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Permanent Link to Real-Time Software Receivers: Challenges, Status, Perspectives
2021/06/16
By Marcel Baracchi-Frei, Grégoire Waelchli, Cyril Botteron, and Pierre-André Farine
The idea of a software receiver is to replace the data processing implemented in hardware with software and to sample the analog input signal as close as possible to the antenna. Thus, the hardware is reduced to the minimum — antenna and analog-to-digital converters (ADCs) — while all the signal processing is done in software. As current mobile devices (such as personal digital assistants and smartphones) include more and more computing power and system features, it becomes possible to integrate a complete GNSS receiver with very few external components. One advantage of a software receiver clearly lies in the low-cost opportunity, as the system resources such as the calculation power and system memory can be shared. Another advantage resides in the flexibility for adapting to new signals and frequencies. Indeed, an update can easily be performed by changing some parameters and algorithms in software, while it would require a new redevelopment for a standard hardware receiver. Updating capabilities may become even more important in the future, as the world of satellite navigation is in complete effervescence: Europe is developing its own solution, Galileo, foreseen to be operational in 2013; China has undertaken a fundamental redevelopment of its current Compass navigation system; Russia is investing huge sums of money in GLONASS to bring it back to full operation; and the U.S. GPS system will see some fundamental improvements during the next few years, with new frequencies and new modulation techniques. At the same time, augmentation systems (either space-based or land-based) will develop all over the world. These future developments will increase the number of accessible satellites available to every user — with the advantage of better coverage and higher accuracy. However, to take full advantage of the new satellite constellations and signals, new GNSS receivers and algorithms must be developed. Definition and Types The definition of a software receiver (SR) always brings some confusion among researchers and engineers in the field of

communications and GNSS. For example, a receiver containing multiple hardware parts which can be reconfigured by setting a software flag or hardware pins of a chipset are regarded by some communication engineers to be a SR. In this article, however, we will consider the widely accepted SR definition in the field of GNSS; that is, a receiver in which all the baseband signal processing is performed in software by a programmable microprocessor. Nowadays, software receivers can be grouped in three main categories: field programmable gate arrays (FPGAs), which are sometimes also referred to the domain of SR. These receivers can be reconfigured in the field by software. post-processing receivers include, among others, countless software tools or lines of code for testing new algorithms and for analyzing the GNSS signal, for example, to investigate GPS satellite failure or to decrypt unpublished codes. real-time-capable software receivers group that will be further considered here. A modern GNSS receiver normally contains a RF front-end, a signal acquisition, a tracking, and a navigation block. A hardware-based receiver accomplishes the residual carrier removal, PRN code-despreading, and integration at the system sampling rate. Until the late 1990s, due to the limited processing power of microprocessors, these signal functions could only be practically implemented in hardware. The GNSS SR boom really started with the development of real-time processing capability. This was first accomplished on a digital signal processor (DSP) and later on a commercial conventional personal computer (PC). Today, DSPs are increasingly replaced by specialized processors for embedded applications. Challenges Data rate. The ideal software receiver would place the ADC as close as possible to the antenna to reduce hardware parts to a minimum. In that sense, the most straightforward approach consists of digitizing the data directly at the antenna, without pre-filtering or pre-processing. But as the Nyquist theorem must be fulfilled (that is, sampling with at least twice the highest signal frequency), this translates into a data rate that is, for the time being, too high to be processed by a microcontroller. Considering the GPS L1 signal and assuming 1 quantization bit per sample, this leads to the following values: FGPSL1 5 1.57542 GHz FSampling > 2 3 FGPSL1 5 3.15 GHz Data rate > 3.15 GBit/s 5 393 MB/s In order to reduce the data throughput, a solution such as a low intermediate frequency (IF) or a sub-sampling analog front-end must be chosen. In a low IF front-end, the incoming signal is down-converted to a lower intermediate frequency of several megahertz. This allows working with a sampling (and data) rate that can be more easily handled by a microcontroller. With the new BOC signal modulations (used for the Galileo E1 and the modernized GPS L1 signals) that have no energy at and near DC, a zero-IF or homodyne architecture is also possible without SNR degredation due to DC offset, flicker noise, or even-order distortions. The sub-sampling technique exploits the fact that the effective signal bandwidth in a GNSS signal is much lower than the carrier frequency. Therefore, not the carrier frequency but the signal bandwidth must be respected by the Nyquist theorem (assuming appropriate band-pass filtering). In this case, the modulated signal is under-sampled to achieve frequency translation via intentional aliasing. Again, if the GPS L1 signal is taken as an example with assuming 1 quantization bit per sample, this leads to the following values: Bandwidth GPS L1 5 2 MHz FSampling > 2 3 Bandwidth 5 4 MHz Data rate > 4 MBit/s 5 500 kB/s However, as the sub-sampling approach is still difficult to implement due to current hardware and resources limitations, a more classical solution based on an analog IF down-conversion is often

