GL-104

ENCODER/DECODER MANUAL

GLOLAB
CORPORATION

Thank you for buying our Encoder / Decoder Module.

The goal of Glolab is to produce top quality electronic kits, products and components. All of our kits are designed by Glolab engineers and tested in our laboratory. Mechanical devices, prototypes and enclosures are fabricated in our precision machine shop.

We think that Glolab kits are the easiest to assemble of any available. To ease assembly for both experienced and new kit builders, we package each part in individual plastic zip-lock envelopes that are labeled with the value and part number. It is not necessary to read resistor color codes or capacitor number codes while assembling the PC boards. You simply locate the part and insert it into the PC board where the corresponding part number is marked on the board. Each kit includes assembly instructions and a complete description of how it works.

In addition to our kits, we supply some special and hard to find parts for those of you who want to design and build your own projects.

Technical help is available by email from lab@glolab.com.

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Introduction_____

The radio frequency spectrum is filled with noise and other signals, especially those frequencies where unlicensed transmitter operation under FCC part 15 rules is allowed. When using a wireless remote control system it is desirable to have a way of filtering out or ignoring those unwanted signals to prevent false data from activating your control circuits. One way to accomplish this is to use an encoder IC that automatically generates serial coded data at the transmitter and a decoder IC that deserializes and decodes the data at the receiver. The codes generated at the transmitter and decoded at the receiver must match before received data is accepted as valid by the decoder circuit.

In the early days of "radio control", before these coding ICs were available, radio controlled garage doors sometimes opened themselves when they received transmissions from a plane passing overhead or a two-way radio operating in the area. Encoding and decoding is now used in most wireless control systems to prevent this type of interference.

Glolab GL-104

- **One chip can be used as either an encoder or decoder**
- **Uses only 1 microampere of standby current**
- **16 selectable addresses**
- **4 input / output data ports**
- **Operates on 5 volts**
- **Uses ceramic resonator for reliable serial data communication**
- **Encoder**
    - **active high data with active high trigger input**
    - **active low data triggered by any or all data inputs**
    - **Internal pullups in active low mode**
- **Decoder**
    - **momentary outputs**
    - **cumulative latched data outputs**
    - **reset for latched outputs**
    - **outputs source and sink 25 milliamperes**

The Glolab GL-104 Encoder/Decoder is microprocessor based and is designed for use with wireless modules, infrared remote controls and other devices that operate with serial input and output data. It may be used as either an encoder or a decoder by simply connecting one pin either high or low. It can encode or decode four bits of data and four address bits.

When used as an encoder, one of two Input modes can be selected by connecting a pin either high or low. In one mode the encoding of data can be active high initiated by a transmit enable pin and in another mode the encoding can be active low initiated by any or all data pins, however the level on this pin cannot be changed while the circuits are active or in standby. When used as a decoder, either momentary or latched data outputs can be selected by connecting a pin either high or low. A momentary valid transmit output indicates when valid data is being received.

The GL-104 is powered by 5 volts and draws about 3.5 milliamperes not including loads when active. When not encoding or decoding it remains in a low power mode where it draws only 1 microampere making it ideal for battery powered applications. As an encoder it becomes active when triggered by transmit enable or data input. As a decoder it becomes active when it receives serial data.

An internal clock is generated by a 4 MHz ceramic resonator which provides more accurate frequency control and therefore better serial data synchronization than the resistor controlled oscillators used in some encoders and decoders. This allows higher speed data transfer without the risk of lost data.

Figure 1 shows the pin configuration for the 18 pin DIP package. The labeled pins serve a common function in both the encoder and decoder. The functions of the remaining pins are described in the following sections.

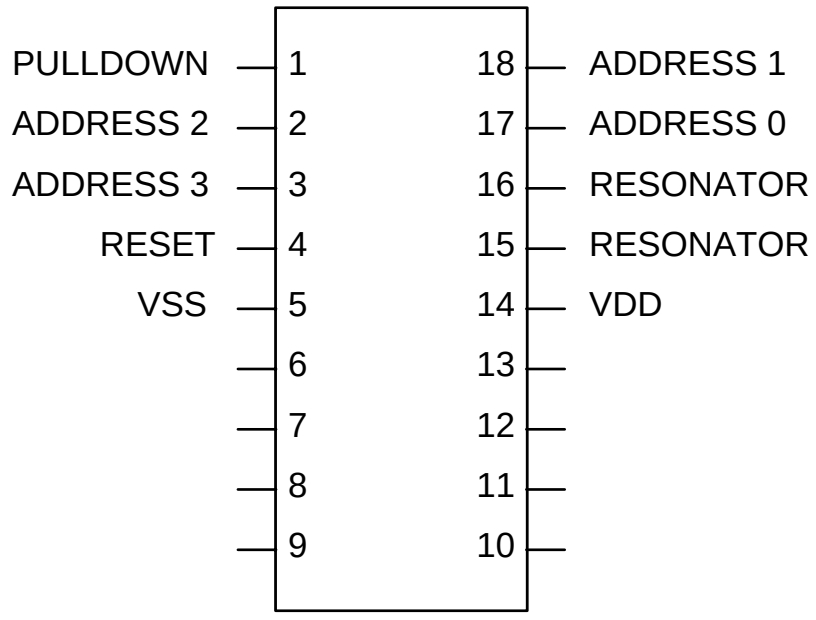

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FIGURE 1

Addressing

There are 4 address pins that can be used to select 16 different addresses by connecting them in binary format to either Vss or Vdd. Address pins must be connected the same in an encoder/decoder pair in order for the decoder to receive data from the encoder. Addressing is used to give a unique identity to one pair of encoded devices such as an RF transmitter and receiver and to distinguish that pair from another that has its address pins connected for a different address. This allows a transmission from a transmitter/receiver pair to be received only by its own receiver. Also, by changing addresses, the transmitter can send to a different receiver that matches its new address.

All address pins must be connected to either Vdd or Vss by being hard wired, through a DIP or other type of switch or by a logic or other type circuit or through resistors, they cannot be floating. Since it is difficult to find double throw DIP switches that will connect to either Vss or Vdd, pulldown resistors may be connected to the address pins and standard single throw DIP switches can then selectively connect the address pins to Vdd. This would normally result in increased standby current, however, a switched pulldown pin has been provided that goes high during standby to turn pulldown current off. This pin is described below.

It should be noted that the use of different addresses does not imply the possibility of full duplex operation or of simultaneous transmission by more than one RF transmitter on the same frequency in close proximity.

