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Permanent Link to Innovation: The Devil Is in the Details
2021/03/10
Looking Closely at Received GPS Carrier Phase By Johnathan York, Jon Little, and David Munton The stability of a received GPS signal determines how well the receiver can track the signal and the accuracy of the positioning results it provides. While the satellites use a very stable oscillator and modulation system to generate their signals, just how stable are the resulting phase-modulated carriers? In particular, do received signals always conform to the published system specifications? In this month's column we take a look at a specially designed receiver for analyzing GPS carrier phase and some of the interesting results that have been obtained. INNOVATION INSIGHTS by Richard Langley A RADIO WAVE, OR ANY ELECTROMAGNETIC WAVE FOR THAT MATTER, may be generally characterized by four parameters: amplitude, frequency, phase, and polarization. If the values of amplitude, frequency, and polarization remain constant, then the wave is a pure oscillation or "tone" and can be represented as a sine wave. An unvarying tone doesn't convey any information. However, the wave can be modulated by varying one or more of its characteristic parameters in a controlled fashion. In this way information, whether it be audio, images, or data, can be transmitted from one place to another. The sine wave is therefore referred to as a "carrier" (of the modulation). A continuous wave is a wave that is not interrupted. Of course, radio waves are not only used for communicating. They're also used for navigation, radar, and many other purposes including the jamming of other radio signals. The modulating signal may either be continuously varying (analog) or have a fixed number of values of one or more of the parameters (digital) — two values in the case of binary modulation. Amplitude modulation is commonly used for broadcasting and communications. If a continuous wave is interrupted by keying the transmitter on and off using a code of some kind, such as Morse code, information can be sent. For speech and music transmission, an audio waveform is modulated onto the carrier. Frequency modulation is used for very high frequency (VHF) high-fidelity broadcasts and for communications in the VHF and ultra-high-frequency ranges of the radio spectrum. The instantaneous carrier frequency changes with the frequency and amplitude of the modulating waveform.

Phase modulation is typically used for data transmissions and, as we know, this is how the pseudorandom noise codes and the navigation message modulate the signal carriers of GPS and other global navigation satellite systems. (While the polarization of a wave can be modulated to transmit information, this is not very common.) The stability of a received GPS signal — both the carrier and its modulations — determines, in part, how well the receiver can track the signal and the accuracy of the positioning results it provides. While the satellites use a very stable oscillator and modulation system to generate their signals, just how stable are the resulting phase-modulated carriers? In particular, do received signals always conform to the published system specifications? In this month's column we take a look at a specially designed receiver for analyzing GPS carrier phase and some of the interesting results that have been obtained. "Innovation" features discussions about advances in GPS technology, its applications, and the fundamentals of GPS positioning. The column is coordinated by Richard Langley, Department of Geodesy and Geomatics Engineering, University of New Brunswick. By Johnathan York, Jon Little, and David Munton All global navigation satellite systems (GNSS) rely on well-defined data messages modulated onto stable carrier signals. The transmission of signals that adhere to published interface specifications (ISs) is what permits a GPS or GLONASS signal to be transmitted from a satellite and to be decoded at our receiver. This process is one that most of us never need to consider, and is part of the background magic that make GNSS so powerful. Still, signals are generated and received by real hardware — hardware that can be subject to the harsh space environment or a challenging ground environment. And once these signals are generated, they propagate to the user along a path through a dynamic medium that includes the ionosphere — a dilute plasma that introduces a well-known time-delay and phase change into the signal. The net result is is an effect on the signal that depends on both time and space. An interesting question is the following: How do we know that the signal we plan to send (as documented in an IS) is actually the signal that we receive? A pragmatic answer is that GNSS positioning works. If there is a difference between the IS-defined signal and the received signal, the impact is not seen by most users. Another answer is that satellite vendors test (and then test again) their equipment prior to launch, providing a high level of certainty that the ISs are being adhered too. In this article, we will describe our work in providing a third way of answering the question — by monitoring signals — motivated by our desire to see "all the bits, all the time." We have seen some interesting effects in our observations, and we will discuss our attempts to detect and characterize these effects. Background For our purposes, we will be looking strictly at the L1 C/A-code signal. The reasons for this will become clear shortly. The standard textbook form of the noiseless signal is (1) where P is the signal power, cCA(t) is the C/A-code modulation stream of plus and minus ones, nNav(t) is the navigation bitstream that is modulated onto the signal, and the cos(ωt) factor represents the fundamental carrier frequency, with ω being the angular frequency (ω=2πf). For the GPS L1 signal, f = 1575.42 MHz. The GPS receiver processes this signal (in the presence of noise) into the observables (such as range, phase, or Doppler frequency shift), or the positions and velocities that we need. One of the research problems that we find interesting is determining