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Velicer et al.

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(54) **HANDHELD GPS JAMMER LOCATOR**

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(73) Assignee: **The United States of America as represented by the Secretary of the Navy**, Washington, DC (US)

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(51) **Int. Cl.**
G01S 5/04 (2006.01)

(52) **U.S. Cl.** **342/433**; 342/357.06

(58) **Field of Classification Search** 342/433, 342/357.06, 432
See application file for complete search history.

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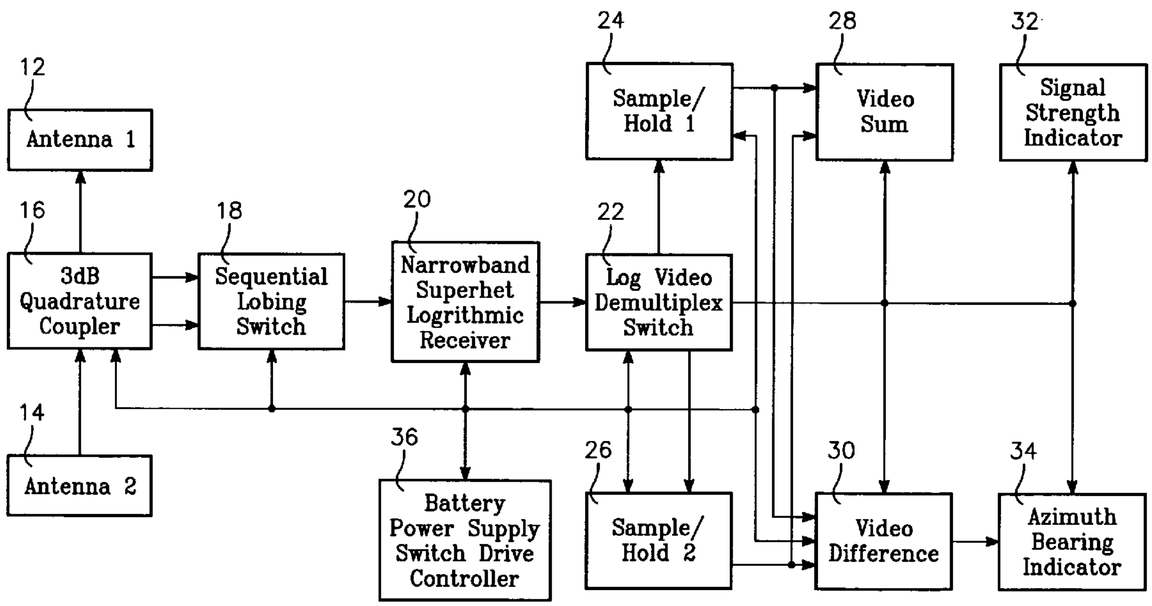
(57) **ABSTRACT**

A handheld GPS jammer locator for locating a GPS jamming signal generated by a jammer. The handheld GPS jammer locator has two modes of operation, a amplitude mode and a difference finding mode. The amplitude measures the strength of an incoming GPS jamming signal and the difference finding mode determines the direction of the incoming jamming signal.

20 Claims, 7 Drawing Sheets



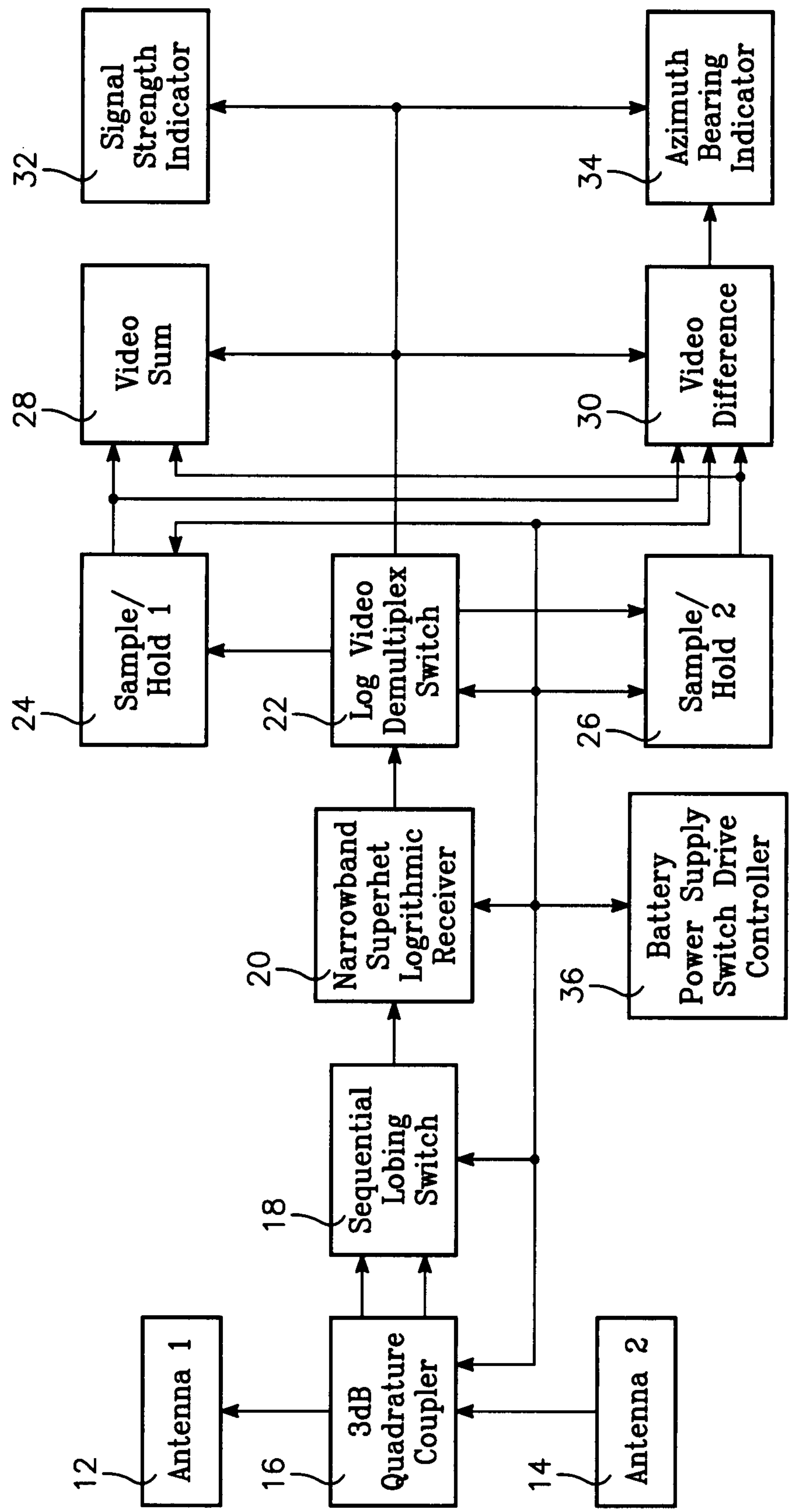

Signal Strength Indicator
32
Azimuth Bearing Indicator
34
Video Sum
28
Video Difference
30
Sample/ Hold 1
24
Log Video Demultiplex Switch
22
Sample/ Hold 2
26
Narrowband Superhet Logrithmic Receiver
20
Battery Power Supply Switch Drive Controller
36
Sequential Lobing Switch
18
Antenna 1
12
3dB Quadrature Coupler
16
Antenna 2
14

