



16 FUNCTION

TRANSMITTER MODULE

GF16TMB

RECEIVER MODULE

GF16RMB

GLOLAB
CORPORATION

Thank you for buying our Wireless GF16 Transmitter and Receiver modules.

Glolab Corporation started in business in 1994. We are located in New York's Mid Hudson valley about 75 miles north of Manhattan. The goal of Glolab is to produce top quality electronic products and components. All of our electronic devices are designed by our engineers and tested in our Wappingers Falls laboratory. Mechanical devices, prototypes and enclosures are fabricated in our precision machine shop in Wappingers Falls.

A GF16 transmitter and receiver can be used for applications as simple as operating a remote doorbell or as complex as simultaneous triggering of multiple special effects, for robot control, or for the remote control of multi-function machinery. The latch feature allows up to 16 lights or other devices to be remotely turned on and off individually. You need add only a battery, antenna and a push button switch to transmit a signal for a remote doorbell (fig 4, page 15).

The GF16RMB receiver outputs can directly drive up to 16 light emitting diodes, piezo buzzers or any loads that draw 25 milliamperes or less. When used with relays, you can drive large motors, high wattage lights and solenoids for special effects, robot control, and other applications.

The line of sight outdoor range of these modules is more than 500 feet (150 meters) when used with ¼ wavelength long whip antennas (3 inches) (76.2mm).

GF16 modules are designed for remote control applications only. You cannot feed high-speed serial data into a GF16TMB transmitter module and it will not transmit audio or video.

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

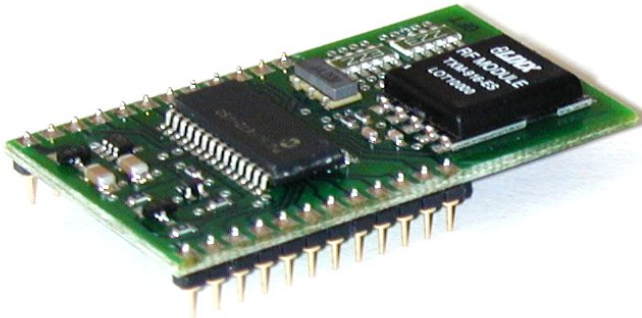
NOTICE:

The Federal Communications Commission has not certified these modules. Any product that they are used in must be submitted to a qualified testing laboratory and FCC certified before it can be sold. These modules operate at a frequency that is shared by many other users and must accept interference that may come from other sources. They should not be used in any application where loss of communication might result in injury or damage. It is the buyer's responsibility to determine legality of use outside the USA.

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Glolab Corporation
307 Pine Ridge Drive
Wappingers Falls, NY 12590

TRANSMITTER

RECEIVER



GF16TMB transmitter module

L = 2.0" (50.8mm)
W = 1.2" (30.48mm)
H = 0.2" (5.08mm)

GF16RMB receiver module

L = 2.0" (50.8mm)
W = 1.2" (30.48mm)
H = 0.23" (5.84mm)

Modules are supplied with 0.019 inch (0.483mm) diameter, 0.125 inch (3.17mm) long pins on 0.1 inch (2.54mm) centers for plugging into single in-line sockets. The pins can also be inserted through holes and soldered into a PC board.

Ultra low profile single in-line socket strips are available from Digi-Key Corporation, 1-800-344-4539. They can also be ordered on-line at www.digikey.com. The Digi-Key part number is ED7964. The socket strips, made by Mill-Max have 64 sockets but can be cut to the required lengths of 3 and 12 sockets using a utility knife. The sockets will fit in 0.035 inch (0.89mm) diameter PC board holes.

Ordering Information:

GF16TMB
GF16RMB

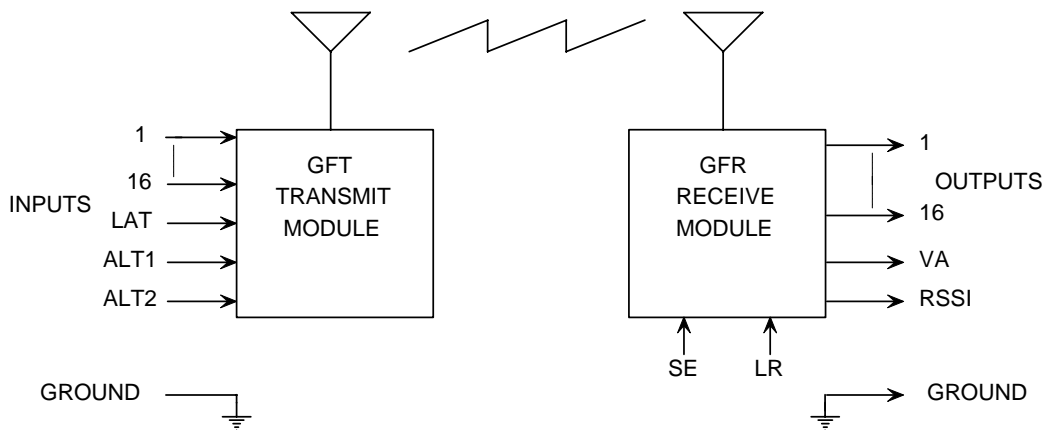
Transmitter module
Receiver module

Introduction_____

The GF16TMB Transmitter and GF16RMB Receiver have been designed as modular units for wireless remote control applications. They provide 16 transmit and 16 receive functions, or up to 64 functions with one transmitter and four receivers. A GF16TMB transmitter and GF16RMB receiver can send and receive up to 16 control bits individually or in any combination including all 16 bits simultaneously. Receiver outputs can be momentary or can be individually latched and unlatched. The modules use FSK modulation and operate at 916 MHz where continuous and unlicensed transmission is allowed.

Grounding one or more transmitter inputs starts a transmission. The transmitter then sends pre-programmed access codes to the receiver that can learn any GF16TMB transmitter access code. There are no address switches to set in either the transmitter or receiver. The purpose of the access code is to control access by transmitters to receivers, however this is not a high security system since the transmitter codes are preset for each transmitter and cannot be changed. When a transmission starts, access codes are sent first and are followed by data that contains control functions. Any voltage of from 4.8 to 15.5 volts DC may power the transmitter. The power source may be AAA, AA or lithium coin cells or a 9 or 12 volt battery.

The GF16RMB receiver is a superhetrodyne with a SAW filter and LNA for improved selectivity and sensitivity. A board mounted push button places the receiver in access code learn mode. Receiver outputs can source and sink up to 25 milliamperes each. A received signal strength output is available for driving an external circuit to indicate the relative strength of a received signal and a valid data output indicates that valid data is being received. The receiver module must be powered by a regulated and filtered 5 volt DC source.



