



Data Mapping Guide for BL67 DeviceNet™ Gateway

Scope

This BL67 application note provides:

- Guideline for DeviceNet gateway data mapping
- IO data size for each type of IO module
- Procedure for configuration of 1747-SDN DeviceNet scanner
- Description of status and control words
- Description of LED indicators

The same IO data map, as shown in the note, may be obtained by using **IOassistant** configuration software, by TURCK.

Module IO data size

The discrete and analog input modules are mapped into input data map. This data is referred to as produced data or input data, from PLC stand point of view. Output modules are mapped into output data map. This data map is referred to as consumed or output data. Specialty modules are mapped into both input and output data map.

The discrete module data format is Byte or Word oriented, which depends on capacity of an IO module. The analog module data format is signed integer (16-bit analog-to-digital conversion format) or unsigned integer (12-bit left justified ADC format). The IO data size is usually entered into scan list as byte count. For example: 24 bytes of input data and 16 bytes of output data, as shown hereafter, in example 1 data mapping.

The following tables provide memory requirements for each type of BL67 module.

| Gateway | Memory requirements | |
|------------|-----------------------|-----------------------|
| | Input Map | Output Map |
| BL67-GW-DN | 2 bytes ¹⁾ | 2 bytes ²⁾ |

| Discrete Modules | Memory requirements | |
|--------------------------|---------------------|------------|
| | Input Map | Output Map |
| Input | | |
| BL67-4DI-P | 4 bits | |
| BL67-4DI-N | 4 bits | |
| BL67-4DI-PD | 4 bits | |
| BL67-8DI-P | 8 bits | |
| BL67-8DI-N | 8 bits | |
| BL67-8DI-PD | 8 bits | |
| Output | | |
| BL67-4DO-0.5A-P | | 2 bits |
| BL67-4DO-2A-P | | 2 bits |
| BL67-4DO-2A-N | | 2 bits |
| BL67-8DO-0.5A-P | | 2 bits |
| BL67-8DO-0.5A-N | | 2 bits |
| Discrete Combined | | |
| BL67-4DI4DO-PD | 4 bits | 4 bits |
| BL67-8XSG-PD | 8 bits | 8 bits |



| Analog Modules | Memory requirements | |
|----------------|---------------------|------------|
| | Input Map | Output Map |
| Input | | |
| BL67-2AI-I | 4 bytes | |
| BL67-2AI-V | 4 bytes | |
| BL67-2AI-PT | 4 bytes | |
| BL67-2AI-TC | 4 bytes | |
| BL67-4AI-V/I | 8 bytes | |
| Output | | |
| BL67-2AO-I | | 4 bytes |
| BL67-2AO-V | | 4 bytes |

| Specialty Modules | Memory requirements | |
|-------------------|---------------------|------------|
| | Input Map | Output Map |
| BL67-1SSI | 8 bytes | 8 bytes |
| BL67-1RS232 | 8 bytes | 8 bytes |
| BL67-1RS422/485 | 8 bytes | 6 bytes |

BL67 Data Mapping

BL67 creates its IO data map during device initialization at power-up or upon "SET" button being pressed. The gateway allocates for each module necessary space in input and/or output data map. This process is done in sequential order starting from the gateway to the right of it.

The mapped data interpretation, in terms of the least (b0) and most (b15) significant bits, is identical to 16-bit PLC memory map commonly found in AB SLC-500 series of PLC's. For example, the BL67 status word has the following format:

| BIT | 15 | 14 | 13 | 12 | 11 | 10 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
|-------|---------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| I:1.1 | GATEWAY STATUS WORD | | | | | | | | | | | | | | | |

I: 1.1 notification has the following meaning:

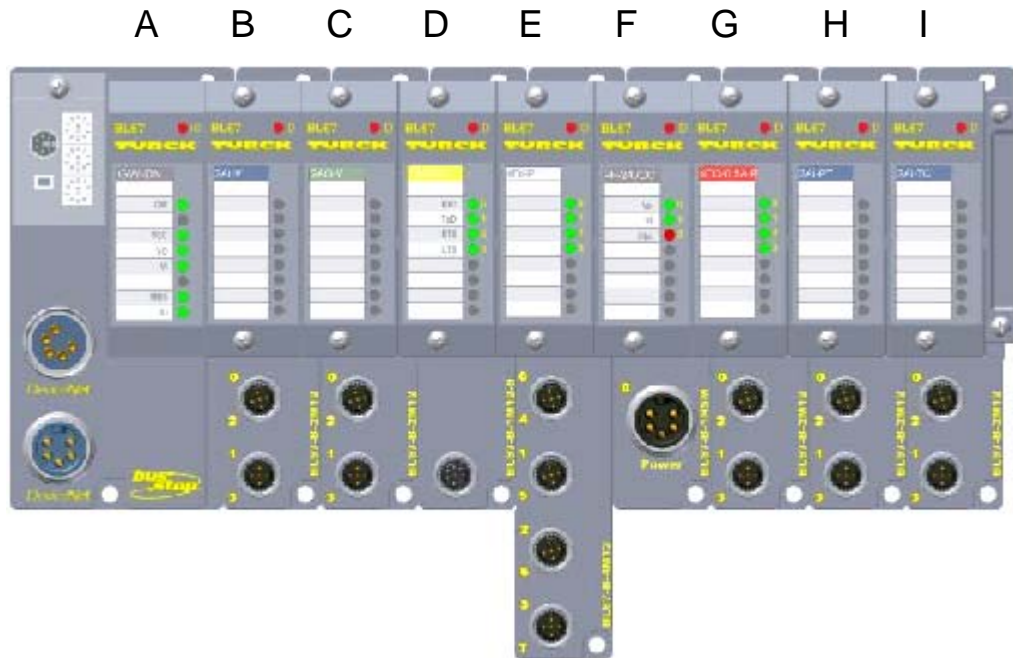
- I = indicates discrete input table of the SLC500 controller
- 1 = indicates slot number where the scanner card is located
- 0001 = indicates offset counted in words, from the beginning of the table

