GL116

ENCODER/DECODER MANUAL

GLOLAB
CORPORATION

Thank you for buying our GL116 Encoder / Decoder Module. This device was developed in response to many requests for an encoder and decoder that would serialize and de-serialize sixteen bits of data. Typical applications are remote control of machinery and special effects.

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

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_____

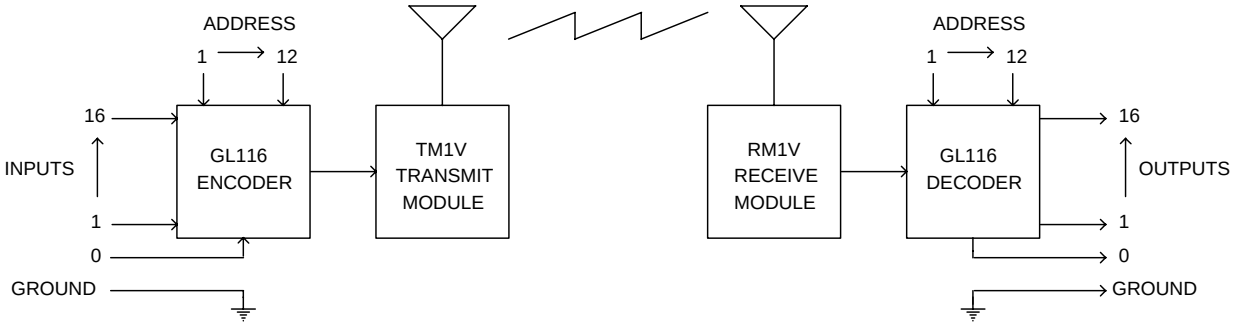
The radio frequency spectrum is filled with noise and other signals, especially those frequencies where unlicensed transmitter operation under FCC part 15 rules is allowed. When using a wireless remote control system it is desirable to have a way of filtering out or ignoring those unwanted signals to prevent false data from activating your control circuits. One way to accomplish this is to use an encoder IC that automatically generates serial coded addresses and data at the transmitter and a decoder IC that deserializes and decodes the addresses and data at the receiver. The addresses 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 GL116

- **One chip can be used as either an encoder or decoder**
- **Uses only 1 microampere of standby current**
- **4096 selectable addresses**
- **16 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 with active low trigger input**
- **Decoder**
    - **momentary data outputs**
    - **sequentially latched data outputs**
    - **outputs source and sink 25 milliamperes**

The Glolab GL116 Encoder/Decoder is housed in a 40 pin Plastic Dual Inline Package (PDIP) or a 44 pin Thin Quad Flat Pack (TQFP) package. It is microprocessor based and is designed for use with wireless RF 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 sixteen bits of data and has twelve address bits for a total of 4,096 addresses.



BOLCK DIAGRAM OF TYPICAL TRANSMITTER AND RECEIVER

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 high on a transmit enable pin and in another mode the encoding can be active low initiated by a low on a transmit enable pin (the level on this mode pin cannot be changed while the circuits are active or in standby - they must be powered down). 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 GL116 maintains continuous reception of transmitted data even if some data bits change during transmission. Unlike some decoders that produce a momentary interrupt of all received data when any transmitted data bit changes, the GL116 will continue to receive unchanged data bits without interruption. For example, if bits 1 and 2 are being transmitted and bit 1 is turned off, bit 2 will continue to be received without interruption. This is an important feature in the remote control of multi-function machinery.

The GL116 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 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 40 pin PDIP 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.

