Smart encoders & actuators

User's guide

DWA Series

Absolute draw-wire encoder with analog output

- **Absolute draw-wire encoder with analog output**
- **Voltage or current signals**
- **Programmable via keys**
- **Max. measuring length 5000 (196.85”) or 10000 mm (393.7”)**
- **M12 connector**

Suitable for the following models:

- DWA-5M-4A-M12
- DWA-5M-0V-M12
- DWA-10M-4A-M12
- DWA-10M-0V-M12

General Contents

General contents

Typographic and iconographic conventions

	This icon, followed by the word **WARNING**, is meant to highlight the parts of the text where information of great significance for the user can be found: user must pay the greatest attention to them! Instructions must be followed strictly in order to guarantee the safety of the user and a correct use of the device. Failure to heed a warning or comply with instructions could lead to personal injury and/or damage to the unit or other equipment.

Preliminary information

This guide is designed to provide the most complete and exhaustive information the operator needs to correctly and safely install and operate the **DWA series absolute draw-wire encoders with analog interface**.

The DWA series cable-pulling encoder is aimed at speed and position measurements and controls in a variety of industrial applications through the movement of a **5,000 mm (196.85") or 10,000 mm (393.7")** stainless steel wire. The typical back and forth travel of the moving equipment causes the wire to reel and unreel and thus the linear movement to be converted into a rotative motion detected by the encoder which is coupled to the drum.

Two keys located in the enclosure (or two external inputs, as an alternative) allow to easily set the initial and the final limits of the application stroke, then the available analog range will be scaled automatically within the set limits.

1 Safety summary

1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning ! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic assumes no liability for the customer's failure to comply with these requirements.

1.2 Electrical safety

- Turn OFF the power supply before connecting the device;
- connect according to the explanation in the "Electrical connection" section on page 11;
- in compliance with 2014/30/EU norm on electromagnetic compatibility, the following precautions must be taken:
  - before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stabilized without noise; install EMC filters on device power supply if needed;
  - always use shielded cables (twisted pair cables whenever possible);
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
  - to guarantee a correct working of the device, avoid using strong magnets on or near by the unit;

- minimize noise by connecting the shield and the frame to ground. Make sure that ground is not affected by noise. Ground the encoder cable shield at the cable end. If this is not sufficient, the ground can also be attached at the encoder side, but there is the risk of increasing conducted EMI by creating a ground loop. The best solution to minimize the interference will be unique to each installation and must ultimately be determined by the user.

1.3 Mechanical safety

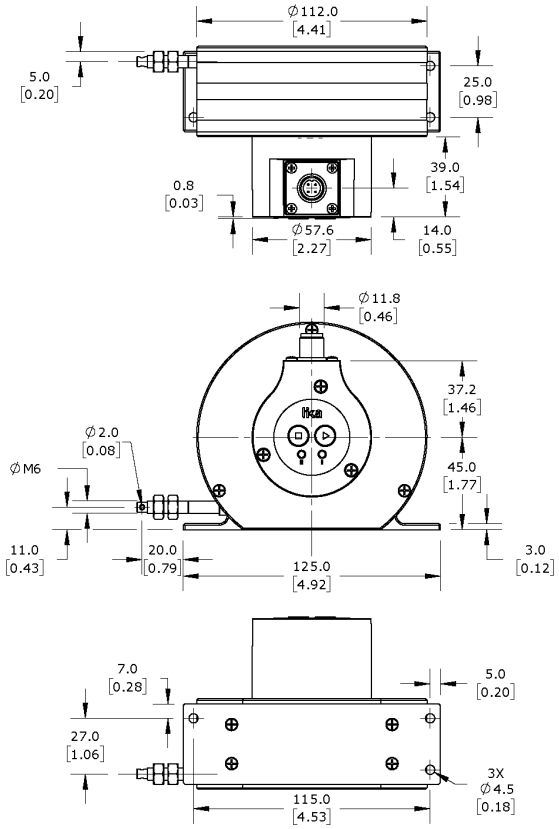
- Install the device following strictly the information in the "Mechanical installation" section on page 7;
- mechanical installation has to be carried out with stationary mechanical parts;
- do not disassemble the unit;
- do not tool the unit;
- delicate electronic equipment: handle with care; do not subject the device to knocks or shocks;
- respect the environmental characteristics of the product;
- we suggest installing the unit providing protection means against waste, especially swarf as turnings, chips, or filings; should this not be possible, please make sure that adequate cleaning measures are in place in order to prevent the wire from jamming;
- to avoid failures, never exceed the maximum measuring length and prevent the wire from tangling up;
- never release the wire freely, always help the wire wind properly: risk of personal injury and/or equipment damage;
- always keep the wire aligned not to damage the equipment;
- the feed out per turn of the draw-wire unit is 200mm (7.874").

