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Abstract: An equivalent circuit model for planar printed circuit board (PCB) transformers is presented. The model utilizes the 1-D analysis of Maxwell's equations to develop a frequency-dependent representation of a multilayer, planar PCB transformer that can be implemented in the circuit simulation software. In this transformer model, each conductor layer is implemented as a complex impedance network, while each insulator layer is implemented as an air-cored inductor. Each magnetic core layer is modeled as a non-linear inductance whose magnetic characteristic is based on a temperature-dependent Jiles-Atherton hysteresis model. These impedances and inductances are then arranged side by side as they are arranged in the layer stack of the actual planar PCB transformer. Through this model, the skin and proximity effect in the conductors and current distribution across windings can be simulated. The developed model also enables the modeling of temperature-dependent hysteresis and saturation effects in the magnetic material. The model provides a simpler method to derive the core and winding loss of the transformer than using a finite-element analysis software. It also enables direct integration to circuit simulation tools. A prototype planar PCB transformer was used to obtain experimental data for model validation. Comparisons made show good agreement between the performance of the model and experimental results.
keywords: {circuit simulation;equivalent circuits;finite element analysis;magnetic materials;Maxwell equations;printed circuits;transformer cores;transformer windings;planar PCB transformer winding;equivalent circuit model;planar printed circuit board transformer model;Maxwell equation 1D analysis;circuit simulation software;conductor layer;complex impedance network;insulator layer;air-cored inductor;magnetic core layer;nonlinear inductance;magnetic characteristic;temperature-dependent Jiles-Atherton hysteresis model;skin effect;proximity effect;current distribution;temperature-dependent hysteresis effects;temperature-dependent saturation effects;magnetic material;winding loss;core loss;finite-element analysis software;circuit simulation tool;Integrated circuit modeling;Power transformer insulation;Mathematical model;Circuit faults;Magnetic cores;Magnetic hysteresis;Atmospheric modeling;Jiles-Atherton hysteresis model;lumped element model;PCB transformer;Jiles–Atherton (JA) hysteresis model;lumped element model;printed circuit board (PCB) transformer},
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Abstract: Electrical impedance spectroscopy has been introduced as a cost-effective platform in electrical characterization of biological cells. Conventional impedance sensor usually requires sophisticated and expensive fabrication process for patterning metal electrodes, which are in direct contact with carrying electrolyte to perform the impedance measurement. In this letter, we demonstrate a low cost impedance-based microfluidic device built upon a thin film deposited printed circuit board (PCB) with pre-deposited metal electrodes. Sensing electrodes are isolated from the carrying electrolyte by a thin dielectric film-polydimethylsiloxane (PDMS) film to protect them from erosion and electrochemical reactions. A type of circulating tumor cell, HeLa cell, was used to demonstrate the capability of the Lab-on-PCB chip in the characterization of electrical property of biological cells.
keywords: {biology;electric impedance measurement;electric properties;printed circuits;dielectric film deposited PCB device;electrical property;biological cells;electrical impedance spectroscopy;impedance sensor;impedance measurement;low cost impedance-based microfluidic device;thin film deposited printed circuit board;metal electrodes;sensing electrodes;film-polydimethylsiloxane film;PDMS film;erosion reactions;tumor cell;HeLa cell;lab-

on-PCB chip;Impedance;Electrodes;Sensors;Biological cells;Metals;Apertures;Microfluidics;Electrical impedance spectroscopy;microfluidics;impedance Cytometer;dielectric film;Lab-on-PCB},
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Abstract: This paper presents the design of two configurations of electrodes ("gold versus Ag/AgCl" and "gold versus gold") and an electrochemiluminescence (ECL) microfluidic device fabricated in the inexpensive printed circuit board (PCB) technology. The PCB electrodes are electrochemically characterized to determine appropriate working potentials. The ECL microfluidic device with integrated PCB electrodes is tested using luminol as luminophore to quantify H₂O₂ concentrations. Synchronous detection technique is implemented for weak signal recovery. For both PCB electrode configurations, a 100 nM H₂O₂ concentration is detected and a linear range extending from 100 nM to 10 mM is observed with a photomultiplier tube. A lab-on-board compatible potentiostat and a compact CMOS photodetector module are also designed and validated. The proposed instrumental approach may represent a low-cost way to develop portable analytical systems.
keywords: {chemiluminescence;CMOS integrated circuits;electrodes;microfluidics;photodetectors;photomultipliers;printed circuits;PCB electrodes;printed circuit board technology;low-cost portable analytical systems;electrochemiluminescence microfluidic device;ECL;photomultiplier tube;lab-on-board compatible potentiostat;CMOS photodetector module;Au;Ag-AgCl;H_2O_2;Microfluidics;Electrodes;Fabrication;Etching;Copper;Printed circuits;Photodetectors;Instruments;Microchannel;Insulation;CMOS;electrochemiluminescence (ECL);luminol;microfluidic device;PCB electrodes;synchronous detection},
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Abstract: Field-programmable gate arrays (FPGAs) are commonly used in board designs. The authors consider the constrained FPGA pin-mapping problem in the FPGA-printed circuit board (PCB) codesign process. Unlike all previous works, which only saw constrained FPGA pin mapping as an independent chip-level problem, they take into account the connectivity of the FPGA with other components on the PCB to minimize the occurrence of net crossover and the PCB wirelength when computing a pin mapping. They propose an efficient tool, the versatile input/output (VIO) mapper, to automatically generate a proper pin-mapping upfront during the FPGA-PCB codesign process. Their input/output (I/O) mapper has a high level of flexibility. It can handle the different kinds of complex restrictions found in different FPGA devices. And it allows the PCB designers to lock down, say, the pin assignments for some critical signals before generating the assignments for the rest of the signals. Their mapper is based on an elegant 0-1 integer linear program (ILP) formulation. They show that due to the effective control of the number of integer variables and the use of a strong formulation (instead of an alternative weak formulation), their ILP-based approach is highly efficient in practice. It runs much faster than the mapping tool in Altera's Quartus II tool suite. In addition, they experimentally showed that the industrial tool's mapping algorithm is very far from optimal. For many instances on which Quartus II failed, feasible I/O mappings were found using the VIO mapper

keywords: {field programmable gate arrays;integer programming;linear programming;logic design;printed circuit design;constrained pin-mapping;FPGA-PCB codesign;field-programmable gate arrays;FPGA pin mapping;PCB wirelength;versatile input/output mapper;integer linear program;Altera Quartus II tool suite;field-programmable gate array;printed circuit board;Field programmable gate arrays;Printed circuits;Signal design;Signal processing;Signal generators;Code standards;Standards organizations;Pins;Computer science;Routing;Field-programmable gate array (FPGA);FPGA-PCB codesign;input/output (I/O) standards;integer linear program (ILP);pin-mapping;printed circuit board (PCB)},
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Abstract: This paper proposes a new output current measuring method using tiny printed-circuit-board (PCB) current sensors. The method will make it possible to install the PCB current sensors in an insulated-gate bipolar transistor (IGBT) module. The PCB sensor picks up a switching current flowing through an IGBT chip, and then a combination of a digital circuit based on field-programmable gate array and an integrator circuit reproduces the output current of an inverter from the switching current. A proof-of-concept experimental verification is carried out using a buck converter, which verifies that the proposed method detects a dc component of the output current as well as a ripple component although the PCB sensor is based on the so-called Rogowski coil.
keywords: {bipolar transistor circuits;electric current measurement;field programmable gate arrays;integrating circuits;invertors;power convertors;printed circuit design;sensors;output current measurement;IGBT module;printed-circuit-board current sensors;PCB current sensors;insulated-gate bipolar transistor;switching current;field-programmable gate array;integrator circuit;inverter;buck converter;Rogowski coil;Insulated gate bipolar transistors;Inverters;Switches;Current measurement;Field programmable gate arrays;Sensor phenomena and characterization;Insulated-gate bipolar transistor (IGBT) modules;integration;inverters;printed-circuit-board (PCB) current sensors},
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Abstract: With the continuous development of the electronics industry, the number of printed circuit board (PCB) has grown at a rapid rate, and the requirements for the detection systems of PCB have also continuously increased. In the traditional PCB detection, the main reference is the comparison method. However, in a real scene, there are a series of problems such as non-uniform illumination, tilting of the camera angle, and the like, resulting in a less satisfactory effect of the reference comparison method. So, the authors proposed a non-reference comparison framework of PCB defects detection. This framework has achieved good results in speed and accuracy. The authors extract the histogram of oriented gradients and local binary pattern features for each PCB image, respectively, put into the support vector machine to get two independent models. Then, according to Bayes fusion theory, the authors fuse two models for defects classification. The authors have established a PCB data set that includes both defective and defect-free. It has been verified that the accuracy of the verification set is improved compared to the individual features using the fused features. The authors also illustrate the effectiveness of Bayes feature fusion in terms of speed.
keywords: {image classification;support vector machines;feature extraction;Bayes methods;printed circuits;automatic optical inspection;image fusion;electronic engineering

computing;nonreference comparison framework;local binary pattern features;PCB image;Bayes fusion theory;PCB data set;fused features;Bayes feature fusion;electronics industry;printed circuit board;traditional PCB detection;nonuniform illumination;reference comparison method;PCB defect detection;defect classification},
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Abstract: The integration of a Vivaldi antenna on a printed circuit board (PCB) targeting 60-GHz WiGig applications is presented in this letter. The integrated passive device (IPD)technology from STMicroelectronics based on a glass substrate is used for the antenna manufacturing. In free space, the radiation pattern measurements show a realized gain higher than 4 dBi in the endfire direction from 56 to 65 GHz. The impact of the integration of the antenna on the PCB is investigated in details showing reasonable disturbance of the reflection coefficient, but strong modifications of the radiation pattern, especially the pointing direction of the main beam. From the analysis of the surface waves propagating along the PCB when the Vivaldi is integrated, a novel topology is proposed to preserve the main radiation in the endfire direction with enhanced realized gain.
keywords: {antenna radiation patterns;electromagnetic wave reflection;millimetre wave antenna arrays;printed circuits;PCB integration;Vivaldi antenna;IPD technology;printed circuit board;WiGig applications;integrated passive device technology;STMicroelectronics;glass substrate;antenna manufacturing;radiation pattern measurements;endfire direction;reflection coefficient;topology;frequency 56 GHz to 65 GHz;Antenna measurements;Vivaldi antennas;Antenna radiation patterns;Substrates;Surface waves;Endfire antennas;IPD technology;millimeter-wave antennas;printed circuit board (PCB) integration;surface waves},
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Abstract: The proposed innovative manufacturing process-described in detail-uses metal foam to create a pressed contact between the top side of a printed circuit board-embedded power die and the rest of the circuit. Initial prototypes were constructed using diodes with die dimensions of 4 mm × 6.35 mm. The prototypes were electrically characterized: the chip and contact dc and ac impedance values were measured and compared with those obtained for conventional packaging that uses bond wires. The electrical impedance of the prototypes was found to be similar to that of a state-of-the-art industrial package. Moreover, the proposed process is simple and cost-effective. Although the results presented in this letter are promising, further research is necessary to fully assess the benefits and limitations of the process.
keywords: {electric impedance;electronics packaging;laminates;metal foams;power electronics;printed circuits;laminated metal foam;top-side contact;PCB-embedded power die;printed circuit board;bond wires;electrical impedance;Prototypes;Current measurement;Metal foam;Wires;Impedance;Contacts;Bonding;Embedded die;high-density integration converter;PCB embedding;PCB integration;power electronics packaging;pressed contact},
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Abstract: Size reduction has become one of the most important aspects of motor design. This

paper presents a miniature axial-flux spindle motor with a rhomboidal printed circuit board (PCB) winding. The design of its mechanical structure aims to eliminate any unnecessary space. Prior to prototyping, the motor geometry is calculated using an approximate analytical model, which helps speed up the design process. The flexible PCB winding represents an ultrathin electromagnetic exciting source where coils are wound in a rhomboidal shape in order to reduce the end-winding length and minimize the copper loss. The design process also incorporates finite-element analysis for further performance evaluation and refinement. The proposed motor is prototyped, and excellent agreement is found between simulation and measurement
keywords: {finite element analysis;machine windings;motor drives;permanent magnet motors;printed circuits;miniature spindle motor;axial-flux spindle motor;rhomboidal PCB winding;mechanical structure;motor geometry;electromagnetic exciting source;end-winding length;copper loss;finite-element analysis;Process design;Flexible printed circuits;Prototypes;Geometry;Analytical models;Coils;Wounds;Shape;Copper;Finite element methods;Axial-flux spindle motor;motor design;printed circuit board (PCB) winding},
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Abstract: Length-matching is an important technique to balance delays of bus signals in high-performance printed circuit board (PCB) routing. Existing routers, however, may generate very dense meander segments. Signals propagating along these meander segments exhibit a speedup effect due to crosstalk between the segments of the same wire, thus leading to mismatch of arrival times even under the same physical wire length. In this paper, we present a post-processing method to enlarge the width and the distance of meander segments and hence distribute them more evenly on the board so that crosstalk can be reduced. In the proposed framework, we model the sharing of available routing areas after removing dense meander segments from the initial routing, as well as the generation of relaxed meander segments and their groups for wire length compensation. This model is transformed into an ILP problem and solved for a balanced distribution of wire patterns. In addition, we adjust the locations of long wire segments according to wire priorities to swap free spaces toward critical wires that need much length compensation. To reduce the problem space of the ILP model, we also introduce a progressive fixing technique so that wire patterns are grown gradually from the edge of the routing toward the center area. Experimental results show that the proposed method can expand meander segments significantly even under very tight area constraints, so that the speedup effect can be alleviated effectively in high-performance PCB designs.
keywords: {printed circuit design;ILP-based alleviation;dense meander segments;prioritized shifting;progressive fixing;PCB routing;length-matching;bus signals;printed circuit board;wire length compensation;PCB designs;Wires;Routing;Delays;Crosstalk;Nickel;Integrated circuit modeling;Delay lines;PCB routing;Speedup effect;Dense meander segments;ILP model;Dense meander segments;ILP model;printed circuit board (PCB) routing;speedup effect},
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Abstract: A novel uniplanar compact electromagnetic band-gap (EBG) structure is proposed for ultrawideband (UWB) suppression of ground bounce noise (GBN) in multilayer PCB. The power plane integrates the features of L-shaped bridges and slits (LBS), which can suppress the GBN at

