M090 Modbus TCP / DALI converter

Summary **M090 is a serial converter which acts as a Modbus TCP server (accepts Modbus TCP commands) and controls a DALI (Digital Addressable Light Interface) bus with up to 64 DALI devices. M090 acts as a single master of the DALI bus. It also incorporates a web interface for manual entering of DALI commands inclusive bus configuration and diagnostic commands.**

Applications

- **integration of DALI light controllers to a Modbus TCP compatible SCADA or PLC**
- **configuring and controlling of a DALI bus over a comfortable web interface, even on a remote basis**

Function

The M090 converter acts as a single master of the DALI bus. **It cannot be used with another DALI master, like switches, light sensors etc. on the same bus.** The Modbus and web commands are translated into DALI protocol telegrams and sent to the DALI devices. The responses from the light controllers are translated back to Modbus registers and available at the corresponding addresses, see tables below.

The DALI bus supports up to 64 light controller addresses, up to 16 scenes, and up to 16 groups. Wire length and diameter must always be respected! For the complete overview of the DALI bus specification, see e.g. http://www.dali-ag.org/c/manual_gb.pdf . The DALI bus uses 22.5 V operation voltage.

If the bus is loaded, the warm dissipation have to be guaranteed. The warm is product of frequent communication with high number of converters. Please do not exceed maximal permitted working temperature 55 °C, otherwise the proper function is not guaranteed and the converter could be damaged!

The bus devices are connected over a 2-pole connector, regardless of polarity. The Ethernet is connected over RJ45 connector with PoE (Power over Ethernet).

Technical data

Power supply	PoE according to PoE specification, *or* 12...24 V AC, 16...36 V DC
Consumption	max. 6 VA (full load, 64 DALI slaves) 1.4 VA (no DALI load)
Working temperature	-20 ÷ 55°C
Relative humidity	5% ÷ 95% non-condensing
Ethernet	10 Mbps, half-duplex
DALI	standard IEC 60929 Annex E, 1200 bps
Galvanic separation	DALI bus is separated up to 1000 V
Short circuit protection	electronic with automatic reset, short-circuit current I_k = 250 mA
Overload sustainability	Sustainable to unlimited bus short-circuit
LED	power (PWR) – green DALI bus receive RxD – green DALI bus transmit TxD (flashing) or overload / short-circuit (steadily on) - red
Dimensions	see below

Power supply

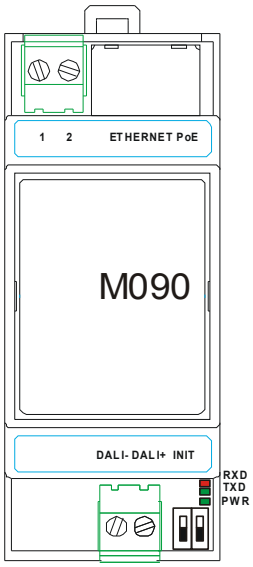
Alternative power supply (G/G0 terminals vs. PoE):

1. If the G/G0 power is applied first, the M090 is powered from this G/G0 external source. At power dropout the power is switched over to PoE with a short dropout (device reset).

2. If the PoE power is applied first, the M090 is powered from the PoE. The switchover to G/G0 follows only if the G/G0 voltage is 27 V DC (19 V AC) and above.

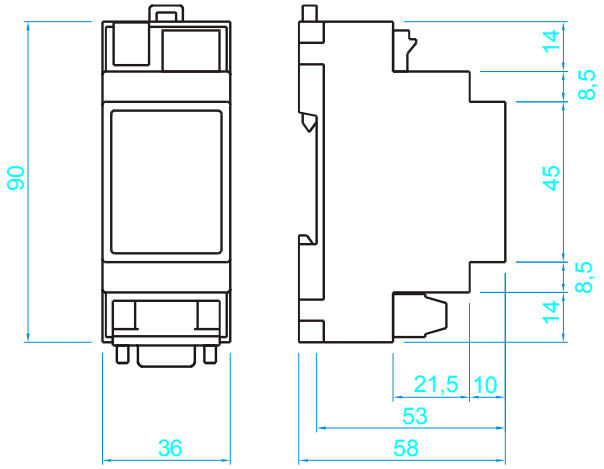
3. If both G/G0 and PoE are applied at the same time, the M090 is powered from G/GO terminals. The device will not be damaged.

Terminals, LED



G, G0	power, any polarity
ETH	Ethernet, 8 pin RJ45 socket
DALI +	DALI bus, positive
DALI -	DALI bus, negative
TXD / ALR	data transmit to DALI bus, (flashing)/ DALI bus overload (steadily on), red LED
RXD	data receive from DALI bus, green LED
PWR	power OK, green LED
INIT	INIT switch (DIP switch 1) – when set on power on, the IP address is set to defaults (192.168.1.99, mask 255.255.255.0)

Dimensions



Settings

The network properties are set over the M090's web interface. The default network settings are:

IP address	192.168.1.99
Network mask	255.255.255.0
Default gateway	192.168.1.1

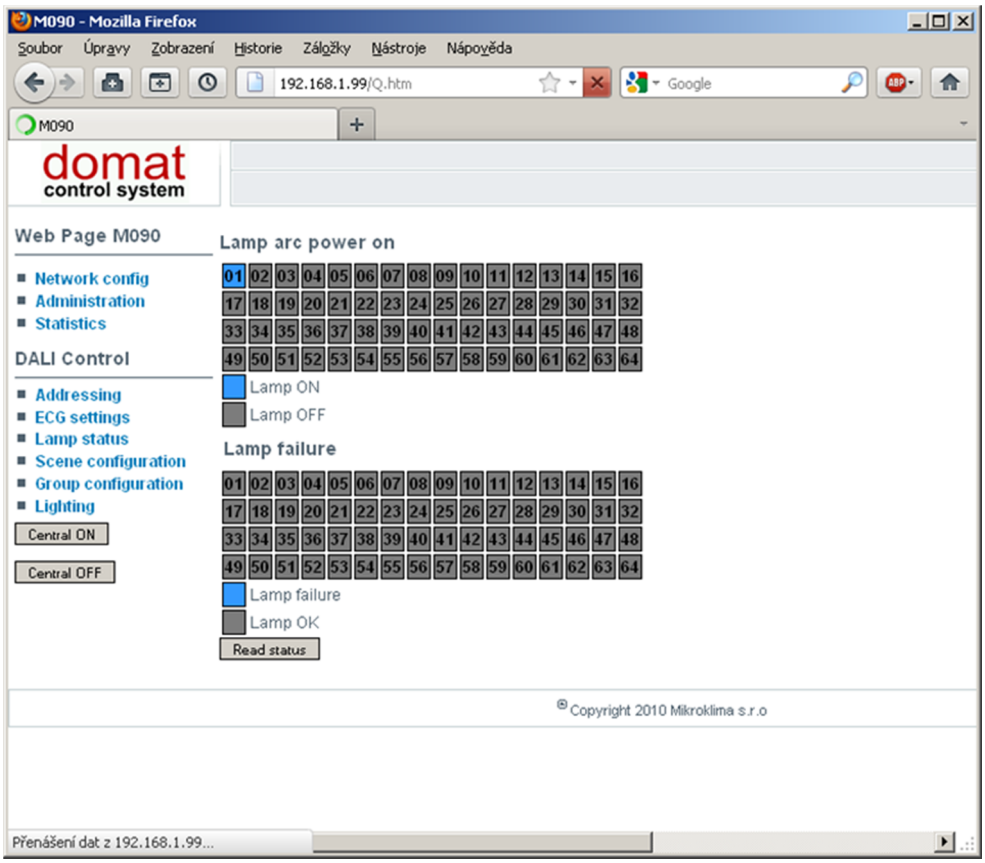
All settings are stored in EEPROM.

Bringing the device to default settings:

1. Power off the M090.
2. Set the DIP switch 1 (INIT) to ON.
3. Apply power.
4. Locate the device on its default IP address and configure it as necessary.
5. Remove power.
6. Set the INIT switch to OFF.
7. Apply power again.
8. The M090 has the new settings.

Web interface

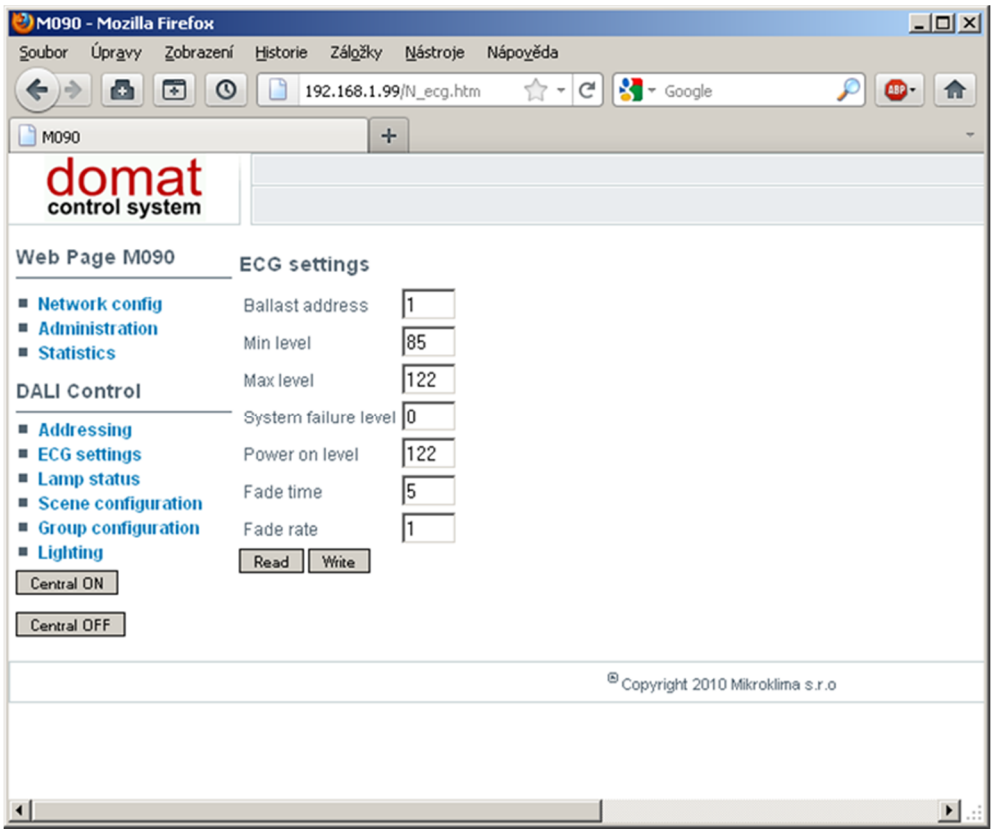
Over the web interface it is possible to set the M090 up (*Network config*), upload new firmware if necessary (*Administration*), and diagnose the interface (*Statistics*). The DALI Control menu is used to test if the DALI part is operating properly, to address the ballasts (*Addressing*), set the individual ballast parameters (*ECG settings*), see the states of the lamps at a glance (*Lamp status*), configure scenes and groups, issue group commands (*Ligthing*), and enable registers for simple control (*Conf*).



