LB 6770

Technical Information

63038TI
Rev. No.: 00, 07/2018

FracSENS LB 6770 Detector

Densitometer for Hydraulic Fracturing and Cementing Applications

The FracSENS LB 6770 densitometer is specifically developed for the harsh environments that are typical for hydraulic fracturing and cementing.

- State-of-the-art SiPM technology instead of Vacuum PMT
- Best repeatability and temperature stability on the market ≤ 0.2% over 100°C temperature regime
- Rugged design ensures long availability (tested according to subsea standard ISO 13628-6)
- High sensitive scintillation technology
- Various output options available (0/4…20mA, 0…10V, pulses, Modbus)
- Condensed to lowest energy consumption
- Short response time
- Adjustable thresholds for individual selection of energy spectrum
- Configurable via the LB 47x evaluation unit or via the service modem

Technical Data

NOTICE / HINWEIS

The detector FracSENS LB 6770 is not explosion protected and is not designed for hazardous environments

Mechanical Design	
Housing	Stainless Steel 1.4301 (304)
Scintillator	NaI-crystal; Ø 40 mm, H: 50 mm
Gain	Semi-conductor based
Operating Temp.	-40…+60°C (-40…140°F) ambient temperature
Storage Temp.	-40…+70°C (-40…158°F)
IP class	IP 66
Connection	Amphenol PT02 E10-6P
Weight	Approx. 3 kg
Altitude	Max. 5000 m above sea level
Humidity	Max. 99%
Environment	The device is designed for wet environments

Electrical Design	
Power	15…28 V ⎓ (+-10% supply tolerance) 2.6 W
Output Signals	Output signal proportional to count rate or logarithmic count rate. 0…10 V output 0/4…20 mA output (max. 400 Ohm)
Cable	6 wires, 1.5 mm², shielded
Communication	RS 485 – Modbus RTU (Baud Rate: 9600, 19200, 38400, 57600. Default Value: 19200). Max. Output 3,3 V, 250 mA. Detector Temperature, Actual High Voltage and setting (Auto, Fixed), All measurement thresholds, see and acknowledge detector errors and warnings, internal damping time constant, Modbus address, part no., HW and SW version, serial number.

Performance	
Internal Cycle Time	100 ms
Damping	0.1 … 99 s
Stability	At constant count rate ≤ 0.1% (≤0.002 % / °C), over complete temperature regime

Approvals	▪ Environmental test conditions acc. to ISO 13628-6 (subsea standard) concerning temperature, vibration and shock. ▪ CE certification ▪ UL/CSA certification (cNEMCOus)

Supported Modbus Function Codes

Command	Codes
Read Coils	01
Read Holding Registers	03
Read Input Registers	04
Write Single Coil	05
Write Single Register	06
Diagnostics	08 / 0, 11, 12, 13, 14, 15, 16, 17, 18
Write Multiple Registers	16

Modbus Communication Settings

Command	Codes
Automatic Baudrate Detection	No
Supported Baudrates	9600, 19200, 38400, 57600
Parity Mode	None, Even, Odd
Stop Bits	1 – 2
Modbus slave addressing range	1 – 247

Parameter List

Coil	Adress	Description	Value
Reboot	0	If set to 1, the device will be rebooted. Afterwards returns this value back to 0.	0 = OFF 1 = ON
Reset	*1*	If set to 1, all device's parameters will be set to their defaults values. Device restarts and this value will be set to 0 again.	0 = OFF 1 = ON
Reserved	2		
Reserved	3		
Voltage Loop Monitoring	4	Activates/deactivates monitoring of voltage loop.	0 = OFF **1 = ON**
Voltage Loop Error Mode	5	„Error Voltage"selection.	0 = 0 V 1 = 10 V
Voltage Loop Test Mode	6	Activates/deactivates test mode of voltage loop. If activated, the "Test Voltage" is output. (Reboot deactivates test mode automatically).	**0 = OFF** 1 = ON
Current Loop Monitoring	7	Activates/deactivates monitoring of current loop.	0 = OFF **1 = ON**
Current Loop Error Mode	8	„Error Current" selection.	**0 = 22 mA** 1 = 2 mA
Current Loop Test Mode	9	Activates/deactivates test mode of current loop. If activated, the "Test Current" is output. (Reboot deactivates test mode automatically).	**0 = OFF** 1 = ON
Reserved	10-12		