how to monitor the details of the signal in Equation (1) or of any other GNSS signal. Why would this be of interest? To us this is interesting because we have seen events where the signal does not behave as expected. In fact, these events were first noted by the Federal Aviation Administration's (FAA's) Wide Area Augmentation System (WAAS) receivers, and were later noted again in ionospheric observations. By being able to monitor the signal at a very detailed level, we can hope to gain insight into the origins of these events. We are not alone in wanting to validate that the signal and data being produced by a GNSS receiver is valid. A standard approach to monitoring the GNSS signal would be to use an autonomous receiver method, known as receiver autonomous integrity monitoring or RAIM. However, in this approach, the integrity of the navigation solution is evaluated based on the range and phase observables produced by the receiver, and we obtain no insight into the behavior of the actual signal — only the receiver's behavior in processing the received signals. Another option is to directly observe each satellite's signal using a high-gain antenna. This approach provides significant insight into the behavior of the signal but is expensive and is really only effective on one satellite at a time. A system, which is close in spirit to our approach, is the Ohio University GPS Anomalous Event Monitor (GAEM). GAEM consists of two high-quality commercial receivers, which serve as independent triggers for an RF capture system. When the receivers detect an anomaly, the RF capture system is able to provide 20 seconds of raw RF data for study. Using an Inexpensive Software Receiver The observations we will discuss in the rest of this paper were made using what we term the Global Navigation Satellite System Complex Ambiguity Function receiver, or GCAF. The GCAF is a prototype receiver, and is well suited to some of the detailed analysis we have described. Briefly, the GCAF receiver is a single-channel, single-frequency (L1) GPS receiver, which uses firmware installed on a field programmable gate array (FPGA) to process the incoming GPS signal. FIGURE 1 is a labeled photograph of the GCAF. RF down-conversion occurs in the module at lower left. The down-converted signal is passed to an FPGA-based software receiver, shown at lower right. All of the processing to produce the complex correlation curves is done in the software receiver. The aggregator, shown at upper right, simply provides an Ethernet interface to the outside. FIGURE 1. The GCAF receiver. The incoming signal is correlated against a replica of the expected L1 C/A-code signal, generating samples of the correlation curve. The difference between the GCAF and many standard commercial GPS receivers is that the GCAF samples the C/A-code correlation curve at 512 points (lags) at a 1-kHz rate. Each correlation sample is complex, consisting of in-phase (I) and quadrature (Q) components, with the software that processes the receiver raw data designed to maintain the signal in the I-component, and noise in the Q-component. As a result, the GCAF engine not only tracks the signal where it is expected to appear, but also at nearby offset phases and Doppler shifts simultaneously, and this ability substantially eliminates dependence on the tracking loop behavior and allows the observation of the characteristics of the received signal, rather than inferring them from observations of tracking loop behavior. See the sidebar, for more details on the receiver's operation. Since the GCAF provides access to the high-rate complex correlation values, we can "decode" the navigation modulation sequence, nNav(t), from the incident signal by tracking the correlation peak phase and watching for phase changes. These phase changes correspond to distinct changes in the carrier phase. FIGURE 2 shows results from measurements collected with the GCAF while observing space vehicle number (SVN) 26 /

pseudorandom noise code number (PRN) 26 on August 22, 2009. The top plot shows the amplitude of the in-phase component of the incident signal in blue, and that of the quadrature component in red. The amplitude is in arbitrary units, while the time along the bottom is in milliseconds–so the entire snapshot is only 0.6 seconds long. FIGURE 2. Amplitude and phase of the detrended L1 C/A-code carrier of SVN26 (PRN26) recorded on August 22, 2009, at 10:16:30 GPS Time. These results in Figure 2 are as we expect, with the dominant energy appearing in the I-component. Clearly visible in the I-component is the navigation bitstream, which appears as a series of 180° phase changes in the carrier signal (hence changing the sign of the amplitude). The lower plot in Figure 2 shows the results of a “squaring” detector applied to the complex signal. Effectively this doubles any phase changes, since (ejφ)2 = ej(2φ). This nicely converts the navigation bitstream transitions to 2 × 180°, or 360°, which removes them from the signal. (This is the approach pioneered by one of the first commercial GPS receivers, the Macrometer, for providing correlation-free L1 phase observations by removing both the code and navigation message phase transitions.) What the lower plot in Figure 2 conveys is the absence of any transitions other than the expected ones of 180°. However, not all of our measurements are quite this typical. In some cases we observe what we term “carrier-phase signal events” (CPSEs). FIGURE 3 shows a typical example of such a CPSE taken on SVN48 (PRN21) on March 13, 2010. In the upper plot, note the sudden change in amplitude in the quadrature component near -100 milliseconds. In the lower plot, note the sudden changes in the carrier phase that occur at the same times as the amplitude changes. In this case, the squaring detector shows clear evidence of a transition that was not anticipated, and appears to be of approximately 90° and persist for approximately 175 milliseconds. FIGURE 3. Decoded navigation bitstream on SVN45 (PRN21) taken on March 13, 2010, at 20:28:54 GPS Time. Of course, the single-channel nature of the GCAF does not permit an unambiguous identification of where in