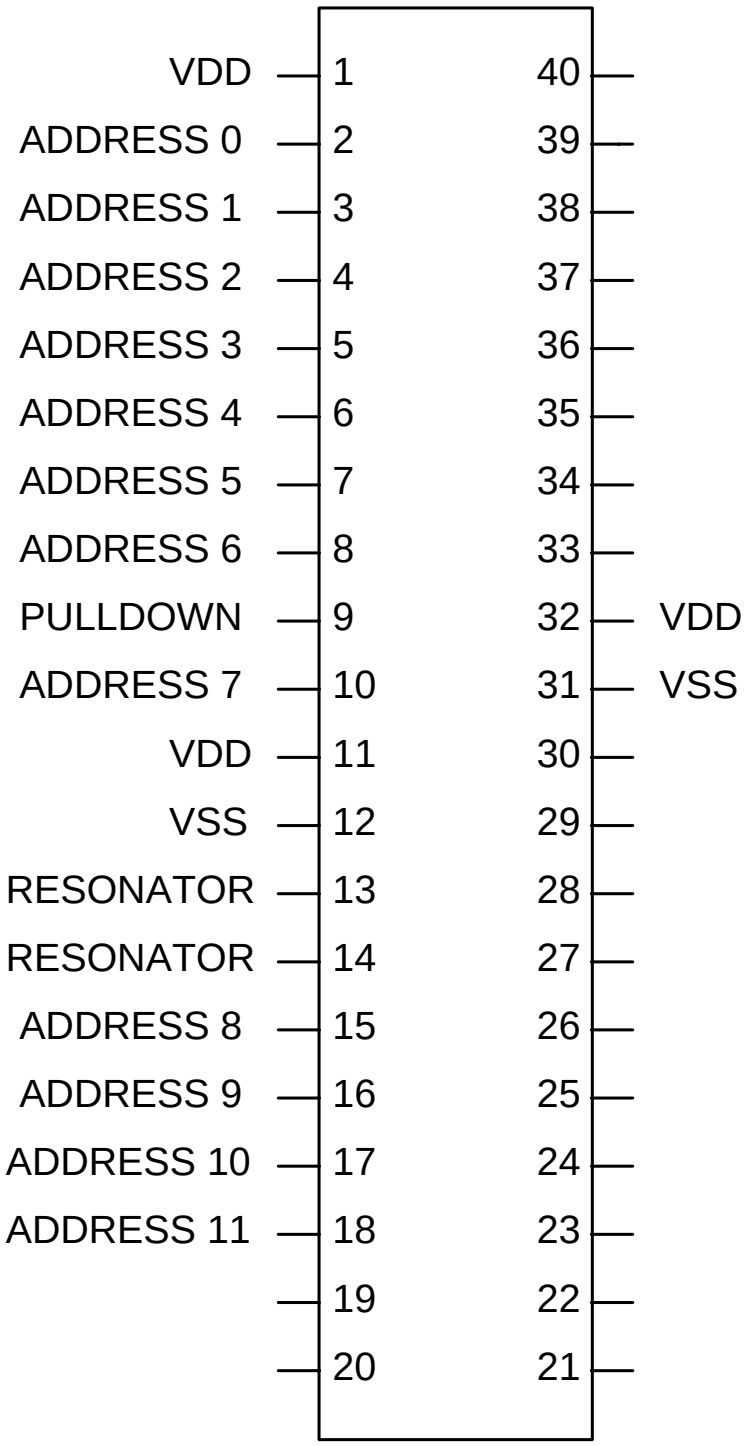

VDD 1
ADDRESS 0 2
ADDRESS 1 3
ADDRESS 2 4
ADDRESS 3 5
ADDRESS 4 6
ADDRESS 5 7
ADDRESS 6 8
PULLDOWN 9
ADDRESS 7 10
VDD 11
VSS 12
RESONATOR 13
RESONATOR 14
ADDRESS 8 15
ADDRESS 9 16
ADDRESS 10 17
ADDRESS 11 18
19
20
40
39
38
37
36
35
34
33
32 VDD
31 VSS
30
29
28
27
26
25
24
23
22
21

FIGURE 1

Addressing

There are 12 address pins that can be used to select 4,096 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, a 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 9 is a switched pulldown that goes down to Vss only while the circuit is active and goes high 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 9 when the circuit is active. Pulldown resistors connected to closed switches use no power when pin 9 is high during standby. This allows the use of standard single throw DIP switches. Pulldown resistors that are returned to pin 9 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 9 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. Resonator connections are shown in figure 2.

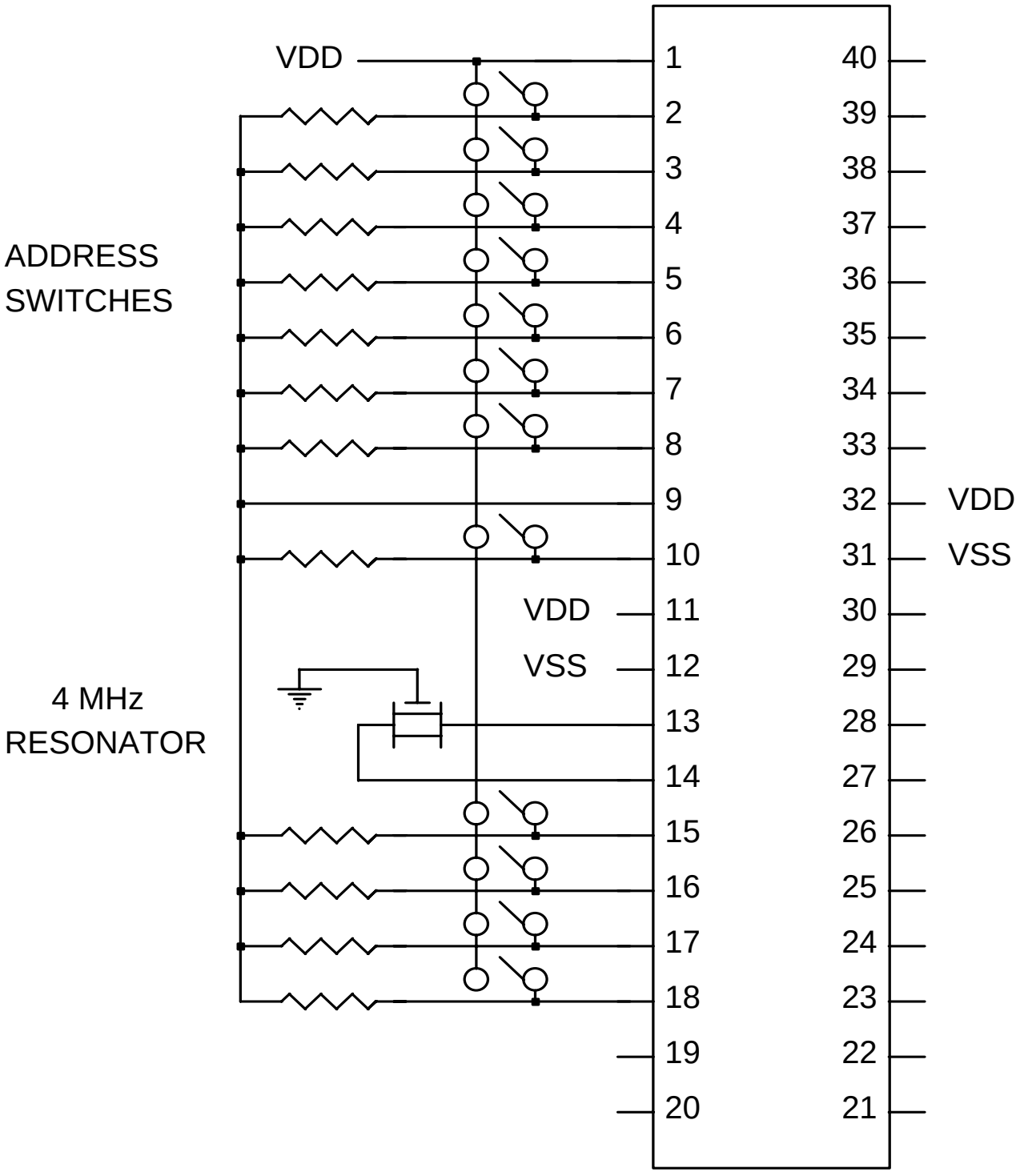

VDD
ADDRESS
SWITCHES
4 MHz
RESONATOR
VDD
VSS
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
40
39
38
37
36
35
34
33
32
31
30
29
28
27
26
25
24
23
22
21
VDD
VSS

FIGURE 2

Power supply

The GL116 can be powered with 5 volts from a battery or other power source. A 5 volt low dropout micropower voltage regulator such as the Seiko S812C50AY in a TO92 package, available from Mouser Electronics is recommended for operating the encoder or decoder from a 9 volt battery.