BLOCK DIAGRAM OF GFT AND GFR

Features of the GF system

Transmitter

- 16 data inputs
- Transmits up to 16 commands simultaneously
- Alternate modes extend commands to 64
- Momentary and latched modes
- Pre- programmed access codes – no switches to set
- Can be powered by any voltage from 4.8 to 15.5 volts DC
- Reverse polarity protected
- Less than 5 microamperes standby current
- 916 MHz, FSK modulation – continuous transmission allowed
- Short antenna – only 3 inches (76.2mm) for full $\frac{1}{4}$ wavelength whip
- Small size, low profile

Receiver

- Superhetrodyne with SAW filter, LNA front end
- 16 data outputs
- Receives up to 16 commands simultaneously
- Outputs may be momentary or may be cumulative or sequentially latched
- Outputs source and sink up to 25 milliamperes each
- Valid data output indicates valid data is being received
- RSSI output to measure received signal strength
- Can learn and store up to 32 transmitter access codes
- Powered by 5 volts DC from external source
- Short antenna - only 3 inches (76.2mm) for full $\frac{1}{4}$ wavelength whip
- Small size, low profile

ABSOLUTE MAXIMUM RATINGS

PARAMETER	RATING	UNITS
Transmitter module power supply voltage	16.0	Volts
Voltage applied to any transmitter control input	5.3	Volts
Receiver module power supply voltage ^{1, 2}	5.2	Volts

Notes

1. Not reverse polarity protected
2. Must be regulated and well filtered

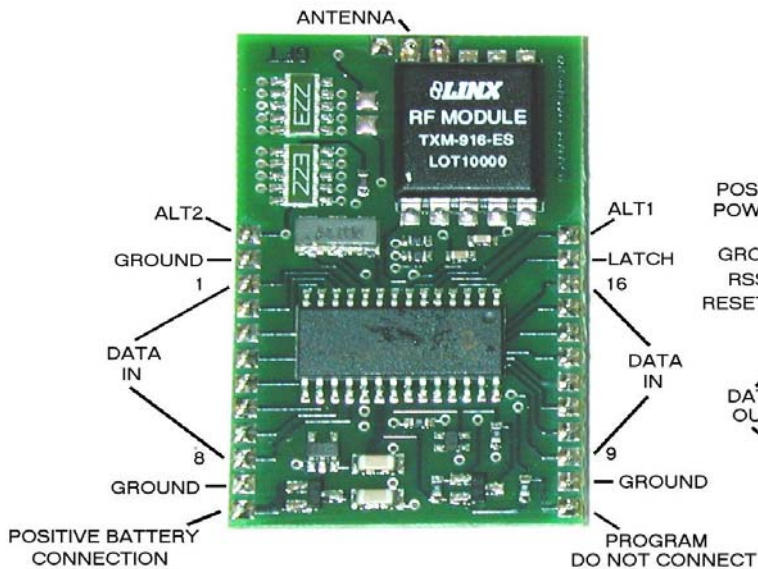
TYPICAL OPERATION

PARAMETER	MIN	TYPICAL	MAX	UNITS
Transmitter module power supply voltage ³	4.8	9.0	15.5	Volts
Transmitter module quiescent current	3	4	5	μA
Transmitter module low level input current	110	150	200	μA
Transmitter module Input device resistance ⁴	0	-	3000	Ohms
Transmitter input low level time ⁵	60	-	-	milliseconds
Transmitter input data transition rate ⁶	-	-	16	/second
Receiver module power supply voltage (Vdd) ⁷	4.9	5.0	5.1	Volts
Receiver module power supply current ⁸	8.5	9	9.5	mA
Receiver module output low level ⁹	0	-	.6	Volts
Receiver module output high level ⁹	Vdd - 0.7	-	Vdd	Volts
Receiver module output drive current ¹⁰	-	-	25	mA
Receiver module RSSI output ¹¹	1.1	-	2.3	Volts

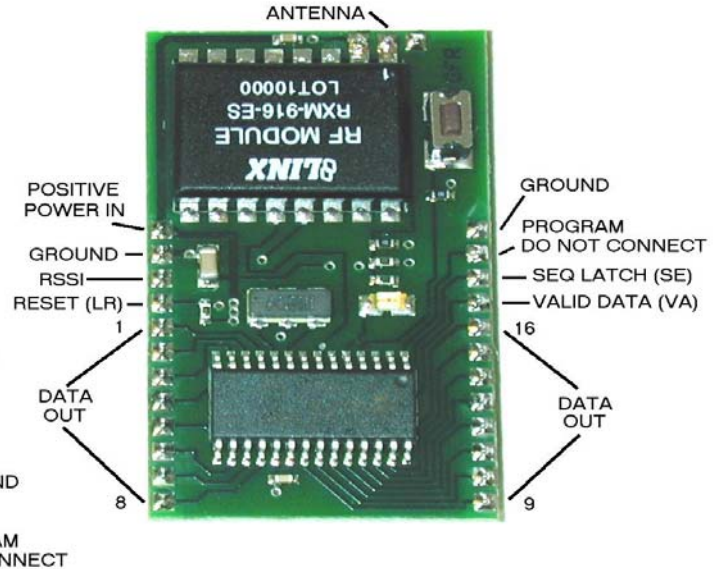
Notes

3. From battery or power supply. Reverse polarity protected
4. Maximum resistance from input to ground to pull an input to a logic 0 level
5. Minimum time that an input must be held low to send a complete data packet
6. Maximum number of times transmitter input can change state in 1 second
7. Must be regulated and well filtered. Not reverse polarity protected
8. With no external loads
9. With output load current = 8.5 mA
10. Each output. Maximum total for 16 outputs = 200 Milliamperes
11. Received Signal Strength Indicator

TRANSMITTER



RECEIVER



QUICK START

How to assemble a quick and easy wireless remote control system:

- **TRANSMITTER**

1. Connect a 3 inch long wire to the antenna terminal
2. Connect a 9 volt battery to the positive and negative battery terminals
3. Connect a toggle switch or push button switch to data in 1 and ground

- **RECEIVER**

1. Connect a 3 inch long wire to the antenna terminal
2. Connect a 5 volt power supply to the positive power in terminal and ground
3. Connect a piezo buzzer or connect an LED with a 200 ohm series resistor to data out 1 and ground

Switches can also be connected to other transmitter data in terminals to send more data bits. Switches can be connected to the latch and alternate address terminals to use those features.

Buzzers or LEDs can also be connected to other receiver data out terminals to receive more data bits. Data out terminals can also connect to transistors that drive relays or other loads.

Transmitter description_____

The GF16TMB Transmitter operates at 916 MHz using FSK modulation. It has an encoder with factory pre programmed access codes to control which receiver is activated by its transmissions. The access codes are different for each transmitter and cannot be changed. There are no address switches to set. The transmitter has 16 data inputs and can send up to 16 control data bits individually or in any combination including all 16 bits simultaneously. All data inputs are internally pulled up to 4.2 volts through 22K resistors. Transmission starts when one or more transmitter data inputs are grounded. When not grounded, the data inputs should be allowed to float. They should not be driven to a high level.

Two alternate inputs (ALT1, ALT2), when grounded at the same time as one or more data inputs, allows data bits to be sent to a second, third or fourth receiver for a total of 64 commands. When one or both of the ALT inputs are grounded along with one or more data inputs, a different access code is transmitted so that another receiver can learn it and receive the alternate data bits. A total of 64 control data bits can therefore be sent with one transmitter although only 16 can be sent simultaneously. Grounding an ALT input alone does not initiate a transmission.

A latch input, when grounded at the same time as a data input, adds a latch bit to the data and causes its corresponding receiver data output to latch on. A latched receiver output can be reset by sending data without grounding the LAT input.

Any voltage of from 4.8 to 15.5 volts may power the transmitter. An on-board voltage regulator generates 4.0 volts to power the RF module regardless of the power source voltage. The power source may be AAA, AA or lithium coin cells or a 9 or 12 volt battery. Standby current is only 4 microamperes with a 9 volt battery. The transmitter power system is reverse polarity protected.

Transmitter output power may be adjusted during product certification by adding a chip resistor labeled RADJ to the transmitter module at the location shown in figure 1. The addition of this resistor may be necessary to bring the transmitter power within FCC limits and eliminates the need for a T pad attenuator in the antenna circuit to control output power. Pads are provided for a surface mount 1206 size chip resistor of 15K to 40K. A lower resistance results in less radiated transmitter energy. The output power will be at its maximum when no resistor is used.

Receiver description_____

The GF16RMB receiver operates at 916 MHz and receives FSK modulated data. It has a learning decoder that can learn the access code sent by any GF16TMB transmitter. There are no address switches to set in the receiver. Learning is done by pressing a learn button for one second and then transmitting any data. The received access code is stored in a non-volatile memory and will not be lost when power is turned off. Transmitter access codes can be erased from the receiver memory by pressing the learn button for 10 seconds.

