

Description

The DML3020UDC is a protection switch intended for applications that require reverse-current protection. The input operating voltage range is from 3.4V to 22V, and both VIN and VOUT terminals are rated at 28V absolute maximum. The power switch is capable for 15A surge current for 10ms. The DML3020UDC provides undervoltage lockout, overvoltage and overtemperature protection. The FLT pin flags thermal shutdown, overvoltage and reverse-current faults.

An internal soft-start circuit controls inrush current due to highly capacitive loads and the slew rate can be adjusted using an external capacitor. The integrated back-to-back MOSFET offers industry's lowest ON-resistance and highest SOA to safely handle high current and wide range of output capacitances on VOUT.

The DML3020UDC is housed in the low-profile and space-saving V-DFN3030-12 (Type C) package which is manufactured with environmental-friendly material.

Applications

- Thunderbolt/USB Type-C® PD power switches
- Notebooks & desktops & AIO PCs, servers, and tablets
- Docking stations, universal & multimedia hubs
- Power banks and power ORing applications

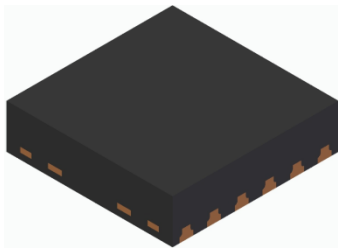
Features and Benefits

- Wide Operating Voltage Range: 3.4V to 22V
- 5.5A Continuous Sink Current
- 36mΩ Typical ON-Resistance
- Adjustable DV/DT Control at Startup
- VIN Undervoltage Lockout (UVLO)
- VIN Overvoltage Lockout (OVLO)
- Thermal Shutdown Protection (OTP)
- Ideal Diode True Reverse-Current Blocking (IDTRCB)
- Reverse-Current Protect (RCP)
- Short Circuit Protection During Startup (SCP)
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- Halogen and Antimony Free. "Green" Device (Note 3)**
- For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please [contact us](https://www.diodes.com/quality/product-definitions/) or your local Diodes representative.**

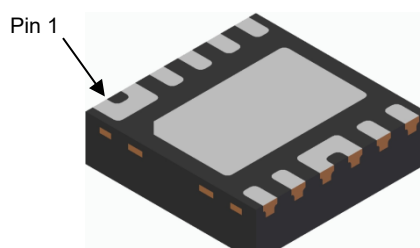
Mechanical Data

- Package: V-DFN3030-12
- Package Material: Molded Plastic, "Green" Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish — NiPdAu over Copper Leadframe. Solderable per MIL-STD-202, Method 208 @4
- Weight: 0.024 grams (Approximate)

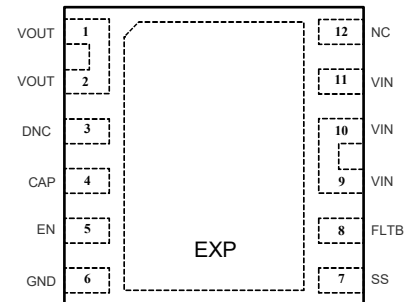
V-DFN3030-12 (Type C)



Top View



Bottom View



Top View

Ordering Information (Note 4)

Orderable Part Number	Package	Packing	
		Qty.	Carrier
DML3020UDC-13	V-DFN3030-12 (Type C)	3,000	Tape & Reel

- Notes:
- No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
 - See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
 - Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
 - For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.

