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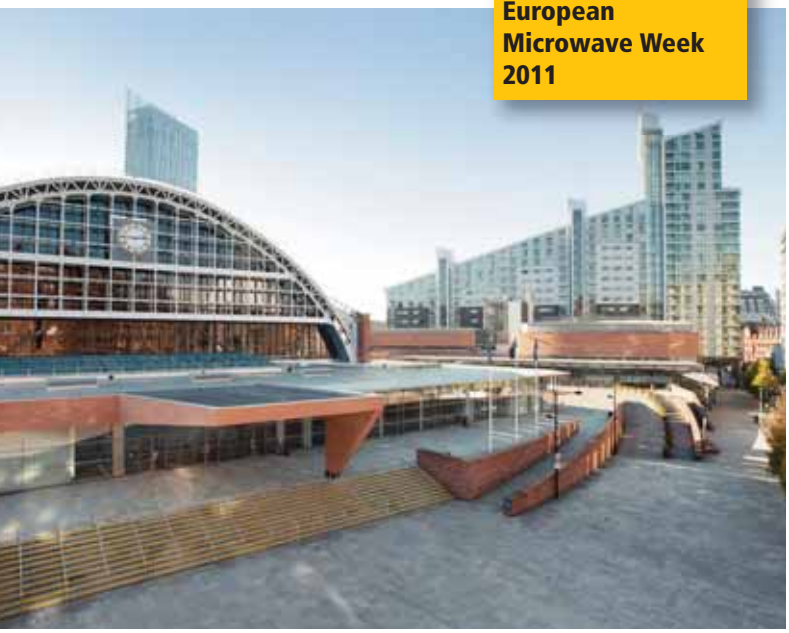

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Variant	Input	Output
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WIRELESS TECHNOLOGIES OF THE (NEAR) FUTURE

The whole world becomes more and more wireless. We deal with 'wireless' every day. It is really difficult to find a place on Earth not covered by a signal, a place without access to wireless technology. Radio, TV, satellites, GPS, GSM, Bluetooth, WiFi, RFID, keyless entry – these are just a few examples of wireless technologies we come into contact with on a daily basis.

ISM NETWORKS

A phenomenon of the last several years is the trend to discover solutions for low (or of less) power wireless networks working in the ISM bands. Smart Houses, Smart Buildings, Smart Meters, Smart Grids, Smart Anything – they all need wireless inside them to be Smart, or at least to be qualified for the Smart moniker.

DO WE NEED ISM WIRELESS NETWORKS?

Yes, we do: to be more comfortable; to be more flexible; for safety and security; to save money; to allow better supervision; to easier control a host of machines, homes, equipment etc; and to create a path towards convenient living, among others.

LOW POWER WIRELESS

It's not only the goal of a greener world, but costs and battery lifetime are also the predominant factors in the development of low power technologies. Like in other industrial segments, wireless technologies should also be low power. But, what does low power wireless mean? Take a closer look at the marketing brochures of several vendors of wireless technologies. They redefine existing standards for low power wireless: you can find new units, like ultra-low, extra-low or super-low. Sometimes ultra-low power fit in the mA to low power range, sometimes even 100 times higher. Wireless devices are often in receive mode for many applications, and transmit data only a few times per day. Therefore, the key to low power wireless from a technical point of view is low consumption in receive mode, best stated in some non-marketing units, in the order of µA.

MESH, MESH, MESH

A couple of years ago only a select few (scientists) used the word Mesh in connection with wireless. However, nowadays every trained salesperson in the field of electronic components claims to be an expert in selling products supporting Wireless Mesh Networks (WMN). There are a lot of Mesh-supporting technologies gaining attention, especially from the purchasing managers.

Currently, many different wireless technologies available in the market declare WMN support. So, it seems that commercial availability is quite wide

> ***Although there is no best (universal) wireless technology, there will be many different wireless technologies coexisting in the future***

and would satisfy every technical need. On the other hand, going deeper into specifications and datasheets, an engineer would find certain limitations. Some technologies support only a few (2 to 6) routing hops, some declare infinite number of routing hops and some do not declare anything and avoid broaching the subject.

WIRELESS MESH NETWORKS AND PHYSICS

The most popular ISM band for WMN seems to be the 2.4GHz ISM band. Its worldwide availability is attractive and promises a lot of benefits. Achieving relatively high transmitting power seems to be advantageous, and it is a nice tool for engineers who are looking for simple solutions. However, Messieurs Lorentz, Faraday, Maxwell, Herz, Einstein and others defined the physical behaviour of the world we inhabit, and discovered some interrelations and limitations, e.g. between wavelength and the ability of the radio wave to penetrate walls. Our world is full of walls, which is why 2.4GHz (marketing driven) enthusiasm has slightly decreased and new ISM sub-GHz bands were re-discovered shortly after the first low power WMNs had been practically tested.

THE BEST WIRELESS TECHNOLOGY

Claiming something to be the best is always dangerous. In technical forums, this usually results in heated discussions. Supporting this claim seems to be quite difficult, but it is not. It actually proves to be relatively easy. The best wireless technology should be read as the most convenient wireless technology for a specific purpose or target application. No (wireless) technology is universally convenient for every purpose.

WIRELESS MESH NETWORKS AND THE FUTURE

Although there is no best (universal) wireless technology, there will be many different wireless technologies coexisting in the future. Current ISM bands will become extremely crowded with the expected boom of WMN. If we are at the very beginning of that expected boom, and as we are already experiencing interferences, what may we expect when the boom of wireless mesh networks really comes to a head? Is it advantageous to use transmitting power on the same edge and create noise for thousands of future wireless 'neighbours'?

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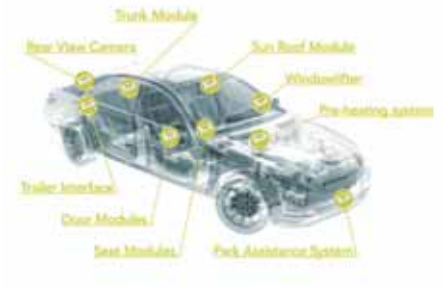
NXP Introduces "Game-Changing" Partial Networking Solution for Vehicles



Selective ECU power switch-off helps save CO2 emissions and fuel consumption

Chip maker NXP Semiconductors has announced an innovation in vehicle car network design that significantly reduces CO2 emissions and fuel consumption, while also extending the operating range of electric vehicles.

The NXP's TJA1145 CAN transceiver is the industry's first ISO compliant CAN Partial Networking Solution (NWP ISO 11898-6) at a time when car manufacturers are pushing for power-efficient CAN Partial Networking and governments around the world call for a reduction in CO2 emissions from vehicles.

The stand-alone TJA1145 CAN transceiver and system basis chip UJA1168 are, the company claims, the world's first highly integrated solution to support CAN Partial Networking and give design engineers precision control over a vehicle's bus communication network. By de-activating those Electronic Control Units (ECUs) that are not needed at a time, engineers are able to significantly reduce vehicle fuel consumption and CO2 emissions without sacrificing performance or consumer experience.

In current in-vehicle networking architectures, all ECUs are always active and consuming power when the vehicle is in use. This is the case even if the applications they control aren't continuously required, such as seat positioning, sunroof operation, window lifting and others. CAN Partial Networking changes this model by activating only those ECUs that are functionally required, while the other ECUs remain in a low-power mode until needed. This equates to significant savings in power consumption, reducing costs, wiring and CO2 emissions. CAN Partial Networking is also extremely beneficial for electric and hybrid vehicles as it helps extend their operating range and optimize their charging time.

"CAN Partial Networking is a real game-changing innovation in in-vehicle electronics, enabling a level of intelligent control over ECUs not previously possible," said Kurt Sievers, senior vice president and general manager for Automotive at NXP.

TJA1145 and UJA1168 combine analogue systems with high-density digital circuits. TJA1145 is a high-speed CAN transceiver, while UJA1168 is a CAN system basis chip with 5V/100mA microcontroller supply. Both support CAN Partial Networking by enabling "Selective wake-up" and "Selective sleep" functionality.

They are the first solution to be NWP ISO 11898-6 and AUTOSAR R3.2.1 compliant and supporting CAN Partial Networking.

WHAT CAR MAKERS ARE DOING NEXT

Car makers including Audi, BMW, Daimler, Porsche and Volkswagen have already made a public announcement in favour of establishing new industry standards to actively support the rapid introduction of Partial Networking architectures and solutions.

Ricky Hudi, Managing Director at Audi said: "Audi and Volkswagen corporations have started to introduce Partial Networking into the next generation of car models. Audi estimates a mid-term reduction potential on CO2 emissions of about 2.6g/km and fuel savings of 0.11 litres/100km, when using CAN Partial Networking."

"CAN Partial Networking is an area where we see great potential for energy savings. In addition, intelligent wake-up concepts improve the lifetime of ECUs and increase the operating reach of electrical vehicles," he added.

NXP'S first CAN Partial Networking chip

PANASONIC DEVELOPS NEW CHIP FOR SMART TVS

Panasonic Corporation has developed a new UniPhier type semiconductor chip (MN2WS0220) for smart televisions.

To improve performance and user interface, smart TVs require powerful software processing capability as they support various applications on the Internet. Achieving these improvements has called for a system LSI that has both a high quality AV processor and a high-speed CPU on a single chip.

Using its own UniPhier architecture Panasonic has enabled the chip to process AV content in real time, whereas a general-purpose 1.4GHz dual-core Cortex-based CPU from ARM handles a wide range of open-source software. The chip integrates these processors with a high-performance 3D graphics circuitry and a unified memory architecture that achieves efficient data transfers between shared external memory devices.

Panasonic's new chip is expected to open the way to a next generation smart TVs that will allow users to simultaneously enjoy two high-resolution TV broadcasting channels, as well as Internet-based content and applications, at the same time.

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MAERSK LINE

Farnell introduces more than 130 new RoHs compliant Schmersal-Automation products

New safety switch series, safety interlocks, actuators, input and output expansion modules as well as position switches now available for next day delivery

Farnell has added over 130 new RoHs compliant Automation products from Schmersal, the leading provider of electrical and electronic safety switchgear. This includes new safety switch series, safety interlocks, actuators, input and output expansion modules as well as position switches.

The new input expansion modules provide a clear visualisation of diagnostic signals and lead to time saving in the wiring of series connections in safety circuits. Up to 4 (2-channel) emergency stop control devices, safety switches and/or other protective devices with floating contacts can be connected to every module by means of 1:1 wiring of the safety contacts. Up to 20 modules (80 sensors) can be cascaded together in this fashion.

On the other hand output expanders with adjustable delay fulfil Stop Category 1 to EN 60204-1 and are used in order to securely switch off variable speed drives. Depending on the external circuit arrangement, it is possible to secure the guard device up to Control Category 4 to EN 954-1. These units have a redundant circuit internal design. They are equipped with safety relays with monitored positive-guided contacts. The enabling paths comprise the relay contacts wired in series.

The new AZM170 safety interlock switch series is designed for machines/work cells where access to a hazardous work area must be controlled until safe conditions exist. Their solenoid-latching feature permits locking a machine guard until dangerous conditions, which may exist immediately after removal of power, have abated. Solenoid-latching may be controlled by a time delay, motion detector, position sensor or other suitable component. The unit features independent actuator key (guard) position and solenoid-latching pin position contacts. These permit the prevention of machine restart until the guard is closed and the solenoid-latching pin is in the locked position.

This series consists of an electromechanical safety interlock switch joined to a solenoid-latching mechanism. Both the safety switch and solenoid mechanism feature positive-break contacts. In addition the actuator key features a built-in latch and an auxiliary manual unlocking device, the latter provided to aid in installation and for use in the event of a power failure (when using the unlocking by solenoid model). Each unit is supplied with a cord grip and a cap to seal the unused key entry port in the solenoid-latching mechanism.

Additionally, the innovative AZ3350 Series is designed for use with movable machine guards/access gates which must be closed for operator safety. Their positive-opening NC contacts provide a significantly higher level of safety than conventional springdriven switches whose contacts can weld or stick shut. The switch's tamper-resistant design prevents bypassing with simple tools, bent wires or other readily available means. Their rugged metal housing and IP67 rating make them ideal for interlocking safety guards in industrial and hostile environments. ●

Schmersal Safety interlock switches, AZM 170 series

The complete new Schmersal product overview is available to order from Farnell at: http://uk.farnell.com/schmersal

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LTE Networks – Facing the Challenges

JONATHAN BORRILL FROM ANRITSU AND **NASIM HYDER** AT LIVINGSTON LOOK AT THE TECHNICAL AND COMMERCIAL CHALLENGES OF TESTING AND TROUBLESHOOTING LTE NETWORKS

Eagerly awaited and highly anticipated, the advent of the Long Term Evolution (LTE) sees the mobile industry take its first steps into fourth generation (4G) "all IP" based communication. It will support much higher data rates (> 100Mb/s through a 20MHz channel bandwidth), while providing lower latency levels (~ 10ms), so that mobile operators can offer more feature-rich and compelling applications to their subscribers, as well as a far broader gamut of different types of multimedia content.

Troubleshooting LTE networks can be challenging

The Global Mobile Suppliers Association (GSA) expects there to be at least 40 LTE networks brought into operation within the next two years. Infonetics forecasts that the customer base for mobile broadband services through LTE networks will be over 153 million by 2014, with a large proportion of this coming specifically from Europe. The annual revenues being generated from this will exceed $70bn by that time, according to a report recently published by Juniper Research.

Though for many LTE is already viewed as a ready to deploy turnkey technology, there are certain difficulties with both its implementation and its ongoing operation that are still to be fully addressed if operators are to achieve the cost benefits and performance expected. Among these are:

Bandwidth – LTE requires high bandwidth to support next generation video/multimedia services. Operators will need to be able to support a 100Mb/s peak data rate for the downlink and a 50Mb/s peak data rate for the uplink. This will mean that higher performance test equipment has to be specified, and new Orthogonal Frequency-Division Multiple Access (OFDMA) and Multiple-In Multiple-Out (MIMO) technology will place additional requirements onto the teams charged with carrying out test activities, as well as demands for Gigabit Optical Ethernet backhaul testing.

Dealing with congestion issues – Research conducted by Analysys Mason (see Figure 1) suggests that the average volume of mobile traffic per connection in developed markets will rise to more than 0.5GBytes each month in the 2015 timeframe, fuelled by the ongoing proliferation of smartphone devices. This will impact heavily on the network, as they will need to uphold a control plane

capacity of 200 LTE users per cell. Vast numbers of Gigabit Ethernet connections will have to be added not just to the backbone, but also to the access network, so bottlenecks can be avoided. The increase in traffic levels and subsequent upgrading of the access network, will once again heighten the pressures being placed on test engineers. This effect has already been seen on HSPA networks, where handsets supporting many 'apps' have been launched but the backhaul network did not have enough capacity to carry all of this data, resulting in the network suffering significant performance and usability issues.

Ensuring interoperability with legacy networks – It is anticipated that LTE networks will not be deployed with full geographic coverage, but implemented at 'hot spots' where high population densities allow the greatest return on the large investment involved. There will thus be frequent inter-technology handovers taking place between legacy UMTS/EDGE/GSM infrastructure and the newly deployed LTE-based infrastructure, and this will complicate the running of the networks and the operators' ability to maintain their services. Operators and their subcontractors will need to have equipment in their inventory that covers testing of legacy UMTS/EDGE/GSM networks together with new equipment for LTE testing. An increased breadth of test hardware will have to be maintained, further raising operational expense. Where LTE 800MHz (Digital Dividend) is deployed then it is likely that GSM/UMTS and LTE will have similar coverage. In this case, there needs to be good network characterisation and handovers so the network can easily and smoothly select the best network to provide the requested user service. The user will not care if the data is on LTE or UMTS, only that there is a smooth and reliable connection.

Lack of available spectrum – Although LTE will allow one single mobile communications protocol to be followed, finding somewhere to place it has been difficult. As a result there was not a way for a single global frequency to be adopted, and the various geographic regions have been forced to use different parts of the spectrum, with 700MHz and 1900MHz being allocated for the United States, 800MHz and 2600MHz in Europe, 1800 and 2600MHz throughout most of Asia, 2100MHz in Japan and 2300MHz in China. LTE simplify design for the semiconductor companies producing communications ICs, as they will be able to create solutions that can be used universally (just calling for minor tweaking to suit particular geographic markets). However, handset manufacturers will need to

Infonetics forecasts that the customer base for mobile broadband services through LTE networks will be over 153 million by 2014, with a large proportion coming from Europe

introduce models that can be used anywhere in the world, with multiple antennas and supporting circuitry, so they can cope with a plethora of different frequency bands. There will, therefore, be an exponential rise in the quantity of conformance tests that need to be fulfilled (and the time taken for this) compared to those required for 2.5 and 3G handsets.

Assess Quality-of-Service (QoS) levels – As LTE finally moves mobile network to a fully packet switched architecture, mobile operators will be forced to change their strategy for looking at QoS. Different mechanisms for measuring QoS in terms of service availability and service continuity are employed by LTE and existing networks. LTE will enable end-to-end QoS monitoring extending all the way to the user, rather than being forced to stop at the base station, as had previously been the case. This is because the headers for carrying QoS information are built directly into its protocol stack. Operators will be thus able to prioritise the transmission of data traffic based on the subscriber's service level agreement, the nature of the data (whether a certain degree of latency can be accepted – such as for SMS or MMS texts, or whether it cannot – for mobile video, etc). The increased complexity could also have major implications for the test tools that need to be specified, the amount of additional training operatives require, the man hours needed to undertake tests, the costs involved and the possibility for human errors arising. To offset this, LTE is also introducing some automated processes, but these will need careful testing to ensure that correct parameters and settings have been made into the automated algorithms.

> *One element of LTE that also needs to be discussed is its use of more complex antenna configurations in order to support MIMO technology*

Cell planning – LTE calls for a different approach to cell planning than was followed for 2G/2.5G/3G networks as it uses Single Frequency Networks (SFN). Greater emphasis will be placed on activities such as initial coverage mapping and interference measurements. Use of Inter-Cell Interference Cooperation (ICIC) mechanisms will allow the checking to ensure that no adjacent cell is utilising the same sub-carrier frequency in an area of overlap. Currently though there are no LTE cells that are overlapping with each other, as the first cells to be implemented are just covering the aforementioned hotspots and are therefore in isolation. However, as the LTE network begins to grow and all the gaps are filled, the full repercussions of this technology will become apparent.

