

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畫國外公差報告

服務機關：中山科學研究院
出國人職稱：簡聘技正 薦聘技士
姓名：李清源 何 怡
出國地區：美國加州
出國期間：89年11月2日至89年11月11日
報告日期：90年1月15日

壹、出國目的及緣由

為執行經濟部委託之科技專案「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線性微波功率放大器等之設計、製程、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及用戶端所有射頻收發系統之開發、及量產技術先期研究。本組對整個計劃之執行包含了策略、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提昇技術水平，派員赴美國參訪 CTT、Kyocera America Inc. . . . 等六家公司，研討微波砷化鎵單晶放大器元件之設計、製程與構裝；探討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，達成經濟部科技專案之研發目標。

貳、公差心得

參訪各公司商討課題及心得如下(依系統架構為順序，未按參訪公司順序撰寫)：

為提昇射頻收發模組性能與良率問題，本組採自行開發通訊微波積體電路晶片組(RFIC Chip set)方式，除了需建立波積體電路設計能力外並且需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，以達頻段在 5.8GHz WBCDMA 之計畫目標。

因此，在本組自有之半導體實驗室，建構 HBT 製程以及驗證能量，亦是此次參訪任務中之重要目標。為瞭解開發通訊微波功率晶體及功率模組之相關製程設備我們拜訪了 American Pinpointek 以及 Versatile Technologies Inc. 兩家設備廠並帶回相關資料(如附件一)。前者該公司主要專研於開發高精密光罩對準機有 20 年歷史。由於微波功率晶體製程之關鍵技術為黃光區之微影 (photolithography) 技術。其設計規則 (design rule) 需小於次微米，因此機械強度以及抗震度考量相當重要；另外光罩對準之重複性以及 deep UV light 照度之穩定性亦是挑戰。本次拜訪，除了與專業產品工程師討論光罩對準機之設計架構與使用技巧之外，亦讓我們參觀其設備之生產線。同時也吸收其從研發到產品化之規劃經驗。後者 Versatile 公司研發之產品主要為化學區之相關製程設備。我們也參觀了該公司之生產線與實驗室；另一方面，該公司亦投入建立砷化鎵微波積體電路晶片製程代工廠，特別在 20GHz 以上波段產品。顯然高頻元件積體電路此一市場需求量將逐年增加。

針對 5.8GHz 射頻通訊晶片組構裝問題，目前美國各大公司均採 Plastic Micro X 及 LGA (Land Grid Array) 方式解決構裝問題。彼等解決方案係以成本為考量重點，並不適合解決高頻構裝問題。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低溫共燒陶瓷構裝 (low temperature cofired ceramic) 雖然製程與材料系統尚未成熟，但已是形成一股風潮(與目前

本組自行開發低溫共燒陶瓷構裝雷同)。為解決高品質高頻晶片組構裝問題，此行特地安排參訪 Kyocera America Inc.。該公司為日本京都陶瓷公司之美國分公司，位於南加州的聖地牙哥，占其母公司先進陶瓷工藝技術之利及拜美國業界成熟微波科技之賜，其主要專長為先進光電及微波構裝研究發展；在微波構裝方面主要產品為通訊頻段功率晶體構裝及毫米波、微波多晶方模組及高密度構裝(如附件二)。其中尤以微波功率放大品構裝之研發為其特色。近年來有專利檔案顯示已有人開發塑膠材質毫米波構裝，但尚未商品化。此議題尚未有定論，所以仍有發展空間。目前該公司亦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。國內也有日月光公司具此技術，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。

本次參訪經任職該公司研發部友人 Dr. Panayiotis Tirkas 安排，針對微波構裝設計製造及應用等議題進行研討，以解決寬頻無線通訊系統發展計劃中微波積體電路商業標準構裝問題。該公司人員指出微波表面黏著構裝早有其標準如微小十字(Micro X)構裝即為一例，該公司亦推出一系列標準化微波構裝如功率元件構裝、微波晶片構裝及微波表面黏著構裝，最高工作頻率可達50GHz。其中高功率構裝已廣受如易利信和摩托羅拉等大廠所採用。

其在毫米波構裝、波導及天線研發亦多有所成就，該公司研究人員 Chong Il Park 及 Roger T. Kuroda 今年在波士頓國際微波研討會所發表之專題課程提到該公司近期開發之各項技術。由於考量目前技術成熟度，在材料系統採用該公司專精之高溫陶瓷與銅合金焊接技術，電特性佳且可靠度極高。目前該公司日本總公司已積極開發低溫共燒陶瓷技術(LTCC)在微波構裝運用技術，新開發基

本構型最高工作頻率可達 30GHz。目前該公司研究部對外公開之低溫共燒陶瓷技術(LTCC)材料系統共有兩種，即杜邦(Du Pont)與美國 Ferro 系統，該公司對商業界開放之低溫共燒陶瓷製程服務，也只提供此兩種成熟材料系統。本單位過去一直也採用 Ferro 公司材料系統，在微波構裝及多晶方模組之研究開發有相當成效及能量，若再接再厲繼續投入人才及資源應能得到令人滿意之成果。

由於低溫共燒陶瓷技術(LTCC)在微波構裝運用具有多重意義，目前國內部份陶瓷工業廠家亦對此一市場持高度興趣，惟其專業在於材料及製程，對於電子特性研究及微波領域應用及設計仍處於摸索階段，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。

為吸取先進廠家在寬頻無線通訊微波系統設計及切入市場之經驗，特別安排參訪在這一行業新興起之 MM/COM 公司。該公司從事寬頻無線通訊微波系統設計，其目前主力能量著重於 LMDS 毫米波通訊系統之開發(如附件三)。該公司工程師多聘請自前休斯公司毫米波及微波積體電路部門，從事寬頻無線高通訊多年。該公司自創立至今不過數年，員工人數從六人成長到目前二十二人，人力結構以資深設計研究人員為其骨幹，輔以少數支援人力和線上作業人員。由於該公司人員專精毫米波技術且善於評估微波積體電路，該公司之產品經完善生產作業流程設計與技術管理，在極精簡的人力結構下每年可產出高附加價值之毫米波功率放大器，數目超過兩仟個。由於目前 LMDS 毫米波通訊系統之需求量，尚未達大量生產規模，該公司捨低價格 PCB 製程，採造價稍高但可靠度極高之薄膜製程，將不良率控制在仟分之一以內。該公司對市場需求與供應成本之看法，的確與目前一般不具經驗之通訊業，一味地壓低成本的做法大異其

趣。該公司由於製程良率控制得宜，利潤反而相對得高，這樣思考方式值得參考。MM/COM 公司除了提供各式各樣毫米波功率放大器外，也生產波導元件及量測用功率放大器。該公司產品最大客戶為韓國，用於 CDMA 基地臺對通訊中心通訊使用。由於此一系統因工作頻率高可提供寬頻通訊服務，可突破傳統固定網路業者之壟斷，改變了通訊市場之生態與結構期規模將不可忽視。由於此一領域技術層次高，利潤相對也高，所以國內知名大廠如臺揚及明碁等公司，正準備投入人才資本搶攻市場。本單位具豐富研究發展經驗之生產型態，以小量多樣為主，應可考慮介入此一型態市場。

為瞭解寬頻分碼擷取(W-CDMA)微波系統線性功率放大器之設計及生產製程相關技術，期能提升本單位線性功率放大器開發及生產製造技術，此行特地走訪 CTT 專業微波功率放大器製造公司。CTT 公司為一約有 90 人之小型公司，其核心技術為功率放大器模組，產品亦旁及其週邊次系統。其客戶 75%為國防業者，25%為商用業者。由於其訂單多為少量多樣特殊規格 Custom design 之產品，非常適合與其合作獲得國內所需之高功率放大器模組。此外，該公司大迎部分承接國防軍品，故對品質管制作業極為重視值得借鏡。CTT 未來發展方向包括 Digital Radio 用次系統 LDMS 之關鍵零組件，如低雜訊放大器、0.1-1 Watt 功率放大器、升/降頻器、倍頻器及收發機模組等。其次為高功率放大器，分為儀器型放大器、基地台放大器及 TWT 推動放大器等各類放大器模組。此外就是應用於 PCS, MMDS 與 LMDS 之功率放大器模組。

CTT 為傳統放大器設計公司，在高功率放大器設計製造和量測能量，已投注大量時間與經費，也累積深厚的經驗。其在高線性度放大器之開發亦不遺餘力。由於高功率放大器已成為通訊業的主要產品，故各公司無不在此一領域全力衝刺，據該公司戴總裁指稱功率放大器技術一日千里，CTT 仍稍落後市場

的水準，現正努力迎頭趕上市場水準。該公司從設備齊全到今日，已有五年努力才有目前的成績，故其發展關鍵技術之模式，也有值得我們參考的地方。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 CTT 公司，是值得考慮的合作夥伴。

Stellex Microwave Systems. 為此行唯一安排專業微波系統器製造公司，以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，做為本單位未來發展之借鏡。

Stellex Microwave Systems Inc. 原為成立於 1957 年之 Watkins-Johnson Company 的 Microwave Device Sector，1996 年為 Stellex 公司所併購，為一國防微波元件、次系統廠商。員工約 2000 人，主要技術能量以薄膜微波積體電路為主，與本組相當類似，故其發展方向值得借鏡。該公司基本上維持薄膜微波積體電路之技術能量，大部份供商業使用；少部份仍供國防計畫使用。美國軍方之反戰術彈道飛彈 ATMB Pac III 及先進中程空對空飛彈 AMRAAM 內之雷達系統微波組件都為該公司所生產。目前，與本組於 1991 年派員參訪時已有重大變革。

該公司在製程技術研發相當先進：薄膜微波積體電路之組裝採量產型 Pick & Place 方式，一部 Pick & Place System 可取代約 20 個人力。生產線任務編組亦由產品導向改為功能導向，裝配人員只需專注於專長動作即可，因此，生產效率及良率都大幅提升。電路封裝亦揚棄傳統方式；機械外殼大量採用金屬射出成型技術 Metal Injection Molding，質輕易於再加工成本低廉。電性及機械熱特性與 Covar 相近，陶瓷基片不需基座可直接安裝，也使設計、組裝技術更

具挑戰性。至於模組與模組間改採 GPO Snap on Type 接頭而非傳統 SMA Type 旋轉螺絲接頭，據該公司宣稱改用此接頭除了易於組裝、節省空間外並可提高可靠度。此外，該公司建立包含收發機、放大器等全套微波線路自動測試系統簡化測試流程，縮短測試時間，均值得我們學習、借鏡。

參、效益分析

此行目的係為搜集國外微波通訊相關技術資源，解決無線通訊關鍵零組件之設計、製程、封裝、可靠度等問題以協助寬頻無線通訊系統之發展。參觀了各廠商的研發、生產及量測設備，其中有不少地方值得參考、學習改進。在參訪期間也與各公司工程師舉行專題討論，除了對我們的技術有所助益外，同時也激發我們對於解決問題的新的思考模式。如能參酌他們的經驗，運用其可提供的資源，對計畫之執行的確大有幫助。

肆、國外工作日程表 表填表人：李清源

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.	891103 0930-1630	CIT INC.	David Tai C. S. Lee	美	男	3005 Democracy way Santa Clara CA95054	討論 W-CDMA、LMDS 功率放大器設計技術	
2.	891104 0930-1530	Stellex	Edward L. McGhee, Timothy J. Galla Andrew Varga Barry P. Woo Jim R. Blaser	美	男	Stanford Research Park 3333 Hillview Ave., Palo Alto CA 94304-1223	參觀工廠、討論混波器設計技術	
3.	891107 0900-1150	Versatile Tech.	John Chiller Michino Fuzy	美	男	4079 Realm Drive, San Jose, CA95119	參觀工廠、研討半導體相關化學製程設 備	
4.	891107 1350-1700	American Pinpointek	Nelson choa	美	男	1630 Oakland Rd. Suit A-112, San Jose, CA 95131	參觀工廠、研討半導體相關黃光製程技 術	
5	890708 0900-1630	MMCom Inc.	Mi-Chi Shih, Chic Shishido Steve Vaughn	美	男	4030 Spencer Street #3 Torrance, CA90503	討論微波功率放大器設計、封裝技術、 量測及 MMIC 技術與製程、市場趨勢	
3	890709 0930-1430	Kyocera America, Inc	Panayiotis A. Tirkas Chong H Park	美	男	8611 Balboa Ave. San Diego, CA 92123-1580	參觀工廠、討論微波構裝設計技術	
填說 寫明	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

由於參訪任務與行程安排密集，故除夜間抽空拜顧問王博士。假日時亦與友人一同遊覽優聖美地以及 Stanford university，目睹世界美景及百年名校，覺得不虛此行。

陸、出國公差建議事項表

	<p>一、各公司在計畫研發階段，即著手進行相關技術文件之彙整。所有研發技術資料需建檔，結案時必須完整提供，如此才能縮短研發至量產時程，亦不易藏私。這是我們一般研發部門較易忽略之處。</p> <p>二、研發時即考慮試產及未來量產之易產性，是各部門經驗累積之結果。因此，急需建立相關技術資料庫，勿存私，互相分享，將可提高產品開發效率。</p>	<p>出國 單位</p>	<p>三所 七組</p>	<p>出國 日期</p>	<p>89 07 05 ~ 89 07 14</p>
		<p>備 考</p>	<p>出國 人員</p>	<p>李 清 源 、 何 怡</p>	
<p>註： 1 請將建議事項表附於出國公差報告中 2 另請影印一份送中心初審小組。</p>					

附件（一）

About Quintel Corporation

INNOVATION IN PRECISION ALIGNMENT AND IMAGING

Becoming a customer of Quintel Corporation means entering into a relationship with an established company that has a wide global reach and a solid reputation as a designer and manufacturer of mask alignment and exposure systems. As Quintel celebrates its 20th anniversary, the company has attained a reputation for outstanding engineering and customer support. It is this strength which enables Quintel to support a diverse customer base.

An early pioneer in value-added remanufactured equipment, Quintel has evolved into a leading provider of new equipment. At the time the company incorporated in 1978, it was a second source of parts and service for Kasper and Cobilt contact mask alignment systems. The company soon gained renown for proactivity in the rebuilding of machines, exchanging older equipment for improved equipment and becoming expert in retrofitting engineering improvements.

