



CAN SERVO Control Protocol Manual

Revision 1.03

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HITEC RCD INC.

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1 CAN SERVO Control Protocol

1-1 Protocol

Using CAN SERVO Control Protocol, you can write or read data in the registers of CAN Servos.

1-2 Communication System

CAN communication is a Multi Master Network, and all CAN controllers sharing a communication bus can act as a Master. CAN communication is resistant to noise by the Differential communication method using Two Wire Twist Pair. It supports CAN protocol standard CAN (2.0A) and extended CAN (2.0 B) and can communicate at speeds up to 1Mbps (ISO11898).

1-3 Test Configuration

SERVO setting and TEST are available by connecting to PC using DPC-CAN provided separately. (DPC-CAN Communication: Baud rate - 115,200bps, stop bit - 1, parity – none)

1-4 Normal Packet Format

Normal Packet Format is divided into 6 areas such as Header, ID, Address, REG Length, Data, Check Sum as follow.

- Data format - Little Endian
- Check Sum = (ID + Address + REG Length + Data Low + Data High) & 0xFF

● Normal Write

- Data write to Servo

| | | | | | | |
|--------------|------|---------|------------|----------|-----------|-----------|
| Write Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
| 0x96 | 0xXX | 0xXX | 0x02 | 0xXX | 0xXX | 0xXX |

● Normal Read

- Request a response to SERVO

| | | | | |
|--------------|------|---------|------------|-----------|
| Write Header | ID | Address | REG Length | Check Sum |
| 0x96 | 0xXX | 0xXX | 0x00 | 0xXX |

- Response from SERVO

| | | | | | | |
|---------------|------|---------|------------|----------|-----------|-----------|
| Return Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
| 0x69 | 0xXX | 0xXX | 0x02 | 0xXX | 0xXX | 0xXX |

1-4.1 Header

Packet starts with Byte.

Every Protocol Packet should start with Header Byte.

Packets sent from the controller to SERVO begin with 150 (0x96), and packets returned by the SERVO to the controller begin with 105 (0x69).

| | | | | | | |
|---------------|----|---------|------------|----------|-----------|-----------|
| Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
|---------------|----|---------|------------|----------|-----------|-----------|

1-4.2 ID

It shows Byte which represents the unique ID of CAN SERVO to receive the packet.

The corresponding packet is recognized only in the servo that matches the ID of the packet. Unmatched servos will not respond. ID can be specified from 0 to 255.

| | | | | | | |
|--------|-----------|---------|------------|----------|-----------|-----------|
| Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
|--------|-----------|---------|------------|----------|-----------|-----------|

- Packets whose ID is set to 0 (0x00) are recognized as the same parameters in all servos regardless of the SERVO's unique ID.

1-4.3 Address

Register Address Byte.

Registers of CAN SERVO are configured in 2-byte units, and Register Address has Even value.

| | | | | | | |
|--------|----|----------------|------------|----------|-----------|-----------|
| Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
|--------|----|----------------|------------|----------|-----------|-----------|

1-4.4 Register Length

A Byte that indicates the length of Data in the Packet.

Among the Packet Format (Header, ID, Address, REG Length, Data, Check Sum), Register Length means the number of Byte in the area of "Data".

| | | | | | | |
|--------|----|---------|-------------------|----------|-----------|-----------|
| Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
|--------|----|---------|-------------------|----------|-----------|-----------|

- Write Mode
It indicates the number of Bytes behind REG Length. It is fixed to 2.
- Read Mode

If the .REG Length is '0', it means that there is no data transmitted afterwards, which is used to read the data from the register corresponding to the packet address.

1-4.5 Data

The data you want to write to the Register.

When the Data is [Write Mode], the length is 2Byte. When the Data is [Read Mode], the length is 0 Byte. In other words, Data is omitted after REG Length in Packet.

When writing or reading 2 Byte Data value to register specified by Address of Packet, follow Little Endian rule as follows. Data [0] has 2 bytes of Low Byte and Data[1] has High Byte.

| | | | | | | |
|--------|----|---------|---------------|---------------------|----------------------|--------------|
| Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
|--------|----|---------|---------------|---------------------|----------------------|--------------|

1-4.6 Check Sum

A byte to verify the error of the packet. If CheckSum does not match, it recognizes as an error packet and does not respond to the corresponding packet. CheckSum is the lower 1 byte value of the sum of the bytes of all areas excluding the header in the packet.

| | | | | | | |
|--------|----|---------|---------------|-------------|--------------|----------------------|
| Header | ID | Address | REG Length | Data Low | Data High | Check Sum |
|--------|----|---------|---------------|-------------|--------------|----------------------|

- Read Mode Check Sum Calculation

$$\text{Check Sum} = (\text{ID} + \text{Address} + \text{Length}) \& 0\text{xFF}$$

- Write Mode Check Sum Calculation

$$\text{Check Sum} = (\text{ID} + \text{Address} + \text{Length} + \text{Data [0]} + \text{Data [1]}) \& 0\text{xFF}$$

1-5 Custom Packet Format

Removed REG Length and Check Sum from the Normal Packet Format protocol and extended the function with the separator of Message ID.

It is recommended to use Custom Packet protocol in TURN MODE situation.

ex) Write 2 Address Data (Position New, Turn New),

Read 2 Address Data (Position Now, Turn Count)

Read Long DATA (32bit position)

Custom Packet Format is divided into 6 areas, Message Id, ID, Address A, B, DATA A, B as follows.

● Custom Write

- Data write to SERVO

| Message | ID | Address | Data | Data |
|---------|------|---------|------|------|
| ID | | | Low | High |
| 'w' | 0xXX | 0xXX | 0xXX | 0xXX |

- Lowercase 'w'

- Data write to SERVO (2 Address Data)

| Message | ID | Address | Data | Data | Address | Data | Data |
|---------|------|---------|-------|--------|---------|-------|--------|
| ID | | A | Low A | High A | B | Low B | High B |
| 'W' | 0xXX | 0xXX | 0xXX | 0xXX | 0xXX | 0xXX | 0xXX |

- Uppercase 'W'
- If you use 'x' or 'X' instead of 'w' or 'W', CAN SERVO processes the read after writing. In other words, it sends a Return after writing.

