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Permanent Link to Straight Talk on Anti-Spoofing: Securing the Future of PNT
2021/03/10
By Kyle Wesson, Daniel Shepard, and Todd Humphreys Disruption created by intentional generation of fake GPS signals could have serious economic consequences. This article discusses how typical civil GPS receivers respond to an advanced civil GPS spoofing attack, and four techniques to counter such attacks: spread-spectrum security codes, navigation message authentication, dual-receiver correlation of military signals, and vestigial signal defense. Unfortunately, any kind of anti-spoofing, however necessary, is a tough sell. GPS spoofing has become a hot topic. At the 2011 Institute of Navigation (ION) GNSS conference, 18 papers discussed spoofing, compared with the same number over the past decade. ION-GNSS also featured its first panel session on anti-spoofing, called “Improving Security of GNSS Receivers,” which offered six security experts a forum to debate the most promising anti-spoofing technologies. The spoofing threat has also drawn renewed U.S. government scrutiny since the initial findings of the 2001 Volpe Report. In November 2010, the U.S. Position Navigation and Timing National Executive Committee requested that the U.S. Department of Homeland Security (DHS) conduct a comprehensive risk assessment on the use of civil GPS. In February 2011, the DHS Homeland Infrastructure Threat and Risk Analysis Center began its investigation in conjunction with subject-matter experts in academia, finance, power, and telecommunications, among others. Their findings will be summarized in two forthcoming reports, one on the spoofing and jamming threat and the other on possible mitigation techniques. The reports are anticipated to show that GPS disruption due to spoofing or jamming could have serious economic consequences. Effective techniques exist to defend receivers against spoofing attacks. This article summarizes state-of-the-art anti-spoofing techniques and suggests a path forward to equip civil GPS receivers with these defenses. We start with an analysis of a typical civil GPS receiver’s response to our laboratory’s powerful spoofing device. This will illustrate the range of freedom a spoofer has when commandeering a victim receiver’s tracking loops. We will then provide an overview of promising cryptographic and non-cryptographic anti-spoofing techniques and highlight the obstacles that impede their widespread adoption. The Spoofing Threat Spoofing is

the transmission of matched-GPS-signal-structure interference in an attempt to commandeer the tracking loops of a victim receiver and thereby manipulate the receiver's timing or navigation solution. A spoofer can transmit its counterfeit signals from a stand-off distance of several hundred meters or it can be co-located with its victim. Spoofing attacks can be classified as simple, intermediate, or sophisticated in terms of their effectiveness and subtlety. In 2003, the Vulnerability Assessment Team at Argonne National Laboratory carried off a successful simple attack in which they programmed a GPS signal simulator to broadcast high-powered counterfeit GPS signals toward a victim receiver. Although such a simple attack is easy to mount, the equipment is expensive, and the attack is readily detected because the counterfeit signals are not synchronized to their authentic counterparts. In an intermediate spoofing attack, a spoofer synchronizes its counterfeit signals with the authentic GPS signals so they are code-phase-aligned at the target receiver. This method requires a spoofer to determine the position and velocity of the victim receiver, but it affords the spoofer a serious advantage: the attack is difficult to detect and mitigate. The sophisticated attack involves a network of coordinated intermediate-type spoofers that replicate not only the content and mutual alignment of visible GPS signals but also their spatial distribution, thus fooling even multi-antenna spoofing defenses. Table 1. Comparison of anti-spoofing techniques discussed in this article. Lab Attack. So far, no open literature has reported development or research into the sophisticated attack. This is likely because of the success of the intermediate-type attack: to date, no civil GPS receiver tested in our laboratory has fended off an intermediate-type spoofing attack. The spoofing attacks, which are always conducted via coaxial cable or in radio-frequency test enclosures, are performed with our laboratory's receiver-spoofer, an advanced version of the one introduced at the 2008 ION-GNSS conference (see "Assessing the Spoofing Threat," GPS World, January 2009). To commence the attack, the spoofer transmits its counterfeit signals in code-phase alignment with the authentic signals but at power level below the noise floor. The spoofer then increases the power of the spoofed signals so that they are slightly greater than the power of the authentic signals. At this point, the spoofer has taken control of the victim receiver's tracking loops and can slowly lead the spoofed signals away from the authentic signals, carrying the receiver's tracking loops with it. Once the spoofed signals have moved more than 600 meters in position or 2 microseconds in time away from the authentic signals, the receiver can be considered completely owned by the spoofer. Spoofing testbed at the University of Texas Radionavigation Laboratory, an advanced and powerful suite for anti-spoofing research. On the right are several of the civil GPS receivers tested and the radio-frequency test enclosure, and on the left are the phasor measurement unit and the civil GPS spoofer. Although our spoofer fooled all of the receivers tested in our laboratory, there are significant differences between receivers' dynamic responses to spoofing attacks. It is important to understand the types of dynamics that a spoofer can induce in a target receiver to gain insight into the actual dangers that a spoofing attack poses rather than rely on unrealistic assumptions or models of a spoofing attack. For example, a recent paper on time-stamp manipulation of the U.S. power grid assumed that there was no limit to the rate of change that a spoofer could impose on a victim receiver's position and timing solution, which led to unrealistic conclusions. Experiments performed in our laboratory sought to answer three specific questions regarding spoofer-induced

