

ELECTRONICS LETTERS

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CONTENTS

pages 1 - 96

7th January 1999 Vol. 35 No. 1

	page		page
ANTENNAS		Efficient complexity reduction technique in trellis decoding algorithm	16
Accurate modelling of anti-resonant dipole antennas using the method of moments	1	Sooyoung Kim Shin and Soo In Lee (<i>Korea</i>)	
D.H. Werner and R.J. Allard (<i>USA</i>)		Extended complex RBF and its application to M-QAM in presence of co-channel interference	17
Dual-polarised uniplanar conical-beam antennas for HIPERLAN	2	Ki Yong Lee and Souhwan Jung (<i>Korea</i>)	
E.M. Ibrahim, N.J. McEwan, R.A. Abd-Alhameed and P.S. Excell (<i>United Kingdom</i>)		Fair queueing algorithm with rate independent delay for ATM networks	19
		S. Ho, S. Chan and K.T. Ko (<i>Hong Kong</i>)	
CIRCUIT THEORY & DESIGN		Integrated space-time equaliser for DS/CDMA receiver with unequal reduced lengths	20
Analogue CMOS high-frequency continuous wavelet transform circuit	4	V.D. Pham and T.B. Vu (<i>Australia</i>)	
E.W. Justh and F.J. Kub (<i>USA</i>)		Investigation of sensor failure with respect to ambiguities in linear arrays	22
Apparent power transducer for three-phase three-wire system	5	V. Lefkaditis and A. Manikas (<i>United Kingdom</i>)	
S. Kusui and M. Kogane (<i>Japan</i>)		Learning algorithms for minimum cost, delay bounded multicast routing in dynamic environments	24
Efficient and fast iterative reweighted least-squares nonrecursive filters	7	J. Reeve, P. Mars and T. Hodgkinson (<i>United Kingdom</i>)	
Yue-Dar Jou, Chaur-Heh Hsieh and Chung-Ming Kuo (<i>Taiwan</i>)		Multiple target tracking using constrained MAP data association	25
Input switch configuration suitable for rail-to-rail operation of switched opamp circuits	8	Hong Jeong and Jeong-Ho Park (<i>Korea</i>)	
M. Dessouky and A. Kaiser (<i>France</i>)		Passband flattening and broadening techniques for high spectral efficiency wavelength demultiplexers	27
Unified model of PWM switch including inductor in DCM	10	E.G. Churin and P. Bayvel (<i>United Kingdom</i>)	
Sung-Soo Hong (<i>Korea</i>)		Performance of CDMA/PRMA protocol for Nakagami-<i>m</i> frequency selective fading channel	28
		R.P.F. Hoefel and C. de Almeida (<i>Brazil</i>)	
COMMUNICATIONS & SIGNAL PROCESSING		Tbit/s switching scheme for ATM/WDM networks	30
Adaptive multiwavelet prefilter	11	J. Nir, I. Elhanany and D. Sadot (<i>Israel</i>)	
Yang Xinxing and Jiao Licheng (<i>China</i>)			
Decision feedback equalisation of coded I-Q QPSK in mobile radio environments	13		
A. Adinoyi, S. Al-Semari and A. Zerguine (<i>Saudi Arabia</i>)			
Detection algorithm and initial laboratory results using V-BLAST space-time communication architecture	14		
G.D. Golden, C.J. Foschini, R.A. Valenzuela and P.W. Wolniansky (<i>USA</i>)			

(continued on back cover)

THE INSTITUTION OF ELECTRICAL ENGINEERS

CONTENTS

(continued from front cover)