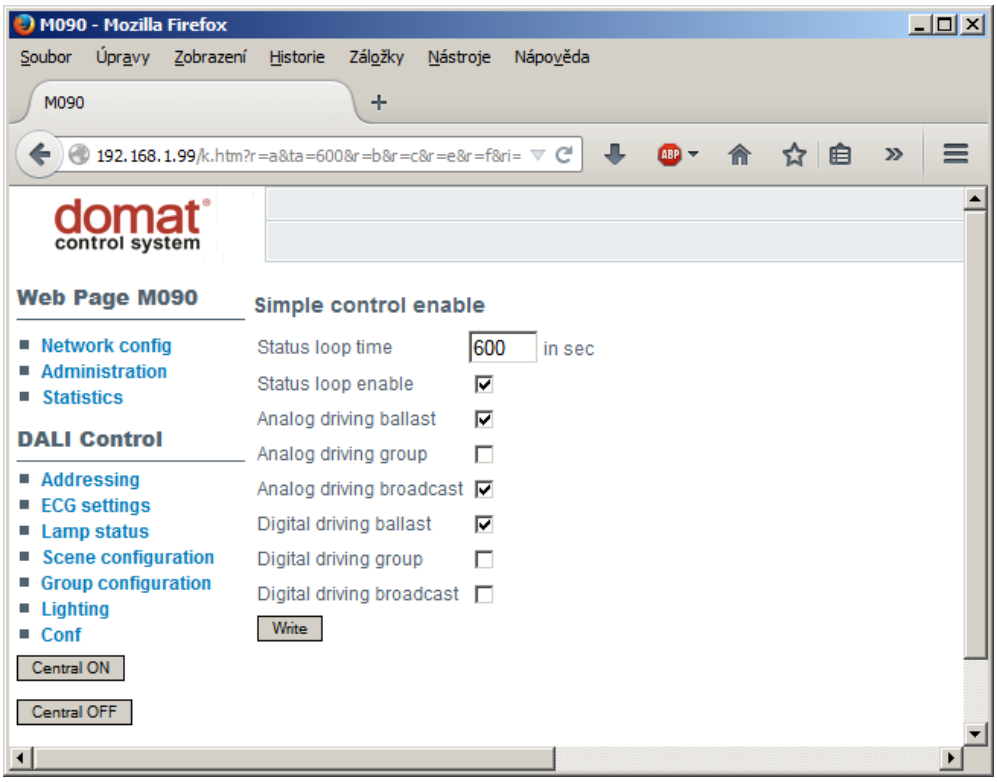
Menu Lamp Status

When updating the firmware, update of the internal web pages may be necessary. The files are part of the firmware release package. For upload, use a ftp client with username/password: root / root99.

Please note that the numbering of the ballasts is:
1...64 at the web interface
0...63 in the Modbus telegrams.



Menu ECG Settings



Conf – Simple control enable menu

The web interface is useful when commissioning the system: the DALI bus may be checked separately from the PLC program. As soon as the groups are configured and it is possible to control the DALI ballasts over the web interface, it is time to commission

the PLC part.

In the SoftPLC, there is a special driver for M090 so that the integration is easy – it is not necessary to map the Modbus registers via a generic Modbus driver, there are dedicated variables to control central commands, groups, scenes, as well as individual ballasts.

Installation

Please ensure that, when installed onto a DIN rail, there is at least a 15 mm gap for air circulation at both vertical device sides, which is necessary for proper cooling of the device.

Related products

IPLC510	process station MiniPLC – Linux
IPLC301	process station MiniPLC
IPLC201	process station MiniPLC
IPCT.1	process station with touch screen display
IPCB.1	process station without display
RC-Vision	SCADA software

Modbus TCP communication

The supported Modbus functions are:

03 Read Holding Registers – read words
16 Force Multiple Registers – write words

The memory is divided into sections, and only registers which functionally stick together, like 95 to 158, 160 to 175, etc. are able to be written in a single command. In other words, the F16 command can not cross borders, like writing to registers 157 to 162 in one command.