lower and higher frequencies, respectively, without using hybrid periods cascading structures. The GBN suppression bandwidth is broadened from 432 MHz to 15 GHz covering almost the whole noise band for UWB applications. A locally embedded LBS-EBG structure in power plane is proposed to improve signal integrity (SI). Full-wave simulation and measurement are performed to verify the high performance.
keywords: {bandwidth allocation;interference suppression;photonic band gap;printed circuits;ultra wideband communication;ultrawideband ground bounce noise suppression;multilayer PCB;embedded uniplanar compact electromagnetic band-gap structure;L-shaped bridge-slit;signal integrity;frequency 432 MHz to 15 GHz;Ultra wideband technology;Electromagnetic interference;Nonhomogeneous media;Periodic structures;Metamaterials;Circuit noise;Optical noise;Printed circuits;Radio frequency;Bandwidth;Electromagnetic band-gap (EBG);ground bounce noise (GBN);locally embedded;multilayer printed circuit board (PCB);signal integrity},
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Abstract: Due to the low atmospheric absorption over W-band, numerous applications are expected, which should be developed at low cost. Short wavelength makes the dimension of antennas in this frequency range small, which usually requires sophisticated and expensive fabrication process. This communication presents a class of integrated wideband pyramidal horn antennas which can be made of low-cost multilayered printed circuit board (PCB) process. The proposed horn antenna radiates along the broadside to the substrate and uses substrate integrated waveguide (SIW) as its feeder. Transverse slot on the top metallic surface at the end of SIW is deployed to drive the horn antenna. Metalized via holes are used to synthesize the horn walls. The opening of the horn antenna is discretely flared from the bottom to the top layer. Measured bandwidth of the antenna is 35 GHz (70-105 GHz) while a relatively constant gain of 10 ± 1 dB is obtained over most of the bandwidth.
keywords: {antenna feeds;horn antennas;millimetre wave antennas;printed circuits;slot antennas;millimeter-wave integrated pyramidal horn antenna;multilayer printed circuit board;PCB process;atmospheric absorption;W-band;integrated wideband pyramidal horn antennas;low-cost multilayered printed circuit board process;substrate integrated waveguide;feeder;transverse slot;metallic surface;horn walls;bandwidth;frequency 70 GHz to 105 GHz;bandwidth 35 GHz;Horn antennas;Antenna measurements;Substrates;Bandwidth;Nonhomogeneous media;E band;integrated horn antenna;multilayered PCB;substrate integrated waveguide (SIW);W-band},
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Abstract: In this letter, a dual-band printed circuit board (PCB) antenna suitable for Wi-Fi applications is described. The antenna geometry is modeled by means of a spline curve and a partial metallic ground plane. The proposed antenna is suitable for Wi-Fi bands, and it guarantees good impedance-matching conditions at the working frequencies centered at 2.448 and 5.512 GHz, respectively. A prototype of the synthesized antenna, built on an Arlon substrate, is analyzed to assess the effectiveness of the proposed antenna model in terms of VSWR values as well as radiation patterns.
keywords: {antenna radiation patterns;impedance matching;microwave antennas;multifrequency antennas;printed circuits;UHF antennas;wireless LAN;dual-band spline-shaped PCB antenna;Wi-Fi

application;printed circuit board antenna;partial metallic ground plane;antenna geometry;impedance-matching condition;VSWR value;radiation pattern;wireless local area network;WLAN;frequency 2.448 GHz to 5.512 GHz;Dual band;Spline;Printed circuits;Geometry;Solid modeling;Impedance;Frequency;Prototypes;Pattern analysis;Antenna radiation patterns;Printed circuit board (PCB) antenna;spline shape;Wi-Fi applications},
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keywords: {eddy current testing;flaw detection;Fourier analysis;giant magnetoresistance;harmonic analysis;magnetic noise;magnetic sensors;printed circuits;spin valves;defect detection;PCB inspection;ECT technique;multi SV GMR sensors;printed circuit board;eddy current testing;multi spin valve giant magnetoresistance sensors;exciting coils;Fourier transform harmonic analysis;signal-noise ratio;Inspection;Electrical capacitance tomography;Magnetic sensors;Circuit testing;Harmonic analysis;Printed circuits;Giant magnetoresistance;Sensor phenomena and characterization;Coils;Fourier transforms;Eddy-current testing (ECT);multisensor;printed circuit board (PCB);scanning speed;signal averaging;signal-to-noise ratio (SNR);spin-valve giant magnetoresistance (SV-GMR)},
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keywords: {ultra wideband antennas;microstrip antennas;transient response;delays;double-sided printed circuit board;PCB antenna;ultra-wideband application;UWB antenna;delay;Federal Communications Commission;FCC;impulse response;Knight helm shape antenna;Ultra wideband antennas;Delay;FCC;Shape;Printed circuits;Ultra wideband technology;Frequency;Costs;Production;Antenna measurements;Knight's helm shape antenna;printed circuit board (PCB) antenna;UWB antenna},
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keywords: {absorption;adhesion;ageing;cantilevers;electronics packaging;moulding;plasma applications;printed circuits;resins;surface cleaning;PCB surface modification effect;electronic packages;epoxy molding compound;printed circuit board;PCB adhesion;EMC adhesion;solder resist layers;manufacturing process;reliability test conditions;plasma treatment;surface cleaning process;aging effect;EMC molding;moisture absorption;unsymmetric double cantilever beam test method;symmetrical double cantilever beam;phase angle;enhanced chemical bonding;EMC resin;SR resin;cohesive crack propagation;Adhesives;Electronics packaging;Surface cleaning;Strontium;Electromagnetic compatibility;Surface treatment;Moisture;Plasma applications;Plasma chemistry;Delay effects;Adhesion;delamination;energy release rate;fracture mechanics;interfacial crack;moisture absorption;moisture desorption;plasma treatment;unsymmetric double cantilever beam (UDCB)},
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keywords: {image classification;printed circuits;neural nets;automatic optical inspection;electronic

engineering computing;digital image processing;convolutional neural network;CNN-based reference comparison method;printed circuit board inspection;PCB production process;automatic optic inspection;PCB bare board defect detection methods;bare PCB defect classification algorithm;reference comparison method},
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Abstract: This paper illustrates the extension of Rayleigh wave-based surface acoustic wave (SAW) viscosity and density sensor previously developed by the authors for integration with microfluidics and printed circuit board (PCB)-based electronics. The SAW device is first modeled with a microchannel and analyzed using finite-element method (FEM) software. Precise fabrication, alignment, and bonding of polydimethylsiloxane microchannels on diced Y-Z lithium niobate substrates are accomplished. A high-frequency PCB is built to obtain a better performance for SAW device testing. Low glycerin concentrations in deionized (DI) water are analyzed. The FEM simulation results and vector network analyzer measurements of the devices with the microchannel and PCB integration are presented. For low-frequency SAW sensor, a sensitivity of 171.9 Hz/(% glycerin) or 5.57 kHz/(kg/m^2√s) in frequency shifts, 0.09°/(% glycerin) or 2.92°/(kg/m^2√s) in phase difference, and minimum signal-to-noise ratio of 13.9 dB are achieved at peak frequency of 29.7 MHz. On the other hand, high-frequency (86.1 MHz) SAW sensor provides a sensitivity of 937.5 Hz/(% glycerin) or 37.15 kHz/(kg/m^2√s) in absolute frequency shifts, 0.37°/(% glycerin) or 14.7°/(kg/m^2√s) in phase difference, and minimum signal-to-noise ratio of 20.5 dB.
keywords: {electric sensing devices;finite element analysis;lithium compounds;microfluidics;network analysers;piezoelectric devices;printed circuits;Rayleigh waves;surface acoustic wave devices;surface acoustic wave sensors;surface acoustic waves;viscosity measurement;surface acoustic wave viscosity sensor;integrated microfluidics;PCB platform;Rayleigh wave;density sensor;printed circuit board;microchannel;finite-element method software;polydimethylsiloxane microchannels;diced Y-Z lithium niobate substrates;high-frequency PCB;SAW device testing;vector network analyzer measurements;PCB integration;low-frequency SAW sensor;minimum signal-to-noise ratio;FEM simulation;PCB-based electronics;frequency 29.7 MHz;frequency 86.1 MHz;Liquids;Microchannels;Viscosity;Surface acoustic waves;Substrates;Sensor phenomena and characterization;Surface acoustic waves (SAWs);microfluidics;viscosity sensor;liquid sensing;finite element method;PCB},
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Abstract: An efficient numerical approach based on the 2-D finite-difference time-domain (FDTD) method is proposed to model the power/ground plane noise or simultaneously switching noise (SSN), including the interconnect effect between the package and the print circuit board (PCB). The space between the power and ground planes on the package and PCB are meshed with 2-D cells. The equivalent R-L-C circuits of the via and the solder balls connecting the package and PCB can be incorporated into a 2-D Yee cell based on a novel integral formulation in the time domain. An efficient recursive updating algorithm is proposed to fit the lumped networks into the Yee equations. A test sample of a ball grid array (BGA) package mounted on a PCB was fabricated. The power/ground noise coupling behavior was measured and compared with the

simulation. The proposed method significantly reduces the computing time compared with other full-wave numerical approaches.
keywords: {ball grid arrays;circuit noise;finite difference time-domain analysis;lumped parameter networks;printed circuits;noise coupling;package-PCB power/ground planes;2D FDTD;lumped element method;2D finite-difference time-domain method;power/ground plane noise;simultaneous switching noise;interconnect effect;print circuit board;equivalent R-L-C circuits;ball grid array package;Packaging;Finite difference methods;Time domain analysis;Circuit noise;Switching circuits;Integrated circuit interconnections;Printed circuits;Joining processes;Integral equations;Circuit testing;Ball grid array (BGA);print circuit board (PCB);signal integrity (SI);simultaneous switching noise (SSN);two-dimensional (2-D) finite-difference time-domain (FDTD) modeling;Ball grid array (BGA);print circuit board (PCB);signal integrity (SI);simultaneous switching noise (SSN);two-dimensional (2-D) finite-difference time-domain (FDTD) modeling},
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Abstract: In future applications, e.g., in ultra-flat OLED lamp drivers or flat screen power supplies, ultra-flat ac/dc and dc/dc converter systems are highly demanded. Therefore, the design and implementation of a printed circuit board (PCB)-integrated flyback transformer for a 1-mm-thin single-phase power factor correction rectifier is under investigation. In this paper, first an overview on several integration methods is given. It is shown that the PCB integration of magnetic cores allows us to achieve the required thickness of 1 mm and a high energy density. In a next step, the design and the realization of ultra-flat magnetic components with PCB-integrated cores are discussed in detail. The presented multi-objective design procedure determines the inductor and/or transformer setup optimal with respect to minimal losses and/or minimal footprint area; for this purpose, all required electrical, magnetic, and geometrical parameters of the magnetic component are considered in the design process. Furthermore, all specific implications entailed by the PCB-integrated core, e.g., the core setup, anisotropic core losses, the interleaving of windings, or an accurate reluctance model are treated. Finally, experimental results are used to verify the design procedure.
keywords: {geometry;inductors;magnetic cores;power factor correction;printed circuits;rectifiers;transformers;multiobjective optimization;ultraflat magnetic components;PCB-integrated core;ultra-flat OLED lamp drivers;flat screen power supplies;dc-dc converter systems;ac-dc converter systems;printed circuit board-integrated flyback transformer;magnetic cores;high energy density;multiobjective design procedure;geometrical parameters;inductor;transformer setup;electrical parameters;core setup;anisotropic core losses;reluctance model;single-phase power factor correction rectifier;size 1 mm;Perpendicular magnetic anisotropy;Transformer cores;Amorphous magnetic materials;Core loss;Toroidal magnetic fields;Flyback transformer;PCB-integrated transformer;printed circuit board (PCB)-integrated inductor;power sheet;ultra-flat magnetics},
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Abstract: In this paper, trace orientation function (TOF) is proposed for statistical prediction of printed circuit board (PCB) radiated susceptibility and emission. This function relates the orientations and angle of incident electromagnetic wave to the location of a trace in wiring

