| **9-20 V** | **0 - 20V** | **20A** | **Non-** | **Eighth-brick** |
|---|---|---|---|---|
| Continuous Input | Outputs | Current | Isolated | DC-DC Converter |

The NiQor® Eighth-brick dc-dc converter is a non-isolated buck-boost regulator, which employs synchronous rectification to achieve extremely high conversion efficiency. The High Input Voltage NiQor Brick family of converters can be used in traditional DPA (distributed power architecture) systems or provide a regulated output voltage from a battery source or other variable voltage source. The NiQor Eighth-brick family can be configured to Buck the input voltage down to a lower voltage or Boost the input voltage up to a higher voltage using a single external resistor. These modules are RoHS 6/6 compliant (see page 12).

**NiQor Eighth-brick module**

## Operational Features

- High efficiency, 95% at full rated load current
- Delivers up to 20A of output current
- Input Voltage Range: 9-20 Vdc
- Output Voltage Range: 0 - 20V (negative output is possible)
- Extensive on-board input and output filtering
- No minimum load requirement means no preload resistors required
- Buck or buck-boost versions available
- Adjustable current limit with current monitor (C option)
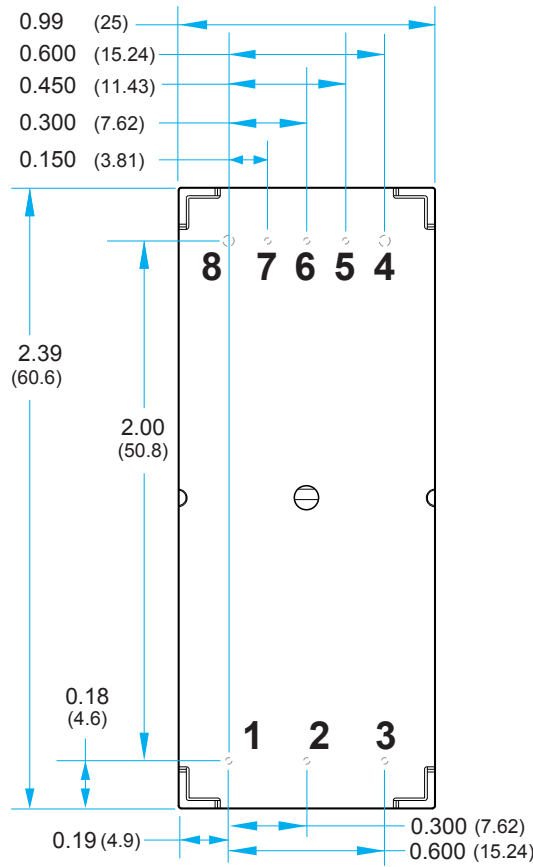
## Protection Features

- Input under-voltage lockout protects the converter at low input voltage conditions
- Over-current shutdown protects converter from excessive load current or short circuits
- Input/output over-voltage protection protects load and regulator from damaging voltages
- Thermal shutdown protects converter from abnormal environmental conditions

## Mechanical Features

- Industry standard eighth-brick pin-out configuration
- Sizes: .99" x 2.39" (25 x 60.6 mm)
- Total height only 0.500" (12.7 mm)
- Total weight: 1.7oz (48g)

## Safety Features

- UL 62368-1
- EN 62368-1
- CAN/CSA C22.2 No. 62368-1

## Control Features

- On/Off control
- Output voltage trim permits custom voltages
- Remote Sense (S option, standard)
- Current limit trim (C option)
- Output voltage trim range from 0 - 20V

## Contents

# SynQor®

**Encased Mechanical Diagram**

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*

0.99 (25)
0.600 (15.24)
0.450 (11.43)
0.300 (7.62)
0.150 (3.81)

0.500 ±0.025
(12.7 ±0.63)
Overall height

**8 7 6 5 4**

2.39
(60.6)

2.00
(50.8)

0.145
(3.68)

0.18
(4.6)

**1  2  3**

0.19 (4.9)

0.300 (7.62)
0.600 (15.24)

Bottom side Clearance
0.020 ±0.010
(0.51 ±0.25)
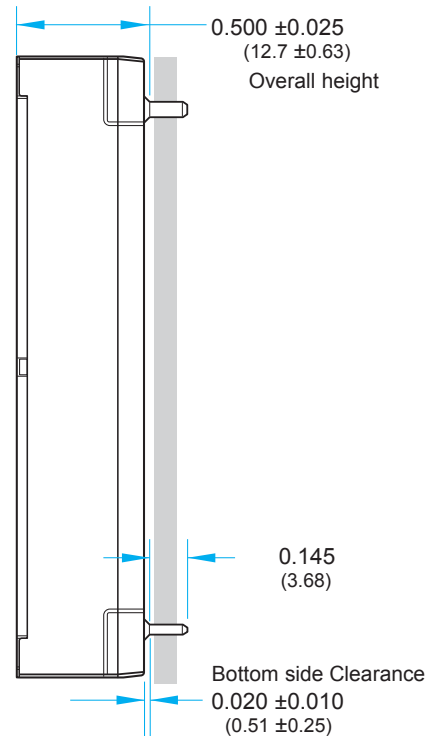
**Top View**        **Side View**

## NOTES

1) BASEPLATE FLATNESS TOLERANCE IS 0.004" (.10mm)
   TIR FOR SURFACE
2) PINS 1-3, 5-7 ARE 0.040" (1.02mm) DIA. WITH
   0.080" (2.03mm) DIA. STANDOFF SHOULDERS
3) PINS 4 AND 8 ARE 0.062" (1.57mm) DIA. WITH
   0.100" (2.54mm) DIA. STANDOFF SHOULDERS
4) ALL PINS: MATERIAL: COPPER ALLOY
            FINISH: MATTE TIN OVER NICKEL PLATE
5) UNDIMENSIONED COMPONENTS ARE SHOWN
   FOR VISUAL REFERENCE ONLY
6) ALL DIMENSIONS IN INCHES(mm)
   TOLERANCES: X.XXIN +/-0.02   (X.Xmm +/-0.5mm)
               X.XXXIN +/-0.010 (X.XXmm +/-0.25mm)
7) WEIGHT: 1.7oz (48g) TYPICAL
8) WORKMANSHIP: MEETS OR EXCEEDS IPC-A-610 CLASS II