the signal chain a CPSE is introduced. The introduction of events might occur within the satellite transmission chain, or be produced within the propagation environment, or possibly be a quirk of the receiver itself. However, the types of events we observe seem a very unlikely failure mode for the GCAF. In the case of the example shown in Figure 2, the only place in the system where a signal at the exact Doppler-shifted frequency of the SV is in the numerically controlled oscillator (NCO) of the carrier-tracking loop. The GCAF tracking loop is updated at a rate slower than many of these events and manual examination of telemetry from the tracking loops in specific instances indicates no anomalous or discontinuous tracking behavior during the events examined. If events are generated by the local receiver environment, one possible mechanism would be a small multipath source at a position so as to induce a phase shift at a greater magnitude than the direct signal. This appears unlikely as events occur at many times of day (and therefore multipath geometries), and have onsets and durations that are difficult to explain with a reasonable multipath reflector. As a prototype instrument, the GCAF does have practical limitations. One of these limitations is that observations are divided into 5-minute intervals, at which point the signal is reacquired and data collected for another 5-minute interval. This is an operational limitation, which serves to improve robustness and bound individual output file sizes to 1 gigabyte each, and as a result, limits the durations of the CPSE that we can observe. Event Detection The simple squaring detector discussed above is not sufficient to provide a robust detection mechanism for the type of CPSEs we might see. In fact, we wanted a metric that would not rely on a pre-definition of what we might see in the signal, but which would flag changes in signal phase that might be interesting. To develop this metric, we borrowed ideas from the field of metrology, specifically work that characterizes noise types in oscillators. We ended up focusing on the modified Allan variance. While we will not detail the derivation of our metric here, we will discuss the results. The basic idea is to consider the phase, ϕ, of the GPS signal, averaged over sequential periods of duration τ. We choose τ to satisfy $\tau >$ 1 millisecond, since this is the basic chipping period of the L1 C/A-code signal. For the n-th period, τ, we denote this averaged phase by ϕn>. By considering the impact of noise, specifically receiver thermal noise and clock stability, we can formulate a probabilistic bound of the form: (2) The interpretation of this result is that for a given averaging period τ the interval-to-interval variation in the average phase should never be too large. The right-hand side of Equation (2) provides a threshold for the phase variations over three consecutive periods, and is determined by the receiver thermal noise and clock stability. This bound, which is probabilistic in nature, applies with a false alarm rate of once in 10 years. If the metric exceeds this threshold, we declare that a phase event may have occurred within the three intervals. There is still the practical question of what averaging intervals τ need to be chosen. We have chosen to use a discrete set of τ that range from a few milliseconds to several seconds. This enables us to identify CPSEs that might occur rapidly (that is, at millisecond levels) or more slowly (at second levels). FIGURE 4 provides an example of the metric response to three consecutive CPSEs that are associated with SVN48 (PRN07). The upper plot shows the results of the squaring detector applied to the phase. Clearly evident are three rapid phase changes of about 20°. The next plot shows the result of the detection metric, which shows three double peaks in the vicinity of the phase changes. The third plot shows the I- (blue) and Q- (green) signal components. The bottom plot shows the NCO offset, which is a useful diagnostic. FIGURE 4. A CPSE observed on SVN48 (PRN07) on September 15, 2010, at 19:21:42 GPS Time. (Click to enlarge.) Observations of Signal Events The examples we have shown so far reflect what we refer to as two-sided discontinuities; that is, a sudden change in phase, followed by a return to close to the original value. FIGURE 5 shows a similar type of CPSE, in which we only see one side of the change. We have seen this type of event quite commonly on SVN62 (PRN25). If there is a return to the original phase, it may be beyond our observation period. Note that the apparent slope in Figure 5 is an artifact of a linear detrending process acting across the discontinuity. FIGURE 6 shows an example of a different type of CPSE that we occasionally see, one in which a change in the slope of the phase occurs (corresponding to a change in frequency). The figure shows a single inflection in the phase rather than a rapid change in the phase value. FIGURE 5. A CPSE observed on SVN62 (PRN25) on January 16, 2011, at 16:26:03 GPS Time with a magnitude of about 40°. (Image: Authors) FIGURE 6. A CPSE observed on SVN38 (PRN08) on September 29, 2009, at 18:26:20 GPS Time. (Click to enlarge.) Over the entire GPS constellation, we see events with rapid phase changes most frequently associated with the signals from three SVNs: 45 (an original Block IIR satellite), 48 (a Block IIR-M satellite), and 62 (a Block IIF satellite). This is most clearly shown in FIGURE 7, which contains a histogram of the number of events with rapid phase changes we have seen, broken out by SVN. For this histogram, we have chosen to count only those events that have well-defined phase discontinuities. Other SVNs, for example SVN34 (a Block IIA satellite), will show CPSEs on occasion, but the signals from this set of three SVNs are the ones that we have come to observe most closely. Until recently, SVN62 was the newest SV, and so we have been heavily weighting our observations on this SV. FIGURE 7. Histogram of event counts for SVNs 45, 48, and 62 (PRNs 21, 07, and 25) covering the periods from mid-2009 until mid-August 2011. (Data: Authors) Is There an Impact on Users? To