C&D ELETTRONICA

SP034 rev 1.2 – Programmable current driver

User Manual rev 1.5

Features

- 1-channel constant-current LED driver
- Multi-range: Vin: 24 ÷ 48 V, Vout: 5 ÷ 45 V
- High power (Vin×Iout): 250W continuous, 500W pulsed
- Programmable output current: 0.3 ÷ 10 A
- Programmable soft start/stop: 0 ÷ 5 s
- Opto-isolated trigger input
- TEST switch
- LED indicators for Power-on and Trigger
- No external cooling
- 35mm DIN-rail mounting (EN60715)
- CEI EN 61326-1 (2013) compliance
- Preventive overtemperature protection (through current limitation)

Specifications

Power Supply (Vin)	24Vdc ÷ 48Vdc
Output (Vout) (dependent on the load)	5Vdc ÷ 45Vdc (≤ Vin – 3V)
Output (Iout) (configured by SW1)	300mA ÷ 10A
Output resolution	39mA (8bit, 10A / 256)
Output error	≤ 10mA[1] (@ Iout > 500mA) ≤ 150mA (@ Iout ≤ 500mA)
Output current ripple	≤ ±10%
Ripple frequency	200kHz
Duration of turn-on/turn-off ramps (configured by SW2)	0 ÷ 5s
Resolution of turn-on/turn-off ramps	19.6ms (8bit, 5s/255)
Accuracy of turn-on/turn-off ramps	±0.5% (time)
Settling time when turn-on/turn-off ramps are disabled (from input command to 95% of target current)	≤ 100 µs (typical)[4] ≤ 500 µs (maximum)
Maximum power (Vin × Iout)	250W[2] 500W[3]
Efficiency @ 48Vin, 38Vout, 10Aout @ 48Vin, 18Vout, 10Aout @ 24Vin, 18Vout, 10Aout	 ≥ 97% ≥ 95% ≥ 96%

[1] The device is calibrated at a specific working point. See the label on the PCB bottom layer.

[2] At 25°C ambient temperature. Indefinitely long operation, no derating.

[3] About 5 minutes of continuous operation before thermal derating.

[4] Low response times are achieved when the system is "warm"; that is, when it's triggered at a sufficiently high frequency (< 2s of OFF time between two ON periods), so that the system is already in its steady state when it is triggered again.

Settings

(factory settings in **boldface**)

- JP3
    - **closed: IN_TRIGGER_- and GND are shorted.**
    - open: IN_TRIGGER_- and GND are isolated.
- JP2
    - **closed: inserts a resistor between IN_TRIGGER_- and IN_TRIGGER_+**, to avoid floating signals.
    - open: no resistor.
- JP1
    - **closed: the trigger signal is < 10V.**
    - open: the trigger signal is >= 10V.
- SW1
    - Iout, **300mA ÷ 10A**, calibrated (see functional overview)
- SW2
    - Turn-on/turn-off time, **0 ÷ 5s**, calibrated (see functional overview)

Functional overview

Output current

The device drives an LED load in constant-current mode.

The current is the sum of the currents set by the selected switches below:

Iout = 10A / 256 × (binary_number + 1)

	SW1 – current setting
Pin 8	~5 A
Pin 7	~2.5 A
Pin 6	~1.25 A
Pin 5	~625 mA
Pin 4	~313 mA
Pin 3	~156 mA
Pin 2	~78.1 mA
Pin 1	~39.1 mA

The configuration 11111111 corresponds to the maximum current (10A).

Configurations 0-6 (00000000-00000110) would set a current below the minimum (300mA); in these cases, the minimum current will be set.

Example: bits 8-1 = 11001100 -> 10A / 256 × (204 + 1) = 8.008A

This setting is sampled on startup. Any change will require power-cycling the device.

Turn on/off

When the on/off state changes, the output current is gradually increased/decreased to reduce sudden changes in luminosity, which could be harmful for the operator.

The time is the sum of the times set by the selected switches below:

t = 5s / 255 × (binary_number)

	SW2 – Turn-on/turn-off time
Pin 8	~2.510 s
Pin 7	~1.255 s
Pin 6	~627 ms
Pin 5	~314 ms
Pin 4	~157 ms
Pin 3	~78.4 ms
Pin 2	~39.2 ms
Pin 1	~19.6 ms

The configuration 11111111 corresponds to the maximum time (5s).

Example: bit 8-1 = 00101100 -> 5s / 255 * 44 = 0.863s

This setting is sampled on startup. Any change will require power-cycling the device.

If the time is set to 0, there are no turn-on/turn-off ramps; the change is immediate (see the settling time in the specifications).

The trigger signal can change state before the ramp is over. The current will smoothly change according to the new command (following a partial ramp).

During ramp-up, the current follows a super-linear curve, so that the brightness perceived by the human operator will vary approximately linearly. During ramp-down, the opposite curve is used.

During ramps, the current is modulated as follows:

- For I < 300mA, the current is PWM-modulated (modulating a 300mA current setting)
- For I ≥ 300mA, the current is analogically modulated

When the ramp is over and the target current is reached, the current is modulated analogically using a 200kHz feedback loop. This is true of any value of the target current; it does not produce a square wave for the current output, just a ripple.

Turn-on preload

The first turn-on after power-up is slower since the feedback loop has not adjusted to the load yet. This can result in an additional ≈500µs for the settling time.

This delay is negligible when using ramps, while it can be noticeable when using a time setting of 0.

To avoid the delay, the device will preload the feedback loop by pulsating the output current for 2ms at startup (at the selected target current). This only happens if the time setting is 0. If the load is not connected at startup, the pulse will still occur, but it the feedback loop won't adjust properly. In this case, if the delay is too long for the application, a manual preload should be performed by sending a pulse ≥2ms on the trigger input.

Overheating protection

The device mounts a temperature sensor (NTC resistor) to limit the output current when the device gets overheated.

The sensor is calibrated to operate starting from 79°C. The current is reduced non-linearly to stabilize the temperature:

79°C	≈10 A
92°C	≈8 A
107°C	≈6 A
116°C	≈5 A
126.5°C	≈4 A

That is, if the ambient is not overheated itself, the current is limited to a value that should not produce an increase in temperature. E.g. at 79°C, the device can dissipate the heat produced by 10A without increasing its temperature.

Connections

The following is a front view of the SP034.

Hardware rev 1.2:

- IN TRIGGER +, IN TRIGGER-: optically isolated input.
- VCC, GND: input voltage supply
- LED+, LED-: output to the LED load
- TEST switch: this switch allows testing the Output LED during installation. The switch is accessible from the hole located in the front cover with the tip of a screwdriver (as indicated by the front label). It allows the manual turn-on of the LED output, with the current/time settings set by the dip-switches. If the Vin × Iout power is over the maximum continuous power, the operator should not hold down the button for too long.
- TRIGG (Green LED): it is ON whenever the output LEDs are being driven (also during the turn-on/turn-off ramps and while holding the TEST switch).
- POWER (Green LED): power on.

Housing

- Shock- and contamination-proof (IP40 housing, IP20 terminal blocks).
- Dimensions: 77mm (length), 107.5mm (height), 22.6mm (width).

Revision history

1.0	30 October 2018	First revision.
1.1	20 November 2018	Updated specifications; more detailed functional overview.
1.2	22 November 2018	Added front view image of Rev 1.2.
1.3	21 March 2019	Updated specifications.
1.4	30 September 2019	Updated output error specifications. Corrected front view image for hw rev. 1.2. Removed front view image for hw rev. 1.1.
1.5	08 November 2021	Corrected the revision number and date of the document.

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