O:1.1 indicates the output data table, slot 1, offset 1.

| BIT | 15 | 14 | 13 | 12 | 11 | 10 | 09 | 08 | 07 | 06 | 05 | 04 | 03 | 02 | 01 | 00 |
|-------|----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| O:1.1 | GATEWAY CONTROL WORD | | | | | | | | | | | | | | | |

Example 1:

The following hardware configuration is used to show data mapping:



Designators Ax, Bx, Cx, etc. are bogus and are used to differentiate modules in the IO map. They have following meaning:

- A, B, C, ... indicate the position of the BL67 modules in the BL67 rack,
- "x" indicates position of a discrete IO point or bit position of an analog value.

I/O Mapping Rules

- The first word of the input data map is always reserved for the BL67 status word.
- The first word of the output data map is always reserved for the BL67 control word. The value of the control word is always '0' from a PLC prospective.
- Power refreshing or feeding modules are not included in this process, as they do not carry any information.
- Analog I/O is always mapped as 16-bit information starting from bit0 of the next free word location.
- Consecutive discrete I/O modules are mapped in the same word as long as space is available. If the next discrete module can not fit into current word, then:
 - Current word is rounded-up with unused bits (reserved space)
 - Module is mapped into next memory word. It means that new word is written when there in not enough free space in current memory word to fit all data of a single module.
- If the last word of input or output data map is always rounded-up to the word boundary when it is partially used.

EDS file parameters 9 and 10 contain the length of input and output data respectively.



Table 3: BL67 DeviceNet Gateway

| Module Pos. | Module Part Number | Desc. | Data Size In | Data Size Out |
|---|--------------------|---------|-----------------|------------------|
| Position 0* | BL67-GW-DN | Term OA | 16 bits(status) | 16 bits(control) |
| Position 1 | BL67-2AI-V | Term OB | 32 bits | 0 bits |
| Position 2 | BL67-2AO-V | Term OC | 0 bits | 32 bits |
| Position 3 | BL67-1RS232 | Term OD | 64 bits | 64 bits |
| Position 4 | BL67-4DI-P | Term OE | 4 bits | 0 bits |
| Position 5 | BL67-PF-24VDC | Term OF | 0 bits | 0 bits |
| Position 6 | BL67-4DO-0.5A-P | Term OG | 0 bits | 4 bits |
| Position 7 | BL67-2AI-PT | Term OH | 32 bits | 0 bits |
| Position 8 | BL67-2AI-TC | Term OI | 32 bits | 0 bits |
| Total Data In/Out size in Bytes: | | | 24 Byte | 16 Byte |

BL67 Discrete Input Map: 24 bytes of input data

| - | Byte n+1 | | | | | | | | Byte n | | | | | | | |
|---------|----------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Word 0* | 0A.15 | 0A.14 | 0A.13 | 0A.12 | 0A.11 | 0A.10 | 0A.9 | 0A.8 | 0A.7 | 0A.6 | 0A.5 | 0A.4 | 0A.3 | 0A.2 | 0A.1 | 0A.0 |
| Word 1 | 0B.15 | 0B.14 | 0B.13 | 0B.12 | 0B.11 | 0B.10 | 0B.9 | 0B.8 | 0B.7 | 0B.6 | 0B.5 | 0B.4 | 0B.3 | 0B.2 | 0B.1 | 0B.0 |
| Word 2 | 0B.31 | 0B.30 | 0B.29 | 0B.28 | 0B.27 | 0B.26 | 0B.25 | 0B.24 | 0B.23 | 0B.22 | 0B.21 | 0B.20 | 0B.19 | 0B.18 | 0B.17 | 0B.16 |
| Word 3 | 0D.15 | 0D.14 | 0D.13 | 0D.12 | 0D.11 | 0D.10 | 0D.9 | 0D.8 | 0D.7 | 0D.6 | 0D.5 | 0D.4 | 0D.3 | 0D.2 | 0D.1 | 0D.0 |
| Word 4 | 0D.31 | 0D.30 | 0D.29 | 0D.28 | 0D.27 | 0D.26 | 0D.25 | 0D.24 | 0D.23 | 0D.22 | 0D.21 | 0D.20 | 0D.19 | 0D.18 | 0D.17 | 0D.16 |
| Word 5 | 0D.47 | 0D.46 | 0D.45 | 0D.44 | 0D.43 | 0D.42 | 0D.41 | 0D.40 | 0D.39 | 0D.38 | 0D.37 | 0D.36 | 0D.35 | 0D.34 | 0D.33 | 0D.32 |
| Word 6 | 0D.63 | 0D.62 | 0D.61 | 0D.60 | 0D.59 | 0D.58 | 0D.57 | 0D.56 | 0D.55 | 0D.54 | 0D.53 | 0D.52 | 0D.51 | 0D.50 | 0D.49 | 0D.48 |
| Word 7 | - | - | - | - | - | - | - | - | - | - | - | - | 0E.3 | 0E.2 | 0E.1 | 0E.0 |
| Word 8 | 0H.15 | 0H.14 | 0H.13 | 0H.12 | 0H.11 | 0H.10 | 0H.9 | 0H.8 | 0H.7 | 0H.6 | 0H.5 | 0H.4 | 0H.3 | 0H.2 | 0H.1 | 0H.0 |
| Word 9 | 0H.31 | 0H.30 | 0H.29 | 0H.28 | 0H.27 | 0H.26 | 0H.25 | 0H.24 | 0H.23 | 0H.22 | 0H.21 | 0H.20 | 0H.19 | 0H.18 | 0H.17 | 0H.16 |
| Word 10 | 0I.15 | 0I.14 | 0I.13 | 0I.12 | 0I.11 | 0I.10 | 0I.9 | 0I.8 | 0I.7 | 0I.6 | 0I.5 | 0I.4 | 0I.3 | 0I.2 | 0I.1 | 0I.0 |
| Word 11 | 0I.31 | 0I.30 | 0I.29 | 0I.28 | 0I.27 | 0I.26 | 0I.25 | 0I.24 | 0I.23 | 0I.22 | 0I.21 | 0I.20 | 0I.19 | 0I.18 | 0I.17 | 0I.16 |