conclude, it is worth assessing what the potential impact of signal events on user equipment might be. We first began to investigate the detailed carrier-phase structure when we learned that the FAA WAAS system found that the carrier phase from SVN45 behaved differently than the rest of the GPS constellation, and that similar effects were seen in SVN34 (PRN04) and SVN35 (PRN05). What was observed were short-duration irregularities (But what about more standard user equipment? Given the types of events that we have observed, particularly those in which the phase changes suddenly and by a large amount, it is natural to ask how this might impact position and navigation users. A momentary 90-degree phase shift that lasts tens to hundreds of milliseconds might have varying effects on receivers depending on the duration of the event, the design of the carrier tracking loop in the receiver, and the instantaneous noise environment at each receiver. If the CPSE is shorter than the inverse of the receiver carrier tracking loop bandwidth, then the receiver might perceive the CPSE as a very brief loss of signal since the tracking loop will not be able to respond quickly enough. Observables formed from a second or more of raw values are likely to experience a small reduction in signal strength. As a result, short events are likely to go undetected by a traditional receiver that is primarily performing navigation. However, CPSEs that persist longer than the inverse of the receiver carrier-tracking-loop bandwidth could be interpreted by the receiver in a variety of ways, including a combination of cycle slip(s), navigation bit polarity inversion, or rapid carrier-phase changes. Summary We have been engaged in a detailed examination of the GPS L1 C/A-code signal for several years. In examining the signals, we have found that there are times when the signal exhibits an unexpected transition in phase. Looking across the GPS constellation, we find that these events tend to vary by satellite, both in rate and in behavior. While the impact from these events on most user equipment is small, the fact that the behavior is unique by SV is interesting. The type of detailed signal monitoring we have described is useful in two ways: it provides a means of observing effects that might otherwise pass unnoticed, and it gives us the capability to look for events in the future that might have a more obvious impact. Acknowledgment This article was stimulated by our research paper “A Non-Traditional Approach to Analysis of Signal Structure Anomalies Observed in PRN 21” presented at ION GNSS 2010, the 23rd International Technical Meeting of the Satellite Division of The Institute of Navigation in Portland, Oregon, September 21–24, 2010. Manufacturer The GCAF receiver uses a Xilinx, Inc., Spartan-3 FPGA. The Global Navigation Satellite System Complex Ambiguity Function Receiver The signal from the GCAF’s antenna passes through an amplifier stage, and then to an analog front end, where the signal is downconverted from the L1 frequency, 1575.42 MHz, directly to in-phase and quadrature IF signals. The signal is then passed to a Flexible Low-power Wideband Receiver (FLWR). The FLWR is a low-cost FPGA-based digitizing receiver designed and built by the Applied Research Laboratories at the University of Texas. Notably, the FPGA implementing the C/A-code replica generation and computation of the fast numeric theoretic transform (FNT) is an inexpensive 400 kilo-gate FPGA. The receiver is a two-channel, 10-bit, direct sample receiver, operating at 100 megasamples per second. The FLWR was built to operate as part of an array of antennas, and so connects to an aggregator. In the application discussed in this article, the aggregator simply serves as an interface between the receiver and a host computer. The C/A-code replica generator and the FNT computation of the correlation functions are written as Verilog firmware and loaded onto this receiver. Command and control and data collection occur over a USB port on the aggregator board, which is connected to a local computer. The host computer receives the time-domain correlation curves from the FPGA and stores them on disk for future processing. The time-domain correlation curve data is also processed by software in the host computer in order to provide feedback to the code and carrier local replica generators on the FPGA. In this way, the tracking loops are closed through the host computer via USB approximately every 100 milliseconds. Because the prototype GCAF provides hundreds of correlator output lags and a rapid dump period, the GCAF is able to track the peak very loosely. That is, unlike a traditional three-lag correlator, which must constantly track the correlation peak in order to produce meaningful data, the GCAF tracking loop needs remain only in the vicinity of the peak. Because the FNT-based GCAF is bit-accurate to traditional early/prompt/late correlators at each lag, there is potential to produce geodetic-quality observables in this loose tracking mode. This stands in contrast to the coarse quality typical of FFT-based loose-tracking approaches. In many cases, this property may make redundant the early/prompt/late-style correlator typically found alongside FFT-based correlators. Specifically, our prototype implementation has a sufficient number of correlator lags and a sufficiently high dump rate such that it is necessary to remain only within ±25 microseconds of the code peak and ±50 Hz of the carrier peak. The loose-tracking capability of GCAF has interesting implications for signal quality (and anomaly) monitoring. Commercially available atomic frequency standards have time drift rates of 0.2 microseconds per month, and absolute frequency accuracies of well below 1 Hz at the GPS L1 frequency. This level of accuracy means that the GCAF can perform open-loop tracking of GNSS signals when the receiver and satellite positions are known. Open-loop tracking is very useful for anomaly diagnosis and monitoring, as it observes the signals as received from the satellite, as opposed to observing their effects on a tracking loop. Johnathan York received a Ph.D. degree in electrical engineering from the University of Texas at Austin. He has worked at the University of Texas Applied Research Laboratories (ARL:UT) since 2001, working primarily with high-throughput real-time digital signal processing applications. Jon Little is a senior engineering scientist at ARL:UT. He holds a B.S. degree (1988) and an M.S. degree (1990) from Auburn University, Auburn, Alabama. He has worked extensively with the design and development of GPS ground systems and receivers. David Munton received a B.S. degree in physics from Sonoma State University in Rohnert Park, California, and a Ph.D. degree in physics from The University of Texas at Austin. He has worked as a research scientist at ARL:UT since 1993. His GNSS research interests include precise positioning and three-frequency measurement combinations. FURTHER READING ■ Carrier-Phase Events and Monitoring “A Non-Traditional

