

4 A, 31 V, 350 kHz, Buck Converter NR110K

Description

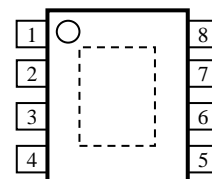
The NR110K is buck converter ICs that integrate the power MOSFET. With the current mode control, ultra low ESR capacitors such as ceramic capacitors can be used. The ICs have protection functions such as Overcurrent Protection (OCP), Under-Voltage Lockout (UVLO) and Thermal Shutdown (TSD). An adjustable Soft-Start by an external capacitor prevents the excessive inrush current in startup. The feature increasing efficiency at light loads allows the device to be used in the energy-saving applications. The ICs integrate phase compensation circuit which reduces the number of external components and simplifies the design of customer application. The IC has the EN pin that turns the regulator on or off, and achieves low power consumption requirements. The package of NR117K is the HSOP8 with an exposed thermal pad on the back side.

Features

- Up to 90% Efficiency
($V_{IN} = 12\text{ V}$, $V_O = 5\text{ V}$, $I_O = 1\text{ A}$)
Up to 70% Efficiency at Maximum at Ligh Load
($V_{IN} = 12\text{ V}$, $V_O = 5\text{ V}$, $I_O = 30\text{ mA}$)
- Current mode PWM control
- Stable with Low ESR Ceramic Output Capacitors
- No External Components Required by Incorporating Phase Compensation
- Soft-Start Function
Adjustable Soft-Start time with an External Capacitor
- External ON/OFF Function
- Protection Functions:
 - Overcurrent Protection (OCP): Drooping, auto-restart
 - Thermal Shutdown (TSD): Auto-restart
 - Under Voltage Lockout (UVLO)

Package

HSOP8



Not to scale

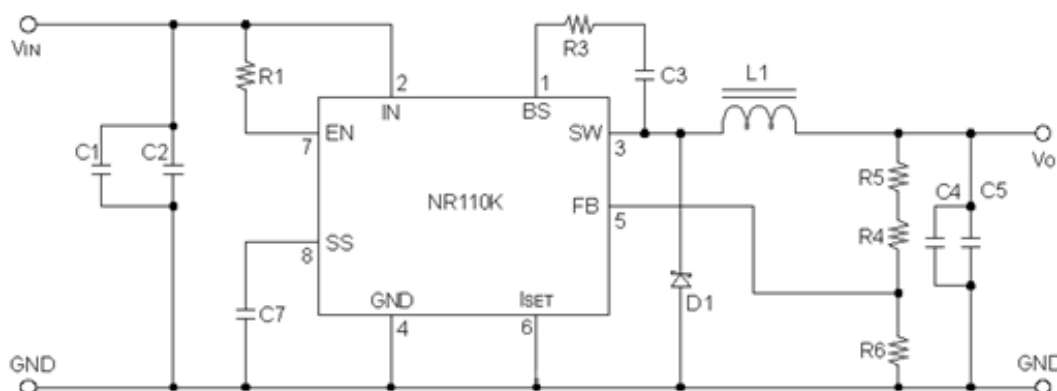
Specification

- Input Voltage, $V_{IN} = 8\text{ V}$ to 31 V
- Output Voltage, $V_O = 0.8\text{ V}$ to 24 V
- Maximum Output Current, $I_O = 4\text{ A}$
- Operation Frequency 350 kHz

Application

- AV Equipment
- Auxiliary Power Supply

Typical Application



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1. Absolute Maximum Ratings

Unless otherwise specified, $T_A = 25\text{ }^{\circ}\text{C}$.

Parameter	Symbol	Conditions	Rating	Unit	Remarks
DC Input Voltage	V_{IN}		35	V	
BS Pin Voltage	V_{BS}		44	V	
BS–SW Voltage	V_{BS-SW}	DC	8	V	
		Pulse width $\leq 30\text{ns}$	12		
SW Pin Voltage	V_{SW}		35	V	
FB Pin Voltage	V_{FB}		5.5	V	
EN Pin Voltage	V_{EN}		35	V	
SS Pin Voltage	V_{SS}		5.5	V	
Power Dissipation ⁽¹⁾	P_D	The IC is mounted on the glass-epoxy board (30 × 30mm) with copper area 25 × 25mm) $T_J \text{ Max} = 150\text{ }^{\circ}\text{C}$	1.69	W	
Junction Temperature ⁽²⁾	T_J		–40 to 150	$^{\circ}\text{C}$	
Storage Temperature	T_S		–40 to 150	$^{\circ}\text{C}$	
Thermal Resistance (junction–GND Pin)	θ_{JP}		40	$^{\circ}\text{C}/\text{W}$	
Thermal Resistance (junction–ambient air)	θ_{JA}	The IC is mounted on the glass-epoxy board (30 × 30mm) with copper area (25 × 25 mm)	74	$^{\circ}\text{C}/\text{W}$	

