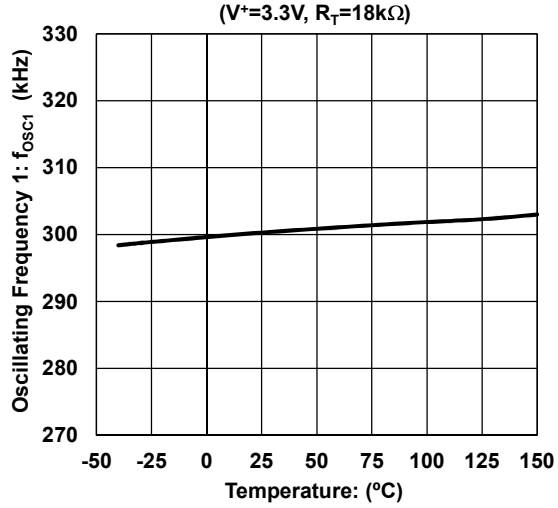


Quiescent Current vs. Supply Voltage
(R_L=No Load, Not Switching,
$V_{EN/SYNC}$=3.3V, Ta=25ºC)

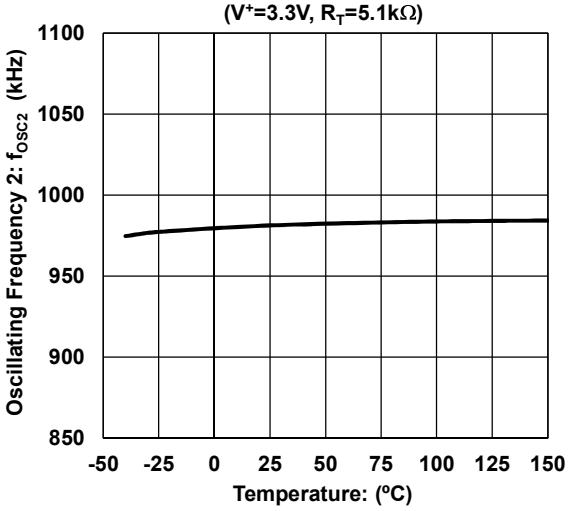


■TYPICAL CHARACTERISTICS

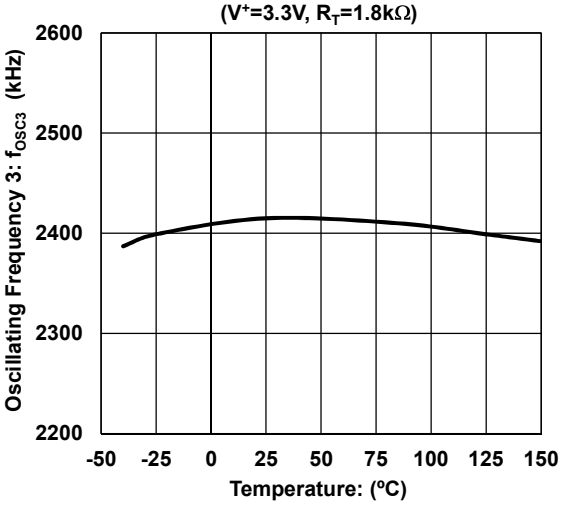
Oscillating Frequency 1 vs Temperature
(V^+=3.3V, R_T=18kΩ)



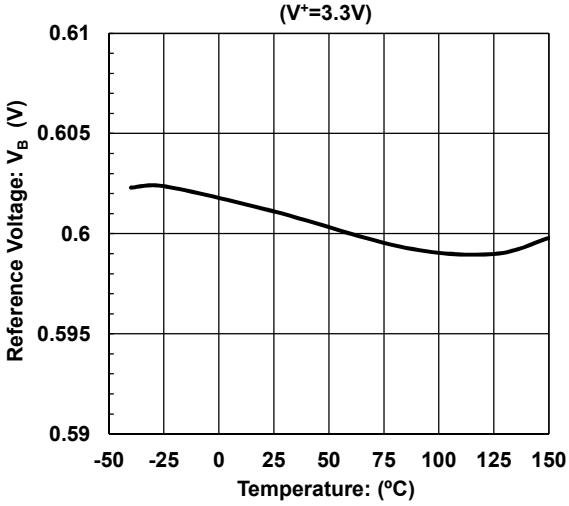
Oscillating Frequency 2 vs Temperature
(V^+=3.3V, R_T=5.1kΩ)