## PIN DESIGNATIONS

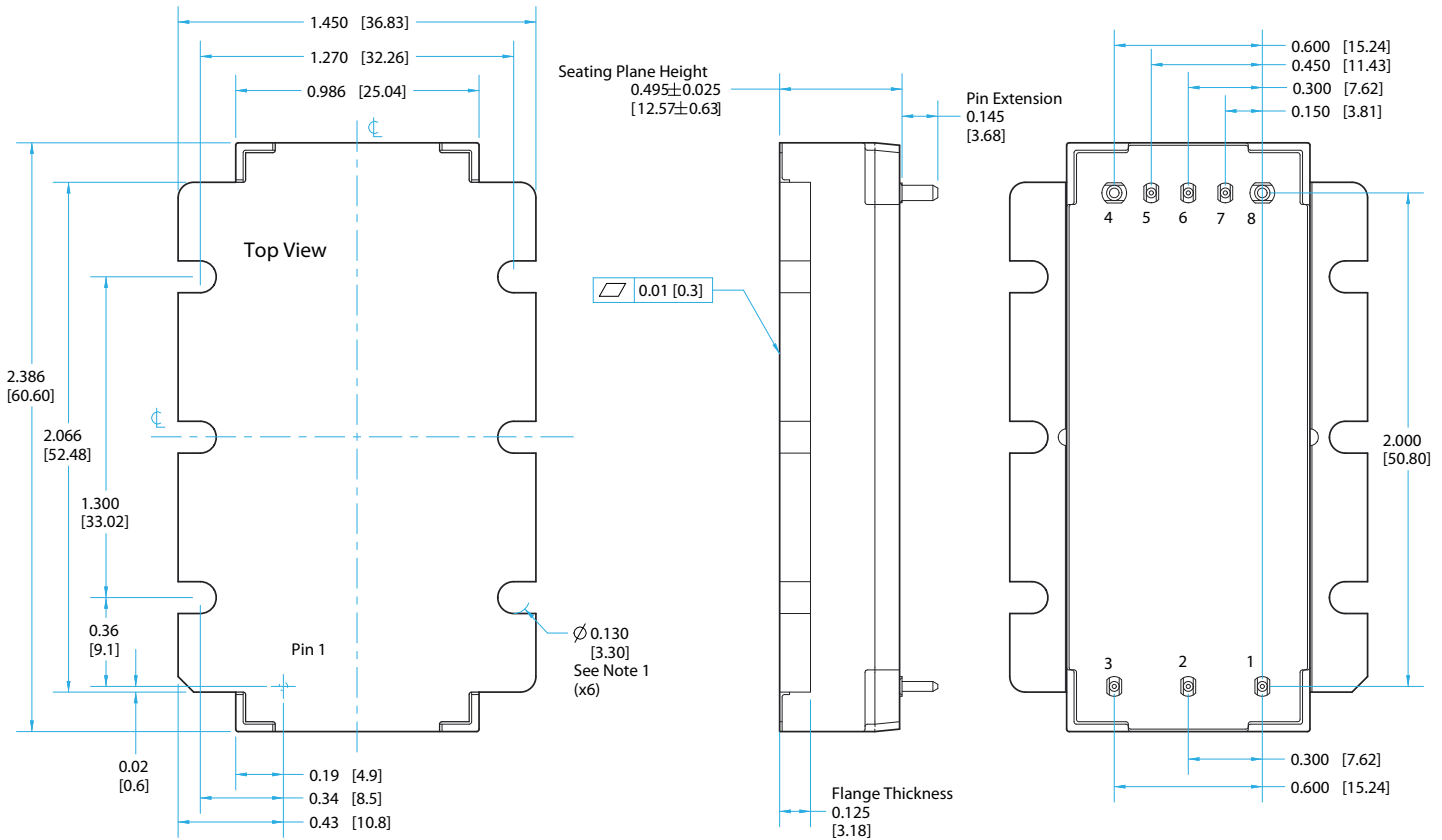| Pin | Label | Name | Function |
|-----|-------|------|----------|
| 1 | +VIN | Vin(+) | Positive Supply Input |
| 2 | ON/OFF | On/Off | Input to enable/disable the converter, TTL |
| 3 | -VIN | Vin(-) | Negative Supply Input, internally connected to Pin 4 |
| 4 | -VOUT | Vout(-) | Negative Power Output, internally connected to Pin 3 |
| 5 | -SNS | Sense(-) | Negative Power Voltage Sense. See Note 1 (S option) |
|   |       |          | ITRIM (C option) |
| 6 | TRIM | TRIM | Output voltage trim |
| 7 | +SNS | Sense(+) | Positive Output Voltage Sense. See Note 2 (S option) |
|   |       |          | IMON (C option) |
| 8 | +VOUT | Vout(+) | Positive Power Output |

**Notes:**
1) For S option only, -SNS should be permanently connected
   to -Vout either at the converter or remotely.
2) For S option only, +SNS should be permanently connected
   to +Vout either at the converter or remotely.

# SynQor®
## Flanged Mechanical Diagram

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*

Top View

1.450 [36.83]
1.270 [32.26]
0.986 [25.04]

Seating Plane Height
0.495±0.025
[12.57±0.63]

Pin Extension
0.145
[3.68]

0.600 [15.24]
0.450 [11.43]
0.300 [7.62]
0.150 [3.81]

2.386 [60.60]
2.066 [52.48]
1.300 [33.02]
0.36 [9.1]

0.01 [0.3]

2.000 [50.80]

4  5  6  7  8

3  2  1

Pin 1

Ø 0.130 [3.30]
See Note 1 (x6)

0.02 [0.6]
0.19 [4.9]
0.34 [8.5]
0.43 [10.8]

0.300 [7.62]
0.600 [15.24]

Flange Thickness
0.125 [3.18]

