NCP630

Linear Voltage Regulators - Fast

3.0 A

The NCP630 is a low dropout positive voltage regulator that is capable of providing a guaranteed output current of 3.0 A with a maximum dropout voltage of 1.25 V at 3.0 A over temperature. The fast turn on time allows step changes in loads commonly found in low voltage microprocessor applications. The NCP630 is currently offered as an adjustable output version that can be programmed down to 1.2 V with two external resistors and as a fixed output version at 3.47 V. On chip trimming adjusts the reference/output voltage to within ±1.5% accuracy. Internal protection features consist of output current limiting and thermal shutdown. NCP630 is available in D^2PAK package.

Features

- Output Current of 3.0 A
- 1.25 V Maximum Dropout Voltage at 3.0 A Over Temperature
- Voltage on Shutdown Pin is TTL Compatible
- Reference/Output Voltage Trimmed to ±1.5%
- Current Limit Protection
- Thermal Shutdown Protection
- –40°C to 125°C Junction Temperature Range
- Pb–Free Packages are Available

Applications

- Microprocessor Power Supplies
- DSP Power Supplies
- SMPS Post Regulation
- Battery Chargers

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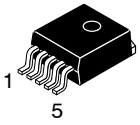
MARKING DIAGRAM



D^2PAK
D2T SUFFIX
CASE 936A



NCP630A

Tab = Ground
Pin 1. Shutdown
2. V_{in}
3. Ground
4. V_{out}
5. Adj

NCP630G

Tab = Ground
Pin 1. Shutdown
2. V_{in}
3. Ground
4. V_{out}
5. Sense

x = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb–Free Package

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 9 of this data sheet.

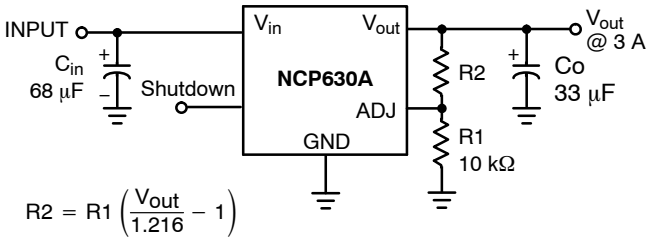


Figure 1. Typical Application Circuit for NCP630A

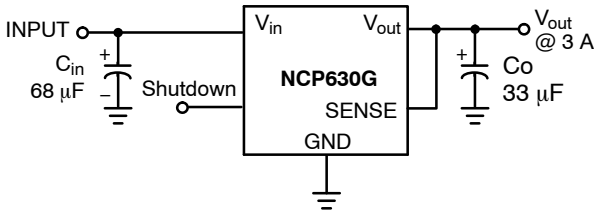


Figure 2. Typical Application Circuit for NCP630G

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MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Input Voltage (Note 1)	V_{in}	12	V
Shutdown Voltage	Shutdown	−0.3 to V_{in} + 0.3	V
Output Voltage	V_{out}	−0.3 to V_{in} + 0.3	V
Output Short Circuit Duration (Note 2)	–	Infinite	–
Power Dissipation and Thermal Characteristics Case 936F (D^2PAK) Power Dissipation (Note 2) Thermal Resistance, Junction−to−Ambient Thermal Resistance, Junction−to−Case	 P_D $R_{\theta JA}$ $R_{\theta JC}$	 Internally Limited 45 5.0	 W °C/W °C/W
Operating Junction Temperature Range	T_J	−40 to 125	°C
Storage Temperature Range	T_{stg}	−55 to 150	°C
Lead Soldering Temperature @ 260°C	T_{solder}	10	sec

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. This device series contains ESD protection and exceeds the following tests:
   Human Body Model JESD 22−A114−B
   Machine Model JESD 22−A115−A
2. The maximum package power dissipation is:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

PIN FUNCTION DESCRIPTION

Pin No.	NCP630A	NCP630G	Description
1	Shutdown	Shutdown	This input is used to place the NCP630 into shutdown mode. The NCP630 is active when a voltage greater than 2.0 V is applied. The NCP630 will be placed into a shutdown mode when a voltage less than 0.8 V is applied. If left unused then connect the pin high.
2	V_{in}	V_{in}	Positive power supply input voltage
3, Tab	Ground	Ground	Power supply ground
4	V_{out}	V_{out}	Regulated output voltage
5	Adj	–	This pin is to be Connected to the R_{sense} resistors on the output. It maintains 1.216 V between itself and ground. Refer to Figure 1 for equation.
5	–	Sense	This pin is to be connected near the load for better regulation.