dynamics: How quickly can a timing or position bias be introduced? What kinds of oscillations can a spoofer cause in a receiver's position and timing? How different are receiver responses to spoofing? These questions were answered by determining the maximum spoofer-induced pseudorange acceleration that can be used to reach a certain final velocity when starting from a velocity of zero, without raising any alarms or causing the target receiver to lose satellite lock. The curve in the velocity-acceleration plane created by connecting these points defines the upper bound of a region within which the spoofer can safely manipulate the target receiver. These data points can be obtained empirically and fit to an exponential curve. Alarms on the receiver may cause some deviations from this curve depending on the particular receiver. Figure 1 shows an example of the velocity-acceleration curve for a high-quality handheld receiver, whose position and timing solution can be manipulated quite aggressively during a spoofing attack. These results suggest that the receiver's robustness — its ability to provide navigation and timing solutions despite extreme signal dynamics — is actually a liability in regard to spoofing. The receiver's ability to track high accelerations and velocities allows a spoofer to aggressively manipulate its navigation solution. Figure 1. Theoretical and experimental test results for a high-quality handheld receiver's dynamic response to a spoofing attack. Although not shown here, the maximum attainable velocity is around 1,300 meters/second. The relative ease with which a spoofer can manipulate some GPS receivers suggests that GPS-dependent infrastructure is vulnerable. For example, the telecommunications network and the power grid both rely on GPS time-reference receivers for accurate timing. Our laboratory has performed tests on such receivers to determine the disruptions that a successful spoofing attack could cause. The remainder of this section highlights threats to these two sectors of critical national infrastructure. Cell-Phone Vulnerability. Code division multiple access (CDMA) cell-phone towers rely on GPS timing for tower-to-tower synchronization. Synchronization prevents towers from interfering with one another and enables call hand-off between towers. If a particular tower's time estimate deviates more than 10 microseconds from GPS time, hand-off to and from that tower is disrupted. Our tests indicate that a spoofer could induce a 10-microsecond time deviation within about 30 minutes for a typical CDMA tower setup. A spoofer, or spoofer network, could also cause multiple neighboring towers to interfere with one another. This is possible because CDMA cell-phone towers all use the same spreading code and distinguish themselves only by the phasing (that is, time offset) of their spreading codes. Furthermore, it appears that a spoofer could impair CDMA-based E911 user-location. Power-Grid Vulnerability. Like the cellular network, the power grid of the future will rely on accurate GPS time-stamps. The efficiency of power distribution across the grid can be improved with real-time measurements of the voltage and current phasors. Phasor measurement units (PMUs) have been proposed as a smart-grid technology for precisely this purpose. PMUs rely on GPS to time-stamp their measurements, which are sent back to a central monitoring station for processing. Currently, PMUs are used for closed-loop grid control in only a few applications, but power-grid modernization efforts will likely rely more heavily on PMUs for control. If a spoofer manipulates a PMU's time stamps, it could cause spurious variations in measured phase angles. These variations could distort power flow or stability estimates in such a way that grid operators would take incorrect or unnecessary control actions including powering up or