## NOTES

1) APPLIED TORQUE PER SCREW SHOULD NOT EXCEED 6in-lb (.7Nm)
2) BASEPLATE FLATNESS TOLERANCE IS 0.010" (.25mm) TIR FOR SURFACE.
3) PINS 1-3 and 5-7 ARE 0.040" (1.02mm) DIA. WITH 0.080" (2.03mm) DIA. STANDOFFS.
4) PINS 4 AND 8 ARE 0.062" (1.57mm) DIA. WITH 0.100" (2.54mm) DIA STANDOFFS
5) ALL PINS: MATERIAL: COPPER ALLOY
   FINISH: MATTE TIN OVER NICKEL PLATE
6) UNDIMENSIONED COMPONENTS ARE SHOWN FOR VISUAL REFERENCE ONLY
7) ALL DIMENSIONS IN INCHES(mm)
   TOLERANCES: X.XXin +/-0.02 (X.Xmm +/-0.5mm)
              X.XXXin +/-0.010 (X.XXmm +/-0.25mm)
8) WEIGHT: 1.9oz (53g) TYPICAL
9) WORKMANSHIP: MEETS OR EXCEEDS IPC-A-610 CLASS II

## PIN DESIGNATIONS

| Pin | Label | Name | Function |
|-----|-------|------|----------|
| 1 | +VIN | Vin(+) | Positive Supply Input |
| 2 | ON/OFF | On/Off | Input to enable/disable the converter, TTL |
| 3 | -VIN | Vin(-) | Negative Supply Input, internally connected to Pin 4 |
| 4 | -VOUT | Vout(-) | Negative Power Output, internally connected to Pin 3 |
| 5 | -SNS | Sense(-) | Negative Power Voltage Sense. See Note 1 (S option) |
| | | | ITRIM (C option) |
| 6 | TRIM | TRIM | Output voltage trim |
| 7 | +SNS | Sense(+) | Positive Output Voltage Sense. See Note 2 (S option) |
| | | | IMON (C option) |
| 8 | +VOUT | Vout(+) | Positive Power Output |

Notes:
1) For S option only, -SNS should be permanently connected to -Vout either at the converter or remotely.
2) For S option only, +SNS should be permanently connected to +Vout either at the converter or remotely.

# SynQor®
## Technical Specification

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*

## NQ20x20ETx20 Electrical Characteristics

Ta = 25 °C, airflow rate = 300 LFM, Vin = 12 V dc unless otherwise noted; full operating temperature range is -40 °C to +105 °C ambient temperature with appropriate power derating. Specifications subject to change without notice.

| Parameter | Vout | Min. | Typ. | Max. | Units | Notes & Conditions |
|---|---|---|---|---|---|---|
| **ABSOLUTE MAXIMUM RATINGS** | | | | | | |
| Input Voltage | | | | | | |
| Non-Operating | All | 0 | | 30 | V | Continuous |
| Operating | All | | | 20 | V | Continuous |
| Storage Temperature | All | -45 | | 125 | °C | |
| Voltage at ON/OFF input pin | All | -0.5 | | 5.5 | V | |
| **RECOMMENDED OPERATING CONDITIONS** | | | | | | |
| Input Voltage Range | All | 9 | | 20 | V | Turn on at 10V |
| Input Fuse Rating | All | | | 25 | A | Fast blow external fuse recommended |
| Input Current | | | | 20 | A | Input current max equals output rated current |
| External Input Capacitance | All | 100 | | | µF | ESR < 1.5 Ω |
| Output Voltage | All | 0 | | 20 | V | |
| Output Current | All | 0 | | 20 | A | Output voltage dependent |
| **INPUT CHARACTERISTICS** | | | | | | |
| Input Under-Voltage Lockout | | | | | | |
| Turn-On Voltage Threshold | All | 9.2 | 9.5 | 10 | V | |
| Turn-Off Voltage Threshold | All | 8.1 | 8.5 | 8.9 | V | |
| Lockout Hysteresis | All | | 1.0 | | V | |
| Input Current Limit | All | | 24 | | A | |
| No-Load Input Current | 5 | | 115 | | mA | |
| " | 12 | | 140 | | mA | |
| " | 20 | | 150 | | mA | |
| Disabled Input Current | All | | 60 | | mA | |
| Input Filter Components Value (C\L\C) | All | | 20\1.1\60 | | µF\µH\µF | |
| **OUTPUT CHARACTERISTICS** | | | | | | |
| Output Voltage Range | All | 0 | | 20 | V | Set output by Rtrim resistor |
| Operating Output Current Range | All | 0 | | 20 | A | |
| Output Voltage Regulation | | | | | | |
| Total Output Voltage Range | All | | ±160 mV ±4%*Vout | | | Sense pin, over sample, line, load, temp. & life |
| Output Voltage Ripple and Noise (pk-pk/36Vin) | 3.3 | | 10 | | mV | 10 Vin Full Load; 100uF; 20 MHz b.w. |
| " | 5 | | 20 | | mV | " |
| " | 20 | | 40 | | mV | |
| Output DC Over Current limit | All | | 24 | | A | Effective on input, output condition |
| External Output Capacitance | All | 0 | | 5000 | µF | ESR > 1 mΩ |
| C Option: Isense voltage | | | | | | |
| No load | All | | 1.25 | | V | |
| Full load | All | | 1.83 | | V | 10 A load |
| Output resistance of Isense | All | | 10 | | kΩ | |
| C Option: Itrim voltage | | | | | | |
| Voltage at no load | All | | 0.12 | | V | |
| Voltage at maximum load | All | | 2.12 | | V | 10 A load |
| Pull-Up Resistance of Itrim Pin | All | | 10.2 | | kΩ | |
| Pull-Up Voltage | All | | 2.5 | | V | |
| C Option: Reverse Current | All | | | 2 | µA | Enabled or Disabled |
| **EFFICIENCY** | | | | | | |
| 100% Load; 20 Vin | 5 | | 88 | | % | |
| 100% Load; 20 Vin | 12 | | 94 | | % | |
| 100% Load; 12 Vin | 20 | | 95 | | % | W mode only |
| 50% Load; 20 Vin | 5 | | 90 | | % | |
| 50% Load; 20 Vin | 12 | | 95 | | % | |
| 50% Load; 12 Vin | 20 | | 95 | | % | W mode only |

**SynQor®**

**Technical Specification**

Input: *9-20 V*
Outputs: *0 - 20V*
Current: *20A*
Package *Eighth-brick*

## NQ20x20ETx20 Electrical Characteristics (continued)

Ta = 25 °C, airflow rate = 300 LFM, Vin = 12 V dc unless otherwise noted; full operating temperature range is -40 °C to +105 °C ambient temperature with appropriate power derating. Specifications subject to change without notice.

