DELTA ELECTRONICS, INC.

DVP02LC-SL

Load Cell Module

Operation Manual

http://www.delta.com.tw/industrialautomation

DVP-0071020-01

⚠ Warning

- ✓ This operation manual provides introduction on the functions, specifications, installation, basic operation and settings for DVP02LC-SL and information on load cell measurement.
- ✓ This is an OPEN TYPE device and therefore should be installed in an enclosure free of airborne dust, humidity, electric shock and vibration. The enclosure should prevent non-maintenance staff from operating the device (e.g. key or specific tools are required to open the enclosure) in case danger and damage on the device may occur. DO NOT touch any terminal when the power is switched on.
- ✓ Please read this operation manual thoroughly and follow the instructions in case damages on the device or injuries on the operation staff occur.

🕮 Table of Content

1 Theory of Load Cell

When metallic materials encounter a pulling force or tension, they will become thin, and the electrical resistance will increase. In other words, when the materials are compressed, the resistance will become small. The strain meter adopting this theory is called a load cell. Such sensing device is able to convert physical pressure changes into output electrical signals and is widely used in loading, tension and pressure conversion applications.

2 Introduction to DVP02LC-SL

1. Thank you for choosing Delta DVP02LC-SL load cell module. DVO02LC-SL provides 24-bit resolution applicable for 4-wire or 6-wire load cells with various eigenvalues. Therefore, the response time can be adjusted in coordination with each other according to users' needs. On this basis, the market requirements on weight measurement can easily be met.
2. To ensure correct installation and operation of DVP02LC-SL, please read this operation manual carefully before using it. This operation manual only provides introductory information on DVP02LC-SL. For more detailed information on the theory of load cell, please refer to relevant references of literature.
3. The DVP02LC-SL load cell module is able to read/write data by using FROM/TO instructions through the DVP series PLC MPU*Note*.

Note: The MPU (main processing unit) refers to PLC compatible with left-side extension, e.g. DVP-SV, DVP-EH2-L, DVP-SA2, DVP-SX2 series PLC.

2.1 Functions

Rated power supply voltage/power consumption	24 VDC (-15 to +20%)/3 W
Voltage boundary	18 to 31.2 VDC
Max. current consumption	125 mA
Input signal range	±40 mVDC
Sensibility	+5 VDC +/-10%
Internal resolution	24 bits
Communication port	RS-232, RS-485
Applicable sensor type	4-wire or 6-wire load cell
Temperature coefficient span	≤ ± 50 ppm/K v. E
Temperature coefficient zero point	≤ ± 0.4 μV/K
Linearity error	≤ 0.02%
Response time	2, 10, 20, 40, 80 ms × number of channels
4 measuring ranges	0 to 1, 0 to 2, 0 to 4, 0 to 6 mV/V
Max. distance for connecting to load cell	100m
Max. current output	5 VDC × 300 mA
Permitted load cell resistance	40 to 4,010 Ω
Common mode rejection (CMRR @50/60 Hz)	≥ 100dB
Dynamic value filter	Setting range: K1 to K5
Average value filter	Setting range: K1 to K100
Isolation method	500 VAC between digital circuits and ground 500 VAC between analog circuits and ground 500 VAC between analog circuits and digital circuits
Serial connection to DVP-PLC MPU	Connectable to the left side of the MPU, numbered from 100 to 107 according to the position of the module from the closest to the farthest to the MPU.
Operation/storage	Operation: 0 to 55°C (temperature),50 to 95% (humidity), pollution degree 2 Storage: -25 to 70°C (temperature), 5 to 95% (humidity)
Vibration/shock immunity	International standards: IEC 61131-2, IEC 68-2-6 (TEST Fc)/IEC 61131-2 & IEC 68-2-27 (TEST Ea)

2.2 Effective Number of Bits (ENOB)

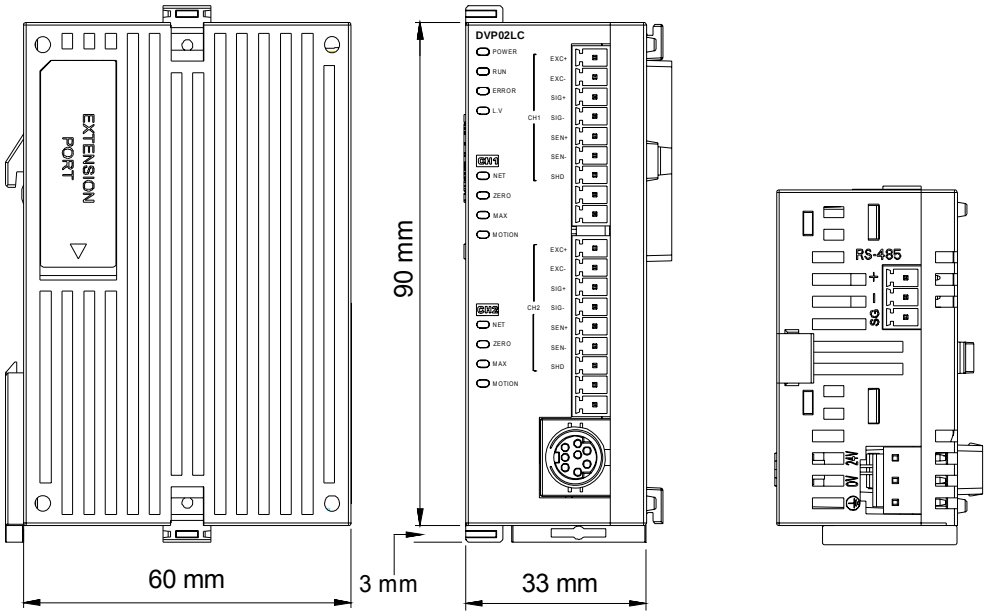
Load cell eigenvalue	CR#2: eigenvalue*	CR#3: Reaction time for measurement*				
		2 ms	10 ms	20 ms	40 ms	80 ms
0 to 1 mV/V	0	18	19.1	19.5	19.8	20.2
1 to 2 mV/V	1	19	19.6	20.1	20.3	20.7
2 to 4 mV/V	2	19	20	20.5	20.7	21
4 to 6 mV/V	3	19	20	20.4	20.5	20.8

Example: If you use a load cell of eigenvalue 3.8 mV/V, please set CR#2 to “2” to acquire the best ENOB. When CR#3 is set to “2 ms”, the ENOB will be 19 bits. When CR#3 is set to “20 ms”, the ENOB will be 20.5 bits.

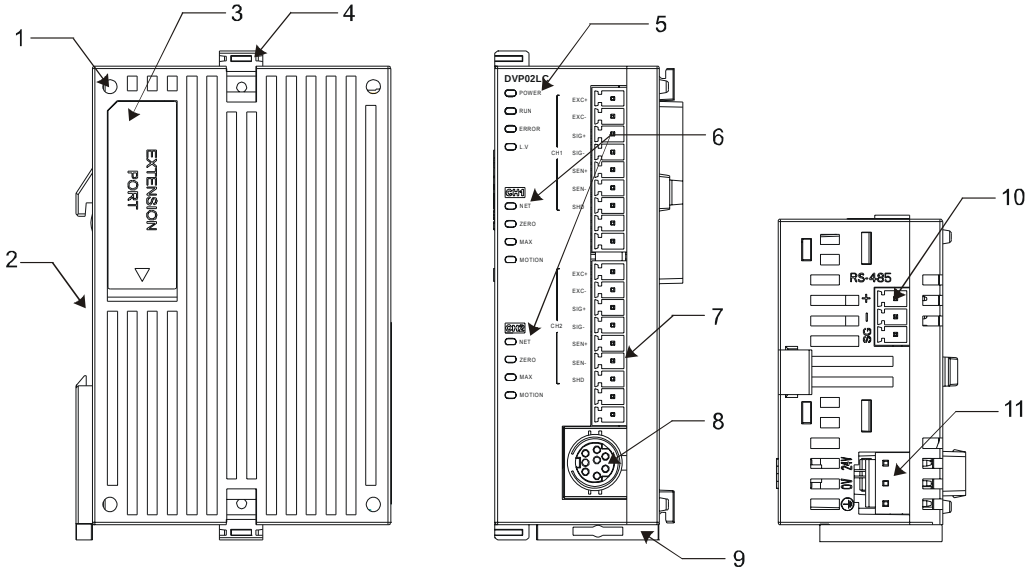
** For explanations on CR#2 and CR#3, see 5.2.*

3 Product Profile and Outline

3.1 Dimensions

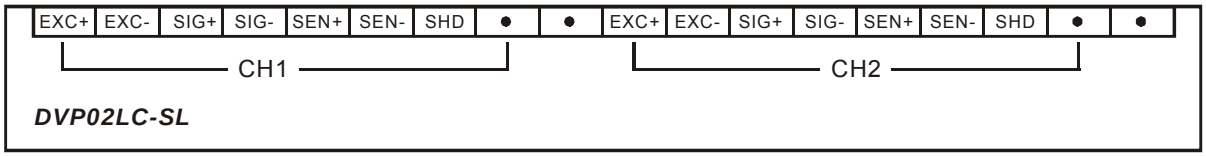


3.2 Product Profiles



1.	Mounting hole for the I/O module	2.	DIN rail slot (35mm)
3.	I/O module connection port	4.	I/O module clip
5.	Status indicators (POWER, RUN, ERROR, L.V)	6.	Function status indicators (NET, ZERO, MAX, MOTION)
7.	I/O terminals	8.	RS-232 port
9.	DIN rail clip	10.	RS-485 port
11.	DC power input		

3.3 Terminal Layout



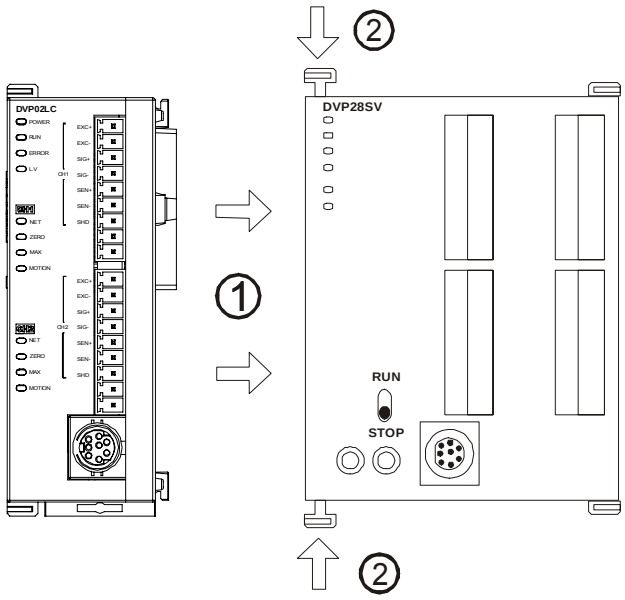
3.4 LED Indicators

LED	Color	Function
POWER	Green	Indicating the power supply status.
RUN	Green	Indicating the operating status of DVP02LC-SL.
ERROR	Red	Indicating error statuses.
L.V	Red	Indicating low voltage from the external power supply.
NET	Orange	Indicating net/gross weights.
ZERO	Orange	Indicating the zero point weight.
MAX	Orange	Indicating the maximum weight.
MOTION	Orange	Indicating stable measurements.