Access codes from up to 32 transmitters can be learned and stored in the receiver's memory so that one receiver can receive data from up to 32 transmitters, however, only one transmitter can transmit at a time to avoid data collisions. The purpose of the access codes is to control access by transmitters to receivers. This is not a high security rolling code or code hopping system.

Receiver outputs can be momentary or latched, depending on whether the transmitted data includes a latch bit. Transmitting the same data without the latch bit will reset a latched output. Outputs can be individually latched and individually reset, or by grounding the sequential latch pin, they can be sequentially latched so that a previously latched output unlatches and is replaced by new latched data. Latched outputs can be reset at the receiver module by grounding the latch reset pin. The momentary valid data output goes high when any valid data is being received. Outputs can source or sink up to 25 milliamperes each but are limited to a total of 200 milliamperes when multiple outputs are driving loads simultaneously to prevent overheating of the circuits. The GF16RMB receiver must be powered by a regulated and well filtered 5 volt source that can supply 200 milliamperes. Noise spikes on the power supply will degrade receiver performance.

Access code scanning

When a receiver module receives a transmission, it scans its memory locations to see if it can find an access code that matches the transmitter's code. If it finds a match, the receiver LED, figure 2, turns on for as long as data is being received and the received data appears as a high level at the receiver outputs. If a match cannot be found, the receiver LED will blink slowly to indicate that it has received a transmission but does not recognize the access code. Data received from an unrecognized transmitter will not be transferred to the outputs.

Learning access codes

A receiver is placed into learn mode by pressing the learn button, figure 2, for about one second which causes the receiver LED to turn on and remain on. When a transmission is received, the transmitter's access code will be stored in memory and the receiver LED will blink fast five times indicating that the receiver has learned the transmitter's code. The receiver is now ready to receive data from the transmitter that it has learned. The receiver can be placed into learn mode again and can store the access code from another transmitter. This can be repeated until the receiver learns 32 access codes.

When one or both GF16TMB transmitter's ALT inputs are grounded at the same time as a data input, the transmitter will send one of three new access codes. Other receivers can learn these alternate codes and thereby provide additional output commands from the same transmitter.

Erasing access codes

The entire receiver memory can be erased by pressing the learn button for ten seconds or more. The receiver LED will turn on while the button is being pressed and after ten seconds will blink slowly three times, indicating that the memory has been erased. Individual access codes cannot be erased; the entire memory will be erased. The memory can be erased and re-learned an almost unlimited number of times.

Module interconnect and mounting _____

Transmitter and receiver modules have 0.019" (0.483mm) diameter pins for use with three pin Mill-Max p/n 315-91-103-41-003 and twelve pin Mill-Max p/n 315-91-112-41-003 socket strips that can be mounted on a circuit board. Socket strips have pin buckets that will fit in 0.035" (0.89mm) diameter PC board holes.

64 pin Mill-Max low profile socket strips that can be cut to required lengths using a utility knife are available from Digi-Key Corporation, 1-800-344-4539. They can also be ordered on-line at www.digikey.com. The Digi-Key part number is ED7964.

Transmitter module

The GF16TMB transmitter module, figure 1, should be mounted so that there is no metal surrounding or close to the antenna area of the module. The antenna can be a wire whip 3 inches (76.2mm) long connected to the module's antenna pin or it can be remote and connected to the module by a 50-ohm coaxial cable no longer than 8 inches (200mm). Transmission may be activated by push buttons, toggle switches or other devices that conduct at least 200 microamperes from each data input pin to ground or have a maximum contact resistance of 3000 ohms. Ground interconnect pins are provided for grounding DATA, ALT and LAT inputs. Data inputs should not be forced high; they should be allowed to float when not grounded. If driven by other circuits, those circuits should have open collectors or open drains.

If a keypad is used as an input device it must be of the bussed type. A matrix keypad cannot be used with this module. Push button switches or three position momentary off and on switches can be used to ground DATA inputs. The LAT input will usually be a momentary switch.

Since grounding the ALT1 or ALT2 inputs does not initiate a transmission a momentary switch does not have to be used. A rotary selector or toggle switches can be used to ground them. The ALT switches are grounded in the following binary configuration:

ALT INPUTS GROUNDED	ADDRESSES TRANSMITTED
NONE	ADDRESS1
ALT1	ADDRESS2
ALT2	ADDRESS3
ALT1 AND ALT2	ADDRESS4

Reverse polarity protection in the GF16TMB transmitter prevents damage to the circuits if a battery or other power source is connected in the wrong direction.

Receiver module

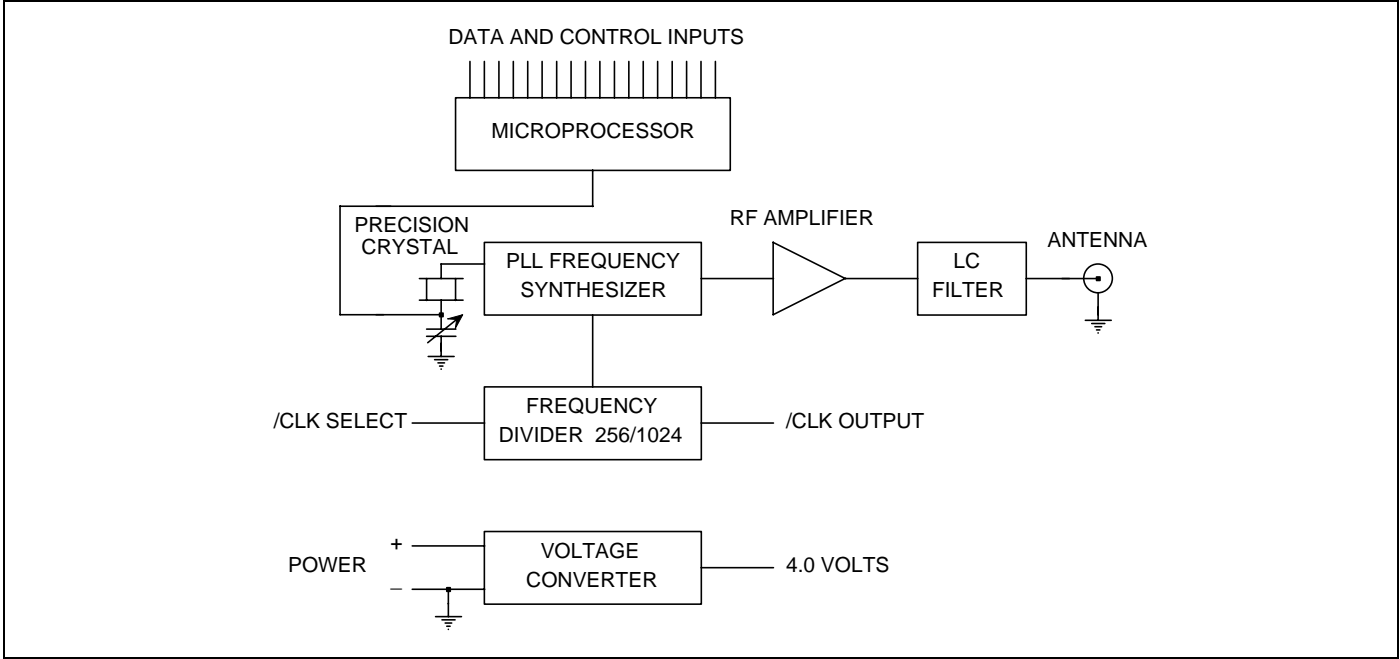
The GF16RMB receiver module, figure 2, should be mounted so that there is no metal surrounding or close to the antenna area of the module. The antenna can be a wire whip 3 inches (76.2mm) long connected to the module's antenna pin or can be remote and connected to the module by a 50-ohm coaxial cable no longer than 8 inches (200mm). One +5 volt and two ground interconnect pins are provided for power and output ground connections. The power source must be a well regulated and filtered 5 volts. Battery operation is not recommended since receiver current, not including load current is about 9 milliamperes and can be as high as 200 milliamperes with full loading. If an accessory board is used it will supply the regulated and filtered power required by the module.

