

NCV8855BMNR2GEVB

Quad-Output Automotive System Power Supply IC with Integrated High-Side 2 A Switch Evaluation Board User's Manual



ON Semiconductor®

<http://onsemi.com>

EVAL BOARD USER'S MANUAL

Introduction

The NCV885x is a multiple output controller / regulator IC with an integrated high-side load switch. The NCV885x will address automotive radio system and instrument cluster power supply requirements. In addition to the high-side load switch, the NCV885x comprise a switch-mode power supply (SMPS) buck controller, a 2.5 A SMPS buck regulator, and two low dropout linear regulator controllers (LDO).

The NCV885x is intended to supply power to various loads, such as a tuner, CD logic, audio processor and CD / tape control within a car radio. The high-side switch can be used for a CD / tape mechanism or switching an electrically-powered antenna or display unit. In an instrument cluster application, the NCV885x can be used to power graphics display, flash memory and CAN transceivers. In addition, the high-side switch can be used to limit power to a TFT display during a battery overvoltage condition.

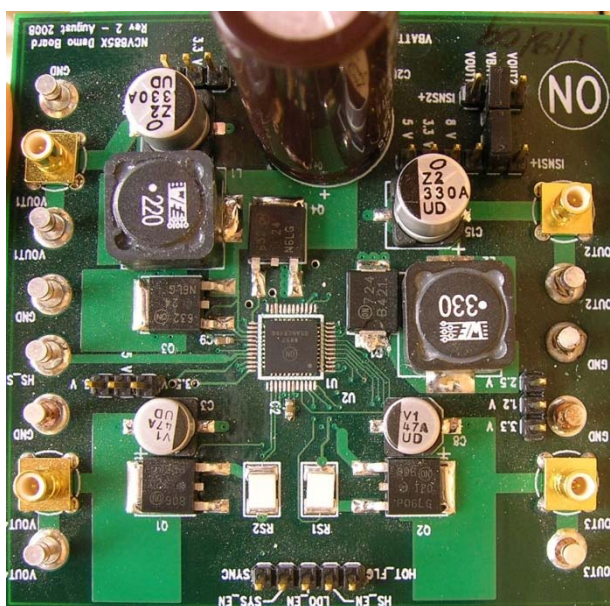


Figure 1. NCV8855 Evaluation Board

NCV8855BMNR2GEVB

Table 1. EVALUATION BOARD TERMINAL DESCRIPTIONS

Terminal	Function
VBATT	Positive dc input voltage.
VOOUT1	Synchronous SMPS regulated dc output voltage.
VOOUT2	Nonsynchronous SMPS regulated dc output voltage.
VOOUT3	LDO regulated dc output voltage.
VOOUT4	LDO regulated dc output voltage.
HS_S	High Side Switch output.
HOT_FLG	Thermal warning indicator. Provides an early warning of impending thermal shutdown.
HS_EN	Enable pin for the high-side load switch. A logic high on this pin will enable the HSS. If this pin is left floating, an internal pull down keeps the HSS disabled.
LDO_EN	Enable pin for both LDO controllers. A logic high on this pin will enable both LDO controllers. If this pin is left floating, an internal pull down keeps the LDOs disabled.
SYS_EN	Main enable pin for the IC. A logic high on this pin will enable the part. Leaving this pin floating or driving it to ground will place the IC in shutdown mode.
SYNC	Synchronization pin. Use this pin to synchronize the internal oscillator to an external clock.
GND	Common DC return.