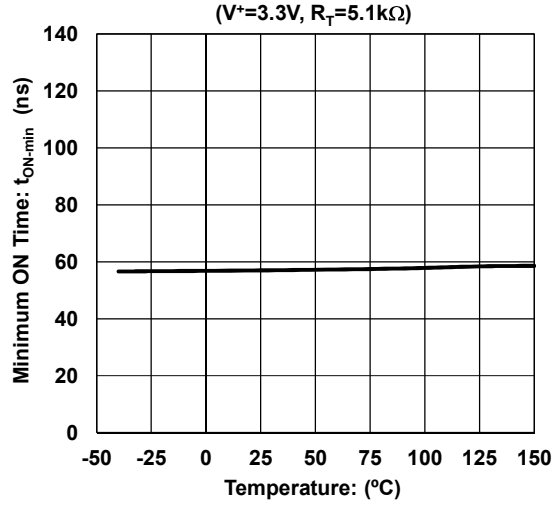
Oscillating Frequency 3 vs Temperature
(V^+=3.3V, R_T=1.8kΩ)



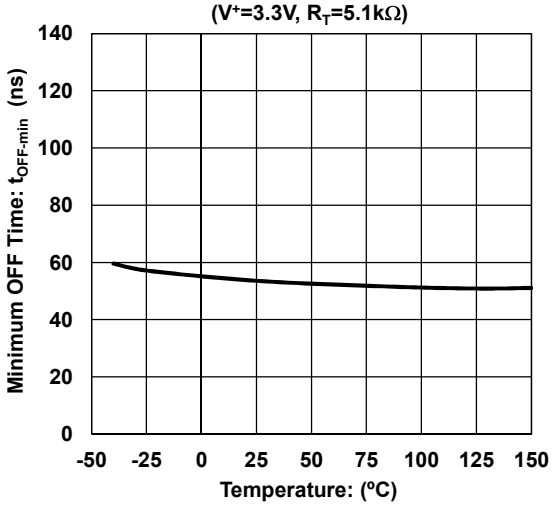
Reference Voltage vs. Temperature
(V^+=3.3V)



Minimum ON Time vs. Temperature
(V^+=3.3V, R_T=5.1kΩ)

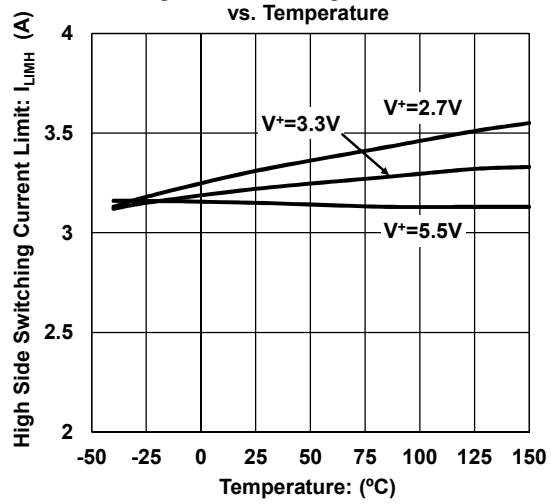


Minimum OFF Time vs. Temperature
(V^+=3.3V, R_T=5.1kΩ)