A Received Signal Strength Indicator (RSSI) output is provided on the module. It can be used to drive a single LED or LED bar graph or other type of display to indicate the relative strength of a received signal or to indicate the presence of an interfering signal while no transmission is being made. The RSSI output will be at about 1.1 volts with no signal or a weak signal and will linearly increase to about 2.3 volts with a strong signal. The RSSI output comes from an emitter follower through a 200 ohm resistor. An external pulldown resistor is required when driving CMOS or other high impedance loads. A buffer, amplifier or transistor should be used when driving a low impedance load such as an LED.

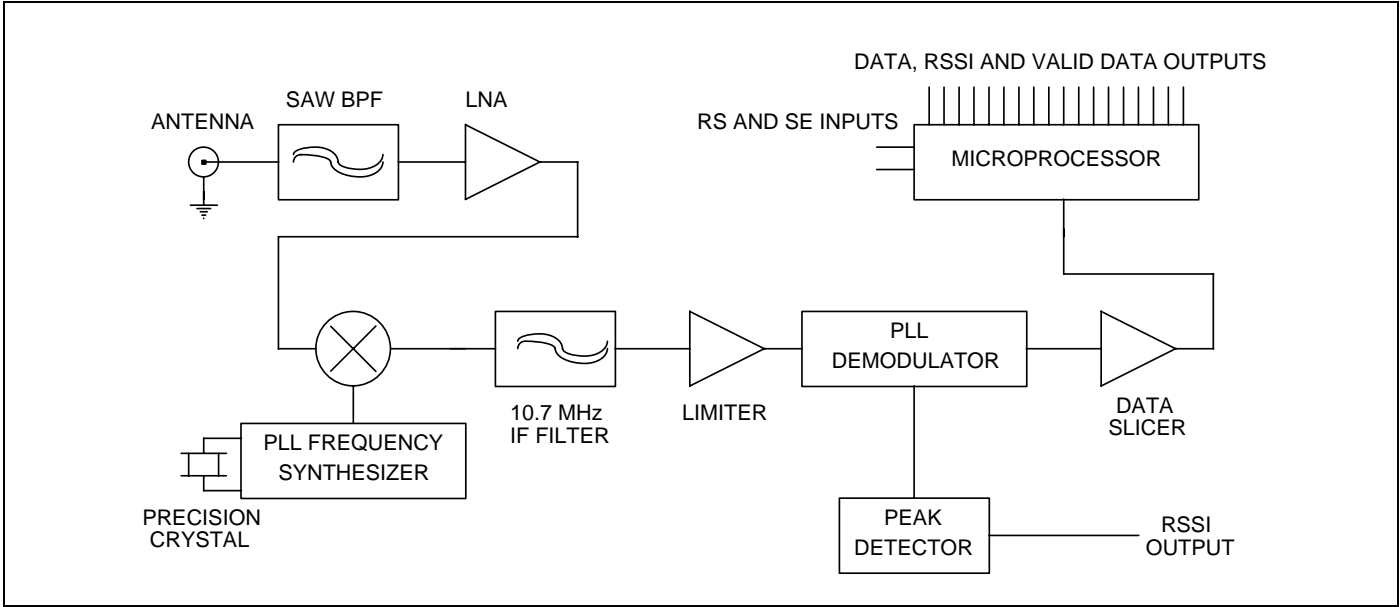
Characteristics of a wireless system_____

Access codes are used to give identities to individual transmitters and receivers to allow control over which transmitter produces output from a receiver. Each transmitter has four unique codes programmed within it; a main access code and alternate access codes that are used when the ALT inputs are grounded to access other receivers. Each receiver is capable of storing access codes from up to 32 transmitters so that up to 32 transmitters can control one receiver. However, since all transmitters and receivers operate on the same frequency of 916 MHz, only one transmitter can send data at a time. If two or more transmitters send data simultaneously there will be a data collision and all data will be corrupted. The result of multiple transmissions is that no valid data will be received by any receiver within range of two or more transmitters that are sending data simultaneously.

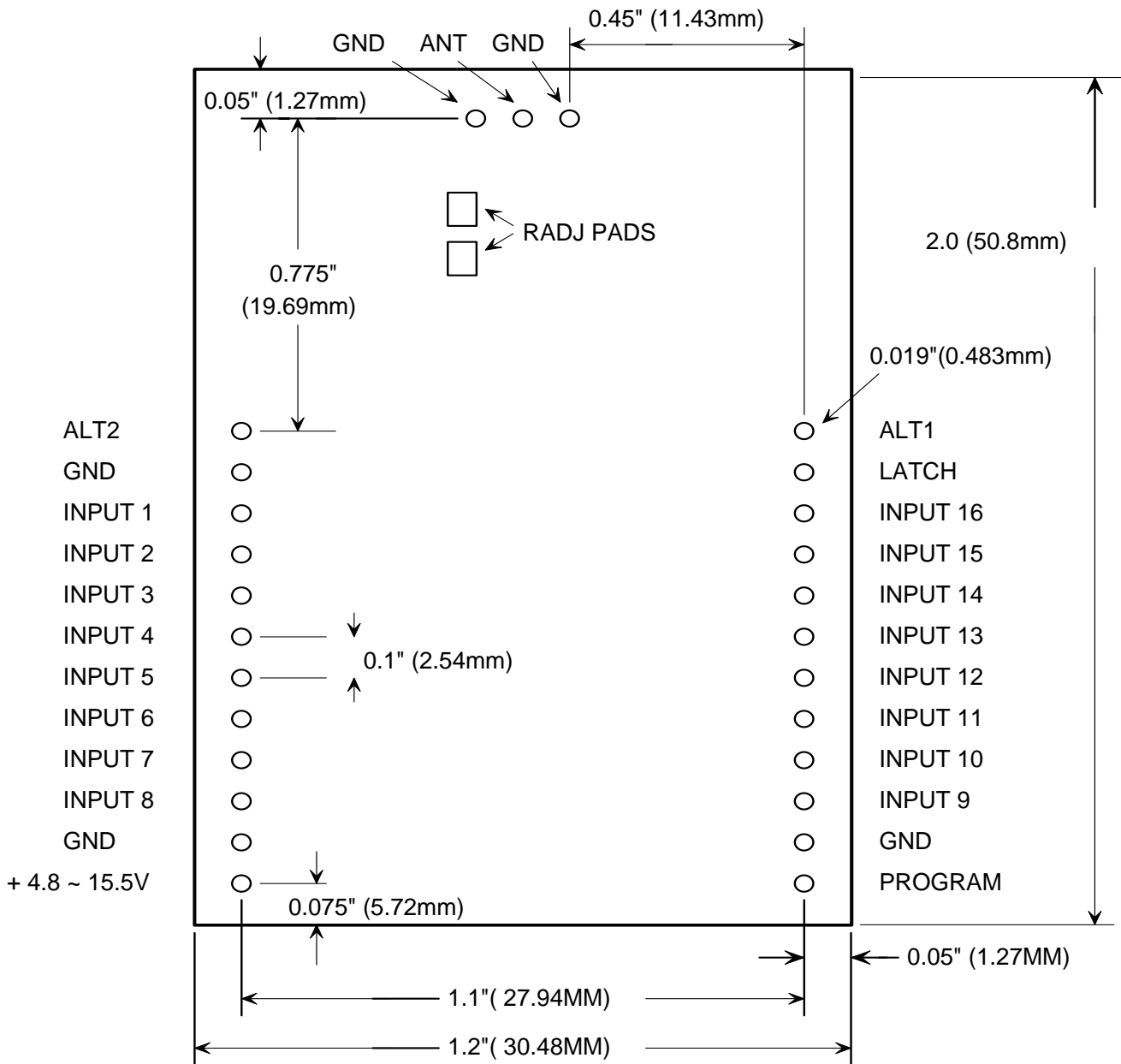
High frequency signals can reflect from surrounding objects and can arrive at a receiving antenna at a different time than the signal that comes directly from the transmitter. This time difference results in a phase shift that can partially cancel the direct signal if its phase is opposite that of the direct signal. The result will be reduced reception range. Since the wavelength at 916 MHz is short, moving the transmitter or receiver a few inches might change the phase angle between a direct and reflected signal enough to improve range. This effect is more likely to occur indoors and wherever reflecting objects are present.