Table 2. ABSOLUTE MAXIMUM RATINGS (Voltages with Respect to GND)

Rating	Value	Unit
DC Supply Voltage (VBATT)	–0.3 to 30	V
DC Supply Voltage (HS_EN, LDO_EN, SYS_EN, SYNC)	–0.3 to 7	V
Junction Temperature (NCV8855)	–40 to 150	°C
Ambient Temperature (Evaluation board)	–40 to 105	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

JUMPER EXPLANATION

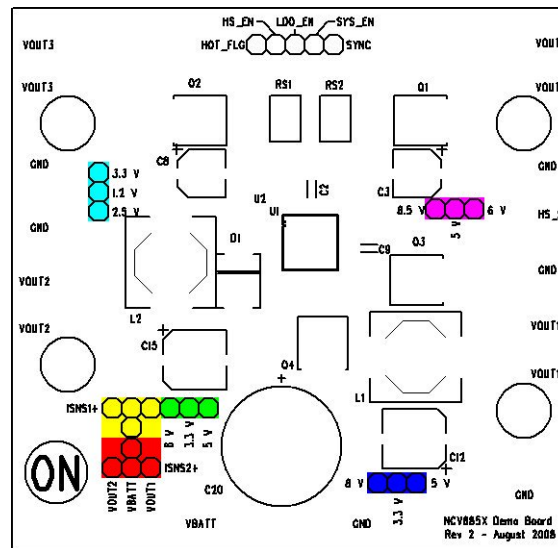


Figure 2. Jumper Groups

Cyan: VOUT3 (LDO1) output voltage selection. With no jumper VOUT3 is 1.2 V. With a jumper between the middle pin and the pin labeled 3.3 V, VOUT3 is 3.3 V. With a jumper between the middle pin and the pin labeled 2.5 V, VOUT3 is 2.5 V.

Magenta: VOUT4 (LDO2) output voltage selection. With no jumper VOUT4 is 5 V. With a jumper between the middle pin and the pin labeled 6 V, VOUT4 is 6 V. With a jumper between the middle pin and the pin labeled 8.5 V, VOUT4 is 8.5 V.

Yellow: VOUT3 (LDO1) input source selection. With a jumper between the middle two pins, the input to VOUT3 is VBAT. With a jumper between the middle pin and the pin inline with the other pin labeled VOUT2, the input to VOUT3 is VOUT2. With a jumper between the middle pin and the pin inline with the other pin labeled VOUT1, the input to VOUT3 is VOUT1 (The selected voltage must be at least 5 V to ensure proper function).

Green: VOUT2 (SMPS2) output voltage selection. With no jumper VOUT2 is 3.3 V. With a jumper between the middle pin and the pin labeled 5 V, VOUT2 is 5 V. With a jumper between the middle pin and the pin labeled 8 V, VOUT2 is 8 V.

Red: VOUT4 (LDO2) input source selection. With a jumper between the middle two pins, the input to VOUT4 is VBAT. With a jumper between the middle pin and the pin labeled VOUT2, the input to VOUT4 is VOUT2. With a jumper between the middle pin and the pin labeled VOUT1, the input to VOUT4 is VOUT1 (The selected voltage must be at least 5 V to ensure proper function).

Blue: VOUT1 (SMPS1) output voltage selection. With no jumper VOUT1 is 3.3 V. With a jumper between the middle pin and the pin labeled 5 V, VOUT1 is 5 V. With a jumper between the middle pin and the pin labeled 8 V, VOUT1 is 8 V.

