DEVELOPING OF THE HMI MICROPROCESSOR CONTROL UNIT FOR SINGLE SHUNTING TRAFFIC LIGHTS

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Abstract. The issue of developing a Microprocessor operate unit for single shunting traffic lights HM1 discussed in the article. The schematic diagram of the block was analyzed and determined which elements, with which microelectronic devices, should be replaced. In a block containing 5 relay circuits, the rails are considered electric loops of the direction of movement of the currents in the working holate transition. The analysis of the operation of the block in the circuit of push-button relays that receive power from the HMID block, the calculation of the estimated current strength, showed the need to use a Pvg612 type optocoupler in this circuit.
Key words: railway automatics and telemechanics, electromagnetic relays, mechanical contacts, block electrical relay centralization, optical-relays, electrical circuits, automatic push-button relays, control relays, correspondence circuit, microprocessor system, microelectronic, microcontroller, optocoupler.

Annotatsiya. Maqolada bittalik manevr svetoforlari uchun HMI mikroelektron elementlardan tashkil topgan mikroprotsessorli boshqaruv blokini ishlab chiqish masalasi ko'rib chiqiladi. Blokning sxematik diagrammasi tahlil qilindi va qaysi elementlarni, qaysi mikroelektron qurilmalar bilan almashtirish kerakligi aniqlandi. 5 ta rele sxemani o'z ichiga olgan blokda relelar ishchi holata o’tishdagi toklar harakatlanish yo'nalishi elektr zanjirlari ko'rib chiqiladi. HMID blokidan quvvat oladigan tugmachali rele o‘rniga blokning ishlashini tahlil qilish, qabul qilingan oqim kuchini hisoblash ushbu sxemada pvg612 tipidagi optoreldan foydalanish zarurligini ko'rsatdi.
Kalit so'zlar: Temir yo‘l avtomatikasi va telemexanikasi, elektromagnit rele, mexanik kontaktlar, blokli elektr-releli markazlashtirish, optorele, elektr zanjirlari, avtomatik tugmali rele, boshqaruv relesi, mikroprotsessorli tizim, mikroelektron, mikrokontroller, optojuftlik.

Аннотация. В статье рассматривается вопрос о разработке микроэлектронного блока управления одиночный маневровый светофорами HMI. Была проанализирована принципиальная схема блока и определено, какие элементы, с какими микроэлектронными устройствами необходимо заменить. В блоке, содержащем 5 релейных цепей, рассматриваются электрические цепи направления движения токов при переходе реле в рабочее состояние. Проведен анализ работы блока в цепи кнопочных реле, которые получают питание из блока HMID, расчет предполагаемой силы тока, показал необходимость использования в этой цепи оптореле типа Pvg612.
Ключевые слова: железнодорожная автоматика и телемеханика, электромагнитные реле, механические контакты, блочная электрическая релейная централизация, оптореле, электрические цепи, автоматические кнопочные реле, управляющие реле, микропроцессорная система, микроэлектроника, микроконтроллер, оптопара.

Introduction

In the automation and telemechanics system of the railways of Uzbekistan, the system of route relay centralization has been actively used for many years. This system uses a large number of electromagnetic relays. Microprocessor systems are used in railway stations in many developed countries. Because of this, the demand for relay production decreased sharply and most factories ceased operations. Compared to microprocessor-based systems, electrical interlocking relay systems are characterized by relatively low system speed, relay sizes requiring significantly more space than microprocessor-based systems, and signal transmission types. This article discusses the devices of the electrical centralization block system, namely the HMI dialer unit. In connection with the abolition of the use of these relays and their replacement with microelectronic devices, the issue of considering the possibility of using microelectronic devices instead of electromechanical ones in routing nodes of relay centralization becomes relevant [1].