Input Register	Adress	Reg.Size	Type	Description	Value
V_{bias} Actual	0	2	Float	Actual calculated V_{bias} value	
Min. Temperature	2	2	Float	Minimal measured electronic temperature	
Max. Temperature	4	2	Float	Maximal measured electronic temperature	
Temperature	6	2	Float	Actual measured electronic temperature	

Input Register	Adress	Reg.Size	Type	Description	Value
Measurement Cps	8	2	Float	Pulses counted and averaged in measurement channel. (Used for detector controlling)	
Control Cps	10	2	Float	Pulses counted and averaged in control channel. (Used for detector controlling)	
Auxiliary Cps	12	2	Float	Pulses counted and averaged in auxiliary channel. (Used for detector controlling)	
Live Cps	14	2	Float	Pulses counted in measured channel. (Used for application)	
Average Cps	16	2	Float	Averaged „Live Cps“	
Stop Bits	18	1	Int	Number of stop bits for Modbus communication..	1 - **2**
Event Date	19	2	Int	Date of occurrence of actual indexed event entry in event log. (Number of days since last known date / device restart)	0
Event Time	21	2	Int	Time of occurrence of actual indexed event entry in event log.	0
Event Priority	23	8	ASCII	Priority of actual indexed event entry in event log. (NAMUR NE-107)	No Event
Event Description	31	16	ASCII	Description of actual indexed event entry in event log.	No Event
Plateau V_{bias}	47	2	Float	V_{bias} of actual indexed plateau entry in plateau table.	
Plateau Cps	49	2	Float	Pulse Rate of actual indexed plateau entry in plateau table.	
Application Name	51	8	ASCII	Application’s name.	

Application Version	59	4	ASCII	Application's version number.	[xx.xx.xx]
Application Date	63	4	ASCII	Application's date.	[mm.tt.yy]
Unique Id.	67	2	Int	Device's unique identification number.	

Input Register	Adress	Reg.Size	Type	Description	Value
Voltage Loop State	69	1	Short	Actual state of Voltage Loop state machine. (Reboot deactivates test mode automatically).	0 = NORMAL 1 = TEST 2 = CHECK HIGH 3 = CHECK LOW 4 = ERR. HIGH 5 = ERR. LOW 6 = ERR. LOW OFF
Actual Voltage	70	2	Float	Calculated voltage to output.	0 - 10 V
Error Voltage	72	2	Float	Voltage outputted if failure is detected.	0 | 10 V
Feedback Voltage	74	2	Float	Actual measured output voltage.	0 – 10 V
Current Loop State	76	1	Short	Actual state of Current Loop state machine. (Reboot deactivates test mode automatically).	0 = NORMAL 1 = TEST 2 = CHECK HIGH 3 = CHECK LOW 4 = ERR HIGH 5 = ERR LOW 6 = ERR LOW OFF
Actual Current	77	2	Float	Calculated current to output.	4 - 20 mA
Error Current	79	2	Float	Current outputted if failure is detected.	2 | 22 mA
Feedback Current	81	2	Float	Actual measured output current	2 - 22 mA
Reserved	83-89	7	-		

Holding Register:	Adress	Reg.Size	Type	Description	Value
Reserved	0	1	-		
Detector Work Mode	1	1	Short	HV controlling method	0 = AUTO 1 = MANUAL 2 = PLATEAU
Vbias Default	2	2	Float	Start V_{bias} if AUTO	60 - 80 V
Vbias Manual	4	2	Float	Fixed V_{bias} if MANUAL	60 - 80 V
Reserved	6-11	6	-		
Application Work Mode	12	1	Short	Application's work mode. (Reboot deactivates test mode automatically).	0 = NORMAL 1 = TEST

Holding Register:	Adress	Reg.Size	Type	Description	Value
Lower Range	13	2	Float	Pulse Rate related to lower range of voltage/current output	
Upper Range	15	2	Float	Pulse Rate related to upper range of voltage/current output	
Test Cps	17	2	Float	Pulse Rate used if application's work mode is test.	
Time Constant	19	2	Float	Time constant used for averaging of „Live Cps" if application's work mode is normal	**0.1 s**
Communication Work Mode	21	1	Short	Communication selector	0 – MODBUS initial 1 – MODBUS temp. **2 – MODBUS fixed** 3 – EROA temp.
Modbus Id.	22	1	Short	Modbus slave address	**1** - 247
Baudrate	23	2	Int	Baudrate *Baudrate*	9600 **19200** 38400 56700
Parity	25	1	Short	Parity *Parität*	0 = None 4 = Odd **12 = Even**
Event Index	26	1	Short	Index of event entry in event log.	**0 = Aktuelles Ereignis**
Event Code	27	1	Short	Code of actual indexed event entry in event log. (Writing to this value causes acknowledge of event).	