2. Recommended Operating Conditions

Parameter	Symbol	Ratings		Units	Conditions
		Min.	Max.		
DC Input Voltage ⁽¹⁾	V_{IN}	8	31	V	
DC Output Current ⁽²⁾⁽³⁾	I_O	0	4.0	A	
Output Voltage	V_O	0.8	24	V	
Ambient Operating Temperature ⁽³⁾	T_{OP}	–40	85	$^{\circ}\text{C}$	

⁽¹⁾ Limited by thermal shutdown.

⁽²⁾ The temperature detection of thermal shutdown is about 160 $^{\circ}\text{C}$.

⁽¹⁾ The minimum value of input voltage is taken as the larger one of either 8 V or $V_O + 3\text{ V}$.

When $I_O < 1\text{ A}$, $V_{IN} = V_O + 1$.

Input voltage is limited by the maximum ON duty. $V_{IN} > V_O / 0.9$ (typ.)

⁽²⁾ See Typical Application Circuit for recommended circuit.

⁽³⁾ To be used within the allowable package power dissipation characteristics.

3. Electrical Characteristics

Unless otherwise specified, $T_A = 25\text{ }^{\circ}\text{C}$.

Parameter		Symbol	Conditions	Min.	Typ.	Max.	Unit
Reference Voltage		V _{REF}	V _{IN} = 12 V, I _O = 1.0 A	0.784	0.800	0.816	V
Output Voltage Temperature Coefficient		ΔV _{REF} /ΔT	V _{IN} = 12 V, I _O = 1.0 A, −40 °C to +85 °C	—	±0.05	—	mV/°C
Switching Frequency		f _{OSC}	V _{IN} = 12 V, V _O = 5 V、I _O = 1.0 A	280	350	420	kHz
Line Regulation ⁽⁴⁾		V _{Line}	V _{IN} = 8 V to 31 V, V _O = 5 V, I _O = 1.0 A	—	50	—	mV
Load Regulation ⁽⁴⁾		V _{Load}	V _{IN} = 12 V, V _O = 5 V, I _O = 0.1 A~2.0 A	—	50	—	mV
Overcurrent Protection Threshold		I _S	V _{IN} = 12 V, V _O = 5 V, ISET = GND	—	5.5	—	A
Overcurrent Protection Threshold		I _{S1}	V _{IN} = 12 V, V _O = 5 V, ISET = Open		1.5		A
		I _{S2}	V _{IN} = 12 V, V _O = 5 V, ISET = GND		5.5		A
Supply Current		I _{IN}	V _{IN} = 12 V, V _O = 5 V, I _O = 0 A	—	1.0	—	mA
Shutdown Supply Current		I _{IN(off)}	V _{IN} = 12 V, V _O = 5 V, I _O = 0 A, V _{EN} = 0 V	—	1.0	—	μA
SS Pin	Source current at Low Level Voltage	I _{EN/SS}	V _{SS} = 0 V, V _{IN} = 12 V	6	10	14	μA
EN Pin	Sink Current	I _{EN}	V _{EN} = 10 V	—	16	50	μA
	Threshold Voltage	V _{C/EH}	V _{IN} = 12 V	0.7	1.4	2.1	V
Max On-duty ⁽⁴⁾		D _{MAX}		—	90	—	%
Minimum On-time ^{(4) (5)}		t _{ON(MIN)}		—	150	—	ns
Thermal Shutdown Threshold Temperature ⁽⁴⁾		TSD		151	165	—	°C
Thermal Shutdown Restart Hysteresis of Temperature ⁽⁴⁾		TSD_hys		—	20	—	°C
High-side Switch ON Resistance ⁽⁴⁾		R _{ON(H)}		—	85	—	mΩ

⁽⁴⁾ Guaranteed by design, not tested.

