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Chapter 1 : Pulse-width modulation - Wikipedia

4. TITLE AND SUBTITLE Modification Of An Emp Facility To Support Threshold Testing Of Pulse Figure 2. 2 4 6 8 Time (s).

History[edit] One of the crude pre-vacuum tube AM transmitters, a Telefunken arc transmitter from The carrier wave is generated by 6 electric arcs in the vertical tubes, connected to a tuned circuit. Modulation is done by the large carbon microphone cone shape in the antenna lead. One of the first vacuum tube AM radio transmitters, built by Meissner in with an early triode tube by Robert von Lieben. He used it in a historic 36 km 24 mi voice transmission from Berlin to Nauen, Germany. Compare its small size with above transmitter. Although AM was used in a few crude experiments in multiplex telegraph and telephone transmission in the late s, [2] the practical development of amplitude modulation is synonymous with the development between and of " radiotelephone " transmission, that is, the effort to send sound audio by radio waves. The first radio transmitters, called spark gap transmitters , transmitted information by wireless telegraphy , using different length pulses of carrier wave to spell out text messages in Morse code. In effect they were already amplitude modulated. His first transmitted words were, "Hello. One, two, three, four. Is it snowing where you are, Mr. The words were barely intelligible above the background buzz of the spark. Fessenden was a significant figure in the development of AM radio. He was one of the first researchers to realize, from experiments like the above, that the existing technology for producing radio waves, the spark transmitter, was not usable for amplitude modulation, and that a new kind of transmitter, one that produced sinusoidal continuous waves , was needed. This was a radical idea at the time, because experts believed the impulsive spark was necessary to produce radio frequency waves, and Fessenden was ridiculed. He invented and helped develop one of the first continuous wave transmitters - the Alexanderson alternator , with which he made what is considered the first AM public entertainment broadcast on Christmas Eve, He also discovered the principle on which AM is based, heterodyning , and invented one of the first detectors able to rectify and receive AM, the electrolytic detector or "liquid baretter", in Other radio detectors invented for wireless telegraphy, such as the Fleming valve and the crystal detector also proved able to rectify AM signals, so the technological hurdle was generating AM waves; receiving them was not a problem. The first practical continuous wave AM transmitters were based on either the huge, expensive Alexanderson alternator , developed , or versions of the Poulsen arc transmitter arc converter , invented in The modifications necessary to transmit AM were clumsy and resulted in very low quality audio. Modulation was usually accomplished by a carbon microphone inserted directly in the antenna or ground wire; its varying resistance varied the current to the antenna. The limited power handling ability of the microphone severely limited the power of the first radiotelephones; many of the microphones were water-cooled. Vacuum tubes[edit] The discovery in of the amplifying ability of the Audion vacuum tube , invented in by Lee De Forest , solved these problems. The vacuum tube feedback oscillator , invented in by Edwin Armstrong and Alexander Meissner , was a cheap source of continuous waves and could be easily modulated to make an AM transmitter. Wartime research greatly advanced the art of AM modulation, and after the war the availability of cheap tubes sparked a great increase in the number of radio stations experimenting with AM transmission of news or music. The vacuum tube was responsible for the rise of AM radio broadcasting around , the first electronic mass entertainment medium. Amplitude modulation was virtually the only type used for radio broadcasting until FM broadcasting began after World War 2. After WW2 it was developed by the military for aircraft communication. Simplified analysis of standard AM[edit] Illustration of amplitude modulation Consider a carrier wave sine wave of frequency fc and amplitude A given by:

Chapter 2 : Amplitude modulation - Wikipedia

be referred to as PAM-2 (pulse amplitude modulation, 2-level) for the two amplitude levels that contain 1 bit of information in every symbol (Figure 1). The NRZ eye diagram (Figure 1), providing timing and voltage used to measure.

