PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

Synchronous Buck Boost Switching Controller IC for USB Power Delivery

■ FEATURES

- AEC-Q100 Grade 1 qualification in progress
- Programmable output voltage control for USB PD
  5V, 9V, 15V, 20V (2bit logic input control)
- Wide input voltage range
  4.8V to 36V (45V maximum ratings)
- Nch. MOSFET available for all external FETs
- Synchronous operation in all switching topologies
- High efficiency power conversion 90%
- Oscillation frequency 100kHz to 700kHz
- Discharge function at RESETX enable
- Adjustable soft start function
- Protection circuit
  - Over current protection
  - Under voltage lockout
  - Thermal shutdown circuit
- Package EQFN24-LE

■ APPLICATIONS

- USB PD power block

** T1 grade is not recommend for Powertrain, Vehicle Electrification and Autonomous driving related application.*

■ DESCRIPTION

The NJW4210 is a buck boost switching controller IC for USB Power Delivery (USB PD) with output voltage select function.

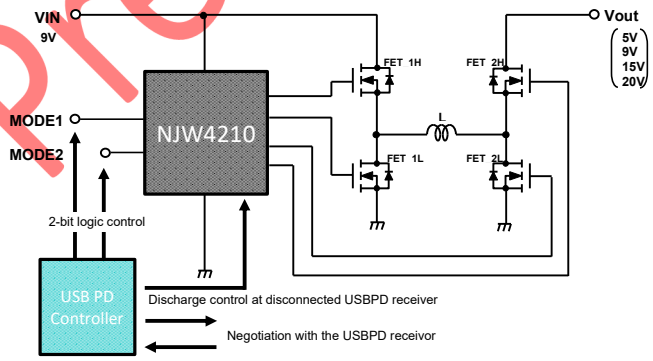
The NJW4210 built-in Nch. MOSFET driver and performs synchronous rectification operation in all switching topologies (boost, step-down, buck-boost).

The NJW4210 has output voltage select function with 2-bit logic input and is compatible with USB PB standard voltages 5V, 9V, 15V and 20V.

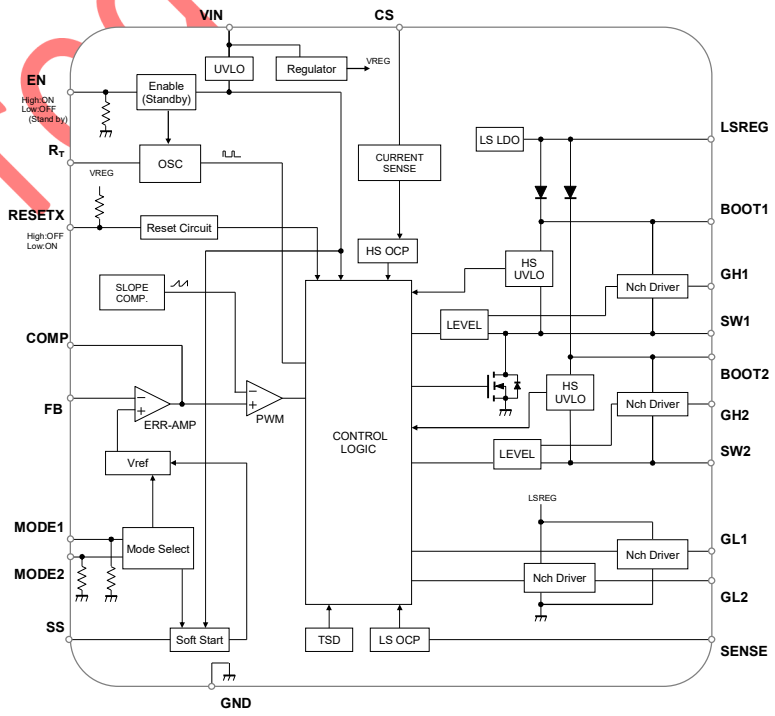
The NJW4210 has multiple protection circuits and mounted in a small leadless package EQFN24.

These features make the NJW4210 suitable for USB PD devices including automotive applications.