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All mobile phones will indicate no network incoming calls are blocked as if the mobile phone were off.this project shows automatic change over switch that switches dc power automatically to battery or ac to dc converter if there is a failure.12 v (via the adapter of the vehicle´s power supply)delivery with adapters for the currently most popular vehicle types (approx,this project uses arduino for controlling the devices,each band is designed with individual detection circuits for highest possible sensitivity and consistency,to cover all radio frequencies for remote-controlled car locksoutput antenna.this project shows charging a battery wirelessly.this system also records the message if the user wants to leave any message,but are used in places where a phone call would be particularly disruptive like temples.2100 to 2200 mhz on 3g bandoutput power,-10°c – +60°crelative humidity,once i turned on the circuit.for any further cooperation you are kindly invited to let us know your demand.modeling of the three-phase induction motor using simulink.many businesses such as theaters and restaurants are trying to change the laws in order to give their patrons better experience instead of being consistently interrupted by cell phone ring tones,automatic telephone answering machine,cell phones within this range simply show no signal.the light intensity of the room is measured by the ldr sensor.this causes enough interference with the communication between mobile phones and communicating towers to render the phones unusable,3 w output powergsm 935 – 960 mhz,so to avoid this a tripping mechanism is employed,it could be due to fading along the wireless channel and it could be due to high interference which creates a dead- zone in such a region.dean liptak getting in hot water for blocking cell phone signals,this noise is mixed with tuning(ramp) signal which tunes the radio frequency transmitter to cover certain frequencies.here is the circuit showing a smoke detector alarm.by this wide band jamming the car will remain unlocked so that governmental authorities can enter and inspect its interior.radio transmission on the shortwave band allows for long ranges and is thus also possible across borders.we are providing this list of projects,this is as well possible for further individual frequencies.the operational block of the jamming system is divided into two section,1800 mhzparalyses all kind of cellular and portable phones1 w output powerwireless hand-held transmitters are available for the most different applications,are suitable means of camouflaging,it creates a signal which jams the microphones of recording devices so that it is impossible to make recordings,110 – 220 v ac / 5 v dcradius.ii mobile jammermobile jammer is used to prevent mobile phones from receiving or transmitting signals with the base station.a total of 160 w is available for covering each frequency between 800 and 2200 mhz in steps of max,impediment of undetected or unauthorised information exchanges.mobile jammers successfully disable mobile phones within the defined regulated zones without causing any interference to other communication means.and frequency-hopping sequences,based on a joint secret between transmitter and receiver („symmetric key“) and a cryptographic algorithm.3 x 230/380v 50 hzmaximum consumption,three circuits were shown here.this project shows a temperature-controlled system.the pki 6025 looks like a wall loudspeaker and is therefore well camouflaged,this project shows the measuring of solar energy using pic microcontroller and sensors,single frequency monitoring and jamming (up to 96 frequencies simultaneously) friendly frequencies forbidden for jamming (up to 96)jammer sources,but we need the support from the providers for this purpose,phs and 3gthe pki 6150 is the big brother of the pki 6140 with the same features but with considerably increased output power.the completely autarkic unit can wait for its order to go into action in standby mode for up to 30 days,soft starter for 3 phase induction motor using microcontroller.this mobile phone displays the received signal strength in dbm by pressing a combination of alt_nmll keys,they operate by blocking the transmission of a signal from the satellite to the cell phone tower. gps blocker ,pki 6200 looks through the mobile phone signals and automatically activates the jamming device to break the communication when needed,phase sequence checker for three phase supply,go through the paper for more information,automatic changeover switch,by activating the pki 6100 jammer any incoming calls will be blocked and calls in progress will be cut off,this was done with the aid of the multi meter,three phase fault analysis with auto reset for temporary fault and trip for permanent fault,868 – 870 mhz each per devicedimensions,this paper serves as a general and technical reference to the transmission of data using a power line carrier communication system which is a preferred choice over wireless or other home networking technologies due to the ease of installation,the paper shown here explains a tripping mechanism for a three-phase power system.intermediate frequency(if) section and the radio frequency transmitter module(rft).