● Custom Read

- Request a data to SERVO

| Message | ID | Address |
|---------|------|---------|
| ID | | |
| 'r' | 0xXX | 0xXX |

- Response from SERVO

| Message | ID | Address | Data | Data |
|---------|------|---------|------|------|
| ID | | | Low | High |
| 'v' | 0xXX | 0xXX | 0xXX | 0xXX |

- Request 2 data to SERVO (2 Address Data)

| | | | |
|---------|------|---------|---------|
| Message | ID | Address | Address |
| ID | | A | B |
| 'R' | 0xXX | 0xXX | 0xXX |

- Response from SERVO (2 Address Data)

| | | | | | | | |
|---------|------|---------|-------|--------|---------|-------|--------|
| Message | ID | Address | Data | Data | Address | Data | Data |
| ID | | A | Low A | High A | B | Low B | High B |
| 'V' | 0xXX | 0xXX | 0xXX | 0xXX | 0xXX | 0xXX | 0xXX |

1-5.1 Message ID

A start Byte of Custom Packet. Message Id values are identified by the characters 'w', 'W', 'x', 'X', 'r', 'R', 'v' and 'V'.

| | | | | | | | |
|---------|----|---------|-------|--------|---------|-------|--------|
| Message | ID | Address | Data | Data | Address | Data | Data |
| ID | | A | Low A | High A | B | Low B | High B |

1-5.2 ID

A Byte which represents the unique ID of CAN SERVO to receive the packet. The corresponding packet is recognized only in the servo that matches the ID of the packet. Unmatched servos will not respond. ID can be specified from 0 to 255.

| | | | | | | | |
|---------|----|---------|-------|--------|---------|-------|--------|
| Message | ID | Address | Data | Data | Address | Data | Data |
| ID | | A | Low A | High A | B | Low B | High B |

- Packets whose ID is set to 0 (0x00) are recognized as the same parameters in all servos regardless of CAN SERVO's unique ID.

1-5.3 Address

Register Address Byte.

Registers of SERVO are configured in 2-byte units, and Register Address has Even value.

| | | | | | | | |
|---------|----|---------|-------|--------|---------|-------|--------|
| Message | ID | Address | Data | Data | Address | Data | Data |
| ID | | A | Low A | High A | B | Low B | High B |

1-5.4 Data

The data you want to write to the Register.

Data is 2 bytes or 2x2 bytes and follows Little Endian rules. Data [0] has Low Byte among 2 Byte data and Data [1] has High Byte.

| | | | | | | | |
|---------------|----|--------------|---------------|----------------|--------------|---------------|----------------|
| Message ID | ID | Address A | Data Low A | Data High A | Address B | Data Low B | Data High B |
|---------------|----|--------------|---------------|----------------|--------------|---------------|----------------|

2 CAN SERVO Register

2-1 Address Table

| Address | Name | length | R/W | Range | | | Feature | Unit | |
|------------------------|-------------------------|-----------------------|-----|-------|--------|--------|--|--|-------------------------------------|
| | | | | reset | min | max | | | |
| Status | 0x48 | REG_EMERGENCY_STOP | 2 | R | 0 | 0 | 65535 | Bit 8: Position min error. | 0 = OK, 1 = Error |
| | | | | | | | | Bit 9: Position max error | 0 = OK, 1 = Error |
| | | | | | | | | Bit 10: MCU temper under error | 0 = OK, 1 = Error |
| | | | | | | | | Bit 11: MCU temper over error | 0 = OK, 1 = Error |
| | | | | | | | | Bit 13: Volt under error | 0 = OK, 1 = Error |
| | Bit 14: Volt over error | 0 = OK, 1 = Error | | | | | | | |
| | 0x0C | REG_POSITION | 2 | R | 0 | 0 | 16383 | Read the Position. | 4096=90° |
| | 0x0E | REG_VELOCITY | 2 | R | 0 | 0 | 65535 | Read the Velocity. | Vel = v*10°90/4096 (deg/sec) |
| | 0x10 | REG_TORQUE | 2 | R | 0 | 0 | 4095 | Read the Motor PWM Duty. | 4095=100% |
| | 0x12 | REG_VOLTAGE | 2 | R | 0 | 0 | 65535 | Read the Input Voltage. | 100 = 1.00V |
| | 0x14 | REG_MCU_TEMPER | 2 | R | 0 | -57 | 196 | Read the MCU temperature. | °C |
| | 0x16 | REG_CURRENT | 2 | R | 0 | 0 | 65535 | Read the generated Current. | mA |
| | 0x18 | REG_TURN_COUNT | 2 | R/W | 0 | -32760 | 32760 | Read the Accumulated Turn Count. | 1 = 360° |
| | 0x1A | REG_32BITS_POSITION_L | 2 | R | 0 | 0 | 65535 | Read the Accumulated Turn Position High 2 Bytes. | 4096=90° |
| | 0x1C | REG_32BITS_POSITION_H | 2 | R | 0 | 0 | 65535 | Read the Accumulated Turn Position Low 2 Bytes. | 1=4 x 360° |
| 0xC8 | REG_TIME_L | 2 | R | 0 | 0 | 65535 | Read the Servo operation time Low 2 Bytes. | sec | |
| 0xCA | REG_TIME_H | 2 | R | 0 | 0 | 65535 | Read the Servo operation time High 2 Bytes. | 1=65536 sec | |
| 0xD0 | REG_MOTOR_TEMP | 2 | R | 0 | -32767 | 32767 | Read the Motor temperature. | °C | |
| 0xD2 | REG_TEMP | 2 | R | 0 | -32767 | 32767 | Read the internal temperature of the Servo. | °C | |
| 0xD4 | REG_HUM | 2 | R | 0 | 0 | 100 | Read the internal relative humidity of the servo. | %RH | |
| Action | 0x1E | REG_POSITION_NEW | 2 | R/W | - | 0 | 16383 | Set New Position. | 4096=90° |
| | 0x24 | REG_TURN_NEW | 2 | R/W | 0 | -32760 | 32760 | Set New Turn (TURN mode only) | 1=360° |
| | 0x46 | REG_POWER_CONFIG | 2 | R/W | 0 | 0 | 65535 | Bit 9: Forced Emergency Stop | 1 = Motor power off |
| Bit 0: SERVO S/W Reset | | | | | | | | 1 = Reset | |
| Comm unication | 0x32 | REG_ID | 2 | R/W | 0 | 0 | 254 | Set the SERVO ID. | - |
| | 0x38 | REG_CAN_BAUDRATE | 2 | R/W | 0 | 0 | 8 | Set the baud rate. | 0 = 1000 kbps |
| | | | | | | | | | 1 = 800 kbps |
| | | | | | | | | | 2 = 750 kbps |
| | | | | | | | | | 3 = 500 kbps |
| | | | | | | | | | 4 = 400 kbps |
| | | | | | | | | | 5 = 250 kbps |
| 6 = 200 kbps | | | | | | | | | |
| 7 = 150 kbps | | | | | | | | | |
| 8 = 125 kbps | | | | | | | | | |
| 0x3C | REG_CAN_BUS_ID_H | 2 | R/W | 0 | 0 | 65535 | Set the CAN ID Low 2 Bytes. (2.0A: 0~2047, 2.0B: 0~536870911) | '0' is Broadcast. | |
| 0x3E | REG_CAN_BUS_ID_L | 2 | R/W | 0 | 0 | 65535 | Set the CAN ID High 2 Bytes. (2.0A: 0~2047, 2.0B :0~536870911) | '0' is Broadcast. | |
| 0x40 | REG_SAMPLE_POINT | 2 | R/W | 0 | 0 | 1 | Set the CAN Sample Point. | 0 = 50%, 1 = 87.5% | |
| 0x6A | REG_CAN_MODE | 2 | R/W | 0 | 0 | 1 | Set the CAN Specification. | 0 = 2.0A, 1 = 2.0B | |
| Mode | 0x44 | REG_RUN_MODE | 2 | R/W | 0 | 0 | 1 | Set the run mode. | 0: Multi-Turn mode 1: Servo mode |
| | 0x9A | REG_POS_LOCK_TIME | 2 | R/W | 3 | 0 | 5000 | Set the time for OLP to operate. (Only Use SERVO Mode) | sec |

