

LH70/71/71A/72, LY71/72

Angle Display Function Quick Reference Manual



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1. Introduction

This manual describes how to use the angle display function of the display unit (LH70 series and LY70 series). Ribbon scale (Digiruler) or commercially available rotary encoder can be used as the encoder that can be used for angle detection. When using a rotary encoder, the display range is $\pm 360^\circ$.

If the selected display resolution is too fine for the number of output pulses (angle data) from the encoder, the displayed value will be skipped. For continuous and smooth angle display, it is necessary to consider the number of output pulses from the encoder and the display resolution to be selected.

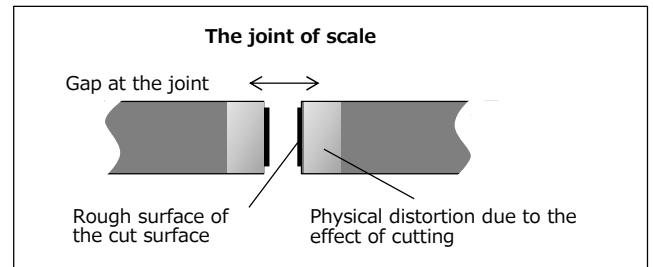
For encoders with origin, the origin function of the counter can be used.

2. Angle display using Digiruler

All ribbon scales can be used, but consider the combination depending on the length and radius of the arc to which the scale is actually mounted and the display resolution. Ribbon scales cannot measure angles of 360 degrees. Errors occur at the point where the joint crosses over.

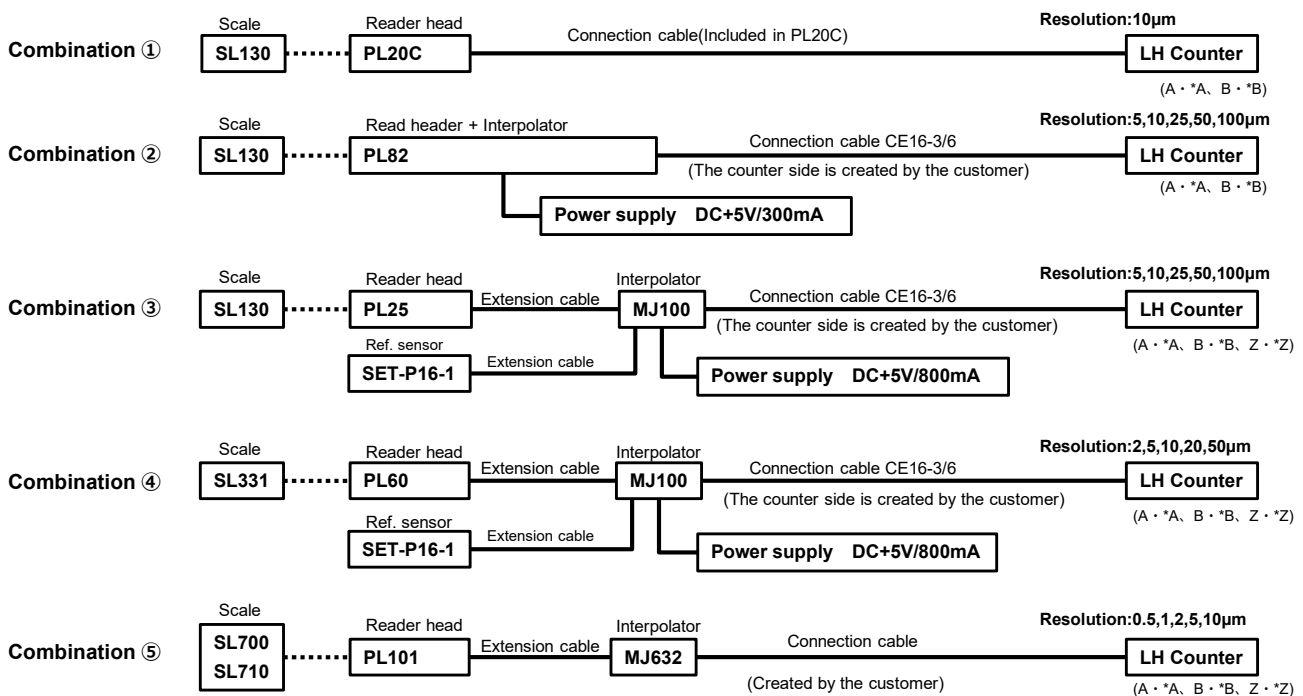
Note: The minimum installation radius is $R = 250 \text{ mm}$.