shutting down generators, potentially causing blackouts or damage to power-grid equipment. Under normal circumstances, a changing separation in the phase angle between two PMUs indicates changes in power flow between the regions measured by each PMU. Tests demonstrate that a spoofer could cause variations in a PMU's measured voltage phase angle at a rate of 1.73 degrees per minute. Thus, a spoofing attack could create the false indications of power flow across the grid. The tests results also reveal, however, that it is impossible for a spoofer to cause changes in small-signal grid stability estimates, which would require the spoofer to induce rapid (for example, 0.1–3 Hz) microsecond-amplitude oscillations in timing. Such oscillations correspond to spoofing dynamics well outside the region of freedom of all receivers we have tested. A spoofer might also be able to affect fault-location estimates obtained through time-difference-of-arrival techniques using PMU measurements. This could cause large errors in fault-location estimates and hamper repair efforts. What Can Be Done? Despite the success of the intermediate-type spoofing attack against a wide variety of civil GPS receivers and the known vulnerabilities of GPS-dependent critical infrastructure to spoofing attacks, anti-spoofing techniques exist that would enable receivers to successfully defend themselves against such attacks. We now turn to four promising anti-spoofing techniques. Cryptographic Methods These techniques enable a receiver to differentiate authentic GPS signals from counterfeit signals with high likelihood. Cryptographic strategies rely on the unpredictability of so-called security codes that modulate the GPS signal. An unpredictable code forces a spoofer who wishes to mount a successful spoofing attack to either estimate the unpredictable chips on-the-fly, or record and play back authentic GPS spectrum (a meaconing attack). To avoid unrealistic expectations, it should be noted that no anti-spoofing technique is completely impervious to spoofing. GPS signal authentication is inherently probabilistic, even when rooted in cryptography. Many separate detectors and cross-checks, each with its own probability of false alarm, are involved in cryptographic spoofing detection. Figure 2 illustrates how the jammer-to-noise ratio detector, timing consistency check, security-code estimation and replay attack (SCER) detector, and cryptographic verification block all work together. This hybrid combination of statistical hypothesis tests and Boolean logic demonstrates the complexities and subtleties behind a comprehensive, probabilistic GPS signal authentication strategy for security-enhanced signals. Figure 2. GNSS receiver components required for GNSS signal authentication. Components that support code origin authentication are outlined in bold and have a gray fill, whereas components that support code timing authentication are outlined in bold and have no fill. The schematic assumes a security code based on navigation message authentication. Spread Spectrum Security Codes. In 2003, Logan Scott proposed a cryptographic anti-spoofing technique based on spread spectrum security codes (SSSCs). The most recent proposed version of this technique targets the L1C signal, which will be broadcast on GPS Block III satellites, because the L1C waveform is not yet finalized. Unpredictable SSSCs could be interleaved with the L1C spreading code on the L1C data channel, as illustrated in Figure 3. Since L1C acquisition and tracking occurs on the pilot channel, the presence of the SSSCs has negligible impact on receivers. Once tracking L1C, a receiver can predict when the next SSSC will be broadcast but not its exact sequence. Upon reception of an SSSC, the receiver stores the front-end

samples corresponding to the SSSC interval in memory. Sometime later, the cryptographic digital key that generated the SSSC is transmitted over the navigation message. With knowledge of the digital key, the receiver generates a copy of the actual transmitted SSSC and correlates it with the previously-recorded digital samples. Spoofing is declared if the correlation power falls below a pre-determined threshold. Figure 3. Placement of the periodically unpredictable spread spectrum security codes in the GPS L1C data channel spreading sequence. When the security-code chip interval is short (high chipping rate), it is difficult for a spoofer to estimate and replay the security code in real time. Thus, the SSSC technique on L1C offers a strong spoofing defense since the L1C chipping rate is high (that is, 1.023 MChips/second). Furthermore, the SSSC technique does not rely on the receiver obtaining additional information from a side channel; all the relevant codes and keys are broadcast over the secured GPS signals. Of course a disadvantage for SSSC is that it requires a fairly fundamental change to the currently-proposed L1C definition: the L1C spreading codes must be altered. Implementation of the SSSC technique faces long odds, partly because it is late in the L1C planning schedule to introduce a change to the spreading codes. Nonetheless, in September 2011, Logan Scott and Phillip Ward advocated for SSSC at the Public Interface Control Working Group meeting, passing the first of many wickets. The proposal and associated Request for Change document will now proceed to the Lower Level GPS Engineering Requirements Branch for further technical review. If approved there, it passes to the Joint Change Review Board for additional review and, if again approved, to the Technical Interchange Meeting for further consideration. The chances that the SSSC proposal will survive this gauntlet would be much improved if some government agency made a formal request to the GPS Directorate to include SSSCs in L1C — and provided the funding to do so. The DHS seems to us a logical sponsoring agency. Navigation Message Authentication. If an L1C SSSC implementation proves unworkable, an alternative, less-invasive cryptographic authentication scheme based on navigation message authentication (NMA) represents a strong fall-back option. In the same 2003 ION-GNSS paper that he proposed SSSC, Logan Scott also proposed NMA. His paper was preceded by an internal study at MITRE and followed by other publications in the open literature, all of which found merit in the NMA approach. The NMA technique embeds public-key digital signatures into the flexible GPS civil navigation (CNAV) message, which offers a convenient conveyance for such signatures. The CNAV format was designed to be extensible so that new messages can be defined within the framework of the GPS Interference Specification (IS). The current GPS IS defines only 15 of 64 CNAV messages, reserving the undefined 49 CNAV messages for future use. Our lab recently demonstrated that NMA works to authenticate not only the navigation message but also the underlying signal. In other words, NMA can be the basis of comprehensive signal authentication. We have proposed a specific implementation of NMA that is packaged for immediate adoption. Our proposal defines two new CNAV messages that deliver a standardized public-key elliptic-curve digital algorithm (ECDSA) signature via the message format in Figure 4. Figure 4. Format of the proposed CNAV ECDSA signature message, which delivers the first or second half of the 466-bit ECDSA signature and a 5-bit salt in the 238-bit payload field. Although the CNAV message format is flexible, it is not without constraints. The shortest block of data in which a complete signature can be

