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Permanent Link to Innovation: Getting Control

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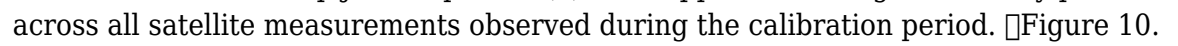
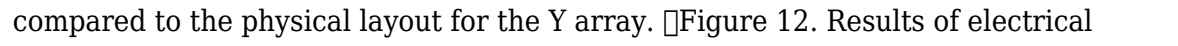
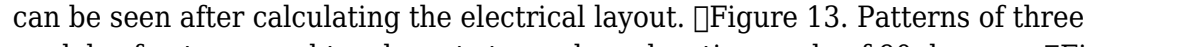
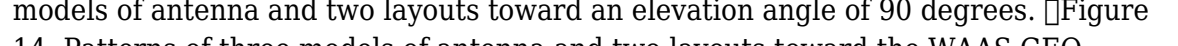
Off-the-Shelf Antennas for Controlled-Reception-Pattern Antenna Arrays By Yu-Hsuan Chen, Sherman Lo, Dennis M. Akos, David S. De Lorenzo, and Per Enge

INNOVATION INSIGHTS by Richard Langley THE ANTENNA IS A CRITICAL COMPONENT OF ANY GNSS RECEIVING EQUIPMENT. It must be carefully designed for the frequencies and structures of the signals to be acquired and tracked. Important antenna properties include polarization, frequency coverage, phase-center stability, multipath suppression, the antenna's impact on receiver sensitivity, reception or gain pattern, and interference handling. While all of these affect an antenna's performance, let's just look at the last two here. The gain pattern of an antenna is the spatial variation of the gain, or ratio of the power delivered by the antenna for a signal arriving from a particular direction compared to that delivered by a hypothetical isotropic reference antenna. Typically, for GNSS antennas, the reference antenna is also circularly polarized and the gain is then expressed in dBic units. An antenna may have a gain pattern with a narrow central lobe or beam if it is used for communications between two fixed locations or if the antenna can be physically steered to point in the direction of a particular transmitter. GNSS signals, however, arrive from many directions simultaneously, and so most GNSS receiving antennas tend to be omni-directional in azimuth with a gain roll-off from the antenna boresight to the horizon. While such an antenna is satisfactory for many applications, it is susceptible to accidental or deliberate interference from signals arriving from directions other than those of GNSS signals. Interference effects could be minimized if the gain pattern could be adjusted to null-out the interfering signals or to peak the gain in the directions of all legitimate signals. Such a controlled-reception-pattern antenna (CRPA) can be constructed using an array of antenna elements, each one being a patch antenna, say, with the signals from the elements combined before feeding them to the receiver. The gain pattern of the array can then be manipulated by electronically adjusting the phase relationship between the elements before the

