



MP1029

Cold Cathode Fluorescent Lamp Driver

PROPRIETARY INFORMATION — RIHUI USE ONLY

DESCRIPTION

The MP1029 offers a complete power IC solution for driving 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 control techniques it greatly increases the power conversion efficiency.

FEATURES

- Integrated Power Switches
- 6.0V to 17V Variable Supply Voltage with Regulated Lamp Current
- 12W Power Output at 12V Input
- Open Lamp Regulation
- Current and Voltage Feedback Control
- Logic Level Burst Mode Control
- Supports Open/Short Lamp protection
- Soft-Start
- Output Short Circuit Protection
- Low Lamp Operating Voltage for Increasing Transformers or Using Smaller Transformers
- Analog and Burst Dimming

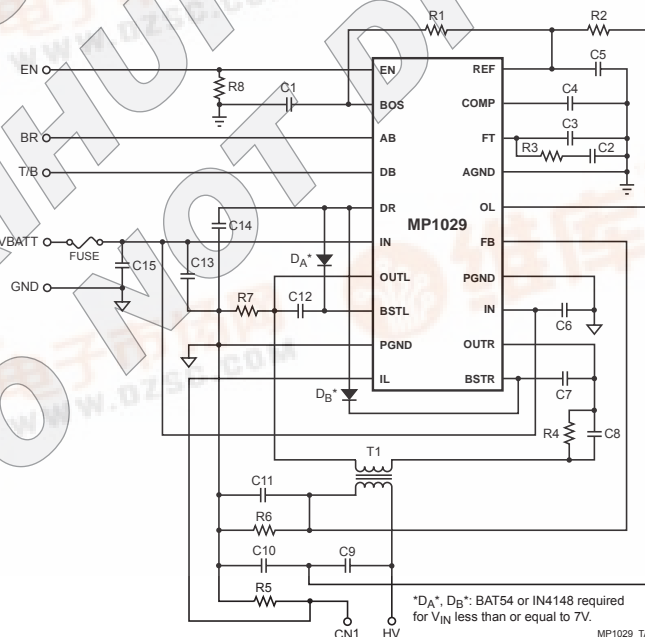
APPLICATIONS

- Backlight Inverters for Portable/Automotive DVD, GPS, Automotive Video Display Systems

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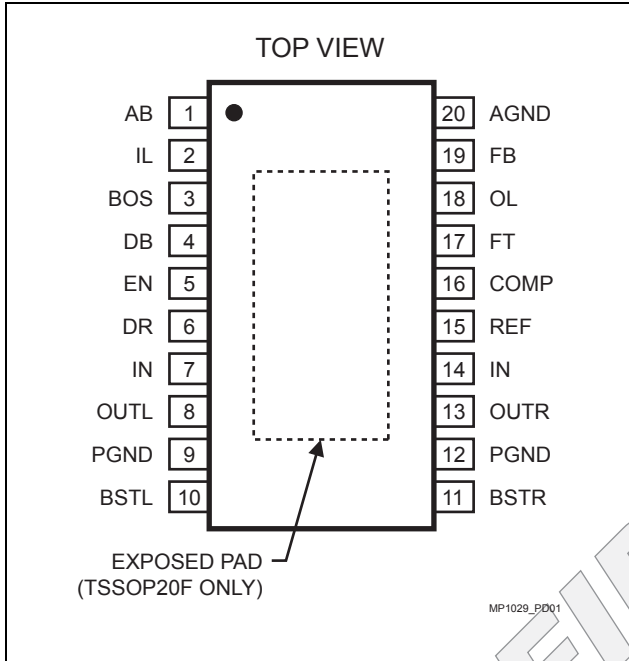
The MP1029 is covered by US Patents 6,114,814, 6,316,881.

TYPICAL APPLICATION



*D_A, D_B: BAT54 or IN4148 required for V_{IN} less than or equal to 7V.