Encoder_____

Function

Figure 3 shows the GL116 configured an encoder. The encoder function is selected by connecting pin 19 to Vdd.

Input modes

Two different input modes are selectable by connecting pin 20 to either Vdd or Vss. The Vdd connection causes the transmit enable and all sixteen data in pins to be active high. A low to high level transition on the transmit enable pin will initiate a transmit sequence A high level on a data input pin will produce a high level on the corresponding serial output data bit that drives an RF transmitter module or infrared LED. Transmit enable is also a zero bit. A low to high transition on this pin alone will send zero data. To send a bit other than zero, both transmit enable and the input pin to be sent must go high. For example, to send a 1, both data in 1 and transmit enable must go high. This can be accomplished by connecting diodes from each data input pin to transmit enable as shown in the applications circuit of figure 7.

When pin 20 is connected to Vss the transmit enable and all data in pins become active low. A high to low transition on the transmit enable pin will initiate a transmit sequence and a low level on any data in pin will produce a high level on the corresponding serial data output Bit. The active low function is convenient for use with push button switch inputs when one end of each button is grounded.

Transmit enable is transition activated. An enabling transition must occur after power is applied to the GL116 in order to start a transmission. Transmit enable and data input pins cannot be floating. They are usually driven by logic or other circuits in this mode. When switches are used for inputs, pullup or pulldown resistors can be used with push button or toggle switches to provide a high or low state when the switches are open.

