封面格式

行政院及所屬各機關出國報告

（出國類別：考察 ）

寬頻無線通訊系統發展五年計劃國外公差報告

服務機關：國防部中山科學研究院

出 國 人 職　稱：簡聘技正、簡聘技正、薦聘技士

姓　名：梁春村、 牛道智、陳佳揚

出國地區：日本、新加坡

出國期間：901212~901221

報告日期：910323

附件二

系統識別號:C09102745

行政院及所屬各機關出國報告提要

出國報告名稱：寬頻無線通訊系統發展五年計劃國外公差報告

頁數__ 含附件：v是□否

出國計畫主辦機關/聯絡人/電話

出國人員姓名/服務機關/單位/職稱/電話

國防部中山科學研究院電子系統所元件組，簡聘技正梁春村、

簡聘技正牛道智、薦聘技士陳佳揚

電話號碼:03-4712201 轉 355638

出國類別：■1 考察□2 進修□3 研究□4 實習□5 其他

出國期間：901212~901221 出國地區：日本、

報告日期： 910323 新加坡

分類號/目

關鍵詞：寬頻無線通訊系統、微波功率放大器、微波積體電路、微波通訊晶片組

內容摘要：

為執行經濟部委託之科專「寬頻無線通訊系統發展五年計劃」，解決寬頻分碼擷取(W-CDMA)通訊系統微波射頻收發模組次系統整合及關鍵微波組件如基地台、用戶台線性微波功率放大器之設計、構裝、可靠度及易測性等技術問題。

由於本單位負責分項為寬頻無線通訊系統中之微波射頻收發模組次系統，整個任務包括基地臺台及用戶端所有射頻收發系統之開發、及量產技術先期研究。整個計劃對本組而言為一包含策略、技術、管理及資源整合之重要任務。為期有效吸取他人豐富經驗以為我方避險求勝，派員赴日本及新加坡參訪 AGILENT、ANRITSU、THOMSON MULTI MEDIA、DSO 等四家公司，研討微波放大器單晶元件設計、構裝，基地台及用戶台微波射頻收發模組自動測試技術並蒐集寬頻分碼擷取(W-CDMA) 通訊系統相關之技術資料、瞭解市場現況及技術發展趨勢。期能使研發試產順遂，達成經濟部科專案任務。

本文電子檔已上傳至出國報告資訊網（http://report.gsn.gov.tw）

CSIPW-91E-H0003

國外公差報告

中山科學研究院

國外公差心得報告

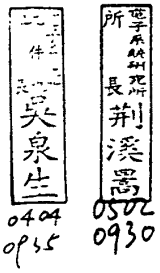
批				示
				請將資料上傳行政院研考會網站，並請將報告裝訂四份送貴單位專責人員後轉送本處。電子檔送交本處「公差出國報告信箱」副本送專責人員。
公年 差度	90 年度	所屬單位 各級主管	政戰部	企劃處
單位	電子系統所 元件組		已完成資料審查	
級職	簡聘技正 簡聘技正 薦聘技士			
姓名	梁春村 牛道智 陳佳揚			

(91)蓮茹所會字 061 號

國外公差人員返國報告主官（管）審查意見表

一、國外寬頻無線通訊產業建構完整，無論是關鍵零組件之設計、系統整合、製造量測與封裝運用等技術之發展皆面面俱到，規劃精細，值得無線通訊微波關鍵零組件技術及產品發展計畫及國內無線通訊產業技術發展借鏡。

二、攜回之資料具參考價值，盼能妥善運用。



依本院85.11.25（85）蓮菁字15378號令，返國報告上呈時應附主官評審意見

報　　告　　資　　料　　頁			
1.報告編號： CSIPW-91E-H0003	2.出國類別： 考察	3.完成日期： 91 年 03 月 20 日	4.總頁數： 16 頁(不含附頁資料)
5.報告名稱： 『寬頻無線通訊系統發展五年計劃』國外公差報告			
6.核准文號	人令文號	九〇銓鑑字第〇〇八七三三號令	
	部令文號		
7.經　　費		新台幣：新台幣肆拾肆萬零肆佰參拾柒元整	
8.出(返)國日期		自 90 年 12 月 12 日至 90 年 12 月 21 日	
9.公 差 地 點		日本東京、新加坡	
10.公 差 機 構		AGILENT 公司、ANRITSU 公司、THOMSOM MULTI MEDIA 公司、DSO 公司	
11.附　　記			

附件三

行政院及所屬各機關出國報告審核表

出國報告名稱：寬頻無線通訊系統發展五年計劃國外公差報告	
出國計畫主辦機關名稱：國防部中山科學研究院	
出國人姓名/職稱/服務單位：國防部中山科學研究院簡聘技正梁春村等參人	
出國計畫主辦機關審核意見	☐1. 依限繳交出國報告 ☑2. 格式完整 ☑3. 內容充實完備 ☑4. 建議具參考價值 ☑5. 送本機關參考或研辦 ☑6. 送上級機關參考 ☐7. 退回補正，原因：☐ 不符原核定出國計畫 ☐ 以外文撰寫或僅以所蒐集外文資料為內容 ☐ 內容空洞簡略 ☐ 未依行政院所屬各機關出國報告規格辦理 ☐ 未於資訊網登錄提要資料及傳送出國報告電子檔 ☑8. 其他處理意見：
層轉機關審核意見	☐同意主辦機關審核意見 ☐全部 ☐部分_____（填寫審核意見編號） ☐退回補正，原因：_____（填寫審核意見編號） ☐其他處理意見：

說明：

一、出國計畫主辦機關即層轉機關時，不需填寫「層轉機關審核意見」。

二、各機關可依需要自行增列審核項目內容，出國報告審核完畢本表請自行保存。

三、審核作業應於出國報告提出後二個月內完成。

目 錄:　　頁次

壹、出國目的及緣由

為執行經濟部委託之科專「寬頻無線通訊系統發展五年計劃」，解決寬頻分碼擷取(W-CDMA)通訊系統微波射頻收發模組次系統整合及關鍵微波組件如基地台、用戶台線性微波功率放大器之設計、構裝、可靠度及易測性等技術問題。

整個計劃對本組而言為一包含策略、技術、管理及資源整合之重要任務。為有效吸取日本與新加坡在無線通訊系統的成功模式與豐富經驗，派員赴日本參訪 AGILENT、ANRITSU 及新加坡 THOMSON MULTIMEDIA、DSO 等四家公司，研討微波放大器單晶元件設計、構裝，基地台及用戶台微波射頻收發模組自動測試技術並蒐集寬頻分碼擷取(W-CDMA) 通訊系統相關之技術資料、瞭解市場現況及技術發展趨勢。期能使研發試產順遂，達成經濟部科專案任務。

貳、公差心得

(1)在整個寬頻無線通訊研發及生產過程免不了性能量測，參訪 Agilent 專業量測儀器、模擬軟體公司，商討寬頻無線通訊微波系統電腦輔助設計、及量測自動化技術，期能以電腦輔助及自動化技術縮短研發時程並提高生產效能。該公司微波量測儀器向來種類完整且性能獨具，本組也長期採用其所生產之各項量測儀器，從基本的電表、電源供應器到高性能微波頻率合成器、頻譜分析儀及網路分析儀不一而足。該公司特別展示頻率範圍高達 110GHz 之網路分析儀

及 Noise Figure 量測系統，前者除了可量測頻寬至毫米波之外，更可快速量得元件散射參數，在元件內部熱能尚未累積前取得元件散射參數，特別適合運用於具熱效應功率元件量測及模型建立，搭配其元件模型擷取軟體可建立元件大訊號非線性模型，在微波功率放大器電腦輔助設計為一不可或缺之要素。若經費充裕，應儘速建立此一能量以補目前本組在微波系統中獨缺之部分。後者則為微波元件、模組組測雜訊量測系統，該系統改進以往僅能量測單點頻率之缺點，可完整掃描並顯示所需頻寬之雜訊指數與增益，為通訊接收系統量測之利器。此二系統對寬頻無線通訊微波放大器之開發均能提供高性能量測支援。該公司除了在儀器技術之獨步外，其在於去年推出微波通訊系統設計模擬應用軟體，整合微波電路設計、佈局、電磁計算模擬及數位類比系統模擬，成為一完整微波通訊系統設計模擬套裝軟體。該軟體可直接執行 I/Q 數位編碼微波系統模擬，透過此功能使用者可直接獲得寬頻無線通訊系統要求之相關特性參數，如特定通訊系統規範之鄰近頻道功率比(ACPR)、無線通訊傳輸因環境造成之位元誤差比(BER)甚至可模擬系統編碼、傳輸到解碼等各項系統參數。加上其所展示的兩項量測系統，可將無線設計人員的工作劃分，隨著工具軟體發展的完備及微波積體電路組技術之成熟已將工作區塊擴大至基頻至微波整個領域，亦可發展以矽晶片為主之微波積體電路組技術成熟系統晶片(SOC)，今後設計工程人員便很難區分數位線路與微波線路間之界線區分，此一趨勢可從 BLUETOOTH 晶片開發預測得到。不僅通訊系統如此，雷達及其他軍用系統亦如此，所以本單