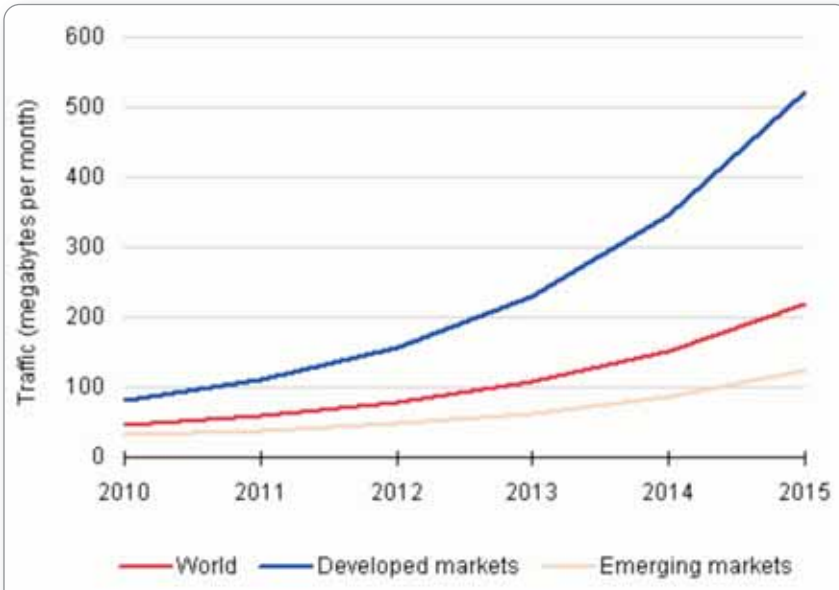

Figure 1: Average global wireless network traffic per connection 2010-2015
[Source: Analysys Mason, 2010]

LTE is introducing new automated algorithms to help manage this, such as ICIC and Self Organising Network (SON), but these algorithms are dependent on user settings and targets for optimisation, so again careful testing is required to ensure that these processes are configured to run in the optimum setting for the required.

Implications of multipath on testing – One element of LTE that also needs to be discussed is its use of more complex antenna configurations in order to support MIMO technology. MIMO means that data throughput (close to the base station) and cell coverage (especially at the cell edge) can be enhanced without an increase to the bandwidth or transmission power, since the signal is transmitted through several different paths at once, by bouncing off buildings, etc. The result of this is more sophisticated measurements will need to taken by test engineers to predict or measure the throughput performance. With traditional over the air test methods it was the received signal-to-noise ratio that defined the data rate that could be supported (in accordance with Shannon's Law), furthermore the transmission range was improved by having a clear 'line-of-sight' transmission path, but now with MIMO these principles no longer apply. This will call for a re-education of engineers out in the field.

In conclusion, those installing LTE network hardware have a challenging time ahead. They will need access to equipment that allows them to carry out modulation, throughput and spectrum measurements at the physical layer. They will also have to be able to undertake handover, protocol sequence and protocol conformance testing, plus analysis of cell coverage and of the integrity of the transmission spectrum in order to safeguard against interference. There will also be a need for more sophisticated test tools that can handle both incumbent and emerging mobile standards. Finally, sourcing issues will need to be tackled. These will have the ability to complicate matters for the many subcontractors commissioned to carry out LTE network implementation. As a result, under certain circumstances, the adoption of new business models, based on the rental/leasing of the high end test equipment required for these projects, may need to be investigated as an alternative to direct purchase.

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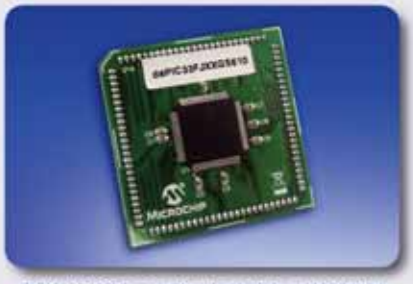

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Beacon synchronisation: a useful low power radio technique

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Very few low power radio applications consist of a continuously streaming simplex data-link. In practice, most tasks will involve the infrequent transmission of relatively small amounts of data. This sounds simple, until the other strictures usually present are considered:

- Multiple users (or multiple data sources in the same system) share a single channel;
- Transmit duration (duty cycle) must be minimised (regulations, or power limits);
- Receiver power consumption must be minimized;
- Data throughput and response times must be optimized.

Experienced users of low power wireless devices will already be familiar with a number of techniques that address one or more of these requirements, such as:

- **Frequency division multiplexing:** Assigning each radio link a unique frequency. Maximum autonomy for different links, but profligate in band-allocation usage, and requires complex multichannel radio hardware.
- **Very low duty cycle random transmission:** By sending a very short burst at infrequent intervals, transmitter power is minimised (at the cost of a very low data throughput). In multiple transmitter systems the likelihood of a packet being lost through collision can be reduced by the inclusion of random length delays between bursts, and repeat transmissions of the same data.
- **Receiver "battery economisation":** A term originating in paging, this minimizes receiver power consumption by cycling the receiver circuitry on (for long enough to recognize valid data) and off (for a longer period, saving power). The transmit burst is lengthened (with added redundant preamble/framing patterns, or repeats of the data) to exceed the receiver cycle period. Receive power falls, but response time is degraded.
- **Master/slave polling:** A given unit only transmits when it receives a request/command from the central "master" unit. This allows many "slave" units to share one channel, at the cost of low data throughput and the continuous power hungry operation of all the slave receivers.

There is a further technique used in some network architectures that is worth examining, as it can (with suitable "tweaking") give a better balance of performance benefits and limitations than any of the simple methods

There is, however, a further technique (used in some network architectures) that is worth examining, as it can (with suitable "tweaking") give a better balance of performance benefits and limitations than any of the simple methods listed above:

Beacon synchronisation is a technique whereby a designated "master" transmitter sends a "synchronising" message at regular, accurately timed, but infrequent intervals. This gives a known timing reference to all the other receiving "nodes" in range. It also means that, once a sync message has been received, the node can predict when the next sync transmission will occur and can disable its own receiver (saving power) in the interim. (Should subsequent sync bursts be missed, from interference or range issues, the node will have to enter a "receiver constantly on" mode to re-acquire synchronisation, but as the timing accuracy of simple crystal oscillators is good enough to maintain timing over several, if not dozens, of sync periods, this occurrence should be unusual).

In the simplest case (where nodes only receive, and the master sync burst also contains payload data), this resembles the "receiver battery economy" example, albeit with much shorter transmission bursts. This does not, however, utilize the technique to the full.

If the inter-sync burst period (or "frame") is divided up into a number of "slots", each the length of a valid message burst (with some timing error allowances), then a beacon synchronised system offers some very powerful features:

By assigning each slot to a particular node (either a fixed assignment, or a dynamic system), then all have access to their "own" segment of the channel bandwidth without risk of burst collisions, and while still keeping their RF circuitry in standby most of the time. This permits a single master to receive data from a constellation of nodes (as with a polled system, or a low duty cycle set-up, but with much better use of the available data bandwidth) or a master to send data to many (low power consumption) slaves.

Of course, it also opens another possibility: within the frame timing structure imposed by the master "heartbeat" sync transmission, a given nodes might communicate not with the master unit but with another node. Now give each node the ability to operate as a repeater (to store data received in one frame for re-transmission in the next) and we have the basic framework for a mesh network – which is a whole new subject!

AN EXAMPLE

A SIMPLE TRANSCEIVER SENDS AN 8-BYTE BURST IN 10MS. (typical wide band UHF performance with 5mS tx-on switching, then 8 (payload) + 4 (overhead) bytes at 20kbit/s).
It consumes 20mA (in active tx or rx).
A data gathering system is built, with 25 of these transceivers communicating to a single master node.
Allow 2mS extra timing error per slot, 1 slot per node, plus 1 for the master:
1 frame = 312mS (which equals the response time from node to master)
In-sync power consumption of a node (on for 24mS, off for 288mS) = 1.5mA

If the inter-sync burst period is divided up into a number of "slots", then a beacon synchronised system offers some very powerful features

AVIONIC & MILITARY APPLICATIONS NEED -55°C OPERATION

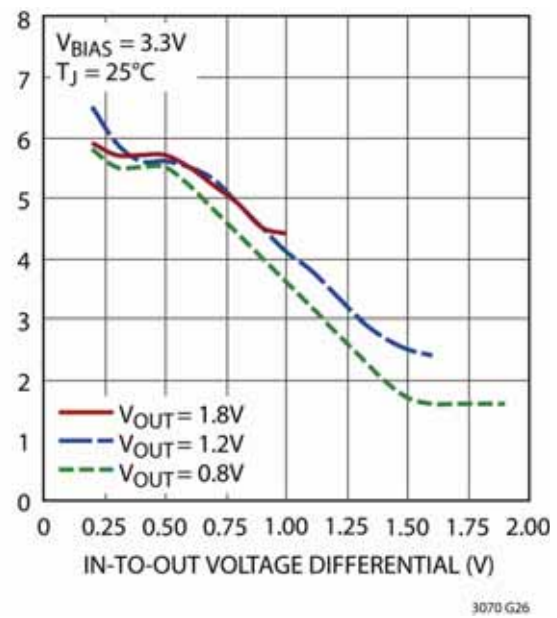
STEVE KNOTH, SENIOR PRODUCT MARKETING ENGINEER AT LINEAR TECHNOLOGY CORPORATION, DISCUSSES THE CHALLENGES IMPOSED BY THE NEEDS OF MILITARY ELECTRONICS SYSTEMS AND HOW TO MEET THOSE

The commercial-off-the-shelf (COTS) initiative of 1994 significantly shook up the military IC industry. In conjunction with improvements in semiconductor vendor IC reliability, no longer were /883 or JAN qualified ICs required. The military was allowed to integrate commercial and industrial grade ICs into their weapons systems. This trend freed designers of military and avionics (electronics for aircraft) systems to newly scour the portfolios of various semiconductor IC companies who did not necessarily specialize in military grade parts, or look into other portions of the IC portfolios of those companies that previously did. The benefits of COTS have included reduced system development & maintenance time and costs.

However, the requirements for many of these systems are still very stringent. For example, commercial aircraft and unmanned aerial vehicles (UAV) that soar at altitudes in excess of 30,000 feet encounter temperatures approaching -50°C or worse. Therefore, industrial (down to -40°C) and commercial (down to 0°C) temperature-rated ICs would not suffice. Some key applications include outside cabin-mounted environmental sensors (air speed, temperature, humidity, etc.), flight control computers, infrared image sensors and cockpit voice recorders.

With ongoing assault against terrorism and the desire to continually protect armed forces on the ground, in the sea and in the air, there has been an increase in safer first-strike capability technology as well as predictive and defense counter-measures technology. Important applications in this area include:

- Integrated defensive electronic countermeasures (IDECM);
- Sophisticated fighter aircraft such as the joint strike fighter (JSF);
- Joint-air-to-ground missiles (JGAM);
- Joint direct attack munitions (JDAM) smart bombs with their GPS-embedded modular (GEMS) inertial guidance systems;



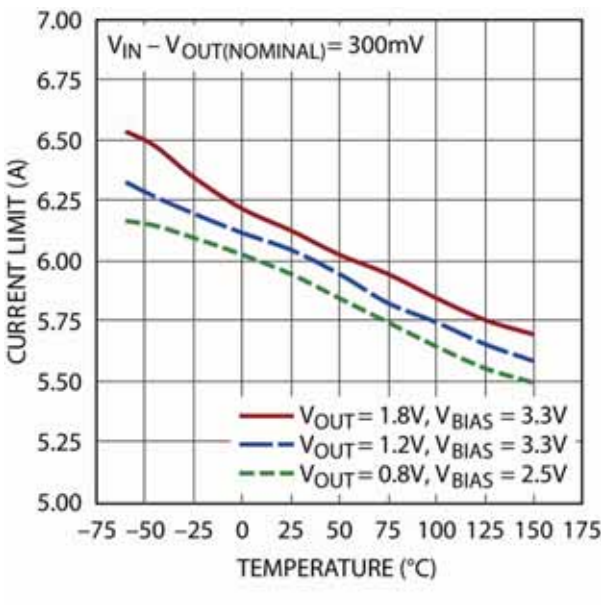


Figure 1 and 2: LT3070 current limit characteristics

Part Number	Output Current (A)	Min VIN (V)	Max VIN (V)	Reference Voltage (V)	Dropout Voltage (V@I OUT)	Typ IQ (Supply) (_A)	Shutdown Current (_A)	Output Voltage (V)	Package	Extended Temp Range
Positive Regulators										
LT3008	0.02	2.0	45	0.60	0.28	3	<1	Adj, 1.2, 1.5, 1.8, 2.5, 3.3, 5	SC-70-8, 2x2 DFN-6	E, I, MP
LT3010	0.05	1.5	80	1.28	0.30	30	<1	Adj, 5	MSOP-8	E, H, MP
LT3050	0.1	2.0	45	0.60	0.30	50	<1	Adj (0.6V to 44.5)	3x2 DFN-12, eMSOP-12	E, I, MP
LT1761	0.1	1.8	20	1.22	0.30	20	<1	Adj, 1.2, 1.5, 1.8, 2, 2.5, 2.8, 3, 3.3, 5	ThinSOT	E, MP
LT3060	0.1	1.7	45	0.60	0.30	40	<1	Adj (0.6 to 36)	2x2 DFN-8, TSOT-8	E, I, H, MP
LT3082	0.2	1.2	40	current 10µA	1.30	510	<1	Adj (0 to 38.5)	3x3 DFN-8, TSOT-23-8, SOT-223-3	E, I, MP
LT3013	0.2	4.0	80	1.24	0.40	65	<1	Adj (1.24 to 60)	TSSOP-16	H, MP
LT1763	0.5	1.8	20	1.22	0.30	30	<1	Adj, 1.5, 1.8, 2.5, 3, 3.3, 5	SO-8, 4x3 DFN-12	I, MP
LT3085	0.5	1.2	36	current 10µA	0.275	510	n/a	Adj (0 to 35.7)	2x3 DFN-6, eMSOP-8	E, I, MP
LT3029	Dual 0.5	1.9	20	1.22	0.30	100	<1	Adj (1.218 to 19.5)	eMSOP-16, 3x4 DFN-16	E, I, H, MP
LT1129	0.7	4.2	30	3.75	0.40	50	16	Adj, 3.3, 5	DD, SOT-223, SO-8, TO-220, TSSOP-20	E, I, MP
LT1963/A	1.5	2.1	20	1.21	0.34	1mA	<1	Adj,1.5, 1.8, 2.5, 3.3	eTSSOP-16,DD,TO-220, SOT-223, SO-8	E, I, MP
LT1764/A	3	2.7	20	1.21	0.34	1mA	<1	Adj, 1.5, 1.8, 2.5, 3.3	DD, TO-220, eTSSOP-16	E, MP
LT3070	5	0.95	3	0.80	0.09	1.1mA	n/a	0.8V to 1.8V	4x5 QFN-28	E, I, MP

Table 1: Linear Technology's family of MP-grade single output LDOs

● Various radar jamming systems.

Once again, a military temperature range IC is required in these applications due the wide temperature variation of their deployment environment.

Many ground-based military applications (some battery-powered) such as soldier man-packs, radar systems, joint tactical radio systems (JTRS), armored vehicles and night vision apparatus also require ICs that operate across hot-to-cold temperature extremes from a high of 125°C down to -55°C since they can be placed almost anywhere and, further, in humid or arid environmental conditions.

Challenges for ICs at Harsh Cold Temperatures

Ambient temperature extremes may cause parametric and, in some cases, catastrophic problems for ICs. Hot temperature issues including electromigration, parametric drift, parasitic leakage, hot spots and high power dissipation traditionally have been identified and dealt with through improved design and layout techniques by designers.

On the other hand, cold temperature issues for ICs are coming more to the forefront thanks to adoption in applications for the military and avionics market segments. For example, at altitudes above 30,000 feet – where most commercial aircraft fly – temperatures approach a frigid -55°C. Furthermore, in addition to IC parametric drift, designers must deal with board leakage/condensation potentially causing trace shorting, thermal shock if rapid changes from cold to hot occur, low temperature oscillations, instability, overshoot and poor filter performance. IC designs at cold temperature must carefully compensate for these factors.

The use of low dropout (LDO) linear regulators is commonplace in both non-portable and handheld electronic systems. Improved specifications, reliability and protection features are enticing system designers to consider them in harsh environments too. For example, lower dropout voltages enable higher efficiency conversion, paralleling regulators spreads heat and reduces hot spots on PCBs, while lower input-to-output voltage differentials open up the types of system rails to be powered. Further, low quiescent currents increase battery run time, higher input voltage specifications protect against system voltage transients, reverse input/output and reverse current protection shield the IC and the surrounding electronics thereby increasing robustness, low output voltage noise minimizes system EMI concerns, and compact thermally-enhanced packaging drives heat out of systems more effectively. These features, in addition to their design simplicity, have allowed LDOs to occupy 1A-5A application spaces that were previously solely serviced by switching regulators.

> Linear regulators typically use one of two types of short circuit protection on-chip: constant current limit or a more sophisticated form, current limit with foldback

Different Protection for Different Conditions

A problem in battery-powered systems is the threat of damage to the IC and/or the load when an end user inserts the battery with reverse polarity or misconnects the battery, i.e. in a vehicular system. If an IC is

LINEAR'S PORTFOLIO OF VOLTAGE REGULATORS

Linear Technology also manufactures a full line of high performance, µModule voltage regulator devices with design-in simplicity near that of an LDO, in MP and other grades. See Table 2 below and links.

MP-grade µModule voltage regulators:
http://www.linear.com/designtools/dcdcmicromodule.html

Full line of µModule voltage regulators:
http://www.linear.com/micromodule

Part Number	V_{IN} Min (V)	V_{IN} Max (V)	V_{OUT} Min (V)	V_{OUT} Max (V)	Output Current (A)	Current Share	LGA Package Dimensions
LTM8020MPV	4	36	1.25	5	0.2		6.25mm x 6.25mm x 2.3mm
LTM8022MPV	3.6	36	0.8	10	1	-	9mm x 15mm x 2.8mm
LTM8032MPV	3.6	36	0.8	10	1	-	9mm x 15mm x 2.8mm
LTM8023MPV	3.6	36	0.8	10	2	Up to 2	9mm x 15mm x 2.8mm
LTM8025MPV	3.6	36	0.8	24	3	Up to 2	9mm x 15mm x 4.32mm
LTM8027MPV	4.5	60	2.5	24	4	-	15mm x 15mm x 4.32mm
LTM4606MPV	4.5	28	0.6	5	6	-	15mm x 15mm x 2.8mm
LTM4612MPV	4.5	36	3.3	15	6	-	15mm x15mm x 2.8mm
LTM4608AMPV	2.375	5.5	0.6	5	6	Up to 3	9mm x 15mm x 2.8mm
LTM4600HVMPV	4.5	28	0.6	5	10	Up to 2	15mm x 15mm x 2.8mm
LTM4601AHVMPV	4.5	28	0.6	5	12	Up to 4	15mm x 15mm x 2.8mm

Table 2: Linear Technology's family of MP-grade µModule voltage regulators

For the full line of Linear's MP-grade and H-grade (operating range > 125°C) power ICs, see the following websites:

MP-grade ICs:
http://cds.linear.com/docs/Information%20Card/LTCMP.pdf
H-grade ICs:
http://www.linear.com/pc/solutionDetail.jsp?navId=H0,C2,C1623,C1779

exposed to a reverse voltage, large currents will flow to ground through parasitic junctions in the IC, potentially destroying fragile junctions. Insertions of single or multiple diodes help, but these fixes waste power and reduce the supply voltage by adding diode drops between the battery voltage and the supply rail. An alternative on-chip solution would not only protect the IC and the load but eliminate those tradeoffs resulting from adding more components.

Reverse output voltage protection prevents reverse current from flowing through the IC's parasitic body diodes under a reverse output voltage condition, or if the load is returned to the negative supply rail, or if the negative supply is turned on before V_{IN}, or if the output is sitting at the negative rail's potential during power up.

