



**THE DATASHEET OF  
SC4201IMSTRT**



### POWER MANAGEMENT

#### Description

The SC4201 is a multi-phase link controller, ideal for isolated and non-isolated applications. Its frequency of operation can be programmed in excess of 2MHz per phase (oscillator frequency = phase frequency times number of phases 3 or 4) and can be easily synchronized to an external faster frequency. The SC4201 output frequencies can be set to 2/4 or 3 phase operation. A single pin can either set a 4 phase operation (each phase is 90 degrees apart) or 3 phase operation (120 degrees apart).

Multi-phase operation of multiple primary or secondary controllers reduces input/output ripple, the number of components required for filtering, and noise due to frequency beating generated by multiple free running oscillators.

The SC4201 is available in the MSOP-8 surface mount package.

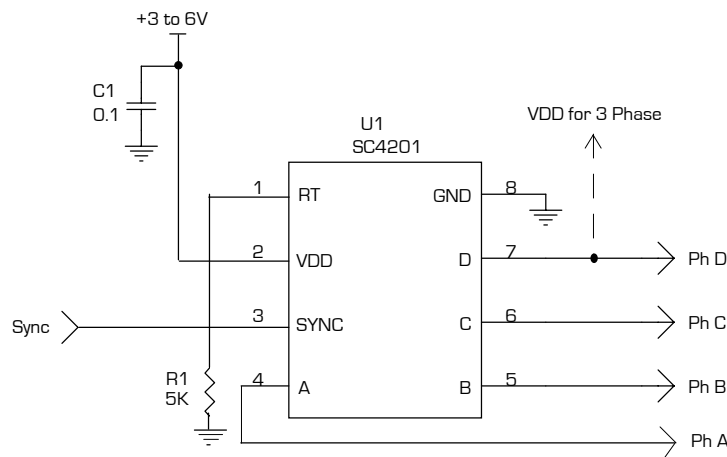
#### Features

- ◆ Small footprint MSOP-8
- ◆ Programmable frequency > 2MHz, each phase
- ◆ Synchronized to faster frequency
- ◆ Programmable 2/4 or 3 phase operation

#### Applications

- ◆ Telecom distributed power architectures
- ◆ Multi-phase operation of isolated power supplies
- ◆ Multi-phase operation of non-isolated switching regulators

#### Typical Application Circuit



**POWER MANAGEMENT**
**Absolute Maximum Ratings**

Exceeding the specifications below may result in permanent damage to the device, or device malfunction. Operation outside of the parameters specified in the Electrical Characteristics section is not implied.

| Parameter                             | Symbol        | Limits                 | Units |
|---------------------------------------|---------------|------------------------|-------|
| Supply Voltage                        | $V_{IN}$      | 7                      | V     |
| RT, SYNC                              | $V_{P\_K}$    | -0.3V to $V_{DD}$ +0.3 | V     |
| Operating Ambient Temperature Range   | $T_A$         | -40 to +125            | °C    |
| Junction Temperature Range            | $T_J$         | -40 to 150             | °C    |
| Storage Temperature Range             | $T_{STG}$     | -65 to 150             | °C    |
| Lead Temperature (Soldering) 10 sec   | $T_{LEAD}$    | +300                   | °C    |
| Thermal Impedance Junction to Ambient | $\theta_{JA}$ | 206                    | °C/W  |
| ESD Rating (Human Body Model)         | ESD           | 2                      | kV    |

**Electrical Characteristics**

Unless specified:  $T_A = T_J = -40$  to  $+125^\circ\text{C}$ ,  $V_{DD} = 5\text{V}$ ,  $R_T = 100\text{k}\Omega$ , 4-phase.

| Parameter                   | Symbol     | Conditions  | Min | Typ        | Max      | Units    |
|-----------------------------|------------|---|-----|------------|----------|----------|
| Supply Voltage, Operating   | $V_{DD}$   |   | 3.0 |            | 6.0      | V        |
| Supply Current              | $I_{DD}$   | $V_{DD} = 6\text{V}$ , $R_T = 36.5\text{k}\Omega$ , $C_{OUT} = 20\text{pF}$ |     | 2.35       | 2.60     | mA       |
| VDD Start Threshold         |            |   |     |            | 3.10     | V        |
| VDD UVLO Hysteresis         |            |   | 70  | 100        | 130      | mV       |
| Output Frequency, per phase | $F_{OUT}$  | See graphs, Fig 2 - 5   | 0.1 |            | 2        | MHz      |
| Output Frequency Stability  |            | $V_{DD} = 3\text{V}$ to $6\text{V}$   |     |            | 10       | %        |
| Phase Accuracy              |            | By design, not tested   |     |            | 1        | %        |
| Sync Input Threshold        | $V_{SYNC}$ | See pin description   |     | $V_{DD}/3$ |          | V        |
| O/P Rise Time               | $T_R$      | $C_{OUT} = 20\text{pF}$ , $V_{DD} = 3\text{V}$ to $6\text{V}$               |     | 10         |          | ns       |
| O/P Fall Time               | $T_F$      | $C_{OUT} = 20\text{pF}$ , $V_{DD} = 3\text{V}$ to $6\text{V}$               |     | 10         |          | ns       |
| Output Voltage              | $V_{OUT}$  |   |     |            | $V_{DD}$ | V        |
| Output Current (peak)       | $I_{OUT}$  | $V_{DD} = 5\text{V}$  |     | 25         |          | mA       |
|                             |            | $V_{DD} = 3.3\text{V}$  |     | 10         |          |          |
| Output Impedance            | $R_{OUT}$  |   |     | 60         |          | $\Omega$ |
| Output Duration             | $T_P$      |   |     | (1)        |          | ns       |

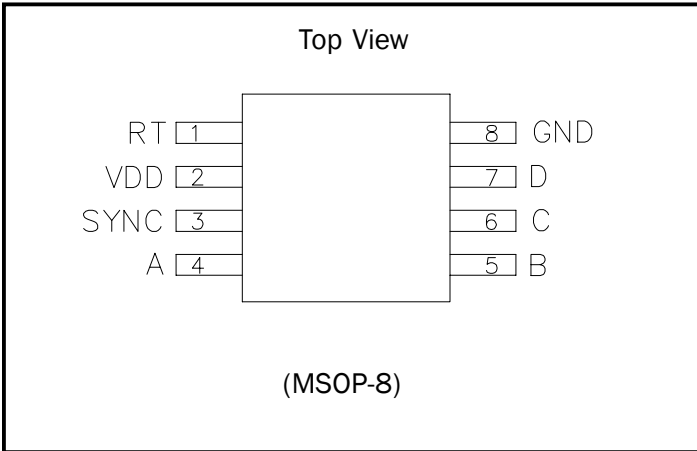
Note:

$$(1) T_P = \frac{T_{OUT}}{N} \text{ where } T_{OUT} = \text{output signal period of individual phase.}$$

$N = 3$  for 3 phase operation,  $N = 4$  for 2/4 phase operation.

