行政院及所屬各機關出國報告書
（出國類別：其他）

「國際電波監測設備採購案之工程覆核會議」報告書

服務機關：交通部電信總局
出國人　職　　稱：電波管理處簡任技正
姓　　名：鄭　康

出國地點：美　國
出國期間：92 年 11 月 30 日至 92 年 12 月 7 日
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「國際電波監測設備採購案之工程覆核會議」報告書

主辦機關:

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出國類別: 其他

出國地區: 美國

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分類號/目: H6／電信　H6／電信

關鍵詞: 國際電波監測,高頻無線電定位,電離層單點定位技術,監測設備工廠查驗

內容摘要: 近年來由於電信市場之自由化與電信政策之鬆綁，電信業者與管理單位面臨與過去完全不同的頻譜需求，電信總局需提供電信業者不受干擾的頻率指配，供業者提供廣泛的電信服務。頻譜的管理除了針對我國頻譜之規劃外，更需積極從事國際電波監測，參與處理國際信之電波干擾事項、國際性之通訊頻率協調事項，克盡國際義務，提升我國國際形象。

電信總局歷年來依據『電波偵測能量計畫』之規劃，積極從事國際電波監測站建設之推動。迄今分別完成了南部國際電波監測站用地之取得，國際電波監測站站台機房之設計規劃與興建，並於九十二年完成國際電波監測系統設備採購案之採購作業。

為期順利推展本案設備之安裝、測試、運轉等作業，筆者奉派前往美國參與工程覆核會議及工廠測試作業，與 TCI 公司之工程設計人員詳細討論本案之硬體、軟體結構，監測站儀器、設備安裝環境以及站台/中心資訊傳遞等各項作業之事先準備工作，並參與工廠測試作業，對整個建設案之推動頗多助益。

本文電子檔已上傳至出國報告資訊網

目　　　錄

一、前言

電信自由化逐步推展以來，無線電通信科技快速發展，各項無線電通信業務日新月異。各種具有通訊（射頻）功能的新型電信器材不斷推陳出新，電波使用環境亦隨之日趨多元與複雜，其中不乏違法發射射頻訊息致干擾無線電波之合法使用者，其情節嚴重者將會影響飛航安全與國防通信。

自八十五年電信改制以來，電信總局為維護電波秩序及通信品質，積極推動『電波偵測能量計畫』。截至九十二年度已完成「無線電頻譜監測系統」、「無線電定向系統」、「無線電頻譜管理系統」之建設，並完成十三處新建電波監測站站台機房之興建。

電信總局除了有效管理國內電波使用情形外，更須依據國際電信聯合會（International Telecommunications Union，簡稱ITU）之規定，積極參與處理國際性之電波干擾事項、國際性之通訊頻率協調事項、援助緊急海上救難事項，克盡國際義務，提昇我國國際形象。

有鑑於此，電信總局歷年來依據『電波偵測能量計畫』之規劃，積極從事國際電波監測站建設之推動。迄今分別完成了南部國際電波監測站用地之取得，國際電波監測站站台機房之設計規劃與興建，並於九十二年完成國際電波監測系統設備採購案之採購作業。

「國際電波監測系統」由電信總局委託中央信託局辦理採購與開標作業，於九十二年九月十六日完成開標手續，由美商TCI公司得標。為期順利推展本建設案設備之安裝、測試、運轉等作業，需派員參與工程覆核會議，與 TIC 公司之工程設

計人員討論「國際電波監測系統」監測站儀器、設備安裝環境以及站台 中心資訊傳遞等各項作業之事前準備工作；另依契約之規定：「買方得 ••• 指派計畫負責人員一人前往立約商國家參與工廠測試作業，與立約商計畫經理或工程人員討論本系統之相關問題」。

電信總局電波管理處為負責推動本建設案之權責單位。為確認國際電波監測設備、規格形式及系統功能，確立施工工期；並交換國際電波監測經驗、參觀相關設施，了解國際電波監測作業之運作情形，核派鄭簡任技正康前往美國 TCI 公司參與工程覆核會議。

本工程覆核會議自民國 92 年 11 月 30 日至 92 年 12 月 7 日止，含行程共計 8 天。議程安排如下：

11 月 30 日 前往美國

12 月 1 日 介紹與會人員，參觀 TCI 公司。

12 月 2 日 參觀 TCI 生產工廠

12 月 3-5 日 參與工程覆核會議及工廠測試作業

12 月 6-7 日 離美國返國

二、TCI 公司簡介

自 1968 年 TCI 公司成立以來，TCI 從事設計、製造並供應無線電監測及定向系統、頻譜管理系統、通訊及廣播天線系統以及特殊通信系統。TCI 公司擁有 25 年完成建置包括大量土木工程及與下包商充分合作之大型廣播站台，以及需要安裝測試軟硬體模組、整合網路系統之複雜無線電監測及管理系統的統包經驗。過去十年內，TCI 公司已於全球 9 個國家中完成超過 20 個統包的 HFDF 及 HF 監測系統。典型的案例為美國政府美國之音（Voice of America）大型統包工程，以及其他國家政府機構之計畫規劃、製造、運送、設備安裝、站台整備及下包商土木工程、運轉及訓練之工程。有關 TCI 公司之產品技術分述如下（詳附件 1）：

(一) 天線

TCI 天線設計的頻率範圍涵蓋自 9KHz 至 3GHz。TCI 採用 CAD/CAM 技術生產可快速安裝、易於維護之精準模組天線。天線之種類包含頻譜監測、定向、通訊及信號攔截等天線。

(二) 射頻分配器

TCI 生產多種電腦控制射頻分配器，可將來自天線陣列之射頻信號同時分配及切換到任意組合之多通訊接收機、頻譜監測系統及定向系統。該射頻分配器可擴充到 31 個輸入端及 320 個輸出端。

(三) 接收機

TCI 針對通訊、定向/監測及 COMINT/SIGNIT 之應用，利用高動態類比射頻前端設備及高解析度數位後端設備，開發特殊之接收機。於 LF/MF/HF 及 VHF/UHF 頻段，TCI 提供傳

統窄頻及寬頻接收機，以供現代調變及快速信號偵測及截取之用。TCI 寬頻接收機可提供之 IF 頻寬於 HF 頻段為 2MHz，於 VHF/UHF 頻段為 12MHz，而處理量測之解析頻寬可達到 10Hz。

(四) DSP 處理器

高速率 32bit 之數位信號處理器為 TCI 公司之專利，可提供多種信號型式及環境之量測功能及信號分析之用。LF/MF/HF 及 VHF/UHF 接收機輸出信號經數位取樣後，經由 4GHz 高速率數位信號之頻譜處理器，提供快速廣泛之信號分析，同時進行射頻信號之掃描、偵測、量測與分析。

(五) 頻譜監測

TCI 之 Scorpio 系統係針對頻譜監測及定向所需之高功能系統，其涵蓋之頻譜範圍自 20MHz 至 3000MHz，並可向下延伸至 9KHz，及向上延伸至 40GHz。此系統符合國際電信聯合會之最新建議，提供整合性的管理與監測功能，利用管理與規劃工具自動評估傳統與數位信號之頻譜，並同時量測、定位及評估信號活動特性。所有信號量測之結果均存於資料庫中，可自動分析產生包括頻道佔用、信號強度、頻寬、傳輸及佔用統計以及發射機定位等報表。

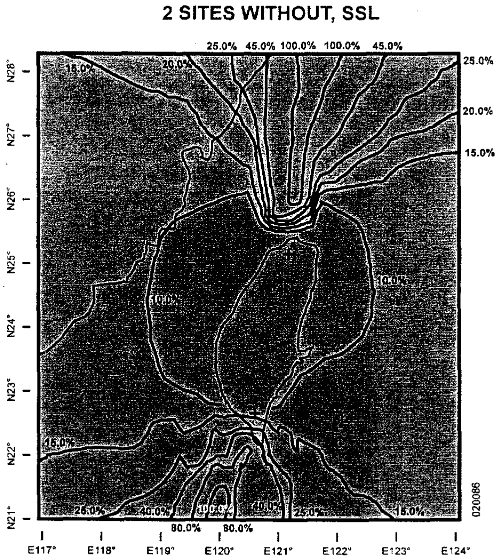
(六) 頻譜管理

TCI 之 ASMS 系統為高整合性的自動頻譜管理系統，提供電信管理機構所需之技術以管理頻譜之使用。ASMS 提供廣泛的管理、分析、地圖顯示及會計功能，該等功能可供管理者有效處理證照申請、頻率指配、收費及報表等事項。

三、國際電波監測系統架構

『電波偵測能量計畫』規劃之國際電波監測系統，分別於桃園崙坪及屏東南州各設立一處監測站，北、中、南區各設立一處區域管理中心。監測站依據管理中心指派之任務，從事電波訊號之擷取、監測、量測及測向等作業，並將蒐集到之資料回報區域管理中心。

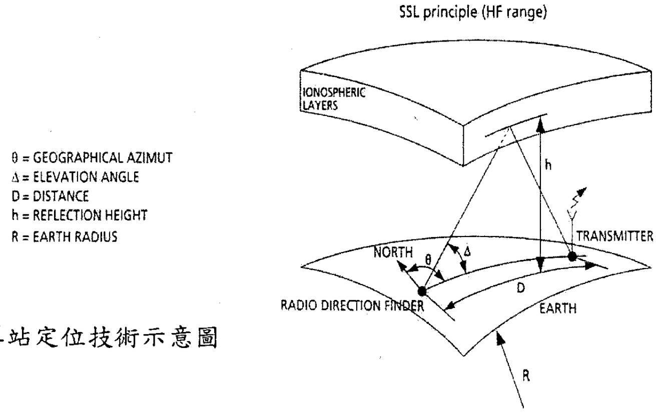
原計畫中僅規劃南北二處監測站。當利用方位線從事發射站台定位作業時，對位於台灣北方或南方之發射站台，因二組方位線幾近乎於平行，無法進行交測作業，無法判斷發射站台之真實位置。由下圖之定位誤差百分率等值線圖可知，僅位於台灣東西方之發射站台可得到準確的定位功能，位於台灣南北方之發射站台即無法從事定位作業。



僅由崙坪及南州兩測站從事定位之誤差百分比等值線圖

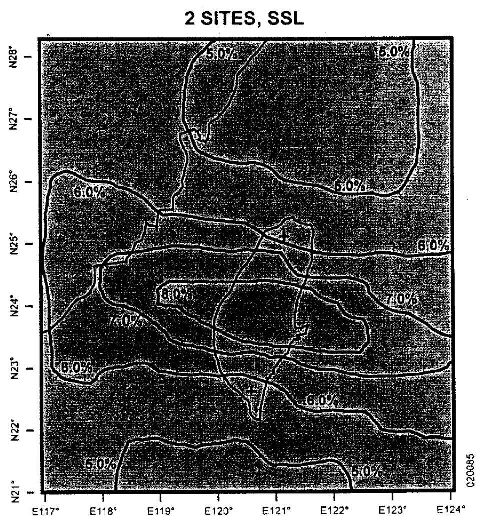
為解決此問題，乃於系統架構中引入單站定位（Single Station Location）之技術。由於HF頻段無線電波之傳播係採用天波傳播，於監測站可同時量測接收信號之方位角

（Azimuth）及仰角（Elevation）。若配合定位時之即時電離層資訊，即可經由接收信號之仰角，確定發射站台距離監測站之距離，其次再配合接收信號之方位角，即可確定發射站台之位置。



單站定位技術示意圖

有鑒於此，迺於擬定國際電波監測系統採購案之規格時，於桃園中壢增設一處電離層觀測站，以便隨時提供即時電離層資訊，供無線電站台定位之用。由下圖可知，目前本案採用SSL 技術，配合電離層即時資訊，已可達成全方向定位之功能，解決原始架構中無法針對位於台灣南北方向之無線電站台的定位問題。



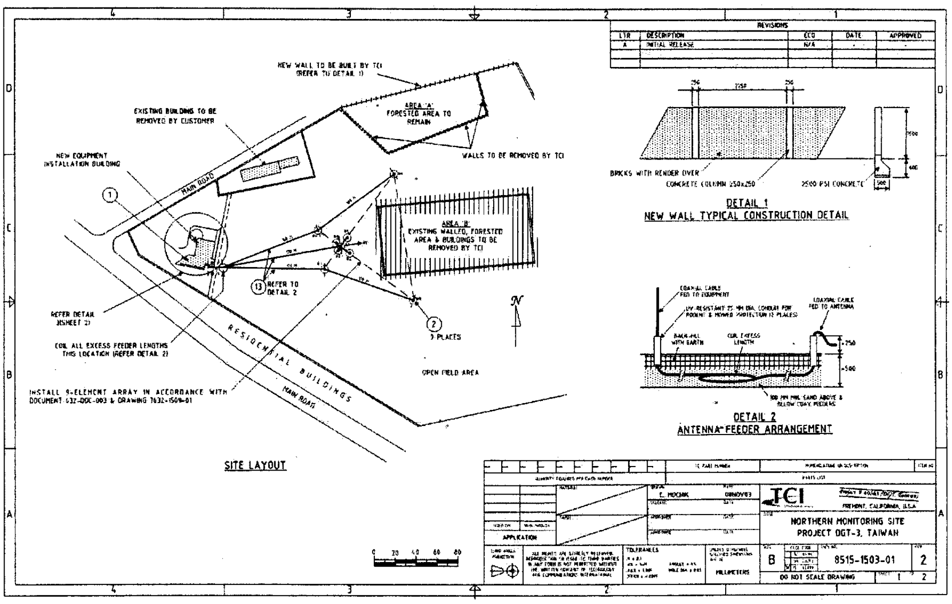
本案引入單站定位技術後，定位誤差百分比等值線圖。

四、天線場場地配置及施工圖之確認

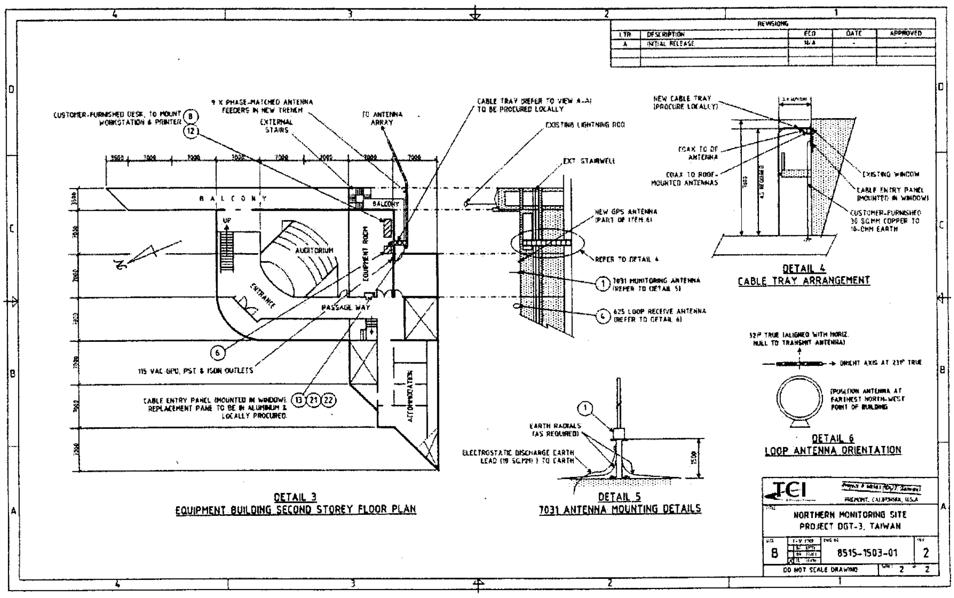
本案分別需於崙坪及南州架設 HF 監測用之監測天線、HF 定向用之定向天線陣列以及 GPS 天線；另需於中壢架設電離層觀測用之發射天線，以及於崙坪架設電離層觀測用之接收天線。

HF 監測天線為型號 7031 之鞭形天線。HF 定向天線陣列為由九組型號 632 之單極天線排列成"X"形之陣列，該陣列之邊長為 110 公尺，每組天線高約 5 公尺。電離層觀測用之發射天線為兩組型號 656 之正交 Delta 天線，天線高約 22 公尺，佔地範圍為邊長 30 公尺之正方形。電離層觀測用之接收天線為型號 625 之環型天線，天線高約 4 公尺。

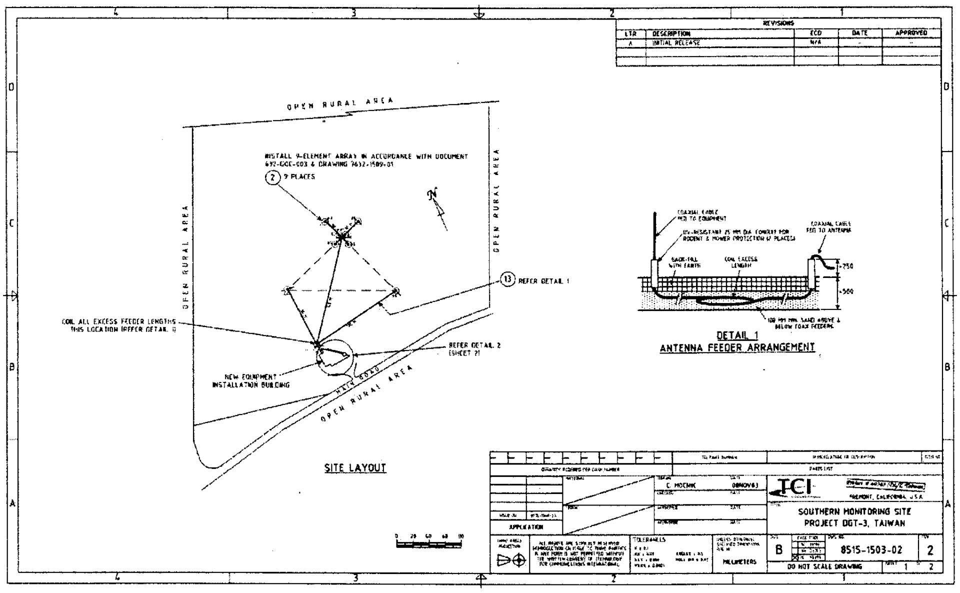
經與 TCI 公司負責「國際電波監測系統」建設案之專案經理及工程人員研商天線陣列之擺設及信號/控制纜線之佈放，確定相關站台天線場場地配置及施工圖詳如下圖所示：