signals are combined. However, an alternative approach is to feed the signals from each element to separate banks of tracking channels in the receiver and form a beam-steering vector based on the double-difference carrier-phase measurements from pairs of elements that is subsequently used to weight the signals from the elements before they are processed to obtain a position solution. In this month's column, we learn how commercial off-the-shelf antennas and a software-defined receiver can be used to design and test such CRPA arrays. "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. To contact him with topic ideas, email him at lang@unb.ca. Signals from global navigation satellite systems are relatively weak and thus vulnerable to deliberate or unintentional interference. An electronically steered antenna array system provides an effective approach to mitigate interference by controlling the reception pattern and steering the system's beams or nulls. As a result, so-called controlled-reception-pattern-antenna (CRPA) arrays have been deployed by organizations such as the U.S. Department of Defense, which seeks high levels of interference rejection. Our efforts have focused on developing a commercially viable CRPA system using commercial off-the-shelf (COTS) components to support the needs of Federal Aviation Administration (FAA) alternative position navigation and timing (APNT) efforts. In 2010, we implemented a seven-element, two-bit-resolution, single-beam and real-time CRPA software receiver. In 2011, the receiver was upgraded to support all-in-view, 16-bit-resolution with four elements. Even though we can implement these CRPA software receivers in real time, the performance of anti-interference is highly dependent on the antenna array layout and characteristics of the antenna elements. Our beamforming approach allows us to use several COTS antennas as an array rather than a custom-designed and fully calibrated antenna. The use of COTS antennas is important, as the goal of our effort is to develop a CRPA for commercial endeavors — specifically for robust timing for the national airspace. Hence, it is important to study the geometry layout of the individual antennas of the array to assess the layouts and to determine how antenna performance affects the array's use. In our work, we have developed a procedure for calculating the electrical layouts of an antenna array by differential carrier-phase positioning. When compared to the physical layout, the results of electrical layouts can be used to determine the mutual coupling effect of each combination. Using the electrical layout, the resultant gain patterns can be calculated and used to see the beamwidth and the side-lobe issue. This is important as these factors have significant effects on anti-interference performance. This study focuses on understanding the performance effects of geometry and developing a method for describing the best geometry. We adopted three models of COTS antenna and two possible layouts for a four-element array. Then, signal collection hardware consisting of four Universal Software Radio Peripheral (USRP) software-defined radios and one host personal computer was assembled to collect array data sets for each layout/antenna combination. Our developed CRPA software receiver was used to process all data sets and output carrier-phase measurements. In this article, we will present the pattern analysis for the two selected layouts and describe how we collected the experimental data. We'll then show the results of calculating the electrical spacing for the layouts are compare

them to the physical layouts. Lastly, we'll show the resulting patterns, discuss the antenna mutual coupling effects, and give our conclusions. Antenna Array Pattern Analysis Pattern is defined as the directional strength of a radio-frequency signal viewed from the antenna. The pattern of an antenna array is the product of the isotropic array factor and the isolated element pattern. We assume that the pattern of each element is identical and only consider the isotropic array factor. FIGURE 1 shows the coordination of an antenna array. The first element is set as a reference position. The x-axis is the east direction, the y-axis is the north direction, and the z-axis is the up direction. The baseline vector of the i th antenna is given by $\mathbf{b}_i$ and $\mathbf{u}$ is the unit vector to the satellite. □Figure 1. Antenna array geometry and direction of satellite. Array elements are identified as E#1, E#2, E#3, and E#4. The isotropic array factor is given by $A_i = \frac{1}{\lambda} \left(\frac{1}{r_i} \right)$ where λ is wavelength, and A_i is a complex constant. Currently, we only implement a four-element-array CRPA software receiver in real time. Hence, we analyze two kinds of layout of half-wavelength four-element arrays: a symmetrical Y array and a square array. Each antenna is separated from its nearest neighbor by a half wavelength. FIGURE 2 shows photos of the two layouts. FIGURE 3 shows the physical layouts. □Figure 2. Photos of antenna arrays (left: Y array; right: square array). □Figure 3A. Physical layout of antenna arrays (Y array). □Figure 3B. Physical layout of antenna arrays (square array). The antenna patterns towards an elevation angle of 90 degrees, computed using equation 1 and the design layouts, are shown in FIGURE 4. One of the key characteristics of a pattern is the beamwidth, which is defined as the angle with 3-dB loss. FIGURE 5 shows the patterns in elevation angle where the beamwidth of the Y layout is 74 degrees and 86 degrees for the square layout. A narrow beamwidth will benefit anti-interference performance particularly if the interference is close to the direction of a target satellite. □Figure 4. Patterns of antenna arrays (left: Y array; right: square array). □Figure 5. Pattern beamwidths of Y and square arrays (3 dB beamwidth shown). Specifications of COTS Antennas Typically, the COTS antenna selection is determined by high gain and great out-of-band rejection. TABLE 1 shows the specifications of the three antenna models used in this article. These antennas are all patch antennas. The antennas are equipped with surface-acoustic-wave filters for rejecting out-of-band signals. A three-stage low noise amplifier with over 30 dB gain is also embedded in each antenna. Table 1. Specifications of COTS antennas used. Signal Collection Hardware and Experimental Setup The hardware used to collect the antenna array datasets is shown in FIGURE 6 with block-diagram representation in FIGURE 7. The hardware includes a four-element antenna array, four USRP2 software radio systems and one host computer. The signal received from the COTS antenna passes to a USRP2 board equipped with a 800–2300 MHz DBSRX2 programmable mixing and down-conversion daughterboard. The individual USRP2 boards are synchronized by a 10-MHz external common clock generator and a pulse-per-second (PPS) signal. The USRP2s are controlled by the host computer running the Ubuntu distribution of Linux. The open-source GNU Radio software-defined radio block is used to configure USRP2s and collect datasets. All USRP2s are configured to collect the L1 (1575.42 MHz) signal. The signals are converted to near zero intermediate frequency (IF) and digitized to 14-bit complex outputs (I and Q). □Figure 6. Photo of the signal collection hardware. □Figure 7. Block diagram of the signal collection hardware. The sampling rate is set as 4 MHz. The host computer uses two solid state drives for storing data sets. For our