distribution of electronic board. For both susceptibility and emission of signal traces, TOF is a compact function that considers the location, orientations, and its probability of distribution. By using the TOF, one can estimate the radiated susceptibility and emission of a PCB for different points of view and derive a safe spatial region to increase the electromagnetic compatibility of electronic systems. In addition, the TOF helps to predict the electromagnetic compatibility of a system before the final step of its PCB implementation. To show the accuracy and effectiveness of TOF concept, the method is applied on a board and the results are compared with CST field solver simulations. The simulation result shows 8.1% error between statistical method and full-wave analysis for maximum electric far field of the board and maximum 42.4% error for average induced voltage on whole traces. Also, an analytic circuit level method is proposed for estimating the current amplitude of modeling dipoles, based on power consumption of the electronic system on PCB.
keywords: {electric fields;electromagnetic compatibility;electromagnetic waves;printed circuit interconnections;statistical distributions;wiring;trace orientation function;TOF;statistical prediction;printed circuit board;PCB radiated susceptibility;incident electromagnetic wave;wiring distribution;electronic board;signal traces;electromagnetic compatibility;electronic systems;CST field solver simulations;statistical method;full-wave analysis;electric far field;analytic circuit level method;power consumption;Estimation;Integrated circuit modeling;Magnetic susceptibility;Integrated circuit interconnections;Electromagnetic scattering;Power demand;Wiring;Electromagnetic compatibility (EMC);electromagnetic interference (EMI);printed circuit board (PCB) trace distribution;radiated emission;radiated susceptibility;Electromagnetic compatibility (EMC);electromagnetic interference (EMI);printed circuit board (PCB) trace distribution;radiated emission;radiated susceptibility},
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Abstract: Due to the rapid development of printed circuit board (PCB) design technology, inspection of PCB surface defects has become an increasingly critical issue. The classification of PCB defects facilitates the root causes of detects' identification. As PCB defects may be intensive, the actual PCB classification should not be considered as a binary or multi-category problem. This type of problem is called multi-label classification problem. Recently, as one of the deep learning frameworks, a convolutional neural network (CNN) has a major breakthrough in many areas of image processing, especially in the image classification. This study proposes a multi-task CNN model to handle the multi-label learning problem by defining each label learning as a binary classification task. In this study, the multi-label learning is transformed into multiple binary classification tasks by customising the loss function. Extensive experiments demonstrate that the proposed method achieves great performance on the dataset of defects.
keywords: {printed circuits;image classification;learning (artificial intelligence);feedforward neural nets;convolution;electronic engineering computing;feature extraction;automatic optical inspection;convolutional neural network-based multilabel classification;PCB defects;printed circuit board design technology;image classification;multitask CNN model;multilabel learning problem;multiple binary classification tasks;multicategory problem;deep learning frameworks;PCB surface defects inspection},
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Abstract: Robust and precise defect detection is of great significance in the production of the

high-quality printed circuit board (PCB). However, due to the complexity of PCB production environments, most previous works still utilise traditional image processing and matching algorithms to detect PCB defects. In this work, an improved bare PCB defect detection approach is proposed by learning deep discriminative features, which also greatly reduced the high requirement of a large dataset for the deep learning method. First, the authors extend an existing PCB defect dataset with some artificial defect data and affine transformations to increase the quantity and diversity of defect data. Then, a deep pre-trained convolutional neural network is employed to learn high-level discriminative features of defects. They fine-tune the base model on the extended dataset by freezing all the convolutional layers and training the top layers. Finally, the sliding window approach is adopted to further localise the defects. Extensive comparisons with three traditional shallow feature-based methods demonstrate that the proposed approach is more feasible and effective in PCB defect detection area.
keywords: {automatic optical inspection;learning (artificial intelligence);printed circuit manufacture;feature extraction;image representation;printed circuits;feedforward neural nets;convolution;image matching;affine transforms;deep feature learning;high-quality printed circuit board;PCB production environments;matching algorithms;deep discriminative features;artificial defect data;high-level discriminative features;image processing;convolutional neural network;PCB defect detection approach;affine transformations;shallow feature-based methods;convolutional layers;sliding window approach},
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Abstract: With the increasing complexity of circuit design in recent years, the pin assignment and escape routing problems for field-programmable gate array (FPGA) on a printed circuit board (PCB) have become greatly difficult due to the fast increase in pin count and density. Most existing works only focus on either the FPGA pin assignment problem or the PCB escape routing problem independently, but cannot handle them simultaneously. In this paper, we propose an integer linear programming based method to simultaneously solve the problem of pin assignment and escape routing for FPGA-PCB co-design. Moreover, differential pairs and single-ended signals are handled together optimally to minimize the total wirelength in escape routing. Encouraging experimental results are shown to support our approach showing reduction in the number of PCB routing layers and/or wirelength.
keywords: {circuit optimisation;field programmable gate arrays;integer programming;linear programming;logic design;network routing;printed circuit design;constrained pin assignment;differential pair;FPGA-PCB codesign;field programmable gate array;printed circuit board;FPGA pin assignment problem;PCB escape routing problem;integer linear programming;total wirelength;PCB routing layers;Field programmable gate arrays;Printed circuits;Design automation;Integer linear programming;Differential pairs;escape routing;field-programmable gate array (FPGA)-printed circuit board (PCB) co-design;pin assignment},
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Abstract: As technology develops, the number of chips increases while the thickness of mobile products continuously decreases, which leads to the need for high-density packaging techniques with high numbers of power and signal lines. By applying wireless power transfer technology at the printed circuit board (PCB) and package levels, the number of power pins can be greatly

reduced to produce more space for signal pins and other components in the system. For the first time, in this paper, we propose and demonstrate a high-efficiency PCB- and package-level wireless power transfer interconnection scheme. We enhance the efficiency by applying magnetic field resonance coupling using a matching capacitor. The proposed scheme can replace a high number of power interconnections with rectangular spiral coils to wirelessly transfer power from the source to the receiver at the PCB and package levels. The equivalent circuit model is suggested with analytic equations, which is then analyzed to optimize the test vehicle design. For the experimental verification of the suggested model, the Z -parameter results obtained from the model-based equation and measurement of the designed and fabricated test vehicles are compared at up to 1 GHz. The power transfer efficiency from the source coil to the receiver coil in this scheme is able to reach 85.6%. Finally, we designed and fabricated a CMOS full-bridge rectifier and mounted it on the receiver board to convert the transferred voltage from ac voltage to dc voltage. A measured dc voltage of 2.0 V is sufficient to operate the circuit, which generally consists of 1.5 V devices.
keywords: {bridge circuits;CMOS integrated circuits;coils;electronics packaging;equivalent circuits;inductive power transmission;integrated circuit design;integrated circuit manufacture;integrated circuit modelling;magnetic fields;printed circuit interconnections;rectifiers;package-level wireless power transfer interconnection scheme;magnetic field resonance coupling;mobile products;high-density packaging techniques;signal lines;wireless power transfer technology;printed circuit board;PCB- wireless power transfer interconnection scheme;power pins;signal pins;matching capacitor;rectangular spiral coils;equivalent circuit model;model-based equation;power transfer efficiency;source coil;receiver coil;CMOS full-bridge rectifier;receiver board;AC voltage;DC voltage;Z-parameter;voltage 2.0 V;voltage 1.5 V;Coils;Integrated circuit modeling;Mathematical model;Wireless communication;Integrated circuit interconnections;Spirals;Inductance;CMOS full-bridge rectifier;ferrite;high efficiency;low turn-ON voltage;magnetic field resonance coupling;package;power transfer efficiency;printed circuit board (PCB);voltage transfer ratio;wireless power transfer.;CMOS full-bridge rectifier;ferrite;high efficiency;low turn-ON voltage;magnetic field resonance coupling;package;power transfer efficiency;printed circuit board (PCB);voltage transfer ratio;wireless power transfer},
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Abstract: This paper details the design, assembly, and detailed characterization of printed circuit board (PCB) embedded thin magnetic film inductors for Power Supply in Package applications. Solenoidal inductors were assembled on copper tracks printed on PCB with wire bonds to complete the copper loop. Furthermore, the solenoid inductors have laminated amorphous soft magnetic thin films embedded between the two conductor layers. The devices have chemically thinned Vitrovac films laminated as core material. Three different designs of solenoid inductors with different numbers of turns are assembled and characterized. The assembled PCB inductor measured a highest quality factor of 8.5 for a three-turn device at 10 MHz.
keywords: {amorphous magnetic materials;copper;inductors;laminates;lead bonding;magnetic cores;magnetic thin films;power supply circuits;printed circuit design;Q-factor;soft magnetic materials;Power Supply in Package;PCB embedded thing magnetic film inductors;wire bonds;laminated amorphous soft magnetic thin films;conductor layers;assembled PCB inductor;Vitrovac films;copper loop;copper tracks;solenoidal inductors;printed circuit board;discrete thin-film magnetic core;PCB embedded bondwire inductors;frequency 10.0 MHz;Magnetic cores;Inductors;Inductance;Copper;Wires;Magnetic films;Integrated circuits;power conversion;power inductors;printed circuit board (PCB)-based magnetic devices;switched-mode

power supply;thin-film magnetic core},
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Abstract: Power efficiency and utilization are important factors for a cloud service provider. In this paper, we provide one quick design method both for a high-current density power distribution printed circuit board (PCB) design and for an improvement of a high end server system. This design method also takes into consideration both load balance and failures of a multipower supply server system, when the server system is supported by a redundancy power source. Our design is based on a system power source to sink the current path for both PCB copper shape dimension and thickness design, and to add some power or ground via for stitching either each power or ground plane on a multilayer PCB design to reduce direct current resistance. It also considers the airflow necessary for cooling the power distribution board to lower the temperature rise when high current is delivered with a resulting lower power loss and higher power efficiency and performance per watt.
keywords: {current density;power supply circuits;printed circuit design;printed circuits;redundancy;high-current density PCB design method;PSU load balance;high end server system;power efficiency;cloud service provider;high-current density power distribution printed circuit board design;multipower supply server system;redundancy power source;system power source;current path;PCB copper shape;ground plane;multilayer PCB design;direct current resistance;power distribution board cooling;power supply unit;Servers;Power distribution;Copper;Vents;Power supplies;Current density;Cooling;Airflow;current density;direct current resistance;load balance;power efficiency;power redundancy;printed circuit board (PCB);temperature rise;thermocouple;wind tunnel chamber},
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Abstract: A novel design for configurable electromagnetic bandgap (CEBG) filter on printed circuit board (PCB) is presented. The CEBG filter is implemented in FR4 substrate with surface mounted lumped capacitors. Working frequency of the filter can be controlled by adjusting the value of the capacitor. The CEBG filter is unique in that it creates resonance by introducing a surface mounted capacitor instead of relying on modification of a periodic lattice in the substrate and in that it can cover large frequency range with a compact size. A particular example of a frequency controllable filter is implemented by CEBG process and experimentally demonstrated on the same EBG substrate and with different lumped capacitors. The results show a filter with a size of 2.50 × 3.00 × 1.00 mm^3in PCB achieving performance of an unloaded quality factor (Qu) of 81, an insertion loss (IL) of 3.48 dB at 3.22 GHz, and a Qu of 105, an IL of 2.93 dB at 4.07 GHz using a capacitor of 3.3 and 2.2 pf, respectively.
keywords: {capacitors;microwave circuits;microwave filters;printed circuits;surface mount technology;compact configurable EBG filter;PCB;CEBG filter;printed circuit board;FR4 substrate;surface mounted lumped capacitor;surface mounted capacitor;periodic lattice modification;frequency controllable filter;insertion loss;IL;loss 3.48 dB;frequency 3.22 GHz;loss 2.93 dB;frequency 4.07 GHz;capacitance 3.3 pF;capacitance 2.2 pF;Capacitors;Substrates;Resonant frequency;Frequency measurement;Metals;Periodic structures;Metamaterials;Configurable electromagnetic bandgap (CEBG) filter;frequency controllable;printed circuit board (PCB);surface mount capacitor.;Configurable electromagnetic bandgap (CEBG) filter;frequency

controllable;printed circuit board (PCB);surface mount capacitor},
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Abstract: This paper presents a power amplifier module (PAM) that operates efficiently in low-power mode for IEEE 802.11g Wi-Fi applications. The PAM consists of a power amplifier (PA), a buck converter, and a power detector. Two packaging technologies were used to integrate the compact module: a low-temperature co-fired ceramic (LTCC) technology and a ferrite-filled printed circuit board (PCB) technology. The LTCC portion includes radio-frequency inductors, capacitors, transmission lines, and interconnection lines to minimize the overall size, while a power inductor for the buck converter is implemented in ferrite-filled PCB. The PA and the buck converter are designed in 2-μm InGaP/GaAs heterojunction bipolar transistor technology and 0.35-μm CMOS technology, respectively. The output power level is converted into a voltage by the power detector, and the voltage controls the buck converter, thereby optimizing the supply voltage of the PA. This adaptive supply voltage helps to improve the power-added efficiency (PAE) in the low-power regime while maintaining linearity. The PAM showed an error vector magnitude of less than 4% up to an output power of 22 dBm. The PAE is 8% and 11% at output powers of 11 and 16 dBm, respectively, representing respective improvements of 60% and 43%. The overall size of the PAM is $5\times7.5\times1.2$ mm^3.
keywords: {ceramic packaging;CMOS analogue integrated circuits;ferrites;gallium arsenide;heterojunction bipolar transistors;III-V semiconductors;indium compounds;power amplifiers;power capacitors;power convertors;power inductors;printed circuits;telecommunication power supplies;wireless LAN;power-added efficiency;PAE;error vector magnitude;adaptive supply voltage;CMOS technology;heterojunction bipolar transistor technology;interconnection lines;transmission lines;radio-frequency inductors;packaging technologies;power detector;IEEE 802.11g Wi-Fi applications;ferrite-filled PCB technology;printed circuit board;power inductor;buck converter;PAM;Wi-Fi power amplifier LTCC module;LTCC technology;low-temperature cofired ceramic technology;size 2 mum;size 0.35 mum;size 5 mm;size 7.5 mm;size 1.2 mm;InGaP-GaAs;Inductors;IEEE 802.11 Standards;Switches;Voltage control;Detectors;Directional couplers;Packaging;Adaptive supply voltage;buck converter;ferrite-filled printed circuit board (PCB);low-temperature co-fired ceramic (LTCC);power amplifier (PA);power detector;power-added efficiency (PAE);WiFi.;Adaptive supply voltage;buck converter;ferrite-filled printed circuit board (PCB);low-temperature co-fired ceramic (LTCC);power amplifier (PA);power detector;power-added efficiency (PAE);WiFi},
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Abstract: A microfluidic sensing platform (MSP) for the detection of bio/chemicals has been successfully developed. Polydimethylsiloxane (PDMS)-based microfluidic channels were fabricated using master molds created with printed circuit board (PCB) technology. Silver (Ag)-based ink was employed to inkjet print interdigitated electrodes on flexible polyethylene terephthalate (PET) substrate. The printed PET substrate and PDMS were bonded to form the MSP. The capability of the fabricated MSP for detecting very low concentrations of heavy metal compounds was investigated. The electrochemical impedance spectroscopy response of the MSP revealed picomolar concentration levels of detection for mercury sulfide and cadmium sulfide.