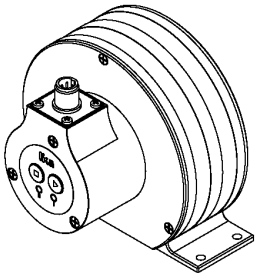
2 Mechanical installation

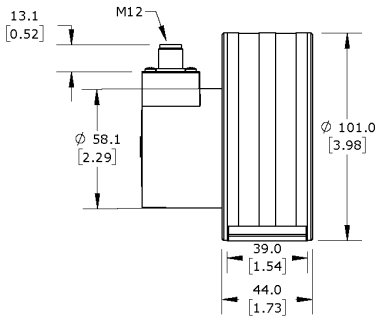
WARNING
Installation has to be carried out by qualified personnel only, with power supply disconnected and mechanical parts completely stopped.

2.1 Overall dimensions

DWA-5M Encoders:

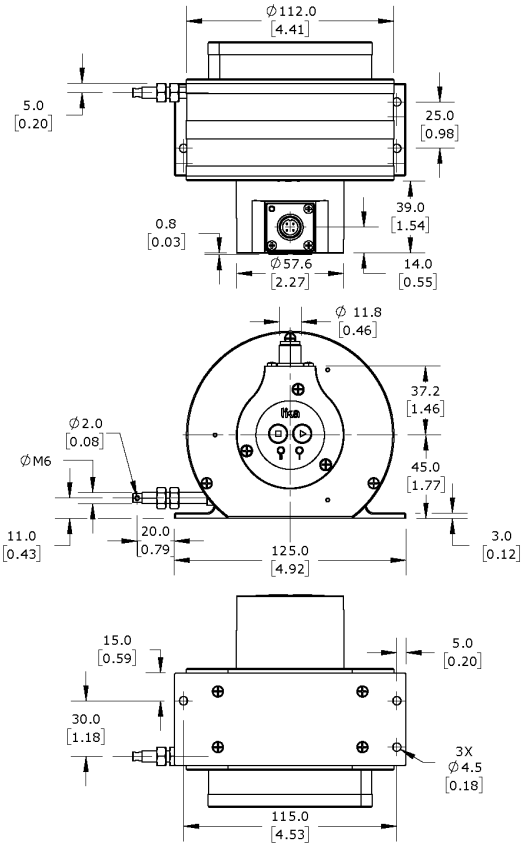


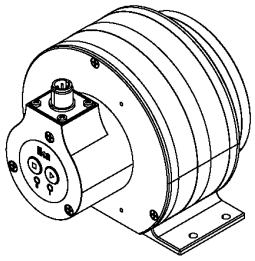


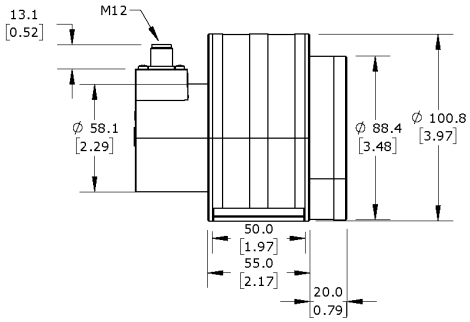


Values are expressed in mm

DWA-10M Encoders:

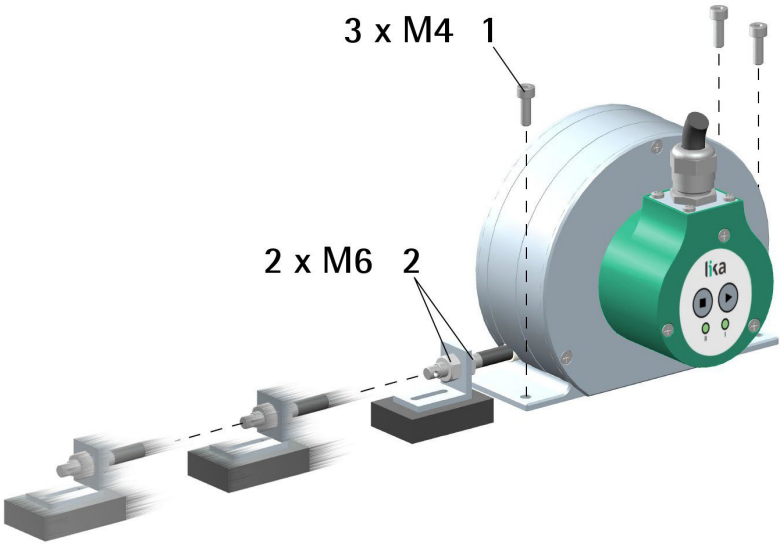






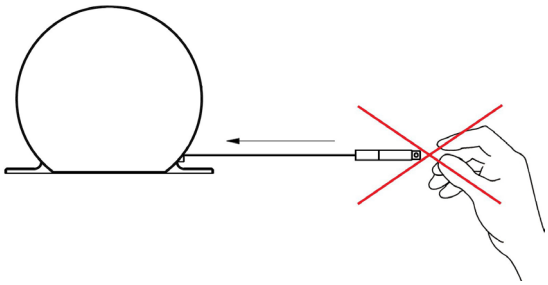
Values are expressed in mm

2.2 Mounting instructions

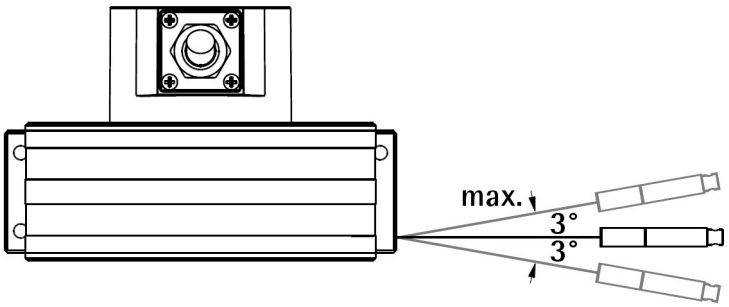


- Fasten the draw-wire unit onto a fixed support using **three M4 screws 1**;
- remove the transport safety wire that pins the end of the measuring wire;
- fix the end of the measuring wire to the moving unit using the provided **M6 nuts 2**.

WARNING
We suggest installing the unit providing protection means against waste, especially swarf as turnings, chips, or filings; should this not be possible, please make sure that adequate cleaning measures are in place in order to prevent the wire from jamming.
To avoid irreparable failures, never exceed the maximum measuring length and prevent the wire from tangling up.
Never release the wire freely, always help the wire wind properly: risk of personal injury and/or equipment damage.



Always keep the wire aligned not to damage the equipment (maximum deviation: 3°).



2.3 Useful information

The draw-wire encoder is shipped with default values: the START position begins after the wire is unwound 50mm (they are calculated starting from wire fully wound) and the analog value in the first 50mm is the low limit overrun value; the analog range is scaled in a 5000mm travel for the DWA-5M; in a 10000mm travel for the DWA-10M. Pulling out the draw wire will result in an increase in the analog value by default. This can be changed with teach points.

2.4 Maintenance

The measuring system does not need any particular maintenance; but it should be handled with care like any delicate electronic equipment. From time to time we recommend the following operations:

- the unit and the wire have to be cleaned regularly using a soft and clean cloth to remove dust, chips, moisture etc.; do not use oil to clean the wire.

3 Electrical connection

WARNING
Electrical connection has to be carried out by qualified personnel only, with power supply disconnected and mechanical parts completely stopped.

3.1 Connector Signals

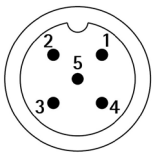
Function	Cable[1]	M12 5-pin
+Iout / +Vout	Brown	1
+13Vdc +30Vdc	White	2
0Vdc	Blue	3
START ▶	Black	4
STOP ■	Grn/Yel	5
Shielding	Shield	Case

[1] Note: These wire colors are for the 7000-13221-349xxxx and 7000-13221-349xxxx cables listed below.