**POWER MANAGEMENT**

**Pin Configuration**



**Ordering Information**

| Part Number <sup>(1)</sup> | Package          |
|----------------------------|------------------|
| SC4201MSTRT <sup>(2)</sup> | MSOP-8           |
| SC4201EVB                  | Evaluation Board |

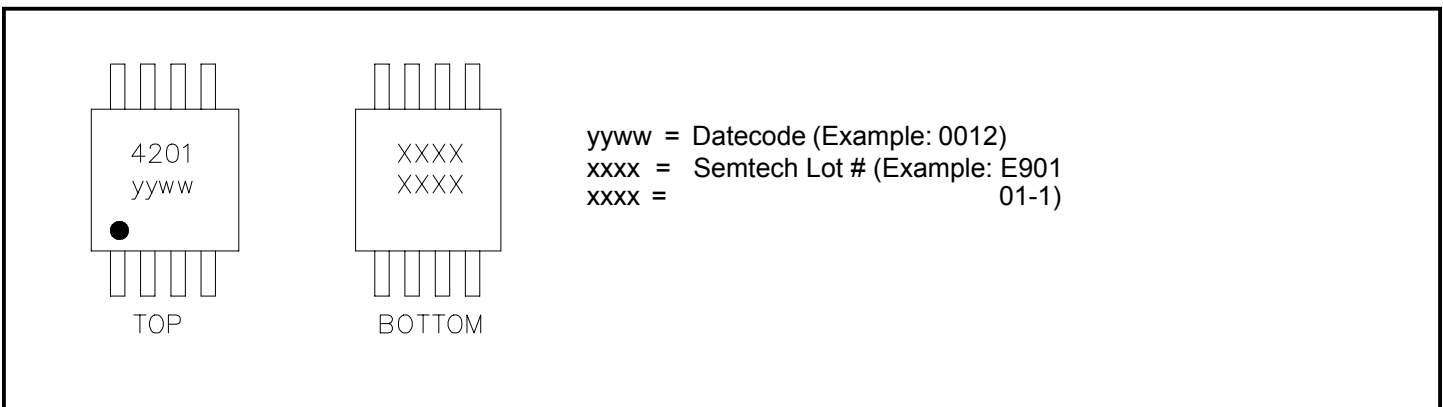
**Notes:**

- (1) Only available in tape and reel packaging. A reel contains 2500 devices.
- (2) Lead free product. This product is fully WEEE and RoHS compliant.

**Pin Descriptions**

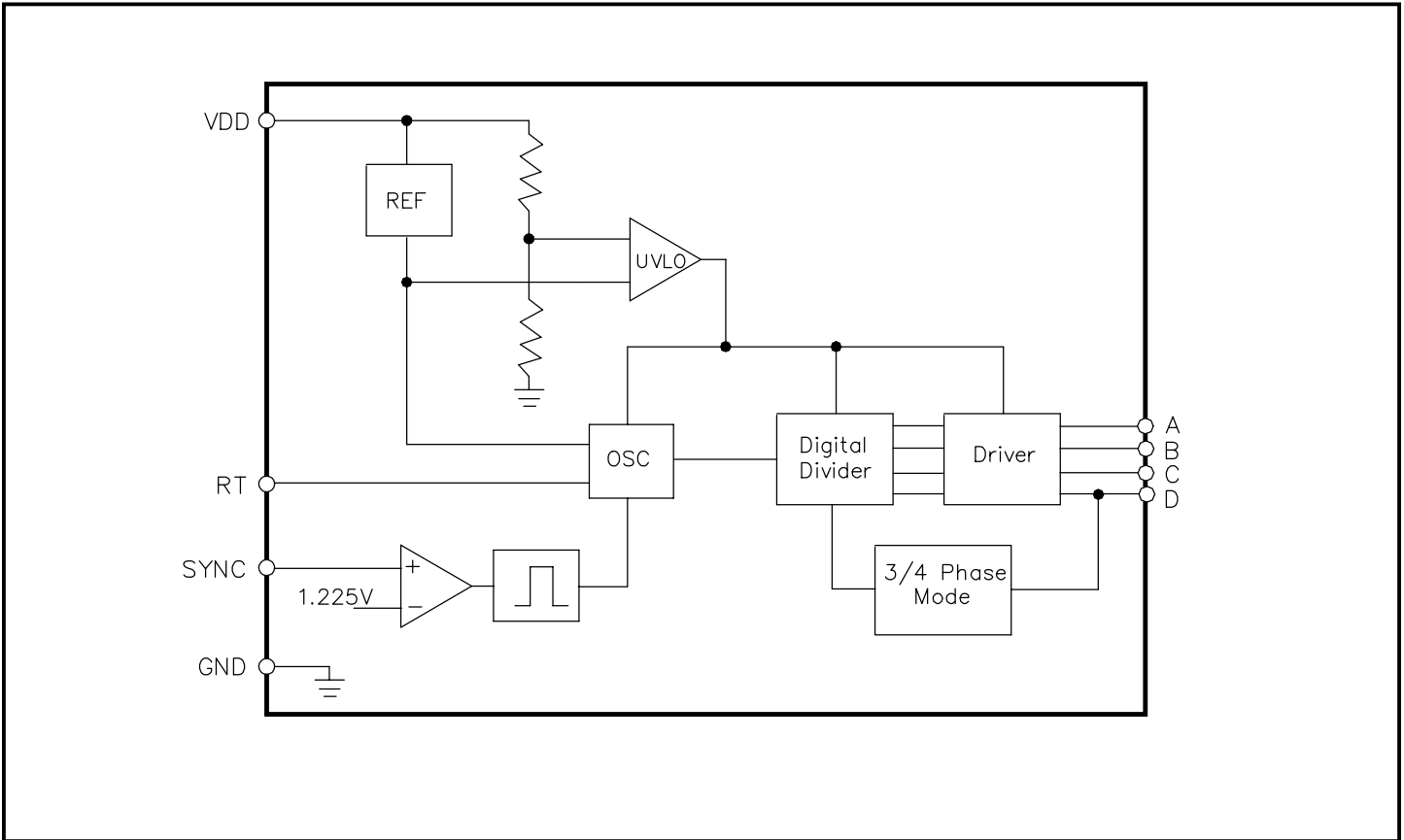
| Pin | Pin Name | Pin Function   |
|-----|----------|--|
| 1   | RT       | Oscillator frequency is configured by connecting resistor R from RT to ground. Values for R can be selected to provide desired 3 phase or 4 phase output frequencies.  |
| 2   | VDD      | The power input connection for the device.   |
| 3   | SYNC     | SYNC is a positive edge triggered input with a threshold of $\sim V_{DD}/3$ . SYNC should be grounded when not required or connected to an external synchronization clock with frequency higher than the on board oscillator frequency (with respect to internal clock). SYNC frequency = phase frequency times number of phases 3 or 4. |
| 4   | A        | Logic level output clock. Phase "A", totem-pole type.  |
| 5   | B        | Logic level output clock. Phase "B", totem-pole type.  |
| 6   | C        | Logic level output clock. Phase "C", totem-pole type.  |
| 7   | D        | Logic level output, totem-pole type, lock and phase selection pin. Default operation 4 phase/2 phase (90°/180°). Tie D to VDD to select 3 phase operation through A, B and C 120° out of phase.  |
| 8   | GND      | Reference ground and power ground for all functions.   |

