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Design of audio source switcher using for medium wave transmitter based on Microcontroller

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Abstract. Based on microcontroller, an audio source switcher (patent number: 201220738954.9) using for medium wave transmitter is proposed in this paper. According to the default priority and the operating status of current audio source, the proposed switcher can correctly distinguish the statuses of speech pause and transmission fault to realize the functionality of automatic switching among three single channels. Moreover, in order to improve the stability and practical value of the proposed switcher, the trap filter is also used in switcher to inhabit the high frequency interference of transmitting station. It is expected that this switcher has potential application in future

Keywords: Signal Source Switch, Microcontroller, Medium Wave Transmitter

1 Introduction

The audio sources of transmitter are always electrical signals of optical cables, satellite signals and FM signals in medium wave transmitting station. These three channels audio source provide three different ways for transmitting station to deliver audio programs to ensure the purpose of multiple backup. Three channels audio sources usually have different priority and the operating status of current audio source is indicated by indicator unit [1-3]. So far, the switch of signal sources is operated manually in many transmitting stations. In this paper, an audio source switcher (patent number: 201220738954.9) using for medium wave transmitter is proposed, which can be realized with microcontroller. The proposed switcher can automatically switch the audio source according to the default priority and the operating status of current audio source. The advantages of the proposed switcher are that it can not only correctly distinguish the statuses of speech pause and transmission fault, but also can effectively inhabit the high frequency interference of transmitting station. Therefore, the switcher exhibits high stability, and has practical value in the field of medium wave transmitter.

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2 System Composition and Principle

The audio source switcher is composed of microcontroller, optical signal monitoring circuit, satellite signal monitoring circuit, FM signal monitoring circuit, relay control unit and indicator unit. The structure diagram of audio source switcher is shown in Fig. 1. The indicator units indicate the operating statues of electrical signals of optical cable, satellite signal and FM signal by three light-emitting diodes. The three channels audio sources are monitored by corresponding signal monitoring circuit, respectively. The output of the monitoring circuit is finally transmitted to microcontroller. According to the monitoring values and the default priority of signal channels, the microcontroller can automatically close the corresponding signal relay of relay control circuit, and realize the connection of the corresponding signal with transmitter. The circuit structure of the optical signal monitoring circuit, satellite signal monitoring circuit and FM signal monitoring circuit are the same, as shown in Fig. 2.

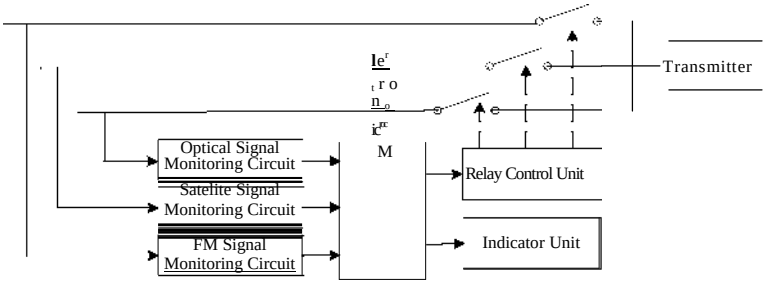


Fig. 1. The structure diagram of audio source switcher

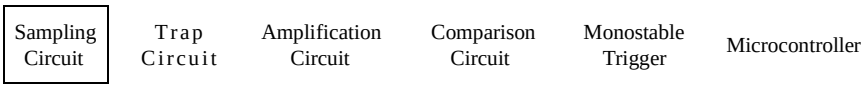


Fig. 2. The structure diagram of monitoring circuit

The sampling circuit is used to sample the corresponding channel signal, and transmit the signal to trap filter to inhabit the high frequency interference of transmitting station. The sampled signal is amplified by amplification circuit and transmitted to comparison circuit. When the current audio source is normal, the comparison circuit output is a series of low-pulse signal. Otherwise, the output of comparison circuit is a high level value. Then the above output of comparison circuit is transmitted to monostable trigger which is designed to a type of repeatable trigger by LM555 [4]. When the input is a low-pulse in a period time, the output of the trigger is high level value, while the output is low level value. So the monitoring circuit can effectively distinguish the statuses of speech pause and transmission fault. By the means of incessantly monitoring the output of the monostable trigger, the microcontroller can finally realize the control of the relay control unit and indicator unit.

3 System Hardware Design

According to principle of the system, the outputs of monitoring circuit of three signal channels were connected to the I/O port of microcontroller (STM32F103RBT6), respectively [5-6]. According the values of monitoring circuit, one of three relays in the relay control unit is closed to connect the corresponding single channel with the transmitter. And the status of the current operating audio sources is indicated by the indicator unit which is composed of three light-emitting diodes and a buzzer. When all three audio sources are in the status of fault transmission, the buzzer will be ring. Fig. 3 shows the monitoring circuit diagram of three single channels. In Fig. 3, inductor (L3) and capacitor (C7) compose the trap filter which is a series resonance circuit, LP339MX (U5A) is used to amplify the sampling signal, and the LP339MX (U5B) is a comparator to compare the output of diode (D3) with a fixed level. The role of diode (D3) is half wave rectification of the amplification circuit output, and LM555 is used to monostable trigger which is designed to a type of repeatable trigger.