3.2 Available Cables

Part	Description
7000-13221-3490500:	M12 5m axial cable
7000-13221-3491000:	M12 10m axial cable
7000-13281-3490500:	M12 5m right angle cable
7000-13281-3491000:	M12 10m right angle cable

3.3 M12 5-pin connector specifications



Male
Frontal side (this is the view looking at the connector on the draw wire)
A coding

3.4 Ground connection

Minimize noise by connecting the shield and the frame to ground. Make sure that ground is not affected by noise. Ground the encoder cable shield at the cable end. If this is not sufficient, the ground can also be attached at the encoder side, but there is the risk of increasing conducted EMI by creating a ground loop. The best solution to minimize the interference will be unique to each installation and must ultimately be determined by the user.

3.5 Output circuits

3.5.1 Analog current output description

- Out: min position = 4mA, max position = 20mA

Increment per step (encoder resolution): 0.366 µA

3.5.2 Analog voltage output description

- Out: min position = 0 V, max position = 10V

Increment per step (encoder resolution): 0.153 mV

3.5.3 Output signals description

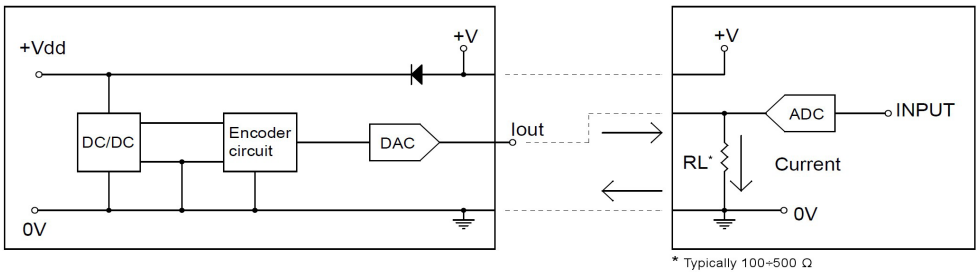
- **+Iout**: current analog output;
- **+Vout**: voltage analog output;

3.5.4 Input signals description

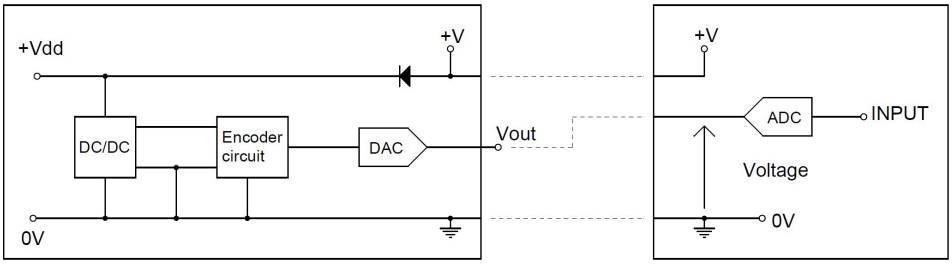
- **+13Vdc +30Vdc, 0Vdc**: encoder power supply;
- **START**: the same as the **START** ▶ key; it is active at HIGH logic level (voltage greater than 10V must be applied). For any further information on using the **START** ▶ and **STOP** ■ keys and the relevant input signals refer to the Teach-window section on page 15;
- **STOP**: the same as the **STOP** ■ key; it is active at HIGH logic level (voltage greater than 10V must be applied). For any further information on using the **START** ▶ and **STOP** ■ keys and the relevant input signals refer to the Teach-window section on page 15.

