ELECTRONIC CIRCUIT FOR INCREMENTAL TRANSLATORS

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ABSTRACT

Electronic measurement devices includes two distinct sections: electrical translator for displaces and electronic unit which process the signals from translator.
Electric translator for displaces is realized by a circular ruler with equally distanced slots. To translate mechanical displace in electrical signal, the ruler is equipped with one or two optoelectronic reading heads. At least two reading heads must be used in order to determine the direction of moving object. The main problems that must be solved by the electronic block are the precision of measurement, the elimination of loss of impulses generated by the reading heads and to reduce the influence of parasite signals in measurement operation. The electronic circuit presented in this study guarantee the small mechanic displaces between +9,999 mm and -9,999 mm, with a resolution of 0,04 mm. The measured maximum frequency in condition of a 40 cm/s moving object is 10 kHz.

Keywords: Incremental translators. Digital displace translator. Photoelectrical displace translators. Translator with circular ruler. Incremental translator with circular disk and optoelectronic heads.

1. Incremental electronic device for mechanical displaces measurement

Incremental electronic devices for mechanical displaces measurement are structured in two main sections: electrical displace translator and electronic block for signal processing [2].

Electrical displace translator may be either analog if analog signals are provided, or digital if digital signals are provided.

Digital displace translators have electrical output impulses, giving us device measured position information by number or range coded impulses.

For industrial purpose, digital measurement devices for mechanic displaces must guarantee non-linear errors below 1% for small displaces e.g. 4 mm, resolutions higher than 0,01 mm and the possibility of determining the direction of displace [l , 3].

Incremental electronic device for small displaces purposed in here contains:

- digital displace translator;
- reading heads;
- electronic process block.

Digital displace translator converts mechanical displace in electrical signal. The translator is realized by an incremental measurement circular ruler. The ruler is operated by feel with rod, which translates the linear motion in circular motion.

The circular ruler is equipped with distances, equal periodical slots, radial at with the ruler step. This ruler has the advantage that for any relative position from the reading head, the number of impulses for displaying the position might be tarred to zero, action that allow easily changing the place of zero.

Two optoelectronic translators delayed with ¼ period of the circular ruler realize the reading heads.

Using two reading heads the measurement sensitivity of the device is increased and the motion direction can be determined. [5].

The electronic process block will processes the electrical impulses generated by the reading heads in order to display the range and direction of motion [1].

The electronic process block is structured by:

- discrimination circuit for motion direction;
- digital comparison circuit for signaling;
- cross of pre-established thresholds;
- counter;
- digital display;
- power unit.

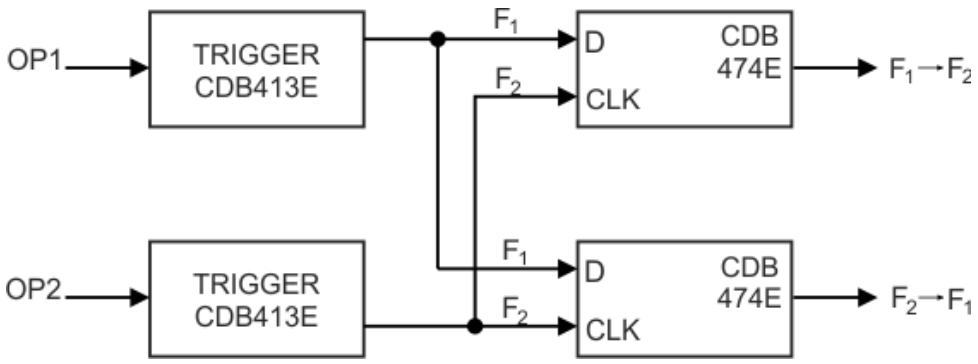

Fig. 1 – Impulse information unit and direction detector unit scheme

2. Electronic circuit for incremental translators

The electronic circuit for incremental translators processes the electrical signals generated by the reading heads in order to display the range and direction of displace.