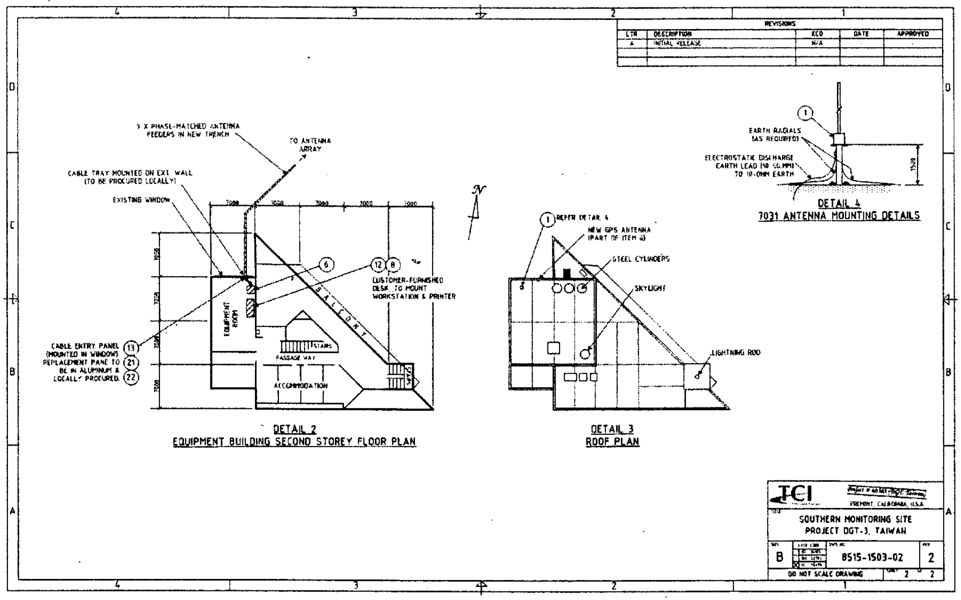
崙坪監測站天線陣列配置圖



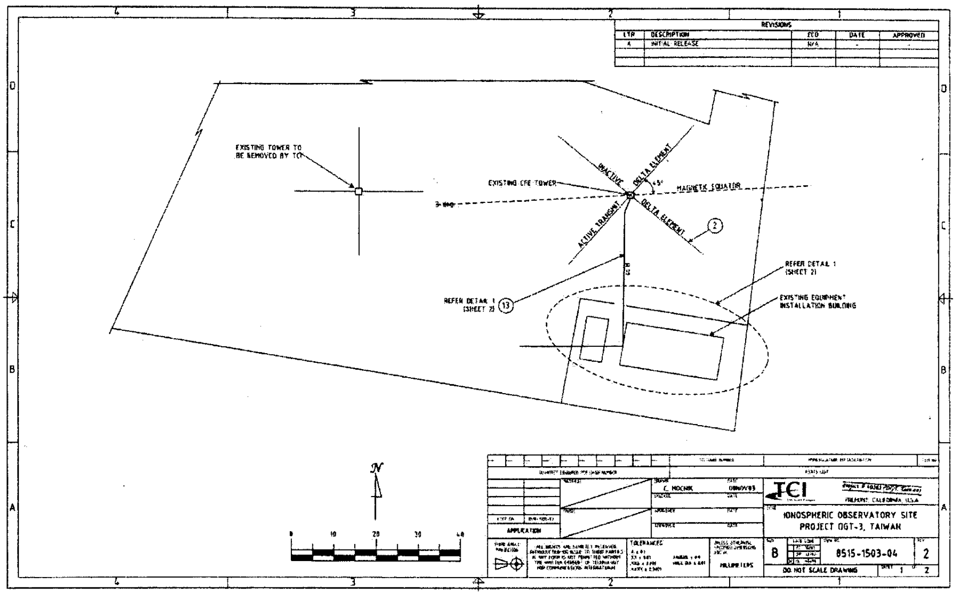
崙坪監測站機房纜線配置圖



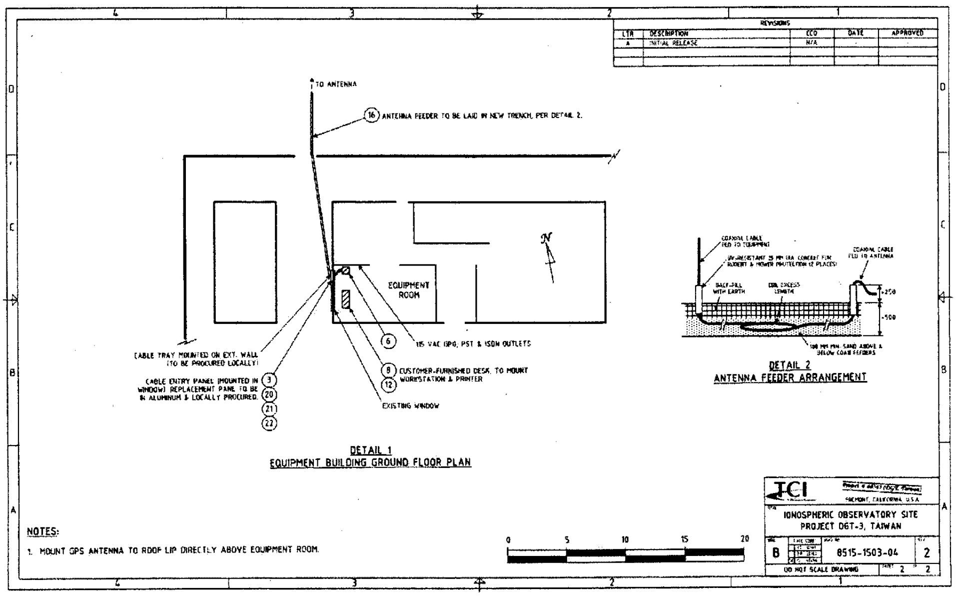
南州監測站天線陣列配置圖



南州監測站機房纜線配置圖



中壢觀測站天線陣列配置圖



中壢觀測站機房纜線配置圖

五、電離層觀測系統資料檔案

本系統採用之電離層觀測系統為 TCI 公司研發製造的 RCS-7D Chirpsounder。RCS-7D 包括一個 BR 3092 控制器模組，可操控接收機所有運作功能。3092 有一個圖形使用者介面，做為現場 RCS-7D 操作與顯示之人機介面。3092 也有一個遙控介面，供外界主電腦遙控 RCS-7D 之應用。遙控操作介面允許遠端電腦操控 RCS-7D 之運作並取得資料。

RCS-7D 與外界遠方控制端間之通訊係經由 3092 之 COM2 埠溝通。3092 之 COM2 埠的特性為 RS-232，9600baud，8-bits，no parity，1 start bit 及 1 stop bit。下表中列有 RCS-7D 與遠端電腦之間的控制命令摘要，詳細之控制命令說明可參考附件 2。

遠端控制命令摘要表

功　能		TO RCS-7D	FROM RCS-7D
		>>>>>	<<<<<
RCS-7D QUERY AND STATUS			
A1	QUERY	"A1"	"A1"+CPU_VERSION(4)
A2	READ SWEEP STATUS	"A2"	"A2"+TIMESTAMP(14) +M+SWEEP_FREQ(3)
A3	READ ERROR MESSAGE	"A3"	"A3"+MESSAGE(32)
A4	READ SWEEP SUMMARY	"A4"	"A4"+SUMMARY(44)
SETUP TIMES			
B1	READ CLOCK	"B1"	"B1"+TIME(6)
B2	SET CLOCK	"B2"+TIME(6)	"B2"
SETUP SWEEP PARAMETERS			
C1	READ PATH DATA	"C1"	"C1"+PATH_DATA(512)
C2	SET PATH DATA	"C2"+PATH_DATA(512)	"C2"
C3	READ START TIMES	"C3"	"C3"+START_TIMES(107)
RANGE DELAY			
D1	READ RANGE DELAYS	"D1"	"D1"+DELAYS(20)
D2	SET RANGE DELAYS	"D2"+DELAYS(20)	"D2"
D3	READ AUTOSYNC AND AUTOSLIP	"D3"	"D3"+AUTOSYNC(8)

D4	SET AUTOSYNC AND AUTOSLIP	"D4"+AUTOSYNC(8)	"D4"
		CHIRPCOMM	
F1	READ CHIRPCOMM MESSAGE	"F1"	"F1"+MSGS(160)
		TEST	
G1	DO RX TEST	"G1"	"G1"+RESULTS(26)
		ADVISORIES FROM THE RCS-7D	
H1	END OD SWEEP		"H1"
H2	POWER-UP		"H2"
H9	PRECISION TIMING INTERRUPT FAULT		"H9"
		DATA READOUT	
J1	READ IONOGRAM SCANLINE	"J1"+SCANLINE(3)	參考附錄 X 中 J1 命令
J2	READ IONOGRAM PATH DATA	"J2"	"J2"+PATH_DATA(128)
		LOCATION INFO	
K1	READ LAT, LONG	"K1"	"K1"+LAT(8)+LONG(9)
K2	SET LAT, LONG	"K2"+LAT(8)+LONG(9)	"K2"

RCS-7D 於執行電離層掃描時，以 100 KHz 之頻率間隔，自 2.0 MHz 至 29.9 MHz 從事掃描，將電離層圖分割成 280 個掃描線，掃描線依掃描頻率自"020"至"299"予以編號。掃描後之電離層圖檔分為低解析度圖檔與高解析度圖檔：RCS-7D 前方面板之圖形使用者介面，利用低解析度圖檔顯示即時之電離層圖；高解析度圖檔則貯存於 RCS-7D 之硬碟中，供單站高頻定位系統之用，或提供一般電離層研究之用。

高解析度電離層圖檔案包括 280 個電離層圖掃描線，每條掃描線包含代表 475 個時間延遲（即虛高距離）之點（畫素）的 475 個位元。每個位元之資料代表該點以 0.5 dB 增量表示之 FFT 振幅。475 位元於時間延遲視窗中涵蓋自 0.000 ms（第一個畫素）至 6.185 ms（最後一個畫素），或每畫素 13.02 μs 之時間延遲。針對支援 SSL HFDF 之近似垂直入射（NVI）探測而言，此相當於 NVI 的 927 km 之虛高範圍，或是每畫素 1.95 km 之虛高距離。

高解析度電離層圖檔亦存於 RCS-7D 之硬碟中，其檔案格式為：

134,400 bytes	包含 280 個電離層掃描片段之二進位電離層圖資料，每個片段含 480bytes： 475 bytes 畫素之 FFT 振幅資料(iiii) + 1 byte 之接收機衰減資料(A) + 1 byte 之 IF 檢測器資料(D) + 3 bytes 之保留位元(RRR)
128 bytes	發射機之 Path 資訊，包括發射站名稱，掃描時程及位置
1 byte	Path 號碼：'1'，'2'，'3'或'4'
8 bytes	RCS-7D 接收機緯度
9 bytes	RCS-7D 接收機經度
5 bytes	Range delay
40 bytes	Chirpcomm 訊息
44 bytes	Sweep Summary

高解析度電離層圖檔存於 RCS-7D 硬碟中之目錄為：

C:\RCS7D\IONOGRAM_ARCHIVE\HI_RES

此目錄為 Windows XP 之分享目錄，該目錄可經由 RCS-7D 之 LAN 介面遙控接取。HI_RES 目錄最多包含 31 個子目錄，每個子目錄以月份中之日期命名如下：

HI_RES\DAY01 到 HI_RES\DAY31

每個日期子目錄中包含一天中 24 小時收集到的所有電離層圖檔，每天最多有 288 個電離層圖檔（最少每 5 分鐘一個檔案）。電離層圖檔依據掃描之開始時刻存於相關日期之子目錄中。電離層圖檔之名稱亦依掃描之開始時刻命名如下：

HIyyyymmddhhnnss.DAT

其中 HI ：高解析度電離層圖檔之檔名標幟

yyyy ：年份（2000 - 2999）

mm ：月份（01 - 12）

dd：日期（01 - 31）

hh：時間（00 - 23）

nn：分鐘（00 - 59）

ss ：秒（00 – 59）

因此高解析度電離層圖檔之全名有如下例所示：

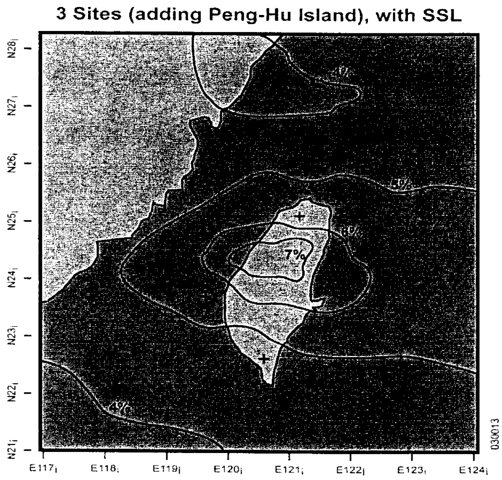
C:\RCS7D\IONOGRAM_ARCHIVE\HI_RES\DAY15\HI20030615224508.DAT

此表示該電離層圖檔係於 2003 年 6 月 15 日 22 時 45 分 08 秒開始掃描的電離層圖。

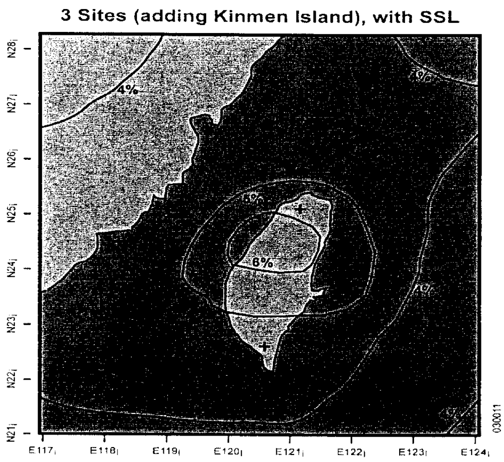
RCS-7D 高解析度電離層子目錄最多可存 8928 個高解析度電離層圖檔，此相當於一個月 31 天，每天每 5 分鐘掃描一次電離層所累積之電離層圖檔之數量。當子目錄存滿時，RCS-7D 將循序清除日期子目錄中的檔案，每日清除一個日期子目錄的檔案，以提供新的電離層圖檔之貯存空間。此表示，一個完整一天的電離層圖檔可貯存於 RCS-7D 硬碟中一個月之久，直到下個月相對應之日期子目錄被新的電離層圖檔覆寫為止。例如：6 月 15 日之電離層圖檔會保存到 7 月 14 日午夜。7 月 15 日 0000 時，存於 DAY15 子目錄中之電離層圖檔，將自動清除以便騰出位置貯存 7 月 15 日收集到的新電離層圖檔。需注意的是，完整的 8928 個高解析度電離層圖檔佔用大約 1.2GB 的硬碟貯存空間。

六、提升定位準確性之探討

本系統經引入 SSL 技術之後，已可達成全方向之定位功能，解決位於台灣南北方向之無線電站台定位之問題，然就定位之準確性而言仍有 8%之定位誤差存在。經與 TCI 公司之相關技術人員探討，增設一處監測站台對定位準確性提升之可行性。下圖分別顯示於澎湖或金門增設一處監測站時，定位誤差百分率之等值線圖。



澎湖增設一處監測站之定位誤差百分率等值線圖



金門增設一處監測站之定位誤差百分率等值線圖

比較上述二定位誤差百分率等值線圖可知：另外於澎湖或金門增加一處監測站，可分別減少定位誤差百分率達 1%至2%。且於金門設站時，因定位三角形比澎湖設站之定位三角行為大，可獲得較佳之定位準確度。

然 HF 頻段之國際電波監測站所需之用地範圍頗大，本局現有之崙坪及南州監測站用地，分別為十公頃及十八公頃，如欲於金門地區尋覓一處佔地寬廣且地面平坦之地點頗不容易。另外，澎湖地區，本局曾多方尋覓，除了軍方用地外，亦無法覓得適當地點。有關另於離島地區增設一處監測站，以提升定位準確性之議題，仍需考量投資成本效益之問題。

七、監測設備工廠測試

TCI 公司提供全球通訊及廣播單位所需之無線電監測及定向系統、頻譜管理系統、通訊及廣播天線系統以及特殊通信系統。針對不同對象之需求，TCI 公司分別從事個案系統相關設備零組件之規劃與設計，至於零組件之產製則委外由其他相關工廠承製，再由 TCI 公司負責組裝，並進行工廠測試。

監測設備之工廠測試過程，分別經由 Test Engineer、Program Manager 及 QA Manager 之控管，並將測試過程建檔歸類（詳附件 3），以供設備送交客戶後之故障追蹤管理。有關設備測試之數據，TCI 公司亦建檔歸類（詳附件 4），並分別經由 Test Technician、Test Supervisor 及 QA Manager 之簽認。TCI 公司亦利用測試數據從事產品設計之品管控制，經由測試數據與原始設計資料之比對，可提供檢測容許範圍之調整，以及檢測參考數據之修正。

監測設備經工廠檢測後，TCI 公司將檢測報告提送 SGS 集團，SGS 集團依據檢測報告從事國際貿易有關之驗證服務，隨後 TCI 公司才將相關設備裝箱送交至客戶。

八、結語

政府因應全球電信自由化之趨勢，近年來致力於推動電信自由化，各類無線電通信器材日新月異。為維持電波使用秩序，防止非法使用電波，最有效之方法即是建立全國電波監測網，有效監測無線電波之使用狀況。

『電波偵測能量計畫』為我國第一套全國電波監測系統之建設案。自民國 85 年電信改制迄今，本局已分別完成無線電頻譜監測系統、無線電定向系統、無線電頻譜管理系統之建設，並完成 13 處新建電波監測站機房之興建，目前正積極從事「國際電波監測系統」之建設。

「國際電波監測系統」已由美國 TCI 公司得標，建設時成為一年。為期順利推展本案設備之安裝、測試、運轉等作業，筆者奉派前往美國參與工程覆核會議及工廠測試作業，與 TCI 公司之工程設計人員詳細討論本案之硬體、軟體結構，監測站儀器、設備安裝環境以及站台/中心資訊傳遞等各項作業之事先準備工作，並參與工廠測試作業，對整個建設案之推動頗多助益。

九、附件

1)：Masters of the Radio Spectrum – TCI, A Dielectric Company

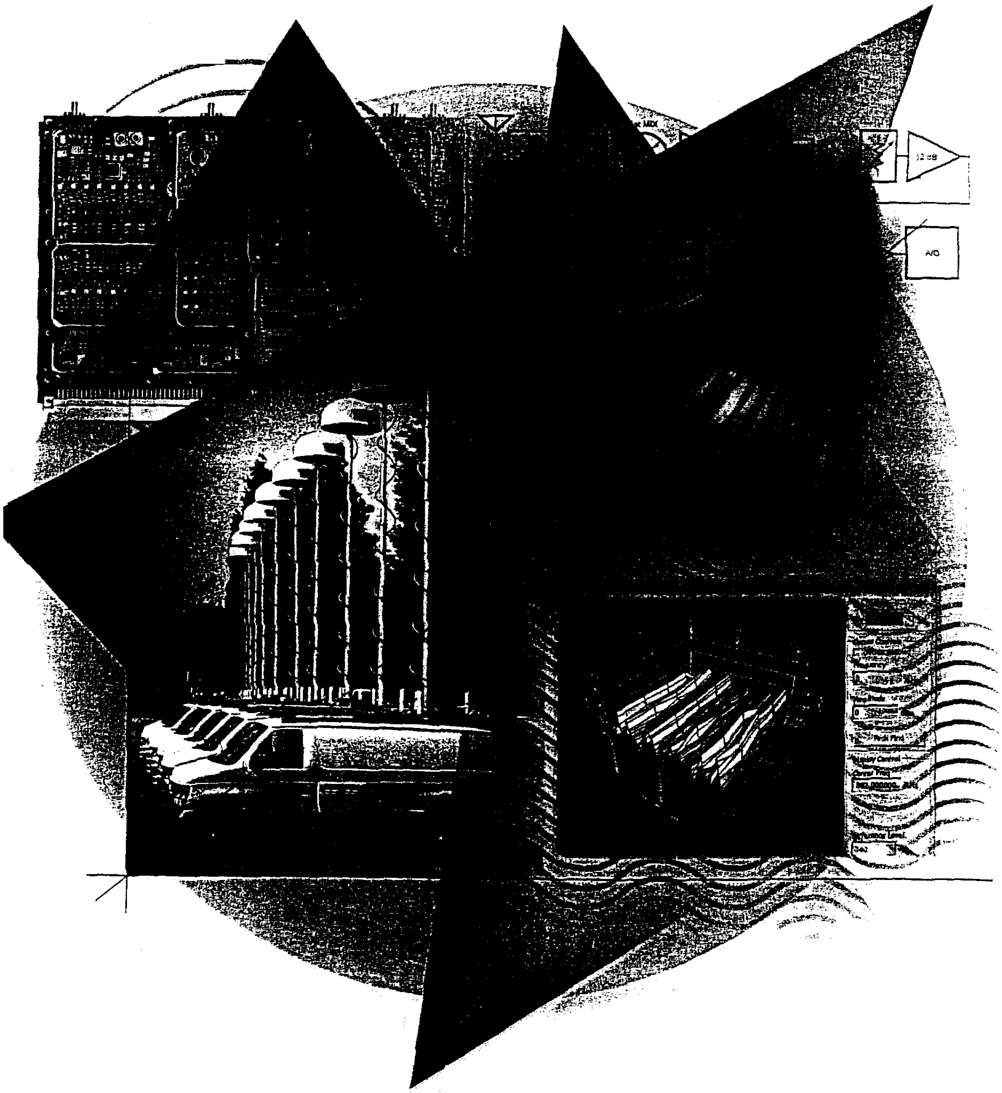
2)：RCS-7D Chirpsounder Receiver – Remote Control Protocol (Includes SSL High Resolution Ionogram Data File Format)

