Keywords: Cold-Cathode Fluorescent Lamp, CCFL, DS3984, DS3988, backlight control,

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APPLICATION NOTE 3695

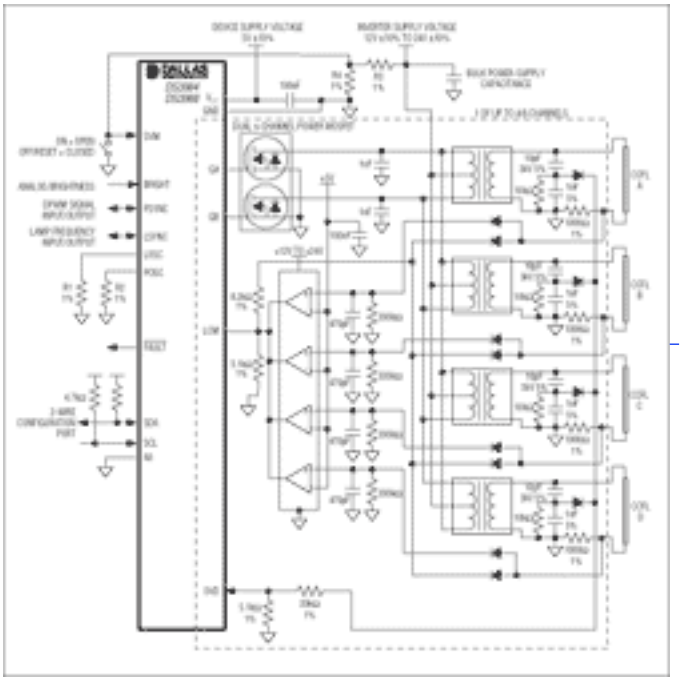
DS3984/DS3988 Common Lamp Return

Abstract: The DS3984 and DS3988 are multi-channel Cold-Cathode Fluorescent Lamp (CCFL) controllers. The DS3984 supports up to four channels and the DS3988 supports up to eight channels. These controllers use a push-pull drive architecture to convert a DC supply voltage to the high voltage AC waveform that is required to power the CCFL lamps. Application note 3615 describes a multiple lamp per channel drive scheme using an independent return path for each lamp. This application note describes the issues involved in converting the multiple lamp per channel drive scheme from an independent lamp return path to a common lamp return path.

Note: This application note refers to details outlined in application note 3615. Application note 3615 is available for download.

Independent Lamp Return Drive Scheme

Figure 1 details the multiple lamp per channel drive scheme as shown in **Figure 1** of application note 3615. In this scheme, each CCFL lamp has an independent return to ground and the CCFL multi-channel controllers monitor the current through each lamp on the low voltage side of the lamp.



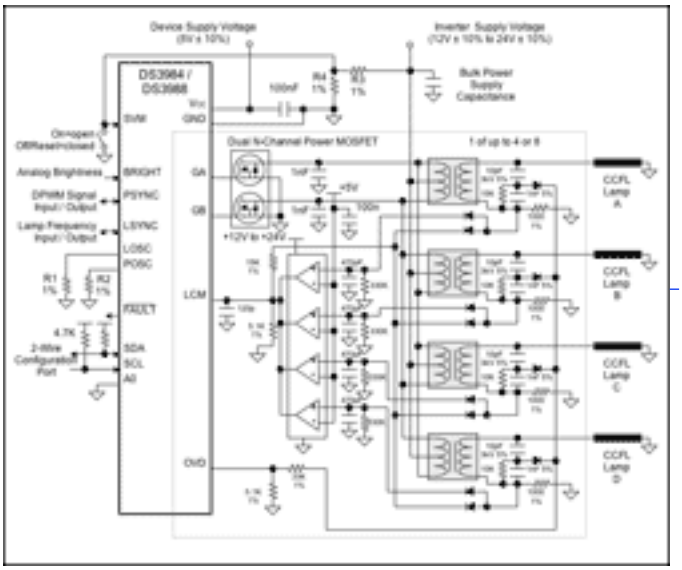
More Detailed Image (PDF, 153kb)

Figure 1. Independent lamp current return.

The key advantage of this type of drive arrangement is that it accurately sets the lamp current regardless of any parasitic capacitance that may be present in the system. Parasitic capacitance on the high voltage side of the transformer secondary can cause current to be diverted before making it to the lamp. In this scheme, the true lamp current will be measured by the feedback resistor (1000 ohms 1% shown in Figure 1) since any current that is diverted due to parasitic capacitance will not be sensed by the feedback resistor. The key disadvantage of this type of arrangement is that it requires a return path (or current sense line) for each lamp.

Common Lamp Return Drive Scheme

Another possible drive arrangement is to sense the lamp current on the low voltage side of the transformer secondary. See **Figure 2**. In this type of drive arrangement, all of the lamps can share a common ground return which can be located at the far end of the lamps or provided via a single return connection. This type of configuration typically reduces system cost however any current diverted due to parasitic capacitance must be accounted for via the lamp current sense feedback mechanism or else the proper amount of current will not be driven through the lamp.



More Detailed Image

Figure 2. Common lamp current return.

The common lamp return arrangement requires some different implementation details from the independent lamp return drive scheme. See the table below for a few recommendations.

	Recommendation	Reason
1.	Use a transformer with a low side secondary connection that is not close to the primary connections.	The switching impulses of the MOSFET can be easily coupled onto the feedback components and cause stability problems.
2.	Route the ground connection for the over-voltage capacitor divider through the lamp current feedback components.	Reduces the affect of the over-voltage capacitor divider on the feedback measurement.
3.	Keep the over-voltage capacitor divider at a ratio of about 100:1. This will require the use of an additional resistor divider (33k and 5.1k in Figure 2) to properly set the voltage at the OVD input.	To reduce the affect of grounding the over-voltage capacitor divider through the lamp current feedback resistor.
4.	Include a low pass filter (15k ohms and 120pF in Figure 2) on the lamp current monitor feedback.	To reduce the some of the high frequency energy created by the parasitic capacitance from influencing the lamp current feedback.

Adjusting the Lamp Current

Since the lamp feedback resistor will shunt both the true lamp current plus any current due to parasitic capacitance, the lamp current feedback resistive divider (formed by the 15.0k and 5.11k resistors in Figure 2) must be adjusted to match the application. The best method for picking the proper resistor divider ratio is by empirical testing. For testing purposes, small resistors (100 ohms) can be added at the low voltage side of the lamps to measure the actual lamp current. The resistor divider can then be adjusted until the desired lamp

current is achieved.

Eliminating False Lamp Strike Detection

The comparator in the multiple lamp per channel drive scheme is used to detect when a lamp does not strike or goes open. Please see application note 3615 for details. The parasitic capacitance in the system can create peak voltages large enough to cross the 5V lamp strike / open lamp threshold that is monitored for each lamp via the comparator. Care must be taken to properly select the value of the lamp feedback resistor to insure that when no lamps are present, that the parasitic capacitance does not create a voltage high enough to cross the 5V lamp out detection threshold. Lab testing has shown that using a 1000 ohm lamp feedback resistor for a nominal lamp current of 5mArms as shown in Figure 2 provides sufficient guard band against false triggering.

Application Note 3695: www.maxim-ic.com/an3695

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