Site 1

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YYWW
LS302

LS302 = Product Type Marking Code
YYWW = Date Code Marking
YY = Last Two Digits of Year (ex: 25 = 2025)
WW = Week Code (01 to 53)

YWX
LS302

LS302 = Product Type Marking Code
YWX = Date Code Marking
Y = Year (ex: 5 = 2025)
W = Week (ex: a = Week 27; z Represents Week 52 and 53)
X = Internal Code (ex: U = Monday)

Date Code Key												
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
Code	5	6	7	8	9	0	1	2	3	4	5	6

Week	1-26				27-52				53			
Code	A-Z				a-z				z			

Internal Code	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Code	T	U	V	W	X	Y	Z

August 2025
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Pin Description

Pin Number	Pin Name	Type	Function
1, 2	VOUT	O	Output pin.
3	DNC	O	Do Not Connect. Internally connected to the Exposed Pad (EXP)
4	CAP	I/O	Connect a 22nF Capacitor to GND
5	EN	I	Active-high enable signal. This pin accepts no more than 5V. "1" = Device ON; "0" = Device OFF. Pin has an internal pulldown resistor to GND.
6	GND	Ground	GND. This should be connected to the ground of the printed circuit board.
7	SS	I	Slew rate Control Input. Voltage level at this pin determines how the output voltage ramps.
8	FLT B	O	Fault status indicator. Active-Low, open-drain output. When an exception happens, the output of this pin is pulled to GND. External tie to System Power 3.3V or 5V
9, 10	VIN	Power	Power-supply input pin.
11	VIN	Power	Power-supply input pin.
12	NC	I/O	No Connect.
—	EXP	O	Exposed Thermal Pad. It is the common drain node for the power switches and it must be electrically isolated. Solder to a metal surface directly underneath the EXP and connect to floating copper thermal pads on multiple PCB layers through many VIAs. For best thermal performance, make the floating copper pads as large as possible.