The address space is accessible wordwise (16 bit words). See table below**.**
Tab. 1: Modbus table

Name	Address	Type	Description	Note
modul LSB	1 LSB	R	module ID lower byte	0x0090 hex
modul MSB	1 MSB	R	module ID upper byte	
firmware LSB	2 LSB	R	firmware version lower byte	
firmware MSB	2 MSB	R	firmware version upper byte	
	3 LSB	R	reserved	

status MSB	3 MSB	R	module status upper byte **bit 0** - 0 normal mode - 1 init mode **bit 1** - 0 **bit 2 -** 0 **bit 3 -** 0 **bit 4** - 0 **bit 5** - 1 **bit 6** - 0 **bit 7** - 1	
reserved	4 LSB	R RAM		
reserved	4 MSB	R RAM		
command mask	5 LSB	R,W RAM	**bit 0** = block 0 **bit 1** = block 1 **bit 2** = block 2 **bit 3** = block 3 **bit 4** = block 4 **bit 5** = block 5 **bit 6** = block 6 **bit 7** = block 7	By setting the bit, executing of the corresponding block is enabled. The module executes the enabled blocks one after another from **bit 7** to **bit 0**
command executed	5 MSB	R RAM		The set bit indicates the executed block, **bit 0** = **block 0** etc.
DALI command block 0	6 LSB	R,W RAM		DALI command for block 0 according to the tables
DALI address block 0	6 MSB	R,W RAM		DALI address for block 0
D0 block 0	7 LSB	R,W RAM	if the request is performed by a single DALI command which contains answer, the answer is in this block	additional data 0 for block 0 -> tables

D1 block 0	7 MSB	R,W RAM	If the request is performed by a single DALI command, then: **0x00** – no reply returned **0x55** – valid DALI reply returned, and stored in register **7LSB** **0x02 –** bus error, bus permanently short-circuited **0x03** – DALI reply returned but damaged (unrecognized)	***Note 1*** additional data 1 for block 0 -> tables
D2 block 0	8 LSB	R,W RAM		additional data 2 for block 0 -> tables
	8 MSB		reserved	
DALI command block 1	9 LSB	R,W RAM		
DALI address block 1	9 MSB	R,W RAM		
D0 block 1	10 LSB	R,W RAM		
D1 block 1	10 MSB	R,W RAM		
D2 block 1	11 LSB	R,W RAM		
	11 MSB		reserved	
DALI command block 2	12 LSB	R,W RAM		
DALI address block 2	12 MSB	R,W RAM		
D0 block 2	13 LSB	R,W RAM		
D1 block 2	13 MSB	R,W RAM		
D2 block 2	14 LSB	R,W RAM		
	14 MSB		reserved	
DALI command block 3	15 LSB	R,W RAM		
DALI address block 3	15 MSB	R,W RAM		
D0 block 3	16 LSB	R,W RAM		
D1 block 3	16 MSB	R,W RAM		
D2 block 3	17 LSB	R,W RAM		
	17 MSB			
DALI command block 4	18 LSB	R,W RAM		

DALI address block 4	18 MSB	R,W RAM		
D0 block 4	19 LSB	R,W RAM		
D1 block 4	19 MSB	R,W RAM		
D2 block 4	20 LSB	R,W RAM		
	20 MSB		reserved	
DALI command block 5	21 LSB	R,W RAM		
DALI address block 5	21 MSB	R,W RAM		
D0 block 5	22 LSB	R,W RAM		
D1 block 5	22 MSB	R,W RAM		
D2 block 5	23 LSB	R,W RAM		
	23 MSB		reserved	
DALI command block 6	24 LSB	R,W RAM		
DALI address block 6	24 MSB	R,W RAM		
D0 block 6	25 LSB	R,W RAM		
D1 block 6	25 MSB	R,W RAM		
D2 block 6	26 LSB	R,W RAM		
	26 MSB		reserved	
DALI command block 7	27 LSB	R,W RAM		
DALI address block 7	27 MSB	R,W RAM		
D0 block 7	28 LSB	R,W RAM		
D1 block 7	28 MSB	R,W RAM		
D2 block 7	29 LSB	R,W RAM		
	29 MSB		reserved	

enable functions for simple control	30 LSB, MSB	R,W EEPROM default 0x7F hex (all enabled)		bit0 – enable round for error states and status readout bit1 – enable analogue intensity control - ballasts bit2 – enable analogue intensity control - groups bit3 – enable analogue intensity control - broadcast bit4 – enable bit (on/off) control - ballasts bit5 – enable bit (on/off) control – groups bit6 – enable bit (on/off) control broadcast (central on/off)
status of ballast 1	31 LSB	R RAM	bit 0 - Status of ballast; "0" = OK bit 1 -Lamp failure; "0" = OK bit 2 - Lamp arc power on; "0" = OFF bit 3 - Query: Limit Error; "0" = Last requested arc power level is between MIN..MAX LEVEL or OFF bit 4 - Fade ready; "0" = fade is ready; "1" = fade is running bit 5 - Query: "RESET STATE"? "0" = "No" bit 6 - Query: Missing short address? "0" = "No" bit 7 - Query: "POWER FAILURE"? "0" = "No"; "RESET" or an arc power control command has been received since last power-on. The "STATUS INFORMATION" shall be available in the RAM of the ballast and shall be updated regularly by the ballast according to the actual situation. The responses are same as command 144 responses from standard DALI table.	See DALI standard.
status of ballast 1	31 MSB	R RAM	bit 0: - 0 - ballast communication is OK - 1 - ballast is not communicate	
status of ballast 2	32 LSB	R RAM	See status of ballast 1.	
status of ballast 2	32 MSB	R RAM	See status of ballast 1.	
...	...	...	...	...

