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24V Input, 5A DC-DC PWM Buck Controller + FET

Device	Application	Input Voltage	Output Voltage	Output Current	Topology
NCP3020	16W Industrial Application	21.6-26.4V	3.3V	0.01-5A	Buck

Table 1: Buck Power Supply

Characteristic	Min	Typ	Max	Unit
Input Voltage	9	12	18	V
Output Voltage	3.20	3.326	3.34	V
Output Current	.01	1	5	A
Oscillator Frequency	270	300	330	kHz
Output Voltage Ripple		86		mVpk-pk
Load Regulation I _{out} = 0.02-10A / V _{in} = 24V NCP3020		1.53		mV/A

Circuit Description

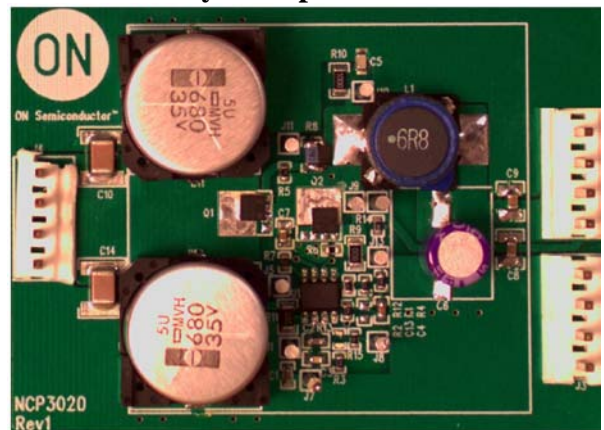
This circuit is proposed for a +24V input industrial application where there is a need to step-down the voltage to +3.3V @ 5A. The requirement specified a large electrolytic input capacitance and also to utilize electrolytic capacitors on the output. Target efficiency is >85%.

The PCB for the NCP3020 is a 2-layer board for use in applications up to 50W. The synchronous buck converter uses voltage mode control, which can be compensated externally with a transconductance amplifier. The soft start time is fixed. The NCP3020 demonstration board is a flexible design allowing the use of electrolytic capacitors or ceramic capacitors.

Key Features

- High Efficiency
- Adjustable Current Limit
- Output Overvoltage and Output Undervoltage protection
- Short Circuit Protection
- Fixed Switching Frequency

Electrolytic Capacitor Version



Performance

The following figures show typical performance of the NCP3020 demonstration boards.

