DRIVER BOARD EBD5000

Product Specification Document

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CONTENTS

1 SCOPE

1.1 PURPOSE

The purpose of this document is to describe the set of functional features, the performance and the user interfaces of EXALOS' analog driver board EBD5000 for SLEDs (Super-Luminescent Emitting Diodes) and pin-compatible laser diodes. The EBD5000 features a multi-pin connector, which is used to connect an adapter board that is specific to the module type of the SLED.

1.2 BOARD REVISION

This product specification is based on the EBD5000 production series, revision V3.1.

1.3 RESPONSIBILITY

EXALOS is responsible for establishing, implementing and maintaining this specification. The quality representative shall ensure that a timely Engineering Change Notice (ECN) is issued in accordance with EXALOS' procedure for any changes.

2 PRODUCT DESCRIPTION

2.1 ARCHITECTURE

The EBD5000 is a high-performance analog driver board that consists of a multi-layer PCB board with a multi-pin connector to which adapter boards can be connected supporting various types of optical modules, for example 14-pin butterfly (BTF), 14-pin dual-in-line (DIL), transmit optical sub-assembly (TOSA) or others. The multi-layer PCB design with shielding ground layers allows for the co-existence of a highly efficient switched-mode temperature controller (TEC) with a low-noise linear SLED drive current controller in a compact form factor with the size of a credit card. Furthermore, the multi-layer PCB design features a sophisticated heat-spreading thermal design that reduces hot spots, which is the basis for stable operation at high ambient temperatures.

2.2 FEATURES

The main characteristics of the EBD5000 are:

- High-efficiency switched-mode TEC supporting high-power SLEDs at high ambient temperatures
- Generation of an ultra-stable, ultra-low noise SLED drive current
- Adjustment of the SLED drive current either through an external analog control voltage (0-2.5V) or through the on-board potentiometer
- SLED enable either through a mechanical code switch or through an electrical TTL signal
- Digital on-off modulation with TTL signals
- Noise and spike filter network and brown-out detector for input supply voltage

The EBD5000 features a stabilization feedback loop for the SLED drive current (automatic current control, ACC) but not for the SLED output power (automatic power control, APC). If required, APC would have to be realized through external control loops, for example using either the monitor photodiode (MPD) signal of the JP2 connector or using any external MPD in conjunction with control of the SLED drive current through an analog control signal at JP3.

2.3 OPERATING RANGE

The EBD5000 has been designed for operation over a wide temperature range. Only industrial-grade components have been selected that are qualified for operating temperatures from -40 °C to +85 °C. The standard temperature operating range of the EBD5000 is -20 °C to +65 °C.

The EBD5000 is designed to ensure proper operation in environments with electro-magnetic interference (EMI) by using a star-like ground concept and various levels of analog grounds throughout the design.

The EBD5000 requires a stable +5V power supply in the range of 4.90 V to 5.20 V. Supply voltages outside this range may result in improper operation or elevated power dissipation of the electronics. Spiky and unstable supply voltages may activate the on-board spike and brown-out detector, resulting in a controlled shut-off followed by a ramp-up of the SLED current. The required supply current is composed of the SLED drive current and the Peltier current. The maximum supply current is 3 A for a maximum SLED drive current of 1000 mA and a maximum Peltier current of 1800 mA. Typical supply current under operation might be significantly lower, depending on the SLED and ambient temperature.

2.4 ROHS COMPLIANCE

All components and fabrication or assembly processes used for the EBD5000 are compliant to the Restriction of Hazardous Substances (RoHS) directive 2002/95/EC.

3 EBD5000 DRIVER BOARD

3.1 PRINTED CIRCUIT BOARD (PCB)

The EBD5000 board has a size of 70 mm (L) x 55 mm (W). Fig. 1 shows pictures of the front side of the EBD5000 board. Fig. 2 shows a schematic top view of the board and the names of connectors, switches, potentiometers and LED indicators.

