Communication Protocol – LDD-1321

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1 General Description

This document mainly describes the proprietary MeCom Protocol. Details about each parameter can be found in this document and in the User Manual.

1.1 Protocol Specifications

- General serial interface specifications: 8 data bits; no parity; 1 stop bit; no handshaking.
- The communication protocol used is based on the “MeCom Protocol Specification 5117x” document.
- Our demo applications and APIs can help you implement this specification. Please also check the example communication strings at the end of this document.
    - The **MeComAPI** (with demo application) shows the full implementation of this protocol for C and C++ applications. Tested on Windows, Linux, and microcontrollers.
    - The **MeComAPI for .NET** (with demo application) is a C# based library that enables communication over RS232/RS485, direct FTDI driver access or Ethernet.
    - The **MeCom Command Tool** is a web app to easily generate MeCom command strings.
    - We also provide **Python** and **LabVIEW** examples. These are not directly compatible with the LDD-1321 as they feature parameters of other devices, but they feature the same communication protocol.

1.2 Addressing

The package format contains an address field, to address up to 254 devices on the same bus. The device reacts in the following cases:

- The device receives a package that matches to the user configurable device address.
    - The device address can be configured and is nonvolatile.
    - An offset can be added to the configured address by using the GPIO pins. This allows the user to have the same configuration on more than one device on a bus. The individual address is then set by hardware-bridged pins on the GPIO pins.
- The device receives a package with the address 0 (broadcast).
- The device receives a package with the address 255. Similar to 0, but the device does not send an answer back to the host. This can for example be used to change the serial speed on all devices connected to the bus.

1.3 Connecting Service Software

- By default, the Service Software always sends to each FTDI USB interface the “?IF” command with 57600 Baud and checks if it gets the correct answer.
- If an answer has been received, then it checks the firmware version.
- If the firmware version matches, then it uses the CS (Change Speed) command to temporarily change the speed from 57600 to 1M Baud. Please have a look at the 2 tables on the next page.
- Using the factory default settings, it is possible to connect the Service Software on each interface (USB, RS232 TTL, RS485).
- If the Base Baud Rate has been changed to a different value, it is possible to change the Service Software behavior by passing some additional startup parameters. It is recommended to create a shortcut to the .exe file and then modify the shortcut parameters. Startup parameters:
    - Service_LDD-1321.exe /LoSpeed 115200
      Sets the initial speed to a certain Baud Rate. The default value is 57600.
    - Service_ LDD-1321.exe /HiSpeed 921600
      Sets the high-speed value to a certain Baud Rate. The default value is 1000000.
    - Service_ LDD-1321.exe /Speed 115200:
      Changes both the LoSpeed and the HiSpeed to a certain Baud Rate.
    - Service_ LDD-1321.exe /IP 192.168.1.191 /DevAddr 3
      Sets the Mode to Ethernet and uses the given IP Address and Device Address to connect.
- To use RS485 we recommend the following interface cable:
  http://www.ftdichip.com/Products/Cables/USBRS485.htm
- To use RS232 TTL we recommend the 3.3V versions of the following interface cable:
  http://www.ftdichip.com/Products/Cables/USBTTLSerial.htm

1.4 Interfaces, Baud Rate

The following table shows the available interfaces for the different products. All interfaces support the same commands. It is also possible to use several interfaces simultaneously, for example one interface to connect the Service Software and a second one to connect a custom application.

	LDD-1321
Interface 1	USB UART MODE 3
Interface 2	RS485 Channel 1 UART MODE 2
Interface 3	RS232 Channel 2 UART MODE 2

UART Modes

	Primary Base Baud Rate	**Secondary Baud Rate**	**Description**
UART MODE 1	Fixed to 57600	None	Fixed to 57600 but can temporarily be changed with the CS command to a different value. Falls back to 57600 if no data has been received for more than 5 s. Always compatible with the Service Software.
UART MODE 2	Configurable	None	Configurable Primary Base Baud Rate but can temporarily be changed with the CS command to a different value. Falls back to Primary Base Baud Rate if no data has been received for more than 5 s. Compatible with the Service Software only when the Primary Base Baud Rate is set to 57600 or Startup Parameters are used.
UART MODE 3	Configurable	57600	Configurable Primary Base Baud Rate but can temporarily be changed with the CS command to a different value. Falls back to Primary Base Baud Rate if no data has been received for more than 5 s. A secondary UART is always listening on this interface with 57600 and therefore it is always compatible with the Service Software.

1.5 Flash Parameters (non-volatile) / RAM Parameters (volatile)

This device does not save any parameters automatically to the flash (nonvolatile memory). If the parameters should be saved to the nonvolatile memory, then send the “Save Parameter to Flash” command. This command is described in the Document “MeCom Protocol Specification 5117”.

For compatibility with older host applications, there can be some RAM parameters available. These parameters are never be saved to flash. We do not recommend using the parameters anymore.

The Service Software automatically sends the save command after clicking “Write Config”.

The flash can only be re written about 100'000 times. Therefore, we recommend not sending the “Save Parameter to Flash” command periodically to the device but only as needed by the application.

2 LDD-1321 Commands

2.1 Set Commands

Only the device-specific commands are listed here. The standard device-agnostic commands (like reset and value set) are specified in the document 5117.