| Parameter | Vout | Min. | Typ. | Max. | Units | Notes & Conditions |
|---|---|---|---|---|---|---|
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Output Voltage during Current Transient | | | | | | |
|    For a Step Change in Output Current | All | | 1 | | V | (0.1 A/µs); 50%-75%-50% Iout max |
|    Settling Time | All | | 5 | | ms | To within 1.5% Vout nom. |
| Turn on Transient | | | | | | |
|    Startup delay | All | | 2 | | ms | Resistive load |
|    Rise Rate | All | | 0.2 | | V/ms | " |
|    Output Voltage Overshoot | All | | | 0 | V | " |
| **FEATURE CHARACTERISTICS** | | | | | | |
| Switching Frequency | All | 240 | 250 | 260 | kHz | |
| ON/OFF Control | | | | | | |
| Negative Logic (N) ON/OFF Control | | | | | | |
|    Off-State Voltage | All | 1.8 | | 3.3 | V | |
|    On-State Voltage | All | 0 | | 0.8 | V | |
|    Pull-Up Voltage | All | | 3.3 | | V | |
|    Pull-Up Resistance | All | | 10 | | kΩ | |
| Output Voltage Trim Range | All | 0 | | 20 | V | Measured Vout+ to common pins |
| Input/Output Over-Voltage Protection | All | 22 | 24 | 25 | V | Over full temp range |
| Over-Temperature Shutdown | All | | 115 | | °C | Average PCB Temperature |
| Over-Temperature Shutdown Restart Hysteresis | All | | 15 | | °C | |
| **TEMP LIMITS FOR POWER DERATING** | | | | | | |
| Semiconductor Junction Temperature | All | | | 125 | °C | Package rated to 150 °C |
| Board Temperature | All | | | 125 | °C | ULrated max operating temp 130 °C |
| Baseplate Temperature | All | | | 100 | °C | |
| **RELIABILITY CHARACTERISTICS** | | | | | | |
| Calculated MTBF (TR-NWT-000332; Telcordia) | All | | 2.5 | | $10^6$ Hrs. | 100% load, 200LFM, 40 °C Ta |
| Calculated MTBF (MIL-HDBK-217F; MIL-217) | All | | 1.9 | | $10^6$ Hrs. | 100% load, 200LFM, 40 °C Ta |
| Field Demonstrated MTBF | All | | | | $10^6$ Hrs. | See our website for details |

# SynQor®

## Standards & Qualifications

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*

| Parameter | Notes & Conditions |
|---|---|
| **STANDARDS COMPLIANCE** | |
| UL 62368-1 | |
| CAN/CSA C22.2 No. 62368-1 | |
| EN 62368-1 | |

Note: An external input fuse must always be used to meet these safety requirements. Contact SynQor for official safety certificates on new releases or download from the SynQor website.

| Parameter | # Units | Test Conditions |
|---|---|---|
| **QUALIFICATION TESTING** | | |
| Life Test | 32 | 95% rated Vin and load, units at derating point, 1000 hours |
| Vibration | 5 | 10-55 Hz sweep, 0.060 " total excursion, 1 min./sweep, 120 sweeps for 3 axis |
| Mechanical Shock | 5 | 100 g minimum, 2 drops in x, y, and z axis |
| Temperature Cycling | 10 | -40 °C to 100 °C, unit temp. ramp 15 °C/min., 500 cycles |
| Power/Thermal Cycling | 5 | Toperating = min to max, Vin = min to max, full load, 100 cycles |
| Design Marginality | 5 | Tmin-10 °C to Tmax+10 °C, 5 °C steps, Vin = min to max, 0-105% load |
| Humidity | 5 | 85 °C, 95% RH, 1000 hours, continuous Vin applied except 5 min/day |
| Solderability | 15 pins | MIL-STD-883, method 2003 |
| Altitude | 2 | 70,000 feet (21 km), see Note |

Note: A conductive cooling design is generally needed for high altitude applications because of naturally poor convective cooling at rare atmospheres.

# SynQor®

## Technical Charts

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*
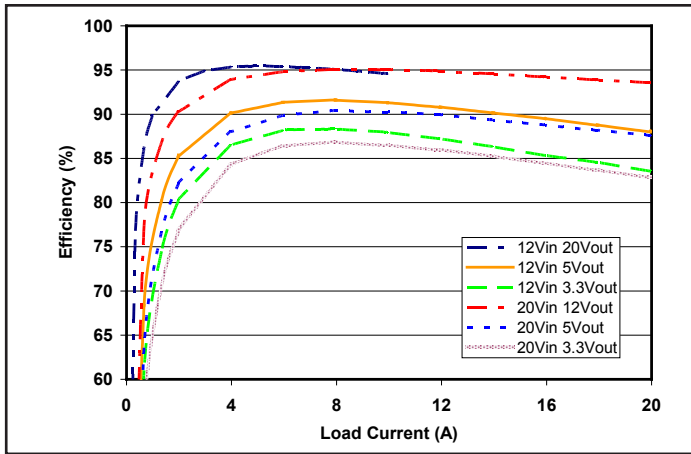
*Figure 1: Efficiency at different output voltage vs. load current for different input voltage at 25 °C.*
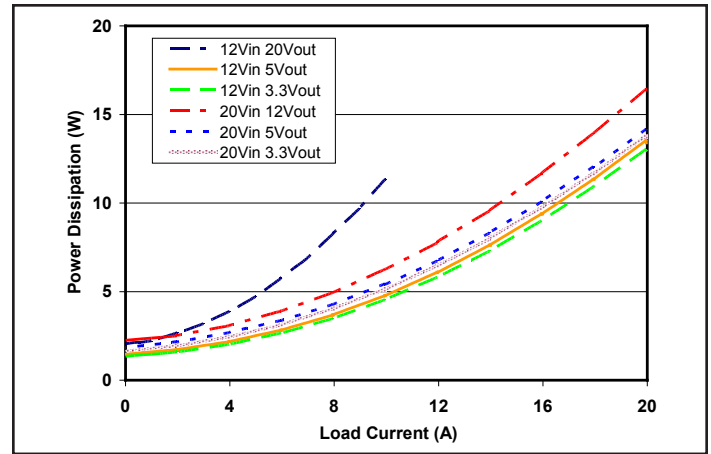