Error factors at the scale joint

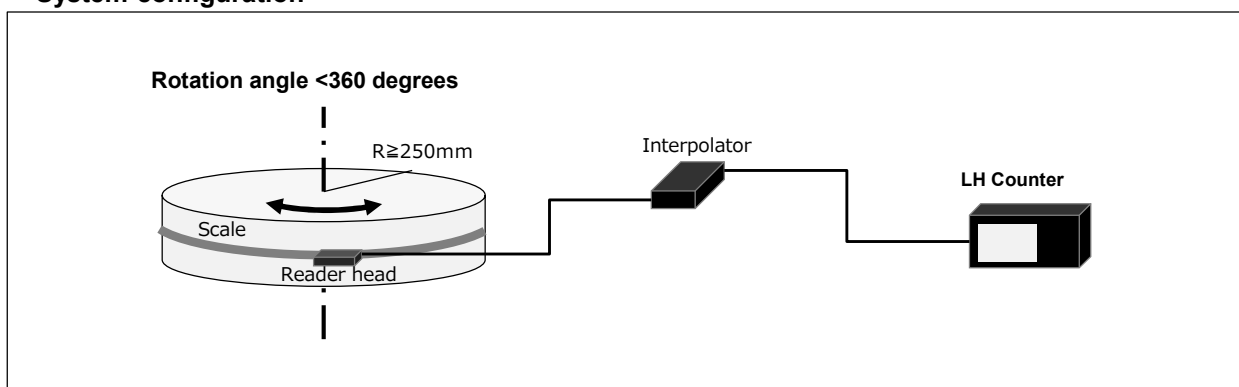


2-1. Combinations

Scale	Reader head	Extension cable	Interpolator	Connection cable	Counter	Power supply	Reference point	Extension cable (ref.)	
SL130	PL20C	-	-	-	LH71 LH71A LH72	-	-	-	
	PL82	-	Including	-		DC+5V 300mA	-	-	
	PL25	CE08-xx CE27-xx CK-T12 CK-T13 CK-T14 CK-T15	MJ100	CE15-xx		DC+5V 800mA	SET-P16-1	CE16-1 CE16-3	
SL331	PL60		MJ632	Created by the customer		DC+5V 200mA	-	-	
SL700	PL101-RA PL101-RHA						-	-	
SL710							Built-in	-	



System configuration



2-2. Configurable arc radius

Unit : mm

Scale	Mounting radius R		Output resolution	Display resolution			
	Min.	Max.		10 minutes	1 minute	10 seconds	1 second
SL130 t=1.38mm ※1	250mm	<For reference> For reference 30m Radius when applying at 360° 4774mm	5	-	-	250~1031	1032 ≤
			10	-	-	250~2062	2063 ≤
			12.5	Can not be selected			
			20	-	250~412	413~4125	4126 ≤
			25	-	250~515	516~5156	5157 ≤
			50	-	250~1031	1032~10313	10314 ≤
			100	250~343	344~2062	2063~20627	20627 ≤
SL331 t=1.38mm ※1	250mm	<For reference> For reference 8m Radius when applying at 360° 1273mm	2	-	-	150~412	413 ≤
			2.5	Can not be selected			
			4	Can not be selected			
			5	-	-	250~1031	1032 ≤
			10	-	-	250~2062	2063 ≤
			20	-	250~412	413~4125	4126 ≤
			50	-	250~1031	1032~10313	10314 ≤
SL700 SL710 t=0.15mm ※1	250mm	<For reference> For reference 100m Radius when applying at 360° 15915mm	0.2	Can not be selected			
			0.5	-	-	-	250 ≤
			1	-	-	-	250 ≤
			2	-	-	250~412	413 ≤
			5	-	-	250~1031	1032 ≤
			10	-	-	250~2062	2063 ≤