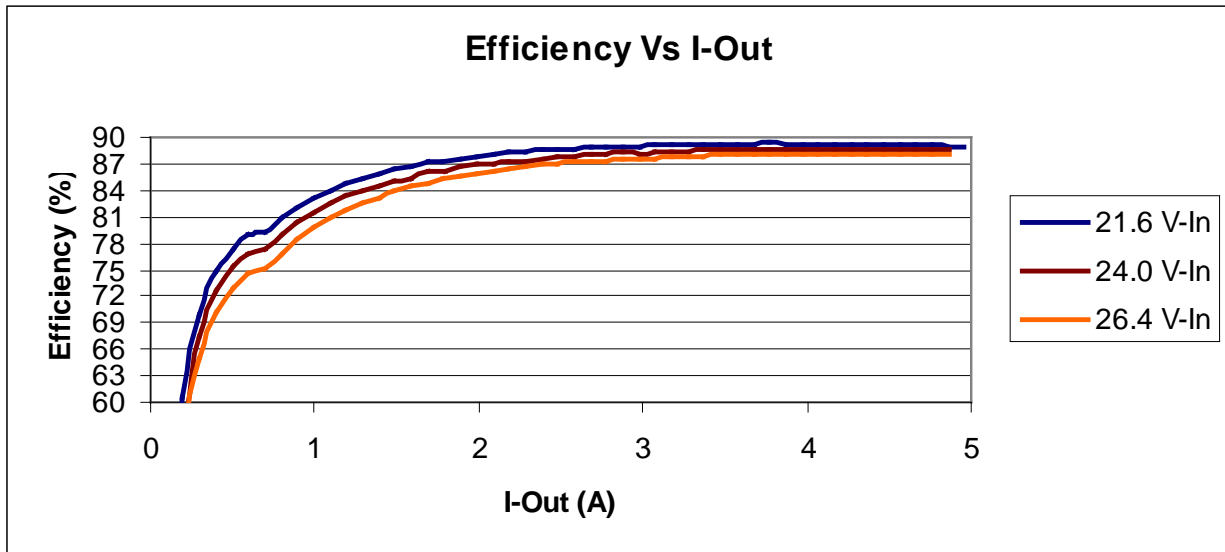


Figure 1: NCP3020 Efficiency at 21.6-26.4 V with a 3.3V Output Voltage

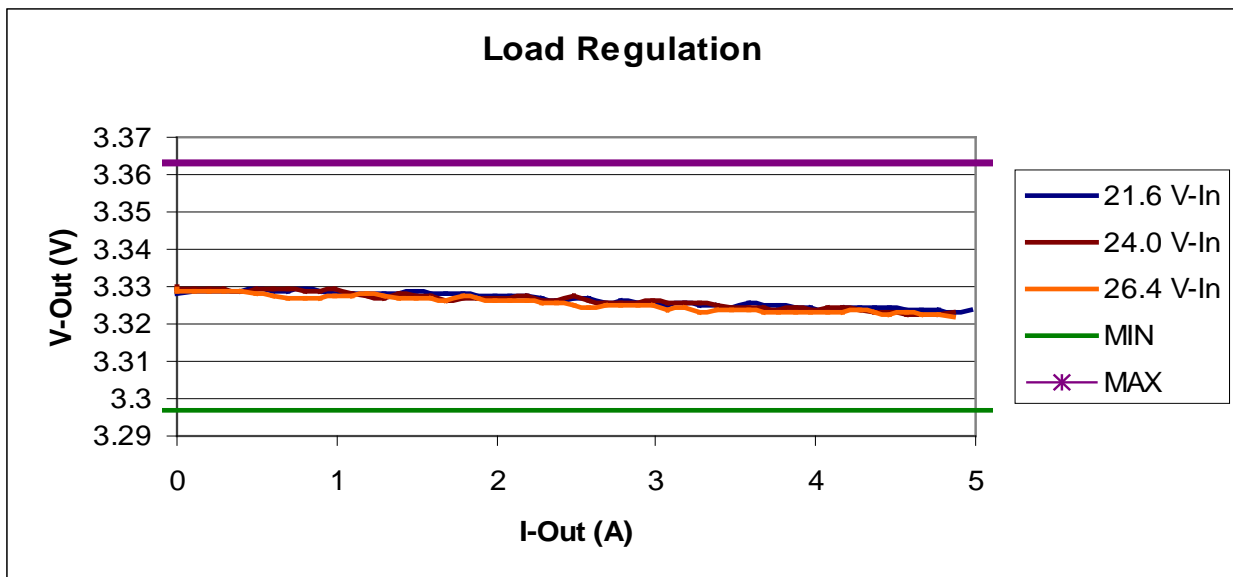


Figure 2: NCP3020 Load Regulation

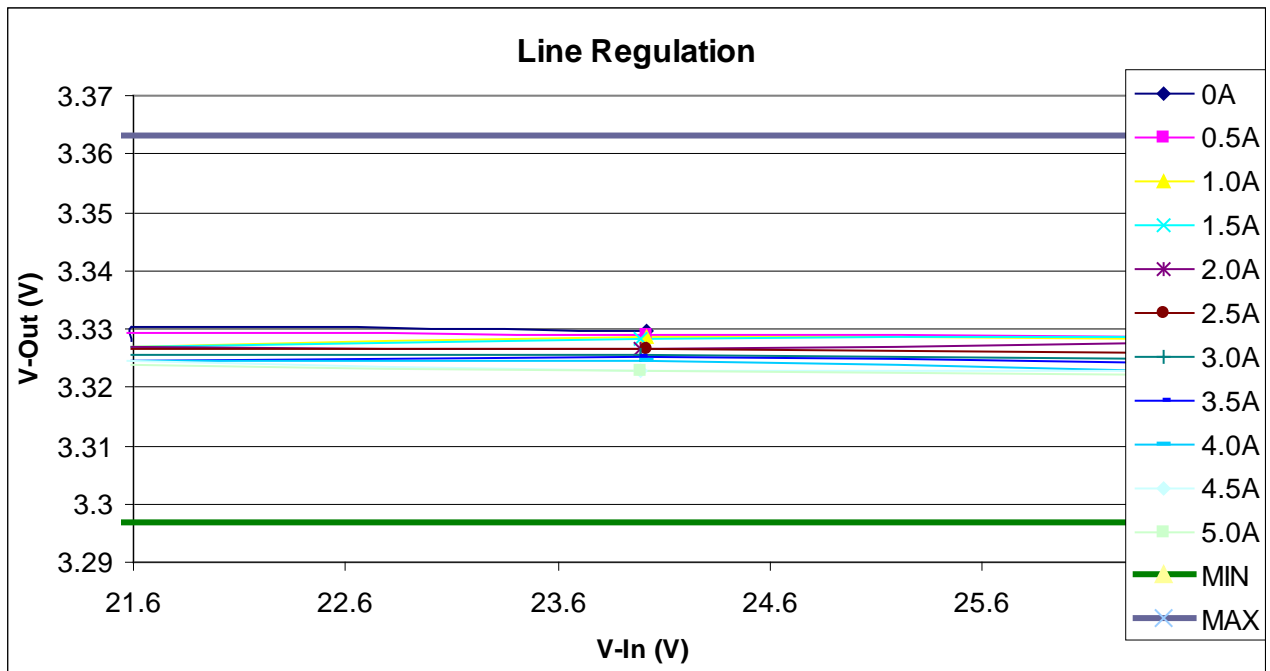


Figure 3: NCP3020 Line Regulation

Schematics

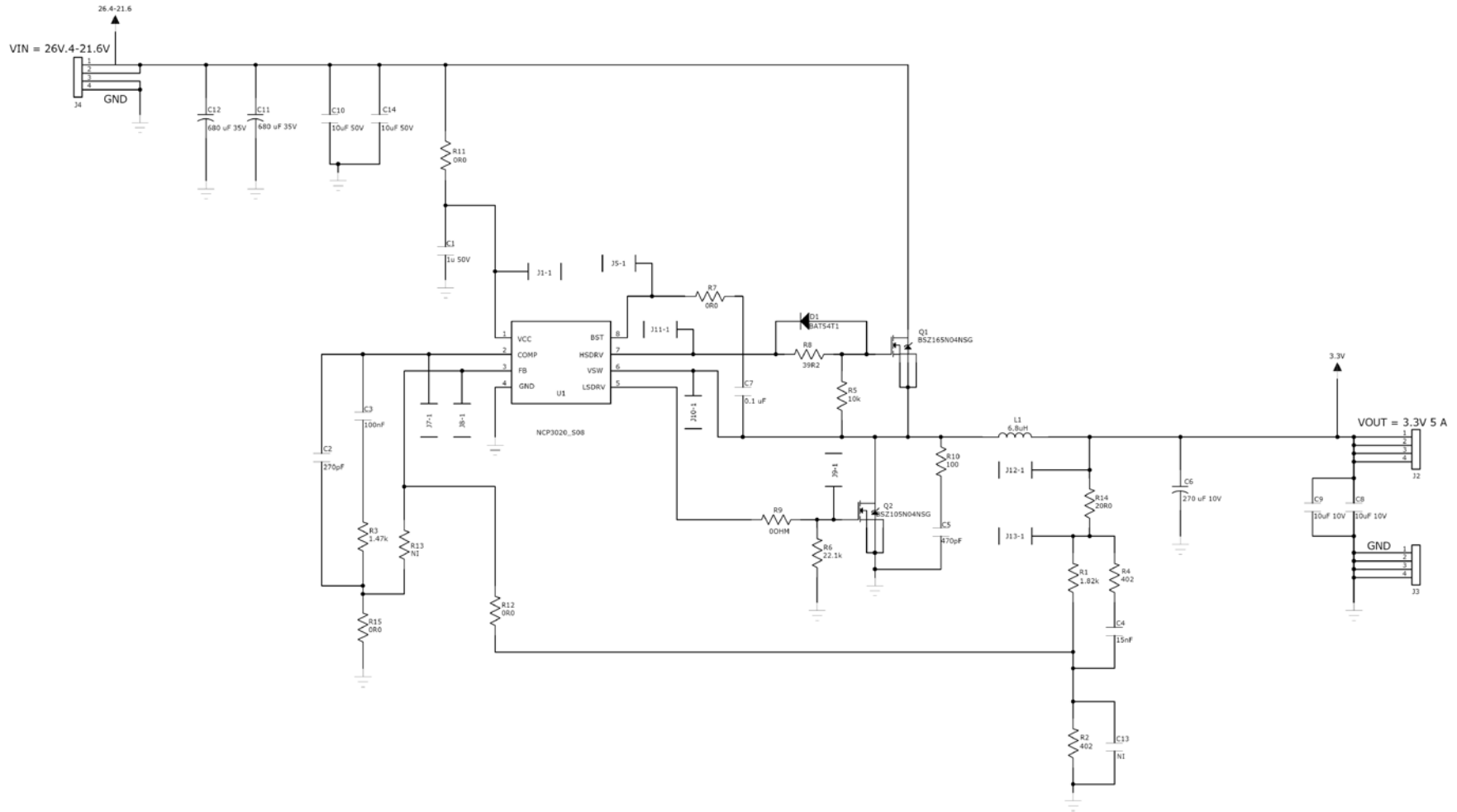


Figure 4: NCP3020 Schematic

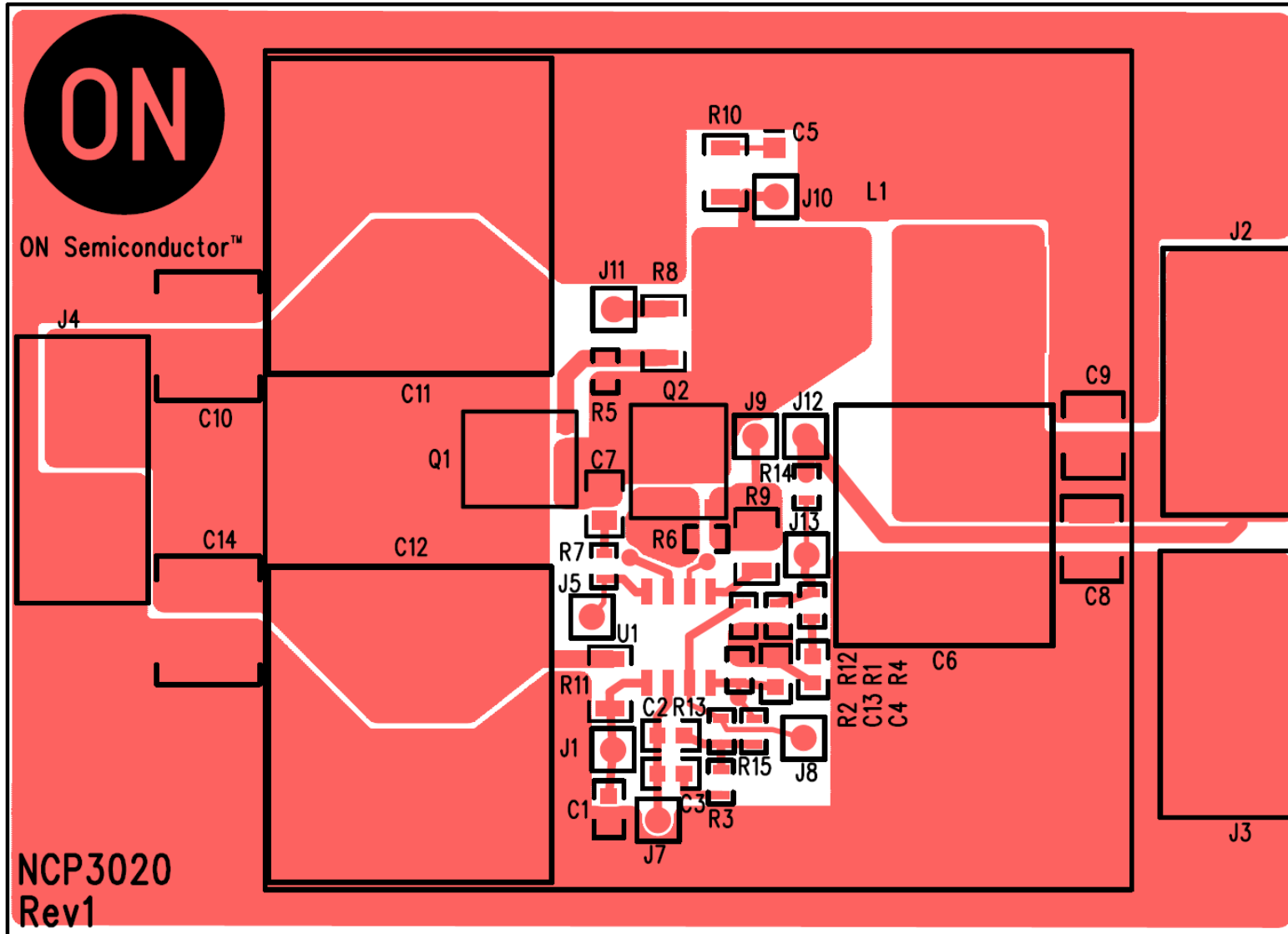


Figure 5: NCP3020 Top Layout

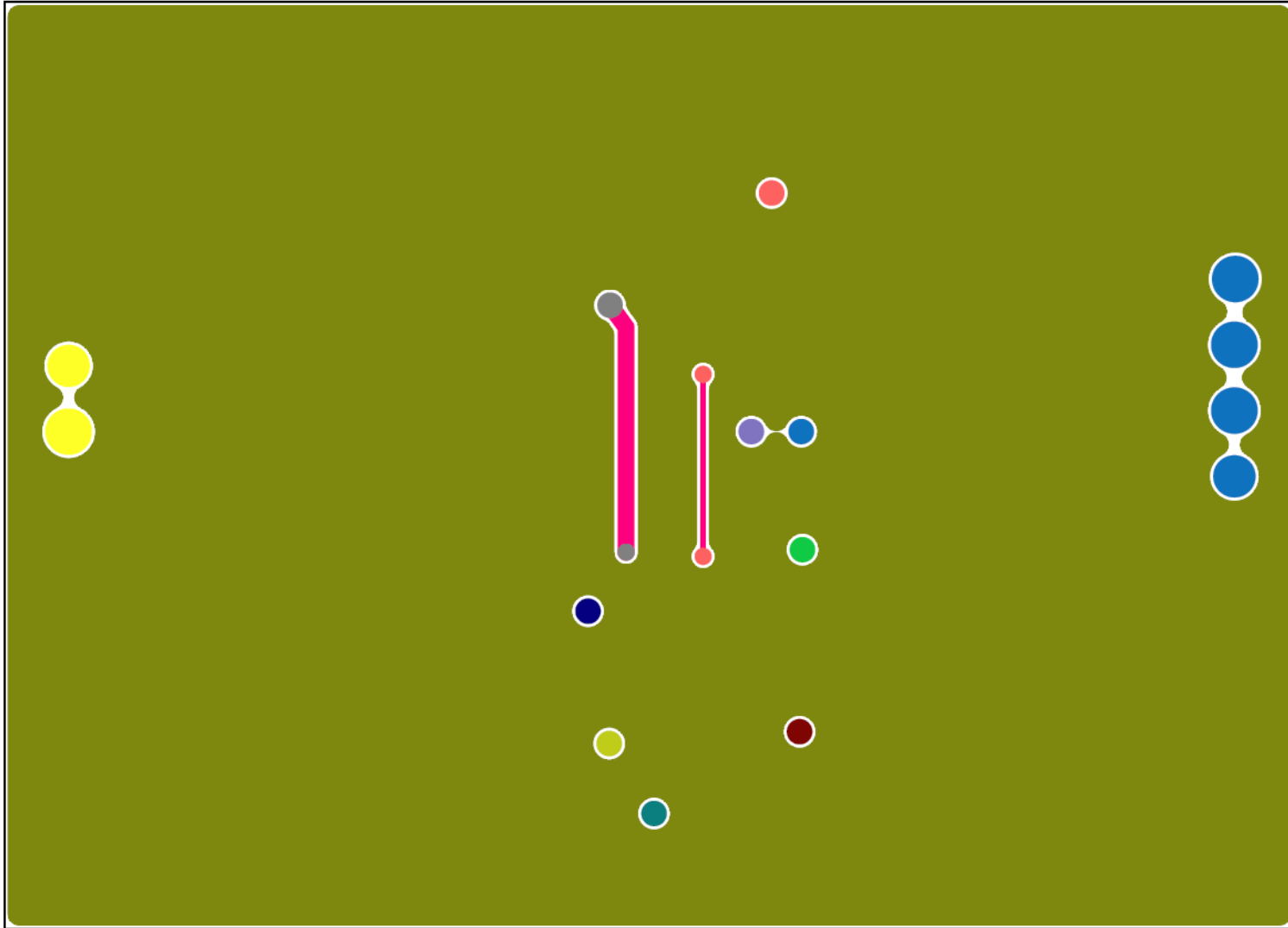


Figure 6: NCP3020 Bottom Layout