As market conditions changed and new technologies required more extensive redesign, Quintel initiated its entry into the development of new equipment. In 1986, Quintel introduced its own line of mask alignment exposure systems to better serve the microelectronic industry. By 1994, the company's primary focus had become new equipment.

Quintel's core strength is its ability to customize design to meet specific needs of the end user. Quintel systems are used all over the world in production facilities for manufacturing a variety of products, as well as in research and development centers and universities.

Welcome to QuintelCorp.com

PHOTOLITHOGRAPHY AND PRECISION ALIGNMENT EQUIPMENT

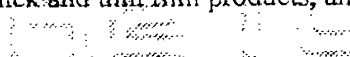
Custom Model Capability at Standard Model Prices!

Mask alignment and exposure systems and more....

- Experience adapting photolithography technology to specialized needs
- Engineering strength to support emerging technologies
- Expertise in supplier management and manufacturing
- Flexibility to satisfy the individual service and support needs of customers

Technology for a Broad Range of Applications

In the constantly changing environment of microelectronic manufacturing, customers must get maximum leverage from their investment in equipment. The design of Quintel products accommodates a wide variety of device applications, including MEMs, semiconductors, power and solar devices, telecommunications devices, ~~thick and thin film products,~~ and electro-optics.



Engineering Design with the User in Mind

Manufacturing quality depends not only on precision equipment but on ease of use. The ergonomic design of Quintel products optimizes operator comfort. Conveniently located control panels increase ease of adjustment. Removable covers, substrate tooling design, plug-in modules and self-contained units make servicing quick and uncomplicated.

Economical Ownership

Quintel's wide selection of options ensures that a customer gets equipment that meets his exact requirements at an affordable price. All Quintel products are designed to require minimum maintenance and provide ease of adjustment and servicing. As customer needs change, Quintel's design flexibility allows for reconfiguration, reducing obsolescence and extending equipment life cycles.

| [About Quintel](#) | [Product Line](#) | [Service/Support](#) | [Contact Us](#) |

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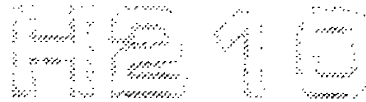
Service and Support

ENSURING YOUR CONTINUED SUCCESS WITH QUINTEL PRODUCTS

Quintel started business twenty years ago as a source of parts and service for various OEM contact mask alignment systems. Because of the company's origin, Quintel understands better than most manufacturers the value of service, reliability and customer satisfaction. The company backs its products with a staff of highly trained specialists who thoroughly understand the products they support.

Quintel's customer support includes:

- On-site and factory training
- Field service support
- Spare parts support
- Service contracts



Quintel makes it easy for customers to get the technical support and service they need, whether the equipment was purchased twenty years ago or just last week.

For service contact:

Durt Gamm, Customer Support Manager.
Telephone: 408-435-1995 ext. 15
E-mail: service@quintelcorp.com

For spare parts contact:

Janet Dunbar at the Order Desk.
Telephone: 408-435-1995
E-mail: spares@quintelcorp.com

Product Line

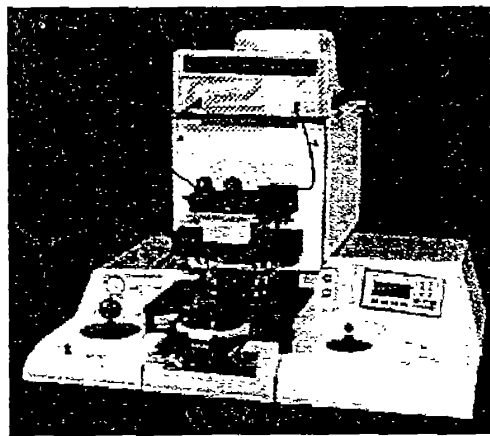
DESIGN FOR OPTIMUM PERFORMANCE TODAY AND TOMORROW

Throughout its 20-year history in the contact and proximity photolithography industry, Quintel has maintained a commitment to innovation, value, quality, service and reliability. It is a commitment that will carry customers into the 21st Century with leading-edge equipment.

Q-4000 Series Mask Aligner

The ideal manual system for custom manufacturing facilities, research and development centers and university programs

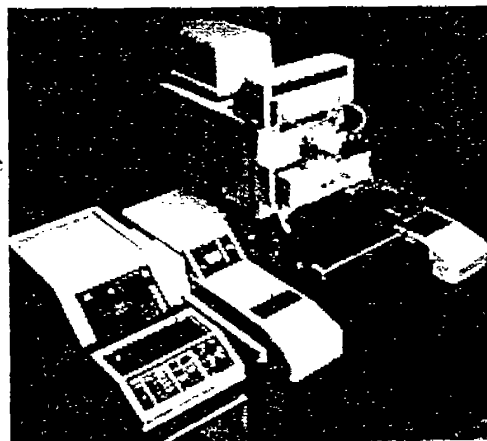
- Tabletop design
- Handles substrates up to 6" (150mm) diameter
- Vacuum or contact printing
- Front and back side alignment capability
- Microscope for split-field and single-field higher resolution viewing
- Tray load or carousel substrate loading
- Flexible tooling designs
- Selectable UV power ranges
- PLC menu-driven software
- Easy to set up and use
- Affordable



Ultraline 7000 Series Mask Aligner

An expandable R & D or production tool that provides optimum process control to ensure repeatable precision alignment and high resolution exposure

- Multiple exposure modes (contact/proximity)
- Handles substrates up to 8" (200mm) diameter; alternate configuration for larger substrates
- Front and back side alignment capability
- Open architecture for customization and upgrades
- High resolution split-field and single-field microscope with zoom
- Tray load or robotic auto-load
- Alternate UV configurations / UV, NUV, DUV
- Programmable logic with built-in diagnostics
- Easy to set up and use
- Economical



Q-1200 Flood Expose System

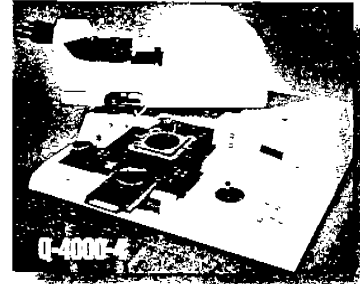
An inexpensive alternative for non-critical alignment and printing applications

Q-4000 Table Top Mask Alignment Systems

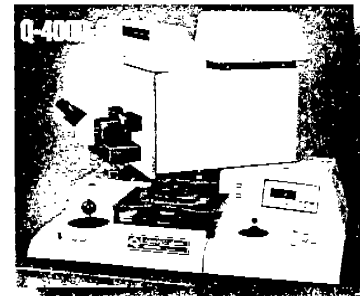
SPECIFICATIONS & CONFIGURATIONS

Technical Data	Model Q-4000-4	Model Q-4000-6
ALIGNMENT STAGE		
Alignment Travel X-Y		
Manual Joy Stick	Standard	Standard
Manual Micrometer	Optional	Optional
Alignment Travel (z)		
Manual Micrometer	Standard	Standard
Stage Scan	±16mm	±16mm
X-Y Movement	±6mm	±6mm
z Rotation Range	±7°	±7°
Z Axis Shiftage	<0.05µm	<0.05µm
Mask/Water Separation	0-180µm	0-180µm
ELECTRONICS		
Programming & Control	PLC	PLC
Read Out Panel	LCD	LCD
UV POWER SUPPLY		
Vari-Watt (Constant Power)	Standard	Standard
Ultra-Sense (Constant Intensity)	Optional	Optional
Power Range	200/350, 350/500	200/350, 350/500, 500/1000
ALIGNER TABLE		
Double Isolation	Standard	Standard
CERTIFICATION		
C.E.	Yes	Yes
Options/Up-Grades		
Back Side Infrared	Optional	Optional
Sequencing Pulse Timer (Three Program Venue)	Optional	Optional
Carousel Loading	Optional	Optional (100mm max.)
Utilities		
High Pressure (Dry Air)	80 PSI (5.4mbar)	80 PSI (5.4mbar)
Low Pressure (Nitrogen)	40 PSI (2.7mbar)	40 PSI (2.7mbar)
Vacuum	21" Hg (<150mbar)	21" Hg (<150mbar)
Voltage (Main Power)	110V/60Hz or 220V/50Hz	110V/60Hz or 220V/50Hz
Dimensions (Table Included)		
Width	48"	48"
Height	56"	56"
Depth	36"	36"
Weight	450 LB	480 LB

The
Quintel
Advantage



for substrates 100mm diameter & smaller



for substrates 150mm diameter & smaller



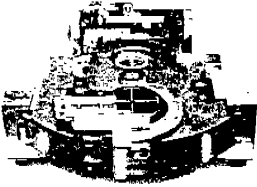
2431 Zanker Rd. • San Jose, CA 95131
(408) 435-1995 • Fax (408) 435-8120
E-mail: sales@quintelcorp.com
Visit us on the World Wide Web at
www.quintelcorp.com



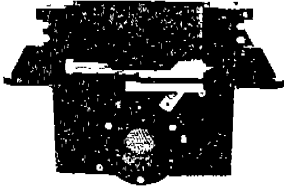
Q-4000 Table Top Mask Alignment Systems



Wafer Tooling Kit



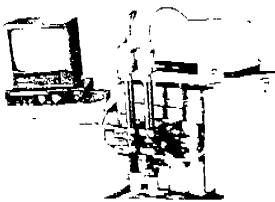
Carousel Load



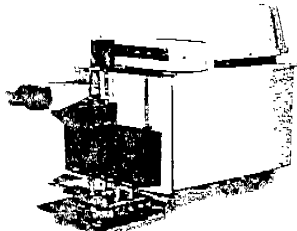
Q170/15 Integrator



Vari-View Viewing Optics



Video-View Viewing Optics



Magna-View Viewing Optics

SPECIFICATIONS & CONFIGURATIONS

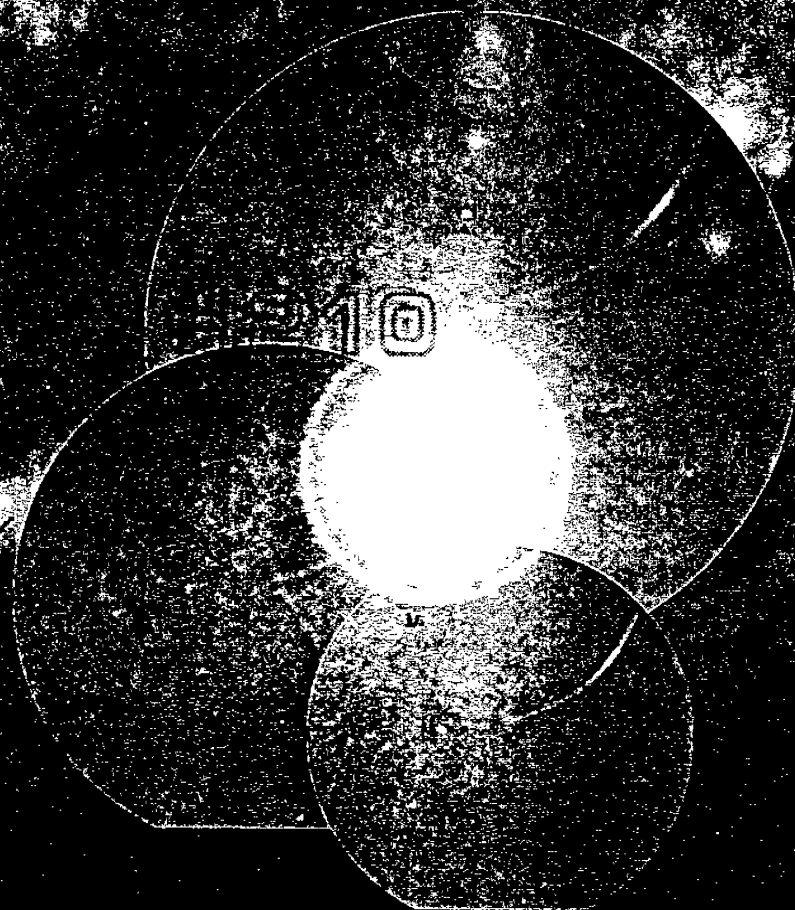
Technical Data	Model Q-4000-4	Model Q-4000-6
WAFER		
Size	1/4" Chip up to 100 mm Dia.	1/4" Chip up to 150 mm Dia.
Thickness	0-6 mm	0-6 mm
SUBSTRATE		
Size	1/4" Square up to 3" Square	1/4" Square up to 4" Square
Thickness	0-6 mm	0-6 mm
MASK		
Size	Up to 5" Square	Up to 7" Square
Thickness	60 - 120 mls	60 - 150 mls
EXPOSURE MODES		
	Pressure Contact Vacuum Contact Contact Calibration	Pressure Contact Vacuum Contact Contact Calibration
EXPOSURE OPTICS		
Integrator	Q170/15 Quartz	Q170/15 Quartz
Lamp Size	200/350/500 Watts	200/350/500/1000 Watts
UV Wavelength:		
UV (Hg) - Standard	350 nm to 450 nm	350 nm to 450 nm
NUV (Hg) - Optional	280 nm to 350 nm	280 nm to 350 nm
DUV (HgXe) - Optional	220 nm to 280 nm	220 nm to 280 nm
Uniformity	≤ 2% (100 mm Field)	≤ 3% (150 mm Field)
VIEWING OPTICS - OPTIONS		
QUINTEL VARI-VIEW		
Zoom	Standard 5.2	N.A.
Magnification		
Splitfield	120X - 300X (6X OBJ•10X EYP•2X-5X Zoom)	
Singlefield	50X - 125X (2.5X OBJ•10X EYP•2X-5X Zoom)	
Objective Spacing	20mm-80mm(8mm-100mm Option)	
Illumination	Halogen-Lamp or Fiber Optic	
CCTV & IR Port	Standard	
QUINTEL CCTV VIDEO-VIEW		
Zoom (Manual)	N.A.	Standard 4:1
TV Magnification		
Splitfield		30X - 1000X Range
Singlefield		30X - 1000X Range
Objective Spacing		40mm - 150mm
Illumination		Halogen-Fiber Optic
Monitor		
9" B&W		Standard
13" Color		Optional
QUINTEL MAGNA-VIEW		
Zoom	N.A.	Optional 5.2
Magnification		
Splitfield		40X - 600X Range
Singlefield		40X - 600X Range
Objective Spacing		20mm - 150mm
Dual Focus Objective Mounts		4 Objective per Mount
Illumination		Halogen-Lamp or Fiber Optic
CCTV & IR Port		Standard



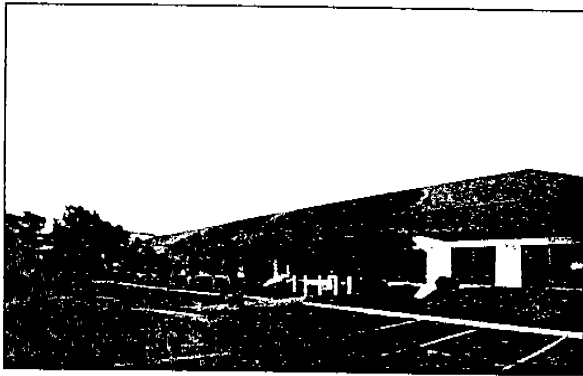
Versatile Technologies, Inc.