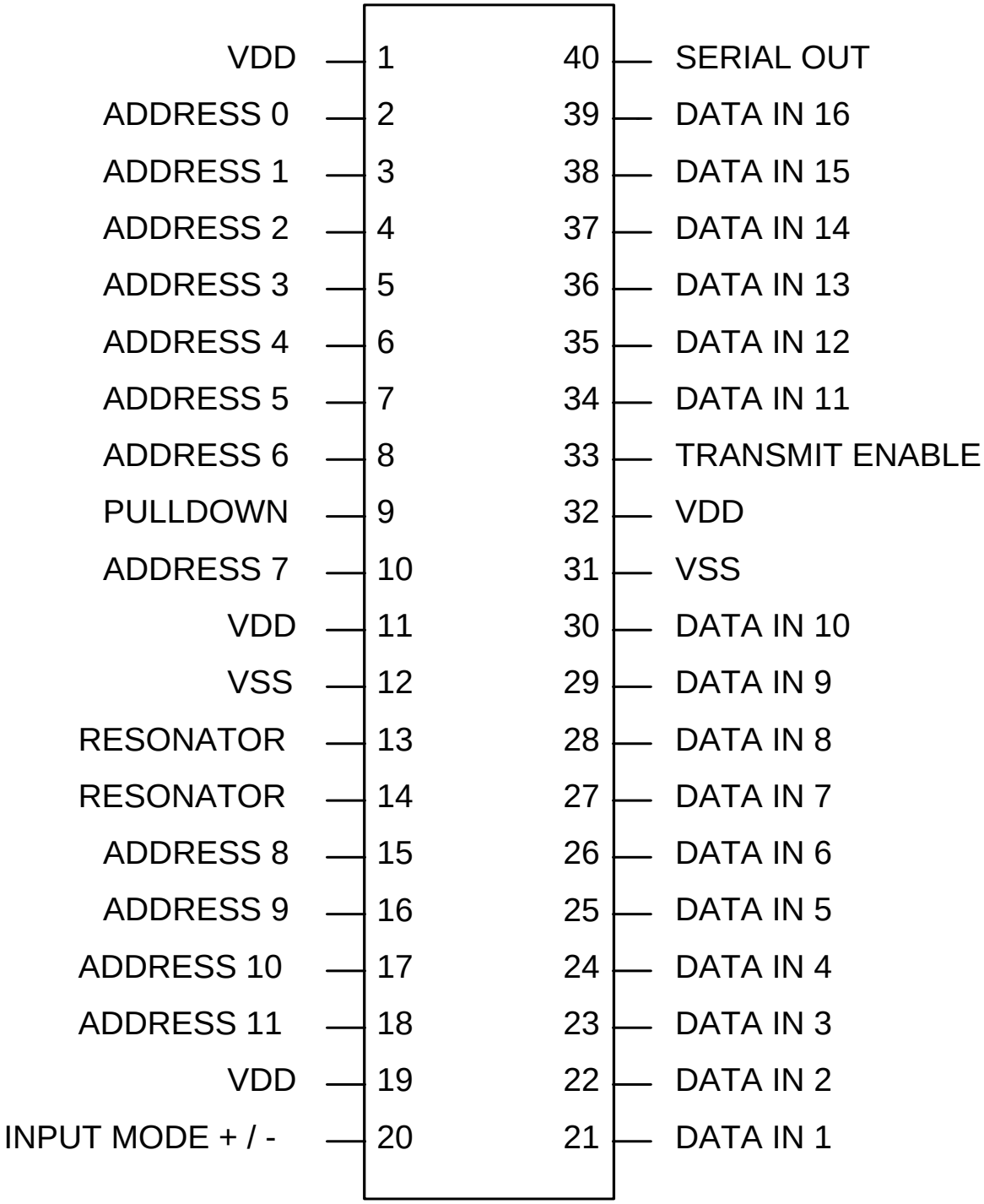

VDD 1
ADDRESS 0 2
ADDRESS 1 3
ADDRESS 2 4
ADDRESS 3 5
ADDRESS 4 6
ADDRESS 5 7
ADDRESS 6 8
PULLDOWN 9
ADDRESS 7 10
VDD 11
VSS 12
RESONATOR 13
RESONATOR 14
ADDRESS 8 15
ADDRESS 9 16
ADDRESS 10 17
ADDRESS 11 18
VDD 19
INPUT MODE + / - 20
40 SERIAL OUT
39 DATA IN 16
38 DATA IN 15
37 DATA IN 14
36 DATA IN 13
35 DATA IN 12
34 DATA IN 11
33 TRANSMIT ENABLE
32 VDD
31 VSS
30 DATA IN 10
29 DATA IN 9
28 DATA IN 8
27 DATA IN 7
26 DATA IN 6
25 DATA IN 5
24 DATA IN 4
23 DATA IN 3
22 DATA IN 2
21 DATA IN 1

FIGURE 3

Serial output

The serial output generated by the encoder at pin 40 when a transmit sequence is initiated consists of four bytes. The first two bytes contain address bits and the second two contain 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 about 30 milliseconds. The transmission rate is 5,000 bits per second.

Decoder

Function

Figure 4 shows the GL-116 configured as a decoder. The decoder function is selected by connecting pin 19 to Vss.

Serial input

The address + data packet of serial output generated by the encoder and sent by wireless, infra red or other means are received by an RF receiver module, photo transistor or other receiving device and fed into serial input pin 40 of the decoder. The packet is stored and the groups of address bytes within it are compared with the decoder address pin settings, usually set by DIP switches. The three groups of address and data bytes within the packet are compared with each other and if at least two groups match and if the received address matches the switch settings, the data is passed to the output pins.

Output modes

Two different output modes are selectable by connecting pin 20 to either Vdd or Vss. When pin 20 is connected to Vdd the valid data pin and all sixteen data outputs become momentary and will produce output only for as long as valid data is being received.

When pin 20 is connected to Vss all sixteen 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 sequential. For example if a high level bit 1 is sent it will latch high. Then if a high level bit 2 is sent, bit 1 will go low and bit 2 will go high. If multiple bits are sent simultaneously, all received bits will latch high. All of the latched bits can be reset to low levels remotely by sending a zero bit.

The valid data pin will produce a momentary high level for as long as valid data is being received even if that data is a zero. The valid data pin and the output pins are each capable of both sourcing and sinking 25 milliamperes.