Linear regulators can be easily destroyed if they are forced to source excessive current. Therefore, current limiting (short circuit) protection circuitry kicks under short circuit or excessive load conditions in which $V_{OUT} < V_{IN}$; the current limiting circuitry prevents excessive current flow from V_{IN} to V_{OUT}. In a short circuit condition, not only is the pass transistor sourcing excessive current, the voltage across it is at a maximum (since V_{OUT} is at ground, the voltage across the transistor is V_{IN}).

Linear regulators typically use one of

BLACK STICK
pledges its support for WorldSkills London 2011

Black Stick, which provides PCB design to the electronics industry, has pledged its support for WorldSkills London 2011 by providing training for Andrew Fielding who will be representing the UK in Electronics.

Supporter

worldskills London 2011

Showcasing skills that shape our world

WorldSkills London 2011, the world's largest international skills competition, takes place from 5 – 8 October at ExCeL London. Team UK, which consists of 43 of the UK's most talented apprentices, employers and learners in 37 skills ranging from Mobile Robotics, Electrical Installation and Graphic Design to Cooking, Hairdressing and Electronics. Visitors to WorldSkills London 2011 will be able to cheer on Team UK, try their hand at dozens of skills and receive impartial advice and guidance on apprenticeships and vocational training.

Andrew Fielding, 21, from Bolton, who is employed by MBDA UK, has been training with Black Stick providing him with the opportunity to increase his knowledge and practical skills ahead of WorldSkills London 2011. In particular, Black Stick has been working with Andrew on circuit board layout and design training, two areas which Andrew will be tested on during the four day competition.

Director Alan Graham from Black Stick said "PCB design is a very niche skill set, and Andrew has quickly adapted to our training programme. This should provide him with the skills he needs to fast track him into the front line of PCB design."

Andrew Fielding, Team UK Member in Electronics for WorldSkills London 2011 said: "I am hugely grateful for the training, advice and guidance that Black Stick has provided me with. Competing against the world's leading engineers over four days will be challenging but I am privileged that along with the support of my employer MBDA UK, I have been able to train with experienced professionals. This support can only set me in good stead for the tough competition ahead."

www.worldskillsteamuk.org

Thermal limiting is a slightly less sophisticated technique than thermal shutdown, in which the maximum die temperature is controlled by the protection circuit

two types of short circuit protection on-chip: constant current limit or a more sophisticated form, current limit with foldback. The addition of foldback protection to the current limit decreases the current limit as the input voltage increases to keep the power transistor in its safe operating area (SOA).

When $V_{OUT} > V_{IN}$, i.e. if V_{IN} is shorted or V_{OUT} is pulled above V_{IN}, the reverse current (a.k.a. reverse output-to-input) circuitry prevents any flow of reverse current from V_{OUT} to V_{IN}.

With thermal shutdown protection, an IC is actually shut off and the die must cool down by the amount of hysteresis built into the thermal shutdown circuitry. Once the part has cooled down sufficiently, it is restarted. If a fault or overload condition exists, the part heats back up to the thermal shutdown temperature and turns itself back off. Therefore, the part sits and thermally oscillates at some low frequency and duty cycle depending on the thermal shutdown temperature, the amount of hysteresis, the package and the associated thermal time constants.

Thermal limiting is a slightly less sophisticated technique than thermal shutdown, in which the maximum die temperature is controlled by the protection circuit.

The ideal solution to the problems and required protection features outlined above would be a family of low dropout linear regulators that can operate with high precision and offer bulletproof protection features across the entire junction temperature range of -55°C to +125°C.

Solving Problems

Linear Technology has provided bulletproof, reliable, high performance PNP and NPN LDO regulators operating across the extended industrial junction temperature range of -40°C to +125°C for many years. However, sophisticated wafer fabrication technology enhancements and improved layout techniques have allowed extension of the operating junction temperature range down to -55°C, opening up a variety of "high reliability" military range applications, unleashing a new generation of military plastic or "MP-grade" devices.

Linear's new MP-grade portfolio encompasses output currents from 20mA (LT3008) all the way up to 5A (LT3070), with dropout voltages as low as 85mV, input voltages as high as 80V, ultralow output voltage noise as low as 20uVrms, sub-5uA quiescent currents and a full set of protection features. See Table 1 for a portfolio summary.

Bulletproof Protection Features

Linear's LDO family incorporates several protection features that make them ideal for use in both battery-powered and non-portable circuits and systems. In addition to the normal protection features associated with monolithic regulators, such as current limiting and thermal limiting/shutdown, these ICs also protect against reverse input voltages, reverse output voltages and reverse output-to-input voltages.

Current limit protection and thermal overload protection protect the devices against overload conditions at its output. The addition of foldback keeps the power transistor in its SOA. For example, the LT3070 has SOA protection. The safe area protection decreases current limit as input-to-output voltage increases and keeps the power transistor inside a safe operating region for all values of input-to-output voltage up to the absolute maximum voltage rating. Under conditions of maximum I_{LOAD} and maximum V_{IN}-V_{OUT}, the device's power dissipation peaks at around 3W. If the ambient temperature is high enough, the die junction temperature will exceed the 125°C maximum operating temperature. If this occurs, the LT3070 relies on two additional thermal safety features. At about 145°C, the PWRGD output pulls low providing an early warning of an impending thermal shutdown condition.

At 165°C typically, the LT3070's thermal shutdown engages and the output is shut down until the IC temperature falls below the thermal hysteresis limit. The SOA protection decreases current limit as the IN-to-OUT voltage increases and keeps the power dissipation at safe levels for all values of input-to-output voltage. The LT3070 provides some output current at all values of input-to-output voltage up to the absolute maximum voltage rating. See the Current Limit vs Temperature curve in Figures 1 and 2.

Wide-Ranging Effects

The COTS initiative from the mid 1990s has had a wide-ranging effect on both the military and the semiconductor IC industry. One result was an increase in industrial-grade ICs being integrated into military, avionic and commercial aircraft systems. However, the -40 to +85°C temperature range, or even the extended industrial -40°C to +125°C range is not sufficient for applications.

Linear Technology has developed a new family of high reliability, MP grade products including LDOs and µModule regulators, that extend operation down to -55°C. These MP LDOs offer the same wide voltage range, high accuracy, low dropout, high reliability and bulletproof protection. ●

SUMMARY CHARACTERISTICS OF LINEAR'S MP-GRADE LDOS

- Quiescent Current – As Low as 3uA
- Up to 80V Input Voltage
- Reverse Protection – Output, Output-to-Input, Input
- Directly Parallelable
- VOUT to 0V
- Low Dropout Voltage: As Low as 90mV Typical
- Ultralow Output Noise: As Low as 20uVRMS
- Fast Transient Response
- Output Current – Up to 5A
- Output Tolerance: Down to ±2% Over Line, Load & Temperature
- Stable with Low-ESR, Ceramic Output Capacitors
- Thermal Limiting
- Current Limit with Foldback Protection
- Variety of Compact, Thermally Enhanced Packages

DESIGNING A SPEAKER RECOGNITION SYSTEM

PROFESSOR DR. DOGAN IBRAHIM AND **MAYSA RADWAN** OF THE FACULTY OF ENGINEERING AT THE NEAR EAST UNIVERSITY IN NICOSIA, CYPRUS, DESCRIBE THE THEORY AND BASIC BUILDING BLOCKS OF SPEAKER RECOGNITION SYSTEMS, AND GIVE AN EXAMPLE TO SHOW HOW SUCH A SYSTEM CAN EASILY BE CONSTRUCTED USING THE MATLAB SOFTWARE PACKAGE

Recently there have been many developments and research in the field of speech processing. Speaker recognition is the process of determining the identity of a speaker by comparing speech produced by a speaker with a number of speakers stored in a speech database. This article describes the development of a MATLAB-based speaker recognition system.

Groups of Processing

Speaker processing is divided into two groups: speaker recognition and speaker verification. In speaker recognition, the task is to use a speech sample to determine the identity of the person that produced the speech from among a number of speakers. In speaker verification, the task is to determine whether or not a person who claims to have produced the speech has in fact done so.

Speech verification has many practical applications and is mainly used in remote voice-based password verification systems where the user enters his or her password by means of speech.

Speaker recognition systems can be divided into two methods: text-dependent methods and text-independent methods. In a text-dependent system, the identity of the speaker is based on his or her speaking a specific phrase, like passwords, PIN codes, credit card numbers, etc. Here, the system can recognise the speaker only when the expected word has been spoken. Such a system is commonly used in many security based real-time applications. In a text-independent system, the speaker is identified irrespective of what he or she is saying. In general, it is more difficult and less reliable to recognise a speaker in such a system.

The choice of a text-dependent or text-independent speaker recognition system depends very much on the specific application, and each system has its own advantages or disadvantages. In general, like most signal processing (e.g. image processing) recognition systems, the main recognition system consists of five modules: input data capturing, pre-processing, feature extraction, feature matching and output display. Figure 1 shows the block diagram of a typical speaker recognition system. The functions of various blocks are described in Figure 1 in detail.

The purpose of the speech input data capturing module is to record (or capture) the speech of speakers. Usually, microphones are used to sense the speech signals and these signals are converted from analog to digital and are stored in a database, usually in the form of ".wav" type files. These files can later be read, displayed, played back, or processed in other forms using a computer program such as MATLAB.

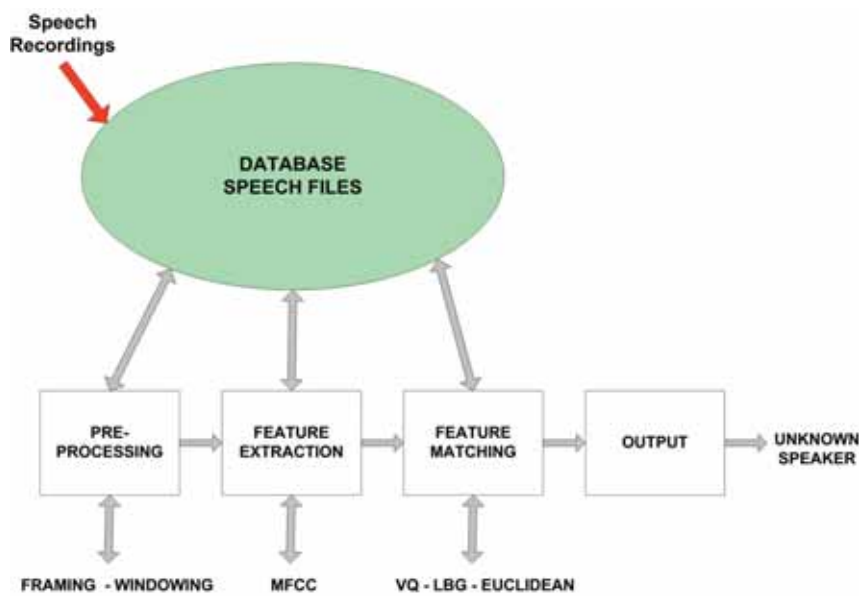


Figure 1: Speaker recognition system

Speech Pre-Processing

Speech pre-processing is used to prepare a given speech signal so that it can be used in speaker processing applications. The speech signal is slowly varying over time and the signal is nearly stationary when small samples of the signal (in the range of 20 to 40ms) are considered. Therefore, speech signals are normally analysed in short time segments. Thus, a given signal is initially divided into frames where the edges of the signals overlap for continuity. This process is in general referred to as the framing of the speech signal and the processing is applied to each segment (or frame) of the signal at the same time.

Figure 3: Block diagram of the MFCC processing

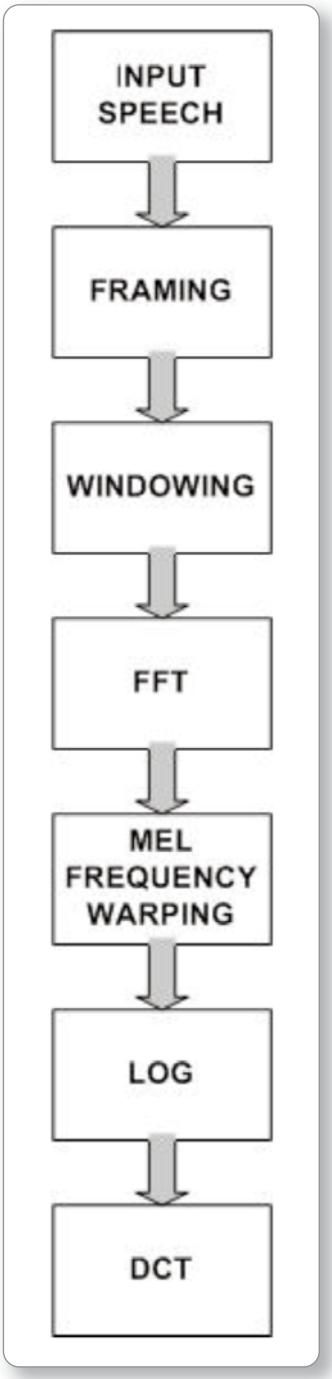


Figure 2 shows code for a MATLAB function (called FRAME) that can be used to frame a speech signal "s" having sampling frequency "fs" with 256 samples. Here, the speech signal is divided into frames of "N" samples (N = 256) and adjacent frames are separated by "m" (m = 100). The resultant output "M" is a 256 x 129 matrix.

```
function r = FRAME(s, fs)
L = length(s);
m = 100;
n = 256;

nFrame = floor((L – n) / m ) + 1;
%
% Create a matrix M containing all the frames
%
 disp('CREATE MATRIX M CONTAINING ALL THE
FRAMES...');
 for i = 1:n
 for j = 1:nFrame
 M(i, j) = s(((j – 1) * m) + i);
 end
 end
```

Figure 2: MATLAB function to frame a signal

After the speech signal has been framed, each frame is multiplied by a windowing function in order to remove the edge effects and the discontinuities at the edges of the signals. Although there are several windowing functions, usually the Hamming window is used in speech pre-processing applications. An N sample Hamming window is given by the following equation:

$$h(n) = 0.54 - 0.46\cos\left(\frac{2\pi n}{N-1}\right)$$
$$where, \quad 0 \le n \le N-1$$

The windowing operation involves multiplying the input signal with the windowing function. The MATLAB code to window signal frames in matrix "M" and produce matrix Y is given by:

```
disp('APPLY THE HAMMING WINDOW...');
h = hamming(n);
Y = diag(h) * M;
```

Speech Feature Extraction

The main purpose of the speech feature extraction module is to convert the speech waveform to some type of parametric representation that can be used later in determining the identity of the speakers. It is well known that when a speech signal is examined over a short period of time, its characteristics are nearly stationary and therefore the signals can be analysed for speech recognition.

There are several methods of speech feature extraction. Some commonly used methods are: Linear Prediction Coding (LPC), Mel Frequency Cepstrum Coefficients (MFCC) and so on.

In this article, the MFCC method is used for feature extraction of speech signals. MFCC processing produces a number of coefficients that identify the processed speech and these parameters are used in speaker recognition or in speaker verification systems. Figure 3 shows a block diagram of the MFCC processing steps.

After framing and windowing, the signal is converted from time domain into the frequency domain (i.e. its frequency spectrum) by taking its Fast Fourier Transform (FFT); i.e. each frame of "N" samples is converted from time domain into frequency domain. This is easily done in MATLAB by using the built-in function FFT; i.e. the FFT of the signal is obtained in matrix "F" using the following code extract:

```
disp('APPLY FFT...');
for i = 1:nFrame
F(:,i) = fft(N(:, i));
end
```

Because the frequencies in the FFT spectrum are very wide and the voice signal does not follow the linear scale, the speech signal is multiplied by a Mel-frequency wrapping which provides a linear scaling below 1000Hz. Each filter's magnitude frequency response is triangular in shape and each filter output is the sum of its filtered spectral components. The following formula is used to compute the Mel frequency, Mel, for a given frequency, f:

$$mel = 2595 * \log_{10}(1 + \frac{f}{700})$$

The log mel spectrum is converted into the time domain using Discrete Cosine Transform (DCT). The result of this conversion is called Mel Frequency Cepstrum Coefficient (MFCC), which is a set of real numbers in the time domain. The set of MFCC coefficients are called acoustic vectors and these vectors identify a speaker uniquely. These acoustic vectors are usually stored in a database and are used in matching an unknown speaker to a speech signal in the database. This is the speech feature matching process described next.

After the speech signal has been framed, each frame is multiplied by a windowing function in order to remove the edge effects and the discontinuities at the edges of the signal

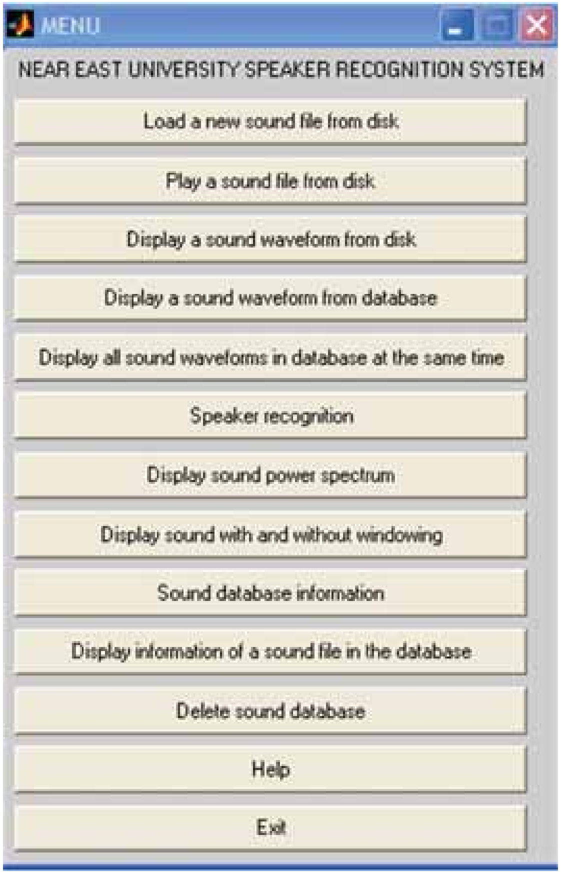


Figure 4: Speaker recognition system MENU

Speech Feature Matching

Feature matching is the process of matching a speaker to a speech signal in the database in order to determine the identity of the speaker (assuming that a sample of the speaker's speech is already in the database).

There are several speech feature matching methods used, and some of the popular ones are: Dynamic Time Warping (DTW), Hidden Markov Modeling (HMM) and Vector Quantisation (VQ). Here, the VQ approach is used for its ease of implementation and relatively high accuracy and success rate.

The VQ method is like an approximator, and in this method a lossy data compression is used, based on the principle of coding. Here, a speaker-specific codebook is generated for each known speaker by clustering his/her acoustic vectors. The distances from a vector to the codebooks are then calculated and the speaker corresponding to the VQ codebook with the smallest total distance is the identified speaker.

The LBG (Linde-Buzo-Gray) algorithm is used to solve the optimality criteria and derive a good codebook. This is an iterative algorithm and requires an initial codebook. The iterative process is repeated until the desired number of code vectors is obtained. Based on the Euclidean distance, the speaker with the lowest distortion distance is chosen to be identified as the unknown speaker.

There's also the speech output display which displays the identity (such as the name) of the speaker whose speech sample matched one of the speech signals in the database.