status of ballast 64	94 LSB	R RAM	See status of ballast 1.	
status of ballast 64	94 MSB	R RAM	See status of ballast 1.	
ballast 1 intensity	95 LSB, MSB	R,W RAM	Analogue intensity value for ballast 1 (0-255). It is written during writing. Function must be enabled in register 30 bit 1.	***Note 2***
ballast 2 intensity	96 LSB, MSB	R,W RAM		
ballast 3 intensity	97 LSB, MSB	R,W RAM		
...	...	....		
ballast 64 intensity	158 LSB, MSB	R,W RAM		
error and status readout round trip	159 LSB, MSB	R,W EEPROM default 60 sec	Value is in sec. (0 – 65535). If the value is 0, status and error is not read.	
group intensity 1	160 LSB,MSB	R,W RAM	Analogue value of group 1 intensity (0-255). It is written during writing. Function must be enabled in register 30 bit 2.	
group intensity 2	161 LSB,MSB	R,W RAM		
group intensity 3	162 LSB,MSB	R,W RAM		
...	...	...		
group intensity 16	175 LSB,MSB	R,W RAM		
analogue broadcast value	176 LSB,MSB	R,W RAM	Analogue value of all ballasts intensity (0-255) – central command	
bit control of ballasts 1-16	177 LSB,MSB	R,W RAM	– switch off – switch on It is written during writing. Function must be enabled in register 30 bit 4.	bit 0 –ballast 1 bit 1 – ballast 2 bit 2 – ballast 3
bit control of ballasts 17-32	178 LSB,MSB	R,W RAM		
bit control of ballasts 33-49	179 LSB,MSB	R,W RAM		

bit control of ballasts 50-64	180 LSB,MSB	R,W RAM		
bit control of groups 1-16	181 LSB,MSB	R,W RAM	0 – switch off 1 – switch on It is written during writing. Function must be enabled in register 30 bit 5.	***Note 3*** bit 0 – group 1 bit 1 – group 2 bit 2 – group 3 etc.
bit broadcast control	182 LSB,MSB	R,W RAM	It is written during writing. Function must be enabled in register 30 bit 6.	bit 0 – 0 = central OFF, 1 = central ON

Modbus table history

FW V16: the Modbus F16 writing multiple registers error was fixed: in the previous versions it was not possible to write more registers in one telegram.
FW V17: fixed bug: when using extended commands (273, 275, 277, 279), ballast adresses 32 to 63 returned values shifted by one position.

Notes

Note 1: Possible reasons of error messages:
0x00 No reply: Bad M090 hardware, wiring problems, ...
0x02 Bus error: Appears when the bus is short-circuited. If there is no traffic on the bus, the microcontroller checks the bus every second. If a short-circuit is detected, the red LED goes on and the bus power is switched off. After 1 s the bus power is switched on again and the check is repeated. If there is no short-circuit, the converter goes to normal. If the problem persists, the check is performed again after 1 s. The problem may also be in the damaged analogue output circuits of the converter, which the processor can not distinguish from a real bus short-circuit.
0x03 Unrecognized reply: It may happen that at installations where there bus contains 50 – 60 ballasts more ballasts reply at the same time, or if there is a signal interference.

Note 2: For all analogue values, the maximum settable value depends on the particular ballast type. Some ballasts allow e.g. to set analogue value in range of 80 to 250 only. If the current value is 80 and a command to set to 255 is sent, the new value of 255 is displayed in the Modbus map and sent to the ballast, but the ballast does not accept this value and keeps its previous setting of 80.

Note 3: Even if a single bit is changed only, the register to control all 16 groups is always set as a whole (Modbus function F16). If, for example, a ballast is assigned to groups 15 and 16, both groups are off, and there is a command issued to set group 15 to on and group 16 to off, the ballast just blinks shortly and goes to off.

Tab. 2: Standard DALI commands

No.	DALI command (bin)	DALI address	D0	D1	D2	Function
0	0000 0000	YAAA AAA 1	0	0	0	Extinguish the lamp without fading (Off)
1	0000 0001	YAAA AAA 1	0	0	0	Set to MAX LEVEL using FADE RATE
2	0000 0010	YAAA AAA 1	0	0	0	Set to MIN LEVEL using FADE RATE
3	0000 0011	YAAA AAA 1	0	0	0	One step higher without fading
4	0000 0100	YAAA AAA 1	0	0	0	One step lower without fading
5	0000 0101	YAAA AAA 1	0	0	0	Set to MAX LEVEL (On)
6	0000 0110	YAAA AAA 1	0	0	0	Set to MIN LEVEL (Dim)
7	0000 0111	YAAA AAA 1	0	0	0	One step lower, if the light is at MIN LEVEL it goes to Off
8	0000 1000	YAAA AAA 1	0	0	0	One step higher, if the light is Off it goes to MIN LEVEL
9-15	0000 1XXX					Not used
16-31	0001 XXXX	YAAA AAA 1	0	0	0	Set the light value to the scene XXXX
32	0010 0000	YAAA AAA 1	0	0	0	Reset the ballast to default settings
33	0010 0001	YAAA AAA 1	0	0	0	Save actual value to DTR
34-41	0010 XXXX					Not used
42	0010 1010	YAAA AAA 1	0	0	0	Save DTR as MAX LEVEL
43	0010 1011	YAAA AAA 1	0	0	0	Save DTR as MIN LEVEL
44	0010 1100	YAAA AAA 1	0	0	0	Save DTR as SYSTEM FAILURE LEVEL
45	0010 1101	YAAA AAA 1	0	0	0	Save DTR as POWER ON LEVEL
46	0010 1110	YAAA AAA 1	0	0	0	Save DTR as FADE TIME
47	0010 1111	YAAA AAA 1	0	0	0	Save DTR as FADE RATE
48-63	0011 XXXX					Not used
64-79	0100 XXXX	YAAA AAA 1	0	0	0	Save DTR as new value for scene 0-15
80-95	0101 XXXX	YAAA AAA 1	0	0	0	Remove ballast from scene 0-15, i.e. set 0xFF to the Scene register XXXX
96-111	0110 XXXX	YAAA AAA 1	0	0	0	Add ballast to group 0-15
112-127	0111 XXXX	YAAA AAA 1	0	0	0	Remove ballast from group 0-15
128	1000 0000	YAAA AAA 1	0	0	0	Save DTR as short address
129-143	1000 XXXX					Not used
144	1001 0000	YAAA AAA 1	0	0	0	Ballast status request **bit 0** – Ballast status; 0 = OK **bit 1** – Lamp failure; 0 = OK