位未來在微波積體電路之開發亦應及早投入矽晶相關之微波積體電路技術設計開發與應用；若有大廠邀請解決矽晶片在微波應用之問題時應著眼於未來發展與其建立良好合作關係，以因應未來變局。

(2) 參訪 Anritsu Company 專業量測儀器公司微波儀器部門之目的，在於該公司與 Agilent 同質性極高，藉實地參訪之機會期能進一步瞭解並評估其產品技術能量，尋覓一同等技術能量之儀器製造公司，為寬頻無線通訊微波系統生產量測自動化開闢另一管道，期能透過市場機制降低研發、生產成本。該公司在改組前原為 Wiltron Instrument Inc. 專長為微波量測儀器製造，在國內透過代理商銷售，十多年前本單位對其產品性能及服務品質頗有微詞，後來該公司與日本專業光通訊傳播系統公司 ANRITSU 合併，加強產品行銷及技術服務工作，來台建立分公司並加強各項業務推展。由於該公司重返我國市場，對吾等來訪極為重視，安排本單位與各項專題相關工程技術部門負責人員進行研討。該公司看準近年來無線通訊市場蓬勃發展，向我方介紹展示尚未上市之最新之高功率量測系統(ME78XX, Power Amplifier Test System, PATS)，該系統排除雜訊量測功能(高功率量測與雜訊量測要求環境不同)專門處理微波高功率量測，最大功率可達 100W，更具備有功率元件大訊號 S22 量測功能，若搭配電流探測具執行輸出入功率掃瞄量測則可量得微波功率增加效率參數。此一系統功能可與負載牽引量測系統量測功能相比擬，提供功率放大器最佳化設計一項利器，而價格花費低於負載牽引量測系統之四成。目前此系統工作頻率最高到

2.4GHz 可滿足基地台高功率微波放大器之設計量測需求。

(3)為了解射頻收發前端問題，我方參訪了新加坡 Thomson Multimedia 公司。該公司具有寬頻 CDMA 升頻、降頻轉換器模組設計及量測、製程縮裝整合等技術優勢，我方針對研發升頻、降頻轉換器模組過程所蹧遇之問題與其進行討論。本組採自行開發微波積體電路晶片組(RFIC Chip set)方式，並選用適合功率元件且高良率之異質介面二極電晶體(HBT)製程，有鑑於傳統 GaAs MESFET (砷化鎵金屬氧化物場效電晶體)製程穩定性問題，該公司亦採用新開發之異質二極電晶體(HBT)製程。該公司具有成熟晶片微波積體電路設計能力，主要目標為自行開發寬頻 CDMA 升頻、降頻轉換器模組。其產品應用範圍含蓋有線、無線通訊及光電通訊領域；目前通訊產品定位於 CDMA 無線通訊功率元件，準備爭取成為國內通訊廠家主要供應者。再者，該公司也開發第三代通訊訊系統 WCDMA 功率元件，以因應寬頻無線通訊系統規格需求，此一目標正與本計劃不謀而和。

(4) 新加坡 DSO 公司為專業微波系統與零組件製造公司，赴該公司觀摩其先進微波混成線路製程技術、微波系統構裝技術並討論無線通訊微波系統發展趨勢及因應開發之製程技術，討論寬頻微波系統線性功率放大器設計及生產製程相關技術，並與該公司研討混波器設計技術和低雜訊模組之設計介面，可做為本單位未來發展之借鏡，以提升本單位系統整合之技術能量。針對 CDMA 射頻通訊晶片組構裝問題，目前高頻構裝並無標準規範，一般公司為解決此問題通常採用陶瓷構裝(與目前本組自行開發低溫共燒陶瓷構裝雷同)。目前該公司亦正

正在評估塑膠材質無接腳晶片構裝(PLCC, Plastic Leadless Chip Carrier)在高頻應用之可行性。國內也有公司具此技術，此技術應用與傳統膠材構裝技術相容，但成品具微小化及電性、導熱特性佳之優點，推測其缺點可能有二，一為膠模材質對更高頻特性(5.8GHz)受質疑、二為其腳位數目受限於四周長度。故在此議題上本單位早有解決方案，但並非標準化〈因未有既定標準〉及最經濟途徑，值得結合國內產業界進一步追尋解答。該公司在微波混波器與功率放大器設計之研究開發有相當成效及能量，其研發方向、產品內容在所有參訪公司中與本組最為接近。因高功率放大器需要三大技術：(1) 功率晶體、(2)元件模型及(3)設計組裝能力，在這三者中本組皆較 DSO 落後，故本組若要發展功率放大器，宜借重外來經驗輔助：運用本組新建立之負載牽引量測系統(Load Pull System)直接取得設計資料，再培養組裝、測試能量，行有餘力再漸漸培養對晶體與元件模型的理解，如此才能使本組以最短時間達到市場技術水準。就此一角度思考，以華人組成的 DSO 公司，是值得考慮的合作伙伴。若有類似本單位具先進電子特性研究及微波領域應用及設計能量加以協助，配合目前我國產業環境及在世界科技產業分工地位，應可創造新的契機，確立我國為先進高頻無線製造中心之地位。

參、效益分析

藉由與各大廠專家進行面對面特定議題研討、資訊交流及實際觀摩其公司在解決寬頻無線通訊微波系統各項元件、次系統問題採取之方法，幫助本單位提升解決寬頻分碼擷取(W-CDMA)微波收發系統研發時排除障礙之能力；透過實驗室及生產線參觀考察，有助於本單位製程能力及量測技術之提升。正有助於解決本單位目前所遭遇到之技術瓶頸。除此之外蒐集最新通訊規範發展動態、市場狀況及最新材料、設計及製程技術資料，可奠定相關技術知識，作為往後科技專案建案之目標方向及執行計畫之重要參考。

此行目的係為尋找國外資源，解決寬頻無線通訊系統發展及無線關鍵零組件之設計、包裝、可靠度及易測性等問題，藉由面對面討論、交流深入問題核心，避免受困於技術瓶頸而時程延誤，同時也激發我們對於解決問題的新的思考模式。參觀了各廠商的研發、生產及量測設備和技術，其中有不少地方值得參考、學習改進。在整個參訪過程，我們也發現我們本身的優缺點。如能參酌他們的經驗，運用其可提供的資源，對解決計畫執行的確大有幫助。各參訪公司的技術、經營導向也值得本組參考用以確立未來發展方向與經營模式。

肆、國外工作日程表　填表人：陳佳揚

項次	時間	地點	交往接觸人士及機關(外文名及譯名)				洽談內容記要	備考
			姓名	國籍	性別	地址		
1.	901213	AGILENT	Steve Huang	中華民國	男	9-1, TAkakura-cho, Hachioji, Tokyo 192 8510 Japan	參訪公司，研討寬頻分碼擷取微波系統設計整合，規範設計製造及微波精密測試技術等議題。	
2.	901214	ANRITSU	Makoto Furukawa	日本	男	5-10-27, Minamiazabu, Minato-ku, Tokyo, 106-8570 Japan	觀摩先進微波電路製程與設計技術，研討無線通訊製程縮裝整合與微波精密測試技術。	
3	901217	THOMSON MULTI MEDIA	Tang Jianfeng	新加坡	男	8 jurong town hall road #26-01/03 the JTC Summit Singapore 609434	研討寬頻 CDMA 升頻、降頻轉換器模組設計及量測、製程縮裝整合技術事宜。	
4.	901218	DSO	Chew Siou Teck	新加坡	男	20 Science Park Drive Singapore 118230	研討微波混頻器規格及設計相關事項，並瞭解高線性放大器研製及生產技術。	
5	901219	DSO	Chew Siou Teck ANG Kian Sen	新加坡	男	20 Science Park Drive Singapore 118230	研討功率放大器設計之先進微波封裝技術，解決高頻封裝之瓶頸；並研討低雜訊模組之設計介面等問題。	
6	901220	DSO	ANG Kian Sen	新加坡	男	20 Science Park Drive Singapore 118230	研討如何使用現有之 PCB 與厚、薄膜技術降低生產成本與未來之合作事宜。	
說明	1.填寫內容力求詳實，生活中一般瑣碎事務請勿填寫。2.回國後一個月內送交計畫處彙辦。							

伍、社交活動

由於工作日程短暫，行程安排密集故除夜間抽空訪友外並未從其他事社交活動。在日本拜訪之友人為國內科技業派駐當地之員工，而新加坡之友人則皆為華裔移民，故對家鄉都有一份情，對國內大小新聞關心，對故友熱忱招待。不論是日本或新加坡，市容整潔乾淨，城市景觀優美，交通便利，地鐵四通八達，顯見其都市計劃之完善。兩國人民生活方式、環境建築與飲食文化都和臺灣相當接近，所以雖身處異鄉卻不感到隻身在外的感覺。

陸、建議事項

一、各公司在微波積體電路上除採用先進生產技術(Pick & Place ,Package without carrier, RF Snap on connector) 改變傳統微波積體電路組裝之「一人統包」方式為「一貫作業」方式，以最佳化製程設計、自動化生產流程及優良的技術管理經營微波生產線，使組裝人員工作單純技巧熟練，大幅提昇製成率。建議本組宜集思廣益加強生產技術研究（含微波連接介面、微小化包裝、高密度線路、新材料運用及組裝技術等)，使本組從設計、研發、生產、組裝技術提升以提供各式先進微波線路需求。