Switched pulldown

Pin 1 is a switched pulldown that goes down to Vss only while the circuit is active and goes up to Vdd during standby. Figure 2 shows how this pin can be used to save power during standby. In this example, DIP switches selectively connect the address pins to Vdd while pulldown resistors pull pins having open switches down to Vss through pin 1 when the circuit is active. Pulldown resistors connected to closed switches use no power when pin 1 is high during standby. This allows the use of standard single throw DIP switches. Pulldown resistors that are returned to pin 1 can also be used with DIP or other single throw switches to set the state of the data-in pins when operating in the active high mode. Pin 1 can sink 25 milliamperes and can also be used to turn a PFET on that can provide Vdd power to peripheral circuits.

Resonator

A 4 MHz ceramic resonator of the type that has three pins and contains internal capacitors to minimize components is recommended for oscillator frequency control. 4 MHz Resonators are available from Digi-Key and from other distributors. A quartz crystal may also be used, however a 27 pf ceramic capacitor is required from each side of the crystal to ground.

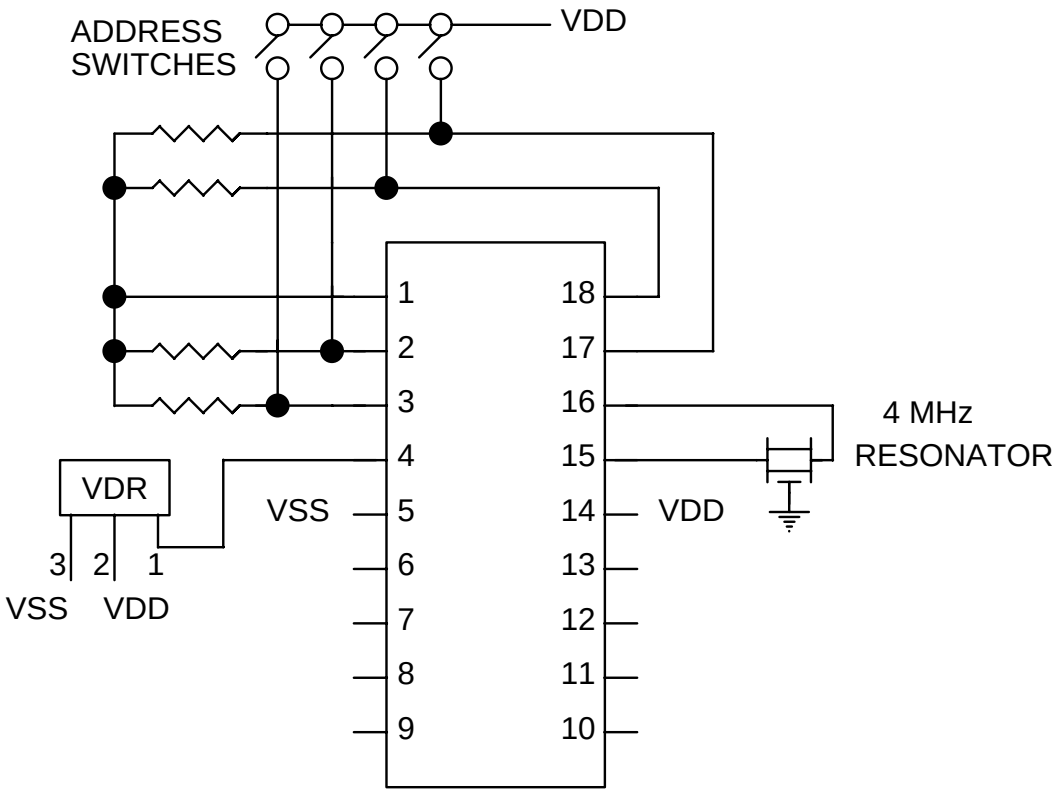


FIGURE 2

Power supply

The GL-104 can be powered with 5 volts from a battery or other power source. For completely fail safe operation under all conditions, a voltage detector reset (VDR) circuit that produces a brownout reset can be used as shown in figure 2. This guards against loss of memory data or unpredictable operation in a case where the power supply voltage momentarily drops but not low enough to produce an internal power on reset. A VDR made by Seiko, 80840CLY is available in a TO92 package from Mouser Electronics and Glolab .

New GL-104 devices are based on a microprocessor with a flash memory and can operate at VDD as low as 2 volts making a VDR device unnecessary, although one can still be used. Pin 4 should be connected to VDD if a VDR is not used.

A low dropout micropower voltage regulator such as the Seiko S812C50AY in a TO92 package, available from Mouser Electronics and Glolab is recommended for operating the encoder or decoder from a 9 volt battery.

Encoder_____

Function

Figure 3 shows the GL-104 configured an encoder. The encoder function is selected by connecting pin 7 to Vdd.

Input modes

Two different input modes are selectable by connecting pin 8 to either Vss or Vdd. The Vss connection causes the transmit enable and all four data in pins to be active high. The data pins do not initiate a transmit sequence in this mode. A high level must be placed on the transmit enable pin to initiate a transmit sequence and a high level on the data pins will produce a high level on the serial output pin that drives an RF module or infrared LED. Transmit enable and data in pins cannot be floating. They are usually driven by logic or other circuits in this mode.

When pin 8 is connected to Vdd the transmit enable and all data in pins are pulled up to Vdd by internal 200 microampere current sources and they become active low. In this mode a low level on either the transmit enable or on any data in pin will initiate a transmit sequence and will produce a high level on the serial output. The internal pullups in combination with active low and transmit initiate for each data in pin is convenient for use with push button switch inputs.