The results obtained demonstrated the feasibility of integrating conventional PCB and printing technology to create flexible MSPs for heavy metal sensing applications.
keywords: {biosensors;bonding processes;cadmium compounds;chemical sensors;chemical variables measurement;electrochemical electrodes;electrochemical impedance spectroscopy;II-VI semiconductors;ink jet printing;level measurement;mercury compounds;microchannel flow;microfabrication;microsensors;moulding;printed circuits;wide band gap semiconductors;microfluidic sensing platform;integrating PCB technology;inkjet printing process;MSP;biochemical detection;polydimethylsiloxane;PDMS;microfluidic channel;master molding;printed circuit board;interdigitated electrode;flexible polyethylene terephthalate;printed PET substrate;bonding;heavy metal compound;electrochemical impedance spectroscopy response;picomolar concentration level detection;mercury sulfide detection;cadmium sulfide detection;heavy metal sensing application;HgS;CdS;Microfluidics;Sensors;Impedance;Metals;Fluids;Electrodes;Printing;Microfluidic sensing platform (MSP);Inkjet printing;Printed circuit board (PCB);Microfluidic sensing platform (MSP);inkjet printing;interdigitated electrodes (IDE);printed circuit board (PCB);polydimethylsiloxane (PDMS)},
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Abstract: Image registration technology has been widely used in many parts of the computer vision system such as the automatic optical inspection system which is used to detect the printed circuit board (PCB) defects. The accuracy of the image registration will deeply influence the system's performance, so this study proposed an accurate image registration algorithm and applied it to the PCB defect detection. Good features to track feature detector and speeded up robust feature descriptor are combined to extract efficient features to achieve the first accurate image registration. Afterwards, cross-correlation functions were used to compute the shift between the reference image and the first-registered image for further accurate registration. Experimental results show that the authors' algorithm performs a much better registration, with a lower root-mean-square error value between the reference image and transformed image. What is more, they applied it to detect the defects of PCB with a high accuracy.
keywords: {automatic optical inspection;computer vision;image registration;feature extraction;printed circuits;electronic engineering computing;computer vision system;automatic optical inspection system;printed circuit board defects;PCB defect detection;feature detector;robust feature descriptor;reference image;first-registered image;accurate image registration method;PCB defects detection;lower root-mean-square error},
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Abstract: Printed circuit board (PCB) integrated inductors have been adapted for operation as fluxgate sensors. A ring core is made from an electrodeposited permalloy thin film and is sandwiched between the layers of the PCB. The sensor excitation winding is also integrated into the PCB design. The pick-up coil is wound around the frame of the PCB core. Different types of current excitation waveforms with tuned and nontuned pick-up coils were used. The achieved sensitivities for 60 turns of tuned/nontuned pick-up coil, a sinusoidal waveform excitation current of Irms=300 mA, and an excitation frequency of 150 kHz were 13100/1800 V/T. The achieved sensitivity for pulse excitation (Ipeak-peak=900 mA, Irms=184 mA, duty 20%) was 2100 V/T. Noise power density for pulse excitation was 1.2 nTrms//spl radic/Hz@1 Hz, noise rms value from 10 mHz to 10 Hz was 3.3 nT. A perming error of 1 /spl mu/T was measured for a wide range

of excitation currents.
keywords: {fluxgate magnetometers;printed circuit design;fluxgate sensor;printed circuit board;integrated inductors;ring core;permalloy thin film;sensor excitation winding;pick-up coil;temperature stability;Temperature sensors;Magnetic sensors;Coils;Magnetic cores;Printed circuits;Circuit stability;Wounds;Circuit noise;Current measurement;Inductors;Excitation;fluxgate sensor;printed circuit board (PCB);temperature stability},
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Abstract: A K/Ka-band low-cost continuously tunable quasiabsorptive bandstop filter fabricated with PCB technology is presented for the first time in this letter. A unique implementation of vertically integrated PCB-based evanescent-mode cavity resonator allows the filter to reach a maximum operating frequency of 42 GHz with commercially available linear actuators. The measured results reveal a state-of-the-art performance with less than 1-dB out-of-band insertion loss (1.5-3.2 dB with connectors) and higher than 50-dB isolation. The measured 3-dB bandwidth varies from 1.47% at 22 GHz to 4.65% at 42 GHz. This firstof-its-kind demonstration reveals the high potential of low-cost PCB technologies for manufacturing the high-performance RF front-end filters for high-frequency applications.
keywords: {actuators;band-stop filters;cavity resonator filters;circuit tuning;microwave filters;microwave resonators;millimetre wave filters;millimetre wave resonators;printed circuits;continuously tunable quasiabsorptive bandstop filter;vertically integrated PCB-based evanescent-mode cavity resonator;maximum operating frequency;out-of-band insertion loss;low-cost PCB technologies;high-performance RF front-end filters;linear actuators;PCB technology-based quasiabsorptive bandstop filter;K-Ka-band low-cost continuously tunable quasiabsorptive bandstop filter;frequency 22 GHz to 42 GHz;loss 1.5 dB to 3.2 dB;Cavity resonators;Topology;Notch filters;Printed circuits;Tunable circuits and devices;Actuators;Double-layer cavities;evanescent-mode resonator;quasi-absorptive bandstop;tunable bandstop filter},
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doi: 10.1109/63.931055
Abstract: A new design of low-cost and low-profile power transformer is presented in this paper. The manufacturing cost of a power transformer can be reduced using the proposed printed-circuit board (PCB) transformer. The transformer windings are etched on the opposite sides of a double-sided PCB. Self-adhesive ferrite polymer composite (FPC) sheets are stuck on the two PCB surfaces to shield the magnetic flux induced from the transformer windings. The PCB transformer does not require manual winding and bobbin. A power converter prototype employing the PCB transformer has been implemented. The technique of choosing the optimum switching frequency of the power converter using the PCB transformer is addressed in this paper. The maximum power delivered from the prototype is 94 W. The maximum efficiency of the power converter is 83.5%.
keywords: {DC-DC power convertors;power transformers;transformer windings;magnetic flux;magnetic shielding;printed circuits;ferrites;polymers;composite materials;switching circuits;low-profile power converter;printed-circuit board;PCB power transformer;ferrite polymer composite;manufacturing cost reduction;transformer windings;double-sided PCB;magnetic flux shielding;optimum switching frequency;94 W;83.5 percent;Power transformers;Windings;Prototypes;Manufacturing;Costs;Etching;Ferrites;Polymers;Flexible printed

circuits;Magnetic flux},
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Abstract: This paper describes a process for batch manufacturing, assembly, and packaging of metal alloy microrelays directly on printed circuit board (PCB) substrates for high-power radio frequency (RF) applications. Stainless steel cantilevers with Pt-Rh tips are mounted on Rogers 4003 PCB substrates to demonstrate the approach. A multilayer PCB design allows for the use of subsurface metal layers to transmit the RF signal into and out of the sealed encapsulation. The electrostatically actuated microrelays with 8.4- footprints have 78-V pull-in voltage and 1.1- on-state resistance. Packaged microrelays exhibit down-state insertion loss and up-state isolation better than 0.25 and 15 dB, respectively, for frequencies up to 5 GHz. Packaged devices remain functional up to 20-W RF power under hot switching conditions. The high power lifetime of the microrelays is 10 913 cycles for 1-W incident RF power in 1-s pulses and 8414 cycles for 10-W incident RF power in 0.1-s pulses. The impact of device encapsulation and multilayer PCB substrate on device performance is addressed.
keywords: {batch production systems;microrelays;packaging;printed circuit manufacture;batch-fabricated high-power RF microrelays;direct on-PCB packages;batch manufacturing;metal alloy microrelays;printed circuit board substrates;high-power radio frequency applications;multilayer PCB design;subsurface metal layers;sealed encapsulation;electrostatically actuated microrelays;packaged microrelays;down-state insertion loss;Radio frequency;Bridge circuits;Microrelays;Substrates;Contacts;Assembly;Nonhomogeneous media;Batch fabrication;high power;package;printed circuit board (PCB);radio frequency (RF) microrelay},
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Abstract: The PCB spill cleanup policy is reviewed. Methods of disposal available to owners are discussed. The pain associated with complying with spill cleanup requirements is causing many power transformer owners to dispose of equipment as a method of eliminating PCB-related risks. Some methods of legal disposal, which are allowed under the regulations, do not eliminate risks but may actually increase them. Once the rules are discussed, an alternative that eliminates the long-term exposure risks caused by disposal of PCB-containing equipment is given. In particular, a three-step solution to this problem is presented that depends on the following: specifying an appropriate method of disposal to completely destroy PCBs; utilizing vendors who are EPA approved and inspected; and reviewing thoroughly the control mechanisms and procedures used by vendors to prevent environmental exposures to PCBs and to ensure that the customers long-term liabilities are completely eliminated.<<ETX>>
keywords: {insulating oils;legislation;polymers;power transformers;safety;transformer insulation;waste disposal;polychlorinated biphenyls;safety;waste disposal;insulating oils;legislation;PCB;risk management;spill cleanup policy;power transformer;regulations;Risk management;Transformers;Protection;Costs;Rubber;Plastics industry;Industry Applications Society;Heat transfer;Control systems;Industrial plants},
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Jian-Ming Wu, Fu-Yi Han, Tzyy-Sheng Horng and Jenshan Lin, "Direct-conversion quadrature modulator MMIC design with a new 90/spl deg/ phase shifter including package and PCB effects

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Abstract: This paper presents a wideband code-division multiple-access direct-conversion quadrature modulator monolithic-microwave integrated-circuit (MMIC) design that employs a new technique to generate the 90deg phase shift with low implementation loss. From the bare-chip measurement, this new 90deg phase shifter has been proven with an amplitude and phase error less than 0.6 dB and 0.8deg, respectively, within the applied frequency range from 1.85 to 1.98 GHz. The package and printed circuit board (PCB) interconnects are also analyzed using the three-dimensional electromagnetic simulation tool and transformed into the equivalent-circuit elements for co-simulation with the designed quadrature modulator MMIC. The degradation of error vector magnitude and sideband suppression due to the package and PCB can be well predicted and verified by measurements. Although the proposed 90deg phase shifter has a remarkable advantage over the others in implementation loss, it is quite susceptible to the package and PCB effects and needs more design efforts to deal with those effects
keywords: {circuit simulation;code division multiple access;equivalent circuits;integrated circuit interconnections;MMIC phase shifters;modulators;printed circuits;quadrature amplitude modulation;UHF integrated circuits;UHF phase shifters;direct-conversion quadrature modulator;UHF;MMIC design;phase shifter;PCB effects;W-CDMA;wideband code division multiple access;monolithic-microwave integrated-circuit design;bare-chip measurement;printed circuit board interconnects;PCB interconnects;3D electromagnetic simulation tool;equivalent-circuit elements;error vector magnitude;sideband suppression;1.85 to 1.98 GHz;Phase modulation;MMICs;Phase shifters;Packaging;Multiaccess communication;Electromagnetic measurements;Wideband;Modulation coding;Frequency measurement;Phase measurement;Package and printed circuit board (PCB) effects;phase shifter;quadrature modulator},
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Abstract: A leaky-wave antenna array with a low sidelobe level (SLL) fed by the substrate-integrated image guide (SIIG) is proposed in this letter. First, the single-layer printed circuit board (PCB) technology is applied here to fabricate the SIIG. The technology not only reduces the fabrication complexity, but also avoids the air gap between the substrate and the metallic ground. A method is introduced here to reduce the additional loss of the single-layer PCB-based SIIG caused by the air holes on the metallic cladding in the perforated regions. As the waveguide wavelength of the SIIG is short, small element spacing can be realized by utilizing this kind of feeding line. Besides, metallic strips with an optimal length-to-width ratio placed on top of the SIIG are employed as radiation elements, which exhibit strong radiation abilities and large controllable range of the leakage constant. Considering these conditions, this type of antenna can realize a low-SLL characteristic within a short length and achieve high gain at the same time. An example antenna with the vertical polarization is designed and measured to validate the theory. A single-layer transition between a coaxial probe and the SIIG is also designed to excite the antenna. The measured gain of the antenna is 14.4 dBi at 13.6 GHz with -19.2 dB SLL, and the radiation efficiency is 84.5%, considering the insertion loss of the feeding line.
keywords: {antenna feeds;antenna radiation patterns;claddings;electromagnetic wave polarisation;leaky wave antennas;microwave antennas;printed circuits;substrate integrated waveguides;single-layer PCB-based substrate-integrated image guide;single-layer printed circuit board technology;air gap;metallic ground;single-layer PCB-based SIIG;air holes;metallic cladding;feeding line;metallic strips;single-layer transition;low-sidelobe-level short leaky-wave