Command	Mnemonic	Arguments			
		Type	Min	Max	Description
Change Speed	CS	INT32	4800	1M	Changes the speed of the communication interface where this command was received. If no communication is detected on the interface for more than 5s, the speed is changed back to the Base Baud Rate. The address is ignored when detecting communication on the interface, just a valid package frame is necessary.

2.2 Query Commands

Only the device-specific commands are listed here. The standard commands are specified in document 5117.

The firmware identification string of LDD-1321 devices is: "8157-LDD-AN-LIN G01" (20 chars).

Request	Mnemonic	Description	Server Response	
			Type	**Description**
Bootloader Control	?BC	Control the bootloader	UINT32	See 4 Bootloader for details
Bootloader Stream	?BS	Bootloader data stream		See 4 Bootloader for details
Settings Download	?SD	Can be used to load the exported Settings Dump (*.mepar) of the Service Software.		
		One line of the settings dump File (*.mepar)	UINT4	0: Parameter accepted 1: CRC incorrect. Possible causes: The *.mepar file has been modified The firmware version is not exactly the same as it was while the *.mepar file has been created The *.mepar file was created for another device.

3 Service Software Parameters

3.1 Payload Format Description

See document 5117 for more information about the MeCom protocol.

The parameter instance is used to control multiple instances of the same feature, if available on a device. If a feature is present only once, it will be controlled through instance 1. For example, the LDD-1321 has a single current drive channel, so the target current only has one instance.

3.2 Parameter List

3.2.1 Common Product Parameters

3.2.1.1 LDD Device Identification and Common Parameters

ID	Name	Format	Unit/Range	Description
100	Device Type	INT32		E.g. 1321 → LDD-1321
101	Hardware Version	INT32		E.g. 123 → 1.23
102	Serial Number	INT32		
103	Firmware Version	INT32		E.g. 123 → 1.23
104	Device Status	INT32		0: Init 1: Ready 2: Run 3: Error 4: Bootloader 5: Device will reset within next 200 ms
105	Error Number	INT32		
106	Error Instance	INT32		
107	Error Parameter	INT32		
109	Parameter System: Flash Status	INT32		0: all parameters are saved to Flash 1: save to flash pending or in progress (please do not power off the device during this process).
110	Error Text	LATIN1		Use the ?VB command to query the error text.
111	Device Reset	INT32	0 … 1	Write 1 to this parameter, to trigger a reset.
112	Firmware Version	FLOAT32		Same as parameter 103, but as float. Round it to two decimal places.

Hint: parameters 100-999 are read-only.

3.2.1.2 TEC Driver Hardware Info

These parameters read 0 if no or no compatible TEC-Controller is detected.

ID	Name	Format	Unit/Range	Description
120	Device Type	INT32		E.g. 1191 → PWR-1191
121	Hardware Version	INT32		E.g. 123 → 1.23
122	Serial Number	INT32		
123	Maximum Current	FLOAT32	A	Maximum Output Current of TEC Controller

3.2.2 Tab: Monitor (read-only)

3.2.2.1 LDD Output Monitoring

ID	Name	Format	Unit/Range	Description
1100	Actual Output Current	FLOAT32	A	
1101	Actual Output Voltage	FLOAT32	V	
1102	Actual Output Current Raw ADC Value	INT32		
1106	Nominal Anode Voltage	FLOAT32	V	
1104	Actual Anode Voltage	FLOAT32	V	
1105	Actual Cathode Voltage	FLOAT32	V	

3.2.2.2 LDD Internal Parameters

ID	Name	Format	Unit/Range	Description
1402	Nominal Output Current (Ramp)	FLOAT32	A	
1404	Gate Voltage	FLOAT32	V	
1103	Raw DAC Value	INT32		

3.2.2.3 Temperature Control

ID	Name	Format	Unit/Range	Description
1010	Target Object Temperature	FLOAT32	°C	
1011	(Ramp) Nominal Object Temperature	FLOAT32	°C	
1012	Thermal Power Model Current	FLOAT32	A	

3.2.2.4 TEC Driver Output Monitoring

ID	Name	Format	Unit/Range	Description
1020	Actual Output Current	FLOAT32	A	
1021	Actual Output Voltage	FLOAT32	V	

3.2.2.5 Temperature Control Actual Temperatures

ID	Name	Format	Unit/Range	Description
1000	Object Temperature	FLOAT32	°C	
1001	Sink Temperature	FLOAT32	°C	

3.2.2.6 Temperature Controller PID Status

ID	Name	Format	Unit/Range	Description
1030	PID Lower Limitation	FLOAT32	%	
1031	PID Upper Limitation	FLOAT32	%	
1032	PID Control Variable	FLOAT32	%	

Temperature stability indicator (color):

ID	Name	Format	Unit/Range	Description
1050	Temperature is Stable	INT32	0 … 2	Temperature control is 0: not active 1: not stable 2: stable

3.2.2.7 External Temperature Measurement x

ID	Name	Format	Unit/Range	Description
1200	Temperature	FLOAT32	°C	
1201	Resistance	FLOAT32	Ω	
1202	Raw ADC Value	FLOAT32		

3.2.2.8 Analog Interfaces

ID	Name	Format	Unit/Range	Description
1502	Analog Voltage Input Raw ADC Value	INT32		
1500	Analog Voltage Input	FLOAT32	V	
1501	Photodiode Input	FLOAT32	mA	