Function Block Diagram

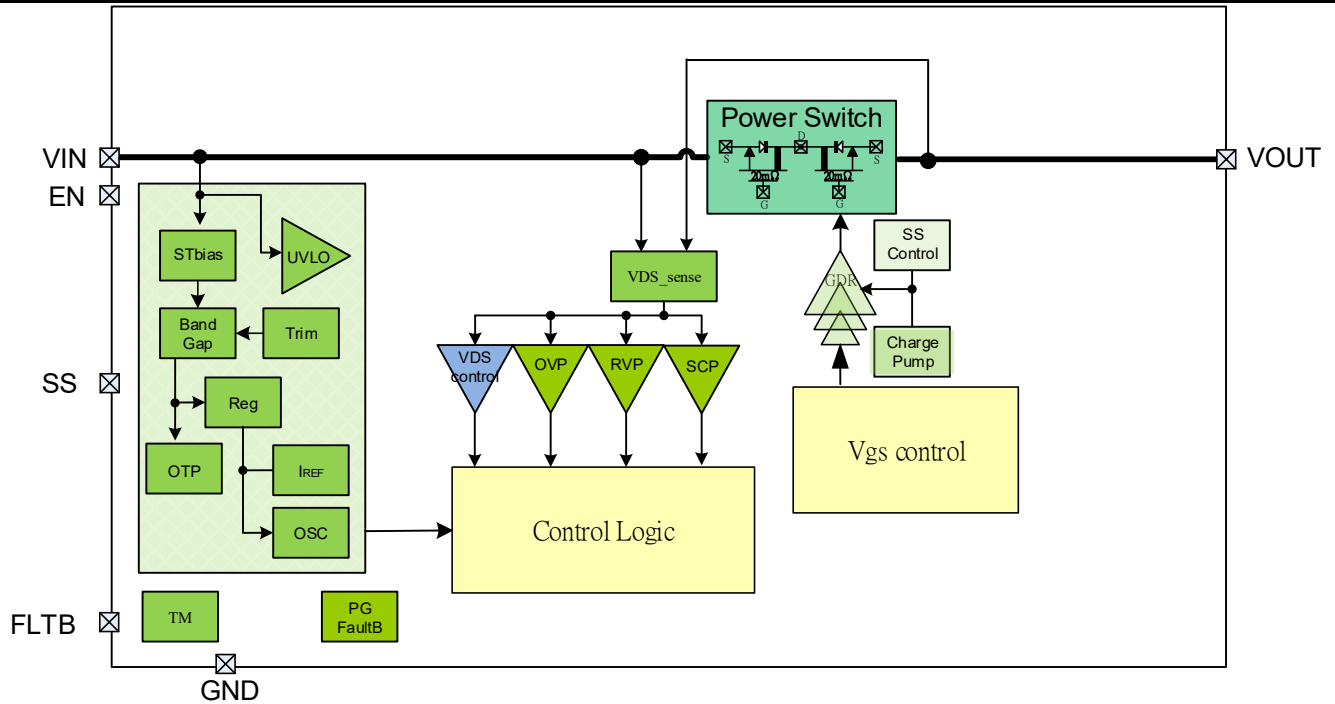


Figure 2. Internal Functional Blocks of DML3020UDC

Absolute Maximum Rating

Parameter	Rating
V _{IN} , V _{OUT} to GND	-0.3V to 28V
CAP to GND	-0.3V to 28V
EN, FLTB, SS to GND	-0.3V to 6V
Peak Output Current I _{OUT}	15A
Storage Temperature (T _{ST})	-65°C to +150°C
Junction Temperature (T _J)	+150°C

Recommended Operating Conditions

Parameter	Rating
Input Voltage (V _{IN} to V _{GND})	3.4V to 22V
Operation Voltage of (V _{CAP} to V _{GND})	0 to 28V
Operation Voltage of (V _{I/O} to V _{GND})	0 to 5.5V
Load Current (I _{OUT})	0 to 5.5A
Operating Junction Temperature (T _J)	-40°C to +125°C
Package Thermal Resistance (θ _{JC})	2°C/W
Package Thermal Resistance (θ _{JA})	30°C/W

Electrical Characteristics (V_{IN} = 12V, V_{EN} = 3.3V, C_{IN} = C_{OUT} = 10μF, C_{SS} = 10nF, T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Bias Supply						
V _{IN}	V _{IN} Input Power Range	—	3.4	—	22	V
V _{UVP_VIN}	V _{IN} Undervoltage Lockout	V _{IN} Rising	3	3.15	3.35	V
V _{UVHY_VIN}	UVLO Hysteresis	—	—	270	—	mV
I _{QIN}	Quiescent Current	V _{IN} = 5.0V, I _{OUT} = 0	—	500	700	μA
		V _{IN} = 12V, I _{OUT} = 0	—	550	800	
		V _{IN} = 20V, I _{OUT} = 0	—	600	900	
I _{STBY}	Standby Current	V _{IN} = 5.0V, V _{EN} = 0, I _{OUT} = 0	—	17	22	μA
		V _{IN} = 12V, V _{EN} = 0, I _{OUT} = 0	—	22	27	
		V _{IN} = 20V, V _{EN} = 0, I _{OUT} = 0	—	28	32	
		V _{IN} = 28V, V _{EN} = 0, I _{OUT} = 0	—	35	40	
I _{VOUT_OFF}	Output Leakage Current	V _{OUT} = 28V, V _{IN} = 0, V _{EN} = 0	—	6	—	μA
Enable Control (High active)						
V _{ENH}	EN Threshold Voltage High	V _{IN} = 12V	1.6	—	—	V