antenna array;low-SLL characteristics;antenna radiation pattern;vertical polarization;coaxial probe;frequency 13.6 GHz;gain -19.2 dB;efficiency 84.5 percent;Leaky wave antennas;Antenna measurements;Substrates;Probes;Antenna arrays;Antenna radiation patterns;Leaky-wave antenna;low sidelobe level (SLL);single-layer printed circuit board (PCB);substrate-integrated image guide (SIIG)},
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Abstract: An antenna-in-package solution is introduced for millimeter-wave applications. The solution is implemented in an asymmetric PCB technology incorporating 4 laminates of a Teflon-based and one laminate of a Ceramic-based material. A Horn-like element embedded in the PCB technology is designed and manufactured. The simulated and measured return losses are better than 10 dB in the frequency band 55-68 GHz, which makes the element suitable to be used for 60 GHz multi-Gb/Sec applications. The antenna element also provides 6 dB of gain with a ripple less that 0.5 dB from 53 GHz to 60 GHz. Moreover, 3 different arrays have been designed using the same Horn-like antenna as the radiating element. The simulated and measured radiation characteristics of all the antennas are investigated at different frequencies. It is shown that the antenna element is capable of being arrayed for applications where non-line-of-sight communication is needed or multi-path spatial diversity techniques are to be implemented.
keywords: {antenna radiation patterns;ceramic insulation;horn antennas;millimetre wave antenna arrays;printed circuits;teflon-based multilayer PCB technology;millimeter-wave horn-type antenna-in-package solution;asymmetric PCB technology;ceramic-based material;antenna radiating element;laminates;return loss measurement;radiation characteristics simulation;nonline-of-sight communication;multipath spatial diversity technique;frequency 55 GHz to 68 GHz;frequency 53 GHz to 60 GHz;Antenna measurements;Antenna arrays;Laminates;Loss measurement;Horn antennas;Antenna-in-package solution;embedded horn;millimeter-wave transceivers;multi-layer PCB technology},
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Abstract: In this paper, a statistical method is proposed to analyze the radiated susceptibility of printed circuit boards (PCBs). The quantification of hazard severity is done by three levels, including performance degradation, operation suspension, and physical damage. For detection of a fault, while the system is operating itself safely, threshold levels for decision of a performance suspension should be defined. Hypothetical operating voltage/current levels are proposed for each element of the system. These levels are estimated by using high-level information of the system and provide a statistical measure to find threshold/decision levels. The overall system fault is defined based on the entropy of faults in decision levels on the entire board. In addition, a simple method is proposed for checking the physical damage of the board due to high power microwave illumination. Verification is simply done by some full-wave simulations and measurements on a designed and implemented digital system PCB. The proposed method can be a fast and high-level check for the system PCB whether it satisfies a radiated susceptibility standard level or not.
keywords: {entropy;fault diagnosis;printed circuits;statistical analysis;statistical prediction;radiated susceptibility quantification;electronic systems PCB;electromagnetic polluted environment;statistical method;printed circuit boards;hazard severity;performance

degradation;operation suspension;physical damage;fault detection;performance suspension;hypothetical operating voltage level;hypothetical operating current level;fault entropy;microwave illumination;digital system PCB;Electromagnetic interference;Electromagnetic scattering;Circuit faults;Pollution measurement;Radio frequency;Electromagnetics;Degradation;Electromagnetic compatibility (EMC);printed circuit board (PCB);radiated susceptibility;statistical prediction},
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Abstract: This paper describes the design and implementation of a W-band phased-array system with printed circuit board (PCB) integrated antennas in two polarizations capable of multi-gigabit spectrally efficient wireless communication. The chipset is manufactured in a 0.18-μm SiGe BiCMOS technology with $f_T/f_{MAX}$of 240-/270-GHz and is flip-chipped onto a lowcost organic PCB with integrated antenna arrays. Each chip is equipped with 16-transmit/4-receive or 16-receive/4-transmit calibrated phase shifter elements and direct upand downconverters plus a half-rate phase-locked loop. The different system tradeoffs required to establish a multi-Gb/s wireless link at millimeter waves are carefully studied. Built-in element failure detectors, power detectors, and digital interface enable factory calibration and self-test capability. Each transceiver chip operates from 1.5and 2.5-V supplies and consumes 5.5 and 4.5 W in transmit and receive mode, respectively. The peak transmitter effective isotropic radiation power is 34 dBm in each polarization with a measured receiver noise figure of 6.5 dB at 94 GHz. At a distance of 1 m, a maximum wireless data rate of 30 Gb/s (per polarization) using 64-QAM can be achieved and at 20 m, 8 Gb/s (dual polarization) can be established using QPSK modulation.
keywords: {antenna phased arrays;BiCMOS integrated circuits;flip-chip devices;Ge-Si alloys;millimetre wave antenna arrays;phase locked loops;phase shifters;printed circuits;quadrature amplitude modulation;quadrature phase shift keying;radio receivers;radio transceivers;16-element W-band phased-array transceiver chipset;flip-chip PCB integrated antennas;printed circuit board;integrated antenna arrays;maximum wireless data rate;wireless communication;SiGe BiCMOS technology;peak transmitter;multigigabit wireless data links;low cost organic PCB;16-receive-4-transmit calibrated phase shifter elements;16-transmit-4-receive calibrated phase shifter elements;direct upand downconverters;half-rate phase-locked loop;built-in element failure detectors;power detectors;isotropic radiation power;64-QAM;QPSK modulation;noise figure 6.5 dB;frequency 94.0 GHz;power 5.5 W;power 4.5 W;distance 1.0 m;distance 20.0 m;bit rate 8 Gbit/s;voltage 1.5 V;voltage 2.5 V;size 0.18 mum;frequency 240 GHz;frequency 270 GHz;SiGe;Phase shifters;Wireless communication;Phase locked loops;Detectors;Antenna arrays;Receivers;5G wireless;die on printed circuit board (PCB);direct conversion;downconverter;E-band;integrated antenna;millimeter wave;monolithic microwave integrated circuit;multi-gigabit wireless link;phase-locked loop (PLL);phased-array calibration;QAM constellation;receiver array;SiGe BiCMOS;transmitter array;upconverter;W-band;wireless link analysis},
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doi: 10.1109/TEMC.2010.2064319
Abstract: The mixed-mode ABCD parameters are newly introduced and developed, where the definition and the connection are carefully established to have both the advantages of the mixed-mode S-parameters and the ABCD parameters, simultaneously. In addition, closed-form

equations to model symmetric and asymmetric coupled transmission lines are derived. With the derived equations, the voltage transfer functions and the eye diagram of a variety of printed circuit board (PCB)-level differential interconnects are analytically attainable, which greatly enhances their applicability for signal integrity analysis. To verify the derived equations and to validate the proposed mixed-mode ABCD parameters, a series of microstrip-type differential lines on PCB test vehicles were fabricated and tested. The effectiveness of the proposed mixed-mode ABCD parameters was successfully confirmed through the comparison studies, in particular for the case of mode-conversion occurrence at the differential lines.
keywords: {microstrip lines;printed circuit testing;printed circuits;S-parameters;transmission lines;mixed-mode ABCD parameters;signal integrity analysis;PCB-level differential interconnects;mixed-mode S-parameters;closed-form equations;asymmetric coupled transmission lines;voltage transfer functions;printed circuit board-level differential interconnects;derived equations;microstrip-type differential lines;PCB test vehicles;Scattering parameters;Mathematical model;Equations;Transmission line matrix methods;Power transmission lines;Impedance;Transfer functions;Differential interconnect;eye diagram;mixed-mode ABCD parameters;printed circuit board (PCB);signal integrity;transfer function},
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Abstract: Position sensing is one of the crucial parts of many systems, specifically in an active magnetic bearing. The position is used to control the magnetic forces within an active magnetic bearing to keep a rotor levitated. Sensors used in these systems must be very sensitive and are usually very expensive. In this paper a low cost printed circuit board position sensor is analysed. The sensor uses an excitation coil to establish a magnetic field. Four sensing coils are then used to measure the influence a conducting target has on the magnetic field to enable position sensing. The sensor's magnetic operation is analysed using finite element methods and very good correlation is found with measured results. The effects of the target material and the number of PCB layers are analysed. It is shown that a two layer sensor can produce acceptable sensitivity and linearity.
keywords: {Sensors;Voltage measurement;Eddy currents;Rotors;Aluminum;Atmospheric modeling;Magnetic levitation;eddy current;displacement sensor;multiple layer PCB},
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Abstract: Self-integrating Rogowski coil has been widely used for measurements of pulsed currents from nanosecond timescale to microsecond timescale in pulsed power systems. Appropriate designs of coil's structure are vital to high-frequency response. This paper proposed a new structure of Rogowski coil so as to provide a better response to fast pulsed current. Four Rogowski coils with different structures were tested in three different platforms. Experimental results showed that the hybrid Printed Circuit Board Rogowski coil had the best performance in this paper, which could respond to square waves with fronts of ~ 2 ns and had a sensitivity of 0.585 V/kA. The designed maximal peak current was 100 kA.
keywords: {coils;electric current measurement;printed circuits;pulsed power technology;nanosecond-risetime pulsed current measurement;self-integrating hybrid PCB Rogowski coil;microsecond timescale pulsed current measurement;pulsed power system;high-frequency response;printed circuit board;current 100 kA;Current measurement;Resistors;Windings;Copper;Pulse measurements;Wires;Inductance;High frequency;integrating resistor;PCB Rogowski coil;pulsed current.;High frequency;integrating

resistor;PCB Rogowski coil;pulsed current},
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doi: 10.1109/JMEMS.2008.916291
Abstract: In this paper, a MEMS-based electronically steerable antenna array (ESA) fabricated using printed circuit processing techniques is reported. A Kapton polyimide film is used as the structural layer for fabricating MEMS varactors. The MEMS varactors have been used in the bistable mode to design loaded- line-type MEMS phase shifters. These MEMS phase shifters have been monolithically integrated with the ESA on a Duroid substrate using printed circuit processing techniques. For proof-of-concept demonstration of the proposed MEMS-based ESA, a 3-bit MEMS phase shifter has been monolithically integrated with a two- element double-folded slot-antenna array on a Duroid substrate. An X-band ESA prototype with a beam steering angle of 20deg at 9.1 GHz is presented.
keywords: {antenna arrays;beam steering;micromechanical devices;phase shifters;polymer films;printed circuit manufacture;slot antenna arrays;varactors;electronically steerable antenna array fabrication;PCB technology;printed circuit processing techniques;Kapton polyimide film;MEMS varactors;bistable mode;MEMS phase shifters;Duroid substrate;double-folded slot-antenna array;beam steering angle;Antenna arrays;Micromechanical devices;Phase shifters;Printed circuits;Varactors;Substrates;Phased arrays;Polyimides;Prototypes;Beam steering;Kapton polyimide film;MEMS-based electronically steerable antenna array (ESA);MEMS phase shifters;printed circuit board (PCB) MEMS;slot antenna;Kapton polyimide film;MEMS-based electronically steerable antenna array (ESA);MEMS phase shifters;printed circuit board (PCB) MEMS;slot antenna},
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keywords: {biomedical electronics;biomedical equipment;brain;copper;eddy currents;fractals;medical disorders;neurophysiology;patient treatment;printed circuits;clinical

treatment;H-shaped fractal pattern slot;eddy currents;safety risks;energy transfer efficiency;PCB;printed circuit board;brain disorders;PCB copper layers;rechargeable neurostimulator;temperature 34.5 degC to 39.5 degC;Cu},
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Abstract: A thin film thermocouple (TFTC) on printed circuit board (PCB) substrate is investigated for measuring transient high temperature. The thermal conductivity of PCB is smaller than that of ceramic, which indicates less influence of substrate on heat conduction of TFTC. Therefore, PCB is suitable to make fast response sensors although it cannot withstand continuous high temperature as ceramic. On the other hand, the TFTC is fabricated on the PCB with measurement circuit together, which integrates a miniature measurement unit. A k-type TFTC was fabricated by magnetron sputtering while the film naturally connected with tracks of PCB, which achieves an integration of the sensor with measurement circuit. Experimental result indicates that the response time of TFTC is less than 2 ms.
keywords: {heat conduction;printed circuits;sputter deposition;temperature measurement;thermal conductivity;thermocouples;thin films;PCB-integrated thin film thermocouples;response time;magnetron sputtering;heat conduction;thermal conductivity;printed circuit board substrate;transient temperature measurement},
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Abstract: We present a theoretical and experimental investigation into the effect of the motion of a printed circuit board (PCB) on the response of microelectromechanical systems (MEMS) devices to shock loading. For the theoretical part, a 2-DOF model is used, where the first degree of freedom accounts for the PCB. The second degree of freedom represents the motion of the MEMS microstructure. Low-g acceleration pulses are applied to the MEMS-PCB assembly base to simulate shock pulses generated from a drop-table test. Simulation data are presented to show the effects of the natural frequency of the PCB, the natural frequency of the microstructure, and the shock pulse duration. Universal 3-D spectra representing the effect of these parameters are presented. It is found that neglecting the PCB effect on the design of MEMS devices under shock loads can lead to undesirable motion of their microstructures. The effects of electrostatic force and squeeze film damping are investigated. It is found that the amplification of motion due to the PCB can cause early pull-in instability for MEMS devices implementing electrostatic forces. The effect of higher order modes of a microbeam is studied through a continuous beam model coupled with a lumped model of the PCB. The limitations of the 2-DOF model are discussed. An experimental investigation is conducted to verify the theoretical results using a capacitive accelerometer. Experimental data for the response of the accelerometer while it is mounted on two representative PCBs due to different low-g shock conditions are shown.
keywords: {accelerometers;damping;micromechanical devices;printed circuits;shock waves;PCB motion;MEMS devices;mechanical shock;printed circuit board;microelectromechanical systems;shock loading;degree of freedom;MEMS microstructure;low-g acceleration pulses;shock pulse duration;3-D spectra;electrostatic force;squeeze film damping;pull-in instability;capacitive accelerometer;Microelectromechanical devices;Electric shock;Microstructure;Micromechanical devices;Frequency;Electrostatics;Accelerometers;Printed circuits;Microelectromechanical systems;Life estimation;Electrostatic force;mechanical shock;microelectromechanical systems (MEMS);microstructure;printed circuit board (PCB);reliability;squeeze film damping (SQFD)},

