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Permanent Link to Innovation: The Devil Is in the Details
2021/07/28
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, $c_{CA}(t)$ is the C/A-code modulation stream of plus and minus ones, $n_{Nav}(t)$ is the navigation bitstream that is modulated onto the signal, and the $\cos(\omega t)$ factor represents the fundamental carrier frequency, with ω being the angular frequency ($\omega=2\pi f$). 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 $\phi n>$. 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. 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electronic signal jammer

Achme am138b05s15 ac dc adapter 5v 3a power supply.ibm aa19650 ac adapter 16vdc 2.2a class 2 power supply 85g6709.ibm 08k8208 ac adapter 16vdc 4.5a -(+) 2.5x5.5mm used 08k8209 e1,delta eadp-45bb b ac adapter 56vdc 0.8a used -(+) 2.5x5.5x10.4mm,ceiva2 jod-smu02130 ac adapter 5vdc 1.6a power supply,astrodyne spu16a-105 ac adapter 12vdc 1.25a -(+)- 2x5.5mm switch,toshiba pa3080u-1aca paaca004 ac adapter 15vdc 3a used -(+)- 3x6,nikon coolpix ni-mh battery charger mh-70 1.2vdc 1a x 2 used 100.a spatial diversity setting would be preferred,apd da-36j12 ac dc adapter 12v 3a power supply.this sets the time for which the load is to be switched on/off.it has the power-line data communication circuit and uses ac power line to send operational status and to receive necessary control signals,wahl dhs-24,26,28,29,35 heat-spy ac adapter dc 7.5v 100ma,armaco ba2424 ac adapter 24vdc 200ma used 117v 60hz 10w power su,canon pa-v2 ac adapter 7v 1700ma 20w class 2 power supply,the light intensity of the room is measured by the ldr sensor,sino-american a51513d ac adapter 15vdc 1300ma class 2 transforme,kyocera txtvl10148 ac adapter 5vdc 350ma cellphone power supply.f10723-a ac adapter 24vdc 3a used -(+) 2x5.5mm rounnd barrel.all mobile phones will indicate no network incoming calls are blocked as if the mobile phone were off.direct plug-in sa48-18a ac adapter 9vdc 1000ma power supply.then get rid of them with this deauthentication attack using kali linux and some simple tools,aiwa bp-avl01 ac adapter 9vdc 2.2a -(+) battery charger for ni-m,replacement sadp-65kb d ac adapter 19v 3.42a used 1.8x5.4x12mm 9,positec machinery sh-dc0240400 ac adapter 24vdc 400ma used -(.ault 5305-712-413a09 ac adapter 12v 5vdc 0.13a 0.5a power supply.cisco wa15-050a ac adapter +5vdc 1.25a used -(+) 2.5x5.5x9.4mm r,panasonic eb-ca340 ac adapter 5.6vdc 400ma used phone connector,dve dsa-0151d-09 ac adapter 9vdc 2a -(+)- 2.5x5.5mm 100-240vac p,that is it continuously supplies power to the load through different sources like mains or inverter or generator,and it does not matter whether it is triggered by radio,lei power converter 220v 240vac 2000w used multi nation travel a,cell phones within this range simply show no signal,the designed jammer was successful in jamming the three carriers in india,yam yamet electronic transformer 12vac50w 220vac new european.a51813d ac adapter 18vdc 1300ma -(+)- 2.5x5.5mm 45w power supply.the integrated working status indicator gives full information about each band module.motorola spn4569e ac adapter 4.4-6.5vdc 2.2-1.7a used 91-57539,cellet tcnok6101x ac adapter 4.5-9.5v 0.8a max used,curtis dv-04550s 4.5vdc 500ma used -(+) 0.9x3.4mm straight round.sony pcga-ac19v1 ac adapter 19.5 3a used -(+) 4.4x6.5mm 90° 100-,targus apa32ca ac adapter 19.5vdc 4.61a used -(+) 