3.2.2.9 Light Measurement

ID	Name	Format	Unit/Range	Description
1600	Laser Power	FLOAT32	W	

3.2.2.10 Fan Controller x

ID	Name	Format	Unit/Range	Description
1210	Relative Cooling Power	FLOAT32	%	
1212	Actual Fan Speed	FLOAT32	rpm	

Not visible in Service Software:

ID	Name	Format	Unit/Range	Description
1211	Fan Nominal Speed	FLOAT32		
1213	Actual Fan PWM Level	FLOAT32		

3.2.2.11 Firmware and Hardware Versions

ID	Name	Format	Value Range	Description
1051	Firmware Build Number	INT32		
1054	Min Version for Firmware Downgrade	INT32		123 → 1.23

3.2.2.12 Power Supplies and Temperature

ID	Name	Format	Unit/Range	Description
1060	Driver Input Voltage	FLOAT32	V	
1061	8V Internal Supply	FLOAT32	V	
1062	5V Internal Supply	FLOAT32	V	
1063	3.3V Internal Supply	FLOAT32	V	
1064	−3.3V Internal Supply	FLOAT32	V	
1065	Device Temperature	FLOAT32	°C	
1066	Powerstage Temperature	FLOAT32	°C	Instance 1: LD Driver Temperature Instance 2: TEC Controller Temperature

3.2.3 Tab: Operation

3.2.3.1 LDD Input Source Selection

ID	Name	Format	Unit/Range	Description
2100	Output Enable	INT32		0: Static OFF 1: Static ON 2: Volatile 3: GPIO
2101	Nominal Output Current	INT32		0: Set Current 1: Volatile 2: Analog Input 3: LPC

3.2.3.2 LDD Nominal Output Current Values

ID	Name	Format	Unit/Range	Description
2102	Set Current	FLOAT32	A	Non-volatile parameter for setting the current.

3.2.3.3 LDD Current Control Settings

ID	Name	Format	Unit/Range	Description
2113	Slope Limit	FLOAT32	A/s	

3.2.3.4 LDD Anode Voltage Settings

ID	Name	Format	Unit/Range	Description
2130	Supply Enable	INT32		0: Static OFF 1: Static ON
2131	Laser Forward Voltage	FLOAT32		
2132	Laser Diff. Resistance	FLOAT32		

3.2.3.5 LDD Output Stage Limits

ID	Name	Format	Unit/Range	Description
2122	Max Nominal Current	FLOAT32	A	
2123	Min Nominal Current	FLOAT32	A	
2120	Current Error Threshold	FLOAT32	A	
2121	Voltage Error Threshold	FLOAT32	V	

3.2.3.6 TEC Output Stage Input Selection

ID	Name	Format	Unit/Range	Description
2010	Input Selection	INT32	0 … 1	0: Static Current/Voltage (uses parameter 2020) 1: Temperature Controller

3.2.3.7 TEC Output Stage Enable

ID	Name	Format	Unit/Range	Description
2000	Output Enable	INT32	0 … 2	0: Static OFF 1: Static ON 2: HW Enable (check GPIO config)

3.2.3.8 TEC Output Stage 'Static Current/Voltage' Control Values

ID	Name	Format	Unit/Range	Description
2020	Set Current	FLOAT32	−4 … 4 A	
2021	Set Voltage	FLOAT32	0 … 21 V	

3.2.3.9 TEC Output Stage Limits

ID	Name	Format	Unit/Range	Description
2030	Current Limitation	FLOAT32	See parameter ID 2020	
2031	Voltage Limitation	FLOAT32	See parameter ID 2021	
2032	Current Error Threshold	FLOAT32	0 … 5.6 A	
2033	Voltage Error Threshold	FLOAT32	0 … 24 V	

3.2.3.10 Communication Device Address

ID	Name	Format	Unit/Range	Description
2051	Device Address	INT32	0 … 254	

3.2.3.11 Communication UART Interface Settings

ID	Name	Format	Unit/Range	Description
2050	Base Baud Rate	INT32	4800 … 1M	Instance 1 = Interface 1 etc.
2052	Response Delay	INT32	0 … 1E6 µs	Instance 1 = Interface 1 etc.

3.2.3.12 Communication Watchdog

ID	Name	Format	Unit/Range	Description
2060	Timeout	FLOAT32	0.1 … 600 s	0: Disable the watchdog

3.2.3.13 CANopen Interface

ID	Name	Format	Unit/Range	Description
2070	Node ID	INT32	1 … 127	
2071	Bit Rate	INT32	10 … 1000 kbit/s	
2072	CAN1	INT32	0 … 1	0: CAN1 Disabled 1: CAN1 Enabled

3.2.4 Tab: Light Power Control

3.2.4.1 Nominal Output Power Values

ID	Name	Format	Unit/Range	Description
3100	Nominal Output Power	INT32	0 … 1	0: use flash parameter 1: use volatile parameter
3101	Set Power (flash)	FLOAT32	W	
50022	Set Power (volatile)	FLOAT32	W	

3.2.4.2 Power Controller PID Values

ID	Name	Format	Unit/Range	Description
3110	Kp	FLOAT32	A/W	
3111	Ti	FLOAT32	s	
3112	Td	FLOAT32	s	
3113	Slope Limit	FLOAT32	W/s	