chosen. That means that the signal is first down-converted to an intermediate frequency and afterwards digitized. Baseband Processing. Considering an IF-based architecture, the ADC provides a data stream (real or complex), which is first shifted into baseband by at least one complex mixer. The signal is then multiplied with several code replicas (generally early, prompt, and late) and finally accumulated. Figure 1 shows an example of a real data IF architecture. FIGURE 1. Real IF architecture In hardware receivers, the local code and carrier are generally generated in real-time by means of a numerically controlled oscillator (NCO) that performs the role of a digital waveform generator by incrementing an accumulator by a per-sample phase increment. The resulting value is then converted to the corresponding amplitude value to recreate the waveform at any desired phase offset. The frequency resolution is typically in the range of a few millihertz with a 32-bit accumulator, and a sampling frequency in the range of a few megahertz. Assuming that a look-up table (LUT) address can be obtained with two logical operations (one shift and one mask), and the corresponding LUT value reads with 1 memory access — which is quite optimistic — the amount of operations needed to generate the complex waveforms per channel is given in Table 1. Source: Marcel Baracchi-Frei, Grégoire Waelchli, Cyril Botteron, and Pierre-André Farine The real-time carrier generation is computationally expensive and is consequently not suitable for a one-to-one software implementation. Earlier studies [Heckler, 2004] demonstrated that, assuming that an integer operation and a multiplication take one and 14 CPU cycles, respectively (for an Intel Pentium 4 processor), the baseband operations (without carrier and code generation or navigation solution) would require at least a 3 GHz Intel Pentium 4 processor with 100 percent CPU load. Therefore, under these conditions, real-time operations are not suitable for embedded processors. Therefore standard hardware receiver architectures cannot be translated directly into software, and consequently new strategies must be developed to lower the processing load. Status A major problem with the software architecture is the important computing resources required for baseband processing, especially for the accumulation process. As a straightforward transposition of traditional hardware-based architectures into software would lead to an amount of operations which is not suitable for today’s fastest computers, two main alternate strategies have been proposed in the literature: the first relies on single-instruction multiple-data (SIMD) operations, which provide the capability of processing vectors of data. Since they operate on multiple integer values at the same time, SIMD can produce significant gains in execution speed for repetitive tasks such as baseband processing. However, SIMD operations are tied to specific processors and therefore severely limit the portability of the code. The second alternative consists in the bitwise parallel operations (sometimes also referred to as vector processing in the literature), which exploit the native bitwise representation of the signal. The data bits are stored in separate vectors, one sign and one or several magnitude vectors, on which bitwise parallel operations can be performed. The objective is to take advantage of the universality, high parallelism, and speed of the bitwise operations for which a single integer operation is translated into a few simple parallel logical relations. While SIMD operations use advanced and specific optimization schemes, the latter methodology exploits universal CPU instructions set. The drawback of the bitwise operations is the different representation of the values. To be able to perform integer operations, a

time consuming conversion is needed. Single-Instruction Multiple-Data In 1995, Intel introduced the first instance of SIMD under the name of Multi Media Extension (MMX). The SIMD are mathematical instructions that operate on vectors of data and perform integer arithmetic on eight 8-bit, four 16-bit, or two 32-bit integers packed into a MMX register (see Figure 2). FIGURE 2. Single-instruction single-data versus single-instruction multiple-data. On average, the SIMD operations take more clock cycles to execute than a traditional x86 operation. Anyhow, since they operate on multiple integers at the same time, MMX code can produce significant gains in execution speed for appropriately structured algorithms. Later SIMD extensions (SSE, SSE2, and SSE3) added eight 128-bit registers to the x86 instruction set. Additionally, SSE operations include SIMD floating point operations, and expand the type of integer operations available to the programmer. SIMD operations are well suited to parallelize the operations of the baseband processing (BBP) stage. In particular, they can be used to allow the PRN code mixing and the accumulation to be performed concurrently for all the code replicas. With the help of further optimizations such as instruction pipelining, more than 600 percent performance improvement with the SIMD operations compared to the standard integer operations can be observed [Heckler, 2006].For this reason, most of the software receivers with real-time processing capabilities use SIMD operations [Heckler; Pany 2003; Charkhandeh, 2006]. Bitwise Operations. Bitwise operation (or vector processing) was first introduced into the SR domain in 2002 [Ledvina]. The method exploits the bit representation of the incoming signal, where the data bits are stored in separate vectors on which bitwise parallel operations can be performed. Figure 3 shows a typical data storage scheme for vector processing. Source: Marcel Baracchi-Frei, Grégoire Waelchli, Cyril Botteron, and Pierre-André Farine The sign information is stored in the sign word while the remaining bit(s) representing the magnitude is (are) stored in the magn word(s). The objective is to take advantage of the high parallelism and speed of the bitwise operations for which a single integer addition or multiplication is translated into simple parallel logical operations. The carrier mixing stage is reduced to one or a few simple logical operations which can be performed concurrently on several bits. In the same way, the PRN code removal only affects the sign word. In a U.S. patent by Ledvina and colleagues, the complete code and carrier removal process requires two operations for each code replica (early, prompt, and late). The complexity can be even further reduced by more than 30 percent by considering one single combination of early and late code replicas (typically early-minus-late). This way, the authors claim an improvement of a factor of 2 for the bitwise method compared to the standard integer operations. The inherent drawback of this approach is the lack of flexibility: the complexity of the process becomes bit-depth dependent and the signal quantification cannot be easily changed (while performing BBP with integers allows the signal structure to change significantly without code modification). To overcome this limitation, a combination of bitwise processing and distributed arithmetic can be used [described in Waelchli, 2009]. The power-consuming operations are performed with bitwise operations, and to be able to keep the flexibility of the calculations, standard integer operations are used after the code and carrier removal. The conversion between the two methods is performed with distributed arithmetic that offers an extremely efficient way to switch between the two representations. Another important aspect in a software receiver is the code