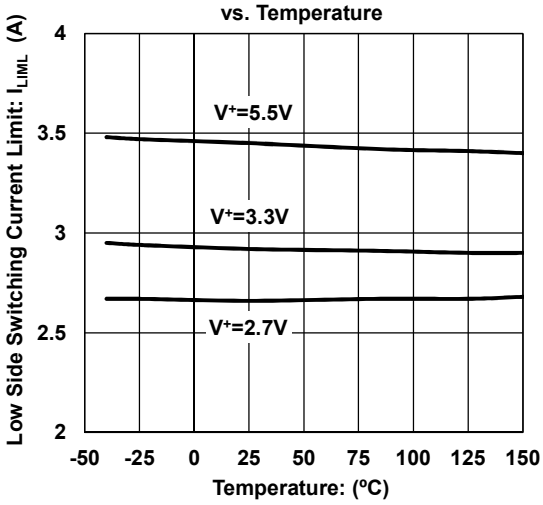


■TYPICAL CHARACTERISTICS

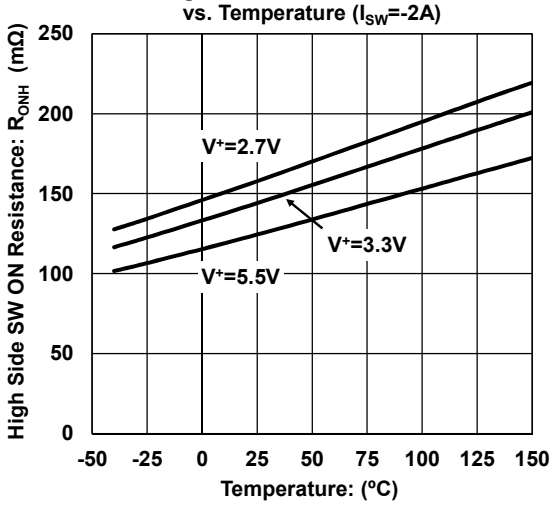
High Side Switching Current Limit vs. Temperature



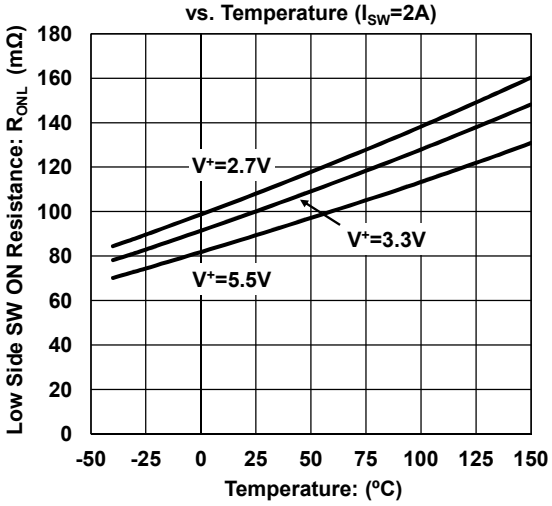
Low Side Switching Current Limit vs. Temperature



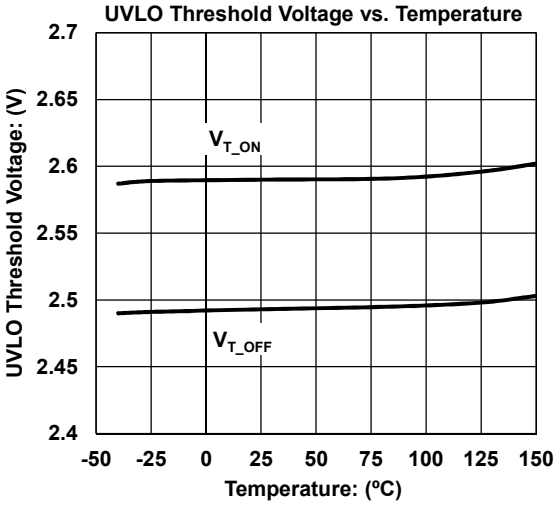
High Side SW ON Resistance vs. Temperature (I_{SW}=-2A)