7019 Realm Drive
San Jose, CA 95119-1131
Phone: (408) 574-7960
Fax: (408) 574-7961

Versatile Technologies, Inc.



***A Recognized World Leader in
Wet Process Equipment***




VTI's State-of-the-Art Silicon Valley Location.
World-Wide Sales and Field Service Support.



VTI's Certified Class 100 Clean Room Provides
Guaranteed System Particle Qualification.
Class 1 Nitrogen and 17 Meg Ohm DI Water Facility

Quality Remanufacturing Warranty and Particle Guarantees

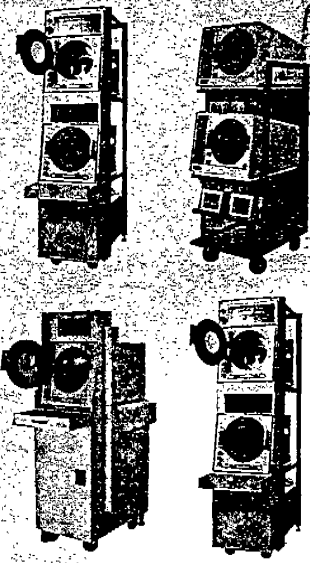


Unsurpassed Service and Support

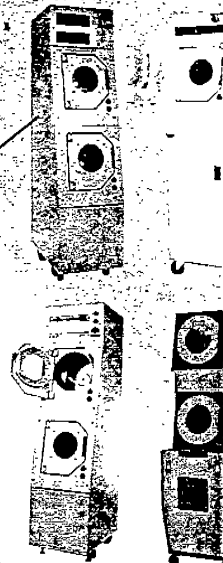
- Comprehensive Field Service Organization
- Complete Remanufacture
- Full Warranty
- Guaranteed Particle Counts
- Rotor Manufacturing
- Complete Spare Parts
- Controller Repair/Replacement
- Semiconductor, Disk Drive, and Flat Panel Products
- Large Inventory of Wet Process Equipment Available

Automation Robotic Integration Available

Verteq

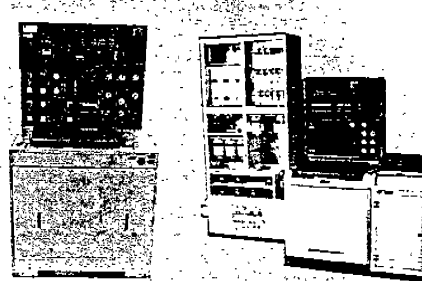


Semitool

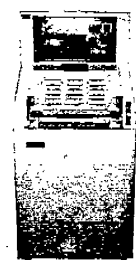


FSI Titan, Saturn, Mercury

Semitool Acid Processors Also Available



Megasonics

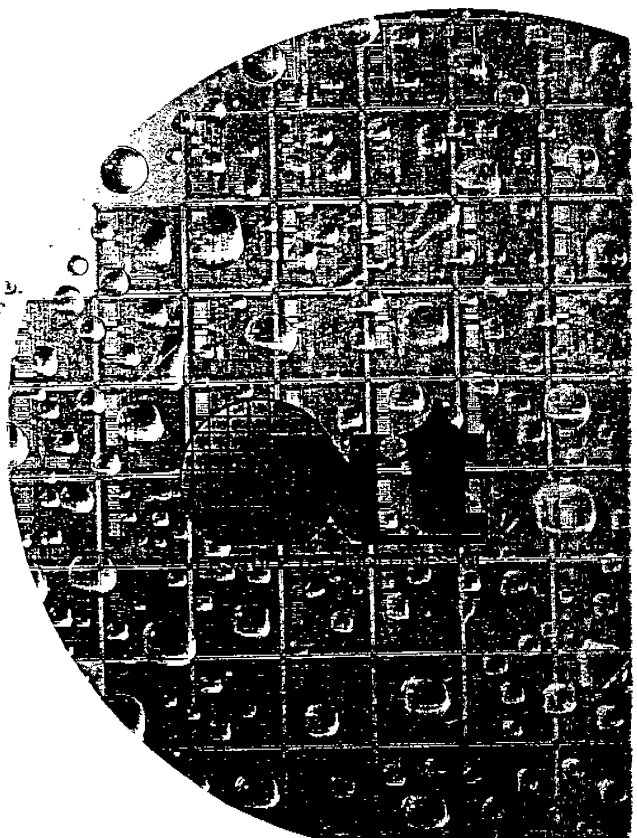


Up to 12 in. Upgrades, Expansions, and Remanufacturing of Existing Equipment

Versatile Technologies, Inc. is a team of dedicated professionals committed to long term relationships of trust and confidence with our customers through unsurpassed service, technical support, and product quality.

A recognized world leader in wet processing equipment.

*For more information, contact
Versatile Technologies, Inc.*



附件（二）



January 31, 2001

[GLOBAL HEADQUARTERS \(JAPAN\)](#)

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Welcome to Kyocera in the Americas!

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[COPIERS, PRINTERS & FAXES](#)
[CAMERAS & EQUIPMENT](#)
[CERAMIC CONSUMER PRODUCTS](#)
[SOLAR ENERGY PRODUCTS](#)
[CERATIP CUTTING TOOLS](#)
[LCDs & THINFILM DEVICES](#)
[ELECTRONIC COMPONENTS](#)
[SEMICONDUCTOR PARTS](#)
[ADVANCED CERAMICS](#)

Today's Feature: Ceratip Cutting Tools

Kyocera's CERATIP cutting tool inserts are designed for industrial metal removal. Made from advanced ceramic, cermet and carbide materials, these inserts can slice through the hardest metal alloys with extreme speed and precision.



Ceratip Cutting Tools

[Site Map](#) | [Search](#)

RECENT DEVELOPMENTS

- Kyocera Announces Merger Agreement With Tycom Corporation
- Kyocera Introduces the CONTAX N1, an Auto-Focus 35mm Camera System
- Kyocera America, Inc. Purchases VisPro Corporation
- Kyocera Introduces OptoBGA (TM) Electro-Optic Package For Fiber Networks



INDUSTRIAL CERAMIC PRODUCTS

ABOUT US	TYPES OF CERAMIC	PRODUCTION PROCESS	TOLERANCE GUIDELINE	PRODUCTS & MARKETS	ASSEMBLY TECHNOLOGY	CONTACT US
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February 1 2001

ABOUT US

Press Releases

A Kyocera White Paper: The Unique Properties Of Advanced Ceramics

Copyright January 1999 by Kyocera

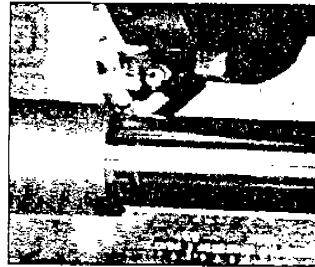
New Technologies Need New Materials

During the 20th Century, technology has sometimes failed to keep pace with advances in basic science. Today, many technological breakthroughs remain unrealized not because of inadequate theoretical knowledge; but rather because they require unattainable performance from basic materials. Metals and plastics, in many applications, have now been developed beyond the point of further significant improvement. This, unfortunately, threatens to impede the continued advancement of fields with great influence over the future well-being of human society -- such as electronics, semiconductors, automobiles, industrial equipment, chemical processing, medicine, and energy.

Fortunately, mankind has now entered an exciting era of advanced ceramic technology which some people are calling the "New Stone Age." With a 10,000-year history in the form of earthenware and pottery, traditional ceramic is hardly a new material. However, recent advances in processing, forming and manufacturing technologies have created a new category of "super ceramics" with unprecedented capabilities. These advanced ceramics possess remarkable characteristics not found in any other known material; they hold great promise for solving many of mankind's most pressing technical challenges. Through special formulation, Kyocera produces advanced ceramics which can exhibit any of the following traits:

Extreme Hardness

For many demanding structural applications, ceramics can be formulated with Moh's Scale ratings above 9.5 -- making them the hardest known substance next to diamond (which rates 10 on Moh's Scale). Because of this extreme hardness, ceramics can actually be used to cut steel and other metals in high-speed, high-precision machining operations. In many applications already, today's competitive machining industries require performance that only ceramic materials can provide.



Cutting Ceramics

Extreme hardness also makes ceramics ideal for use as friction-resistant components in industrial equipment. Paper manufacturing, textile production, wire-drawing and can tooling are just a few of the applications in which higher productivity depends on the unique abrasion resistance of advanced ceramics. Some advanced ceramic components for structural applications literally never wear out.

Physical Stability

Because they are extremely physically stable, ceramics can be machined into shapes and dimensions accurate to within a fraction of a micron (1/1000 of a millimeter) if required. This physical stability is essential in structural applications where accuracy is critical, such as high-precision industrial machinery, testing and measuring devices, and semiconductor processing equipment. The further advancement of many high-tech fields now depends upon attaining record levels of mechanical precision from basic materials. Increasingly, the levels required necessitate the use of advanced ceramics.



Ceramic Electronic Components

Extreme Heat Resistance

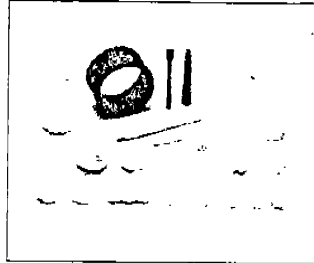
Most cast steels begin to lose their functionality at about 1,000 degrees Fahrenheit -- slightly cooler than a "red hot" burner on your kitchen stove. Structural ceramics, in contrast, can function effectively at up to 2,000 degrees Fahrenheit for extended periods.



automotive engines, where further performance improvements depend on higher operating temperatures. The engine of the future must offer drastic improvements in emissions and fuel efficiency. Kyocera has successfully built and tested ceramic engine prototypes in production cars where the higher operating temperatures permitted by ceramics translate directly into better fuel economy, significantly lower pollution, and greater engine power. Many experts now believe that the engine of the future will be comprised of up to 50% ceramic materials.

Chemical Inertness

Metals corrode, rust and deteriorate over time -- especially when exposed to weather, saltwater, extreme temperatures or chemicals. In contrast, ceramics do not react with most chemicals and are virtually impervious to corrosion. This chemical inertness allows Kyocera's ceramics to be used in equipment that is exposed to corrosive substances for extended periods without deteriorating or requiring frequent maintenance.

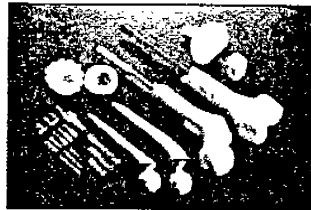


Ceramic Pump and Valve Components

Almost all liquids are corrosive to some -- even water and human blood. Unfortunately, whenever pump and valve components corrode, leaks and fluid contamination can result. Ceramic seals and valves have thus become essential for the specialized medical pumps used in many new surgical procedures. The latest cancer treatments employ blood-component therapies that depend on ceramic-equipped blood processing machines. In addition, efforts to conserve donated blood have led to the development of blood cleansing machines -- which can now enable an entire heart-bypass operation to be conducted with as little as one transfusion. Without the chemical inertness, hardness and stability of ceramic materials, many of these new machines would be technically unfeasible.

Biocompatibility

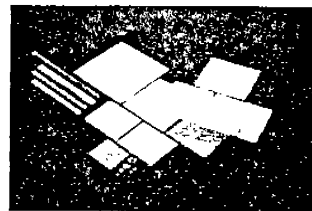
As a result of their chemical inertness, ceramics are also "biocompatible." This makes ceramics suitable for implantation into the human body with little or no risk of being rejected by the immune system. Kyocera uses this quality to create long-lasting ceramic components for orthopedic joint and tooth replacement systems. Today's common metal implant materials often cause inflammation, which can lead to implant failure. In contrast, tissues thrive next to ceramic implants -- and bone can even bond to them as if it were reacting to other living cells.



EXCELPAK Dental and Orthopedic Implants (with Kyocera Japan)

Superior Electrical Properties

In addition to their physical and structural characteristics, ceramics also possess valuable electrical properties that make them indispensable in modern electronics. First, because they do not conduct electricity, ceramics are perfect electrical insulators. Secondly, ceramics possess the property of "capacitance" which enables them to store electrical charges much like a battery. A third quality, known as the "piezoelectric phenomenon," can allow ceramic wafers to generate small electrical signals when exposed to sound waves or mechanical vibration -- and to resonate, thus creating sound waves when electrically charged.

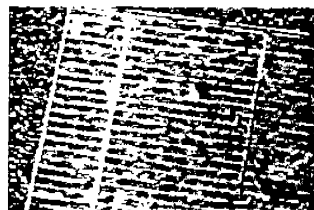


Ceramic Wafers Used in the Electronic Industry

These qualities have already given ceramics a unique role in miniaturizing modern electronic products. In fact, without advanced ceramics, the cellular telephone, pager, laptop computer and entire lines of other electronic equipment could not exist as we know them. Further, thanks to the miniaturization that ceramic materials help create, engineers are now envisioning future electronic products with truly amazing capabilities -- like video telephones you can wear like a wristwatch -- and TV sets thin enough to hang on a wall like pictures.