3.6 Recommended circuit

3.6.1 Current analog output

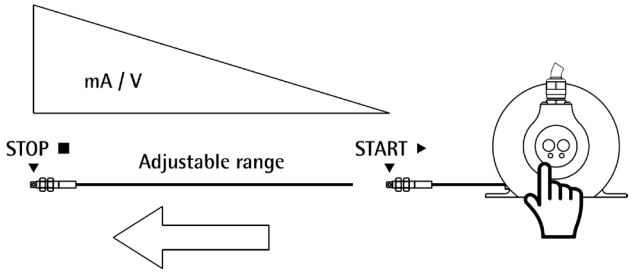


3.6.2 Voltage analog output



4 Teach-window procedure

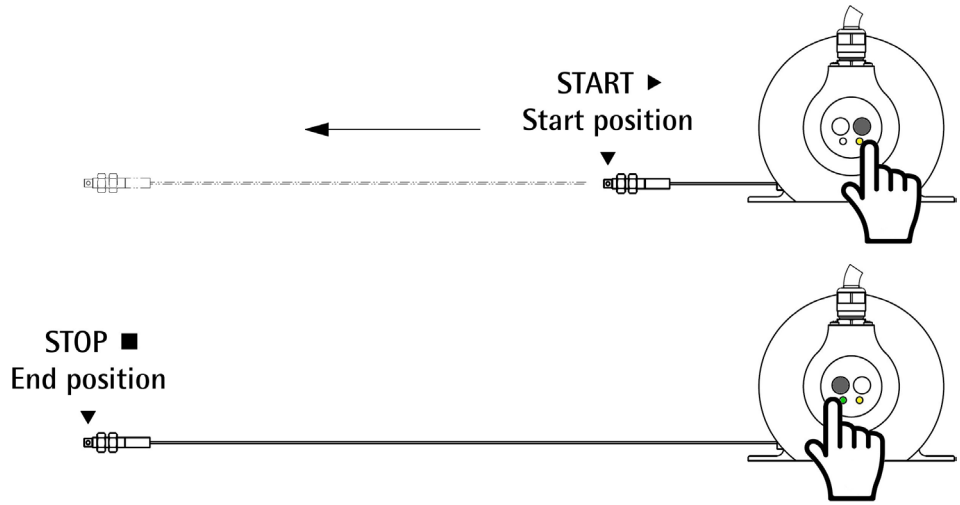
The Teach-window function allows to easily and intuitively set (by means of two keys or, as an alternative, two external signals) both the furthermost points in the travel of an axis, then the available analog range will be scaled automatically within the set limits.



4.1 Commissioning

The Teach-window procedure can be executed both by pressing the two keys in the encoder enclosure and by means of the two START and STOP signal inputs.
To start the Teach-window procedure and use the keys, simultaneously press both **START** ▶ and **STOP** ■ keys and hold them down for 5 seconds (be careful not to exceed 10 seconds; see the "4.4 Restoring the factory default settings" section on page 19); both LEDs I and II light up solidly. As soon as the keys are released both LEDs start blinking.
Likewise, you can enter the Teach-window procedure by applying for 5 seconds a voltage greater than 10V to both START and STOP inputs (see the "Electrical connection" section and the "3.6.4 Input signals description" section for more details).
The analog output is disabled while executing the procedure.

NOTE
Set the START position first and then the END position of the travel by pressing the **START** ▶ key first and then the **STOP** ■ key (see the Figure below); otherwise you can do the opposite, i.e. you can set the END position first and then the START position of the travel by pressing the **STOP** ■ key first and then the **START** ▶ key.
Moreover you can choose to have an increasing ramp either when the wire is being pulled out or when it is retracting. For an increasing ramp when the wire is pulled out, press the **START** ▶ key when the wire is retracted and press the **STOP** ■ key when the wire is unreeled; you can also choose to have an increasing ramp when you retract the wire, so you must press the **START** ▶ key when the wire is unreeled and press the **STOP** ■ key when the wire is reeled.



- Move the steel wire to your START position (or to the END position, see the NOTE above) in the travel of the application;
- press the **START** ▶ key for 2 seconds; LED I will light up, LED II will keep on blinking;

WARNING
From now on exit is inhibited until completion of the process.

- now move the steel wire to your END position (or to the START position, see the NOTE above) in the travel of the application;
- press the **STOP** ■ key for 2 seconds; LED II will light up; the analog output will be enabled again; releasing the keys causes the LEDs to signal the normal operation with user settings (LED I = ON; LED II = OFF).

NOTE
Should the START position (**START** ▶) be the same as the end position (**STOP** ■), in other words, you do not change the axis position when you press the keys, unit resets and restores the factory default settings (see the 4.4 Restoring factory defaults section on page 19).

4.2 OVERRUN function

4.2.1 Overrun function with 0-10V models

The 0-10V encoders implement an OVERRUN function that acts like an outside of range indication by maintaining the 0V or 10V output for a period of distance. The analog voltage value cannot increase beyond 10V or decrease below 0V.

After programming is completed, the system calculates the lowest power of 2 that the programmed travel window will fit in (2, 4, 8, 16, etc... revolutions). Then it aligns the travel window to the center of the next higher power of 2 revolutions. This results in the low limit overtravel area and the high limit overtravel area being the same distance. In the lower overtravel area the reading will remain at 0V, and in the upper overtravel area the reading will remain at 10V.

Example: If a programmed window was 11.7 encoder revolutions then the next higher power of 2 would be 16 revolutions. (Note: 1 encoder revolution = 200mm of draw wire).