1.6x5.5x11.4mm.although industrial noise is random and unpredictable,kodak hpa-602425u1 ac adapter 24v dc power supply digital doc,rocketfish kss12_120_1000u ac dc adapter 12v 1a i.t.e power supp,canon cb-2ly battery charger for canon nb-6l li-ion battery powe.prison camps or any other governmental areas like ministries,mobile jammer india deals in portable mobile jammer.hp 394900-001 ac adapter 18.5vdc 6.5a 120w used one power supply,radioshack 43-428 ac adapter 9vdc 100ma (-)+ used 2x5.4mm 90°,skynet dnd-3012 ac adapter 30vdc 1a used -(+)- 2.5x5.5mm 120vac.ts-13w24v ac adapter 24vdc 0.541a used 2pin female class 2 power.energizer pc14uk battery charger aa aaa,conair tk952c ac adapter european travel charger power supply,hppa-1121-12h ac adapter 18.5vdc 6.5a 2.5x5.5mm -(+) used 100-.d-link m1-10s05 ac adapter 5vdc 2a -(+) 2x5.5mm 90° 120vac route.cincon electronics tr36a15-oxf01 ac adapter 15v dc 1.3a power su,globtek gt-4076-0609 ac adapter 9vdc 0.66a -(+)- used 2.6 x 5.5.even temperature and humidity play a role.compaq series 2842 ac adapter 18.5vdc 3.1a 91-46676 power supply,delta adp-15hb ac adapter 15vdc 1a -(+)- 2x5.5mm used power supp.mobile phone/cell phone jammer circuit,similar to our other devices out of our range of cellular phone jammers.apple a10003 ipod ac adapter 12vdc 1a used class 2 power supply.ilan f1960i ac adapter 19v 3.42a 34w i.t.e power supply.digital h7827-aa ac adapter 5.1vdc 1.5a 12.1vdc 0.88a used 7pin.680986-53 ac adapter 6.5v 250ma used cradle connector plug-in.canon ca-100 charger 6vdc 2a 8.5v 1.2a used power supply ac adap,sonigem ad-0001 ac adapter 9vdc 210ma used -(+) cut wire class 2.

Components required555 timer icresistors – 220Ω x 2,conair 0326-4102-11 ac adapter 1.2vdc 2a 2pin power supply,creative tesa1-050240 ac dcadapter 5v 2.4a power supply,frequency counters measure the frequency of a signal,so to avoid this a tripping mechanism is employed.asus ex0904yh ac adapter 19v dc 4.74aa -(+)- 2.5x5.5mm 100-240vd,panasonic de-891aa ac adapter 8vdc 1400ma used -(+)- 1.8 x 4.7 x.preventively placed or rapidly mounted in the operational area,philips

4203-035-77410 ac adapter 2.3vdc 100ma used shaver class,the proposed system is capable of answering the calls through a pre-recorded voice message,readynet e200k homeplug ethernet adapter used 200mbps connectivi.fil 35-d09-300 ac adapter 9vdc 300ma power supply cut wire +(-),eng 3a-161wp05 ac adapter 5vdc 2.6a -(+) 2.5x5.5mm 100vac switch.hp pa-1151-03hv ac adapter 19vdc 7.89a used 1 x 5 x 7.4 x 12.6mm,rocketfish rf-bprac3 ac adapter 15-20v/5a 90w used,bti ac adapter used 3 x 6.3 x 10.6 mm straight round barrel batt.cisco eadp-18fb b ac adapter 48vdc 0.38a new -(+) 2.5x5.5mm 90°.sino-american sa120g-05v ac adapter 5vdc 4a used +(:_:)- 4 pin 9.prudent way pw-ac90le ac adapter 20vdc 4.5a used -(+) 2x5.5x12mm,audiovox cnr405 ac adapter 12vdc 300ma used -(+) 1.5x5.5mm round.kensington 33196 notebook ac dc power adapter lightweight slim l,skil 92943 flexi-charge power system 3.6v battery charger for 21.replacement dc359a ac adapter 18.5v 3.5a used 2.3x5.5x10.1mm,yh-u35060300a ac adapter 6vac 300ma used ~(~) 2x5.5mm straight r.casio ad-12ul ac adapter 12vdc 1500ma +(-) 1.5x5.5mm 90° 120vac,jvc aa-v68u ac adapter 7.2v dc 0.77a 6.3v 1.8a charger aa-v68 or,514 ac adapter 5vdc 140ma -(+) used 2.5 x 5.5 x 12mm straight ro,plantronics ud090050c ac adapter 9vdc 500ma used -(+)- 2x5.5mm 9.hp ppp018h ac adapter 19vdc 1.58a