Note:

- The ribbon scales have minimum mounting radius and maximum effective length of the scale.
- While it is possible to make the display resolution coarsely, it is not recommended as it causes measurement errors.
- Dimensions include the thickness of the scale.
- ※1 Including the thickness of the double-sided adhesive tape.

2-3. Installation

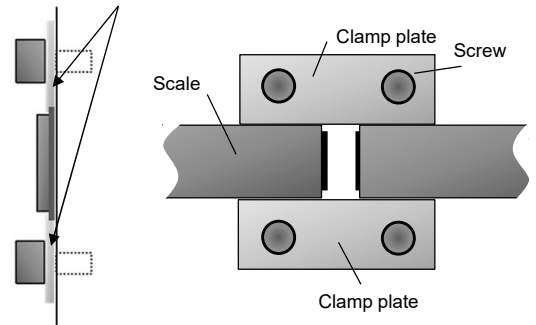
Some typical methods for mounting scales in parallel are shown below.

SL130 and SL331 have a high elasticity of scale base material, so the scale edge may bounce back when mounted on an arc surface. It is recommended to fix the base material of the scale with a suitable clamping plate.

Refer to the head unit's instruction manual for detailed installation instructions.

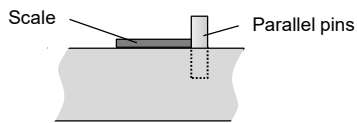
Example of anti-bounce measures

Clamp plate to prevent bounce at the scale edge of SL130, SL331

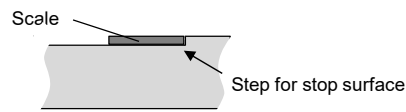


Typical example of how to install

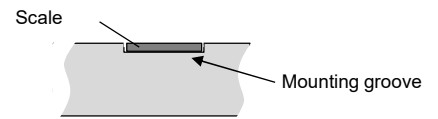
(1) Insert parallel pins into the flat surface and mount the scale. Remove pins after installation.



(2) Make a stop surface for mounting the scale. Consider the thickness of the scale and the amount of clearance with the reader head.



(3) Provide a mounting groove with a width slightly larger than the scale.



Scale cross section and clearance

SL130	SL331	SL700

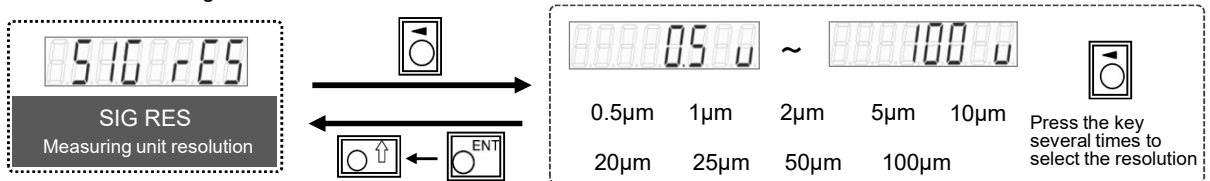
2-4. Setting procedure

First, in the basic settings, set the "Measuring unit resolution" setting to the output resolution of the connected Digiruler. For details on the basic settings, refer to the separate initial setup manual of display unit. Then enter the display resolution and mounting radius values in the advanced settings. Compare the mounting radius value with an angle reference device (right angle ruler: 90 degrees), etc., and narrow down the radius value so that the angle error is minimized.