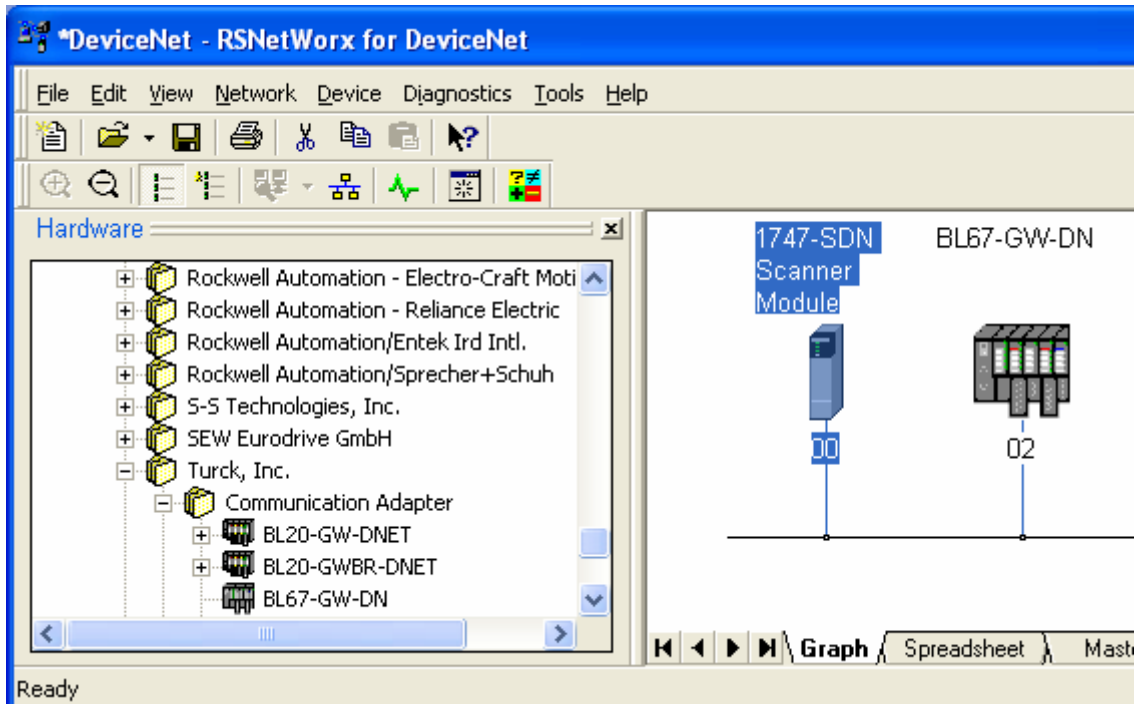
BL67 Discrete Output Map: 16 bytes of output data

| - | Byte n+1 | | | | | | | | Byte n | | | | | | | |
|---------|----------|-------|-------|-------|-------|-------|-------|-------|--------|-------|-------|-------|-------|-------|-------|-------|
| | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Word 0* | 0A.15 | 0A.14 | 0A.13 | 0A.12 | 0A.11 | 0A.10 | 0A.9 | 0A.8 | 0A.7 | 0A.6 | 0A.5 | 0A.4 | 0A.3 | 0A.2 | 0A.1 | 0A.0 |
| Word 1 | 0C.15 | 0C.14 | 0C.13 | 0C.12 | 0C.11 | 0C.10 | 0C.9 | 0C.8 | 0C.7 | 0C.6 | 0C.5 | 0C.4 | 0C.3 | 0C.2 | 0C.1 | 0C.0 |
| Word 2 | 0C.31 | 0C.30 | 0C.29 | 0C.28 | 0C.27 | 0C.26 | 0C.25 | 0C.24 | 0C.23 | 0C.22 | 0C.21 | 0C.20 | 0C.19 | 0C.18 | 0C.17 | 0C.16 |
| Word 3 | 0D.15 | 0D.14 | 0D.13 | 0D.12 | 0D.11 | 0D.10 | 0D.9 | 0D.8 | 0D.7 | 0D.6 | 0D.5 | 0D.4 | 0D.3 | 0D.2 | 0D.1 | 0D.0 |
| Word 4 | 0D.31 | 0D.30 | 0D.29 | 0D.28 | 0D.27 | 0D.26 | 0D.25 | 0D.24 | 0D.23 | 0D.22 | 0D.21 | 0D.20 | 0D.19 | 0D.18 | 0D.17 | 0D.16 |
| Word 5 | 0D.47 | 0D.46 | 0D.45 | 0D.44 | 0D.43 | 0D.42 | 0D.41 | 0D.40 | 0D.39 | 0D.38 | 0D.37 | 0D.36 | 0D.35 | 0D.34 | 0D.33 | 0D.32 |
| Word 6 | 0D.63 | 0D.62 | 0D.61 | 0D.60 | 0D.59 | 0D.58 | 0D.57 | 0D.56 | 0D.55 | 0D.54 | 0D.53 | 0D.52 | 0D.51 | 0D.50 | 0D.49 | 0D.48 |
| Word 7 | - | - | - | - | - | - | - | - | - | - | - | - | 0G.3 | 0G.2 | 0G.1 | 0G.0 |

