

## DUAL CHANNEL POWER DRIVER

### FEATURES

- Two Independent Drivers
- 1.5 A Totem Pole Outputs
- Inverting and Non-Inverting Inputs
- 40 ns Rise and Fall Into 1000 pF
- High-Speed, Power MOSFET Compatible
- Low Cross-Conduction Current Spike
- Analog Shutdown With Optional Latch
- Low Quiescent Current
- 5 V to 40 V Operation
- Thermal Shutdown Protection
- 16-Pin Dual-In-Line Package
- 20-Pin PLCC and CLCC Package

### DESCRIPTION

The UC1707 family of power drivers is made with a high-speed Schottky process to interface between low-level control functions and high-power switching devices—particularly power MOSFETs. These devices contain two independent channels, each of which can be activated by either a high or low input logic level signal. Each output can source or sink up to 1.5 A as long as power dissipation limits are not exceeded.

Although each output can be activated independently with its own inputs, it can be forced low in common through the action either of a digital high signal at the Shutdown terminal or a differential low-level analog signal. The Shutdown command from either source can either be latching or not, depending on the status of the Latch Disable pin.

Supply voltage for both  $V_{IN}$  and  $V_C$  can independently range from 5 V to 40 V.

These devices are available in two-watt plastic "bat-wing" DIP for operation over a 0°C to 70°C temperature range and, with reduced power, in a hermetically sealed cerdip for –55°C to +125°C operation. Also available in surface mount DW, Q, L packages.

**TRUTH TABLE**  
**(Each Channel)<sup>(1)</sup>**

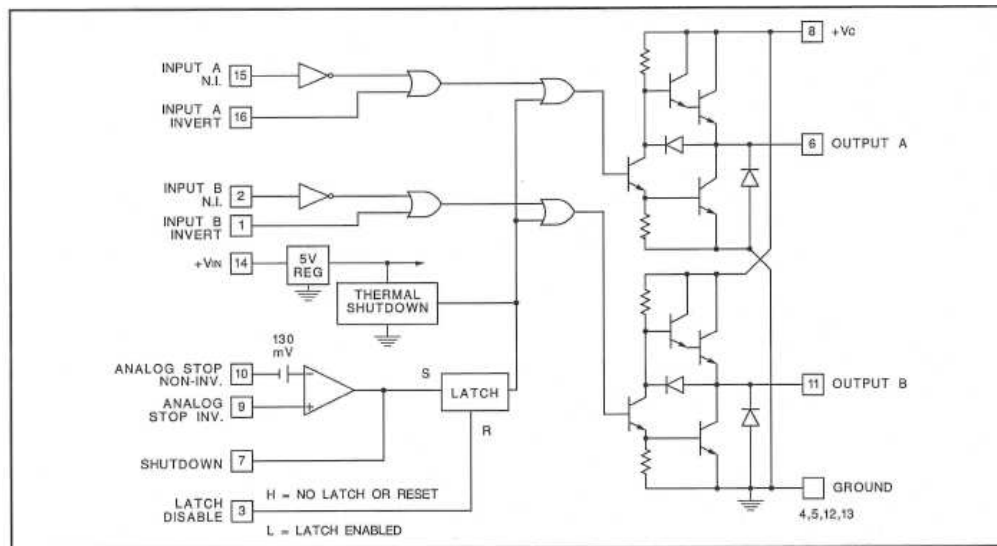
| INV. | N.I. | OUT |
|------|------|-----|
| H    | H    | L   |
| L    | H    | H   |
| H    | L    | L   |
| L    | L    | L   |

(1)  $\overline{OUT} = \overline{INV}$  and N.I.  
 $\overline{OUT} = INV$  or N.I.

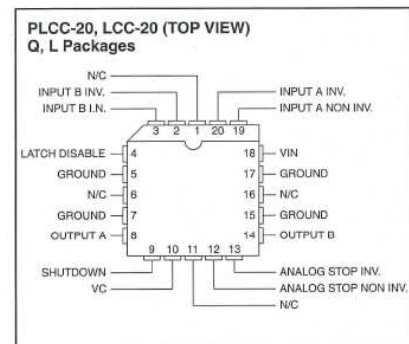
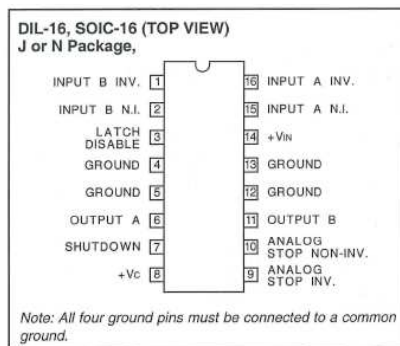


Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

## BLOCK DIAGRAM



## CONNECTION DIAGRAMS



## ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)

|          |                                                                           |             | MIN | MAX      | UNIT             |
|----------|---------------------------------------------------------------------------|-------------|-----|----------|------------------|
| $V_{IN}$ | Supply voltage                                                            | N/J package |     | 40       | V                |
| $V_C$    | Collector supply voltage                                                  | N/J package |     | 40       | V                |
|          | Output current (each output, source or sink) steady-state                 | N/J package |     | ±500     | mA               |
|          | Peak transient                                                            | N package   |     | ±1.5     | A                |
|          |                                                                           | J package   |     | ±1.0     |                  |
|          | Capacitive discharge energy                                               | N package   |     | 20       | mJ               |
|          |                                                                           | J package   |     | 15       |                  |
|          | Digital inputs <sup>(1)</sup>                                             | N/J-package |     | 5.5      | V                |
|          | Analog stop inputs                                                        | N/J package |     | $V_{IN}$ |                  |
|          | Power dissipation at $T_A = 25^\circ\text{C}$                             | N package   |     | 2        | W                |
|          |                                                                           | J package   |     | 1        |                  |
|          | Power dissipation at $T$ (leads/case) = $25^\circ\text{C}$ <sup>(1)</sup> | N package   |     | 5        | W                |
|          |                                                                           | J package   |     | 2        |                  |
|          | Operating temperature range                                               |             | –55 | +125     | $^\circ\text{C}$ |
|          | Storage temperature range                                                 |             | –65 | +150     | $^\circ\text{C}$ |
|          | Lead temperature (soldering, 10 seconds)                                  |             |     | 300      | $^\circ\text{C}$ |

- (1) All voltages are with respect to the four ground pins which must be connected together. All currents are positive into, negative out of the specified terminal. Digital drive can exceed 5.5 V if input current is limited to 10 mA. Consult packaging section of databook for thermal limitations and considerations of package.

## ELECTRICAL CHARACTERISTICS

Unless otherwise stated, these specifications apply for  $T_A = -55^\circ\text{C}$  to  $+125^\circ\text{C}$  for the UC1707,  $-25^\circ\text{C}$  to  $+85^\circ\text{C}$  for the UC2707, and  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  for the UC3707;  $V_{IN} = V_C = 20\text{ V}$ .  $T_A = T_J$ .

| PARAMETER                    | TEST CONDITIONS                              | MIN | TYP   | MAX  | UNIT             |
|------------------------------|----------------------------------------------|-----|-------|------|------------------|
| $V_{IN}$ Supply current      | $V_{IN} = 40\text{ V}$                       |     | 12    | 15   | mA               |
| $V_C$ Supply current         | $V_C = 40\text{ V}$ , outputs low            |     | 5.2   | 7.5  | mA               |
| $V_C$ Leakage current        | $V_{IN} = 0$ , $V_C = 30\text{ V}$ , no load |     | 0.05  | 0.1  | mA               |
| Digital input low level      |                                              |     |       | 0.8  | V                |
| Digital input high level     |                                              | 2.2 |       |      | V                |
| Input current                | $V_I = 0$                                    |     | –0.06 | –1.0 | mA               |
| Input leakage                | $V_I = 5\text{ V}$                           |     | 0.05  | 0.1  | mA               |
| $V_C - V_O$ Output high sat. | $I_O = -50\text{ mA}$                        |     |       | 2.0  | V                |
|                              | $I_O = -500\text{ mA}$                       |     |       | 2.5  |                  |
| $V_O$ Output low sat.        | $I_O = -50\text{ mA}$                        |     |       | 0.4  | V                |
|                              | $I_O = -500\text{ mA}$                       |     |       | 2.5  |                  |
| Analog threshold             | $V_{CM} = 0$ to $15\text{ V}$                | 100 | 130   | 160  | mV               |
| Input bias current           | $V_{CM} = 0$                                 |     | –10   | –20  | $\mu\text{A}$    |
| Thermal shutdown             |                                              |     | 155   |      | $^\circ\text{C}$ |
| Shutdown threshold           | Pin 7 input                                  | 0.4 | 1.0   | 2.2  | V                |
| Latch disable threshold      | Pin 3 input                                  | 0.8 | 1.2   | 2.2  | V                |

**TYPICAL SWITCHING CHARACTERISTICS**

$V_{IN} = V_C = 20\text{ V}$ ,  $T_A = 25^\circ\text{C}$ . Delays measured to 10% output change.