NCV8855BMNR2GEVB

APPLICATION DIAGRAM

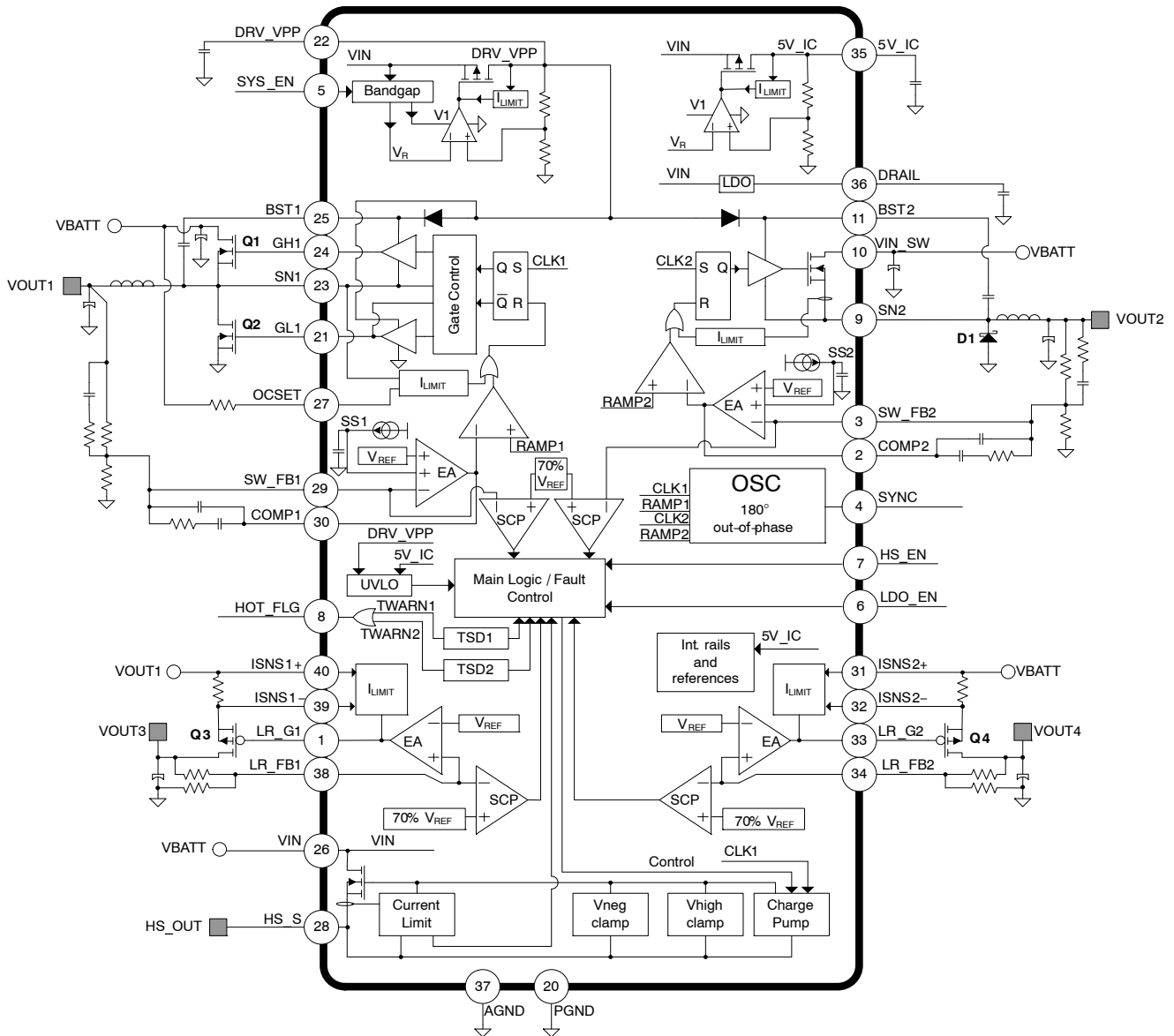


Figure 3. Application Diagram

TEST PROCEDURE**Equipment Needed**

Power Supplies (1 High Power, 1-3 Logic Level)
Digital Volt Meter
Digital Ampere Meter
Function Generator (optional)

Set-up

1. Remove jumpers from Vout 1, Vout 2, Vout 3, and Vout 4 voltage select jumpers.
2. Set the ISNS1+ and ISNS2+ jumpers to the middle positions (VBATT)
3. Set the high power supply to 13.2 V and a current limit of at least 1.5 A.
4. Connect VBATT to the positive end of the power supply and the adjacent GND to the negative end of the power supply.
5. The DC current on VBATT should be around 6 μ A

Switcher Test

6. Set one of the logic level power supplies to a voltage between 2.0 V and 5.5 V.
7. Connect SYS_EN to the positive end of the power supply and a GND pin to the negative end of the power supply.
8. Switcher 1 and 2 will turn on. Switcher 2 includes a minimum load of 340 Ω to ensure continuous conduction mode switching. The DC current on VBATT should be around 37 mA.
9. The Vout1 and Vout2 should be around 3.3 V.