ELECTRICAL CHARACTERISTICS (C_{in} = 68 μF, C_{out} = 33 μF, V_{in} = V_{out} + 1.5 V, I_{out} = 10 mA, for typical value T_J = 25°C, for min and max values T_J = −40°C to 125°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP630A					
Reference Voltage (V_{in} = V_{out} + 1.5 V to 7.0 V, I_{out} = 10 mA to 3.0 A, T_J = 25°C) (V_{in} = V_{out} + 1.5 V to 7.0 V, I_{out} = 10 mA to 3.0 A, T_J = −40°C to 125°C)	V_{adj}	 1.198 1.180	 1.216 –	 1.234 1.253	V
Line Regulation (Notes 3 and 4) (V_{in} = V_{out} + 1.5 V to 7.0 V, T_J = 25°C) (V_{in} = V_{out} + 1.5 V to 7.0 V, T_J = −40°C to 125°C)	Reg_{line}	 – –	 0.02 0.06	 – –	%
Load Regulation (Notes 3 and 4) (I_{out} = 10 mA to 3.0 A, T_J = 25°C) (I_{out} = 10 mA to 3.0 A, T_J = −40°C to 125°C)	Reg_{load}	 – –	 0.01 0.06	 – –	%
Dropout Voltage (Measured at V_{out} − 2%) (I_{out} = 300 mA) (I_{out} = 3.0 A)	V_{in}–V_{out}	 – –	 0.75 1.0	 1.0 1.25	V
Ground Pin Current in Normal Mode (I_{out} = 300 mA) (I_{out} = 3.0 A)	I_{Gnd}	 – –	 0.4 1.0	 1.0 2.0	mA
Ground Pin Current in Shutdown Mode ($V_{shutdown}$ = 0.8 V)	I_{Gnd}	 –	 15	 50	μA
Peak Output Limit	I_{out}	3.0	6.0	–	A
Short Current Limit (Note 5)	I_{SC}	–	6.5	–	A
Thermal Shutdown	–	–	165	–	°C
Shutdown Input Threshold Voltage (Voltage Increasing, Output Turns On, Logic High) (Voltage Decreasing, Output Turns Off, Logic Low)	$Vt_{th(shutdown)}$	 2.0 –	 – –	 – 0.8	V
Turn−off Delay, I_{out} = 3.0 A	$T_{D(off)}$	–	20	–	μs
Turn−on Delay, I_{out} = 3.0 A	$T_{D(on)}$	–	25	–	μs
Shutdown Input Low Current ($V_{Shutdown}$ = 0.8 V), (Negative current flows out of pin)	I_{IL}	−10	−5.0	−1.0	μA
Shutdown Input High Current ($V_{Shutdown}$ = 2.0 V), (Negative current flows out of pin)	I_{IH}	−10	−4.5	−1.0	μA
Ripple Rejection (C_{out} = 100 μF, f = 1.0 kHz)	RR	 –	 85	 –	dB
Output Noise Density (f = 120 Hz)	–	–	0.6	–	$\mu V/\sqrt{Hz}$
Output Noise Voltage (f = 20 Hz − 100 kHz)	Vn	 –	 210	 –	μV_{rms}

3. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.
4. Line regulation is defined as the change in output voltage for a change in input voltage. Load regulation is defined as the change in output voltage for a change in output load current at a constant temperature. The limits for line and load regulation are contained within the reference voltage specification, V_{adj}. Typical numbers are included in the specification for line and load regulation.
5. The short circuit limit is for device protection. Maximum output current is guaranteed to be greater or equal to 3.0 A with a 6.0 A typical as listed in the peak output limit specification.

ELECTRICAL CHARACTERISTICS (C_{in} = 68 μF, C_{out} = 33 μF, V_{in} = V_{out} + 1.5 V, I_{out} = 10 mA, for typical value T_J = 25°C, for min and max values T_J = 0°C to 125°C unless otherwise noted.)