二、與各公司資深工程師討論收穫豐富，建議本單位可經常舉辦專題討論，請單位內資深或績優工程師與同仁分享工作心得及技術經驗，提升組內人員技術水準。亦可邀院外相關研究機構、學校或公司舉辦技術研討，除可相互切磋外亦藉以增進對相關產業技術能力的瞭解。

柒、附件

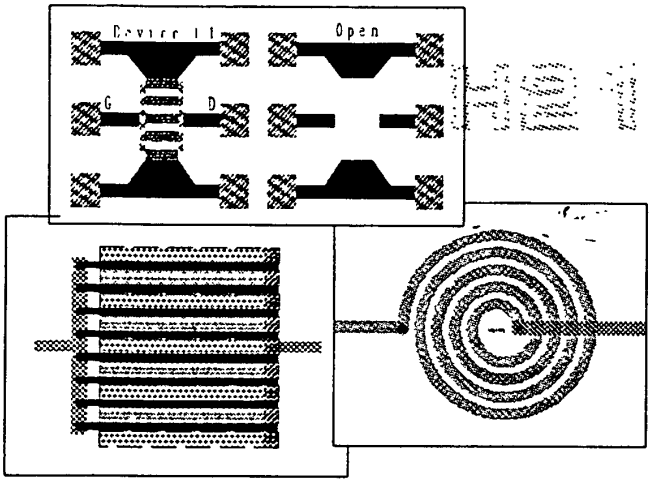
附件 1-1

Agilent Technologies
Innovating the HP Way

Agilent EEsof EDA

RF Test Structure Design Service

Solution Services



Capabilities At A Glance

- Layout of various individual transistors, capacitors, varactors, resistors and inductors for the development of models or as part of process characterization.
- Test structure designs that effectively minimize parasitics, which are associated with the interconnect metal lines and probe pads, for the accurate device characterization and modeling.
- Appropriate test structures and standards, which allow the employment of up-to-date calibration and de-embedding techniques for accurate RF/microwave measurements.
- Test structure design files are in industry formats, such as GDSII.

Agilent EEsof provides design services of on-wafer RF test-structures as one of the initial critical steps in electronic device modeling. Good RF test structures enable consistent model parameter extractions and are needed for RF parasitic characterization and de-embedding. Proper RF test structures addresses the issues of scalable modeling efforts and are also crucial for optimum device design. It also generates layout out of passive/active devices for accurate characterization and model parameter extraction at DC as well as RF frequencies.

Agilent EEsof generates the test structure layouts of passive/active devices for accurate characterization and model parameter extraction at RF/microwave frequencies, and outputs industry-standard file formats such as GDS-II.

With the test structures in place, semiconductor foundries could efficiently model their devices.

Agilent EEsof also has the expertise to accurately extract the models and implement a design kit, which allows easy access of the foundries processes to high frequency IC designers.

Other Services

- Bipolar Transistor Modeling
- Noise Characterization
- RF CMOS Modeling
- RF Sub-system Characterization
- Passive Component Modeling
- MESFET/HEMT Modeling
- Packages/Connector Modeling
- RF Production Test Board Modeling

For more information, contact your local Agilent Sales Representative or Agilent EEsof's Microelectronics Modeling Center

Email : smmc@agilent.com Fax : [65] 2752608 Tel : [65] 2158286

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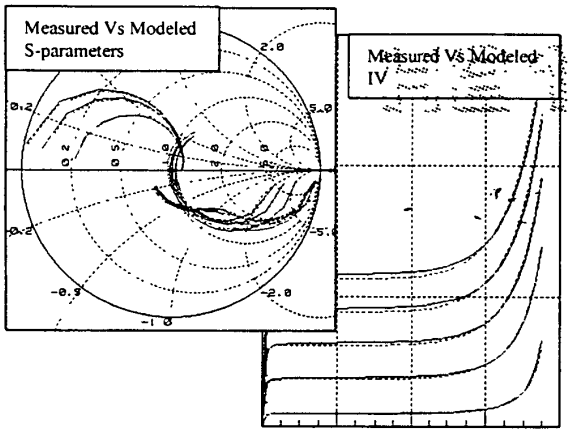
Agilent EEsof EDA

Bipolar Transistor Modeling Service

Solution Services



Agilent EEsof makes accurate measurements of your BJT/HBTs, and extracts model parameters based on state-of-the-art electrical models for accurate prediction of your high-frequency circuit performance. These models include :

- Gummel Poon
- VBIC
- MEXTRAM

Depending on your design needs, Agilent EEsof extracts parameters of the model of your choice and provides you with modeled-vs-measured verification plots of DC and S-parameter data. Model files fully compatible with Agilent's Advanced Design System will also be available.

Capabilities At A Glance

- Gummel Poon, VBIC, MEXTRAM models with temperature parameters (optional)
- Accurate, Fast Turnaround, Cost Competitive
- Make measurements up to 50 GHz, and ambient temperatures up to 200 ° C
- Models accepted by most industry-standard simulators
- Wide range of RF probes and fixtures available
- Model files fully compatible with Advance Design System, eliminating manual data entry

Other Services

- RF Test Structure Design
- Noise Characterization End 2001
- RF CMOS Modeling
- RF Sub-system Characterization End 2001
- Passive Component Modeling
- MESFET/HEMT Modeling
- Packages/Connector Modeling End 2001
- RF Production Test Board Modeling

For more information, contact your local Agilent Sales Representative or
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Agilent Technologies
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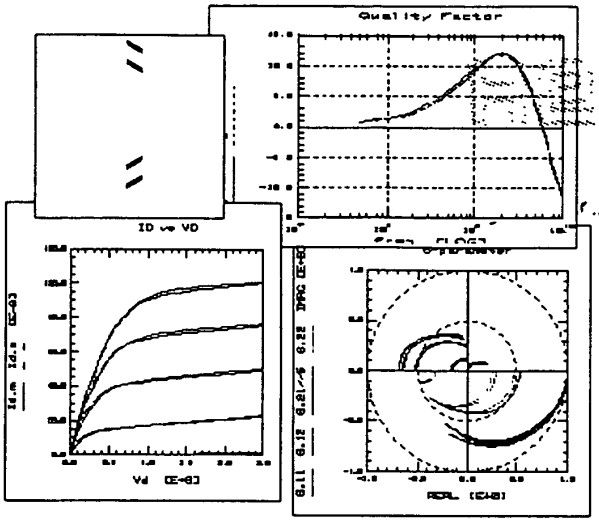
Agilent EEsof EDA

RF CMOS Modeling Service

solution services



To complement semiconductor foundries' in-house modeling facilities, Agilent EEsof provides the expertise to design RF test-structures for CMOS devices designed for wireless applications. It also generates models of passive/active devices on silicon, and validate them against measured data at RF frequencies.

Agilent EEsof EDA has the expertise to accurately extract the models and implement a design kit, which allows easy access of the foundries processes to high frequency designers.

Capabilities At A Glance

- BSIM3v3 modeling of CMOS transistors for RF applications, which include various short channel effects experienced by modern deep sub-micrometer MOSFETs. BSIM4 will be available soon.
- Accurate modeling of passive structures such as varactors, MIM/MOM capacitors, resistors and spiral inductors (octagonal, circular,etc).
- Test-structures design of passive/active devices for accurate RFIC characterization and model parameter extraction.
- Make measurements up to 50 GHz, and ambient temperatures up to 200 ° C
- Up-to date models accepted by most industry-standard simulators
- Model files fully compatible with Advance Design System, eliminating manual data entry

Other Services

- RF Test Structure Design
- Noise Characterization
- Bipolar Transistor Modeling
- RF Sub-system Characterization
- Passive Component Modeling
- MESFET/HEMT Modeling
- Packages/Connector Modeling
- RF Production Test Board Modeling

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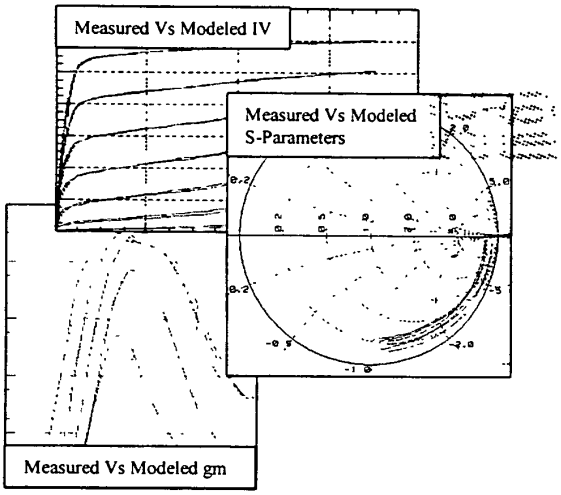
Solution Services

MESFET/HEMT Modeling Service



Capabilities At A Glance

- EEHEMT, ROOT models available at various temperatures
- Accurate, Fast Turnaround, Cost Competitive
- Measurements up to 50 GHz, and ambient temperatures up to 200 ° C
- Wide range of RF probes and fixtures available
- Model files fully compatible with Agilent EEsof's product offering, such as Advance Design System

Need good electrical models of your MESFETs or HEMTs ? Agilent EEsof's Solution Services group makes accurate measurements of your transistors, and extracts model parameters based on the popular EEHEMT/EEFET models, or the measurement-based ROOT models. These models have been proven to accurately represent your physical devices in the simulation environment.

