

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、薦聘技士、

姓名：李清源、李適貴

出國地區：日本

出國期間：910731~910809

報告日期：911031

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CSIPW-91E-H0011

# 國外公差報告

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11. 附 記			

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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，簡聘技正李清源、

薦聘技士李適貴

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：910731~910809 出國地區：日本、

報告日期：911031

分類號/目

關鍵詞：寬頻無線通訊系統、微波放大器、LTCC

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、用戶台無線通訊製程縮裝整合技術、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，派員赴日本參訪 ANRITSU、TOSHIBA、TDK、KEISO、UHT、KYOCERA、Panasonic 等七家公司，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 3GPP 技術發展趨勢。期能使研發試產順遂，達成經濟部科專業任務。

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

## 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」，解決寬頻分碼撷取(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、用戶台無線通訊製程縮裝整合技術、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，派員赴日本參訪 ANRITSU、TOSHIBA、TDK、KEISO、UHT、KYOCERA、Panasonic 等七家公司，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撷取(W-CDMA) 通訊系統相關之技術資料、瞭解市場現況及 3GPP 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) 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，向我方介紹展示最新之 W-CDMA BS Test System 量測系統，該系統能精準的量測出 W-CDMA 解調後的資料正確性，對本組執行此科專計畫有很大的幫助。此外，該公司也展示 110GHz Broadband VNA，該系統能量到 110GHz，on-wafer 的測量方法對本組在建立元件模型將會有所幫助。

(2) 參訪日本 TOSHIBA 公司，該公司具有完整的 CDMA 產品，也很早就投入 W-CDMA 技術的研發，對於整個系統的整合是很有經驗的，這次參訪該公司與其

研討有關通訊系統整合相關技術問題，特別是有關鎖相迴路(PLL)的問題，該公司也向我方展示一顆針對 W-CDMA 所生產的鎖相迴路模組，相信經過這次與該公司研討時經驗的交流，本組無線通訊系統整合的能量會有所提升。

(3) 參訪日本 TDK 公司，該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被動元件發展趨勢及因應開發之製程技術，該公司所研發的技術與本單位極為類似，若能與其技術交流，有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。

(4) 參訪日本 KEISO 公司，討論有關儀器氣體偵測器的相關問題，該公司有研發一套無線傳輸資料，氣體偵測器所發生的任何問題都會馬上回傳。本組有許多的儀器必須用到氣體，故氣體流量控制相當重要，此外，有關氣體洩漏的偵測關係到工作同仁的安全，該公司對此有很專精的研究，所以與此公司討論有關儀器氣體偵測器之規格。

(5) 參訪日本 UHT 公司，討論 LTCC 製程相關問題並討論先前跟該公司所購買的儀器後續維修及升級問題。LTCC 可用於高頻元件的封裝以及微波系統的整

合，它具有損耗低、價格低、體積小…等優點，尤其適合高頻封裝及系統整合，因高頻時接腳的寄生電容、電感對微波元件特性的影響很大。此外，LTCC 可以向上整合，所以體積可有效縮小。這次與該公司討論 LTCC 製程上的相關問題，可幫助本組縮短建立該項能量的時程。

(6) 參訪日本 KYOCERA 公司，該公司所生產的手機在日本有很高的市場佔有率，在系統整合尤其是基頻方面有很多的經驗，此行討論在系統整合時基頻所遭遇到的問題。另外，該公司也發展出 LTCC 高頻封裝技術，並投入研發 LTCC 相關技術及其在系統整合的可行性，此一目標與本組相同，若能與其合作對本組提升 LTCC 相關技術有很大的幫助。

(7) 參訪日本 Panasonic 公司，該公司很早就著手開發第三代通訊系統 W-CDMA 功率元件，該公司在放大器設計之研究開發有相當成效及能量，其研發方向、產品內容與本組極為接近，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。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 Panasonic 落後，故本組若要發展放大器，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。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。再者，該公司也開發第三代通訊系統 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，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。

## 參、效益分析

隨著 W-CDMA 的最終規範即將完成，具有語音和數據功能的無線上網手機也將面世，但要使這類產品真正實現商用化，還有許多的問題等待解決。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如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。另外也收集 LTCC 用於無線通訊縮裝及高頻元件封裝相關資料，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：李適貴

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			
1.	910731	ANRITSU	Jacky Tseng	中華民國	男	5-10-27, Minamiazabu, Minato-ku, Tokyo, 106-8570 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.	910801	TOSHIBA	Makoto Furukawa	日本	男	1-1 shibaura 1 chome Minato-ku, Tokyo, 105-01 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	910802	TDK	Tang Jianfeng	日本	男	13-1 Nihonbashi 1-chome, Chuo ku, Tokyo 103-8272, Japan	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被動元件發展趨勢及因應開發之製程技術。	
4.	910805	KEISO	Kanji Furukawa	日本	男	Shiba Toho Bldg, 1-7-24, shibakoen Minato=ku, Tokyo, Japan 105-8558	討論本組儀器所需之氣體流量控制、氣體偵測器等相關規格。	
5	910806	UHT	Chew Siou Teck ANG Kian Sen	日本	男	470-0162 446-268 Shimokagamida, Haruki, Togo-T, aicki-gun, aichi, Japan	討論本組所購LTCC製程相關儀器後續的服務問題並研討LTCC相關製程技術。	



6	910807	Kyocera	Yasuhiro Satake	日本	男	1-2-28 Tamatsukuri, Chuo-ku , Osaka 540-8585, Japan	討論在系統整合時基頻所遭遇到 的問題。另外，該公司也發展出 LTCC 高頻封裝技術，並投入研發 LTCC 相關技術及其在系統整合的 可行性	
7	910808	Panasonic	ANG Kian Sen	日本	男	1-30 Shiba-Daimon 1-chome, Minato-ku Tokyo 105-8586 Japan	研討放大器設計之研究並討論開發 寬頻 CDMA 升頻、降頻轉換器模組 相關問題。	
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集。								

## 伍、社交活動

由於工作日程短暫，行程安排密集並未從其他事社交活動。只有在假日時搭日本地鐵到東京附近走走，所到之處市容整潔乾淨，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。日本人民生活方式、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、各公司在無線通訊系統的縮裝開始採用 LTCC 的技術，可以把一些被動元件整合在一起，具有低損耗、體積小、花費小的好處。另外，對於高頻元件封裝的解決方案也有越來越多的公司採用 LTCC 的技術，故建議本組加強建立 LTCC 生產技術之能量（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:ANRITSU

# **UE Test Standard**

## **Conformance Test System**

The following four systems make the Conformance Test System possible

### **TRX Test System**

- TS 34.121 clause 5 Measurement of a Transmit Performance**
- TS 34.121 clause 6 Measurement of a Receive Performance**

### **Performance Test System**

- TS 34.121 clause 7 Performance under Fading Condition**

### **RRM Test System**

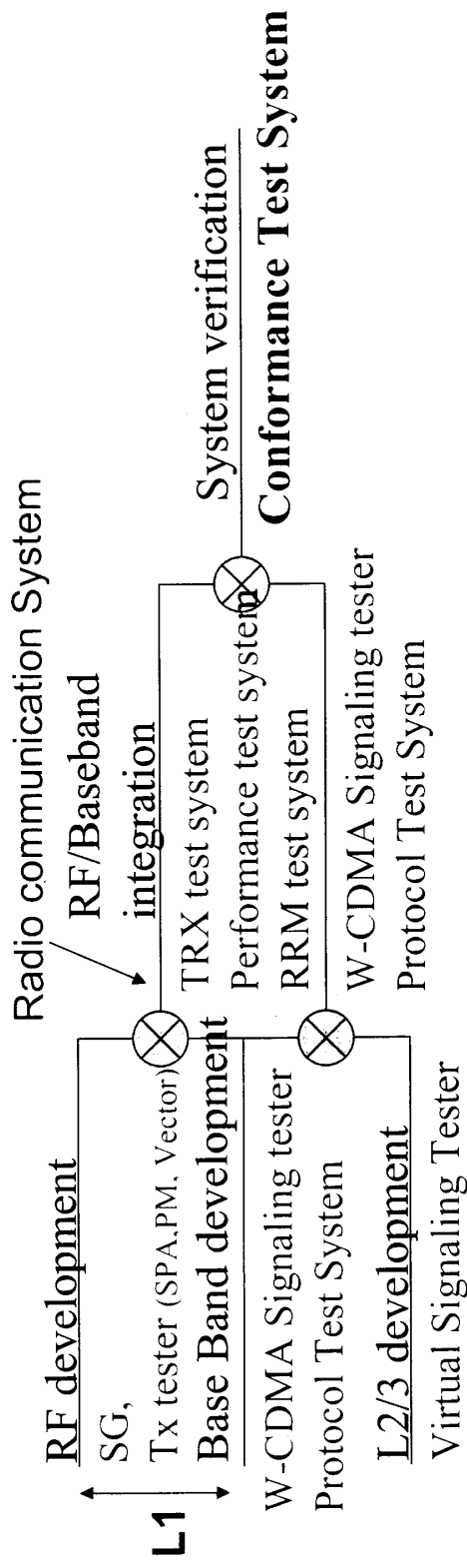
- TS 34.121 clause 8 The Test of RRM Function**

### **Protocol Test System**

- TS 34.123 The Test of Protocol Function**

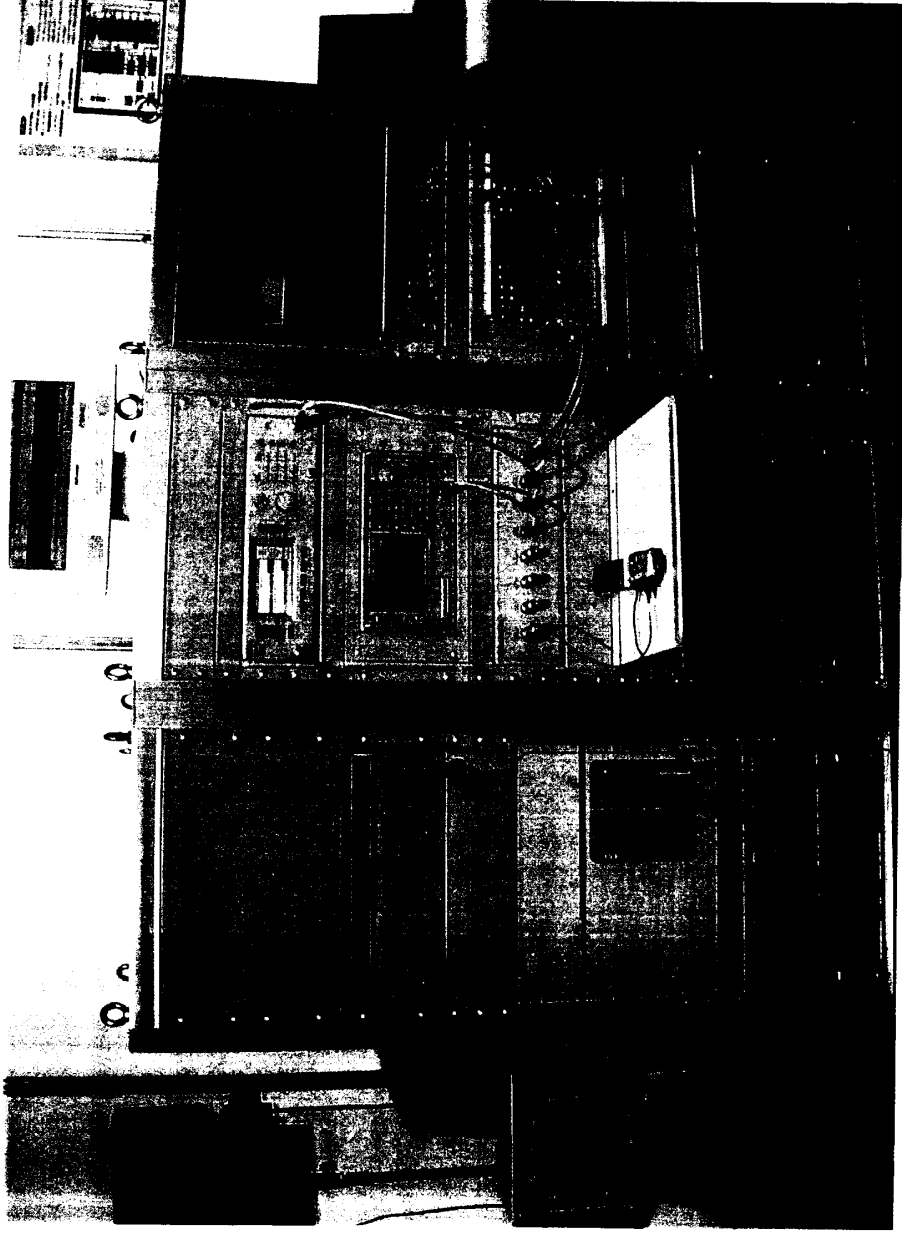
# UE Development Cycle

- Support parallel development streams to speed time to market



Common building blocks allow systems to be re-used and upgraded

# TRX/Performance Test System



# 3GPP conformance test support system

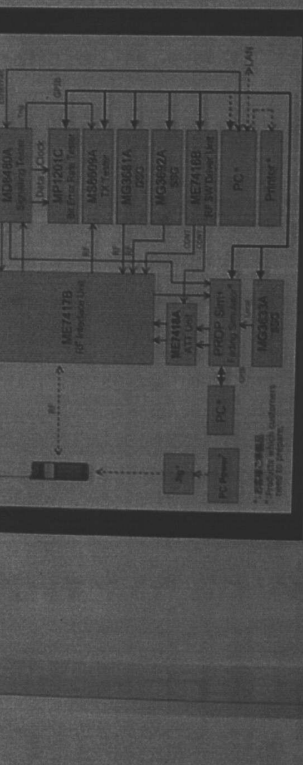
## 3GPP conformance test support system

**W-CDMA TRX/Performance Test System ME7873A**  
 W-CDMA TRX/Performance Test System ME7873A

3GPP TS34.121 5章の特性、6章の特性、7章/パフォーマンス要求を自動試験できるテストシステムです。  
 The test system which can perform auto measurement for 3GPP TS34.121 Chap.5 Transmitter Characteristics, Chap.6 Receiver Characteristics and Chap.7 Performance Requirements.

- 3GPP規格に完全準拠  
 世界標準に準じた自動試験が可能
- コールプロセッシング及び外部コントロールにより  
 試験試験をサポート
- コールプロセッシング及び外部コントロールによる試験も可能  
 後述の試験機に対応
- リクランクテストによる発射・受信試験が可能

Completely conforming to 3GPP standards  
 Auto testing is available conforming to world standard  
 Supporting UE test with Call-processing and External control  
 Test with Call-processing or test with external control is also available  
 Supporting total protocol sequence test  
 Origination / Termination test is available with Signaling Tester





# **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**

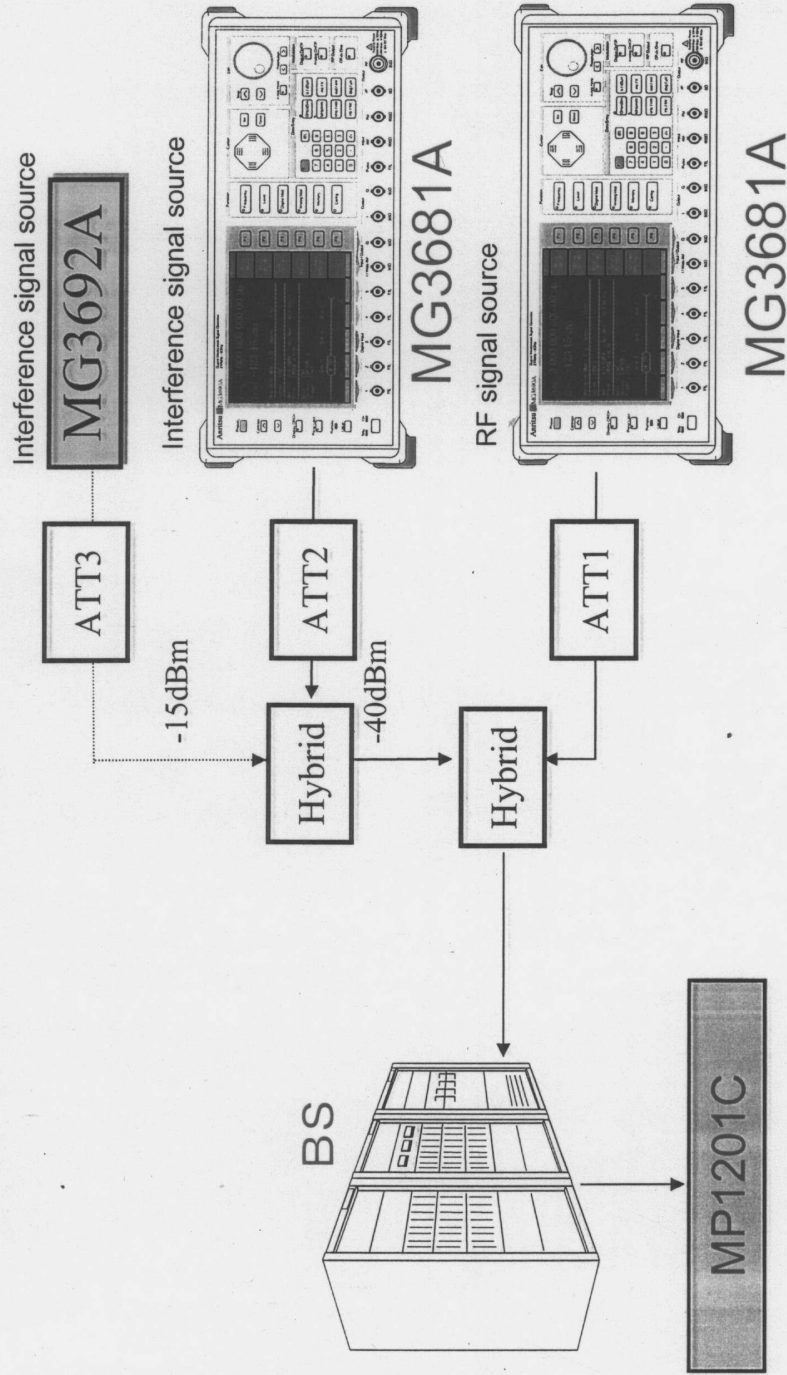
**TS 25.141 clause 7 Measurement of a Receive Performance**

## **Performance Test System**

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

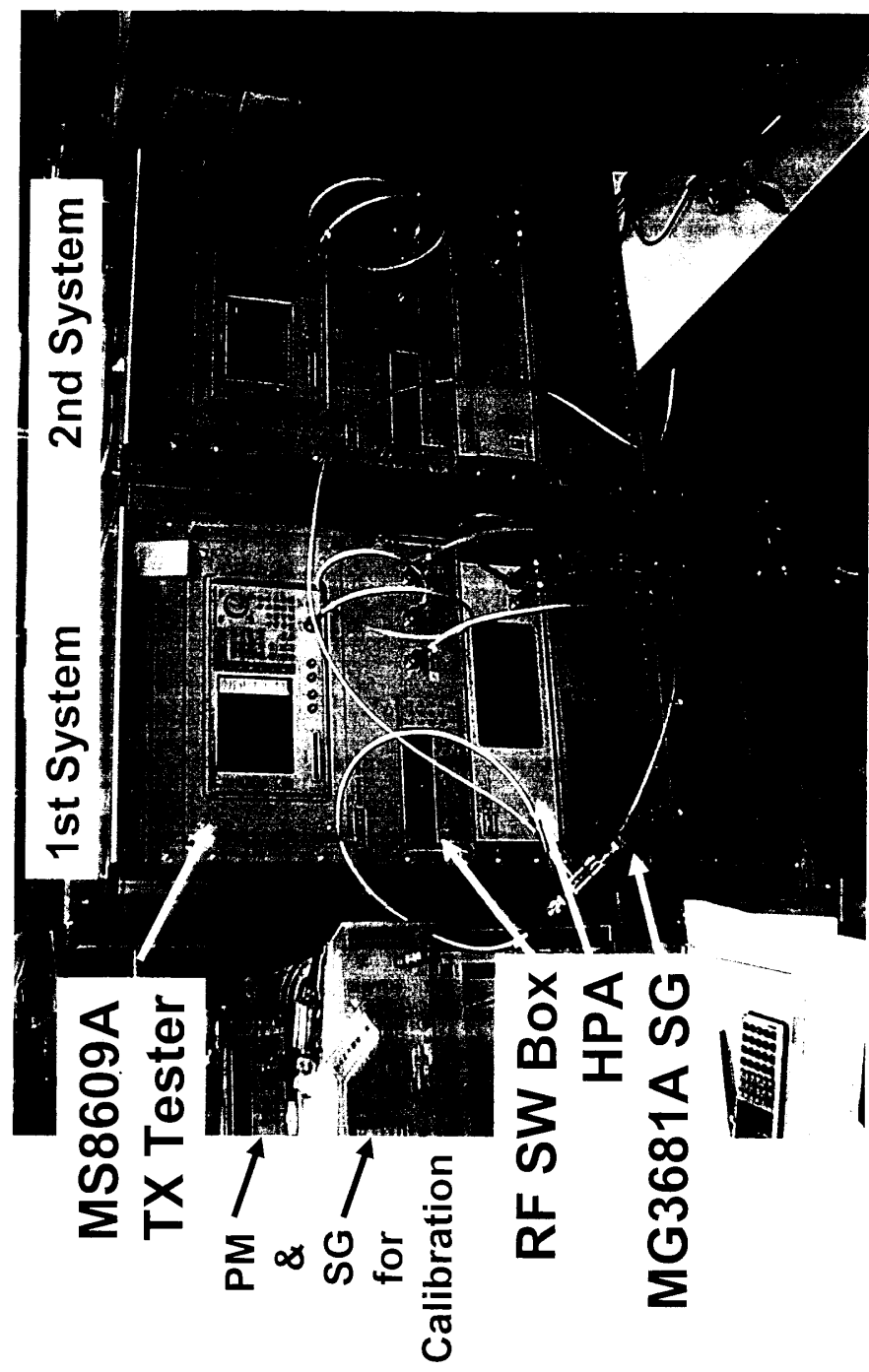
# BS Conformance Test System

## 7.6 Intermodulation characteristics



# W-CDMA·BS Test System

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



# **110GHz Broadband VNA**



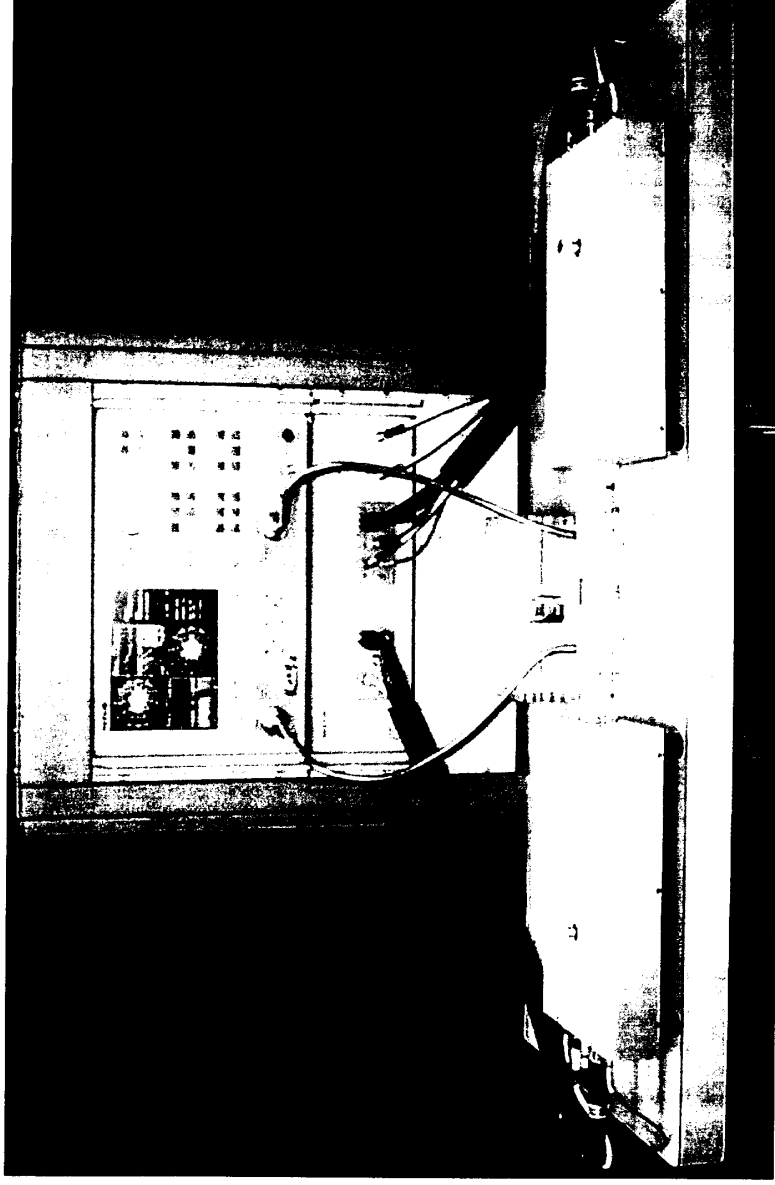
# Broadband VNA

- Continuous sweep from 40 MHz to 110 GHz
- Integrated rack system with coaxial (1 mm) test ports
  - 65 GHz VNA
  - Two 65-110 GHz transmission/reflection modules for complete 4 S parameters test.
  - Broadband test set
  - Two multiplexing couplers: V(f) and WR10 in, W1(f) out
  - Two CW synthesized sources
- Device characterization and modeling
- Upgrade from any VNA to 110GHz VNA

## **Key Features**

- **Test set flexibility - run coax or waveguide band independently**
- **Upgrade path from 65 GHz VNA**
- **Small size of mmW modules simplifies integration with on-wafer probe system**
- **Fast broadband frequency sweep**
- **High dynamic range**
- **Enhanced serviceability**
- **Cost effective measurement solution**