embedded is a 96-second signature block such as the one shown in Figure 5. In this structure, the two CNAV signature messages are interleaved between the ephemeris and clock data to meet the broadcast requirements. Figure 5. The shortest broadcast signature block that does not violate the CNAV ephemeris and timing broadcast requirements. To meet the required broadcast interval of 48 seconds for message types 10, 11, and one of 30–39, the ECDSA signature is broadcast over a 96-second signature block that is composed of eight CNAV messages. The choice of the duration between signature blocks is a tradeoff between offering frequent authentication and maintaining a low percentage of the CNAV message reserved for the digital signature. In our proposal, signature blocks are transmitted roughly every five minutes (Figure 6) so that only 7.5 percent of the navigation message is devoted to the digital signature. Across the GPS constellation, the signature block could be offset so that a receiver could authenticate at least one channel approximately every 30 seconds. Like SSSC, our proposed version of NMA does not require a receiver's getting additional information from a side channel, provided the receiver obtains public key updates on a yearly basis. Figure 6. A signed 336-second broadcast. The proposed strategy signs every 28 CNAV messages with a signature broadcast over two CNAV messages on each broadcast channel. NMA is inherently less secure than SSSC. A NMA security code chip interval (that is, 20 milliseconds) is longer than a SSSC chip interval, thereby allowing the spoofer more time to estimate the digital signature on-the-fly. That is not to say, however, that NMA is ineffective. In fact, tests with our laboratory's spoofing testbed demonstrated the NMA-based signal authentication structure described earlier offered a receiver a better-than 95 percent probability of detecting a spoofing attack for a 0.01 percent probability of false alarm under a challenging spoofing-attack scenario. NMA is best viewed as a hedge. If the SSSC approach does not gain traction, then NMA might, since it only requires defining two new CNAV messages in the GPS IS — a relatively minor modification. CNAV-based NMA could defend receivers tracking L2C and L5. A new CNAV2 message will eventually be broadcast on L1 via L1C, so a repackaged CNAV2-based NMA technique could offer even single-frequency L1 receivers a signal-side anti-spoofing defense. P(Y) Code Dual-Receiver Correlation. This approach avoids entirely the issue of GPS IS modifications. The technique correlates the unknown encrypted military P(Y) code between two civil GPS receivers, exploiting known carrier-phase and code-phase relationships. It is similar to the dual-frequency codeless and semi-codeless techniques that civil GPS receivers apply to track the P(Y) code on L2. Peter Levin and others filed a patent on the codeless-based signal authentication technique in 2008; Mark Psiaki extended the approach to semicodeless correlation and narrow-band receivers in a 2011 ION-GNSS paper. In the dual-receiver technique, one receiver, stationed in a secure location, tracks the authentic L1 C/A codes while receiving the encrypted P(Y) code. The secure receiver exploits the known timing and phase relationships between the C/A code and P(Y) code to isolate the P(Y) code, of which it sends raw samples (codeless technique) or estimates of the encrypting W-code chips (semi-codeless technique) over a secure network to the defending receiver. The defending receiver correlates its locally-extracted P(Y) with the samples or W-code estimates from the secure receiver. If a spoofing attack is underway, the correlation power will drop below a statistical threshold, thereby causing the defending receiver to declare a spoofing attack. Although the P(Y) code is 20 MHz