Fig. 1 Top view of the EBD5000 board

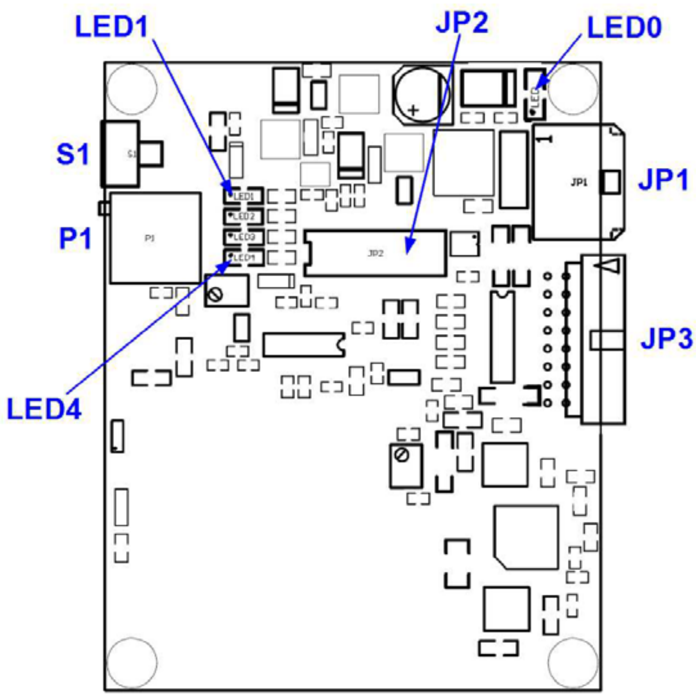

Fig. 2 Schematic top view of the EBD5000 indicating the user interfaces

3.2 ELECTRICAL USER INTERFACES

Different to the EBD5200, EBD5800 or similar OEM boards, the EBD5000 is not intended to be packaged in a metal case. Therefore, in principle, more connectors or status signals are available, for example the LED indicators or the JP2 connector to which a display board (DIB) can be connected. Table 1 provides a list of all electrical connectors that belong to the user interface.

Name	Connector on EBD5000 board	Function	Mating connector for cable assembly
JP1	MOLEX "Micro-Fit 3.0"; 43650-0300 Header (male)	+5V power supply, GND, PE	MOLEX "Micro-Fit 3.0"; 43645-0300 Receptacle (female)
JP2	Tyco "Micro-MaTch"; 1-215079-0 female-on-board	On-board diagnostics (for EXALOS use only)	Tyco "Micro-MaTch"; 8-215083-0 male-on-wire
JP3	MOLEX "Milli-Grid"; 87833-1620 Header (male)	SLED enable & on-off modulation, analog and digital input & output signals	MOLEX "Milli-Grid"; 51110-1651 Crimp Housing

Table 1 List of electrical connectors (user interface)

Fig. 3 shows the front view of the connector JP1 and JP3. The corresponding pinout information is listed in Table 2 and Table 3, respectively.

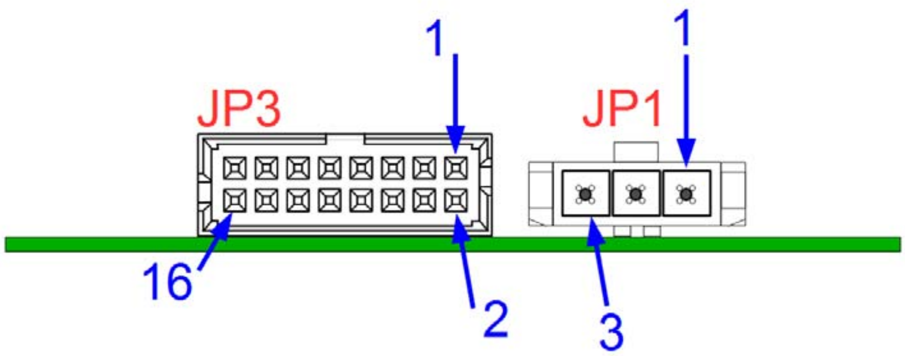

Fig. 3 Front view of header JP3 and JP1 with pin indication. The green bar indicates the PCB of the EBD5000.

Pin	Name	Function	Description /Comment
1	PE	Input	Protective Earth, to ground the metal case
2	GND	Input	External electrical Ground (3A)
3	+5Vext	Input	External 5V power supply (4.90-5.20 V, 3A)