⁽⁵⁾ Input/ Output conditions are controlled by the minimum on time.

4. Typical Performance Characteristics

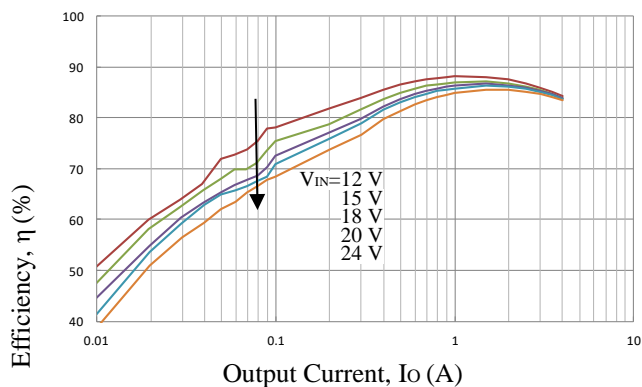
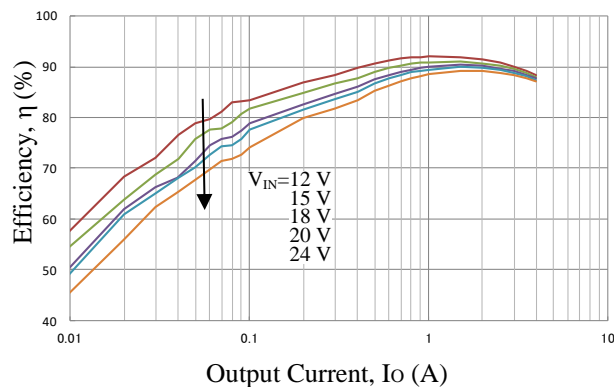
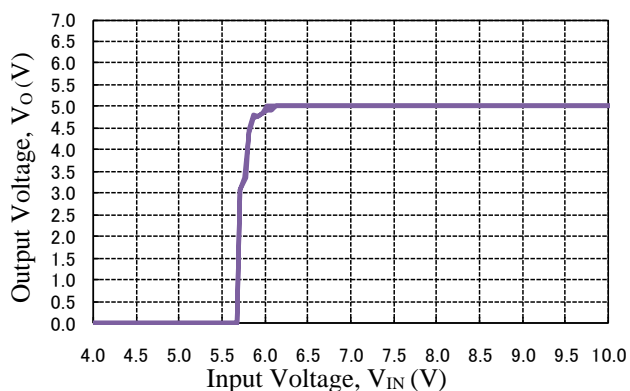
Figure 4-1. Efficiency ($V_O = 3.3$ V)Figure 4-2. Efficiency ($V_O = 5.0$ V)

Figure 4-3. Output Startup (Load = CR)