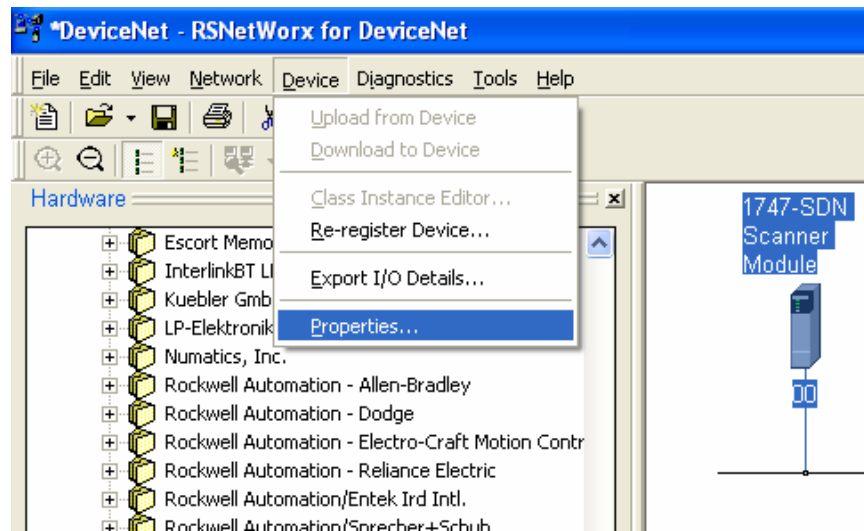
Configuring BL67 with 1747-SDN Scanner

Once the BL67 IO data size and map is determined, the device may be configured with AB 1747-SDN scanner card. It is assumed that you are familiar with Rockwell Software tools used for DeviceNet configuration.

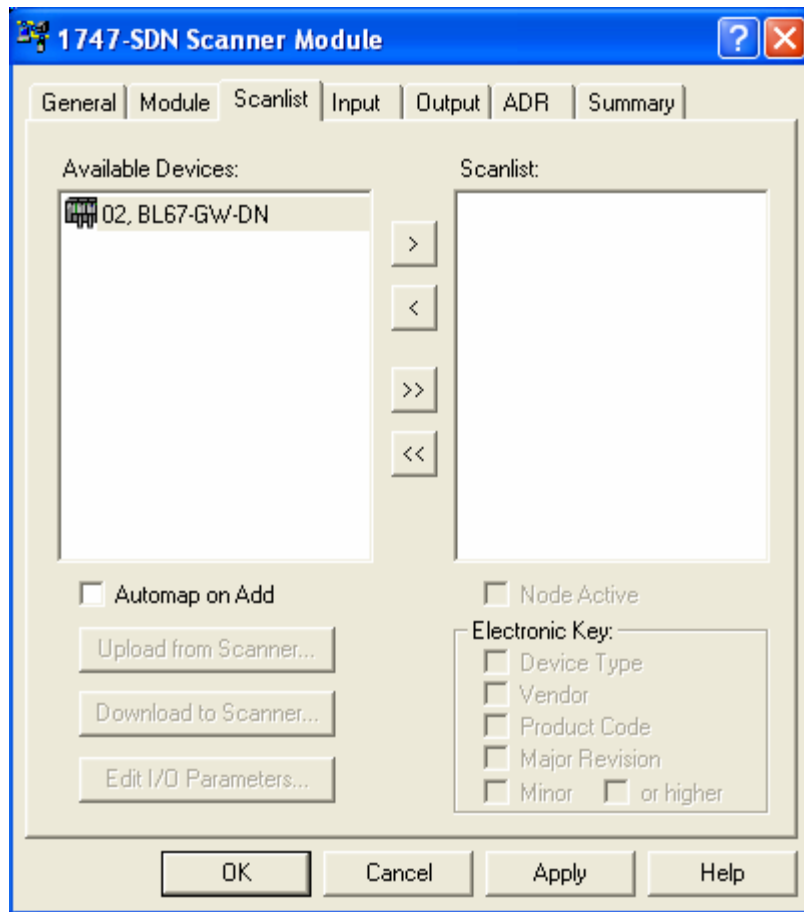
Open new project in RSNetWorx, add 1747-SDN communication adapter and BL67 gateway.



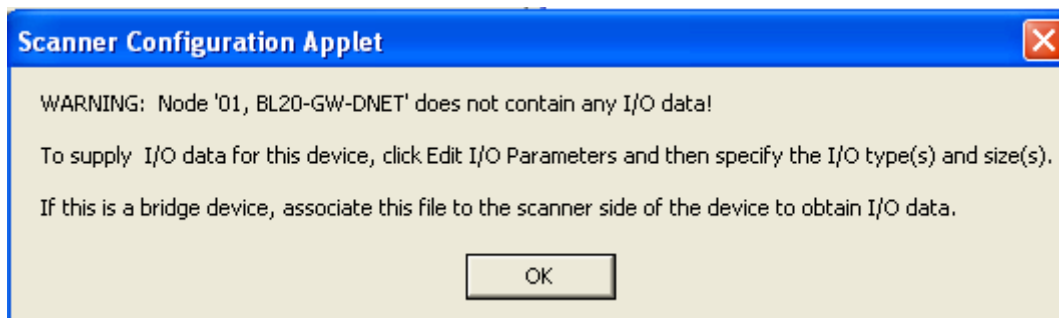
Open scanner properties.



