

# High Performance Stepper Motor Drive Circuit

## FEATURES

- Full-Step, Half-Step and Micro-Step Capability.
- Bipolar Output Current up to 2A.
- Wide Range of Motor Supply Voltage: 10–50V
- Low Saturation Voltage
- Wide Range of Current Control: 5mA–2A.
- Current Levels Selected in Steps or Varied Continuously.
- Thermal Protection and Soft Intervention.

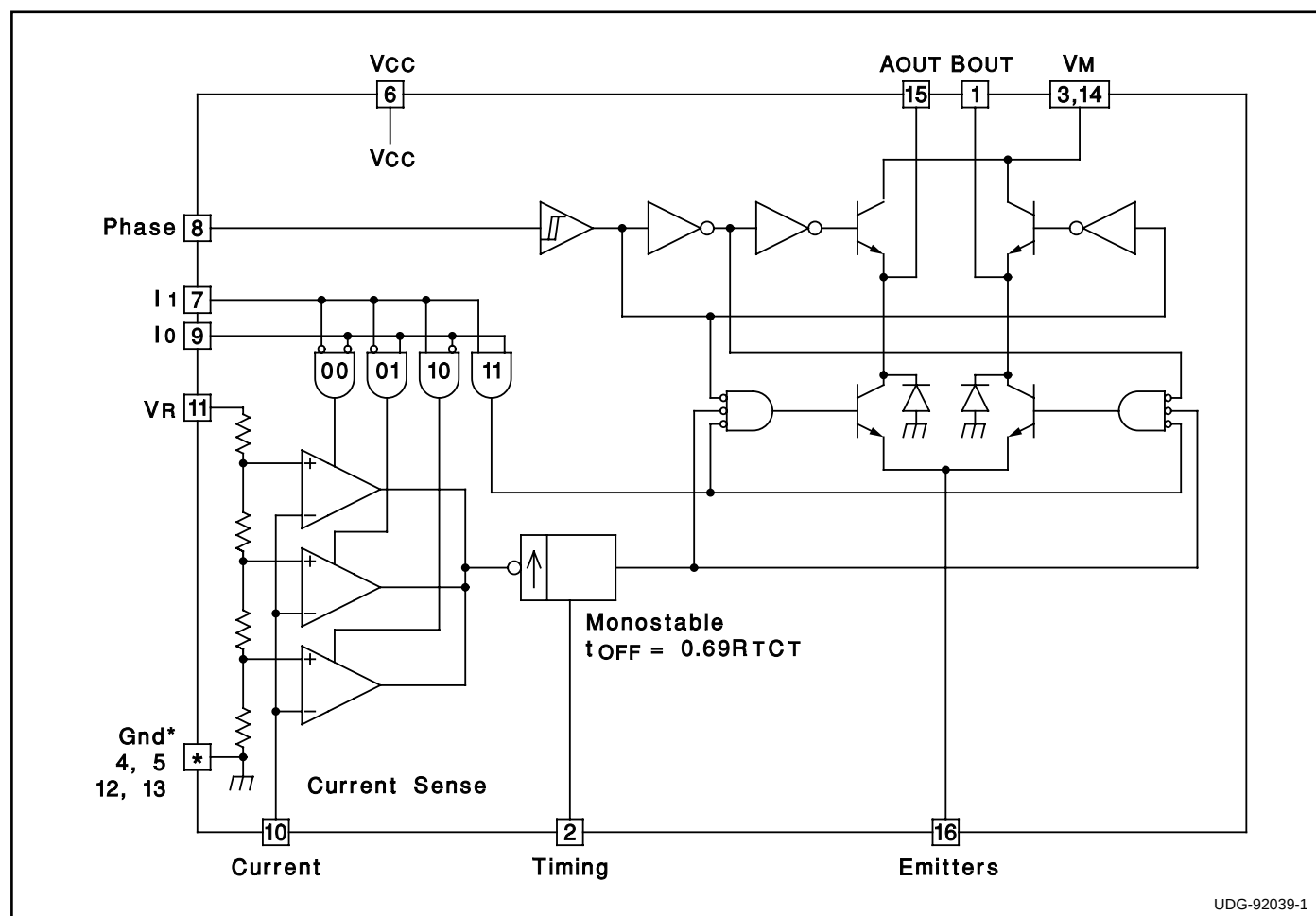
## DESCRIPTION

The UC3770A and UC3770B are high-performance full bridge drivers that offer higher current and lower saturation voltage than the UC3717 and the UC3770. Included in these devices are LS-TTL compatible logic inputs, current sense, monostable, thermal shut-down, and a power H-bridge output stage. Two UC3770As or UC3770Bs and a few external components form a complete micro-processor-controllable stepper motor power system.