FIG. 1

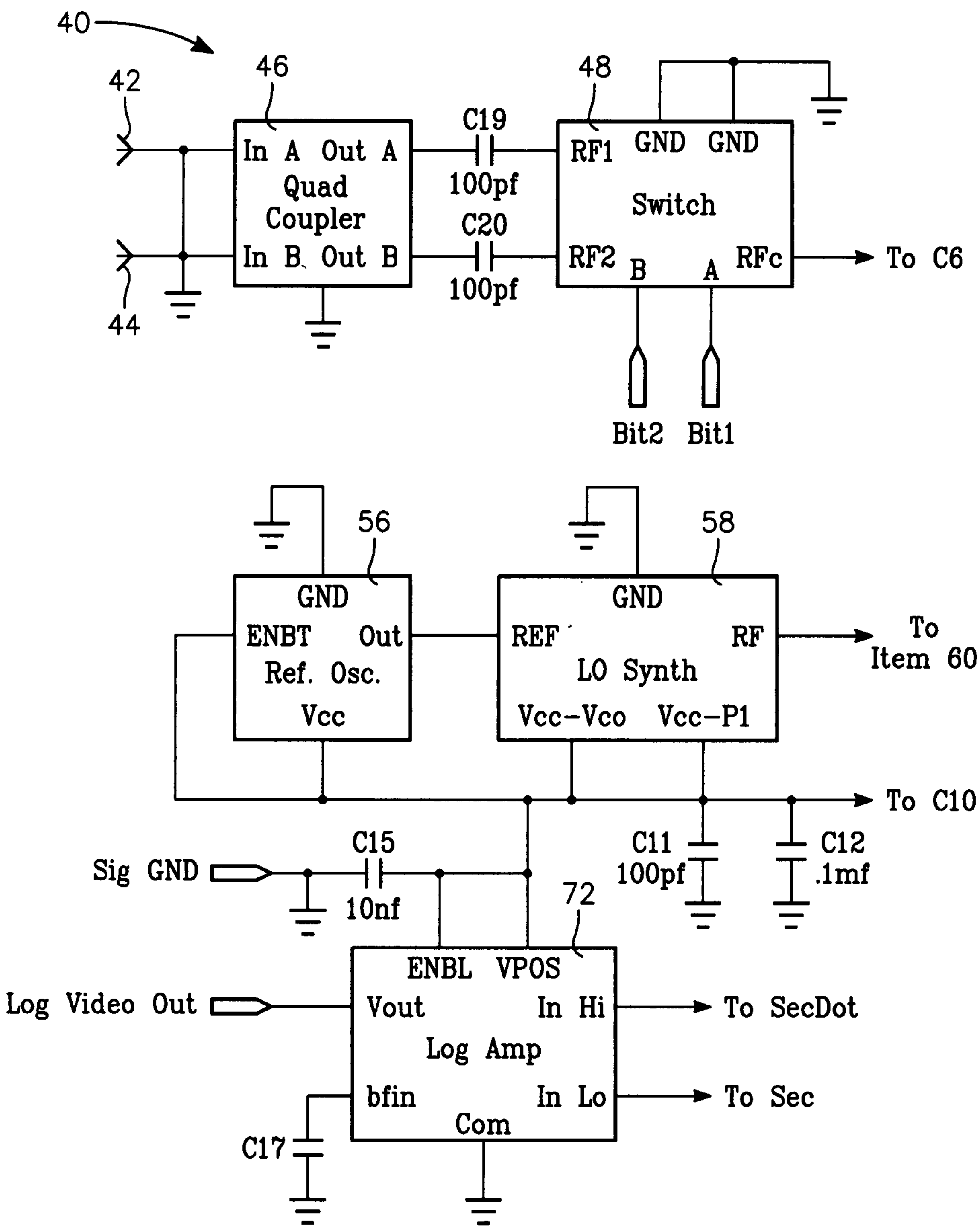

40
42
44
46
In A Out A
Quad
Coupler
In B Out B
C19
100pf
C20
100pf
48
RF1
GND GND
Switch
RF2
B
A
RFc
To C6
Bit2 Bit1
56
GND
ENBT Out
Ref. Osc.
Vcc
58
GND
REF RF
LO Synth
Vcc-Vco Vcc-P1
To
Item 60
To C10
Sig GND
C15
10nf
C11
100pf
C12
.1mf
72
ENBL VPOS
Vout In Hi
Log Amp
bfin In Lo
Com
Log Video Out
To SecDot
To Sec
C17

FIG. 2A

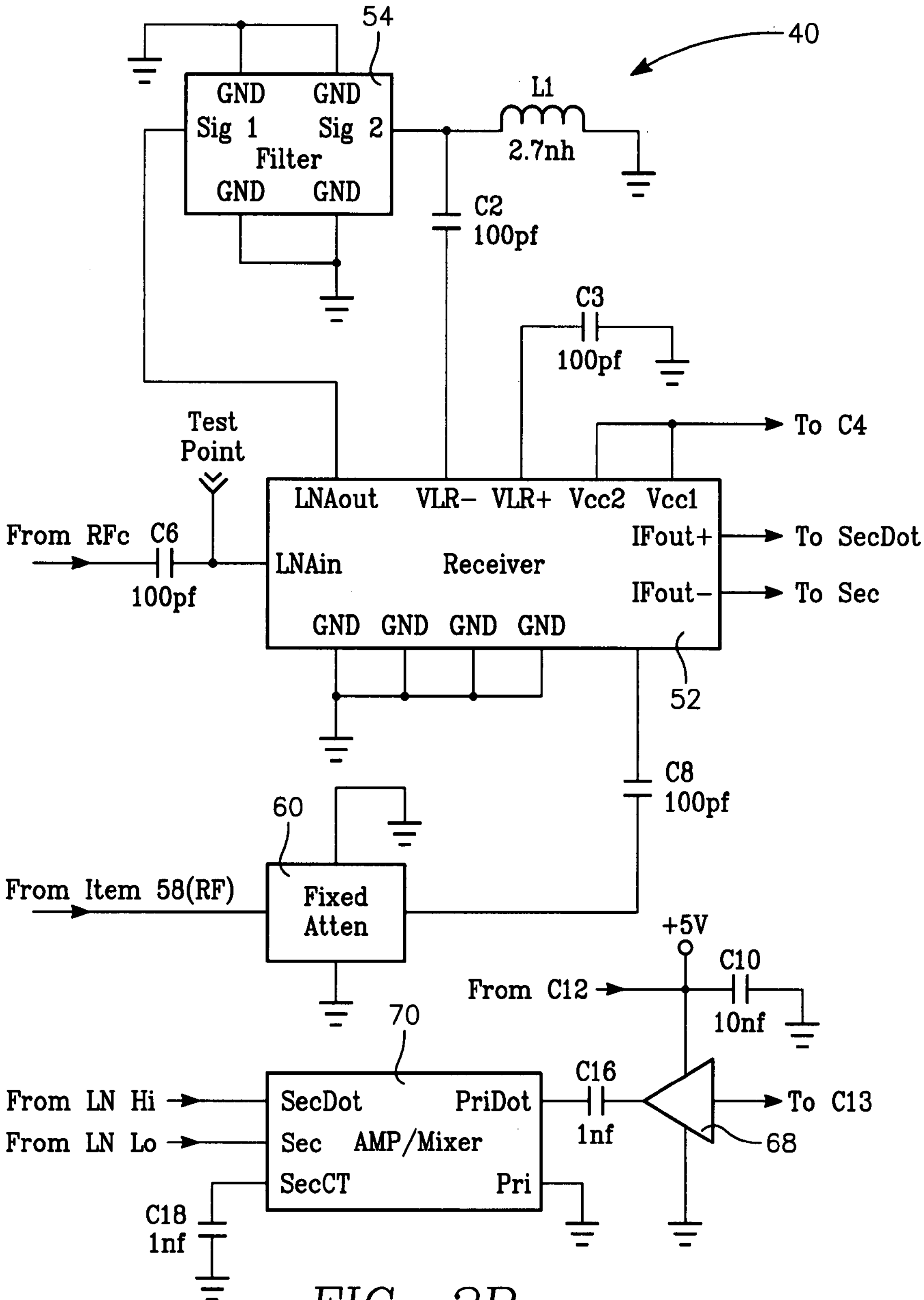

54
40
GND GND
Sig 1 Sig 2
Filter
GND GND
L1
2.7nh
C2
100pf
C3
100pf
To C4
Test
Point
LNAout VLR− VLR+ Vcc2 Vcc1
From RFc C6
100pf
LNAin
Receiver
IFout+
IFout−
To SecDot
To Sec
GND GND GND GND
52
C8
100pf
60
From Item 58(RF)
Fixed
Atten
+5V
From C12
C10
10nf
70
C16
1nf
From LN Hi
From LN Lo
SecDot
Sec
SecCT
AMP/Mixer
PriDot
Pri
To C13
68
C18
1nf