*Figure 2: Power dissipation at different output voltage vs. load current for different input voltage at 25 °C.*
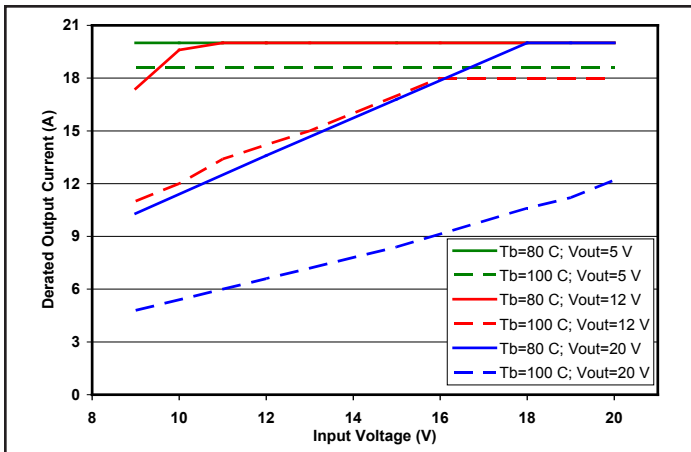


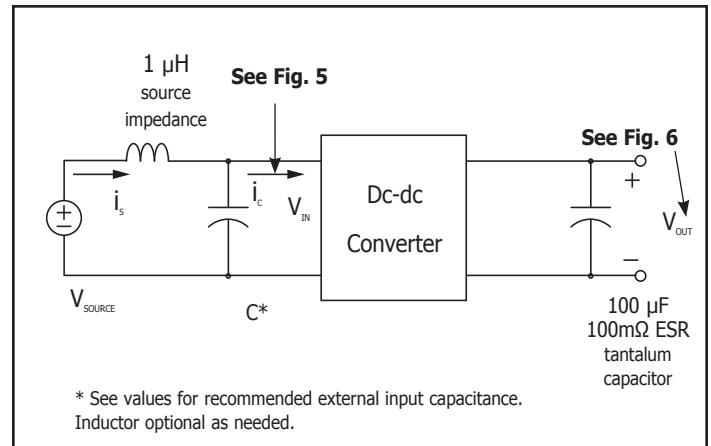*Figure 3: Maximum output power derating curve with a controlled baseplate temperature of 80°C and 100°C.*



*Figure 4: Test set-up diagram showing measurement points for Input Terminal Ripple Current (Fig 5), and Output Voltage Ripple (Fig 6).*
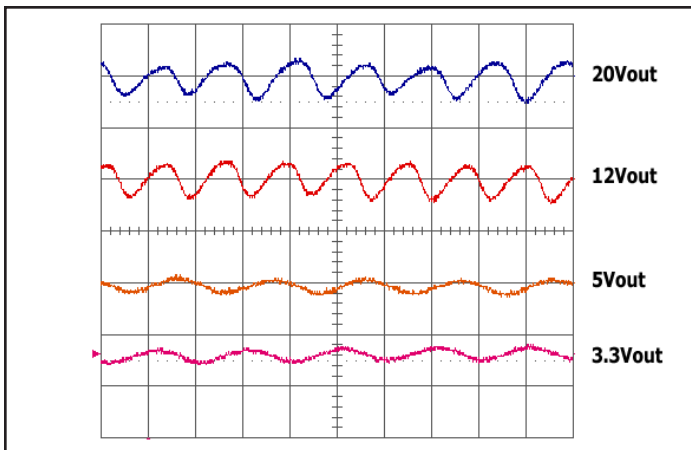


*Figure 5: Input Terminal Ripple Current at 10 V input voltage and rated load current (500 mA/div). Bandwidth: 20 MHz (See Figure 4). Timescale: 2 µs/div.*
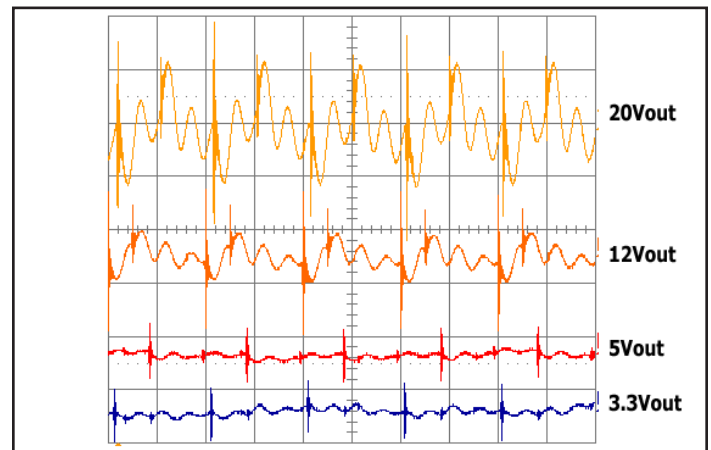


*Figure 6: Output Voltage Ripple at 10 V input voltage and rated load current (20mV/div). Zero load capacitance. Bandwidth: 20 MHz (See Figure 4). Timescale: 2 µs/div.*

# SynQor®

## Technical Charts

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*
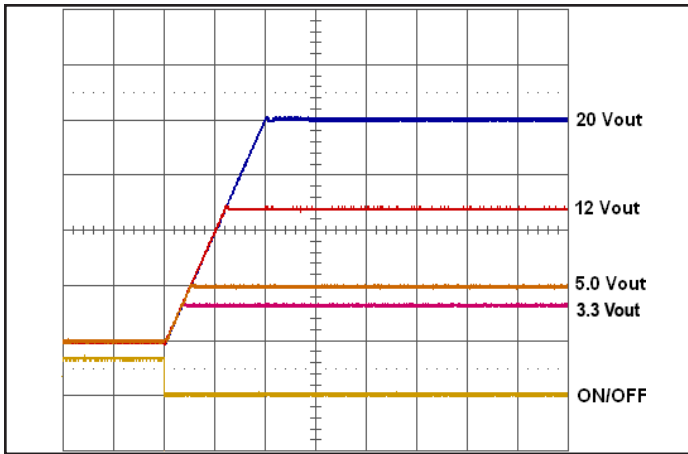
*Figure 7: Turn-on transient at zero load. Ch 1-4: Vout (5 V/div), ON/OFF input (5 V/div). Timescale: 50 ms/div.*
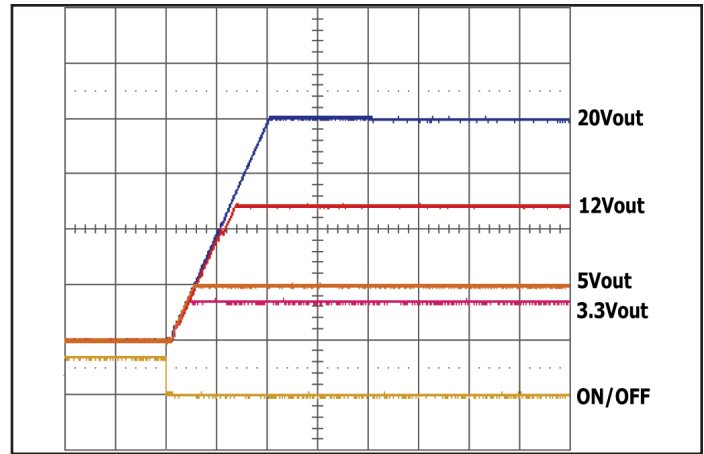