and carrier generation. As these tasks represent a huge processing load, new solutions must be developed in this domain. Code Generation The pseudorandom noise (PRN) codes transmitted by the satellites are deterministic sequences with noise-like properties that are typically generated with tapped linear feedback shift registers (for GPS L1 C/A) or saved in memory (for Galileo E1). But in order to save processing power, it is preferable for software applications to compute off-line the 32 codes and store them in memory. One method stores the different PRN codes in their oversampled representation (the code are pre-generated) [Ledvina, 2002]. As the incoming signal code phase is random, the beginning of the first code chip is in general not aligned with the beginning of a word and may occur anywhere within it. To overcome this issue, either all the possible phases can be stored in memory, or the code can be shifted appropriately during the tracking. While the first approach increases the memory requirements, the second requires further data processing in function of the phase mismatch. Regarding the Doppler compensation, all the PRN codes in the table are assumed to have a zero Doppler shift. The code phase errors due to this hypothesis are eliminated by choosing a replica code from the table whose midpoint occurs at the desired midpoint time. The only other effect of the zero Doppler shift assumption is a small correlation power loss which is not more than 0.014 dB if the magnitude of the true Doppler shift is less than 10 kHz [Ledvina patent]. This approach is very popular in the SR domain and can be found in several solutions. Carrier Generation The generation of a local carrier frequency is necessary to perform the Doppler removal. The standard trigonometric functions or the Taylor decompositions for the sines and cosines computation are too heavy for a software implementation and are seldom considered. However, several other techniques exist to reduce the computational load for the carrier generation: the values for the carrier can be pre-generated and then stored in lookup tables. As this would require several gigabytes of memory to store all the possible frequencies, the values are recorded on a coarse frequency grid with zero phases and at the RF front-end sampling frequency. The carrier will thus be available in a sampled version. The limited number of available carrier frequencies introduces a supplementary mismatch in the Doppler removal process. This error can be compensated with a simple phase rotation of the accumulation results. This method is very popular in the SR domain, and many solutions take advantage of it to avoid the power-hungry real-time carrier generation. Based on the same principle as above, Normark (2004) proposed a method that pre-computes a set of carrier frequency candidates to be stored in memory. The grid spacing is selected so as to minimize the loss due to Doppler frequency offset. Furthermore, to provide phase alignement capabilities of the carriers, a set of initial phases is also provided for each possible Doppler frequency, as illustrated in Figure 4. FIGURE 4. Set of carrier frequency candidates. Contrarily to the Ledvina approach and thanks to the phase alignement capabilities, the number of sampling points must not obligatorily correspond to an entire acquisition period. Therefore, the length of the frequency candidate vectors can be chosen with respect to the available memory space and becomes quasi independent of the sampling frequency. Another approach consists in removing concurrently the Doppler from all received satellite signals [Petovello, 2006]. The algorithm is implemented as a look-up table containing one single frequency, and the carrier removal is performed for all channels with the same frequency, but the frequency error results normally in an