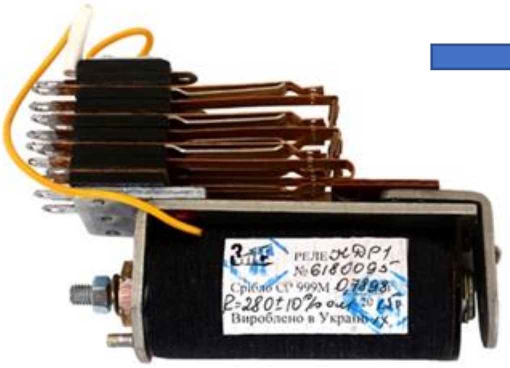


Fig.1. KDR relay

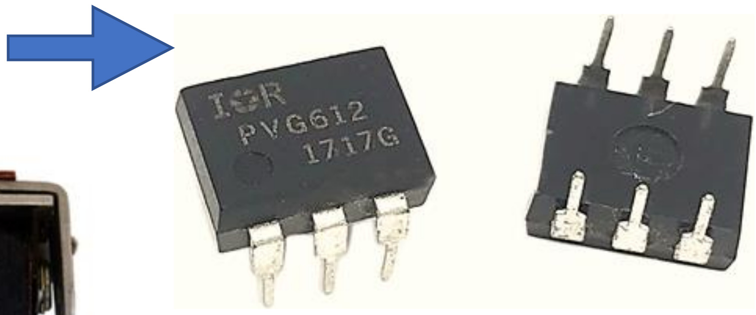


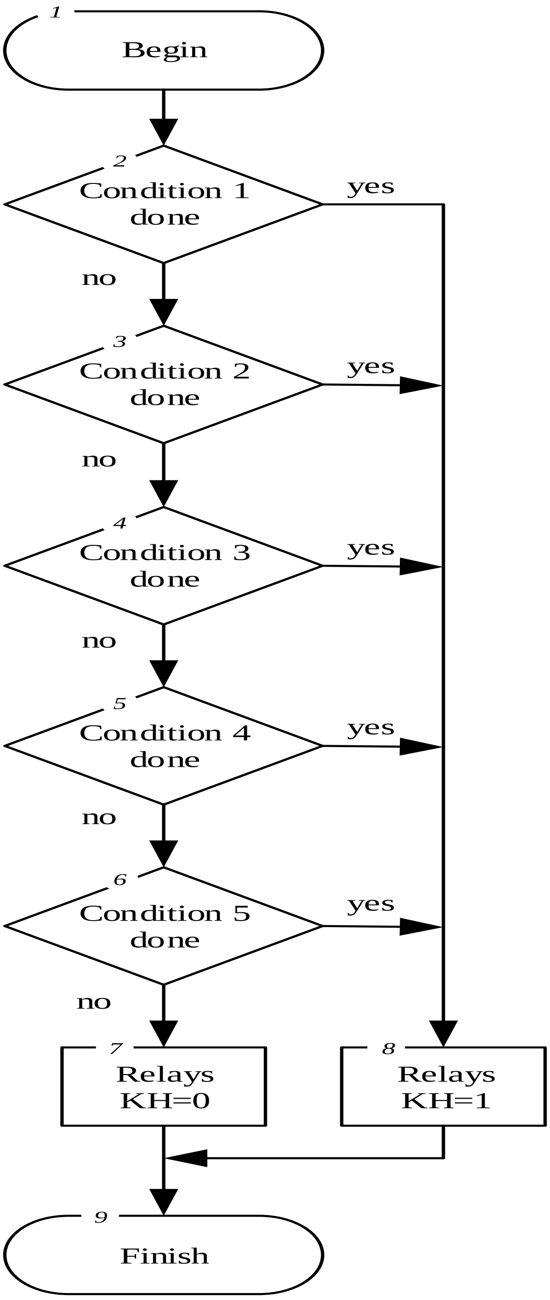
Fig.2. PVG-612 optocoupler

Methods

The purpose of the article is to consider the problem of creating an algorithm for replacing existing CDR relays (coded relays) in the HMI block with microelectronic devices using a partial opto-relay. As a solution to the technical issue, it is proposed to abandon the use of electromechanical relays with mechanical contacts and replace their coils and opto-relay contacts. Let's analyze the basic block diagram and create algorithms for implementing the exchange. Let's look at the block diagram of the algorithm and the operating conditions of each relay in the block. It is also worth noting that the introduction of new and modern microprocessor centralization systems does not always increase economic efficiency, since the cost of such systems requires many years of payback. Additionally, it is much easier and more cost-effective to upgrade parts of an existing system one by one rather than upgrade it completely.