						bit 2 – Power on; 0 = OK **bit 4** – Fading up/down; 0 = not active 1 = active **bit 5** – Ballast in reset mode; 0 = is not 1 = is in reset mode **bit 6** – Short ballast address missing; 0 = not missing **bit 7** – POWER FAILURE; 0 = no Power Failure
145	1001 0001	YAAA AAA 1	0	0	0	Ballast request; if ballast with this address is connected and communicative, it responds YES otherwise NO
146	1001 0010	YAAA AAA 1	0	0	0	Request if there is a problem with the lamp
147	1001 0011	YAAA AAA 1	0	0	0	Request if the lamp connected to the ballast is working properly
148	1001 0100	YAAA AAA 1	0	0	0	Request if the last command for writing actual level has been performed
149	1001 0101	YAAA AAA 1	0	0	0	Request if ballast is in Reset mode
150	1001 0110	YAAA AAA 1	0	0	0	Request if ballast is without short address
151	1001 0111	YAAA AAA 1	0	0	0	Returns ballast version according to IEC standard
152	1001 1000	YAAA AAA 1	0	0	0	Returns actual DTR value
153	1001 1001	YAAA AAA 1	0	0	0	Returns device type, standard is 0
154	1001 1010	YAAA AAA 1	0	0	0	Returns „PHYSICAL MINIMUM LEVEL“ value
155	1001 1011	YAAA AAA 1	0	0	0	Returns the POWER FAILURE value
156-159	1001 11XX					Not used
160	1010 0000	YAAA AAA 1	0	0	0	Returns the current light level
161	1010 0001	YAAA AAA 1	0	0	0	Returns the MAX LEVEL value
162	1010 0010	YAAA AAA 1	0	0	0	Returns the MIN LEVEL value
163	1010 0011	YAAA AAA 1	0	0	0	Returns the POWER ON LEVEL value
164	1010 0100	YAAA AAA 1	0	0	0	Returns the SYSTEM FAILURE LEVEL value
165	1010 0101	YAAA AAA 1	0	0	0	Returns the FADE TIME/FADE RATE value Answer **XXXXYYYY** means: XXXX = FADE TIME, and YYYY = FADE RATE
166-175	1010 XXXX					Not used
176-191	1011 XXXX	YAAA AAA 1	0	0	0	Returns the light level for the selected scene 0-15 0000 – scene 0
192	1100 0000	YAAA AAA 1	0	0	0	Returns the bit pattern indicating which groups the slave belongs to (0-7) **bit 0** = group 0 etc.

						value 0 = ballast is not member of the group value 1 = ballast is member of the group
193	1100 0001	YAAA AAA 1	0	0	0	Returns the bit pattern indicating which groups the slave belongs to (8-15), see above
194	1100 0010	YAAA AAA 1	0	0	0	Returns the high bits of the random address H
195	1100 0011	YAAA AAA 1	0	0	0	Returns the middle bits of the random address M
196	1100 0100	YAAA AAA 1	0	0	0	Returns the low bits of the random address L
197-223	110X XXXX					Not used
224-255	11XX XXXX	YAAA AAA 1	0	0	0	Extended requests, free to interpret
257	1010 0011	XXXX XXXX	0	0	0	Store value XXXX XXXX to DTR

Tab. 3: Address types

Short address	0-63	0AAAAAA1
Group address	0-15	100AAAA1
Broadcast		11111111
Direct control	0-63	0AAAAAA0
Direct control of a single ballast	0-63	1AAAAAA0
Direct control of group of ballasts	0-15	100AAAA0