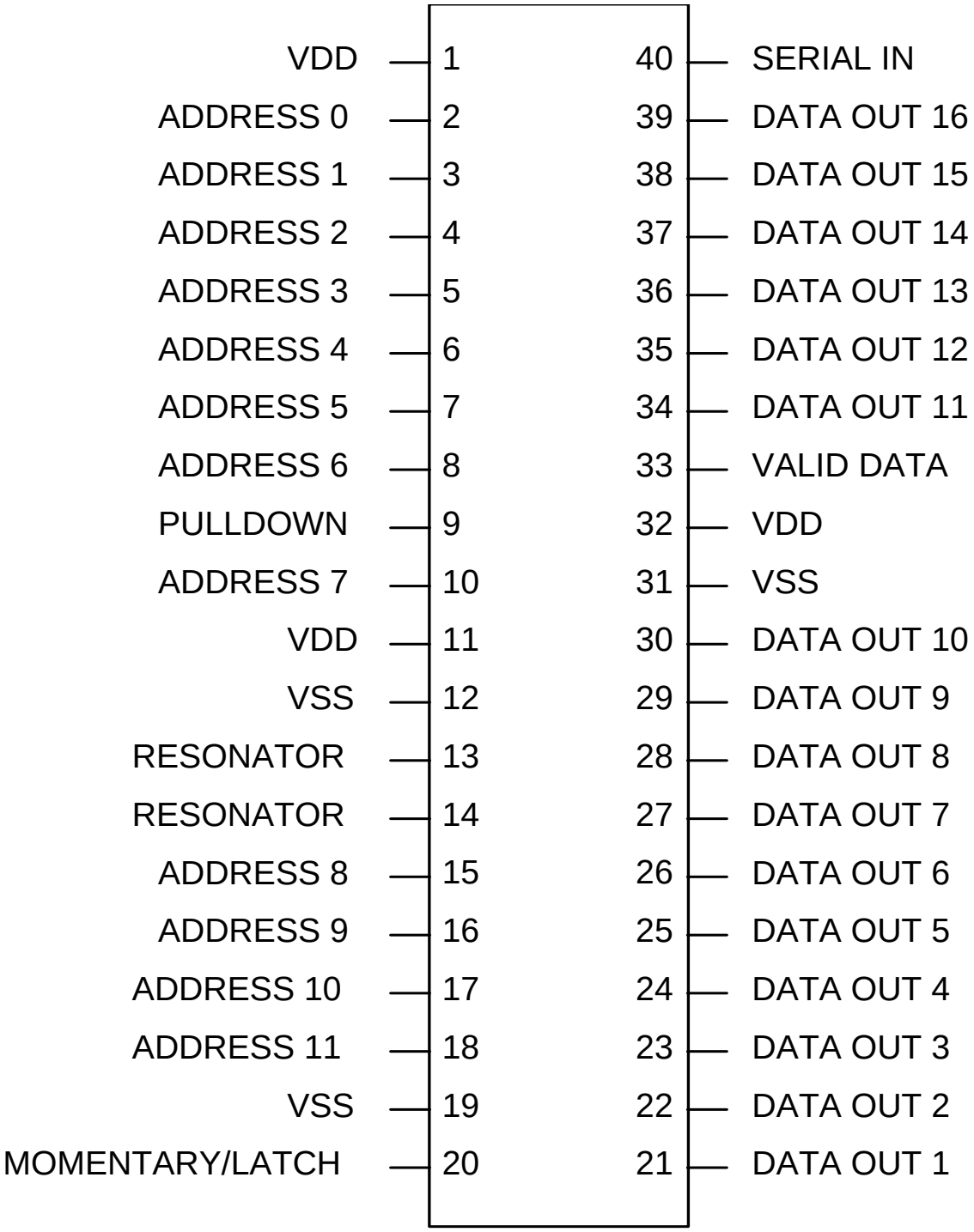

VDD 1
ADDRESS 0 2
ADDRESS 1 3
ADDRESS 2 4
ADDRESS 3 5
ADDRESS 4 6
ADDRESS 5 7
ADDRESS 6 8
PULLDOWN 9
ADDRESS 7 10
VDD 11
VSS 12
RESONATOR 13
RESONATOR 14
ADDRESS 8 15
ADDRESS 9 16
ADDRESS 10 17
ADDRESS 11 18
VSS 19
MOMENTARY/LATCH 20
40 SERIAL IN
39 DATA OUT 16
38 DATA OUT 15
37 DATA OUT 14
36 DATA OUT 13
35 DATA OUT 12
34 DATA OUT 11
33 VALID DATA
32 VDD
31 VSS
30 DATA OUT 10
29 DATA OUT 9
28 DATA OUT 8
27 DATA OUT 7
26 DATA OUT 6
25 DATA OUT 5
24 DATA OUT 4
23 DATA OUT 3
22 DATA OUT 2
21 DATA OUT 1

FIGURE 4

Basic transmitter

Figures 5 shows a basic implementation of the GL116 as it is used with an RF transmit module. The input mode is usually defined by the application and pin 20 can be hard wired to either Vss for active low input mode or Vdd for active high input mode. It is shown wired to Vdd for active high mode. 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 the address pins that are shown hard wired to Vss can be wired to either Vss or Vdd. Where address selection is necessary, pulldown resistors to pin 9 can be used together with standard DIP switches that selectively connect address pins to Vdd.

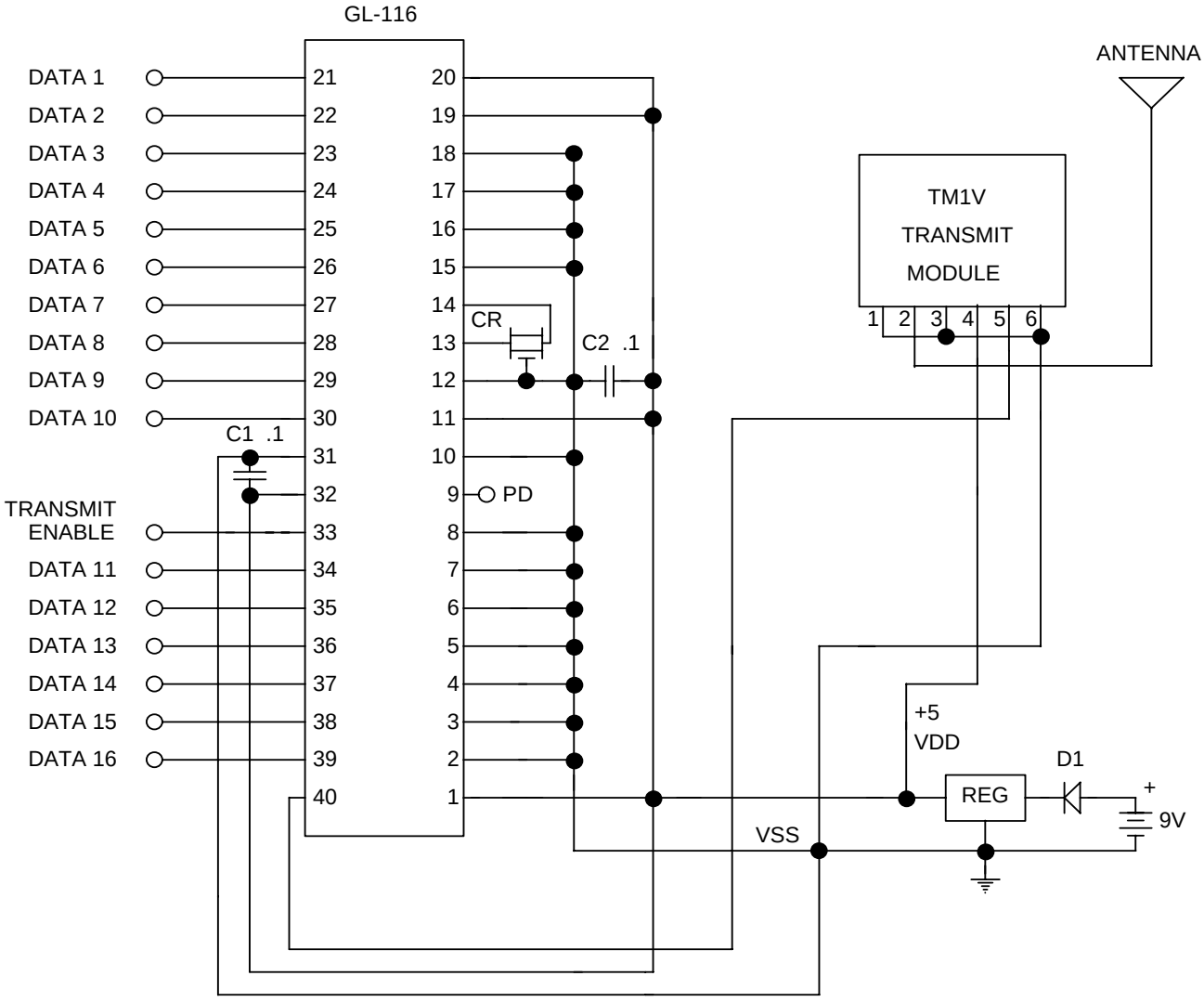


FIGURE 5

Basic receiver

Figures 6 shows a basic implementation of the GL116 as it is used with an RF receive module. The selection of latched or momentary mode controlled by pin 20 is usually defined by the application so pin 20 can be hard wired to either Vss or directly or through a resistor to Vdd. Figure 6 shows it wired to Vdd for momentary mode. Address pins can be connected to Vss or Vdd. They are all wired to Vss to match the transmitter connections of figure 5. Each data output can source or sink 25 milliamperes but the total simultaneous currents must not exceed 200 milliamperes.