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keywords: {power transformers;transformer oil;environmental factors;pollution control;PCB-filled transformers;environmental threat;polychlorinated biphenyls;transformer oils;turnkey replacement programmes;PCB-filled capacitors;long-term savings;state-of-the-art equipment},
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keywords: {calibration;circuit optimisation;electric properties;electronics packaging;network analysers;printed circuits;probes;S-parameters;short-open-load standards;SOL calibration standards;PCB channel probing;on-wafer probes;vector network analyzer;VNA measurements;close packed PCB channels;S-parameter model;channel data;two-tier calibration;electrical property;calibration substrate;3D full wave field solver;Calibration;Probes;Vector network analyzers;Scattering parameters;Substrates;Solid modeling;Optimization;on-wafer probe;calibration;vector network analyzer (VNA);zero-length thru;optimization},
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layers by a factor of up 10. The layer density within a multilayer PCB is therefore improved, which again leads to a higher packing density of components. Using the results generated by the simulation, the authors then proceed to investigate the sensitivity of embedded resistor temperature to resistor size under different conditions of surface heat transfer. The results show that large embedded resistors are more sensitive to surface heat transfer than smaller ones and that small components are more effectively cooled by placing embedded copper ground planes in close proximity to them.
keywords: {resistors;printed circuit design;heat transfer;capacitors;inductors;cooling;embedded component temperature;PCB structure;copper ground plane;packing density;thermal interaction;layer density;multilayer PCB;resistor size;surface heat transfer},
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keywords: {Humans;Floors;Soil;Contamination;Concrete;Cities and towns;Dielectrics;Slabs;Steel;Rain},
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Abstract: This paper reports the design of a self-powered telemetric wireless sensor node for temperature measurement. The device is realized with a conventional off-the-shelf thermoelectric generator as a power source. It is sandwiched between two aluminum core printed circuit boards (PCBs). One board is exposed to the heat source and has the role of a heat collector, whereas another one with the mounted low profile heatsink acts as a heat spreader. Electronic components of the node are placed on the inner surfaces of the boards. Implemented step-up circuitry is accommodated to achieve stabile cold boot of the node at a low temperature difference between its hot side and ambient (less than 15 °C), even when it is in thermally inefficient position. Operational autonomy of the node in the absence of the heat source is extended by 30% comparing with the common step-up circuitry implementation. The aluminum core PCBs provide node simplicity and compactness, with small overall dimensions.
keywords: {aluminium;energy harvesting;heat sinks;printed circuits;telecommunication power supplies;temperature measurement;thermoelectric conversion;thermal energy harvesting;telemetric wireless sensor node;aluminum core printed circuit boards;aluminum core PCB technology;temperature measurement;thermoelectric generator;heat source;heat collector;low profile heatsink;heat spreader;operational autonomy;Heating;Temperature sensors;Aluminum;Temperature measurement;Thermal conductivity;Resistance;Aluminum core PCB;energy harvesting;telemetry;thermoelectric generator},
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keywords: {elemental semiconductors;hybrid integrated circuits;integrated circuit manufacture;silicon;substrate testing;PCB;IC fabrication techniques;Research Initiative in Silicon Hybrids;chip-to-substrate connection technology;packaging;IC testing;computer-aided-design;CAD;software;Si hybrid;Hybrid integrated circuits;Integrated circuit manufacture;Silicon},
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keywords: {DC-DC power convertors;power transformers;printed circuits;switching circuits;transformer windings;low-profile low-power converter;coreless PCB isolation transformer;very small manually wound transformers;sub-watt DC-DC power converters;soft-switching power converter;printed circuit board;transformer efficiency;high-frequency capability;reliability;mega-hertz switching converters;micro-circuits;8 MHz;0.5 W;0.46 cm;63 percent;Transformer cores;Circuit faults;Switching converters;Magnetic materials;Magnetic cores;Costs;Packaging;Wounds;Printed circuits;Ferrites},
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Abstract: Cables attached to a PCB can produce a significant amount of unintentional common-mode (CM) radiated emissions (REs). Therefore, it is important to predict these emissions at the design stage before the first prototype is fabricated to ensure time and cost savings. In this Letter, a novel method was proposed to estimate the CM RE from two cables attached to a PCB using the imbalance difference model and asymmetrical dipole antenna model. The proposed method consists of two steps: first, the induced CM voltages on the junctions between the cables

and PCB are computed using the imbalance difference model; secondly, the CM REs are then estimated separately for each cable related to half of the ground plane using the asymmetrical dipole antenna model. The overall REs are then computed by the superposition of the RE from the two asymmetrical dipoles. The effectiveness of the proposed method has been verified by comparing the predicted results to both 3D high-frequency structure simulator simulation results and measurement results taken in a semi-anechoic chamber. A good agreement with the accuracy of more than 95% is observed for the upper bounds of the measured REs.
keywords: {dipole antennas;printed circuits;PCB;asymmetrical dipole antenna models;common-mode radiated emissions;imbalance difference model;asymmetrical dipole antenna model;3D high-frequency structure},
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keywords: {electronics packaging;finite element analysis;insulated gate bipolar transistors;invertors;low-power electronics;metallisation;printed circuits;printed circuit board embedded power electronics;PCB embedded power electronics;three-phase invertor module;insulated gate bipolar transistors;Semikron MiniSKiiP 23AC126V1;PCB embedding assembly process;comparative switching performance assessment;thermal resistance measurement;electric insulation;top-side metallization;bottom-side metallization;copper interconnect technology;turn-ON currents;turn-OFF currents;finite-element-method thermal simulation;PCB embedded package;maximum breakdown limit;partial discharge onset;LV power conversion;voltage 650 V;voltage 1.2 kV;current 25 A;voltage 600 V;temperature 150 C;Copper;Thermal resistance;Switches;Insulated gate bipolar transistors;Lead;Electronics packaging;semiconductor device packaging;thermal management},
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keywords: {printed circuit layout;printed circuit design;approximation theory;interconnections;high speed PCB design;printed circuit board design;rise time signals;board layout;first order approximation equations;design practices;design complexity;three-dimensional analysis;signal integrity engineer;Impedance;Power transmission lines;Frequency;Propagation delay;Propagation losses;Routing;Signal design;Circuits;Microstrip;Dielectric materials},
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keywords: {coplanar waveguide components;mobile antennas;multifrequency antennas;printed circuits;multiband antenna;resonant circuit;PCB;mobile phones;matching circuit;coplanar waveguide;lumped elements},
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keywords: {electromagnetic interference;ferrite devices;fixtures;interference suppression;printed circuits;surface mount technology;ferrite EMI suppressor;parameter extraction;microstrip test fixture;PCB;electromagnetic interference;vector network analyzer;printed circuit board;multilayer chip SMD inductors;VNA E5071B;FeO_4;Parameter extraction;Ferrites;Electromagnetic interference;Microstrip;Fixtures;Circuit testing;Semiconductor device measurement;Electromagnetic measurements;Electric variables measurement;Instruments;Electromagnetic interference (EMI);ferrite devices;frequency-domain

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keywords: {liquid crystal polymers;printed circuits;adhesion;laminations;rheology;shear modulus;copper;recrystallisation;thermal analysis;thermotropic liquid crystalline polymer;PCB applications;rheological properties;Cu adhesion properties;Cu lamination;Cu foil;modulus growth rate damping;recrystallization process;lamination cycle;DSC;dynamical mechanical spectroscopy;shear storage modulus;shear loss modulus;peel testing;Cu;Copper;Lamination;Rheology;Adhesives;Crystallization;Liquid crystal polymers;Printed circuits;Modular construction;Building materials;Crystalline materials},
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keywords: {biological techniques;bioMEMS;lab-on-a-chip;microfluidics;printed circuits;wash droplets;droplet routing algorithms;PCB layer count;orthogonal routing capacity;FPPC-DMFB;scalable single-layer PCB wiring scheme;printed circuit board layers;high optimized application-specific pin-constrained DMFB;low-cost field-programmable pin-constrained digital microfluidic biochip;Electrodes;Routing;Pins;Wires;Arrays;Layout;Reservoirs;Digital microfluidic biochip (DMFB);PCB escape routing;pin-constrained DMFB;Digital microfluidic biochip (DMFB);PCB escape routing;pin-constrained DMFB},
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keywords: {electromagnetic coupling;electromagnetic interference;electromagnetic shielding;integration;printed circuits;hybrid method;PCB;nested shielding enclosure;electromagnetic topology;electromagnetic coupling effect;EM coupling effect;printed circuit board;complicated electric systems;analytical method;radiation coupling interference;conductive coupling interference;BLT equation;total load disturbance voltage;full-wave simulation method;numerical integration method;electric field;numerical simulation;interference paths;Couplings;Interference;Mathematical model;Junctions;Transmission line matrix methods;Integrated circuit modeling;Electron tubes;Baum–Liu–Tesche (BLT) equation;electromagnetic topology (EMT);full-wave simulation;numerical integration;printed circuit board (PCB)},
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keywords: {microswitches;printed circuits;substrates;planarisation;photoresists;organic compounds;copper;RF-MEMS switch;PCB substrates;polyimide planarization;radio frequency microelectromechanical systems;laminated printed circuit board;photoresist sacrificial layer;metallic membrane;insertion loss;Switches;Radiofrequency microelectromechanical systems;Polyimides;Planarization;Fabrication;Radio frequency;Copper;Pulp manufacturing;Microelectromechanical systems;Switching circuits;Microelectromechanical systems (MEMS);polyimide;printed circuit board (PCB);radio frequency (RF);switch},
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keywords: {cavity resonators;printed circuits;cavity resonator model;radiation estimation;printed circuit board;PCB-chassis system;electric far-field radiated;equivalent magnetic current loop;inductive network method;frequency spectra;electric field strength;correction coefficients;Fasteners;Cavity resonators;Current measurement;Frequency measurement;Electromagnetic compatibility;Probes;Cavity resonators;chassis;electromagnetic radiation;printed circuit board (PCB)},
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keywords: {chaos;Monte Carlo methods;polynomial approximation;printed circuits;sensitivity analysis;global sensitivity analysis;uncertainty quantification;radiated susceptibility;printed circuit board;PCB;nonintrusive polynomial chaos expansions;metamodeling technique;stochastic terminal response;external plane wave excitation;Monte Carlo approach;statistical moments;Sobol sensitivity indices;geometrical parameters;electrical parameters;Uncertainty;Electromagnetic compatibility;Sensitivity analysis;Indexes;Chaos;Mathematical model;Field coupling;printed circuit board;sensitivity analysis;transmission lines;uncertainty quantification;Field coupling;printed circuit board;sensitivity analysis;transmission lines;uncertainty quantification},
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multilayer substrates. Good agreements between the simulation and the measurement in the frequency range from 0.45 to 5 GHz can be achieved. The measured results at the center frequency of 2.4 GHz have the return loss better than -15dB; the insertion loss of coupled and direct ports is about 3/spl plusmn/ 0.2dB and the relative phase difference of 89/spl plusmn/0.3/spl deg/. The dimension of the coupler is 3.1cm /spl times/ 1.8cm.
keywords: {coplanar waveguides;directional couplers;printed circuits;UHF couplers;microstrip transitions;PCB-compatible 3-dB coupler;microstrip lines;microstrip-to-CPW via-hole transitions;UHF;microstrip-to-coplanar waveguide transitions;printed circuit board;insertion loss;return loss;0.45 to 5 GHz;Microstrip;Coupling circuits;Frequency measurement;Waveguide transitions;Coplanar waveguides;Bonding;Wires;Printed circuits;Manufacturing processes;Nonhomogeneous media;Coplanar waveguide (CPW);coupler;microstrip line},
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keywords: {printed circuit design;component modeling;PCB design;wireless applications;RF circuit;capacitor;inductor;high-pass filter;3 GHz;Inductors;Calibration;Capacitors;Radio frequency;Filters;Testing;Connectors;Probes;Delay;Frequency measurement},
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Abstract: Gate drive circuits for modern power electronic switches, such as MOSFET and insulated gate bipolar transistor (IGBT), often require electrical isolation. This paper describes the modeling and experimental results of some coreless printed circuit board (PCB)-based transformers that can be used for MOSFET and IGBT devices at high-frequency (500 kHz to 2 MHz) operation. PCB-based transformers do not require the manual winding procedure and thus simplify the manufacturing process of transformer-isolated gate drive circuits. With no core loss, coreless transformers are found to have favorable characteristics at high-frequency operations. This project demonstrates an important point that the size of the magnetic core can approach zero and become zero when the frequency is sufficiently high.
keywords: {printed circuit accessories;transformers;power semiconductor switches;power MOSFET;power bipolar transistors;insulated gate bipolar transistors;driver circuits;coreless PCB transformers;power MOSFET/IGBT gate drive circuits;power electronic switches;electrical isolation;printed circuit board;manufacturing process;transformer-isolation;high-frequency operating characteristics;magnetic core size;500 kHz to 2 MHz;Transformer cores;Printed circuits;Insulated gate bipolar transistors;MOSFET circuits;Magnetic cores;Power electronics;Switching circuits;Switches;Power MOSFET;Manufacturing processes},
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keywords: {equivalent circuits;coreless PCB transformers;printed circuit board transformers;high power density;high efficiency;power conversion;1 cm;19 W;90 percent},
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Abstract: A novel process for monolithic integration of RF microelectromechanical system (MEMS) switches with three-dimensional antenna elements on a microwave laminate printed circuit board (PCB) is presented. This process calls for a low-temperature (90/spl deg/C-170/spl deg/C) high-density inductively coupled plasma chemical vapor deposition technique that allows the choice of any PCB substrate, such as RO4003-FR4 (/spl epsiv//sub r/=3.38, tan/spl delta/=0.002), with the desired electrical properties for antenna applications. A two-element diversity antenna system monolithically integrated with RF MEMS switches is designed and demonstrated.
keywords: {microwave antennas;microswitches;printed circuits;plasma CVD;monolithic integration;RF MEMS switch;diversity antenna;PCB substrate;three-dimensional antenna;microwave laminate printed circuit board;high-density inductively coupled plasma chemical vapor deposition;RO4003-FR4;electrical properties;low-temperature process;90 to 170 degC;Monolithic integrated circuits;Radiofrequency microelectromechanical systems;Switches;Plasma properties;Micromechanical devices;Switching circuits;Microwave antennas;Chemical elements;Laminates;Printed circuits},
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Abstract: The impact of different geometrical parameters on the performance of printed circuit board (PCB) integrated inductors with electroplated magnetic cores is investigated in this paper. The parameters of winding and core structures are limited only by PCB design rules for this novel type of integrated magnetic component. The performance of the resulting structures are compared in terms of achievable inductance, flux confinement in the core, and power handling. Initial design recommendations are presented for different power applications.
keywords: {inductors;printed circuits;magnetic cores;windings;low-power electronics;ultraflat PCB-integrated inductors;low-power conversion applications;geometrical parameters;printed circuit board;electroplated magnetic cores;winding;core structures;integrated magnetic component;achievable inductance;flux confinement;power handling;design recommendations;power applications;Inductors;Magnetic cores;Magnetic flux;Magnetic confinement;Inductance;Printed circuits;Etching;Magnetic materials;Wire;Wounds},
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Abstract: This paper presents the analysis and design of a 30 MHz resonant SEPIC converter. With the conventional design method, tuning the amplitude and phase of the fundamental input voltage and current of the rectifier stage affect each other so that the design procedure is coupled seriously. Based on the circuit duality theory, an improved design method is proposed by redividing the resonant SEPIC topology to realize the independent tuning of the amplitude and phase. The implementation and loss analysis of the SEPIC with the new design are provided in details. Moreover, a novel structure of the PCB embedded inductors is introduced and the comparison among the discrete inductor, the planar spiral inductor and the four-layered solenoid PCB inductor is given in terms of the loss. A 15 V input, 25 W/28 V output/30 MHz SEPIC converter was built to verify the proposed design method and the benefit of the new structure of the PCB embedded inductors. The power density of the power stage is realized over 200 W/in^{3}and the efficiency is 82.5% at the rated output. The temperature of the proposed PCB embedded inductor is reduced from 102.6 °C (the discrete inductor) to 64.8 °C (a reduction of 37%) and the efficiency is improved 2% over the discrete solution at the full load.
keywords: {duality (mathematics);inductors;resonant power convertors;resonant SEPIC converter;rectifier stage;circuit duality theory;loss analysis;PCB embedded inductors;discrete inductor;planar spiral inductor;four-layered solenoid PCB inductor;frequency 30 MHz;voltage 15 V;power 25 W;voltage 28 V;efficiency 82.5 percent;temperature 102.6 C;temperature 64.8 C;Rectifiers;Inductors;Design methodology;Topology;Density measurement;Power system measurements;Inverters;Very High Frequency;resonant dc-dc converter;SEPIC converter;resonant gate driver;PCB inductors;air core inductor;class E inverter;resonant rectifier;Air core inductor;class E inverter;PCB inductors;resonant dc–dc converter;resonant gate driver;resonant rectifier;SEPIC converter;very high frequency},
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Abstract: Exposure to polychlorinated biphenyals (PCBs) is hazardous to human health. The United Nations Environment Programme has decreed that nations, including Canada and USA, must eliminate PCB contaminated equipment such as transformers by 2025. To determine the PCB status of a transformer with absolute certainty, the oil mixture of the transformer must be sampled because transformers labeled as non-PCB could be cross-contaminated. Since sealed oil mixture sampling is costly, for the first time, we apply an iterative machine learning technique called active learning to classify PCB contaminated transformers while minimizing a cost metric that integrates the classification error cost and the sampling cost. We propose a dynamic sampling method to address two key issues in active learning: the sampling size per iteration and the stopping criterion of the sampling process. The proposed algorithm is evaluated using the real-world datasets from BC Hydro in Canada.
keywords: {hazardous materials;iterative methods;learning (artificial intelligence);mixtures;power engineering computing;printed circuits;sampling methods;transformer oil;PCB contaminated transformers;active learning;polychlorinated biphenyals;human health;hazards;United Nations Environment Programme;Canada;USA;PCB contaminated equipment;PCB status;cross-contamination;sealed oil mixture sampling;classification error cost;sampling cost;dynamic sampling method;stopping criterion;sampling process;real-world datasets;BC hydro;Active learning;polychlorinated biphenyals (PCBs);sampling;transformer},
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keywords: {integrated circuit packaging;printed circuits;S-parameters;power switching current estimation;chip-package-PCB cosimulation;printed circuit boards;timing controller chip macromodel;pseudo H-pattern data;transistor-level simulations;passive impedance network;power delivery network models;RLCG netlist;S-parameter touch stone files;resonance frequency;power switching current;harmonic frequency;frequency 20 MHz;frequency 80 MHz;Integrated circuit modeling;Semiconductor device measurement;Switches;Impedance;Impedance measurement;Electromagnetic interference;Automotive;cosimulation;electromagnetic interference (EMI);impedance;integrated circuit (IC);IC emission model (ICEM);macromodel;power integrity (PI);power noise transfer function;power switching current;printed circuit board (PCB);timing controller (T-con) chip},
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Abstract: The effect of conductor spacing and applied voltage on the insulation performance of printed circuit board (PCB) has been investigated under temperature-humidity-bias (THB) conditions in this paper. Based on the electrochemical migration failure mechanism, this paper proposes an accelerated statistical model, which includes a life-stress relationship model and a life distribution model. The accelerated statistical model can effectively quantify the effect of concurrent conductor spacing and applied voltage on the characteristic life of the PCB. Because THB test can produce less life data in limited test period, an accelerated degradation theory is applied for the modeling research. In addition, a methodology on how to verify the accelerated statistical model for the CNC PCB is introduced. In the case of small samples, the least square regression method is applied for parameter calculation due to its high precision. Furthermore, the residual analysis is carried out to check the fitting effect. The results show that the accelerated statistical model can describe the life characteristics of CNC PCBs preferably under the comprehensive action of conductor spacing stress and applied voltage stress.
keywords: {electromigration;least squares approximations;life testing;printed circuit testing;regression analysis;reliability analysis;accelerated statistical model;CNC PCB;insulation performance;printed circuit board;temperature-humidity-bias condition;electrochemical migration failure mechanism;life-stress relationship model;life distribution model;concurrent conductor spacing;accelerated degradation theory;least square regression method;residual analysis;fitting effect;conductor spacing stress;applied voltage stress;Electronic