Characteristic	Symbol	Min	Typ	Max	Unit
NCP630G					
Output Voltage (V_{in} = 5.0 V to 7.0 V, I_{out} = 10 mA to 3.0 A, T_J = 25°C) (V_{in} = 5.0 V to 7.0 V, I_{out} = 10 mA to 3.0 A, T_J = 0°C to 125°C)	V_{out}	 3.418 3.383	 3.470 –	 3.522 3.557	V
Line Regulation (Notes 6 and 7) (V_{in} = 5.0 V to 7.0 V, T_J = 25°C) (V_{in} = 5.0 V to 7.0 V, T_J = 0°C to 125°C)	Reg_{line}	 – –	 0.02 0.06	 – –	%
Load Regulation (Notes 6 and 7) (I_{out} = 10 mA to 3.0 A, T_J = 25°C) (I_{out} = 10 mA to 3.0 A, T_J = 0°C to 125°C)	Reg_{load}	 – –	 0.01 0.06	 – –	%
Dropout Voltage (Measured at V_{out} − 2%) (I_{out} = 300 mA) (I_{out} = 3.0 A)	V_{in}–V_{out}	 – –	 0.75 1.0	 1.0 1.25	V
Ground Pin Current in Normal Mode (I_{out} = 300 mA) (I_{out} = 3.0 A)	I_{Gnd}	 – –	 0.4 1.0	 1.0 2.0	mA
Ground Pin Current in Shutdown Mode ($V_{shutdown}$ = 0.8 V)	I_{Gnd}	 –	 26	 50	μA
Peak Output Limit	I_{out}	3.0	5.0	–	A
Short Current Limit (Note 8)	I_{SC}	–	5.0	–	A
Thermal Shutdown	–	–	165	–	°C
Shutdown Input Threshold Voltage (Voltage Increasing, Output Turns On, Logic High) (Voltage Decreasing, Output Turns Off, Logic Low)	$Vt_{th(shutdown)}$	 2.0 –	 – –	 – 0.8	V
Turn−off Delay, I_{out} = 3.0 A	$T_{D(off)}$	–	20	–	μs
Turn−on Delay, I_{out} = 3.0 A	$T_{D(on)}$	–	25	–	μs
Shutdown Input Low Current (V_{in} = 0.8 V), (Negative current flows out of pin)	I_{IL}	−10	−5.0	−1.0	μA
Shutdown Input High Current (V_{in} = 2.0 V), (Negative current flows out of pin)	I_{IH}	−10	−4.5	−1.0	μA
Ripple Rejection (C_{out} = 100 μF, f = 1.0 kHz)	RR	 –	 85	 –	dB
Output Noise Density (f = 120 Hz)	–	–	0.6	–	$\mu V/\sqrt{Hz}$
Output Noise Voltage (f = 10 Hz − 100 kHz)	Vn	 –	 210	 –	μV_{rms}

6. Low duty cycle pulse techniques are used during testing to maintain the junction temperature as close to ambient as possible.
7. Line regulation is defined as the change in output voltage for a change in input voltage. Load regulation is defined as the change in output voltage for a change in output load current at a constant temperature. The limits for line and load regulation are contained within the output voltage specification, V_{out}. Typical numbers are included in the specification for line and load regulation.
8. The short circuit limit is for device protection. Maximum output current is guaranteed to be greater or equal to 3.0 A with a 5.0 A typical as listed in the peak output limit specification.