Photovoltaic Phenomenon

Decades of development in ceramic and crystalline manufacturing technologies have made Kyocera a world-leading producer of "photovoltaic" solar cells. Based on silicon, one of the Earth's most common elements, Kyocera's solar cells convert sunlight directly into usable electricity -- with no noise, moving parts or pollution. Consequently, Kyocera's solar cells offer great promise in meeting society's future energy needs. Although solar



February 1, 2001

PRODUCTS & MARKETS

Semiconductor Processing Equipment: Wafer Processing Products

ELECTRO-STATIC CHUCK

Computer
Materials: Aluminum Nitride, Alumina and Sapphire

Single Crystal
Applications: Wide Range, Low and High Temperature

Substrate Products

High Dielectric Products

- Excellent Thermal Conductivity and Uniformity

Ni-Zn Ferrite Products

- High Chucking Force Regardless of Thickness

Textile Products

- High Dielectric Constant
- High Wear Resistance

Seal, Pump & Valve Products

DOME AND CHAMBER LINER

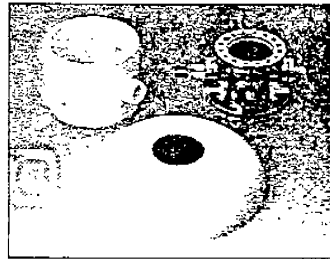
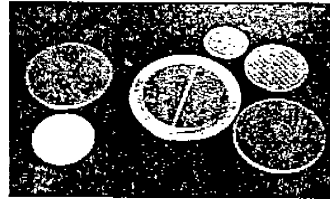
Wire Drawing Products

Materials: Alumina, Silicon Carbide and Aluminum Nitride

Applications: Etch, CVD and PVD

Features:

- Plasma Durability
- Less Metal Contamination
- Available in Any Size and Shape

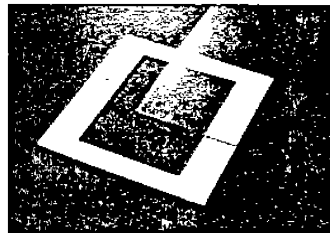


LARGE PARTS FOR LCD PROCESSING EQUIPMENT

Material: Alumina

Features:

- High Purity
- Reliability
- Available in Large Custom Sizes

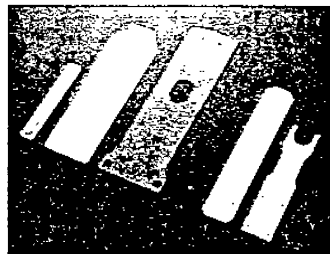


END EFFECTORS

Material: Alumina

Features:

- High Rigidity
- Excellent Wear Resistance
- Less Backside Particle Contamination
- Available With Various Coatings



ALUMINUM NITRIDE HEATER

Material: 99.9% Aluminum Nitride

Features:

- Excellent Thermal Uniformity



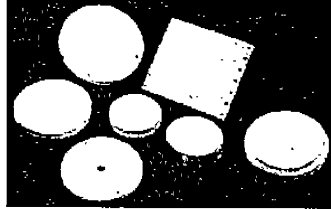
- Rapid Heat Up
- Easy Temperature Control
- Excellent Plasma Durability
- Less Contamination

VACUUM CHUCKS

Materials: Alumina, Silicon Carbide and Aluminum Nitride

Features:

- Less Backside Particle Contamination
- High Rigidity, Excellent Flatness
- Excellent Wear Resistance
- High Chemical Stability



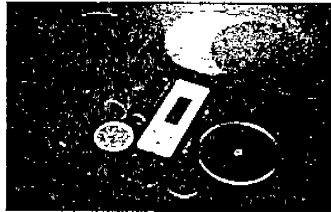
SAPPHIRE PRODUCTS (see Single Crystal Sapphire Products)

Material: Single Crystal Sapphire, 99.99% Purity

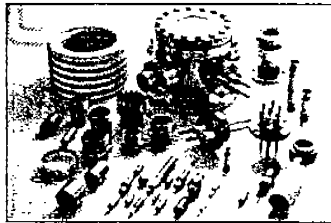
Applications: GaAs Carrier Plates, windows, SOS substrates, dummy wafers, microwave plasma tubes and high speed IC chips

Features:

- Transparent
- High Thermal Conductivity
- Excellent Plasma Durability
- High Mechanical Strength



ASSEMBLY PRODUCTS (see Assembly Technology)



Wafer - Making Products | Wafer Processing Products
Ultrasonic Motor X-Y Stage

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YOCCERA NORTH AMERICA

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INDUSTRIAL CERAMIC PRODUCTS

ABOUT US	TYPES OF CERAMIC	PRODUCTION PROCESS	TOLERANCE GUIDELINE	PRODUCTS & MARKETS	ASSEMBLY TECHNOLOGY	CONTACT US
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February 1, 2001

TOLERANCE GUIDELINE

One of the advantages of advanced ceramics is the ability to grind, lap and polish them to extremely tight tolerances. Ceramics physical stability enables the component to maintain precise tolerancing even in severe environments

Below is a tolerance design guideline to aid you in creating a ceramic component drawing. Kyocera engineers are always available to help with any design concerns or questions. We will work with you to ensure that you get the most out of your ceramic design. Please contact us.

ITEM	REF. SIZE	NO GRINDING		GRINDING	
		Inches	As-fired	Economical	Typical
Diameter O D	<1 0	+/- 012	+/- 010	+/- 005	+/- 0004
	>1 0	+/- 1%	+/- 015	+/- 005	+/- 0004
Hole I D	<1 0	+/- 012	+/- 010	+/- 005	+/- 0004
	>1 0	+/- 1%	+/- 015	+/- 005	+/- 0006
Hole Pitch	<1 0	+/- 012	+/- 010	+/- 005	+/- 0008
	>1 0	+/- 1%	+/- 015	+/- 005	+/- 0008
Angle	-	+/- 2 Deg	+/- 1 Deg	+/- 30	+/- 3
Surface Finish	-	32-125 Ra	64 Ra	44 Ra	<8 Ra
Flatness	<8 0	.006/inch	005	002	00002
	>8 0	.008/inch	008	005	.00004
Parallelism	<8 0	.01/inch	005	002	0008
	>8 0	.02/inch	005	002	0008
Radius	<1 0	+/- C2	+/- 015	+/- 01	+/- 005
	>1 0	+/- 1%	+/- 02	+/- 012	+/- 005
Chamfer	<1 0	+/- 02	+/- 015	+/- 01	+/- 002
	>1 0	+/- 1%	+/- 02	+/- 012	+/- 003

Tighter tolerancing is achievable depending on the component design and material selection

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[KYOCERA NORTH AMERICA](#)



INDUSTRIAL CERAMIC PRODUCTS

- ABOUT US
- TYPES OF CERAMIC
- PRODUCTION PROCESS
- TOLERANCE GUIDELINE
- PRODUCTS & MARKETS
- ASSEMBLY TECHNOLOGY
- CONTACT US

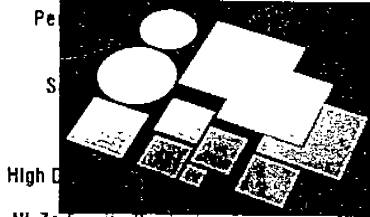
February 1, 2001

PRODUCTS & MARKETS

- Substrates
- Processing Equipment
- Thin Film Substrates
- Computer
- Pe
- S
- High D
- NI-Zn Ferrite Products
- Textile Products
- Wire

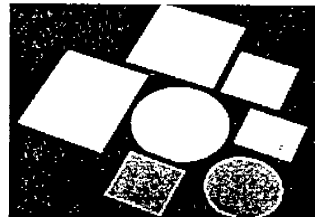
Substrates

Thin Film Substrates



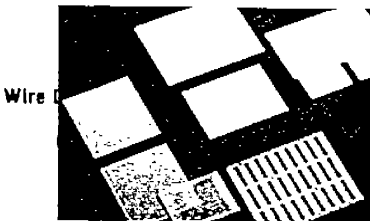
Material: 99.6% Alumina

Polished Thin Film Substrates



Material: 99.6% Alumina

Textile Products



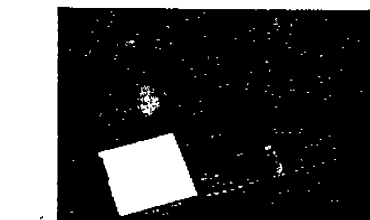
Material: 93% and 96% Alumina

Sapphire Substrates



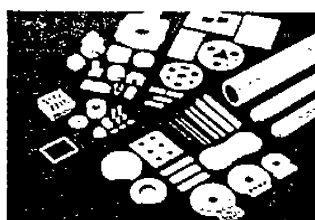
Material: Single Crystal Sapphire

Aluminum Nitride Substrates



Material: Aluminum Nitride

Pressed & Extruded Parts



Materials: Alumina, Forsterite, Steatite, Mullite, Zirconia

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PRODUCTS & MARKETS | ASSEMBLY TECHNOLOGY | CONTACT US
SITE MAP | SEARCH

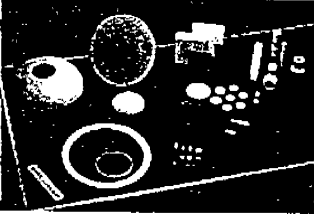
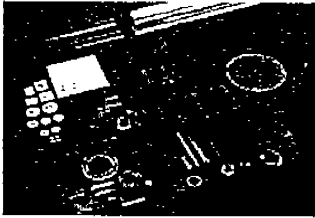
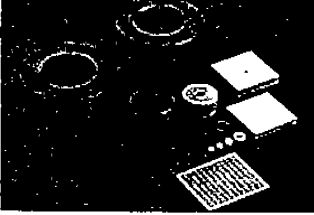
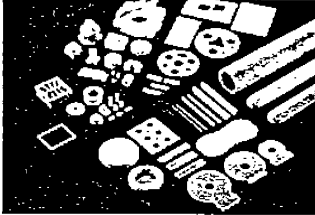


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PRODUCTS & MARKETS

<p>Proce</p> <hr/> <p>Pa</p> <hr/> <p>S</p> <hr/> <p>S</p> <hr/>		
ADVANCED CERAMIC SOLUTIONS		
<p>High Dielectric Products</p> <hr/> <p>NI-Zn</p> <hr/> <p>Wire</p> <hr/>		

General Products

What we like to do next is what people tell us we can never do.

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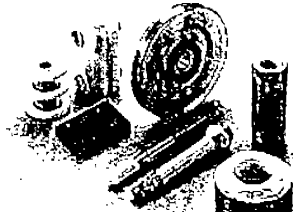
February 1, 2001

ASSEMBLY TECHNOLOGY

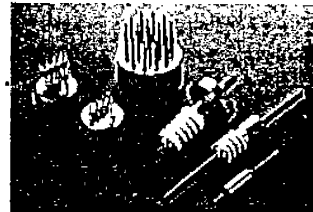
Kyocera Industrial Ceramics Corporation has the capability to link an abundance of technological resources. The Kyocera Group is comprised of a diversified technology network consisting of advanced ceramic materials, components, optics, devices, consumer products and services. We can vertically integrate one or more of our technologies to better serve your assembly or sub-assembly requirements.

Typical methods of joining advanced ceramic components to other materials are mechanical assembly, shrink fitting, epoxy bonding, metallizing and brazing, resin molding and metal casting.

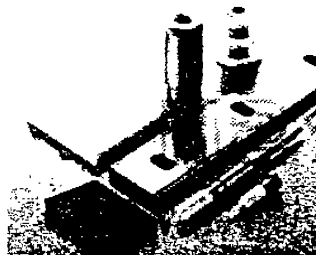
Mechanical Assembly



Metallizing / Brazing



Epoxy Bonding



Shrink Fitting



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INDUSTRIAL CERAMIC PRODUCTS



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TOLERANCE GUIDELINE

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ITEM	REF. SIZE	NO GRINDING		GRINDING		
		Inches	As-fired	Economical	Typical	Special
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	>1.0		+/- .1%	+/- .015	+/- .005	+/- .0004
Hole I.D	<1.0		+/- .012	+/- .010	+/- .005	+/- .0004
	>1.0		+/- .1%	+/- .015	+/- .005	+/- .0005
Hole Pitch	<1.0		+/- .012	+/- .010	+/- .005	+/- .0008
	>1.0		+/- .1%	+/- .015	+/- .005	+/- .0008
Angle	-		+/- 2 Deg	+/- 1 Deg	+/- 30	+/- 3
Surface Finish	-		32-125 Ra	64 Ra	44 Ra	<8 Ra
Flatness	<8.0		.006/inch	.005	.002	.0002
	>8.0		.008/inch	.008	.005	.0004
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	>8.0		.02/inch	.005	.002	.0008
Radius	<1.0		+/- .02	+/- .015	+/- .01	+/- .005
	>1.0		+/- .1%	+/- .02	+/- .012	+/- .005
Chamfer	<1.0		+/- .02	+/- .015	+/- .01	+/- .002
	>1.0		+/- .1%	+/- .02	+/- .012	+/- .003

Tighter tolerancing is achievable depending on the component design and material selection.

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KYOCERA NORTH AMERICA

GRINDING AND LAPPING



Hard (Diamond) Grinding

CUSTOM ASSEMBLY



Epoxy Bonding



Mechanical Assembly

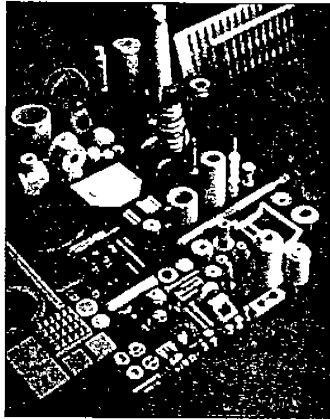


Shrink Fitting



Metallizing

FINAL PRODUCT



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February 1, 2001

TYPES OF CERAMIC

Material Specs

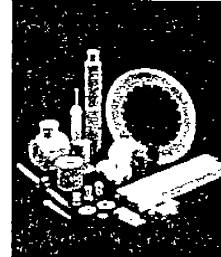
Kyocera has a wide range of advanced ceramic materials to offer. Each one with its own unique characteristics designed to meet the requirements of many diverse applications. Some of the more widely used materials are described below.

[Click here for Material Specification Sheet.](#)

ALUMINA

Alumina is the most widely used advanced ceramic material. It offers very good performance in terms of wear resistance, corrosion resistance and strength at a reasonable price. Its high dielectric properties are beneficial in electronic products.

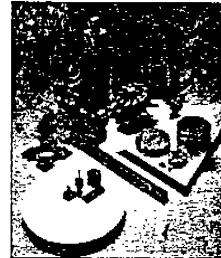
Applications include semiconductor processing equipment parts, faucet disc valves, seals, electronic substrates and industrial machine components.



