Apollo Display Technologies

A Data Display Company

Constant Current Buck Regulator Board Technical Specification

CCBR-x-yyy

Constant Current Buck Regulator for Powering White LEDs

Single and Dual Output Channels

Rev. 4

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flatpanel displays and solutions

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1. Revision History

Date	Rev.	Author	Description	Page
29-Oct-07	0	wc1	Initial Release	
06-Nov-07	1	wc1	Fix typo. note 1	5
14-Dec-07	2	wc1	Added side view	7
28-Dec-07	3	wc1	Added new variants	7
29-Oct-09	4	wc1	Added new variants	7
			Clarified conditions	4
			Update characteristics	4

2. Product Description

Apollo's Constant Current Buck Regulator product (CCBR) provides a constant current power source for high power white LEDs used for LCD backlighting. Step-down (buck) converters provide up to 1A per channel, two channels maximum (depending on configuration ordered). The CCBR is a highly electrically efficient printed circuit board assembly and is the preferred power solution for Apollo's LED backlit LCD modules.

LED backlighting has become very popular due to the following features:

- Greater reliability under extreme shock and vibration
- Reduced hazardous material content (mercury-free and lead-free)
- Long useful lifetime before field replacement is necessary
- Ability to startup and operate at extremely low temperatures
- Low voltage power supply requirements
- Reduced electromagnetic emissions

A white LED is activated by applying a forward voltage. The light output is determined by controlling the current through the LED, the forward current. The number of photons emitted by the LED is nearly directly proportional to its forward current.

Dimming a white LED by varying voltage or current will shift the dominant wavelength. This effect is proportional to wavelength, with the longer wavelengths undergoing the strongest shift/variation versus current. The CCBR provides a constant current to the LED throughout the dimming range utilizing pulse-width modulation (PWM). The forward current through the LED remains constant, so no wavelength (or color shift) occurs. A control voltage varies the PWM duty cycle.

Optimal thermal management is the key to achieving long lifetime for an LED. White LEDs contain a blue chip-LED which excites a yellow phosphor, in turn emitting white light. The die temperature must be maintained well below a specified threshold in order to have long life. The CCBR contains circuits which monitor the ambient temperature for the LCD module and modifies the current delivered to the LED if necessary, preserving backlight lifetime throughout the operating temperature range.

Thermal shutdown limits total power dissipation by turning off the LEDs when the driver IC junction temperature exceeds 165°C. After thermal shutdown occurs, the power switch does not turn on until the junction temperature drops below approximately 150°C. Over-current protection is provided on a cycle-by-cycle basis.

3. Specifications

3.1. Absolute Maximum Ratings

ITEM	SYMBOL	MIN.	MAX	UNIT
VIN Voltage to GND (operating)	VIN	-0.5	20.0	V
VBRITI Voltage to GND	VBRITI	-0.5	5.5	V
VBRITC,VPWM Voltage to GND	VBRITC, VPWM	-0.5	6.5	V
Operating Temperature	TOP, TA	-40	85	°C
Storage Temperature	TSTG	-65	150	°C

Note: Top,Tstg ≤ 40°C : 90%RH max. without condensation. TOP,TSTG > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

3.2. Operating Characteristics

Conditions: VIN = 12V, -40<TA<85ºC unless otherwise noted. Typical values are for TA=25ºC.

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	Remarks
Supply Voltage	VIN	11.4	12	15	V	
Efficiency			89		%	
Regulator switching frequency	FSW	1.2	1.6	1.9	MHz	
Thermal Shutdown Threshold	TTH		165		ºC	Tj driver IC
Thermal Shutdown Hysteresis	THYST		15		ºC	
Min. ON Voltage	VPWMIN, VBRITC			1.6	V	
Max. OFF Voltage	VPWMIN, VBRITC	0.4			V	
Brightness control voltage	VBRITI	0			V	IRAIL = min.
				5	V	IRAIL = max.
PWM frequency	FPWM		162		Hz	
IRAIL LED rail current	IRAIL		SEE ORDERING INFO		mA	VBRITI = 5V
VRAIL LED rail forward voltage	VRAIL			10.5	V	

4. I/O Interface

4.1. Input Power/Control Connector

Location: J1

Connector used: DF13-8P-1.25H(20) (Hirose)

Mating housing: DF13-8S-1.25C (Hirose)

Function:

Pin No.	Symbol	Function	Note
1	V_{IN}	+12VDC input power	
2	V_{IN}	+12VDC input power	
3	GND	Power return	
4	GND	Power return	
5	V_{BRITC}	On/Off control	1
6	V_{BRITI}	Brightness control voltage (0-5VDC)	1,2
7	+5VDC$_{OUT}$	+5VDC regulated output	3
8	V_{PWMIN}	External PWM input (optional)	1, 2

Notes:

1) To use voltage control of dimming, leave V_{PWMIN} unconnected and apply DC voltage to V_{BRITC}.

2) To use external PWM control of dimming, connect V_{BRITI} to +5VDC$_{OUT}$ or other +5VDC supply and apply PWM control signal to V_{PWMIN}.

3) Regulated +5VDC output is intended to provide power to an external potentiometer in the range 10K – 50K ohms or looped back to V_{BRITI} as described in note 2 above only. Connect no other devices.