Discussion and results

It is necessary to replace the existing mechanical contacts on the opto-relay. To determine the type of optocoupler used, we determine the maximum required switching current for a given optocoupler. The KDR1-200 relay coil is the final element of the push-button relay circuit. According to the reference book [2], the relay coil has a resistance of 200 Ohms, and the starting current is 120 mA. In this relay circuit, only one relay coil is used, therefore, to switch the push-button relay circuit, you need an optocoupler relay with a switching current of at least 200 mA.



$$(2-8)\cap\overline{AKH}\cap(2-1)=1\left[KH=1\right]$$

$$(2-9)\cap\overline{B\Pi}\cap\overline{HKH}\cap\overline{AKH}\cap(2-1)=1\left[KH=1\right]$$

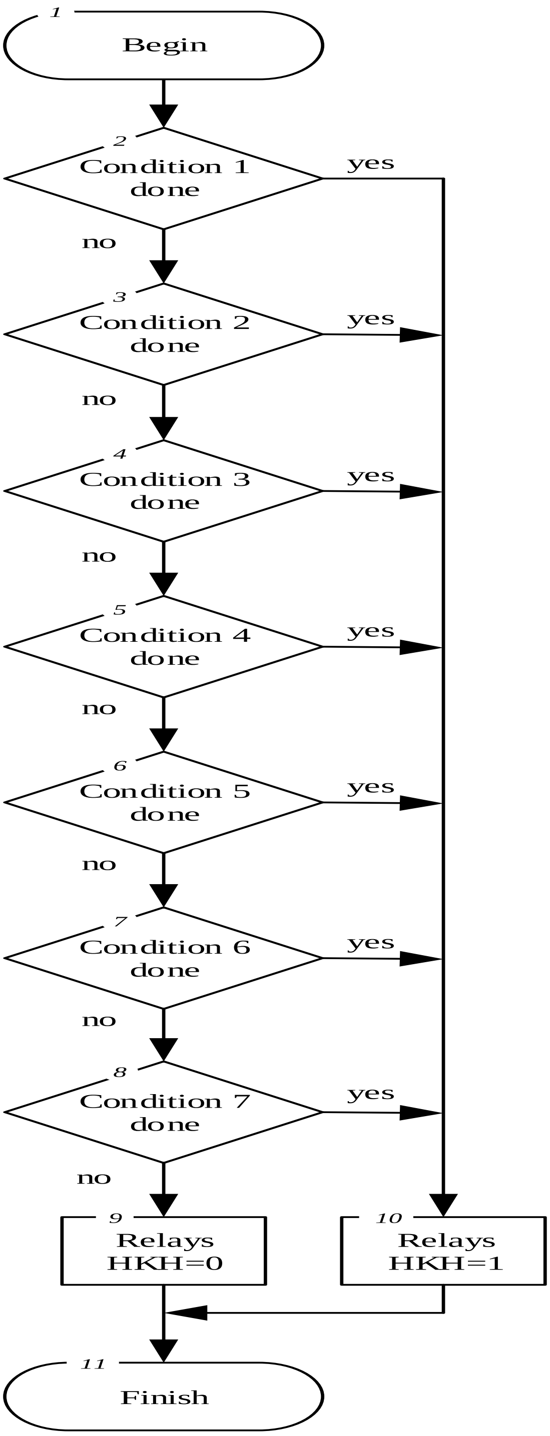
$$(2-11)\cap HKH\cap\overline{AKH}\cap(2-1)=1\left[KH=1\right]$$