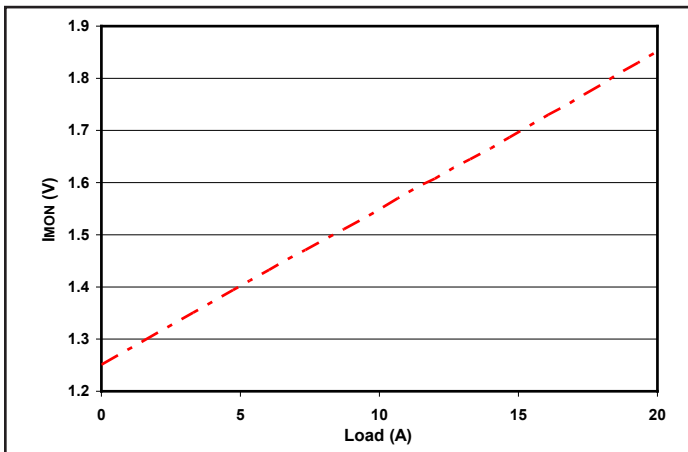*Figure 8: Turn-on transient at full load. Ch 1-4: Vout (5 V/div), ON/OFF input (5 V/div). Timescale: 50 ms/div.*



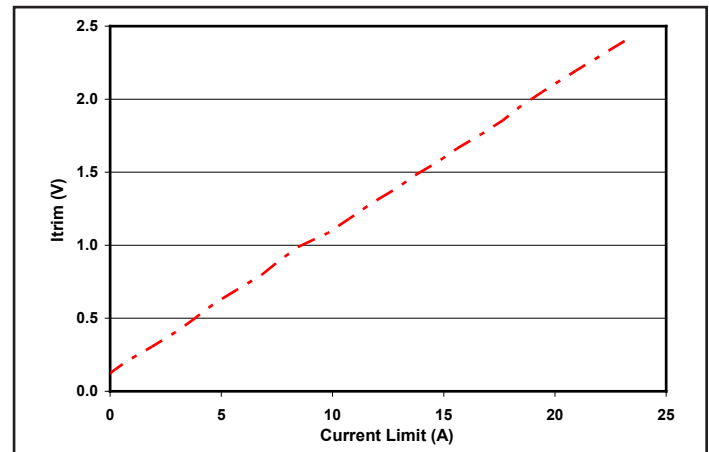*Figure 9: Imon pin voltage vs. load current at 16 V input and 13.8 V output. Load capacitance: 100µF electrolytic cap. C option only.*



*Figure 10: Current limit vs. Itrim pin voltage with 16 V input and 13.8 V output. Load capacitance: 100µF electrolytic cap. C option only.*
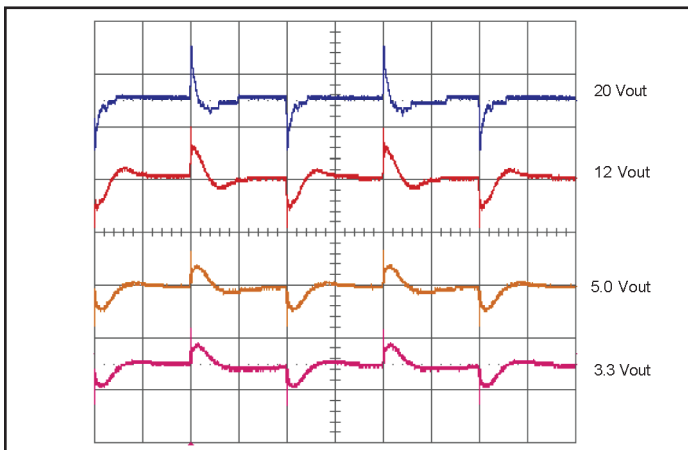


*Figure 11: Output voltage response for 3.3 V, 5 V, 12 V, 20 V units to step-change in load current (50-75-50% of Iout max; di/dt=0.1A/µs). Load cap: 100µF, 100mΩ ESR tant, Ch 1-4: Vout (1 V/div). Timescale: 5 ms/div.*

# SynQor®

## Application Section

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*

## BASIC OPERATION AND FEATURES

These converters use a digital controller for the buck stage and the boost stage. It automatically changes operating mode (buck or boost) when the line voltage or output set point changes. Both stages are accomplished with synchronous rectifiers. Very high efficiency is maintained over wide input and output voltage ranges by the change in operational mode and the use of synchronous rectifiers.

The converter runs at a fixed frequency with a predictable EMI performance.

**Note:** Since this converter supports a wide range of input and output voltage, the current rating and current limit function affect both input and output current, whichever is higher at the time. When in buck mode, the output current is higher. In boost mode the input current is higher.

## CONTROL FEATURES

**REMOTE ON/OFF:** The On/Off input permits the user to control when the converter is on or off. Only Negative ON/OFF logic is available in this power module series.

The negative logic ON/OFF signal turns the module OFF when it is high (leave the pin floating or set its voltage between 1.8~3.3 V) and turns the module ON when it is low (below 0.8V with respect to Vin-).