TYPICAL CHARACTERISTICS

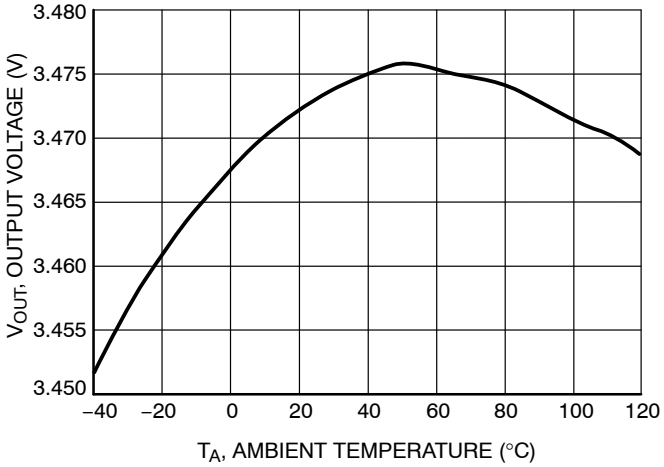


Figure 3. Output Voltage versus Temperature

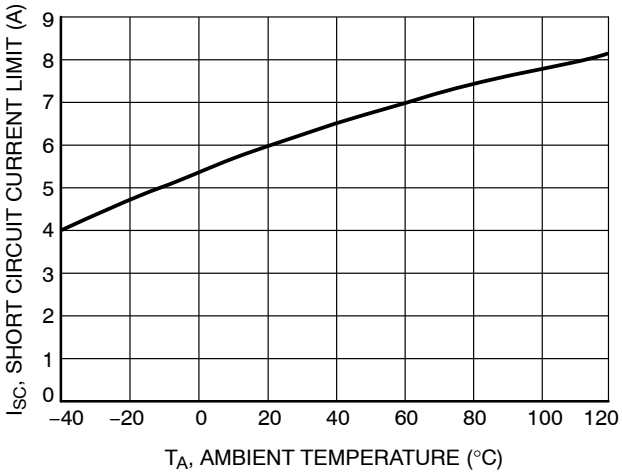


Figure 4. Short Circuit Current Limit versus Temperature

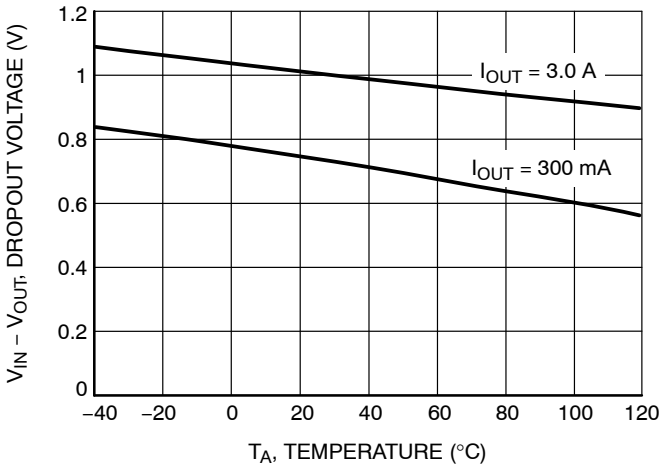


Figure 5. Dropout Voltage versus Temperature

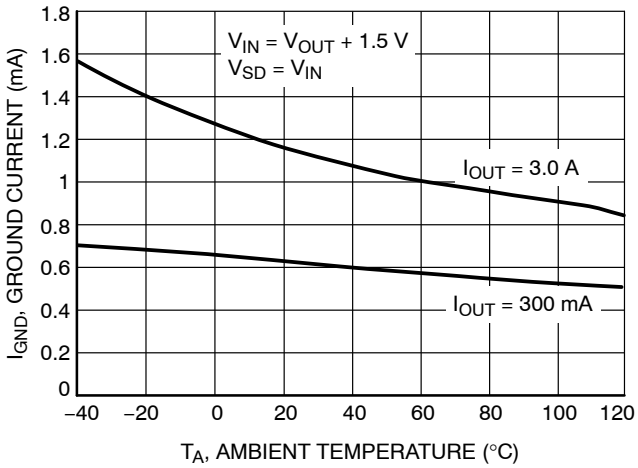


Figure 6. Ground Current versus Temperature

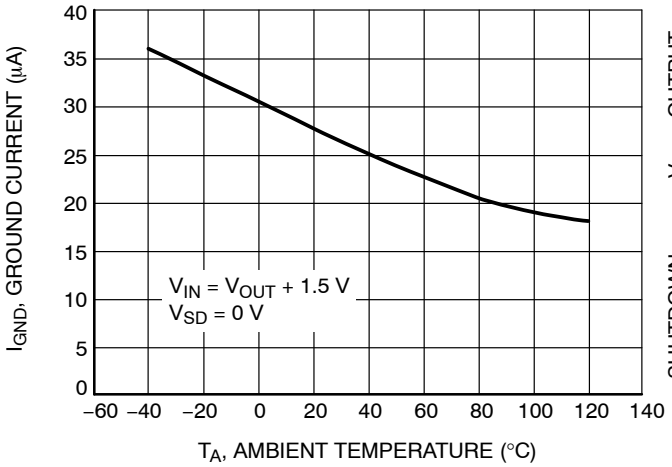


Figure 7. Ground Pin Current in Shutdown Mode versus Temperature

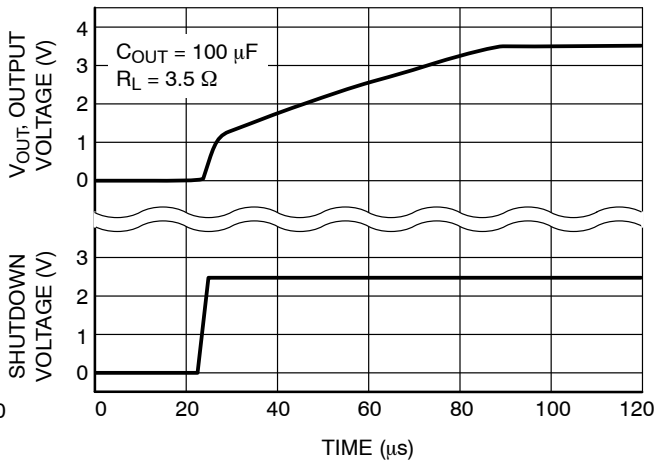


Figure 8. Start−up Transient

TYPICAL CHARACTERISTICS

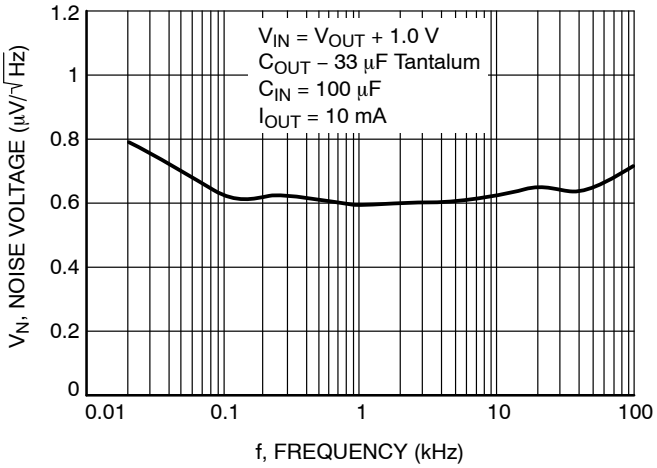


Figure 9. Output Noise Density

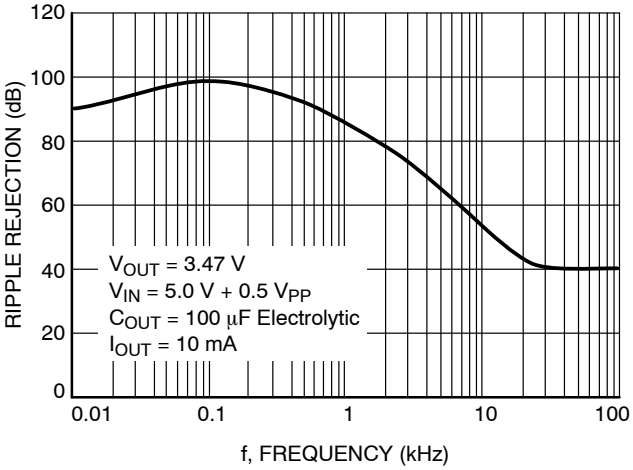


Figure 10. Ripple Rejection

APPLICATION INFORMATION

Input Capacitor

The minimum capacitance required for stability is a 68 μF aluminum electrolytic or tantalum capacitor. The maximum ESR allowed for stability is 5.0 Ω. The capacitor should be place as close as possible to the input of the device.

The placement of a ceramic capacitor in parallel is not recommend due to possible instabilities.

Output Capacitor

A minimum output capacitor value of 33 μF is required for stability. The type of capacitor can be aluminum electrolytic or tantalum capacitor. ESR can vary up to a maximum of 2.0 ohms for stability. The capacitor should be placed as close as possible to the output of the device.

The placement of a ceramic capacitor in parallel is not recommend due to possible instabilities.

Sense Pin

The sense pin of the NCP630G will need to be connected near the output voltage. This provides great advantages when the linear regulator can't be near the load. The sense pin will monitor the load and allow the linear regulator to adjust for losses in the line between itself and the load. Thus it will provide good accuracy for a remote load.

ADJ Pin

The typical application circuits for the fixed and adjustable output regulators are shown in Figures 1 and 2. The adjustable devices develop and maintain the nominal 1.216 V reference voltage between the adjust and ground pins. The adjust pin current, I_{adj}, is typically 40 nA and normally lower than the current flowing through R1 and R2, thus it generates a small output voltage error that can usually be ignored. For the fixed output devices R1 and R2 are included within the device.