Basic Settings

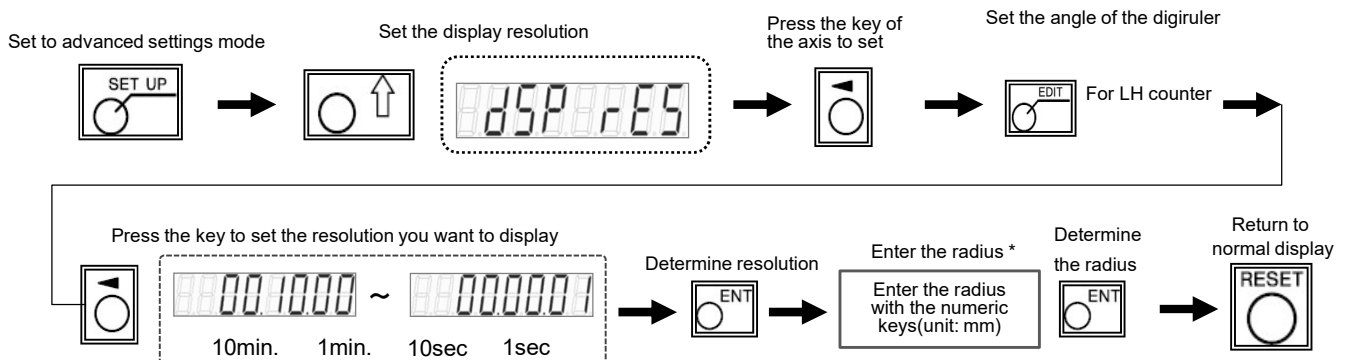
In the basic settings, set the output resolution of the connected Digiruler.

It is not angular resolution.



Advanced Settings

Set to the advanced setting mode and set the display resolution and radius in the display resolution setting.



*: If the radius cannot be entered and an error occurs, the angle display for the measurement unit is too small, so increase the radius or coarsen the resolution of the angle display.

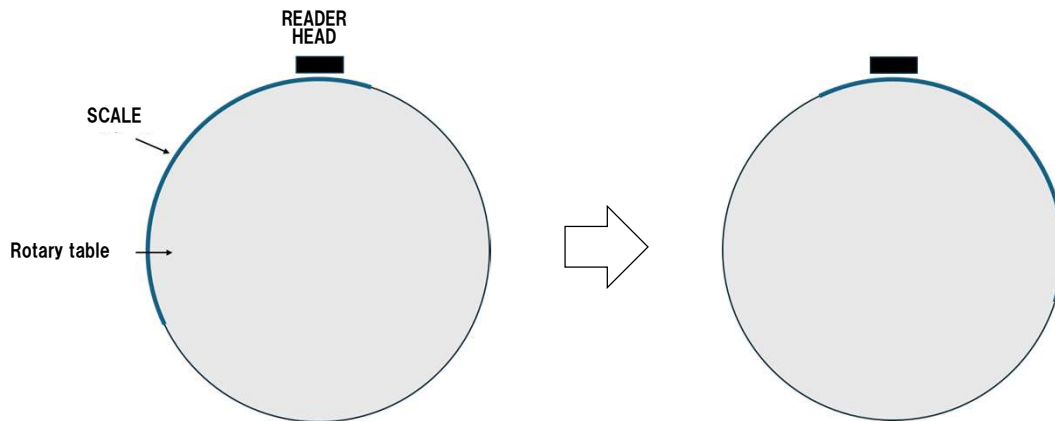
2-5. To display accurate angles

Angular errors may occur due to mechanical errors in the arc being mounted or thickness errors in the scale base material. However, these errors can be reduced using the following methods.

Set the counter to linear display. (Refer to the separate Initial Setup Manual for basic configuration methods.)

- ① Reset at the reference position (counter value 0).
- ② Rotate to any angle and read the value.

The read value represents the rotational distance traveled.