4 Installation and Wiring

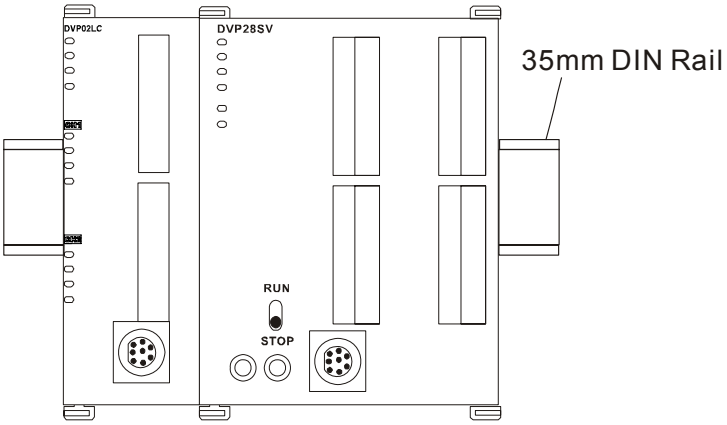
4.1 Connecting DVP02LC-SL to DVP-SV series PLC MPU

- Open the fixing clips on the top and bottom at the left side of DVP-SV series PLC MPU. Meet the connection ports alongside the 4 corners of DVP02LC-SL with DVP-SV, as step ①.
- Press the fixing clips on the top and bottom of the DVP-SV series PLC MPU and check if the connection is tight enough, as step ②.



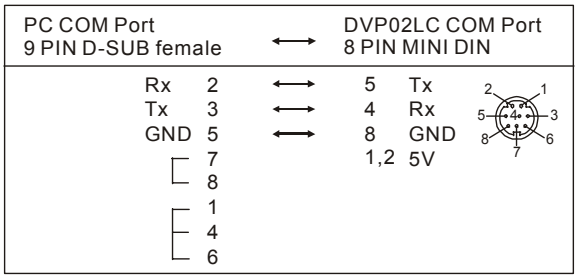
4.2 Installing DVP02LC-SL and DVP-SV Series PLC MPU into DIN Rail

- Use 35mm DIN rail.
- Open the DIN rail clips on DVP02LC-SL and DVP-SV series PLC MPU and insert them onto the DIN rail.
- Clip up the DIN rail clips to fix them on the rail.

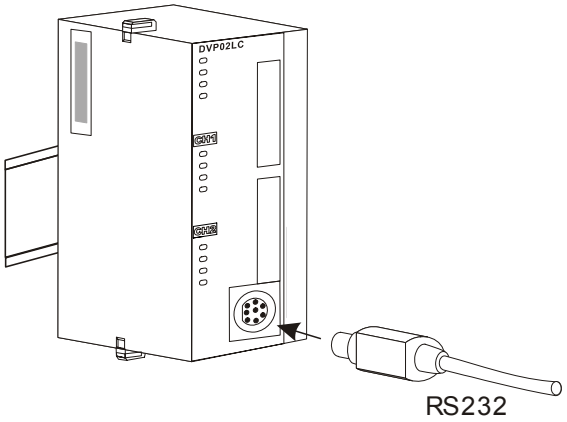


4.3 Communication

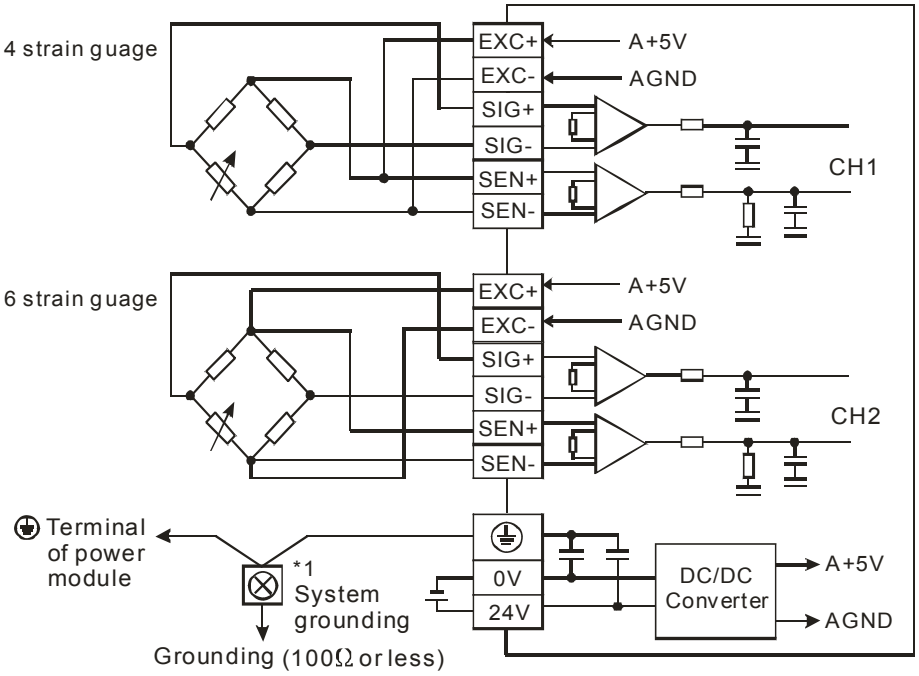
- Please follow the PIN definitions for the wiring.



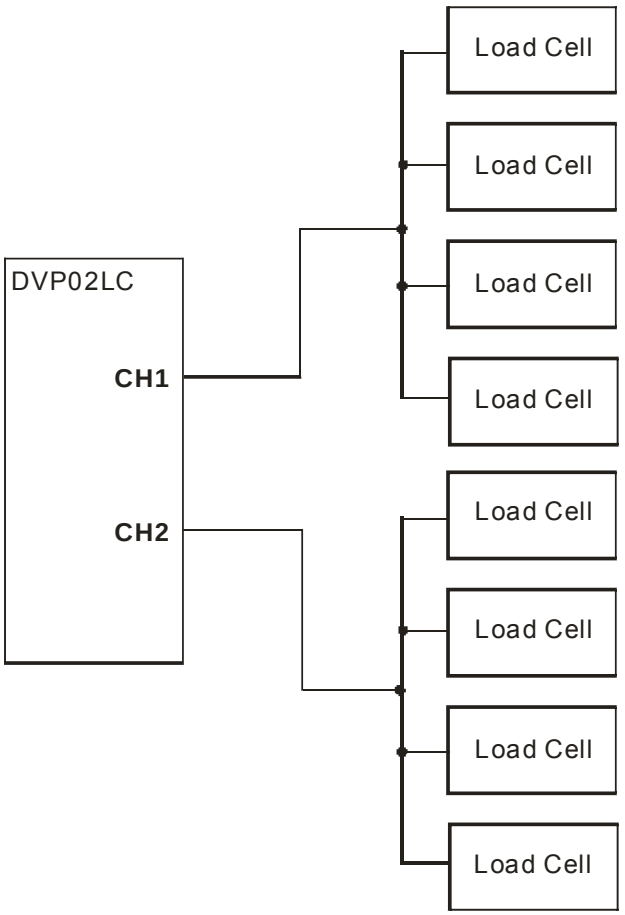
- There are 2 communication interfaces in DVP02LC-SL available for the communication with the PC or other devices. COM1 is the RS-232 port, and COM2 is the RS-485 port. Both ports comply with standard Modbus protocol. The PC can communicate directly with DVP02LC-SL through COM1.
- We recommend you use Delta's power supply modules for DVP02LC-SL.



4.4 External Wiring



Many load cells connected in parallel connected to a single DVP02LC-SL:



Note 1: Please connect the ⏚ on both the power module and load cell module to the system earth point and ground the system contact or connect it to the cover of the power distribution cabinet.
Note 2: When many load cells are connected in parallel, the total impedance shall be bigger than 40Ω.

5 Functions of DVP02LC-SL

5.1 Control Registers (CR)

CR#	Address	Attribute		Content	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
#0	H'1000	O	R	Model name	Set up by the system. DVP02LC-SL model code = H'4206															
#1	H'1001	O	R	Firmware version	Displaying the current firmware version in hex.															
#2	H'1002	O	R/W	Eigenvalue	Mode 0 (H'0000): 1 mV/V Mode 1 (H'0001): 2 mV/V (Default) Mode 2 (H'0002): 4 mV/V Mode 3 (H'0003): 6 mV/V															
#3	H'1003	O	R/W	Reaction time for measurement	Mode 0 (H'0000): 2 ms Mode 1 (H'0001): 10 ms Mode 2 (H'0002): 20 ms Mode 3 (H'0003): 40 ms Mode 4 (H'0004): 80 ms (Default)															
#4	H'1004	O	R	Average value of all channels	Summing up the CH1 average value and CH2 average value and equalizing them. Equation = (CH1 average value + CH2 average value) ÷ 2															
#6	H'1006	X	R/W	CH1 to CH2 read tare weight	Reading the present average value as the tare weight value. bit0: CH1; bit1: CH2; bit2 to bit15: reserved															
#7	H'1007	O	R/W	CH1 to CH2 gross/net weight	Selecting the present weight to be gross weight (K0) or net weight (K1). bit0 to bit3: CH1; bit4 to bit7: CH2; bit8 to bit15: reserved Take CH1 for example: bit3 to bit0 = 0000 (gross); bit3 to bit0 = 0001 (net); bit3 to bit0 =1111 (channel disabled)															
#8	H'1008	O	R/W	CH1 tare weight	The user can write in the weight or read it by commands. Default: K0; Range: K-32,768 to K32,767															
#9	H'1009	O	R/W	CH2 tare weight																
#10	H'100A	O	R/W	CH1 average times	Default: K10; Range: K1 to K100 When the value exceeds the range, it will automatically be changed to K1 or K100.															
#11	H'100B	O	R/W	CH2 average times																
#12	H'100C	X	R	CH1 average weight	Displaying the average weight.															
#13	H'100D	X	R	CH2 average weight																
#14	H'100E	X	R	CH1 present weight	Displaying the present weight.															
#15	H'100F	X	R	CH2 present weight																
#16	H'1010	O	R/W	CH1 times of standstill check	Default: K5 Range: K1 to K500															
#17	H'1011	O	R/W	CH2 times of standstill check																
#18	H'1012	O	R/W	CH1 range for standstill check	Default: K10 Range: K1 to K10,000															
#19	H'1013	O	R/W	CH2 range for standstill check																
#20	H'1014	O	R/W	CH1 decimal point place	Default: K2 Range: K1 to K4															
#21	H'1015	O	R/W	CH2 decimal point place																