■ TYPICAL APPLICATION



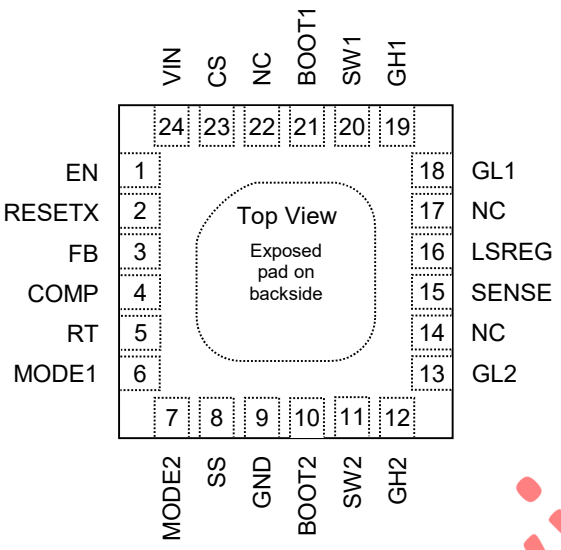
■ BLOCK DIAGRAM



PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

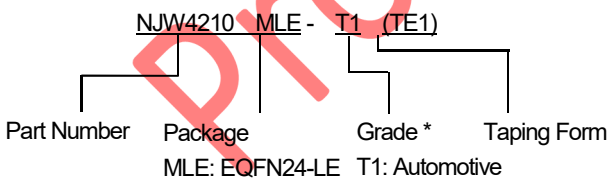
■ PIN CONFIGURATIONS

EQFN24-LE



PIN NO.	SYMBOL	DESCRIPTION	PIN NO.	SYMBOL	DESCRIPTION
1	EN	Enable input	13	GL2	Low-side drive output 2
2	RESETX	Reset input (Enable High)	14	N.C.	N.C.
3	FB	Voltage feedback input	15	SENSE	Switching current sense input
4	COMP	Error amp output	16	LSREG	Internal regulator output
5	RT	Oscillation frequency setting(RT)	17	N.C.	N.C.
6	MODE1	Mode select 1 input	18	GL1	Low-side drive output 1
7	MODE2	Mode select 2 input	19	GH1	High-side drive output 1
8	SS	Soft start setting pin	20	SW1	Switching node voltage input 1
9	GND	Ground	21	BOOT1	Bootstrap input 1
10	BOOT2	Bootstrap input 2	22	N.C.	N.C.
11	SW2	Switching node voltage input 2	23	CS	Input current sense input
12	GH2	High-side drive output 2	24	VIN	Supply voltage input

■ PRODUCT NAME INFORMATION



* The detail information of automotive grades and recommended applications are described in NJR Web site.
(https://www.njr.com/electronic_device/semiconductor/application/automotive.html)

■ ORDERING INFORMATION

PRODUCT NAME	PACKAGE	RoHS	HALOGEN-FREE	TERMINAL FINISH	MARKING	WEIGHT (mg)	MOQ (pcs)
NJW4210MLE-T1 (TE1)	EQFN24-LE	yes	yes	yes	4210T	31	1000

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	RATINGS		UNIT
VIN pin voltage	V_{IN}	-0.3 to +45		V
CS pin voltage	V_{CS}	-0.3 to +45		V
VIN pin to CS pin voltage	V_{IN}-V_{CS}	7		V
BOOTx voltage	V_{BOOT1} V_{BOOT2}	-0.3 to +45		V
GHx pin voltage	V_{GH1} V_{GH2}	-0.3 to +45		V
SWx pin voltage	V_{SW1} V_{SW2}	-0.3 to +45		V
BOOTx pin to SWx pin voltage	V_{BOOT1}-V_{SW1} V_{BOOT2}-V_{SW2}	+7		V
GHx pin to SWx pin voltage	V_{GH1}-V_{SW1} V_{GH2}-V_{SW2}	+7		V
GLx pin voltage	V_{GL1} V_{GL2}	-0.3 to +7		V
LSREG pin voltage	V_{LSREG}	-0.3 to +7		V
SENSE pin voltage	V_{SENSE}	-0.3 to +7		V
EN pin voltage	V_{EN}	-0.3 to +45		V
RESETX pin voltage	V_{RESETX}	-0.3 to +45		V
RT pin voltage	V_{RT}	-0.3 to +7		V
FB pin Voltage	V_{FB}	-0.3 to +7		V
COMP pin voltage	V_{COMP}	-0.3 to +7		V
MODEx pin voltage	V_{MODE1} V_{MODE2}	-0.3 to +7		V
SS pin Voltage	V_{SS}	-0.3 to +7		V
Power Dissipation(Ta=25°C)	P_D	EQFN24-LE	1000 (1) 2400 (2)	mW
Junction Temperature	Tj	-40 to +150		°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, with Exposed Pad)
(2): Mounted on glass epoxy board. (101.5×114.5×1.6mm:based on EIA/JEDEC standard,4layers, with Exposed Pad)
(For 4Layers: Applying 99.5×99.5mm inner Cu area and a thermal via hole to a board based on JEDEC standard JESD51-5)

■ RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	VALUE	UNIT
Supply voltage	V_{IN}	4.8 to 36	V
EN pin voltage	V_{EN}	0 to 40	V
RESETX pin voltage	V_{RESETX}	0 to 5.5	V
MODEx pin voltage	V_{MODE1} V_{MODE2}	0 to 5.5	V
Timing Resistor	R_T	6.8 to 56	kΩ
Operating Frequency	f_{OSC}	100 to 700	kHz
CLSREG	C_{LSREG}	1	µF
CBOOT	C_{BOOT}	0.1	µF
Operating Temperature	T_{opr}	-40 to +125	°C

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, V_{IN}= 12V, V_{EN}=5V, V_{SENSE}=0V, R_T=10kΩ Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
GENERAL CHARACTERISTICS						
Quiescent Current	I_Q	Not Switching	–	3	4.5	mA
		Not Switching Ta = -40ºC to +125ºC	–	–	6	
Standby Current	I_{Q_STBY}	V_{EN} = L	–	1	2	µA
		V_{EN} = L Ta = -40ºC to +125ºC	–	–	3	
UNDER VOLTAGE LOCKOUT						
ON Threshold Voltage	V_{T_ON}	V_{IN} = L → H	4.5	4.65	4.8	V
		V_{IN} = L → H Ta = -40°C to +125°C	4.5	–	4.8	
OFF Threshold Voltage	V_{T_OFF}	V_{IN} = H → L	4.3	4.45	4.6	V
		V_{IN} = H → L Ta = -40°C to +125°C	4.3	–	4.6	
Hysteresis Voltage	V_{HYS}		100	200	–	mV
EN CONTROL (EN)						
High Threshold Voltage	V_{THH_EN}	V_{EN} = L → H	1.6	–	V_{IN}	V
		V_{EN} = L → H Ta = -40ºC to +125ºC	1.7	–	V_{IN}	
Low Threshold Voltage	V_{THL_EN}	V_{EN} = H → L	0	–	0.5	V
		V_{EN} = H → L Ta = -40ºC to +125ºC	0	–	0.4	
Input Bias Current	I_{EN}	V_{EN} = 5V	–	2	4.5	µA
		V_{EN} = 5V Ta = -40ºC to +125ºC	–	–	6	
RESET CONTROL (RESETX)						
ON Threshold Voltage	V_{THH_RESETX}	V_{RESETX} = H→ L	0	–	0.5	V
		V_{RESETX} = H → L Ta = -40ºC to +125ºC	0	–	0.4	
OFF Threshold Voltage	V_{THL_RESETX}	V_{RESETX} =L → H	2	–	5.5	V
		V_{RESETX} =L → H Ta= -40ºC to +125ºC	2.1	–	5.5	
Input Bias Current	I_{RESETX}	V_{RESETX} =0V	–	-5	-8	µA
		V_{RESETX} =0V Ta = -40ºC to +125ºC	–	–	-10	