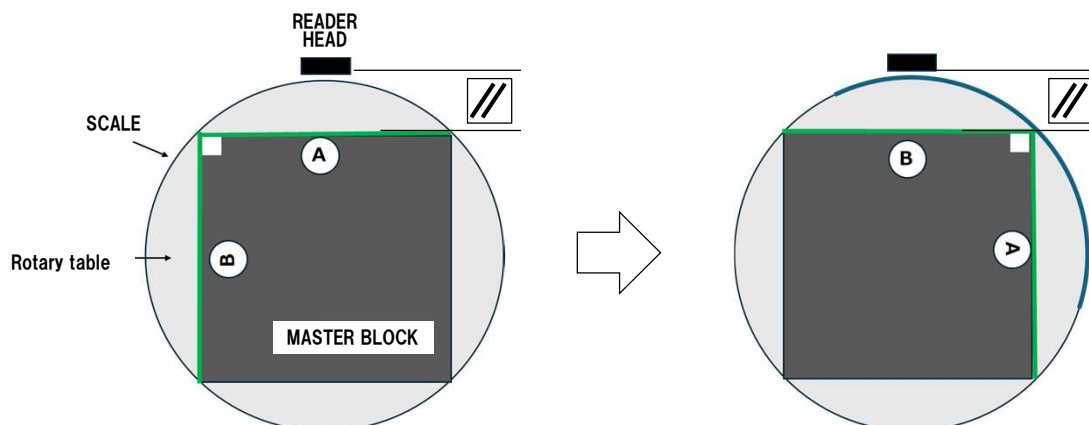


(Example)

	For 10μm resolution (SL130,331)	For 1μm resolution (SL700,710)
Distance traveled when rotated 90 degrees	:785.39mm	785.398mm
Circumference	:785.39×4 = 3141.56mm	785.398×4 = 3141.592mm
Radius	:3141.56 / (2×PI) = 499.994803mm	3141.592 / (2×PI) = 499.999896mm
Radius input value	:499.9948	499.9999

- ③ Record the above values.
- ④ Set the display to show angles in the detailed settings. (Refer to section 2-4. Setting procedure for instructions.)
- ⑤ Enter the above values in the radius input screen.

Using master blocks and other tools will further increase accuracy.

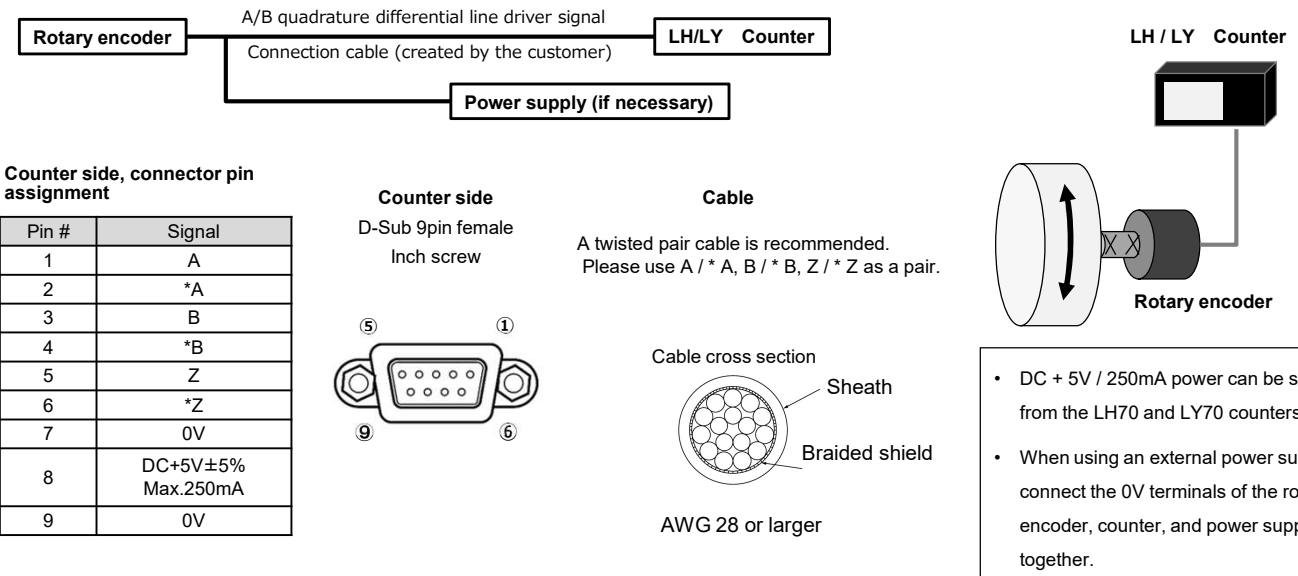


3. Angle display using rotary encoder

A rotary encoder with incremental differential line driver output can be connected.
The connection cable must be created by the customer.