Table 2 Pinout of header JP1

Pin	Name	Function	Description / Comment
1	Modulation	Input	5V TTL digital modulation signal
2	+5Vin	Output	5V supply voltage from JP1, for configuration purposes only, e.g., enable the SLED through short to pin3
3	SLEDenable	Input	5V TTL digital signal to enable/disable the SLED
4	GNDext	Output	GND reference for Modulation or SLEDenable when realized with open-collector outputs, preferably not be used otherwise to avoid GND loops (use instead pin2 of JP1 as GND reference for Modulation and SLEDenable if possible)
5	n/c	None	Not connected
6	n/c	None	Not connected
7	SLED_enabled	Output	Open-collector output indicating SLED is on
8	AIN_enabled	Output	Open-collector output indicating that SLED current is controlled through pin15/pin16
9	AIN_alarm	Output	Open-collector output indicating excessive analog input voltage at pin15/pin16 is applied and limited to +2.5V
10	TEC_alarm	Output	Open-collector output indicating the read temperature of the SLED being either 1.5°C above or below the set temperature
11	GNDext	Output	GND reference for pin7, pin8, pin9, pin10
12	GNDext	Output	GND reference for pin7, pin8, pin9, pin10
13	AINenable	Input	Enable SLED current control through pin15/pin16
14	+5Vin	Output	5V supply voltage from JP1, for configuration purposes only, e.g., enable analog control through short to pin13
15	+AINextern	Input	Analog input voltage (0-2.5V) to control SLED current
16	-AINextern	Input	GND reference of analog input signal (pin 15)

Table 3 Pinout of header JP3

Pin7 to pin10 of connector JP3 contain digital alarm or status signals that are decoupled from the rest of the electronics through opto-couplers. They are open-collector outputs with a common ground "GNDext" that is on pin11 and pin12 of JP3. These alarm signals are also logically connected to the four LEDs that are found on the board. As shown in Table 4, the pinout sequence of JP3 matches the configuration sequence of the LED indicators (except for power indicator LED0).

LED	Name	Description / Comment
LED0 (green)	Power	Indicating supply voltage with correct polarity after the fuse and brown-out and spike detector
LED1 (green)	SLED_enabled	Open-collector output indicating SLED is on
LED2 (orange)	AIN_enabled	Open-collector output indicating that SLED current is controlled through pin15/pin16
LED3 (orange)	AIN_alarm	Open-collector output indicating excessive analog input voltage at pin15/pin16 is applied and limited to +2.5V
LED4 (red)	TEC_alarm	Open-collector output indicating the read temperature of the SLED being either 1.5°C above or below the set temperature

Table 4 Configuration of LED indicators

The left side of connector JP3 contains pins for analog control of the SLED drive current and hence of the optical output power. The analog input pins shall be handled with care as they are not decoupled through opto-couplers, which may, in cases of false connectivity, result in unwanted GND loops. Pin15 and pin16 allow for applying an analog control voltage (0 to +2.5V) in order to control the SLED current and to use the EBD5000 as part of an analog control loop. The analog control input voltage at +AINext and –AINext are fed into an instrumentation amplifier of high accuracy, low offset voltage and low drift.

Position	AINenable	SLEDenable	TECenable
0	Off	Off	On
1	Off	On	On
2	On	Off	On
3	On	On	On
4	Off	Off	Off
5	Off	On	Off
6	On	Off	Off
7	On	On	Off

Table 5 Configuration table for code switch S1

Table 5 shows possible configurations of the EBD5000 that can be selected through the code switch S1. The default configuration of S1 is '0', i.e. the temperature controller (TEC) is enabled but the SLED and the current control through an analog input signal is disabled. This means that the TEC is working as soon as a supply voltage is applied. The SLED is turned off and can be turned on through an active-HIGH (5V) signal on pin3 of JP3 or by switching the code switch S1 to '1'. The SLED current can be adjusted through the potentiometer P1.

Still, even in configuration '1' the SLED current can be adjusted electronically through pin15 and pin16 of JP3. In order to enable the control through an external analog signal an active-HIGH (5V) signal needs to be applied to pin13 of JP3, for example by shortening pin13 and pin14. In this case the setting of potentiometer P1 is ignored.

The TEC shall only be disabled for SLED modules not featuring a Peltier element. For standard BTF or DIL modules with an internal Peltier element the default configuration of S1 has the TEC enabled as it cannot be enabled electronically.

3.3 OPERATING CONDITIONS

Table 6 shows the typical, minimum and maximum operating conditions of the EBD5000 driver board.

Parameter	Min.	Typ.	Max.
Supply Voltage	4.9 V	5.0 V	5.2 V
Supply current, SLED disabled, TEC enabled (1)		0.3 A	2.0 A
Supple current, SLED enabled, TEC enabled (2)		0.8 A	3.0 A
Ambient operating temperature (3)	-20 °C		65 °C
Ambient storage temperature	-40 °C		85 °C

(1): Typical value at room temperature. Larger than typical supply currents can occur during power-up of the board or at extreme ambient temperatures.
(2): Typical value at room temperature and SLEDs up to 500 mA. Larger than typical supply currents can occur during power-up of the board or at extreme ambient temperatures.
(3): Extended temperature range from -40°C to +85°C available upon request.