MATLAB-Based Speaker Recognition

A MATLAB-based program has been developed at the Near East University for speaker recognition. The program is used initially to create a database of known speakers where the speech signals of these speakers are stored as ".wav" files in the database. Then, the framing: Hamming windowing, MFCC feature extraction and VQ feature matching methods are used to identify an unknown speaker.

The developed program is MENU based and is shown in Figure 4. The MATLAB code to implement the MENU is given in Figure 5.

```
options = 13;
sel = 0;
% THE MAIN MENU
% = = = = = = = = = = = = =
while sel ~ = options,
 sel = menu('NEAR EAST UNIVERSITY SPEAKER
RECOGNITION SYSTEM',...
'Load a new sound file from disk',...
'Play a sound file from disk',...
'Display a sound waveform from disk',...
'Display a sound waveform from database',...
'Display all sound waveforms in database at the same
time',...
'Speaker recognition',...
'Display sound power spectrum',...
'Display sound with and without windowing',...
'Sound database information',...
'Display information of a sound file in the database',...
'Delete sound database',...
'Help',...
'Exit');
```

Figure 5: MATLAB code to implement the MENU

Option 1: Load a New Sound File from Disk

This is the first option of the MENU and it allows the user to add sound files to the database. The files must already exist on a digital medium (e.g. on the hard disk) and must have ".wav" file extensions. In a typical speaker recognition application a microphone is used to record and save the speech signals as files on a digital medium. These files are just like any other ordinary computer files and can be copied, deleted, renamed and so on. It is important to note that all the recordings should be done in the same environment, using the same equipment and same settings.

Option 2: Play a Sound File from Disk

This option allows the user to play a selected sound file on the speakers of the PC. The MATLAB code to implement this option is given in Figure 6.

```
% MENU OPTION 2 - PLAY A SOUND FILE FROM DISK
% = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = = = = = = = = = = = = = =

if sel = = 2
 [filename,pathname] = uigetfile('*.wav');
 [y, Fs, nbits] = wavread(strcat(pathname,filename));
 wavplay(y,Fs);
end
```

Figure 6: Code to implement Option 2

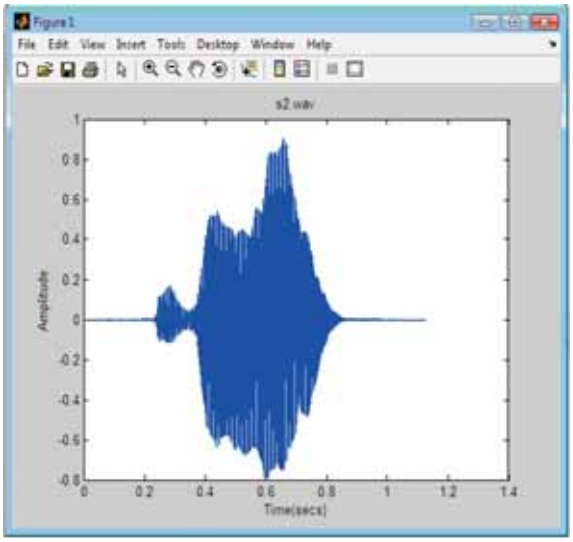


Figure 7: Typical output from Option 3

Option 3: Display a Sound Waveform from Disk

This option allows the user to select and display a sound file using a Dialog Box. Figure 7 shows a typical output when sound file called "s2.wav" was selected and displayed.

The MATLAB code used to implement Option 3 is given in Figure 8.

```
% MENU OPTION 3 - DISPLAY A SOUND
WAVEFORM FROM DISK
% = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

 if sel = = 3
 [filename,pathname] = uigetfile('*.wav');
 [y, Fs, nbits] =
wavread(strcat(pathname,filename));
 t = 0:1/Fs:length(y)/Fs-1/Fs;
 plot(t,y)
 xlabel('Time(secs)');
 ylabel('Amplitude');
 title (filename);
 end
```

Figure 8: Code to implement Option 3

Option 4 is similar to Option 3, but here the sound file is selected from the database and not from the disk.

Option 5: Display All Sound Waveforms in the Database

This option displays the waveform of all the sound files stored in the database. Figure 9 shows an example output when this option is selected (in this example there were only three files in the database named "s1.wav", "s2.wav" and "s3.wav").

The MATLAB code extract used to implement Option 5 is shown in Figure 10.

```
% MENU OPTION 5-DISPLAY ALL WAVEFORMS IN
DATABASE
% = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

if(sel = = 5)
for ii = 1:sound_no
id = data{ii,2};
filename = data{ii,4};
pathname = data{ii,3};
[y, Fs, nbits] =
wavread(strcat(pathname,filename));
t = 0:1/Fs:length(y)/Fs-1/Fs;
subplot(4,3,ii); plot(t,y); xlabel('Time(secs)');
ylabel('Amplitude'); title (filename);
end
end
```

Figure 10: Displaying all waveforms in the database

Option 6: Speaker Recognition

This is the main option of the program where the actual speaker recognition process is carried out. Here, the MFCC coefficients are extracted and the acoustic vectors are formed. The VQ method is then used to generate codebooks and the features of the unknown speaker are compared to those in the database. Details of the best matching speaker are displayed. Figure 11 shows an extract from the speaker recognition process where the speech signal "s2.wav" has been identified and its details are displayed.

Option 7: Display Sound Power Spectrum

This option displays the power spectrum of a sound file selected by the user. Both the linear and the logarithmic power

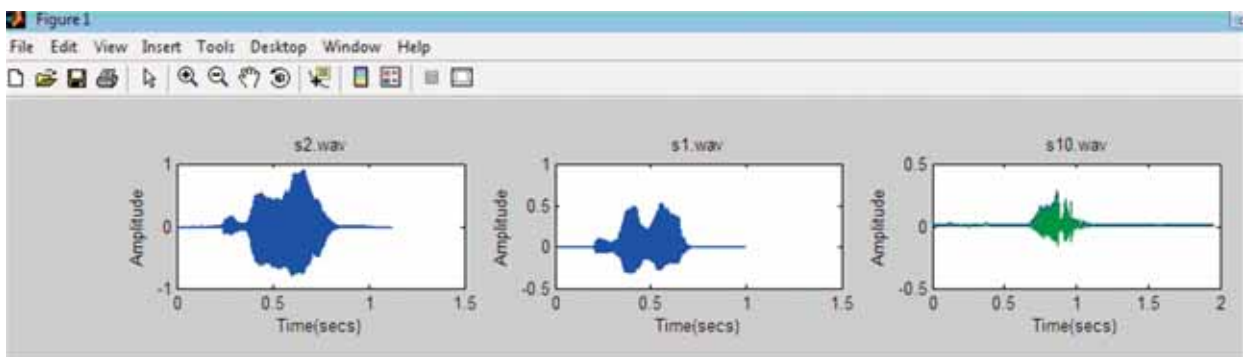


Figure 9: Displaying waveforms of all sound files in the database

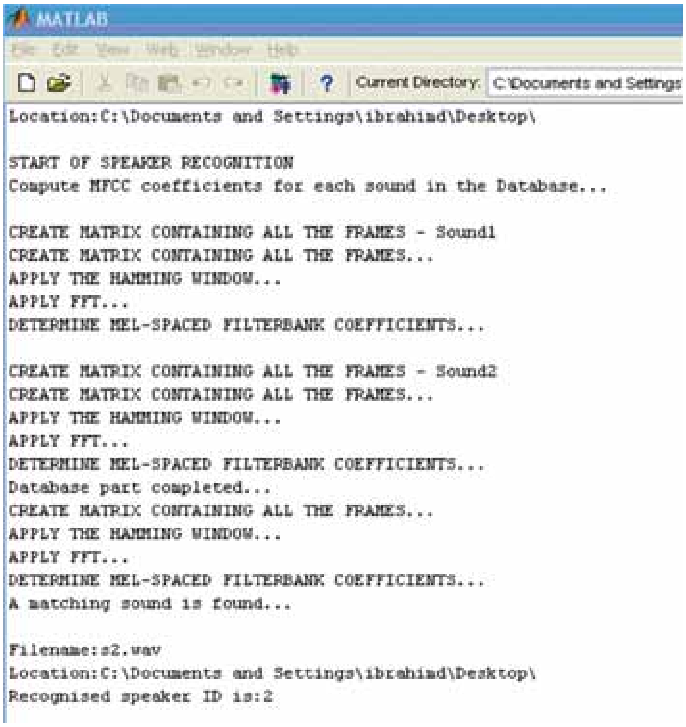


Figure 11: Typical speaker recognition process

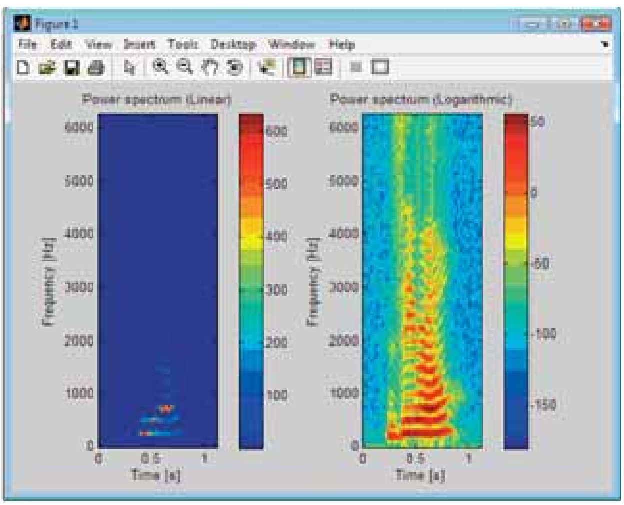


Figure 12: Typical power spectrum displayed by Option 7

spectrums are displayed. Figure 12 shows a typical output displayed when this option is selected.

The MATLAB code (function "pspectrum") used to plot the power spectrum is shown in Figure 13.

```
% OPTION 7 - DISPLAY SOUND POWER SPECTRUM
(Linear and Logarithmic)
% = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = = = = =

function r = pspectrum(s, fs)
 L = length(s);
 m = 100;
 n = 256;

 nbFrame = floor((L - n) / m ) + 1;
 %
 % Create a matrix M containing all the frames
 %
 for i = 1:n
 for j = 1:nbFrame
 M(i, j) = s(((j - 1) * m) + i);
 end
 end
 %
 % Now apply HAMMING window and store in
matrix N.
 %
 h = hamming(n);
 N = diag(h) * M;
 %
 % Now apply FFT and create a new matrix M2.
 %
 for i = 1:nbFrame
 M2(:,i) = fft(N(:, i));
 end

 t = n / 2;
 tm = length(s) / fs;
 subplot(121);
 imagesc([0 tm], [0 fs/2], abs(M2(1:t, :)).^2), axis xy;
 title('Power spectrum (Linear)');
 xlabel('Time [s]');
 ylabel('Frequency [Hz]');
 colorbar;

 subplot(122);
 imagesc([0 tm], [0 fs/2], 20*log10(abs(M2(1:t, :)).^2)),
axis xy;
 title('Power spectrum (Logarithmic)');
 xlabel('Time [s]');
 ylabel('Frequency [Hz]');
 colorbar;
```

Figure 13: Code used to plot the power spectrum

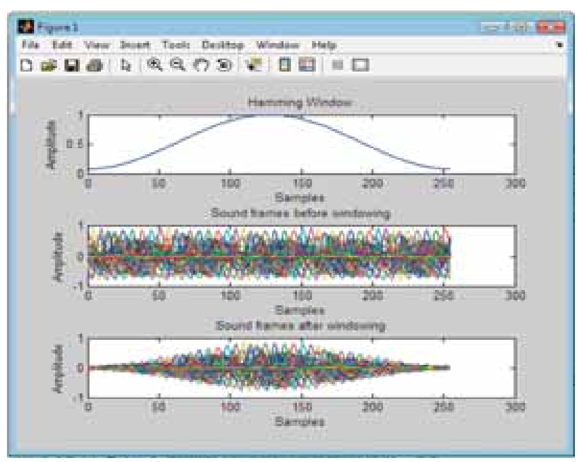


Figure 14: Typical output from Option 8 showing the effects of windowing

IN GENERAL, LIKE MOST SIGNAL PROCESSING (E.G. IMAGE PROCESSING) RECOGNITION SYSTEMS, THE MAIN RECOGNITION SYSTEM CONSISTS OF FIVE MODULES:

RECOGNITION SYSTEM MODULES

- input data capturing,
- pre-processing,
- feature extraction,
- feature matching, and
- output display.

Option 8: Display Sound With and Without Windowing

The windowing is done to avoid problems due to truncation of the signal. This option displays a sound signal waveform before and after applying Hamming windowing to the sound frames. Figure 14 shows a typical output from the program. The Hamming Windows is displayed at the top, followed by the sound frames before and after windowing.

The MATLAB code (function "compwind") extract used to implement Option 8 is given in Figure 15.

```
% MENU OPTION 8 - DISPLAY SOUND WITH AND
WITHOUT WINDOWING
% = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = = = = = = = = = = = = = = = = = = = = = = = = = = =
= = =

function r = compwind(s, fs)
 L = length(s);
 m = 100;
 n = 256;

 nbFrame = floor((L - n) / m ) + 1;

%
% Create a matrix M containg all the frames
%
 for i = 1:n
 for j = 1:nbFrame
 M(i, j) = s(((j - 1) * m) + i);
 end
 end

%
% Now apply HAMMING window and store in
matrix N
%
 h = hamming(n);
 N = diag(h) * M;
%
% Now plot the signal, without window, and with
window
%
 t = (0:n-1);
 subplot(3,1,1);
 plot(t,h);
 title('Hamming Window');
 xlabel('Samples');
 ylabel('Amplitude');
%
% Plot the signal without windowing
%
 subplot(3,1,2);
 plot(t,M);
 title('Sound frames before windowing');
 xlabel('Samples');
 ylabel('Amplitude');
%
% Plot the signal with windowing
%
 subplot(3,1,3);
 plot(t,N);
 title('Sound frames after windowing');
 xlabel('Samples');
 ylabel('Amplitude');
```

Figure 15: Code to implement Option 8

Option 9 and Option 10 display information about all the files or a single file in the database respectively. The names and identities of files are displayed. Option 11 deletes the existing sound database and all its contents. Finally, Option 12 is a "Help" display and it shows a list of all the options with a brief description of each option.

Implementation

The development of a MENU-based speaker recognition system has been described. The system has been implemented in MATLAB 6.5 on a Windows XP platform. Initially, samples of speech signals are created and are stored in a database. Then, the program is used to determine the identity of an unknown speaker. It is assumed that the speech sample of the unknown speaker is already in the database. This speech sample is compared with the existing samples in the database, and the identity of the speaker is determined and displayed.

The performance of a speaker recognition system is measured by its identification rate, which is the ratio of the number of speakers identified to the total number of speakers tested. Here, 10 speech samples have been used and the identification rate has been 100%. Noise was injected into the speech files and it was observed that the identification rate falls as the level of noise is increased. It was found that a higher identification rate was obtained when the number of centroids used in the program was increased.

The developed system can be used as an educational tool to teach the basic principles of speaker recognition. The system can be developed further by adding an option to record and save the speech files on disk. In addition, the effect of natural environmental noise on speaker recognition can be investigated. ●

ESTABLISHMENT OF SWITCH-TRANSMISSION ALGEBRA SYSTEM FOR RESONANT TUNNELING CIRCUITS

LIN MI, ZHANG HAI-PENG, LU WEI-FENG AND **SUN LING-LING** FROM THE ZHEJIANG UNIVERSITY AND THE HANGZHOU DIANZI IN CHINA RESPECTIVELY, PROPOSE A SWITCH-TRANSMISSION ALGEBRA THEORY APPLIED TO RESONANT TUNNELING CIRCUITS, BASED ON THE SWITCH-SIGNAL THEORY IN CONVENTIONAL DIGITAL CIRCUITS AND THE PRINCIPLE OF RESONANT TUNNELING DEVICES

Boolean algebra is the fundamental mathematics theory of binary digital circuits. The logic variable is usually expressed as "T" or "F" in Boolean algebra, which represents two opposite states, such as "ON" and "OFF" of a switch, independent of the numerical value at the beginning. However "T" or "F" are often expressed as "1" and "0" correspondingly in digital circuits, which represent high and low voltage or current signals, obtained by comparing them to a threshold voltage. Hence, logic variables can be used to express numerical values. But, there confusion can arise when the variables in Boolean algebra indicate signal states.

In conventional digital circuits, these variables are always confused with each other as the switch algebra and the signal algebra have an isomorphic structure, which does not apply in resonant tunneling circuits. This means that they are distinctly different operations and have to be defined independently of each other.

In this article, we propose a self-closed switch-transmission algebra system applied to resonant tunneling circuits, which can explicitly characterize both signals and states without confusion, and is an improved theory for resonant tunneling circuits.

Background

In conventional digital circuits, if the switch variables describing the states of a switch device (such as a transistor for example) corresponding to "T" and "F" are expressed as "ON" and "OFF", their operations can be expressed as AND, OR and NOT which constitute the series, parallel and "opposite" operations of that switch device. They make up a system called switch algebra system. If the signal variables express information in the form of high and low voltages or currents by using binary codes, they can be determined by comparing them to a threshold value, which means they have a definite numerical or character value.

In the signal algebra system, information is also processed with the AND, OR and NOT operations. As the switch operations and the signal operations have a similar algebra structure, they are often confused with each other. The switch-signal theory can clearly characterize the difference and relationship between these two systems; this can be described by two correlation operations as shown in Figure 1. The definitions are as follows:

- Correlation Operation I defines the process when a signal controls the switch state of the device. This state is determined by comparing the values of the signal and the threshold.
- Correlation Operation II defines the process when the state of the switch controls the transmission of the signals. This operation depends on the specific devices and circuits such as nMOS, CMOS, ECL, TTL and so on.

Switch-Transmission Algebra System For Resonant Tunneling Circuits

Here we will describe a novel resonant tunneling switch-transmission algebra system with two improved resonant tunneling correlation operations, and then we'll analyze the circuits of the basic correlation operations.

Resonant tunneling circuits can be designed with an improved 3-level Karnaugh map which is a simple, convenient and highly efficient design tool for small and middle scale integrated resonant tunneling circuits.

A resonant tunneling device is one of the most popular quantum devices. It offers ultra-high-speed, ultra-high-frequency, ultra-high-integration density, high efficiency and low power loss that

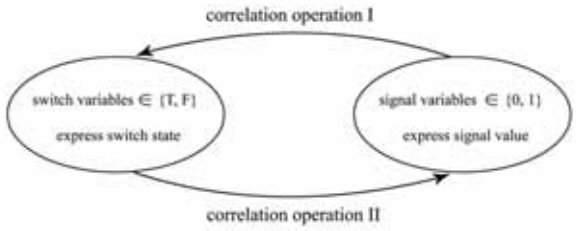


Figure 1: Switch and signal algebra system denotation graph

makes it highly applicable for VLSI in the future. However, unlike conventional digital circuits, resonant tunneling circuits do not have a general and systematic design method. The switch-transmission algebra theory and system can have a great effect on the design of resonant tunneling circuits. Some simple ways such as a new Karnaugh map method can also be used to design basic RTD logic units.

A Resonant Tunneling Diodes (RTD) and a conventional transistor, such as an HBT or a HEMT (which is commonly used), could be integrated into a tri-terminal resonant tunneling device. This makes the circuit design more flexible and could be used to realize superior functions in a simpler structure.