3-1. Combinations

Rotary encoder	Connection cable	Power supply	External power supply	Counter
Differential line driver output (A · *A、 B · *B、 Z · *Z)	Created by the customer	DC+5V Max.250mA	Unnecessary (Supplied from the counter)	LH70 LH71/LH71A LH72 LY71 LY72
		Other than DC + 5V Max.250mA	Necessary	



Conversion table: Number of rotary encoder output pulses for scaling value

Unit: Pulse / 1 rotation

Scaling (magnification)	Display resolution			
	10 minutes	1 minute	10 seconds	1 second
0.10	21600.00	216000.00	1296000.00	12960000.00
0.20	10800.00	108000.00	648000.00	6480000.00
0.30	7200.00	72000.00	432000.00	4320000.00
0.40	5400.00	54000.00	324000.00	3240000.00
0.50	4320.00	43200.00	259200.00	2592000.00
0.60	3600.00	36000.00	216000.00	2160000.00
0.70	3085.71	30857.14	185142.86	1851428.57
0.80	2700.00	27000.00	162000.00	1620000.00
0.90	2400.00	24000.00	144000.00	1440000.00
1.00	2160.00	21600.00	129600.00	1296000.00
1.10	1963.64	19636.36	117818.18	1178181.82
1.20	1800.00	18000.00	108000.00	1080000.00
1.30	1661.54	16615.38	99692.31	996923.08
1.40	1542.86	15428.57	92571.43	925714.29
1.50	1440.00	14400.00	86400.00	864000.00
1.60	1350.00	13500.00	81000.00	810000.00
1.70	1270.59	12705.88	76235.29	762352.94
1.80	1200.00	12000.00	72000.00	720000.00
1.90	1136.84	11368.42	68210.53	682105.26
2.00	1080.00	10800.00	64800.00	648000.00
3.00	720.00	7200.00	43200.00	432000.00
4.00	540.00	5400.00	32400.00	324000.00
5.00	432.00	4320.00	25920.00	259200.00
6.00	360.00	3600.00	21600.00	216000.00
7.00	308.57	3085.71	18514.29	185142.86
8.00	270.00	2700.00	16200.00	162000.00
9.00	240.00	2400.00	14400.00	144000.00
9.99999(10.00)	(216.00)	(2160.00)	(12960.00)	(129600.00)

Recommended

Note:

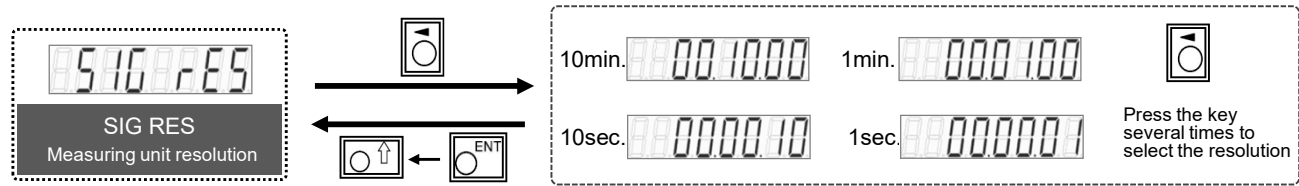
- If the scaling is increased, the display of the minimum digit becomes rough.
- The scaling setting range is 0.1 to 9.999999 times.
- Scaling applies to all axes.