# 110GHz VNA (W1 Coax)





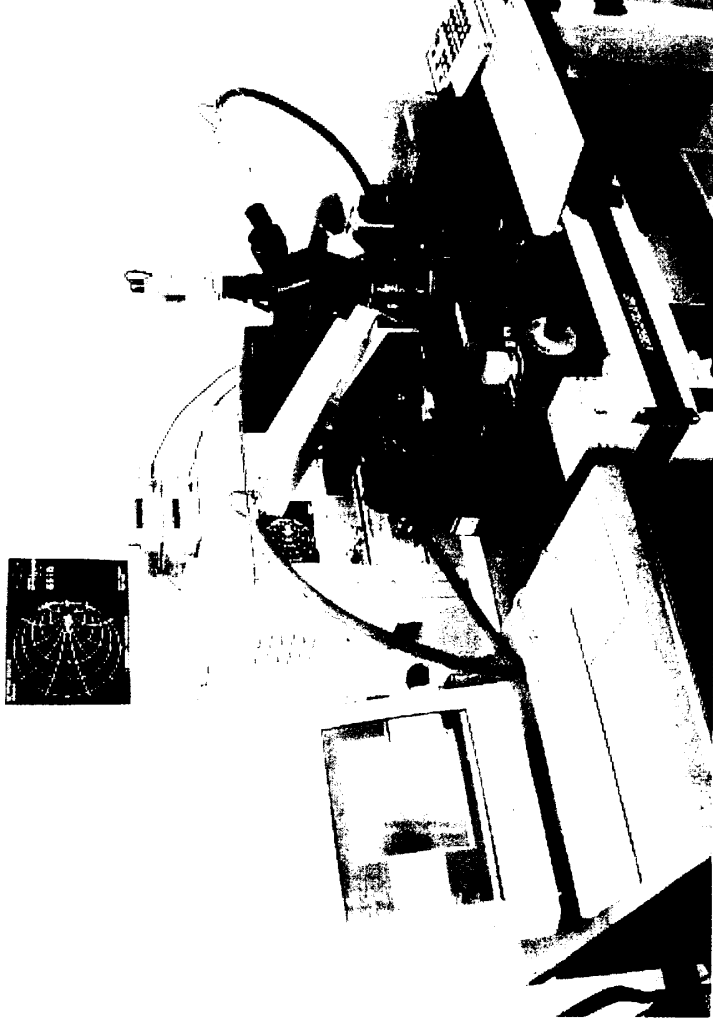
# Complete On-Wafer Test Solution

- Anritsu “Panorama 110GHz” Broadband VNA
- Karl Suss Probe System and Software
  - PM5 HF manual or PA200 HF semi-automatic system
  - PH250 HF probeheads
  - Suss ProberBench® operating system
  - SussCal® automatic calibration software
- GGB Picoprobe® Probes and Calibration Substrates
  - 110H microwave probes (GSG, GS, or SG )\*
  - CS-5 or CS-8 calibration substrates
- Parameter Extraction and Device Modeling Software
  - Compatible with Agilent EEsof IC-CAP (release 5.3)

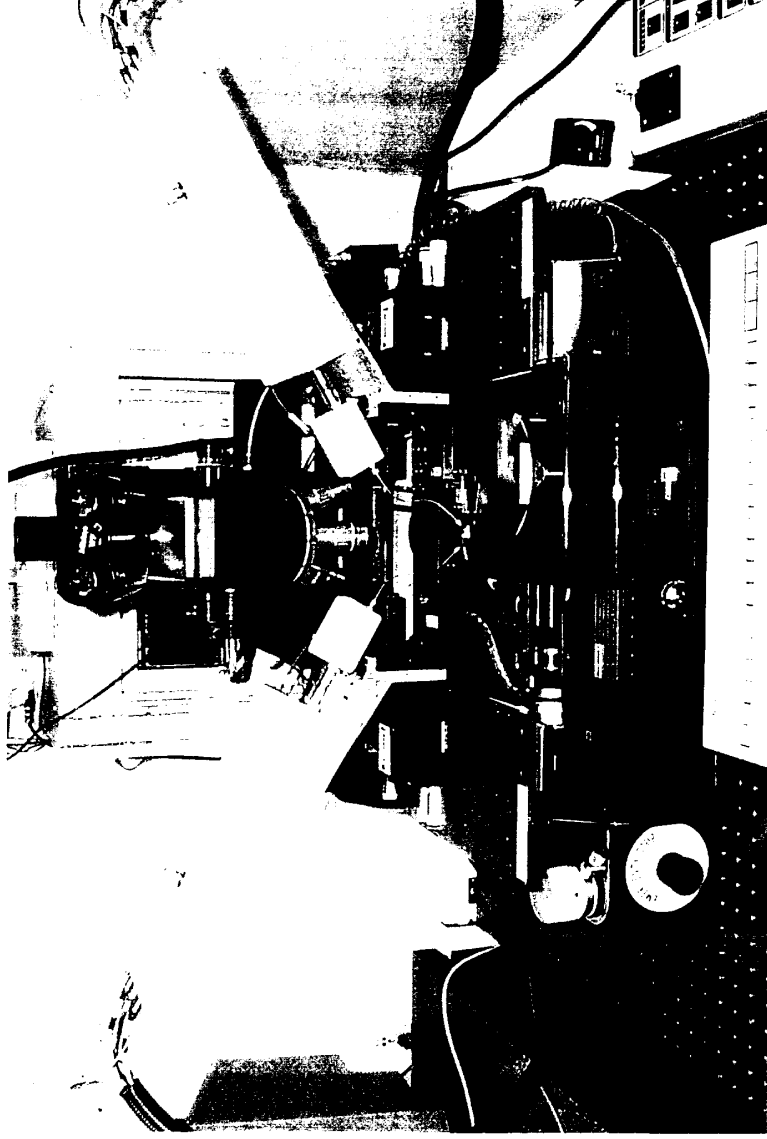


\* ground-signal-ground

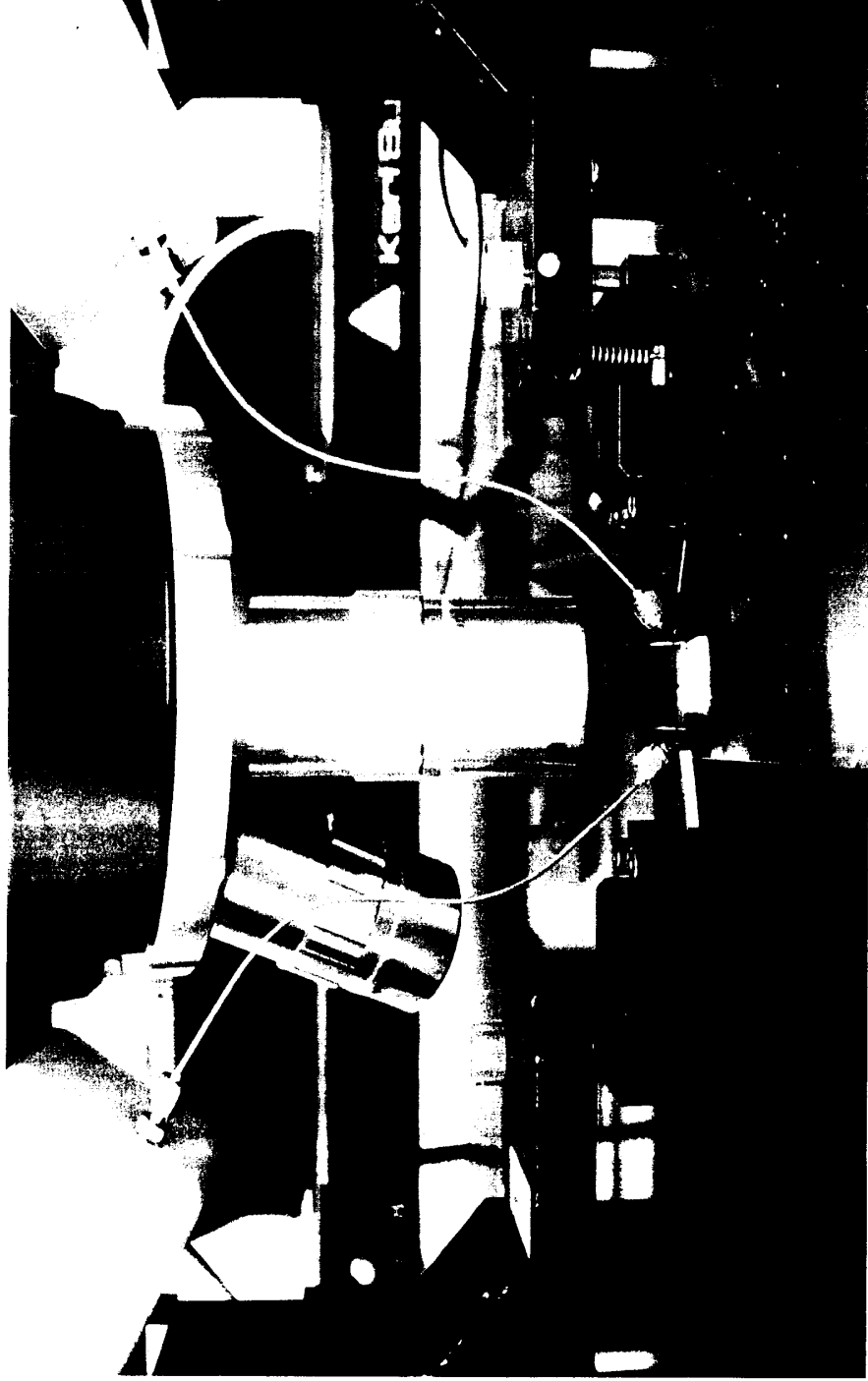
# 110GHz VNA (On-Wafer)



# 110GHz VNA (On-Wafer)



# 110GHz VNA (On-Wafer)



# Dynamic Range

Frequency (GHz)	0.04	2	20	40	50	<65	>65	75	85	100	110
Max Signal into Port 2 (dBm)	30	30	30	30	30	30	16	14	13	12	12
Port 1 Power, Typical (dBm)	-1	3	-7	-14	-10	-12	-14	-10	-11	-9	-11
Noise Floor (dBm)	-76	-103	-92	-88	-79	-67	-65	-78	-81	-78	-73
System Dynamic Range (dB)	75	106	85	74	69	55	51	68	70	69	62
Receiver Dynamic Range (dB)	106	133	122	118	109	97	81	92	94	90	85

Frequency (GHz)	0.04	2	20	40	50	<65	>65	75	85	100	110
Max Signal into Port 2 (dBm)	30	30	30	30	30	30	18	17	16	16	16
Port 1 Power, Typical (dBm)	-1	3	-8	-16	-12	-14	-16	-13	-14	-13	-15
Noise Floor (dBm)	-76	-103	-91	-86	-77	-65	-63	-75	-78	-74	-69
System Dynamic Range (dB)	75	106	83	70	65	51	47	62	64	61	54
Receiver Dynamic Range (dB)	106	133	121	116	107	95	81	92	94	90	85

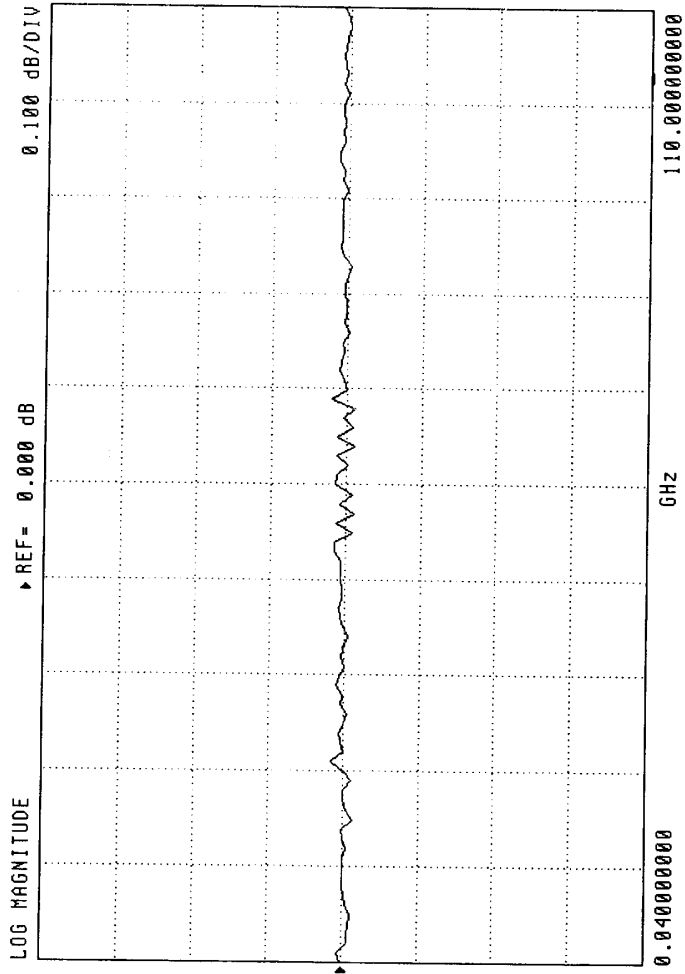
# Dynamic Range

Frequency (GHz)	0.04	2	20	40	50	65
Max Signal into Port 2 (dBm)	30	30	30	30	30	30
Port 1 Power, Typical (dBm)	0	5	-2	-7	-2	-2
Noise Floor (dBm)	-77	-105	-97	-95	-87	-77
System Dynamic Range (dB)	77	110	95	88	85	75
Receiver Dynamic Range (dB)	107	135	127	125	117	107

Frequency (GHz)	65	75	85	100	110
Max Signal into Port 2 (dBm)	8	8	8	8	8
Port 1 Power, Typical (dBm)	-6	-4	-6	-5	-7
Noise Floor (dBm)	-73	-84	-86	-82	-77
System Dynamic Range (dB)	67	80	80	77	70
Receiver Dynamic Range (dB)	81	92	94	90	85

# Thru Line (On-Wafer)

S21 FORWARD TRANSMISSION



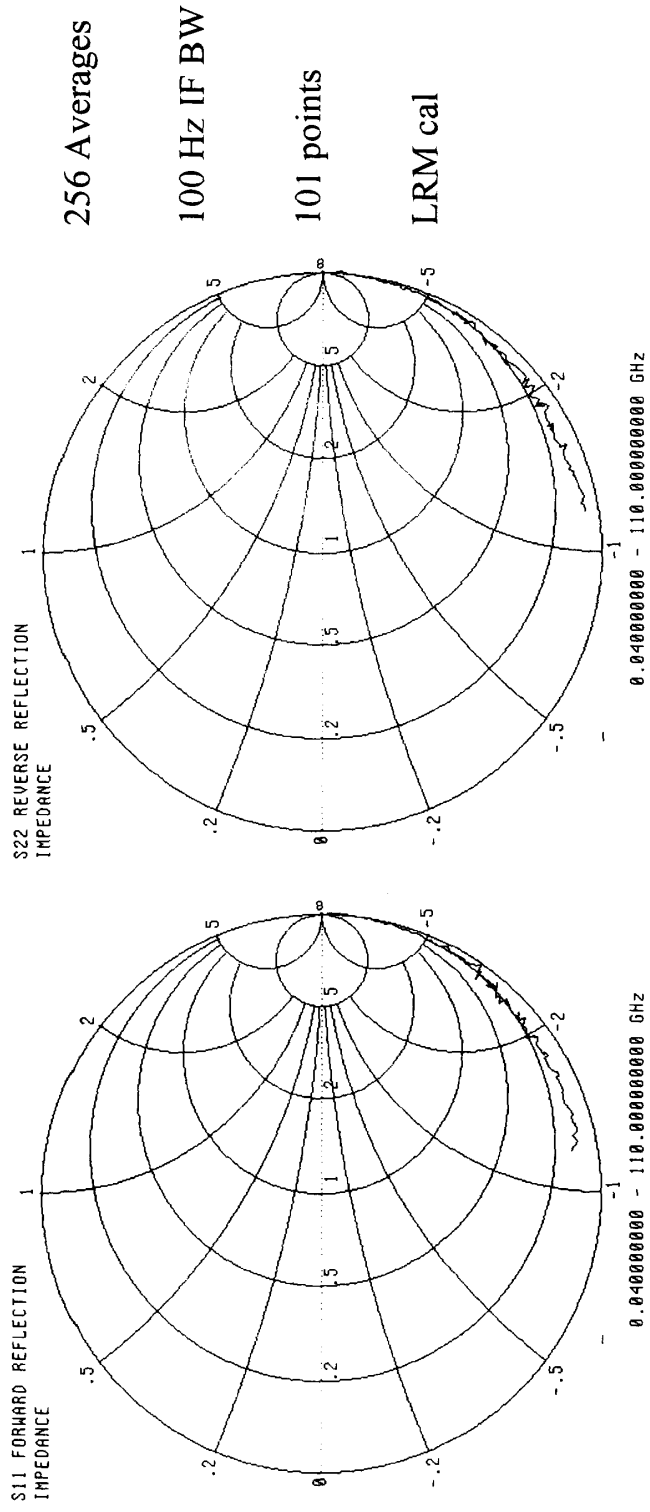
256 Averages

100 Hz IF BW

101 points

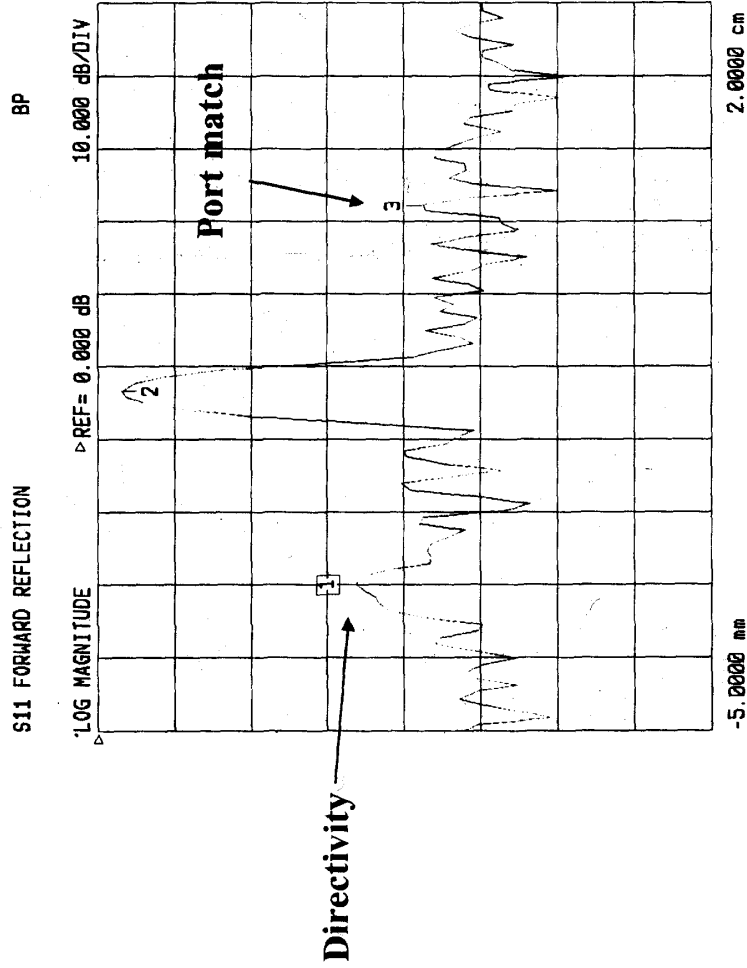
SOLT cal

# Extended Open (On-Wafer, 200 $\mu\text{m}$ )





# Directivity and Port Match (On-Wafer)



CH 1 - S11  
 REFERENCE PLANE  
 0.0000 mm

MARKER 1  
 0.0000 mm  
 -33.868 dB

MARKER TO MAX  
 MARKER TO MIN

2 6.6972 mm  
 -3.211 dB

3 1.3200 cm  
 -42.666 dB

256 averages

100 Hz IF BW

101 points

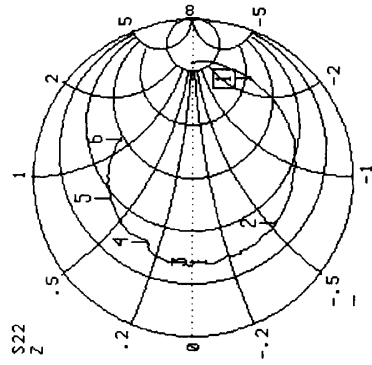
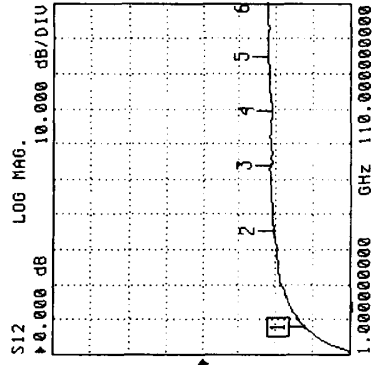
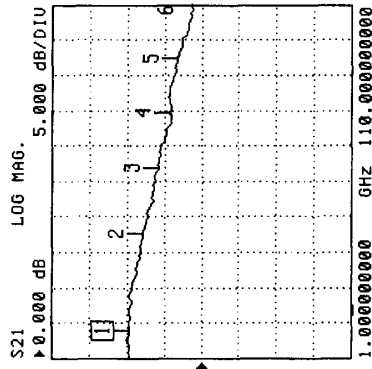
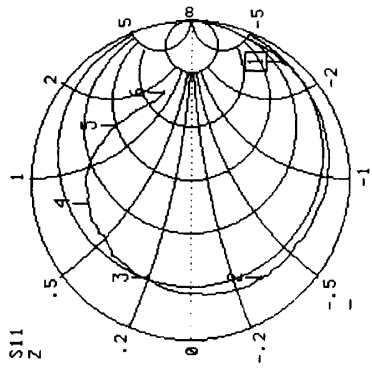
Time domain

LRRM (WinCal)

6.6 mm open

MARKER READOUT  
 FUNCTIONS

# FET (On-Wafer)



CH 3 - S21  
REFERENCE PLANE  
0.0000 mm

256 averages

▶ MARKER 1  
10.00000000 GHz  
9.564 dB

100 Hz IF BW

MARKER TO MAX  
MARKER TO MIN

101 points

2 40.00000000 GHz  
7.768 dB

3 60.00000000 GHz  
5.742 dB

LRM (SussCal)

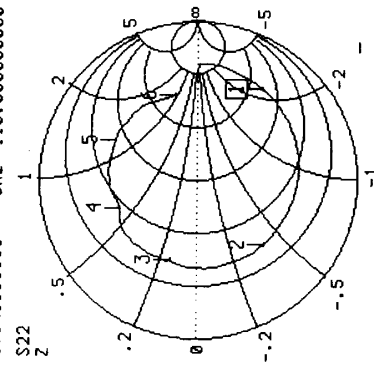
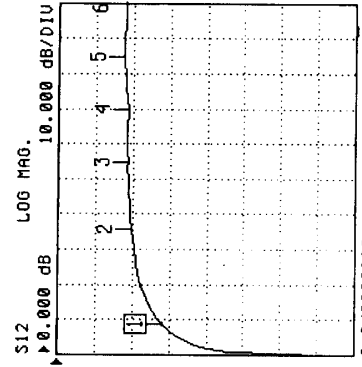
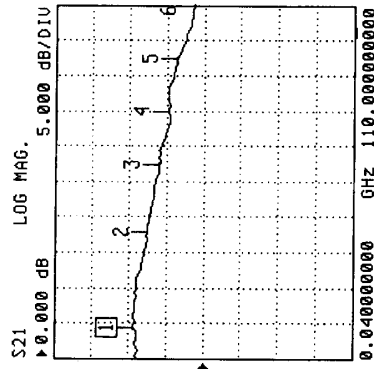
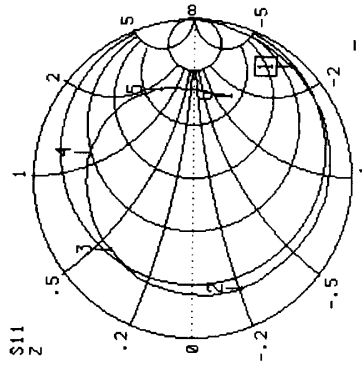
4 77.00000000 GHz  
4.225 dB

5 94.00000000 GHz  
3.093 dB

6 110.00000000 GHz  
1.286 dB

MARKER READOUT  
FUNCTIONS

# FET (On-Wafer)



CH 3 - S21  
REFERENCE PLANE  
0.0000 mm

MARKER 1  
9.936400000 GHz  
9.184 dB

MARKER TO MAX  
MARKER TO MIN

2 39.625600000 GHz  
7.410 dB

3 60.518000000 GHz  
5.837 dB

4 77.012000000 GHz  
4.533 dB

5 93.506000000 GHz  
3.465 dB

6 110.000000000 GHz  
1.292 dB

MARKER READOUT  
FUNCTIONS

256 averages

100 Hz IF BW

101 points

LRRM (WinCal)

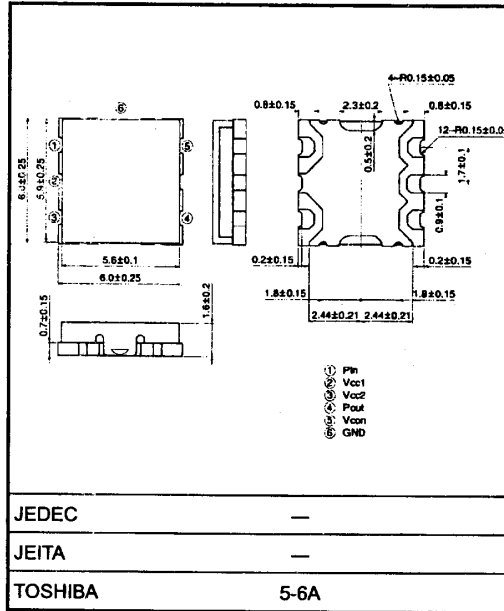
附件：TOSHIBA

# S-AU81

Power Amplifier Modules for Domestic cdmaOne

- GaAs HBT Micro PA (on-chip bias circuit and matching circuit)
- Output power:  $P_o = 27.0\text{dBmW}$  (min)
- Gain:  $G_p = 28.0\text{dB}$  (typ.)
- Total current:  $I_t(1) = 385\text{ mA}$  (typ.)  
(@ $P_{out} = 27.0\text{dBmW}$ )
- Low-voltage operation: Operation at  $V_{CC} = 1.5\text{ V}$  is possible  
 $I_t(2) = 97\text{ mA}$  (typ.) (@ $P_{out} = 14\text{dBmW}$ ,  $V_{CC} = 1.5\text{ V}$ )
- This device features an output control pin which can be switched between low-power and high-power settings.  
 $I_t = 90\text{ mA}$  (typ.) (@ $P_{out} = 14\text{dBmW}$ ,  $V_{CC} = 2.70\text{ V}$ )

Unit: mm



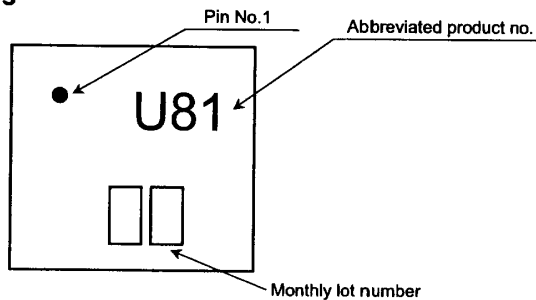
Weight: 0.0 g (typ.)

### Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating	Unit
Supply voltage 1	$V_{CC1}$	5	V
Supply voltage 2	$V_{CC2}$	5	V
Control voltage	$V_{con}$	4	V
Collector current	$I_{CC}$	1	A
Power dissipation	$P_D$ (Note 1)	2	W
Operating temperature	$T_{op}$	-20~+60	°C
Storage temperature range	$T_{stg}$	-30~+125	°C

Note 1: Ta = 25°C

### Marking



## Electrical Characteristics (Tc = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit	
Power gain (1)	G <sub>p</sub> (1)	V <sub>CC1</sub> , V <sub>CC2</sub> = 3.6 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> = 27dBmW	25.0	28.0	—	dB	
Control current	I <sub>con</sub>	f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω	—	3	5	mA	
Total current (1)	I <sub>t</sub> (1)		—	385	—	mA	
Adjacent-channel power ratio (1)	ACPR1 (1)	V <sub>CC1</sub> , V <sub>CC2</sub> = 3.6 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> = 27dBmW, f = 887~925 MHz, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω (Note 3)	900 kHz	—	-50	-45	dB
	ACPR2 (2)		1.98 MHz	—	-60	-56	dB
Power gain (2)	G <sub>p</sub> (2)	V <sub>CC1</sub> , V <sub>CC2</sub> = 1.5 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> = 14dBmW, f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω	21.0	24.0	—	dB	
Total current (2)	I <sub>t</sub> (2)		—	97	—	mA	
Adjacent-channel power ratio (2)	ACPR1 (2)	V <sub>CC1</sub> , V <sub>CC2</sub> = 1.5 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> = 14dBmW, f = 887~925 MHz, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω (Note 3)	900 kHz	—	-50	-45	dB
	ACPR2 (2)		1.98 MHz	—	-60	-56	dB
Power gain (3)	G <sub>p</sub> (3)	V <sub>CC1</sub> , V <sub>CC2</sub> = 3.6 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> = 27dBmW, f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω, Tc = -20~+60°C	24.0	27.0	—	dB	
Adjacent-channel power ratio (3)	ACPR1 (3)	V <sub>CC1</sub> , V <sub>CC2</sub> = 3.6 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> = 27dBmW, f = 887~925 MHz, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω, Tc = -20~+60°C (Note 3)	900 kHz	—	-48	-43	dB
	ACPR2 (3)		1.98 MHz	—	-58	-55	dB
VSWRin	VSWRin	V <sub>CC1</sub> , V <sub>CC2</sub> = 3.6 V, V <sub>con</sub> = 2.85 V (Note 3), P <sub>o</sub> = 27dBmW, f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω	—	2	3	—	
Harmonics	2fo	HRM (1)	—	—	-30	dB	
	3fo	HRM (2)	—	—	-45	dB	
Stability	SPR	V <sub>CC1</sub> , V <sub>CC2</sub> = 1.5 V, 2.5 V, 3.6 V, 4.2 V, V <sub>con</sub> = 2.85 V (Note 3), P <sub>o</sub> ≤ 27dBmW, f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = 50 Ω, VSWR LOAD = 3:1 all phase	—	—	-60	dB	
Receiving band noise	NRB	V <sub>CC1</sub> , V <sub>CC2</sub> = 3.6 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> ≤ 27dBmW, f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = Z <sub>L</sub> = 50 Ω	—	-135	—	dBmW/Hz	
Load mismatch	—	V <sub>CC1</sub> , V <sub>CC2</sub> = 1.5 V~4.2 V, V <sub>con</sub> = 2.85 V (Note 2), P <sub>o</sub> ≤ 27dBmW, f = 887~925 MHz, P <sub>in</sub> = adjust, Z <sub>G</sub> = 50 Ω, VSWR LOAD = 3:1 all phase	No degradation			—	

Caution: This RF power amplifier is the electrostatic sensitive device. Please handle with caution.

Note 2: V<sub>con</sub> = 2.85 V is set to obtain Idle ≈ 75 mA when V<sub>CC1</sub>, V<sub>CC2</sub> = 3.6 V

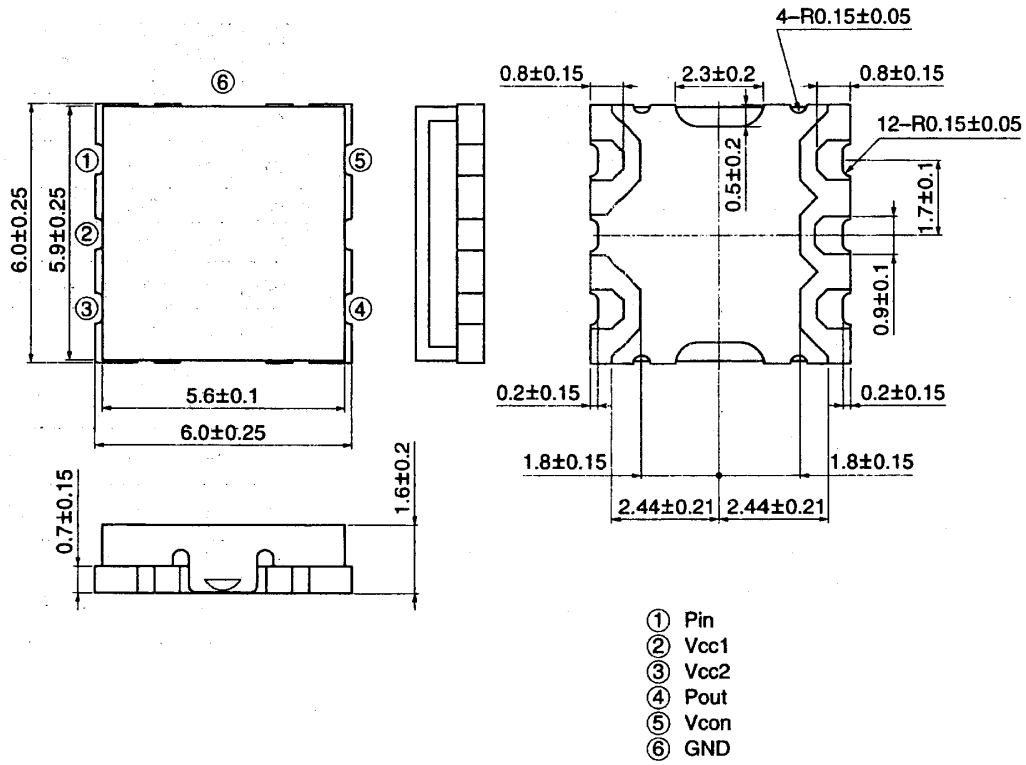
Note 3: ACPR

- P<sub>c</sub> (1.23 MHz) is average power measured for 1.23 MHz bandwidth with CDMA signal.
- P (30 kHz) is average power measured for 30 kHz bandwidth with 900 kHz/1.98 MHz offset.
- ACPR1 (or ACPR2) = P (30 kHz) - P<sub>c</sub> (1.23 MHz) dB

Note 4: These electrical characteristics are measured using Toshiba recommended test board.

**Package Dimensions**

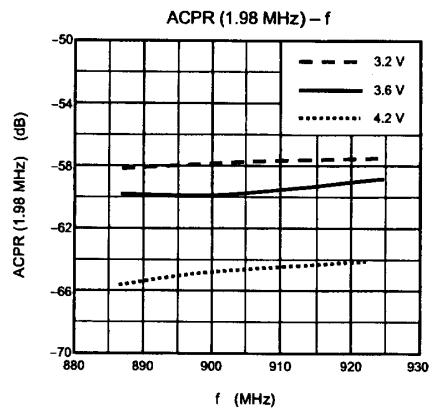
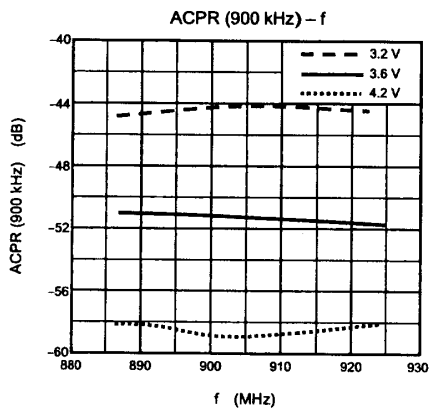
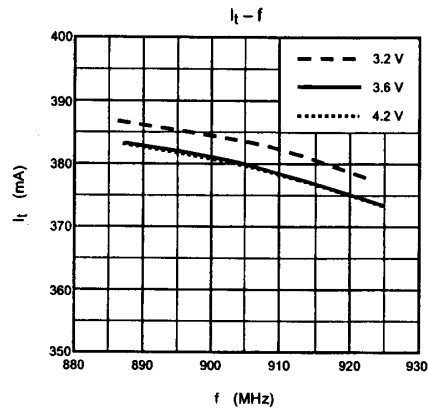
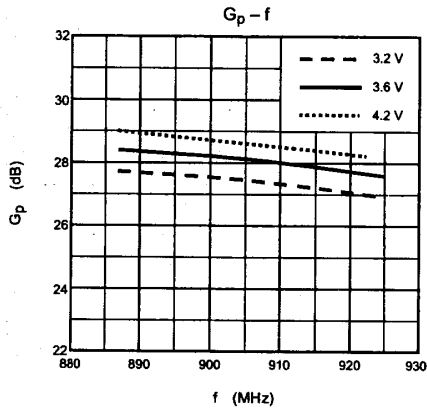
unit : mm



**Typical Characteristic Curves**

(1) Frequency Characteristics

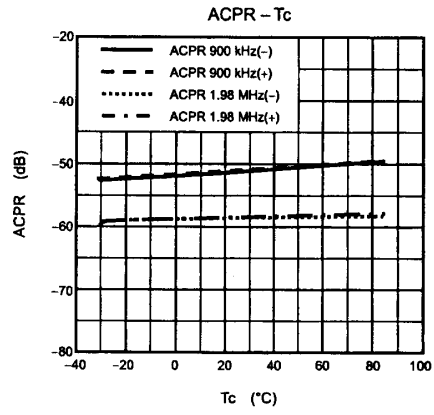
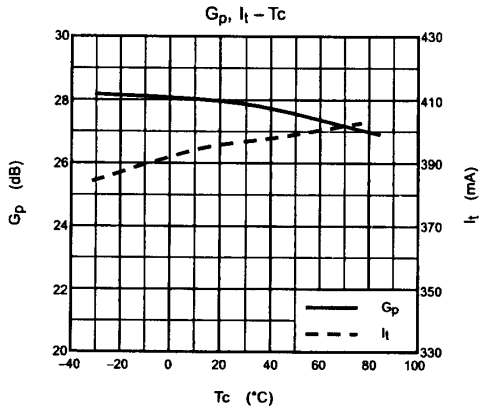
$P_o = 27\text{dBmW}$ ,  $V_{con} = 2.85\text{ V}$ ,  $V_{CC1}$ ,  $V_{CC2} = 3.6\text{ V}$



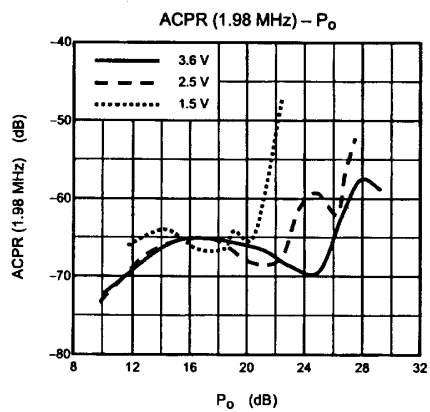
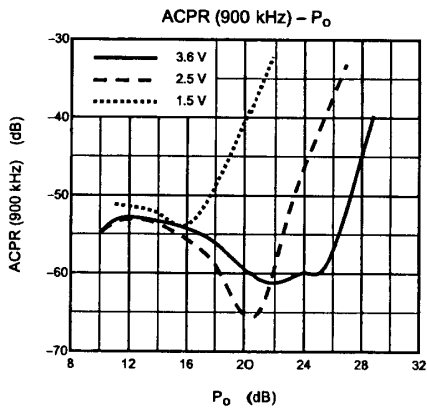
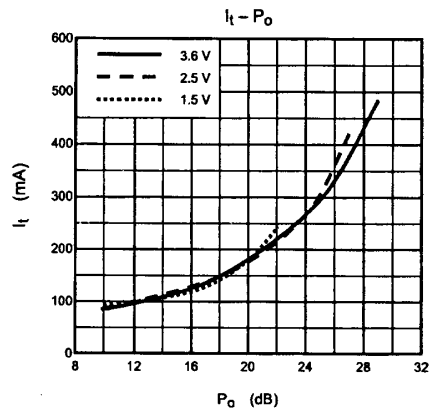
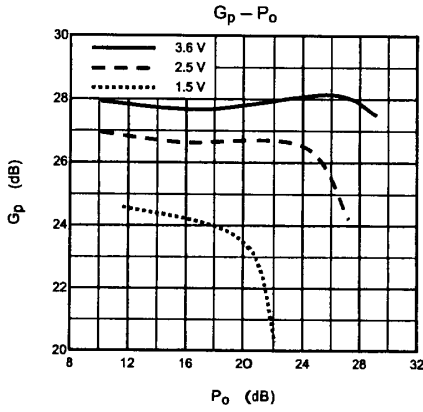


(2) Temperature Characteristics

$P_o = 27\text{dBmW}$ ,  $V_{con} = 2.85\text{ V}$ ,  $f = 906\text{ MHz}$ ,  $V_{CC1}$ ,  $V_{CC2} = 3.6\text{ V}$

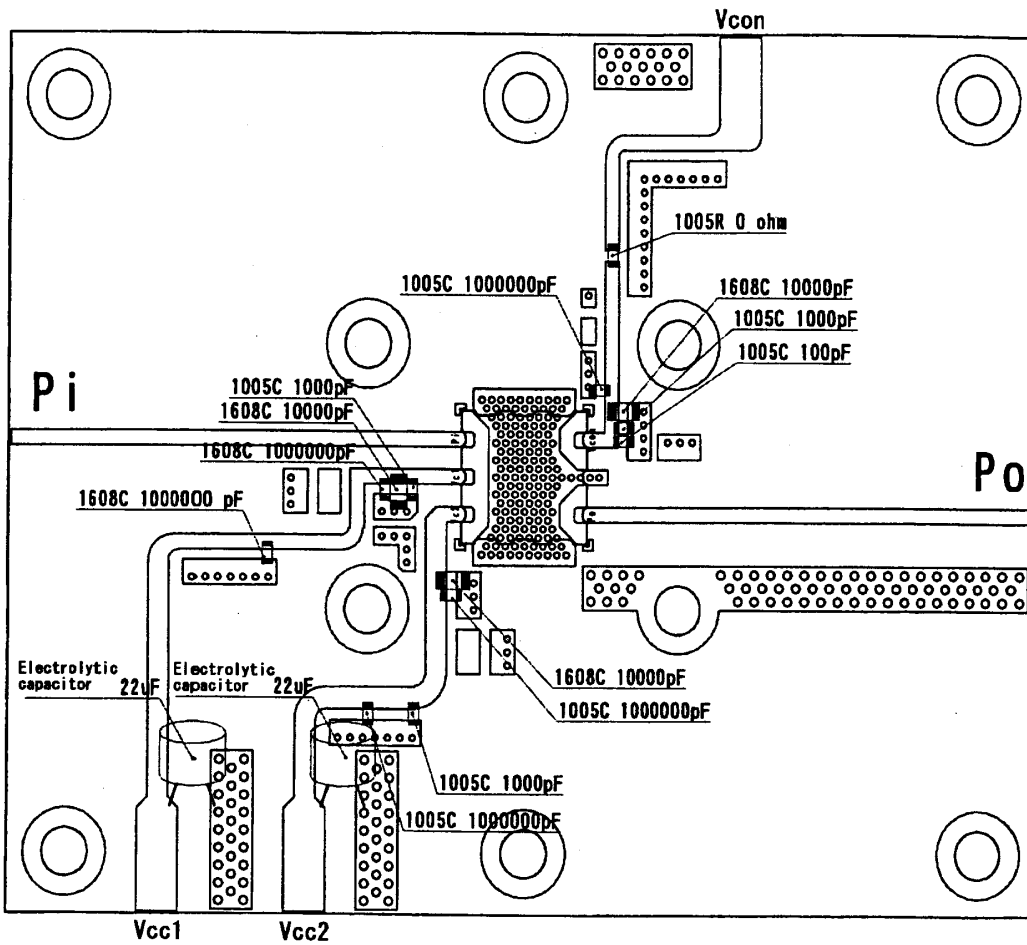


(3) Power Supply Voltage  
 VCC Characteristics (f = 906 MHz, V<sub>con</sub> = 2.85 V)



Note: These are only typical curves and devices are not necessarily guaranteed at these curves.

Test Board



Note for biasing procedure: Please follow this sequence when you measure a device bias sequence.

- a) Vcc1, Vcc2 On      0 V to Supply Voltage
- b) Vcon On            adjust idle current
- c) RF on

**RESTRICTIONS ON PRODUCT USE**

000707EAA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.  
In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
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- The information contained herein is subject to change without notice.

附件：TDK

# RF Components

## Band Pass Filters

### Shielded

## DEA-B Series

### FEATURES

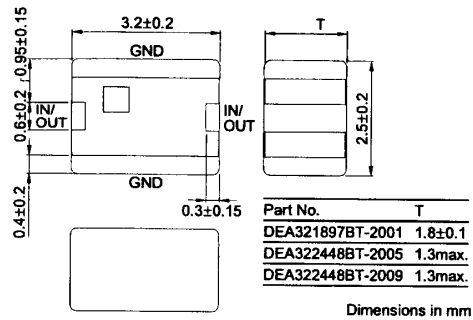
- Compact, low profile, and light weight.
- Low insertion loss, high attenuation.
- Shielded type.

### TEMPERATURE RANGES

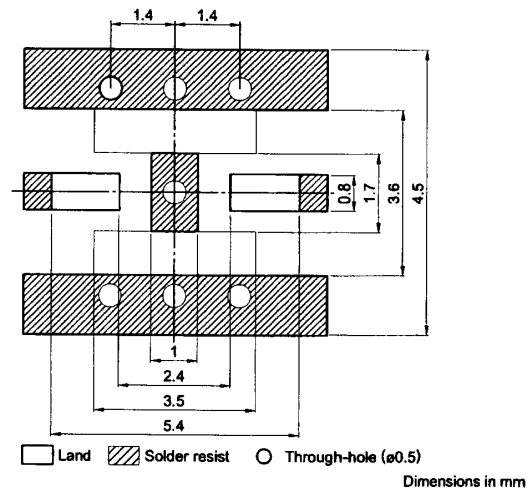
Operating	-40 to +85°C
Storage	-40 to +85°C

### SHAPES AND DIMENSIONS

DEA321897BT-2001/DEA322448BT-2005/DEA322448BT-2009



### RECOMMENDED PC BOARD PATTERN



### APPLICATIONS/TYPICAL ELECTRICAL CHARACTERISTICS

Part No.	Applications	Center frequency f <sub>0</sub> (MHz)	Bandpass width (MHz)	Insertion loss (dB)max.	Attenuation (dB)min.
DEA321897BT-2001	DCS/PCS	1897	185	2.5	30[at 2f <sub>0</sub> ]
DEA322448BT-2005	Bluetooth	2448	97	2.8	30[at 2f <sub>0</sub> ]
DEA322448BT-2009	Bluetooth	2448	97	2.2	30[at 2f <sub>0</sub> ]

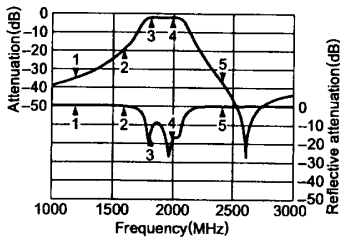
• Company and product names mentioned are registered trademarks.

### TYPICAL ELECTRICAL CHARACTERISTICS

#### DCS/PCS

##### DEA321897BT-2001

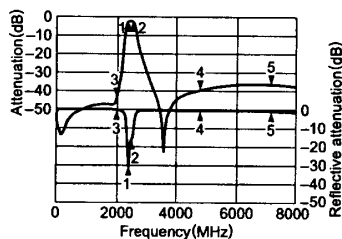
- 1: 1190.0MHz, -35.260dB
- 2: 1590.0MHz, -19.240dB
- 3: 1805.0MHz, -1.9384dB
- 4: 1990.0MHz, -2.0348dB
- 5: 2410.0MHz, -38.205dB



#### Bluetooth

##### DEA322448BT-2005

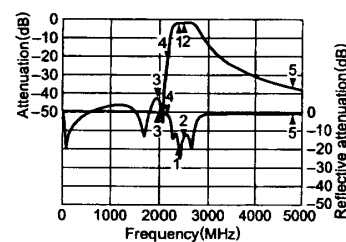
- 1: 2400.0MHz, -2.2746dB
- 2: 2497.0MHz, -2.1410dB
- 3: 1990.0MHz, -43.860dB
- 4: 4800.0MHz, -39.798dB
- 5: 7200.0MHz, -36.603dB



#### Bluetooth

##### DEA322448BT-2009

- 1: 2400.0MHz, -1.5937dB
- 2: 2497.0MHz, -1.3768dB
- 3: 1990.0MHz, -42.383dB
- 4: 2170.0MHz, -23.052dB
- 5: 4800.0MHz, -36.765dB



⚠ Specifications which provide more details for the proper and safe use of the described product are available upon request.  
All specifications are subject to change without notice.

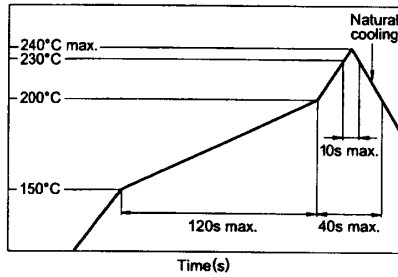
# RF Components

## Band Pass Filters

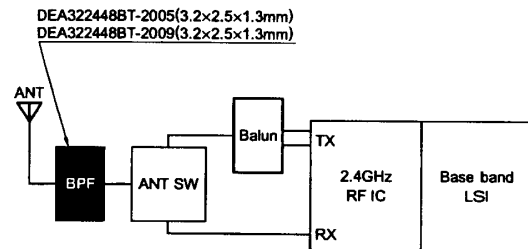
### Shielded

## DEA-B Series

### RECOMMENDED REFLOW SOLDERING CONDITIONS



### APPLICATION EXAMPLE CONSTRUCTION OF BLUETOOTH



# RF Components

## Low Pass Filters

### Shielded

## DEA-L Series

### FEATURES

- Smallest-in-the-industry-class compact, thin, and lightweight chip low pass filter manufactured in ceramic sheet multilayering process (L1.6xW0.8xT0.8mm/4mg).
- Wide range of characteristics including low loss type (corresponding to 3rd level) to high attenuation type (corresponding to 5th level) achieved according to circuit in use.
- Provided with excellent environmental resistance and stable characteristics achieved under use of portable remote terminal in hostile environment.

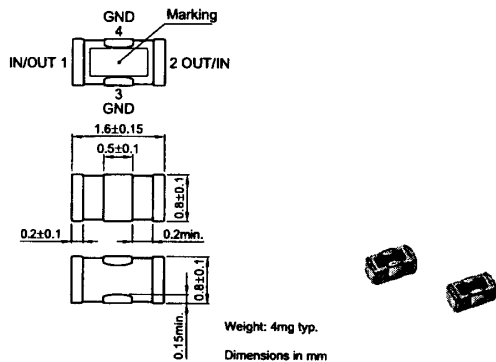
### APPLICATIONS

Cellular and digital cordless phones.

### TEMPERATURE RANGES

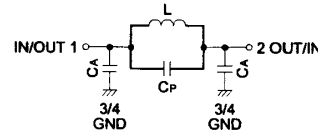
Operating	-25 to +80°C
Storage	-40 to +85°C

### SHAPES AND DIMENSIONS

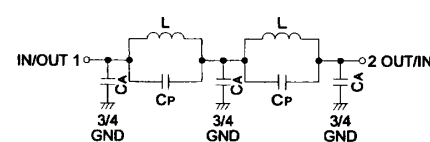


### EQUIVALENT CIRCUIT

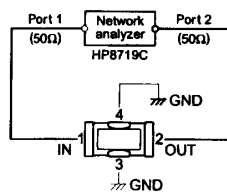
#### LOW LOSS TYPE



#### HIGH ATTENUATION TYPE

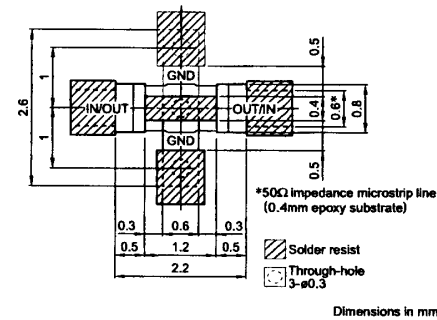


### MEASURING DIAGRAM



### RECOMMENED PC BOARD PATTERN

#### REFLOW SOLDERING



### APPLICATIONS/TYPICAL ELECTRICAL CHARACTERISTICS

#### FOR 0.8 to 2.0GHz DIGITAL CELLULAR AND CORDLESS PHONES

Ta=25±5°C

Part No.	Applications	Frequency fo(MHz)	Insertion loss (dB) max.	2fo attenuation (dB)min.*1	3fo attenuation (dB)min.*2
DEA160915LT-1160	GSM	880 to 915	0.5	17	17
DEA160915LT-1156	GSM	880 to 915	0.6	27	23
DEA160915LT-1169	GSM	880 to 915	0.7	30	25
DEA160960LT-1153	PDC800	940 to 960	0.5	20	17
DEA161785LT-1158	DCS1800	1710 to 1785	0.5	27	23
DEA161880LT-1154	DCS1800	1710 to 1880	0.7	27	23
DEA161990LT-1155	PCS1900	1850 to 1990	0.5	27	20
DEA161990LT-1182	PCS1900	1850 to 1990	0.7	30	25
DEA161453LT-1152	PDC1500	1429 to 1453	0.5	20	20
DEA161980LT-1164	IMT-2000	1920 to 1980	0.5	27	20

\*1 2fo=Second harmonics out of band rejection

\*2 3fo=Third harmonics out of band rejection

△ Specifications which provide more details for the proper and safe use of the described product are available upon request.  
All specifications are subject to change without notice.