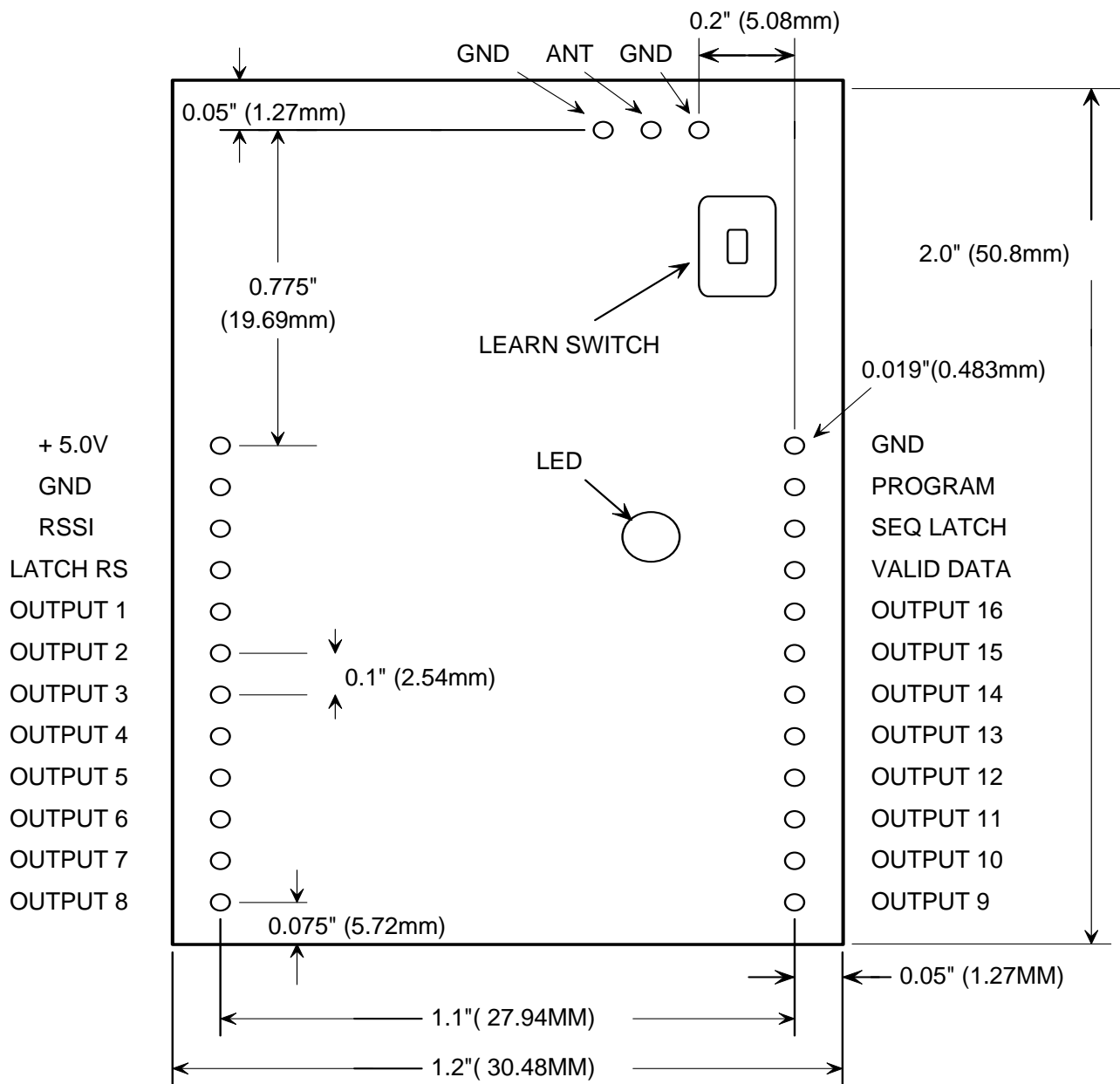
TRANSMITTER BLOCK DIAGRAM



RECEIVER BLOCK DIAGRAM



TRANSMITTER MODULE FIGURE 1



RECEIVER MODULE FIGURE 2

Applications _____

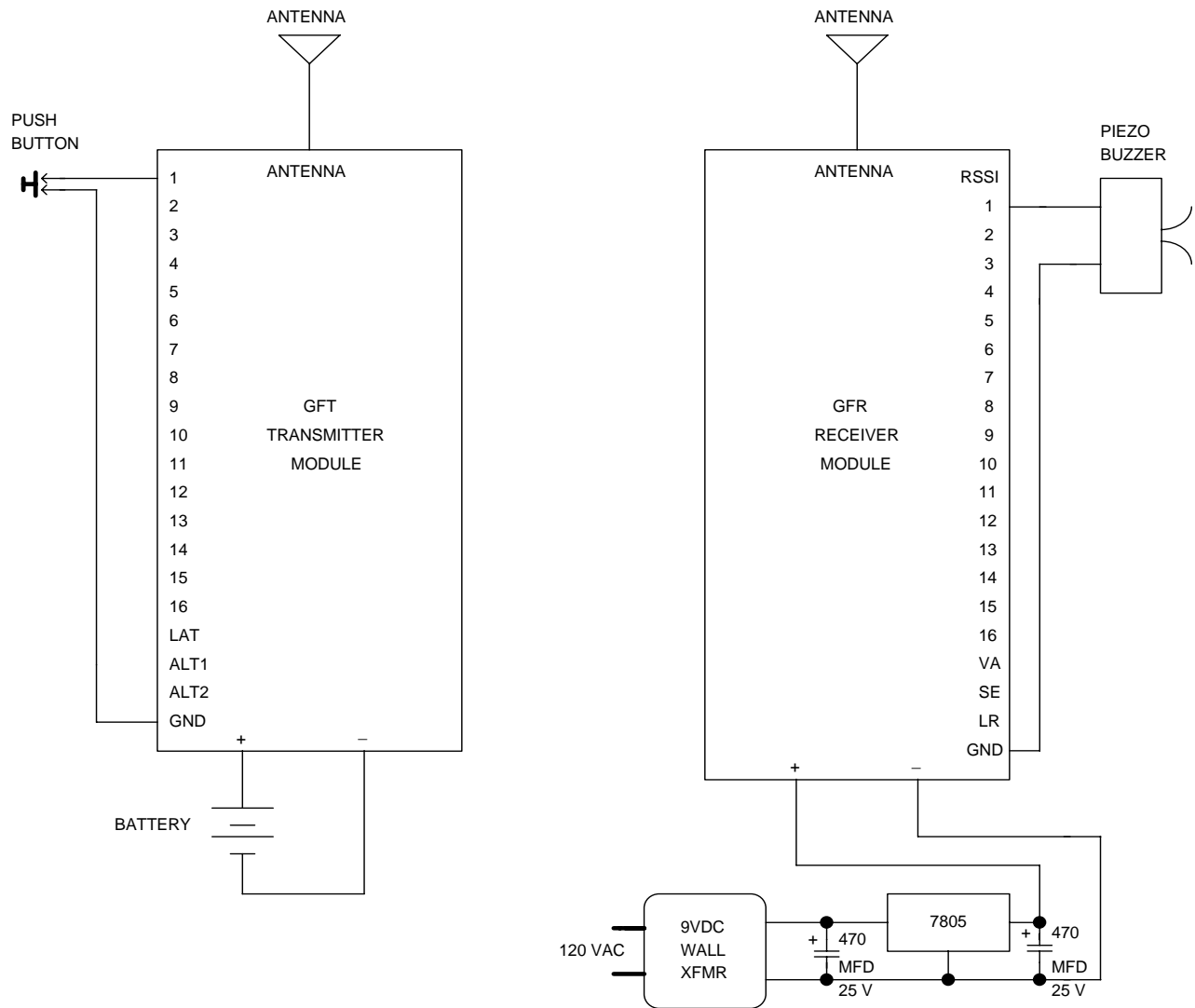


FIGURE 4

Figure 4 shows that a GF16TMB, antenna, battery and push button switch are all you need to build a remote doorbell transmitter. Also a GF16RMB, antenna, simple power supply and piezo buzzer are all you need to build a remote doorbell receiver.

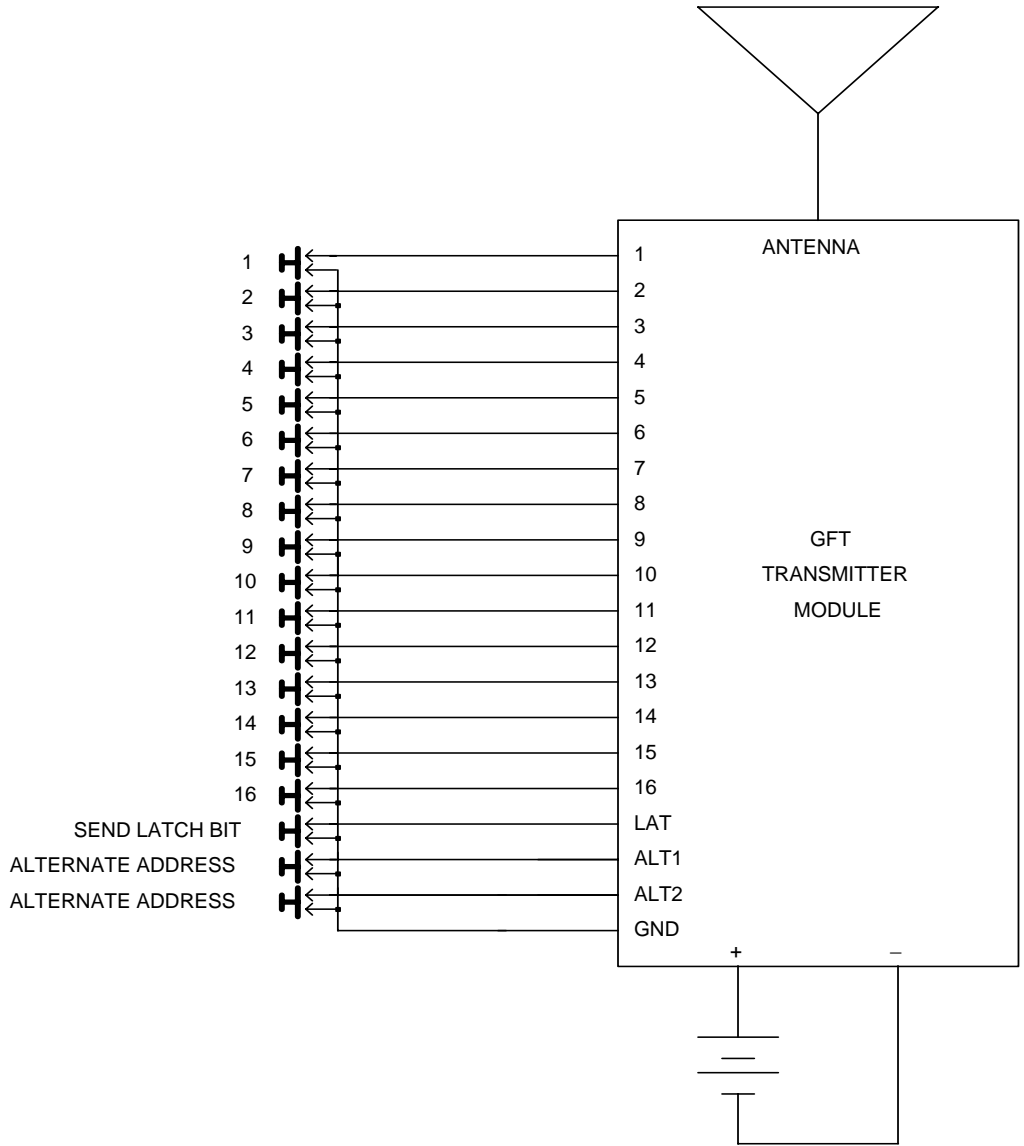


FIGURE 5

Figure 5 shows how push button switches can be used to transmit up to 16 functions either momentary or latched and with standard or alternate address. In this basic configuration, a battery, antenna and 19 push button switches are all that you need to build a 16 function transmitter. By using the latch button, this configuration can be used to switch 16 remote circuits on and off individually (up to 64 circuits if you use four receivers and the alternate address buttons).