Reverse Current

Some situations might occur were the output pin is raised to a voltage while the input pin is at zero volts. This situation will not damage the device.

If the output voltage is raised to a higher voltage than the input voltage a diode is recommended from output to input with the anode connect to the output pin.

Thermal Considerations

This series contains an internal thermal limiting circuit that is designed to protect the regulator in the event that the maximum junction temperature is exceeded. When activated, typically at 165°C, the regulator output switches off and then back on as the die cools. As a result, if the device is continuously operated in an overheated condition, the output will appear to be oscillating. This feature provides protection from a catastrophic device failure due to accidental overheating. It is not intended to be used as a substitute for proper heatsinking. The maximum device power dissipation can be calculated by:

$$P_D = \frac{T_{J(max)} - T_A}{R_{\theta JA}}$$

The devices are available in surface mount D^2PAK package. The package has an exposed metal tab that is specifically designed to reduce the junction to air thermal resistance, $R_{\theta JA}$, by utilizing the printed circuit board copper as a heat dissipater. Figure 11 shows typical $R_{\theta JA}$ values that can be obtained from a square pattern using economical single sided 2.0 ounce copper board material. The final product thermal limits should be tested and quantified in order to insure acceptable performance and reliability. The actual $R_{\theta JA}$ can vary considerably from the graphs shown. This will be due to any changes made in the copper aspect ratio of the final layout, adjacent heat sources, and air flow.

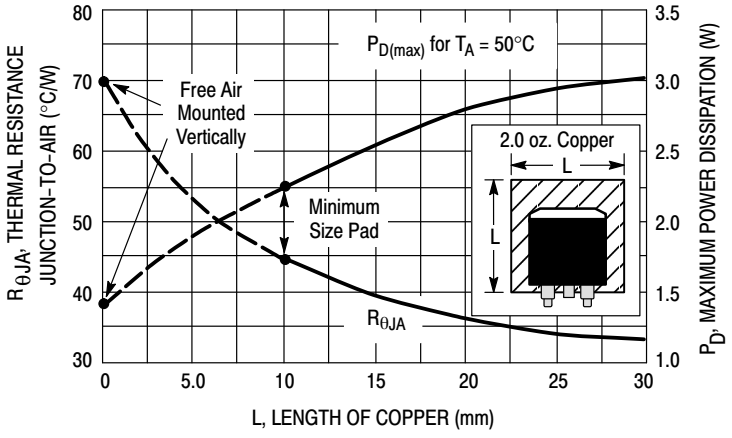
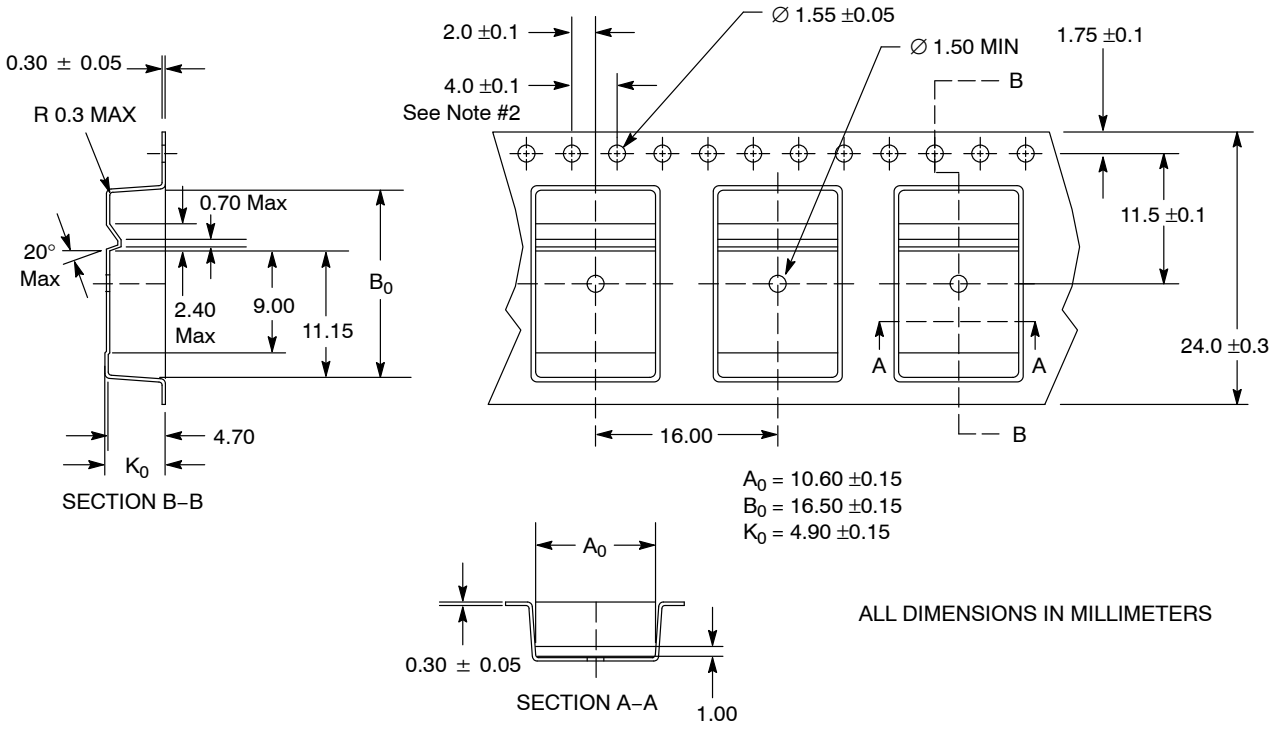