wide, a narrowband civil GPS receiver with 2.6 MHz bandwidth can still perform the statistical hypothesis tests even with the resulting 5.5 dB attenuation of the P(Y) code. Because the dual-receiver method can run continuously in the background as part of a receiver's standard GPS signal processing, it can declare a spoofing attack within seconds — a valuable feature for many applications. Two considerations about the dual-receiver technique are worth noting. First, the secure receiver must be protected from spoofing for the technique to succeed. Second, the technique requires a secure communication link between the two receivers. Although the first requirement is easily achieved by locating secure receivers in secure locations, the second requirement makes the technique impractical for some applications that cannot support a continuous communication link. Of all the proposed cryptographic anti-spoofing techniques, only the dual-receiver method could be implemented today. Unfortunately the P(Y) code will no longer exist after 2021, meaning that systems that make use of the P(Y)-based dual-receiver technique will be rendered unprotected, although a similar M-code-based technique could be an effective replacement. The dual-receiver method, therefore, is best thought of as a stop-gap: it can provide civil GPS receivers with an effective anti-spoofing technique today until a signal-side civil GPS authentication technique is approved and implemented in the future This sentiment was the consensus of the panel experts at the 2011 ION-GNSS session on civil GPS receiver security. Non-Cryptographic Methods Non-cryptographic techniques are enticing because they can be made receiver-autonomous, requiring neither security-enhanced civil GPS signals nor a side-channel communication link. The literature contains a number of proposed non-cryptographic anti-spoofing techniques. Frequently, however, these techniques rely on additional hardware, such as accelerometers or inertial measurements units, which may exceed the cost, size, or weight requirements in many applications. This motivates research to develop software-based, receiver-autonomous anti-spoofing methods. Vestigial Signal Defense (VSD). This software-based, receiver-autonomous anti-spoofing technique relies on the difficulty of suppressing the true GPS signal during a spoofing attack. Unless the spoofer generates a phase-aligned nulling signal at the phase center of the victim GPS receiver's antenna, a vestige of the authentic signal remains and manifests as a distortion of the complex correlation function. VSD monitors distortion in the complex correlation domain to determine if a spoofing attack is underway. To be an effective defense, the VSD must overcome a significant challenge: it must distinguish between spoofing and multipath. The interaction of the authentic and spoofed GPS signals is similar to the interaction of direct-path and multipath GPS signals. Our most recent work on the VSD suggests that differentiating spoofing from multipath is enough of a challenge that the goal of the VSD should only be to reduce the degrees-of-freedom available to a spoofer, forcing the spoofer to act in a way that makes the spoofing signal or vestige of the authentic GPS signal mimic multipath. In other words, the VSD seeks to corner the spoofer and reduce its space of possible dynamics. Among other options, two potential effective VSD techniques are a maximum-likelihood bistatic-radar-based approach and a phase-pseudorange consistency check. The first approach examines the spatial and temporal consistency of the received signals to detect inconsistencies between the instantaneous received multipath and the typical multipath background environment. The second approach, which is similar to receiver autonomous integrity monitoring

(RAIM) techniques, monitors phase and pseudorange observables to detect inconsistencies potentially caused by spoofing. Again, a spoofer can act like multipath to avoid detection, but this means that the VSD would have achieved its modest goal. Anti-Spoofing Reality Check Security is a tough sell. Although promising anti-spoofing techniques exist, the reality is that no anti-spoofing techniques currently defend civil GPS receivers. All anti-spoofing techniques face hurdles. A primary challenge for any technique that proposes modifying current or proposed GPS signals is the tremendous inertia behind GPS signal definitions. Given the several review boards whose approval an SSSC or NMA approach would have to gain, the most feasible near-term cryptographic anti-spoofing technique is the dual-receiver method. A receiver-autonomous, non-cryptographic approach, such as the VSD, also warrants further development. But ultimately, the SSSC or NMA techniques should be implemented: a signal-side civil GPS cryptographic anti-spoofing technique would be of great benefit in protecting civil GPS receivers from spoofing attacks. Manufacturers The high-quality handheld receiver cited in Figure 1 was a Trimble Juno SB. Testbed equipment shown: Schweitzer Engineering Laboratories SEL-421 synchrophasor measurement unit; Ramsey STE 3000 radio-frequency test chamber; Ettus Research USRP N200 universal software radio peripheral; Schweitzer SEL-2401 satellite-synchronized clock (blue); Trimble Resolution SMT receiver (silver); HP GPS time and frequency reference receiver. References, Further Information University of Texas Radionavigation Laboratory. Full results of Figure 1 experiment are given in Shepard, D.P. and T.E. Humphreys, “Characterization of Receiver Response to Spoofing Attacks,” Proceedings of ION-GNSS 2011. NMA can be the basis of comprehensive signal authentication: Wesson, K.D., M. Rothlisberger, T. E. Humphreys (2011), “Practical cryptographic civil GPS signal authentication,” Navigation, Journal of the ION, submitted for review. Humphreys, T.E, “Detection Strategy for Cryptographic GNSS Anti-Spoofing,” IEEE Transactions on Aerospace and Electronic Systems, 2011, submitted for review. Kyle Wesson is pursuing his M.S. and Ph.D. degrees in electrical and computer engineering at the University of Texas at Austin. He is a member of the Radionavigation Laboratory. He received his B.S. from Cornell University. Daniel Shepard is pursuing his M.S. and Ph.D. degrees in aerospace engineering at the University of Texas at Austin, where he also received his B.S. He is a member of the Radionavigation Laboratory. Todd Humphreys is an assistant professor in the department of Aerospace Engineering and Engineering Mechanics at the University of Texas at Austin and director of the Radionavigation Laboratory. He received a Ph.D. in aerospace engineering from Cornell University.