Plateau Start	28	2	Float	V_{bias} voltage used as start point for plateau recording	**60** - Plateau Stop

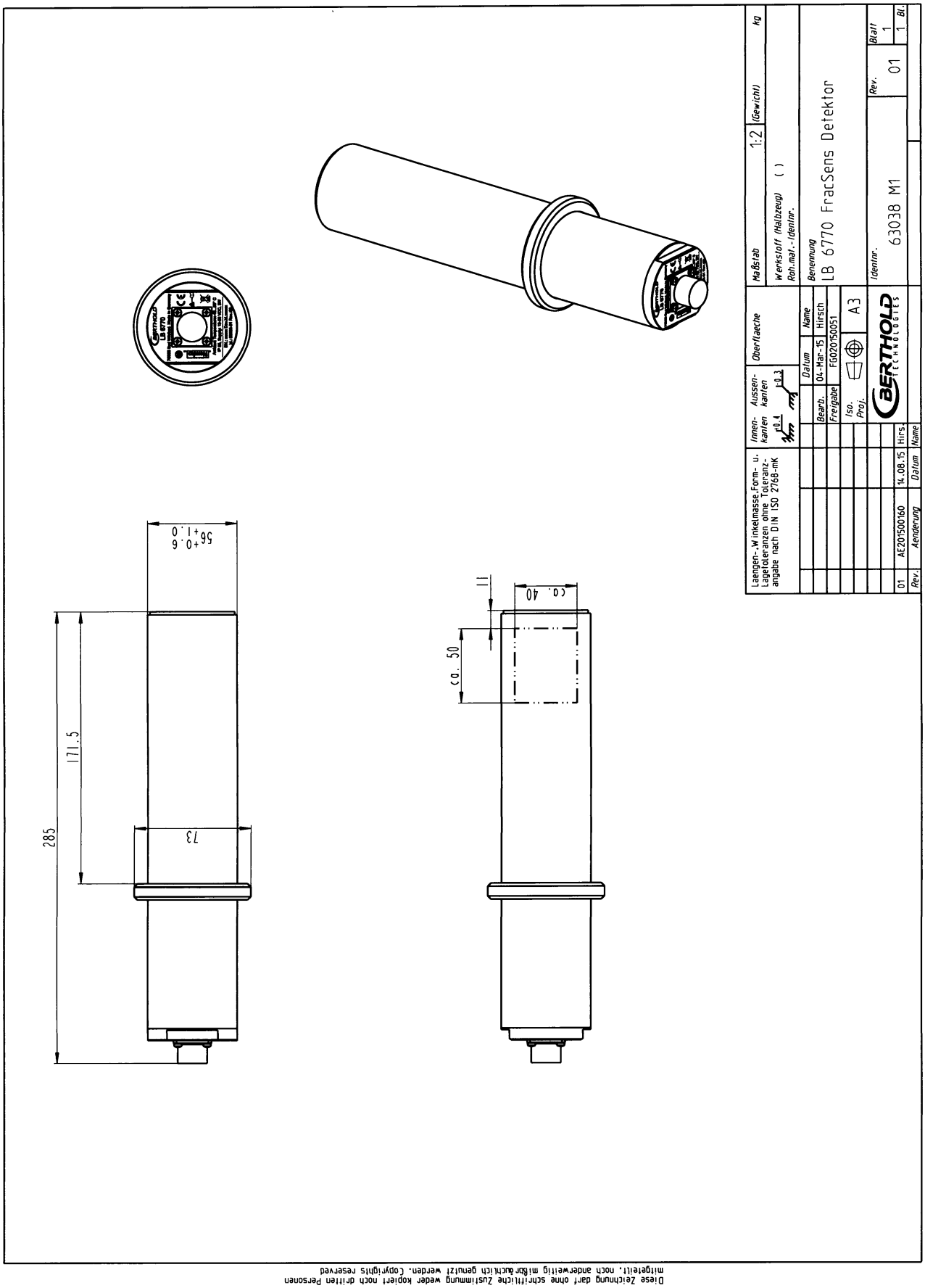
Holding Register:	Adress	**Reg.Size**	Type	Description	Value
Lower Range (Current Loop)	51	2	Float	Extension of output current range according to NAMUR NE-43. *Wertebereich der Ausgangsspannungs gemäß NAMUR NE-43.*	**3,8** - 4.0 mA
Upper Range (Current Loop)	53	2	Float	Extension of output current range according to NAMUR NE-43. *Wertebereich der Ausgangsspannungs gemäß to NAMUR NE-43.*	20,0 - **20.5** mA
Reserved	55	2	-		
Cps Output Function	57	1	Short	Function transfers application's result to output signall	**0** = Linear 1 = Exponential
Reserved	58	1	-		