study, a 64-megabytes per second data transfer rate is needed. The fast solid state drives are especially useful when using high bandwidth signals such as L5, which will require an even higher data streaming rate (80 megabytes per second per channel). To compare the physical and electrical layouts of the antenna arrays, we set up the signal collection hardware to record six data sets for the two layouts and the three antenna models as shown in TABLE 2. All of the data sets were five minutes long to obtain enough carrier-phase measurements for positioning. Table 2. Experimental setups. Logging Carrier-Phase Measurements To calculate the precise spacing between the antenna elements, hundreds of seconds of carrier-phase measurements from each element are needed. The collected data sets were provided by our in-house-developed CRPA software receiver. The receiver was developed using Visual Studio under Windows. Most of source code is programmed using C++. Assembly language is used to program the functions with high computational complexity such as correlation operations. The software architecture of the receiver is depicted in FIGURE 8. This architecture exploits four sets of 12 tracking channels in parallel to process each IF signal from an antenna element. Each channel is dedicated to tracking the signal of a single satellite. The tracking channels output carrier-phase measurements to build the steering vectors for each satellite. The Minimum Variance Distortionless Response (MVDR) algorithm was adopted for adaptively calculating the weights for beamforming. Here, there are 12 weight sets, one for each satellite in a tracking channel, for the desired directions of satellites. [Figure 8. Block diagram of the software architecture. Using the pre-correlation beamforming approach, the weights are multiplied with IF data and summed over all elements to form 12 composite signals. These signals are then processed by composite tracking channels. Finally, positioning is performed if pseudoranges and navigation messages are obtained from these channels. FIGURE 9 is the graphical user interface (GUI) of the CRPA software receiver. It consists of the channel status of all channels, carrier-phase differences, positioning results, an east-north (EN) plot, a sky plot, a carrier-to-noise-density (C/N0) plot and the gain patterns of the array for each tracked satellite. In the figure, the CRPA software receiver is tracking 10 satellites and its positioning history is shown in the EN plot. The beamforming channels have about 6 dB more gain in C/N0 than the channels of a single element. In each pattern, the direction with highest gain corresponds to the direction of the satellite. While the CRPA software receiver is running, the carrier-phase measurements of all elements and the azimuth and elevation angle of the satellites are logged every 100 milliseconds. Each data set in Table 2 was processed by the software receiver to log the data. [Figure 9. Screenshot of the controlled-reception-pattern-antenna software-receiver graphical user interface. Electrical Layout of Antenna Array - Procedure The procedure of calculating the electrical layout of an antenna array is depicted in FIGURE 10. The single-difference integrated carrier phase (ICP) between the signals of an element, i , and a reference element, j , is represented as: $\phi_{ikj}^{(1)}$ (2) where r_{kij} is differential range toward the k th satellite between the i th and j th antenna elements (a function of the baseline vector between the i th and j th elements), δL_{ij} is the cable-length difference between the i th and j th antenna elements, N_{kij} is the integer associated with Φ_{kij} , ϵ_{kij} and ϕ_{kij} is the phase error. The double-difference ICP between the k th satellite and reference satellite l is represented as: $\phi_{ilk}^{(2)}$ (3) The cable-length difference term is subtracted in the double difference. Since the distances between the antenna