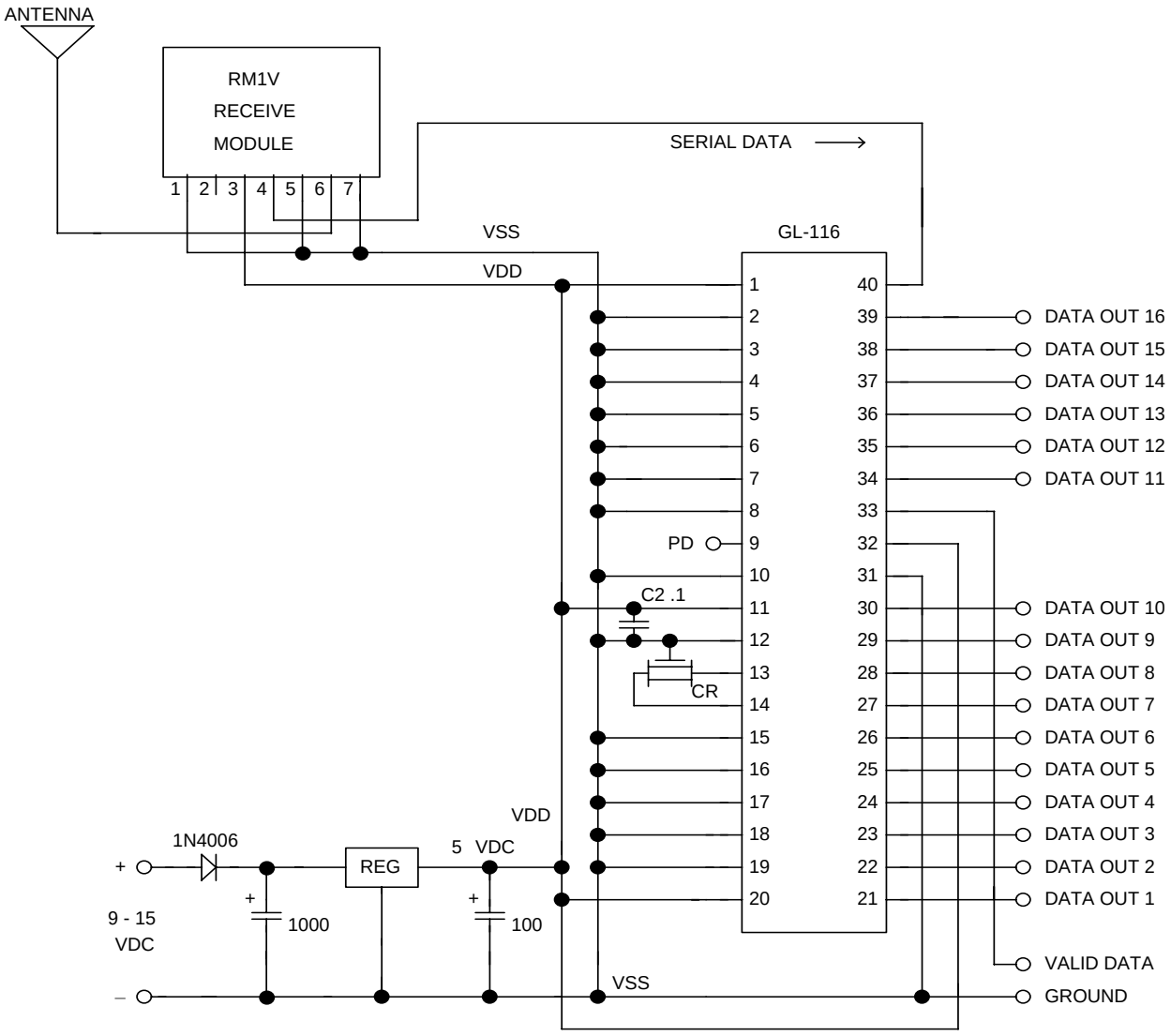


FIGURE 6

GL116 versions_____

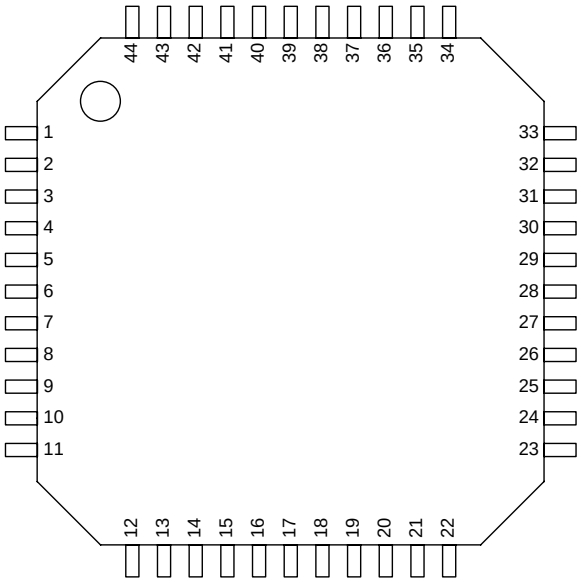
GL116PDIP

Gl116 in a 40 pin Plastic Dual Inline Package (PDIP) for through hole or socket mounting.

GL116TQFP

Gl116 in a 44 pin surface mount Thin Quad Flat Pack (TQFP).