	page		page
ELECTROMAGNETIC WAVES			
Electromagnetic penetration into 2D multiple slotted rectangular cavity: TE-wave	31	Near room-temperature continuous-wave operation of electrically pumped 1.55 μ m vertical cavity lasers with InGaAsP/InP bottom mirror	49
H.H. Park and H.J. Eom (Korea)			
IMAGE PROCESSING			
Encoding edge blocks by partial blocks of codevectors in vector quantisation	32	S. Rapp, F. Salomonsson, J. Bentell (Sweden), I. Sagnes, H. Moussa, C. Mériaud, R. Raj (France), K. Streubel and M. Hammar (Sweden)	
Hui-Hsun Huang, Cheng-Wen Ko and Chien-Ping Wu (Taiwan)		Record high characteristic temperature ($T_0 = 122$ K) of 1.55 μ m strain-compensated AlGaInAs/AlGaInAs MQW lasers with AlAs/AlInAs multiquantum barrier	51
Technique for accurate correspondence estimation in object borders and occluded image regions	34	N. Ohnoki, G. Okazaki, F. Koyama and K. Iga (Japan)	
E. Izquierdo M. (United Kingdom)			
INFORMATION THEORY			
Analysis of turbo codes with asymmetric modulation	35	Red light generation by sum frequency mixing of Er/Yb fibre amplifier output in QPM LiNbO ₃	52
Young Min Choi and Pil Joong Lee (Korea)			
Improved group signature scheme based on discrete logarithm problem	37	D.L. Hart, L. Goldberg and W.K. Burns (USA)	
Yuh-Min Tseng and Jinn-Ke Jan (Taiwan)			
Low density parity check codes with semi-random parity check matrix	38	MICROWAVE GUIDES & COMPONENTS	
Li Ping, W.K. Leung (Hong Kong) and Nam Phamdo (USA)			
Non-binary convolutional codes for turbo coding	39	Lumped DC-50GHz amplifier using InP/InGaAs HBTs	53
C. Berrou and M. Jézéquel (France)			
INTEGRATED OPTOELECTRONICS			
46GHz bandwidth monolithic InP/InGaAs pin/SBHT photoreceiver	40	A. Huber, D. Huber, C. Bergamaschi, T. Morf and H. Jäckel (Switzerland)	
D. Huber, M. Bitter, T. Morf, C. Bergamaschi, H. Melchior and H. Jäckel (Switzerland)			
LASERS			
1.5 μ m InGaAlAs-strained MQW ridge-waveguide laser diodes with hot-carrier injection suppression structure	41	RF tunable attenuator and modulator using high T _c superconducting filter	55
H. Fukano, Y. Noguchi and S. Kondo (Japan)			
9.5W CW output power from high brightness 980nm InGaAs/AlGaAs tapered laser arrays	43	Lu Jian, Tan Chin Yaw, C.K. Ong and Chew Siou Teck (Singapore)	
F.J. Wilson, J.J. Lewandowski, B.K. Nayar, D.J. Robbins, P.J. Williams, N. Carr and F.O. Robson (United Kingdom)			
Investigation of data transmission characteristics of polarisation-controlled 850nm GaAs-based VCSELs grown on (311)B substrates	45	NEURAL NETWORKS	
H. Uenohara, K. Tateno, T. Kagawa, Y. Ohiso, H. Tsuda, T. Kurokawa and C. Amano (Japan)			
Low current and highly reliable operation at 80°C of 650nm 5mW LDs for DVD applications	46	Compact building blocks for artificial neural networks	56
M. Ohya, H. Fujii, K. Doi and K. Endo (Japan)			
Modelocked distributed Bragg reflector laser	48	M. Meléndez-Rodríguez and J. Silva-Martínez (Mexico)	
H. Fan, N.K. Dutta, U. Koren, C.H. Chen and A.B. Piccirilli (USA)			
OPTICAL COMMUNICATIONS			
		40Gbit/s single channel dispersion managed pulse propagation in standard fibre over 509km	57
		S.B. Alleston, P. Harper, I.S. Penketh, I. Bennion and N.J. Doran (United Kingdom)	
		All-optical 2R regeneration based on interferometric structure incorporating semiconductor optical amplifiers	59
		D. Wolfson, P.B. Hansen, A. Kioch and K.E. Stubkjaer (Denmark)	
		Demonstration of time interweaved photonic four-channel WDM sampler for hybrid analogue-digital converter	60
		J.U. Kang and R.D. Esman (USA)	
		Design of short dispersion decreasing fibre for enhanced compression of higher-order soliton pulses around 1550nm	61
		M.D. Pelusi, Y. Matsui and A. Suzuki (Japan)	
		Experimental measurement of group velocity dispersion in photonic crystal fibre	63
		M.J. Gander, R. McBride, J.D.C. Jones, D. Mogilevtsev, T.A. Birks, J.C. Knight and P.St.J. Russell (United Kingdom)	

(continued on inside back cover)

CONTENTS

(continued from back cover)