Synchronize the Switchers

10. Set the function generator to a square wave with logic low 0.0-0.8 V and logic high 2.0-5.5 V with frequency 190-255 kHz.
10. Connect the positive end of the function generator to the SYNC and the negative end to GND.
11. VSW1 will synchronize to the rising edge and VSW2 will synchronize to the negative edge of the square wave.

Changing the Switcher Output Voltage

12. Remove the SYS_EN voltage
13. Connect a jumper in the Vout1 (to change the Vout1 voltage) or Vout2 (to change the Vout2 voltage) areas between the middle pin labeled 3.3 V and the pin labeled 5 V (to change the output 5 V) or the pin labeled 8 V (to change the output voltage).
14. Reapply the SYS_EN voltage
15. The output should now be around the set voltage. The current consumption from VBATT will increase if the output voltage is increased.

LDO Test

16. With the SYS_EN connected to a power supply, connect the LDO_EN pin to a power supply in the same voltage range in a similar fashion.
17. Vout3 should be around 1.2 V and Vout 4 should be around 5 V.

Changing the LDO Output Voltage

18. Remove the LDO_EN Voltage (optionally the SYS_EN voltage as well)
19. Add a jumper between the middle pin and the desired output voltage in the area around the respective outputs to change the voltage. (Note: Vout4 has a pin that may appear to be labeled 3.5 V due to overlapping a via. Actually this sets the output voltage to 8.5 V)

High Side Switch Test

20. With a SYS_EN powered as above, measure the voltage on HS_S with respect to GND. This should be around 0 V.
21. Connect the HS_S pin to a power supply in the same voltage range and in a similar fashion to the SYS_EN voltage.
22. Measure the voltage on HS_S with respect to GND. This should be around VBATT.