V _{ENL}	EN Threshold Voltage Low		—	—	0.6	
I _{EN}	EN Input Leakage Current	V _{IN} = 12V, V _{EN} = 5V	—	6.85	—	μA
MOSFET						
R _{DS(ON)}	Switch ON Resistance	V _{IN} = 5.0V, I _{OUT} = 1A	—	36	—	mΩ
		V _{IN} = 12V, I _{OUT} = 1A	—	36	—	
		V _{IN} = 20V, I _{OUT} = 1A	—	36	—	
I _{LKGSW}	Leakage Current in OFF State	V _{IN} = 12V, V _{EN} = 0, V _{OUT} = 0	—	—	20	μA
Protection						
V _{OVP}	V _{IN} Overvoltage Threshold	V _{IN} Rising	23	24	25	V
t _{OVP_DEB}	OVP Debounce Time	Latch off, No restart	—	512	—	μs
V _{IDTRCB}	Ideal Diode TRCB Regulation Voltage	V _{IN} = 12V, V _{IDTRCB} = [V _{IN} - V _{OUT}], I _{OUT} = 1A	—	70	—	mV
V _{RCP}	Reverse-Current Protection Entry Threshold	V _{IN} = 12V, V _{RCP} = [V _{OUT} - V _{IN}]	—	45	—	mV
t _{RCP}	RCP Response Time	V _{IN} = 12V, V _{RCP} = 50mV, over Drive	—	0.5	—	μs
Output Timing						
t _{DON}	Output Turn-ON Delay Time	V _{IN} = 5V, C _{OUT} = 10μF, V _{EN} = 0 to 3.3V, R _{LOAD} = 100Ω	—	8	—	ms
		V _{IN} = 12V, C _{OUT} = 10μF, V _{EN} = 0 to 3.3V, R _{LOAD} = 100Ω	—	8	—	
		V _{IN} = 20V, C _{OUT} = 10μF, V _{EN} = 0 to 3.3V, R _{LOAD} = 100Ω	—	8	—	
t _r	Output Turn-ON Rise Time	V _{IN} = 5V, C _{OUT} = 10μF, V _{EN} = 0 to 3.3V, R _{LOAD} = 100Ω	—	0.83	—	ms
		V _{IN} = 12V, C _{OUT} = 10μF, V _{EN} = 0 to 3.3V, R _{LOAD} = 100Ω	—	2	—	
		V _{IN} = 20V, C _{OUT} = 10μF, V _{EN} = 0 to 3.3V, R _{LOAD} = 100Ω	—	3.16	—	
t _{DOFF}	Output Turn-OFF Delay Time	V _{IN} = 5V, C _{OUT} = 10μF, V _{EN} = 3.3V to 0, R _{LOAD} = 100Ω	—	32	—	μs
		V _{IN} = 12V, C _{OUT} = 10μF, V _{EN} = 3.3V to 0, R _{LOAD} = 100Ω	—	32	—	
		V _{IN} = 20V, C _{OUT} = 10μF, V _{EN} = 3.3V to 0, R _{LOAD} = 100Ω	—	32	—	