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, V_{IN}= 12V, V_{EN}=5V, V_{SENSE}=0V, R_T=10kΩ, Ta=25°C)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
ERROR AMP.						
Reference Voltage 1	V_{B1}	MODE1 = L, MODE2 = L	-1.0%	0.5	+1.0%	V
		MODE1 = L, MODE2 = L Ta = -40ºC to +125ºC	-2.0%	–	+2.0%	
Reference Voltage 2	V_{B2}	MODE1 = H, MODE2 = L	-1.5%	0.9	+1.5%	V
		MODE1 = H, MODE2 = L Ta = -40ºC to +125ºC	-2.5%	–	+2.5%	
Reference Voltage 3	V_{B3}	MODE1 = L, MODE2 = H	-1.5%	1.5	+1.5%	V
		MODE1 = L, MODE2 = H Ta = -40ºC to +125ºC	-2.5%	–	+2.5%	
Reference Voltage 4	V_{B4}	MODE1 = H, MODE2 = H	-1.5%	2	+1.5%	V
		MODE1 = H, MODE2 = H Ta = -40ºC to +125ºC	-2.5%	–	+2.5%	
Input Bias Current	I_{FB}		-0.1	–	0.1	µA
		Ta = -40ºC to +125ºC	-0.2	–	0.2	
SOFT START						
SS pin Output Current	I_{SS}		12	16	20	µA
		Ta = -40°C to +125°C	10	–	22	
CURRENT SENSE (SENSE)						
Threshold Voltage	V_{SENSE}		100	130	160	mV
		Ta = -40ºC to +125ºC	80	–	180	
Input Bias Current	I_{SENSE}	V_{SENSE} = 5V	–	–	0.1	µA
		V_{SENSE} = 5V Ta = -40ºC to +125ºC	–	–	0.2	
Cool Down Time	t_{COOL}		–	110	–	ms
CURRENT SENSE (CS)						
Threshold Voltage	V_{CS}		100	130	160	mV
		Ta = -40ºC to +125ºC	80	–	180	
Input Bias Current	I_{CS}	V_{IN} - V_{CS} = 5V	–	–	0.1	µA
		V_{IN} - V_{CS} = 5V Ta = -40ºC to +125ºC	–	–	0.2	
Cool Down Time	t_{COOL}		–	110	–	ms

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ ELECTRICAL CHARACTERISTICS

(Unless otherwise noted, V_{IN}= 12V, V_{EN}=5V, V_{SENSE}=0V, R_T=10kΩ, Ta=25°C)

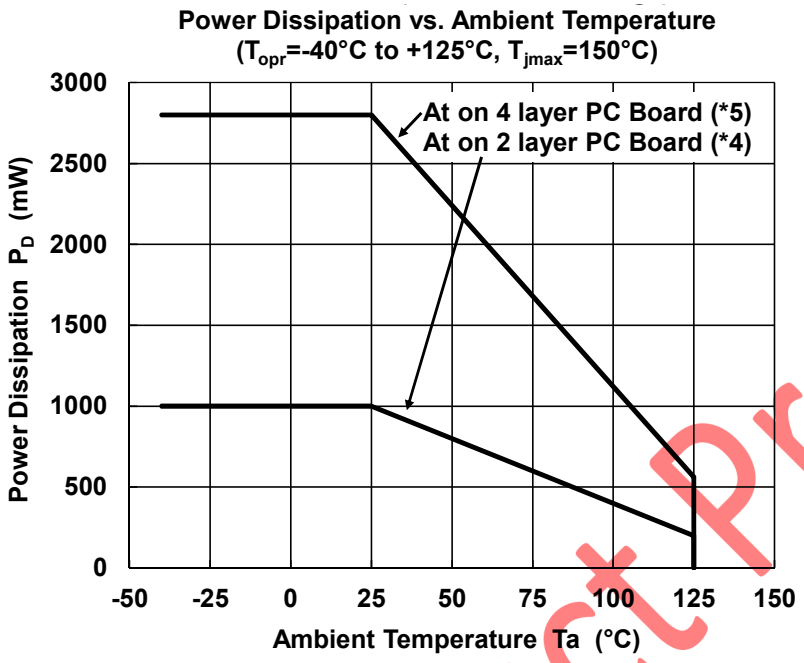
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
OSCILLATOR						
Oscillating Frequency 1	f_{OSC1}	R_T = 56kΩ	90	100	110	kHz
		R_T = 56kΩ Ta = -40°C to +125°C	85	–	115	
Oscillating Frequency 2	f_{OSC2}	R_T = 10kΩ	450	500	550	kHz
		R_T = 10kΩ Ta = -40°C to +125°C	425	–	575	
Oscillating Frequency 3	f_{OSC3}	R_T = 6.8kΩ	630	700	770	kHz
		R_T = 6.8k kΩ Ta = -40°C to +125°C	595	–	805	
PWM COMPARATOR						
Minimum OFF Time	$t_{OFF-min}$		–	350	–	ns
Minimum ON Time	t_{ON-min}		–	80	–	ns
LDO						
Output Voltage	V_{LSREG}	V_{IN} = 12V	4.5	5.0	5.5	V
		V_{IN} = 12V Ta = -40°C to +125°C	4.5	–	5.5	
Dropout Voltage	$V_{DROPOUT}$	I_{LSREG} = -50mA	300	400	500	mV
		I_{LSREG} = -50mA Ta = -40°C to +125°C	200	–	600	
GATE DRIVER						
HS Output ON Resistance	R_{GHH1} R_{GHH2} R_{GLH1} R_{GLH2}	I_{GxHx} = -50mA	–	3	4.5	Ω
		I_{GxHx} = -50mA, Ta = -40°C to +125°C	–	–	7	
LS Output ON Resistance	R_{GHL1} R_{GHL2} R_{GLL1} R_{GLL2}	I_{GxLx} = +50mA	–	3	4.5	Ω
		I_{GxLx} = +50mA, Ta = -40°C to +125°C	–	–	7	
SW1 pin Shunt Switch ON Resistance	R_{ON-SW1}		–	35	–	Ω
MODE CONTROL (MODEx)						
ON Threshold Voltage	V_{THH_MODE1} V_{THH_MODE2}	V_{THH_MODEx} = L → H	2	–	5.5	V
		V_{THH_MODEx} = L → H Ta = -40°C to +125°C	2.1	–	5.5	
OFF Threshold Voltage	V_{THL_MODE1} V_{THL_MODE2}	V_{THL_MODEx} = H → L	0	–	0.5	V
		V_{THL_MODEx} = H → L Ta = -40°C to +125°C	0	–	0.4	
Input Bias Current	I_{MODE1} I_{MODE2}	V_{THL_MODEx} = 5V	–	10	12	μA
		V_{THL_MODEx} = 5V Ta = -40°C to +125°C	–	–	14	