MP1029_TAC

PACKAGE REFERENCE


Part Number*	Package	Temperature
MP1029EM	TSSOP20	-20°C to +85°C
MP1029EF	TSSOP20F	-20°C to +85°C

* For Tape & Reel, add suffix -Z (eg. MP1029EM-Z)
 For Lead Free, add suffix -LF (eg. MP1029EM-LF-Z)

ABSOLUTE MAXIMUM RATINGS ⁽¹⁾

Input Voltage (V_{IN})	21V
IL, FB Input Voltages (V_{IL}, V_{FB})	±6V
OL Input Voltage (V_{OL})	-0.3V to +12V
Logic Input Voltages	-0.3V to +6.8V
Power Dissipation	1.0W
Operating Frequency	150KHz
Junction Temperature	150°C
Lead Temperature (Solder)	260°C
Storage Temperature	-55°C to +150°C

Recommended Operating Conditions ⁽²⁾

Input Voltage (V_{IN})	6V to 17V
Analog Brightness Voltage (V_{AB})	0V to 1.9V
Digital Brightness Voltage (V_{DB})	0V to 1.8V
Enable (V_{EN})	0V to 5V
Operating Frequency (Typical)	60KHz
Ambient Operating Temp	-20°C to +85°C

Thermal Resistance ⁽³⁾

	θ_{JA}	θ_{JC}
TSSOP20	140	25... °C/W
TSSOP20F	110	6... °C/W

Notes:

- 1) Exceeding these ratings may damage the device.
- 2) The device is not guaranteed to function outside of its operating conditions.
- 3) Measured on approximately 1" square of 1 oz copper.

ELECTRICAL CHARACTERISTICS

$V_{IN} = 12V, T_A = +25^\circ C$, unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Units
Reference Voltage						
Output Voltage	V_{REF}	$I_{REF} = 3mA$	4.75	5.0	5.25	V
Reference Current	I_{REF}				3.0	mA
Line Regulation		$6.5V < V_{IN} < 17V$			30	mV
Load Regulation		$0 < I_{REF} < 3.0mA$			30	mV
Output Drivers						
Switch On Resistance ⁽⁴⁾	$R_{(ON)}$		0.08	0.12	0.15	Ω
Short Circuit Current	I_{SC}			4		A
Minimum On Time	$T_{ON(MIN)}$	$V_{COMP} = 0V, V_{IN} = 17V$		480	630	ns
		$V_{COMP} = 0V, V_{IN} = 6V$		1750	2100	ns
Battery Supply						
Supply Current (Quiescent)	$I_{CC(OFF)}$				10	μA
Supply Current (Operating)	$I_{CC(ON)}$	$V_{IN} = 17V$		1.8	2.5	mA

ELECTRICAL CHARACTERISTICS (continued)
 $V_{IN} = 12V$, $T_A = 25^\circ C$, unless otherwise noted.

Parameters	Symbol	Condition	Min	Typ	Max	Units
Brightness Control						
Sense Full Brightness	V_{IL}	$V_{AB} = 2.0V$	360	379	400	mV
Sense Full Dim	V_{IL}	$V_{AB} = 0V$	105	117	130	mV
Lamp Current Regulation		$7V < V_{IN} < 17V$		2	5	%
Burst Oscillator Peak Voltage	V_{BOS}		1.7	1.8	1.9	V
Fault Detect						
Open Lamp Threshold	$V_{(TH)OL}$			0		V
Secondary Current Threshold	$V_{(TH)FB}$			1.2		V
Fault Mode COMP Current	I_{COMP}	$V_{OL} < 0V$, $V_{FB} > 1.2V$		475		μA
Shutdown Logic						
Fault Timer Threshold	$V_{(TH)FT}$		1.1	1.2	1.3	V
Fault Timer Sink Current		$V_{OL} > 0$, $V_{FB} < 1.2V$		1		μA
Fault Timer Source Current						
Open Lamp		$V_{OL} < 0$, $V_{FB} < 1.2V$		1		μA
Secondary Overload		$V_{FB} > 1.2V$		120		μA
Enable Voltage Low	$V_{(L)EN}$				0.5	V
Enable Voltage High	$V_{(H)EN}$		2.0			V

Note:

4) This parameter guaranteed by design.