FIG. 2B

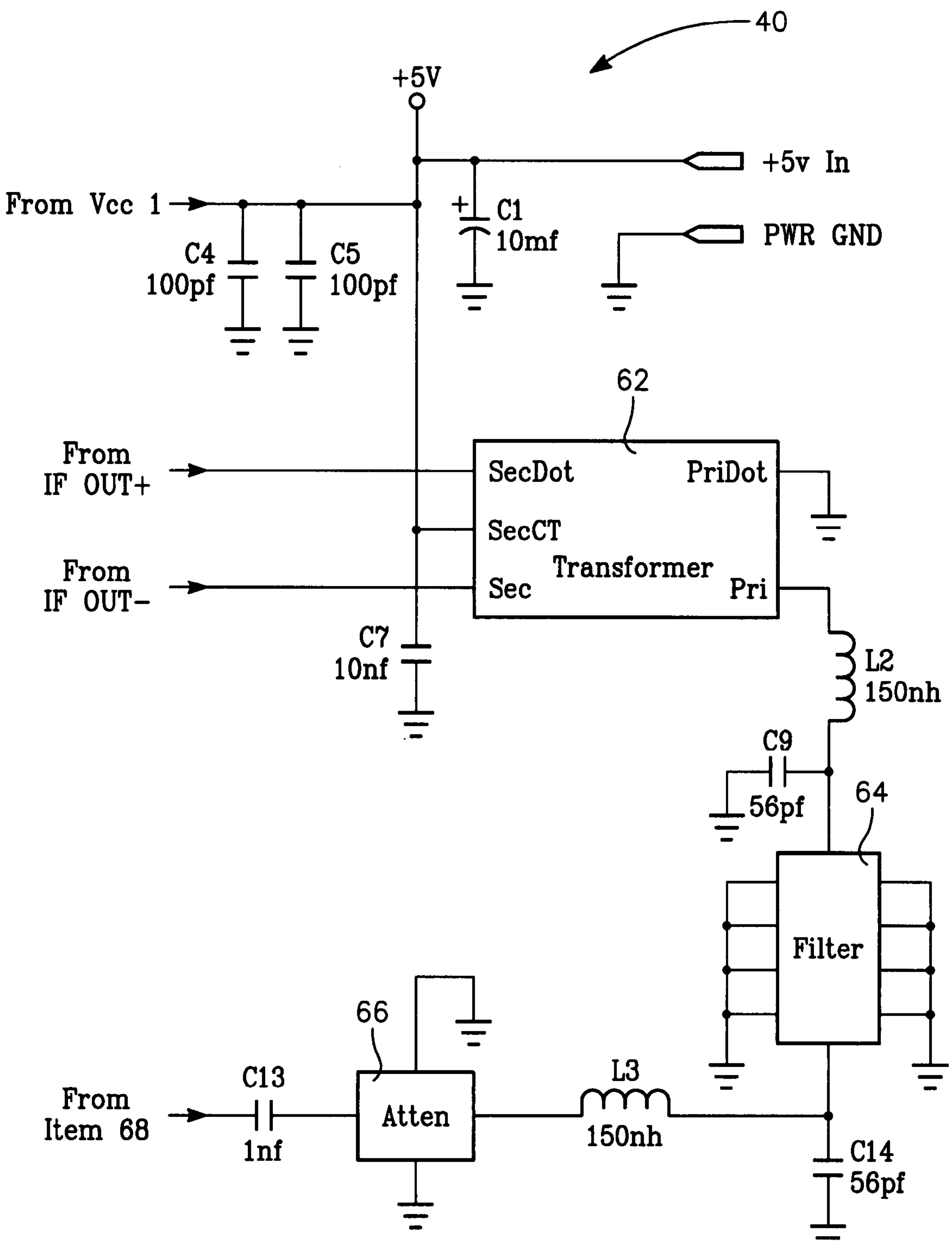

40
+5V
+5v In
From Vcc 1
C1
10mf
PWR GND
C4
100pf
C5
100pf
62
From
IF OUT+
SecDot
PriDot
SecCT
Transformer
From
IF OUT-
Sec
Pri
C7
10nf
L2
150nh
C9
56pf
64
Filter
66
From
Item 68
C13
1nf
Atten
L3
150nh
C14
56pf