Depending on your design needs, Agilent EEsof extracts parameters of the model of your choice and provides you with modeled-vs-measured verification plots of DC and S-parameter data. Model files fully compatible with Agilent's Advanced Design System are also available.

Other Services

- RF Test Structure Design
- Noise Characterization
- RF CMOS Modeling
- RF Sub-system Characterization
- Passive Component Modeling
- Bipolar Transistor Modeling
- Packages/Connector Modeling
- RF Production Test Board Modeling

End 2001
End 2001
End 2001

For more information, contact your local Agilent Sales Representative or Agilent EEsof's Microelectronics Modeling Center

Email : smmc@agilent.com **Fax : [65] 2752608** **Tel : [65] 2158286**

Resonext Communication Uses IC-CAP Modeling Software to Provide Accurate RF Device Models for Wireless Network IC Designs

Customer Success story

"IC-CAP saves us engineering time and development costs. We were able to take measurements quickly and perform parameter extractions efficiently. IC-CAP improves the productivity of our engineers and helps them meet their project deadlines."

Ali Rezvani
Director of Device Characterization and Modeling, Resonext Communication, Inc.

Customer: Resonext Communication, Inc. (www.resonext.com)

Challenge: To build and extract accurate industry standard and customized RF models for various active devices and passive components in order to gain competitive advantage.

Solution: Agilent Technologies IC-CAP Modeling Software and the 85122A Precision Modeling System

Results:
- Accurately modeled RF CMOS and Bipolar devices.
- Developed in-house extraction routines and successfully extracted SPICE models for many RF passive components.
- Reduced engineering time and improved productivity.

The Company

Resonext Communication is a recognized fabless IC design company whose mission is to develop silicon ICs for Wireless Local Area Network (WLAN) applications. Their chipset consists of a radio chip for front-end communication and a base-band chip that implements algorithms for OFDM (Orthogonal Frequency Division Multiplexing) modulation. Both chips are designed to be manufactured using 0.18-micron CMOS process technology.

The Challenge

The management team at Resonext realized that device modeling was vital to the success of the company. They needed accurate RF models to improve their circuit design simulation and accuracy, which ultimately provides a competitive advantage.

The company decided to build a device characterization lab to test and evaluate device models from foundries and vendors as well as to build in-house models.

The device modeling group needed to:

- Build and extract in-house models for many CMOS devices, RF spiral inductors and MOS varactors.
- Customize extraction algorithms to fit specific process and device technology.
- Create RF extensions to standard models to improve design accuracy

The Solution

Resonext Communication used IC-CAP software to control the Agilent 85122A Precision Modeling System while it acquired DC and RF measurements directly from silicon wafers. The measured data was then used to extract model parameters within IC-CAP.

The Results

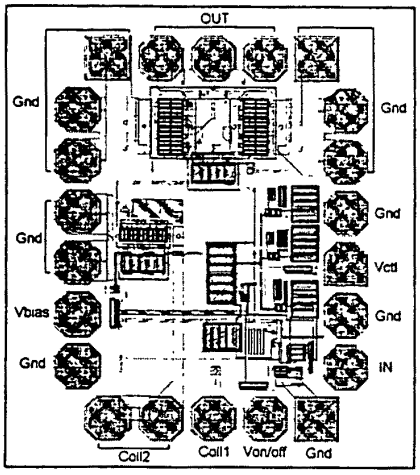
For CMOS and BJT transistor modeling, model parameters from an external RF simulator were imported into IC-CAP and compared against the actual measured results. This allowed modeling engineers to provide

RESONEXT COMMUNICATIONS INC

Agilent Technologies

PHILIPS SEMICONDUCTORS reduces design time using Agilent Advanced Design System

Customer Success Story



Philips DECT power amplifier layout

Company: Philips Semiconductors

Challenge: Reduce design cycle times in order to achieve right-first-time silicon on high-density CMOS RFICs.

Solution: Standardize on Advanced Design System software from Agilent Technologies

Results:
- Increased speed of RF circuit simulation tenfold
- Improved the quality of simulation results
- Reduced design times for new chips.

"Simulating complex circuits, particularly under the conditions in which RF transistors operate in a power amplification regime, can take so much time using conventional simulation tools that it is difficult to iterate the design enough times to create right-first-time silicon. ADS has significantly reduced our design cycle times."

Jean-Pierre Manhout
Senior RF Design Engineer

The Company
Philips Semiconductors is the third largest supplier of semiconductors for the global multimedia and telecommunications markets. Its facility in Caen, Normandy, France, is a world leader in the design and production of microelectronic components for the digital media, optical networks, and telecommunications industries.

A particularly important market for Philips Semiconductors is RF ICs (Radio Frequency Integrated Circuits) for mobile telephony and data communications. This market is booming – from cordless phones using the DECT protocol to second-generation mobile phones using GSM, through GPRS and EDGE (2G+), to third-generation (3G), W-CDMA and UMTS devices, and beyond to the future generation of wireless connections using Bluetooth* technology in the 2.4 GHz ISM band.

The Challenge
To meet the needs of their telephony customers, the designers at Philips Semiconductors were faced with the problem of controlling analog, digital and RF signals in very high-density circuits. For example, integrating bipolar transistors alongside passive components and high-speed CMOS logic introduces significant uncertainty in the operational behavior of the circuits. Conventional simulation tools are not up to the task.

Philips Semiconductors designs its ICs using its advanced QUBiC BiCMOS process family. "The QUBiC family is ideal for integrating

PHILIPS

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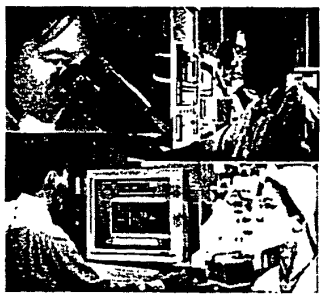
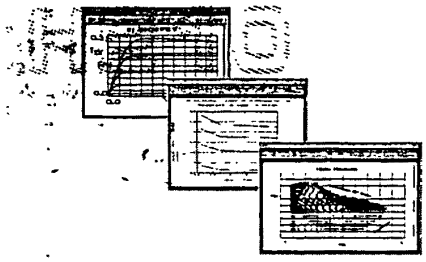
Agilent EEsof
Singapore Microelectronics Modeling Center

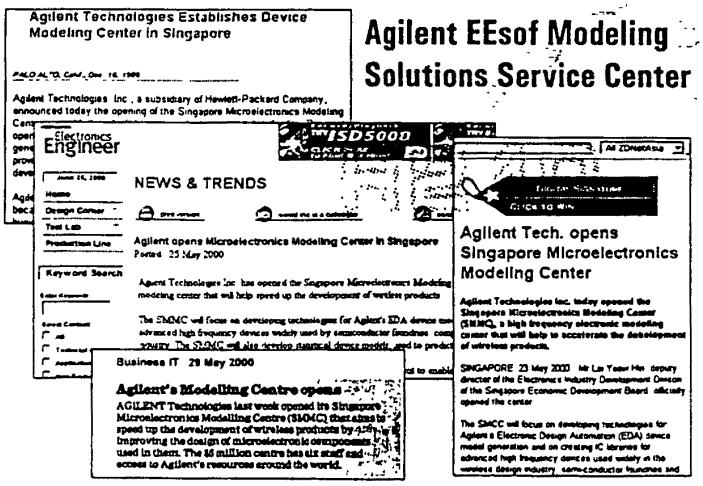




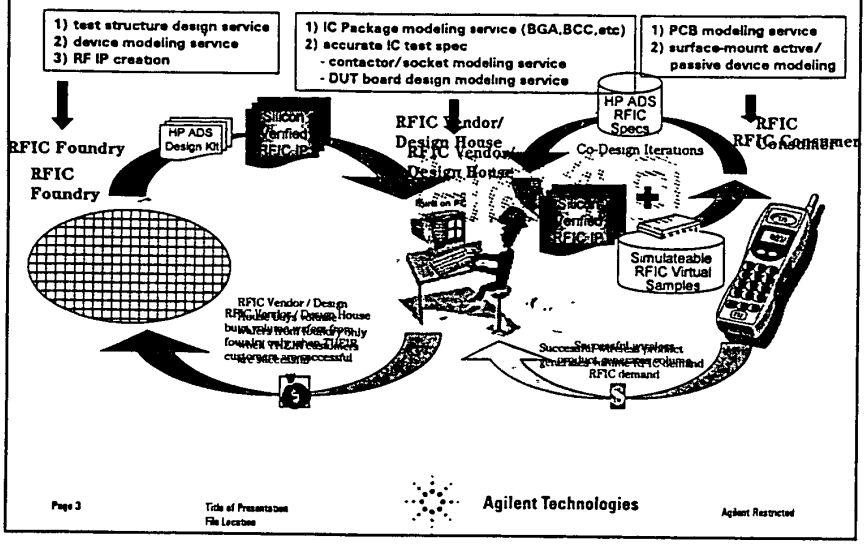
Agilent Technologies
Innovating the HP Way

Who are we ?