3.2.4.3 Output Stage Limits

ID	Name	Format	Unit/Range	Description
3121	Max Nominal Power	FLOAT32	W	
3122	Min Nominal Power	FLOAT32	W	

3.2.5 Tab: Lookup Table

3.2.5.1 Lookup Table Settings

ID	Name	Format	Unit/Range	Description
3201	Loop Enable	INT32	0 … 1	0: loop disabled 1: loop enabled
3202	Interval	INT32	≥ 1 cycle*	

3.2.5.2 Lookup Table Download (parameter updated by download widget)

ID	Name	Format	Unit/Range	Description
3200	Lookup Table	Big Data FLOAT32		Limited to 1000 samples

*1 cycle = 0.64 ms

3.2.6 Signal Generator

3.2.6.1 Signal Generator Settings

ID	Name	Format	Unit/Range	Description
3300	Wave Function	INT32	0 … 3	0: Custom 1: Sine 2: Square 3: Triangle
3301	Current High	FLOAT32	A	
3302	Current Low	FLOAT32	A	

3.2.6.2 Waveform Settings

3.2.6.2.1 Custom Waveforms

ID	Name	Format	Unit/Range	Description
3303	Rise Time	INT32	≥ 0 cycles*	
3304	Fall Time	INT32	≥ 0 cycles*	
3305	High Time	INT32	≥ 0 cycles*	
3306	Low Time	INT32	≥ 0 cycles*	

*1 custom waveform cycle = 0.64 ms

3.2.6.2.2 Preset Waveforms

ID	Name	Format	Unit/Range	Description
3307	Signal Period Time	INT32	≥ 1 cycle*	

*1 preset waveform cycle = 2.56 ms

3.2.7 Tab: Temperature Control / Settings

3.2.7.1 Nominal Temperature

ID	Name	Format	Unit/Range	Description
4000	Target Object Temp	FLOAT32	−273 °C … 1000 °C	
4003	Coarse Temp Ramp	FLOAT32	1E−6 °C/s … 50 °C/s	
4002	Proximity Width	FLOAT32	0°C … 200°C	

3.2.7.2 Temperature Controller PID Values

ID	Name	Format	Unit/Range	Description
4010	Kp	FLOAT32	0 %/°C … 10000 %/°C	
4011	Ti	FLOAT32	0 … 10000 s	0s disables the integral term
4012	Td	FLOAT32	0 … 10000 s	
4013	D Part Damping PT1	FLOAT32	0 … 1	

3.2.7.3 Modelization for Thermal Power Control

ID	Name	Format	Unit/Range	Description
4020	Mode	INT32	0 … 2	0: Peltier, Full Control 1: Peltier, Heat Only - Cool Only 2: Resistor, Heat Only

3.2.7.4 Peltier Characteristics

ID	Name	Format	Unit/Range	Description
4030	Maximum Current Imax	FLOAT32	0 %/°C … 10000 %/°C	
4031	Delta Temperature dTmax	FLOAT32	0 s … 10000 s	0s disables the integral term
4032	Positive Current is	INT32	0 … 1	0: Cooling 1: Heating

3.2.7.5 Resistor Characteristics

ID	Name	Format	Unit/Range	Description
4040	Resistance	FLOAT32	0.001 Ω … 10 kΩ	
4041	Maximum Current	FLOAT32	0.01 A … 1000 A	

3.2.7.6 Peltier, Heat Only – Cool Only Boundaries

ID	Name	Format	Unit/Range	Description
4051	Upper Boundary	FLOAT32	-273 °C … 1000 °C	
4050	Lower Boundary	FLOAT32	-273 °C … 1000 °C	

3.2.7.7 Object Temperature Stability Indicator Settings

ID	Name	Format	Unit/Range	Description
4060	Temperature Deviation	INT32	0°C … 50°C	
4061	Min Time in Window	INT32	0 s … 86400 s	
4062	Max Stabilization Time	INT32	0 s … 86400 s	

3.2.8 Tab: Temperature Control / Auto Tuning

The following parameters are volatile parameters.

ID	Name	Format	Unit/Range	Description
51000	Auto Tuning Start	INT32	1	Writing 1 to this parameter initiates the Auto Tuning process.
51001	Auto Tuning Cancel	INT32	1	Writing 1 to this parameter cancels the Auto Tuning process.
51010	Tuning Parameter 2A (Temperature peak-peak value)	FLOAT32 Read Only	°C	Returns the Temperature peak-peak value recorded while the Tuning Process was running.
51011	Tuning Parameter 2D (Control Variable peak-peak value)	FLOAT32 Read Only	%	Returns the Control Variable peak-peak value recorded while the Tuning Process was running.
51012	Tuning Parameter Ku (Ultimate gain)	FLOAT32 Read Only	%/°C	Returns the Ultimate Gain calculated based upon the 2A and 2D values.
51013	Tuning Parameter Tu (Ultimate period)	FLOAT32 Read Only	s	Returns the recorded Ultimate Period.
51014	PID Parameter Kp	FLOAT32 Read Only	%/°C	Returns the optimized Proportional Gain for the PID Controller.
51015	PID Parameter Ti	FLOAT32 Read Only	s	Returns the optimized Integral Time for the PID Controller.
51016	PID Parameter Td	FLOAT32 Read Only	s	Returns the optimized Derivative Time for the PID Controller.
51017	Coarse Temp Ramp	FLOAT32 Read Only	°C/s	Returns a recommendation value for the Target Temperature Ramp function.
51018	Proximity Width	FLOAT32 Read Only	°C	Returns a recommendation value for the Target Temperature Ramp function.
51020	Tuning Status	FLOAT32 Read Only	..	0: Idle 1: Ramping to Target Temperature... 2: Preparing for Acquisition... 3: Acquiring Data... 4: Success. Tuning Complete! 10: Error. Check Error Number!
51021	Tuning Progress	FLOAT32 Read Only	0 … 100%	
51022	Slow PI Parameter Kp	FLOAT32 Read Only	%/°C	Returns the optimized Proportional Gain for the PID Controller.
51023	Slow PI Parameter Ti	FLOAT32 Read Only	s	Returns the optimized Integral Time for the PID Controller.
51024	PID D Part Damping PT1 Recommendation	FLOAT32 Read Only	..	Returns a recommendation value for the PID D Part Damping.