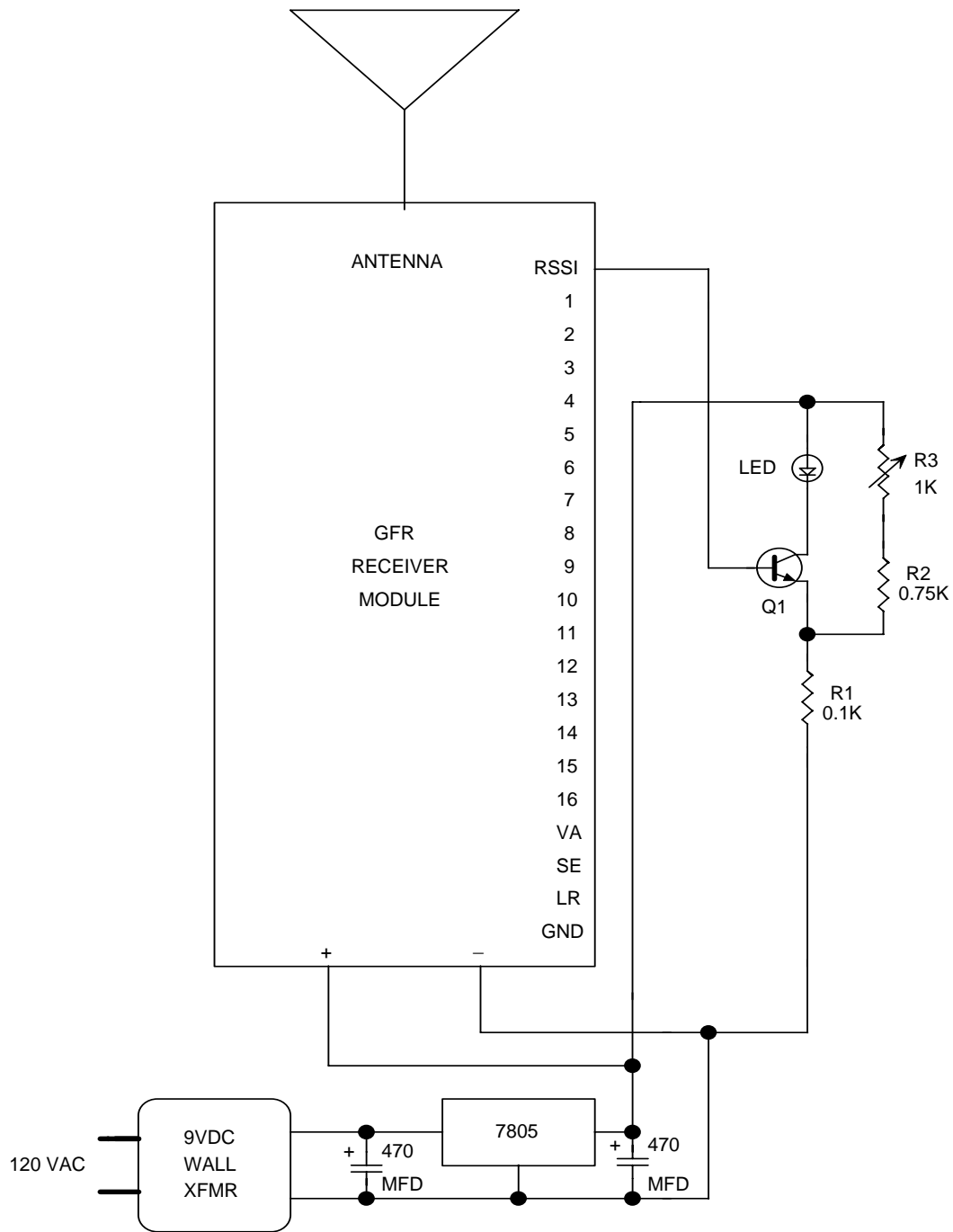


FIGURE 7

Figure 7 is a simple Received Signal Strength Indicator (RSSI) circuit. The intensity of the LED light increases with an increasing signal strength. Potentiometer R3 is adjusted until the LED just goes out with no received signal.

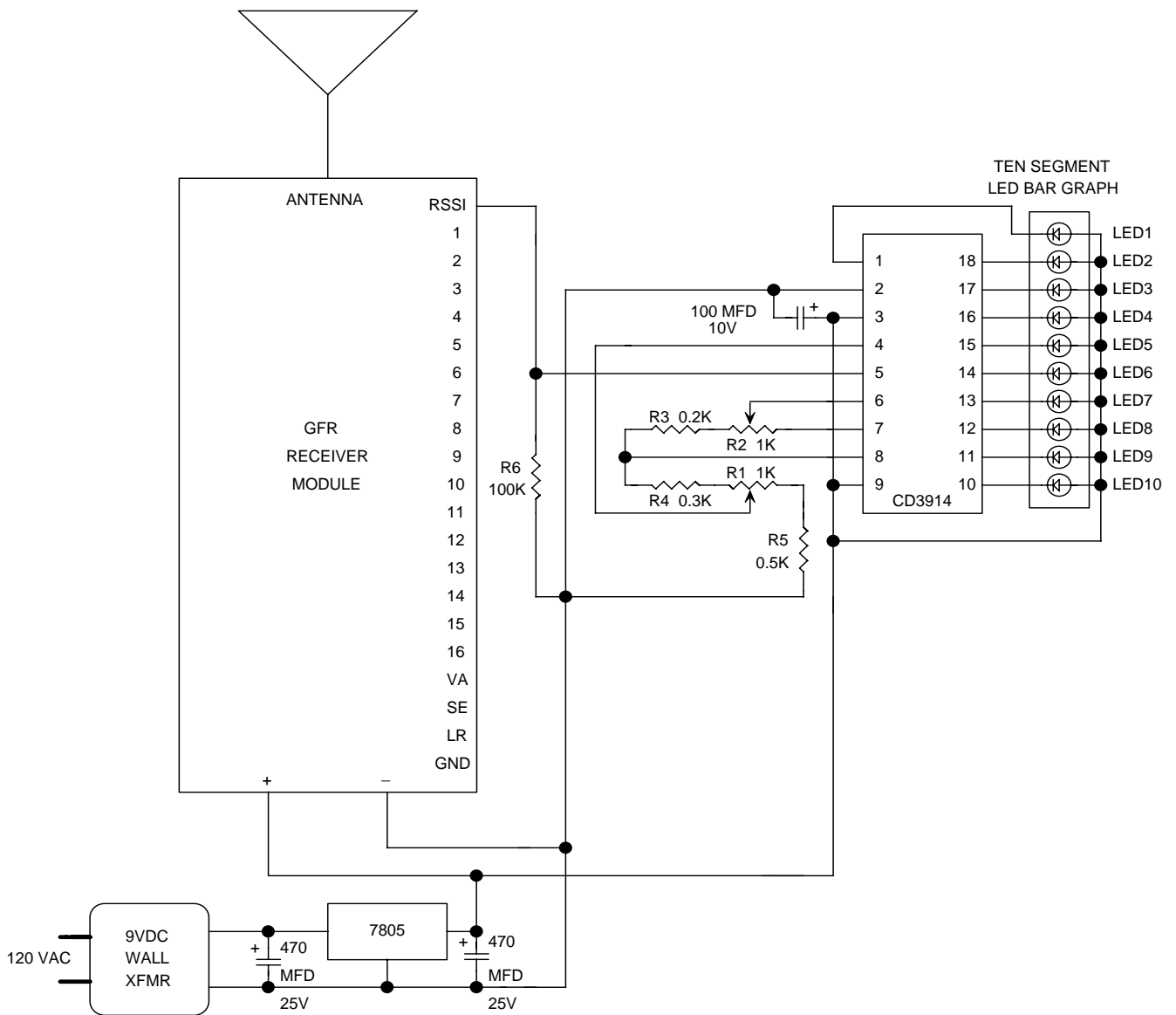


FIGURE 8

Figure 8 shows a ten segment LED bar graph Received Signal Strength Indicator (RSSI) driven by a CD3914 driver. Potentiometer R1 sets the high end and R2 sets the low end of the indicator range. Adjust R2 so the first segment (LED1) just turns off with no received signal and adjust R1 so the last segment (LED10) turns on with a strong received signal.