CR#	Address	Attribute		Content	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
#22	H'1016	O	R/W	CH1 unit of measurement	Containing max. 4 ASCII words. CR#22, CR#24: for high words CR#23, CR#25: for low words															
#23	H'1017	O	R/W	CH1 unit of measurement																
#24	H'1018	O	R/W	CH2 unit of measurement																
#25	H'1019	O	R/W	CH2 unit of measurement																
#26	H'101A	X	R/W	Weight correction command	For the user to correct the weight. Default: H'0000 H'0001: CH1 reset to zero command H'0002: CH1 weight base point command H'0003: CH2 reset to zero command H'0004: CH2 weight base point command																
#33	H'1021	O	R/W	CH1 weight base point	For CR#33 to CR#34, the default value is K1,000 and the range is K-32,768 to K32,767. Steps for correction: (take CH1 for example) 1: Place no weights on the load cell. 2: Set up CR#26 command = H'0001. 3: Place standard weights on the load cell. 4: Write the weight of the weights on the plate into CR#33. 5: Set up CR#26 command = H'0002.															
#34	H'1022	O	R/W	CH2 weight base point																
#35	H'1023	O	R	CH1 max. weight	For setting up the maximum weight. When the measured value exceeds the set value, error codes will be recorded.															
#36	H'1024	O	R	CH2 max. weight																
#37	H'1025	O	R/W	Upper limit for CH1 zero point check	Default: K10; Range: K-32,768 to K32,767 Reference for reset to zero. When the weight is within the range, the status code will be set to "zero bit", indicating the current zero weight status.															
#38	H'1026	O	R/W	Upper limit for CH2 zero point check																
#39	H'1027	O	R/W	Lower limit for CH1 zero point check	Default: K-10; Range: K-32,768 to K32,767 Reference for reset to zero. When the weight is within the range, the status code will be set to "zero bit", indicating the current zero weight status.															
#40	H'1028	O	R/W	Lower limit for CH2 zero point check																
#41	H'1029	X	R/W	Saving set value (H'5678)	Saving the present set value and writing all set values into the internal Flash for use next time when DVP02LC-SL is switched on. H'0: No action (Default) H'FFFF: Saving is successful H'5678: Writing to internal Flash When H'5678 is written in, all set values will be saved in the Flash. When the saving is completed, CR#41 will become H'FFFF. If the value written in is not H'5678, it will automatically return to H'0, e.g. write K1 into the CR to return it to K0.															
#43	H'102B	X	R/W	CH1 filter percentage	Default: K2 Range: K1 to K5 (Unit: 10%)															
#44	H'102C	X	R/W	CH2 filter percentage																
#45	H'102D	X	R/W	CH1 filter average value	Displaying the average value after the filtering. Default: K0 Condition to enable the filter: Average times ≥ 30															
#46	H'102E	X	R/W	CH2 filter average value																

CR#	Address	Attribute		Content	b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
#50	H'1032	X	R	Status code	b0 (H'0001): CH1 zero point weight (empty) b1 (H'0002): CH2 zero point weight (empty) b2 (H'0004): CH1 exceeds max. weight (overload) b3 (H'0008): CH2 exceeds max. weight (overload) b4 (H'0010): CH1 measured value is stable. b5 (H'0020): CH2 measured value is stable. b6 to b15: Reserved															
#51	H'1033	X	R	Error code	Storing all error statuses. See the "Error Code" table.															
#52	H'1034	O	R/W	RS-232 node address	For CR#52 and CR#54, the default value is K1 and the range is K1 to K255. For CR#53 and CR#55, the default value is H'0000 and the range is "ASCII, 9600, 7, E, 1". See the "Communication Format" table.														
#53	H'1035	O	R/W	RS-232 communication format																
#54	H'1036	O	R/W	RS-485 node address																
#55	H'1037	O	R/W	RS-485 communication format																
Symbols: O means latched; X means non-latched; R means able to read data; W means able to write data.																				

5.2 Explanations on Control Registers

CR#0: Model name

Explanations:

The model code of DVP02LC-SL is H'4206.

CR#1: Firmware version

Explanations:

The high byte is the ones digit, and the low byte is the tenths and hundredths digits, e.g. V1.01 = H'0101.

CR#2: Eigenvalue

Explanations:

Since load cells of different brands own different specifications, please set up eigenvalues for DVP02LC-SL following the instructions and specification of the load cell you use.

Specification	Eigenvalue you need	Value to be set in CR#2	Note
0 < eigenvalue ≤ 1 mV/V	1 mV/V	H'0000	
1 < eigenvalue ≤ 2 mV/V	2 mV/V	H'0001	Default
2 < eigenvalue ≤ 4 mV/V	4 mV/V	H'0002	
4 < eigenvalue ≤ 6 mV/V	6 mV/V	H'0003	
Eigenvalue > 6 mV/V	Not supported		

CR#3: Reaction time for measurement

Explanations:

The reaction time refers to how long you sample once. The shorter the reaction time, the shorter the filtering time, bringing forth less stable measured values. However, the longest the reaction time, the most stable measured values you will acquire.

Mode 0: H'0000	2 ms
Mode 1: H'0001	10 ms
Mode 2: H'0002	20 ms
Mode 3: H'0003	40 ms
Mode 4: H'0004	80 ms (Default)

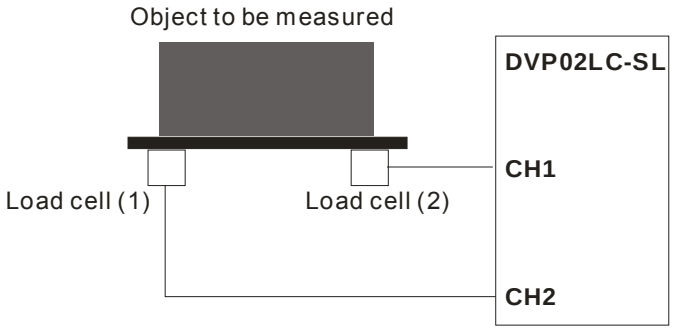
CR#4: Average value of all channels

Explanations:

The average values of CH1 and CH2 are summed up and equalized.

The average value of all channels = (CH1 average value + CH2 average value) ÷ 2

If you use 2 load cells to measure the same object, you can read the average value of all channels to be the measured value.



CR#6: CH1 to CH2 read tare weight

Explanations:

You can set up the tare weight yourself, or read the present average value as the tare weight value.

bit15 ~ bit2	bit1	bit0
Reserved	CH2	CH1

CR#7: CH1 to CH2 gross/net weight

Explanations:

You can choose to presently display the gross weight or net weight. The channel that is not used can be disabled.

bit15 ~ 2	bit7 ~ 4	bit3 ~ 0
Reserved	CH2	CH1
	H'0 = gross weight H'1 = net weight H'F = channel disabled	

CR#8, 9: CH1 to CH2 tare weight

Explanations:

You can write in the weight or read it by commands. Default: K0. Range: K-32,768 to K32,767.

CR#10, 11: CH1 to CH2 average times

Explanations:

The range is 1 to 100. When the value exceeds 100, it will automatically be switched to 100. When it falls below 1, it will automatically be switched to 1.

Range	Default
1 ≤ average times ≤ 100	10

CR#12, 13: CH1 to CH2 average weight

Explanations:

The average weight is displayed.

CR#14, 15: CH1 to CH2 present weight

Explanations:

The present weight is displayed.

CR#16, 17: CH1 to CH2 times of standstill check

Explanations:

Default: K5. Range: K1 to K500. See 5.3.2 for details.

CR#18, 19: CH1 to CH2 range for standstill check

Explanations:

Default: K10. Range: K1 to K10,000. See 5.3.2 for details.

CR#20, 21: CH1 to CH2 decimal point place

Explanations:

The place of the decimal point set up by the user.

Range	Default
0 ≤ decimal point place ≤ 4	2

CR#22, 23, 24, 25: CH1 to CH2 unit of measurement

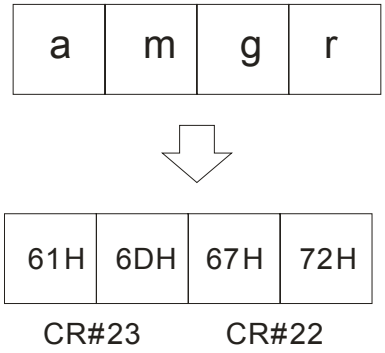
Explanations:

These control registers record the units of measurement in hex values corresponding to the ASCII words set up by the user. Each channel is able to contain maximum 4 ASCII words.

ASCII/hex table:

Hex	30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
ASCII	0	1	2	3	4	5	6	7	8	9	☒	☒	☒	☒	☒	☒
Hex	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
ASCII	☒	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Hex	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F
ASCII	P	Q	R	S	T	U	V	W	X	Y	Z	☒	☒	☒	☒	☒
Hex	60	61	62	63	64	65	66	67	68	69	6A	6B	6C	6D	6E	6F
ASCII	☒	a	b	C	d	e	f	g	h	i	j	k	l	m	n	o
Hex	70	71	72	73	74	75	76	77	78	79	7A	7B	7C	7D	7E	7F
ASCII	p	q	r	s	t	u	v	w	x	y	z	☒	☒	☒	☒	☒

Example: If you would like the unit for CH1 to be “gram”, set up CR#22 and CR#23 following the figure below.



CR#26: Weight correction command

Explanations:

Commands for the user to correct weights.

Value	Function
H’0001	CH1 reset to zero
H’0002	CH1 weight base point
H’0003	CH2 reset to zero
H’0004	CH2 weight base point

CR#33, 34: CH1 to CH2 weight base point

Explanations:

The weight of the weights has to be written in during the correction.

CR#35, 36: CH1 to CH2 maximum weight

Explanations:

The maximum weight set up by the user. When the value exceeds the maximum weight, bit2 and bit3 of CR#50 will be set to “1”.

CR#37, 38, 39, 40: Upper/Lower limit for CH1 to CH2 zero point check

Explanations:

The references for reset to zero. When the weight is within the range, bit0 and bit1 of CR#50 will be set to “1”.

CR#41: Saving set value

Explanations:

The present set value is saved, and all set values are written into the internal Flash for use next time when DVP02LC-SL is switched on. Default: 0.

When H’5678 is written in, all set values will be saved in the Flash. When the saving is completed, CR#41 will become H’FFFF. If the value written in is not H’5678, it will automatically return to H’0, e.g. write K1 into the CR to return it to K0.

H’0	No action
H’FFFF	Saving is successful.
H’5678	Writing to internal Flash

CR#43, 44: CH1 to CH2 filter percentage

Explanations:

Range: K1 to K5. Unit: 10%. Default: K2, i.e. 20%.

CR#45, 46: CH1 to CH2 filter average value

Explanations:

The average weight value is displayed after the filtering. The condition to enable the filter is that the average times have to be larger than 30.

CR#50: Status code

Explanations:

bit		Status
bit0	H’0001	CH1 zero point weight (empty)
bit1	H’0002	CH2 zero point weight (empty)
bit2	H’0004	CH1 exceeds max. weight (overload)

bit		Status
bit3	H'0008	CH2 exceeds max. weight (overload)
bit4	H'0010	CH1 measured value is stable.
bit5	H'0020	CH2 measured value is stable.
bit6 ~ 15	Reserved	

CR#51: Error code

Explanations:

Bit	Content	Error	Bit	Content	Error
b0	K1 (H'0001)	Power supply abnormality	b1	K2 (H'0002)	Hardware abnormality
b2	K4 (H'0004)	CH1 conversion error	b3	K8 (H'0008)	CH1 SEN voltage error
b4	K16 (H'0010)	CH2 conversion error	b5	K32 (H'0020)	CH2 SEN voltage error
b6 ~ b15	K64 (H'0040)	Reserved			
Note: Every error status is determined by its corresponding bit, so there might be more than 2 error statuses occurring at the same time. 0 refers to no error; 1 refers to error occurring.					

CR#52, 53 ,54, 55: Communication format for RS-232 and RS-485

Explanations:

bit15	bit14 ~ bit8	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
ACSII/RTU	Reserved	Baudrate				Data length	Stop bit	Parity	

Description					
bit15	ACSII/RTU	0	ACSII	1	RTU
bit7 ~ bit4	Baudrate	0	9,600 bps	1	19,200 bps
		2	38,400 bps	3	57,600 bps
		4	115,200 bps	5	Else none
bit3	Data length (RTU = 8 bits)	0	7	1	8
bit2	Stop bit	0	1 bit	1	2 bits
bit1 ~ bit0	Parity	0	Even	1	Odd
		2	None	3	None

Example: If you would like to communication format for RS-232 to be "115200, 7, E, 1, ASCII" set CR#53 to "H'0400".