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Item	Qty	Reference	Manufacturer Part Name	Manufacturer	Description	FootPrint	Value	Tolerance
2	1	D1	ON Semiconductor	BAT54T1G	Schottky Barrier Diodes	SOD123	0.35 Vf	NA
3	1	C3	AVX	06036C104JAT2A	Ceramic Chip Capacitor	603	100nF	10%
4	1	C4	AVX	06035C153KAT2A	Ceramic Chip Capacitor	603	15nF	10%
5	1	C1	Taiyo Yuden	UMK107C5105KA	Ceramic Chip Capacitor	603	1uF 50V	10%
6	1	C2	AVX	0603ZC271KAT2A	Ceramic Chip Capacitor	603	270pF	10%
7	1	C13	Vishay/Dale	VJ0603Y103KXACW1BC	Ceramic Chip Capacitor	603	NI	10%
8	1	C7	Vishay	08053G104ZAT2A	Ceramic Chip Capacitor	805	0.1 uF	10%
9	1	C5	Vishay	08055A471JAT2A	Ceramic Chip Capacitor	805	470pF	20%
10	2	C8-9	AVX Corporation	1210ZC106KAT2A	Ceramic Chip Capacitor	1210	10uF 10V	20%
11	2	C10 C14	TDK	GRM32DF51H106ZA01L	Ceramic Chip Capacitor	2210	10uF 50V	20%
12	1	L1	TDK Corporation	SLF12575T-6R8N5R9-PF	SMT Inductor	(12.50x12.50x7.50)mm	6.8uH	10%
13	1	C6	SANYO	10SP270M	OS-CON Capacitor	(11.5x 8)mm	270 uF 10V	20%
14	2	C11-12	United Chemi-Con	EMVH350GDA681MMH0S	Electrolytic Capacitor	(13.0x 13.0 x16.0)mm	680 uF 35V	20%