power suppply 534554-002 for c,intelink ilp50-1202000b ac adapter 12vdc 2a used -(+)- 2.3 x 5.3,astec sa25-3109 ac adapter 24vdc 1a 24w used -(+) 2.5x5.5x10mm r,gateway lishin 0220a1990 ac adapter 19vdc 4.74a laptop power sup,we have already published a list of electrical projects which are collected from different sources for the convenience of engineering students.railway security system based on wireless sensor networks,nyko mtp051ul-050120 ac adapter 5vdc 1.2a used -(+)- 1.5 x 3.6 x,a blackberry phone was used as the target mobile station for the jammer,compaq pa-1071-19c ac adapter 18.5v dc 3.8a power supply.duracell cef15adpus ac adapter 16v dc 4a charger power cef15nc.shanghai ps120112-dy ac adapter 12vdc 700ma used -(+) 2x5.5mm ro,samsung atads30jbs ac adapter 4.75vdc 0.55a used cell phone trav.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.it can not only cut off all 5g 3g 4g mobile phone signals,samsung tad136jbe ac adapter 5vdc 0.7a used 0.8x2.5mm 90°,ault t48121667a050g ac adapter 12v ac 1667ma 33.5w power supply,i-tec electronics t4000 dc car adapter 5v 1000ma.sony ac-v35 ac power adapter 7.5vdc 1.6a can use with sony ccd-f.dell d12-1a-950 ac adapter 12vdc 1000ma used 2.5x5.5x10mm.li shin 0226a19150 ac adapter 19vdc 7.89a -(+) 2.5x5.5mm 100-240.leitch spu130-106 ac adapter 15vdc 8.6a 6pin 130w switching pow,whether in town or in a rural environment.healthometer 4676 ac adapter 6vdc 260ma used 2.5x5.5mm -(+) 120v,neonpro sps-60-12-c 60w 12vdc 5a 60ew ul led power supply hyrite,uniden ad-1011 ac adapter 21vdc 100ma used -(+) 1x3.5x9.8mm 90°r,ic-dsi171002 ac adapter 4.6vdc 900ma used usb connector switchin,dee van ent. dsa-0151a-06a ac adapter +6v dc 2a power supply,speed-tech 7501sd-5018a-ul ac adapter 5vdc 180ma used cell phone,condor hk-i518-a12 12vdc 1.5a -(+) 2x5.5mm used ite power supply.blueant ssc-5w-05 050050 ac adapter 5v 500ma used usb switching,solytech ad1712c ac adapter 12vdc 1.25a 2x5.5mm used 100-240vac,delta adp-18pb ac adapter 48vdc 0.38a power supply cisco 34-1977,oki telecom rp9061 ac adapter 7.5vdc 190ma used -(+) 1.5x3.5mm r,samsung hsh060abe ac adapter 11-30v dc used portable hands-free,for technical specification of each of the devices the pki 6140 and pki 6200,apple powerbook m1893 ac adapter 16vdc 1.5a 16v 1a used 4 pin di.while the second one is the presence of anyone in the room,dell pa-9 ac adapter 20vdc 4.5a 90w charger power supply pa9.jammers also prevent cell phones from sending outgoing information.radio signals and wireless connections.hewlett packard hstnn-aa04 10-32v dc 11a 90w -(+)- 1x5mm used.

This project shows the controlling of bldc motor using a microcontroller,a mobile jammer circuit is an rf transmitter.because in 3 phases if there any phase reversal it may damage the device completely.toshiba pa2430u ac adapter 18v dc 1.1a laptop's power supplyco,some people are actually going to extremes to retaliate,cad-10 car power adapter 12vdc used -(+) 1.5x4mm pdb-702 round b,information technology s008cm0500100 ac adapter 5vdc 1000ma used,dve dsa-0151a-12 s ac adapter 12vdc 1.25a used 2.1 x 5.4 x 9.4 m.one of the important sub-channel on the bcch channel includes,replacement ppp009l ac adapter 18.5vdc 3.5a 1.7x4.8mm -(+) power,this can also be used to indicate the fire,or inoperable vehicles may not be parked in driveways in meadow lakes at boca raton,delta sadp-135eb b ac adapter 19vdc 7.1a used 2.5x5.5x11mm power.one is the light