5.3 Further Explanations on Each Function

5.3.1 Measure the Weight

Normally, we can choose to measure the net weight or gross weight of an object. The net weight means the weight of the product itself, that is, the actual weight of the product without its external packaging. The weight of the packaging is called the tare weight. The gross weight is the total weight, namely the net weight plus the tare weight.

- Tare weight: Weight of the packaging
- Net weight: The weight of the product, excluding the packaging.
- Gross weight: The net weight plus the tare of the product.
- Gross weight = net weight + tare weight

Example: A product weighs 10kg and the carton contains it weighs 0.2kg, then its gross weight is 10.2kg. (net weight = 10kg, tare weight = 0.2kg, gross weight = 10.2kg)

■ Relevant control registers

- CR#6: Reads the tare weight
- CR#7: Selects gross or net weight
- CR#8, 9: The tare weight

■ Example

Use the measured value at CH1 as the net weight and disable CH2. If you know the weight of the packaging already, you can skip the step of reading the tare weight.

1. Read the tare weight
   Step 1: Write H'0000 into CR#7.
   Step 2: Place the packaging on the CH1 load cell.
   Step 3: Write H'0001 into CR#6 to take the weight of the packaging as the tare weight.
2. Set CR#7 = H'00F1.

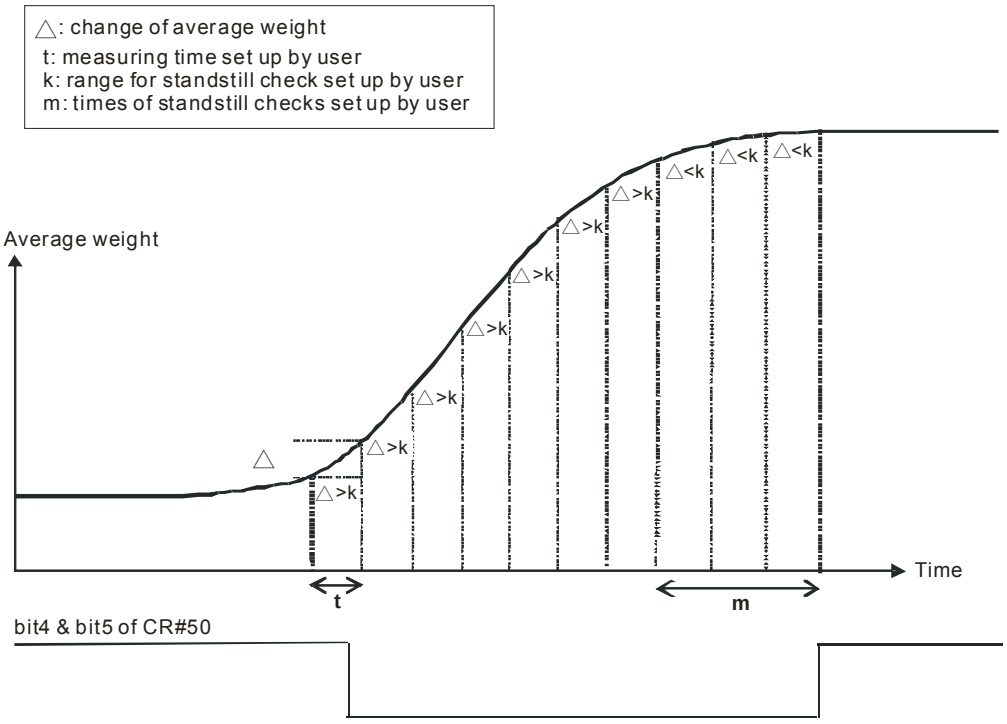
5.3.2 Standstill Check

When an object is placed on the load cell to measure its weight, you can use the standstill check to know that the measured value has been stable.

- If the measured value shifts within the range for standstill check (CR#18, 19) set up by the user, bit4 and bit5 of CR#50 will be set to "1".
- If the measured value shifts beyond the range for standstill check set up by the user, bit4 and bit5 of CR#50 will be set to "0". They will be set to "1" again when the range is returned to the set range.

Example: The measuring time is 10ms, the times of standstill check is 10, and the range for standstill check is 1,000. When the range for standstill check exceeds 1,000, the measured value will be regarded unstable, i.e. bit4 and bit5 of CR#50 will be set to 0. When the measuring time is within

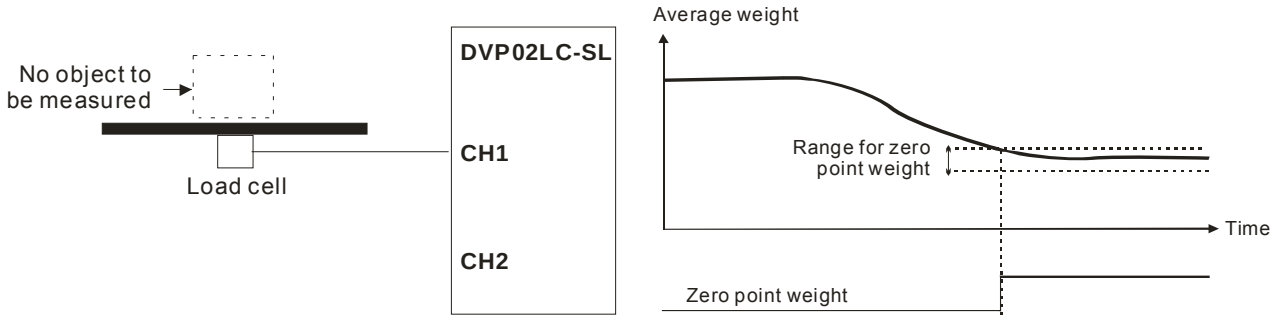
100ms (10 × 10ms) and the range returns to be within 1,000, bit4 and bit5 of CR#50 will be set to 1 again. We recommend you check if the measured value is stable enough before controlling it.



- Relevant control registers
  - CR#16,17: Times of standstill check
  - CR#18,19: Range for standstill check

5.3.3 Determining Zero Point

You can use the zero point determination function to know if the object has been removed from the load cell. If the bit4 and bit5 of CR#50 are 1, and the bit0 and bit1 are 1 as well, the object has been removed from the load cell already, and you will be able to perform the next step of the control.

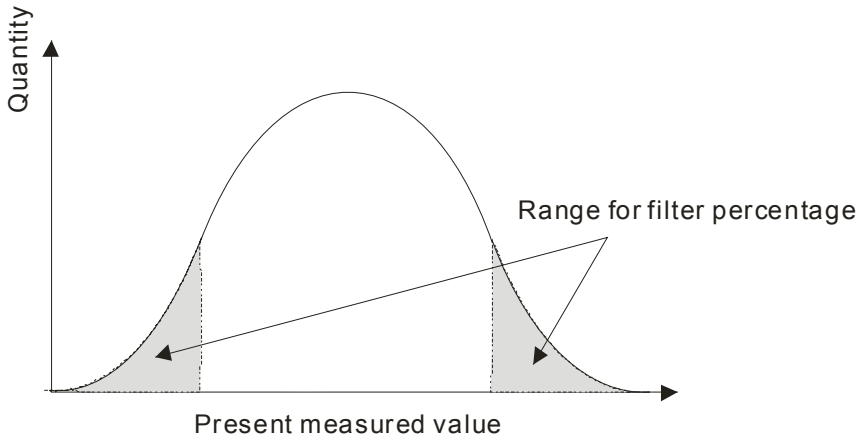


- Relevant control registers
  - CR#37, 38, 39, 40: Upper/Lower limits for zero point check

5.3.4 Filtering

The average value is a steady value obtained from the sum of the read values. However, due to unavoidable external factors, the read values may be an acute pulse, resulting in fierce changes in the

average value. The filtering function thus exclude the read value that is an acute pulse from the sum-up and equalization, so the average value obtained will not be affected by the acute read value. The condition to enable the filtering function is that the average times have to be ≥ 30, and the filter percentage has to be 10 to 50%.

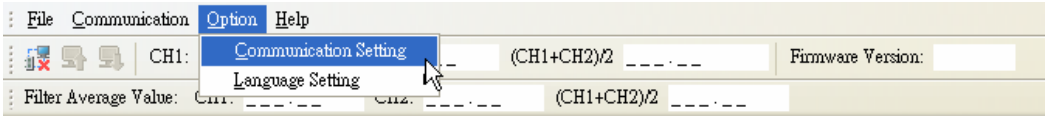


- Relevant control registers
  - CR#43, 44: Filter percentage
  - CR#45, 46: Filter average value

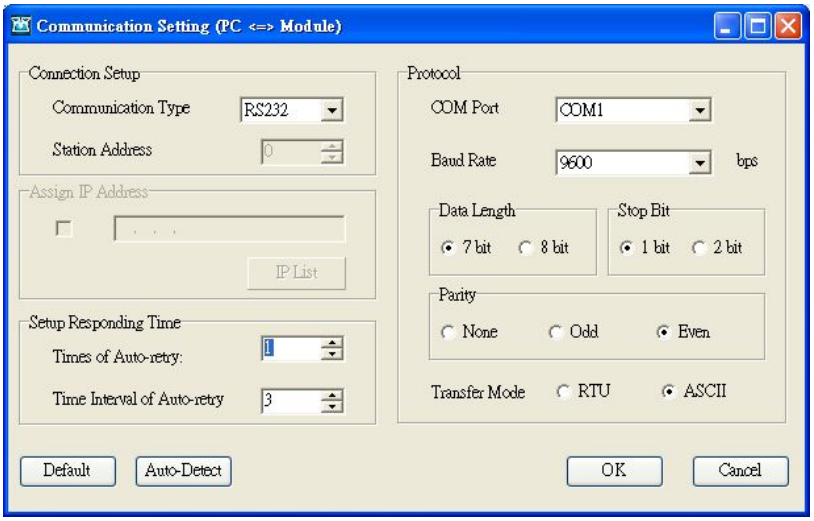
6 Setting up DVP02LC-SL in Software

6.1 Initial Settings

1. Connect DVP02LC-SL to the PC. For how to connect, see 4.3.
2. Open the software for DVP02LC-SL. Select “Option” -> “Communication Setting”.



3. Set up the communication parameters according to the settings below.



- Setting up responding time

  Times of auto-retry: Default = 1, range: 0 ~ 50

  Time interval of auto-retry: Default = 3, range: 1 ~ 20

- Setting up COM port

  COM port: Select the communication port to be connected with the MPU.

  Baud rate: 9600, 19200, 38400, 57600 or 115200

  Data length: 7 bit or 8 bit. When the transmission mode is set to RTU, it will automatically be set to “8 bit”.

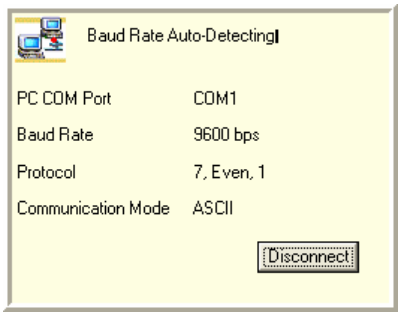
  Stop bit: 1 bit or 2 bit

  Parity: None, Odd or Even

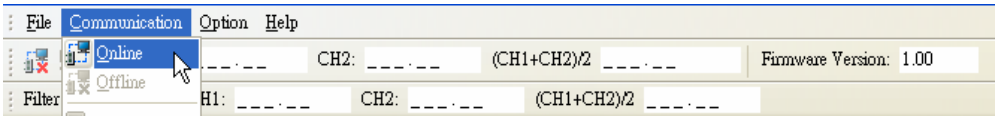
  Transfer (transmission) mode: RTU or ASCII

- Auto-detection

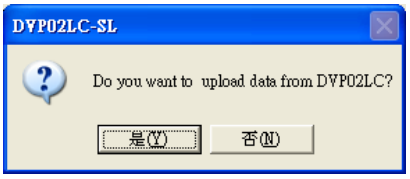
  Click the “Auto-Detect” button, and all the connections will be auto-detected in the current transmission mode.