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ THERMAL CHARACTERISTICS

PARAMETER	SYMBOL	VALUE	UNIT
Junction-To-Ambient Thermal Resistance EQFN24-LE	θ_{ja}	2-Layer / 4-Layer 126 (4) / 45 (5)	°C/W
Junction-To-Top of Package Characterization Parameter EQFN24-LE	Ψ_{jt}	2-Layer / 4-Layer / High Power 4-Layer 8.0 (4) / 2.8 (5)	°C/W

■ POWER DISSIPATION vs. AMBIENT TEMPERATURE



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

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ TYPICAL CHARACTERISTICS

In preparation

■ APPLICATION NOTE

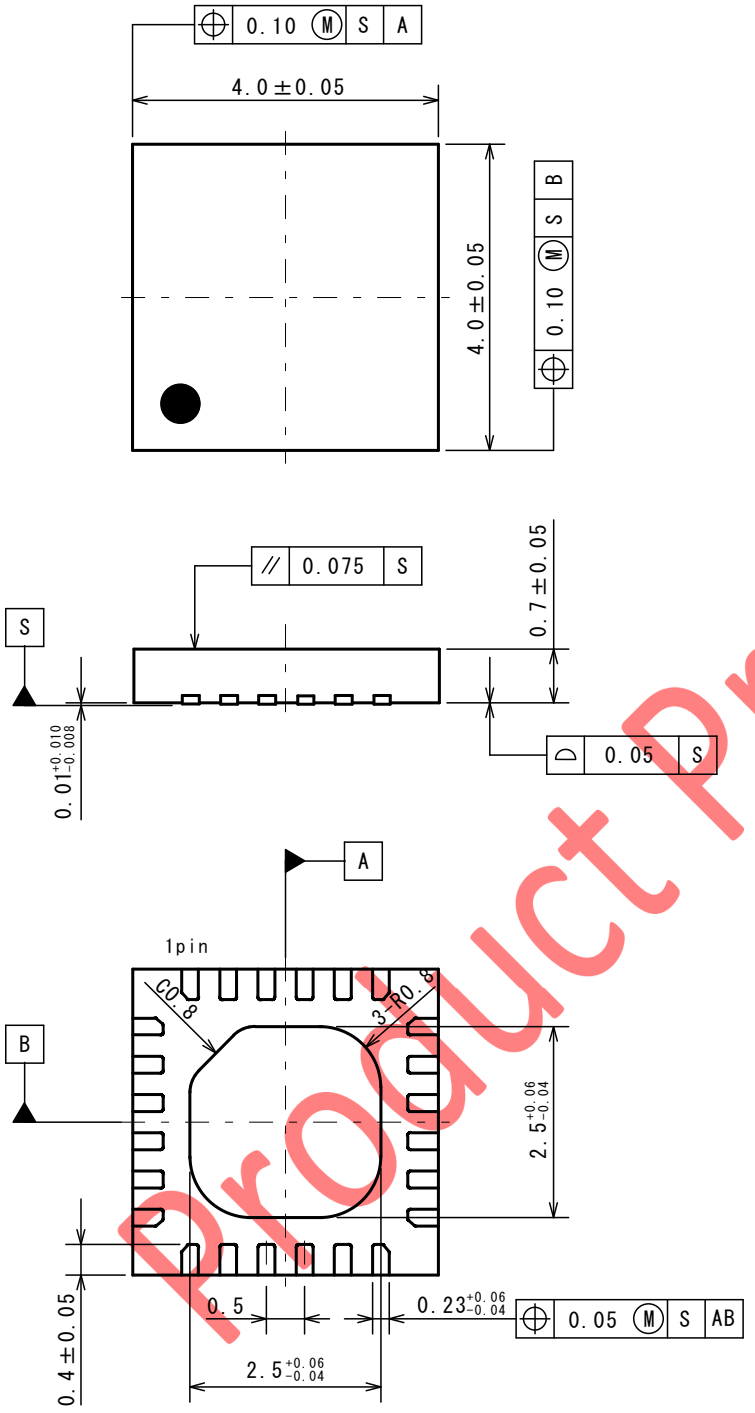
In preparation

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