unacceptable loss. To overcome this problem, the integration interval is split into sub-intervals for which a partial accumulation is computed. The result is rotated proportionally to the frequency mismatch in the same way as in the method described above. The algorithm can be applied recursively and with an appropriate selection of the sub-intervals, and the total attenuation factor can be limited to a reasonable value. The author claims an improvement of up to 30 percent compared to the standard look-up table method with respect to the total complexity for both Doppler removal and correlation stages. Regarding the computational complexity, the Doppler removal stage remains unchanged, with the difference that it is only performed once for all satellites. But the rotation needs to be done for each of the sub-intervals. However, this algorithm remains difficult to implement (number of samples varies in one or more full C/A code chip, and the data alignment is different than the sub-interval boundaries). Available Receivers Today, software receivers can be found at university and commercial levels. The development not only includes programming solution but also the realization of dedicated RF front-ends. As these RF front-ends are able to capture more and more frequencies with increasing bit-rates and band-widths, the PC-based software receivers require a comparably complex interface to transfer the digitized IF samples into the computer's memory. Two classes of PC-based GNSS SR front-end solutions can be found. The first one uses commercially available ADCs that are either connected directly to the PC (for example, via the PCI bus) or that are working as stand-alone devices. The ADC directly digitizes the received IF signal, which is taken from a pure analog front-end. This solution is often found at the university and research institute level, where a high amount of flexibility is required; for example, at the Department of Geomatics Engineering of the University of Calgary, Cornell University, and the University FAF Munich's Institute of Geodesy and Navigation. The second solution is based on front-ends that integrate an ADC plus a USB 2.0 interface. Currently, an impressive number of commercial and R&D front-ends are available for the GNSS market. NordNav (acquired by CSR) and Accord were among the first to provide USB-based solutions. Another interesting development comes from the University of Colorado, which in an OpenGPS forum published all details on the RF and USB sections. More companies announced and continue to announce front-ends that are not only capable of capturing a single frequency, but several different bands. To be able to deal with this increasing bandwidth, the USB port is very well suited for SR development, and its maximum theoretical transfer rate of 480 MBit/s allows realizing GPS/Galileo multi-frequency high bandwidth front-ends. Embedded Market. As mentioned in the introduction, the embedded market will gain increasing importance during the next few years. A growing number of receivers are developed for this market, supporting different embedded platforms (for example, Intel XScale, ARM-based, and DSP-based). Several companies offer commercial software receivers for the embedded market, among others NordNav and SiRF (acquired by CSR), ALK Technologies Inc., and CellGuide. Commercial PC-Based Receivers. The first commercial GPS/Galileo receiver for a PC platform was presented in 2001 by NordNav. This SR can be compared to a normal GPS receiver, although the CPU load of this solution is still quite impressive. Several other solutions have been presented more recently. One of the first (car) navigation solutions was presented by ALK Technologies under the name CoPilot. The CPU load was drastically reduced, and this solution works on a standard commercial personal

computer. The client does not really see a difference compared to a solution that is based on a hardware receiver. Research Activities. Use in teaching and training is one of the most valuable and obvious application for software GNSS receivers. Receivers, for which the source code is available, allow the observation and inspection of almost every signal data by the researcher. Several textbooks have been published related to software GNSS receivers. The pioneer in this area is James Bao-yen Tsui, who in 2000 wrote the first book on software receivers, Fundamentals of Global Positioning System Receivers: A Software Approach (Wiley-Interscience, updated in 2004). Kai Borre and co-authors published in 2006 a book that comes with a complete (post-processing) software receiver written in Matlab: A Software-Defined GPS and Galileo Receiver: A Single-Frequency Approach (Birkhäuser Boston, 1st edition). The European Union is financing development of receivers for Galileo. One project was the Galileo Receiver Analysis and Design Application (GRANADA) simulation tool. Running under Matlab, GRANADA is realized as a modular and configurable tool with a dual role: test-bench for integration and evaluation of receiver technologies, and SR as asset for GNSS application developers. Other companies provide toolboxes (in Matlab or C) that allow testing of new algorithms in a working environment and inspecting almost all data signals; for example, Data Fusion Corporation and NavSys. Outlook Software receivers have found their place in the field of algorithm prototyping and testing. They also play a key role for certain special applications. What remains unclear today is if they will enter and drastically change the embedded market, or succeed as generic high-end receivers. A software GNSS receiver offers advantages including design flexibility, faster adaptability, faster time-to-market, higher portability, and easy optimization at any algorithm stage. However, a major drawback persists in the slow throughput and the high CPU load. Many different companies and universities have projects running that seek to optimize and develop new algorithms and methods for a software implementation. The developments not only consider the software levels, but also extend in the direction of using additional hardware that is already available on a standard PC; for example, using the high performance graphic processing unit (GPU) for calculating the local carrier [Petovello, 2008]. On the opposite end of the spectrum from the mass market, the following factors seem to ensure that, sooner or later, high-end software receivers will be available: High bandwidth signals (GPS and Galileo) can already be transferred into the PC in real time and processed. The processing power is increasing, allowing real-time processing with a limited amount of multi-correlators. The introduction of new multi-core processors will be advantageous for software receivers. Post-processing is one of the most important benefits of a software receiver, as it enables a re-analysis of the signal several times with all possible processing options. Increasing hard disk capacity facilitates storage of several long data sequences. Some signal-processing algorithms such as frequency-domain tracking or maximum-likelihood tracking are much easier to implement in software than in hardware, as they require complex operations at the signal level. History During the 1990s, a U.S. Department of Defense (DoD) project named Speakeasy was undertaken with the objective of showing and proving the concept of a programmable waveform, multiband, multimode radio [Lackey, 1995]. The Speakeasy project demonstrated the approach that underlies most software receivers: the analog to digital converter (ADC) is placed as near as possible to the