Telecommunications[edit] In telecommunications , PWM is a form of signal modulation where the widths of the pulses correspond to specific data values encoded at one end and decoded at the other. Pulses of various lengths the information itself will be sent at regular intervals the carrier frequency of the modulation. Drawbacks to this technique are that the power drawn by the load is not constant but rather discontinuous see Buck converter , and energy delivered to the load is not continuous either. However, the load may be inductive, and with a sufficiently high frequency and when necessary using additional passive electronic filters , the pulse train can be smoothed and average analog waveform recovered. Power flow into the load can be continuous. Power flow from the supply is not constant and will require energy storage on the supply side in most cases. In the case of an electrical circuit, a capacitor to absorb energy stored in often parasitic supply side inductance. High frequency PWM power control systems are easily realisable with semiconductor switches. As explained above, almost no power is dissipated by the switch in either on or off state. However, during the transitions between on and off states, both voltage and current are nonzero and thus power is dissipated in the switches. By quickly changing the state between fully on and fully off typically less than nanoseconds , the power dissipation in the switches can be quite low compared to the power being delivered to the load. Variable-speed computer fan controllers usually use PWM, as it is far more efficient when compared to a potentiometer or rheostat. Neither of the latter is practical to operate electronically; they would require a small drive motor. Light dimmers for home use employ a specific type of PWM control. Home-use light dimmers typically include electronic circuitry which suppresses current flow during defined portions of each cycle of the AC line voltage. Adjusting the brightness of light emitted by a light source is then merely a matter of setting at what voltage or phase in the AC half-cycle the dimmer begins to provide electric current to the light source e. These rather simple types of dimmers can be effectively used with inert or relatively slow reacting light sources such as incandescent lamps, for example, for which the additional modulation in supplied electrical energy which is caused by the dimmer causes only negligible additional fluctuations in the emitted light. Some other types of light sources such as light-emitting diodes LEDs , however, turn on and off extremely rapidly and would perceivably flicker if supplied with low frequency drive voltages. Perceivable flicker effects from such rapid response light sources can be reduced by increasing the PWM frequency. If the light fluctuations are sufficiently rapid faster than the flicker fusion threshold , the human visual system can no longer resolve them and the eye perceives the time average intensity without flicker. In electric cookers, continuously variable power is applied to the heating elements such as the hob or the grill using a device known as a simmerstat. This consists of a thermal oscillator running at approximately two cycles per minute and the mechanism varies the duty cycle according to the knob setting. The thermal time constant of the heating elements is several minutes, so that the temperature fluctuations are too small to matter in practice. Switched-mode power supply PWM is also used in efficient voltage regulators. By switching voltage to the load with the appropriate duty cycle, the output will approximate a voltage at the desired level. The switching noise is usually filtered with an inductor and a capacitor. One method measures the output voltage. When it is lower than the desired voltage, it turns on the switch. When the output voltage is above the desired voltage, it turns off the switch. Audio effects and amplification[edit] PWM is sometimes used in sound music synthesis, in particular subtractive synthesis , as it gives a sound effect similar to chorus or slightly detuned oscillators played together. In fact, PWM is equivalent to the difference of two sawtooth waves with one of them inverted. In addition, varying the duty cycle of a pulse waveform in a subtractive-synthesis instrument creates useful timbral variations. A new class of audio amplifiers based on the PWM principle is becoming popular. Called class-D amplifiers , they produce a PWM equivalent of the analog input signal which is fed to the loudspeaker via a suitable filter network to block the carrier and recover the original audio. For a few decades, industrial and military PWM amplifiers have been in common use, often for driving servo motors. In more recent times, the Direct Stream Digital sound encoding method was introduced, which uses a generalized form of pulse-width modulation called pulse density modulation , at a high enough sampling rate typically in the order of MHz to cover the whole acoustic frequencies range with sufficient fidelity. This method is used in the SACD format, and reproduction of the encoded audio signal is essentially similar to the method used in class-D amplifiers. Electrical[edit] SPWM Sineâ€"triangle pulse width modulation signals are used in micro-inverter design used in solar and wind power applications. These switching signals are fed to the FETs that are used in the device. There is much research on eliminating unwanted harmonics and improving the fundamental strength, some of which involves using a modified carrier signal instead of a classic sawtooth signal [9] [10] [11] in order to decrease power losses and improve efficiency. Another common application is in robotics where PWM signals are used to control the speed of the robot by controlling the motors.

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Chapter 3 : Input Pulsed Test Cases

Tracking an analog waveform and converting it to pulses that represent the wave's height above (or below) a threshold is termed pulse amplitude modulation (PAM) The most common example of ____ data is the human voice.