Electrical Characteristics (V_{IN} = 12V, V_{EN} = 3.3V, C_{IN} = C_{OUT} = 10μF, C_{SS} = 10nF, T_A = +25°C, unless otherwise specified.) (continued)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Fault Flag (FLT B): Active Low						
R _{FLTB}	FLT B Pulldown Resistor	—	—	10	100	Ω
I _{LKGFLT B}	FLT B Leakage Current	—	—	—	1	μA
Thermal Shutdown						
T _{SHDN}	Thermal Shutdown Threshold	Guaranteed by Design	—	+150	—	°C

Application Information

General Description

The DML3020UDC is a power switch which supports applications requiring 24V/5.5A capabilities. It is designed to meet the input and output voltage/current requirement which is common with many hot-pluggable serial interfaces found in the computing devices as well as consumer electronics.

Startup Time Control at VOUT Pin

An external capacitor connected from the SS pin to GND defines the slew rate of the output voltage at power-on at VOUT pin.

$$C_{SS} = C_{OUT} \times 0.0645 + 0.3$$

C_{SS} : soft start capacitor (nF)

C_{OUT} : output capacitor (μF)

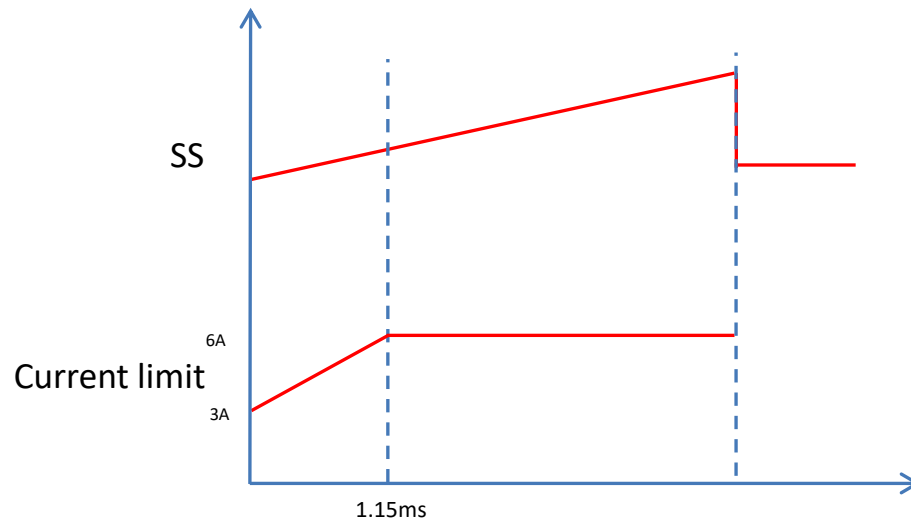
$$t_R = \frac{V_{in}}{8} \times \frac{C_{SS}}{0.0006} + 100$$

C_{SS} : soft start capacitor (nF)

t_R : soft start time (μs)

Choosing a proper value for the capacitor C_{SS} ensures that the device is turned ON with the pre-set ramp-up imposed over the output voltage. The in-rush current at power-up shall be limited by the regulated output voltage ramp or the limited current setting. During soft-start time, $I_{IN} \geq$ control current and count $\geq 350\mu s$ will trigger OCP protect, and FLTB pin will be pulled low and IC be latched.

Startup Time Control Current



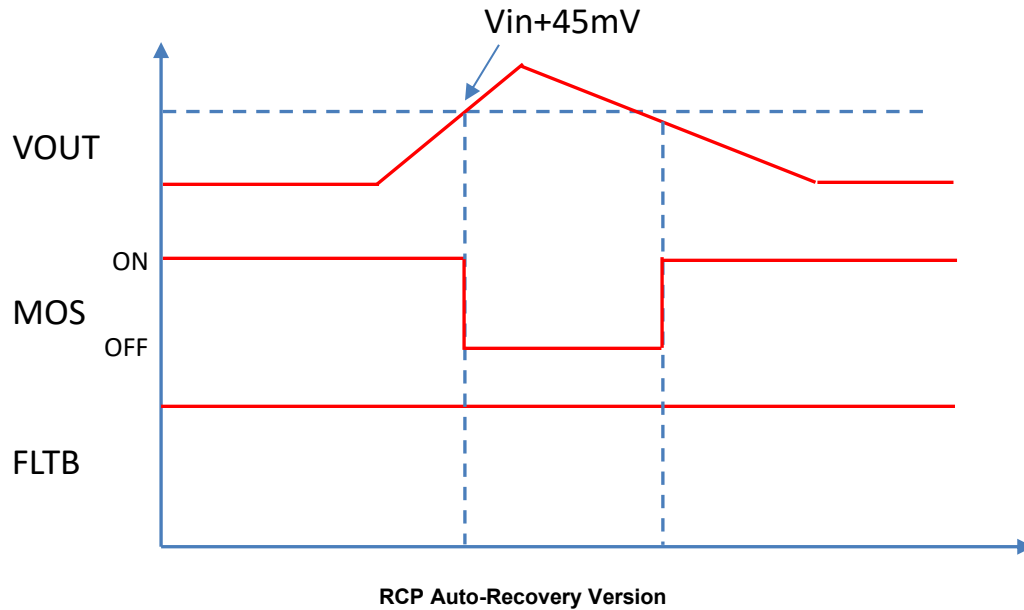
Input Overvoltage Protection (OVP)

The voltage at the VIN port is being monitored continuously. Whenever this voltage is found to be larger than the V_{OVP} , the built-in overvoltage protection (OVP) fault-handling mechanism is triggered. The internal power MOSFET will be turned OFF to protect the downstream equipment connected and be latched.