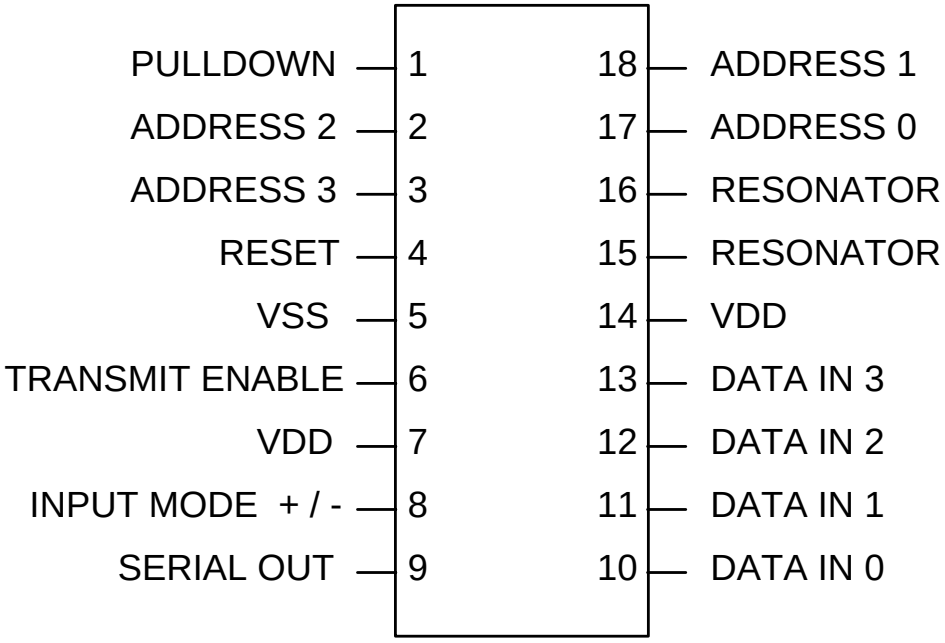


FIGURE 3

Serial output

The serial output generated by the encoder at pin 9 when a transmit sequence is initiated consists of three bytes. The first two bytes contain address bits and the third byte contains data bits. Address and data bytes are sent at least three times (one packet) when a transmit sequence is initiated regardless of how short a time transmit is enabled in either active high or active low modes. Transmission of these packets will repeat as long as transmit is enabled. The time required to send a packet is 20 milliseconds. The transmission rate is 5,000 bits per second.

Decoder_____

Function

Figure 4 shows the GL-104 configured as a decoder. The decoder function is selected by connecting pin 7 to Vss.

Serial input

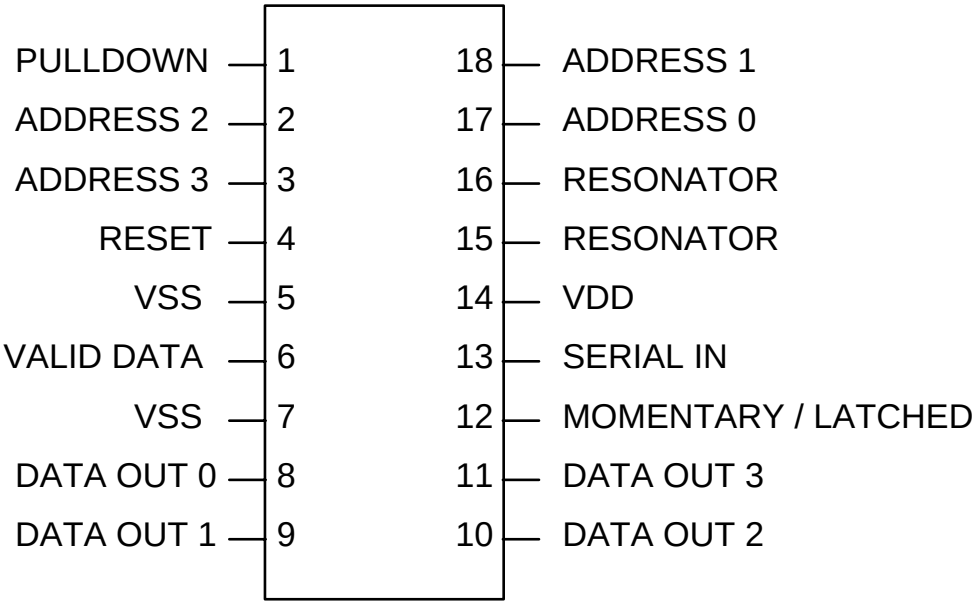
The address plus data packet of serial output generated by the encoder and sent by wireless, infra red or other means are fed into serial input pin 13 of the decoder. The packet is stored and the address bytes within it are compared to those of the decoder address pin settings. If the addresses match then the data is passed to the output pins.

Output modes

Two different output modes are selectable by connecting pin 12 to either Vss or Vdd. When pin 12 is connected to Vss all four data outputs become momentary and will produce output only for as long as valid data is being received. The valid data pin will output a momentary high level whenever a valid transmission is received even if all data bits are low.

When pin 12 is connected to Vdd all four data out pins latch their data. In this mode, if a high level appears on an output pin or pins it will remain there even after data is no longer being received. The outputs will not change state until new data is received. Latched outputs are cumulative. For example if a high level bit 1 is sent it will latch. Then if a high level bit 2 is sent, bit 1 will remain latched and bit 2 will also latch. All of the latched bits can be simultaneously reset to low levels remotely by sending all zero (low) bits. The valid transmit pin will, however, produce a momentary high level for as long as valid data is being received even if that data is all zeros. If pin 12 is connected to Vdd through a pullup resistor it can be pulled down by a push button switch at the decoder or by other means to reset all latched outputs to low.

The valid data pin and the output pins are each capable of both sourcing and sinking 25 milliamperes.



GL-104
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FIGURE 4

Basic transmitter

Figures 5 shows a basic implementation of the GL-104 as it is used with an RF transmit module. Although switches are shown in the diagram, the input mode is usually defined by the application and pin 8 can be hard wired to either Vss or Vdd. Address selection will not be necessary for many applications especially where only one RF transmitter pair will be used or for infrared remote control applications. For these applications all address pins can be hard wired to either Vss or Vdd. Where address selection is necessary, pulldown resistors to pin 1 can be used together with standard DIP switches that selectively connect address pins to Vdd.