3.2.9 Tab: External Temperature

3.2.9.1 External Temperature Error Limits x

ID	Name	Format	Unit/Range	Description
5011	Upper Error Threshold	FLOAT32	°C	
5010	Lower Error Threshold	FLOAT32	°C	

3.2.9.2 External Temperature Errors Enable x

ID	Name	Format	Unit/Range	Description
5030	ADC Limit Errors	INT32		0: None 1: Upper Only 2: Lower Only 3: Both
5031	Temperature Limit Errors	INT32		0: None 1: Upper Only 2: Lower Only 3: Both

3.2.9.3 External Temperature Measurement Limits x

ID	Name	Format	Unit/Range	Description
5040	Lowest Resistance	FLOAT32	Ω	
5041	Highest Resistance	FLOAT32	Ω	
5042	Temperature at Lower Resistance	FLOAT32	°C	
5043	Temperature at Highest Resistance	FLOAT32	°C	

3.2.10 Tab: Advanced / External Temperature Measurement

3.2.10.1 External Temperature User Calibration x

ID	Name	Format	Unit/Range	Description
5001	Temperature Offset	FLOAT32	°C	
5002	Temperature Gain	FLOAT32	°C/°C	

3.2.10.2 External NTC Sensor Characteristics x

ID	Name	Format	Unit/Range	Description
5020	Lower Point: Temperature	FLOAT32		
5021	Lower Point: Resistance	FLOAT32		
5022	Middle Point: Temperature	FLOAT32		
5023	Middle Point: Resistance	FLOAT32		
5024	Upper Point: Temperature	FLOAT32		
5025	Uppper Point: Resistance	FLOAT32		

3.2.10.3 External Temperature Hardware Calibration x

ID	Name	Format	Unit/Range	Description
5100	Offset	FLOAT32		
5101	Gain	FLOAT32		

3.2.11 Tab: Advanced / LDD

3.2.11.1 Current Measurement User Calibration

ID	Name	Format	Unit/Range	Description
8000	Offset	FLOAT32	A	
8001	Gain	FLOAT32	A/A	

3.2.11.2 Current Set User Calibration

ID	Name	Format	Unit/Range	Description
8002	Offset	FLOAT32	A	
8003	Gain	FLOAT32	A/A	

3.2.11.3 Current Measurement Hardware Calibration

ID	Name	Format	Unit/Range	Description
8004	Offset	FLOAT32		
8005	Gain	FLOAT32		

3.2.11.4 Current Set Hardware Calibration

ID	Name	Format	Unit/Range	Description
8006	Offset	FLOAT32		
8007	Gain	FLOAT32		

3.2.11.5 VLDA Set Hardware Calibration

ID	Name	Format	Unit/Range	Description
8008	Offset	FLOAT32	V	
8009	Gain	FLOAT32	V/V	

3.2.12 Tab: Advanced / TEC

3.2.12.1 Object Temperature

ID	Name	Format	Unit/Range	Description
6300	Input Source	INT32	0 … 2	0: Ext Temp 1 1: Ext Temp 2 2: Device

3.2.12.2 Sink Temperature

ID	Name	Format	Unit/Range	Description
6320	Input Source	INT32	0 … 3	0: Ext Temp 1 1: Ext Temp 2 2: Device 3: Fixed Value
6321	Fixed Temperature	FLOAT32	-273 °C … 1000 °C	

3.2.12.3 Output Stage Controller Limit (Error 208)

ID	Name	Format	Unit/Range	Description
6330	Error Delay	INT32	-1 … 20000000 ms	-1: fully disable the Error 108 (not recommended) 0: set the delay to 1ms automatically

3.2.12.4 Additional Settings

ID	Name	Format	Unit/Range	Description
6340	Disable on LDD Error	INT32	0 … 1	0: Off 1: On

3.2.13 Tab: Advanced / Analog Interfaces

3.2.13.1 Analog Voltage Input User Calibration

ID	Name	Format	Unit/Range	Description
7011	Offset	FLOAT32	V	
7012	Gain	FLOAT32	V/V	

3.2.13.2 Photodiode Input User Settings

ID	Name	Format	Unit/Range	Description
7010	LP System Scale	FLOAT32	V/A	

3.2.13.3 Analog Voltage Input User Settings

ID	Name	Format	Unit/Range	Description
7013	Current Factor	FLOAT32	A/V	This factor sets the scale when the analog input is used as source for the laser current setpoint.