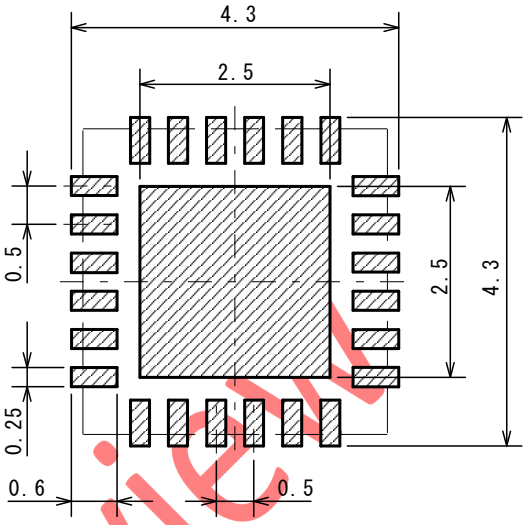
EQFN24-LE

Unit: mm

■ PACKAGE DIMENSIONS



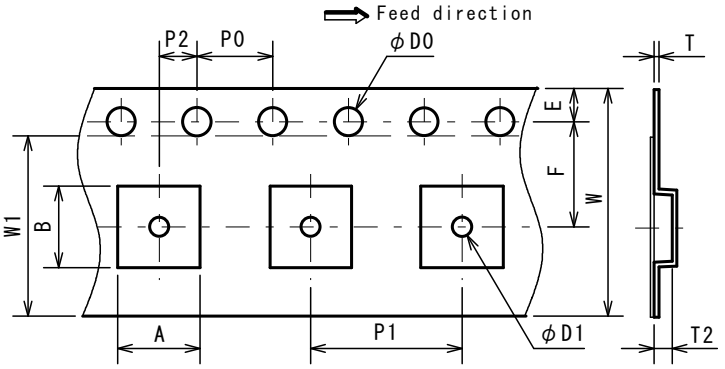
■ EXAMPLE OF SOLDER PADS DIMENSIONS



Unit: mm

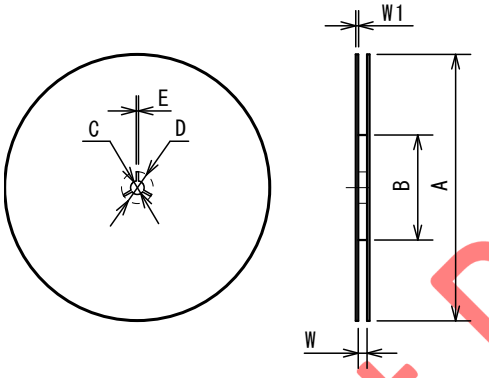
■ PACKING SPEC

TAPING DIMENSIONS



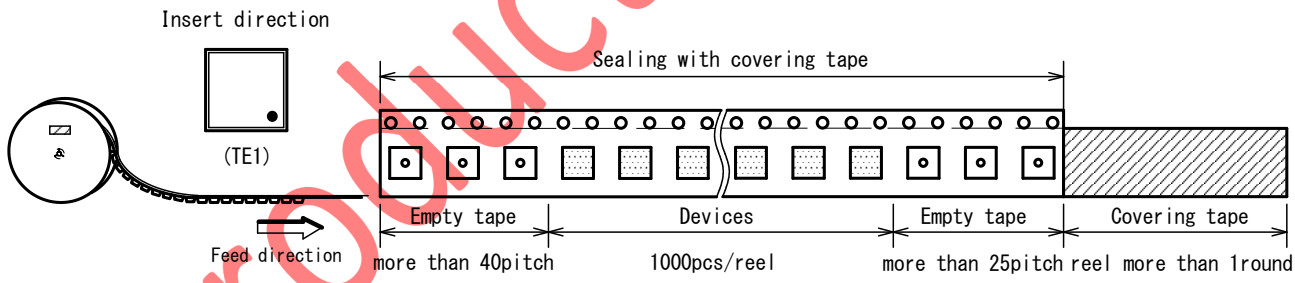
SYMBOL	DIMENSION	REMARKS
A	4.35±0.05	BOTTOM DIMENSION
B	4.35±0.05	BOTTOM DIMENSION
D0	$1.5^{+0.1}_{0}$	
D1	1.0±0.1	
E	1.75±0.1	
F	5.5±0.05	
P0	4.0±0.1	
P1	8.0±0.1	
P2	2.0±0.1	
T	0.3±0.05	
T2	1.3±0.05	
W	12.0±0.3	
W1	9.5	THICKNESS 0.1max

REEL DIMENSIONS

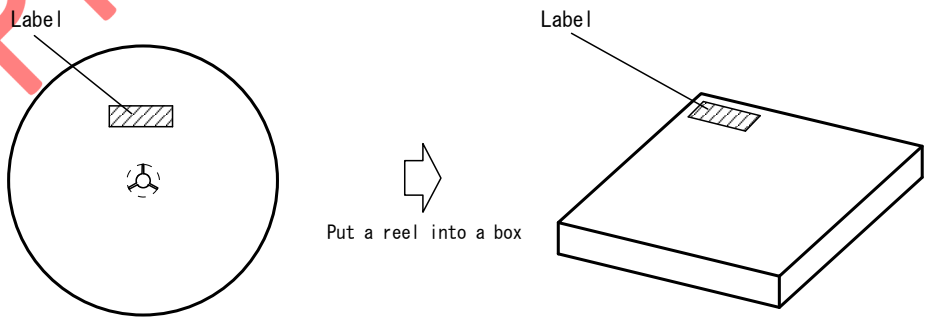


SYMBOL	DIMENSION
A	$\phi 180^{0}_{-1.5}$
B	$\phi 60^{+1}_{0}$
C	φ 13±0.2
D	φ 21±0.8