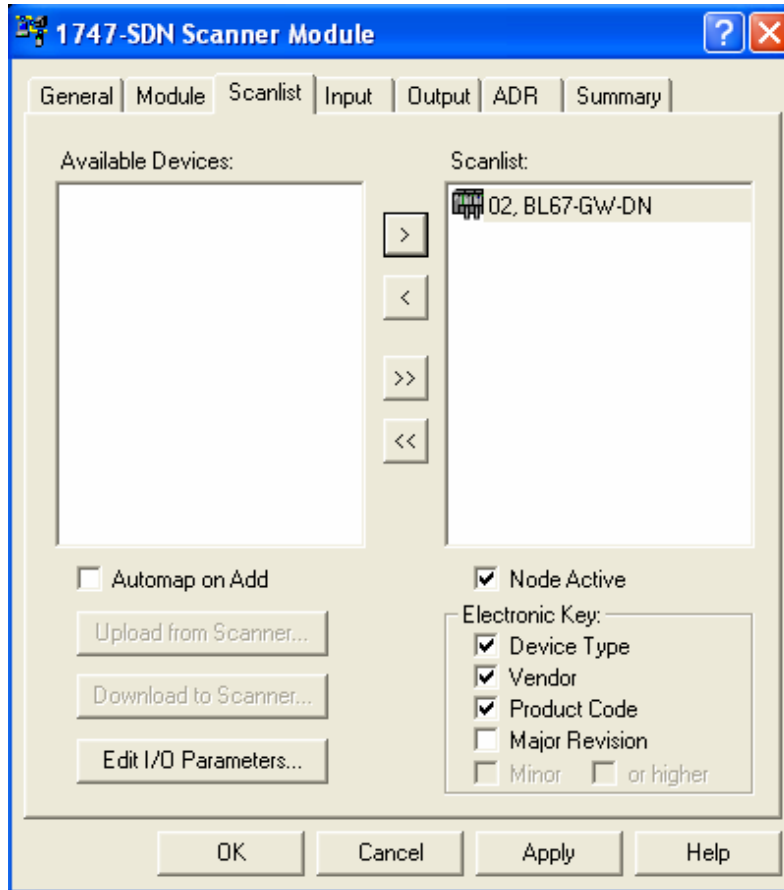
Open “Scanlist” tab, uncheck “Automap on Add”, and add BL67 gateway to the scanlist by pressing “>”.



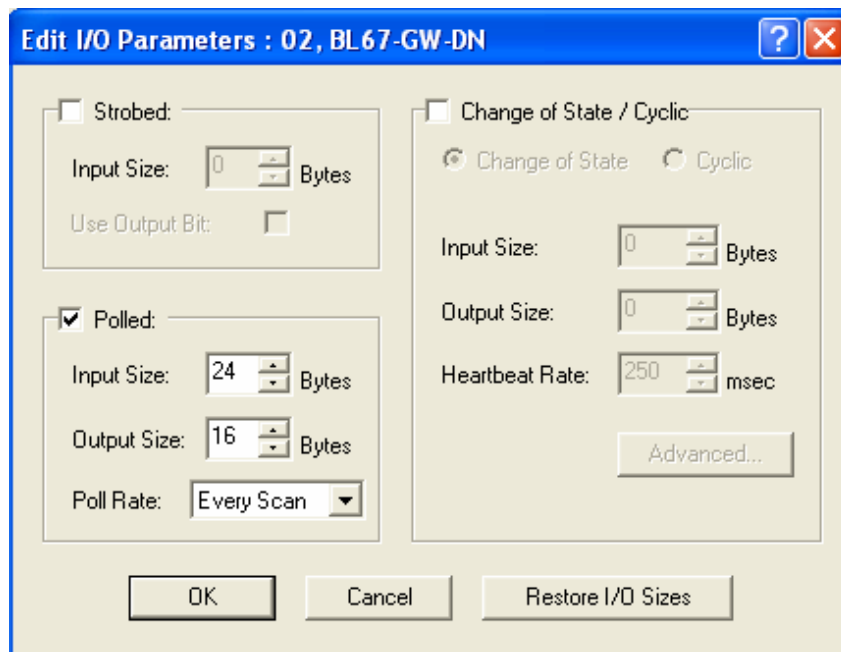
RSnetWorx will show warning that BL67’s IO data size and connection are not defined. It is normal, as BL67 configuration and IO map data are unknown until the actual node is assembled.



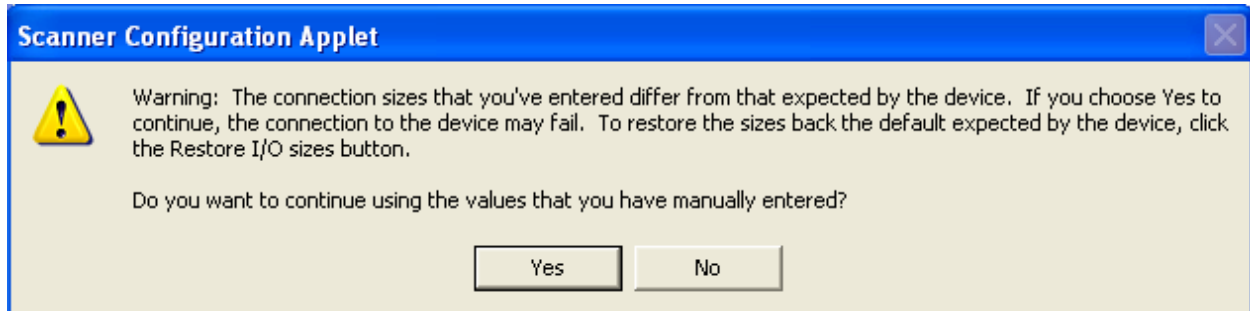
Highlight BL67 device and click on “Edit IO Parameters”.