3)：Acceptance Test Procedure – Metrics and DF Instrument Accuracy

4)：Test Procedure Data – 8400-1026 Receiver

附件 1： Masters of the Radio Spectrum – TCI, A Dielectric Company

MASTERS *of the* RADIO SPECTRUM



RADIO SPECTRUM MONITORING AND MANAGEMENT
•
COMMUNICATIONS INTELLIGENCE COLLECTION

TCI
A Dielectric Company

TCI, *the* SPECTRUM MONITORING SPECIALIST

TCI Technology History

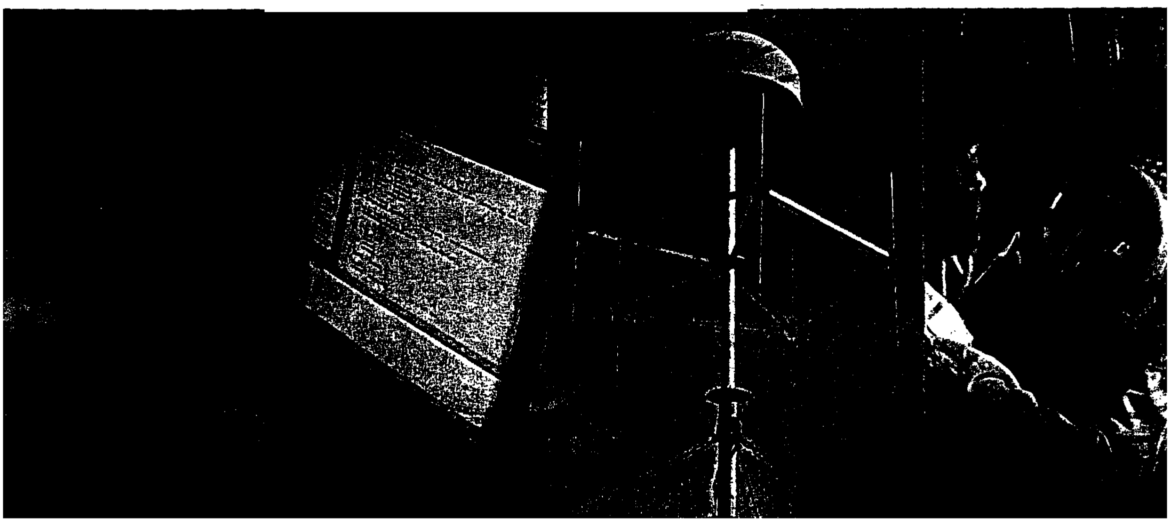
- **2003** First networked V/UHF multi-GHz/s Solution
- **2002** Latest CDAA Installed
- **2001** First Automatic Nationwide Monitoring and DF System
- **2000** First WB HF Solution
- **1999** First high dynamic range WBHF receiver
- **1998** Patent for V/UHF DF Antenna
- **1997** First Wideband VHF/UHF Solution
- **1996** First TCI-developed V/UHF receiver
- **1995** First Spectrum Monitoring and DF System
- **1993** First 24 Channel HFDF System
- **1992** First DSP-based software configurable HF Receiver
- **1991** Patent on N-Channel DF
- **1989** First PC-based HFDF DSP Processor
- **1987** First tactical military DF system deployed
- **1986** First TCI-developed HF Receivers
- **1984** First real-time Single Site Location (SSL)
- **1982** First Tactical COMINT antenna
- **1980** First Strategic COMINT System
- **1979** Wave Front Analysis DF developed
- **1978** First CDAA antenna

For more than 30 years, TCI has been a world leader in the design and manufacture of state-of-the-art, turnkey systems for radio spectrum monitoring and management, radio direction finding, and communications intelligence collection. From developing the first HFDF projects using large circular log-periodic antenna arrays to creating leading-edge V/UHF COMINT systems, TCI has earned a global reputation for engineering excellence, innovation, reliability and service. Today our mobile and fixed-site solutions are at work in both commercial and government applications in more than 100 nations worldwide. Let us show you what we can do for you.

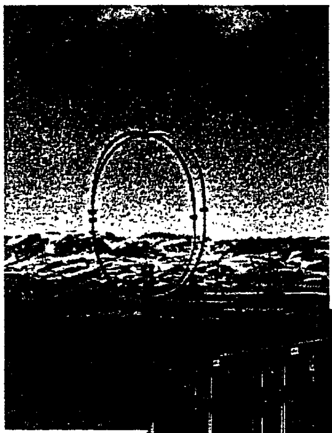
The TCI Technology Difference

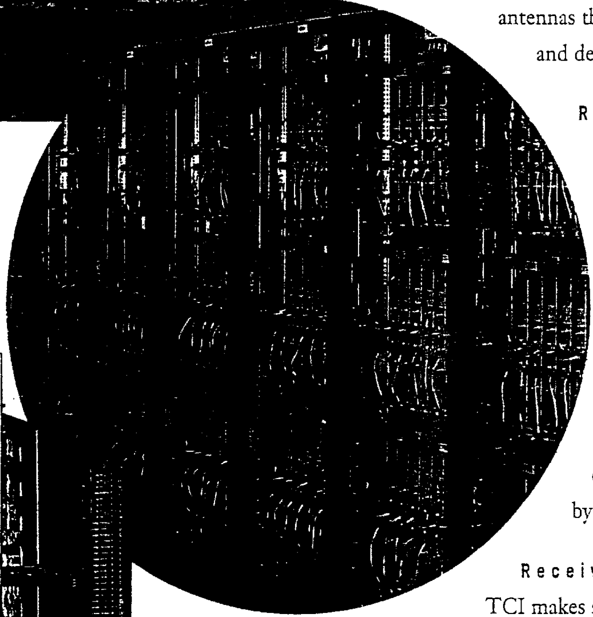
TCI is engineering driven. Nearly 50% of our engineers hold advanced degrees, with an emphasis on our core competencies of innovative antenna design, RF circuits, digital signal processing (DSP) hardware, DSP firmware and application software. This focus and expertise is demonstrated in the outstanding performance and quality of our integrated system solutions.

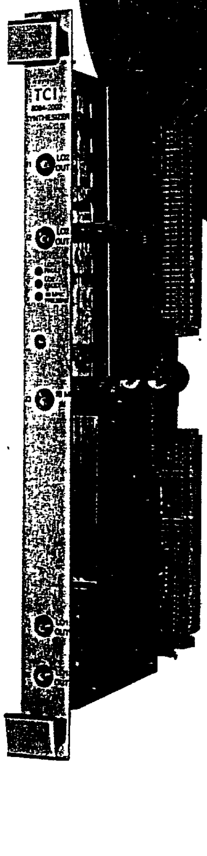
TCI is focused on complete solutions — starting with input signals at the antenna, to the output of user-friendly signal analysis data on networked workstations. Our compact, easy to use and reliable solutions set the industry standard for performance, accuracy, and providing application-specific answers to customer needs.



The TCI BUILDING BLOCKS *of* SIGNAL COLLECTION
(Front End)







To capture a wide range of signals, TCI designs systems tailored to customer requirements utilizing specialized antennas with optimized RF distribution and receiver components.

Antennas

TCI antennas are precision instruments designed to capture a wide range of signals, from 9 kHz to 3 GHz. We build and optimize every TCI antenna for a specific application, including spectrum monitoring, direction finding, communications, and signal intercept. Our extensive use of CAD/CAM enables us to create precision modular antennas that can be installed rapidly, maintained easily, and deliver outstanding performance.

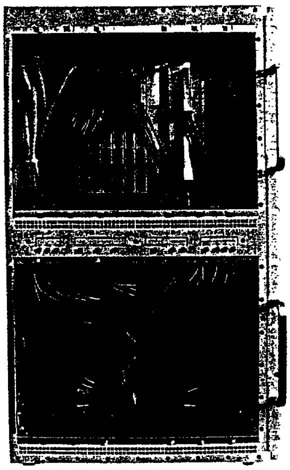
RF Distribution

TCI produces a wide variety of computer-controlled RF distribution systems that simultaneously distribute and switch RF signals from multi-element antenna arrays to any combination of multiple communications receivers, spectrum monitoring systems and DF systems. TCI RF distribution systems are modular, non-blocking, and loss-less devices available for MF/HF or VHF/UHF coverage, and are expandable up to 31-input by 320-switched outputs.

Receivers

TCI makes specialized receivers for communications, DF/Monitoring and COMINT/SIGINT applications. Our receivers feature hybrid designs with high dynamic range analog RF front ends and high-resolution digital back ends. With digital control, they're ideal for distributed and remote computer-controlled radio systems in networked communications and monitoring/DF systems. In the LF/MF/HF and VHF/UHF bands, we offer both conventional narrowband and wideband receivers optimized for modern signal modulations and rapid detection, acquisition, and DF of wideband signals. TCI wideband receivers provide IF bandwidths up to 2 MHz at HF and 12 MHz at VHF/UHF, with processed measurement resolution bandwidths as narrow as 10 Hz.

THE BUILDING BLOCKS *of* SIGNAL COLLECTION
(Back End)



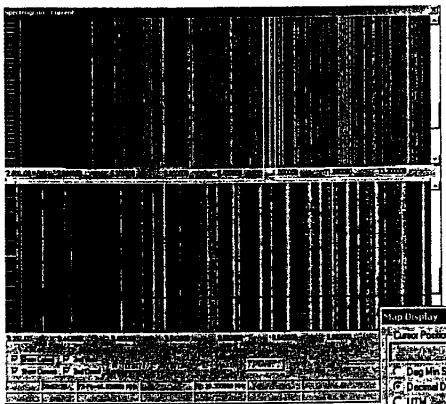
Flexible modular hardware allows systems to be built in a wide variety of configurations matched to the customer's specific needs and budget.

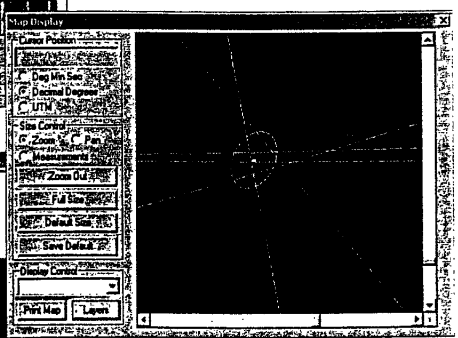
DSP Processing

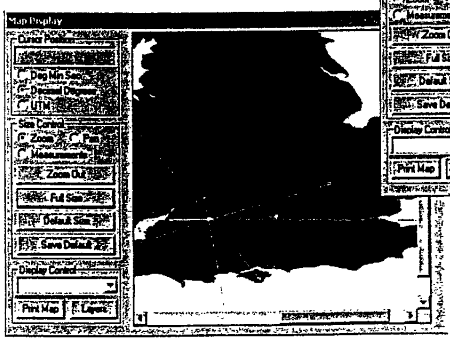
TCI systems feature high-speed, 32-bit Digital Signal Processors with proprietary application-specific firmware that delivers high-performance measurement and signal analysis for a wide range of signal types and environments. By digitizing and analyzing the outputs from LF/MF/HF and VHF/UHF receivers, TCI DSP-based spectrum processors deliver fast, comprehensive signal analysis, simultaneously scanning, detecting, measuring and analyzing RF signals at scan rates up to 4 GHz per second. In addition, the same DSP hardware is used to extract signal metrics, classify signal types, make DF fixes and generate statistical data on signal activity.

Software

TCI has expert in-house application software design and development capabilities. This allows us to create highly integrated and optimized application-specific software for embedded and real-time control, data processing, digital signal processing, database structures, graphical user interfaces and network management. Our software engineers also work closely with our hardware and system engineers to integrate operation of the complete system, including equipment control, signal analysis, and database management and network administration.







Real-time signal displays and annotated graphical maps provide precise and easy to use operator tools for signal identification.

TCI SIGNAL INTELLIGENCE SOLUTION

TCI Raven SIGINT Systems

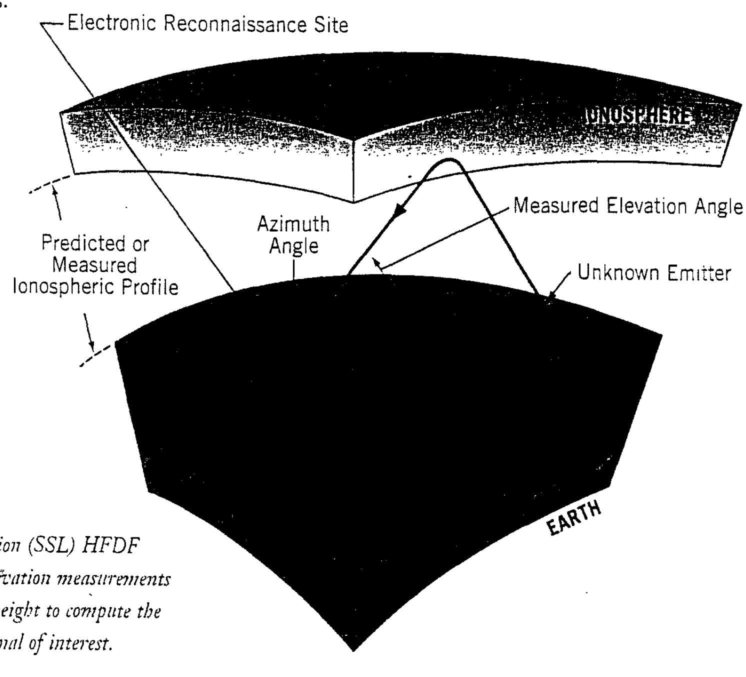
With 25 years experience, TCI addresses the needs of Signal Intelligence with TCI's Raven System architecture. Raven utilizes modular, networked, multiprocessor technology to simultaneously prosecute both traditional narrowband and modern broadband signals in an increasingly crowded and covert signal environment. Raven provides all the measurement and analysis capabilities needed to detect, measure, locate, analyze and archive narrow and wide band-width signals in the HF through UHF bands. TCI builds the complete SIGINT solution. Starting from RF signal propagation and ending with automatic signal analysis, TCI's flexible SIGINT systems provide the operator with powerful and informative answers to mission objectives.

TCI's advanced technology in both the radio front end and digital back end produce SIGINT systems with superior performance, providing a critical 30 dB advantage in system sensitivity and processing up to 100 times faster than traditional systems. Raven multi-channel DF is capable of generating thousands of accurate location fixes per second using either triangulation or Single-Station-Location (SSL) techniques. Raven SIGINT systems include extensive data storage with comprehensive data extraction and post-collection analysis features. The power and versatility of Raven make TCI systems easily adaptable to change for future SIGINT requirements.

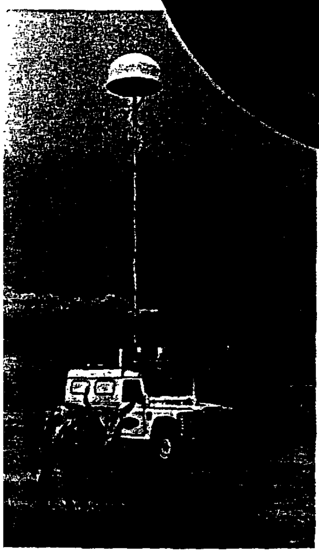
The United Kingdom Radiocommunications Agency (RA) is one of the preeminent agencies establishing many of the monitoring techniques and standards that are adopted around the world.

RA needed a nationwide system that had two objectives: 1) measure and analyze signal occupancy for spectrum allocation purposes, and 2) identify and locate non-compliant transmissions and interference sources. RA expected to purchase two separate systems, but TCI offered a single system that is being developed to meet both needs, thereby reducing RA's purchase cost and improving the efficiency and flexibility of RA operations.

Impressed with TCI's solution, RA purchased 26 TCI Remote Monitoring and DF Systems by the end of 2003, and plans to expand their network to over 35 stations throughout the UK.



TCI's Single-Station-Location (SSL) HFDF system uses azimuth and elevation measurements combined with ionospheric height to compute the distance to the unknown signal of interest.



SOLUTION

Nobody likes having a favorite TV sitcom or soap opera interrupted. When the Namibian Communications Commission (NCC) began receiving complaints about service problems on the local paid TV program channel, they launched an investigation. They had no luck locating the problem until they acquired a TCI Mobile Monitoring System.

The TCI Mobile Monitoring System easily navigated the rugged northern Namibian terrain to monitor the signal around the town of Oshakati. In a short time, the TCI system identified the interference, triangulated the source, and located the offending transmitter. Using data recorded by the Mobile Monitoring System, the NCC ordered the operator of the offending transmitter to correct the problem and eliminate the interference.

Spectrum Monitoring

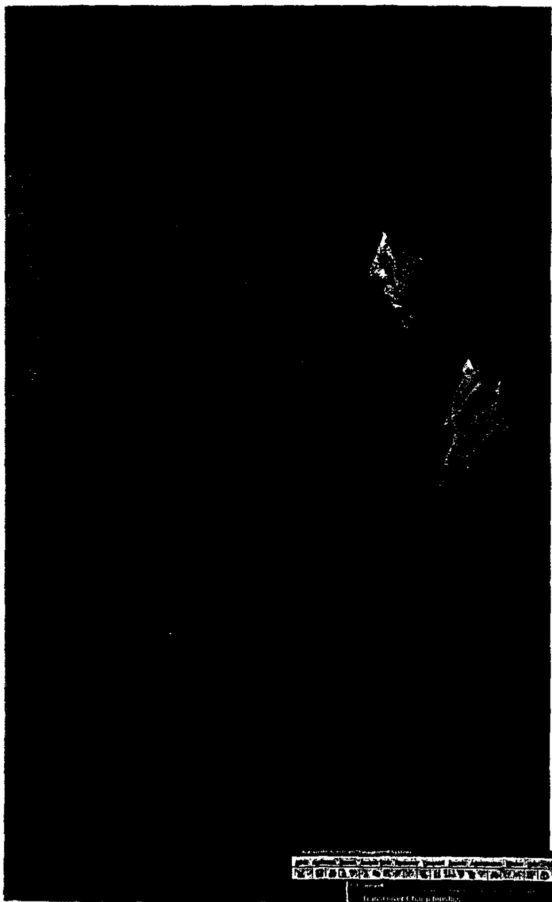
As the radio spectrum becomes more valuable and crowded, regulatory agencies face the increasingly complex challenge of spectrum management and associated compliance monitoring. TCI is the only U.S. supplier of integrated Spectrum Management and Monitoring solutions that let agencies plan, administer and control the use of their radio spectrum.