4. After the communication settings are completed, click the  icon on the toolbar, or select “Communication” -> “Online” to establish the connection between the software and DVP02LC-SL.

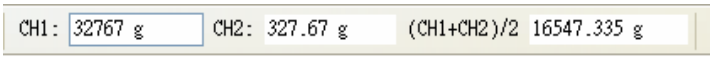


5. When you click “Online”, a window to upload the module data will appear, asking whether you are to upload the module data to the PC. Click “OK” to upload them and replace the set values already in the software.



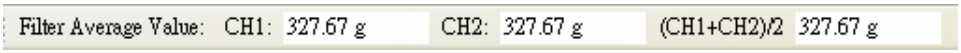
6. Once you enter the online status, the screen will show the real-time data of DVP02LC-SL, including its current firmware version, the average values of CH1 and CH2, the average value of CH1 + CH2, the filter average values of CH1 and CH2[Note] and the filter average value of CH1 + CH2. You can click a value, and a window displaying the enlarged character will appear.

- The average values



Click on a value, and the enlarged characters of the value will appear.

- The filter average values



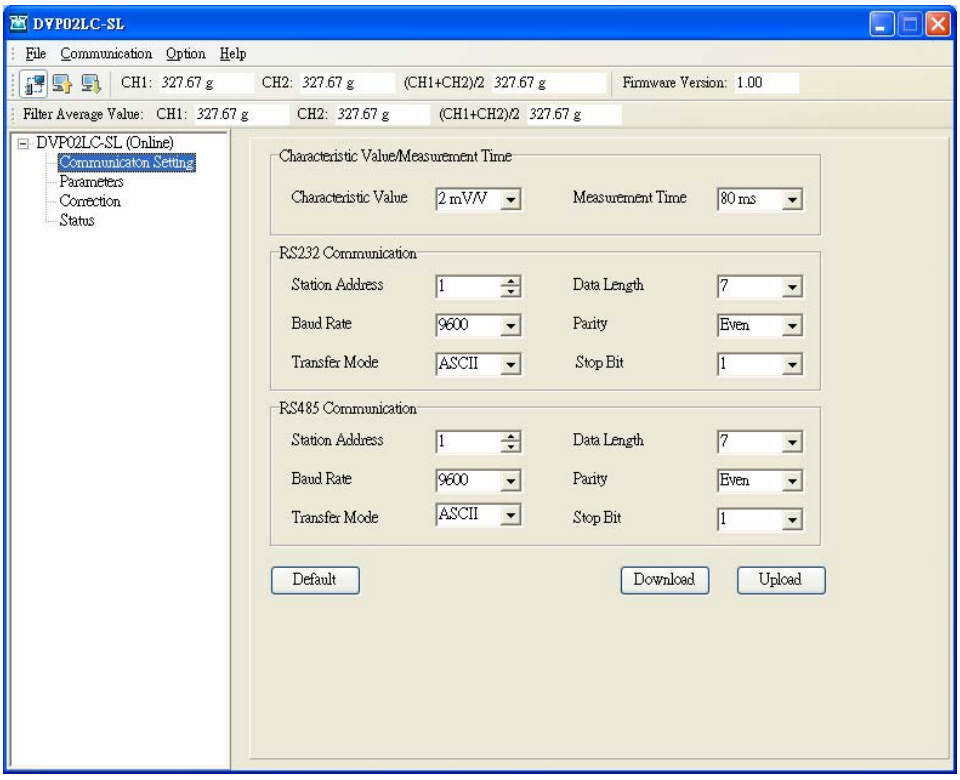
Click on a value, and the enlarged characters of the value will appear.

Note: When the filtering function is not enabled, the window for the filter average value will display "32767". Once the filtering function is enabled, the average times have to be > 30, and the filter percentage has to be set.

7. In the connection, if you would like to upload the data in DVP02LC-SL to software, click the icon  . Or click the icon  if you would like to download all the parameters set in the software to DVP02LC-SL.

6.2 Communication Settings

The communication setting window allows you to set up the communication formats for RS-232 and RS-485, the characteristic value (eigenvalue) and measuring time. When all the settings are done, click the icon  to download the parameters to DVP02LC-SL, or click "Upload" to display the parameters of DVP02LC-SL in the software. Click "Default" and all the parameters set will return to the default settings.



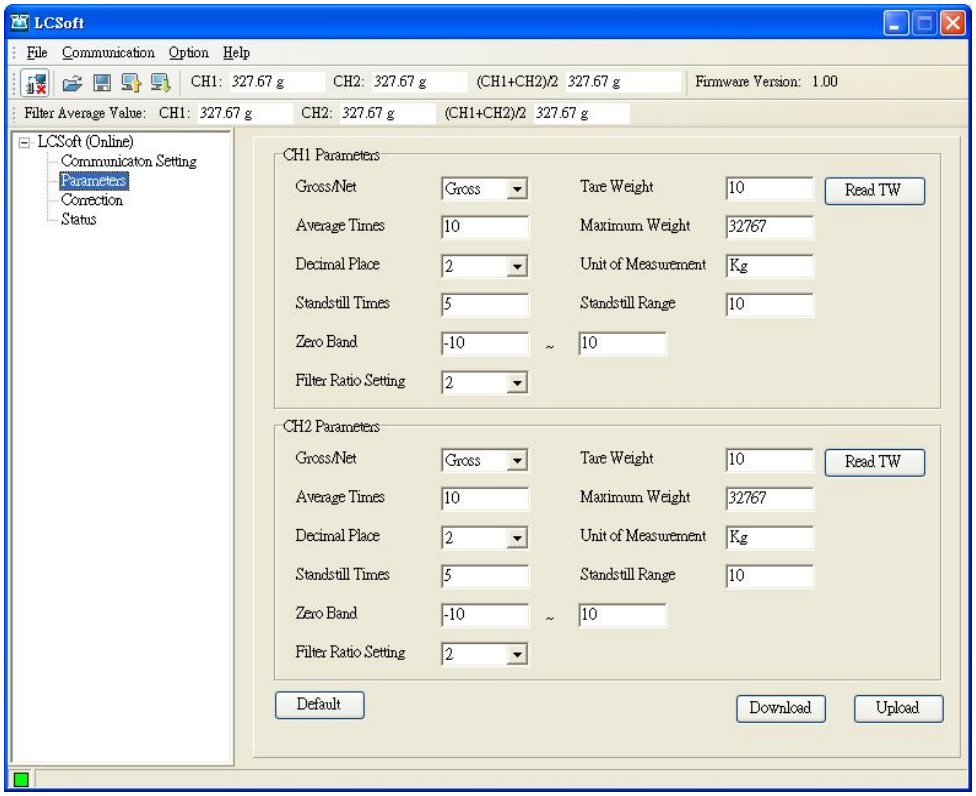
- Characteristic Value/Measurement time
  - Characteristic value: The eigenvalue, corresponding to the value set in CR#2. Scroll down to select 1, 2, 4 or 6 mV/V. The default setting is 2 mV/V.
  - Measurement time: Corresponds to the value set in CR#3. Scroll down to select 2, 10, 20, 40 or 80 ms. The default setting is 80 ms.

- RS-232 Communication
  - Station address: The node address, corresponding to the value set in CR#52. The range is 1 to 255, and the default setting is 1.
  - Baud rate: Corresponds to bit4 to bit7 of CR#53. Scroll down to select 9600, 19200, 38400, 57600 or 115200. The default setting is 9600.
  - Transfer mode: The transmission mode, corresponding to bit15 of CR#53. Scroll down to select RTU or ASCII. The default setting is ASCII.
  - Data length: Corresponds to bit3 of CR#52. Scroll down to select 7 or 8. The default setting is 7. When the transmission mode is set to be RTU, the data length will be automatically set to 8.
  - Parity: Corresponds to bit0 to bit1 of CR#53. Scroll down to select none, odd or even. The default setting is even.
  - Stop bit: Corresponds to bit2 of CR#53. Scroll down to select 0 or 1. The default setting is 1.

- RS-485 Communication
  - Station address: The node address, corresponding to the value set in CR#54. The range is 1 to 255, and the default setting is 1.
  - Baud rate: Corresponds to bit4 to bit7 of CR#55. Scroll down to select 9600, 19200, 38400, 57600 or 115200. The default setting is 9600.
  - Transfer mode: The transmission mode, corresponding to bit15 of CR#55. Scroll down to select RTU or ASCII. The default setting is ASCII.
  - Data length: Corresponds to bit3 of CR#55. Scroll down to select 7 or 8. The default setting is 7. When the transmission mode is set to be RTU, the data length will be automatically set to 8.
  - Parity: Corresponds to bit0 to bit1 of CR#55. Scroll down to select none, odd or even. The default setting is even.
  - Stop bit: Corresponds to bit2 of CR#55. Scroll down to select 0 or 1. The default setting is 1.

6.3 Parameter Settings

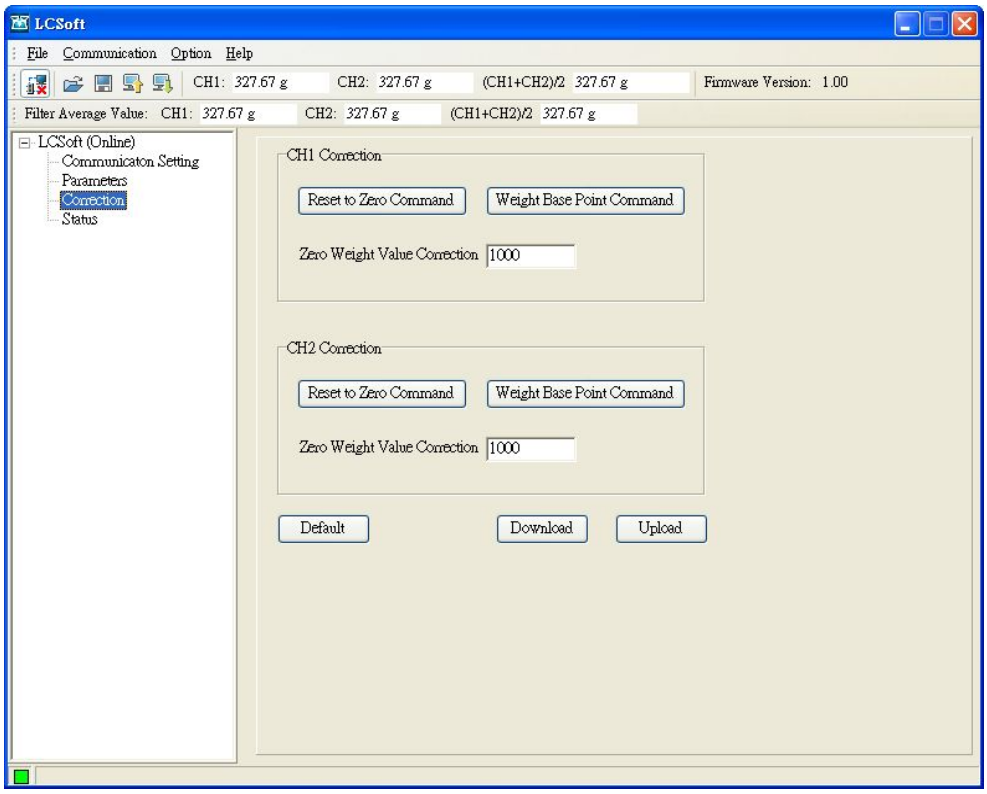
The parameter setting window allows you to set up parameters for CH1 and CH2, including displaying the net weight or gross weight, the tare weight, average times, maximum weights, units for measurements, the decimal point place, range and times for standstill checks, zero point checks and filter percentages. When all the settings are done, click “download” to download the parameters to DVP02LC-SL, or click “Upload” to display the parameters of DVP02LC-SL in the software.