SILICON NITRIDE

Silicon nitride exceeds other ceramic materials in thermal shock resistance. It also offers an excellent combination of low density, high strength, low thermal expansion and good corrosion resistance and fracture toughness.

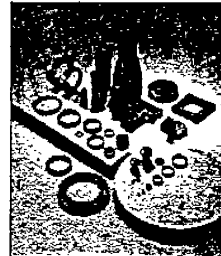
Applications include various aerospace and automotive engine components, papermaking machine wear surfaces, burner nozzles and molten metal processing parts.



SILICON CARBIDE

Silicon carbide has the highest corrosion resistance of all the advanced ceramic materials. It also retains its strength at temperatures as high as 1400°C and offers excellent wear resistance and thermal shock resistance.

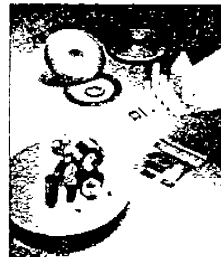
Applications include mechanical seals, nozzles, silicon wafer polishing plates and pump parts.



ZIRCONIA

Zirconia has the highest strength and toughness at room temperature of all the advanced ceramic materials. The fine grain size allows for extremely smooth surfaces and sharp edges.

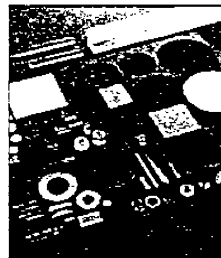
Applications include scissors, knives, slitters, pump shafts, metal-forming tools, fixtures, tweezers, wire drawing rings, bearing sleeves and valves.



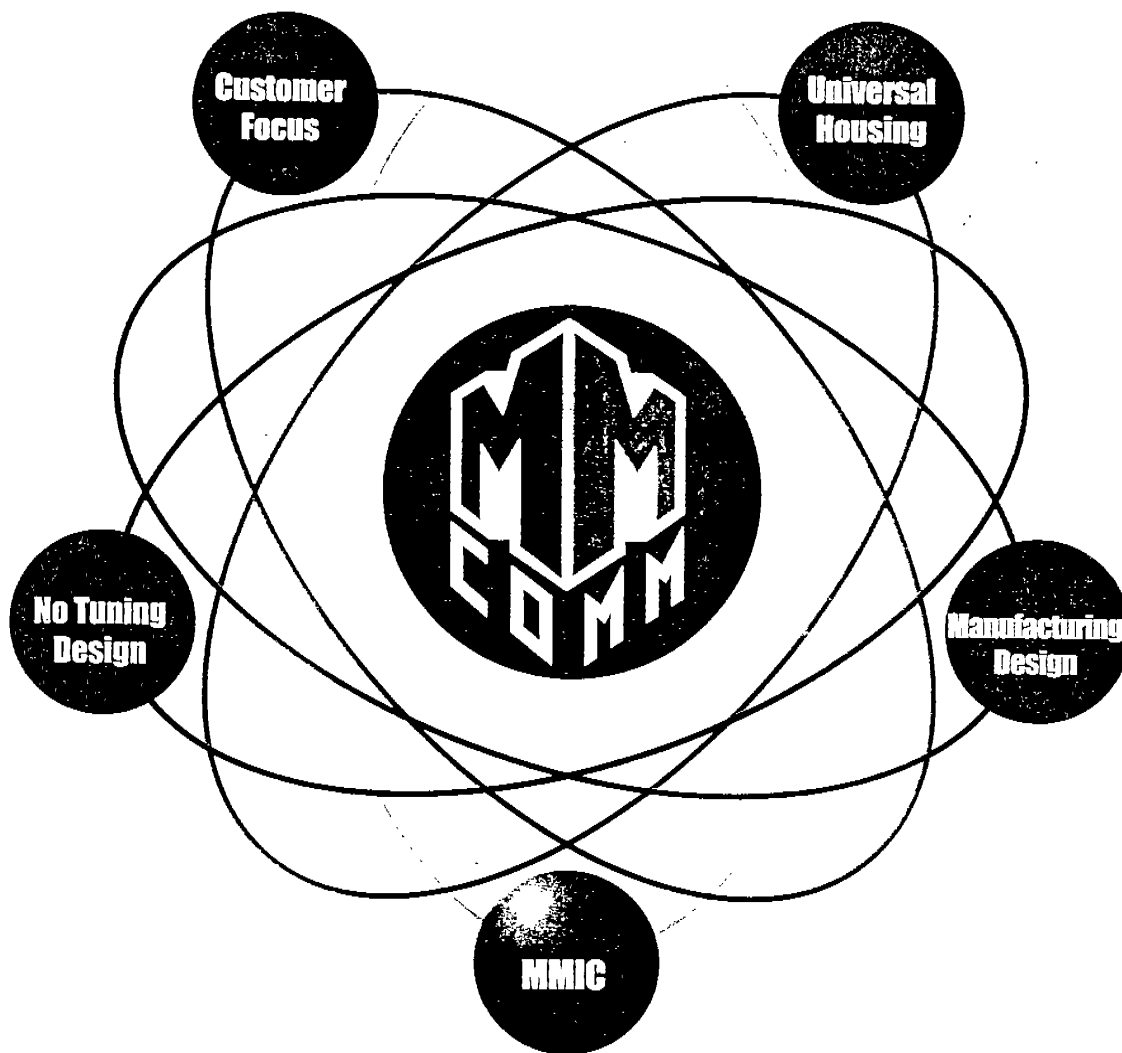
SAPPHIRE

Single crystal sapphire offers superior mechanical properties and chemical stability coupled with light transmission.

Applications include GaAs carrier plates, POS scanner window, microwave plasma tubes and windows, fixtures for high temperature equipment and blue LED.



Millimeter - Microwave of the Future



sponsiveness - *Quick*

Producibility - *Low Cost*

Reliability - *High*

THE WAVE OF THE FUTURE

MMCOMM is a privately owned, small, but growing company whose primary focus is broadband wireless radio frequency (RF) equipment. For the past couple of years, MMCOMM has been devoted to the building of component product lines. While these products are sold separately, the design and source control of the components offers the foundation to building the Point-to-point and LMDS products.

The MMIC device is a cornerstone to the active devices, which have the most significant impact on specification and resolution performance of the Point-to-point and LMDS products. MMCOMM is unique in that it has its own MMIC design capacity and in conjunction with MMIC foundries, today is producing its own MMIC chip for the Point-to-point and LMDS products.

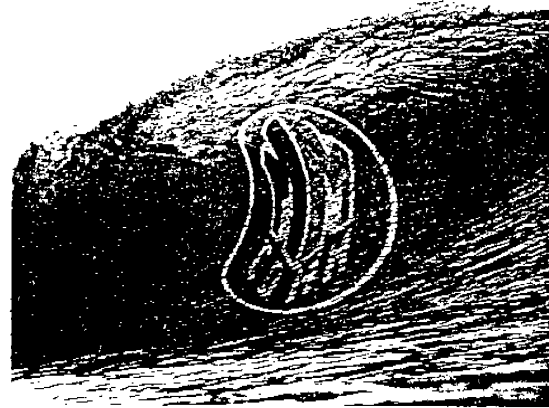
By retaining source control and only buying those elements to the products where source and costs are not an issue, we retain significant flexibility in design of the Point-to-point and LMDS products and consequently have the ability to control pricing without the influence of sources and market trends.

Besides the microwave and millimeter wave products, we have also developed the other critical elements of the Point-to-point and LMDS systems. These include a microcontroller based network management capability coupled with an expert BITE interface to have a digital remote monitoring capability of the system status. The controller also manages the thermal system, which maintains temperature in all weather extremes to minimize the effect of severe cold and heat on the performance and life of the systems.

The combined strength of MMCOMM's component foundation and the resultant modules and subsystems allows MMCOMM to offer aggressive market setting prices for fielding of MMDS and LMDS products to meet the emerging market demands.

While MMCOMM is a small company, its growth today has given cause to double its facility size to manage continued R&D, component

manufacturing and system integration/test. Given that the manufacturing capacity in the United States may be limited to potential market demands as the Point-to-point and LMDS market grow, MMCOMM has already established overseas manufacturing to provide an extension to meet high production demands. Today, these overseas facilities are producing some of the components used in the Point-to-point and LMDS products,



which allows for the economies in pricing.

While MMCOMM is focused on the Point-to-point and LMDS markets, given the expert design engineering capability of the company, there is the capacity to develop other products from DC to 110 GHz giving the Company's significant diversity in meeting new opportunities. These frequency extension opportunities are an extension of the basic building blocks established for the Point-to-point and LMDS products. Hence the design flexibility and pricing remains very aggressive to meet customer expectation.

Visit us web at www.mmcomm-inc.com or contact us for information.

Yi-Chi Shih, Ph.D.

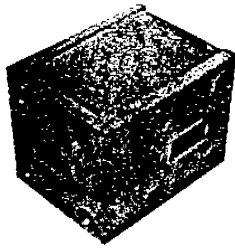
President

Dutch Neilson

VP Business Development

Long Bui

VP Engineering



Circulator

Product Line

Description and Key Features

The waveguide junction circulator is a three port ferrite device. These circulators cover specific frequency ranges in the band from 18 to 42 GHz. Typical insertion loss is .25 db with minimum isolation and return loss of 20 db over the specified frequency range. At the center of the frequency range, the isolation and return loss usually exceed 25 dB. These are designed for high quantity production rate up to 2000 pieces a month.

They are also available with WR-34 waveguide flange interface which is straddle band. MMCOMM uses these circulators in their duplexers to enhance the isolation from a high transmitter to receiver by 20 dB. By terminating the third port, the circulator can be used as a broadband isolator. This port can also be used for monitoring output power when used in conjunction with a high power amplifier.

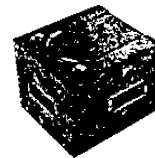
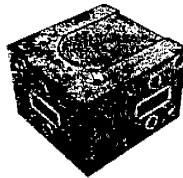
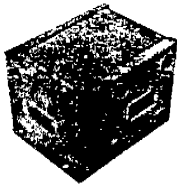
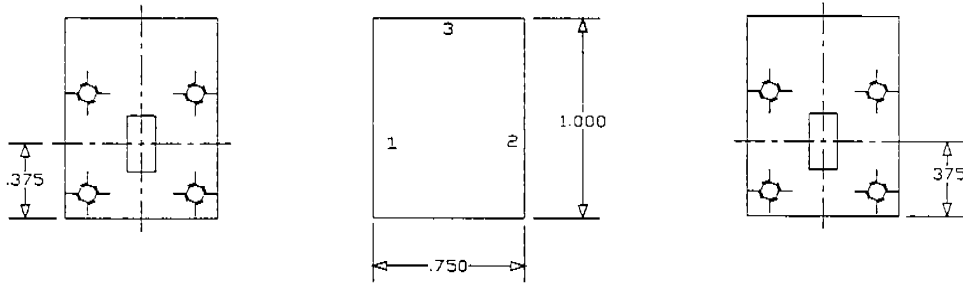
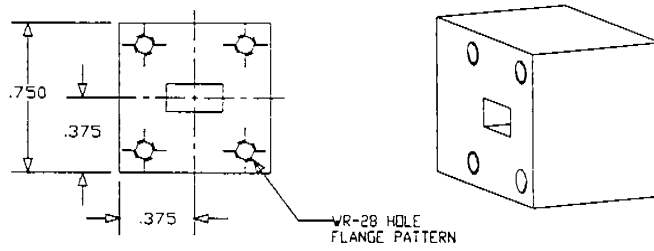
Specifications

Model Number	Frequency Band (GHz)	Insertion Loss (dB)	Isolation (dB)	VSWR
CIR-JN-1723	17.7 - 23.0	0.2 max	20 min	1.22:1 max
CIR-JN-2731	27.5 - 31.5	0.3 max	20 min	1.22:1 max
CIR-JN-3740	37.0 - 40.0	0.3 max	20 min	1.22:1 max

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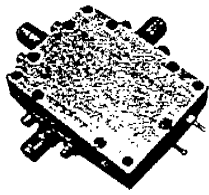


Dimensions and Outline Drawing



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Converter

Product Line

Description and Key Features

MMCOMM converters are highly integrated modules to provide either up or down conversion in a mm-wave transceiver. The upconverter module consists of a sub-harmonic mixer, RF/IF filters and driver amplifier. Output is about 200 mW with 30 dB sideband suppression. These upconverters can be used with low loss E-plane bandpass filters and a high power SSPA to form a high performance transmitter for point-to-point, repeater, and ODU applications. The down converter uses the same outline housing with the RF input and IF input

are reversed. The driver amplifier is replaced by a low noise and the internal filter can provide up to 30 dB image rejection. Input and output of these converters are highly flexible using MMCOMM's proprietary in-line coaxial to waveguide adapter. These adapters eliminate waveguide inter-connections and allow maximum flexibility to the system integrators to configure their box in the most volumetric efficient manner.