$$(2-10)\cap AKH\cap(2-1)=1\left[KH=1\right]$$

$$(2-10)\cap KH\cap(2-1)=1\left[KH=1\right]$$

Fig.3. Algorithm scheme and electrical circuits of KH relays

The button relay circuit starts from terminals 28, 29, 210 and 211, we will look at its current control circuits. According to the following 4 circuits, the KH relay is energized. Electrical circuits are chosen arbitrarily (Fig.3). The push-button relay is switched on by the rear contacts of the AKH relay, starting from the 1st electrical circuit of the block of 2-8 terminals. Starting from the 2nd circuit of block 2-9, the KH relay switches to the current state when the current reaches terminal 2-1 through the rear contacts of the BP, HKH and AKH relays. 3- the electrical circuit starts from terminal 2-11 of the block, when the current reaches terminal 2-1 through the front contacts of the HKH relay and the rear contacts of the AKH relay, the KN relay is activated.



$$(1-9)\cap HKH\cap M\Pi\cap(1-1)=1\left[HKH=1\right]$$

$$(2-10)\cap HKH\cap\overline{M\Pi}\cap(1-1)=1\left[HKH=1\right]$$

$$(2-10)\cap AKH\cap(1-1)=1\left[HKH=1\right]$$

$$(1-7)\cap\overline{AKH}\cap(1-1)=1\left[HKH=1\right]$$

$$(2-16)\cap KH\cap\overline{AKH}\cap(1-1)=1\left[HKH=1\right]$$

$$(1-8)\cap\overline{KH}\cap\overline{AKH}\cap(1-1)=1\left[HKH=1\right]$$

$$(1-19)\cap HKH\cap\overline{KH}\cap\overline{AKH}\cap(1-1)=1\left[HKH=1\right]$$

Fig.4. Algorithm scheme and electrical circuits of HKH relay

4. When the electrical circuit is started from terminal 2-10 of the block and the current reaches terminal 2-1 through the front contacts of the AKH relay, the KH relay operates. Next is our last electrical circuit, if after starting one of the 3 circuits is triggered, it keeps the KH relay in its current state, that is, the current comes from terminal 2-10 of the block, and through the front contact of the KN. relay, the relay is held from the current state, this state from 2-10 continues until the power is interrupted. The HKH relay drive circuit begins at block terminals 1-7, 1-8, 1-9, 1-19, 2-10 and 2-16 and drives the relay by passing current to terminals 1-1. Relay HKH is turned on starting from terminals 1-7 of the 1st electrical circuit, relay HKH is turned on by the current supplied to terminals 1-1 through the rear contacts of relay AKH. 2- electrical circuit, starting from terminals 1-8 of the block,

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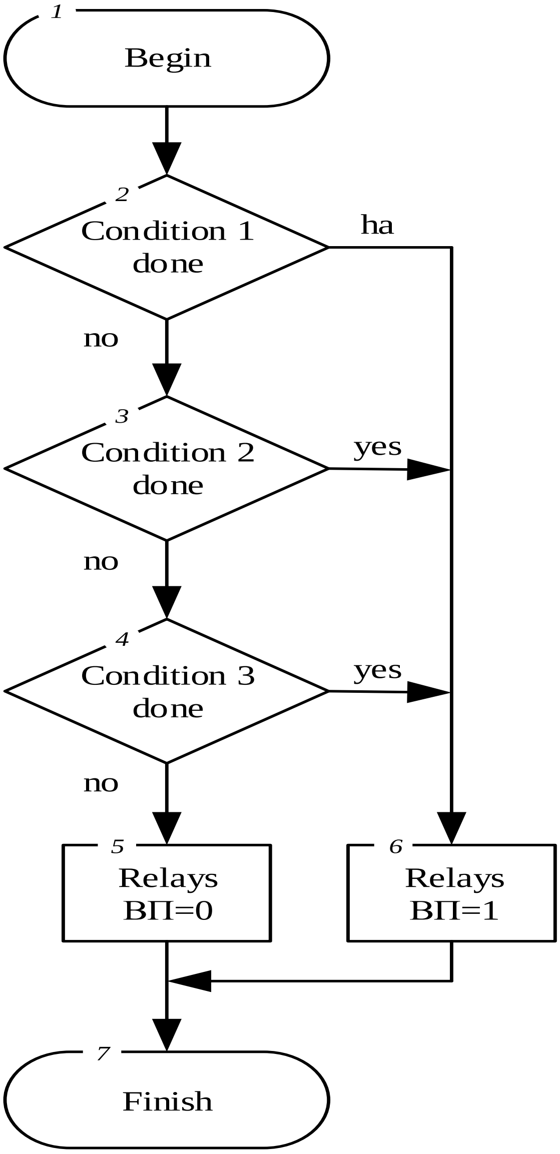
through the rear contacts of the KN and AKH relays, the current reaches terminals 1-1, and the HKH relay is energized. 3- electrical circuit, starting from terminal 2-16 of the block, through the front contacts of the KN relay and the rear contacts of the AKH relay, the current reaches terminal 11, and the HKH relay is energized. 4- electrical circuit, starting from terminal 2-10 of the block, through the front contacts of the AKH relay, the current reaches terminal 1-1, and the HKH relay is energized.
Depending on the operation of one of the circuits, the circuit tries to maintain the current state through the contact of the relay itself: a) starting from terminals 1-9, the current reaches terminals 1-1 through the front contacts of the HKH and MП; b) starting from terminal 2-10, the current reaches terminal 1-1 through the front contacts HKH and the rear contacts MП; d) starting from terminal 1-19 of the block, the current flows to terminal 1-1 through the rear contacts of the relay HKH, KH, AKH (Fig.4).