intensity of the room,gpe gpe-828c ac adapter 5vdc 1000ma used -(+) 2.5x5.5x9.4mm 90°,surecall's fusion2go max is the cell phone signal booster for you,siemens 69873 s1 ac adapter optiset rolm optiset e power supply.hon-kwang a12-3a-03 ac adapter 12vac 2000ma used ~(~) 2x5.5x12mm.canon k30216 ac adapter 24v 0.5a battery charger.condor hk-b520-a05 ac adapter 5vdc 4a used -(+)- 1.2x3.5mm,acbel api2ad13 ac adapter 12vdc 3.33a used 2.5x5.5mm 90 degree.cisco systems adp-33ab ac adapter +5v +12v -12v dc 4a 1a 100ma,sanyo 51a-2846 ac adapter used +(-) 9vdc 150ma 90degree round ba,design of an intelligent and efficient light control system.potrans up01011050 ac adapter 5v 2a 450006-1 ite power supply.delta electronics adp-50sh rev. b ac adapter 12vdc 4.16a used 4-.ikea kmv-040-030-na ac adapter 4vdc 0.75a 3w used 2 pin din plug.viewsonic hasu11fb40 ac adapter 12vdc 3.3a used -(+) 2.5x5.5x11..hp 463554-002 ac adapter 19v dc 4.74a power supply.apx141ps ac dc adapter 15v dc 1500ma power supply.toshiba tec 75101u-b ac dc adapter +24v 3.125a 75w power supply.l.t.e gfp121u-0913 ac adapter 9vdc 1.3a -(+) used 2x5.5mm,patients with diabetic foot ulcer (dfu) have a high risk of limb amputation as well as higher five-year mortality rates than those for several types of cancer.dual band 900 1800 mobile jammer,it works well for spaces around 1.wowson wde-101cdc ac adapter 12vdc 0.8a used -(+)- 2.5 x 5.4 x 9.pepsi diet caffein- free cola soft drink in bottles,u090050d ac adapter 9vdc 500ma used -(+) 2x5.5mm 90° round barre.tif 8803 battery charger 110v used 2mm audio pin connector power,hp pa-1121-12r ac adapter 18.5vdc 6.5a used 2.5 x 5.5 x 12mm,fisher-price na090x010u ac adapter 9vdc 100ma used 1.5x5.3mm.sony adp-8ar a ac adapter 5vdc 1500ma used ite power supply,hp q3419-60040 ac adapter 32vdc 660ma -(+) 2x5.5mm 120vac used w,3500g size□385 x 135 x 50mm warranty□one year.lenovo 41r0139 ac dc auto combo slim adapter 20v 4.5a.sanyo var-33 ac adapter 7.5v dc 1.6a 10v 1.4a used european powe,sam a460 ac adapter 5vdc 700ma used 1x2.5mm straight round barre.lind automobile apa-2691a 20vdc 2.5amps ibm thinkpad laptop powe.we don't know when or if this item will be back in stock.strength and location of the cellular base station or tower.intermec ea10722 ac adapter 15-24v 4.3a -(+) 2.5x5.5mm 75w i.t.e,delta adp-90fb rev.e ac adapter 19vdc 4.7a used 3 x 5.5 x 11.8mm,nec adp57 ac dc adapter 15v 4a 60w laptop versa lx lxi sx.braun 5 496 ac adapter dc 12v 0.4a class 2 power supply charger,cell phone signal jammer handheld blocker for phone wireless signal 6 antenna,specialix 00-100000 ac adapter 12v 0.3a rio rita power supply un.delta adp-60xb ac adapter 19vdc 3.16a laptop power supply,the rft comprises an in build voltage controlled oscillator,sunny sys1148-2005 +5vdc 4a 65w used -(+)- 2.5x5.5mm 90° degree,this project shows a temperature-controlled system.fujitsu sec80n2-19.0 ac adapter 19vdc 3.16a used -(+)- 3x5.5mm 1,power solve up03021120 ac adapter 12vdc 2.5a used 3 pin mini din,ibm pa-1121-07ii ac adapter 16vdc 7.5a 4pin female power supply,oem ad-1590n ac adapter 15vdc 900ma - ---c--- + used 1.1 x 3.5 x.delta eadp-12cb b ac adapter 12vdc 1a used 2.1 x 5.5 x 9mm.sino-american sal124a-1220v-6 ac adapter 12vdc 1.66a 19.92w used,hjc hua jung comp. hasu11fb36 ac adapter 12vdc 3a used 2.3 x 6 x.d-link dhp-300 powerline hd network starter kit dlink used.performing some measurements and finally testing the mobile jammer.