Tab. 4: Extended commands

No.	DALI command (dec)	DALI address	D0	D1	D2	Function
258	258	YAAA AAA1	0100 XXXX	Value	0x01	Store value as new parameter of scene XXXX
259	259	1AAA AAA1	0110 XXXX 0111 XXXX	-	0x02	0110 XXXX = Add ballast to group XXXX 0111 XXXX = Remove ballast from group XXXX
260	260	YAAA AAA1	-	Value	0x03	Store value as „FADE TIME“
261	261	YAAA AAA1	-	Value	0x04	Store value as „FADE RATE“
262	262	YAAA AAA1	-	Value	0x05	Store value as „MAX LEVEL“
263	263	YAAA AAA1	-	Value	0x06	Store value as „MIN LEVEL“
264	264	YAAA AAA1	-	Value	0x07	Store value as „SYSTEM FAILURE LEVEL“
265	265	YAAA AAA1	-	Value	0x08	Store value as „POWER ON LEVEL“
266	266				0x09	Completely new addressing
267	267		Address to start with	0AAA AAA1	0x0A	New addressing of all ballasts with given address

268	268		Address to start with		0x0B	New addressing of ballasts without short address
269	269	0AAA AAA1	-	-	0x0C	Deletes given short address of ballast
270	270	YAAA AAA1 (current address)	-	YAAA AAA1 (new address)	0x0D	Changes current address to new address
271	271	YAAA AAA1	number of winks [1-255]	wink time in secs [1-255]	0x0E	winks the addressed ballast; wink values must not be 0!
272	272				0x0F	Short addresses request [0-31]
273	273				0x10	Short addresses request [32-63]
274	274				0x11	Ballast status request [0-31]
275	275				0x12	Ballast status request [32-63]
276	276				0x13	“Lamp failure“ request [0-31]
277	277				0x14	“Lamp failure“ request [32-63]
278	278				0x15	“Lamp power on“ request [0-31]
279	279				0x16	“Lamp power on“ request [32-63]

Tab. 5: Answers for extended commands

No.	DALI command	DALI address	D0	D1	D2	Function
258	-	-	-	-		
259	-	-	-	-	-	
260	-	-	-	-	-	
261	-	-	-	-	-	
262	-	-	-	-	-	
263	-	-	-	-	-	
264	-	-	-	-	-	
265	-	-	-	-	-	
266	-	-	Number of addressed ballasts [0-63]	-	-	Completely new addressing
267	-	-	Number of addressed ballasts [0-63]	-	-	New addressing of all ballasts with given address
268	-	-	Number of addressed ballasts [0-63]	-	-	New addressing of all ballasts without short address
269	-	-	-	-	-	
270	-	-	-	-	-	
271	-	-	-	-	-	
272	Addresses 8-15	Addresses 0-7	Addresses 23-31	Addresses 16-22	-	1 – Yes

						0 - No
273	Addresses 40-47	Addresses 32-39	Addresses 56-63	Addresses 48-55	-	1 – Yes 0 - No
274	Addresses 8-15	Addresses 0-7	Addresses 23-31	Addresses 16-22	-	1 - Error 0 - OK
275	Addresses 40-47	Addresses 32-39	Addresses 56-63	Addresses 48-55	-	1 - Error 0 - OK
276	Addresses 8-15	Addresses 0-7	Addresses 23-31	Addresses 16-22	-	1 - Error 0 - OK
277	Addresses 40-47	Addresses 32-39	Addresses 56-63	Addresses 48-55	-	1 - Error 0 - OK
278	Addresses 8-15	Addresses 0-7	Addresses 23-31	Addresses 16-22	-	1 - On 0 - Off
279	Addresses 40-47	Addresses 32-39	Addresses 56-63	Addresses 48-55	-	1 - On 0 - Off

Light level control

It is possible to control the light level using two different ways. DALI recognizes direct and indirect light level control.

Indirect light level control

The command consists of 2 bytes.

Byte 1 DALI address (short address / group address / broadcast)
Byte 2 Standard or Extended DALI command – see tables above.

Direct light level control

The command consists of 2 bytes.

Byte 1 DALI address; this is the DALI ballast short address, with the first bit of 0.
Byte 2 Light level: a number in the range of 0...255 which specifies a value within MIN LEVEL and MAX LEVEL interval. Example: MIN = 100, MAX = 200: to set the light to 50 %, a value of 150 must be sent.

This is a way how to control the light level directly without using of groups, scenes etc.

Example of Modbus TCP command

There are 8 "blocks" - (0 to 7) – which represent positions for the DALI commands. To execute a command

- the block(s) must be filled with the data representing the command(s)
- bit(s) in Register 5 LSB which corresponds to the block to be executed must be set.

After executing of the command, the info bit in register 5 MSB is set so that the Modbus master can read that the execution was OK.

If a command is generating a response, the response is stored in the D0..D2 registers of the particular block.

More blocks may be filled at the same time and executed all together by writing a corresponding bit pattern into register 5 LSB.

Example:

Tx: 00 07 00 00 00 0D 01 10 00 05 00 03 06 0B 05 00 00 00 00

A Modbus TCP example telegram for **ballast Adr 6: set to max (DALI function 5)**. It is written in command block 0 (Modbus register 6, which is Modbus address 5).

00 07 00 00 00 0D 01	Details see Modbus TCP frame structure
10	Modbus F16, write multiple registers
00 05	Modbus address to be written to, address 5 = register 6
00 03	Number of 16bit registers to be written
06	Number of bytes to follow
0B 05 00 00 00 00	The data is 0B 05 for command block 0, other command blocks 1 and 2 are empty (00 00 00 00) - (this is how the client software, with which the example was done, is communicating: it writes three blocks at a time; other clients may only send the first couple of bytes).