FIG. 2C

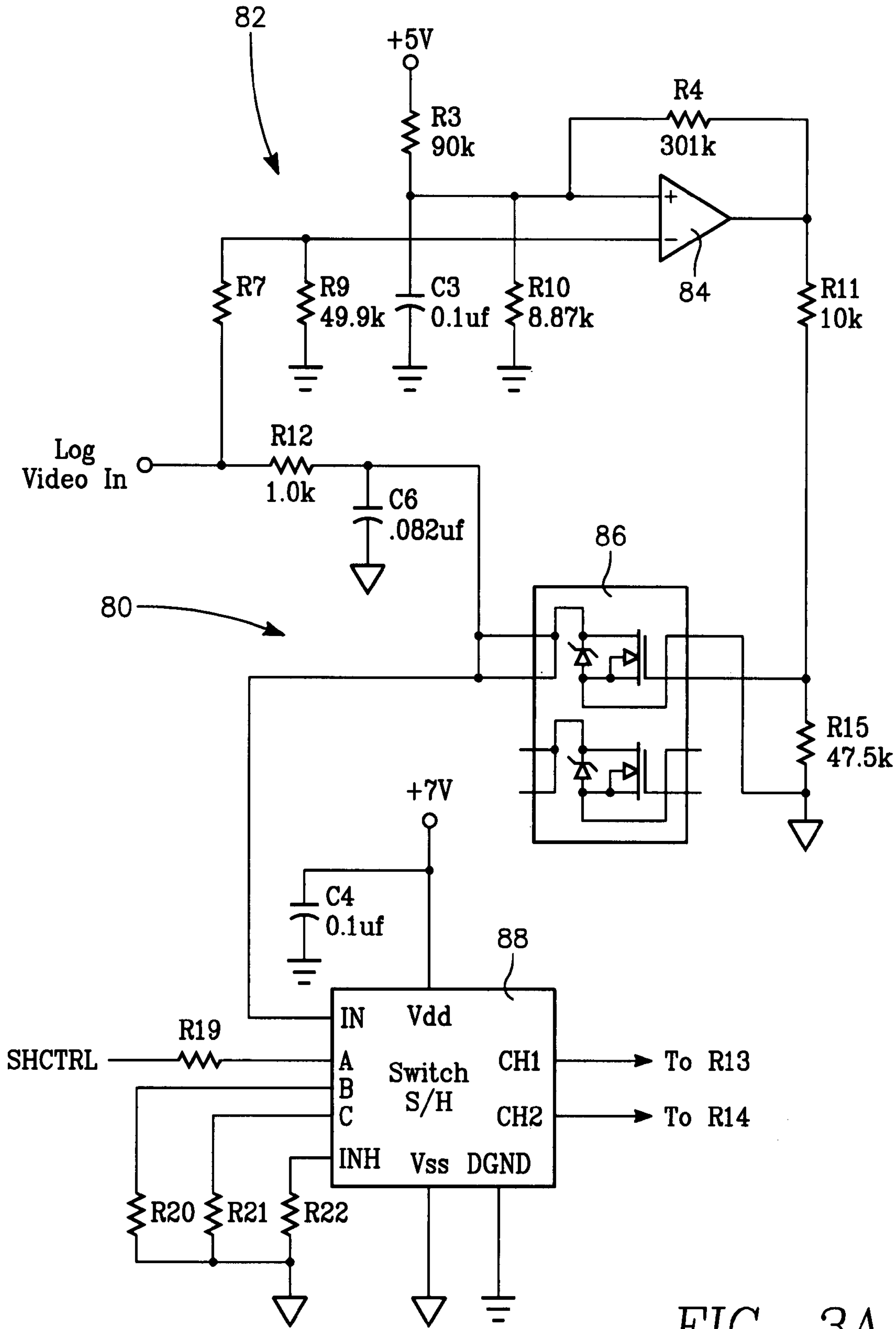
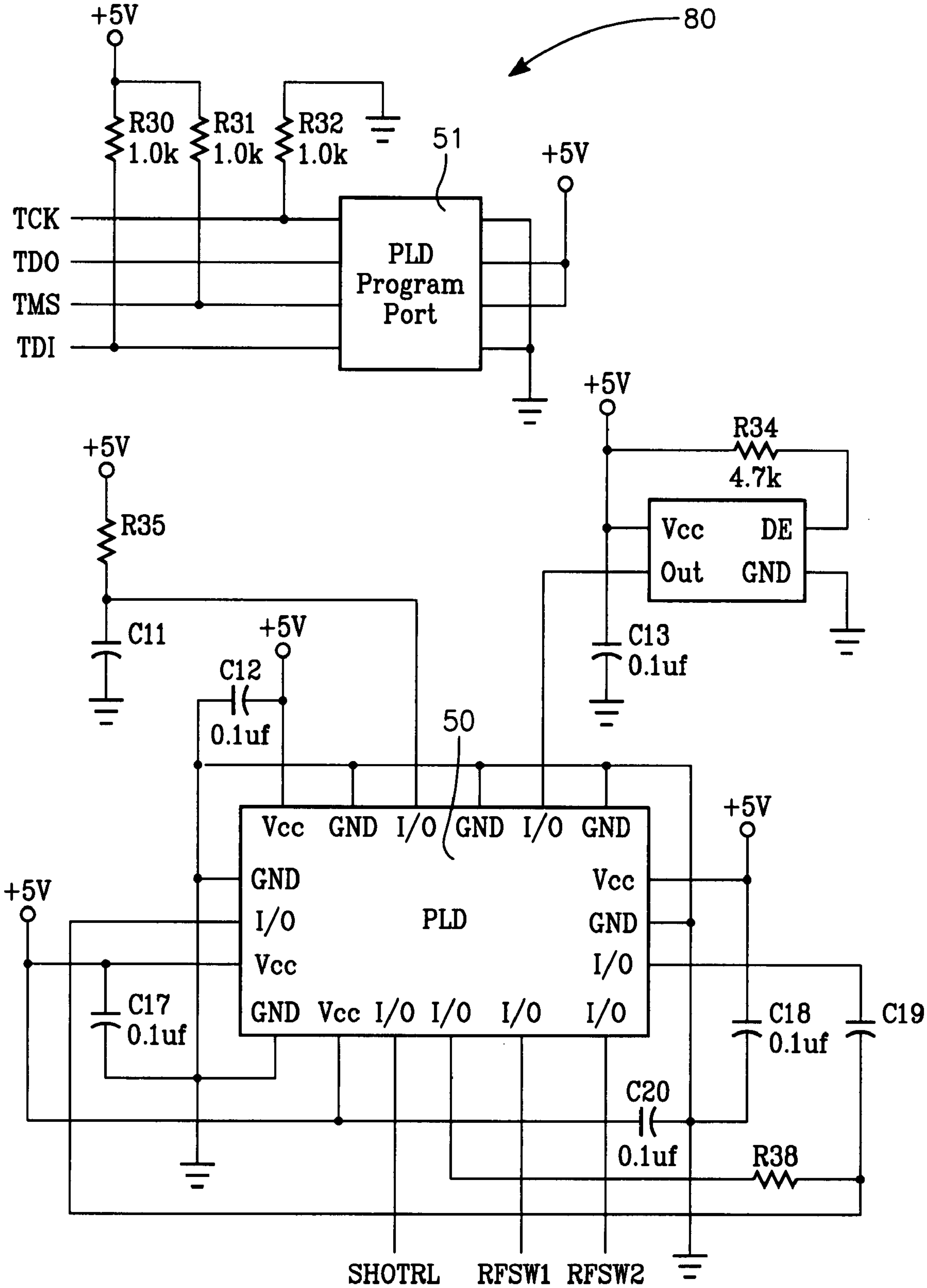
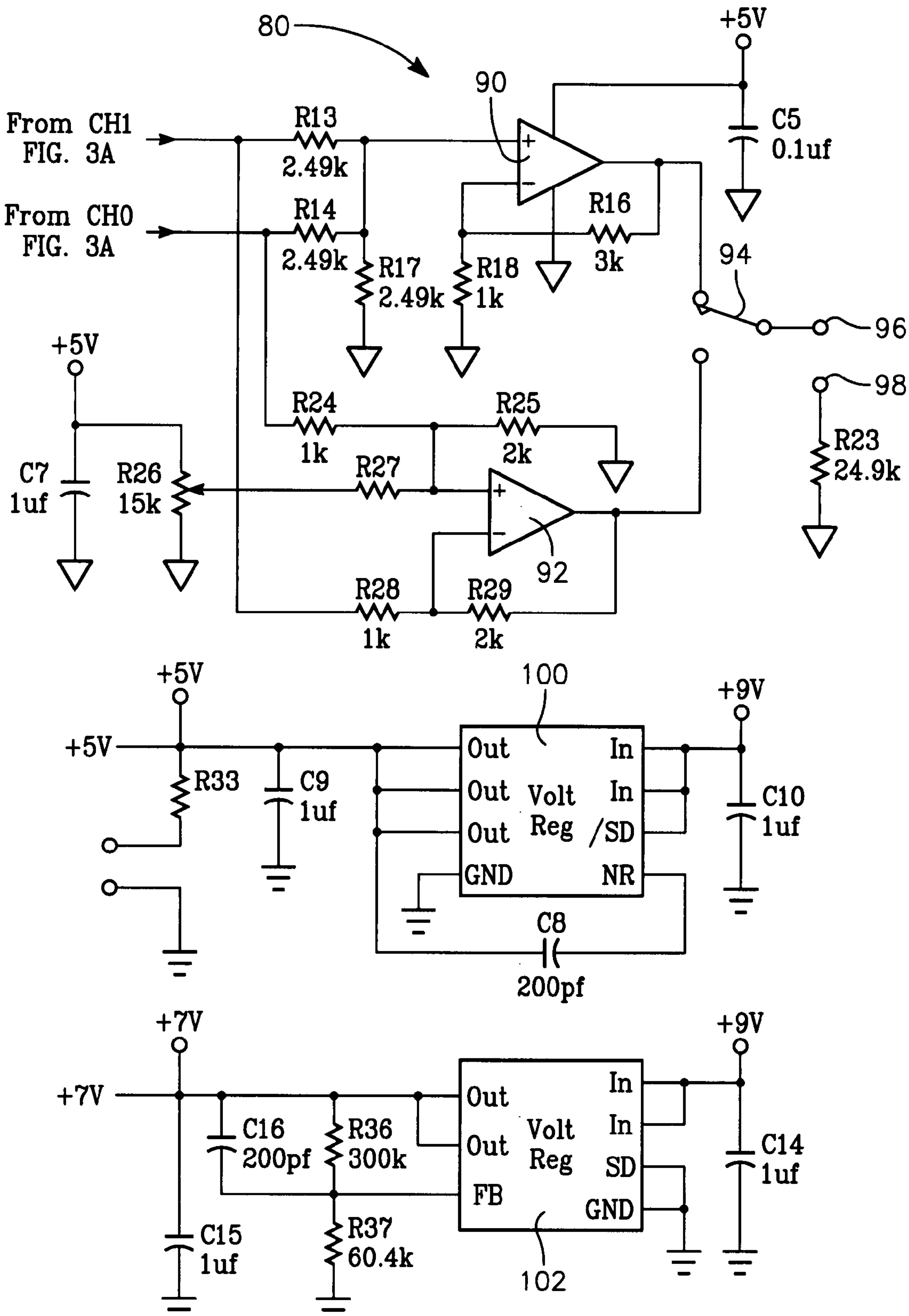