| | | | | | | | | | |
|---------------------------|-----------------|---------------------------|-----|-------|-------|--------|----------------------------------|--|---|
| | 0x9C | REG_POS_LOCK_TORQUE_RATIO | 2 | R/W | 100 | 0 | 100 | Set torque ratio when OLP operates. (Only Use SERVO Mode) | % |
| | 0xB0 | REG_POSITION_MAX_LIMIT | 2 | R/W | 15018 | 0 | 16383 | Set the position max limits. (Only Use SERVO Mode) | 4096=90° |
| | 0xB2 | REG_POSITION_MIN_LIMIT | 2 | R/W | 1366 | 0 | 16383 | Set the position min limits. (Only Use SERVO Mode) | 4096=90° |
| option | 0x26 | REG_SPEC_TORQUE | 2 | R/W | 0 | 0 | 65535 | Set the torque output by measuring the current. | 1 = 10mW (9000=90.00W) |
| | 0x2E | REG_STREAM_TIME | 2 | R/W | 1000 | 0 | 10000 | Set the Stream Period. | ms |
| | 0x30 | REG_STREAM_MODE | 2 | R/W | 0 | 0 | 1 | Set the Stream Mode. | 0 = Off, 1 = On |
| | 0x46 | REG_POWER_CONFIG | 2 | R/W | 0 | 0 | 257 | Bit 9: Forced Emergency Stop | 0 = Off, 1 = On |
| | | | | | | | | Bit 0: S/W Reset | 0 = Off, 1 = Reset |
| | 0x4E | REG_DEADBAND | 2 | R/W | 0 | 0 | 4095 | Set the Position Dead band. | us |
| | 0x50 | REG_POS_MAX | 2 | R/W | 16383 | 0 | 16383 | Set the maximum position. (0 is inactive) | 4096=90° |
| | 0x52 | REG_POS_MIN | 2 | R/W | 0 | 0 | 16383 | Set the maximum position. (0 is inactive) | 4096=90° |
| | 0x54 | REG_VELOCITY_MAX | 2 | R/W | 65535 | 0 | 65535 | Set the maximum velocity. (100% output when setup value is over 20.) | - |
| | 0x56 | REG_TORQUE_MAX | 2 | R/W | 4095 | 0 | 4095 | Set the maximum torque. | 4095=100% |
| | 0x58 | REG_VOLTAGE_MAX | 2 | R/W | 0 | 0 | 65535 | Set the maximum Voltage | 10mV (100 = 1.00V) |
| | 0x5A | REG_VOLTAGE_MIN | 2 | R/W | - | 0 | 65535 | Set the minimum Voltage | 10mV (100 = 1.00V) |
| | 0x5C | REG_TEMPER_MAX | 2 | R/W | 0 | -32767 | 32767 | Set the maximum Temperature. | °C |
| | 0x6C | REG_TEMPER_MIN | 2 | R/W | 0 | -32767 | 32767 | Set the minimum Temperature. | °C |
| | 0xC2 | REG_POSITION_MID | 2 | R/W | 8192 | 0 | 16383 | Set Mid position. | 4096=90° |
| | 0xC6 | REG_ECHO | 2 | R/W | 0 | 0 | 65535 | User define Volatile memory. (It becomes '0' when power is reset.) | - |
| 0xCC | REG_USER_1 | 2 | R/W | 0 | 0 | 65535 | User define Non-volatile memory. | - | |
| 0xCE | REG_USER_2 | 2 | R/W | 0 | 0 | 65535 | User define Non-volatile memory. | - | |
| 0xD8 | REG_CURRENT_MAX | 2 | R/W | 65535 | 0 | 65535 | Set the Max Current. | mA | |
| Configurat ion | 0x6E | REG_DEFAULT | 2 | W | 0 | 0 | 65535 | Restore data to default | 3855 = factory default 65536 = Reload |
| | 0x70 | REG_CONFIG_SAVE | 2 | W | 0 | 0 | 65535 | Save changed data in memory. | 1 = Save |