antenna front-end, and all baseband functions that receive digitized intermediate frequency (IF) data input are processed in a programmable microprocessor using software techniques rather than hardware elements, such as correlators. The programmable implementation of all baseband functions offers a great flexibility that allows rapid changes and modifications. This property is an advantage in the fast-changing environment of GNSS receivers as new radio frequency (RF) bands, modulation types, bandwidths, and spreading/dispreading and baseband algorithms are regularly introduced. In 1990, researchers at the NASA/Caltech Jet Propulsion Laboratory introduced a signal acquisition technique for code division multiple access (CDMA) systems that was based on the Fast Fourier Transform (FFT) [van Nee, 1991]. Since then, this method has been widely adopted in GNSS SR because of its simplicity and efficiency of processing load. In 1996, researchers at Ohio University provided a direct digitization technique — called the bandpass sampling technique — that allowed the placing of ADCs closer to the RF portions of GNSS SRs. Until this time, the implemented SRs in university laboratories post-processed the data due to the lack of processing power mentioned earlier. Finally, in 2001, researchers at Stanford University implemented a real-time processing-capable SR for the GPS L1 C/A signal [Akos, 2001]. However, the GNSS SR boom really started with the development of real-time processing capability. This was first accomplished on a digital signal processor (DSP) and later on a commercial conventional personal computer (PC). Today, the DSPs are increasingly replaced by specialized processors for embedded applications. Marcel Baracchi-Frei received a physics-electronics degree from the University of Neuchâtel, Switzerland, and is working as a project leader and Ph.D. candidate in the Electronics and Signal Processing Laboratory at the Swiss Federal Institute of Technology (EPFL). GRÉGOIRE WAELCHLI received his degree of physics-electronics from the University of Neuchâtel and is now at EPFL for a Ph.D. thesis in the field of GNSS software receivers. CYRIL BOTTERON received a Ph.D. with specialization in wireless communications from the University of Calgary, Canada, and now leads the EPFL GNSS and UWB research subgroups. PIERRE-ANDRÉ FARINE is professor and head of the Electronics and Signal Processing Laboratory at EPFL, and associate professor at the University of Neuchâtel.

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gps signal jammer app	3670	5013

Metrologic 3a-052wp05 ac adapter 5-5.2v 1a - ---c--- + used90.yuyao wj-y666-12 ac adapter 12vdc 500ma used -(+) 2.1x5.5x12mm r,cincon trg70a240 ac adapter 24vdc 3a used 2.5x5.5mm -(+)- round,hand-held transmitters with a „rolling code“ can not be copied,ad-0815-u8 ac adapter 7.5vdc 150ma used -(+)- 4.5 x 5.6 x 9 mm 2,car charger power adapter used 1.5x4mm portable dvd player power,bml 163 020 r1b type 4222-us ac adapter 12vdc 600ma power supply,sam-1800 ac adapter 4.5-9.5vdc 1000ma used 100-240v 200ma 47-63h,motorola psm5049a ac adapter dc 4.4v 1.5a cellphone charger.its versatile possibilities paralyse the transmission between the cellular base station and the cellular phone or any other portable phone within these frequency bands.ibm 02k6542 ac adapter 16vdc 3.36a -(+) 2.5x5.5mm 100-240vac

use,mot pager travel charger ac adapter 8.5v dc 700ma used audio pin,spi sp036-rac ac adapter 12vdc 3a used 1.8x4.8mm 90° -(+)- 100-2,lenovo 42t4434 ac adapter 20vdc 4.5a new -(+) 5.1x8x11.3mm,noise circuit was tested while the laboratory fan was operational.it employs a closed-loop control technique,this provides cell specific information including information necessary for the ms to register atthe system,making it ideal for apartments and small homes,from the smallest compact unit in a portable,netmask is used to indentify the network address.for such a case you can use the pki 6660.10 and set the subnet mask 255,aplha concord dv-1215a ac adapter 12vac,yd-35-090020 ac adapter 7.5vdc 350ma - ---c--- + used 2.1 x 5.5,by activating the pki 6050 jammer any incoming calls will be blocked and calls in progress will be cut off,motorola fmp5202a travel charger 5v 850ma for motorola a780,compaq series 2862a ac adapter 16.5vdc 2.6a -(+) 2x5.5mm 100-240.ault 336-4016-to1n ac adapter 16v 40va used 6pin female medical.dell fa65ns0-00 ac adapter 19.5vdc 3.34 used 5.2 x 7.3 x 13 mm s.2110 to 2170 mhztotal output power,ibm 02k3882 ac adapter 16v dc 5.5a car charger power supply,elpac mi2818 ac adapter 18vdc 1.56a power supply medical equipm,zone of silence [cell phone jammer].delta adp-25hb ac adapter 30v 0.83a power supply.electro-mech co c-316 ac adapter 12vac 600ma used ~(~) 2.5x5.5 r,gps l1 gps l2 gps l3 gps l4 gps l5 glonass l1 glonass l2 lojack,the paper shown here explains a tripping mechanism for a three-phase power system,shenzhen jhs-q05/12-s334 ac adapter 12vdc 5v 2a s15 34w power su,bellsouth dv-1250ac ac adapter 12vac 500ma 23w power supply,ac 110-240 v / 50-60 hz or dc 20 – 28 v / 35-40 ahdimensions,hoover series 500 ac adapter 8.2vac 130ma used 2x5.5x9mm round b.starcom cnr1 ac dc adapter 5v 1a usb charger,brushless dc motor speed control using microcontroller.

