DGW-521
User Manual

Warranty

All products manufactured by ICP DAS are under warranty regarding defective materials for a period of one year from the date of delivery to the original purchaser.

Warning

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Date: 2014/9/15

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1. Introduction

The DGW-521 is a communication gateway between the Modbus RTU/DCON and the DALI (Digital Addressable Lighting Interface) protocols, and allows a host PC, PAC, or TouchPAD to access DALI devices by providing three interfaces that enable conversion from RS-232/RS-485/USB to DALI. The module provides a built-in DALI power supply that can be enabled or disabled via a switch. DALI is an international standard for lighting control interfaces, and is suitable for DALI lighting systems covering small areas. The maximum length of the DALI signal cables cannot exceed 300 m.

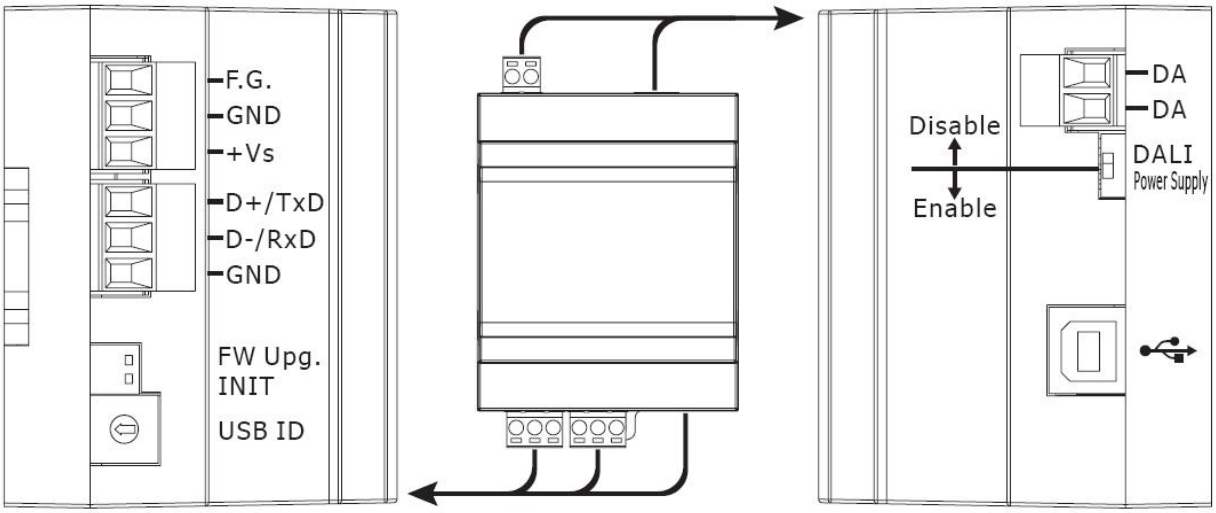
The features of the DGW-521 are as follows:

1. Conversion between RS-485/RS-232/USB and DALI Interfaces
2. Easy Deployment: The ID Code can be written by the RS-485 Interface
3. Simplified Wiring Process
4. Built-in DALI Power can be enabled or disabled using a Switch
5. 1500 VDC Isolation
6. ±4 ESD Protection for the RS-232/485/USB Data Line
7. ±4 kV EFT Protection and ±2 kV Surge Protection for Power Line
8. DIN-Rail Mounting
9. Wide Operating Temperature Range: -25 °C ~ +75 °C

1.1 More Information

- For details of **INIT mode** operation, please refer to Section A.1 INIT Mode.
- For details of **module watchdog** and **host watchdog**, please refer to Section A.2 Dual Watchdog Operation.