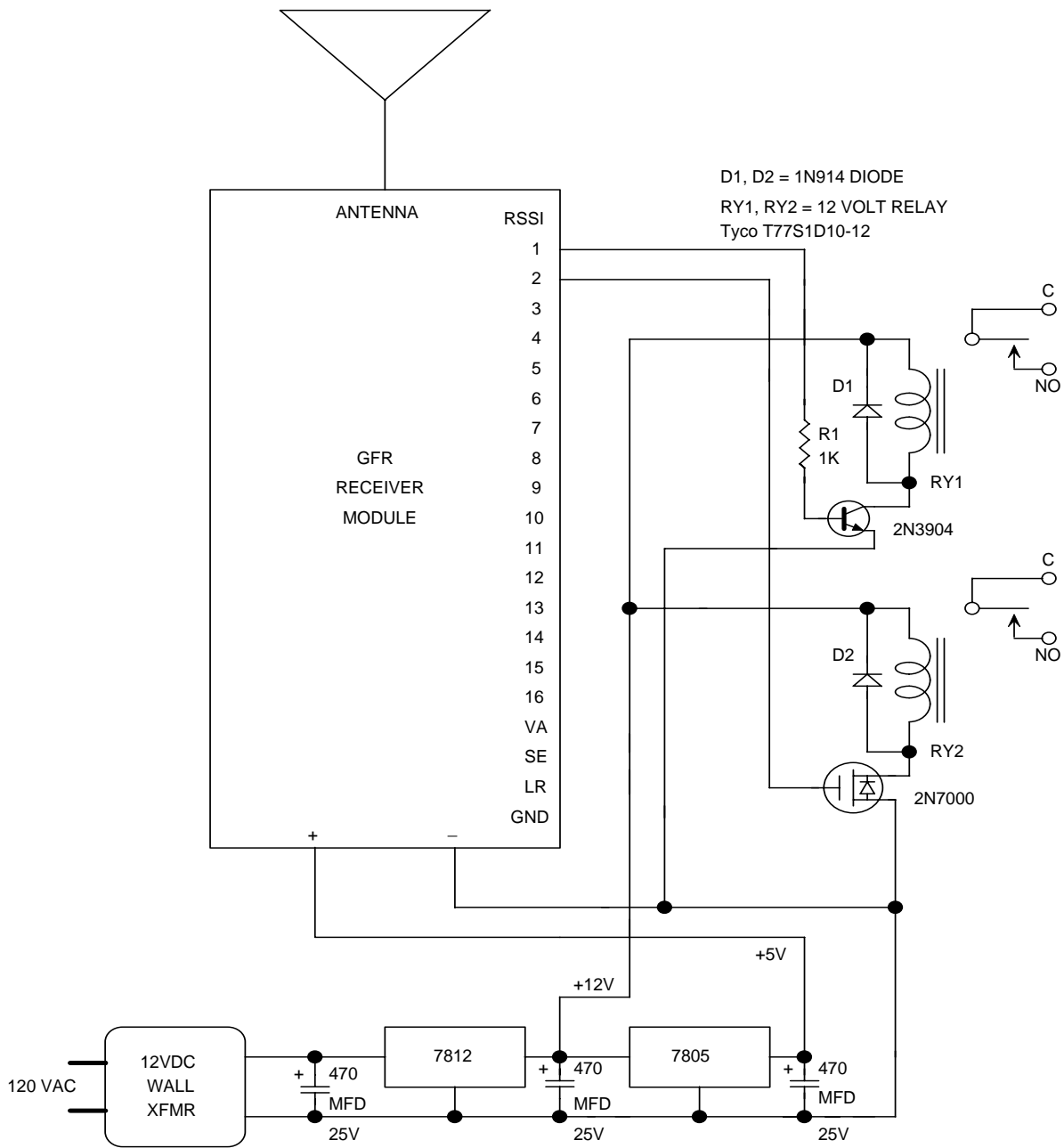
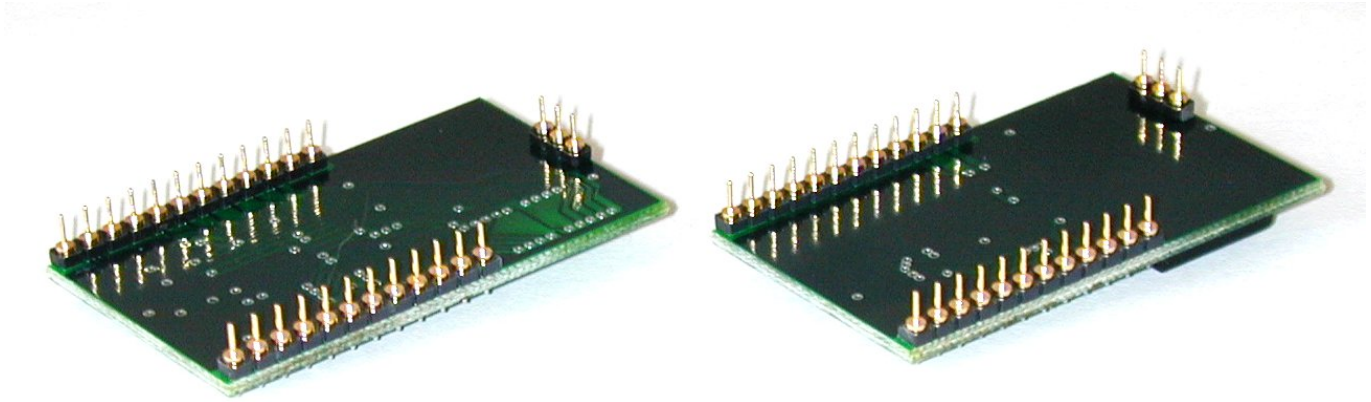


FIGURE 9

Figure 9 shows how to use either a 2N3904 bipolar transistor or a 2N7000 FET to drive a relay for powering heavier loads. The 12 volt DC wall transformer should have a current rating high enough to power all of the relays that are used. A heat sink may be required for the 7812 regulator if a large number of relays are turned on simultaneously.

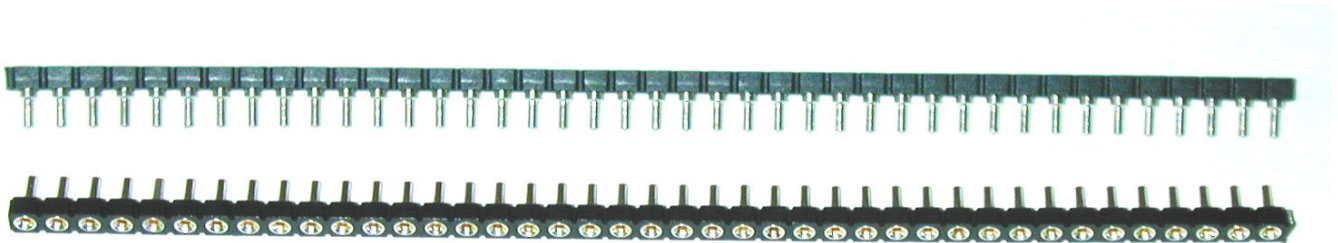
module pins

Bottom view



Module pins are 0.019 inch (0.483mm) diameter and 0.125 inch (3.17mm) long on 0.1 inch (2.54mm) centers for plugging into single inline sockets. The pins can also be inserted through holes and soldered into a PC board.

64 pin low profile socket strips for the GF16 modules are available from Digi-Key Corporation, 1-800-344-4539. They can also be ordered on-line at www.digikey.com. The Digi-Key part number is ED7964. The socket strips, made by Mill-Max can be cut to required lengths using a utility knife. The sockets will fit in 0.035 inch (0.89mm) diameter PC board holes. Figures 1 and 2 show socket placements.



WARRANTY STATEMENT

WHAT DOES OUR WARRANTY COVER?

- Any defect in material or workmanship.

FOR HOW LONG AFTER THE ORIGINAL PURCHASE?

- To the original purchaser only – 90 days

HOW DO I SEND MY MODULE, IN OR OUT OF WARRANTY?

- Fax to (845) 297-9772 or email to service@glolab.com for return authorization.
- Properly pack your module, use anti-static packing.
- Include invoice number, a copy of the sales receipt or other evidence of date of original purchase (if the module was purchased within the last 90 days).
- Include a description of the defect.
- Include payment for any service or repair not covered by warranty, as determined by Glolab Corporation.
- Ship the unit via FedEx insured or equivalent to:

GLOLAB CORPORATION
307 PINE RIDGE DRIVE
WAPPINGERS FALLS, NY 12590

WHAT DOES OUR WARRANTY NOT COVER?

- Water or moisture damage.
- Damage from misuse, neglect, or acts of nature (lightning, floods etc.).
- Modules that have been operated beyond absolute maximum ratings.
- Modules that may have been modified without authorization from Glolab Corp.
- Modules purchased and/or operated outside the USA, its territories, or Canada.
- Modules serviced by a service facility other than Glolab Corporation.
- Other equipment that may or may not have been connected to Glolab modules.
- Modules purchased more than 90 days from current date.

LIMITS OF LIABILITY

- No liability is assumed for any consequential damages resulting from the use of Glolab modules.
- Glolab is not responsible for nor warrants modules for merchantability or fitness for a particular purpose.

The information in this manual is believed to be accurate at the time of publication. However, Glolab assumes no responsibility arising from the use of the specifications described. The applications mentioned herein are used solely for the purpose of illustration and Glolab makes no warranty or representation that such applications will be suitable without further modification, nor recommends the use of its products for applications that may present risk to human life or to property due to malfunction or otherwise. Glolab reserves the right to change its design and specifications without prior notification.



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