3.2.13.4 Analog Voltage Input Hardware Calibration

ID	Name	Format	Unit/Range	Description
9001	Offset	FLOAT32		
9002	Gain	FLOAT32		

3.2.13.5 Photodiode Input Hardware Settings

9000	Photodiode Rs	FLOAT32	Ω	

3.2.14 Tab: Advanced / GPIO

3.2.14.1 GPIO General / GPIO Configuration (GPIO1 … GPIO10)

The instance number corresponds to the GPIO number.

ID	Name	Format	Unit/Range	Description
6100	GPIO Function	INT32		0: No Function 1: Signal Control (see 3.2.17.2) 2: LDD OK (1 when Ready or Running) 3: No Function 4: HW Enable 5: No Function 6: Fan Tacho 7: No Function 8: LDD Run 9: No Function 10: No Function 11: Pump 12: No Function 13: Dev Adr +1 (Device Address) 14: Dev Adr +2 (Device Address) 15: Dev Adr +4 (Device Address) 16: Fan Stop 17: No Function 18: No Function 19: No Function 20: No Function 21: No Function 22: Pulse Input
6101	GPIO Level Assignment	INT32		0: Positive 1: Negative
6102	GPIO Hardware Configuration	INT32		0: IN WeakNo 1: IN WeakUp 2: IN WeakDown 3: OUT PushPull 4: OUT OD NoPull 5: OUT OD WeakUp
6103	GPIO Channel	INT32		1: Channel 1 … 10: Channel 10

3.2.14.2 GPIO Detail / Pump Control x

ID	Name	Format	Unit/Range	Description
6120	Actual Temperature Source	INT32		0: External 1 1: External 2 2: Device LD 3: Device TEC
6121	ON Threshold	FLOAT32	−273 °C … 1000 °C	
6122	OFF Threshold	FLOAT32	−273 °C … 1000 °C	

3.2.14.3 GPIO Detail / Alternative TEC Target Temperature over GPIO Pin

ID	Name	Format	Unit/Range	Description
6130	Temperature 1	FLOAT32	−273 °C … 1000 °C	
6131	Temperature 2	FLOAT32	−273 °C … 1000 °C	
6132	Temperature 3	FLOAT32	−273 °C … 1000 °C	

3.2.15 Tab: Advanced / Fan

3.2.15.1 CHx Fan Control Enable

ID	Name	Format	Unit/Range	Description
6200	Fan Control Enable	INT32		0: Disabled 1: Enabled

3.2.15.2 CHx Fan Temperature Controller

ID	Name	Format	Unit/Range	Description
6210	Actual Temperature Source	INT32		0: External 1 1: External 2 2: Device LD 3: Device TEC
6211	Target Temperature	FLOAT32	−273 °C … 1000 °C	
6212	Kp	FLOAT32	0 %/°C … 10000 %/°C	Temperature Controller
6213	Ti	FLOAT32	100 us … 10000 s	Temperature Controller, 0 s disables the integral term
6214	Td	FLOAT32	0 s … 10000 s	Temperature Controller

3.2.15.3 CHx Fan Speed Controller

ID	Name	Format	Unit/Range	Description
6220	0% Speed	FLOAT32	0 … 100000	Fan speed when no cooling is required
6221	100% Speed	FLOAT32	0 … 100000	Fan speed when maximum cooling is required
6227	Fan Min Speed Start	FLOAT32	0 … 100000	Speed above which the fan starts
6228	Fan Min Speed Stop	FLOAT32	0 … 100000	Speed below which the fan stops
6222	Kp	FLOAT32	0 %/°C … 10000 %/°C	Speed Controller
6223	Ti	FLOAT32	100 us … 10000 s	Speed Controller 0 s disables the integral term
6224	Td	FLOAT32	0 s … 10000 s	Speed Controller
6225	Bypassing Speed Controller	INT32		0: No 1: Yes
6226	Fan Surveillance	INT32		0: Enabled 1: Disabled

3.2.15.4 CHx Fan General Settings

ID	Name	Format	Unit/Range	Description
6230	Fan PWM Frequency	INT32		0: 25kHz 1: 1kHz

3.2.16 Tab: Advanced / System

3.2.16.1 Parameter System Save to Flash Configuration

ID	Name	Format	Unit/Range	Description
108	Save Data to Flash	INT32		0: Enabled 1: Disabled

3.2.16.2 Error State Auto Reset Delay

ID	Name	Format	Unit/Range	Description
6310	Delay until Reset	FLOAT32	0 s … 86400 s	0: No Auto Reset

3.2.17 Other Parameters (not displayed in the Service Software)

3.2.17.1 Driver Parameters

ID	Name	Format	Unit/Range	Description
50000	Volatile Output Enable	INT32		0: Static OFF 1: Static ON
50001	Volatile Set Current	FLOAT32		

3.2.17.2 Temperature Controller Additional Parameters

The following parameters are volatile parameters. They have a defined reset state.

ID	Name	Format	Unit/Range	Description
50010	Sine Ramp Start Point	INT32	0 … 1	0: On a new Target Value, the actually measured Temperature is taken as Start Temperature. (Reset State) 1: On a new Target Value, the current Target Temperature is taken as Start Temperature

3.2.17.3 GPIO Signal Control

The following parameters are volatile parameters.