82
+5V
R3
90k
R4
301k
84
R7
R9
49.9k
C3
0.1uf
R10
8.87k
R11
10k
Log
Video In
R12
1.0k
C6
.082uf
86
80
R15
47.5k
+7V
C4
0.1uf
88
IN
Vdd
SHCTRL
R19
A
B
C
Switch
S/H
CH1
CH2
To R13
To R14
INH
Vss
DGND
R20
R21
R22

FIG. 3A



80
+5V
R30 1.0k
R31 1.0k
R32 1.0k
51
+5V
TCK
TDO
TMS
TDI
PLD Program Port
+5V
R34 4.7k
Vcc
DE
Out
GND
+5V
R35
C11
+5V
C12 0.1uf
C13 0.1uf
50
Vcc GND I/O GND I/O GND
GND
I/O
Vcc
GND Vcc I/O I/O I/O I/O
PLD
Vcc
GND
I/O
+5V
+5V
C17 0.1uf
C18 0.1uf
C19
C20 0.1uf
R38
SHOTRL
RFSW1
RFSW2

FIG. 3B



80
90
+5V
From CH1 FIG. 3A
From CH0 FIG. 3A
R13 2.49k
R14 2.49k
R17 2.49k
R18 1k
R16 3k
C5 0.1uf
94
96
98
R23 24.9k
+5V
C7 1uf
R26 15k
R24 1k
R25 2k
R27
R28 1k
R29 2k
92
+5V
+5V
R33
C9 1uf
100
Out
Out
Out
GND
Volt Reg
In
In
/SD
NR
+9V
C10 1uf
C8 200pf
+7V
+7V
C16 200pf
R36 300k
R37 60.4k
C15 1uf
Out
Out
FB
Volt Reg
In
In
SD
GND
+9V
C14 1uf
102

FIG. 3C

HANDHELD GPS JAMMER LOCATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to electronic countermeasures. More specifically, the present invention relates to a handheld electronic device which is useful in locating a GPS jammer signal.

2. Description of the Prior Art

Emitting sources such as GPS jammers can be accurately located by highly classified airborne and space tracking devices. However these devices are few in number and may not be available in a timely manner. Also, visual confirmation of jammers at close range is not generally possible. The use of a handheld or mini remote piloted vehicles complement the capability of these devices to permit pinpoint destruction of the emitters, especially if the emitters are small and dispersed in large numbers.

Anti-jam capabilities incorporated in GPS receivers are limited in the number of simultaneously received jamming signals which can be suppressed. A large number of inexpensive jammers, as is expected to be deployed in a wartime scenario, will therefore render the GPS receivers useless. Such a situation also calls for a locating device capable of attacking the jammers without a large amount of collateral damage or excessive cost.

Vehicle mounted signal identification and location systems are large and expensive. The military's man portable LMRFDS system weighs 60 pounds, requires two soldiers to carry the system, and must be set up on the ground. The LMRFDS system is designed to be used against a wide variety of signals over a large frequency range, thus the system is complex and requires extensive training to operate. It and several other military used locating systems are to be replaced by the vehicle mounted Prophet Block system, leaving no man portable signal location systems in the military's inventory.

Technology is presently available for the production of small, inexpensive GPS jammers by potential adversaries, and these are beginning to appear, as has been noted in open literature. In a wartime environment, it is anticipated that these GPS jammers will be placed in or very near sensitive civilian facilities to prevent their destruction by large warhead precision guided munitions or anti-radiation missiles and without civilian casualties. In a peacetime environment, it is anticipated that these devices will be placed near airports or other facilities relying on GPS data. Even unintentional GPS jammers have been reported (i.e. active VHF/UHF antennas not working, interference due to civilian/military testing, etc.) to cause significant troubles in routine commercial operations. Accordingly there is a need to have a device which is hand held for use by ground personnel to locate and identify the jammers.

SUMMARY OF THE INVENTION

The present invention overcomes some of the difficulties of the past including those mentioned above in that it comprises a lightweight and inexpensive, yet highly efficient and effective handheld electronics jammer locating device for determining the strength of an L1 GPS frequency jamming signal and the direction of the jamming signal. The GPS Jammer Locator has two modes of operation, an amplitude mode for determining signal strength and a difference finding mode for determining signal direction.

The GPS jammer locator consists of two small antennas separated by a half wavelength of a GPS carrier frequency. The RF signals from the antennas are then combined in a 3 DB quadrature coupler. The two RF signals output from the coupler represent two displaced antenna beams. An RF switch sequentially selects the two RF signals and then supplies the selected RF signal to a receiver, terminating the coupler output not selected during a particular time period.

The RF signals are reduced in frequency from the L1 GPS frequency of 1575.42 MHZ to an IF (intermediate frequency) signal of 70 MHZ by the receiver which includes a low noise amplifier, an RF amplifier and a balanced mixer. A log amplifier utilizes signal compression to provide a log transfer function covering IF signals within a power level range of +10 dBm to −70 dBm. The log amplifier then provides a one volt to five volt signal which represents the power level range of +10 dBm to −70 dBm for the 70 MHz IF signal. The output of the log amplifier is sequentially switched by an intergrated switch with sample and hold circuits in synchronization with the RF signal switching by the RF switch. The output signals from the sample and hold circuits are summed to determine signal strength which is an indication of approximate distance to the jammer source and differenced to indicate the azimuth direction of arrival of the jamming signal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of the handheld GPS Jammer Locator comprising the present invention;

FIGS. **2A**-**2C** illustrate an electrical schematic diagram of the GPS jammer locator RF/log IF circuit for GPS Jammer Locator of FIG. **1**; and

FIGS. **3A**-**3C** illustrate an electrical schematic diagram of the GPS frequency detector video control board.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring to FIG. **1**, FIG. **1** illustrates a block diagram of the handheld GPS jammer locator **10** which is used to locate a source which interferes with the reception of RF signals at the GPS frequency of 1.575 GHz. GPS jammer locator **10** has two modes of operation which are an amplitude mode and a DF mode. The amplitude mode of operations indicates if an interfering source is present and detectable. In this mode, the display is a signal strength indicator. The DF mode of operation indicates a precise direction in which the interfering signal is located. In this mode the display points towards the interference. The GPS jammer locator **10** can also be turned off to conserve power. The modes or power off are selected by a switch and a single display is used to conserve power and space.

GPS jammer locator **10** operates as a single channel logarithmic amplitude receiver and an antenna system which provides two beams displaced equally about the centerline of the unit. By switching alternately between the two beams, and storing the received amplitudes, both signal strength and direction-of-arrival are obtained.