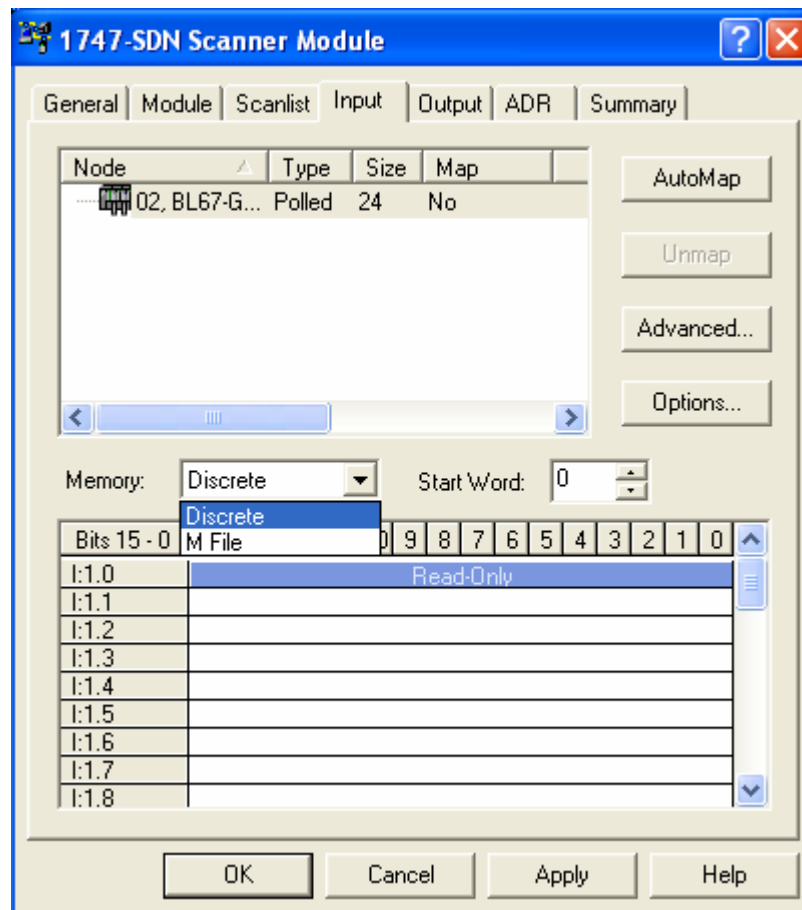
Select type of connection (Poll is most common), enter IO data size from above example and click OK.



Enter “Yes” to the following message.



Open scanner “Input” data map tab, select “Memory: Discrete” and press “AutoMap”.

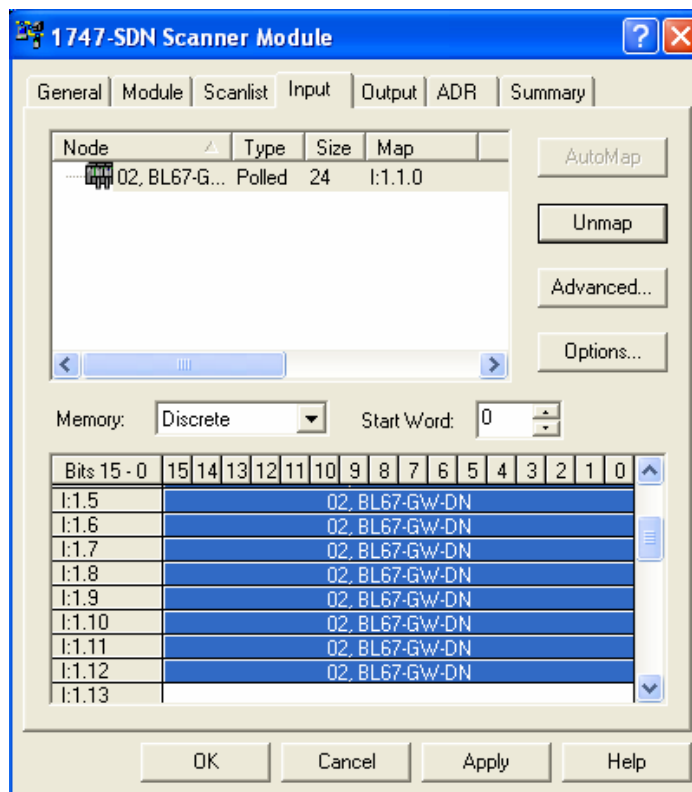


There are different mapping techniques which depend on actual application requirements. Some of them are:

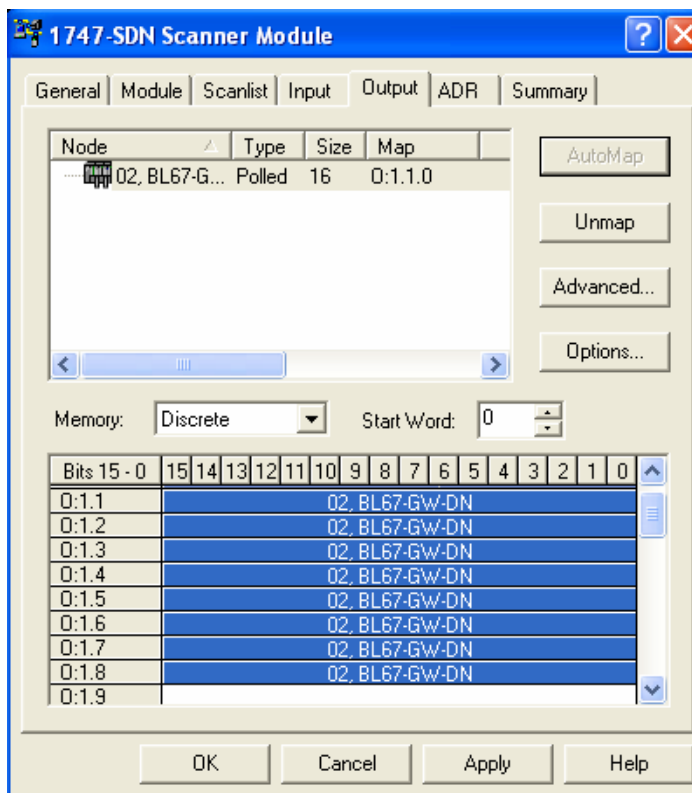
- Data auto-mapping
- Data mapping to designated offset word, where offset is specified in “Start Word”
- Advanced data mapping
- Mapping to “Discrete” input table (data directly accessible by controller)
- Mapping to M1 file (data needs to be copied to the controller)

For more information on data mapping use 1747-SDN Installation Instruction manual.