GL116 IN TQFP PACKAGE



DIP TO TQFP PIN TRANSLATION TABLE

TQFP PINS 12, 13, 33, 34 NOT USED, NO CONNECTION (NC)

DIP PIN	TQFP PIN	DIP PIN	TQFP PIN	DIP PIN	TQFP PIN	DIP PIN	TQFP PIN
1	18	11	28	21	40	31	6
2	19	12	29	22	41	32	7
3	20	13	30	23	42	33	8
4	21	14	31	24	43	34	9
5	22	15	32	25	44	35	10
6	23	16	35	26	1	36	11
7	24	17	36	27	2	37	14
8	25	18	37	28	3	38	15
9	26	19	38	29	4	39	16
10	27	20	39	30	5	40	17

Specifications _____

Absolute maximum ratings

Ambient temperature under power ---------- -40° to + 125°
Storage temperature ---------- - 65° to +150°
Voltage on any pin (except Vdd) with respect to Vss ---------- -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 9 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	100			ns
Transmit time - packet		30		ms

(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

Applications

Although Glolab is not a parts distributor we stock some of the parts used in the 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	GL116PDIP	Glolab
Encoder/Decoder	GL116TQFP	Glolab
4 MHz ceramic resonator	CR4	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 regulator LDO 5V	Seiko 812C50AY	Mouser 628-812C50AY

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

Active high push button transmitter

Figures 7 is a complete push button transmitter that operates in the input active high mode. The circuit operates from a 9 volt battery and uses only 3 microamperes of current when no buttons are being pressed. All address pins can be set by a 12 position DIP switch giving 4,096 possible addresses.

Pressing button 0 will activate the valid data pin in a receiver. Pressing 1-16 will activate valid data and one or more data out pins in a receiver. Multiple buttons may be pressed to send up to 16 bits simultaneously. Latched receiver outputs can be reset by pressing button 0

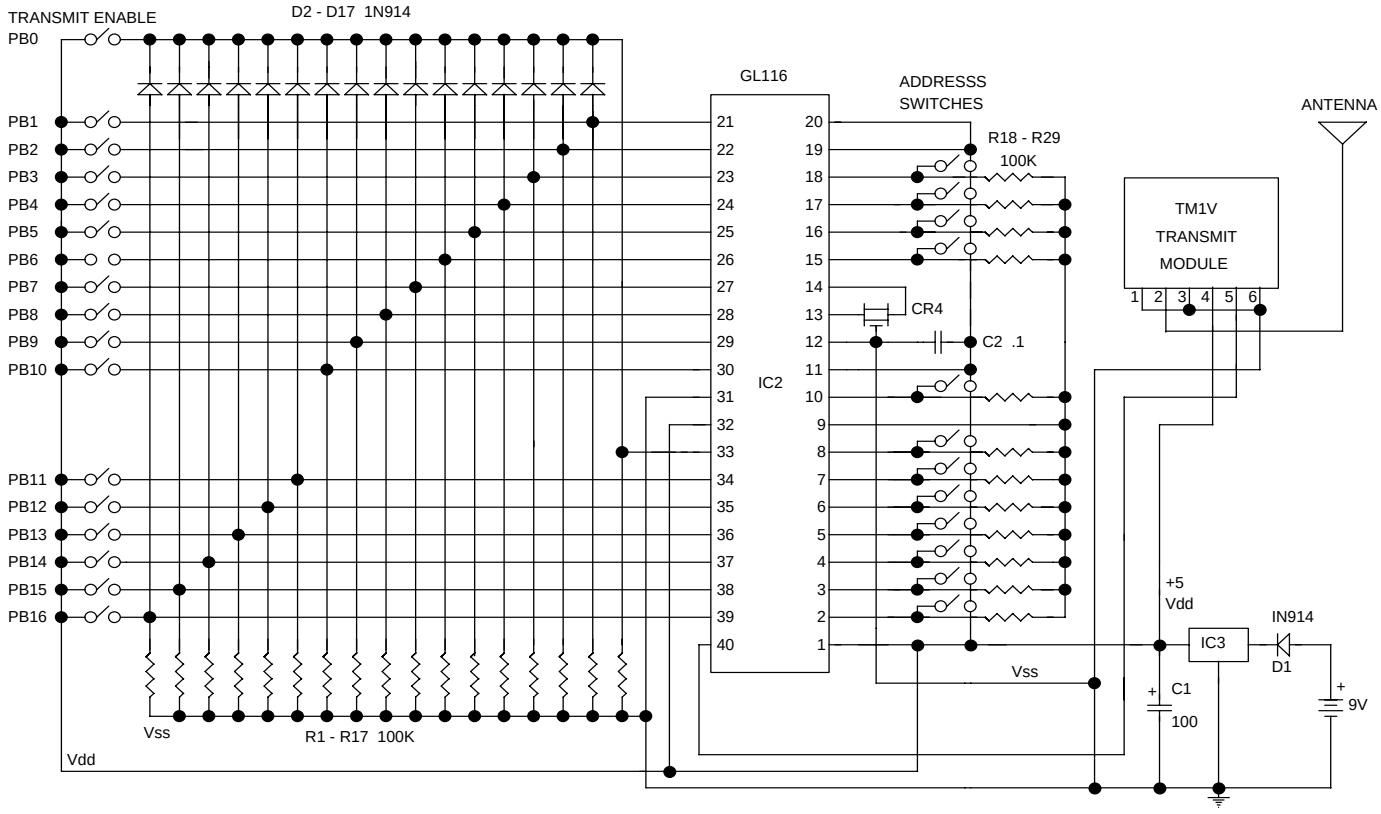


FIGURE 7

Momentary output receiver

Figures 8 is a complete receiver circuit having momentary outputs. The decoder drives open collector bipolar transistors in TO92 packages that can sink 200 milliamperes to power relays or other loads directly. 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. The Valid Data LED will be on whenever any other data pin is on. The data outputs may be energized either individually or simultaneously. Outputs may be operated in the latched mode by connecting pin 20 to Vss. Latched outputs can be reset from the transmitter by sending a zero bit.