# RF Components

## Low Pass Filters

### Shielded

## DEA-L Series

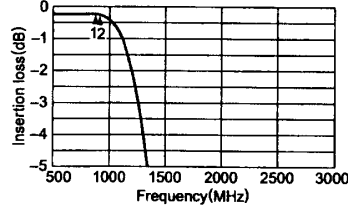
### TYPICAL ELECTRICAL CHARACTERISTICS

#### ATTENUATION vs. FREQUENCY CHARACTERISTICS

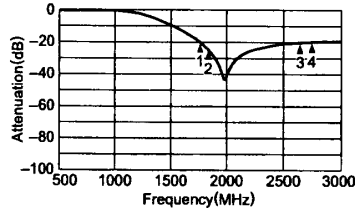
#### GSM

##### DEA160915LT-1160

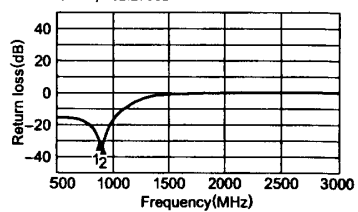
- 1: 880.0MHz, -0.238dB
- 2: 915.0MHz, -0.260dB



- 1: 1760.0MHz, -20.181dB
- 2: 1830.0MHz, -24.492dB
- 3: 2640.0MHz, -20.138dB
- 4: 2745.0MHz, -19.699dB

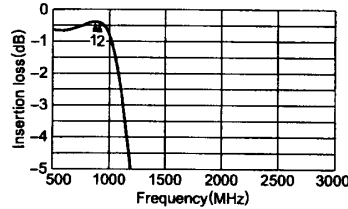


- 1: 880.0MHz, -30.972dB
- 2: 915.0MHz, -32.275dB

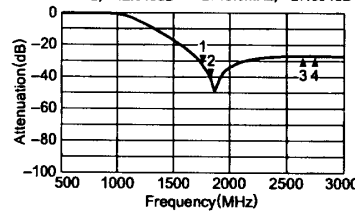


##### DEA160915LT-1156

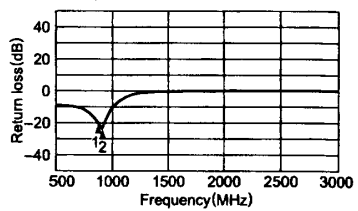
- 1: 880.0MHz, -0.371dB
- 2: 915.0MHz, -0.398dB



- 1: 1760.0MHz, -32.838dB
- 2: 1830.0MHz, -42.519dB
- 3: 2640.0MHz, -27.037dB
- 4: 2745.0MHz, -27.094dB

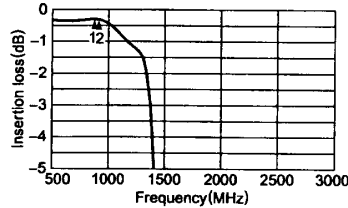


- 1: 880.0MHz, -21.279dB
- 2: 915.0MHz, -23.566dB

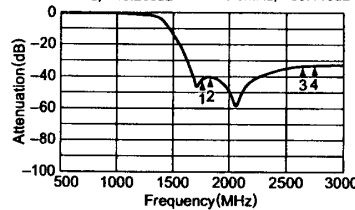


##### DEA160915LT-1169

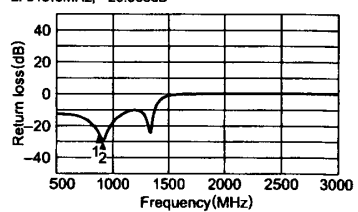
- 1: 880.0MHz, -0.276dB
- 2: 915.0MHz, -0.297dB



- 1: 1760.0MHz, -41.563dB
- 2: 1830.0MHz, -40.206dB
- 3: 2640.0MHz, -33.647dB
- 4: 2745.0MHz, -33.116dB



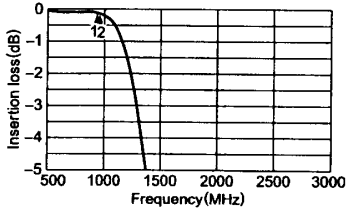
- 1: 880.0MHz, -25.276dB
- 2: 915.0MHz, -29.385dB



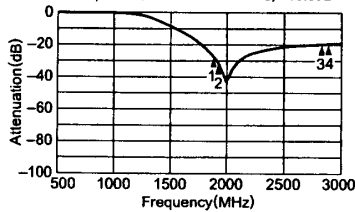
#### PDC800

##### DEA160960LT-1153

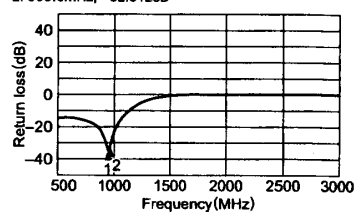
- 1: 940.0MHz, -0.130dB
- 2: 960.0MHz, -0.143dB



- 1: 1880.0MHz, -27.0dB
- 2: 1920.0MHz, -31.6dB
- 3: 2820.0MHz, -20.1dB
- 4: 2880.0MHz, -19.9dB



- 1: 940.0MHz, -34.673dB
- 2: 960.0MHz, -32.612dB



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All specifications are subject to change without notice.

**RF Components**  
Low Pass Filters  
Shielded

DEA-L Series

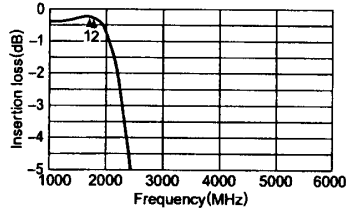
**TYPICAL ELECTRICAL CHARACTERISTICS**

**ATTENUATION vs. FREQUENCY CHARACTERISTICS**

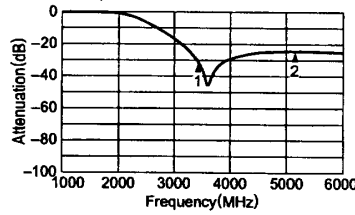
**DCS1800**

**DEA161785LT-1158**

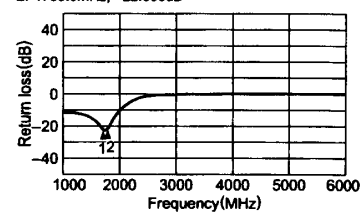
- 1: 1710.0MHz, -0.209dB
- 2: 1785.0MHz, -0.240dB



- 1: 3420.0MHz, -31.110dB
- 2: 5130.0MHz, -24.519dB

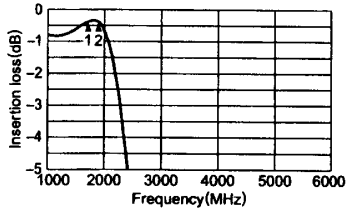


- 1: 1710.0MHz, -22.548dB
- 2: 1785.0MHz, -22.338dB

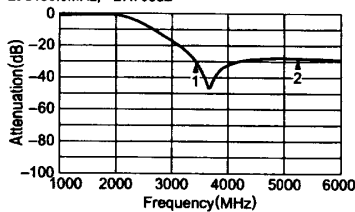


**DEA161880LT-1154**

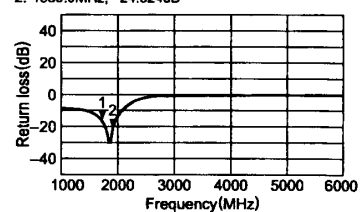
- 1: 1710.0MHz, -0.387dB
- 2: 1880.0MHz, -0.398dB



- 1: 3420.0MHz, -30.113dB
- 2: 5130.0MHz, -27.703dB



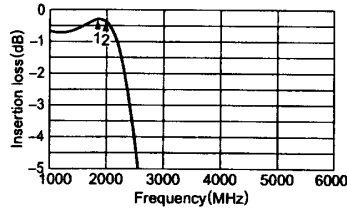
- 1: 1710.0MHz, -16.474dB
- 2: 1880.0MHz, -24.324dB



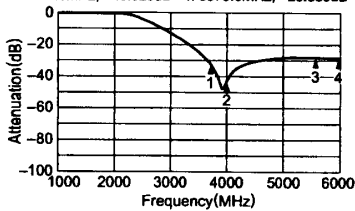
**PCS1900**

**DEA161990LT-1155**

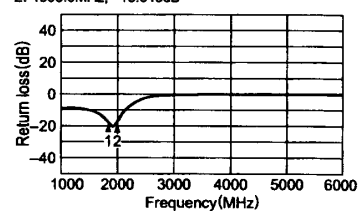
- 1: 1850.0MHz, -0.305dB
- 2: 1990.0MHz, -0.353dB



- 1: 3700.0MHz, -32.713dB
- 2: 3980.0MHz, -43.823dB
- 3: 5550.0MHz, -28.256dB
- 4: 5970.0MHz, -28.555dB

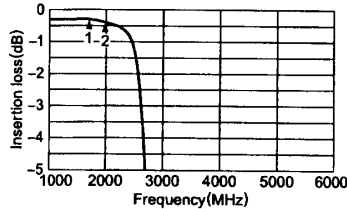


- 1: 1850.0MHz, -18.192dB
- 2: 1990.0MHz, -18.643dB

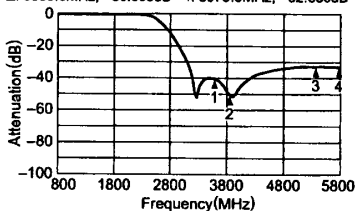


**DEA161990LT-1182**

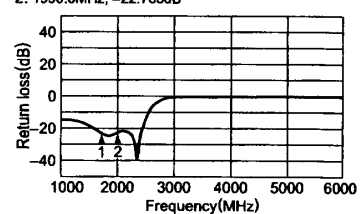
- 1: 1710.0MHz, -0.283dB
- 2: 1990.0MHz, -0.375dB



- 1: 3700.0MHz, -40.413dB
- 2: 3980.0MHz, -50.603dB
- 3: 5550.0MHz, -32.642dB
- 4: 5970.0MHz, -32.636dB



- 1: 1710.0MHz, -23.360dB
- 2: 1990.0MHz, -22.763dB



△ Specifications which provide more details for the proper and safe use of the described product are available upon request.  
All specifications are subject to change without notice.

# RF Components

## Low Pass Filters

### Shielded

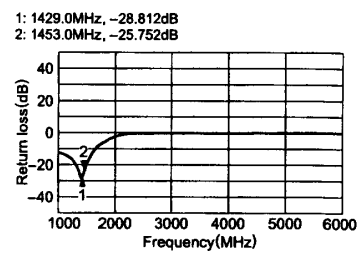
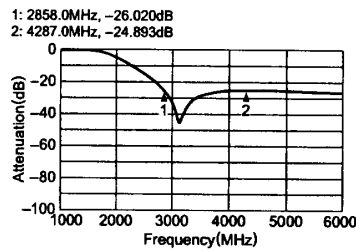
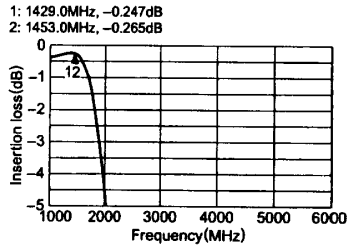
## DEA-L Series

### TYPICAL ELECTRICAL CHARACTERISTICS

#### ATTENUATION vs. FREQUENCY CHARACTERISTICS

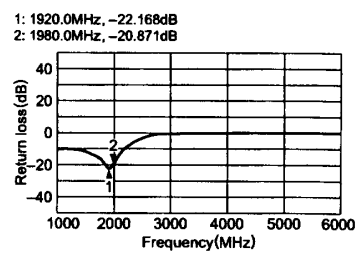
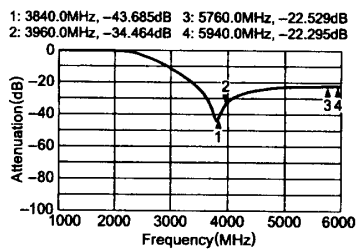
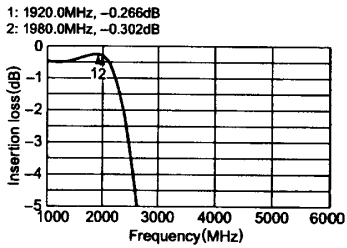
##### PDC1500

##### DEA161453LT-1152

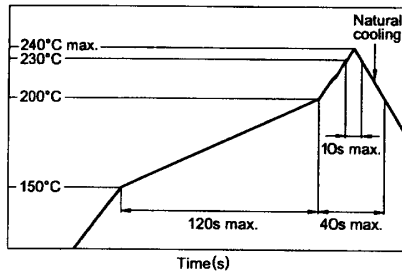


##### IMT-2000

##### DEA161980LT-1164



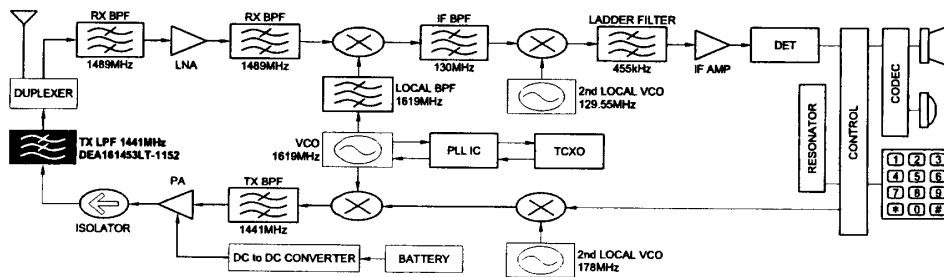
### RECOMMENDED REFLOW SOLDERING CONDITIONS



### APPLICATION EXAMPLES

#### DIGITAL CELLULAR

##### PDC1500



# RF Components

## Balun Transformers For Cellular Phone

### HHM-10 series

This small SMD type chip balun transformer is formed using a multi-layer process. This miniaturized product(3.2x2.5mm) has roughly 1/2 the volume of previous product with equivalent characteristics.

#### FEATURES

- Miniaturized SMD type(L3.2xW1.6xT1.2mm typ.).
- Low insertion loss(0.8dB max.).

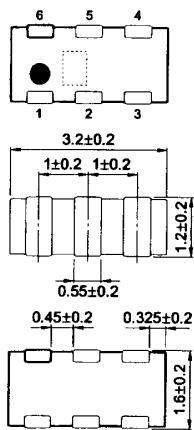
#### APPLICATIONS

Impedance matching, balanced to unbalanced conversion for mobile communication equipment

#### TEMPERATURE RANGE

Condition	Type	
	LC	Transformer
Operating	-25 to +70°C	-25 to +85°C
Storage	-25 to +85°C	-40 to +85°C

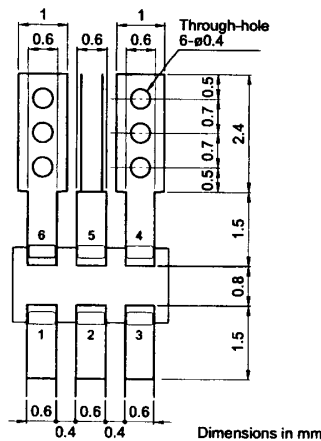
#### SHAPES AND DIMENSIONS/RECOMMENDED PC BOARD PATTERN REFLOW



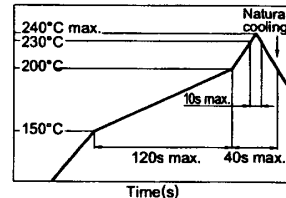
#### TERMINAL CONNECTIONS

No.1	GND
No.2	Unbalanced port
No.3	GND
No.4	Balanced port
No.5	GND(N.C.)
No.6	Balanced port

Weight: 25mg typ.  
Dimensions in mm



#### RECOMMENDED REFLOW SOLDERING CONDITIONS



#### APPLICATIONS/ELECTRICAL CHARACTERISTICS(Typical)

Ta=25°C

Part No.	Type	Application	Frequency (MHz)	Impedance (Ω)		Return loss (dB)min.	Phase imbalance at balanced port (degree)	Amplitude imbalance at balanced port (dB)max.	Insertion loss (dB)
				Unbalanced	Balanced				
HHM1101	LC	EGSM/TX	880 to 915	50	100	10	180±5°	2	0.8
HHM1102		EGSM/RX	925 to 960	50	150	10	180±5°	2	0.8
HHM1104		EGSM/RX	925 to 960	50	50	10	180±5°	1	0.8
HHM1110		EGSM/TX	880 to 915	50	200	10	180±5°	2	0.8
HHM1111		EGSM/RX	925 to 960	50	200	10	180±5°	2	0.8
HHM1009	Transformer	DCS-PCS	1600 to 1800	50	50	10	180±10°	2	0.8
HHM1010		DCS-PCS	1700 to 1900	50	50	10	180±10°	2	0.8
HHM1011		DCS-PCS	1800 to 2000	50	50	10	180±10°	2	0.8
HHM1012		DCS/RX	1805 to 1880	50	50	10	180±5°	1	0.5
HHM1015		EGSM-DCS/LO	1200 to 1600	50	50	10	180±10°	2	1
HHM1016		EGSM/TX-RX	880 to 960	50	200	10	180±5°	1	0.8
HHM1017		DCS-PCS/TX-RX	1710 to 1990	50	200	10	180±5°	1	0.8
HHM1018		EGSM/LO	1126 to 1206	50	200	10	180±10°	2	0.8

⚠ Specifications which provide more details for the proper and safe use of the described product are available upon request.  
All specifications are subject to change without notice.

# RF Components

## Balun Transformers For Cellular Phone

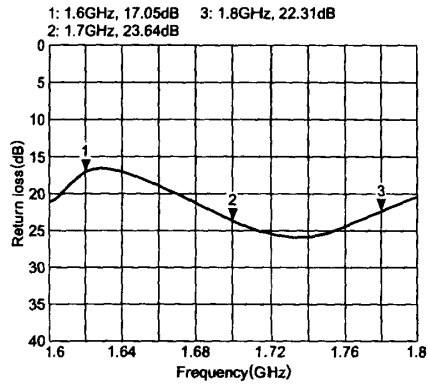
# HHM-10 series

### TYPICAL ELECTRICAL CHARACTERISTICS

#### FREQUENCY CHARACTERISTICS

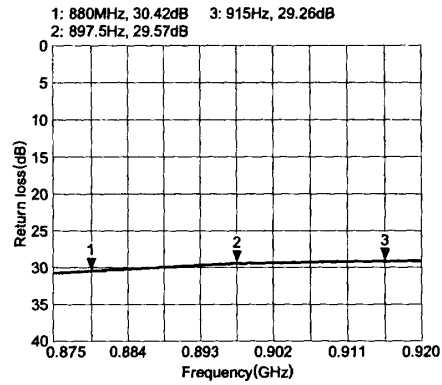
##### HHM1009

#### RETURN LOSS

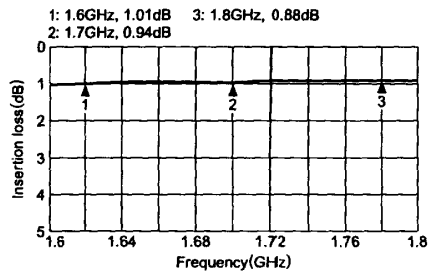


##### HHM1101

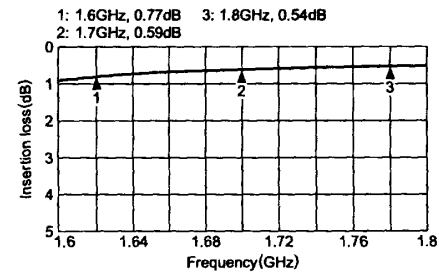
#### RETURN LOSS



#### INSERTION LOSS(BACK TO BACK MEASUREMENT)

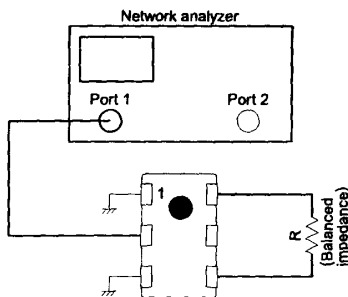


#### INSERTION LOSS(BACK TO BACK MEASUREMENT)

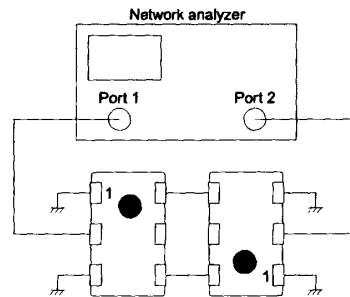


#### TEST CIRCUIT

##### RETURN LOSS



##### INSERTION LOSS



附件：KEISO

**"WE WANT TO MEASURE FLOW ..."**

**"WE WANT TO MEASURE LEVEL !!"**

**"WE NEED SOME SUITABLE MEASUREMENT SYSTEMS..."**

**OK,  
WE WILL  
TAKE CARE  
OF  
EVERYTHING.**

THE TOTAL SENSOR SUPPLIER,

**TOKYO KEISO  
CO., LTD.**



## **FLOW MEASUREMENT AND CONTROL INSTRUMENTS**

Metal Tube Rotameters	1
Micro flowmeters	2
Glass Tube Rotameters	
Plastic Made flowmeters	
Direct Indication type flowmeters	
Steam flowmeters	
Slurry flowmeters	
Sanitary flowmeters	
Purgemeters	3
Purgesets	
Orifice type flowmeters	
Thermal Mass flowmeters/Controllers	4
Thermal flowmeters	5
Thermal Liquid Meters	
Magnetic flowmeters	6
Corioli Mass flowmeters	
Ultrasonic flowmeters	7
V Cone flowmeters	
Vortex flowmeters	
Mag-Wheel flowmeters	8
Flowmeters for air conditioning application	
Flow Set Valves	
Flowmonitors	
Flowmonitors	9
Flow switches	
Sight glasses	
Brine Monitor	
Opto-Wheel flowmeters	
Open channel flowmeters	
Air Conditioner flowmeters	



## **LEVEL MEASUREMENT AND CONTROL INSTRUMENTS**

Spring balanced tank gauges	10
Servo operated tank gauges	
Tank gauge transmitters	
Analog outputs	
Digital outputs	
Supporting Instruments for Tank Gauging System	
Receiving instruments for Tank Gauging System	11
Optical Fibre Tank Gauging System	
Level switches	12
Metal Tube level gauges	
Gauge glasses	
Displacement type level transmitters	13
Float type level transmitters	
Ultrasonic level gauges	
Microwave level gauges	
Air purging type level meters	
Capacitance type level switches/level meters	14
MICROCELL level system	
Marine use Cargo Monitoring System	15







## **OTHER INSTRUMENTS**

Pressure transmitters	16
IR Universal Totalizers	
Batch Delivery System "Auto-Boy"	
Conductivity meters	
Engine Blow-by gas measurement system	17
CNG flow measurement system	
Propeller type velocity meter	
Flowmeter Alarm Unit	
Relay Driver	
Mass Flow Computer	
Totalizer, Recorder for water treatment application	

# FLOW MEASUREMENT AND CONTROL INSTRUMENTS

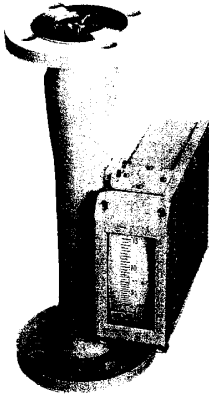
Almost all types of instruments for flow measurement are available from one source.

For FLOW MEASUREMENT AND CONTROL INSTRUMENTS, the following abbreviations are applicable for identification :

-  : Liquids can be measured
-  : Gases can be measured
-  : Steam can be measured
-  : Ex-proof available

## AM series Compact Flowmeters (Metal Tube Rotameters)

The Best-Seller Metal Tubes, 15mm~150mm  
Lining material available.



**AM-1400**  
Local Indication



**AM-1500**  
Electric Output  



**AM-1300**  
Pneumatic Output



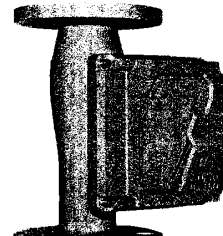
**AM-1700**  
Alarm Contact(s)  



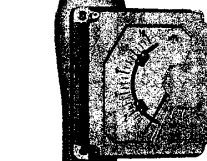
**AM-1600**  
Integration with Pulse Output 


## MX series 250mm version

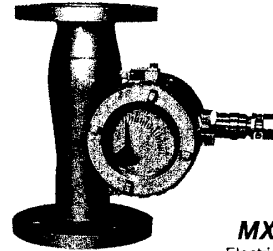
Unified installation length of 250mm  
for all sizes. Cost-effective metal  
tube rotameter. 15mm~100mm size available.



**MX-400**  
Local Indicator



**MX-700**  
Alarm Output 



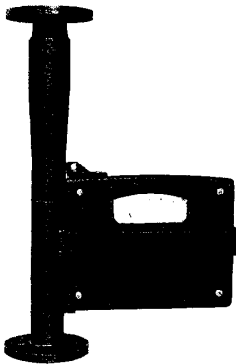
**MX-50E**  
Electric Output 



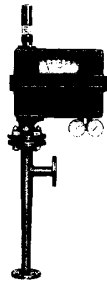
**MX-50D**  
Intelligent, Electric Output  
Digital Indication 

## M series Metal Tube Rotameters

Have been supplied for tough applications of Nuclear, High pressure...



**M-400**  
Local indicator



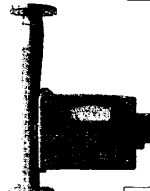
**M-300**  
Pneumatic Output



**M-500**  
Electric Output  



**M-600**  
Integration with Pulse Output 

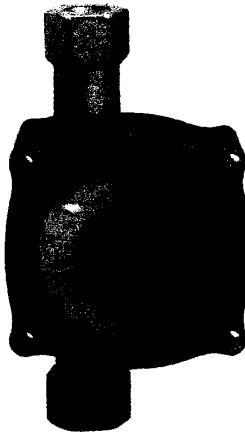


**M-700**  
Alarm contact(s)  

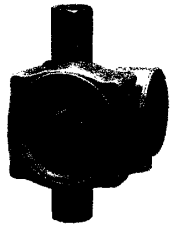


## M-900, MA-900 series Micro Flowmeter

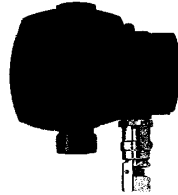
Minimum 0.1~5 l/min, can be measured. Stainless steel and other metallic material i.e. Titanium etc. available. From equipment assembling to general industrial process measurement.



**MA-900**  
Local Indicator



**MA-950**  
With alarm contact



**MA-920**  
Electric output



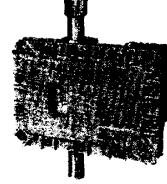
**M-900**  
Local Indicator



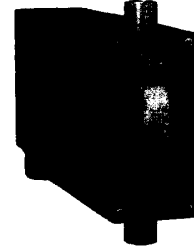
**M-910**  
Pneumatic Output



**M-920**  
Electric Output



Exd



Exi

**M-950/960** With alarm contact

## R series Glass Tube Rotameters

The Standard of Glass Tube, 10mm~100mm.



**R-101**



**R-101-E**



**R-101-H**



**R-105-RK**

## Direct Indication type Rotameters Easy handling, Low cost



**A-101**

Glass tube direct indication



**A-102**



**M-202**

Magnet tracking indication



**V-201**



## AC series Plastic Made Rotameters



All connection fittings of TS socket, Rc thread and flanges are available. Easy dismounting from line by Union thread construction. Best cost-performance and quick delivery. All-Teflon construction type, AC-T, newly added. 15mm~50mm. Alarm contact available.

## Rotameters for Steam Measurement



**M-403-FD**  
Local Indicator



**M-524-D**  
Electric Output



**M-316-FD**  
Pneumatic Output



**M-693-FD**  
Totalizer, Pulse Output

## Rotameters for Slurry Measurement



Smooth path,  
High anti-erosion capability



**AS-1400**



**S-100**



**S-400**

## Rotameters for Sanitary Applications



Suitable for Food, Pharmaceuticals



**R-101-SR**  
Glass tube

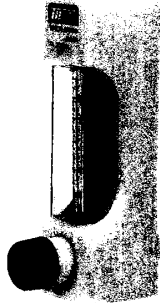


**AM-1000-SR**  
Various output available

# P series Purgemeters

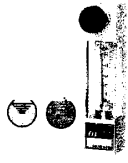
Wide variation. Suitable for assembling onto various devices.