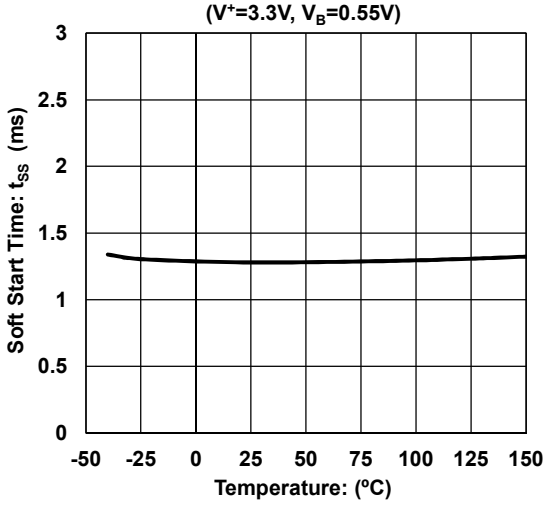
Low Side SW ON Resistance vs. Temperature (I_{SW}=2A)



UVLO Threshold Voltage vs. Temperature

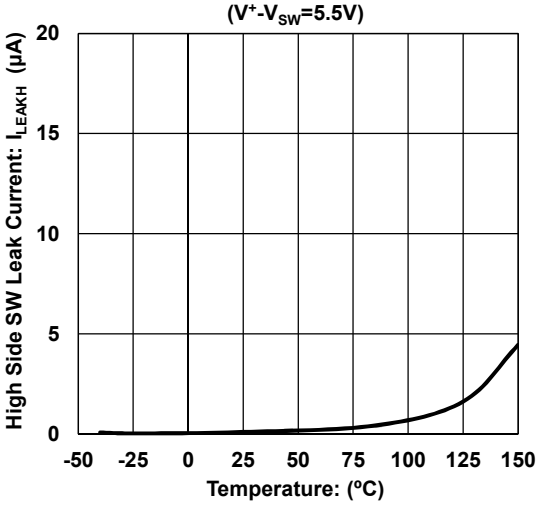


Soft Start Time vs. Temperature (V^+=3.3V, V_B=0.55V)

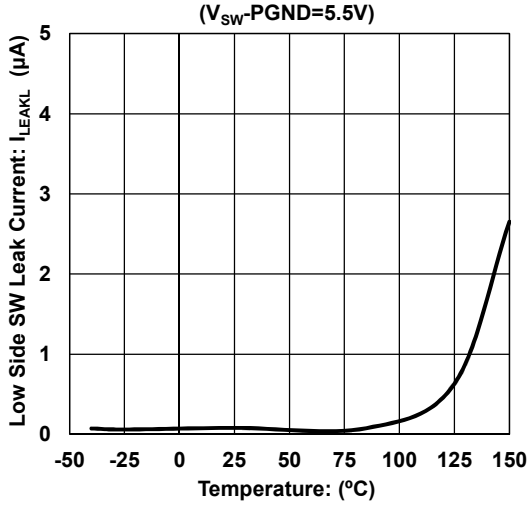


■TYPICAL CHARACTERISTICS

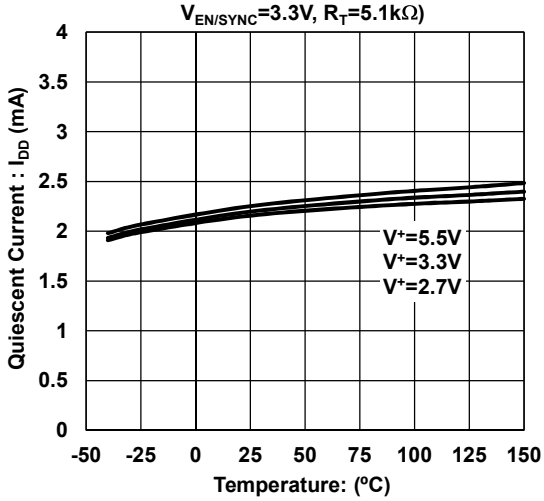
High Side SW Leak Current vs. Temperature
(V^+-V_{SW}=5.5V)