The RTD+HEMT combination is used in this article too (see Figure 2a). RTD is responsible for the switching function and data latching, whilst the input-output isolation is provided by the input-gate of the HEMT. This structure enables the use of RTD only for the core of the circuit, leading to a significant enhancement of the performances of various kinds of circuits. Figure 2b illustrates its *I-V* curve.

There are two positive resistance regions with positive slopes and one negative resistance region with negative grads. When RTD+HEMT operates in the positive regions (where it is an "ON" state), RTD+HEMT shows the general PN junction characteristics, the on resistance is very small – it is in a stable state. It is when the "SWITCH" state from the first positive grads region (origin V_P) coming into the negative grads region (V_P to V_V) that RTD+HEMT has a high resistance after switching. Therefore, according to the characteristics of the RTD+HEMT combination, it is defined as an "ON" state when RTD+HEMT operates in the positive grads region, and in "SWITCH" state when operates in the negative grads region, corresponding to "ON" and "OFF" states of a switch device. RTD+HEMT is a voltage-control device; its peak current corresponds to the current of V_P and will vary with V_G – the smaller the peak current is, the easier the switch state occurs at a smaller V_{DS} value. Equally, the higher the peak current is, the later the switching occurs. Accordingly, it can control the state of RTD+HMET by varying the value of the input signal V_G, which is shown in Figure 2c.

The value of V_G that makes RTD+HEMT operating in the first positive region is a low or "0" and that makes RTD+HEMT operating in the second positive region a high or "1".

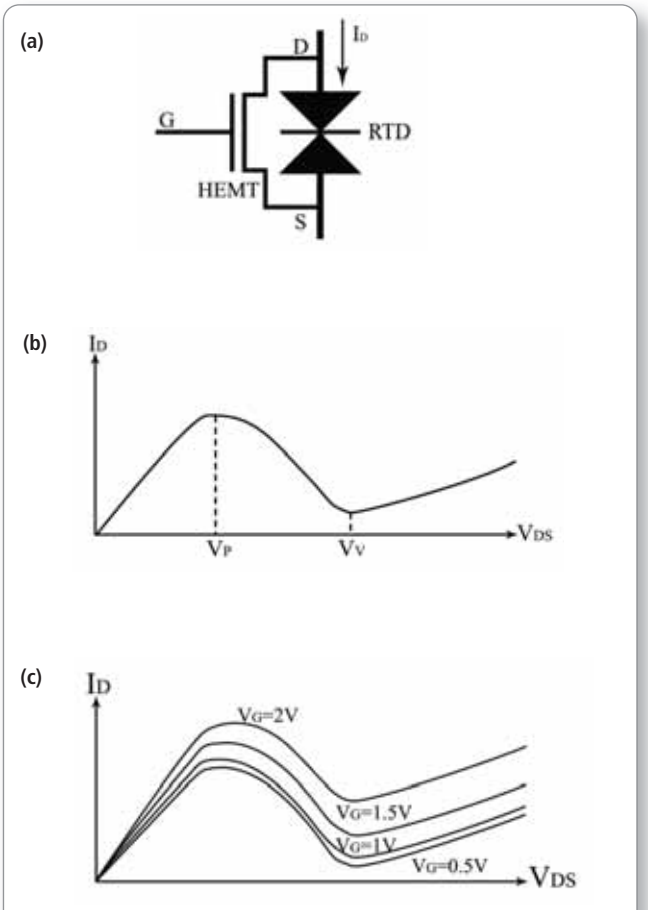


Figure 2: (a) RTD+HEMT; (b) I-V characteristic curve of RTD+HEMT; (c) Voltage-control characteristic

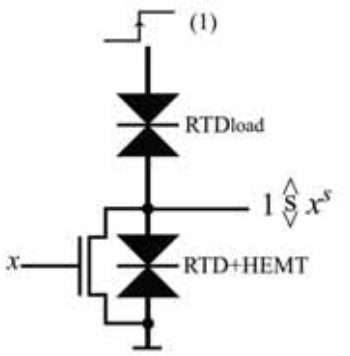


Figure 3: $1\hat{s}x^s$ operation circuit

Correlation Operation

The resonant tunneling Correlation Operation I can be divided into two sub-operations: a comparison operation with a high threshold and a comparison operation with a low threshold. Their definitions are as follows.

Comparison operation with high threshold:

$$ {}^{s}x = \begin{cases} T\left(when\ x > V_V\right) \\ F\left(when\ V_P < x < V_V\right) \end{cases} \qquad (1) $$

Comparison operation with low threshold:

$$x^s = \begin{cases} T\,(when\ x < V_P) \\ F\,(when\ V_P < x < V_V) \end{cases} \quad (2)$$

where x is a signal variable, operating in the first positive resistance region and the second positive resistance region; it corresponds to a signal "0" and "1" in the resonant tunneling circuits. s is threshold, $s \in \{ V_P, V_V \}$, which is a voltage range and covers the negative resistance region of RTD and it is different from the conventional digital circuits in which the threshold is a certain value, such as 0.5 for example, and s will vary with the input signal.

Correlation Operation II reflects the process where the "SWITCH" state or "ON" state of the resonant tunneling devices determines which signal will be transmitted to the output terminal. It may also be defined into two sub-operations.

One is a switching operation:

$$y \overset{\wedge}{\underset{\vee}{S}} a = \begin{cases} y\,(when\ a = T) \\ 0\,(when\ a = F) \end{cases} \quad (3)$$

where y is the signal that needs to be transmitted and a is the switching variable.

The other is incorporation operation where several signals need to be transmitted:

$$y_1 \overset{\wedge}{\underset{\vee}{S}} a_1 \,\|\, y_2 \overset{\wedge}{\underset{\vee}{S}} a_2 = \begin{cases} y_1 \overset{\wedge}{\underset{\vee}{S}} a_1\,(when\ a_2 = F) \\ y_2 \overset{\wedge}{\underset{\vee}{S}} a_2\,(when\ a_1 = F) \end{cases} \quad (4)$$

It is assumed that the switching operations $\overset{\wedge}{\underset{\vee}{S}}$ have higher priority than the incorporation operations and when $y_1 \neq y_2$, a_1 and a_2 are not both equal to T.

By using these two correlation operations, the execution process of the resonant tunneling circuits can be easily described. The resulting value of the comparison between the signal x and threshold s decides whether RTD+HEMT is in the "ON" or "SWITCH" state, which further decides whether the signal y is transmitted to the next node.

(1) If $y = 1$

As x^s is a comparison operation with a low threshold, when $x = 0$, $1 \overset{\wedge}{\underset{\vee}{S}} x^s$ can transmit a signal "1" to the output, otherwise the transmission signal is cut off. The $1 \overset{\wedge}{\underset{\vee}{S}} x^s$ operation can be expressed by a basic RTD gate circuit as shown in Figure 3.

Coincidentally, the unit for the comparison operation with a low threshold in transmitting the signal "1" has the same structure as a MOBILE (monostable-bistable transition logic element), as discussed by Maezawa K, Matsuzaki H, Arai K, et al in *'High-speed operation of a resonant tunneling flip-flop circuit employing a MOBILE'* in the 55th Device Research Conference Digest, 1997:94-95. Notice that in this structure, the transmission signal "1" is the supply voltage and is transmitted to the output only when the supply voltage jumps from "0" to "1" instead of operating at a stabilized "1" voltage, and its peak voltage must be greater than twice of V_P. The operating of $1 \overset{\wedge}{\underset{\vee}{S}} x^s$ is taken as an example to analyze the process at the level of the device.

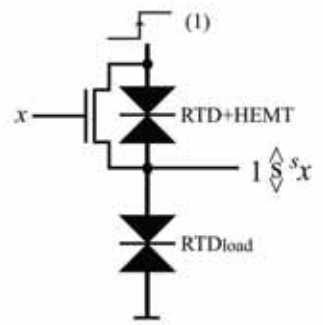


Figure 4: $1 \overset{\wedge}{\underset{\vee}{S}} x$ operation circuit

According to the definition of the comparison operation with a low threshold, the relationship between the RTD+HEMT state and the signal variable x is that "0" corresponds to ON and "1" corresponds to OFF. When $x = 0$, once the positive supply pulse comes in, the RTD+HEMT driver, whose peak current is lower, will switch first and then it'll act as a very high negative resistance, which can be regarded as "open" state. Consequently, the signal "1" is transmitted to the output terminal via RTD_{load} as RTD_{load} is in the "ON" state. When $x = 1$, it's the other way around. Therefore, it is key to choose an appropriate RTD_{load} and RTD+HEMT, with an appropriate peak current.

(2) If $y = 0$

The structure in Figure 3 also fits the $0 \overset{\wedge}{\underset{\vee}{S}} x^s$ operation when the supply voltage is "0", meaning if only the transmission signal y is zero the output is zero regardless of the value of x. So, we can mainly focus on $1 \overset{\wedge}{\underset{\vee}{S}} x^s$ in the $y \overset{\wedge}{\underset{\vee}{S}} x^s$ operation.

Similar to the $y \overset{\wedge}{\underset{\vee}{S}} x^s$ operation, $y \overset{\wedge}{\underset{\vee}{S}} {}^s x$ also has two cases. Their basic structure is illustrated in Figure 4.

If $y = 1$, when $x = 0$ RTD+HEMT switches first into high impedance so that the output terminal is shorted to the ground via RTD_{load}. When $x = 1$, RTD+HEMT is in "ON" state and the signal of "1" is transmitted to the output terminal. If the transmission signal y is zero,

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Basic accuracy of 1.5%.

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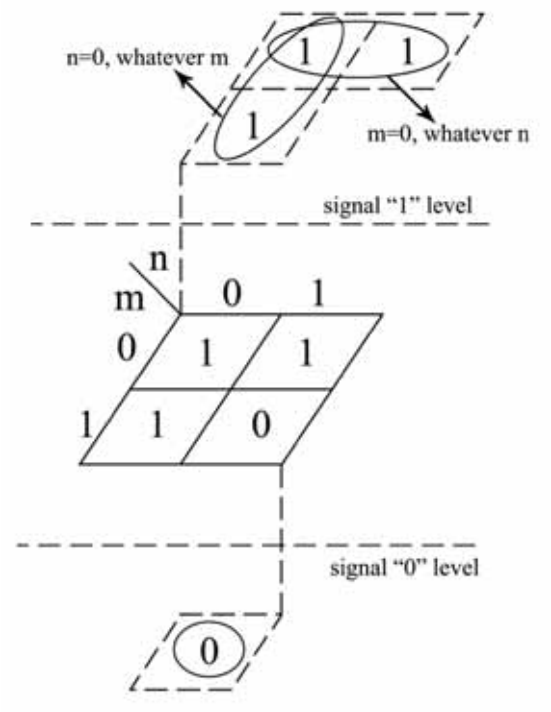

Figure 5: 3-level Karnaugh map of a binary NAND operation

the output is zero regardless of what x is. The supply voltage is the same as $y \overset{\wedge}{\underset{\vee}{s}} x^s$, a pulse signal jumping from "0" to "1".

Application Examples

Here, we explain how to use the switch-transmission theory and a new 3-level Karnaugh map to design and realize resonant tunneling logic units. We take a binary NAND operation as an example; its 3-level Karnaugh map is illustrated in Figure 5. The signal which is to be transmitted can be divided into two parts as "0" and "1".

When variable $m = 0$, whatever n, the output is 1; when variable $n = 0$, whatever m, the output is also 1; when both m and n are 1, the output is 0. Thus, combined 3-level Karnaugh map with correlation operations the output expression f of the NAND operation in resonant tunneling circuits can be expressed as:

$$f = 1 \overset{\wedge}{\underset{\vee}{s}} (m^s \| n^s) + 0 \overset{\wedge}{\underset{\vee}{s}} (\bar{}^s m \cdot^s n) \quad (5)$$

Here, "·" reflects the AND operation.

According to the correlation operations, only part of $1 \overset{\wedge}{\underset{\vee}{s}} (m^s \| n^s)$ matters here. Based on the definition of the comparison operation with low threshold and incorporation operation, the binary resonant tunneling NAND circuit's structure with two variables is shown in Figure 6a.

Figure 6b is the results of the functional simulation. The supply voltage V_{CC} is a 2.0V pulse signal, the high voltage of m and n are 1.6V, and the high voltage of output f is 1.48V, whereas the low voltage of output f is 0.26V.

Figure 7 is the structure of a NOR circuit. The high voltage of the output f is 1.47V, whereas the low voltage of the output f is 0.18V.

Future Work

A novel and improved switch-transmission theory and algebra system are discussed here; two correlation operations and their basic logic unit circuits are realized and analyzed based on resonant tunneling devices. We also discuss a new method to design basic logic resonant tunneling circuits by using a 3-level Karnaugh map.

Going forward, research efforts will be needed on more sophisticated resonant tunneling logic circuits designs. Future work should focus on the mathematics as well as the experimental data, and discuss whether there are other expression circuits of the $y \overset{\wedge}{\underset{\vee}{s}} x^s$ and $y \overset{\wedge}{\underset{\vee}{s}} {}^s x$ operation; whether the transmitted signals "0" and "1" have other circuit structures; whether there are three-dimensional Karnaugh map adapted to resonant tunneling circuits' concluding variables and threshold; and whether the theory and algebra system can be applied in a multi-valued resonant tunneling circuits design. ●

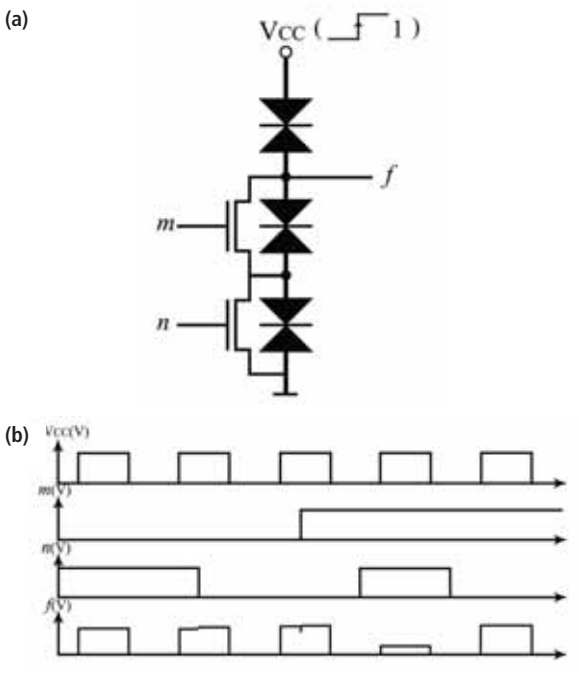

Figure 6: (a) Structure of resonant tunneling NAND circuit; (b) Simulation curves

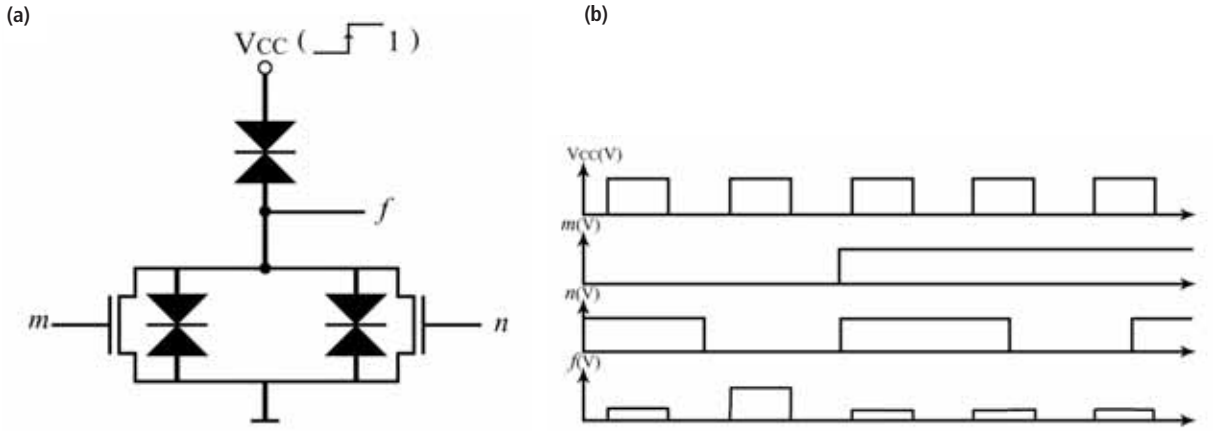

Figure 7: (a) Structure of resonant tunneling NOR circuit; (b) Functional simulation curves

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41ST EUROPEAN MICROWAVE CONFERENCE 2011
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THE ELECTRONICS BEHIND LIGHTING – PART 5

HAKKI CAVDAR FROM THE KARADENIZ TECHNICAL UNIVERSITY IN TURKEY PREPARES THIS FIVE-PART SERIES ON LIGHTING ELECTRONICS – THE FUNDAMENTALS, THE TOPOLOGIES AND THE TYPES OF BALLAST CIRCUITS USED. IN THIS FIFTH AND LAST PART, HE DESCRIBES THE DESIGN OF A DRIVER FOR LED TYPE LIGHTING

The use of LED lamps has recently increased minifold in our life, including for indoor and outdoor applications, as LED technology continues to develop.

LED lighting has many advantages over other types of lighthing, including efficiency of up to 80%, which means that over 80% of the electrical energy is converted into light energy. The operational life of current white LED lamps is very long – some 100,000 hours.

Although there are many kinds of LEDs in the electronics world, LED types may be classified into to two main categories such as: low current LEDs (20mA) and high power LEDs (above 350mA). LEDs need to operate at approximately 3-4V on their terminals. Their voltage-current characteristics may differ though between different LEDs, but they all need a constant current to be driven and as such their ballast circuit need an LED driver. Low current LEDs operate with a constant 20mA current, whereas high-power LEDs (HPLEDs) may be driven at the 350mA or above with respect to their power rates. LEDs work at direct (dc) and constant currents.

> The threshold values of HPLEDs vary with the manufacturer, because of their different dopant materials and wavelengths

Like with other lamp ballasts, LED drivers must include EMI filter and PFC sections. After these stages, an LED driver should be designed according to the structure of the lamp and its power ratings. Generally LED lamps can be configured as a string of LEDs. An HPLED's power rating is approximately 1W at 350mA and 3.3W at 1A. So, in order to build a high power LED lamp, many LEDs are connected in series and/or parallel. For example, for a 50W LED lamp, 50 LEDs should be used at 350mA, the configuration of which could be in series or parallel strings.

The design of the LED lamp driver depends on the structure of the LED strings. Every LED lamp needs a driver with own building specifications; it is possible to find from 1W to 200W LED lamps on the market today.

It is well understood that the LED voltage-current charasteristics are very important in order to design the LED drivers optimally. Figure 1 shows the LED V-I characteristics, where it can be seen that the relationship between the forward voltage and the LED current is exponantial with a threshold voltage value (Vf). Vf varies for different HPLEDS. For example, while Vf is equal 2V for a red LED, it is 3.5V for a blue LED.

The threshold values of HPLEDs vary with the manufacturer, because or different dopant materials and wavelengths. A 1W white LED has a typical Vf = 3.42V but the minimum voltage is 2.79V and the maximum 3.99V. This is over ±15% tolerance on the forward voltage threshold. It is because of such differences within an LED group that LEDs are driven with constant current techniques.