PIN FUNCTIONS

Pin #	Name	Description
1	AB	Analog Dimming
2	IL	Lamp Current Feedback Sense Input
3	BOS	Burst Oscillator Timing
4	DB	Burst Mode Dimming
5	EN	Chip Enable. Do not float this pin.
6	DR	Internally Generated MOSFET Gate Drive Supply Voltage (6V)
7	IN	Power Supply Input
8	OUTL	Output to Load (tank circuit)
9	PGND	Power Ground
10	BSTL	Regulated Output Voltage for Bootstrap Capacitor on Phase L
11	BSTR	Regulated Output Voltage for Bootstrap Capacitor on Phase R
12	PGND	Power Ground
13	OUTR	Output to Load (tank circuit)
14	IN	Power Supply Input
15	REF	Internally Generated Reference Voltage Output (5V)
16	COMP	Loop Compensation Capacitor
17	FT	Fault Timer
18	OL	Open Lamp Detect (Lamp Voltage Feedback.)
19	FB	Shorted Lamp Detect (Secondary Current Feedback)
20	AGND	Small Signal Ground ⁽⁵⁾

Note:

5) For the MP1029EF, connect the exposed pad to AGND (Pin 20).

BLOCK DIAGRAM

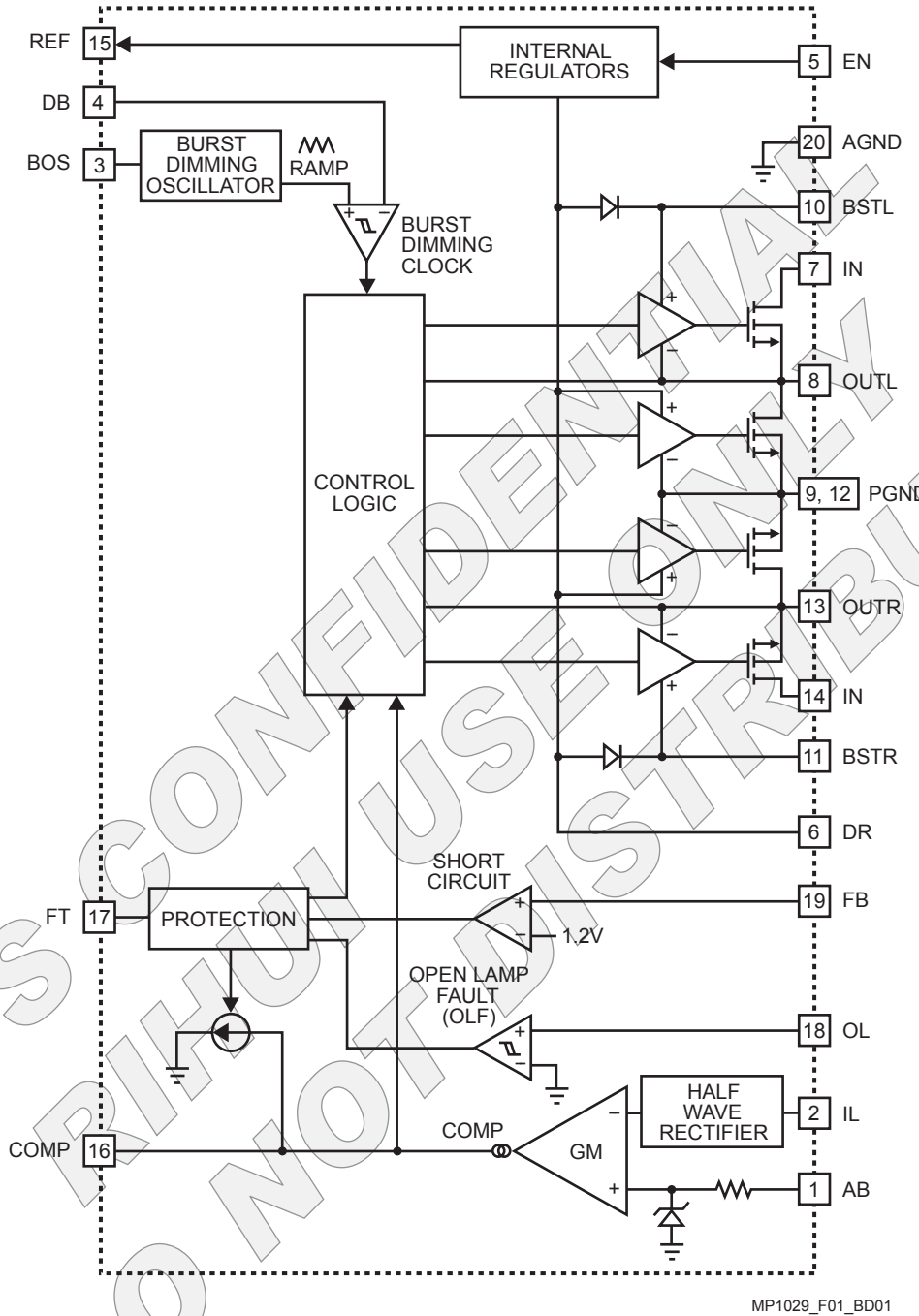


Figure 1—Functional Block Diagram

OPERATION

Brightness Control

The MP1029 can operate in three modes: Analog Mode, Burst Mode with a DC Input and Burst Mode with an External PWM.

The three modes are dependent on the pin connections as per Table 1. The MP1029 has a soft on and soft off feature to reduce noise when using burst mode dimming.

Table 1—Function Mode

Function	Pin Connection		
	Pin 1	Pin 4	Pin 3
	AB	DB	BOS
Analog Mode	0 – 1.9V	V _{REF}	AGND
Burst Mode with DC input voltage	V _{REF}	0 to 1.8V	R1 C1