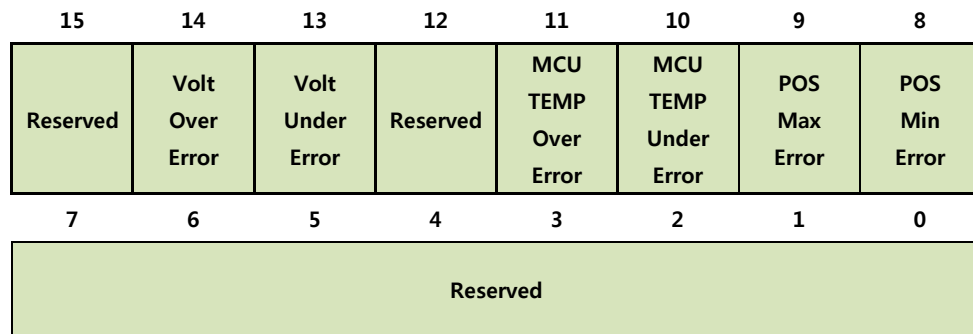
NOTE) Yellow Values need SAVE and RESET

2-2 Status

It is a Register that store status information.

2-2.1 REG_EMERGENCY_STOP

The current error states. Items that do not meet the set criteria can be checked with Flag.



| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x48 | 2 | R | 0 | 0 | 65535 |

- Bit 15,12, 7~0: Reserved – Do not use.
- Bit 14: Volt over error – Set to 1, if the current voltage is higher than the standard voltage.
- Bit 13: Volt under error – Set to 1, if the current voltage is lower than the standard voltage.
- Bit 11: MCU Temp over error – Set to 1, if the current MCU temperature is higher than the standard temperature.
- Bit 10: MCU Temp under error – Set to 1, if the current MCU temperature is lower than the standard temperature.
- Bit 9: POS max error – Set to 1, if the current position is higher than the maximum position.
- Bit 8: POS min error – Set to 1, if the current position is lower than the minimum position.

2-2.2 REG_POSITION

The current position value of CAN Servo and the range is 0 to +16383.
Based on the position '0', it can be operated 360° in clockwise direction.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x0C | 2 | R/O | - | 0 | 16383 |

- The resolution is $4096 = 90^\circ$

2-2.3 REG_VELOCITY

The current speed.

The speed value is expressed by the following equation.

$pos/100msec.$

$Vel = v*10*90/4096 (deg/sec)$

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x0E | 2 | R/O | - | 0 | 65535 |

2-2.4 REG_TORQUE

The Duty of current Motor's PWM. It affects the torque.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|------|
| 0x10 | 2 | R/O | 0 | 0 | 4095 |

- It outputs 100% Duty at 4095

2-2.5 REG_VOLTAGE

The value of current supply voltage.

It represents 0.01 V per 1 register value. If the value is 1200, the actual supply voltage is 12V.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x12 | 2 | R/O | - | 0 | 65535 |

2-2.6 REG_MCU_TEMPER

The internal temperature of MCU.

It can be set to 0.1 °C per data value and the actual temperature is 20°C when the value of Register is 20.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0x14 | 2 | R/O | 0 | -32760 | 32760 |

2-2.7 REG_CURRENT

The current value used.

It can be set to 1mA per data value and the actual current is 10A when the value of Register is 10000.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x16 | 2 | R/O | 0 | 0 | 65535 |

- This function works only for SG series SERVO.

2-2.8 REG_TURN_COUNT

The current number of rotations.

In case of + 360° position, it is +1. In case of -360° position, Register value is -1.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|--------|
| 0x18 | 2 | R/O | 0 | -32760 | +32760 |

2-2.9 REG_32BITS_POSITION_L

The low value of current position (angle).

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x1A | 2 | R/O | - | 0 | 65535 |

- REG_POSITION+ (REG_TURN_COUNT *16384)의 Low Word

2-2.10 REG_32BIT_POSITION_H

The high value of current position (angle).

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-------|-----------------|
| 0x1C | 2 | R/O | - | 65535 | 2 ³¹ |

- REG_POSITION+ (REG_TURN_COUNT *16384)의 High Word

2-2.11 REG_TIME_L

The operating time after SERVO power is turned on.

It is the low value and the total running time can be checked by adding up the high value with low value.

1sec per value. If Register value is 20, run time is 20 seconds.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0xC8 | 2 | R/O | 0 | -32760 | 32760 |

2-2.12 REG_TIME_H

The operating time after SERVO power is turned off.

It is the high value and the total running time can be checked by adding up the high value with low value.

65535sec per value. If Register value is 10, run time is 655350 seconds.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0xCA | 2 | R/O | 0 | -32760 | 32760 |

2-2.13 REG_MOTOR_TEMP

The temperature of the current Motor.

1°C per value. If Register value is 20, the actual temperature is 20°C.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0xD0 | 2 | R/O | 0 | -32760 | 32760 |

2-2.14 REG_TEMP

The internal temperature of the current SERVO.

1°C per value. If Register value is 20, the actual temperature is 20°C.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0xD2 | 2 | R/O | 0 | -32760 | 32760 |

- This function works only for SG series SERVO.

2-2.15 REG_HUM

The relative humidity inside the SERVO.

1%RH per value. If Register value is 20, the actual humidity is 20%RH.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x4D | 2 | R/O | 0 | 0 | 100 |

- This function works only for SG series SERVO.

2-3 Action

It is the Register to operate CAN SERVO.

2-3.1 REG_POSITION_NEW

Specify a new position for SERVO with a resolution of 4096 = 90°

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x1E | 2 | R/W | - | 0 | 16383 |

- In SERVO Mode, it only can move from the range of POSITION_MIN_LIMIT to POSITION_MAX_LIMIT.

2-3.2 REG_TURN_NEW

Set the number of rotations. The initial value is 0.