The equivalent circuit of an LED is also given in Figure 1. The behavior of an LED is about a series resistance and a Zener diode. The Zener diode in the LED equivalent circuit represents the threshold voltage Vf, and the series resistance, R, is also the inverse of the slope of the V-I curve. In order to test the HPLED, this equivalent circuit can be used before designing the LED lighting's electronics.

LED Driver Typologies and Design Techniques

LEDs may be classified into two groups: low current LEDs and high power LEDs. Low current LEDs are generally driven by a 20mA current and this type of current source can be designed and built by various methods. A BJT, MOSFET, operational amplifier or a linear voltage regulator may be used in the 20mA current design. On the other hand, IC manufacturers such as Supertex, Infineon, TI, Linear and others have been producing 20mA LED drivers ICs.

In Figure 2, two samples of 20mA current driver ICs, CL2 and BCR402R are given. Both ICs can have over 95% efficiency, if their

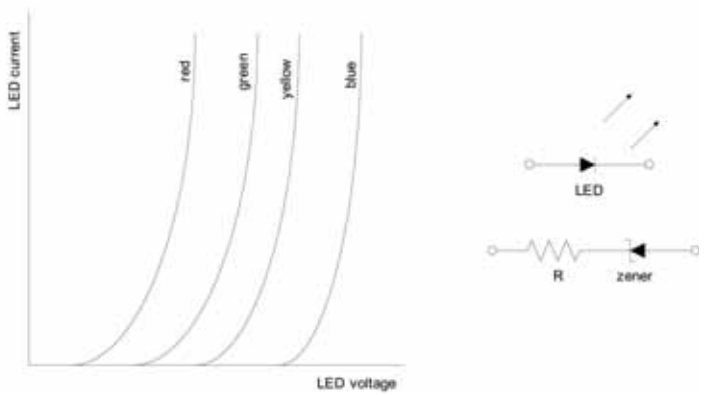

Figure 1: V-I characteristics and the equivalent circuit of HPLED

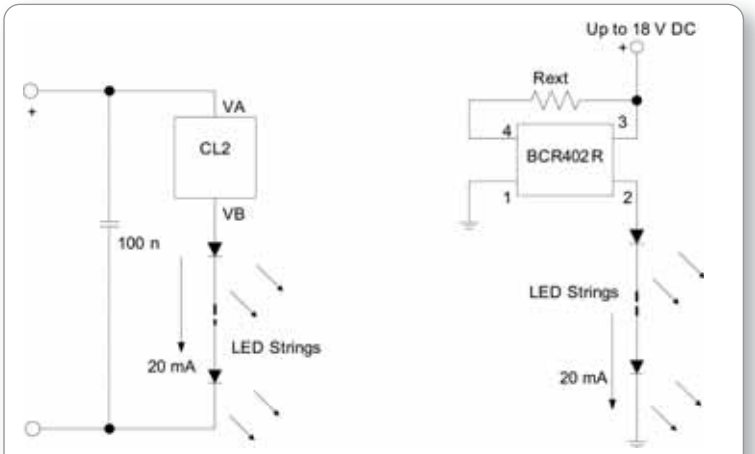

Figure 2: Two examples of 20mA drivers for a low current LED

supply voltages are selected regarding an optimal number of LEDs in a string.

High power LEDs (HPLEDs) are driven from 350mA up to 1.5A and as such the structure of their driver is different from the low current LEDs. There are different HPLED driver topologies and they can be grouped into two ways:

1. **Drivers that use low voltage DC:** This group uses a low voltage DC supply (5V-48V). Generally, solar energy and batteries can be used as a power supply for outdoor lighting. DC/DC converters are used to drive HPLEDS; Buck and Boost converters are suitable topologies.

   Figure 3 shows an example of this type of drivers. An HV9910B Buck IC is mainly used in this design. Also, a comparator is needed and LM311 is possible in order to control the current.

2. **Drivers that use main AC power:** isolated drivers and non-isolated drivers.

Indoor, outdoor and street lighting should use main AC power, so the HPLED drivers need power supplies that work as AC/DC from the mains supply directly.

The mains AC drivers can be classified as isolated and non-isolated. Some lighting standards deploy isolated LED drivers, especially for indoor applications. Outdoor and street lighting electronics can use non-isolated drivers.

An HPLED driver that uses low voltage DC is given Figure 3. The DC bus voltage is 24V, and the HPLED current is selected at 500mA. Current adjustment is provided by a 2V7 Zener diode, 2K7 and 470-ohm voltage divider resistances and the 0.8-ohm serial resistance at the LED string. The driver topology is Buck-based (HV9910B).

Six HPLED should be connected in series at the output of driver. The power rating of the driver is around 10-11W with over 90% efficiency. The string can consist of 1 to 6 LEDs at a constant current of 500mA.

In Figure 4 is an example of an HPLED driven from the mains. For such configuration an EMI filter and PFC circuits are necessary. Following PFC, a 400VDC voltage is provided and the driver is driven by this DC voltage. Here an isolated driver is preferable, as it offers certain advantages, especially at indoor lighting applications. Isolation is provided by the flyback transformer, T. The topology is based on a flyback DC/DC converter. The transformer is the crucial element. It should be designed according to power ratings, output voltage value, efficiency and working temperature of the lighting design in mind.

There are many SMPS transformer manufacturers, including Coilcraft and Magnetica.

In our case, the LED driver is designed based on the popular flyback SMPS power supply that uses the L6561 IC. The second side of the secondary coil of T is described as CC (constant current) driver. Here, the HPLED current is selected at 800mA. Due to different common terminal between the SMPS and CC sides, an opto coupler (4N35) is used to control the triggering signals.

An LED string voltage may be used up to 24V DC, which means six HPLEDs may be driven at the output. If more LEDs are to be connected, for example 12 LEDs, the output voltage rises to 48VDC, therefore the DC supply of the comparator, LM311, has to be regulated so it does not exceed 24 VDC. ●

If you've missed other parts of this article, you can order their digital issue copies on line at **www.electronicsworld.co.uk**

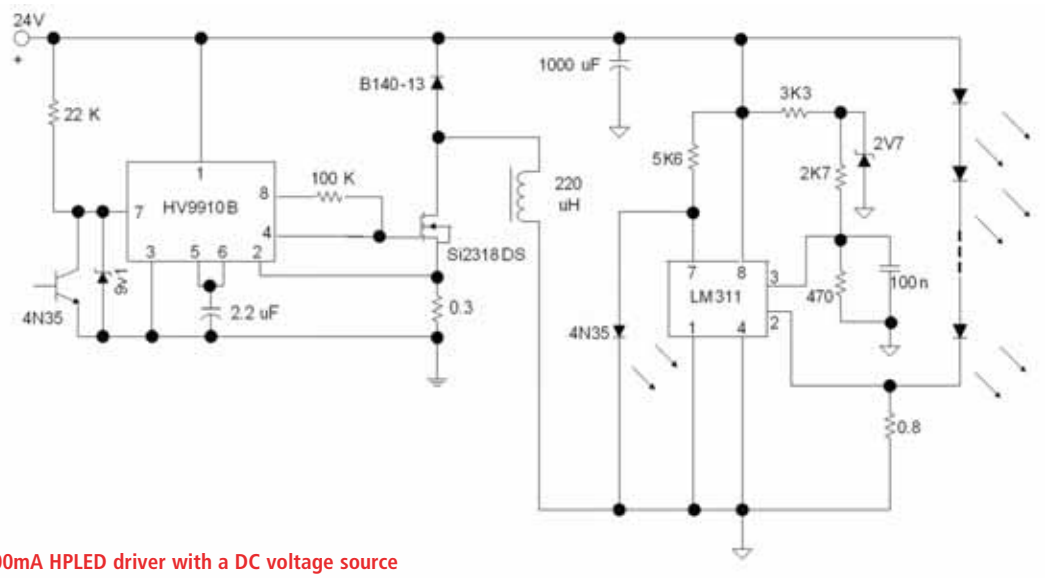

Figure 3: 500mA HPLED driver with a DC voltage source

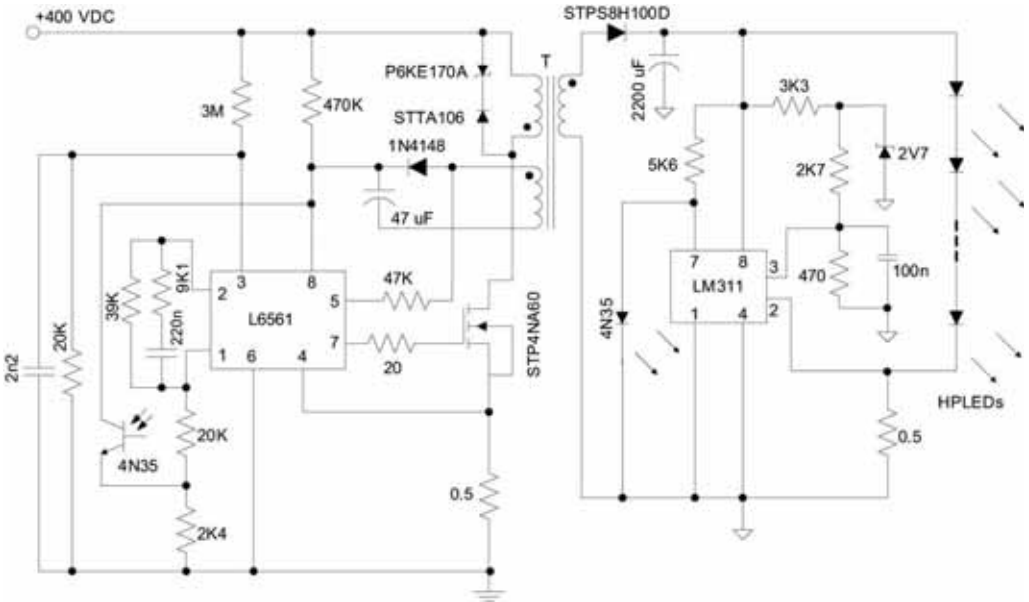

Figure 4: HPLED driver at a constant current using the AC mains power

EUROPEAN MICROWAVE WEEK 2011

9th - 14th October 2011

Manchester Central, Manchester, UK

European Microwave Week 2011 is a 6-day international event with a 3-day exhibition and 3 major conferences spread over 5 days, associated workshops and hands-on exhibitor workshops and seminars.

It is considered to be the largest trade show dedicated to the subject of RF and Microwave in Europe. This year, its organizers expect an even larger number of visitors and delegates.

The event provides some 7500sqm of exhibition space, with around 5000 visitors from around the globe, up to 2000 conference delegates and in excess of 250 exhibitors.

The exhibition offers companies an invaluable opportunity to present their latest technological developments, as well as a forum for discussing trends and exchanging scientific and technical information. There is a series of conferences, tutorials and workshops. The conferences encompass many subject areas including:

- Microwave components;
- Systems and subsystems for telecommunications;
- Satellite and aerospace;
- Defence/homeland security;
- Radar;
- Automotive;
- High frequency applications;
- Emerging technologies.

This year, it will be the 14th European Microwave Week and it's being held in Manchester, UK. The previous years the event was staged in Amsterdam, The Netherlands, in 1998, 2004 and 2008; London, UK, in 2001; Manchester, UK, in 2006; Milan, Italy, in 2002; Munich, Germany, in 1999, 2003 and 2007; Paris, France, in 2000, 2005 and 2010; and Rome, Italy, in 2009.

The conference has grown over the years and is now considered the premier event in this field in Europe. In addition, Exhibitor Workshops, Seminars and Round Table Forums will be a platform for leading manufacturers, institutes and industry bodies to stimulate dialogue and interaction with attendees on relevant Microwave, RF, Wireless, Defence/Security and Radar issues.

The week provides an invaluable opportunity for industrialists, academics and researchers to consider the latest trends and developments within the ever-widening field of microwaves.

To find out more and register go on line at www.eumweek.com

CONFERENCES

The conference part of European Microwave Week has grown over the years and is now considered "the premier event" in this field in Europe. The European Microwave Week consists of three conferences:

- **The European Microwave Conference (EuMC)**
- **The European Microwave Integrated Circuits Conference (EuMIC)**
- **The European Radar Conference (EuRAD)**

THE 41ST EUROPEAN MICROWAVE CONFERENCE (EUMC) represents the main event in the European Microwave Week 2011 and now incorporates the wireless topics previously covered in the Wireless Technologies Conference (EuWIT) in a series of dedicated sessions common with the European Microwave Integrated Circuits Conference (EuMIC).

THE 8TH EUROPEAN RADAR CONFERENCE (EURAD 2011) will be held from Wednesday 12th to Friday 14th October 2011 in Manchester, UK, as part of the European Microwave Week 2011. This Radar Conference is the major European forum for the present status and the future trends in the field of radar technology, system design, and applications.

THE 6TH EUROPEAN MICROWAVE INTEGRATED CIRCUITS (EUMIC) Conference will be held from 10 - 11 October 2011 in Manchester, UK as part of the European Microwave Week. This microwave integrated circuits conference will continue to help make European Microwave Week the largest event in Europe related to RF microelectronics.

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Steady Flow of New Products by Pickering Interfaces

Pickering Interfaces has continued in 2011 to regularly release a steady flow of new products in both the LXI and the PXI platforms.

"LXI enquiries have been particularly strong in the last six months as more and more users are realizing the benefits of this platform. These enquiries are leading to a steadily increasing number of switching solutions being made available by Pickering Interfaces and LXI is becoming an increasingly important part of our business model. But PXI is as usual an important part of our business and we are committed to continuing to expand our range of switching solutions using this platform. We consider PXI and LXI to be complementary platforms that we will pursue in parallel, selecting the most appropriate platform for each application," said Nick Hickford, Sales Manager for UK and Ireland, at Pickering Interfaces.

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Analog Devices Exhibits at European Microwave Week

Analog Devices will be exhibiting at the 14th European Microwave Week 2011 at booth #319. Using a unique combination of design skills, system understanding and process technologies, Analog Devices offers the broadest portfolio of RFICs covering the entire RF signal chain from industry-leading high-performance RF function blocks to highly integrated single chip transceiver solutions. The RF function blocks include PLL, PLL/VCO and DDS synthesizers; power detectors; amplifiers; mixers, modulator and demodulators; ADC drivers; clocks and data converters. They are supported by a wide range of free design tools to ease the development of RF systems.

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UK Designed and Manufactured RF Connectors on show at European Microwave Week

The only UK manufacturer of 50Ω coaxial and triaxial RF connectors will be at the European Microwave Week event in October supporting its UK Technical Representative UKRF. At the Manchester-based show Intelliconnect products will be found on stand number 618.

UKRF Managing Director Peter Frost commented: "Intelliconnect, with its unique approach to the connectivity market, has enabled UKRF to offer timely and cost-effective solutions to our customers' connectivity problems. Its success is clear proof that there are still opportunities for the emergence of UK manufacturers to cover niche markets that the global manufacturers are not able to service effectively."

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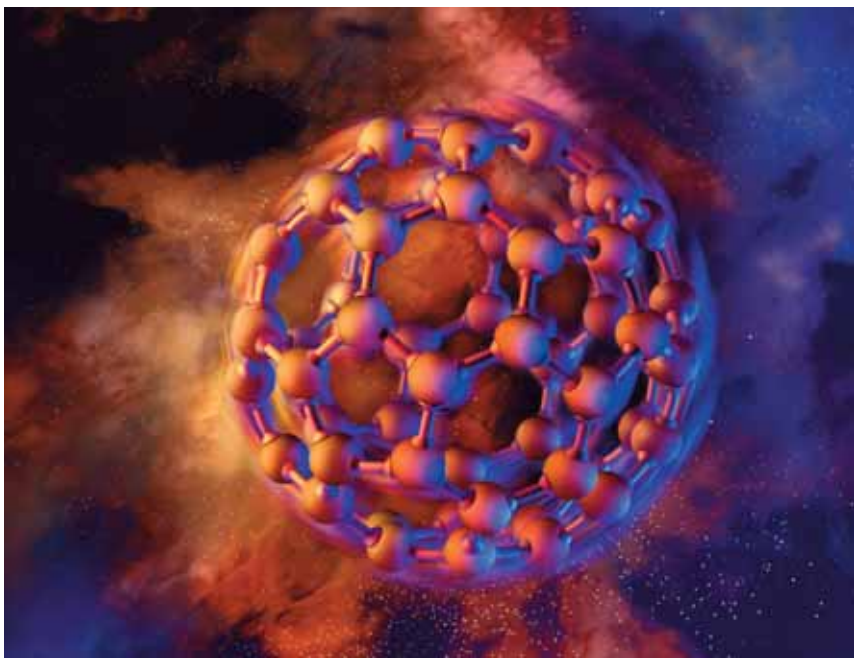
The Emerging Challenges of NANOTECHNOLOGY TESTING

OVER THE NEXT SEVERAL ISSUES OF ELECTRONICS WORLD MAGAZINE, **JONATHAN TUCKER**, CHAIRMAN, IEEE NANOTECHNOLOGY COUNCIL STANDARDS COMMITTEE, WILL PRESENT THIS TUTORIAL ON THE TEST AND MEASUREMENT ISSUES ASSOCIATED WITH NANOTECHNOLOGY

Nanotechnology offers the potential to improve our quality of life in almost unimaginable ways, starting with faster electronics, huge memory/storage capacities for PCs, cheaper energy through more efficient energy conversion, and improved security through the development of nanoscale bio and chemical-detection systems. However, in order to exploit this potential, the sensitivity of the instruments used to characterize experimental materials and devices must be much higher than with normal electronics testing, as electrical currents are much lower and many nanoscale materials exhibit significantly improved properties, such as conductivity. The magnitude of measured currents may be in the femtoamp range and resistances may be as low as microohms. Therefore, measurement techniques and instruments must minimize noise and other sources of error that might interfere with the signal.



Electrical characterization is essential to gain insight into phenomena that occur beneath the surface of nanomaterials

Although optical and electro-optical characterization techniques, such as scanning electron microscopy (SEM), emission microscopy, atomic force microscopy and ultraviolet microscopy can provide valuable information, electrical characterization is essential to gain insight into phenomena that occur beneath the surface of nanomaterials. For example, gate dielectrics in advanced semiconductors can have a physical thickness of less than one nanometer; the performance of these dielectrics can only be predicted by evaluating their equivalent electrical thickness. Similar considerations apply to carbon nanotubes, silicon wires and graphene,

BIOGRAPHICAL NOTE

JONATHAN TUCKER IS A SENIOR MARKETER, ADVANCED SCIENTIFIC RESEARCH INSTRUMENTS, AT KEITHLEY INSTRUMENTS IN CLEVELAND, OHIO which is part of the Tektronix test and measurement portfolio. He joined Keithley Instruments in 1987 and has held numerous positions including Test Engineer, Applications Engineer, Applications Manager and Product Marketer. His current focus is business strategy and product development of electrical characterization and measurement tools for nanotechnology applications. He holds a Bachelors of Electrical Engineering degree from Cleveland State University and an MBA from Kent State University.

which are the basis for many nano innovations.

The essence of nanotechnology research is to work at the molecular level, atom by atom, to create structures with fundamentally new properties. Some of the current research involves:

- Carbon nanotube enhanced materials and electronic devices;
- Semiconducting nanowires of silicon and other materials;
- Polymer nanofibers and nanowires;
- Nano and molecular electronics;
- Single electron devices;
- Graphene-based electronics.