In the example shown in Figure 3 on the next page, the encoder is programmed to run from a position of 4.7 revolutions to 10.5 revolutions. This is a total of 5.8 revolutions, segment **A**. The next power of 2 is 8 revolutions.

The difference between 8 and 5.8 is 2.2 revolutions. This is the combined distance of segments **B** and **C**. In this example, **B** segment will be 1.1 revolutions and **C** segment will be 1.1 revolutions.

The combination of all three segments is one cycle. Segment **B** will always be 0V and segment **C** will always be 10V. The cycle will continue to repeat after the 1st cycle which is identified by teach points 1 and 2. The voltage will remain at 0V prior to the distance of teach point 1 regardless of the distance from the encoder.

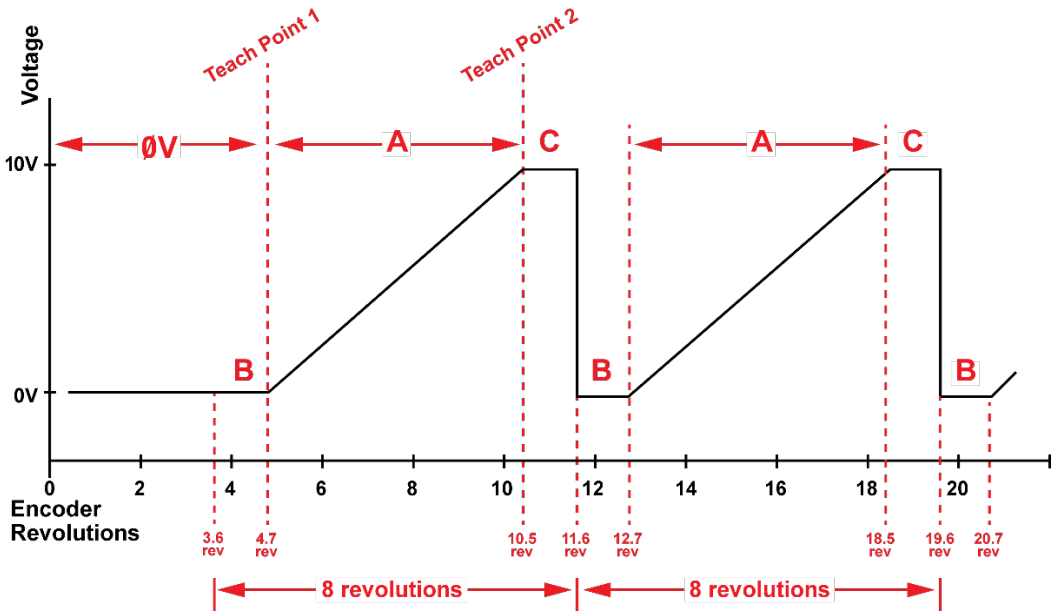


Figure 3

Note: The resolution of 65536 steps is spread out over segment A distance in the above figure.

4.2.2 Overrun function with 4-20 mA models

The DWA-xM-4A-M12 encoder implements the OVERRUN function which operates as a limit switch and allows to detect an overtravel position by decreasing or increasing the output value beyond the analog range.
After programming is completed, the system calculates the lowest power of 2 that the programmed travel window will fit in (2, 4, 8, 16, etc... revolutions). Then it aligns the travel window to the center of the next higher power of 2 revolutions. This results in the the low limit overtravel area and the high limit overtravel area being the same distance. In lower overtravel area the reading will be 3.6 mA, in the upper overtravel area the reading will be 22mA.

Example: If a programmed window was 11.7 encoder revolutions then the next higher power of 2 would be 16 revolutions. (Note: 1 encoder revolution = 200mm of draw wire). In the example shown in Figure 4 below the DWA-xxx-4A-M12 4-20 mA analog encoder is programmed to run a 5-revolution travel **A** (1.5 … 6.5, 9.5 … 14.5). The set travel **A** is aligned to the centre of the longest travel resulting from the lowest power of 2 among which it is included (i.e. 8 revolutions). The difference between the travels, i.e. 3 revolutions, is evenly distributed between the low limit overtravel area **B** and the high limit overtravel area **C**. The low limit overtravel area **B** is 1.5-revolution long and provides a 3.6 mA analog output value; while the high limit overtravel area **C** is 1.5-revolution long and provides a 22mA analog output value.