GPS jammer locator **10** consists of two small antennas **12** and **14** separated by a half wavelength of the GPS carrier frequency, which is 1.575 GHz. The antennas **12** and **14** are tuned to the GPS carrier frequency to minimize unwanted interference. The output signals from antennas **12** and **14** are combined in a 3 DB quadrature coupler **16**. The two output signals from the coupler **16** represent two displaced antenna beams that are formed by the antennas **12** and **14**. A solid-state switch **18** connected to coupler **16** sequentially selects the output signals from coupler **16** with the selected output signal being supplied to a narrow-band superhet logarithmic receiver **20**. Switch **20** terminates the coupler output signal not selected during a given time period.

Since a GPS jammer concentrates its energy on the carrier frequency of 1.575 GHz, narrow band fixed tuned receiver **20** operates within GPS jammer locator **10** at this frequency. The bandwidth for receiver **20** is chosen to encompass the GPS signal modulation bandwidth with allowance for small frequency errors. The logarithmic IF/video section of receiver **20** is suitable for pure CW (continuous wave) signals or modulated CW signals.

The log video output signal from receiver **20** is switched sequentially by a log video switch **22** and then supplied to two video sample/hold circuits **24** and **26** in synchronization with the antenna beam switching by solid-state switch **18**. The switching rate is selected to avoid errors due to modulation of the jammer signal. The output signals from sample/hold circuits **24** and **26** are summed by a video summer circuit **28** to indicate signal strength (approximate distance to the jammer source) and a video difference circuit **30** to indicate the azimuth direction of arrival of the beam. The direction of arrival indication is limited to avoid ambiguous indications in antenna side and back lobes. Signal strength indicator **32** and azimuth bearing indicator **34** represent a single display in two different modes of operation which are the approximate distance to the jammer source and the direction of arrival of the beam. The block represented by reference numeral **36** represents the control circuitry used to control the switches **18** and **22**, and the power supply/battery for the circuitry of FIG. **1**.

The prototype unit of the handheld GPS jammer locator **10** is packaged in a small plastic housing suitable to be held in the hand of a user and is powered by a single commercially available 9-volt battery. A folding handle and a sighting device may be also be employed as locator **10**. In use, the signal strength mode of locator **10** is first used to obtain coarse direction of arrival of the GPS jamming signal and identify if serious multipath conditions exist. This is accomplished by standing in a single location with the locator pointing outward, pivoting a full 360 degrees, and noting the power reading as the user pivots. If a serious multipath does exist, the user needs to move to another location. Once an interfering source is identified with no multipath issues, the direction of arrival is obtained, and is determined utilizing the difference mode to obtain an accurate bearing for the interfering signal. Note that with direction of arrival normal to the unit package (antenna baseline) the two beam amplitudes are equal and a null (boresight) condition is indicated. This means that when the needle is in the middle of the display, the interference is straight ahead. In the amplitude mode, the needle in the display will be to the far left if no signal is present, and move from this position as the interfering signal increases in strength.

Referring to FIGS. **2A-2C**, there is shown an electrical schematic diagram of the GPS jammer locator RF/log IF circuit **40** for GPS Jammer Locator **10**. Circuit **40** includes a pair of GPS dielectric patch antennas **42** and **44** which are tuned for the L1 GPS frequency band. The antenna **42** and **44** are model number DAK1575MS50 flat patch antennas commercially available from TOKO America Inc. of Prospect, Ill. The signals received by antennas **42** and **44** are spaced one half wavelength apart at 1575 MHz to obtain an amplitude difference between antenna **42** and antenna **44**.

It should be noted that the antennas for locator **10** could also be spaced apart by one wavelength, one half wavelength or multiple wavelengths.

The signals from antenna **42** and **44** are fed to a 3 dB quadrature coupler **46** which is an impedance matching device matching the impedance of antennas **42** and **44**. The quadrature coupler is a Model 2K1305-3 3 dB Hybrid Coupler commercially available from Anaren Microwave of East Syracuse, N.Y.

The output signals from coupler **46** are supplied to an RF switch **48**. When the bit**1** input of switch **48** is selected, switch **48** transfers signals from antenna **42** through its RF**1** input to its RFC output. When the bit**2** input of switch **48** is selected, switch **48** transfers signals from antenna **44** through its RF**2** input to its RFC output. The signal from the non-selected antenna **42** or **44** is terminated. The frequency range that operates switch **48** is selected by the user of handheld GPS jammer locator **10** and is generally in the range of ten hertz to one kilohertz. A programmable logic device **50** is programmed by the user utilizing program device **51** to provide logic bits to the A and B inputs of RF switch **48** to effect the switching of RF switch **48** between the output signals from antenna **42** and the output signals from antenna **44**. RF switch **48** is a Hittite HMC284MS8G SPDT Non-Reflective switch commercially available from Hittite Microwave Corporation of Chelmaford, Mass.

The selected signals which are transferred through RF switch **48** are supplied to an RF low noise amplifier/mixer **52**. Amplifier/mixer **52** includes an internal low noise amplifier, an RF amplifier and a balanced mixer which are utilized to implement the RF functions of a receiver. Amplifier/mixer **52** mixes the frequency of the input signal down from 1575.42 MHz to an IF (intermediate frequency) signal of 70 MHZ. The RF low noise amplifier/mixer **52** used in handheld GPS jammer locator **10** is a RF Micro Devices Inc. Model RF2411 low noise amplifier/mixer commercially available from RF Micro Devices of Greensboro, N.C. The gain provided by amplifier/mixer **52** is approximately 3 dB.

Connected to amplifier/mixer **48** is a 1575.42 MHz bandpass filter **54**. The signal from RF switch **48** passes through bandpass filter **54** which filters the signal to a bandpass frequency of 1575.42 MHz and then returns the 1575.42 MHz RF signal to the rfin- input of amplifier/mixer **52**. Filter **54** is a Sawtek Incorporated Model 855969 1575.42 MHz filter commercially available from Sawtek, Inc. of Orlando, Fla. Amplifier/mixer **48** also receives a local oscillator (LO) signal generated by the combination of a 10 MHz reference oscillator **56**, a local oscillator synthesizer **58** which is set at 1505.42 MHz and a fixed attenuator **60**. The amplifier/mixer **48** then mixes the filtered RF signal with the LO signal to generate the IF signal of 70 MHz. The output level from synthesizer **58** is +10 dBm. The attenuator **60** then attenuates the LO signal approximately 10 dB and provides the 1505.42 MHz attenuated LO signal to amplifier/mixer **48**. The 70 MHz IF signal provided at the output of amplifier/mixer **70** is the difference between the 1575.42 MHz RF signal and the 1505.42 MHz LO signal.

At this time it should be noted that the local oscillator signal can also be set above the RF carrier signal of 1575.42 by 70 MHz to obtain the required IF signal of 70 MHZ. The local oscillator signal when set above the RF carrier signal is 1645.42 MHz.

The output of amplifier/mixer **52** is connected to a RF transformer **62** which operates as an impedance matching transformer. Transformer **62** is connected to a 70 MHz bandpass filter **64** which filters the incoming IF signal to a bandpass frequency of 70 MHz. Filter **64** is a Sawtek

Incorporated Model 854654 70 MHz Low-Loss filter commercially available from Sawtek, Inc. of Orlando, Fla. The 70 MHz IF signal from filter **64** is supplied to an attenuator **66** which attenuates the 70 MHz IF signal and then supplied to a buffer amplifier **68**.

The buffered 70 MHz IF signal from buffer amplifier **68** is supplied to a transformer **70**. The transformer **70** matches the impedance of log amplifier **72** which allows for measurement of signals from high voltage levels to microvoltage levels. The log amplifier **72** utilizes signal compression to provide a log transfer function covering signals within a power level range of +10 dBm to −70 dBm. The output of log amplifier **72** is then provided as a zero volt to three volt signal which represents the power level range of +10 dBm to −70 dBm for the 70 MHz IF signal which is input to log amplifier **72**.