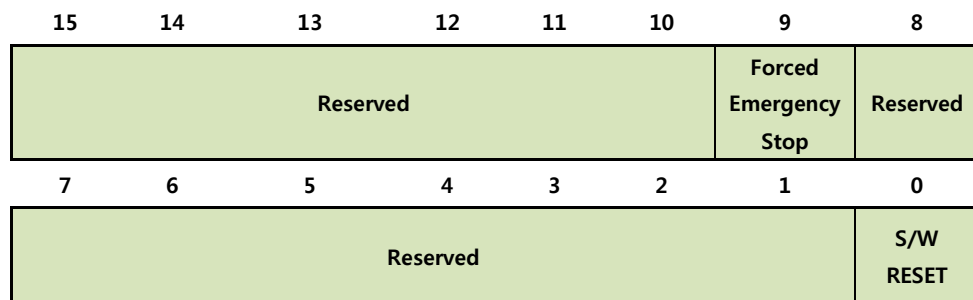
If set +1, the servo rotates 360° in the + direction relative to 0.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0x24 | 2 | R/W | 0 | -32760 | 32760 |

- It only operates in TURN Mode.

2-3.3 REG_POWER_CONFIG

Set the power management method.



| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x46 | 2 | W | - | 0 | 65535 |

- Bit 15~10, 7~1: Reserved – Do not use.
- Bit 9: Forced Emergency Stop – Use Forced Emergency Stop
 - 0: Forced Emergency Stop OFF
 - 1: Forced Emergency Stop ON (Motor Power Off)
- Bit 0: Reset – Software Reset of SERVO
 - 1: Reset On (Reset to 0)

2-4 Communication

Register that set the communication environment of the servo. Communication Data can be saved and initialized.

2-4.1 REG_ID

Set the ID.

Set the ID. If multiple CAN SERVOS are connected by the same signal line, the ID must be assigned a unique value. Only the CAN SERVOS that matches the ID of the packet will recognize the corresponding packet. Unmatched CAN SERVOS will not respond. ID can be specified from 0 to 255.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x32 | 2 | R/W | 0 | 0 | 255 |

- If REG_ID is changed and saved, it operates with changed ID from the next power reset.

2-4.2 REG_BAUDRATE

Set the Baud Rate.

It can support communication speeds from at least 125 Kbps up to 1000 Kbps.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x38 | 2 | R/W | 5 | 0 | 8 |

| REG_BAUDRATE | Baud Rate |
|--------------|-----------|
| 0 | 1000 Kbps |
| 1 | 800 Kbps |
| 2 | 750 Kbps |
| 3 | 500 Kbps |
| 4 | 400 Kbps |
| 5 | 250 Kbps |
| 6 | 200 Kbps |
| 7 | 150 Kbps |
| 8 | 125 Kbps |

- If you save after changing BAUDRATE, it operates at changed baud rate after power reset.

2-4.3 REG_CAN_BUS_ID_H

Set the CAN BUS ID.

CAN BUS ID can be set by adding high value and low value.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|------|
| 0x3C | 2 | R/W | 0 | 0 | 8191 |

2-4.4 REG_CAN_BUS_ID_L

Set CAN BUS ID.

CAN BUS ID can be set by adding low value and high value.

| Address | Length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x3E | 2 | R/W | 0 | 0 | 65535 |

- In CAN 2.0A, it can be specified from 0 to 2047.
- In case of CAN 2.0B, it is available to designate 0 ~ 536870911 as low and high data.
- To change this item, save and power reset are required.

2-4.5 REG_SAMPLE_POINT

Selects the sampling point ratio of the CAN communication signal.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x40 | 2 | R/W | 0 | 0 | 1 |

- 0 = 50% and 1 = 87.5%
- To change it, save and power reset are required.

2-4.6 REG_CAN_MODE

Set CAN MODE.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x6A | 2 | R/W | 0 | 0 | 1 |

- 0 = CAN 2.0 and 1 = CAN 2.0B
- To change it, save and power reset are required.

2-5 MODE

This Register is used to set RUN MODE of Servo. MODE Data can be saved and initialized.

2-5.1 REG_RUN_MODE

Select SERVO MODE or Multi-Turn MODE of CAN SERVO.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x44 | 2 | R/W | 1 | 0 | 1 |

- 0= Multi-Turn MODE, 1= SERVO MODE
- To change it, save and power reset are required.

- **SERVO MODE**

SERVO MODE is the mode to control within 0~360 degree.

By using REG_POSITION_MAX_LIMIT and REG_POSITION_MIN_LIMIT, you can adjust the angle of CAN SERVO.

- **Multi-Turn MODE**

Multi-Turn MODE is the mode to control until ± 32760 turns.

By using REG_TURN_NEW, you can adjust the number of turns. And also, by using REG_POSITION_NEW, you can adjust the position.

2-5.2 REG_POS_LOCK_TIME

Set the operation time, when CAN SERVO is in OLP condition.

1 = 1 second. If you set 3, OLP will be activate when CAN SERVO is being in OLP condition over 3 seconds.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|------|
| 0x9A | 2 | R/W | 3 | 0 | 5000 |

- At 0, OLP is activate all the time.
- Only activate in SERVO MODE (Not applicable in Multi-turn MODE)

2-5.3 REG_POS_LOCK_TORQUE_RATIO

Set the Torque when OLP is activate.

The torque is output as much as the percentage of the currently set torque.

1= 1% and 100 = 100%.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x9C | 2 | R/W | 100 | 0 | 100 |

- Only activate in SERVO MODE (Not applicable in Multi-turn MODE)

2-5.4 REG_POSITION_MAX_LIMIT

Set the maximum position that can be operated.

Data = 0~ +16383 and the resolution of data = 4096 = 90°.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xB0 | 2 | R/W | 15018 | 0 | 16383 |

- If the value of REG_POSITION_NEW is higher than REG_POSITION_MAX_LIMIT, It moves to the position of REG_POSITION_MAX_LIMIT.
- REG_POSITION_MAX_LIMIT should be set higher than REG_POSITION_MIN_LIMIT value.