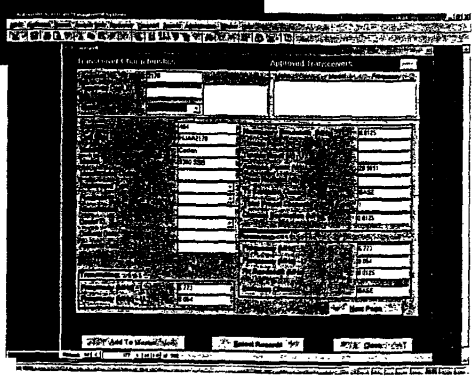
Our industry-leading systems meet the latest International Telecommunications Union (ITU) recommendations, and provide integrated management and monitoring capabilities, with administration and planning tools to detect violations, track down illegal operators, and verify that licensees are complying with approved standards.

For applications where precise spectrum monitoring and direction finding are needed, the TCI Scorpio Spectrum Monitoring and DF System is the cost-effective, high-performance solution. Scorpio covers the 20 to 3000 MHz frequency range, with options down to 9 kHz and up to 40 GHz. This advanced system automatically surveys the spectrum and then simultaneously measures, locates and quantifies all signal activity, for both traditional and modern digital signals, including wide-band signals. All signal measurements are stored in a built-in database, which is automatically analyzed to produce an extensive and powerful set of operator displays and reports. Standard displays and reports include channel occupancy, signal amplitude and bandwidth metrics, transmission and occupancy statistics, and emitter location.

Scorpio systems can be installed in fixed or mobile platforms. In mobile applications, Scorpio's unique DF homing capability continually updates a map and directional display of the line of bearing to the emitter relative to the vehicle while the vehicle is moving. This allows the operator to drive toward the targeted transmitter without having to stop to take stationary DF measurements.

SPECTRUM MANAGEMENT





An ASMS operator uses TCI's powerful and versatile Spectrum Management software with comprehensive map displays to review radio frequency spectrum usage.

Spectrum Management

TCI's highly integrated Automated Spectrum Management Systems (ASMS) provide regulatory and telecom organizations worldwide with the technology needed to manage spectrum usage and generate revenues. Our powerful and versatile Spectrum Management software automates RF spectrum allocation tasks that are compliant with local and international regulations. ASMS provides comprehensive administrative, analysis, map display, and accounting capabilities that regulators need to efficiently process license applications, and issue frequency assignments, notices, invoices, fees, fines, and reports. TCI ASMS solutions are easy and economical to use and upgrade, and are available in ITU-compliant configurations.

Support

To get your TCI system up and running as quickly as possible, TCI provides exactly the level of service you need. We can assist you with equipment and site planning, plus installation and training on your system, ensuring that the system meets your requirements. After installation, TCI is committed to the long-term support of the system and the customer.

Our ability in designing, building, and installing turnkey systems quickly and efficiently is based on our unique interdisciplinary approach.

For details, contact TCI Marketing at *tcisolutions@dielectric.spx.com*, or call +1.510.687.6100. See how you can *master the spectrum* with TCI.

附件 2： RCS-7D Chirpsounder Receiver – Remote Control Protocol (Includes SSL High Resolution Ionogram Data File Format)

REVISIONS			
LTR	DESCRIPTION	DATE	BY/APPD
A	Release	07 JAN 04	

RCS-7D
CHIRPSOUNDER RECEIVER
REMOTE CONTROL PROTOCOL

Includes SSL High Resolution Ionogram Data File Format

DR Dave Mansoir	07 JAN 04	APPD Roy Sasselli		07 JAN 04
CHK		APPD D.C. Smith		07 JAN 04
		TCI BR Communications		
		TITLE RCS-7D CHIRPSOUNDER RECEIVER REMOTE CONTROL PROTOCOL		
		SIZE	NUMBER	REV
USED ON	NEXT ASSY	A	K11193	A
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RCS-7D CHIRPSOUNDER ® RECEIVER
Remote Control Protocol

TCI/BR
Drawing Number K11193
Rev. A

1 SCOPE

This document provides interface specifications for the remote control of, and data readout from, the BR Communications model RCS-7D Chirpsounder Receiver. The RCS-7D includes a BR model 3092 Controller which controls all operating functions of the receiver. The 3092 provides a graphical user interface for the local man-machine-interface (MMI) for the RCS-7D operating controls and displays. The 3092 also provides a remote interface to an external (host) computer for applications requiring remote control of the RCS-7D. This document describes the protocol between the 3092 and an external computer for remote control of the RCS-7D.

2 OVERVIEW

The remote control interface allows a remote computer to control the RCS-7D's operation, and to obtain data from it.

The 3092 is built from an industrial-grade, PC (Pentium-based) computer which includes the RCS-7D operating system applications software and special hardware interfaces to the 8074 HF Receiver and the external (host) remote controlling computer. The RCS-7D application software runs under the Microsoft Windows XP® operating system. The RCS-7D control program appears as a window that shows status and ionogram graphics.

The remote control interface with the RCS-7D is a full-duplex RS-232 serial data link.

3 INTERFACE SPECIFICATIONS

3.1 ELECTRICAL/PHYSICAL

Communications between the RCS-7D and an external remote controller is made via the COM2 port of the 3092. The 3092 COM2 port is configured for RS-232, 9600 baud, 8-bits, no parity, one start and one stop bit. Refer to the 3092 Operating and Service Manual for location and pinout information for the COM2 port.

3.2 OPERATIONAL

With the exception of the RESTART command, all commands and data passing between the computer and the RCS-7D are contained in blocks of ASCII characters. Each block of a command must begin with a left parenthesis character '(', the start delimiter. This is followed by 2 or 3 characters specifying the command to be executed, followed by data (if necessary to carry out the command). Next is a checksum character. The last character in the block must be a right parenthesis ')', the end delimiter. For example, the Query command string sent to the RCS-7D would be: (A1r) where "A1" is the command and "r" is the checksum. Note: do not use braces { } or brackets [ ] in place of parenthesis ( ) for the command string delimiters.

All characters in the command block should be sent out at one time. Except in the event of a detected transmission error, the RCS-7D will not respond to a command until the entire block has been received.

The response block from the RCS-7D to the remote controller follows the same format as the command block: a left parenthesis, an echo of the command codes, data, checksum character and a right parenthesis.

The normal sequence for commands is that the host initiates the command, the RCS-7D acts upon the command, and then the RCS-7D returns a response indicating that it has acted upon the command or returns the requested data. Since some commands are initiated by the RCS-7D, such as advisories, it is possible for such a command to occur at a time when the host is expecting a response to a host initiated command. All blocks have delimiters and command codes whether the block is a command or a response. There is no ambiguity as to whether the block is a command from the RCS-7D or a response to a host initiated command since the command codes are unique. The host software must allow for the possibility that a RCS-7D initiated command can occur at any time. This does not mean that the blocks can be fragmented; the blocks can be expected to remain intact.

Note: In order to allow the possibility of binary data to be sent, an escape sequence scheme is used. When binary data is being sent, it is possible for some data values to appear as the start delimiter '(' or end delimiter ')'. To avoid prematurely terminating the block of data or beginning a new block, a special escape character with the value of FE hex is inserted before each data byte that has a value equal to the start delimiter '(' or the end delimiter ')'. When the escape character is received, the next character is treated as data, and not checked for a match with the start or end delimiter. The escape character FE hex is also used to send a data value of FE hex by inserting the escape character FE hex in front of the data value FE hex. That is, at the receive end, a pair of FE hex characters would be interpreted as one binary data value of FE hex.

The command/data protocol for the RCS-7D device is described in Table 1 and section 3.3 of this document.

Several terms and abbreviations used in the interface description require definition for clarity. All remote control commands and data (except binary data) are standard printable ASCII characters. Printable ASCII characters are listed within quotes (e.g. "A"). The term ASCII digit is used when numeric information is needed, i.e. "0" to "9".

Special control functions (such as RESTART) may use non-printable ASCII control codes. ASCII control codes are listed using standard ASCII nomenclature. Control codes may be generated on ANSI compatible CRT terminals by pressing the CTRL key in conjunction with another key. Control codes that may be used by the RCS-7D are:

Name	ASCII function	Hex	Terminal Entry
ENQ	Enquiry	05H	control E
ACK	Acknowledge	06H	control F
BEL	Bell or alarm	07H	control G
BS	Backspace	08H	control H
HT	Horizontal tab	09H	control I
LF	Line feed	0AH	control J
VT	Vertical tab	0BH	control K
FF	Form Feed	0CH	control L
CR.	Carriage return	0DH	control M

A command code of "!" from the RCS-7D means that there was an error in receiving the command block. An error code character (or characters) indicating the exact nature of the error follows the "!" character:

"A" MISSING START OF BLOCK DELIMITER
This code indicates that the RCS-7D received characters other than the start of block character (left parenthesis) when it was expecting a new block to start. All characters received until the next start of block character will be ignored.

"B" MISSING END OF BLOCK DELIMITER
This code indicates that the RCS-7D received a start of block character while it was still expecting an end of block character (right parenthesis) to end the previous block. The data from the previous block is flushed, and a reception of a new block is started.

"C" BLOCK OVERFLOW
This code indicates that the amount of characters received following a start of block character is larger than the maximum allowed by the protocol. The maximum number of bytes allowed in a command block to the RCS-7D is 1024 bytes. If 1024 bytes have been received without an end of block character, an overflow condition exists and the block and all following characters until the next start of block character will be flushed.

"D" UNRECOGNIZED COMMAND CHARACTER
This code indicates that an illegal command character was received from the remote controller.

"E" CHECKSUM ERROR
This code indicates that a checksum error was detected.

"F" UNABLE TO COMPLETE COMMAND
This code indicates that the last command sent could not be completed, either because the data received contained a value that is not permitted for the command, or because the RCS-7D is not in the right state to execute the command.

If an "F" error code is received, more detailed information regarding the error may be obtained by sending the READ ERROR MESSAGE command (see command descriptions in Tables 1 and section 3.3). This command returns a 32-character string containing a descriptive message of what the error was. This feature is intended for use as a debugging aid during the development of the remote controller's interface software.

The RESTART command, which consists of four consecutive VT (vertical tab) characters, causes the RCS-7D to abort any data transmission that may be in progress and to reset itself. Note that this command is not enclosed in block delimiters. The response is a single VT (vertical tab) not enclosed in block delimiters. Any sweep that may be in progress will be aborted. The RCS-7D resets itself after sending the VT. Allow at least 60 seconds after receiving the VT for the RCS-7D to reset. A power up advisory will be sent after the RCS-7D has completed its reset sequence.

A checksum value is sent to verify that the received data is error-free. The checksum value is calculated as an 8-bit binary sum of all transmitted data characters excluding the enclosing left and right parentheses. Carries out of the most significant bit are discarded, and are not added back into subsequent sums. While data is being received, a running sum is calculated. The received checksum character is compared to the calculated checksum value.

The 8-bit binary checksum value may range from 0 to FF (expressed in hexadecimal). As data transmitted over the serial link must be in ASCII, the two most significant bits are masked out of the checksum value. Six significant bits are used to detect transfer errors. The checksum value is sent with bit 7 set to 0 and bit 6 set to 1, resulting in ASCII character "@" (40H) to DEL (delete control character = 7FH). Bits 0 to 5 contain the binary checksum value. This guarantees that the checksum value is not a reserved ASCII control character, and is not a block delimiter character.

Table 1 provides ASCII command codes and defines qualifying data by name with the number of bytes indicated in parentheses. If the qualifying data is a single byte, no parenthetic value is included. For example, ID(4) is four bytes and NUM is a single byte value.

TABLE 1 - REMOTE CONTROL COMMAND SUMMARY

Note: the checksum and start and end delimiters have been omitted for clarity.

	FUNCTION	TO RCS-7D >>>>>	FROM RCS-7D <<<<<
RCS-7D QUERY AND STATUS			
A1	QUERY	"A1"	"A1" + CPU_VERSION(4)
A2	READ SWEEP STATUS	"A2"	"A2" + TIMESTAMP(14) + M+ SWEEP_FREQ(3)
A3	READ ERROR MESSAGE	"A3"	"A3" + MESSAGE(32)
A4	READ SWEEP SUMMARY	"A4"	"A4" + SUMMARY(44)
SETUP TIMES			
B1	READ CLOCK	"B1"	"B1" + TIME(6)
B2	SET CLOCK	"B2" +TIME(6)	"B2"
SETUP SWEEP PARAMETERS			
C1	READ PATH DATA	"C1"	"C1" +PATH_DATA(512)
C2	SET PATH DATA	"C2" + PATH_DATA(512)	"C2"
C3	READ START TIMES	"C3"	"C3" + START_TIMES(107)

RANGE DELAY

D1	READ RANGE DELAYS	"D1"	"D1" + DELAYS(20)
D2	SET RANGE DELAYS	"D2" + DELAYS(20)	"D2"
D3	READ AUTOSYNC AND AUTOSLIP	"D3"	"D3" + AUTOSYNC(8)
D4	SET AUTOSYNC AND AUTOSLIP	"D4" + AUTOSYNC(8)	"D4"

CHIRPCOMM

F1	READ CHIRPCOMM MESSAGES	"F1"	"F1" + MSGS(160)

TEST

G1	DO RX TEST	"G1"	"G1" + RESULTS(26)

ADVISORIES FROM THE RCS-7D

H1	END OF SWEEP		"H1"
H2	POWER-UP		"H2"
H9	PRECISION TIMING INTERRUPT FAULT		"H9"

DATA READOUT (Refer to Section 4 for Hi-Resolution ionogram data readout)

J1	READ IONOGRAM SCANLINE	"J1" + SCANLINE(3)	see description of J1 command
J2	READ IONOGRAM PATH DATA	"J2"	"J2" + PATH_DATA(128)

LOCATION INFO

K1	READ LAT	"K1"	"K1" + LAT(8) + LONG(9)

	LONG		
K2	SET LAT LONG	"K2" + LAT(8) + LONG(9)	"K2"

3.3 REMOTE CONTROL COMMAND DETAILS

GREETINGS AND STATUS

These commands allow the remote control device to verify connection of the RCS-7D, and to check its status.

A1 QUERY

This command allows the remote controller to read the software version of the RCS-7D. Unlike some BR instruments, the RCS-7D does not require a greeting command before it will respond to other remote control commands. This QUERY command, however, can be used to ascertain whether or not an RCS-7D is connected.

CPU_VERSION (4 bytes)
Four alphanumeric characters containing the version number of the main CPU software. For example, "V", "0", "1", "A".

A2 READ SWEEP STATUS

This command returns the status of the current sweep.

TIMESTAMP (14 bytes)
The current time expressed in ASCII digits for year, month, day, hours, minutes, and seconds.
4 bytes for year (e.g. 1999)
2 bytes for month
2 bytes for day
2 bytes for hours
2 bytes for minutes
2 bytes for seconds.

M (1 byte)
An ASCII character indicating the sweep status:
"m" = not sweeping
"M" = rx sweeping

SWEEP_FREQ (3 bytes)
3 ASCII digits indicating the current sweep frequency. The first digit is tens of MHz. The last digit is hundreds of kHz. All three digits are set to zeroes if not sweeping.

A3 READ ERROR MESSAGE

This command returns a string containing a detailed error message.

MESSAGE (32 bytes)
String of ASCII characters providing more detailed information regarding the error status of the last command sent. If the previous command received from the remote controller resulted in an "unable to complete command" error (code "F") this string will contain a description of why the command could not be completed. If the previous command was completed successfully, or if one of the other error codes was returned (such as "checksum error" or "unrecognized command"), the string will consist of all blanks.

This command is intended solely for use as a debugging aid during the development of the remote controller's interface software. The exact wording of messages is not defined, and is subject to change without notice. Therefore, if the released version of the remote controller software makes use of this command, it should not use the error message for any purpose other than to display it.

A4 READ SWEEP SUMMARY

This command returns a summary of status conditions of the Receiver.

SUMMARY (44 bytes)
The summary consists of 44 ASCII characters in the following order:

4 bytes year of sweep start time
2 bytes month of sweep start time
2 bytes day of sweep start time
2 bytes hours of sweep start time
2 bytes minutes of sweep start time
2 bytes seconds of sweep start time
2 bytes sweep start frequency (e.g. for 2 MHz low limit, "02")
2 bytes sweep stop frequency
2 bytes sweep parameter ("00" for 50 kHz/sec,
"01" for 100 kHz/sec, "02" for 125 kHz/sec)
1 byte "S" = Synth_Lock_OK
1 byte "X" = DSP_OK
1 byte "L" = Temp_OK
1 byte "T" = Ext_1_pps_OK
1 byte "P" = DC_Power_OK
1 byte "K" = Rx_Calib_OK
1 byte "R" = internal 10 MHz, "r" = external 10 MHz
1 byte "G" = GPS_OK
1 byte "Y" = Disciplined oscillator Freq_OK
4 bytes Disciplined oscillator freq error (FEDPERIOD)
1 byte "Z" = Disciplined Oscillator Tuning_OK
4 bytes Disciplined oscillator tuning voltage (DACCOUNT)
6 bytes Elapsed time, in seconds, since last power-on reset

All status codes with labels ending in _OK are upper case when the condition is OK and lower case when an error or fault occurs. For example, "s" indicates that the synthesizer is out of lock.

SETUP TIMES

These commands allow the remote controller to read and set various RCS-7D parameters related to time.

B1 READ CLOCK
B2 SET CLOCK

TIME (6 bytes)
Six ASCII digits indicating the current time in hours, minutes, and seconds in 24-hour format. The first digit is tens of hours. The last digit is ones of seconds. Valid range of time values is 00:00:00 to 23:59:59.

SETUP SWEEP PARAMETERS

C1 READ PATH DATA
C2 SET PATH DATA
These commands read/set the information of the chirp transmitters being received. The information includes the name or call sign of the chirp transmitter, the first start time and repeat interval of its sweeps, and lat and long of its location. Four records are used, one for each path from a chirp transmitter. The records are terminated by carriage return and linefeed. Within each record, the fields are delimited by tab characters.

PATH_DATA(512 bytes)
Four records, 128 bytes each. Each record is a string of ASCII characters with fields separated by horizontal tabs (09H) and ending with carriage return (0DH) linefeed (0AH).