| PARAMETER                                     | TEST CONDITIONS        | OUTPUT CL = |     |     | UNIT |
|-----------------------------------------------|------------------------|-------------|-----|-----|------|
| <b>From Inv. Input to Output</b>              |                        | open        | 1.0 | 2.2 | nF   |
| Rise time delay                               |                        | 40          | 50  | 60  | ns   |
| 10% to 90% rise                               |                        | 25          | 40  | 50  | ns   |
| Fall time delay                               |                        | 30          | 40  | 50  | ns   |
| 90% to 10% fall                               |                        | 25          | 40  | 50  | ns   |
| <b>From N.I. Input to Output</b>              |                        |             |     |     |      |
| Rise time delay                               |                        | 30          | 40  | 50  | ns   |
| 10% to 90% rise                               |                        | 25          | 40  | 50  | ns   |
| Fall time delay                               |                        | 45          | 55  | 65  | ns   |
| 90% to 10% fall                               |                        | 25          | 40  | 50  | ns   |
| $V_C$ cross-conduction current spike duration | Output rise            | 25          |     |     | ns   |
|                                               | Output fall            | 0           |     |     | ns   |
| Analog shutdown delay                         | Stop non-Inv. = 0 V    | 180         |     |     | ns   |
|                                               | Stop Inv. = 0 to 0.5 V | 180         |     |     | ns   |
| Digital shutdown delay                        | 2 V input on Pin 7     | 50          |     |     | ns   |