- Gross/Net:
  Corresponds to the value in CR#7. Scroll down to select displaying the gross weight or net weight.
- Tare weight:
  Corresponds to the value in CR#8 and CR#9. Enter the tare weight here, or click “Read TW” to set it up. The range is -32,768 to 32,767, and the default setting is 0.
- Read TW:
  Corresponds to the value in CR#6. Click “Read TW” to take the average value of each channel as the tare weight.
- Average times:
  Corresponds to the value in CR#10 and CR#11. The range is 1 to 100, and the default setting is 10.
- Maximum weight:
  Corresponds to the value in CR#35 and CR#36. Enter the maximum weight here. When the measured value exceeds this weight, an error status will be displayed. The range is -32,768 to 32,767, and the default setting is 32,767.
- Unit of measurement:
  Corresponds to CR#22 and CR#23 for CH1 and CR#24 and CR#25 for CH2. You can enter a unit here for the user’s reference. Maximum 4 characters are allowed in this column. The default setting is Kg.
- Standstill times:
  The times of standstill checks, corresponding to the value in CR#16 and CR#17. Enter the times here. The range is 1 to 500, and the default setting is 5.
- Standstill range:
  The range for standstill check, corresponding to the value in CR#18 and CR#19. Enter the range (1 to 10,000) here. The default setting is 10.
- Zero band:
  The upper and lower limits for the zero point check. The upper limit for CH1 corresponds to the value in CR#37, and the lower limit corresponds to the value in CR#39. The upper limit for CH2 corresponds to the value in CR#38, and the lower limit corresponds to the value in CR#40. When the weight measured is within the range, the status code will be set to “zero bit” indicating that it is currently in empty status now. Enter the upper and lower limits here. The range is K-32,768 to K32,767, and the default setting is -10 to 10.
- Filter ratio setting
  The filter percentage, corresponding to the value in CR#43 and CR#44. The range is 1 to 5. The average weight after being filtered will be displayed as the filter average values for CH1 and CH2 on the toolbar, or you can check CR#45 and CR#46 for the filter average value. The default setting is 2.

6.4 Correction Settings

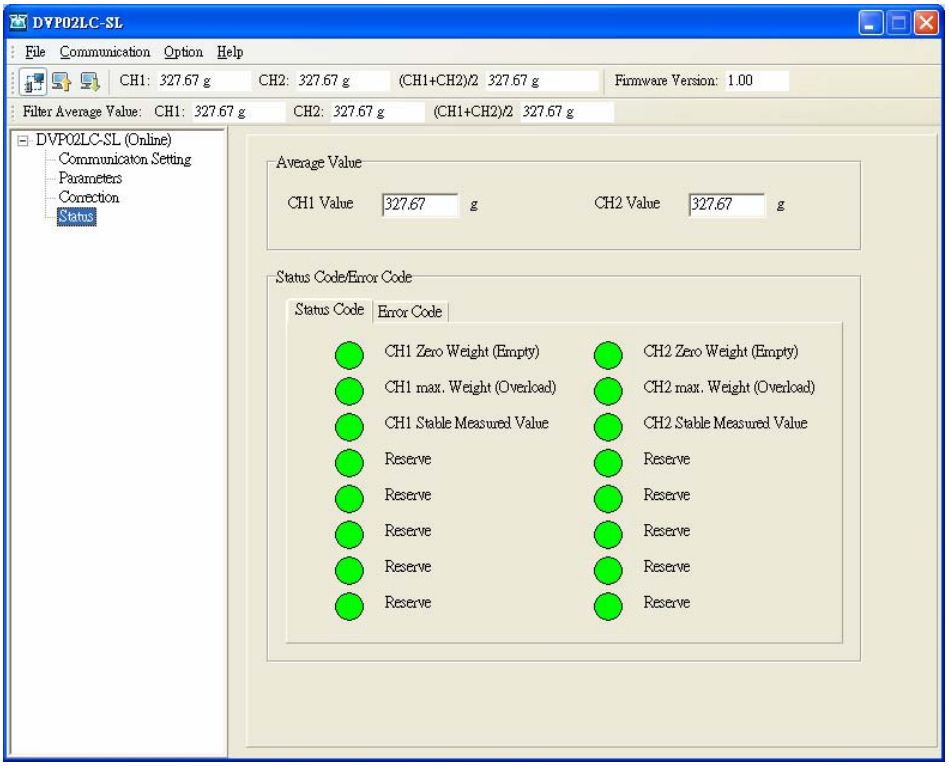
Here we introduce parameters and corresponding control registers related to correction in the software. Parameters include reset to zero point commands, weight base point commands and weight correction commands for CH1 and CH2. When all the settings are done, click “download” to download the parameters to DVP02LC-SL, or click “Upload” to display the parameters of DVP02LC-SL in the software.



- Reset to zero command:
  Corresponds to the value in CR#26. Click it to set the presently measured signal to the zero point base.
- Weight base point command:
  Corresponds to the value in CR#26. Click it to set the presently measured signal to the weight base point.
- Zero weight value correction:
  Corresponds to CR#33 and CR#34. Enter the weight base value here. The range is -32,768 to 32,767, and the default setting is 1,000.

6.5 Status Settings

In the status setting window, you can view the measuring results and the operation status of DVP02LC-SL, including the present average value in CH1 and CH2, the unit of measurement, status codes and error codes.

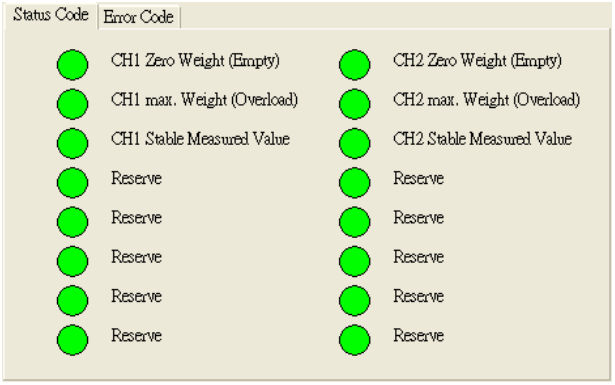


- Average value:

  The average weights at CH1 and CH2, corresponding to the values in CR#12 and CR#13. The unit after the figure is the previously set unit for measurement.

- Status code:

  Corresponds to the value set in CR#50, indicating the measuring statuses at CH1 and CH2, including the empty load, overload and whether the measured values are stable.

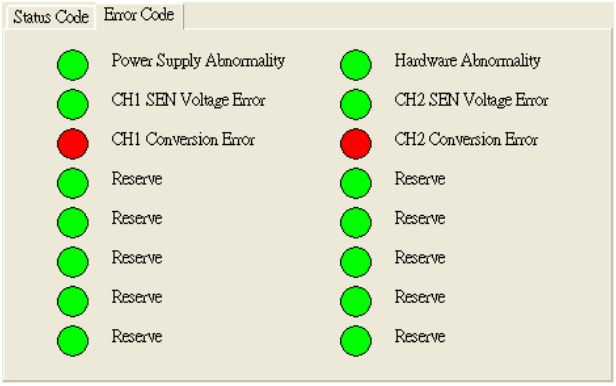


  - CH1 zero weight (empty): Corresponds to bit0 of CR#50. When the value measured at CH1 equals 0, the indicator will turn red.
  - CH1 max. weight (overload): Corresponds to bit2 of CR#50. When the value measured at CH1 exceeds the maximum weight set, the indicator will turn red.

- CH1 stable measured value: Corresponds to bit4 of CR#50. When the value measured at CH1 is stable, the indicator will turn red.
- CH2 zero weight (empty): Corresponds to bit1 of CR#50. When the value measured at CH2 equals 0, the indicator will turn red.
- CH2 max. weight (overload): Corresponds to bit3 of CR#50. When the value measured at CH2 exceeds the maximum weight set, the indicator will turn red.
- CH2 stable measured value: Corresponds to bit5 of CR#50. When the value measured at CH2 is stable, the indicator will turn red.

■ Error Code:

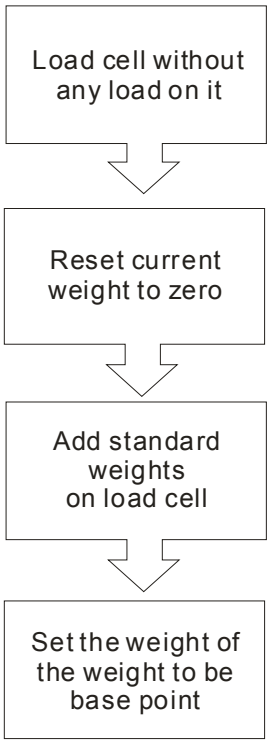
Corresponds to the value in CR#51, displaying the operation status of DVP02LC-SL, including power supply abnormality, hardware abnormality, SEN voltage errors and conversion errors.



- Power supply abnormality: Corresponds to bit0 of CR#51. When the power supply for DVP02LC-SL encounters abnormality, the indicator will turn red.
- Hardware abnormality: Corresponds to bit1 of CR#51. When the hardware of DVP02LC-SL encounters abnormality, the indicator will turn red.
- CH1 SEN voltage error: Corresponds to bit3 of CR#51. When the SEN signal input at CH1 encounters error, i.e. abnormal load cell signal occurs, the indicator will turn red.
- CH2 SEN voltage error: Corresponds to bit5 of CR#51. When the SEN signal input at CH2 encounters error, i.e. abnormal load cell signal occurs, the indicator will turn red.
- CH1 conversion error: Corresponds to bit4 of CR#51. When the conversion of the measured signal at CH1 encounters an error, the indicator will turn red.
- CH2 conversion error: Corresponds to bit6 of CR#51. When the conversion of the measured signal at CH2 encounters an error, the indicator will turn red.

7 Steps of Correction

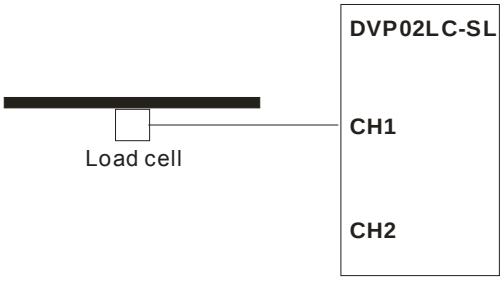
The correction is made to match DVP02LC-SL with the weight of the load cell, including the correction by MPU and correction by software. The correction by MPU is done by first connecting DVP02LC-SL to a DVP series PLC MPU and correcting by using TO/FROM instructions. The correction by software, on the other hand, is done by connecting DVP02LC-SL to a PC via a RS-232 communication cable and correcting on the software.