E	2±0.5
W	$13^{+1.0}_{0}$
W1	1.2

TAPING STATE



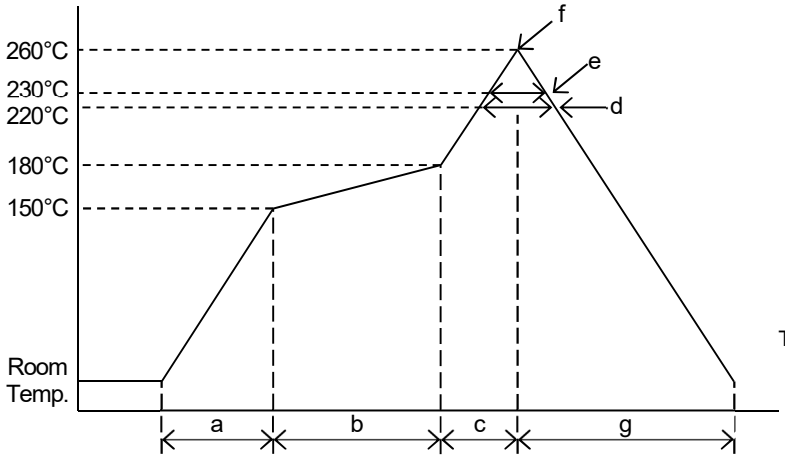
PACKING STATE



PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

■ RECOMMENDED MOUNTING METHOD

INFRARED REFLOW SOLDERING PROFILE



a	Temperature ramping rate	1 to 4°C/s
b	Pre-heating temperature Pre-heating time	150 to 180°C 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
March 31, 2021	Ver.0.8	Revised datasheet format Add AEC-Q100 qualification status, a precaution for recommended application and web link for the description of automotive grade.

PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE

[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.