This feature can be used to control the GPIO signals. The pins are addressed by a bit field.

Example:
To configure GPIO3 / GPIO4 as output pins, and to set GPIO3 to high level and GPIO4 to low level, use the following commands:

Set ID 52102 to 4 (sets bit #2 to '1')
Set ID 52101 to 12 (sets bits #2 and #3 to '1')
Set ID 52100 to 1 (enables the function)

Bit Field Description

Bit Number	Output Signal
0	GPIO1
⋮	⋮
10	GPIO2

This command order has been chosen to avoid spikes. After reset, all values are set to 0.

ID	Name	Format	Unit/Range	Description
52100	Enable Function	INT32	0 … 1	Enable the output signal control function.
52101	Set Output to Push-Pull	INT32	0 … 255	If a bit is set to 0, the output signal is at high impedance s(set as input). If a bit is set to 1, the output signal is driven.
52102	Set Output States	INT32	0 … 255	Set the output states of driven signals.
52103	Read Input States	INT32	0 … 255	Read back the (input) states of all signals.

4 Bootloader

- The firmware can be downloaded using all communication interfaces.
- The Bootloader can be controlled with the Control and Stream commands.
- The whole new firmware will be cached and verified onboard, before the old firmware gets erased.
- Do not interrupt the power after the ReBoot command, until the device answers to your queries again. Interrupting the power after the ReBoot command can cause irreversible memory errors.
- Do not worry about communication failures, wrong command sequences or downloading the wrong firmware using this bootloader. Everything is verified, before the bootloader enters the critical process. If the power is not interrupted after the ReBoot command, no irreversible errors are possible.

It's necessary to use the correct command sequence:

1. Activate the bootloader using the **BootloaderActivate** command.
2. Query the status using **NoOperation** and wait until it reports the "activated" status.
3. Clear the update memory using the **ClearMemory** command**.**
4. Query the status using **NoOperation** and wait until it reports the "memory is cleared" status.
5. Send the whole *.hex* file using the Bootloader Stream command.
6. Query the status using **NoOperation** and wait until it reports the "valid application" status.
7. Start replacing the running application by sending the **ReBoot** command. Attention:
    a. The device will typically not answer your queries for 10s (it may take longer).
    b. Do not interrupt the power during this process!
    c. Constantly send queries (e.g. ?IF) to the device, to see if the new firmware is already running. If the device is answering your queries again, the critical process has ended.
8. Verify if the firmware version is as expected.

4.1 Bootloader Control (BC?)

Type	Mnemonic	Field 1
Query	?BC	UINT32 Bootloader Command

Type	Field 1
Response	UINT32 Bootloader Status or Server Error Code

4.1.1 Bootloader Command

Bit	Value	Description
NoBit	0x00	(No bit set) **NoOperation**. Can be used to read the Bootloader Status.
0	0x01	**BootloaderActivate**. Starts enabling the update memory.
1	0x02	**ClearMemory**. Starts clearing the update memory.
2	0x04	**ReBoot**. Starts replacing the running application. Will only be accepted if the Bootloader Status reports “Valid Application”.

4.1.2 Bootloader Status

Bit	Value	Description
0	0x0001	Bootloader is activated.
1	0x0002	Memory is cleared.
2	0x0004	Valid application. There is a valid application in the update memory.
3	0x0008	Bootloader error. This flag will always be set if an error occurs. See additional flags below (FW >= v5.00).
4	0x0010	Error: CRC error detected in the downloaded file.
5	0x0020	Error: the firmware identification string does not match. The downloaded firmware is not intended for this device.
6	0x0040	Error: this firmware is not made for this firmware branch.
7	0x0080	Error: the firmware is too old for this device.
8	0x0100	Error: AES decryption failure. The code was encrypted with a different key.
9	0x0200	Error: this firmware is too new for the currently installed firmware version. Please check the Software Release Notes. An intermediate firmware might be needed.
10	0x0400	Error: unencrypted firmware file detected. It is not possible to install this firmware anymore. Please contact the manufacturer.
11	0x0800	Error: firmware update limit reached. The downloaded file contains a firmware that is too old for the device.
12	0x1000	Error: firmware update limit reached. The downloaded file contains a firmware that is too new for the device.

4.2 Bootloader Stream (BS?)

Type	Mnemonic	Field 1	Field 2
Query	?BS	UINT32 Length in bytes of field 2	Data Stream Part of the Hex File

Type	Field 1
Response	UINT32 Bootloader Status or Server Error Code

4.2.1 Data Stream

The Data Stream command is used to send the hex file content to the microcontroller.

Add a few hex file lines to the payload field of the communication protocol frame and remove all '\n' and '\r' from the stream (the hex file lines are then only separated by the double dot).

The maximum size of the Payload Field is 512 Bytes.

It is recommended to send 10 hex file lines in one package. This will not exceed the 512 Byte limit.

4.2.2 Bootloader Status

See 4.1.2 Bootloader Status.