countermeasures;Conductors;Computer numerical control;Degradation;Power supplies;Insulation;Humidity;Accelerated statistical model;CNC printed circuit board (PCB);electrochemical migration (ECM);insulation performance degradation;life data analysis},
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Abstract: In this paper, a compact filter based on substrate integrated coaxial line (SICL) stubs was designed using an advanced multilayer printed circuit board (PCB) substrate. This technology is convenient to implement high-density interconnect (HDI) devices, which are dedicated to mass market and require to be compact and low cost. In addition, in order to avoid parasitic effects, HDI devices need to be shielded. The laser-drilled microvias used in the low-loss advanced multilayer PCB are the assets that allow the fabrication of compacted and shielded microwave filters. Using this technology, a third-order X-band filter based on SICL stubs was designed. The SICL topology is convenient to be used for shielded devices thanks to the outer-grounded metallization. The filter was implemented in an advanced PCB substrate composed of seven layers of Megtron 6+. The via-holes fabricated with plated through holes or laser-drilled microvias allow implementing SICL stubs throughout the thickness of the substrate. Measurements of the X-band filter are in a good agreement with the simulation. In comparison with other compact filters, the X-band filter based on SICL stubs has a good footprint reduction while maintaining good electrical performances.
keywords: {electromagnetic shielding;microwave filters;printed circuit interconnections;vias;X-band filter;substrate integrated coaxial line stubs;SICL stubs;advanced multilayer printed circuit board substrate;advanced multilayer PCB technology;high-density interconnect devices;HDI devices;laser-drilled microvias;compacted microwave filters;shielded microwave filters;outer-grounded metallization;Megtron 6+;via-holes;Substrates;Nonhomogeneous media;Metallization;Microwave filters;Microwave circuits;High-density interconnect (HDI);microwave devices;microwave filters;multilayer technology;printed circuit board (PCB) technology;substrate integrated coaxial line (SICL)},
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Abstract: Rogowski coil is used as a current transducer in complex electromagnetic environment, whose anti-interference property bears on the accuracy of the current measurement. Based on the ordinal straight-coupled foils of the current PCB Rogowski coil, this paper proposes a newly designed PCB Rogowski coil with symmetrical double-printed imprints and returning turn to gain better precision and performance. The mutual inductance between the coil and the primary conductor is chosen as the sensitivity parameter to contrastively analyze the anti-interference property of three coils, including the ordinary straight-coupled coil, the symmetrically printed coil with or without returning turn. The calculation and measurement of mutual inductance have been made under different disturbed conditions, such as the eccentricity from axis of the primary conductor and the influence of external parallel and perpendicular currents. The results indicate that the newly designed PCB Rogowski coil with symmetric imprints and returning turn is good in compatibility, strong in anti-interference property, and also accurate and steady in mutual inductance. Therefore, it is suitably applied as the sensing head of current measurement in the complex stray electromagnetic fields.
keywords: {coils;conductors (electric);interference suppression;PCB Rogowski coil;antiinterference

property;transducer;complex electromagnetic environment;straight-coupled foils;symmetrical double-printed imprints;primary conductor;symmetrically printed coil;symmetric imprints;mutual inductance;complex stray electromagnetic fields;Inductance;Conductors;Wiring;Current measurement;Windings;Transducers;Anti-interference property;electromagnetic parameters;mutual inductance;PCB Rogowski coil;precise returning turn;symmetrical double-printed imprints},
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keywords: {CAD/CAM;manufacturing computer control;printed circuit manufacture;printed circuits;standards;PCB manufacture;PCB design;integration standards;information technology;electronic equipment;computer integrated manufacturing;CIM;standards;communication;data representation},
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keywords: {printed circuits;conductors (electric);electromagnetic wave propagation;electric fields;finite difference time-domain analysis;electronic engineering education;electric fields prediction;conductor electric fields;PCB;3D finite-difference time-domain method;FDTD method;electromagnetic wave propagation;university final-year projects;Printed circuits;Conductors;Electromagnetic propagation;Electric fields;FDTD methods;Electronics engineering education},
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keywords: {coupled transmission lines;current distribution;inductance;printed circuits;S-parameters;coupled transmission lines;current-distribution dependent inductance;PCB;RLGC model;printed circuit board technology;common signal propagation modes;differential signal propagation modes;series inductance;S-parameters;Inductance;Integrated circuit modeling;Time-

domain analysis;Data models;Frequency-domain analysis;Transmission line measurements;Mathematical model;Current distribution and series inductance;differential interconnect;mixed-mode model},
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Abstract: Crosstalk among interconnects and printed-circuit board (PCB) traces is a major limiting factor of signal quality in high-speed digital and communication equipment. The paper evaluates coupled surface microstrip transmission lines with periodical loading and coupling. The situation may represent stray coupling and loading of digital buses due to connector pins, plated through holes at connector slots, and stubs as well as the input capacitance of active devices. This paper shows that discrete periodical coupling along coupled surface microstrip transmission lines may be used to reduce far-end crosstalk. An expression is given to calculate the discrete coupling capacitance to achieve optimum far-end crosstalk reduction. The reduction of far-end crosstalk is verified by measurements, and the good agreement between the simulated and measured data is shown. On the other hand, discrete loading does not significantly reduce near-end crosstalk, but will introduce additional ringing in the time domain.<<ETX>>
keywords: {microstrip lines;crosstalk;electric noise measurement;lumped parameter networks;microstrip components;waveguide couplers;printed circuit accessories;printed circuit testing;circuit analysis computing;frequency-domain analysis;time-domain analysis;interference suppression;simulation;crosstalk reduction;discrete discontinuities;coupled PCB traces;printed-circuit board;signal quality;high-speed communication equipment;digital communication equipment;coupled surface microstrip transmission lines;periodical loading;discrete periodical coupling;stray coupling;digital buses;connector pins;measurement;discrete coupling capacitance;far-end crosstalk reduction;discrete loading;near-end crosstalk;ringing;time domain;Crosstalk;Transmission line measurements;Capacitance;Capacitors;Inductance;Impedance;Frequency;Circuit testing;Coupling circuits;Microstrip},
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keywords: {printed circuits;integrated circuit noise;switching circuits;simultaneous switching noise mitigation;PCB;cascaded high-impedance surfaces;ultra-wide-bandwidth suppression;high-speed printed circuit boards;different stop bands},
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results based on two signal recovery methods, the impulse sampling method and the integrate-sample-and-dump method, are generated to aid printed circuit board (PCB) design for high-frequency applications.
keywords: {printed circuit design;microstrip lines;digital signals;signal sampling;error statistics;digital circuits;EM coupling;interline coupling effects;bit error rate;high-speed digital signal propagation;PCB;parallel microstrip lines;signal recovery methods;impulse sampling method;integrate-sample-and-dump method;printed circuit board design;high-frequency applications;BER;Bit error rate;Microstrip;Coupling circuits;Sampling methods;Printed circuits;Frequency;Bit rate;Signal generators;Signal design;Electromagnetic coupling},
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keywords: {antenna feeds;dipole antenna arrays;printed circuits;slot antenna arrays;PCB slot based transformer;common mode resonances;connected dipole array;balanced feeding lines;printed circuit board;transmit-receive modules;Transformers;Resonance;Phased arrays;Bandwidth;Antenna arrays;Slot antennas;Printed circuits;Sampling methods;Dipole antennas;Antenna accessories;Microstrip components;phased arrays;slot fed antennnas;ultrawideband antennas},
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keywords: {data communication;optical interconnections;optical links;optical waveguides;laser beam applications;printed circuits;gallium arsenide;III-V semiconductors;surface emitting lasers;quantum well lasers;error statistics;Gbit/s data transmission;GaAs VCSELs;PCB integrated polymer waveguides;quantum-well-based VCSEL;QW-based VCSEL;vertical-cavity lasers;surface-emitting lasers;intraboard polymer waveguide links;pseudorandom bit sequence;nonreturn-to-zero data transmission;NRZ data transmission;printed circuit board;integrated multinode polymer waveguide arrays;bit-error rates;BER;3 Gbit/s;855 nm;5 cm;GaAs;Data communication;Gallium arsenide;Vertical cavity surface emitting lasers;Polymers;Quantum well lasers;Surface waves;Surface emitting lasers;Waveguide lasers;Optical signal processing;Printed circuits},
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keywords: {multifrequency antennas;microstrip antenna arrays;monopole antenna arrays;mobile handsets;mobile antennas;automotive antenna;mobile telephone band;printed antenna;PCB;printed circuit board;circuit component;antenna tuning;quarter-wave monopole antenna},
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keywords: {baluns;microstrip couplers;microwave phase shifters;printed circuits;power dividers;wide-band microstrip planar balun;single-layer PCB;wide-band Wilkinson power divider;broad-band phase shifter;10 dB;1.7 to 3.3 GHz;Wideband;Impedance matching;Loss measurement;Microstrip;Printed circuits;Power dividers;Phase shifters;Design methodology;Prototypes;Circuit simulation;Balun;planar;broadband 180;wideband;Wilkinson power divider},
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keywords: {printed circuit manufacture;copper;current density;metallisation;electroplating;vibrations;cathodes;pulse plating parameters;Cu plating