Specifications

Model Number	UPC-MM-1823
IF frequency	850 - 900 MHz
RF frequency	17.7 - 18.2 GHz
LO frequency	9.3 GHz
LO Power	10 dBm
Output Power	200 mW
IF/RF Gain	30 dB typical
Image Rejection	20 dB minimum
Input P1dB	0 dBm
VSWR	2:1 typical (all ports)
Operating Temp.	-30 to 50 C
IF/LO port	SMA Female
RF port	SMA Female (WR-42)

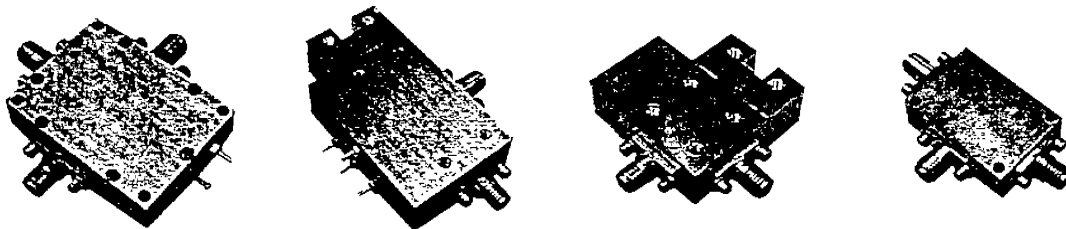
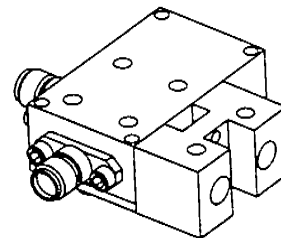
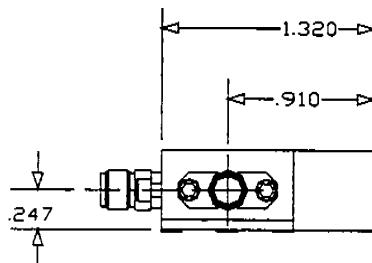
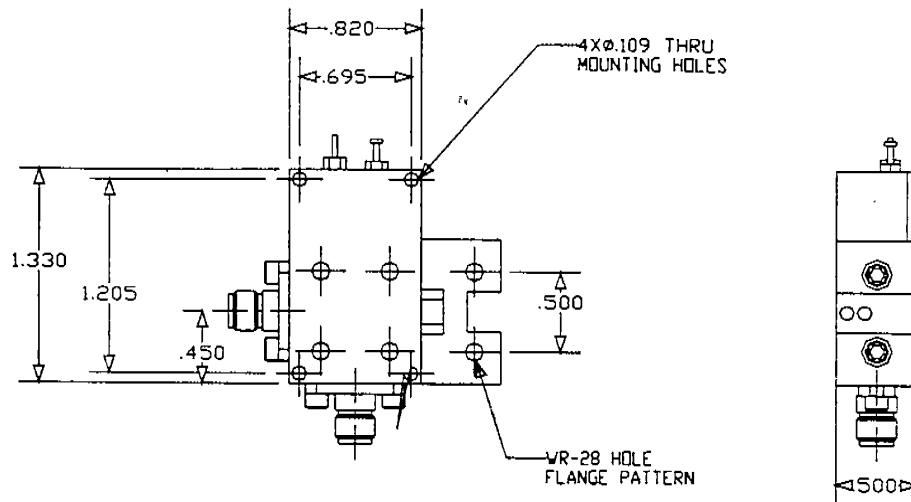
Model Number	DNC-MM-2831
RF frequency	28.0 - 31.0 GHz
IF frequency	840 - 900 MHz
LO frequency	9.3 GHz
LO Power	10 dBm
Noise Figure	4 dB typical
RF/IF Gain	30 dB typical
Image Rejection	20 dB minimum
Input P1dB	0 dBm
VSWR	2:1 typical (all ports)
Operating Temp.	-30 to 50 C
IF/LO port	SMA Female
RF port	SMA Female (WR-28)



Dimensions and Outline Drawing

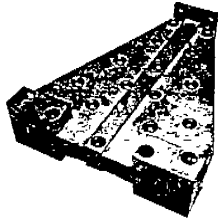
The outline drawing depicts the standard SMA/WR28 interface. As shown in the pictures of the amplifiers, a variety of interface options are available. The adapter displayed is a patent pending device that facilitates assembly by allowing for direct connection, thus eliminating connector and waveguide costs, improving insertion loss and decreasing total volume.

To facilitate system integration, the design of the Amplifier housing is a common block with a variety of interface options. The design objective is to use common housing for similar components to facilitate design layout. This approach allows for substantial cost savings and flexibility in meeting customer quick reaction requirements.



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Diplexer

Product Line

Description and Key Features

MMCOMM has developed a series of narrow-band diplexers that cover the 18-40 GHz band for North America point-to-point digital radio applications.

The diplexer consists of two E-plane filter connected by either an E plane or H plane T junction. A junction circulator can be used to increase the isolation of one side up to 20 dB. These filters are inductive direct-coupled cavity filters in which the conventional inductive posts are replaced by axial inductive strips. These strips can be modeled exactly and fabricated using printed circuit techniques.

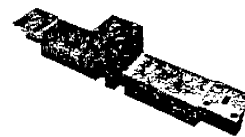
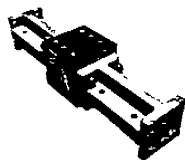
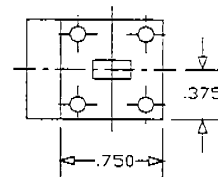
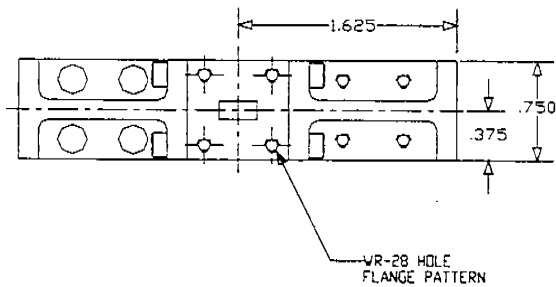
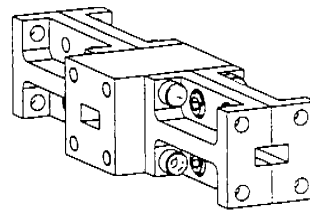
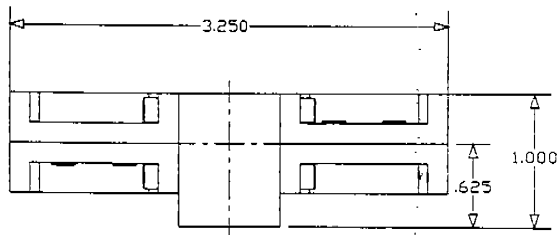
The diplexer body is designed as a common housing for the series of narrow band filter inserts for various sub-band requirements. The diplexers require no tuning, which makes them suitable for low cost, high volume production. Typical diplexer with 0.1 dB ripple has a measured insertion loss of 0.4 to 1.5 dB depending on the channel filter bandwidth and isolation requirements. With aluminum housing, these diplexers have a typical temperature coefficient of 0.4 MHz/°C. Guard bands are required to ensure the performance over any specified temperature range.

Specifications

Model Number	Passband Freq. (GHz)	I.L. (dB)	Channel Isolation (dB at bandedge)	VSWR
DIX-2A-1819	17.7:18.1 / 18.7:19.1	1.0	>50	1.25:1
DIX-2B-1819	18.0:18.4 / 19.0:19.4	1.0	>50	1.25:1
DIX-2C-1819	18.3:18.7 / 19.3:19.7	1.0	>50	1.25:1
DIX-2A-2831	27.5:28.2 / 31.0:31.3	0.9	>50	1.25:1
DIX-1A-3839	37.0:37.35 / 37.7:38.05	1.8	>50	1.25:1
DIX-1B-3839	37.35:37.7 / 38.05:38.4	1.8	>50	1.25:1
DIX-1C-3839	38.6:38.95 / 39.3:39.65	1.8	>50	1.25:1
DIX-2A-3839	38.95:39.3 / 39.65:40.0	1.4	>50	1.25:1
DIX-2B-3839	37.05:37.65 / 38.31:38.91	1.4	>50	1.25:1
DIX-2C-3839	37.60:38.201 / 38.86:39.46	1.4	>50	1.25:1

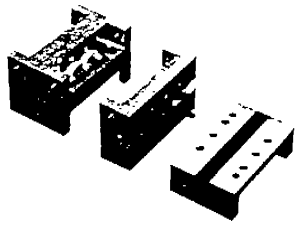


Dimensions and Outline Drawing



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Filter

Product Line

Description and Key Features

MMCOMM's waveguide bandpass filters provide high electrical performance encompassed in a small, lightweight component. These are high performance E-plane filters in which the designs are proven from 18 to 170 GHz.

These E-plane filters are inductive direct-coupled cavity filters in which the conventional inductive posts are replaced by axial inductive strips. These strips can be modeled exactly and fabricated by chemical-milling within +/- .2 mil. Our in-house CAD/CAM design

procedure is precise, yielding filters with no tuning element thereby suitable for low-cost production. This offers system integrators the low production material and labor cost consistent with a non-tuning device.

Typical design is .1 dB ripple, Tchebychev response with measured insertion loss of .15 to 1.0 dB depends on the filter bandwidth and skirt selectivity. In a system design, using a broad band amplifier, the filter is used for frequency selection thus offering significant flexibility by replacing only the filter.

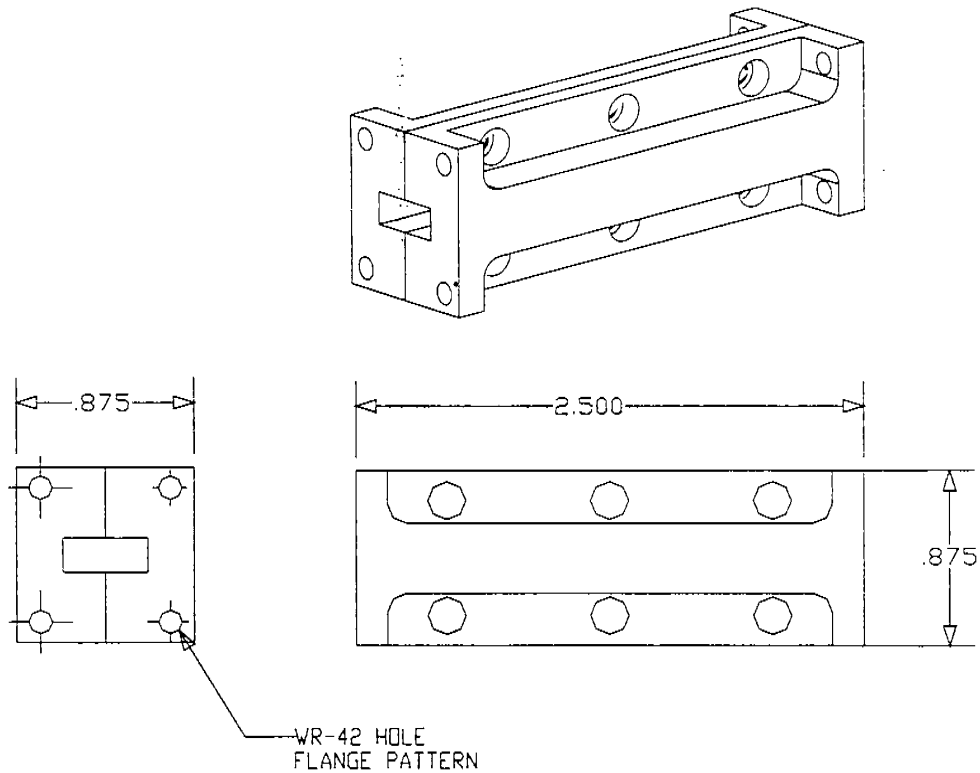
Specifications

Model Number	Passband Freq. (GHz)	I.L. (dB)	Rejection (dB)	VSWR
FTR-EP-1802	17.7 - 18.1	0.6 max	>40 @ 17.1 / 18.7 GHz	1.25:1
FTR-EP-1902	18.7 - 19.1	0.6 max	>40 @ 18.1 / 19.7 GHz	1.25:1
FTR-EP-2605	25.5 - 26.7	0.5 max	>35 @ 24.8 / 27.5 GHz	1.25:1
FTR-EP-2803	27.5 - 28.3	0.5 max	>50 @ 24.8 / 27.5 GHz	1.25:1
FTR-EP-3102	31.0 - 31.3	0.6 max	>50 @ 29.5 / 33.0 GHz	1.25:1
FTR-EP-3505	34.1 - 35.9	0.5 max	>25 @ 33.0 / 37.0 GHz	1.25:1
FTR-EP-3801	38.0 - 38.35	1.1 max	>50 @ 37.6 / 38.7 GHz	1.25:1
FTR-EP-3902	39.2 - 39.55	1.1 max	>50 @ 38.8 / 39.9 GHz	1.25:1
FTR-EP-4405	42.9 - 45.1	0.7 max	>25 @ 41.8 / 46.2 GHz	1.25:1
FTR-EP-6005	60.0 - 63.0	0.8 max	>30 @ 58.5 / 65.0 GHz	1.25:1
FTR-EP-7703	76.0 - 78.0	0.9 max	>40 @ 75.0 / 79.0 GHz	1.25:1
FTR-EP-9405	91.7 - 96.3	1.0 max	>25 @ 90.0 / 98.0 GHz	1.25:1



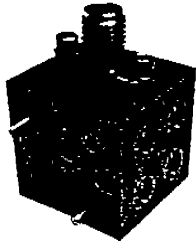
Dimensions and Outline Drawing

The outline drawing depicts the standard Waveguide interface. A waveguide to SMA adapter is an available option. To facilitate system integration, the design of the Filter housing is a common block with the waveguide connection. MMCOMM can design unique housing to meet customer integration requirements.



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Broadband Pin Switch

Product Line

Description and Key Features

MMCOMM's Pin Switches utilize beamlead diodes on finline circuit and can cover the full waveguide bandwidths up to V-band and more than 10 GHz at W-band. Typical insertion loss is about 0.5 dB with 30 dB minimum isolation. These switches can also be used as

variable or programmable attenuators by controlling the forward bias currents. Using the same high speed driver, switching speed is dependent on the PIN diodes which can run from 10 to 200 nanoseconds. A built-in driver is also available as an option.

Switch Specifications

Model Number	SPT-MM-9415
Frequency Band	85 - 100 GHz
Insertion Loss	1.0 dB typical
Isolation	30 dB minimum
VSWR	2:1 max
Switching Speed	300 nSec
Input/Output Interface	MIL-F-3922/54-001 (WR-10)

Model Number	SPT-MM-2800
Frequency Band	26 - 40 GHz
Insertion Loss	0.5 dB typical
Isolation	35 dB minimum
VSWR	1.25 :1 max
Switching Speed	300 nSec
Input/Output Interface	MIL-F-3922/54-003 (WR-28)

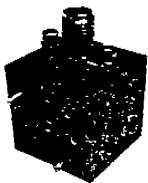
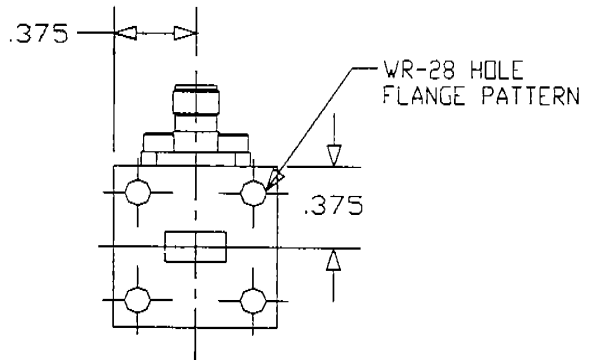
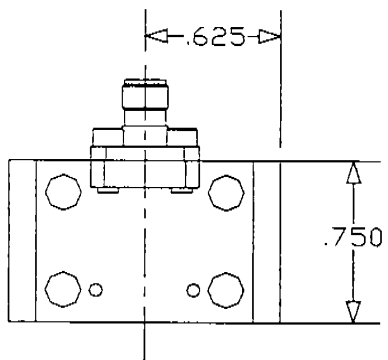
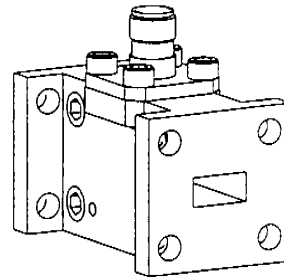
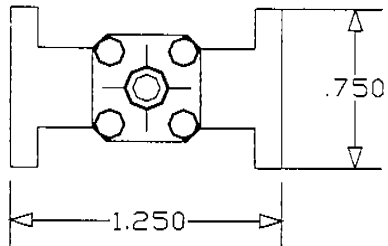
Ordering Specifications

RF Bandwidth

Indicate with or without driver option.