Once the BL67 gateway input data is mapped, it looks like:



Repeat same procedure for BL67 gateway output data. Press “Apply”, “OK” and save the project.



BL67 Status Word

The first two bytes of every I/O message transmitted by the gateway are reserved for BL67 status. The first byte of the Status Word represents a Message Register that provides message and error codes in hex format on a byte level. The second byte of the Status Word provides hardware diagnostic on a bit level. Format and meaning of status bits are detailed in Table 4.

Table 4: Status Word

| Status bit | Designation | Meaning |
|--------------------|---|--|
| B7-B0 | Message Register | When set it provides error codes |
| 0x00 | Message is OK | |
| 0x01 – 0x0F | Reserved | |
| 0x10 | Additional explicit connection is established | At least one Explicit Message connection is established with another slave device. |
| 0x11 – 0x1F | Reserved | |
| 0x20 | Module ID is unknown | At least one BL67 module is unknown. It is neither represented by an existing Vendor Specific Class, nor listed in the EDS file. Nevertheless, the module takes part in the process data exchange. |
| 0x21 – 0xCF | Reserved | |
| Error codes | | |
| 0xD0 | DupMacID ¹ error | DupMacID check failed. Multiple nodes have same address. |
| 0xD1 | MacID error | MacID error – Node address is > 63. |
| 0xD2 | Baud rate not permitted | Baud Rate set by DIP switches is not permissible. |
| 0xD3 – 0xDF | Reserved | |
| 0xE0 | EEPROM ¹ error | Internal memory error – replace Gateway. |
| 0xE1 | Rotary/DIP switch error ¹ | Replace Gateway. |
| 0xE2 | ROM/flash CRC error ¹ | Replace Gateway. |
| 0xE3 – 0xEF | Reserved | |
| 0xF0 | CNFG modification in progress | Gateway configuration is being modified. |
| 0xF1 – 0xFE | Reserved | |
| 0xFF | Command execution error | An error occurred while a command was being executed. The command will not be carried out. |
| B15-B8 | Diagnostic Register | When set it indicates that: |
| B8 | Outputs not processing | BL67 is not configured: scanner is in idle state, initial I/O configuration has changed (e.g. module removed). |
| B9 | Module list warning | Initial I/O configuration has changed: module removed or added to empty pre-configured slot. |
| B10 | Local force mode | Force mode of IOassistant is active. IOassistant controls outputs. |
| B11 | Module diagnostics | At least one module has a diagnostic message. Use IOassistant to resolve or search Device Parameters for a module diagnostics. |
| B12 | No DeviceNet power ¹ | No network power at Gateway DeviceNet connector. |
| B13 | Module list error | Gateway module list has been modified. At least one module has been replaced with a different part number. |
| B14 | Internal bus fault | Hardware error. Internal bus communication interrupted. |
| B15 | CMD confirmation | This bit reflects the Activate Command bit of the Control Word. The execution of a command from the Command Register (Control Word) is confirmed by setting this bit. |

¹ Information can only be read by **IOassistant**.

BL67 Control Word

The first two bytes of every poll request sent by a master (PLC/PC scanner) to the Gateway contain a Control Word. The Control Word is set to a specific value when a designated command has to be executed. Otherwise, the Control Word is set to "0" during the regular polling. The format and meaning of status bits are detailed in Table 5.

Table 5: Control Word

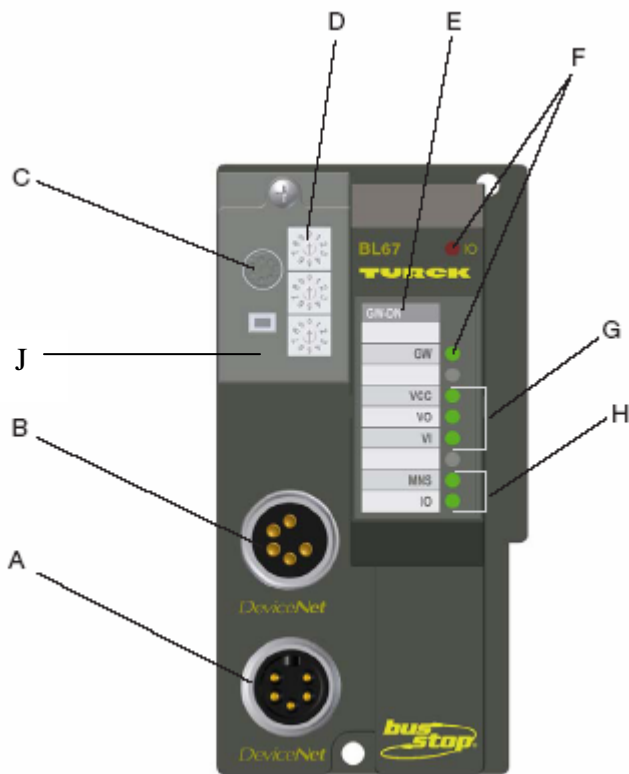
| Control bit | Designation | Meaning |
|----------------------|----------------------------|---|
| B7 – B0 | Command Register | |
| Command codes | | |
| 0x00 | Abort Command | A pending command is aborted; no other command is given. |
| 0x01 – 0x7F | Reserved | |
| 0x80 | Force Outputs OFF | Output of Consumed Data is stopped. Outputs are no longer operated via I/O connection; outputs switched off. Reset gateway or send Force Output Processing command to resume output operation. |
| 0x81 | Force Outputs Fault Values | Output of Consumed Data is stopped. Outputs are no longer operated via I/O connection; outputs switched to substitute fault states. Reset gateway or send Force Output Processing command to resume output operation. |
| 0x82 | Force Outputs Hold | Output of Consumed Data is Stopped. Outputs are no longer operated via I/O connection; outputs retained in current state. Reset gateway or send Force Output Processing command to resume output operation. |
| 0x83 | Force Outputs Processing | Resume output operation. |
| 0x84 – 0xEF | Reserved | |
| 0xF0 | Module Bus Shutdown | Data transmission over local bus is stopped. I/O modules will be set according to their parameterization. |
| 0xF1 | Restart Module Bus | Resume data transmission over local bus. |
| 0xF2 – 0xFF | Reserved | |
| | | |
| B14 – B8 | Reserved | |
| B15 | Activate Command | Execute command specified in Command Register. |