**Marking Information**

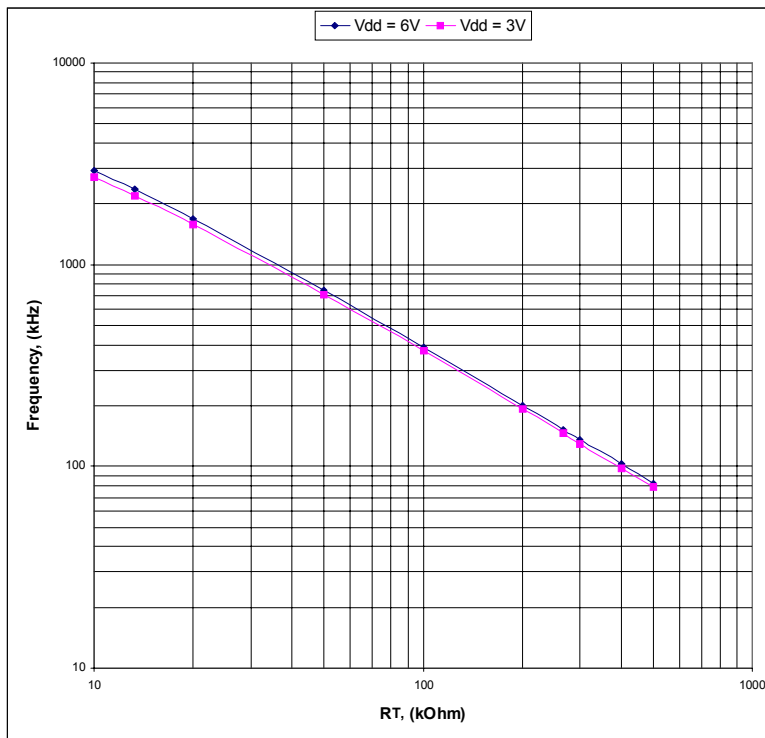
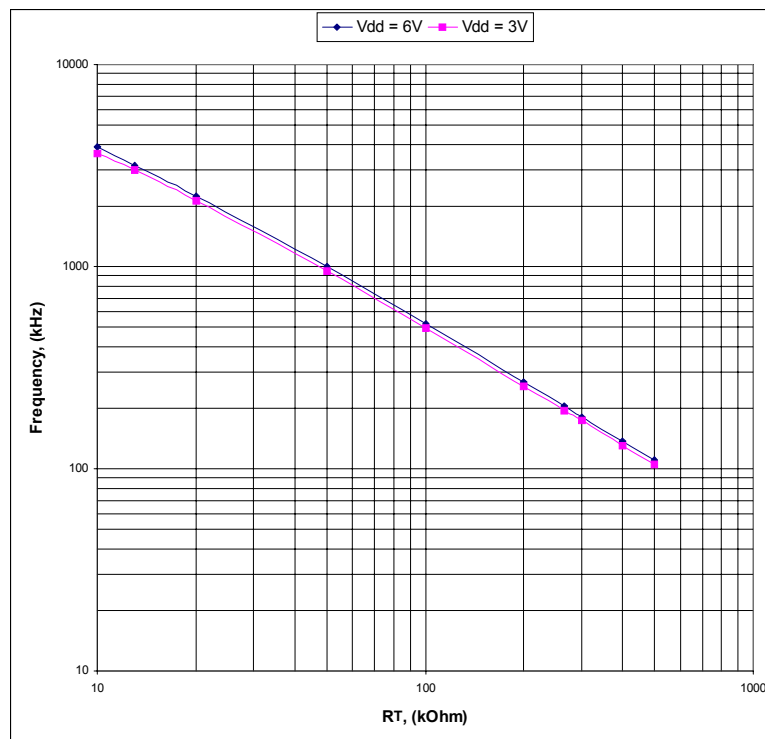