Holding Register:	Adress	**Reg.Size**	Type	Description	Value
Plateau Stop	30	2	Float	V_{bias} voltage used as stop point for plateau recording	Plateau Start - **80**
Plateau Step	32	2	Float	Voltage use to increment V_{bias} during plateau recording	
Plateau Time	34	2	Float	Time used for cps averaging during plateau recording	
Plateau Index	36	1	Short	Index of plateau entry in plateau table.	**0** – 40
Test Voltage	37	2	Float	Voltage outputted if test state of Voltage Loop state machine is activated	**0 V**
Lower Cal. Point (Voltage Loop)	39	2	Float	Value measured with external voltmeter and usually used for offset calibration of voltage loop.	**0 V**
Upper Cal. Point (Voltage Loop)	41	2	Float	Value measured with external voltmeter and usually used for gain calibration of voltage loop	**0 V**
Calibration Type (Voltage Loop)	43	1	Short	Voltage Loop calibration. After calibration, the value returns back to 0 again	**0 = Idle** 1 = Offset 2 = Gain

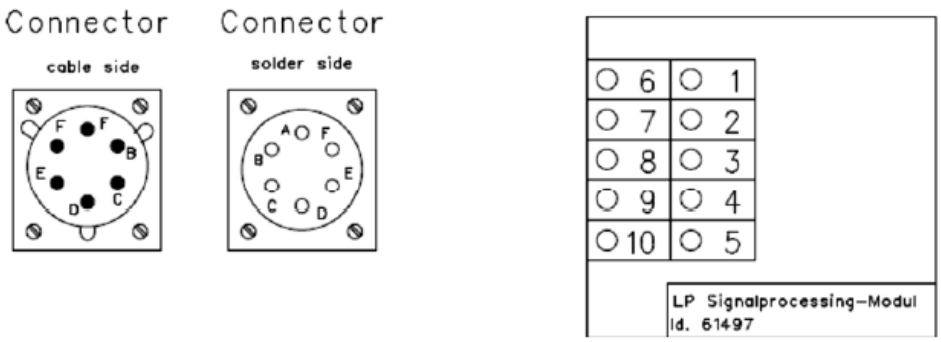
Test Current	44	2	Float	Current outputted if test state of Current Loop state machine is activated	**4 mA** 2 – 23.9 mA
Lower Cal. Point (Current Loop)	46	2	Float	Value measured with external ampermeter and usually used for offset calibration of current loop.	**0 mA**
Upper Cal. Point (Current Loop)	48	2	Float	Value measured with external ampermeter and usually used for gain calibration of current loop.	**0 mA**
Calibration Type (Current Loop)	50	1	Short	Current Loop calibration. After calibration, the value returns back to 0 again.	**0 = Idle** 1 = Offset 2 = Gain

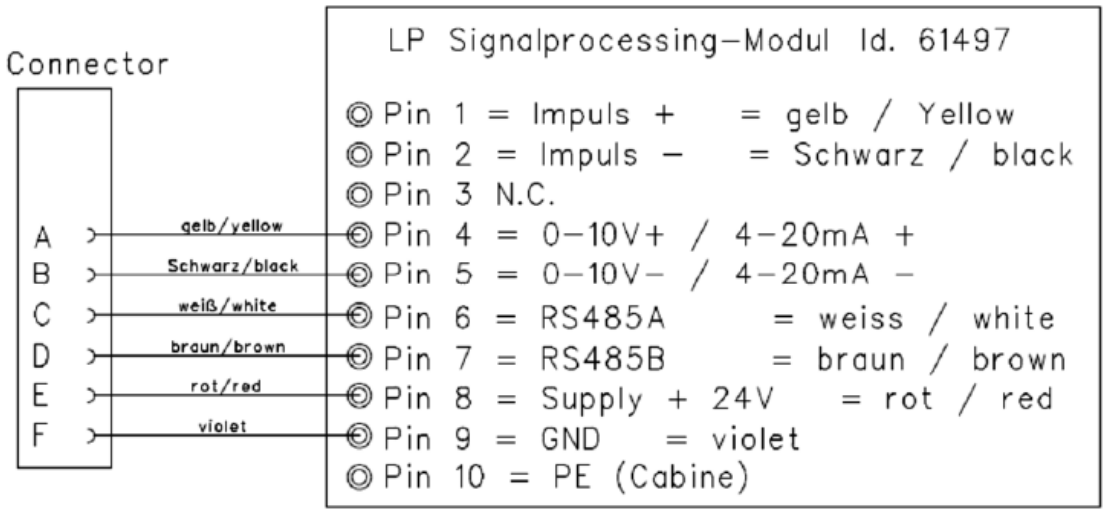
Holding Register:	Adress	**Reg.Size**	Type	Description	Value
Lower Range (Current Loop)	51	2	Float	Extension of output current range according to NAMUR NE-43	**3.8** - 4.0 mA
Upper Range (Current Loop)	53	2	Float	Extension of output current range according to NAMUR NE-43	20.0 - **20.5** mA
Reserved	55	2	-		
Cps Output Function	57	1	Short	Function transfers application's result to output signal	**0** = Linear 1 = Exponential
Reserved	58	1	-		