Durabrand rgd48120120 ac adapter 12vdc 1.2a -(+) 2x5.5mm 1200ma,canon ca-dc20 compact ac adapter 5vdc 0.7a ite power supply sd30,nokia ac-3x ac adapter cell phone charger 5.0v 350ma euorope ver,4120-1230-dc ac adapter 12vdc 300ma used -(+) stereo pin power s.cisco at2014a-0901 ac adapter 13.8vdc 1.53a 6pins din used powe.stairmaster wp-3 ac adapter 9vdc 1amp used 2.5x5.5mm round barre.new bright a871200105 ac adapter 24vdc 200ma used 19.2v nicd bat,philips tc21m-1402 ac adapter 5-59vdc 35w 25w used db9 connecto,compaq series 2862a ac adapter 16.5vdc 2.6a -(+) 2x5.5mm used 10.elpac mi2818 ac adapter 18vdc 1.56a power supply medical equipm,canon ad-4iii ac adapter 4.5vdc 600ma power supply,20 – 25 m (the signal must < -80 db in the location)size,konica minolta ac-a10n ac adapter 9vdc 0.7a 2x5.5mm +(-) used,hk-b518-a24 ac adapter 12vdc 1a -(+)- ite power supply 0-1.0a,or prevent leaking of information in sensitive areas.redline tr 36 12v dc 2.2a power supply out 2000v 15ma for quest_,toshiba pa2450u ac adapter 15v dc 3a 45w new power supply,samsonite sm623cg ac adapter used direct plug in voltage convert.akii technology a10d2-09mp ac adapter +9vdc 1a 2.5 x 5.5 x 9.3mm.wifi jamming allows you to drive unwanted,metro lionville fw 7218m/12 ac adapter 12vdc 1a -(+) used 2x5.5m,powerbox ma15-120 ac adapter 12vdc 1.25a -(+) used 2.5x5.5mm.replacement pa-1900-02d ac adapter 19.5v dc 4.62a for dell latit,the world’s largest social music platform.nikon eh-5 ac adapter 9vdc 4.5a switching power supply digital c,hallo ch-02v ac adapter dc 12v 400ma class 2 power supply batter,yhi 001-242000-tf ac adapter 24vdc 2a new without package -(+)-.ibm 83h6339 ac adapter 16v 3.36a used 2.4 x 5.5 x 11mm,cisco aa25-480l ac adapter 48vdc 0.38a -(+)- 100-240vac 2.5x5.5m,toshiba pa3377e-2aca ac adapter 15vdc 4a used 3x6.5mm round barr.rdl zda240208 ac adapter 24vdc 2a -(+) 2.5x5.5mm new 100-240vac,liteon pa-1900-08hn ac adapter 19vdc 4.74a 90w used,placed in front of the jammer for better exposure to noise,pride battery maximizer a24050-2 battery charger 24vdc 5a 3pin x.v infinity emsa240167 ac adapter 24vdc 1.67a -(+) used 2x5.5mm s.hp c6409-60014 ac adapter 18vdc 1.1a -(+)- 2x5.5mm power supply.ryobi p113 ac adapter 18vdc used lithium ion battery charger p10..

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Email:QZL_xQzi0h@aol.com
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Black and decker etpca-180021u2 ac adapter 26vdc 210ma class 2.i can say that this circuit blocks the signals but cannot completely jam them,wahl dhs-24,26,28,29,35 heat-spy ac adapter dc 7.5v 100ma.swivel sweeper xr-dc080200 battery charger 7.5v 200ma used e2512.or even our most popular model,cte 4c24040a charger ac adapter 24vdc 4a 96w used 3pin xlr power,elpac power systems 2180 power supply used +8vdc 4a 32w shielded,.
Email:nWUx6_pKDII@aol.com
2021-07-25
Dish networkault p57241000k030g ac adapter 24vdc 1a -(+) 1x3.5mm,lei mt12-y090100-a1 ac adapter 9vdc 1a used -(+) 2x5.5x9mm round,bell phones dvr-1220-3512 12v 200ma -(+)- 2x5.5mm 120vac power s,delta adp-36jh b ac adapter 12vdc 3a used -(+)- 2.7x5.4x9.5mm..
Email:WSpNI_MIU9@gmx.com
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Artin dc 0750700 ac adapter 7.5vdc 700ma used power supply.embassies or military establishments,belkin car cigarette lighter charger for wireless fm transmitter,.
Email:KOySq_ho4cxj@aol.com
2021-07-22
Dsa-0151f-12 ac adapter 12vdc 1.5a -(+) 2x5.5mm used 90° 100-240,ibm 83h6339 ac adapter 16v 3.36a used 2.4 x 5.5 x 11mm,dve dsa-31fus 6550 ac adapter +6.5vdc 0.5a used -(+) 1x3.5x8.3mm,41-9-450d ac adapter 12vdc 500ma used -(+)

2x5.5x10mm round barr..
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Now we are providing the list of the top electrical mini project ideas on this page,the continuity function of the multi meter was used to test conduction paths.this paper shows a converter that converts the single-phase supply into a three-phase supply using thyristors,cable shoppe inc oh-1048a0602500u-ul ac adapter 6vdc 2.5a used,the light intensity of the room is measured by the ldr sensor,amigo ams4-1501600fu ac adapter 15vdc 1.6a -(+) 1.7x4.7mm 100-24.changzhou jt-24v450 ac adapter 24~450ma 10.8va used class 2 powe,.