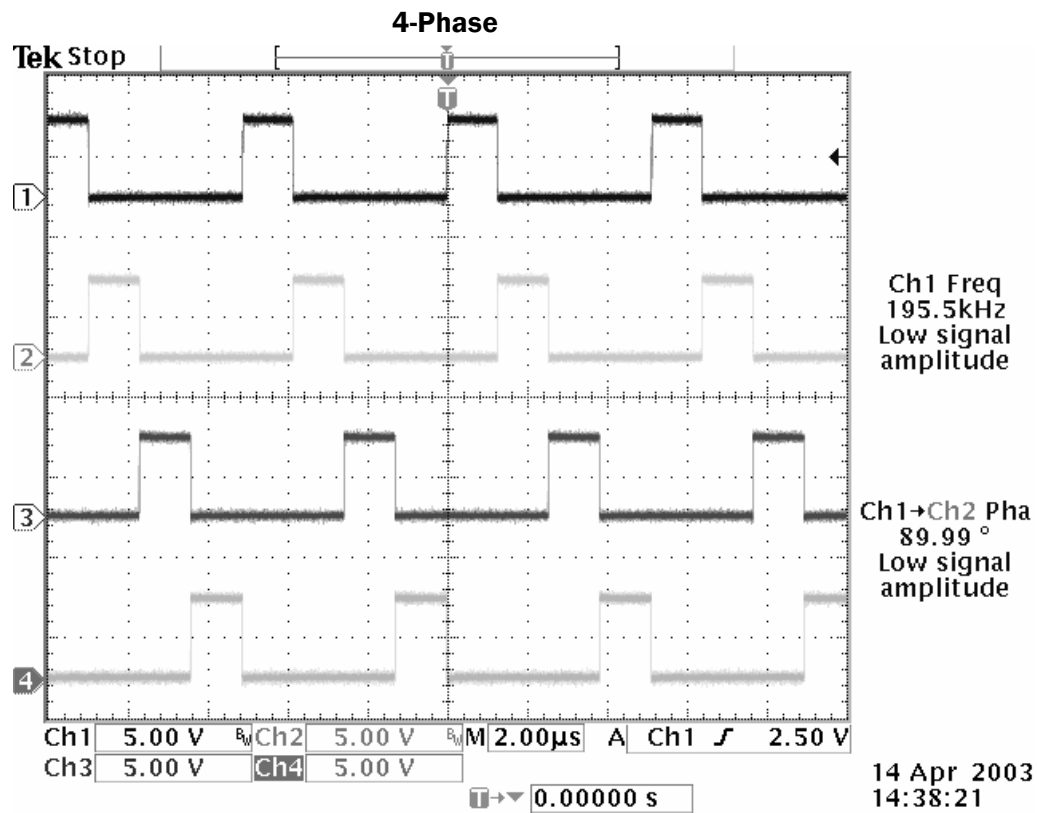
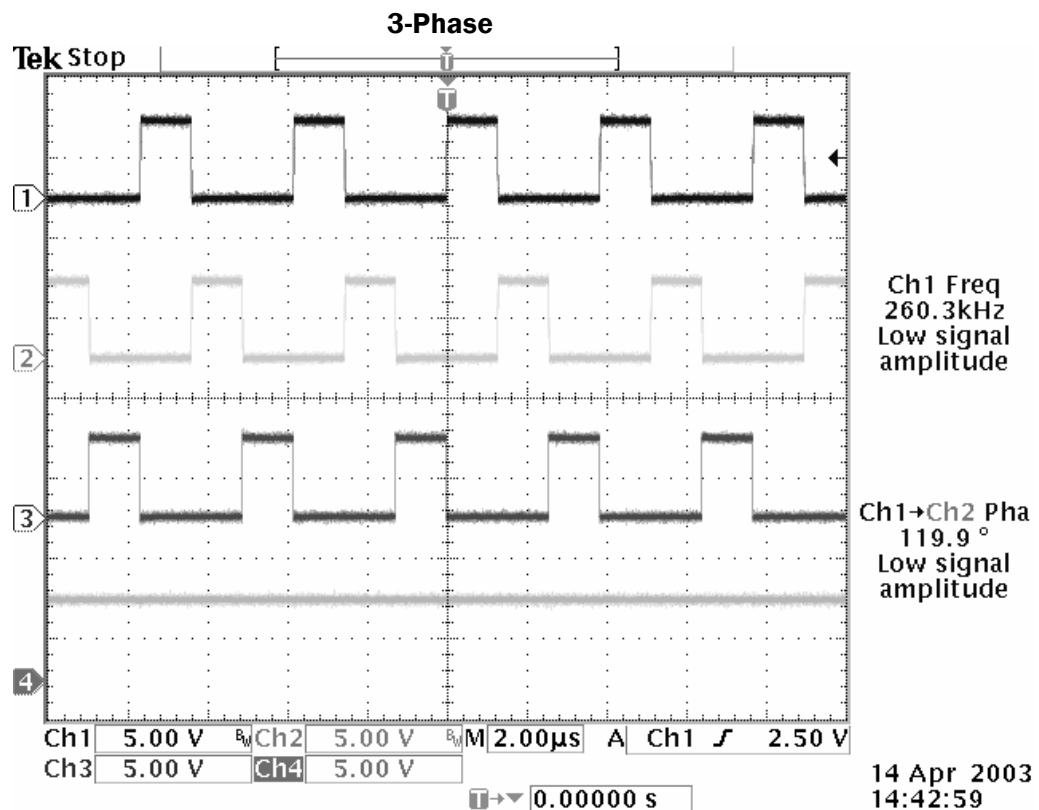
**POWER MANAGEMENT**