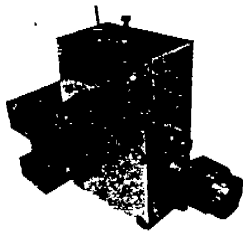


Dimensions and Outline Drawing



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General Purpose Amplifier

Product Line

Description and Key Features

MMCOMM offers a full product line of General Power Amplifiers that cover the 17 to 42 GHz band. These amplifiers are a key element in the design and build of the base station LMDS outdoor unit and Point-to-Point Radio applications. These are high performance amplifier with the 1 dB gain compression up to .5 Watts or 27 dBm.

Integral elements of the amplifier is the MIC's and MMIC chips which are essential to achieve superior performance. These MMIC's are multi-stage amplifier design and matched to 50 Ohms allows cascading several MMIC's for higher gain in a single housing.

Well-proven hermetic feed-thrus are used throughout to provide low input/output VSWR in a common housing.

The active devices are mounted on top a spacer which is directly attached to the aluminum housing for efficient heat transfer and reliability. All units have built in regulator and/or sequential bias circuit for protection for the required 8V DC. The specifications shown below are guaranteed at +25°C case temperature, but the units can work from -20°C to -70°C with degraded performance.

All units are screened which includes visual inspection, burn in, temperature cycle, high temperature bake, electrical test, and final inspection. These amplifiers have been proven in CDMA repeaters which require high linearity and extremely low spurious response.

Specification

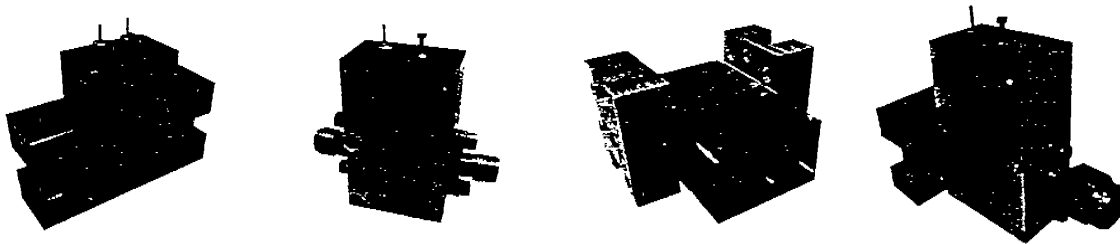
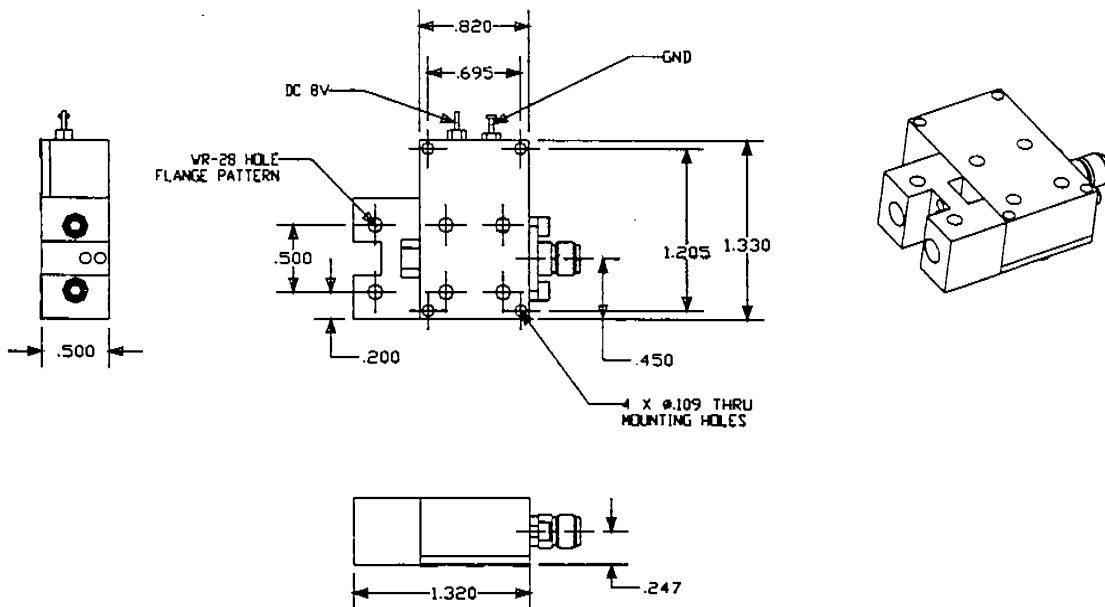
Model Number	Frequency GHz	P1dB (dBm)	Gain (dB)	Noise Figure (dB)	DC Power Nom.	Temp Range (C)
GPA-MM-1820	17.7-19.7	20	30-34	5.0	+8V/400mA	-30 to +70
GPA-MM-2123	17.7-19.7	23	30-34	5.0	+8V/700mA	-30 to +70
GPA-MM-1826	17.7-19.7	26	30-34	5.0	+8V/1000mA	-30 to +70
GPA-MM-2120	21.2-23.0	20	30-34	5.0	+8V/400mA	-30 to +70
GPA-MM-2123	21.2-23.0	23	30-34	5.0	+8V/700mA	-30 to +70
GPA-MM-2126	21.2-23.0	26	30-34	5.0	+8V/1000mA	-30 to +70
GPA-MM-2520	24.0-26.0	20	30-34	5.0	+8V/400mA	-30 to +70
GPA-MM-2523	24.0-26.0	23	30-34	5.0	+8V/700mA	-30 to +70
GPA-MM-2527	24.0-26.0	27	30-35	5.0	+8V/900mA	-30 to +70
GPA-MM-2820	27.5-29.0	20	32-37	5.0	+8V/400mA	-30 to +70
GPA-MM-2823	27.5-29.0	23	30-37	5.0	+8V/700mA	-30 to +70
GPA-MM-2827	27.5-29.0	27	30-35	5.0	+8V/900mA	-30 to +70
GPA-MM-3120	31.0-31.3	20	30-36	5.0	+8V/400mA	-30 to +70
GPA-MM-3123	31.0-31.3	23	30-36	5.0	+8V/700mA	-30 to +70
GPA-MM-3127	31.0-31.3	27	30-35	5.0	+8V/900mA	-30 to +70
GPA-MM-3820	37.0-40.0	20	20-30	6.0	+8V/400mA	-30 to +70



Dimensions and Outline Drawing

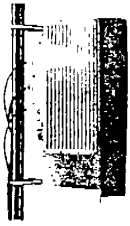
The outline drawing depicts the standard SMA/WR28 interface. As shown in the pictures of the amplifiers, a variety of interface options are available. The adapter displayed is a patent pending device that facilitates assembly by allowing for direct connection, thus eliminating connector and waveguide costs, improving insertion loss and decreasing total volume.

To facilitate system integration, the design of the Amplifier housing is a common block with a variety of interface options. The design objective is to use common housing for similar components to facilitate design layout. This approach allows for substantial cost savings and flexibility in meeting customer quick reaction requirements.



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LMDS Transmitter/Receiver ODU

Product Line

Description and Key Features

The Transmitter ODU is designed specifically to meet the LMDS base station requirements. The IF input is upconverted into 26 to 32 GHz frequency bands anywhere from 950 MHz to 4.5 GHz. The converter output is filtered and drives the solid state SSPA to achieve 1 Watt or 2 Watt output power. Low phase noise LO which is locked to the reference provided by the base station satisfies the high stability requirement. A single micro-controller provides the closed loop temperature control which allows for an upgrade path to a linearized SSPA in the near future. Built-in telemetry

provides the unit status such as RF power level, lock indicator, over-temp etc. via LED's and RS-232 interface. The same controller can be used to provide networking interface as required. In the receiver unit the SSPA is replaced by the LNA and the integrated upconverter is replaced by the down converter since these units have the same outline dimensions. Dependent on the customer requirement, the external reference is provided separately or on the same coaxial cable with TNC connector for IF, reference and -48 VDC.

Specifications

Transmitter

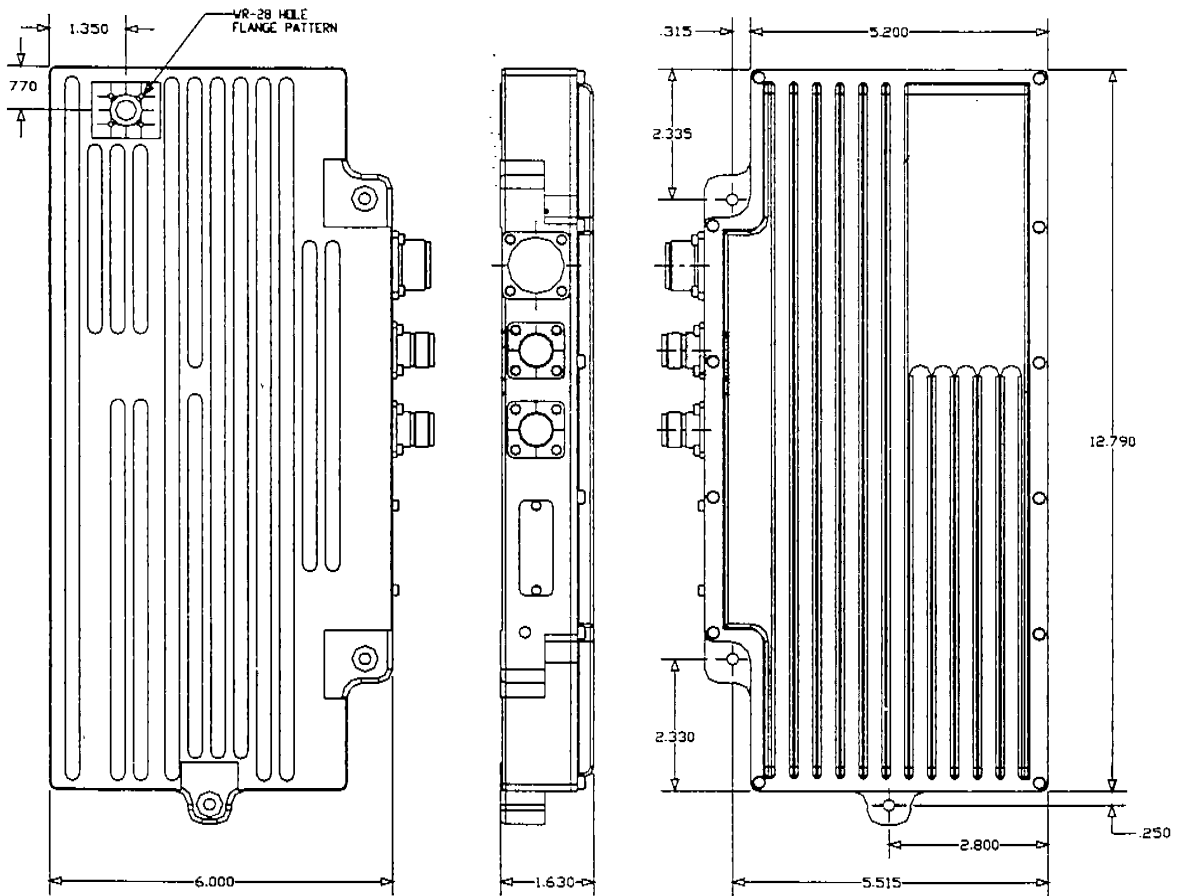
Frequency Range	27.45 to 28.35 GHz
Gain	40 +/- 3 dB
1 dB Gain-Compression	30 dBm @ 50 C
Gain Flatness over Full Band	+/- 1 dB
Transmit IF	950 to 1950 MHz
Input Level	-10 dBm max.
IF Input Impedance	50 Ohms
Input Reference Frequency	100 MHz
Phase Noise - Carrier power ratio	
10 KHz	-85 dBc/Hz
100 KHz	-105 dBc/Hz
Spurious	-55 dBc
Operating Temperature Range	-30 to 70 °C

Receiver

Frequency Range	31.0 to 31.3 GHz
Receiver Gain	40 +/- 3 dB
Noise Figure	4 dB @ LNA input
1 dB Gain-Compression	30 dBm @ 50 °C
Gain Flatness over Full Band	+/- 1 dB
Receive IF	1000 to 1300 MHz
Input RF Compression	-20 dBm minimum
Input Reference	100 MHz
Phase Noise - Carrier power ratio	
10 KHz	-85 dBc/Hz
100 KHz	-105 dBc/Hz
Image Rejection	>50 dB
Receiver Selectivity	-20 dBm min. at P-1dBm/single carrier

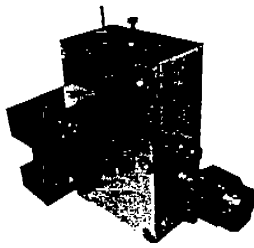


ODU Dimensions and Outline Drawing



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High Power Amplifier

Product Line

Description and Key Features

MMCOMM offers a full product line of High Power Amplifiers that cover the 17 to 42 GHz band. These amplifiers are a key element in the design and build of the base station LMDS outdoor unit and Point-to-Point Radio applications. These are high performance amplifier with the 1dB gain compression up to 2 Watts or 33 dBm.