15	1	U1	ON Semiconductor	NCP3020	300 kHz PWM Controller	SOIC8	300 kHz	NA
16	1	Q2	Infineon	BSZ105N04NSG	40V N-MOSFET	8-TSDSON	10.5m 40 V	NA
17	1	Q1	Infineon	BSZ165N04NSG	40V N-MOSFET	8-TSDSON	16.5m 40 V	NA
19	2	R12 R15	Vishay/Dale	CRCW06030000Z0EA	SMT Resistor	603	0R0	1%
20	1	R7	Vishay/Dale	CRCW06030000Z0EA	SMT Resistor	603	0R0	NA
21	1	R3	Vishay/Dale	CRCW06031K47FKEA	SMT Resistor	603	1.47k	1%
22	1	R1	Vishay/Dale	CRCW06031K82FKEA	SMT Resistor	603	1.82k	1%
23	1	R5	Vishay/Dale	CRCW060310K0FKEA	SMT Resistor	603	10k	1%
24	1	R14	Vishay/Dale	CRCW060320R0FKEA	SMT Resistor	603	20R0	1%
25	1	R6	Vishay/Dale	CRCW060322K1FKEA	SMT Resistor	603	22.1k	1%
26	2	R2 R4	Vishay/Dale	CRCW0603402RFKEA	SMT Resistor	603	402	1%
27	1	R13	Vishay/Dale	CRCW060310K0FKEA	SMT Resistor	603	NI	1%
28	1	R9	Vishay / Dale	CRCW12060000Z0EA	Resistor	1206	0OHM	NA
29	1	R11	Vishay / Dale	CRCW12060000Z0EA	Resistor	1206	0R0	±5.0%
30	1	R10	Vishay / Dale	CRCW1206100RFKEA	Resistor	1206	100	±1.0%
31	1	R8	Vishay / Dale	CRCW120639R2FKEA	Resistor	1206	39R2	NA