**Block Diagram**



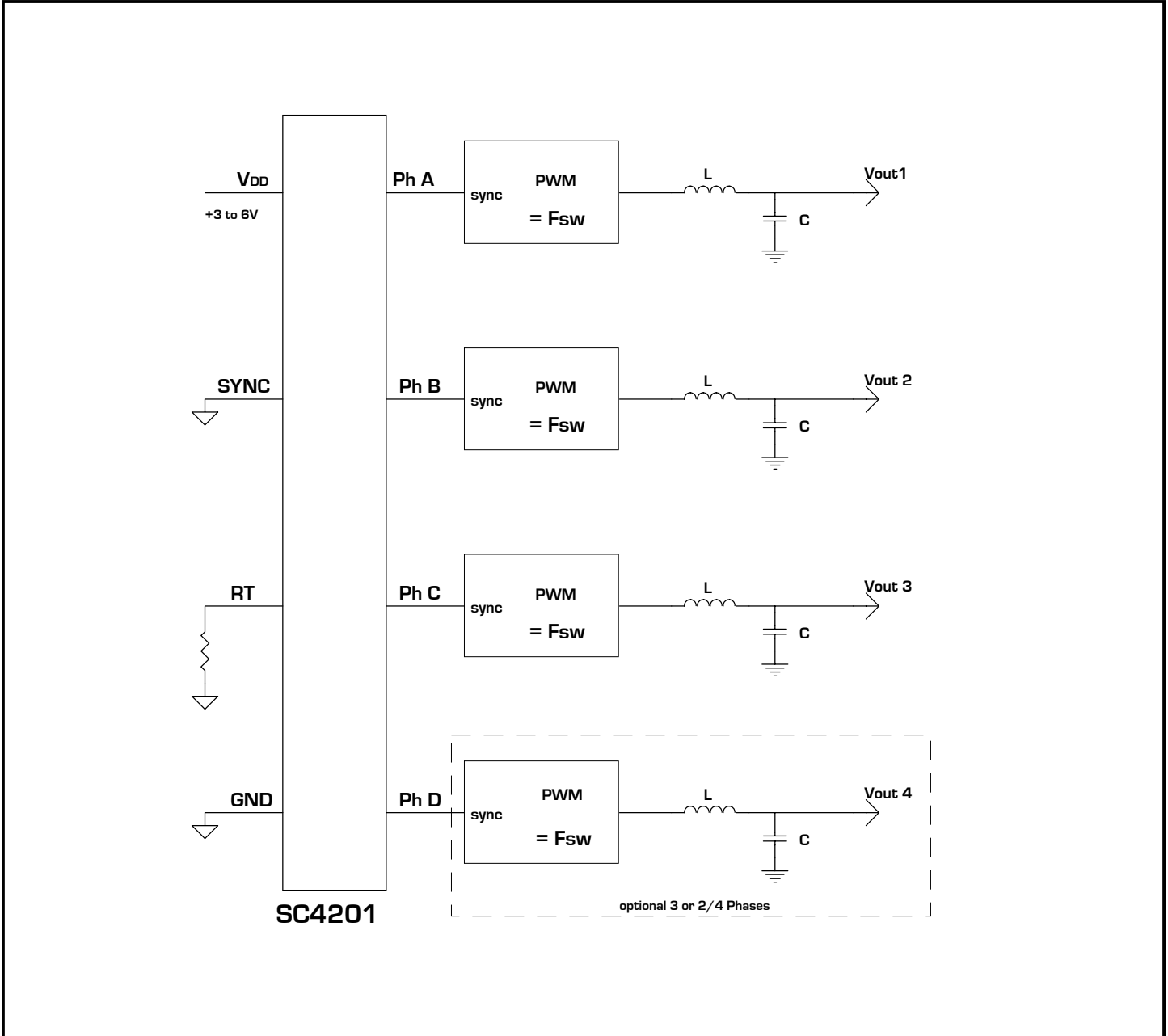
**Figure 1**

**Phase Frequency vs.  $R_T$ , 4-Phase Operation**

**Figure 2**
**Phase Frequency vs.  $R_T$ , 3-Phase Operation**

**Figure 3**

**POWER MANAGEMENT**
**Typical Characteristics (Cont.)**

**Figure 4**

**Figure 5**

**POWER MANAGEMENT**
**Application Information**

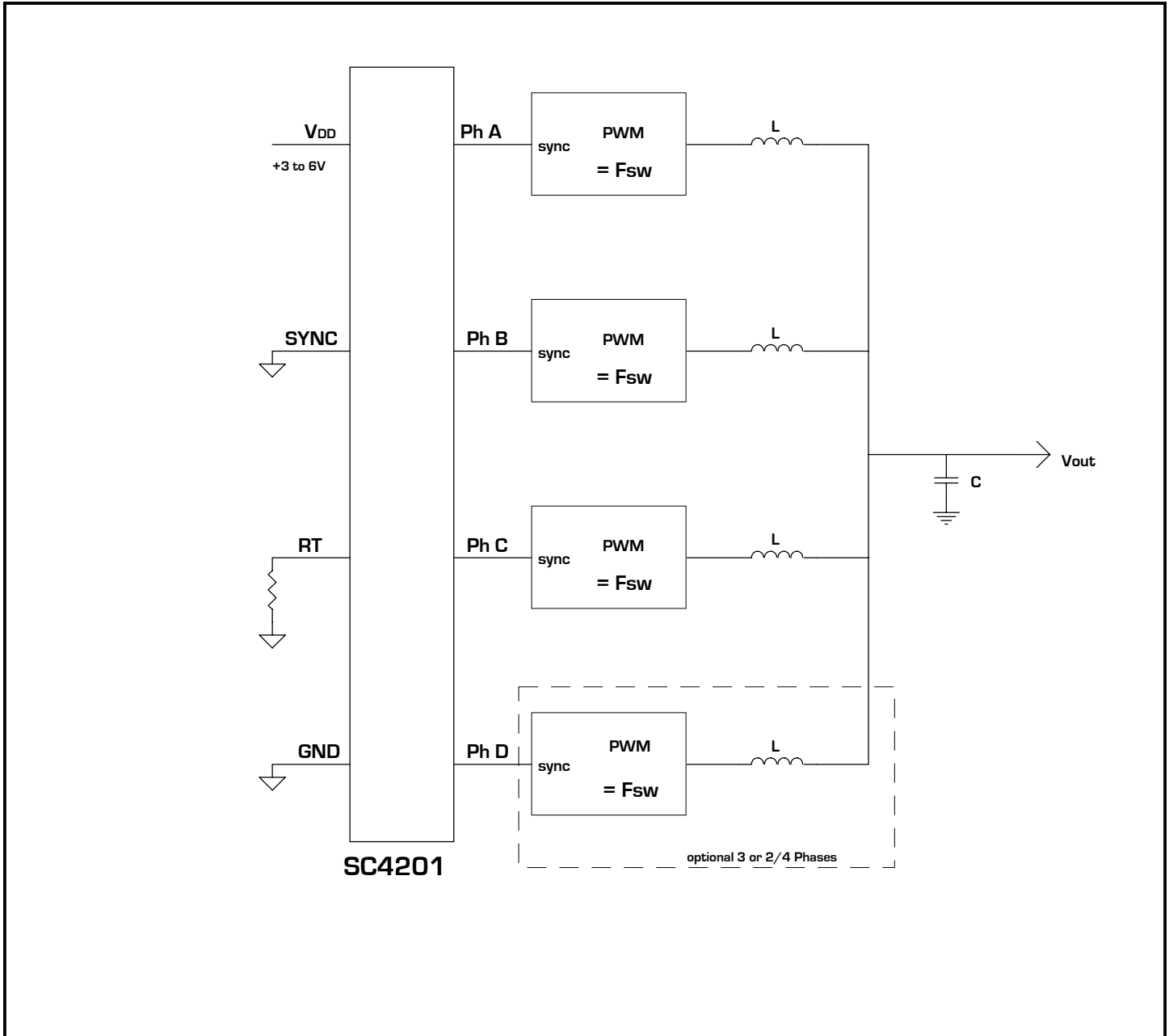
Diagram in Figure 6 shows multi-phase operation of several power converters with fixed switching frequency FSW.



