## General Description

The MP1011A is a Power IC offering a complete solution for driving one or more Cold Cathode Fluorescent Lamps (CCFL). This Power IC converts unregulated DC voltage to a nearly pure sine wave required to ignite and operate the CCFL. Based on proprietary power topology and patented control techniques, it greatly increases the power conversion efficiency. The MP1011A supports both **analog** and **burst mode** dimming without any additional external components. The MP1011A offers four distinct performance advantages:

1. **More light for less power**
2. **Small board implementation**
3. **Low EMI emission**
4. **Low cost off the shelf components**

## Features

- Integrated power switches
- 6.0 to 22v variable supply voltage with regulated lamp current.
- Rated 12W power output at 12V input
- Open lamp regulation
- Current and Voltage feedback control
- Logic Level burst mode control
- Thermal Shutdown
- Supports Open/Short Lamp protection
- Soft Start
- Output is short circuit protected
- Low lamp operating voltage for increasing transformer or using smaller transformer
- Allows Burst-Mode Operation
- No ballast capacitor required

## Ordering Information

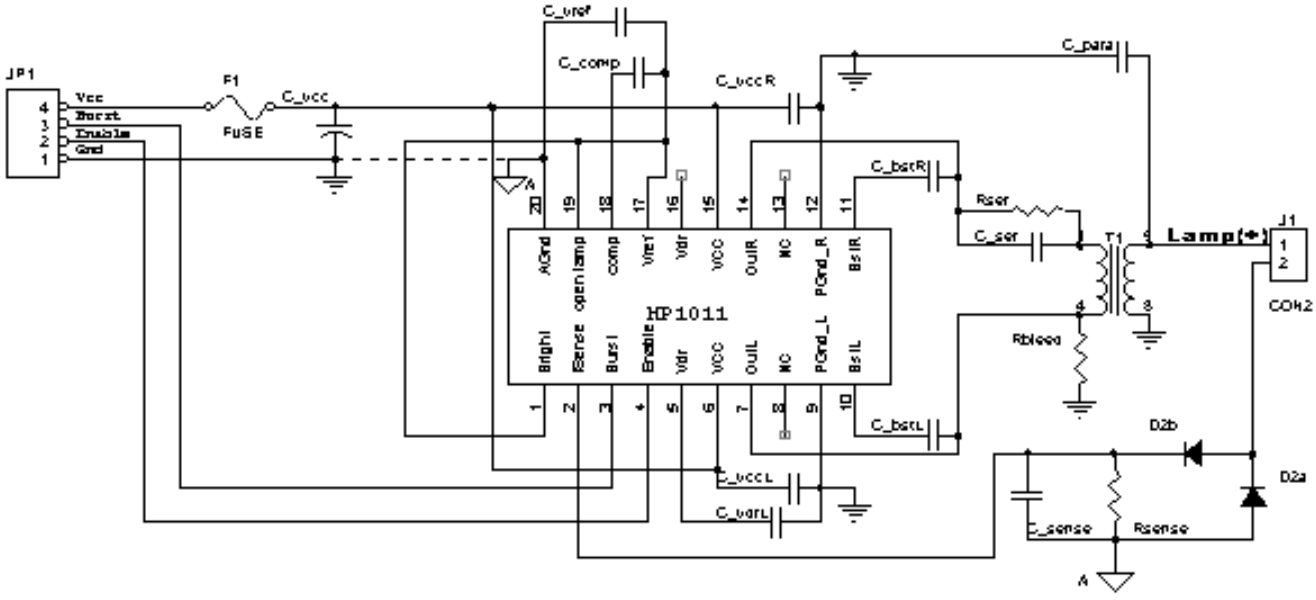
| Part Number * | Package | Temperature |
|---|---|---|
| MP1011EMA | TSSOP 20 pin | -20°C to + 85°C |

* For Tape & Reel use suffix - Z (e.g. MP1011EMA-Z)

## Applications

LCD backlight inverter for large portable or desktop display.

## Typical Application Circuit:



**Absolute Maximum Ratings:**

| | |
|---|---|
| Vcc | 25 V |
| Power Dissipation | 1.0 W |
| Logic Inputs | -0.7 V to 6.8V |
| Thermal resistance | 140° C/W |
| Junction Temperature | 150° C |
| Lead Temperature (Solder) | 260° C |
| Operating Frequency | 150KHz |
| Storage Temperature | –55° C to 150° C |

**Recommended Operating Conditions:**

| | |
|---|---|
| Input Voltage Vcc | 6.0V to 22V |
| Brightness Voltage | 0 to 2.0V |
| Enable | 0 to 5.0 V |
| Operating Frequency | 20KHz to 90KHz |
| Operating Temperature | -20° C to + 85° C |