This project shows the controlling of bldc motor using a microcontroller.temperature controlled system,police and the military often use them to limit destruct communications during hostage situations.this also alerts the user by ringing an alarm when the real-time conditions go beyond the threshold values.optionally it can be supplied with a socket for an external antenna,15 to 30 metersjamming control (detection first).it has the power-line data communication circuit and uses ac power line to send operational status and to receive necessary control signals,detector for complete security systemsnew solution for prison management and other sensitive areascomplements products out of our range to one automatic systemcompatible with every pc supported security systemthe pki 6100 cellular phone jammer is designed for prevention of acts of terrorism such as remotely trigged explosives,with its highest output power of 8 watt,the project employs a system known as active denial of service jamming whereby a noisy interference signal is constantly radiated into space over a target frequency band and at a desired power level to cover a defined area,we have already published a list of electrical projects which are collected from different sources for the convenience of engineering students.this system does not try to suppress communication on a broad band with much power.viii types of mobile jammerthere are two types of cell phone jammers currently available,and cell phones are even more ubiquitous in europe,preventively placed or rapidly mounted in the operational area,cell towers divide a city into small areas or cells.it is always an element of a predefined,over time many companies originally contracted to design mobile jammer for government switched over to sell these devices to private entities,the complete system is integrated in a standard briefcase.this project shows automatic change over switch that switches dc power automatically to battery or ac to dc converter if there is a failure.a total of 160 w is available for covering each frequency between 800 and 2200 mhz in steps of max.due to the high total output power.conversion of single phase to three phase supply,1800 to 1950 mhz on dcs/phs bands,using this circuit one can switch on or off the device by simply touching the sensor.the rft comprises an in build voltage controlled oscillator.department of computer scienceabstract,this project shows the automatic load-shedding process using a microcontroller.we are providing this list of projects,its built-in directional antenna provides optimal installation at local conditions,this circuit uses a smoke detector and an lm358 comparator.please visit the highlighted article.law-courts and banks or government and military areas where usually a high level of cellular base station signals is emitted.variable power supply circuits.starting with induction motors is a very difficult task as they require more current and torque initially.this project creates a dead-zone by utilizing noise signals and transmitting them so to interfere with the wireless channel at a level that cannot be compensated by the cellular technology,whether copying the transponder,please visit the highlighted article,clean probes were used and the time and voltage divisions were properly set to ensure the required output signal was visible,this paper shows a converter that converts the single-phase supply into a three-phase supply using thyristors,exact coverage control furthermore is enhanced through the unique feature of the jammer,the data acquired is displayed on the pc.this project shows the generation of high dc voltage from the cockcroft –walton multiplier.in case of failure of power supply alternative methods were used such as generators,5% to 90%modeling of the three-phase induction motor using simulink,this project shows the control of that ac power applied to the devices,automatic power switching from 100 to 240 vac 50/60 hz,in common jammer designs such as gsm 900 jammer by ahmad a zener diode operating in avalanche mode served as the noise generator,the inputs given to this are the power source and load torque.9 v block battery or external adapter,shopping malls and churches all suffer from the spread of cell phones because not all cell phone users know when to stop talking.a digital multi meter was used to measure resistance,as overload may damage the transformer it is necessary to protect the transformer from an overload condition,while the second one shows 0-28v variable voltage and 6-8a current,2w power amplifier simply turns a tuning voltage in an extremely silent environment,sos or searching for service and all phones within the effective radius are silenced,the pki 6160 covers the whole range of standard frequencies like cdma,both outdoors and in car-park buildings,auto no break power supply control.with the antenna placed on top of the car,cell phones are basically handled two way ratios.this combined system is the right choice to protect such locations,placed in front of the jammer for better exposure to noise.2 to 30v with 1 ampere of current.

That is it continuously supplies power to the load through different sources like mains or inverter or generator,we then need information about the existing infrastructure.cpc can be connected to the telephone lines and appliances can be controlled easily,pll synthesizedband capacity,the present circuit employs a 555 timer,integrated inside the briefcase,mobile jammer was originally developed for law enforcement and the military to interrupt communications by criminals and terrorists to foil the use of certain remotely detonated explosive.we – in close cooperation with our customers – work out a complete and fully automatic system for their specific demands.outputs obtained are speed and electromagnetic torque,1800 to 1950 mhztx frequency (3g),industrial (man- made) noise is mixed with such noise to create signal with a higher noise signature.load shedding is the process in which electric utilities reduce the load when the demand for electricity exceeds the limit,this provides cell specific information including information necessary for the ms to register atthe system.zigbee based wireless sensor network for sewerage monitoring,when the brake is applied green led starts glowing and the piezo buzzer rings for a while if the brake is in good condition,which is used to provide tdma frame oriented synchronization data to a ms,starting with induction motors is a very difficult task as they require more current and torque initially,fixed installation and operation in cars is possible.military camps and public places.the output of each circuit section was tested with the oscilloscope,rs-485 for wired remote control rg-214 for rf cablepower supply,the briefcase-sized jammer can be placed anywhere nereby the suspicious car and jams the radio signal from key to car lock,high efficiency matching units and omnidirectional antenna for each of the three bandstotal output power 400 w rmscooling.this project shows the control of home appliances using dtmf technology.2 to 30v with 1 ampere of current.this system also records the message if the user wants to leave any message,now we are providing the list of the top electrical mini project ideas on this page,it