Burst Mode from external source	V _{REF}	PWM	1.5V

Brightness Polarity:

Burst: 100% duty cycle is at 1.8V

Analog: 1.9V is maximum brightness

Choosing the required burst repetition frequency can be achieved by an RC combination, as defined in component selection.

Chip Enable

The chip has an On/Off function, which is controlled by the EN pin (#5). The enable signal goes directly to a Schmitt trigger. The chip will turn ON with an EN = High and OFF with an EN = Low.

Fault Protection

Open Lamp: The OL pin (Pin 18) is used to detect whether an open lamp condition has occurred. During normal operation the OL pin is typically at 5V DC with an AC swing of ±2V. If an open lamp condition exists then the AC voltage on the OL line will swing below zero volts. When this occurs, the IC will regulate the OL voltage to 10V p-p and a 1μA current source will inject into the FT pin. If the voltage at the FT pin exceeds 1.2V, the chip will shut down.

Excessive Secondary Current (Shorted Lamp and UL safety specs): The FB pin (Pin 19) is used to detect whether excessive secondary current has occurred. During normal operation the FB voltage is a 1V p-p AC signal centered at zero volts D.C. If a fault condition occurs that increases the secondary current, then the voltage at FB will be greater than 1.2V. When this occurs, the IC will regulate the FB voltage to 2.4V p-p and a 120μA current source will inject into the FT pin. If the voltage at the FT pin exceeds 1.2V, the chip will shut down.