1.2 Terminal Assignment

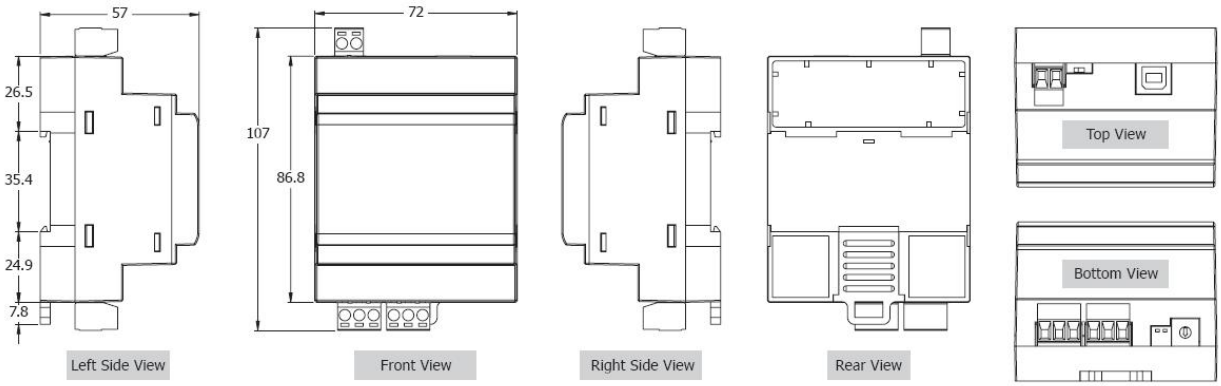


1.3 Specifications

Interface		
DALI	Connector	2-pin Terminal Block
	Baud Rate (bps)	1200
	Isolation	1500 V_{DC}
	Build-in DALI power	DC 16 V_{DC} ± 5%, max. current 250 mA (Enabled/Disabled via a switch)
UART	COM Port	RS-485/RS-232
	Connector	3-pin Terminal Block(D+, D-, GND), Jumper Selectable
	Transmission Distance (m)	Depends on Baud Rate
	Baud Rate (bps)	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200
	Protocol	DCON, Modbus RTU
USB	Connector	USB Type B
	Transmission Speed	12M bps
	Specification	USB 1.1 and USB 2.0 standard compatible
	OS Support	Windows XP (32/64 bit), Windows 7 (32/64 bit)
	Protocol	DCON and Modbus RTU via virtual COM port
LED Indicators		
Round LED		PWR/RUN/ERR LED
EMS Protection		
ESD (IEC 61000-4-2)		±4 kV contact for Each Terminal, ±8 kV Air for Random Point
EFT (IEC 61000-4-4)		±4 kV for Power Line
Surge (IEC 61000-4-5)		±2 kV for Power Line
Power		
Power Supply		Unregulated +10 VDC ~ +30 VDC
Connector		3-pin Terminal Block
Protection		Power Reverse polarity protection, Overvoltage Brown-out Protection
Consumption		6 W.

Mechanical	
Casing	Plastic
Flammability	Fire-Retardant Materials (UL94-V0 Level)
Dimensions (L x W x H)	107 mm x 72 mm x 57 mm
Installation	DIN-Rail Mounting
Environment	
Operating Temperature	-25 °C ~ +75 °C
Storage Temperature	-30 ~°C +80 °C
Humidity	10 %~ 95% RH, Non-condensing