3-2. Setting procedure

First, in the basic settings, set the “Measuring unit resolution” setting to the angular resolution that takes into account the output pulse per rotation of the rotary encoder. For details on the basic settings, refer to the separate initial setup manual of display unit.
Next, set the display resolution and scaling value in the advanced settings. Unless the number of rotary encoder output pulses is the same as the number of pulses converted to minutes and seconds, it is always necessary to correct the number of pulses by scaling.
(Factory default scaling: 1.000000)

Basic Settings

Select the measuring unit resolution that can be used in the basic settings. Check the number of output pulses per rotation of the rotary encoder, select the angular resolution that can be set from the table below, and set it.



Rotary encoder output pulse number and configurable angular resolution

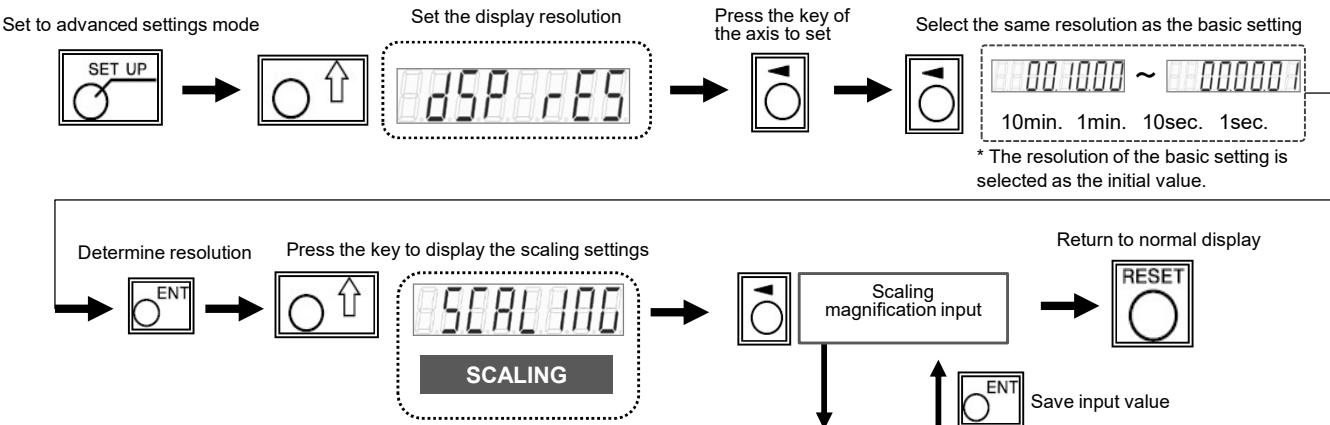
Classification	Number of output pulses (N / 1 rotation)	Settable resolution		Selection of display resolution	
		≤ 1.0 ※	> 1.0	≤ 1.0 ※	> 1.0
①	216 ≤ N < 2,160	—	10 min.	—	10 min.
②	2,160 ≤ N < 21,600	10 min.	1 min.	10 min.	1 min.
③	21,600 ≤ N < 129,600	1 min.	10 sec.	1 min.	10 sec.
④	129,600 ≤ N < 1,296,000	10 sec.	1 sec.	10 sec.	1 sec.
⑤	1,296,000 ≤ N < 12,960,000	1 sec.	—	1 sec.	—

※ Recommended

- Notes:
- While it is possible to make the display resolution coarsely, it is not recommended as it causes measurement errors.
 - Setting the scaling to >1.0 will result in a coarser minimum digit display.
 - A setting of 12,960,000 pulses or higher is not possible.

Advanced Settings

Set to the advanced settings mode and set the display resolution and scaling.



How to calculate the scaling magnification

Magnification = $\frac{P}{\text{Encoder output pulse number (1 rotation)}}$

例) When using RU74-4096ACB (3,600,384/rotation)

Scaling factor = $\frac{1,296,000}{3,600,384} = 0.359962$

Enter the scaling magnification using the numeric keys

≤ magnification ≤

default

P	Measurement unit resolution set in the basic settings
2,160	10min.
21,600	1min.
129,600	10sec.
1,296,000	1sec.