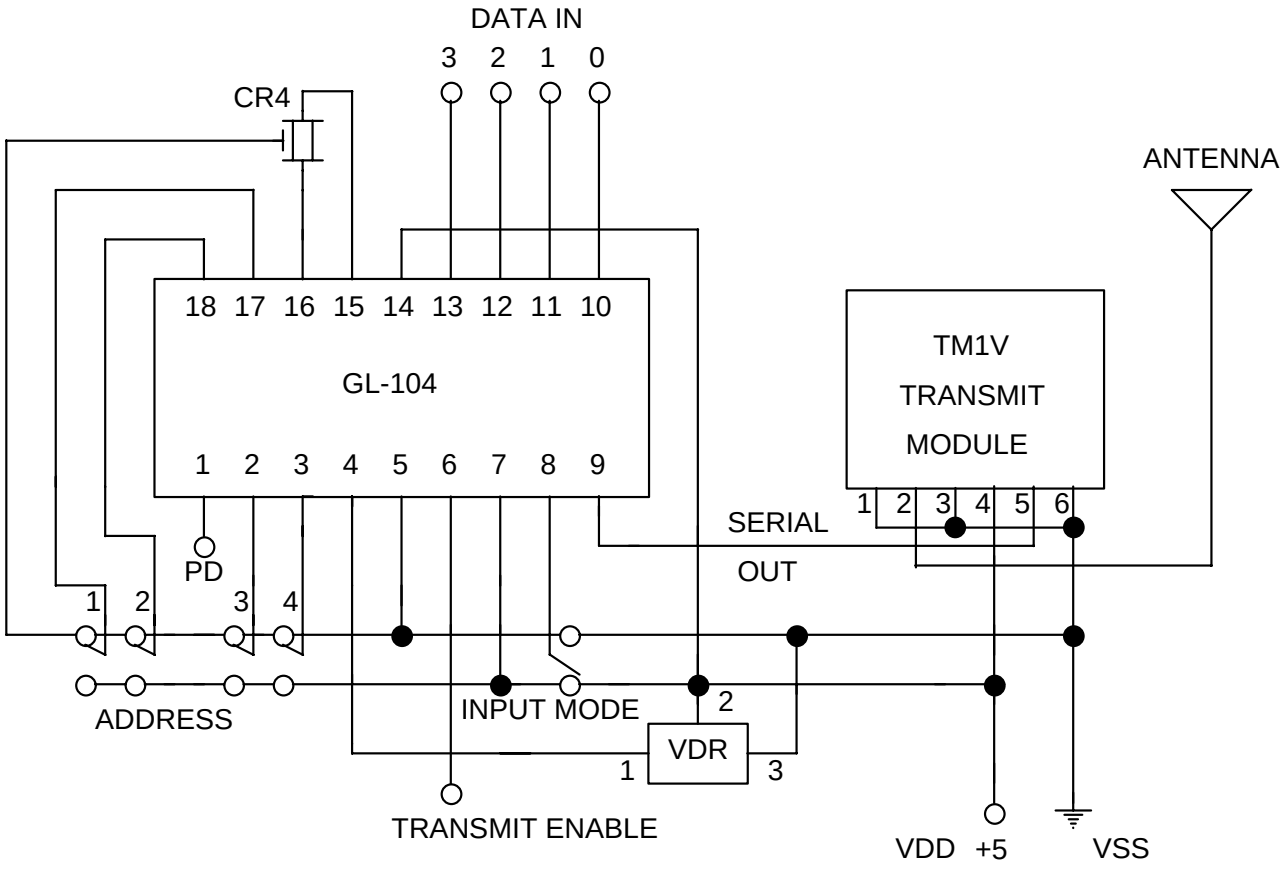


FIGURE 5

Basic receiver

Figures 6 shows a basic implementation of the GL-104 as it is used with an RF receive module The momentary or latched mode controlled by pin 12 is usually defined by the application so pin 12 can be hard wired to either Vss or directly or through a resistor to Vdd. Address pins should be set the same as in the transmitter.

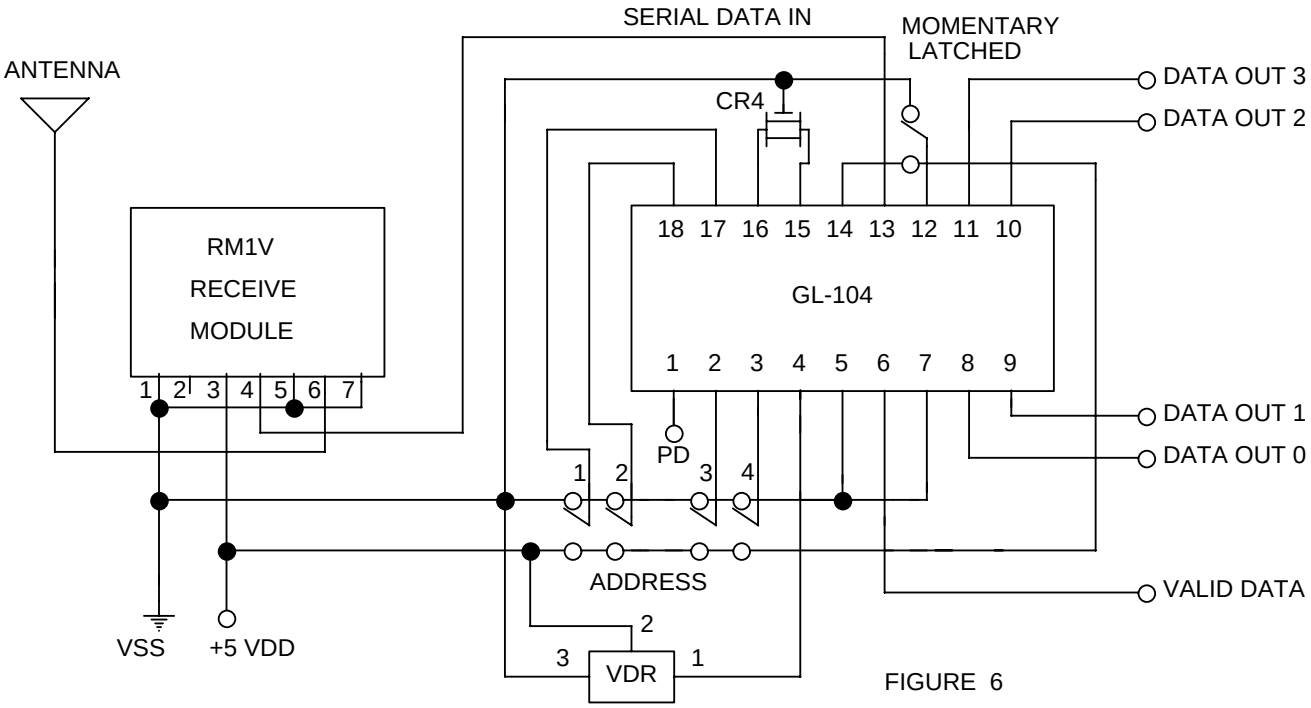


FIGURE 6

Specifications _____

Absolute maximum ratings

Ambient temperature under power ---------- -40° to + 125°
Storage temperature ---------- - 65° to +150°
Voltage on any pin with respect to Vss (except Vdd) ---------- -0.6 to Vdd + 0.6V
Voltage on Vdd with respect to Vss ---------- 0 to +7.5V
Input clamp current ---------- ±20 ma
Output clamp current ---------- ±20 ma
Maximum current sunk by an output pin ---------- 25 ma
Maximum current sourced by an output pin ---------- 25 ma

Standard operating conditions

PARAMETER	MIN	TYP	MAX	UNITS
Operating temperature	-20	+ 25	+ 70	°C
Supply voltage (Vdd)	4.5	5.0	5.5	V
Supply current (1)		3.5		ma
Power down standby current		1.0	2.5	μa
Reset voltage (2)	3.7	4.0	4.3	V
Pin 1 pulldown current			25	ma
Input leakage current			±1.0	μa
Input high voltage	2.0		Vdd	V
Input low voltage	Vss		0.8	V
Output high voltage (3)	Vdd -0.7			V
Output low voltage (4)			0.6	V
Output source current			25	ma
Output sink current			25	ma
Transmit enable pulse width (5)	100			ns
Transmit time - packet		20		ms
Transmit data rate		5000		bps

(1) Not including output loads or pullup resistors.
(2) Supplied by VDR device.
(3) Output current = 3 ma, Vdd = 4.5V
(4) Output current = 8.5 ma, Vdd = 4.5V
(5) Transmit enabled through pin 6, 10 -13

Applications _____

Although Glolab is not a parts distributor we stock some of the parts used in the following applications circuits that are also available from distributors so project builders can collect the necessary parts without having to buy from many distributors and pay multiple minimum quantity and shipping costs.