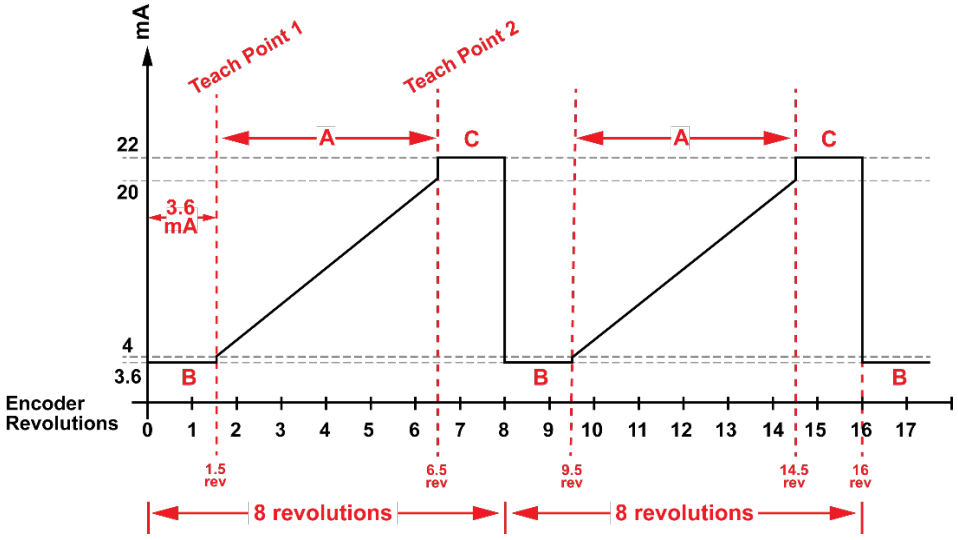


Figure 4

Note: The resolution of 65536 steps is spread out over segment A distance in the above figure.

4.3 Aborting the Teach-window procedure

The Teach-window procedure can be aborted only before setting the START position. Otherwise you must complete the process before exiting. Simultaneously press both **START** ▶ and **STOP** ■ keys to abort the Teach-window procedure. The unit will be restored to the previous working condition before starting the Teach-window procedure, signalled through LEDs.

4.4 Restoring the factory default settings

WARNING
Fully retract the wire before accomplishing the operation.

Simultaneously press both **START** ▶ and **STOP** ■ keys and hold them down for 10 seconds. Both LEDs light up solidly after about 5 seconds. After 10 seconds all parameters will be set to defaults, LED I switches off while LED II stays lit (working operation with default settings, see the "4.5 Function of the LEDs" paragraph). With default values, the START position begins after the wire is unwound 50mm. The voltage will remain at 0V until 50mm is achieved and will increase after that with 10V being the max distance of the encoder.

4.5 Function of the LEDs

Two LEDs are located just above the keys, they are designed to show visually the current working mode and the operational state of the encoder as explained in the following table.

LED I	LED II	Description
ON	OFF	Normal operation with user settings
OFF	ON	Normal operation with factory default settings
ON	ON	Entering the Teach-window procedure, both **START** ▶ and **STOP** ■ keys have been pressed for 5 seconds
Flash	Flash	Entering the Teach-window procedure, both **START** ▶ and **STOP** ■ keys have been released after 5 seconds
ON	Flash	During the normal Teach-window procedure (i.e. starting from the initial position), the initial position has been set by pressing the **START** ▶ key

Flash	ON	During the inverted Teach-window procedure (i.e. starting from the final position), the final position has been set by pressing the **STOP** ■ key

4.6 Times and functions

When you press both or just one key for a given time, you will activate a specific function. In the following table actions and times to activate the implemented functions are listed.

Action	Time (sec.)	Function	LED
Both **START** ▶ and **STOP** ■ keys pressed	10	The encoder is reset and factory default settings are restored	After 5 sec. both LEDs light up solidly, after 10 sec. LED I = OFF, LED II = ON
Both **START** ▶ and **STOP** ■ keys pressed	5	Enter the Teach-window procedure	After 5 sec. both LEDs light up solidly, they start blinking at key release
START ▶ key pressed	2	Set the initial position of the travel	Both LEDs are blinking; after pressing the **START** ▶ key for 2 seconds, LED I lights up solidly, while LED II keeps on blinking
STOP ■ key pressed	2	Set the final position of the travel	LED I is solidly lit, LED II is blinking; after pressing the **STOP** ■ key for 2 seconds also LED II lights up solidly. At key release LED II switches off

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