Ex-stock, Low price  
Compact and Good  
in design



XP

General purpose  
(115mm)



P-100

General purpose  
(200mm)



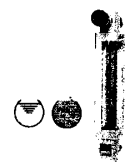
P-200

Simple design



P-300

Stainless steel  
construction



P-400

Max. 20ℓ/min.  
(Water)



P-510

PVC construction



P-520

Acryl moulded



P-610

Acryl moulded



P-620

Teflon tube available



P-710

For semi-conductor  
applications



P-810

Minute bellows  
valve provided



P-820

Ex-stock,  
stainless steel



P-900

## CLEAN FLOW series ALL-TEFLON Purgemeters

Particle free, No ion production...  
Suitable for Pure/Ultra pure water lines in  
Semi-Conductor applications.



P-720



P-771



P-772

## Purgemeters with Alarm contact and Analog output

For remote instrumentation of Purgemeter process  
Reed switch alarms



P-510



PAU Optical Alarm Unit



P-820



IAU Analog Output Unit  
DC4~20mA Output

## HQ series High Quality Purgemeters

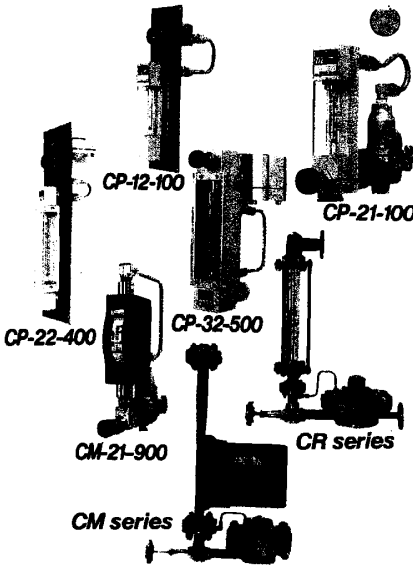
Electro-polished finish  
Low leakage level



P-810HQ

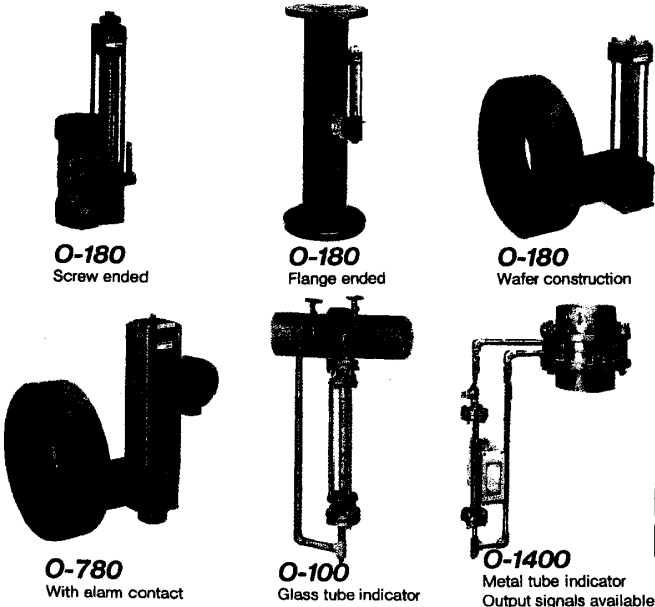
## CP, CM series Purge Sets

To keep constant flow even when  
process pressure changes



## O series Orifice Flowmeters

Cost effective flow measurement even for large lines



Exd  
Exi

# TF, TC series Thermal Mass Flowmeters, Controllers

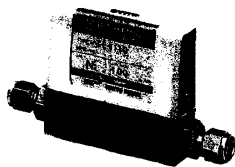
For accurate measurement and control of gases

**TF-1000/1100 series**  
**Mini-Thermal flowmeter**  
 Non by-pass type, Competitive price

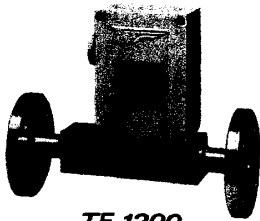


**TF-1000P**  
 All plastic moulded

**TF-1000S**  
 Stainless steel cast



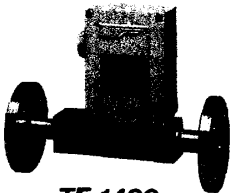
**TF-1100**  
 Stainless steel machined



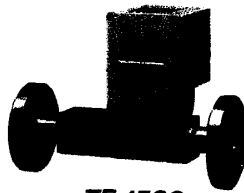
**TF-1200**  
 Water tight housing



**TF-1300**  
 Low  $\Delta P$ ,  
 In-door type

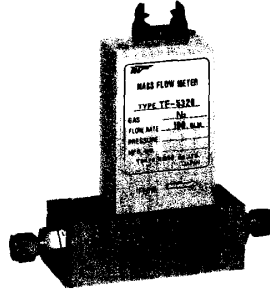


**TF-1400**  
 Low  $\Delta P$ ,  
 Water tight housing

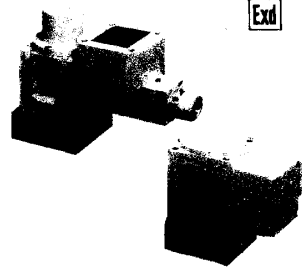


**TF-1500**  
 With indicator,  
 Water tight housing

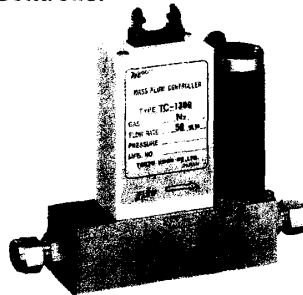
**TF-5000/6000 series**  
**Thermal Flowmeter**  
 Standard type thermal mass



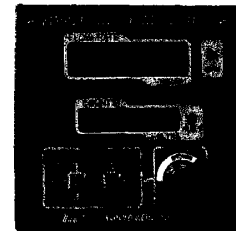
**EP-TF-5000/EP-TC-1000**  
 Ex-proof, Thermal Mass + Controller  
 Covers upto 150kg/cm<sup>2</sup> G high press.



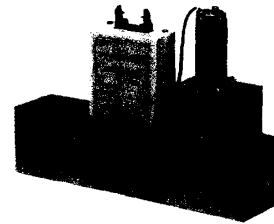
**TC-1000/2000 series**  
**Thermal Mass Flow Controller**



**TM-7000 Convertor unit**  
 All necessary functions  
 in DIN 96x96 compact housing



**TC-3000 series**  
**Mini-Thermal Mass Flow Controller**  
 Best cost-effective controller



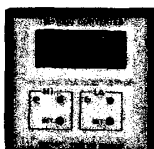
TM-1000 Series, Converter unit for for Min-Thermal Massflowmeter



**TM-1100**  
 Indication



**TM-1200**  
 Indication + Totalization



**TM-1300**  
 Indication + Alarm



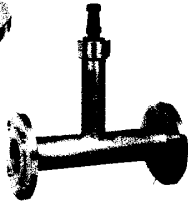
**TM-1400**  
 Converter Unit

# TH series Thermal Flowmeters

General purpose



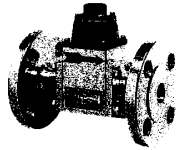
**TH-1100**  
Insertion type



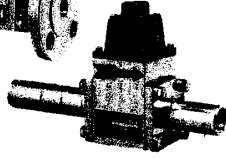
**TH-1200**  
Flange ended



**TH-1400**  
Variable  
insertion type



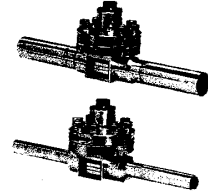
**TH-1500**  
Mini-Thermal  
upto 50mm



**TH-1600**  
Built-in  
straightener type



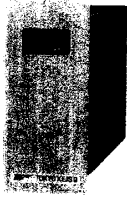
**TH-1100HQ**  
Insertion type



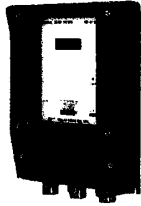
**TH-1500HQ**  
In-line type

High Quality Version  
EP Polished,  
Hermetic Sealing

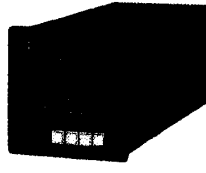
Convertors



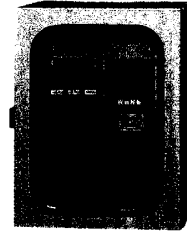
**TR-1000**  
Standard,  
Panel mount



**TR-5000**  
Standard,  
Field mount



**TR-7000**  
High functional,  
Panel mount



**TR-9000**  
High functional,  
Field mount

High/Low temp. version

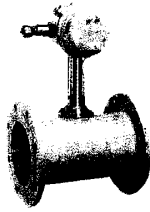


**TH-3200/3300**  
Covers  $-190^{\circ}\text{C}\sim 550^{\circ}\text{C}$



**TR-3000**

Ex-proof version  
For hydrogen atmosphere **Exi**



**TH-2200**



**TH-2400**



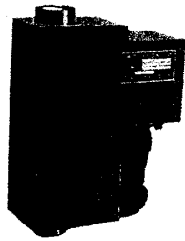
**TR-2000**

# TL series Thermal liquid flowmeters

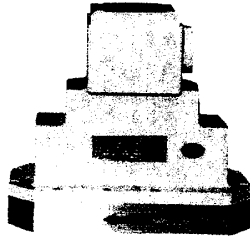
Small flow of 5cc/min. measured



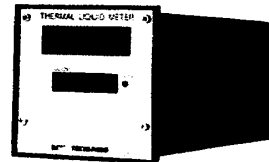
**TL-2100**  
In door use detector



**TL-2200**  
Water tight detector



**EP-TL-3000** **Exd**  
Ex-proof detector



TN series convertor

**ALTOFLUX Magnetic Inductive Flowmeters\*** Wide-selection. This is one of the features of ALTOFLUX 

Compact version (Non-Ex)



**IFM1010K ECOFLUX**  
Ecohomical & Ecology  
10~150mm, PFA liner + Hastelloy C  
electrode



**IFM1080K**  
Polysulfon tube  
Best cost performance  
15~80mm



**IFM4080K**  
Standard version  
PFA and others  
10~600mm



**IFM5080K**  
New ceramic  
version  
2.5~100mm

Compact version (Ex) 



**K280AS-Ex**  
Ceramic version  
2.5~100mm

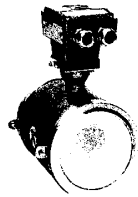


**K480AS-Ex**  
Standard version  
PFA and others  
10~300mm

Separate version (Non-Ex)



**IFS4000F**  
Standard version  
PFA and others  
10~3000mm



**IFS5000F**  
New ceramic  
2.5~100mm



**X2000**  
Ceramic  
150, 200 and 250mm



**SC100 AS**  
Microprocessor  
based converter,  
Full functions

Separate version (Ex)



**EX-1000**  
Ceramic version  
2.5~100mm

Separate version (Slurry use)



**IFS2005F**  
Ceramic tube  
150, 200 and 250mm



**IFS4005F**  
Various lining  
50~1200mm



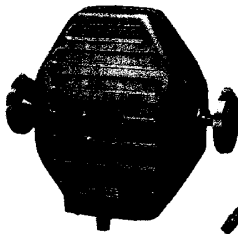
**SC150**  
Converter for  
Slurry applications

**CORIMASS Corioli's force Mass Flowmeters\***  

Highest accuracy in the world of  $\pm 0.2\%$ .  
Direct mass measurement.  
Density and temperature are also measured.

**CORIMASS G series**

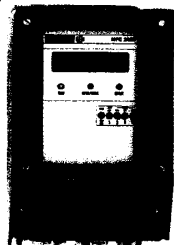
Single tube, straight through.  
The Epoch-Making Corioli Mass flowmeter



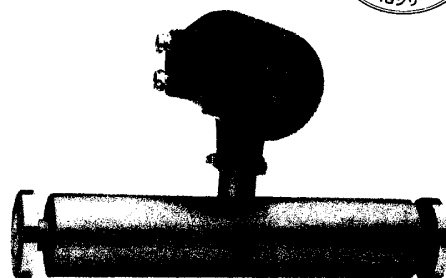
**MF2200P**  
detector  
Max. 1500kg/min.



**MF2200-1.5E**  
detector  
Max. 1.5kg/min.



**MFC2000**  
converter

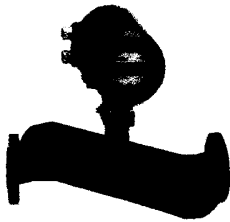


**MFM4085K**  
Single tube, Compact type

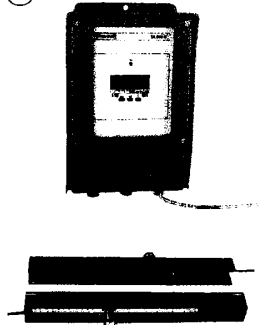
\* : For limited sales area. Consult factory for details.

# ALTOSONIC Ultrasonic Flowmeters \*

Non contact, Non movement Flow measurement



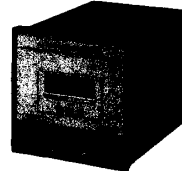
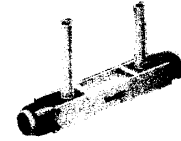
**UL 500K**  
In-line, Double beam  
Opening new age  
25~3000mm



**UL 600N**  
Clamp-on type.  
Best Seller Ultrasonic  
now up-graded.



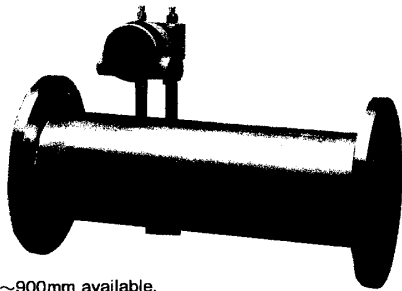
**UL 600P**  
Portable type  
Anytime, anywhere



**UCUF**  
Ultra Clean Ultrasonic Flowmeter  
Complete PFA construction  
Suitable for Pure/Ultrapure  
water application in semiconductor plants

## V Cone flowmeter

The total new concept of flow measurement by  $\Delta P$  theory.  
Eliminates all the weak-points likely to Orifice and Vortex flowmeters  
Transmitter mounted type, VD series, newly added in product line for  
easy field installation.



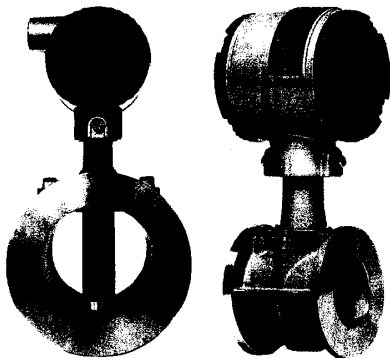
15mm~900mm available.  
Liquids, gases and steam can be measured.



**GFM 700**  
For gases,  
In-line type

## VF series Vortex Flowmeters

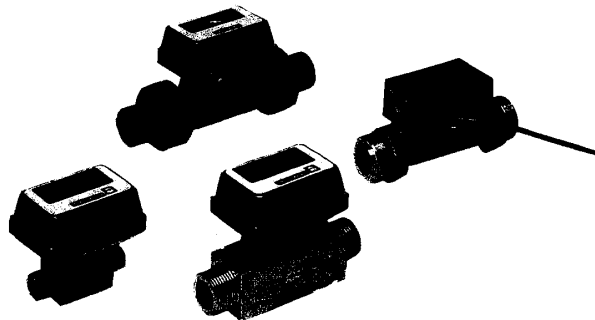
Best cost performance



15mm~100mm, Compact, wafer design

## KARUMAN ACE Vortex Flowmeter

Compact flowmeter for liquids. Battery driven and 2 wire, DC 4~20mA output versions are ready. Perfect Non-metallic construction suitable for Pure/Ultra pure water lines, chemical injection process in semiconductor production process.

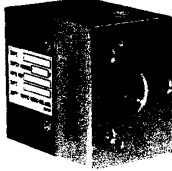


10, 15, 20 and 25mm size available.

## W series Mag-wheel Flowmeters

### W-300 Mini-Wheel Flowmeters

Compact design for built-in use



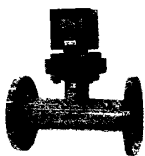
Model	Function
<b>W-31</b> <input type="checkbox"/>	Open collector pulse
<b>W-32</b> <input type="checkbox"/>	DC0~5V
<b>W-33</b> <input type="checkbox"/>	DC0~5V+Alarm contact
<b>W-34</b> <input type="checkbox"/>	Alarm contact
<b>W-35</b> <input type="checkbox"/>	DC4~20mA
<b>W-36</b> <input type="checkbox"/>	DC0~10V
<b>W-37</b> <input type="checkbox"/>	DC0~5V
<b>W-38</b> <input type="checkbox"/>	DC1~5V

### W-400, W-500 Mag-wheel flowmeter

Medium size of 15~200mm



**W-421**



**W-551**



**W-491**

Model	Function
<b>W-421</b> <b>W-521</b>	2 wire, DC 4~20mA output
<b>W-451</b> <b>W-551</b>	Local flow rate indication without power supply.
<b>W-452</b> <b>W-552</b>	Remote flow rate indication without power supply. (Upto 10m distance)
<b>W-453</b> <b>W-553</b>	Unscaled pulse output. Used in combination with IR series Universal Totalizers for indication, totalization, alarm etc.
<b>W-491</b> <b>W-591</b>	Battery driven, alternative indication of flow rate and total volume.
<b>W-492</b> <b>W-592</b>	Remote version of above (upto 2 m distance)

## CF series Flowmeters for Air Conditioning Application



**CF-1200**  
Quick FLOW  
(Fixed type)

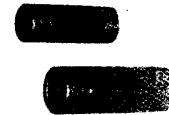


**CF-2300**  
OneTouch Flow  
(Indicator detectable)

## CX series Flow Set Valve

To maintain flow rate of liquids and gases even supply/load pressure dranges.

**CX-1000**  
For liquids,  
Fixed setting  
15mm~40mm



**CX-1500**  
For gases,  
Fixed setting  
15mm~150mm



**CX-2000**  
For liquids,  
adjustable setting  
15mm~100mm



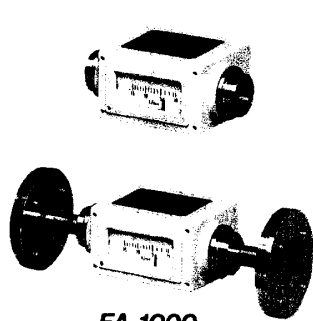
## FA-5000 FLOW MONITOR

Most simple and cost-effective flowmeter for water lines.  
Min. 1~10 l/min., Max. 10~50 l/min.  
Rc 3/4 thread conn., for any flow direction.



## FLOWMONITOR

Flow indication with alarm contact. Suitable for monitoring of cooling water supply line/devices etc. Any flow direction acceptable.



**FA-1000**  
Stainless steel made.  
Max. 100 l/min.



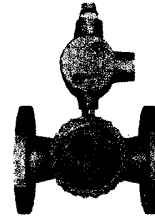
**FA-2000**  
Compact with  
Plastic body.  
Max. 30 l/min.

## Flow Switches

For flow monitoring



**F-740**   
No indication, contact only



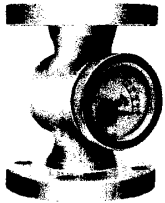
**K-700**   
Flapper detection,  
Magnet coupling indication



**R-700**   
Glass tube type  
upto 100mm

## K series Sight Glasses

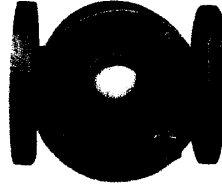
Watch the Flow!



**K-200**  
Flapper detection.  
Magnet coupling indication



**K-400**  
Flapper direct indication



**K-500**  
Direct observation type  
Glass lining material available

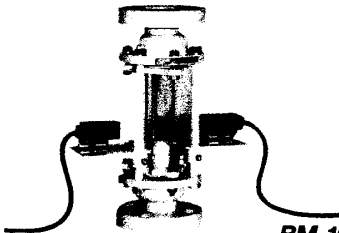


**K-600**  
Straight glass tube direct  
indication

## BRINE MONITOR



Simultaneous monitoring of flow and concentration of brine fed to Electrolysis reactor



**BM-1000**

## WX series Opto-Wheel Flowmeters

Flow measurement under strong magnetic field by optical sensing



**WX-2000**



**EP-WX-2000**

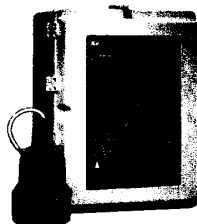
## Open Channel Flowmeters



To measure water flow through Weirs, partial flumes etc. Very suitable for water supply and water treatment applications.



**FD-2**  
Float type



**SONOFLOW**  
Ultrasonic type

## AF series Air Conditioner Flowmeter



For testing and evaluation of air conditioners



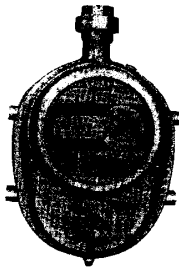


# LEVEL MEASUREMENT AND CONTROL INSTRUMENTS

From large Crude oil tanks to small vessels and underground pits, we have various types of level measurement and detecting instruments.

## Spring Balanced Tank Gauges

Low pressure  
Counter indication

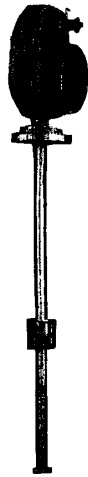


**FT-1000**  
Standard, Float-Tape type

High pressure,  
Dial indication



**FP-1000**  
Pipe sealed type



## Servo Operated Tank Gauges

Tank side type



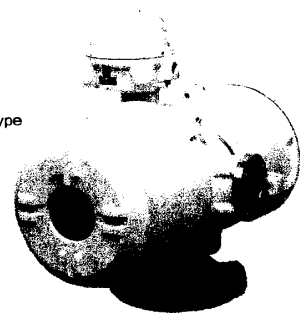
**FT-2000** Tape type

Tank Top type

The best-seller servo gauge  
with world best accuracy.



**FW-2000**  
All-wire  
Heavy duty type



**FW-9000**  
Super Intelligent  
Tank Gauge

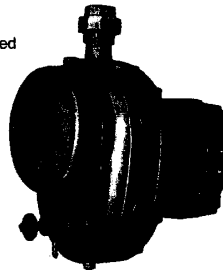
## Transmitters for Tank Gauges

Analog output versions

**TR-100 Alarm transmitter**  
Max. 4 point micro switch contact provided  
Ex-proof ready

**AT-101W Pneumatic transmitter**  
0.2~1.0kg/cm<sup>2</sup> pneumatic output

**TR-200 Electric transmitter**  
DC4~20mA output  
Alarm contact(s) additionally available  
Ex-proof ready



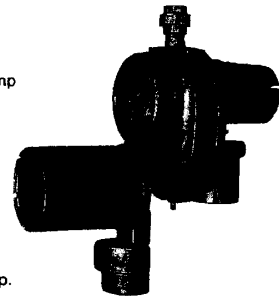
Attachable onto FT-1000, FP-1000, FT-2000 and FW-2000 type tank gauges for remote indication.

Digital output versions

**DB-M type**  
2 Wire for  
Power supply including level and temp  
Data in serial BCD

**DM type**  
Best seller, non-contact  
A/D converter for level data

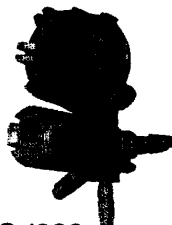
**DM-III type**  
Intelligent, 2 way-2 wire system  
Max. 8 point contacts 2 way transfer  
possible in addition to level and temp.  
Data transmission



## Supporting Instruments for Tank Gauging System



**DIR-100E**  
Ex-proof tank side  
Indicator used together  
with tank top tank gauges



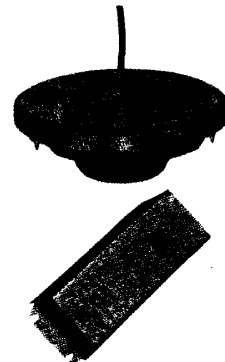
**FDC-1000**  
Field device controller  
2 way contact transfer upto 8 points  
and field analog data transfer  
to control room are possible  
by one unit.  
Suitable for Motor valve control  
through bus line of tank gauges



**TS**  
Spot type

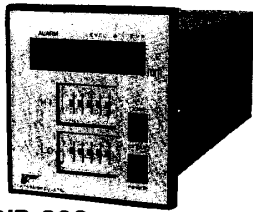


**ATM/ATS**  
Average type  
Temperature sensors



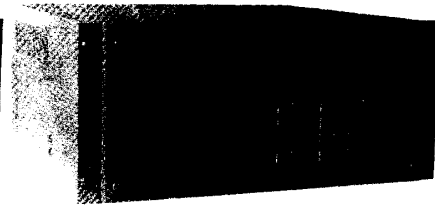
**OD-6000S**  
Oil leak detector

## Receiving Indicators for Tank Gauging System



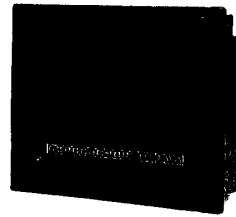
### DIR-200

One tank receiver for one way data transmission system  
Parallel data output for HOST CPU communication can be provided



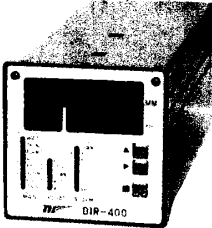
### NMR

Selection type indicator,  
Max. 63 tank capacity



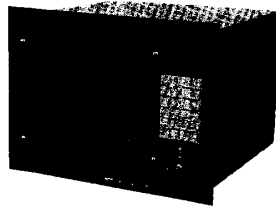
### NMR-III

Panel computer based indicator  
Easy to install onto instrument panel



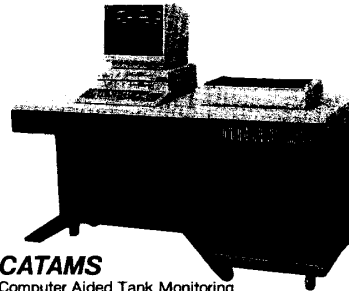
### DIR-400

Compatible for all Tokyo Keiso's digital transmitters  
2 way communication for remote control of field tank gauge possible



### NMR-II

Personal computer integrated for volume calculation and other sophisticated functions  
Plasma illuminating indication

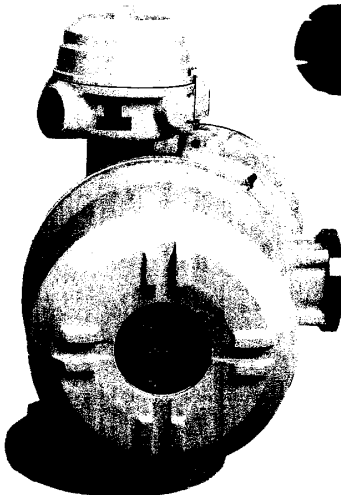


### CATAMS

Computer Aided Tank Monitoring System  
Full function incl. data printing

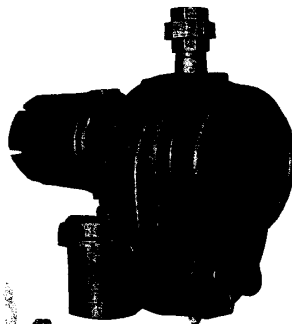
## Optical Fiber Tank Gauging System

Data transmission is conducted through optical fibre cable to eliminate the effect of external noise such as thunder storms. Different signal formats of FFI\*1 compatible, CNT\*2 compatible and Tokyo Keiso originals are ready for clients' choice.