**Figure 6**

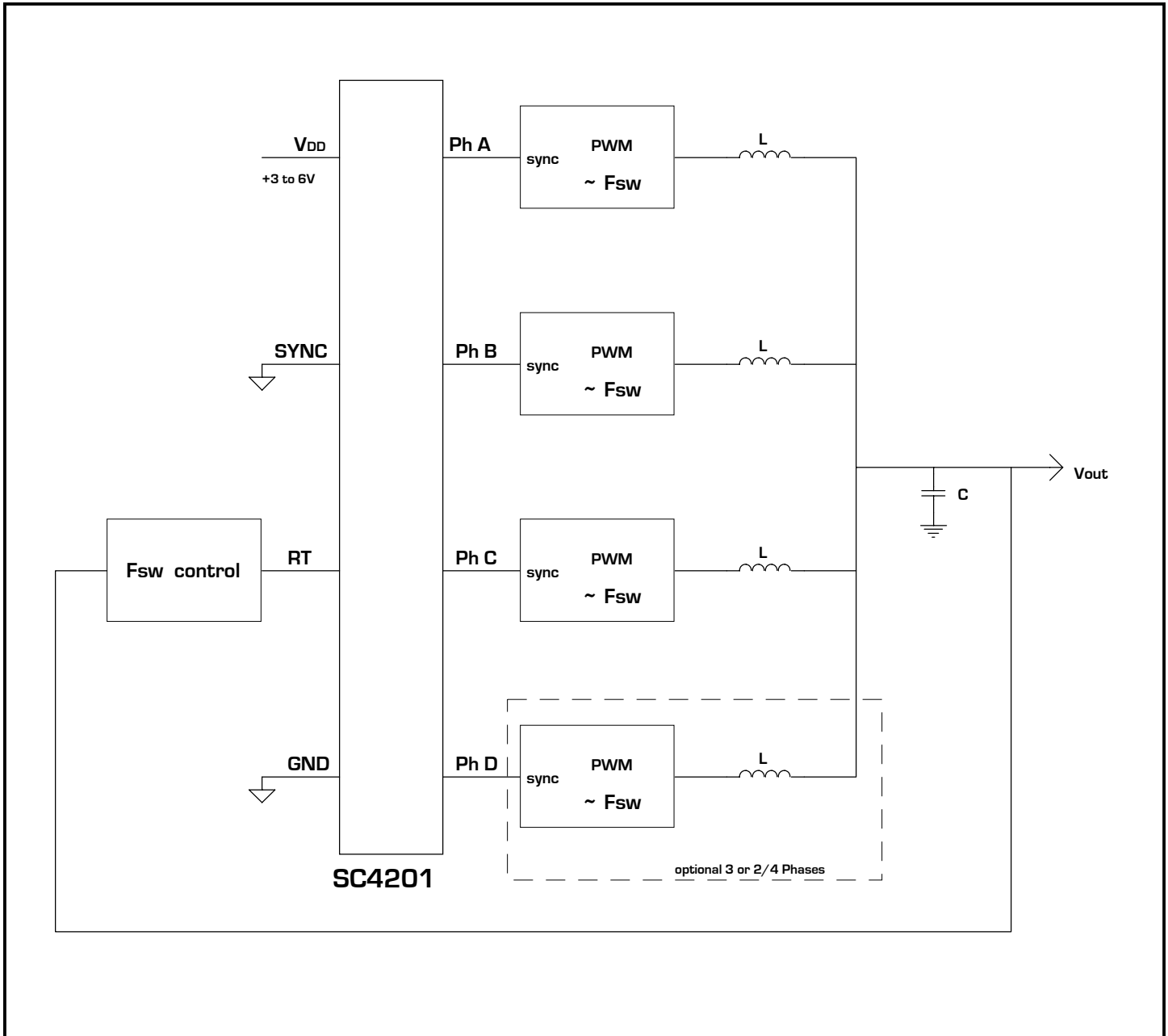
**POWER MANAGEMENT**
**Application Information (Cont.)**

Diagram in Figure 7 demonstrates a multi-phase operation of a single power supply with current sharing through the individual phases and with fixed switching frequency FSW.