One of the main challenges in electrical characterization of these materials and structures is the wide range of behavior they can exhibit. For example, polymer materials can have resistances greater than one giga-ohm. However, when drawn into fibers less than 100nm in diameter and doped with various nanoparticles, a polymer may be changed from a superb insulator into a highly conductive wire. The result is an extremely wide range of test signals.

Detecting tiny electrical signals at the low end of the range requires high sensitivity, high-resolution instruments such as electrometers, picoammeters and nanovoltmeters. Using one of these instruments for high level signals as well demands an instrument with a very wide dynamic range.

The nature of nanotech materials requires some novel testing techniques. Because these materials are built at the atomic or molecular level, quantum mechanics come into play. As a result of small particle sizes, the atoms and molecules of these new materials may bond differently than they might otherwise in bulk substances. There may be new electronic structures, crystalline shapes and material behavior. Nanoparticles with these new properties can be used individually or as building blocks for bulk material. Although the discovery of bulk properties remains important, measurements also need to uncover the characteristics unique to nanoscale structures.

Particle size and structure have a major influence on the measurement techniques used to investigate a material's chemical and electrical characteristics. The actual quantity being measured is often a low level current or voltage that was translated from another physical quantity. Direct electrical measurements are possible on many substances with the probing instruments and nano-manipulators now available. ●

FURTHER READING

AN ARTICLE DISCUSSING THE CHALLENGES

associated with testing materials and devices based on nanotechnology and the importance of industry standards is available at no charge: '*Standards Will Help Ensure Order in Nano-Enabled Industries*'.

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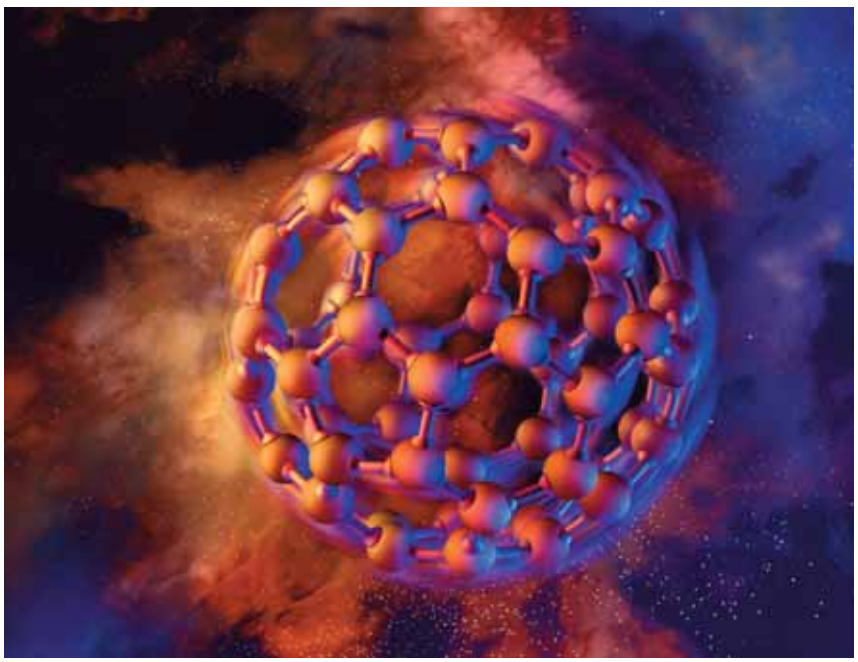

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The essence of nanotechnology research is to work at the molecular level, atom by atom, to create structures with fundamentally new properties. Some of the current research involves:

- Carbon nanotube enhanced materials and electronic devices;
- Semiconducting nanowires of silicon and other materials;
- Polymer nanofibers and nanowires;
- Nano and molecular electronics;
- Single electron devices;
- Graphene-based electronics.

One of the main challenges in electrical characterization of these materials and structures is the wide range of behavior they can exhibit. For example, polymer materials can have resistances greater than one giga-ohm. However, when drawn into fibers less than 100nm in diameter and doped with various nanoparticles, a polymer may be changed from a superb insulator into a highly conductive wire. The result is an extremely wide range of test signals.

Detecting tiny electrical signals at the low end of the range requires high sensitivity, high-resolution instruments such as electrometers, picoammeters and nanovoltmeters. Using one of these instruments for high level signals as well demands an instrument with a very wide dynamic range.

The nature of nanotech materials requires some novel testing techniques. Because these materials are built at the atomic or molecular level, quantum mechanics come into play. As a result of small particle sizes, the atoms and molecules of these new materials may bond differently than they might otherwise in bulk substances. There may be new electronic structures, crystalline shapes and material behavior. Nanoparticles with these new properties can be used individually or as building blocks for bulk material. Although the discovery of bulk properties remains important, measurements also need to uncover the characteristics unique to nanoscale structures.

Particle size and structure have a major influence on the measurement techniques used to investigate a material's chemical and electrical characteristics. The actual quantity being measured is often a low level current or voltage that was translated from another physical quantity. Direct electrical measurements are possible on many substances with the probing instruments and nano-manipulators now available. ●

FURTHER READING

AN ARTICLE DISCUSSING THE CHALLENGES

associated with testing materials and devices based on nanotechnology and the importance of industry standards is available at no charge: '*Standards Will Help Ensure Order in Nano-Enabled Industries*'.

INFO

THIS TUTORIAL CONTINUES IN THE NEXT ISSUE OF ELECTRONICS WORLD MAGAZINE.

If you don't want to miss any part of this series subscribe now by going online at www.electronicsworld.co.uk

INTERCONNECTING USB DEVICES

JOHN HYDE FROM FUTURE TECHNOLOGY DEVICES INTERNATIONAL (FTDI) IMPLEMENTS A SERIES OF USB PROJECTS FOR *ELECTRONICS WORLD*

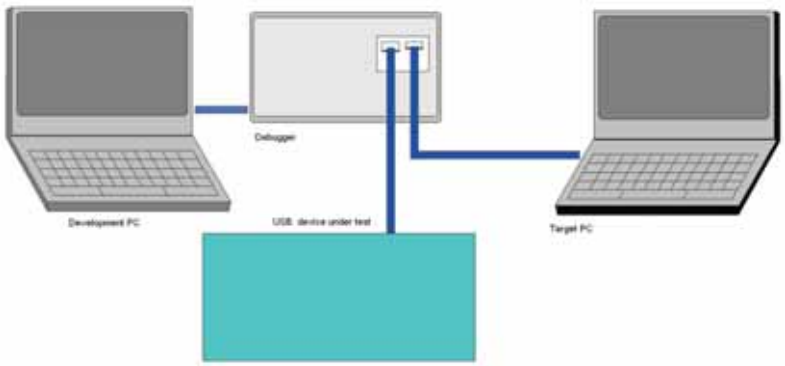


Figure 1: Equipment set up to explore USB device operation

In this article we get to be part explorer, part detective and part engineer. We're going to look at USB devices that you currently use, or would like to use, with your PC and we will repurpose these to operate in an embedded environment. We previously saw that adding a HID into a Vinculum-II project was easy, now let's look at other interesting USB devices that can be used in an embedded applications.

The range of available USB devices is enormous and, due to "PC economics", they are inexpensive. By replacing your PC with a Vinculum-II the cost reduction opens up new product opportunities. The benefit of a PC is that it is able to dynamically support all USB devices since it can be loaded with device drivers at runtime. Most of these devices have many configurable options which the PC must understand and select from. An embedded application is different – it has limited memory and is configured at design time.

Typically it only has a few devices and the developer will pre-select the operating mode of each device. An embedded application will recognize the device by its Vendor ID (VID) and Product ID (PID) so it is not necessary to read in and parse all of the device descriptors since these are pre-known by the embedded systems designer. This will simplify our coding effort.

An essential tool for our explorer phase is a USB bus spy. I use an Ellisys Tracker/Explorer but there are many other hardware tools available. We are only interested in USB devices that operate at low or full speed since these are the speeds supported by the Vinculum-II. It is likely that your PC has high-speed USB ports so you also need a USB 1.1 hub as shown in Figure 1; this ensures the high-speed mode of the USB device under test is not activated.

Figure 2: Representative audio device from cmedia

Audio In/Out Device

I decided to start by exploring an audio device since this is a complicated device in the PC world but a simple device from a Vinculum-II perspective. I chose a representative USB audio adapter from cmedia as shown in Figure 2. This sub allows me to connect a monaural audio source, such as a microphone, and a stereo audio sink, such as speakers, to a PC.

Enable your USB bus spy and attach an audio device to the PC. Once the device has been recognized (note that it will use standard class drivers as supplied with the operating system, you will not need to supply a driver), run a sound recorder application and record about 10 seconds of audio. You may have to configure your PC hardware if your target PC already contains audio hardware; then playback this audio. Finally, stop the bus spy and look at the trace of USB operation.

Figure 3 shows the general structure of the trace – the specific details will vary depending upon which audio device you selected and, to a certain extent, which OS you are using. The first phase of the trace shows the operating system reading the device descriptors and, therefore, discovering that this is an audio class device. This phase ends with the OS enabling the device via a SetConfiguration command, and selecting the zero bandwidth setting for the input and output interfaces; SetInterface(1,0), SetInterface(2,0).

Most of the descriptors are audio class descriptors used to define the elements and topology of the analogue components within the USB interface device. We could use the audio class specification to interpret these descriptors or we could do a Google search on the VID and PID and uncover a datasheet for the product; I chose the latter.

From the audio device datasheet I replicated the audio function block diagram (see Figure 4). The upper portion of the diagram describes a 16-bit stereo output channel that can run at 44.1kHz or 48kHz. The lower portion describes a 16-bit mono input channel that can run 44.1kHz or 48kHz. The input microphone can be directly mixed into the output stream.

The second phase of the USB trace shown in Figure 3 is the audio class driver reading in the settings of the audio hardware. The PC does this since the structure of the audio device is unknown.

My target PC was running Windows XP and phase three is the PC enabling the audio output channel with a SetInterface(1,1) and setting the sampling frequency to 48kHz so that it can play the familiar 'bing-bong' when a new device is detected. The two channel 16-bit, 48kHz sampling will

result in 196bytes/frame of isochronous transfers. This phase lasts 0.86s and ends when the PC turns off the audio channel using a SetInterface(1,0). Phase four is the audio recording which the PC enabled via a SetInterface(2,1) and, in my case, it chose a sampling frequency of 44.1kHz for the single channel recording. This results in mainly 88-byte isochronous transfers with about 10% 90-byte transfers to meet the 44.1kHz sample rate. This phase ends with a SetInterface(2,0).

Phase five, the audio playback, is similar to phase three.

Now let's look at the audio operation. The PC has to do a lot of work to discover the topology and details of a particular audio device. We, as embedded engineers, will choose an appropriate component that meets or exceeds our products requirements. We will identify this using its VID and PID. So there is no need to read most of the devices descriptors. To start and stop audio transfers we need to select the correct alternate interface and set the sampling rate. We will choose 48kHz since this gives a constant byte count per frame.

I have two audio examples that you can build upon. The first records audio onto a flash drive – it is a sound recorder. The second plays back audio from a flash drive – it is a sound player. I only implement a single file in each example but I use the FTDI BOMS (Bulk Only Mass Storage) driver so that will be easy for you to add buttons and save or playback multiple files. Once you see how easy it is to record and playback audio using the Vinculum-II you may consider adding audio cues to your application.

Sound Recorder

The 16-bit mono, 48kHz sampling rate produces 96 bytes every frame or 96kBytes/s. Even the slowest of flash drives I tested could keep up with this rate with modest buffering by the application. The BOMS driver works best with 512 byte writes so my example double-buffers these sector writes. You could constantly record for 24 hours and still not fill a 2GByte flash drive.

Open the SoundRecorder project and review main.c. The application program waits for a flash drive to be connected to host port 2 and waits for the cmedia device to be connected to port 1. Once both are connected a sound.dat file is created and recording continues until either device is removed or the flash drive is full. The sound that file will not be recognized by the PC since it does not have a recognized file format. I wrote a Windows console program that creates a standard Windows WAV file from sound.dat so that the data can be processed by any Windows application. If a helpful reader would like to send me an OS X version then I would be most grateful and will redistribute it to your fellow readers.

Sound Playback

The playback example uses 16-bit, stereo, 48kHz sampling so there are 192 bytes of isochronous transfers per frame. I had no problems reading all flash drives at 192kByte/s. I created a Windows console utility that removes the header from a standard WAV audio file so the audio generated on a Windows PC could be played back using the embedded Vinculum-II example. Open the SoundPlayback project and review main.c. Again I wait for both devices to be attached and then I send sound.dat to the cmedia audio device. I double buffer as before.

Position Recorder

Most GPS modules are serial-based but the Vinculum-II only has one UART and I am already using this for my debug monitor. My debug monitor displays progress messages on V2EvalTerm so, in fact, I only use the transmit half of the UART. This is the easy half since the Vinculum-II creates the data and does not have to synchronize with an external source. The SPI port could create the same data portion of the UART transmit signal but, of course, I also need to generate a start signal and two stop signals. Figure 5 shows my UART transmit signal created on the SPI port. UART data is sent lsb first so the first and every even character is a 0x7F. My UART data is sent in every odd character position and the final character is a 0xFF. The 0x7F generates my start signal and also seven stop signals. I run SPI at 6MHz so V2EvalTerm is unaware of this hardware trick. I had to change the pin routing in initialize.c and needed to add a jumper on CN10 from pin 1 to pin 5 but otherwise this additional "UART" was a zero cost option.

Figure 3: Structure of trace of an audio device operation

Having freed up the Vinculum-II UART I can now use it to receive data from the GPS module. The module runs that 4800baud and starts transmitting standard NEMA sentences as soon that it is powered on. Figure 6 shows the default sentence generated by my Garmin GPS module; this NEMA data is standardized and extensively documented on the web.

Open the PositionRecorder project and review main.c. I wait for the GPS module to lock onto the satellite signals then gather data. If adjacent samples are changing then I record this data in GPS0001.txt. When five adjacent samples show no movement I close the file and wait for changing data again. I saw no point recording data if the unit is stopped. The text files are standard, comma-delimited data files that and may be opened in Microsoft Excel or similar. The data can also be pasted into Google Earth and the recorded position data can be displayed on a map. ●

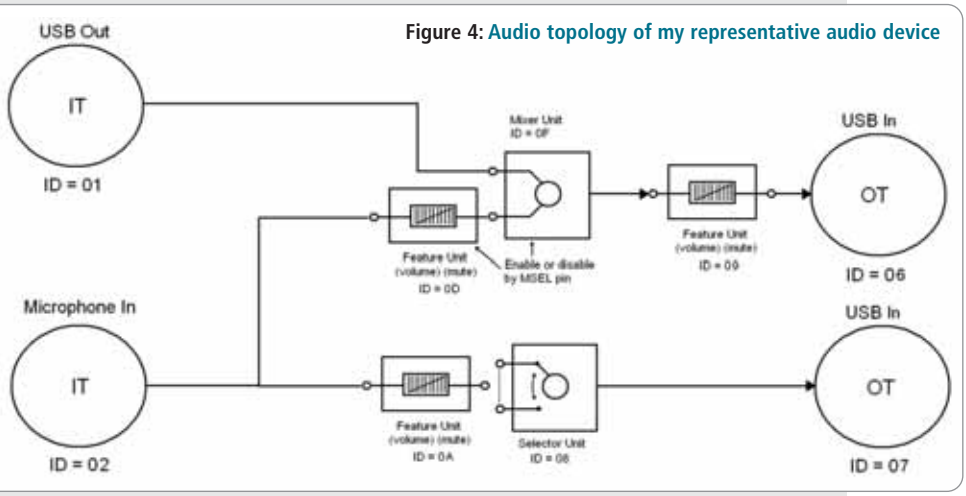


Figure 4: Audio topology of my representative audio device

Apacer Unveils Next Generation Industrial Modular PATA SSD

Apacer Technology Inc demonstrates customizability by rolling out the next-generation industrial modular PATA SSD for embedded/Thin Client devices: ADM 4 (ATA Disk Module). ADM4 boasts the slimmest profile among Apacer's PATA SSDs. It adopts a 44-pin connector and can be used either in parallel (at 180°) or perpendicularly (at 90° or 270°) for various mechanisms.

The just-launched next-generation modular SSD breaks through the speed barriers by reaching the read/write speed of as fast as 80/50MB/s, which is several times higher than its predecessors. Widely recognized by Thin Client device users for its extreme reliability, the ADM series has made Apacer one of the main SSD suppliers for Thin Client systems around the world.

The new modular SSD ADM 4 (ATA Disk Module 4), available in capacities from 1GB to 16GB, adopts a highly reliable SLC (Single-Level-Cell) chip. In order to be used in stringent environments, products of the series are all designed to operate at extended temperatures.

www.apacer.com

WORLD'S FASTEST CMOS DAC FOR NEXT-GENERATION OPTICAL TRANSPORT SYSTEMS

Fujitsu Semiconductor Europe (FSEU) announces its first generation 8-bit, 4-channel DAC in 40nm CMOS technology. With a sampling rate range of 55-65GSa/s per channel, small footprint and low power (0.75W/channel), this technology supports long-haul optical transport systems providing data links of 100Gbps and higher over a single lambda. Complimenting the 40nm 55-65GSa/s Fujitsu CHAIS ADC for 100Gbps coherent receivers, the new DAC also offers unparalleled ultra-fast sampling rates, high resolution, low noise and wide bandwidth signal generation for OTU4 signals.

The advantage of having such high-performance converters in standard CMOS process technology is that it allows for their integration on a single die together with a complex DSP and high-speed serial OTN framer interfaces to form a 100Gbps DP-QPSK transceiver. For such a device with 4 ADC and 4 DAC channels running at 65GSa/s, the sheer volume of data (2 Tbps) being converted to and from the analogue to the digital domain dictates a single die solution.

http://emea.fujitsu.com/semiconductor

LINEAR AUDIO VOLUME 2 IS NOW PUBLISHED

Vol. 2 from Linear Audio is now published. It again presents a wide variety of technologies and subjects. Bob Cordell is back with a very high quality KT-88-based tube power amplifier, while Rudolf Moers covers an ultra-linear adventure.

Rudolf's book Fundamental Amplifier Techniques with Electron Tubes is reviewed by Guido Tent and gets high marks. If there was ever anything you wanted to know about the design, advantages and trade-offs in ultra-linear tube (ULT) power amps, this article is sure to answer it. Another review discusses Douglas Self's latest book The Design of Active Crossovers.

On the solid-state front, Kendall Castor-Perry presents his design for a novel and ingenious unity gain power output stage that needs no adjustments or thermal compensation yet is extremely linear, even open-loop.

Samuel Groner from Switzerland describes an equally high-performance push-pull transimpedance stage and Nelson Pass has a sequel to the Arch Nemesis.

www.linearaudio.net

NEW JUMPERS FROM HARWIN ELIMINATE NEED FOR SWITCHES

Harwin has added a wide range of compact jumper sockets/shunts to its popular 1.27mm pitch Archer pin header range. The jumpers can be used to eliminate switches from PCBs saving money and increasing reliability.