The most important data is **0B 05**.
05: LSB = DALI command, see Tab 2 No.5
0B: MSB = 0000 1011 - the structure of a standard DALI command - see Tab 2:

Y AAA AAA 1, where
Y = 0 for Short address (see Tab 3), and
AAA AAA = 000 101 = 5 = DALI address of the ballast.

In a similar way more command blocks may be filled, and then activated at the same time.

Another Modbus TCP telegram has to activate (execute) this command:

Address 6: execute block 0 (write 1 into Modbus register 5, or Modbus address 4)

00 08 00 00 00 09 01	Details see Modbus TCP frame structure
10	Modbus F16, write multiple registers
00 04	Modbus address to be written to, address 4 = register 5
00 01	Number of 16bit registers to be written
02	Number of bytes to follow
00 01	1 at Bit 0 means **Execute command block 1**. At this time the commands from Block D0 are sent to the DALI bus.

Registers for simple control and status monitoring

To make Modbus communication easier, it is possible to read out statuses and control the ballasts also **using a simple Modbus read / write commands to dedicated Modbus registers 30 to 182**. These commands are converted to DALI commands in the converter, and sent to the DALI bus (unlike the standard commands, where the Modbus client actually has to compile the DALI telegrams and send them over Modbus). The Modbus client then may assign a separate register or bit to each ballast which makes the Modbus client engineering easier.

It is necessary to enable the required functions in Register 30 (see table above) for two reasons:

- this communication may bring extra load to the DALI bus, it is advisable to set e.g. the status update interval to the longest acceptable time

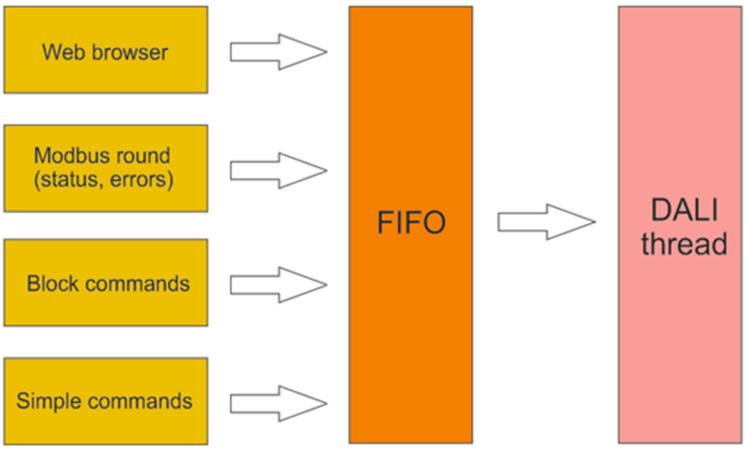
- only enabled command types are sent to the DALI bus – security reason.

If these functions are not used, they should be disabled in register 30.

Note that if more commands to control a single DALI ballast are set over different registers, the last one is active. Make sure that the Modbus client does not send weird commands over different registers which could spoil the DALI functionality.

To use the simple control commands in a proper way, it is necessary to understand the principle of command processing within the M090. There is an internal FIFO queue of 96 commands. The commands are read over the Modbus TCP interface or web pages, and put into the queue. On the queue output, the commands are translated into DALI telegrams, and sent to the DALI interface. **There is no feedback between the DALI command execution and the respective Simple command.** The Modbus server response to confirm a Simple command receipt only means that the

command has been received by the M090, not that the command has been queued or executed at the DALI bus.
There are no exceptions, priorities, nor any other internal logics in the queue. As the DALI bus communication speed is 1200 bps while the Modbus TCP commands travel at a speed of Ethernet, in case that the Simple commands are sent in a fast sequence, it may happen that the queue gets full.



If the queue is full, all incoming Modbus Simple commands are discarded. At the *Statistics* web page, there is a **Dali failure counter** item which counts the discarded commands. If this value is increasing steadily, it means that the Simple commands queue is permanently full and the Modbus communication should be less frequent.

Always select only the relevant simple command types at the *Conf* page. It is advised to disable the types of commands which are not used.

Firmware update

With firmware version 13, there are new functions in M090, which requires a specific firmware update process. The firmware update steps are as follows:

- Open the web page of the M090, go to *Administration*, and upload the new firmware file (*z_Upload.bin*)
- set the INIT switch at M090 to ON
- power off / on the M090
- the IP address of M090 is 192.168.1.99 now
- go to the M090 web pages, *Conf*
- click the *Write* button
- connect to the M090 over FTP (name / password: root / root99)
- delete all web pages which are in the M090
- copy the new web pages from your PC to the M090
- disconnect the FTP server
- set the INIT switch to OFF
- power off / on the M090
- set the new IP address of the module, and all other settings.

Changes in versions

04/2015 – Removing M090/300mA version.
07/2015 – From firmware version 01500 there is indication of bad communication between ballast and M090 converter in register 31-94 MSB bit 0.
10/2015 – Changed maximal working temperature.
11/2015 – Single master function emphasized.
11/2015 – Single master description – enhancement, adding of the Installation section
04/2016 – Information about F16 sector writing added, Modbus table history added.