**Electrical Characteristics** (Unless otherwise specified Vcc=12v, Ta=25° C)

| Parameters | Symbol | Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| **Reference Voltage** | | | | | | |
| Output Voltage | Vref | Iref=3mA | 4.85 | 5.1 | 5.35 | V |
| Reference Current | Iref | | | | 3.0 | mA |
| Line Regulation | | 6.5V < VCC < 22 V | | | 30 | mV |
| Load Regulation | | 0 < Ire < 3.0 mA | | | 30 | mV |
| **Voltage Supply** | | | | | | |
| Supply Current (quiescent) | Icc (off) | | | | 10 | µA |
| Supply Current (operating) | Icc (on) | 6.0V < Vcc < 22V | | 1.8 | 2.5 | mA |
| Operating Range | Vcc | **(Note 2)** | 6.0 | | 22 | V |
| **Shutdown Logic** | | | | | | |
| Thermal Shutdown | | | | 145 | | °C |
| Open Lamp Detect | Vol | | 1.0 | 1.2 | 1.4 | V |
| Enable Voltage Low | Vil | | | | 0.6 | V |
| Enable Voltage High | Vih | | 2.0 | | | V |
| Burst Voltage Low | Vil | | | | 0.8 | V |
| Burst Voltage High | Vih | | 2.4 | | | V |
| **Output Drivers** | | | | | | |
| On Resistance | Ron | **(Note 1)** | 0.10 | 0.12 | 0.15 | Ω |
| Short Circuit Current | Isc | | | 4 | | A |
| Operating Frequency | | | 20 | 60 | 90 | KHz |
| Zero-Crossing Voltage | Vzc | | 0 | 6 | 10 | mV |
| Ton(min) | | Vcomp=0V, Vcc = 22V | 500 | 625 | 750 | nS |
| Ton(min) | | Vcomp=0V, Vcc = 6V | 900 | 1200 | 1500 | nS |
| **Brightness Control** | | | | | | |
| Sense Full Brightness | Vsense | Vbright= 2.0V | 357 | 375 | 393 | mV |
| Sense Full Dim | Vsense | Vbright= 0V | 83 | 92 | 101 | mV |
| Lamp Current Regulation | | 6.0v < Vcc < 22v | | 2 | 5 | % |

**Note 1: This parameter is guaranteed by design.**
**Note 2: See Leakage Inductance Guide lines for Minimum Operating Voltage (Table 2).**



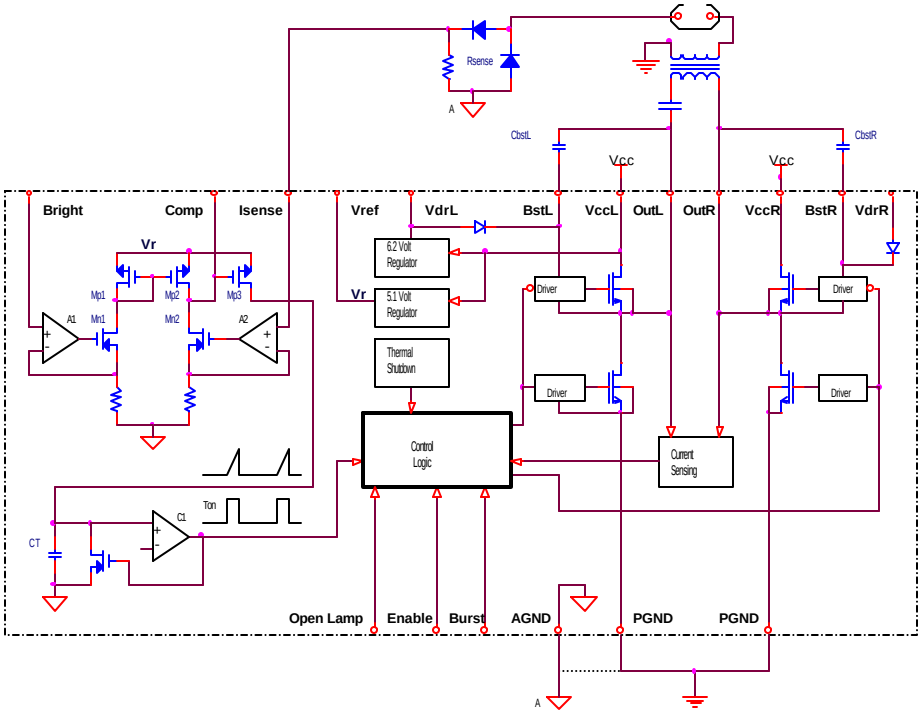
MPS, Inc 3777 Stevens Creek Blvd.
Suite 400 Santa Clara, 95051-7364 USA
Tel (408) 243-0088, Fax (408) 243-0099
www.monolithicpower.com