7.1 Correction by MPU

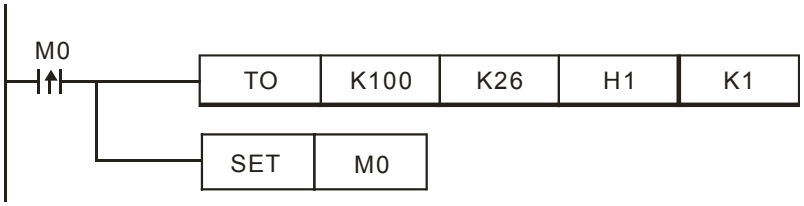
In this example, we connect DVP02LC-SL to a DVP series PLC MPU and correct CH1 by TO instruction.

1. See 4.1 for how to connect DVP02LC-SL to the left side of the PLC MPU and supply power to the two devices.
2. Connect the load cell to CH1. See 4.4 for external wiring.

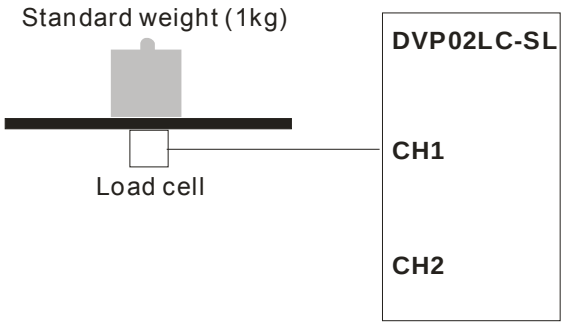


3. Set up every parameter and eigenvalue according to the actual measuring requirements and specifications of the load cell. In this example, we use the default settings of all parameters.

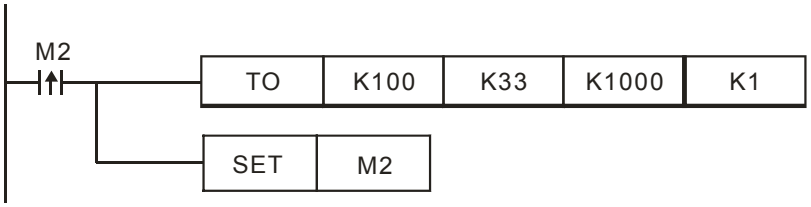
4. Execute the reset to zero command by writing H'0001 into CR#26, as the WPLSoft program below.



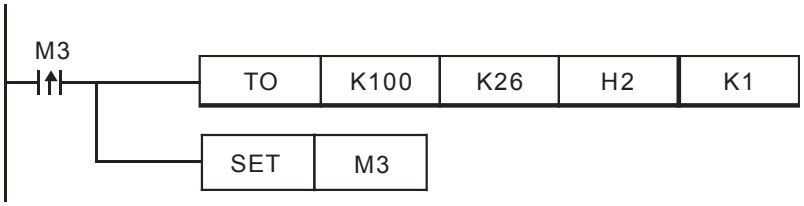
5. Add a 1kg weight on the load cell. Please be aware of the maximum weight the load cell can take.



6. Write the weight of the weight (weight base point) into CR#33, as the WPLSoft program below.



7. Execute the weight base point command by writing H'0002 into CR#26, as the WPLSoft program below.

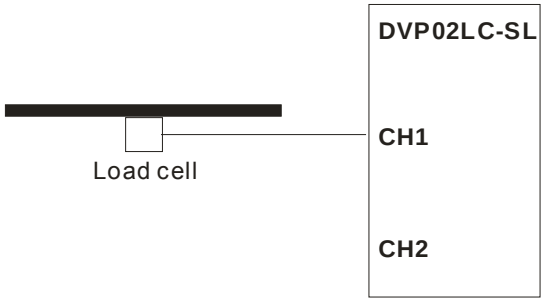


7.2 Correction by Software

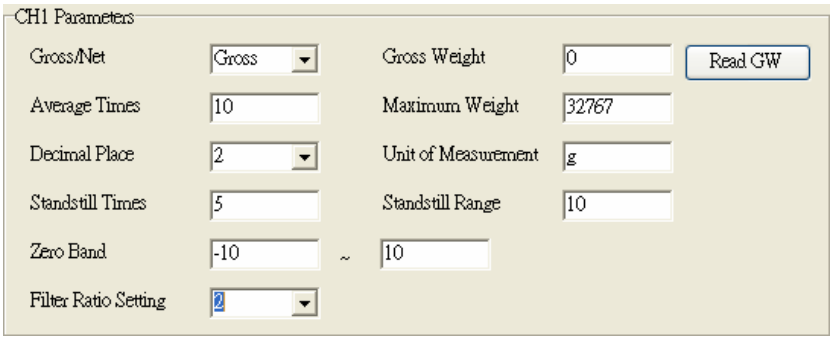
In this example, we will demonstrate how to correct CH1 on DVP02LC-SL by the software.

1. See 4.3 for how to wire the communication. Use a RS-232 communication wire to connect DVP02LC-SL to the PC and supply power to the two devices.

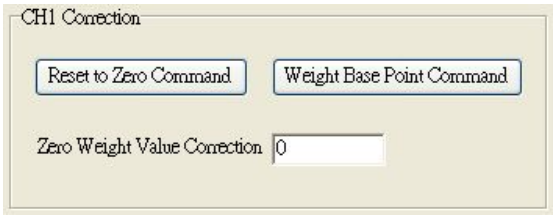
2. Connect the load cell to CH1. See 4.4 for external wiring.



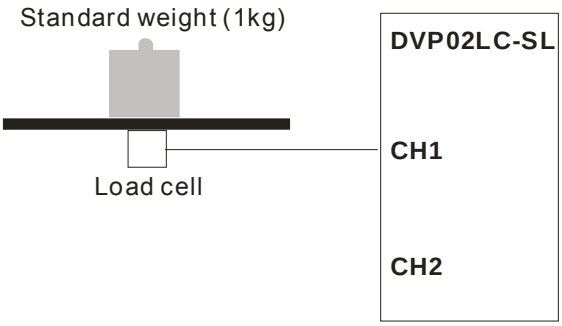
3. Open the software and see 6.1 for how to set up the connection between the software and DVP02LC-SL.
4. Click “Parameters” on the left-hand side column to start setting up the parameters. Set up every parameter and eigenvalue according to the actual measuring requirements and specifications of the load cell. After the parameter setups are done, click “Download” to download them to DVP02LC-SL.



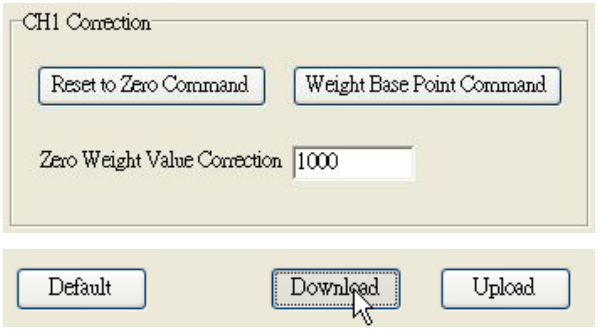
5. Click “Correction” on the left-hand side column to start correcting. First click “Reset to Zero Command” when there is nothing placed on the load cell. Now, the weight at CH1 is 0g.



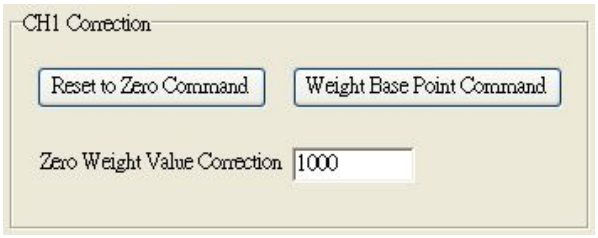
6. Add a 1kg weight on the load cell. Please be aware of the maximum weight the load cell can take.



7. Enter “1000” in “Zero Weight Value Correction” and click “Download” to download the settings to DVP02LC-SL.



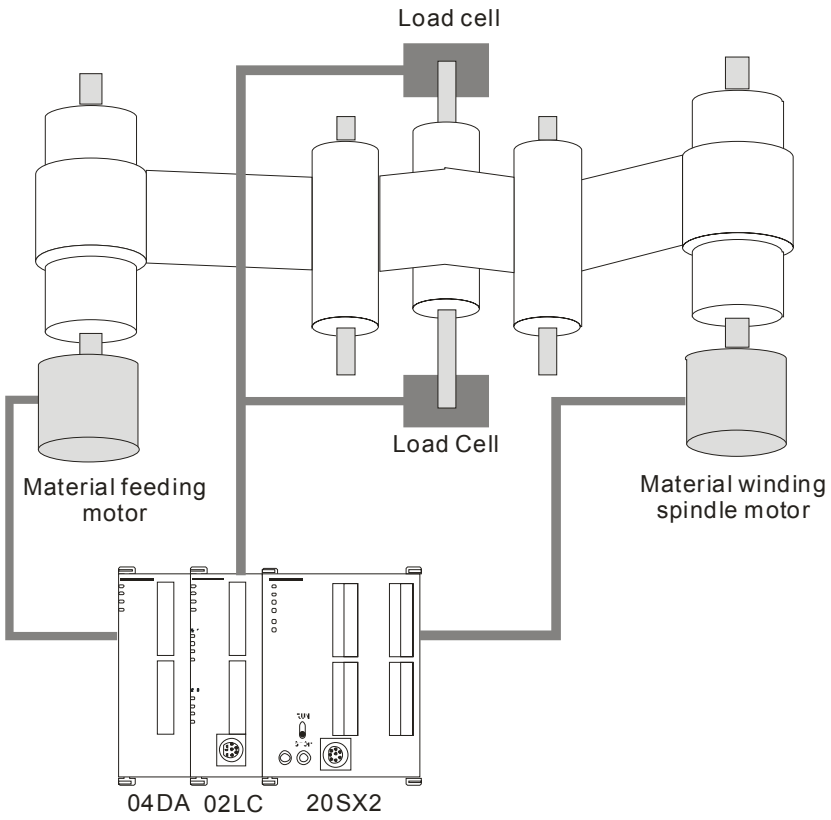
8. Click “Weight Base Point Command” to set up the weight base point. Now, the weight at CH1 is 1,000kg.



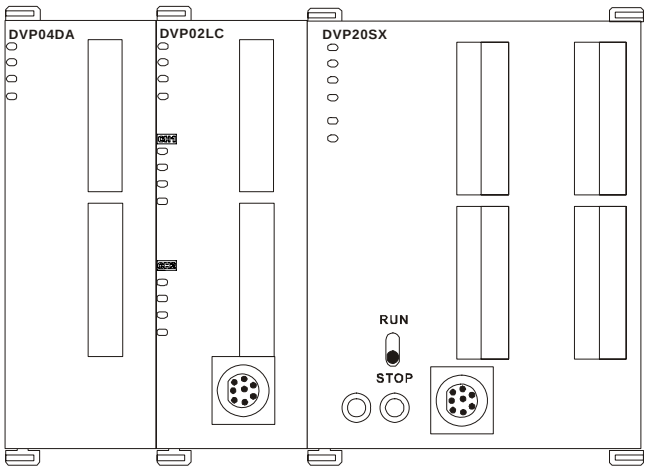
8 Application Examples

■ Tension Control

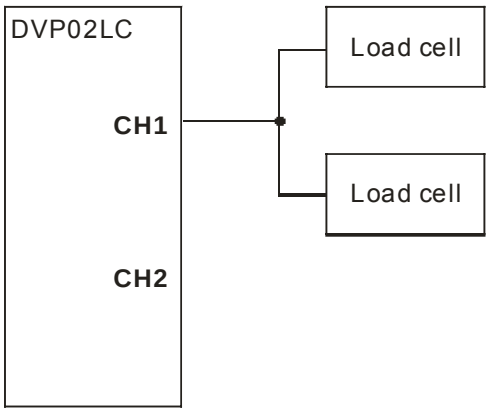
This is an example of using DVP02LC-SL in a tension control application. The main processing unit is DVP-SX2 series PLC (DVP20SX2), responsible for the PID operation. The DVP02LC-SL is used for detecting the tension of the load cell. The measured value is outputted to the brake system from the DVP04DA-SL analog output module after the PID operation is done by DVP20SX2 in order to control the tension. See the figure below for the tension control demonstration.