Transformers **62** and **70** are Model MCL ADT9-1T RF transformers commercially available from Mini-Circuits of Brooklyn New York. Attenuators **60** and **66** are Model MCL-PAT fixed attenuators also commercially available from Mini-Circuits. Buffer amplifier **68** is a Model MAX2650 DC-to-Microwave, +5V Low-Noise Amplifier commercially available from Maxim Integrated Products, Inc. of Sunnyvale, Calif. Log amplifier **72** is a Model AD8310 90 dB logarithmic amplifier commercially available from Analog Devices of Norwood, Mass.

Referring to FIGS. **3**A-3C, there is shown an electrical schematic diagram of the GPS frequency detector video control board **80** for jammer locator **10**. The zero to three volt signal from log amplifier **72** is supplied to the log video in input of video control board **80**. The signal is first provided to a comparator circuit **82** which a low power comparator **84** and a HEXFET power MOSFET **86**. Comparator **84** is configured to provide a threshold such that any input signal which is below −70 dBm is clamped to ground. Signals below −70 dBm or 10 millivolts are generally noise signal and a signal below 10 millivolts triggers comparator **84** clamping the signal to zero.

Connected to the output of comparator circuit **82** is connected to a multiple channel sample and hold circuit **88** which is controlled by a sample hold control signal generated by programmable logic device **50**. When the sample hold control signal from programmable logic device **50** is zero, the output from channel zero of circuit **88** is selected for a sample and hold. When the sample hold control signal from programmable logic device **50** is one, the output from channel one of circuit **88** is selected for a sample and hold. The switching rate between the channel zero output of sample and hold circuit **88** and the channel one output of sample and hold circuit **88** is identical and in phase with the switching rate for RF switch **48**.

The sample and hold circuit **86** is a Model SMP08 Octal Sample and Hold Device with Multiplexed Input commercially available from Analog Devices of Norwood, Mass. The comparator **84** is a Model LTC 1441 comparator commercially available from Linear Technology Corporation of Milpitas, Calif. and the power MOSFET **86** is a Model IRF7503 HEXFET power MOSFET commercially available from International Rectifier of El Segundo, Calif.

The channel zero and channel one outputs of sample and hold circuit **86** are connected to a summing amplifier **90** which is utilized with the amplitude mode of operation of handheld GPS jammer locator **10**. The channel zero and channel one outputs of sample and hold circuit **86** are also connected to a difference amplifier **92** which is utilized with the DF mode of operation of handheld GPS jammer locator **10**. The summing amplifier **90** and the difference amplifier **92** is a single chip Model AD 822 dual precession lower power FET operational amplifier commercially available from Analog Devices of Norwood, Mass. The amplitude mode, which is the summation of the channel zero and one signals, indicates the signal strength of the GPS jamming signal. The difference mode, which is the difference between the channel zero and one signals, indicates the signal direction for the GPS jamming signal. A single pole double throw switch **94** allows a user to select between the amplitude mode and the DF (Direction Finding) mode. The output of switch **94** is connected via a pair of holes **96** and **98** in the control board **80** to a meter. The needle in the meter changes more slowly when signal strength is being measured in the amplitude mode of operation for handheld GPS jammer locator **10** and more rapidly when direction is being determined in the DF mode of operation.

The programmable logic device **50** used in jammer locator **10** is an Altera Model EPM7064STC44-10 Field Programmable Gate Array commercially available from Altera Corporation of San Jose, Calif. A state machine programmed into programmable logic device **50** generates Bit **1** and Bit **2** which are used to switch RF switch **48** and the sample hold control signal used to control multiple channel sample and hold circuit **88**.

Control board **80** also provides +5 volts and +7 volts to the electronics components of jammer locator **10**. A nine volt battery is connected to a five volt voltage regulator **100** and a seven volt voltage regulator **102** which supply +5 volts and +7 volts to the electronics components of jammer locator **10**. Voltage regulator **100** is an Analog Devices model ADP3335 voltage regulator and voltage regulator **102** is an Analog Devices model ADP3334 voltage regulator.

From the foregoing, it is readily apparent that the present invention comprises a new, unique, and exceedingly useful handheld GPS jammer locator for determining the strength and direction of a GPS jamming signal, which constitutes a considerable improvement over the known prior art. Many modifications and variations of the present invention are possible in light of the above teachings. It is to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A handheld GPS jammer locator for locating a GPS jamming signal comprising:

(a) first and second antennas separated by a half wavelength of a GPS carrier frequency, said first and second antennas receiving said GPS jamming signal and providing first and second RF electrical signals at the GPS carrier frequency of approximately 1.575 GHz;

(b) a quadrature coupler connected to said first and second antennas to receive said first and second RF electrical signals, said quadrature coupler combining said first and second RF electrical signals and than generating third and fourth RF electrical signals representing a pair of displaced antenna beams received by said first and second antenna beams;

(c) an RF switch connected to said quadrature coupler to receive said third and fourth RF electrical signals, said RF switch, responsive to an RF switching signal, sequentially passing said third and fourth RF signals through said RF switch;

(d) a logarithmic narrow band receiver connected to said RF switch to receive said third and fourth RF signals passed through said RF switch, said logarithmic narrow band receiver converting said third and fourth RF signals to Intermediate Frequency (IF) signals having a logarithmic scaling factor of approximately zero volts to three volts;

(e) a video switch connected to said logarithmic narrow band receiver to receive said IF signals;

(f) first and second sample/hold circuits connected to said video switch;

(g) said video switch switching said IF signals generating samples of said IF signals and providing the samples of said IF signals to said first and second sample/hold circuits, wherein the samples of said IF signals are provided to said first and second sample/hold circuits and held within said first and second sample/hold circuits at a sampling frequency synchronized to a switching frequency for said RF switch;

(h) a summing amplifier connected to said first and second sample/hold circuits to receive and add the samples of said IF signals held by said first and second sample/hold circuits generating a summed signal which indicates a signal strength for said GPS jamming signal; and

(i) a difference amplifier connected to said first and second sample/hold circuits to receive and subtract the samples of said IF signals held by said first and second sample/hold circuits generating a difference signal which indicates a direction of arrival for said GPS jamming signal.

2. The handheld GPS jammer locator of claim **1** further comprising a programmed logic device connected to said RF switch to provide said RF switching signal to said RF switch.

3. The handheld GPS jammer locator of claim **2** wherein said programmed logic device generates a sample hold control signal provided to said video switch and said first and second sample/hold circuits to control sampling of said IF signals by said first and second sample/hold circuits and storage of each sample of said IF signals taken within said first and second sample/hold circuits.

4. The handheld GPS jammer locator of claim **2** further comprising a five volt power supply for providing five volts to said quadrature coupler, said RF switch, said logarithmic narrow band receiver, said programmed logic device, said summing amplifier and said difference amplifier.

5. The handheld GPS jammer locator of claim **1** further comprising a seven volt power supply for providing seven volts to said first and second sample/hold circuits.

6. The handheld GPS jammer locator of claim **1** wherein the switching frequency for said RF switch is within a range of ten hertz to one kilohertz.

7. The handheld GPS jammer locator of claim **1** wherein said RF switching signal is a two bit digital code, said first RF electrical signals from said first antenna pass through said RF switch when bit one of said two bit digital code is active and said second RF electrical signals from said second antenna pass through said RF switch when bit two of said two bit digital code is active.