Integral elements of the amplifier is the MIC's and MMIC chips which are essential to achieve superior performance. These MMIC's are multi-stage amplifier design and matched to 50 Ohms allows cascading several MMIC's for higher gain in a single housing.

Well-proven hermetic feed-thrus are used throughout to

provide low input/output VSWR in a common housing. The active devices are mounted on top a spacer which is directly attached to the aluminum housing for efficient heat transfer and reliability. All units have built in regulator and/or sequential bias circuit for protection and require only 8V DC. The specifications shown below are guaranteed at +25°C case temperature, but the units can work from -20°C to -70°C with degraded performance.

All units are screened which includes visual inspection, burn in, temperature cycle, high temperature bake, electrical test, and final inspection. These amplifiers have been proven in CDMA repeaters which require high linearity and extremely low spurious response.

Specifications

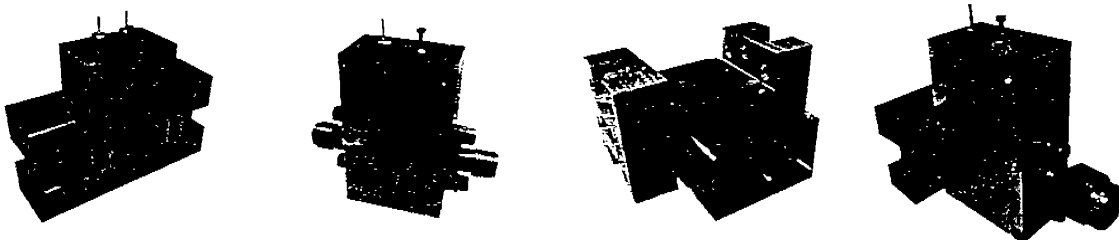
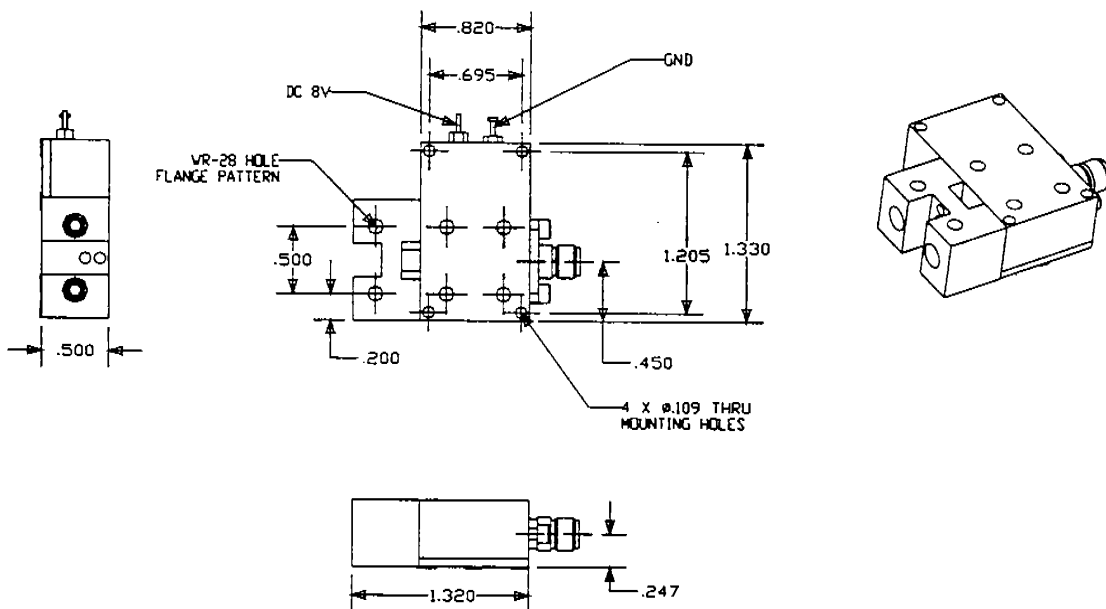
Model Number	Frequency GHz	P1dB (dBm)	Gain (dB)	Noise Figure (dB)	DC Power Nom.	Temp Range (C)
HPA-MM-1830	17.7-19.7	30	33-36	8.0	+8V/1200mA	-30 to +50
HPA-MM-2130	21.2-23.0	30	30-40	8.0	+8V/1200mA	-30 to +50
HPA-MM-2530	24.0-26.0	30	35-40	6.0	+8V/1400mA	-30 to +50
HPA-MM-2830	27.5-29.0	30	35-40	6.0	+8V/1400mA	-30 to +50
HPA-MM-3130	31.0-31.3	30	35-40	6.0	+8V/1400mA	-30 to +50
HPA-MM-1833	17.7-19.7	33	33-36	8.0	+8V/2400mA	-30 to +50
HPA-MM-2833	27.5-29.0	33	33-36	8.0	+8V/2600mA	-30 to +50
HPA-MM-3133	31.0-31.3	33	33-36	8.0	+8V/2600mA	-30 to +50



Dimensions and Outline Drawing

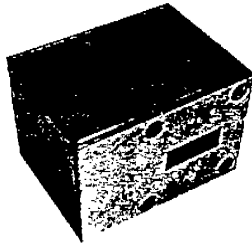
The outline drawing depicts the standard SMA/WR28 interface. As shown in the pictures of the amplifiers, a variety of interface options are available. The adapter displayed is a patent pending device that facilitates assembly by allowing for direct connection, thus eliminating connector and waveguide costs, improving insertion loss and decreasing total volume.

To facilitate system integration, the design of the Amplifier housing is a common block with a variety of interface options. The design objective is to use common housing for similar components to facilitate design layout. This approach allows for substantial cost savings and flexibility in meeting customer quick reaction requirements.



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Isolator

PRODUCT LINE

Isolator Description and Key Features

The Isolator is an important element in microwave system integrations. Isolators effectively remove the interaction between functional building blocks that may degrade the system performance.

The junction isolators are designed to minimize the size and weight of specific radio bands. Larger Isolators are also available for broader frequency average. Typical insertion loss is 0.25 dB with minimum isolation and return loss of 20 dB.

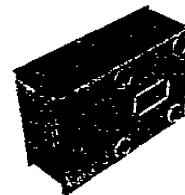
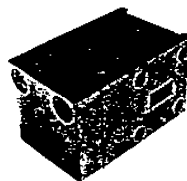
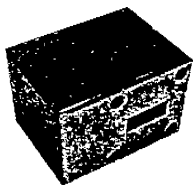
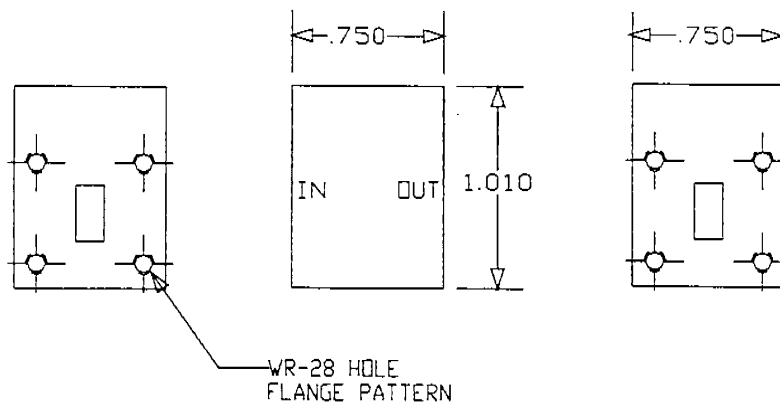
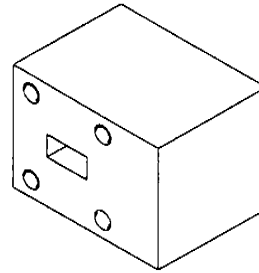
Isolator Specification

Model Number	Frequency Band (GHz)	I.L. (dB)	Isolation (dB)	VSWR
ISO-JN-1314	13.0 - 14.0	0.35 max	20 min	1.2:1
ISO-JN-1719	17.7 - 19.7	0.3 max	20 min	1.2:1
ISO-JN-2123	21.2 - 23.6	0.3 max	20 min	1.2:1
ISO-JN-2325	23.6 - 25.2	0.3 max	20 min	1.2:1
ISO-JN-2729	27.5 - 29.0	0.3 max	20 min	1.2:1
ISO-JN-2931	29.0 - 31.4	0.3 max	20 min	1.2:1
ISO-JN-3738	37.0 - 38.5	0.3 max	20 min	1.2:1
ISO-JN-3940	38.5 - 40.0	0.3 max	20 min	1.2:1
ISO-JN-3740	37.0 - 40.0	0.3 max	20 min	1.2:1

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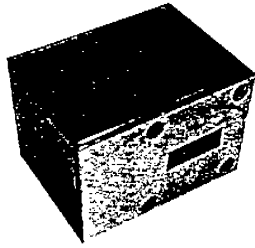


Dimensions and Outline Drawing



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Isolator

PRODUCT LINE

Isolator Description and Key Features

The Isolator is an important element in microwave system integrations. Isolators effectively remove the interaction between functional building blocks that may degrade the system performance.

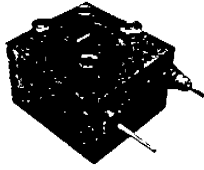
The junction isolators are designed to minimize the size and weight of specific radio bands. Larger Isolators are also available for broader frequency average. Typical insertion loss is 0.25 dB with minimum isolation and return loss of 20 dB.

Isolator Specification

Model Number	Frequency Band (GHz)	I.L. (dB)	Isolation (dB)	VSWR
ISO-JN-1314	13.0 - 14.0	0.35 max	20 min	1.2:1
ISO-JN-1719	17.7 - 19.7	0.3 max	20 min	1.2:1
ISO-JN-2123	21.2 - 23.6	0.3 max	20 min	1.2:1
ISO-JN-2325	23.6 - 25.2	0.3 max	20 min	1.2:1
ISO-JN-2729	27.5 - 29.0	0.3 max	20 min	1.2:1
ISO-JN-2931	29.0 - 31.4	0.3 max	20 min	1.2:1
ISO-JN-3738	37.0 - 38.5	0.3 max	20 min	1.2:1
ISO-JN-3940	38.5 - 40.0	0.3 max	20 min	1.2:1
ISO-JN-3740	37.0 - 40.0	0.3 max	20 min	1.2:1

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Oscillator

Product Line

Description and Key Features

MMCOMM's GUNN Oscillators provide an exceptional value for millimeter-wave digital radio and power generation applications. Reliable InP/GaAs Gunn diodes produce ample power up to 300 mW over 400 MHz bandwidth at Ka-band with excellent phase noise. Electronic tuning enables FSK direct modulation for

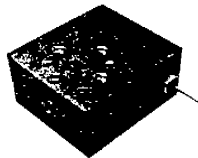
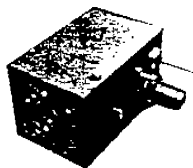
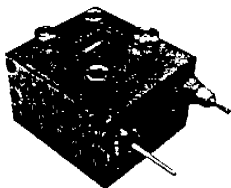
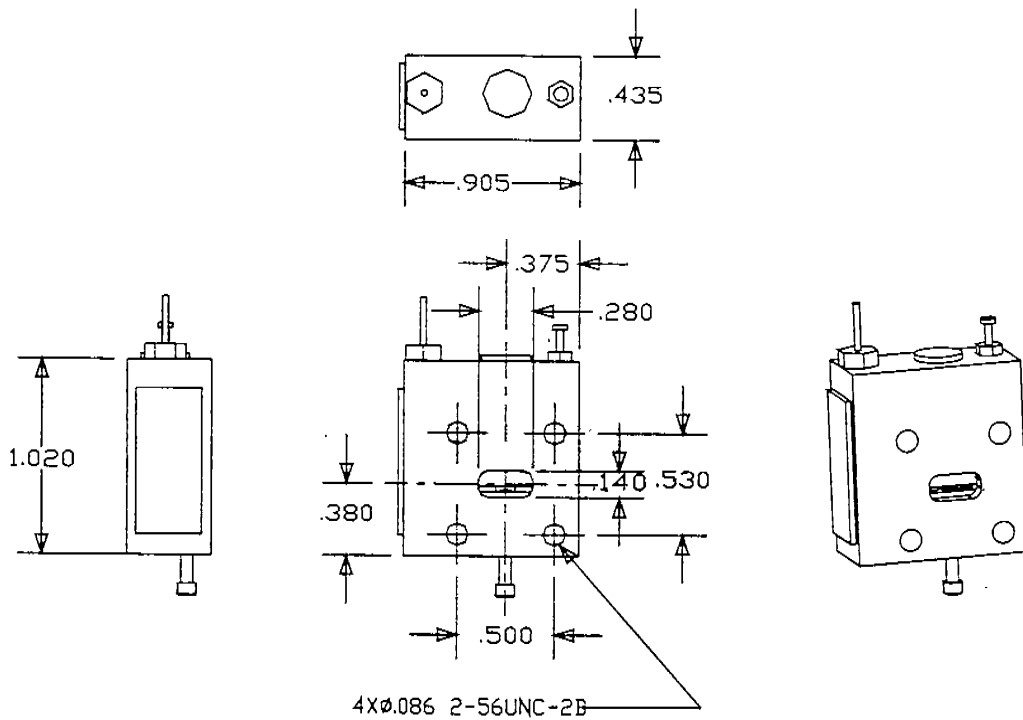
your transmitter. DC power is supplied to the Gunn device through an internal bias network that suppresses bias oscillations. An optional temperature controller is available to improve temperature stability over temperature. MMCOMM can supply these oscillators in production quantity at an attractive price.

Specifications

Model Number	Tuning Bandwidth (GHz)	Minimum Power (mW)	Frequency Stability (MHz/°C)	Power Stability (dB/°C)	Voltage (V)	Current (A)
GUN-F0-KA0L	f_0	100	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-F0-KA0H	f_0	250	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-VT-KA0H	$f_0 \pm 1.5$	100	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MT-KALH	26.5 - 33.0	100	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MT-KAHH	30 - 40	100	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MV-KALH	26 - 34	100	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MVKAHH	32 - 40	100	-2 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MV-VH60	58 - 62	80	-4 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MV-WH77	75 - 79	50	-5 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1
GUN-MV-WH94	92 - 96	40	-5 typical	-0.02 typical	5.6 - 6.4	0.9 - 1.1



Dimensions and Outline Drawing



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