Digital integrated circuits are used, to process the electrical information provided by the reading heads to generate successive impulses. The number of impulses is proportional with the range of the mechanical displace. The electronic incremental measurement device for mechanical displaces is composed of electronic process circuits and contains:

- impulse formation unit;
- direction detector unit;
- counting validation unit.

The impulse formation unit is realized by two integrated circuits CDB-413E, driven by impulses from the reading heads output (fig.1). Impulse formation unit will generate successively rectangular impulses delayed with ¼ period of repetition (fig.2).

The displace direction measurement ruler will generate F1 or F2 impulses depending of the ruler motion direction. Every impulse generated by the formation unit is applied to a direction detector.

Direction detector unit is realized by two bistable integrated circuits, connected as figured in fig. l.

Supposing that both optoelectrical translators are generating logical 1 level at the CDB-413 trigger output, at the first rising front, the proper output turns to logic 1 which will constitute the data input for direction bistable.

When the other trigger CDB-413 turns to logic 1, the bistable will set itself establishing the direction for the reversible counter.

The first trigger output is used as date input for the bistable, the second trigger output is used to transfer input for the same bistable.

For the other bistable the situation reverses. Only one of the two bistable circuits will have the tilt condition fulfilled, contain the one which has logic 1 at input before applying the transfer impulse.

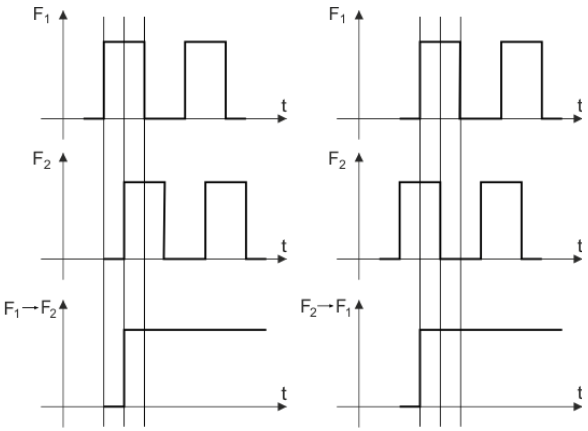

Fig. 2 – Signal validation from direction unit diagram

The counting validation circuit (fig.3) is realized by integrated circuits as presented in diagrams in fig. 4, and guarantees the precise determination of motion direction. In order to determine this, it increments or decrements the content of counter in comparison with a reference shares previously defined (or zero share).

Considering that the state measurement starts from high to low value, as usual in industry, in correlation with the way that the mechanical translator rod acts, that is from low to high, we suppose that is grasped first the slot A crossing, which will determine decreasing counting. That fact presumes the existence of dates in counting cells in order to decrement their contents.

For this purpose we provided a data loading circuit which realizes this desire in the moment of plugging on the system. Manual command has been also provided for safety purposes.

If the measured signal will change to ascending, the direction detectors will catch that change, the direction counting bistable will switch and the counting direction will be forward.

When reaching ZERO, an impulse will be generated which will change the counting direction from reverse to forward.

Similar functioning in measuring from low to high, if the state alternates in reverse direction, the direction detector will modify the counting sequence

from forward to reverse.

In order to realize a proper correspondence of indication provided by this device, referring to real share, the device should be first standardized to zero share, as the 0000 or display to correspond with real zero share fact that can be made by the "reset" button.