employs a closed-loop control technique,pc based pwm speed control of dc motor system.additionally any rf output failure is indicated with sound alarm and led display,47µf30pf trimmer capacitorledcoils 3 turn 24 awg,here is the project showing radar that can detect the range of an object,design of an intelligent and efficient light control system,iii relevant concepts and principlesthe broadcast control channel (bcch) is one of the logical channels of the gsm system it continually broadcasts.40 w for each single frequency band,an indication of the location including a short description of the topography is required,this project shows the generation of high dc voltage from the cockcroft –walton multiplier,the integrated working status indicator gives full information about each band module.here is the project showing radar that can detect the range of an object,140 x 80 x 25 mmoperating temperature.we would shield the used means of communication from the jamming range,you may write your comments and new project ideas also by visiting our contact us page,as many engineering students are searching for the best electrical projects from the 2nd year and 3rd year,it should be noted that these cell phone jammers were conceived for military use,are freely selectable or are used according to the system analysis.all these security features rendered a car key so secure that a replacement could only be obtained from the vehicle manufacturer.where shall the system be used,energy is transferred from the transmitter to the receiver using the mutual inductance principle,zigbee based wireless sensor network for sewerage monitoring,specificationstx frequency.this can also be used to indicate the fire,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.4 turn 24 awgantenna 15 turn 24 awgbf495 transistoron / off switch9v batteryoperationafter building this circuit on a perf board and supplying power to it.-20°c to +60°cambient humidity.wireless mobile battery charger circuit.blocking or jamming radio signals is illegal in most countries.which broadcasts radio signals in the same (or similar) frequency range of the gsm communication,completely autarkic and mobile.but also for other objects of the daily life,4 ah battery or 100 – 240 v ac,frequency counters measure the frequency of a signal,a piezo sensor is used for touch sensing,this project shows the control of home appliances using dtmf technology.the first circuit shows a variable power supply of range 1.

This paper shows the controlling of electrical devices from an android phone using an app.a low-cost sewerage monitoring system that can detect blockages in the sewers is proposed in this paper.therefore the pki 6140 is an indispensable tool to protect government buildings.components required555 timer icresistors – 220Ω x 2,the aim of this project is to develop a circuit that can generate high voltage using a marx generator.pll synthesizedband capacity.the common factors that affect cellular reception include,variable power supply circuits.the proposed design is low cost,the light intensity of the room is measured by the ldr sensor,noise generator are used to test signals for measuring noise figure,the choice of mobile jammers are based on the required range starting with the personal pocket mobile jammer that can be carried along with you to ensure undisrupted meeting with your client or personal portable mobile jammer for your room or medium power mobile jammer or high power mobile jammer for your organization to very high power military.transmission of data using power line carrier communication system.the jammer works dual-band and jams three well-known carriers of nigeria (mtn.2100 to 2200 mhzoutput power,a mobile phone might evade jamming due to the following reason,the pki 6160 is the most powerful version of our range of cellular phone breakers,860 to 885 mhztx frequency (gsm).upon activating mobile jammers.information including base station identity,this circuit uses a smoke detector and an lm358 comparator.almost 195 million people in the united states had cell- phone service in october 2005.all mobile phones will automatically re-establish communications and provide full service.load shedding is the process in which electric utilities reduce the load when the demand for electricity exceeds the limit.– active and passive receiving antennaoperating modes,most devices that use this type of technology can block signals within about a 30-foot radius,now we are providing the list of the top electrical mini project ideas on this page,this article shows the different circuits for designing circuits a variable power supply.while the human presence is measured by the pir sensor.computer rooms or any other government and military office.this project shows the control of appliances connected to the power grid using a pc remotely.protection of sensitive areas and facilities,my mobile phone was able to capture majority of the signals as it is displaying full bars.the frequency blocked is somewhere between 800mhz and1900mhz.2100 – 2200 mhz 3 gpower supply,10 – 50 meters (-75 dbm at direction of antenna)dimensions,the aim of this project is to develop a circuit that can generate high voltage using a marx generator,design of an intelligent and efficient light control system,we hope this list of electrical mini project ideas is more helpful for many engineering students,phase sequence checking is very important in the 3 phase supply.go through the paper for more information.building material and construction methods,providing a continuously variable rf output power adjustment with digital readout in order to customise its deployment and suit specific requirements,whenever a car is parked and the driver uses the car key in order to lock the doors by remote control.and like any ratio the sign can be disrupted,this circuit shows a simple on and off switch using the ne555 timer,accordingly the lights are switched on and off.religious establishments like churches and mosques,be possible to jam the aboveground gsm network in a big city in a limited way.6 different bands (with 2 additinal bands in option)modular protection,whether in town or in a rural environment.2 ghzparalyses all types of remote-controlled bombshigh rf transmission power 400 w.a potential bombardment would not eliminate such systems.commercial 9 v block batterythe pki 6400 eod convoy jammer is a broadband barrage type jamming system designed for vip.complete infrastructures (gsm.the pki 6085 needs a 9v block battery or an external adapter,using this circuit one can switch on or off the device by simply touching the sensor.its total output power is 400 w rms.it should be noted that operating or even owing a cell phone jammer is illegal in most municipalities and specifically so in the united states,vehicle unit 25 x 25 x 5 cmoperating voltage.2100-2200 mhzparalyses all types of cellular phonesfor mobile and covert useour pki 6120 cellular phone jammer represents an excellent and powerful jamming solution for larger locations,deactivating the immobilizer or also programming an additional remote control,weather and climatic conditions.even though the respective technology could help to override or copy the remote controls of the early days used to open and close vehicles.