Figure 11. 3−Pin and 5−Pin D^2PAK Thermal Resistance and Maximum Power Dissipation versus P.C.B. Copper Length

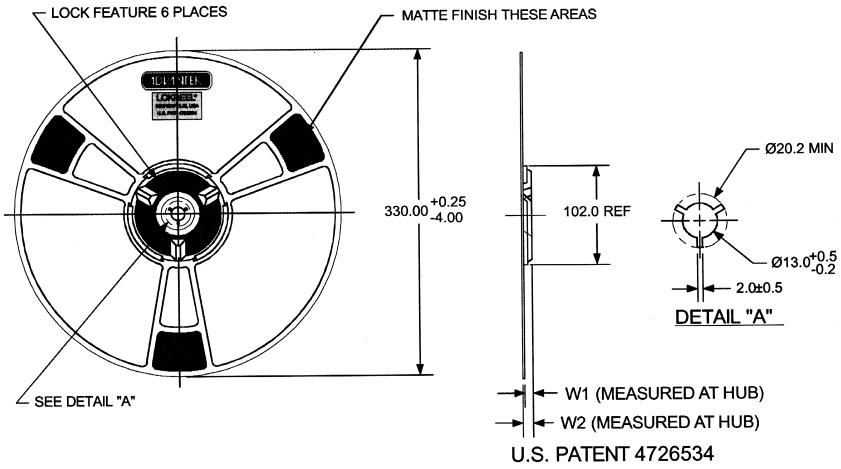
TAPE AND REEL SPECIFICATION

SOP Description	Leads	Package Length	Package Width	Package Thickness	Reel Quantity	Tape Pitch	Tape Width	Vendor P/N
D^2PAK	5	9.2 mm	10 mm	4.4 mm	800	16 mm	24 mm	DDPAK–B



NOTES:
1. A_0 & B_0 MEASURED AT 0.3 mm ABOVE BASE OF POCKET
2. 10 PITCHES CUMULATIVE TOTAL ±0.2 mm

Figure 12. Package Carrier Dimensions

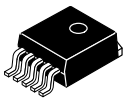


Nominal Hub Depth	W_1 $^{+3}_{-2}$	W_2MAX
4 mm	4.4	7.1
8 mm	8.4	11.1
16 mm	16.4	19.1
28 mm	28.4	31.1

Figure 13. Reel Dimensions

ORDERING INFORMATION

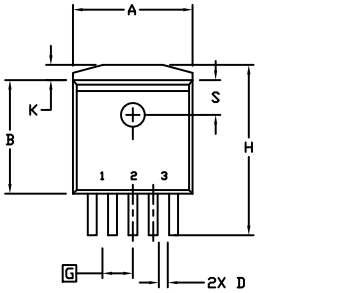
Device	Nominal Output Voltage	Package	Shipping
NCP630AD2T	Adj	D^2PAK	50 Units/Rail
NCP630AD2TG	Adj	D^2PAK (Pb−Free)	50 Units/Rail
NCP630AD2TR4	Adj	D^2PAK	800/Tape & Reel
NCP630AD2TR4G	Adj	D^2PAK (Pb−Free)	800/Tape & Reel
NCP630GD2T	3.47	D^2PAK	50 Units/Rail
NCP630GD2TG	3.47	D^2PAK (Pb−Free)	50 Units/Rail
NCP630GD2TR4	3.47	D^2PAK	800/Tape & Reel
NCP630GD2TR4G	3.47	D^2PAK (Pb−Free)	800/Tape & Reel