Table 6 Operating conditions of the EBD5000

3.4 PERFORMANCE CHARACTERISTICS

Table 7 shows the typical performance of an EBD5000 driver board that was assessed with various short-wavelength and long-wavelength SLED modules from EXALOS. Furthermore, spectral noise measurements were performed with a high-precision electrical resistor and compared to optical relative intensity noise (RIN) measurements carried out with SLED modules.

During mid-term (up to 24 hours) experiments in an environmental chamber, measurements of the SLED current were performed every 6 seconds. The time-related drift was extracted through adjacent-averaging smoothing with a 1-hour window size (sliding-window averaging); the drift is not cumulative, i.e. drift over 24 hours can be zero. During mid-term and long-term (up to 1000 hours) experiments in a module test system, measurements of the SLED current and temperature were performed every 1 second and averaged over five minutes (300 samples) in order to record long-term trends.

Parameter (ptp=peak-to-peak, rms=root mean square)	**Typical**	**Maximum Rating**	**Conditions/Comments**
Drive current		600 mA	Extended current range up to 1000 mA upon request
Compliance voltage		3.0 V	
TEC current		1.8 A	Extended TEC currents up to 3.0 A upon request
TEC temperature stability ptp 24h	±0.002 °C	±0.01 °C	Equivalent to ±100 ppm @ 20 °C
TEC temperature drift 1000h	±0.07 ppm/h	±0.1 ppm/h	Linear interpolation over 1000 h
Current stability ptp 24h	±75 ppm	±100 ppm	Ambient temperature constant within ±0.5 °C
Current stability rms 24h	±20 ppm	±30 ppm	Ambient temperature constant within ±0.5 °C
Current stability ptp 1h	±75 ppm	±100 ppm	Ambient temperature constant within ±0.5 °C
Current stability rms 1h	±20 ppm	±30 ppm	Ambient temperature constant within ±0.5 °C
Mid-term current drift 24h	±9 ppm/h	±12 ppm/h	1h sliding window
Long-term current drift 1000h	±0.5 ppm/h	±0.8 ppm/h	Linear interpolation over 1000 h
Temperature-related current change (1)	±10 µA/°C	±15 µA/°C	Average value, not including warm-up
Current noise	1.3 μA_{rms}	1.5 μA_{rms}	Extracted from spectral noise measurements (1 kHz – 10 MHz)
Turn-on delay for SLED enable (2)	100 ms		
Turn-on delay on-off modulation (2)	10 ms		
10:90 rise time on-off modulation (2)	1 ms		
Max. on-off modulation frequency (3)	50 Hz		
Max. analog modulation frequency (3)	3 Hz		

(1): Typically a change of 1.0 mA or less in drive current is measured over temperature range from -40°C to +85°C.

(2): The EBD5000 features a built-in safety circuitry that powers down the electronic driver stage of the SLED whenever the SLED is disabled. This guarantees that under no circumstances the driver board can generate any light output from the SLED as long as the SLED is disabled. Furthermore, this turn-on delay also guarantees a controlled power-up behavior of the board in case the supply voltage is cycled while the SLED is enabled.

(3): The default configuration of the EBD5000 board is optimized for lowest possible noise performance with modulation rates of a few Hertz. The modulation switch on the board supports modulation rates up to 10 MHz and the default OpAmps support modulation rates up to 30 kHz. Upon request customized versions of the EBD5000 can be realized that support faster modulation rates, for example up to 10 kHz, at the expense of higher current noise.

Table 7 Typical performance characteristics of the EBD5000

4 ADAPTER BOARD (EBA)

The EBD5000 belongs to the EBD5x00 OEM driver board family and shares the design concept and most of the components. However, the EBD5000 features a multi-pin connector that allows for supporting various types of SLED modules through module-specific adapter boards (EBAs). The whole assembly of EBD5000 driver board and module-specific adapter board is called EBD50y0 (the y specifies the package type of the optical module and hence the type of EBA).