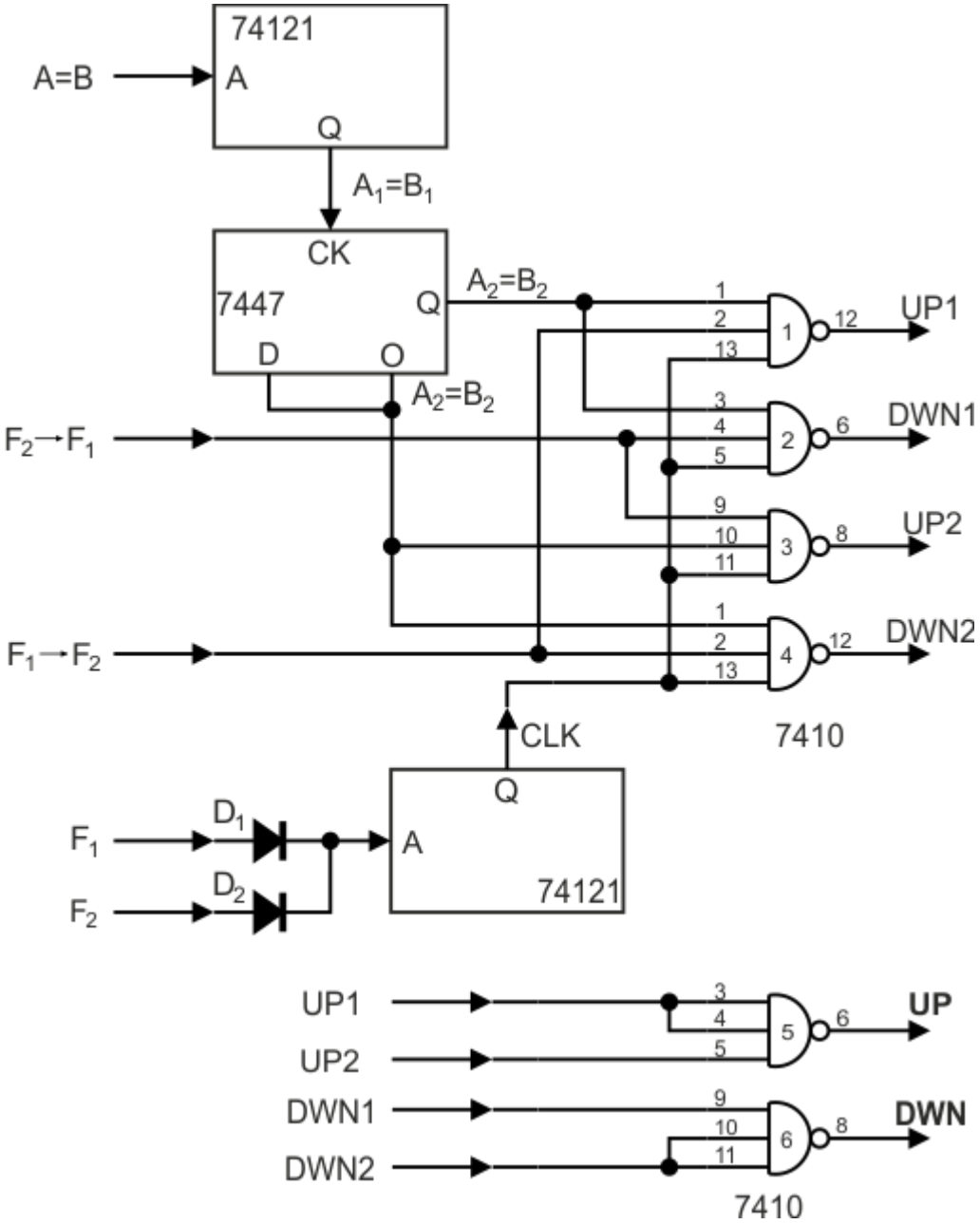

Fig. 3 – Counting validation circuit schema

The electronic circuit for incremental translators allows:

- measuring of small displaces between +9.999 mm and -9,999 mm, with a resolution of 0,04 mm;
- maximum frequency of impulses to be measured of 10 kHz for an 0.04 mm increment and a maximum speed of moving object of 40 cm/s [1].

$$f_{\max} = \frac{40cm/s}{0{,}04mm} = 10kHz \qquad (1)$$

Comparing this device with other electrical circuit for incremental translators it has a clock generator with a frequency determined by the motion speed. The frequency of impulses generated by the reading heads depends by the speed of the object that is measured.