Agilent EEsof Modeling Solutions Service Center



Modeling Services for the RFIC Food Chain



SMMC Mission

Fast, Accurate, High Volume RF Characterization & Simulation Model Generation

- component manufacturers
- semiconductor foundries
- wireless design houses

Faster

Better

Lower Cost

....then doing it yourself!

- Active devices
  - packaged or on-wafer
  - Si or GaAS or SiGe
  - All industry standard device models
  - Characterization to 50 GHz, up to 200 ° C
  - Discretes and ICs
- Passive devices
  - Chip capacitors, inductors, resistors, filters
  - Packages & Connectors
  - Substrates/PCB

Partnering with SMMC's strengths

- Industry proven accuracy of Agilent Instrumentation
- 60 years of high-frequency design & modeling experience- from the people who invented the 8510 and ICCAP device modeling tool
- Specialized staff & instrumentation focused on fast precision measurement and modeling

Allows you to:

- Quickly respond to changing business needs (customers /designers want updated accurate models; statistical models)
- Focus on your core expertise (product development & manufacturing)
- Reduce risks of inaccurate design simulation and product delay for you or your customers
- Increase design wins by providing simulation models to try before buy

Modeling Capabilities

- Bipolar Transistors - Standard GP
  - VBIC
  - EEBJT
  - MEXTRAM
- MESFET/HEMT - EEHEMT, ROOT, EEFET3
- Diode - Diode model
- Connector/Package - First order approximations
  - Equivalent Circuit (for IC simulation)
  - EM model for design optimization
- Substrate/PCB - accurate modeling of Er and tangential loss
- RF/high speed DUT board modeling - contactor modeling
  - accurate prediction of IC performance

FOR DESIGNS AT HIGHER FREQUENCIES

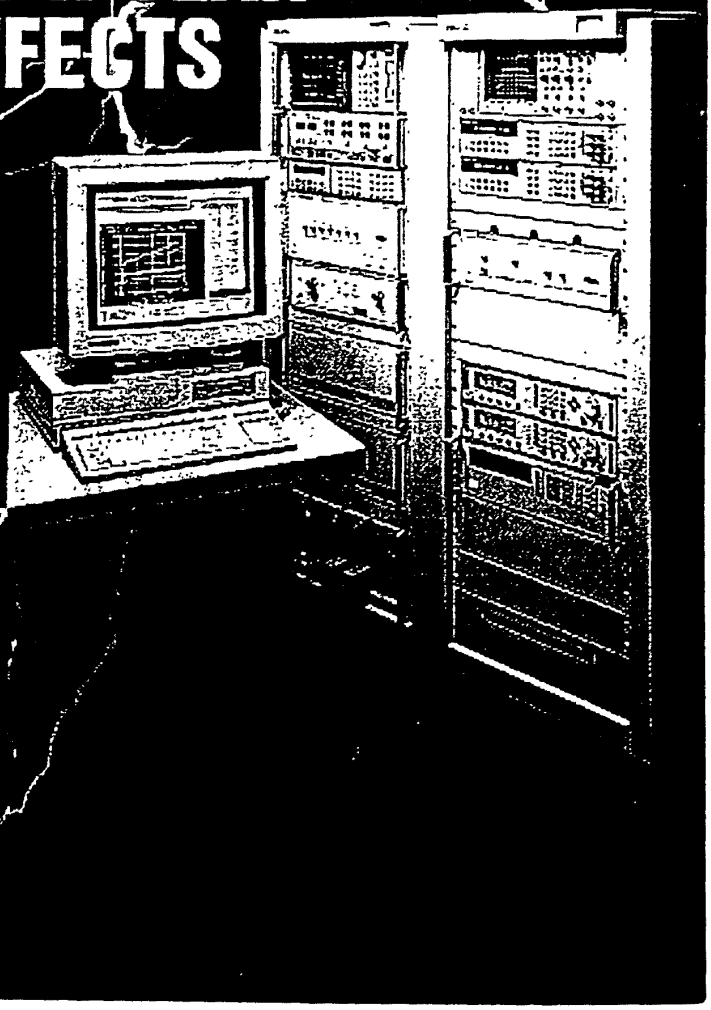
Microwaves & RF

A PENTON PUBLICATION • FEBRUARY 1996

SOFTWARE PREDICTS NONLINEAR BIPOLAR THERMAL EFFECTS

Plus...

- Commercial superconductors
- Modeling GaAs FETs
- Build a Class AB amp



BIPOLAR MODELING

verely compromised.

To overcome this model shortcoming, the HP 85124A Pulsed Modeling System was developed. The goal of this modeling system (see table) is to pulse the bias of a DUT and measure the DC and AC characteristics before the junction temperature can change appreciably (since the bias pulse widths are much shorter than the thermal time constant of the device material). In this way, the measured device data will not contain any thermal information other than the device's ambient junction temperature. Consequently, any parameters derived from this data will be equally free of any implicit thermal information. The result is an isothermal nonlinear model.

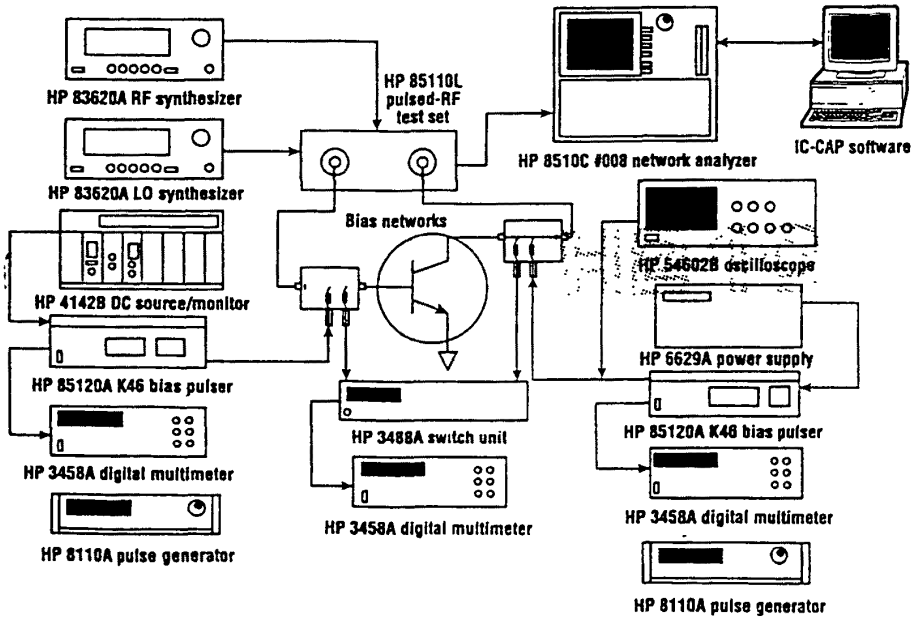
The final step of the modeling process is to explicitly determine both the static and dynamic thermal characteristics of the various device model parameters. Once these thermal properties have been coupled back into the model, the result is a truly-dynamic thermal nonlinear device model that is accurate and, except for two parameters, independent of its measurement environment.

The Pulsed Modeling System at a glance

voltage	
current	
range	
range	(with existing bias networks)
power	
width	
range	
range	