The product range includes closed top sockets with and without handles; both styles are end-stackable, devices with handles are also side-stackable. A choice of bright colours – blue, black and red – enables manufacturing flexibility and simplifies programming if varying models within a product family, for example, motherboards with different processor options, are being produced at the same time.

Archer is a cost-effective system offering good electrical and mechanical performance. Current rating is 1A and devices employ a twin beam contact design for cost-effective reliability, enabling sockets to be used for up to 300 operations.

Available ex-stock for rapid delivery, Archer jumper shunts/sockets are ideally-suited to applications including test & measurement, robotics, marine, industrial, handheld and medical equipment.

www.harwin.com/archer

New 3D Model Prototyping Service from Beta LAYOUT

Beta LAYOUT has announced the introduction of a new 3D model prototyping service, featuring the possibility to check the construction unit accuracy of PCB designs prior to manufacture.

The new FITS-OR-NOT 3D Model service tackles wrongly positioned connectors, off-centre mounting holes and other errors early on. The FITS-OR-NOT Model is an exact replica of a fully-assembled PCB and it can be manufactured in 3 working days. With the help of an on-line ordering facility, the FITS-OR-NOT model is very easy to order. Having received the customer's model, the construction unit can be checked and then an error-free printed circuit board ordered.

The FITS-OR-NOT models are manufactured by Beta LAYOUT using a 3D printer and are made of ABS plastic. The models do not shrink, are characterised by high surface hardness and impact strength and can if necessary be polished, drilled, sawed, painted and even plated.

A free FITS-OR-NOT 3D sample can be ordered through: fits-or-not@pcb-pool.com.

www.pcb-pool.com

JTAG TARGETS FUNCTIONAL TESTERS

JTAG Technologies has released a new JTAG/boundary-scan hardware interface product compatible with the MAC Panel SCOUT mass interconnect system. The JT 2147/DAK is a signal conditioning module that allows 'perfect world' connections from JTAG Technologies's PXI DataBlaster to the SCOUT's connection system.

Based on the highly successful QuadPod architecture form JTAG Technologies, the JT 2147/DAK has been specifically designed to locate in the form-factor allowed by MAC Panel's 'Direct Access Kits' (DAKs). In using the JT 2147/DAK, test system builders will greatly simplify their wiring tasks and, at the same time, retain the excellent signal integrity assured by the QuadPod's active interface.

JTAG/boundary-scan applications prepared using JTAG Technologies's ProVision or 'classic' software tools may be executed on this PXI platform with driver packages that are available for NI LabView, TestStand and LabWindows alongside Geotest ATEasy and a number of generic language compilers (e.g. .NET framework, C++ and VB).

www.jtag.co.uk

GREEN HILLS SOFTWARE LAUNCHES AUTONOMOUS VEHICLE OPEN PLATFORM

Green Hills Software's INTEGRITY Security Services (ISS) business unit announced its new Autonomous Vehicle (AV) Open Platform, representing a significant investment and commitment to the security and management of Autonomous Vehicles and Universal Control Segments (UCS) in the embedded and special-purpose computing market.

Targeting the autonomous systems community, the platform provides a secure, highly reliable and safe software foundation for Autonomous Vehicle and UCS developers to host their UAS (Unmanned Autonomous Systems) applications. At the foundation is Green Hills Software's INTEGRITY-178B real-time operating system (RTOS), a multi-level secure operating system that is the only operating system in the world proven to simultaneously meet the software safety requirements of RTCA/DO-178B Level A for safety and total reliability, and the information assurance requirements of the U.S. Government's EAL6+ Separation Kernel Protection Profile (SKPP) for absolute security.

The ISS AV Open Platform is promised to reduce cost and time-to-market without compromising or sidestepping the demanding high-assurance software requirements.

www.ghs.com

Intersil Expands Family of High-Speed ADCs

Intersil Corporation has expanded its growing family of high-speed analog-to-digital converters (ADCs) with a new series of devices that provide industry leading signal-to-noise ratios while consuming little power. The new devices offer excellent high input frequency performance, enabling simplified system architectures that improve manufacturability while reducing cost over traditional baseband architectures.

The ISLA212Pxx and ISLA214Pxx are 12-bit and 14-bit ADCs with maximum sampling rates of 130, 200 and 250MSPS. The series offers the industry's best signal-to-noise ratios for high speed 12- and 14-bit ADCs (over 73.0dBFS at 14-bits and 70.5dBFS at 12-bits for input frequencies up to 105MHz), while consuming less than 450mW from a single 1.8V supply.

The devices use Intersil's proprietary FemtoCharge technology, which enables very low power consumption without sacrificing the ADC's dynamic performance. They increase accuracy and save power in high-performance data acquisition and instrumentation systems, communications test equipment, broadband or wideband communications systems, software defined radios and radar array processing equipment.

www.intersil.com

KONTRON COM EXPRESS FAMILY NOW OFFERED IN NINE PERFORMANCE CLASSES

Kontron extended its COM Express basic ETXexpress-SC Computer-On-Module product family with three entry-level modules equipped with the cost-optimized Intel Celeron dual-core processor and Intel HM65 Platform Controller Hub. The new Intel Celeron processor-based SKUs are entry-level additions to Kontron's comprehensive COM Express Computer-on-Modules line, based on Intel's monolithic microarchitecture. With these new versions, the Kontron ETXexpress-SC is now available in nine different performance versions with Type 2 and Type 6 Pin-out ensuring developers get the exact performance they require.

The new Intel Celeron based Computer-on-Modules are ideal for applications that demand dual-core processing and extended graphics capabilities, but do not require the extended features of the Intel Core i3/i5/i7 versions. Not only do the new modules bring excellent price/performance ratio, but also high quality features including long-lasting POSCAP capacitors for higher reliability and thermal resistance.

The energy-saving power-off state S5 Eco microampere mode minimizes power consumption by a factor of 200 (minimum), compared to the regular S5 state.

www.kontron.com/COMExpress

Roband Launches 30kV Mains-Powered, High Voltage DC Power Supply

Specialist developer and manufacturer of electronic power supplies for the defence market, Roband Electronics has launched a mains-powered, high-voltage, dc-output bench-top power supply. The RO-HV 30-1 provides variable output voltages and currents up to a maximum of 30kV and 1mA, with these being displayed via digital meters on the front panel of the instrument to resolutions of 100V and 1µA respectively. Maximum power output is 30W.

Output voltage and current limits can be set before the output is enabled and these may be adjusted when in use. Current limit can either be constant or trip, selectable from the front panel. At switch-on, or following a power interruption, the unit defaults to 'output-disabled' or 'constant current' mode. Polarity is factory preset and must be specified at time of ordering.

The output is via a screened connector, with 2m of cable supplied as standard. For safety reasons, the GES HS40 output connector is touch-proof even when unmated.

www.roband.co.uk

NEW MILLIMETRE WAVE CONNECTORS FROM INTELLICONNECT

Intelliconnect (Europe) Ltd, the specialist manufacturer of Coaxial and Triaxial RF connectors, announced the introduction of a new range of Millimetre Wave RF connectors. This new product range offers very competitive pricing and short lead-times.

Millimetre Wave connectors are designed for use in 50-ohm systems and operate in the frequency ranges up to 110GHz, dependent upon series. The connectors are designed to have a low VSWR and return loss.

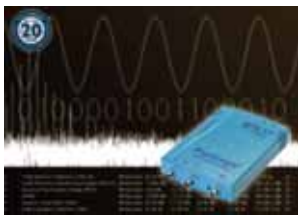
The construction of these devices ensures that the body engages before the centre conductor and ensures a rugged and reliable mating interface. The interface is an air dielectric with the contact supported by a short glass or polymer bead.

All Intelliconnect Millimetre Wave connectors can be configured to be terminated with flexible or semi-rigid cables. The series designation refers to the outer conductor diameter and generally the smaller the outer contact the higher the maximum operating frequency.

www.intelliconnect.co.uk

A DIGITAL OSCILLOSCOPE FOR THE ANALOG WORLD

The new PicoScope 4262 from Pico Technology is a 2-channel, 16-bit very-high-resolution oscilloscope (VHRO) with a built-in low-distortion signal generator. With its 5MHz bandwidth, it can easily analyze audio, ultrasonic and vibration signals, characterize noise in switched mode power supplies, measure distortion and perform a wide range of precision measurement tasks.



The PicoScope 4262 is a full-featured oscilloscope, with a function generator and arbitrary waveform generator that includes a sweep function to enable frequency response analysis. It also offers mask limit testing, maths and reference channels, advanced triggering, serial decoding, automatic measurements and colour persistence display. When used in spectrum analyzer mode, the scope provides a menu of eleven automatic frequency-domain measurements such as IMD, THD, SFDR and SNR.

The PicoScope 4262 connects to any Windows XP, Vista or Windows 7 computer with a USB 2.0 port. As it is USB-powered, there is no need to carry a separate AC adapter.

www.picotech.com

LeCroy Announces International Distribution Agreement with Mouser

LeCroy Corporation, a leading manufacturer and supplier of oscilloscopes and serial data solutions, announced an international distribution agreement with Mouser Electronics. Mouser's state-of-the-art global distribution network will place LeCroy oscilloscopes, arbitrary function generators and logic analyzers within easy reach of electronic design engineers and production equipment buyers in nearly every corner of the world as well as expand the support network for LeCroy products. LeCroy is committed to working with Mouser Electronics in all key geographical markets to provide a one stop shop capability for test equipment needs.

"LeCroy's heritage of technical innovation is without question," states Keith Privett, Mouser Vice President of Electromechanical, Power & Test. "As a distributor committed to supplying the newest advancements in technology, we consider LeCroy a partner that shares our business philosophy of delivering What's Next to design engineers across the globe."

The partnership with Mouser is expected to help LeCroy continue to grow internationally.

www.lecroy.com www.mouser.com

Apacer Rolls Out the New DDR3 LRDIMM

The ever-evolving cloud computing landscape fuels not only the global demand for servers but also the growth of server memories. According to market research firm IDC, the global server market recorded a YoY increase of 17.9% for Q2 of 2011, with the entire shipping volume reaching up to 2.1 million units, a YoY increase of 8.5%.

To address enterprises' demand for data transfer and capacity, Apacer Technology Inc has introduced the new high-capacity (up to 16GB) DDR3-1333 load-reduced dual in-lane memory module, or LRDIMM. By reducing the bus load, the storage system can run great in data computing while eliminating noise. The result is an even more reliable server storage environment, where computing is made more powerful and bulk data can be processed more efficiently.

The DDR3-1333 LRDIMM supports the standard voltage of 1.5V for DDR3 memory and can also run at the industry's lowest voltage of 1.35V. It also features performance 33% higher than Dual Rank REG DIMM.

www.apacer.com

PCB-POOL – Now with Assembly

Beta LAYOUT Ltd., a leading manufacturer of prototype printed circuit boards, SMD laser stencils, custom front panels and supplier of tools and accessories for component assembly, has extended its range of services. As of now, not only are prototype and small series printed circuit board manufactured by PCB POOL, but they can also be assembled with SMT and THT components.

Beta LAYOUT becomes one of the first companies to offer this complete one stop service online.

An easy to use online matrix enables customers to configure, calculate and place an order. Subsequently, the customer simply uploads his/her Eagle (*.brd) and/or Target PCB layout files. Starting with quantities from 1 to 50 printed circuit boards and as little as one component (SOIC, PLCC, TSOP, QFP, BGA and various connectors) the printed circuit boards are then assembled within 8 days. Both complete and partial assembly are possible.

www.pcb-pool.com

‘NET NEUTRALITY’ COULD SPELL THE END OF NETWORK INNOVATION

Three of Europe’s largest telecoms operators and the European Union (EU) recently held a summit to discuss targets to improve broadband speeds across the continent by 2020.

The operators need large capital investment to achieve its targets and develop new business models to generate the revenues needed to finance broadband network construction. This approach is in conflict with the decision by the Dutch parliament to introduce net neutrality legislation, a move that could have drastic consequences for mobile operators.

Even though providing universal access to high-speed broadband is good, any decision to impose net neutrality may not be in the best interests of the end user, as it may lead to the degradation of the very service that the EU is striving to open up. Network innovation would be stifled considerably by a restrictive policy that would permit the non-discrimination of traffic and leave the operators incapable of meeting future broadband needs, claim some firms.

You can go on line at www.electronicsworld.co.uk to read the full story.

PROFESSOR DR DOGAN IBRAHIM, Near East University in Nicosia, Cyprus: Net neutrality is the basic principle that makes Internet open and free to everyone, where the ISPs may not discriminate between the content users are accessing. In a free Internet the ISPs should not block any lawful content, or control in any preferential way what the users may wish to access. It is the basic human right that everyone has a right to free and open information, and this has been the very basic principle Internet was founded upon. I totally agree with the net neutrality, as otherwise we could be seeing a pay-per-view type Internet where we may be forced to pay for using a search engine, or perhaps sending an e-mail. Maybe it is about time the governments inject some money into supporting the future developments in the Internet technology and lessen the burden on telecoms operators.

BARRY MCKEOWN, RF and Microwave Engineer in the Defence Industry, and Director of Datod Ltd, UK: For ‘Net Neutrality’ read fear and ignorance; with both being exploited by vested interests. This issue is pure politics, so, the Dutch should be commended for sticking their head above the parapet. But as open-minded scientists and engineers we are able to distinguish between the true and false statements made about the technical issues. To deliver minimum 30MBPS downloads by 2020, EU Commissioner, Keelie Kroes has a tough nut to crack, with the latest estimates for broadband infrastructure at $410bn and network operators rightly nervous about return on investment. The politics although originating in the US will be decided in China. But technically it will be decided by mobile healthcare.

“For ‘Net Neutrality’ read fear and ignorance; with both being exploited by vested interests. This issue is pure politics, so, the Dutch should be commended for sticking their head above the parapet

HAFIDH MECHERGUI, Associate Professor in Electrical Engineering and Instrumentation, University of Tunisia: The world evolves quickly and it is an economic world of competition. It has a free confrontation between the offer and market demand.

The innovation and creation are at the base of this competition. In other terms, the market of the 21st century needs innovation which is added to freedom of movement. This is why Europe must have its share in this situation to ensure the development of its services and its industries in order to reinforce its economy. Thus the idea to have Net neutrality will block the development. It is necessary to remove the restrictions imposed on the communication network because the laws based on restriction still block innovation and competition. Indeed, using a digital market based on fast Internet can offer durable economic and social advantages.

The development of broadband networks, today, is revolutionary for the deployment and adaptation of such a network and the way it is open to innovative services taking advantage of high speeds.

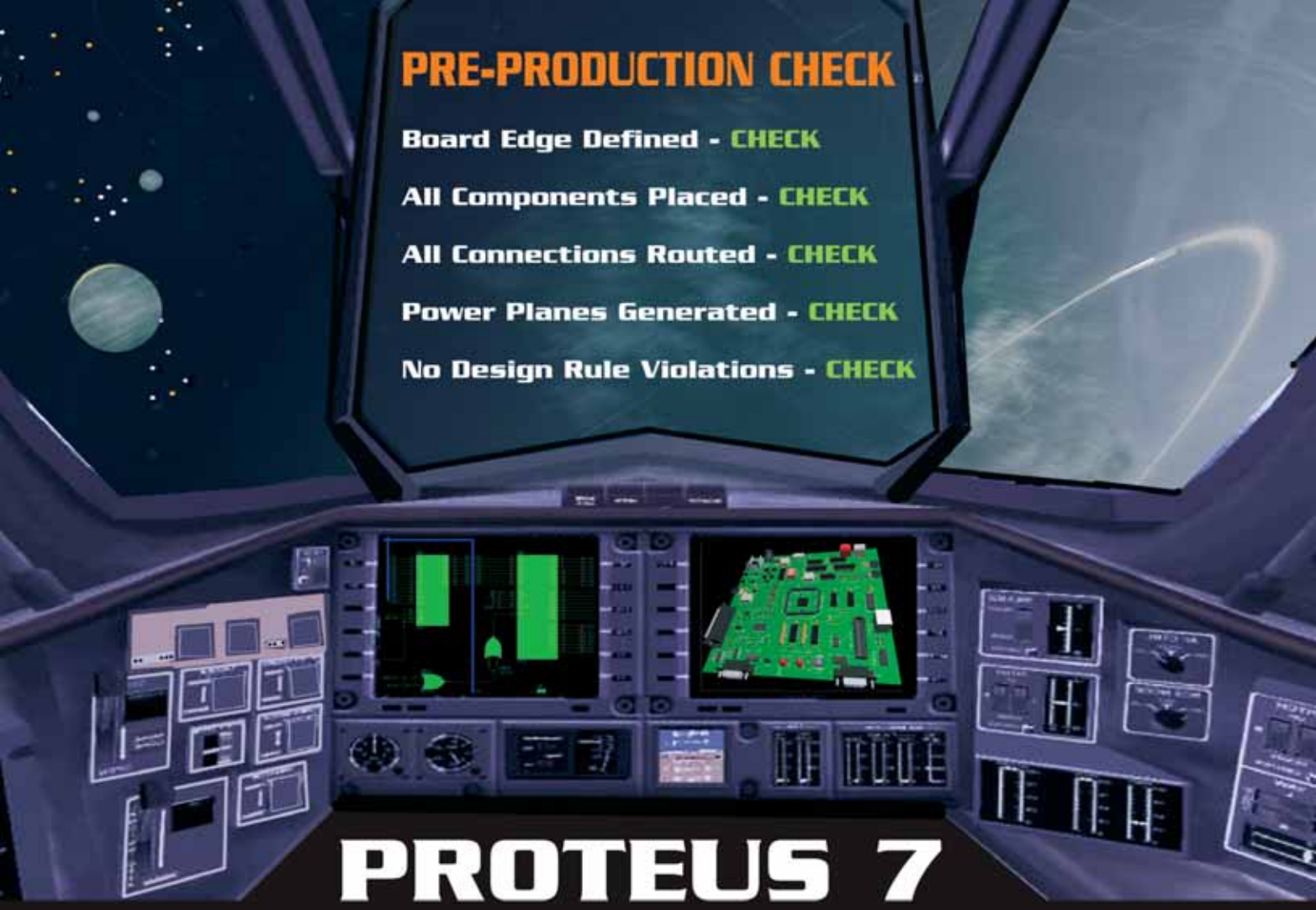
Finally, I think that it is necessary to aim at promoting mutual measures likely to encourage private investment supplemented by well-targeted public investments.

BURKHARD VOGEL, Managing Director, Germany: The word ‘net neutrality’ is totally misleading because it leads us to believe in facts that do not exist. As long as business representatives think that their view of neutrality is the only one to follow neutrality, per definition, is no longer neutrality for all users of the net. This behaviour represents a tendentious touch. On the other hand, net users that hide themselves behind names that do not allow identifying the real person, should no longer be accepted – or not?

That’s why there is a need for regulation of the web’s usage. There can’t be net neutrality because of the diverging interests of the many different users.

Under the line, in the past standards and regulations by democratic organisations were very helpful and not business-damaging. The cry for money (... not be able to finance the network construction ...) is an old game and it characterizes losers more than winners.

If you are interested in becoming a member of our panel and comment on new developments and technologies within the electronics sector please register your interest with the editor by writing to Svetlana.josifovska@stjohnpatrick.com



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