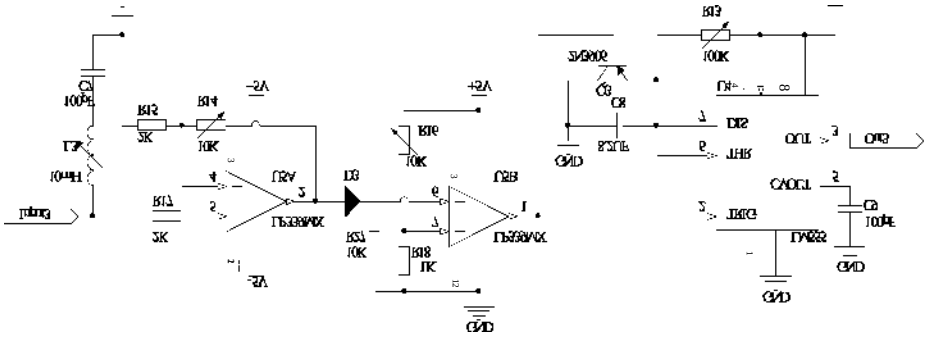
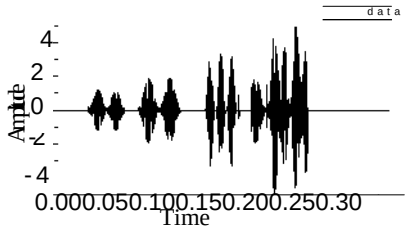


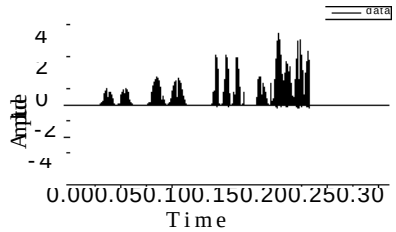
Fig. 3. The circuit diagram of monitoring circuit

4 Testing and Analysis

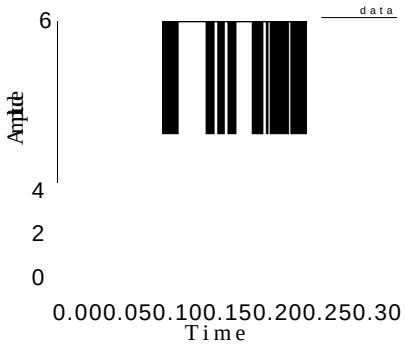
To validate the functionality of above design, the performance of the monitoring circuit is simulated. The audio signal is input and amplified by the amplification circuit, as shown in Fig. 4(a). Fig. 4 (b) shows the output waveform of diode D3 with the input of the amplified signal. Compared Fig. 4 (a) with (b), we can see that the amplified signal is half wave rectified. Fig. 4 (c) shows the output waveform of comparator with the input of the above half wave rectified signal. Fig. 4 (d) shows the output waveform of monostable trigger. Compared Fig. 4 (c) with (d), we can see that the output of trigger is keeping high level when the signal with normal pauses is input. While the output is turned into low level value when the input is no audio signal over a period time, which mean the signal line is transmission fault. At this time, the microcontroller can correctly switch the audio source according to the default priority to ensure the regular work of the station.



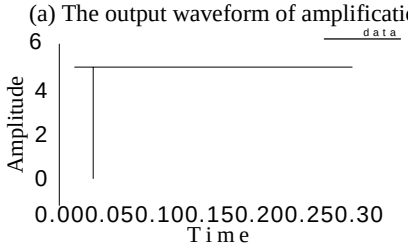
(a) The output waveform of amplification



(b) The output waveform



(c) The output waveform of comparator



(d) The output waveform of monostable trigger

Fig. 4. The output waveform of circuit

5 Conclusions

In order to realize the purpose of automatic switching among three channels audio source, an audio source switcher using for medium wave transmitter is proposed in this paper, which can be realized with microcontroller. The proposed switcher can distinguish the statuses of speech pause and transmission fault to ensure switching the audio source correctly, and automatically choose one of three channels as audio source for the medium wave transmitter according to the default priority and the operating status of current audio source. The operating status of audio source can be indicated by indicator unit. In addition, the trap filter is also used in switcher to inhabit the high frequency interference of transmitting station to improve the stability and practical value of the proposed switcher. It is expected that this switcher has potential application in the field of medium wave transmitting.

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