2-5.5 REG_POSITION_MIN_LIMIT

Set the minimum position that can be operated.

Data = 0~ +16383 and the resolution of data = 4096 = 90°.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xB2 | 2 | R/W | 1366 | 0 | 16383 |

- If the value of REG_POSITION_NEW is lower than REG_POSITION_MIN_LIMIT, It moves to the position of REG_POSITION_MIN_LIMIT
- REG_POSITION_MIN_LIMIT should be set lower than REG_POSITION_MAX_LIMIT value.

2-6 Option

Register to set Servo function. Option data can be saved and initialized.

2-6.1 REG_SPEC_TORQUE

Set the maximum power of the torque output.

1 = 10mW. 9000 = 90W.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x26 | 2 | R/W | 0 | 0 | 65535 |

2-6.2 REG_STREAM_TIME

The cycle of STREAM function. The unit is 1ms.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x2E | 2 | R/W | 1000 | 0 | 10000 |

2-6.3 REG_STREAM_MODE

Set STREAM MODE ON / OFF.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-----|
| 0x30 | 2 | R/W | 0 | 0 | 1 |

- 0: STREAM_MODE_OFF
- 1: STREAM_MODE_ON
- **STREAM_MODE**
- CAN SERVO returns REG_POSITION and REG_TURN_COUNT values automatically at specified time intervals without the need for manual read by HOST.
(Return REG_TURN_COUNT only when using TURN MODE.)

2-6.4 REG_DEADBAND

Set Dead Band area of SERVO.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|------|
| 0x4E | 2 | R/W | 0 | 0 | 4095 |

- If the value is high, Jitter may occur during operation.
(20 or less recommended)

2-6.5 REG_POS_MAX

Set the maximum position value that operates in the normal state.

Data = 0~ +16383 and the resolution of data = 4096 = 90°.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x50 | 2 | R/W | 16383 | 0 | 16383 |

- 0 = Off
- REG_EMERGENCY_STOP condition is met, if the REG_POSITION value is higher than REG_POS_MAX.

2-6.6 REG_POS_MIN

Set the minimum position value that operates in the normal state.

Data = 0~ +16383 and the resolution of data = 4096 = 90°.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x52 | 2 | R/W | 0 | 0 | 16383 |

- 0 = Off
- REG_EMERGENCY_STOP condition is met, if the REG_POSITION value is lower than REG_POS_MIN.

2-6.7 REG_VELOCITY_MAX

Set the maximum speed value operating in the normal state.

The maximum speed is expressed by the following equation.

$$V_{max} = V * 10000 / T_s * 90 / 4096 \text{ deg/sec}$$

$$T_s = \text{PID Sampling Time}(=10)$$

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x54 | 2 | R/W | 65535 | 0 | 65535 |

2-6.8 REG_TORQUE_MAX

Set the maximum width of the motor PWM duty. 4095 = 100%

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|------|
| 0x56 | 2 | R/W | 4095 | 0 | 4095 |

2-6.9 REG_VOLTAGE_MAX

Set the highest voltage that operates in the normal state.

1 = 0.01V. 1200 = 12V.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x58 | 2 | R/W | 0 | 0 | 65535 |

- 0 = Off
- REG_EMERGENCY_STOP condition is met, if the REG_VOLTAGE value is higher than REG_VOLTAGE_MAX.

2-6.10 REG_VOLTAGE_MIN

Set the lowest voltage that operates in the normal state.

1 = 0.01V. 1200 = 12V.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x5A | 2 | R/W | - | 0 | 65535 |

- 0 = Off.
- REG_EMERGENCY_STOP condition is met, if the REG_VOLTAGE value is lower than REG_VOLTAGE_MIN.

2-6.11 REG_TEMPER_MAX

Set the maximum temperature value at which MCU TEMPER operates in a normal state.

1 = 1°C, 20 = 20°C.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0x5C | 2 | R/W | 0 | -32767 | 32767 |

- 0 = Off.
- REG_EMERGENCY_STOP condition is met, if REG_MCU_TEMPER value is higher than REG_TEMPER_MAX.

2-6.12 REG_TEMPER_MIN

Set the maximum temperature value at which MCU TEMPER operates in a normal state.

1 = 1°C, 20 = 20°C.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|--------|-------|
| 0x6C | 2 | R/W | 0 | -32767 | 32767 |

- 0 = Off.
- REG_EMERGENCY_STOP condition is met, if REG_MCU_TEMPER value is lower than REG_TEMPER_MIN.

2-6.13 REG_POSITION_MID

Set the center value of the position that can be operated.

Data = 0~ +16383 and the resolution of data = 4096 = 90°

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xC2 | 2 | R/W | 8192 | 0 | 16383 |

- It should be set to the center value between REG_POSITION_MAX_LIMIT and REG_POSITION_MIN_LIMIT.

2-6.14 REG_ECHO

This value can be set by the user. It will be 0 when the SERVO is reset.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xC6 | 2 | R/W | 0 | 0 | 65535 |

2-6.15 REG_USER_1

It is a data address that users can save randomly.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xCC | 2 | R/W | 0 | 0 | 65535 |

- Only after SAVE after changing REG_ECHO, it can be saved after power reset.

2-6.16 REG_USER_2

It is a data address that users can save randomly.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xCE | 2 | R/W | 0 | 0 | 16383 |

- Only after SAVE after changing REG_ECHO, it can be saved after power reset.

2-6.17 REG_CURRENT_MAX

Set the maximum current to limit for products with a current measurement circuit.

1 = 1mA, 10000 = 10A.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0xD8 | 2 | R/W | 65535 | 0 | 65535 |

- 0 = Off.
- This function works only for SG series SERVO.

2-7 Configuration

The Register to configure CAN SERVO.

2-7.1 REG_DEFAULT

Restore all register values to factory default or recently saved.

Writing 3855 to this register will return all register values to their factory defaults. If you write 0xFFFF, it will return to the last saved state.

If you want to maintain this state after power reset, you should save all the register values using REG_CONFIG_SAVE register.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x6E | 2 | W | - | - | 65535 |

- When returning to the factory defaults, all register values you have changed will be erased. Please be careful to use.