**Figure 7**

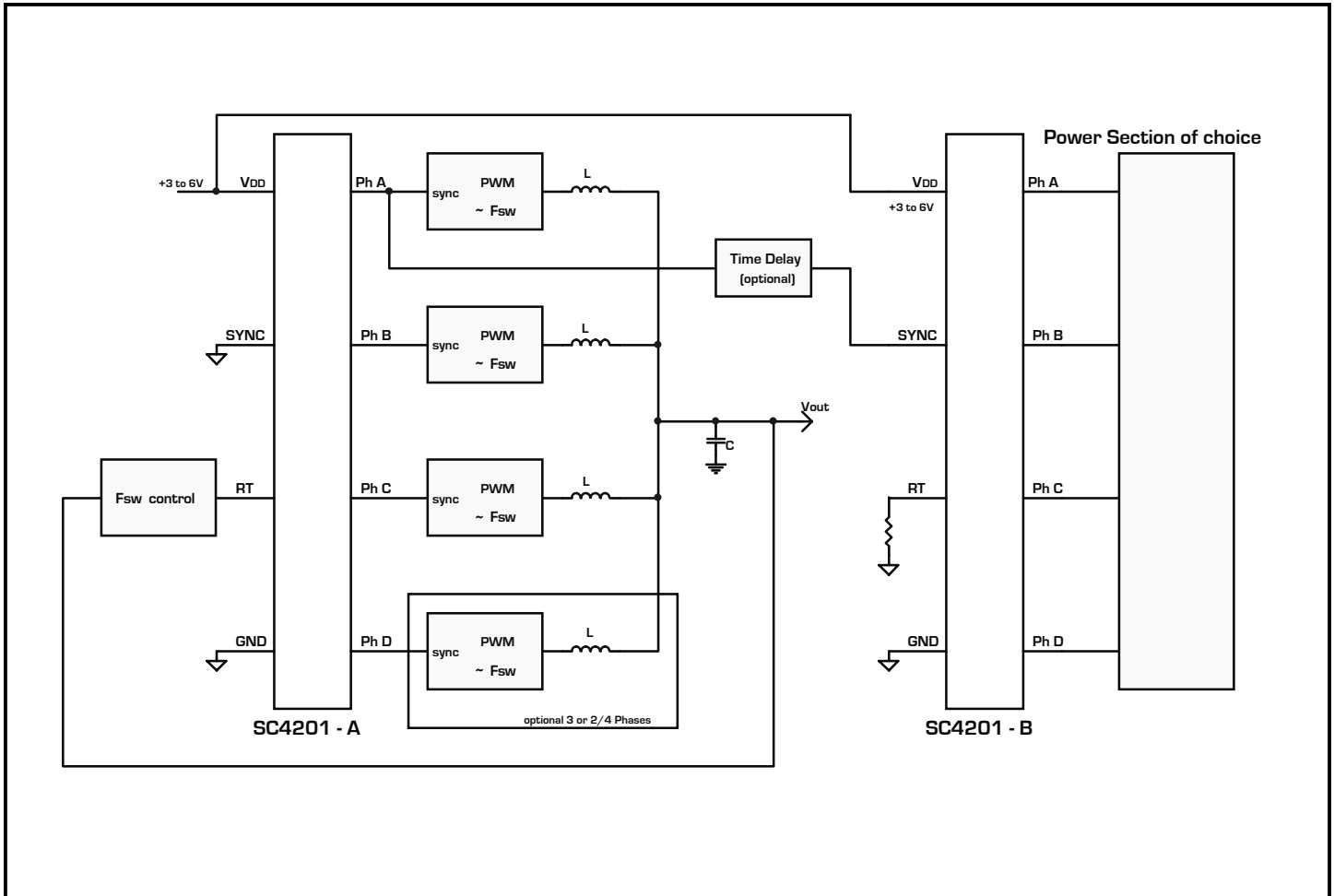
**POWER MANAGEMENT**
**Application Information (Cont.)**

Diagram in Figure 8 assumes variable switching frequency FSW, e.g. resonant power converters. This circuit will require additional "FSW Control" block, which is a task for a power designer.


**Figure 8**

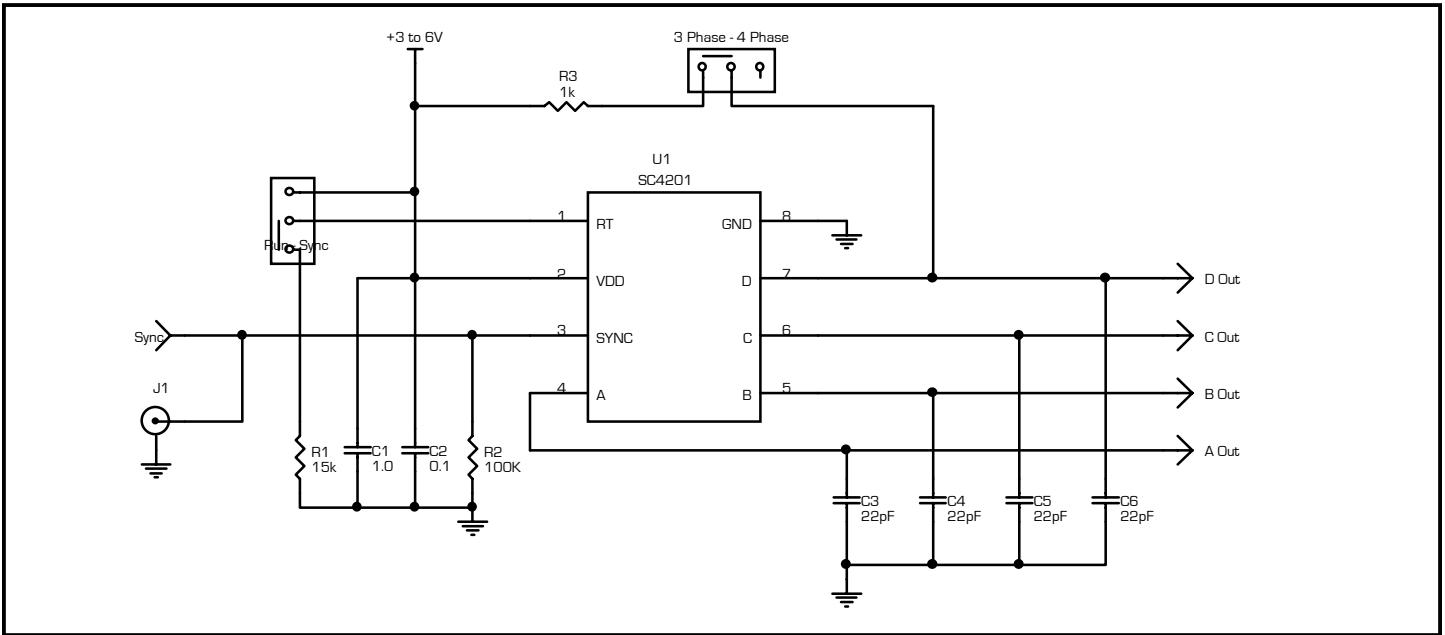
**POWER MANAGEMENT**
**Application Information (Cont.)**

Diagram in Figure 9 demonstrates a synchronous operation of two (or more) SC4201 controllers. If the “time delay” circuit is to be employed then 6-phase, 8-phase and other configurations become possible.