Glolab Parts list

The following are parts used in the applications circuits that are available from Glolab.

DESCRIPTION	PART NUMBER	SOURCE
Transmitter module	TM1V	Glolab
Receiver module	RM1V	Glolab
Encoder/Decoder	GL-104	Glolab
4 MHz ceramic resonator	CR	Glolab
Voltage detector/reset	VDR	Glolab

Distributor Parts list

The following are parts used in the applications circuits that are available from electronics parts distributors.

DESCRIPTION	MFG PART NUMBER	SOURCE PART NUMBER
4 MHz ceramic resonator	ECS ZTT-4.00MG	Digi-Key X902
	ECS ZTT-4.00MG	Mouser 520-ZTT400MG
	Panasonic EFOMC4004A4	Digi-Key PX400
Voltage detector/reset	Seiko S-80840CLY-B-G	Mouser 628-80840CLY-G
Voltage regulator LDO 5V	Seiko S-812C50AY-B-G	Mouser 628-812C50AY-G

Digi-Key 1-800-344-4539 http://www.digikey.com
Mouser 1-800-346-6873 http://www.mouser.com

Active low push button transmitter

Figures 7 is a complete push button transmitter that operates in the input active low mode. The circuit operates from a 9 volt battery through a 5 volt low dropout micropower regulator and uses only 3 microamperes of current when no buttons are being pressed. This design needs no resistors and only one capacitor. All address pins 2-3, 17-18 are shown connected to Vss but addresses may be changed by connecting some or all to Vdd. If only one transmitter - receiver pair will be used in an area, all pins can be as shown.

Pressing button 0 will activate the valid data pin in a decoder. Pressing 1-4 will activate valid data and one or more data out pins in a decoder. If the decoder has momentary outputs the data pins will remain active for as long as a button is pressed. If the decoder has latched outputs valid data will be momentary but data out pins will latch on. If multiple buttons are pressed then multiple decoder outputs will latch. Latched outputs can be reset by pressing button 0.

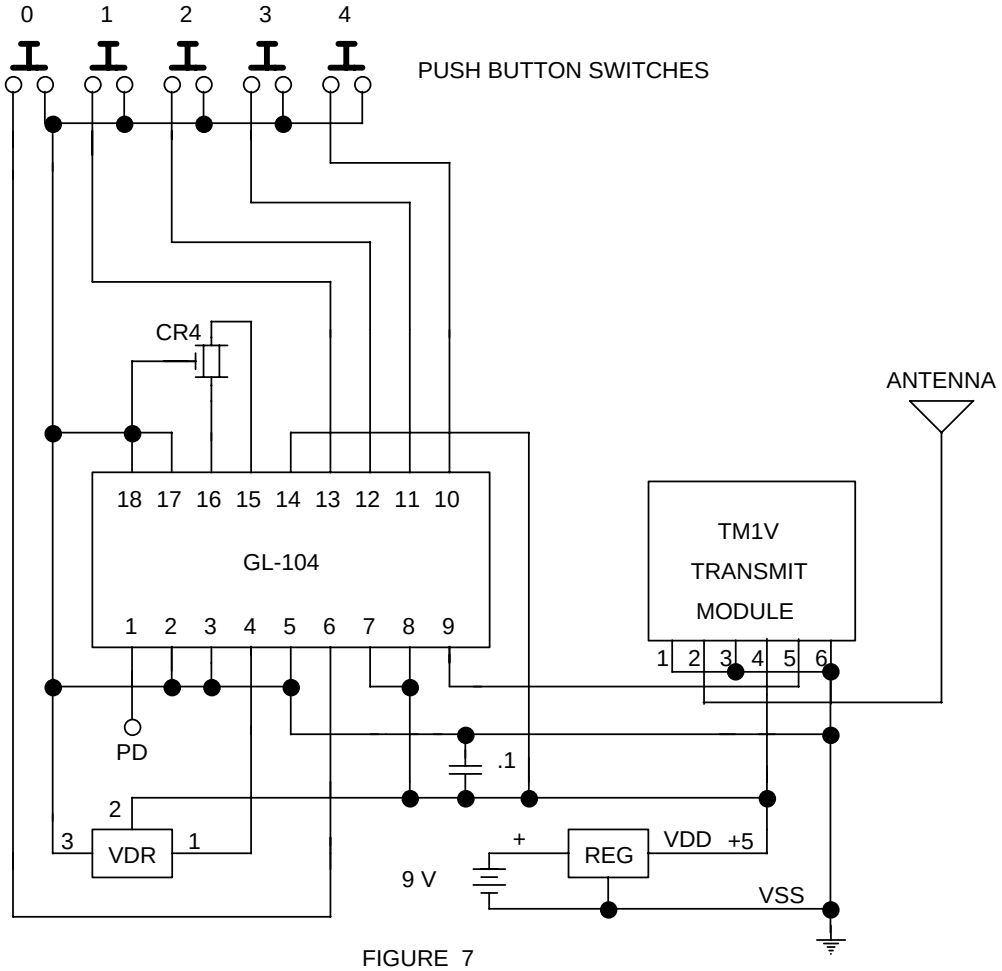


FIGURE 7

Active high push button transmitter

Figures 8 is a complete push button transmitter that operates in the active high input mode. This design also uses only three microamperes of standby current even though it has pulldown resistors on its input pins to allow the use of single throw DIP switches to set the input data pattern. This low standby current is achieved by connecting the pulldown resistors to pin 1 which is open during standby and pulls down to Vss only when the circuit is active. All address pins 2-3, 17-18 are shown connected to Vss but addresses may be changed by connecting some or all to Vdd. Input data is set by DIP or other switches and the data is transmitted when the transmit enable button is pressed.