Unlike the UC3717, the UC3770A and the UC3770B require external high-side clamp diodes. The UC3770A and UC3770B are identical in all regards except for the current sense thresholds. Thresholds for the UC3770A are identical to those of the older UC3717 permitting drop-in replacement in applications where high-side diodes are not required. Thresholds for the UC3770B are tailored for half stepping applications where 50%, 71%, and 100% current levels are desirable.

The UC3770A and UC3770B are specified for operation from 0°C to 70°C ambient.

## BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

|                                    |          |
|------------------------------------|----------|
| Logic Supply Voltage, $V_{CC}$     | 7V       |
| Output Supply Voltage, $V_{MM}$    | 50V      |
| Logic Input Voltage (Pins 7, 8, 9) | 6V       |
| Analog Input Voltage (Pin 10)      | $V_{CC}$ |
| Reference Input Voltage (Pin 11)   | 15V      |
| Logic Input Current (Pins 7, 8, 9) | -10mA    |
| Analog Input Current (Pins 10, 11) | -10mA    |
| Output Current (Pins 1, 15)        | $\pm 2A$ |
| Junction Temperature, $T_J$        | +150°C   |

Note 1: All voltages are with respect to Gnd (DIL Pins 4, 5, 12, 13); all currents are positive into, negative out of the specified terminal.

Note 2: Consult Unitrode Integrated Circuits databook for thermal limitations and considerations of packages.

## CONNECTION DIAGRAMS

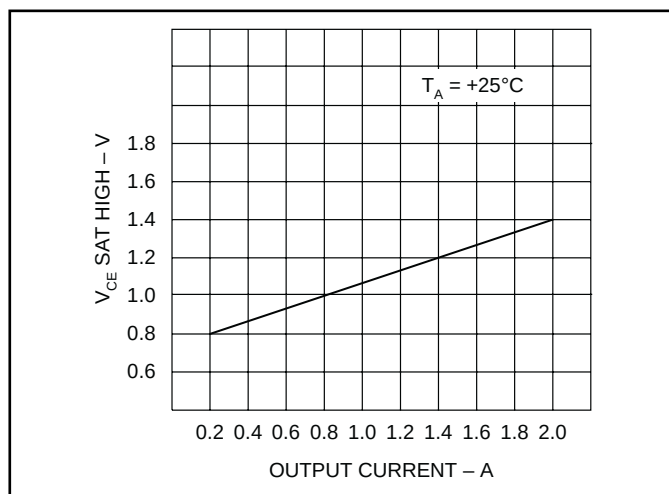
| DIL-16 (Top View)<br>J Or N Package |  | PLCC-28 (Top View)<br>Q Package |  | PACKAGE PIN FUNCTION |       |
|-------------------------------------|--|---------------------------------|--|----------------------|-------|
|                                     |  |                                 |  | FUNCTION             | PIN   |
|                                     |  |                                 |  | Gnd                  | 1-3   |
|                                     |  |                                 |  | $V_M$                | 4     |
|                                     |  |                                 |  | N/C                  | 5     |
|                                     |  |                                 |  | AOUT                 | 6     |
|                                     |  |                                 |  | N/C                  | 7     |
|                                     |  |                                 |  | Emitters             | 8     |
|                                     |  |                                 |  | Gnd                  | 9     |
|                                     |  |                                 |  | BOUT                 | 10    |
|                                     |  |                                 |  | Timing               | 11    |
|                                     |  |                                 |  | $V_M$                | 12    |
|                                     |  |                                 |  | Gnd                  | 13-17 |
|                                     |  |                                 |  | $V_{CC}$             | 18    |
|                                     |  |                                 |  | $I_1$                | 19    |
|                                     |  |                                 |  | Phase                | 20    |
|                                     |  |                                 |  | $I_0$                | 21    |
|                                     |  |                                 |  | N/C                  | 22    |
|                                     |  |                                 |  | Current              | 23    |
|                                     |  |                                 |  | VR                   | 24    |
|                                     |  |                                 |  | N/C                  | 25-27 |
|                                     |  |                                 |  | Gnd                  | 28    |

**ELECTRICAL CHARACTERISTICS:** (All tests apply with  $V_M = 36V$ ,  $V_{CC} = 5V$ ,  $V_R = 5V$ , No Load, and  $0^\circ C < T_A < 70^\circ C$ , unless otherwise stated,  $T_A = T_J$ .)