Table 2: NCP3020 BOM

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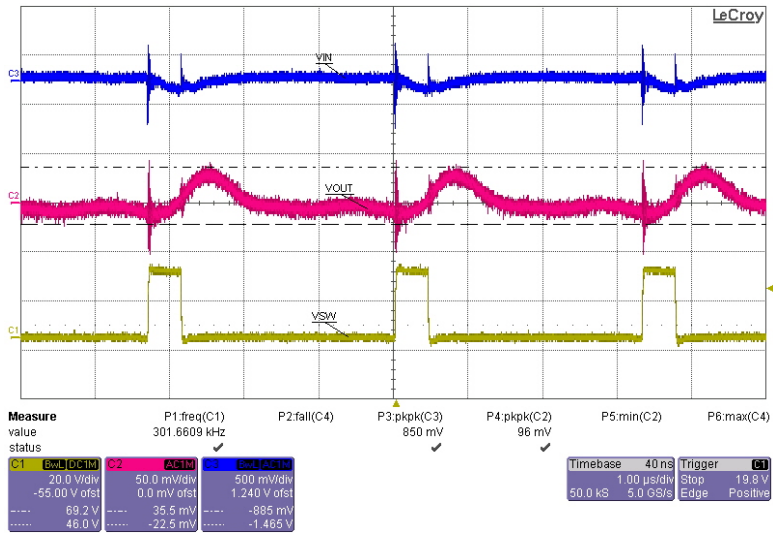


Figure 7: Input = 24V, Output = 3.3V, Load = 5A,
Red = VOUT, Yellow = VSW Blue = VIN

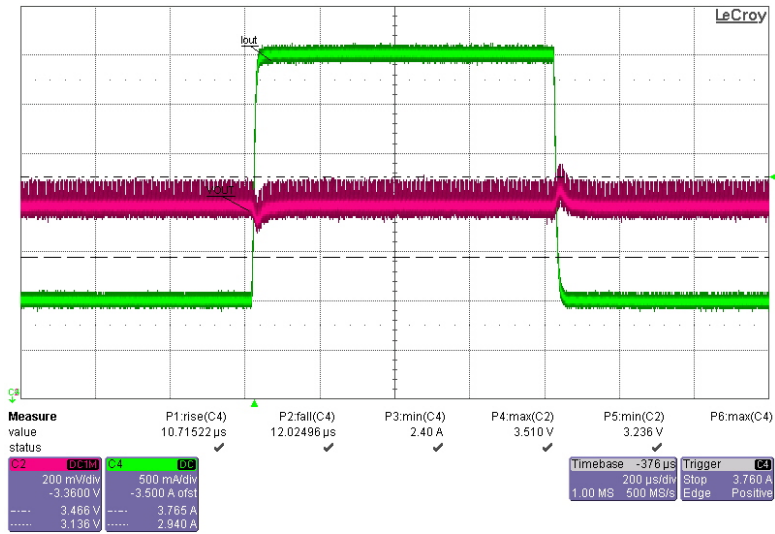


Figure 8: Input = 18V, Output = 3.3, Load = 10A,
Transient Response Red = VOUT, Green = IOUT

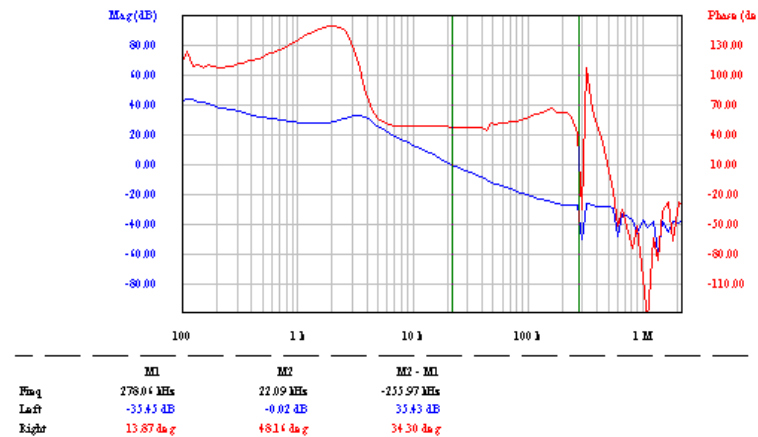


Figure 9: Input = 24V, Output = 3.3V, Load = 5A
Crossover Frequency = 22.09kHz at 48 deg

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Design note created by Tim Kaske and Jim Hill, e-mail: Tim.Kaske@onsemi.com ; Jim.Hill@onsemi.com