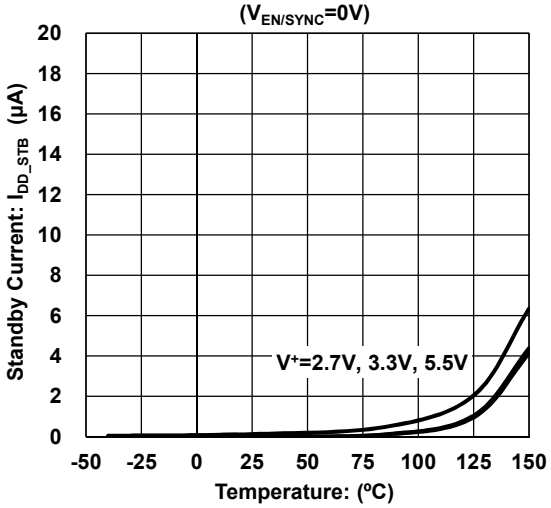
Low Side SW Leak Current vs. Temperature
(V_{SW}-PGND=5.5V)



Quiescent Current vs. Temperature
(R_L=No Load, Not Switching,
$V_{EN/SYNC}$=3.3V, R_T=5.1kΩ)



Standby Current vs. Temperature
($V_{EN/SYNC}$=0V)



■ **PIN DESCRIPTIONS**

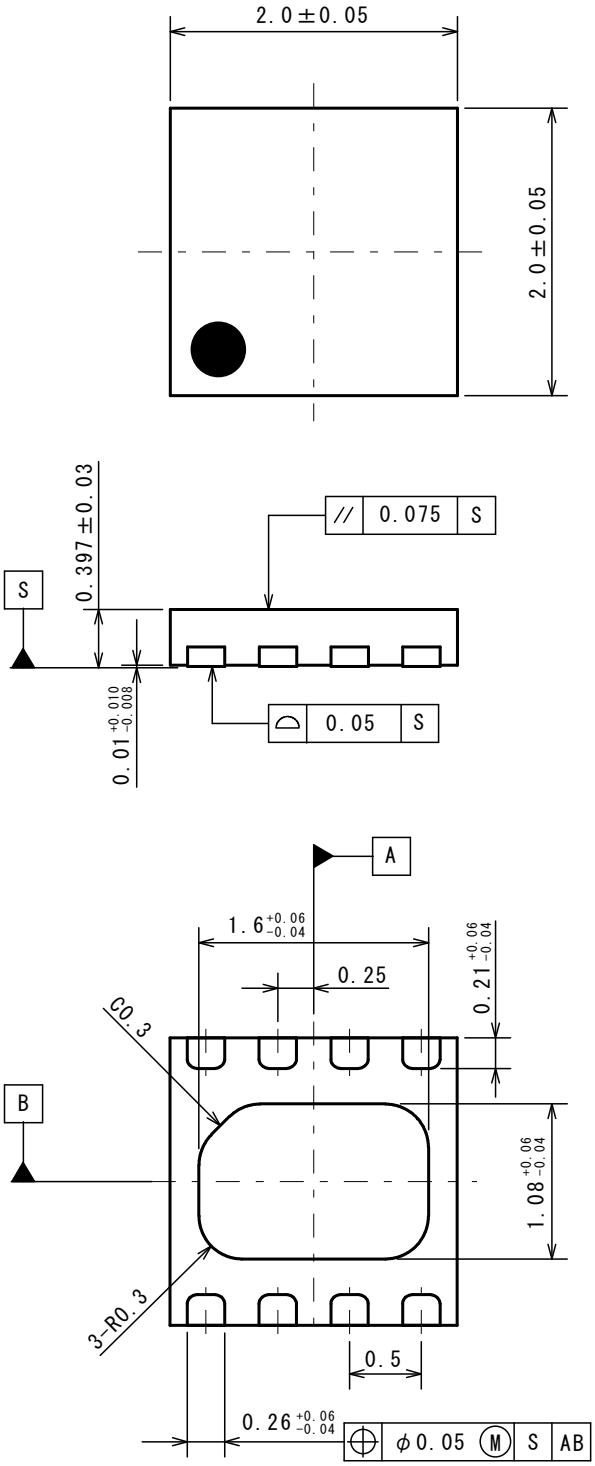
PIN NAME	PIN NUMBER	FUNCTION
V^+	1	Power Supply pin for Power Line. Insert a bypass capacitor close to the V^+ pin – the GND pin connection in order to lower high frequency impedance.
FB	2	Output Voltage Detecting pin. Connects output voltage through the resistor divider tap to this pin in order to voltage of the FB pin become 0.6V.
COMP	3	Output pin of the Error Amplifier. A resistor and capacitors for compensation are connected between the COMP pin and the GND.
RT	2	Oscillating Frequency Setting pin by Timing Resistor. Oscillating Frequency should be set between 100kHz and 2.4MHz.
GND	4	GND pin
EN/SYNC	6	Standby Control pin The EN/SYNC pin internally pulls down to GND by resistor. Normal Operation at the time of High Level. Standby Mode at the time of Low Level or OPEN. Moreover, it operates at a frequency synchronized with the external clock signal.
PGND	7	Power GND pin for Power Line
SW	8	Switch Output pin of Power MOSFET
Exposed PAD	–	Exposed PAD on backside should be connected to ground and soldered to PCB.