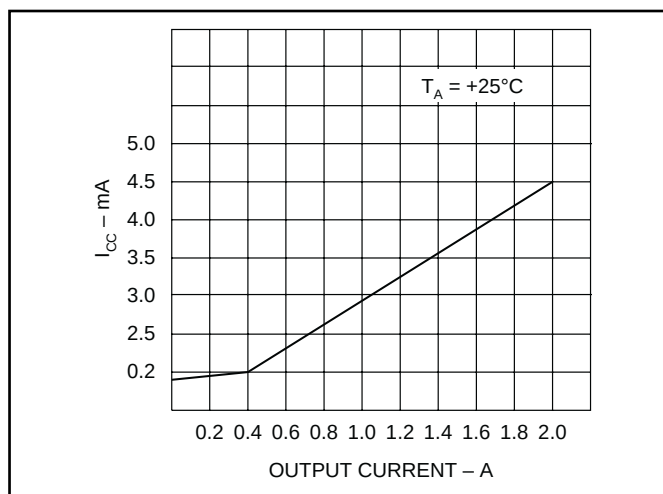
| PARAMETER                             | TEST CONDITIONS                    | UC3770A |      |          | UC3770B |      |          | UNITS   |
|---------------------------------------|------------------------------------|---------|------|----------|---------|------|----------|---------|
|                                       |                                    | MIN     | TYP  | MAX      | MIN     | TYP  | MAX      |         |
| Supply Voltage $V_M$ (Pins 3, 14)     |                                    | 10      |      | 45       | 10      |      | 45       | V       |
| Logic Supply Voltage $V_{CC}$ (Pin 6) |                                    | 4.75    | 5    | 5.3      | 4.75    | 5    | 5.3      | V       |
| Logic Supply Current $I_{CC}$ (Pin 6) | $I_0 = I_1 = H$ , $I_M = 0$        |         | 15   | 25       |         | 15   | 25       | mA      |
|                                       | $I_0 = I_1 = L$ , $I_M = 0$        |         | 18   | 28       |         | 18   | 28       | mA      |
|                                       | $I_0 = I_1 = H$ , $I_M = 1.3A$     |         | 33   | 40       |         | 33   | 40       | mA      |
| Thermal Shutdown Temperature          |                                    |         | +170 |          |         | +170 |          | °C      |
| Logic Threshold (Pins 7, 8, 9)        |                                    | 0.8     |      | 2.0      | 0.8     |      | 2.0      | V       |
| Input Current Low (Pin 8)             | $V_I = 0.4V$                       |         |      | -100     |         |      | -100     | $\mu A$ |
| Input Current Low (Pins 7, 9)         | $V_I = 0.4V$                       |         |      | -400     |         |      | -400     | $\mu A$ |
| Input Current High (Pins 7, 8, 9)     | $V_I = 2.4V$                       |         |      | 10       |         |      | 10       | $\mu A$ |
| Comparator Threshold (Pin 10)         | $V_R = 5V$ , $I_0 = L$ , $I_1 = L$ | 400     | 415  | 430      | 400     | 415  | 430      | mV      |
|                                       | $V_R = 5V$ , $I_0 = H$ , $I_1 = L$ | 240     | 255  | 265      | 290     | 300  | 315      | mV      |
|                                       | $V_R = 5V$ , $I_0 = L$ , $I_1 = H$ | 70      | 80   | 90       | 195     | 210  | 225      | mV      |
| Comparator Input Current (Pin 10)     |                                    |         |      | $\pm 20$ |         |      | $\pm 20$ | $\mu A$ |
| Off Time                              | $R_T = 56k$ , $C_T = 820pF$        | 25      | 30   | 35       | 25      | 30   | 35       | ms      |

**ELECTRICAL CHARACTERISTICS (cont.):** (All tests apply with  $V_M = 36V$ ,  $V_{CC} = 5V$ ,  $V_R = 5V$ , No Load, and  $0^\circ C < T_A < 70^\circ C$ , unless otherwise stated,  $T_A = T_J$ .)