Reverse-Current Protection (RCP)

The voltage difference, $[V_{OUT} - V_{IN}]$, between the VOUT and VIN ports is being monitored continuously. Once the voltage difference rises above the V_{RCP} level, the device will turn OFF the internal power MOSFET to prevent the reverse-current flowing to the VIN source. When the reverse-current condition is no longer valid, i.e. $[V_{OUT} - V_{IN}]$ becomes smaller than the V_{RCP} level, the internal power MOSFET shall be turned ON again.

Application Information (continued)



Overtemperature Protection (OTP)

During overload conditions, the output voltage would drop with the limited current I_{OCP} . It will result in the increasing junction temperature T_J with the increased power consumption on device. When T_J reaches to the thermal shutdown threshold T_{SHDN} , the internal power MOSFET would be turned OFF and be latched.

Fault Response

An external pullup resistor is required. The device generates a warning flag whenever one of the following fault conditions becomes valid: input overvoltage, overtemperature, startup short-circuit. The FLT signal shall remain at "low" and the internal power MOSFET remains OFF until the device restart.

Application Information (continued)

Schottky Diode for Protection of Current Surge

When a cable is hot-plugged in/out of the USB-C® connector behind which the VOUT port of the DML3020UDC is connected, a large ground current could be seen at the VOUT port of the DML3020UDC. When the far end of a connected cable is short to ground for whatever reason, the VOUT port of the DML3020UDC could also see a large ground current. With the Schottky diode, SBR3U40P1, populated as close as possible to the USB-C connector, no ground current can go through the DML3020UDC to cause false operation.

PCB Layout Consideration

1. Place the input/output capacitors C_{IN} and C_{OUT} as close as possible to the VIN and VOUT pins.
2. The power traces, including the power ground, the VIN trace and the VOUT trace should be kept direct, short and wide.
3. All VIN pins need to short together by directly trace.
4. DNC pin needs to short with EXP paddle by directly trace.
5. Connect the signal ground to the GND pin behind the input or output capacitors.
6. Place the resistors and capacitors (R_{EN} , R_{FLT} , C_{SS} and C_{CAP}) near the device pins.
7. For better power dissipation, via holes are recommended to connect the exposed pads (VIN/VOUT) landing area to a large copper polygon on the other side of the printed circuit board. Those copper polygons and exposed pad of VIN/VOUT shall be connected to VIN/VOUT trace on the printed circuit board.