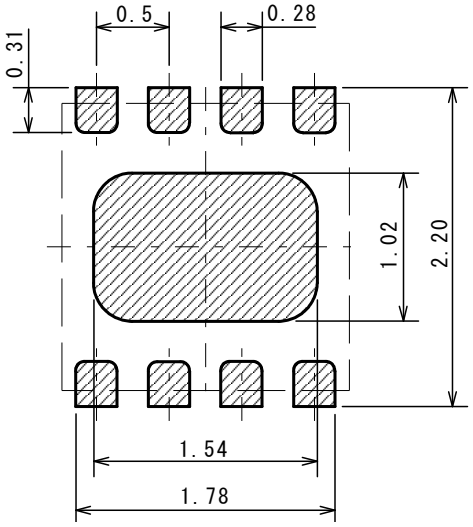
DFN8-U1(ESON8-U1)

■PACKAGE DIMENSIONS

■EXAMPLE OF SOLDER PADS DIMENSIONS

Unit: mm

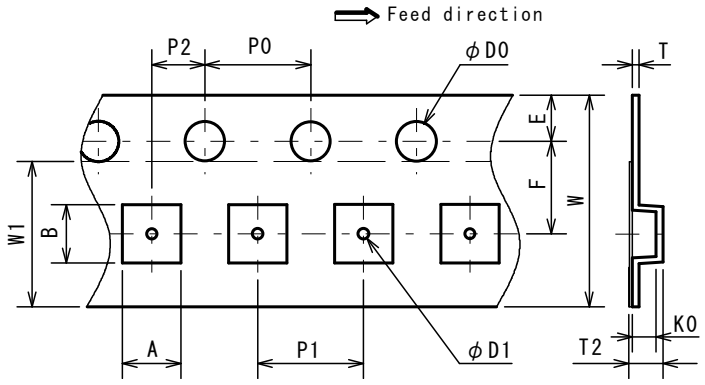




■PACKING SPEC

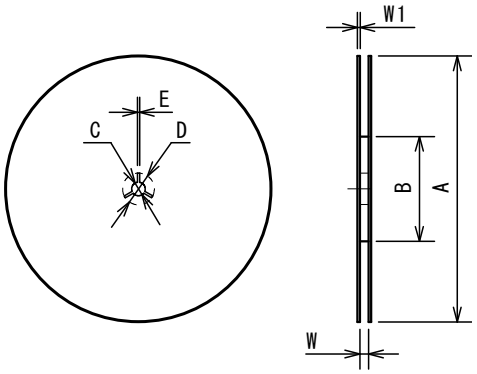
Unit: mm

TAPING DIMENSIONS



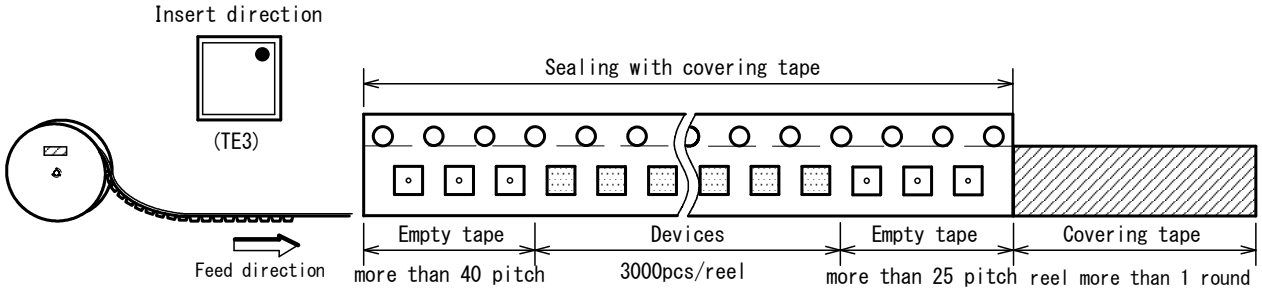
SYMBOL	DIMENSION	REMARKS
A	2.25±0.05	BOTTOM DIMENSION
B	2.25±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	0.5±0.1	
E	1.75±0.1	
F	3.5±0.05	
P0	4.0±0.1	
P1	4.0±0.1	
P2	2.0±0.05	
T	0.25±0.05	
T2	1.00±0.07	
K0	0.65±0.05	
W	8.0±0.2	
W1	5.5	THICKNESS 0.1max