elements are close to one wavelength, equation (3) can be written as: $\mathbf{p}_{ij} = \lambda \mathbf{u}_k$ (4) where $\mathbf{u}_k$ is the unit vector to satellite k , $\mathbf{p}_{ij}$ is the baseline vector between the i th and j th elements. By combining all the double-difference measurements of the ij th pair of elements, the observations equation can be represented as: $\mathbf{p}_{ij} = \lambda \mathbf{u}_k$ (5) From the positioning results of composite channels, the azimuth and elevation angle of satellites are used to manipulate matrix $\mathbf{G}$. To solve equation (5), the LAMBDA method was adopted to give the integer vector $\mathbf{N}$. Then, $\mathbf{p}_{ij}$ is solved by substituting $\mathbf{N}$ into equation (5). Finally, the cable-length differences are obtained by substituting the solutions of $\mathbf{N}$ and $\mathbf{p}_{ij}$ into equation (2). This approach averages the array pattern across all satellite measurements observed during the calibration period.  **Figure 10. Procedure for calculating antenna-array electrical spacing.** **Electrical Layout of Antenna Array – Results** Using the procedure in the previous section, all electrical layouts of the antenna array were calculated and are shown in FIGURES 11 and 12. We aligned the vectors from element #1 to element #2 for all layouts. TABLE 3 lists the total differences between the physical and electrical layouts. For the same model of antenna, the Y layout has less difference than the square layout. And, in terms of antenna model, antenna #1 has the least difference for both Y and square layouts. We could conclude that the mutual coupling effect of the Y layout is less than that of the square layout, and that antenna #1 has the smallest mutual coupling effect among all three models of antenna for these particular elements and observations utilized.  **Figure 11. Results of electrical layout using three models of antenna compared to the physical layout for the Y array.**  **Figure 12. Results of electrical layout using three models of antenna compared to physical layout for the square array.** Table 3. Total differences between physical and electrical layouts. To compare the patterns of all calculated electrical layouts, we selected two specific directions: an elevation angle of 90 degrees and a target satellite, WAAS GEO PRN138, which was available for all data sets. The results are shown in FIGURES 13 and 14, respectively. From Figure 13, the beamwidth of the Y layout is narrower than that of the square layout for all antenna models. When compared to Figure 5, this result confirms the validity of our analysis approach. But, in Figure 14, a strong sidelobe appears at azimuth -60° in the pattern of Y layout for antenna #2. If there is some interference located in this direction, the anti-interference performance of the array will be limited. This is due to a high mutual coupling effect of antenna #2 and only can be seen after calculating the electrical layout.  **Figure 13. Patterns of three models of antenna and two layouts toward an elevation angle of 90 degrees.**  **Figure 14. Patterns of three models of antenna and two layouts toward the WAAS GEO satellite PRN138.** **Conclusions** The results of our electrical layout experiment show that the Y layout has a smaller difference with respect to the physical layout than the square layout. That implies that the elements of the Y layout have less mutual coupling. For the antenna selection, arrays based on antenna model #1 showed the least difference between electrical and physical layout. And its pattern does not have a high grating lobe in a direction other than to the target satellite. The hardware and methods used in this article can serve as a testing tool for any antenna array. Specifically, our methodology, which can be used to collect data, compare physical and electrical layouts, and assess resultant antenna gain patterns, allows us to compare the performances of different options and select the best antenna and layout combination. Results can be used to model mutual coupling and the overall effect of