- Hardware Wiring
  - Connecting DVP20SX2 with the two modules:



  - Wiring for load cell: Connect two 4-wire load cells in parallel, and then to CH1 on DVP02LC-SL.



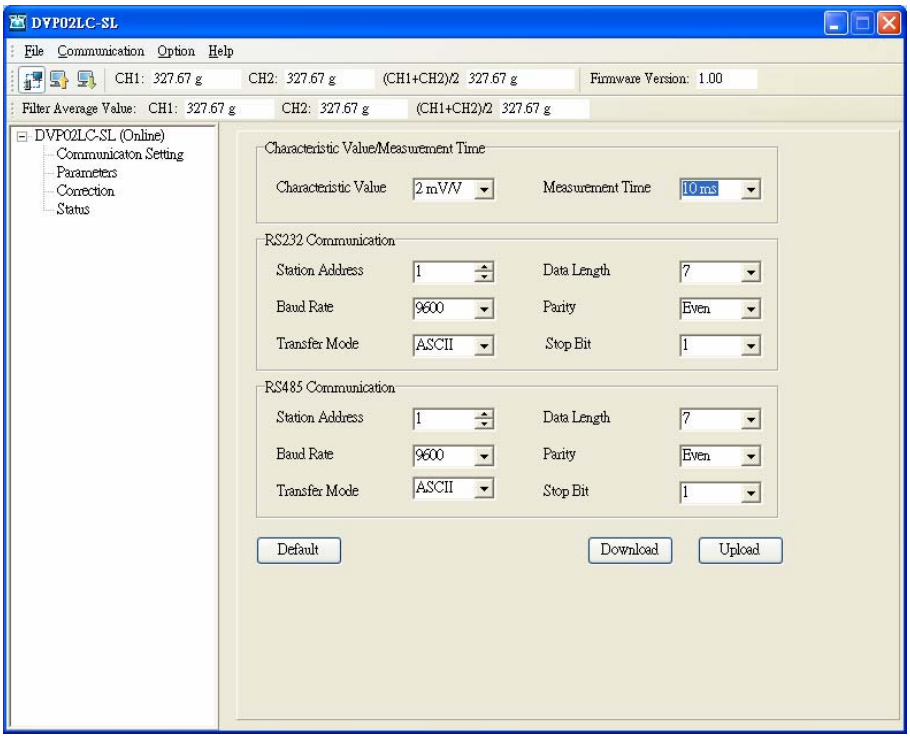
- Setting up Parameters
  - Parameters for DVP02LC-SL:

Parameter	Set value	Explanation
Eigenvalue	2 (mV/V)	2 mV/V is the eigenvalue spec. for the load cell.
Measuring time	10 (ms)	--
CH1 average times	50	--
CH1 max. weight	32,767	The max. weight is limited to 32,767.
CH2 net or gross weight	Disabled	CH2 function is disabled.

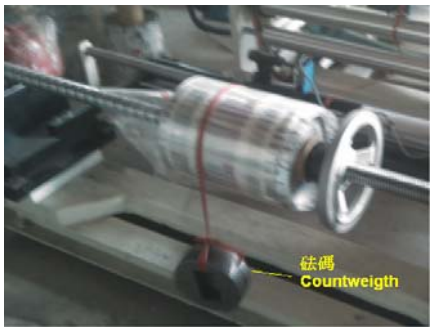
Note: Parameters that are not set up will use the software default setting.

  - Correction by software

1. Set the eigenvalue (characteristic value) of the load cell to 2 mV/V and the measuring time to 10 ms.

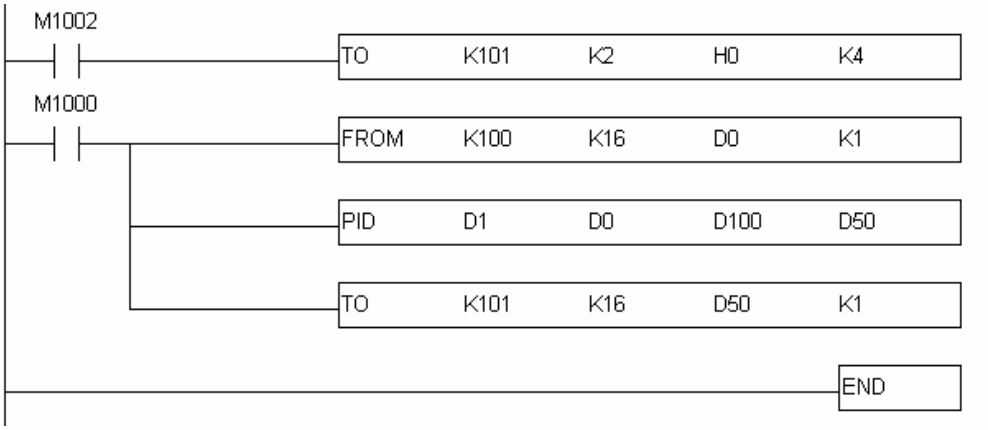


2. Set up also the average times and maximum weight. Due to that we connect two load cells in parallel and connect them to a single channel here, we have to disable CH2.
3. The actual use of a weight for the correction.



■ PLC Program

In actual operation, DVP20SX2 is responsible for reading the average value from DVP02LC-SL for PID operation and outputting the operated value to DVP04DA-SL for voltage output to control the running speed of the material feeding motor.



- Program explanations
  1. The PLC switches from STOP to RUN. Due to the range for analog output voltage for the brake system is 0 to 10 VDC, we first set the voltage output mode for DVP04DA-SL to “0” (-10 to +10 V).
  2. Use the FROM instruction to read the average weight from the load cell.
  3. Calculate the output value (MV) by the PID instruction and output the value to DVP04DA-SL.

- Devices

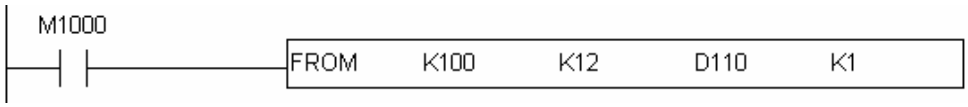
  D0: Average tension value

  D1: Target tension value

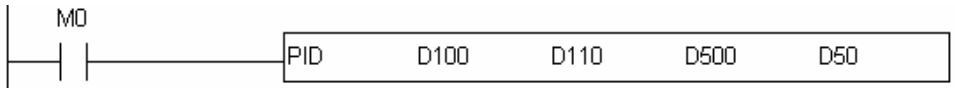
  D50: Voltage output from DVP04DA-SL

  D100: PID parameter

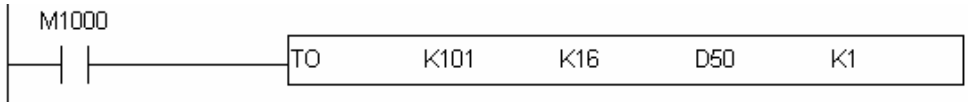
- Steps of PID tuning
  1. Read the average value from DVP02LC-SL and store it in D110.



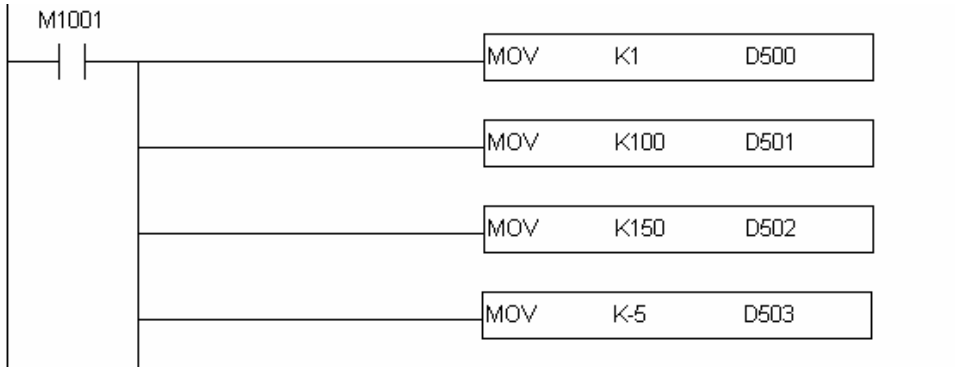
  2. For the PID operation: PV = D110, SV = D100, PID parameter = D500. Place the result of PID operation in D50.



  3. Output D50 to CH1 of DVP04DA-SL.



  4. Set the PID sampling time to 10 ms. For the parameter settings: KP = D501, KI = D502, KD = D503.

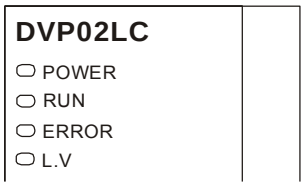


  5. After the tuning, we acquire the best parameters KP = 100, KI = 150 and KP = -5.

9 LED Indicators and Trouble-shooting

9.1 LED Indicators

There are 4 LED indicators on DVP02LC-SL. The POWER LED displays whether the power supply is working normally. The RUN LED and ERROR LED display the current operation status of DVP02LC-SL. The L.V LED warns the user when the voltage of the module is too low.



- POWER LED

LED status	Indication
Off	Power supply is abnormal.
Green light constantly on	Power supply is normal.

- RUN LED

LED status	Indication
Off	DVP02LC-SL stops operating.
Green light flashes	DVP02LC-SL operates normally.

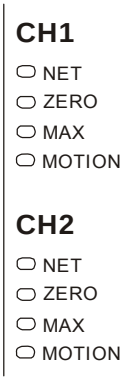
- ERROR LED

LED status	Indication
Off	No error occurring
Red light flashes	An error code is generated.

- L.V LED

LED status	Indication
Off	External 24V power supply is normal.
Red light constantly on	External 24V power supply is abnormal.

There are other 4 LED indicators beside each channel on DVP02LC-SL. The NET LED indicates the current weight is net weight or gross weight. The ZERO LED indicates whether the current weight is 0. The MAX LED indicates if the current weight exceeds the maximum weight set. The MOTION LED indicates whether the current weight measured is stable.



- NET LED

LED status	Indication
Off	The current weight is gross weight.
Orange light constantly on	The current weight is net weight.

- ZERO LED

LED status	Indication
Off	The current weight is not zero point weight.
Orange light constantly on	The current weight is zero point weight.

- MAX LED

LED status	Indication
Off	The current weight does not exceed max. weight.
Orange light constantly on	The current weight exceeds max. weight.

- MOTION LED

LED status	Indication
Off	The current weight is an unstable value.
Orange light constantly on	The current weight is a stable value.

9.2 Trouble-shooting

Abnormality	How to correct
POWER LED off	Check if the power supply is normal.
RUN LED off	There is problem in internal hardware. Send the module back to factory for repair.
ERROR LED on	1. Check the error code in CR#50. 2. Check if the voltage at SEN+ and SEN- is +5V.
L.V LED constantly on	Check if the input voltage is lower than 18V.