### O-FW-9000

Optical signal output version of Super Intelligent Servo Gauges.



### O-DM-III

Optical tank data transmitter to install tank side type tank gauges



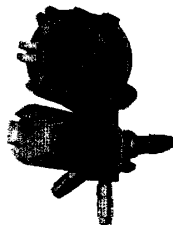
### O-DB-M

FFI compatible



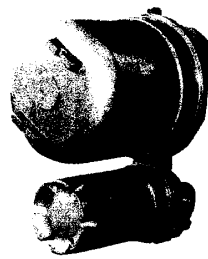
### O-ATM

Temp. signal is transmitted by optical signal



### O-FDC-1000

Field Device Controller  
Two way max. 8 point contact transfer in Optical signal.  
Suitable for valve control.



### DNM

CNT compatible



### O-AT

2 way contact data transmission by optical signal

\* 1 : Trade mark of Fuji Electric Co.

\* 2 : Optical Tank Gauging system jointly developed by Chiyoda Instrumentation Co., Japan Gear Ind. Co. and Tokyo Keiso

LEVEL MEASUREMENT INSTRUMENTS

## LEVEL SWITCHES



**FS-100**  
Spring  
balanced displacer type  
ExdIICT 6 which covers  
Hydrogen atmosphere  
available.



**FP-4000**  
Multi point  
detection for pump  
control by one unit

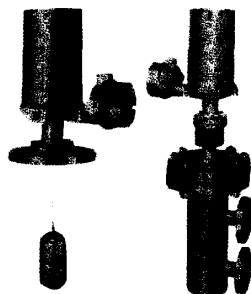
**FB-5000**  
Magnetic coupling,  
Reed switch contact,  
2" flange mount



**FB-7000**  
Magnetic coupling,  
Micro switch contact,  
3" flange mount



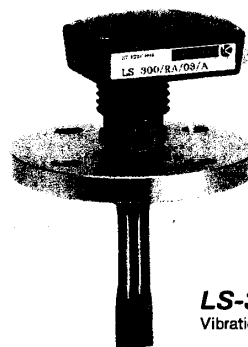
**FB-9000**  
Bellows type mechanical  
action.  
Suitable for slurries with  
ferrous particles



**FR-6000**  
Most well accepted Float type.  
ExdIICT 6 which covers  
Hydrogen atmosphere available.



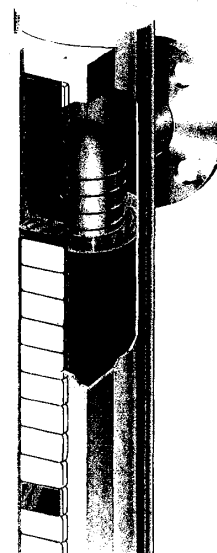
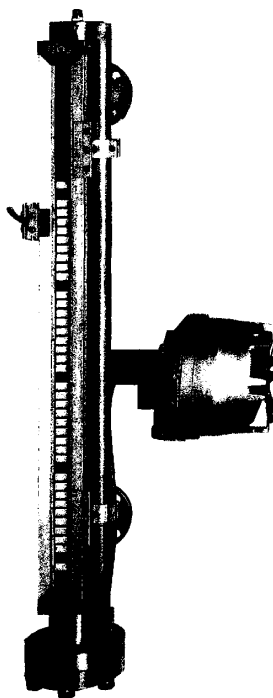
**LS-200**  
All Teflon  
Capacitance type



**LS-300**  
Vibration Type

## FM series Metal Tube Level Gauges

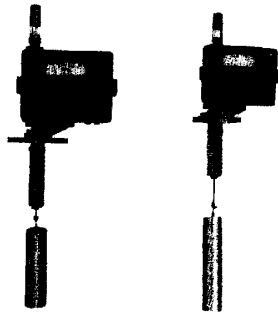
Multi-function by one unit. Cost-saving.  
Eliminates common problems of existing glass tube gauges.  
Alarm contacts and/or analog output additionally available.



Max. 430°C and 30MPa(300kg/cm<sup>2</sup>) possible.  
PVC, Teflon, FRP and other special  
material available in addition to  
standard stainless steel version.

## Displacement type level transmitters

Spring balanced type



**FS-110**  
Indication

**FS-512**  
Indication+Electric output

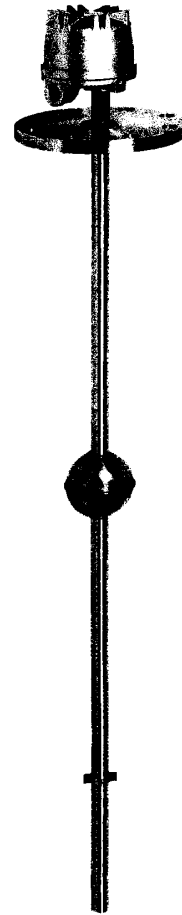


Torque tube type

### FST-3000

Intelligent type.  
Operation parameters, i.e. Sp. Gr., Range, Zero adjustment can be done by pressing Ex-proof built-in key board during operation in hazardous area. The totally new idea of Displacer type level transmitter.

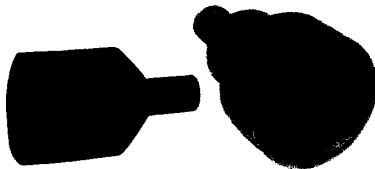
## FP-7100 Float Type Level Transmitter



Liquid level is output by DC 4~20mA electric signal.  
Max. 4810mm.

## SONOLOGIC Ultrasonic Level meters

Non-contact level measurement of powders, solids and liquids.



**General purpose sensor**  
Max. 60m range

**Anti-corrosive sensor**  
PvdF housing for anti-corrosivity



**5000**  
Standard indicator



**High humidity sensor**  
Teflon face for prevention of condensation



**Sanitary sensor**  
IDF Clamp mount



**5100**  
Dual point indicator

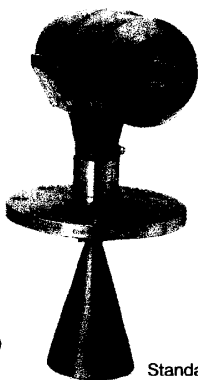


**MVS**  
Multi-Vessel System

## LEVEL RADAR Micro Wave Level Gauge \*

Non-contact level measurement free from change of temp., press. etc.

**BM70 Stick** Compact type newly added.



**BM70**  
Upto 30

Standard type



**BM70 Stick**  
Upto 10m.

Compact type

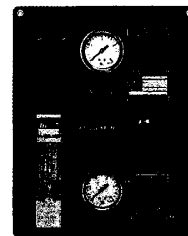
Liquids, slurry and paste level is measured by perfect non contact by microwave. Suitable for heavy duty applications.  
BM70 Stick can be installed through 25 IDF sanitary clamps.

## CP, PGT Pressure type Level Meter

Level measurement by purge pressure.  
Density measurement also possible.



**PGT**  
Purge tube



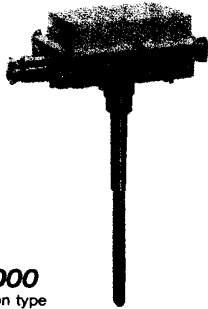
**CP**  
Purge set

\* : For limited sales area. Consult factory for details.

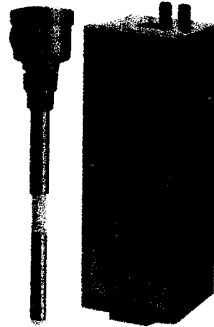
## CAPATIC Capacitance type Level Switches, Level Meters

Non movement detection/measurement for powders, solids and liquids

### Level Switches



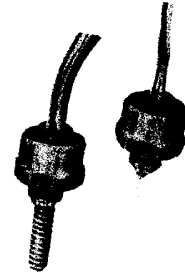
**CA-1000**  
Integration type



**CA-1000S**  
Intrinsically safe version



**CA-2000**  
Separate type



**CA-6000**  
CAPATIC-MINI

### Level Meters



**CB-1000**  
General use



**CB-1000S**  
Intrinsically safe version



## MICROCELL Weighing System

For measurement of contents in silos and hoppers

Semi-conductor strain sensor weighs the contents in silos and hoppers.



Bolt-on Sensor



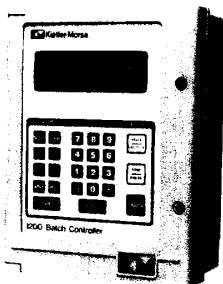
LOADLINK Sensor



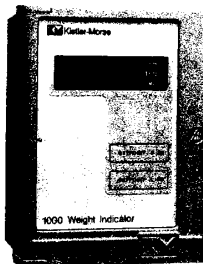
LOADSTAND/LOAD BLOCK Sensor



LOAD DISC Sanitary Sensor



**1200**  
Batch Controller




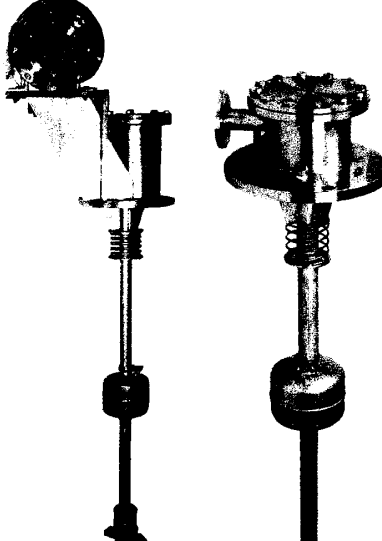
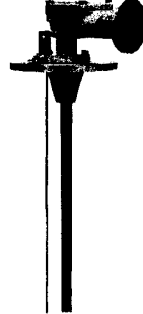
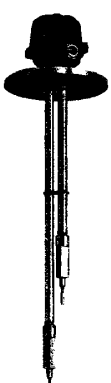
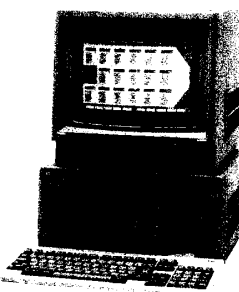




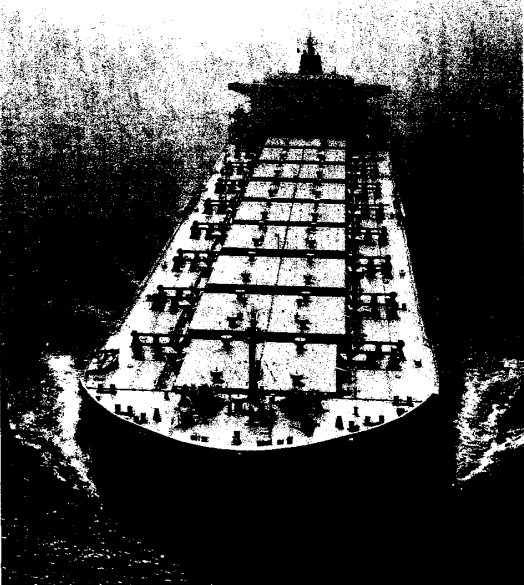
**1000**  
Digital Indicator



**MVS**  
Multi-Vessel System

# Marine Use Cargo Monitoring System

For total monitoring of level and temperature of cargo of oil tankers and product carriers  
High level/Over-flow monitoring system also ready.

Cargo Level and Temp. Sensors	High Level Alarm Sensors	CCR Equipments
  <p><b>SPT-3000 S</b> Magnet float type Hall element sensing offers durability, stability and high accuracy. Large sized local indicator provided for easy on-deck monitoring. Saves wiring cost by 2 core wiring system.</p> <p><b>SPT-7200 S</b> Magnetic float, analog output type</p>	 <p><b>FPT-7091S</b> Float switch for high alarm system</p>  <p><b>MIA-LIDEC</b> Resonance type Level switch</p>	 <p><b>CALTIS</b> Cargo Level and Temp. Information System</p>  <p><b>DIR-M1600</b> 16 tanks capacity</p>  <p><b>DIR-700-DB</b> DIN 96 x 96</p>
 <p><b>BM 70M</b> Micro-wave type Suitable for sulphur, asphalt and other sticky cargo liquids.</p>  <p><b>SAT-1000</b> Hydro-static type Liquid density simultaneously measured</p>		

**LEVEL MEASUREMENT INSTRUMENTS**

# OTHER INSTRUMENTS

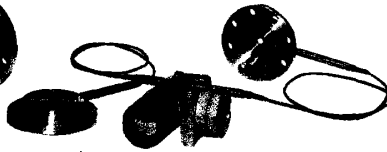
We still have more types of Instruments !

## Fcx series Dp Pressure transmitters

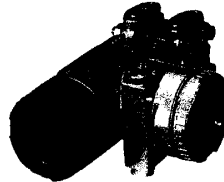
For level, flow, pressure... Full line-up to meet all possible requirements, Intelligent type also available. Try once and you will be satisfied.



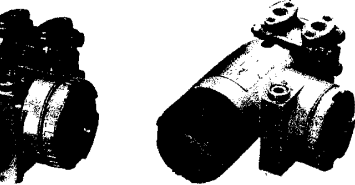
**FHK, FKE**  
Level transmitter



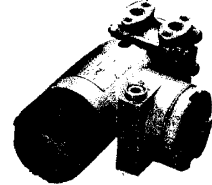
**FHD, FKD**  
Remote seal type



**FHC, FKC**  
Dp (Flow) transmitter



**FHG, FKG**  
Press. transmitter



**FHF**  
Flow transmitter

## IR series Universal Totalizer

Totalization by analog flow signal possible. Save space, save cost.

Indication, totalization, 2 point alarm, dual pre-set counter, loop power supply

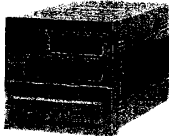
Indication, totalization (alternative), 2 point alarm, dual pre-set counter, loop power supply

Indication + 2 point alarm

Indication

Indication + 2 point alarm

Indication



**IR-7000**  
DIN 96 x 96



**IR-4000**  
DIN 96 x 48  
Best cost performance



**IP-3500**  
Digital scaling  
meter-relay



**IR-3400**  
Digital scaling  
panel meter  
(DC4~20mA input)



**IR-3200**  
Digital scaling  
meter-relay  
(Pulse input)

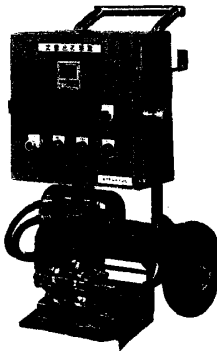


**IR-3100**  
Digital scaling  
panel meter  
(Pulse input)

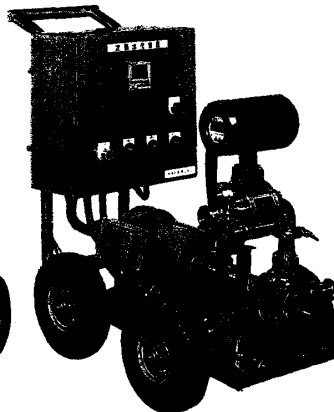
## BD series Movable Batch Control System "BATCH AUTO-BOY"



Anywhere, anytime, any liquids...  
Combination of pump, flowmeter and batch control unit.  
For automatic operation in various liquid food industries,  
i.e. beer, juice, wine...



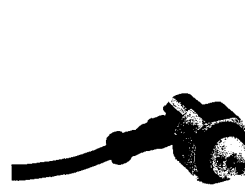
**BD-1100**  
External pump control  
version



**BD-1200**  
Pump integrated  
version

## CT series Conductivity meter

Liquid conductivity and temperature are measured and simultaneously output.  
Full line up including electrode type, magnetic type and sanitary type.



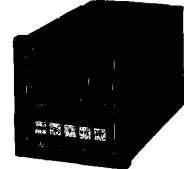
**CTS-1000**  
Electrode type  
for Low  
conductivity



**CTS-2000**  
Electrode type  
for Medium  
conductivity



**CTS-3000**  
Magnetic type  
for high  
conductivity

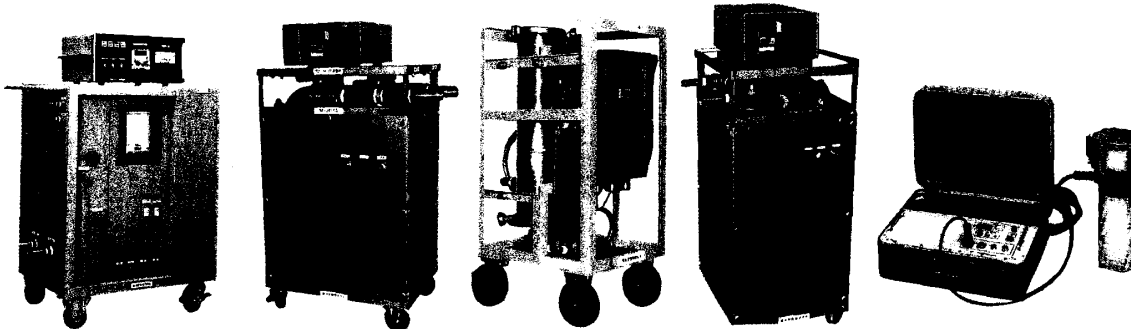


**CTC**  
Microprocessor based  
High functional  
converter

## BF series Engine Blow-By Gas Measurement System

(Direct and high accuracy mass flow measurement by TH Thermal flowmeter)

For evaluation test of cylinders, piston rings, engine oils. Wide range preparation to meet requirements.



### BF-1000

Pressure loss compensated by integrated blower  
Highest accuracy and versatile function for continuous operation

### BS-2000

For large sized engines

### BF-3000 S

Compact, light and cost effective, for small and medium sized engines

### BF-4000

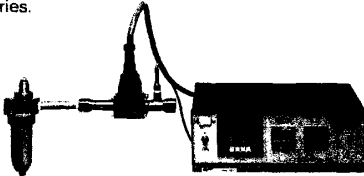
Automatic operation function provided

### BF-5000

Portable driven by DC12V battery  
On vehicle running test possible

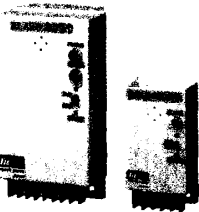
## CNG Flow Measurement System

CNG, the new energy source for engines, is measured in mass flow with high accuracy and wide range. Suitable for R & D in Automobile industries.



## AU-1000 Flowmeter Alarm Unit

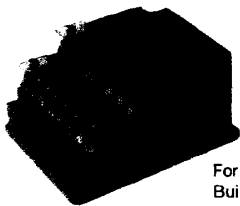
Low alarm contact from flowmeter is connected to drive buzzer for quick notice of flow cut-off. Easy installation and wiring. Battery driven type available.



ply type

Battery Driven type

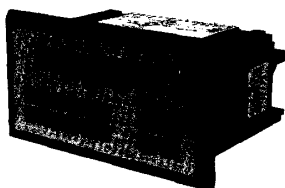
## RD-1000 Relay Driver



For amplifying of level switch contacts.  
Built-in sequence for pump control provided.

## MASS FLOW COMPUTER

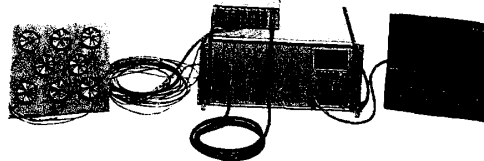
Automatic compensation to obtain mass flow rate and totalization by inputting flow, press. and temp. signal.



**EA-275**  
MASS FLOW COMPUTER

## RF series Propeller Air Velocity Meters

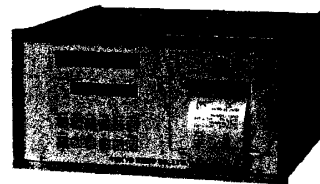
Propeller type velocity meter for detection of air flow. Suitable for evaluation of air flow distribution profile for radiators.



## TOTALIZER, RECORDER FOR WATER TREATMENT APPLICATION

### •For Multi-loop application

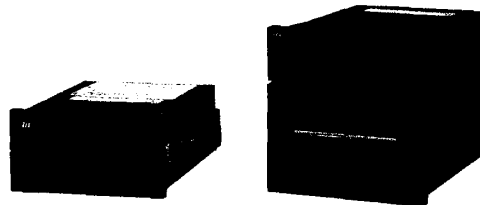
Max. 16 point flow sensor can be connected. Automatic totalization and programmed interval printing.



**FMM series**

### •For Single-loop application

Counter and printer for one flow sensor.  
Totalization and programmed interval printing.



(Counter 3601-B)

(Printer 3403)

**3000 series**

OTHER INSTRUMENTS



附件：UHT

2.

## SPECIFICATION

### 2.1. Leading Particulars

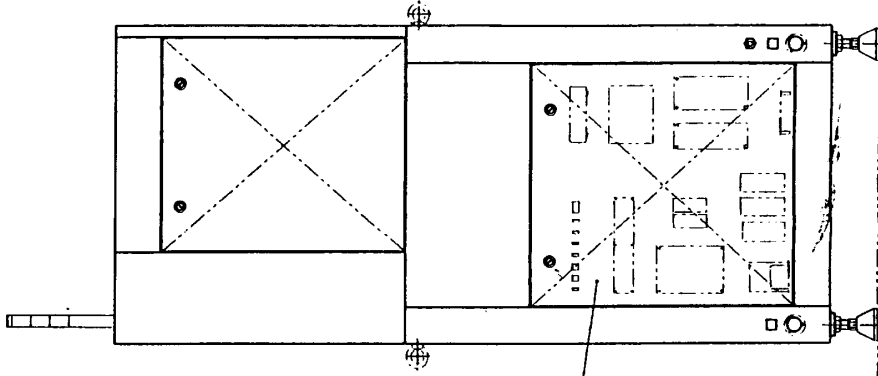
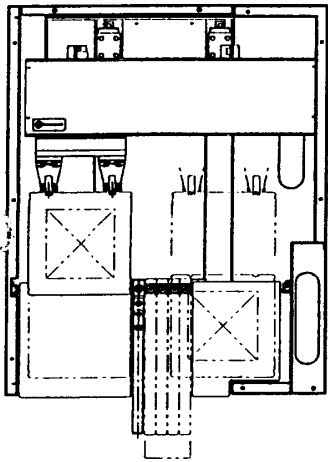
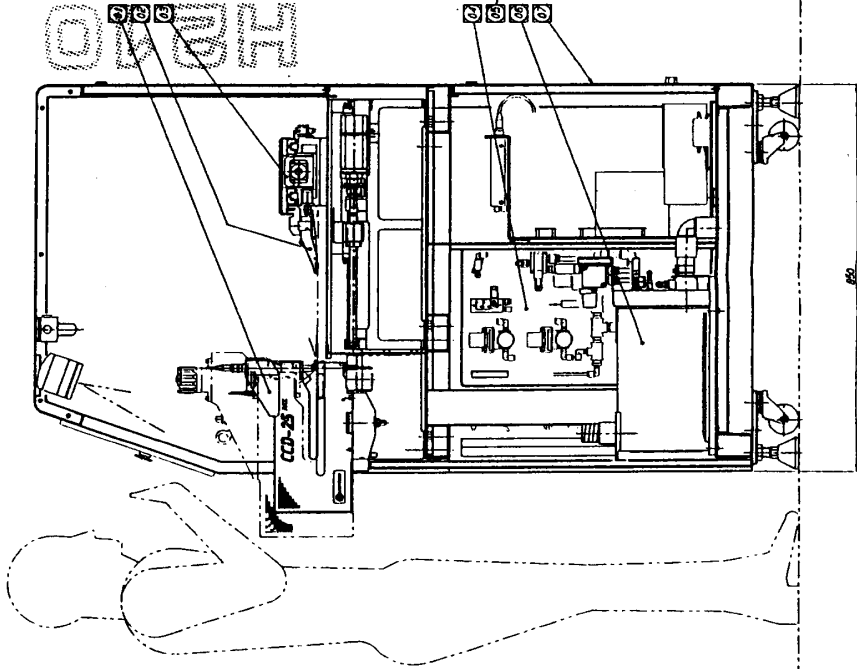
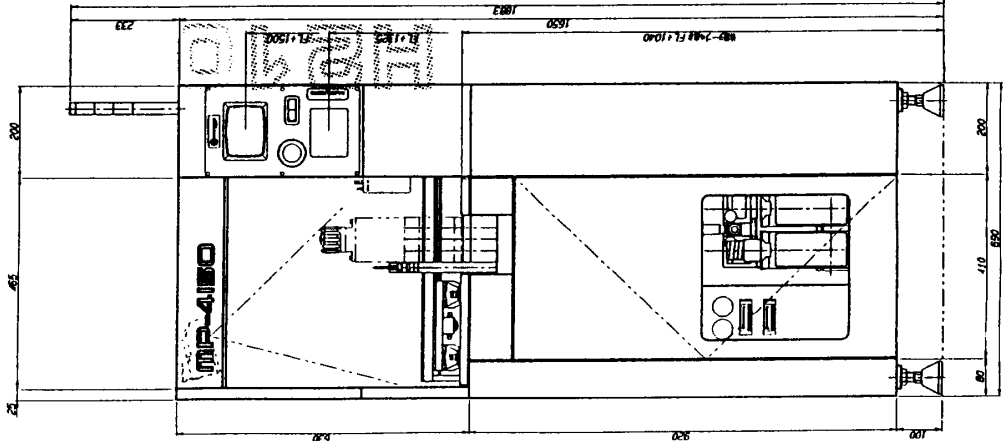
Model: MP-4150

Usage: Punching Green ceramic sheet.