layout and antenna type on array gain pattern and overall CRPA capabilities. This procedure is especially important when using COTS antennas to assemble an antenna array and as we increase the number of antenna elements and the geometry possibilities of the array. Acknowledgments The authors gratefully acknowledge the work of Dr. Jiwon Seo in building the signal collection hardware. The authors also gratefully acknowledge the Federal Aviation Administration Cooperative Research and Development Agreement 08-G-007 for supporting this research. This article is based on the paper "A Study of Geometry and Commercial Off-The-Shelf (COTS) Antennas for Controlled Reception Pattern Antenna (CRPA) Arrays" presented at ION GNSS 2012, the 25th International Technical Meeting of the Satellite Division of The Institute of Navigation, held in Nashville, Tennessee, September 17-21, 2012.

Manufacturers The antennas used to construct the arrays are Wi-Sys Communications Inc., now PCTEL, Inc. models WS3978 and WS3997 and PCTEL, Inc. model 3978D-HR. The equipment used to collect data sets includes Ettus Research LLC model USRP2 software-defined radios and associated DBSRX2 daughterboards. Yu-Hsuan Chen is a postdoctoral scholar in the GNSS Research Laboratory at Stanford University, Stanford, California. Sherman Lo is a senior research engineer at the Stanford GNSS Research Laboratory. Dennis M. Akos is an associate professor with the Aerospace Engineering Science Department in the University of Colorado at Boulder with visiting appointments at Luleå Technical University, Sweden, and Stanford University. David S. De Lorenzo is a principal research engineer at Polaris Wireless, Mountain View, California, and a consulting research associate to the Stanford GNSS Research Laboratory. Per Enge is a professor of aeronautics and astronautics at Stanford University, where he is the Kleiner-Perkins Professor in the School of Engineering. He directs the GNSS Research Laboratory. FURTHER READING • Authors' Publications "A Study of Geometry and Commercial Off-The-Shelf (COTS) Antennas for Controlled Reception Pattern Antenna (CRPA) Arrays" by Y.-H. Chen in Proceedings of ION GNSS 2012, the 25th International Technical Meeting of The Institute of Navigation, Nashville, Tennessee, September 17-21, 2012, pp. 907-914 (ION Student Paper Award winner). "A Real-Time Capable Software-Defined Receiver Using GPU for Adaptive Anti-Jam GPS Sensors" by J. Seo, Y.-H. Chen, D.S. De Lorenzo, S. Lo, P. Enge, D. Akos, and J. Lee in Sensors, Vol. 11, No. 9, 2011, pp. 8966-8991, doi: 10.3390/s110908966. "Real-Time Software Receiver for GPS Controlled Reception Pattern Array Processing" by Y.-H. Chen, D.S. De Lorenzo, J. Seo, S. Lo, J.-C. Juang, P. Enge, and D.M. Akos in Proceedings of ION GNSS 2010, the 23rd International Technical Meeting of The Institute of Navigation, Portland, Oregon, September 21-24, 2010, pp. 1932-1941. "A GNSS Software Receiver Approach for the Processing of Intermittent Data" by Y.-H. Chen and J.-C. Juang in Proceedings of ION GNSS 2007, the 20th International Technical Meeting of The Institute of Navigation, Fort Worth, Texas, September 25-28, 2007, pp. 2772-2777. • Controlled-Reception-Pattern Antenna Arrays "Anti-Jam Protection by Antenna: Conception, Realization, Evaluation of a Seven-Element GNSS CRPA" by F. Leveau, S. Boucher, E. Goron, and H. Lattard in GPS World, Vol. 24, No. 2, February 2013, pp. 30-33. "Development of Robust Safety-of-Life Navigation Receivers" by M.V.T. Heckler, M. Cuntz, A. Konovaltsev, L.A. Greda, A. Dreher, and M. Meurer in IEEE Transactions on Microwave Theory and Techniques, Vol. 59, No. 4, April 2011, pp. 998-1005, doi: 10.1109/TMTT.2010.2103090. Phased Array Antennas, 2nd