2-7.2 REG_CONFIG_SAVE

Save all register change values.

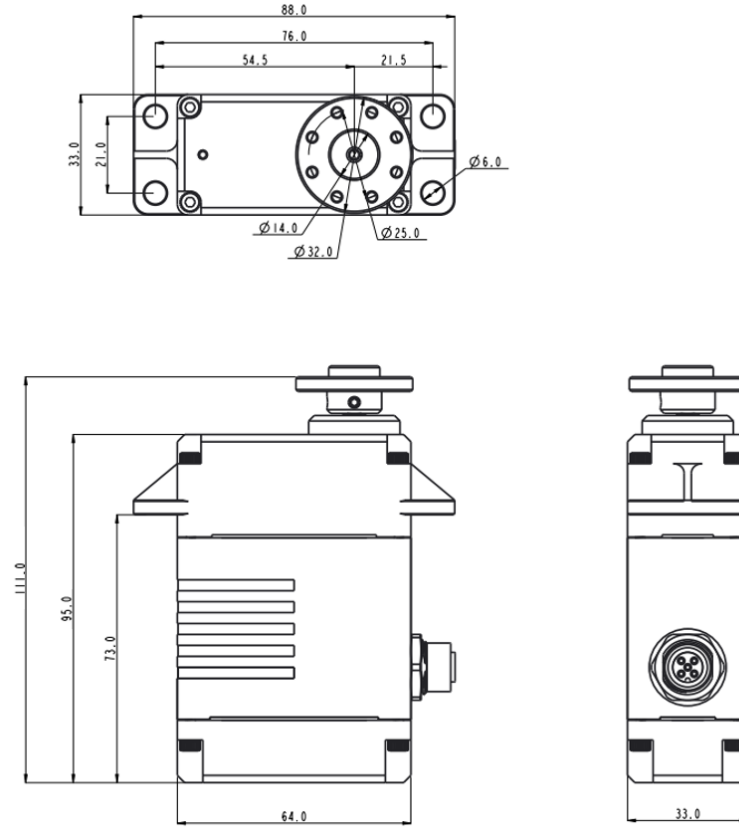
Even if the register value is changed, it will return to the last saved setting after the power is reset. If you write 0xFFFF to DATA, all current register values are saved and you can maintain the current state even after power reset.

| Address | length | R/W | Reset | Min | Max |
|---------|--------|-----|-------|-----|-------|
| 0x70 | 2 | R/W | 0 | 0 | 65535 |

- After saved, previous Configuration Register values cannot be recalled. Please be careful to use.

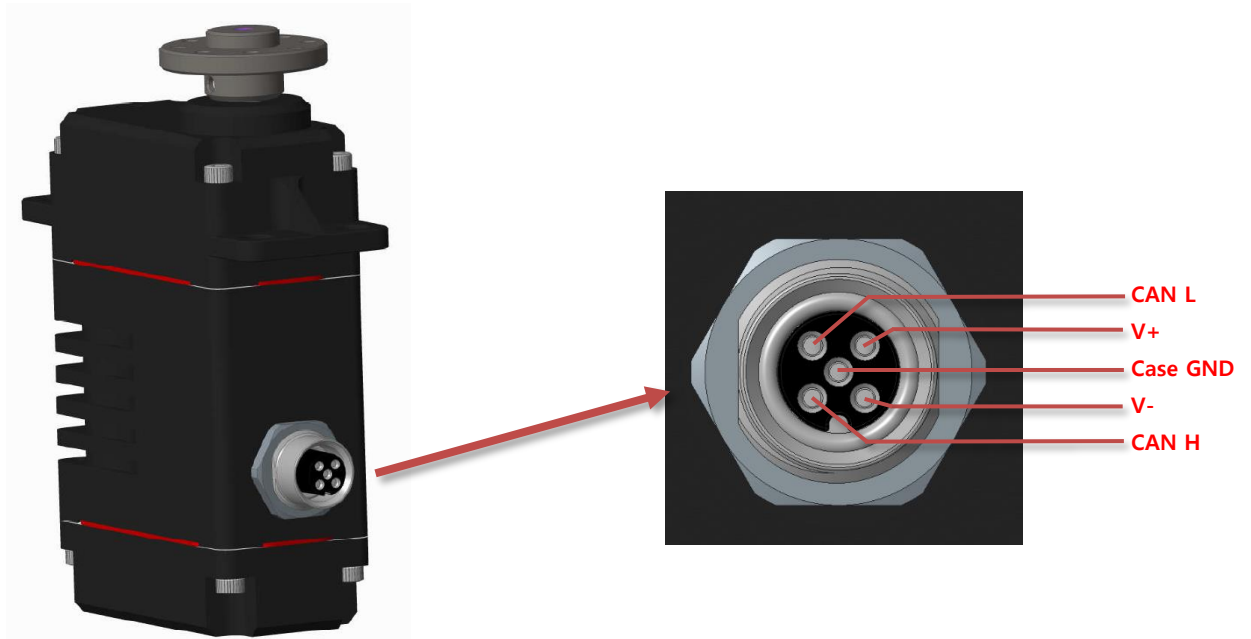
3 Drawing

3-1 Dimension (SG33BL-CAN Circular Connector Type)