As the EBD50y0 assembly is not packaged into a metal case like the other EBD5x00 OEM boards, the on-board diagnostic connector JP2 is easily accessible. An optional alphanumeric display board (DIB, see section 5) can be connected to JP2 that informs about various SLED parameters. The following pictures show such driver board assemblies for BTF modules (EBD5020, Fig. 4), for DIL modules (EBD5010 or EBD50F0, Fig. 5) or for TOSA modules (EBD5080, Fig. 6), respectively.

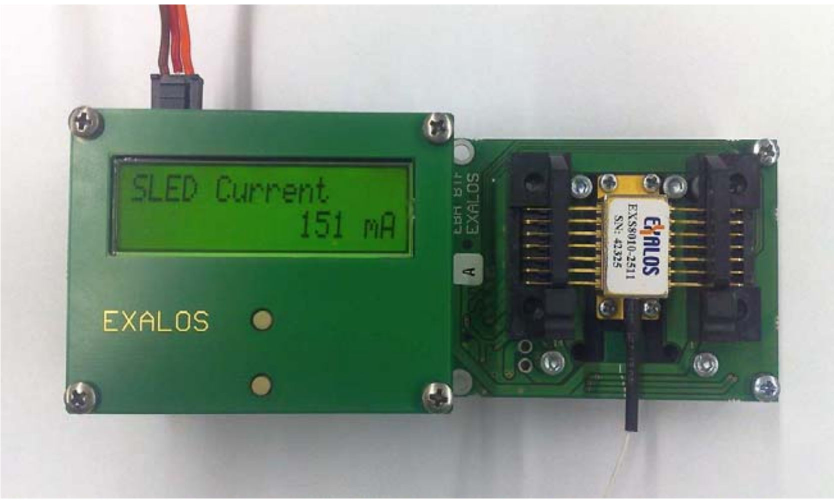

Fig. 4 Top view of an EBD5020 with an adapter board for 14-pin BTF modules

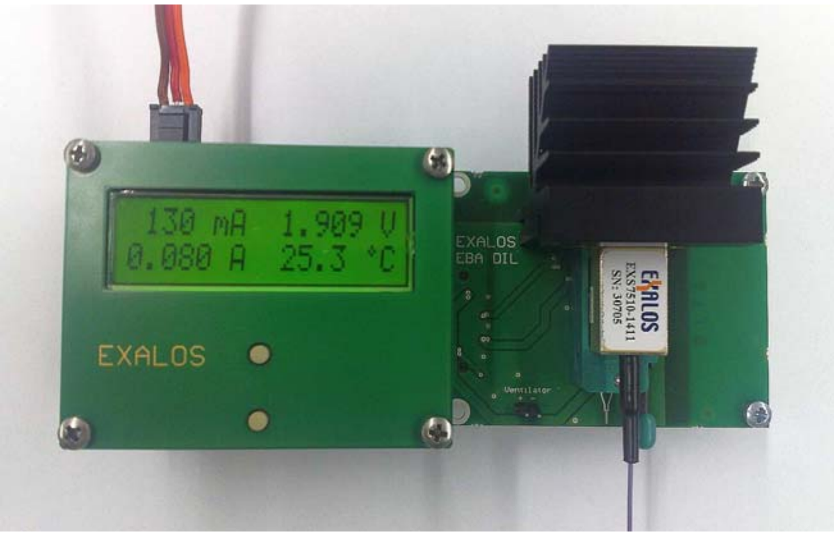

Fig. 5 Top view of an EBD5010 with an adapter board for 14-pin DIL modules.
The EBD50F0 will feature an adapter board for floating 14-pin DIL modules.

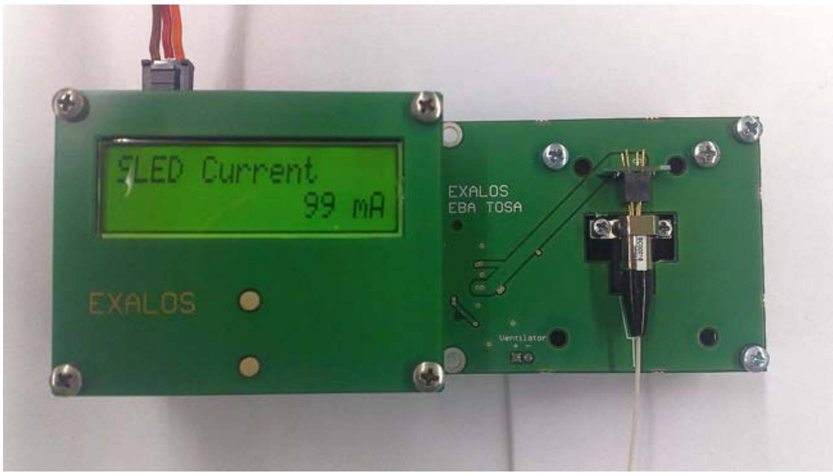

Fig. 6 Top view of an EBD5080 with an adapter board for TOSA modules.