#### Standard Specification

A) Maximum material size	175 mm × 175 mm
B) Work handling	Work holder
C) Work holder positioning	V/F method
D) Maximum working area	150 mm × 150 mm
E) Punch unit mount	Max 5 set of PU-25
F) Camera unit	use for Punch centering (sight area 1.2mm × 1.4mm)
G) Positioning accuracy	±10micron within the above item A)
H) Number of hits of punch	850 hit/min
I) Axis Stroke	X 330 mm Y 180 mm
J) Minimum setting	X 0.001 mm Y 0.001 mm
K) Quick feed speed	30 m/min
L) Dust collector	2 lined Continuous / intermittent selectable
M) Signal tower	3 colors
N) Safety sensor	Emergency stop by Area sensor (with Restart function)
O) Data string	Machine :Memory card
P) Maximum stored data	8,000 position (1 program)
Q) Machine size	640×1116×1610 mm
R) Machine Weight	300 kg
S) Air consumption	300 normal litter / min
T) Source pressure	6.5 to 8.0 kg/cm <sup>2</sup>
U) Electric power source	AC 200V triple phase 0.5KVA
V) controller	machine:UHT ASCA-contoroller
W) Work clamp	Clamped with special fingers
X) Work mounting method	As negotiated separately
Y) Standard dies	0.1 to 5.0 mm dia (circular) 0.2 to 5.0 mm side (square)

01	01	01	01
02	02	02	02
03	03	03	03
04	04	04	04
05	05	05	05
06	06	06	06
07	07	07	07
08	08	08	08
09	09	09	09
10	10	10	10



□ 配置  
○ 設置  
NOTE: ○ 設置

MP-4150  
MP-4150  
MP-4150  
MP-4150  
MP-4150

MP-4150

6900093/0

3.

## INSTALLATION AND TRANSPORTATION

### 3.1. Environmental Conditions

- Attention to environment is necessary for precision instruments
- Temperature
  - When operating: 15 to 25°C
  - When not operating: 5 to 40°C
- Humidity (R. H) : 60% or under
- Temperature change: 0.2°C /min or less
- Vibration: 0.5 G or less
- The machine shall not be exposed to direct sunshine.
- The machine shall not be subjected to local temperature rise by heaters, etc.
- No dust shall exist.
- The floor shall be stable, as leveling is important.

### 3.2. Installation

- Select a place which satisfies the environmental condition.
- Install on a stable floor.
- Select a location where the fluctuation of electric power and pneumatic power is slight.
- Be sure there is no noise source in the vicinity. (Ex. Crane, high-frequency sealer, electric discharge machine)
- Install with a levelness of 0.05mm/m or less. (measure on the Y-axis)

### 3.3. Transportation

- Use the attached eye-bolts where locate both side of X-axis when lifting with a crane.
- Place wooden blocks under the machine so that the weight will not be supported by the jacks or casters.
- Separate the Power Source Box from the machine before transporting.
- Be sure to remove the dust collector before transporting.

### 3.4. Electric Power Supply

- Use electric wires of not less than 2mm<sup>2</sup> dia. There shall be no voltage drop from other machines.
- The diameter of the grounding wire shall be not less than 1.6mm dia.
- Use the stabilized electric power source device if the supplied power may be instable or noise may enter.
- Use an earth leakage breaker as a circuit breaker.

- Notification to UHT is required before using other than standard electric power sources. When used without prior notice, the user must bear all repair costs which may be required.

### 3. 5. Specification for electric

- The electric power source shall be single phase, AC 200V  $\pm 10\%$  50Hz / 60Hz 0.5KVA.

### 3. 6. Pneumatic Power Supply

- Use a compressor of 5 HP or more.
- Use an air hose with an inside diameter of not less than 9 mm. The length of the hose shall be 5 m or less. In an event the length exceeds 5 m, use the inside diameter of not less than 11 mm, to minimize pressure drop.
- Be sure to use the air drier (standard equipment) specified by UHT. Do not use the drier in common with other machines.
- Adjust the pneumatic power source to provide the pressure of 6.5 kg/cm<sup>2</sup> or more. If the pneumatic power source is under 6.5 kg/cm<sup>2</sup>, use the booster (optional equipment). UHT does not bear any responsibility for any trouble which may occur by pressure drop.
- Install the filter, mist separator, etc. before the drier, if dirt, carbon, water, oil, etc. may enter the pneumatic power system.
- For malfunctions which may occur by the use of improper pneumatic power source, the user must bear all repair costs even within the guarantee period.

### 3. 7. Specification for Air

Maximum air consumption : 300 normal liter/min

Pressure range of power source : 6.5 to 8 kg/cm<sup>2</sup>

PRECAUTIONS

## 4. 1. Safety

(UHT bears no responsibility for any accident which may occur by carelessness)

- The following are the minimum requirement for safe operations. Be sure to observe them. Specially important precautions are indicated by the label applied on the machine body.
- Do not put any part of your body or a tool, etc. into the work area of the machine, as the machine moves very rapidly. Especially important, do not put your hand or a tool on the table while the machine is operating.
- When the machine is operating, turn off the electric power and make sure it is safe before putting your hand into the work area of the machine.
- Make sure that the machine has been completely stopped before removing or mounting the work.
- Do not put your hand on the punch packs while the machine is operating.
- Be sure not to put your hand under the punch.
- Wear clothes suitable to perform the work safely.
- Make sure that the punches have been secured before starting the operation.
- Operate the machine with no work on the table, to verify the program, before starting the automatic operation.
- Do not wear gloves when operating the keyboard, and switches.
- Be sure to install or close the safety cover, body cover, control box door, etc. before starting the operation.
- Be sure not to neglect to clean the machine.
- No person other than the operator shall be allowed to come near the machine which is operating.

## 4. 1. 1. Emergency Stop

The emergency stop switch is provided on the front of the machine. if this switch is pressed, the electric power is turned off, and the X and Y-axis stop movement. When releasing the emergency stop, check safety, release the emergency stop, and place the electric power switch to ON, then the X-Y robot automatically returns to the home position.

5.

## TURN ON & TURN OFF ELECTRIC POWER

### 5.1. Verification and Checking Items before Turn on

- Nothing is placed on table.
- Air pressure is 7kg/cm<sup>2</sup> or more.
- Arm is not obstructed by other objects, because it returns to home position automatically.

### 5.2. Turn on Method

- Breaker on the front of machine to ON
- Press the RESET button.
- Place the machine power switch on the front surface of the machine.
- The X-and Y-axes of the machine automatically return to the home position. When returned, the initial menu is displayed on the screen.

NOTE: If the machine electric power is not turned on, examine the electric power source, pneumatic power source, and emergency stop button. If the machine does not return to the home position, even when the electric power is supplied, the overstroke limit switch must be ON. Turn off the machine POWER switch, move the arm (X-, and Y-axes) to the center of the table, and repeat Turn on method again.

### 5.3. Turn off method

- Place the machine POWER switch on the front surface of the machine to OFF.
- Place the machine breaker on the front of the machine to OFF.

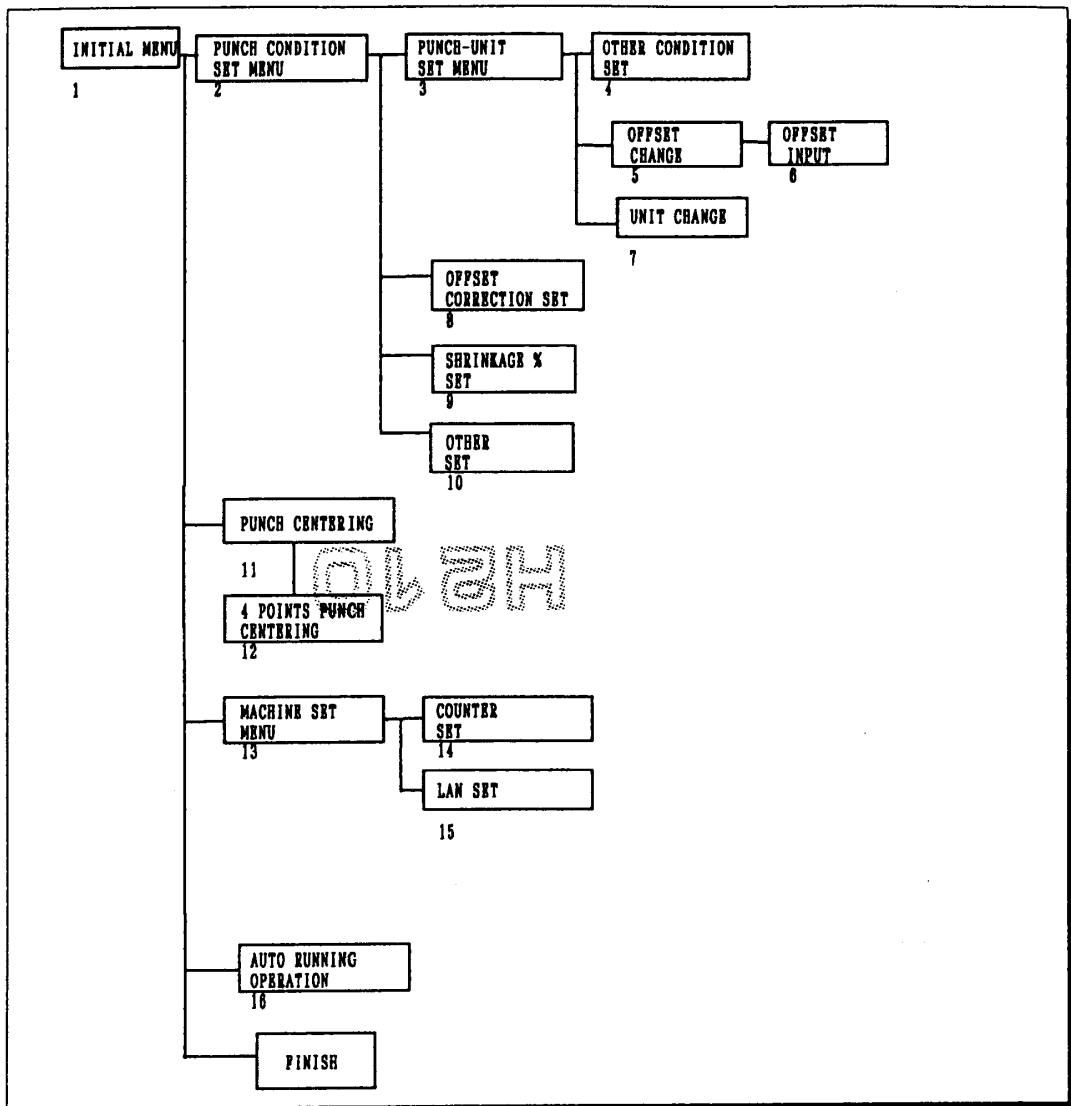
### 5.4. Verification after Turn on Electric Power

- There is no abnormal indication nor alarm message on the screen.
- Pneumatic source pressure is 7.0 Kg/cm<sup>2</sup> or more.
- Air drier is operating.
- There is no abnormal sound or noise in servo motor.

0124

6.

## TOUCH PANEL

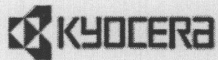


### Operation

- As above ladder logic shows, each menu is subdivided into a few items to be set. Select item to set on each menu.
- Can select items shown in reverse video. Touch proper item on the panel.
- This manual explains each menu subdivided it into some items. Outline of each function is stated in menu screen and basic operation is stated in operation screen.
- Refer to item No. Marks on above ladder logic.

### 6.1. Initial menu





SEMICONDUCTOR PARTS

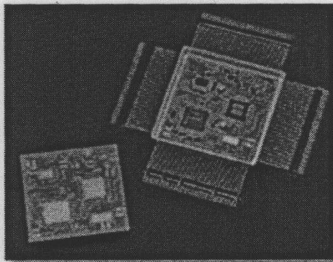
ABOUT • PRODUCTS • APPLICATIONS • TECHNOLOGY • SERVICES

## KAI LTCC DIVISION

About KAI's  
LTCC Division

LTCC Products

Contact Us



Multilayer air-fired LTCC products for high frequency applications are the cornerstone of the KAI LTCC Division of Kyocera America. Coupling commercially available materials from Ferro

and DuPont with the high frequency simulation, test and design capabilities of Kyocera, unique products for the emerging satellite, wireless and high speed digital markets are developed and implemented in world class cycle times. Close interaction between designers, engineers and key customer contacts ensures solid communication, clear understanding of needs and capabilities and a rapid resolution of customer requirements. The excellent dielectric properties of Ferro and DuPont LTCC systems along with the ability to embed passive and active components enables the design and fabrication of products that are key to meeting the needs of microwave and higher frequency applications. Hermetic packages with brazed metal components are fabricated to support the demanding requirements of these markets.

The KAI LTCC Division Mission is:

*To become the preferred supplier of LTCC multilayer ceramic substrates and Pressed Products in the markets we serve by:*

- *Maintaining our technology leadership in ceramic material systems through continuous product, process and materials engineering*
- *Providing products and services that meet or exceed our customer's expectations*

附件：KYOCERA



Resistor Tolerance Issues in  
Producing High Performance LTCC  
Devices

- Dr. Eric Ness - Senior Material Scientist
- Ed Graddy – New Product Development





## RESISTANCE TOLERANCE ISSUES

- DUPONT 951
- BIROX 2000 SERIES RESISTORS
- ALL GOLD SYSTEM (5734)
- ALL SILVER SYSTEM (6146 & 6148)
- TEST COUPONS FOR DESIGN RULES



## PROCESS PARAMETERS

- 3 RESISTOR DECADES
  - 10, 100, & 1K OHM
- TERMINATION OVERLAP
  - GOLD AND SILVER
  - 5 MILS OR 15 MILS
- FIRING FURNACE/PROFILE
  - BELT AND BATCH
- ARRAY OF 30 RESISTOR SIZES
  - 10 X 10 TO 40 X 50 MILS



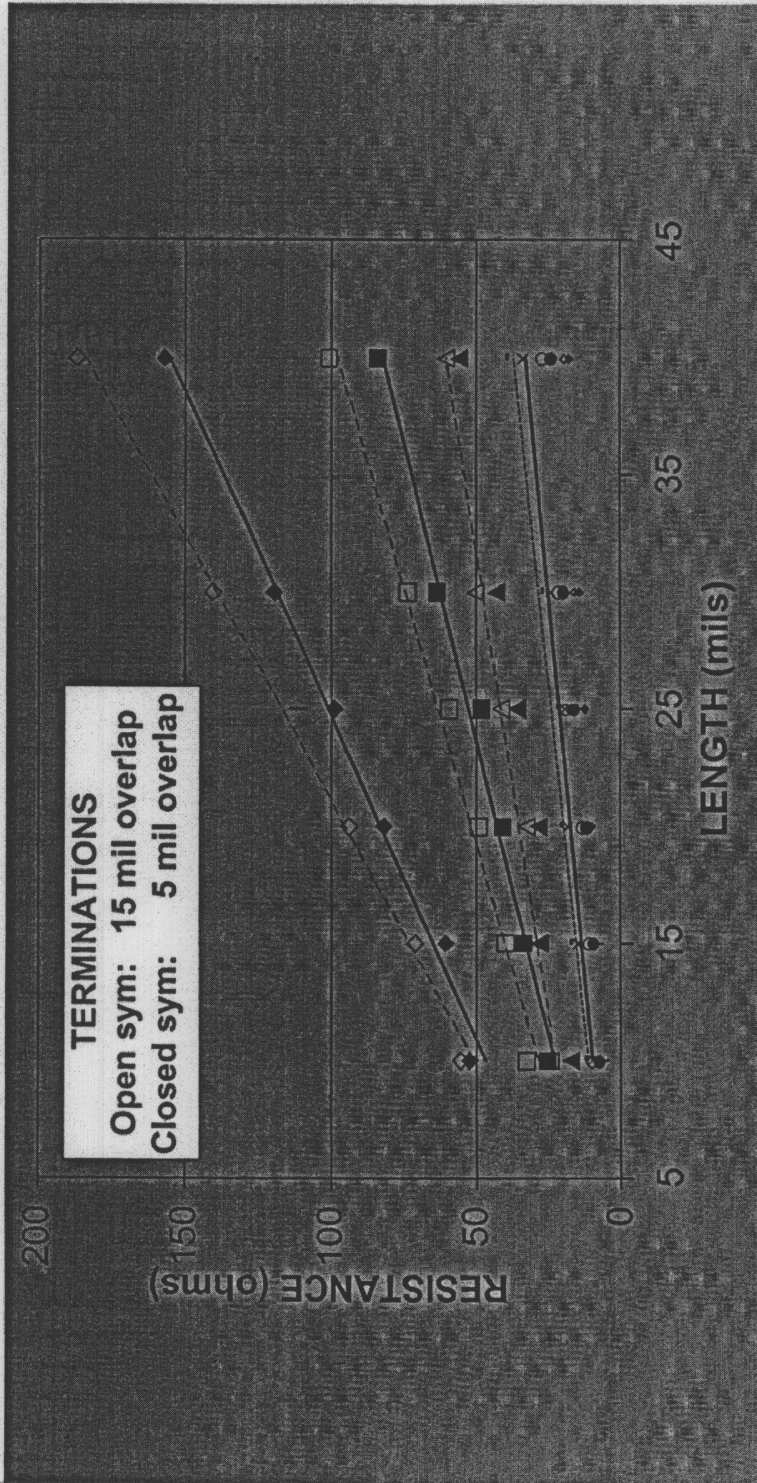


## TEST MATRIX

- 2,880 RESISTORS
  - 60 Resistors/test
  - 48 Tests
- GROUP TEST BY WIDTH
  - Narrow length range
  - Model as linear



## GOLD, 10 OHMS, SURFACE, BELT









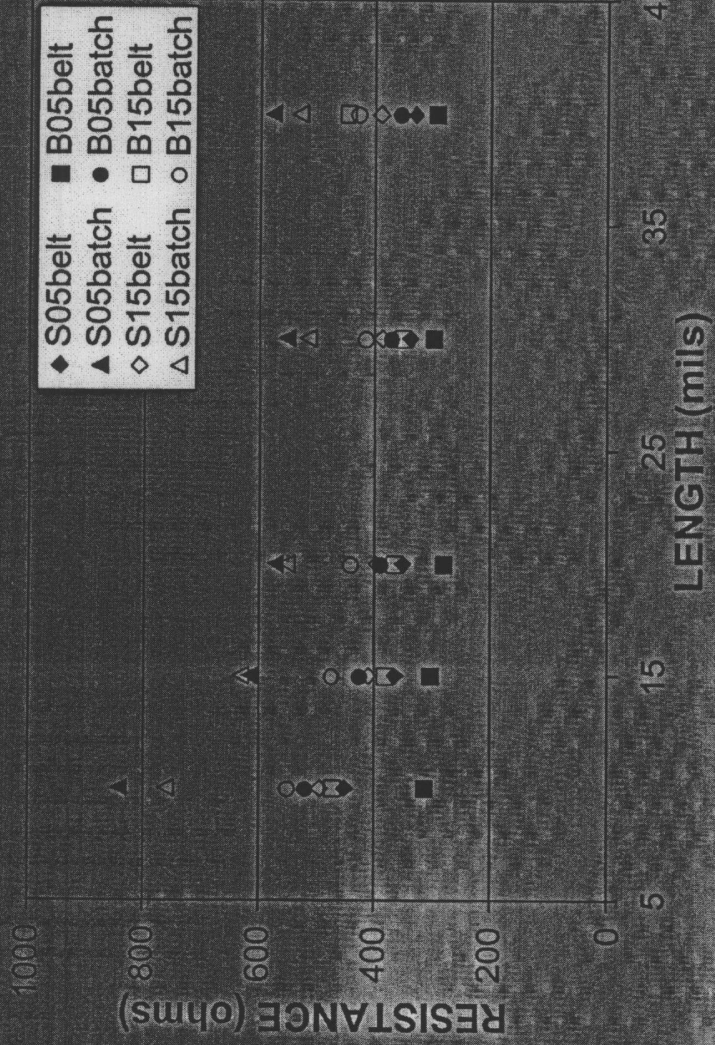


# GOLD, 100 OHM, 1 SQUARE





# GOLD, 1K OHM, 1 SQUARE





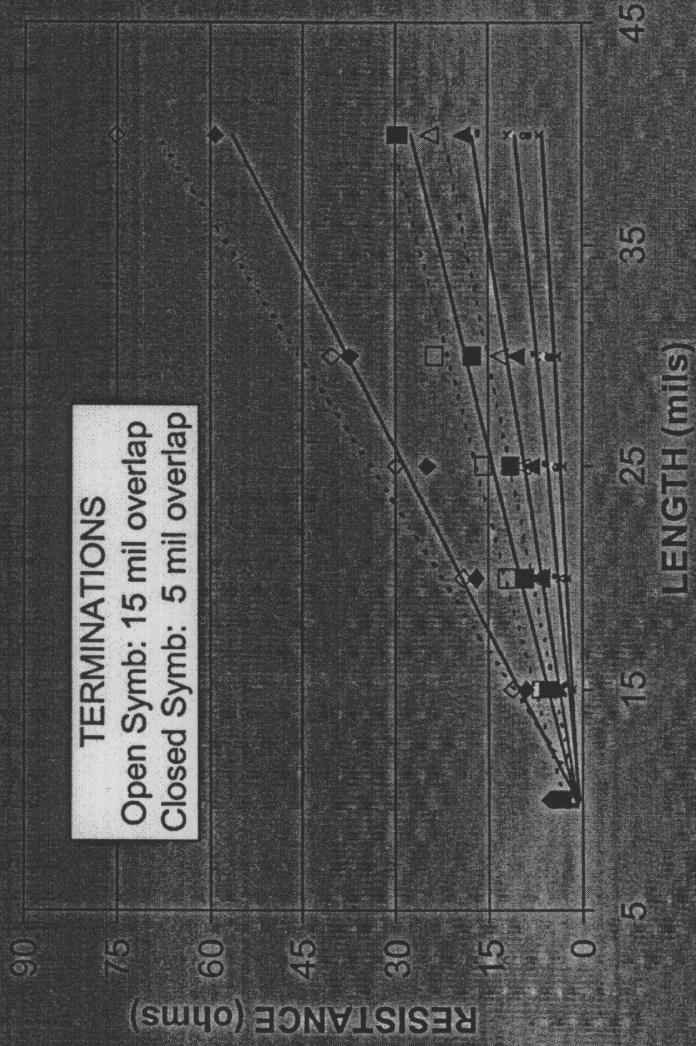


## DUPONT 951 GOLD SUMMARY

- RESISTANCE OF 15 ml OVERLAP > 5 ml
  - (except S05batch, 1K ohm)
- RESISTANCE OF BATCH > BELT
  - Specific Firing Profiles
- SIZE EFFECT ON RESISTANCE
  - Small tends to be > than large
  - Glass Boundary Layer?
- LARGE PROCESS VARIATION
  - 25% to 50%



## SILVER, 10 OHMS, SURFACE, BATCH

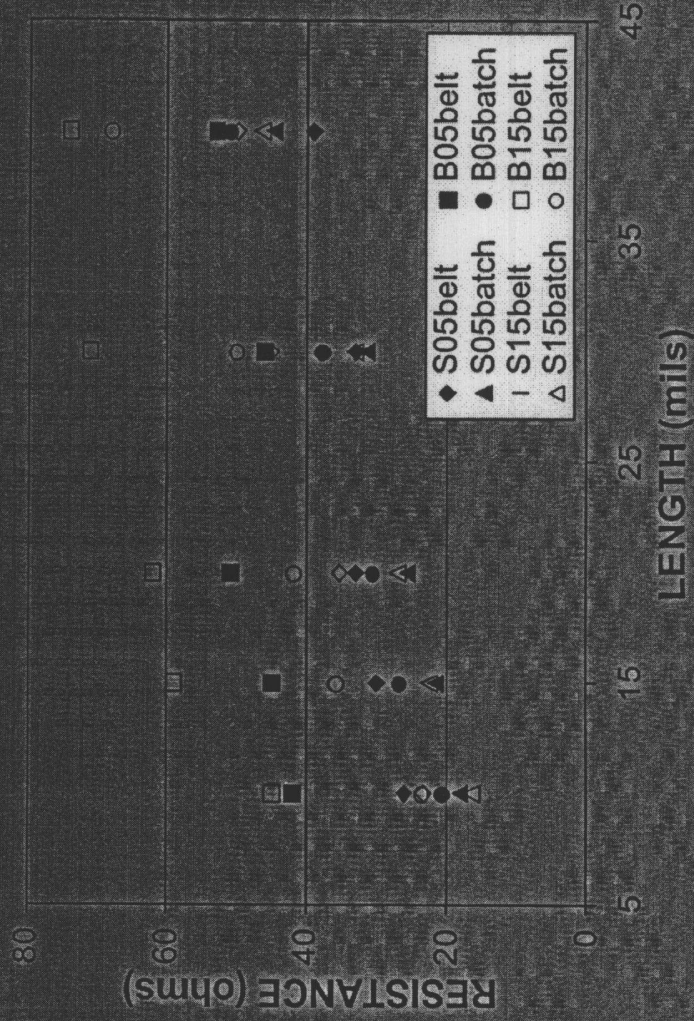








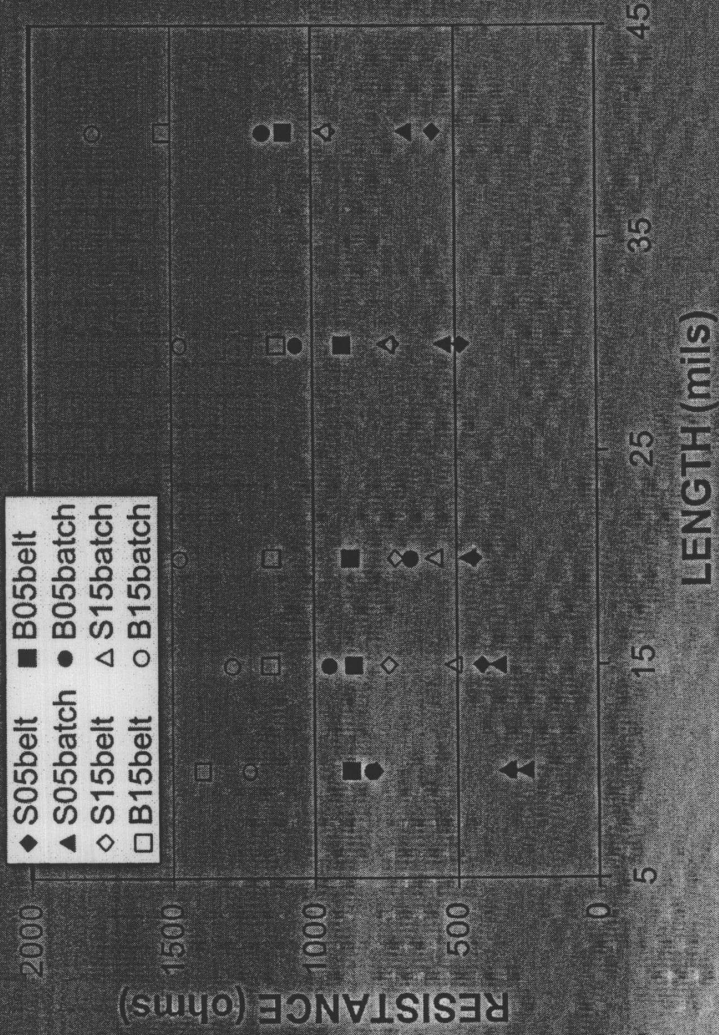
# SILVER, 100 OHM, 1 SQUARE







# SILVER, 1K OHM, 1 SQUARE





## DUPONT 951 SILVER SUMMARY

- RESISTANCE OF BATCH 15 mil OVERLAP > 5 mil
  - Most surface resistors behaved similarly
- SIZE EFFECT ON RESISTANCE
  - 50% change from 10 mil to 40 mil
  - Too large to be explained by printing
  - Silver diffusion in resistor?
- LARGE PROCESS VARIATION
  - 40% to 50%





## CONCLUSIONS

- Co-fired resistor behavior in LTCC bodies is highly variable but predictable for a given set of resistor and termination material.
- Resistor behavior varies widely depending on the termination material used.
- Detailed examination of material interactions is needed to fully understand the differences between Au and Ag systems.
- Improvements in resistor systems are needed to attain the demands of the industry.