REEL DIMENSIONS

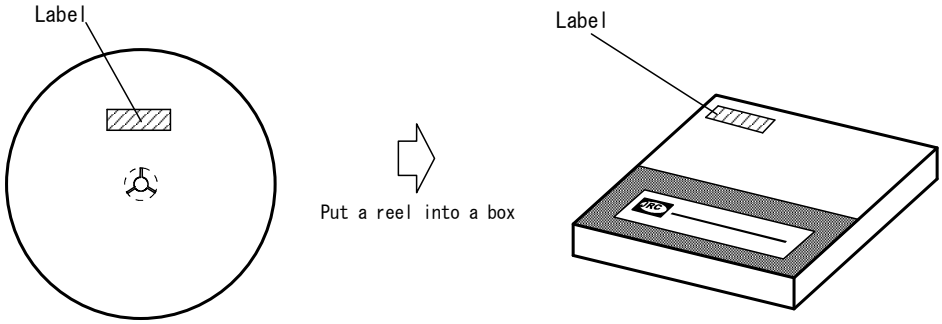


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$9^{+0.3}_{0}$
W1	1.2

TAPING STATE



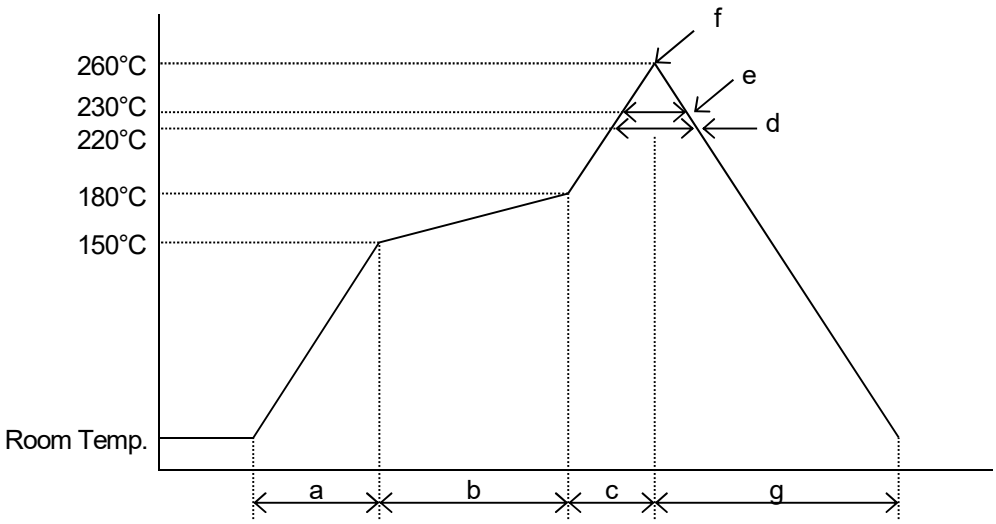
PACKING STATE



■MOUNTING METHOD

INFRARED REFLOW SOLDERING METHOD

Recommended reflow soldering procedure



a : Temperature ramping rate	: 1 to 4°C /s
b : Pre-heating temperature	: 150 to 180°C
time	: 60 to 120s
c : Temperature ramp rate	: 1 to 4°C /s
d : 220°C or higher time	: Shorter than 60s
e : 230°C or higher time	: Shorter than 40s
f : Peak temperature	: Lower than 260°C
g : Temperature ramping rate	: 1 to 6°C /s

The temperature indicates at the surface of mold package.

■REVISION HISTORY

DATE	REVISION	CHANGES
17.Mar.2020	Ver.1.0	New Release

[CAUTION]

1. NJR strives to produce reliable and high quality semiconductors. NJR's semiconductors are intended for specific applications and require proper maintenance and handling. To enhance the performance and service of NJR's semiconductors, the devices, machinery or equipment into which they are integrated should undergo preventative maintenance and inspection at regularly scheduled intervals. Failure to properly maintain equipment and machinery incorporating these products can result in catastrophic system failures

2. The specifications on this datasheet are only given for information without any guarantee as regards either mistakes or omissions. The application circuits in this datasheet are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial property rights.
   All other trademarks mentioned herein are the property of their respective companies.

3. To ensure the highest levels of reliability, NJR products must always be properly handled.
   The introduction of external contaminants (e.g. dust, oil or cosmetics) can result in failures of semiconductor products.

4. NJR offers a variety of semiconductor products intended for particular applications. It is important that you select the proper component for your intended application. You may contact NJR's Sale's Office if you are uncertain about the products listed in this datasheet.