The dimensions of the EBD5000 and of the EBAs are 70 mm (L) x 55 mm (W), respectively. The dimensions of the EBD50y0 assembly are therefore 140 mm (L) x 55 mm (W). The driver board assembly is mounted on metal stands (typically 30 mm) such that heat sinks below the EBA can be mounted, for example for BTF or TOSA modules.

The metal case of the SLED module is, except for the EBD5010, connected to pin1 of JP1, which shall be connected to protective earth (PE).

The EBA adapter boards do not require a separate external power supply unit but receive the supply voltage through the EBD5000 driver board.

5 DISPLAY BOARD (DIB)

The display board of the EBD5000 series features a 2-line illuminated alphanumeric display that is operated by a microcontroller, two control buttons (up/down) and a serial UART interface for data logging through an external PC. The DIB is powered by the 5V supply voltage of the EBD5000 driver board that is provided through the JP2 connector.

During the power-up of the DIB the display shows the firmware version for one second. After this boot screen the DIB displays the SLED drive current (mode 1), as shown in Fig. 7. The lower button allows for incrementing the display mode by one, the upper button allows for decrementing the display mode by one. The supported modes are:

- mode 1 = SLED drive current (Fig. 7)
- mode 2 = SLED forward voltage (Fig. 8)
- mode 3 = SLED temperature (Fig. 9)
- mode 4 = TEC current (Fig. 10)
- mode 0 = all four parameters displayed at the same time (Fig. 11)

Repeated pressing of either the up or down button will cycle through all modes, i.e. incrementing the mode 4 by one will result in mode 0 and decrementing mode 0 by one will result in mode 4.

Fig. 7 Display-Board DIB5000 in default display mode 1 (SLED drive current)

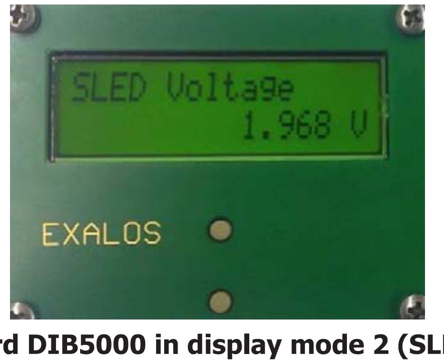

Fig. 8 Display-Board DIB5000 in display mode 2 (SLED forward voltage)

Fig. 9 Display-Board DIB5000 in display mode 3 (SLED temperature)

Fig. 10 Display-Board DIB5000 in display mode 4 (TEC current)

Fig. 11 Display-Board DIB5000 in display mode 0 (all four parameters)

As mentioned above, the DIB also features an UART interface at which the current four parameter readings are transmitted at a rate of 10 Hz. Using an UART-to-RS-232 adapter the DIB can be connected to a serial port of a PC for data monitoring or data logging. EXALOS can provide, upon request, software tools that read out and display these signals.

6 OPERATING INSTRUCTIONS

6.1 AMBIENT TEMPERATURE

Make sure the ambient operating temperature is within -20 °C to +65 °C, unless specified differently by EXALOS.

6.2 SUPPLY VOLTAGE

Make sure a stable supply voltage within 4.90 V to 5.20 V is applied with the correct polarity. Polarity inversion will not harm the SLED but might eventually result in damage of the on-board supply voltage filter network. For first testing it might be therefore useful to set the current limit to 1.5-2.0 A and monitor the LED0 indicator. The on-board 3A fuse has a current- and temperature-dependent pre-arcing time, i.e. lower current limits will result in longer pre-arcing times and hence more time for the user to react to accidental polarity inversion. The EBD5000 is not sensitive to noise of the supply voltage as it features various filter networks and ground decoupling stages as well as a spike and brown-out detector.

6.3 PROTECTIVE EARTH (PE)

Make sure to provide a low-impedance connection to protective earth in order to avoid unwanted and uncontrolled electro-static discharges (ESD). A PE connection shall be realized through a short cable connection at the power supply connector JP1 (pin 1).