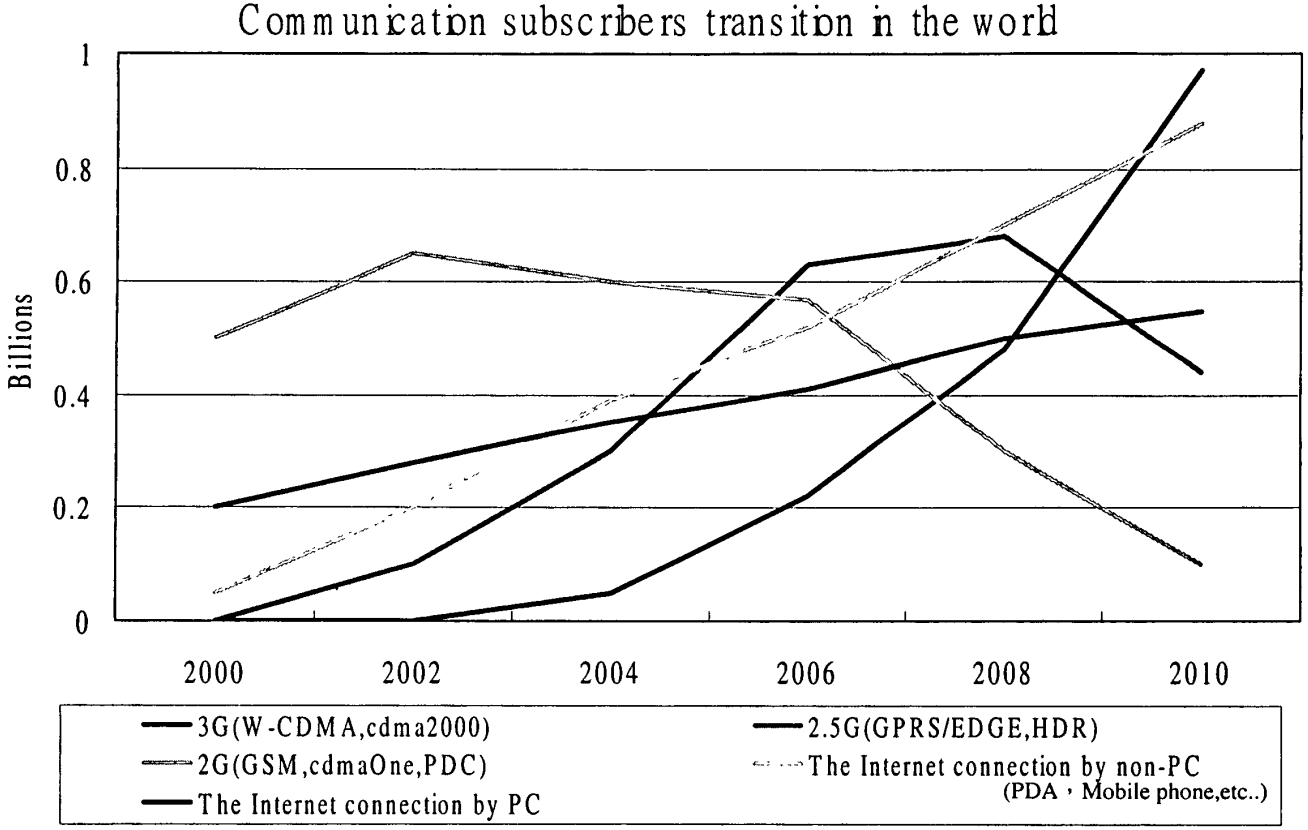
Many issues arise when developing a measurement system that is capable of making DC and RF measurements under both steady-state and pulsed conditions. The system should be accurate but also easy to use, minimizing multiple connections to the device. Some of the issues encountered in developing this system include:

- the need for high-current, low-impedance pulsed sources with sufficient rise and fall times,
- the integration of steady-state and pulsed DC and pulsed RF measurement capabilities,
- the necessity of minimizing cable lengths and impedance mismatches



2. This block diagram illustrates the Pulsed Modeling System.

IMT-2000 business potential to



※EDGE and HDR are located and standardized as 3G now.

Source:OVUM Corp. forecast(March,2000)

別紙1-2

BS Test Standard
Conformance Test System

The following four systems make the Conformance Test System possible

TX Test System

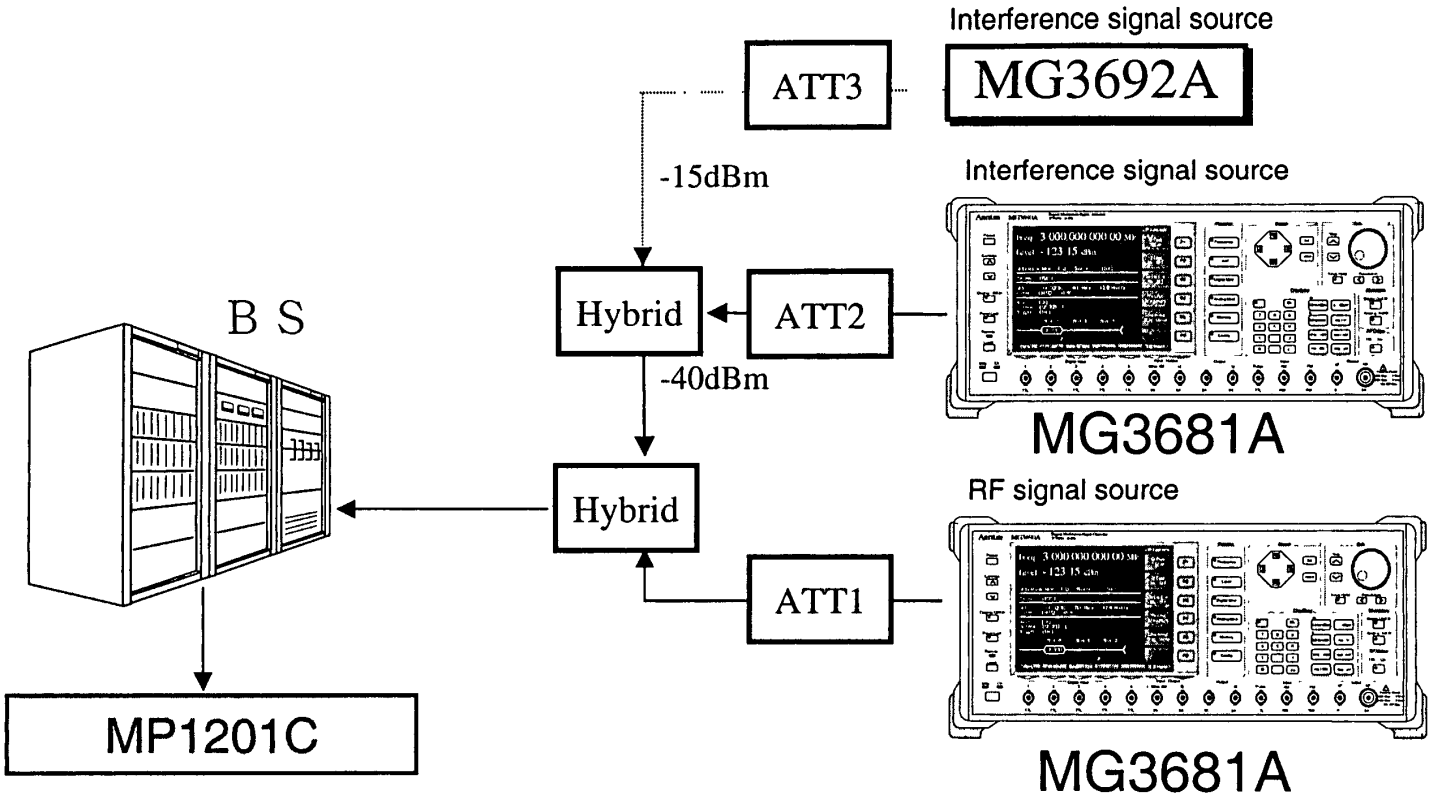
- **TS 25.141 clause 6 Measurement of a Transmit Performance**
- **TS 25.141 clause 7 Measurement of a Receive Performance**