## SIMPLIFIED INTERNAL CIRCUITRY

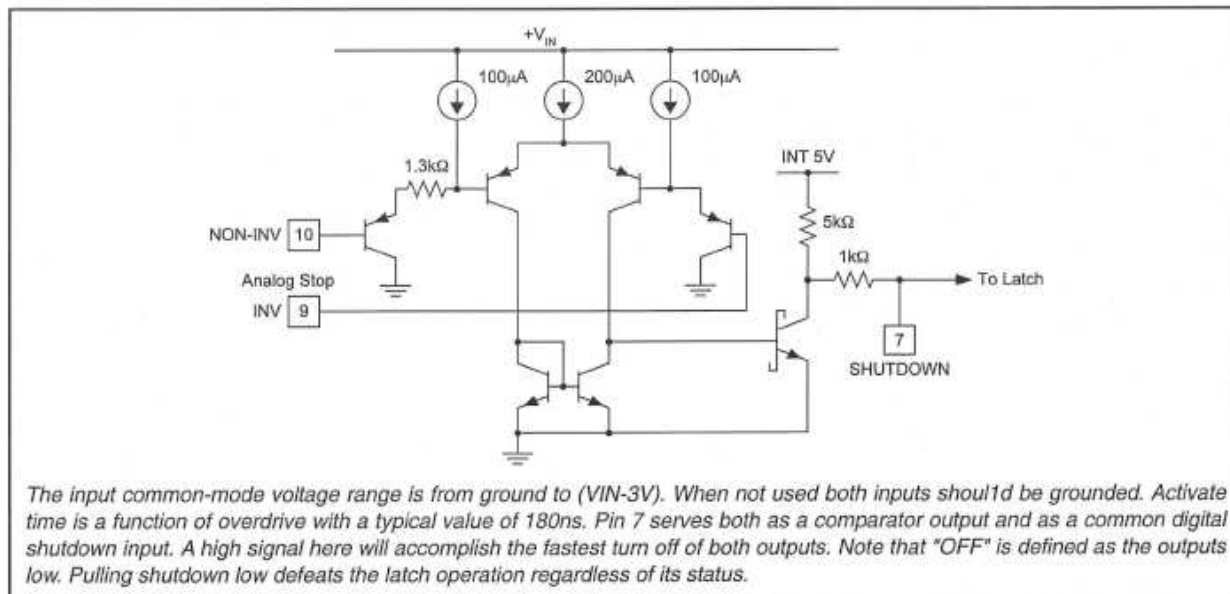


Figure 1. Typical Digital Input Gate

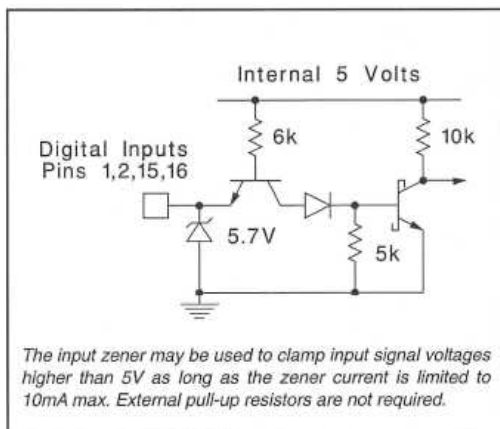


Figure 2. Typical Digital Input Gate

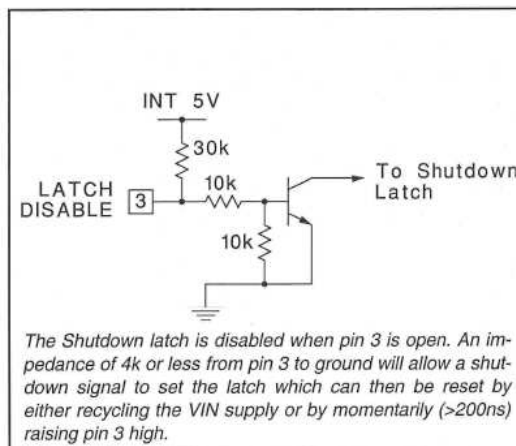
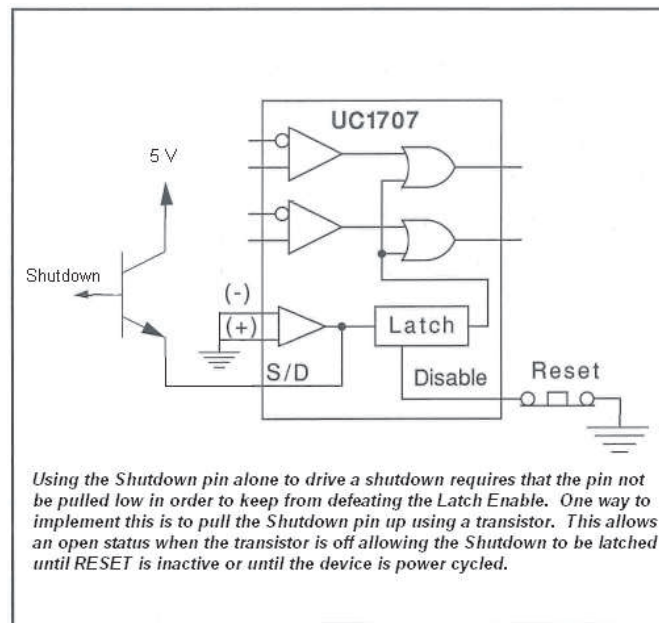


Figure 3. Latch Disable

## SIMPLIFIED INTERNAL CIRCUITRY (continued)



### Figure 4. Use of the Shutdown Pin

## SHUTDOWN CIRCUIT DESCRIPTION

The function of the circuitry is to be able to provide a shutdown of the device. This is defined as functionality that will drive both outputs to the low state. There are three different inputs that govern this shutdown capability.

- **Analog Stop Pins** — The differential inputs to this comparator provide a way to execute a shutdown.
- **Latch Disable Pin** — Assuming that the Shutdown pin is left open, a high on this pin disables the latching functionality of the Analog Stop shutdown. A low on this pin enables the latching functionality of the Analog Stop shutdown. If a shutdown occurs through the Analog Stop circuit while Latch Disable is high, then the outputs will go low, but will return to normal operation as soon as the Analog Stop circuit allows it. If a shutdown occurs through the Analog Stop circuit while Latch Disable is low, then the outputs will go low and remain low even if the Analog Stop circuit no longer drives the shutdown. The outputs will remain "latched" low (in shutdown) until the Latch Disable goes high and the Analog Stop circuit allows it to return from shutdown or the VIN voltage is cycled to 0V and then returned above 5V.
- **Shutdown Pin** — This pin serves two purposes.
  1. It can be used as an output of the Analog Stop circuit.
  2. It can be used as an input to force a shutdown or to force the device out of shutdown. This pin can override both the Analog Stop circuit as well as the Latch Disable Pin. When driving hard logic levels into the Shutdown pin, the Latch Disable functionality will be overridden and the Latch Disable will not function as it does when used in conjunction with the Analog Stop circuit. When the Shutdown pin is high, the outputs will be in the low state (shutdown). When the Shutdown pin is low (hard logic low) the outputs will operate normally, regardless of the state of the Latch Disable pin or the Analog Stop pins.

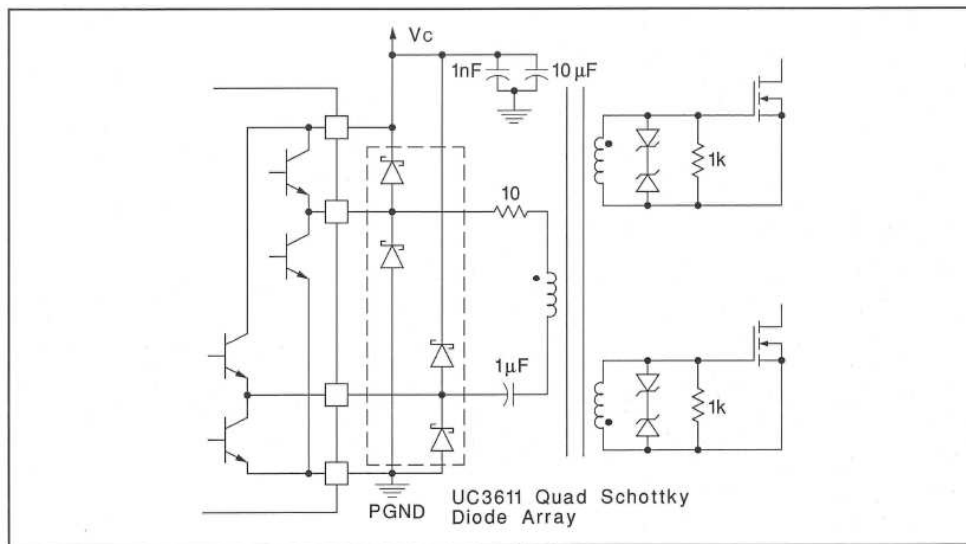
In order to use the Shutdown Pin with the Latch Disable functional it is necessary to use either a diode in series with the Shutdown signal or to use an open collector pull-up so that the Shutdown pin is not pulled low. This configuration will allow the Latch Disable function to work with the Shutdown pin.