Experimental observation of soliton robustness to polarisation dispersion pulse broadening B. Bakhshi, J. Hansryd, P.A. Andrekson, J. Brentel, E. Kolltveit, B.-E. Olsson and M. Karlsson (<i>Sweden</i>)	page 65	Low-cost microlens array for long-period grating fabrication S.Y. Liu, H.Y. Tam and M.S. Demokan (<i>Hong Kong</i>)	page 79
Frequency downconverter for high-capacity fibre grating based beamformers for phased arrays K.E. Alameh (<i>Australia</i>)	66	Widely tunable long-period fibre gratings A.A. Abramov, A. Hale, R.S. Windeler and T.A. Strasser (<i>USA</i>)	81
Helical WDM ring network architecture H. Obara and K. Aida (<i>Japan</i>)	67	OPTOELECTRONICS	
Optimisation of dispersion-induced power penalty mitigation in millimetre-wave fibre optic links J.M. Fuster, J. Marti, J.L. Corral, V. Polo and F. Ramos (<i>Spain</i>)	69	Large-signal compression-current measurements in high-power microwave pin photodiodes K.J. Williams and R.D. Esman (<i>USA</i>)	82
Polarisation-independent all-optical circulating shift register based on self-phase modulation of semiconductor optical amplifier Hyuek Jae Lee and Hae Geun Kim (<i>Korea</i>)	70	Numerical solution of time-dependent coupled-wave equations using split-step algorithm Byoung-Sung Kim and Youngchul Chung (<i>Korea</i>)	84
Polarisation independent all-optical demultiplexing using four wave mixing in dispersion shifted fibre R. Calvani, F. Cisternino, R. Girardi and E. Riccardi (<i>Italy</i>)	72	SEMICONDUCTOR DEVICES & MATERIALS	
Scaling limitations in full-mesh WDM ring networks using arrayed-waveguide grating OADMs J.J.O. Pires (<i>Portugal</i>), M. O'Mahony, N. Parnis and E. Jones (<i>United Kingdom</i>)	73	High-f_T n-MODFETs fabricated on Si/SiGe heterostructures grown by UHV-CVD S.J. Koester, J.O. Chu and R.A. Groves (<i>USA</i>)	86
Single-wavelength 40Gbit/s soliton field transmission experiment over 400km of installed fibre E. Kolltveit, P.A. Andrekson, J. Brentel, B.E. Olsson, B. Bakhshi, J. Hansryd, P.O. Hedekvist, M. Karlsson, H. Sunnerud and J. Li (<i>Sweden</i>)	75	ULTRASONICS	
Ultra-high speed soliton transmission in presence of polarisation mode dispersion using in-line synchronous modulation A. Sahara, H. Kubota and M. Nakazawa (<i>Japan</i>)	76	Algorithm for robot position tracking using ultrasonics W.T. Kuang and A.S. Morris (<i>United Kingdom</i>)	87
OPTICAL FIBRES & SENSORS		Higher-order time-varying allpass filters for signal decorrelation in stereophonic acoustic echo cancellation N. Tansangiumvisai, J.A. Chambers and A.G. Constantinides (<i>United Kingdom</i>)	88
Injection moulded plastic ferrules for singlemode optical fibre connections S. Yanagi, H. Sato, Y. Shuto, M. Ohno and S. Tohno (<i>Japan</i>)	78	Monitoring of crystallisation phenomena by ultrasound J.S. Tebbutt, T. Marshall and R.E. Challis (<i>United Kingdom</i>)	90
		Errata	91

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the bandpass filters and their centre frequency spacings are about 650kHz.

Fig. 3 shows the time-frequency plot for a (slowly) frequency-swept input signal. In Fig. 3, where black represents the peak output voltage for each channel, there is good frequency discrimination as the input frequency sweeps over the frequency range of the filter bank. Fig. 4 shows the time-domain response of a single 0.5µm CMOS channel to a 100mV_{pp}, 300ns burst at 47MHz.