**OUTPUT VOLTAGE TRIM:** The output voltage can be programmed to any voltage between 0Vdc and $V_{rated}$ by connecting one resistor between the Pin 6 (TRIM) pin and Pin 5 [Sense(-)](S-version) or Pin 4 [Vout(-)](C-version). For a desired output voltage, the value of the resistor is:

$$R_{Vtrim}(V_{out}) = \left[ \left( \frac{12465 \times V_{rated}}{V_{trim} + 0.0569 \times V_{rated}} \right) - 10912 \right] (\Omega)$$

Alternatively, the TRIM pin can be driven from an external voltage source:

$$V_{pin6} = 2.366 - 2.180 \left( \frac{V_{trim}}{V_{rated}} \right)$$

Where, for both approaches:

      Vtrim = desired output voltage setpoint
      Vrated = rated output voltage
      Vpin6 = trim pin voltage (when driven externally)
      RVtrim = resistor value to set Vout

**Note:** To maintain the accuracy of the output voltage over load current, it is vital that any trim resistor be connected to the converter's Sense(-) pin (for the S-option) or Vout(-) pin (for the C-option), locally at the converter, not at a remote location nearer to the load. A separate Kelvin connection to the PCB pad for the Vout(-) is optimal for the C-option.

## PROTECTION FEATURES

**Input Under-Voltage Lockout:** The converter is designed to turn off when the input voltage is too low, which helps to avoid an input system instability problem (described in more detail in the application note titled "Input System Instability"). The lockout circuitry is a comparator with DC hysteresis. When the input voltage is rising, it must exceed the typical Turn-On Voltage Threshold value (listed on the specification page) before the converter will turn on. Once the converter is on, the input voltage must fall below the typical Turn-Off Voltage Threshold value before the converter will turn off.

**Output Current Shutdown:** To provide protection in an output short condition, the unit is equipped with internal short circuit protection. When the short circuit protection is triggered, the unit first shuts down. After an approximately 16 ms inhibit time, the unit turns on again. If the short circuit condition remains, the current limit circuit will control the output current. The unit will operate normally once the fault condition is removed.

**Internal Over-Voltage Protection (OVP):** To protect the load against an excessive output voltage, an output over-voltage shutdown feature is included. This OVP is fixed and independent of the output voltage set point.

**Over-Temperature Shutdown:** A temperature sensor on the converter senses the average temperature of the module. The over temperature shutdown circuit is designed to turn the converter off when the temperature at the sensed location reaches the Over-Temperature Shutdown value. It will allow the converter to turn on again when the temperature of the sensed location falls by the amount of the Over-Temperature Shutdown Restart Hysteresis value.

# SynQor®

Input: *9-20 V*
Outputs: *0 - 20V*
Current: *20A*
Package *Eighth-brick*

## Application Section

## APPLICATION CONSIDERATIONS

**Limited output voltage resolution:** The internal voltage control feedback loop is digital and has limited resolution. Therefore, the output voltage will exhibit discrete steps as the loop responds to changes in line, load, trim, or remote sense. For instance, on close examination, the startup ramp has a "stair-step" shape. Likewise, a load transient response will be composed of multiple discrete steps.

**Input filtering:** These modules should be connected to a low-impedance source. A highly inductive source can affect the stability of the module. An input capacitor with an ESR must be placed directly adjacent to the input pin of the module to minimize input ripple voltage and ensure module stability.

See application note: Input System Instability
(http://www.synqor.com/documents/appnotes/appnt_System_Instability.pdf)

**Output capacitance:** No extra external capacitor is required. However, to reduce the output ripple and improve dynamic response to a step load change additional capacitance at the output can be used. Low ESR polymer and ceramic capacitors are recommended to improve the dynamic response of the module. The addition of external output capacitance may cause the start-up time to change.

**Remote sense (S-option only):** Vout remote sensing is provided to achieve proper regulation at the load points and reduce effects of distribution losses on output line. The module can correct for a total of 10% drop in the output lines. In the event of an open remote sense line, the module will maintain regulation through an internal resistor connection.

**Current limit:** The available power is limited by an output current limit in buck mode (when Vin>Vout) and by an input current limit in boost mode (when Vin<Vout).

for Vin >Vout:
$$I_{limit} = 1.2 \times I_{max}$$

for Vin < Vout:
$$I_{limit} = 1.2 \times I_{max} \times \left( \frac{Vin}{Vout} \right)$$

where $I_{max}$ = maximum rated output current

**Negative output:** This series of converters can be connected to achieve a negative output from a positive input as shown in Fig A.
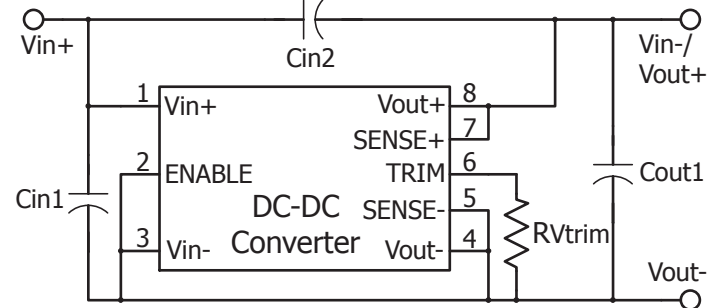


*Figure A:* *Negative output setup*

Using this negative output configuration impacts the available output voltage range and current limit.

The output voltage range becomes 0 to (Vmax - Vin), and the current limit (for either the buck or boost modes) is scaled by:

$$I_{rated(neg)} = \frac{Vin}{(Vin + Vout)} * I_{rated}$$

# SynQor®
## Application Section

**Input:** *9-20 V*
**Outputs:** *0 - 20V*
**Current:** *20A*
**Package** *Eighth-brick*

## C-FEATURE SET (Current monitor/ trimmable current limit (C-option)

In addition to voltage trim, the C-option offers an adjustable current limit trim and a current monitor $I_{mon}$ pin. It does not have remote sense.

**Zero back-drive current:** The C-option includes an ideal diode circuit in series with the Vout+ pin that prevents reverse current flow. This enables applications such as battery charging, current sharing, and current monitoring.
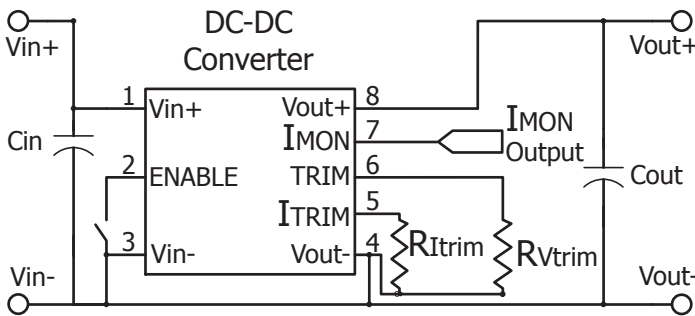
### C-Option Connection



*Figure B: Current monitor/trimmable current limit setup*

**Output voltage trim:** The $RV_{trim}$ resistor increases the output voltage, identical in function to the S-option (p.9).