NCV8855BMNR2GEVB

TYPICAL WAVEFORMS

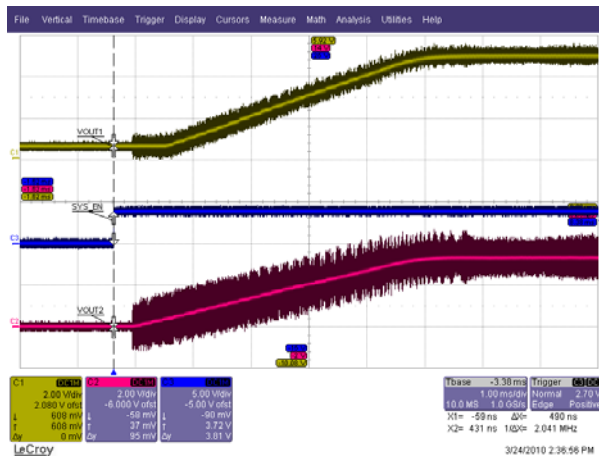


Figure 4. VOUT1 (5 V) and VOUT2 (3.3 V), start up with 340 Ω load on both

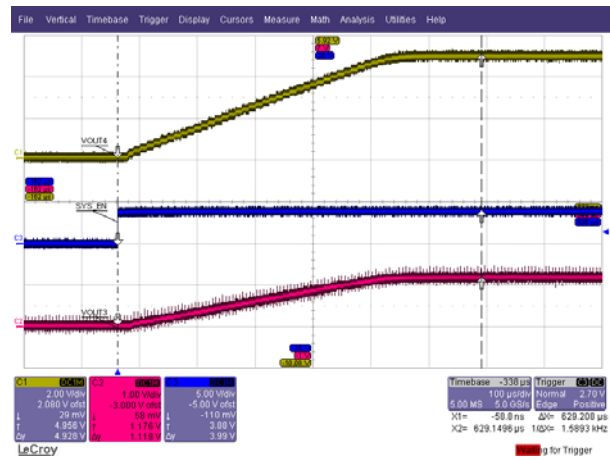


Figure 5. VOUT4 (5 V) and VOUT3 (1.2 V), start up with no load

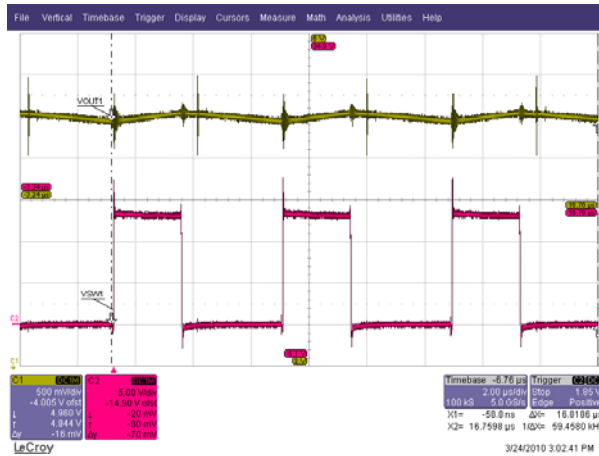


Figure 6. VOUT1 (5 V) and VSW1, 4 A load

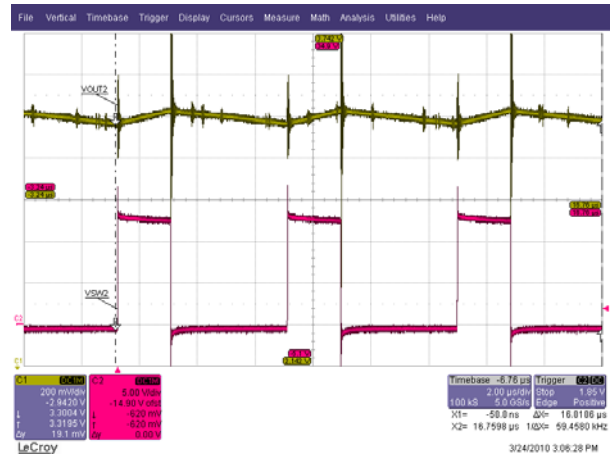


Figure 7. VOUT2 (3.3 V) and VSW2, 2 A load

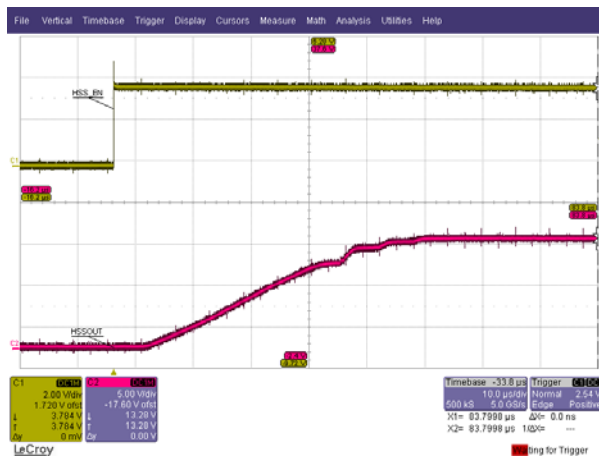


Figure 8. High Side Switch Turn On

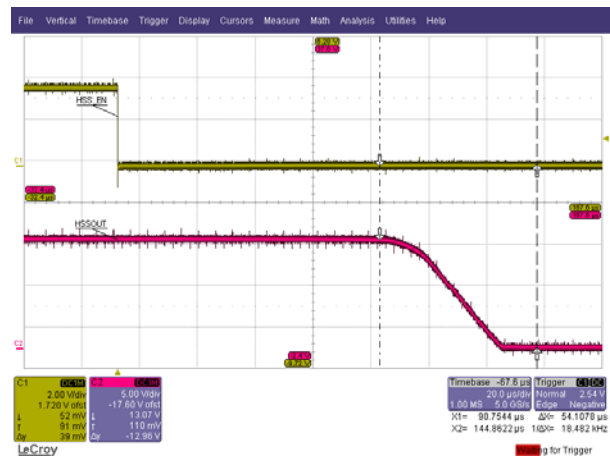


Figure 9. High Side Switch Turn Off

SCHEMATIC



NCV8855BMNR2GEVB

Table 3. BILL OF MATERIALS

Reference	Part	Tolerance	PCB Foot-print	Part Description	Manufacturer	Manufacturer's Part Number	Substitution Allowed	RoHS Compliant
CF21	22nF	10%	603	CAP CER 22000PF 50V X7R 0603	Murata Electronics North America	GCM188R71H22 3KA37	YES	YES
CF22	22nF	10%	603	CAP CER 22000PF 50V X7R 0603	Murata Electronics North America	GCM188R71H22 3KA37	YES	YES
CV11	1nF	10%	603	CAP CER 1000PF 50V X7R 0603	Murata Electronics North America	GCM188R71H10 2KA37	YES	YES
CV12	1nF	10%	603	CAP CER 1000PF 50V X7R 0603	Murata Electronics North America	GCM188R71H10 2KA37	YES	YES
CV21	3.3nF	10%	603	CAP CER 3300PF 50V 10% X7R 0603	Murata Electronics North America	GRM188R71H33 2KA01D	YES	YES