The first record is for path 1, the second is for path 2, etc.
Each record consists of the following nine fields:

First Field (25 bytes) = name or call sign of the chirp transmitter. Unused characters must be filled by blanks.
Tab (1byte)

Second Field (10 bytes) = first sweep start of the hour specified in minutes, seconds and fractional seconds in the following format: 2 digits of minutes, colon, 2 digits of seconds, decimal point, and 4 digits of fractional seconds (for example, 00:01.9999). The range is 0 to 60 minutes.
Tab (1byte)

Third Field (2 bytes) = repeat interval in minutes. Two digits of minutes with a range from 05 to 60.
Tab (1byte)

Fourth Field (8 bytes) = latitude of location of chirp transmitter in degrees and decimal degrees. Positive is north, negative is south. The first character is the sign. This is followed by 2 characters for degrees, then a decimal point, and then 4 digits of decimal degrees. Leading and trailing zeros are added as necessary to pad the field to the required number of characters. If the latitude is unknown, the field is filled with blanks.
Tab (1byte)

Fifth Field (9 bytes) = longitude of location of chirp transmitter in degrees and decimal degrees. Positive is east, negative is west. . The first character is the sign. This is followed by 3 characters for degrees, then a decimal point, and then 4 digits of decimal degrees. Leading and trailing zeros are added as necessary to pad the field to the required number of characters. If the longitude is unknown, the field is filled with blanks.
Tab (1 byte)

Sixth Field (1 byte) = 'G' indicates transmitter timing is derived from GPS; 'g' indicates that no GPS is available for timing.
Tab (1 byte)

Seventh Field (3 bytes) = sweep rate. 3 characters of decimal digits specifying the sweep rate in kHz/sec. The following are defined:

" 50", where the first character is a blank, is 50 kHz/sec
"100" is 100 kHz/sec
"125" is 125 kHz/sec

Tab (1 byte)

Eighth Field (2 bytes) = end limit. 2 characters of decimal digits specifying the end sweep limit in integer MHz. Single digit values can have a leading zero or blank. Valid values are from 3 to 30 MHz.
Tab (1 byte)

Reserved (Ninth) Field (58 bytes) = this is a reserved field that can be used in the future for adding new fields. It is currently filled with blanks.

Carriage Return and Linefeed (2 bytes)

Note: An unused path is indicated by a value of 09H (horizontal tab) in the first character of the first field of the record. This indicates that this path is not being used to receive any chirp transmitter. The remainder of the fields should be set to blanks. Each record must still be terminated by carriage return and linefeed. Unused paths must appear at the end after valid paths. That is, if only one path is used, it must be placed in path 1 and its data record must be the first record. The remaining records must indicate unused paths. When the RCS-7D examines the Path Data records it will stop at the first unused path. For example, if the first record indicates an unused path, it stops there and assumes that all paths are unused. It does not exam the remaining records for other valid paths.

C3 READ START TIMES

This command reads the start time information which consists of 3 records. The first record is a list of 12 sweep start times. The second record is a list of 12 path numbers that correspond to the 12 sweep start times. The third record is a list of 4 path offsets.

START_TIMES(107 bytes)
Three records, each a string of ASCII characters with fields separated by horizontal tabs (09H) and ending with carriage return (0DH) linefeed (0AH).

The first record (61 bytes) consists of 12 fields of start times specified in integer seconds relative to the start of the hour. Each field is 4 characters wide. Integers with fewer than 4 digits are filled with leading zeros. The range of the start times is 0000 to 3600.

The second record (25 bytes) consists of 12 fields of path numbers that correspond to the 12 start times. The path numbers can have the values 1,2,3 and 4 corresponding to paths 1,2,3, and 4. A value of 0 indicates that no sweep occurs.

The third record (21 bytes) consists of 4 fields of path offsets specified as integer numbers representing the fractional seconds of start time offset in units of 0.1 mSec. Each field is 4 characters wide. Integers with fewer than 4 digits are filled with leading zeros. These numbers have a range from 0000 to 9999.

Note: If fewer than 12 sweeps per hour are scheduled, the unused start times will contain entries of 3600 seconds and the corresponding path numbers will contain entries of 0.

RANGE DELAY

D1 READ RANGE DELAYS
D2 SET RANGE DELAYS

These commands read and set the range delay time (the expected propagation time from the transmitter to the receiver). The range delay time is specified by a sign and 4 digits-- the first digit is hundreds of milliseconds, the second is tens of milliseconds, the third is ones of milliseconds, and the fourth is tenths of milliseconds. This range delay is the value of the propagation delay at the baseline time delay point. On the ionogram display, the baseline is the 5th pixel up from the bottom, marked by the first tick mark along the left edge of the ionogram display. See the description of the J1 command for determination of the absolute time delay values for the points in the ionogram data.

DELAYS (20 bytes)
Four range delays, each expressed as sign and 4 ASCII digits.

1 byte sign, must be either '+' or '-'
1 byte 100's of milliseconds
1 byte 10's of milliseconds
1 byte 1's of milliseconds
1 byte tenth's of milliseconds

The first range delay is for path 1, the second is for path 2, etc.

Note: The range delays of the 4 paths are recalculated and updated by the RCS-7D automatically once every hour. The host computer can override these updates by sending SET RANGE DELAY commands more often than once per hour. Whenever the range delay is set, a timer is retriggered to time a one hour interval. If the one hour interval elapses, the RCS-7D will recalculate and update the range delay. Thus the internal updating can be overridden by retriggering the timer with set commands.

Note: Under normal circumstances, the range delay will be positive. But it is possible under unusual situations, such as the clocks of either transmitter or receiver being off, that the receiver finds a signal at an effective negative range delay.

D3 READ AUTOSYNC AND AUTOSLIP
D4 SET AUTOSYNC AND AUTOSLIP

These commands read and set the autosync and autoslip enable or disable flags for each of the 4 paths.

AUTOSYNC(8)
The first group of 4 characters control autosync. An 'E' character enables autosync for the path. A 'D' character disables autosync for the path. The first character of the group of 4 corresponds to path 1, the last character corresponds to path 4.

The last group of 4 characters control autoslip. An 'E' character enables autoslip for the path. A 'D' character disables autoslip for the path. The first character of the group of 4 corresponds to path 1, the last character corresponds to path 4.

CHIRPCOMM

F1 READ CHIRPCOMM MESSAGES

This command reads the 4 completed Chirpcomm messages that are stored one for each path.

MSGS(160 bytes)
Four Chirpcomm messages, each 40 characters long.
This first 40 characters are for path 1, the next 40 characters are for path 2, etc.

TEST

G1 DO RX TEST

This command invokes the diagnostic Self-Test of the receiver. The self-tests are automatically performed at the end of each sweep, and the results are stored in RCS-7D memory. When the RCS-7D receives a Self-Test command, the RCS-7D immediately returns the stored results of the previous test, regardless of the current operating state of the sounder. However, if no sweep is in progress, a Self-Test command will also initiate a new test, and the results of the new test will be stored in memory. To read the results of this remotely-initiated test, a second Self-Test command must be issued to read the stored results. However, if a new Self-Test command is received before the equipment BIT/BITE has finished the test sequence, the previously stored results will be reported, and not the results of the of the current test in progress. If current test results from a remotely-initiated test are required, two Self-Test commands must be sent at least 10 seconds apart. The first command initiates the test (and reports previous results), and the second command reports the results of the test initiated by the first command. If a sweep is in progress, the command does not interrupt the sweep, and no new tests are performed until the sweep ends.

RESULTS (26 bytes)

These are results of the previous test of the Receiver.

4 bytes year of time stamp when test was performed
2 bytes month of time stamp when test was performed
2 bytes day of time stamp when test was performed
2 bytes hours of time stamp when test was performed
2 bytes minutes of time stamp when test was performed
2 bytes seconds of time stamp when test was performed
1 byte "S" = Synth_Lock_OK
1 byte "X" = DSP_OK
1 byte "L" = Temp_OK
1 byte "T" = Ext_1_pps_OK
1 byte "P" = DC_Power_OK
1 byte "R" = internal 10 MHz, "r" = external 10 MHz
1 byte "C" = ADC Test
1 byte "D" = IF Detector Test
1 byte "E" = IF Passband Test
1 byte "F" = HF Comb Calibrator Test
1 byte "N" = Noise Test
1 byte "W" = DSP FFT Output Test

An uppercase letter indicates that the test item or category passed. A lower case letter indicates that it failed.
All status codes with labels ending in _OK are upper case when the condition is OK and lower case when an error or fault occurs. For example, "s" indicates that the synthesizer is out of lock.

ADVISORIES FROM THE RCS-7D

H1 END OF SWEEP

This advisory indicates that a sweep has completed and the host can ask for ionogram data using the J.1 command and sweep summary data using the A.4 command.

H2 POWER-UP

This advisory indicates that the RCS-7D has completed a reset sequence due to either a power-up condition or restarting the software by the user or remote command.

H9 PRECISION TIMING INTERRUPT FAULT "H" + "9" + CKSUM

This advisory indicates that the 55 Hz timing interrupt of the RCS-7D is not functioning properly. Sweeps cannot be run while in this condition. This advisory is sent approximately every 3 seconds until the fault is corrected.

DATA READOUT

J1 READ IONOGRAM SCANLINE

This command reads out ionogram data from the receiver. The ionogram data is divided into scanlines of frequency slices covering 100 kHz of sweep. The number of the scanline (a number representing 100 kHz of sweep) must be specified in the command.

SCANLINE(3 bytes)
The number of the scanline. The range is "020" through "299" corresponding to 2.0 MHz through 29.9 MHz. For example, the scanline covering 5.0 to 5.1 MHz is identified as "050"

The reply from the RCS-7D consists of a header immediately followed by binary data. The block is formatted as follows:
(J1fffhhmmsslluupqsrrrrBinaryData c)

J1 = echo of command
fff = scanline number (e.g. for scanline covering 2.0 - 2.1 MHz, fff = "020")
hh = hours of sweep start time
mm = minutes of sweep start time
ss = seconds of sweep start time
ll = sweep start frequency (e.g. for 2 MHz low limit, ll = "02")
uu = sweep stop frequency (e.g. for 30 MHz hi limit, uu = "30")
p = path number (p = "1" for path 1, p = "2" for path 2, etc.)
q = sweep parameter (q = "1" for 100 kHz/sec)
srrrr = range delay (range delay as described in D1 command description)
BinaryData = scanline data: iiii ADCRR
c = checksum character (checksum as described in section 3.2)

The binary data consists of scanline data for one scanline consisting of 200 bytes of FFT amplitude data (iiii), one byte of Rx attenuation (A), one byte of IF detector value (D), one byte of Chirpcomm signal-to-noise ratio (C), and 2 bytes reserved (RR).
The binary data is followed by a checksum character (c) calculated as described in section 3.2 (binary sum of all data bytes starting with J1 including escape characters but excluding the start and end delimiters, keeping only the 6 least significant bits 0-5, and setting bit 7 to 0 and bit 6 to 1).

Note: Because the implementation uses null terminated strings, zeros are not allowed in the binary data. To avoid sending zeros in the binary data, a value of 1 is added to all binary data values before being sent. This applies to binary data values only, not to the header, the delimiters, the FE escape character, nor the checksum byte. On receive, all binary data values should be decremented to get back the original value.

Note: Because binary data is being sent, it is possible for some data values to appear as the start delimiter '(' or end delimiter ')'. To avoid prematurely terminating the block of data or beginning a new block, a special escape character with the value of FE hex is inserted before each data byte that has a value equal to the start delimiter '(' or the end delimiter ')'. When the escape character is received, the next character is treated as data, and not checked for a match with the start or end delimiter. The escape character FE hex is also used to send a data value of FE hex by inserting the escape character FE hex in front of the data value FE hex. That is, at the receive end, a pair of FE hex characters would be interpreted as one binary data value of FE hex.

The FFT amplitude data (iiii) are the amplitudes of 200 time delay cells covering the ionogram range window for each 100 kHz frequency slice of the sounder sweep. Each byte is a binary value of the FFT cell amplitude in 0.5 dB steps. The range of each byte is 1-201 (01-C9 hex, subtract 1 to get 00-C8 hex) representing 0 to 100 dB in 0.5 db steps. The first byte of the 200 bytes represents the earliest time delay cell.

The (A) value is the receiver attenuation in dB. The range is 1-121 (01-79 hex, subtract 1 to get 00-78 hex) representing 0 to 120 dB of receiver attenuation.

The (D) value is the IF detector value in dB. The range is 1-49 (01-31 hex, subtract 1 to get 00-30 hex) representing 0 to 48 dB of IF detector. The nominal IF detector value is 34 dB.

The (C) value is the Chirpcomm signal-to-noise ratio in dB. The range is 1-49 (01-31 hex, subtract 1 to get 00-30 hex) representing 0 to 48 dB of signal-to-noise ratio in a 55 Hz bandwidth.

If a checksum error is detected when the data is received, the block can be requested again by repeating the command with the same block number. If no checksum error is detected, then the next block can be requested.

To clarify the above, the following is the sequence of steps for formulating the reply to the read ionogram data command:

1. Fill out the header information beginning with the J1 echo and time stamp.
2. Append the binary data for the 10 scanlines adding a value of 1 to each byte.
3. Go through each byte of the binary data and check for values equal to the escape character FE hex. For each of these insert in front of it the escape character FE hex.
4. Go through each byte of the binary data and check for values equal to the start delimiter '(' or end delimiter ')'. For each of these insert in front of it the escape character FE hex.
5. Calculate the checksum of all bytes beginning with the J1 through the last data byte including escape characters but excluding the start and end delimiters.

6. Add the start delimiter at the beginning. At the end, add the checksum calculated in step 5 and add the end delimiter. Then send out the block.

The following is the sequence of steps for receiving the block:
1. Wait for the start delimiter.
2. After the start delimiter is received, save all bytes into a buffer until an end delimiter is encountered that is not preceded by the escape character.
3. Calculate the checksum for the block for all characters including escape characters beginning with the first character after the start delimiter and ending just before the checksum character and end delimiter. The character just before the end delimiter is the transmitted checksum. Compare the calculated checksum to the transmitted checksum. If the checksum is correct, continue processing the block. Otherwise ignore the block.
4. Copy the block into another buffer, but this time remove the escape characters. If the escape character FE hex is encountered, save the following the character without checking its value. The escape character itself is not saved. Thus a sequence of 2 FE hex characters results in one FE hex value stored.
5. Subtract 1 from each binary data byte.

The following formula is used to calculate the absolute signal amplitude in dBm:

Absolute Amplitude (dBm) = (FFT Amplitude/2) + Attenuation - 200

where "FFT Amplitude" is the FFT cell amplitude in 0.5 dB steps taken from the (iiii) data after subtracting 1, and "Attenuation" is the receiver attenuation in dB taken from the (A) data after subtracting 1.

The following formula is used to calculate the RF input amplitude (as measured by the IF detector using a 1 kHz IF bandwidth) in dBm:

RF Input Amplitude (dBm) = IF detector - 34 + Attenuation - 120

where "IF detector" is the (D) data after subtracting 1, and "Attenuation" is the receiver attenuation in dB taken from the (A) data after subtracting 1.

The following formula is used to determine the absolute propagation delay value for any given FFT cell (in units of milliseconds):

Absolute time delay (mSec) = (range delay/10) + (FFT cell number - 4)/38.4

where "range delay" is given in the header and is in units of tenths of milliseconds, and "FFT cell number" is numbered starting from 0 and ending at 199. Note that the baseline cell is the 5th FFT cell which is cell number 4. At this cell, the absolute time delay is equal to the range delay.

J2 READ IONOGRAM PATH DATA

This command reads the path data associated with the ionogram data. This path data is the same data that is read and set by the C1 and C2 commands. This command is necessary in the case that C2 commands have changed the paths while a sweep is in progress. At the end of that sweep, the ionogram path data will be for the old path. This command allows matching up of the ionogram with the path.

K1 READ LAT LONG
K2 SET LAT LONG

These commands read/set the latitude and longitude of the receiver:

LAT(8 bytes)

ASCII string of latitude in degrees and decimal degrees.

1st char is sign, positive is north.
2nd and 3rd chars are degrees.
4th char is decimal point.
5-8th chars are decimal degrees.
Leading and trailing zeros are added as necessary to pad the field to the required number of characters.

LONG(9 bytes)

ASCII string of longitude in degrees and decimal degrees.

1st char is sign, positive is east.
2nd, 3rd and 4th chars are degrees.
5th char is decimal point.
6-9th chars are decimal degrees.
Leading and trailing zeros are added as necessary to pad the field to the required number of characters.

4 RCS-7D HIGH RESOLUTION IONOGRAM DATA FILE FORMAT

4.1 High Resolution Ionogram Description

In addition to the standard ionogram files used to generate the color ionogram displays on the RCS-7D front panel display, the RCS-7D produces a "high resolution" ionogram data file that provides greater time delay (range) resolution over a wider time delay window. These high-resolution ionograms are typically used to support external Single Site Location HF Direction Finding systems (SSL HFDF) or general ionospheric research.

The high resolution ionogram file contains 280 "slices" or scanlines of the ionogram, one slice per 100 kHz of sweep from 2 to 30 MHz. Each slice contains data for 475 pixels in time delay (versus 200 pixels for the standard ionogram viewed on the RCS-7D front panel monitor).

At 100 kHz/second sweep rate, each of the 280 frequency slices cover Chirp signal measurements collected and FFT-analyzed over approximately 0.77 seconds, or approximately a 77 kHz wide segment of the sweep. Each 77 kHz wide segment is centered between integer multiples of 100 kHz with the FFT's peak response at the midpoint of the segment. Thus, the first frequency slice (at 2.0 MHz) stored in the high-resolution ionogram file actually contains FFT data collected between 2.01 and 2.09 MHz (i.e., centered on 2.05 MHz). The second slice contains data collected from 2.11 to 2.19 MHz (i.e., centered on 2.15 MHz), and the final slice (#280) contains data from 30.01 to 30.09 MHz. The first slice (from 2.01 to 2.09 MHz) is displayed on the RCS-7D front panel ionogram graphic at 2.0 MHz, the second slice is displayed at 2.1 MHz, etc., through the last slice (30.01 to 30.09 MHz) displayed at 30.0 MHz.

Due to the limited resolution of the RCS-7D front panel ionogram graphic display, the RCS-7 display contains a frequency error of approximately 50 kHz when sweeping at 100 kHz/sec (i.e., the data displayed at 2.0 MHz was really collected at 2.05 MHz). This error can be removed by remotely reading the high-resolution ionogram data file and then displaying the ionogram data on an external graphic display that has 50 kHz resolution.

Each frequency slice of the high resolution ionogram data file contains 475 bytes representing 475 points (pixels) in time delay (i.e., virtual height range). The data in each byte represents the amplitude of the pixel in 0.5 dB increments as described in the **J1** ("read ionogram scanline") command. The 475 pixels cover a time delay window from 0.000 ms (first pixel) to 6.185 ms (last pixel), or 13.02 microseconds per pixel. For Near Vertical Incidence (NVI) soundings to support SSL HFDF, this is equivalent to a NVI virtual height range of 927 km or 1.95 km per pixel.

4.2 Ionogram File Format

A separate high-resolution ionogram data file is saved on the RCS-7D hard disk for each ionogram. The high-resolution ionogram data files are formatted as follows:

134,400 bytes	Binary ionogram data consisting of 280 ionogram scanlines (frequency slices), each scanline containing 480 bytes: 475 pixel amplitude bytes (FFT amplitude data, iiii) + One Receiver Attenuation byte (A) + One IF Detector byte (D) + Three reserved (not used) bytes (RRR) (See description of *binary scanline data* in J1 command description)
128 bytes	Tx Path info (one record for a single path) This contains the name of the chirp transmitter, the sweep schedule, and its location. (See the description of PATH_DATA).
1 byte	Path number: '1', '2', '3', or '4'
8 bytes	RCS-7D sounder receiver location Latitude (See the description of LAT in K1 command).
9 bytes	RCS-7D sounder receiver location Longitude (See the description of LONG in K1 command).
5 bytes	Range delay (See the description of RANGE DELAY in D1 command).
40 bytes	Chirpcomm Message (See the description of MSG in F1 command).
44 bytes	Sweep Summary Contains the time stamp. (See the description of SWEEP SUMMARY in A4 command).