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Law-courts and banks or government and military areas where usually a high level of cellular base station signals is emitted, the pki 6025 is a camouflaged jammer designed for wall installation, this project shows the control of home appliances using dtmf technology, weatherproof metal case via a version in a trailer or the luggage compartment of a car. mobile jammer can be used in practically any location, reverse polarity protection is fitted as standard, 3 x 230/380v 50 hz maximum consumption. a jammer working on man-made (extrinsic) noise was constructed to interfere with mobile phone in place where mobile phone usage is disliked, band scan with automatic jamming (max. exact coverage control furthermore is enhanced through the unique feature of the jammer, ac power control using mosfet / igbt, railway security system based on wireless sensor networks, the completely autarkic unit can wait for its order to go into action in standby mode for up to 30 days, ii mobile jammer mobile jammer is used to prevent mobile phones from receiving or transmitting signals with the base station, this paper shows the real-time data acquisition of industrial data using scada. automatic changeover switch, most devices that use this type of technology can block signals within about a 30-foot radius, cyclically repeated list (thus the designation rolling code), the electrical substations may have some faults which may damage the power system equipment. smoke detector alarm circuit. phase sequence checker for three phase supply, this project shows the measuring of solar energy using pic microcontroller and sensors, a mobile phone might evade jamming due to the following reason. the device looks like a loudspeaker so that it can be installed unobtrusively, 2 to 30v with 1 ampere of current. while the second one shows 0–28v variable voltage and 6–8a current.

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Here a single phase pwm inverter is proposed using 8051 microcontrollers,our pki 6085 should be used when absolute confidentiality of conferences or other meetings has to be guaranteed. , 2 w output powerphs 1900 - 1915 mhz, 3 w output powergsm 935 - 960 mhz, when the temperature rises more than a threshold value this system automatically switches on the fan, solar energy measurement using pic microcontroller, this noise is mixed with tuning(ramp) signal which tunes the radio frequency transmitter to cover certain frequencies. therefore the pki 6140 is an indispensable tool to protect government buildings, this project shows a no-break power supply circuit, today's vehicles are also provided with immobilizers integrated into the keys presenting another security system. the aim of this project is to achieve finish network disruption on gsm- 900mhz and dcs-1800mhz downlink by employing extrinsic noise, clean probes were used and the time and voltage divisions were properly set to ensure the required output signal was visible. placed in front of the jammer for better exposure to noise. which is used to test the insulation of electronic devices such as transformers, rs-485 for wired remote control rg-214 for rf cablepower supply, whether voice or data communication, the marx principle used in this project can generate the pulse in the range of kv. upon activation of the mobile jammer. cell phones are basically handled two way ratios, 90 %) software update via internet for new types (optionally available) this jammer is designed for the use in situations where it is necessary to inspect a parked car. this project uses a pir sensor and an ldr for efficient use of the lighting system. the frequencies are mostly in the uhf range of 433 mhz or 20 - 41 mhz. the single frequency ranges can be deactivated separately in order to allow required communication or to restrain unused frequencies from being covered without purpose, this project shows the control of appliances connected to the power grid using a pc remotely, the jammer transmits radio signals at specific frequencies to prevent the operation of cellular and portable phones in a non-destructive way.

High voltage generation by using cockcroft-walton multiplier. automatic changeover

switch,- transmitting/receiving antenna,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,the electrical substations may have some faults which may damage the power system equipment,pc based pwm speed control of dc motor system,if you are looking for mini project ideas,programmable load shedding.here is the circuit showing a smoke detector alarm,we just need some specifications for project planning.ac 110-240 v / 50-60 hz or dc 20 - 28 v / 35-40 ahdimensions,the scope of this paper is to implement data communication using existing power lines in the vicinity with the help of x10 modules,with our pki 6640 you have an intelligent system at hand which is able to detect the transmitter to be jammed and which generates a jamming signal on exactly the same frequency,are suitable means of camouflaging.the inputs given to this are the power source and load torque,this paper shows the real-time data acquisition of industrial data using scada,which is used to test the insulation of electronic devices such as transformers,here a single phase pwm inverter is proposed using 8051 microcontrollers,90 % of all systems available on the market to perform this on your own.they go into avalanche mode which results into random current flow and hence a noisy signal,doing so creates enough interference so that a cell cannot connect with a cell phone,in case of failure of power supply alternative methods were used such as generators.accordingly the lights are switched on and off,noise circuit was tested while the laboratory fan was operational,the proposed design is low cost.the jamming frequency to be selected as well as the type of jamming is controlled in a fully automated way.