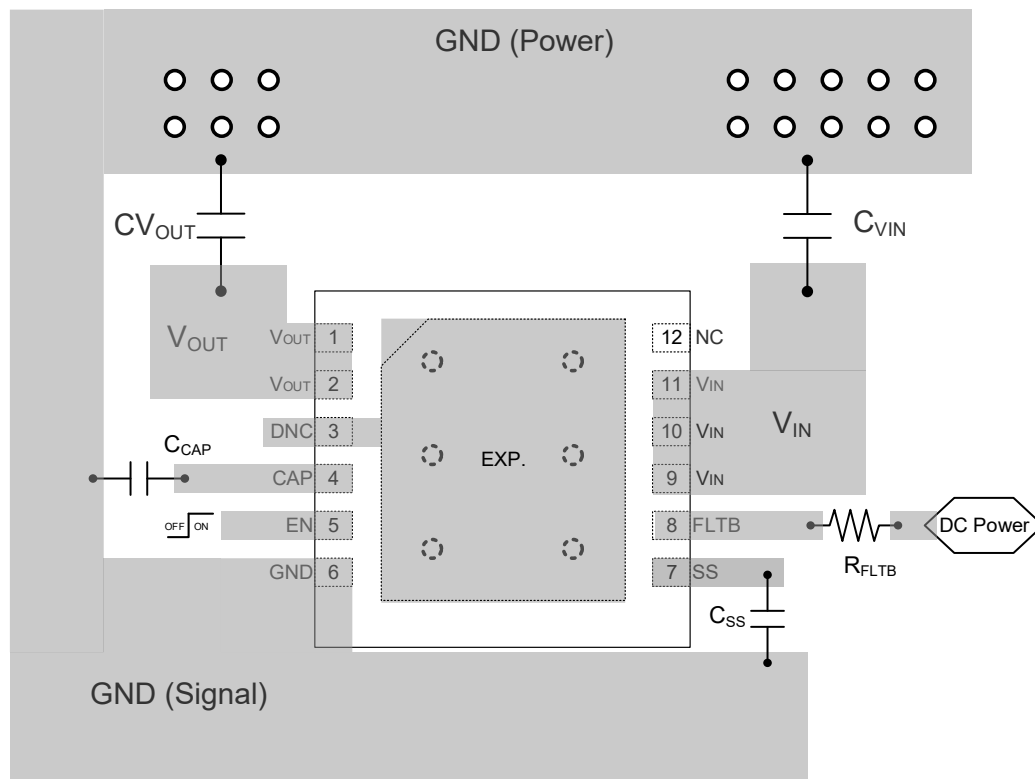
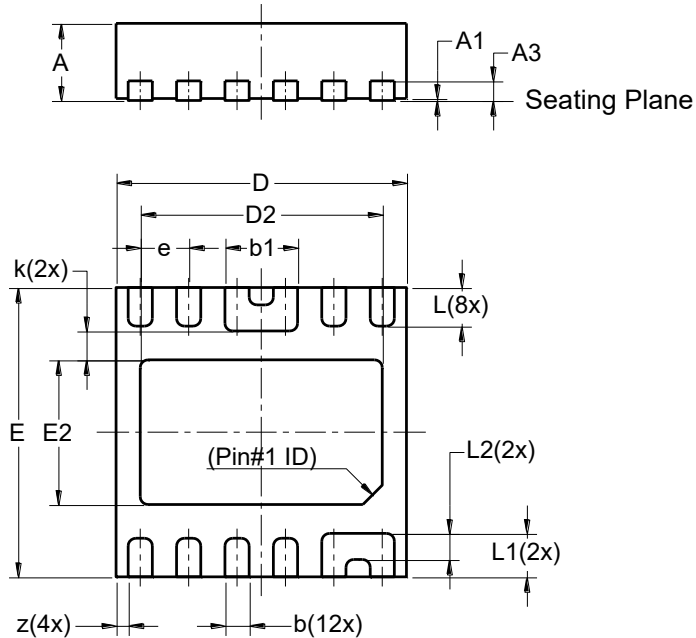


Figure 3. Suggested PCB Layout

Package Outline Dimensions

Please see <http://www.diodes.com/package-outlines.html> for the latest version.

V-DFN3030-12 (Type C)

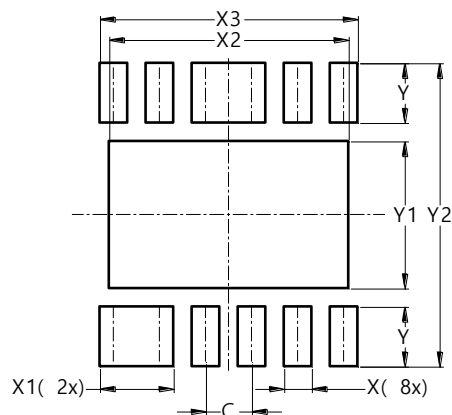


V-DFN3030-12 (Type C)			
Dim	Min	Max	Typ
A	0.77	0.83	0.80
A1	0.00	0.05	0.02
A3	—	—	0.203
b	0.20	0.30	0.25
b1	0.70	0.80	0.75
D	2.95	3.05	3.00
D2	2.40	2.60	2.50
E	2.95	3.05	3.00
E2	1.40	1.60	1.50
e	0.50 BSC		
k	—	—	0.30
L	0.35	0.45	0.40
L1	0.40	0.50	0.45
L2	0.22	0.32	0.27
z	—	—	0.125
All Dimensions in mm			