The twelve address switches should be set the same as in the transmitter encoder. Power may be supplied by a 12 volt wall transformer and regulated down to 5 volts by a 7805 regulator IC3.

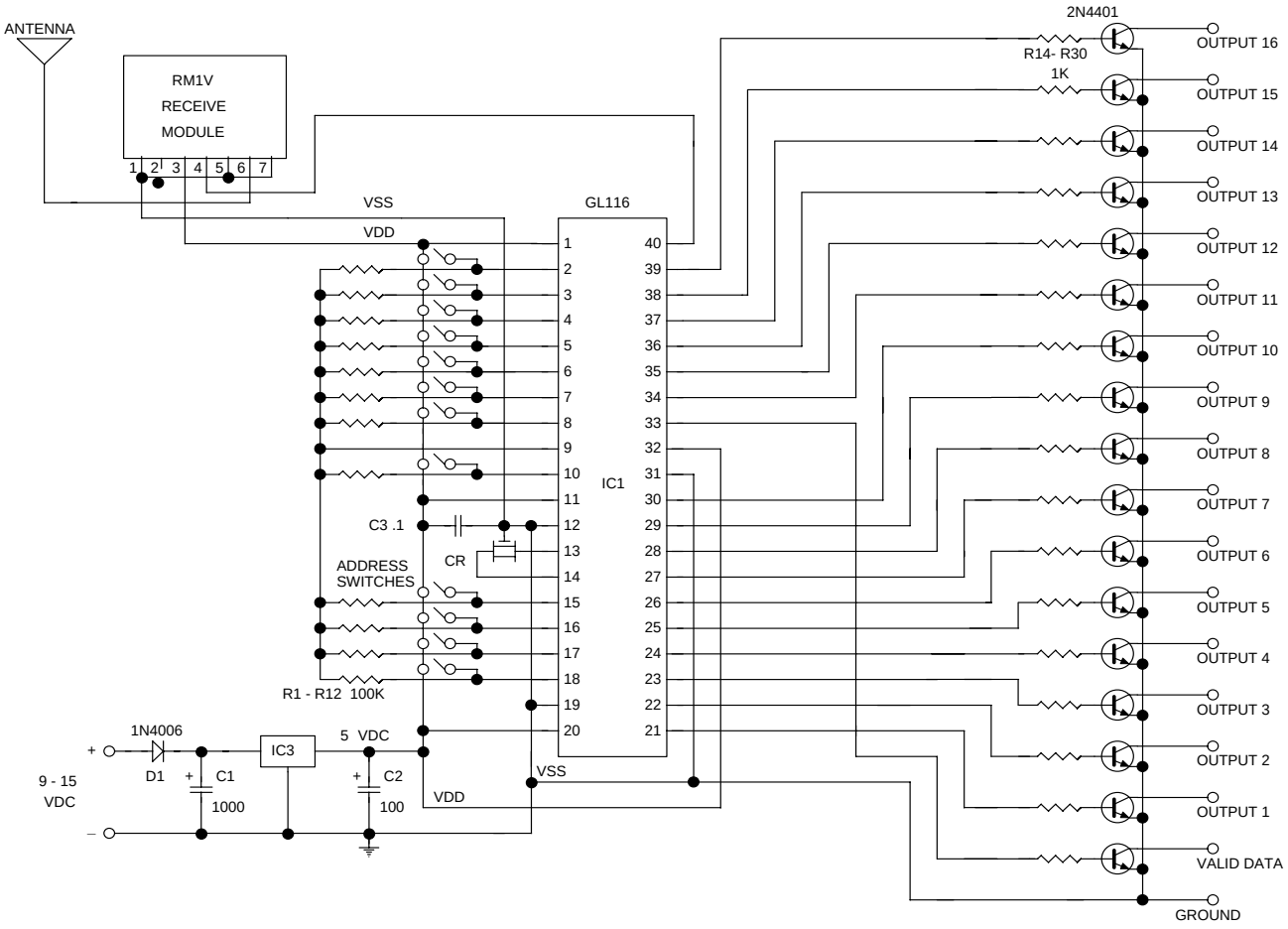
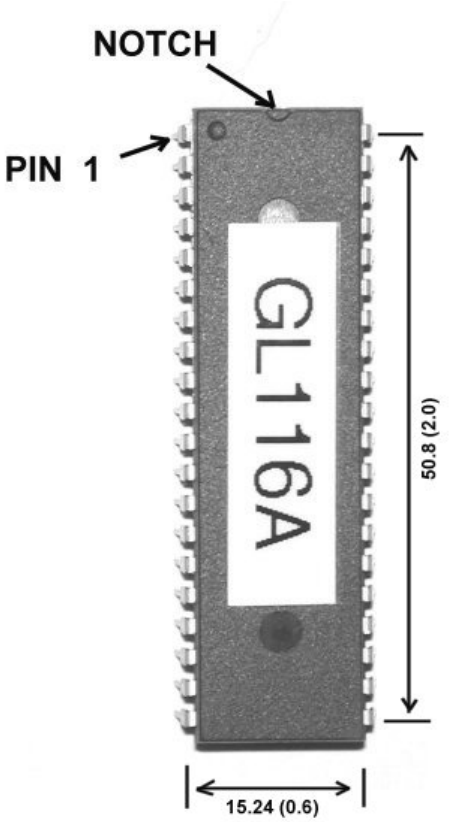
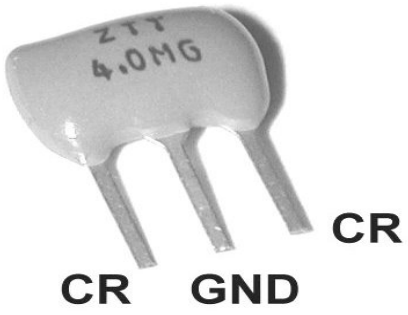


FIGURE 8





CR4

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