Performance Test System

- **TS 25.141 clause 8 Performance under Fading Condition**

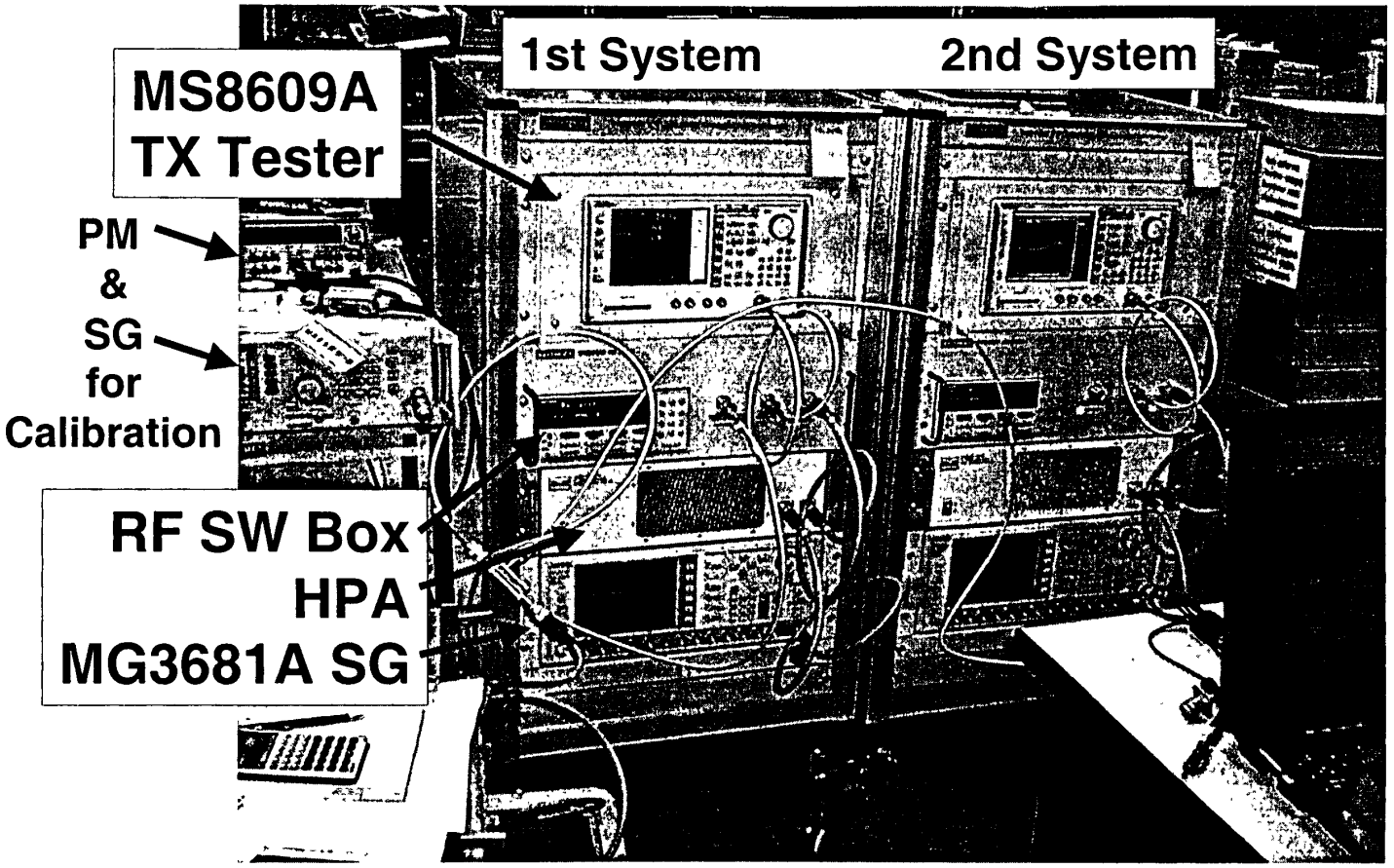
BS Conformance Test System

7.6 Intermodulation characteristics

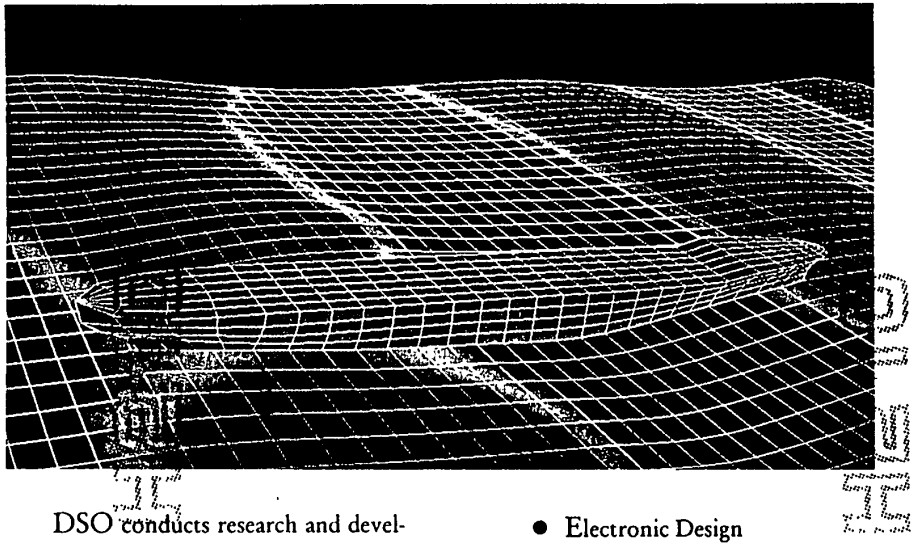


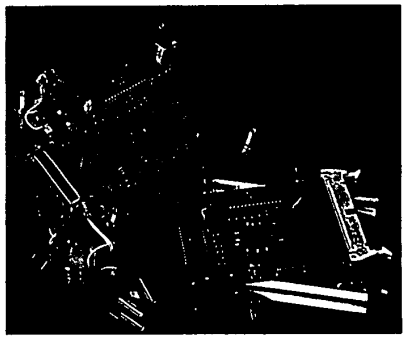
W-CDMA BS Test System

(also a part of UE Test System for Type Approval)



PURSUING TECHNOLOGICAL BREAKTHROUGHS



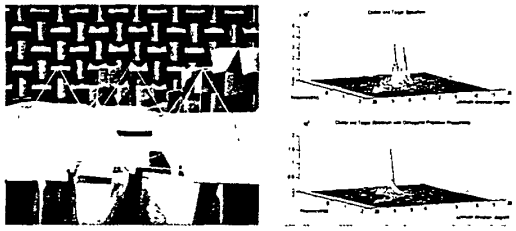


DSO conducts research and development in the following areas :

- Aeronautics
- Guidance & Control
- Marine Technology
- Artificial Intelligence
- Computer Networks
- Cryptology
- Communications
- RF Systems
- Electromagnetic
- Electronic Design
- Chemical Research
- Materials & Mechanics
- Physical Sciences
- Signal Processing

DSO also conducts development projects that bring our technology into real systems to fulfil our customers' needs. This is often done with industrial partners.

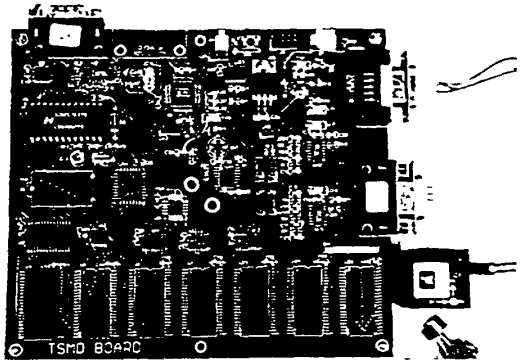
Space-Time-Adaptive-Processing Concept



In the area of advanced radar signal processing, DSO is exploring innovative concepts in Space-Time Adaptive Processing (STAP). It has obtained interesting results based on the STAP concept by using adequately scaled-down acoustic experiments. These experiments on STAP have deepened DSO's understanding of the technique beyond publications and Matlab simulations.

Smart Built-in-Test

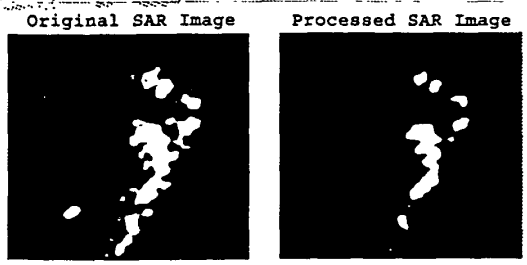
The Smart Built-in-Test (BIT) concept helps to classify BIT failures into hard failures, intermittent failures and false alarms. This is intended for applications where intermittent failures constitute a high percentage of reported failures. The Smart BIT combines temperature and vibration sensors with a neural



network to learn and correlate environmental stress with the occurrence of intermittent failures that is used for the classification task.

Radar Super-Resolution Algorithms

This is an in-house technology development project to develop super-resolution radar algorithms using



ADVANCED ELECTRONICS AND SIGNAL PROCESSING

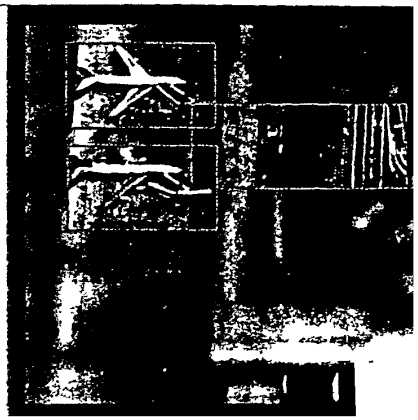
The Centre conducts research and development in tw synergistic areas. The first is in the area of mixed-sign and digital electronics for wideband digital receive and high-performance signal and data processin miniaturised and packaged to meet harsh environmenta constraints. The second area is in advanced signal an image processing concepts and techniques for detectio parameter estimation and tracking applications unde challenging real-time constraint

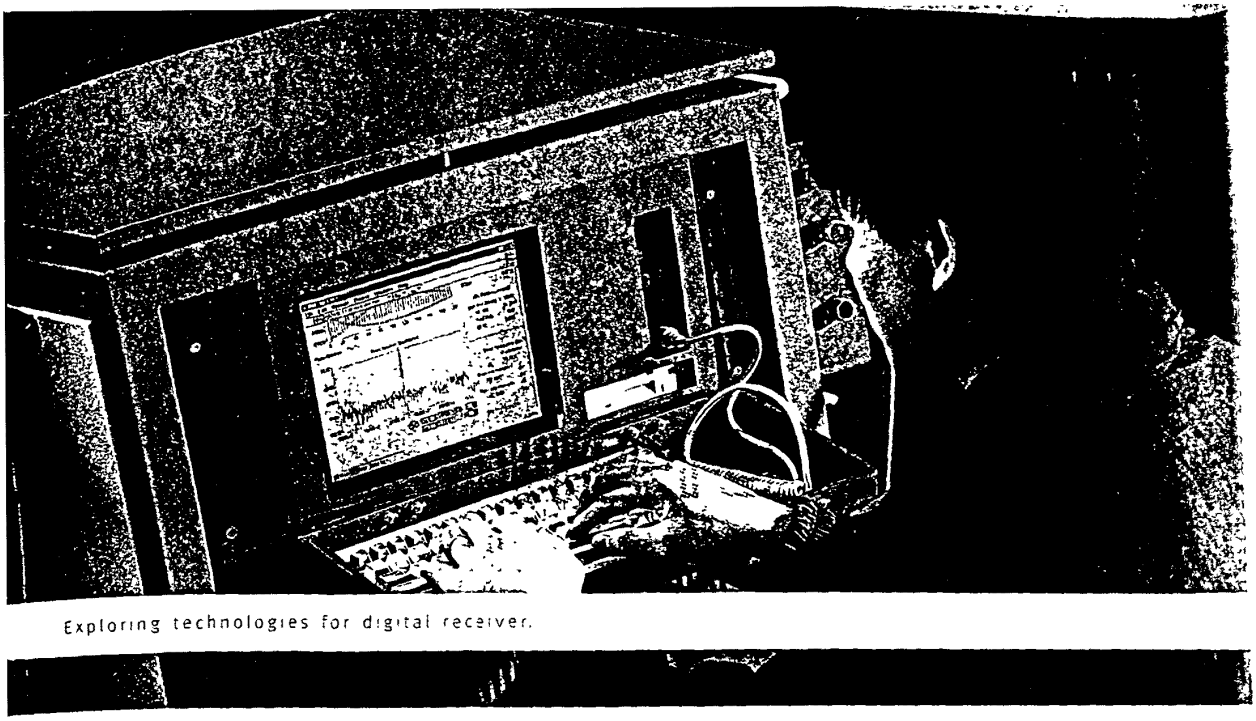
We conduct research in high-speed digital and mixed-signal design, high-density electronic packaging, including chip-on-board and multichip module technologies, high performance signal processor architectures, and low-power electronic devices. We are developing the capability to design high-density CMOS ASICs at high clock rates and high speed silicon bipolar ASICs.