CV22	2.2nF	10%	603	CAP CER 2200PF 50V 10% X7R 0603	Murata Electronics North America	GRM188R71H22 2KA01D	YES	YES
C1	0.47uF	10%	805	CAP CER .47UF 50V X7R 0805	Murata Electronics North America	GRM21BR71H47 4KA88L	YES	YES
C4	0.47uF	10%	805	CAP CER .47UF 50V X7R 0805	Murata Electronics North America	GRM21BR71H47 4KA88L	YES	YES
C11	0.47uF	10%	805	CAP CER .47UF 50V X7R 0805	Murata Electronics North America	GRM21BR71H47 4KA88L	YES	YES
C17	0.47uF	10%	805	CAP CER .47UF 50V X7R 0805	Murata Electronics North America	GRM21BR71H47 4KA88L	YES	YES
C18	0.47uF	10%	805	CAP CER .47UF 50V X7R 0805	Murata Electronics North America	GRM21BR71H47 4KA88L	YES	YES
C19	0.47uF	10%	805	CAP CER .47UF 50V X7R 0805	Murata Electronics North America	GRM21BR71H47 4KA88L	YES	YES
C2	0.1uF	10%	603	CAP CER .1UF 50V X7R 0603	Murata Electronics North America	GCM188R71H10 4KA57D	YES	YES
C9	0.1uF	10%	603	CAP CER .1UF 50V X7R 0603	Murata Electronics North America	GCM188R71H10 4KA57D	YES	YES
C10	0.1uF	10%	603	CAP CER .1UF 50V X7R 0603	Murata Electronics North America	GCM188R71H10 4KA57D	YES	YES
C21	0.1uF	10%	603	CAP CER .1UF 50V X7R 0603	Murata Electronics North America	GCM188R71H10 4KA57D	YES	YES
C3	47uF	20%	UD_6.3x5.8	CAP 47UF 10V ELECT UD SMD	Nichicon	UUD1A470MCL1 GS	NO	YES
C8	47uF	20%	UD_6.3x5.8	CAP 47UF 10V ELECT UD SMD	Nichicon	UUD1A470MCL1 GS	NO	YES
C12	330uF	20%	UD_8x10	CAP 330UF 10V ELECT UD SMD	Nichicon	UUD1A331MNL1 GS	NO	YES