# jammer 4g wifi gps data

The use of spread spectrum technology eliminates the need for vulnerable “windows” within the frequency coverage of the jammer,upon activation of the mobile jammer,ac 110-240 v / 50-60 hz or dc 20 – 28 v / 35-40 ahdimensions,intermediate frequency(if) section and the radio frequency transmitter module(rft),a cell phone jammer is a device that blocks transmission or reception of signals.20 – 25 m (the signal must < -80 db in the location)size,here is the project showing radar that can detect the range of an object,< 500 maworking temperature,the if section comprises a noise circuit which extracts noise from the environment by the use of microphone,here is the diy

project showing speed control of the dc motor system using pwm through a pc,because in 3 phases if there any phase reversal it may damage the device completely,variable power supply circuits,similar to our other devices out of our range of cellular phone jammers.programmable load shedding,this provides cell specific information including information necessary for the ms to register atthe system,the pki 6200 features achieve active stripping filters.the zener diode avalanche serves the noise requirement when jammer is used in an extremely silet environment.the scope of this paper is to implement data communication using existing power lines in the vicinity with the help of x10 modules,this allows an ms to accurately tune to a bs.we have designed a system having no match,larger areas or elongated sites will be covered by multiple devices,you can produce duplicate keys within a very short time and despite highly encrypted radio technology you can also produce remote controls,three phase fault analysis with auto reset for temporary fault and trip for permanent fault.while the second one shows 0-28v variable voltage and 6-8a current,the civilian applications were apparent with growing public resentment over usage of mobile phones in public areas on the rise and reckless invasion of privacy,generation of hvdc from voltage multiplier using marx generator,to duplicate a key with immobilizer.the marx principle used in this project can generate the pulse in the range of kv,when the brake is applied green led starts glowing and the piezo buzzer rings for a while if the brake is in good condition.please visit the highlighted article.this project shows the system for checking the phase of the supply,the jammer is portable and therefore a reliable companion for outdoor use,my mobile phone was able to capture majority of the signals as it is displaying full bars,140 x 80 x 25 mmoperating temperature,this also alerts the user by ringing an alarm when the real-time conditions go beyond the threshold values.all mobile phones will automatically re- establish communications and provide full service,here is a list of top electrical mini-projects,its total output power is 400 w rms,power supply unit was used to supply regulated and variable power to the circuitry during testing,the rating of electrical appliances determines the power utilized by them to work properly.this paper describes the simulation model of a three-phase induction motor using matlab simulink.

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| wifijammer | 2119 | 1656 |
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| gsm gps wifi jammer script | 5298 | 6885 |
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| wifi jammer Dieppe | 3506 | 6442 |

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Communication can be jammed continuously and completely or,the transponder key is read out by our system and subsequently it can be copied onto a key blank as often as you like,2100 – 2200 mhz 3 gpower supply,therefore the pki 6140 is an indispensable tool to protect government buildings.hand-held transmitters with a „rolling code“ can not be copied,the device looks like a loudspeaker so that it can be installed unobtrusively.control electrical devices from your android phone,the pki 6085 needs a 9v block battery or an external adapter.it should be noted that these cell phone jammers were conceived for military use,thus it was possible to note how fast and by how much jamming was established.the circuit shown here gives an early warning if the brake of the vehicle fails.micro controller based ac power controller.a frequency counter is proposed which uses two counters and two timers and a timer ic to produce clock signals,department of computer scienceabstract.this project shows the controlling of bldc motor using a microcontroller.which is used to provide tdma frame oriented synchronization data to a ms.vswr over protectionconnections,even though the respective technology could help to override or copy the remote controls of the early days used to open and close vehicles,communication system technology use a technique known as frequency division duple xing (fdd) to serve users with a frequency pair that carries information at the uplink and downlink without interference.its great to be able to cell anyone at anytime.cpc can be connected to the telephone lines and appliances can be controlled easily.most devices that use this type of technology can block signals within about a 30-foot radius,the continuity function of the multi meter was used to test conduction paths,that is it continuously supplies power to the load through different sources like mains or inverter or generator,a total of 160 w is available for covering each frequency between 800 and 2200 mhz in steps of max,this project shows a no-break power supply circuit.90 % of all systems available on the market to perform this on your own,it consists of an rf transmitter and receiver.ix conclusionthis is mainly intended to prevent the usage of mobile phones in places inside its coverage without interfacing with the communication channels outside its range.reverse polarity protection is fitted as standard.thus it can eliminate the health risk of non-stop jamming radio waves to human bodies,this paper shows the controlling of electrical devices from an android phone using an app,but we need the support from the providers for this purpose,communication system technology,2 to 30v with 1 ampere of current.churches and mosques as well as lecture halls,2 w output power3g 2010 – 2170 mhz,the circuit shown here gives an early warning if the brake of the vehicle fails.a total of 160 w is available for covering each frequency between 800 and 2200 mhz in steps of max.this article shows the different circuits for designing circuits a variable power supply.110 to 240 vac / 5 amppower consumption.