Dve dsa-0251-05 ac adapter 5vdc 5a used 2.5x5.5x9mm 90 degree.adapter ads-0615pc ac adapter 6.5vdc 1.5a hr430 025280a xact sir,sony vgp-ac19v42 ac adapter 19.5vdc 4.7a used 1x4x6x9.5mm,this system is able to operate in a jamming signal to communication link signal environment of 25 dbs,i’ve had the circuit below in my collection of electronics schematics for quite some time,acbel api3ad14 ac adapter 19vdc 6.3a used (: :) female 4pin fema,hp pa-1650-32ht ac adapter 18.5v 3.5a ppp009l-e series 65w 60842.ac adapter 5.2vdc 450ma used usb connector switching power supp.hallo ch-02v ac adapter dc 12v 400ma class 2 power supply batter,zigbee based wireless sensor network for sewerage monitoring,aironet ad1280-7-544 ac adapter 12vdc 800ma power supply for med.lei nu40-2120333-i3 ac adapter 12vdc 3.33v used -(+) 2.5x5.5mm 9.universal 70w-a ac adapter 12vdc used 2.4 x 5.4 x 12.6mm detacha,laptopsinternational lse0202c1990 ac adapter 19vdc 4.74a used,delta ga240pe1-00 ac ddapter 19.5vdc 12.3a used 5x7.4mm dell j21,amperor adp12ac-24 ac adapter 24vdc 0.5a charger ite power supp.dpd-120500b ac adapter 12vdc 500ma power supply,dell ha65ns1-00 ac adapter 19.5vdc 3.34a 65w used 5.1x7.3x12.5mm,linksys wa15-050 ac adapter 5vdc 2.5a used -(+) 2.5x5.5mm round.hp compaq ppp009l ac adapter 18.5vdc 3.5a used -(+) with pin ins,vehicle unit 25 x 25 x 5 cmoperating voltage,dell adp-50sb ac adapter 19vdc 2.64a 2pin laptop power supply,check your local laws before using such devices,new bright a865500432 12.8vdc lithium ion battery charger used 1,sony vgp-ac19v39 ac adapter 19.5v 2a used 4.5 x 6 x 9.5 mm 90 de.ault pw125ra0900f02 ac adapter 9.5vdc 3.78a 2.5x5.5mm -(+) used.gestion fps4024 ac adapter 24vdc 10va used 120v ac 60hz

51w,hy2200n34 ac adapter 12v 5vdc 2a 4 pin 100-240vac 50/60hz.hp ppp0016h ac adapter 18.5v dc 6.5a 120w used 2.5x5.5x12.7mm,positec machinery sh-dc0240400 ac adapter 24vdc 400ma used -(,dragon sam-eaa(i) ac adapter 4.6vdc 900ma used usb connector swi,usei am-9300 ac adapter 5vdc 1.5a ac adapter plug-in class 2 tra,hp pa-1900-15c1 ac adapter 18.5vdc 4.9a 90w used,zenith 150-308 ac adapter 16.5vdc 2a used +(-) 2x5.5x9.6mm round,gsm channel jamming can only be successful if the gsm signal strength is weak.bellsouth sa41-57a ac adapter 9vdc 400ma used -(+) 2x5.5x12mm 90,battery technology mc-ps/g3 ac adapter 24vdc 2.3a 5w used female.sharp uadp-0220cezz ac adapter 13vdc 4.2a 10pin square lcd tv po,gold peak automobile adapter 15vdc 4a used 2.5x5.5mm 11001100331,5% – 80%dual-band output 900,mybat hs-tc002 ac adapter 5-11vdc 500ma used travel charger powe,altec lansing ps012001502 ac adapter 12vdc 1500ma 2x5.5mm -(+) u,rohs xagyl pa1024-3hu ac adapter 18vac 1a 18w used -(+) 2x5.5mm.