On the signal processing front, we focus on how we can exploit and interpret signals that arise from a range of sensors such as aerial and acoustic signals, visual signatures, and rad waveforms. The work in image processing focuses on techniques to manipulate images, as well as to understand scenes in images.

IMAGE-ON-DEMAND (IOD) DEMONSTRATOR

We have successfully developed an image-on-demand technology demonstrator that finds wide-ranging surveillance applications. The technology caters to increasing demand for transmission, storage and retrieval of high resolution, large image sizes (more than 10000 x 10000 pixels). Its key features allow multiple users simultaneous access and flexibility to decide on regions of interest from the incoming data.





Exploring technologies for digital receiver.

Examples of the Centre's work include the following:

MOBILE ACOUSTIC SURVEILLANCE SYSTEM (MASS)

We have developed and successfully demonstrated on-the-move acoustic detection and localisation of targets. The small acoustic array and noisy moving platform presented non-trivial technical challenges. Adaptive signal processing is the key technology researched and implemented to yield signal enhancement and platform noise reduction.

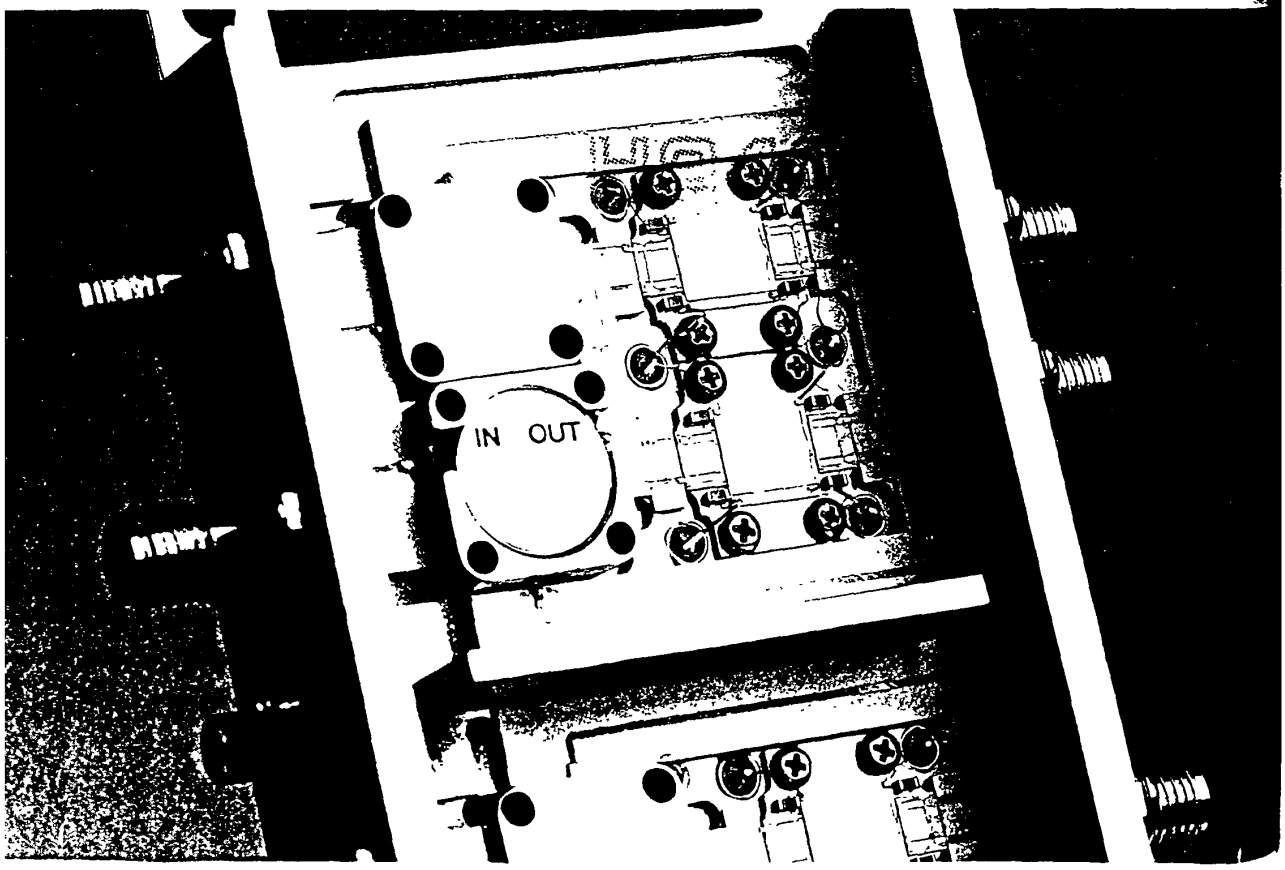
DIGITAL RECEIVER ENABLING TECHNOLOGY (DRET)

We are currently developing building blocks and exploring technologies for digital receivers. These include analog-to-digital converters and digital-to-analog converters with high dynamic range and fast sampling rate. Another enabling technology being developed is a deep and fast memory architecture with flexible addressing. At the same time, high speed ASICs for Fast Fourier Transform (FFT) are being developed. We have partnerships with renowned companies to achieve the best synergy in our research efforts. Advanced packaging concepts, like direct die attach and multi-chip module will be employed to achieve more functionality in any given space.

ELECTROMAGNETICS

This Centre focuses on establishing a high level of competency in radar signatures, antennae, electromagnetic interference and compatibility (EMI/EMC), and miniaturised radio frequency systems to enhance platform survivability, weapon effectiveness and systems operability.

A miniaturised RF transmitter.



Highlights of the Centre's capabilities and facilities include the following:

RF COMPONENT DESIGN AND DEVELOPMENT

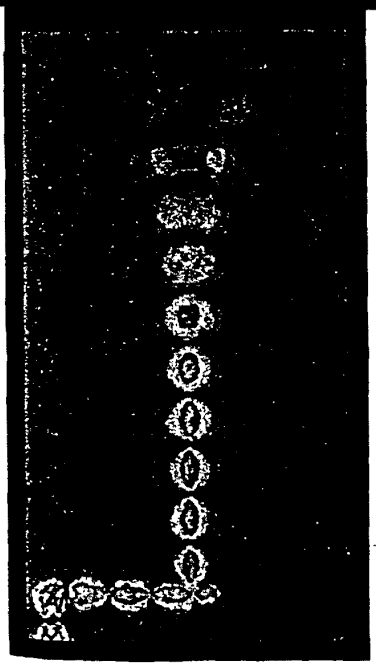
We focus on the design and development of RF components for defence and commercial applications such as radar and communications and phased array systems. We design and fabricate microwave filter and active components like oscillators, small-signal amplifiers and power amplifiers. Our focus is in miniaturisation of RF systems.

ELECTROMAGNETIC COMPATIBILITY (EMC)

EMC is the ability of equipment and systems to function as designed in their intended operational environment without adversely affecting or being affected by other equipment and systems. Our specialised expertise includes EMC design of electronic systems, electromagnetic interference (EMI) prediction and measurement, certification and trouble-shooting, electromagnetic radiation hazard assessment to ordnance, personnel and fuel, and managing EM compliance programmes.

FIRST COMPACT RANGE IN SINGAPORE

We are building the first Compact Range in Singapore, in joint collaboration with the National University of Singapore. This Compact range, when completed, will offer very high accuracy testing of electromagnetic scattering from complex objects, antennae and radomes.



ANTENNAE DEVELOPMENT AND CUSTOMISATION

Communication has become very much a part of modern life and the modern battlefield. Communication devices depend on antennae to transmit and receive information. We have the capabilities to analyse and custom-design antenna systems for military and commercial applications, such as communications and radar. Some of our specialties include printed antennae, wire antennae, tapered slotline antennae, aperture antennae and radomes

An Electromagnetic Field Distribution in Tapered Slotline Antennae