5. Special care is required in designing devices, machinery or equipment which demand high levels of reliability. This is particularly important when designing critical components or systems whose failure can foreseeably result in situations that could adversely affect health or safety. In designing such critical devices, equipment or machinery, careful consideration should be given to amongst other things, their safety design, fail-safe design, back-up and redundancy systems, and diffusion design.

6. The products listed in this datasheet may not be appropriate for use in certain equipment where reliability is critical or where the products may be subjected to extreme conditions. You should consult our sales office before using the products in any of the following types of equipment.

   - Aerospace Equipment
   - Equipment Used in the Deep Sea
   - Power Generator Control Equipment (Nuclear, steam, hydraulic, etc.)
   - Life Maintenance Medical Equipment
   - Fire Alarms / Intruder Detectors
   - Vehicle Control Equipment (Airplane, railroad, ship, etc.)
   - Various Safety Devices

7. NJR's products have been designed and tested to function within controlled environmental conditions. Do not use products under conditions that deviate from methods or applications specified in this datasheet. Failure to employ the products in the proper applications can lead to deterioration, destruction or failure of the products. NJR shall not be responsible for any bodily injury, fires or accident, property damage or any consequential damages resulting from misuse or misapplication of the products. The products are sold without warranty of any kind, either express or implied, including but not limited to any implied warranty of merchantability or fitness for a particular purpose.

8. Warning for handling Gallium and Arsenic (GaAs) Products (Applying to GaAs MMIC, Photo Reflector). These products use Gallium (Ga) and Arsenic (As) which are specified as poisonous chemicals by law. For the prevention of a hazard, do not burn, destroy, or process chemically to make them as gas or power. When the product is disposed of, please follow the related regulation and do not mix this with general industrial waste or household waste.

9. The product specifications and descriptions listed in this datasheet are subject to change at any time, without notice.