Lamp Startup

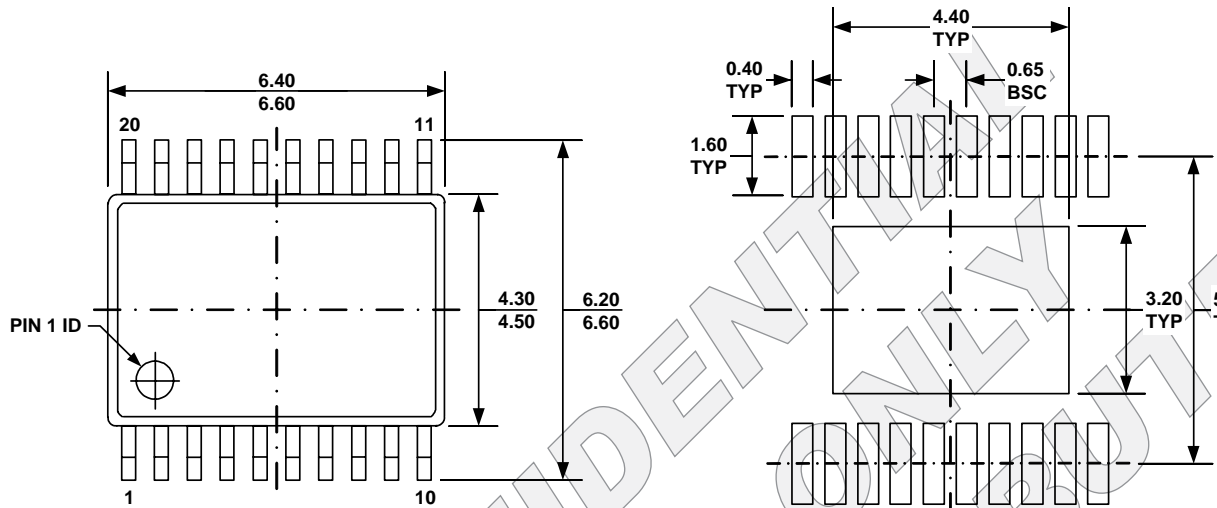
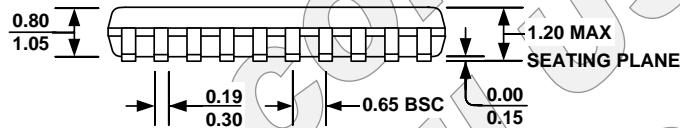
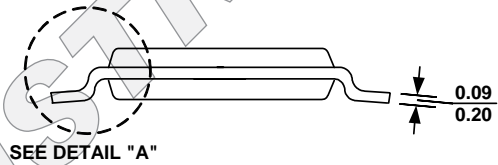
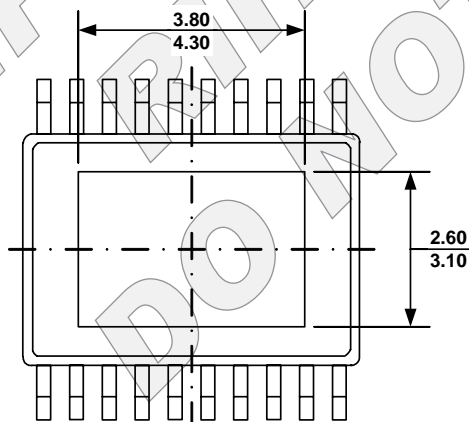
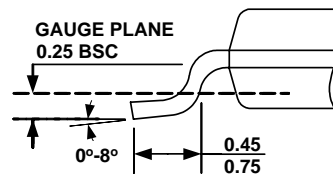
The strike voltage of the lamp will always be guaranteed at any temperature because the MP1029 uses a resonant topology for switching the outputs. The device will continue to switch at the resonant frequency of the tank until the strike voltage is achieved. This eliminates the need for external ramp timing circuits to ensure startup.

Fault Timer

The timing for the fault timer will depend on the sourcing current as described above and the capacitor on the FT pin. The user can program the time for the voltage to rise before the chip detects a “real” fault. When a fault is triggered, the internal drive voltage (V_{DR}) will collapse from 6.2V to 0V and the reference voltage will stay high at 5V.

Low V_{IN} Applications

If the minimum V_{IN} is less than 7V, it is required that the external boost diodes DA and DB be used. The boost diodes can be implemented using low cost components such as IN4148 or BAT54.

PACKAGE INFORMATION
TSSOP20 OR TSSOP20F (EXPOSED PADDLE)

TOP VIEW
RECOMMENDED LAND PATTERN

FRONT VIEW

SIDE VIEW

BOTTOM VIEW

DETAIL "A"
NOTE:

- 1) ALL DIMENSIONS ARE IN MILLIMETERS.
- 2) PACKAGE LENGTH DOES NOT INCLUDE MOLD FLASH, PROTRUSION OR GATE BURR.
- 3) PACKAGE WIDTH DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
- 4) LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.10 MILLIMETERS MAX.
- 5) DRAWING CONFORMS TO JEDEC MO-153, VARIATION ACT.
- 6) DRAWING IS NOT TO SCALE.

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