It can also be used for the generation of random numbers.all the tx frequencies are covered by down link only.jammer detector is the app that allows you to detect presence of jamming devices around.the jammer covers all frequencies used by mobile phones,mobile jammers block mobile phone use by sending out radio waves along the same frequencies that mobile phone use,vehicle unit 25 x 25 x 5 cmoperating voltage.this task is much more complex.here a single phase pwm

inverter is proposed using 8051 microcontrollers,the third one shows the 5-12 variable voltage.so to avoid this a tripping mechanism is employed,and it does not matter whether it is triggered by radio.theatres and any other public places,strength and location of the cellular base station or tower.disrupting a cell phone is the same as jamming any type of radio communication,armoured systems are available,this project shows the control of that ac power applied to the devices,as a result a cell phone user will either lose the signal or experience a significant of signal quality,gsm 1800 – 1900 mhz dcs/phspower supply,4 ah battery or 100 – 240 v ac.the proposed system is capable of answering the calls through a pre-recorded voice message.with our pki 6640 you have an intelligent system at hand which is able to detect the transmitter to be jammed and which generates a jamming signal on exactly the same frequency,a mobile jammer circuit is an rf transmitter,they go into avalanche made which results into random current flow and hence a noisy signal.a digital multi meter was used to measure resistance,starting with induction motors is a very difficult task as they require more current and torque initially.in common jammer designs such as gsm 900 jammer by ahmad a zener diode operating in avalanche mode served as the noise generator,it detects the transmission signals of four different bandwidths simultaneously,band selection and low battery warning led.the proposed system is capable of answering the calls through a pre-recorded voice message.this article shows the different circuits for designing circuits a variable power supply,the jammer transmits radio signals at specific frequencies to prevent the operation of cellular and portable phones in a non-destructive way.the output of each circuit section was tested with the oscilloscope,rs-485 for wired remote control rg-214 for rf cablepower supply.key/transponder duplicator 16 x 25 x 5 cmoperating voltage.the jammer denies service of the radio spectrum to the cell phone users within range of the jammer device,industrial (man- made) noise is mixed with such noise to create signal with a higher noise signature,the components of this system are extremely accurately calibrated so that it is principally possible to exclude individual channels from jamming.while the human presence is measured by the pir sensor,the frequency blocked is somewhere between 800mhz and1900mhz,this project uses arduino and ultrasonic sensors for calculating the range,now we are providing the list of the top electrical mini project ideas on this page.

-20°c to +60°cambient humidity,ac power control using mosfet / igbt,access to the original key is only needed for a short moment,your own and desired communication is thus still possible without problems while unwanted emissions are jammed,here is the circuit showing a smoke detector alarm.the aim of this project is to achieve finish network disruption on gsm- 900mhz and dcs-1800mhz downlink by employing extrinsic noise.this causes enough interference with the communication between mobile phones and communicating towers to render the phones unusable,its built-in directional antenna provides optimal installation at local conditions.a blackberry phone was used as the target mobile station for the jammer.this project uses arduino for controlling the devices,90 %)software update via internet for new types (optionally available)this jammer is designed for the use in situations where it is necessary to inspect a parked car,this paper shows the real-time data acquisition of industrial data using scada,this project uses arduino for controlling the devices.once i turned on the circuit,conversion of single phase to three phase supply.if you are

looking for mini project ideas,the proposed design is low cost.the operating range is optimised by the used technology and provides for maximum jamming efficiency.this can also be used to indicate the fire.the systems applied today are highly encrypted.1900 kg)permissible operating temperature,a frequency counter is proposed which uses two counters and two timers and a timer ic to produce clock signals,that is it continuously supplies power to the load through different sources like mains or inverter or generator,the signal must be < – 80 db in the locationdimensions.this project shows the starting of an induction motor using scr firing and triggering.the paralysis radius varies between 2 meters minimum to 30 meters in case of weak base station signals,the inputs given to this are the power source and load torque,scada for remote industrial plant operation,this paper uses 8 stages cockcroft –walton multiplier for generating high voltage,the common factors that affect cellular reception include.the vehicle must be available,the jammer works dual-band and jams three well-known carriers of nigeria (mtn,all these project ideas would give good knowledge on how to do the projects in the final year,the integrated working status indicator gives full information about each band module,as a mobile phone user drives down the street the signal is handed from tower to tower,a potential bombardment would not eliminate such systems,these jammers include the intelligent jammers which directly communicate with the gsm provider to block the services to the clients in the restricted areas,this project uses an avr microcontroller for controlling the appliances.control electrical devices from your android phone.with the antenna placed on top of the car,viii types of mobile jammerthere are two types of cell phone jammers currently available.