Suggested Pad Layout

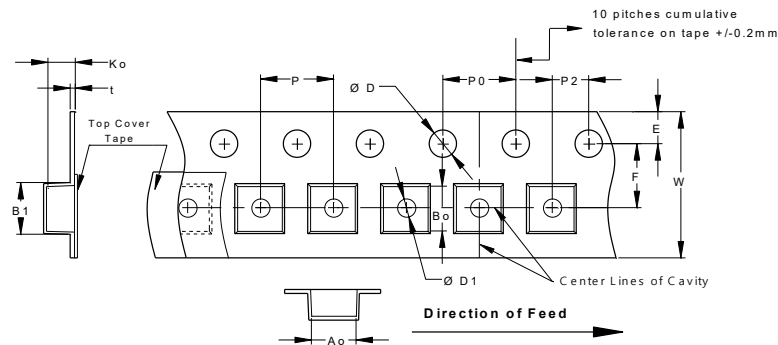
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V-DFN3030-12 (Type C)



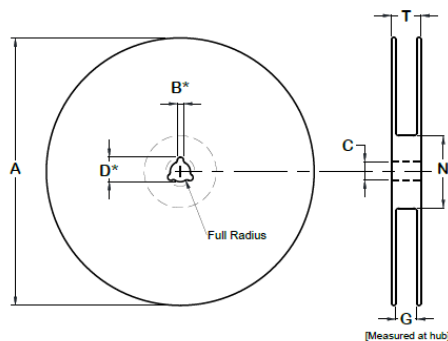
Dimensions	Value (in mm)
C	0.50
X	0.30
X1	0.80
X2	2.60
X3	2.80
Y	0.65
Y1	1.60
Y2	3.30

Embossed Carrier Tape Specifications



Tape Width	P	K0	W
12mm	8.0 ± 0.10	1.1 ± 0.10	12.0 ± 0.30

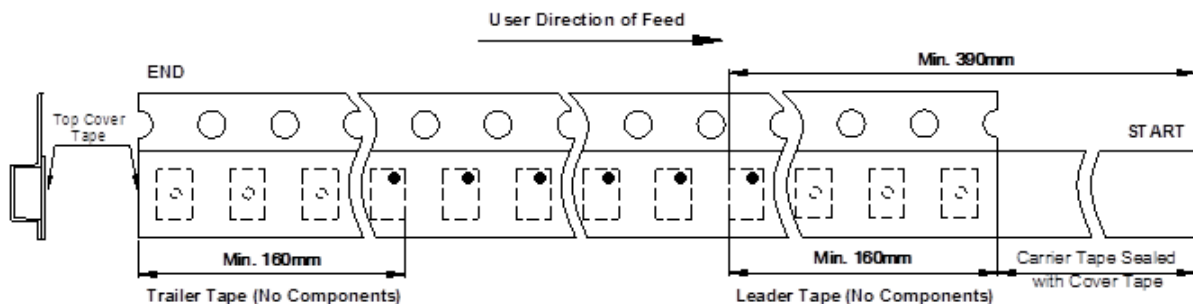
Surface-Mount Reel Specifications



* Drive spokes optional. If used, dimensions with asterisks apply.

Tape Size	A Max	B* Max	C	D* Max	N Min	G	T Max
12mm	330 ± 2	$2.0^{+0.5}_{-0}$	$13^{+0.5}_{-0.2}$	20.5 ± 0.2	100 ± 2	$12.4^{+2.0}_{-0.0}$	18.4

Tape Leader and Trailer Specifications (Notes 5 and 6)



- Notes:
- There shall be a leader of 230mm [9.05 inches] minimum which may consist of carrier and/or cover tape or a start tape followed by a minimum of 160mm [6.30 inches] of empty carrier tape sealed with cover tape.
 - There shall be a trailer of 160mm [6.30 inches] minimum of empty carrier tape sealed with cover tape. The entire carrier tape must release from the reel hub as the last portion of the tape unwinds from the reel without damage to the carrier tape and the remaining components in the cavities.

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