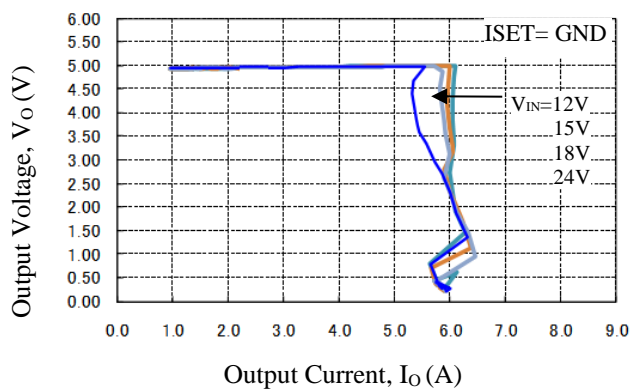


Figure 4-4. Overcurrent Protection

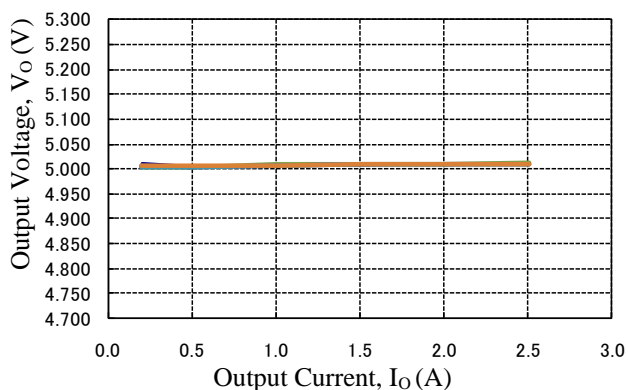


Figure 4-5. Load Regulation

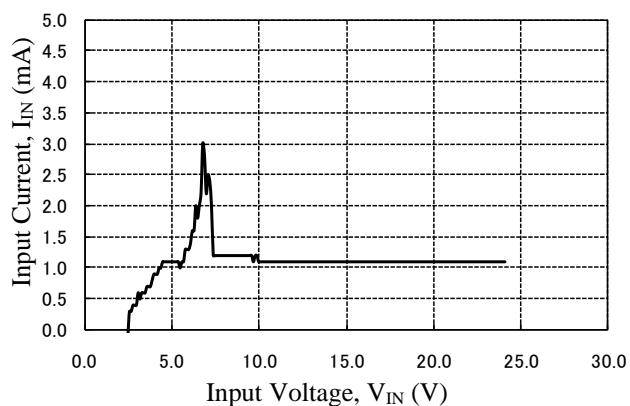


Figure 4-6. IN Pin Sink Current at No Load

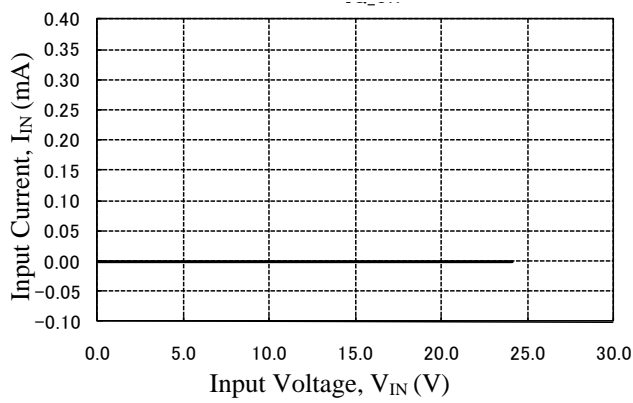


Figure 4-7. Quiescent Current

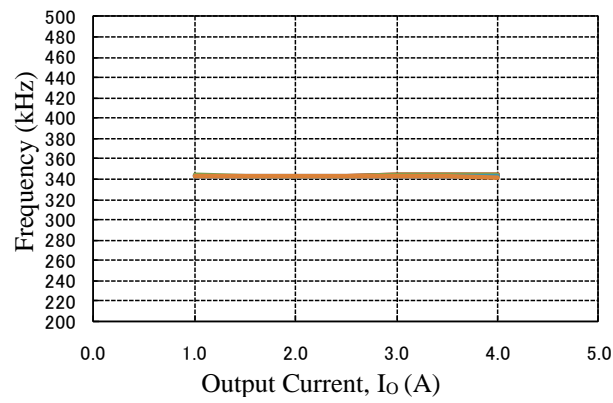
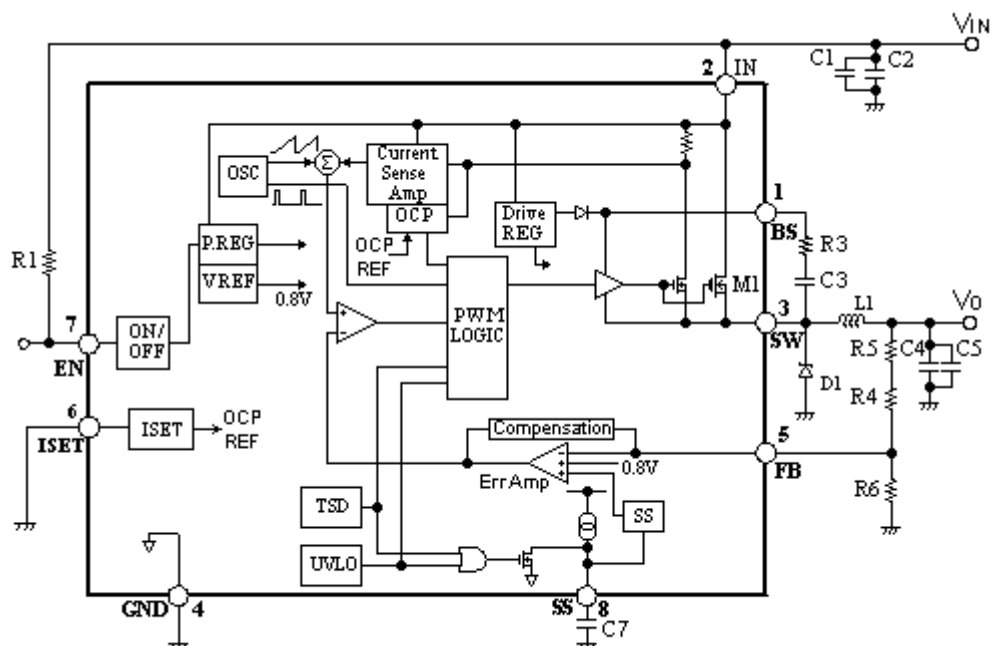
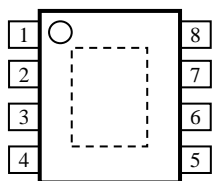