4.2. Output Power Connector(s)

Location: J2, J3 (*Note)

Connector used: 22-01-3027 (Molex)

Mating housing: 22-05-3021 (Molex)

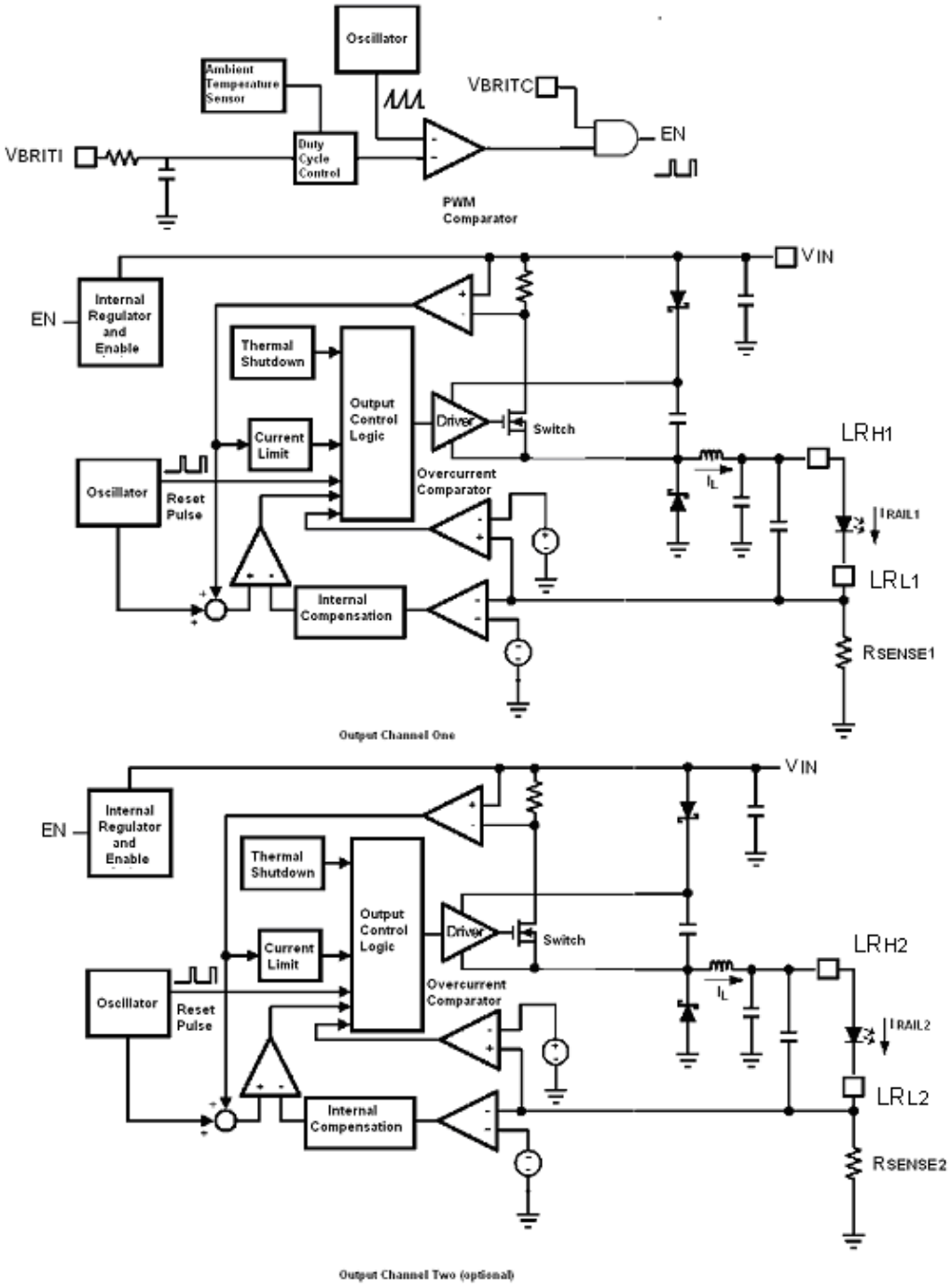
Function:

Pin No.	Symbol	Function
1	$LR_{H1,2}$	V_{BLH} (High voltage)
2	$LR_{L1,2}$	V_{BLL} (Low voltage)

Note] $V_{BLH} - V_{BLL} = V_{RAIL}$

*Note: Output Channel 2 Connector (J3) is populated on dual channel models only (see ordering info).

4.3. Block Diagram



5. Ordering Information

The following product variants have been defined and are available for ordering. Contact Apollo sales for additional information:

Product Code	Output Channels	Current Sourced per Channel (I_{RAIL} typ.)
CCBR-2-240	2	240mA
CCBR-2-300	2	357mA
CCBR-1-600	1	600mA
CCBR-2-600	2	600mA
CCBR-1-750	1	748mA
CCBR-2-750	2	748mA
CCBR-1-800	1	820mA
CCBR-2-800	2	820mA

6. Application Precautions

Please contact us when questions and/or new problems not specified in this specification arise.

7. Mechanical Specifications

Mechanical drawing is found below.