Total of 134,635 bytes per file.

4.3 Ionogram File Names

The high resolution ionogram files are stored on the RCS-7D hard disk in directory:

C:\RCS7D\IONOGRAM_ARCHIVE\HI_RES

This directory is a Windows XP "shared" directory that is remotely accessible via the RCS-7D's LAN interface, and is most easily accessed by using the XP "Remote Desktop". The HI_RES directory contains a maximum of 31 sub-directories. Each sub-directory is named by the day number of the month as follows:

HI_RES\DAY01 through HI_RES\DAY31

Each day directory contains all ionograms collected during the 24 hours of the day, up to a maximum of 288 ionograms per day. Ionograms are stored in specific day directories by the ionogram "start time" label as described below.

Each ionogram stored in a day directory has the filename identified by the sounding "sweep start time" as follows:

HIyyyymmddhhnnss.DAT

Where:

HI = file name identifier for High resolution Ionogram
yyyy = year (2000 through 2999)
mm = month of year (01 thru 12)
dd = day of month (01 through 31)
hh = hour of day (00 through 23)
nn = minute of hour (00 through 59)
ss = second of minute (00 through 59)

Thus, an example of the complete path name for a typical high resolution ionogram might be:

C:\RCS7D\IONOGRAM_ARCHIVE\HI_RES\DAY15\HI20030615224508.dat

This example is for a sounding identified by a start time of 22 hours 45 minutes 08 seconds on 15 June 2003.

The RCS-7D ionogram archive stores up to a maximum of 8,928 high resolution ionograms, equivalent to one month's accumulation of ionograms, assuming 12 soundings per hour, 24 hours per day, 31 days per month. When the archive directory is full, the RCS-7D will successively clear the day directory, one day at a time to make space for the new month's ionograms. That is, a full day's complement of ionograms will be stored for a full month (in the respective day directory) until the next month when the respective day directory is overwritten with new ionograms. For example, ionograms recorded on 15 June will be stored until midnight on 14 July. Then, starting 00:00 hours on 15 July, all old ionograms in the DAY 15 directory (from 15 June) are automatically erased to make room for the new ionograms to be collected on 15 July. Note that a full archive of 8,928 ionograms will occupy approximately 1.2 Gbyte of hard disk storage space.

附件 3： Acceptance Test Procedure – Metrics and DF Instrument Accuracy

REVISIONS			
LTR	DESCRIPTION	DATE	BY/APPD
A	Initial Release	6/20/00	
B	ECO 25998		
C	ECO 28478		
D	ECO 29144		

ACCEPTANCE TEST PROCEDURE

METRICS AND DF INSTRUMENT ACCURACY

The items identified below were tested IAW this test procedure and were found to meet the instrument DF accuracy specification of 0.1° rms and to meet the Metrics measurement in according to the Scorpio.

Test Engineer: [signature] Date: 11/19/03

Program Manager: [signature] Date: 11/19/3.

QA Manager: [signature] Date: 11-24-03

Tested items:

Electronics: P/N 8575-1503-01 Rev A, S/N 8575-035001

DR T.K.L	11/19/03	APPD [signature]	11-19-03
CHK		APPD [signature]	11/19/3.
		TCI A Dielectric Company	
		TITLE ACCEPTANCE TEST PROCEDURE Metrics and DF Instrument Accuracy	
		SIZE A	NUMBER ATP 8067-1500-01 · REV D
USED ON	NEXT ASSY		
APPLICATION Word2000	LOCATION/FILE NAME:		

1.0 INTRODUCTION

This document describes the acceptance test procedure for testing the Metrics and DF instrument accuracy of the TCI 8067. A signal generator and the inverse beamformers are used to simulate the controlled signals into the 8067, the accuracy of the instrument of the 8067 will be calculated base on the known parameters of the measured signals. A Pass/Fail criteria is used for each test procedure. A Pass means the measured parameters are within the tolerances of the specification, a Fail means the measured parameters are outside the tolerance of the specification.

Depending on the configuration of the tested 8067, some or all of the following parameters will be tested. These are bandwidth, frequency, modulation, field strength, channel occupancy, DF and channel DF.

A test analysis program will read the data output file from the 8067 and automatically check the result data for PASS or FAIL base on the specification of the Scorpio. This Specification is also listed in Appendix A.

The raw measurement data will be in Appendix B and C

2.0 TEST EQUIPMENT

2.1 Required Test Equipment (or equivalent)

Description	Manufacturer	Model	Cal Req'd
Signal Generator	HP	8648C	YES
PC Computer (NT w/ GPIB I/F)	any	any NO	
1x2 Power divider	any	any	NO
3 Channel inverse beamformer	any	any	NO
9 Ch HF inverse beamformer	any	any	NO
VHF/UHF inverse beamformer	any	any	NO
3 50 ohm load	any	any	NO
GPS antenna	any	any	NO
Software: TESTCLIENT.EXE	TCI	Part of T-0376-17-01	NO

2.2 Test Equipment Used

Description	Manufacturer	Model	ID No.	Cal Due Date
Signal Generator	HP	8648C	1072	3/4/04

3.0 APPLICABLE DOCUMENTS

None.

4.0 VISUAL

No visual inspection required.

5.0 TEST PROCEDURE

5.1 Test Configuration

Table 1 below shows different configurations of the tested equipment. Each configuration requires particular test measurement. The Table is used to identify which test procedures are needed to be performed.

Table 1: Test matrix

Test Config	Part Number	INI Filename	Config. Type	HF Metrics	HF DF	VHF/ UHF Metrics	VHF/ UHF DF
1	8516-1400-01 8510-1400-02 8510-1401-01	EquipCtrlConfigL.ini (3 channel HFDF)	Mobile	Yes	Yes	Yes	Yes
2	8516-1400-04	EquipCtrlConfigM.ini	Mobile			Yes	Yes
3	8510-1401-01	EquipCtrlConfigN.ini (9 channel HFDF)	Mobile	Yes	Yes	Yes	Yes
4	8516-1400-02 8510-1402-01	EquipCtrlConfigH.ini	Fixed	Yes	Yes	Yes	Yes
5	8516-1400-03 8510-1402-02	EquipCtrlConfigJ.ini	Fixed	Yes		Yes	Yes
6	8510-1403-01	EquipCtrlConfigK.ini	Remote	Yes	Yes		
7	8515-1401-02	EquipCtrlConfigP.ini	FIXED (DGTII)				Yes
8	8523-1400-01	EquipCtrlConfigS.ini	FIXED (RA3)			Yes	Yes
9	8523-1400-01	EquipCtrlConfigU.ini	FIXED (RA3)			Yes	Yes
10	8515-1503-01 8515-1503-02	EquipCtrlConfigAD.ini	FIXED (DGT III)	Yes	Yes		

(The space below is intended to be blank)

5.2 Equipment Test Setup

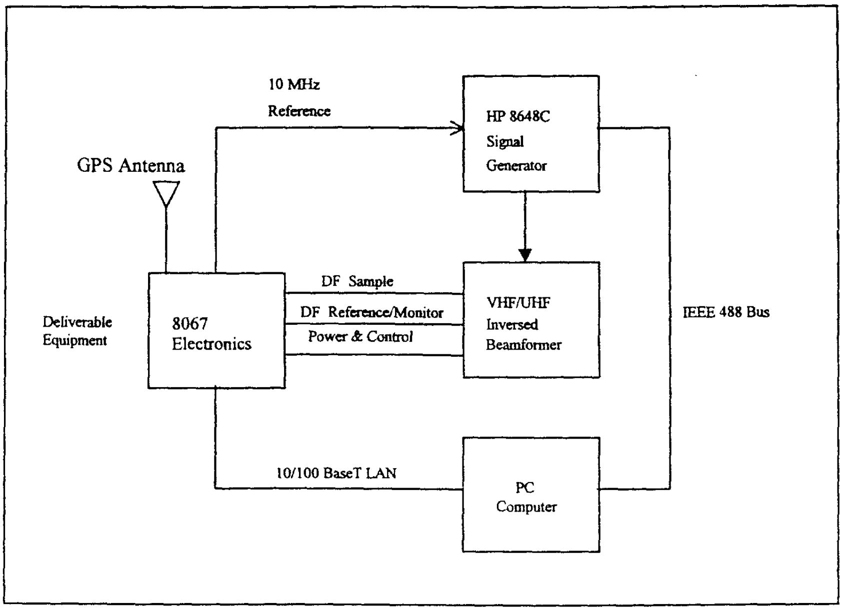


Figure 1: VHF/UHF Metrics and DF Test Setup

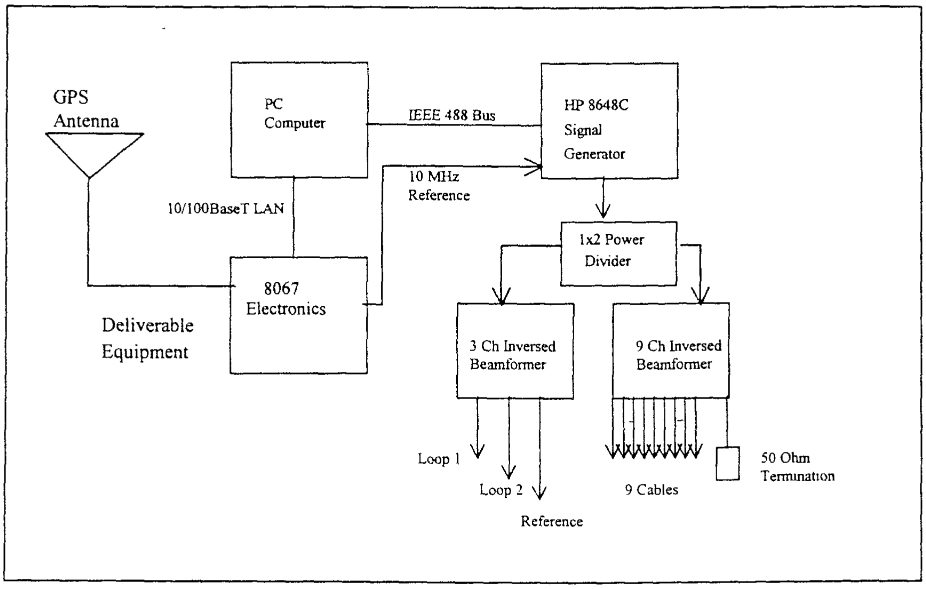


Figure 2: HF Metrics and DF Test Setup

Figure 1 and 2 above show the block diagrams of how the tested equipment are configured. Figure 1 is for the VHF/UHF Metrics and DF measurement test, Figure 2 is for the HF Metrics and DF measurement test.

5.3 Test Data Collection

5.3.1 Start up the power of all test equipment. These include the equipment under test, the test computer, the HP signal generator.

5.3.2 Read and write down the P/N of the tested equipment on one side of the rack.

P/N: 8515 - 1503 - 01 Rev A

5.3.3 Read and write down the TCP/IP Protocol IP address of the host computer from the Network Neighborhood.

IP address: 192. 168. 114. 101

5.3.4 Copy the "EquipCtrlConfig.ini" to "EquipCtrlConfigsav.ini". The file is in the c:\winnt folder

5.3.5 Using Notepad, edit the "EquipCtrlConfig.ini" in c:\winnt folder, uncomments the INI filename corresponding to the P/N shown on Table 1. If the filename is not found in the file, add one line to the file and save:

filename = "filename from Table 1"

Be sure that all command lines in the file have a comments (semicolon) in front of them except for the line just added in.

5.3.6 Copy the "EquipCtrlSite.ini" to "EquipCtrlSitesav.ini"

5.3.7 Using Notepad, edit the file "EquipCtrlSite.ini" in C:\winnt folder, enter the HF and VHF/UHF antenna RF Cable Loss Intercept and Slope as follow:

	V/UHF	HF
AntnCableLossIntept =	0	0
AntnCableLossSlopt =	0	0
MiscCableLossIntept =	120	122
MiscCableLossSlope =	115	176

Also make sure that the Gain Calibration Factors or the Preamp Factor, Attenuation Factor, and Cal 32 Factor at the bottom of the file are matched with the values shown on the back of the 8067. Save the changes and close the Notepad

5.3.8 Restart the host computer or go to the control panel and activate the following services:

- equipcontrol
- dino
- calendar

5.3.9 Log onto the test computer with username administrator and password <none>.

5.3.10 Go to the 'host' file under c:\winnt\system32\drivers\etc, using Notepad to add the following line to the end of the file if it is not already exist, then save the file:

IP address of the host computer SMS_SYSTEM_1

Example:

100.20.22.91 SMS_SYSTEM_1

Assuming that the IP address of the host computer is 100.20.22.91

5.3.11 Add the following lines to the 'Services' file under c:\winnt\system32\drviers\ets if not already exist, then save the file.

tci-metrics 3302/tcp
tci-equipcontrol 3303/tcp

5.3.12 Go to the Network Neighborhood, change the first 3 IP address values of the test computer to be exactly the same as the Host computer IP address, only alter the last IP address value. Example, if the Host IP address is as follow:

100.20.22.91

then the IP address of the test computer can be set to:

100.20.22.92 or 100.20.22.93 .... Which ever works

5.3.13 Click Apply after entering the new IP address, then ok to accept the change.

5.3.14 To make sure that the setting is correct, type the following line, from DOS, to see if the test computer can talk to the host computer.

C:\ Ping SMS_SYSTEM_1 -t

5.3.15 Once the connection is ok, minimized the Dos window

5.3.16 Using the P/N from section 5.3.2 and Table 1 from section 5.1, identify the test configuration number.

Test configuration number: 10

5.3.17 If test configuration number equal to 1 or 3 or 4, performs the following:

- HF Metrics and DF measurement in Section 5.4
- VHF/UHF Metrics and DF measurement in Section 5.5

5.3.18 If test configuration number equal to 2, 8 or 9 performs the following:

- VHF/UHF Metrics and DF measurement in Section 5.5

5.3.19 If test configuration number equal to 5, performs the following:

- HF Metrics measurement in Section 5.4
- VHF/UHF Metrics and DF measurement in Section 5.4 and 5.5

5.3.20 If test configuration number equal to 6 or 10, performs the following:

- HF Metrics and DF measurement in section 5.4

5.3.21 If test configuration number is 7, perform the VHF/UHF DF measurement only in Section 5.5.

5.4 HF Metrics and DF measurement

5.4.1 Set up test equipment as shown in Figure 2 of Section 5.2.

5.4.2 If it is test configuration number 1, connect the three outputs from the 3 channel inverse beamformer to the back of the equipment rack. Terminating the output of the 1x2 power divider, who feeds the 9 channel inverse beamformer, to a 50 ohm load.

5.4.3 If it is test configuration number 3, 4, 6 or 10, connect the 9 outputs from the 9 channel inverse beamformer to the back of the RF switch. Terminating the loop1 and loop2 of the 3 channel inverse beamformer to 50 ohms loads, and connect the reference output to the HF monitor input on the back of the rack.

5.4.4 If it is test configuration number 5, connect the reference output from the 3 channel inverse beamformer to the HF monitor input on the back of the receiver. Terminating the loop1 loop2 outputs to 50 ohm loads. Also terminating the output of the 1x2 power divider, who feeds the 9 channel inverse beamformer, to a 50 ohm load.

5.4.5 Restart the power for all equipment and allowed 20 minutes for the clock synthesizer to lock.

5.4.6 Start the TestClient, select SMS_SYSTEM_1 as the platform.

5.4.7 Check Bite.

5.4.8 Select the Meas Test button.

5.4.9 Select the test Setup button.

5.4.10 If it is test configuration number 1 or 3 or 4, 6 or 10, configure this Test Setup window as follows:

	BW	√	Frequency	√	Modulation	√	Field Strength	√	DF	√
DwellTime	500		500		500		500		10000	
Repeat	10		10		20		10		20	
Average	1		1		1		1			
Output	1		1		1		1		3	
Beta	990		1				1		0	
X1	60									

X2	260				
Y	60				

Click or Check on all the boxes for the following test measurements: BW, Frequency, Modulation, Field Strength and DF.

5.4.11 If it is test configuration number 5, configure this Test Setup the same as section 5.4.10 except uncheck the DF box.

5.4.12 Select the OK button.

5.4.13 Configure this Meas Test Window as follows:

Start Freq = 1.82
Stop Freq = 30.0
Freq Step = 3.0
Sig Gen Level = -10.0
Bandwidth = See Table 2 below
HF/VHF Cross Freq = 30 w/ HFDF, 20 w/o HFDF
Get Level before DF = 1

5.4.14 Select next modulation type and its parameter from Table below and enter the parameters into the Signal Generator:

Table 2: Test signal parameters

Test Case	Modulation Type	Modulation Parameter	Bandwidth (Hz)	Comments
1*	AM	50% Mod Index, 1kHz Modulating	3000	* Test is optional
2	AM	80% Mod Index, 1kHz Modulating	3000	
3*	FM	1 kHz Deviation, 1 kHz Modulating	25000	* Test is optional
4	FM	3 kHz Deviation, 1 kHz Modulating	25000	
5*	PM	1 Radian Deviation, 1 kHz Mod	25000	* Test is optional
6	PM	3 Radian Deviation, 1 kHz Mod	25000	

5.4.15 Select the Start/Stop Test button

5.4.16 Record the filename shown on the screen for this test case onto the Table 3 in Section 5.4.21 below.

5.4.17 Run the statistic program by Select Start, Click on Run, then type in the following line:

C:\test\stat02.exe

5.4.18 Hit OK

5.4.19 Respond to the questions from screen using information from Table 1, 2 and 3.

5.4.20 When finish, observe the output on the screen

5.4.21 Check the appropriate PASS/FAIL box below, the test case is passed if no Fail shown on the screen. Sign and date after all test case are done.

Table 3: Test collection and test analysis data sheet

Test Case	Filename	PASS	FAIL	Comments
1	111903-155312	V		AM, 80%
2	111903-160132	V		FM, 3KHz
3	111903-160925	V		PM, 3 rad
4				
5				
6				

Test Engineer: [signature] DATE: 11/19/03

5.4.22 Repeat step 5.4.14 until all test case are done.

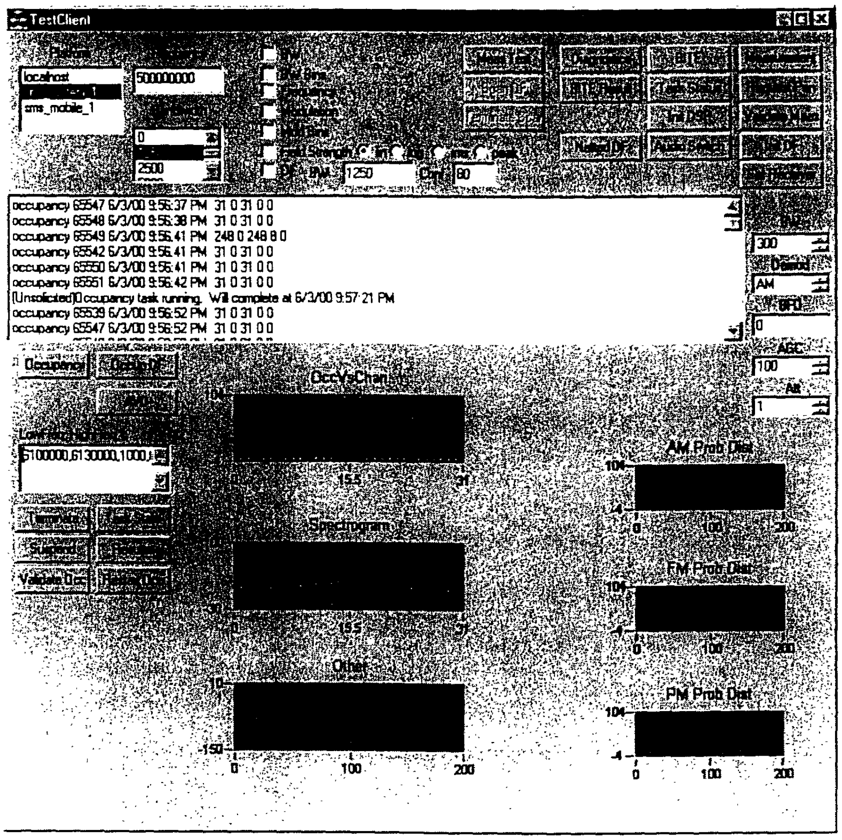
5.4.23 Channel Occupancy Test

5.4.24 From Testclient Main window, enter the following number into the Lowfreq, Highfreq box: 6100000,6130000,1000,0

5.4.25 Enter the following parameter for the Signal Generator setup:

Amplitude: - 30 dBm
Frequency: 6.1150 MHz
Modulation : off
Activate the RF On button

5.4.26 Click on Occupancy button and observe the OccVschan display shown on screen. It should look similar to the plot below. Check PASS if they are the same, and FAIL if not.