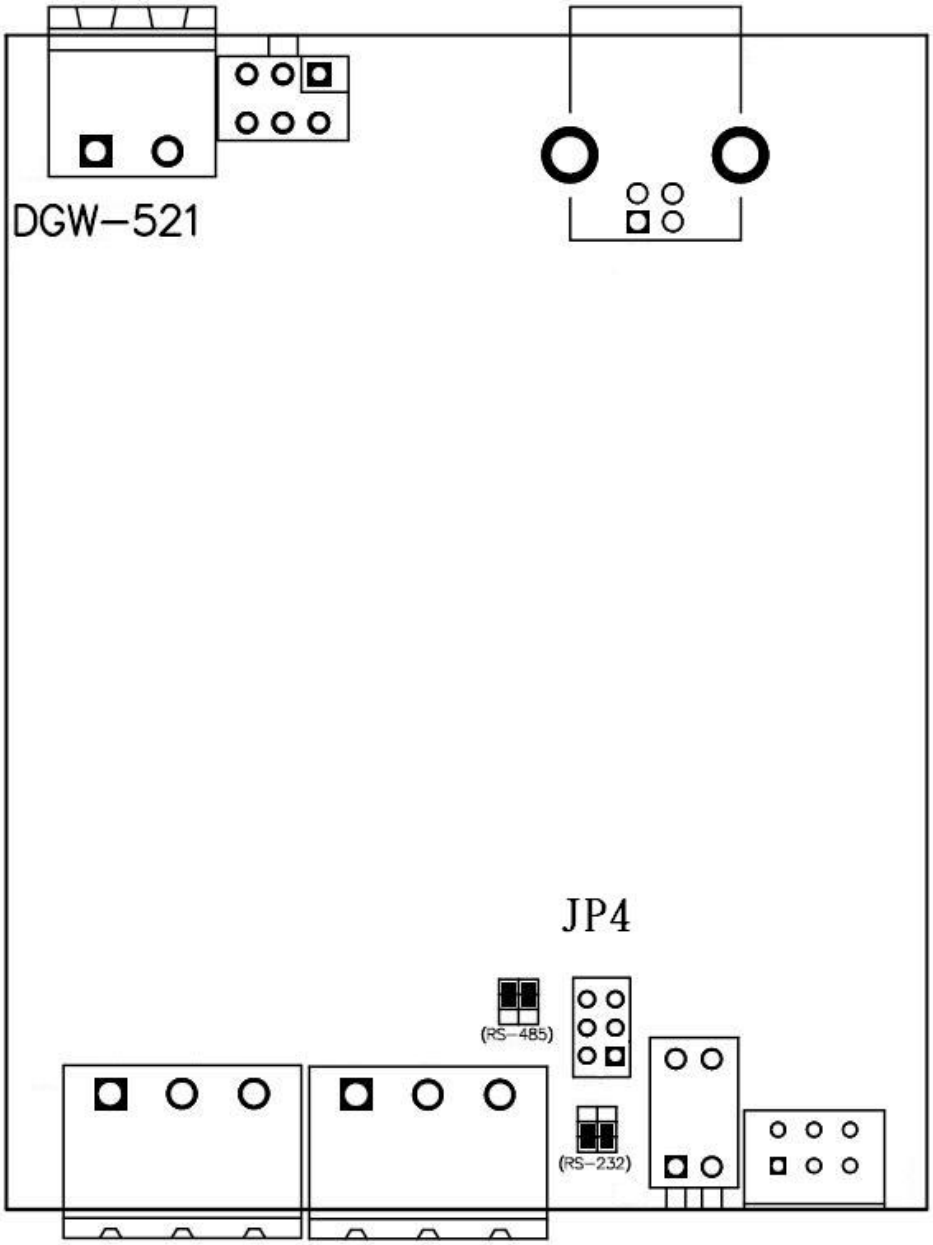
1.4 Dimensions



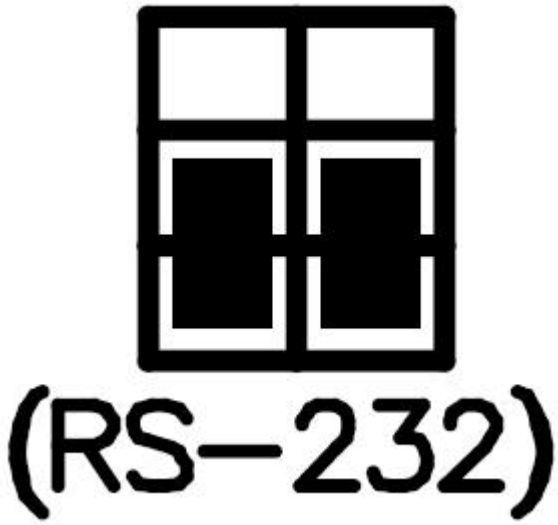
1.5 Jumper Setting

Note: To access the jumper, the cover must be opened.

For DGW-521 the RS-485 terminals are shared with the RS-232 terminals. The functionality of the terminals is set using the JP4 jumper. The position of the JP4 jumper is shown in the figure below.



The settings for the JP4 jumper are as follows.

	The terminals are used for RS-485 communication. (factory default)
	The terminals are used for RS-232 communication.

1.6 Quick Start

Please refer to the Quick Start for DGW-521.