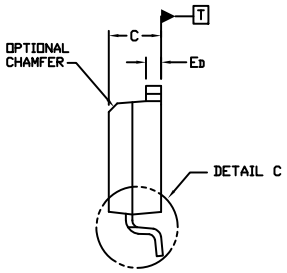
D²PAK 5–LEAD
CASE 936A–02
ISSUE E

DATE 28 JUL 2021

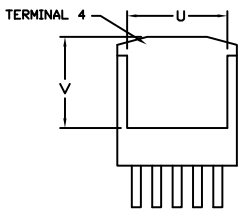
SCALE 1:1



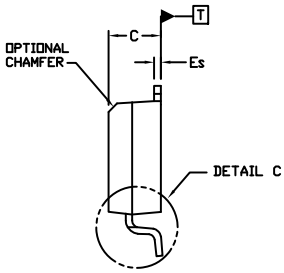
TOP VIEW



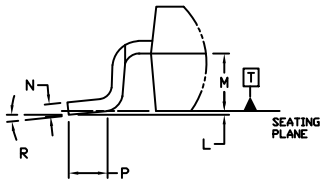
SIDE VIEW
DUAL GUAGE CONSTRUCTION



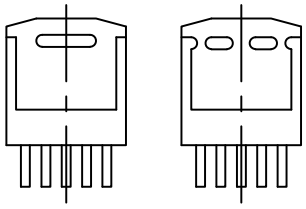
BOTTOM VIEW



SIDE VIEW
SINGLE GUAGE CONSTRUCTION



DETAIL C
TIP LEADFORM
ROTATED 90° CW



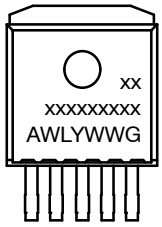
BOTTOM VIEW
OPTIONAL CONSTRUCTIONS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCHES
3. TAB CONTOUR OPTIONAL WITHIN DIMENSIONS A AND K.
4. DIMENSIONS U AND V ESTABLISH A MINIMUM MOUNTING SURFACE FOR TERMINAL 4.
5. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH OR GATE PROTRUSIONS. MOLD FLASH AND GATE PROTRUSIONS NOT TO EXCEED 0.025 (0.635) MAXIMUM.

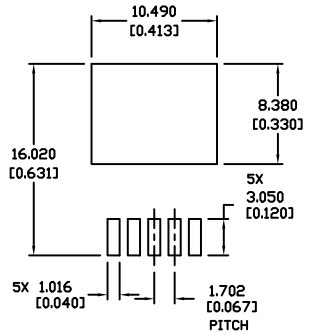
	INCHES		MILLIMETERS	
DIM	MIN.	MAX.	MIN.	MAX.
A	0.396	0.403	9.804	10.236
B	0.356	0.368	9.042	9.347
C	0.170	0.180	4.318	4.572
D	0.026	0.036	0.660	0.914
ED	0.045	0.055	1.143	1.397
ES	0.018	0.026	0.457	0.660
G	0.067 BSC		1.702 BSC	
H	0.539	0.579	13.691	14.707
K	0.050 REF		1.270 REF	
L	0.000	0.010	0.000	0.254
M	0.088	0.102	2.235	2.591
N	0.018	0.026	0.457	0.660
P	0.058	0.078	1.473	1.981
R	0°	8°	0°	8°
S	0.116 REF		2.946 REF	
U	0.200 MIN		5.080 MIN	
V	0.250 MIN		6.350 MIN	

GENERIC MARKING DIAGRAM*



XXXXXX	= Device Code
A	= Assembly Location
WL	= Wafer Lot
Y	= Year
WW	= Work Week
G	= Pb–Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb–Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.



RECOMMENDED
MOUNTING FOOTPRINT *

* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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DESCRIPTION:	**D2PAK 5–LEAD**		**PAGE 1 OF 1**

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