Figure 4-8. Operating Frequency

5. Block Diagram

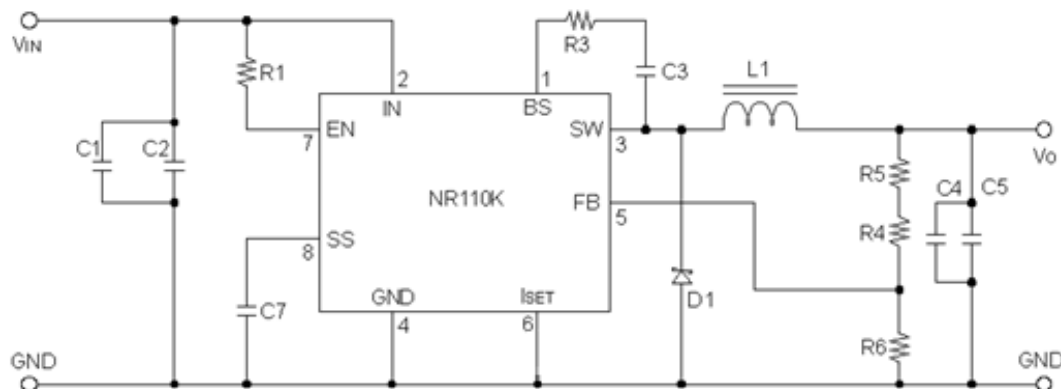


6. Pin Configuration Definitions



Pin	Name	Descriptions
1	BS	High-side boost input pin. The power is supplied to the driver of high-side Nch-MOSFET through the BS pin. A capacitor and a resistor are connected in series between the SW pin and the BS pin.
2	IN	This pin is input pin. The power is supplied to the IC through the IN pin.
3	SW	This pin is output pin. The power is output through the SW pin. Connect the LC filter for the output to the this pin A capacitor is required to be connected between this pin and the BS pin to supply the power to the high-side MOSFET.
4	GND	Ground pin. The exposed pad must be connected to the GND pin.
5	FB	To control constant voltage, the output voltage is input to the FB pin, and is compared with internal reference voltage. The feedback threshold voltage is 0.8 V. The output voltage is set by resistors connected to the FB pin. R5 and R6 are connected between the FB pin and output line. R4 is connected between the FB pin and the GND pin.
6	ISET	OCP setting pin. This pin must be shorted to the ground.
7	EN	Enable signal input pin. When high signal is input to this pin, the internal regulator turns on. When low signal is input to this pin, the internal regulator turns off.
8	SS	Soft-start input. The soft-start period can be adjusted by the capacitor connected between the SS pin and the GND pin. The soft-start operation reduces the over-shoot of the output voltage and rush current.