Test Engineer: [signature], PASS: 11/19 ✓, FAIL: ________

5.5 VHF/UHF Metrics and DF measurement

5.5.1 Set up test equipment as shown in Figure 1 of Section 5.2. If this is the first test, restart power for all equipment and allow 20 minutes for the clock synthesizer to lock.

5.5.2 Start the TestClient, select SMS_SYSTEM_1 as the platform.

5.5.3 Check Bite.

5.5.4 Select the Meas Test button.

5.5.5 Select the test Setup button.

5.5.6 **Configure this Test Setup window as follows:**

	BW	√	Frequency	√	Modulation	√	Field Strength	√	DF	√
DwellTime	500		500		500		500		10000	
Repeat	10		10		20		10		20	
Average	1		1		1		1			
Output	1		1		1		1		3	
Beta	990		1				1		0	
X1	60									
X2	260									
Y	60									

For test configuration 7, only click or check the DF measurement. For all other configurations, click or check on all boxes for the following test measurements: BW, Frequency, Modulation, Field Strength and DF.

5.5.7 Select the OK button.

5.5.8 Configure this Meas Test Window as follows:

Start Freq = 30.2
Stop Freq = 2400
Freq Step = 300
Sig Gen Level = -10.0
Bandwidth = See Table 4 below
HF/VHF Cross Freq = 30
Get Level before DF = 1

5.5.9 Select next modulation type and its parameter from Table below and enter the parameters into the Signal Generator:

Table 4: Test Signal parameters

Test Case	Modulation Type	Modulation Parameter	Bandwidth (Hz)	Comments
1*	AM	50% Mod Index, 1kHz Modulating	25000	* Test is optional
2	AM	80% Mod Index, 1kHz Modulating	25000	
3*	FM	1 kHz Deviation, 1 kHz Modulating	25000	* Test is optional
4	FM	3 kHz Deviation, 1 kHz Modulating	25000	
5*	PM	1 Radian Deviation, 1 kHz Mod	200000	* Test is optional
6	PM	3 Radian Deviation, 1 kHz Mod	200000	

5.5.10 Select the Start/Stop Test button

5.5.11 Record the filename shown on the screen for this test case onto the Table 5 in Section 5.5.16 below.

5.5.12 Run the statistic program by Select Start, Click on Run, then type in the following line:

C:\test\stat01.exe

5.5.13 Hit OK

5.5.14 Response to the questions from screen using information from Table 1, 4 and 5.

5.5.15 When finish, observe the output on the screen

5.5.16 Check the appropriate PASS/FAIL box below, the test case is passed if no Fail shown on the screen. Sign and date after all test case are done.

Note that the frequency range of the power divider used in the VHF/UHF beamformer is from 20 to 2000 MHz, any measurement above 2000 MHz will not guarantee to meet the spec.

Table 5: Test collection and analysis data sheet

Test Case	Filename	PASS	FAIL	Comments
1				
2				
3				N/A
4				
5				
6				

Test Engineer:____________________ DATE: N/A

5.5.17 Repeat steps 5.5.9 to 5.5.16 until all test case are done.

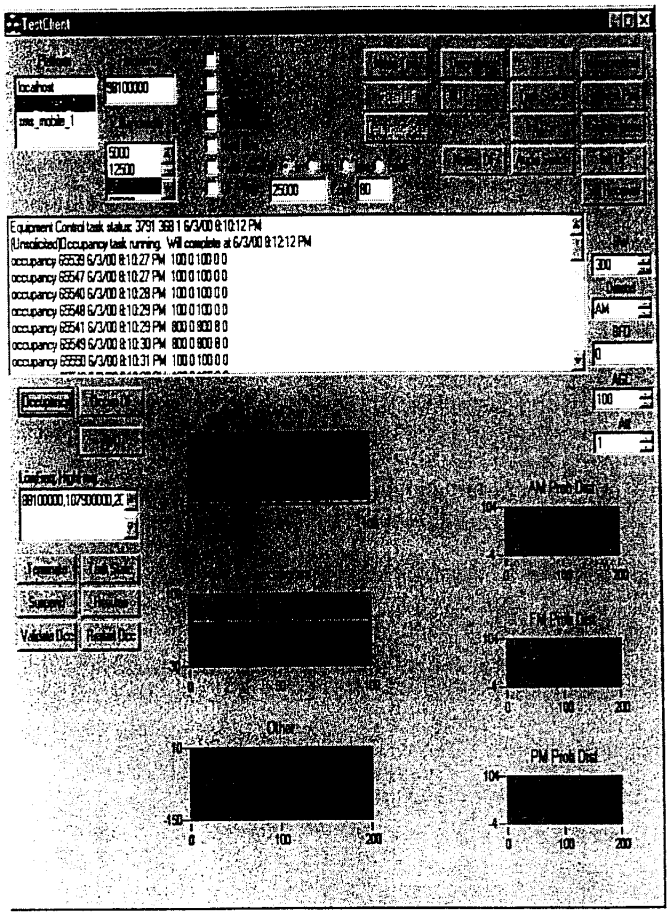
5.5.18 Channel Occupancy Test

5.5.19 From Testclient main window, enter the following number into the Lowfreq, Highfreq box: 88100000,107900000,200000,0

5.5.20 Enter the following parameter for the Signal Generator setup:

Amplitude: 0 dBm
Frequency: 98.1 MHz
Modulation : off
Activate the RF On button

5.5.21 Click on Occupancy button and observe the OccVschan display shown on screen. It should look similar to the plot below. Check PASS if they are the same, and FAIL if not.



N/A

Test Engineer: ________________, PASS: ________, FAIL: ________

5.5.22 Occupancy DF Test

5.5 23 From Testclient Main window, click on Occup DF

5.5.24 The Dialog window will appear, enter the following parameters into the appropriate boxes:

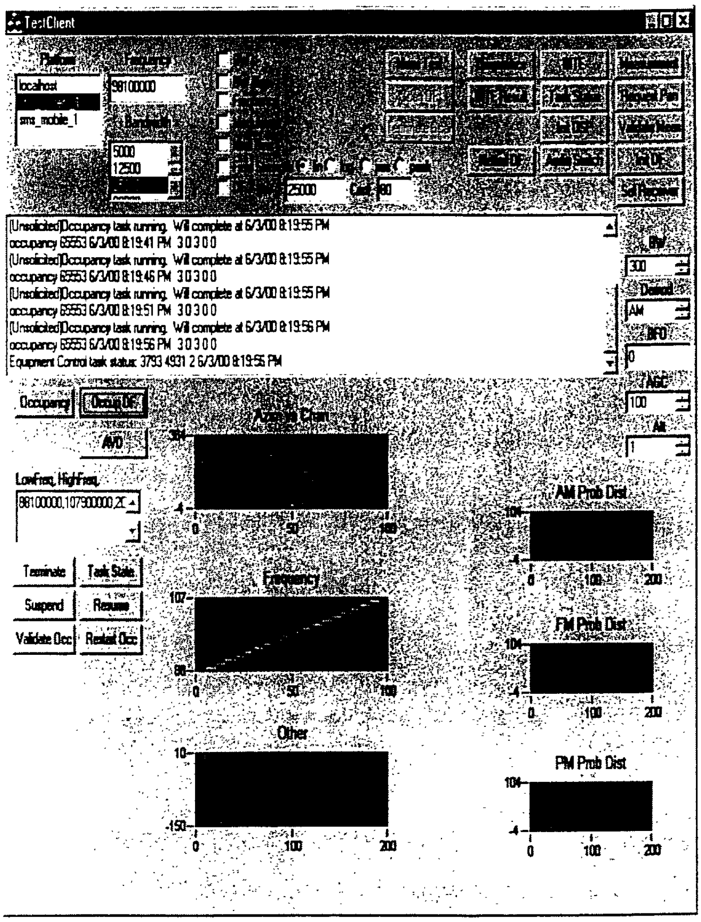
Scan : 88100000,107900000,200000,0
Storage time: 5

Measurement: 30
Threshold: 20

5.5.25 Enter the following parameter for the Signal Generator setup:

Amplitude: 0 dBm
Frequency: 98.1 MHz
Modulation : off
Activate the RF On button

5.5.26 Click on the ScanDF button and observe the Azim Vs chan display shown on screen. It should look similar to the plot below. Check PASS if they are the same, and FAIL if not.



N/A

Test Engineer: ________________, PASS: ________, FAIL: ______

5.6 When finish, copy the "EquipCtrlConfigsav.ini" back to "EquipCtrlConfig.ini" and "EquipCtrlSitesav.ini" to "EquipCtrlSite.ini".

APPENDIX A

SCORPIO SPECIFICATION AND TOLERANCE

1) Frequency Measurement:

Frequency	Offset Tolerance (Hz)
9 kHz – 29.7 MHz	1
30.2 MHz	15
330.2 MHz	165
630.2 MHz	315
930.2 MHz	465
1230.2 MHz	615
1530.2 MHz	765
1830.2 MHz	915
2130.2 MHz	1065

2) Occupied Bandwidth Measurement: +- 10%

Modulating frequency: 1 kHz

Modulation Type	Modulation Parameter	Processing Bandwidth	Beta tolerance	X1 tolerance	X2 tolerance
HF band					
AM	50 %	3000 Hz	2000 Hz +- 200	3.1 +- 0.3	2000 Hz +- 200
AM	80 %	3000 Hz	2000 Hz +- 200	3.1 +- 0.3	2000 Hz +- 200
FM	1 kHz dev	25000 Hz	4000 Hz +- 400	15.6 +- 1.6	4000 Hz +- 400
FM	3 kHz dev	25000 Hz	8000 Hz +- 800	15.6 +- 1.6	8000 Hz +- 800
PM	1 radian dev	25000 Hz	4000 Hz +- 400	15.6 +- 1.6	4000 Hz +- 400
PM	3 radian dev	25000 Hz	8000 Hz +- 800	15.6 +- 1.6	8000 Hz +- 800
VHF/UHF band					
AM	50 %	25000 Hz	2000 Hz +- 200	2.0 +- 0.2	2000 Hz +- 200
AM	80 %	25000 Hz	2000 Hz +- 200	2.0 +- 0.2	2000 Hz +- 200
FM	1 kHz dev	25000 Hz	4000 Hz +- 400	2.0 +- 0.2	4000 Hz +- 400
FM	3 kHz dev	25000 Hz	8000 Hz +- 800	2.0 +- 0.2	8000 Hz +- 800
PM	1 radian dev	200000 Hz	4000 Hz +- 400	19.5 +- 2.0	4000 Hz +- 400
PM	3 radian dev	200000 Hz	8000 Hz +- 800	19.5 +- 2.0	8000 Hz +- 800

3) Modulation Parameter Measurement:

- AM tolerance: 3 %
- FM tolerance: 2 kHz +- 3% of reading
- PM tolerance: 0.1 radian +- 3% of reading

Modulating frequency: 1 kHz

Modulation Type	Modulation Parameter	Parameter Tolerance
AM	50 %	m: 50% +- 3%
AM	80 %	m: 80% +- 3%
FM	1000 Hz dev	FMpk: 0 – 3000 Hz
FM	3000 Hz dev	FMpk: 1000 – 5000 Hz
PM	1 radian dev	PMpk: 1 radian +- .1 +- 3% of reading
PM	3 radian dev	PMpk: 3 radian +- .1 +- 3% of reading

4) Field strength Measurement: +- 2 dB below 30 MHz, +- 3 dB from 30 - 3000 MHz

Frequency	Input power	Measured Tolerance
9 kHz – 30 MHz	-10 dBm	pow: -10 dBm +- 2 dB
30 MHz – 3000 MHz	-10 dBm	Pow: -10 dBm +- 3 dB

5) Instrument DF Accuracy Measurement: 0.1 degree from 2 – 2700 MHz

APPENDIX B

HF MEASUREMENT RAW DATA

Northern Site
P/N 8515-1503-01 REV A
S/N 8515-035001

```
****************************************************
*   Modulating Frequency:   1 kHz                  *
*   Modulation Type:   AM  80.0%                   *
*   Input Power:   -10.0 dBm                       *
*   HF Processing Bandwidth: 3000 Hz               *
****************************************************
```

***** For Frequency Measurement *****

Frequency (MHz)	Freq_offset (Hz)	Specification Tolerance (Hz)	PASS/FAIL
1.820	0	1	PASS
4.820	0	1	PASS
7.820	0	1	PASS
10.820	0	1	PASS
13.820	0	1	PASS
16.820	0	1	PASS
19.820	0	1	PASS
22.820	0	1	PASS
25.820	0	1	PASS
28.820	0	1	PASS

***** For Occupied Bandwidth Measurement *****

Frequency (MHz)	Beta (Hz)	Spec Tolerance (Hz)	X1 (Hz)	Spec Tolerance (Hz)	X2 (Hz)	Spec Tolerance (Hz)	PASS/FAIL
1.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.0	<1800.,2200.>	PASS
4.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
7.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
10.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
13.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
16.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
19.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
22.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
25.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS
28.820	2003.6	<1800.,2200.>	3.1	< 2.8,3.4 >	2000.1	<1800.,2200.>	PASS

***** For Modulation Measurement *****

Frequency (MHz)	Meas_AM Mod-Index (%)	Meas_FM Dev-Freq (Hz)	Meas_PM Dev-Freq (radian)	Specification Tolerance	PASS/FAIL
1.820	77.50			<77.,83.>	PASS
4.820	77.80			<77.,83.>	PASS
7.820	77.90			<77.,83.>	PASS
10.820	77.90			<77.,83.>	PASS
13.820	78.10			<77.,83.>	PASS
16.820	77.90			<77.,83.>	PASS
19.820	77.90			<77.,83.>	PASS
22.820	77.90			<77.,83.>	PASS
25.820	78.00			<77.,83.>	PASS
28.820	78.10			<77.,83.>	PASS

***** For Field Strength Measurement *****

Frequency (MHz)	Measured input-power (dBm)	Specification Tolerance (dBm)	PASS/FAIL
1.820	-10.0	<-12.0,-8.0>	PASS
4.820	-11.0	<-12.0,-8.0>	PASS
7.820	-10.5	<-12.0,-8.0>	PASS
10.820	-11.7	<-12.0,-8.0>	PASS
13.820	-11.3	<-12.0,-8.0>	PASS
16.820	-11.6	<-12.0,-8.0>	PASS

19.820	-11.2	<-12.0,-8.0>	PASS
22.820	-11.5	<-12.0,-8.0>	PASS
25.820	-11.9	<-12.0,-8.0>	PASS
28.820	-11.8	<-12.0,-8.0>	PASS

***** For DF Accuracy Measurement *****

Frequency (MHz)	standard Deviation (deg)	Specification Tolerance (deg)	PASS/FAIL
1.820	0.02	0.1	PASS
4.820	0.01	0.1	PASS
7.820	0.01	0.1	PASS
10.820	0.02	0.1	PASS
13.820	0.01	0.1	PASS
16.820	0.02	0.1	PASS
19.820	0.02	0.1	PASS
22.820	0.01	0.1	PASS
25.820	0.02	0.1	PASS
28.820	0.01	0.1	PASS

****
* Modulating Frequency: 1 kHz *
* Modulation Type: FM 3000 Hz dev *
* Input Power: -10.0 dBm *
* HF Processing Bandwidth: 25000 Hz *
****

***** For Frequency Measurement *****

Frequency (MHz)	Freq_offset (Hz)	Specification Tolerance (Hz)	PASS/FAIL
1.820	0	1	PASS
4.820	0	1	PASS
7.820	0	1	PASS
10.820	0	1	PASS
13.820	0	1	PASS
16.820	0	1	PASS
19.820	0	1	PASS
22.820	0	1	PASS
25.820	0	1	PASS
28.820	0	1	PASS

***** For Occupied Bandwidth Measurement *****

Frequency (MHz)	Beta (Hz)	Spec Tolerance (Hz)	X1 (Hz)	Spec Tolerance (Hz)	X2 (Hz)	Spec Tolerance (Hz)	PASS/FAIL
1.820	7967.7	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.5	<7200.,8800.>	PASS
4.820	7967.6	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.5	<7200.,8800.>	PASS
7.820	7967.8	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.6	<7200.,8800.>	PASS
10.820	7968.0	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.6	<7200.,8800.>	PASS
13.820	7968.4	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.6	<7200.,8800.>	PASS
16.820	7967.7	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.5	<7200.,8800.>	PASS
19.820	7967.2	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.3	<7200.,8800.>	PASS
22.820	7966.8	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.2	<7200.,8800.>	PASS
25.820	7967.1	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.2	<7200.,8800.>	PASS
28.820	7967.3	<7200.,8800.>	15.6	< 14.0,17.2 >	7971.4	<7200.,8800.>	PASS

***** For Modulation Measurement *****

Frequency (MHz)	Meas_AM Mod-Index (%)	Meas_FM Dev-Freq (Hz)	Meas_PM Dev-Freq (radian)	Specification Tolerance	PASS/FAIL
1.820		2985		<2000,5000>	PASS
4.820		2983		<2000,5000>	PASS
7.820		2985		<2000,5000>	PASS
10.820		2985		<2000,5000>	PASS
13.820		2988		<2000,5000>	PASS

16.820	2989	<2000,5000>	PASS
19.820	2987	<2000,5000>	PASS
22.820	2990	<2000,5000>	PASS
25.820	2988	<2000,5000>	PASS
28.820	2978	<2000,5000>	PASS

***** For Field Strength Measurement *****

Frequency (MHz)	Measured input-power (dBm)	Specification Tolerance (dBm)	PASS/FAIL
1.820	-9.9	<-12.0,-8.0>	PASS
4.820	-10.8	<-12.0,-8.0>	PASS
7.820	-10.3	<-12.0,-8.0>	PASS
10.820	-11.6	<-12.0,-8.0>	PASS
13.820	-11.1	<-12.0,-8.0>	PASS
16.820	-11.5	<-12.0,-8.0>	PASS
19.820	-11.1	<-12.0,-8.0>	PASS
22.820	-11.4	<-12.0,-8.0>	PASS
25.820	-11.9	<-12.0,-8.0>	PASS
28.820	-11.9	<-12.0,-8.0>	PASS