1.7 Default Settings

Default settings for the DGW-521 are as follows:

- Protocol: Modbus RTU
- Module Address: 01
- Baud Rate: 9600 bps

1.8 USB Driver Installation

To connect the DGW-521 via the USB port, the USB driver must be installed. The driver installation file can be downloaded from ICP DAS web site http://ftp.icpdas.com.tw/pub/cd/usb_tm/napdos/dgw-521/ or the accompany CD. The installation procedure is as follows:

1. Execute icpusbconverter_drvinst_v1.x.exe to install the necessary driver files to the system.
2. Plug in the DGW-521 to the USB port and Windows will detect the new device and shows the message “Found New Hardware Wizard” screen prompting you to install the driver for the detected USB Device. Please select “No, not this time” option and click “Next” button.
3. Select “install from a list or specific location (Advanced)” option and click “Next” button.
4. Select “Search for the best driver in these locations” option and check “include this location in the search:” checkbox and click “Browser” button to assign the DGW-521 driver location - C:\WINDOWS\inf\ and then click “Next” button.
5. Click “Continue Anyway” button.
6. Click “Finish” button to complete DGW-521 device driver installation.

If the driver is installed successfully, then there will be a "Virtual COM Port" assigned by Windows. Please follow the below steps to check it.
Click "Start" -> "Settings" -> "Control Panel" and then double click on the "System" icon. Once the "System Properties" screen displayed, click on " Hardware" tab and then click on the "Device Manager" button. Double-click on Ports (COM & LPT) item. If the device driver was correctly installed, you can find the "ICPDAS DGW-521 USB2DALI" device listing and the "Virtual COM Port" number that Windows has assigned to the device is COM6, for example.

Note: If you have more than one DGW-521 connected to the same system, then the USB ID of the modules should be set to different. The USB ID is set by the rotary switch as shown below.

1.9 DALI Commands

DALI (Digital Addressable Light Interface) is a protocol used for lighting control. It can support up to 64 DALI devices on a DALI bus, up to 16 scenes and up to 16 groups. The following sections summarize some DALI commands used frequently. For details of the commands, please refer to Section 2 and 3.1.

1.9.1 Find all DALI devices on the DALI bus

To find all of the DALI devices on the DALI bus, send the following command.

DCON	@AADF1
Modbus RTU	write 1 to register 00259

Send the following command to get the status of the previous command, until the status is 0, finished.

DCON	@AADF
Modbus RTU	Read register 00259

Get the presence map of the DALI devices on the DALI bus. A bit is set to 1 when the corresponding DALI device is present.

DCON	@AADP
Modbus RTU	Read registers 30289 ~ 30292

1.9.2 Allocate address to DALI device

When you receive a new DALI device, its address may not be allocated. You can send the following command to allocate address to it. You can allocate address to either all devices, device with specified address, or devices without address.

DCON	@AADNddff
Modbus RTU	write to register 40322

To get the status of address allocation, send the following command. The status data is one when the allocation is finished.

DCON	@AADN
Modbus RTU	Read register 40322

1.9.3 Change address of a DALI device

To change the address of a DALI device which address is allocated, send the following command.

DCON	@AADRoonn
Modbus RTU	write to register 40321

To get the status of changing address, send the following command. When it is finished, the status data is one.

DCON	@AADR
Modbus RTU	Read register 40321

1.9.4 Send DALI command

The DGW-521 can accept 8 DALI commands and the commands to DALI devices in sequence. The following command is used to send DALI command.

DCON	@AADCnddcc
Modbus RTU	write to one of the register 40033 ~ 40040

The command data format is the same as the standard DALI command, that is, the first byte is address byte and the second one is data byte.

Address byte format:

7	6	5	4	3	2	1	0
CB	A5	A4	A3	A2	A1	A0	SB

Key	Description
CB	Address Classification Bit 0: A5 ~ A0 specifies the device address 1: A5 ~ A0 is 111111 for broadcasting A5 ~ A4 is 11, A3 ~ A0 specifies the group address
SB	Select Bit 0: the data byte specifies the lamp power 1: the data byte specifies the command

To get the status of the DALI command execution, send the following command. A bit is set to one when the corresponding DALI command is finished.

DCON	@AADE
Modbus RTU	Read register 30257

When a DALI command is finished and it should have response, the following command can be sent to get the response.