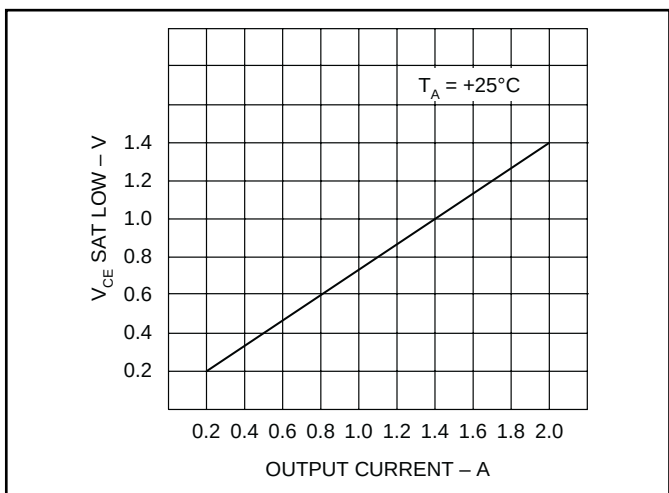
| PARAMETER                        | TEST CONDITIONS | UC3770A |     |     | UC3770B |     |     | UNITS   |
|----------------------------------|-----------------|---------|-----|-----|---------|-----|-----|---------|
|                                  |                 | MIN     | TYP | MAX | MIN     | TYP | MAX |         |
| Turn Off Delay                   |                 |         |     | 2   |         |     | 2   | ms      |
| Sink Driver Saturation Voltage   | $I_M = 1.0A$    |         |     | 0.8 |         |     | 0.8 | V       |
|                                  | $I_M = 1.3A$    |         |     | 1.3 |         |     | 1.3 | V       |
| Source Driver Saturation Voltage | $I_M = 1.0A$    |         |     | 1.3 |         |     | 1.3 | V       |
|                                  | $I_M = 1.3A$    |         |     | 1.6 |         |     | 1.6 | V       |
| Output Leakage Current           | $V_M = 45V$     |         |     | 100 |         |     | 100 | $\mu A$ |



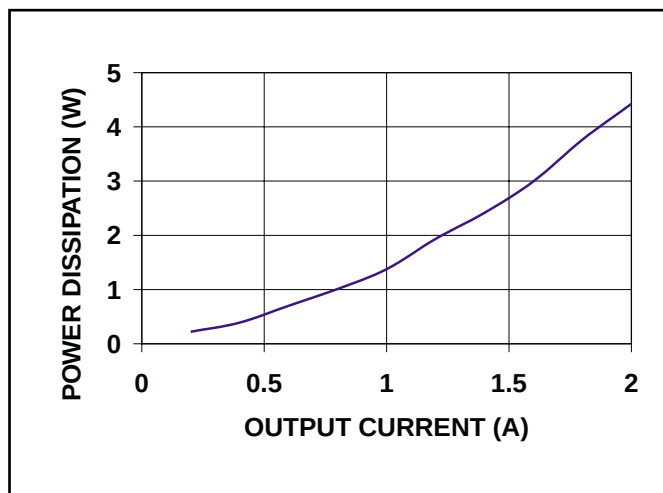
**Figure 1. Typical source saturation voltages vs. load current**



**Figure 3. Typical supply current vs. load current.**



**Figure 2. Typical sink saturation voltages vs. load current**



**Figure 4. Typical power dissipation vs. output current.**

## PACKAGING INFORMATION

| Orderable part number    | Status<br>(1) | Material type<br>(2) | Package   Pins | Package qty   Carrier | RoHS<br>(3) | Lead finish/<br>Ball material<br>(4) | MSL rating/<br>Peak reflow<br>(5) | Op temp (°C) | Part marking<br>(6) |
|--------------------------|---------------|----------------------|----------------|-----------------------|-------------|--------------------------------------|-----------------------------------|--------------|---------------------|
| <a href="#">UC3770AN</a> | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | UC3770AN            |
| UC3770AN.A               | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | UC3770AN            |
| UC3770ANG4               | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | UC3770AN            |
| UC3770AQ                 | Obsolete      | Production           | PLCC (FN)   28 | -                     | -           | Call TI                              | Call TI                           | -            | UC3770AQ            |
| <a href="#">UC3770BN</a> | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | UC3770BN            |
| UC3770BN.A               | Active        | Production           | PDIP (N)   16  | 25   TUBE             | Yes         | NIPDAU                               | N/A for Pkg Type                  | 0 to 70      | UC3770BN            |

<sup>(1)</sup> **Status:** For more details on status, see our [product life cycle](#).

<sup>(2)</sup> **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

<sup>(3)</sup> **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

<sup>(4)</sup> **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

<sup>(5)</sup> **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

<sup>(6)</sup> **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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## TUBE



\*All dimensions are nominal

| Device     | Package Name | Package Type | Pins | SPQ | L (mm) | W (mm) | T (μm) | B (mm) |
|------------|--------------|--------------|------|-----|--------|--------|--------|--------|
| UC3770AN   | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| UC3770AN.A | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| UC3770ANG4 | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| UC3770BN   | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |
| UC3770BN.A | N            | PDIP         | 16   | 25  | 506    | 13.97  | 11230  | 4.32   |

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