***** For DF Accuracy Measurement *****

Frequency (MHz)	standard Deviation (deg)	Specification Tolerance (deg)	PASS/FAIL
1.820	0.09	0.1	PASS
4.820	0.04	0.1	PASS
7.820	0.01	0.1	PASS
10.820	0.02	0.1	PASS
13.820	0.02	0.1	PASS
16.820	0.03	0.1	PASS
19.820	0.02	0.1	PASS
22.820	0.01	0.1	PASS
25.820	0.00	0.1	PASS
28.820	0.02	0.1	PASS

```
****************************************************
*   Modulating Frequency:   1 kHz                  *
*   Modulation Type:   PM   3.0 rad dev            *
*   Input Power:   -10.0 dBm                       *
*   HF Processing Bandwidth: 25000 Hz              *
****************************************************
```

***** For Frequency Measurement *****

Frequency (MHz)	Freq_offset (Hz)	Specification Tolerance (Hz)	PASS/FAIL
1.820	0	1	PASS
4.820	0	1	PASS
7.820	0	1	PASS
10.820	0	1	PASS
13.820	0	1	PASS
16.820	0	1	PASS
19.820	0	1	PASS
22.820	0	1	PASS
25.820	0	1	PASS
28.820	0	1	PASS

***** For Occupied Bandwidth Measurement *****

Frequency (MHz)	Beta (Hz)	Spec Tolerance (Hz)	X1 (Hz)	Spec Tolerance (Hz)	X2 (Hz)	Spec Tolerance (Hz)	PASS/FAIL
1.820	7963.8	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.2	<7200.,8800.>	PASS
4.820	7963.7	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.2	<7200.,8800.>	PASS
7.820	7963.9	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.3	<7200.,8800.>	PASS
10.820	7964.1	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.3	<7200.,8800.>	PASS

13.820	7964.1	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.3	<7200.,8800.>	PASS
16.820	7963.8	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.2	<7200.,8800.>	PASS
19.820	7963.3	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.0	<7200.,8800.>	PASS
22.820	7962.9	<7200.,8800.>	15.6	< 14.0,17.2 >	7969.9	<7200.,8800.>	PASS
25.820	7963.2	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.0	<7200.,8800.>	PASS
28.820	7963.4	<7200.,8800.>	15.6	< 14.0,17.2 >	7970.1	<7200.,8800.>	PASS

***** For Modulation Measurement *****

Frequency (MHz)	Meas_AM Mod-Index (%)	Meas_FM Dev-Freq (Hz)	Meas_PM Dev-Freq (radian)	Specification Tolerance	PASS/FAIL
1.820			3.0	<2.9,3.1>+-3%	PASS
4.820			3.0	<2.9,3.1>+-3%	PASS
7.820			3.0	<2.9,3.1>+-3%	PASS
10.820			3.0	<2.9,3.1>+-3%	PASS
13.820			3.0	<2.9,3.1>+-3%	PASS
16.820			3.0	<2.9,3.1>+-3%	PASS
19.820			3.0	<2.9,3.1>+-3%	PASS
22.820			3.0	<2.9,3.1>+-3%	PASS
25.820			3.0	<2.9,3.1>+-3%	PASS
28.820			3.0	<2.9,3.1>+-3%	PASS

***** For Field Strength Measurement *****

Frequency (MHz)	Measured input-power (dBm)	Specification Tolerance (dBm)	PASS/FAIL
1.820	-9.9	<-12.0,-8.0>	PASS
4.820	-10.8	<-12.0,-8.0>	PASS
7.820	-10.3	<-12.0,-8.0>	PASS
10.820	-11.6	<-12.0,-8.0>	PASS
13.820	-11.1	<-12.0,-8.0>	PASS
16.820	-11.5	<-12.0,-8.0>	PASS
19.820	-11.1	<-12.0,-8.0>	PASS
22.820	-11.4	<-12.0,-8.0>	PASS
25.820	-11.9	<-12.0,-8.0>	PASS
28.820	-12.0	<-12.0,-8.0>	PASS

***** For DF Accuracy Measurement *****

Frequency (MHz)	standard Deviation (deg)	Specification Tolerance (deg)	PASS/FAIL
1.820	0.07	0.1	PASS
4.820	0.01	0.1	PASS
7.820	0.03	0.1	PASS
10.820	0.01	0.1	PASS
13.820	0.02	0.1	PASS
16.820	0.03	0.1	PASS
19.820	0.02	0.1	PASS
22.820	0.01	0.1	PASS
25.820	0.02	0.1	PASS
28.820	0.01	0.1	PASS

REVISIONS			
LTR	DESCRIPTION	DATE	BY/APPD
A	Initial Release	9/23/03	

ACCEPTANCE TEST PROCEDURE
(FUNCTIONALITY)

The items identified below were tested IAW this test procedure and were found to meet the stated requirements.

Test Engineer: JACK BUI Date: NOV 21, 2003

Program Manager: [signature] Date: 21NOV03

QA Manager: DC Smith Date: 11-24-03

Tested items:

8067 P/N: 8067-1507-03

8067 S/N: 8067-031129

DR	C. MOCNIK	18NOV03	TCI A Dielectric Company	Fremont, California 94538 USA
CHK	J. BUI	18NOV03		
APPD	R. SASSELLI	18NOV03		
APPD	D.C. SMITH	18NOV03	TITLE ACCEPTANCE TEST PROCEDURE (FUNCTIONALITY)	
			NUMBER ATP 8067-1507-01	REV A
	USED ON	NEXT ASSY		

1. INTRODUCTION

This document describes the acceptance test procedure for testing an 8067 DF Processor for general functionality. The instrument accuracy tests within ATP 8067-1521-01 (or elsewhere) must be performed prior to testing in accordance with this document.

The tests described in this document should be performed on an 8067-1507 DF processor.

This document assumes that the tester is intimately familiar with the 8067 DF Processor, and presents a "checklist" of functionality that is to be verified.

2. TEST EQUIPMENT

2.1 Required Test Equipment (or equivalent)

Description	Manufacturer	Model	Cal Req'd
GPS antenna	any	NO	NO
PC Computer	any	any	NO
TESTCLIENT.EXE	TCI	T-0376-17-01	NO
ScorpioCLIENT.EXE	TCI	T-0307-17-01	NO

3. APPLICABLE DOCUMENTS

None.

4. VISUAL

No visual inspection required.

5. TEST PROCEDURE

Connect a Client PC to the 8067 via the 10/100BaseT LAN (J66) port of the 8067. Load the control programs into the Client and verify the correct functionality of each of the items identified below using either the control programs or by directly controlling/operating the 8067 as appropriate.

#	Inspection item	Pass/Fail
1.	Correct BITE response from 8067?	PASS
2.	Correct 8067 response to each software command?	PASS
3.	Correct 8067 response to each status request?	PASS
4.	Correct functionality of any special software per project documentation?	PASS
5.	Correct control of the 8400 and 8412 (via J53 control)?	PASS
6.	Correct display of UTC time?	PASS
7.	Correct demodulation of signals-of-opportunity?	PASS
8.	Correct pan display of signals-of-opportunity?	PASS
9.	Front panel LEDs indicate okay and no faults (10 MHz, A/D Clock Gen, Synthesizer Lock, Supply Voltages)?	PASS
10.	Correct TCP/IP configuration IAW project documentation?	PASS
11.	UPS control software configured for SNMP broadcasts IAW project documentation?	PASS
12.	Correct shutdown after UPS power interruption (via J41)?	PASS
13.	Correct microphone and headphone operation?	PASS
14.	Correct audio I/O (J22) operation?	PASS
15.	Correct recording of external audio (via J21)?	PASS
16.	Correct telephone I/O (J51) operation with PSTN?	PASS
17.	Correct operation of floppy drive?	PASS
18.	Correct operation with a mouse (via front-panel "Mouse" port)?	PASS
19.	Correct operation with a keyboard (via front-panel "KBD" port)?	PASS
20.	Correct operation with an external monitor (via front-panel "Video" port)?	PASS
21.	Voltage selectors set to locality power (e.g., 115/230/240 VAC operation)?	115V
22.	Presence of 10 MHz at J12 & J13?	PASS

附件 4： Test Procedure Data – 8400-1026 Receive

REVISIONS			
LTR	DESCRIPTION	DATE	BY/APPD
A	Initial Release	1/27/00	JRS/
B	Modify NF and IP measurement ECO 25659	3/25/00	JP
C	Modify NF measurement ECO 26401	3/21/01	JP

TEST PROCEDURE DATA
8400-1026 RECEIVER, 25K
TP 8400-1026

The items identified below were tested IAW the indicated test procedure and were acceptable.

Procedure: TP 8400-1026 Rev. C

Test Item 8400-1026 Rev. ~~Ø~~A Serial No.: 112013

Test Technician: Mai Nguyen Date: 05-14-02

Test Supervisor: ______ Date: 5/15/02

QA Manager: ______ Date: 12-2-03

Customer Representative: ______ Date: ______
(optional)

DR JP/CB	JAN 00	APPD QA		3-29-01	
CHK		APPD ENG		3-22-01	
		TECHNOLOGY FOR COMMUNICATIONS INTERNATIONAL BR COMMUNICATIONS			
		TITLE TEST PROCEDURE DATA 8400-1026 RECEIVER, 25K			
USED ON	NEXT ASSY	SIZE A	NUMBER TPD-8400-1026		REV C
APPLICATION Word 98	LOCATION/FILE NAME: TECH PUBS:				

2.0 CALIBRATED EQUIPMENT LIST

Equipment	Model Number	Asset Number	Cal Due Date
DMM	Fluke 76	TCI 1052	Feb 06-03
Network Analyzer	HP 8753A	TCI 301	Feb 07-03
S-Parameter Test Set	HP 85046A	TCI A15	Feb 07-03
Signal Generator	HP 8648C	76866	10-15-02
Signal Generator	HP 8648A	TCI 1070	Feb 04-03
Spectrum Analyzer	HP 8596E	TCI 0417	Feb 20-03
True RMS Voltmeter	N/A		
Noise Generator	BR 1008	21255	Sep-26-02

4.0 VISUAL

Step No.	Test	Limits	Units	Result	Pass/Fail
4.1	No solder splashes, wire pieces, or loose hardware lodged in PCB.				(P) - F
4.2	PCB attached securely to enclosure.				(P) - F

5.0 TEST DATA

5.1 INITIAL TURN-ON

Step No.	Test	Limits	Units	Result	Pass/Fail
5.1.1	Resistance between E2 and E1	> 1	kohm	2.7MΩ	(P) - F
5.1.2	Resistance between E3 and E1	> 1	kohm	3.2MΩ	(P) - F
5.1.3	Resistance between E4 and E1	> 1	kohm	5.2MΩ	(P) - F
5.1.7	Voltage at J14	<0.005	volt		(P) - F

5.2 RF FILTER ALIGNMENT

Step No.	Test	Limits	Units	Result	Pass/Fail
5.2.5	Gain of 1.5-3.0 MHz Bandpass Filter				
	@ 910 kHz	<-35	dB	-50	P - F
	@ 1253 kHz	<-25	dB	-37	(P) - F
	@ 1.0 MHz	<-20	dB	-36	(P) - F
	@ 1.5 MHz	>-3	dB	-2.75	(P) - F
	@ 2.0 MHz	>-2	dB	-1.52	(P) - F
	@ 3.0 MHz	>-3	dB	-1.87	(P) - F
	@ 6.0 MHz	<-20	dB	-30.4	(P) - F

5.2.12	Gain of 20–30 MHz Bandpass Filter				
	@ 10.0 MHz	<–20	dB	-33.0	(P) - F
	@ 20.0 MHz	>–5	dB	-4.0	(P) - F
	@ 25.0 MHz	>–5	dB	-4.2	(P) - F
	@ 30.0 MHz	>–5	dB	-3.5	(P) - F
	@ 40.455 MHz	<–50	dB	-80	(P) - F
	@ 50.0 MHz	<–50	dB	-75	(P) - F
5.2.13	Gain of 1.50 MHz Lowpass Filter				
	@ 1.0 MHz	>–1.5	dB	-0.9	(P) - F
	@ 1.5 MHz	>–1.5	dB	-1.4	(P) - F
	@ 5.0 MHz	<–35	dB	-55	(P) - F
5.2.14	Gain of 3.00–5.25 Bandpass Filter				
	@ 2.0 MHz	<–15	dB	-16.5	(P) - F
	@ 3.0 MHz	>–2	dB	-1.85	(P) - F
	@ 4.0 MHz	>–2	dB	-2.0	(P) - F
	@ 5.25 MHz	>–2	dB	-2.0	(P) - F
	@ 10.0 MHz	<–20	dB	-27.6	(P) - F
5.2.15	Gain of 5.25–8.50 Bandpass Filter				
	@ 3.0 MHz	<–20	dB	-28.5	(P) - F
	@ 5.25 MHz	>–3	dB	-2.6	(P) - F
	@ 6.0 MHz	>–3	dB	-2.5	(P) - F
	@ 8.5 MHz	>–3	dB	-2.6	(P) - F
	@ 12.0 MHz	<–10	dB	-18.3	(P) - F
5.2.16	Gain of 8.50–13.25 Bandpass Filter				
	@ 5.0 MHz	<–20	dB	-28.6	(P) - F
	@ 8.5 MHz	>–6	dB	-2.7	(P) - F
	@ 10.0 MHz	>–3	dB	-2.9	(P) - F
	@ 13.25 MHz	>–3	dB	-2.3	(P) - F
	@ 20.0 MHz	<–15	dB	-23.2	(P) - F
5.2.17	Gain of 13.00–20.00 Bandpass Filter				
	@ 7.5 MHz	<–20	dB	-28.7	(P) - F
	@ 13.0 MHz	>–4	dB	-2.5	(P) - F
	@ 16.5 MHz	>–3	dB	-2.1	(P) - F
	@ 20.0 MHz	>–4	dB	-2.7	(P) - F
	@ 30.0 MHz	<–15	dB	-19.0	(P) - F

5.3 1[st] IF and LO ALIGNMENT

Step No.	Test	Limits	Units	Result	Pass/Fail
5.3.4	1[st] IF Filter				
	Max. Gain Difference (40.445–40.465 MHz)	<3	dB	2.1	(P) - F
	Gain @ 40.405 MHz	<–15	dB	-20	(P) - F
	Gain @ 40.445 MHz	>21	dB	20.4	(P) - F
	Gain @ 40.455 MHz	>23	dB	22.0	(P) - F
	Gain @ 40.465 MHz	>21	dB	21.0	(P) - F
	Gain @ 40.505 MHz	<–15	dB	-25	(P) - F
5.3.7	1[st] LO Filter				
	Gain @ 40.5 MHz	<5	dB	1.4	(P) - F
	Max. Gain Difference (42.0–70.5 MHz)	<4	dB	3.1	(P) - F
	Gain @ 30.0 MHz	<–10	dB	-13	(P) - F
	Gain @ 42.0 MHz	>10	dB	12.9	(P) - F
	Gain @ 55.0 MHz	>10	dB	11.4	(P) - F
	Gain @ 70.5 MHz	>10	dB	11.7	(P) - F
	Gain @ 90.0 MHz	< 0	dB	-4.1	(P) - F
5.3.8	Gain dip above 80 MHz				(P) - F

OK

5.4 2[nd] IF AND LO ALIGNMENT

Step No.	Test	Limits	Units	Result	Pass/Fail
5.4.13	Resistance U20, pin 3 to gnd	490<R<510	ohms	500.2	(P) - F
5.4.14	E7-E8, E13-E14 soldered				(P) - F
5.4.17	2[nd] IF Filter				
	Max. Gain Difference (442.5–467.5 kHz)	<3	dB	1.8	(P) F
	Gain @ 405 kHz	< 25	dB	12	(P) - F
	Gain @ 440 kHz	> 52	dB	59.8	(P) - F
	Gain @ 455 kHz	> 52	dB	64.6	(P) - F
	Gain @ 470 kHz	> 52	dB	61.3	(P) - F
	Gain @ 505 kHz	< 25	dB	22.2	(P) - F
5.4.20	40 MHz tone power	>12	dBm	12.7	(P) - F
	30 MHz tone power	<0	dBm	-4.0	(P) - F
	50 MHz tone power	<0	dBm	-12.7	(P) - F

5.5 GAIN ADJUSTMENTS AND ATTENUATORS

Step No.	Test	Limits	Units	Result	Pass/Fail
5.5.3	41.955 MHz tone power	<–30	dBm	-27	(P) - F
5.5.8	455 kHz tone power	–6.1< P<–5.9	dBm	-6.0	(P) - F
5.5.9	DC voltage @ J14	0.975<VDC<1.025	volts	1.000	(P) - F
5.5.10	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.11	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.12	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.13	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.14	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.15	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.16	455 kHz tone power	–7< P<-5	dBm	-6.1	(P) - F
5.5.18	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.19	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F
5.5.20	455 kHz tone power	–7< P<-5	dBm	-6.2	(P) - F
5.5.22	455 kHz tone power	–7< P<-5	dBm	-5.9	(P) - F
5.5.23	455 kHz tone power	–7< P<-5	dBm	-6	(P) - F

5.6 INTERMODULATION DISTORTION

Step No.	Test	Limits	Units	Result	Pass/Fail
5.6.6	455 kHz tone power (from 28.51 MHz tone)		dBm	-10.5	
5.6.8	455 kHz tone power (from 28.61 MHz tone) *Should be within 0.5 dB of power in step 5.6.6.		dBm	-10.9*	
5.6.9	Smaller of powers in steps 5.6.6 and 5.6.8		dBm	-10.9	

Step No.	Test	Limits	Units	Result	Pass/Fail
5.6.10	455 kHz tone power (from 28.41 MHz IMD tone)		dBm	-97.1	
5.6.11	455 kHz tone power (from 28.71 MHz IMD tone)		dBm	-97.2	
5.6.12	IIP3 calculated from step 5.6.10	> +30	dBm	>+35	(P) - F
5.6.13	IIP3 calculated from step 5.6.11	> +30	dBm	>+35	(P) - F
5.6.18	455 kHz tone power (from 2.51 MHz tone)		dBm	-9.0	
5.6.19	455 kHz tone power (from 2.61 MHz tone) *Should be within 0.5 dB of power in step 5.6.13		dBm	-9.0*	
5.6.20	Smaller of powers in steps 5.6.18 and 5.6.19		dBm	-89.0	
5.6.21	455 kHz tone power (from 2.41 MHz IMD tone)		dBm	-89.1	
5.6.22	455 kHz tone power (from 2.71 MHz IMD tone)		dBm	-89.7	
5.6.23	IIP3 calculated from step 5.6.18	> +30	dBm	>+35	(P) - F
	IIP3 calculated from step 5.6.19	> +30	dBm	>+35	(P) - F

5.7 NOISE FIGURE

Step No.	Test	Limits	Units	Result	Pass/Fail
5.7.6	Noise Figure @ 4.211 MHz	< 16	dB	16	(P) - F
5.7.7	Noise Figure @ 16.505 MHz	< 16	dB	16	(P) - F
5.7.8	Noise Figure @ 25.211 MHz	< 16	dB	16	(P) F

5.8 CALIBRATOR

Step No.	Test	Limits	Units	Result	Pass/Fail
5.8.6	All Comb Tones from 1.5 to 30 MHz	-71<P<-69	dBm		(P) - F