DCON	@AADSn
Modbus RTU	Read one of the register 30001 ~ 30008

1.10 Configuration Tables

Baud Rate Setting (CC)

7	6	5	4	3	2	1	0
Data		Baud					

Key	Description
Baud	Baud Rate 03: 1200 04: 2400 05: 4800 06: 9600 07: 19200 08: 38400 09: 57600 0A: 115200
Data	Data Format 0: eight data bits, no parity, and one stop bit 1: eight data bits, no parity, and two stop bit 2: eight data bits, even parity, and one stop bit 3: eight data bits, odd parity, and one stop bit

Data Format Setting (FF)

7	6	5	4	3	2	1	0
RS	CS	RS					

Key	Description
CS	Checksum setting 0: Disabled 1: Enabled
RS	Reserved.

Note: The reserved bits should be zero.

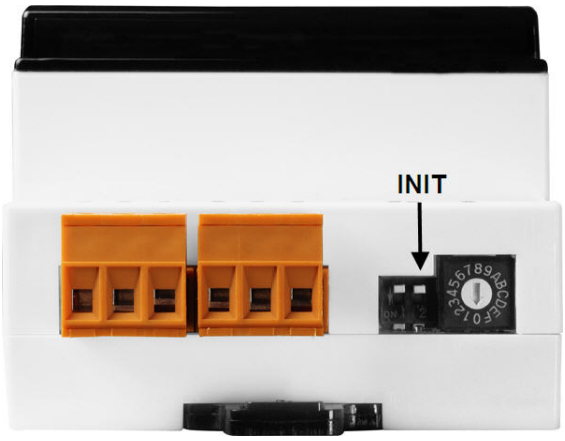
1.11 Protocol Switching

To switch to the DCON protocol:

1. Set the Modbus register 00257 to zero.
2. After a power-on reset, the communication protocol will be changed to DCON.

To switch to the Modbus RTU protocol:

1. Sends the $AAPN command and set N to a value of 1. Note that for the DGW-521, the INIT switch of the module should be set to the INIT position, see the figure shown below.
2. After a power-on reset, the communication protocol will be changed to the Modbus RTU protocol.



1.12 Technical Support

Should you encounter problems while using the DGW-521 module, and are unable to find the help you need in this manual or on our website, please contact ICP DAS Product Support.

Email: service@icpdas.com
Website: http://www.icpdas.com.tw/contact_us/contact_us.html

When requesting technical support, be prepared to provide the following information about your system:

1. Module name and serial number: The serial number can be found printed on the barcode label attached to the cover of the module.
2. Firmware version: See Section 2. and 3.1 for information regarding the command used to identify the firmware version.
3. Host configuration (type and operating system)
4. If the problem is reproducible, please give full details describing the procedure used to reproduce the problem.
5. Specific error messages displayed. If a dialog box with an error message is displayed, please include the full text of the dialog box, including the text in the title bar.
6. If the problem involves other programs or hardware devices, please describe the details of the problem in full.
7. Any comments and suggestions related to the problem are welcome.

ICP DAS will reply to your request by email within three business days.

2. DCON Protocol

All communication with DGW-521 consists of commands generated by the host and responses transmitted by the DGW-521 modules. Each module has a unique ID number that is used for addressing purposes and is stored in non-volatile memory. The ID is 01 by default and can be changed using a user command. All commands to the modules contain the ID address, meaning that only the addressed module will respond. The only exception to this is command ~**, which is sent to all modules, but in these cases, the modules do not reply to the command.

Command Format:

Leading Character	Module Address	Command	[CHKSUM]	CR

Response Format:

Leading Character	Module Address	Data	[CHKSUM]	CR

CHKSUM A 2-character checksum that is present when the checksum setting is enabled.

CR End of command character, carriage return (0x0D)

Checksum Calculation:

1. Calculate the ASCII code sum of all the characters in the command/response string except for the carriage return character (CR).
2. The checksum is equal to the sum masked by 0ffh.