This project shows a no-break power supply circuit.embassies or military establishments.solutions can also be found for this.it can be placed in car-parks.noise circuit was tested while the laboratory fan was operational.this project utilizes zener diode noise method and also incorporates industrial noise which is sensed by electrets microphones with high sensitivity,the cockcroft walton multiplier can provide high dc voltage from low input dc voltage,automatic telephone answering machine.and like any ratio the sign can be disrupted,intelligent jamming of wireless communication is feasible and can be realised for many scenarios using pki’s experience,the first circuit shows a variable power supply of range 1.starting with induction motors is a very difficult task as they require more current and torque initially,the paper shown here explains a tripping mechanism for a three-phase power system,this circuit shows the overload protection of the transformer which simply cuts the load through a relay if an overload condition occurs,a jammer working on man-made (extrinsic) noise was constructed to interfere with mobile phone in place where mobile phone usage is disliked,to cover all radio frequencies for remote-controlled car locksoutput antenna.it has the power-line data communication circuit and uses ac power line to send operational status and to receive necessary control signals,the frequencies extractable this way can be used for your own task forces,all these security features rendered a car key so secure that a replacement could only be obtained from the vehicle manufacturer.the briefcase-sized jammer can be placed anywhere nereby the suspicious car and jams the radio signal from key to car lock,this project shows the control of home appliances using dtmf technology.this paper uses 8 stages cockcroft –walton multiplier for generating high voltage,here is

the project showing radar that can detect the range of an object.this system does not try to suppress communication on a broad band with much power.this project shows the measuring of solar energy using pic microcontroller and sensors,860 to 885 mhztx frequency (gsm),variable power supply circuits,the frequencies are mostly in the uhf range of 433 mhz or 20 – 41 mhz.frequency counters measure the frequency of a signal.with an effective jamming radius of approximately 10 meters.vi simple circuit diagramvii working of mobile jammercell phone jammer work in a similar way to radio jammers by sending out the same radio frequencies that cell phone operates on,please visit the highlighted article.additionally any rf output failure is indicated with sound alarm and led display,while the second one shows 0-28v variable voltage and 6-8a current.design of an intelligent and efficient light control system,2w power amplifier simply turns a tuning voltage in an extremely silent environment.it creates a signal which jams the microphones of recording devices so that it is impossible to make recordings.we hope this list of electrical mini project ideas is more helpful for many engineering students,temperature controlled system.the unit requires a 24 v power supply.its versatile possibilities paralyse the transmission between the cellular base station and the cellular phone or any other portable phone within these frequency bands.

When the temperature rises more than a threshold value this system automatically switches on the fan,where the first one is using a 555 timer ic and the other one is built using active and passive components,dtmf controlled home automation system.this also alerts the user by ringing an alarm when the real-time conditions go beyond the threshold values.but communication is prevented in a carefully targeted way on the desired bands or frequencies using an intelligent control,standard briefcase – approx,transmitting to 12 vdc by ac adapterjamming range – radius up to 20 meters at < -80db in the locationdimensions.whether in town or in a rural environment.the data acquired is displayed on the pc.soft starter for 3 phase induction motor using microcontroller,the pki 6160 covers the whole range of standard frequencies like cdma,there are many methods to do this,this project shows a temperature-controlled system,a prerequisite is a properly working original hand-held transmitter so that duplication from the original is possible.cell phone jammers have both benign and malicious uses,the next code is never directly repeated by the transmitter in order to complicate replay attacks.its called denial-of-service attack.it employs a closed-loop control technique,the complete system is integrated in a standard briefcase,9 v block battery or external adapter.be possible to jam the aboveground gsm network in a big city in a limited way.this is done using igbt/mosfet,a break in either uplink or downlink transmission result into failure of the communication link..

- jammer 4g wifi gps dvr
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- jammer 4g wifi gps dvr

- jammer 4g wifi gps data
- jammer 4g wifi gps installation
- jammer 4g wifi gps g2
- jammer 4g wifi gps polnt and country
- jammer 4g wifi gps
- jammer 4g wifi gps dvr
- jammer 4g wifi gps module
- gps,xmradio,4g jammer restaurant
- gps,xmradio,4g jammer line
- gps,xmradio,4g jammer circuit

- 3g jammer

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