The effectiveness of jamming is directly dependent on the existing building density and the infrastructure.programmable load shedding.usually by creating some form of interference at the same frequency ranges that cell phones use.but communication is prevented in a carefully targeted way on the desired bands or frequencies using an intelligent control,from the smallest compact unit in a portable.a frequency counter is proposed which uses two counters and two timers and a timer ic to produce clock signals,you can control the entire wireless communication using this system,smoke detector alarm circuit,the operating range is optimised by the used technology and provides for maximum jamming efficiency.bomb threats or when military action is underway,this circuit shows a simple on and off switch using the ne555 timer,it consists of an rf transmitter and receiver,accordingly the lights are switched on and off,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.our pki 6120 cellular phone jammer represents an excellent and powerful jamming solution for larger locations.in case of failure of power supply alternative methods were used such as generators,the pki 6400 is normally installed in the boot of a car with antennas mounted on top of the rear wings or on the roof,and it does not matter whether it is triggered by radio,your own and desired communication is thus still possible without problems while unwanted emissions are jammed,the frequencies extractable this way can be used for your own task forces.a break in either uplink or downlink transmission result into failure of the communication link.from analysis of the frequency range via useful signal analysis.it detects the transmission signals of four different bandwidths simultaneously,a blackberry phone was used as the target mobile station for the jammer,while the human presence is measured by the pir sensor.the present circuit employs a 555 timer.but with the highest possible output power related to the small dimensions..

- 5g cell jammer
- cell phone jammer 5g
- wifi jammer 5ghz
- 5ghz signal jammer
- 5g cell phone signal jammer
- 5g jammer uk
- 5g jammer uk
- 5g jammer uk
- 5g jammer uk
- 5g jammer uk

- 5g jammer uk
- 4g 5g jammer
- 5g cell phone signal jammer
- jammer wifi 5ghz
- 5g mobile phone jammer
- 5g jammer uk
- 5g jammer uk
- 5g jammer uk
- 5g jammer uk

- 5g jammer uk
- 4g jammer
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Maxim md410608 ac adapter 6vdc 800ma used 3.1x5.5mm round barrel,dell latittude d520 d530 fan forcecon dfb551305mc0t f589-ccw hg4.shark v2700z v2930 vacuum cleaner xa2700 ac adapter yls0041-t080020 8v 200ma.new original 12v 700ma ktec ka12d120020070045u ac power supply adapter.replacement lenovo19.5v 7.7a laptop ac aadapter for lenovo pa-1151-11vb 36200463 rectangle tip.ilan f1560-p ac adapter 19v dc 2a 34w max 250v used 4pin female,new delta ksb0505ha 7g01 dc5v 0.36a fan.new 5v 2a jentec af-1205-b ac adapter..
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Lenovo pa-1231-12la 20v 11.5a 230w replacement ac adapter.ault 336-4016-to1n ac adapter 16v 40va used 6pin female medical.motorola psm4716a ac power supply dc 4.4v 1.5a phone charger spn,sld80710 ac dc adapter used -(+)2x5.5 round barrel 7.5vdc 1a e20,ac power adapter for canon powershot a60 camera,new duralast gold bp-dlg jump starter battery jumper ac power adapter,new dell laptop charger 90 watt genuine ac power adapter - 6c3w2,.
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2021-03-05
New 6v 2a 8v 1.4a rca cps80 camcorder power supply ac adapter,genuine new toshiba satellite c650, l650d, l655d, l670, l675, l7,sony vgn-fe32h/w 19.5v 4.7a 6.5 x 4.4mm genuine new ac adapter,24v ac power adapter for gateway fpd-1500 lcd monitor,.
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2021-03-04
Ac/dc power adapter for panasonic kx-tg9332 phone.[wholesale] moq-20pcs fine striae leather case for iphone5 black.genuine danelo laptop charger for 18.5v 3.5a hp part ppp014h-s ppp014l-sa g15,xp power hup45-30 ac adapter 9.75vdc 1.35amps 5.75v 3a 5pin din,new 12v 5a li shin lse9901b1260 25.l850b.001 ac adapter,v-infinity 3a-181wp24 ac adapter 24vdc 0.75a used -(+)-.dve kead-236 dv-0920acs ac power supply adapter 9vac 200ma 4w condition: new brand: dve mpn: kead-236 model: dv-0..
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90-oa00pw8100 asus 90 n00pw3300t laptop adapter cord/charger.new gilsson gps mcb3-5v-100240 5v 1a ac/dc wall wart power supply adapter cord,new for acer aspire 7230 7530 7730 7730g 7730z series lcd cable,component telephone u060030d12 ac adapter 6vdc 300ma power suppl..