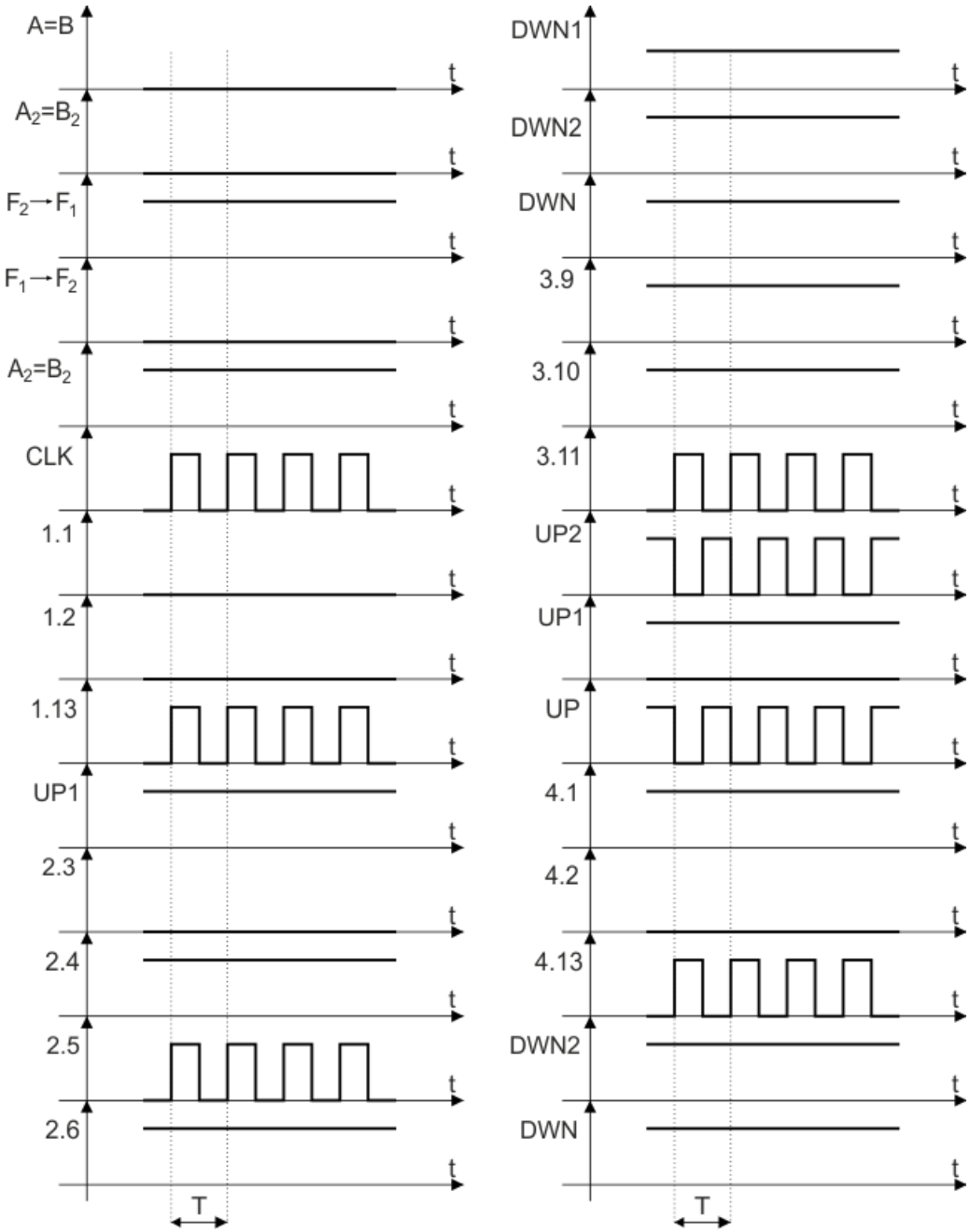

Fig. 4 – Counting validation signal diagram

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