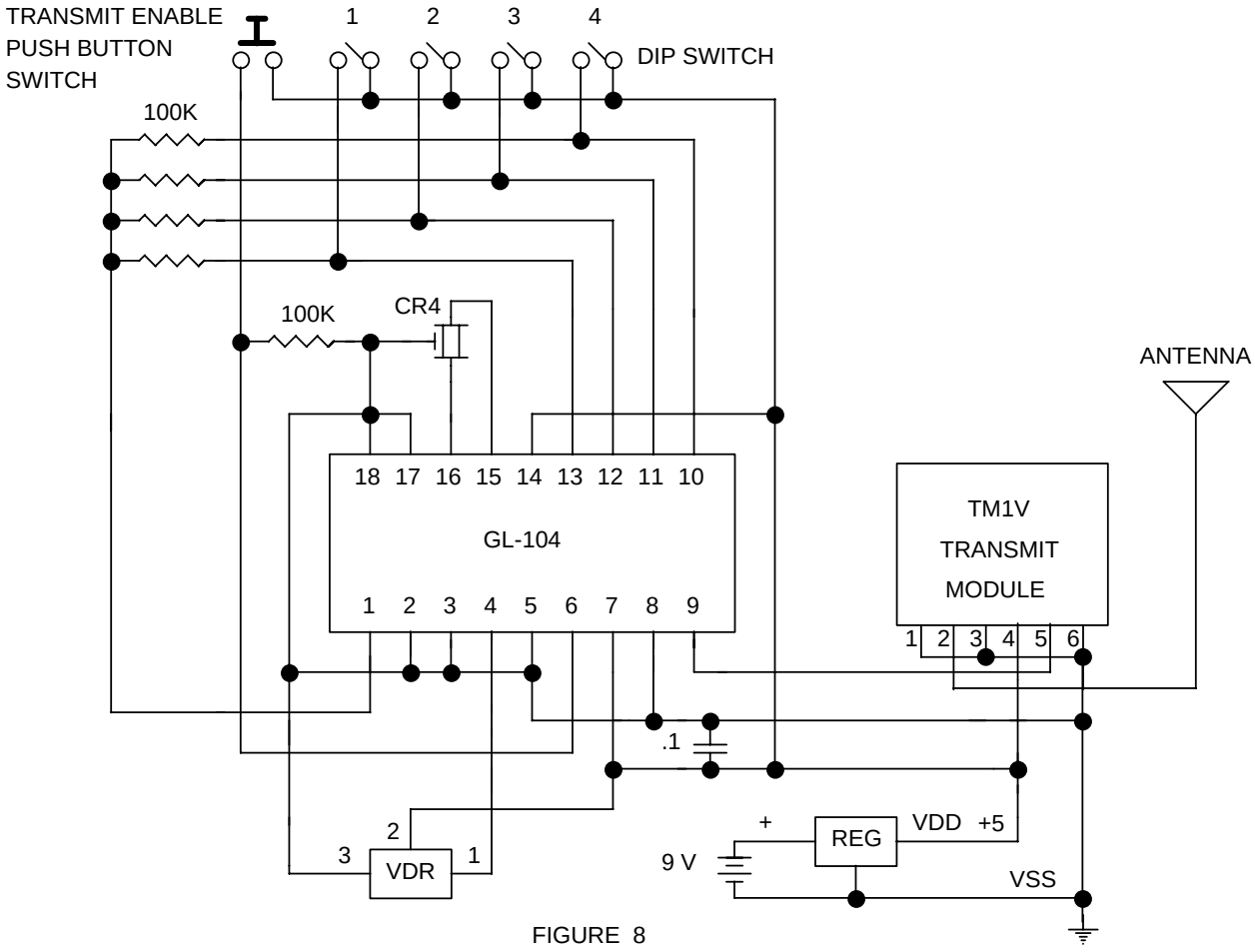


FIGURE 8

High input sensitivity transmitter

Figures 9 is a complete transmitter with high impedance and both normally closed and normally open inputs. A switch or other input device connects from NO to ground or from NC to ground. If the NO input is used, the NC input must be jumpered to ground. Only 1 microampere of current is required to pull the inputs down to ground making this circuit useful for photo transistor, moisture detector and other sensitive types of input devices.

All address pins 2-3, 17-18 are shown connected to Vss but addresses may be changed by connecting some or all to Vdd. Input data is set by DIP or other switches and the data is transmitted whenever the NO input is closed or the NC input is opened. Momentary data is sent even if the NC input remains high or the NO input remains low after an input transition. Transmit time is controlled by the 1 MEG resistor and .1 mfd capacitor time constant.