5 Example Communication Strings

- The following Example Communication Strings have been captured with the MeComAPI ComLog.txt file.
- It shows the Serial Communication Data as it would appear on a normal Serial Terminal Program. Only the “OUT:” and “IN:” tags have been added by the MeComAPI. The End-of-Frame Byte is not shown, because it is an ASCII <CR> (Carriage Return, 0x0D).
- The Checksum is calculated using the CRC16/XMODEM algorithm over the previous frame data as ASCII String.
- All the Frame data is colored to better understand what is going on:
  - Control
  - Address (using address 0, the device will always answer independently from its address.)
  - Sequence Number
  - Payload / Other Payload
  - Checksum

Get firmware identification string (note: example from another device, see Chapter 2.2 for the relevant firmware identification string)

OUT: #001EF8?IFF1E4
IN: !001EF88144-LDD-130X G1 CED8

→ Result: “8144-LDD-130X G1 “

Get device type (using parameter Value Read)

Parameter ID: 100 (0x0064); Instance 1

OUT: #000F24?VR0064012B1A
IN: !000F2400000517EABE

→ Result: 0x00000517 → 1303

Get serial number (using parameter Value Read)

Parameter ID: 102 (0x0066); Instance 1

OUT: #0015AC?VR0066018125
IN: !0015AC00000706F2C

→ Result: 0x00000070 → Interpreted as an INT32: decimal value 112

Querying a non-available parameter ID (using parameter Value Read)

Parameter ID: 1234 (0x04D2); Instance 1

OUT: #0015AC?VR04D2017BFE
IN: !0015AC+0532DA

→ As a result, we get the Server Error Code 0x05 which means that this parameter is not available.

You can use the tool: http://www.h-schmidt.net/FloatConverter/ for tests involving FLOAT32 parameters. Usually, microcontrollers support float according to IEEE754 by Hardware or Software FPU.

6 CANopen

Please consider that this is the first implementation of CANopen. We gladly accept suggestions for improvement (support@meerstetter.ch).

Supported Features:

- All mandatory functions of CiA 301
- 1 SDO Server
- EMCY
- Producer Heartbeat
- 16 RPDO and 16 TPDO with dynamic object mapping
- Store Parameter and Restore Default Parameters

General Information:

- The CAN ID and Bitrate can be set using the Service Software and will be saved in the non-volatile memory.
- All the CAN Objects in the Communication Segment are only saved in the volatile memory, so they need to be re-configured after every reset.
- Expect for the "Monitor" Objects, most of the Objects in the "Manufacturer Segment" are saved in the non-volatile memory.
- The device has its own parameter system, which is used to handle all the parameters for the device operation. This parameter system only supports INT32 and FLOAT32 (REAL32) values. Therefore, every parameter in the Manufacturer Segment have always a size of 4 bytes.
- Most of the parameters have only 1 instance, but some have several instances. For example, the External Temperature Measurement. For simplification, all objects in the Manufacturer Segment are always arrays. The subindex 0 is always the "Highest sub-index supported" or in other words, maximal number of instances. Subindex 1 … n represent the parameter instances 1 … n.
- The name of the objects in the EDS file are closely linked to the Service Software.

6.1 Feature Details

6.1.1 EMCY

The error reporting only reports a few CANopen stack specific error messages. All other error messages are manufacturer specific.

For manufacturer specific errors the EEC Field shows 0xFF00 + <Meerstetter Specific Error Number>. This number can be found in the User Manual.

Usage of the MEF bytes:

- Byte 0: Instance (Channel): For example, if the External Temperature Sensor on channel 2 has a problem, then this byte is set to 2. Usually, it is 1 for this device.
- Byte 1 … 4: Additional information for support purposes. Please provide this number if you contact our support.

6.1.2 PDO

- The mapping tables have always 2 Mapping Entries, because the "Manufacturer Segment" Objects always have a size of 4 bytes.
- Some parameters have a very high update rate internally, so be careful, when using TPDOs with should automatically transmit if the value has changed.

6.1.3 Store Parameter

- Only “Save all Parameters” is available.
- Saves the following CANopen parameters from the Communication Segment:
    - 0x1005 – COB-ID SYNC
    - 0x1015 – Inhibit Time Emergency
    - 0x1017 – Producer Heartbeat Time
    - 0x1400 – Receive PDO Communication Parameters
    - 0x1600 – Receive PDO Mapping Parameters
    - 0x1800 – Transmit PDO Communication Parameters
    - 0x1A00 – Transmit PDO Mapping Parameters
- Saves all Manufacturer Segment parameters, except for the Monitor parameters.

6.1.4 Restore Default Parameters

- Only “Restore all Default Parameters” is available.
- Restores only the CANopen Communication Segment parameters to its default value, not the Manufacturer Parameters.

A Change History

Date of change	Version	Changed/ Approved	Change / Reason
2023-06-14	A	RS / HS	• First edition
2023-09-15	B	RS, HS / RS	• Add parameters related to PWR-1191, analog input
2023-09-26		SC / RS	• Add parameters related to LPC
2023-11-01		SC / RS	• Add parameters related to LUT
2023-12-13		SC / HS	• Add signal generator parameters
2024-01-24		RS / HS	• Mod: 1.5 Flash Parameters (nonvolatile) / RAM Parameters (volatile) • Add: CANopen NonVolatile Parameters • Del: Par 108: Disable save to flash • Mod: Par 109: Delete status “Save to flash disabled” • Add: Par 110: Error Text • Add: Par 111: Device Reset • Add: Par 112: Firmware Version as FLOAT32 • Add: CANopen Chapter