7. Typical Application



C1, C2: 10 μ F / 25 V

C4, C5: 22 μ F / 16 V

C7: 0.1 μ F

C3: 0.1 μ F

R1: 100 k Ω

R3: 22 Ω

R4: 1.6 k Ω

R6: 1.6 k Ω

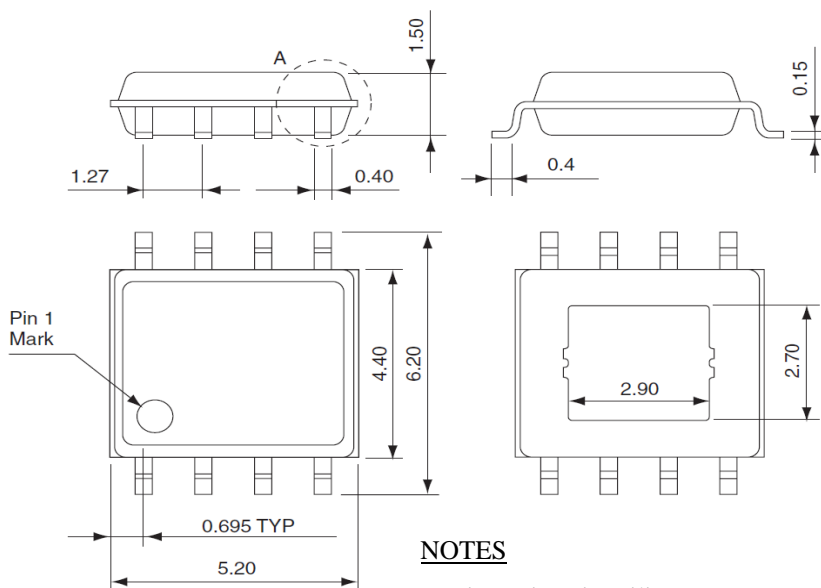
L1: 10 μ H

R5: 6.8 k Ω ($V_O = 5.0$ V)

D1: 40 V, 5 A, Schottky diode

8. Physical Dimensions

• HSOP8 Package Dimensions

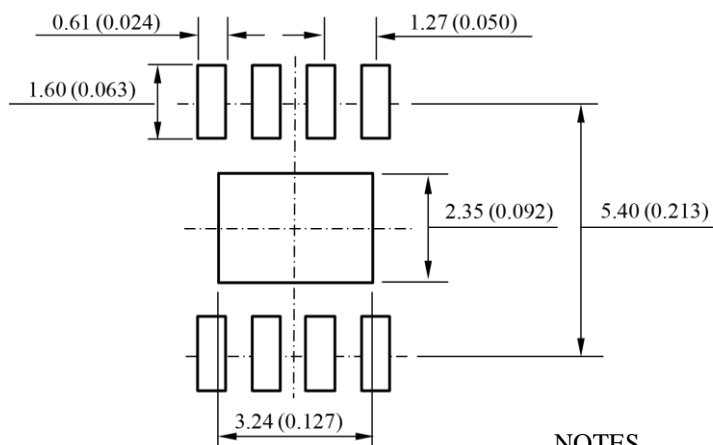


NOTES

- Dimensions in millimeters.
- Not to scale
- Pin treatment: Pb-free (RoHS compliant)
- When soldering the products, please be sure to minimize the working time, within the following limits:
 - Reflow Preheat ; 180 $^{\circ}$ C / 90 \pm 30 s
 - Solder heating ; 250 $^{\circ}$ C / 10 \pm 1 s (260 $^{\circ}$ C peak, 2 times)
- Soldering iron ; 380 \pm 10 $^{\circ}$ C / 3.5 \pm 0.5 s (1 time)

NR110K

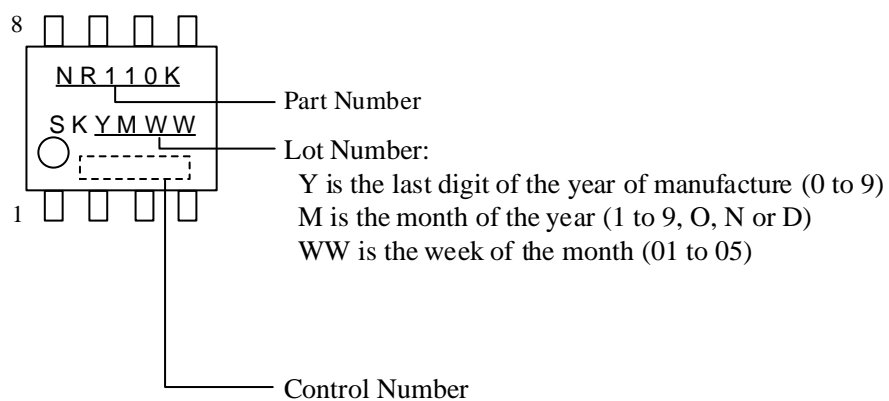
● Recommended Land Pattern



NOTES

- Dimensions in millimeters (inches)
- Not to scale

9. Marking Diagram



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