$$(1-16)\cap KH\cap KHK\cap M\Gamma=1$$
$$(1-16)\cap KH\cap B\Pi\cap M\Gamma=1$$
$$(2-12)\cap B\Pi\cap\overline{KH}\cap M\Gamma=1$$

Fig.5. Algorithm scheme and electrical circuits of BП relay

The BП relay control circuit begins at terminals 1–17 and 2–12, and the relay is activated by current flowing to terminals 1–14. Let's look at the circuits of the BП softener. Starting from the 1-electric circuit of blocks 1-16 terminals, KH and HKH, canceling the front contacts or 1-14 terminals, the BP relay is connected to the current relay. The circuits try to maintain a living state by self-contact: a) if the current reaches terminals 1-14 through

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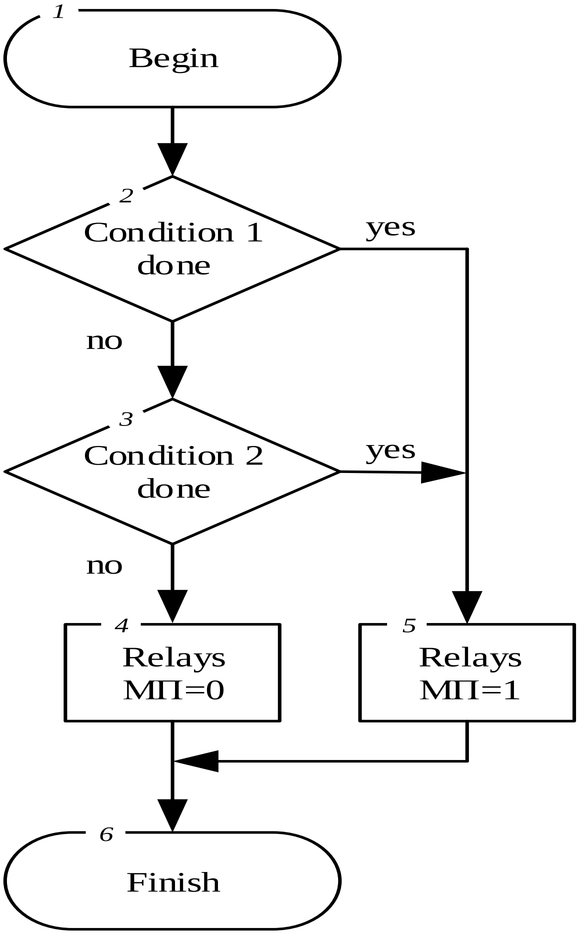
the rear contacts of the KH and BП, starting from terminals 1-16 of the electrical circuit; b) the second case occurs when the electrical circuit starts from terminals 2-12 of the block and reaches terminals 1-14 through the front contacts BП and rear contacts (Fig. 3). Auxiliary relay circuits are small and operate quickly. It is driven by one electrical circuit and comes into current state. As a result of self-contact switching on from the operating state, the connection of the key circuit keeps the relay in operating mode with the MП current. Blocking HM1 when current flows from terminals 2-14 to the HKH, restoration of old contacts, or when current reaches 1-14, the MП relay is activated, and power from terminals 1-9 is supplied to the MП relay through its contact HKH, restoration of contacts ort. Once the current reaches terminals 1-14, the device attempts to maintain the search state and the process continues until the contact or power is interrupted (Fig.5).