NCV8855BMNR2GEVB

Table 3. BILL OF MATERIALS

Reference	Part	Tolerance	PCB Foot-print	Part Description	Manufacturer	Manufacturer's Part Number	Substitution Allowed	RoHS Compliant
C15	330uF	20%	UD_8x10	CAP 330UF 10V ELECT UD SMD	Nichicon	UUD1A331MNL1GS	NO	YES
C20	1500uF	20%	PM_16x40	CAP 1500UF 50V ELECT HE RADIAL	Nichicon	UHE1H152MHD	NO	YES
D1	MBRS4201T3G	N/A	SMC_DIODE	DIODE SCHOTTKY 4A 200V SMC	ON Semiconductor	MBRS4201T3G	NO	YES
JB1	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
JA1	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
JB2	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
JA2	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
JB4	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
JA4	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J5	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J6	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J7	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J8	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J9	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J10	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J15	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J16	JUMPER	N/A	805	CONN HEADER 2POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4024	YES	YES
J1	SMB	N/A	SMB_CONN	CONN JACK RF VERTICAL PCMNT GOLD	Emerson Network Power Connectivity Solutions	131-3701-261	YES	YES

NCV8855BMNR2GEVB

Table 3. BILL OF MATERIALS

Reference	Part	Tolerance	PCB Foot-print	Part Description	Manufacturer	Manufacturer's Part Number	Substitution Allowed	RoHS Compliant
J2	SMB	N/A	SMB_CO NN	CONN JACK RF VERTICAL PCMNT GOLD	Emerson Network Power Connectivity Solutions	131-3701-261	YES	YES
J3	SMB	N/A	SMB_CO NN	CONN JACK RF VERTICAL PCMNT GOLD	Emerson Network Power Connectivity Solutions	131-3701-261	YES	YES
J4	SMB	N/A	SMB_CO NN	CONN JACK RF VERTICAL PCMNT GOLD	Emerson Network Power Connectivity Solutions	131-3701-261	YES	YES
L1	22uH	20%	WE_PD_ L	INDUCTOR POWER 22UH 5.3A SMD	Wurth Electronics Inc	7447709220	NO	YES
L2	33uH	20%	WE_PD_ L	INDUCTOR POWER 33UH 3.2A SMD	Wurth Electronics Inc	744770133	NO	YES
Q1	NTD20P 06L	N/A	MOS_DP AK	MOSFET PWR P-CH LOG 15A 60V DPAK	ON Semiconductor	NTD20P06LT4G	NO	YES
Q2	NTD20P 06L	N/A	MOS_DP AK	MOSFET PWR P-CH LOG 15A 60V DPAK	ON Semiconductor	NTD20P06LT4G	NO	YES
Q3	NTD24N 06	N/A	MOS_DP AK	MOSFET N-CH 60V 24A DPAK	ON Semiconductor	NTD24N06LT4G	NO	YES
Q4	NTD24N 06	N/A	MOS_DP AK	MOSFET N-CH 60V 24A DPAK	ON Semiconductor	NTD24N06LT4G	NO	YES
RFA1	4.87k	1%	603	RES 4.87K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06034K87 FKEA	YES	YES
RFA2	4.87k	1%	603	RES 4.87K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06034K87 FKEA	YES	YES
RFA3	1.96k	1%	603	RES 1.96K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06031K96 FKEA	YES	YES
RFA4	8.45k	1%	603	RES 8.45K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06038K45 FKEA	YES	YES
RFB1	1.74k	1%	603	RES 1.74K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06031K74 FKEA	YES	YES
RFB2	1.74k	1%	603	RES 1.74K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06031K74 FKEA	YES	YES
RFB3	3.16k	1%	603	RES 3.16K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06033K16 FKEA	YES	YES
RFB4	2.43k	1%	603	RES 2.43K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06032K43 FKEA	YES	YES
RF01	3.24k	1%	603	RES 3.24K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06033K24 FKEA	YES	YES