8. A handheld GPS jammer locator for locating a GPS jamming signal comprising:

(a) first and second antennas separated by a half wavelength of a GPS carrier frequency, said first and second antennas receiving said GPS jamming signal and providing first and second RF electrical signals at the GPS carrier frequency of approximately 1575.42 MHz;

(b) a quadrature coupler connected to said first and second antennas to receive said first and second RF electrical signals, said quadrature coupler combining said first and second RF electrical signals and than generating third and fourth RF electrical signals representing a pair of displaced antenna beams received by said first and second antenna beams;

(c) an RF switch connected to said quadrature coupler to receive said third and fourth RF electrical signals, said RF switch, responsive to an RF switching signal, sequentially passing said third and fourth RF signals through said RF switch;

(d) a logarithmic narrow band receiver connected to said RF switch to received said third and fourth RF signals passed through said RF switch, said logarithmic narrow band receiver converting said third and fourth RF signals to Intermediate Frequency (IF) signals having a logarithmic scaling factor of approximately zero volts to three volts, said logarithmic narrow band receiver including:

(i) an RF low noise amplifier/mixer for mixing said third and fourth RF electrical signals at the GPS carrier frequency of approximately 1575.42 MHz with an external 1505.42 MHz Local Oscillator signal to generate said IF signals;

(ii) a bandpass filter connected to said RF low noise amplifier/mixer, said bandpass filter filtering said IF signal to a bandpass frequency of 70 MHz;

(iii) a log amplifier connected to said bandpass filter, said log amplifier having a log transfer function covering signals within a power level range of +10 dBm to −70 dBm, wherein an output signal from log amplifier is provided as said zero volts to three volts signal which represents the power level range of +10 dBm to −70 dBm for IF signals which are input to said log amplifier;

(e) a video switch connected to said logarithmic narrow band receiver to receive said IF signals;

(f) first and second sample/hold circuits connected to said video switch;

(g) said video switch switching said IF signals generating samples of said IF signals and providing the samples of said IF signals to said first and second sample/hold circuits, wherein the samples of said IF signals are provided to said first and second sample/hold circuits and held within said first and second sample/hold circuits at a sampling frequency synchronized to a switching frequency for said RF switch;

(h) a summing amplifier connected to said first and second sample/hold circuits to receive and add the samples of said IF signals held by said first and second sample/hold circuits generating a summed signal which indicates a signal strength for said GPS jamming signal; and

(i) a difference amplifier connected to said first and second sample/hold circuits to receive and subtract the samples of said IF signals held by said first and second sample/hold circuits generating a difference signal which indicates a direction of arrival for said GPS jamming signal.

9. The handheld GPS jammer locator of claim **8** further comprising a programmed logic device connected to said RF switch to provide said RF switching signal to said RF switch.

10. The handheld GPS jammer locator of claim **9** wherein said programmed logic device generates a sample hold control signal provided to said video switch and said first and second sample/hold circuits to control sampling of said IF signals by said first and second sample/hold circuits and storage of each sample of said IF signals taken within said first and second sample/hold circuits.

11. The handheld GPS jammer locator of claim **9** further comprising a five volt power supply for providing five volts to said quadrature coupler, said RF switch, said logarithmic narrow band receiver, said programmed logic device, said summing amplifier and said difference amplifier.

12. The handheld GPS jammer locator of claim **9** further comprising a seven volt power supply for providing seven volts to said first and second sample/hold circuits.

13. The handheld GPS jammer locator of claim **9** wherein the switching frequency for said RF switch is within a range of ten hertz to one kilohertz.

14. The handheld GPS jammer locator of claim **9** wherein said RF switching signal is a two bit digital code, said first RF electrical signals from said first antenna passing through said RF switch when bit one of said two bit digital code is active and said second RF electrical signals from said second antenna passing through said RF switch when bit two of said two bit digital code is active.

15. A handheld GPS jammer locator for locating a GPS jamming signal comprising:

(a) first and second antennas separated by a half wavelength of a GPS carrier frequency, said first and second antennas receiving said GPS jamming signal and providing first and second RF electrical signals at the GPS carrier frequency of approximately 1575 MHz;

(b) a quadrature coupler connected to said first and second antennas to receive said first and second RF electrical signals, said quadrature coupler combining said first and second RF electrical signals and than generating third and fourth RF electrical signals representing a pair of displaced antenna beams received by said first and second antenna beams;

(c) an RF switch connected to said quadrature coupler to receive said third and fourth RF electrical signals, said RF switch, responsive to an RF switching signal, sequentially passing said third and fourth RF signals through said RF switch;

(d) a logarithmic narrow band receiver connected to said RF switch to received said third and fourth RF signals passed through said RF switch, said logarithmic narrow band receiver converting said third and fourth RF signals to Intermediate Frequency (IF) signals having a logarithmic scaling factor of approximately zero volts to three volts, said logarithmic narrow band receiver including:

(i) an RF low noise amplifier/mixer for mixing said third and fourth RF electrical signals at a frequency of 1575.42 MHz with a 1505.42 MHz Local Oscillator signal to generate said IF signals;

(ii) a local oscillator synthesizer connected to said RF low noise amplifier/mixer to provide said 1505.42 MHz Local Oscillator signal to said RF low noise amplifier/mixer;

(iii) a reference oscillator connected to said local oscillator synthesizer, said oscillator providing a 10 MHz reference signal to said local oscillator synthesizer which then generates 1505.42 MHz Local Oscillator signal in response to said 10 MHz reference signal;

(iv) a first bandpass filter having a signal input and a signal output connected to said RF low noise amplifier/mixer, said first bandpass filter filtering said third and fourth RF electrical signals to said frequency of 1575.42 MHz and then returning said third and fourth RF electrical signals to said RF low noise amplifier/mixer;

(v) a second bandpass filter connected to a signal output of said RF low noise amplifier/mixer, said second bandpass filter filtering said IF signal to a bandpass frequency of 70 MHz;

(vi) a log amplifier connected to said bandpass filter, said log amplifier having a log transfer function covering signals within a power level range of +10 dBm to −70 dBm, wherein an output signal from log amplifier is provided as said zero volts to three volts signal which represents the power level range of +10 dBm to −70 dBm for IF signals which are input to said log amplifier;

(e) a comparator connected to said log amplifier, said comparator being configured to provide a threshold voltage of 10 millivolts wherein input signals below said threshold voltage of 10 millivolts are noise signal and are clamped to ground;

(f) a video switch connected to said comparator to receive said IF signals from said comparator;

(g) first and second sample/hold circuits connected to said video switch;

(h) said video switch switching said IF signals generating samples of said IF signals and providing the samples of said IF signals to said first and second sample/hold circuits, wherein the samples of said IF signals are provided to said first and second sample/hold circuits and held within said first and second sample/hold circuits at a sampling frequency synchronized to a switching frequency for said RF switch;

(i) a summing amplifier connected to said first and second sample/hold circuits to receive and add the samples of said IF signals held by said first and second sample/hold circuits generating a summed signal which indicates a signal strength for said GPS jamming signal;

(j) a difference amplifier connected to said first and second sample/hold circuits to receive and subtract the samples of said IF signals held by said first and second sample/hold circuits generating a difference signal which indicates a direction of arrival for said GPS jamming signal; and

(k) a programmed logic device connected to said RF switch to provide said RF switching signal to said RF switch.

16. The handheld GPS jammer locator of claim **15** wherein said programmed logic device generates a sample hold control signal provided to said video switch and said first and second sample/hold circuits to control sampling of said IF signals by said first and second sample/hold circuits and storage of each sample of said IF signals taken within said first and second sample/hold circuits.

17. The handheld GPS jammer locator of claim **15** further comprising a five volt power supply for providing five volts to said quadrature coupler, said RF switch, said logarithmic narrow band receiver, said programmed logic device, said summing amplifier and said difference amplifier.

18. The handheld GPS jammer locator of claim **15** further comprising a seven volt power supply for providing seven volts to said first and second sample/hold circuits.

19. The handheld GPS jammer locator of claim **15** wherein the switching frequency for said RF switch is within a range of ten hertz to one kilohertz.

20. The handheld GPS jammer locator of claim **15** wherein said RF switching signal is a two bit digital code, said first RF electrical signals from said first antenna passing through said RF switch when bit one of said two bit digital code is active and said second RF electrical signals from said second antenna passing through said RF switch when bit two of said two bit digital code is active.

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