### SIMPLIFIED INTERNAL CIRCUITRY (continued)

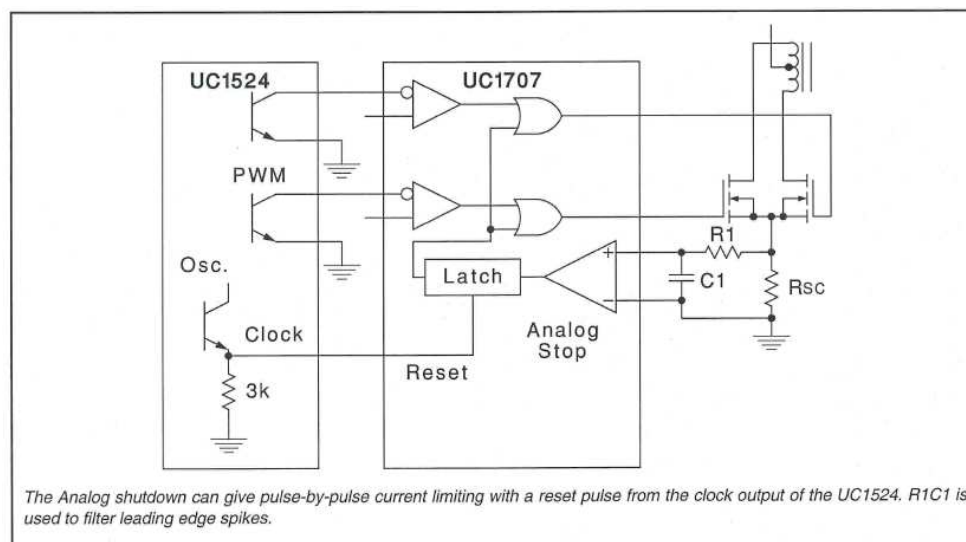
### UG1707 SHUTDOWN TRUTH TABLE

| ANALOG STOP LOGIC | SHUTDOWN | LATCH DISABLE | PREVIOUS STATE OF OUTPUT | OUTPUT                          |
|-------------------|----------|---------------|--------------------------|---------------------------------|
| X                 | 0        | X             | X                        | Follows Input Logic             |
| X                 | 1        | X             | X                        | Low (Shutdown)                  |
| 1                 | Open     | X             | X                        | Low (Shutdown)                  |
| 0                 | Open     | 0             | Shutdown                 | <sup>(1)</sup> Latched Shutdown |
| 0                 | Open     | 0             | Normal                   | Follows Input Logic             |
| 0                 | Open     | 1             | X                        | Follows Input Logic             |

- (1) If the output was previously in Shutdown and Latch Disable was low and stays low, then even if the Analog Stop Logic is changed or the Shutdown pin is open, the outputs will remain in Shutdown.