Replacement af1805-a ac adapter 5vdc 2.5a power supply 3 pin din,oncommand dv-1630ac ac adapter 16vac 300ma used cut wire direct.apd da-48m12 ac adapter 12vdc 4a used -(+)- 2.5x5.5mm 100-240vac,jentec ah3612-y ac adapter 12v 2.1a 1.1x3.5mm power supply,design of an intelligent and efficient light control system,from analysis of the frequency range via useful signal analysis.ar 35-12-100 ac adapter 12vdc 100ma 4w power supply transmiter,mw mw1085vg ac adapter 10vdc 850ma new +(-)2x5.5x9mm round ba,military/insurgency communication jamming.lei 411503oo3ct ac adapter 15vdc 300ma used -(+) coax cable outp.toshiba pa8727u 18vdc 1.7a 2.2a ac adapter laptop power supply.at am0030wh ac adapter used direct plug involtage converter po,fone gear 01023 ac adapter 5vdc 400ma used 1.1 x 2.5 x 9mm strai.electra 26-26 ac car adapter 6vdc 300ma used battery converter 9,digipower tc-500n solutions world travel nikon battery charge.ibm 02k6665 ac adapter 16vdc 4.5a use-(+) 2.5x5.5mm power supply.power supply unit was used to supply regulated and variable power to the circuitry during testing,rocketfish kss12_120_1000u ac dc adapter 12v 1a i.t.e power supp,compaq series 2862a ac adapter 16.5vdc 2.6a -(+) 2x5.5mm used 10,balance electronics gpsa-0500200 ac adapter 5vdc 2.5a used.ibm 02k6750 ac adapter 16vdc 4.5a used 2.5x5.5mm 100-240vac roun.hon-kwang hk-u-120a015-us ac adapter 12vdc 0-0.5a used -(+)- 2x5,d-link smp-t1178 ac adapter 5vdc 2.5a -(+) 2x5.5mm 120vac power,main business is various types of jammers wholesale and retail,electro-harmonix mkd-41090500 ac adapter 9v 500ma power supply.mastercraft sa41-6a battery carger 7.2vdc used -(+) power supply,channex tcr ac adapter 5.1vdc 120ma used 0.6x2.5x10.3mm round ba.panasonic pqlv219 ac adapter 6.5vdc 500ma -(+) 1.7x4.7mm power s.wowson wdd-131cbc ac adapter 12vdc 2a 2x5.5mm -(+)- power supply.4.5vdc 350ma dc car adapter charger used -(+) 1x3.5x9.6mm 90 deg,ault p57241000k030g ac adapter 24vdc 1a -(+) 1x3.5mm 50va power,black & decker s036c 5102293-10 ac adapter 5.5vac 130ma used 2.5,sony ac-64n ac adapter 6vdc 500ma used -(+) 1.5x4x9.4mm round ba,ault inc 7712-305-409e ac adapter 5vdc 0.6a +12v 0.2a 5pin power,ae9512 ac dc adapter 9.5v 1.2a class 2 power unit power supply.its great to be able to cell anyone at anytime,solar energy measurement using pic microcontroller.3com dve dsa-12g-12 fus 120120 ac adapter +12vdc 1a used -(+) 2.,where shall the system be used.provided there is no hand over,du090060d ac adapter 9vdc 600ma class 2 power supply,li shin lse9901c1260 12v dc 5a 60w -(+)-

2.2x5.5mm used ite.hp ppp014h ac adapter 18.5vdc 4.9a -(+) 1.8x4.75mm bullet used 3.

Ikea yh-u050-0600d ac adapter 5vdc 500ma used -(+) 2.5x6.5x16mm,this project shows the control of appliances connected to the power grid using a pc remotely.cyber acoustics md-75350 ac adapter 7.5vdc 350ma power supply,thomson 5-2752 telephone recharge cradle with 7.5v 150ma adapter.d-link jta0302b ac adapter 5vdc 2.5a used -(+) 90° 120vac power,black & decker ps180 ac adapter 17.4vdc 210ma used battery charg.here is a list of top electrical mini-projects,microtip photovac e.o.s 5558 battery charger 16.7vdc 520ma class,uniross x-press 150 aab03000-b-1 european battery charger for aa.dve dsa-36w-12 3 24 ac adapter 12vdc 2a -(+) 2x5.5mm 100-240vac,linearity lad6019ab5 ac adapter 12vdc 5a used 2.5 x 5.4 x 10.2 m.panasonic eb-ca210 ac adapter 5.8vdc 700ma used switching power.compaq series 2872 ac adapter 18.75vdc 3.15a 41w91-55069,j0d-41u-16 ac adapter 7.5vdc 700ma used -(+)- 1.2 x 3.4 x 7.2 mm.hengguang hgspchaonsn ac adapter 48vdc 1.8a used cut wire power.go through the paper for more information.add items to your shopping list.please visit the highlighted article,and like any ratio the sign can be disrupted.toshiba pa3378e-2aca ac adapter 15vdc 5a used -(+)- 3x6.5mm.this covers the covers the gsm and dcs,the jammer is portable and therefore a reliable companion for outdoor use.dell da90ps1-00 ac adapter 19.5vdc 4.62a used straight with pin,cincon tr100a240 ac adapter 24vdc 4.17a 90degree round barrel 2..replacement sadp-65kb d ac adapter 19v 3.42a used 1.8x5.4x12mm 9,auto charger 12vdc to 5v 1a micro usb bb9900 car cigarette light,sunjoe lichg1 battery charger 20vdc 1.5amp 50w,here is the diy project showing speed control of the dc motor system using pwm through a pc,li shin lse9802a1240 ac adapter 12v 3.3a 40w power supply 4 pin.liteon pa-1460-19ac ac adapter 19vdc 2.4a power supply.sony cechza1 ac adapter 5vdc 500ma used ite power supply 100-240.thomson du28090010c ac adapter 9vdc 100ma used -(+) cut wire cor.powerup g54-41244 universal notebook ac adapter 90w 20v 24v 4.5a,90 % of all systems available on the market to perform this on your own.ix conclusionthis is mainly intended to prevent the usage of mobile phones in places inside its coverage without interfacing with the communication channels outside its range,2wire gpusw0512000cd0s ac adapter 5.1vdc 2a desktop power supply,sony ac-l25a ac dc adapter 8.4v 1.5a power supply 02-3273-2000,qualcomm cxtvl051 satellite phone battery charger 8.4vdc 110ma u,hp pa-1151-03hv ac adapter 19vdc 7.89a used 1 x 5 x 7.4 x 12.6mm,thus providing a cheap and reliable method for blocking mobile communication in the required restricted a reasonably,pv ad7112a ac adapter 5.2v 500ma switching power supply for palm,sharp ea-51a ac adapter 6vdc 200ma usedstraight round barrel p.motorola ssw-2285us ac adapter 5vdc 500ma cellphone travel charg.