**Output current limit:** There are three levels of current that must be understood when considering the term "Output Current Limit" as listed below:

$I_{OCL}$ = over-current limit (from datasheet *Output Characteristics: Output DC Over Current Limit*). This is a built in fixed value of current at which the converter will limit.

$I_{rated}$ = rated current of the converter (input or output)

$I_{trim}$ = desired output current limit

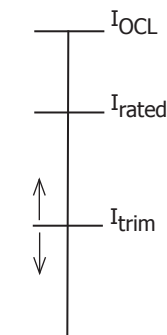Figure C shows the relationship among these three currents.



*Figure C: Relationship of output current terms.*

**Output current limit trim:** The output current limit can be set to any value between zero and $I_{rated}$ by choosing the value of $R_{Itrim}$ as follows:

$$R_{Itrim} = \left[ \left( \frac{0.0469\ I_{rated} + I_{trim}}{1.153\ I_{rated} - I_{trim}} \right) 10200 - 10 \right] (\Omega)$$

Where $I_{trim}$ = desired current limit setpoint

$I_{rated}$ = rated maximum converter current

Alternatively, the $I_{trim}$ pin can be driven from an external voltage source:

$$V_{(pin5)} = 2.085(I_{trim}/I_{rated}) + 0.0953$$

where $I_{trim}$ is the desired current limit setpoint

**Note:** It is possible to choose $R_{Itrim}$ such as that $I_{trim}$ is greater than $I_{rated}$, but SynQor does not recommend continuous operation above $I_{rated}$.

**Note:** When in boost-mode, the output current could still be limited by the maximum current limit, $I_{OCL}$, applied to the input current.

**Current monitor:** The $I_{mon}$ pin voltage tracks the output current, as shown in figure 9. Zero load current is 1.25V and maximum rated load current is 1.83V. This pin has a 49.9 Ohm output impedance.
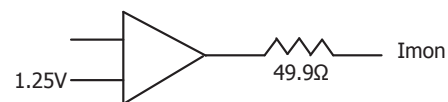


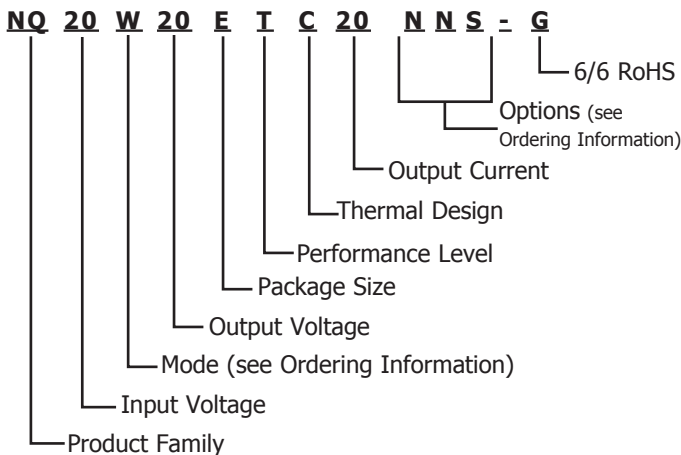*Figure D: Current monitor circuit*

# SynQor®
## Ordering Information

| | |
|---|---|
| **Input:** | *9-20 V* |
| **Outputs:** | *0 - 20V* |
| **Current:** | *20A* |
| **Package** | *Eighth-brick* |

## PART NUMBERING SYSTEM

The part numbering system for SynQor's dc-dc converters follows the format shown in the example below.

**NQ 20 W 20 E T C 20 N N S - G**

- 6/6 RoHS
- Options (see Ordering Information)
- Output Current
- Thermal Design
- Performance Level
- Package Size
- Output Voltage
- Mode (see Ordering Information)
- Input Voltage
- Product Family

The first 12 characters comprise the base part number and the last 3 characters indicate available options. The "-G" suffix indicates 6/6 RoHS compliance.

## Application Notes

A variety of application notes and technical white papers can be downloaded in pdf format from our website.

**RoHS Compliance:** The EU led RoHS (Restriction of Hazardous Substances) Directive bans the use of Lead, Cadmium, Hexavalent Chromium, Mercury, Polybrominated Biphenyls (PBB), and Polybrominated Diphenyl Ether (PBDE) in Electrical and Electronic Equipment. This SynQor product is 6/6 RoHS compliant. For more information please refer to SynQor's RoHS addendum available at our RoHS Compliance / Lead Free Initiative web page or e-mail us at rohs@synqor.com.

## ORDERING INFORMATION

The tables below show the valid model numbers and ordering options for converters in this product family. When ordering SynQor converters, please ensure that you use the complete 15 character part number consisting of the 12 character base part number and the additional 3 characters for options. Add "-G" to the model number for 6/6 RoHS compliance.

| Model Number | Input Voltage | Output Voltage | Max Output Current |
|---|---|---|---|
| NQ20w20ETx20Nyz-G | 9-20 V | 0 - 20V | 20A |

The following options must be included in place of the *w x y z* spaces in the model numbers listed above.

| Options Description: x y z | | | | |
|---|---|---|---|---|
| **Mode: w** | **Thermal Design: x** | **Enable Logic** | **Pin Style: y** | **Feature Set: z** |
| T - Buck<br>W - Buck / Boost | C - Encased<br><br>V - Encased with Flanged Baseplate | N - Negative | K - 0.110"<br>N - 0.145"<br>R - 0.180"<br>Y - 0.250" | S - Standard<br>C - Current monitor output / Trimmable current limit |

Not all combinations make valid part numbers, please contact SynQor for availability. See the Product Summary web page for more options.

## PATENTS
SynQor holds numerous U.S. patents, one or more of which apply to most of its power conversion products. Any that apply to the product(s) listed in this document are identified by markings on the product(s) or on internal components of the product(s) in accordance with U.S. patent laws. SynQor's patents include the following:

6,896,526   6,927,987   7,050,309   7,765,687
7,787,261   8,149,597   8,644,027