Revision 1.7
April, 2001

## Pin Description

| Pin # | Pin Name | Pin Function |
|---|---|---|
| 1 | Bright | Dimming Control: 0 volts is full Dim and 2V is full brightness |
| 2 | I sense | Lamp current feedback sense input. |
| 3 | Burst | To use for burst mode, the pin is switched between 0V and 5V When not using burst mode, then pin must be tied to ground. |
| 4 | Enable | The enable will turn the chip on/off. Do not float this pin. |
| 5 | Vdr | Internally generated MOSFET gate drive supply voltage |
| 6 | Vcc | Power Supply input |
| 7 | OutL | Output to Load ( tank circuit ) |
| 8 | NC | No Connect |
| 9 | PGND | Power Ground |
| 10 | BstL | Regulated output voltage for boost cap on phase L |
| 11 | BstR | Regulated output voltage for boost cap on phase R |
| 12 | PGND | Power Ground |
| 13 | NC | No Connect |
| 14 | OutR | Output to Load ( tank circuit ) |
| 15 | Vcc | Power Supply input |
| 16 | Vdr | Internally connected to Vdr (pin 5). This pin must be left open. |
| 17 | Vref | Reference voltage output |
| 18 | Comp | Loop compensation cap |
| 19 | Open lamp | Latching shutdown for open lamp or low battery |
| 20 | AGND | Small signal ground |

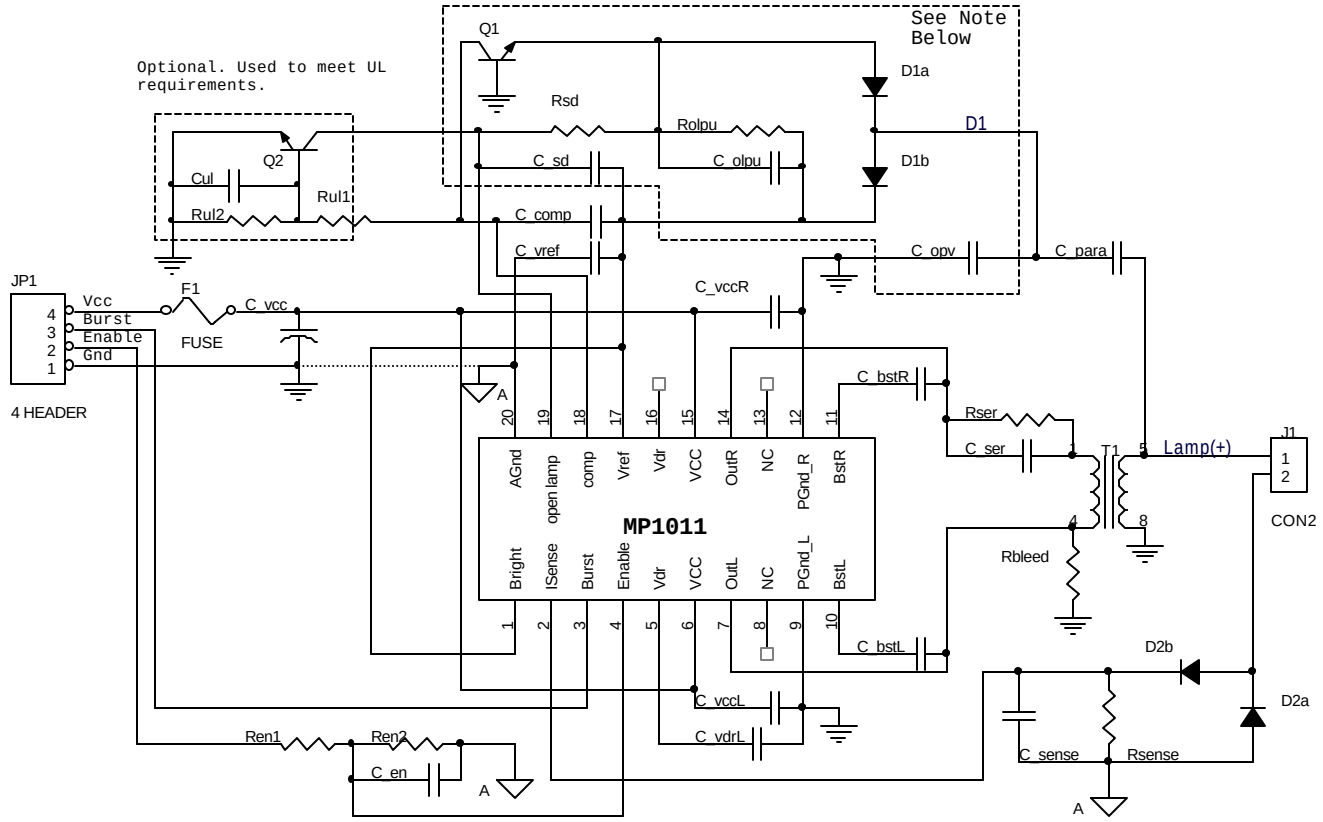
## Functional Block Diagram:



## Truth Table

| Enable | Burst | Output L /Output R |
|---|---|---|
| L | X | High Z |
| H | H | 0 volts ( Standby) |
| L | X | High Z |
| H | L | Normal Operation |

## Reference Design for Burst Mode Operation with Open Lamp Regulation and Shutdown




Note:This circuitry is for 'lamp-out' detection. If this feature is not needed, remove the outlined components, short the upper side of C para to Gnd and short pins 17 and 19 of the MP1011.

For additional reference designs, please see MP1011UG demo board user's guide

## Table 1 Bill of Materials

| Item | Qty | Description | Vendor / Part # | Designation |
|---|---|---|---|---|
| | **Resistors** | | | |
| 1 | 1 | 4.3KΩ, ±5%, SMD, 0805 | | Rbleed |
| 2 | 1 | 100KΩ, ±5%, SMD, 0805 | | Ren1 |
| 3 | 1 | 100KΩ, ±5%, SMD, 0805 | | Ren2 |
| 4 | 2 | 1MΩ, ±5%, SMD, 0805 | | Rsd, Rolpu |
| 5 | 1 | 140Ω, ±1%, SMD, 0805 | | Rsense |
| 6 | 1 | 1KΩ, ±5%, SMD, 0805 | | Rser |
| 7 | 1 | 2MΩ, ±5%, SMD, 0805 | (For UL) | Rul1 |
| 8 | 1 | 280KΩ, ±5%, SMD, 0805 | (For UL) | Rul2 |
| | **Capacitors** | | | |
| 9 | 2 | 10nF, 50V, Y5V, SMD | | C_bstL, C_bstR |
| 10 | 2 | 10nF, 16V, X7R, SMD | | C_olpu, C_comp |
| 11 | 1 | 100pF 50V NPO | | C_en |
| 12 | 1 | 1uF 6.3V X7R | | C_sd |
| 13 | 1 | 6.8nF 16V X7R | | C_opv |
| 14 | 1 | 10pF, 3KV | | C_para |
| 15 | 1 | 0.22uF, 16V, Y5V, (optional) | | C_sense |
| 16 | 1 | 2X.47uF 16V X7R | | C_ser |
| 17 | 2 | 1uF 25V Y5V | | C_vccR, C_vccL |
| 18 | 1 | 10uF, 25V, Y5U, SMD, 1210 | | C_vcc |
| 19 | 1 | 220nF, 10V Y5V, SMD | | C_vdrL |
| 20 | 1 | 0.1uF, 10V, X7R, SMD | | C_vref |
| 21 | 1 | 100nF, 10V, Y5Y, SMD | (for UL) | Cul |
| | **Semiconductors** | | | |
| 22 | 4 | Diode, BAV99L | | D1b, D1a, D2b, D2a |
| 23 | 2 | Transistor, bipolar, 2N3904, SMD | | Q1, Q2 |
| | **Integrated Circuits** | | | |
| 24 | 1 | MP1011A, 20-pin TSSOP | Monolithic Power Systems | U2 |
| | **Magnetics** | | | |
| 25 | 1 | Transformer***** | | T1 |
| | **Hardware** | | | |
| 26 | 1 | Fuse, 1A | | F1 |

### *Transformer Sources:

| **Company** | **Part #** | **Location** | **Contact Info** |
|---|---|---|---|
| Toko | BLC103B | Saitama-Ken, Japan | http://www.toko.co.jp<br>+81-492-791611 |
| Darfon Electronics Corp. | Contact Vendor | Taoyuan 333, Taiwan | +886-3-329-4141 |
| FDK | CD-T-0836-520 | Yamaguchi, Japan | http://www.fdk.co.jp |
| TMP | Contact Vendor | Taipei, Taiwan | +886-2-8667-2081 |

## Table 2: Leakage Inductance Guide Lines for Minimum Operating Voltage

| Minimum Operating Supply Voltage | Recommended Maximum Primary Leakage Inductance* |
|---|---|
| 6 | 38µH |
| 7 | 42µH |
| 8 | 45µH |
| 9 | 47µH |
| 10 | 49µH |

* If the maximum primary leakage cannot be met, consult factory for alternatives.

## Packaging Information