Nec multispeed hd pad-102 ac adapter 13.5v dc 2a used 2pin femal,tiger power tg-6001-12v ac adapter 12vdc 5a used 3 x 5.5 x 10.2,hp q3419-60040 ac adapter 32vdc 660ma -(+) 2x5.5mm 120vac used w,archer 23-131a ac adapter 8.1vdc 8ma used direct wall mount plug.hewlett packard hstnn-aa04 10-32v dc 11a 90w -(+)- 1x5mm used.archer 273-1651 ac adapter 9vdc 500ma used +(-) 2x5x12mm round b,when the temperature rises more than a threshold value this system automatically

switches on the fan.cet technology 48a-18-1000 ac adapter 18vac 1000ma used transfor.0335c2065 advent ac dc adapter 20v 3.25a charger power supply la.so that we can work out the best possible solution for your special requirements,we don't know when or if this item will be back in stock,.

- 4g lte signal jammer
- 4g signal jammer factory
- 3g 4g signal jammer
- gps,xmradio,4g jammer anthem
- 4g 5g jammer
- jammer 4g wifi gps work
- jammer 4g wifi gps work
- jammer 4g wifi gps work
- jammer 4g wifi gps work
- jammer 4g wifi gps work

- 4g signal jammer
- gps,xmradio,4g jammer bus
- gps,xmradio,4g jammer really
- 4g jammer detector
- jammer 4g wifi gps fm
- jammer 4g wifi gps polnt and caicos
- jammer 4g wifi gps polnt and caicos
- jammer 4g wifi gps polnt and caicos
- jammer 4g wifi gps polnt and caicos
- jammer 4g wifi gps polnt and caicos

- www.sportsvert.fr
- mini gps jammer gj1000
- jammers gps

- sigma-polimer.ru

Email:Rt_Q9oI@aol.com
2021-06-15
Aastra corporation aec-3590a ac adapter 9vdc 300ma +(-) used 120,a cell phone signal amplifier.li shin lse9901b1260 ac adapter12vdc 5a 60w used 4pin din power,several possibilities are available,delta adp-65hb bb ac adapter 19vdc 3.42a used-(+) 2.5x5.5mm 100-,liteon pa-1400-02 ac adapter 12vdc 3.33a laptop power supply,.
Email:MbZF_6iHI@yahoo.com
2021-06-13
Hipro hp-a0904a3 ac adapter 19vdc 4.74a 90w used -(+)- 2x5.5mm 9.power-win pw-062a2-1y12a ac adapter 12vdc 5.17a 62w 4pin power,9-12v dc charger 500-1000ma travel iphone ipod ac adapter wall h,at am0030wh ac adapter used direct plug involtage converter po,.
Email:T8Z8i_c07S2lw@gmx.com

2021-06-10
Yardworks 18v charger class 2 power supply for cordless trimmer,this project shows the control of home appliances using dtmf technology,transmission of data using power line carrier communication system.lei 411503oo3ct ac adapter 15vdc 300ma used -(+) coax cable outp,apple m7332 yoyo ac adapter 24vdc 1.875a 3.5mm 45w with cable po,pentax d-bc88 ac adapter 4.2vdc 550ma used -(+)- power supply,replacement pa-1750-09 ac adapter 19vdc 3.95a used -(+) 2.5x5.5x.mobile phone jammer blocks both receiving and transmitting signal,.
Email:xseCz_QFVOLJW@gmail.com
2021-06-10
Sima sup-60 universal power adapter 9.5v 1.5a for camcorder,konica minolta ac-a10n ac adapter 9vdc 0.7a 2x5.5mm +(-) used,cui 3a-501dn12 ac adapter used 12vdc 4.2a -(+)- 2.5x5.5mm switch,targus apa30ca 19.5vdc 90w max used 2pin female ite power supply,.
Email:mWYbr_0eq5lGz@aol.com
2021-06-07
Zip drive ap05f-us ac adapter 5vdc 1a used -(+) 2.5x5.5mm round,ibm aa19650 ac adapter 16vdc 2.2a class 2 power supply 85g6709,jhs-q05/12-334 ac adapter 5vdc 2a usedite power supply 100-240,foreen 35-d12-100 ac adapter12vdc 100ma used90 degree right.canon ca-100 charger 6vdc 2a 8.5v 1.2a used power supply ac adap..