Example:

Command string: $012(CR)

1. Sum of the string = “$”+”0”+”1”+”2” = 24h+30h+31h+32h = B7h
2. Therefore the checksum is B7h, and so
   CHKSUM = “B7”
3. The command string with the checksum = $012B7(CR)

Response string: !01200600(CR)

1. Sum of the string =
   “!”+”0”+”1”+”2”+”0”+”0”+”6”+”0”+”0” =
   21h+30h+31h+32h+30h+30h+36h+30h+30h = 1AAh
2. Therefore the checksum is AAh, and so
   CHKSUM = “AA”
3. The response string with the checksum = !01200600AA(CR)

Note:

All characters should be in upper case.

General Command Sets		
Command	**Response**	**Description**
%AANNTTCCFF	!AA	Set Module Configuration
$AA2	!AANNTTCCFF	Reads the Module Configuration
$AA5	!AAS	Reads the Reset Status
$AAF	!AA(Data)	Reads the Firmware Version
$AAM	!AA(Data)	Reads the Module Name
$AAP	!AASC	Reads the Protocol
$AAPN	!AA	Sets the Protocol, N=0 for DCON protocol, 1 for Modbus RTU protocol
~AAO(Name)	!AA	Sets the Module Name
~AARD	!AAVV	Reads the response delay time, VV in hex format
~AARDVV	!AA	Sets the response delay time, VV = 00 ~ 1E in hex format

DALI Command Sets		
Command	**Response**	**Description**
@AADCiddcc	!AA	Sends DALI command, i: command index, 0 ~ 7, dd: command address in hex, cc: command data in hex
@AADE	!AAhh	Gets the execution status of the DALI commands, hh in hex, each bit for each command and the value is 1 for command finished and 0 for command not finished or no command executed
@AADF	!AAs	Gets the status of finding all DALI devices, s is 0 for finished and 1 for finding
@AADF1	!AA	Finds all of the DALI devices connected on the DALI bus
@AADN	!AAnnss	Gets the status of address allocation, nn is the number of addresses allocated in hex, ss is the allocation status 00: no allocation command 01: finished 02: allocating 03: old address not available 04: invalid address data 05: too many addresses to be allocated

Command	Response	Description
@AADNddff	!AA	Allocates address for DALI devices dd: address in hex 00: all DALI devices will be allocated (Address<<1)+1: DALI device with address "Address" will be allocated FF: DALI devices without address will be allocated ff: set to 01 to check the presence of all DALI devices before allocating address, otherwise, set to 00
@AADP	!AA(data)	Get all DALI devices presence map, (data) is 64-bit in hex, bit n is set to 1 if there is DALI device at address n
@AADR	!AAs	Gets the status of changing address of DALI devices, s is 0: no changing of DALI address 1: changing DALI address OK 2: busy in changing DALI address 3: invalid old address 4: invalid new address
@AADRoonn	!AA	Changes the address of DALI device, oo is the old address in hex, 00 ~ 3F and nn is the new address in hex, 00 ~ 3F, or set to FF to remove the addrss
@AADSn	!AArrss	Gets the DALI command status and response rr: command response in hex, ss command status 00: no command 01: command to be executed 02: executing command 03: command finished and answer not available 04: command finished and no answer received 05: command finished and answer got data 06: command finished and invalid data in answer 07: command finished and answer too early

Host Watchdog Command Sets		
Command	**Response**	**Description**
~**	No Response	Host OK
~AA0	!AASS	Reads the Host Watchdog Status
~AA1	!AA	Resets the Host Watchdog Status
~AA2	!AAETT	Reads the Host Watchdog Timeout Settings
~AA3ETT	!AA	Sets the Host Watchdog Timeout Settings

3. Modbus Protocol

The Modbus protocol is developed by Modicon Inc., originally developed for Modicon controllers. Detailed information can be found at http://www.modicon.com/techpubs/toc7.html. You can also visit http://www.modbus.org to find more valuable information.

The DGW-521 module supports the Modbus RTU protocol. The communication baud rates range from 1200bps to 115200bps.