6.4 TEMPERATURE CONTROLLER (TEC)

For the default configuration of code switch S1 and for SLED modules featuring a Peltier element, the TEC is working as soon as a supply voltage is applied to the board. The TEC is a high-performance switched-mode controller that is working at an internal frequency of 1 MHz. Depending on the ambient temperature it may take a few seconds after turn-on of the board for the TEC to stabilize the SLED temperature. During this stabilization period the TEC may operate the Peltier element at a maximum current of 1.8 A, resulting in a high supply current. It is recommended to enable the SLED only when the TEC is in a stable condition, indicated through the temperature alarm (LED4 and pin10 of JP3) being off.

6.5 ENABLING THE SLED

The SLED is enabled and the optical power is turned on either by applying a 5V signal to pin3 of JP3 (active-HIGH) or by turning the code switch S1, for example to '1'. When using an electronic enable signal, e.g., 5V TTL, make sure that the voltage is relative to the GNDext on pin4 of JP3. Enabling the SLED will first power up all OpAmps of the driver stage before the optical power is turned on after a built-in time delay. The turn-on sequence guarantees proper operation of the driver board even when the power supply is hot-plugged though the SLED was enabled. This means that the SLED can be enabled with the drive current being set to the maximum level, i.e. it is not necessary to ramp up the drive current manually. Furthermore, the driver board generates a current ramp of several milliseconds at turn-on to avoid optical power overshoots. The time delay for the turn-on depends on the SLED drive current. For zero drive current the SLED will not be enabled (infinite time delay) while for maximum drive current the SLED will be enabled fastest.

6.6 ADJUSTING THE DRIVE CURRENT

The SLED current level can be either manually adjusted through the potentiometer P1 using a screwdriver (turning the screw counterclockwise increases the drive current) or through an analog control signal (AIN, 0 to +2.5V) applied to pin15 and pin16 of JP3. When adjusting the current level electronically, make sure that the analog control is enabled (AINenable, pin13 of JP3) or that the code switch S1 is in a position that enables the analog control, for example position '2'. When using a signal for AINenable, e.g., 5V TTL, make sure that the voltage is relative to the GNDext on pin12 of JP3.

The analog input voltage is limited to 2.5V on the board to ensure safe operation. AIN voltages larger than 2.5V are clipped and an alarm signal is enabled (LED3 and pin9 of JP3).

6.7 ON-OFF MODULATION

The SLED current can be turned on and off with a TTL modulation signal through pin1 of JP3. The logic is inverted, i.e. an open connection at pin1 or 0V (LOW) leaves the SLED on (optical power is HIGH) while 5V at pin1 (HIGH) turns the SLED off (optical power is LOW). When using an active modulation signal, e.g., 5V TTL, make sure that the voltage is relative to the GNDext on pin4 of JP3. Fig. 12 shows the modulation behavior and modulation bandwidth of the EBD5000 driver board in its standard configuration. The maximum modulation frequency is specified in Table 7.

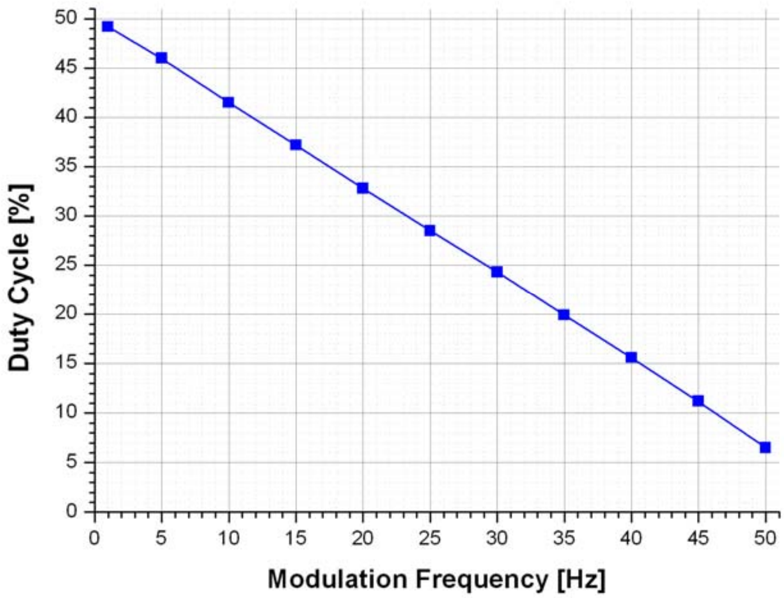

Fig. 12 Duty cycle of SLED current or optical output power for a TTL modulation input signal with 50% duty cycle as a function of modulation frequency for the standard configuration of the EBD5000. Because of the inverted logic of the modulation input this graphs also shows the required duty cycle of the electrical modulation input signal in order to achieve a 50% duty cycle for the optical output or SLED current.