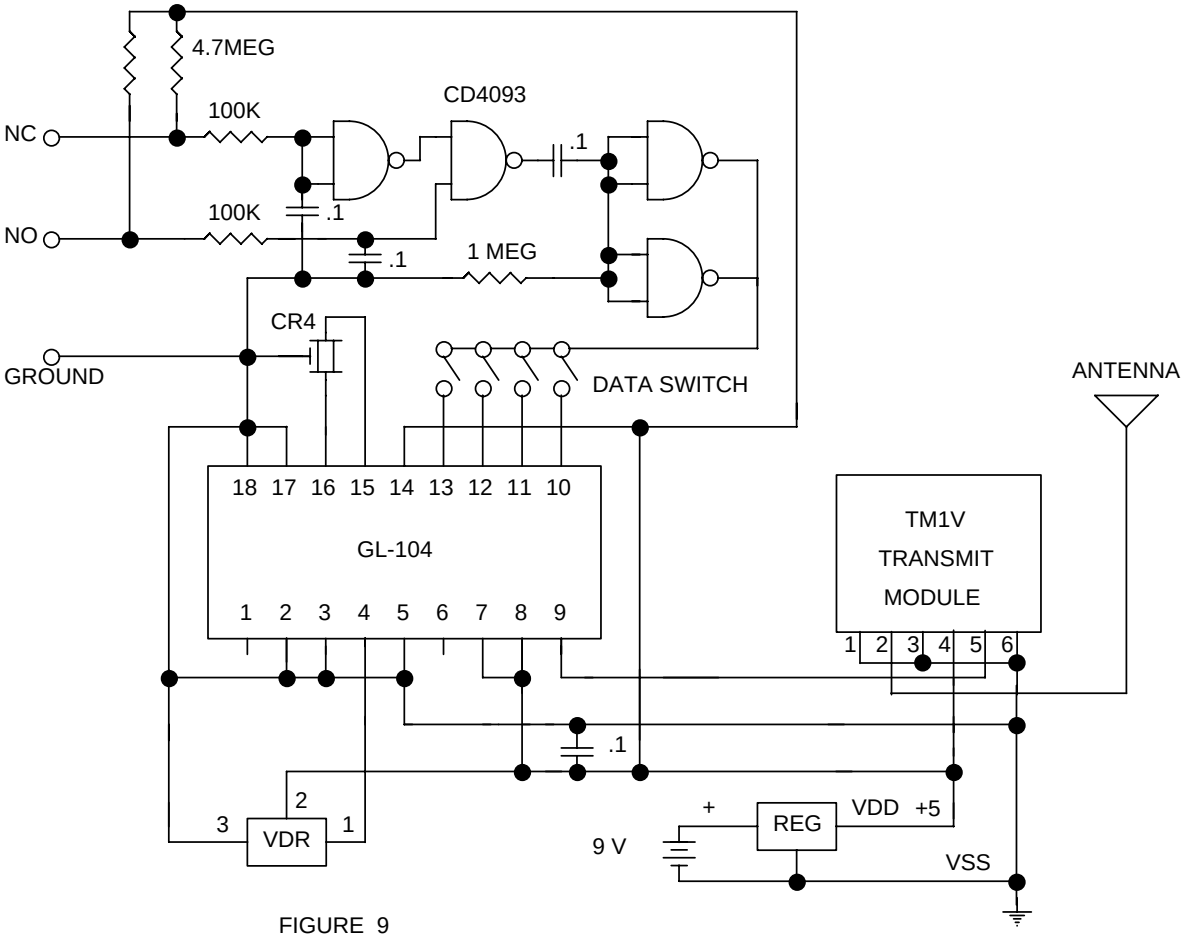


FIGURE 9

Latched output receiver

Figures 10 is a complete receiver circuit having cumulatively latched outputs. LEDs can be driven directly from this decoder since it is capable of sourcing up to 25 milliamperes at each output. The LEDs can be latched on individually or simultaneously from one transmitter or individually from up to four transmitters (simultaneous transmission from multiple transmitters is not allowed). They will remain latched on until remotely reset by an all zero (low) transmission or until they are reset by the reset button at the receiver.

This is useful to record up to four separate events that occur while the LED display is not being viewed. An application example is a transmitter located at a mailbox to signal that the postman has opened the box. A Piezo buzzer sounds an alarm whenever data is being received to alert someone that an event is occurring. The responsible transmitter or transmitters can then be identified by the LEDs that are on. The LEDs can be replaced by solid state relays to control 120 volt AC loads such as a coffee pot, toaster and radio,

All address pins 2-3, 17-18 are shown connected to Vss but addresses may be changed by connecting some or all to Vdd. Power is supplied by a 12 volt wall transformer and regulated down to 5 volts by a 7805 regulator.

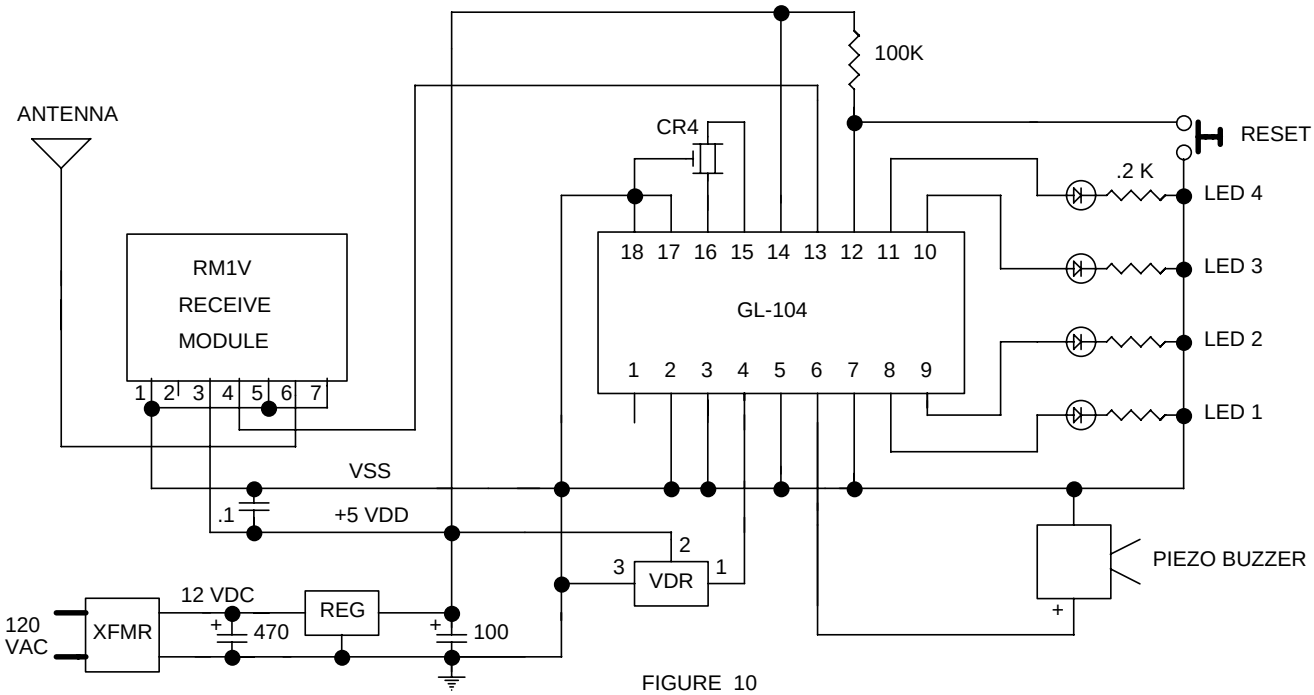


FIGURE 10

Momentary output receiver

Figures 11 is a complete receiver circuit having momentary outputs. The decoder drives IRL510 power FETs in TO220 packages that can sink 5 amperes to power relays or loads directly. Higher power FETs may be used for heavier loads if desired. The momentary function can be used for wireless control of machinery or any device that has to be energized while a remote control button is being pressed. Output 0 will be on whenever any other data pin is on. The other outputs may be energized either individually or simultaneously.

All address pins 2-3, 17-18 are shown connected to Vss but addresses may be changed by connecting some or all to Vdd. Power is supplied by a 12 volt wall transformer and regulated down to 5 volts by a 7805 regulator.