Drawing



Connection plan





Declaration of Conformity

BERTHOLD TECHNOLOGIES GmbH & Co. KG
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Fax +49 7081 177-100
info@Berthold.com
www.Berthold.com

EU-Declaration of Conformity

We, hereby declare under our sole responsibility that the design of the following products / systems / units brought into circulation by us comply with the relevant harmonized rules of the EU.

This declaration loses its validity should modifications or unsuitable and improper use take place without our authorisation.

Description: ***detector for radiometrical measurement system***

Typ: ***LB 6760 / LB6770***

	directive	applied standards	
EMC	2014/30/EU	EN 61326-1	2013
		EN 55011	2011
		EN 61000-4-2	2009
		EN 61000-4-3	2010
		EN 61000-4-4	2010
		EN 61000-4-5	2006
		EN 61000-4-6	2009
		Namur NE 21	
RoHS	2011/65/EG		

This declaration is issued by the manufacturer

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22, D-75323 Bad Wildbad, Germany

released by

Dr. J. Briggmann

Head of R&D
Bad Wildbad, 04th of November, 2015

NRTL Certificate

Nemko

Certificate of Compliance

Nemko-CCL, Inc.

Certificate: NA201610546 **Date Issued:** March 7, 2016

Project: 289999-5.1

Issued to: Berthold Technologies GmbH & Co. KG
Calmbacher Straße 22
75323 Bad Wildbad
Germany

The products listed below have been certified as being compliant with all applicable requirements of the specifications listed and are eligible to bear the following certification mark

c Nemko US

Issued by: Robert Keller, Senior Engineer/Safety Supervisor

Authorized by: Thomas Jackson, Certification Manager

PRODUCTS

MEASUREMENT, CONTROL, OR LABORATORY EQUIPMENT – Certified to US and Canada Standards

Product: Radiometric density measurement device
Model: LB 6770-1I-Z0-.1-01-11(Where the character "." can be "A" or "B")
Ratings: 2.6W, 15-28V d.c., for building in

APPLICABLE REQUIREMENTS

UL Std. No. 61010-1 3rd Edition - Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements

CAN/CSA-C22.2 No. 61010-1-12 Third Edition – Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use – Part 1: General Requirements

This certificate is issued on condition that the holder complies and will continue to comply with the requirements of the above mentioned specifications and pursuant to the terms and conditions specified in the Certification Agreement.

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

Nemko-CCL, Inc. 1940 West Alexander Street Salt Lake City, Utah 84119-2039 Tel (801) 972-6146 Fax (801) 972-8432

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Supplement to Certificate of Compliance

Certificate: **NA201610546** **Project: 289999-5.1**

Nemko-CCL grants a license to the applicant to apply the Certification Mark to the certified products and that the mark shall only be affixed at the following factory locations

Factory Information

Factory Name	Location
Berthold Technologies GmbH & Co. KG	Calmbacher Straβe 22 75323 Bad Wildbad Germany

The products listed, including the latest revision described below, are eligible to be marked in accordance with the referenced Certificate.

Product Certification History

Project	Date	Description
289999-5.1	March 7, 2016	**Original Certification: Model:** LB 6770-1I-Z0-.1-01-11(Where the character "." can be "A" or "B") **Ratings:** 2.6W, 15-28V d.c., for building in

This Supplement forms an integral part of the Certificate of Compliance

The certification system, as described in ISO/IEC Guide 67 (Conformity Assessment – Fundamentals of Product Certification), most closely resembles System 3

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