distribution;PCB manufacture;microvias;printed circuit boards;high-density circuitry;shaped waveforms;reverse current cycle time;throwing power;cathode vibrating;Cu;Copper;Printed circuits;Dielectric substrates;Metallization;Dielectric liquids;Pulse shaping methods;Laser ablation;Current density;Manufacturing industries;Cathodes},
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keywords: {photonic band gap;printed circuits;strip lines;stack up cross section;noise isolation;parallel GND planes;differential striplines;single ended striplines;signal transmission performance;signal integrity;high speed digital printed circuit boards;multilayer PCB;embedded electromagnetic band gap structure;practical EBG application;Metamaterials;Biomedical signal processing;Photonic band gap;Printed circuits;Electromagnetic compatibility;printed circuit boards;signal integrity;electromagneticband gap structures},
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keywords: {software reliability;software packages;circuit CAD;electromagnetic compatibility;printed circuit design;reliable prediction;EM radiation;PCB;design stage;electronic equipment;composite computer-aided design;CCAD package;printed circuit board;EM computation tool;numerical electromagnetic code-2;NEC-2;circuit design packages;reliability;Electromagnetic radiation;Electronic equipment;Electromagnetic compatibility;Consumer electronics;Electronics packaging;Hardware;Electromagnetic interference;Packaging machines;Design automation;Printed circuits},
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Abstract: A kind of low-profile substrate integrated dielectric resonator antenna (SIDRA) is proposed and experimentally verified at millimeter-wave (mmW) bands. The antenna is implemented with a two-layer printed circuit board (PCB) process, in which the integrated dielectric resonate radiator is fabricated in the top layer with moderate permittivity, which is fed by substrate integrated waveguide (SIW) implemented in the bottom layer with low permittivity

through a coupling slot. The evolution of the SIDRA is illustrated based on the investigation of the effective permittivity of the perforated substrate. The design schemes, procedures, and simulation models are discussed in detail. Good agreement between the measurements and simulations verifies the effectiveness and feasibility of the design methodology. The proposed SIDRA shows the advantages of low profile, low cost, easy manufacture for specific-shaped DRA, high radiation efficiency, and convenient integration with other planar circuits.
keywords: {dielectric resonator antennas;millimetre wave antennas;permittivity;printed circuits;substrate integrated waveguides;low-profile substrate integrated dielectric resonator antenna;PCB process;SIDRA;millimeter-wave band;mmW band;two-layer printed circuit board process;integrated dielectric resonate radiator;permittivity;substrate integrated waveguide;SIW;coupling slot;specific-shaped DRA;radiation efficiency;planar circuit;Dielectric resonator antennas;Substrates;Dielectrics;Permittivity;Antenna measurements;Atmospheric modeling;Dielectric measurement;Dielectric resonator antenna (DRA);millimeter-wave antenna;substrate integrated dielectric resonator antenna (SIDRA);substrate integrated waveguide (SIW)},
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keywords: {printed circuit manufacture;printed circuit boards;visual inspection system;PCB manufacture;false rejection;laminate inclusions;contamination;tadpoles;burnt resin;metal;scanning electron microscope;energy disperse x-ray analysis},
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keywords: {disc drives;hard discs;air gaps;small electric machines;printed circuits;machine windings;torque;motor drives;axial-gap spindle motor;computer hard disk drives;PCB winding;dual air gaps;high efficiency;printed circuit board winding;mechanical rigidity;zero cogging torque;Hard disks;Forging;Torque;Air gaps;Magnetic forces;Teeth;Iron;Printed circuits;Computer aided manufacturing;Coils},
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Abstract: This paper presents a fine modeling method for power module used in an Electric or Hybrid Vehicle (EHV) application. A time domain model is developed in order to predict conducted emissions. All parasitic elements of the power components constituting the power module are obtained by modeling, measuring or applying analytical formula. The influence of the Printed Circuit Board (PCB) and the connections of components on conducted emissions levels are shown here. The results obtained by the proposed models are compared with measurements results.
keywords: {electromagnetic compatibility;hybrid electric vehicles;power electronics;printed circuits;time-domain analysis;PCB influence;electromagnetic conducted emission;power module;EHV application;time domain model;parasitic element;power component;printed circuit board;hybrid electric vehicle;Synchronous motors;Electromagnetic compatibility;Electromagnetic interference;Integrated circuit modeling;Semiconductor device modeling;Impedance;Permanent magnet motors;CISPR 25;conducted emission;electric vehicle;parasitic elements},
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Abstract: A novel integration method for the production of cost-effective optoelectronic printed circuit boards (OE PCBs) is presented. The proposed integration method allows fabrication of OE PCBs with manufacturing processes common to the electronics industry while enabling direct attachment of electronic components onto the board with solder reflow processes as well as board assembly with automated pick-and-place tools. The OE PCB design is based on the use of polymer multimode waveguides, end-fired optical coupling schemes, and simple electro-optic connectors, eliminating the need for additional optical components in the optical layer, such as micro-mirrors and micro-lenses. A proof-of-concept low-cost optical transceiver produced with the proposed integration method is presented. This transceiver is fabricated on a low-cost FR4 substrate, comprises a polymer Y-splitter together with the electronic circuitry of the transmitter and receiver modules and achieves error-free 10-Gb/s bidirectional data transmission. Theoretical studies on the optical coupling efficiencies and alignment tolerances achieved with the employed end-fired coupling schemes are presented while experimental results on the optical transmission characteristics, frequency response, and data transmission performance of the integrated optical links are reported. The demonstrated optoelectronic unit can be used as a front-end optical network unit in short-reach datacommunication links.
keywords: {coupled circuits;integrated optoelectronics;optical transceivers;optical waveguides;printed circuit design;printed circuit manufacture;solders;low-cost PCB-integrated optical transceiver;integration method;cost-effective optoelectronic printed circuit board production;cost-effective OE PCB production;OE PCB design;OE PCB fabrication;electronics industry;electronic components;automated pick-and-place tools;solder reflow processes;polymer multimode waveguides;end-fired optical coupling schemes;electrooptic connectors;optical layer;optical components;micromirrors;microlenses;proof-of-concept low-cost optical transceiver;low-cost FR4 substrate;polymer V-splitter;electronic circuitry;receiver modules;transmitter modules;error-free bidirectional data transmission;optical coupling efficiencies;alignment tolerances;employed end-fired coupling schemes;optical transmission characteristics;frequency response;integrated optical links;front-end optical network unit;short-reach data communication links;bit rate 10 Gbit/s;Optical waveguides;Optical device fabrication;Connectors;Optical coupling;Optical receivers;High speed optical techniques;Couplings;Integrated optoelectronics;optical interconnections;optical

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keywords: {circuit layout CAD;knowledge based systems;LISP;planning (artificial intelligence);printed circuit design;printed circuit manufacture;PCB manufacturing;AI-based rule checker;manufacturing design rule checker;path optimizer;PCB production preparation;manufacturing-design-rule checking;path optimization;production control;hierarchy reference model;Y-model;manufacturing design system;integrated system;PCB assembly;AI-language Common LISP;SCHEME dialect;optimizing procedure;hierarchical two-phase cross-linked unit formation;head-collision check;Design optimization;Production control;Manufacturing automation;Manufacturing processes;Computer aided manufacturing;Computer numerical control;Control systems;NIST;Automatic control;Production systems},
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Abstract: This paper presents a novel platform for the formation of cost-effective PCB-integrated optical waveguide sensors. The sensor design relies on the use of multimode polymer waveguides that can be formed directly on standard PCBs and commercially-available chemical dyes, enabling the integration of all essential sensor components (electronic, photonic, chemical) on low-cost substrates. Moreover, it enables the detection of multiple analytes from a single device by employing waveguide arrays functionalised with different chemical dyes. The devices can be manufactured with conventional methods of the PCB industry, such as solder-reflow processes and pick-and-place assembly techniques. As a proof of principle, a PCB-integrated ammonia gas sensor is fabricated on a FR4 substrate. The sensor operation relies on the change of the optical transmission characteristics of chemically functionalised optical waveguides in the presence of ammonia molecules. The fabrication and assembly of the sensor unit, as well as fundamental simulation and characterisation studies, are presented. The device achieves a sensitivity of approximately 30 ppm and a linear response up to 600 ppm at room temperature. Finally, the potential to detect multiple analytes from a single device is demonstrated using principal-component analysis.
keywords: {assembling;dyes;gas sensors;integrated optics;optical sensors;optical waveguides;principal component analysis;printed circuit manufacture;reflow soldering;PCB-integrated optical waveguide sensors;multimode polymer waveguides;chemical dyes;sensor components;low-cost substrates;waveguide arrays;PCB industry;solder-reflow processes;pick-and-place assembly techniques;PCB-integrated ammonia gas sensor;FR4 substrate;sensor

operation;optical transmission characteristics;chemically functionalised optical waveguides;ammonia molecules;sensor unit;principal-component analysis;Optical waveguides;Optical sensors;Optical device fabrication;Polymers;Optical surface waves;Biomedical optical imaging;Ammonia sensors;optical sensors;optoelectronic integration;polymer waveguides},
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Abstract: Analog-to-digital converter (ADC) is becoming of utmost importance in an automotive environment. With the increased number of magnetic field sources near the ADC that can alter its behaviors significantly, we need to model how magnetic field affects the performance of the ADC. Therefore, in order to accurately evaluate the practical performance of the ADC and the considerable off-chip and on-chip effects that are highly complex, the chip-printed circuit board (PCB) comodeling, cosimulation, and coanalysis are required. In this study, a comodel of the magnetic field effects on an ADC is proposed. The proposed comodel includes three separate submodels: a model of the magnetic field coupling from the wireless power transfer (WPT) system input to the PCB integrated with ADC, a model of the noise coupling from the PCB to the ADC input, and a model of the ADC behavior from the ADC input to the ADC outputs. Considering the magnetic field coupling from the magnetic field source to the PCB, a new inductive transmission line model (I-TLM) method is developed. This method achieves fast, precise, and broadband estimation of the magnetic field effects in comparison to previous estimation methods. To validate the proposed comodel, an ADC is fabricated using a 0.13-μm complementary metal-oxide semiconductor process and is wire-bonded to the designed PCB for ADC. A PCB-level WPT system is designed and built as the magnetic field source. The performance factor of the ADC is measured by sweeping the WPT system input frequency from 100 kHz to 1 GHz to find out the critical WPT system frequency for the designed ADC with the chip-PCB hierarchical structure. The results estimated by the proposed model correlate well with the full 3-D electromagnetic field simulation and measurement. The proposed modeling procedure reduces the time and computation resource in the design of the chip, package, and PCB to achieve high-quality analog devices or mixed-mode systems, while also providing an intuitive understanding of the radiated noise effect.
keywords: {analogue-digital conversion;circuit simulation;CMOS digital integrated circuits;inductive power transmission;integrated circuit noise;magnetic field effects;printed circuit design;radiofrequency power transmission;noise coupling effects;CMOS analog-to-digital converter;magnetic field wireless power transfer system;chip-PCB comodeling;ADC;automotive environment;magnetic field sources;on-chip effects;off-chip effects;chip-printed circuit board comodeling;magnetic field effects;magnetic field coupling;WPT system;inductive transmission line model;I-TLM method;broadband estimation;complementary metal-oxide semiconductor process;wire-bonding;chip-PCB hierarchical structure;full 3D electromagnetic field simulation;high-quality analog devices;mixed-mode systems;radiated noise effect;size 0.13 mum;frequency 100 kHz to 1 GHz;Couplings;Noise;Coils;Magnetic separation;System-on-chip;Inductance;Wires;Analog–digital conversion;electromagnetic radiative interference;magnetic noise;transmission line modeling;wireless power transfer (WPT);Analog–digital conversion;electromagnetic radiative interference;magnetic noise;transmission line modeling;wireless power transfer (WPT)},
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