附件：Panasonic

**FOR IMMEDIATE RELEASE**

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Tel: 03-3578-1237 Fax: 03-3437-2776  
Yoshihiro Kitadeya, International Publicity, Osaka  
Tel: 06-6908-0447 Fax: 06-6908-5817

## **Matsushita (Panasonic) Introduces Advanced Onboard Terminal for ETC Systems**

**-- Slim, compact modular approach combines a variety of advanced technologies --**

### **New Products**

TOKYO, Japan -- Matsushita Communication Industrial Co., Ltd. (MCI), a principal subsidiary of Matsushita Electric Industrial Co., Ltd. (NYSE: MC), best known for its Panasonic brand electronics and communications products, today announced the introduction of a new vehicle-mounted terminal for use with Electronic Toll Collection (ETC) systems. The innovative CY-ET100D, one of the lightest and thinnest such ETC terminals in the industry, will go on sale March 12, in preparation for the new ETC service set to go into operation at the end of March. The suggested retail price for the main unit is set at 42,800 yen.

MCI has already established itself as one of the leading manufacturers in the ETC field, developing and deploying road-installed ETC systems at tollgates throughout Japan. The company is also actively engaged in creating Intelligent Transportation Systems (ITS) -- from onboard terminals to system-wide infrastructure itself -- by utilizing the company's own advanced audiovisual and communications technologies. A specially designed one-chip system LSI with a dedicated monolithic microwave IC (MMIC) ensures reliable communication in a slim package. Moreover, the terminal can be used for both ETC systems and ITS, a successor of car navigation systems, whose markets for both personal and business use continue to rapidly expand. This new terminal is designed to connect with car navigation systems developed by MCI (applicable models only), offering the ability to display a wide array of system information, such as the 100 most recent paid and unpaid tolls or an enlarged map of ETC gates at an approaching tollgate.

Designing the antenna and main system of the terminal as separate units has created one of the smallest terminals of its kind in the industry. Both the compact antenna and the slim main unit can be set up almost anywhere, as long as enough room is provided for easy card insertion and removal. Even when installed on the dashboard, the antenna will not hinder driver visibility, and the heat resistance built into both units will ensure long lasting service.

This new onboard ETC terminal was designed and developed specifically with safety, versatility, and ease-of-use in mind. An advanced voice guidance system enables drivers to confirm information solely by ear. Because the driver's eyes never have to leave the road, a safer driving environment is ensured for everyone. With the ability to operate at either 12V or 24V, the terminal can be installed in a wide range of vehicles -- from passenger cars to trucks -- without any conversions necessary. Moreover, the terminal's quick and simple 3-button operation -- for volume control, voice guidance replay, and card eject -- guarantees a terminal that is not only easy to learn but also easy to use.

## Main Specifications (CY-ET100D)

### Weight/Dimensions

	Weight (g)	Height x Width x Depth (mm)
Main unit	170	15 x 70 x 135
Antenna unit	215 (including cables)	12 x 60 x 40

### Electrical Characteristics

Operating voltage	10.8 - 26.4 VDC
Power consumption	Max. 0.7 A or less (at 13.2 V)
Radio frequencies for transmission	5835 MHz and 5845 MHz
Radio frequencies for reception	5795 MHz and 5805 MHz
Modulation method	ASK modulation
Modulation transfer rate	1024 kbps
Frequency interval between transmission and reception	40 MHz
Aerial power	10 mW

### Operation/Voice/Display Characteristics

Number of keys	3 keys: Volume control key, Voice replay key, Card eject key
Voice	ADPCM standardized voice guidance and alarm sounds
ETC card	Terminal contact-type ISO card
ETC card holder	Complete model contains an eject button as well as a lock function for protecting card data.
Display	Two-color indicator: Standby: Green, Error: Red
External I/F	For connecting with MCI's car navigation system (applicable models only)

## GN01096B

GaAs IC (with built-in ferroelectric)

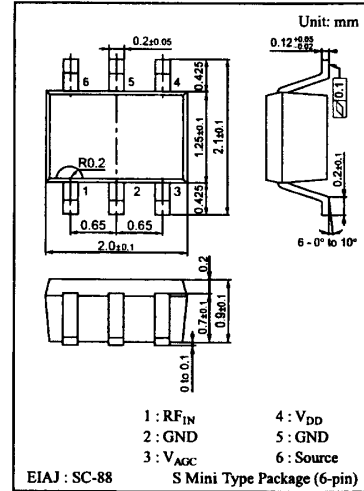
For low noise amplifier of cellular phone  
Other communication equipment

### ■ Features

- Super miniature S-Mini 6-pin package (2125 size)
- Receiver amplifier : Low distortion with built-in gain control function

### ■ Absolute Maximum Ratings $T_a=25\text{ }^\circ\text{C}$

Parameter	Symbol	Ratings	Unit
Power supply voltage	$V_{DD}$	8	V
Circuit current	$I_{DD}$	20	mA
Gate control voltage	$V_{AGC}$	0 to 4	V
Max input power	$P_{IN}$	-5	dBm
Allowable power dissipation	$P_D$	150	mW
Operating ambient temperature	$T_{opr}$	-30 to +90	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-40 to +120	$^\circ\text{C}$



Marking Symbol : KW

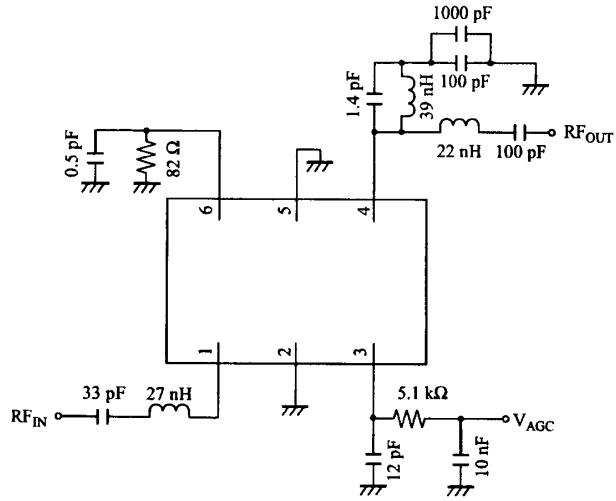
### ■ Electrical Characteristics $V_{DD}=2.9\text{ V}$ , $P_{IN}=-25\text{ dBm}$ , $T_a=25\text{ }^\circ\text{C}\pm 3\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	min	typ	max	Unit
Circuit current *1	$I_{DD}$	$V_{AGC}=1.5\text{ V}$ , $f=850\text{ MHz}$		6.5	10	mA
Power gain 1 *1	PG1	$V_{AGC}=1.5\text{ V}$ , $f=850\text{ MHz}$	12.5	15.0	17.5	dB
Power gain 2 *1	PG2	$V_{AGC}=0.1\text{ V}$ , $f=850\text{ MHz}$	-10.0	-6.5	-3.0	dB
Noise figure 1 *1,2	NF1	$V_{AGC}=1.5\text{ V}$ , $f=832\text{ MHz}$ $f=850\text{ MHz}$ , $f=870\text{ MHz}$		1.4	2.0	dB
Noise figure 2 *1,2	NF2	$V_{AGC}=0.1\text{ V}$ , $f=832\text{ MHz}$ $f=850\text{ MHz}$ , $f=870\text{ MHz}$		17	22	dB
Dynamic range *1	DR	$V_{AGC}=1.5\text{ V}$ to $0.1\text{ V}$ , $f=850\text{ MHz}$	18	22	27	dB
Input return loss *1,2	S11	$V_{AGC}=1.5\text{ V}$ , $f=850\text{ MHz}$		-10	-6	dB
Output return loss *1,2	S22	$V_{AGC}=1.5\text{ V}$ , $f=850\text{ MHz}$		-10	-6	dB
Third input intercept point *1,2	IIP3	$V_{AGC}=1.5\text{ V}$ , $f=850\text{ MHz}/850.9\text{ MHz}$	4.0	5.8		dBm
Third output intercept point *1,2	OIP3	$V_{AGC}=1.5\text{ V}$ , $f=850\text{ MHz}/850.9\text{ MHz}$	16.5	21.0		dBm

Note) \*1 : Refer to measurement circuit.

\*2 : Design-guaranteed items.

■ Measurement Circuit



# 2SK3023 (Tentative)

## Silicon N-Channel Power F-MOS FET

■ Features

- Avalanche energy capacity guaranteed
- High-speed switching
- Low ON-resistance
- No secondary breakdown
- Low-voltage drive
- High electrostatic breakdown voltage

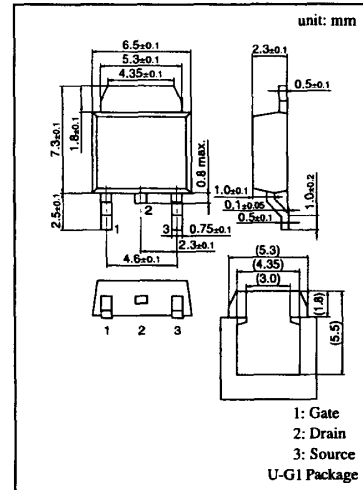
■ Applications

- Contactless relay
- Driving circuit for a solenoid
- Driving circuit for a motor
- Control equipment
- Switching power supply

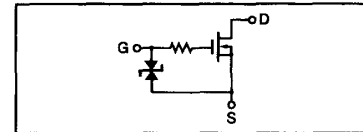
■ Absolute Maximum Ratings (T<sub>C</sub> = 25°C)

Parameter	Symbol	Ratings	Unit
Drain to Source breakdown voltage	V <sub>DSS</sub>	60	V
Gate to Source voltage	V <sub>GSS</sub>	±20	V
Drain current	DC	I <sub>D</sub>	±10 A
	Pulse	I <sub>DP</sub>	±20 A
Avalanche energy capacity	EAS*	5	mJ
Allowable power dissipation	P <sub>D</sub>	T <sub>C</sub> = 25°C	10 W
		T <sub>a</sub> = 25°C	1 W
Channel temperature	T <sub>ch</sub>	150	°C
Storage temperature	T <sub>stg</sub>	-55 to +150	°C

\* L = 0.1mH, I<sub>L</sub> = 10A, 1 pulse



Internal Connection



■ Electrical Characteristics (T<sub>C</sub> = 25°C)

Parameter	Symbol	Conditions	min	typ	max	Unit
Drain to Source cut-off current	I <sub>DSS</sub>	V <sub>DS</sub> = 50V, V <sub>GS</sub> = 0			10	μA
Gate to Source leakage current	I <sub>GSS</sub>	V <sub>GS</sub> = ±20V, V <sub>DS</sub> = 0			±10	μA
Drain to Source breakdown voltage	V <sub>DSS</sub>	I <sub>D</sub> = 1mA, V <sub>GS</sub> = 0	60			V
Gate threshold voltage	V <sub>th</sub>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 1mA	1		2.5	V
Drain to Source ON-resistance	R <sub>DS(on)1</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 5A		50	80	mΩ
	R <sub>DS(on)2</sub>	V <sub>GS</sub> = 4V, I <sub>D</sub> = 5A		70	110	mΩ
Forward transfer admittance	Y <sub>fs</sub>	V <sub>DS</sub> = 10V, I <sub>D</sub> = 5A	3	5		S
Diode forward voltage	V <sub>DSF</sub>	I <sub>DR</sub> = 10A, V <sub>GS</sub> = 0			-1.4	V
Input capacitance (Common Source)	C <sub>iss</sub>	V <sub>DS</sub> = 10V, V <sub>GS</sub> = 0, f = 1MHz		300		pF
Output capacitance (Common Source)	C <sub>oss</sub>			165		pF
Reverse transfer capacitance (Common Source)	C <sub>rss</sub>			65		pF
Turn-on time (delay time)	t <sub>d(on)</sub>	V <sub>DD</sub> = 30V, I <sub>D</sub> = 5A V <sub>GS</sub> = 10V, R <sub>L</sub> = 6Ω		15		ns
Rise time	t <sub>r</sub>			70		ns
Fall time	t <sub>f</sub>			290		ns
Turn-off time (delay time)	t <sub>d(off)</sub>			860		ns
Thermal resistance between channel and case	R <sub>th(ch-c)</sub>				12.5	°C/W
Thermal resistance between channel and atmosphere	R <sub>th(ch-a)</sub>				125	°C/W

## 2SK3043

## Silicon N-Channel Power F-MOS FET

## ■ Features

- Avalanche energy capacity guaranteed: EAS > 100mJ
- $V_{GS} = \pm 30V$  guaranteed
- High-speed switching:  $t_f = 35ns$
- No secondary breakdown

## ■ Applications

- Contactless relay
- Driving circuit for a solenoid
- Driving circuit for a motor
- Control equipment
- Switching power supply

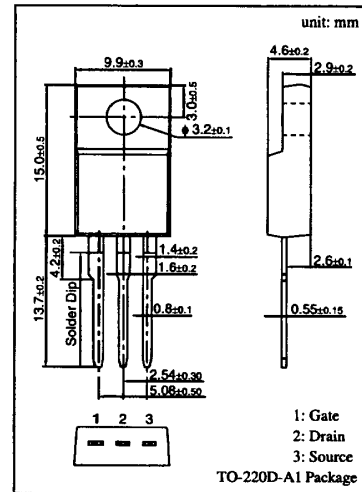
■ Absolute Maximum Ratings ( $T_C = 25^\circ C$ )

Parameter	Symbol	Ratings	Unit	
Drain to Source breakdown voltage	$V_{DSS}$	450	V	
Gate to Source voltage	$V_{GSS}$	$\pm 30$	V	
Drain current	DC	$I_D$	$\pm 5$ A	
	Pulse	$I_{DP}$	$\pm 10$ A	
Avalanche energy capacity	EAS*	100	mJ	
Allowable power dissipation	$T_C = 25^\circ C$	$P_D$	35	W
	$T_a = 25^\circ C$		2	
Channel temperature	$T_{ch}$	150	$^\circ C$	
Storage temperature	$T_{stg}$	-55 to +150	$^\circ C$	

\*  $L = 8mH, I_L = 5A, V_{DD} = 50V, 1 \text{ pulse}$

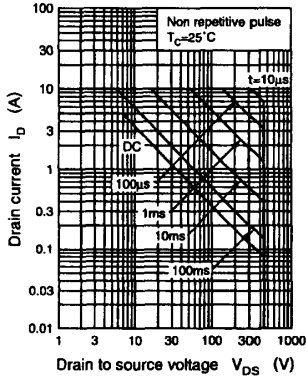
■ Electrical Characteristics ( $T_C = 25^\circ C$ )

Parameter	Symbol	Conditions	min	typ	max	Unit	
Drain to Source cut-off current	$I_{DSS}$	$V_{DS} = 360V, V_{GS} = 0$			0.1	mA	
Gate to Source leakage current	$I_{GSS}$	$V_{GS} = \pm 30V, V_{DS} = 0$			$\pm 1$	$\mu A$	
Drain to Source breakdown voltage	$V_{DSS}$	$I_D = 1mA, V_{GS} = 0$	450			V	
Gate threshold voltage	$V_{th}$	$V_{DS} = 25V, I_D = 1mA$	2		5	V	
Drain to Source ON-resistance	$R_{DS(on)}$	$V_{GS} = 10V, I_D = 3A$		1	1.3	$\Omega$	
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 25V, I_D = 3A$	1.8	2.5		S	
Diode forward voltage	$V_{DSF}$	$I_{DR} = 5A, V_{GS} = 0$			-1.2	V	
Input capacitance (Common Source)	$C_{iss}$	$V_{DS} = 20V, V_{GS} = 0, f = 1MHz$		700		pF	
Output capacitance (Common Source)	$C_{oss}$				100		pF
Reverse transfer capacitance (Common Source)	$C_{rss}$				40		pF
Turn-on time (delay time)	$t_{d(on)}$	$V_{GS} = 10V, I_D = 3A$ $V_{DD} = 150V, R_L = 50\Omega$		25		ns	
Rise time	$t_r$				45		ns
Turn-off time (delay time)	$t_{d(off)}$				80		ns
Fall time	$t_f$				35		ns

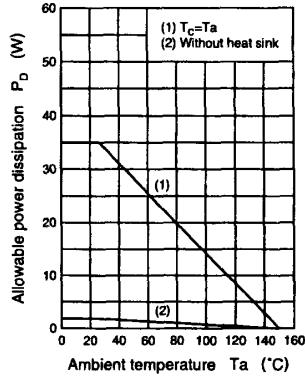




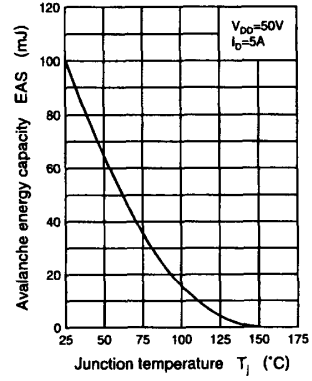
Area of safe operation (ASO)



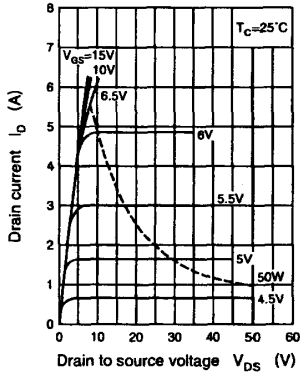
$P_D - T_a$



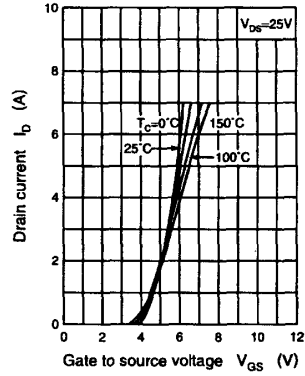
EAS —  $T_j$



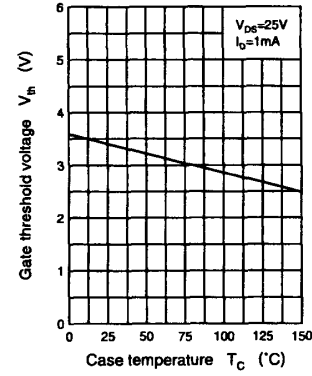
$I_D - V_{DS}$



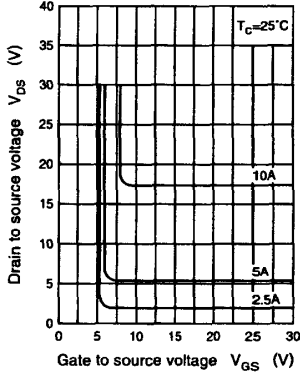
$I_D - V_{GS}$



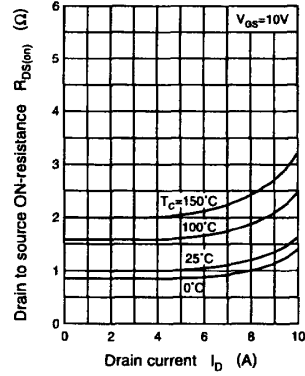
$V_{th} - T_C$



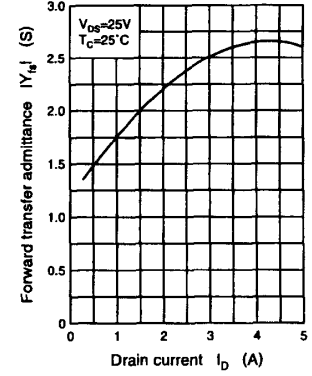
$V_{DS} - V_{GS}$

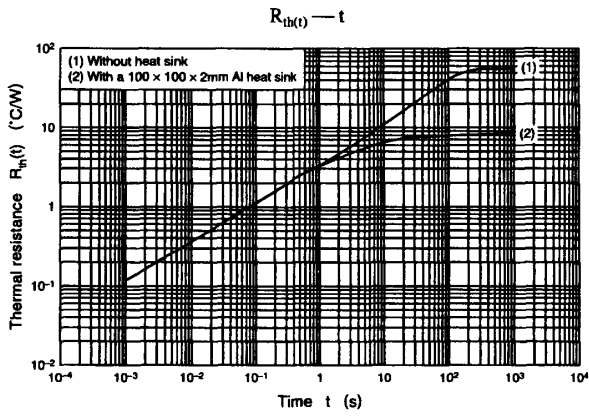
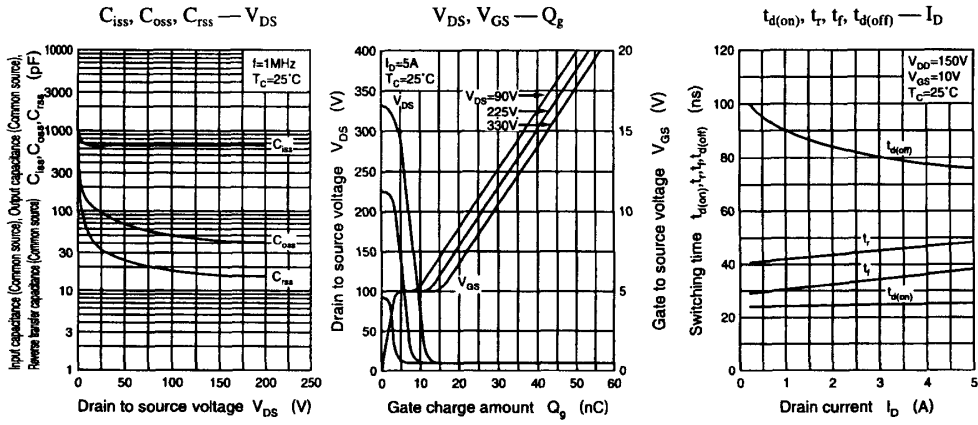


$R_{DS(on)} - I_D$



$|Y_{fs}| - I_D$





# 2SK3192

## Silicon N-channel power F-MOSFET

### ■ Features

- Avalanche energy capacity guaranteed
- High-speed switching
- Low on-resistance
- No secondary breakdown

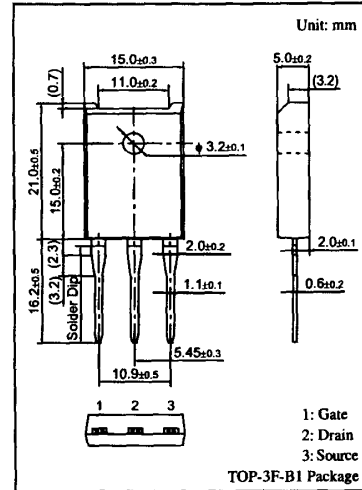
### ■ Applications

- PDP
- Switching power supply

### ■ Absolute Maximum Ratings $T_C = 25^\circ\text{C}$

Parameter	Symbol	Rating	Unit
Drain-source breakdown voltage	$V_{DS}$	250	V
Gate to source voltage	$V_{GS}$	$\pm 30$	V
Drain current	DC	$I_D$	$\pm 30$ A
	Pulse	$I_{DP}$	$\pm 120$ A
Avalanche energy capacity *	EAS	925	mJ
Allowable power dissipation	$T_C = 25^\circ\text{C}$	$P_D$	100 W
	$T_a = 25^\circ\text{C}$		3 W
Channel temperature	$T_{ch}$	150	$^\circ\text{C}$
Storage temperature	$T_{stg}$	-55 to +150	$^\circ\text{C}$

Note) \*:  $L = 1.74 \text{ mH}$ ,  $I_L = 30 \text{ A}$ ,  $V_{DD} = 50 \text{ V}$ , 1 pulse,  $T_a = 25^\circ\text{C}$



### ■ Electrical Characteristics $T_C = 25^\circ\text{C} \pm 3^\circ\text{C}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
Drain cutoff current	$I_{DSS}$	$V_{DS} = 200 \text{ V}$ , $V_{GS} = 0$			10	$\mu\text{A}$	
Gate-source leakage current	$I_{GSS}$	$V_{GS} = \pm 30 \text{ V}$ , $V_{DS} = 0$			$\pm 1$	$\mu\text{A}$	
Drain-source breakdown voltage	$V_{DSS}$	$I_D = 1 \text{ mA}$ , $V_{GS} = 0$	250			V	
Gate threshold voltage	$V_{th}$	$V_{DS} = 10 \text{ V}$ , $I_D = 1 \text{ mA}$	2		4	V	
Drain-source on resistance	$R_{DS(ON)}$	$V_{GS} = 10 \text{ V}$ , $I_D = 15 \text{ A}$		50	68	$\text{m}\Omega$	
Forward transfer admittance	$ Y_{fs} $	$V_{DS} = 10 \text{ V}$ , $I_D = 15 \text{ A}$	8	15		S	
Input capacitance	$C_{iss}$	$V_{DS} = 10 \text{ V}$ , $V_{GS} = 0$ , $f = 1 \text{ MHz}$		4200		pF	
Output capacitance	$C_{oss}$				1600		pF
Reverse transfer capacitance	$C_{rss}$				650		pF
Turn-on delay time	$t_{d(ON)}$	$V_{DD} = 100 \text{ V}$ , $I_D = 15 \text{ A}$ $R_L = 6.7 \Omega$ , $V_{GS} = 10 \text{ V}$		45		ns	
Rise time	$t_r$				115		ns
Turn-off delay time	$t_{d(OFF)}$				330		ns
Fall time	$t_f$				130		ns

■ Electrical Characteristics (continued)  $T_C = 25^\circ\text{C} \pm 3^\circ\text{C}$

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Diode forward voltage	$V_{DSF}$	$I_{DR} = 30\text{ A}, V_{GS} = 0$			-1.5	V
Reverse recovery time	$t_{rr}$	$L = 230\ \mu\text{H}, V_{DD} = 100\text{ V}$		260		ns
Reverse recovery charge	$Q_{rr}$	$I_{DR} = 15\text{ A}, di/dt = 100\text{ A}/\mu\text{s}$		1.6		$\mu\text{C}$
Total gate charge	$Q_g$	$V_{DD} = 100\text{ V}, I_D = 15\text{ A}$		95		nC
Gate-source charge	$Q_{gs}$	$V_{GS} = 10\text{ V}$		34		nC
Gate-drain charge	$Q_{gd}$			12		nC
Thermal resistance (channel to case)	$R_{th(ch-c)}$				1.25	$^\circ\text{C}/\text{W}$
Thermal resistance (channel to ambient)	$R_{th(ch-a)}$				41.7	$^\circ\text{C}/\text{W}$