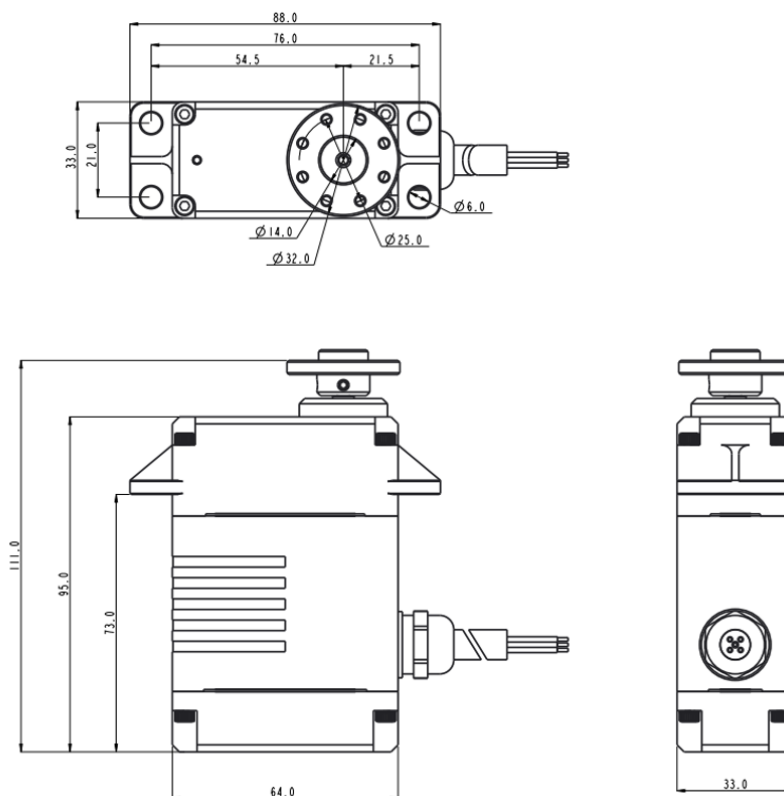


<Unit : mm>

3-2 Connector and Pin Assign (SG33BL-CAN Circular Connector Type)

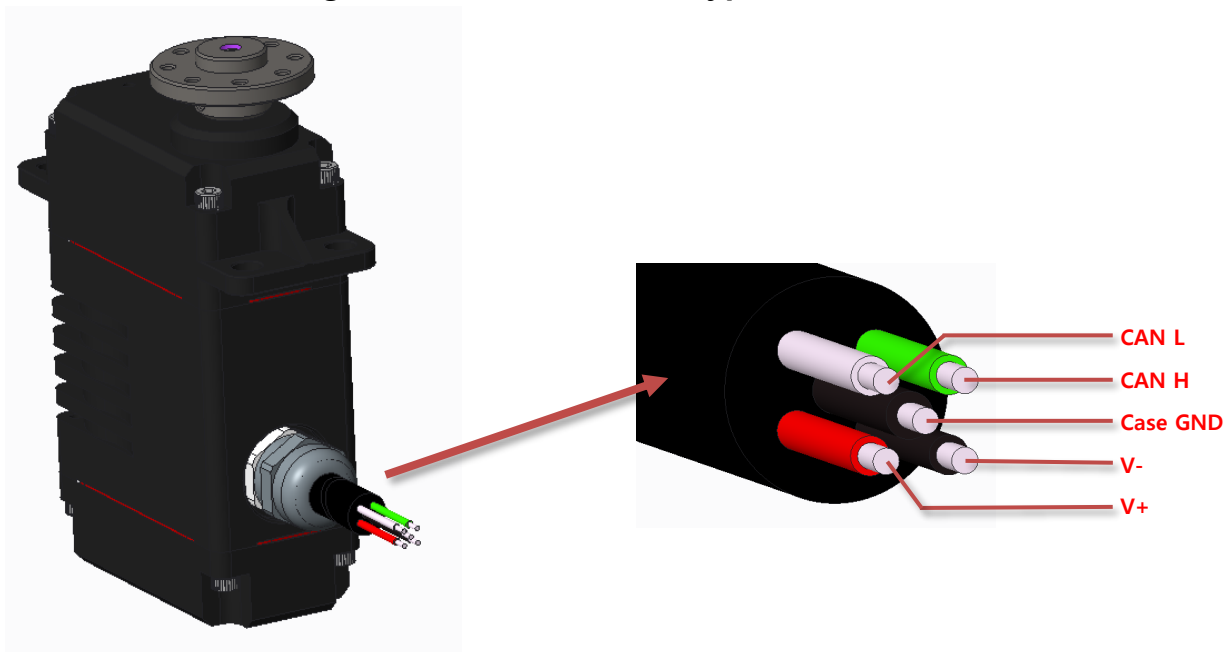


3-3 Dimension (SG33BL-CAN Cable Type)

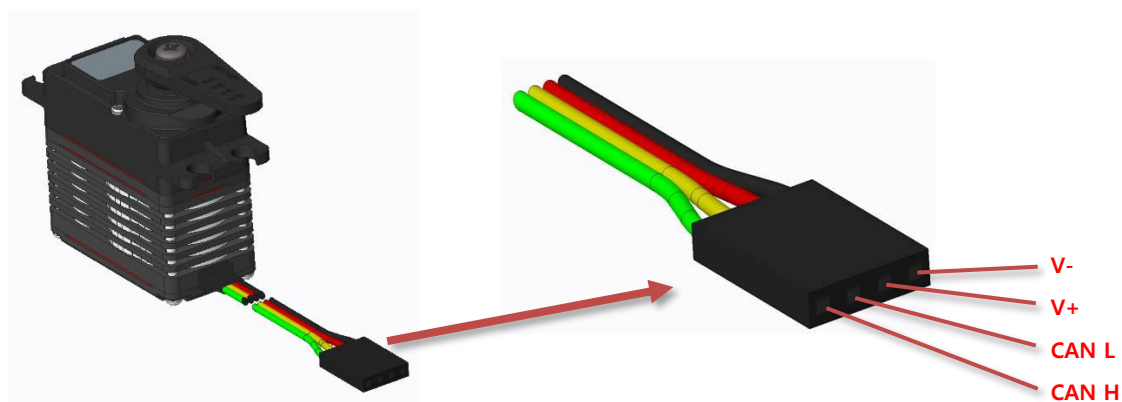


<Unit : mm>

3-4 Cable and Pin Assign (SG33BL-CAN Cable Type)



3-5 Connector and Pin Assign (Standard CAN Servo Connector Type)



4 Revisions

4-1 Updates

| Date | Version | Revisions |
|---------|---------|---|
| 2020-02 | 1.01 | - |
| 2020-03 | 1.02 | SG33BL-CAN series Dimension and Pin Assign added. |
| 2020-03 | 1.03 | Standard CAN Servo Pin Assign added. |