NCV8855BMNR2GEVB

Table 3. BILL OF MATERIALS

Reference	Part	Tolerance	PCB Foot-print	Part Description	Manufacturer	Manufacturer's Part Number	Substitution Allowed	RoHS Compliant
RF02	3.24k	1%	603	RES 3.24K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06033K24 FKEA	YES	YES
RF03	10.2k	1%	603	RES 10.2K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310K2 FKEA	YES	YES
RF11	10.2k	1%	603	RES 10.2K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310K2 FKEA	YES	YES
RF12	10.2k	1%	603	RES 10.2K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310K2 FKEA	YES	YES
RF04	2.00k	1%	603	RES 2.00K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06032K00 FKEA	YES	YES
RF13	5.11k	1%	603	RES 2.00K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW06032K00 FKEA	YES	YES
RF14	10.5k	1%	603	RES 10.5K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310K5 FKEA	YES	YES
RF21	10.0	1%	603	RES 10.0 OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310R0 FKEA	YES	YES
RF22	10.0	1%	603	RES 10.0 OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310R0 FKEA	YES	YES
RT1	OPEN	1%	603				YES	YES
RT2	OPEN	1%	603				YES	YES
RT3	OPEN	1%	603				YES	YES
R17	OPEN	1%	603				YES	YES
RO21	OPEN	1%	603				YES	YES
RO22	OPEN	1%	603				YES	YES
RS1	150m	1%	CC1512F C	RES 0.15 OHM 0.75W 1% 1512 FC SMD	Caddock Electronics, Inc.	CC1512FC-0.15- 1%	YES	YES
RS2	150m	1%	CC1512F C	RES 0.15 OHM 0.75W 1% 1512 FC SMD	Caddock Electronics, Inc.	CC1512FC-0.15- 1%	NO	YES
RV11	15.0k	1%	603	RES 15.0K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060315K0 FKEA	YES	YES
RV12	15.0k	1%	603	RES 15.0K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060315K0 FKEA	YES	YES
R8	10.0k	1%	603	RES 10.0K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310K0 FKEA	YES	YES
R16	10.0k	1%	603	RES 10.0K OHM 1/10W 1% 0603 SMD	Vishay/Dale	CRCW060310K0 FKEA	YES	YES

NCV8855BMNR2GEVB

Table 3. BILL OF MATERIALS

Reference	Part	Tolerance	PCB Foot-print	Part Description	Manufacturer	Manufacturer's Part Number	Substitution Allowed	RoHS Compliant
R18	0	5%	603	RES 0.0 OHM 1/10W 5% 0603 SMD	Vishay/Dale	CRCW06030000 Z0EA	YES	YES
TP1	POST	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP7	POST	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP8	POST	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP9	POST	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP11	POST	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP15	POST	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP2	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP3	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP4	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP5	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP6	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP10	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP12	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP13	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP14	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP16	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES
TP17	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00- 00-07-0	YES	YES

NCV8855BMNR2GEVB

Table 3. BILL OF MATERIALS

Reference	Part	Tolerance	PCB Footprint	Part Description	Manufacturer	Manufacturer's Part Number	Substitution Allowed	RoHS Compliant
TP18	T POINT S	N/A	TURRET	TERM SOLDER TURRET .219" .109"L	Mill-Max Manufacturing Corp.	2501-2-00-44-00-00-07-0	YES	YES
TP19	OPEN	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
TP20	OPEN	N/A	POST	CONN HEADER 36POS .100 VERT GOLD	Molex/Waldom Electronics Corp	22-28-4363	YES	YES
U1	NCV8855	N/A	QFN406x6		ON Semiconductor		NO	YES
U2	OPEN	N/A	48LQFP		ON Semiconductor		NO	YES