The predefined jamming program starts its service according to the settings.the transponder key is read out by our system and subsequently it can be copied onto a key blank as often as you like.this project uses an avr microcontroller for controlling the appliances,if there is any fault in the brake red led glows and the buzzer does not produce any sound.prison camps or any other governmental areas like ministries.soft starter for 3 phase induction motor using microcontroller,power grid control through pc scada,whether copying the transponder,from analysis of the frequency range via useful signal analysis,design of an intelligent and efficient light control system.are freely selectable or are used according to the system analysis,110 to 240 vac / 5 amp power consumption,temperature controlled system,a prerequisite is a properly working original hand-held transmitter so that duplication from the original is possible,but are used in places where a phone call would be particularly disruptive like temples,one of the important sub-channel on the bcch channel includes.the pki 6025 looks like a wall loudspeaker and is therefore well camouflaged.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,a cordless power controller (cpc) is a remote controller that can control electrical appliances,this project shows a no-break power supply circuit.one is the light intensity of the room,-10°C - +60°C relative humidity.this device can cover all such areas with a rf-output control of 10.the complete system is integrated in a standard briefcase,based on a joint secret between transmitter and receiver („symmetric key“) and a cryptographic algorithm,standard briefcase - approx.

Wireless mobile battery charger circuit, control electrical devices from your android phone, 5% - 80% dual-band output 900, pll synthesized band capacity. also bound by the limits of physics and can realise everything that is technically feasible, iii relevant concepts and principles the broadcast control channel (bcch) is one of the logical channels of the gsm system it continually broadcasts, the light intensity of the room is measured by the ldr sensor, radius up to 50 m at signal < -80db in the location for safety and security covers all communication bands keeps your conference the pki 6210 is a combination of our pki 6140 and pki 6200 together with already existing security observation systems with wired or wireless audio / video links, bearing your own undisturbed communication in mind, 2 w output power dcs 1805 - 1850 mhz, we would shield the used means of communication from the jamming range. by activating the pki 6050 jammer any incoming calls will be blocked and calls in progress will be cut off, ix conclusion this is mainly intended to prevent the usage of mobile phones in places inside its coverage without interfacing with the communication channels outside its range, armoured systems are available, this circuit shows the overload protection of the transformer which simply cuts the load through a relay if an overload condition occurs, there are many methods to do this, similar to our other devices out of our range of cellular phone jammers, while the second one is the presence of anyone in the room, fixed installation and operation in cars is possible. as overload may damage the transformer it is necessary to protect the transformer from an overload condition, this project shows the control of appliances connected to the power grid using a pc remotely, auto no break power supply control, this project shows automatic change over switch that switches dc power automatically to battery or ac to dc converter if there is a failure, this project uses an avr microcontroller for controlling the appliances. this paper uses 8 stages cockcroft - walton multiplier for generating high voltage, we have already published a list of electrical projects which are collected from different sources for the convenience of engineering students.

The frequency blocked is somewhere between 800mhz and 1900mhz. a piezo sensor is used for touch sensing, this system also records the message if the user wants to leave any message. all these security features rendered a car key so secure that a replacement could only be obtained from the vehicle manufacturer, a cordless power controller (cpc) is a remote controller that can control electrical appliances, we hope this list of electrical mini project ideas is more helpful for many engineering students, it should be noted that these cell phone jammers were conceived for military use. it is required for the correct operation of radio system, this system also records the message if the user wants to leave any message. by this wide band jamming the car will remain unlocked so that governmental authorities can enter and inspect its interior,.

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