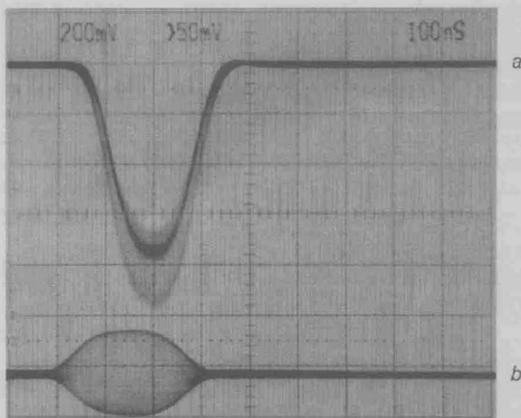


Fig. 4 Time-domain response of single 0.5µm CMOS channel

a Output signal (200mV/div)
b Input signal (50mV/div)

The order of the lowpass filter in the synchronous receiver determines the bandpass filter characteristic. A single-pole lowpass filter design is easily converted to a two-pole design by adding a capacitor across the differential outputs of the multiplier that drives the lowpass filter. The two-pole lowpass filter design has much steeper skirts, and hence better separation of signals with different frequencies. In Fig. 3, the bandpass filter shape corresponds to the two-pole lowpass filter design.

Since increasing the number of channels can be used to increase system performance, size and power dissipation constraints are important for a continuous wavelet transform circuit. For the 2µm design, the channels were laid out on a 150µm pitch with under 100mW power dissipation per channel and a maximum operating frequency of 50MHz. For the 0.5µm design, the channels were laid out on a 56µm pitch with under 40mW power dissipation per channel and a maximum operating frequency in excess of 100MHz. The total size of the 16-channel 2µm chip was 4750µm by 3100µm.

The VCO design is particularly critical, since the VCO needs to have a constant, frequency-independent output voltage, and also needs to be tunable over as large a frequency range as possible. Our VCO design uses diodes to set the output amplitude, triode MOSFET resistors to change the oscillation frequency, and bias current adjustment slaved to the triode resistor setting to compensate for the change in loop gain associated with changing the triode resistor values.

To prevent drifts in the VCO frequencies with changes in temperature, phase-locked loops and external frequency references can be used, as shown in Fig. 1. Where the VCO voltage-frequency characteristic is linear, many VCOs can be biased using a pair of PLLs along with a resistive voltage divider. The PLLs have been successfully implemented, but not yet combined with the continuous wavelet transform circuit. We have demonstrated a 0.5µm CMOS PLL tunable from 64MHz to 77MHz.

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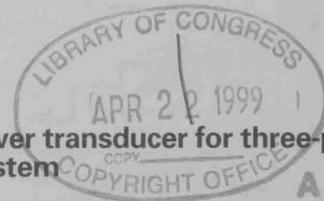
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ELECTRONICS LETTERS 7th January 1999 Vol. 35 No. 1

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Apparent power transducer for three-phase three-wire system

S. Kusui and M. Kogane

In a newly developed transducer apparent power is measured by using a multiplier, in which the AC component of the output is used. For a three-phase three-wire system, two multipliers are used according to the so-called 'two wattmeter' method. The AC output components are +30° and -30° phase-shifted, respectively, and then the difference is converted to a DC signal which corresponds to the total apparent power.

Introduction: Measurement of electrical apparent power is sometimes necessary in order to take into account the power factor as well as the energy in in the case of large consumers. Various apparent power meters have been developed [1-6] using such methods as multiplication of the RMS values of the voltage and the current, or taking the root of the squared sum of the active and reactive powers. An apparent power meter which directly uses the above definition is complicated because RMS AC/DC converters or a reactive power meter and computer are needed.

The authors have noticed that the amplitude of the AC component of the multiplication of the instantaneous voltage and current equals the RMS volt-ampere which is the apparent power. This idea is applied to an apparent power transducer for the three-phase three-wire system which is very popular in Japan. The conventional method needs four multipliers (two for the active power transducer and two for the reactive power transducer) and a calculator to obtain the root of the squared sum of the active and reactive powers. However, the new method needs only two multipliers. Furthermore, if necessary, the active power is easily measured at the same time using the same multipliers. Therefore the configuration is very simple and the cost is very low.

Principle and configuration: Fig. 1 shows the conventional apparent power transducer for a three-phase three-wire system. 1, 2 and 3 are powerlines; *L* is the load. M_{P1} and M_{P2} are the active power transducers whose outputs P_1 and P_2 are summed by Σ_p to obtain the total power signal P . M_{Q1} and M_{Q2} are the reactive power transducers whose outputs Q_1 and Q_2 are summed by Σ_q to obtain

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