LED Diagnostics

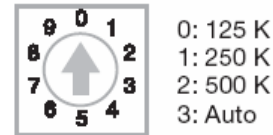
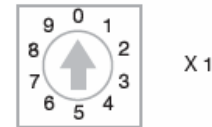
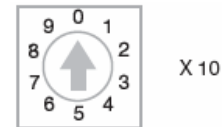
The BL67 gateway contains two pairs of diagnostic LEDs:

- Top pair of LEDs indicates gateway status and local bus operation – refer to **Table 6**.
- Bottom pair of LEDs indicates status of the gateway with regard to DeviceNet operation – refer to **Table 7**.
- Voltage supply LEDs are described in **Table 8**.

Gateway at a glance:



A – DeviceNet in
 B – DeviceNet out
 C – Serial port
 D – Address switches:



E – Gateway designation
 F – Gateway LEDs
 G – Voltage supply LEDs
 H – DeviceNet LEDs
 J – Set switch

Table 6: Gateway LEDs



| LED | Status | Meaning | Remedy |
|---|--|--|---|
| GW | Off | No voltage | Check supply voltage at gateway. |
|  | Green | 5 VDC operating voltage available – firmware active, gateway ready to operate and transmit | |
| | Green flashing slowly – 1 Hz and I/O LED's are Red | Firmware not active – software download necessary | Re-install the firmware or contact your TURCK representative. |
| | Green flashing fast – 4 Hz | Firmware active – gateway hardware defective | Replace gateway. |
| I/O | Off and GW LED Off | No voltage | Check supply voltage at gateway. |
|  | Green | Module bus active, configured module list agrees with current gateway list, communication active | |
| | Green flashing | Station is in force mode of the I/Oassistant. | Deactivate the force mode of the I/Oassistant. |
| | Red and GW LED Off | Controller is not ready or Vcc level is not within the required range | Check 24VDC supply voltage at gateway. If 24VDC voltage is connected correctly, contact your TURCK representative. |
| | Red | Module-bus error | Check individual BL67 modules for correct installation. |
| | Red flashing slowly, 1 Hz | Non-adaptable modification of the physical list of modules | Compare engineered BL67 stations with the physical list of modules. Check station construction for defects or incorrectly installed electronics modules. |
| | Green flashing fast, 4 Hz | No module bus communication | Ensure that the guidelines for the use of power distribution modules have been observed. |
| | Red/green flashing | The engineered and current module lists do not correspond – data exchange is still active. | Check BL67 station for: - Removed modules - Incorrectly installed modules - Subsequently installed modules |



Table 7: DeviceNet LEDs

| LED | Status | Meaning | Remedy |
|-----|-----------------------|---|---|
| MNS | Off | Duplicate MacID check active | Only active device on network. |
| | Green | Connection(s) established – device status OK | Device is configured and running. |
| | Green flashing slowly | No connection established – device status OK | Device not configured in scan list. |
| | Red | Network error | Check devices for possible double MacIDs. Check if CAN controller is set to BUS OFF. |
| | Red flashing | Connection(s) are in Time Out | Scanner stopped scanning device, connections timed out. Check CAN_H / CAN_L wiring between trunk and device. |
| I/O | Green | Outputs are controlled and data exchange is active | |
| | Green flashing slowly | At least one input/output is in “Idle State” status | |
| | Red | At least one input/output has an error | |
| | Red flashing | At least one input/output is in “Faulted State” | |

Table 8: Voltage supply LEDs

| LED | Status | Meaning | Remedy |
|----------------|-----------------------------|---|-----------------------------------|
| Vcc | Off | No voltage | Check system supply at gateway. |
| | Green | Normal operation | |
| V ₀ | Off | Supply voltage to outputs is missing | Check system supply at gateway. |
| | Green | Supply of outputs is normal | |
| | Green flashing slowly, 1 Hz | Undervoltage V ₀ , System running | Check system supply at gateway. |
| | Green flashing fast, 4 Hz | Overvoltage V ₀ , System running | |
| V ₁ | Off | Supply voltage to inputs is missing | Check system supply at gateway. |
| | Green | Supply of inputs is normal | |
| | Green flashing slowly, 1 Hz | Undervoltage V ₁ , System running | Check system supply at gateway. |
| | Green flashing fast, 4 Hz | Overvoltage V ₁ , System running | |
| | Red | Short circuit or overload at sensor supply → V ₁ is switched off | Automatic restart when debugging. |