### Figure 5. Transformer Coupled Push-Pull MOSFET Drive Circuit



### Figure 6. Current Limiting

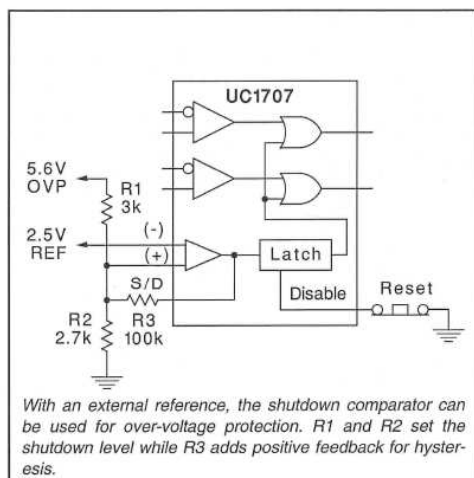


Figure 7. Over-Voltage Protection

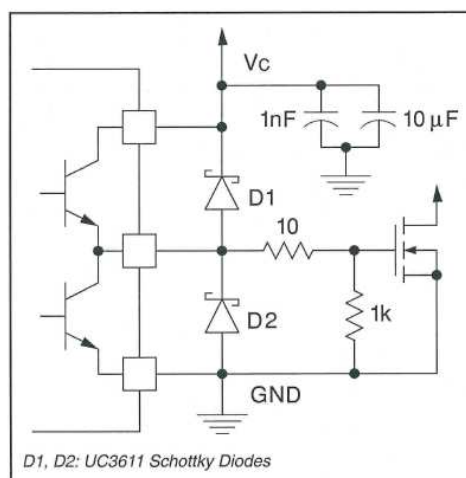


Figure 8. Power MOSFET Drive Circuit

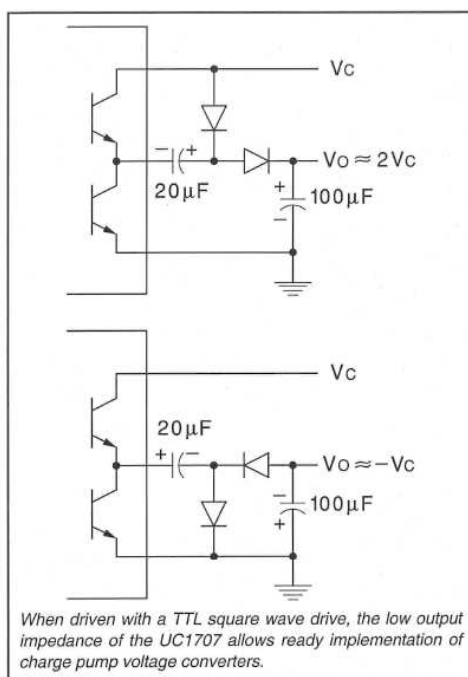
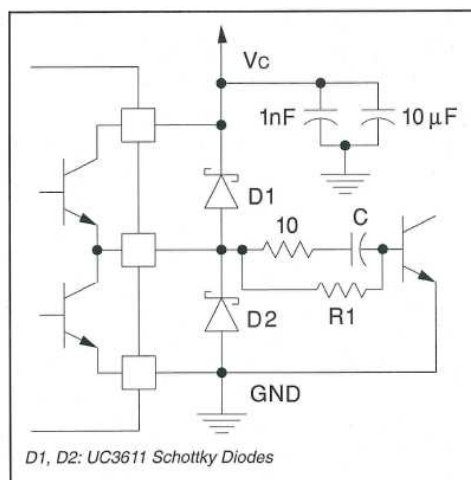
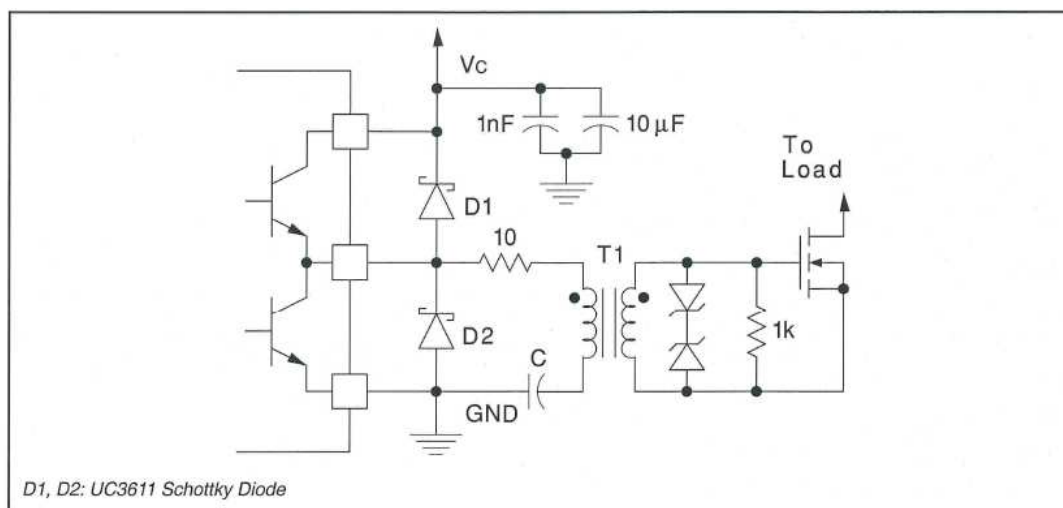