This driver supersedes an older one of the same name, address and ID which required replacing the original kernel audio driver with another which worked only on older Sun SPARC architectures and SunOS operating systems. While it is generic and likely portable to other systems, it is somewhat slower than the original, since the extensive signal conditioning, filtering and decoding is done in user space, not kernel space. This signal is generated by several radio clocks, including those made by Arbiter, Austron, Bancomm, Odetics, Spectracom and TrueTime, among others, although it is often an add-on option. The signal is connected via an optional attenuator box and cable to either the microphone or line-in port. They include automatic gain control AGC , selectable audio codec port and signal monitoring capabilities. For a discussion of these common features, as well as a guide to hookup, debugging and monitoring, see the Reference Clock Audio Drivers page. The IRIG signal format uses an amplitude-modulated carrier with pulse-width modulated data bits. While IRIG-B provides the best accuracy, generally within a few tens of microseconds relative to IRIG time, it can also generate a significant load on the processor with older workstations. Cycle crossings relative to the corrected slice level determine the width of each pulse and its value - zero, one or position identifier. The data encode 20 BCD digits which determine the second, minute, hour and day of the year and sometimes the year and synchronization condition. The comb filter exponentially averages the corresponding samples of successive baud intervals in order to reliably identify the reference carrier cycle. A type-II phase-lock loop PLL performs additional integration and interpolation to accurately determine the zero crossing of that cycle, which determines the reference timestamp. A pulse-width discriminator demodulates the data pulses, which are then encoded as the BCD digits of the timecode. At poll intervals of 64 s, the saved samples are processed by a trimmed-mean filter and used to update the system clock. These are intended for use with noisy signals, such as might be received over a telephone line or radio circuit, or when interfering signals may be present in the audio passband. The driver determines which IRIG format is in use by sampling the amplitude of each filter output and selecting the one with maximum signal. An automatic gain control feature provides protection against overdriven or underdriven input signal amplitudes. It is designed to maintain adequate demodulator signal amplitude while avoiding occasional noise spikes. In order to assure reliable capture, the decompanded input signal amplitude must be greater than units and the codec sample frequency error less than PPM. The program performs a number of error checks to protect against overdriven or underdriven input signal levels, incorrect signal format or improper hardware configuration. The specific checks are detailed later in this page. Note that additional checks are done elsewhere in the reference clock interface routines. Unlike other drivers, which can have multiple instantiations, this one supports only one. It does not seem likely that more than one audio codec would be useful in a single machine. More than one would probably chew up too much CPU time anyway. Position identifiers occur at elements 0, 9, 19 and every ten thereafter to The encoding of elements 50 CF 1 through 78 CF 27 is device dependent. This driver presently decodes the CF elements, but does nothing with them. Where feasible, the IRIG signal source should be operated with signature control so that, if the signal is lost or mutilated, the source produces an unmodulated signal, rather than possibly random digits. The driver will automatically reject the data and declare itself unsynchronized in this case. Performance and Horror Stories The m-law companded data format allows considerable latitude in signal levels; however, an automatic gain control AGC function is implemented to further compensate for varying input signal levels and to avoid signal distortion. Be however acutely aware that the accuracy with Solaris 2. The Sun kernel driver has a sawtooth modulation with amplitude over 5 ms peak-peak and period 5. The result is nominal accuracy and jitter something less than 0. The processor resources consumed by the daemon can be significant, ranging from about 1. However, the overall timing accuracy is limited by the resolution and stability of the CPU clock oscillator and the interval between clock corrections, which is 64 s with this driver. This performance, while probably the best that can be achieved by the daemon itself, can be improved with assist from the PPS discipline as described elsewhere in this documentation. Autotune The driver includes provisions to automatically tune the radio in response to changing radio propagation conditions throughout the day and night. The bus can be connected to a serial port using a level converter such as the CT To activate the CI-V interface, the mode keyword of the server configuration command specifies a nonzero select code in decimal format. A missing mode keyword or a zero argument leaves the interface disabled. However, the driver is liberal in what it assumes of the configuration. Monitor Data The timecode format used for debugging and data recording includes data helpful in diagnosing problems with the IRIG signal and codec connections. With debugging enabled -d on the ntpd command line , the driver produces one line for each timecode in the following format: This is followed by the IRIG status indicator, year of century, day of year and time of day. The status indicator and year are not produced by some IRIG devices. The last field is the on-time timestamp in NTP format. The fraction part is a good indicator of how well the driver is doing. The error flags are defined as follows in hex: The carrier amplitude is less than units. This is usually the result of no signal or wrong input port. The codec frequency error is greater than PPM. This may be due to wrong signal format or rarely defective codec. The IRIG modulation index is less than 0. This is usually the result of an overdriven codec, wrong signal format or wrong input port. The decoder frame does not match the IRIG frame. This is usually the result of an overdriven codec, wrong signal format or noisy IRIG signal. The data bit length is out of tolerance. The decoder second does not match the IRIG second. The machine is not fast enough to keep up with the codec. Fudge Factors Specifies the time offset calibration factor, in seconds and fraction, with default 0. It does not seem useful to specify the compact disc player port. For this purpose, the speaker volume must be set before the driver is started.

Chapter 4 : IRIG Audio Decoder

The IRIG signal format uses an amplitude-modulated carrier with pulse-width modulated data bits. For IRIG-B, the carrier frequency is Hz and bit rate b/s; for IRIG-E, the carrier frequenchy is Hz and bit rate 10 b/s.