Faster modulation frequencies may be realized upon request. However, faster current rise times can, in principle, lead to unwanted optical power transients if the rise time of the drive current is below ten microseconds. Therefore, EXALOS offers faster modulation rates only based on customer requests.

There is no intentional time delay or current ramp for the turn-on of the SLED under on-off modulation, different to the procedure of enabling the SLED. Turning off the SLED through pin1 of JP3 will also not power down the OpAmps of the driver stage.

6.8 ANALOG CURRENT MODULATION

The SLED current level and hence the optical power can be varied or modulated through pin15 and pin16 of JP3. The maximum modulation frequency is specified in Table 7. Faster modulation frequencies may be realized upon request.

6.9 OPEN-COLLECTOR OUTPUTS

Status and alarm indicators at JP3 are realized as open-collector outputs that are decoupled from the GND potentials of the EBD5000 driver board. According to Table 3, these digital outputs are "SLED_enabled" (pin7), "AIN_enabled" (pin8), "AIN_alarm" (pin9) and "TEC_alarm" (pin10). In order, for example, to illuminate an external LED in the presence of an alarm, a minimum load has to be considered to limit the current through the open-collector opto-couplers on the EBD5000 board, as shown in Fig. 13. Positive external voltages (+U) in the range of 3V to 28V are acceptable as long as the current does not exceed 20 mA. For example, for a voltage +U=5V a minimum load R of 250 Ohms would be required. The external voltage +U shall be relative to GNDext at pin11 or pin12 of JP3.

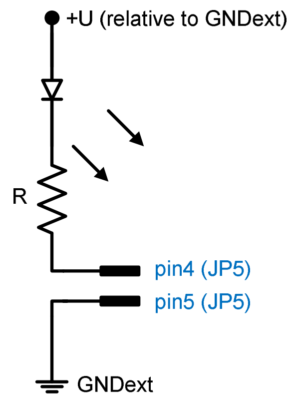

Fig. 13 Example of using an open-collector alarm output of JP3 to illuminate an external LED. The load R limits the current to max. 20 mA.

6.10 DISABLING THE SLED

In order to disable the SLED and hence the optical output apply 0V to pin3 of JP3 (active-HIGH). If the code switch S1 was previously used to enable the SLED then S1 may be switched back to the original position to disable the SLED while it is running, i.e. it is not required to turn down the drive current of the SLED before disabling it. When the SLED is disabled all OpAmps of the SLED driver stage are powered down as an additional safety feature. In case of loss of supply voltage before disabling it, the SLED is automatically and safely powered down.

6.11 HOT-PLUGGING THE SUPPLY VOLTAGE

As mentioned earlier the supply voltage of the EBD5000 can be hot-plugged while the SLED is enabled without harming the SLED. The SLED is safely powered up or powered down when the supply voltage is hot-plugged.

6.12 WARM-UP TIME

As any other electronics the EBD5000 has a warm-up time until, for example, the current drift during the turn-on phase is minimized. Typical warm-up time at 20 °C ambient temperature is 20 minutes.

6.13 TEMPERATURE ALARM

In case of a permanent temperature alarm for more than 30 seconds, the drive current is automatically disabled in order to protect the SLED. This may happen if the heat sinking of the optical module is insufficient or if the ambient temperature is exceeding the specified operating range, or if otherwise the TEC is unable to control the SLED temperature.

7 REVISION HISTORY

Revision History				
Rev.	**Description**	**ECN Number**	**Date (ECN)**	**Released**
0.1	Initial document for EBD5000	-	-	06.01.2010
1.0	First full specification release	-	-	13.12.2010
1.1	Added information on protective earth connection in section 6 and on input/output connectors in section 3.2; renamed "Temperature_alarm" in "TEC_alarm"	0499	29.02.2012	29.02.2012
1.2	Updated information on user interface connector due to new driver board version V3 of EBD5000 with 16-pin connector JP3 instead of JP4 and JP5	0515	13.04.2012	13.04.2012
1.3	Updated Fig.1 and Fig.2 due to new driver board version V3.1 of EBD5000; added section 6.13 about temperature alarm shut-off	0526	24.05.2012	24.05.2012