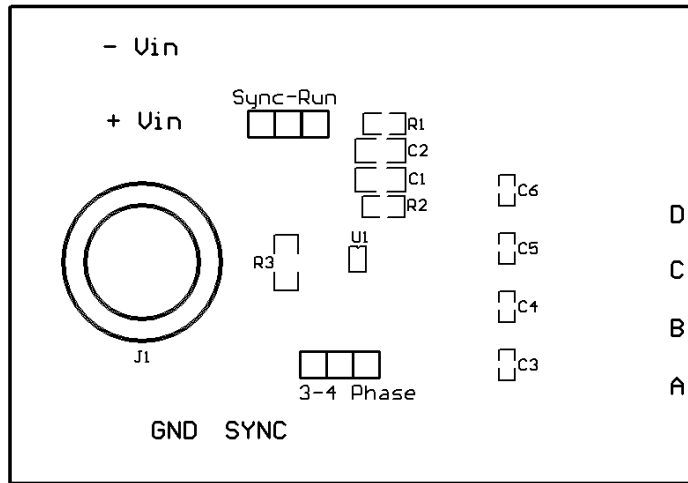

**Figure 9**

POWER MANAGEMENT

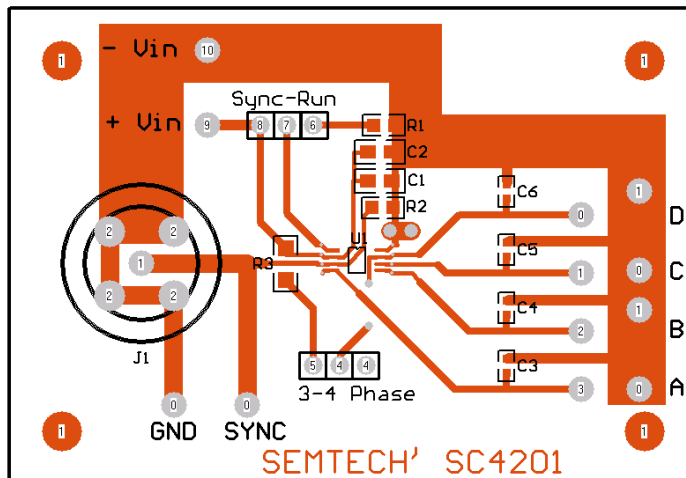
Evaluation Board Schematic



Top View

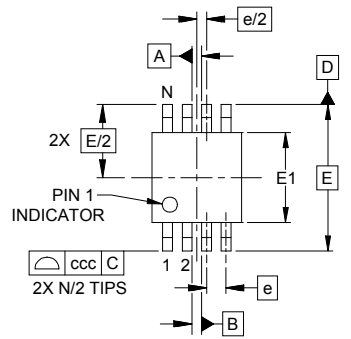


Layout

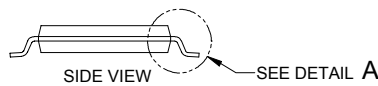
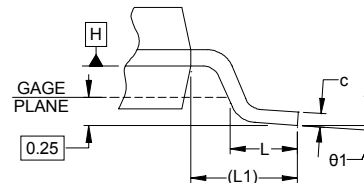
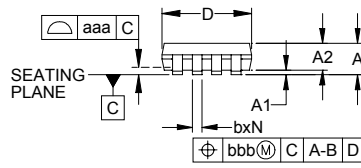


**POWER MANAGEMENT**

**Outline Drawing - MSOP-8**



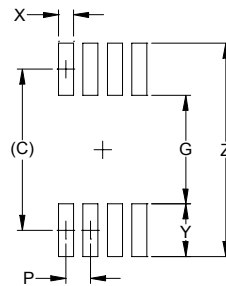
| DIM | INCHES   |      |      | MILLIMETERS |      |      |
|-----|----------|------|------|-------------|------|------|
|     | MIN      | NOM  | MAX  | MIN         | NOM  | MAX  |
| A   | -        | -    | .043 | -           | -    | 1.10 |
| A1  | .000     | -    | .006 | 0.00        | -    | 0.15 |
| A2  | .030     | -    | .037 | 0.75        | -    | 0.95 |
| b   | .009     | -    | .015 | 0.22        | -    | 0.38 |
| c   | .003     | -    | .009 | 0.08        | -    | 0.23 |
| D   | .114     | .118 | .122 | 2.90        | 3.00 | 3.10 |
| E1  | .114     | .118 | .122 | 2.90        | 3.00 | 3.10 |
| E   | .193 BSC |      |      | 4.90 BSC    |      |      |
| e   | .026 BSC |      |      | 0.65 BSC    |      |      |
| L   | .016     | .024 | .032 | 0.40        | 0.60 | 0.80 |
| L1  | (.037)   |      |      | (.95)       |      |      |
| N   | 8        |      |      | 8           |      |      |
| θ1  | 0°       | -    | 8°   | 0°          | -    | 8°   |
| aaa | .004     |      |      | 0.10        |      |      |
| bbb | .005     |      |      | 0.13        |      |      |
| ccc | .010     |      |      | 0.25        |      |      |



NOTES:

1. CONTROLLING DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DATUMS **-A-** AND **-B-** TO BE DETERMINED AT DATUM PLANE **-H-**
3. DIMENSIONS "E1" AND "D" DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
4. REFERENCE JEDEC STD MO-187, VARIATION AA.

**Land Pattern - MSOP-8**



| DIM | DIMENSIONS |             |
|-----|------------|-------------|
|     | INCHES     | MILLIMETERS |
| C   | (.161)     | (4.10)      |
| G   | .098       | 2.50        |
| P   | .026       | 0.65        |
| X   | .016       | 0.40        |
| Y   | .063       | 1.60        |
| Z   | .224       | 5.70        |

NOTES:

1. THIS LAND PATTERN IS FOR REFERENCE PURPOSES ONLY. CONSULT YOUR MANUFACTURING GROUP TO ENSURE YOUR COMPANY'S MANUFACTURING GUIDELINES ARE MET.

**Contact Information**

Semtech Corporation  
 Power Management Products Division  
 200 Flynn Road, Camarillo, CA 93012  
 Phone: (805)498-2111 FAX (805)498-3804

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