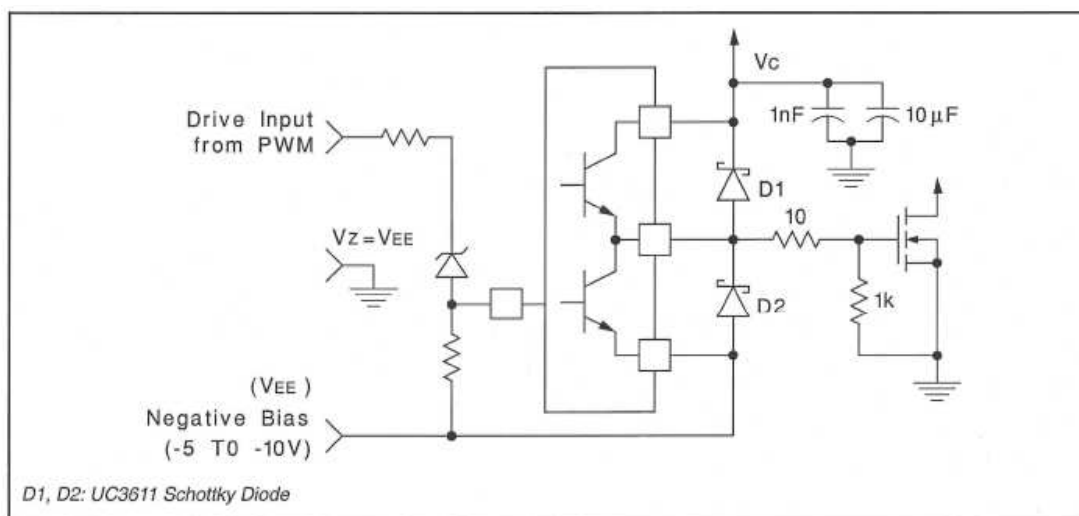
Figure 9. Charge Pump Circuits



**Figure 10. Power Bipolar Drive Circuit**



**Figure 11. Transformer Coupled MOSFET Drive Circuit**



**Figure 12. Power MOSFET Drive Circuit Using Negative Bias Voltage and Level Shifting to Ground Reference PWM**

**PACKAGING INFORMATION**

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5)                 | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|-----------------------------------------|-------------------------|
| 5962-87619012A   | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE       | N / A for Pkg Type   | -55 to 125   | 5962-<br>87619012A<br>UC1707L/<br>81032 | <a href="#">Samples</a> |
| 5962-8761901EA   | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | -55 to 125   | 5962-8761901EA<br>UC1707J/80900         | <a href="#">Samples</a> |
| 5962-8761901V2A  | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE       | N / A for Pkg Type   | -55 to 125   | 5962-<br>8761901V2A<br>UC1707L<br>QMLV  | <a href="#">Samples</a> |
| 5962-8761901VEA  | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | -55 to 125   | 5962-8761901VE<br>A<br>UC1707JQMLV      | <a href="#">Samples</a> |
| 5962-8761903VEA  | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | -55 to 125   | 5962-8761903VE<br>A<br>UC1707J-SP       | <a href="#">Samples</a> |
| 5962-8761903VFA  | ACTIVE        | CFP          | W                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | -55 to 125   | 5962-8761903VF<br>A<br>UC1707W-SP       | <a href="#">Samples</a> |
| UC1707J          | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | -55 to 125   | UC1707J                                 | <a href="#">Samples</a> |
| UC1707J/80313    | OBSOLETE      | CDIP         | J                  | 16   |                | TBD                        | Call TI          | Call TI              | -55 to 125   |                                         |                         |
| UC1707J883B      | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | -55 to 125   | UC1707J/883B                            | <a href="#">Samples</a> |
| UC1707L          | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE       | N / A for Pkg Type   | -55 to 125   | UC1707L                                 | <a href="#">Samples</a> |
| UC1707L883B      | ACTIVE        | LCCC         | FK                 | 20   | 1              | TBD                        | POST-PLATE       | N / A for Pkg Type   | -55 to 125   | UC1707L/<br>883B                        | <a href="#">Samples</a> |
| UC2707DW         | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | -40 to 85    | UC2707DW                                | <a href="#">Samples</a> |
| UC2707DWG4       | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | -40 to 85    | UC2707DW                                | <a href="#">Samples</a> |
| UC2707DWTR       | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | -40 to 85    | UC2707DW                                | <a href="#">Samples</a> |
| UC2707DWTRG4     | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | -40 to 85    | UC2707DW                                | <a href="#">Samples</a> |

| Orderable Device | Status<br>(1) | Package Type | Package<br>Drawing | Pins | Package<br>Qty | Eco Plan<br>(2)            | Lead/Ball Finish | MSL Peak Temp<br>(3) | Op Temp (°C) | Device Marking<br>(4/5) | Samples                 |
|------------------|---------------|--------------|--------------------|------|----------------|----------------------------|------------------|----------------------|--------------|-------------------------|-------------------------|
| UC2707N          | ACTIVE        | PDIP         | N                  | 16   | 25             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | N / A for Pkg Type   | -40 to 85    | UC2707N                 | <a href="#">Samples</a> |
| UC2707NG4        | ACTIVE        | PDIP         | N                  | 16   | 25             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | N / A for Pkg Type   | -40 to 85    | UC2707N                 | <a href="#">Samples</a> |
| UC2707Q          | ACTIVE        | PLCC         | FN                 | 20   | 46             | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-2-260C-1 YEAR  | -40 to 85    | UC2707Q                 | <a href="#">Samples</a> |
| UC2707QG3        | ACTIVE        | PLCC         | FN                 | 20   | 46             | Green (RoHS<br>& no Sb/Br) | CU SN            | Level-2-260C-1 YEAR  | -40 to 85    | UC2707Q                 | <a href="#">Samples</a> |
| UC3707DW         | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | 0 to 70      | UC3707DW                | <a href="#">Samples</a> |
| UC3707DWG4       | ACTIVE        | SOIC         | DW                 | 16   | 40             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | 0 to 70      | UC3707DW                | <a href="#">Samples</a> |
| UC3707DWTR       | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | 0 to 70      | UC3707DW                | <a href="#">Samples</a> |
| UC3707DWTRG4     | ACTIVE        | SOIC         | DW                 | 16   | 2000           | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | Level-2-260C-1 YEAR  | 0 to 70      | UC3707DW                | <a href="#">Samples</a> |
| UC3707J          | ACTIVE        | CDIP         | J                  | 16   | 1              | TBD                        | A42              | N / A for Pkg Type   | 0 to 70      | UC3707J                 | <a href="#">Samples</a> |
| UC3707N          | ACTIVE        | PDIP         | N                  | 16   | 25             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | N / A for Pkg Type   | 0 to 70      | UC3707N                 | <a href="#">Samples</a> |
| UC3707NG4        | ACTIVE        | PDIP         | N                  | 16   | 25             | Green (RoHS<br>& no Sb/Br) | CU NIPDAU        | N / A for Pkg Type   | 0 to 70      | UC3707N                 | <a href="#">Samples</a> |