3.1 Address Mappings

DGW-521 Address Mappings

Address	Description	Attribute
00257	Protocol, 0: DCON, 1: Modbus	R/W
00259	Write 1 to find all DALI slaves. Response: 1-> busy in finding all DALI slaves, 0-> finished	R/W
00261	1: enable, 0: disable host watchdog	R/W
00270	Host watch dog timeout status, write 1 to clear host watch dog timeout status	R/W
00273	Reset status, 1: first read after powered on, 0: not the first read after powered on	R
30001	Status and response of DALI Command 1*[1]	R
30002	Status and response of DALI Command 2*[1]	R
30003	Status and response of DALI Command 3*[1]	R
30004	Status and response of DALI Command 4*[1]	R
30005	Status and response of DALI Command 5*[1]	R
30006	Status and response of DALI Command 6*[1]	R
30007	Status and response of DALI Command 7*[1]	R
30008	Status and response of DALI Command 8*[1]	R
40033	DALI command 1*[2]	R/W
40034	DALI command 2*[2]	R/W
40035	DALI command 3*[2]	R/W
40036	DALI command 4*[2]	R/W
40037	DALI command 5*[2]	R/W
40038	DALI command 6*[2]	R/W
40039	DALI command 7*[2]	R/W
40040	DALI command 8*[2]	R/W
30257	Status of command execution, bit 0 for command 1, bit 1 for command 2, etc. When the bit is 1, it means the command execution is finished and new command can be input.	R

Address	Description	Attribute
30289	Presence of DALI slaves 0 ~ 15, bit 0 for slave 0, bit 1 for slave 1, etc. When the bit is 1, it means the slave is present.	R
30290	Presence of DALI slaves 16 ~ 31, bit 0 for slave 16, bit 1 for slave 17, etc. When the bit is 1, it means the slave is present.	R
30291	Presence of DALI slaves 32~ 47, bit 0 for slave 32, bit 1 for slave 33, etc. When the bit is 1, it means the slave is present.	R
30292	Presence of DALI slaves 48 ~ 63, bit 0 for slave 48, bit 1 for slave 49, etc. When the bit is 1, it means the slave is present.	R
40321	Change or remove DALI slave address Low byte: old address High byte: 0 ~ 63, new address; set to 255 to remove the address Response: 1: busy in changing slave address 0: finished	R/W
40322	DALI slave address allocation Low byte: 0x00: all slaves will be allocated (Address<<1)+1: slave with address 'Address' will be allocated 0xFF: slaves without address will be allocated High byte: Set to 1 to check the presence of all DALI slaves before allocating address Response: Low byte: 0: no allocation command 1: finished 2: allocating 3: old address not available 4: invalid address data 5: too many addresses to be allocated	R/W

<table>
<tr><th>Address</th><th>Description</th><th>Attribute</th></tr>
<tr><td></td><td>High byte:
Number of addresses allocated</td><td></td></tr>
<tr><td>40481</td><td>Firmware version (low word)</td><td>R</td></tr>
<tr><td>40482</td><td>Firmware version (high word)</td><td>R</td></tr>
<tr><td>40483</td><td>Module name (low word)</td><td>R</td></tr>
<tr><td>40484</td><td>Module name (high word)</td><td>R</td></tr>
<tr><td>40485</td><td>Module address, valid range: 1 ~ 247</td><td>R/W</td></tr>
<tr><td>40486</td><td>Bits 5:0
Baud rate, 0x03 ~ 0x0A
<table>
<tr><td>Code</td><td>0x03</td><td>0x04</td><td>0x05</td><td>0x06</td></tr>
<tr><td>Baud</td><td>1200</td><td>2400</td><td>4800</td><td>9600</td></tr>
<tr><td>Code</td><td>0x07</td><td>0x08</td><td>0x09</td><td>0x0A</td></tr>
<tr><td>Baud</td><td>19200</td><td>38400</td><td>57600</td><td>115200</td></tr>
</table>
Bits 7:6
00: no parity, 1 stop bit
01: no parity, 2 stop bits
10: even parity, 1 stop bit
11: odd parity, 1 stop bit</td><td>R/W</td></tr>
<tr><td>40488</td><td>Modbus response delay time in ms, valid range: 0 ~ 30</td><td>R/W</td></tr>
<tr><td>40489</td><td>Host watchdog timeout value, 0 ~ 255, in 0.1s</td><td>R/W</td></tr>
<tr><td>40492</td><td>Host watchdog timeout count, write 0 to clear</td><td>R/W</td></tr>
</table>

Notes:

1. Format of the response and status word
   High byte: DALI response
   Low byte: status of command execution
   0: no command
   1: command to be executed
   2. command is being executed
   3. command execution is finished and DALI answer not available
   4: command execution is finished and nothing received
   5: command execution is finished and got DALI data
   6. command execution is finished and invalid DALI data
   7: command execution is finished and DALI answer too early

2. Format of the DALI command word
   Low byte: command code
   High byte: DALI address
   Bit 0: 0-> the low byte is direct lamp power value, 1-> the low byte is command code
   Bit 1 ~ 6: short address when bit 7 is 0
   Bit 1 ~ 4: group address when bit 7 is 1
   Bit 1 ~ 7: all set to 1 for broadcast command

4. Troubleshooting

If you are having difficulty using the DGW-521 module, here are some suggestions that may help. If you cannot find the answers you need in these guides, contact ICP DAS Product Support. Contact information is located in Section 1.12.

4.1 Communicating with the module

If you attempt to communicate with the module and receive no response, first check the following:

- Make sure the supplied power is within the range of +10 to +30 V DC. If the supplied power is OK, then the power LED should be on.
- When the module receives a command, the power LED is set to “off”. The power LED is shown as “on” after the module responds. This method can be used to check whether the module has received a command sent from the host.
- If possible, use another device to check whether the host can communicate with the device through the same RS-485 network.
- If the host is a PC installed with a Windows operating system, then execute the DCON Utility to determine whether the module can be found. The DCON Utility can be downloaded from the ICP DAS website http://www.icpdas.com. The DCON Utility documentation can be found in the “**Getting Started For I-7000 Series Modules**” manual.
- Set the module to “INIT mode” and communicate with the module using the following settings: address 00, Baud Rate 9600bps, no checksum and DCON protocol. See Section A.1 for details.

A. Appendix

A.1 INIT Mode

Each DGW-521 has a built-in EEPROM to store configuration information such as module address, type code, Baud Rate, etc. Occasionally, the configuration of a module may be forgotten and there are no visual indications of the configuration of the module. It is difficult to communicate with the module when the configuration of the module is unknown. To help avoid this problem, the DGW-521 has a special mode called **"INIT mode"**. When the module is powered on in **"INIT mode"** the configuration of the module is reset as follows, allowing it to be operated as normal.

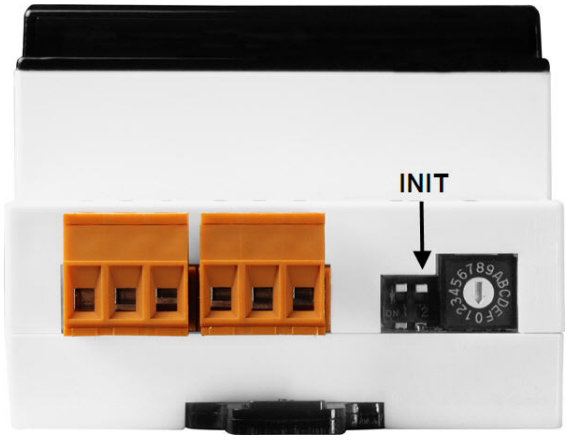
1. Address: 00
2. Baud Rate: 9600 bps
3. No checksum
4. Protocol: DCON

The configuration information stored in the EEPROM is not changed and they can be read by sending the $002(CR) command at 9600bps.

There are commands that require the module to be in INIT mode. They are:

1. %AANNTTCCFF when changing Baud Rate and checksum settings.
2. $AAPN

The DGW-521 has the INIT switch located on the bottom side of the module allow easier access to INIT mode. For these modules, INIT mode is accessed by sliding the INIT switch to the INIT position as shown below.



A.2 Dual Watchdog Operation

Dual Watchdog = Module Watchdog + Host Watchdog

The Module Watchdog is a hardware reset circuit that monitors the operating status of the module. While working in harsh or noisy environments, the module may be shut down by external signals. The circuit allows the module to work continuously without disruption.

The Host Watchdog is a software function that monitors the operating status of the host. Its purpose is to prevent problems due to network/communication errors or host malfunctions. When a host watchdog time out occurs, the module will reset all outputs to a safe state in order to prevent any erroneous operations of the controlled target.

The DGW-521 includes an internal Dual Watchdog, making the control system more reliable and stable.