$$(2\text{-}14)\cap KHK \cap M\Gamma = 1$$

$$(1\text{-}9)\cap M\Pi \cap \overline{HKH} \cap M\Gamma = 1$$

Fig.6. Algorithm scheme and electrical circuits of MП relay

The process of launching the BKM relay is similar to the process of launching the MП relay. This relay is also powered by a single electrical circuit. Then the BKM relay continues to operate in the current operating mode according to a different circuit from the current operating state through its own contact. The BKM relay is triggered by the current coming from terminals 2-14 of the HM1 block and reaching 1-14 through the front contact of the KH relay. When the KH bus goes into a de-energized state, current flows through the front contact of the BKM relay through the rear contacts of the KH relay and the current reaches terminals 1-14, the BKM relay retains its current state, forming a circuit. The process continues until a break occurs in the circuit as a result of a contact or power failure (Fig.6-7).

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$$(2\text{-}14) \cap \text{КН} \cap \text{МГ} = 1$$

$$(2\text{-}12) \cap \text{ВКМ} \cap \overline{\text{КН}} \cap \text{МГ} = 1$$

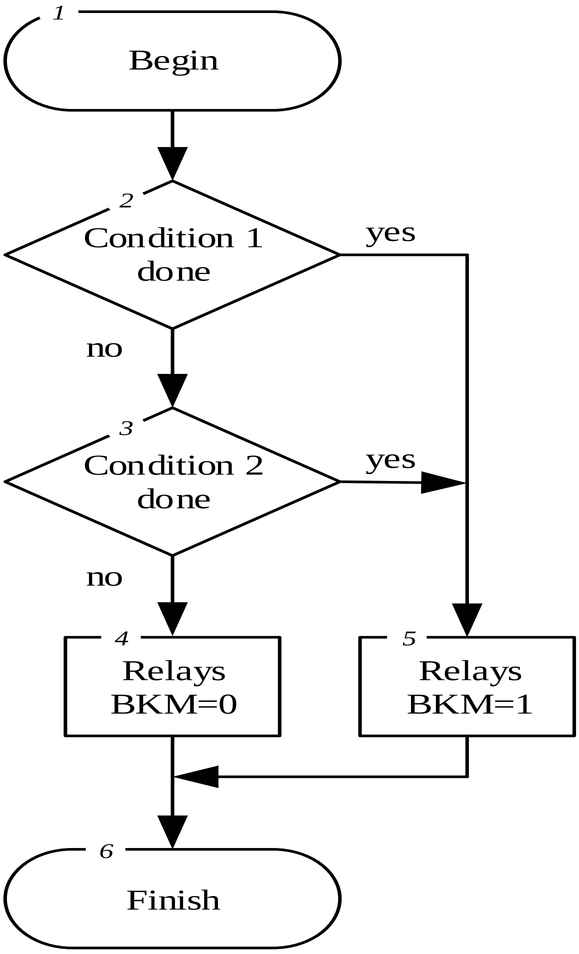

Fig.7. Algorithm scheme and electrical circuits of МП relay

Conclusion

It is concluded that it is proposed to abandon the use of mechanical contact and large-sized electromechanical relays in the HM1 block and replace them with the creation of a microprocessor control unit for a single maneuvering traffic light of a switch group based on the above, - modern and high-speed microelement(optocoupler)s are noted.

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