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

**Important Information and Disclaimer:** The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

**OTHER QUALIFIED VERSIONS OF UC1707, UC1707-SP, UC3707, UC3707M :**

- Catalog: [UC3707](#), [UC1707](#), [UC3707M](#), [UC3707](#)
- Military: [UC1707](#)
- Space: [UC1707-SP](#)

**NOTE: Qualified Version Definitions:**

- Catalog - TI's standard catalog product
- Military - QML certified for Military and Defense Applications
- Space - Radiation tolerant, ceramic packaging and qualified for use in Space-based application

**TAPE AND REEL INFORMATION**


\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1 (mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm) | W (mm) | Pin1 Quadrant |
|------------|--------------|-----------------|------|------|--------------------|--------------------|---------|---------|---------|---------|--------|---------------|
| UC2707DWTR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 12.0    | 16.0   | Q1            |
| UC3707DWTR | SOIC         | DW              | 16   | 2000 | 330.0              | 16.4               | 10.75   | 10.7    | 2.7     | 12.0    | 16.0   | Q1            |

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

| Device     | Package Type | Package Drawing | Pins | SPQ  | Length (mm) | Width (mm) | Height (mm) |
|------------|--------------|-----------------|------|------|-------------|------------|-------------|
| UC2707DWTR | SOIC         | DW              | 16   | 2000 | 367.0       | 367.0      | 38.0        |
| UC3707DWTR | SOIC         | DW              | 16   | 2000 | 367.0       | 367.0      | 38.0        |

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

### Products

|                              |                                                                                      |
|------------------------------|--------------------------------------------------------------------------------------|
| Audio                        | <a href="http://www.ti.com/audio">www.ti.com/audio</a>                               |
| Amplifiers                   | <a href="http://amplifier.ti.com">amplifier.ti.com</a>                               |
| Data Converters              | <a href="http://dataconverter.ti.com">dataconverter.ti.com</a>                       |
| DLP® Products                | <a href="http://www.dlp.com">www.dlp.com</a>                                         |
| DSP                          | <a href="http://dsp.ti.com">dsp.ti.com</a>                                           |
| Clocks and Timers            | <a href="http://www.ti.com/clocks">www.ti.com/clocks</a>                             |
| Interface                    | <a href="http://interface.ti.com">interface.ti.com</a>                               |
| Logic                        | <a href="http://logic.ti.com">logic.ti.com</a>                                       |
| Power Mgmt                   | <a href="http://power.ti.com">power.ti.com</a>                                       |
| Microcontrollers             | <a href="http://microcontroller.ti.com">microcontroller.ti.com</a>                   |
| RFID                         | <a href="http://www.ti-rfid.com">www.ti-rfid.com</a>                                 |
| OMAP Applications Processors | <a href="http://www.ti.com/omap">www.ti.com/omap</a>                                 |
| Wireless Connectivity        | <a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a> |

### Applications

|                               |                                                                                          |
|-------------------------------|------------------------------------------------------------------------------------------|
| Automotive and Transportation | <a href="http://www.ti.com/automotive">www.ti.com/automotive</a>                         |
| Communications and Telecom    | <a href="http://www.ti.com/communications">www.ti.com/communications</a>                 |
| Computers and Peripherals     | <a href="http://www.ti.com/computers">www.ti.com/computers</a>                           |
| Consumer Electronics          | <a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>                   |
| Energy and Lighting           | <a href="http://www.ti.com/energy">www.ti.com/energy</a>                                 |
| Industrial                    | <a href="http://www.ti.com/industrial">www.ti.com/industrial</a>                         |
| Medical                       | <a href="http://www.ti.com/medical">www.ti.com/medical</a>                               |
| Security                      | <a href="http://www.ti.com/security">www.ti.com/security</a>                             |
| Space, Avionics and Defense   | <a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a> |
| Video and Imaging             | <a href="http://www.ti.com/video">www.ti.com/video</a>                                   |

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)