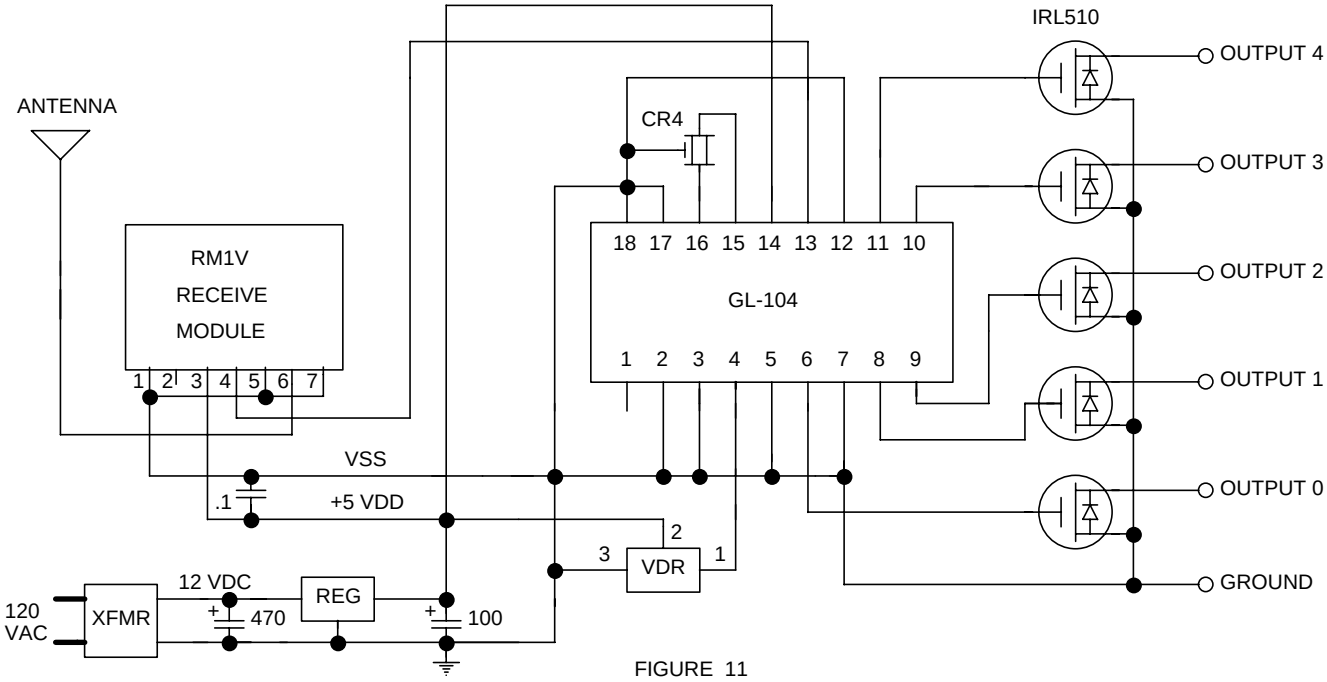
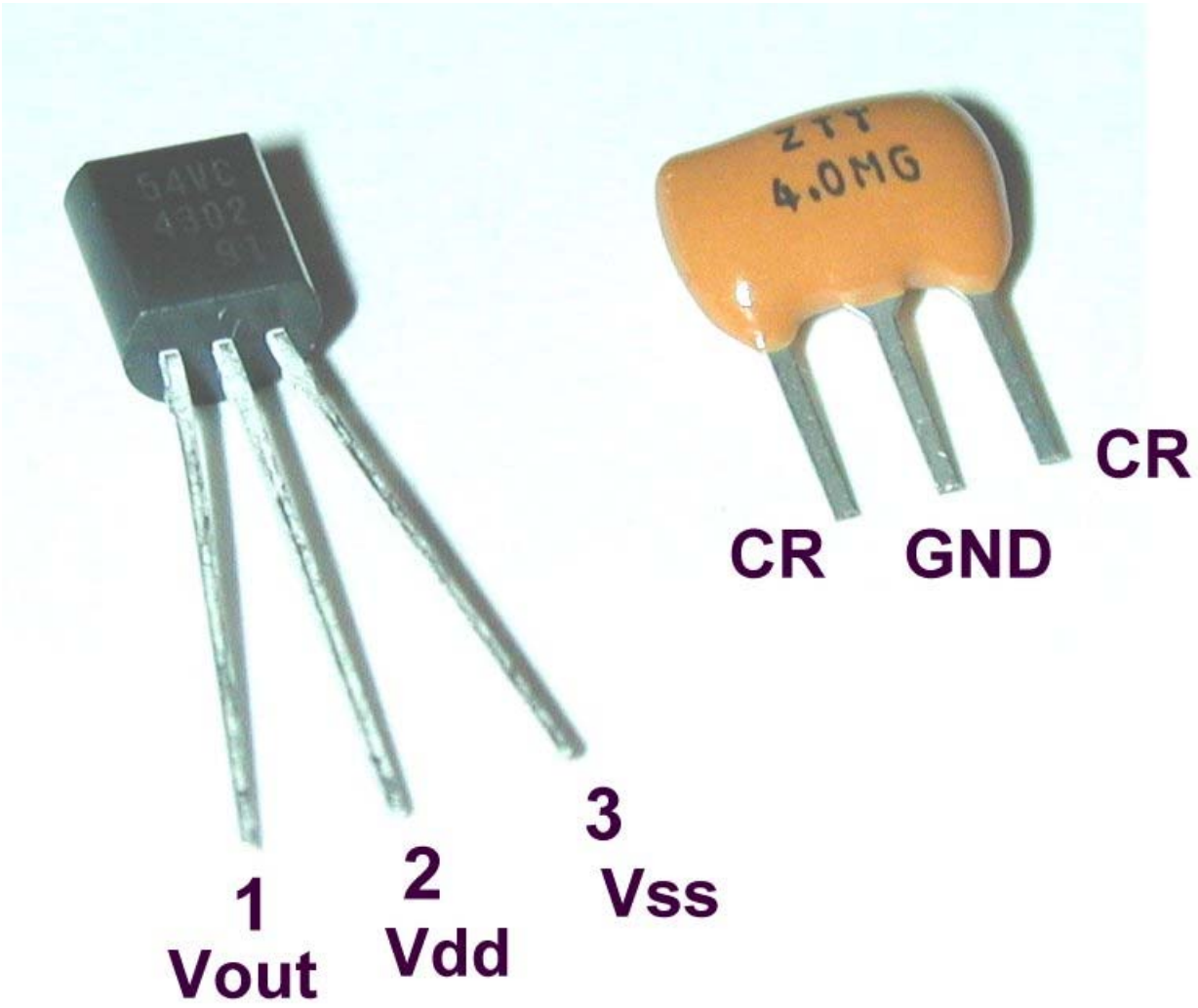


FIGURE 11



VDR and CR4 pin assignments

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